RP5900 Series Regenerative DC Power Supply

RP5913A, RP5923A, RP5933A, RP5943A, RP5915A
RP5925A, RP5935A, RP5945A, RP5916A, RP5926A
RP5936A, RP5946A

OPERATING AND SERVICE GUIDE

Legal and Safety Information

Legal Notices

Safety Symbols

Safety Notices

Legal Notices

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Warranty

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Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU

The following crossed out wheeled bin symbol indicates that separate collection for waste electric and electronic equipment (WEEE) is required, as obligated by DIRECTIVE 2012/19/EU and other National legislation.

Do not dispose in domestic household waste. Please refer to about.keysight.com/en/companyinfo/environment/takeback.shtml to understand your trade in options with Keysight in addition to product takeback instructions.

Declarations of Conformity

Declarations of Conformity for this product and for other Keysight products may be downloaded from the Web. Go to https://regulations.about.keysight.com/DoC/default.htm. You can then search by product number to find the latest Declaration of Conformity.

Safety Symbols

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or DEATH. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

La mention AVERTISSEMENT signale un danger pour la sécurité de l'opérateur. Elle attire l'attention sur une procédure ou une pratique qui, si elle n'est pas respectée ou correctement réalisée, peut se traduire par des accidents graves, voire mortels. En présence de la mention AVERTISSEMENT, il convient de ne pas poursuivre tant que les conditions indiquées n'ont pas été parfaitement comprises et respectées.

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

La mention ATTENTION signale un danger pour le matériel. Si la manœuvre ou la procédure correspondante n'est pas exécutée correctement, il peut y avoir un risque d'endommagement de l'appareil ou de perte de données importantes. En présence de la mention ATTENTION, il convient de ne pas poursuivre tant que les conditions indiquées n'ont pas été parfaitement comprises et remplies.

Direct current


Alternating current


3-phase alternating current


Direct alternating current

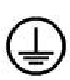

Frame or chassis terminal


Standby supply. Unit is not completely disconnected from AC mains when switch is off.

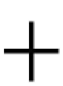

WARNING risk of electric shock
Risque d'électrocution


WARNING refer to accompanying documents
Consultez la documentation fournie


CAUTION hot surface. Please do not touch.
Surface chaude. Ne pas toucher.


Protective earth ground terminal

On supply


Plus, positive polarity

Minus, negative polarity

The CSA mark is a registered trademark of the Canadian Standards Association.

The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.
CAN ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001.
Cet appareil ISM est conforme a la norme NMB-001 du Canada.
ISM GRP.1 Class A indicates that this is an Industrial Scientific and Medical Group 1 Class A product.

The RCM mark is a registered trademark of the Australian Communications and Media Authority.

Contains one or more of the 6 hazardous substances above the maximum concentration value (MCV), 10 Year EPUP.

The UKCA (UK Conformity Assessed) marking is a UK product marking that is used for goods being placed on the market in Great Britain (England, Wales, and Scotland)

South Korean Class A EMC Declaration.
This equipment has been conformity assessed for use in business environments. In a residential environment this equipment may cause radio interference. This EMC statement applies to the equipment only for use in business environments.

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

※ 사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

Models	Certification link
RP5913A, RP5923A, RP5933A	http://www.rra.go.kr/selform/Kst-SP251030
RP5943A	http://www.rra.go.kr/selform/Kst-SP251025
RP5915A, RP5925A, RP5935A	http://www.rra.go.kr/selform/Kst-SP251031
RP5945A	http://www.rra.go.kr/selform/Kst-SP251026
RP5916A, RP5926A, RP5936A	http://www.rra.go.kr/selform/Kst-SP251032
RP5946A	http://www.rra.go.kr/selform/Kst-SP251027
RP5901C	http://www.rra.go.kr/selform/Kst-SP251033
RP5902C	http://www.rra.go.kr/selform/Kst-SP251034

Safety and EMC Requirements

This power supply is designed to comply with the following safety and EMC (Electromagnetic Compatibility) requirements:

– Low Voltage Directive

– EMC Directive

Safety Notices

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings or instructions elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability of the customer's failure to comply with the requirements.

The equipment is for industrial use. Equipment operators are subject to all applicable safety regulations. Along with the warning and safety notices in this manual, all relevant safety, accident prevention, and environmental regulations must also be followed. In particular, the operators of the equipment:

- Must be informed of the relevant safety requirements.
- Must have read and understood the operating manual before using the equipment.
- Must use the designated and recommended safety equipment.

WARNING

BEFORE APPLYING POWER

Ensure the mains supply voltage fluctuation do not exceed ±10% of the nominal supply voltage.

AVANT LA MISE SOUS TENSION

Assurez-vous que les fluctuations de la tension d'alimentation ne dépassent pas ±10 % de la tension d'alimentation nominale.

WARNING

BEFORE APPLYING POWER

Verify that all safety precautions are taken. All connections must be made with the unit turned off, and must be performed by qualified personnel who are aware of the hazards involved. Improper actions can cause fatal injury as well as equipment damage. Note the instrument's external markings described under "Safety Symbols".

AVANT LA MISE SOUS TENSION

Vérifiez que vous avez bien respecté toutes les consignes de sécurité. Tous les branchements doivent être effectués alors que l'unité est hors tension, et ils doivent être réalisés par du personnel qualifié conscient des dangers inhérents. Toute utilisation inappropriée est susceptible de provoquer des blessures mortelles et d'endommager l'équipement. Lisez les mentions apposées sur l'extérieur de l'appareil décrites à la section « Symboles de sécurité ».

WARNING

GENERAL

Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operating instructions.

GÉNÉRAL

N'utilisez pas ce produit d'une autre manière que celle spécifiée par le fabricant. Les fonctions de sécurité de ce produit peuvent être perturbées si vous ne respectez pas les consignes d'utilisation.

WARNING

ENVIRONMENTAL CONDITIONS
Never use the instrument outside of the specified environmental conditions described in the Environmental Characteristics of the specifications.

CONDITIONS ENVIRONNEMENTALES
N'utilisez jamais l'appareil dans des conditions environnementales autres que celles qui sont décrites dans les Conditions environnementales des spécifications.

WARNING

DO NOT LIFT INSTRUMENT BY THE TERMINAL BUSBARS
Do not lift the instrument by the terminal busbars alone. The terminal busbars are not designed for lifting and carrying purposes.

NE PAS SOULEVER L'INSTRUMENT PAR LES BARRES DE BORNES
Ne soulevez jamais l'instrument uniquement par ses barres de bornes. Elles ne sont pas conçues pour supporter le poids de l'instrument.

WARNING

HEAVY WEIGHT
Danger to hands and feet. To avoid personal injury and damage to the instrument, always use a sturdy cart or other suitable device to move the instrument. Do not lift the instrument alone; always use two people to lift the instrument.

POIDS LOURD
Danger pour les mains et les pieds. Pour éviter tout risque de blessure ou d'endommagement de l'instrument, utilisez toujours un chariot ou un autre outil approprié pour le déplacer. Ne soulevez jamais l'instrument seul : vous devez être au moins deux personnes.

WARNING

SHOCK HAZARD Ground the Instrument
This product is a Safety Class I instrument (provided with a protective earth terminal). To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument must be connected to the AC power supply mains through a three-conductor power cable, with the third wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective(grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury or death. If the instrument is to be energized via an external autotransformer for voltage reduction, be certain that the autotransformer common terminal is connected to the neutral (earthed pole) of the AC power lines (supply mains).

RISQUE D’ÉLECTROCUTION Mise à la terre de l’instrument
Ce produit est un instrument de mesure de la catégorie de sécurité I (il comporte une borne de terre de protection). Afin de minimiser les risques d’électrocution, son châssis et son armoire doivent être reliés à une prise de terre. L'instrument doit être relié à une source de courant alternatif par l'intermédiaire d'un cordon d'alimentation à trois conducteurs dont le troisième fil est connecté solidement à une prise de terre (prise de terre de sécurité) au niveau de la prise de courant. Toute interruption du conducteur de protection (mise à la terre) ou déconnexion de la borne de terre de protection entraînera un risque d'électrocution pouvant entraîner des blessures corporelles ou la mort. Si l'instrument doit être alimenté via un autotransformateur externe pour réduire la tension, assurez-vous que la borne commune de l’autotransformateur est connectée au neutre (borne mise à la terre) des lignes électriques (alimentation secteur).

WARNING

SHOCK HAZARD, HAZARDOUS VOLTAGES
Do not touch any output terminal connections by hand. Ensure that all instrument connections, DUT wiring, and DUT connections are either insulated or covered using the safety covers provided, so that no accidental contact with harzardous voltages can occur. Always use the electrical safety gloves when connecting or disconnecting DUT to the output terminals.

RISQUE D’ÉLECTROCUTION, TENSIONS DANGEREUSES
Ne touchez jamais les connexions des bornes de sortie à mains nues. Assurez-vous que toutes les connexions de l’instrument, ainsi que le câblage et les connexions du DUT, soient soit isolés, soit protégés par les capots de protection fournis, afin d’éviter tout contact accidentel avec des tensions dangereuses. Portez toujours des gants isolants lorsque vous connectez ou déconnectez le DUT aux bornes de sortie.

WARNING

SHOCK HAZARD
Ensure the output terminals are either insulated or covered with the provided safety covers to prevent accidental contact with lethal voltages.

RISQUE D’ÉLECTROCUTION
Veillez à ce que les bornes de sortie soient toujours isolées ou protégées par les capots de sécurité fournis, afin d’éviter tout contact accidentel avec des tensions mortelles.

WARNING

SHOCK HAZARD

Always attach the safety cover regardless of whether the instrument is in use or not, so that no accidental contact with hazardous voltages can occur.

RISQUE D'ÉLECTROCUTION

Montez toujours les capots de protection, que l'instrument soit en marche ou non, afin de prévenir tout risque de contact accidentel avec des tensions dangereuses.

WARNING

SHOCK HAZARD

Always verify if the output terminals and lines are hazardous, even if the instrument is turned OFF or ON.

Do not touch cables, terminals, or circuits connected to these lines.

RISQUE D'ÉLECTROCUTION

Vérifiez toujours si les bornes et les lignes de sortie sont sous tension, que l'instrument soit en marche ou non.

Ne touchez jamais les câbles, bornes ou circuits connectés à ces lignes.

WARNING

SHOCK HAZARD

Ensure all electrical connections are correctly and securely installed, and properly grounded to comply with electrical safety standards.

RISQUE D'ÉLECTROCUTION

Vérifiez que toutes les connexions électriques sont correctement installées, sécurisées et mises à la terre, conformément aux normes de sécurité électrique.

WARNING

SHOCK HAZARD

Only basic insulation is provided between AC mains and output terminal. Ensure all electrical connections are correctly and securely installed, and properly grounded to comply with electrical safety standards.

1. Do not touch the output terminal at any time, regardless of the DC voltage.
2. Always disconnect the AC supply before making any changes to the output terminal.
3. Use a multimeter to check the voltage on the output terminal before making any connections.

RISQUE D'ÉLECTROCUTION

Seule une isolation de base est fournie entre le secteur et les bornes de sortie. Vérifiez que toutes les connexions électriques sont correctement installées, sécurisées et mises à la terre, conformément aux normes de sécurité électrique.

1. Ne touchez jamais les bornes de sortie, quelle que soit la tension continue.
2. Déconnectez toujours l'alimentation CA avant toute intervention sur les bornes de sortie.
3. Avant toute connexion, utilisez un multimètre pour vérifier la tension aux bornes de sortie.

WARNING

SHOCK HAZARD

Always assume the positive and negative lines at the output terminal are energized. Verify the lines before making any connections.

RISQUE D'ÉLECTROCUTION

Considérez toujours que les lignes positives et négatives des bornes de sortie sont sous tension. Vérifiez-les avant toute connexion.

WARNING

SHOCK HAZARD FROM EXTERNAL ENERGY SOURCES

Because the instrument can be used as a load to sink current, hazardous voltages from an external energy source such as a battery may be present on the output terminals even with the unit turned off. Provision must be made to disconnect the external energy source before touching the output or sense terminals.

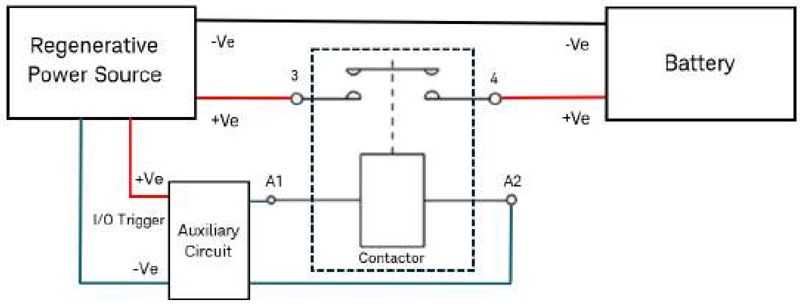
RISQUE D'ÉLECTROCUTION PROVENANT DE SOURCES EXTERNES

Comme l'instrument peut fonctionner comme charge pour absorber du courant, des tensions dangereuses issues d'une source externe (par exemple une batterie) peuvent être présentes sur les bornes de sortie, même lorsque l'appareil est hors tension. Déconnectez toujours toute source externe avant de manipuler les bornes de sortie ou de détection.

WARNING

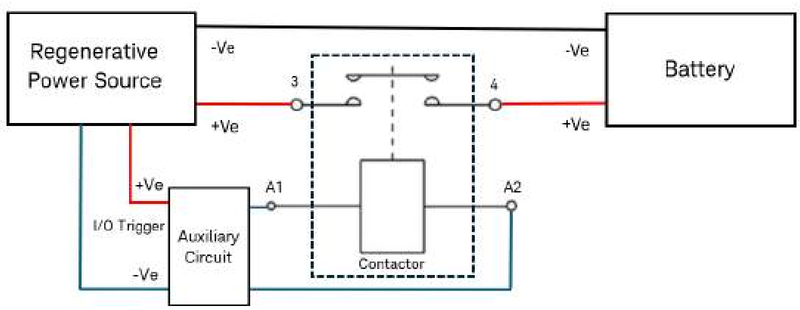
CONNECTION TO AN ENERGIZED SUPPLY (e.g., Battery), SPARKS MAY OCCUR

During connection, it is recommended to use a safety-certified (for example, UL, CSA and etc) contactor to isolate the energized supply (e.g., battery) from the RPS, as illustrated below. Ensure the contactor has the correct voltage and current rating that is higher than the rated RPS voltage and current. Failing to do so may cause injury and equipment damage. For more details, see Contactor Installation.



CONNEXION À UNE SOURCE SOUS TENSION (ex. batterie), RISQUE D'ÉTINCELLES

Lors de la connexion, il est recommandé d'utiliser un contacteur certifié (UL, CSA, etc.) pour isoler la source sous tension (ex. batterie) du RPS, comme indiqué dans le schéma ci-dessous. Vérifiez que le contacteur supporte une tension et un courant supérieurs aux valeurs nominales du RPS. Le non-respect de cette consigne peut entraîner des blessures graves et risque d'endommager l'appareil. Pour plus de détails, consultez la section Installation du contacteur.

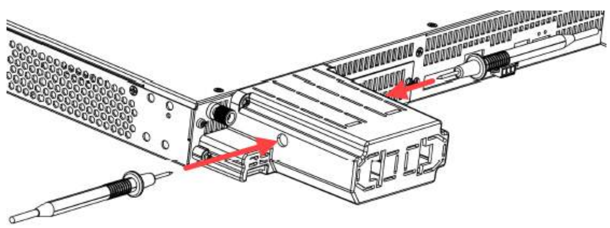


WARNING HAZARDOUS VOLTAGE PRESENT

After turning off the unit, allow time for self-discharge and ensure the capacitors discharge to a safe voltage before handling any components connected to the output terminal, as they may retain a hazardous charge.

Never touch cables or connections immediately after turning off the unit. Depending on use case, such as when connected to an energized supply (e.g., battery), hazardous voltages can remain at the output terminals after turning off the unit. Verify that there is no dangerous voltage on the output or sense terminals before touching them. To disconnect an energized supply, follow the recommended verification procedures as shown below:

1. Use a multimeter to observe the voltage. Probe the output terminals from both sides of the safety cover as shown below.

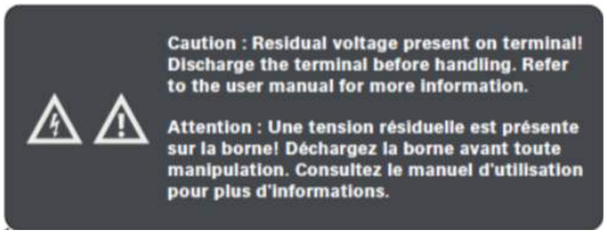


NOTE: For the 80 V unit, the safety cover does not have the probe holes. Wear electrical safety gloves to remove the safety cover and use a multimeter to measure the voltage at the output terminals.

NOTE Ensure the multimeter and measurement probe used have the correct voltage rating to avoid shock hazards.

2. If there is no voltage remaining at the output terminals, proceed with step 7. If voltage remains at the output terminals, proceed with step 3 to 7.
3. Turn on the unit. Press **[Menu]** > **System** > **Emulation** and select **Load.** This action will switch the RPS to Load mode (CC mode by default).
4. Press **[Current]** and set the current to 1 A.
5. Press **[On/Off]** to turn on the output.
6. Use a multimeter to observe the voltage on the output terminals. The voltage will drop to 0 V in approximately two seconds.
7. Disconnect the energized supply from the output terminals.

NOTE Always use electrical safety gloves before disconnecting any energized supply (e.g., battery) from the output terminals.

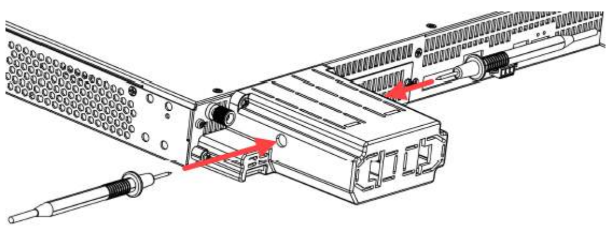


TENSION DANGEREUSE PRÉSENTE

Après avoir éteint l'unité, attendez que les condensateurs se déchargent complètement avant de manipuler les composants connectés aux bornes de sortie, car ils peuvent conserver une charge dangereuse.

Ne touchez jamais les câbles ou les connexions immédiatement après avoir mis l'appareil hors tension. Dans certains cas, par exemple si l'appareil est relié à une source sous tension (batterie, etc.), des tensions dangereuses peuvent subsister sur les bornes de sortie même après la mise hors tension de l'unité. Vérifiez qu'il n'y ait pas de tension dangereuse sur les bornes de sortie ou de détection avant de les toucher. Pour déconnecter une source sous tension, suivez les procédures ci-dessous :

1. Utilisez un multimètre pour mesurer la tension. Testez les bornes de sortie des deux côtés du capot de protection comme indiqué ci-dessous.



   REMARQUE : Sur le module 80 V, le capot de protection ne comporte pas de trous pour la sonde. Portez des gants isolants pour retirer le capot et utilisez un multimètre pour mesurer la tension aux bornes de sortie.

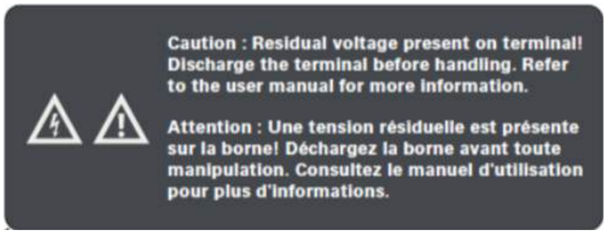
NOTE Vérifiez que le multimètre et la sonde supportent la tension maximale afin d'éviter tout risque d'électrocution.

2. Si aucune tension n'est détectée aux bornes de sortie, passez directement à l'étape 7. Si une tension subsiste aux bornes de sortie, procédez aux étapes 3 à 7.
3. Mettez l'instrument sous tension. Appuyez sur **[Menu]** > **System** (Système) > **Emulation** (Émulation) et sélectionnez **Load** (Charge). Le RPS passe alors en mode Charge (mode CC par défaut).
4. Appuyez sur **[Current]** (Courant) et réglez le courant sur 1 A.
5. Appuyez sur **[On/Off]** pour activer la sortie.
6. Utilisez un multimètre pour mesurer la tension aux bornes de sortie. La tension retombera à 0 V en 2 secondes environ.

7. Déconnectez la source sous tension des bornes de sortie.

NOTE

Portez toujours des gants isolants avant de déconnecter toute source sous tension (comme la batterie) des bornes de sortie.



WARNING

POWER OFF BEFORE CONNECTING
Turn off the device power before connecting or disconnecting the power cord or output terminals.

MISE HORS TENSION AVANT BRANCHEMENT
Mettez l'appareil hors tension avant de brancher ou de débrancher le cordon d'alimentation ou de le connecter aux bornes de sortie.

WARNING

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE
Do not operate the instrument in the presence of flammable gases or fumes.

NE PAS UTILISER EN ATMOSPHÈRE EXPLOSIVE
Ne pas faire fonctionner l'instrument en présence de vapeurs ou de gaz inflammables.

WARNING

DO NOT REMOVE THE INSTRUMENT COVER
Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

NE PAS RETIRER LE CAPOT DE L'INSTRUMENT
Seules des personnes qualifiées, formées pour la maintenance et conscientes des risques d'électrocution encourus, peuvent enlever les couvercles de l'appareil. Toujours débrancher le câble d'alimentation et tout circuit externe avant de retirer le capot de l'instrument.

WARNING

DO NOT USE THE INSTRUMENT WHEN SAFETY COVER IS REMOVED OR LOOSEN
Do not use the instrument when the safety cover is removed or loosened.

NE PAS UTILISER L'INSTRUMENT SI LE CAPOT DE PROTECTION EST RETIRÉ OU DESSERRÉ
N'utilisez pas l'instrument si le capot de protection a été retiré ou s'il est mal fixé.

WARNING

DO NOT MODIFY THE INSTRUMENT

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Keysight Sales and Service Office for service and repair to ensure that safety features are maintained.

NE PAS MODIFIER L'INSTRUMENT

N'installez pas de pièces de remplacement et n'apportez aucune modification non autorisée au produit. Renvoyer le produit à un bureau de service et de ventes Keysight pour toute action de service et de réparation afin de veiller à ce que les caractéristiques de sécurité soient maintenues.

WARNING

FUSES

The instrument contains an internal fuse, which is not customer accessible.

FUSIBLES

L’appareil contient un fusible interne non accessible à l’utilisateur.

WARNING

CLEANING

To prevent electric shock, always disconnect the AC mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not use detergent or chemical solvents. Do not attempt to clean internally.

NETTOYAGE

Pour éviter tout risque d’électrocution, coupez toujours l’alimentation secteur avant de nettoyer l’appareil. Utilisez un chiffon sec ou légèrement humidifié avec de l’eau pour nettoyer les surfaces externes. N’utilisez pas de détergent ni de solvant. Ne tentez aucun nettoyage interne.

WARNING

IN CASE OF DAMAGE

Instrument that are not functioning correctly, appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

EN CAS DE DOMMAGES

Les instruments endommagés ou défectueux doivent être désactivés et protégés contre toute utilisation involontaire jusqu'à ce qu'ils aient été réparés par une personne qualifiée.

WARNING

USE THE DEVICE AS SPECIFIED

If the device is used in a manner not specified by manufacturer, the device protection may be impaired.

UTILISER L’APPAREIL COMME INDIQUÉ

Si l’appareil est utilisé d’une manière non préconisée par le fabricant, il se peut que la protection de l’appareil ne soit plus efficace.

WARNING

OBSERVE ALL MARKINGS ON THE DEVICE
Observe all markings on the device before connecting any wiring to the device.

RESPECTER TOUS LES MARQUAGES SUR L'APPAREIL
Observez tous les marquages portés par l'appareil avant de le brancher.

WARNING

DO NOT BLOCK VENTILATION HOLES
Do not block any of the ventilation holes of the device.

NE PAS BLOQUER LES ORIFICES D'AÉRATION
Ne bloquez aucun des orifices d'aération de l'appareil.

WARNING

OBSERVE ANY UNUSUAL SOUND, ODORS, FIRE, OR SMOKE FROM INSTRUMENT
If you notice strange sounds, unusual odors, fire, or smoke around or from inside the instrument, immediately turn off the instrument, or remove the power cord plug from the outlet. The detachable power cord may be used as an emergency disconnecting device. Removing the power cord will disconnect AC input power to the device.

BRUITS, ODEURS, FUMÉE OU FEU ANORMAUX
Si vous constatez des bruits inhabituels, des odeurs suspectes, de la fumée ou un début d'incendie provenant de l'instrument, éteignez-le immédiatement ou débranchez le cordon d'alimentation de la prise secteur. Le cordon d'alimentation amovible peut être utilisé comme dispositif de débranchement d'urgence. Le débranchement du cordon d'alimentation coupera l'alimentation d'entrée CA de l'appareil.

WARNING

DO NOT DISASSEMBLE THE INSTRUMENT
Do not disassemble the instrument. Only authorized and trained professionals should perform disassembly.

High voltage and hazardous energy may remain within the equipment. Electric shock hazards if come contact with body.

High temperature and burn hazards are present in the internal circuits within the equipment. Heat may still be retained in components (heatsinks, inductors, transformers, and other metal parts) that can cause burns if they come into contact with the skin.

NE PAS DÉMONTER L'INSTRUMENT
Ne démontez jamais l'instrument. Seul le personnel qualifié est habilité à effectuer toute opération de démontage.

Des tensions élevées et dangereuses peuvent subsister à l'intérieur de l'équipement. Un contact direct peut entraîner une électrocution.

Vous pouvez être exposé à des risques de brûlures dues à des températures élevées présentes dans les circuits internes de l'équipement. Certains composants (radiateurs, inducteurs, transformateurs, et autres pièces métalliques) peuvent conserver la chaleur et provoquer des brûlures en cas de contact avec la peau.

WARNING

DO NOT CONNECT THE TERMINALS IN REVERSED POLARITY

Do not connect the + and – polarities in reverse. Always connect the + and – terminals correctly. Reversing the connection may cause fire hazards and electrical shock hazards

NE PAS CONNECTER LES BORNES EN POLARITÉ INVERSÉE

Ne raccordez jamais les polarités + et – de manière inversée. Branchez toujours correctement les bornes positives et négatives. Une inversion de polarité peut entraîner des risques d'incendie ou d'électrocution.

WARNING

DO NOT PLACE INSTRUMENT ON FLOOR

Do not place the instrument on the floor. The DC port copper busbars have potentially sharp edges that can injure your foot if accidentally kicked or stepped on. Always place the product in a suitable location (e.g., on a table, stored appropriately, or installed in a rack system/cabinet).

NE PAS POSER L'INSTRUMENT AU SOL

Ne placez pas l'instrument directement sur le sol. Les barres en cuivre des ports CC peuvent présenter des arêtes tranchantes susceptibles de blesser vos pieds en cas de contact accidentel. Installez toujours l'appareil dans un endroit approprié (sur une table, dans une armoire ou un rack sécurisé).

WARNING

HEARING HAZARD

The RP5900 Series may generate noise from cooling fans that could pose hearing hazards. Always wear hearing protection if it is necessary to be near the instrument for an extended period.

RISQUE AUDITIF

Les ventilateurs de refroidissement des modèles RP5900 peuvent produire un bruit suffisamment important pour présenter un danger pour l'audition. Portez systématiquement une protection auditive si vous devez rester à proximité de l'instrument pendant une longue période.

1
Quick Reference

This document includes user, service, and programming information for the Keysight RP5900 Series Regenerative DC Power Supply.

Documentation, Firmware, and Technical Support

You can download the latest version of this document at www.keysight.com/find/RP5900-doc.

For the latest firmware revision go to Firmware Updates.

If you have questions about your shipment, or if you need information about warranty, service, or technical support, contact Keysight Technologies.

Contacting Keysight Technologies

Use www.keysight.com/find/assist for information on contacting Keysight worldwide, or contact your Keysight Technologies representative.

Introduction to the Instrument

RP5900 Series Regenerative DC Power Supply at a Glance

The Keysight RP5900 Series Regenerative DC Power Supply (RPS) includes 1U and 2U rack-mountable DC power supplies with performance and features that are optimized for automated test systems. The output and system features are described as follows. The Models and Options section describes the features that apply to specific models.

Output features

- Available in 3-phase input
- Available in 2 function modes: Source mode and Load mode
- Output autoranging for greater flexibility
- Output can operate in voltage priority or current priority mode
- Supports eight operation modes under Load mode: CC/CV/CW/CR/CC+CV/CV+CR/CR+CC/CC+CV+CW+CR
- High-speed up and down output programming
- Output resistance programming
- Turn-on/turn-off delays allow output on/off sequencing across multiple units
- Protection capability includes over-voltage, over-current, over-power, over-temperature,and power grid detection
- Two-quadrant operation provides current sourcing and sinking capability
- 100% rated current-sink capability
- 2 kW, 4 kW, 6 kW and 12 kW rated models
- High density with up to 6 kW in 1U unit

Measurement features

- Real-time power measurements
- A-hour & W-hour measurement
- Digitized measurement capability
- Built-in waveform function for battery test simulation
- Integrated arbitrary functions

System features

- 3-inch LCD display
- Supports industrial interface such as USB, LAN, CAN, digital IO, GPIB (optional), and Analog with RS232 (optional)
- Front panel menu setup for CAN, LAN, digital IO, GPIB (optional), and RS232 (optional) parameters
- Front USB Host connector

- LXI compliant, including a built-in Web server
- SCPI (Standard Commands for Programmable Instruments) compatibility
- Stackable parallel connections up to 16 units
- Regenerative power back to grid reduce electricity cost
- Available in standard 1U or 2U form factor to fit standard rack
- Supported on PathWave BV for advance power analysis and advance battery profiling and emulation

Regenerative Operation

Regenerative operation is automatic and requires no programming on the part of the user. Whenever the RPS is sinking current, either by rapidly downprogramming the output, or by discharging an energy source such as a battery, the unit will direct the excess power back to the AC mains. You cannot disable the regenerative operation.

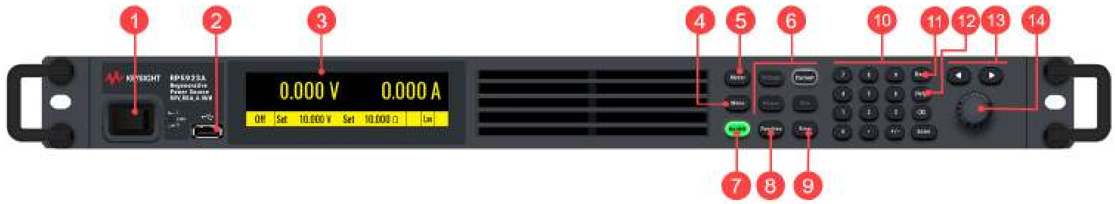
During regenerative operation, the power factor of 0.99 is maintained. Sinewave current distortion is less than 2% at full load. This ensures the quality of the AC signal that is returned to the AC mains.

When an AC mains dropout is sensed, galvanic relays disconnect the AC mains and the unit shuts down. To safeguard your device under test, the RPS can sense if the grid is live before regenerating power back to the grid.

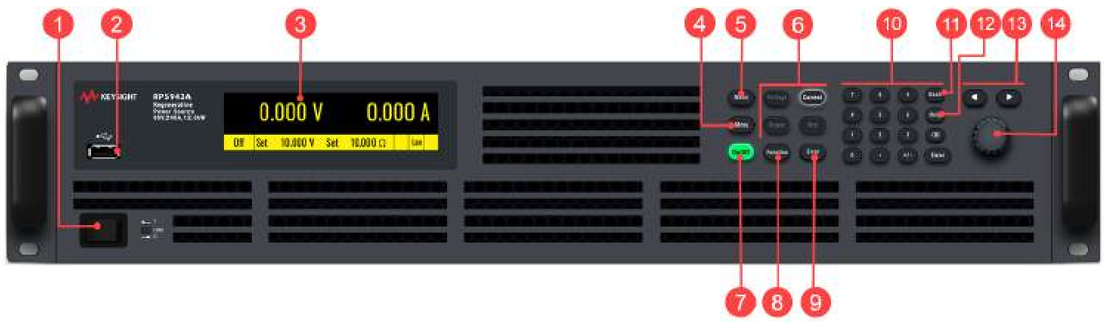
Refer to AC Mains Considerations for additional information about unit shutdown and restart.

Front Panel at a Glance

1U model



2U model

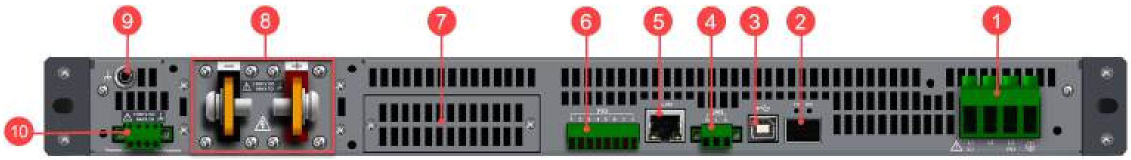


Item	Description
1	On/Off switch and LED Turns on the instrument. – LED indicates power is on. – Green: Normal operation
2	USB port Allows an external USB flash drive to be connected to the instrument.
3	LCD display
4	Menu key Accesses the command menu.
5	Meter key Returns the display to metering mode. Also toggles between current and power measurements.
6	Output keys – **[Voltage]** sets the output voltage. – **[Current]** sets the output current. – **[Power]** sets theoutput power. – **[Res]** sets the output resistance.
7	Output On/Off key Turns output On or Off; output are on when the key is lit.
8	Function key Accesses the advanced functions such as List, battery charge/discharge, and arb waveforms.

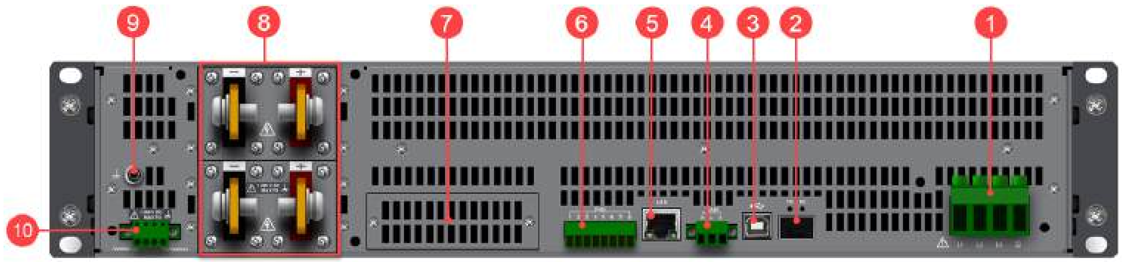
Item	Description
9	Error key Displays any error messages in the error queue.
10	Numeric keypad – Enters numeric values. Press **[Enter]** key to complete the entry. – Deletes the values entered into the dialog using the backspace key. – **[+/-]** toggles and enter the plus (+) and minus (-) sign.
11	Back key Backs out of a menu without activating any changes.
12	Help key Accesses information about the displayed menu control.
13	Left and right navigation keys – Navigate the cursor to specified position. – Moves around in the command menus.
14	Knob – Adjusts the numeric values. – Navigate and select menu. – Confirm the set value or the selected menu.

Rear Panel at a Glance

1U model



2U model

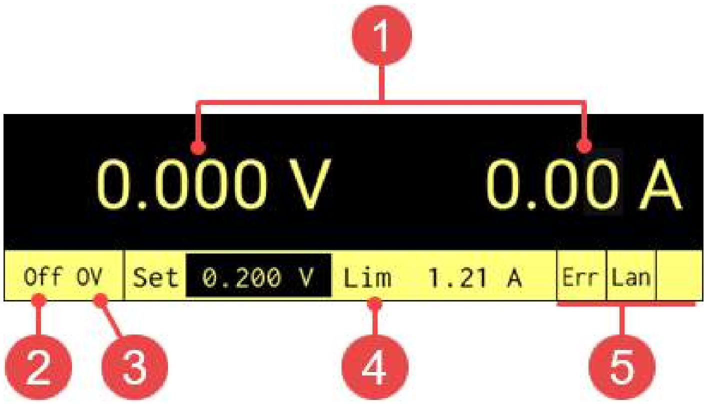


...op.

Item	Description
1	AC input – 3-phase AC input (L1, L2, L3) with chassis ground. The AC input is bi-directional.
2	Fiber optic module port Connects the Fiber Optic Module (optional) for parallel connection.
3	Universal Serial Bus (USB-B) interface port
4	CAN interface port
5	LAN port Left LED indicates activity. Right LED indicates link integrity.
6	Digital IO terminal port Pins are user-configurable.
7	Slot for optional interface: GPIB and Analog/RS232 interface module
8	Output terminals NOTE: When you received the unit, the rear output terminal is covered with a safety cover.
9	Earth ground reference
10	Remote sense terminals

Front Panel Display at a Glance

Press [Meter] to toggle between voltage-current, voltage-power, and voltage-current-power views.



Item	Description
1	Voltage and current measurements Displays the actual output voltage and current.
2	Operating mode Indicates the followings: Off = the output is off CV = the output is in constant voltage mode CC = the output is in constant current mode CR = the output is in constant resistance mode CP = The output is in constant power mode T-on = the output is turning on T-off = the output is turning off NOTE The status is located at the center if no indicator from item 3 is present.

Item	Description
3	Protection and instrument identifier Indicates the followings: OV = the output is disabled by the over-voltage protection OC = the output is disabled by the over-current protection OP = the output is disabled by the over-power protection UV = the output is disabled by the under-voltage protection UC = the output is disabled by the under-current protection OT = the over-temperature protection has tripped PF = the output is disabled by a power-fail condition[1] P = the instrument has been paralleled with another instrument, and is set to Primary S = the instrument has been paralleled with another instrument, and is set to Secondary Inh = the output is disabled by an external inhibit signal Unr = the output is unregulated ESE = the output is disabled by sense error protection. UVI = Under-voltage inhibit protection is tripped. (Applicable for load mode only) SF = a voltage or current sharing fault has occur[1] PNL = the parallel is not locked. Check the fiber optic cable connection. HC = Multi-host collision protection. In a parallel environment, only one instrument can be serve as the host, please correct the configuration.[1] FE = an error has occurred with the fiber optic cable. The optical fiber used in parallel cannot be bent; otherwise, it will need to be replaced.[1] WDG = a watchdog error has occurred HW = a hardware error has occurred[1] UE = an unexpected error has occurred[1] NF = a networking failure has occurred. This error is usually sent in the parallel networking phase because the parallel configuration is incorrect.[1] MCF = a model check fail has occurred. This error is usually caused by instruments with different specifications appearing in the parallel environment.[1] FSF = a function switching failure has occurred. This error often occurs during source-load switching, priority switching, high and low speed switching, and etc.[1] [1] Power cycle the instrument to clear the status indicator.
4	Source mode: Voltage and current settings Displays the programmed voltage and current. These settings may not match the measured output voltage or current. For example, in constant voltage operation, the output current setting (limit) may be set to 1 A, but the actual (measured) output current must be less than 1 A for the output to remain in constant voltage mode. If the Current limit is reached, the output will no longer be operating in constant voltage mode, but will be in current limit mode. In this case, the actual output voltage will now be less than the output voltage setting. Load mode: Voltage, current, power, and resistance settings Displays the programmed voltage, current, power, and resistance settings according to the selected operating mode.
5	Status area Indicates the following remote interface activity: Err = an error has occurred (press Error key to display error message) Lan = the LAN is connected and has been configured IO = there is activity on one of the remote interfaces

Front Panel Menu Reference

Press the **Menu** key to access the front panel menus. For a brief tutorial, refer to Use the front panel menu. If a menu item is grayed-out, it is not available for the model that is being programmed. The menu level may go up to 4th and 5th levels for certain function.

Source mode

1st Menu Level	2nd Level	3rd Level	4th & 5th Level	Description
Output	Mode	Voltage priority		Enters voltage priority mode. Press **[Voltage]**, **[Current]**, **[Power]**, and **[Res]** to program the voltage, current limit, power limit and resistance settings.
		Current priority		Enters current priority mode. Press **[Voltage]**, **[Current]**, **[Power]**, and **[Res]** to program the voltage limit, current, power limit and sink resistance settings.
	Sequence	Delay		Programs output on/off delay
		Couple		Configures output state coupling
	Advanced	Slew	Current	Programs the output current slew time.
			Voltage	Programs the output voltage slew time.
		Bandwidth		Programs the output voltage or current bandwidth
		VoltMax		Programs the maximum output voltage of the instrument
Measure	Sweep			Specifies measurement points, time interval, trigger offset, and trigger source.
	Control			Initiates, triggers, and aborts acquisitions; displays trig state
	AhWh			Measures or resets amp-hours and watt hours
	Dlog	Config		Configures data log settings
		TrigSource		Specifies the datalog trigger source
		Control		Initiates, triggers, and aborts data logging; displays trig state
Function	List	Open		Opens a list file from internal memory or external USB drive.
		Mode		Specifies the operation mode for the list – Voltage or Current

1st Menu Level	2nd Level	3rd Level	4th & 5th Level		Description
		Repeat			Specifies number of list repetitions
		Terminate			Specifies list termination conditions
		Tout			Specifies the trigger output conditions
		Config			Configures the list step settings
		Control			Initiates, triggers, and aborts List; displays trig state
		Export			Exports the internal list data to external USB drive
	Battery	Open			Opens the file to recall
		Config			Configures the battery emulator settings
		Control			Run or stop the battery test
	Arb	BatEmulator	User-defined	Open	Opens the internal battery emulator file
				Config	Configures the battery emulator settings
				Control	Runs or stop the battery emulator
			Curve	Open	Opens the Curve file from internal or USB drive
				View	View the opened Curve file.
				Config	Selects and import the Curve settings to a location in internal memory
				Control	Runs or stop the battery emulator
		Arbwave	Open		Opens an Arb file from internal memory or external USB drive
			View		View the opened Arb waveform file
			Repeat		Specifies number of Arb repetitions
			Terminate		Specifies Arb termination conditions
			Tout		Specifies the trigger output conditions
			Config		Selects and import the Arb settings to a location in internal memory
			Control		Initiates, triggers, and aborts Arb; displays trig state
			Export		Exports the internal Arb data to external USB drive
	TrigSource				Specifies the List and Arb trigger source

1st Menu Level	2nd Level	3rd Level	4th & 5th Level	Description
Protect	OVP			Configures over-voltage protection settings
	UVP			Configures under-voltage protection settings
	OCP			Configures over-current protection
	UCP			Configures under-current protection
	OPP			Configures over-power protection
	WDog			Configures output watchdog protections settings
	Inh			Configures inhibit input mode settings
	Clear			Clears protection conditions and displays output status
States	Reset			Resets all instrument settings to the reset (*RST) state
	SaveRecall			Saves and recalls instrument settings
	PowerOn			Selects the power-on instrument state
	Sense			Enables or disables the remote sense function
	Rzero			Enables or disables voltage zeroing after the output is turned off
System	IO	LAN	Settings	View the currently active network settings
			Modify	Modify the network configuration (IP, Name, DNS, mDNS, Services)
			Apply	Applies the configuration changes and restarts unit
			Cancel	Cancels the configuration changes
			Reset	Performs an LXI LCI reset of LAN settings and restarts
			Default	Resets the network to the as-shipped defaults and restarts
		USB		Specifies USB mode to Host, TMC, or VCP
		CAN		Configures the CAN settings
		GPIB		Display or change the GPIB address
		RS232		Configures the RS232 settings
		DigPort		Configures the digital port pin 1 to pin 7
		Analog		Configures the Analog settings

1st Menu Level	2nd Level	3rd Level	4th & 5th Level	Description
	Groups			Specifies the state of paralleled instrument: None, Primary or Secondary
	Preferences			Configures the preference settings: – Enables or disables the beeper sound – Adjusts the display brightness – Sets the date and time
	Emulation			Switches between Source or Load operation mode
	AC-Meter	View		Observe the power grid information. Displays the energy information.
		Clear		Clear the energy statistics information
	Admin	Logout		Logout of the admin function. When logout, press **Login** and enter a password to access the Admin functions.
		Cal	Volt	Calibrates voltage programming
			SenseVolt	Calibrates sense voltage
			Curr	Calibrates current programming and measurement
			Count	View the calibration count
			Date	Saves the calibration date
			Save	Saves the calibration data
		Sanitize		Performs NISPOM secure erase of all user data
		Update		Password protected firmware update
		Password		Changes the admin password
		DataStorage		Enables or disables the non-volatile data storage for all user settings and data
	About			Displays model, options, serial number, and firmware

Load mode

<table>
<tr><th>1st Menu Level</th><th>2nd Level</th><th>3rd & 4th Levels</th><th>Description</th></tr>
<tr><td>Input</td><td>Mode</td><td></td><td>Programs the operation mode of the electronic load
NOTE: This is a global parameter.

Use the navigation key to select the following modes:

<table>
<tr><th>Mode</th><th>Descriptions</th></tr>
<tr><td>CV</td><td>Enters the Constant Voltage mode.

Press [Voltage] to program the input voltage. Other parameters (current, power, and resistance) are enabled, but cannot be programmed.</td></tr>
<tr><td>CC</td><td>Enters the Constant Current mode.

Press [Current] to program the input current. Other parameters (voltage, power, and resistance) are enabled, but cannot be programmed.</td></tr>
<tr><td>CP</td><td>Enters the Constant Power mode.

Press [Power] to program the input power. Other parameters (current, voltage, and resistance) are enabled, but cannot be programmed.</td></tr>
<tr><td>CR</td><td>Enters the Constant Resistance mode.

Press [Res] to program the input resistance. Other parameters (current, voltage, and power) are enabled, but cannot be programmed.</td></tr>
<tr><td>CV + CC</td><td>Enters the CV + CC mode.

Press [Voltage] and [Current] to program the input voltage and input current. Other parameters (power and resistance) are enabled, but cannot be programmed.</td></tr>
<tr><td>CV + CR</td><td>Enters CV + CR mode.

Press [Voltage] and [Res] to program the input voltage and input resistance. Other parameters (current and power) are enabled, but cannot be programmed.</td></tr>
<tr><td>CC + CR</td><td>Enters CC + CR mode.

Press [Res] and [Current] to program the input resistance and input current. Other parameters (voltage and power) are enabled, but cannot be programmed.</td></tr>
<tr><td>CC + CV + CP + CR</td><td>Enters the CC + CV + CP + CR mode.

Press [Voltage], [Current], [Power], [Res] to program the input voltage, current, power, and resistance on the front panel.</td></tr>
</table>
</td></tr>
</table>

1st Menu Level	2nd Level	3rd & 4th Levels		Description
	Sequence	Delay		Programs input on/off delay.
		Couple		Configures input state coupling.
	Short			Enables or disables short on input terminal.
	Advanced	Slew	Current	Programs the input current slew rate. NOTE: The parameters can be edited when in CC mode only.
			Voltage	Programs the input voltage slew rate. NOTE: The parameters can be edited when in CV mode only.
		Bandwidth		Programs loop speed to High or Low.
		UVI		Programs the under voltage inhibit mode and voltage-on value.
Measure	Sweep			Specifies measurement points, time interval, trigger offset, and trigger source.
	Control			Initiates, triggers, and aborts acquisitions; displays trig state
	AhWh			Measures or resets amp-hours and watt hours
	Dlog	Config		Configures data log settings
		TrigSource		Specifies the datalog trigger source
		Control		Initiates, triggers, and aborts data logging; displays trig state
Function	List	Open		Opens a list file from internal memory or external USB drive.
		Mode		Specifies the operation mode for the list – Voltage or Current
		Repeat		Specifies number of list repetitions
		Terminate		Specifies list termination conditions
		Tout		Specifies the trigger output conditions
		Config		Configures the list step settings
		Control		Initiates, triggers, and aborts List; displays trig state
		Export		Exports the internal list data to external USB drive
	Battery	Open		Opens the file to recall
		Config		Configures the battery emulator settings
		Control		Run or stop the battery test
	Arb	Arbwave	Open	Opens an Arb file from internal memory or external USB drive
			View	View the opened Arb waveform file

1st Menu Level	2nd Level	3rd & 4th Levels		Description
			Repeat	Specifies number of Arb repetitions
			Terminate	Specifies Arb termination conditions
			Tout	Specifies the trigger output conditions
			Config	Selects and import the Arb settings to a location in internal memory
			Control	Initiates, triggers, and aborts Arb; displays trig state
			Export	Exports the internal Arb data to external USB drive
	TrigSource			Specifies the List and Arb trigger source
Protect	OVP			Configures over-voltage protection settings
	UVP			Configures under-voltage protection settings
	OCP			Configures over-current protection
	UCP			Configures under-current protection
	OPP			Configures over-power protection
	WDog			Configures input watchdog protections settings
	Inh			Configures inhibit input mode settings
	Clear			Clears protection conditions and displays input status
States	Reset			Resets all instrument settings to the reset (*RST) state
	SaveRecall			Saves and recalls instrument settings
	PowerOn			Selects the power-on instrument state
	Sense			Enables or disables the remote sense function
System	IO	LAN	Settings	View the currently active network settings
			Modify	Modify the network configuration (IP, Name, DNS, mDNS, Services)
			Apply	Applies the configuration changes and restarts unit
			Cancel	Cancels the configuration changes
			Reset	Performs an LXI LCI reset of LAN settings and restarts
			Default	Resets the network to the as-shipped defaults and restarts
		USB		Specifies USB mode to Host, TMC, or VCP.
		CAN		Configures the CAN settings
		GPIB		Display or change the GPIB address

1st Menu Level	2nd Level	3rd & 4th Levels		Description
		RS232		Configures the RS232 settings
		DigPort		Configures the digital port pin 1 to pin 7
		Analog		Configures the Analog settings
	Groups			Specifies the state of paralleled instrument: None, Primary or Secondary
	Preferences			Configures the preference settings: – Enables or disables the beeper sound – Adjusts the display brightness – Sets the date and time
	Emulation			Switches between Source or Load operation mode
	AC-Meter	View		Observe the power grid information. Displays the energy information.
		Clear		Clear the energy statistics information
	Admin	Logout		Logout of the admin function. When logout, press **Login** and enter a password to access the Admin functions.
		Cal	Volt	Calibrates voltage programming
			SenseVolt	Calibrates sense voltage
			Curr	Calibrates current programming and measurement
			Count	View the calibration count
			Date	Saves the calibration date
			Save	Saves the calibration data
		Sanitize		Performs NISPOM secure erase of all user data
		Update		Password protected firmware update
		Password		Changes the admin password
		DataStorage		Enables or disables the non-volatile data storage for all user settings and data
	About			Displays model, options, serial number, and firmware

Model and Options

Models

Models	Voltage, Current and Power Rating		
	Voltage	Current	Power
RP5913A	0 to 80 V	0 to ±40 A	0 to ±2 kW
RP5923A		0 to ±80 A	0 to ±4 kW
RP5933A		0 to ±120 A	0 to ±6 kW
RP5943A		0 to ±240 A	0 to ±12 kW
RP5915A	0 to 500 V	0 to ±12 A	0 to ±2 kW
RP5925A		0 to ±24 A	0 to ±4 kW
RP5935A		0 to ±36 A	0 to ±6 kW
RP5945A		0 to ±72 A	0 to ±12 kW
RP5916A	0 to 800 V	0 to ±8 A	0 to ±2 kW
RP5926A		0 to ±16 A	0 to ±4 kW
RP5936A		0 to ±24 A	0 to ±6 kW
RP5946A		0 to ±48 A	0 to ±12 kW

Options/Accessories

Option/Accessory	Description
RP5901C	GPIB interface board
RP5902C	Analog/RS232 interface board
RP5903C	Parallel kit - Fiber optics cable and transmitter module (FTCS-1312-20D)
RP5904C	Rackmount kit 1U for EL4900 DC Loads and RP5900 Supplies
RP5905C	Rackmount kit 2U for EL4900 DC Loads and RP5900 Supplies

Specifications and Characteristics

NOTE For the characteristics and specifications of the Keysight RP5900 Series Regenerative DC Power Supply , refer to the datasheet at www.keysight.com/find/RP5900.

2
Installing the Instrument

WARNING

Heavy Weight

Danger to hands and feet. To avoid personal injury and damage to the instrument, always use a sturdy cart or other suitable device to move the instrument. Do not lift the instrument alone; always use two people to lift the instrument.

Poids lourd

Danger pour les mains et les pieds. Pour éviter tout risque de blessure ou d'endommagement de l'instrument, utilisez toujours un chariot ou un autre outil approprié pour le déplacer. Ne soulevez jamais l'instrument seul : vous devez être au moins deux personnes.

NOTE

For load mode, the input terminals are referred to as "Outputs" throughout this document.

Before Installation or Use

Inspect the Unit

When you receive your RPS unit, inspect it for any obvious damage that may have occurred during shipment. If there is damage, notify the shipping carrier and nearest Keysight Sales and Support Office immediately. Refer to www.keysight.com/find/assist. Until you have checked out the unit, save the shipping carton and packing materials in case the unit has to be returned.

Check for Items Supplied

Before getting started, check the following list and verify that you have received these items. If anything is missing, please contact your nearest Keysight Sales and Support Office.

- USB cable with ferrite core, 1.5 m
- LAN cable
- Certificate of calibration
- Keysight safety leaflet
- China ROHS addendum

Review Safety Information

This power supply is a Safety Class 1 instrument, which means it has a protective earth terminal. That terminal must be connected to earth ground through a power source equipped with an earth ground. Refer to the Safety Summary page for general safety information. Before installation or operation, check the power supply and review this guide for safety warnings and instructions. Safety warnings for specific procedures are located at appropriate places throughout this guide.

WARNING

Do not touch any output terminal connections by hand. Ensure that all instrument connections, DUT wiring, and DUT connections are either insulated or covered using the safety covers provided, so that no accidental contact with harzardous voltages can occur. Always use the electrical safety gloves when connecting or disconnecting DUT to the output terminals.

Ne touchez jamais les connexions des bornes de sortie à mains nues. Assurez-vous que toutes les connexions de l’instrument, ainsi que le câblage et les connexions du DUT, soient soit isolés, soit protégés par les capots de protection fournis, afin d’éviter tout contact accidentel avec des tensions dangereuses. Portez toujours des gants isolants lorsque vous connectez ou déconnectez le DUT aux bornes de sortie.

Observe Environmental Conditions

WARNING

Do not operate the instrument in the presence of flammable gases or fumes.

Ne pas faire fonctionner l'instrument en présence de vapeurs ou de gaz inflammables.

The RP5900 Series is designed for indoor use and in an area with low condensation. Do not operate the unit in areas where the ambient temperature exceeds +40 degrees Celsius. This applies for rack-mounting as well as for bench use.

The table below shows the general environmental requirements for this instrument.

Environmental condition	Requirement
Temperature	Operating condition: 0 °C to 40 °C Storage condition: –10 °C to 70 °C
Humidity	Operating condition: 20% to 80% RH (non-condensing) Storage condition: 90% RH, up to 65 °C (non-condensing)
Altitude	Up to 2000 m
Pollution degree	2
Overvoltage category	II

AC Input Ratings

AC Input	Descriptions
Phase and input voltage range	3 phase; 200 – 480 VAC nominal ±10%,
Frequency range	50/60 Hz
Maximum input current	– 12.5 A per phase (2 kw, 4 kw, and 6 kW models) – 25 A per phase (12 kW model)

Instrument Weight

Model	Weight (typical)
RP591xA	26.5 lbs. (12 kg)
RP592xA	29.8 lbs. (13.5 kg)
RP593xA	33.1 lbs. (15 kg)
RP594xA	66.2 lbs. (30 kg)

Provide Adequate Air Flow

CAUTION

Do not block the air intake at the front, or the exhaust at the rear of the instrument.

Ne bloquez pas la prise d'air à l'avant, ni la sortie à l'arrière de l'instrument.

The dimensions of your RPS as well as an outline diagram are given under Outline Diagrams. Fans cool the unit by drawing air through the front and exhausting it out the back. The unit must be installed in a location that allows sufficient space of at least 12 inches (30.5 cm) at the front and 4 inches (10.16 cm) at the back of the unit for adequate air circulation.

Stacking Instruments

CAUTION

For 1U models, never stack more than one instrument on top of one another in a free-standing installation.

For 2U models, DO NOT stack any instrument on top of one another in a free-standing installation.

Pour les modèles 1U, ne placez jamais plus d'un appareil sur un autre dans une configuration autonome.

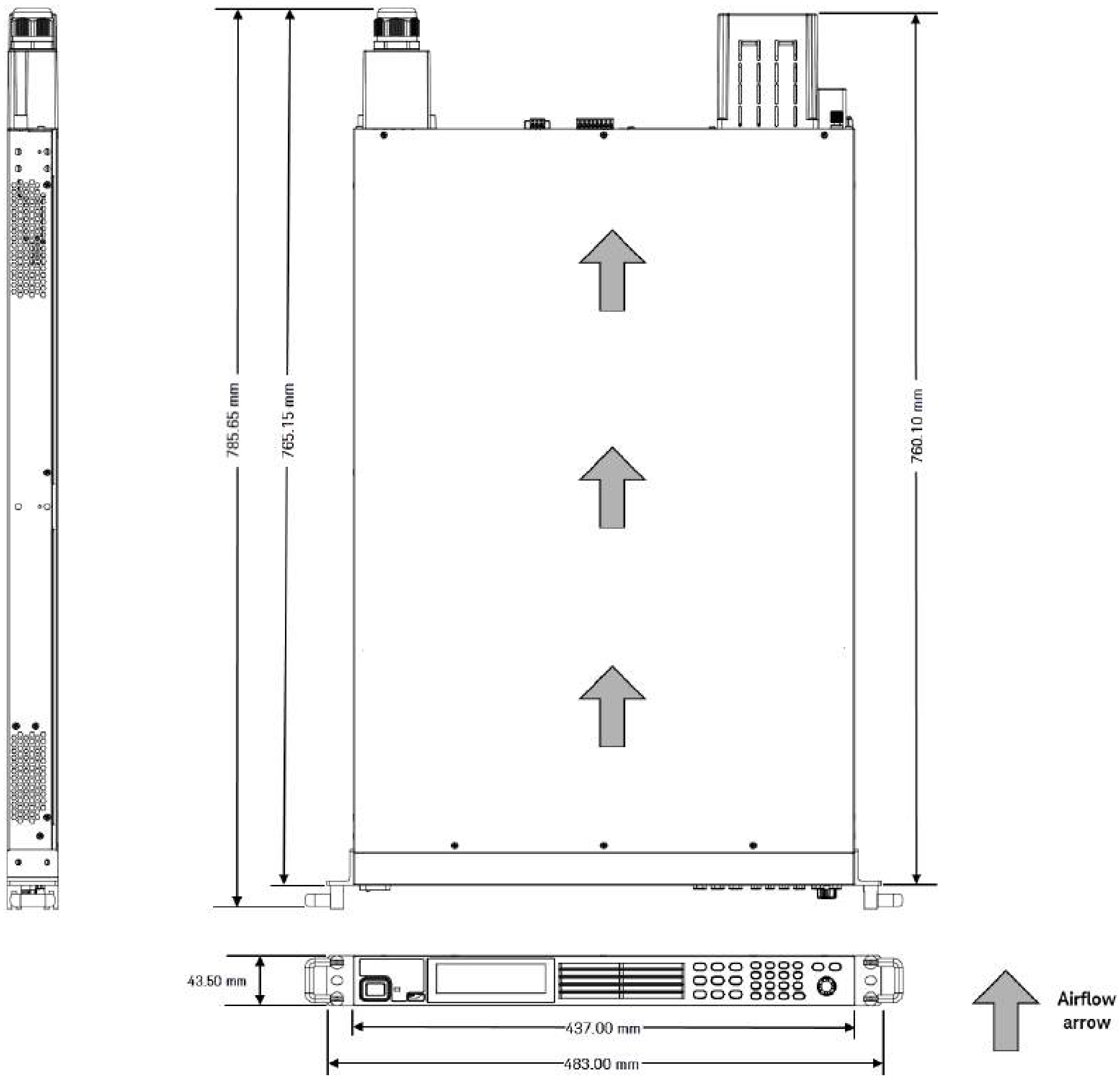
Pour les modèles 2U, vous NE DEVEZ JAMAIS empiler les appareils dans une configuration autonome.

Outline Diagram

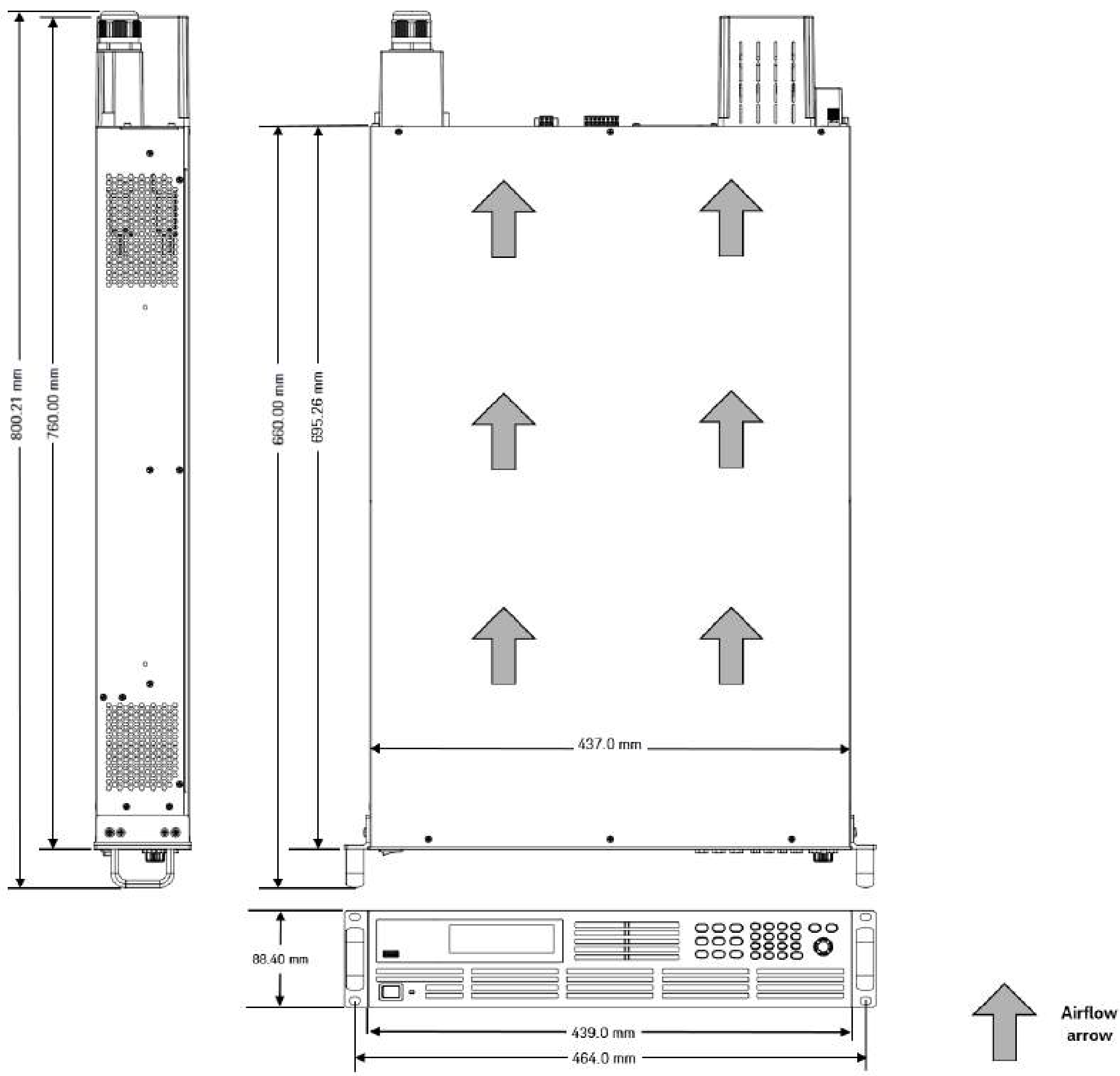
1U Instrument

NOTE

The front panel handle is used for rackmounting purposes only. DO NOT carry the unit by the this handle.



2U Instrument



WARNING

HEARING HAZARD

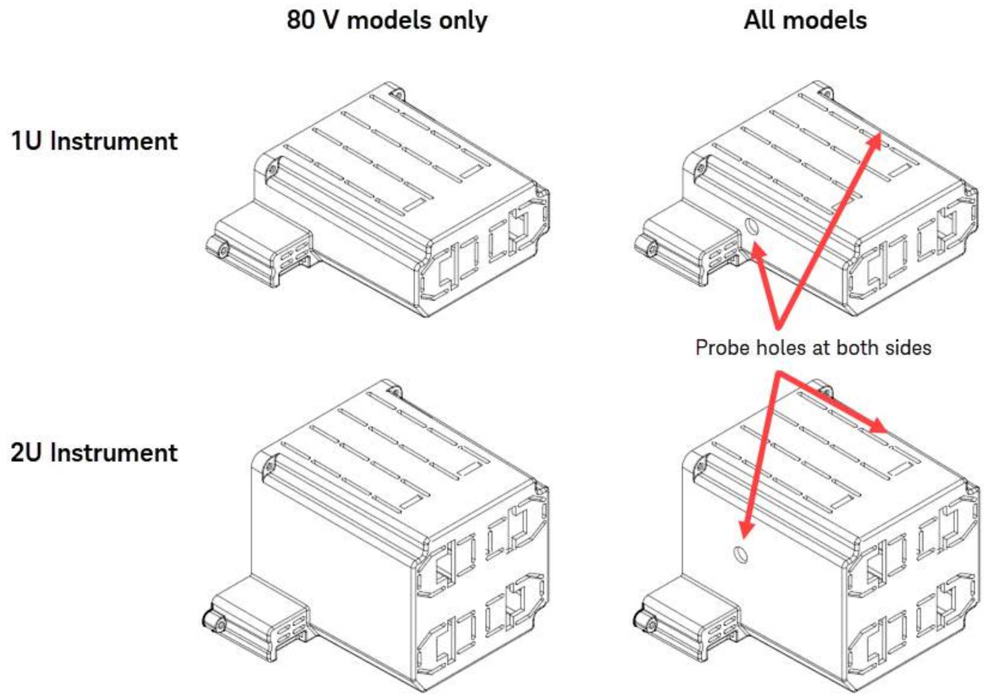
The RP5900 Series may generate noise from cooling fans that could pose hearing hazards. Always wear hearing protection if it is necessary to be near the instrument for an extended period.

RISQUE AUDITIF

Les ventilateurs de refroidissement des modèles RP5900 peuvent produire un bruit suffisamment important pour présenter un danger pour l'audition. Portez systématiquement une protection auditive si vous devez rester à proximité de l'instrument pendant une longue période.

Safety Covers for Output Terminals

For safety purposes, the output terminals is attached with safety cover when shipped.



Rack Mounting

This section contains information for installing the RP5904C and RP5905C Rack Mount Kit. The rack mount kit allows the instruments to be mounted in a 19-inch EIA rack cabinet.

Before getting started, check the following list and verify that you have received these items. If anything is missing, please contact your nearest Keysight Sales and Support Office.

RP5904C rack mount kit

Rack Mount Kit Content	Keysight Part Number
1U slide rail x 2	RP5904-80001
Rail screws, qty 4 (10-32 x 0.5)	
Metal clip-nuts, qty 6 (10-32 x 0.5)	
Front dress screws, qty 2 (10-32 x 0.5)	

RP5905C rack mount kit

Rack Mount Kit Content	Keysight Part Number
2U slide rail x 1	RP5905-80001
Rail screws, qty 8 (10-32 x 0.5)	
Metal clip-nuts, qty 12 (10-32 x 0.5)	
Front dress screws, qty 4 (10-32 x 0.5)	

Installing the Instrument

CAUTION

Keysight RP5900 Series can weigh as much as 66.2 lbs. (30 kg). Two people are required for installation. Do not lift or move the unit alone. Avoid moving the unit by hand. If unavoidable, lift only the unit's chassis; do not lift the unit using the output terminals.

Do not block the air intake at the front, or the exhaust at the rear of the instrument.

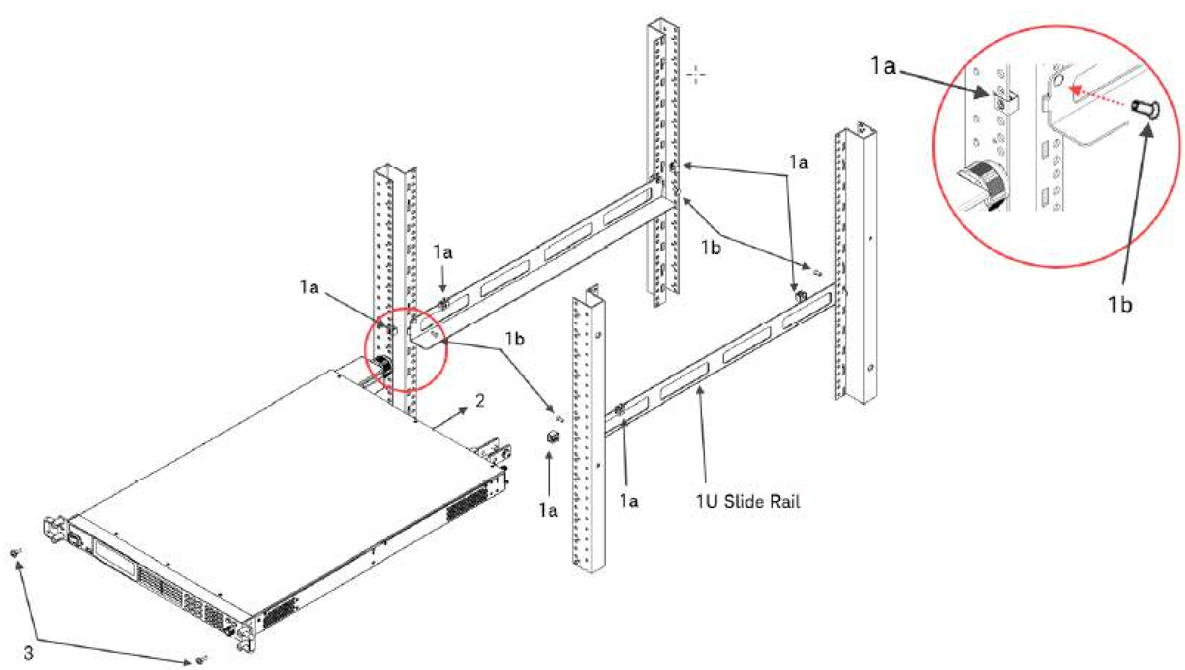
Les modèles RP5900 peuvent peser jusqu'à 30 kg. (66,2 lb). L'installation doit être effectuée par deux personnes. Ne tentez jamais de soulever ou de déplacer l'appareil seul. Évitez autant que possible de déplacer l'instrument à la main. Si vous devez tout de même le déplacer, ne soulevez que le châssis et ne vous servez jamais des bornes de sortie pour le porter.

Ne bloquez pas la prise d'air à l'avant, ni la sortie à l'arrière de l'instrument.

Tools required: Phillips driver, T22 Torx driver, T10 Torx driver.

1. Install the slide rail. Refer to the slide rail instructions.
   a. Install clip-nuts on the rack frame where your instrument will be located.
      a. For 1U: Install one clip nut on each corner.
      b. For 2U: Install two clip nuts on each corner.
   b. Install the stationary part of each slide rail to the sides of the rack frame using the screws provided.
2. Slide the instrument into the rack.
3. Attach the front panel to the instrument to the rack using the dress screws provided.

1U instrument



2U instrument

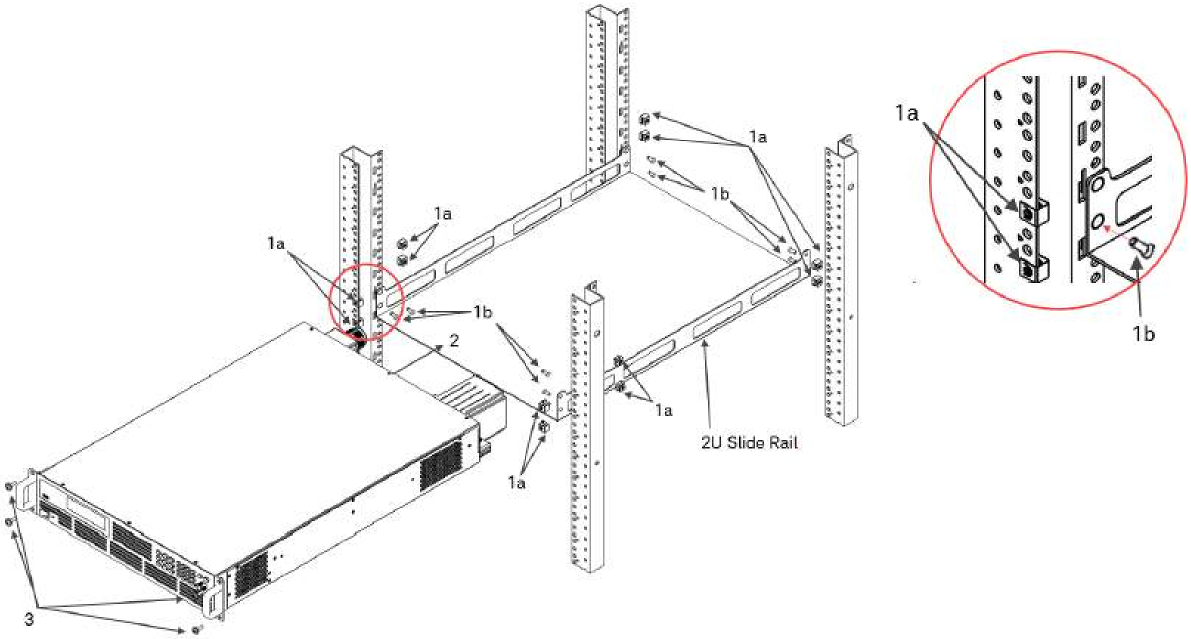
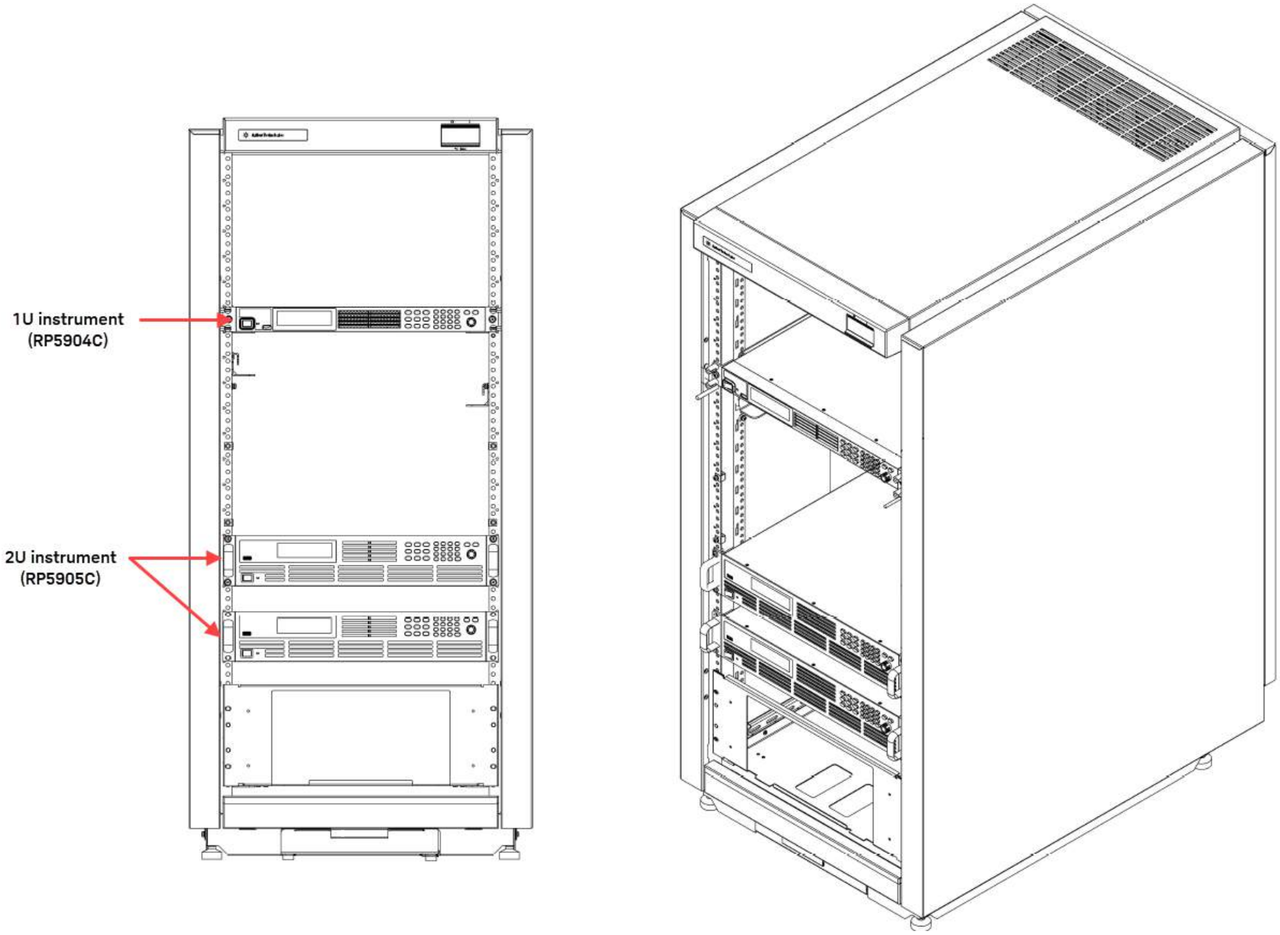


Illustration of mounting the 1U and 2U unit in the Keysight 19-inch EIA rack cabinet.



AC Mains Connections

AC Mains Considerations

Keysight RPS models have a fully bi-directional three-phase AC input converter, which allows for seamless bi-directional power flow between the AC mains and DC output terminals. In a standard power supply, energy only flows from the AC to the DC output terminals. In a regenerative power supply, energy also flows from the DC output terminals back to the AC mains whenever the unit is sinking current, either from rapid downprogramming of the output or from discharging an energy source such as a battery. This return of energy back to the AC mains is called regenerative operation.

Follow all wiring instructions for the power cord provided in this section of the manual.

CAUTION Exceeding the AC input voltage rating or mis-wiring the line connection can create permanent damage of the instrument.

Un dépassement de la tension nominale d'entrée CA ou une erreur de câblage peut endommager définitivement l'appareil.

Output DC Power Limitation at 200 VAC Input

Keysight RPS models are optimized for 3-phase AC input voltages ranging from 380 VAC to 480 VAC. Operating the units at lower input voltages, such as 200 VAC 3-phase, will result in a derated maximum DC output power due to input voltage limitations.

To estimate the maximum available DC output power under low-line conditions, use the following formulas:

1U units: Maximum DC Output Power = $Vac_{input} \times \sqrt{3} \times 12.5\ A \times 0.9$

2U units: Maximum DC Output Power = $Vac_{input} \times \sqrt{3} \times 25\ A \times 0.9$

Where,
Vac_{input} = Measured 3-phase line-to-line AC input voltage
$\sqrt{3}$ = 3-phase conversion factor
12.5 A or 25 A = Nominal input current for 1U or 2U models
0.9 = Power conversion efficiency factor (approximate)

Example (1U at 200 VAC)

$200\ V \times \sqrt{3} \times 12.5\ A \times 0.9 \approx 3.9$ kW maximum output power

Example (2U at 200 VAC)

200 V × $\sqrt{3}$ × 25 A × 0.9 ≈ 7.8 kW maximum output power

NOTE

IMPORTANT

To achieve full rated output power, the unit must be operated within the recommended 380–480 VAC 3-phase input range.

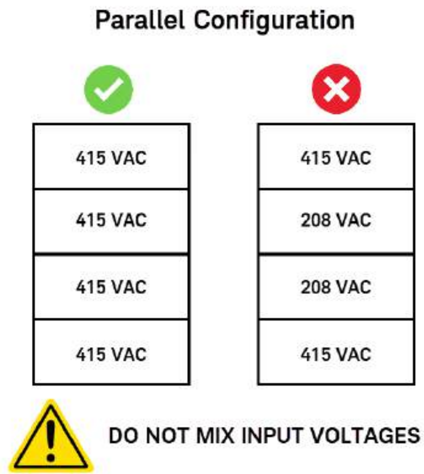
Parallel Operation Input Voltage Requirements

When operating multiple units in a parallel configuration, it is critical that all units receive the same input voltage level on their 3-phase AC power connections. For example, if four units are connected in parallel, each unit must be supplied with the same rated input voltage — e.g., 415 VAC, 3-phase.

CAUTION

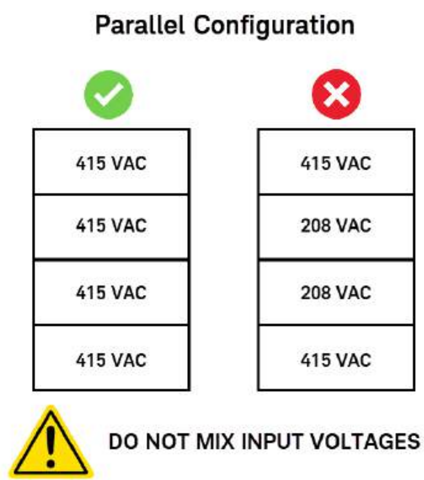
MATCH INPUT VOLTAGE IN PARALLEL OPERATION

When in parallel operation, connect units with the same input voltage. Connecting a lower input voltage (e.g., 208 VAC) in a parallel group configured for 415 VAC input may trigger an MCF (Mismatch Configuration Fault) error. This condition will lock the output of all connected units, and parallel operation may not function.



COMPATIBILITÉ DE LA TENSION D'ENTRÉE EN FONCTIONNEMENT PARALLÈLE

En fonctionnement parallèle, toutes les unités doivent être alimentées avec la même tension d'entrée. Si vous raccordez une tension d'entrée inférieure (par ex. 208 VCA) dans un groupe parallèle configuré pour une entrée de 415 VCA, une erreur MCF (configuration incompatible) peut se produire. Dans ce cas, la sortie de toutes les unités connectées est bloquée et le fonctionnement en parallèle devient impossible.



To ensure safe and proper operation:

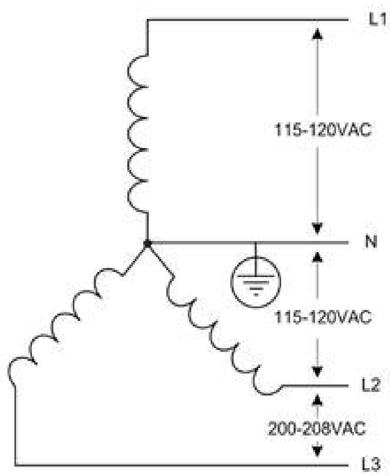
- Verify all units are powered with the same 3-phase input voltage.
- Do not mix input voltage ratings within a parallel group.
- Failure to observe this requirement may result in system malfunction or equipment damage.

Delta and Wye Type AC Distribution Considerations

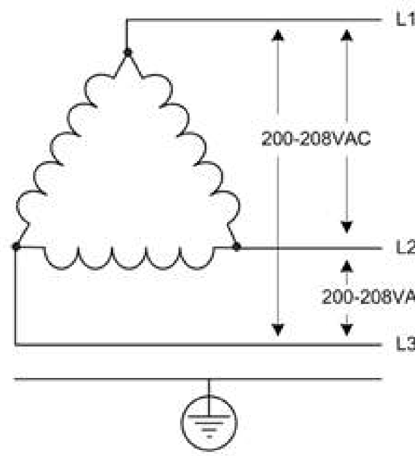
Keysight RPS models can operate with Y-type or delta-type three-phase AC distribution. Configurations shown below are recommended for the 200/208 VAC units. When operating with Delta configurations, the unit should be operated either in a permanently connected configuration or use an AC input connector compliant with IEC 60309. If neither of the above is possible, a secondary conductor in addition to the ground in the three-phase connection) must be used to connect the instrument chassis to earth ground.

AC mains connections must be made by a qualified electrician who knows about 3-phase mains circuits and all applicable safety standards and requirements.

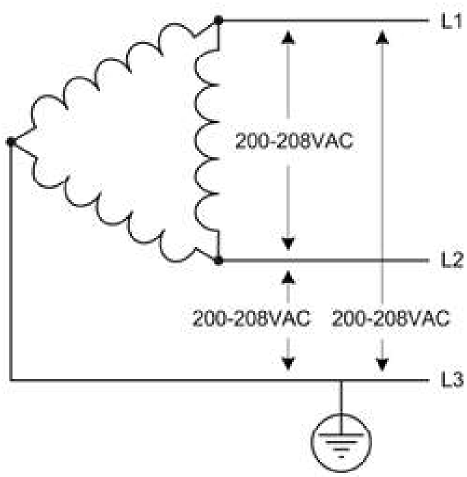
Configurations for 200/208 VAC units



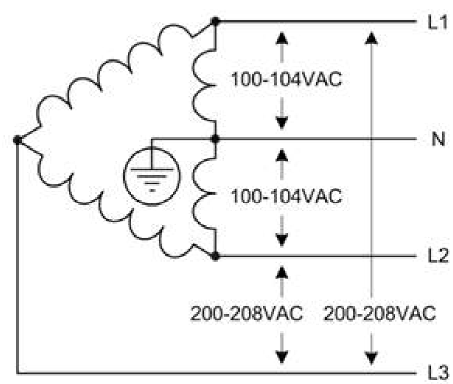
Do not connect the Neutral to the instrument.



This is a floating Delta-type.

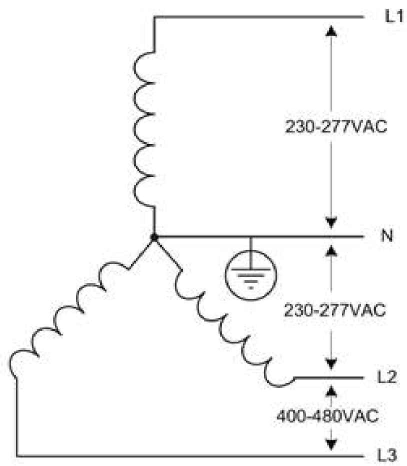


This is a Delta-type with corner ground.

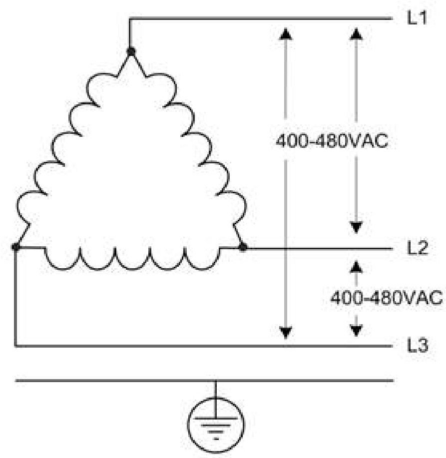


This is a Delta-type with high-leg ground.

Configurations for 400/480 VAC units



Do not connect the Neutral to the instrument.



This is a floating Delta-type.

Power Cable Connections

WARNING

Compliance to all regulations for the operation of and connection to the public grid of energy back-feeding equipment is required.

Connections must be made by a qualified electrician who knows about energy back-feeding equipment to ensure that all applicable safety requirements have been applied and all necessary conditions have been met. Knowledge about 3-phase mains circuits and all applicable safety standards and requirements is also required.

L'appareil doit être raccordé au réseau public conformément à toutes les réglementations applicables aux dispositifs de réalimentation.

Les connexions doivent être réalisées par un électricien qualifié et expérimenté dans le domaine des dispositifs de réalimentation, afin de garantir que toutes les règles de sécurité et conditions requises soient bien respectées. Une bonne connaissance des réseaux triphasés et des normes de sécurité associées est indispensable.

WARNING

For safety reasons, it is essential to physically disconnect the AC mains cable from the unit. A disconnect device, either a switch or circuit breaker, must be provided in the final installation to prevent electrical hazards during maintenance or emergencies. The disconnect device must be close to the equipment, be easily accessible, and be marked as the disconnect device for this equipment. It must meet the input ratings requirements listed in the following table.

Ensure that the circuit breaker is certified to IEC 60947-2, UL 489, or CSA C22.2 No. 5. The circuit breaker must simultaneously disconnect all poles of the lines (L1, L2, L3) and Neutral (if applicable), except for Earth. Additionally, the switch must be certified to IEC 60947-3 or UL/CSA 60947.

Proper certification is crucial to meet safety standards and prevent electrical hazards.

Pour des raisons de sécurité, le câble d'alimentation secteur doit toujours pouvoir être débranché physiquement de l'appareil. Un dispositif de déconnexion (interrupteur ou disjoncteur) doit être intégré à l'installation finale afin d'éliminer tout risque électrique possible lors d'une opération de maintenance ou d'urgence. Ce dispositif doit être installé à proximité de l'appareil, rester facilement accessible, et être clairement identifié comme dispositif de déconnexion pour cet équipement. Il doit respecter les entrée nominales spécifiées dans le tableau ci-dessous.

Le disjoncteur doit être certifié IEC 60947-2, UL 489 ou CSA C22.2 n°5. Il doit permettre la déconnexion simultanée de toutes les phases (L1, L2, L3) ainsi que du neutre (le cas échéant), sauf la terre. L'interrupteur doit être certifié IEC 60947-3 ou UL/CSA 60947.

Ces certifications sont essentielles pour garantir la sécurité et prévenir les risques électriques.

AC mains power cable is not provided with the unit.

Refer to the following table for the maximum current capacity requirements for each cable conductor.

If required by local electrical codes, install a fuse or circuit breaker between the AC mains and the unit. Refer to the following table for current ratings.

Keep the AC mains cables as short as possible. The longer the cable, the greater the voltage loss due to cable resistance.

Model	Unit Rating	L1 I_{max}	L2 I_{max}	L3 I_{max}
RP5913A, RP5915A, RP5916A	2 kW, 200 - 480 VAC	12.5 A	12.5 A	12.5 A
RP5923A, RP5925A, RP5926A	4 kW, 200 - 480 VAC	12.5 A	12.5 A	12.5 A
RP5933A, RP5935A, RP5936A	6 kW, 200 - 480 VAC	12.5 A	12.5 A	12.5 A
RP5943A, RP5945A, RP5946A	12 kW, 200 - 480 VAC	25 A	25 A	25 A

WARNING

The cable cross-section must be suitable for the maximum input current of the instrument. The ground cable must have the same cross-section as the phase cables.

Les câbles d'alimentation doivent avoir une section adaptée au courant d'entrée maximal de l'appareil. Le câble de terre doit être de même section que les câbles de phase.

When connecting the AC mains to 3-phase power, either a delta-type or a Y-type AC mains distribution can be used. **Do not connect the neutral wire on Y-type AC mains distribution**. An earth-ground to chassis-ground connection through a separate conductor must always be provided.

Power Cord Installation

WARNING

SHOCK HAZARD
The instrument requires a chassis ground connection through a separate conductor. The AC mains must include an earth ground connection.
AC mains connections must be made by a qualified electrician who knows about 3-phase mains circuits and all applicable safety standards and requirements.

In cases were the unit is not hardwired to the electrical system, a locking connector scheme should be used such as UL 498, IEC 60309, or equivalent. Consult a local electrician for the connector scheme appropriate for your region.

208V/30A examples:

https://www.grainger.com/product/HUBBELL-WIRING-DEVICE-KELLEMS-30-Amp-Industrial-Grade-Locking-6C549

480V/30A examples:

https://www.grainger.com/product/HUBBELL-WIRING-DEVICE-KELLEMS-30-Amp-Industrial-Grade-Locking-6C549

RISQUE D'ÉLECTROCUTION
L'appareil doit être relié à la masse du châssis au moyen d'un conducteur dédié. L'alimentation secteur doit toujours comporter une connexion à la terre.
Le raccordement au secteur doit être effectué par un électricien qualifié, connaissant les réseaux triphasés et les normes de sécurité en vigueur.

Si l'appareil n'est pas directement relié au système électrique, il convient d'utiliser un connecteur à verrouillage conforme aux normes UL 498, IEC 60309 ou équivalent. Consultez un électricien local pour choisir le connecteur approprié à votre installation.

Exemples 208 V/30 A :

https://www.grainger.com/product/HUBBELL-WIRING-DEVICE-KELLEMS-30-Amp-Industrial-Grade-Locking-6C549

Exemples 480 V/30 A :

https://www.grainger.com/product/HUBBELL-WIRING-DEVICE-KELLEMS-30-Amp-Industrial-Grade-Locking-6C549

BEFORE APPLYING POWER

– Ensure the power voltage matches the rated input voltage of the instrument.

– Verify that all safety precautions are taken. All connections must be made with the unit turned off, and must be performed by qualified personnel who are aware of the hazards involved. Improper actions can cause fatal injury as well as equipment damage.

AVANT LA MISE SOUS TENSION

– Vérifiez que la tension secteur correspond à la tension nominale d’entrée de l’appareil.

– Vérifiez que vous avez bien respecté toutes les consignes de sécurité. Tous les branchements doivent être effectués lorsque l'unité est hors tension, et ils doivent être réalisés par du personnel qualifié conscient des dangers inhérents. Toute utilisation inappropriée est susceptible de provoquer des blessures mortelles et d'endommager l'équipement.

SHOCK HAZARD

Connect the power cord to the AC distribution box with protective grounding. Any interruption of the protective(grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury. Before operation, be sure that the instrument is well grounded.

RISQUE D’ÉLECTROCUTION

Le cordon d’alimentation doit être branché à un boîtier de distribution CA équipé d’un conducteur de protection. Toute interruption du conducteur de protection (mise à la terre) ou tout débranchement de la borne de terre de protection entraîne un risque d'électrocution pouvant provoquer des accidents graves. Avant toute mise en service, assurez-vous que l’appareil est correctement relié à la terre.

SHOCK HAZARD

Do not use an extended power cord without protective grounding. Any interruption of the protective(grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

RISQUE D’ÉLECTROCUTION

N’utilisez jamais de rallonge dépourvue de conducteur de protection. Toute interruption du conducteur de protection (mise à la terre) ou tout débranchement de la borne de terre de protection entraîne un risque d'électrocution pouvant provoquer des accidents graves.

SHOCK HAZARD

Ensure the power cord connection terminal are either insulated or covered with the supplied safety covers to prevent accidental contact with lethal voltages.

RISQUE D’ÉLECTROCUTION

Les bornes du cordon d’alimentation doivent être isolées ou protégées par les capots de sécurité fournis afin d’éviter tout contact accidentel avec des tensions mortelles.

For safety reasons, it is essential to physically disconnect the AC mains cable from the unit. A disconnect device, either a switch or circuit breaker, must be provided in the final installation to prevent electrical hazards during maintenance or emergencies. The disconnect device must be close to the equipment, be easily accessible, and be marked as the disconnect device for this equipment.

Ensure that the circuit breaker is certified to IEC 60947-2, UL 489, or CSA C22.2 No. 5. The circuit breaker must simultaneously disconnect all poles of the lines (L1, L2, L3) and Neutral (if applicable), except for Earth. Additionally, the switch must be certified to IEC 60947-3 or UL/CSA 60947.

Proper certification is crucial to meet safety standards and prevent electrical hazards

Pour des raisons de sécurité, le câble d'alimentation secteur doit toujours pouvoir être débranché physiquement de l'appareil. Un dispositif de déconnexion (interrupteur ou disjoncteur) doit être intégré à l'installation finale afin d'éliminer tout risque électrique possible lors d'une opération de maintenance ou d'urgence. Ce dispositif doit être installé à proximité de l'appareil, rester facilement accessible, et être clairement identifié comme dispositif de déconnexion pour cet équipement.

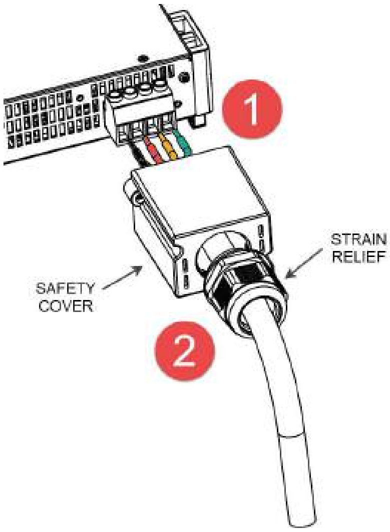
Le disjoncteur doit être certifié IEC 60947-2, UL 489 ou CSA C22.2 n°5. Il doit permettre la déconnexion simultanée de toutes les phases (L1, L2, L3) ainsi que du neutre (le cas échéant), sauf la terre. L'interrupteur doit être certifié IEC 60947-3 ou UL/CSA 60947.

Ces certifications sont essentielles pour garantir la sécurité et prévenir les risques électriques.

NOTE

Compliance to all regulations for the operation of and connection to the public grid of energy back-feeding equipment is required.

Connections must be made by a qualified electrician who knows about energy back-feeding equipment to ensure that all applicable safety requirements have been applied and all necessary conditions have been met. Knowledge about 3-phase mains circuits and all applicable safety standards and requirements is also required.



If the safety cover is attached to the unit, remove the safety cover from the unit.

Step 1: Attach the line wires to the AC mains terminals (U.S. color code shown).

Connect the ground wire (indicated in green) to the chassis ground of the AC line input terminal, as shown.

Step 2: Insert the terminated ends of the power cord through the strain relief of the safety cover.

The safety cover strain relief is designed to accommodate both a wire cable, or individual wires. Do not tighten the strain relief until all wire connections are complete. Tighten the strain relief to 8.85 in-lbs (1 Nm).

Finally, attach the safety cover to the unit with two screws. Tighten the two screws to 6.6 in-lb (0.75 Nm).

Single Unit Output Connections

Output Connections

Single DUT Connections

Multiple DUT Connections

Remote Sense Connections

Additional DUT Considerations - all Models

NOTE For load mode, the input terminals are referred to as "Outputs" throughout this document.

Output Connections

Bus Bar Connections

WARNING SHOCK HAZARD, HAZARDOUS VOLTAGES
Do not touch any output terminal connections by hand. Ensure that all instrument connections, DUT wiring, and DUT connections are either insulated or covered using the safety covers provided, so that no accidental contact with harzardous voltages can occur. Always use the electrical safety gloves when connecting or disconnecting DUT to the output terminals.

RISQUE D’ÉLECTROCUTION, TENSIONS DANGEREUSES
Ne touchez jamais les connexions des bornes de sortie à mains nues. Assurez-vous que toutes les connexions de l’instrument, ainsi que le câblage et les connexions du DUT, soient soit isolés, soit protégés par les capots de protection fournis, afin d’éviter tout contact accidentel avec des tensions dangereuses. Portez toujours des gants isolants lorsque vous connectez ou déconnectez le DUT aux bornes de sortie.

WARNING SHOCK HAZARD
Always assume the positive and negative lines at the output terminal are energized. Verify the lines before making any connections.

RISQUE D’ÉLECTROCUTION
Considérez toujours que les lignes positives et négatives des bornes de sortie sont sous tension. Vérifiez-les avant toute connexion.

WARNING SHOCK HAZARD
Always attach the safety cover regardless of whether the instrument is in use or not, so that no accidental contact with hazardous voltages can occur.

RISQUE D’ÉLECTROCUTION
Montez toujours les capots de protection, que l’instrument soit en marche ou non, afin de prévenir tout risque de contact accidentel avec des tensions dangereuses.

WARNING

SHOCK HAZARD

Always verify if the output terminals and lines are hazardous, even if the instrument is turned OFF or ON.

Do not touch cables, terminals, or circuits connected to these lines.

RISQUE D'ÉLECTROCUTION

Vérifiez toujours si les bornes et les lignes de sortie sont sous tension, que l'instrument soit en marche ou non.

Ne touchez jamais les câbles, bornes ou circuits connectés à ces lignes.

The following factors should be considered when wiring the device under test (DUT) to the unit:

- DUT wire current carrying capacity
- DUT wire insulation rating (must be equivalent to the maximum output voltage)
- DUT wire voltage drop
- DUT wire noise and impedance effect

Wire Size

WARNING

FIRE HAZARD
To satisfy safety requirements, DUT wires must be large enough not to overheat when carrying the maximum short-circuit output current. If there is more than one DUT, any pair of DUT wires must be capable of safely carrying the full-rated current of the unit. Paralleled DUT wires may be required for larger-ampacity models.

RISQUE D'INCENDIE
Pour répondre aux exigences en matière de sécurité, les fils du DUT doivent être assez gros pour ne pas surchauffer lorsqu'ils transportent le courant de sortie maximal en court-circuit. Si plusieurs DUT sont utilisés, chaque paire de fils doit pouvoir supporter en toute sécurité le courant nominal total de l'unité. Pour les modèles à forte intensité, il peut être nécessaire de connecter plusieurs fils en parallèle.

Ensure the DUT wires' connections are appropriately tightened to reduce impedance. High resistance in the connection will generate heat and may melt the insulation and cause fire.

Assurez-vous que les connexions des fils du DUT sont correctement serrées pour réduire l'impédance. Une résistance élevée au niveau des connexions peut provoquer une surchauffe, endommager l'isolation et entraîner un risque d'incendie.

The following table lists the characteristics of AWG (American Wire Gauge) copper wire.

AWG	Equivalent mm^2	Nearest Metric size	Ampacity (Note 1)	Resistance (Note 2)
18	0.82	1.0 mm^2	up to 14 A	6.385 Ω
16	1.31	1.5 mm^2	up to 18 A	4.016 Ω
14	2.1	2.5 mm^2	up to 25 A	2.525 Ω
12	3.3	4 mm^2	up to 30 A	1.588 Ω
10	5.3	6 mm^2	up to 40 A	0.999 Ω
8	8.4	10 mm^2	up to 60 A	0.628 Ω
6	13.3	16 mm^2	up to 80 A	0.395 Ω
4	21.2	25 mm^2	up to 105 A	0.248 Ω
2	33.6	35 mm^2	up to 140 A	0.156 Ω
1/0	53.5	50 mm^2	up to 195 A	0.098 Ω
2/0	67.4	70 mm^2	up to 225 A	0.078 Ω
3/0	85	95 mm^2	up to 260 A	0.062 Ω
4/0	107	120 mm^2	up to 300 A	0.049 Ω
6.2/0 (350 MCM)	177	185 mm^2	up to 420 A	N/A

Note 1 Ampacity is based on a single conductor in free air, 26-30 °C ambient temperature with the conductor rated at 60 °C. Ampacity decreases at higher temperatures.
Note 2 Resistance is in ohms/1000 feet, at 20 °C wire temperature.

Along with temperature, you must also consider voltage drop when selecting wire sizes. The RPSwill tolerate a voltage drop of 1 V per lead while maintaining the specified programming and measurement accuracy (see RP5900A Series datasheet). Voltage drops of up to 25% of the rated output voltage per lead will be tolerated with only slightly reduced programming and measurement accuracy. Of course, any voltage drop in the DUT leads reduces the maximum voltage available at the DUT. Subtract the DUT lead drop from the rated voltage of the unit to determine the maximum voltage available at the DUT.

Single DUT Connections

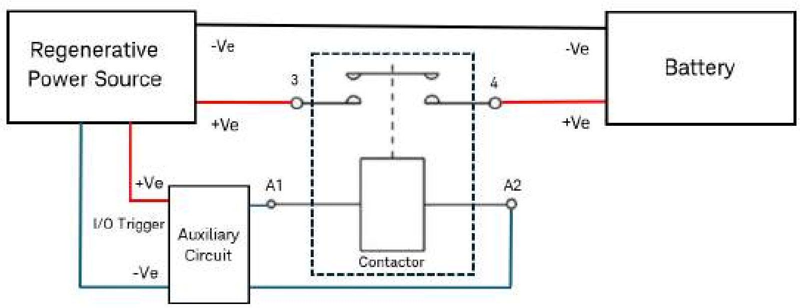
WARNING

SHOCK HAZARD
Always assume the positive and negative lines at the output terminal are energized. Verify the lines before making any connections.

RISQUE D'ÉLECTROCUTION
Considérez toujours que les lignes positives et négatives des bornes de sortie sont sous tension. Vérifiez-les avant toute connexion.

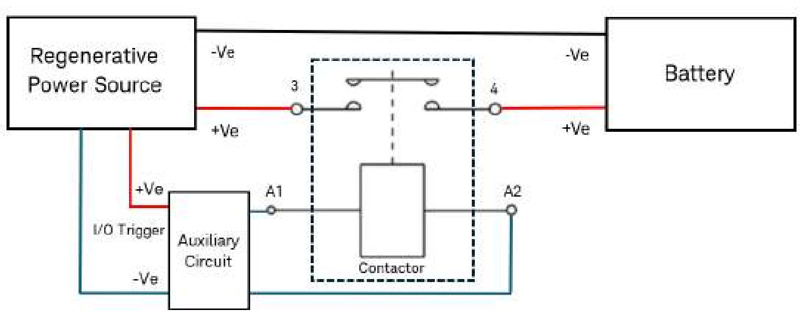
CONNECTION TO AN ENERGIZED SUPPLY (e.g., Battery), SPARKS MAY OCCUR

During connection, it is recommended to use a safety-certified (for example, UL, CSA and etc) contactor to isolate the energized supply (e.g., battery) from the RPS, as illustrated below. Ensure the contactor has the correct voltage and current rating that is higher than the rated RPS voltage and current. Failing to do so may cause injury and equipment damage. For more details, see Contactor Installation.

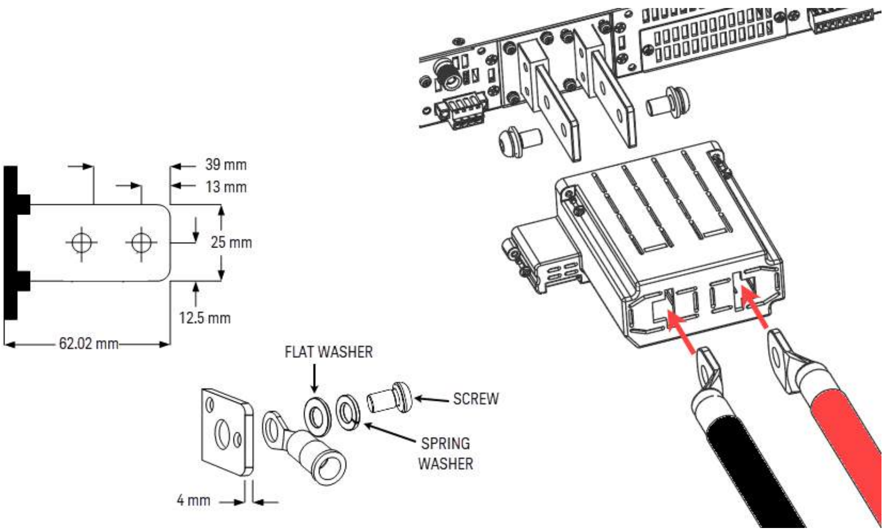


CONNEXION À UNE SOURCE SOUS TENSION (ex. batterie), RISQUE D'ÉTINCELLES

Lors de la connexion, il est recommandé d'utiliser un contacteur certifié (UL, CSA, etc.) pour isoler la source sous tension (ex. batterie) du RPS, comme indiqué dans le schéma ci-dessous. Vérifiez que le contacteur supporte une tension et un courant supérieurs aux valeurs nominales du RPS. Le non-respect de cette consigne peut entraîner des blessures graves et risque d'endommager l'appareil. Pour plus de détails, consultez la section Installation du contacteur.



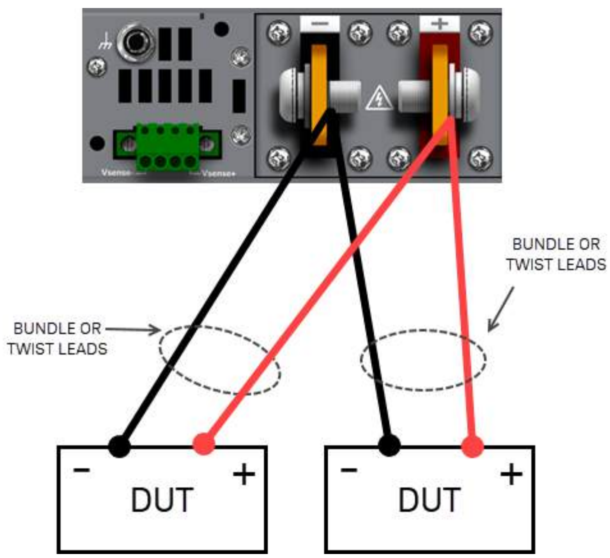
1. As shown in the following figure, terminate all DUT wires with wire terminal lugs securely attached. DO NOT use unterminated wires for DUT connections at the instrument.
2. Route the wires through the safety cover before attaching them to the bus bars. Knockouts are provided on for larger diameter wires. The figure illustrates the recommended hardware for connecting wires to the bus bars. You must provide all cabling. Ensure that the wire-mounting hardware does not short the output terminals.
3. When attaching terminal lugs to the bus bars, ensure there is enough room for the safety cover. Twist or bundle the load wires to reduce lead inductance and noise pickup. Tighten the screws to the bus bar to 8.85 in-lbs (1 Nm).
4. Attach the safety cover to the rear panel. Note that heavy wiring caThe goal is to minimize the loop area or physical space between the + and - output leads from the bus bars to the DUT.
5. Attach the safety cover to the rear panel and tighten the screws to 6.6 in-lbs (0.75 Nm). Note that heavy wiring cables must have some form of strain relief to prevent bending the safety cover or bus bars.



Multiple DUT Connections

If you are using local sensing and are connecting multiple DUTs to one output, connect each DUT to the output terminals using separate connecting wires as shown in the following figure. This minimizes mutual coupling effects and takes full advantage of the power supply's low output impedance. Keep each pair of wires as short as possible and twist or bundle them to reduce lead inductance and noise pickup. The goal is to minimize the loop area or physical space between the + and – output leads from the bus bars to the DUT.

If DUT considerations require the use of distribution terminals that are located away from the power supply, twist or bundle the wires from the output terminals to the remote distribution terminals. Connect each DUT to the distribution terminals separately. Remote voltage sensing is recommended under these circumstances. Sense either at the remote distribution terminals or, if one DUT is more sensitive than the others, directly at the critical DUT.

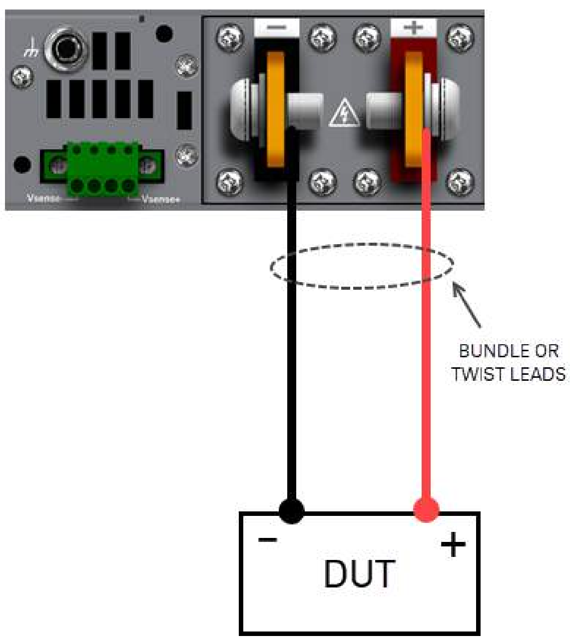


Remote Sense Connections

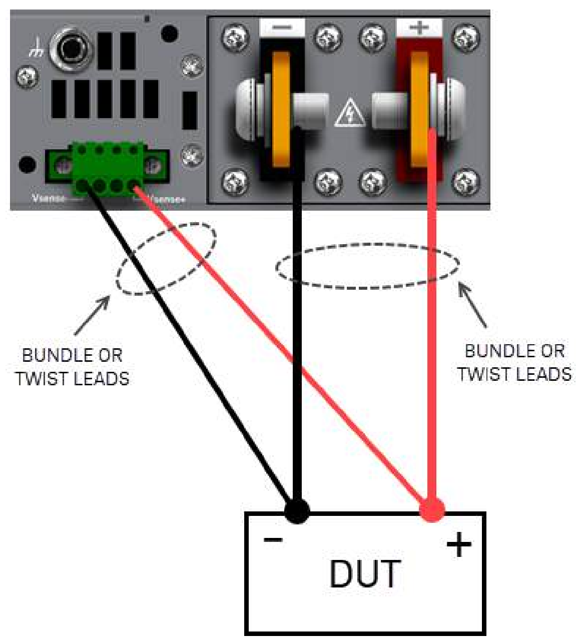
The instrument includes built-in relays that connect or disconnect the ± sense terminals from their corresponding ± output terminals. As shipped, the sense terminals are internally connected to the output terminals. This is referred to as 2-wire, or local sensing.

4-wire, or remote sensing improves the voltage regulation at the load by monitoring the voltage at the DUT rather than at the output terminals. This automatically compensates for the voltage drop in the DUT leads, which is especially useful for CV operation with DUT impedance that vary or have significant lead resistance. Remote voltage sensing also provides greater accuracy when using voltage readback in all operating modes. Because remote sensing is independent of other DUT functions, it can be used regardless of how the instrument is programmed.
Remote sensing has no effect during CC operation.

The following figures illustrate DUT connections using 2-wire sensing and 4-wire sensing.



WITH 2-WIRE SENSE (LOCAL SENSE)



WITH 4-WIRE SENSE (REMOTE SENSE)

Connect the output terminals to the DUT using separate connecting wires. Keep the wire-pair as short as possible and twist or bundle it to reduce lead inductance and noise pickup.

Sense connectors accept wire sizes between AWG 16 (1.5 mm^2) maximum and AWG 24 (0.2 mm^2) minimum. Strip the wire insulation back 10 mm. Tighten the screws securely.

Connect the sense leads as close to the DUT as possible. Do NOT bundle the sense wire-pair together with the DUT leads; keep the DUT wires and sense wires separate. Sense wiring can be of a lighter gauge than the DUT wiring. The sense leads can carry up to 1 mA of current without degrading the current measurement.

NOTE Keep the sense lead resistance less than about 0.5 Ω per lead (this requires 20 AWG or heavier for a 50 foot length).

Use multiple test cables when the maximum current that the test cables can withstand fails to meet the rated current. For example, for a maximum current of 1,200 A, 4 pieces of 360 A red and black cables are required.

To ensure system stability, use armored twisted-pair cables between the remote sense terminals and the DUT. Make sure to connect the positive and negative wires correctly, or it could damage the instrument.

Open sense leads

The sense leads are part of the output's feedback path. Connect them in such a way so that they do not inadvertently become open circuited. The instrument includes protection resistors that reduce the effect of open sense leads during 4-wire-sensing. If the sense leads open during operation, the instrument returns to the local sensing mode, with the voltage at the output terminals approximately 5% higher than the programmed value.

Over-voltage Protection

Over-voltage protection (OVP) provides a configurable over-voltage protection based on sense lead voltage. Having the OVP circuit monitor the sense lead voltage rather than the output terminal voltage allows for more precise voltage monitoring directly at the DUT.

Note that due to the voltage drop in the DUT leads, the voltage at the output of the power supply could be higher than the voltage being regulated at the DUT. The voltage at the output terminals of the power supply can never exceed the unit's voltage rating.

Output Noise

Any noise picked up on the sense leads will appear at the output terminals and may adversely affect CV load regulation. Twist the sense leads to minimize the pickup of external noise. In extremely noisy environments it may be necessary to shield the sense leads. Ground the shield at the power supply end only; do not use the shield as one of the sensing conductors.

Additional DUT Considerations

Response Time with External Capacitor

When programming with an external capacitor, voltage response time may be longer than with purely resistive DUTs. Use the following formula to estimate the additional up-programming response time:

$$\text{Response Time} = \frac{\text{(added output capacitor)X(change in Vout)}}{\text{(current limit setting)–(DUT current)}}$$

Note that programming into an external output capacitor may cause the RPS to briefly enter constant current operating mode, which adds additional response time. By setting the proper voltage slew time when using an external capacitor, it may be possible to prevent mode crossover into constant current.

Positive, Negative, and Floating Voltages

Either positive or negative voltages with respect to ground can be obtained from the output by grounding one of the output terminals. Always use two wires to connect the DUT to the output regardless of where or how the system is grounded.

- 80 V models can operate with any output terminal ± 280 VDC including output voltage from ground.
- 500 V and 800 V models can operate with any output terminal ± 800 VDC including output voltage from ground.

Maximum Load Capacitance

Load capacitance refers to the total effective capacitance presented by the connected DUT at the output terminals.

Capacitive loads can significantly influence the dynamic response of the power supply. Excessive capacitance may lead to control loop instability, voltage overshoot, or prolonged settling times, especially during fast transient events. The RP5900 Series is designed with a defined maximum load capacitance limit.

Ensure that the total capacitance of the connected load—including any parallel capacitors or capacitive behavior from downstream equipment—does not exceed the specified maximum.

Refer table below for the maximum load capacitance value applicable to your model.

Model	Maximum load capacitance			
	2 kW	4 kW	6 kW	12 kW
80 V	RP5913A	RP5923A	RP5933A	RP5943A
	40000 µF	80000 µF	120000 µF	240000 µF
500 V	RP5915A	RP5925A	RP5935A	RP5945A
	300 µF	600 µF	900 µF	1800 µF
800 V	RP5916A	RP5926A	RP5936A	RP5946A
	300 µF	600 µF	900 µF	1800 µF

Multiple Unit Output Connections

Parallel Connections

Primary/Secondary Connections

Series Connections

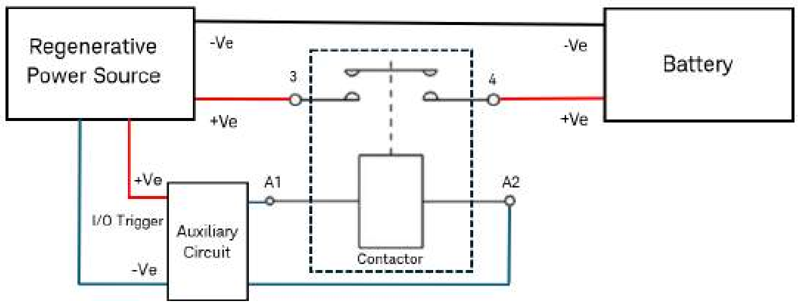
WARNING

SHOCK HAZARD
Always assume the positive and negative lines at the output terminal are energized. Verify the lines before making any connections.

RISQUE D'ÉLECTROCUTION
Considérez toujours que les lignes positives et négatives des bornes de sortie sont sous tension. Vérifiez-les avant toute connexion.

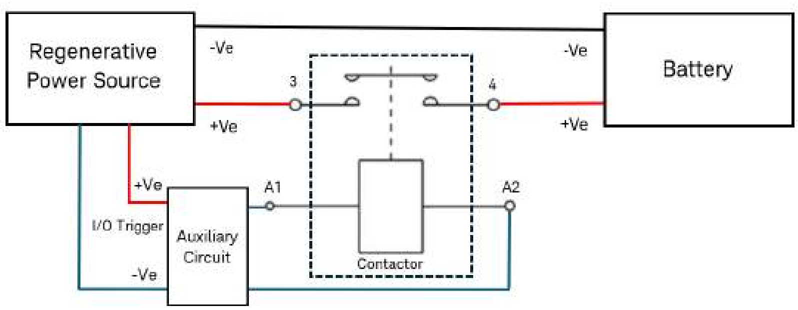
CONNECTION TO AN ENERGIZED SUPPLY (e.g., Battery), SPARKS MAY OCCUR

During connection, it is recommended to use a safety-certified (for example, UL, CSA and etc) contactor to isolate the energized supply (e.g., battery) from the RPS, as illustrated below. Ensure the contactor has the correct voltage and current rating that is higher than the rated RPS voltage and current. Failing to do so may cause injury and equipment damage. For more details, see Contactor Installation.



CONNEXION À UNE SOURCE SOUS TENSION (ex. batterie), RISQUE D'ÉTINCELLES

Lors de la connexion, il est recommandé d'utiliser un contacteur certifié (UL, CSA, etc.) pour isoler la source sous tension (ex. batterie) du RPS, comme indiqué dans le schéma ci-dessous. Vérifiez que le contacteur supporte une tension et un courant supérieurs aux valeurs nominales du RPS. Le non-respect de cette consigne peut entraîner des blessures graves et risque d'endommager l'appareil. Pour plus de détails, consultez la section Installation du contacteur.



NOTE

For load mode, the input terminals are referred to as "Outputs" throughout this document.

Parallel Connections

Connecting the unit in parallel provides a greater current capability than can be obtained from a single unit.

WARNING

SHOCK HAZARD
Always assume the positive and negative lines at the output terminal are energized. Verify the lines before making any connections.

RISQUE D'ÉLECTROCUTION
Considérez toujours que les lignes positives et négatives des bornes de sortie sont sous tension. Vérifiez-les avant toute connexion.

SHOCK HAZARD
All paralleled units must be connected to ground through a grounded power cord at all times. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal on any unit will cause a potential shock hazard that could result in injury or death.

RISQUE D'ÉLECTROCUTION
Toutes les unités connectées en parallèle doivent rester reliées à la terre en permanence via un cordon équipé d'une fiche de courant avec terre. Toute interruption du conducteur de protection (mise à la terre) ou tout débranchement de la borne de terre sur une unité entraîne un risque d'électrocution pouvant provoquer des accidents graves, voire mortels.

Turn off the device power before connecting or disconnecting the power cord or output terminals.

Mettez l'appareil hors tension avant de brancher ou de débrancher le cordon d'alimentation ou de le connecter aux bornes de sortie.

BEFORE APPLYING POWER
– Ensure the power voltage matches the rated input voltage of the instrument.
– Ensure the AC distribution box capacity is sufficient when connecting multiple instruments. See the datasheet for the AC input rating of the instrument.
– Verify that all safety precautions are taken. All connections must be made with the unit turned off, and must be performed by qualified personnel who are aware of the hazards involved. Improper actions can cause fatal injury as well as equipment damage.

AVANT LA MISE SOUS TENSION
– Vérifiez que la tension secteur correspond à la tension nominale d'entrée de l'appareil.
– Assurez-vous que la capacité du tableau de distribution est suffisante si plusieurs instruments sont raccordés simultanément. Consultez la fiche technique pour connaître la tension et le courant d'entrée de l'instrument.
– Vérifiez que vous avez bien respecté toutes les consignes de sécurité. Tous les branchements doivent être effectués lorsque l'unité est hors tension, et ils doivent être réalisés par du personnel qualifié conscient des dangers inhérents. Toute utilisation inappropriée est susceptible de provoquer des blessures mortelles et d'endommager l'équipement.

CAUTION

To Prevent Possible Equipment Damage:

- Connect no more than 16 units **of identical models** in parallel configuration. All units must have the same firmware version installed. Refer to Instrument Identification for details.
- Parallel connection of mixed models is only supported for 6 kW and 12 kW models, and only for those explicitly marked as compatible in Table 1—such as RP5933A and RP5943A.
- Always turn the **AC power** on and off together. Never leave any units powered on while the others are turned off.

Pour éviter tout endommagement de l’appareil :

- Ne connectez pas plus de 16 modules du **même modèle** en configuration parallèle. Toutes les unités doivent utiliser la même version du micrologiciel. Pour plus d'informations, reportez-vous à la section Identification de l’appareil.
- La connexion en parallèle de modèles différents n’est autorisée que pour les versions 6 kW et 12 kW, et uniquement pour les modèles explicitement indiqués comme compatibles dans le Tableau 1— par exemple, RP5933A et RP5943A.
- **L’alimentation secteur** doit toujours être allumée ou éteinte simultanément pour toutes les unités. Ne laissez jamais certaines unités sous tension pendant que d’autres sont éteintes.

Before connecting the optional RP5903C parallel kit, ensure the instrument power switch and the main switch of the AC power input (distribution box) is off.

Avant de raccorder le kit parallèle en option RP5903C, assurez-vous que l’interrupteur d’alimentation de chaque instrument et l’interrupteur principal du tableau de distribution sont désactivés (Off).

Before connecting the optional RP5903C parallel kit, ensure that each instrument is in single mode (Single).

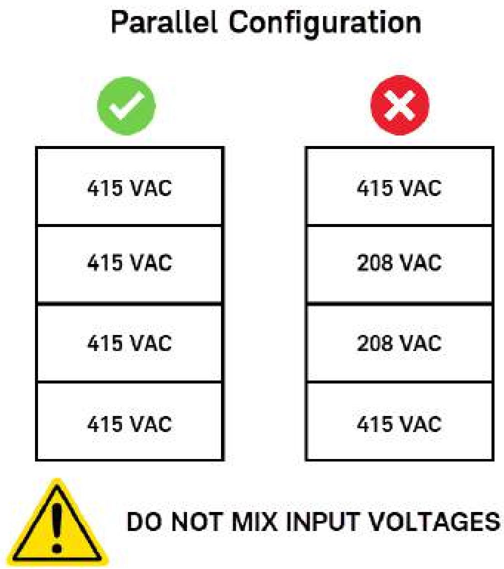
Avant de connecter le kit parallèle en option RP5903C, vérifiez que chaque instrument est en mode Simple.

The fiber optic cables from the optional RP5903C parallel kit cannot be flexed or folded. When the cable is too long and needs to be arranged, gently wrap it in a circle and tie it carefully.

Les câbles à fibre optique du kit parallèle RP5903C ne doivent jamais être pliés ou tordus. Si le câble est trop long, enroulez-le délicatement en spirales et attachez-le soigneusement avec un serre-câble.

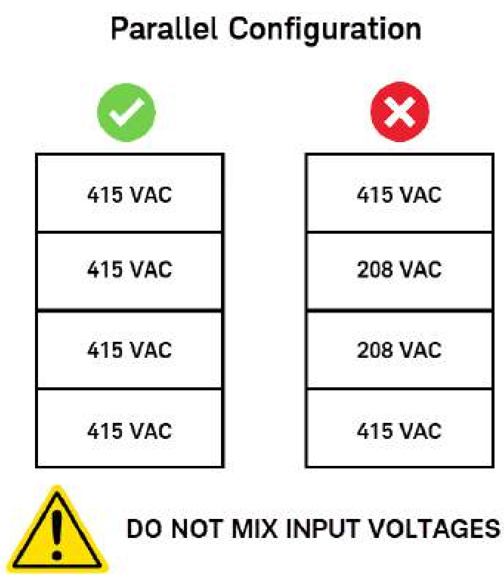
MATCH INPUT VOLTAGE IN PARALLEL OPERATION

When in parallel operation, connect units with the same input voltage. Connecting a lower input voltage (e.g., 208 VAC) in a parallel group configured for 415 VAC input may trigger an MCF (Mismatch Configuration Fault) error. This condition will lock the output of all connected units, and parallel operation may not function.



COMPATIBILITÉ DE LA TENSION D’ENTRÉE EN FONCTIONNEMENT PARALLÈLE

En fonctionnement parallèle, toutes les unités doivent être alimentées avec la même tension d’entrée. Si vous raccordez une tension d’entrée inférieure (par ex. 208 VCA) dans un groupe parallèle configuré pour une entrée de 415 VCA, une erreur MCF (configuration incompatible) peut se produire. Dans ce cas, la sortie de toutes les unités connectées est bloquée et le fonctionnement en parallèle devient impossible.



Parallel Connection Configuration

When configuring units for parallel connection, all instruments must be of the same model type to ensure proper synchronization and stable operation. For mixed model configurations, only those explicitly marked as compatible in Table 1—such as RP5933A and RP5943A—may be connected together. Mixing other models not listed as compatible may result in communication errors or unsafe operation.

Parallel connection of mixed models with identical voltage rating is only applicable for 6 kW and 12 kW models with the same firmware version.

All other models require the same models of the same firmware to be paralleled.

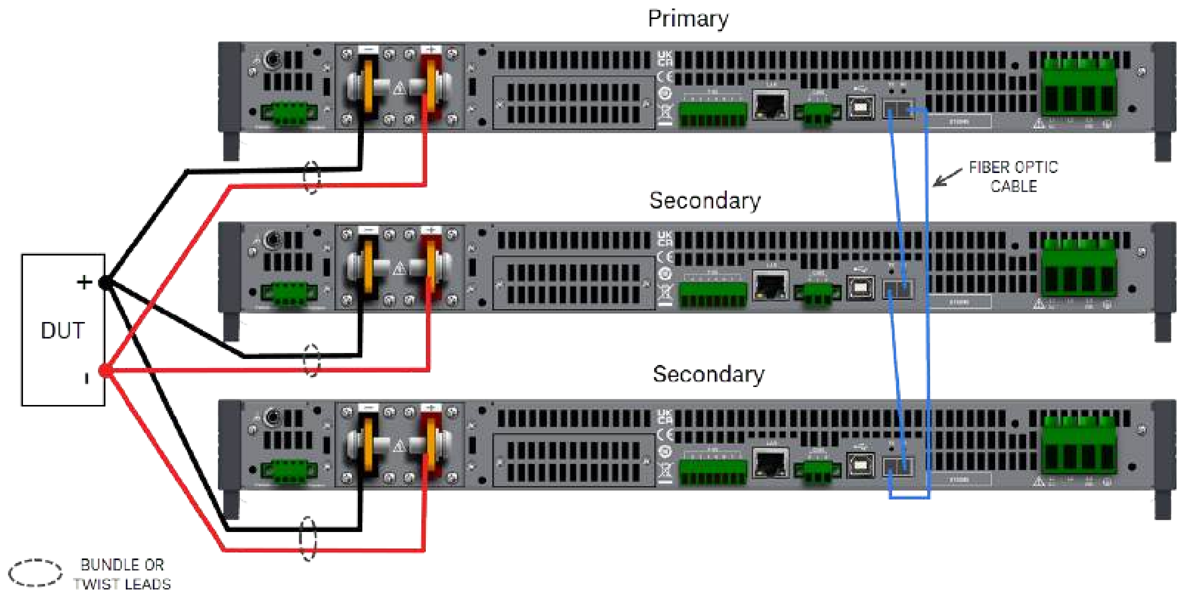
Table 1: Model Compatibility for Parallel Connection

Model	Voltage Rating	Current Rating	Mixable with Other Models
RP5913A	80 V	40 A	No
RP5923A	80 V	80 A	No
RP5933A	80 V	120 A	Yes (RP5943A)
RP5943A	80 V	240 A	Yes (RP5933A)
RP5915A	500 V	12 A	No
RP5925A	500 V	24 A	No
RP5935A	500 V	36 A	Yes (RP5945A)
RP5945A	500 V	72 A	Yes (RP5935A)
RP5916A	800 V	8 A	No
RP5926A	800 V	16 A	No
RP5936A	800 V	24 A	Yes (RP5946A)
RP5946A	800 V	48 A	Yes (RP5936A)

DUT Connections

The following figures illustrate three units connected in parallel. Note the following recommendations:

- Always install the paralleled units relatively close to each other.
- Keep the cables from the unit to the DUT as short as possible and twist or bundle the leads to reduce lead inductance and noise pickup. The goal is to minimize the loop area or physical space between the + and - output leads from the bus bars to the DUT.
- A symmetrical arrangement of separate DUT-wire pairs of **equal** length connecting to a common load point is highly recommended. This provides the best possible dynamic response.
- Bus bars can be used to parallel the output terminals in a stacked configuration. Ensure that the cross-section area of the bus bars will accommodate the total output current of the stack. Bus bars can be placed either on the inside or outside of the output terminals. Exposed bus bar surfaces must either be enclosed in a cabinet or insulated so that no accidental contact with hazardous voltages can occur.



Primary/Secondary Connections

A primary/secondary configuration can be used when connecting units in parallel. This allows one designated unit to be the primary controller of all of the units in the paralleled stack. The primary/secondary communication uses the RP5903C parallel kit. Connections are made using the fiber optic cable supplied by the optional RP5903C paralllel kit as shown in the above figure (indicated by the blue cable). For further information about primary/secondary configurations, refer to Parallel Operation.

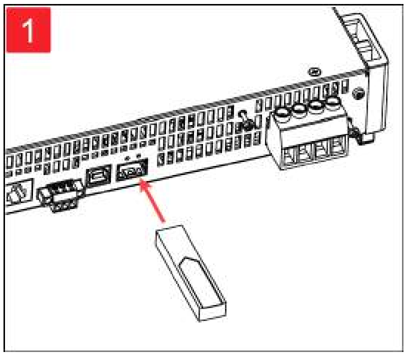
Do not install units into a primary/secondary configuration that are not actively being used as part of the primary/secondary group.

Installing and using the optional RP5903C parallel kit

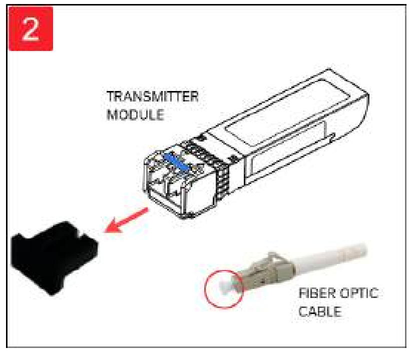
The optional RP5903C parallel kit is an essential option for parallel connections. It is used for data transmission and communication between parallel units.

The parallel kit consists of:

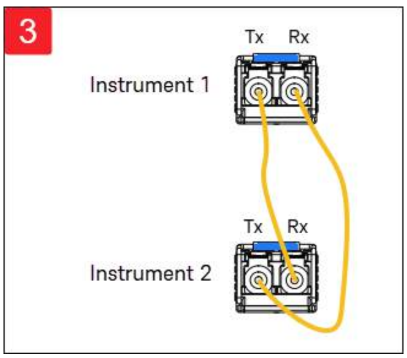
- Transmitter module x 1
- Fiber optic cable (long) x 1
- Fiber optic cable (short) x 1



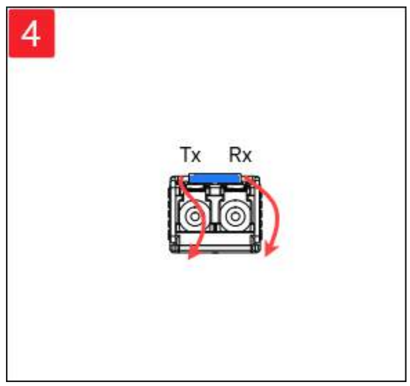
Connect the RP5903C transmitter module to the Tx/Rx port.



Before making the connection, remove the black rubber cover from the transmitter module and the dust cap from the fiber optic cable.



Connect the fiber optic cable to the Tx port and the Rx port of the primary and secondary instruments.



To detach the transmitter module from the instrument, pull the blue handle down.

Optical Module Specifications

An optical module is essential for parallel connections. It is used for data transmission and communication between parallel units and must meet the following technical specifications:

Component	Requirement
Fiber Cable	Optical transmitter: 1310 nm FP laser Receiver: PIN photodetector Link distance: up to 20 km over single-mode fiber.
Fiber Connector Ends	LC interface Note: Each fiber cable has two ends, both must be LC connector.
Module Interface	SFP MSA and SFF-8472 compliant
Module Power Supply	+ 3.3 VDC
Module Data Rate	1.25 Gbps / 1.063 Gbps (dual rate)
Module Dimensions	13.7 mm (W) x 57.0 mm (D) x 10.5 mm (H)

NOTE

Users may purchase a compatible fiber optical module based on the specifications provided above. Please ensure the selected module meets the required specifications for optimal performance. For convenience, the module is also available as an optional accessory (Option RP5903C) through Keysight.

Series Connections

Series connections are not permitted under any circumstances.

WARNING

SHOCK HAZARD/HAZARDOUS VOLTAGES
Series connections are not permitted for many reasons. One of the primary reasons is that floating voltages cannot exceed the isolation ratings, as indicated in the datasheet.

RISQUE D'ÉLECTROCUTION / TENSIONS DANGEREUSES
Les connexions en série sont strictement interdites pour plusieurs raisons. Cette interdiction est notamment dûe au fait que les tensions flottantes ne doivent jamais excéder les limites d'isolation spécifiées dans la fiche technique.

Interface Connections

This section describes how to connect to the various communication interfaces on your RPS. For further information about configuring the remote interfaces, refer to Remote Interface Configuration.

If you have not already done so, install the latest Keysight IO Libraries Suite from www.keysight.com.

NOTE For detailed information about interface connections, refer to the Keysight Technologies USB/LAN/GPIB Interfaces Connectivity Guide, included with the Keysight IO Libraries Suite.

GPIB Connections

The following figure illustrates a typical GPIB interface system.

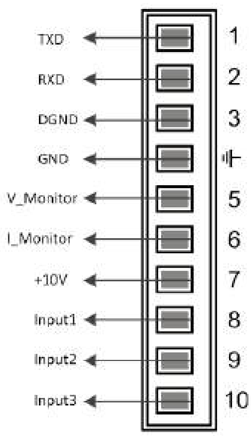
1. Connect your instrument to the GPIB interface card using a GPIB interface cable.
2. Use the Connection Expert utility of the Keysight IO Libraries Suite to configure the GPIB card's parameters.
3. You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments.

NOTE The GPIB cable is not recommended to be longer than 3 meters.

RS232 Connections

The following figure illustrates a typical RS232 interface system.

Only pin 1, 2, and 3 are used for RS232 interface connection. The definitions and descriptions of RS232 connector pins are shown below.



Pins	Descriptions
1	TXD (transmit data)
2	RXD (receive data)
3	DGND (ground)

1. Connect your instrument to the Analog/RS232 interface using a RS232 cable.

NOTE The cable is customized. The other end of the cable, which connects to the workstation (computer), must use either an RS232-USB converter or a standard RS232 female connector.

2. Connect pin 1, pin 2, and pin 3 to your computer.
3. Identify the correct COM port that the instrument is using.
4. Configure the instrument's baud rate to 115200 and number of data bits to 8. The parity and StopBits are non-configurable.
5. Use the Connection Expert utility of the Keysight IO Libraries Suite to configure the RS232 parameters. Make sure Connection Expert utility and instrument is set to the same configuration for serial communications.
6. You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments.

NOTE The RS232 cable is not recommended to be longer than 3 meters.

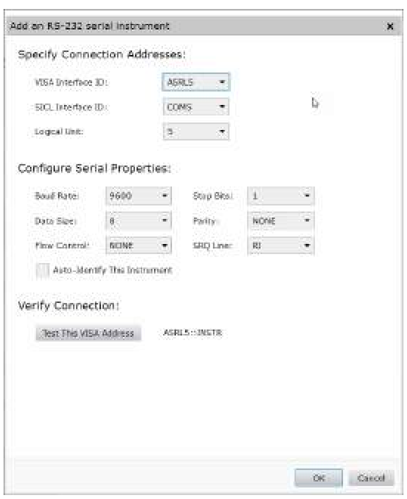
USB Connections

NOTE Ensure you have set the USB mode to VCP or TMC before proceed to communicate through rear panel USB port. Press **[Menu]** > **System** >**IO** >**USB** and select VCP or TMC.

The following figure illustrates a typical USB interface system.

USB VCP

1. Connect your instrument to the USB port on your computer.
2. Identify the correct COM port that the instrument is using.
3. Launch the Connection Expert utility of the Keysight IO Libraries Suite.
4. Click **+Add** to manually add instruments and interfaces.
5. Select the ASLR*n* associate with the COM port identified on Step 2. Modify the interface properties as needed. and click **OK** to add this interface in your configuration.



6. When the instrument is recognized, your computer will display the VISA Address, Aliases and SICL Address. This information is located in the Serial folder.
7. You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments.

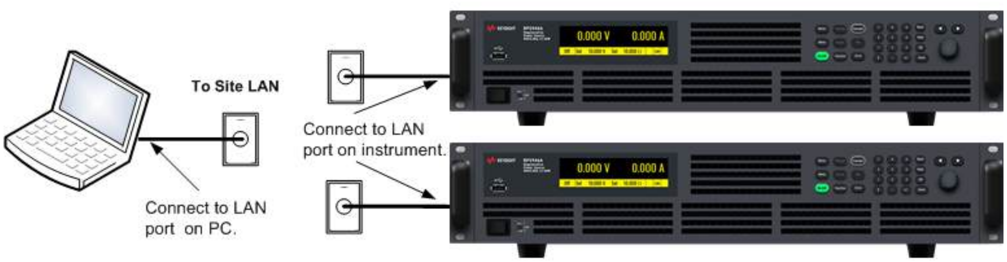
USB TMC

1. Connect your instrument to the USB port on your computer.
2. With the Connection Expert utility of the Keysight IO Libraries Suite running, the computer will automatically recognize the instrument. This may take several seconds. When the instrument is recognized, your computer will display the VISA alias, IDN string, and VISA address. This information is located in the USB folder.
3. You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments.

NOTE The USB cable is not recommended to be longer than 3 meters.

LAN Connections - site and private

A site LAN is a local area network in which LAN-enabled instruments and computers are connected to the network through routers, hubs, and/or switches. They are typically large, centrally-managed networks with services such as DHCP and DNS servers. The following figure illustrates a typical site LAN system.



A private LAN is a network in which LAN-enabled instruments and computers are directly connected, and not connected to a site LAN. They are typically small, with no centrally-managed resources. The following figure illustrates a typical private LAN system.

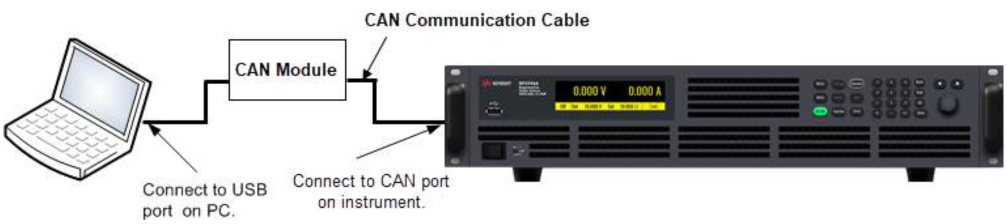
1. Connect the instrument to the site LAN or to your computer using a LAN cable. The as-shipped instrument LAN settings are configured to automatically obtain an IP address from the network using a DHCP server (DHCP is set On). The DHCP server will register the instrument's hostname with the dynamic DNS server. The hostname as well as the IP address can then be used to communicate with the instrument. If you are using a private LAN, you can leave all LAN settings as they are. Most Keysight products and most computers will automatically choose an IP address using auto-IP if a DHCP server is not present. Each assigns itself an IP address from the block 169.254.nnn. The front panel **Lan** indicator will come on when the LAN port has been configured.

2. Use the Connection Expert utility of the Keysight IO Libraries Suite to add the instrument models and verify a connection. To add the instrument, you can request the Connection Expert to discover the instrument. If the instrument cannot be found, add the instrument using the instrument's host-name or IP address.

3. You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments. You can also use the Web browser on your computer to communicate with the instrument as described under Using the Web Interface.

CAN Connections

The following figure illustrates a typical CAN interface system.



The definition of CAN connector pins are as shown below.

Pins	Descriptions
H	CAN_H
L	CAN_L
GND	CAN_GND

1. Connect your instrument and CAN module to the USB port on your computer using a CAN communication cable as shown above.

2. Configure the instrument's baud rate, address, and protocol type according to your system requirement.

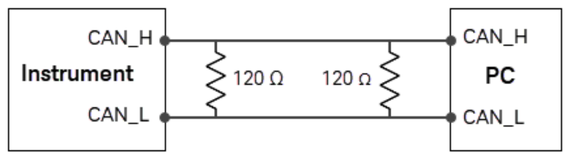
3. Install CAN communication software that supports CANOpen protocol on your PC and configure the CAN interface parameters. Make sure the CAN communication software and instrument is set to the same configuration.

4. Use the CAN software to verify the communication between the instrument and PC.

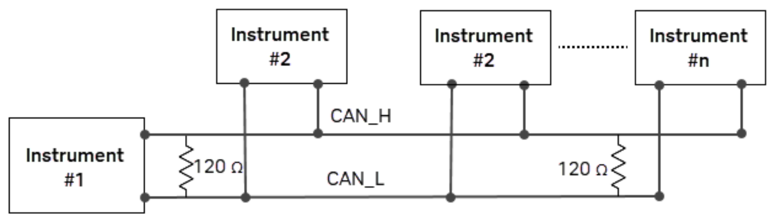
NOTE The CAN communication cable is not recommended to be longer than 3 meters.

Ensure the interface cable is correctly connected (CAN_H to CAN_H, CAN_L to CAN_L).

If the communication signal is poor or unstable, it is recommended to connect a 120 Ω terminating resistance.



Single Instrument Connection



Multiple Instruments Connection

When multiple instruments are connected, it is recommended to connect the pin 8 (GND) of the P-IO terminal on the rear panel of these instruments in parallel. This will improve the communication quality across the entire CAN network.

CAUTION

Proper Grounding for Reliable CAN Communication

To ensure safe and reliable operation of the CAN bus system:

- Establish a common ground connection between all devices on the CAN network.
- Connect the CAN ground (GND) between all nodes to maintain signal reference integrity.
- Tie the CAN ground to the signal ground of each device—do not connect it to chassis ground.
- Maintain a low-impedance ground path to reduce electrical noise and prevent voltage differences.
- For long-distance communication, use twisted-pair shielded cables (including CAN_H, CAN_L, and GND) to enhance signal integrity and minimize interference.

Mise à la terre appropriée pour une communication CAN fiable

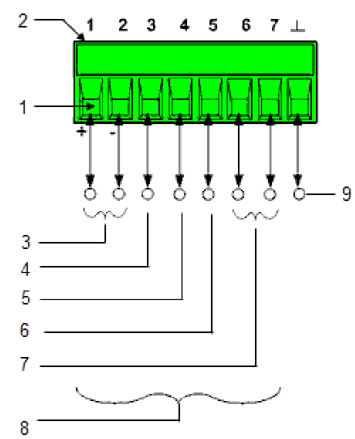
Pour garantir un fonctionnement sécurisé et stable du système CAN :

- Créez une masse commune pour tous les dispositifs connectés au réseau CAN.
- Connectez la masse du bus CAN (GND) entre tous les nœuds afin de garantir une référence de signal cohérente.
- Reliez la masse CAN à la masse de signal interne de chaque dispositif, et non à la masse du châssis.
- Maintenez un chemin de masse à faible impédance afin de réduire le bruit électrique et éviter les différences de tension.
- Pour les communications sur de longues distances, utilisez des câbles blindés à paires torsadées (CAN_H, CAN_L et GND) afin de préserver l'intégrité des signaux et de réduire les interférences.

Digital Port Connections

NOTE It is good engineering practice to twist and shield all signal wires to and from the digital connector. If shielded wire is used, connect only one end of the shield to chassis ground to prevent ground loops.

An 8-pin connector and a quick-disconnect connector plug are provided for accessing the digital port functions. Disconnect the connector plug to make your wire connections. The connector plug accepts wires sizes from AWG 14 (1.5 mm^2) to AWG 28 (0.14 mm^2). Wire sizes smaller than AWG 24 (0.25 mm^2) are not recommended. Strip wire insulation back 7 mm.



1. Insert wires
2. Tighten screws
3. Protection configurable pins
4. On Off trigger configurable pins
5. Output trigger configurable pins
6. Inhibit configurable pins (observe INH polarity)
7. Output Couple configurable pins
8. Digital IO-configurable pins
9. Signal common

Information on using the digital port is found under Programming the Digital Port.

Installing the Optional Analog/RS232 Interface

WARNING

TURN OFF POWER AND REMOVE ALL CONNECTIONS PRIOR TO INSTALLATION
Turn off the power and remove all connections, including the power cord, from the instrument prior installation of the Analog/RS232 interface.

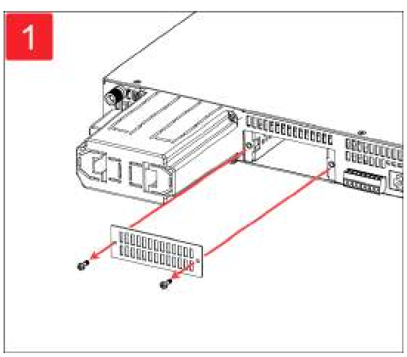
COUPER L'ALIMENTATION ET DÉCONNECTER TOUTES LES CONNEXIONS AVANT L'INSTALLATION
Mettez l'instrument hors tension et débranchez toutes les connexions, y compris le cordon d'alimentation, de l'instrument avant l'installation de l'interface Analogique/RS232.

RETAIN THE COVER PLATE
After installing the Analog/RS232 interface, retain the cover plate for use in the event that you ever remove the Analog/RS232 option. The instrument should never be connected to AC mains or output terminal when the rear-panel opening is not securely covered with either Analog/RS232 interface module or the cover plate.

CONSERVER LA PLAQUE DE PROTECTION
Après avoir installé l'interface Analogique/RS232, conservez la plaque de protection pour pouvoir la réutiliser si l'option Analogique/RS232 est retirée plus tard. L'instrument ne doit jamais être connecté au secteur ou à la borne de sortie si l'ouverture du panneau arrière n'est pas correctement couverte par le module de l'interface Analogique/RS232 ou la plaque de protection.

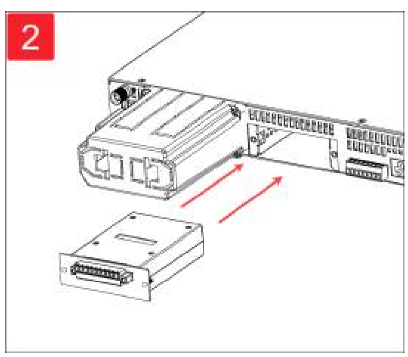
The following tools are required.

– Torx screwdriver

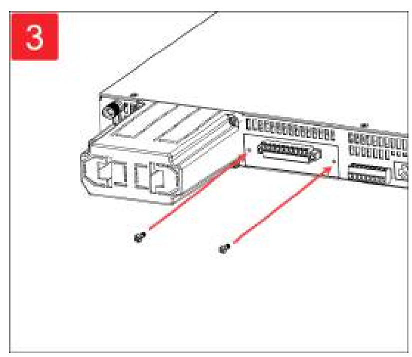


Use a Torx screwdriver to remove the M3 screws from the cover plate. Retain the screws for use later in this procedure.

The, remove the cover plate.



Slot in the Analog/RS232 interface module into the unit.



Use the screws that was removed earlier to secure the Analog/RS232 interface in place. This concludes the Analog/RS232 installation procedure.

Installing the Optional GPIB Interface

WARNING

TURN OFF POWER AND REMOVE ALL CONNECTIONS PRIOR TO INSTALLATION
Turn off the power and remove all connections, including the power cord, from the instrument prior installation of the GPIB interface.

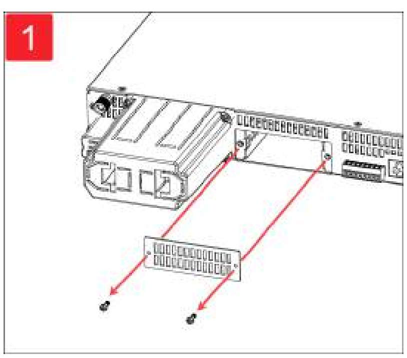
COUPER L'ALIMENTATION ET DÉCONNECTER TOUTES LES CONNEXIONS AVANT L'INSTALLATION
Mettez l'instrument hors tension et débranchez toutes les connexions, y compris le cordon d'alimentation, de l'instrument avant l'installation de l'interface GPIB.

RETAIN THE COVER PLATE
After installing the GPIB inteface, retain the cover plate for use in the event that you ever remove the GPIB option. The instrument should never be connected to AC mains or output terminal when the rear-panel opening is not securely covered with either GPIB interface module or the cover plate.

CONSERVER LA PLAQUE DE PROTECTION
Après avoir installé l'interface GPIB, conservez la plaque de protection afin de pouvoir la réutiliser si l'option GPIB devait être retirée plus tard. L'instrument ne doit jamais être connecté au secteur ou à la borne de sortie si l'ouverture du panneau arrière n'est pas correctement couverte par le module de l'interface GPIB ou la plaque de protection.

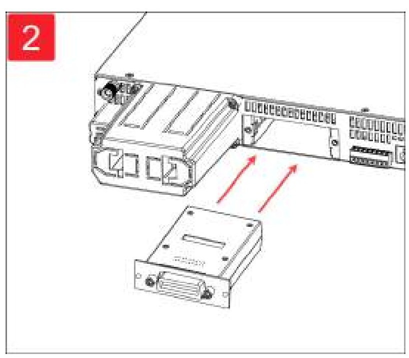
The following tools are required.

– Torx screwdriver

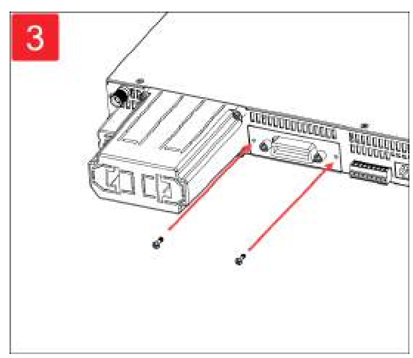


Use a Torx screwdriver to remove the M3 screws from the cover plate. Retain the screws for use later in this procedure.

The, remove the cover plate.



Slot in he GPIB interface module into the unit.



Use the screws that was removed earlier to secure the GPIB interface in place.
This concludes the GPIB installation procedure.

3
Getting Started

NOTE For load mode, the input terminals are referred to as "Outputs" throughout this document.

Using the Front Panel

Turn the Unit On

WARNING

SHOCK HAZARD, HAZARDOUS VOLTAGES
Do not touch any output terminal connections by hand. Ensure that all instrument connections, DUT wiring, and DUT connections are either insulated or covered using the safety covers provided, so that no accidental contact with harzardous voltages can occur. Always use the electrical safety gloves when connecting or disconnecting DUT to the output terminals.

RISQUE D'ÉLECTROCUTION, TENSIONS DANGEREUSES
Ne touchez jamais les connexions des bornes de sortie à mains nues. Assurez-vous que toutes les connexions de l'instrument, ainsi que le câblage et les connexions du DUT, soient soit isolés, soit protégés par les capots de protection fournis, afin d'éviter tout contact accidentel avec des tensions dangereuses. Portez toujours des gants isolants lorsque vous connectez ou déconnectez le DUT aux bornes de sortie.

Be sure to perform related operations and connections to feed energy back to grid in accordance with related regulations, and ensure all necessary conditions are met.

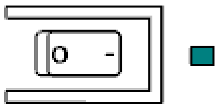
Toutes les opérations d'injection d'énergie sur le réseau doivent être effectuées conformément aux réglementations en vigueur et uniquement lorsque toutes les conditions de sécurité sont réunies.

Do not use extended power cord without protective grounding. Failing to do so may cause injury and equipment damage.

N'utilisez jamais de rallonge dépourvue de conducteur de protection. Le non-respect de cette consigne peut entraîner des blessures graves et risque d'endommager l'appareil.

Verify that the line cord is connected and plugged in.

Turn the unit on with the front panel power switch. The front panel display will light up after a few seconds. A power-on self-test occurs automatically when you turn the unit on. This test assures you that the unit is operational.



NOTE It may take about 30 seconds or so for the unit to initialize before it is ready for use.

If the instrument does not turn on, verify that the power cord is firmly connected (power-line voltage is automatically sensed at power-on). Also make sure that the instrument is connected to an energized power source. If the LED next to the power switch is off, there is no AC power connected. If the LED is green, the instrument is on.

NOTE If a self-test error occurs, a message is displayed on the front panel. For other self-test errors, see Service and Maintenance for instructions on returning the instrument for service.

When turning the unit off with front panel power switch, make sure to wait at least 10 seconds after the fan stops before turning the power on again.

CAUTION Turning the unit on immediately after it has been switched off will cause damage to the inrush current limiter circuit, as well as reduce the lifespan of components such as the power switch and the internal input fuses.

N’allumez pas immédiatement l’appareil après l’avoir éteint. Cette opération peut endommager le circuit de limitation du courant d’appel et réduire la durée de vie des composants comme l’interrupteur d’alimentation et les fusibles internes.

Use the Front Panel Knob

Use the front panel knob to adjust and set values. It also functions as the left/right navigation keys, and can act as [Enter] when pushed.

Rotating the knob clockwise increases the set value, while rotate anti-clockwise decreases the set value.

Specify the Source/Load Function

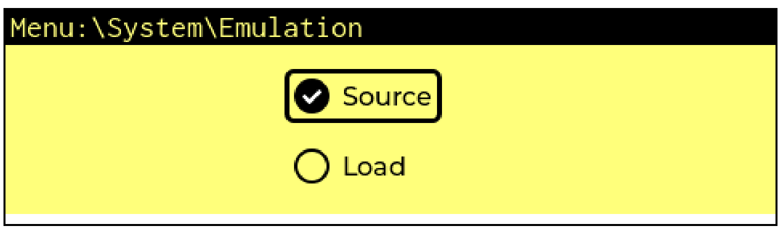
You have the option to use the RP5900 Series either as a bidirectional power supply or electronic load.

Press **[Menu]** > **System** > **Emulation** to specify the operation mode. Use the left and right navigation keys to navigate to the setting that you wish to change..Then press **[Enter]**. A pop-up message will prompt you to confirm your selection. Press **Ok** to continue.

Source – By default. In this mode, the instrument serves as a bidirectional power supply. It can output power at the maximum rated power indicated in the instrument specifications. It can also absorb electric energy at the maximum rated power and convert it into current, which is returned to the grid.

In this mode, the instrument can achieve a fast and continuous seamless switch between output and absorption current, which is useful for charging and discharging tests of the battery. For details, see Chapter 4, Programming the Source.

Load – In this mode, the instrument serves as an energy feedback electronic load. It only absorbs electric energy and converts it into current, which is returned to the local grid. For details, see Chapter 4, Programming the Load.



You can also push the knob to confirm the change. Press **[Meter]** to return to meter mode.

NOTE	Switching between Source and Load mode changes the Menu interface. For common operation such as System, the menu remain unchanged.

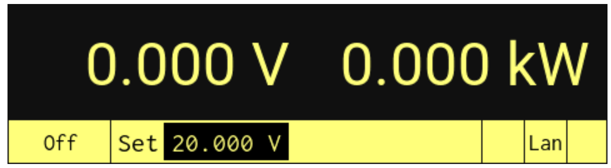
Set the Output Voltage

NOTE	When in Load mode, the allowable input settings will be based on the specified operation mode. For example, when operating mode is set to CVCR, the Set field will display voltage and resistance input settings.

Method 1

Use the left and right navigation keys to navigate to the setting that you wish to change. You may also press **[Voltage]**.

In the following display, the voltage setting is selected. Enter a value using the numeric keypad.Then press **[Enter]**.

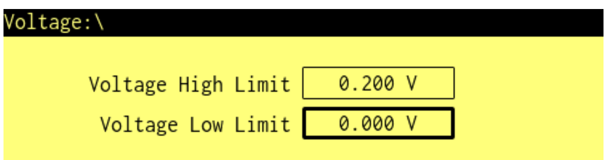
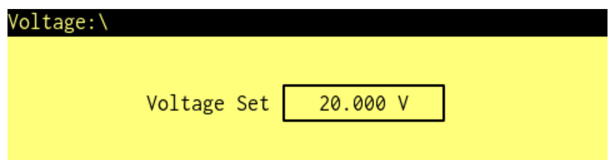
Source mode	Load mode
	

You can also use the knob to adjust the value up or down. Values become effective when the output is turned on.

In voltage priority mode, the unit will maintain the output voltage at its programmed setting. In current priority mode, the unit will limit the output voltage when it reaches the specified voltage limit value. Refer to Set the Output Mode for more information.

Method 2

Press [Menu] > [Voltage] key to select the voltage entry field. In the display below, the voltage setting is selected. Enter the desired setting using the numeric keypad. Then press [Enter].

Source mode	Load mode
	

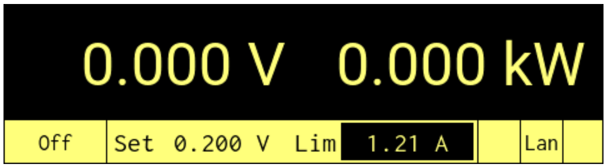
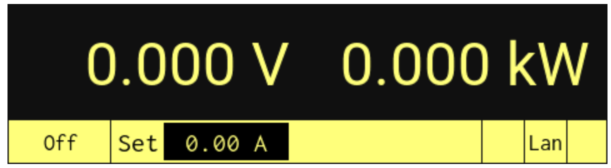
If you make a mistake, either use the backspace key to delete the number, press [Back] to back out of the menu, or press [Meter] to return to meter mode.

Set the Output Current

NOTE When in Load mode, the allowable input settings will be based on the specified operation mode. For example, when operating mode is set to CVCR, the Set field will display voltage and resistance input settings.

Use the left and right navigation keys to navigate to the setting that you wish to change. You may also press [Current].

In the display below, the current setting is selected. Enter a value using the numeric keypad.Then press [Enter].

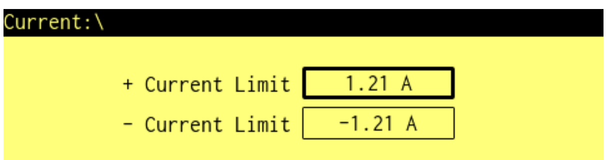
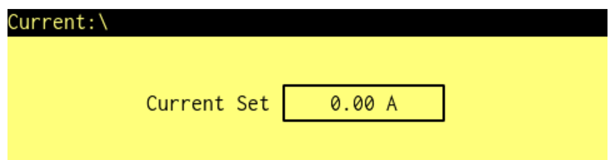
Source mode	Load mode
	

You can also use the knob to adjust the value up or down. You can set both positive and negative current values by pressing **[Current]**. Values become effective when the output is turned on.

In CC priority mode, the unit will maintain the output current at its programmed setting. In CV priority mode, the unit will limit the output current when it reaches the specified current limit value. Refer to Set the Output Mode for more information.

Method 2

Press **[Menu]** > **[Current]** key to select the current entry field. In the display below, the current setting is selected. Enter the desired setting using the numeric keypad. Then press **[Enter]**.

Source mode	Load mode
	

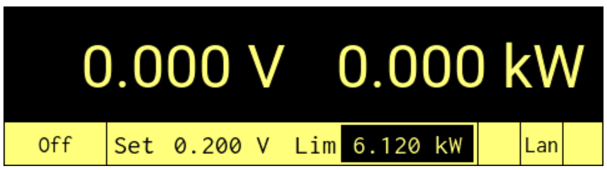
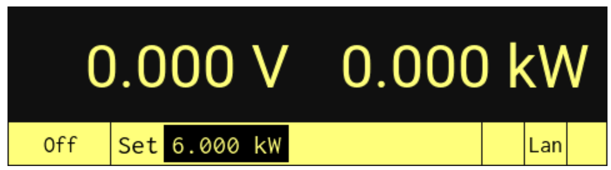
If you make a mistake, either use the backspace key to delete the number, press **[Back]** to back out of the menu, or press **[Meter]** to return to meter mode.

Set the Output Power

NOTE When in Load mode, the allowable input settings will be based on the specified operation mode. For example, when operating mode is set to CVCR, the Set field will display voltage and resistance input settings.

Method 1

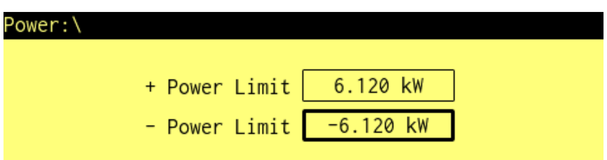
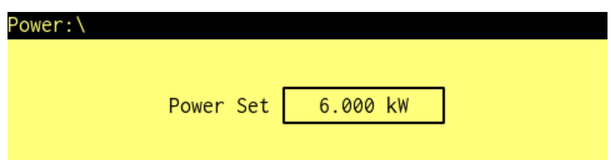
Use the **[Power]** key to select the power limit entry field. In the display below, the power setting is selected. You can set both positive and negative power limit by pressing **[Power]**Enter the desired setting using the numeric keypad. Then press **[Enter]**.

Source mode	Load mode
	

You can also use the knob to adjust the value up or down. Values become effective when **[Enter]** is pressed or when knob is pushed.

Method 2

Press **[Menu]** > **[Power]** to select the power entry field. In the display below, the power limit setting is selected. Enter the desired setting using the numeric keypad. Then press **[Enter]**.

Source mode	Load mode
	

If you make a mistake, either use the backspace key to delete the number, press **[Back]** to back out of the menu, or press **[Meter]** to return to meter mode.

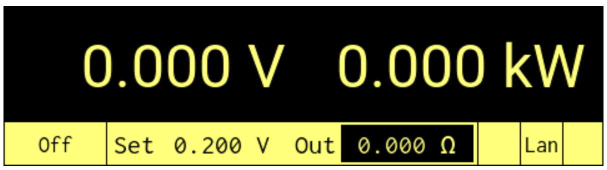
Set the Output Resistance Load Mode only

NOTE In Source mode, you can set the internal resistance value when operating in voltage priority mode only. When in Load mode, the allowable output settings will be based on the specified operation mode. For example, when operating mode is set to CVCR, the Set field will display voltage and resistance input settings.

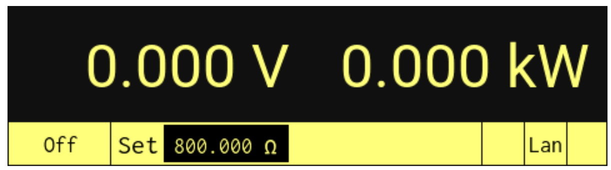
Method 1

Use the **[Res]** key to select the resistance entry field. In the display below, the resistance setting is selected. Enter the desired setting using the numeric keypad. Then press **[Enter]**.

Source mode



Load mode



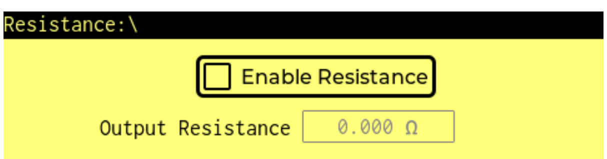
You can also use the knob to adjust the value up or down. Values become effective when **[Enter]** is pressed or when knob is pushed.

Method 2

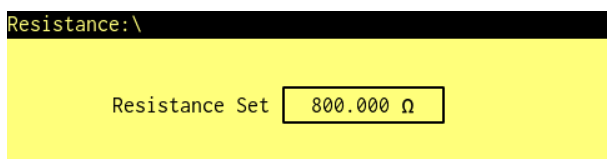
Press **[Menu]** > **[Res]** key to select the resistance entry field. In the display below, the resistance setting is selected. Enter the desired setting using the numeric keypad. Then press **[Enter]**.

In Source mode, check the Enable Resistance checkbox to enable the output resistance (internal resistance) to maintain a stable output voltage under varying load conditions.

Source mode



Load mode



If you make a mistake, either use the backspace key to delete the number, press **[Back]** to back out of the menu, or press **[Meter]** to return to meter mode.

Set Over-voltage Protection

Use the front panel menu.

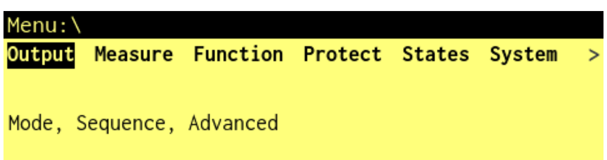
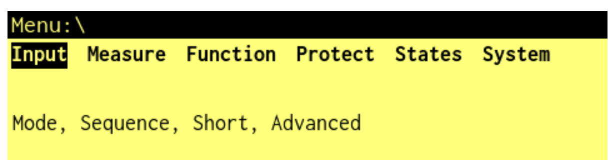
The front panel command menu lets you access most of the instrument's functions. The actual function controls are located at the lowest menu level. Briefly:

- Press **[Menu]** to access the command menu.
- Press the left and right ([<], [>]) navigation keys to move across the menu commands.
- Press the center **[Enter]** to select a command and move down to the next level in the menu.
- Press the **Help** key at the lowest menu level to display help information about the function controls.
- To exit the command menu, press the **[Meter]** key to immediately return to meter mode, or press the **[Menu]** key to return to the top level.

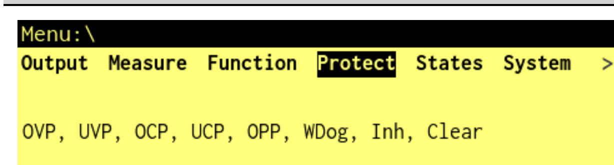
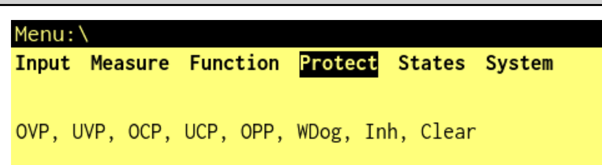
For a map of the front panel menu commands, refer to Front Panel Menu Reference.

Menu example - setting over-voltage protection.

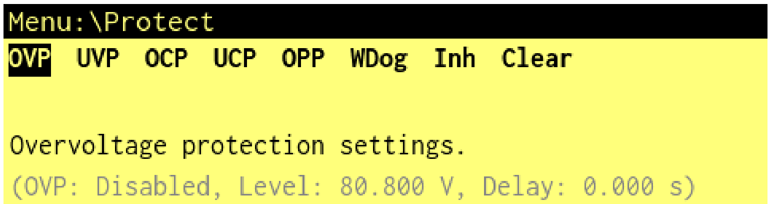
Press **[Menu]** to access the front panel command menu. The first line identifies the menu path. When the menu is first accessed, the menu is at the top or root, and the path is empty. The second line indicates the commands that are available at the present menu level. In this case, the top-level menu commands are shown, with the Output command highlighted. The third line indicates which commands are available under the Output command. If there are no lower level commands, a brief description of the highlighted command is displayed.

Source mode	Load mode
	

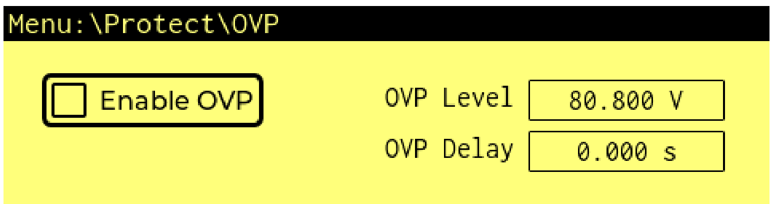
Press the right arrow navigation key **[>]** to traverse the menu until the **Protect** command is highlighted. Press **[Enter]** to access the **Protect** commands.

Source mode	Load mode
	

Since the OVP command is already highlighted, press **[Enter]** or push the knob to access the OVP command.

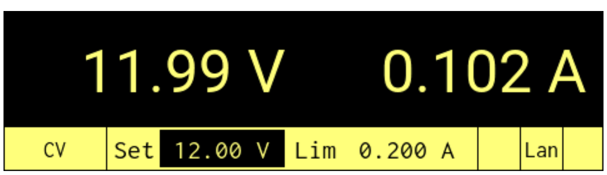
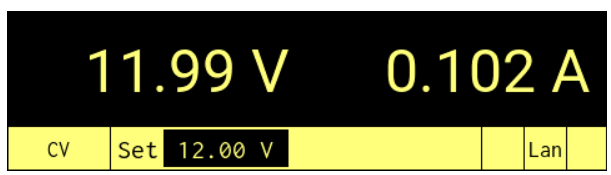


Press **[Enter]** and use the navigation keys to select the desired command such as Status, Level, or Delay. In this example, select Level to specify the OVP setting and press **[Enter]**. In this example for 80 V unit, the default OVP setting is 80.8 V. You can change the OVP setting using the numeric entry keys and pressing **[Enter]** or push the knob. Press **[Back]** to return to the previous menu, or **[Meter]** to return to meter view.



Enable the Output

Use the **[On/Off]** to enable the output. If a load is connected to the output, the front panel display will indicate that it is drawing current. Otherwise, the current reading will be zero. The status indicator shows the output's status. In this case, "CV" indicates the output is in constant voltage mode.

Source mode	Load mode
	

For a description of the status indicators, refer to Front Panel Display at a Glance.

WARNING The **[On/Off]** key is used to turn the output on or off under normal circumstances. The **[On/Off]** key is still operational even when the instrument is in remote operation or when the keyboard is locked.

La touche **[On/Off]** permet de mettre la sortie sous/hors tension en conditions normales. La touche **[On/Off]** reste fonctionnelle même si l'appareil utilise le mode de commande à distance ou si le clavier est verrouillé.

SHOCK HAZARD
Turning the output off does not place the instrument in a safe state. Hazardous voltages may be present on all output and guard terminals. Putting the equipment into an output-off state does not guarantee that the outputs are powered off if a hardware or software fault occurs.

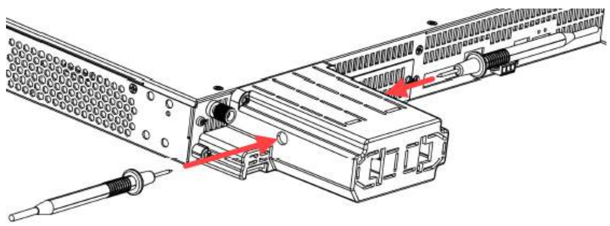
RISQUE D’ÉLECTROCUTION
La mise hors tension de la sortie ne garantit pas que l’appareil soit dans un état sécurisé. Des tensions dangereuses peuvent subsister sur les bornes de sortie et d’isolation. Si vous rencontrez une panne matérielle ou logicielle, les sorties peuvent rester actives même si les sorties des appareils sont mises hors tension.

HAZARDOUS VOLTAGE PRESENT

After turning off the unit, allow time for self-discharge and ensure the capacitors discharge to a safe voltage before handling any components connected to the output terminal, as they may retain a hazardous charge.

Never touch cables or connections immediately after turning off the unit. Depending on use case, such as when connected to an energized supply (e.g., battery), hazardous voltages can remain at the output terminals after turning off the unit. Verify that there is no dangerous voltage on the output or sense terminals before touching them. To disconnect an energized supply, follow the recommended verification procedures as shown below:

1. Use a multimeter to observe the voltage. Probe the output terminals from both sides of the safety cover as shown below.

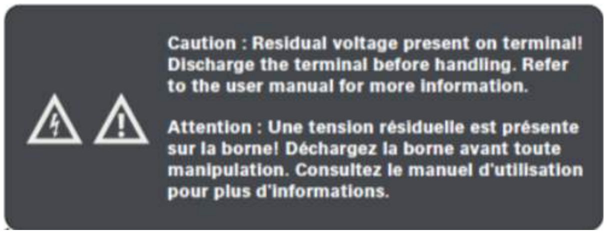


NOTE: For the 80 V unit, the safety cover does not have the probe holes. Wear electrical safety gloves to remove the safety cover and use a multimeter to measure the voltage at the output terminals.

NOTE Ensure the multimeter and measurement probe used have the correct voltage rating to avoid shock hazards.

2. If there is no voltage remaining at the output terminals, proceed with step 7. If voltage remains at the output terminals, proceed with step 3 to 7.
3. Turn on the unit. Press **[Menu]** > **System** > **Emulation** and select **Load**. This action will switch the RPS to Load mode (CC mode by default).
4. Press **[Current]** and set the current to 1 A.
5. Press **[On/Off]** to turn on the output.
6. Use a multimeter to observe the voltage on the output terminals. The voltage will drop to 0 V in approximately two seconds.
7. Disconnect the energized supply from the output terminals.

NOTE Always use electrical safety gloves before disconnecting any energized supply (e.g., battery) from the output terminals.

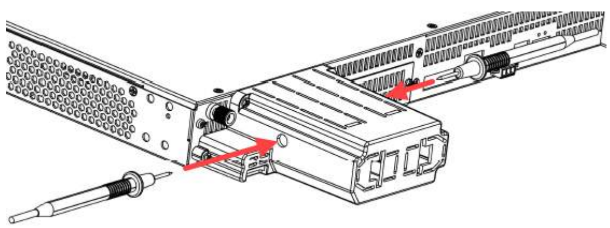


TENSION DANGEREUSE PRÉSENTE

Après avoir éteint l’unité, attendez que les condensateurs se déchargent complètement avant de manipuler les composants connectés aux bornes de sortie, car ils peuvent conserver une charge dangereuse.

Ne touchez jamais les câbles ou les connexions immédiatement après avoir mis l’appareil hors tension. Dans certains cas, par exemple si l’appareil est relié à une source sous tension (batterie, etc.), des tensions dangereuses peuvent subsister sur les bornes de sortie même après la mise hors tension de l’unité. Vérifiez qu’il n’y ait pas de tension dangereuse sur les bornes de sortie ou de détection avant de les toucher. Pour déconnecter une source sous tension, suivez les procédures ci-dessous :

1. Utilisez un multimètre pour mesurer la tension. Testez les bornes de sortie des deux côtés du capot de protection comme indiqué ci-dessous.



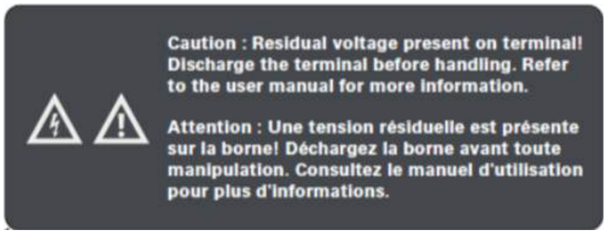
REMARQUE : Sur le module 80 V, le capot de protection ne comporte pas de trous pour la sonde. Portez des gants isolants pour retirer le capot et utilisez un multimètre pour mesurer la tension aux bornes de sortie.

NOTE Vérifiez que le multimètre et la sonde supportent la tension maximale afin d’éviter tout risque d’électrocution.

2. Si aucune tension n’est détectée aux bornes de sortie, passez directement à l’étape 7. Si une tension subsiste aux bornes de sortie, procédez aux étapes 3 à 7.
3. Mettez l’instrument sous tension. Appuyez sur **[Menu]** > **System** (Système) > **Emulation** (Émulation) et sélectionnez **Load** (Charge). Le RPS passe alors en mode Charge (mode CC par défaut).
4. Appuyez sur **[Current]** (Courant) et réglez le courant sur 1 A.
5. Appuyez sur **[On/Off]** pour activer la sortie.
6. Utilisez un multimètre pour mesurer la tension aux bornes de sortie. La tension retombera à 0 V en 2 secondes environ.

7. Déconnectez la source sous tension des bornes de sortie.

NOTE Portez toujours des gants isolants avant de déconnecter toute source sous tension (comme la batterie) des bornes de sortie.



NOTE It is recommended to enable the output after the power supply is connected to the DUT. If the power supply has no output after being turned on, check the voltage and current setting, set the them to non-zero value, and then enable the output again.

The **[On/Off]** is operational even when the instrument is in remote control mode, or when the keypad is locked.

Use Built-in Help System

Press the [Help] to display help information about the menu function controls.

Press [Back] to exit Help.

Remote Interface Configuration

Introduction

This instrument supports remote interface communication over five interfaces: GPIB, RS232, CAN, USB, and LAN. To use the interfaces, you must first install the latest Keysight IO Libraries Suite from www.keysight.com. Then connect your instrument to your PC.

The front panel IO indicator comes on whenever there is activity on the remote interfaces. The front panel Lan indicator comes on when the LAN port is connected and configured.

This instrument provides Ethernet connection monitoring. With Ethernet connection monitoring, the instrument's LAN port is continually monitored, and automatically reconfigured when the instrument is unplugged for a minimum of 20 seconds and then reconnected to a network.

USB Configuration

Before using the USB interface, you need to select the USB interface type:

- Host (default). Front panel usb port.
- TMC: USB_TMC interface.
- VCP: Virtual com port.
  Supports Windows 10 and above.
  If VCP is selected, ensure to set the baud rate and other parameters of the virtual com port. Make sure the configured baud rate matches that of the connected PC.

Front Panel Menu Reference	SCPI Command
Select **System\IO\USB** Use the navigation keys to select the USB interface type and press **[Enter]**.	SYSTem:COMMunicate:USB:FUNCtion HOST|TMC|VCP

GPIB Configuration

Each device on the GPIB (IEEE-488) interface must have a unique whole number address between 0 and 30. The instrument ships with the address set to 5. Your computer's GPIB interface card address must not conflict with any instrument on the interface bus. This setting is non-volatile; it will not be changed by power cycling or *RST. Use the front panel menu to change the GPIB address:

Front Panel Menu Reference	SCPI Command
Select **System\IO\GPIB**. Use the numeric keys to enter a new value from 0 to 30. Then press **[Enter]**.	To set the GPIB address to 5: SYSTem:COMMunicate:GPIB:ADDRess

RS232 Configuration

Before using the RS232 interface, set the communication parameters.

NOTE

Ensure the RS232 cable is connected to the correct serial ports (COM1, COM2, etc) of the computer.

Ensure your computer and instrument is set to the same configuration for serial communications.

Ensure to use the correct cable and adapter during connection. Note that some cables do not have the correct internal wiring even they come with the appropriate plug.

Parameter	Available Settings
Baud rate	9600, 19200, 38400, 57600, or 115200
Data bit	7, or 8
Parity bit	Not applicable
Stop bit	Not applicable

This setting is non-volatile; it will not be changed by power cycling or *RST. Use the front panel menu to change the RS232 settings:

Front Panel Menu Reference	SCPI Command
Select **System\IO\RS232**. Use the navigation keys to set the parameter according to the available settings.. Then press **[Enter]**.	To set the RS232 baud rate to 19200: SYSTem:COMMunicate:SERial:BAUDrate 19200

CAN Configuration

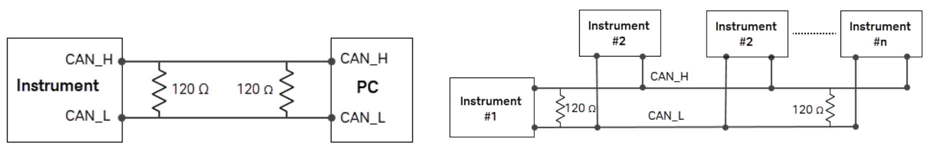
Before using the CAN interface, set the communication parameters.

NOTE

Ensure your computer and instrument is set to the same configuration for serial communications.

Ensure to use the correct communication cable (CAN_H, or CAN_L). Note that some cables do not have the correct internal wiring even they come with the appropriate plug.

If the communication signal is poor or unstable, it is recommended to connect a 120 Ω terminating resistor.



Single Instrument Connection

Multiple Instruments Connection

When connecting multiple devices, it is recommended to connect the pin 8 (GND) of the P-IO terminal on the rear panel of these devices in parallel to improve the communication across the entire CAN network.

Parameter	Available Settings
Protocol	CANopen: Use standard CAN protocol
Address	1 to 127
Baud rate	5k, 10k, 20k, 40k, 50k, 80k, 100k, 125k, 200k, 250k, 400k, 500k, 600k, 800k, or 1000k

This setting is non-volatile; it will not be changed by power cycling or *RST. Use the front panel menu to change the CAN settings:

Front Panel Menu Reference	SCPI Command
Select **System\IO\CAN\Protocol**. Select **System\IO\CAN\Address**. Select **System\IO\CAN\Baudrate**. Use the navigation keys to set the parameter according to the available settings. Then press **[Enter]**.	Not available

LAN Configuration

The following sections describe the primary LAN configuration functions on the front-panel menus. Note that there are no SCPI commands to configure the LAN parameters. All LAN configuration must be done from the front panel.

NOTE

After changing the LAN settings, you must Save the changes. Select: **System\IO\LAN\Apply.** Selecting Apply activates the settings. LAN settings are non-volatile, they will not be changed by power cycling or *RST. If you do not want to save your changes select: **System\IO\LAN\Cancel.** Selecting Cancel cancels all changes.

When shipped, DHCP is on, which may enable communication over LAN. The letters DHCP stands for Dynamic Host Configuration Protocol, a protocol for assigning dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network.

Viewing the active LAN Settings

To view the currently active LAN settings:

Front Panel Menu Reference	SCPI Command
Select **System\IO\LAN\Settings** Displays the active LAN settings. Use the navigation keys or rotate the knob to scroll through the list.	Not available

The currently active settings for the IP Address, Subnet Mask, and Default Gateway may be different from the front panel configuration menu settings - depending on the configuration of the network. If the settings are different, it is because the network has automatically assigned its own settings

Resetting the LAN

Resetting the LAN performs a LAN Configuration Initialize (LCI) reset of the instrument which enables DHCP, DNS and ping. It also resets the web site password to the factory default password. This does not reset the hostname or the mDNS service name.

You can also reset the LAN to the as-shipped (default) settings. This returns ALL LAN settings to the as-shipped values and restarts networking. All default LAN settings are listed under Non-volatile Settings.

Front Panel Menu Reference	SCPI Command
Select **System\IO\LAN\Reset** Select **System\IO\LAN\Defaults** Selecting **Reset** activates the selected LAN settings and restarts networking.	Not available

Modifying the LAN Settings

As shipped from the factory, the power system's pre-configured settings should work in most LAN environments. If you need to manually configure these settings, press the Menu key, then use the navigation keys to select the LAN Modify menu. In the Modify menu you can then access the following items: IP, Name, DNS, WINS, mDNS, and Services.

Refer to Non-volatile Settings for information on the factory-shipped LAN settings.

IP Address

Select Mode to configure the addressing mode of the instrument.

Press the **Menu** key, then select **System\IO\LAN\Modify\IP**. The configurable parameters include:

Front Panel Menu Reference	SCPI Command
Select **System\IO\LAN\Modify\IP** Select Auto or Manual. See below for a full description.	To set the IP mode to MANaul: SYSTem:COMMunicate:LAN:IP:MODE MANual To set the IP address when manual mode is selected: SYSTem:COMMunicate:LAN:IP 192.168.200.100

- **Auto** - automatically configures the addressing of the instrument. When selected, the instrument will first try to obtain an IP address from a DHCP server. If a DHCP server is found, the DHCP server will assign an IP address, Subnet Mask, and Default Gateway to the instrument. If a DHCP server is unavailable, the instrument will try to obtain an IP address using AutoIP. AutoIP automatically assigns an IP address, Subnet Mask, and Default Gateway addresses on networks that do not have a DHCP server.
- **Manual** - allows you to manually configure the addressing of the instrument by entering values in the following four fields. These fields only appear when Manual is selected.
  - IP Address - This value is the Internet Protocol (IP) address of the instrument. An IP address is required for all IP and TCP/IP communications with the instrument. An IP Address consists of 4 decimal numbers separated by periods. Each decimal number ranges from 0 through 255 with no leading zeros (for example, 169.254.2.20).
  - Subnet Mask - This value is used to enable the instrument to determine if a client IP address is on the same local subnet. The same numbering notation applies as for the IP Address. When a client IP address is on a different subnet, all packets must be sent to the Default Gateway.
  - Gateway - This value is the IP Address of the default gateway that allows the instrument to communicate with systems that are not on the local subnet, as determined by the subnet mask setting. The same numbering notation applies as for the IP Address. A value of 0.0.0.0 indicates that no default gateway is defined.
  - Socket Port -This value is the port number for raw socket communication.

Remarks

- Dot-notation addresses ("nnn.nnn.nnn.nnn" where "nnn" is a byte value from 0 to 255) must be expressed with care, as most PC web software interprets byte values with leading zeros as octal (base 8) numbers. For example, "192.168.020.011" is actually equivalent to decimal "192.168.16.9" because ".020" is interpreted as "16" expressed in octal, and ".011" as "9". To avoid confusion, use only decimal values from 0 to 255, with no leading zeros.

Host Name

A hostname is the host portion of the domain name, which is translated into an IP address. To configure the hostname of the instrument:

Front Panel Menu Reference	SCPI Command
Select **System\IO\LAN\Modify\Name** Press **[Enter]** to press the knob to select the Host name for edits. You can enter any value from the numeric keypad. Alternatively, use the knob to enter any numeric and alphabetical characters (turn the knob to left or right). Use the left/right navigation keys to traverse the text field. Use backspace key to delete a value. Press **[Enter]** when you are finished.See below for a full description.	Not available

Remarks

- Host name - This field registers the supplied name with the selected naming service. If the field is left blank, no name is registered. A hostname may contain upper and lower case letters, numbers and dashes(-). The maximum length is 15 characters.
- Each instrument is shipped with a default hostname with the format: Keysight-model-numberserialnumber, where modelnumber is the mainframe’s 7-character model number (e.g. RP5900A), and serialnumber is the last five characters of the 10-character instrument serial number located on the label on the top of the unit (e.g. 45678 if the serial number is MY12345678)

DNS Server

DNS is an internet service that translates domain names into IP addresses. It is also needed for the instrument to find and display its hostname assigned by the network. Normally, DHCP discovers the DNS address information; you only need to change this if DHCP is unused or not functional.

To manually configure the DNS:

Front Panel Menu Reference	SCPI Command
Select **System\IO\LAN\Modify\DNS** Select Auto or Manual. See below for a full description.	Not available

- **Auto** - assigns static IP addresses of Domain Name System (DNS) servers. A primary and a secondary server address may be assigned.
  - If DHCP is available and enabled, DHCP will auto-assign these server addresses. These auto-assigned server addresses take precedence over the static addresses assigned with this command.
- **Manual** - allows you to manually configure the addressing of the instrument by entering values in the following two fields. These fields only appear when Manual is selected.
  - Primary Address - This field enters the primary address of the server. Contact your LAN administrator for server details. The same numbering notation applies as for the IP Address. A value of 0.0.0.0 indicates that no default server is defined.
  - Secondary Address - This field enters the secondary address of the server. Contact your LAN administrator for server details. The same numbering notation applies as for the IP Address. A value of 0.0.0.0 indicates that no default server is defined.

Remarks

- Dot-notation addresses ("nnn.nnn.nnn.nnn" where "nnn" is a byte value from 0 to 255) must be expressed with care, as most PC web software interprets byte values with leading zeros as octal (base 8) numbers. For example, "192.168.020.011" is actually equivalent to decimal "192.168.16.9" because ".020" is interpreted as "16" expressed in octal, and ".011" as "9". To avoid confusion, use only decimal values from 0 to 255, with no leading zeros.

mDNS Service Name

The mDNS service name is registered with the selected naming service. To configure the mDNS service name of the instrument:

Press the **Menu** key, then select **System\IO\LAN\Modify\mDNS**.

Front Panel Menu Reference	SCPI Command
Select **System\IO\LAN\Modify\mDNS** You can enter any value from the numeric keypad. Alternatively, use the knob to enter any numeric and alphabetical characters (turn the knob to left or right). Use the left/right navigation keys to traverse the text field. Use backspace key to delete a value. Press **[Enter]** when you are finished.	Not available

Remarks

- mDNS Service Name - This field registers the service name with the selected naming service. If the field is left blank, no name is registered. A service name may contain upper and lower case letters, numbers and dashes(-).

- Each instrument is shipped with a default service name with the format: Keysight Technologies <modelnumber> <serialnumber>, where modelnumber is the mainframe's 7-character model number (e.g. RP5900A), and serialnumber is the last five characters of the 10-character instrument serial number located on the label on the top of the unit (e.g. 45678 if the serial number is MY12345678).

Using the Web Interface

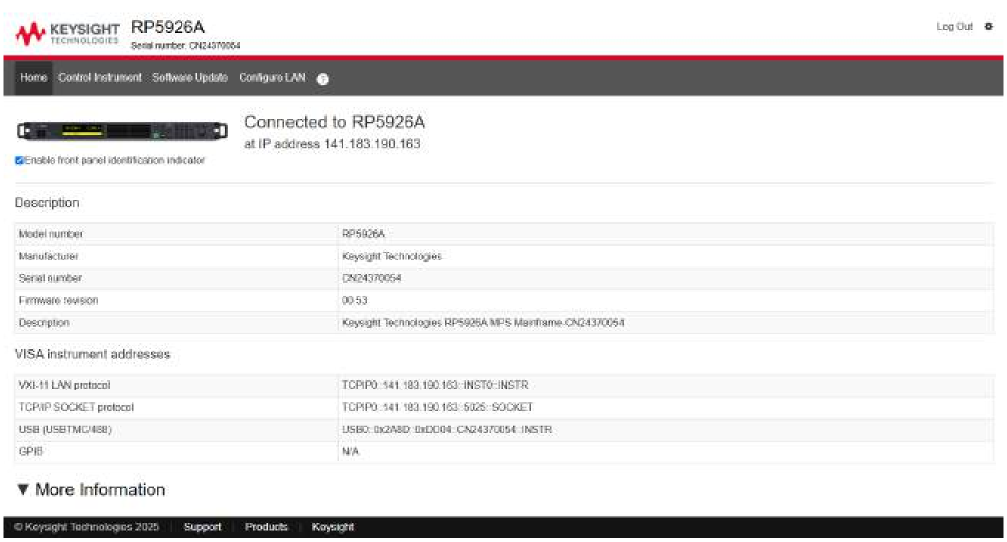
Your RPS has a built-in Web interface that lets you control it directly from the Web browser on your computer. With the Web interface, you can access the front panel control functions including the LAN configuration parameters.

NOTE The built-in Web interface only operates over the LAN. A Web browser is required to use the Web Interface.

If you see an error indicating 400: Bad Request, this is related to an issue with "cookies" in your Web browser. To avoid this issue, either start the Web interface by using the IP address (not hostname) in the address bar, or clear cookies from your browser immediately before starting the Web interface.

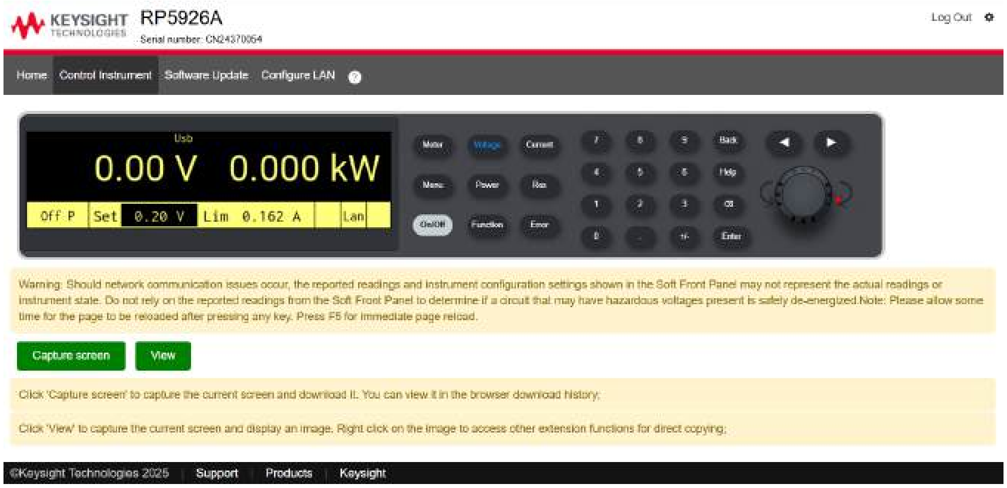
The Web interface is enabled when shipped. To launch the Web interface:

1. Open the Web browser on your computer.
2. Enter the instrument's DNS hostname or IP address into the browser's Address field. The following home page will appear.
3. Click on the Control Instrument tab on the top of the page to begin controlling your instrument.
4. For additional help about any of the pages, click on the **?**.



Control Instrument

When you click the **Control Instrument** tab, the instrument will ask you for a password (default is Keysight), and then it will open a new page, shown below.



This interface allows you to use the instrument just as you would from the front panel.

WARNING READ WARNING

Be sure to read and understand the warning at the top of the Control Instrument page..

LIRE L'AVERTISSEMENT

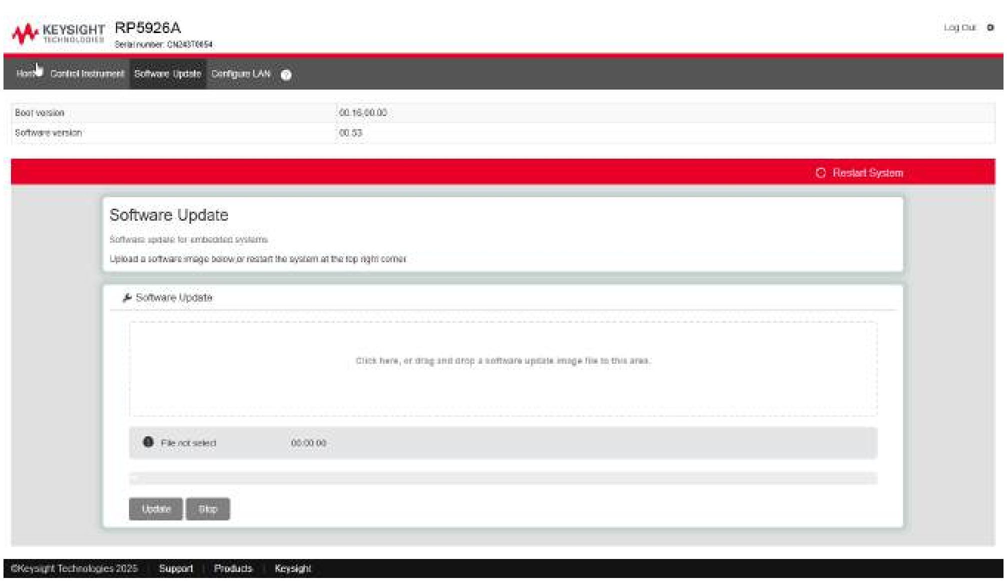
Veillez à lire et à comprendre l'avertissement en haut de la page Instrument de contrôle.

Software Update

NOTE Do not turn off the instrument during the update.

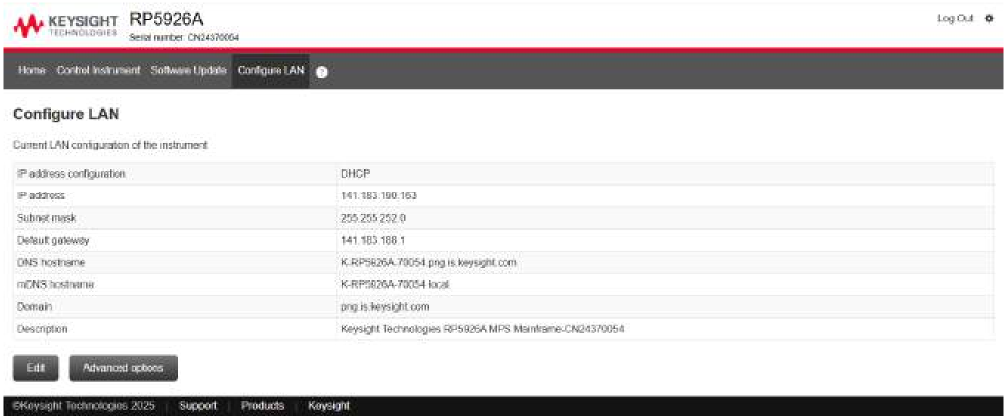
The **Software Update** tab on the top allows you to update the instrument's firmware.

The supported firmware image file is .kfw file. You can choose to click and select the image file, or drag-and-drop the image file to the Software Update box. Press **Update** to start the update process. Press **Stop** to abort the update process.



Configure LAN

The **Configure LAN** tab on the top allows you to change the instrument's LAN parameters; exercise caution when doing so, as you may interrupt your ability to communicate with the instrument.



Using Telnet

In an MS-DOS Command Prompt box type: telnet hostname 5024 where hostname is the instrument hostname or IP address, and 5024 is the instrument's telnet port.

You should get a Telnet session box with a title indicating that you are connected to the power supply. Type the SCPI commands at the prompt.

Using Sockets

NOTE **Power supplies allow any combination of up to six simultaneous data socket, control socket, and telnet connections to be made.**

Keysight instruments have standardized on using port 5025 for SCPI socket services. A data socket on this port can be used to send and receive ASCII/SCPI commands, queries, and query responses. All commands must be terminated with a newline for the message to be parsed. All query responses will also be terminated with a newline.

The socket programming interface also allows a control socket connection. The control socket can be used by a client to send device clear and to receive service requests. Unlike the data socket, which uses a fixed port number, the port number for a control socket varies and must be obtained by sending the following SCPI query to the data socket: SYSTem:COMMunicate:TCPip:CONTrol?

After the port number is obtained, a control socket connection can be opened. As with the data socket, all commands to the control socket must be terminated with a newline, and all query responses returned on the control socket will be terminated with a newline.

To send a device clear, send the string "DCL" to the control socket. When the power supply has finished performing the device clear it echoes the string "DCL" back to the control socket.

Service requests are enabled for control sockets using the Service Request Enable register. Once service requests have been enabled, the client program listens on the control connection. When SRQ goes true the instrument will send the string “SRQ +nn” to the client. The “nn” is the status byte value, which the client can use to determine the source of the service request.

Firmware Updates

NOTE Do not turn off the instrument during the update.

Before connecting the USB drive to the front panel USB port, ensure that the USB drive's file system is in FAT32 format. Any other file system format is not supported by the firmware update system.

Before updating the firmware using the instrument front panel or the USB boot loader, ensure the USB interface is set to Host.

1. Press **[Menu]** > **System**> **IO** > **USB**.
2. Use the navigation keys to select **Host**, then press **[Enter]**.

When updating in parallel configuration, power up both the primary and secondary units. Operate only the master unit according to the following steps. The secondary unit will automatically synchronize and update under the control of the master unit without manual intervention.

1. Press [Menu] > System > About to determine what instrument firmware version is currently installed.
2. Go to www.keysight.com/find/RP5900firmware to find the latest firmware version. If this matches the version installed on your instrument, there is no need to continue with this procedure. Otherwise, download a ZIP file (which contain a .kfw file) of the firmware.
3. Unzip the ZIP file and prepare a USB drive with the updated firmware:
4. You may choose to update the firmware through web interface, front panel, or USB boot loader.
   a. Web interface: See Software Update for details.
   b. Instrument front panel:

      NOTE For seamless update, ensure the firmware update file (.kfw format) and configuration files are placed at the root directory of the USB drive.is placed at the root directory of the USB drive.

      i. Connect the USB drive to the front panel USB port.
      ii. Press [Menu] > System > Admin > Update. Press Update.
      iii. Wait a few seconds, and the instrument will automatically switch to the boot interface. If the USB drive is not connected, the instrument will display "USB Disk not found"; if the USB drive is connected, it will show the "Upgrade Now?" confirmation screen.
      iv. Select Yes to continue with the firmware update. The update process will start automatically. Select No to abort.
      v. When Yes is selected, the instrument will enters the update selection screen, press [Enter] on the front panel to start the update. The interface will show the progress during the update; do not remove the USB drive during this process.
      vi. When the update progress reaches 100%, the instrument will restart automatically.

c. USB boot loader:

NOTE Use this option when your instrument's firmware is corrupted. When this happens, your PC will no longer be able to communicate with the instrument through USB or LAN connection.

Make sure there is only one instrument connected to your PC when performing firmware recovery.

For seamless update, ensure the firmware update file (.kfw format) and configuration files are placed at the root directory of the USB drive.is placed at the root directory of the USB drive.

i. Connect the USB drive to the front panel USB port.

ii. Power off the instrument.

iii. To enter the boot loader for your instrument, press **[Meter View]** and **[Enter]** on the instrument simultaneously while powering on the instrument.

iv. Wait a few seconds, and the instrument will automatically switch to the boot interface. If the USB drive is not connected, the instrument will display “USB Disk not found”; if the USB drive is connected, it will show the “Upgrade Now?” confirmation screen.

v. Select **Yes** to continue with the firmware update. The update process will start automatically. Select **No** to abort.

vi. When **Yes** is selected, the instrument will enters the update selection screen, press **[Enter]** on the front panel to start the update. The interface will show the progress during the update; do not remove the USB drive during this process.

vii. When the update progress reaches 100%, the instrument will restart automatically.

NOTE If the USB drive is not detected, select **Yes** to detect the drive again. Selecting **No** will abort the upgrade process.

Front Panel Operation Mode

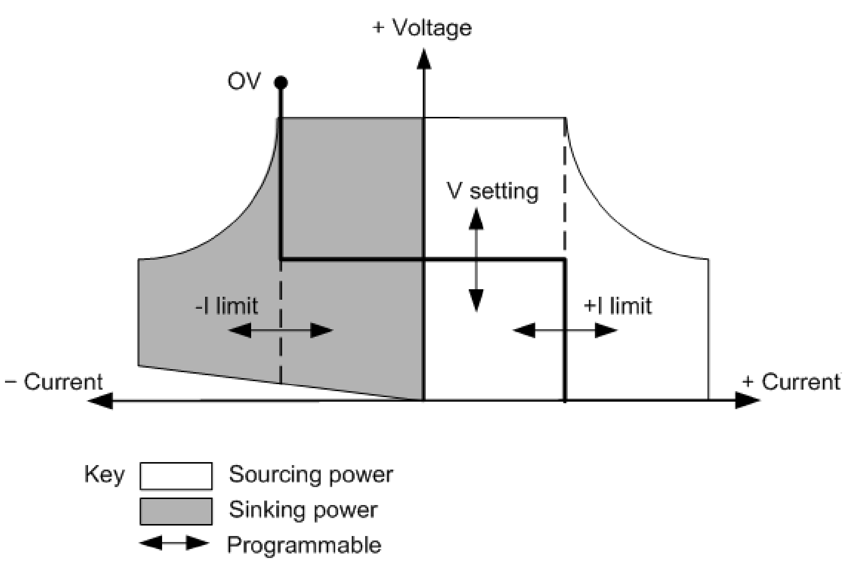
Source mode operation

The Keysight RP5900A Series can operate in either in voltage priority mode or current priority mode over the rated output voltage and current.

Voltage Priority

In voltage priority mode, the output is controlled by a constant-voltage feedback loop, which maintains the output voltage at its programmed setting as long as the load current remains within the positive or negative current limit settings. Voltage priority mode is best suited for use with resistive or high impedance loads, and loads that are sensitive to voltage overshoots. Do not use voltage priority mode with low-impedance sources such as batteries, power supplies, or large charged capacitors.

In voltage priority mode, the output voltage should be programmed to the desired value. A positive and negative current limit value should also be set. The current limit should always be set to a value that is greater than the actual output current requirement of the external load. The following figure shows the voltage priority operating locus of the output. The area in the white quadrants shows the output as a source (sourcing power). The area in the shaded quadrants shows the output as a load (sinking power).



The heavy solid line illustrates the locus of possible operating points as a function of the output load. As shown by the horizontal portion of the line, the output voltage remains regulated at its programmed setting as long as the load current remains within the positive or negative current limit setting. A CV (constant voltage) status flag indicates that the output voltage is being regulated and the output current is within its limit settings.

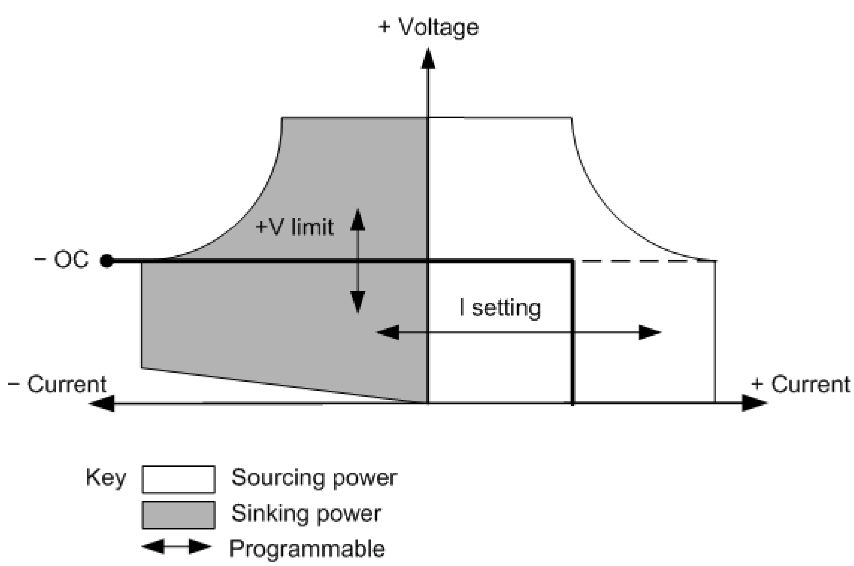
Note that when the output current reaches either the positive or negative current limit, the unit no longer operates in constant voltage mode and the output voltage is no longer held constant. Instead, the power supply will now regulate the output current at its current limit setting.

As shown by the vertical portions of the load line, the output voltage may continue to increase in the positive direction or decrease in the negative direction as current is forced into or pulled out of the unit. When the output voltage exceeds the over-voltage protection setting, the output will shut down, the output relays will open, and the OV status bit will be set.

Current Priority

In current priority mode, the output is controlled by a bi-polar constant current feedback loop, which maintains the output source or sink current at its programmed setting. The output current remains at its programmed setting, provided the load voltage remains within the voltage limit setting. Current priority mode is best suited for use with batteries, power supplies, large charged capacitors, and loads that are sensitive to current overshoots. It minimizes current overshoots during programming, turn-on, and turn-off transitions and seamlessly transitions between positive and negative currents.

In current priority mode, the output current should be programmed to the desired positive or negative value. A positive voltage limit value should also be set. The voltage limit should always be set to a value that is greater than the actual output voltage requirement of the external load. The following figure shows the current priority operating locus of the output. The area in the white quadrants shows the output as a source (sourcing power). The area in the shaded quadrants shows the output as a load (sinking power).



The heavy solid line illustrates the locus of possible operating points as a function of the output load. As shown by the vertical portion of the line, the output current remains regulated at its programmed setting as long as the output voltage remains within its limit setting. A CC (constant current) status flag indicates that the output current is being regulated and the output voltage is within its limit settings.

Note that when the output voltage reaches the voltage limit, the unit no longer operates in constant current mode and the output current is no longer held constant. Instead, the power supply will now regulate the output voltage at its voltage limit setting.

As shown by the horizontal portion of the load line, when the unit is sinking power, the output current may continue to increase in the negative direction as more current is forced into the unit. This can happen when the load is a power source such as a battery, and its output voltage is higher than the voltage limit setting of the power supply. Once the current exceeds the built-in negative over-current limit, the output will shut down, the output relays will open, and the OC status bits will be set. In such a case, it is important to set the voltage limit properly in order prevent this protection shutdown.

Load mode operation

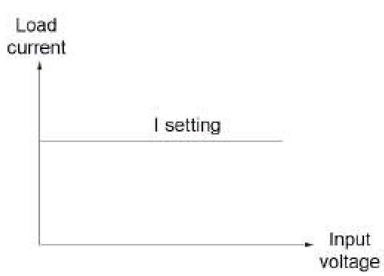
The load operating modes for RP5900A Series are:

- Current Priority (CC mode)
- Voltage Priority (CV mode)
- Power Priority (CP mode)
- Resistance Priority (CR mode)
- CV+CC
- CV+CR
- CC+CR
- CC+CR
- CC+CV+CP+CR (AUTO)

When programmed to a mode, the instrument remains in that mode until the mode is changed or until a fault condition, such as an overpower or over-temperature occurs.

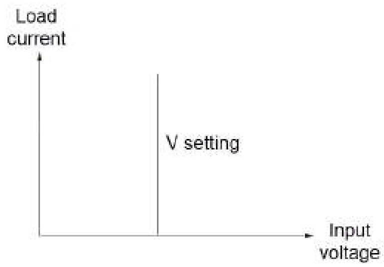
Current Priority (CC mode)

In this mode, the load unit will sink a current in accordance with the programmed value regardless of the input voltage, as illustrated below. The CC mode ensures that the DUT voltage outputs remain stable when the load varies.



Voltage Priority (CV mode)

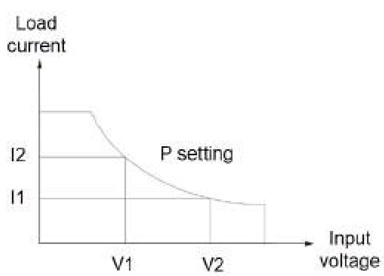
In this mode, the load unit will attempt to sink enough current to maintain the input voltage at its programmed value, as illustrated below. For battery chargers or charging stations, CV mode changes the output voltage to ensure the precision of the charging current.



Power Priority (CP mode)

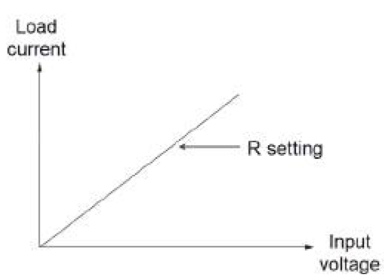
In this mode, the load unit will regulate the power being drawn from the DUT according to the programmed constant-power value, as illustrated below. The load unit regulates the input power by measuring the input voltage and current and adjusting the input power based on data streamed from the measurement ADCs.

When the DUT is a battery, the electronic load changes to simulate device loading behavior. Many battery discharge applications and power consumption profiles can be simulated for analysis, making the CP mode the best choice for simulating electronic device loads.



Resistance Priority (CR mode)

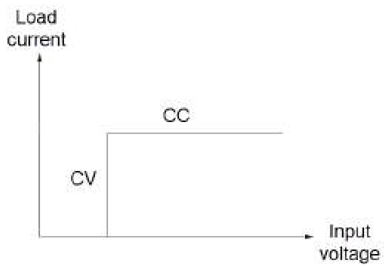
In this mode, the load unit will sink current proportional to the input voltage in accordance with the programmed resistance, as illustrated below. The CR mode ensures that the DUT voltage outputs remain stable when the load varies.



CV+CC mode

In CV+CC mode, you need to program the constant voltage and constant current before turning on the DUT output. When the DUT voltage starts to output, the load unit will sink in CV mode according to the programmed voltage. When the voltage rises to exceed the set constant current for sinking, it will switch to CC mode for sinking, as illustrated below.

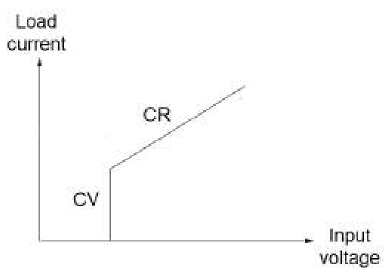
The CV+CC mode can be applied to the load simulation battery and test the charging station or the car charger. When the CV is working, the maximum loading current is limited.



CV+CR mode

In CV+CR mode, you need to program the constant voltage and constant resistance before turning on the DUT output. When the DUT voltage starts to output, the load unit will sink in CV mode according to the programmed constant voltage. When the voltage rises to exceed the set constant resistance for sinking, it will switch to CR mode for sinking, as illustrated below.

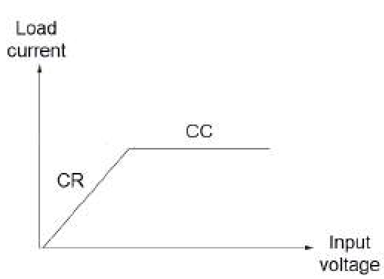
The CV+CR mode can be applied to the LED simulation and test the LED power supply to get the LED current ripple parameters.



CC+CR mode

In CC+CR mode, you need to program the constant resistance and constant current before turning on the DUT output. When the DUT voltage starts to output, the Load will sink in CR mode according to the programmed resistance. When the voltage rises to exceed the set constant current for sinking, it will switch to CR mode for sinking.

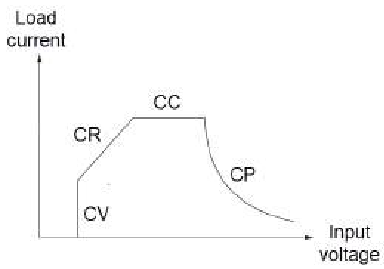
The CR+CC mode is commonly used in the testing of voltage limiting, current limiting characteristics, constant voltage accuracy, and constant current accuracy of on-board chargers, which prevents over-current protection of on-board chargers.



CC+CV+CP+CR mode (AUTO)

In Auto mode, you need to program the constant voltage, constant resistance, constant current and constant power, before turning on the DUT output. When the DUT voltage starts to output, the load unit will sink according to the programmed constant voltage in CV mode. When the voltage rises, it will automatically switch to CR mode and to the CC mode at last for sinking. It will switch to CP mode for sinking if the DUT outputs high voltage abnormally.

With this mode, the load can automatically switch among CV, CR, CC and CP modes. It is suitable for lithium ion battery charger testing to get a complete V-I charging curve. Moreover, the auto mode can avoid damaging the DUT when the protection circuit is damaged.



4
Using the Regenerative DC Power Supply

NOTE For load mode, the input terminals are referred to as "Outputs" throughout this document.

Programming the Source

WARNING

SHOCK HAZARD, HAZARDOUS VOLTAGES
Do not touch any output terminal connections by hand. Ensure that all instrument connections, DUT wiring, and DUT connections are either insulated or covered using the safety covers provided, so that no accidental contact with harzardous voltages can occur. Always use the electrical safety gloves when connecting or disconnecting DUT to the output terminals.

RISQUE D'ÉLECTROCUTION, TENSIONS DANGEREUSES
Ne touchez jamais les connexions des bornes de sortie à mains nues. Assurez-vous que toutes les connexions de l'instrument, ainsi que le câblage et les connexions du DUT, soient soit isolés, soit protégés par les capots de protection fournis, afin d'éviter tout contact accidentel avec des tensions dangereuses. Portez toujours des gants isolants lorsque vous connectez ou déconnectez le DUT aux bornes de sortie.

SHOCK HAZARD
Always turn off the power switch before removing connections from the power cord or output terminals.

RISQUE D'ÉLECTROCUTION
Mettez toujours l'interrupteur d'alimentation hors tension avant de débrancher le cordon d'alimentation ou de désactiver les bornes de sortie.

SHOCK HAZARD
Always assume the positive and negative lines at the output terminal are energized. Verify the lines before making any connections.

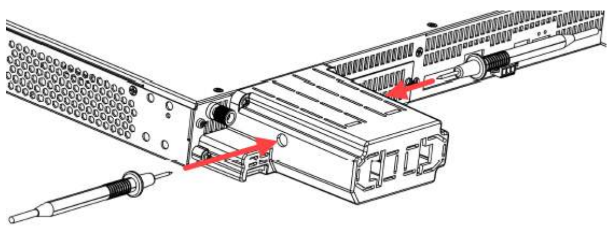
RISQUE D'ÉLECTROCUTION
Considérez toujours que les lignes positives et négatives des bornes de sortie sont sous tension. Vérifiez-les avant toute connexion.

HAZARDOUS VOLTAGE PRESENT

After turning off the unit, allow time for self-discharge and ensure the capacitors discharge to a safe voltage before handling any components connected to the output terminal, as they may retain a hazardous charge.

Never touch cables or connections immediately after turning off the unit. Depending on use case, such as when connected to an energized supply (e.g., battery), hazardous voltages can remain at the output terminals after turning off the unit. Verify that there is no dangerous voltage on the output or sense terminals before touching them. To disconnect an energized supply, follow the recommended verification procedures as shown below:

1. Use a multimeter to observe the voltage. Probe the output terminals from both sides of the safety cover as shown below.

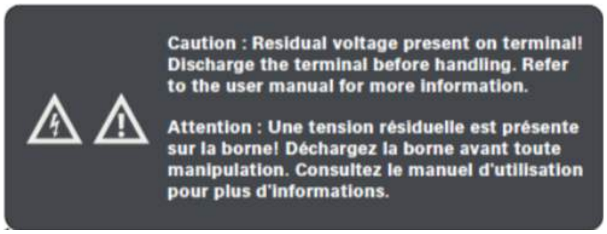
   

   NOTE: For the 80 V unit, the safety cover does not have the probe holes. Wear electrical safety gloves to remove the safety cover and use a multimeter to measure the voltage at the output terminals.

NOTE Ensure the multimeter and measurement probe used have the correct voltage rating to avoid shock hazards.

2. If there is no voltage remaining at the output terminals, proceed with step 7. If voltage remains at the output terminals, proceed with step 3 to 7.
3. Turn on the unit. Press **[Menu]** > **System** > **Emulation** and select **Load**. This action will switch the RPS to Load mode (CC mode by default).
4. Press **[Current]** and set the current to 1 A.
5. Press **[On/Off]** to turn on the output.
6. Use a multimeter to observe the voltage on the output terminals. The voltage will drop to 0 V in approximately two seconds.
7. Disconnect the energized supply from the output terminals.

NOTE Always use electrical safety gloves before disconnecting any energized supply (e.g., battery) from the output terminals.

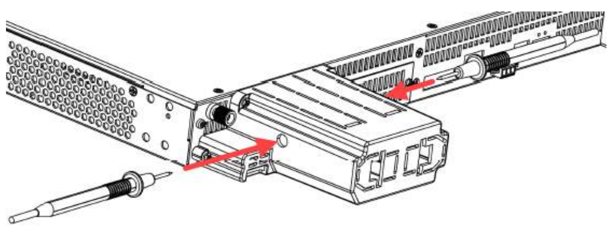


TENSION DANGEREUSE PRÉSENTE

Après avoir éteint l’unité, attendez que les condensateurs se déchargent complètement avant de manipuler les composants connectés aux bornes de sortie, car ils peuvent conserver une charge dangereuse.

Ne touchez jamais les câbles ou les connexions immédiatement après avoir mis l’appareil hors tension. Dans certains cas, par exemple si l’appareil est relié à une source sous tension (batterie, etc.), des tensions dangereuses peuvent subsister sur les bornes de sortie même après la mise hors tension de l’unité. Vérifiez qu’il n’y ait pas de tension dangereuse sur les bornes de sortie ou de détection avant de les toucher. Pour déconnecter une source sous tension, suivez les procédures ci-dessous :

1. Utilisez un multimètre pour mesurer la tension. Testez les bornes de sortie des deux côtés du capot de protection comme indiqué ci-dessous.



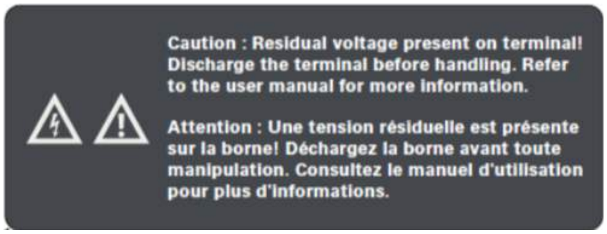
REMARQUE : Sur le module 80 V, le capot de protection ne comporte pas de trous pour la sonde. Portez des gants isolants pour retirer le capot et utilisez un multimètre pour mesurer la tension aux bornes de sortie.

NOTE
Vérifiez que le multimètre et la sonde supportent la tension maximale afin d’éviter tout risque d’électrocution.

2. Si aucune tension n’est détectée aux bornes de sortie, passez directement à l’étape 7. Si une tension subsiste aux bornes de sortie, procédez aux étapes 3 à 7.
3. Mettez l’instrument sous tension. Appuyez sur **[Menu]** > **System** (Système) > **Emulation** (Émulation) et sélectionnez **Load** (Charge). Le RPS passe alors en mode Charge (mode CC par défaut).
4. Appuyez sur **[Current]** (Courant) et réglez le courant sur 1 A.
5. Appuyez sur **[On/Off]** pour activer la sortie.
6. Utilisez un multimètre pour mesurer la tension aux bornes de sortie. La tension retombera à 0 V en 2 secondes environ.

7. Déconnectez la source sous tension des bornes de sortie.

NOTE Portez toujours des gants isolants avant de déconnecter toute source sous tension (comme la batterie) des bornes de sortie.



NOTE When the RPS is first turned on, it may take about 30 seconds or so to initialize the instrument before it is ready for use.

Set the Output Priority Mode

Select either voltage or current priority mode. Refer to Operation Mode for more information.

Voltage priority mode keeps the output voltage constant. The output voltage remains at its programmed setting, provided the load current remains within the + or – current limit setting.

Current priority mode keeps the output current constant. The output current remains at its programmed setting, provided the load voltage remains within the voltage limit setting.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Output\Mode**. Select either Voltage priority or Current priority. Then press **[Enter]**.	To specify current or voltage priority mode: FUNC|MODE CURR|VOLT

In sink mode, there is minimum operating voltage. See below for the minimum operating voltage corresponding to each voltage model.

Voltage Level	Sink Current	Minimum Operating Voltage (MOV)	MOV/V_{max} (%)
80 V	- I_{max}	0.5 V	1 %
500 V	- I_{max}	2.5 V	0.5 %
800 V	- I_{max}	4 V	0.5 %

NOTE When switching between voltage priority and current priority mode, the output is turned off and the output settings revert to their Power-on or RST values.

Set the Output Voltage

When the unit is in voltage priority mode, the output voltage remains at its programmed setting as long as the load current remains within its programmed positive or negative limit.

Front Panel Menu Reference	SCPI Command
Press **[Voltage]**. Enter a value and press **[Enter]**.	To set the output voltage to 400 volts: VOLT 400

When the unit is in current priority mode, you can specify the voltage high limit and voltage low limit which limits the output voltage at the specified value. The output current remains at its programmed setting, provided the load voltage remains within the voltage limit setting.

Front Panel Menu Reference	SCPI Command
Press **[Menu]** > **[Voltage]** Specify a Voltage High Limit and Voltage Low Limit. Then press **[Enter]**.	To set the voltage high limit: VOLT:LIM 420 To set the voltage low limit: VOLT:LIM:LOW 20

Alternatively, you can also specify the voltage limit on the meter view. Press [Voltage] to toggle between Hi and Lo voltage limit and specify the voltage limit accordingly.

Maximum Output Voltage

You can also specify the maximum voltage the instrument is allowed to output. By default, this is set to the instrument's maximum rated voltage.

Front Panel Menu Reference	SCPI Command
Press **[Menu]** > **Output\Advanced\VoltMax** Specify a maximum output voltage. Then press **[Enter]**.	To set the maximum output voltage to 50 V: VOLT:RANG 50 To set the maximum output voltage to maximum value: VOLT:RANG MAX

Set the Output Current

When the unit is in voltage priority mode, you can specify a positive and negative current limit, which limits the output current at the specified value.

Front Panel Menu Reference	SCPI Command
Press **[Current]** to toggle between the positive and negative current value. Alternative, press **[Menu]** > **[Current]** Specify a positive or negative Current limit. Then press **[Enter]**.	To set the positive current limit: CURR 12, or CURR:LIM 12 To set the negative current limit: CURR -3, or CURR:LIM:NEG -3

When the unit is in current priority mode, the output current remains at its programmed setting as long as the output voltage remains within its programmed positive or negative limit.

Front Panel Menu Reference	SCPI Command
Press **[Current]**. Enter a value and press **[Enter]**.	To set the current to +5 amperes: CURR 5 To set the current to –5 amperes: CURR –5

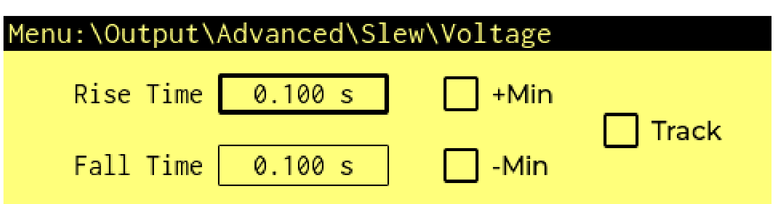
Set the Output Power

You can specify a positive and negative power limit, which limits the output power at a specified value.

Front Panel Menu Reference	SCPI Command
Press **[Power]** to toggle between the positive and negative power value. Alternative, press **[Menu]** > **[Power]** Specify a positive or negative Power limit. Then press **[Enter]**.	To select a positive power limit: POW 5, or POW:LIM 5 To select a negative power limit: POW -5, or POW:LIM:NEG -5

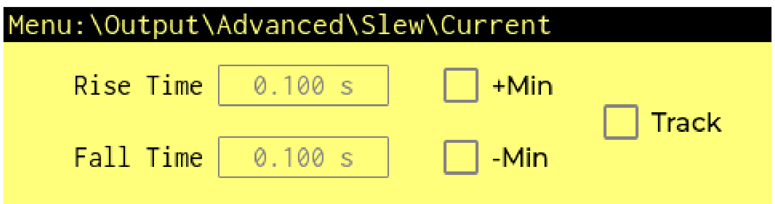
Set the Slew Time

The voltage slew time is the time it takes to reach the specified voltage. This applies only to voltage settings while operating in voltage priority mode. When set to MINimum, the slew time will be limited by the unit's listed programming speed and bandwidth.



Front Panel Menu Reference	SCPI Command
To set the voltage slew time: Select **[Menu]** > **Output\Advanced\Slew\Voltage**. Then select Rise Time or Fall Time. Enter a value in the field. Check the +Min or -Min checkbox to program the fastest time to reach the specified voltage. Check the Track checkbox to let the voltage fall time tracks the rise time settings.	To set the rising voltage slew time to 5 s: VOLT:SLEW:TIME 5 To set the falling voltage slew time to 3 s: VOLT:SLEW:TIME:NEG 3 To set the fastest voltage slew time: VOLT:SLEW:TIME MIN VOLT:SLEW:TIME:NEG MIN To enable the voltage slew time tracking: VOLT:SLEW:TIME:COUP ON

Current slew time is the time it takes to reach the specified current. This applies only to current settings while operating in current priority mode. When set to MINimum, the slew time will be limited by the unit's listed programming speed and bandwidth.

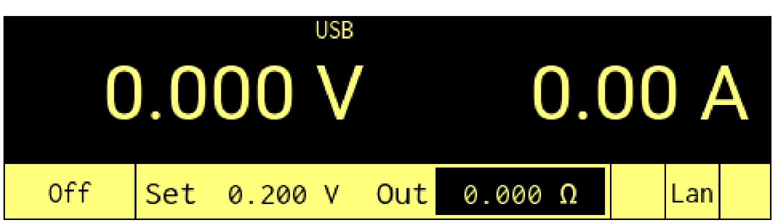


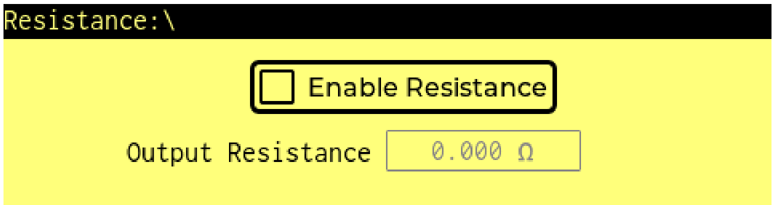
Front Panel Menu Reference	SCPI Command
To set the current slew time: Select **[Menu]** > **Output\Advanced\Slew\Current**. Then select Rise Time or Fall Time. Enter a value in the field. Check the +Min or -Min checkbox to program the fastest time to reach the specified current. Check the Track checkbox to let the current fall time tracks the rise time settings.	To set the rising current slew time to 1 s CURR:SLEW:TIME 1 To set the falling current slew time to 0.5 s CURR:SLEW:TIME:NEG 0.5 To set the fastest current slew time: CURR:SLEW:TIME MIN CURR:SLEW:TIME:NEG MIN To enable the current slew time tracking: CURR:SLEW:TIME:COUP ON

Enable the Output Resistance

In voltage priority, the output resistance programming is mainly used in battery testing applications. It is used to emulate the internal resistance of a non-ideal voltage source such as a battery. Values are programmed in ohms.

Refer to the Data Sheet for the model-specific resistance programming ranges.



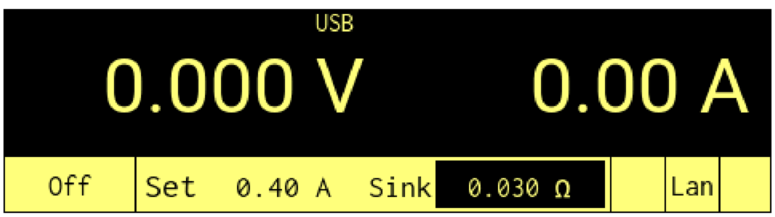


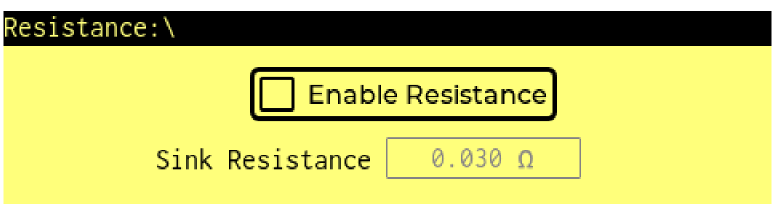
Front Panel Menu Reference	SCPI Command
Press **[Res]** and specify a output resistance value. Alternatively, press **[Menu]** > **[Res]**. Check the Enable Resistance checkbox. On the Output Resistance field, specify an output resistance value.	To enable output resistance: VOLT:RES:STAT ON To select a resistance of 0.5 ohms: VOLT:RES 0.5

NOTE When units are paralleled, the programmable output resistance is reduced. The programmable output resistance for a single unit must be divided by the total number of paralleled units.

Resistance priority function in sink mode

In current priority, this instrument supports resistance priority testing in sink mode, and the sink current capability of resistance priority mode is controlled by the sink current setting value.





Front Panel Menu Reference	SCPI Command
Press **[Res]** and specify a sink resistance value. Alternatively, press **[Menu]** > **[Res]**. Check the Enable Resistance checkbox. On the Sink Resistance field, specify a sink resistance value.	To enable resistance function: VOLT:RES:STAT ON To select a sink resistance of 0.5 ohms: VOLT:RES 0.5

Steps to use the sink resistance function

1. Set to current priority mode. Press **[Menu]** > **Output** > **Mode** > **Current priority**. Then, press **[Back]**.
2. Set the output bandwidth to **High**. Press **Advanced** > **Bandwidth**. On the Current Bandwidth range, select **High**. Then, press **[Back]**.
3. Set the current rise and fall time. Press **Slew** > **Current**. Enter your desired Rise Time and Fall Time value accordingly.
4. Set the Sink Resistance value. Press **[Res]**. On the Sink Resistance field, set a sink resistance value.
5. Check the Enable Resistance checkbox to enable the sink resistance function.

The following is an example of setting a 10 Ω in sink mode.

6. Set the voltage and current. In this example, we will set the current to 5 A and voltage to 20 V.
   a. Press **[Current]** to set the output current value (Is) to 5 A.
   b. Press **[Voltage]** and set the Voltage High Limit to 20 V and Voltage Low Limit to 0 V.
7. Set the DUT (power supply) to output 80 V, 10 A.

At this time, with the 10 Ω is in sink mode (according to the formula I=V/R, the sink current is 80/10=8 A). Due to the limitation of Is = –5 A in Current Priority mode, the actual sink current is 5 A, and the instrument is working In Current Priority mode. If the sink resistance is set to 20 Ω, the sink current is 4 A, which is within the limit of sink current, so the instrument works in Current Resistance mode at this time.

Set the Output Bandwidth

The output bandwidth allows you to optimize the output response time with capacitive loads.

High – This is the default setting and is suitable for the vast majority of applications. It provides a faster response time and is ideal for most testing scenarios.

Low – This mode is recommended when the test device has a very large port capacitance or when the power of the test device is significantly higher than the RPS. When an increased of jitter and ripple are seen during a stable test process, switching to LOW mode can help stabilize the output.

Voltage

Specifies the output bandwidth range when in Voltage Priority mode.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Output\Advanced\Bandwidth**. On the Voltage Bandwidth Range, select either High or Low. Then press **[Enter]**.	To set the voltage bandwidth to HIGH: VOLT:BWID:RANG HIGH

Current

Specifies the output bandwidth when in Current Priority mode.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Output\Advanced\Bandwidth**. On the Current Bandwidth range, select either High or Low. Then press **[Enter]**.	To set the current bandwidth to Low: CURR:BWID:RANG LOW

Enable the Output

Because of internal circuit start-up procedures, OUTPut ON may take tens of milliseconds to complete its function. OUTPut OFF delays may also be in effect. For more information regarding output turn-on and turn-off delays, refer to Turn-On/Turn-Off Delays.

Front Panel Menu Reference	SCPI Command
Press the **[On/Off]** key.	OUTP ON|OFF

In addition to the front panel and SCPI Output On and Output Off commands, you can also use OnCouple and OffCouple signals to enable and disable the output. Refer to Output Couple Control for more information. When coupling is enabled, changing the turn-on setting also changes the turn-off setting and vice-versa.

NOTE

During a 1-cycle AC line dropout the unit may reboot. The output will remain off after reboot until the operator reinstates the previous settings, either by the front panel controls or using a computer program. This behavior is consistent with safe operating procedures.

Programming the Load

WARNING

SHOCK HAZARD, HAZARDOUS VOLTAGES
Do not touch any output terminal connections by hand. Ensure that all instrument connections, DUT wiring, and DUT connections are either insulated or covered using the safety covers provided, so that no accidental contact with harzardous voltages can occur. Always use the electrical safety gloves when connecting or disconnecting DUT to the output terminals.

RISQUE D'ÉLECTROCUTION, TENSIONS DANGEREUSES
Ne touchez jamais les connexions des bornes de sortie à mains nues. Assurez-vous que toutes les connexions de l'instrument, ainsi que le câblage et les connexions du DUT, soient soit isolés, soit protégés par les capots de protection fournis, afin d'éviter tout contact accidentel avec des tensions dangereuses. Portez toujours des gants isolants lorsque vous connectez ou déconnectez le DUT aux bornes de sortie.

SHOCK HAZARD
Always turn off the power switch before removing connections from the power cord or output terminals.

RISQUE D'ÉLECTROCUTION
Mettez toujours l'interrupteur d'alimentation hors tension avant de débrancher le cordon d'alimentation ou de désactiver les bornes de sortie.

SHOCK HAZARD
Always assume the positive and negative lines at the output terminal are energized. Verify the lines before making any connections.

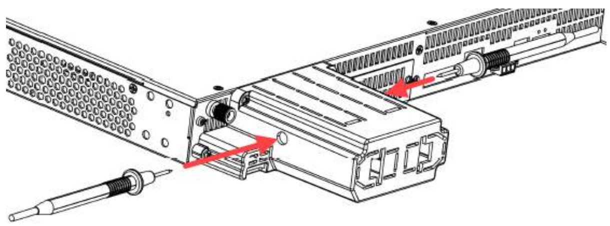
RISQUE D'ÉLECTROCUTION
Considérez toujours que les lignes positives et négatives des bornes de sortie sont sous tension. Vérifiez-les avant toute connexion.

HAZARDOUS VOLTAGE PRESENT

After turning off the unit, allow time for self-discharge and ensure the capacitors discharge to a safe voltage before handling any components connected to the output terminal, as they may retain a hazardous charge.

Never touch cables or connections immediately after turning off the unit. Depending on use case, such as when connected to an energized supply (e.g., battery), hazardous voltages can remain at the output terminals after turning off the unit. Verify that there is no dangerous voltage on the output or sense terminals before touching them. To disconnect an energized supply, follow the recommended verification procedures as shown below:

1. Use a multimeter to observe the voltage. Probe the output terminals from both sides of the safety cover as shown below.

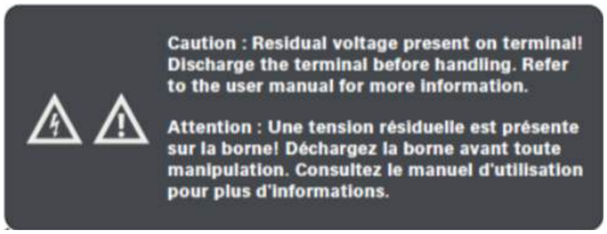


NOTE: For the 80 V unit, the safety cover does not have the probe holes. Wear electrical safety gloves to remove the safety cover and use a multimeter to measure the voltage at the output terminals.

NOTE Ensure the multimeter and measurement probe used have the correct voltage rating to avoid shock hazards.

2. If there is no voltage remaining at the output terminals, proceed with step 7. If voltage remains at the output terminals, proceed with step 3 to 7.
3. Turn on the unit. Press **[Menu]** > **System** > **Emulation** and select **Load**. This action will switch the RPS to Load mode (CC mode by default).
4. Press **[Current]** and set the current to 1 A.
5. Press **[On/Off]** to turn on the output.
6. Use a multimeter to observe the voltage on the output terminals. The voltage will drop to 0 V in approximately two seconds.
7. Disconnect the energized supply from the output terminals.

NOTE Always use electrical safety gloves before disconnecting any energized supply (e.g., battery) from the output terminals.

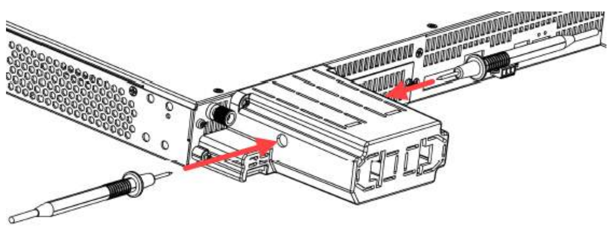


TENSION DANGEREUSE PRÉSENTE

Après avoir éteint l'unité, attendez que les condensateurs se déchargent complètement avant de manipuler les composants connectés aux bornes de sortie, car ils peuvent conserver une charge dangereuse.

Ne touchez jamais les câbles ou les connexions immédiatement après avoir mis l'appareil hors tension. Dans certains cas, par exemple si l'appareil est relié à une source sous tension (batterie, etc.), des tensions dangereuses peuvent subsister sur les bornes de sortie même après la mise hors tension de l'unité. Vérifiez qu'il n'y ait pas de tension dangereuse sur les bornes de sortie ou de détection avant de les toucher. Pour déconnecter une source sous tension, suivez les procédures ci-dessous :

1. Utilisez un multimètre pour mesurer la tension. Testez les bornes de sortie des deux côtés du capot de protection comme indiqué ci-dessous.



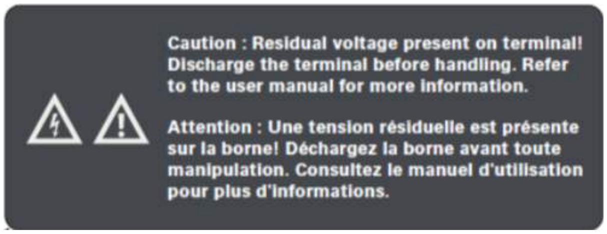
REMARQUE : Sur le module 80 V, le capot de protection ne comporte pas de trous pour la sonde. Portez des gants isolants pour retirer le capot et utilisez un multimètre pour mesurer la tension aux bornes de sortie.

NOTE Vérifiez que le multimètre et la sonde supportent la tension maximale afin d'éviter tout risque d'électrocution.

2. Si aucune tension n'est détectée aux bornes de sortie, passez directement à l'étape 7. Si une tension subsiste aux bornes de sortie, procédez aux étapes 3 à 7.
3. Mettez l'instrument sous tension. Appuyez sur **[Menu]** > **System** (Système) > **Emulation** (Émulation) et sélectionnez **Load** (Charge). Le RPS passe alors en mode Charge (mode CC par défaut).
4. Appuyez sur **[Current]** (Courant) et réglez le courant sur 1 A.
5. Appuyez sur **[On/Off]** pour activer la sortie.
6. Utilisez un multimètre pour mesurer la tension aux bornes de sortie. La tension retombera à 0 V en 2 secondes environ.

7. Déconnectez la source sous tension des bornes de sortie.

NOTE Portez toujours des gants isolants avant de déconnecter toute source sous tension (comme la batterie) des bornes de sortie.



NOTE When the RPS is first turned on, it may take about 30 seconds or so to initialize the instrument before it is ready for use.

Set the Operation Mode

There are eight operation modes, which can be divided to basic operating modes and complex operating modes. Refer to Operation Mode for more information.

- Voltage Priority (CV)
- Current Priority (CC)
- Power Priority (CP)
- Resistance Priority (CR)
- CV+CC
- CV+CR
- CC+CR
- CC+CV+CP+CR (AUTO)

After the operation mode is set, the corresponding key will lit. Set the value according to the operating mode. If other key is pressed, a pop-up message "Operation Mistake" will be displayed.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Input\Mode**. Select CC, CV, CP, CR, CV+CC, CV+CR, CC+CR, or CC+CV+CP+CR. Then press **[Enter]**.	To specify the operation mode to current priority: FUNC|MODE CC To specify the operation mode to CC+CV++CP+CR: FUNC|MODE AUTO NOTE: AUTO = CC+CV+CP+CR operation mode

Set the Input Voltage

NOTE

When the desired operation mode is set, the corresponding key will lit. Press the key to set the value. For example, when CV+CC mode is set, the **[Voltage]** and **[Current]** keys will lit.

When the unit is in CV, CV+CC, CV+CR, or AUTO mode, you can specify the input voltage.

Front Panel Menu Reference	SCPI Command
Press **[Voltage]**. Enter a value and press **[Enter]**.	To set the input voltage to 400 volts: VOLT 400

Set the Input Current

When the unit is in CC, CV+CC, CC+CR, or CC+CV+CP+CR mode, you can specify the input current.

Front Panel Menu Reference	SCPI Command
Press **[Current]**. Enter a value and press **[Enter]**.	To set input current: CURR 10

Set the Input Resistance

When the unit is in CR, CV+CR, CC+CR, or CC+CV+CP+CR mode, you can specify the input resistance.

Front Panel Menu Reference	SCPI Command
Press **[Res]**. Enter a value and press **[Enter]**.	To select a resistance of 0.5 ohms: RES 0.5

Set the Input Power

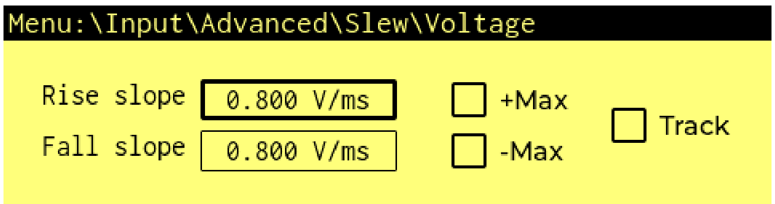
When the unit is in CP or CC+CV+CP+CR mode, you can specify the input power:

Front Panel Menu Reference	SCPI Command
Press **[Power]**. Enter a value and press **[Enter]**.	To select a power of 1 kW: POW 1000

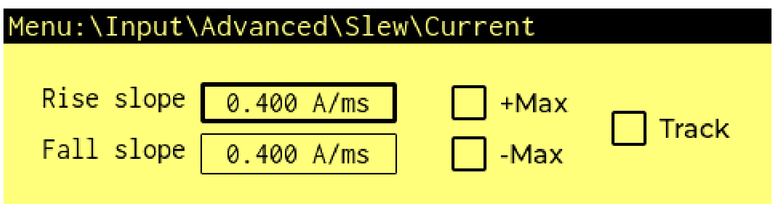
Set the Slew Rate

The voltage slew rate determines the rate at which the voltage changes to a new setting. This only applies to voltage settings while operating in CV mode. When set to MAXimum, INFinity, or to a very large value, the slew rate will be limited by the unit's listed programming speed and bandwidth. This setting can be used to prevent crossover into current limit while up- and down-programming capacitive loads, or to limit programming response to a controlled rate. Use the following equation to calculate the maximum slew rate limit to ensure smooth and linear up- and down-programming performance.

Max slew rate (V/s) = (Current limit setting (A) – Load current (A))/(Load capacitance (F))



The current slew rate determines the rate at which the current changes to a new programmed setting. This only applies to current settings while operating in CC mode. When set to MAXimum, INFinity, or to a very large value, the slew rate will be limited by the unit's listed programming speed and bandwidth.



Model	Current Slew (A/ms)		Voltage Slew (V/ms)	
	Minimum	Maximum	Minimum	Maximum
RP5913A	0.001	10	0.001	10
RP5923A	0.001	20	0.001	10
RP5933A	0.001	30	0.001	10
RP5943A	0.001	60	0.001	10
RP5915A	0.001	3	0.001	50
RP5925A	0.001	6	0.001	50
RP5935A	0.001	9	0.001	50
RP5945A	0.001	18	0.001	50
RP5916A	0.001	2	0.001	33
RP5926A	0.001	4	0.001	33

Model	Current Slew (A/ms)		Voltage Slew (V/ms)	
	Minimum	Maximum	Minimum	Maximum
RP5936A	0.001	6	0.001	33
RP5946A	0.001	12	0.001	33

Front Panel Menu Reference	SCPI Command
To set the voltage slew rate: Select **[Menu]** > **Input\Advanced\Slew\Voltage** Then select Rise slope or Fall slope. Enter the slew rate in field. Check the +Max or -Max checkbox to program the fastest slew rate. Check the Track checkbox to let the voltage fall slew tracks the rise slew settings.	To set the rising voltage slew rate to 5 V/ms VOLT:SLEW 5 To set the falling voltage slew rate to 1 V/ms VOLT:SLEW:NEG 1 To set the fastest voltage slew rate: VOLT:SLEW MAX VOLT:SLEW MAX ON VOLT:SLEW:NEG MAX VOLT:SLEW:NEG MAX ON To enable the voltage slew tracking: VOLT:SLEW:COUP ON

Front Panel Menu Reference	SCPI Command
To set the current slew rate: Select **[Menu]** > **Input\Advanced\Slew\Current** Then select Rise slope or Fall slope. Enter the slew rate in field. Check the +Max or -Max checkbox to program the fastest slew rate. Check the Track checkbox to let the current fall slew tracks the rise slew settings.	To set the rising current slew rate to 1 A/ms CURR:SLEW 1 To set the falling current slew rate to 0.5 A/ms CURR:SLEW:NEG 0.5 To set the fastest current slew rate: CURR:SLEW MAX CURR:SLEW MAX ON CURR:SLEW:NEG MAX CURR:SLEW:NEG MAX ON To enable the current slew tracking: CURR:SLEW:COUP ON

Set the Input Bandwidth

The input bandwidth allows you to optimize the input response time with capacitive loads.

High – This is the default setting and is suitable for the vast majority of applications. It provides a faster response time and is ideal for most testing scenarios.

Low – This mode is recommended when the test device has a very large port capacitance or when the power of the test device is significantly higher than the RPS. When an increased of jitter and ripple are seen during a stable test process, switching to LOW mode can help stabilize the input.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Input\Advanced\Voltage\Bandwidth**. Select either High or Low. Then press **[Enter]**.	To set the voltage bandwidth: VOLT:BWID:RANG HIGH|LOW

Short

Lets you short the input terminals. This simulates a short circuit on the input of the instrument. It works in all operating modes and temporarily overrides input and slew settings. Note that the input on/off and the input protection functions take precedence over an input short. An input-short condition is annunciated by the SH status bit. Press **[Enter]** to enable or disable short in this field

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Input\Short**. Press **[Enter]** to enable or disable short.	To enable short: INP|OUTP:SHORt ON To disable short: INP|OUTP:SHORt OFF

Set the Under Voltage Inhibit Mode

When the under-voltage inhibit (UVI) function is enabled by selecting a mode, the load will not sink current until the input voltage rises above the voltage-on setting.

Press UVI to specify the under-voltage inhibit mode:

- Off: Turns the under-voltage inhibit function off.
- Latching: Lets the load sink current when the voltage subsequently drops below the voltage-on setting. An under-voltage inhibit condition is annunciated by the UVI status bit.
- Live: Turns the input off whenever the voltage drops below the voltage-on setting. Turns the input back on when the voltage reaches the voltage-on setting.

To set the voltage-on setting, enter the voltage-on value in the Voltage On field. The voltage-on value can be programmed from 0 to maximum input voltage.

Front Panel Menu Reference	SCPI Command
To set the under voltage inhibit mode: Press **[Menu]** > **Advanced\UVI**. Select Off, Latching or Live. To set the voltage-on value: On the Voltage On field, enter a value and press **[Enter]**.	To set the inhibit mode to Latching: VOLT:INH:VON:MODE LATC To set the voltage-on value to 5 V: VOLT:INH:VON 5

Enable the Input

Because of internal circuit start-up procedures and any installed relay options, OUTPut ON may take tens of milliseconds to complete its function. OUTPut OFF delays may also be in effect. For more information regarding input turn-on and turn-off delays, refer to Turn-On/Turn-Off Delays.

Front Panel Menu Reference	SCPI Command
Press the **[On/Off]** key.	INP|OUTP ON|OFF

In addition to the front panel and SCPI Output On and Output Off commands, you can also use OnCouple and OffCouple signals to enable and disable the output. Refer to Output Couple Control for more information. When coupling is enabled, changing the turn-on setting also changes the turn-off setting and vice-versa.

NOTE

During a 1-cycle AC line dropout the unit may reboot. The input will remain off after reboot until the operator reinstates the previous settings, either by the front panel controls or using a computer program. This behavior is consistent with safe operating procedures.

Applicable to firmware version V01.05-00.01-01.00-01.00 only:
Ensure the input source does not exceed the instrument limit.
When the load is connected to a source that exceeds the instrument's limit, over-voltage protection will occur when the input is turned on and sinking current. Turning off the input will result in HW8000 error flag, which occurs at the top left corner of the display. This incident happens only when in Menu view. Power cycling the instrument will clear the error flag.

Parallel Operation

Introduction

Primary/Secondary Operation

Introduction

WARNING

SHOCK HAZARD
All paralleled units must be connected to ground through a grounded power cord at all times. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal on any unit will cause a potential shock hazard that could result in injury or death.

RISQUE D'ÉLECTROCUTION
Toutes les unités connectées en parallèle doivent rester reliées à la terre en permanence via un cordon équipé d'une fiche de courant avec terre. Toute interruption du conducteur de protection (mise à la terre) ou tout débranchement de la borne de terre sur une unité entraîne un risque d'électrocution pouvant provoquer des accidents graves, voire mortels.

When connecting the DUT (battery/capacitor), do not short-circuit the battery/capacitor.

Ne court-circuitez jamais la batterie/le condensateur lors de la connexion du DUT (batterie/condensateur).

SHOCK HAZARD
Always turn off the power switch before removing connections from the power cord or output terminals.

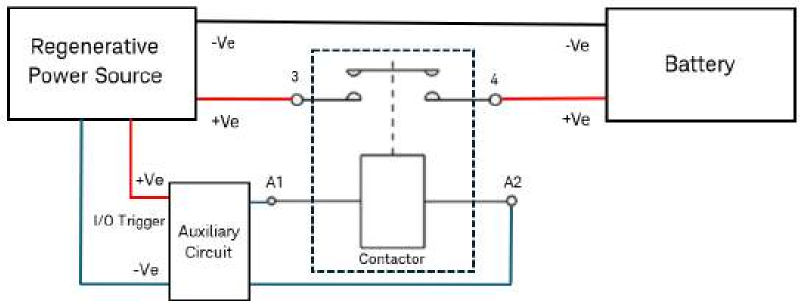
RISQUE D'ÉLECTROCUTION
Mettez toujours l'interrupteur d'alimentation hors tension avant de débrancher le cordon d'alimentation ou de désactiver les bornes de sortie.

SHOCK HAZARD
Always assume the positive and negative lines at the output terminal are energized. Verify the lines before making any connections.

RISQUE D'ÉLECTROCUTION
Considérez toujours que les lignes positives et négatives des bornes de sortie sont sous tension. Vérifiez-les avant toute connexion.

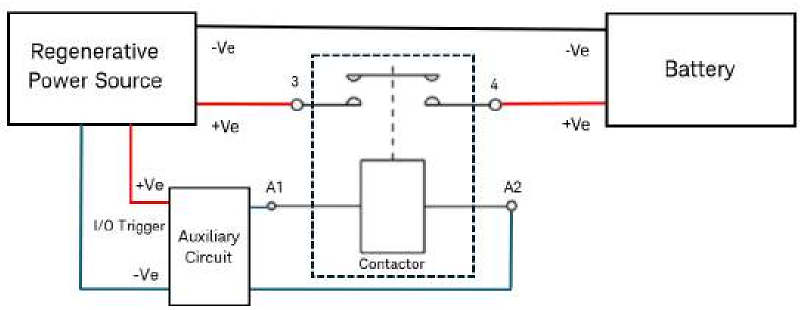
CONNECTION TO AN ENERGIZED SUPPLY (e.g., Battery), SPARKS MAY OCCUR

During connection, it is recommended to use a safety-certified (for example, UL, CSA and etc) contactor to isolate the energized supply (e.g., battery) from the RPS, as illustrated below. Ensure the contactor has the correct voltage and current rating that is higher than the rated RPS voltage and current. Failing to do so may cause injury and equipment damage. For more details, see Contactor Installation.



CONNEXION À UNE SOURCE SOUS TENSION (ex. batterie), RISQUE D'ÉTINCELLES

Lors de la connexion, il est recommandé d'utiliser un contacteur certifié (UL, CSA, etc.) pour isoler la source sous tension (ex. batterie) du RPS, comme indiqué dans le schéma ci-dessous. Vérifiez que le contacteur supporte une tension et un courant supérieurs aux valeurs nominales du RPS. Le non-respect de cette consigne peut entraîner des blessures graves et risque d'endommager l'appareil. Pour plus de détails, consultez la section Installation du contacteur.



Before performing the battery test, you need to connect the Sense cables to both ends of the battery. If the Sense cables are not connected, the instrument cannot detect the Sense voltage and prompt "Wait Power Link", which will prevent the battery test from continuing.

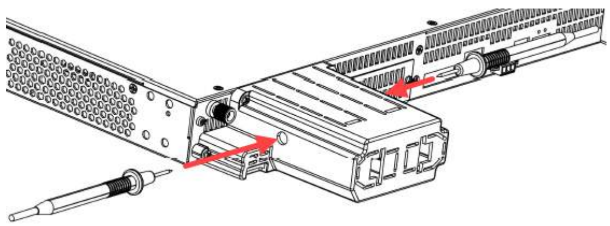
Avant de lancer un test de batterie, assurez-vous que les câbles de détection sont correctement reliés aux deux bornes de la batterie. Sans cette connexion, l'appareil ne pourra pas détecter la tension, affichera le message « Wait Power Link » (En attente de la liaison électrique) et interrompra automatiquement le test.

HAZARDOUS VOLTAGE PRESENT

After turning off the unit, allow time for self-discharge and ensure the capacitors discharge to a safe voltage before handling any components connected to the output terminal, as they may retain a hazardous charge.

Never touch cables or connections immediately after turning off the unit. Depending on use case, such as when connected to an energized supply (e.g., battery), hazardous voltages can remain at the output terminals after turning off the unit. Verify that there is no dangerous voltage on the output or sense terminals before touching them. To disconnect an energized supply, follow the recommended verification procedures as shown below:

1. Use a multimeter to observe the voltage. Probe the output terminals from both sides of the safety cover as shown below.

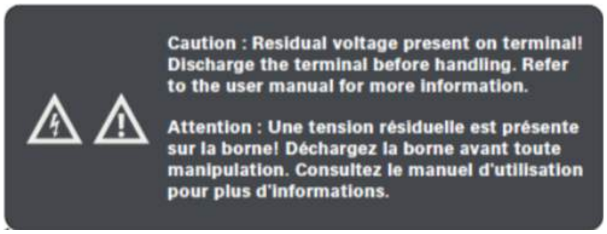


NOTE: For the 80 V unit, the safety cover does not have the probe holes. Wear electrical safety gloves to remove the safety cover and use a multimeter to measure the voltage at the output terminals.

NOTE Ensure the multimeter and measurement probe used have the correct voltage rating to avoid shock hazards.

2. If there is no voltage remaining at the output terminals, proceed with step 7. If voltage remains at the output terminals, proceed with step 3 to 7.
3. Turn on the unit. Press **[Menu]** > **System** > **Emulation** and select **Load**. This action will switch the RPS to Load mode (CC mode by default).
4. Press **[Current]** and set the current to 1 A.
5. Press **[On/Off]** to turn on the output.
6. Use a multimeter to observe the voltage on the output terminals. The voltage will drop to 0 V in approximately two seconds.
7. Disconnect the energized supply from the output terminals.

NOTE Always use electrical safety gloves before disconnecting any energized supply (e.g., battery) from the output terminals.

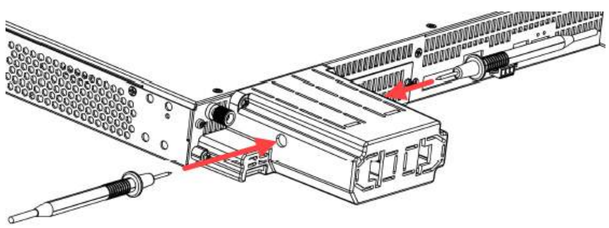


TENSION DANGEREUSE PRÉSENTE

Après avoir éteint l'unité, attendez que les condensateurs se déchargent complètement avant de manipuler les composants connectés aux bornes de sortie, car ils peuvent conserver une charge dangereuse.

Ne touchez jamais les câbles ou les connexions immédiatement après avoir mis l'appareil hors tension. Dans certains cas, par exemple si l'appareil est relié à une source sous tension (batterie, etc.), des tensions dangereuses peuvent subsister sur les bornes de sortie même après la mise hors tension de l'unité. Vérifiez qu'il n'y ait pas de tension dangereuse sur les bornes de sortie ou de détection avant de les toucher. Pour déconnecter une source sous tension, suivez les procédures ci-dessous :

1. Utilisez un multimètre pour mesurer la tension. Testez les bornes de sortie des deux côtés du capot de protection comme indiqué ci-dessous.

   REMARQUE : Sur le module 80 V, le capot de protection ne comporte pas de trous pour la sonde. Portez des gants isolants pour retirer le capot et utilisez un multimètre pour mesurer la tension aux bornes de sortie.

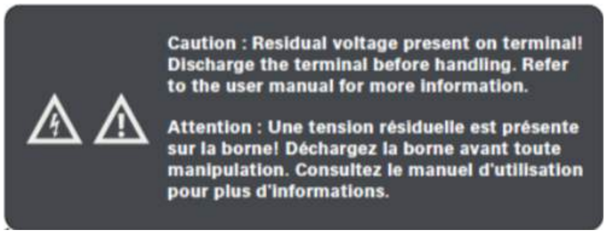
NOTE

Vérifiez que le multimètre et la sonde supportent la tension maximale afin d'éviter tout risque d'électrocution.

2. Si aucune tension n'est détectée aux bornes de sortie, passez directement à l'étape 7. Si une tension subsiste aux bornes de sortie, procédez aux étapes 3 à 7.
3. Mettez l'instrument sous tension. Appuyez sur **[Menu]** > **System** (Système) > **Emulation** (Émulation) et sélectionnez **Load** (Charge). Le RPS passe alors en mode Charge (mode CC par défaut).
4. Appuyez sur **[Current]** (Courant) et réglez le courant sur 1 A.
5. Appuyez sur **[On/Off]** pour activer la sortie.
6. Utilisez un multimètre pour mesurer la tension aux bornes de sortie. La tension retombera à 0 V en 2 secondes environ.

7. Déconnectez la source sous tension des bornes de sortie.

NOTE Portez toujours des gants isolants avant de déconnecter toute source sous tension (comme la batterie) des bornes de sortie.



CAUTION **To Prevent Possible Equipment Damage:**

- Connect no more than 16 units **of identical models** in parallel configuration. All units must have the same firmware version installed. Refer to Instrument Identification for details.
- Parallel connection of mixed models is only supported for 6 kW and 12 kW models, and only for those explicitly marked as compatible in Table 1—such as RP5933A and RP5943A.
- Always turn the **AC power** on and off together. Never leave any units powered on while the others are turned off.

Pour éviter tout endommagement de l'appareil :

- Ne connectez pas plus de 16 modules du **même modèle** en configuration parallèle. Toutes les unités doivent utiliser la même version du micrologiciel. Pour plus d'informations, reportez-vous à la section Identification de l'appareil.
- La connexion en parallèle de modèles différents n'est autorisée que pour les versions 6 kW et 12 kW, et uniquement pour les modèles explicitement indiqués comme compatibles dans le Tableau 1– par exemple, RP5933A et RP5943A.
- **L'alimentation secteur** doit toujours être allumée ou éteinte simultanément pour toutes les unités. Ne laissez jamais certaines unités sous tension pendant que d'autres sont éteintes.

Parallel operation lets you connect multiple power supplies together to create a system with higher total current and power. This applies for current sourcing as well as current sinking operation. Refer to Multiple Unit Connections for detailed information on how to connect the outputs and the primary/secondary cables.

Primary/Secondary Operation

The paralleled group is controlled through the primary unit, and appears as a single higher-power supply or. The primary unit provides the aggregate of most source and measurement functions.

A maximum of sixteen instruments may be connected in a primary/secondary configuration, provided all units are of identical models, and have the same firmware version installed. Refer to Instrument Identification to view the firmware version.

Parallel connection of mixed models is only applicable for 6 kW and 12 kW models, and only for those explicitly marked as compatible in Table 1—such as RP5933A and RP5943A.

The combined programmable current is up to 8192 A, and the total output power of all paralleled units must not exceed 192 kW. The configuration procedure for primary/secondary operation is as follows:

- Configure one unit as the primary
- On the primary unit, set the total of paralleled units
- Configure the other units as secondary units
- After configuration, connect the unit in parallel. Refer to Multiple Unit Connections for detailed information on how to connect the outputs and the primary/secondary cables.
- After connecting the unit in parallel, restart each unit separately.
- At power-on, the primary can connect to the secondary units automatically.
- If the primary/secondary configuration is subsequently changed, it needs to be re-discovered by rebooting the unit.

Primary/Secondary Configuration

Configure each paralleled instrument as either a Primary or Secondary.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **System\Groups** In the dialog box, select either Primary, Secondary, or None. Then press **[Enter]**.	To configure the paralleled unit as primary unit: INST:GRO:FUNC PRIM To configure the paralleled unit as secondary unit: INST:GRO:FUNC SEC

On the primary unit, set the total number of paralleled units. You can configure the number of paralleled units from 2 to 16, including the primary unit.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **System\Groups\Primary** Set the value and then press Enter.	To set the number of paralleled unit to 5: INST:GRO:NUMB 5

After parallel configuration is competed, restart each unit separately. At power-on, the primary can connect to the secondary units automatically.

NOTE If the actual number of parallel units does not match the number configured on the primary unit, the system will enter the PNL state upon power-on. During this state, the **[On/Off]** key will be disabled.

Unparalleled the Unit

In this example, two units of instruments are paralleled.

To unparalleled the units, configure each paralleled unit to None.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **System\Groups** In the dialog box, select None. Then press **[Enter]**.	To configure the paralleled unit to single mode: INST:GRO:FUNC NONE

Then, power off the two instruments and turn off the AC mains of the AC distribution box..

Disconnect the fiber optics cables from the DC output terminal between the two units.

Finally, power on the two instruments separately. The front panel display will show that each instrument is working individually.

Primary/Secondary Programming Considerations

Program the output voltage and current settings of the primary unit the same as you would an individual unit. Refer to Set the Output Voltage and Set the Output Current for details. The secondary units are locked; you cannot program the settings of the secondary units.

Set both positive and negative current limits high to allow for up/down programming transient dynamics. Transient dynamics are mainly a result of DUT capacitance charging currents. Note that the primary unit's current limit and current setting are automatically proportioned among the paralleled group according to the current rating of each unit.

When in source mode, reduce the slew time to mitigate imperfect voltage programming synchronization. By default, the slew time are set to their minimum values.

When in load mode, reduce the slew rates to mitigate imperfect voltage programming synchronization. By default, the slew rates are set to their maximum values.

NOTE In current priority mode, set the output current of the primary unit to the desired value. Set the voltage limit to a higher value than the expected operating voltage of the unit.

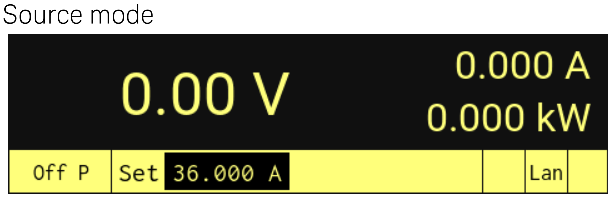
Primary/Secondary Front Panel Display

The following example illustrates the front panel displays during primary/secondary operation. Two units are connected in a primary/secondary configuration.

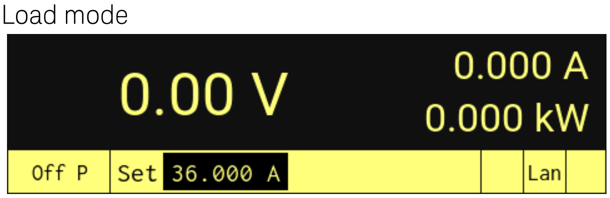
This is the primary unit.

- The "P" indicates the primary unit.

Source mode

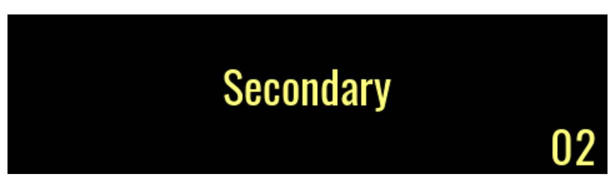


Load mode



This is the secondary unit.

- The "Secondary" indicates a secondary unit.
- The value in the lower right represents the sequence number of the unit in a parallel configuration.



Primary/Secondary Communication

While connected, the primary unit periodically polls the secondary units for status. If communication with any secondary fails, for example if a secondary unit is turned on or off, the primary and remaining secondary units go into primary/secondary protection (PSP). When the remaining secondary units detect that the primary has disconnected, they also go into PSP.

Secondary units use the fiber optic cable status poll as a timer to trip PSP. If the secondary does not receive a status poll every 4 µs or less, it goes into PSP.

Secondary units may go into PSP 4 µs after power-on. Once these units are discovered, the primary unit will establish communication with the secondary units, thereby clearing the PSP.

Primary/Secondary Protection

If the primary unit goes into protection, it sends a protection command to the secondary units. The primary unit indicates the type of protection event that has occurred. The secondary units indicate a protection event. Once the protection condition is corrected, clearing protection on the primary clears protection on all units (see Clearing Protection).

If a secondary unit goes into protection, the primary and the secondary unit on which the protection event occurred indicate the type of protection event. All other secondary units indicate the protection event. Once the protection condition is corrected, clearing protection on the primary clears protection on all units.

Primary/Secondary Command Details

Once connected, the group of units are controlled through the primary and appear as a single higher power unit. All programming commands must be sent to the primary unit.

Current Sharing

Units of equivalent current ratings will share current equally. Units of dissimilar current ratings will share current according the ratio of their current rating. For example, a unit rated at 40 A and a unit rated at 20 A will share their output current in a 2-to-1 ratio.

Current sharing operation

In voltage priority mode:

- Program the initial output voltage setting of each paralleled unit to the same value.
- Set the current limit of each unit according to the following equations. This lets all units share current until the total current limit point is reached, which is the sum of the individual current limits.

For each 6 kW unit: $I_{CL\_6kW} = I_{CL\_TOTAL} / (N_T+N_{12kW})$*

For each 12 kW unit: $I_{CL\_12kW} = 2(I_{CL\_TOTAL}) / (N_T+N_{12kW})$

where:

– I_{CL_6kW} is the current limit setting of the 6 kW unit
– I_{CL_12kW} is the current limit setting of the 12 kW unit
– I_{CL_TOTAL} is the sum total of all individual current limits
– N_T is the total number of paralleled units of any rating
– N_{12kW} is the total number of paralleled 12 kW units

*If there are no 12 kW units used, then N_{12kW}= 0.

NOTE **In a mixed power configuration, you must set the current limit of the 12 kW units to twice the value of the 6 kW units. This is because in a mixed power configuration, each 12 kW unit will contribute twice as much current as each 6 kW unit. When the current limit setting of any paralleled unit is reached, the output current of that unit will limit at its specified setting.**

In current priority mode:

– Set the voltage limit of each paralleled unit to the same value.
– Program the current setting of each paralleled unit according to the equations above if current sharing is desired. The total output current will be the sum of all the individual current settings.mit point is reached, which is the sum of the individual current limits.
– Set the voltage limit of each paralleled unit to the same value.

Parallel Effects on Load Regulation

The design of the RPS has been optimized for parallel operation. Therefore, the effect of paralleled units on the specifications has been kept to a minimum. When units are paralleled, there is no degradation of any specification other than the load regulation specification. All other specifications, including output noise, programming accuracy, readback accuracy, and transient response are unaffected by paralleled operation.

With two or more units are paralleled with current sharing enabled, there will be a small additional voltage regulation effect. The worst case additional voltage regulation effect is as follows:

$\Delta V_{OUT(WORST\_CASE)} = 0.02\%(V_{RATING})$

To determine the total output voltage regulation effect for a specific unit, you must add the worst-case value from the following table to the CV load regulation specification for each paralleled unit. These are the worst-case values for each unit based on its voltage rating.

VRATED	ΔVOUT(WORST_CASE)
80 V	16 mV
500 V	100 mV
800 V	160 mV

Example: You have two 80 V units connected in parallel. The load regulation effect due to current sharing is 16 mV from the table above. The CV load regulation specification is 32 mV. Therefore, the total output voltage regulation effect is 32 mV + 16 mV, or 48 mV.

Troubleshooting

Error/Meter Indicator	Possible Cause	Troubleshooting
PNL	Incorrect number of paralleled units configured. Improper connection or damage to the fiber optic harness.	Check the fiber optic cable connection. Ensure all cables are securely connected between units. Inspect the optical module and fiber optic cable. Confirm that there is no physical damage to the components. Verify and reconfigure the number of paralleled units. Ensure the configuration matches the actual number of connected units. Clear the error and monitor the system. Observe whether the error reoccurs after clearing. Contact Keysight Technologies if the error persists.
FE	Fiber optic cable used in parallel is bent.	Replace with a new fiber optic cable.
HC	Multiple units configured as primary.	In a parallel setup, only one unit can serve as the host. Correct the configuration.
NF	Error sent during parallel networking phase.	Check the fiber optic cable connection. Ensure all cables are securely connected between units. Verify the network parameter configuration.
MCF	Instruments with different specifications detected.	Ensure all paralleled units are from the same model. Parallel connection of mixed models is only applicable for 6 kW and 12 kW models, and only for those explicitly marked as compatible in Table 1.
FSF	Function switching failure has occurred. Possible causes and scenarios: - Switch source mode to load mode. - Set the priority mode of the source. - Set the output bandwidth. -Switch instrument state (primary, secondary, or none) for parallel operation.	Clear protection and reset the instrument. Contact Keysight Technologies if the error persists.
Error 203, Fiber state error	Fiber optic cable networking failure. Improper connection or damage to the fiber optic harness.	Verify the network parameter configuration. Check the fiber optic cable connection. Ensure all cables are securely connected between units. Verify the network parameter configuration.
Error 205, Parallel info check failed	Secondary parameter verification failed. Instruments with different specifications detected.	Ensure all paralleled units are from the same model. Parallel connection of mixed models is only applicable for 6 kW and 12 kW models, and only for those explicitly marked as compatible in Table 1.

Error/Meter Indicator	Possible Cause	Troubleshooting
Error 206, Handshake with node failure	Handshake failure between host and fiber node.	Power cycle the instrument. Contact Keysight Technologies if the error persists.
Error 208, Secondary not ready	Fiber optic node not ready.	Power cycle the instrument. Contact Keysight Technologies if the error persists.

Current Sinking Operation

Current Sinking

Current sinking, also referred to as downprogramming, is the ability to pull current into the positive terminal of the DC power supply. For example, the power supply pulls or sinks current into the positive terminal whenever a lower output voltage is programmed. This is necessary because stored energy from the power supply's output capacitor and external capacitance from the load including the wiring must be discharged to lower the voltage at the output terminals.

The ability to rapidly transition from a higher to a lower constant voltage level greatly improves the power supply’s output response time. This is the most commonly used application of the regenerative function of the RPS, which is automatic and completely transparent to the user.

The DC power supply can continuously sink up to 100% of its rated current for an indefinite time. This two-quadrant sourcing and sinking capability of the DC power supply allows for seamless transitions between sourcing and sinking current without changing the power supply’s output characteristics or introducing any disruptive behavior. The following controls are provided to fully utilize the two-quadrant output capability of the supply.

Current Limit control in voltage priority mode

When operating in voltage priority mode, you can program a negative and positive current limit. This will limit any current overshoots that may occur during rapid up- or down-programming.

Current setting control in current priority mode

When operating in current priority mode, you can program the output current to seamlessly cross the zero point when transitioning from positive to negative or negative to positive. Additionally, when operating in the negative current quadrant, you can program a negative current setting that will hold the sink current at the specified value. This is useful, for example, for discharging a battery at a constant current rate.

If your application requires precise control of the source and sink currents, current slew controls are available to specify a current slew time when sourcing and sinking current.

Regenerative Operation

Regenerative operation is automatic and requires no programming on the part of the user. Whenever the unit is sinking current, either by rapidly downprogramming the output, or by discharging an energy source such as a battery, the unit will direct the excess power back into the AC mains. Refer to AC Mains Considerations for additional information.

Programming Output Protection

Introduction

The RPS models have many protection functions. These functions disable the output to protect the device under test (DUT), as well as the power supply. A front panel status indicator will turn on when a protection function has been set. Most protection functions are latching, which means that they must be cleared once they have been set.

CAUTION

All protections cause a high impedance output disconnect. The output is disconnected without actively sinking current, so the DUT's voltage discharge depends on its characteristics. The DUT and load lead inductance must be within the specified hardware limits to safely absorb any stored energy. Refer to the Data Sheet at www.keysight.com/find/RP5900 for more details.

Toutes les protections entraînent une déconnexion de la sortie avec une impédance élevée. La sortie est déconnectée sans absorption active du courant, de sorte que la décharge de la tension du DUT dépend uniquement de ses caractéristiques propres. L'inductance du DUT et des câbles de charge doit rester dans les limites spécifiées afin d'absorber en toute sécurité l'énergie stockée. Pour plus de détails, consultez la fiche technique disponible à l'adresse www.keysight.com/find/RP5900.

Of the following protection functions, the OV, OC, OP, UV, UC, and Inh are user-programmable.

OV Over-voltage protection is a user-programmable function that can be enabled or disabled. When enabled, the output will be disabled when the output reaches the voltage limit setting.

OC Over-current protection is a user-programmable function that can be enabled or disabled. When enabled, the output will be disabled when the output reaches the current limit setting. An OCP also occurs if internal current limitations are exceeded regardless of the OCP setting.

OP Over-power protection is a user-programmable function that can be enabled or disabled. When enabled, the output will be disabled when the output reaches the power limit setting.

UV Under-voltage protection prevents the voltage from dropping below the low-voltage limit setting when discharging a battery. It also prevents the output from turning on if the output voltage is below the programmed low-voltage level and warm-up time, and exceed the delay time.

UC Under-current protection prevents the voltage from dropping below the low-current limit setting when discharging a battery. It also prevents the output from turning on if the output current is below the programmed low-current level and warm-up time, and exceed the delay time.

OT Over-temperature protection monitors the internal temperature of the instrument and disables the output if the temperature exceeds 85 °C. OT protection is always enabled. For more information, refer to Over-Temperature Protection.

PF Power-fail indicates that a power fail condition on the AC mains has occurred and has disabled the output. PF protection is always enabled.

Inh The Inhibit input (pin 5) on the rear panel digital connector can be programmed to act as an external shutdown signal. Refer to Inhibit Input for details.

Unr The output is unregulated.

UVI Under-voltage inhibit protection is tripped. (Applicable for load mode only).

WDG A watchdog error has occurred.

ESE The output is disabled by reverse sense protection. Reverse sense protection is always enabled. For more information, refer to Reverse Sense Protection.

FE A fiber error has occurred.

SF A voltage or current sharing fault has occurred.

PNL The parallel is not locked. There is mismatch between the parallel settings and the actual setup of the units.

HC Multi-host collision protection.

HW A hardware error has occurred.

UE An unexpected error has occurred. Contact Keysight Technologies.

NF A networking failure has occurred.

MCF A model check fail has occurred.

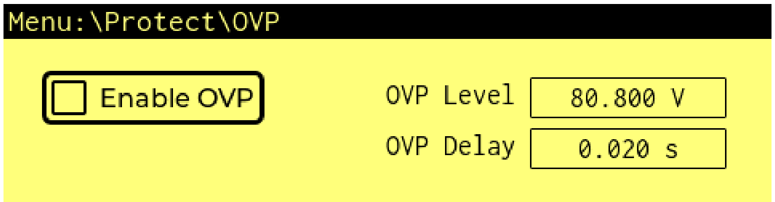
FSF A function switching failure has occurred.

Protection Prompt

When the instrument enters the protection state, the buzzer sounds (if Beep is set to On), the display status indicators and Off are lit, and [On/Off] is turned off.

Set the Over-Voltage Protection

The over-voltage protection will turn the output off if the output voltage reaches the programmed over-voltage limit. The OVP circuit monitors the voltage at the + and – sense terminals. An OVP shutdown will automatically occur if the + and – sense leads are accidentally shorted to each other.



Enable/disable OVP

With over-current protection enabled, the output turns off when the output voltage reaches the voltage limit setting.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\OVP** Check the Enable OVP checkbox to enable OVP.	To enable OVP: VOLT:PROT:STAT ON To disable OVP: VOLT:PROT:STAT OFF

Set the OVP level

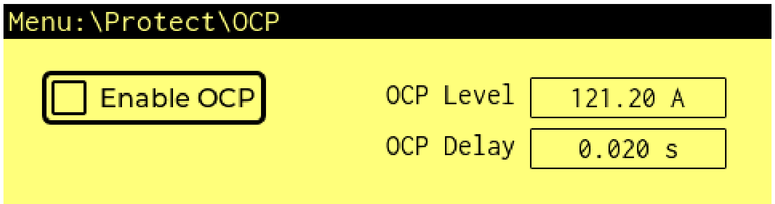
Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\OVP** Enter a value in the OVP Level box. Then press **[Enter]**.	To set the OVP level to 400 volts: VOLT:PROT 400

Set the OVP delay

You can specify an OVP delay to prevent momentary output settings, load, and status changes from tripping the over-voltage protection. In most cases these momentary conditions would not be considered an over-voltage protection fault, and having an OVP condition disable the output when they occur would be a nuisance. Specifying an OVP delay lets the OVP circuit ignore these momentary changes during the specified delay period. Once the OVP delay time has expired and the over-voltage condition persists, the output will shut down.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\OVP** Enter a value in the OVP Delay box. Then press **[Enter]**.	To set the OVP delay to 10 ms: VOLT:PROT:DEL 0.01

Set the Over-Current Protection



Enable/disable OCP

With over-current protection enabled, the output turns off when the output current reaches the current limit setting and transitions from constant voltage (CV) to current limit (CL+ or CL-).

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\OCP** Check the Enable OCP checkbox to enable OCP.	To enable OCP: CURR:PROT:STAT ON

Set the OCP level

For Source mode, you can specify the OCP level to a positive or negative value.

For Load mode, you can specify the OCP level to a positive value only.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\OCP** Enter a value in the OVP Level box. Then press **[Enter]**.	To set the OCP level to 10 A: CURR:PROT 10

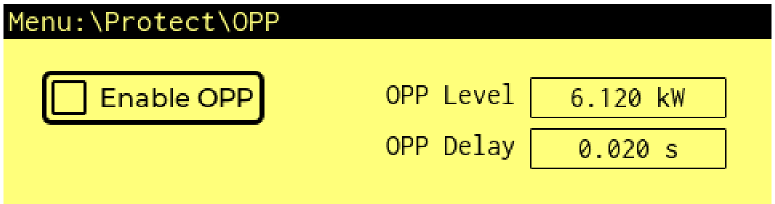
Set the OCP delay

You can specify an OCP delay to prevent momentary output settings, load, and status changes from tripping the over-current protection. In most cases these momentary conditions would not be considered an over-current protection fault, and having an OCP condition disable the output when they occur would be a nuisance. Specifying an OCP delay lets the OCP circuit ignore these momentary changes during the specified delay period. Once the OCP delay time has expired and the over-current condition persists, the output will shut down.

The over-current delay timer can be programmed from 0 to 60 seconds.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\OCP** Enter a value in the OVP Delay box. Then press **[Enter]**.	To specify a 10 millisecond delay: CURR:PROT:DEL 0.01

Set the Over-Power Protection



Enable/disable OPP

With over-power protection enabled, the output turns off when the output power reaches the power limit setting and exceed the delay time.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\OPP** Check the Enable OPP checkbox to enable OPP.	To enable OPP: POW:PROT:STAT ON

Set the OPP level

For Source mode, you can specify the OPP level to a positive or negative value.

For Load mode, you can specify the OPP level to a positive value only.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\OPP** Enter a value in the OPP Level box. Then press **[Enter]**.	To set the OPP level to 5 kW: POW:PROT 5000

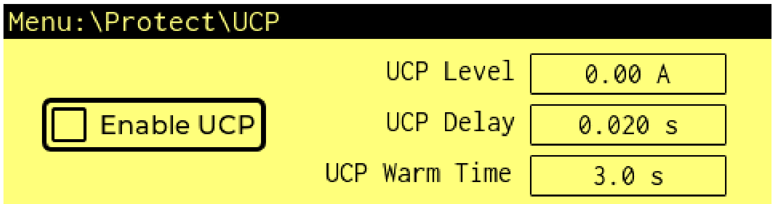
Set the OPP delay

You can specify an OPP delay to prevent momentary output settings, load, and status changes from tripping the over-power protection. In most cases these momentary conditions would not be considered an over-power protection fault, and having an OPP condition disable the output when they occur would be a nuisance. Specifying an OPP delay lets the OPP circuit ignore these momentary changes during the specified delay period. Once the OPP delay time has expired and the over-power condition persists, the output will shut down.

The over-power delay timer can be programmed from 0 to 60 seconds.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\OPP** Enter a value in the OPP Delay box. Then press **[Enter]**.	To specify a 20 millisecond delay: POW:PROT:DEL 0.02

Set the Under-Current Protection



The under-current protection will turn the output off if the output current falls below the protection limit and warm-up time, and exceed the delay time.

This feature is used when discharging batteries to prevent the battery current from dropping below the low current setting.

Enable/disable UCP

With under-current protection enabled, the output turns off when the output current fall below the programmed low current setting.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\UCP** Check the Enable UCP checkbox to enable UCP.	To enable UCP: CURR:UND:PROT:STAT ON

Set the UCP level

You can specify the UCP level to a low-current value.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\UCP** Enter a value in the UCP Level box. Then press **[Enter]**.	To set the UCP level to 1 A: CURR:UND:PROT 1

Set the UCP delay

You can specify an UCP delay to prevent momentary output settings, load, and status changes from tripping the under-current protection. In most cases these momentary conditions would not be considered an under-current protection fault, and having an UCP condition disable the output when they occur would be a nuisance. Specifying an UCP delay lets the UCP circuit ignore these momentary changes during the specified delay period. Once the UCP delay time has expired and the under-current condition persists, the output will shut down.

The under-current delay timer can be programmed from 0 to 60 seconds.

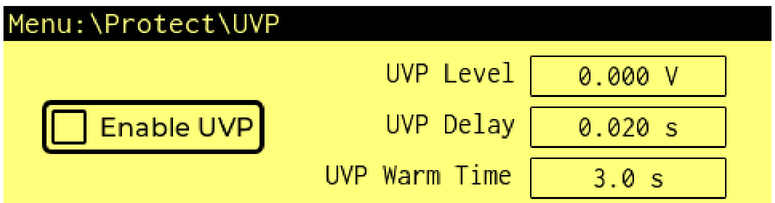
Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\UCP** Enter a value in the UCP Delay box. Then press **[Enter]**.	To specify a 10 millisecond delay: CURR:UND:PROT:DEL 0.01

Set the UCP warm-up time

You can specify the UCP warm up time in seconds. The warm-up time is the period needed for the power supply to stabilize after being turned on. This stabilization is crucial for ensuring that the UCP functions correctly and reliably.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\UCP** Enter a value in the UCP Warm Time box. Then press **[Enter]**.	To set the UCP warm-up time to 0.5 s: CURR:UND:PROT:WARM 0.5

Set the Under-Voltage Protection



The under-voltage protection will turn the output off if the output voltage falls below the protection limit and warm-up time, and exceed the delay time.

This feature is used when discharging batteries to prevent the battery voltage from dropping below the low voltage setting.

Enable/disable UVP

With under-voltage protection enabled, the output turns off when the output voltage fall below the programmed low voltage setting.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\UVP** Check the Enable UVP checkbox to enable UVP.	To enable UVP: VOLT:UND:PROT:STAT ON

Set the UVP level

You can specify the UVP level to a low-voltage value.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\UVP** Enter a value in the UVP Level box. Then press **[Enter]**.	To set the UVP level to 2 V: VOLT:UND:PROT 2

Set the UVP delay

You can specify an UVP delay to prevent momentary output settings, load, and status changes from tripping the under-voltage protection. In most cases these momentary conditions would not be considered an under-voltage protection fault, and having an UVP condition disable the output when they occur would be a nuisance. Specifying an UVP delay lets the UVP circuit ignore these momentary changes during the specified delay period. Once the UVP delay time has expired and the under-voltage condition persists, the output will shut down.

The under-voltage delay timer can be programmed from 0 to 60 seconds.

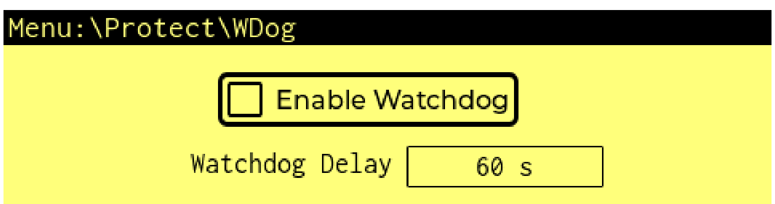
Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\UVP** Enter a value in the UVP Delay box. Then press **[Enter]**.	To specify a 10 millisecond delay: VOLT:UND:PROT:DEL 0.01

Set the UVP warm-up time

You can specify the UVP warm up time in seconds. The warm-up time is the period needed for the power supply to stabilize after being turned on. This stabilization is crucial for ensuring that the UVP functions correctly and reliably.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\UVP** Enter a value in the UVP Warm Time box. Then press **[Enter]**.	To set the UVP warm-up time to 0.5 s: VOLT:UND:PROT:WARM 0.5

Output Watchdog Timer



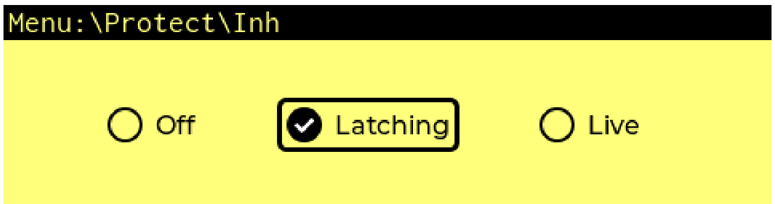
When enabled, the output watchdog timer causes the output to go into protection mode if there is no SCPI I/O activity on the remote interfaces (USB, LAN, GPIB, RS232, CAN) within the user-specified time period. Note that the watchdog timer function is NOT reset by activity on the front panel – the output will still shut down after the time period has elapsed.

After the time period has expired, the output will be disabled, but the programmed output state is not changed. The Prot bit in the status questionable register as well as the Prot indicator on the front panel will be set. A watchdog protect can be cleared as described under Clear Output Protection.

The watchdog delay can be programmed from 1 to 3600 seconds in 1-second increments. To enable the watchdog timer and specify a delay value, proceed as follows:

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\WDog** Check the Enable Watchdog checkbox to enable the watchdog timer. To set the watchdog delay, enter a value in the Watchdog Delay box. Then press **[Enter]**.	To enable the output watchdog timer: OUTP:PROT:WDOG ON To set the output watchdog delay to 120 seconds: OUTP:PROT:WDOG:DEL 120

Inhibit Protection



The following allows you to control the inhibit protection:

LATChing - allows a true signal on digital port Pin 5 when configured as Inhibit input to disable the output.

LIVE - allows the enabled output to follow the state of the Inhibit input pin . When the Inhibit input is true, the output is disabled. When the Inhibit input is false, the output is re-enabled.

OFF - disables the Inhibit protection function.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\Inh** Use the navigation keys to toggle between Off, Latching, and Live.	To select the Inhibit function: DIG:PIN5:FUNC INH To select the pin polarity: DIG:PIN5:POL POS To specify the Inhibit mode: OUTP:INH:MODE LATC OUTP:INH:MODE LIVE OUTP:INH:MODE OFF

Over-Temperature Protection

The over-temperature protection is enabled by default and no setting is required. The protection monitors the internal temperature of the power supply and disables the output if the temperature exceeds 85 °C.

Ensure proper ventilation and airflow around the instrument for effective cooling. Even with adequate ventilation, the instrument may overheat if it operates in a high ambient temperature environment or for extended periods.

When OTP occurs, make sure to turn off the instrument and allows it to cool down for at least 30 minutes. Turn on the instrument when the internal temperature has cooled down.

CAUTION

Ensure the cooling fan is running before power-on. Operating with a defective cooling fan may result in damage to the instrument.

Vérifiez que le ventilateur de refroidissement fonctionne avant de mettre l'appareil sous tension. Ne faites jamais fonctionner l'appareil si le ventilateur est défectueux, vous risqueriez de l'endommager.

Reverse Sense Protection

The reverse sense protection is enabled by default and no setting is required. If the output is enabled and the voltage difference between the output terminal and remote sense exceeds the specified voltage, the system will activate the reverse sense protection after 500 ms. The output will then be disabled and **ESE** will be displayed if the sense terminal are revered.

When in Reverse Sense Protection state (ESE), first check whether the polarities are connected correctly. If they are reversed, reconnect the polarities correctly before enabling the output.

The voltage difference between the output terminal and remote sense terminal varies by product model. When the remote sense terminal is connected in reverse, the maximum voltage will not exceed the sum of the output terminal voltage and the difference voltage.

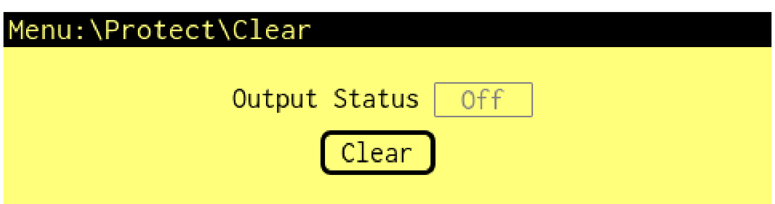
NOTE

If the sense is reversed or short-circuited, the voltage meter will display a value close to 0, either positive or negative, and abnormal high voltage output will not occur, preventing damage to the DUT.

Clear Output Protection

NOTE

For PF protection indicator, power cycle the instrument to clear the status indicator.



If an over-voltage, over-current, over-temperature, power-fail condition, power-limit condition, protection condition, or inhibit signal occurs, the buzzer sounds (if Beep is set to On), the display status indicators Prot and Off are lit, and the output is disabled. The appropriate operating status indicator on the front panel will be on. To clear the protection function and restore normal operation, first remove that condition that caused the protection fault. Then, clear the protection function as follows:

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Protect\Clear** Press **[Enter]** to clear the protection status indicator.	To clear a protection fault: OUTP:PROT:CLE

NOTE

Once the output protection function is cleared, press **[On/Off]** or send OUTP ON command to re-enable the output.

Making Measurements

Average Measurements

The Keysight RPS models have a fully integrated voltmeter and ammeter to measure the actual voltage and current that is being supplied to the load.

Whenever the unit is on, the front panel automatically measures output voltage and current by acquiring 250 samples at a fixed interval of 0.0004 s (400 µs), covering a 0.1 s data window. These samples are then averaged to produce a stable reading.

- For a power line frequency of 50 Hz, the 0.1 s window spans 5 full cycles.
- For 60 Hz, it covers approximately 6 cycles.

This fixed sampling method ensures consistent timing and resolution across different power line frequencies.

Use the following commands to make a measurement:

Front Panel Menu Reference	SCPI Command
Select the **[Meter]** key. Repeatedly press the key to cycle through the following measurement functions: Voltage, Current Voltage, Power Voltage, Current, Power If dashes are displayed, the front panel measurement is interrupted because a remote interface measurement is taking place.	To measure average (DC) output voltage, current, or power: MEAS:VOLT? MEAS:CURR? MEAS:POW? To return measurement data from the previously acquired array: FETC:VOLT? FETC:CURR? FETC:POW?

A-hour & W-hour measurement

Amp-hour and watt-hour measurements are available on all RPS models. These measurements are made independently of other measurements.

Full-range current and power are sampled at a frequency of 200 kHz (200,000 samples/second), with each sample taken every 5 µs. Every 100 ms, the system calculates incremental values using the following formulas:

- **Amp-hour increment**: ΔAh = (I × 100 ms) / 3600 s
- **Watt-hour increment**: ΔWh = (P × 100 ms) / 3600 s

All incremental values are summed to produce the final Ah and Wh readings.

Amp-hour results are stored using a 64-bit double (IEEE-754), with a maximum value of $\pm 1.7976931348623157 \times 10^{308}$.

Watt-hour results are stored using a 32-bit float (IEEE-754), with a maximum value of $\pm 3.40282347 \times 10^{38}$.

The accumulators support continuous operation for up to 1×10^{33} hours at a maximum power of 192 kW, without risk of overflow.

To return Amp-hours and Watt-hours measurements:

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Measure\AhWh.** Displays the accumulated Amp-hours and Watt-hours.	To return the Amp-hours and Watt hours: FETC:AHO? FETC:WHO?

To reset the Amp-hours and Watt-hours measurements:

Front Panel Menu Reference	SCPI Command
Select **[Menu]** >**Measure\AhWh.** Press Reset to return the measurements to zero.	To reset Amp-hours and Watt-hours: SENS:AHO:RES SENS:WHO:RES

Digitized Measurements

In addition to the average voltage, current, and power measurements, which are available from both the front panel and via SCPI commands, digitized measurements can also be returned. Digitized measurements differ from average measurements because you can select the type of measurement returned and fine tune the measurement quality.

Measurement Types

The following digitized measurements are available. These can only be measured using the corresponding SCPI command.

MAX is the maximum value of the digitized measurement.

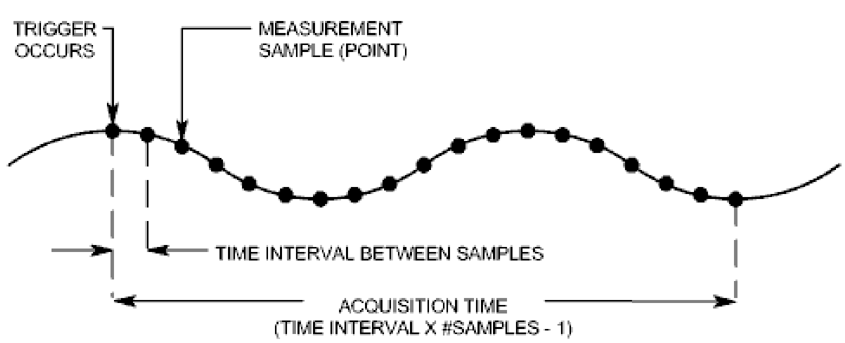
MIN is the minimum value of the digitized measurement.

Array queries are also available to return ALL values in the voltage and current measurement buffer. No averaging is applied, only raw data is returned from the buffer.

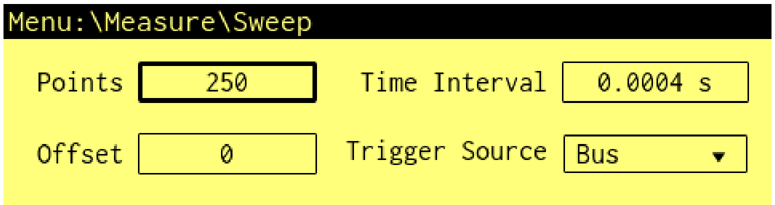
Front Panel Menu Reference	SCPI Command
Not available	To measure the maximum value: MEAS:VOLT:MAX? MEAS:CURR:MAX? MEAS:POW:MAX? To measure the minimum value: MEAS:VOLT:MIN? MEAS:CURR:MIN? MEAS:POW:MIN? To take a measurement and return array data: MEAS:ARR:VOLT? MEAS:ARR:CURR? MEAS:ARR:POW?

Measurement Quality

The following figure illustrates the relationship between measurement samples (or points), and the time interval between samples in a typical measurement. You can fine tune the measurement by specifying the number of points in the measurement acquisition as well as the time interval between points.



You can configure the measurement acquisition as follows:



Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Measure\Sweep**. Enter the number of points. Then press **[Enter]**. Enter the time interval. Then press **[Enter]**.	To set the time interval to 60 ms with 2056 samples: SENS:SWE:TINT 0.06 SENS:SWE:POIN 2056

The maximum number of sample points that are available for all measurements is 4000 points

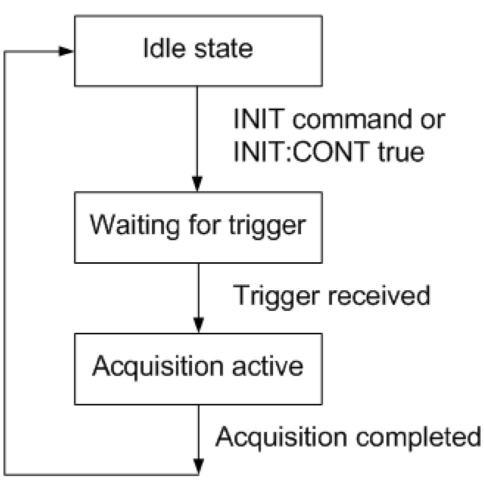
Time interval values can range from 100 microseconds to 100 seconds for both voltage and current measurements. Values above 100 microseconds are rounded to the nearest 2 microsecond increment.

Measurement Triggering

- Select the trigger source
- Initiate the acquisition system
- Trigger the measurement
- Fetch the measurement

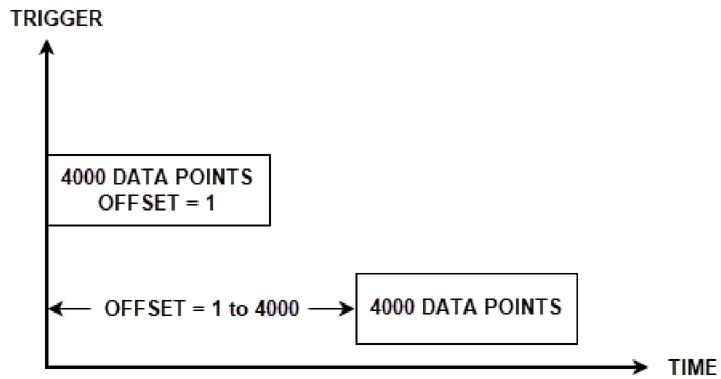
Use the acquisition trigger system to synchronize the digitized measurements with a trigger signal from a number of trigger sources. Then use FETCh commands to return voltage or current information from the acquired data.

The following figure illustrates the measurement acquisition process. This process applies to both measurement triggers and external data logging. For an overview of the trigger system, refer to Trigger Overview.



Capture triggered data

The measurement system lets you capture data after the trigger signal. As shown in the following figure, you can move the block of data being read into the acquisition buffer with reference to the trigger. This allows post-trigger data sampling.



To offset the beginning of the acquisition buffer relative to the acquisition trigger:

Front Panel Menu Reference	SCPI Command
Select **[Menu]** >**Measure\Sweep**. Enter an Offset value. Then press **[Enter]**.	To offset the measurement by 100 points: SENS:SWE:OFFS:POIN 100

Select the trigger source

Select a trigger source from the following:

Trigger Source	Description
Bus	Selects a remote interface trigger command (*TRG).
Current	Selects an output trigger slope, current level, upper level and lower level. Refer to Current/Voltage Trigger Mode for details.
External	Selects ANY pins that have been configured as Trigger Inputs on the digital control port.
Voltage	Selects an output trigger slope, voltage level, upper level and lower level. Refer to Current/Voltage Trigger Mode for details.

Use the following commands to select a trigger source:

Front Panel Menu Reference	SCPI Command
Select **Measure\Sweep**. On the Trigger Source field, use the navigation keys to select either Bus, Voltage, Current, or External. Then, press [Enter].	To select Bus triggers: TRIG:ACQ:SOUR BUS To select any digital pins configured as Trigger Input as trigger sources:TRIG:ACQ:SOUR EXT To select a voltage or current level: TRIG:ACQ:SOUR VOLT TRIG:ACQ:SOUR CURR

Voltage/Current trigger mode

When the trigger source is set to Voltage or Current, the unit monitors the DC output terminals for a specific signal condition. A data acquisition is triggered when the measured voltage or current:

- Reaches the defined Trigger Level
- Crosses the specified Upper (Trig High) and Lower (Trig Low) trigger limits
- Matches the selected Trigger Slope direction

Trigger Parameters

Trig Slope: Defines the direction of the signal change that will trigger the event:

- Rising: Trigger occurs when the signal crosses the level from below (low to high).
- Falling: Trigger occurs when the signal crosses the level from above (high to low).
- Either: Trigger occurs when the signal crosses the level in either direction (rising or falling).

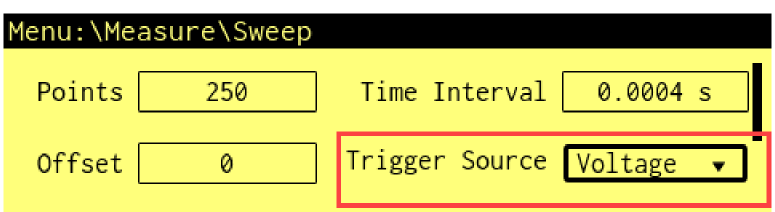
Trig Level: The threshold value that the voltage or current must reach to initiate a trigger.

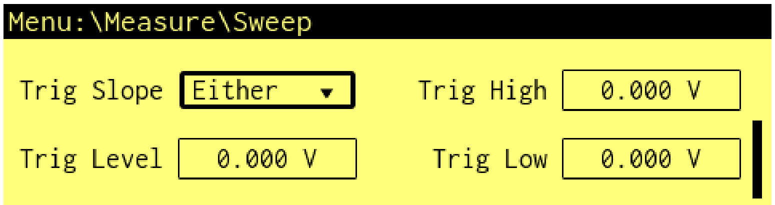
Trig High: The upper limit of the valid trigger.

Trig Low: The lower limit of the valid trigger.

NOTE All conditions must be met for a valid trigger—signal level, range, and slope direction.

Configure the current or voltage trigger source:





Front Panel Menu Reference	SCPI Command
Set the Trigger Source to either **Current** or **Voltage**. Use the navigation arrows to scroll down the menu.	To select voltage slope signal to positive: TRIG:ACQ:VOLT:SLOP POS
On Trig Slope, select either Either, Positive, or Negative.	To select current slope signal to Either: TRIG:ACQ:VOLT:SLOP EITH
On Trig Level, enter the threshold value.	To set the trigger level to 50 V: TRIG:ACQ:VOLT 50
On Trig High, enter the upper trigger limit.	To set the upper voltage level to maximum: TRIG:ACQ:VOLT:HYST:HIGH MAX
On Trig Low, enter the lower trigger limit.	To set the lower current level to minimum: TRIG:ACQ:CURR:HYST:LOW MIN

Voltage trigger example

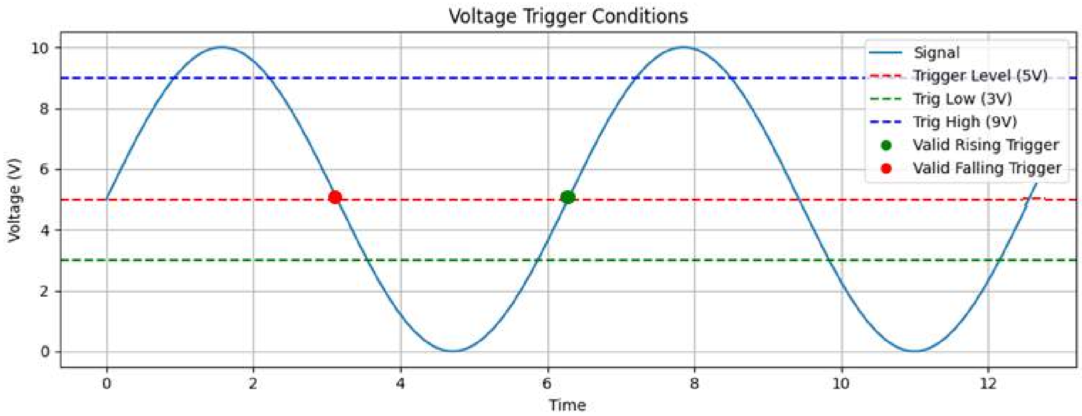
This section illustrates how a valid voltage trigger is determined using the following parameters:

- Trigger Slope = Rising, Falling, or Either
- Trigger Level = 5 V
- Trig Low = 3 V (only relevant for rising slope)
- Trig High = 9 V (only relevant for falling slope)

A valid trigger occurs only when the following condition is met:

- Rising Trigger: The waveform must first cross Trig Low (3 V) and then cross the Trigger Level (5 V) in the rising direction.
- Falling Trigger: The waveform must first cross Trig High (9 V) and then cross the Trigger Level (5 V) in the falling direction.

The diagram below shows a sine wave signal and highlights the valid trigger point where all conditions are satisfied.



Initiate the acquisition system

When the unit is turned on, the trigger system is in the idle state. In this state, the trigger system is disabled, ignoring all triggers. The INITiate commands enable the trigger system to receive triggers.

Front Panel Menu Reference	SCPI Command
Not available	To initiate the measurement trigger system: INIT:ACQ

It takes a few milliseconds for the instrument to be ready to receive a trigger signal after receiving the INITiate:ACQuire command[1]. If a trigger occurs before the trigger system is ready for it, the trigger will be ignored. You can test the WTG_meas bit in the operation status register to know when the instrument is ready to receive a trigger after being initiated.

1 When performing continuous acquisition using firmware version V01.05-00.01-01.00-01.00 , 200 ms delay is required.

Front Panel Menu Reference	SCPI Command
Select **Measure\Control**. The Trig state field indicates "Initiated".	To query the WTG_meas bit (bit 3): STAT:OPER:COND?

If bit 3 is set in the query response, the WTG_meas bit is true, and the instrument is ready to receive the trigger signal. Refer to Status Tutorial for more information.

NOTE The instrument executes one measurement acquisition each time a bus, pin, or level trigger command is received. Thus, it will be necessary to initiate the trigger system each time a triggered measurement is desired.

Trigger the Measurement

The trigger system is waiting for a trigger signal in the initiated state. You can immediately trigger the measurement as follows:

Front Panel Menu Reference	SCPI Command
Not available	To generate a measurement trigger: TRIG:ACQ Alternatively, if the trigger source is BUS, you can also program a *TRG command.

As previously discussed, a trigger can also be generated by a digital pin, and an output voltage or current level. If a digital pin is configured as the trigger source, the instrument will wait indefinitely for the trigger signal. If the trigger does not occur, you must manually return the trigger system to the idle state. The following commands return the trigger system to the idle state:

Front Panel Menu Reference	SCPI Command
Select **Measure\Control**. Then select the Abort control.	ABOR:ACQ

Fetch the measurement

After a trigger is received and the measurement completes, the trigger system will return to the idle state.

Once the measurement completes, FETCh queries can retrieve the most recent measurement data without initiating a new measurement or altering the data in the measurement buffer.

Front Panel Menu Reference	SCPI Command
Not available	To return the maximum value: FETC:VOLT:MAX? FETC:CURR:MAX? FETC:POW:MAX? To return the minimum value: FETC:VOLT:MIN? FETC:CURR:MIN? FETC:POW:MIN? To return array data: FETC:ARR:VOLT? FETC:ARR:CURR? FETC:ARR:POW?

If a FETCh query is sent before the measurement is finished, the response will be delayed until the measurement trigger occurs and the acquisition completes. You can test the MEAS_active bit in the operation status register to know when the measurement trigger system has returned to the idle state.

Front Panel Menu Reference	SCPI Command
Select **Measure\Control**. The Trig state field indicates "Idle".	To query the MEAS_active bit (bit 5): STAT:OPER:COND?

If bit 5 is set in the query response, the MEAS_active bit is true, and the measurement is NOT complete. When the MEAS_active bit is false, you can retrieve the measurement. Refer to Status Tutorial for more information.

Sequencing the Output

This section describes how you can synchronize output turn-on and turn-off sequences on single and multiple units.

Turn-On/Turn-Off Delays

Coupling the Output

Sequencing Multiple Units

Turn on the Output

Turn-On/Turn-Off Delays

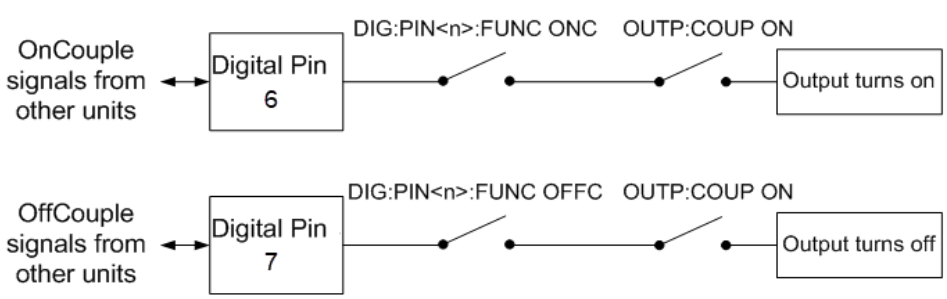
The RPS exhibit an internal delay offset that applies from the time that a command to turn on the output is received until the output actually turns on. Specifying a common delay offset will serves as a reference point for any user-programmed turn-on delays. This user-defined offset also makes it possible to connect multiple units together and program accurate turn-on sequences across multiple outputs. The user-programmed turn-on delay will then be added to the common user-defined reference point.

There is no need to specify a common delay offset when outputs turn off. Outputs start executing their turn-off delays as soon as an Output Off command is received.

Coupling the Output

In addition to the front panel and SCPI Output On and Output Off commands, you can also use OnCouple and OffCouple signals to enable and disable the output. These signals provide an additional level of control when sequencing the outputon individual and multiple units.

The following figure illustrates the programming path when using the OnCouple and OffCouple signals to control the output.



As shown in the figure, you can configure digital ports pins 6 and 7 to provide the OnCouple and OffCouple signals that enable or disable the output. The output is enabled or disabled when the corresponding signal is true. Refer to Output Couple Control for more information on configuring the digital port pins.

Lastly, you must enable output sequencing to use OnCouple and OffCouple signals to enable or disable the output. Refer to Enable Output Sequencing below.

Sequencing Multiple Units

To sequence the output turn-on for multiple units:

1. Connect and configure the digital connector pins of all units.

2. Enable the sequence function on each unit.

3. Specify the user-programmed turn-on delay for each unit.

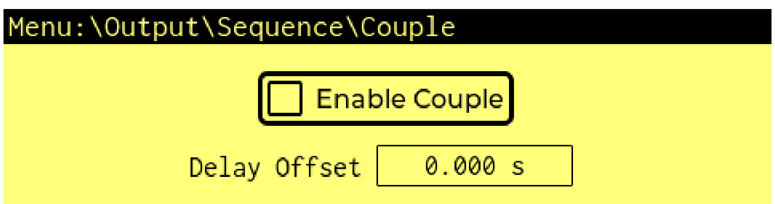
4. This step is required if you have instruments with **different** minimum delay offset. Specify a common delay offset for all of the sequenced units. The common delay offset must be larger or equal to the largest maximum delay offset. When the common delay offset completes, the user-programmed turn-on delays will start.

5. Turn on the output.

Connect and Configure the Digital Connector Pins

The digital connector pins of the sequenced units must be connected together and configured. Refer to Output Couple Control for more information.

Enable Output Sequencing



Output turn-on sequencing must be enabled on each unit that will participate in output turn-on synchronization.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Output\Sequence\Couple**. Check the Enable couple checkbox to enable sequencing.	To enable, send: OUTP:COUP ON To disable, send: OUTP:COUP OFF

Specify the Turn-On and Turn-Off Delays for each Unit

Turn-on delays can be specified for all coupled units. Any delay sequence can be implemented. There are no restrictions on what the sequence is or what unit comes up first.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Output\Sequence\Delay**. Specify the Turn-on Delay in seconds. Repeat for each additional unit.	Program a turn-on delay: OUTP:DEL:RISE 0.02 Repeat for each instrument.

Turn-off delays can also be specified for all coupled units. Any delay sequence can be implemented. There are no restrictions on what the sequence is or what unit turns off first.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Output\Sequence\Delay**. Specify the Turn-off Delay in seconds. Repeat for each additional unit.	Program a turn-off delay: OUTP:DEL:FALL 0.01 Repeat for each instrument.

Specify the Common Delay Offset

NOTE There is no need to specify a common delay offset when outputs turn off. Outputs start executing their turn-off delays as soon as an Output Off command is received (and any user-programmed turn-off delay has expired).

Specifying a common delay offset lets you accurately synchronize the user-programmed turn-on delays when sequencing instruments with different internal delay offsets.

Although you cannot eliminate the internal delay offset times, you can specify a common delay offset to accurately synchronize the user-programmed turn on delays with each other. If you were to program a common delay offset of 170 ms, that common delay offset would then supersede the different internal delay times of the coupled units. The 170 ms common offset would in effect synchronize the internal delay of the coupled units.

The common delay offset assures that the user-programmed turn-on delays will be synchronized to start at the completion of the common delay offset. Query the delay offset of each unit and use the slowest delay as the common delay offset.

Front Panel Menu Reference	SCPI Command
Select **[Menu]** > **Output\Sequence\Couple**. The maximum delay offset for this unit is 60 s. Enter the delay offset value in the Delay offset field in seconds. Then press **[Enter]**.	To query the delay offset: OUTP:COUP:MAX:DOFF? To specify the common delay offset: OUTP:COUP:DOFF 0.170

Turn on the Output

Once output delays have been set, press [On/Off] to start the On and Off delay sequence.

Using the List Function

List lets you generate complex sequences of output changes with rapid, precise timing, which may be synchronized with internal or external signals. This is useful when running test sequences with a minimum amount of programming overhead. In contrast to an output step, which is a one-time outputchange, an output list is a sequence of output changes. Lists can contain up to 200 individually programmed steps, and can be programmed to repeat themselves. Only the parameters associated with one of the operation modes, either voltage or current mode, may be list controlled.

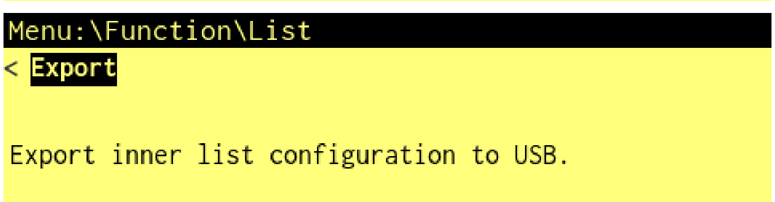
You can set the followings for each of the output in sequence.

1. Set the operation mode, voltage or current.
2. Set the step that will generate the trigger out signal.
3. Set the duration of dwell time for each step.
4. Set the slew rate for each step.
5. Set the last output value after the sequence list completes.
6. Set how the list responds to triggers.
7. Set the trigger source for the transient system.
8. Set the list repeat count.

The instrument support up to 10 list files. You can configure up to 200 steps in each list file. The List can either be stored to internal memory or external USB drive.

List settings

Press [Menu] > Function > List to access the List window. Use the navigation keys to scroll through each of the settings. Press [Back] to exit.



<table>
<tr><th>Settings</th><th></th><th>Available Settings</th><th>Description</th></tr>
<tr><td>Open</td><td></td><td>-</td><td>Opens the list file saved in internal memory or external USB drive.

NOTE: To access files from an external USB drive, connect the drive to the front panel USB port and set the USB mode to Host. If no USB drive is connected, the system will default to using Internal storage only.</td></tr>
<tr><td>Mode</td><td></td><td>Voltage or Current</td><td>Specifies the operation mode.
Default is Voltage (Source mode), Current (Load mode)

Action required:
Use the navigation keys to toggle between Voltage and Current.<table><tr><td>Voltage</td><td>Waveform is defined by the voltage setting</td></tr><tr><td>Current</td><td>Waveform is defined by the current setting</td></tr></table></td></tr>
<tr><td>Repeat</td><td></td><td>1 to 9999999</td><td>Sets the list repeat count. This sets the number of times that a list is executed before it completes.
Default is 1

Enables the 'Run continuously' check box to repeat the list continuously.</td></tr>
<tr><td>Terminate</td><td></td><td>Return to start settings, or Stop at last step settings</td><td>Specifies what happen when the output sequence completes.
Default is Return to start settings

Action required:
Use the navigation keys to toggle between Return to start settings, or Stop at last step settings.<table><tr><td>Return to start settings</td><td>Returns to the value that was in effect before the list started.</td></tr><tr><td>Stop at last step settings</td><td>Remains at the last list value.</td></tr></table></td></tr>
<tr><td>Tout</td><td></td><td>None or Tout</td><td>Specifies the trigger output at the end of the list.
Default is None

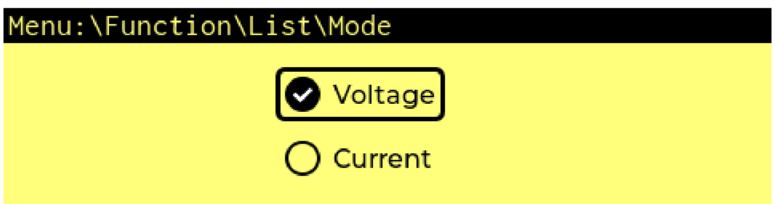
Action required:
Use the navigation keys to toggle between None or Tout.<table><tr><td>None</td><td>No trigger signal will be generated at the end of the list.</td></tr><tr><td>Tout (Trigger output)</td><td>Trigger signal will be generated when the list ends.</td></tr></table></td></tr>
<tr><td>Config</td><td></td><td></td><td>Configure the list settings</td></tr>
<tr><td></td><td>Step Count</td><td>1 to 200</td><td>Sets the list step count. This sets the number of steps in the list.
Default is 2</td></tr>
<tr><td></td><td>Step</td><td>-</td><td>Configures the output sequence.

Action required:
Press Edit to configure the output value, slew rate and dwell time for each step.
NOTE: The output value is dependent on the specified operation mode.</td></tr>
</table>

Settings	Available Settings	Description
Save To File	1 to 10	Specifies the file name. Default is 1 Example, when 1 is entered, the saved file name will be list_01.txt
Save	-	Save the file in internal memory, .txt format.
Control	Initiate	Initiate the list trigger system.
	Trigger	Generate an immediate trigger signal regardless of the trigger source setting.
	Abort	Abort the list trigger system.
Export	-	Export the specified List data from internal memory to external USB drive.

Specify the operation mode

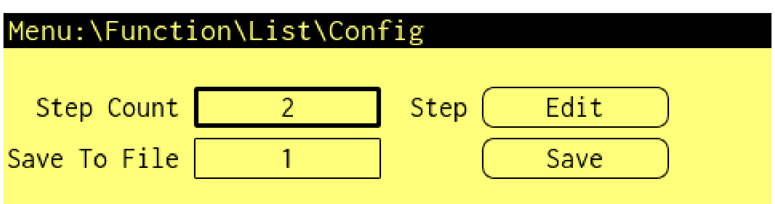
First, you must specify the operation mode. If you are operating in voltage priority mode, select Voltage mode. If you are operating in current priority mode, select Current mode.



Front Panel Menu Reference	SCPI Command
Select **Function\List\Mode.**	To set the waveform type: LIST:FUNC:TYPE VOLT LIST:FUNC:TYPE CURR

Program the list

Press [Menu] > Function > List > Config to access the List Configuration window.



List file name

The List file name is set according to the to list_XX, where XX represents the Save To File location (which can be set from 1 to 10).

For example, when the Save to File location is 2, the List file is named list_02.

Program the list step count

The list step count can be configured from 1 to 200.

Front Panel Menu Reference	SCPI Command
Select the Step Count. Use the numeric key to enter a step count of 5. Press [Enter].	To program a step count to 5: LIST:STEP 5

Program the list sequence

Press Step **Edit**.

NOTE When switching between operation mode, the parameter will change accordingly. For example, switching to Current will change the existing Value (V) to Value (A).

Source mode	Load mode

Source mode:

Menu:\Function\List\Edit\Step

No.	Value(V)	Slew(s)	Width(s)
1	0.000	0.0002	0.001
2	0.000	0.0002	0.001
3	0.000	0.0002	0.001

Load mode:

Menu:\Function\List\Config\Edit Step

No.	Value(A)	Slew(A/ms)	Width(s)
1	0.00	0.001	0.001
2	0.00	0.001	0.001

Fields	Description
Value (V) Value (A)	Sets the voltage or current value for selected step in voltage or ampere.
Slew (s)	Sets the slew time for selected step in seconds. Range from 0 to 8000 s.
Slew (A/ms) Slew (V/ms)	Sets the slew rate for selected step in A/ms or V/ms. Range from 0.001 to MAX. (The maximum value is product dependent)
Width (s)	Sets the dwell time for selected step in seconds. Range from 0.001 to 21000 s

Program the list levels

Use the navigation keys to select the field; use the numeric entry keys to enter the value. The value is set when you press **[Enter]**.

Front Panel Menu Reference	SCPI Command
Select the List Step 1 and enter a value of 15 V. Press [Enter].	To program a voltage level of step 1 to 15 V: LIST:VOLT 1,15
Repeat this for each step. Use the left/right arrows to select the next step.	To program a voltage level of step 2 to 5 V: LIST:VOLT 2,5

Program the list slew

Front Panel Menu Reference	SCPI Command
Select List Step 1 and enter a slew of 5. Press [Enter]. Repeat this for each step. Use the left/right arrows to select the next step.	Source mode: To program a voltage slew time of step 1 to 5 s: LIST:VOLT:SLEW:TIME 1,5 To program a voltage slew time of step 2 to 2 s: LIST:VOLT:SLEW:TIME 2,2 Load mode: To program a voltage slew of step 1 to 5 V/ms: LIST:VOLT:SLEW 1,5 To program a voltage slew of step 2 to 2 V/ms: LIST:VOLT:SLEW 2,2

Program the list dwell times

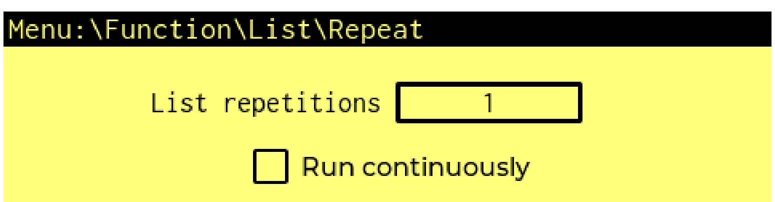
Front Panel Menu Reference	SCPI Command
Select List Step 1 and enter a dwell value of 5. Press [Enter]. Repeat this for each step. Use the left/right arrows to select the next step.	To program a voltage dwell time of step 1 to 5 s: LIST:DWEL 1,5 To program a voltage dwell time of step 2 to 1 s: LIST:DWEL 2,1

Save the list settings to internal memory

Front Panel Menu Reference	SCPI Command
Select Save To File and enter a file name of 2. Press **[Enter]** and press Save.	To save the list to file 2 in the internal memory: LIST:SAVE 2

Specify how many times you want the list to repeat

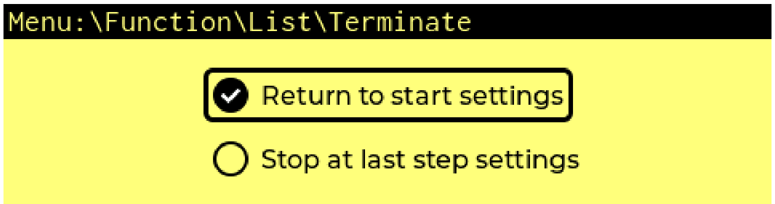
You can specify how many times you want the list (or pulse) to repeat. At reset, the list count is set to 1 repetition. Sending the INFinity parameter in the SCPI command makes the list repeat indefinitely.



Front Panel Menu Reference	SCPI Command
Select **Function\List\Repeat**. Enter the number of list repetitions (2) and press Select. Enable the Run continuously checkbox to repeat the list continuously.	To program the list to repeat twice: LIST:COUN 2 To program the list to run continuously: LIST:COUN INF

Specify how you want the list to end

Specify the output state after the list has completed. There are two choices: the output returns to the value that was in effect before the list started, or the output remains at the value of the last list step.



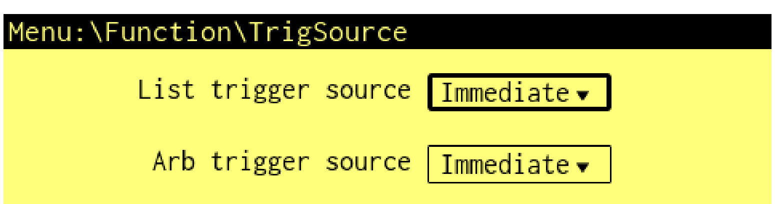
Front Panel Menu Reference	SCPI Command
Select **Function\List\Terminate**. Select either Return to start settings, or Stop at last step settings. Then, press [Enter].	To return the output to the pre-list state: LIST:TERM:LAST OFF To keep the output at the end list state: LIST:TERM:LAST ON

Enables or disables the trigger output

Front Panel Menu Reference	SCPI Command
Select **Function\List\Tout**. Select either None or Tout. Then, press [Enter].	To enable trigger output: LIST:TOUT ON To disable trigger output: LIST:TOUT OFF

Select the trigger source for list

NOTE A TRIGger:LIST[:IMMediate] command over the bus will always generate an immediate measurement trigger, regardless of the selected trigger source.



Unless you are using the front panel menu or a TRIGger:LIST[:IMMediate] to trigger the list, select a trigger source from the following:

Trigger Source	Description
Bus	Selects a remote interface trigger command (*TRG).
External	Selects ANY pins that have been configured as Trigger Inputs on the digital control port.
Immediate	Generates a trigger as soon as the trigger system is INITiated.

Use the following commands to select a trigger source:

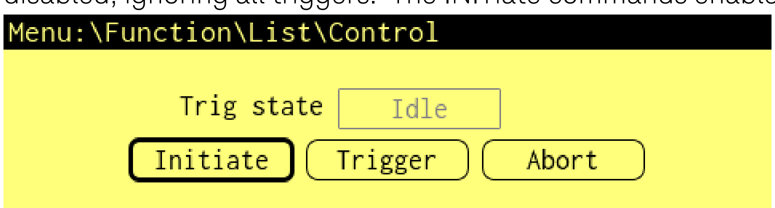
Front Panel Menu Reference	SCPI Command
Select **Function\TrigSource**. Go to List trigger source and select either Immediate, Bus, or External. Then, press [Enter].	To select Bus triggers: TRIG:LIST:SOUR BUS To select any digital pins configured as Trigger Input as trigger sources:TRIG:LIST:SOUR EXT To select immediate trigger: TRIG:LISG:SOUR IMM

Initiate and Trigger the List

NOTE When List is initiated, all the List properties cannot be configured, which includes adding or removing step from the list.

Initiate the list

When the unit is turned on, the trigger system is in the idle state. In this state, the trigger system is disabled, ignoring all triggers. The INITiate commands enable the trigger system to receive triggers.



Front Panel Menu Reference	SCPI Command
Select **Function\List\Control**. Scroll to Initiate. Then press **[Enter]**.	To initiate the list trigger system: INIT:LIST

Trigger the list

The trigger system is waiting for a trigger signal in the initiated state. You can immediately trigger the list as follows:

Front Panel Menu Reference	SCPI Command
Select **Function\List\Control**. Select Trigger to generate an immediate trigger signal regardless of the trigger source setting.	To generate a list trigger: TRIG:LIST Alternatively, if the trigger source is BUS, you can also program a *TRG command.

When a trigger is received, the triggered functions are set to their programmed trigger values. When the triggered actions are completed, the trigger system returns to the idle state.

Front Panel Menu Reference	SCPI Command
Select **Function\List\Control**. The Trig state field indicates "Idle".	To query the TRAN-active bit (bit 6): STAT:OPER:COND?

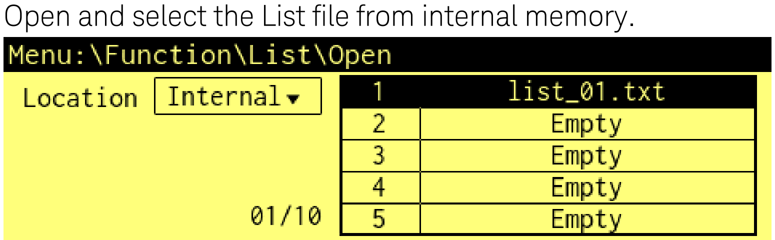
Abort the list trigger

Front Panel Menu Reference	SCPI Command
Select **Function\List\Control**. Then select the Abort control.	ABOR:LIST

Export the list data

After you have configured the list, you can use **Export** to save the list data from internal memory to external USB drive. The exported data is in .csv format. The file name accepts numerical value only.

1. Connect an external USB drive to the front panel USB port before exporting the data.
2. Open and select the List file from internal memory.



Front Panel Menu Reference	SCPI Command
Select **Function\List\Open**. Select Location **Internal** to open and select a List file. Use the navigation keys to navigate through the list and press **Enter** once you have selected the file. Press **[Back]** to return to the previous menu.	Open file 1 from internal memory: LIST:REC 1

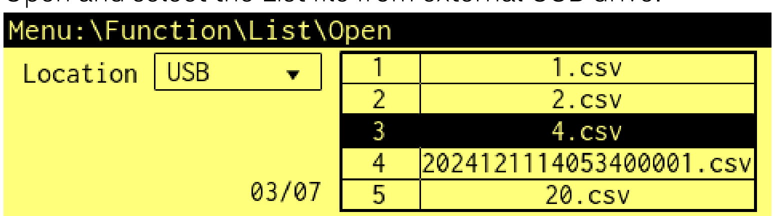
3. After you have open the file, you may continue to export the list data to the external USB drive.

Front Panel Menu Reference	SCPI Command
Select **Function\List\Export**. Press **Enter** and specify the file name using the numeric keys. Press **Enter**to export the data to the specified file.	Not applicable

Import the list data

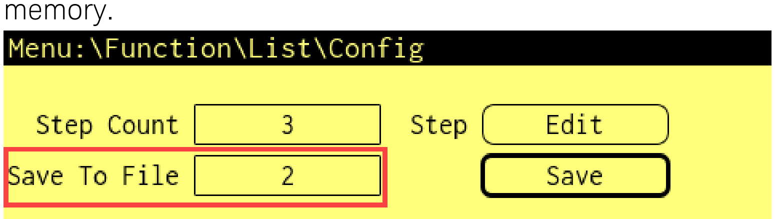
You can import the list from external USB drive to internal memory . The imported data must be in .csv format. Please refer to the exported list file (.csv) template and adjust the editing to align with the list template.

1. Connect an external USB drive to the front panel USB port before importing the data.
2. Open and select the List file from external USB drive.



Front Panel Menu Reference	SCPI Command
Select **Function\List\Open**. Select **USB** to open and select a .csv file. Use the navigation keys to navigate through the list and press **Enter** once you have selected the file. Press **[Back]** to return to the previous menu.	Not applicable

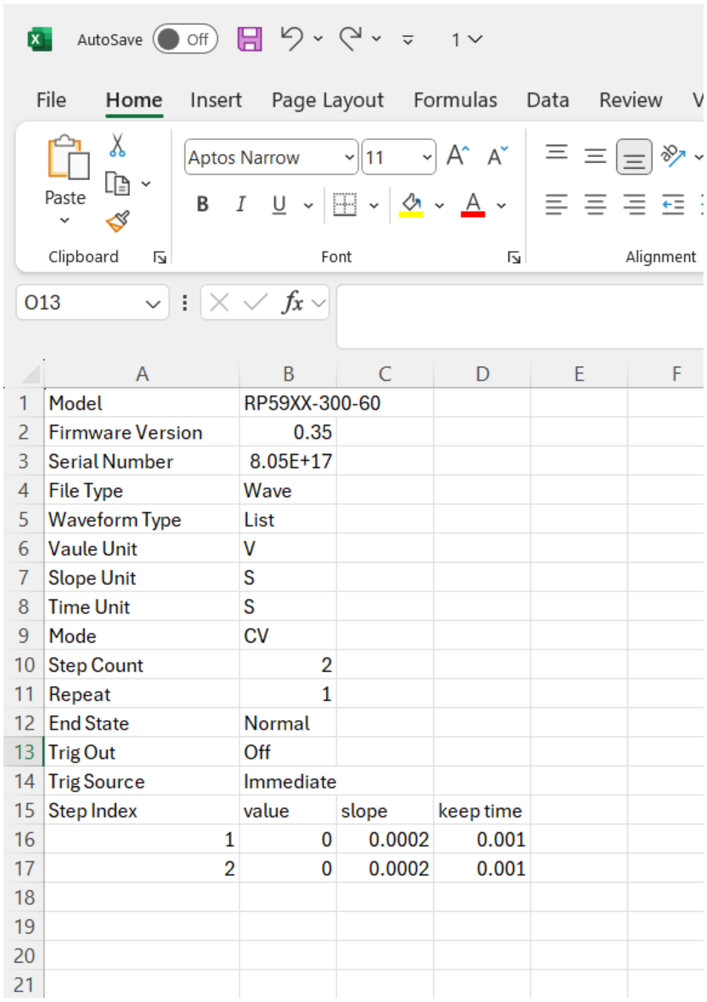
3. After you have open the file, you may continue to edit and import the list data to the internal memory.



Front Panel Menu Reference	SCPI Command
Select **Function\List\Config**. Select Save To File and use the numeric keys to specify the file name. Press **[Save]** to import the file data.	Save to file 2: LIST:SAVE 2

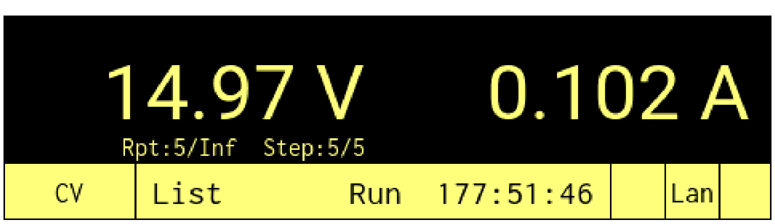
List template

Use the list template to create your own list before importing it to the instrument.



	A	B	C	D
1	Model	RP59XX-300-60		
2	Firmware Version	0.35		
3	Serial Number	8.05E+17		
4	File Type	Wave		
5	Waveform Type	List		
6	Vaule Unit	V		
7	Slope Unit	S		
8	Time Unit	S		
9	Mode	CV		
10	Step Count	2		
11	Repeat	1		
12	End State	Normal		
13	Trig Out	Off		
14	Trig Source	Immediate		
15	Step Index	value	slope	keep time
16	1	0	0.0002	0.001
17	2	0	0.0002	0.001

Meter view when List is running



Using the Data Logger Function

NOTE Before using the data log function, ensure to connect the USB drive to the front panel USB port and set the USB setting to Host so that the recorded data can be stored on the external USB drive.

The Data Logger allows you to log data during measurement acquisition period. You can configure the datalogger to log voltage data, current data or both voltage and current data.

Once data logging completes, the data is automatically stored in the external USB drive in .csv file format.

The data logging start date and time is appended to the file name using the format:

_YYYYMMDD_HHMMSS

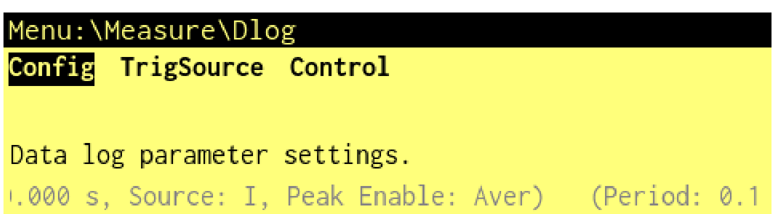
Example of a data log file name is Dlog_20241211_102542.

Configuring the data logger consists of:

- Select the measurement functions.
- Specifying the measurement sampling period.
- Specifying the data logging duration
- Selecting the trigger source.
- Triggering the data logger.
- Retrieving the data log measurement.

Data logger settings

Press [Menu] > Measure > Dlog to access the Dlog window. Use the navigation keys to scroll through each of the settings. Press [Back] to exit.

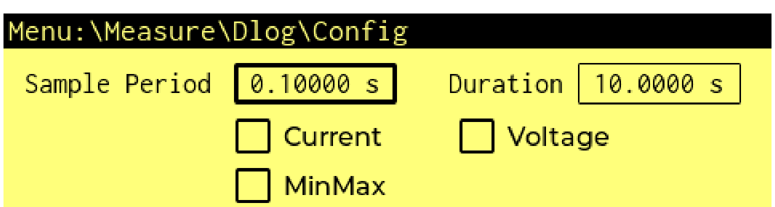


Settings	Available Settings	Description
Config	Sample Period	Configures the interval between data samples in seconds. Default is 0.1 s Range: 0.0001 s to 4000 s
	Duration	Configures the duration of the data log in seconds. Default is 10 s Range: 0 s to 9999999 s

Settings	Available Settings	Description
	Current	Enable the Current checkbox to log the average current data. Default is OFF
	Voltage	Enable the Voltage checkbox to log the average voltage data. Default is ON
	MinMax	Enable the MinMax checkbox to log the average value, maximum value and minimum value of acquired data. Default is OFF
TrigSource	Immediate, Bus, Voltage, Current, or External	Specifies the datalog trigger source. Default is Immediate Action required: Use the navigation keys or knob to select Immediate, Bus, Voltage, Current, or External. then press **[Enter]**. **Bus** — Selects a remote interface trigger command (*TRG). **Current** — Selects an output trigger slope, current level, upper level and lower level. **External** — Selects ANY pins that have been configured as Trigger Inputs on the digital control port. **Voltage** — Selects an output trigger slope, voltage level, upper level and lower level. **Immediate** — Generates a trigger as soon as the trigger system is INITiated.
Control	Initiate	Initiate the list trigger system.
	Trigger	Generate an immediate trigger signal regardless of the trigger source setting.
	Abort	Abort the list trigger system.

Step 1. Program the data logger

Press **[Menu]** > **Measure** > **Dlog** > **Config** to access the Data Logger Configuration window.



Specify the sample period

The sample period can be set from a minimum of 100 microseconds to a maximum of 4000 seconds. The sample period has to be in integral of 100 microseconds.

Front Panel Menu Reference	SCPI Command
Select the Sample Period and enter a value of 0.05 s. Press [Enter].	To program integration period to 0.05 s: SENS:DLOG:PER 0.05

During the integration period, Dlog samples are averaged, and the minimum and maximum values are tracked. Although the absolute minimum integration period is 100 microseconds, the actual minimum depends on the number of measurements that are being logged. The formula is 100_microseconds X #_of_measurements.

For example:

100 microseconds: 1 measurement (voltage or current)

200 microseconds: 2 measurements (voltage and current)

400 microseconds: 4 measurements (voltage+min+max+current)

If the specified integration period is at or near the minimum logging intervals, the data format must be specified as binary. If the REAL format is not specified, the data will be in ASCII format and the minimum logging intervals will typically be up to five times longer than what can be achieved with binary format.

Front Panel Menu Reference	SCPI Command
Not available	To set the data format to REAL: FORM[:DATA] REAL

Specify the duration

The data logger duration can be set from 1 s to 9999999 s.

Front Panel Menu Reference	SCPI Command
Select the Duration and enter a value of 30 s. Press [Enter].	To program datalog duration to 30 s: SENS:DLOG:TIME 30

Select a measurement function

The datalog allows you to log voltage, current, and minmax measurements.

Voltage – enables voltage data logging

Current – enables current data logging

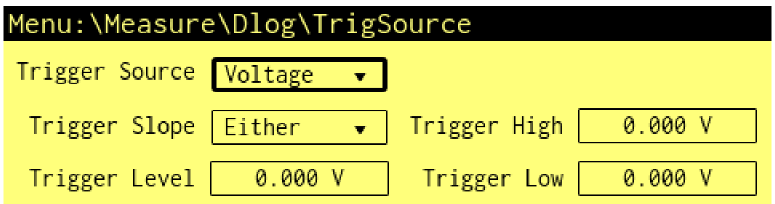
MinMax – When enabled, lets you log the minimum and maximum values of each sample to the data log file.

NOTE Ensure a measurement is enabled before running the data logger. Initiating the data logger without enabling a measurement will cause it to fail.

Front Panel Menu Reference	SCPI Command
Check the Voltage box. Check the Current and Voltage box. Check the MinMax box.	To enable voltage data logging: SENS:DLOG:VOLT ON To enable voltage and current data logging: SENS:DLOG:VOLT ON SENSE:DLOG:CURR ON To enable min/max measurements: SENS:DLOG:FUNC:MINM ON

Step 2. Select the trigger source for datalogger

NOTE A TRIGger:DLOG[:IMMediate] command over the bus will always generate an immediate measurement trigger, regardless of the selected trigger source.



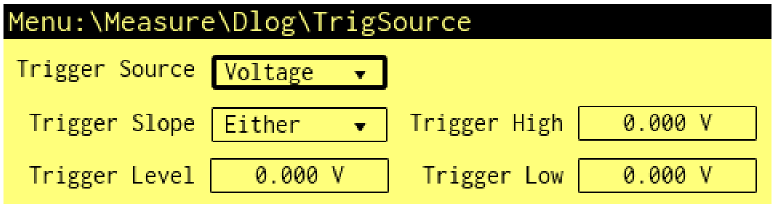
Unless you are using TRIGger:DLOG[:IMMediate], select a trigger source from the following:

Trigger Source	Description
Bus	Selects a remote interface trigger command (*TRG).
Voltage	Selects the output voltage level
Current	Selects the output current level
External	Selects ANY pins that have been configured as Trigger Inputs on the digital control port.
Immediate	Generates a trigger as soon as the trigger system is INITiated.

Use the following commands to select a trigger source:

Front Panel Menu Reference	SCPI Command
Select **Measure\Dlog\TrigSource**. Select either Immediate, Bus, Voltage, Current, or External. Then, press [Enter]. When either Current or Voltage is selected, set the trigger slope, trigger level, high threshold and low threshold accordingly. See Specify the voltage or current trigger.	To select Bus triggers: TRIG:DLOG:SOUR BUS To select voltage level as acquisition trigger: TRIG:DLOG:SOUR VOLT To select any digital pins configured as Trigger Input as trigger sources:TRIG:DLOG:SOUR EXT

Specify the voltage or current trigger level



When either Voltage or Current is selected, you can specify the trigger level from the followings:

Voltage/Current Trigger Level	Description
Trigger Slope	Specifies the trigger slope of the datalog. Selects Either, Positive, or Negative. Default is Either. Action required: Use the navigation keys to select between Either, Positive, and Negative. **Either** – Triggering occurs on either the rising or the falling edge of the signal. **Positive** – Triggering occurs on the rising edge of the signal, from a low to a high level. **Negative** – Triggering occurs on the falling edge of the signal, from a high to a low level.
Trigger Level	Specifies the trigger level.
Trigger High	Specifies the upper limit trigger value.
Trigger Low	Specifies the lower limit trigger value.

Front Panel Menu Reference	SCPI Command
Select **Measure\Dlog\TrigSource**. Select Voltage. Select positive trigger slope as trigger level. Use the navigation keys to select Positive trigger slope. For trigger level, go to Trigger Level and set the trigger level to 5 V. press [Enter].	To select positive trigger slope: TRIG:DLOG:VOLT:SLOP POS To set voltage trigger level of 5 V: TRIG:DLOG:VOLT 5
Select **Measure\Dlog\TrigSource**. Select Current. Select upper limit as trigger level. Select Trigger High and enter a value of 7 A. Press [Enter]. Select lower limit as trigger level. Select Trigger Low and enter a value of 4 A. Press [Enter].	To set the current upper limit of 7 A as trigger level: TRIG:DLOG:CURR:HYST:HIGH 7 To set the current lower limit of 4 A as trigger level: TRIG:DLOG:CURR:HYST:LOW 4

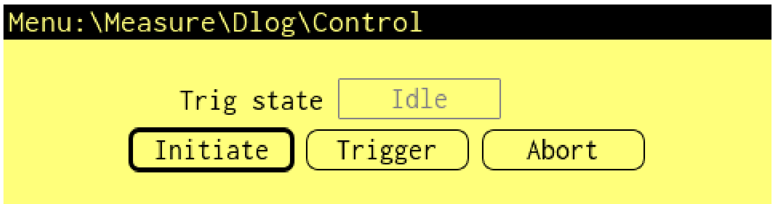
Refer to Voltage trigger example for details on how a valid voltage trigger is determined.

Step 3. Initiate and trigger the data log

NOTE After the last datalog completes, wait for 5 seconds before continuing with another session of data logging.

Initiate the data log

When the unit is turned on, the trigger system is in the idle state. In this state, the trigger system is disabled, ignoring all triggers. The INITiate commands enable the trigger system to receive triggers.



Front Panel Menu Reference	SCPI Command
Select **Measure\Dlog\Control**. Select Initiate. Then press **[Enter]**.	To initiate the data log trigger system: INIT:DLOG

Trigger the data Log

The trigger system is waiting for a trigger signal in the initiated state. You can immediately trigger the list as follows:

Front Panel Menu Reference	SCPI Command
Select **Measure\DLog\Control**. Select Trigger to generate an immediate trigger signal regardless of the trigger source setting.	To generate a data log trigger: TRIG:DLOG Alternatively, if the trigger source is BUS, you can also program a *TRG command.

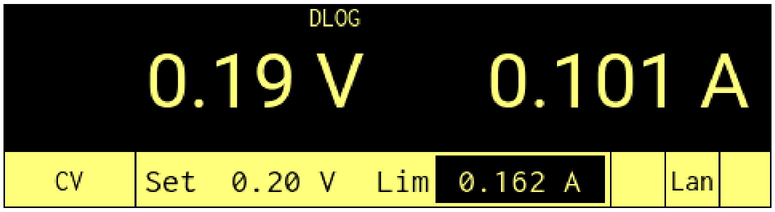
When a trigger is received, the triggered functions are set to their programmed trigger values. When the triggered actions are completed, the trigger system returns to the idle state.

Front Panel Menu Reference	SCPI Command
Select **Measure\Dlog\Control**. The Trig state field indicates "Idle".	To query the TRAN-active bit (bit 6): STAT:OPER:COND?

Abort the data log trigger

Front Panel Menu Reference	SCPI Command
Select **Measure\Dlog\Control**. Then select the Abort control.	ABOR:DLOG

Meter View when Data Logger is Running



Using the External Data Logger Function

NOTE **The external data logging function can only be programmed using SCPI commands.**

In addition to the built-in data logger, the RPS has an external data logger (Elog) function that lets you continuously log voltage and current measurements from the output directly to an internal FIFO- (first-in, first-out) buffer. Data logging is external to the instrument because it can only be implemented using SCPI commands. Note that this buffer is only large enough to hold about 20 seconds of accumulated measurements. This means that you must periodically empty the internal buffer to an external storage device; otherwise the data in the buffer will be overwritten

The following table details the various data logging functions.

Function	Description
Data Storage	Buffers measurements for about 20 seconds and requires that the computer periodically reads measurements to prevent the internal buffer from overflowing. The computer needs to provide the external data storage.
Measurement Function	Both output voltage and output current can be logged.
Integration Period	During the specified integration period, the samples are averaged, and min and max values are tracked.
Data Viewing	No front panel view or control. Data is collected and viewed externally.

Programming the external data logger consists of:

- Select the measurement functions.
- Specifying the measurement sampling period.
- Specifying the data logging duration
- Selecting the trigger source.
- Triggering the data logger.
- Retrieving the data log measurement.

The external data logger function cannot be programmed from the front panel.

Select a measurement function

The Elog allows you to log voltage, current, and minmax measurements.

Voltage – enables voltage data logging

Current – enables current data logging

MinMax – When enabled, lets you log the minimum and maximum values of each sample to the data log file.

Front Panel Menu Reference	SCPI Command
Not available	To enable voltage data logging: SENS:ELOG:FUNC:VOLT ON To enable voltage and current data logging: SENS:ELOG:FUNC:VOLT ON SENSE:ELOG:FUNC:CURR ON To enable min/max measurements: SENS:ELOG:FUNC:MINM ON

Specify the integration period

The integration period can be set from a minimum of 100 microseconds to a maximum of 4000 seconds. The sample period has to be in integral of 100 microseconds.

Front Panel Menu Reference	SCPI Command
Not available	To program sample period to 0.05 s: SENS:ELOG:PER 0.05

During the integration period, Elog samples are averaged, and the minimum and maximum values are tracked. At the end of each integration period, the average, minimum, and maximum values are added to the internal FIFO buffer.

Although the absolute minimum integration period is 100 microseconds, the actual minimum depends on the number of measurements that are being logged. The formula is 102.4_microseconds X #_of_ measurements.

For example:

100 microseconds: 1 measurement (voltage or current)

200 microseconds: 2 measurements (voltage and current)

400 microseconds: 4 measurements (voltage+min+max+current)

If the specified integration period is at or near the minimum logging intervals, the data format must be specified as binary. If the REAL format is not specified, the data will be in ASCII format and the minimum logging intervals will typically be up to five times longer than what can be achieved with binary format.

Front Panel Menu Reference	SCPI Command
Not available	To set the data format to REAL: FORM REAL

Specify the duration

The data logger duration can be set from 1 s to 9999999 s.

Front Panel Menu Reference	SCPI Command
Not available	To program datalog duration to 30 s: SENS:ELOG:TIME 30

Select the trigger source for Elog

NOTE A TRIGger:ELOG[:IMMediate] command over the bus will always generate an immediate measurement trigger, regardless of the selected trigger source.

Unless you are using TRIGger:DLOG[:IMMediate], select a trigger source from the following:

Trigger Source	Description
Bus	Selects a remote interface trigger command (*TRG).
Voltage	Selects the output voltage level
Current	Selects the output current level
External	Selects ANY pins that have been configured as Trigger Inputs on the digital control port.
Immediate	Generates a trigger as soon as the trigger system is INITiated.

Use the following commands to select a trigger source:

Front Panel Menu Reference	SCPI Command
Not available	To select Bus triggers: TRIG:ELOG:SOUR BUS To select voltage level as acquisition trigger: TRIG:ELOG:SOUR VOLT To select any digital pins configured as Trigger Input as trigger sources:TRIG:ELOG:SOUR EXT

When either Current or Voltage is selected, set the trigger slope, trigger level, high threshold and low threshold accordingly. See Specify the voltage or current trigger.

Specify the voltage or current trigger level

When either Voltage or Current is selected, you can specify the trigger level from the followings:

<table>
<tr><th>Voltage/Current Trigger Level</th><th>Description</th></tr>
<tr><td>Trigger Slope</td><td>Specifies the trigger slope of the datalog. Selects Either, Positive, or Negative. Default is Either.

Action required:
Use the navigation keys to select between Either, Positive, and Negative.
<table><tr><td>Either</td><td>Triggering occurs on either the rising or the falling edge of the signal.</td></tr><tr><td>Positive</td><td>Triggering occurs on the rising edge of the signal, from a low to a high level.</td></tr><tr><td>Negative</td><td>Triggering occurs on the falling edge of the signal, from a high to a low level.</td></tr></table></td></tr>
<tr><td>Trigger Level</td><td>Specifies the trigger level</td></tr>
<tr><td>High Threshold</td><td>Specifies the upper limit trigger value</td></tr>
<tr><td>Low Threshold</td><td>Specifies the lower limit trigger value</td></tr>
</table>

<table>
<tr><th>Front Panel Menu Reference</th><th>SCPI Command</th></tr>
<tr><td>Not available</td><td>To select positive trigger slope:
TRIG:ELOG:VOLT:SLOP POS

To set voltage trigger level of 5 V:
TRIG:ELOG:VOLT 5

To set the current upper limit of 7 A as trigger level:
TRIG:ELOG:CURR:HYST:HIGH 7</td></tr>
</table>

Initiate and trigger the Elog

When the unit is turned on, the trigger system is in the idle state. In this state, the trigger system is disabled, ignoring all triggers. The INITiate commands enable the trigger system to receive triggers.

To initiate and trigger Elog:

Front Panel Menu Reference	SCPI Command
Not available	To initiate the Elog: INIT:ELOG To trigger the Elog: TRIG:ELOG Alternatively, if the trigger source is BUS, you can also program a *TRG or an IEEE-488 <get> command.

Periodically Retrieve the Data

Each FETCh command returns number of requested records of the data in the buffer and removes them, making room available for more data. The Elog continues until it is aborted.

An Elog record is one set of voltage and current readings for one time interval. The exact format of a record depends on which functions have been enabled for Elog sensing. If all functions are enabled, then one record will contain the following data in the specified order:

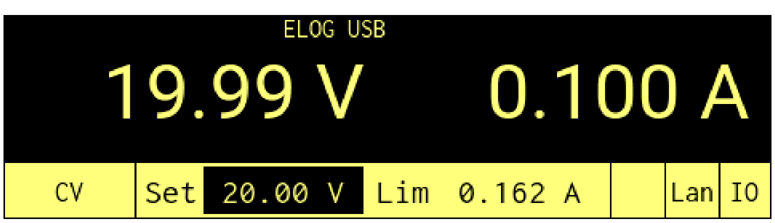
Current average
Current minimum
Current maximum
Voltage average
Voltage minimum
Voltage maximum

Front Panel Menu Reference	SCPI Command
Not available	To retrieve a maximum of 1000 records: FETC:ELOG? 1000

Terminate the Elog

Front Panel Menu Reference	SCPI Command
Not available	To abort the Elog: ABOR:ELOG

Meter View when External Data Logger is Running



Using the Battery Function

The battery function allows you to carry out charging and discharging operations, making it ideal for testing all types of portable batteries.

The RPS models support up to 10 battery test files. The configured test file will be stored to internal memory.

WARNING When connecting the DUT (battery/capacitor), do not short-circuit the battery/capacitor.

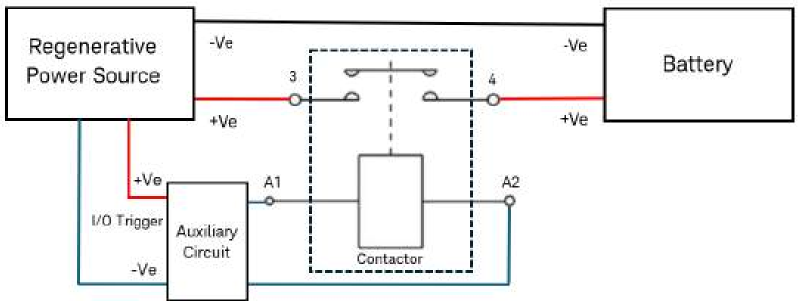
Ne court-circuitez jamais la batterie/le condensateur lors de la connexion du DUT (batterie/condensateur).

SHOCK HAZARD
Always turn off the power switch before removing connections from the power cord or output terminals.

RISQUE D’ÉLECTROCUTION
Mettez toujours l’interrupteur d’alimentation hors tension avant de débrancher le cordon d’alimentation ou de désactiver les bornes de sortie.

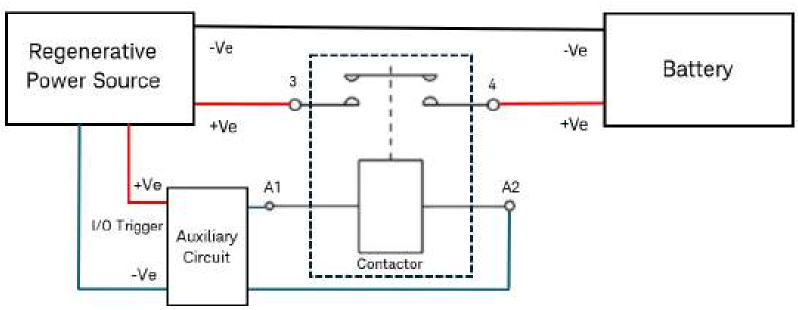
CONNECTION TO AN ENERGIZED SUPPLY (e.g., Battery), SPARKS MAY OCCUR

During connection, it is recommended to use a safety-certified (for example, UL, CSA and etc) contactor to isolate the energized supply (e.g., battery) from the RPS, as illustrated below. Ensure the contactor has the correct voltage and current rating that is higher than the rated RPS voltage and current. Failing to do so may cause injury and equipment damage. For more details, see Contactor Installation.



CONNEXION À UNE SOURCE SOUS TENSION (ex. batterie), RISQUE D'ÉTINCELLES

Lors de la connexion, il est recommandé d'utiliser un contacteur certifié (UL, CSA, etc.) pour isoler la source sous tension (ex. batterie) du RPS, comme indiqué dans le schéma ci-dessous. Vérifiez que le contacteur supporte une tension et un courant supérieurs aux valeurs nominales du RPS. Le non-respect de cette consigne peut entraîner des blessures graves et risque d'endommager l'appareil. Pour plus de détails, consultez la section Installation du contacteur.



Before performing the battery test, you need to connect the Sense cables to both ends of the battery. If the Sense cables are not connected, the instrument cannot detect the Sense voltage and prompt "Wait Sense Link", which will prevent the battery test from continuing.

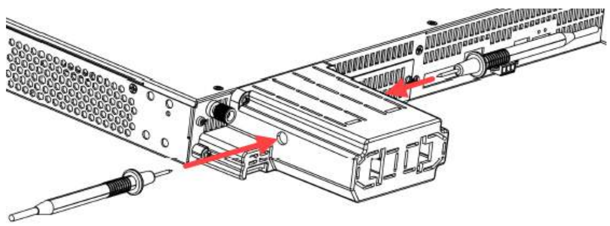
Avant de lancer un test de batterie, assurez-vous que les câbles de détection sont correctement reliés aux deux bornes de la batterie. Sans cette connexion, l'appareil ne pourra pas détecter la tension, affichera le message « Wait Sense Link » (En attente de la liaison du capteur) et interrompra automatiquement le test.

HAZARDOUS VOLTAGE PRESENT

After turning off the unit, allow time for self-discharge and ensure the capacitors discharge to a safe voltage before handling any components connected to the output terminal, as they may retain a hazardous charge.

Never touch cables or connections immediately after turning off the unit. Depending on use case, such as when connected to an energized supply (e.g., battery), hazardous voltages can remain at the output terminals after turning off the unit. Verify that there is no dangerous voltage on the output or sense terminals before touching them. To disconnect an energized supply, follow the recommended verification procedures as shown below:

1. Use a multimeter to observe the voltage. Probe the output terminals from both sides of the safety cover as shown below.

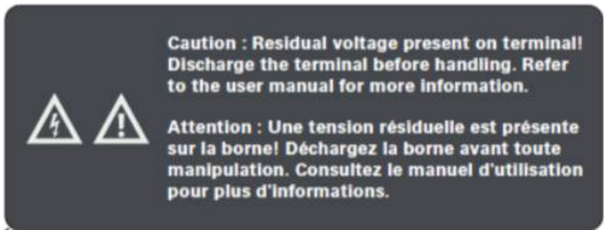


NOTE: For the 80 V unit, the safety cover does not have the probe holes. Wear electrical safety gloves to remove the safety cover and use a multimeter to measure the voltage at the output terminals.

NOTE Ensure the multimeter and measurement probe used have the correct voltage rating to avoid shock hazards.

2. If there is no voltage remaining at the output terminals, proceed with step 7. If voltage remains at the output terminals, proceed with step 3 to 7.
3. Turn on the unit. Press **[Menu]** > **System** > **Emulation** and select **Load**. This action will switch the RPS to Load mode (CC mode by default).
4. Press **[Current]** and set the current to 1 A.
5. Press **[On/Off]** to turn on the output.
6. Use a multimeter to observe the voltage on the output terminals. The voltage will drop to 0 V in approximately two seconds.
7. Disconnect the energized supply from the output terminals.

NOTE Always use electrical safety gloves before disconnecting any energized supply (e.g., battery) from the output terminals.

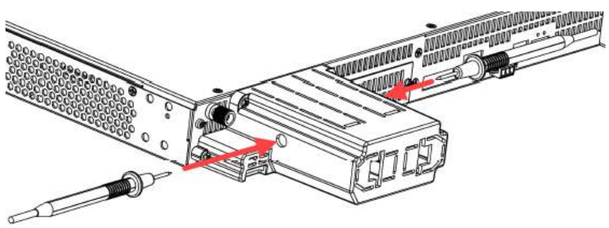


TENSION DANGEREUSE PRÉSENTE

Après avoir éteint l’unité, attendez que les condensateurs se déchargent complètement avant de manipuler les composants connectés aux bornes de sortie, car ils peuvent conserver une charge dangereuse.

Ne touchez jamais les câbles ou les connexions immédiatement après avoir mis l’appareil hors tension. Dans certains cas, par exemple si l’appareil est relié à une source sous tension (batterie, etc.), des tensions dangereuses peuvent subsister sur les bornes de sortie même après la mise hors tension de l’unité. Vérifiez qu’il n’y ait pas de tension dangereuse sur les bornes de sortie ou de détection avant de les toucher. Pour déconnecter une source sous tension, suivez les procédures ci-dessous :

1. Utilisez un multimètre pour mesurer la tension. Testez les bornes de sortie des deux côtés du capot de protection comme indiqué ci-dessous.



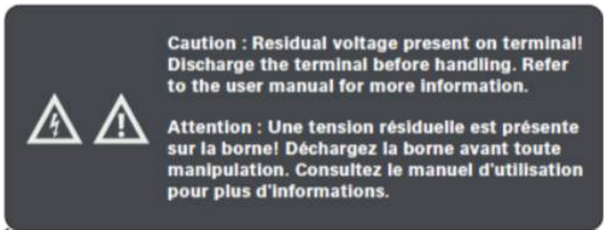
REMARQUE : Sur le module 80 V, le capot de protection ne comporte pas de trous pour la sonde. Portez des gants isolants pour retirer le capot et utilisez un multimètre pour mesurer la tension aux bornes de sortie.

NOTE Vérifiez que le multimètre et la sonde supportent la tension maximale afin d’éviter tout risque d’électrocution.

2. Si aucune tension n’est détectée aux bornes de sortie, passez directement à l’étape 7. Si une tension subsiste aux bornes de sortie, procédez aux étapes 3 à 7.
3. Mettez l’instrument sous tension. Appuyez sur **[Menu]** > **System** (Système) > **Emulation** (Émulation) et sélectionnez **Load** (Charge). Le RPS passe alors en mode Charge (mode CC par défaut).
4. Appuyez sur **[Current]** (Courant) et réglez le courant sur 1 A.
5. Appuyez sur **[On/Off]** pour activer la sortie.
6. Utilisez un multimètre pour mesurer la tension aux bornes de sortie. La tension retombera à 0 V en 2 secondes environ.

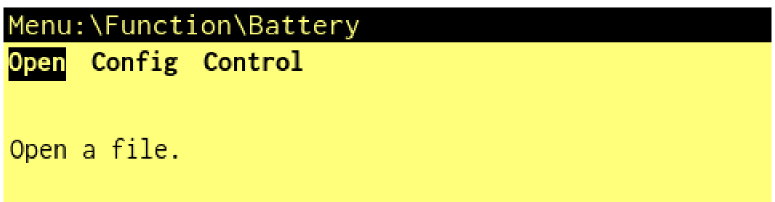
7. Déconnectez la source sous tension des bornes de sortie.

NOTE Portez toujours des gants isolants avant de déconnecter toute source sous tension (comme la batterie) des bornes de sortie.



Battery settings

Press [Menu] > Function > Battery to access the Battery window. Use the navigation keys to scroll through each of the settings. Press [Back] to exit.



Source mode

Settings		Available Settings	Description
Open			Opens the battery test setting file from in internal memory.
Config			Configure the battery test settings
	Mode	Charge, or Discharge	Specifies the operation mode. Default is Charge Action required: Use the navigation keys to toggle between Charge or Discharge. **Charge** — Battery charging operation **Discharge** — Battery discharging operation
	Voltage	0 to V_{max}	Configures the voltage for charging or discharging. Mode dependent. Default is 0.2 V
	Current	Charge mode: 0 to I_{max} Discharge mode: I_{min} to 0	Configures the current for charging or discharging. Mode dependent. Default is I_{max}/100 (Charge mode), I_{min}/100 (Discharge mode) Action required: Press **Edit** to configure the output value, slew rate and dwell time for each step. NOTE: The output value is dependent on the specified operation mode.

Settings		Available Settings	Description
	Cut Off Time	0 to 999999 s	Configure the cutoff time. Check the checkbox to enable the cut-off time. Default is OFF, 60 s
	Cut Off Voltage	0 to V_{max}	Specify the cutoff voltage level. Check the checkbox to enable the cut-off voltage. Default is OFF, 0.2 V
	Cut Off Current	0 to I_{max}	Specify the cutoff current level. Check the checkbox to enable the cut-off current. Default is OFF, I_{max}/100 (Charge mode), I_{min}/100 (Discharge mode)
	Cut Off Capacity	Charge mode: 0 to 999999 Ah Discharge mode: -999999 to 0 Ah	Specify the cutoff capacity level. Check the checkbox to enable the cut-off capacity. Default is OFF, 1 (Charge mode), -1 (Discharge mode)
	Save to File	1 to 10	Save the battery test settings to internal memory. Specifies the file name. Example, when 1 is entered, the saved file name will be battery_01.csv. Action required: Use the numeric key to specify the file location in internal memory. Press **[Enter]**.
	Save		Save the file in internal memory, .csv format.
Control		Run	Run the battery test operation.
		Stop	Stop the battery test operation

Load mode

Settings		Available Settings	Description
Open			Opens the battery discharge test setting file from in internal memory.
Config			Configure the battery discharge test settings
	Cut Off Voltage	0 to V_{max}	Specify the cutoff voltage level. Default is 0 V Check the checkbox to enable the cut-off voltage.
	Cut Off Capacity	0 to 999999 Ah	Specify the cutoff capacity level. Check the checkbox to enable the cut-off capacity. Default is OFF, 999999 Ah
	Cut Off Time	0 to 999999 s	Configure the cutoff time. Check the checkbox to enable the cut-off time. Default is OFF, 999999 s
	Discharge Current	0 to I_{max}	Configure the discharge current. Default is 0.1 A

Settings		Available Settings	Description
	Save to File	1 to 10	Save the battery discharge test settings to internal memory. Specifies the filename. Example, when 1 is entered, the saved file name will be load_battery_01.txt Action required: Use the numeric key to specify the file location in internal memory. Press **[Enter]**.
	Save		Save the file in internal memory, .txt format.
Control		Run	Run the battery discharge test operation.
		Stop	Stop the battery discharge test operation

In Source mode, the RPS supports battery discharge test in constant current mode and constant power modes.

Constant current mode:

1. Press **[Menu]** > **Mode** > **Current Priority**
2. Press **[Menu]** > **[Voltage]** to set the upper and lower limit voltage
3. Press **[Menu]** > **[Power]** to set the upper and lower limit power.
4. Then, configure the Battery settings accordingly. See Configure battery test.

Constant power mode:

1. Press **[Menu]** > **[Power]** to set the upper and lower limit power
2. Go to **[Menu]** > **Function** > **Battery** > **Config**.
3. Set to Discharge mode and specify the value for Voltage and Current. See Configure battery test.

Battery file name

The battery file name is set according to battery_XX, where XX represents the Save To File location (which can be set from 1 to 10).

For example, when the Save to File location is 2, the battery file is named battery_02.

Open a saved file

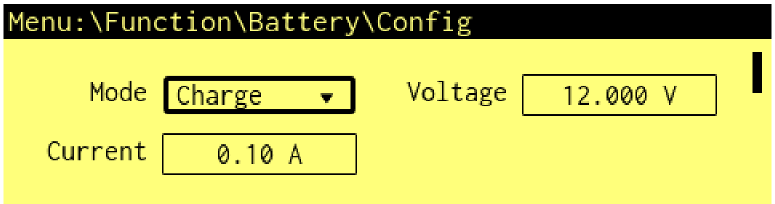
Select a saved file from the internal memory in order to run the battery test.

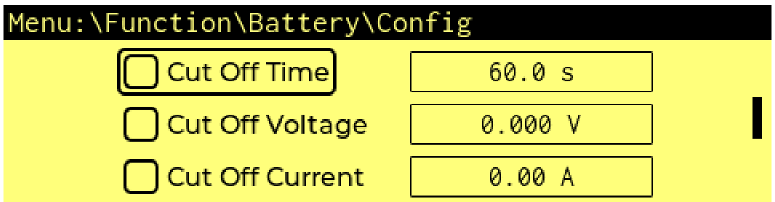
Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Battery\Open**. Select **Internal** to open and select a battery test file. Use the navigation keys to navigate through the list and press **Enter** once you have selected the file. Press **[Back]** to return to the previous menu.	To open the battery test file 2 in the internal memory: BATT:REC 2

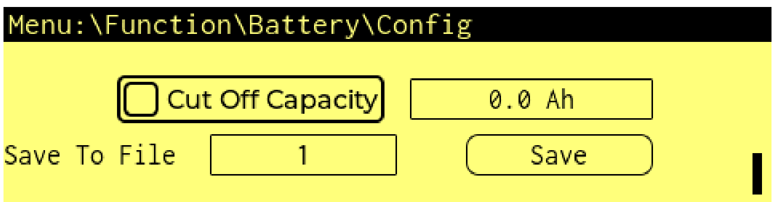
Configure the battery test

Source mode

Press **Config** to configure the battery charge or discharge profile.

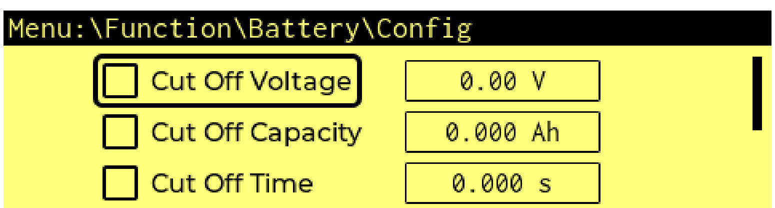


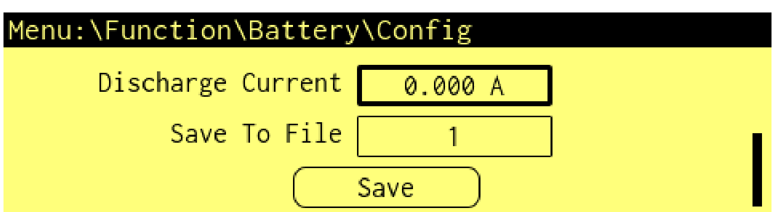




Load mode

Press **Config** to configure the battery discharge profile.





Specify the battery operation mode

First, you must specify the operation mode.

Front Panel Menu Reference	SCPI Command
Select **Mode**. Press **[Enter]** and use the navigation keys to select Charge or Discharge.	To set mode to Charge: BATT:MODE CHAR To set mode to Discharge: BATT:MODE DISC

NOTE When switching between operation mode, the configuration parameter will tie to the selected mode.

Program the voltage

Specifies the voltage level for charging or discharging according to the selected mode.

Use the navigation keys to select the field; use the numeric entry keys to enter the value. The value is set when you press [Enter].

Front Panel Menu Reference	SCPI Command
Charge mode Select **Voltage** and enter a value of 30 V. Press **[Enter]**.	To program battery charge voltage to 30 V: BATT:CHAR:VOLT 30
Discharge mode Select **Voltage** and enter a value of 5 V. Press **[Enter]**.	To program battery discharge voltage to 5 V: BATT:DISC:VOLT 5

Program the current

Specifies the current level for charging or discharging according to the selected mode.

Use the navigation keys to select the field; use the numeric entry keys to enter the value. The value is set when you press [Enter].

Front Panel Menu Reference	SCPI Command
Charge mode Select **Current** and enter a value of 12 A. Press **[Enter]**.	To program battery charge voltage to 12 A: BATT:CHAR:CURR 12
Discharge mode Select **Current** and enter a value of 0.5 A. Press **[Enter]**.	To program battery discharge voltage to 0.5 A: BATT:DISC:CURR 0.5

Specify the cutoff time

Cutoff time in battery testing is the maximum duration allowed for charging or discharging a battery before the test is stopped. This is important to ensure the battery is not overcharged or excessively discharged, which can lead to damage or reduced lifespan.

In a charging test, the cutoff time is set to prevent overcharging. This time is typically determined based on the battery's capacity and the charging current.

In a discharging test, the cutoff time ensures the battery is not discharged beyond its safe limit. This time is also based on the battery's capacity and the discharge current.

Front Panel Menu Reference	SCPI Command
Charge mode Select **Cut Off Time** and enter a value of 60 s. Press **[Enter]**. Check the Cut Off Time box to enable the timer. Discharge mode Select **Cut Off Time** and enter a value of 60 s. Press **[Enter]**. Uncheck the Cut Off Time box to disable the timer.	To program battery charge cutoff time to 60 s: BATT:CUT:TIM 60 To program battery discharge cutoff time to 60 s: BATT:CUT:TIM 60 To enable battery charge cutoff timer: BATT:CUT:TIM:STAT ON To disable battery discharge cutoff timer: BATT:CUT:TIM:STAT OFF

Specify the cutoff voltage

In a charging test, the cutoff voltage is the maximum voltage to which a battery is charged before the charging process is stopped. This is crucial to prevent overcharging, which can damage the battery and reduce its lifespan.

In a discharging test, the cutoff voltage is the minimum voltage at which the battery is considered fully discharged. Discharging below this voltage can damage the battery and reduce its lifespan.

Front Panel Menu Reference	SCPI Command
Charge mode Select **Cut Off Voltage** and enter a value 12 V. Press **[Enter]**. Check the Cut Off Voltage box to enable the cutoff voltage Discharge mode Select **Cut Off Voltage** and enter a value of 0.9 V. Press **[Enter]**. Check the Cut Off Voltage box to disable the cutoff voltage.	To program battery charge cutoff voltage to 12 V: BATT:CUT:VOLT 12 To enable battery charge cutoff voltage: BATT:CUT:VOLT:STAT ON To program battery discharge cut-off voltage to 0.9 V: BATT:CUT:VOLT 0.9 To enable battery discharge cutoff voltage: BATT:CUT:VOLT:STAT ON To disable battery discharge cutoff voltage: BATT:CUT:VOLT:STAT OFF

Specify the cutoff current

Specifies the current level at which the charging or discharging process is terminated. This is crucial for ensuring the battery's safety and longevity.

In a charging test, the cutoff current is the point at which the charging current drops to a small percentage of the initial charging current. When the current drops to this level, the charging process is terminated to prevent overcharging and ensure battery safety.

In a discharging test, the cutoff current is the current level at which the discharging process is stopped to protect the battery.

Front Panel Menu Reference	SCPI Command
Charge mode Select **Cut Off Current** and enter a value 0.05 A. Press **[Enter]**. Check the Cut Off Current box to enable the cutoff current. Discharge mode Select **Cut Off Current** and enter a value of 0.05 A. Press **[Enter]**. Uncheck the Cut Off Current box to disable the cutoff current.	To program battery charge cutoff current to 0.05 A: BATT:CUT:CURR 0.05 To program battery discharge cutoff current to 0.05 A: BATT:CUT:CURR 0.05 To enable battery charge cutoff current: BATT:CUT:CURR:STAT ON To disable battery discharge cutoff current: BATT:CUT:CURR:STAT OFF

Specify the cutoff capacity

Specifies the capacity level at which the charging or discharging process is stopped.

Front Panel Menu Reference	SCPI Command
Charge mode Select **Cut Off Capacity** and enter a value 100 Ah. Press [Enter]. Check the Cut Off Capacity box to enable the cutoff capacity. Discharge mode Select **Cut Off Capacity** and enter a value of 20 Ah. Press **[Enter]**. Uncheck the Cut Off Capacity box to disable the cutoff capacity.	To program battery charge cutoff capacity to 100 Ah: BATT:CUT:CAP 100 To program battery discharge cutoff capacity to 20 Ah: BATT:CUT:CAP 20 To enable battery charge cutoff capacity: BATT:CUT:CAP:STAT ON To disable battery discharge cutoff capacity: BATT:CUT:CAP:STAT OFF>

Specify the discharge current (Load mode only)

Specifies the current drawn from the battery during the battery discharging test.

Use the navigation keys to select the field; use the numeric entry keys to enter the value. The value is set when you press [Enter].

Front Panel Menu Reference	SCPI Command
Select **Discharge Current** and enter a value of 10 A. Press **[Enter]**.	To program discharge current to 10 A: BATT:DISC:CURR 10

Save the battery test settings to internal memory

Front Panel Menu Reference	SCPI Command
Select **Save to File** and enter a file name of 2. Press **[Enter]** and press **Save**. NOTE: You can save up to 10 battery file. The filename must be from 1 to 10.	To save the battery test to file 2 in the internal memory: BATT:SAV 2

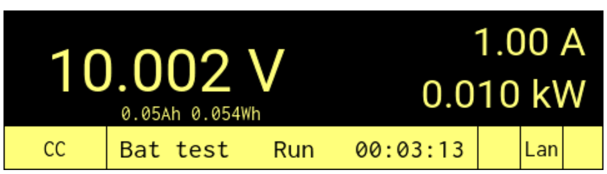
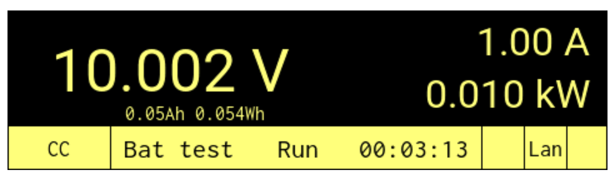
Run or stop the battery test

NOTE The RPS supports sense anti-reverse function. When sense cables are reversed, the Meter will display a negative voltage value and the output cannot be turned on. Ensure the cables are properly connected in order to turn on the output.

Ensure you have turned on the output before running the battery test.

Front Panel Menu Reference	SCPI Command
Select **Function\Battery\Control**. Press **Run** to run the battery test. Press **Stop** to stop the battery test.	To run the battery test: BATT ON To stop the battery test: BATT OFF

Meter view when Battery test is running

Charge mode	Discharge mode
	

Using the Battery Emulator Function Source Mode only

NOTE The Battery Emulator function is only available when the instrument is operating in Source mode.

The battery emulator enables the simulation of battery characteristics in practical applications, based on its unique bidirectional properties and the variable output impedance. You can configure battery-related parameters to simulate the charge and discharge characteristics of the battery to facilitate comprehensive testing.

The emulator provides selections of user-defined battery simulation files or battery simulation curve files for testing purposes.

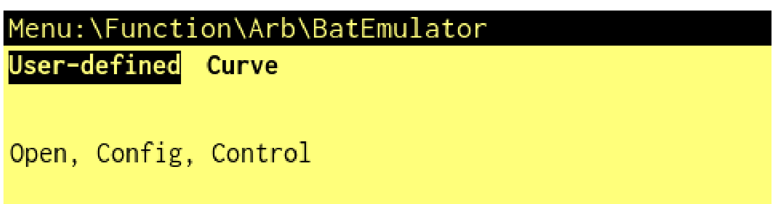
Configuring the battery emulator consists of:

- Editing the battery simulation file
- Import external battery simulation file
- Run the battery simulation file
- Stop or reset the battery simulation file

The instrument support up to 10 battery simulation files. The battery simulation file can either be stored to internal memory or external USB drive, in .csv format.

Battery emulator settings

Press [Menu] > Function > Arb > BatEmulator to access the battery emulator window. Use the navigation keys to scroll through each of the settings. Press [Back] to exit.



Settings		Available Settings	Description
User-defined	Open	Not applicable	Open or select the user-defined file saved in internal memory or external USB drive. **NOTE** To access files from an external USB drive, connect the drive to the front panel USB port and set the USB mode to Host. If no USB drive is connected, the system will default to using Internal storage only.
	Config		Configure the user-defined battery emulator settings

Settings			Available Settings	Description
		Full Voltage	V_{min} to V_{max}	Specify the full voltage value. This simulates the voltage value when the cell battery is fully charged. Default is 5 V
		Empty Voltage	V_{min} to V_{max}	Specify the empty voltage value. This simulates the voltage value when the cell battery is in the empty state. Default is 1 V
		Inner resistance	R_{min} to R_{max}	Specify the inner resistance value. This simulates the internal resistance of a cell battery. Default is 0 Ω
		Capacity	0.01 to 9999.99	Set the capacity of a cell battery. Default is 1 Ah
		Parallel	1 to 1000	Set the number of parallel-connected batteries. Default is 1
		Serial	1 to 1000	Set the number of series-connected batteries. Default is 1
		+ Current Limit	0 to I_{max}	Set the positive current limit value, which simulates the maximum discharge current of the battery pack. Default is I_{max}
		– Current Limit	I_{min} to 0	Set the negative current limit value, which simulates the minimum discharge current of the battery pack. Default is I_{min}
		Initial Setting	SOC, VOC, or CAP	Specifies the initial setting to SOC, VOC or CAP. Default is SOC
		Initial SOC Initial VOC Initial CAP	0 to 100 V_{min} to V_{max} 0.01 to 9999.99	Set the specified initial setting value. Initial setting dependent. Default is Initial SOC **Initial SOC**: Set the initial state of charge (SOC), of the battery. Default is 50 %. **Initial VOC**: Set the open-circuit voltage of the battery. Default is 3 V. **Initial CAP**: Set the battery capacity of the battery. Default is 0.5 Ah.
		Save To File	1 to 10	Specifies the file name. Example, when 1 is entered, the saved file name will be user_01.csv
		Save		Save the file in internal memory, .csv format.
	Control		Run	Run the selected user-defined battery test file.
			Stop	Stop the test operation
Curve	Open		-	Opens the list file saved in internal memory or external USB drive. **NOTE** To access files from an external USB drive, connect the drive to the front panel USB port and set the USB mode to Host. If no USB drive is connected, the system will default to using Internal storage only.

Settings		Available Settings	Description
View		-	View the number of curve point in an opened file.
Config		-	
	Capacity	C_{min} to C_{max}	Set the capacity of a cell battery. Default is 1 Ah
	Parallel	1 to 10	Set the number of parallel-connected batteries. Default is 1
	Series	1 to 10	Set the number of series-connected batteries. Default is 1
	End Mode	Last, or last+Off	Specify how the battery emulator will behave at the end of a test cycle. Default is Last. **Last** – The emulator will maintain the last state or condition it was in at the end of the test, and the output is on. **Last+Off** – The emulator will maintain the last state as described above, but the output is off.
	SOC high	0 to 110%	Set the maximum state of charge (SOC), of the battery. Default is 110%
	SOC low	-10 to 110%	Set the minimum state of charge (SOC), of the battery. Default is -10%
	Initial Setting	SOC, VOC, or CAP	Specifies the initial setting to SOC, VOC or CAP. Default is SOC
	Initial SOC Initial VOC Initial CAP	0 to 100% V_{min} to V_{max} 0.01 to 999.99	Set the specified initial setting value. Initial setting dependent. Default is Initial SOC **Initial SOC** – Set the initial state of charge (SOC), of the battery. Default is 50%. **Initial VOC** – Set the open circuit voltage of the battery. Default is 3 V. **Initial CAP** – Set the battery capacity of the battery. Default is 0.5 Ah.
	+ Current Limit	I_{min} to I_{max}	Set the positive current limit value, which simulates the maximum discharge current of the battery pack.
	– Current Limit	I_{min} to I_{max}	Set the negative current limit value, which simulates the minimum discharge current of the battery pack.
	Save To File	1 to 10	Specifies the file name. Example, when 1 is entered, the saved file name will be curve_01.csv
	Save	-	Save the file in internal memory, .txt format.
Control		Run	Run the selected user-defined battery test file.
		Stop	Stop the test operation

Battery emulator file name

The user-defined and curve file name are set to user_XX and curve_XX respectively, where XX represents the Save To File location (which can be set from 1 to 10).

For example, when the Save to File location is 2, the user-defined file is named user_02, while the curve file is named curve_02.

Open a saved file

Select a saved file from the internal memory in order to run the battery emulator test.

Front Panel Menu Reference	SCPI Command
For user-defined file, select **Function\Arb\BatEmulator\User-defined\Open**. For curve file, select **Function\Arb\BatEmulator\Curve\Open**. Select **Internal** to open and select a battery test file. Use the navigation keys to navigate through the list and press **Enter** once you have selected the file. Press **[Back]** to return to the previous menu.	To open the battery simulation test file 2 in the internal memory: BATT:EMUL:REC 2

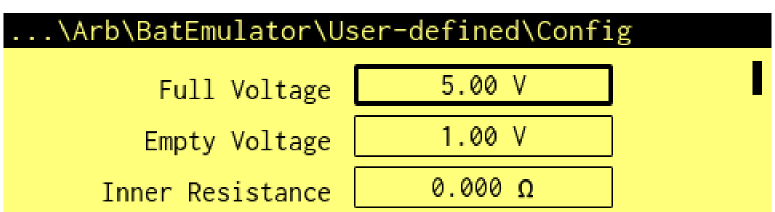
View the number of curve point

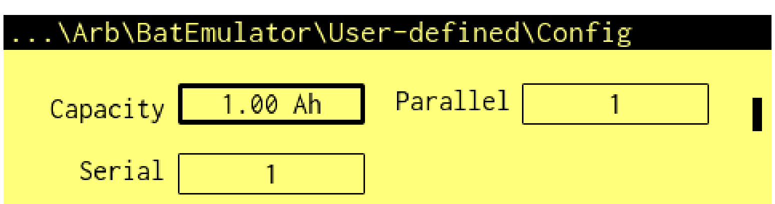
NOTE Only applicable when a curve file is opened.

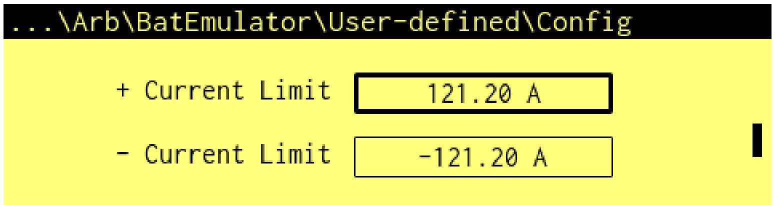
Front Panel Menu Reference	SCPI Command
Select **Function\Arb\BatEmulator\Curve\View** to view the number of curve points available in the opened file. NOTE: The View selection will only be visible when a file is opened. Otherwise, it will be grayed-out.	Not applicable

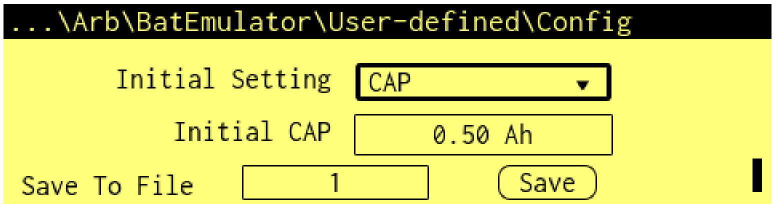
Configure the user-defined battery emulator file

Press Function > Arb > BatEmulator >User-defined > Config to configure the user-defined file.









Specify the full and empty voltage

Front Panel Menu Reference	SCPI Command
Select **Full Voltage** and enter a value of 12 V. Press **[Enter]**.	To set full voltage to 12 V BATT:EMUL:VOC:FULL 12
Select Empty Voltage and enter a value of 0.05 V. Press **[Enter]**.	To set empty voltage to 0.05 V BATT:EMUL:VOC:EMPT 0.05

Specify the inner resistance

Front Panel Menu Reference	SCPI Command
Select **Inner Resistance** and enter a value of 5 mΩ. Press **[Enter]**.	To set inner resistance to 5 mΩ BATT:EMUL:RES 0.005

Specify the capacity

Front Panel Menu Reference	SCPI Command
Select **Capacity** and enter a value of 10 Ah. Press **[Enter]**.	To set inner resistance to 10 Ah BATT:EMUL:CAP:LIM 10

Specify the number of parallel-connected batteries

Front Panel Menu Reference	SCPI Command
Select **Parallel** and enter a value of 4. Press **[Enter]**.	To set the number of battery connected in parallel to 4 BATT:EMUL:PAR 4

Specify the number of series-connected batteries

Front Panel Menu Reference	SCPI Command
Select **Serial** and enter a value of 3. Press **[Enter]**.	To set the number of battery connected in series to 3 BATT:EMUL:SER 3

Specify the positive and negative current limit

In battery simulations, the positive and negative current limits refer to the maximum and minimum currents that the battery can handle during charging and discharging.

Negative current limit — maximum current the battery can safely accept during charging. Exceeding this limit can lead to overcharging, which can damage the battery and reduce its lifespan.

Positive current limit – maximum current the battery can safely discharge. Exceeding this limit can cause overheating and potential damage to the battery.

Front Panel Menu Reference	SCPI Command
Select **+ Current Limit** and enter a value of 30 A. Press **[Enter]**.	To set the positive current limit to 30 A BATT:EMUL:CURR:LIM:POS 30
Select **– Current Limit** and enter a value of -10 A. Press **[Enter]**.	To set the negative current limit to -10 A BATT:EMUL:CURR:LIM:NEG -10

Specify the initial setting of the battery simulation

When setting up a battery simulation test, there are several key parameters to initialize: State of Charge (SOC), Open Circuit Voltage (VOC), and Capacity (CAP).

SOC – current charge level of the battery as a percentage of its total capacity

VOC – voltage of the battery when it is not under any load

CAP – total amount of charge the battery can hold, measured in ampere-hours (Ah)

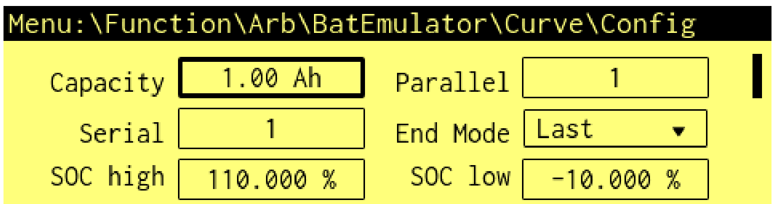
Front Panel Menu Reference	SCPI Command
Select **Initial setting** and select SOC. Then, enter a value of the Initial SOC. Press **[Enter]**.	To set the initial setting to SOC mode of 50% BATT:EMUL:INIT:MODE SOC BATT:EMUL:SOC:INIT 50
Select **Initial setting** and select CAP. Then, enter a value of the Initial CAP. Press **[Enter]**.	To set the initial setting to CAP mode of 10 Ah BATT:EMUL:INIT:MODE CAP BATT:EMUL:CAP:INIT 10
Select **Initial setting** and select VOC. Then, enter a value of the Initial VOC. Press **[Enter]**.	To set the initial setting to VOC mode of 5 V BATT:EMUL:INIT:MODE VOC BATT:EMUL:VOC:INIT 5

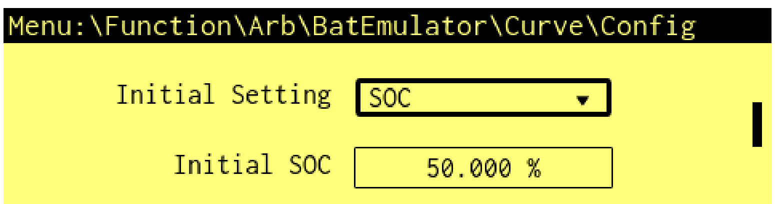
Save the battery simulation test settings to internal memory

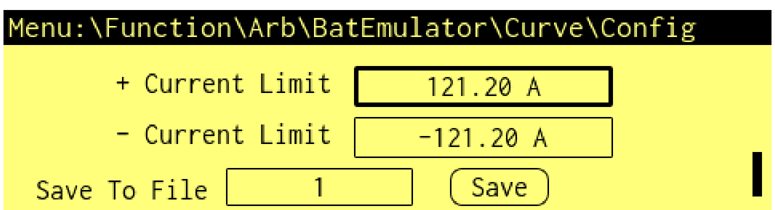
Front Panel Menu Reference	SCPI Command
Select **Save to File** and enter a file name of 2. Press **[Enter]**and press **Save**. NOTE: You can save up to 10 battery file. The filename must be from 1 to 10.	To save the battery simulation test to file 2 in the internal memory: BATT:EMUL:SAV 2

Configure the curve battery emulator file

Press Function > Arb > BatEmulator >Curve > Config to configure the curve file.







Refer to Configure the user-defined battery emulator file for steps to configure each of the above parameters, except the below.

Specify the end mode

In battery simulations, the End Mode specify how the battery emulator will behave at the end of a test cycle.

Last – maintain the last state or condition it was in at the end of the test, and the output is on.

Last+Off– maintain the last state as described above, but the output is off.

Front Panel Menu Reference	SCPI Command
Select **End Mode** and use the navigation keys to select between Last or Last+Off. Press **[Enter]**.	Not applicable

Specify the state of charge (SOC)

The state of charge (SOC) of a battery represents the current charge level relative to its capacity. It is determined in percentage, where 100% means the battery is fully charged, and 0% means it's completely discharged.

SOC high – highest level to which a battery can be charged. This is set to prevent overcharging.

SOC low – lowest level to which a battery can be discharged. This is set to prevent excessive discharge.

Front Panel Menu Reference	SCPI Command
Select **SOC high** and enter a value. Press **[Enter]**. Select **SOC low** and enter a value. Press **[Enter]**.	Not applicable

Run or stop the battery simulation test

NOTE Ensure you have turned on the output before running the battery test.

Ensure you have select a saved file from the internal memory before running the battery simulation test.

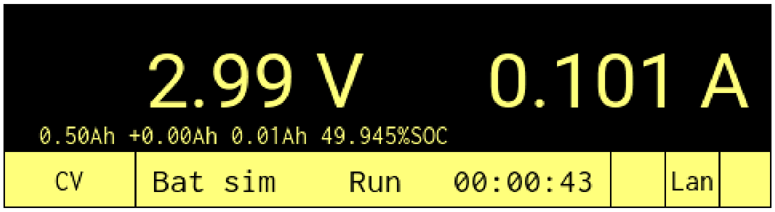
As the battery simulation test runs, the State of Charge (SOC) value constantly changes:

Simulated Charge – When the SOC rises, the voltage also increases. Upon reaching the full voltage (Full Voltage), the voltage will continue to rise. To stop testing at this point, enable the Over-Voltage Protection (OVP) function and set the OVP level to the full voltage value. Refer to Set the Over-Voltage Protection for details.

Simulated Discharge – When the SOC drops, the voltage decreases. Upon reaching the empty voltage (Empty Voltage), the voltage will continue to drop. To stop testing at this point, enable the Under-Voltage Protection (UVP) function and set the UVP level to the empty voltage value. Refer to Set the Under-Voltage Protection for details.

Front Panel Menu Reference	SCPI Command
For user-defined file, select **Function\Arb\BatEmulator\User-defined\Control**. For curve file, select **Function\Arb\BatEmulator\Curve\Control**. Press **Run** to run the battery simulation test. Press **Stop** to stop the battery simulation test.	To run the battery simulation test: BATT:EMUL ON To stop the battery simulation test: BATT:EMUL OFF

Meter view when Battery Emulator is running



Using the Arbitrary Waveform Function

The output of the Keysight RP5900 Series can be modulated by the instrument's built-in arbitrary waveform generator. This allows the output to generate complex user-defined voltage or current waveforms. The Arb function can be operated in two methods:

- Open a created Arb data file using the provided template
- SCPI programming

Key features of the arbitrary waveform function:

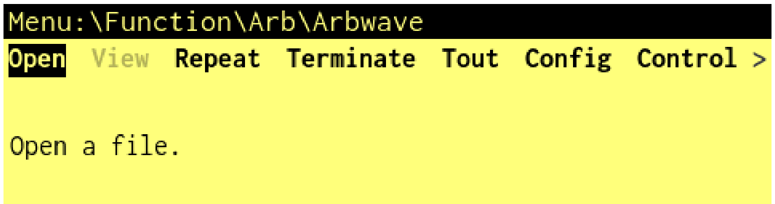
- Generates voltage or current arbitrary waveforms.
- Supports .csv Arb file that contains up to 10 millions data points.
- A .csv file of several of megabytes can be imported and parsed within 5 seconds.
- Supports importing .csv files corresponding to the following waveforms:
  - Cdwell: Constant dwell arbitrary waveform
  - List: User-defined waveform
  - Pulse: Pulse waveform
  - Sine: Sine waveform
  - Ramp: Ramp waveform
  - Exponential: Exponential waveform
  - Sequence: Sequence waveform

Steps to use the Arb function are as follows:

1. Create and edit the Arb waveform according to the template and save it to PC.
2. Open the saved Arb data on the instrument.
3. Set the Arb repeat count.
4. Set the last output value after the sequence Arb completes.
5. Set how the Arb responds to triggers.
6. Set the trigger source for the transient system.
7. Turn on the output.

Arb Settings

Press **[Menu]** > **Function** > **Arb** > **Arbwave** to access the Arbitrary Waveform window. Use the navigation keys to scroll through each of the settings. Press **[Back]** to exit.



<table>
<tr><th>Settings</th><th>Available Settings</th><th>Description</th></tr>
<tr><td>Open</td><td>Not applicable</td><td>Opens the Arb file saved in internal memory or external USB drive.

NOTE: To access files from an external USB drive, connect the drive to the front panel USB port and set the USB mode to Host. If no USB drive is connected, the system will default to using Internal storage only.</td></tr>
<tr><td>View</td><td>-</td><td>View the selected arbitrary file.</td></tr>
<tr><td>Repeat</td><td>1 to 9999999</td><td>Sets the Arb repeat count. This sets the number of times that a Arb is executed before it completes.
Default is 1

Enables the 'Run continuously' check box to repeat the list continuously.</td></tr>
<tr><td>Terminate</td><td>Return to start settings, or Stop at last step settings</td><td>Specifies what happen when the output sequence completes.
Default: Return to start settings

Action required:
Use the navigation keys to toggle between Return to start settings, or Stop at last step settings.<table><tr><td>Return to start settings</td><td>Returns to the value that was in effect before the Arb started.</td></tr><tr><td>Stop at last step settings</td><td>Remains at the last Arb value.</td></tr></table></td></tr>
<tr><td>Tout</td><td>None or Tout</td><td>Specifies the trigger output at the end of the Arb.
Default is None

Action required:
Use the navigation keys to toggle between None or Tout.<table><tr><td>None</td><td>No trigger signal will be generated at the end of the Arb.</td></tr><tr><td>Tout (Trigger output)</td><td>Trigger signal will be generated when the Arb ends.</td></tr></table></td></tr>
<tr><td>Config</td><td></td><td>Configure the Arb settings</td></tr>
</table>

Settings		Available Settings	Description
	Save To File	1 to 10	Specifies the file name. Default is 1 Example, when 1 is entered, the saved file name will be source_arb_01.txt.
	Save	-	Save the file in internal memory, .txt format.
Control		Initiate	Initiate the Arb trigger system.
		Trigger	Generate an immediate trigger signal regardless of the trigger source setting.
		Abort	Abort the Arb trigger system.
Export			Export the specified Arb data from internal memory to external USB drive.

Create a Microsoft Excel spreadsheet file according to the template

You can create an arbitrary waveform in a Microsoft Excel spreadsheet (.csv format) and import it into the instrument. Likewise, you can also export an arbitrary waveform from the instrument to a spreadsheet.

Refer to Arb templates for the examples of the spreadsheet file format.

After you have created the spreadsheet on a PC, save the file in the root directory of the USB drive.

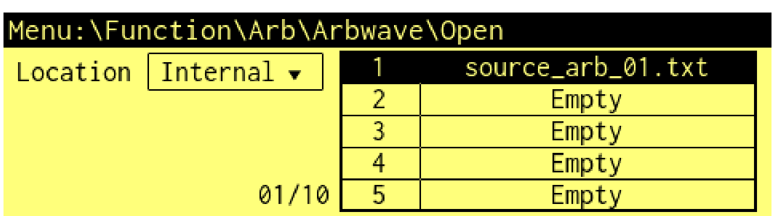
Open the Arb data

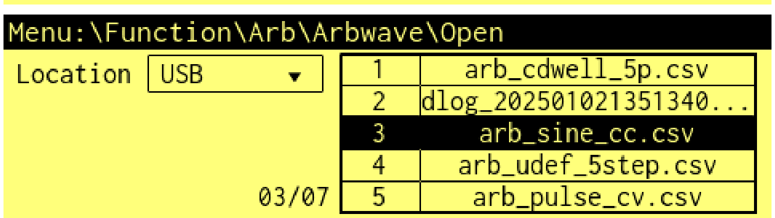
NOTE Ensure the Arb data (.csv file) is saved in the root directory of the external USB drive before attempting to open it. Saving the file elsewhere will prevent the system from locating it.

To access files from an external USB drive, connect the drive to the front panel USB port and set the USB mode to Host. If no USB drive is connected, the system will default to using Internal storage only.

In order to run a specific file, you may need to open the Arb file located on the internal or USB drive.

Open and select the Arb file from internal or external USB drive.



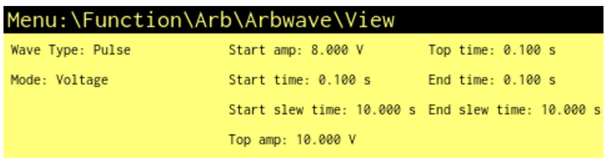


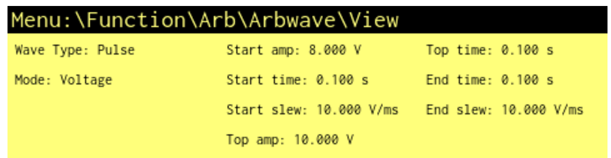
Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Open**. Go to Location and select **Internal** or **USB** to open the directory. Use the navigation keys to navigate through the list and press **Enter** once you have selected the file. Press **[Back]** to return to the previous menu.	Not applicable

View the Arb file

View allows you to view the file information after an Arb file is selected and opened.

Source mode	Load mode



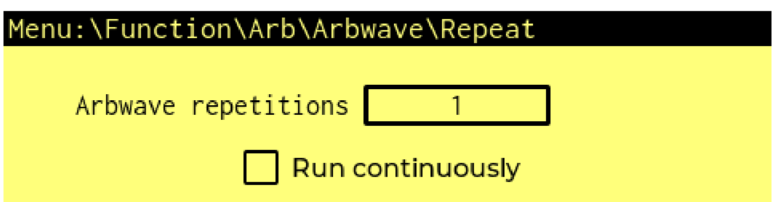


Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\View**.	Not applicable

Configure the Arb

Specify how many times you want the Arb to repeat

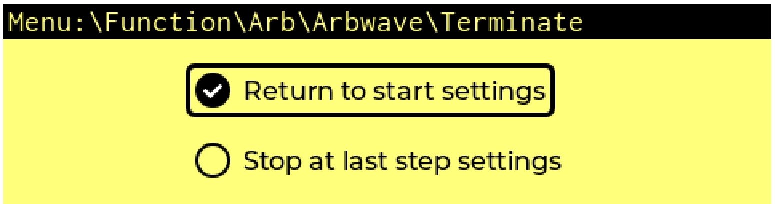
You can specify how many times you want the Arb to repeat. At reset, the Arb count is set to 1 repetition. Sending the INFinity parameter in the SCPI command makes the Arb repeat indefinitely.



Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Repeat**. Enter the number of Arb repetitions (2) and press **Select**. Enable the Run continuously checkbox to repeat the Arb continuously.	To program the Arb to repeat twice: ARB:COUN 2 To program the Arb to run continuously: ARB:COUN INF

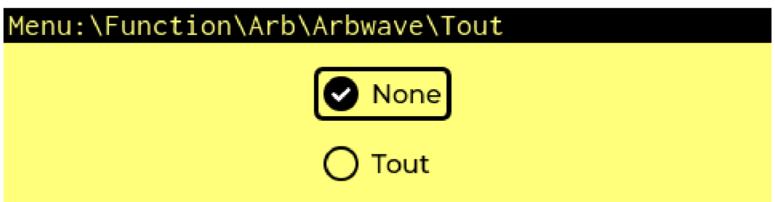
Specify how you want the Arb to end

Specify the output state after the Arb has completed. There are two choices: the output returns to the value that was in effect before the Arb started, or the output remains at the value of the last Arb step.



Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Terminate**. Select either Return to start settings, or Stop at last step settings. Then, press **[Enter]**.	To return the output to the pre-Arb state: ARB:TERM:LAST OFF To keep the output at the end Arb state: ARB:TERM:LAST ON

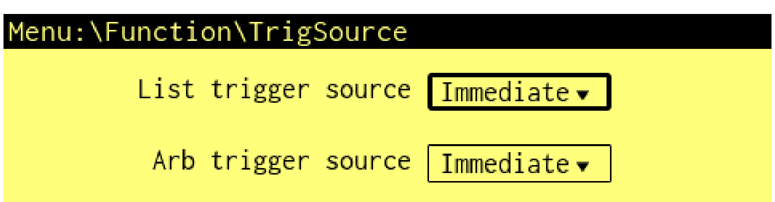
Enables or disables the trigger output



Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Tout**. Select either None or Tout. Then, press **[Enter]**.	To enable trigger output: ARB:TOUT ON To disable trigger output: ARB:TOUT OFF

Select the trigger source for Arb

NOTE A TRIGger:ARB[:IMMediate] command over the bus will always generate an immediate measurement trigger, regardless of the selected trigger source.



Unless you are using the front panel menu or a TRIGger:ARB[:IMMediate] or to trigger the Arb, select a trigger source from the following:

Trigger Source	Description
Bus	Selects a remote interface trigger command (*TRG).
External	Selects ANY pins that have been configured as Trigger Inputs on the digital control port.
Immediate	Generates a trigger as soon as the trigger system is INITiated.

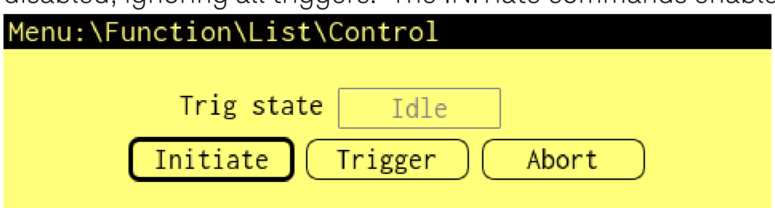
Use the following commands to select a trigger source:

Front Panel Menu Reference	SCPI Command
Select **Function\TrigSource**. Go to Arb trigger source and select either Immediate, Bus, or External. Then, press **[Enter]**.	To select Bus triggers: TRIG:ARB:SOUR BUS To select any digital pins configured as Trigger Input as trigger sources:TRIG:ARB:SOUR EXT To select immediate trigger: TRIG:ARB:SOUR IMM

Initiate and Trigger the Arb

Initiate the Arb

When the unit is turned on, the trigger system is in the idle state. In this state, the trigger system is disabled, ignoring all triggers. The INITiate commands enable the trigger system to receive triggers.



Front Panel Menu Reference	SCPI Command
Select **Function\Aeb\Arbwave\Control**. Scroll to Initiate. Then press **[Enter]**.	To initiate the Arb trigger system: INIT:ARB

Trigger the Arb

The trigger system is waiting for a trigger signal in the initiated state. You can immediately trigger the Arb as follows:

Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Control**. Select Trigger to generate an immediate trigger signal regardless of the trigger source setting.	To generate a Arb trigger: TRIG:ARB Alternatively, if the trigger source is BUS, you can also program a *TRG command.

When a trigger is received, the triggered functions are set to their programmed trigger values. When the triggered actions are completed, the trigger system returns to the idle state.

Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Control**. The Trig state field indicates "Idle".	To query the TRAN-active bit (bit 6): STAT:OPER:COND?

Abort the Arb trigger

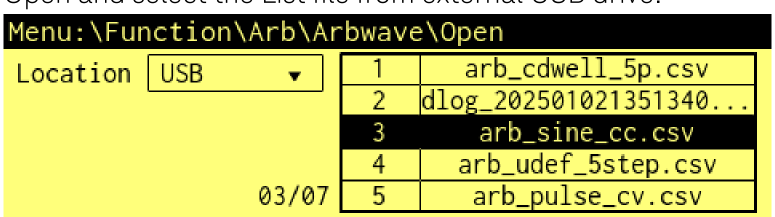
Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Control**. Then select the Abort control.	ABOR:ARB

Import and Export Arb data

Import the Arb data

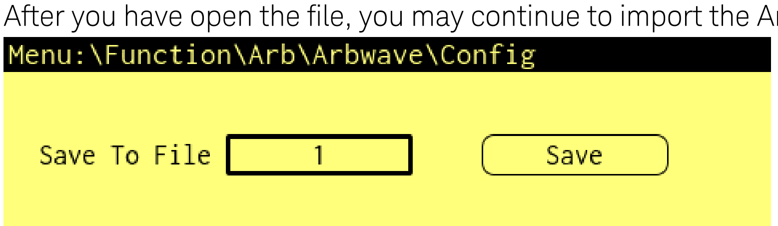
You can import the Arb data from external USB drive to internal memory . The imported data must be in .csv format.

1. Connect an external USB drive to the front panel USB port before importing the data.
2. Open and select the List file from external USB drive.



Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Open**. Select **USB** to open and select a .csv file. Use the navigation keys to navigate through the list and press **Enter** once you have selected the file. Press **[Back]** to return to the previous menu.	Not applicable

3. After you have open the file, you may continue to import the Arb data to the internal memory.



Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Config**. Select Save To File and use the numeric keys to specify the file name. Press **[Save]** to import the file data.	Save to file 2: ARB:SAVE 2

Arb file name

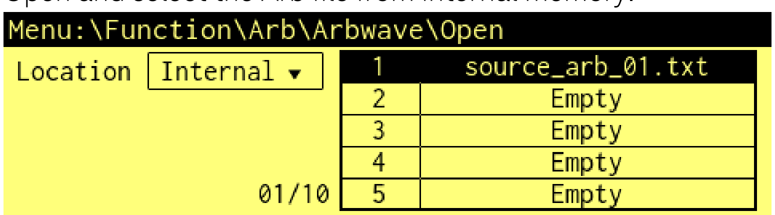
When importing the file to internal memory, the Arb file name is set according to source_arb_XX or load_arb_XX depending on whether the instrument is operating in source mode or load mode. The XX represent the Save To File location (which can be set from 1 to 10).

For example, in source mode, when the Save to File location is 2, the Arb file is named source_arb_02.

Export the Arb data

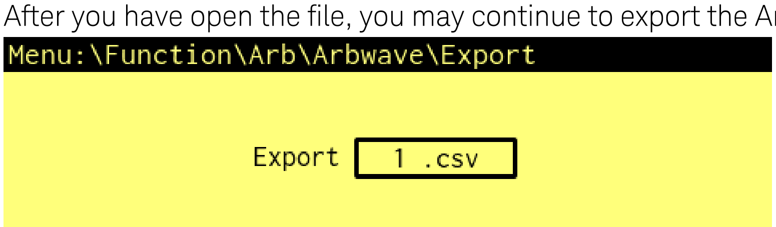
You can use Export to save the Arb data from internal memory to external USB drive. The exported data is in .csv format. The file name accepts numerical value only.

1. Connect an external USB drive to the front panel USB port before exporting the data.
2. Open and select the Arb file from internal memory.



Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Open**. Select Location **Internal** to open and select a List file. Use the navigation keys to navigate through the list and press **Enter** once you have selected the file. Press **[Back]** to return to the previous menu.	Open file 1 from internal memory: ARB:REC 1

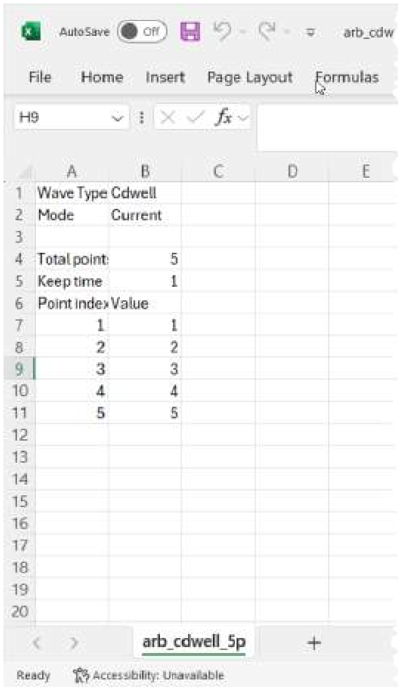
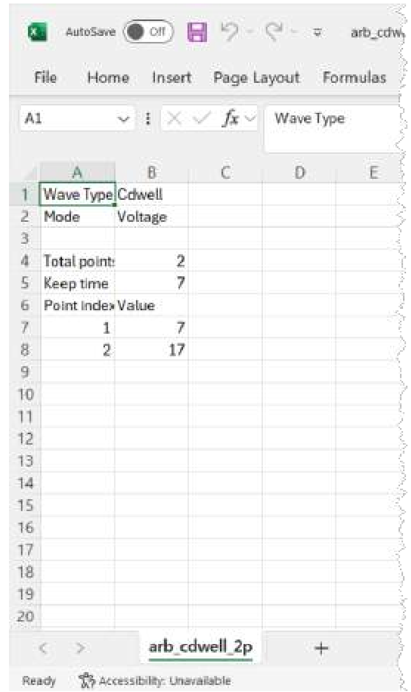
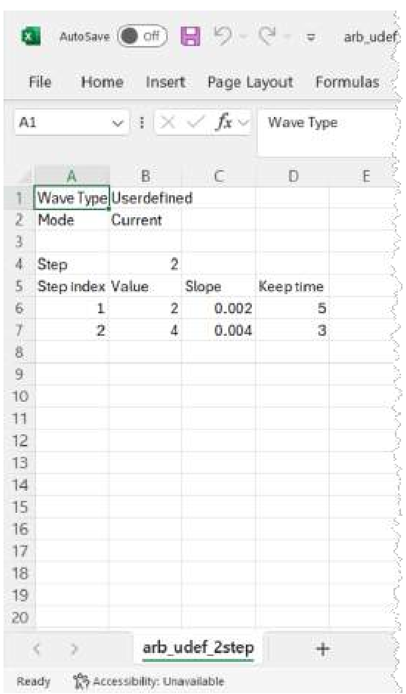
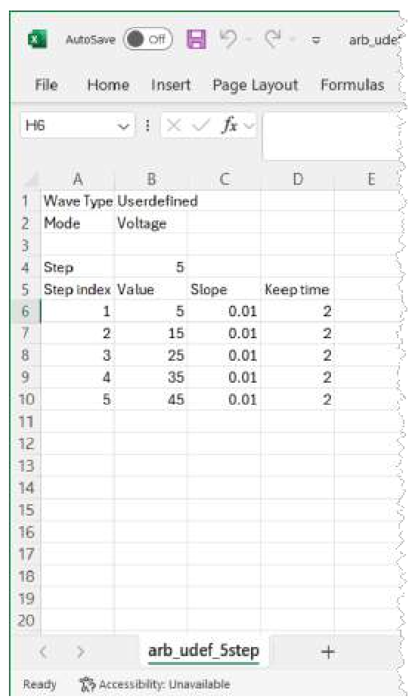
3. After you have open the file, you may continue to export the Arb data to the external USB drive.



Front Panel Menu Reference	SCPI Command
Select **Function\Arb\Arbwave\Export**. Press **Enter** and specify the file name using the numeric keys. Press **Enter**to export the data to the specified file.	Not applicable

Arb template

Use the below Arb templates as your reference to create your own Arb waveform before importing to the instrument.

<table>
<tr><th>Waveform type</th><th>Current</th><th>Voltage</th></tr>
<tr><td>Cdwell</td><td>
</td><td>
</td></tr>
<tr><td>List (user-defined)</td><td>
</td><td>
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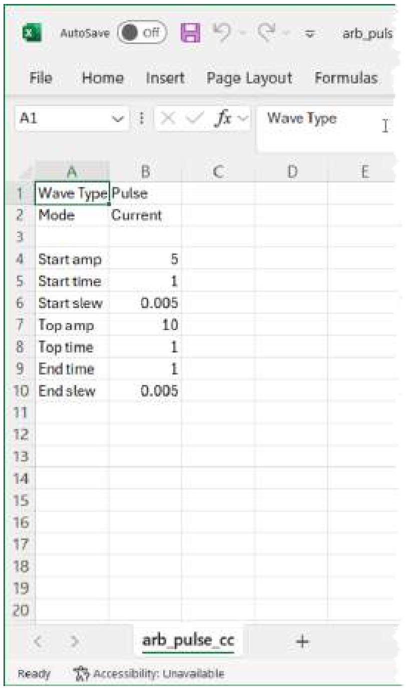
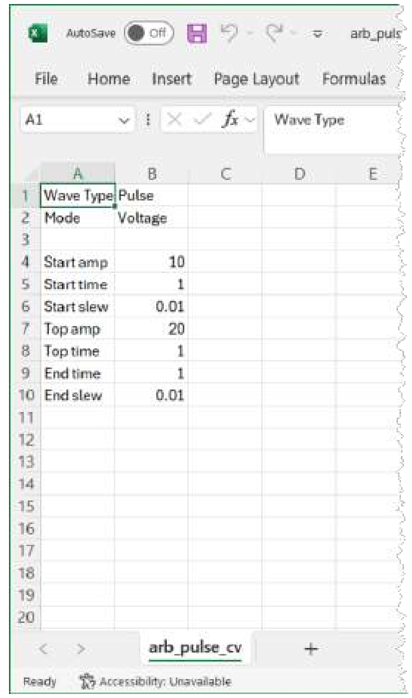
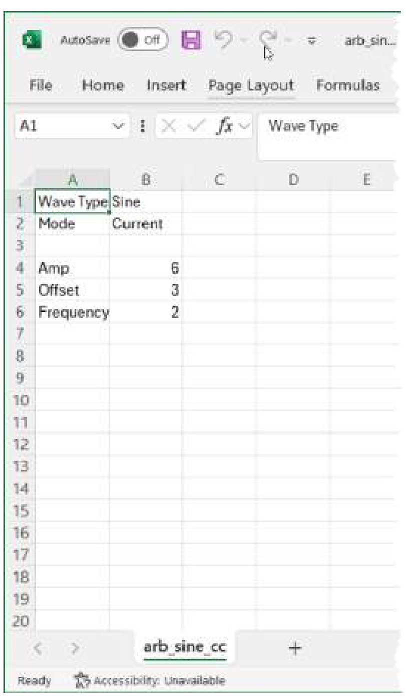
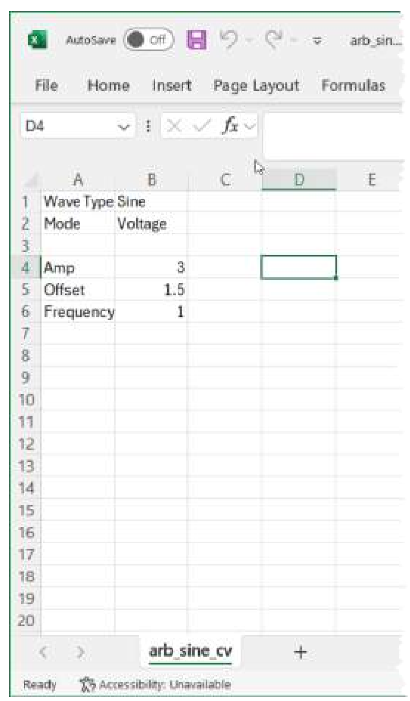
<table>
<tr><th>Waveform type</th><th>Current</th><th>Voltage</th></tr>
<tr><td>Pulse</td><td>
</td><td>
</td></tr>
<tr><td>Sine</td><td>NOTE To obtain a standard sine wave, set the ARB:SINusoid:OFFSet to 5 V or higher.

</td><td>NOTE To obtain a standard sine wave, set the ARB:SINusoid:OFFSet to 5 V or higher.

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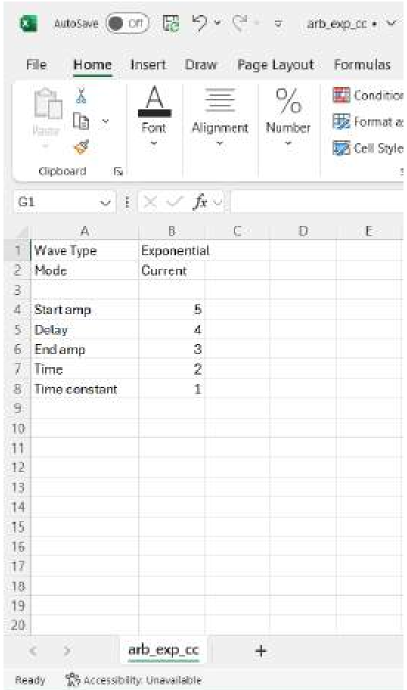
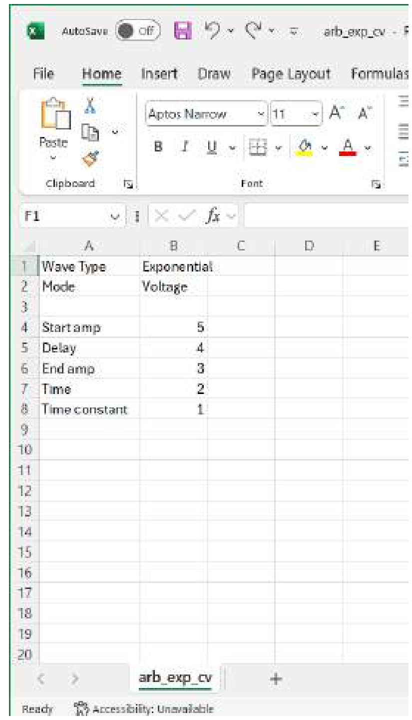
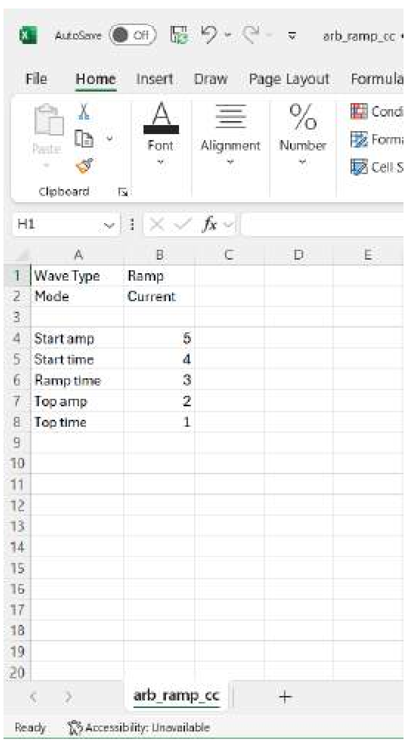
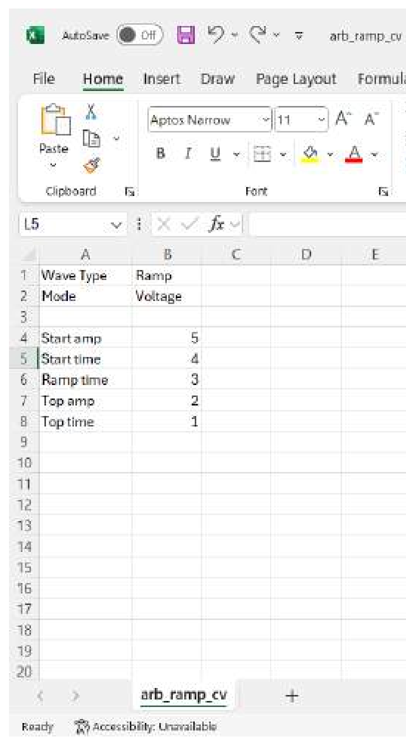
<table>
<tr><th>Waveform type</th><th>Current</th><th>Voltage</th></tr>
<tr><td>Exponential</td><td>
</td><td>
</td></tr>
<tr><td>Ramp</td><td>
</td><td>
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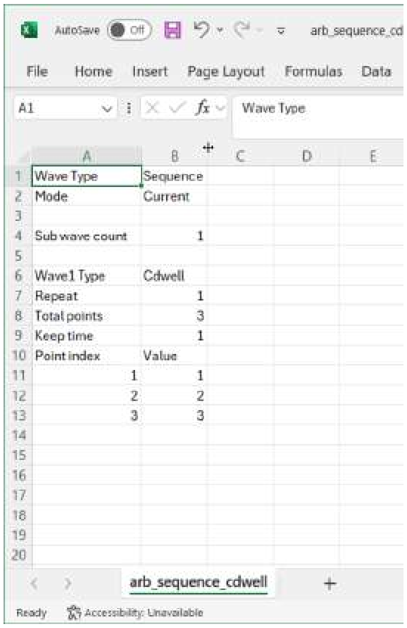
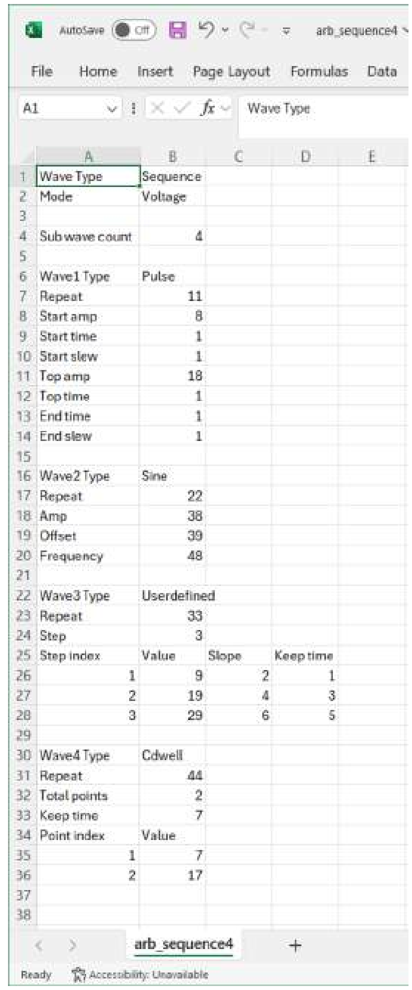
Waveform type	Current	Voltage

Sequence

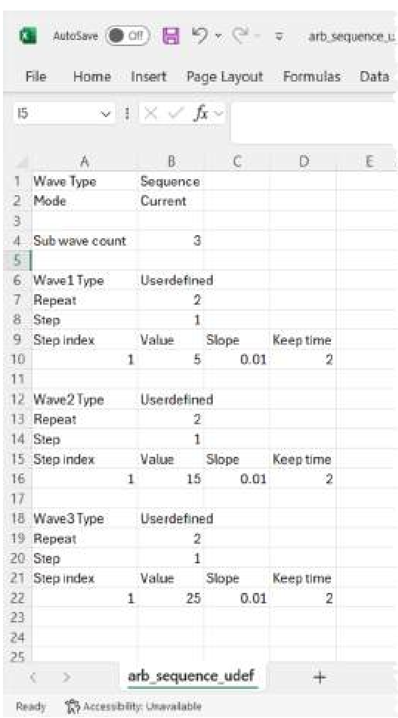


	A	B	C	D	E
1	Wave Type	Sequence			
2	Mode	Current			
3					
4	Sub wave count	1			
5					
6	Wave1 Type	Cdwell			
7	Repeat	1			
8	Total points	3			
9	Keep time	1			
10	Point index	Value			
11	1	1			
12	2	2			
13	3	3			

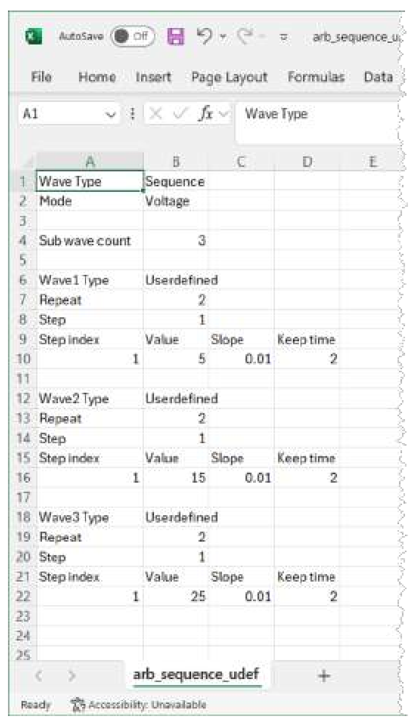


	A	B	C	D	E
1	Wave Type	Sequence			
2	Mode	Voltage			
3					
4	Sub wave count	4			
5					
6	Wave1 Type	Pulse			
7	Repeat	11			
8	Start amp	8			
9	Start time	1			
10	Start slew	1			
11	Top amp	18			
12	Top time	1			
13	End time	1			
14	End slew	1			
15					
16	Wave2 Type	Sine			
17	Repeat	22			
18	Amp	38			
19	Offset	39			
20	Frequency	48			
21					
22	Wave3 Type	Userdefined			
23	Repeat	33			
24	Step	3			
25	Step index	Value	Slope	Keep time	
26	1	9	2	1	
27	2	19	4	3	
28	3	29	6	5	
29					
30	Wave4 Type	Cdwell			
31	Repeat	44			
32	Total points	2			
33	Keep time	7			
34	Point index	Value			
35	1	7			
36	2	17			

Sequence (user-defined)



	A	B	C	D	E
1	Wave Type	Sequence			
2	Mode	Current			
3					
4	Sub wave count	3			
5					
6	Wave1 Type	Userdefined			
7	Repeat	2			
8	Step	1			
9	Step index	Value	Slope	Keep time	
10	1	5	0.01	2	
11					
12	Wave2 Type	Userdefined			
13	Repeat	2			
14	Step	1			
15	Step index	Value	Slope	Keep time	
16	1	15	0.01	2	
17					
18	Wave3 Type	Userdefined			
19	Repeat	2			
20	Step	1			
21	Step index	Value	Slope	Keep time	
22	1	25	0.01	2	



	A	B	C	D	E
1	Wave Type	Sequence			
2	Mode	Voltage			
3					
4	Sub wave count	3			
5					
6	Wave1 Type	Userdefined			
7	Repeat	2			
8	Step	1			
9	Step index	Value	Slope	Keep time	
10	1	5	0.01	2	
11					
12	Wave2 Type	Userdefined			
13	Repeat	2			
14	Step	1			
15	Step index	Value	Slope	Keep time	
16	1	15	0.01	2	
17					
18	Wave3 Type	Userdefined			
19	Repeat	2			
20	Step	1			
21	Step index	Value	Slope	Keep time	
22	1	25	0.01	2	

Arb Waveform SCPI Examples

Cdwell Arb

ABOR:ARB
ARB:FUNC:SHAP CDW
ARB:FUNC:TYPE CURR
ARB:CDWell:POIN 5
ARB:CDWell 1,1
ARB:CDWell 2,2
ARB:CDWell 3,3
ARB:CDWell 4,4
ARB:CDWell 5,5
ARB:CDWell:DWEL 1
ARB:TERM:LAST ON
ARB:COUN 2
INIT:ARB

Pulse

Source mode

TRIGger:ARB:SOUR BUS
ARB:FUNC:SHAP PULS
ARB:FUNC:TYPE VOLT
ARB:PULS:STARt 5
ARB:PULS:STARt:TIME 1
ARB:PULS:STARt:SLEW 0.005 Load Mode only
ARB:PULS:STARt:SLEW:TIME 0.005 Source Mode only
ARB:PULS:TOP 10
ARB:PULS:TOP:TIME 1
ARB:PULS:END:TIME 1
ARB:PULS:END:SLEW 0.005 Load Mode only
ARB:PULS:END:SLEW:TIME 0.005 Source Mode only
ARB:TERM:LAST ON
ARB:COUNt 2
INITIate:ARB
TRIGger:ARB

Sequence

TRIG:ARB:SOUR BUS
ARB:FUNC:SHAP SEQ
ARB:FUNC:TYPE VOLT
ARB:COUN 5
ARB:SEQ:LENG 2
ARB:SEQ:SEL 1

ARB:SEQ:FUNC CDW
ARB:SEQ:CDW:POIN 3
ARB:SEQ:CDW:LEV 1,6
ARB:SEQ:CDW:LEV 2,8
ARB:SEQ:CDW:LEV 3,10
ARB:SEQ:CDW:WID 1
ARB:SEQuence:COUN 1
ARB:SEQ:SEL 2
ARB:SEQ:FUNC UDEF
ARB:SEQ:UDEF:COUN 1
ARB:SEQ:UDEF:LEV 1,15
ARB:SEQ:UDEF:SLEW 1,0.005 Load Mode only
ARB:SEQ:UDEF:SLEW:TIME 1,0.005 Source Mode only
ARB:SEQ:UDEF:DWEL 1,2
ARB:SEQuence:COUNt 1
SYST:ERR?

Sine

ABOR:ARB
ARB:FUNC:SHAP SIN
ARB:FUNC:TYPE CURR
ARB:SIN:AMPL 5
ARB:SIN:OFFS 5
ARB:SIN:FREQ 1
ARB:COUN 22
ARB:TERM:LAST ON
INIT:ARB

Exponential

ABOR:ARB
ARB:FUNC:SHAP EXP
ARB:FUNC:TYPE CURR
ARB:EXP:STAR 5
ARB:EXP:END 3
ARB:EXP:TCON 1
ARB:EXP:TIM 2
ARB:COUN 22
ARB:TERM:LAST ON
INIT:ARB

Ramp

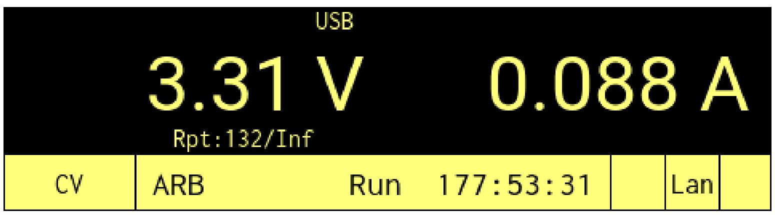
ABOR:ARB
ARB:FUNC:SHAP RAMP
ARB:FUNC:TYPE VOLT
ARB:RAMP:STAR 5

ARB:RAMP:END 10
ARB:RAMP:STAR:TIM 1
ARB:RAMP:END:TIM 3
ARB:RAMP:RTIM 2
ARB:COUN 22
ARB:TERM:LAST ON
INIT:ARB

SCPI Programming

For detailed Arb parameter introduction, refer to "ARB Subsystem" under SCPI Programming chapter.

Meter view when Arbwave is running



Programming the Digital Port

Bi-Directional Digital I/O

Digital Input

ON OFF Trigger

External Trigger I/O

Protection State

Inhibit Input

Output Couple Control

Digital Control Port

A Digital Control Port consisting of seven I/O pins is provided to access various control functions. Each pin is user-configurable. The following control functions are available for the I/O pins. See SCPI Programming Reference for details on the SCPI commands to program the Digital Port.

The following table describes the possible pin configuration for the digital port functions. For a complete description of the electrical characteristics of the digital control port, refer to the Specifications section.

Function	Description
DIO	General-purpose ground-referenced digital input/output function. The output can be set with [SOURce:]DIGital:OUTPut:DATA.
DINPut	Digital input-only mode. The digital output data of the pin is ignored.
PSSTate	Applies only to pin 2. The PSSTate parameter determines the protection status of the instrument.
PSCLear	Applies only to pin 1. When pin 1 is configured as PSCLear, instrument protection will be cleared.
OFFState	Applies only to pin 3. The OFFState pin will trigger a level output based on the On/Off state of the instrument.
INHibit	Applies only to pin 5. When pin 5 is configured as an inhibit input; a true signal at the pin will disable the output.
ONCouple	Applies only to pin 6. The ONCouple pin synchronizes the output On state between instruments. The pin functions as both an input and an output.
OFFCouple	Applies only to pin 7. The OFFCouple pin synchronizes the output Off state between instruments. The pin functions as both an input and an output.
TINPut	Applies only to pin 4. A trigger input pin can be selected as the source for measurement and transient trigger signals. See TRIGger:ACQuire:SOURce, TRIGger:ARB:SOURce, TRIGger:LIST:SOURce, TRIGger:DLOG:SOURce, and TRIGger:ELOG:SOURce.
TOUTput	Applies only to pin 4. A trigger output pin will generate output triggers from any subsystem that has been configured to output trigger signals.
Common	Applies only to pin 8. Connected to ground.

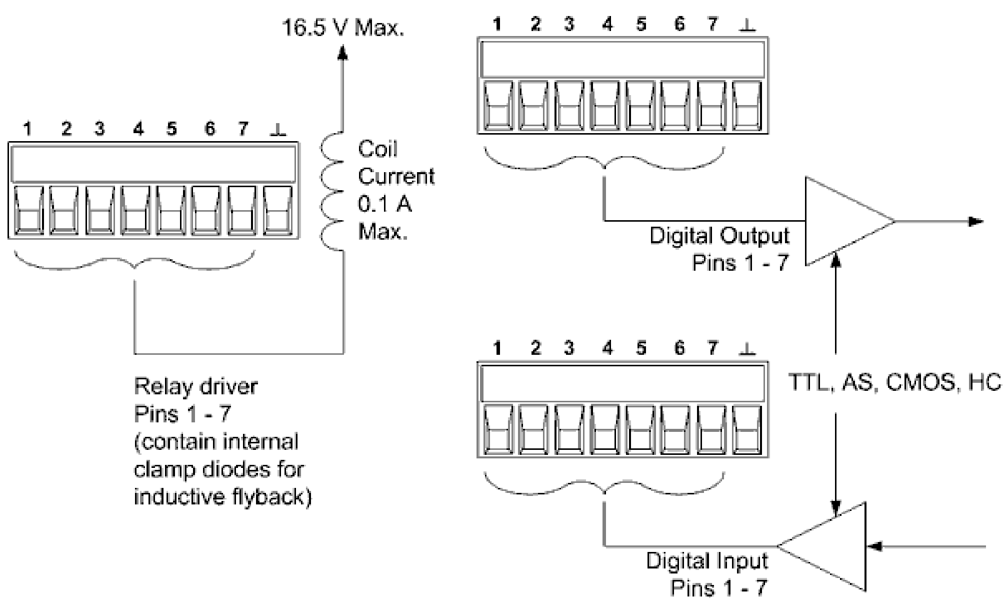
In addition to the configurable pin functions, the signal polarity (Positive (Invert) or Negative(Non-Invert)) for each pin is also configurable. For level signals, POSitive indicates a voltage high at the pin. NEGative indicates a voltage low at the pin. For edge signals, POSitive means a rising edge and NEGative means a falling edge.

Bi-Directional Digital I/O

Each of the seven pins can be configured as general purpose bi-directional digital inputs and outputs. The polarity of the pins can also be configured. Pin 8 is the signal common for the digital I/O pins. Data is programmed according to the following bit assignments:

Pin	7	6	5	4	3	2	1
Bit Weight	6 (MSB)	5	4	3	2	1	0 (LSB)

The digital I/O pin can be used to control both relay circuits as well as digital interface circuits. The following figure illustrates typical relay circuits as well as digital interface circuit connections using the digital I/O functions



Signal definition

Input signal	High level	Typical: 5 V
		Range: 1.6 V to 15 V
		Current: ≤ 100 mA
	Low level	Typical: 0 V
		Range: -5 V to 0.8 V
		Current: ≤ 100 mA
Output signal	High level	Voltage level: 5 V

	Low level	Voltage level: 0 V
Pulse	Level rise slope	10 µs
	Level fall slope	2 µs
	Width	30 µs

To configure the pins for digital I/O:

Front Panel Menu Reference	SCPI Command
Select **System\IO\DigPort**. Select a pin in the Select Pin field. In the Function field, select DIO. Check the Invert On checkbox to reverse the polarity of the default input/output signal (Negative) to Positive. Select the binary bit (1 or 0) on the Set field. NOTE: For Digital I/O function, a binary bit 1 with Invert On enabled specify a voltage high at the pin while a binary bit 0 with Invert On enabled specify a voltage low at the pin. To send a binary data to configure the pin 1 through 7, use DIG:INP:DATA	To select the pin function: DIG:PIN<1-7>:FUNC DIO To select the pin polarity: DIG:PIN<1-7>:POL POS To configure pins 1 through 7 as “0000111”: DIG:OUTP:DATA 7

Digital Input

Each of the seven pins can be configured as digital input only. The polarity of the pins can also be configured. Pin 8 is the signal common for the digital input pins. The pin status reflects the true condition of the external signal that is applied to the pin. The pin state is not affected by the setting of DIGital:OUTPut:DATA. To configure the pins for digital input only:

Front Panel Menu Reference	SCPI Command
Select **System\IO\DigPort**. Select a pin in the Select Pin field. In the Function field, select **Dig In**. Check the Invert On checkbox to reverse the polarity of the default input/output signal (Negative) to Positive. Select the binary bit (1 or 0) on the Set field. NOTE: For Digital I/O function, a binary bit 1 with Invert On enabled specify a voltage high at the pin while a binary bit 0 with Invert On enabled specify a voltage low at the pin. To send a binary data to configure the pin 1 through 7, use DIG:INP:DATA	To select the pin function: DIG:PIN<1-7>:FUNC DINP To select the pin polarity: DIG:PIN<1-7>:POL POS To read the data on the pins: DIG:INP:DATA?

ON OFF Trigger

Pin 3 can be configured as trigger level output based on [On/Off] state of the instrument, inputs or trigger outputs. The polarity of the pins can also be configured. When you program trigger polarity, POSitive (Invert) means a rising edge and NEGative (Non-Invert) means a falling edge. Pin 8 is the signal common for the trigger pins.

In the ON state, Pin 3 will output a high signal to indicate that the instrument is active. In the OFF state, Pin 3 will output a low signal (e.g., 0 V) to indicate that the instrument is inactive.

Front Panel Menu Reference	SCPI Command
Select **System\IO\DigPort**. Select **Pin 3** in the Select Pin field. In the Function field, select the **OFFState** function. Check the Invert On checkbox to reverse the polarity of the default input/output signal (Negative) to Positive.	To select the trigger output function for pin 3: DIG:PIN3:FUNC OFFS To select the pin polarity: DIG:PIN3:POL POS DIG:PIN3:POL NEG

External Trigger I/O

Pin 4 can be configured as trigger inputs or trigger outputs. The polarity of the pins can also be configured. When you program trigger polarity, POSitive (Invert) means a rising edge and NEGative (Non-Invert) means a falling edge. Pin 8 is the signal common for the trigger pins. For an overview of the trigger system, refer to Trigger Overview.

When configured as a trigger input, you can apply either a negative-going or a positive-going pulse to the designated trigger input pin. The trigger latency is 10 microseconds. The minimum pulse width is 10 microseconds. The pin’s polarity setting determines which edge generates a trigger-in event.

When configured as a trigger output, the trigger pin will generate a 10 microsecond-wide pulse when a Trigger Out occurs. Depending on the polarity setting, it can be either positive-going (rising edge) or negative-going (falling-edge) when referenced to common.[1]

1 When using firmware version V01.05-00.01-01.00-01.00, the digital port polarity is reversed. Configuring the polarity to POSITIVE results in a falling edge, while setting it to NEGATIVE results in a rising edge.

Front Panel Menu Reference	SCPI Command
Select **System\IO\DigPort**. Select **Pin 4** in the Select Pin field. In the Function field, select either the **TINPut** or **TOUTput** function. Check the Invert On checkbox to reverse the polarity of the default input/output signal (Negative) to Positive.	To select the trigger output function for pin 4: DIG:PIN4:FUNC TOUT To select the trigger input function for pin 4: DIG:PIN4:FUNC TINP To select the pin polarity: DIG:PIN4:POL POS DIG:PIN4:POL NEG

Protection State

Pins 2 can be configured as a Protection State. The Protection State function enables a fault condition that generate a protection signal on the digital port. Refer to Protection Functions for a list of protection signals that will generate a protection state.

Note that the Protection State output signal remains latched until the Protection condition is removed and the protection circuit is cleared. as explained under Clear Output Protection.

Front Panel Menu Reference	SCPI Command
Select **System\IO\DigPort**. In the Pin field, select pin 2. In the Function field, select PSState. Check the Invert On checkbox to reverse the polarity of the default input/output signal (Negative) to Positive.	To configure the Protection State function: DIG:PIN2:FUNC PSSTate To select the pin polarity: DIG:PIN2:POL POS

Clearing a Protection State

Pins 1 can be configured as a Protection State Clear (PSCLear). The PSCLear function clears or resets a protection state. When pin 1 is set to Ps-Clear function, it has a bi-directional I/O capability. It can receive pulse signal input from an external instrument and also output pulse signals to an external instrument.

When the instrument is under protection, the PSCLear function will clear the protection status upon receiving a pulse signal from an external digital input. Conversely, when the instrument's protection state is released and the [On/Off] switch is turned from Off to On, pin 1 will send a pulse signal to the external instrument.

Inhibit Input

Pin 5 can be configured as a remote inhibit input. The Inhibit Input function lets an external input signal control the output state of instrument. The input is level triggered. The signal latency is 10 microseconds. Pin 8 is the common for pin 5. The following non-volatile inhibit input modes can be programmed:

LATChing - causes a logic-true transition on the Inhibit input to disable the output. The output will remain disabled after the inhibit signal is received.

LIVE - allows the enabled output to follow the state of the Inhibit input. When the Inhibit input is true, the output is disabled. When the Inhibit input is false, the output is re-enabled.

OFF - The Inhibit input is ignored.

To configure the Inhibit Input function:

Front Panel Menu Reference	SCPI Command
Select **System\IO\DigPort**. In the Pin field, select pin 5. In the Function field, select INHibit. Check the Invert On checkbox to reverse the polarity of the default input/output signal (Negative) to Positive. NOTE: To configure the Inhibit mode, use OUTP:INH:MODE	To select the Inhibit function: DIG:PIN5:FUNC INH To select the pin polarity: DIG:PIN5:POL POS To specify the Inhibit mode: OUTP:INH:MODE LATC OUTP:INH:MODE LIVE OUTP:INH:MODE OFF

Output Couple Control

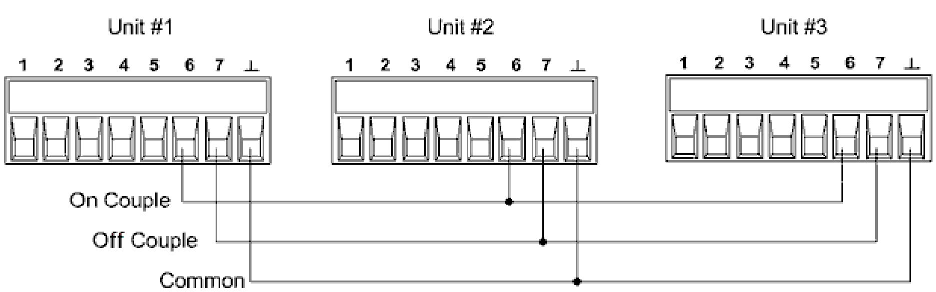
This function lets you connect multiple instruments together and synchronize the output on/off sequence across all units. Each unit that will be sequenced must also be "coupled" to the other units.

1. Couple the output on each unit as described under Sequencing the Output.

2. Set the delay offset of each individual unit to match the longest delay offset of the group.

3. Connect and configure the digital connector pins of the sequenced units as shown below.

Only pin 6 can be configured as ONCouple and pin 7 can be configured as OFCouple. The designated pins will function as both an input and an output. Depending on the polarity setting, it can be either positive-going (rising edge) or negative-going (falling-edge) when referenced to common.



In this example, pin 6 is configured as the output On control. Pin 7 is configured as the output Off control. The ground or Common pins are connected together.

Front Panel Menu Reference	SCPI Command
Select **System\IO\DigPort**. In the Pin field, select pin 6. In the Function field, select ONCouple. Check the Invert On checkbox to reverse the polarity of the default input/output signal (Negative) to Positive. In the Pin field, select pin 7. In the Function field, select OFCouple. Check the Invert On checkbox to reverse the polarity of the default input/output signal (Negative) to Positive. Repeat these steps for units #2 and #3	To set pin 6 of unit 1 as the ON control: DIG:PIN6:FUNC ONC To configure pin 7 of unit 1 as the OFF control: DIG:PIN7:FUNC OFFC To select the pin polarity: DIG:PIN6:POL POS DIG:PIN7:POL NEG Repeat commands for units 2 and 3.

Once configured and enabled, turning the output on or off on any coupled unit will cause all coupled units to turn on or off according to their user-programmed delays.

Using the Analog Quantity Function (Optional)

Introduction

Source Mode

Load Mode

WARNING

SHOCK HAZARD
The maximum allowable input voltage for the Analog/RS232 interface is 10 V.
Do not connect this interface to any hazardous voltage source or to any signal exceeding 10 V, as this may result in permanent damage to the module and pose a safety risk.
Always verify the voltage level of the external control signal before connection.

RISQUE D'ÉLECTROCUTION
La tension d'entrée maximale admissible sur l'interface Analogique/RS232 est de 10 V.
Ne connectez jamais cette interface à une source de tension dangereuse ou à un signal supérieur à 10 V, cela risque d'endommager définitivement le module et de créer un risque pour la sécurité.
Vérifiez toujours le niveau de tension du signal de commande externe avant de procéder au branchement.

Introduction

The optional Analog/RS232 interface card integrates the RS232 and analog quantity function. The analog quantity function allows the user to input an analog signal in the range of 0 V to 10 V through the analog quantity input interface for remote setting of the instrument's input setting value.

In source mode, the Analog/RS232 interface card provides the following capability:

- Remote control of voltage and current values.
- Remote control of voltage and current upper limit values.
- Remote control of voltage and current lower limit values.
- Remote monitoring of output voltage or current measurement.
- RS-232 communication interface. Refer to RS232 Configuration for more details.

In load mode, the Analog/RS232 interface card provides the following capability:

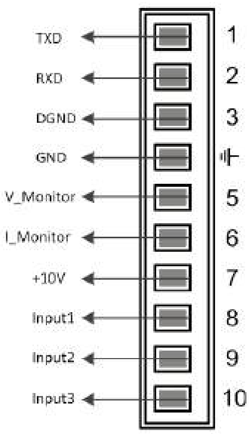
- Remote control of setting values in different modes.
- Remote switching of CC, CV, CP, and CR modes.
- Remote monitoring of input voltage or current measurement.
- RS-232 communication interface. Refer to RS232 Configuration for more details.

Source Mode

Analog/RS232 Interface

An Analog/RS232 interface consisting of 10 pins is provided to access various control functions. The following control functions are available for the analog pins. See SCPI Programming Reference for details on the SCPI commands to program the Analog Interface.

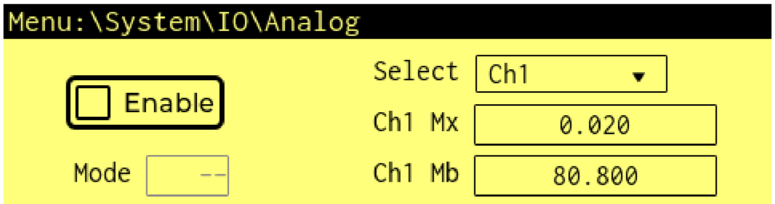
The following table describes the pin configuration for the Analog/RS232 interface functions.



Pins	Name	Function	Description
1, 2, 3	TXD, RXD, DGND	Communication terminal	RS232 interface connection terminal.
4	GND	Ground	Ground for analog inputs and outputs.
5	V_Monitor	Analog out	Voltage monitor signal.
6	I_Monitor	Analog out	Current monitor signal.
7	+10V	Analog out	The +10V reference voltage output by the power supply can be connected to a resistance subdivision for precise analog control.
8	Input1	Analog in	The setting for the output voltage/current value corresponds to Ch1 in the menu. - Voltage priority: Specify the value of, Vs. - Current priority: Specify the value of, Is.
9	Input2	Analog in	The setting for the voltage/current upper limit corresponds to Ch2 in the menu. - Voltage priority: Specify the value of the current upper limit, I+. - Current priority: Specify the value of the voltage upper limit, Vh.
10	Input3	Analog in	The setting for the voltage/current lower limit corresponds to Ch3 in the menu. - Voltage priority: Specify the value of the current lower limit, I-. - Current priority: Specify the value of the voltage lower limit, Vl.

Analog Settings

Press **[Menu]** > **System** > **IO** > **Analog** to access the Analog function window. Use the navigation keys to scroll through each of the settings. Press **[Back]** to exit.



Settings	Available Settings	Description
Enable	-	Enables or disables the analog function. Default: Disabled When enabled, the channel parameter cannot be set. When disabled, the channel parameter can be set.
Mode	-	Displays the coperating mode (CC or CV) when analog function is enabled.
Select	Ch1, Ch2, or Ch3	Specifies the channel 1, 2 or 3.
Ch<n> Mx	CV: $-V_{max}/10$ to $+V_{max}/10$ CC: $-I_{max}/10$ to $+I_{max}/10$	Specifies the slope factor of selected channel. Default: CV: 0.02 CC: $I_{max}/1000$
Ch<n> Mb	CV: $-V_{max}$ to $+V_{max}$ CC: $-I_{max}$ to $+I_{max}$	Specifies the offset of the selected channel. Default: CV: $V_{max}/10$ CC: $I_{max}/10$

Analog Conversion Relationship

When using the analog quantity control function, user are required to set the conversion relationship for the expected analog quantity value based on their requirements. The analog quantity values in each channel follow the calculation relationship of (y = Mx + Mb). The user needs to set the Mx (slope coefficient) and Mb (offset) values in different channels in the analog quantity menu for the calculation of the analog quantity value. The user can calculate the Mx and Mb values based on their analog requirements using the formula below.

– Voltage priority

$$Mx = \frac{(V_{out2} - V_{out1})}{(V_{in2} - V_{in1})}$$

$$Mb = V_{out2} - V_{in2} \times Mx$$

– Current priority

$$Mx = \frac{(I_{out2} - I_{out1})}{(V_{in2} - V_{in1})}$$

$$Mb = I_{out2} - V_{in2} \times Mx$$

NOTE The principle for setting calculation parameter for Ch1 and Ch2 and Ch3 is the same.

Taking the Ch1 programming channel as an example, the user needs to convert the values of Mx and Mb according to the following formulas, and then set the two values through the front panel keys or SCPI remote commands.

For example:

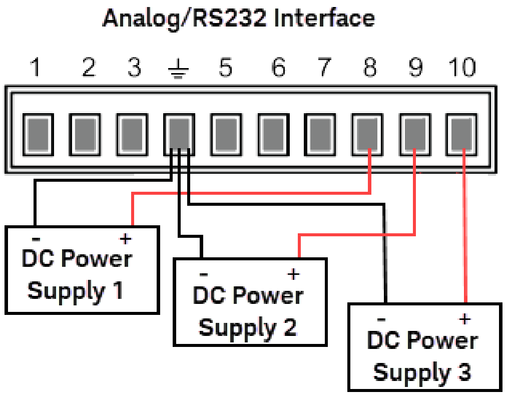
If the desired output voltage range is 0 V to 10 V and the input control voltage range is 0 V to 5 V, the slope coefficient (Mx) would be 2 (since (10 V / 5 V = 2)) and the offset (Mb) would be 0.

If the desired output current range is 0 A to 20 A and the input control voltage range is 0 V to 5 V, the slope coefficient (Mx) would be 4 (since (20 A / 5V = 4)) and the offset (Mb) would be 0.

Name	Description
V_{in1}	Indicates the minimum voltage input pin 8. The setting range is from –10 V to 10 V.
V_{in2}	Indicates the maximum voltage input to pin 8. The setting range is from –10 V to 10 V, and $V_{in2} > V_{in1}$.
Vout1	The minimum value of the output voltage in voltage priority mode.
V_{out2}	The maximum value of the output voltage in voltage priority mode, and $V_{out2} > V_{out1}$.
I_{out1}	The minimum value of the output current in current priority mode.
Iout2	The maximum value of the output current in current priority mode.

Using the Analog Function in Source Mode

1. Connect the analog interface pin and instrument according to the figure below.



2. Calculate the Mx and Mb for channel 1, channel 2 and channel 3 according to the equation above. See below for example of sample data.

Pins	Input Voltage	Output Voltage or Current	Mx	Mb	Description
8	$V_{in1} = 0$	$V_{out1} = 0$	10	0	By applying a voltage of 0 V to 5 V to pin 8, the actual output voltage (Vs) is controlled from 0 V to 500 V.
	$V_{in2} = 5$	$V_{out2} = 500$			
9	$V_{in1} = 0$	$I+_{out1} = 0$	3	0	By applying a voltage of 0 V to 10 V to pin 9, the actual output current upper limit (I+) is controlled from 0 A to 30 A.
	$V_{in2} = 10$	$I+_{out2} = 30$			
10	$V_{in1} = -10$	$I-_{out1} = -30$	1.5	-15	By applying a voltage of -10 V to 10 V to pin 10, the actual output current lower limit (I-) is controlled from -30 A to 0 A.
	$V_{in2} = 10$	$I-_{out2} = 0$			

3. Specifies the Mx and Mb in the Analog menu for channel 1, 2 and 3 accordingly.

Front Panel Menu Reference	SCPI Command
Select **System\IO\Analog**. Select a channel in the Select field. In the Mx field, use the numeric key to enter the Mx value. In the Mb field, use the numeric key to enter the Mb value. Repeat this for each channel.	To select Ch1 and set the Mx value to 2 EXT:PROG:CHAN:MX 1,2 To select Ch1 and set the Mb value to 0 EXT:PROG:CHAN:MB 1,0

4. Turn on the Analog function.

Front Panel Menu Reference	SCPI Command
Select **System\IO\Analog**. Check the Enable checkbox to turn on the analog function.	To turn on the analog function: EXT:PROG ON To turn off the analog function: EXT:PROG OFF

5. Adjust the output of DC Power Supply 1 from 0 V to 5 V, DC Power Supply 2 from 0 V to 10 V , and DC Power Supply 3 from -10 V to 10 V.

   The actual output voltage and current of the instrument will change according to the following rules:

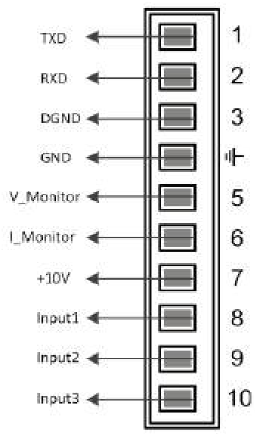
   - Pin 8 controls the actual output voltage of the instrument from 0 V to 500 V.
   - Pin 9 and pin 10 monitor the actual output current of the instrument. When the output current is higher than the upper limit (I+) set by pin 9, the instrument outputs the current at the value of (I+); When the output current is lower than the lower limit (I-) set by pin 10, the instrument outputs the current at the value of (I-).

Load Mode

Analog/RS232 Interface

An Analog/RS232 interface consisting of 10 pins is provided to access various control functions. The following control functions are available for the analog pins. See EXTernal Subsystem for details on the SCPI commands to program the Analog Interface.

The following table describes the pin configuration for the Analog/RS232 interface functions.



Pins	Name	Function	Description
1, 2, 3	TXD, RXD, DGND	Communication terminal	RS232 interface connection terminal.
4	GND	Ground	Ground for analog inputs and outputs.
5	V_Monitor	Analog out	Voltage monitor signal. This pin generates a voltage of 0 V to 10 V to monitor an input voltage of 0 V to the maximum rated value.
6	I_Monitor	Analog out	Current monitor signal. This pin generates a voltage of 0 V to 10 V to monitor an input current of 0 V to the maximum rated value.
7	+10V	Analog out	The +10 V reference voltage output by the instrument can be connected to a resistance subdivision for precise analog control.
8	Input1	Analog in	Set the input setting value.

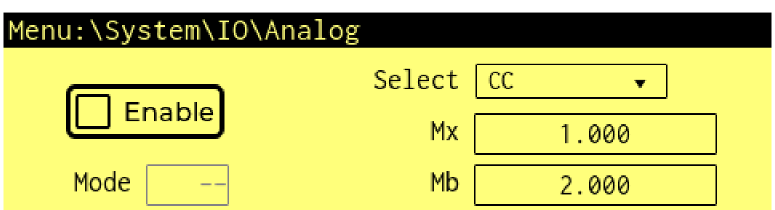
<table>
<tr><th>Pins</th><th>Name</th><th>Function</th><th>Description</th></tr>
<tr><td>9</td><td>Input2</td><td>Analog in</td><td>Set the basic mode of the load.

When the input voltage of the pin is ≤ 1V, it is low level. When the input voltage is ≥ 3V, it is high level. Set the load mode with the input voltage and level combination of the Input3:
<table>
<tr><th>Input2</th><th>Input3</th><th>Mode</th></tr>
<tr><td>Low</td><td>Low</td><td>CC</td></tr>
<tr><td>Low</td><td>High</td><td>CP</td></tr>
<tr><td>High</td><td>Low</td><td>CV</td></tr>
<tr><td>High</td><td>High</td><td>CR</td></tr>
</table></td></tr>
<tr><td>10</td><td>Input3</td><td>Analog in</td><td>Set the basic mode of the load.

When the input voltage of the pin is ≤ 1V, it is low level. When the input voltage is ≥ 3V, it is high level. Set the load mode with the input voltage and level combination of the Input2.
<table>
<tr><th>Input2</th><th>Input3</th><th>Mode</th></tr>
<tr><td>Low</td><td>Low</td><td>CC</td></tr>
<tr><td>Low</td><td>High</td><td>CP</td></tr>
<tr><td>High</td><td>Low</td><td>CV</td></tr>
<tr><td>High</td><td>High</td><td>CR</td></tr>
</table></td></tr>
</table>

Analog Settings

Press **[Menu]** > **System** > **IO** > **Analog** to access the Analog function window. Use the navigation keys to scroll through each of the settings. Press **[Back]** to exit.



Settings	Available Settings	Description
Enable	-	Enables or disables the analog function. Default: Disabled When enabled, the mode parameter cannot be set. When disabled, the mode parameter can be set.
Mode	-	Displays the operating mode (CC, CV, CP, or CR) when analog function is enabled.

Settings	Available Settings	Description
Select	CC, CV, CP, or CR	Specifies the load operation mode. Default: CV Action required: Use the navigation keys to select either CV, CC, CP, or CR mode. **CC** — CC operation mode **CV** — CV operation mode **CP** — CP operation mode **CR** — CR operation mode **NOTE** In [SOURce:]EXTern:PROGram:CHANnel:MX<chan>,<level>, the <chan> is used to indicates the operation mode: ch1: CC mode ch2: CV mode ch3: CP mode ch4: CR mode
Mx	CC: $-I_{max}/10$ to $+I_{max}/10$ CV: $-V_{max}/10$ to $+V_{max}/10$ CP: $-P_{max}/10$ to $+P_{max}/10$ CR: $-R_{max}/10$ to $+R_{max}/10$	Specifies the slope coefficient set by the selected mode (current, voltage, power or resistance). Default: CC: 0 CV: $V_{max}/10$ CP: 0 CR: $R_{max}/10$
Mb	CC: $-I_{max}$ to $+I_{max}$ CV: $-V_{max}$ to $+V_{max}$ CP: $-P_{max}$ to $+P_{max}$ CR: $-R_{max}$ to $+R_{max}$	Specifies the offset set by the selected mode (current, voltage, power or resistance). Default: CC: $I_{max}/10$ CV: $V_{max}/10$ CP: $P_{max}/10$ CR: $R_{max}/10$

Analog Conversion Relationship

When using the analog quantity control function, user are required to set the conversion relationship for the expected analog quantity value based on their requirements. The analog quantity values in each channel follow the calculation relationship of (y = Mx + b). The user needs to set the Mx (slope coefficient) and Mb (offset) values in different channels in the analog quantity menu for the calculation of the analog quantity value. The user can calculate the Mx and Mb values based on their analog requirements using the formula below.

$$Mx = \frac{(V_{out2} - V_{out1})}{(V_{in2} - V_{in1})}$$

$$Mb = V_{out1} - Mx \times V_{in1}$$

NOTE The principle for setting calculation parameters is the same in other modes.

Taking the CV program setting as an example, the user needs to convert the values of Mx and Mb according to the following formulas, and then set the two values through the front panel keys or SCPI remote commands.

For example:

If the desired output voltage range is 2 V to 8 V and the input control voltage range is 1 V to 4 V, the slope coefficient (Mx) would be 2 (8 V - 2V /4V - 1V = 2) and the offset would be 0 (2V - 2 x 1 V = 0 V).

Name	Description
V_{in1}	Indicates the start voltage input to pin 8. The setting range is from –10 V to 10 V.
V_{in2}	Indicates the end voltage input to pin 8. The setting range is from –10 V to 10 V, and $V_{in2} > V_{in1}$.
Vout1	The starting value of the input voltage in CV mode.
V_{out2}	The end value of the input voltage in CV mode.

Using the Analog Function in Load Mode

CAUTION

Before connecting the hardware device that controls the analog interface, ensure that the hardware device does not output a voltage higher than 20% of the specified value to the pin. Failing to do so, may cause equipment damage. For example, when setting the voltage or current, the input voltage must not exceed 12 V.

Avant de connecter le dispositif matériel qui pilote l’interface analogique, assurez-vous qu’il n’injecte pas une tension dépassant 20 % de la valeur spécifiée sur les broches. Le non-respect de cette consigne risque d’endommager l’appareil. Par exemple, lors du réglage de la tension ou du courant, la tension d’entrée ne doit jamais dépasser 12 V.

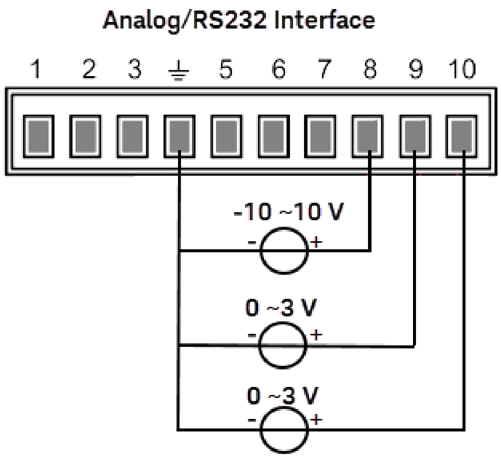
Ensure all analog quantity input pins are used together in remote control mode; do not leave any pins partially connected or floating.

En mode de commande à distance, toutes les broches d’entrée analogiques doivent être utilisées ensemble : n’en laissez jamais une partiellement connectée ou flottante.

Maintain safe electrical isolation between the analog interface and the input terminal Avoid connecting any ground wire of the analog interface to the positive or negative terminals of the input terminal.

Conservez une isolation électrique stricte entre l’interface analogique et la borne d’entrée. Ne reliez en aucun cas la masse de l’interface analogique aux bornes positive ou négative de l’entrée.

1. Connect the analog interface pin and instrument according to the figure below.



2. Calculate the Mx and Mb for voltage setting value according to the equation above.
   For example, when the instrument voltage input range is 0 - 100 V, the user needs a 0 - 10 V analog signal to control the setting value of 0 - 100 V. Then, Mx is: 100–0/10–0=10, and Mb is: 0–0=0
3. Specifies the Mx and Mb in the Analog menu for CV mode.

Front Panel Menu Reference	SCPI Command
Select **System\IO\Analog**. Select a CV in the Select field. In the Mx field, use the numeric key to enter the Mx value. In the Mb field, use the numeric key to enter the Mx value. Repeat this for each mode.	To select CV and set the Mx value to 10 EXT:PROG:CHAN:MX 2,10 To select CV and set the Mb value to 0 EXT:PROG:CHAN:MB 2,0

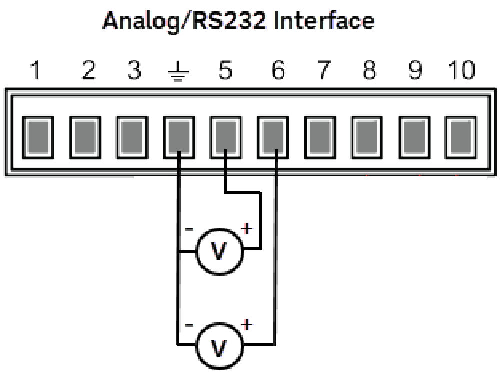
4. Turn on the Analog function.

Front Panel Menu Reference	SCPI Command
Select **System\IO\Analog**. Check the Enable checkbox to turn on the analog function.	To turn on the analog function: EXT:PROG ON To turn off the analog function: EXT:PROG OFF

5. Input a high-level voltage of 3 V to Pin 9.
6. Input a low-level voltage of 1 V to Pin 10.
7. Switch the existing mode on the instrument to CV mode. Press [Menu] > Input > Mode > Voltage priority (CV).
8. Input 0 to 10 V voltage in Pin 8, and adjust the set value of the input voltage of this instrument.
   For example, when the input voltage of Pin 8 is 1 V, the set value of the input voltage for this instrument is 10 V. When the input voltage of Pin 8 is 5 V, the set value of the input voltage for this instrument is 50 V. This relationship follows the linear equation y=Mx+b.

Voltage Monitoring and Current Monitoring

The analog interface can monitor the existing input voltage and input current. Connect a digital voltmeter between Pin 5 and Pin 6 of the analog interface and ground Pin 4. The voltage reading from -10 to 10 V corresponds to the zero to full-scale voltage/current setting of the instrument. The connection diagram is as shown below:



System-Related Operations

Though not directly related to output programming, the following functions also control instrument operation.

Instrument Identification

You can query the model number, serial number, options, and firmware revision. SCPI commands return information with the *IDN? and *OPT? queries.

Front Panel Menu Reference	SCPI Command
Select **System\About**.	To return manufacturer, model number, serial number, and firmware revision: *IDN? To return the installed options: *OPT?

Instrument Operation Mode

You have the option to use the RP5900 Series either as a bidirectional power supply or electronic load.

Source – By default. In this mode, the instrument serves as a bidirectional power supply. It can output power at the maximum rated power indicated in the instrument specifications. It can also absorb electric energy at the maximum rated power and convert it into current, which is returned to the grid.

In this mode, the instrument can achieve a fast and continuous seamless switch between output and absorption current, which is useful for charging and discharging tests of the battery. For details, see Chapter 4, Programming the Source.

Load – In this mode, the instrument serves as an energy feedback electronic load. It only absorbs electric energy and converts it into current, which is returned to the local grid. For details, see Chapter 4, Programming the Load.

Front Panel Menu Reference	SCPI Command
Select **System\Emulation** to specify the operation mode.	Set the instrument to source mode: SYST:EMUL SOUR Set the instrument to load mode: SYST:EMUL LOAD

Instrument Reset

Selecting Reset lets you immediately return the instrument to its power-on settings (*RST) as described under Reset State.

Front Panel Menu Reference	SCPI Command
Select **States\Reset**. Press **Reset**.	Reset the instrument to its power-on settings: *RST

Instrument State Storage

The RPS has ten storage locations in non-volatile memory to store instrument states. The locations are numbered 0 through 9. Any state previously stored in the same location will be overwritten.

Front Panel Menu Reference	SCPI Command
Select **States\SaveRecall**. In the SaveRecall field, enter a location from 0 to 9. Then press **[Enter]**. Select Save to save the state to Recall to recall a state.	To save a state in location 1: *SAV 1 To recall a state from location 1: *RCL 1

Specifying a power-on state

When shipped, the instrument is configured to automatically recall the reset (*RST) settings at power-on. However, you can configure the RPS to use the settings you have stored in memory location 0 at power-on.

Front Panel Menu Reference	SCPI Command
Select **States\PowerOn**. Select Recall State 0. Then press **[Enter]**.	OUTP:PON:STAT RCL0

Enable sense

NOTE Always connect the sense cables before enabling remote sensing.

If remote sensing is enabled without the sense cables connected, the system will trigger a protection fault and activate the buzzer alarm. To stop the buzzer, clear the protection function.

When shipped, the instrument is configured for local sense measurement. Enable the sense to switch the instrument to remote sensing.

Front Panel Menu Reference	SCPI Command
Select **States\Sense**. Check the Enable Sense checkbox to turn on the sense.	To turn on the sense function: VOLT:SENS EXT

Enable Rzero (Applicable for Source mode only)

Rzero controls whether the voltage is quickly zeroed (source mode only) after the output is turned off.

Front Panel Menu Reference	SCPI Command
Select **States\Rzero**. Check the Enable Rzero checkbox to turn on the Rzero.	To turn on the Rzero function: SYST:VOLT:RZER ON

Front Panel Display

Specifying the display brightness

Brightness adjusts the display brightness. Use the navigation keys or numeric keypad to adjust the level of display brightness and press [Enter] to confirm the settings.

Brightness can be configured from 1 to 6.

Front Panel Menu Reference	SCPI Command
Select **System\Preferences**. Select Brightness and enter a value. Then press **[Enter]**.	To set the brightness to 6: SYST:BRIG:LEV 6

Sound

Beep enables or disables the beeper or click sound when an error is generated from the front panel or remote interface, when the instrument is under protection state, and front panel key clicks.

Front Panel Menu Reference	SCPI Command
Select **System\Preferences**. Check Enable Beep checkbox to enable the beeper.	To enable beeper SYST:BEEP:STAT ON Set the beeper to sound once SYST:BEEP

Clock Setup

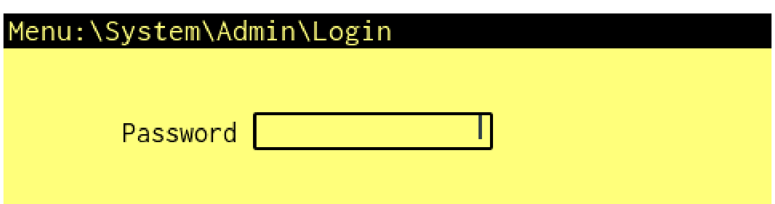
The real-time clock is used to provide time stamp information when used with optional Keysight software products, which is its only function. When shipped, the real-time clock is set to Greenwich mean time. To set the clock:

Front Panel Menu Reference	**SCPI Command**
Select **System\Preferences**. Select Date. Use the navigation keys and numeric keypad to enter the time in the field. Press **[Enter]**. Select Time. Use the navigation keys and numeric keypad to enter the time in the field. Press **[Enter]**.	To set the date: SYST:DATE 2018,06,30 To set the time: SYST:TIME 20,30,0

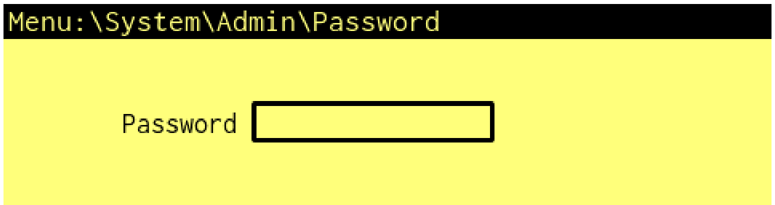
Password Protection

You can password-protect all functions located in the Admin menu. These include: instrument calibration, interface access, non-volatile memory reset, firmware update, password updates, and data storage.

As shipped, the Admin menu password is 0 (zero). Simply select **System\Admin\Login**.



To password-protect or change the password for the Admin menu, log into the Admin menu and select Password. Select a password that is numeric and up to 15 digits long. Enter it into the Password field and then press [Enter].



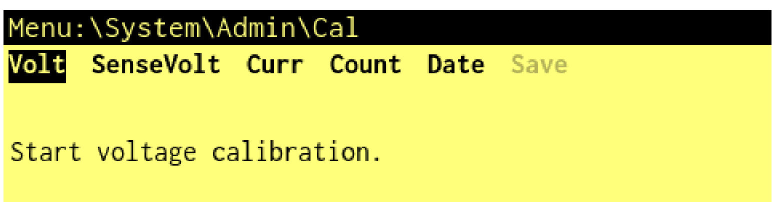
When done, go to Admin Login/Logout to log out of the menu and activate the password. You can now only enter the Admin menu by providing the new password.

Front Panel Menu Reference	SCPI Command
To login to Admin menu, select **System\Admin\Login**. Enter the password (0) and press **[Enter]**.	Enter calibration mode using the original password CAL:SEC:STAT OFF, "0"
To change the password, select **System\Admin\Password** Enter a numeric password, up to 15 digits long. Then press **[Enter]**.	To change the password to 50 CAL:SEC:CODE "50"
Log out of the Admin menu to activate the password. You can now only enter the Admin menu by providing the correct password in the Password field.	To exit calibration mode and activate the password: CAL:SEC:STAT ON, "0"

Calibration

Calibration accesses the instrument calibration procedure.

Press Cal to open the calibration menu. Make sure you have run the self-test before performing any calibration. Refer to "Calibration Procedures" in the Chapter 6 for details.

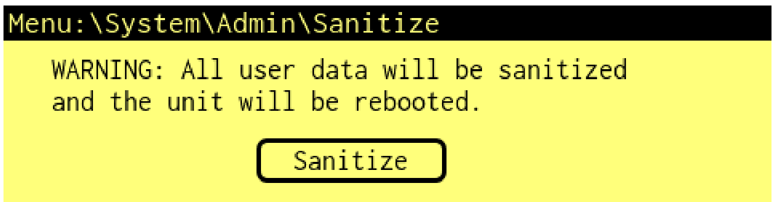


Sanitize

NOTE This procedure is not recommended for use in routine applications because of the possibility of unintended loss of data.

Sanitize removes all user-data from the instrument and restores the factory-shipped settings. Refer to Non-Volatile Settings for a list of the factory settings.

This procedure is typically used to prepare the instrument for removal from a secure area. It writes all zeros to flash memory and then performs a full chip erase as per the manufacturer's data sheet. Identification data such as instrument firmware, model number, serial number, MAC address, and calibration data is not erased. After the data is cleared, the instrument is rebooted.



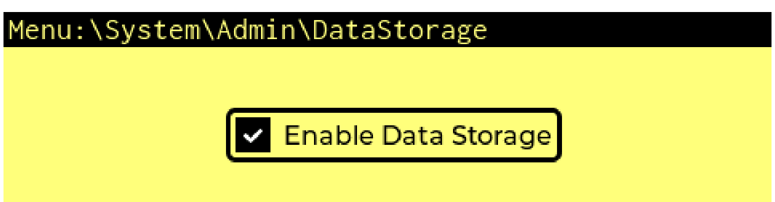
Front Panel Menu Reference	SCPI Command
Select **System\Admin\Sanitize** Press **Sanitize**.	To sanitize the instrument SYST:SEC:IMM

Firmware Update

You can update the firmware from the front panel using USB drive. Refer to Firmware Update for more information.

Non-volatile Data Storage

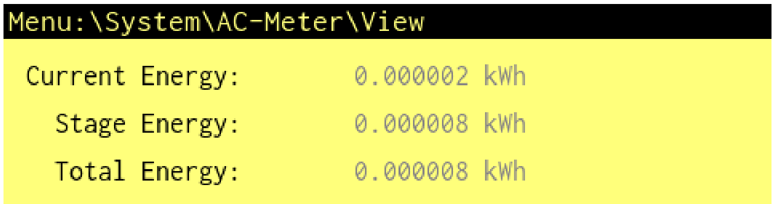
Data Storage enables or disables the non-volatile data storage for all user settings and data.



Front Panel Menu Reference	SCPI Command
Select **System\Admin\DataStorage**. Check the Enable Data Storage checkbox to enable non-volatile data storage.	Not available

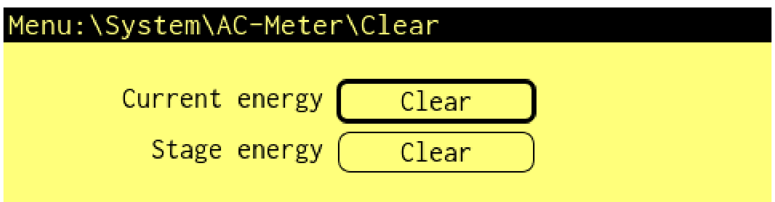
Observe the Power Grid Information

The regenerative power value can be observed on the front panel. This includes voltage, frequency, and power, as well as total power, total current regeneration, and total historical regenerative power.



Front Panel Menu Reference	SCPI Command
Select **System\AC-Meter\View** to view the power grid information.	Not available

Clear the grid information



Front Panel Menu Reference	SCPI Command
Select **System\AC-Meter\Clear.** On Current energy, press **Clear** to clear the current energy. On Stage energy, press **Clear** to clear the stage energy.	To clear the stage energy data: SENS:ACM:EACS:RES To clear the current energy data: SENS:ACM:CURR:RES

5
SCPI Programming Reference

Related Software

PW9252A Pathwave Advanced Power Control and Analysis Software

The PW9252A PathWave Advanced Power Control and Analysis App gives you fast and easy access to the advanced sourcing and measurement functionality of your RP5900 Series Regenerative Power Supply without any programming. PW9252A allows flexibility on the number of instrument connections by just purchase the number of licenses based on the number of connecting instruments. They are flexible tools for any application and allow you to control any RP5900 Series model via LAN, GPIB, and USB interface. The software can also control other Keysight power supplies, including the popular N6700 modules, the N6705 DC Power Analyzer, the N7900 Advanced Power Supplies, and the RP7900 Series Regenerative Power System. Learn more and download a free trail at: www.keysight.com/find/PW9252A.

PW9253A PathWave Advanced Battery Test and Emulation Software

The Keysight PW9253A PathWave Advanced Battery Test and Emulation App provides a test environment for you to easily run battery tests, generate battery models, and perform battery emulation using one or more Keysight two-quadrant power supplies. The emulation function allows you to quickly output the desired battery operation conditions. It allows you to cover various test scenarios without waiting for a real battery to go through discharging or charging conditions. PW9253A allows flexibility on the number of instrument connections by just purchase the number of licenses based on the number of connecting instruments. The software can also control other Keysight power supplies, including the popular N6700 modules, the N6705 DC Power Analyzer, the N7900 Advanced Power Supplies, and the RP7900 Series Regenerative Power System. Learn more and download a free trail at: www.keysight.com/find/PW9253A.

IO Libraries and Instrument Drivers

You can download the Keysight IO Libraries Suite software, along with IVI-COM and LabVIEW drivers from the Keysight Developer Network at www.keysight.com/find/adn.

Interface Documentation

For detailed information about interface connections, refer to the Keysight Technologies USB/LAN/GPIB Interfaces Connectivity Guide, included with the Keysight IO Libraries Suite. Or you can download the guide from the Web at www.keysight.com/find/connectivity.

Web Interface

The RPS provides a Web interface that is built into the instrument. You can use this interface over LAN for remote access and control of the instrument via a Web browser. See Using the Web Interface for details.

SCPI Introduction

Introduction

This instrument complies with the rules and conventions of the present SCPI version (see SYSTem:VERSion?).

SCPI (Standard Commands for Programmable Instruments) is an ASCII-based instrument command language designed for test and measurement instruments. SCPI has two types of commands, common and subsystem.

IEEE-488.2 Common Commands

The IEEE-488.2 standard defines a set of common commands that perform functions such as reset, self-test, and status operations. Common commands always begin with an asterisk (*), are three characters in length, and may include one or more parameters. The command keyword is separated from the first parameter by a blank space. Use a semicolon (;) to separate multiple commands as shown below:

Subsystem Commands

Subsystem commands perform specific instrument functions. They are comprised of alphabetically arranged commands that extend one or more levels below the root in a hierarchical structure, also known as a *tree system*. In this structure, associated commands are grouped together under a common node or root, thus forming *subsystems*. A portion of the OUTPut subsystem is shown below to illustrate the tree system. Note that some [optional] commands have been included for clarity.

```
OUTPut
      [:STATe] OFF|0|ON|1
      :DELay
            :FALL <value>|MIN|MAX
            :RISE <value>|MIN|MAX
      :INHibit
            :MODE LATChing|LIVE|OFF
```

Keywords

Keywords, also referred to as headers, are instructions recognized by the instrument. Common commands are also keywords.

OUTPut is the root keyword, DELay is a second-level keyword, FALL and RISE are third-level keywords. Colons (:) separate the keyword levels.

The command syntax shows most commands (and some parameters) as a mixture of upper- and lower-case letters. The upper-case letters indicate the abbreviated spelling for the command. For shorter program lines, you can send the abbreviated form. For better program readability, you can send the long form.

In the above examples, OUTP and OUTPUT are both acceptable forms. You can use upper- or lower-case letters. Therefore, OUTPUT, outp, and Outp are all acceptable. Other forms such as OUT, are not valid and will generate an error.

Queries

Following a keyword with a question mark (?) turns it into a query (Example: VOLTage?, VOLTage:TRIGgered?). If a query contains parameters, place the query indicator at the end of the last keyword, before the parameters. Insert a space between the query indicator and the first parameter.

You can query the programmed value of most parameters. For example, you can query the previously set OUTPut:DELay:FALL time by sending:

```
OUTPut:DELay:FALL?
```

You can also query the minimum or maximum allowable fall time as follows:

```
OUTPut:DELay:FALL? MIN
OUTPut:DELay:FALL? MAX
```

You must read back all the results of a query before sending another command to the instrument. Otherwise, a *Query Interrupted* error will occur and the unreturned data will be lost.

Command Separators and Terminators

Separators

Colons (:) separate keyword levels. Blank spaces must be used to separate command parameters from their corresponding keyword. If a command requires more than one parameter, use a comma to separate adjacent parameters. In the following example, the *step* and *value*parameters must be separated with a comma. Note the space between LIST:CURR and the first parameter.

```
LIST:CURR <step>, <value>
```

Semicolons (;) separate commands within the same subsystem. This lets you send several subsystem commands within the same message string. For example, sending the following command string:

```
OUTPut:STATe ON;DELay:RISE 1;FALL 2
```

is the same as sending the following commands:

```
OUTPut ON
OUTPut:DELay:RISE 1
OUTPut:DELay;FALL 2
```

Note that the semicolon follows the implied path of the hierarchical tree structure. In the above example, the optional :STATe keyword must follow the OUTPut keyword to place the command parser at the second level in the hierarchy. This allows the use of the DELay keyword after the semicolon, since DELay is a second-level keyword. Next, the command parser is placed at the third level in the hierarchy by the :RISE keyword. This allows the use of the FALL keyword after the second semicolon, since FALL is a third-level keyword.

You can also combine commands of different subsystems within the same message string. In this case, you must use a colon to return the command parser to the root level in order to access another subsystem. For example, you could clear the output protection and check the status of the Operation Condition register in one message by using a root specifier as follows:

```
OUTPut:PROTection:CLEar;:STATus:OPERation :CONDition?
```

Note the use of the colon *after* the semicolon in order to return the command parser to the root.

Terminators

A command string sent to the instrument must terminate with a new line (<NL>) character. The IEEE-488 EOI (End-Or-Identify) message is interpreted as a <NL> character and can be used to terminate a command string in place of an <NL>. A carriage return followed by a new line (<CR><NL>) is also accepted. Command string termination will always reset the current SCPI command path to the root level.

Syntax Conventions

- Triangle brackets (< >) indicate that you must specify a value for the enclosed parameter. For example, in the OUTPut:DELay syntax statements shown above, the <*value*> parameter is enclosed in triangle brackets. The brackets are not sent with the command string. You must specify a value for the parameter (Example: "OUTP:DEL:FALL 0.1") unless you select another option shown in the syntax (Example: "OUTP:DEL:FALL MIN").
- A vertical bar (|) separates multiple parameter choices for a given command string. For example, LATChing|LIVE|OFF in the OUTPut:INHibit command indicates that you can specify "LATChing", "LIVE", or "OFF". The bar is not sent with the command string.

- Square brackets ([ ]) enclose some syntax elements - nodes and parameters for example. This indicates that the element is optional and can be omitted. The brackets are not sent with the command string. In the case of an optional parameter, if you do not specify a value for an optional parameter the instrument will ignore the parameter. In the FETCh:CURRent? example above, the optional <startindex> and <points> parameters let you return array data starting at startindex and containing the specified number of data points. If these parameters are not specified, the query returns all of the array data.
- Braces ({ }) indicate parameters that may be repeated zero or more times. It is used especially for showing lists. The notation <value>{,<value>} shows that the first value must be entered, while additional values may be omitted or may be entered one or more times.

Parameter Types

The SCPI language defines several data formats to be used in commands and queries.

Numeric Parameters

Commands that require numeric parameters will accept all commonly used decimal representations of numbers including optional signs, decimal points, and scientific notation. If a command accepts only certain specific values, the instrument will automatically round the input numeric parameters to the accepted values. The following command requires a numeric parameter for the voltage value:

```
[SOURce:]VOLTage 50V|MIN|MAX|DEF
```

Note that special values for numeric parameters such as MINimum, MAXimum, and INFinity are also accepted. Instead of selecting a specific value for the voltage parameter, you can substitute MIN to set the voltage to its minimum allowable value, MAX to set it to its maximum allowable value.

You can also send engineering unit suffixes with numeric parameters (e.g., V for volts, A for amperes, W for Watts). All parameters values are in base units.

Discrete Parameters

Discrete parameters are used to program settings that have a limited number of values (like IMMediate, EXTernal, or BUS). They may have a short form and a long form just like command keywords. You can use upper- or lower-case letters. Query responses will always return the short form in all upper-case letters. The following command requires a discrete parameter for the display settings:

```
DISPlay:VIEW METER_VI|METER_VP|METER_VIP
```

Boolean Parameters

Boolean parameters represent a single binary condition that is either true or false. For a false condition, the instrument will accept "OFF" or "0". For a true condition, the instrument will accept "ON" or "1". When you query a Boolean setting, the instrument will always return "0" or "1". The following command requires a Boolean parameter:

```
DISPlay OFF|0|ON|1
```

ASCII String Parameters

String parameters can contain virtually any set of ASCII characters. A string must begin and end with matching quotes; either with a single quote or a double quote. You can include the quote delimiter as part of the string by typing it twice without any characters in between. The following command uses a string parameter:

```
CALibrate:DATE "12/12/12"
```

Arbitrary Block Program or Response Data

Definite-length block data <Block> allows any type of device-dependent data to be programmed or returned as a series of 8-bit binary data bytes. This is particularly useful for transferring large quantities of data or 8-bit extended ASCII codes.

Device Clear

Device Clear is an IEEE-488 low-level bus message that you can use to return the instrument to a responsive state. Different programming languages and IEEE-488 interface cards provide access to this capability through their own unique commands. The status registers, the error queue, and all configuration states are left unchanged when a Device Clear message is received.

Device Clear performs the following actions:

- If a measurement is in progress, it is aborted.
- The instrument returns to the trigger idle state.
- The instrument's input and output buffers are cleared.
- The instrument is prepared to accept a new command string.

NOTE The ABORt command is the recommended method to terminate an instrument operation.

Programming Ranges

Model	Voltage (V)		Current (A)		Power (kW)		Resistance (Ω)			
							Source mode		Load mode	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
RP5913A	0	80.8	-40.4	40.4	-2.04	2.04	0	0 to 0.3	0.03	2400
RP5923A		80.8	-80.8	80.8	-4.08	4.08		0 to 0.3	0.015	1200
RP5933A		80.8	-121.2	121.2	-6.12	6.12		0 to 0.3	0.01	800
RP5943A		80.8	-242.4	242.4	-12.24	12.24		0 to 0.3	0.005	400
RP5915A		505	-12.12	12.12	-2.04	2.04		0 to 1	0.3	15k
RP5925A		505	-24.24	24.24	-4.08	4.08		0 to 1	0.15	7.5k
RP5935A		505	-36.36	36.36	-6.12	6.12		0 to 1	0.1	5k
RP5945A		505	-72.72	72.72	-12.24	12.24		0 to 1	0.05	2.5k
RP5916A		808	-8.08	8.08	-2.04	2.04		0 to 1	0.45	22.5k
RP5926A		808	-16.16	16.16	-4.08	4.08		0 to 1	0.22	11.25k
RP5936A		808	-24.24	24.24	-6.12	6.12		0 to 1	0.15	7.5k
RP5946A		808	-48.48	48.48	-12.24	12.24		0 to 1	0.08	3.75k

Model	Slew Time (s)		Current Slew Rate (A/ms)		Voltage Slew Rate (V/ms)	
	Source mode		Load mode			
	Min	Max	Min	Max	Min	Max
RP5913A		8000		10		10
RP5923A		8000		20		10
RP5933A		8000		30		10
RP5943A		8000		60		10
RP5915A	0	8000	0.001	3	0.001	50
RP5925A		8000		6		50
RP5935A		8000		9		50
RP5945A		8000		18		50
RP5916A		8000		2		33
RP5926A		8000		4		33
RP5936A		8000		6		33
RP5946A		8000		12		33

Commands by Subsystem

ABORt Subsystem

Abort commands cancel any triggered actions and returns the trigger system back to the Idle state. Abort commands are also executed with the *RST command.

ABORt:ACQuire
ABORt:ARB
ABORt:DLOG
ABORt:ELOG
ABORt:LIST

ABORt:ACQuire – Cancels any triggered measurements. It also resets the WTG-meas and MEAS-active bits in the Operation Status registers.

ABORt:ARB – Stops the ARB commands. It also resets the WTG-meas and MEAS-active bits in the Operation Status registers.

ABORt:DLOG – Stops data logging. It also resets the WTG-meas and MEAS-active bits in the Operation Status registers.

ABORt:ELOG – Stops external data logging. It also resets the WTG-meas and MEAS-active bits in the Operation Status registers.

ABORt:LIST – Stops the LIST commands. It also resets the WTG-meas and MEAS-active bits in the Operation Status registers.

Parameter	Typical Return
(none)	(none)
Aborts the triggered measurement: ABOR:ACQ	

ARB Subsystem

ARB commands program the pulse, sine wave, user-defined waveform, constant-dwell waveform, exponential waveform, ramp waveform and the sequence of arbitrary waveforms.

Constant-Dwell

Exponential

Pulse

Ramp

Sequence

Sinusoid

User-Defined

[SOURce:]ARB:COUNt <*value*>|MINinimum|MAXimum|DEFault|INFinity [SOURce:]ARB:COUNt? [MINimum|MAXimum|DEFault]

Specifies the number of times the Arb repeats. Use the INFinity parameter to repeat the Arb continuously.

Parameter	Typical Return
1 – 9999999, *RST 1	<count>
Programs a repeat count of 10: ARB:COUN 10	

Remarks

- ARB:FUNCtion:SHAPe must be set before ARB:COUNt.
- This parameter for each waveform type is configured and stored independently, and they do not affect each other.

[SOURce:]ARB:EXE:STATe?

Queries the status of the ARB:

IDLE	ARB is in idle state
WTG	ARB is waiting to be triggered
RUN	ARB is running
END	ARB operation is completed

Parameter	Typical Return
(none)	IDLE|WTG|RUN|END
Queries the status of the ARB: ARB:EXE:STAT	

[SOURce:]ARB:FUNCtion:SHAPe PULSe|SINusoid|UDEFined|CDWell|SEQuence|RAMP|EXPonential [SOURce:]ARB:FUNCtion:SHAPe?

Sets the function of the arbitrary waveform generator as follows:

PULSe	Specifies a pulse
SINusoid	Specifies a sine wave
UDEFined	Specifies a user-defined waveform
CDWell	Specifies a constant-dwell waveform
SEQuence	Specifies a sequence of arbitrary waveforms
RAMP	Specifies a ramp waveform
EXPonential	Specifies a exponential waveform

Parameter	Typical Return
PULSe|SINusoidv|UNEFined|CDWell|SEQuence|RAMP|EXPonential, *RST CDW	(none)
Specifies a sine wave: ARB:FUNC:SHAP SIN	

Remarks

– Set the ARB:FUNCtion:SHAPe before editing any of the arbitrary parameters such as ARB:COUNt and the subsequent waveform.

[SOURce:]ARB:FUNCtion:TYPE CURRent|VOLTage [SOURce:]ARB:FUNCtion:TYPE?

Specifies either a voltage or current Arb. Only one type of Arb may be output at a time. The selection must match the priority mode.

Parameter	Typical Return
Source mode: CURRent|VOLTage, *RST VOLTage Load mode: CURRent|VOLTage, *RST CURRent	VOLT or CURR
Specifies a voltage Arb: ARB:FUNC:TYPE VOLT	

[SOURce:]ARB:RECall <*value*>
[SOURce:]ARB:SAVE <*value*>

Saves or recalls the edited ARB file with the file name file.csv.

Parameter	Typical Return
1 – 10	(none)
Saves a Arb file: ARB:SAVE	

[SOURce:]ARB:TERMinate:LAST 0|OFF|1|ON
[SOURce:]ARB:TERMinate:LAST?

Selects the output setting after the Arb ends. When ON (1), the output voltage or current remains at the last Arb value. The last Arb voltage or current value becomes the IMMediate value when the ARB completes. When OFF (0), and also when the Arb is aborted, the output returns to the settings that were in effect before the Arb started.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Terminates with the output at the last Arb value: ARB:TERM:LAST ON	

[SOURce:]ARB:TRIgout 0|OFF|1|ON
[SOURce:]ARB:TRIgout?

Selects the trigger output of ARB. When ON (1), turn on the trigger output. When OFF (0), turn off the trigger output.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Turns on the trigger output: ARB:TRI ON	

[SOURce:]ARB:ZOOM:COF <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:ZOOM:COF? [MINimum|MAXimum|DEFault]

Sets the ARB scaling factor to change the amplitude of the ARB. The default scaling factor is 1.

Parameter	Typical Return
0.01 – 100, *RST 1	(none)
Sets 5 as the ARB scaling factor: ARB:ZOOM:COF 5	

[SOURce:]ARB:ZOOM:LIMIt:NEGative <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:ZOOM:LIMIt:NEGative? [MINimum|MAXimum|DEFault]

Sets the lower limit of ARB.

Parameter	Typical Return
Source mode: CC: -Imax – 0 , *RST -Imax CV: 0 – Vmax, *RST 0 Load mode: CC: 0 – Imax , *RST 0 CV: 0 – Vmax, *RST 0	(none)
Sets 5 as the lower limit of ARB scaling: `ARB:ZOOM:LIM:NEG 5`	

[SOURce:]ARB:ZOOM:LIMIt:POSitive <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:ZOOM:LIMIt:POSitive? [MINimum|MAXimum|DEFault]

Sets the upper limit of ARB.

Parameter	Typical Return
Source mode: CC: Imax/100 – Imax, *RST Imax CV: Vmax/100 – Vmax, *RST Vmax Load mode: CC: 0 – Imax, *RST Imax CV: Vmax/100 – Vmax, *RST Vmax	(none)
Sets 5 as the upper limit of ARB: `ARB:ZOOM:LIMI:POS 5`	

Constant-Dwell

Back to Arb Commands

[SOURce:]ARB:CDWell:DWELl <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:CDWell:DWELl? [MINimum|MAXimum|DEFault]

Specifies the dwell time of each point in the Arb.

Parameter	Typical Return
0.001 s – 3600 s, *RST 0.001 s	<dwell value>
Programs a constant dwell time of 0.2 seconds: ARB:CDW:DWEL 0.2	

Remarks

- You can program dwell times that are much faster than the response time of the instrument. The "extra" points and dwell times can serve the purpose of smoothing the resultant waveform.
- Use the ARB:CDWell:POINts to set the number of points before specifying other parameters in constant dwell Arb.
- Use the ARB:SEQuence:CDWell:POINts to set the number of points before specifying other parameters in constant dwell Arb for Arb sequence steps.

[SOURce:]ARB:CDWell[:LEVel] <step#>,<*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:CDWell[:LEVel]?<*step#*>

Specifies the level of each point in the constant-dwell Arb. Values are specified in either amperes or volts. The minimum and maximum values depend on the ratings of the unit. A comma-delimited list of up to 65,535 points may be programmed.

[SOURce:]ARB:SEQuence:CDWell:LEVel <step#>,<*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:CDWell:LEVel?<*step#*>[,MINimum|MAXimum|DEFault]

Specifies the level of each point in the constant-dwell Arb for Arb sequence steps. Values are specified in either amperes or volts. The minimum and maximum values depend on the ratings of the unit. A comma-delimited list of up to 65,535 points may be programmed.

Parameter	Typical Return
Step : 1 – 65535, *RST 1	(none)
Source mode: CC: Imin – Imax, *RST: Imax/100 CV: 0 – Vmax, *RST 0.2 Load mode: 0 – Imax|Vmax, *RST 0	<dwell level>
Programs a constant dwell level of 0.2: ARB:CDW:LEV 0.2 Programs a constant dwell level of 0.2 for step 1: ARB:CDW:LEV 1,0.2	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb.
- Use the ARB:CDWell:POINts to set the number of points before specifying other parameters in constant dwell Arb.
- Use the ARB:SEQuence:CDWell:POINts to set the number of points before specifying other parameters in constant dwell Arb for Arb sequence steps.

[SOURce:]ARB:CDWell:POINts <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:CDWell:POINts? [MINimum|MAXimum|DEFault]

Specifies the number of points in the constant-dwell Arb.

[SOURce:]ARB:SEQuence:CDWell:POINts <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:SEQuence:CDWell:POINts? [MINimum|MAXimum|DEFault]

Specifies the number of points in the constant-dwell Arb for Arb sequence steps. Set the number of points first before proceeding to set other sequence constant-dwell parameters.

Parameter	Typical Return
1 – 65535, *RST 1	<points>
Programs the number of points to 5: ARB:CDW:POIN 5 Programs the number of points to 5 in Arb sequence: ARB:SEQ:CDW:POIN 5	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb.
- Use the ARB:CDWell:POINts to set the number of points before specifying other parameters in constant dwell Arb.
- Use the ARB:SEQuence:CDWell:POINts to set the number of points before specifying other parameters in constant dwell Arb for Arb sequence steps.

[SOURce:]ARB:CDWell:STOP

Terminates the output of the constant-dwell Arb and terminates after all the transmitted data has been executed. Unlike the ABORt:ARB command, ABOR:ARB is stopped immediately.

Parameter	Typical Return
(none)	(none)
Terminates the output of the Arb: ARB:CDW:STOP	

[SOURce:]ARB:SEQuence:CDWell:WIDth <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:SEQuence:CDWell:WIDth? [MINimum|MAXimum|DEFault]

Specifies the time width (dwell time) of each point in the constant-dwell Arb for Arb sequence, in seconds.

Parameter	Typical Return
0.001 – 3600, *RST 0.001	<dwell time>
Sets the time width: ARB:SEQ:CDW:WID	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .
- Use the ARB:SEQuence:CDWell:POINts to set the number of points before specifying other parameters in constant dwell Arb for Arb sequence steps.

EXPonential

Back to Arb Commands

[SOURce:]ARB:EXPonential:END[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:EXPonential:END[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the ending current or voltage level after the exponential waveform ends.

[SOURce:]ARB:SEQuence:EXPonential:END[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:EXPonential:END[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the ending current or voltage level after the exponential waveform ends for the selected step in Arb sequence.

Parameter	Typical Return
CC: Imin – Imax, *RST Imax/100 CV: 0 – Vmax, *RST 0.2	<end value>
Sets 20 as the ending level: `ARB:RAMP:STAR 20`	

[SOURce:]ARB:EXPonential:STARt[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:EXPonential:STARt[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the initial current or voltage level when the exponential waveform starts.

[SOURce:]ARB:SEQuence:EXPonential:STARt[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:EXPonential:STARt[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the initial current or voltage level when the exponential waveform starts for the selected step in Arb sequence.

Parameter	Typical Return
CC: Imin – Imax, *RST Imax/100 CV: 0 – Vmax, *RST 0.2	<start value>
Sets 5 as the initial level: `ARB:RAMP:STAR 5`	

[SOURce:]ARB:EXPonential:STARt:TIMe <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:EXPonential:STARt:TIMe? [MINimum|MAXimum|DEFault]

Specifies the delay in seconds after the trigger is received, but before the exponential waveform occurs.

[SOURce:]ARB:SEQuence:EXPonential:STARt:TIMe <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:SEQuence:EXPonential:STARt:TIMe? [MINimum|MAXimum|DEFault]

Specifies the delay in seconds after the trigger is received, but before the exponential waveform occurs for the selected step in Arb sequence.

Parameter	Typical Return
0.001 – 21000, *RST 1	<start time>
Sets a start time of 1 s: ARB:RAMP:STAR:TIM 1	

[SOURce:]ARB:EXPonential:TCONstant <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:EXPonential:TCONstant? [MINimum|MAXimum|DEFault]

Specifies the time constant of the exponential curve.

[SOURce:]ARB:SEQuence:EXPonential:TCONstant <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:SEQuence:EXPonential:TCONstant? [MINimum|MAXimum|DEFault]

Specifies the time constant of the exponential curve for the selected step in Arb sequence.

Parameter	Typical Return
0.001 – 21000, *RST 1	<time constant>
Sets a time constant of 5 s: ARB:RAMP:RTIM 5	

[SOURce:]ARB:EXPonential:TIMe <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:EXPonential:TIMe? [MINimum|MAXimum|DEFault]

Specifies the total time for the current or voltage to go from the starting level to the ending level in seconds.

[SOURce:]ARB:SEQuence:EXPonential:TIMe <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:EXPonential:TIMe? [MINimum|MAXimum|DEFault]

Specifies the total time for the current or voltage to go from the starting level to the ending level in seconds for the selected step in Arb sequence.

Parameter	Typical Return
0.001 – 21000, *RST 1	<total time>
Sets a time of 10 s for the waveform: ARB:RAMP:TIM 10	

Pulse

Back to Arb Commands

[SOURce:]ARB:PULSe:END:SLEW <*value*>|MINimum|MAXimum|DEFault Load Mode only
[SOURce:]ARB:PULSe:END:SLEW? [MINimum|MAXimum|DEFault]

Specifies the slew rate at the end of the pulse signal.

[SOURce:]ARB:SEQuence:PULSe:END:SLEW <*value*>|MINimum|MAXimum|DEFault Load Mode only
[SOURce:]ARB:SEQuence:PULSe:END:SLEW? [MINimum|MAXimum|DEFault]

Specifies the slew rate at the end of pulse signal for the selected step in Arb sequence.

Parameter	Typical Return
Load mode: 0.001 – MAX (The maximum value is product dependent), *RST MAX	<slew rate>
Specifies the pulse end slew rate: ARB:PULS:END:SLEW 1 Specifies the pulse end slew rate in Arb sequence: ARB:SEQ:PULS:END:SLEW 1	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

[SOURce:]ARB:PULSe:END:SLEW:TIME <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]ARB:PULSe:END:SLEW:TIME? [MINimum|MAXimum|DEFault]

Specifies the slew time at the end of the pulse signal in seconds.

[SOURce:]ARB:SEQuence:PULSe:END:SLEW:TIME <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]ARB:SEQuence:PULSe:END:SLEW:TIME? [MINimum|MAXimum|DEFault]

Specifies the slew time at the end of pulse signal for the selected step in Arb sequence.

Parameter	Typical Return
0 – 8000, *RST 0.1	<slew time>
Specifies the pulse end slew time: ARB:PULS:END:SLEW:TIME 1 Specifies the pulse end slew time in Arb sequence: ARB:SEQ:PULS:END:SLEW:TIME 1	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

[SOURce:]ARB:PULSe:END:TIME <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:PULSe:END:TIME? [MINimum|MAXimum|DEFault]

Specifies the time in seconds, after the pulse completes.

[SOURce:]ARB:SEQuence:PULSe:END:TIME <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:PULSe:END:TIME? [MINimum|MAXimum|DEFault]

Specifies the time in seconds, after the pulse completes for the selected step in Arb sequence.

Parameter	Typical Return
0.001 – 3600, *RST 0.001	<time>
Specifies a pulse end time: ARB:PULS:END:TIME 1 Specifies a pulse end time in Arb sequence: ARB:SEQ:PULS:END:TIME 1	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

[SOURce:]ARB:PULSe:STARt[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:PULSe:STARt[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the initial amplitude of the pulse signal.

[SOURce:]ARB:SEQuence:PULSe:STARt[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:PULSe:STARt[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the initial amplitude of the pulse signal for the selected step in Arb sequence.

Parameter	Typical Return
Source mode: CC: -Imin – +Imax, *RST Imax/100 CV: 0 – Vmax, *RST 0.2 Load mode: 0 – Imax|Vmax, *RST 0	<amplitude>
Specifies a pulse start level: ARB:PULS:STAR:LEV 1	

Remarks

– Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

[SOURce:]ARB:PULSe:STARt:SLEW <*value*>|MINimum|MAXimum|DEFault Load Mode only
[SOURce:]ARB:PULSe:STARt:SLEW? [MINimum|MAXimum|DEFault]

Specifies the slew rate at the start of the pulse signal.

[SOURce:]ARB:SEQuence:PULSe:STARt:SLEW <*value*>|MINimum|MAXimum|DEFault Load Mode only
[SOURce:]ARB:SEQuence:PULSe:STARt:SLEW? [MINimum|MAXimum|DEFault]

Specifies the slew rate at the start of the pulse signal for the selected step in Arb sequence.

Parameter	Typical Return
Load mode: 0.001 – MAX (The maximum value is product dependent), *RST MAX	<slew>
Specifies pulse start slew rate: ARB:PULS:STAR:SLEW 1 Specifies pulse start slew rate in Arb sequence: ARB:SEQ:PULS:STAR:SLEW 1	

Remarks

– Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

[SOURce:]ARB:PULSe:STARt:SLEW:TIME <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]ARB:PULSe:STARt:SLEW:TIME? [MINimum|MAXimum|DEFault]

Specifies the slew time at the start of the pulse signal in seconds.

[SOURce:]ARB:SEQuence:PULSe:STARt:SLEW:TIME <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]ARB:SEQuence:PULSe:STARt:SLEW:TIME? [MINimum|MAXimum|DEFault]

Specifies the slew time at the start of the pulse signal for the selected step in Arb sequence.

Parameter	Typical Return
Source mode: 0 – 8000, *RST 0.1	<slew time>
Specifies pulse start slew time: ARB:PULS:STAR:SLEW:TIME 1 Specifies pulse start slew time in Arb sequence: ARB:SEQ:PULS:STAR:SLEW:TIME 1	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

[SOURce:]ARB:PULSe:STARt:TIME <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:PULSe:STARt:TIME? [MINimum|MAXimum|DEFault]

Specifies the delay in seconds after the trigger is received, but before the pulse occurs.

[SOURce:]ARB:SEQuence:PULSe:STARt:TIME <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:PULSe:STARt:TIME? [MINimum|MAXimum|DEFault]

Specifies the delay in seconds after the trigger is received, but before the pulse occurs for the selected step in Arb sequence.

Parameter	Typical Return
0.001 – 3600, *RST 0.001 s	<time>
Specifies a pulse Arb time: ARB:PULS:STAR:TIME 1 Specifies a pulse Arb time in Arb sequence: ARB:SEQ:PULS:STAR:TIME 1	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

[SOURce:]ARB:PULSe:TOP[:LEVel] <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:PULSe:TOP[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the amplitude at the top of the pulse signal.

[SOURce:]ARB:SEQuence:PULSe:TOP:LEVel <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:SEQuence:PULSe:TOP:LEVel? [MINimum|MAXimum|DEFault]

Specifies the amplitude at the top of the pulse signal for the selected step in Arb sequence.

Parameter	Typical Return
Source mode: CC: Imin – Imax, *RST Imax/100 CV: 0 – Vmax, *RST 0.2 Load mode: 0 – Imax|Vmax, *RST 0	<amplitude>
Specifies a pulse Arb top level: ARB:PULS:TOP:LEV 1 Specifies a pulse Arb top level in Arb sequence: ARB:SEQ:PULS:TOP:LEV 1	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

[SOURce:]ARB:PULSe:TOP:TIME <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:PULSe:TOP:TIME? [MINimum|MAXimum|DEFault]

Specifies the top (high level) time width of the pulse signal in seconds.

[SOURce:]ARB:SEQuence:PULSe:TOP:TIME <*value*>|MINimum|MAXimum|DEFault[SOURce:]ARB:SEQuence:PULSe:TOP:TIME? [MINimum|MAXimum|DEFault]

Specifies the top (high level) time width of the pulse signal in seconds for the selected step in Arb sequence.

Parameter	Typical Return
0.001 – 3600, *RST 0.001	<time>
Specifies a pulse Arb time: ARB:PULS:TOP:TIME 1 Specifies a pulse Arb time in Arb sequence: ARB:SEQ:PULS:TOP:TIME 1	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

Sequence

Back to Arb Commands

[SOURce:]ARB:SEQuence:COUNt <*value*>|MINinimum|MAXimum|DEFault|INFinity[SOURce:]ARB:SEQuence:COUNt? [MINimum|MAXimum|DEFault]

Specifies the number of times that the Arb sequence is repeated. The repeat count range is 1 through infinity.

Parameter	Typical Return
1 – 9999999, *RST 1	<sequence count>
Sets the sequence count to 10: ARB:SEQ:COUN 10	

Remarks

- Set the ARB:SEQuence:FUNCtion and ARB:SEQuence:SELect before ARB:SEQuence:COUNt . This ensures the sequence is properly defined before assigning the repeat count.

[SOURce:]ARB:SEQuence:FUNCtion PULSe|SINusoid|UDEFined|CDWell [SOURce:]ARB:SEQuence:FUNCtion?

Selects the waveform type in the Arb sequence. The following waveforms may be assigned to a sequence step:

PULSe	Specifies a pulse
SINusoid	Specifies a sine wave
UDEFined	Specifies a user-defined waveform
CDwell	Specifies a constant-dwell waveform
RAMP	Specifies a ramp waveform
EXPonential	Specifies an exponential waveform

Parameter	Typical Return
PULSe|SINusoidv|UNEFined|CDWell|RAMP|EXPonential, *RST PULSe	PULS, SIN, UDEF, or CDW, RAMP. or EXP
Specifies a waveform type of a sequence: ARB:SEQ:FUNC SIN	

Remarks

- Set the ARB:SEQuence:SELect before specifying ARB:SEQuence:FUNCtion.

[SOURce:]ARB:SEQuence:LENGth <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:LENGth? [MINimum|MAXimum|DEFault]

Specifies the total length of the Arb sequence, which is the total number of steps including multiple waveforms.

Parameter	Typical Return
1 – 10, *RST 1	<number of steps>
Specifies the total sequence step to 7: ARB:SEQ:LENG 7	

Remarks

- Set the ARB:SEQuence:LENGth before specifying other parameters for Arb sequence. This ensures the sequence structure is initialized correctly before further configuration.

[SOURce:]ARB:SEQuence:PACing 0|OFF|1|ON
[SOURce:]ARB:SEQuence:PACing?

This command specifies the control of pacing for the arbitrary waveform sequence.

- ON: When pacing is turned on, the arbitrary waveform generator will insert a delay between each step of the sequence. This delay is typically used to synchronize the waveform with external events or to ensure that each step is executed at a specific time interval.

- OFF: When pacing is turned off, the arbitrary waveform generator will execute each step of the sequence immediately after the previous one without any additional delay.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	(none)
Selects the sequence pacing: ARB:SEQ:PAC ON	

[SOURce:]ARB:SEQuence:SELect <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:SELect? <*value*>|MINimum|MAXimum|DEFault

Selects the waveform step in the Arb sequence for edits. This value cannot exceed the sequence length specified in ARB:SEQuence:LENGth.

Parameter	Typical Return
1 – <specified sequence length>, *RST 1	(none)
Selects step 8 in Arb sequence: ARB:SEQ:SEL 8	

Remarks

- Set the ARB:SEQuence:LENGth before specifying ARB:SEQuence:SELect.
- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

Sinusoid

Back to Arb Commands

[SOURce:]ARB:SINusoid:AMPLitude <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:SINusoid:AMPLitude? [MINimum|MAXimum|DEFault]

Specifies the amplitude of the sine wave.

[SOURce:]ARB:SEQuence:SINusoid:AMPLitude <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:SEQuence:SINusoid:AMPLitude? [MINimum|MAXimum|DEFault]

Specifies the amplitude of the sine wave for the selected step in Arb sequence.

Parameter	Typical Return
Source mode: CC: Imin – Imax, *RST Imax/100 CV: 0 – Vmax, *RST 0.2 Load mode: 0 – Imax|Vmax, *RST 0	<amplitude>
Sets 5 as the amplitude sequence range: ARB:SEQ:SIN:AMPL 5	

[SOURce:]ARB:SINusoid:FREQuency <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:SINusoid:FREQuency? [MINimum|MAXimum|DEFault]

Specifies the frequency of the sine wave in Hertz.

[SOURce:]ARB:SEQuence:SINusoid:FREQuency <*value*>|MINimum|MAXimum|DEFault [SOURce:]ARB:SEQuence:SINusoid:FREQuency? [MINimum|MAXimum|DEFault]

Specifies the frequency of the sine wave in Hertz for the selected step in Arb sequence.

Parameter	Typical Return
1 – 100, *RST 50	<frequency>
Sets 5 as the frequency: ARB:SEQ:SIN:FREQ 5	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

[SOURce:]ARB:SINusoid:OFFSet <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SINusoid:OFFSet? [MINimum|MAXimum|DEFault]

Specifies the offset of the sine wave from zero.

[SOURce:]ARB:SEQuence:SINusoid:OFFSet <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:SINusoid:OFFSet? [MINimum|MAXimum|DEFault]

Specifies the offset of the sine wave from zero for the selected step in Arb sequence.

Parameter	Typical Return
Source mode: CC: Imin – Imax, *RST Imax/100 CV: 0 – Vmax, *RST 0.2 Load mode: 0 – Imax|Vmax, *RST 0	<offset>
Sets 5 as the offset sequence range: `ARB:SEQ:SIN:OFFS 5`	

Remarks

– Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

Ramp

Back to Arb Commands

[SOURce:]ARB:RAMP:END[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:RAMP:END[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the ending current or voltage after the ramp occurs.

[SOURce:]ARB:SEQuence:RAMP:END[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:RAMP:END[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the ending current or voltage after the ramp occurs for the selected step in Arb sequence.

Parameter	Typical Return
CC: Imin – Imax, *RST Imax/100 CV: 0 – Vmax, *RST 0.2	<end value>
Sets 20 as the ending level: `ARB:RAMP:STAR 20`	

[SOURce:]ARB:RAMP:STARt[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:RAMP:STARt[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the initial current or voltage before the ramp occurs.

[SOURce:]ARB:SEQuence:RAMP:STARt[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:RAMP:STARt[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the initial current or voltage before the ramp occurs for the selected step in Arb sequence.

Parameter	Typical Return
Source mode: CC: Imin – Imax, *RST Imax/100 CV: 0 – Vmax, *RST 0.2	<start value>
Sets 5 as the initial level: `ARB:RAMP:STAR 5`	

[SOURce:]ARB:RAMP:END:TIMe <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:RAMP:END:TIMe? [MINimum|MAXimum|DEFault]

Specifies the time in seconds, after the ramp completes, that the ending current or voltage level persists.

[SOURce:]ARB:SEQuence:RAMP:END:TIMe <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:RAMP:END:TIMe? [MINimum|MAXimum|DEFault]

Specifies the time in seconds, after the ramp completes, that the ending current or voltage level persists for the selected step in Arb sequence.

Parameter	Typical Return
0.001 – 21000, *RST 1	<end time>
Sets a end time of 2 s: `ARB:RAMP:END:TIM 2`	

[SOURce:]ARB:RAMP:RTIMe <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:RAMP:RTIMe? [MINimum|MAXimum|DEFault]

Specifies the rise time of the ramp in seconds.

[SOURce:]ARB:SEQuence:RAMP:RTIMe <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:RAMP:RTIMe? [MINimum|MAXimum|DEFault]

Specifies the rise time of the ramp in seconds for the selected step in Arb sequence.

Parameter	Typical Return
0.001 – 21000, *RST 1	<rise time>
Sets a rise time of 10 s: `ARB:RAMP:RTIM 10`	

[SOURce:]ARB:RAMP:STARt:TIMe <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:RAMP:STARt:TIMe? [MINimum|MAXimum|DEFault]

Specifies the delay in seconds after the trigger is received, but before the ramp occurs.

[SOURce:]ARB:SEQuence:RAMP:STARt:TIMe <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:RAMP:STARt:TIMe? [MINimum|MAXimum|DEFault]

Specifies the delay in seconds after the trigger is received, but before the ramp occurs for the selected step in Arb sequence.

Parameter	Typical Return
0.001 – 21000, *RST 1	<start time>
Sets a start time of 1 s: `ARB:RAMP:STAR:TIM 1`	

User-defined

Back to Arb Commands

[SOURce:]ARB:UDEFined:COUNt <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:UDEFined:COUNt? [MINimum|MAXimum|DEFault]

Specifies the total number of steps in the user-defined Arb.

[SOURce:]ARB:SEQuence:UDEFined:COUNt <*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:UDEFined:COUNt? [MINimum|MAXimum|DEFault]

Specifies the total number of steps in the user-defined Arb for the selected step in Arb sequence.

Parameter	Typical Return
Source mode: 1 – 200, *RST 2 Load mode: 1 – 200, *RST 2	<count>
Sets 6 as the number of steps in the list: ARB:SEQ:UDEF:COUN 6	

Remarks

- Make sure the number of steps in List is configured before setting the amplitude, time width and slope.
- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb.
- Use the ARB:UDEFined:COUNt or ARB:SEQuence:UDEFined:COUNt to specify the total number of steps before specifying other parameters for the user-defined Arb.

[SOURce:]ARB:UDEFined:DWELl <*step#*>,<*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:UDEFined:DWELl? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the step dwell time of the user-defined waveform in seconds.

[SOURce:]ARB:SEQuence:UDEFined:DWELl <*step#*>,<*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:UDEFined:DWELl? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the step dwell time of the user-defined waveform for the selected step in Arb sequence, in seconds.

Parameter	Typical Return
Step: 1 – 200	(none)
Dwell time: Source mode: 0.001 – 21000, *RST 1 Load mode: 0.001 – 21000, *RST 0.001	<dwell>

Parameter	Typical Return
Sets the dwell time for step 2 in user-defined waveform: ARB:UDEF:DWEL 2,3 Sets the dwell time for step 2 in user-defined waveform for Arb sequence: ARB:SEQ:UDEF:DWEL 2,3	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb.
- Use the ARB:UDEFined:COUNt or ARB:SEQuence:UDEFined:COUNt to specify the total number of steps before specifying other parameters for the user-defined Arb.

[SOURce:]ARB:UDEFined:LEVel <step#>,<*value*>|*MINimum*|*MAXimum*|*DEFault*
[SOURce:]ARB:UDEFined:LEVel? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the step value (voltage or current) in the user-defined Arb.

[SOURce:]ARB:SEQuence:UDEFined:LEVel <*step#*>,<*value*>|MINimum|MAXimum|DEFault
[SOURce:]ARB:SEQuence:UDEFined:LEVel? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the step value in the user-defined Arb for the selected steps in Arb sequence.

Parameter	Typical Return
Step: 1 – 200	(none)
Source mode: CC: 0 – Vmax, *RST 0.2 CV: Imin – Imax, *RST Imax/100 Load mode: 0 – Imax|Vmax, *RST 0	<level>
Sets 2 as the level of step value: ARB:UDEF:LEV 2, 10 Sets 2 as the level of step value in Arb sequence: ARB:SEQ:UDEF:LEV 2, 10	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb.
- Use the ARB:UDEFined:COUNt or ARB:SEQuence:UDEFined:COUNt to specify the total number of steps before specifying other parameters for the user-defined Arb.

[SOURce:]ARB:UDEFined:SLEW <*step#*>,<*value*>|MINimum|MAXimum|DEFault

Load Mode only

[SOURce:]ARB:UDEFined:SLEW? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the step slew rate in the user defined Arb.

[SOURce:]ARB:SEQuence:UDEFined:SLEW <*step#*>,<*value*>|MINimum|MAXimum|DEFault

Load Mode only

[SOURce:]ARB:SEQuence:UDEFined:SLEW? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the step slew rate in the user defined Arb for the selected step in Arb sequence.

Parameter	Typical Return
Step: Step: 1 – 200	(none)
Load mode: 0.001 – MAX (The maximum value is product dependent), *RST MAX	<slew>
Specifies the slew rate for step 3: ARB:SEQ:UDEF:SLEW 3,2	

Remarks

- Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb.
- Use the ARB:UDEFined:COUNt or ARB:SEQuence:UDEFined:COUNt to specify the total number of steps before specifying other parameters for the user-defined Arb.

[SOURce:]ARB:UDEFined:SLEW:TIME <*step#*>,<*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]ARB:UDEFined:SLEW:TIME? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the step slew time in the user defined Arb in seconds.

[SOURce:]ARB:SEQuence:UDEFined:SLEW <*step#*>,<*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]ARB:SEQuence:UDEFined:SLEW? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the step slew time in the user defined Arb for the selected step in Arb sequence.

Parameter	Typical Return
Step: Step: 1 – 200	(none)
0 – 8000, *RST 0.1	<slew time>
Specifies the slew time for step 2 to 0.5 s: ARB:SEQ:UDEF:SLEW:TIME 2,0.5	

Remarks

– Use the ARB:SEQuence:SELect to select the sub-waveform step in the Arb sequence before specifying the parameter for each Arb .

BATTery Subsystem

BATTery commands programs the battery testing and battery simulation function.

[SOURce:]BATTery[:ENABle] 0|OFF|1|ON
[SOURce:]BATTery[:ENABle]?

Enables or disables the battery function.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the battery function: BATT:ENAB ON	

[SOURce:]BATTery:CHARge:CURRent <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]BATTery:CHARge:CURRent? [MINimum|MAXimum|DEFault]

Sets the battery charging current in amperes.

Parameter	Typical Return
0 – Imax, *RST Imax/100	<current>
Specifies battery charging current to 2 A: BATT:CHAR:CURR 2	

[SOURce:]BATTery:CHARge:VOLTage <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]BATTery:CHARge:VOLTage? [MINimum|MAXimum|DEFault]

Sets the battery charging voltage in volts.

Parameter	Typical Return
0 – Vmax, *RST 0.2 (The maximum value is product dependent)	<voltage>
Specifies battery charging voltage to 2 V: BATT:CHAR:VOLT 2	

[SOURce:]BATTery:CUToff:CAPacity[:IMMediate] <*value*>|MINimum|MAXimum|DEFault [SOURce:]BATTery:CUToff:CAPacity[:IMMediate]? [MINimum|MAXimum|DEFault]

Sets the battery cutoff capacity in ampere-hour (Ah).

Parameter	Typical Return
Source mode: Charging: 0 – 999999, *RST 1 Discharging: -9999999 – 0, *RST -1 Load mode: 0 – 999999, *RST 999999	<cutoff capacity>
Specifies the battery cutoff capacity to 50 Ah: BATT:CUT:CAP MAX	

[SOURce:]BATTery:CUToff:CAPacity:STATe 0|OFF|1|ON [SOURce:]BATTery:CUToff:CAPacity:STATe?

Sets the status of the battery cutoff capacity function.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the battery cutoff capacity: BATT:CUT:CAP ON	

[SOURce:]BATTery:CUToff:CURRent[:IMMediate] <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]BATTery:CUToff:CURRent[:IMMediate]? [MINimum|MAXimum|DEFault]

Sets the battery cutoff current in amperes.

Parameter	Typical Return
Charging: 0 – Imax, *RST Imax/100 Discharging: Imin – 0, *RST Imin/100 (The minimum and maximum value is product dependent)	<cutoff current>
Specifies the battery cutoff current to 20 A: BATT:CUT:CURR 20	

[SOURce:]BATTery:CUToff:CURRent:STATe 0|OFF|1|ON Source Mode only [SOURce:]BATTery:CUToff:CURRent:STATe?

Enables or disables the battery cutoff current function.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the battery cutoff current: BATT:CUT:CURR ON	

[SOURce:]BATTery:CUToff:TIMer[:IMMediate] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]BATTery:CUToff:TIMer[:IMMediate]? [MINimum|MAXimum|DEFault]

Sets the battery cutoff time in seconds.

Parameter	Typical Return
0 – 999999, *RST 999999	<time>
Specifies the battery timer cutoff time to 7 s: `BATT:CUT:TIM: 7`	

[SOURce:]BATTery:CUToff:TIMer:STATe 0|OFF|1|ON
[SOURce:]BATTery:CUToff:TIMer:STATe?

Enables or disables the battery timer cutoff function.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the battery timer cutoff: `BATT:CUT:TIM ON`	

[SOURce:]BATTery:CUToff:VOLTage[:IMMediate] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]BATTery:CUToff:VOLTage[:IMMediate]? [MINimum|MAXimum|DEFault]

Sets the battery cutoff voltage value.

Parameter	Typical Return
Source mode: 0 – Vmax, *RST 0.2 Load mode: 0 – Vmax, *RST 0 (The maximum value is product dependent)	<cutoff volatge>
Specifies the battery cutoff voltage to 7 V: `BATT:CUT:VOLT 7`	

[SOURce:]BATTery:CUToff:VOLTage:STATe 0|OFF|1|ON
[SOURce:]BATTery:CUToff:VOLTage:STATe?

Enables or disables the battery cutoff voltage function.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the battery cutoff voltage: `BATT:CUT:VOLT ON`	

[SOURce:]BATTery:DISCharge:CURRent <*value*>|MINimum|MAXimum|DEFault [SOURce:]BATTery:DISCharge:CURRent? [MINimum|MAXimum|DEFault]

Sets the battery discharge current in amperes.

Parameter	Typical Return
Source mode: Imin – 0, *RST Imin /100 Load mode: 0 – Imax, *RST 0.1 (The minimum and maximum value is product dependent)	<discharge current>
Specifies the battery discharge current: BATT:DISC:CURR 7	

[SOURce:]BATTery:DISCharge:VOLTage <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]BATTery:DISCharge:VOLTage? [MINimum|MAXimum|DEFault]

Sets the battery discharge voltage in volts.

Parameter	Typical Return
0 – Vmax, *RST 0.2 (The maximum value is product dependent)	<discharge voltage>
Specifies the battery discharge voltage to 7 V: BATT:DISC:VOLT 7	

[SOURce:]BATTery:EMULator:CAPacity:INIT <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]BATTery:EMULator:CAPacity:INIT? [MINimum|MAXimum|DEFault]

Sets the initial capacity of the battery simulation in ampere-hour (Ah).

Parameter	Typical Return
0.01 – 9999.99, *RST 0.5	<initial capacity>
Specifies the initial capacity to 2 Ah: BATT:EMUL:CAP:INIT 2	

[SOURce:]BATTery:EMULator:CAPacity:LIMit <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]BATTery:EMULator:CAPacity:LIMit? [MINimum|MAXimum|DEFault]

Sets the battery capacity.

Parameter	Typical Return
0.01 – 9999.99, *RST 1	<battery capacity>
Specifies the battery capacity 8 Ah: BATT:EMUL:CAP:LIM 8	

[SOURce:]BATTery:EMULator:CURRent:LIMit:NEGative <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]BATTery:EMULator:CURRent:LIMit:NEGative? [MINimum|MAXimum|DEFault]

Sets the negative current limit for battery simulation.

Parameter	Typical Return
Imin – 0, *RST Imin (The minimum and maximum value is product dependent)	<current>
Specifies the negative current limit to -2 A: BATT:EMUL:CURR:LIM:NEG -2	

[SOURce:]BATTery:EMULator:CURRent:LIMit:POSitive <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]BATTery:EMULator:CURRent:LIMit:POSitive? [MINimum|MAXimum|DEFault]

Sets the positive current limit for battery simulation.

Parameter	Typical Return
0 – Imax, *RST Imax (The minimum and maximum value is product dependent)	<current>
Specifies the positive current limit to 7 A: BATT:EMUL:CURR:LIM:POS 7	

[SOURce:]BATTery:EMULator:INIT:MODE SOC|VOC|CAP Source Mode only
[SOURce:]BATTery:EMULator:INIT:MODE?

Sets the initialization mode of battery simulation.

SOC – Uses the initial SOC value when starting the battery simulation.

VOC – Uses the initial VOC value when starting the battery simulation.

CAP – Uses the initial CAP value when starting the battery simulation.

Parameter	Typical Return
SOC|VOC|CAP, *RST SOC	SOC, VOC, or CAP
Selects CAP as the initial mode: BATT:EMUL:INIT:CAP	

[SOURce:]BATTery:EMULator:PARallel <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]BATTery:EMULator:PARallel? [MINimum|MAXimum|DEFault]

Sets the number of batteries connected in parallel.

Parameter	Typical Return
1 – 1000, *RST 1	<number of paralleled batteries>
Connects 7 batteries in parallel: BATT:EMUL:PAR 7	

[SOURce:]BATTery:EMULator:REAL:CAPacity? Source Mode only
[SOURce:]BATTery:EMULator:REAL:SOC? Source Mode only
[SOURce:]BATTery:EMULator:REAL:VOC? Source Mode only

Returns the current real-time capacity, state of charge (SOC), or open-circuit voltage (VOC) value of the battery simulation.

Parameter	Typical Return
(none)	(none)
Returns the current real-time SOC value: BATT:EMUL:REAL:SOC	

[SOURce:]BATTery:EMULator:RECall <*value*> Source Mode only
[SOURce:]BATTery:EMULator:SAVe <*value*> Source Mode only

Recalls or saves the battery simulation data in a file location located in the internal memory.

Parameter	Typical Return
1 – 10	<file>
Recalls data from file 1: BATT:EMUL:REC 1	

[SOURce:]BATTery:EMULator:RESistance <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]BATTery:EMULator:RESistance? [MINimum|MAXimum|DEFault]

Sets the internal resistance of the battery.

Parameter	Typical Return
Rmin – Rmax, *RST 0 (The minimum and maximum value is product dependent)	<resistance>
Specifies the internal resistance to 0.1 Ω: BATT:EMUL:RES 0.1	

[SOURce:]BATTery:EMULator:SERies <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]BATTery:EMULator:SERies? [MINimum|MAXimum|DEFault]

Sets the number of batteries connected in series.

Parameter	Typical Return
1 – 1000, *RST 1	<number of battery connected in series>
Connects 7 batteries in series: BATT:EMUL:SER 7	

[SOURce:]BATTery:EMULator:SOC:INIT <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]BATTery:EMULator:SOC:INIT? [MINimum|MAXimum|DEFault]

Sets the initial state of charge (SOC) of the battery in percentage (%)

Parameter	Typical Return
0 – 100, *RST 50	(none)
Specifies the initial SOC value at 80%: BATT:EMUL:SOC:INIT 80	

[SOURce:]BATTery:EMULator[:STATe] 0|OFF|1|ON Source Mode only
[SOURce:]BATTery:EMULator[:STATe]?

Enables or disables the battery emulation function.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the battery emulation: BATT:EMUL ON	

[SOURce:]BATTery:EMULator:VOC:EMPTy <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]BATTery:EMULator:VOC:EMPTy? [MINimum|MAXimum|DEFault]

Sets the empty voltage value of the battery.

Parameter	Typical Return
Vmin – Vmax, *RST 1 (The minimum and maximum value is product dependent)	(none)
Specifies 2 V as the empty voltage value: BATT:EMUL:VOC:EMPT 2	

[SOURce:]BATTery:EMULator:VOC:FULL <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]BATTery:EMULator:VOC:FULL? [MINimum|MAXimum|DEFault]

Sets the full voltage value of the battery.

Parameter	Typical Return
Vmin – Vmax, *RST 5 (The minimum and maximum value is product dependent)	(none)
Specifies 7 V as the full voltage value: BATT:EMUL:VOC:FULL 7	

[SOURce:]BATTery:EMULator:VOC:INIT <*value*>|MINimum|MAXimum|DEFault

Source Mode only

[SOURce:]BATTery:EMULator:VOC:INIT? [MINimum|MAXimum|DEFault]

Sets the initial open-circuit voltage (VOC) of the battery in volts.

Parameter	Typical Return
Vmin – Vmax, *RST 3 (The minimum and maximum value is product dependent)	<voltage>
Specifies the initial VOC value as 7 v: BATT:EMUL:VOC:INIT 7	

[SOURce:]BATTery:MEASure:CAPacity?
[SOURce:]BATTery:MEASure:POWer?
[SOURce:]BATTery:MEASure:TIMe?

Returns the capacity, power and running time of the battery:

CAPacity – the current battery capacity.

POWer – the current power of the battery.

TIMe – the battery test running time.

Parameter	Typical Return
(none)	(none)
Returns the current power: BATT:MEAS:POW	

[SOURce:]BATTery:MODE CHARge|DISCharge Source Mode only
[SOURce:]BATTery:MODE?

Sets the battery mode.

Parameter	Typical Return
CHAR|DISC, *RST CHAR	CHAR or DISC
Selects discharge mode: BATT:MODE DISC	

[SOURce:]BATTery:RECall <*value*>
[SOURce:]BATTery:SAVe <*value*>

Recalls or saves the battery data in a file location located in the internal memory.

Parameter	Typical Return
1 – 10	<file>
Saves the battery data in file 1: BATT:SAV 1	

CALibrate Subsystem

Calibrate commands calibrate the instrument.

NOTE Read the calibration section before calibrating. Improper calibration reduces accuracy and reliability.

CALibrate:COUNt?

Returns the number of times the unit has been calibrated. Your instrument was calibrated before it left the factory. When you receive your unit, read the count to determine its initial value.

The count is incremented whenever the calibration (and date) is saved, or the administration password is changed or reset.

Parameter	Typical Return
(none)	<count>
Returns the calibration count: `CAL:COUN?`	

CALibrate:DATE <*"date"*>
CALibrate:DATE?

Enters the calibration date in non-volatile memory. Enter any ASCII string up to 15 characters. The query returns the date.

Parameter	Typical Return
<*"date"*> String program data. Enclose string parameters in single or double quotes.	<last cal date>
Enters the calibration date: `CAL:DATE "12/12/12"`	

CALibrate:SAVE

Saves the calibration constants in non-volatile memory. Do this at the end of the calibration to avoid losing changes.

Parameter	Typical Return
(none)	(none)
Stores calibration constants into non-volatile memory: `CAL:SAVE`	

CALibrate:SECure:CODE <"*code*">

Sets a new security passcode. To change the passcode, first unsecure the instrument using the old passcode. Then, enter the new passcode. The passcode can be set up to 15 numeric digits.

Parameter	Typical Return
<code> a numeric up to 15 digits	(none)
Sets the new security passcode: CAL:SEC:CODE "5"	

CALibrate:SECure:STATe <0\|OFF\|1\|ON>,<"*code*">
CALibrate:SECure:STATe?

Unsecures or secures the machine for calibration, using the passcode specified by CALibration:SECure:CODE.
The query returns 0 (calibration unsecured) or 1 (calibration secured).

By default, the passcode is 0.

Parameter	Typical Return
0|OFF|1|ON, *RST ON	0 or 1
<code>: Default is 0	(none)
Secures the machine for calibration: CAL:SEC:STAT ON, "0"	

CALibrate:STRing <"*string*">
CALibrate:STRing?

Saves information, such as the calibration message, the next calibration due date, or the calibration string. You must unsecure the instrument before saving the string, but you can read the string regardless of the security status. The query returns a quoted string.

Parameter	Typical Return
"<string>"	"<string>"
Sets the string to "4/22/17": CAL:STR "4/22/17"	

CURRent Subsystem

Current commands program the output current of the instrument.

[SOURce:]CURRent:BWIDth:RANGe HIGH|LOW Source Mode only
[SOURce:]CURRent:BWIDth:RANGe?

Specifies the output bandwidth of the instrument, which only takes effect when current priority is used. The output bandwidth for different priority modes are saved separately and do not affect each other.

The output bandwidth allows you to optimize the output response time with capacitive loads.

High – This is the default setting and is suitable for the vast majority of applications. It provides a faster response time and is ideal for most testing scenarios.

Low – This mode is recommended when the test device has a very large port capacitance or when the power of the test device is significantly higher than the RPS. When an increased of jitter and ripple are seen during a stable test process, switching to LOW mode can help stabilize the output.

Parameter	Typical Return
HIGH|LOW, *RST HIGH	HIGH or LOW
Sets the output bandwidth to HIGH: CURR:BWID:RANG LOW	

[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

Source mode: Sets the immediate current level when the output is operating in current priority mode. The triggered level is a stored value that is transferred to the output when an output Step is triggered. Units are in amperes. The maximum value depends on the current rating of the unit.

Load mode: Sets the immediate current level when the output is operating in CC, CVCC, CRCC, or AUTO mode. The triggered level is a stored value that is transferred to the output when an output Step is triggered. Units are in amperes. The maximum value depends on the current rating of the unit. The input current is limited when in CVCC or CRCC mode.

Parameter	Typical Return
Source mode: Imin – Imax, *RST Imax/100 Load mode: 0 – Imax, *RST 0 (The minimum and maximum value is product dependent)	<current level>
Sets the output to 2 A: CURR 2	

[SOURce:]CURRent[:LEVel]:TRIGgered[:AMPLitude] <*value*>|MINimum|MAXimum|DEFault [SOURce:]CURRent[:LEVel]:TRIGgered[:AMPLitude]? [MINimum|MAXimum|DEFault]

Source mode: Sets the triggered current level when the output is operating in current priority mode. The triggered level is a stored value that is transferred to the output when an output Step is triggered. Units are in amperes. The maximum value depends on the current rating of the unit.

Load mode: Sets the triggered current level when the output is operating in CC or AUTO mode. The triggered level is a stored value that is transferred to the output when an output Step is triggered. Units are in amperes. The maximum value depends on the current rating of the unit.

Parameter	Typical Return
Source mode: Imin – Imax, *RST Imax/100 Load mode: 0 – Imax, *RST 0 (The minimum and maximum value is product dependent)	<current level>
Sets the triggered current to 2 A: CURR:TRIG 2	

[SOURce:]CURRent:LIMit[:POSitive][:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault [SOURce:]CURRent:LIMit[:POSitive][:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

[SOURce:]CURRent:LIMit:NEGative[:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault Source Mode only [SOURce:]CURRent:LIMit:NEGative[:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

Sets the current limit when in voltage priority mode. Units are in amperes. The maximum value depends on the current rating of the unit.

Parameter	Typical Return
Source mode: Positive: 0 – Imax, *RST Imax/100 Negative: Imin – 0, *RST Imin/100 Load mode: Positive: 0 – Imax, *RST 0 (The minimum and maximum value is product dependent)	<+current limit> <–current limit>
Sets the positive current limit to 2 A: CURR:LIM:POS 2 Sets the negative current limit to -4 A: CURR:LIM:NEG -4	

[SOURce:]CURRent:MODE FIXed|STEP|LIST|BATTery|ARB
[SOURce:]CURRent:MODE?

Source mode: Sets the transient mode when in current priority mode. This command determines what happens to the output voltage when the transient system is initiated and triggered.

Load mode: Sets the transient mode when in CC or AUTO mode. This command determines what happens to the output voltage when the transient system is initiated and triggered.

FIXed keeps the output current at its immediate value.

STEP steps the output to the triggered level when a trigger occurs.

LIST causes the output to follow the list values when a trigger occurs.

BATT causes the output to follow the edited battery test file values when a trigger occurs.

ARB causes the output to follow the arbitrary waveform values when a trigger occurs.

Parameter	Typical Return
FIXed|STEP|LIST|BATTery|ARB, *RST FIXed	FIXed, STEP, LIST, BATTery, or ARB
Sets the current mode to Step: CURR:MODE STEP	

[SOURce:]CURRent:PROTection:DELay[:TIME] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]CURRent:PROTection:DELay[:TIME]? [MINimum|MAXimum|DEFault]

Sets the over-current protection delay. The over-current protection function will not be triggered during the delay time. After the delay time has expired, the over-current protection function will be active. This prevents momentary changes in output status from triggering the over-current protection function.

Parameter	Typical Return
0 – 60, *RST 0.02	<delay value>
Sets the protection delay to 0.2 seconds: CURR:PROT:DEL 0.2	

- The operation of over-current protection is affected by the setting of the current protection delay start event, which is specified by CURRent:PROTection:DELay:STARt.

[SOURce:]CURRent:PROTection[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]CURRent:PROTection[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the current protection limit.

Parameter	Typical Return
Source mode: Imin – Imax, *RST Imax Load mode: 0 – Imax, *RST Imax (The minimum and maximum value is product dependent)	<current limit>
Sets the OCP protection value to 5 A: `CURR:PROT 5`	

[SOURce:]CURRent:PROTection:STATe 0|OFF|1|ON
[SOURce:]CURRent:PROTection:STATe?

Enables or disables the over-current protection. If the over-current protection function is enabled and the output goes into current limit, the output is disabled and the Questionable Condition status register OCP bit is set.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable the current protection state: `CURR:PROT:STAT ON`	

- An over-current condition can be cleared with OUTPut:PROTection:CLEar after the cause of the condition is removed.

[SOURce:]CURRent:PROTection:TRIPped?

The query indicates whether an over-current protection occurred (1) or not (0). This is reset to 0 by CURRent:PROTection:CLEar.

Parameter	Typical Return
(none)	0 or 1
Indicates whether an over-current protection occurred: `CURR:PROT:TRIP?`	

[SOURce:]CURRent:RESistance[:LEVel][:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]CURRent:RESistance[:LEVel][:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

Sets the sink resistance value of the power supply in current priority mode. This setting is applicable only in current priority mode. Units are in Ohms.

Parameter	Typical Return
Rmin – Rmax, *RST Rmax (The minimum and maximum value is product dependent)	<internal resistance>
Sets the sink resistance to 1 Ω: CURR:RES 1	

[SOURce:]CURRent:RESistance:STATe 0|OFF|1|ON Source Mode only
[SOURce:]CURRent:RESistance:STATe?

Enables or disables the sink resistance setting for current priority mode.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the sink resistance: CURR:RES:STAT ON	

[SOURce:]CURRent:SLEW:COUPle 0|OFF|1|ON Load Mode only
[SOURce:]CURRent:SLEW:COUPle?

Sets the slew tracking state.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the current slew tracking state: CURR:SLEW:COUP ON	

[SOURce:]CURRent:SLEW[:POSitive][:IMMediate] <*value*>|MINimum|MAXimum|DEFault|INFinity Load Mode only
[SOURce:]CURRent:SLEW[:POSitive][:IMMediate]? [MINimum|MAXimum|DEFault]
[SOURce:]CURRent:SLEW:NEGative[:IMMediate] <*value*>|MINimum|MAXimum|DEFault|INFinity Load Mode only
[SOURce:]CURRent:SLEW:NEGative[:IMMediate]?[MINimum|MAXimum|DEFault]

Sets the current slew rate. The slew rate is set in amps per millisecond and affects all programmed current changes, including those due to the output state turning on or off.

Parameter	Typical Return
Load mode: 0.001 – MAX, *RST MAX (The minimum and maximum value is product dependent)	<slew rate>
Sets the positive output slew rate to 1 A/ms: CURR:SLEW 1 Sets the negative output slew rate to 1 A/ms: CURR:SLEW:NEG 1	

[SOURce:]CURRent:SLEW[:POSitive]:MAXimum<0|OFF|1|ON> Load Mode only
[SOURce:]VOLTageCURRent:SLEW[:POSitive]:MAXimum?
[SOURce:]CURRent:SLEW:NEGative:MAXimum<0|OFF|1|ON> Load Mode only
[SOURce:]CURRent:SLEW:NEGative:MAXimum?

Enables/disables the maximum slew rate override. When enabled, the slew rate is set to its maximum value. When disabled, the slew rate is set to the immediate value set by CURRent:SLEW. Use CURRent:SLEW? MAX to query the maximum slew rate

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Disables the positive maximum slew rate: CURR:SLEW:MAX OFF Disables the negative maximum slew rate: CURR:SLEW:NEG:MAX OFF	

[SOURce:]CURRent:SLEW:TIME:COUPle 0|OFF|1|ON Source Mode only
[SOURce:]CURRent:SLEW:TIME:COUPle?

Sets the slew time tracking state.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the current slew time tracking state: CURR:SLEW:TIME:COUP ON	

[SOURce:]CURRent:SLEW:TIME[:POSitive][:IMMediate] <*value*>|MINimum|MAXimum|DEFault|INFinity Source Mode only
[SOURce:]CURRent:SLEW:TIME[:POSitive][:IMMediate]? [MINimum|MAXimum|DEFault]
[SOURce:]CURRent:SLEW:TIME:NEGative[:IMMediate] <*value*>|MINimum|MAXimum|DEFault|INFinity Source Mode only
[SOURce:]CURRent:SLEW:TIME:NEGative[:IMMediate]? [MINimum|MAXimum|DEFault]

Sets the current slew time.

Parameter	Typical Return
0 – 8000, *RST 0.1	<slew time>
Sets the output rising slew time to 1 s: CURR:SLEW:TIME 1 Sets the output falling slew time to 1 s: CURR:SLEW:TIME:NEG 1	

[SOURce:]CURRent:SLEW:TIME[:POSitive]:MINimum 0|OFF|1|ON Source Mode only
[SOURce:]CURRent:SLEW:TIME[:POSitive]:MINimum?
[SOURce:]CURRent:SLEW:TIME:NEGative:MINimum 0|OFF|1|ON Source Mode only
[SOURce:]CURRent:SLEW:TIME:NEGative:MINimum?

Enables/disables the fastest current slew time override. When enabled, the slew time is set to its minimum value. When disabled, the slew time is set to the immediate value set by CURRent:SLEW:TIME or CURRent:SLEW:TIME:NEG. Use CURRent:SLEW:TIME? MIN or CURRent:SLEW:TIME:NEG? MIN to query the minimum slew time.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the fastest rising slew time: CURR:SLEW:TIME:MIN ON Disables the fastest falling slew time: CURR:SLEW:TIME:NEG:MIN OFF	

[SOURce:]CURRent:UNDer:PROTection:DELay[:TIME] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]CURRent:UNDer:PROTection:DELay[:TIME]? [MINimum|MAXimum|DEFault]

Specifies the under-current protection delay time in seconds. The under-current protection function will not be triggered during the delay time. After the delay time has expired, the under-current protection function will be active.

Parameter	Typical Return
0 – 60, *RST 0.02	<delay time>
Sets the under protection delay to 0.2 s: CURR:UND:PROT:DEL 0.2	

[SOURce:]CURRent:UNDer:PROTection[:LEVel] <*value*>|MINimum|MAXimum|DEFault [SOURce:]CURRent:UNDer:PROTection[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the undercurrent protection limit.

Parameter	Typical Return
Source mode: Imin – Imax, *RST 0 Load mode: 0 – Imax, *RST 0 (The minimum and maximum value is product dependent)	<current>
Sets UCP limit to 10 A: `CURR:UND:PROT 10`	

[SOURce:]CURRent:UNDer:PROTection:STATe 0|OFF|1|ON [SOURce:]CURRent:UNDer:PROTection:STATe?

Enables or disables the undercurrent protection.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the undercurrent protection: `CURR:UND:PROT:STAT ON`	

[SOURce:]CURRent:UNDer:PROTection:TRIPped?

The query indicates whether an undercurrent protection occurred (1) or not (0). This is reset to 0 by CURRent:PROTection:CLEar.

Parameter	Typical Return
(none)	0 or 1
Indicates whether an undercurrent protection occurred: `CURR:UND:PROT:TRIP?`	

[SOURce:]CURRent:UNDer:PROTection:WARM <*value*>|MINimum|MAXimum|DEFault [SOURce:]CURRent:UNDer:PROTection:WARM? [MINimum|MAXimum|DEFault]

Specifies the warm-up time for undercurrent protection. This setting prevents the instrument from triggering protection during a rising current, as this transient condition should not be considered an undercurrent fault and does not require protection.

Parameter	Typical Return
0 – 60, *RST 3	<time>
Sets the UCP warm-up time 5 s: `CURR:UND:PROT:WARM 5`	

DIGital Subsystem

Digital commands program the digital control port on the rear panel of the instrument.

[SOURce:]DIGital:INPut:DATA?

Reads the state of the digital control port. Returns the binary-weighted value of the state of pins 1 through 7 in bits 0 through 6 respectively.

Parameter	Typical Return
(none)	<bit value>
Reads the state of the digital control port: DIG:INP:DATA?	

[SOURce:]DIGital:OUTPut:DATA <*value*>|MINimum|MAXimum
[SOURce:]DIGital:OUTPut:DATA? [MINimum|MAXimum]

Sets the state of the digital control port. This only affects the pins whose function has been set to Digital IO operation. The port has seven signal pins and a digital ground pin. In the binary-weighted value that is written to the port, the pins are controlled according to the following bit assignments:

Pin	1	2	3	4	5	6	7
Bit number	0	1	2	3	4	5	6
Decimal value	1	2	4	8	16	32	64

Bit values corresponding to digital port pins that are not configured as DIO are ignored.

Parameter	Typical Return
0 – 127	<bit value>
Programs pins 1, 3, and 5 on: DIG:OUTP:DATA?	

[SOURce:]DIGital:PIN1:FUNCtion DIO|DINPut|PSClear
[SOURce:]DIGital:PIN2:FUNCtion DIO|DINPut|PSSTate
[SOURce:]DIGital:PIN3:FUNCtion DIO|DINPut|OFFState
[SOURce:]DIGital:PIN4:FUNCtion DIO|DINPut|TOUTput|TINPut
[SOURce:]DIGital:PIN5:FUNCtion DIO|DINPut|INHibit
[SOURce:]DIGital:PIN6:FUNCtion DIO|DINPut|ONCouple
[SOURce:]DIGital:PIN7:FUNCtion DIO|DINPut|OFFCouple
[SOURce:]DIGital:PIN<1–7>:FUNCtion?

Sets the pin function. The functions are saved in non-volatile memory.

DIO	General-purpose ground-referenced digital input/output function.
DINPut	Digital input-only mode.
PSCLear	Pin 1 functions as clear the protection status.
PSSTate	Pin 2 functions as indication of output level is protected.
OFFState	Pin 3 indicates the **[ON/OFF]** status.
TINPut	Pin 4 functions as trigger input function.
TOUTput	Pin 4 functions as trigger output function.
INHibit	Pin 5 functions as an inhibit input.
ONCouple	Pins 6 synchronizes the output On state.
OFFCouple	Pins 7 synchronizes the output Off state.

Parameter	Typical Return
Pin1: DIO|DINP|PSCL, Default: PSC Pin2: DIO|DINP|PSST, Default: PSST Pin3: DIO|DINP|OFFS, Default: OFFS Pin4: DIO|DINPTOUT|TINP, Default: TINP Pin5: DIO|DINPINH, Default: INH Pin6: DIO|DINP|ONC, Default: ONC Pin7: DIO|DINP|OFFC, Default: OFFC	PSCL, PSST, OFFS, TINP, INH, ONC, or OFFC
Sets pin 1 to DIO mode: `DIG:PIN1:FUNC DIO`	

[SOURce:]DIGital:PIN<1–7>:POLarity POSitive|NEGative
[SOURce:]DIGital:PIN<1–7>:POLarity?

Sets the pin polarity.
POSitive means a logical true signal is a voltage high at the pin. For trigger inputs and outputs, POSitive means a rising edge.
NEGative means a logical true signal is a voltage low at the pin. For trigger inputs and outputs, NEGative means a falling edge. The pin polarities are saved in non-volatile memory.

Parameter	Typical Return
POSitive|NEGative, Default: NEGative	POS or NEG
Sets pin 1 to POSitive polarity: DIG:PIN1:POL POS	

DISPlay Subsystem

Display commands control the front panel display.

DISPlay[:WINDow]:VIEW METER_VI|METER_VP|METER_VIP
DISPlay[:WINDow]:VIEW?

Selects the parameters to display on the front panel. METER_VI displays output voltage and current, METER_VP displays output voltage and power, while METER_VIP displays output voltage, current, and power.

Parameter	Typical Return
METER_VI|METER_VP|METER_VIP, *RST METER_VI	METER_VI, METER_VP, or METER_VIP
To display voltage and power: DISP:VIEW METER_VP	

EXTernal Subsystem

NOTE Only applicable when the RS232/Analog board is installed.

[SOURce:]EXTern:PROGram:CHANnel:MB <*channel*>,<*value*>|MINimum|MAXimum|DEFault
[SOURce:]EXTern:PROGram:CHANnel:MB? <*channel*>[,MINimum|MAXimum|DEFault]

Sets the offset calibration coefficient for channel 1, 2, or 3. This command requires two parameters, separated by a comma: the channel number before the comma and the offset calibration coefficient after the comma.

In source mode, the channel function is determined by the instrument operating mode (voltage priority or current priority).

Voltage priority:

- ch1 indicates the voltage setting
- ch2 indicates the current limiting positive value
- ch3 indicates a negative current limit.

Voltage priority:

- ch1 indicates the current setting
- ch2 indicates the voltage limiting high value
- ch3 indicates the voltage limiting low value.

In load mode, the operating mode of the electronic load is determined by the IO levels of ch2 and ch3 on the analog card.

- ch1: CC mode
- ch2: CV mode
- ch3: CP mode
- ch4: CR mode

Parameter	Typical Return
<channel>: Source mode: 1 – 3, *RST 1 Load mode: 1 – 4, *RST 1	(none)

Parameter	Typical Return
<value>: Source mode: CV mode: -Vmax – +Vmax, *RST Vmax/10 CC mode: -Imax – +Imax, *RST Imax/10 Load mode: ch1: -Imax – +Imax, *RST Imax/10 ch2: -Vmax – +Vmax, *RST Vmax/10 ch3: -Pmax – +Pmax/, *RST Pmax/10 ch4: -Rmax – +Rmax, *RST Rmax/10	<offset calibration coefficient>
Specifies the offset calibration coefficient of the channel 1: EXT:PROG:CHAN:MB 1,20	

[SOURce:]EXTern:PROGram:CHANnel:MX <*channel*>,<*value*>\|MINimum\|MAXimum\|DEFault [SOURce:]EXTern:PROGram:CHANnel:MX? <*channel*>[,MINimum\|MAXimum\|DEFault]

Sets the linear calibration coefficient for channel 1, 2, or 3. This command requires two parameters, separated by a comma: the channel number before the comma and the linear calibration coefficient after the comma.

In source mode, the channel function is determined by the instrument operating mode (voltage priority or current priority).

Voltage priority:

- ch1 indicates the voltage setting
- ch2 indicates the current limiting positive value
- ch3 indicates a negative current limit.

Voltage priority:

- ch1 indicates the current setting
- ch2 indicates the voltage limiting high value
- ch3 indicates the voltage limiting low value.

In load mode, the operating mode of the electronic load is determined by the IO levels of ch2 and ch3 on the analog card.

- ch1: CC mode
- ch2: CV mode
- ch3: CP mode
- ch4: CR mode

Parameter	Typical Return
<channel>: Source mode: 1 – 3, *RST 1 Load mode: 1 – 4, *RST 1	(none)

Parameter	Typical Return
<value>: Source mode: CV mode: -Vmax/10 – +Vmax/10, *RST 0.02 CC mode: -Imax/10 – +Imax/10, *RST Imax/1000 Load mode: ch1: -Imax/10 – +Imax/10, *RST 0 ch2: -Vmax/10 – +Vmax/10, *RST Vmax/10 ch3: -Pmax/10 – +Pmax/10, *RST 0 ch4: -Rmax/10 – +Rmax/10, *RST Rmax/10	<linear calibration coefficient>
Specifies the linear calibration coefficient of the channel 1: EXT:PROG:CHAN:MB 1,20	

Remarks

- For example, when target value = external analog voltage value * Mx + Mb.
  The external analog voltage value range can be -10 V to +10 V. The user may set Mx and Mb to achieve the output of the instrument in accordance with the analog voltage signal sent.

[SOURce:]EXTern:PROGram[:STATe] 0|OFF|1|ON
[SOURce:]EXTern:PROGram[:STATe]?

Enables or disables the external analog function.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the external analog function: EXT:PROG ON	

FETCh Subsystem

Fetch commands return measurement data that has been previously acquired. FETCh queries do not generate new measurements, but allow additional measurement calculations from the same acquired data. The data is valid until the next MEASure or INITiate command occurs.

FETCh:ARRay:CURRent[:DC]?
FETCh:ARRay:POWer[:DC]?
FETCh:ARRay:VOLTage[:DC]?

Returns the instantaneous measurement. Values returned are either in amperes, volts, or watts.

The return format depends on the settings of the FORMat:BORDer and FORMat[:DATA] commands. When the data format is set to ASCII, returned values are comma separated. When the data format is set to REAL, data is returned as single precision floating point values in definite length arbitrary block response format.

Parameter	Typical Return
(none)	<value> [,<value>] or <Block>
Returns the measured current array: FETC:ARR:CURR? Returns the measured voltage array: FETC:ARR:VOLT? Returns the measured power array: FETC:ARR:POW?	

FETCh[:SCALar]:ACMeter:CURRstage?
FETCh[:SCALar]:ACMeter:EACStage?
FETCh[:SCALar]:ACMeter:EACTotal?

This command queries the AC Meter current statistical power value, periodic statistical power value and the historical total power value fed back to the power grid.

CURRstage– Returns the current stage power value from an AC meter.

EACStage – Returns the total regenerative energy in stages from an AC meter.

EACTotal – Returns the total accumulated energy from an AC meter.

Parameter	Typical Return
(none)	<power value>
Returns the AC Meter current stage power value: FETC:SCAL:ACM:CURR?	

FETCh[:SCALar]:AHOur?
FETCh[:SCALar]:WHOur?

FETCh[:SCALar]:AHOur? – Returns the accumulated amp-hours.

FETCh[:SCALar]:WHOur? – Returns the accumulated watt-hours.

See Amp-Hour and Watt-Hour Measurements for details.

Parameter	Typical Return
(none)	<amp-hours> <watt-hours>
Returns the amp-hour measurement: FETC:SCAL:AHO? Returns the watt-hour measurement: FETC:SCAL:WHO?	

FETCh[:SCALar]:CURRent[:DC]?
FETCh[:SCALar]:POWer[:DC]?
FETCh[:SCALar]:VOLTage[:DC]?

Returns the averaged measurement. Values returned are either in amperes, volts, or watts. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<DC value>
Returns the averaged DC current: FETC:SCAL:CURR? Returns the averaged DC voltage: FETC:SCAL:VOLT? Returns the averaged DC power: FETC:SCAL:POW?	

FETCh[:SCALar]:CURRent:MAXimum?
FETCh[:SCALar]:POWer:MAXimum?
FETCh[:SCALar]:VOLTage:MAXimum?
FETCh[:SCALar]:CURRent:MINimum?
FETCh[:SCALar]:POWer:MINimum?
FETCh[:SCALar]:VOLTage:MINimum?

Returns the maximum or minimum value. Values returned are either in amperes, volts, or watts.

Parameter	Typical Return
(none)	<MIN value> <MAX value>
Returns the measured maximum current: FETC:CURR:MAX? Returns the measured minimum voltage: FETC:VOLT:MIN? Returns the measured maximum power: FETC:POW:MAX?	

FETCh[:SCALar]:DLOG:STATe?
FETCh[:SCALar]:ELOG:STATe?

Returns the status of DLOG and ELOG.

IDLE – System is not logging data, or logging process is over

WTG – Waiting for Trigger

ACT – Active or Logging in Progress

END – End of Logging or Completed

Parameter	Typical Return
(none)	DILE, WTG, ACT, or END
Queries the DLOG status: FETC:SCAL:DLOG?	

FETCh[:SCALar]:ELOG? <*maxrecords*>

Returns the most recent external datalog records. Data must be read from the buffer periodically to avoid the buffer overflowing. Whenever data is read using FETCh:ELOG? then that buffer space is made available in the instrument for storing more acquired data.

Maxrecords is the maximum number of records of datalog data that the controller will return.

The return format depends on the settings of the FORMat:BORDer and FORMat[:DATA] commands. When the data format is set to ASCII, returned values are comma separated. When the data format is set to REAL, data is returned as single precision floating point values in definite length arbitrary block response format.

Parameter	Typical Return
<maxrecords>: 1 to 10,000	<value> [,<value>] or <Block>
Returns 100 data records: FETC:SCAL:ELOG? 100	

FORMat Subsystem

FORMat commands specify the format for transferring measurement data.

FORMat:BORDer NORMal|SWAPped
FORMat:BORDer?

Specifies how binary data is transferred. This only applies when the FORMat:DATA is set to REAL.
NORMal transfers data in normal order. The most significant byte is returned first, and the least significant byte is returned last (big-endian).
SWAPped transfers data in swapped-byte order. The least significant byte is returned first, and the most significant byte is returned last (little-endian).

Parameter	Typical Return
NORMal|SWAPped, *RST NORMal	NORM or SWAP
Specifies Swapped as the data transfer: FORM:BORD SWAP	

- The byte order is used when fetching real data from SCPI measurements.

FORMat[:DATA] ASCII|REAL
FORMat[:DATA]?

Specifies the format of the returned data. This is used by queries that can return a block of data.
ASCII returns data as ASCII bytes in numeric format as appropriate. The numbers are separated by commas.
REAL returns data in a definite length block as IEEE single precision floating point values. In this case the 4 bytes of each value can be returned in either big-endian or little-endian byte order, determined by the FORMat:BORDer setting.

Parameter	Typical Return
ASCII|REAL, *RST ASCII	ASCII or REAL
Sets the data format to ASCII: FORMat ASCII	

- The data format is used by a small sub set of queries that can return large quantities of data.

FUNCtion|MODE Command

These commands set the input priority mode. Function and Mode command are equivalent.

[SOURce:]FUNCtion CURRent|VOLTage Source Mode only
[SOURce:]FUNCtion CURRent|VOLTage|POWer|RESistance|CVCC|CRCC|CVCR|AUTO Load Mode only
[SOURce:]FUNCtion?

[SOURce:]MODE CURRent|VOLTage Source Mode only
[SOURce:]MODE CURRent|VOLTage|POWer|RESistance|CVCC|CRCC|CVCR|AUTO Load Mode only
[SOURce:]MODE?

Specifies the output regulation mode.

VOLTage: In voltage priority mode, the output is controlled by a bi-polar constant voltage feedback loop, which maintains the input voltage at its positive or negative programmed setting. In voltage priority mode, the output is controlled by a constant voltage feedback loop, which maintains the output voltage at its programmed setting

CURRent: In current priority mode, the output is controlled by a bi-polar constant current feedback loop, which maintains the input sourcing or sinking current at its programmed setting.

POWer: In power priority mode, the constant current along with the constant voltage feedback loops maintain the output power at their programmed settings.

RESistance: In resistance priority mode, the constant current along with the constant voltage feedback loops maintain the output resistance at their programmed settings.

CVCC: In CV+CC mode, the input is controlled by both constant voltage and constant current feedback loops, ensuring that the input voltage and current are maintained at their respective programmed settings.

CRCC: In CR+CC mode, the input is controlled by constant resistance and constant current feedback loops, maintaining the input resistance and current at their programmed settings.

CCCR: In CC+CR mode, the input is controlled by constant current and constant resistance feedback loops, ensuring that the input current and resistance are maintained at their respective programmed settings.

CVCR: In CV+CR mode, the input is controlled by constant voltage and constant resistance feedback loops, ensuring that the input voltage and resistance are maintained at their respective programmed settings.

AUTO: In AUTO mode, the system automatically switches between CV, CC, CP, and CR modes based on the input conditions and programmed settings to optimize performance and maintain the desired parameters.

Refer to Operation Mode for more information.

Parameter	Typical Return
Source mode: CURRent|VOLTage, *RST VOLT Load mode: CURR|VOLT|POW|RES|CVCC|CVCR|CRCC|AUTO, *RST CURR	CURR, VOLT, POW, RES, CVCC, CVCR, CRCC, AUTO
Selects the current mode: FUNC CURR Selects the power mode: MODE POW	

HCOPy Subsystem

HCOPy commands return the display image.

HCOPy:SDUMp:DATA? [BMP]

Returns an image of the front panel display.

Parameter	Typical Return
BMP	BMP
Returns the image: HCOP:SDUM:DATA?	

IEEE-488 Common Commands

IEEE-488 Common commands generally control overall instrument functions, such as reset, status, and synchronization. All common commands consist of a three-letter mnemonic preceded by an asterisk: *RST *IDN? *SRE 8.

*CLS

Clear status command. Clear Status Command. Clears the event registers in all register groups. Also clears the status byte and error queue. If *CLS immediately follows a program message terminator (<NL>), then the output queue and the MAV bit are also cleared. Refer to Status Tutorial for more information.

Parameter	Typical Return
(none)	(none)
Clears event registers, status byte, and error queue: *CLS	

*ESE *<enable value>*
*ESE?

Event status enable command and query. Sets the value in the enable register for the Standard Event Status group. Each set bit of the register enables a corresponding event. All enabled events are logically ORed into the ESB bit of the status byte. The query reads the enable register. Refer to Status Tutorial for more information.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enables bits 3 and 4 in the enable register: *ESE 24	

- The value returned is the binary-weighted sum of all enabled bits in the register.For example, with bit 2 (value 4) and bit 4 (value 16) set, the query returns +20.
- Any or all conditions can be reported to the ESB bit through the enable register. To set the enable register mask, write a decimal value to the register using *ESE.
- *CLS does not clear the enable register, but does clear the event register.

*ESR?

Event status event query. Reads and clears the event register for the Standard Event Status group. The event register is a read-only register, which latches all standard events. Refer to Status Tutorial for more information.

Parameter	Typical Return
(none)	<bit value>
Reads event status enable register: *ESR?	

- The value returned is the binary-weighted sum of all enabled bits in the register.
- Any or all conditions can be reported to the ESB bit through the enable register. To set the enable register mask, write a decimal value to the register using *ESE.
- Once a bit is set, it remains set until cleared by this query or *CLS.

*IDN?

Identification Query. Returns instrument’s identification string, which contains at least five comma-separated fields. The first field is the manufacturer's name, the second field is the instrument model number, the third field is the serial number, and the fourth field is the firmware revision.

Parameter	Typical Return
(none)	Keysight Technologies, RP5933A,CN12345678,01.01-01.00-01.00
Returns the instrument's identification string: *IDN?	

*OPC

Sets the OPC (operation complete) bit in the standard event register. This occurs at the completion of the pending operation. Refer to Status Tutorial for more information.

Parameter	Typical Return
(none)	(none)
Sets the Operation Complete bit: *OPC	

- The purpose of this command is to synchronize your application with the instrument.
- Used in conjunction with initiated acquisitions, transients, output state changes, and output settling time to provide a way to poll or interrupt the computer when these pending operations complete.
- Other commands may be executed before the operation complete bit is set.

- The difference between *OPC and *OPC? is that *OPC? returns "1" to the output buffer when the current operation completes.

*OPC?

Returns a 1 to the output buffer when all pending operations complete. The response is delayed until all pending operations complete.

Parameter	Typical Return
(none)	1
Returns 1 when commands complete: *OPC?	

- The purpose of this command is to synchronize your application with the instrument.
- Other commands cannot be executed until this command completes.

*OPT?

Returns a string identifying any installed options. A 0 (zero) indicates no options are installed.

"GPIB" indicates that GPIB option is installed.

"ANRS" indicates that Analog/RS232 option is installed.

Parameter	Typical Return
(none)	"GPIB" or "ANRS"
Returns installed options *OPT?	

*PSC <0|1>
*PSC?

The command clears the Status Byte and the Standard Event register enable masks when power is turned on (*PSC 1). When *PSC 0 is in effect, the Status Byte and Standard Event register enable masks are not cleared when power is turned on.
The query returns a 0 (*PSC 0) or a 1 (*PSC 1).

Parameter	Typical Return
0|1, Default is 0	0 or 1
Clears the Status Byte and Standard Event register enable masks: *PSC 1	

*RCL <0–9>

Recalls a saved instrument state. This restores the instrument to a state that was previously stored in locations 0 through 9 with the *SAV command. All instrument states are recalled except: (1) the output state is set to OFF, (2) the trigger systems are set to the Idle state, (3) calibration is disabled, (4) all lists are set to their *RST values, and (5) the non-volatile settings are not affected.

Parameter	Typical Return
0 – 9	(none)
Recalls state from location 1: *RCL 1	

- Location 0 is automatically recalled at power turn-on when the Output Power-On state is set to RCL 0.
- Stored instrument states are not affected by *RST.

*RST

Resets the instrument to pre-defined values that are either typical or safe. These settings are described in Reset State.

This command:

- Resets the machine to the default value state at power-on;
- Does not clear any status registers or error queues.
- Does not affect any error conditions interface;
- Forces the ABORt command, cancels all current trigger outputs and clears the WTG bit in the Status Questionable Instrument Summary Registers.

Parameter	Typical Return
(none)	(none)
Resets the instrument: *RST	

*SAV <0–9>

Saves the instrument state to one of ten non-volatile memory locations. For safety reasons, when a saved state is recalled, the output state will be set to OFF.

Parameter	Typical Return
0 – 9	(none)
Saves state to location 1: *SAV 1	

- If a particular state is desired at power-on, it should be stored in location 0. Location 0 is automatically recalled at power turn-on when the Output Power-On state is set to RCL 0.

- Output state, List data, and the calibration state is NOT saved as part of the *SAV operation.
- Data saved in non-volatile memory, described under Non-Volatile Settings, is not affected by the *SAV command.
- When shipped, locations 0 through 9 are empty.

*SRE <*enable value*>
*SRE?

Service request enable command and query. This sets the value of the Service Request Enable register. This determines which bits from the Status Byte Register are summed to set the Master Status Summary (MSS) bit and the Request for Service (RQS) summary bit. A 1 in any Service Request Enable register bit position enables the corresponding Status Byte register bit. All such enabled bits are then logically OR-ed to cause the MSS bit of the Status Byte register to be set. Refer to Status Tutorial for more information.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enables bit 3 and bit 4 in the enable register: *SRE 24	

- When a serial poll is conducted in response to SRQ, the RQS bit is cleared, but the MSS bit is not. When *SRE is cleared (by programming it with 0), the instrument cannot generate an SRQ.

*STB?

Status byte query. Reads the Status Byte Register, which contains the status summary bits and the Output Queue MAV bit. The Status Byte is a read-only register and the bits are not cleared when it is read. Refer to Status Tutorial for more information.

Parameter	Typical Return
(none)	<bit value>
Reads status byte: *STB?	

*TRG

Trigger command. Generates a trigger when the trigger subsystem has BUS selected as its source. The command has the same effect as the Group Execute Trigger (<GET>) command.

Parameter	Typical Return
(none)	(none)
Generates an immediate trigger: *TRG	

– *TRG will be ignored if the trigger system is not initialized.

*TST?

Self-test query. Performs a instrument self-test. A 0 (zero) indicates the instrument passed self-test. If self-test fails, one or more error messages will provide additional information. Use SYSTem:ERRor? to read error queue. See SCPI Error Messages for more information.

Parameter	Typical Return
(none)	0 (pass) or +1 (failed)
Performs self-test: *TST?	

– The power-on self-test is the same self-test performed by *TST.

– *TST? also forces an *RST command.

*WAI

Pauses additional command processing until all pending operations are complete. See OPC for more information.

Parameter	Typical Return
(none)	(none)
Waits until all pending operations complete. *WAI	

– *WAI can only be aborted by sending the instrument a Device Clear command.

INITiate Subsystem

Initiate commands initialize the trigger system. This moves the trigger system from the "idle" state to the "wait-for- trigger" state; which enables the instrument to receive triggers. An event on the selected trigger source causes the trigger to occur.

INITiate[:IMMediate]:ACQuire
INITiate[:IMMediate]:ARB
INITiate[:IMMediate]:DLOG
INITiate[:IMMediate]:ELOG
INITiate[:IMMediate]:LIST

INITiate:ACQuire – Initiates the measurement trigger system.

INITiate:ARB – Initiates the ARB trigger system. Before initiating the ARB, ensure a waveform type is selected (ARB:FUNCtion:SHApe) beforehand, otherwise an error will be reported.

INITiate:DLOG – Initiates the data logging function on the front panel.

INITiate:ELOG – Initiates the external data logging. When the external data log is initiated, an event on a selected external data log trigger source starts the data log.

INITiate:LIST – Initiates the LIST system.

Parameter	Typical Return
(none)	(none)
Initiates the measurement-trigger system: INIT:ACQ	

- It takes a few milliseconds for the instrument to be ready to receive a trigger signal after receiving the INITiate command.
- If a trigger occurs before the trigger system is ready for it, the trigger will be ignored. Check the WTG_meas bit in the operation status register to know when the instrument is ready.
- Use ABORt commands to return the instrument to Idle.
- Before using the data log function, ensure to connect the USB drive to the front panel USB port and set the USB setting to Host so that the recorded data can be stored on the external USB drive. After the last datalog completes, wait for 5 seconds before continuing with another session of data logging

INPut|OUTPut Subsystem

NOTE In Load mode, both INPut and OUTPut commands are supported. In Source mode, only the OUTPut command is supported.

These commands control the power supply output, load input, power-on and protection clear function. The INPut and OUTPut commands are equivalent when in Load mode.

INPut|OUTPut:INHibit:MODE LATChing|LIVE|OFF
INPut|OUTPut:INHibit:MODE?

Sets the operating mode of the Inhibit input (INH) digital pin. The inhibit function shuts down the output in response to an external signal on the Inhibit input pin.

LATChing – A transition to True on the Inhibit input disables all outputs, and they remain disabled until the Inhibit input goes False and the latched INH status bit is cleared by OUTPut:PROTection:CLEar or a front-panel protection clear.

LIVE – The enabled outputs follow the state of the Inhibit input. Outputs are disabled if Inhibit is true and enabled if Inhibit is false.

OFF – The Inhibit input is ignored.

Parameter	Typical Return
LATC|LIVE|OFF, *RST LATC	LATC, LIVE, or OFF
Sets Latching as the Inhibit input mode: OUTP:INH:MODE LATC	

INPut|OUTPut:PON:STATe RST|RCL0
INPut|OUTPut:PON:STATe?

This determines whether the power-on state is set to the *RST state (RST) or the state stored in one of the memory locations (RCL0). Instrument states can be stored using the *SAV command. This parameter is saved in non-volatile memory.

Parameter	Typical Return
RST|RCL0, *RST RST	RST or RCL0
Sets the power-on state stored in memory location: INP:PON:STAT RCL0	

INPut|OUTPut:PROTection:CLEar

This clears the latch that disables the output when a protection condition occurs. The output is restored to the state it was in before the protection condition occurred.

Parameter	Typical Return
(none)	(none)
Clears the latched protection status: OUTP:PROT:CLE	

INPut|OUTPut:PROTection:WDOG:DELay <*value*>|MINimum|MAXimum|DEFault
INPut|OUTPut:PROTection:WDOG:DELay? [MINimum|MAXimum|DEFault]

Sets the watchdog delay time. When the watchdog timer is enabled, the output is disabled if there is no SCPI I/O activity on any remote interface (USB, LAN, GPIB, RS232, CAN) within the delay time. The watchdog timer function is NOT reset by activity on the front panel - the output will still shut down after the time period has elapsed. Programmed values can range from 1 to 3600 seconds in 1 second increments.

Parameter	Typical Return
1 – 3600, *RST 60	<delay value>
Sets a watchdog delay of 600 seconds: OUTP:PROT:WDOG:DEL 600	

INPut|OUTPut:PROTection:WDOG[:STATe] 0|OFF|1|ON
INPut|OUTPut:PROTection:WDOG[:STATe]?

Enables/disables the I/O watchdog timer. When enabled, the output will be disabled if there is no I/O activity on any remote interface within the time period specified by OUTPut:PROTection:WDOG:DELay.

The output is latched off but the programmed output state is not changed.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the watchdog timer protection: OUTP:PROT:WDOG ON	

INPut|OUTPut:SHORt[:STATe] 0|OFF|1|ON Load Mode only
INPut|OUTPut:SHORt[:STATe]?

Simulates a short circuit mode of the electronic load.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Simulates a short on the input terminals: OUTP:SHOR ON	

INPut|OUTPut[:STATe]<0|OFF|1|ON>
INPut|OUTPut[:STATe]?

Enables/disables the output. The state of a disabled output is a condition of zero output voltage and zero current.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the output: OUTP ON	

INPut|OUTPut[:STATe]:COUPle[:STATe] 0|OFF|1|ON
INPut|OUTPut[:STATe]:COUPle[:STATe]?

Enables or disables output coupling. output coupling allows the output of multiple instruments to turn on and off sequentially according to their specified OUTPut:DELay:RISE and OUTPut:DELay:FALL programming delays. This parameter is saved in non-volatile memory.

Parameter	Typical Return
0|OFF|1|ON, Default OFF	0 or 1
Enables the output couple function: OUTP:COUP ON	

INPut|OUTPut[:STATe]:COUPle[:STATe]:DOFFset <*value*>|MINimum|MAXimum|DEFault
INPut|OUTPut[:STATe]:COUPle[:STATe]:DOFFset? [MINimum|MAXimum|DEFault]

Sets a delay offset to synchronize coupled output state changes. Delay times can be programmed from 0 to 60 seconds. Setting this time to the maximum delay offset specified for any instrument that is being coupled will cause all coupled outputs to synchronize to the turn-on times specified by OUTPut:DELay:RISE. This delay only applies to coupled channels, provided OUTPut:COUPle is enabled. This parameter is saved in non-volatile memory.

Parameter	Typical Return
0 – 60, Default 0	<offset value>
Sets the outputcoupling offset time to 7 s: OUTP:COUP:DOFF 7	

INPut|OUTPut[:STATe]:COUPle[:STATe]:MAX:DOFFset?

Returns the maximum offset time for the output coupling.

Parameter	Typical Return
(none)	<max offset value>
Returns the coupling maximum offset time: OUTP:COUP:MAX:DOFF?	

INPut|OUTPut[:STATe]:DELay:FALL <*value*>|MINimum|MAXimum|DEFault
INPut|OUTPut[:STATe]:DELay:FALL? [MINimum|MAXimum|DEFault]

INPut|OUTPut[:STATe]:DELay:RISE <*value*>|MINimum|MAXimum|DEFault
INPut|OUTPut[:STATe]:DELay:RISE? [MINimum|MAXimum|DEFault]

Specifies the delay in seconds that the instrument waits before turning the output on (rise) or off (fall). This allows multiple channels to turn on or off in sequence. The output will not turn on or off until its delay time has elapsed. This command affects on-to-off state transitions. It does NOT affect transitions to off caused by protection functions. Delay times can be programmed from 0 to 60 seconds.

Parameter	Typical Return
0 – 60, *RST 0	<delay value>
Sets a delay of 0.5 s before turning the output on: OUTP:DEL:RISE 0.5	

INSTrument Subsystem

Instrument commands program the Primary/Secondary function of the instrument. Primary/secondary operation is used when connecting a number of instruments in parallel to create a system with higher total current and, hence, higher power.

INSTrument:GROup:FUNCtion NONE|PRIMary|SECondary
INSTrument:GROup:FUNCtion?

Set the function of an instrument in a primary/secondary configuration. This setting is saved in non-volatile memory.

NONE – Disables the primary/secondary function. The unit operates independently.
PRIMary – Configures the instrument as the primary unit in a primary/secondary group.
SECondary – Configures the instrument as a secondary unit in a primary/secondary group.

Parameter	Typical Return
NONE|PRIMary|SECondary	PRIM, SEC, or NONE
Configures the instrument as the primary: INST:GRO:FUNC:PRIM	

INSTrument:GROup:NUMBer <*value*>|MINimum|MAXimum|DEFault
INSTrument:GROup:NUMBer? [MINimum|MAXimum|DEFault]

Specifies the number of paralleled units.

Parameter	Typical Return
2 – 16, Default: 2	(none)
Sets the paralleled units to 3: INST:GRO:NUMB 3	

LIST Subsystem

List commands program an output sequence of multiple voltage or current settings. A comma-delimited list of up to 512 steps may be programmed. Note that these commands only apply in the presently active priority mode, either voltage priority or current priority.

[SOURce:]LIST:COUNt <*value*>|MINinimum|MAXimum|DEFault|INFinity
[SOURce:]LIST:COUNt? [MINimum|MAXimum|DEFault]

Sets the list repeat count. This sets the number of times that a list is executed before it completes. Infinity runs the list continuously.

Parameter	Typical Return
Source mode: 1 – 9999999, *RST 1 Load mode: 0 – 9999999, *RST 1	<count>
Sets the list count to 10: LIST:COUN 10	

[SOURce:]LIST:CURRent[:LEVel] <*step#*>,<*value*>|MINimum|MAXimum|DEFault
[SOURce:]LIST:CURRent[:LEVel]? <*step#*>[,MINimum|MAXimum|DEFault]
[SOURce:]LIST:VOLTage[:LEVel] <*step#*>,<*value*>|MINimum|MAXimum|DEFault
[SOURce:]LIST:VOLTage[:LEVel]? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the setting for each list step. Values are specified in either amperes or volts.

Parameter	Typical Return
Step : 1 – 9999999, *RST 1	(none)
Source mode: Current: Imin – Imax, *RST 0 Voltage: 0 – Vmax, *RST 0 Load mode: Current: 0 – Imax, *RST 0 Voltage: 0 – Vmax, *RST 0	<list value>
Programs a current list of 2 A for step 3: LIST:CURR 3,2 Programs a voltage list of 3 V for step 5: LIST:VOLT 5,3	

[SOURce:]LIST:CURRent:SLEW <*step#*>,<*value*>|MINimum|MAXimum|DEFault Load Mode only
[SOURce:]LIST:CURRent:SLEW? <*step#*>[,MINimum|MAXimum|DEFault]
[SOURce:]LIST:VOLTage:SLEW <*step#*>,<*value*>|MINimum|MAXimum|DEFault Load Mode only
[SOURce:]LIST:VOLTage:SLEW? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the current or voltage slew rate for each step of the List waveform.

Parameter	Typical Return
Step : 1 – 9999999, *RST 1	(none)
Load mode: Current: 0.001 – MAX, *RST MAX Voltage: 0.001 – MAX, *RST MAX (The maximum value is product dependent)	<slew rate>
Specifies current slew for step 5 to 7 A/ms: LIST:CURR:SLEW 5,7 Specifies voltage slew for step 3 to 2 V/ms: LIST:VOLT:SLEW 3,2	

[SOURce:]LIST:CURRent:SLEW:TIME <*step#*>,<*value*>|MINimum|MAXimum|DEFault
Source Mode only
[SOURce:]LIST:CURRent:SLEW:TIME? <*step#*>[,MINimum|MAXimum|DEFault]
[SOURce:]LIST:VOLTage:SLEW:TIME <*step#*>,<*value*>|MINimum|MAXimum|DEFault
Source Mode only
[SOURce:]LIST:VOLTage:SLEW:TIME? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the current or voltage slew time for each step of the List waveform in seconds.

Parameter	Typical Return
Step : 1 – 9999999, *RST 1	(none)
0 – 8000, *RST 0.1	<slew time>
Specifies current slew time for step 5 to 7 s: LIST:CURR:SLEW:TIME 5,7 Specifies voltage slew time for step 3 to 2 s: LIST:VOLT:SLEW:TIME 3,2	

[SOURce:]LIST:DWELl <*step#*>,<*value*>|MINimum|MAXimum|DEFault [SOURce:]LIST:DWELl? <*step#*>[,MINimum|MAXimum|DEFault]

Specifies the dwell time for each list step. Dwell time is the time that the output will remain at a specific step.

Parameter	Typical Return
Step : 1 – 9999999, *RST 1	(none)
Source mode: 0.001 – 21000, *RST 1 Load mode: 0.001 – 21000, *RST 0.001	<dwell time>
Programs a dwell time for step 5 to 3 s: LIST:DWEL 5,3	

[SOURce:]LIST:FUNCtion:TYPE CURRent|VOLTage [SOURce:]LIST:FUNCtion:TYPE?

Specifies the List waveform type.

Parameter	Typical Return
Source mode: CURRent|VOLTage, *RST VOLT Load mode: CURRent|VOLTage, *RST CURR	VOLT or CURR
Specifies voltage as the waveform type: LIST:FUNC:VOLT	

[SOURce:]LIST:RECall <*value*> [SOURce:]LIST:SAVE <*value*>

Saves or recalls the edited List file in internal memory. Example, when 1 is entered, the saved file name will be list_01.txt

Parameter	Typical Return
1 – 10	(none)
Saves a List file: LIST:SAVE 1	

[SOURce:]LIST:STEP <*value*>|MINimum|MAXimum|DEFault [SOURce:]LIST:STEP? [MINimum|MAXimum|DEFault]

Specifies the total of steps to be edited in the list.

Parameter	Typical Return
1 – 200, *RST 2	(none)
Specifies 10 list steps for edits: LIST:STEP 10	

[SOURce:]LIST:TERMinate:LAST 0|OFF|1|ON
[SOURce:]LIST:TERMinate:LAST?

Determines the output value when the list terminates. When ON (1), the output voltage or current remains at the last list step. The value of the last voltage or current list step becomes the IMMediate value when the list completes. When OFF (0), and also when the list is aborted, the output returns to the settings that were in effect before the list started.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Terminates with the output at the last step value: LIST:TERM:LAST ON	

[SOURce:]LIST:TOUTput[:STATe] 0|OFF|1|ON
[SOURce:]LIST:TOUTput[:STATe]?

Specifies which list steps generate a trigger signal. A trigger is only generated when the state is set to ON. The trigger signal can be used as a trigger source for measurements and transients of other units, and for digital port pins configured as trigger outputs.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Generates trigger step list: LIST:TOUT:ON	

MEASure Subsystem

Measure commands measure the output voltage, current, or power. They trigger the acquisition of new data before returning the reading. Measurements are performed by digitizing the instantaneous output voltage, current, or power for a specified measurement time, storing the results in a buffer, and calculating the value for the specified measurement type.

MEASure:ARRay:CURRent[:DC]?
MEASure:ARRay:POWer[:DC]?
MEASure:ARRay:VOLTage[:DC]?

Initiates and triggers a measurement; returns a list of the digitized output measurement samples. Values returned are either in amperes, volts, or watts.

The return format depends on the settings of the FORMat:BORDer and FORMat[:DATA] commands. When the data format is set to ASCII, returned values are comma separated. When the data format is set to REAL, data is returned as single precision floating point values in definite length arbitrary block response format.

Parameter	Typical Return
(none)	<value> [,<value>] or <Block>
Returns the measured current array: MEAS:ARR:CURR?	

MEASure[:SCALar]:CURRent[:DC]?
MEASure[:SCALar]:POWer[:DC]?
MEASure[:SCALar]:VOLTage[:DC]?

Initiates, triggers, and returns the averaged output measurement. Values returned are either in amperes, volts, or watts.

Parameter	Typical Return
(none)	<DC value>
Returns the measured DC current: MEAS:SCAL:CURR?	

MEASure[:SCALar]:CURRent:MAXimum?
MEASure[:SCALar]:POWer:MAXimum?
MEASure[:SCALar]:VOLTage:MAXimum?
MEASure[:SCALar]:CURRent:MINimum?
MEASure[:SCALar]:POWer:MINimum?
MEASure[:SCALar]:VOLTage:MINimum?

Initiates, triggers, and returns the maximum or minimum values of a measurement. Values returned are either in amperes, volts, or watts.

Parameter	Typical Return
(none)	<MIN value>, <MAX value>
Returns the measured maximum current: MEAS:SCAL:CURR:MAX? Returns the measured minimum voltage: MEAS:SCAL:VOLT:MIN? Returns the measured maximum power: MEAS:SCAL:POW:MAX?	

MEASure[:SCALar]:REMote:VOLTage?

Measures the voltage value of the device under test (DUT) remotely. When the device is in local mode, use this command to read the remote voltage to further determine the voltage of the DUT.

Parameter	Typical Return
(none)	<voltage>
Reads the remote measured voltage: MEAS:SCAL:REM:VOLT	

POWer Subsystem

[SOURce:]POWer[:LEVel][:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]POWer[:LEVel][:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

Source mode: Sets the immediate output power level. Units are in Watts. When the parameter is positive, this command is equivalent to POWer:LIMit. When the parameter is negative, this command is equivalent to POWer:LIMit:NEG.

Load mode: Sets the immediate output power level when the input is in CP or AUTO mode. Units are in Watts.

Parameter	Typical Return
Source mode: Pmin – Pmax, *RST Pmax Load mode: 0 – Pmax, *RST 0 (The minimum and maximum value is product dependent)	<power level>
Sets a power level of 50 Watts: POW 50	

[SOURce:]POWer[:LEVel]:TRIGgered[:AMPLitude] <*value*>|MINimum|MAXimum|DEFault

Load Mode only

[SOURce:]POWer[:LEVel]:TRIGgered[:AMPLitude]? [MINimum|MAXimum|DEFault]

Sets the triggered power level when the output is in CP mode. The triggered level is a stored value that is transferred to the output when an output step is triggered. Units are in watts.

Parameter	Typical Return
0 – Pmax, *RST 0 (The minimum and maximum value is product dependent)	<power level>
Sets a triggered power level to 75 watts: POW:TRIG 75	

[SOURce:]POWer:LIMit[:POSitive][:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]POWer:LIMit[:POSitive][:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

Sets the upper power limit on the output. Units are in Watts.

Parameter	Typical Return
0 – Pmax, *RST Pmax (The minimum and maximum value is product dependent)	<upper power limit>
Sets the upper power limit to maximum: POW:LIM MAX	

[SOURce:]POWer:LIMit:NEGative[:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]POWer:LIMit:NEGative[:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

Sets the lower power limit on the output. Units are in Watts.

Parameter	Typical Return
Pmin – -1, *RST Pmin (The minimum and maximum value is product dependent)	<lower power lmit>
Sets the lower power limit to 20 W: POW:LIM:NEG -20	

[SOURce:]POWer:MODE FIXed|STEP Load Mode only
[SOURce:]POWer:MODE?

Sets the transient mode. This determines what happens to the power when the transient system is initiated and triggered. Only applicable when the instrument is set to power priority mode only.

FIXed – Nothing happens. The output power remains at the immediate value.

STEP – The output goes to the triggered level when a trigger occurs.

Parameter	Typical Return
	FIX or STEP
Sets the power mode to Step: POW:MODE STEP	

[SOURce:]POWer:PROTection:DELay[:TIME] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]POWer:PROTection:DELay[:TIME]? [MINimum|MAXimum|DEFault]

Sets the over-power protection delay. The over-power protection function will not be triggered during the delay time. This prevents momentary changes in output status from triggering the over-power protection function. If the output is regulating in power limit longer than the programmable delay time, the OPP will trip, and the output will be turned off. Programmed values can range from 0 to 60 seconds.

Parameter	Typical Return
0 – 60, *RST 0.02	<delay time>
Specifies the power delay time to 5 s: POW:PROT:DEL:TIME 5	

[SOURce:]POWer:PROTection[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]POWer:PROTection[:LEVel] ? [MINimum|MAXimum|DEFault]

Sets the power protection limit

Parameter	Typical Return
Source mode: Pmin – Pmax, *RST Pmax Load mode: 0 – Pmax, *RST Pmax (The minimum and maximum value is product dependent)	<power limit>
Specifies the power protection limit: POW:PROT MAX	

[SOURce:]POWer:PROTection:STATe <0|OFF|1|ON>
[SOURce:]POWer:PROTection:STATe?

Enables or disables the power protection. When the output power exceeds the power limit, the output is disabled.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the power protection: POW:PROT ON	

[SOURce:]POWer:PROTection:TRIPped?

The query indicates whether an over power protection occurred (1) or not (0).

Parameter	Typical Return
(none)	0 or 1
Indicates whether an over power protection occurred: POW:PROT:TRIP?	

RESistance Subsystem

RESistance commands program the input resistance. The SOURce keyword is optional in the following commands.

[SOURce:]RESistance[:LEVel][:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault Load Mode only
[SOURce:]RESistance[:LEVel][:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

Sets the immediate input resistance level when the input is in CR, CVCR, CRCC, or AUTO mode. Units are in Ohms.

Parameter	Typical Return
Rmin – Rmax, *RST Rmax (The minimum and maximum value is product dependent)	(none)
Sets a resistance level of 0.5 ohms: RES 0.5	

RESistance[:LEVel]:TRIGgered[:AMPLitude] <*value*>|MINimum|MAXimum|DEFault Load Mode only
[SOURce:]RESistance[:LEVel]:TRIGgered[:AMPLitude]? [MINimum|MAXimum|DEFault]

Sets the triggered resistance level when the input is in CR and CRCC mode. The triggered level is a stored value that is transferred to the input when an input step is triggered. Units are in Ohms.

Parameter	Typical Return
Rmin – Rmax, *RST Rmax (The minimum and maximum value is product dependent)	(none)
Sets a triggered resistance level of 1 ohms: RES:TRIG 1	

[SOURce:]RESistance:MODE FIXed|STEP Load Mode only
[SOURce:]RESistance:MODE?

Sets the transient mode. This determines what happens to the resistance when the transient system is initiated and triggered.

FIXed – Nothing happens. The input resistance remains at the immediate value.

STEP – The input goes to the triggered level when a trigger occurs.

Parameter	Typical Return
FIXed | STEP, *RST FIXed	FIX or STEP

Parameter	Typical Return
Sets the resistance mode to Step: RES:MODE STEP	

SENSe Subsystem

Sense commands control the current measurement ranges, and window as well as the data acquisition sequence.

SENSe:ACMeter:CURRstage:RESet
SENSe:ACMeter:EACStage:RESet

Clears the current or periodic total power statistics value fed to the grid.

Parameter	Typical Return
(none)	(none)
Clears the current total power statistics: SENS:CURR:RES Clears the periodic total power statistics: SENS:EACS:RES	

SENSe:AHOur:RESet
SENSe:WHOur:RESet

Resets the amp-hour or watt-hour measurement to zero.

Parameter	Typical Return
(none)	(none)
Resets the amp-hour measurement: SENS:AHO:RES Resets the watt-hour measurement: SENS:WHO:RES	

SENSe:DLOG:FUNCtion:CURRent 0|OFF|1|ON
SENSe:DLOG:FUNCtion:CURRent?

Enables or disables the current data logging.

The query returns the status (on or off) of the current data logging

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables current data logging: SENS:DLOG:FUNC:CURR ON	

SENSe:DLOG:FUNCtion:VOLTage 0|OFF|1|ON
SENSe:DLOG:FUNCtion:VOLTage?

Enables or disables the voltage data logging.

The query returns the status (on or off) of the voltage data logging

Parameter	Typical Return
0|OFF|1|ON, *RST ON	0 or 1
Disables datalog voltage measurements: SENS:DLOG:FUNC:VOLT OFF	

SENSe:DLOG:FUNCtion:MINMax 0|OFF|1|ON
SENSe:DLOG:FUNCtion:MINMax?

Enables or disables the logging of minimum and maximum values for each sample of data.

The query returns whether the logging of minimum and maximum values is enabled

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables MIN/MAX logging values: SENS:DLOG:FUNC:MINM ON	

SENSe:DLOG:PERiod <*value*>|MINimum|MAXimum|DEFault
SENSe:DLOG:PERiod? [MINimum|MAXimum|DEFault]

NOTE This command replaces the previous SENSe:DLOG:TINTerval command and should be used in new applications. SENSe:DLOG:TINTerval is still available for backward compatibility

Sets the integration time of a data log measurement. Units are in seconds.

Parameter	Typical Return
0.0001 – 4000, *RST 0.1	<period>
Sets the integration time to 0.4 s: SENS:DLOG:PER 0.4	

SENSe:DLOG:TIME <*value*>|MINimum|MAXimum|DEFault SENSe:DLOG:TIME? [MINimum|MAXimum|DEFault]

Sets the duration time of a data log measurement.

Parameter	Typical Return
1 – Infinity, *RST 10	<time>
Specifies the data log duration time to 2 minutes: SENS:DLOG:TIME 120	

SENSe:DLOG:TINTerval <*value*>|MINimum|MAXimum|DEFault SENSe:DLOG:TINTerval? [MINimum|MAXimum|DEFault]

NOTE This command has been superseded by SENSe:DLOG:PERiod, but is still available for backward compatibility.

Sets the integration time of a data log measurement. Units are in seconds.

Parameter	Typical Return
0.0001 – 4000, *RST 0.1	<time interval>
Sets the integration time to 0.01 s: SENS:DLOG:TINT 0.01	

SENSe:ELOG:FUNCtion:CURRent 0|OFF|1|ON SENSe:ELOG:FUNCtion:CURRent?

Enables or disables the Elog current data logging.

The query returns the status (on or off) of the Elog current data logging.

Parameter	Typical Return
0|OFF|1|ON, *RST ON	0 or 1
Enables Elog current data logging: SENS:ELOG:FUNC:CURR ON	

SENSe:ELOG:FUNCtion:VOLTage <0|OFF|1|ON>
SENSe:ELOG:FUNCtion:VOLTage?

Enables or disables the Elog voltage data logging.

The query returns the status (on or off) of the Elog voltage data logging.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables Elog voltage data logging: SENS:ELOG:FUNC:VOLT ON	

SENSe:ELOG:FUNCtion:MINMax 0|OFF|1|ON
SENSe:ELOG:FUNCtion:MINMax?

Enables or disables the logging of minimum and maximum for each sample of data.

The query returns whether the logging of minimum and maximum current is enabled

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables MIN/MAX logging values: SENS:ELOG:FUNC:MINM ON	

SENSe:ELOG:PERiod <*value*>|MINimum|MAXimum|DEFault
SENSe:ELOG:PERiod? [MINimum|MAXimum|DEFault]

Sets the integration time of an Elog measurement. Units are in seconds.

Parameter	Typical Return
0.0001 – 4000, *RST 0.1	<period>
Sets the integration time to 0.4 s: SENS:ELOG:PER 0.4	

SENSe:ELOG:TIME <<*value*>|MINimum|MAXimum|DEFault
SENSe:ELOG:TIME? [MINimum|MAXimum|DEFault]

Sets the duration time of an Elog measurement.

Parameter	Typical Return
1 – Infinity, *RST Infinity	<time>
Sets the Elog duration time to 2 minutes: SENS:ELOG:TIME 120	

SENSe:ELOG:TINTerval <*value*>|MINimum|MAXimum|DEFault SENSe:ELOG:TINTerval? [MINimum|MAXimum|DEFault]

Sets the integration time of an Elog measurement. Units are in seconds.

Parameter	Typical Return
0.0001 – 4000, *RST 0.1	<time>
Sets the integration time to 0.01 s: SENS:ELOG:TINT 0.01	

SENSe:SWEep:OFFSet:POINts <*value*>|MINimum|MAXimum|DEFault SENSe:SWEep:OFFSet:POINts? [MINimum|MAXimum|DEFault]

Defines the offset in a data sweep for triggered measurements.

Parameter	Typical Return
0 – 4000, *RST 0	<offset points>
Sets 100 offset points : SENS:SWE:OFFS:POIN 100	

SENSe:SWEep:POINts <*value*>|MINimum|MAXimum|DEFault SENSe:SWEep:POINts? [MINimum|MAXimum|DEFault]

Defines the number of points in a measurement.

Parameter	Typical Return
2 – 4000, *RST 250	<points>
Specifies 2048 points: SENS:SWE:POIN 2048	

SENSe:SWEep:TINTerval <*value*>|MINimum|MAXimum|DEFault SENSe:SWEep:TINTerval? [MINimum|MAXimum|DEFault]

Defines the time period between measurement samples. Programmed values can range from 100 microseconds to 100 seconds. Units are in seconds. Values above 100 microseconds are rounded to the nearest 2 microsecond increment.

Parameter	Typical Return
0.0001 – 100, *RST 0.0004	<time interval>
Specifies an interval of 1 s between points: SENS:SWE:TINT 1	

[SOURce] Subsystem

The SOURce keyword is optional in many commands that set parameters for a source or output, such as [SOURce:]CURRent <value>.

Because SOURce subsystem commands are often used without the optional SOURce keyword, these commands are listed by their individual subsystems, below:

Subsystems and Commands Using the Optional [SOURce:] Keyword

ARB

BATTery

CURRent

DIGital

EXTern:PROGram

FUNCtion

LIST

MODE

POWer

RESistance

VOLTage

STATus Subsystem

Status register programming lets you determine the operating condition of the instrument at any time. The instrument has three groups of status registers; Operation, Questionable, and Standard Event. The Operation and Questionable status groups each consist of the Condition, Enable, and Event registers as well as NTR and PTR filters.

The Status subsystem is also programmed using Common commands. Common commands control additional status functions such as the Service Request Enable and the Status Byte registers. Refer to Status Tutorial for more information.

STATus:OPERation[:EVENt]?

Queries the event register for the Operation Status group. This is a read-only register, which stores (latches) all events that are passed by the Operation NTR and/or PTR filter. Reading the Operation Status Event register clears it.

Parameter	Typical Return
(none)	<bit value>
Reads the operation status event register: STAT:OPER?	

- The value returned is the binary-weighted sum of all enabled bits in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set and enabled, the query returns +40.
- *RST has no effect on this register.

STATus:OPERation:CONDition?

Queries the condition register for the Operation Status group. This is a read-only register, which holds the live (unlatched) operational status of the instrument. Reading the Operation Status Condition register does not clear it.

Parameter	Typical Return
(none)	<bit value>
Reads the operation status condition register: STAT:OPER:COND?	

- The value returned is the binary-weighted sum of all enabled bits in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set and enabled, the query returns +40.
- The condition register bits reflect the current condition. If a condition goes away, the corresponding bit is cleared.
- *RST clears this register, other than those bits where the condition still exists after *RST.

STATus:OPERation:ENABle <*value*>
STATus:OPERation:ENABle?

Sets the value of the enable register for the Operation Status group. The enable register is a mask for enabling specific bits from the Operation Event register to set the OPER (operation summary) bit of the Status Byte register. STATus:PRESet clears all bits in the enable register.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enables bit 3 and 4 in the enable register: `STAT:OPER:ENAB 24`	

- For example, with bit 3 (value 8) and bit 5 (value 32) set and enabled, the query returns +40.
- *CLS does not clear the enable register, but does clear the event register.

STATus:OPERation:NTRansition <*value*>|MINimum|MAXimum|DEFault
STATus:OPERation:NTRansition? [MINimum|MAXimum|DEFault]
STATus:OPERation:PTRansition <*value*>|MINimum|MAXimum|DEFault
STATus:OPERation:PTRansition? [MINimum|MAXimum|DEFault]

Sets and queries the value of the NTR (Negative-Transition) and PTR (Positive-Transition) registers. These registers serve as a polarity filter between the Operation Condition and Operation Event registers.

When a bit in the NTR register is set to 1, then a 1-to-0 transition of the corresponding bit in the Operation Condition register causes that bit in the Operation Event register to be set.

When a bit in the PTR register is set to 1, then a 0-to-1 transition of the corresponding bit in the Operation Condition register causes that bit in the Operation Event register to be set.

STATus:PRESet sets all bits in the PTR registers and clears all bits in the NTR registers.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enables bit 3 and 4 in the NTR register: `STAT:OPER:NTR 24` Enables bit 3 and 4 in the PTR register: `STAT:OPER:PTR 24`	

- If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Operation Condition register sets the corresponding bit in the Operation Event register.
- If the same bits in both NTR and PTR registers are set to 0, then no transition of that bit at the Operation Condition register can set the corresponding bit in the Operation Event register.
- The value returned is the binary-weighted sum of all enabled bits in the register.

STATus:PRESet

Presets all Enable, PTR, and NTR registers.

Operation register	Questionable register	Preset setting
STAT:OPER:ENAB	STAT:QUES:ENAB	all defined bits are disabled
STAT:OPER:NTR	STAT:QUES:NTR	all defined bits are disabled
STAT:OPER:PTR	STAT:QUES:PTR	all defined bits are enabled

Parameter	Typical Return
(none)	(none)
Presets the Operation and Questionable registers: STAT:PRES	

STATus:QUEStionable<1|2>[:EVENt]?

Queries the event register for the Questionable Status group. This is a read-only register, which stores (latches) all events that are passed by the Operation NTR and/or PTR filter. Reading the Questionable Status Event register clears it.

Parameter	Typical Return
(none)	<bit value>
Reads questionable status event register #1: STAT:QUES1?	

- The value returned is the binary-weighted sum of all enabled bits in the register. For example, with bit 2 (value 4) and bit 4 (value 16) set, the query returns +20.
- *RST has no effect on this register.

STATus:QUEStionable<1|2>:CONDition?

Queries the condition register for the Questionable Status group. This is a read-only register, which holds the live (unlatched) operational status of the instrument. Reading the Questionable Status Condition register does not clear it.

Parameter	Typical Return
(none)	<bit value>
Reads questionable status condition register #1: STAT:QUES1:COND?	

- The value returned is the binary-weighted sum of all enabled bits in the register. For example, with bit 2 (value 4) and bit 4 (value 16) set, the query returns +20.
- The condition register bits reflect the current condition. If a condition goes away, the cor-

responding bit is cleared.

- *RST clears this register, other than those bits where the condition still exists after *RST.

STATus:QUEStionable<1|2>:ENABle <*value*>|MINimum|MAXimum|DEFault
STATus:QUEStionable<1|2>:ENABle? [MINimum|MAXimum|DEFault]

Sets the value of the enable register for the Questionable Status group. The enable register is a mask for enabling specific bits from the Operation Event register to set the QUES (questionable summary) bit of the Status Byte register. STATus:PRESet clears all bits in the enable register.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enable bit 2 and 4 in the questionable enable register #1: STAT:QUES1:ENAB 24	

- For example, with bit 2 (value 4) and bit 4 (value 16) set, the query returns +20.
- *CLS does not clear the enable register, but does clear the event register.

STATus:QUEStionable<1|2>:NTRansition <*value*>|MINimum|MAXimum|DEFault
STATus:QUEStionable<1|2>:NTRansition? [MINimum|MAXimum|DEFault]
STATus:QUEStionable<1|2>:PTRansition <*value*>|MINimum|MAXimum|DEFault
STATus:QUEStionable<1|2>:PTRansition? [MINimum|MAXimum|DEFault]

Sets and queries the value of the NTR (Negative-Transition) and PTR (Positive-Transition) registers. These registers serve as a polarity filter between the Questionable Condition and Questionable Event registers.

When a bit in the NTR register is set to 1, then a 1-to-0 transition of the corresponding bit in the Questionable Condition register causes that bit in the Questionable Event register to be set.

When a bit in the PTR register is set to 1, then a 0-to-1 transition of the corresponding bit in the Questionable Condition register causes that bit in the Questionable Event register to be set.

STATus:PRESet sets all bits in the PTR registers and clears all bits in the NTR registers.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enable bit 3 and 4 in the questionable NTR register #1: STAT:QUES1:NTR 24 Enable bit 3 and 4 in the questionable PTR register #1: STAT:QUES1:PTR 24	

- If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Questionable Condition register sets the corresponding bit in the Questionable Event register.
- If the same bits in both NTR and PTR registers are set to 0, then no transition of that bit at the

Questionable Condition register can set the corresponding bit in the Questionable Event register.

- The value returned is the binary-weighted sum of all enabled bits in the register.

SYSTem Subsystem

System commands control system functions that are not directly related to output control, measurement, or status functions. Note that IEEE-488 Common commands also control system functions such as self-test, saving and recalling states, and others.

SYSTem:BEEPer[:IMMediate]

Issues a single beep immediately.

Parameter	Typical Return
(none)	(none)
Issues a single beep immediately: SYST:BEEP:IMM	

Remarks

- You can issue a beep with this command regardless of the current beeper state (SYSTem:BEEPer:STATe command).

SYSTem:BEEPer:STATe <0|OFF|1|ON>
SYSTem:BEEPer[:STATe]?

Enables or disables the beeper.

Parameter	Typical Return
0|OFF|1|ON, Default ON	0 or 1
Enables the beeper: SYST:BEEP ON	

SYSTem:BRIGhtness:LEVel <*value*>|MINimum|MAXimum|DEFault
SYSTem:BRIGhtness:LEVel? [MINimum|MAXimum|DEFault]

Enables or disables the beeper.

Parameter	Typical Return
1 – 6, Default 3	<brightness level>
Sets the front panel display brightness to maximum: SYST:BRIG:LEV 6	

SYSTem:COMMunicate:GPIB:ADDRess <*address*>
SYSTem:COMMunicate:GPIB:ADDRess?

Sets the GPIB communication address.

Parameter	Typical Return
0 – 30, Default 10	<address>
Sets the GPIB address to 5:SYST:COMM:GPIB:ADDR 5	

SYSTem:COMMunicate:LAN:CONTrol?
SYSTem:COMMunicate:TCPip:CONTrol?

Returns the initial socket control connection port number. This connection is used to send and receive commands and queries. Unlike the data socket, which uses a fixed port number, the control socket port number varies and must be obtained using these queries.

Parameter	Typical Return
(none)	<port #> (0 if sockets not supported)
Query the Control connection port number: SYST:COMM:LAN:CONT? or SYST:COMM:TCP:CONT?	

SYSTem:COMMunicate:LAN:DGATeway "<*address*>"
SYSTem:COMMunicate:LAN:DGATeway?

Sets the static LAN gateway address for the instrument.

Parameter	Typical Return
Four-byte dot notation ("nnn.nnn.nnn.nnn"), where "nnn" in each case is a byte value in the range of 0 through 255. Default 192.168.200.1	<gateway address>
Sets the gateway address to 192.168.0.1: SYST:COMM:LAN:DGAT 192.168.0.1	

SYSTem:COMMunicate:LAN:IP[:CONFiguration] <*address*>
SYSTem:COMMunicate:LAN:IP[:CONFiguration]?

Sets the static IP address of the instrument.

Parameter	Typical Return
Four-byte dot notation ("nnn.nnn.nnn.nnn"), where "nnn" in each case is a byte value in the range of 0 through 255. Default 192.168.200.100	<IP address>
Sets the IP address to 192.168.0.11: SYST:COMM:LAN:IP 192.168.0.11	

SYSTem:COMMunicate:LAN:IP[:CONFiguration]:MODE AUTO|MANual
SYSTem:COMMunicate:LAN:IP[:CONFiguration]:MODE?

Sets the IP mode of the LAN port.

AUTO – Enable the use of the Dynamic Host Configuration Protocol (DHCP) for the instrument. The instrument will try to obtain an IP address from a DHCP server. If a DHCP server is found, it will assign a dynamic IP address, Subnet Mask, and Default Gateway to the instrument. If a DHCP server is not found, the instrument uses AutoIP to automatically configure its IP setting in the Automatic Private IP Addressing range (169.254.xxx.xxx).

MANual – The instrument will use the static IP address, Subnet Mask, and Default Gateway during power-on.

NOTE If you change this setting, you must execute a SYSTem:COMMunicate:LAN:UPDate command to activate the setting.

Parameter	Typical Return
AUTO|MANual, Default AUTO	AUTO or MAN
Sets the IP mode: SYST:COMM:LAN:IP:MODE AUTO	

- Most site LANs have a DHCP server.
- If a DHCP LAN address is not assigned by a DHCP server, then an AutoIP address static IP will be assumed after approximately two minutes.
- This setting is stored in non-volatile memory, and does not change when power has been off, or after a Factory Reset (*RST).

SYSTem:COMMunicate:LAN:RAWSocketport <*value*>
SYSTem:COMMunicate:LAN:RAWSocketport?

Sets the socket port for LAN communication. The socket port must be set to 5025.

Parameter	Typical Return
5000 – 60000, Default 5025	<socket port>
Edits the port number: SYST:COMM:LAN:RAWS 5025	

SYSTem:COMMunicate:LAN:RESet

Restores the LAN communication network to factory settings.

Parameter	Typical Return
(none)	(none)
Resets the network: SYST:COMM:LAN:RES	

SYSTem:COMMunicate:LAN:SMASK "<*value*>"
SYSTem:COMMunicate:LAN:SMASK?

Assigns a subnet mask for the instrument to use in determining whether a client IP address is on the same local subnet. When a client IP address is on a different subnet, all packets must be sent to the Default Gateway. Contact your LAN administrator for details.

NOTE If you change this setting, you must execute a SYSTem:COMMunicate:LAN:UPDate command to activate the setting.

Parameter	Typical Return
Four-byte dot notation ("nnn.nnn.nnn.nnn"), where "nnn" in each case is a byte value in the range 0 through 255. Default: 255.255.255.0	<subnet mask>
Sets the subnet mask to 255.255.252.0: SYST:COMM:LAN:SMASK 255.255.252.0	

SYSTem:COMMunicate:LAN:UPDate

Stores any changes made to the LAN settings into non-volatile memory and restarts the LAN driver with the updated settings. Must be sent after changing the settings for DHCP, gateway, IP address, or subnet mask. Make all changes to the LAN settings before this command.

Parameter	Typical Return
(none)	(none)
Configures the instrument to use statically assigned LAN settings (Manual mode): SYST:COMM:LAN:MODE MAN SYST:COMM:LAN:DGAT "198.105.232.1" SYST:COMM:LAN:IP "198.105.232.101" SYSTem:COMMunicate:LAN:SMASK "255.255.255.1" SYST:COMM:LAN:UPD Configures the instrument back to use DHCP (AUTO mode): SYST:COMM:LAN:MODE AUTO SYST:COMM:LAN.UPD	

SYSTem:COMMunicate:RLSTate LOCal|REMote|RWLock
SYSTem:COMMunicate:RLSTate?

Configures the remote/local state of the instrument. Remote and local do the same thing and are included for compatibility with other products.
LOCal sets instrument to front panel control.
REMote also sets the instrument to front panel control, but locks the **[Menu]** key. To unlock the **[Menu]** key or return to LOCal mode, press the **[Menu]** key. A pop-up message will appear—select **Yes** to proceed.
RWLock disables the front panel keys. The instrument can only be controlled via the remote interface.

Parameter	Typical Return
LOCal|REMote|RWLock , Default LOCal	LOC, REM, or RWL
Sets the remote/local state to remote: SYST:COMM:RLST REM	

- The remote/local state is unaffected by *RST or any SCPI commands other than SYSTem:COMMunicate:RLState.
- The remote/local instrument state can also be set by other interface commands over the GPIB and some other I/O interface.
- When multiple remote programming interfaces are active, the interface with the most recently changed remote/local state determines the instrument's remote/local state.

SYSTem:COMMunicate:SERial:BAUDrate 9600|19200|38400|57600|115200
SYSTem:COMMunicate:SERial:BAUDrate?

Sets the baud rate of the serial port.

Parameter	Typical Return
9600|19200|38400|57600|115200, Default 9600	9600, 19200, 38400, 57600, or 115200
Sets the baud rate to 38400: `SYST:COMM:SER:BAUD 38400`	

SYSTem:COMMunicate:USB:FUNCtion HOST|TMC|VCP
SYSTem:COMMunicate:USB:FUNCtion?

Specifies the function of the USB communication interface on the instrument.

Parameter	Typical Return
HOST|TMC|VCP, Default HOST	HOST, TMC, or VCP
Specifies the USB function to VCP: `SYST:COMM:USB:FUNC VCP`	

SYSTem:DATE <*yyyy*>,<*mm*>,<*dd*>
SYSTem:DATE?

Sets the date of the system clock. Specify the year (2000 to 2099), month (1 to 12), and day (1 to 31).

Parameter	Typical Return
<yyyy,<mm>,<dd>	2025/03/14
Set the date to March 14, 2025: `SYST:DATE 2025,03,14`	

- The real-time clock does not adjust itself for time zone changes or daylight savings time.

SYSTem:EMULation SOURce|LOAD
SYSTem:EMULation?

Sets the operating mode of the instrument.

SOURce – Power supply. This mode emulates a power supply operation.

LOAD – Electronic load. This mode emulates an electronic load operation.

Parameter	Typical Return
SOUR|LOAD, Default SOUR	(none)
Selects power supply as the emulation type: `SYST:EMUL SOUR`	

SYSTem:ERRor[:NEXT]?

Reads and clears one error from the error queue.

Parameter	Typical Return
(none)	<+0,"No error">
Reads and clear first error in error queue: SYST:ERR:NEXT	

- The front-panel ERR annunciator turns on and beeps when one or more errors are currently stored in the error queue. Error retrieval is first-in-first-out (FIFO), and errors are cleared as you read them. When you have read all errors from the error queue, the ERR annunciator turns off.
- The error queue is cleared by the *CLS and when power is cycled. It is not cleared by a *RST.
- Errors have the following format (the error string may contain up to 127).
  <error code>,*<error string>*
  For a list of error codes and message strings, see SCPI Error Messages.

SYSTem:REBoot

Reboots the instrument to its power-on state.

Parameter	Typical Return
(none)	(none)
Reboots the instrument: SYST:REB	

SYSTem:SECurity:IMMediate

Clears all user memory and reboots the instrument. This command is typically used to prepare the instrument for removal from a secure area. It sanitizes all user data. It writes all zeros to flash memory and then performs a chip erase as per manufacturer's data sheet. Identification data (instrument firmware, model number, serial number, MAC address and calibration data) is not erased. After the data is cleared, the instrument is rebooted.

This procedure is not recommended for use in routine applications because of the possibility of unintended loss of data.

Parameter	Typical Return
(none)	(none)
Sanitizes the instrument: SYST:SEC:IMM	

SYSTem:TIME <hh>,<mm>,<ss>
SYSTem:TIME?

Sets the time of the system clock. Specify hours (0 to 23), minutes (0 to 59), and seconds (0 to 59).

Parameter	Typical Return
<hh>,<mm>,<ss>	14:30:54
Set the clock to 8:30 PM: SYST:TIME 20,30,00	

SYSTem:VERSion?

Returns the SCPI version that the instrument complies with. Cannot be determined from front panel.

Parameter	Typical Return
(none)	1991.0
Return the SCPI version: SYST:VERS?	

- The command returns a string in the form "YYYY.V", where YYYY represents the year of the version and V represents a version for that year.

SYSTem:VOLTage:RZERo 0|OFF|1|ON
SYSTem:VOLTage:RZERo ?

Enables or disables voltage zeroing mode.

Parameter	Typical Return
0|OFF|1|ON, Default ON	0 or 1
Enables voltage zeroing: SYST:VOLT:RZER ON	

TRIGger Subsystem

Trigger commands control the transient and acquisition subsystems. Refer to Trigger Overview for more information.

TRIGger:ACQuire[:IMMediate]
TRIGger:ARB[:IMMediate]
TRIGger:DLOG[:IMMediate]
TRIGger:ELOG[:IMMediate]
TRIGger:LIST[:IMMediate]

Generates an immediate trigger. This overrides any selected trigger source.

TRIGger:ACQuire triggers the acquisition system.

TRIGger:ARB triggers the ARB subsystem function.

TRIGger:DLOG triggers the data logger.

TRIGger:ELOG triggers the external data logger.

TRIGger:LIST triggers the list value.

Parameter	Typical Return
(none)	(none)
Generate a measurement trigger: TRIG:ACQ	

TRIGger:ACQuire:CURRent:HYSTeresis:HIGH <*value*>|MINimum|MAXimum|DEFault
TRIGger:ACQuire:CURRent:HYSTeresis:HIGH? [MINimum|MAXimum|DEFault]
TRIGger:ACQuire:VOLTage:HYSTeresis:HIGH <*value*>|MINimum|MAXimum|DEFault
TRIGger:ACQuire:VOLTage:HYSTeresis:HIGH? [MINimum|MAXimum|DEFault]

Sets the upper current or voltage level at which a trigger event occurs. The specified value must be greater than the current TRIGger:ACQuire:CURRent or TRIGger:ACQuire:VOLTage setting.

Parameter	Typical Return
Current: Imin – Imax, *RST (Imax x 0.1) + (Imax x 0.005) Voltage: Vmin – Vmax, *RST (Vmax x 0.1) + Maximum voltage ripple (fixed value by hardware) (The minimum and maximum value is product dependent)	(none)
Set current hysteresis to maximum: TRIG:ACQ:CURR:HYST:HIGH MAX Set voltage hysteresis to maximum: TRIG:ACQ:VOLT:HYST:HIGH MAX	

TRIGger:ACQuire:CURRent:HYSTeresis:LOW <*value*>|MINimum|MAXimum|DEFault
TRIGger:ACQuire:CURRent:HYSTeresis:LOW? [MINimum|MAXimum|DEFault]
TRIGger:ACQuire:VOLTage:HYSTeresis:LOW <*value*>|MINimum|MAXimum|DEFault
TRIGger:ACQuire:VOLTage:HYSTeresis:LOW? [MINimum|MAXimum|DEFault]

Sets the lower current or voltage level at which a trigger event occurs. The specified value must be greater than the current TRIGger:ACQuire:CURRent or TRIGger:ACQuire:VOLTage setting.

Parameter	Typical Return
Current: Imin – Imax, *RST (Imax x 0.1) + (Imax x 0.005) Voltage: Vmin – Vmax, *RST (Vmax x 0.1)+ Maximum voltage ripple (fixed value by hardware) (The minimum and maximum value is product dependent)	<hysteresis value>
Set lower current hysteresis to maximum: TRIG:ACQ:CURR:HYST:LOW MAX Set lower voltage hysteresis to maximum: TRIG:ACQ:VOLT:HYST:LOW MAX	

TRIGger:ACQuire:CURRent[:LEVel] <*value*>|MINimum|MAXimum|DEFault
TRIGger:ACQuire:CURRent[:LEVel]? [MINimum|MAXimum|DEFault]
TRIGger:ACQuire:VOLTage[:LEVel] <*value*>|MINimum|MAXimum|DEFault
TRIGger:ACQuire:VOLTage[:LEVel]? [MINimum|MAXimum|DEFault]

Sets the triggered level of the output. Applies when the measurement trigger source is set to a level. Values are specified in either amperes or volts. The minimum and maximum values depend on the ratings of the unit.

Parameter	Typical Return
Current: Imin – Imax, *RST Imax x 0.1 Voltage: Vmin – Vmax, *RST Vmax x 0.1 (The minimum and maximum value is product dependent)	<level value>
Set the triggered current level to 3 A: TRIG:ACQ:CURR 3 Set the triggered voltage level to 50 V: TRIG:ACQ:VOLT 50	

TRIGger:ACQuire:CURRent:SLOPe POSitive|NEGative|EITHer
TRIGger:ACQuire:CURRent:SLOPe?
TRIGger:ACQuire:VOLTage:SLOPe POSitive|NEGative|EITHer
TRIGger:ACQuire:VOLTage:SLOPe?

Sets the slope of the signal. Applies when the measurement trigger source is set to a level.
POSitive specifies a rising slope of the output signal.
NEGative specifies a falling slope of the output signal.
EITHer specifies both rising and falling slope.

Parameter	Typical Return
POS|NEG|EITH, *RST EITHer	POS, NEG, or EITH
Set current slope to negative (falling edge): TRIG:ACQ:CURR:SLOP NEG Set voltage slope to negative (falling edge): TRIG:ACQ:VOLT:SLOP NEG	

TRIGger:ACQuire:SOURce VOLTage|CURRent|EXTernal|BUS
TRIGger:ACQuire:SOURce?

Selects the trigger source for the acquisition system.

BUS	Selects a remote interface trigger command.
CURRent	Selects an output trigger slope, current level, upper level and lower level.
EXTernal	Selects digital port pin 4 as a trigger source.
VOLTage	Selects an output trigger slope, voltage level, upper level and lower level.

Parameter	Typical Return
VOLTage|CURRent|EXTernal|BUS, *RST BUS	VOLT, CURR, EXT, or BUS
Selects a current level as the acquire trigger: TRIG:ACQ:SOUR CURR	

TRIGger:ACQuire:STATe?

Returns the trigger state of the acquisition system.

Parameter	Typical Return
(none)	INIT, TRIG, or IDLE
Returns the trigger state of the acquisition system: TRIG:ACQ:STAT?	

TRIGger:ARB:SOURce IMMediate|BUS|EXTernal TRIGger:ARB:SOURce? TRIGger:LIST:SOURce IMMediate|BUS|EXTernal TRIGger:LIST:SOURce?

TRIG:ARB:SOURce – selects the trigger source for arbitrary waveforms .

TRIG:LIST:SOURce – selects the trigger source for the list value.

BUS	Selects a remote interface trigger command.
EXTernal	Selects digital port pin 4 as a trigger source.
IMMediate	Triggers the transient as soon as it is INITiated.

Parameter	Typical Return
BUS | EXTernal | IMMediate, *RST IMMediate	BUS, EXT, or IMM
Selects Immediate as Arb trigger source: TRIG:ARB:SOUR IMM Selects remote interface as List trigger source: TRIG:LIST:SOUR BUS	

TRIGger:DLOG:CURRent:HYSTeresis:HIGH <*value*>|MINimum|MAXimum|DEFault TRIGger:DLOG:CURRent:HYSTeresis:HIGH? [MINimum|MAXimum|DEFault] TRIGger:DLOG:VOLTage:HYSTeresis:HIGH <*value*>|MINimum|MAXimum|DEFault TRIGger:DLOG:VOLTage:HYSTeresis:HIGH? [MINimum|MAXimum|DEFault]

Sets the upper current or voltage level at which a trigger event occurs during data logging. The specified value must be greater than the current TRIGger:DLOG:CURRentor TRIGger:DLOG:VOLTage setting.

Parameter	Typical Return
Current: Imin – Imax, *RST (Imax x 0.1) + (Imax x 0.005) Voltage: Vmin – Vmax, *RST (Vmax x 0.1)+ Maximum voltage ripple (fixed value by hardware) (The minimum and maximum value is product dependent)	<hysteresis value>
Set current hysteresis to maximum: TRIG:DLOG:CURR:HYST:HIGH MAX Set voltage hysteresis to maximum: TRIG:DLOG:VOLT:HYST:HIGH MAX	

TRIGger:DLOG:CURRent:HYSTeresis:LOW <*value*>|MINimum|MAXimum|DEFault
TRIGger:DLOG:CURRent:HYSTeresis:LOW? [MINimum|MAXimum|DEFault]
TRIGger:DLOG:VOLTage:HYSTeresis:LOW <*value*>|MINimum|MAXimum|DEFault
TRIGger:DLOG:VOLTage:HYSTeresis:LOW? [MINimum|MAXimum|DEFault]

Sets the lower current or voltage level at which a trigger event occurs during data logging. The specified value must be greater than the current TRIGger:DLOG:CURRentor TRIGger:DLOG:VOLTage setting.

Parameter	Typical Return
Current: Imin – Imax, *RST (Imax x 0.1) + (Imax x 0.005) Voltage: Vmin – Vmax, *RST (Vmax x 0.1)+ Maximum voltage ripple (fixed value by hardware) (The minimum and maximum value is product dependent)	<hysteresis value>
Set current hysteresis to maximum: TRIG:DLOG:CURR:HYST:LOW MAX Set voltage hysteresis to maximum: TRIG:DLOG:VOLT:HYST:LOW MAX	

TRIGger:DLOG:CURRent[:LEVel] <*value*>|MINimum|MAXimum|DEFault
TRIGger:DLOG:CURRent[:LEVel]? [MINimum|MAXimum|DEFault]
TRIGger:DLOG:VOLTage[:LEVel] <*value*>|MINimum|MAXimum|DEFault
TRIGger:DLOG:VOLTage[:LEVel]? [MINimum|MAXimum|DEFault]

Sets the current or voltage triggered level of the data logger. Applies when the data logger trigger source is set to a level. Values are specified in either amperes or volts. The minimum and maximum values depend on the ratings of the unit.

Parameter	Typical Return
Current: Imin – Imax, *RST Imax x 0.1 Voltage: Vmin – Vmax, *RST Vmax x 0.1 (The minimum and maximum value is product dependent)	<level value>
Set the triggered current level to 3 A: TRIG:DLOG:CURR 3 Set the triggered voltage level to 50 V: TRIG:DLOG:VOLT 50	

TRIGger:DLOG:CURRent:SLOPe POSitive|NEGative|EITHer
TRIGger:DLOG:CURRent:SLOPe?
TRIGger:DLOG:VOLTage:SLOPe POSitive|NEGative|EITHer
TRIGger:DLOG:VOLTage:SLOPe?

Sets the slope of the signal. Applies when the measurement trigger source is set to a level.
POSitive specifies a rising slope of the output signal.
NEGative specifies a falling slope of the output signal.
EITHer specifies both rising and falling slope.

Parameter	Typical Return
POSitive|NEGative|EITHer, *RST EITHer	(none)
Set current slope to negative (falling edge): TRIG:DLOG:CURR:SLOP NEG Set voltage slope to negative (falling edge): TRIG:DLOG:VOLT:SLOP NEG	

TRIGger:DLOG:SOURce IMMediate|BUS|VOLTage| CURRent|EXTernal
TRIGger:DLOG:SOURce?
TRIGger:ELOG:SOURce IMMediate|BUS|VOLTage| CURRent|EXTernal
TRIGger:ELOG:SOURce?

TRIG:DLOG:SOURce – selects the trigger source for the data logger.

TRIG:ELOG:SOURce – selects the trigger source for the external data logger.

BUS	Selects a remote interface trigger command.
CURRent	Selects an output trigger slope, current level, upper level and lower level.
EXTernal	Selects digital port pin 4 as a trigger source.
IMMediate	Triggers the transient as soon as it is INITiated.
VOLTage	Selects an output trigger slope, voltage level, upper level and lower level.

Parameter	Typical Return
IMMediate|BUS|VOLTage| CURRent|EXTernal, *RST IMMediate	BUS, EXT, IMM, CURR, or VOLT
Selects voltage level as Dlog trigger source: TRIG:DLOG:SOUR VOLT Select remote interface as the Elog trigger source: TRIG:DLOG:SOUR BUS	

TRIGger:ELOG:CURRent:HYSTeresis:HIGH <*value*>|MINimum|MAXimum|DEFault
TRIGger:ELOG:CURRent:HYSTeresis:HIGH? [MINimum|MAXimum|DEFault]
TRIGger:ELOG:VOLTage:HYSTeresis:HIGH <*value*>|MINimum|MAXimum|DEFault
TRIGger:ELOG:VOLTage:HYSTeresis:HIGH? [MINimum|MAXimum|DEFault]

Sets the upper current or voltage level at which a trigger event occurs during external data logging. The specified value must be greater than the current TRIGger:ELOG:CURRent or TRIGger:ELOG:VOLTage setting.

Parameter	Typical Return
Current: Imin – Imax, *RST (Imax x 0.1) + (Imax x 0.005) Voltage: Vmin – Vmax, *RST (Vmax x 0.1)+ Maximum voltage ripple (fixed value by hardware) (The minimum and maximum value is product dependent)	<hysteresis value>
Set current hysteresis to maximum: `TRIG:ELOG:CURR:HYST:HIGH MAX` Set voltage hysteresis to maximum: `TRIG:ELOG:VOLT:HYST:HIGH MAX`	

TRIGger:ELOG:CURRent:HYSTeresis:LOW <*value*>|MINimum|MAXimum|DEFault
TRIGger:ELOG:CURRent:HYSTeresis:LOW? [MINimum|MAXimum|DEFault]
TRIGger:ELOG:VOLTage:HYSTeresis:LOW <*value*>|MINimum|MAXimum|DEFault
TRIGger:ELOG:VOLTage:HYSTeresis:LOW? [MINimum|MAXimum|DEFault]

Sets the lower current or voltage level at which a trigger event occurs during external data logging. The specified value must be greater than the current TRIGger:ELOG:CURRent or TRIGger:ELOG:VOLTage setting.

Parameter	Typical Return
Current: Imin – Imax, *RST (Imax x 0.1) + (Imax x 0.005) Voltage: Vmin – Vmax, *RST (Vmax x 0.1)+ Maximum voltage ripple (fixed value by hardware) (The minimum and maximum value is product dependent)	<hysteresis value>
Set current hysteresis to maximum: `TRIG:ELOG:CURR:HYST:LOW MAX` Set voltage hysteresis to maximum: `TRIG:ELOG:VOLT:HYST:LOW MAX`	

TRIGger:ELOG:CURRent[:LEVel] <*value*>|MINimum|MAXimum|DEFault
TRIGger:ELOG:CURRent[:LEVel]? [MINimum|MAXimum|DEFault]
TRIGger:ELOG:VOLTage[:LEVel] <*value*>|MINimum|MAXimum|DEFault
TRIGger:ELOG:VOLTage[:LEVel]? [MINimum|MAXimum|DEFault]

Sets the current or voltage triggered level of the external data logger. Applies when the external data logger trigger source is set to a level. Values are specified in either amperes or volts. The minimum and maximum values depend on the ratings of the unit.

Parameter	Typical Return
Current: Imin – Imax, *RST Imax x 0.1 Voltage: Vmin – Vmax, *RST Vmax x 0.1	<level value>
Set the triggered current level to 3 A: TRIG:ELOG:CURR 3 Set the triggered voltage level to 50 V: TRIG:ELOG:VOLT 50	

TRIGger:ELOG:CURRent:SLOPe POSitive|NEGative|EITHer
TRIGger:ELOG:CURRent:SLOPe?
TRIGger:ELOG:VOLTage:SLOPe POSitive|NEGative|EITHer
TRIGger:ELOG:VOLTage:SLOPe?

Sets the slope of the signal. Applies when the measurement trigger source is set to a level.
POSitive specifies a rising slope of the output signal.
NEGative specifies a falling slope of the output signal.
EITHer specifies both rising and falling slope.

Parameter	Typical Return
POSitive|NEGative|EITHer, *RST EITHer	(none)
Set current slope to negative (falling edge): TRIG:ELOG:CURR:SLOP NEG Set voltage slope to negative (falling edge): TRIG:ELOG:VOLT:SLOP NEG	

VOLTage Subsystem

Voltage commands program the output voltage of the instrument.

[SOURce:]VOLTage:BWIDth:RANGe HIGH|LOW
[SOURce:]VOLTage:BWIDth:RANGe?

In Source mode: Sets the output bandwidth when the unit is operating in constant voltage (CV). This lets you optimize output response time with capacitive loads. The bandwidth of different priority mode is saved separately and do not affect each other.

In Load mode: Sets the input bandwidth. This applies to all operating mode.

Parameter	Typical Return
HIGH|LOW, *RST HIGH	<bandwidth>
Sets the loop speed: VOLT:BWID:RANG LOW	

[SOURce:]VOLTage:INHibit:VON[:LEVel] <*value*>|MINimum|MAXimum|DEFault Load Mode only
[SOURce:]VOLTage:INHibit:VON[:LEVel]? [MINimum|MAXimum|DEFault]

When enabled, as specified by VOLTage:INHibit:VON:MODE, the electronic load will not sink current until the input voltage rises above the voltage-on setting. Units are in volts.

Applicable for all operating modes: CC, CV, CP, CR, CVCC, CVCR, CRCC, and AUTO.

Parameter	Typical Return
Vmax/1000 – Vmax, *RST Vmax/1000 (The minimum and maximum value is product dependent)	<voltage-on value>
Specifies a voltage-on of 4 V: VOLT:INH:VON 4	

[SOURce:]VOLTage:INHibit:VON:MODE LATChing|LIVE|OFF Load Mode only
[SOURce:]VOLTage:INHibit:VON:MODE?

Specifies the behavior of the under-voltage inhibit function. When enabled (not OFF), the electronic load will not sink current until the input voltage rises above the voltage-on setting specified by VOLTage:INHibit:VON <value>.

LATChing – Allows the load to sink current even if the voltage subsequently drops below the voltage-on setting.

LIVE – Turns the input off whenever the voltage drops below the voltage-on setting. Turns the input back on when the voltage reaches the voltage-on setting.

OFF – Turns the under-voltage inhibit function off.

Parameter	Typical Return
LATChing|LIVE|OFF, *RST LIVE	LATC, LIVE, or OFF
Sets the inhibit mode to latching: VOLT:INH:VON:MODE LATC	

[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault [SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

Source mode: Sets the immediate voltage level when the output is operating in voltage priority mode (CV), both in voltage priority and in current priority (when in voltage limit). Units are in voltage. The maximum value depends on the voltage rating of the unit.

Load mode: Sets the immediate voltage level when the output is operating in CV, CVCC, CVCR, or AUTO mode. Units are in voltage. The maximum value depends on the voltage rating of the unit.

Parameter	Typical Return
Source mode: 0 – Vmax, *RST 0.2 Load mode: 0 – Vmax, *RST Vmax (The minimum and maximum value is product dependent)	<voltage level>
Sets the output voltage to 20 V: VOLT:LEV:IMM:AMP 20	

[SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude] <*value*>|MINimum|MAXimum|DEFault [SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude]? [MINimum|MAXimum|DEFault]

Source mode: Sets the triggered voltage level when the output is operating in voltage priority mode. The triggered level is a stored value that is transferred to the output when an output Step is triggered. Units are in voltage. The maximum value depends on the voltage rating of the unit.

Load mode: Sets the triggered voltage level when the output is operating in CV, CVCC, or CVCR mode. The triggered level is a stored value that is transferred to the output when an output Step is triggered. Units are in voltage. The maximum value depends on the voltage rating of the unit.

Parameter	Typical Return
Source mode: 0 – Vmax, *RST 0.2 Load mode: 0 – Vmax, *RST Vmax (The minimum and maximum value is product dependent)	<voltage level>
Sets the triggered voltage to 10 V VOLT:LEV:TRIG:AMP 10	

[SOURce:]VOLTage:LIMit:LOW <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]VOLTage:LIMit:LOW? [MINimum|MAXimum|DEFault]

Sets the low voltage limit when in current priority mode. This prevents the voltage from dropping below the low voltage limit when discharging a battery. When the voltage drops to the specified low limit value, the output transitions from current priority to negative voltage limit and the discharging stops. This sets the LIM- bit in the Questionable Status Register.

Parameter	Typical Return
0 – Vmax, *RST 0 (The minimum and maximum value is product dependent)	<voltage limit>
Sets the low voltage limit to 2 V: VOLT:LIM:LOW 2	

[SOURce:]VOLTage:LIMit[:POSitive][:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]VOLTage:LIMit[:POSitive][:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

Sets the voltage limit when in current priority mode. Units are in volts. The maximum value depends on the voltage rating of the unit.

Parameter	Typical Return
0 Vmax, *R – ST 0.2	<voltage limit>
Sets the voltage limit to 20 V: VOLT:LIM:POS:IMM 20	

[SOURce:]VOLTage:MODE FIXed|STEP|LIST|BATTery|ARB|BEMulator Source Mode only
[SOURce:]VOLTage:MODE FIXed|STEP|LIST|BATTery|ARB Load Mode only
[SOURce:]VOLTage:MODE?

Source mode: Sets the transient mode when in voltage priority mode. This command determines what happens to the output voltage when the transient system is initiated and triggered.

Load mode: Sets the transient mode when in CV, CVCC, or CVCR mode. This command determines what happens to the output voltage when the transient system is initiated and triggered.

FIXed nothing happens. The output voltage remains at the immediate value.

STEP steps the output to the triggered level when a trigger occurs.

LIST causes the output to follow the list values when a trigger occurs.

BATT causes the output to follow the edited battery test file values when a trigger occurs.

ARB causes the output to follow the arbitrary waveform values when a trigger occurs.

BEM causes the output to follow the battery emulator when a trigger occurs.

Parameter	Typical Return
Source mode: FIXed|STEP|LIST|BATT|ARB|BEM, *RST FIXed Load mode: FIXed|STEP|LIST|BATTery|ARB, *RST FIXed	FIX, STEP, LIST, BATT, ARB, or BEM
Sets the voltage mode to Step: VOLT:MODE STEP	

[SOURce:]VOLTage:ON:HYSTeresis[:LEVel] <*value*>|MINimum|MAXimum|DEFault

Load Mode only

[SOURce:]VOLTage:ON:HYSTeresis[:LEVel]? [MINimum|MAXimum|DEFault]

Sets the hysteresis value. The maximum value is limited by the currently set Voltage-On (Von) value under load.

The actual maximum value that can be set is the lower of:

- The system's predefined Maximum, and
- The current Von value under load.

This ensures the hysteresis voltage remains within the safe operating range defined by the Von setting.

Parameter	Typical Return
When Vmax ≥ 200, range is from 0 – Vmax/20.2 When Vmax < 200, range is from 0 – Vmax/10.1, *RST Vmax/2	<hysteresis value>
Sets the hysteresis value: VOLT:ON:HYST 5	

[SOURce:]VOLTage:PROTection:DELay[:TIME] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]VOLTage:PROTection:DELay[:TIME]? [MINimum|MAXimum|DEFault]

Sets the over-voltage protection delay. The over-voltage protection function will not be triggered during the delay time. After the delay time has expired, the over-voltage protection function will be active. This prevents momentary changes in output status from triggering the over-voltage protection function. Units in seconds.

Parameter	Typical Return
0 – 60, *RST 0.02	<delay value>
Sets the protection delay to 0.2 seconds: VOLT:PROT:DEL 0.2	

– The operation of over-voltage protection is affected by the setting of the voltage protection delay start event, which is specified by VOLTage:PROTection:DELay:STARt.

[SOURce:]VOLTage:PROTection[:LEVel] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]VOLTage:PROTection[:LEVel]? [MINimum|MAXimum|DEFault]

Sets the over-voltage protection level. Units are in volts. If the output voltage exceeds the OVP level, the output is disabled and the Questionable Condition status register OV bit is set.

Parameter	Typical Return
0 – Vmax, *RST Vmax (The minimum and maximum value is product dependent)	<protect level>
Sets the OVP protection value to 20 V: VOLT:PROT 20	

[SOURce:]VOLTage:PROTection:STATe <0|OFF|1|ON>
[SOURce:]VOLTage:PROTection:STATe?

Enables or disables the over-voltage protection. If the over-voltage protection function is enabled and the output goes into voltage limit, the output is disabled and the Questionable Condition status register OVP bit is set.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable the voltage protection state: VOLT:PROT:STAT ON	

– An over-protection condition can be cleared with OUTPut:PROTection:CLEar after the cause of the condition is removed.

[SOURce:]VOLTage:PROTection:TRIPped?

The query indicates whether an over-voltage protection occurred (1) or not (0). This is reset to 0 by VOLTage:PROTection:CLEar.

Parameter	Typical Return
(none)	0 or 1
Indicates whether an over-voltage protection occurred: VOLT:PROT:TRIP?	

[SOURce:]VOLTage:RANGe <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]VOLTage:RANGe? [MINimum|MAXimum|DEFault]

Sets the output voltage range. The value that you enter must be the highest value in volts that you expect to source. The instrument selects the range with the best resolution for the value entered.

Parameter	Typical Return
0.5 – Vmax, *RST Vmax (The minimum and maximum value is product dependent)	<voltage range>
Sets the high voltage range: VOLT:RANG 30	

Remarks:

- This command is coupled with [SOURce:]VOLTage. This means that if a range command places an output on a range with a lower maximum voltage than the present voltage level, an out of range error occurs. This also occurs if a voltage is programmed that is too large for the present range. Errors can be avoided by sending both level and range commands in the same SCPI message. When the range and level information is received as a set, no range/setting conflict occurs.
- If a programmed range change occurs while the output is enabled, the output will be temporarily disabled while the range switch occurs. The transition from on-to-off and then from off-to-on will also be delayed by the settings of OUTPut:DELay:FALL and OUTPut:DELay:RISE.

[SOURce:]VOLTage:RESistance[:LEVel][:IMMediate][:AMPLitude] <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]VOLTage:RESistance[:LEVel][:IMMediate][:AMPLitude]? [MINimum|MAXimum|DEFault]

Sets the output resistance level (internal resistance) when in voltage priority mode. Units are in Ohms.

Parameter	Typical Return
0 –Rmax, *RST 0	(none)
Sets the voltage priority resistance level to 30 ohm: VOLT:RES 30	

[SOURce:]VOLTage:RESistance:STATe 0|OFF|1|ON Source Mode only
[SOURce:]VOLTage:RESistance:STATe?

Enables or disables output resistance (internal resistance) in voltage priority mode.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable resistance in voltage priority mode: VOLT:RES:STAT ON	

[SOURce:]VOLTage:SENSe[:SOURce] INTernal|EXTernal
[SOURce:]VOLTage:SENSe[:SOURce]?

Sets the state of the remote sense relays. The query returns the selected state of the remote sense relay.

INTernal – Sets the remote sense relays to local sensing. The front panel remote sense terminals are internally connected to the output terminals. The 4 wire indicator is off.

EXTernal – Sets the remote sense relays to remote sensing. The front panel remote sense terminals are not internally connected to the output terminals and must be connected to the external load. The 4 wire indicator is on.

Parameter	Typical Return
INT|EXT, *RST INT	INT or EXT
Sets the sense mode to external: VOLT:SENS EXT	

[SOURce:]VOLTage:SLEW:COUPle 0|OFF|1|ON Load Mode only
[SOURce:]VOLTage:SLEW:COUPle?

Enables or disables the voltage slew tracking state.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the voltage slew tracking state: VOLT:SLEW:COUP ON	

[SOURce:]VOLTage:SLEW[:POSitive][:IMMediate] <*value*>|MINimum|MAXimum|DEFault|INFinity Load Mode only
[SOURce:]VOLTage:SLEW[:POSitive][:IMMediate]? [MINimum|MAXimum|DEFault]
[SOURce:]VOLTage:SLEW:NEGative[:IMMediate] <*value*>|MINimum|MAXimum|DEFault|INFinity Load Mode only
[SOURce:]VOLTage:SLEW:NEGative[:IMMediate]?[MINimum|MAXimum|DEFault]

Sets the voltage slew rate. The slew rate is set in amps per millisecond and affects all programmed current changes, including those due to the output state turning on or off.

Parameter	Typical Return
Load mode: 0.001 – MAX, *RST MAX (The minimum and maximum value is product dependent)	<slew rate>
Sets the positive output slew rate to 5 V/ms: VOLT:SLEW 5 Sets the negative output slew rate to 5 V/ms: VOLT:SLEW:NEG 5	

[SOURce:]VOLTage:SLEW[:POSitive]:MAXimum<0|OFF|1|ON> Load Mode only
[SOURce:]VOLTage:SLEW[:POSitive]:MAXimum?
[SOURce:]VOLTage:SLEW:NEGative:MAXimum<0|OFF|1|ON> Load Mode only
[SOURce:]VOLTage:SLEW:NEGative:MAXimum?

Enables/disables the maximum slew rate override. When enabled, the slew rate is set to its maximum value. When disabled, the slew rate is set to the immediate value set by VOLTage:SLEW. Use VOLTage:SLEW? MAX to query the maximum slew rate

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Disables the positive maximum slew rate: VOLT:SLEW:MAX OFF Disables the negative maximum slew rate: VOLT:SLEW:NEG:MAX OFF	

[SOURce:]VOLTage:SLEW:TIME:COUPle 0|OFF|1|ON Source Mode only
[SOURce:]VOLTage:SLEW:TIME:COUPle?

Enables or disables the voltage slew time tracking state.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the voltage slew time tracking state: VOLT:SLEW:TIME:COUP ON	

[SOURce:]VOLTage:SLEW:TIME[:POSitive][:IMMediate] <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]VOLTage:SLEW:TIME[:POSitive][:IMMediate]? [MINimum|MAXimum|DEFault]
[SOURce:]VOLTage:SLEW:TIME:NEGative[:IMMediate] <*value*>|MINimum|MAXimum|DEFault Source Mode only
[SOURce:]VOLTage:SLEW:TIME:NEGative[:IMMediate]?[MINimum|MAXimum|DEFault]

Sets the voltage slew time.

Parameter	Typical Return
0 – 8000, *RST 0.1	<slew time>
Sets the output rising slew time to 5 s: VOLT:SLEW:TIME 5 Sets the output falling slew time to 5 s: VOLT:SLEW:TIME:NEG 5	

[SOURce:]VOLTage:SLEW[:POSitive]:TIME:MINimum<0|OFF|1|ON> Source Mode only
[SOURce:]VOLTage:SLEW[:POSitive]:MINimum?
[SOURce:]VOLTage:SLEW:TIME:NEGative:MINimum<0|OFF|1|ON> Source Mode only
[SOURce:]VOLTage:SLEW:TIME:NEGative:MINmum?

Enables/disables the fastest voltage slew time override. When enabled, the slew time is set to its minimum value. When disabled, the slew time is set to the immediate value set by VOLTage:SLEW:TIME or VOLTage:SLEW:TIME:NEG. Use VOLTage:SLEW:TIME? MIN or VOLTage:SLEW:TIME:NEG? MIN to query the minimum slew time.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the fastest rising slew time: VOLT:SLEW:TIME:MIN ON Disables the fastest falling slew time: VOLT:SLEW:TIME:NEG:MIN OFF	

[SOURce:]VOLTage:UNDer:PROTection:DELay[:TIME] <*value*>|MINimum|MAXimum|DEFault
[SOURce:]VOLTage:UNDer:PROTection:DELay[:TIME]? [MINimum|MAXimum|DEFault]

Specifies the under-voltage protection delay time in seconds. The under-voltage protection function will not be triggered during the delay time. After the delay time has expired, the under-voltage protection function will be active.

Parameter	Typical Return
0 – 60, *RST 0.02	<delay time>
Sets the protection delay to 0.2 seconds: VOLT:UND:PROT:DEL 0.2	

[SOURce:]VOLTage:UNDer:PROTection[:LEVel] <*value*>|MINimum|MAXimum|DEFault [SOURce:]VOLTage:UNDer:PROTection[:LEVel]? [MINimum|MAXimum|DEFault]

Specifies the under-voltage protection level. Units are in volts.

Parameter	Typical Return
0 – Vmax, *RST 0 (The minimum and maximum value is product dependent)	<voltage>
Sets the under-voltage protection value to 10 V: VOLT:UND:PROT 10	

[SOURce:]VOLTage:UNDer:PROTection:STATe<0|OFF|1|ON> [SOURce:]VOLTage:UNDer:PROTection:STATe?

Enables or disables the under-voltage protection.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the under-voltage protection: VOLT:UND:PROT:STAT ON	

[SOURce:]VOLTage:UNDer:PROTection:TRIPped?

This query indicates whether a under-voltage protection occurred (1) or not (0).

Parameter	Typical Return
(none)	0 or 1
Indicates whether an under-voltage protection occurred: VOLT:UND:PROT:TRIP?	

[SOURce:]VOLTage:UNDer:PROTection:WARM <*value*>|MINimum|MAXimum|DEFault [SOURce:]VOLTage:UNDer:PROTection:WARM? [MINimum|MAXimum|DEFault]

Specifies the warm-up time for under-voltage protection. This setting prevents the instrument from triggering protection during a rising current, as this transient condition should not be considered an undercurrent fault and does not require protection.

Parameter	Typical Return
0 – 60, *RST 3	<time>
Sets the UVP warm-up time 5 s: CURR:UND:PROT:WARM 5	

Status Tutorial

This section provides a detailed description of the individual registers and register groups. The status diagram provides an graphical view of how the status registers and groups are interconnected.

Status Registers

The Operation and Questionable status groups use four different types of registers to track qualify, flag, and enable instrument events. The Standard Event group only uses Event and Enable registers.

- A Condition register continuously monitors the state of the instrument. The bits in the condition register are updated in real time and the bits are not latched.
- An PTR/NTR register qualifies the signal that passes to the event register. When a PTR bit is set, signals with positive edge transition pass to the event register. When an NTR bit is set, signals with a negative edge transition pass to the event register. When both bits are set, all signal pass. When neither bits are set, no signals pass.
- An Event register latches transitions that pass through the PTR and NTR registers. When an event bit is set, it remains set until the Event register is read. Reading the Event register clears it.
- An Enable register defines which bits in the event register will be reported to the Status Byte register. You can write to or read from an enable register.

Operation Status Group

These registers record signals that occur during normal operation. The groups consist of a Condition, PTR/NTR, Event, and Enable register. The outputs of the Operation Status register group are logically ORed into the OPERation summary bit (7) of the Status Byte register. Refer to Status Diagram.

The following table describes the Operation Status register bit assignments.

Source mode:

Bit	Bit Name	Decimal Value	Definition
0	CV	1	Output is in constant voltage mode
1	CC	2	Output is in constant current mode
2	CR	4	Output is in constant resistance mode.
3	CP	8	Output is in constant power mode.
4	OFF	16	Output is programmed off.
5	Not Used	32	0 is returned.
6	WTG-meas	64	Measurement system is waiting for a trigger.
7	WTG-tran	128	Arb or List system is waiting for a trigger.
8	WTG-log	256	Data logging or External logging is waiting for a trigger.
9	MEAS-active	512	Measurement system is initiated.
10	TRAN-active	1024	Arb or List system is initiated.
11	LOG-active	2048	Data logging or External logging is initiated.
12-15	Not Used	61440	0 is returned.

Load mode:

Bit	Bit Name	Decimal Value	Definition
0	CV	1	Input is in constant voltage mode.
1	CC	2	Input is in constant current mode.
2	CR	4	Input is in constant resistance mode.
3	CP	8	Input is in constant power mode.
4	OFF	16	Input is programmed off.
5	SH	32	Load input terminals are shorted.
6	WTG-meas	64	Measurement system is waiting for a trigger.
7	WTG-tran	128	Arb or List system is waiting for a trigger.
8	WTG-log	256	Data logging or External logging is waiting for a trigger.
9	MEAS-active	512	Measurement system is initiated.
10	TRAN-active	1024	Arb or List system is initiated.
11	LOG-active	2048	Data logging or External logging is initiated.
12	Mixed	4096	The input is one of the mixed modes (CV+CC, CV+CR, CC+CR, and CC+CV+CP+CR).
13 - 15	Not Used	57344	0 is returned.

Questionable Status Groups

These registers record signals that indicate abnormal operation. The groups consist of a Condition, PTR/NTR, Event, and Enable register. The outputs of the Questionable Status groups are logically-ORed into the QUEStionable summary bit (3) of the Status Byte register. Refer to Status Diagram.

The following table describes the Questionable1 Status register bit assignments.

Source mode:

Bit	Bit Name	Decimal Value	Definition
0	OV	1	Output is disabled by the over-voltage protection.
1	OC	2	Output is disabled by the over-current protection.
2	OP	4	Output is disabled by the over-power protection.
3	OT	8	Output is disabled by the over-temperature protection.

4	UC	16	Output is disabled by the under-current protection.
5	UV	32	Output is disabled by the under-voltage protection.
6	PF	64	Output is disabled by a power-fail condition.
7	Inh	128	Output is disabled by an external inhibit signal.
8	Unr	256	Output is unregulated.
9	ESE	512	Error sense. When the difference between the local voltage and the voltage of the device to be measured exceeds the threshold, the sense fault occurs.
10	SF	1024	A voltage or current sharing fault has occurred.
11	PNL	2048	The parallel is not locked.
12	HC	4096	Multi-host collision protection.
13	FE	8192	A fiber error has occurred.
14	WDG	16384	A watchdog error has occurred.
15	Not Used	32768	0 is returned.

Load mode:

Bit	Bit Name	Decimal Value	Definition
0	OV	1	Input is disabled by the over-voltage protection.
1	OC	2	Input is disabled by the over-current protection.
2	OP	4	Input is disabled by the over-power protection.
3	OT	8	Input is disabled by the over-temperature protection.
4	UC	16	Input is disabled by the under-current protection.
5	UV	32	Input is disabled by the under-voltage protection.
6	PF	64	Input is disabled by a power-fail condition.
7	Inh	128	Input is disabled by an external inhibit signal.
8	Unr	256	Input is unregulated.
9	ESE	512	Error sense. When the difference between the local voltage and the voltage of the device to be measured exceeds the threshold, the sense fault occurs.
10	SF	1024	A voltage or current sharing fault has occurred.
11	PNL	2048	The parallel is not locked.
12	HC	4096	Multi-host collision protection.

13	FE	8192	A fiber error has occurred.
14	WDG	16384	A watchdog error has occurred.
15	Not Used	32768	0 is returned.

The following table describes the Questionable2 Status register bit assignments.

Source mode:

Bit	Bit Name	Decimal Value	Definition
0	Not Used	1	0 is returned.
1	Not Used	2	0 is returned.
2	Not Used	4	0 is returned.
3	Not Used	8	0 is returned.
4	Not Used	16	0 is returned.
5	Not Used	32	0 is returned.
6	HW	64	A hardware error has occurred.
7	UE	128	An unexpected error has occurred.
8	NF	256	A networking failure has occurred.
9	MCF	512	A model check fail has occurred.
10	FSF	1024	A function switching failure has occurred.
11 - 15	Not Used	63488	0 is returned.

Load mode:

Bit	Bit Name	Decimal Value	Definition
0	Not Used	1	0 is returned.
1	UVI	2	An under-voltage inhibit condition occurred.
2	Not Used	4	0 is returned.
3	Not Used	8	0 is returned.
4	Not Used	16	0 is returned.
5	Not Used	32	0 is returned.
6	HW	64	A hardware error has occurred.
7	UE	128	An unexpected error has occurred.

8	NF	256	A networking failure has occurred.
9	MCF	512	A model check fail has occurred.
10	FSF	1024	A function switching failure has occurred.
11 - 15	Not Used	63488	0 is returned.

Standard Event Status Group

These registers are programmed by Common commands. The group consists of an Event and Enable register. The Standard Event register latches events relating to communication status. It is a read-only register that is cleared when read. The Standard Event enable register functions similarly to the enable registers of the Operation and Question and Questionable status groups. Refer to Status Diagram.

The following table describes the Standard Event Status register bit assignments.

Bit	Bit Name	Decimal Value	Definition
0	OPC	1	Operation Complete. All commands before and including *OPC have been executed.
1	NU	2	not used. 0 is returned.
2	QYE	4	Query Error. The output buffer was empty, a new command was received before a previous query was read, or both the input and output buffers are full.
3	DDE	8	Device- specific Error. A device-specific error, including a self-test error, calibration error or other device-specific error occurred. See Error Messages.
4	EXE	16	Execution Error. An execution error occurred. See Error Messages.
5	CME	32	Command. A command syntax error occurred. See Error Messages.
6	NU	64	not used. 0 is returned.
7	PON	128	Power On. Power has been cycled since the last time the event register was read or cleared.

Status Byte Register

This register summarizes the information from all other status groups as defined in the IEEE 488.2 Standard Digital Interface for Programmable Instrumentation. Refer to Status Diagram.

The following table describes the Status Byte register bit assignments.

Bit	Bit Name	Decimal Value	Definition
0	Not Used	1	0 is returned.
1	Not Used	2	0 is returned.

2	Error Queue	4	One or more errors in the Error Queue. Use SYSTem:ERRor? to read and delete errors.
3	Questionable Status Summary	8	One or more bits are set in the Questionable Data Register. Bits must be enabled, see STATus:QUEStionable:ENABle.
4	Message Available	16	Data is available in the instrument's output buffer.
5	Event Status Summary	32	One or more bits are set in the Standard Event Register. Bits must be enabled, see *ESE.
6	Master Status Summary	64	One or more bits are set in the Status Byte Register and may generate a Service Request. Bits must be enabled, see *SRE.
7	Operation Status Summary	128	One or more bits are set int the Operation Status Register. Bits must be enabled, see STATus:OPERation:ENABle.

Master Status Summary (MSS) and Request for Service Bits (RQS)

MSS is a real-time (unlatched) summary of all Status Byte register bits that are enabled by the Service Request Enable register. MSS is set whenever the instrument has one or more reasons for requesting service. *STB? reads the MSS in bit position 6 of the response but does not clear any of the bits in the Status Byte register.

The RQS bit is a latched version of the MSS bit. Whenever the instrument requests service, it sets the SRQ interrupt line true and latches RQS into bit 6 of the Status Byte register. When the controller does a serial poll, RQS is cleared inside the register and returned in bit position 6 of the response. The remaining bits of the Status Byte register are not disturbed.

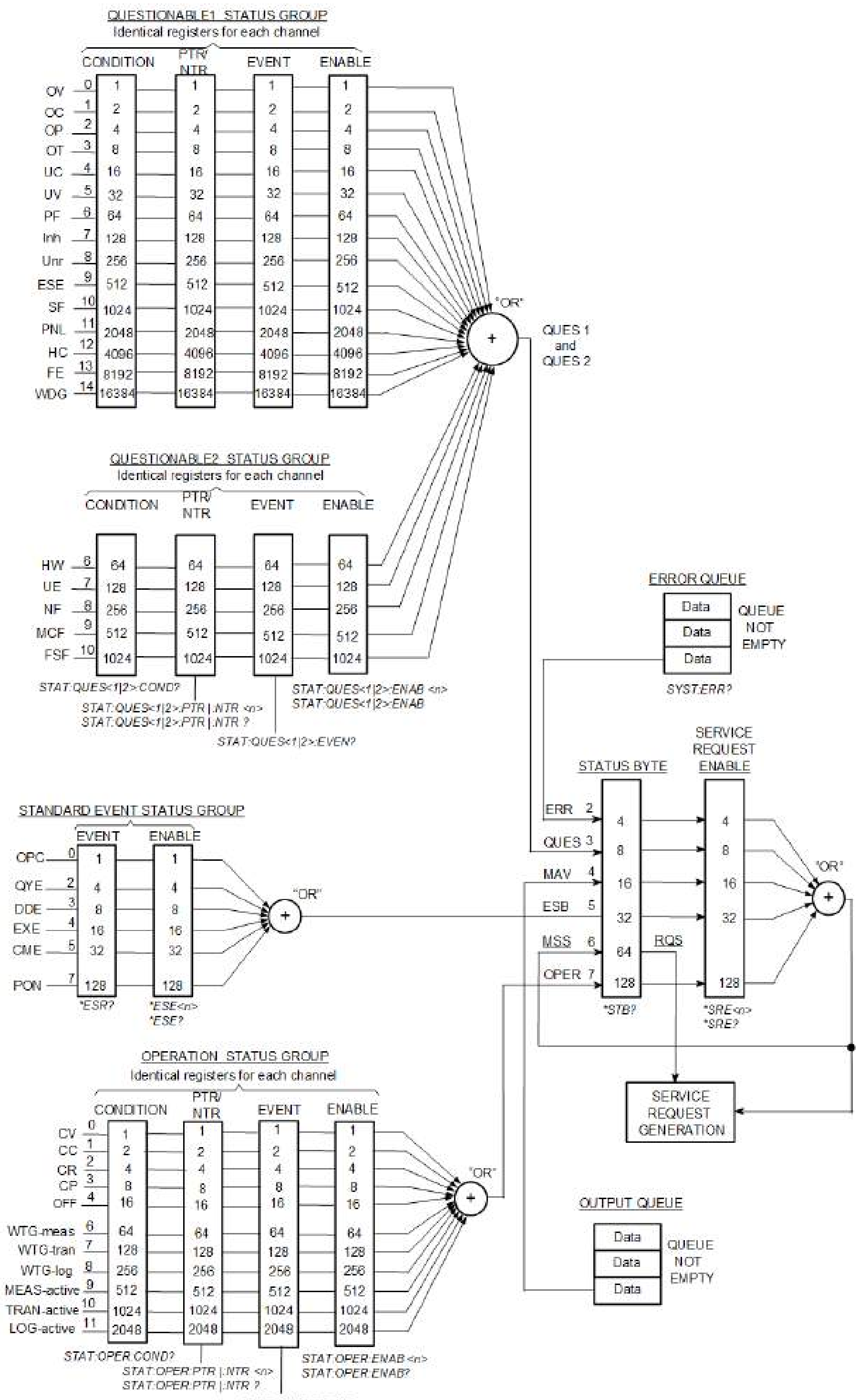
Error and Output Queues

The Error Queue is a first-in, first-out (FIFO) data register that stores numerical and textual description of an error or event. Error messages are stored until they are read with SYSTem:ERRor? If the queue overflows, the last error/event in the queue is replaced with error -350,"Queue overflow".

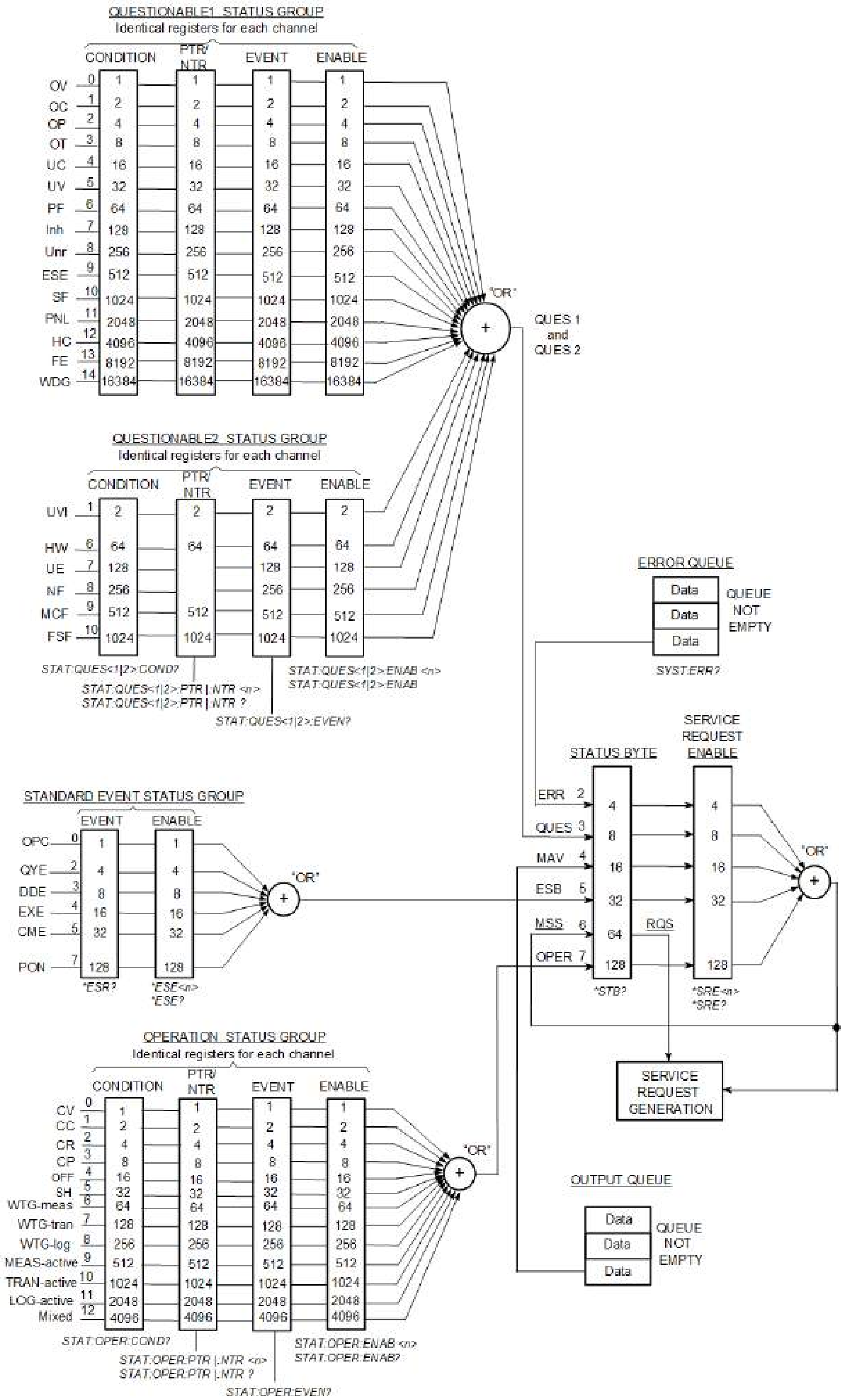
The Output Queue is a first-in, first-out (FIFO) data register that stores messages until the controller reads them. Whenever the queue holds messages, it sets the MAV bit (4) of the Status Byte register.

Status Diagram

Source mode:



Load mode:


QUESTIONABLE1 STATUS GROUP
Identical registers for each channel
CONDITION
PTR/NTR
EVENT
ENABLE
OV
OC
OP
OT
UC
UV
PF
Inh
Unr
ESE
SF
PNL
HC
FE
WDG
"OR"
QUES 1 and QUES 2
QUESTIONABLE2 STATUS GROUP
Identical registers for each channel
UVI
HW
UE
NF
MCF
FSF
STAT:QUES<1|2>:COND?
STAT:QUES<1|2>:PTR | :NTR <n>
STAT:QUES<1|2>:PTR | :NTR ?
STAT:QUES<1|2>:EVEN?
STAT:QUES<1|2>:ENAB <n>
STAT:QUES<1|2>:ENAB
ERROR QUEUE
Data
QUEUE NOT EMPTY
SYST:ERR?
STATUS BYTE
SERVICE REQUEST ENABLE
ERR
QUES
MAV
ESB
MSS
OPER
RQS
*STB?
*SRE<n>
*SRE?
STANDARD EVENT STATUS GROUP
EVENT
ENABLE
OPC
QYE
DDE
EXE
CME
PON
*ESR?
*ESE<n>
*ESE?
SERVICE REQUEST GENERATION
OPERATION STATUS GROUP
Identical registers for each channel
CV
CC
CR
CP
OFF
SH
WTG-meas
WTG-tran
WTG-log
MEAS-active
TRAN-active
LOG-active
Mixed
OUTPUT QUEUE
STAT:OPER:COND?
STAT:OPER:PTR | :NTR <n>
STAT:OPER:PTR | :NTR ?
STAT:OPER:EVEN?
STAT:OPER:ENAB <n>
STAT:OPER:ENAB?

Trigger Tutorial

The RPS trigger system is a flexible, multi-purpose system that controls the operation of the instrument to suit a variety of user-defined applications. The trigger diagram below provides a graphical view of how the trigger sources and destinations are interconnected.

Trigger Sources

Trigger Destinations

Trigger Diagram

Trigger Sources

The following table describes the available trigger sources, which are shown on the left of the trigger diagram. Not all trigger sources can be applied to every trigger subsystem.

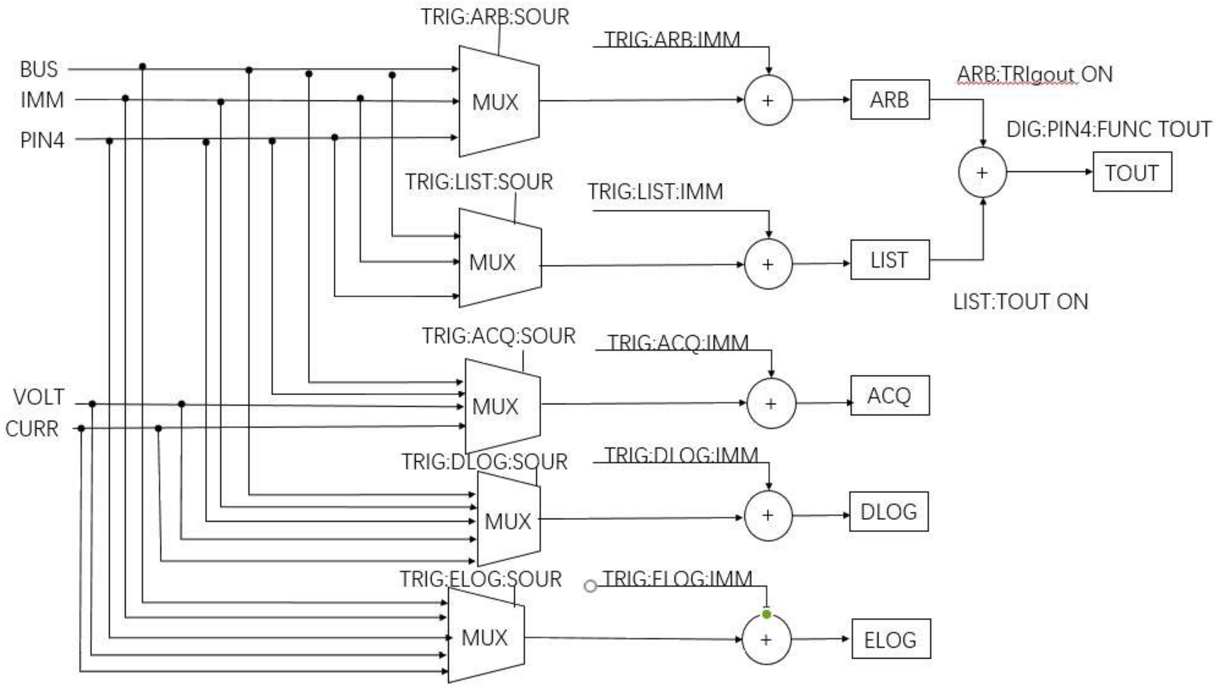
Source	Description
BUS	Enables GPIB device triggers, *TRG, or <GET> (Group Execute Trigger).
CURR	Selects an output trigger slope, current level, upper level and lower level.
IMMediate	Triggers the transient as soon as it is INITiated.
EXTernal	EXTernal selects ALL connector pins that have been configured as trigger inputs.
VOLT	Selects an output trigger slope, voltage level, upper level and lower level.

Trigger Destinations

The following table describes the trigger system destinations.

Destination	Description
Digital pin	Sends the trigger to the designated digital pin. See Programming the Digital Port.
Acquisition system	Sends the trigger to the acquisition system.
Arb	Starts the arbitrary waveform. Note that the waveform must first be enabled and initiated.
Data Log	Starts the data logging.
External Data Log	Starts the external data logging.
List	Starts the list.

Trigger Diagram



Reset State (*RST)

NOTE The power-on/reset state may differ from that shown below if you have enabled power-on state recall mode from the **States** menu (see Instrument State Storage)..

Reset Settings

The following table shows the reset state. These parameters are reset to the indicated values at power-on or after *RST.

SCPI Command	*RST	
	Source Mode	Load Mode
CALibrate:SECure:STATe	ON	ON
DISPlay[:WINDow]:VIEW	METER_VI	METER_VI
FORMat:BORDer	NORMal	NORMal
FORMat:DATA	ASCII	ASCII
INPut|OUTPut:PON:STATe		RST
INPut|OUTPut:PROTection:WDOG:DELay		60
INPut|OUTPut:PROTection:WDOG[:STATe]		OFF
INPut|OUTPut:SHORt[:STATe]		OFF
INPut|OUTPut[:STATe]		OFF
INPut|OUTPut[:STATe]:DELay:FALL		0
INPut|OUTPut[:STATe]:DELay:RISE		0
OUTPut:PON:STATe	RST	
OUTPut:PROTection:WDOG:DELay	60	
OUTPut:PROTection:WDOG[:STATe]	OFF	
OUTPut[:STATe]	OFF	
OUTPut[:STATe]:DELay:FALL	0	
OUTPut[:STATe]:DELay:RISE	0	
SENSe:DLOG:FUNCtion:CURRent	OFF	OFF
SENSe:DLOG:FUNCtion:VOLTage	ON	ON
SENSe:DLOG:FUNCtion:MINMax	OFF	OFF

SCPI Command	*RST	
	Source Mode	Load Mode
SENSe:DLOG:PERiod	0.1	0.1
SENSe:DLOG:TIME	10	10
SENSe:DLOG:TINTerval	0.1	0.1
SENSe:ELOG:FUNCtion:CURRent	ON	ON
SENSe:ELOG:FUNCtion:VOLTage	OFF	OFF
SENSe:ELOG:FUNCtion:MINMax	OFF	OFF
SENSe:ELOG:PERiod	0.1	0.1
SENSe:ELOG:TIME	Infinity	Infinity
SENSe:ELOG:TINTerval	0.1	0.1
SENSe:SWEep:POINts	250	250
SENSe:SWEep:OFFSet:POINts	0	0
SENSe:SWEep:TINTerval	0.0004	0.0004
[SOURce:]ARB:CDWell:DWELl	0.001	0.001
[SOURce:]ARB:CDWell[:LEVel]	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:CDWell:POINts	1	1
[SOURce:]ARB:COUNt	1	1
[SOURce:]ARB:EXPonential:END[:LEVel]	CC: Imax/100 CV: 0.2	CC: Imax/100 CV: 0.2
[SOURce:]ARB:EXPonential:STARt[:LEVel]	CC: Imax/100 CV: 0.2	CC: Imax/100 CV: 0.2
[SOURce:]ARB:EXPonential:STARt:TIMe	1	1
[SOURce:]ARB:EXPonential:TCONstant	1	1
[SOURce:]ARB:EXPonential:TIMe	1	1
[SOURce:]ARB:FUNCtion:SHAPe	CDWell	CDWell
[SOURce:]ARB:FUNCtion:TYPE	VOLT	CURRent
[SOURce:]ARB:PULSe:END:SLEW		MAXimum
[SOURce:]ARB:PULSe:END:SLEW:TIME	0.1	
[SOURce:]ARB:PULSe:END:TIME	0.001	0.001

SCPI Command	*RST	
	Source Mode	Load Mode
[SOURce:]ARB:PULSe:STARt[:LEVel]	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:PULSe:STARt:SLEW		MAXimum
[SOURce:]ARB:PULSe:STARt:SLEW:TIME	0.1	
[SOURce:]ARB:PULSe:STARt:TIME	0.001	0.001
[SOURce:]ARB:PULSe:TOP[:LEVel]	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:PULSe:TOP:TIME	0.001	0.001
[SOURce:]ARB:RAMP:END[:LEVel]	CC: Imax/100 CV: 0.2	CC: Imax/100 CV: 0.2
[SOURce:]ARB:RAMP:STARt[:LEVel]	CC: Imax/100 CV: 0.2	CC: Imax/100 CV: 0.2
[SOURce:]ARB:RAMP:END:TIMe	1	1
[SOURce:]ARB:RAMP:RTIMe	1	1
[SOURce:]ARB:RAMP:STARt:TIMe	1	1
[SOURce:]ARB:SEQuence:CDWell[:LEVel]	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:SEQuence:CDWell:POINts	1	1
[SOURce:]ARB:SEQuence:CDWell:WIDth	0.001	0.001
[SOURce:]ARB:SEQuence:COUNt	1	1
[SOURce:]ARB:SEQuence:EXPonential:END[:LEVel]	CC: Imax/100 CV: 0.2	CC: Imax/100 CV: 0.2
[SOURce:]ARB:SEQuence:EXPonential:STARt[:LEVel]	CC: Imax/100 CV: 0.2	CC: Imax/100 CV: 0.2
[SOURce:]ARB:SEQuence:EXPonential:STARt:TIMe	1	1
[SOURce:]ARB:SEQuence:EXPonential:TCONstant	1	1
[SOURce:]ARB:SEQuence:EXPonential:TIMe	1	1
[SOURce:]ARB:SEQuence:FUNCtion	PULSe	PULSe
[SOURce:]ARB:SEQuence:LENGth	1	1
[SOURce:]ARB:SEQuence:PACing	OFF	OFF
[SOURce:]ARB:SEQuence:PULSe:END:SLEW		MAXimum
[SOURce:]ARB:SEQuence:PULSe:END:SLEW:TIME	0.1	

SCPI Command	*RST	
	Source Mode	Load Mode
[SOURce:]ARB:SEQuence:PULSe:END:TIME	0.001	0.001
[SOURce:]ARB:SEQuence:PULSe:STARt[:LEVel]	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:SEQuence:PULSe:STARt:SLEW		MAXimum
[SOURce:]ARB:SEQuence:PULSe:STARt:SLEW:TIME	0.1	
[SOURce:]ARB:SEQuence:PULSe:STARt:TIME	0.001	0.001
[SOURce:]ARB:SEQuence:PULSe:TOP[:LEVel]	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:SEQuence:PULSe:TOP:TIME	0.001	0.001
[SOURce:]ARB:SEQuence:RAMP:END[:LEVel]	CC: Imax/100 CV: 0.2	CC: Imax/100 CV: 0.2
[SOURce:]ARB:SEQuence:RAMP:STARt[:LEVel]	CC: Imax/100 CV: 0.2	CC: Imax/100 CV: 0.2
[SOURce:]ARB:SEQuence:RAMP:END:TIMe	1	1
[SOURce:]ARB:SEQuence:RAMP:RTIMe	1	1
[SOURce:]ARB:SEQuence:RAMP:STARt:TIMe	1	1
[SOURce:]ARB:SEQuence:SELect	1	1
[SOURce:]ARB:SEQuence:SINusoid:AMPLitude	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:SEQuence:SINusoid:FREQuency	50	50
[SOURce:]ARB:SEQuence:SINusoid:OFFSet	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:SEQuence:UDEFined:COUNt	2	2
[SOURce:]ARB:SEQuence:UDEFined:DWELl	1	0.001
[SOURce:]ARB:SEQuence:UDEFined:LEVel	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:SEQuence:UDEFined:SLEW		MAXimum
[SOURce:]ARB:SEQuence:UDEFined:SLEW:TIME	0.1	
[SOURce:]ARB:SINusoid:AMPLitude	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:SINusoid:FREQuency	50	50

SCPI Command	*RST	
	Source Mode	Load Mode
[SOURce:]ARB:SINusoid:OFFSet	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:TERMinate:LAST	OFF	OFF
[SOURce:]ARB:UDEFined:COUNt	2	2
[SOURce:]ARB:UDEFined:DWELl	1	0.001
[SOURce:]ARB:UDEFined:LEVel	CC: Imax/100 CV: 0.2	0
[SOURce:]ARB:UDEFined:SLEW		MAXimum
[SOURce:]ARB:UDEFined:SLEW:TIME	0.1	
[SOURce:]ARB:TRIgout	OFF	OFF
[SOURce:]ARB:ZOOM:COF	1	1
[SOURce:]ARB:ZOOM:LIMIt:NEGative	CC: -Imax CV: 0	CC: 0 CV: 0
[SOURce:]ARB:ZOOM:LIMIt:POSitive	CC: Imax CV: Vmax	CC: Imax CV: Vmax
[SOURce:]BATTery[:ENABle]	OFF	OFF
[SOURce:]BATTery:CHARge:CURRent	Imax/100	
[SOURce:]BATTery:CHARge:VOLTage	0.2	
[SOURce:]BATTery:CUToff:CAPacity[:IMMediate]	Charging: 1 Discharging: -1	999999
[SOURce:]BATTery:CUToff:CAPacity:STATe	OFF	OFF
[SOURce:]BATTery:CUToff:CURRent[:IMMediate]	Charging: Imax /100 Discharging: Imin/100	
[SOURce:]BATTery:CUToff:CURRent:STATe	OFF	
[SOURce:]BATTery:CUToff:TIMer[:IMMediate]	60	999999
[SOURce:]BATTery:CUToff:TIMer:STATe	OFF	OFF
[SOURce:]BATTery:CUToff:VOLTage[:IMMediate]	0.2	0
[SOURce:]BATTery:CUToff:VOLTage:STATe	OFF	OFF
[SOURce:]BATTery:DISCharge:CURRent	Imin/100	0.1
[SOURce:]BATTery:DISCharge:VOLTage	0.2	
[SOURce:]BATTery:MODE	CHAR	

SCPI Command	*RST	
	Source Mode	Load Mode
[SOURce:]BATTery:EMULator:CAPacity:INIT	0.5	
[SOURce:]BATTery:EMULator:CAPacity:LIMit	1	
[SOURce:]BATTery:EMULator:CURRent:LIMit:NEGative	Imin	
[SOURce:]BATTery:EMULator:CURRent:LIMit:POSitive	Imax	
[SOURce:]BATTery:EMULator:INIT:MODE	SOC	
[SOURce:]BATTery:EMULator:PARallel	1	
[SOURce:]BATTery:EMULator:RESistance	0	
[SOURce:]BATTery:EMULator:SERies	1	
[SOURce:]BATTery:EMULator:SOC:INIT	50	
[SOURce:]BATTery:EMULator[:STATe]	OFF	
[SOURce:]BATTery:EMULator:VOC:EMPTy	1	
[SOURce:]BATTery:EMULator:VOC:FULL	5	
[SOURce:]BATTery:EMULator:VOC:INIT	3	
[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude]	Imax/100	0
[SOURce:]CURRent[:LEVel]:TRIGgered[:AMPLitude]	Imax/100	0
[SOURce:]CURRent:BWIDth:RANGe	HIGH	
[SOURce:]CURRent:LIMit:NEGative[:IMMediate][:AMPLitude]	Imin/100	
[SOURce:]CURRent:LIMit[:POSitive][:IMMediate][:AMPLitude]	Imax/100	0
[SOURce:]CURRent:MODE	FIXed	FIXed
[SOURce:]CURRent:PROTection:DELay[:TIME]	0.02	0.02
[SOURce:]CURRent:PROTection[:LEVel]	Imax	Imax
[SOURce:]CURRent:PROTection:STATe	OFF	OFF
[SOURce:]CURRent:RESistance[:LEVel][:IMMediate][:AMPLitude]	Rmax	
[SOURce:]CURRent:RESistance:STATe	OFF	
[SOURce:]CURRent:SLEW:COUPle		OFF
[SOURce:]CURRent:SLEW:TIME:COUPle	OFF	
[SOURce:]CURRent:SLEW:NEGative[:IMMediate]		MAXimum

SCPI Command	*RST	
	Source Mode	Load Mode
[SOURce:]CURRent:SLEW:TIME:NEGative[:IMMediate]	0.1	
[SOURce:]CURRent:SLEW[:POSitive][:IMMediate]		MAXimum
[SOURce:]CURRent:SLEW:TIME[:POSitive][:IMMediate]	0.1	
[SOURce:]CURRent:SLEW:NEGative:MAXimum		OFF
[SOURce:]CURRent:SLEW:TIME:NEGative:MINimum	OFF	
[SOURce:]CURRent:SLEW[:POSitive]:MAXimum		OFF
[SOURce:]CURRent:SLEW:TIME[:POSitive]:MINimum	OFF	
[SOURce:]CURRent:UNDer:PROTection:DELay[:TIME]	0.02	0.02
[SOURce:]CURRent:UNDer:PROTection[:LEVel]	0	0
[SOURce:]CURRent:UNDer:PROTection:STATe	OFF	OFF
[SOURce:]CURRent:UNDer:PROTection:WARM	3	3
[SOURce:]EXTern:PROGram:CHANnel:MB	CC: Imax/10 CV: Vmax/10	Ch1: Imax/10 Ch2: Vmax/10 Ch3: Pmax/10 Ch4: Rmax/10
[SOURce:]EXTern:PROGram:CHANnel:MX	CC: Imax/1000 CV: 0.02	Ch1: 0 Ch2: Vmax/10 Ch3: 0 Ch4: Rmax/10
[SOURce:]EXTern:PROGram[:STATe]	OFF	OFF
[SOURce:]FUNCtion	VOLT	CURRent
[SOURce:]LIST:COUNt	1	1
[SOURce:]LIST:CURRent[:LEVel]	0	0
[SOURce:]LIST:CURRent:SLEW		MAXimum
[SOURce:]LIST:CURRent:SLEW:TIME	0.1	
[SOURce:]LIST:DWELl	1	0.001
[SOURce:]LIST:FUNCtion:TYPE	VOLT	CURRent
[SOURce:]LIST:STEP	2	2
[SOURce:]LIST:TERMinate:LAST	OFF	OFF
[SOURce:]LIST:TOUTput[:STATe]	OFF	OFF
[SOURce:]LIST:VOLTage[:LEVel]	0	0

SCPI Command	*RST	
	Source Mode	Load Mode
[SOURce:]LIST:VOLTage:SLEW		MAXimum
[SOURce:]LIST:VOLTage:SLEW:TIME	0.1	
[SOURce:]MODE	VOLT	CURR
[SOURce:]POWer[:LEVel][:IMMediate][:AMPLitude]	Pmax	0
[SOURce:]POWer[:LEVel]:TRIGgered[:AMPLitude]		0
[SOURce:]POWer:LIMit:NEGative[:IMMediate][:AMPLitude]	Pmin	
[SOURce:]POWer:LIMit[:POSitive][:IMMediate][:AMPLitude]	Pmax	
[SOURce:]POWer:MODE		FIXed
[SOURce:]POWer:PROTection:DELay[:TIME]	0.02	0.02
[SOURce:]POWer:PROTection[:LEVel]	Pmax	Pmax
[SOURce:]POWer:PROTection:STATe	OFF	OFF
[SOURce:]RESistance[:LEVel][:IMMediate][:AMPLitude]		Rmax
[SOURce:]RESistance[:LEVel]:TRIGgered[:AMPLitude]		Rmax
[SOURce:]RESistance:MODE		FIXed
[SOURce:]VOLTage:BWIDth:RANGe	HIGH	HIGH
[SOURce:]VOLTage:INHibit:VON[:LEVel]		Vmax/1000
[SOURce:]VOLTage:INHibit:VON:MODE		LIVE
[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude]	0.2	Vmax
[SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude]	0.2	Vmax
[SOURce:]VOLTage:LIMit:LOW	0	
[SOURce:]VOLTage:LIMit[:POSitive][:IMMediate][:AMPLitude]	0.2	
[SOURce:]VOLTage:MODE	FIXed	FIXed
[SOURce:]VOLTage:ON:HYSTeresis[:LEVel]		Vmax/2
[SOURce:]VOLTage:PROTection:DELay[:TIME]	0.02	0.02
[SOURce:]VOLTage:PROTection[:LEVel]	Vmax	Vmax
[SOURce:]VOLTage:PROTection:STATe	OFF	OFF

SCPI Command	*RST	
	Source Mode	Load Mode
[SOURce:]VOLTage:RESistance[:LEVel][:IMMediate][:AMPLitude]	0	
[SOURce:]VOLTage:RESistance:STATe	OFF	
[SOURce:]VOLTage:SENSe[:SOURce]	INTernal	INTernal
[SOURce:]VOLTage:SLEW:COUPle		OFF
[SOURce:]VOLTage:SLEW:TIME:COUPle	OFF	
[SOURce:]VOLTage:SLEW:NEGative[:IMMediate]		MAXimum
[SOURce:]VOLTage:SLEW:TIME:NEGative[:IMMediate]	0.1	
[SOURce:]VOLTage:SLEW:NEGative:MAXimum		OFF
[SOURce:]VOLTage:SLEW:TIME:NEGative:MINimum	OFF	
[SOURce:]VOLTage:SLEW[:POSitive][:IMMediate]		MAXimum
[SOURce:]VOLTage:SLEW:TIME[:POSitive][:IMMediate]	0.1	
[SOURce:]VOLTage:SLEW[:POSitive]:MAXimum		OFF
[SOURce:]VOLTage:SLEW:TIME[:POSitive]:MINimum	OFF	
[SOURce:]VOLTage:UNDer:PROTection:DELay[:TIME]	0.02	0.02
[SOURce:]VOLTage:UNDer:PROTection[:LEVel]	0	0
[SOURce:]VOLTage:UNDer:PROTection:STATe	OFF	OFF
[SOURce:]VOLTage:UNDer:PROTection:WARM	3	3
TRIGger:ACQuire:CURRent:HYSTeresis:HIGH	0	0
TRIGger:ACQuire:CURRent:HYSTeresis:LOW	0	0
TRIGger:ACQuire:CURRent[:LEVel]	0	0
TRIGger:ACQuire:CURRent:SLOPe	EITHer	EITHer
TRIGger:ACQuire:SOURce	BUS	BUS
TRIGger:ACQuire:VOLTage:HYSTeresis:HIGH	0	0
TRIGger:ACQuire:VOLTage:HYSTeresis:LOW	0	0
TRIGger:ACQuire:VOLTage[:LEVel]	0	0
TRIGger:ACQuire:VOLTage:SLOPe	EITHer	EITHer
TRIGger:ARB:SOURce	IMMediate	IMMediate
TRIGger:DLOG:CURRent:HYSTeresis:HIGH	0	0

SCPI Command	*RST	
	Source Mode	Load Mode
TRIGger:DLOG:CURRent:HYSTeresis:LOW	0	0
TRIGger:DLOG:CURRent[:LEVel]	0	0
TRIGger:DLOG:CURRent:SLOPe	EITHer	EITHer
TRIGger:DLOG:SOURce	IMMediate	IMMediate
TRIGger:DLOG:VOLTage:HYSTeresis:HIGH	0	0
TRIGger:DLOG:VOLTage:HYSTeresis:LOW	0	0
TRIGger:DLOG:VOLTage[:LEVel]	0	0
TRIGger:DLOG:VOLTage:SLOPe	EITHer	EITHer
TRIGger:ELOG:CURRent:HYSTeresis:HIGH	0	0
TRIGger:ELOG:CURRent:HYSTeresis:LOW	0	0
TRIGger:ELOG:CURRent[:LEVel]	0	0
TRIGger:ELOG:CURRent:SLOPe	EITHer	EITHer
TRIGger:ELOG:SOURce	IMMediate	IMMediate
TRIGger:ELOG:VOLTage:HYSTeresis:HIGH	0	0
TRIGger:ELOG:VOLTage:HYSTeresis:LOW	0	0
TRIGger:ELOG:VOLTage[:LEVel]	0	0
TRIGger:ELOG:VOLTage:SLOPe	EITHer	EITHer
TRIGger:LIST:SOURce	IMMediate	IMMediate

Non-Volatile Settings

The following table shows the as-shipped settings of the **non-volatile** parameters. These are not affected by power cycling or *RST.

SCPI as-shipped settings	Source Mode	Load Mode
*PSC	0	0
CALibrate:COUNt?	<count>	<count>
CALibrate:DATE	empty string	empty string
CALibrate:SECure:CODE	0	0
CALibrate:STRing	empty string	empty string

SCPI as-shipped settings	Source Mode	Load Mode
INPut|OUTPut:INHibit:MODE		LATC
OUTPut:INHibit:MODE	LATC	
INSTrument:GROup:FUNCtion	NONE	NONE
INSTrument:GROup:NUMBer	2	2
DIGital:OUTPut:DATA	-	-
DIGital:PIN1:FUNCtion	PSCLear	PSCLear
DIGital:PIN2:FUNCtion	PSSTate	PSSTate
DIGital:PIN3:FUNCtion	OFFState	OFFState
DIGital:PIN4:FUNCtion	TINPut	TINPut
DIGital:PIN5:FUNCtion	INHibit	INHibit
DIGital:PIN6:FUNCtion	ONCouple	ONCouple
DIGital:PIN7:FUNCtion	OFFCouple	OFFCouple
DIGital:PIN<1-7>	NEGative	NEGative
STATus:OPERation:ENABle	0	0
STATus:OPERation:NTRansition	0	0
STATus:OPERation:PTRansition	32767	32767
STATus:QUEStionable<1|2>:ENABle	0	0
STATus:QUEStionable<1|2>:NTRansition	0	0
STATus:QUEStionable<1|2>:PTRansition	32767	32767
SYSTem:DATE	<yyyy>,<mm>,<dd>	<yyyy>,<mm>,<dd>
SYSTem:EMULation	SOURce	
SYSTem:COMMunicate:GPIB	10	10
SYSTem:COMMunicate:LAN:RAWSocketport	5025	5025
SYSTem:COMMunicate:SERial:BAUDrate	9600	9600
SYSTem:COMMunicate:USB:FUNCtion	HOST	HOST
SYSTem:TIME	<hh>,<mm>, <ss>	<hh>,<mm>, <ss>
VOLTage:RANGe	Vmax	
Front Panel as-shipped settings		
Beeper	Enabled	Enabled

SCPI as-shipped settings	Source Mode	Load Mode
Brightness level	3	3
Firmware update password protected	Disabled	Disabled
LAN interface	Enabled	Enabled
USB interface	Enabled	Enabled
USB function	HOST	HOST
Interface as-shipped settings		
Get IP Address	AUTO	AUTO
IP address	192.168.200.100	192.168.200.100
LAN -raw socket	5025	5025
Subnet mask	255.255.255.0	255.255.255.0
Default gateway	192.168.200.1	192.168.200.1
Host name	K-<serial number>.local	K-<serial number>.local
mDNS service name	Keysight RP59xxx <serial number>	Keysight RP59xxx <serial number>
Web password	Keysight	Keysight

Volatile Settings

The following table shows the as-shipped settings of the **volatile** parameters. These are not affected by *RST, but is affected by power cycling.

SCPI as-shipped settings	Source Mode	Load Mode
*ESE	255	255
*SRE	255	255
CALibrate:DATA	<value>	<value>
CALibrate:CURRent:LEVel	<level>	<level>
CALibrate:VOLTage:LEVel	<level>	<level>
INPut|OUTPut[:STATe]:COUPle[:STATe]		OFF
OUTPut[:STATe]:COUPle[:STATe]	OFF	
INPut|OUTPut[:STATe]:COUPle[:STATe]:DOFFset		0
OUTPut[:STATe]:COUPle[:STATe]:DOFFset	0	
SYSTem:COMMunicate:RLSTate	LOCal	LOCal

SCPI as-shipped settings	Source Mode	Load Mode
SYSTem:EMULation:STATe	ON	ON
SYSTem:VOLTage:RZERo	ON	ON

SCPI Error Messages

The Keysight instrument returns error messages in accord with the SCPI standard.

- Up to 127 errors can be stored in each interface-specific error queue (one each for GPIB, USB, RS232, CAN, VXI-11, and Telnet/Sockets.) Errors appear in the error queue of the I/O session that caused the error.
- The front-panel ERR annunciator turns on when there are one or more errors are in the error queue.
- A special global error queue holds all power-on and hardware-related errors (for example, over-temperature).
- Error retrieval is first-in-first-out (FIFO), and errors are cleared as you read them. Once you have read all interface-specific errors, the errors in the global error queue are retrieved. When you have read all errors from the error queue, the ERR annunciator turns off.
- If more than 127 errors have occurred, the last error stored in the queue (the most recent error) is replaced with -350,"Too many errors". No additional errors are stored until you remove errors from the queue. If no errors have occurred when you read the error queue, the instrument responds with 0,"No error".
- The front panel reports errors from all I/O sessions and the global error queue. To read the error queue from the front panel, press the ERROR key.
- Error conditions are also summarized in the Status Byte Register. See Status Subsystem Introduction for details
- The interface-specific error queues are cleared by power cycles and *CLS. The error queue is not cleared by *RST.
- SCPI:

  SYSTem:ERRor? *Read and clear one error from the queue*

  Errors have the following format (the error string may contain up to 255 characters):

Calibration Error

Error Code	Error Messages
0	No error This is the response to the ERR? query when there are no errors.
101	Calibration state is off Calibration is not enabled. The instrument will not accept calibration commands.
102	Calibration password is incorrect The calibration password is incorrect.
103	Calibration is inhibited by switch setting Calibration mode is locked out by the calibration switch.

Error Code	Error Messages
104	Bad sequence of calibration commands Calibration commands have not been entered in the proper sequence.
105	Unexpected output current The measured output current is outside the acceptable range.
106	Zero measurement out of range error Zero measurement value is outside the acceptable range.
107	Programming cal constants out of range The programmed calibration constant is outside the acceptable range.
108	Measurement cal constants out of range The measurement calibration constant is outside the acceptable range.
109	Over voltage cal constants out of range The over voltage calibration constant is outside the acceptable range.
110	Wrong V+I The instrument was unable to set the correct voltage or current value.
114	Wrong status An incorrect status function has been reported.
116	Locked out by internal switch setting This function has been locked out by an internal switch.
117	Calibration error A calibration error has occurred. Do not save calibration constants. Try re-calibrating the unit.
118	Calibration data loss
119	Calibration data save failure

Self-Test Error

Error Code	Error Messages
200	Hardware error A hardware error has occurred on the output.
201	Communication with module failed Communication failure between main board and control board 1.
202	Get module data failed The main board failed to read data from control board 1.
203	Fiber state error Fiber optic networking failure
204	Communication with ctrl2 failed Communication failure between main board and control board 2
205	Parallel info check failed Secondary parameter verification failed
206	Handshake with node failed Handshake failure between host and fiber node
207	Ctrl2 grid identify error Identification error of power grid form

Error Code	Error Messages
208	Secondary not ready Fiber optic node not ready
209	Group parameter error Networking parameter error
210	Communication with the front panel failed
211	Selftest Fail A selftest failure has occurred. See selftest failure list for details.
212	Machine type check failed Parallel machine type verification error
213	Module number check failed Parallel module number verification error
214	Module connect type check failed Parallel module connect verification error
215	Maximum voltage value check failed Parallel maximum voltage verification error
216	Minimum voltage value check failed Parallel minimum voltage verification error
217	Maximum current value check failed Parallel maximum current verification error
218	Minimum current value check failed Parallel minimum current verification error
219	Maximum power value check failed Parallel maximum power verification error
220	Minimum power value check failed Parallel minimum power verification error
221	Unreasonable voltage value Unreasonable voltage value configuration
222	Unreasonable current value Unreasonable current value configuration
223	Unreasonable power value Unreasonable power value configuration

Function Error

Error Code	Error Messages
302	Option not installed The option that is programmed by this command is not installed.
303	There is not a valid acquisition to fetch from. There is no valid data in the measurement buffer.
308	This setting cannot be changed while function is running Setting cannot be changed while the instrument is running a function.

Error Code	Error Messages
310	The command is not supported by this model This instrument either does not have the hardware capability or the options required to support this command.
315	Settings conflict error A data element could not be programmed because of the present instrument state.
324	Inconsistent arb settings The arb settings are inconsistent; most likely a mismatch in the arb lengths.
340	Output parameter config timeout Output parameter configuration timeout.
341	Source load switch disabled
342	Parameter out of range
344	Open file fail

Command Errors (these errors set Standard Event Status register bit #5)

Error Code	Error Messages
-100	Command error Generic syntax error
-101	Invalid character An invalid character was found in the command string.
-102	Syntax error Invalid syntax was found in the command string. Check for blank spaces.
-103	Invalid separator An invalid separator was found in the command string. Check for proper use of , ; :
-104	Data type error A different data type than the one allowed was found in the command string.
-105	GET not allowed A group execute trigger is not allowed in a command string.
-108	Parameter not allowed More parameters were received than were expected.
-109	Missing parameter Fewer parameters were received than were expected.
-110	Command header error An error was detected in the header.
-111	Header separator error A character that was not a valid header separator was found in the command string.
-112	Program mnemonic too long The header contains more than 12 characters.
-113	Undefined header A command was received that was not valid for this instrument.
-114	Header suffix out of range The value of the numeric suffix is not valid.

Error Code	Error Messages
-120	Numeric data error Generic numeric data error.
-121	Invalid character in number An invalid character for the data type was found in the command string.
-123	Exponent too large The magnitude of the exponent was larger than 32000.
-124	Too many digits The mantissa of a numeric parameter contained more than 255 digits, excluding leading zeros.
-128	Numeric data not allowed A numeric parameter was received but a character string was expected.
-130	Suffix error Generic suffix error
-131	Invalid suffix A suffix was incorrectly specified for a numeric parameter
-134	Suffix too long The suffix contains more than 12 characters.
-138	Suffix not allowed A suffix is not supported for this command.
-140	Character data error Generic character data error
-141	Invalid character data Either the character data element contains an invalid character, or the element is not valid.
-144	Character data too long The character data element contains more than 12 characters.
-148	Character data not allowed A discrete parameter was received, but a string or numeric parameter was expected.
-150	String data error Generic string data error
-151	Invalid string data An invalid character string was received. Check that the string is enclosed in quotation marks.
-158	String data not allowed A character string was received, but is not allowed for this command.
-160	Block data error Generic block data error
-161	Invalid block data The number of data bytes sent does not match the number of bytes specified in the header.
-168	Block data not allowed Data was sent in arbitrary block format but is not allowed for this command.

Execution Errors (these errors set Standard Event Status register bit #4)

Error Code	Error Messages
-200	Execution error Generic syntax error
-221	Settings conflict A data element could not be executed because of the present instrument state.
-222	Data out of range A data element could not be executed because the value was outside the valid range.
-223	Too much data A data element was received that contains more data than the instrument can handle.
-224	Illegal parameter value An exact value was expected but not received.
-225	Out of memory The device has insufficient memory to perform the requested operation.
-230	Data corrupt or stale Possible invalid data. A new reading was started but not completed.

Execution Queue Errors

Error Code	Error Messages
-350	Too many errors When more than 127 errors occurs, the last error stored in the queue (the most recent error) will be replaced with -350,"Too many errors ".

Query Errors (these errors set Standard Event Status register bit #2)

Error Code	Error Messages
-400	Query Error Generic error query
-410	Query INTERRUPTED A condition causing an interrupted query error occurred.
-420	Query UNTERMINATED A condition causing an unterminated query error occurred.
-430	Query DEADLOCKED A condition causing a deadlocked query error occurred.
-440	Query UNTERMINATED after indefinite response A query was received in the same program message after a query indicating an indefinite response was executed.

6
Verification and Calibration

Test Equipment and Setups

Test Equipment

Measurement Setups

Test Equipment

The test equipment recommended for the performance verification and adjustment procedures is listed below. If the exact instrument is not available, substitute calibration standards of equivalent accuracy.

Instrument	Requirements	Recommended Model	Use [1]
Digital Multimeter	Resolution: 10 nV @ 1 V; Readout: 8 1/2 digits Accuracy: 20 ppm	Keysight 3458A	V, C
Current Shunt [2]	50 A (0.05 Ω) 0.01%, TC = 4 ppm/ΩC 100 A (0.01 Ω) 0.01%, TC = 4 ppm/ΩC 300 A (0.001 Ω) 0.01%, TC = 4 ppm/ΩC	Guildline 9230A/50 Guildline 9230A/100 Guildline 9230A/300 or equivalent	V, C
Electronic load/ source [2]	80 V, 250 A, 10 kW 500 V, 120 A, 20 kW 1000 V, 60 A, 20 kW	Keysight RP7935A/RP7945A x 2 Keysight RP7971A/RP7981A Keysight RP7972A/RP7982A or equivalent	V
GPIB controller	Full GPIB capabilities	Keysight 82350B or equivalent	V, C
Oscilloscope	Sensitivity: 1 mV Bandwidth: 20 MHz Probe: 100:1 with RF tip Probe: 10:1 with RF tip	Keysight DSO6054A or equivalent Keysight 10076C Keysight 10074D (for 80 V models only)	V
RMS Voltmeter	Bandwidth: 10 MHz	Rhode and Schwartz URE3, Keysight 3458A, or equivalent	V

[1] V=Verification; C=Calibration

[2] Dependent on output voltage rating of the model being tested

Measurement Setups

Voltmeter

To ensure that the values read by the voltmeter during both the verification procedure and the calibration procedure are not affected by the instantaneous measurement of the AC peaks of the output current ripple, make several DC measurements and average them.

If you are using a Keysight 3458A DMM, you can set up the voltmeter to do this automatically. From the instrument’s front panel, program 100 power line cycles per measurement. Press NPLC 100 ENTER. Additionally, turn on auto-calibration (ACAL) and the autorange function (ARANGE).

Current Shunt

The 4-terminal current shunt is used to eliminate output current measurement error caused by voltage drops in the load leads and connections. It has special current-monitoring terminals inside the load connection terminals. Connect the voltmeter directly to these current-monitoring terminals.

Electronic Load

Many of the test procedures require the use of a variable load capable of dissipating the required power. For all tests, a Keysight RP79xxA unit can be used as a load. The RP79xxA load unit is considerably easier to use than load resistors.

Fixed load resistors may be used in place of a variable load, with minor changes to the test procedures. To avoid contact with any high voltages during operation, use switches to connect, disconnect, or short the load resistors.

Also, if computer controlled test setups are used, the relatively slow (compared to computers and system voltmeters) settling times and slew rates of the RPS may have to be taken into account. "Wait" statements can be used in the test program if the test system is faster than the unit under test.

Performance Verification

Introduction

WARNING

Do not touch any output terminal connections by hand. Ensure that all instrument connections, DUT wiring, and DUT connections are either insulated or covered using the safety covers provided, so that no accidental contact with harzardous voltages can occur. Always use the electrical safety gloves when connecting or disconnecting DUT to the output terminals.

Ne touchez jamais les connexions des bornes de sortie à mains nues. Assurez-vous que toutes les connexions de l'instrument, ainsi que le câblage et les connexions du DUT, soient soit isolés, soit protégés par les capots de protection fournis, afin d'éviter tout contact accidentel avec des tensions dangereuses. Portez toujours des gants isolants lorsque vous connectez ou déconnectez le DUT aux bornes de sortie.

Use the performance verification tests to verify that the device under test (DUT) is operating normally and meets its published specifications. You can perform two different levels of performance verification tests:

- **Performance Verification Tests** An extensive set of tests that are recommended as an acceptance test when you first receive the instrument or after performing adjustments.
- **Calibration-Tests** These tests verify that the instrument is operating within its calibration limits.

The performance verification tests are recommended as acceptance tests when you first receive the instrument. The acceptance test results should be compared against the instrument specifications.

Keysight Technologies recommends that you repeat the performance verification tests at every calibration interval. This ensures that the instrument will remain within specifications for the next calibration interval and provides the best long-term stability. Performance data measured using this method may be used to extend future calibration intervals.

Perform the verification tests before calibrating your power supply. If the instrument passes the verification tests, the unit is operating within its calibration limits and does not need to be re-calibrated.

If the instrument fails any of the tests or if abnormal test results are obtained, try calibrating the unit. If calibration is unsuccessful, return the unit to a Keysight Technologies Service Center.

Refer to the Recommended Test Equipment and Setups section for a list of the equipment and test setups required for verification. Also refer to the Measurement Setups section for information about connecting the voltmeter, current shunt, and load.

WARNING

Do not touch any output terminal connections by hand. Ensure that all instrument connections, DUT wiring, and DUT connections are either insulated or covered using the safety covers provided, so that no accidental contact with harzardous voltages can occur. Always use the electrical safety gloves when connecting or disconnecting DUT to the output terminals.

Always turn off the output when connecting or disconnecting any equipment on the sense or output terminals of the unit.

Ne touchez jamais les connexions des bornes de sortie à mains nues. Assurez-vous que toutes les connexions de l'instrument, ainsi que le câblage et les connexions du DUT, soient soit isolés, soit protégés par les capots de protection fournis, afin d'éviter tout contact accidentel avec des tensions dangereuses. Portez toujours des gants isolants lorsque vous connectez ou déconnectez le DUT aux bornes de sortie.

Désactivez toujours la sortie lorsque vous connectez ou déconnectez un équipement sur les bornes de détection ou de sortie de l'unité.

CAUTION

Equipment Damage

It is recommended to set the overvoltage protection function of the instrument slightly higher than its operating point during the verification procedure. This will prevent damage to any external equipment (electronic load) that may occur if the output voltage is accidentally programmed higher than the prescribed voltage setting.

Dommages à l'équipement

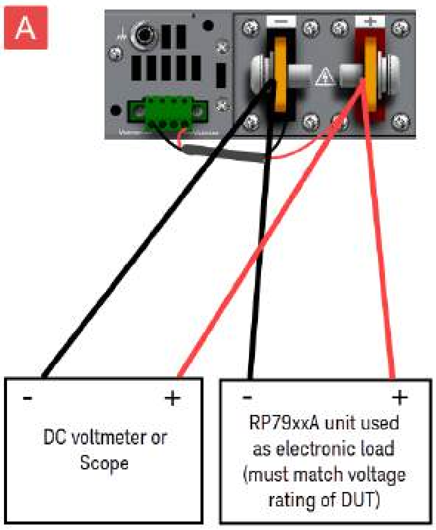
Lors de la vérification, il est recommandé de régler la protection contre les surtensions légèrement au-dessus du point de fonctionnement normal. Ce principe de précaution permet d'éviter d'endommager des équipements externes (charge électronique) si la tension de sortie est accidentellement programmée au-delà de la valeur nominale prescrite.

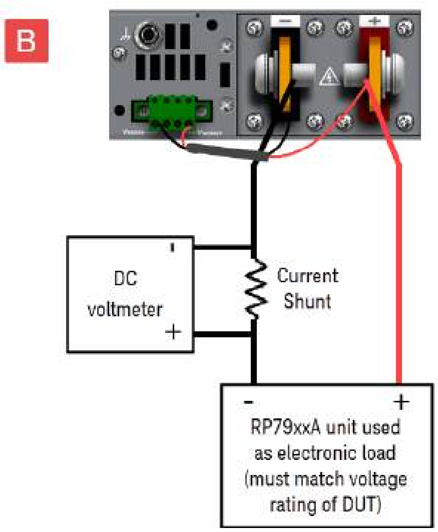
NOTE

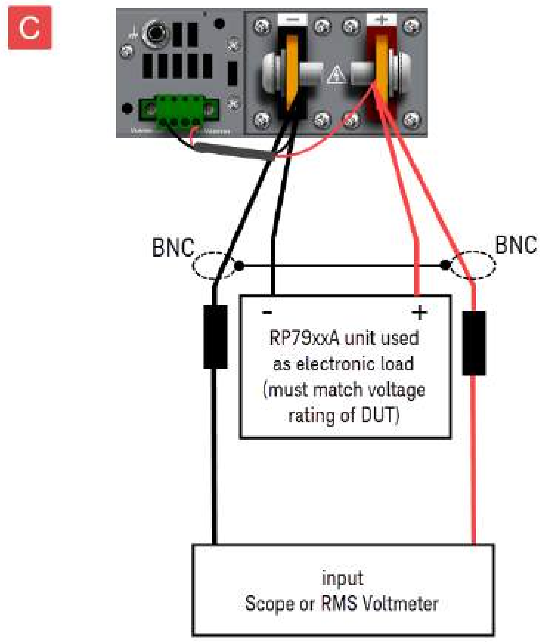
Turn the unit off or send a Reset command after completing the verification procedure to return all instrument settings to their default values.

Verification Setups

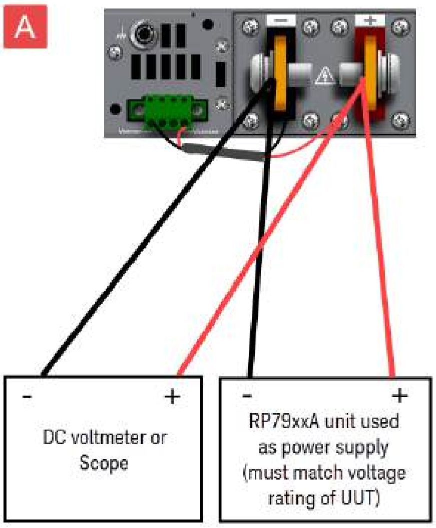
Source mode

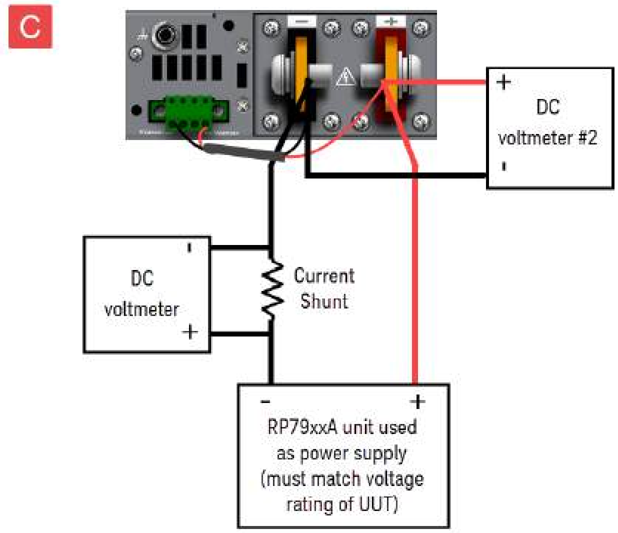


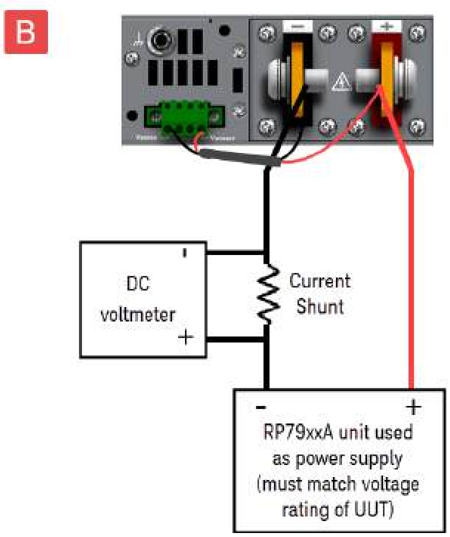




Load mode







Model under test	RP79xxA load unit
RP5913A, RP5923A, RP5933A	RP7935A or RP7945A
RP5943A	2 x RP7935A or RP7945A
RP5915A, RP5925A, RP5935A, RP5945A	RP7971A or RP7981A
RP5916A, RP5926A, RP5936A, RP5946A	RP7972A or RP7982A

Test Considerations

For optimum performance, all verification and calibration procedures should comply with the following:

- Ambient temperature is stable, between 23 ± 5 °C.
- Ambient relative humidity is less than 80%.
- 30 minute warm-up period before verification or adjustment.
- Cables as short as possible, twisted or shielded to reduce noise.

Verification Procedure (Source Mode)

Voltage Programming and Readback Accuracy

This test verifies that the voltage programming and measurement functions are within specifications.

Step 1. Turn off the unit under test. Only connect the DMM to the sense terminals (see Test Setup A). Do NOT connect the RP79xxA load unit.

Step 2. Turn on the unit under test and program the instrument settings as described in the test record form under “Voltage Programming & Readback, Min Voltage”. Turn the output on. The output status should be “CV”, with the output current close to zero.

Step 3. Record the output voltage reading from the DMM (Vout) and the voltage measured by the instrument over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming & Readback, Minimum Voltage”.

WARNING **The next step applies the full output voltage of the unit under test to the output.**

L’étape suivante applique la tension de sortie maximale de l’unité testée à la sortie.

Step 4. Program the instrument settings as described in the test record form under “Voltage Programming & Readback, High Voltage”.

Step 5. Record the output voltage reading from the DMM (Vout) and the voltage measured by the instrument over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming & Readback, High Voltage”.

Constant Voltage Load Effect

This test measures the change in voltage resulting from a change in current from full load to no load.

Step 1. Turn off the unit under test. Connect the DMM to the sense terminals and connect the RP79xxA load unit. Make sure that the voltage rating of the load unit matches the voltage rating of the unit under test. (see Test Setup A).

Step 2. Turn on the unit under test and program the instrument settings as described in the test record form under “CV Load Effect”. Turn the output on.

Step 3. Set the RP79xxA load for the rated output current as described in the test record form under “CV Load Effect”. Turn the output on. The output status of the unit under test should be “CV”. If it isn’t, adjust the load so that the output current drops slightly.

Step 4. Record the output voltage reading from the DMM.

Step 5. Turn off the output of the RP79xxA load. Record the voltage reading from the DMM again. The difference between the DMM readings in steps 4 and 5 is the load effect, which should not exceed the value listed in the test record form for the appropriate model under “CV Load Effect”.

Constant Voltage Ripple and Noise

Periodic and random deviations in the output combine to produce a residual AC voltage superimposed on the DC output voltage. This residual voltage is specified as the rms or peak-to-peak noise in the indicated frequency range (see RP5900 series datasheet)

Step 1. Turn off the unit under test. Connect the RP79xxA load unit, and an oscilloscope (ac coupled) to the output (see Test Setup C). Make sure that the voltage rating of the load unit matches the voltage rating of the unit under test.

Step 2. As shown in the diagram, connect the + and - output terminals to the input of the oscilloscope.

Step 3. Set the probe to 1:100 and set the inputs to AC coupling. Set the input resistance to 1 MΩ. Set the oscilloscope's time base to 5 ms/div, and set the vertical scale to the maximum sensitivity without clipping the waveform. Turn the bandwidth limit on (usually 20 MHz), and set the sampling mode to peak detect.

Step 4. Turn on the unit under test and program the instrument settings as described in the in the test record form under "CV Ripple and Noise". Turn the output on. Program the RP79xxA load as shown in the test record card and turn the output on. Let the oscilloscope run for a few seconds to generate enough measurement points. On the Keysight Infiniium scope, the maximum peak-to-peak voltage measurement is indicated at the bottom of the screen on the right side. The result should not exceed the peak-to-peak limits in the test record form under "CV Ripple and Noise, peak-to-peak".

NOTE If the measurement contains any question marks, clear the measurement and try again. This means that some of the scope data received was questionable.

Step 5. Disconnect the oscilloscope and connect an rms voltmeter in its place. The result should not exceed the rms limits in the test record form for the appropriate model under "CV Ripple and Noise, rms".

Transient Recovery Time

This test measures the time for the output voltage to recover to within the specified value following a 50% change in the instrument's rated load current.

Step 1. Turn off the unit under test. Connect an oscilloscope with the specified probe across the sense terminals (see Test Setup A). Connect the RP79xxA load unit to the output terminals. Make sure that the voltage rating of the load unit matches the voltage rating of the unit under test.

Step 2. Turn on the unit under test and program the instrument settings as described in the test record form under "Transient Response".

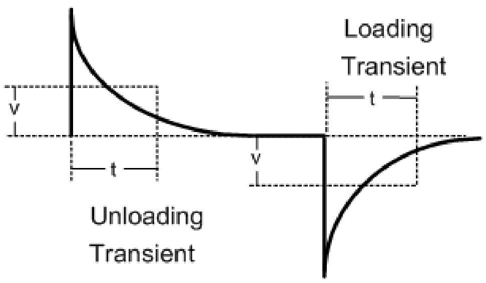
Step 3. Set the RP79xxA load unit's list generator to generate a 100 Hz current waveform with a duty cycle of 50%.

Use the following commands to program the list:

FUNC CURR - specifies current priority
VOLT:LIM <value> - refer to test record card for voltage limit value
CURR:BWID:LEV 0, 100000 - specifies the bandwidth frequency

CURR:MODE LIST - specifies current priority
LIST:CURR <low_value>,<high_value> - refer to test record card for low and high current values
LIST:DWEL 0.005, 0.005 - specifies a 100 Hz current waveform with a 50% duty cycle
LIST:COUN INF - sets the list count to infinity
INIT:LIST - initiates the transient system
TRIG:LIST - triggers the transient system
OUTP ON - turns on the load

Step 4. Adjust the oscilloscope for a waveform similar to that shown in the following figure.



Step 5. The output voltage should return to within the specified voltage at the specified time after the load change. Check both loading and unloading transients by triggering on the positive and negative slope. Record the voltage at time “t” in the performance test record form under “Transient Response”.

Current Programming and Readback Accuracy

This test verifies that the current programming and measurement functions are within specifications.

Step 1. Turn off the unit under test. Connect the current shunt directly across the output terminals. Connect the DMM directly across the current shunt (see Test Setup B). Note that the RP79xxA load is not used in this portion of the test.

Step 2. Turn on the unit under test and program the instrument settings as described in the test record form under “Current Programming & Readback, Min Current”. The output status should be “CC”, with the output voltage close to zero. Wait 5 minutes for the temperature to settle.

Step 3. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value. (Iout). Also, record the current measured by the instrument over the interface. The readings should be within the limits specified in the test record form under “Current Programming & Readback, Minimum Current”.

Step 4. Program the instrument settings as described in the test record form under “Current Programming & Readback, High Current”. Wait 5 minutes for the temperature to settle.

Step 5. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value.(Iout). Also, record the current reading measured by the instrument over the interface. The readings should be within the limits specified in the test record form under “Current Programming & Readback, High Current”.

Constant Current Load Effect

This test measures the change in current resulting from a change in voltage from a short to full scale.

Step 1. Turn off the unit under test. Connect the current shunt directly across the output terminals. Connect the DMM directly across the current shunt (see Test Setup B). Note that the RP79xxA load is not used in this portion of the test.

Step 2. Turn on the unit under test and program the instrument settings as described in the test record under “CC Load Effect”. The output status should be “CC”, with the output voltage be close to zero. Wait 5 minutes for the temperature to settle.

Step 3. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value.

Step 4. Turn off the unit under test and connect the RP79xxA load unit between the current shunt and the output terminals (see Test Setup B). Make sure that the voltage rating of the load unit matches the voltage rating of the unit under test.

Step 5. Set the RP79xxA load for voltage priority mode and program its voltage and current limit as described in the test record under “CC Load Effect”. Enable the load's output.

Step 6. Program the unit under test to the settings as described in the test record under “CC Load Effect”. Enable the output of the unit under test. The output status should be “CC”. If it isn’t, adjust the load so that the output voltage drops slightly.

Step 7. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value. The difference in the current reading in step 3 is the load effect, which should not exceed the value specified in the test record for the appropriate model under “CC Load Effect”.

Current Sink Capability Verification

This test checks the ability of the power supply to sink up to 100% of its rated output current.

Step 1. Turn off the unit under test and connect the RP79xxA load unit as an external source to the + and - output terminals (see Test Setup B).

Step 2. Set the RP79xxA external source for voltage priority mode and program it to the voltage as described in the test record under “100% of Current Rating (Isink)”.

Step 3. Turn on the unit under test. Set the operating mode to current priority. Program the instrument settings as described in the test record under “100% of Current Rating (Isink)"..

Step 4. Check the front panel display of the unit under test and verify that it is sinking 100% of its rated current and has a -CL status. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value. The readings should be within the limits specified in the test record form under “Current Sink Tests”.

Verification Procedure (Load Mode)

Voltage Programming and Readback Accuracy

Test category = performance, calibration

This test verifies that the voltage programming and measurement functions are within specifications.

Step 1. Turn off the unit under test. Connect a DMM across the sense terminals and an external power supply (RP79xxA) across the input terminals (see Load-Test Setup A).

Step 2. Turn on the unit under test and program the instrument settings as described in the test record form under “Voltage Programming & Readback, Min Voltage”. Turn the input on. The input status should be “CV”, with the input current close to zero.

Step 3. Record the output voltage reading from the DMM (Vout) and the voltage measured by the instrument over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming & Readback, Minimum Voltage”.

WARNING **The next step applies the full output voltage of the unit under test to the output.**

L’étape suivante applique la tension de sortie maximale de l’unité testée à la sortie.

Step 4. Program the instrument settings as described in the test record form under “Voltage Programming & Readback, High Voltage”.

Step 5. Record the output voltage reading from the DMM (Vout) and the voltage measured by the instrument over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming & Readback, High Voltage”.

Current Programming and Readback Accuracy

This test verifies that the current programming and measurement functions are within specifications.

Step 1. Turn off the unit under test. Connect the current shunt and an external power supply (RP79xxA) across the output terminals. Connect the DMM directly across the current shunt. (see Load-Test Setup B).

Step 2. Turn on the unit under test and program the instrument settings as described in the test record form under “Current Programming & Readback, Min Current”. Turn on the power supply and program it according to the power supply settings as described in the test record form under “Current Programming & Readback, Min Current”. Turn on the load input. The input status should be “CC”, with the input voltage close to zero. Wait 5 minutes for the temperature to settle.

Step 3. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value. (Iin). Also, record the current measured by the instrument over the interface. The readings should be within the limits specified in the test record form under “Current Programming & Readback, Minimum Current”.

Step 4. Program the instrument settings as described in the test record form under “Current Programming & Readback, High Current”. Wait 5 minutes for the temperature to settle.

Step 5. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value.(Iin). Also, record the current reading measured by the instrument over the interface. The readings should be within the limits specified in the test record form under “Current Programming & Readback, High Current”.

Power Programming and Readback Accuracy

This test verifies that the current programming and measurement functions are within specifications.

Step 1. Turn off the unit under test. Connect the current shunt and an external power supply (RP79xxA) across the output terminals. Connect the DMM directly across the current shunt. Connect the second DMM across the sense terminals (see Load-Test Setup C).

Step 2. Turn on the unit under test and program the instrument settings as described in the test record form under “Power Programming & Readback, Min Power”. Turn on the power supply and program it according to the power supply settings as described in the test record form under “Power Programming & Readback, Min Power”. Turn on the load input. The input status should be “CP”. Wait 5 minutes for the temperature to settle.

Step 3. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value. (Iin). Also, record the power measured by the instrument over the interface. The readings should be within the limits specified in the test record form under “Power Programming & Readback, Minimum Power”.

Step 4. Calculate the power as follows: P = Iin x Vin. Vin is the voltage measured by the second DMM. The readings should be within the limits specified in the test record form for the appropriate model under “Power Programming & Readback - Minimum power”

Step 5. Program the instrument settings as described in the test record form under “Power Programming & Readback, High Power”. Wait 5 minutes for the temperature to settle.

Step 6. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value.(Iin). Also, record the power reading measured by the instrument over the interface.

Step 7. Calculate the power as follows: P = Iin x Vin. Vin is the voltage measured by the second DMM. The readings should be within the limits specified in the test record form under “Power Programming & Readback, High Power”.

Instrument Calibration

Introduction

WARNING

Do not touch any output terminal connections by hand. Ensure that all instrument connections, DUT wiring, and DUT connections are either insulated or covered using the safety covers provided, so that no accidental contact with harzardous voltages can occur. Always use the electrical safety gloves when connecting or disconnecting DUT to the output terminals.

Ne touchez jamais les connexions des bornes de sortie à mains nues. Assurez-vous que toutes les connexions de l'instrument, ainsi que le câblage et les connexions du DUT, soient soit isolés, soit protégés par les capots de protection fournis, afin d'éviter tout contact accidentel avec des tensions dangereuses. Portez toujours des gants isolants lorsque vous connectez ou déconnectez le DUT aux bornes de sortie.

The instrument features closed-case electronic calibration; no internal mechanical adjustments are required. The instrument calculates correction factors based on input reference values that you set and stores correction factors in non-volatile memory until the next calibration adjustment is performed. This EEPROM calibration memory is not changed by cycling power or *RST.

Refer to the Recommended Test Equipment and Setups section for a list of the equipment and test setups required for calibration. Also refer to the Measurement Setups section for information about connecting the voltmeter, current shunt, and load. Additional information about calibration follows.

- The correct password is required to enter the Admin menu, which contains the calibration function. The password is pre-set to 0 (zero). You can change the password once calibration mode is entered to prevent unauthorized access to the calibration mode. Refer to Password Protection for more information.

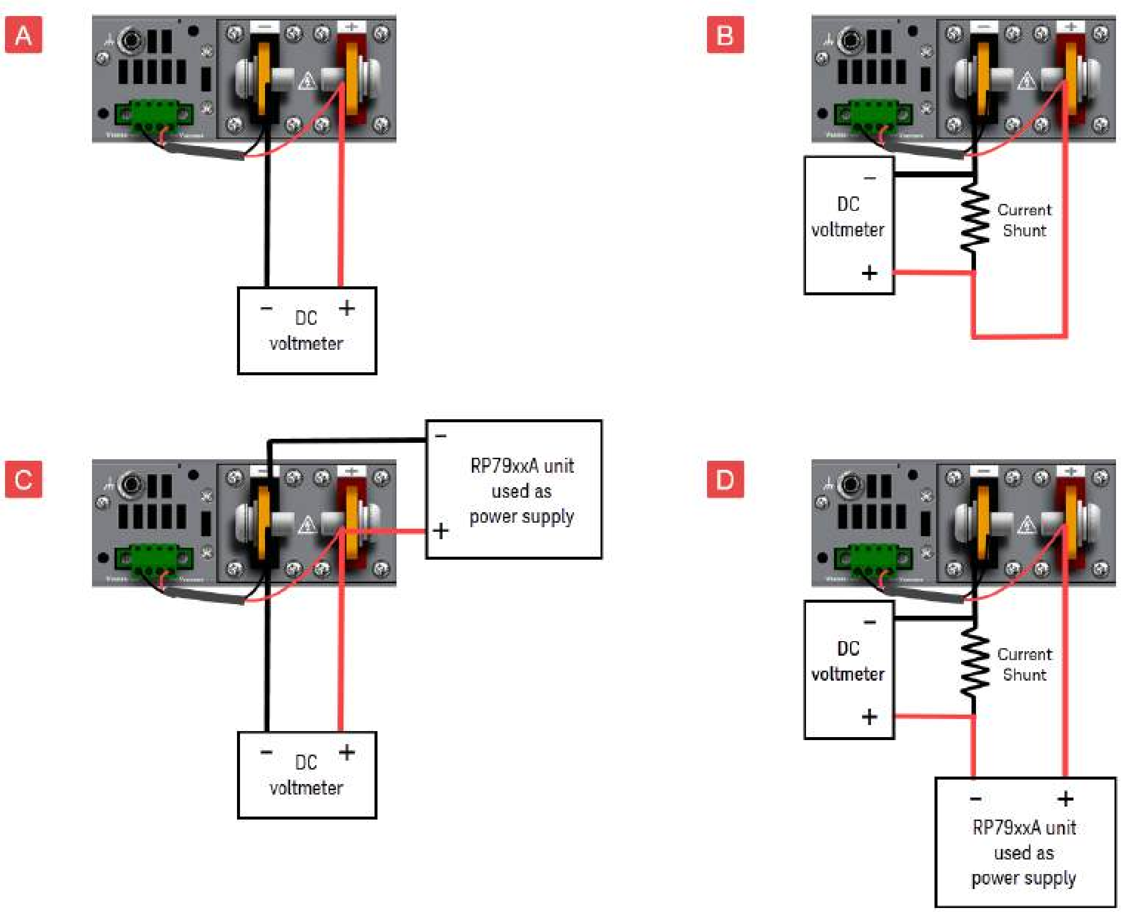
- Once started, you must complete each calibration section in its entirety. As each calibration section is completed, the instrument calculates new calibration constants and begins using them. However, these constants are not saved in nonvolatile memory until a SAVE command is explicitly given.
- Exit the calibration mode either by logging out of the Admin menu or by sending CAL:STAT OFF. Note that any calibration section that was calibrated but not saved will revert to its previous calibration constants.

Calibration Interval

One Year Calibration Interval

The instrument should be calibrated on a regular interval determined by the accuracy requirements of your application. A **one-year** interval is adequate for most applications. Accuracy specifications are warranted only if adjustment is made at regular calibration intervals. Published accuracy specifications are not warranted beyond the one-year calibration interval.

Calibration Setups



Test Considerations

For optimum performance, all verification and calibration procedures should comply with the following:

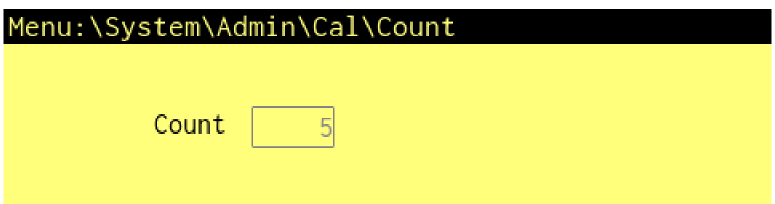
- Ambient temperature is stable, between 23 ± 5 °C.
- Ambient relative humidity is less than 80%.
- 30 minute warm-up period before verification or adjustment.
- Cables as short as possible, twisted or shielded to reduce noise.

Enter Calibration Mode

To begin the calibration procedure, you must enter the calibration mode.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Login**. Enter your password (Default password is 0) in the Password field. Then press **[Enter]**.	CAL:SEC:STAT OFF, "<passcode>"

Calibration Count

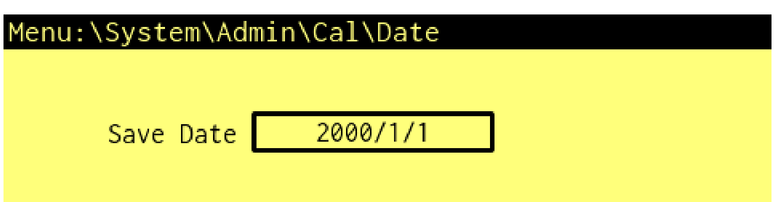


Count allows you to view the calibration count.

The instrument counts the number of times it has saved calibration data. Your instrument was calibrated at the factory; when you receive your instrument, read and record the initial count. You can also read the calibration count by sending the CAL:COUNt? query, and the calibration count is not change by a power cycle or *RST.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Count**. View the calibration count.	CAL:COUN?

Enter a Calibration Date



Date allows you to set the calibration date.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Date**. Enter the calibration date in the Date field. If desired, you can enter alphanumeric data in this field.	CAL:DATE "<date>"

Save Calibration and Log Out

Save will be available only when calibration completes. If the calibration fails, Save will be grayed out.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Save**. Select Save to save all calibration data. Press Back to return to calibration homepage. Select **System\Admin\Logout** to exit calibration mode.	To save calibration data: CAL:SAVE To exit calibration mode: CAL:SEC:STAT ON, "0"

Calibration Procedures (Source Mode)

Enter the Source Mode

Front Panel Menu Reference	SCPI Command
Select **System\Emulation\Source**.	SYST:EMUL SOUR

Enter Calibration Mode

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Login**. Enter your password (Default password is 0) in the Password field. Then press **[Enter]**.	CAL:SEC:STAT OFF, <passcode>

Voltage Calibration

Calibrate voltage

Step 1. Connect the voltage input of the DMM to the output (see Cal Setup A).

Step 2. Select the voltage calibration.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt**. Check that the multimeter is connected and press **Start**.	Not applicable

Step 3. Select the first voltage calibration point. Wait 4 seconds for the voltage to stabilize. Measure the output voltage with the DMM and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

WARNING The next step applies the full output voltage of the unit under test to the output.

L'étape suivante applique la tension de sortie maximale de l'unité testée à la sortie.

Step 4. Select the second voltage calibration point. Wait 4 seconds for the voltage to stabilize. Measure the output voltage with the DMM and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Calibrate Sense Voltage

Step 1. Connect the voltage input of the DMM to the output (see Cal Setup A).

Step 2. Select the sense voltage calibration.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\SenseVolt**. Check that the multimeter is connected and press **Start**.	Not applicable

Step 3. Select the first sense voltage calibration point. Wait 4 seconds for the voltage to stabilize. Measure the output voltage with the DMM and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

WARNING The next step applies the full output voltage of the unit under test to the output.

L'étape suivante applique la tension de sortie maximale de l'unité testée à la sortie.

Step 4. Select the second sense voltage calibration point. Wait 4 seconds for the voltage to stabilize. Measure the output voltage with the DMM and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Current Calibration

Step 1. Connect a precision shunt resistor to the output. The shunt resistor should be able to measure the output's full-scale current (see Cal Setup B). Connect the Keysight 3458A DMM across the shunt resistor.

Step 2. Select the current calibration.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr**. Check that the electronic load and shunt is connected to the output and select **Start**.	Not applicable

Step 3. Select the first current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Step 4. Select the second current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command

Enter the data from the external DMM. Press **Next**.	Not applicable

Step 5. Select the third current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Step 6. Select the fourth current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Step 7. Select the fifth current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Step 8. Select the sixth current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Calibration Procedures (Load Mode)

Enter the Load Mode

Front Panel Menu Reference	SCPI Command
Select **System\Emulation\Load**.	SYST:EMUL LOAD

Enter Calibration Mode

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Login**. Enter your password (Default password is 0) in the Password field. Then press **[Enter]**.	CAL:SEC:STAT OFF, <passcode>

Voltage Calibration

Calibrate voltage

Step 1. Connect the RP79xxA power supply unit and voltage input of the DMM to the input terminal (see Cal Setup C). Set the power supply according to the DUT's voltage rating as shown below. Turn on the output of the power supply.

DUT Voltage Rating	Power Supply Settings	
	Voltage	Current
80 V	82 V	1 A

Step 2. Select the voltage calibration.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt**. Check that the multimeter is connected and press **Start**.	Not applicable

Step 3. Select the first voltage calibration point. Wait 4 seconds for the voltage to stabilize. Measure the output voltage with the DMM and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

WARNING The next step applies the full output voltage of the unit under test to the output.

L’étape suivante applique la tension de sortie maximale de l’unité testée à la sortie.

Step 4. Select the second voltage calibration point. Wait 4 seconds for the voltage to stabilize. Measure the output voltage with the DMM and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Calibrate Sense Voltage

Step 1. Connect the RP79xxA power supply unit and voltage input of the DMM to the input terminal (see Cal Setup C). Set the power supply according to the DUT's voltage rating as shown below.

DUT Voltage Rating	Power Supply Settings	
	Voltage	Current
80 V	82 V	1 A

Step 2. Select the sense voltage calibration.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\SenseVolt**. Check that the multimeter is connected and press **Start**.	Not applicable

Step 3. Select the first sense voltage calibration point. Wait 4 seconds for the voltage to stabilize. Measure the output voltage with the DMM and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

WARNING

The next step applies the full output voltage of the unit under test to the output.

L'étape suivante applique la tension de sortie maximale de l'unité testée à la sortie.

Step 4. Select the second sense voltage calibration point. Wait 4 seconds for the voltage to stabilize. Measure the output voltage with the DMM and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Current Calibration

Step 1. Connect an RP79xxA power supply unit to the input terminals and set the power supply with the below configuration. Connect a precision shunt resistor in series with the input terminal and a DMM to measure the voltage across the shunt (see Cal Setup D). Turn on the output of the power supply.

DUT Voltage Rating	Power Supply Settings	
	Voltage	Current
80 V	5 V	260 A

Step 2. Select the current calibration.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr**. Check that the electronic load and shunt is connected to the output and select **Start**.	Not applicable

Step 3. Select the first current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Step 4. Select the second current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Step 5. Select the third current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Step 6. Select the fourth current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Step 7. Select the fifth current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Step 8. Select the sixth current calibration point. Wait 5 seconds for the current to stabilize. Calculate the shunt current (I=V/R) and enter the data.

Front Panel Menu Reference	SCPI Command
Enter the data from the external DMM. Press **Next**.	Not applicable

Test Record Forms

Keysight RP5913A

Source mode

RP5913A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	0.9757	______	1.0243
Voltage measured over interface:	Vout - 0.0243	______	Vout + 0.0243
High voltage (Vout):	79.952	______	80.048
Voltage measured over interface:	Vout - 0.048	______	Vout + 0.048
CV Load Effect:	- 0.016	______	+ 0.016
CV Ripple and Noise			
peak-to-peak:	N/A	______	0.200
rms:	N/A	______	0.080
Transient response @ ≤ 1 ms:	- 0.8	______	+ 0.8
Current Programming			
Minimum current (Iout):	0.959	______	1.041
High current (Iout):	39.92	______	40.08
Current Readback			
Minimum current measured over interface:	Iout - 0.061	______	Iout + 0.061
High current measured over interface:	Iout - 0.1	______	Iout + 0.1
CC Load Effect:	- 0.04	______	+ 0.04
Current Sink Tests			
100% of current rating:	- 40.08	______	- 39.92

	RP5913A DUT Settings	RP7935A/RP7945A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 1 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 80 V, 5 A	not used
CV Load Effect:	Voltage priority: 50 V, 40.4 A	Current priority: 55 V, -40 A
CV Ripple and Noise:	Voltage priority: 50 V, 40.4 A	Current priority: 55 V, -40 A
Transient Response:	Voltage priority: 50 V, 40.4 A	Current priority: 55 V, -20 A to -40 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 55 V, 1 A	not used
Current Programming & Readback High:	Current priority: 55 V, 40 A	not used
CC Load Effect:	Current priority: 55 V, 40 A	Voltage priority: 50 V, -41 A
100% of current rating (Isink):	Current priority: 55 V, -40 A	Voltage priority: 50 V, 44 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5913A - Load Mode Test Record		Date________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	0.9757	_____	1.0243
Voltage measured over interface:	Vin - 0.0243	_____	Vin + 0.0243
High voltage (Vin):	79.952	_____	80.048
Voltage measured over interface:	Vin - 0.048	_____	Vin + 0.048
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.959	_____	1.041
High current (Iin):	39.92	_____	40.08
Current Readback			
Minimum current measured over interface:	Iin - 0.061	_____	Iin + 0.061
High current measured over interface:	Iin - 0.1	_____	Iin + 0.1
Power Priority Tests			
Power Programming & Readback			
Minimum power:	9.9	_____	30.1
Power measured over interface:	Pin - 10.1	_____	Pin + 10.1
High power:	1980	_____	2020
Power measured over interface:	Pin - 20	_____	Pin + 20

	RP5913A DUT Settings	RP7935A/RP7945A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 1 V	Current priority: 8 V, 10 A
Voltage Programming & Readback High:	Voltage priority: 80 V	Current priority: 81 V, 10 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 81 V, 10 A
Current Programming & Readback High:	Current priority: 40 A	Voltage priority: 81 V, 50 A
Power Programming & Readback Min:	Power priority: 20 W	Voltage priority: 60 V, 10 A
Power Programming & Readback High:	Power priority: 2000 W	Voltage priority: 80 V, 26 A

Keysight RP5923A

Source mode

RP5923A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	0.9757	______	1.0243
Voltage measured over interface:	Vout - 0.0243	______	Vout + 0.0243
High voltage (Vout):	79.952	______	80.048
Voltage measured over interface:	Vout - 0.048	______	Vout + 0.048
CV Load Effect:	- 0.016	______	+ 0.016
CV Ripple and Noise			
peak-to-peak:	N/A	______	0.200
rms:	N/A	______	0.080
Transient response @ ≤ 1 ms:	- 0.8	______	+ 0.8
Current Programming			
Minimum current (Iout):	0.919	______	1.081
High current (Iout):	79.84	______	80.16
Current Readback			
Minimum current measured over interface:	Iout - 0.121	______	Iout + 0.121
High current measured over interface:	Iout - 0.2	______	Iout + 0.2
CC Load Effect:	- 0.08	______	+ 0.08
Current Sink Tests			
100% of current rating:	- 80.16	______	- 79.84

	RP5923A DUT Settings	RP7935A/RP7945A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 1 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 80 V, 5 A	not used
CV Load Effect:	Voltage priority: 50 V, 80.8 A	Current priority: 55 V, -80 A
CV Ripple and Noise:	Voltage priority: 50 V, 80.8 A	Current priority: 55 V, -80 A
Transient Response:	Voltage priority: 50 V, 80.8 A	Current priority: 55 V, -40 A to -80 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 55 V, 1 A	not used
Current Programming & Readback High:	Current priority: 55 V, 80 A	not used
CC Load Effect:	Current priority: 55 V, 80 A	Voltage priority: 50 V, -81 A
100% of current rating (Isink):	Current priority: 55 V, -80 A	Voltage priority: 50 V, 88 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5923A - Load Mode Test Record		Date_________	
Test Description	Min. Specs	Results	Max. Specs
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	0.9757	______	1.0243
Voltage measured over interface:	Vin - 0.0243	______	Vin + 0.0243
High voltage (Vin):	79.952	______	80.048
Voltage measured over interface:	Vin - 0.048	______	Vin + 0.048
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.919	______	1.081
High current (Iin):	79.84	______	80.16
Current Readback			
Minimum current measured over interface:	Iin - 0.121	______	Iin + 0.121
High current measured over interface:	Iin - 0.2	______	Iin + 0.2
Power Priority Tests			
Power Programming & Readback			
Minimum power:	19.8	______	60.2
Power measured over interface:	Pin - 20.2	______	Pin + 20.2
High power:	3960	______	4040
Power measured over interface:	Pin - 40	______	Pin + 40

	RP5923A DUT Settings	RP7935A/RP7945A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 1 V	Current priority: 8 V, 10 A
Voltage Programming & Readback High:	Voltage priority: 80 V	Current priority: 81 V, 10 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 50 V, 10 A
Current Programming & Readback High:	Current priority: 80 A	Voltage priority: 50 V, 85 A
Power Programming & Readback Min:	Power priority: 40 W	Voltage priority: 60 V, 10 A
Power Programming & Readback High:	Power priority: 4000 W	Voltage priority: 80 V, 51 A

Keysight RP5933A

Source mode

RP5933A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	0.9757	______	1.0243
Voltage measured over interface:	Vout - 0.0243	______	Vout + 0.0243
High voltage (Vout):	79.952	______	80.048
Voltage measured over interface:	Vout - 0.048	______	Vout + 0.048
CV Load Effect:	- 0.016	______	+ 0.016
CV Ripple and Noise			
peak-to-peak:	N/A	______	0.200
rms:	N/A	______	0.080
Transient response @ ≤ 1 ms:	- 0.8	______	+ 0.8
Current Programming			
Minimum current (Iout):	0.879	______	1.121
High current (Iout):	119.76	______	120.24
Current Readback			
Minimum current measured over interface:	Iout - 0.201	______	Iout + 0.201
High current measured over interface:	Iout - 0.32	______	Iout + 0.32
CC Load Effect:	- 0.120	______	+ 0.120
Current Sink Tests			
100% of current rating:	- 120.24	______	- 119.76

	RP5933A DUT Settings	RP7935A/RP7945A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 1 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 80 V, 5 A	not used
CV Load Effect:	Voltage priority: 50 V, 121 A	Current priority: 55 V, -120 A
CV Ripple and Noise:	Voltage priority: 50 V, 121 A	Current priority: 55 V, -120 A
Transient Response:	Voltage priority: 50 V, 121 A	Current priority: 55 V, -60 A to -120 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 55 V, 1 A	not used
Current Programming & Readback High:	Current priority: 55 V, 120 A	not used
CC Load Effect:	Current priority: 55 V, 120 A	Voltage priority: 50 V, -121 A
100% of current rating (Isink):	Current priority: 55 V, -120 A	Voltage priority: 50 V, 122 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5933A - Load Mode Test Record		Date________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	0.9757	_____	1.0243
Voltage measured over interface:	Vin - 0.0243	_____	Vin + 0.0243
High voltage (Vin):	79.952	_____	80.048
Voltage measured over interface:	Vin - 0.048	_____	Vin + 0.048
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.879	_____	1.121
High current (Iin):	119.76	_____	120.24
Current Readback			
Minimum current measured over interface:	Iin - 0.201	_____	Iin + 0.201
High current measured over interface:	Iin - 0.320	_____	Iin + 0.320
Power Priority Tests			
Power Programming & Readback			
Minimum power:	29.7	_____	90.3
Power measured over interface:	Pin - 30.3	_____	Pin + 30.3
High power:	5940	_____	6060
Power measured over interface:	Pin - 60	_____	Pin + 60

	RP5933A DUT Settings	RP7935A/RP7945A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 1 V	Current priority: 8 V, 10 A
Voltage Programming & Readback High:	Voltage priority: 80 V	Current priority: 81 V, 10 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 50 V, 10 A
Current Programming & Readback High:	Current priority: 120 A	Voltage priority: 50 V, 125 A
Power Programming & Readback Min:	Power priority: 60 W	Voltage priority: 60 V, 10 A
Power Programming & Readback High:	Power priority: 6000 W	Voltage priority: 80 V, 76 A

Keysight RP5943A

Source mode

RP5943A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	0.9757	______	1.0243
Voltage measured over interface:	Vout - 0.0243	______	Vout + 0.0243
High voltage (Vout):	79.952	______	80.048
Voltage measured over interface:	Vout - 0.048	______	Vout + 0.048
CV Load Effect:	- 0.016	______	+ 0.016
CV Ripple and Noise			
peak-to-peak:	N/A	______	0.200
rms:	N/A	______	0.080
Transient response @ ≤ 1 ms:	- 0.8	______	+ 0.8
Current Programming			
Minimum current (Iout):	0.759	______	1.241
High current (Iout):	239.52	______	240.48
Current Readback			
Minimum current measured over interface:	Iout - 0.381	______	Iout + 0.381
High current measured over interface:	Iout - 0.62	______	Iout + 0.62
CC Load Effect:	- 0.240	______	+ 0.240
Current Sink Tests			
100% of current rating:	- 240.48	______	- 239.52

	RP5943A DUT Settings	2 x RP7935A or 2 x RP7945A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 1 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 80 V, 5 A	not used
CV Load Effect:	Voltage priority: 50 V, 242 A	Current priority: 55 V, -240 A
CV Ripple and Noise:	Voltage priority: 50 V, 242 A	Current priority: 55 V, -240 A
Transient Response:	Voltage priority: 50 V, 242 A	Current priority: 55 V, -120 A to -240 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 55 V, 1 A	not used
Current Programming & Readback High:	Current priority: 55 V, 240 A	not used
CC Load Effect:	Current priority: 55 V, 240 A	Voltage priority: 50 V, -241 A
100% of current rating (Isink):	Current priority: 55 V, -240 A	Voltage priority: 50 V, 241 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test. When using two RP7935A/RP7945A units as the load, set the first RP7935A/RP7945A in CC to -120 A, and the second RP7935A/RP7945A to create a 0 to -120 A pulse.

Load mode

RP5943A - Load Mode Test Record		Date________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	0.9757	______	1.0243
Voltage measured over interface:	Vin - 0.0243	______	Vin + 0.0243
High voltage (Vin):	79.952	______	80.048
Voltage measured over interface:	Vin - 0.048	______	Vin + 0.048
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.759	______	1.241
High current (Iin):	239.52	______	240.48
Current Readback			
Minimum current measured over interface:	Iin - 0.381	______	Iin + 0.381
High current measured over interface:	Iin - 0.620	______	Iin + 0.620
Power Priority Tests			
Power Programming & Readback			
Minimum power:	59.4	______	180.6
Power measured over interface:	Pin - 60.6	______	Pin + 60.6
High power:	11880	______	12120
Power measured over interface:	Pin - 120	______	Pin + 120

	RP5943A DUT Settings	2 x RP7935A or 2 x RP7945A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 1 V	Current priority: 8 V, 10 A
Voltage Programming & Readback High:	Voltage priority: 80 V	Current priority: 81 V, 10 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 50 V, 10 A
Current Programming & Readback High:	Current priority: 240 A	Voltage priority: 50 V, 241 A
Power Programming & Readback Min:	Power priority: 120 W	Voltage priority: 60 V, 10 A
Power Programming & Readback High:	Power priority: 12000 W	Voltage priority: 80 V, 151 A

Keysight RP5915A

Source mode

RP5915A - Source Mode Test Record		Date________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	4.8485	_____	5.1515
Voltage measured over interface:	Vout - 0.1515	_____	Vout + 0.1515
High voltage (Vout):	499.7	_____	500.3
Voltage measured over interface:	Vout - 0.3	_____	Vout + 0.3
CV Load Effect:	- 0.1	_____	+ 0.1
CV Ripple and Noise			
peak-to-peak:	N/A	_____	1.500
rms:	N/A	_____	0.300
Transient response @ ≤ 1 ms:	- 5.0	_____	+ 5.0
Current Programming			
Minimum current (Iout):	0.987	_____	1.013
High current (Iout):	11.976	_____	12.024
Current Readback			
Minimum current measured over interface:	Iout - 0.013	_____	Iout + 0.013
High current measured over interface:	Iout - 0.024	_____	Iout + 0.024
CC Load Effect:	- 0.012	_____	+ 0.012
Current Sink Tests			
100% of current rating:	- 12.024	_____	- 11.976

	RP5915A DUT Settings	RP7971A/RP7981A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 5 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 500 V, 5 A	not used
CV Load Effect:	Voltage priority: 166 V, 12.5 A	Current priority: 170 V, -12 A
CV Ripple and Noise:	Voltage priority: 166 V, 12.5 A	Current priority: 170 V, -12 A
Transient Response:	Voltage priority: 166 V, 12.5 A	Current priority: 170 V, -6 A to -12 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 170 V, 1 A	not used
Current Programming & Readback High:	Current priority: 170 V, 12 A	not used
CC Load Effect:	Current priority: 170 V, 12 A	Voltage priority: 166 V, -13 A
100% of current rating (Isink):	Current priority: 170 V, -12 A	Voltage priority: 166 V, 12.5 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5915A - Load Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	4.8485	______	5.1515
Voltage measured over interface:	Vin - 0.1515	______	Vin + 0.1515
High voltage (Vin):	499.7	______	500.3
Voltage measured over interface:	Vin - 0.3	______	Vin + 0.3
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.987	______	1.013
High current (Iin):	11.976	______	12.024
Current Readback			
Minimum current measured over interface:	Iin - 0.013	______	Iin + 0.013
High current measured over interface:	Iin - 0.024	______	Iin + 0.024
Power Priority Tests			
Power Programming & Readback			
Minimum power:	9.9	______	30.1
Power measured over interface:	Pin - 10.1	______	Pin + 10.1
High power:	1980	______	2020
Power measured over interface:	Pin - 20	______	Pin + 20

	RP5915A DUT Settings	RP7971A/RP7981A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 5 V	Current priority: 50 V, 10 A
Voltage Programming & Readback High:	Voltage priority: 500 V	Current priority: 500.5 V, 4 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 166 V, 4 A
Current Programming & Readback High:	Current priority: 12 A	Voltage priority: 166 V, 12.5 A
Power Programming & Readback Min:	Power priority: 20 W	Voltage priority: 50 V, 10 A
Power Programming & Readback High:	Power priority: 2000 W	Voltage priority: 500 V, 5 A

Keysight RP5925A

Source mode

RP5925A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	4.8485	______	5.1515
Voltage measured over interface:	Vout - 0.1515	______	Vout + 0.1515
High voltage (Vout):	499.7	______	500.3
Voltage measured over interface:	Vout - 0.3	______	Vout + 0.3
CV Load Effect:	- 0.1	______	+ 0.1
CV Ripple and Noise			
peak-to-peak:	N/A	______	1.000
rms:	N/A	______	0.150
Transient response @ ≤ 1 ms:	- 5	______	+ 5
Current Programming			
Minimum current (Iout):	0.975	______	1.025
High current (Iout):	23.952	______	24.048
Current Readback			
Minimum current measured over interface:	Iout - 0.025	______	Iout + 0.025
High current measured over interface:	Iout - 0.048	______	Iout + 0.048
CC Load Effect:	- 0.024	______	+ 0.024
Current Sink Tests			
100% of current rating:	- 24.048	______	- 23.952

	RP5925A DUT Settings	RP7971A/RP7981A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 5 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 500 V, 5 A	not used
CV Load Effect:	Voltage priority: 166 V, 24.5 A	Current priority: 170 V, -24 A
CV Ripple and Noise:	Voltage priority: 166 V, 24.5 A	Current priority: 170 V, -24 A
Transient Response:	Voltage priority: 166 V, 24.5 A	Current priority: 170 V, -12 A to -24 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 170 V, 1 A	not used
Current Programming & Readback High:	Current priority: 170 V, 24 A	not used
CC Load Effect:	Current priority: 170 V, 24 A	Voltage priority: 166 V, -25 A
100% of current rating (Isink):	Current priority: 170 V, -24 A	Voltage priority: 166 V, 24.5 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5925A - Load Mode Test Record		Date________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	4.8485	______	5.1515
Voltage measured over interface:	Vin - 0.1515	______	Vin + 0.1515
High voltage (Vin):	499.7	______	500.3
Voltage measured over interface:	Vin - 0.3	______	Vin + 0.3
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.975	______	1.025
High current (Iin):	23.952	______	24.048
Current Readback			
Minimum current measured over interface:	Iin - 0.025	______	Iin + 0.025
High current measured over interface:	Iin - 0.048	______	Iin + 0.048
Power Priority Tests			
Power Programming & Readback			
Minimum power:	19.8	______	60.2
Power measured over interface:	Pin - 20.2	______	Pin + 20.2
High power:	3960	______	4040
Power measured over interface:	Pin - 40	______	Pin + 40

	RP5925A DUT Settings	RP7971A/RP7981A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 5 V	Current priority: 50 V, 10 A
Voltage Programming & Readback High:	Voltage priority: 500 V	Current priority: 500.5 V, 8 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 166 V, 8 A
Current Programming & Readback High:	Current priority: 24 A	Voltage priority: 166 V, 24.5 A
Power Programming & Readback Min:	Power priority: 40 W	Voltage priority: 50 V, 10 A
Power Programming & Readback High:	Power priority: 4000 W	Voltage priority: 500 V, 9 A

Keysight RP5935A

Source mode

RP5935A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	4.8485	______	5.1515
Voltage measured over interface:	Vout - 0.1515	______	Vout + 0.1515
High voltage (Vout):	499.7	______	500.3
Voltage measured over interface:	Vout - 0.3	______	Vout + 0.3
CV Load Effect:	- 0.1	______	+ 0.1
CV Ripple and Noise			
peak-to-peak:	N/A	______	0.500
rms:	N/A	______	0.100
Transient response @ ≤ 1 ms:	- 5	______	+ 5
Current Programming			
Minimum current (Iout):	0.963	______	1.037
High current (Iout):	35.928	______	36.072
Current Readback			
Minimum current measured over interface:	Iout - 0.037	______	Iout + 0.037
High current measured over interface:	Iout - 0.072	______	Iout + 0.072
CC Load Effect:	- 0.036	______	+ 0.036
Current Sink Tests			
100% of current rating:	- 36.072	______	- 35.928

	RP5935A DUT Settings	RP7971A/RP7981A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 5 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 500 V, 5 A	not used
CV Load Effect:	Voltage priority: 166 V, 36.5 A	Current priority: 170 V, -36 A
CV Ripple and Noise:	Voltage priority: 166 V, 36.5 A	Current priority: 170 V, -36 A
Transient Response:	Voltage priority: 166 V, 36.5 A	Current priority: 170 V, -18 A to -36 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 170 V, 1 A	not used
Current Programming & Readback High:	Current priority: 170 V, 36 A	not used
CC Load Effect:	Current priority: 170 V, 36 A	Voltage priority: 166 V, -37 A
100% of current rating (Isink):	Current priority: 170 V, -36 A	Voltage priority: 166 V, 36.5 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5935A - Load Mode Test Record		Date________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	4.8485	______	5.1515
Voltage measured over interface:	Vin - 0.1515	______	Vin + 0.1515
High voltage (Vin):	499.7	______	500.3
Voltage measured over interface:	Vin - 0.3	______	Vin + 0.3
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.963	______	1.037
High current (Iin):	35.928	______	36.072
Current Readback			
Minimum current measured over interface:	Iin - 0.037	______	Iin + 0.037
High current measured over interface:	Iin - 0.072	______	Iin + 0.072
Power Priority Tests			
Power Programming & Readback			
Minimum power:	29.7	______	90.3
Power measured over interface:	Pin - 30.3	______	Pin + 30.3
High power:	5940	______	6060
Power measured over interface:	Pin - 60	______	Pin + 60

	RP5935A DUT Settings	RP7971A/RP7981A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 5 V	Current priority: 50 V, 10 A
Voltage Programming & Readback High:	Voltage priority: 500 V	Current priority: 500.5 V, 12 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 166 V, 12 A
Current Programming & Readback High:	Current priority: 36 A	Voltage priority: 166 V, 36.5 A
Power Programming & Readback Min:	Power priority: 60 W	Voltage priority: 50 V, 10 A
Power Programming & Readback High:	Power priority: 6000 W	Voltage priority: 500 V, 13 A

Keysight RP5945A

Source mode

RP5945A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	4.8485	______	5.1515
Voltage measured over interface:	Vout - 0.1515	______	Vout + 0.1515
High voltage (Vout):	499.7	______	500.3
Voltage measured over interface:	Vout - 0.3	______	Vout + 0.3
CV Load Effect:	- 0.1	______	+ 0.1
CV Ripple and Noise			
peak-to-peak:	N/A	______	0.500
rms:	N/A	______	0.100
Transient response @ ≤ 1 ms:	- 5	______	+ 5
Current Programming			
Minimum current (Iout):	0.927	______	1.073
High current (Iout):	71.856	______	72.144
Current Readback			
Minimum current measured over interface:	Iout - 0.073	______	Iout + 0.073
High current measured over interface:	Iout - 0.144	______	Iout + 0.144
CC Load Effect:	- 0.072	______	+ 0.072
Current Sink Tests			
100% of current rating:	- 72.144	______	- 71.856

	RP5945A DUT Settings	RP7971A/RP7981A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 5 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 500 V, 5 A	not used
CV Load Effect:	Voltage priority: 166 V, 72.5 A	Current priority: 170 V, -72 A
CV Ripple and Noise:	Voltage priority: 166 V, 72.5 A	Current priority: 170 V, -72 A
Transient Response:	Voltage priority: 166 V, 72.5 A	Current priority: 170 V, -36 A to -72 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 170 V, 1 A	not used
Current Programming & Readback High:	Current priority: 170 V, 72 A	not used
CC Load Effect:	Current priority: 170 V, 72 A	Voltage priority: 166 V, -73 A
100% of current rating (Isink):	Current priority: 170 V, -72 A	Voltage priority: 166 V, 72.5 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5945A - Load Mode Test Record			Date________
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	4.4845	______	5.1515
Voltage measured over interface:	Vin - 0.1515	______	Vin + 0.1515
High voltage (Vin):	499.7	______	500.3
Voltage measured over interface:	Vin - 0.3	______	Vin + 0.3
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.927	______	1.073
High current (Iin):	71.856	______	72.144
Current Readback			
Minimum current measured over interface:	Iin - 0.073	______	Iin + 0.073
High current measured over interface:	Iin - 0.144	______	Iin + 0.144
Power Priority Tests			
Power Programming & Readback			
Minimum power:	59.4	______	180.6
Power measured over interface:	Pin - 60.6	______	Pin + 60.6
High power:	11880	______	12120
Power measured over interface:	Pin - 120	______	Pin + 120

	RP5945A DUT Settings	RP7971A/RP7981A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 5 V	Current priority: 50 V, 10 A
Voltage Programming & Readback High:	Voltage priority: 500 V	Current priority: 500.5 V, 24 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 166 V, 24 A
Current Programming & Readback High:	Current priority: 72 A	Voltage priority: 166 V, 72.5 A
Power Programming & Readback Min:	Power priority: 120 W	Voltage priority: 50 V, 10 A
Power Programming & Readback High:	Power priority: 12000 W	Voltage priority: 500 V, 25 A

Keysight RP5916A

Source mode

RP5916A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	7.7576	______	8.2424
Voltage measured over interface:	Vout - 0.2424	______	Vout + 0.2424
High voltage (Vout):	799.52	______	800.48
Voltage measured over interface:	Vout - 0.480	______	Vout + 0.480
CV Load Effect:	- 0.160	______	+ 0.160
CV Ripple and Noise			
peak-to-peak:	N/A	______	2.400
rms:	N/A	______	0.800
Transient response @ ≤ 1 ms:	- 8.0	______	+ 8.0
Current Programming			
Minimum current (Iout):	0.991	______	1.009
High current (Iout):	7.984	______	8.016
Current Readback			
Minimum current measured over interface:	Iout - 0.009	______	Iout + 0.009
High current measured over interface:	Iout - 0.016	______	Iout + 0.016
CC Load Effect:	- 0.008	______	+ 0.008
Current Sink Tests			
100% of current rating:	- 8.016	______	- 7.984

	RP5916A DUT Settings	RP7972A/RP7982A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 8 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 800 V, 5 A	not used
CV Load Effect:	Voltage priority: 250 V, 8.5 A	Current priority: 255 V, -8 A
CV Ripple and Noise:	Voltage priority: 250 V, 8.5 A	Current priority: 255 V, -8 A
Transient Response:	Voltage priority: 250 V, 8.5 A	Current priority: 255 V, -4 A to -8 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 255 V, 1 A	not used
Current Programming & Readback High:	Current priority: 255 V, 8 A	not used
CC Load Effect:	Current priority: 255 V, 8 A	Voltage priority: 250 V, -8.5 A
100% of current rating (Isink):	Current priority: 255 V, -8 A	Voltage priority: 250 V, 9 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5916A - Load Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	7.7576	______	8.2424
Voltage measured over interface:	Vin - 0.2424	______	Vin + 0.2424
High voltage (Vin):	799.52	______	800.48
Voltage measured over interface:	Vin - 0.480	______	Vin + 0.480
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.991	______	1.009
High current (Iin):	7.984	______	8.016
Current Readback			
Minimum current measured over interface:	Iin - 0.009	______	Iin + 0.009
High current measured over interface:	Iin - 0.016	______	Iin + 0.016
Power Priority Tests			
Power Programming & Readback			
Minimum power:	9.9	______	30.1
Power measured over interface:	Pin - 10.1	______	Pin + 10.1
High power:	1980	______	2020
Power measured over interface:	Pin - 20	______	Pin + 20

	RP5916A DUT Settings	RP7972A/RP7982A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 8 V	Current priority: 80 V, 2.5 A
Voltage Programming & Readback High:	Voltage priority: 800 V	Current priority: 800.5 V, 2.5 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 250 V, 2.5 A
Current Programming & Readback High:	Current priority: 8 A	Voltage priority: 250 V, 8.5 A
Power Programming & Readback Min:	Power priority: 20 W	Voltage priority: 80 V, 10 A
Power Programming & Readback High:	Power priority: 2000 W	Voltage priority: 800 V, 3 A

Keysight RP5926A

Source mode

RP5926A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	7.7576	______	8.2424
Voltage measured over interface:	Vout - 0.2424	______	Vout + 0.2424
High voltage (Vout):	799.52	______	800.48
Voltage measured over interface:	Vout - 0.480	______	Vout + 0.480
CV Load Effect:	- 0.160	______	+ 0.160
CV Ripple and Noise			
peak-to-peak:	N/A	______	1.600
rms:	N/A	______	0.300
Transient response @ ≤ 1 ms:	- 8	______	+ 8
Current Programming			
Minimum current (Iout):	0.983	______	1.017
High current (Iout):	15.968	______	16.032
Current Readback			
Minimum current measured over interface:	Iout - 0.017	______	Iout + 0.017
High current measured over interface:	Iout - 0.032	______	Iout + 0.032
CC Load Effect:	- 0.016	______	+ 0.016
Current Sink Tests			
100% of current rating:	- 16.032	______	- 15.968

	RP5926A DUT Settings	RP7972A/RP7982A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 8 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 800 V, 5 A	not used
CV Load Effect:	Voltage priority: 250 V, 16.5 A	Current priority: 255 V, -16 A
CV Ripple and Noise:	Voltage priority: 250 V, 16.5 A	Current priority: 255 V, -16 A
Transient Response:	Voltage priority: 250 V, 16.5 A	Current priority: 255 V, -8 A to -16 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 255 V, 1 A	not used
Current Programming & Readback High:	Current priority: 255 V, 16 A	not used
CC Load Effect:	Current priority: 255 V, 16 A	Voltage priority: 250 V, -17 A
100% of current rating (Isink):	Current priority: 255 V, -16 A	Voltage priority: 250 V, 17 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5926A - Load Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	7.7576	______	8.2424
Voltage measured over interface:	Vin - 0.2424	______	Vin + 0.2424
High voltage (Vin):	799.52	______	800.48
Voltage measured over interface:	Vin - 0.480	______	Vin + 0.480
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.983	______	1.017
High current (Iin):	15.968	______	16.032
Current Readback			
Minimum current measured over interface:	Iin - 0.017	______	Iin + 0.017
High current measured over interface:	Iin - 0.032	______	Iin + 0.032
Power Priority Tests			
Power Programming & Readback			
Minimum power:	19.8	______	60.2
Power measured over interface:	Pin - 20.2	______	Pin + 20.2
High power:	3960	______	4040
Power measured over interface:	Pin - 40	______	Pin + 40

	RP5926A DUT Settings	RP7972A/RP7982A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 8 V	Current priority: 80 V, 5 A
Voltage Programming & Readback High:	Voltage priority: 800 V	Current priority: 800.5 V, 5 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 250 V, 5 A
Current Programming & Readback High:	Current priority: 16 A	Voltage priority: 250 V, 16.5 A
Power Programming & Readback Min:	Power priority: 40 W	Voltage priority: 800 V, 5 A
Power Programming & Readback High:	Power priority: 4000 W	Voltage priority: 800 V, 6 A

Keysight RP5936A

Source mode

RP5936A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	7.7576	______	8.2424
Voltage measured over interface:	Vout - 0.2424	______	Vout + 0.2424
High voltage (Vout):	799.52	______	800.48
Voltage measured over interface:	Vout - 0.480	______	Vout + 0.480
CV Load Effect:	- 0.160	______	+ 0.160
CV Ripple and Noise			
peak-to-peak:	N/A	______	1.000
rms:	N/A	______	0.160
Transient response @ ≤ 1 ms:	- 8	______	+ 8
Current Programming			
Minimum current (Iout):	0.975	______	1.025
High current (Iout):	23.952	______	24.048
Current Readback			
Minimum current measured over interface:	Iout - 0.025	______	Iout + 0.025
High current measured over interface:	Iout - 0.048	______	Iout + 0.048
CC Load Effect:	- 0.032	______	+ 0.032
Current Sink Tests			
100% of current rating:	- 24.048	______	- 23.952

	RP5936A DUT Settings	RP7972A/RP7982A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 8 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 800 V, 5 A	not used
CV Load Effect:	Voltage priority: 250 V, 24.5 A	Current priority: 255 V, -24 A
CV Ripple and Noise:	Voltage priority: 250 V, 24.5 A	Current priority: 255 V, -24 A
Transient Response:	Voltage priority: 250 V, 24.5 A	Current priority: 255 V, -12 A to -24 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 255 V, 1 A	not used
Current Programming & Readback High:	Current priority: 255 V, 24 A	not used
CC Load Effect:	Current priority: 255 V, 24 A	Voltage priority: 250 V, -25 A
100% of current rating (Isink):	Current priority: 255 V, -24 A	Voltage priority: 250 V, 25 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5936A - Load Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	7.7576	______	8.2424
Voltage measured over interface:	Vin - 0.2424	______	Vin + 0.2424
High voltage (Vin):	799.52	______	800.48
Voltage measured over interface:	Vin - 0.480	______	Vin + 0.480
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.975	______	1.025
High current (Iin):	23.952	______	24.048
Current Readback			
Minimum current measured over interface:	Iin - 0.025	______	Iin + 0.025
High current measured over interface:	Iin - 0.048	______	Iin + 0.048
Power Priority Tests			
Power Programming & Readback			
Minimum power:	29.7	______	90.3
Power measured over interface:	Pin - 30.3	______	Pin + 30.3
High power:	5940	______	6060
Power measured over interface:	Pin - 60	______	Pin + 60

	RP5936A DUT Settings	RP7972A/RP7982A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 8 V	Current priority: 80 V, 7.5 A
Voltage Programming & Readback High:	Voltage priority: 800 V	Current priority: 800.5 V, 7.5 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 250 V, 7.5 A
Current Programming & Readback High:	Current priority: 24 A	Voltage priority: 250 V, 24.5 A
Power Programming & Readback Min:	Power priority: 60 W	Voltage priority: 80 V, 10 A
Power Programming & Readback High:	Power priority: 6000 W	Voltage priority: 800 V, 8 A

Keysight RP5946A

Source mode

RP5946A - Source Mode Test Record		Date_________	
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Programming & Readback			
Minimum voltage (Vout):	7.7576	______	8.2424
Voltage measured over interface:	Vout - 0.2424	______	Vout + 0.2424
High voltage (Vout):	799.52	______	800.48
Voltage measured over interface:	Vout - 0.480	______	Vout + 0.480
CV Load Effect:	- 0.160	______	+ 0.160
CV Ripple and Noise			
peak-to-peak:	N/A	______	1.000
rms:	N/A	______	0.160
Transient response @ ≤ 1 ms:	- 8	______	+ 8
Current Programming			
Minimum current (Iout):	0.951	______	1.049
High current (Iout):	47.904	______	48.096
Current Readback			
Minimum current measured over interface:	Iout - 0.049	______	Iout + 0.049
High current measured over interface:	Iout - 0.096	______	Iout + 0.096
CC Load Effect:	- 0.064	______	+ 0.064
Current Sink Tests			
100% of current rating:	- 48.096	______	- 47.904

	RP5946A DUT Settings	RP7972A/RP7982A Load Settings
Voltage Programming & Readback Min:	Voltage priority: 8 V, 5 A	not used
Voltage Programming & Readback High:	Voltage priority: 800 V, 5 A	not used
CV Load Effect:	Voltage priority: 250 V, 48.5 A	Current priority: 255 V, -48 A
CV Ripple and Noise:	Voltage priority: 250 V, 48.5 A	Current priority: 255 V, -48 A
Transient Response:	Voltage priority: 250 V, 48.5 A	Current priority: 255 V, -24 A to -48 A, slew=max, Comp 3 *
Current Programming & Readback Min:	Current priority: 255 V, 1 A	not used
Current Programming & Readback High:	Current priority: 255 V, 48 A	not used
CC Load Effect:	Current priority: 255 V, 48 A	Voltage priority: 250 V, -49 A
100% of current rating (Isink):	Current priority: 255 V, -48 A	Voltage priority: 250 V, 48.5 A

* Current comp 3 generates a 40 µs risetime step in the load list, which is required for the transient response test.

Load mode

RP5946A - Load Mode Test Record			Date________
Test Description	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests			
Voltage Programming & Readback			
Minimum voltage (Vin):	7.7576	______	8.2424
Voltage measured over interface:	Vin - 0.2424	______	Vin + 0.2424
High voltage (Vin):	799.52	______	800.48
Voltage measured over interface:	Vin - 0.480	______	Vin + 0.480
Current Priority Tests			
Current Programming			
Minimum current (Iin):	0.951	______	1.049
High current (Iin):	47.904	______	48.096
Current Readback			
Minimum current measured over interface:	Iin - 0.049	______	Iin + 0.049
High current measured over interface:	Iin - 0.096	______	Iin + 0.096
Power Priority Tests			
Power Programming & Readback			
Minimum power:	59.4	______	180.6
Power measured over interface:	Pin - 60.6	______	Pin + 60.6
High power:	11880	______	12120
Power measured over interface:	Pin - 120	______	Pin + 120

	RP5946A DUT Settings	RP7972A/RP7982A Power Supply Settings
Voltage Programming & Readback Min:	Voltage priority: 8 V	Current priority: 80 V, 10 A
Voltage Programming & Readback High:	Voltage priority: 800 V	Current priority: 800.5 V, 15 A
Current Programming & Readback Min:	Current priority: 1 A	Voltage priority: 250 V, 15 A
Current Programming & Readback High:	Current priority: 48 A	Voltage priority: 250 V, 48.5 A
Power Programming & Readback Min:	Power priority: 120 W	Voltage priority: 80 V, 10 A
Power Programming & Readback High:	Power priority: 12000 W	Voltage priority: 800 V, 15.5 A

7
Service and Maintenance

KEYSIGHT

Introduction

Repair Service Available

If your instrument fails during the warranty period, Keysight Technologies will repair or replace it under the terms of your warranty. After your warranty expires, Keysight offers repair services at competitive prices.

Many Keysight products have optional service contracts that extend coverage after the standard warranty expires.

Obtaining Repair Service (Worldwide)

To obtain service for your instrument, contact your nearest Keysight Technologies Service Center. They will arrange to have your unit repaired or replaced, and can provide warranty or repair–cost information where applicable. Ask the Keysight Technologies Service Center for shipping instructions, including what components to ship. Keysight recommends that you retain the original shipping carton for return shipments.

Before Returning the Unit

Before returning the unit, make sure the failure is in the instrument rather than any external connections. Also make sure that the instrument was accurately calibrated within the last year (see Calibration Interval).

If the unit is inoperative, verify that:

- the AC power cord is securely connected to the instrument
- the AC power cord is plugged into a live outlet
- the front-panel Power On/Standby switch has been pushed

If self-test failed, verify that:

Ensure that all connections (front and rear) are removed when self-test is performed. During self-test, errors may be induced by signals present on external wiring, such as long test leads that can act as antennae.

Repackaging for Shipment

To ship the unit to Keysight for service or repair:

- Attach a tag to the unit identifying the owner and indicating the required service or repair. Include the model number and full serial number.
- Place the unit in its original container with appropriate packaging material.
- Secure the container with strong tape or metal bands.

– Remove all accessories from the instrument. Do not include accessories unless they are associated with the failure symptoms.

Keysight suggests that you always insure shipments.

Cleaning

WARNING **SHOCK HAZARD To prevent electric shock, disconnect the AC mains before cleaning.**

RISQUE D'ÉLECTROCUTION Pour éviter tout risque d'électrocution, coupez l'alimentation secteur avant de nettoyer l'appareil.

Clean the outside of the instrument with a soft, lint-free, slightly damp cloth. Do not use detergent. Disassembly is not required or recommended for cleaning.

Self-Test Procedure

Power-On Self-Test

Each time the instrument is powered on, a self-test is performed. This test assures you that the instrument is operational.

Self-test checks that the minimum set of logic and power mesh systems are functioning properly. Self-test does not enable the output or place any voltages on the output. It leaves the instrument in the reset state.

User-Initiated Self-Test

The user-initiated self-test is the same as the power-on self-test.

Front Panel Menu Reference	SCPI Command
Cycle ac power. If self-test fails, the front panel ERR indicator comes on. Press **[Error]** to display the list of errors along with the reasons of the failures.	*TST? If 0, self-test passed. If non-zero is received, self-test failed. If self test-fails, use SYSTem:ERRor? to view the self-test error.

For a list of errors, see SCPI Error Messages.

Instrument Sanitize

NOTE This procedure is not recommended for use in routine applications because of the possibility of unintended loss of data.

This procedure sanitizes all user data. It writes all zeros to flash memory and then performs a full chip erase as per the manufacturer's data sheet. Identification data such as instrument firmware, model number, serial number, MAC address, and calibration data is not erased. After the data is cleared, the instrument is rebooted.

If you cannot access the Admin menu, it may be password protected.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Sanitize** Select Sanitize. Selecting Sanitize removes all user-data from the instrument and cycles power.	SYST:SEC:IMM

Refer to http://rfmw.em.keysight.com/aerospace/index.aspx for detailed information.

Turn-on after Sanitization

The first time the unit is turned on after it has been sanitized, several NVRAM checksum errors will be generated. These errors annunciate the fact that two files were missing, which have been recreated with default values. The next time the unit tuns on, there should be no errors.

Battery Replacement

WARNING SHOCK HAZARD Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover. Some circuits are active and have power for a short time even when the power switch is turned off.

RISQUE D'ÉLECTROCUTION Seules des personnes qualifiées, formées pour la maintenance et conscientes des risques d'électrocution encourus, peuvent enlever les couvercles de l'appareil. Toujours débrancher le câble d'alimentation et tout circuit externe avant de retirer le capot de l'instrument. Certains circuits sont activés et brièvement alimentés, même lorsque l'interrupteur d'alimentation est en position d'arrêt.

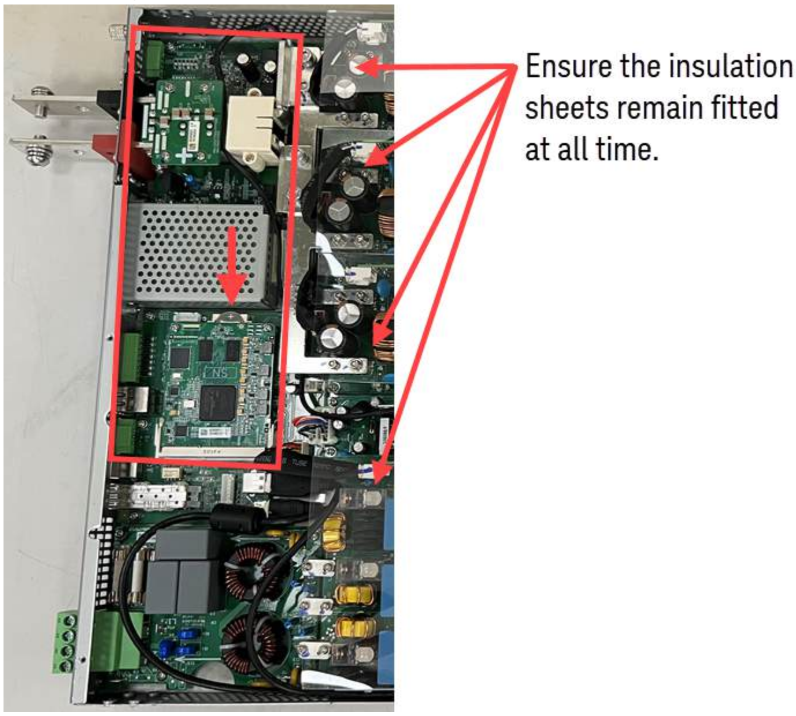
The internal battery powers the real-time clock. The primary function of the clock it to provide time stamp information for optional Keysight software products. If the battery fails, the time will not be available for the software. No other instrument functions are affected.

Under normal use at room temperature, the lithium battery has a life expectancy between seven and ten years. Note that battery life will be reduced if the instrument is stored for a prolonged period at temperatures above 40 degrees C.

The battery type is Panasonic CR 2032.

Replacement Procedure

1. Remove the instrument cover as described under Disassembly.
2. The battery is located on the main board as shown below.

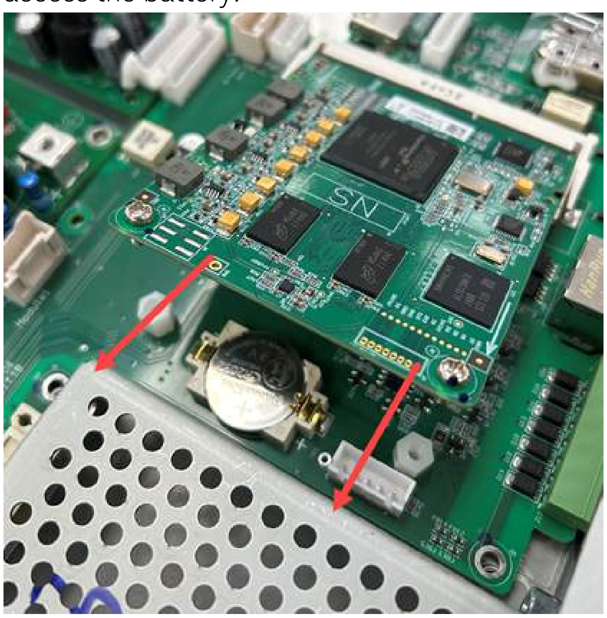


3. If there is space limitation during the battery removal, you may access the battery by removing the CPU board located above the battery.

a. Remove the two screws (indicated by the red circles).

b. Use both fingers to press the spring inward (indicated by the red arrows), and the CPU board will lift up automatically.

c. Pull the CPU board in the direction of the red arrow to remove it. Removing the board allows you to access the battery.



4. Use a flat-bladed screwdriver and carefully pry up on the side of the battery indicated by the arrow.

5. Install the new battery. Make sure that the positive side (+) is facing up. Place the battery *under* the small spring clips indicated by the circle, then push down on the opposite end of the battery indicated by the red arrow. The top of the small spring clips should be visible after the battery is seated (see red circle).
6. Assemble the board and top cover when finished.
7. Reset the date and time (see Clock Setup).

Disassembly

WARNING

SHOCK HAZARD Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover. Some circuits are active and have power for a short time even when the power switch is turned off.

RISQUE D’ÉLECTROCUTION Seules des personnes qualifiées, formées pour la maintenance et conscientes des risques d’électrocution encourus, peuvent enlever les couvercles de l’appareil. Toujours débrancher le câble d'alimentation et tout circuit externe avant de retirer le capot de l'instrument. Certains circuits sont activés et brièvement alimentés, même lorsque l'interrupteur d'alimentation est en position d'arrêt.

Electrostatic Discharge (ESD) Precautions

Almost all electrical components can be damaged by electrostatic discharge (ESD) during handling. Component damage can occur at electrostatic discharge voltages as low as 50 V.

The following guidelines will help prevent ESD damage during service operations:

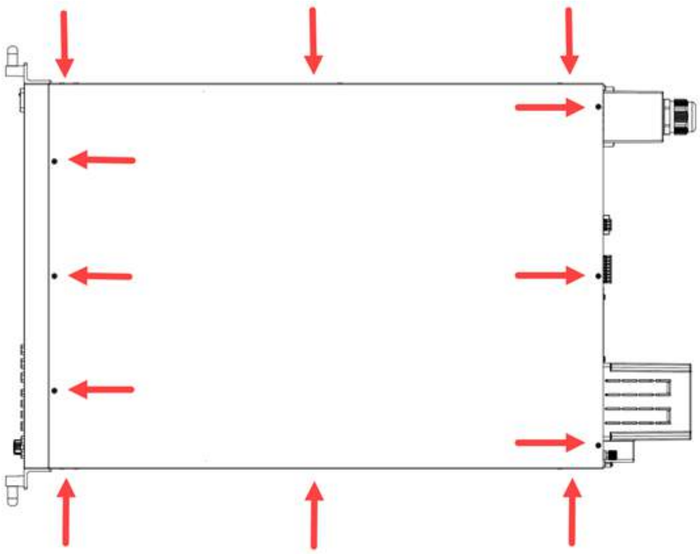
- Disassemble instruments only in a static-free work area.
- Use a conductive work area to reduce static charges.
- Use a conductive wrist strap to reduce static charge accumulation.
- Minimize handling.
- Keep replacement parts in original static-free packaging.
- Remove all plastic, foam, vinyl, paper, and other static-generating materials from the immediate work area.

Tools Required

- T10 Torx driver for cover and board disassembly
- Small flat bladed screwdriver for battery removal

Cover Disassembly

1. Turn off the power. Remove all cables from the instrument.
2. Remove the six screws (M3x6) located on the top and the six screws (M3x6) along the sides (see figure below). Place the screws in a container so that you do not lose them.
3. Remove the instrument cover.



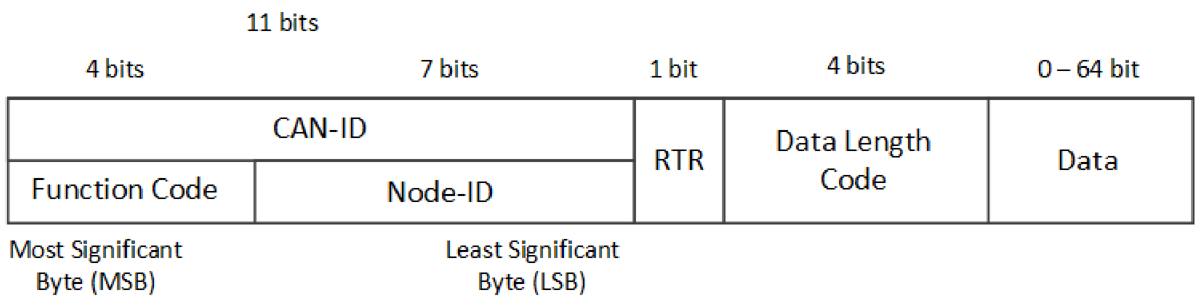
8 CANopen Programming Reference

CANopen Programming Introduction

CANopen is a communication protocol built on the Controller Area Network (CAN), specifically designed for embedded systems in industrial automation. It provides a standardized framework for device communication, enabling efficient data exchange and system integration. The application layer and communication profile of CANopen are defined in the CiA 301 specification, which outlines how devices interact using structured data objects and predefined messaging formats.

CANopen Frame

CANopen communication is based on the standard CAN 2.0A frame format, which utilizes an 11-bit identifier and supports up to 8 bytes of data.



CAN-ID (COB-ID): 11-bit identifier that defines function code and node ID.

Function Code: Defines the type of communication or purpose of the message.

RTR (Remote Transmission Request): Special bit in the CAN frame that allows a node to request data from another node without sending any data itself. In CANopen, RTR is generally not used.

Data Length Code: Number of data bytes.

Data: Payload containing command or process data.

Communication Objects

CANopen defines several standardized message types, each serving a specific role in device communication.

SYNC (Synchronization Object)[1]: Synchronizes PDO transmission.

EMCY (Emergency Object)[1]: Used by CANopen device to report critical errors immediately.

TIME (Timestamp Object)[1]: A broadcast message that provides a global time reference to all nodes on the CANopen network.

PDO (Process Data Object): A CAN message that supports real-time data transfer without protocol overhead.

SDO (Service Data Object): Used to transfer data sets between a client and a server.

1. Not supported by RP5900 Series.

Generic Pre-defined Connection Set

The default communication setup defined by CiA 301 contains the predefined COB-IDs to the communication objects.

Item	Communication Object	Function Code (4 bit, bin)	Node ID (7 bit, bin)	COB ID (hex)
1	NMT	0000	0000000	0
2	SYNC [1]	0001	0000000	80
3	EMCY[1]	0001	0000001 – 1111111	81 – FF
4	TIME [1]	0010	0000000	100
5	Transmit PDO 1	0011	0000001 – 1111111	181 –1FF
	Receive PDO 1	0010	0000001 – 1111111	201 – 27F
	Transmit PDO 2	0101	0000001 – 1111111	281 – 2FF
	Receive PDO 2	0110	0000001 – 1111111	301 – 37F
	Transmit PDO 3	0111	0000001 – 1111111	381 – 3FF
	Receive PDO 3	1000	0000001 – 1111111	401 – 47F
	Transmit PDO 4	1001	0000001 – 1111111	481 – 4FF
	Receive PDO 4	1010	0000001 – 1111111	501 – 57F
6	Transmit SDO	1011	0000001 – 1111111	581 – 5FF
	Receive SDO	1100	0000001 – 1111111	601 – 67F
7	Heartbeat	1110	0000001 – 1111111	701 – 77F

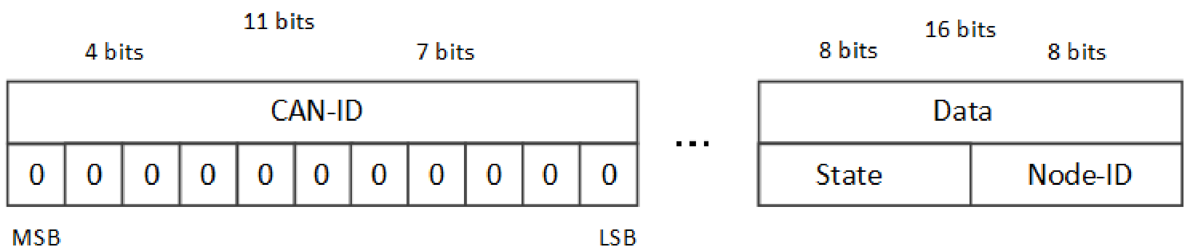
where,
NMT = Network Management Object
SYNC = Synchronization Object
EMCY = Emergency Object
TIME = Timestamp Object
PDO = Process Data Object
SDO = Service Data Object

Valid range for each node is 1 – 127. Each node will have unique ID.

1 Not supported by RP5900 Series.

NMT Command Format

CANopen devices are initialized, started, monitored, reset, or stopped through NMT services. All CANopen devices are regarded as NMT secondaries.



The COB-ID 0x0 is reserved for NMT. The state value includes Start Remote Mode (0x01), Stop Remote Mode (0x02), Enter Pre-operational State (0x80), Reset Node (0x81), and Reset Communication (0x82). Node-ID uniquely identifies an NMT secondary in a CANopen network using a value in the range of 1 to 127.

Enable CAN Communication

To enable CAN communication and transition the device to the Operational state, the NMT manager must send an NMT command with the 'Start Remote Node' specifier (0x01). Although the instrument does not acknowledge this message, it begins transmitting TPDOs—such as voltage, current, and power readings—to the TPDO consumer once the command is received.

NMT Start Remote Node Command Format:

Field	Value	Description
COB ID	0x0000	Fixed identifier reserved for NMT commands
Data (Hex)	01 01	Byte 1: Command specifier 0x01 (Start Remote Node) Byte 2: Node-ID (0x01 in this example)

NOTE The instrument will not acknowledge this message. However, it will begin transmitting TPDO data automatically.

Disable CAN Communication

To stop CAN communication and return the device to local control, the NMT manager sends an NMT command with the Stop Remote Node specifier (0x02). After receiving this command, the device ceases all CAN communication and stops transmitting TPDOs.

Stop message format:

Field	Value	Description
COB ID	0x0000	Fixed identifier reserved for NMT commands
Data (Hex)	02 01	Byte 1: Command specifier 0x02 (Stop Remote Node) Byte 2: Node-ID (0x01 in this example)

NOTE **After receiving this message, the instrument will cease all CAN communication—it will no longer respond to or transmit CAN messages.**

Process Data Object (PDO)

PDOs are used for real-time, unconfirmed data exchange between devices. Each PDO can carry up to 8 bytes of application data and is identified by a unique COB-ID (Communication Object Identifier). PDOs are categorized into:

Transmit PDOs (TPDOs): Sent by a device to share its process data.

Receive PDOs (RPDOs): Received by a device to update its internal state.

PDO frame structure

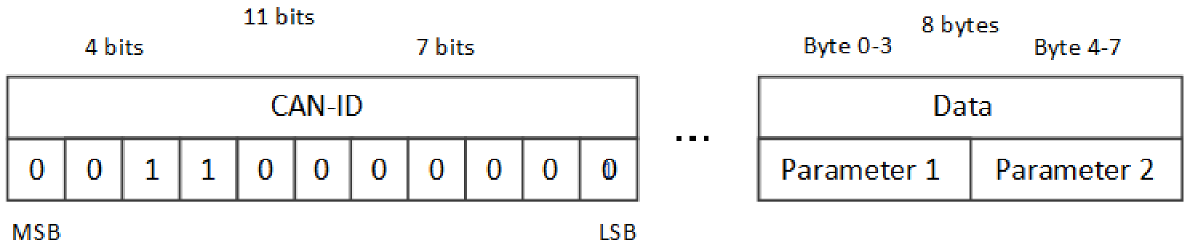
Each PDO frame consists of:

COB-ID: Identifies the PDO on the CAN bus (e.g., 0x180 + Node ID for TPDO1).

Data Field: Up to 8 bytes, containing application parameters mapped to specific byte positions according to the PDO mapping configuration.

PDO frame layout example

The diagram below illustrates a typical TPDO frame structure:



TPDO COB ID: Identifies the message (e.g., 0x180 + CAN Address)

Parameter 1: 4 bytes (e.g., V_rms)

Parameter 2: 4 bytes (e.g., I_rms)

Example: Writing a TPDO1 Frame

Assume the following values for a device with CAN address 0x01:

V_rms = 0x000186A0 (100,000 in decimal)

I_rms = 0x00002710 (10,000 in decimal)

The TPDO1 frame would be constructed as:

COB-ID: 0x180 + 0x01 = 0x181

Data: A0 86 01 00 10 27 00 00

Byte Breakdown:

- Byte 0–3: A0 86 01 00 → V_rms (little-endian)
- Byte 4–7: 10 27 00 00 → I_rms (little-endian)

This frame is broadcast by the RP5900 device to share voltage and current readings with consumers on the CANopen network.

Refer to PDO Mapping for more details.

Regular Report Message

Once CAN communication is enabled and the device enters the Operational state, it automatically begins transmitting TPDO messages to the consumer. These messages contain real-time process data. The first of these, TPDO1, reports voltage and current values.

Frame ID: 0x181

This is calculated as 0x180 + CAN Address. Since the CAN address is 0x01, the resulting Frame ID is 0x181.

Data (HEX): 00 00 40 40 00 00 E0 40

This represents:

Bytes 0–3: Voltage RMS (V_rms)

Bytes 4–7: Current RMS (I_rms)

NOTE: The instrument sends this message periodically without requiring a request from the PC.

Field	Value	Description
Frame ID	00000181	0x180 + CAN Address (0x01) = 0x181
Data (Hex)	00 00 40 40 00 00 E0 40	Voltage RMS (0–3 bytes), Current RMS (4–7 bytes)
Remarks	Report the message	Sent periodically after CAN is enabled

PDO Frame Structure and Reporting Example

Upon CAN bus initialization, the instrument begins transmitting TPDO messages to the PC. These messages contain real-time measurement and status data. The structure of each TPDO frame is defined by its COB-ID and data content, as shown below.

Example: TPDO1 Reporting Frame

COB ID	Data (Hex)	Description
0x00000181	00 00 40 40 00 00 E0 40	TPDO1 message from CAN address 0x01

COB ID: 0x181 = 0x180 + 0x01 (TPDO1 from Node 1)

Data Breakdown:

Byte 0–3: 00 00 40 40 → V_rms (Average Voltage)

Byte 4–7: 00 00 E0 40 → I_rms (Average Current)

Modifying TPDO Reporting Cycle Time

The RPS supports four TPDO timers: TPDO1, TPDO2, TPDO3, and TPDO4. By default, each TPDO reports data every 1000 ms. You can configure each timer independently to either disable reporting or adjust the reporting interval to meet specific application requirements.

Example: Set TPDO1 Reporting Cycle to 100 ms

To change the reporting cycle of TPDO1 to 100 ms, send an SDO write message to the instrument using the following format:

SDO write message:

Field	Value	Description
COB ID	0x0601	SDO request (0x600 + Node ID 0x01)
Data (Hex)	2B 00 18 05 64 00 00 00	2B: Command byte (write 2 bytes) 00 18: Index 0x1800 (TPDO1) 05: Sub-index 0x05 (event timer) 64 00: Value 0x0064 = 100 ms Note: The value 0x0064 is in hexadecimal and represents 100 ms in decimal.

Expected response:

Field	Value	Description
COB ID	0x0581	SDO response (0x580 + Node ID 0x01)
Data (Hex)	60 00 18 05 00 00 00 00	Acknowledges successful write to index 0x1800, sub-index 0x05

After sending the above message, the instrument updates the TPDO1 timer and begins reporting data every 100 ms instead of the default 1000 ms.

Disable the TPDO Reporting Cycle Function

To disable the TPDO reporting cycle for a specific TPDO (e.g., TPDO1), follow these two steps:

Step 1: Set the Transmission Type to 254

Send an SDO message to set the transmission type of TPDO1 to 254, which disables cyclic transmission.

SDO write message:

Field	Value	Description
COB ID	0x0601	SDO request (0x600 + Node ID 0x01)
Data (Hex)	2F 00 18 02 FE 00 00 00	2F: Command byte (write 1 byte) 00 18: Index 0x1800 (TPDO1) 02: Sub-index 0x02 (transmission type) FE: Value 254 (disable cyclic transmission)

Expected response:

Field	Value	Description
COB ID	0x0581	SDO response (0x580 + Node ID 0x01)
Data (Hex)	60 00 18 02 00 00 00 00	Acknowledges successful write to index 0x1800, sub-index 0x02

Step 2: Set the Timer Cycle to 0 ms

Send another SDO message to set the TPDO1 timer cycle to 0 ms, effectively disabling the periodic reporting.

SDO write message:

Field	Value	Description
COB ID	0x0601	SDO request (0x600 + Node ID 0x01)
Data (Hex)	2B 00 18 05 00 00 00 00	2B: Command byte (write 2 bytes) 00 18: Index 0x1800 (TPDO1) 05: Sub-index 0x05 (event timer) 00 00: Value 0 ms

Expected response:

Field	Value	Description
COB ID	0x0581	SDO response (0x580 + Node ID 0x01)
Data (Hex)	60 00 18 05 00 00 00 00	Acknowledges successful write to index 0x1800, sub-index 0x05

After completing these two steps, the instrument disables the TPDO1 reporting cycle. You can apply the same procedure to TPDO2, TPDO3, and TPDO4 by modifying the corresponding object dictionary entries.

Re-enable the TPDO Reporting Cycle Function

To re-enable the TPDO reporting cycle function, follow these steps:

1. Disable CAN communication
2. Enable CAN communication again

Once the instrument restarts CAN communication, it automatically resumes the TPDO reporting cycle based on the default or previously configured timer settings.

Service Data Object (SDO) Communication

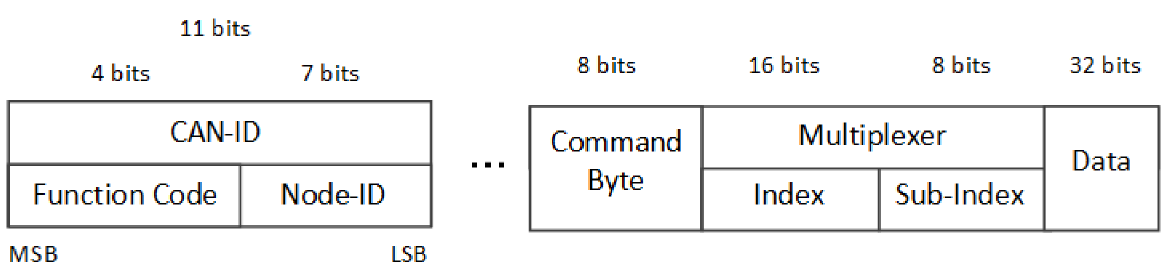
SDOs are used in CANopen networks for configuration and access to a device’s Object Dictionary. Unlike PDOs, which are used for real-time data exchange, SDOs provide a reliable, confirmed communication mechanism for reading from and writing to device parameters. SDO communication is typically used during device initialization, diagnostics, or parameter tuning.

Each SDO message consists of a request and a response:

SDO Client: Initiates the request (e.g., a primary device or controller)

SDO Server: Responds to the request (e.g., a secondary device)

SDO frame structure



Each SDO frame consists of:

COB-ID: Communication Object Identifier (e.g., 0x600 + NodeID for request, 0x580 + NodeID for response)

Command Byte: Indicates the type of access (read/write), data size, and transfer type

Multiplexer: 24-bit field composed of a 16-bit Index and 8-bit Sub-Index, identifying the target object

Data: Up to 4 bytes of data (little-endian format)

Example: Writing to a Device Using SDO

Set the DC voltage level to 6 V

SDO Write Frame:

COB-ID: 0x600 + 0x01 = 0x601 (assuming Node ID = 0x01)

Command Byte: 0x23 (expedited write, 4 bytes)

Index: 0x02 0x30 (little-endian for 0x3002)

Sub-Index: 0x02

Data: 00 00 C0 40 (IEEE 754 representation of 6.0)

The final frame (Hex) will be constructed as:

COB-ID: 0x601

Data : 23 02 30 02 00 00 C0 40

This message instructs the device to set the DC voltage to 6.0 V.

Refer to SDO Parameter for more details.

Querying Status Register

To read a register (such as status, operation, or questionable), send a SDO Read command in the following format:

Field	Value	Description
COB ID	0x3003	SDO request (0x3003 + Node ID 0x01)
Data (Hex)	43 03 30 06 00 00 00 00	43: Command byte (read 4 byte) 03 30: Index 0x3003 (little-endian) 01: Sub-index 0x06 (transmission type) 0: Reserved/padding

Expected response:

Field	Value	Description
COB ID	0x3003	SDO response (0x3003 + Node ID 0x01)
Data (Hex)	43 03 30 01 11 08 00 00	Response to read request for index 0x3003, sub-index 0x01.

Reading the response:

Extract the last 4 bytes: 11 08 00 00

Convert it to 32-bit hex value (little endian): 0x00000811

Convert it to binary: 0000 0000 0000 0000 0000 1000 0001 0001

Then, map each bit according to the register definition. In this case, only bit 0, 4, and 11 are active.

Bit	Value	Meaning (if set to 1)
0	1	OV (Over-voltage protection)
4	1	UC (Under-current protection)
11	1	PNL (Parallel not locked)

CANopen Command Reference

SDO Parameter

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
System Status (0x3001)									
onoff_reg	Control output or input	RW	uint (32)	4	43	23	01 30 01	0: Off; 1: On	Turn on output: 01 00 00 00
heartbeat	1 heartbeat/s	R	uint (32)	4	43	-	01 30 02	-	NULL
timer_onoff	Timer ON/OFF	RW	uint (32)	4	43	23	01 30 03	0: Off; 1: On	Turn on timer: 01 00 00 00
timer_ timeout	Timer duration	RW	float	4	43	23	01 30 04	-	Set duration to 1 s: 00 00 80 3f
timer_reset	Reset timer	W	-	-	-	23	01 30 05	-	NULL
Remote_ Sense_Sta- tus	Set sense status	RW	uint (32)	4	43	23	01 30 06	0: Off; 1: On	Turn on sense: 01 00 00 00
Remote_ Sense_Level	Read the voltage comparison threshold	R	float	4	43	-	01 30 07	-	NULL
Output_ Rzero	Voltage zeroing mode Source Mode only	RW	uint (32)	4	43	23	01 30 08	0: Off; 1: On	Turn on Rzero: 01 00 00 0 0
DC Source (0x3002) Source Mode only									
dc_mode	Operating mode	RW	uint (32)	4	43	23	02 30 01	0: CV; 1: CC	Set to CC mode: 01 00 00 00
dc_volt	Voltage level	RW	float	4	43	23	02 30 02	0 - Vmax	Set to 6 V: 00 00 c0 40
dc_volt_rise	Voltage rising slew time	RW	float	4	43	23	02 30 03	0 - 8000 s	Set to 6 s: 00 00 c0 40
dc_volt_fall	Voltage falling slew time	RW	float	4	43	23	02 30 04	0 - 8000 s	Set to 6 s: 00 00 c0 40
dc_volt_trig	Triggered voltage level	RW	float	4	43	23	02 30 05	0 - Vmax	Set to 50 V: 00 00 48 42

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
dc_current	Current level	RW	float	4	43	23	02 30 06	Imin - Imax	Set to 3 A: 00 00 40 40
dc_cur_rise	Current rising slew time	RW	float	4	43	23	02 30 07	0 to 8000 s	Set to 10 s: 00 00 20 41
dc_cur_fall	Current falling slew time	RW	float	4	43	23	02 30 08	0 to 8000 s	Set to 5 s: 00 00 a0 40
dc_cur_trig	Triggered current level	RW	float	4	43	23	02 30 09	Imin - Imax	Set to 2 A: 00 00 00 40
dc_v_high	Voltage limit, Vh	RW	float	4	43	23	02 30 0A	0 - Vmax	Set to 20 V: 00 00 a0 41
dc_v_low	Low voltage limit, Vl	RW	float	4	43	23	02 30 0B	0 - Vmax	Set to 2 V: 00 00 00 40
dc_i_high	Positive current limit, I+	RW	float	4	43	23	02 30 0C	0- Imax	Set to 4 A: 00 00 80 40
dc_i_low	Negative current limit, I-	RW	float	4	43	23	02 30 0D	Imin - 0	Set to -5 A: 00 00 a0 c0
power_high	Upper power limit, P+	RW	float	4	43	23	02 30 0E	0 - Pmax	Set to 1800 W: 00 00 e1 44
power_low	Lower power limit, P-	RW	float	4	43	23	02 30 0F	Pmin – -1	Set to 20 W: 00 00 a0 41
cc_speed_ state	CC loop speed	RW	uint (32)	4	43	23	02 30 10	0: High; 1: Low	Set to High: 00 00 00 00
cv_speed_ state	CV loop speed	RW	uint (32)	4	43	23	02 30 11	0: High; 1: Low	Set to Low: 01 00 00 00
cc_resis-tance_state	Sink resistance state	RW	uint (32)	4	43	23	02 30 12	0: Off; 1: On	Set to On: 01 00 00 00
cc_resis-tance_level	Sink resistance value	RW	float	4	43	23	02 30 13	Rmin - Rmax	Set to 1 Ω: 00 00 80 3f
cv_resis-tance_state	Output resistance state	RW	uint (32)	4	43	23	02 30 14	0: Off; 1: On	Set to Off: 00 00 00 00
cv_resis-tance_level	Output resistance level (internal resistance)	RW	float	4	43	23	02 30 15	0 - Rmax	Set to 30 Ω: 00 00 f0 41
dc_volt_ slew_ couple_state	Slew tracking state	RW	uint (32)	4	43	23	02 30 16	0: Off; 1: On	Set to On: 01 00 00 00

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
dc_volt_rise_ max_state	Maximum slew rate for rising slew	RW	uint (32)	4	43	23	02 30 17	0: Off; 1: On	Set to On: 01 00 00 00
dc_volt_fall_ max_state	Maximum slew rate for fallng slew	RW	uint (32)	4	43	23	02 30 18	0: Off; 1: On	Set to On: 01 00 00 00
dc_cur_ slew_ couple_state	dc_cur_slew_couple_ state	RW	uint (32)	4	43	23	02 30 19	0: Off; 1: On	Set to Off: 00 00 00 00
dc_cur_rise_ max_state	dc_cur_rise_max_ state	RW	uint (32)	4	43	23	02 30 1A	0: Off; 1: On	Set to Off: 00 00 00 00
dc_cur_fall_ max_state	dc_cur_fall_max_state	RW	uint (32)	4	43	23	02 30 1B	0: Off; 1: On	Set to Off: 00 00 00 00
DC Meter (0x3003)									
v_rms	Measure Vrms	R	float	4	43	-	03 30 01	-	Get Vrms: 00 00 00 00
i_rms	Measure Irms	R	float	4	43	-	03 30 02	-	Get Irms: 00 00 00 00
p_rms	Measure Prms	R	float	4	43	-	03 30 03	-	Get Prms: 00 00 00 00
oper_reg	Operation status register. Refer to Status Tutorial for bit details.	R	uint (32)	4	43	-	03 30 04	-	Get oper_ reg: 00 00 00 00
state_reg	Standard status register. Refer to Status Tutorial for bit details.	R	uint (32)	4	43	-	03 30 05	-	Get state_ reg: 00 00 00 00
ques_ reg1+ques_ reg2	Questionable status register. Refer to Status Tutorial for bit details.	R	uint (32)	4	43	-	03 30 06	-	Get ques_ reg1+ques_ reg2: 00 00 00 00
sense_volt	Sense voltage	R	float	4	43	-	03 30 07	-	Get sense voltage: 00 00 00 00
ahour	FETCh AHOur	R	float	4	43	-	03 30 08	-	Get AHOur: 00 00 00 00
whour	FETCh WHOur	R	float	4	43	-	03 30 09	-	Get WHOur: 00 00 00 00
Battery Emulator (0x3004) Source Mode only									
onoff	Enable or disable the battery emulator	RW	uint (32)	4	43	23	04 30 01	0: Off; 1: On	Set to On: 01 00 00 00

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
full_volt	Full voltage of the batery	RW	float	4	43	23	04 30 02	Vmin - Vmax	Set to 7 V: 00 00 e0 40
empty_volt	Empty voltage of the battery	RW	float	4	43	23	04 30 03	Vmin - Vmax	Set to 2 V: 00 00 00 40
single_capa-city	Single battery capa-city	RW	float	4	43	23	04 30 04	0 to 9999.99	Set to 8 Ah: 00 00 00 41
resistance	Internal resistance of battery	RW	float	4	43	23	04 30 05	Rmin - Rmax	Set to 0.1 Ω: cd cc cc 3d
parallel_num	Number of battery connected in parallel	RW	uint (32)	4	43	23	04 30 06	1 - 1000	Set to 12: 0C 00 00 00
series_num	Number of battery connected in series	RW	uint (32)	4	43	23	04 30 07	1 - 1000	Set to 7: 07 00 00 00
init_mode	Initialization mode	RW	uint (32)	4	43	23	04 30 08	0: SOC; 1: VOC; 2: CAP	Set to VOC: 02 00 00 00
init_soc	Initial SOC value	RW	float	4	43	23	04 30 09	0 - 100	Set to 80%: 00 00 a0 42
init_voc	Initial VOC value	RW	float	4	43	23	04 30 0A	Vmin - Vmax	Set to 7 V: 00 00 e0 40
init_cap	Initial CAP value	RW	float	4	43	23	04 30 0B	0.01 - 9999.99	Set to 2 Ah: 00 00 00 40
positive_curr	Positive current limit	RW	float	4	43	23	04 30 0C	Imin - Imax	Set to 7 A: 00 00 e0 40
negative_curr	Negative current limit	RW	float	4	43	23	04 30 0D	Imin - Imax	Set to -2 A: 00 00 00c0
save_group	Save to battery data	W	uint (32)	4	-	23	04 30 0E	1 to 10	Set to 5: 05 00 00 00
recall_group	Recall the battery data	W	uint (32)	4	-	23	04 30 0F	1 to 10	Set to 5: 05 00 00 00
real_soc	Return the realtime SOC	R	float	4	43	-	04 30 10	-	Get realtime SOC: 00 00 00 00
real_voc	Return the realtime VOC	R	float	4	43	-	04 30 11	-	Get realtime VOC: 00 00 00 00

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
real_cap	Return the realtime CAP	R	float	4	43	-	04 30 12	-	Get realtime CAP: 00 00 00 00
List (0x3005) Source Mode only									
onoff	Set list on/off status	RW	uint (32)	4	43	23	05 30 01	0: Stop; 1: Run	Set to Run: 01 00 00 00
ode	Set list working mode	RW	uint (32)	4	43	23	05 30 02	0: CV; 1: CC	Set to CV: 00 00 00 00
step	Set list total step count	RW	uint (32)	4	43	23	05 30 03	1 - 200	Set to 40: 28 00 00 00
current_step	Set list current step	RW	uint (32)	4	43	23	05 30 04	1 - 9999999	Set to 5: 05 00 00 00
value	Set current value or voltage value for current step.	RW	float	4	43	23	05 30 05	Source mode Current: Imin - Imax Voltage: 0 - Vmax Load mode: Current: 0 - Imax Voltage: 0 - Vmax	Set to 50 V: 00 00 48 42
slope	Set slope value for current step	RW	float	4	43	23	05 30 06	Source mode Current: 0.001 - MAX Voltage: 0.001 - MAX Load mode 0 - 8000 s	Set to 5 s: 00 00 a0 40
width	Set dwell time for current step	RW	float	4	43	23	05 30 07	1 - 9999999	Set to 5 s: 00 00 a0 40
repeat	Set the list repeat count.	RW	uint (32)	4	43	23	05 30 08	1 - 9999999	Set to 10: 0A 00 00 00
end_state	Set the running state after the list program is running over.	RW	uint (32)	4	43	23	05 30 09	0: Off; 1: On	Set to On: 01 00 00 00
tout_state	Set trig status of list	RW	uint (32)	4	43	23	05 30 0A	0: Off; 1: On	Set to On: 01 00 00 00

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
trig_source	Set trigger source.	RW	uint (32)	4	43	23	05 30 0B	0: Immediate; 1: Bus; 2: External	Set to External: 02 00 00 00
save_group	Save the edited List program.	W	uint (32)	4	-	23	05 30 0C	1 to 10	Set to 5: 05 00 00 00
recall_group	Recall the edited List program.	W	uint (32)	4	-	23	05 30 0D	1 to 10	Set to 5: 05 00 00 00
run_state	Read list running status	R	uint (32)	4	43	-	05 30 0E	0: Stop; 1: Active; 2: WTG; 3: Abort	Get list running status: 00 00 00 00
Protect (0x3006) Source Mode only									
OVP_state	Set OVP status	RW	uint (32)	4	43	23	06 30 01	0: Off; 1: On	Set to On: 01 00 00 00
OVP_level	Set OVP value	RW	float	4	43	23	06 30 02	0 - Vmax	Set to 20 V: 00 00 a0 41
OVP_delay	Set OVP delay time	RW	float	4	43	23	06 30 03	0 - 60	Set to 0.2 s: cd cc 4c 3e
OCP_state	Set OCP status	RW	uint (32)	4	43	23	06 30 04	0: Off; 1: On	Set to On: 01 00 00 00
OCP_level	Set OCP value	RW	float	4	43	23	06 30 05	Imin - Imax	Set to 5 A: 00 00 a0 40
OCP_delay	Set OCP delay time	RW	float	4	43	23	06 30 06	0 - 60	Set to 0.2 s: cd cc 4c 3e
OPP_state	Set OPP status	RW	uint (32)	4	43	23	06 30 07	0: Off; 1: On	Set to On: 01 00 00 00
OPP_level	Set OPP value	RW	float	4	43	23	06 30 08	Pmin - Pmax	Set to -1000 W: 00 00 7a c4
OPP_delay	Set OPP delay time	RW	float	4	43	23	06 30 09	0 - 60	Set to 0.2 s: cd cc 4c 3e
UCP_state	Set UCP status	RW	uint (32)	4	43	23	06 30 0A	0: Off; 1: On	Set to On: 01 00 00 00
UCP_level	Set UCP value	RW	float	4	43	23	06 30 0B	Imin - Imax	Set to 10 A: 00 00 20 41
UCP_delay	Set UCP delay time	RW	float	4	43	23	06 30 0C	0 - 60	Set to 0.2 s: cd cc 4c 3e

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
UCP_war-mup	Set UCP warm-up time	RW	float	4	43	23	06 30 0D	0 - 60	Set to 5 s: 00 00 a0 40
UVP_state	Set UVP status	RW	uint (32)	4	43	23	06 30 0E	0: Off; 1: On	Set to On: 01 00 00 00
UVP_level	Set UVP value	RW	float	4	43	23	06 30 0F	0 - Vmax	Set to 10 V: 00 00 20 41
UVP_delay	Set UVP delay time	RW	float	4	43	23	06 30 10	0 - 60	Set to 0.2 s: cd cc 4c 3e
UVP_war-mup	Set UVP warm-up time	RW	float	4	43	23	06 30 11	0 - 60	Set to 5 s: 00 00 a0 40
Protect info (0x3007)									
clear_pro-tect	clear protection	W	uint (32)	4	-	23	07 30 01	0: Clear	Set to clear: 00 00 00 00
software_ protect_info	Retrieve software protection failure information.	R	uint (32)	4	43	-	07 30 02	Refer to Soft-ware Pro-tection Failure Information.	Get OV, UV, and OT: C1 00 00 00
System (0x3008)									
io_port1	Configure IO pin 1.	RW	uint (32)	4	43	23	08 30 01	Refer to Digi-tal IO Con-figuration Information.	Set to DIO, Invert: 01 00 00 00
io_port2	Configure IO pin 2.	RW	uint (32)	4	43	23	08 30 02	Refer to Digi-tal IO Con-figuration Information.	Set to PSSTate, Invert: 05 00 00 00
o_port3	Configure IO pin 3.	RW	uint (32)	4	43	23	08 30 03	Refer to Digi-tal IO Con-figuration Information.	Set to DINPut, Not Invert: 02 00 00 00
io_port4	Configure IO pin 4.	RW	uint (32)	4	43	23	08 30 04	Refer to Digi-tal IO Con-figuration Information.	Set to TINPut, Not Invert: 01 00 00 00
io_port5	Configure IO pin 5.	RW	uint (32)	4	43	23	08 30 05	Refer to Digi-tal IO Con-figuration Information.	Set the DIO to invert only: 01 00 00 00

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
io_port6	Configure IO pin 6.	RW	uint (32)	4	43	23	08 30 06	Refer to Digital IO Configuration Information.	Set the DIO to invert only: 01 00 00 00
io_port7	Configure IO pin 7.	RW	uint (32)	4	43	23	08 30 07	Refer to Digital IO Configuration Information.	Set the DIO to invert only: 01 00 00 00
emulation	Instrument operation mode	RW	uint (32)	4	43	23	08 30 08	0: Source; 1: Load	Set to Load: 01 00 00 00
Output (0x3008) Load Mode only									
inhibit_mode	Inhibit mode	RW	uint (32)	4	43	23	08 30 09	0: LATChing; 1: LIVE; 2: OFF	Set to LIVE: 01 00 00 00
DC Load (0x4002) Load Mode only									
dc_mode	Operating mode	RW	uint (32)	4	43	23	02 40 01	0: CC; 1: CV; 2: CP; 3: CR; 4: CVCC; 5: CVCR; 6: CRCC; 7: AUTO	Set to CR: 04 00 00 00
dc_volt	Voltage level	RW	float	4	43	23	02 40 02	0 - Vmax	Set to 20 V: 00 00 a0 41
dc_volt_rise	Voltage rising slew time	RW	float	4	43	23	02 40 03	0.001 - MAX	Set to 6 V/ms: 00 00 c0 40
dc_volt_fall	Voltage falling slew time	RW	float	4	43	23	02 40 04	0.001 - MAX	Set to 6 A/ms: 00 00 c0 40
dc_volt_trig	Triggered voltage level	RW	float	4	43	23	02 40 05	0 - Vmax	Set to 50 V: 00 00 48 42
dc_current	Current level	RW	float	4	43	23	02 40 06	0 - Imax	Set to 3 A: 00 00 40 40
dc_cur_rise	Current rising slew time	RW	float	4	43	23	02 40 07	0.001 - MAX	Set to 10 V/ms: 00 00 20 41

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
dc_cur_fall	Current falling slew time	RW	float	4	43	23	02 40 08	0.001 - MAX	Set to 5 A/ms: 00 00 a0 40
dc_cur_trig	Triggered current level	RW	float	4	43	23	02 40 09	0 - Imax	Set to 2 A: 00 00 00 40
dc_power	Power level	RW	float	4	43	23	02 40 0A	0 - Pmax	Set to 50 W: 00 00 48 42
dc_power_ trig	Triggered power level	RW	float	4	43	23	02 40 0B	0 - Pmax	Set to 75 W: 00 00 96 42
dc_resis- tance	Resistance level	RW	float	4	43	23	02 40 0C	Rmin - Rmax	Set to 0.5 Ω: 00 00 00 3f
dc_resis- tance_trig	Triggered resistance level	RW	float	4	43	23	02 40 0D	Rmin - Rmax	Set to 1Ω: 00 00 80 3f
speed_state	Set input bandwidth	RW	uint (32)	4	43	23	02 40 0E	0: High; 1: Low	Set to High: 00 00 00 00
input_short	Set input short status	RW	uint (32)	4	43	23	02 40 0F	0:Off; 1:On	Set to On: 01 00 00 00
von_mode	Set behavior of under-voltage inhibit function	RW	uint (32)	4	43	23	02 40 10	0: LATChing; 1: LIVE; 2: OFF	Set to LIVE: 01 00 00 00
von_level	Set voltage-on level	RW	float	4	43	23	02 40 11	Vmax/1000 - Vmax	Set to 4 V: 00 00 40 80
dc_volt_ slew_ couple_state	Voltage slew rate tra-cking state	RW	uint (32)	4	43	23	02 40 12	0: Off; 1: On	Set to On: 01 00 00 00
dc_volt_rise_ max_state	Maximum rising voltage slew rate override.	RW	uint (32)	4	43	23	02 40 13	0: Off; 1: On	Set to On: 01 00 00 00
dc_volt_fall_ max_state	Maximum falling voltage slew rate override	RW	uint (32)	4	43	23	02 40 14	0: Off; 1: On	Set to On: 01 00 00 00
dc_cur_ slew_ couple_state	Current slew rate tra-cking state	RW	uint (32)	4	43	23	02 40 15	0: Off; 1: On	Set to On: 01 00 00 00
dc_cur_rise_ max_state	Maximum rising current slew rate override	RW	uint (32)	4	43	23	02 40 16	0: Off; 1: On	Set to On: 01 00 00 00

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
dc_cur_fall_ max_state	Maximum falling current slew rate override	RW	uint (32)	4	43	23	02 40 17	0: Off; 1: On	Set to On: 01 00 00 00
DC Load Protect (0x4006) Load Mode only									
OVP_state	Set OVP status	RW	uint (32)	4	43	23	06 40 01	0: Off; 1: On	Set to On: 01 00 00 00
OVP_level	Set OVP value	RW	float	4	43	23	06 40 02	0 - Vmax	Set to 20 V: 00 00 a0 41
OVP_delay	Set OVP delay time	RW	float	4	43	23	06 40 03	0 – 60	Set to 0.2 s: cd cc 4c 3e
OCP_state	Set OCP status	RW	uint (32)	4	43	23	06 40 04	0: Off; 1: On	Set to On: 01 00 00 00
OCP_level	Set OCP value	RW	float	4	43	23	06 40 05	0 - Imax	Set to 5 A: 00 00 a0 40
OCP_delay	Set OCP delay time	RW	float	4	43	23	06 40 06	0 – 60	Set to 0.2 s: cd cc 4c 3e
OPP_state	Set OPP status	RW	uint (32)	4	43	23	06 40 07	0: Off; 1: On	Set to On: 01 00 00 00
OPP_level	Set OPP value	RW	float	4	43	23	06 40 08	0 - Pmax	Set to -1000 W: 00 00 7a c4
OPP_delay	Set OPP delay time	RW	float	4	43	23	06 40 09	0 – 60	Set to 0.2 s: cd cc 4c 3e
UCP_state	Set UCP status	RW	uint (32)	4	43	23	06 40 0A	0: Off; 1: On	Set to On: 01 00 00 00
UCP_level	Set UCP value	RW	float	4	43	23	06 40 0B	0 - Imax	Set to 10 A: 00 00 20 41
UCP_delay	Set UCP delay time	RW	float	4	43	23	06 40 0C	0 – 60	Set to 0.2 s: cd cc 4c 3e
UCP_war- mup	Set UCP warm-up time	RW	float	4	43	23	06 40 0D	0 – 60	Set to 5 s: 00 00 a0 40
UVP_state	Set UVP status	RW	uint (32)	4	43	23	06 40 0E	0: Off; 1: On	Set to On: 01 00 00 00
UVP_level	Set UVP value	RW	float	4	43	23	06 40 0F	0 - Vmax	Set to 10 V: 00 00 20 41
UVP_delay	Set UVP delay time	RW	float	4	43	23	06 40 10	0 – 60	Set to 0.2 s: cd cc 4c 3e

Command	Description	Access[1]	Data type	Data length (byte)	Command byte		Multiplexor	Parameter	Data (hex)[2]
					Read	Write			
UVP_war-mup	Set UVP warm-up time	RW	float	4	43	23	06 40 11	0 – 60	Set to 5 s: 00 00 a0 40

1 R = Read, W = write

2 Information on this column illustrates an example of data setting.

PDO Mapping

PDO Name	COB ID (Hex)	Data Mapping	Description	Byte Allocation
TPD01	0x180 + CAN address	V_rms	Average voltage	Byte 0–3
		I_rms	Average current	Byte 4–7
TPD02	0x280 + CAN address	P_rms	Average power	Byte 0–3
		sense_volt	Sense voltage	Byte 4–7
TPD03	0x380 + CAN address	oper_reg	Operation status register	Byte 0–3
		ques_reg1	Questionable standard register 1	Byte 4–5
		ques_reg2	Questionable standard register 2	Byte 6–7
TPD04	0x480 + CAN address	software_protect_info	Software protection information	Byte 0–3
		hardware_protect_info	Hardware protection information	Byte 4–7

Source mode only

PDO Name	COB ID (Hex)	Data Mapping	Description	Byte Allocation
RPD01	0x200 + CAN address	dc_mode	Operation mode	Byte 0–3
		power_high	High power	Byte 4–7
RPD02	0x300 + CAN address	dc_volt	Voltage	Byte 0–3
		dc_current	Current	Byte 4–7
RPD03	0x400 + CAN address	dc_v_high	High voltage	Byte 0–3
		dc_v_low	Low voltage	Byte 4–7
RPD04	0x500 + CAN address	dc_i_high	High current	Byte 0–3
		dc_i_low	Low current	Byte 4–7

Load mode only

PDO Name	COB ID (Hex)	Data Mapping	Description	Byte Allocation
RPD01	0x200 + CAN address	dc_mode	Operation mode	Byte 0–3
		input_short	Input short	Byte 4–7
RPD02	0x300 + CAN address	dc_volt	Voltage	Byte 0–3
		dc_current	Current	Byte 4–7

PDO Name	COB ID (Hex)	Data Mapping	Description	Byte Allocation
RPD03	0x400 + CAN address	dc_power	Power	Byte 0–3
		dc_resistance	Resistance	Byte 4–7
RPD04	0x500 + CAN address	dc_volt_trigger	Triggered voltage	Byte 0–3
		dc_curr_trigger	Triggered current	Byte 4–7

Software Protection Failure Information

Bit	Bit Name	Decimal Value	Definition
bit 0	ov	1	Over-voltage protection
bit 1	oc_high	2	Over-current protection
bit 2	Not Used	4	0 is returned.
bit 3	op_high	8	Over-power protection
bit 4	Not Used	16	0 is returned.
bit 5	uc	32	Under-current protection
bit 6	uv	64	Under-voltage protection
bit 7	ot	128	Over-temperature protection
bit 8	sense	256	Sense error
bit 9	Not Used	512	0 is returned.
bit 10	Not Used	1024	0 is returned.
bit 11	fiber_multiple_primary	2048	Multiple primary unit detected
bit 12	fiber_ext_unlock	4096	Fiber not locked (multi-panel parallel)
bit 13	fiber_inner_unlock	8192	Fiber not locked (single-panel parallel)
bit 14	model_check_fail	16384	Module check error
bit 15	ecp	32768	Uneven current protection
bit 16	hardware	65536	Hardware protection
bit 17	power_fail	131072	Mainframe power failure protection
bit 18	inhibit_latch	262144	Output inhibited (latch mode)
bit 19	inhibit_living	524288	Output inhibited (living mode)
bit 20	Not Used	1048576	0 is returned.
bit 21	secondary_power_fail	2097152	Secondary unit power failure protection

Digital I/O Configuration Information

Bit	Bit 0	Bit 2 – Bit 1	Bit 3	Bit 4	Bit 31-Bit 5
Bit Name	Invert Status	special_func	output_status	input_status	no_use
System: io_port1	0: Not invert 1: Invert	0: DIO 1: DINPut 2: PSCLear	0: High 1: Low	0: True 1: False	Not Used
System: io_port2		0: DIO 1: DINPut 2: PSSTate			
System: io_port3		0: DIO 1: DINPut 2: OFFState			
System: io_port4		0: DIO 1: DINPut 2: TOUTput 3: TINPut			
System: io_port5		0: DIO 1: DINPut 2: INHibit			
System: io_port6		0: DIO 1: DINPut 2: ONCouple			
System: io_port7		0: DIO 1: DINPut 2: OFFCouple			

Appendix A
Contactor Installation

Contactor Installation

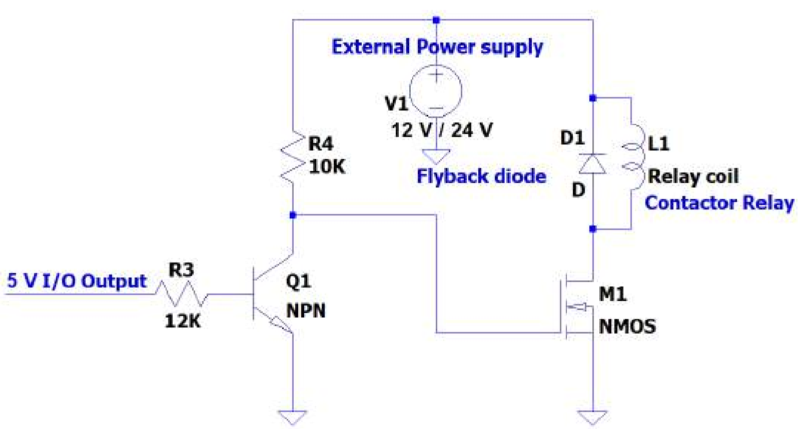
Choosing the right contactor

During connection, it is recommended to use a safety-certified (For example, UL, CSA, and etc) contactor to isolate the energized supply (e.g., battery) from the RPS. Ensure the contactor has the correct voltage and current rating that is higher than the rated RPS voltage and current. See example below:

- For a 80 V RP5913A, use a contactor with rating 100 V and above.
- For a 120 A RP5933A, use a contactor with rating 150 A and above.
- For relay coil, use a preferred voltage, 12 V or 24 V.

To control the contactor, auxiliary circuit must be included in the system. The auxiliary's function is to translate the I/O output of 5 V/1 mA to control the contactor relay voltage of 12 V or 24 V. See below for an example of auxiliary circuit.

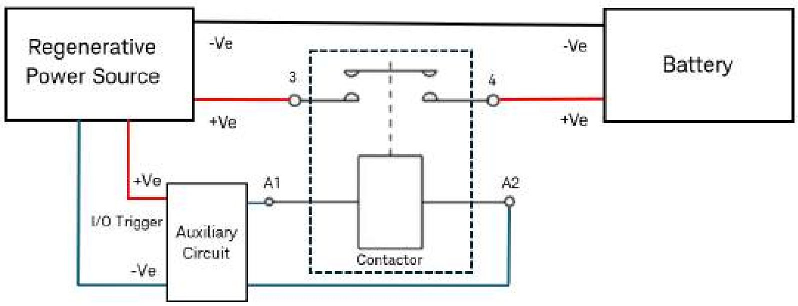
Example of an auxiliary circuit



Installing the contactor

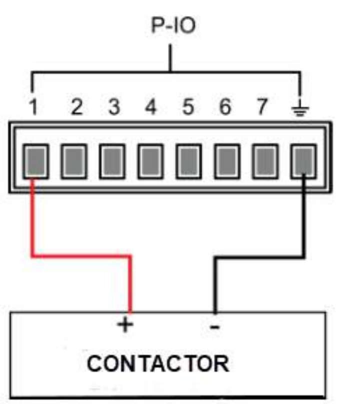
NOTE

The RP5900 Series's I/O interface is only for signal output as the current only provides ≤ 1 mA. Therefore, external auxiliary circuit is necessary to trigger the contactor's relay coil.



1. Connect the control wires from unit's digital I/O interface to the contactor's coil terminals (A1 and A2).
2. Connect the output terminals of the unit to the power terminals of the contactor.
3. Connect the load to the output terminal of the contactor.
4. Test the connection. Energize the contactor and ensure it operates correctly by closing and opening the relay as intended. For detailed instruction, see Controlling the contactor.

In this example, the relay of the contactor is connected to pin 1 of the P-IO interface.



Controlling the contactor (external relay) using Digital I/O

The below specifies the specification of the RP5900 Series I/O signal level.

	Output Signal	
	High level	Low level
Voltage	5 V	0 V
Current	≤ 1 mA	0.5 mA

When connected to the RP5900 Series, the relays of the contactor automatically open and close along with the output state of the unit.

The following steps demonstrate how to control the opening and closing of the relay using the Digital I/O menu.

1. Press **Menu** > **System** > **DigPort** access the Digital I/O menu.
2. Select the output pin. In this case, use the arrow keys to select **Pin1**. Press **Enter** .
3. Select **Invert** . Use the arrow key to select **On** or **Off**. **Invert On** indicates the output signal is reversed. Press **[Enter]** to confirm your selection.
4. Select **Function** > **DIO**. Press **[Enter]** and set the output to **True** or **False**. Press **[Enter]** to confirm your selection.
   - When the status is True , there is a 5 V voltage between pin 1 of the I/O and ground (GND)
   - When the status is False, there is a 0.3 V voltage between pin 1 of the I/O and ground (GND)