Autoranging DC Power Supplies

E36150 Series

This manual provides operating instructions for the Keysight E36150 Series Autoranging DC Power Supplies.

Always refer to the English version for latest edition.

KEYSIGHT

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Safety Information

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.

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.

Safety and Regulatory Information

Safety Considerations

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

WARNING BEFORE APPLYING POWER
– Verify that the correct fuse is installed. See Fuse Information for additional details.
– Ensure the mains supply voltage fluctuation do not exceed ±10% of the nominal supply voltage.

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 cover 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. 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).

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE OR WET ENVIRONMENTS
Do not operate the device around flammable gases or fumes, vapor, or wet environments.

DO NOT OPERATE DAMAGED OR DEFECTIVE INSTRUMENTS
Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT
Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Keysight Technologies Sales and Service Office for service and repair to ensure that safety features are maintained. To contact Keysight for sales and technical support, refer to the support links on the following Keysight website: www.keysight.com/find/assist (worldwide contact information for repair and service).

USE THE POWER CORD PROVIDED
Use the device with the power cord provided with the shipment.

USE THE DEVICE AS SPECIFIED
 If the device is used in a manner not specified by manufacturer, the device protection may be impaired.

DO NOT BLOCK VENTILATION HOLES
Do not block the rear ventilation hole and keep at least 130 mm free space from the rear panel.

OBSERVE ALL DEVICE MARKINGS BEFORE CONNECTING TO DEVICE
Observe all markings on the device before connecting any wiring to the device.

TURN DEVICE OFF BEFORE CONNECTING TO OUTPUT TERMINALS
Turn off the device power before connecting to the output terminals.

WARNING ENSURE THE DETACHABLE FRONT PANEL BINDING POST IS FIRMLY SCREWED
Ensure the detachable front panel binding post is firmly screwed to the output terminal. This binding post comes together with the instrument and is connected to the output terminal.

DO NOT REMOVE REAR OUTPUT TERMINAL COVER
- Do not remove the rear output terminal cover as it acts as safety cover to the output terminal.
- Output terminal connection must be performed with the presence of the output terminal cover.

ENSURE COVER IS SECURED IN PLACE
Do not operate the device with the cover removed or loosened.

TURN DEVICE OFF AND REMOVE ALL CONNECTIONS BEFORE INSTALLING THE GPIB INTERFACE
Turn off the power and remove all connections, including the power cord, from the instrument prior installation of the GPIB interface.

ENSURE PROPER AWG CABLE IS USED
Use a cable with the correct voltage and AWG rating based on the intended setup when operating the E36150 Series autoranging DC power supplies.

DO NOT TOUCH CABLES DURING OPERATION
Do not touch the cable while the instrument output is operational to prevent electric shock hazard and burn hazard.

DO NOT CONNECT FRONT AND REAR OUTPUT TERMINAL CONCURRENTLY
Do not connect the front and rear output terminal concurrently for the same output channel. Failing to observe the connection requirement could potentially raise a fire hazard if the output current exceeding 80 A.

LETHAL VOLTAGES AND CURRENTS
- SHOCK HAZARD. Floating voltage must not exceed 240 V_{DC}. The total voltage on the output terminal and the floating voltage must not be more than 240 V_{DC} from chassis ground.
- The output terminal is designed for DC application. Ensure that transient voltages do not exceed 90 V_{PK}.
- The connector screw terminals will be at hazardous potential when in operation.
- Personal injury on contact may result if these terminals are touched when equipment is in operation.
- To avoid injuries, always disconnect power, discharge circuits, and remove external voltage sources before any installation.
- Installation procedures must be performed by a qualified and trained personnel on this equipment.

CLEANING
To prevent electric shock, unplug the unit before cleaning.

COIN BATTERY REPLACEMENT
- Be sure to use battery (KPN 1420-0942) for the coin battery replacement.
- Incorrect battery type and battery polarity used during the battery replacement can cause damage to the instrument.
- Refer to *E36150 Service Guide* for coin battery replacement procedures. Battery replacement must be made only by qualified service personnel.

CAUTION CLEAN WITH DRY CLOTH

Clean the outside of the instrument with a soft, lint-free, dry cloth. Do not use detergent, volatile liquids, or chemical solvents.

Safety Symbols

Symbol	Description
⚠	Caution, risk of danger (refer to the manual for specific Warning or Caution information)
⚡	Caution, risk of electric shock
⏚	Protective earth (ground) terminal.
⏚	Earth ground
⏚	Frame or chassis (ground) terminal.
⏻	Standby supply. The instrument is not completely disconnected from AC mains when switch is off.
∼	Alternating current (AC).
+	Plus, positive polarity.
—	Minus, negative polarity.
WARNING	The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.
CAUTION	The CAUTION sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond CAUTION sign until the indicated conditions are fully understood and met.
NOTE	The NOTE sign denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

Regulatory Markings

Symbol	Description
	The RCM mark is a registered trademark of the Australian Communications and Media Authority.
CE CAN ICES/NMB-001(A) ISM GRP 1-A	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(A) 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-A indicates that this is an Industrial Scientific and Medical Group 1 Class A product.
UK CA	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)
40	This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.
KC	This symbol is a South Korean Class A EMC Declaration. This is a Class A instrument suitable for professional use and in electromagnetic environment outside of the home.
CSA® C US	The CSA mark is a registered trademark of the Canadian Standards Association.

South Korean Class A EMC declaration:

Information to the user:

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 environment.

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

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Safety and EMC Requirements

CAUTION   This power supply is designed to comply with the following safety and EMC (Electromagnetic Compatibility) requirements:
- Low Voltage Directive
- EMC Directive

Environmental Conditions

CAUTION

The E36150 Series is designed for indoor use and in an area with low condensation. The table below shows the general environmental requirements for this instrument.

Environmental condition	Requirement
Temperature	Operating condition: 0 °C to 40 °C Storage condition: –20 °C to 70 °C
Humidity	Operating condition: Up to 80% RH at 40 °C (non-condensing) Storage condition: Up to 90% RH at 65 °C (non-condensing)
Altitude	Up to 2000 m
Pollution degree	2
Installation category	II (for AC input)
Mains voltage (rms)	100, 115, or 230 V input (±10%)
Mains frequency	50/60 Hz

1 Getting Started

Product Introduction

Prepare Instrument for Use

Fuse Information

Programming Ranges

Installation

Remote Interface Configuration

Remote Control

Using the Built-in Help System

Firmware Update

License for Optional Features

Front Panel Menu Reference

This chapter gets you started with the E36150 Series autoranging DC power supplies.

Product Introduction

Features at a Glance

The Keysight E36150 Series Autoranging DC Bench Power Supply consists of the following models:

– E36154A Autoranging DC Power Supply 30 V, 80 A, 800 W

– E36155A Autoranging DC Power Supply 60 V, 40 A, 800 W

All models include:

Plenty of usable power

– Autoranging

– Peak power handling up to 3X maximum power rating

Safe, clean and reliable power

– Low output ripple and noise

– Excellent line/load regulation

– 2-wire or 4-wire remote sense

– Detachable high current front binding post

– Over voltage, over current, and over temperature protection

Convenient benchtop capabilities and intuitive interfaces

– Thermal-control fan speed for minimal acoustic noise

– 4-wire front output terminal - with sense and ground connection

– 4.3-inch LCD color display

– Individual knobs for voltage and current

– LAN/LXI, USB, and GPIB (optional) interfaces

Advanced characterization

- – Built-in voltage and current measurements
- – Data logging
- – Output sequencing and syncing with digital I/O
- – LIST mode programming
- – Low range current measurement
- – Adjustable voltage slew rate
- – Scope view (optional)
- – Arbitrary (Arb) waveform generator (optional)

Application Software and Automation

- – BV0003B Pathwave BenchVue Power Supply
- – BV9201B Pathwave BenchVue Advanced Power Control and Analysis (optional)

Options

Options 0EM, 0E3, and 0E9 determine which power-line voltage is selected at the factory.

WARNING Ensure you order the proper instrument option for the mains power that will be used for the instrument.

Options	Description
0EM	115 VAC ± 10%, 50/60 Hz input voltage
0E3	230 VAC ± 10%, 50/60 Hz input voltage
0E9	100 VAC ± 10%, 50/60 Hz input voltage
SEC	NISPOM and file security
UK6	Commercial calibration with test results data
1A7	ISO 17025 calibration certificate with uncertainty

Upgradable options (available post-purchase)

Options	Description
E363GPBU	GPIB user installable interface module.
E36150ADVU	Advance features of scope view and AWG capabilities

Front panel at a glance

Item	Description
1	Information-packed, high contrast 4.3-inch LCD color display; easily viewable even from sharp angles
2	Voltage and Current knobs Set the output voltage and current. These knobs are active in Meter View, Scope View, Data Logger View, and Source Settings page.
3	Meter View, List Run/Stop, and Scope/Datalog keys – **[Meter View]** turns on the meter view – **[List Run/Stop]** runs or stops the Arb. This key is equivalent to Arb Run/Stop key as described in the manual. – **[Scope/Datalog]** toggles between Scope view and Data Logger view.
4	Navigation keys. – Navigate through the control dialog windows; press **[Enter]** key to select a control.
5	Numeric keypad – Enters numeric values. Press **[Enter]** key to complete the entry. – Deletes the values entered into the dialog using the back key.
6	Output On key Turns the output On or Off; output is on when the key is lit.
7	Output terminals
8	On/Standby key and LED indicator Turns on the instrument. If the LED is amber, the instrument is in standby mode with AC inlet power connected, and if it is green, the instrument is on.
9	Sense terminals
10	Earth ground reference
11	Softkeys Accesses the soft front panel menu.
12	USB port Allows an external USB drive to be connected to the instrument. NOTE: The USB cable is not recommended to be longer than 3 meters.

Rear panel at a glance
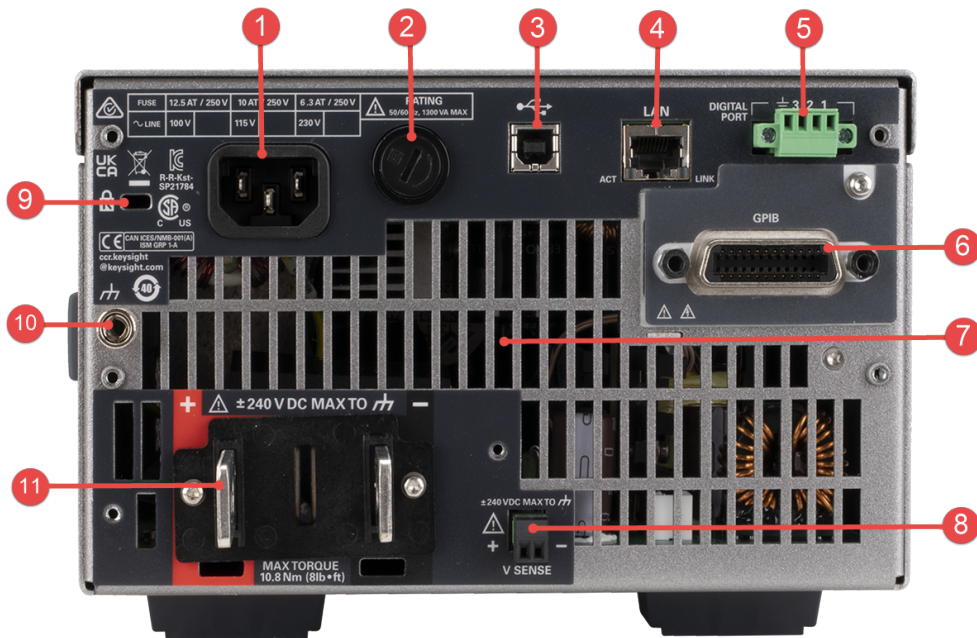
Item	Description
1	AC inlet
2	AC fuse-holder assembly
3	USB port
4	LAN port
5	Digital I/O terminal port
6	GPIB port (Option E363GPBU only)
7	Fan ventilation hole
8	Sense terminals
9	Kensington security slot
10	Earth ground reference
11	Output terminals NOTE: When you received the unit, the rear output terminal is covered with safety cover as illustrated below.

Meter view

The power supply's front panel features a high contrast 4.3-inch LCD color display. Press [**Meter View**].

Item	Description
1	**Remote sense status** 2wire or 4wire indicates that 2-wire or 4-wire sensing measurement is in use.
2	**Preferred mode status** Volt or Curr indicates the preferred mode for output on or output off transitions.
3	**Current range indicator** Displays the current range indicator. This indicator will only show when low current range is selected.
4	**Output status** **OFF**: The output is off **CV**: The output is in constant voltage mode **CC**: The output is in constant current mode **CCN**: The output is limited by negative constant current. **UR**: The output is unregulated **OV**: Over-voltage protection is tripped **OC**: Over-current protection is tripped **OT**: Over-temperature protection is tripped **+IPK**: The output is protected by positive peak current **-IPK**: The output is protected by negative peak current
5	**Instrument/Interface status** : The instrument is connected to USB. : The instrument is connected to LAN. (blinking): The instrument is under identification mode via remote interface. : The instrument is not connected to LAN. (blinking): The LAN connection is at fault. **ARB**: Arb is running. **!ERR**: An error has occurred (press **Utilities** > **Error** to view the Error Log).
6	**Ratings and protection** Displays the present over-voltage protection (OVP) setting.
7	**Output delay** Displays the OCP, Output On, and Output Off delay status/values.
8	**Voltage slew** Displays the rising slew and falling voltage slew rate.
9	**Soft front panel menu**

Item	Description
10	Output settings Displays the present output voltage and current settings. Use the numeric keypad or turn the front panel voltage or current knob to adjust these settings.
11	Output meters Displays the actual output voltage and current. Displays power in single output view.

Data logger view

Press **Data Logger** from the soft front panel menu.

Alternatively, press **[Scope/Datalog]**. This key toggles between Data Logger view and Scope view (if Option E36150ADVU is enabled).
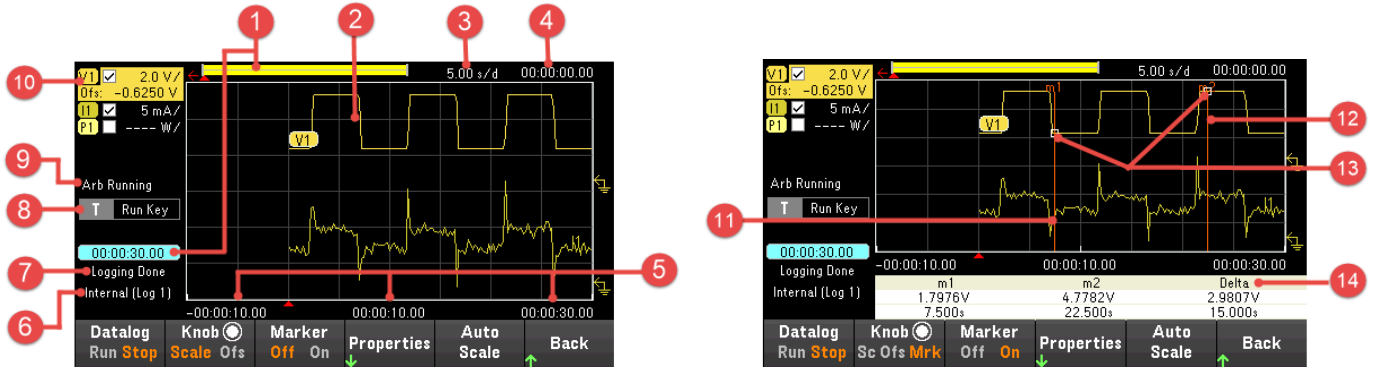
Item	Description
1	**Data bar and time elapsed** Displays the progress of the data logger. The yellow bar indicates the visible data. Numbers to the left indicate time elapsed/total duration.
2	**Data traces** Voltage, current, or power traces. Voltage and current traces (V1 and I1) are shown. Press **Auto Scale** to auto scale all traces.
3	**Time/Div** Indicates the horizontal time-base setting.
4	**Offset time** Indicates the time that the right gridline is offset or away from the end of the data log.
5	**Grid time** Displays the time on the gridline.
6	**Filename** Indicates the file to which the data is being logged.
7	**Status** Indicates whether the Data Logger is logging data, done logging, or is empty.
8	**Trigger Source** Indicates the trigger source for the data logger.
9	**Arb status** Indicates the Arb is running. No indicator when Arb is idle.
10	**Trace controls** Identifies the voltage or current trace that will be displayed. Dashes (----) indicate that the specified trace is turned off. Select the trace and press **[Enter]** to turn it on or off.
11	**m1 marker** Measurement Marker 1 enabled. This can be adjusted using the Vertical knob after pressing **Knob Mrk**.
12	**m2 marker** Measurement Marker 2 enabled. This can be adjusted using the Horizontal knob after pressing **Knob Mrk**.

Item	Description	
13	Intersect point Shows where the measurement markers intersect the waveform.	
14	Measurements Shows the calculations of the waveform data between Marker 1 and Marker 2.	

Scope view (Option E36150ADVU)

Press [**Scope/Datalog**]. This key toggles between Data Logger view and Scope view.
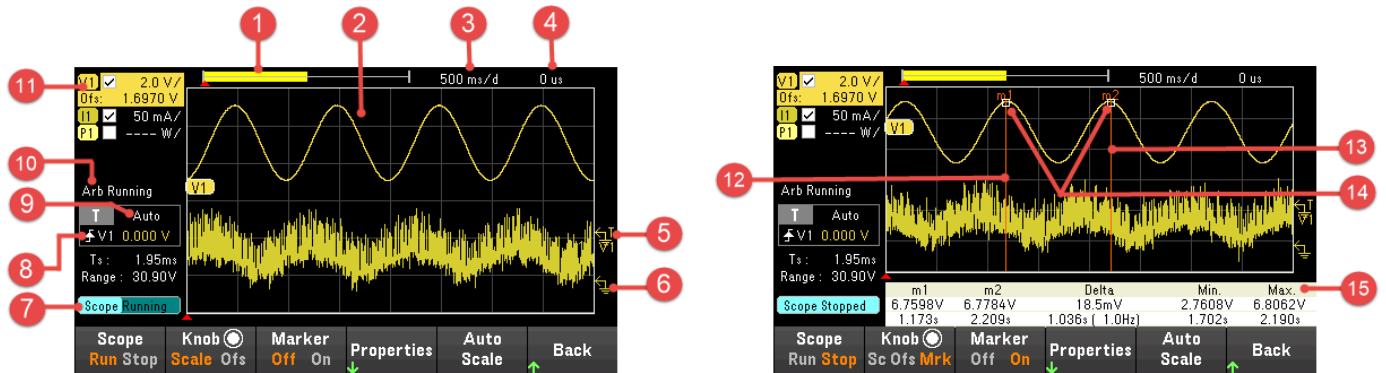
Item	Description
1	Data bar The highlighted area shows how much of the entire measurement is actually shown on the display.
2	Scope traces Voltage, current, or power traces. Voltage and current traces (V1 and I1) are shown. Press **Auto Scale** to auto scale all traces.
3	Time/Div Indicates the horizontal time-base setting. This can be adjusted using the Horizontal knob after pressing **Knob Scale**.
4	Offset time Indicates the time from the trigger point indicator to the horizontal reference. Negative values indicate horizontal reference is to the left of the trigger point. Positive values indicate the horizontal reference is to the right of the trigger point.
5	Trigger level Identifies the trigger level through which the waveform must pass before the scope will trigger.
6	Ground Identifies the ground reference level for the trace. The initial vertical offset of each trace is set to a different level to prevent the traces from overlapping.
7	Scope status Indicates whether the scope is idle, running, or waiting for a trigger.
8	Trigger source Identifies the trigger source and trigger level. V1 indicates a voltage level on output 1 is the trigger source.
9	Trigger mode Identifies the trigger mode setting. This can be selected by pressing **Properties** > **Settings**.
10	Arb status Indicates the Arb is running. No indicator when Arb is idle.
11	Trace controls Identifies the voltage, current, or power trace that will be displayed. Dashes (----) indicate that the specified trace is turned off. Select the trace and press [**Enter**] to turn it on or off.
12	m1 marker Measurement Marker 1 enabled. This can be adjusted using the Vertical knob after pressing **Knob Mrk**.
13	m2 marker Measurement Marker 2 enabled. This can be adjusted using the Horizontal knob after pressing **Knob Mrk**.

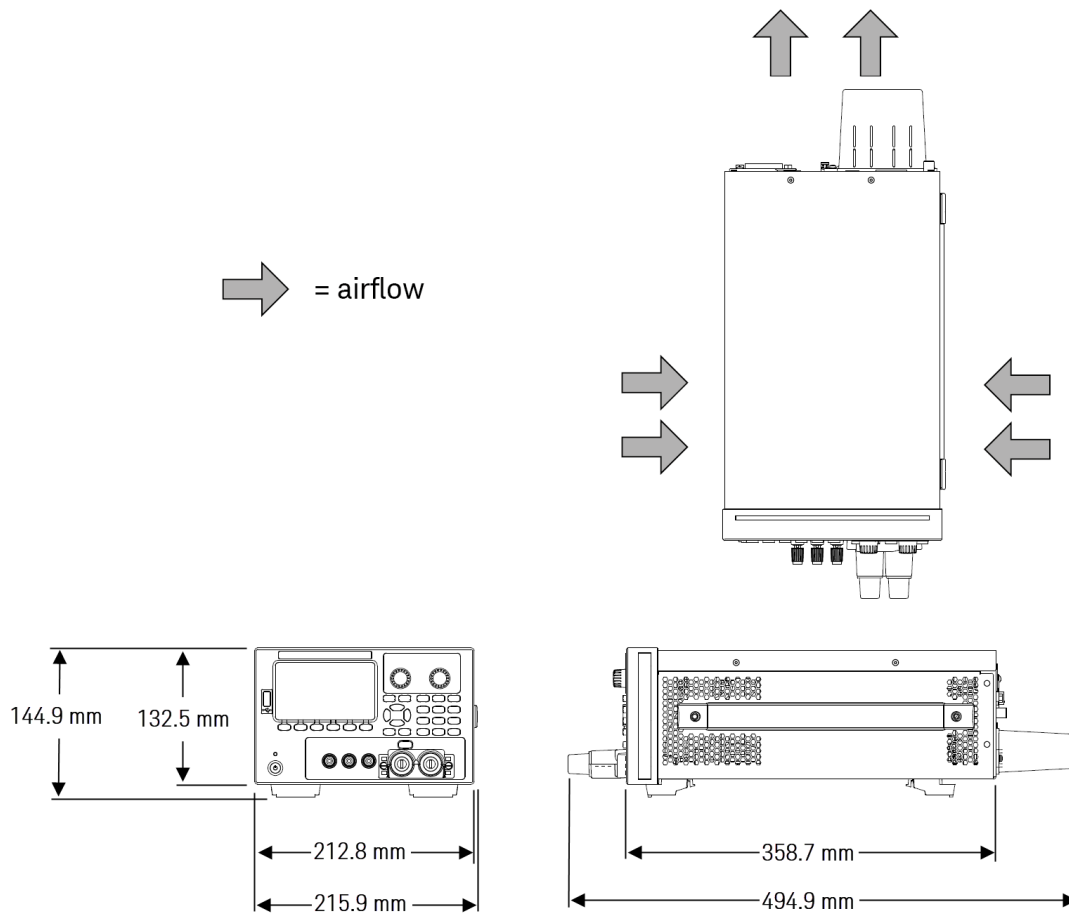| Item	Description
14	Intersect point Shows where the measurement markers intersect the waveform.
15	Measurements Shows the calculations of the waveform data between Marker 1 and Marker 2.

Dimension diagram

= airflow

144.9 mm   132.5 mm

←— 212.8 mm —→

←—— 215.9 mm ——→

←——— 358.7 mm ———→

←———— 494.9 mm ————→

Setup the instrument

Place the instrument's feet on a flat, smooth horizontal surface. Connect output to the front panel or connect output and sense leads to the rear panel, being careful not to short the leads together. Attach the power cable to the rear panel, then plug it into main power. Connect LAN, USB, or GPIB cables as desired, and you may also secure the instrument with a security lock cable.

Before disconnecting cables and cords from the instrument, turn the instrument off using the front-panel **[On/Standby]** key and disconnect from the supply source by unplugging the detachable power cord.

Prepare Instrument for Use

Initial inspection

When you receive your power supply, 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 power supply, save the shipping carton and packing materials in case the unit has to be returned. Check the list under **Standard Shipped Items** and verify that you have received these items with your instrument. If anything is missing, please contact your nearest Keysight Sales and Support Office.

Standard shipped items

- Keysight E36154A/E36155A autoranging DC power supply
- AC power cord
- Certificate of calibration
- One 10 A, 3.5 mm female 4-pin terminal connector (P/N: 0360-3139)
- One 8 A, 3.5 mm female 2-pin terminal connector (P/N: 0360-3191)
- One 80 A detachable binding post assembly (P/N: E36154-60003)

Documentation and firmware revisions

The Keysight E36150 Series documentation listed below can be downloaded for free through our website at www.keysight.com/find/e36150manuals.

- Keysight E36150 Series Autoranging DC Power Supplies User's Guide. This manual.
- Keysight E36150 Series Autoranging DC Power Supplies Programming Guide.
- Keysight E36150 Series Autoranging DC Power Supplies Service Guide.

For the latest firmware revision and firmware update instruction, go to www.keysight.com/find/e36150firmware.

Recommended calibration interval

Keysight Technologies recommends a one-year calibration cycle for the E36150 Series autoranging DC power supplies.

Fuse Information

BEFORE APPLYING POWER
– Verify that the correct fuse is installed.
– Ensure the mains supply voltage fluctuation do not exceed ±10% of the nominal supply voltage.

The following table describes the fuse that you should use.

Option	Fuse part number	Description	Fuse type	Application
E36154A-0E3 E36155A-0E3	2110-0623	Fuse 6.3 A, 250 V, 5 x 20 mm Time Delay	Cartridge	230 V line voltage
E36154A-0EM E36155A-0EM	2110-0624	Fuse 10 A, 250 V, 5 x 20 mm Time Delay	Cartridge	115 V line voltage
E36154A-0E9 E36155A-0E9	2110-1747	Fuse 12.5 A, 250 V, 5 x 20 mm Time Delay	Cartridge	100 V line voltage

To configure the correct fuse, follow the three steps shown below:
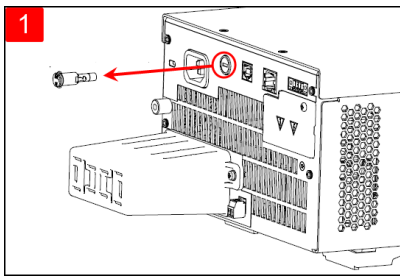
Locate the fuse holder as shown in the image above, and pull the fuse holder out of the power supply.
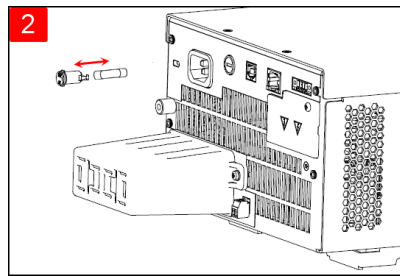
Remove the blown fuse and insert the proper replacement fuse into the fuse holder.
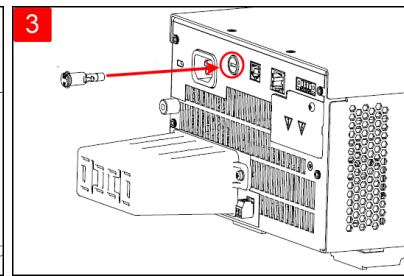
Re-insert the fuse holder into the power supply.

Programming Ranges

The following table shows the output ranges (voltage and current) and its default value that can be programmed for each model. DEFault voltage is always 0 V.

| NOTE | The allowable settings for both current and voltage are from minimum to maximum value. |

Output		E36154A	E36155A
Current	MAXimum	82.4 A	41.2 A
	MINimum	8 mA	4 mA
	DEFault (*RST)	8 A	4 A
Voltage	MAXimum	30.9 V	61.8 V
	MINimum	0 V	0 V
	DEFault (*RST)	0 V	0 V

Installation

Connecting the power cord

WARNING	FIRE HAZARD Use only the power cord that was supplied with your instrument. Using other types of power cords may cause overheating of the power cord, resulting in fire and electric shock hazard.
	SHOCK HAZARD The power cord provides a chassis ground through a third conductor. Be certain that your power outlet is of the three-conductor type with the correct pin connected to earth ground.

Connect the power cord to the AC inlet connector on the rear of the unit. If the wrong power cord was shipped with your unit, contact your nearest Keysight Sales and Support Office.
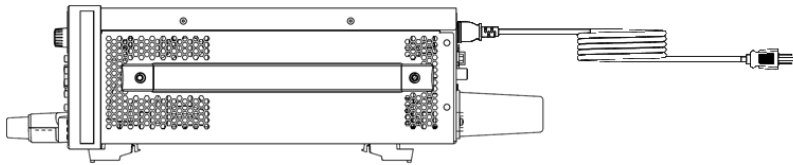
Removing the power cord will disconnect AC input power to the unit.

Connecting the outputs

NOTE	All loads should either be connected to the front panel binding post or rear panel output.

WARNING	**TURN DEVICE OFF BEFORE CONNECTING TO OUTPUT TERMINALS** Turn off the device power before connecting to the output terminals.

LETHAL VOLTAGES AND CURRENTS
- SHOCK HAZARD. Floating voltage must not exceed 240 V_{DC}. The total voltage on the output terminal and the floating voltage must not be more than 240 V_{DC} from chassis ground.
- The output terminal is designed for DC application. Ensure that transient voltages do not exceed 90 V_{PK}.
- The connector screw terminals will be at hazardous potential when in operation.
- Personal injury on contact may result if these terminals are touched when equipment is in operation.
- To avoid injuries, always disconnect power, discharge circuits, and remove external voltage sources before any installation.
- Installation procedures must be performed by a qualified and trained personnel on this equipment.

DO NOT TOUCH CABLES DURING OPERATION
Do not touch the cable while the instrument output is operational to prevent electric shock hazard and burn hazard.

DO NOT CONNECT FRONT AND REAR OUTPUT TERMINAL CONCURRENTLY
Do not connect the front and rear output terminal concurrently for the same output channel. Failing to observe the connection requirement could potentially raise a fire hazard if the output current exceeding 80 A.

ENSURE PROPER AWG CABLE IS USED
Use a cable with the correct voltage and AWG rating based on the intended setup when operating the E36150 Series autoranging DC power supplies.

Binding posts

WARNING	SHOCK HAZARD Turn off AC power before connecting wires to the front panel. All wires and straps must be properly connected with the binding posts securely tightened. For any application where the output voltage exceed 60 VDC, ensure proper wire insulation to avoid electric shock hazard.

The E36150 Series power supply comes with high current detachable binding post (KPN E36154-81000) that provides you with a quick and safe DUT connections.

The front binding posts accept wires sizes up to AWG 6 in location (A).

Wire size AWG 6 is the recommended wire. If you are connecting more than one wire on each binding post, twist the wires to ensure a good contact and securely fasten all wires by hand-tightening the binding posts. If you are using a slotted screwdriver, tighten the binding post to 8 in-lb (90 N-cm) for a secure connection.

Maximum current rating:

(A) = 80 A
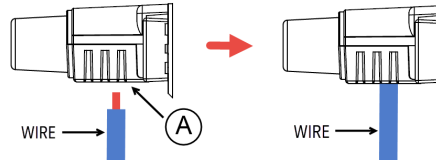
Once you have connect the wire, simply push and attach the binding post to the front panel, as shown below.

Front view   **Side view**
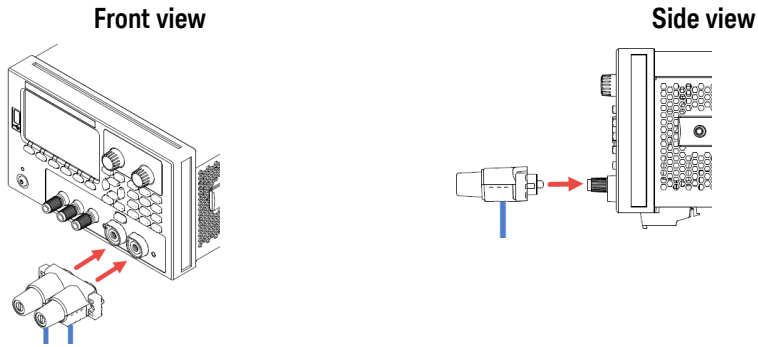
| NOTE | Fasten the two screws at both side of the binding post (see below) to secure binding post to the front panel. Recommended torque 9 lb-in (1 N-m). |

Screws

Rear outputs connections

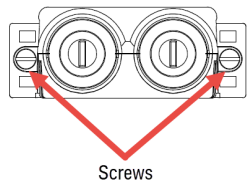| **WARNING**	SHOCK HAZARD Turn off AC power before connecting wires to the rear panel. All wires and straps must be properly connected with the terminal block screws securely tightened.
	DO NOT REMOVE REAR OUTPUT TERMINAL COVER - Do not remove the rear output terminal cover as it acts as safety cover to the output terminal. - Output terminal connection must be performed with the presence of the output terminal cover.
	ENSURE COVER IS SECURED IN PLACE Do not operate the device with the cover removed or loosened.
CAUTION	Tightening torque cannot exceed 95 lb-in (10.8 N-m).

The rear panel connector is rated 80 A and accepts wires sizes from AWG 14 to AWG 4. Wire sizes smaller than AWG 14 are not recommended. Connect the load wires to the + and - terminals.

1. As shown in the following figure, terminate all load wires with wire terminal lugs securely attached. DO NOT use unterminated wires for load connections at the power supply.

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. Attach the wire terminals to the inside of the bus bars to ensure enough space for installing the shield. Twist or bundle the load wires to reduce lead inductance and noise pickup. The goal is to always minimize the loop area or physical space between the + and - output leads from the power supply to the load.

4. Attach the safety cover to the rear panel. Note that heavy wiring cables must have some form of strain relief to prevent bending the safety cover or bus bars.

Keysight E36150 Series User's Guide
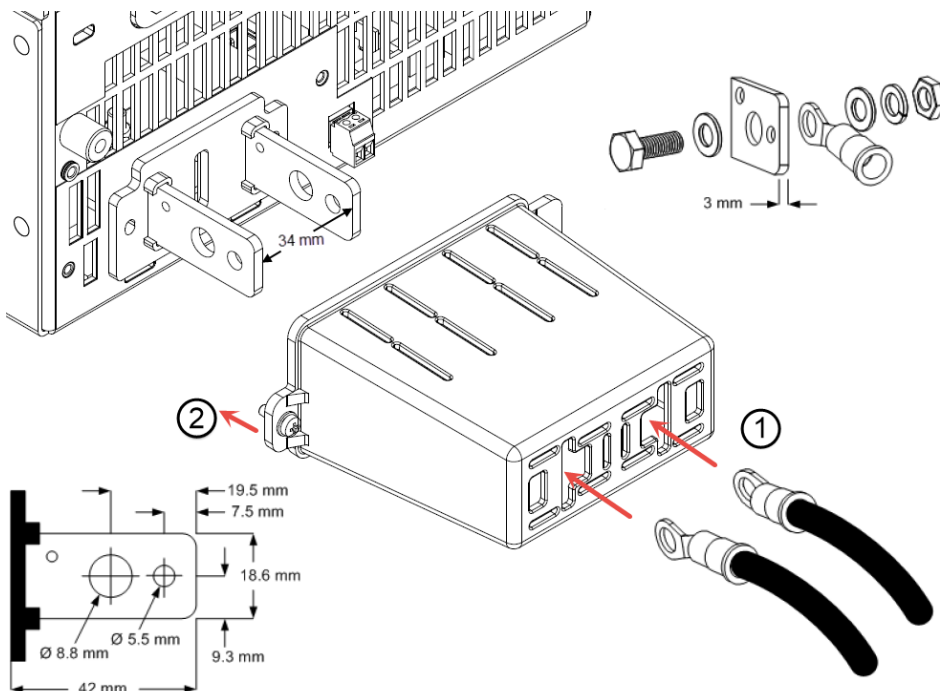
Wire sizing

> **WARNING** FIRE HAZARD
> Select a wire size large enough to carry short-circuit current without overheating (refer to the following table). To satisfy safety requirements, load wires must be heavy enough not to overheat while carrying the short-cir- cuit output current of the unit.

AWG	Ampacity [1] (A)	Resistance [2] (Ω/m)
14	25	0.0103
12	30	0.0065
10	40	0.0041
8	60	0.0025
6	80	0.0016
4	105	0.0010
2	140	0.00064
1/0	195	0.00040
2/0	225	0.00032
3/0	260	0.00025
4/0	300	0.00020

Notes:

1. Ampacity is based on 30 °C ambient temperature with conductor rated at 60 °C. For ambient temperature other than 30 °C, multiply the above ampacities by the following constants:

Temperature (°C)	Constant
21 - 25	1.08
26 - 30	1.00
31 - 35	0.91
36 - 40	0.82
41 - 45	0.71
46- 50	0.58
51 - 55	0.41

2. Resistance is nominal at 75 °C wire temperature.

Output isolation

The outputs of the E36150 Series power supplies are isolated from earth ground. Any output terminal may be grounded, or an external voltage source may be connected between any terminal output and ground. However, output terminals must be kept within ±240 Vdc of ground. Any one of the terminals can be tied to ground as needed. An earth ground terminal is provided on the front panel for convenience.

WARNING	**SHOCK HAZARD.** Floating voltages must not exceed 240 Vdc. No output terminal may be more than 240 Vdc from chassis ground.
	The output terminal is designed for DC application. Ensure that transient voltages do not exceed 90 Vpk.
	Before making any external connection, ensure the equipment input supply is grounded to MAINS.

The figure below shows an example of floating a power supply to 200 V above ground. The power supply output is set to 40 V.
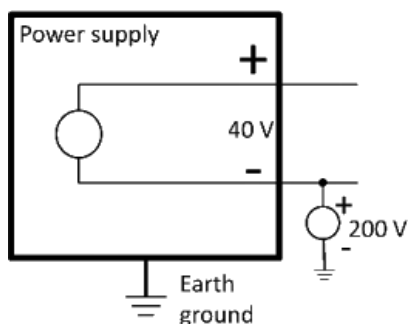
Example of negative terminal floating +200 V above ground (positive terminal is +240 V above ground)

You can see from this example that you have to take the power supply output voltage into consideration when ensuring you are not violating the float voltage rating. If you exceed the float voltage rating of the power supply, you are potentially exceeding the voltage rating of internal parts that could cause the internal parts to fail or break down and present a shock hazard, so do not violate the float voltage rating!

Multiple loads

When connecting multiple loads to the power supply, each load should be connected to the output terminals using separate connecting wires. This minimizes mutual coupling effects between loads and takes full advantage of the low output impedance of the power supply. Each pair of wires should be as short as possible and twisted or shielded to reduce lead inductance and noise pick-up. If a shield is used, connect one end to the power supply ground terminal and leave the other end disconnected.

If cabling considerations require the use of distribution terminals that are located remotely from the power supply, connect output terminals to the distribution terminals by a pair of twisted or shielded wires. Connect each load to the distribution terminals separately.
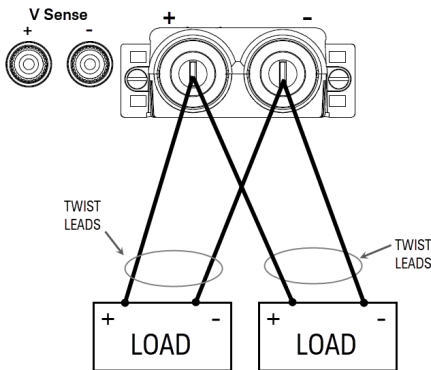
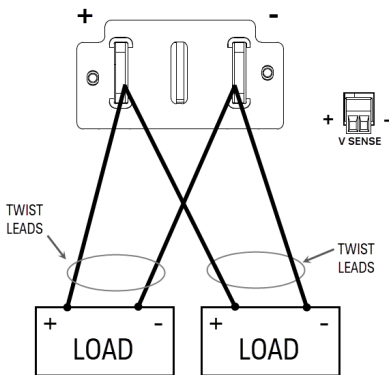| NOTE	For multiple load application, all loads should either be connected to the front panel binding post or rear panel output.

CAUTION	Turn off AC power before connecting loads to prevent currents from damaging the loads.

Front panel

Rear panel

4-wire sense connection

WARNING

SHOCK HAZARD
Turn off AC power before making rear panel connections. All wires and straps must be properly connected with the terminal block screws securely tightened.

TURN DEVICE OFF BEFORE CONNECTING TO OUTPUT TERMINALS
Turn off the device power before connecting to the output terminals.

LETHAL VOLTAGES AND CURRENTS
- SHOCK HAZARD. Floating voltage must not exceed 240 V_{DC}. The total voltage on the output terminal and the floating voltage must not be more than 240 V_{DC} from chassis ground.
- The output terminal is designed for DC application. Ensure that transient voltages do not exceed 90 V_{PK}.
- The connector screw terminals will be at hazardous potential when in operation.
- Personal injury on contact may result if these terminals are touched when equipment is in operation.
- To avoid injuries, always disconnect power, discharge circuits, and remove external voltage sources before any installation.
- Installation procedures must be performed by a qualified and trained personnel on this equipment.

DO NOT TOUCH CABLES DURING OPERATION
Do not touch the cable while the instrument output is operational to prevent electric shock hazard and burn hazard.

DO NOT CONNECT FRONT AND REAR OUTPUT TERMINAL CONCURRENTLY
Do not connect the front and rear output terminal concurrently for the same output channel. Failing to observe the
connection requirement could potentially raise a fire hazard if the output current exceeding 80 A.


ENSURE PROPER AWG CABLE IS USED
Use a cable with the correct voltage and AWG rating based on the intended setup when operating the E36150 Series autoranging DC power supplies.

The power supply 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 load rather than at the output terminals. This automatically compensates for the voltage drop in the load leads, which is especially useful for CV operation with load impedance that vary or have significant lead resistance. Because remote sensing is independent of other power supply functions, it can be used regardless of how the instrument is programmed. Remote sensing has no effect during CC operation.

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

Front panel

WITH 2-WIRE SENSE

WITH 4-WIRE SENSE

Rear panel

WITH 2-WIRE SENSE

WITH 4-WIRE SENSE
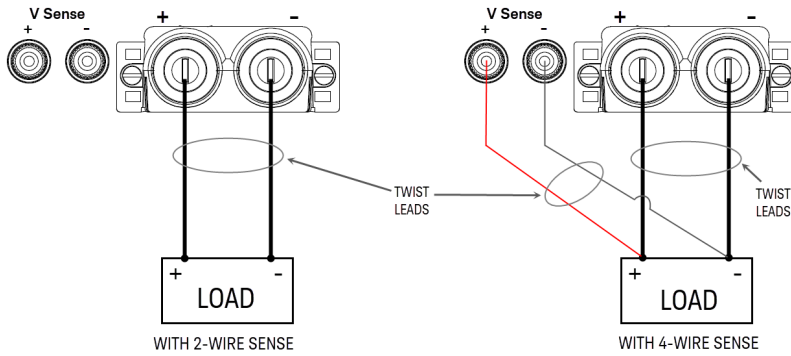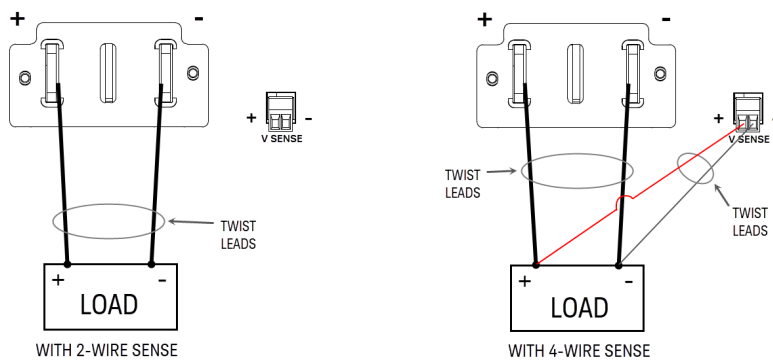
Connect the load to the output terminals using separate connecting wires. Keep the wire-pair as short as possible and twist or bundle it to reduce lead inductance and noise pickup. Keep the load leads under 14.7 meters (50 feet) per lead because of inductance effects.

Connect the sense leads as close to the load as possible. Do NOT bundle the sense wire-pair together with the load leads; keep the load wires and sense wires separate. The sense leads carry only a few milliamperes of current and can be a lighter gauge than the load leads. However, any voltage drop in the sense leads can degrade the voltage regulation of the instrument. Try to keep the sense lead resistance less than about 0.5 Ω per lead (this requires 20 AWG or heavier for a 50-foot length).

After turning the unit on, activate 4-wire remote voltage sensing by pressing **Source Settings** > **Sense 4w**. Refer to Specifying 2-Wire or 4-Wire Sense.

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 power supply includes protection resistors that reduce the effect of open sense leads during 4-wire-sensing. If the sense leads open during operation, the power supply returns to the local sensing mode, with the voltage at the output terminals approximately 5% higher than the programmed value.

Over-voltage protection considerations

You must take into account any voltage drop in the load leads when setting the over-voltage trip point. This is because the OVP circuit senses at the output terminals and not at the sense terminals. Due to the voltage drop in the load leads, the voltage sensed by the OVP circuit could be higher than the voltage being regulated at the load.

Output noise considerations

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 or use a ribbon cable 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.

Interface connections

GPIB connections

USB connections

LAN connections - site and private

Digital port connections

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

> **NOTE**   If you have not already done so, install the Keysight IO Libraries Suite, which can be found at www.keysight.com/find/iolib. 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 (optional)**

The following figure illustrates a typical GPIB interface system.

1. If you do not have a GPIB interface card installed on your computer, turn off your computer and install the GPIB card.

2. Connect your instrument to the GPIB interface card using a GPIB interface cable.

3. Use the Connection Expert utility of the Keysight IO Libraries Suite to configure the GPIB card's parameters.

4. The power supply is shipped with its GPIB address set to 5. Use the front panel menu if you need to change the GPIB address.

5. 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 connections

The following figure illustrates a typical USB interface system.

USB Cable

Connect to USB port on PC   Connect to USB port on instrument
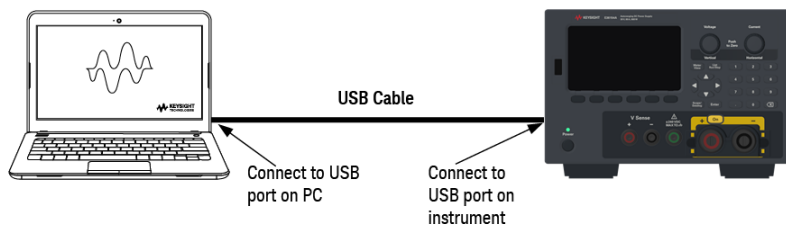
1. Connect your instrument to the USB port on your computer using a USB cable.

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. You can also view the instrument's VISA address from the front panel menu.

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.

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.

To Network Interface Card (NIC)   To Site LAN   To LAN Port
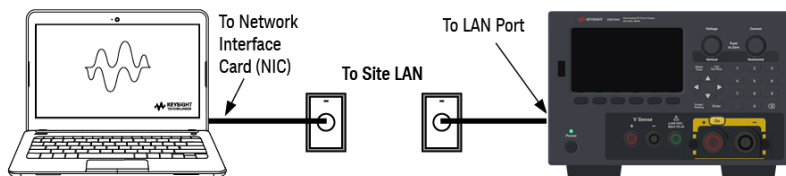
1. Connect the instrument to the site LAN or to your computer using a LAN cable. The as-shipped instrument LAN settings are configured to automatically obtain an IP address from the network using a DHCP server (DHCP is ON by default). The DHCP server will register the instrument's hostname with the dynamic DNS server. The hostname as well as the IP address can then be used to communicate with the instrument. The front panel **LAN** indicator will come on when the LAN port has been configured.

> **NOTE**   If you need to manually configure any instrument LAN settings, refer to Remote Interface Configuration for information about configuring the LAN settings from the front panel of the instrument.

2. Use the Connection Expert utility of the Keysight IO Libraries Suite to add the power supply 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 its hostname or IP address.

> **NOTE**   If this does not work, refer to "Troubleshooting Guidelines" in the Keysight Technologies USB/LAN/GPIB Interfaces Connectivity Guide included with the Keysight IO Libraries Suite.

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 Remote Control.

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.
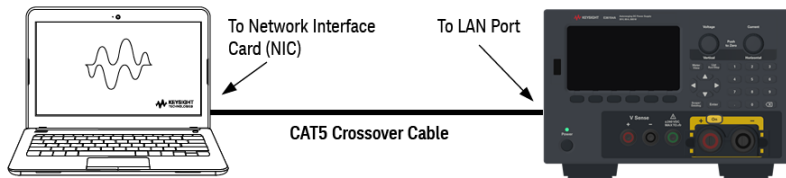
1. Connect the instrument to the computer using a LAN crossover cable. Alternatively, connect the computer and the instrument to a standalone hub or switch using regular LAN cables.

> **NOTE** Make sure your computer is configured to obtain its address from DHCP and that NetBIOS over TCP/IP is enabled. Note that if the computer had been connected to a site LAN, it may still retain previous network settings from the site LAN. Wait one minute after disconnecting it from the site LAN before connecting it to the private LAN. This allows Windows to sense that it is on a different network and restart the network configuration.

2. The factory-shipped instrument LAN settings are configured to automatically obtain an IP address from a site network using a DHCP server. You can leave these 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. Note that this may take up to one minute. The front panel LAN indicator will come on when the LAN port has been configured.

> **NOTE** Turning off DHCP reduces the time required to fully configure a network connection when the power supply is turned on. To manually configure the instrument LAN settings, refer to Remote Interface Configuration for information about configuring the LAN settings from the front panel of the instrument.

3. Use the Connection Expert utility of the Keysight IO Libraries Suite to add the power supply 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 its hostname or IP address.

> **NOTE** If this does not work, refer to "Troubleshooting Guidelines" in the Keysight Technologies USB/LAN/GPIB Interfaces Connectivity Guide included with the Keysight IO Libraries Suite.

4. 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 Remote Control.

Digital port connections

A 4-pin connector is provided on each instrument to access the three digital control port functions. The digital control connector accepts wire sizes from AWG 16 to AWG 22.

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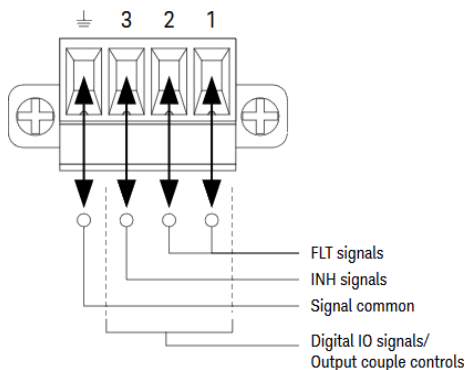
Pin functions

The following table describes the possible pin configuration for the digital port functions. For a complete description of the electrical characteristics of the digital I/O port, refer to the product data sheet.

Pin function	Available configurable pins
Digital I/O and Digital In	Pins 1 through 3
External Trigger In/Out	Pins 1 through 3
Fault Out	Pin 1 and Pin 2
Inhibit In	Pin 3
Output Coupling	Pins 1 through 3
Common	Pin 4

In addition to the configurable pin functions, the active signal polarity for each pin is also configurable. When Positive polarity is selected, a logical true signal is a voltage high at the pin. When Negative polarity is selected, a logical true signal is a voltage low at the pin.

For more information on configuring the digital port functions, refer to Using the Digital Control Port.

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.
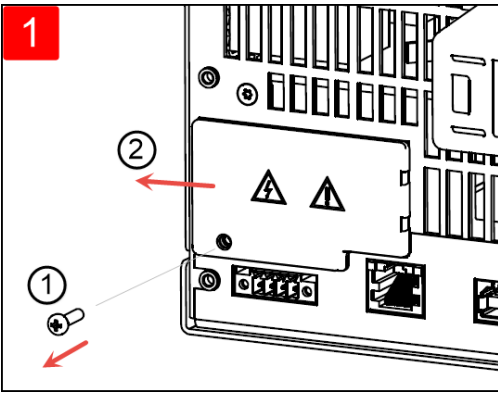
RETAIN COVER PLATE

After installing the GPIB option, 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 module or the cover plate.

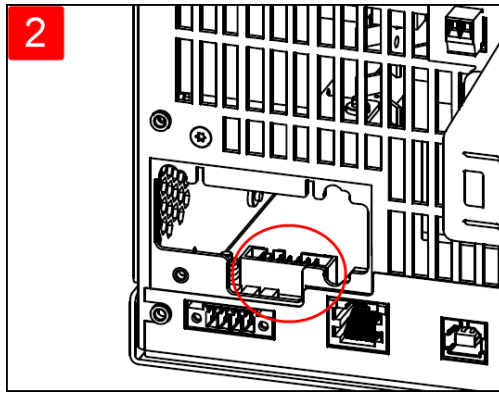The following tools are required.

– Phillips head screwdriver

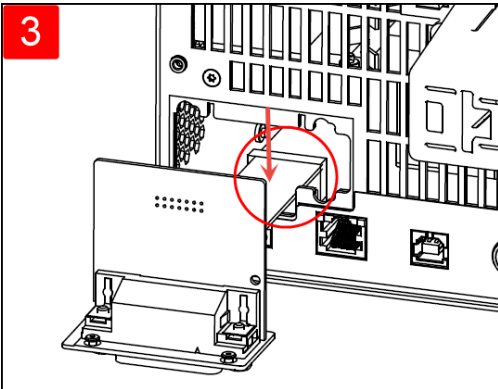Make sure you turn the power supply upside down before proceeding.

Use Phillips head screwdriver to remove the screw from the cover plate. Retain the screw for use later in this procedure.
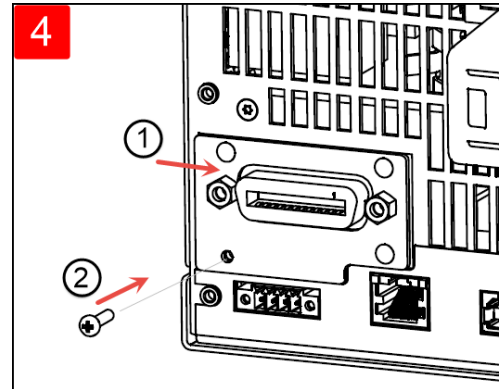
Then, remove the cover plate by sliding it to the left.

Locate the connector, just inside the unit, to connect the cable that is attached to the GPIB module.

Attach the cable to the connector located in the previous step.

Put the module into the unit and slide the GPIB board to the right so that it is flushed against the instrument's sheet metal. Use the screw that was removed earlier to secure the GPIB plate in place.

This concludes the GPIB installation procedure.

Rack mounting the instrument

| WARNING	DO NOT BLOCK VENTILATION HOLES Do not block the rear ventilation hole and keep at least 130 mm free space from the rear panel.
CAUTION	To prevent overheating, do not block airflow to or from the instrument. Allow enough clearance at the rear, sides, and bottom of the instrument to permit adequate internal air flow.
NOTE	Use the Rack Mount kit as stated below to rack mount the instrument. Installation instructions are provided with the rack mount kit.

The power supply can be mounted in a standard 19-inch rack cabinet. They are designed to fit in three rack-units (3U) of space.

Remove the feet before rack mounting the unit. Do not block the air intake and exhausts at the sides and rear of the unit.
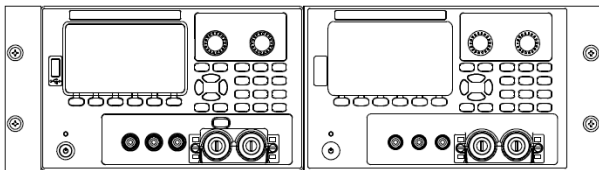
Rack mounting a single instrument

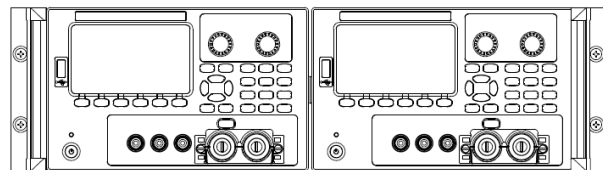To rack mount a single instrument, order adapter kit (1CM116A).
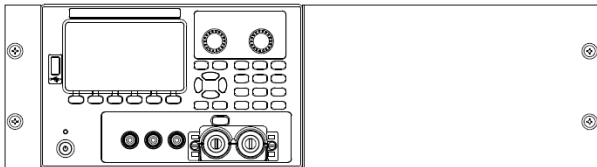
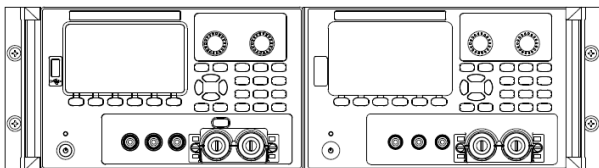**Rack mounting instruments side-by-side**

To rack mount two instruments side-by-side, order lock-link kit (5061-8769). Be sure to use the support rails in the rack cabinet.

Rackmount kit without handles (1CM104A)

Front handle kit (1CN107A)

Rackmount kit with handles (1CP108A)

Remote Interface Configuration

The instrument supports remote interface communication over three interfaces: USB, GPIB, and LAN.

- USB Interface: Use the rear-panel USB port to communicate with your PC.

- GPIB Interface: Set the instrument's GPIB address and connect to your PC using a GPIB cable.LAN Interface: By default, DHCP is on, which may enable communication over LAN. The acronym DHCP stands for Dynamic Host Configuration Protocol, a protocol for assigning dynamic IP addresses to networked devices. With dynamic addressing, a device can have a different IP address every time it connects to the network.

Keysight IO Libraries Suite

> **NOTE** Ensure that the Keysight IO Libraries Suite is installed before you proceed for the remote interface configuration.

Keysight IO Libraries Suite is a collection of free instrument control software that automatically discovers instruments and allows you to control instruments over LAN, USB, GPIB, RS-232, and other interfaces. For more information, or to download IO Libraries, go to www.keysight.com/find/iosuite.

GPIB configuration

> **NOTE** There are no SCPI commands to configure the GPIB parameter. All GPIB configuration must be done from the front panel.

Each device on the GPIB (IEEE-488) interface must have a unique whole number address between 0 and 30. The instrument ships with a default address of 5.

- This setting is non-volatile; it will not be changed by power cycling or *RST or SYSTem:PRESet.

- Your computer's GPIB interface card address must not conflict with any instrument on the interface bus.

1. Press **Utilities**> **I/O Config** > **GPIB** to access the GPIB window.

2. From this window, you can set the GPIB address using the numeric keys and press **[Enter]**.

3. Press **Back** to exit.

LAN configuration

The following sections describe the primary front panel LAN configuration functions on the front-panel menu.

NOTE	There are no SCPI commands to configure the LAN parameters. All LAN configuration must be done from the front panel.
	After changing the LAN settings, you must save the changes. Press Back once you have completed the changes. You will be prompted to press Yes to save the LAN setting or No to exit without saving. Press Yes cycles power to the instrument and activates the settings. LAN settings are nonvolatile, they will not be changed by power cycling or *RST. If you do not want to save your changes, press No to cancel all changes.

When shipped, DHCP is on, which may enable communication over LAN. The acronym 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.

Some LAN settings require you to cycle instrument power to activate them. The instrument briefly displays a message when this is the case, so watch the screen closely as you change LAN settings.

Viewing the LAN status

Press **Utilities**> **I/O Config** > **LAN Status** to view the LAN status.

The LAN status 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.

Restarting the LAN

Press **Utilities** > **I/O Config** > **LAN Status** > **LAN Restart** restarts the networking using ALL current LAN settings. LAN restart does not clear the Web interface password.

Resetting the LAN

Press **Utilities** > **I/O Config** > **LAN Settings** > **Set to Default** resets the LAN settings to their factory default values. All default LAN settings are listed under Non-volatile Settings in Programming Guide.

Press **Utilities** > **I/O Config** > **LAN Status** > **LAN Reset** resets the LAN using its current settings and enables DHCP and DNS. The **LAN Reset** softkey also clears any user-defined Web Interface password.

Modifying the LAN settings

As shipped from the factory, the instrument pre-configured settings should work in most LAN environments. Refer to Non-Volatile Settings in the Programming Guide for information on the factory-shipped LAN settings.

Press **Utilities**> **I/O Config** > **LAN Settings** to access the LAN Settings window. From this menu, you can manually configure the LAN settings.

DHCP

DHCP (Dynamic Host Configuration Protocol) can automatically assign a dynamic IP address to a LAN device. This is typically the easiest way to configure the instrument for LAN.

– This setting is non-volatile; it will not be changed by power cycling or *RST or SYSTem:PRESet.

1. Press **Utilities** > **I/O Config** > **LAN Settings** > **DHCP On** to use DHCP to automatically assign an IP address.

2. Press **Back**. You will be prompted by the below message.

3. Press **Yes** to save the setting.

4. Press **No** to cancel all the changes and exit without saving.

To manually set an IP address, Subnet Mask, or Default Gateway, press **DHCP Off**. Then, change the IP setup as described below.

IP Address

You can enter a static IP address for the instrument as a four-byte integer expressed in dot notation. Each byte is a decimal value, with no leading zeros (for example, 192.168.2.20).

– If DHCP is on, it attempts to assign an IP address to the instrument. If it fails, Auto-IP attempts to assign an IP address to the instrument.

– Contact your LAN administrator for details.

– This setting is non-volatile; it will not be changed by power cycling or *RST or SYSTem:PRESet.

1. Press **Utilities** > **I/O Config** > **LAN Settings** > **DHCP Off**.

2. Select IP Address field using the navigation keys. Set the desired IP address and press **Back**.

3. Press **Yes** to save the setting.

4. Press **No** to cancel all the changes and exit without saving.

Subnet Mask

Subnetting allows the LAN administrator to subdivide a network to simplify administration and minimize network traffic. The subnet mask indicates the portion of the host address used to indicate the subnet.

– Contact your LAN administrator for details.

– This setting is non-volatile; it will not be changed by power cycling or *RST or SYSTem:PRESet.

1. Press **Utilities** > **I/O Config** > **LAN Settings** > **DHCP Off**.

2. Select Subnet Mask field using the navigation keys. Set the desired subnet mask address and press **Back**. (Example: 255.255.0.0)

3. Press **Yes** to save the setting.

4. Press **No** to cancel all the changes and exit without saving.

Gateway

A gateway is a network device that connects networks. The default gateway setting is the IP address of such a device.

– You need not set a gateway address if using DHCP.

– Contact your LAN administrator for details.

– This setting is non-volatile; it will not be changed by power cycling or *RST or SYSTem:PRESet.

1. Press **Utilities** > **I/O Config** > **LAN Settings** > **DHCP Off**.

2. Select Gateway field using the navigation keys. Set the appropriate gateway address and press **Back**.

3. Press **Yes** to save the setting.

4. Press **No** to cancel all the changes and exit without saving.

DNS

DNS (Domain Name Service) is an Internet service that translates domain names into IP addresses. The DNS server address is the IP address of a server that performs this service.

– Normally, DHCP discovers DNS address information; you only need to change this if DHCP is unused or not functional. Contact your LAN administrator for details.

– This setting is non-volatile; it will not be changed by power cycling or *RST or SYSTem:PRESet.

1. Press **Utilities** > **I/O Config** > **LAN Settings** > **AutoDNS On** to configure the addressing of the instrument in DNS server automatically.

2. Press **Utilities** > **I/O Config** > **LAN Settings** > **AutoDNS Off** to configure the addressing of the instrument manually.

3. Select DNS(1) Addr and DNS(2) Addr using the navigation keys. These fields only appear when AutoDNS is set to Off.

4. Set the desired primary and secondary address and press **Back**.

5. Select mDNS Service field using the navigation keys.

6. Press **Yes** to save the setting.

7. Press **No** to cancel all the changes and exit without saving.

DNS Hostname

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

Each power supply is shipped with a default hostname with the format: Keysight-modelnumber-serialnumber, where modelnumber is the power supply's 6-character model number (e.g. E36154A), and serialnumber is the last five characters of the 10-character power supply serial number located on the label on the top of the unit (e.g. 45678 if the serial number is MY12345678).

– The instrument receives a unique hostname at the factory, but you may change it. The hostname must be unique on the LAN.

– The name must start with letter; other characters can be an upper- or lower-case letters, numeric digits, or dashes ("-").

– This setting is non-volatile; it will not be changed by power cycling or *RST or SYSTem:PRESet.

1. Press **Utilities** > **I/O Config** > **LAN Settings**.

2. Select DNS Hostname field using the navigation keys. Press and enter the hostname with the keyboard provided. Press **Back**.

3. Press **Yes** to save the setting.

4. Press **No** to cancel all the changes and exit without saving.

mDNS Service

The mDNS service name is registered with the selected naming service.

Each power supply is shipped with a default service name with the format: Keysight-modelnumberserialnumber, where modelnumber is the power supply's 7-character model number (e.g. E36154A), and serialnumber is the last five characters of the 10-character power supply serial number located on the label on the top of the unit (e.g. 45678 if the serial number is MY12345678).

   – The instrument receives a unique mDNS service name at the factory, but you may change it. The mDNS service name must be unique on the LAN.

   – The name must start with letter; other characters can be an upper- or lower-case letters, numeric digits, or dashes ("-").

1. Press **Utilities** > **I/O Config** > **LAN Settings** > **mDNS Off** to configures the service name registered with the selected naming service automatically.

2. Press **Utilities** > **I/O Config** > **LAN Settings** > **mDNS On** to configure the service name of the instrument manually.

3. Select mDNS Service field using the navigation keys.

4. Press **mDNS Srv** and enter the service name with the keyboard provided.

5. Press **Back** to exit.

Using sockets

> **NOTE**   Power supplies allow any combination of up to two 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 system 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 the SRQ value is 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.

More about IP addresses and dot notation

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 equivalent to decimal "192.168.16.9" because ".020" is 16 expressed in octal, and ".011" (octal) is "9" (base 10). To avoid confusion, use only decimal values from 0 to 255, with no leading zeros.
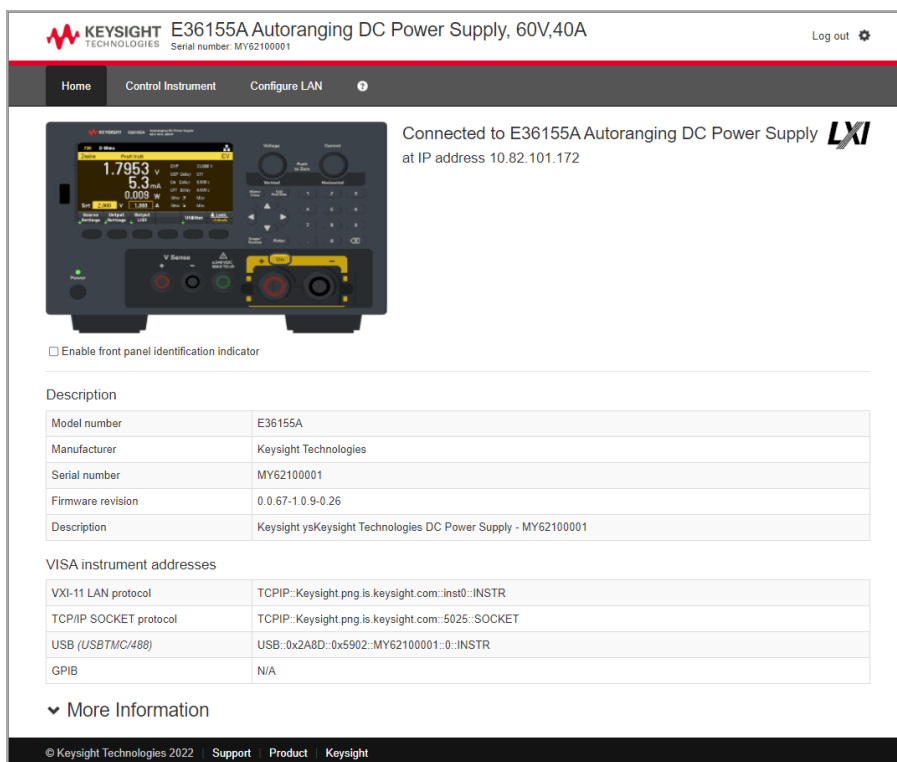
Remote Control

You can control the instrument via SCPI with Keysight IO Libraries or via a simulated front panel with the instrument's Web interface.

Web interface

You can monitor and control the instrument from a Web browser by using the instrument's Web interface. To connect, simply enter the instrument's IP address or hostname in your browser's address bar and press Enter.

> **NOTE** If you see an error indicating 400: Bad Request, that 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.

Check the checkbox below the picture of the instrument to enable an indicator on the instrument's front panel. This is helpful if you have several E36150 Series instruments and you wish to identify the one to which you are connected.

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.

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.
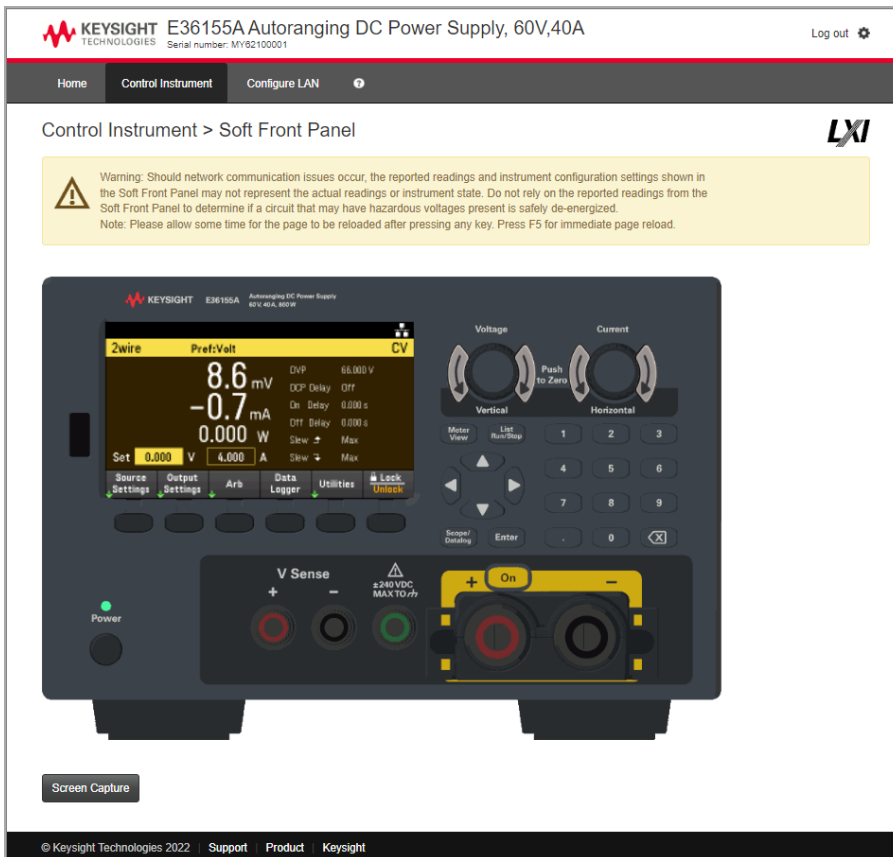
This interface allows you to use the instrument just as you would from the front panel. Note the curved arrow keys that allow you to "rotate" the knob. You can press the arrow keys to rotate the knob clockwise and counter-clockwise, just as you would press any of the other keys on the front panel.

> **NOTE**   READ WARNING
> Be sure to read and understand the warning at the top of the Control Instrument page.

Technical connection details

In most cases, you can easily connect to the instrument with the IO Libraries Suite or Web interface. In certain circumstances, it may be helpful to know the following information.

| Interface	Details
VXI-11 LAN	VISA String: TCPIP0::<IP Address>::inst0::INSTR
	Example: TCPIP0::192.168.10.2::inst0::INSTR
Web UI	Port number 80, URL http://<IP address>/
USB	USB0::0x2A8D::<Prod ID>::<Serial Number>::0::INSTR
	Example: USB0::0x2A8D::0x5802::MY55160003::0::INSTR
	The vendor ID: 0x2A8D, the product ID is 0x5802, and the instrument serial number is MY55160003.
	The product ID varies by model: 0x5802 (E36154A) and 0x5902 (E36155A)

Use the Built-in Help System

The built-in help system provides context-sensitive help on any front panel key or menu softkey. A list of help topics is also available to help you learn about the instrument.

View the help information for the front panel key

NOTE Note that there is no help information available for [Meter View] and Lock|Unlock keys.

Press and hold any softkey or key, such as **[Scope/Data Logger]**. If the message contains more information than will fit on the display, press the down arrow softkey to scroll down.
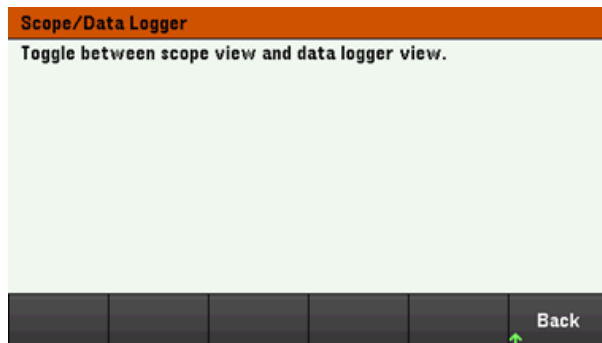
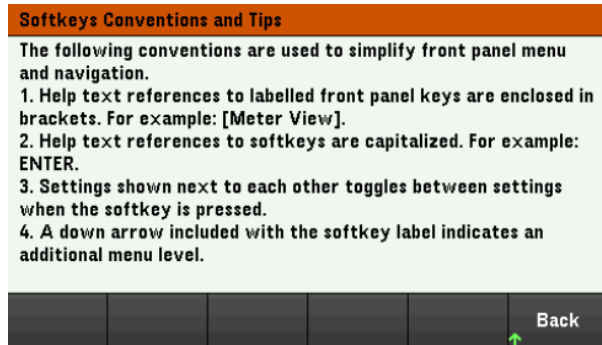Press **Back** to exit.

View the list of help topics

Press **Utilities** > **Test / Setup** > **Help** to view the list of help topics. Press the arrow softkeys or use the front panel arrow keys to highlight the desired topic. Then press **Select**.
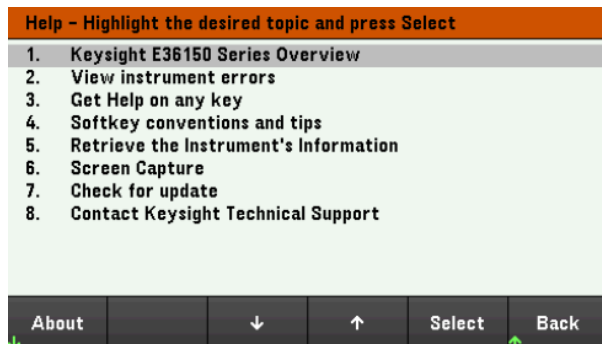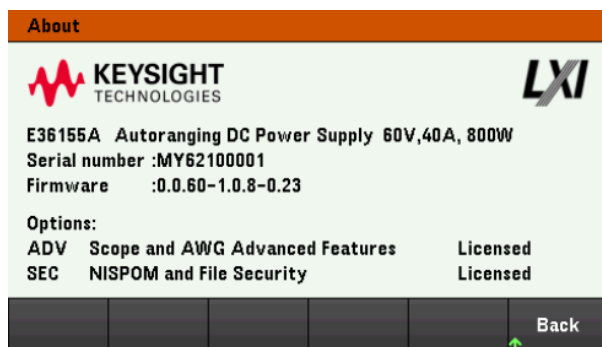
In this case, the following help topic appears:

View the instrument model and serial number

Press **About** to view the instrument's model number, description, serial number, firmware revision, and options.

Press **Back** to exit.

> **NOTE**
>
> LOCAL LANGUAGE HELP
> All front-panel keys' help, and help topics are available in English, French, German, Japanese, Korean, and Chinese. To select the local language, press **Utilities** > **Test / Setup** > **User Settings** > **Display Options** > **Help Lang.**. Then select the desired language. The menu softkey labels and status line messages are not translated.

Firmware Update

NOTE	Do not turn off the instrument during the update.

1. Press **Utilities** > **Test / Setup** > **Help** > **About** to determine what instrument firmware version is currently installed.

2. Go to www.keysight.com/find/e36150firmware 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 the firmware update utility and a ZIP file of the firmware. Detailed firmware update instructions are located on the download page.

License for Optional Features

The License function lets you install firmware options into the power supply.

You will need license to access the following features:

- **Option E36150ADVU** - Scope and AWG Advanced Feature
- **Option SEC** - NISPOM and File Security. This is factory installable option.

For more information on how to purchase a license, go to www.keysight.com/find/E36150.

Obtaining the License for Option E36150ADVU

To obtain the license, you must first purchase the option. After you have purchased the option, you will receive a Software Entitlement Certificate. When this is received, you can start obtaining the license.

To get the license key, log onto the website www.keysight.com/find/softwaremanager and follow the on-screen directions. These include:

1. Creating a user account (if not already set up).
2. Entering your Order and Certificate number (these appear in your Software Entitlement Certificate).
3. Entering the Host instrument's 10-character serial number (this is located on the rear panel of the instrument).
4. Selecting the software license for the instrument.

Upon completion, the .lic license file will be sent via email.

Installing License for Option E36150ADVU

After receiving a license file from Keysight, use the following procedure to install the license:

1. Save the license file to a USB drive and connect the USB drive to the power supply's front panel USB connector.
2. Press **Utilities** > **Test/Setup** > **User Settings** > **License**.
3. Press **Browse** to browse and specify the location where the license file is placed. Then, press **Select**.
4. Press **Load** to install the license . License verification will take place in the background.
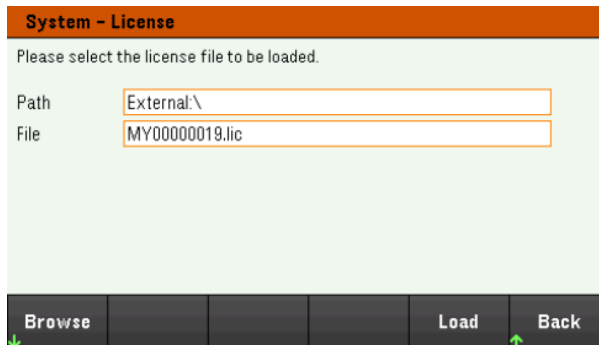
5. Upon successful license installation, the purchased optional feature will be shown as "Licensed" in the **About** page as shown below.
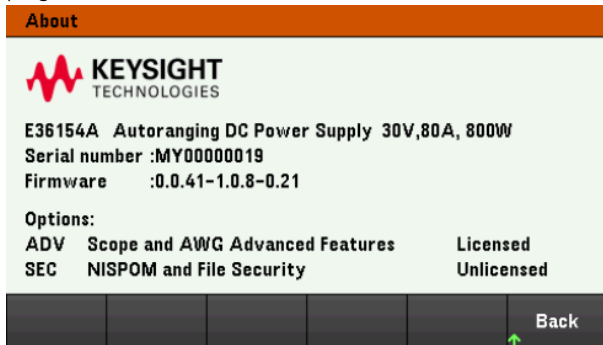
6. The optional feature will be shown as "Unlicensed" should the installation or verification of the license failed. Please contact Keysight support for more information.

| NOTE | Ensure the latest firmware is installed on the E36150 Series power supply in order to receive the latest updates and enhancements for the E36150ADVU features and functionalities. Go to www.keysight.com/find/e36150firmware to get the latest firmware revision and instructions on how to update the firmware. |

Front Panel Menu Reference

This is an overview of the front-panel menus. Press the softkeys to access the front panel menus.

| Menu heading	Description
Source Settings >	
Curr Range	Configures the current measurement range to high or low
Sense	Configures the output sense to 2-wire or 4-wire.
Out Pref	Configures the preferred mode for output on/off transitions.
Protection >	Configures the protection setting for the output.
Voltage Slew>	Configures the voltage slew rate.
Output Settings >	
On/Off Coupling >	Enables or disables the output coupling or synchronization between multiple output channels.
Output Inhibit >	Configures the inhibit input mode and Digital IO Pin 3.
Arb >	
Arb List >	List is selected by default. Selects arbitrary waveforms for the output and configures the selected Arb. (Option E36150ADVU)
Run/Stopped	Runs or stops the Arb.
Add	Inserts a new step to the list.
Delete	Deletes a specified step from the list.
Clear All	Clears all the steps in the list.
Properties >	Configures the Arb settings.
Data Logger >	
Datalog Run Stop	Runs or stops the data logger.
Knob Scale Ofs	Configures the knob operation settings. Refer to Using the knob in data logger view for more information.
Marker Off On	Enables or disables the marker.
Properties >	Configures the data log traces and voltage and current measurement ranges. Also configures the data log duration, sample period, Min/Max values as well as trigger position.
Auto Scale	Auto-scales the traces on the display.
Utilities >	
Store/Recall >	Saves and recalls instrument states.
I/O Config >	Displays and configures the I/O parameters for remote operations over the USB, LAN, GPIB, or digital IO interface.
Test/Setup >	Accesses the self-test, calibration, and help function as well as configures the user preferences, and sets date and time.
Error >	Displays the instrument's error queue. Errors will be cleared after viewing or instrument reset.
Manage Files >	Creates, copies, deletes, and renames files and folders on the USB drive attached to the front panel. Also allows you to capture the current screen to either a bitmap (*.bmp) or portable network graphics (*.png) file.
**Lock	Unlock**	Locks and unlocks the display.

2 General Operating Information

This chapter describes the general operating information of the E36150 Series.

NOTE	For the characteristics and specifications of the E36150 Series autor-anging DC power supplies, refer to the datasheet at https://www.key-sight.com/us/en/assets/3122-1798/data-sheets/E36150-Series.pdf.

Turning the Unit On

After you have connected the power cord, press the **[On/Standby]** key to turn the unit on. The front panel display lights up after a few seconds. When the front panel meter view appears, use the Voltage and Current knobs to enter voltage and current values.
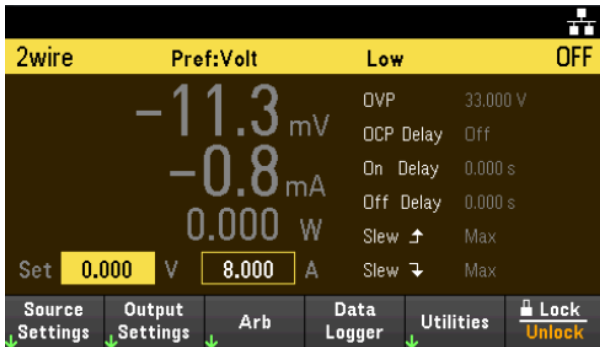

Press the **[On]** key to enable the output.

In meter view, the power supply continuously measures and displays the output voltage and current.

> **NOTE** A power-on self-test occurs automatically when you turn the unit on. This assures you that the instrument is operational. If self-test fails, or if other operating problems occur with your instrument, the front panel error indicator (!Err) appears at the upper top of the display.
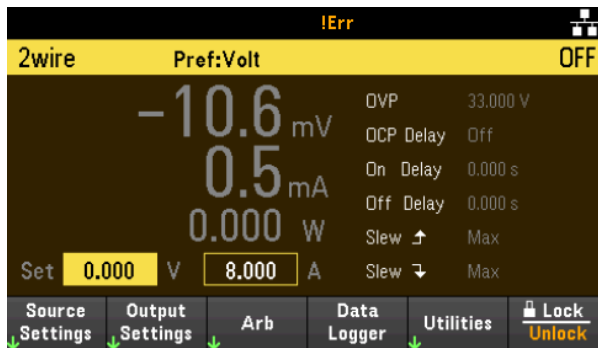
Using the front panel knobs

There are two knobs on the front panel: Voltage and Current.
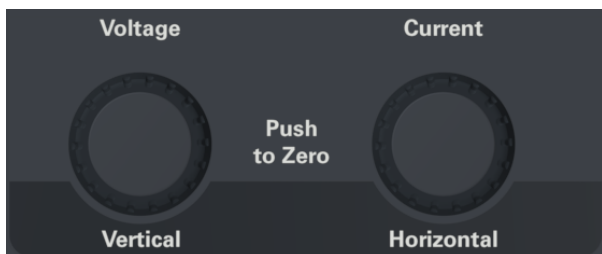
These knobs are active in Meter View, Scope View, Data Logger View, as well as in Source Settings page.

– In Meter View, adjusting the Voltage and Current knobs will adjust the voltage and current value accordingly. Turn the knob to set the output.

– In Scope and Data Logger view, these knobs can be programmed according to the different operating function for value adjustment.

  – For more information on the knob usage in data logger view, see Using knob in data logger view.

  – For more information on the knob usage in scope view, see Using knob in scope view.

– In Source Settings page, adjusting the Voltage and Current knobs will toggle between the voltage and current parameter.

Keysight E36150 Series User's Guide

View the error log

Press **Utilities** > **Error** to display the error log. If there are more than 10 errors on the display, press **Next** to scroll to the next page.
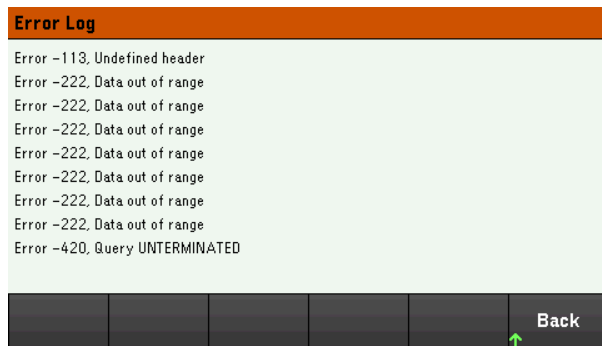
Press **Back** or **[Meter View]** to return to the meter-view display.

‐ Errors are stored in the order they are received. The error at the end of the list is the most recent error.

‐ If there are more than 20 errors in the queue, the last error stored is replaced with -350,"Queue overflow". No more errors are stored until you remove errors from the queue. If there are no errors, the instrument responds with +0,"No error".

‐ Except for self-test errors, errors are cleared when exiting the Error Log menu or when cycling power.

If you suspect that there is a problem with the power supply, refer to the "Troubleshooting" section in the *Service Guide*.

Controlling the Outputs

Step 1 - Set the output voltage and current

Turn the Voltage and Current knobs. The output voltage or current setting changes when they are turned.
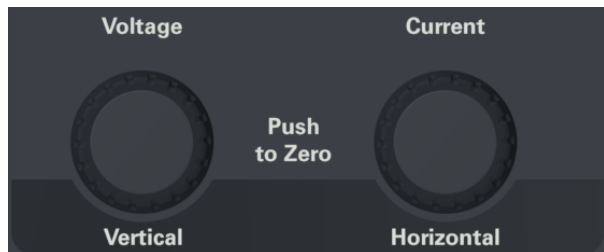

You can also enter the voltage and current values directly in the numeric entry fields (the Set fields) in the meter-view display. Use the navigation keys to select the field; use the numeric entry keys to enter the value. The value becomes active when you press [Enter].
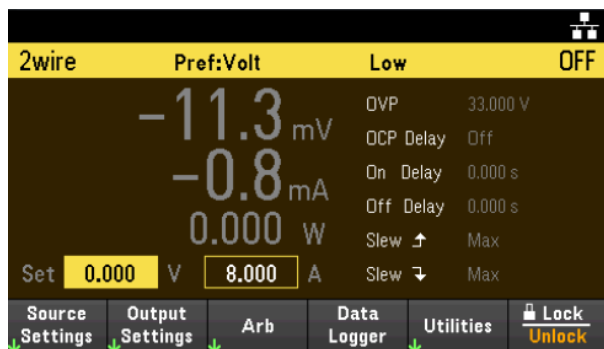
Lastly, you can press the **Source Settings** key to access the Source Settings window. Use the navigation keys to highlight the Voltage or Current fields. Then enter the voltage and current values with the numeric keys. You can use the Voltage and Current knobs to adjust the values in the Voltage and Current fields.

Press [Enter] to enter the value. Press **Back** to return to the meter-view display.
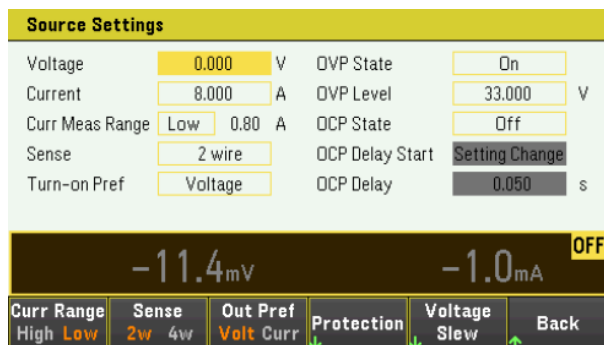
The table below indicates the output range and default value for voltage and current settings:

| Settings	E36154A		E36155A	
	Output range	Default value	Output range	Default value
Voltage	0 to 30.9 V	0 V	0 to 61.8 V	0 V
Current	0 to 82.4 A	8 A	0 to 41.2 A	4 A

Step 2 - Enable the output

Press the color-coded **[On]** key to enable the output. When an output is on, the **[On]** key for that output is lit. When an output is off, the **[On]** key is not lit.

The state of a disabled output (output off) is a condition of zero output voltage and zero source current.

Step 3 - View the output voltage and current

Press **[Meter View]** to view the output voltage and current. When an output is enabled, the front panel meters continuously measure and display the output voltage and current.
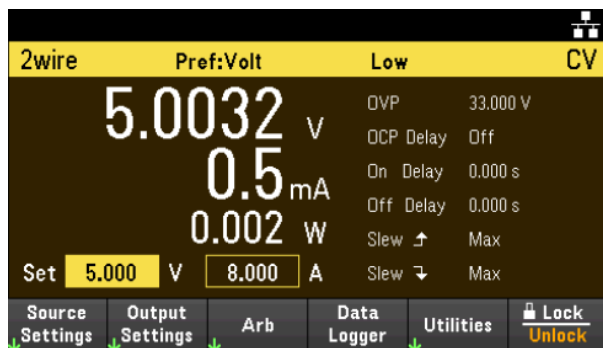
Constant voltage and constant current

If the output load resistance exceeds the voltage setting divided by the current setting, the instrument will operate in constant-voltage (CV) mode. The current will equal the voltage divided by the load resistance.

If the output load resistance is less than the voltage setting divided by the current setting, the instrument will operate in constant-current (CC) mode. The voltage will equal the current multiplied by the load resistance.

From the remote interface:

To set output to 5 V and 8 A:
APPL 5, 8

To enable output:
OUTP ON

To measure the output voltage and current:
MEAS:VOLT?
MEAS:CURR?

Using the Protection Function

Protection function

Each output has independent protection functions. A front panel status indicator will turn on when a protection function is set. Protection functions are latching, which means that they must be cleared once they are set.

Of the following protection functions, only OV and OC are user-programmable.

- **OV**: Over-voltage protection is a hardware OVP whose trip level is a programmable value. The OVP is enabled by default.

- **OC**: Over-current protection is a programmable function that can be enabled or disabled. When enabled, the output will be disabled when the output current reaches the current limit setting.

- **OT**: Over-temperature protection monitors the temperature of each output and shuts down the output if any temperature exceeds the maximum factory-defined limits.

Configuring protection

Protection functions are configured on the Source Settings window.

Press **Source Settings** to access the Source Settings window. Next, press **Protection** to access the protection functions.
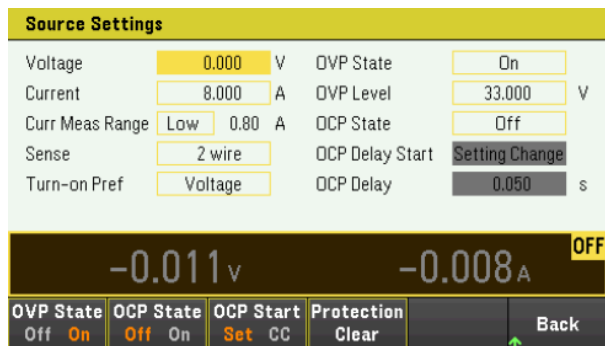
OV Protection

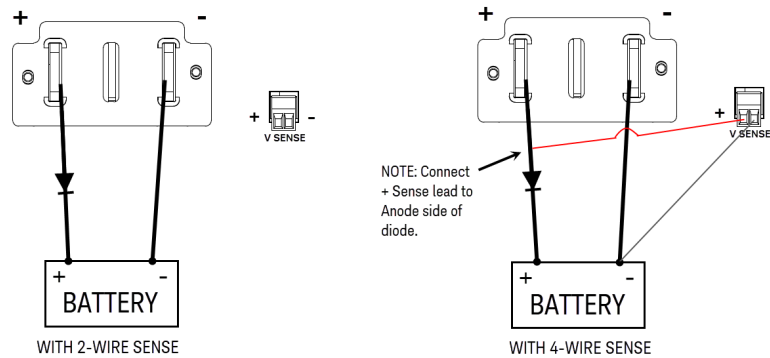Over-voltage protection disables the output if the output voltage reaches the OVP level.

Press **OVP State On** to enable over-voltage protection. This is the default state.

Press **OVP State Off** to disable over-voltage protection.

To set the over-voltage protection, enter an over-voltage value in the OV Protection field.

NOTE The power supply's OVP circuit will program the output to zero whenever the overvoltage condition occurs. If external voltage source such as battery is connected across the output, and the overvoltage condition inadvertently occurs, the current from the voltage source will sink through the internal circuitry; possibly damaging the power supply. To avoid this, a diode must be connected in series with the output as shown below.

OC Protection

With over-current protection enabled, the power supply disables the output if the output current reaches the current limit setting, which causes a transition from CV to CC mode.

Press **OCP State On** to enable over-current protection.

Press **OCP State Off** to disable over-current protection.

NOTE You can also specify a delay to prevent momentary CV-to-CC status changes from tripping the OCP. The delay can be programmed from 0 to 3600 seconds. You can specify if the start of the delay is initiated by any transition into CC mode, or only at the end of a settings change in voltage, current or output state.

OCP Delay

The power supply may momentarily cross into CC mode when it is turned on, when an output value is programmed, or when the output load is connected. In most cases these temporary conditions would not be considered an over-current protection fault, and having an OCP condition disables the output when the CC status bit is set would be a nuisance. Specifying an OCP delay will ignore the CC status bit during the specified delay period.

To set the over-current protection delay, enter the delay value in the OC Protection Delay field. The delay can be programmed from 0 to 3600 seconds.

OCP Delay Start

Specifying an OCP Delay Start lets the OCP circuit ignore the CC status bit during the specified delay period. Once the OCP delay time has expired and if the CC mode persists, the output will shut down.

You can specify the OCP delay start timer through:

- CC Transition: Delay timer starts at any transition of the output into CC mode. Press **OCP Start CC**.

- Setting Change: Delay timer starts at the end of a settings change in voltage, current, or output state. Press **OCP Start Set**.

Clears and OVP and OCP Event

To clear the protection function, first remove that condition that caused the protection fault.

Press **Protection Clear** to clear the protection function and returns the output to its previous operating state.

From the remote interface:

To set the over-voltage protection to the maximum limit:
VOLT:PROT MAX

To enable the over-current protection:
CURR:PROT:STAT ON

To set the over-current protection delay time at 3 seconds:
CURR:PROT:DEL 3

To set the over-current protection delay timer start to CC transition:
CURR:PROT:DEL:STAR CCTR

To clear protection:
OUTP:PROT:CLE

Specifying 2-Wire or 4-Wire Sense

NOTE	When 4w mode is selected, ensure the load is connected to the rear panel output for accurate reading.
	DO NOT USE both front and rear panel output concurrently. This may lead to inaccurate output reading.

You have the option to use the remote sense terminals on the rear panel to measure the voltage at the device under test (DUT).

1. Press **Source Settings**.

2. Press **Sense 2w** or **Sense 4w** to select 2-wire sense or 4-wire sense.

3. Press **Back** to exit and return to the meter-view display.

The 2w mode closes a relay within the power supply to short the output and sense connectors. This means that only two wires are used, and 4-wire sense is disabled. The 4w mode opens the relay in order to separate the output and 4-wire sense inputs. By default, 2w is selected.

From the remote interface:

To set the remote sense relay to 4-wire sense:
VOLT:SENS EXT

Specifying the Current Measurement Range

You can select a lower current measurement range if you need better output resolution.

1. Press **Source Settings**.

2. Press **Curr Range High** or **Curr Range Low** to select high current measurement range or low current measurement range.

3. Press **Back** to exit and return to the meter-view display.

From the remote interface:

To set the current measurement range to High:
CURR:RANG:HIGH

To set the current measurement range to Low:
CURR:RANG:LOW

Specifying the Turn-on Preference

You can specify the preferred mode for output on/off transitions. It allows output state transitions to be optimized for either constant voltage or constant current operation.

Selecting Voltage minimizes output on/off voltage overshoots in constant voltage operation. Selecting Current minimizes output on/off current overshoots in constant current operation.

1. Press **Source Settings**.

2. Press **Out Pref Volt** or **Out Pref Curr** to select Voltage or Current.

3. Press **Back** to exit and return to the meter-view display.

From the remote interface:

To set the preferred mode to Voltage:
OUTP:PMOD VOLT

To set the preferred mode to Current:
OUTP:PMOD CURR

Specifying the Voltage Slew Rate

You can set the rising voltage slew rate or falling voltage slew rate in volts per second. The slew rate setting affects the rising and falling programmed voltage changes, including those due to the output state turning on.

The slew rate can be set from 0.003 (for E36155A model) or 0.0015 (for E36154A model) up to any value, however, if the value set is more than the max slew rate, the DUT will slew based on the max slew rate. For very large values, the slew rate will be limited by the analog performance of the output circuit.
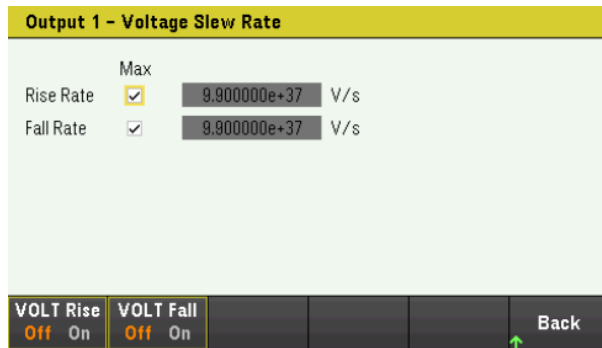
1. Press **Source Settings**.

2. Press **Voltage Slew** to enter the voltage slew rate settings.

3. Configure the **Rise Rate** or **Fall Rate** accordingly. 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]**. You can also enable the **Max** checkbox to set the slew rate to the maximum value.

4. Select **VOLT Rise On** or **VOLT Rise Off** to enable or disable the voltage slew rate rising configuration and select **VOLT Fall On** or **VOLT Fall Off** to enable or disable the voltage slew rate falling configuration.

5. Press **Back** to exit and return to the meter-view display.

From the remote interface:

To set the rising voltage slew rate to 5 volts per second:
VOLT:SLEW:RIS 5

To set the falling voltage slew rate to the maximum value:
VOLT:SLEW:FALL MAX

Configuring the Output Turn On Turn Off Sequence

Turn-on and turn-off delays control the turn-on and turn-off timing of the outputs in relation to each other.

Step 1 – Set the output voltage and current

Refer to steps 1 and 2 under **Controlling the Outputs** and set the output voltage and current values that will be sequenced.

Step 2 – Configure the turn-on turn-off delays:

Press **Output Settings** to access the Output Settings – On/Off Delays. Enter the On Delays and Off Delays for all outputs that will participate in the output on/off delay sequence. Values can range from 0 to 3600 seconds.
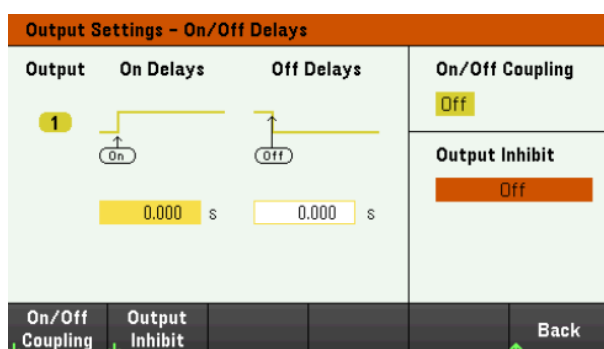

Step 3 – Coupling selected outputs:

> **NOTE** This step is only required if you will be including some outputs to participate in an output on/off delay sequence or if you are coupling multiple power supplies. If only a single output is to be used in the sequence, you can skip this step.

From the menu, press **On/Off Coupling** to access the On/Off Coupling mode settings.

– Press **Coup CH 1** to toggle between Off and On in order to turn off or on the coupling for Output 1.
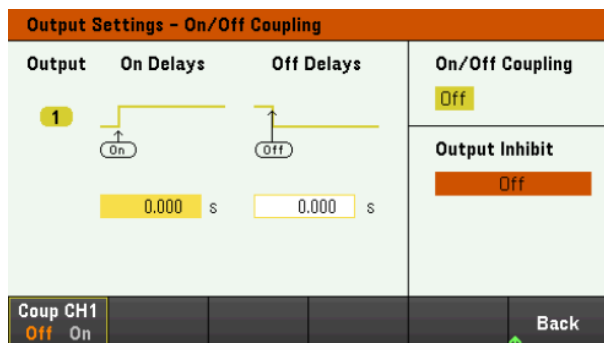
Step 4 – Use the On key:

Once output delays have been set, press **[On]** to start the On delay and Off delay sequence.

From the remote interface:

To program turn-on and turn-off delays:
OUTP:DEL:RISE 0.01
OUTP:DEL:FALL 0.04

To include output 1 in a sequence:
OUTP:COUP:CHAN CH1

To turn on output 1 in a sequence:
OUTP ON

Generating Arbitrary Waveforms (Option E36150ADVU)

List Arb

Sine Arb

Step Arb

Ramp Arb

Staircase Arb

Pulse Arb

Trapezoid Arb

Exponential Arb

Arb Sequence

The output on the E36150 Series can be modulated by the built-in arbitrary waveform generator function. This allows the output to act as a DC bias transient generator or an arbitrary waveform generator.

There are nine types of Arb waveform shapes available: List, Step, Ramp, Staircase, Sine, Pulse, Trapezoid, Exponential, and Sequence.

| NOTE | List Arb is available as standard. The remaining Arb waveforms are available with Option E36150ADVU. |

Press **Arb** to select the arbitrary waveform shape.
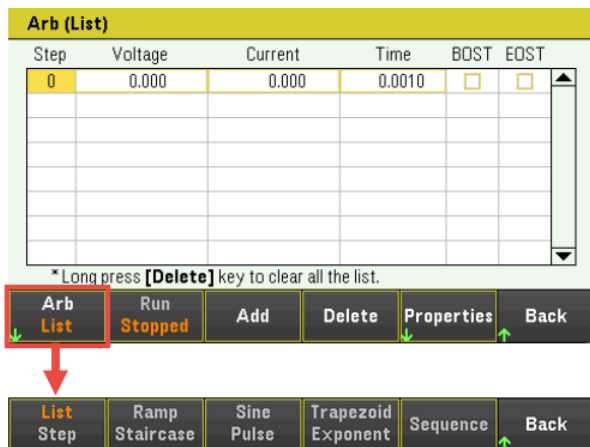
Press **Back** to return to Arb main menu.

List Arb

The List Arb allows output to run in sequence.

List Arb contains up to 512 current or voltage steps (Option E36150ADVU) that are entered individually in the Arb (List) Properties window. For standard option, you can configure up to 100 voltage and current steps.
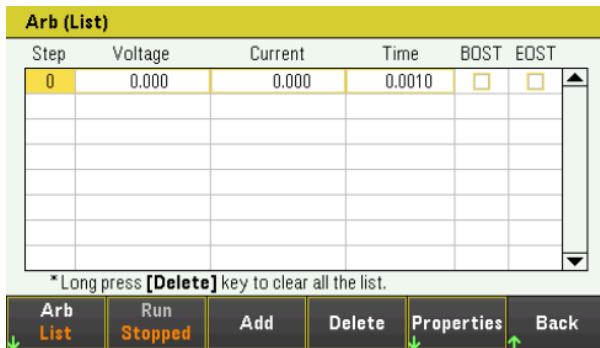
You can also populate the List Arb with values from a previously configured "standard" Arb and then edit the steps in the Arb (List) Properties window by using **Edit Points** function.

Step 1– Select Arb waveform

Press **Arb** to access the List Arb. The List Arb is selected by default.
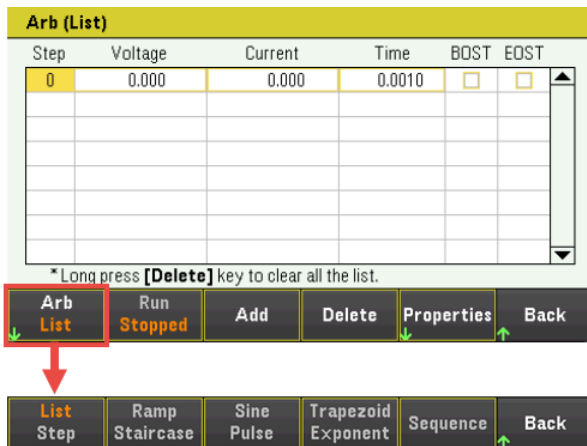
Step 2– Add/remove steps to/from the List

Press **Add** to insert a new step below the selected step. Note that the values in the new step are copied from the previous step. Continue to add steps until your sequence is complete. Use the navigation keys to move through the list.

Press **Delete** if you want to delete the selected step. Press and hold **Delete** if you want to remove all steps from the list.

Step 3 – Configure the List properties

Configure the Voltage, Current, Time, BOST, and EOST accordingly. 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]**.

Fields	Description
Voltage	Sets the voltage value for selected step in voltage.
Current	Sets the current value for selected step in ampere.
Time	Sets the run-time for selected step in seconds.
BOST	Enables check box to set which step will generate a trigger-out signal at the beginning of the step (BOST).
EOST	Enables check box to set which step will generate a trigger-out signal at the end of the step (EOST).

For additional settings, press **Properties** to open the Arb (List) Properties window.

Configure the List Arb accordingly. Refer to the below table for details.

Settings	Available Key Settings	Description	
Voltage After Arb Current After Arb	DC or LAST	Specifies what happens to the parameter settings when the Arb completes. Default is DC.	
		Action required: Press **After Arb** to toggle between DC and LAST.	
		DC (Return to DC Value)	The parameter setting returns to the DC value that was in effect prior to the Arb.
		LAST (Last List Value)	The parameter setting remains at the last Arb value.
Pace	Dwl or Trg	Configures the pacing of the step. Default is Dwl.	
		Action required: Press **Pace** to toggle between Dwl and Trg.	
		Dwl (Dwell)	The next step immediately outputs when the dwell time has elapsed.
		Trg (Trigger)	The next step immediately outputs when an external trigger is received. If the step time completes before trigger occurs, the step remains at the last list value while waiting for the trigger.
Voltage Mode	Fix, Stp, or Arb	Sets the voltage mode. This determines what happens to the output voltage when the system is initiated or triggered. Default is Fix.	
		Note: If current mode is set to Step, voltage mode is not allowed to set to Arb and vice versa.	
		Action required:	
		Press **V Mode** to toggle between Fix, Stp, and Arb.	
		Fix (Fixed)	Keeps the output at its immediate value.
		Stp (Step)	Steps the output to the triggered level when a trigger occurs
		Arb (Arb)	Causes the output to follow the Arb values when a trigger occurs.
Current Mode	Fix, Stp, or Arb	Sets the current mode. This determines what happens to the output current when the system is initiated or triggered. Default is Fix.	
		Note: If voltage mode is set to Step, current mode is not allowed to set to Arb and vice versa.	
		Action required: Press **I Mode** to toggle between Fix, Stp, and Arb.	
		Fix (Fixed)	Keeps the output at its immediate value.
		Stp (Step)	Steps the output to the triggered level when a trigger occurs.
		Arb (Arb)	Causes the output to follow the Arb values when a trigger occurs.

Settings	Available Key Settings	Description	
Trigger Source	Key, IO, or Rmt	Sets the trigger source for the system. Default is Rmt. Action required: Press **Trig Src** to toggle between Key, IO, and Rmt.	
		Key (Arb Run/Stop Key)	Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
		IO (DIO Trigger In)	Selects any configured digital IO (with Trigger Input function) as a trigger source
		Rmt (Remote Command)	Selects a remote interface command as a trigger source.
Trigger Delay	0 – 3600 s	Sets the trigger delay in seconds. Default is 0 s.	
Repeat Count	1 to 9999 (standard) 1 - 16,777,216 (Option E36150ADVU)	Sets the Arb repeat count. This sets the number of times that an Arb is executed before it completes. Default is 1.	
Continuous	-	Enables check box to repeat the Arb continuously.	

Step 4 – Run the output sequence list

> **NOTE** When Arb List is initiated, all the List properties cannot be configured, which includes adding or removing step from the list.
>
> When Step mode transient system is initiated, properties such as voltage mode, current mode, trigger source, and trigger delay cannot be configured.
>
> If both Voltage and Current Mode is set to Fix and Trigger Source is set to Key, pressing **Run** will automatically set both voltage and current mode to Arb and start the list operation.

– Set Voltage Mode to Arb: Press **V Mode Arb**.

– Set Current Mode to Arb: Press **I Mode Arb**.

– Set Trigger Source to Key. Press **Trig Src Key**.

– Press the color-coded **[On]** key to enable the output.

– Press **Run** to start the Arb operation. To abort the operation, press **Stop**. Alternatively, press **[List Run/Stop]**.

– Press **Back** to exit and return to the previous menu.

– Press **[Scope/Datalog]** to enter Scope view and display the Arb.

From the remote interface:

To select the Arb Shape:
ARB:FUNC:SHAP UDEF

To configure the List voltage with 1 V, 2 V, 3 V, 4 V and 5 V:
ARB:VOLT:UDEF:LEV 1,2,3,4,5

To configure the List current with 0.1 A, 0.2 V, 0.3 A, 0.4 A and 0.5 A:
ARB:CURR:UDEF:LEV 0.1,0.2,0.3,0.4,0.5

To configure all the List time with 1 s:
ARB:UDEF:DWEL 1,1,1,1,1

To enable all the List BOST:
ARB:UDEF:BOST 1,1,1,1,1

To disable all the List EOST:
ARB:UDEF:EOST 0,0,0,0,0

To set the voltage mode to Arb:
VOLT:MODE ARB

To set the current mode to Arb:
CURR:MODE ARB

To set the trigger source to Key/Immediate:
TRIG:SOUR IMM

To enable the output:
OUTP ON

To initiate and run the list:
INIT:TRAN

Sine Arb (Option E36150ADVU)

Step 1– Select Arb waveform

Press **Arb** to access the Arb selection menu. Then select **Sine**.

Press **Back** to return to Arb main menu.

Step 2 – Configure the Sine Arb
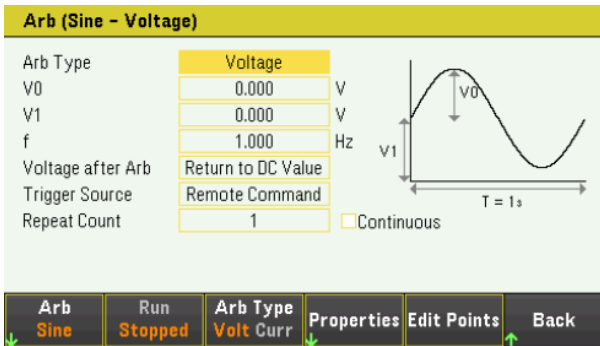
Configure the Sine Arb accordingly. Refer to the below table for details.

NOTE	During configuration, ensure the offset value (V1) must always be greater than the waveform amplitude (V0).

Parameter	Available Key Settings	Description
Arb Type	Voltage or Current	Sets the output Arb type. Default is Voltage. Action required: Press **Arb Type** to toggle between Volt and Curr. Volt — Selects voltage as output Arb type. Curr — Selects current as output Arb type.
Amplitude (I0 or V0)	minimum to maximum	Sets the amplitude or peak value.
Offset (I1 or V1)	minimum to maximum	Sets the offset value.
Frequency (f)	2.7778 µHz - 100 Hz	Sets the frequency of the sine wave.

Parameter	Available Key Settings	Description
Voltage after Arb Current after Arb	DC or LAST	Specifies what happens to the parameter settings when the Arb completes. Default is DC. Action required: Press **Properties** > **After Arb** to toggle between DC and LAST.
		DC (Return to DC Value) — The parameter setting returns to the DC value that was in effect prior to the Arb.
		LAST (Last List Value) — The parameter setting remains at the last Arb value.
Trigger Source	Key, IO, or Rmt	Sets the trigger source for the system. Default is Rmt. Action required: Press **Properties** > **Trig Src** to toggle between Key, IO, and Rmt.
		Key (Arb Run/Stop Key) — Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
		IO (DIO Trigger In) — Selects any configured digital IO (with Trigger Input function) as a trigger source
		Rmt (Remote Command) — Selects a remote interface command as a trigger source.
Repeat Count	1 to 16,777,216	Sets the Arb repeat count. This sets the number of times that an Arb is executed before it completes. Default is 1.
Continuous	On or Off	Enables check box to repeat the Arb continuously. Default is On. Action required: Press **Properties** > **Continuous** to toggle between On and Off.
		On — Enables the check box.
		Off — Disables the check box.
Edit Points	-	Create a List Arb from the present Arb property values. This lets you edit specific points in the standard arbitrary waveform.

Step 3 – Run the Arb

> **NOTE** When the arbitrary waveform runs, front panel voltage and current controls as well as any remote voltage and current commands are ignored until after the Arb completes.

In this example, the Arb type is Voltage.

- Set the Arb Type to Voltage.

- Set V0, V1, frequency, Voltage after Arb, and repeat count accordingly: 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]**.

- Set Trigger Source to Key. Press **Properties** > **Trig Src Key**.

- Press the color-coded **[On]** key to enable the output.

- Press **Run** to start the Arb operation. To abort the operation, press **Stop**. Alternatively, press **[List Run/Stop]**.

- Press **[Scope/Datalog]** to enter Scope view and display the Arb.

From the remote interface:

Select the Arb Type and Shape:
ARB:FUNC:TYPE VOLT
ARB:FUNC:SHAP SIN

Enter the values for the voltage amplitude, offset from zero, and frequency:
ARB:VOLT:SIN:AMPL 5
ARB:VOLT:SIN:OFFS 5
ARB:VOLT:SIN:FREQ 1

The parameter setting returns to the DC value that was in effect prior to the Arb.
ARB:TERM:LAST OFF

The parameter setting remains at the last Arb value after the Arb completes.
ARB:TERM:LAST ON

Specify the repeat count of the Arb, or specify continuous repetition (INF):
ARB:COUN 10
ARB:COUN INF

To set the voltage mode to Arb:
VOLT:MODE ARB

Set the trigger source to Key/Immediate:
TRIG:SOUR IMM

To enable the output:
OUTP ON

To initiate the transient trigger system:
INIT:TRAN

Step Arb (Option E36150ADVU)

Step 1– Select Arb waveform

Press **Arb** to access the Arb selection menu. Then select **Step**.

Press **Back** to return to Arb main menu.

Step 2 – Configure the Step Arbs
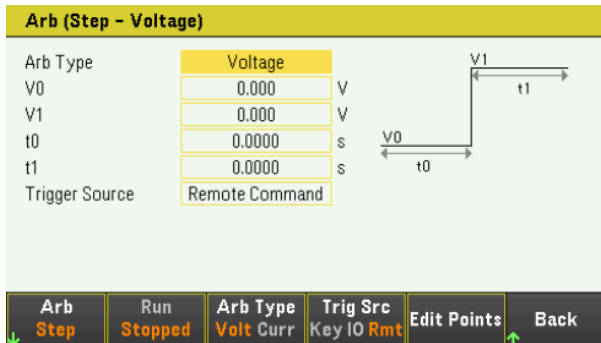
Configure the Step Arb accordingly. Refer to the below table for details.

Parameter	Available Key Settings	Description
Arb Type	Voltage or Current	Sets the output Arb type. Default is Voltage. Action required: Press **Arb Type** to toggle between Volt and Curr. Volt — Selects voltage as output Arb type. Curr — Selects current as output Arb type.
Start Setting (I0 or V0)	minimum to maximum	Sets the setting before the step.
End Setting (I1 or V1)	minimum to maximum	Sets the setting after the step.
Delay (t0)	0 – 3600 s	Sets the delay time after the trigger is received but before the step occurs.
End time (t1)	0 – 3600 s	Sets the time the output remains at the end setting after the step occurs.

Parameter	Available Key Settings	Description	
Trigger Source	Key, IO, or Rmt	Sets the trigger source for the system. Default is Rmt. Action required: Press **Properties** > **Trig Src** to toggle between Key, IO, and Rmt.	
		Key (Arb Run/Stop Key)	Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
		IO (DIO Trigger In)	Selects any configured digital IO (with Trigger Input function) as a trigger source
		Rmt (Remote Command)	Selects a remote interface command as a trigger source.
Edit Points	-	Create a user-defined Arb from the present Arb property values. This lets you edit specific points in the standard arbitrary waveform.	

Step 3 – Run the Arb

> **NOTE** When the arbitrary waveform runs, front panel voltage and current controls as well as any remote voltage and current commands are ignored until after the Arb completes.

In this example, the Arb type is Voltage.

- Set the Arb Type to Voltage.

- Set V0, V1, t0, and t1 accordingly: 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]**.

- Set Trigger Source to Key. Press **Properties** > **Trig Src Key**.

- Press the color-coded **[On]** key to enable the output.

- Press **Run** to start the Arb operation. To abort the operation, press **Stop**. Alternatively, press **[List Run/Stop]**.

- Press **[Scope/Datalog]** to enter Scope view and display the Arb.

From the remote interface:

Select the Arb Type and Shape:
ARB:FUNC:TYPE VOLT
ARB:FUNC:SHAP STEP

Enter the values for the level before and after a voltage step:
ARB:VOLT:STEP:STAR 0,(@1)
ARB:VOLT:STEP:END 5,(@1)

Enter the delay time before the step:
ARB:VOLT:STEP:STAR:TIM 0.01,(@1)

To set the voltage mode to Arb:
VOLT:MODE ARB

Set the trigger source to Key/Immediate:
TRIG:SOUR IMM

To enable the output:
OUTP ON

To initiate the transient trigger system:
INIT:TRAN

## Ramp Arb (Option E36150ADVU)

Step 1– Select Arb waveform

Press **Arb** to access the Arb selection menu. Then select **Ramp**.
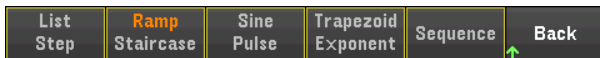
Press **Back** to return to Arb main menu.

Step 2 – Configure the Ramp Arbs
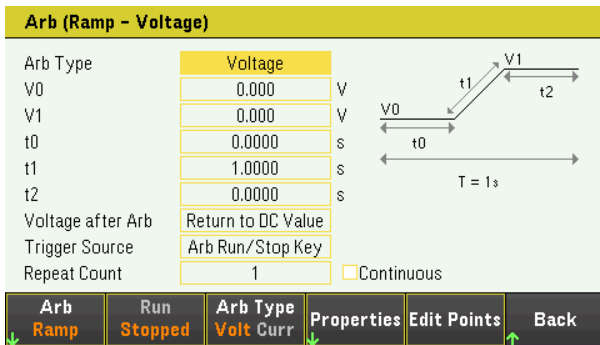
Configure the Ramp Arb accordingly. Refer to the below table for details.

Parameter	Available Key Settings	Description
Arb Type	Voltage or Current	Sets the output Arb type. Default is Voltage. Action required: Press **Arb Type** to toggle between Volt and Curr.
		Volt Selects voltage as output Arb type.
		Curr Selects current as output Arb type.
Start Setting (I0 or V0)	minimum to maximum	Sets the setting before the ramp.
End Setting (I1 or V1)	minimum to maximum	Sets the setting after the ramp.
Delay (t0)	0 – 3600 s	Sets the delay time after the trigger is received but before the ramp starts.

Parameter	Available Key Settings	Description
Ramp time (t1)	0 – 3600 s	Sets the time that the output ramps up.
End time (t2)	0 – 3600 s	Sets the time the output remains at the end setting after the ramps completes.
Voltage after Arb Current after Arb	DC or LAST	Specifies what happens to the parameter settings when the Arb completes. Default is DC.
		Action required: Press **Properties** >**After Arb** to toggle between DC and LAST.
		DC (Return to DC Value) — The parameter setting returns to the DC value that was in effect prior to the Arb.
		LAST (Last List Value) — The parameter setting remains at the last Arb value.
Trigger Source	Key, IO, or Rmt	Sets the trigger source for the system. Default is Rmt.
		Action required: Press **Properties** > **Trig Src** to toggle between Key, IO, and Rmt.
		Key (Arb Run/Stop Key) — Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
		IO (DIO Trigger In) — Selects any configured digital IO (with Trigger Input function) as a trigger source
		Rmt (Remote Command) — Selects a remote interface command as a trigger source.
Repeat Count	1 to 16,777,216	Sets the Arb repeat count. This sets the number of times that an Arb is executed before it completes. Default is 1.
Continuous	On or Off	Enables check box to repeat the Arb continuously. Default is On.
		Action required: Press **Properties** > **Continuous** to toggle between On and Off.
		On — Enables the check box.
		Off — Disables the check box.
Edit Points	-	Create a user-defined Arb from the present Arb property values. This lets you edit specific points in the standard arbitrary waveform.

Step 3 – Run the Arb

NOTE   When the arbitrary waveform runs, front panel voltage and current controls as well as any remote voltage and current commands are ignored until after the Arb completes.

In this example, the Arb type is Voltage.

- Set the Arb Type to Voltage.

- Set V0, V1, t0, t1, t2, Voltage after Arb, and repeat count accordingly. 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]**.

- Set Trigger Source to Key. Press **Properties** > **Trig Src Key**.

- Press the color-coded **[On]** key to enable the output.

- Press **Run** to start the Arb operation. To abort the operation, press **Stop**. Alternatively, press **[List Run/Stop]**.

- Press **[Scope/Datalog]** to enter Scope view and display the Arb.

From the remote interface:

Select the Arb Type and Shape:
ARB:FUNC:TYPE VOLT
ARB:FUNC:SHAP RAMP

Enter the values for the level before and after a voltage ramp:
ARB:VOLT:RAMP:STAR 0
ARB:VOLT:RAMP:END 5

Enter the time before the pulse, the time of the pulse, and the time after the pulse:
ARB:VOLT:RAMP:STAR:TIM 0.25
ARB:VOLT:RAMP:RTIM 0.5
ARB:VOLT:RAMP:END:TIM 0.01

The parameter setting returns to the DC value that was in effect prior to the Arb.
ARB:TERM:LAST OFF

The parameter setting remains at the last Arb value after the Arb completes.
ARB:TERM:LAST ON

Specify the repeat count of the Arb, or specify continuous repetition (INF):
ARB:COUN 10
ARB:COUN INF

To set the voltage mode to Arb:
VOLT:MODE ARB

Set the trigger source to Key/Immediate:
TRIG:SOUR IMM

To enable the output:
OUTP ON

To initiate the transient trigger system:
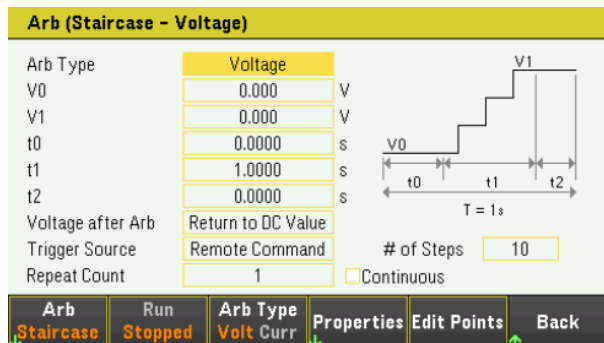INIT:TRAN

Staircase Arb (Option E36150ADVU)

Step 1– Select Arb waveform

Press **Arb** to access the Arb selection menu. Then select **Staircase**.

Press **Back** to return to Arb main menu.

Step 2 – Configure the Staircase Arb

Configure the Staircase Arb accordingly. Refer to the below table for details.

Parameter	Available Key Settings	Description	
Arb Type	Voltage or Current	Sets the output Arb type. Default is Voltage. Action required: Press **Arb Type** to toggle between Volt and Curr.	
		Volt	Selects voltage as output Arb type.
		Curr	Selects current as output Arb type.
Start Setting (I0 or V0)	minimum to maximum	Sets the setting before the staircase.	
End Setting (I1 or V1)	minimum to maximum	Sets the setting after the staircase.	
Delay (t0)	0 – 3600 s	Sets the delay time after the trigger is received but before the staircase starts.	
Step time (t1)	0 – 3600 s	Sets the time to complete all staircase steps.	
End time (t2)	0 – 3600 s	Sets the time the output remains at the end setting after the staircase completes.	

Parameter	Available Key Settings	Description
Voltage after Arb Current after Arb	DC or LAST	Specifies what happens to the parameter settings when the Arb completes. Default is DC.
		Action required: Press **Properties** > **After Arb** to toggle between DC and LAST.
		DC (Return to DC Value) · The parameter setting returns to the DC value that was in effect prior to the Arb.
		LAST (Last List Value) · The parameter setting remains at the last Arb value.
Trigger Source	Key, IO, or Rmt	Sets the trigger source for the system. Default is Rmt.
		Action required: Press **Properties** > **Trig Src** >to toggle between Key, IO, and Rmt.
		Key (Arb Run/Stop Key) · Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
		IO (DIO Trigger In) · Selects any configured digital IO (with Trigger Input function) as a trigger source
		Rmt (Remote Command) · Selects a remote interface command as a trigger source.
Repeat Count	1 to 16,777,216	Sets the Arb repeat count. This sets the number of times that an Arb is executed before it completes. Default is 1.
Continuous	On or Off	Enables check box to repeat the Arb continuously. Default is On.
		Action required: Press **Properties** > **Continuous** to toggle between On and Off.
		On · Enables the check box.
		Off · Disables the check box.
# of Steps	1 to 500	Sets the total number of staircase steps. Default is 10.
Edit Points	-	Create a user-defined Arb from the present Arb property values. This lets you edit specific points in the standard arbitrary waveform.

Step 3 – Run the Arb

NOTE	When the arbitrary waveform runs, front panel voltage and current controls as well as any remote voltage and current commands are ignored until after the Arb completes.

In this example, the Arb type is Voltage.

- Set the Arb Type to Voltage.

- Set V0, V1, t0, t1, t2, # of Steps, Voltage after Arb, and repeat count accordingly. 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]**.

- Set Trigger Source to Key. Press **Properties** > **Trig Src Key**.

- Press the color-coded **[On]** key to enable the output.

- Press **Run** to start the Arb operation. To abort the operation, press **Stop**. Alternatively, press **[List Run/Stop]**.

- Press **[Scope/Datalog]** to enter Scope view and display the Arb.

From the remote interface:

Select the Arb Type and Shape:
ARB:FUNC:TYPE VOLT
ARB:FUNC:SHAP STA

Enter the values for the level before and after a voltage staircase:
ARB:VOLT:STA:STAR 0
ARB:VOLT:STA:END 5

Enter the time before the staircase, the stair-time of the ramp, and the time after the staircase:
ARB:VOLT:STA:STAR:TIM 0.2
ARB:VOLT:STA:TIM 0.2
ARB:VOLT:STA:END:TIM 0.2

Enter the total number of staircase steps:
ARB:VOLT:STA:NST 3

The parameter setting returns to the DC value that was in effect prior to the Arb.
ARB:TERM:LAST OFF

The parameter setting remains at the last Arb value after the Arb completes.
ARB:TERM:LAST ON

Specify the repeat count of the Arb, or specify continuous repetition (INF):
ARB:COUN 10
ARB:COUN INF

To set the voltage mode to Arb:
VOLT:MODE ARB

Set the trigger source to Key/Immediate:
TRIG:SOUR IMM

To enable the output:
OUTP ON

To initiate the transient trigger system:
INIT:TRAN

Pulse Arb (Option E36150ADVU)

Step 1– Select Arb waveform

Press **Arb** to access the Arb selection menu. Then select **Pulse**.

Press **Back** to return to Arb main menu.

Step 2 – Configure the Pulse Arbs

Press **Properties**. Then program the following parameters:
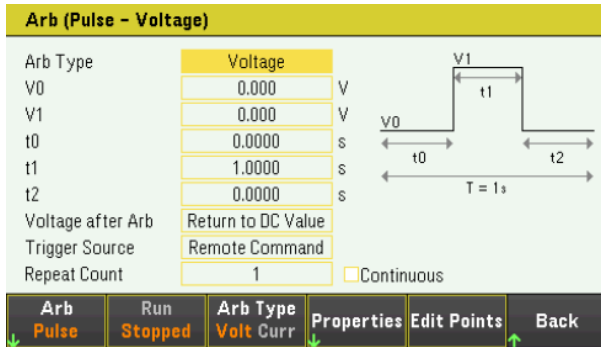
Configure the Pulse Arb accordingly. Refer to the below table for details.

Parameter	Available Key Settings	Description
Arb Type	Voltage or Current	Sets the output Arb type. Default is Voltage. Action required: Press **Arb Type** to toggle between Volt and Curr. Volt — Selects voltage as output Arb type. Curr — Selects current as output Arb type.
Start Setting (I0 or V0)	minimum to maximum	Sets the setting before and after the pulse.
Pulse Setting (I1 or V1)	minimum to maximum	Sets the amplitude of the pulse.
Delay (t0)	0 – 3600 s	Sets the delay time after the trigger is received but before the pulse starts.
Pulse Width (t1)	0 – 3600 s	Sets the width of the pulse.
End time (t2)	0 – 3600 s	Sets the time the output remains at the end setting after the pulse completes.

Parameter	Available Key Settings	Description
Voltage after Arb Current after Arb	DC or LAST	Specifies what happens to the parameter settings when the Arb completes. Default is DC.
		Action required: Press **After Arb** to toggle between DC and LAST.
		DC (Return to DC Value) — The parameter setting returns to the DC value that was in effect prior to the Arb.
		LAST (Last List Value) — The parameter setting remains at the last Arb value.
Trigger Source	Key, IO, or Rmt	Sets the trigger source for the system. Default is Rmt.
		Action required: Press **Properties** > **Trig Src**>to toggle between Key, IO, and Rmt.
		Key (Arb Run/Stop Key) — Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
		IO (DIO Trigger In) — Selects any configured digital IO (with Trigger Input function) as a trigger source
		Rmt (Remote Command) — Selects a remote interface command as a trigger source.
Repeat Count	1 to 16,777,216	Sets the Arb repeat count. This sets the number of times that an Arb is executed before it completes. Default is 1.
Continuous	On or Off	Enables check box to repeat the Arb continuously. Default is On.
		Action required: Press **Properties** > **Continuous** to toggle between On and Off.
		On — Enables the check box.
		Off — Disables the check box.
Edit Points	-	Create a user-defined Arb from the present Arb property values. This lets you edit specific points in the standard arbitrary waveform.

Step 3 – Run the Arb

NOTE	When the arbitrary waveform runs, front panel voltage and current controls as well as any remote voltage and current commands are ignored until after the Arb completes.

In this example, the Arb type is Voltage.

- – Set the Arb Type to Voltage.

- – Set V0, V1, t0, t1, t2, Voltage after Arb, and repeat count accordingly. 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]**.

- – Set Trigger Source to Key. Press **Properties** > **Trig Src Key**.

- – Press the color-coded **[On]** key to enable the output.

- – Press **Run** to start the Arb operation. To abort the operation, press **Stop**. Alternatively, press **[List Run/Stop]**.

- – To view the Arb waveform, press **[Scope/Datalog]** to enter Scope view.

- – Press **[Scope/Datalog]** to enter Scope view and display the Arb.

From the remote interface:

Select the Arb Type and Shape:
ARB:FUNC:TYPE VOLT
ARB:FUNC:SHAP PULS

Enter the values for the level before and the top of a voltage pulse:
ARB:VOLT:PULS:STAR 0
ARB:VOLT:PULS:TOP 10

Enter the time before the pulse, the time of the pulse, and the time after the pulse:
ARB:VOLT:PULS:STAR:TIM 0.25
ARB:VOLT:PULS:TIM 0.5
ARB:VOLT:PULS:END:TIM 0.25

The parameter setting returns to the DC value that was in effect prior to the Arb.
ARB:TERM:LAST OFF

The parameter setting remains at the last Arb value after the Arb completes.
ARB:TERM:LAST ON

Specify the repeat count of the Arb, or specify continuous repetition (INF):
ARB:COUN 10
ARB:COUN INF

To set the voltage mode to Arb:
VOLT:MODE ARB

Set the trigger source to Key/Immediate:
TRIG:SOUR IMM

To enable the output:
OUTP ON

To initiate the transient trigger system:
INIT:TRAN

Trapezoid Arb (Option E36150ADVU)

Step 1– Select Arb waveform

Press **Arb** to access the Arb selection menu. Then select **Trapezoid**.

Press **Back** to return to Arb main menu.

Step 2 – Configure the Trapezoid Arbs
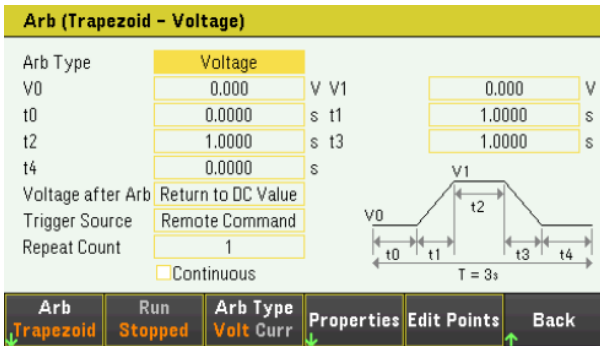
Configure the Trapezoid Arb accordingly. Refer to the below table for details.

Parameter	Available Key Settings	Description
Arb Type	Voltage or Current	Sets the output Arb type. Default is Voltage. Action required: Press **Arb Type** to toggle between Volt and Curr.
		Volt Selects voltage as output Arb type.
		Curr Selects current as output Arb type.
Start Setting (I0 or V0)	minimum to maximum	Sets the setting before and after the trapezoid.
Peak Setting (I1 or V1)	minimum to maximum	Sets the peak setting.
Delay (t0)	0 – 3600 s	Sets the delay time after the trigger is received but before the trapezoid starts.
Rise time (t1)	0 – 3600 s	Sets the time the trapezoid ramps up.
Peak Width (t2)	0 – 3600 s	Sets the width of the peak.
Fall Time (t3)	0 – 3600 s	Sets the time that the trapezoid ramps down.
End Time (t4)	0 – 3600 s	Sets the time the output remains at the end setting after the trapezoid completes.

Parameter	Available Key Settings	Description	
Voltage after Arb Current after Arb	DC or LAST	Specifies what happens to the parameter settings when the Arb completes. Default is DC.	
		Action required: Press **After Arb** to toggle between DC and LAST.	
		DC (Return to DC Value)	The parameter setting returns to the DC value that was in effect prior to the Arb.
		LAST (Last List Value)	The parameter setting remains at the last Arb value.
Trigger Source	Key, IO, or Rmt	Sets the trigger source for the system. Default is Rmt.	
		Action required: Press **Properties** > **Trig Src**>to toggle between Key, IO, and Rmt.	
		Key (Arb Run/Stop Key)	Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
		IO (DIO Trigger In)	Selects any configured digital IO (with Trigger Input function) as a trigger source
		Rmt (Remote Command)	Selects a remote interface command as a trigger source.
Repeat Count	1 to 16,777,216	Sets the Arb repeat count. This sets the number of times that an Arb is executed before it completes. Default is 1.	
Continuous	On or Off	Enables check box to repeat the Arb continuously. Default is On.	
		Action required: Press **Properties** > **Continuous** to toggle between On and Off.	
		On	Enables the check box.
		Off	Disables the check box.
Edit Points	-	Create a user-defined Arb from the present Arb property values. This lets you edit specific points in the standard arbitrary waveform.	

Step 3 – Run the Arb

NOTE	When the arbitrary waveform runs, front panel voltage and current controls as well as any remote voltage and current commands are ignored until after the Arb completes.

In this example, the Arb type is Voltage.

- Set the Arb Type to Voltage.

- Set V0, V1,t0, t1, t2, t3, t4, Voltage after Arb, and repeat count accordingly. 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]**.

- Set Trigger Source to Key. Press **Properties** > **Trig Src Key**.

- Press the color-coded **[On]** key to enable the output.

- Press **Run** to start the Arb operation. To abort the operation, press **Stop**. Alternatively, press **[List Run/Stop]**.

- Press **[Scope/Datalog]** to enter Scope view and display the Arb.

From the remote interface:

Select the Arb Type and Shape:
ARB:FUNC:TYPE VOLT
ARB:FUNC:SHAP TRAP

Enter the values for the level before and during the top of a voltage trapezoid:
ARB:VOLT:TRAP:STAR 0
ARB:VOLT:TRAP:TOP 5

Enter the time before the trapezoid, the rise-time,fall-time, top-time, and the time after the trapezoid:
ARB:VOLT:TRAP:STAR:TIM 0.25
ARB:VOLT:TRAP:RTIM 0.5
ARB:VOLT:TRAP:FTIM 0.5
ARB:VOLT:TRAP:TOP:TIM 1.5
ARB:VOLT:TRAP:END:TIM 0.25

The parameter setting returns to the DC value that was in effect prior to the Arb.
ARB:TERM:LAST OFF

The parameter setting remains at the last Arb value after the Arb completes.
ARB:TERM:LAST ON

Specify the repeat count of the Arb, or specify continuous repetition (INF):
ARB:COUN 10
ARB:COUN INF

To set the voltage mode to Arb:
VOLT:MODE ARB

Set the trigger source to Key/Immediate:
TRIG:SOUR IMM

To enable the output:
OUTP ON

To initiate the transient trigger system:
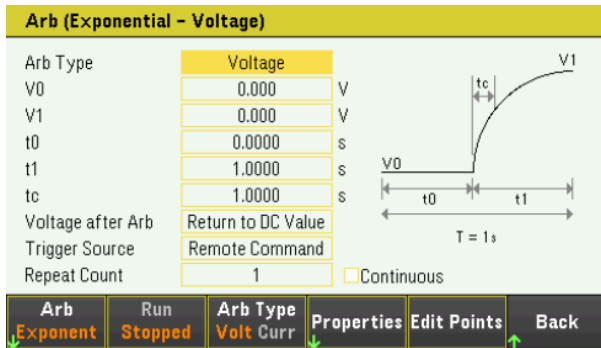INIT:TRAN

Exponential Arb (Option E36150ADVU)

Step 1– Select Arb waveform

Press **Arb** to access the Arb selection menu. Then select **Exponent**.

Press **Back** to return to Arb main menu.

Step 2 – Configure the Exponential Arb

Configure the Exponential Arb accordingly. Refer to the below table for details.

Parameter	Available Key Settings	Description
Arb Type	Voltage or Current	Sets the output Arb type. Default is Voltage.
		Action required:
		Press **Arb Type** to toggle between Volt and Curr.
		Volt — Selects voltage as output Arb type.
		Curr — Selects current as output Arb type.
Start Setting (I0 or V0)	minimum to maximum	Sets the setting before the waveform.
Peak Setting (I1 or V1)	minimum to maximum	Sets the end setting of the waveform.
Delay (t0)	0 – 3600 s	Sets the delay time after the trigger is received but before the waveform starts.
Time (t1)	0 – 3600 s	Sets the time for the amplitude to go from the start setting to the end setting.
Time Constant (tc)	0 – 3600 s	Sets the time constant of the curve.

Parameter	Available Key Settings	Description
Voltage after Arb Current after Arb	DC or LAST	Specifies what happens to the parameter settings when the Arb completes. Default is DC. Action required: Press **After Arb** to toggle between DC and LAST.
		DC (Return to DC Value) — The parameter setting returns to the DC value that was in effect prior to the Arb.
		LAST (Last List Value) — The parameter setting remains at the last Arb value.
Trigger Source	Key, IO, or Rmt	Sets the trigger source for the system. Default is Rmt. Action required: Press **Properties** > **Trig Src**>to toggle between Key, IO, and Rmt.
		Key (Arb Run/Stop Key) — Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
		IO (DIO Trigger In) — Selects any configured digital IO (with Trigger Input function) as a trigger source
		Rmt (Remote Command) — Selects a remote interface command as a trigger source.
Repeat Count	1 to 16,777,216	Sets the Arb repeat count. This sets the number of times that an Arb is executed before it completes. Default is 1.
Continuous	On or Off	Enables check box to repeat the Arb continuously. Default is On. Action required: Press **Properties** > **Continuous** to toggle between On and Off.
		On — Enables the check box.
		Off — Disables the check box.
Edit Points	-	Create a user-defined Arb from the present Arb property values. This lets you edit specific points in the standard arbitrary waveform.

Step 3 – Run the Arb

NOTE — When the arbitrary waveform runs, front panel voltage and current controls as well as any remote voltage and current commands are ignored until after the Arb completes.

In this example, the Arb type is Voltage.

– Set the Arb Type to Voltage.

– Set V0, V1, t0, t1, tc, Voltage after Arb, and repeat count accordingly. 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]**.

– Set Trigger Source to Key. Press **Properties** > **Trig Src Key**.

– Press the color-coded **[On]** key to enable the output.

– Press **Run** to start the Arb operation. To abort the operation, press **Stop**. Alternatively, press **[List Run/Stop]**.

– Press **[Scope/Datalog]** to enter Scope view and display the Arb.

From the remote interface:

Select the Arb Type and Shape:
ARB:FUNC:TYPE VOLT
ARB:FUNC:SHAP EXP

Enter the values for the level before and after a voltage exponential:
ARB:VOLT:EXP:STAR 0
ARB:VOLT:EXP:END 5

Enter the time before the exponential, the exponential time, and the time constant of the exponential:
ARB:VOLT:EXP:STAR:TIM 0.25
ARB:VOLT:EXP:TIM 0.75
ARB:VOLT:EXP:TCON 0.1

The parameter setting returns to the DC value that was in effect prior to the Arb.
ARB:TERM:LAST OFF

The parameter setting remains at the last Arb value after the Arb completes.
ARB:TERM:LAST ON

Specify the repeat count of the Arb, or specify continuous repetition (INF):
ARB:COUN 10
ARB:COUN INF

To set the voltage mode to Arb:
VOLT:MODE ARB

Set the trigger source to Key/Immediate:
TRIG:SOUR IMM

To enable the output:
OUTP ON

To initiate the transient trigger system:
INIT:TRAN

Arb Sequence (Option E36150ADVU)

The Arb Sequence allows multiple and different Arbs to run one after another is succession. Any of the standard Arb types can be included in the Arb sequence. All Arbs in the sequence must be of the same type; either voltage, or current.

As with single Arbs, each Arb in the sequence has its own repeat count, can be set for dwell or trigger pacing, and can be set to repeat continuously. Note also that a repeat count can be set for the entire sequence, and it can also be set to repeat continuously.

The following figure illustrates a sequence comprised of a pulse Arb, a ramp Arb, and a sine Arb. The repeat count value indicates how many times each Arb repeats before moving to the next type.
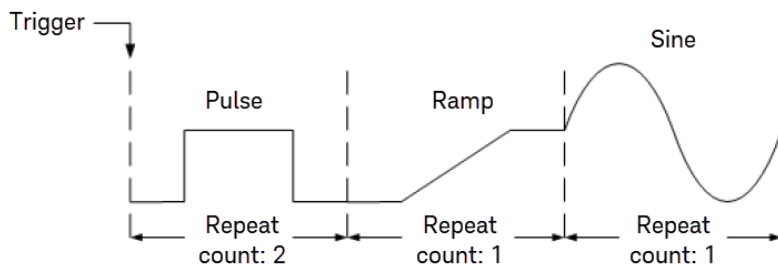
Step 1– Select Arb waveform

Press **Arb** to access the Arb selection menu. Then select **Sequence**.

Press **Back** to return to Arb main menu.

Step 2– Configure the Arb Sequence

Fields	Description
Step <n>	Each step of the sequence includes a step number, an arbitrary waveform, step time, pacing option, and repeat count. The total number of steps determines the length. Use the navigation keys to scroll through the steps.
Out Type	Displays the Arb of the step.
Time	Displays the total time that is allocated to the step in the Edit Table function.

Fields	Description
Pacing	Displays the pacing of the step. Dwell-paced transitions to the next step when the dwell time has elapsed. Trigger-paced transitions to the next step when an external trigger is received. If the step time completes before the trigger occurs, the step remains at the last Arb value while waiting for the trigger.
Repeat Count	Sets the Arb repeat count. This sets the number of times that the Arb is executed before it completes.

Configure the Arb sequence accordingly. Refer to the below table for details.

Parameter	Available Key Settings	Description	
Arb Type	Voltage or Current	Sets the output Arb type. Default is Voltage. Action required: Press **Arb Type** to toggle between Volt and Curr.	
		Volt	Selects voltage as output Arb type.
		Curr	Selects current as output Arb type.
Edit Table >			
Add	-	Inserts a step below the selected step. Continue to Add steps until your sequence is complete.	
Delete	-	Deletes the presently selected step.	
Clear	-	Clears all steps from sequence table.	

Parameter	Available Key Settings	Description
Change Out Type	List, Step, Ramp, Staircase, Sine, Pulse, Trapezoid, or Exponent	Selects an Arb for the selected step. Default is Pulse.

Action required:

Press **Change Out Type** and select the Arb waveform.

List	Selects the List Arb.
Step	Selects the Step Arb.
Ramp	Selects the Ramp Arb.
Staircase	Selects the Staircase Arb.
Sine	Selects the Sine Arb.
Pulse	Selects the Pulse Arb.
Trapezoid	Selects the Trapezoid Arb.
Exponent	Selects the Exponential Arb.

Edit

Edit the selected Arb waveform.
Example of the Pulse waveform edit fields are shown below:

Move to the Next Step - specifies the step pacing, either dwell or trigger-paced.
Repeat Count - specifies how many times the Arb repeats. The repeat count can be set up to 16,777,216.
Continuous - can only be selected if the Arb is trigger-paced.

Properties >

Parameter	Available Key Settings	Description
After Arb	DC or LAST	Specifies what happens to the parameter settings when the Arb sequence completes. Default is DC.

Action required:
Press **After Arb** to toggle between DC and LAST.

DC (Return to DC Value)	The parameter setting returns to the DC value that was in effect prior to the Arb.
LAST (Last List Value)	The parameter setting remains at the last Arb value.

Parameter	Available Key Settings	Description	
Trig Src	Key, IO, or Rmt	Sets the trigger source for the system. Default is Rmt. Action required: Press **Trig Src** to toggle between Key, IO, and Rmt.	
		Key (Arb Run/Stop Key)	Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
		IO (DIO Trigger In)	Selects any configured digital IO (with Trigger Input function) as a trigger source
		Rmt (Remote Command)	Selects a remote interface command as a trigger source.
Repeat Count	1 to 4096	Sets the Arb sequence repeat count. This sets the number of times that the Arb sequence is executed before it completes. Default is 1.	
Continuous	-	Enables check box to repeat the sequence step continuously.	

Step 4 – Run the Arb sequence

> **NOTE** When Arb sequence is initiated, all the Arb properties cannot be configured, which includes adding or removing step from the sequence list.

- Set Trigger Source to Key. Press **Trig Src Key**.

- Press the color-coded **[On]** key to enable the output.

- Press **Run** to start the Arb operation. To abort the operation, press **Stop**. Alternatively, press **[List Run/Stop]**.

- Press **Back** to exit and return to the previous menu.

- Press **[Scope/Datalog]** to enter Scope view and display the Arb.

From the remote interface:

Observe the following when creating or editing an Arb sequence:

- The Arb function type must match the Arb type specified in each sequence step.

- Sequence steps must be specified sequentially. The last value in the parameter list is the sequence step number.

- When a step is added, all Arb parameters must be entered.

The following commands program a voltage sequence comprised of a pulse, a ramp, and a sine Arb with the pulse Arb repeated twice.

To set up output 1 to program a sequence of voltage waveforms:
ARB:FUNC:TYPE VOLT
ARB:FUNC:SHAP SEQ
ARB:SEQ:RESet

To program step 0 as a voltage pulse:
ARB:SEQ:STEP:FUNC:SHAP PULS,0
ARB:SEQ:STEP:VOLT:PULS:STAR:TIM 0.25,0
ARB:SEQ:STEP:VOLT:PULS:TOP 10.0,0
ARB:SEQ:STEP:VOLT:PULS:TOP:TIM 0.5,0
ARB:SEQ:STEP:VOLT:PULS:END:TIM 0.25,0,(@1)

To program step 1 as a voltage ramp:
ARB:SEQ:STEP:FUNC:SHAP RAMP,1
ARB:SEQ:STEP:VOLT:RAMP:STAR:TIM 0.25,1
ARB:SEQ:STEP:VOLT:RAMP:END 10.0,1
ARB:SEQ:STEP:VOLT:RAMP:RTIM 0.5,1
ARB:SEQ:STEP:VOLT:RAMP:END:TIM 0.25,1

To program step 2 as a voltage sine wave:
ARB:SEQ:STEP:FUNC:SHAP SIN,2
ARB:SEQ:STEP:VOLT:SIN:FREQ 1,2
ARB:SEQ:STEP:VOLT:SIN:OFFS 10.0,2
ARB:SEQ:STEP:VOLT:SIN:AMPL 5.0,2

To repeat step 0 twice:
ARB:SEQ:STEP:COUN 2,0

To end the sequence at the last Arb value:
ARB:SEQ:TERM:LAST ON

To make the entire sequence repeat twice:
ARB:SEQ:COUN 2

To set the voltage mode to Arb:
VOLT:MODE ARB

To set the current mode to Arb:
CURR:MODE ARB

To set the trigger source to Key/Immediate:
TRIG:SOUR IMM

To enable the output:
OUTP ON

To initiate and run the list:
INIT:TRAN

Using the Digital Control Port

Bi-directional digital IO

Digital input

Fault output

Inhibit input

Fault/inhibit system protection

Trigger input

Trigger output

Output Couple Controls

A Digital Control Port consisting of three 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:

Bi-directional digital IO

Each of the three pins can be configured as general purpose bi-directional digital inputs and outputs. The polarity of the pins can also be configured. Pin 4 is the signal common for the digital I/O pins. Data is programmed according to the following bit assignments:

Pins	3	2	1
Bit Weight	2 (msb)	1	0 (lsb)
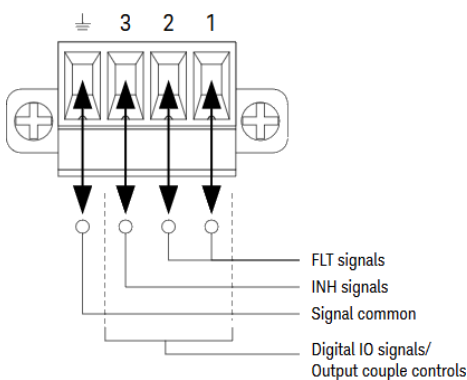
The digital I/O pin can be used to control both relay circuits as well as digital interface circuits. The figure above illustrates typical relay circuits as well as digital interface circuit connections using the digital I/O functions.

From the front panel:

1. Press **Utilities** > **I/O Config** > **Digital IO** to access the Digital I/O window.
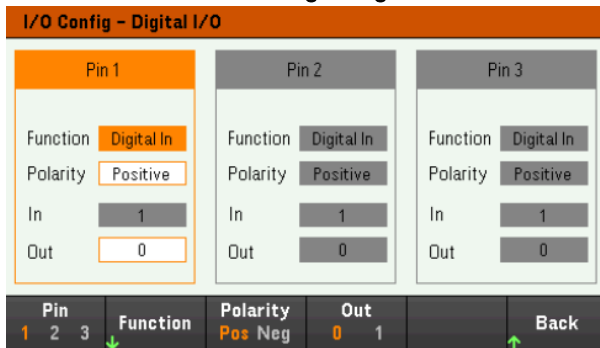
2. Select the pin you wish to configure. For example, press **Pin 1** to configure Pin 1.

3. Press **Function** and select **Digital I/O**. Select and program the remaining pins in the same manner. Press **Back** to return to previous page.

4. Configure the polarity for each of the pin. Press **Polarity Pos** to select Positive and **Polarity Neg** to select Negative. Select and program the remaining pins in the same manner.

5. The In and Out field only apply to the Digital I/O and Digital In functions. Press **Out** to toggle and enter the binary bit (0 or 1) into the Out field of the digital I/O window. For Digital I/O function, a binary bit 1 with positive polarity specify a voltage high at the pin while a binary bit 0 with positive polarity specify a voltage low at the pin. The In field reflects the condition of the external signal that is applied to the pins.

From the remote interface:

To configure the digital I/O function for pins 1 through 3:
DIG:PIN 1:FUNC DIO
DIG:PIN 2:FUNC DIO
DIG:PIN 3:FUNC DIO

To configure the pin polarity to positive for pins 1 through 3:
DIG:PIN 1:POL POS
DIG:PIN 2:POL POS
DIG:PIN 3:POL POS

To send a binary weighted value to configure pins 1 through 3 as "111":
DIG:OUTP:DATA 7

Digital input

Each of the three pins can be configured as digital input only. The ground reference for the input pins is Signal Common on pin 4.

From the front panel:

1. Press **Utilities** > **I/O Config** > **Digital IO** to access the Digital I/O window.

2. Select the pin you wish to configure. For example, press **Pin 1** to configure Pin 1.

3. Press **Function** and select **Digital In**. Select and program the remaining pins in the same manner. Press **Back** to return to previous page.

4. Configure the polarity for each of the pin. Press **Polarity Pos** to select Positive and **Polarity Neg** to select Negative. Select and program the remaining pins in the same manner.

5. The In and Out field only apply to the Digital I/O and Digital In functions. The In field reflects the condition of the external signal that is applied to the pins. The pin state is not affected by the value of the binary output word.

From the remote interface:

To configure the pin function:
DIG:PIN 1:FUNC DINP

To select the pin polarity:
DIG:PIN 1:POL POS
DIG:PIN 1:POL NEG

To read the pin data:
DIG:INP:DATA?

Fault output

Pins 1 and 2 can be configured as a fault output. The Fault Output function enables a fault condition on any channel to generate a protection fault signal on the digital port. The following conditions will generate a fault event: over-voltage, over-current, over-temperature and inhibit signal.

Both pins 1 and 2 are dedicated to this function. Pin 1 is the fault output; pin 2 is the common for pin 1. This provides for an optically-isolated output. The polarity of pin 1 can also be configured. Note that the fault output signal remains latched until the fault condition is removed and the protection circuit is cleared.

NOTE	Pin 2's selected function is ignored. Pin 2 should be connected to the ground of the external circuit.

From the front panel:

1. Press **Utilities** > **I/O Config** > **Digital IO** to access the Digital I/O window.

2. Press **Pin 1** to configure Pin 1.

3. Press **Function** and select **Fault Out**. Press **Back** to return to previous page.

4. Configure the polarity for each of the pin. Press **Polarity Pos** to select Positive and **Polarity Neg** to select Negative.

From the remote interface:

To configure the pin function:
DIG:PIN1:FUNC FAUL

To select the pin polarity:
DIG:PIN1:POL POS
DIG:PIN1:POL NEG

Inhibit input

Pin 3 can be configured as a remote inhibit input. The Inhibit Input function lets an external input signal control the output state of all the output channels in the power supply. The polarity of pin 3 can also be configured. The input is level triggered. The signal latency is less than 450 microseconds. Maximum time required for all the output channels to start to turn off is 45 ms. Pin 4 is the common for pin 3.

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.

From the front panel:

Configure Pin 3 as a remote inhibit input:

1. Press **Utilities** > **I/O Config** > **Digital IO** to access the Digital I/O window.

2. Press **Pin 3** to configure Pin 3.

3. Press **Function** and select **Inhibit In** to configure Pin 3 as a remote inhibit input. Press **Back** to return to previous page.

4. Configure the polarity for Pin 3. Press **Polarity Pos** to select Positive and **Polarity Neg** to select Negative.

Alternatively, you can configure Pin 3 as a remote inhibit input by pressing **Output Settings** > **Output Inhibit** > **DIO Pin 3 INH**. In this setting, the polarity is set to Positive by default.

Configure the inhibit input mode:

1. Press the **Output Settings** > **Output Inhibit** to configure the inhibit input mode.

2. Select the desired mode (**Off**, **Latched** or **Live**).

To clear the Inhibit protection function, first remove the external Inhibit signal. Then select **Source Settings** > **Protection Clear** for all outputs. This clears the Inhibit protection function and returns the output to its previous operating state.

From the remote interface:

To select the Inhibit function:
DIG:PIN3:FUNC INH

To select the pin polarity:
DIG:PIN3:POL POS
DIG:PIN3:POL NEG

To set Inhibit mode to Latching:
OUTP:INH:MODE LATC

To set Inhibit mode to Live:
OUTP:INH:MODE LIVE

To disable the Inhibit signal:
OUTP:INH:MODE OFF

Fault/inhibit system protection

The following figure illustrates some ways that you can connect the Fault/Inhibit pins of the connector.
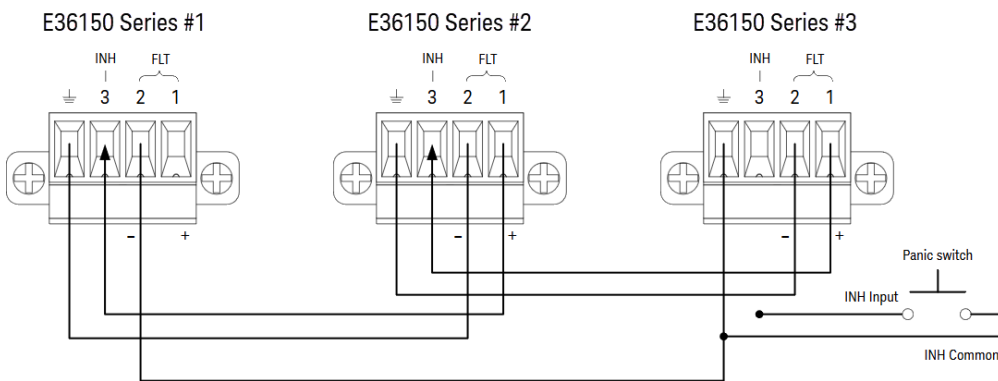
As shown in the figure, when the Fault outputs and Inhibit inputs of several instruments are daisy-chained, an internal fault condition in one of the units will disable all outputs without intervention by either the controller or external circuitry. Note that when using the Fault/Inhibit signals in this manner, both signals must be set to the same polarity.

You can also connect the Inhibit input to a manual switch or external control signal that will short the Inhibit pin to common whenever it is necessary to disable all outputs. **Negative** polarity must be programmed for all pins in this case. You can also use the Fault output to drive an external relay circuit or signal other devices whenever a user-definable fault occurs.

Clearing a System Protection Fault

To restore all instruments to a normal operating condition when a fault condition occurs in a daisy-chained system protection configuration, two fault conditions must be removed:

1. The initial protection fault or external Inhibit signal.

2. The subsequent daisy-chained fault signal (which is sourced by the Inhibit signal).

> **NOTE**   Even when the initial fault condition or external signal is removed, the fault signal is still active and will continue to shut down the outputs of all the units.

To clear the daisy-chained fault signal if the operating mode of the Inhibit input is Live, simply clear the output protection on any ONE unit by pressing **Source Settings** > **Protection Clear** for all outputs.

If the operating mode of the Inhibit input is Latched, turn off the inhibit input and clear the output protection for all outputs on ALL units individually. To re-enable the chain, re-program the Inhibit input on each unit to Latched mode.

Trigger input

Any of the Digital Control pins can be programmed to function as a trigger input. All pins are referenced to the signal common pin.

To input an external trigger signal, you can apply either a negative-going or a positive-going pulse to the designated trigger input pin. The trigger latency is less than 450 microseconds. The minimum pulse width is 2 microseconds. The pin's polarity setting determines which edge generates a trigger-in event. Positive means a rising edge and Negative means a falling edge.

You can configure the data logger and the output list to be triggered by external trigger signals. Simply select DIO Trigger In as the trigger source when configuring the data logger and output list. This will enable input trigger signals on the configured digital pins. A trigger is generated when an external signal that meets the signal criteria is applied to any configured trigger input pin.

From the front panel:

1. Press **Utilities** > **I/O Config** > **Digital IO** to access the Digital I/O window.

2. Select the pin you wish to configure. For example, press **Pin 1** to configure Pin 1.

3. Press **Function** and select **Trigger In**. Select and program the remaining pins in the same manner. Press **Back** to return to previous page.

4. Configure the polarity for each of the pin. Press **Polarity Pos** to select Positive and **Polarity Neg** to select Negative. Select and program the remaining pins in the same manner.

From the remote interface:

To select the trigger input function:
DIG:PIN1:FUNC TINP

To select the pin polarity:
DIG:PIN1:POL POS
DIG:PIN1:POL NEG

Trigger output

Any of the Digital Control pins can be programmed to function as a trigger output. All pins are referenced to the Signal Common pin.

When configured as a trigger output, the designated trigger pin will generate a 10-microsecond trigger pulse in response to a trigger event. The polarity setting can be either positive-going (rising edge) or negative-going (falling edge) when referenced to common.

Trigger out signals can be generated when configuring the voltage and current in the Output LIST. If you check the BOST and EOST boxes when configuring the Output LIST, an output trigger signal will be generated on the configured digital pin at the start and end of the voltage and current step.

From the front panel:

1. Press **Utilities** > **I/O Config** > **Digital IO** to access the Digital I/O window.

2. Select the pin you wish to configure. For example, press **Pin 1** to configure Pin 1.

3. Press **Function** and select **Trigger Out**. Select and program the remaining pins in the same manner. Press **Back** to return to previous page.

4. Configure the polarity for each of the pin. Press **Polarity Pos** to select Positive and **Polarity Neg** to select Negative. Select and program the remaining pins in the same manner.

From the remote interface:

To select the trigger output function:
DIG:PIN1:FUNC TOUT

To select the pin polarity:
DIG:PIN1:POL POS
DIG:PIN1:POL NEG

Output couple controls

This function lets you connect multiple Keysight E36150 Series power supplies together and synchronize the output on/off sequence across units. Each power supply that will be synchronized must have at least one coupled output.

1. Configure the outputs on each power supply as described under **Configuring the Output Turn-On/Turn-Off Sequence**. Set the output coupling mode to ON.

2. Set the delay offset of each individual unit to match the longest delay offset of the power supply group.

3. Connect and configure the digital connector pins of the synchronized power supplies as described in this section.

> **NOTE** All synchronized E36150 Series power supplies must have the same firmware revision. Only pins 1 through 3 can be configured as synchronization pins. You cannot configure more than one On Couple and one Off Couple pin per power supply. The polarity of the pins is not programmable; it is set to Negative.

The digital connector pins of the synchronized power supplies that contain coupled outputs must be connected together as shown in the following figure. In this example, pin 2 will be configured as the output On control. Pin 3 will be configured as the output Off control. The ground or Common pins also need to be connected together.

Only two of the digital connector pins on each power supply can be configured as "On Couple" and "Off Couple" on each synchronized power supply. The designated pins will function as both an input and an output, with a negative transition on one pin providing the synchronization signal to the other pins.
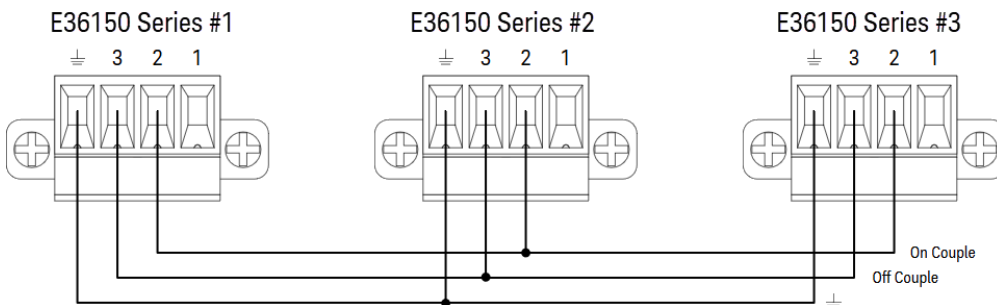
From the front panel:

1. Press **Utilities** > **I/O Config** > **Digital IO** to access the Digital I/O window.

2. Press **Pin 2**. Press **Function** and select **Couple On**.

3. Press **Pin 3**. Press **Function** and select **Couple Off**.

4. Repeat these steps for power supply #2 and #3.

From the remote interface:

To configure pin 2 of power supply #1 as the ON control:
DIG:PIN2:FUNC ONC

To configure pin 3 of power supply #1 as the OFF control:
DIG:PIN3:FUNC OFFC

Repeat these commands for power supply #2 and #3.

Operation

Once configured and enabled, turning the output on or off on any coupled output will cause all coupled outputs on all configured power supplies to turn on or off according to their user-programmed delays. This applies to the front panel On and Off keys, the Web server, and to SCPI commands.

Turning the outputs on or off using the front panel **[All On/Off]** key will cause all coupled outputs as well as non-coupled outputs on that power supply to turn on or off.

Using the Data Logger Function

The Data Logger allows you to view and log output voltage and current data for up to 10,000 hours (for single output, depending on the memory size) and up to 5 MB of data.

You can configure the Data Logger View to display voltage or current waveforms for all outputs. Once data logging completes, the data is automatically stored to a file named default.dlog.

Logging data

In the following data log example, a user-defined arbitrary waveform is captured on the data logger. The data logger records the actual output current of the arbitrary waveform.

Step 1 – Program the sequence for the output channel

Configure the output sequence as described under List Arb.
Program the output voltage, current and time values as follows:

Step 0: 0.5 V; 8 A; 1 s
Step 1: 1 V; 8 A; 1 s
Step 2: 2 V; 8 A; 1 s
Step 3: 3 V; 8 A; 1 s
Step 4: 4 V; 8 A; 1 s
Current After List: Return to DC Value
Pace: Dwell
Voltage Mode: Arb
Current Mode: Arb
Trigger Source: Arb Run/Stop Key
Continuous checkbox: Enabled

Arb (List)

Step	Voltage	Current	Time	BOST	EOST
0	0.500	8.000	1.0000	☐	☐
1	1.000	8.000	1.0000	☐	☐
2	2.000	8.000	1.0000	☐	☐
3	3.000	8.000	1.0000	☐	☐
4	4.000	8.000	1.0000	☐	☐

*Long press **[Delete]** key to clear all the list.

| Arb List | Run Stopped | Add | Delete | Properties | Back |

Arb (List) Properties

Voltage/Current After Arb	Return to DC Value
Pace	Dwell
Voltage Mode	Arb
Current Mode	Arb
Trigger Source	Arb Run/Stop Key
Trigger Delay	0.000
Repeat Count	1 ✓ Continuous

| After Arb DC LAST | Pace Dwl Trg | V Mode Fix Stp Arb | I Mode Fix Stp Arb | Trig Src Key IO Rmt | Back |

Step 2 – Configure the data logger traces

Set V1 to 5 V/Div. Set the knob function by pressing **Knob Scale** and use the Vertical knob to adjust the V1 value accordingly.

Traces are color coded according to output. The ground symbol on the right side of the display indicates the ground reference of the trace.

Step 3 – Configure the data logger properties

Press **Properties** to display the Data Logger properties field.

– Leave the default Duration and Sample Period at 30 s and 200 ms respectively.

– Set the Trigger Source to Run/Stop Key. Press **Trigger Settings** > **Trigger Source** > **Run Key**.
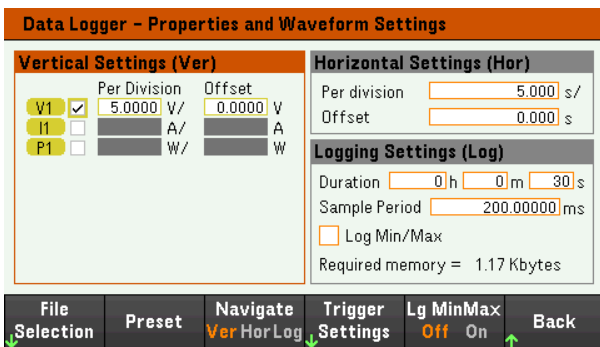
Step 4 – Turn on Output, start the sequencing and log the data

Press **Back** to return the display to the data logger view.

– Press **[On]** to turn on the output.

– Press **Datalog Run** to run the data logger. The data logger will be initiated and the output trace is displayed on the screen.

– Press **Arb** > **Arb List** > **Run Stopped** to start output sequencing. Alternatively, press **[List Run/Stop]**.

The data logger will run for 30 seconds and log the voltage data. When the data log completes, press **Auto Scale**. You should see the output waveform displayed as follows:
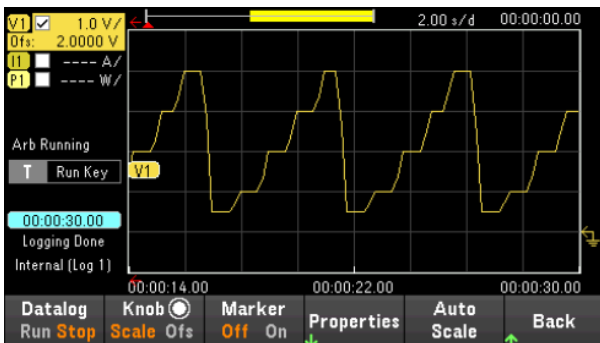

A message will indicate that the logged data has been saved in a file named default.dlog. If you wish to save the data under a different filename, you must specify the filename before the data logger runs.

Press **File Name** located at the data logger Properties menu to specify a filename.

Step 5 – Export the data

After you have completed the data logging, you can use the **Export File** key to export the logged data to a .csv (comma separated values) file.
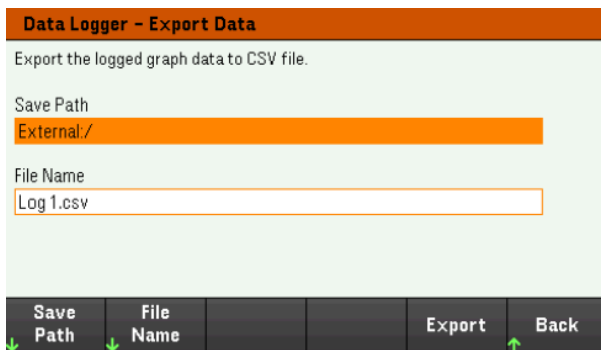
When exporting the data, specify the output you want to export the logged data.

Press **Save Path** to browse and specify the location where the export file will be placed. Use the front-panel navigation keys to navigate through the list. The left and right arrows contract or expand a folder to hide or show its files. Press **Select** once you have specified the path or **Cancel** to abort the changes made.

Press **File Name** to configure the filename. Use the keyboard to enter your desired filename in the File Name field. Press **Back** to save or **Cancel** to abort the changes made.

Press **Export** to export the file.

From the remote interface:

To program output sequence of five steps:
LIST:VOLT 0.5,1,2,3,4
LIST:CURR 0.1,0.1,0.1,0.1,0.1
LIST:DWEL 1,1,1,1,1
LIST:COUNT INF
LIST:STEP AUTO
VOLT:MODE ARB
CURR:MODE ARB

To initiate the trigger system:
TRIG:SOUR BUS
INIT (@1)

To set up the data log:
SENS:DLOG:FUNC:VOLT 1
SENS:DLOG:TIME 30
SENS:DLOG:PER 0.2

To initiate that data logger and specify the filename in which to save the data:
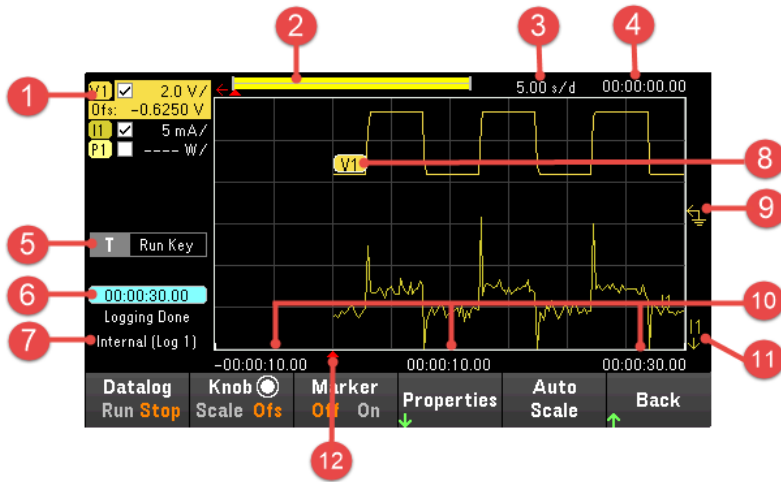TRIG:DLOG:SOUR BUS
INIT:DLOG "External:\log1.csv"

To turn on the output and run the data logger:
OUTP ON
*TRG

Data logger view

Press **Data Logger** to access the data logger.

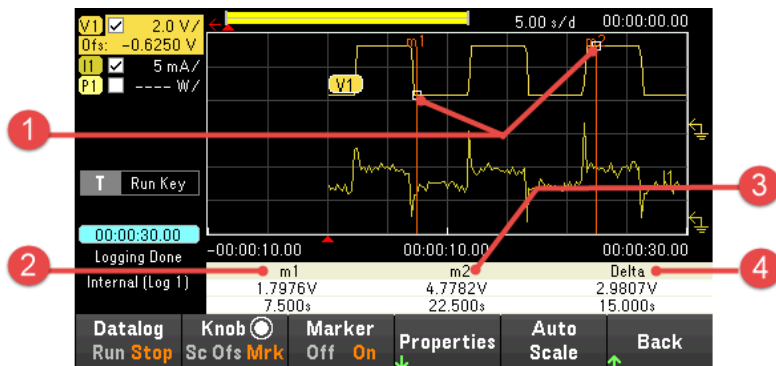| Items		Description
1	Trace controls	Identifies the voltage, current, or power trace that will be displayed. √ indicates the trace is on. Dashes (----) indicate the trace is off. Select the trace and press **[Enter]** to turn it on or off.
2	Data bar	The data bar represents all of the logged data. The yellow part indicates the portion of the data that is visible on the display. The black part represents the data that is not visible.
3	Time/Div	Identifies the horizontal time-base setting. This can be adjusted using the Horizontal knob after pressing **Knob Scale**.
4	Offset time	Indicates the time that the right gridline is offset or away from the end of the data log. When this value is zero, it means that the right gridline is positioned at the end of the data log. Adjusting the offset will move the grid away from the end of the data log, as indicated by the Offset Time. The offset can be adjusted using the Horizontal knob after pressing **Knob Ofs**.
5	Trigger source	Indicates the trigger source for the data logger.
6	Time elapsed	Indicates the time elapsed during the data log and the total duration. The values match when data logging finishes.
7	Filename	Indicates the filename of the data that is being logged.
8	Data traces	Voltage trace labels appear on the left side of the grid (V1) as shown in the display. Current trace labels appear on the right side of the grid (I1). Power trace labels appear on the center of the grid (P1). Press **Auto Scale** to auto-scale the data traces.
9	Ground reference	The ground reference of the trace. Ground references are offset so that they do not overlap. The ground reference offset value is referenced to the horizontal center line of the grid.
10	Grid time	Displays the time on the gridline.
11	Out of view arrows	Indicate that the trace, I1 in the figure, is out of view. Press **Knob Scale** or **Knob Ofs** and use the Vertical knob to bring the trace into view. Press **Auto Scale** to autoscale the data traces.

Items	Description
12 Trigger point indicator ▲	Indicates the trigger position in the data log. In this example the trigger point was offset by 0%, and the pre trigger and post trigger data was logged. The time at the trigger point is always zero. Change the trigger offset in the Data Logger Logging Settings.

Menu	Description
Datalog Run Stop	Run or stop data logging.
Knob Scale or Ofs	Scale or Ofs
Sc, Ofs, or Mrk	Marker (Mrk) only appear when Marker is enabled. Selecting **Mrk** set the function of the Vertical and Horizontal knob to adjust the m1 and m2 marker position. See Using knob in data logger view.
Marker On or Off	Enables or disables the Marker view.
Properties	Sets the data logging and waveform displays properties. See Data logger properties and waveform settings.
Auto Scale	Auto scales the traces on the display.

Data logger marker view

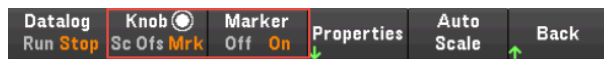| Items	Description
1 m1/m2 points	Shows where the measurement markers intersect the selected waveform. Data values at the bottom of the display are referenced to the intersect locations of the markers. Calculations are based on the data points in between the intersect locations.
2 m1	Indicates the m1 marker value in volts, amps, or watts at the intersection point. Also indicates the distance in time of the m1 marker in relation to the present trigger position. If a marker is out of view, an arrow indicates the direction of the marker < m1.
3 m2	Indicates the m2 marker value in volts, amps, or watts at the intersection point. Also indicates the distance in time that the m2 marker is in relation to the present trigger position. If a marker is out of view, an arrow indicates the direction of the marker m2 >.
4 Delta	Indicates the delta or absolute difference between the markers in units (volts, amps, or watts) and in time (seconds).

Using the knob in data logger view

The **Knob** softkey in Data Logger view determines the function for both Vertical and Horizontal knob.
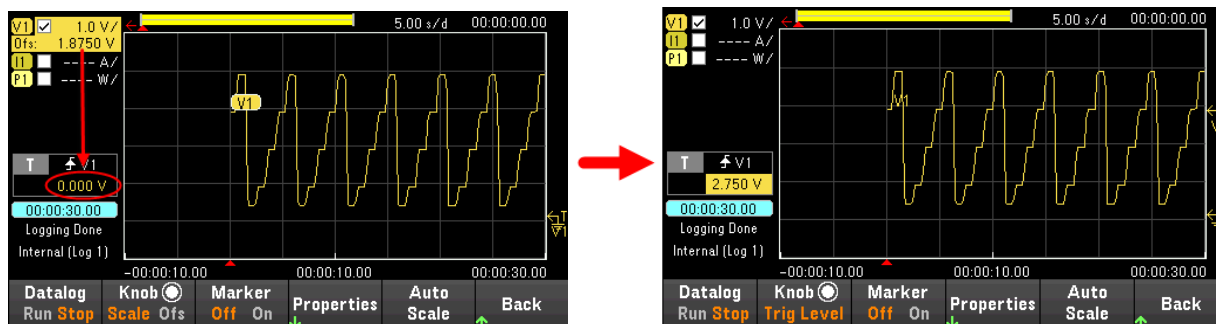
Marker Off

Marker On

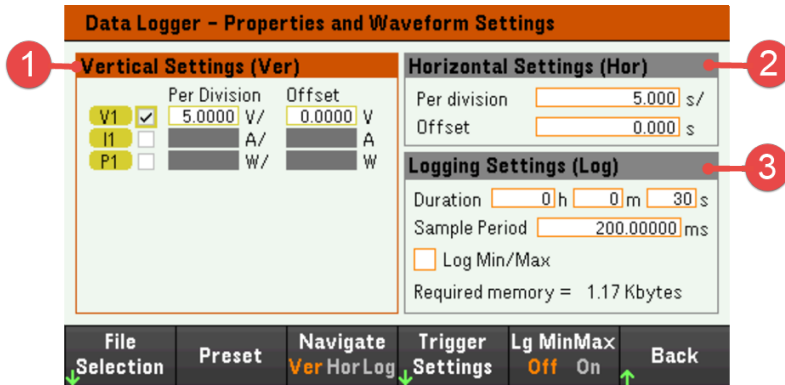| Knob control settings	Knob	Description
Scale or Sc	Vertical knob	Makes the waveform bigger or smaller vertically in relation to its ground reference. Specified in volts/division, ampere/division and watts/division on the y axis.
	Horizontal knob	Stretches or shrinks the waveform horizontally around the timebase reference. Specified in time/-division on the x axis. Applies to ALL traces.
Offset (Ofs)	Vertical knob	Moves the ground reference of the trace up or down in relation to the horizontal center line of the grid.
	Horizontal knob	Moves the waveform to the right or left of the timebase reference.
Marker (Mrk)	Vertical knob	Moves the m1 marker right or left.
	Horizontal knob	Moves the m2 marker right or left.

Using the knob for adjusting trigger level

Use the navigation keys to select the trigger level located on the left pane of data logger view, as shown below.

Adjusting the Vertical or Horizontal knob will adjust the trigger level for Voltage level, or Current level accordingly.
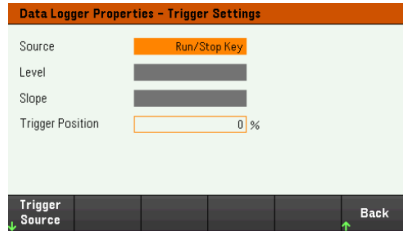
Data logger properties and waveform settings

Items		Available settings	Description
1	Vertical Settings (Ver)	Trace checkbox	Selects the trace to display for the output. If no checkbox is enabled, data logging will not be logged. Configures the voltage/division, current/division, power/division and offsets for the output.
2	Horizontal Settings (Hor)	Time/Division	Configures to zoom in or out of the data so that you can view waveform details. The numbers on the top of the display indicate the location of the data that is being viewed relative to the entire data log. Specified in time/division on the x axis. Applies to ALL traces.
		Offset	Configures the waveform location (right or left) of the timebase reference. The trigger point is indicated by the solid arrow ◢.
3	Logging Settings (Log)	Duration	Configures the duration of the data log in hours, minutes, and seconds. The maximum duration is 10,000 hours. The logging information applies to data logger measurements on all outputs.
		Sample Period	Configures the interval between data samples in milliseconds, which can be set from 10 milliseconds to 60 seconds.
		Trigger Pos	Trigger Position specifies a trigger offset. This allows the specified time of pre-trigger data to be logged to the file. For example, if you specified a data log duration of 30 s and a trigger position of 50%, the Data Logger will log 15 s of pre-trigger data to the file before the trigger occurs. Subsequently, 15 s of post-trigger data will then be logged to the data file.
		Log Min/Max checkbox	When enabled, lets you log the minimum and maximum values of each sample to the data log file. With Log Min/Max checked, the resulting file size will triple.
		Required memory	Indicates the file size when the data log completes. The maximum file size is 5 MB. If settings exceed this limit, the logging interval will automatically increase to keep the size within the limit. If the file size exceeds the available space on the drive to which it will be written, an error is generated and the Data Logger will not run.

Menu	Available settings	Description
File Selection	-	Configures the file location and filename for logged data, export the file to .csv format and load the previously logged file to the instrument.
Preset	–	Returns the Data Logger View to the power-on display settings.
Navigate	Ver, Hor or Log	Selects the Vertical Settings, Horizontal Settings or Logging Settings field. Action required: Press **Navigate** to toggle between Ver, Hor and Log.

Trigger Settings >	Trigger Source	V1 Level, I1 Level, Run Key, Arb Key, On/Off, DIO or Remote	Configures the trigger source. Default is Run Key.

Trigger Settings > — Trigger Source — V1 Level, I1 Level, Run Key, Arb Key, On/Off, DIO or Remote

Configures the trigger source. Default is Run Key.

Action required:
Press **Trigger Source** to select a trigger source. This trigger source will trigger the data logging on the output channel.

V1 Level	Selects the voltage trigger level as trigger source.
	Triggers the measurement when the voltage of the corresponding output passes through the specified level.
I1 Level	Selects the current trigger level as trigger source.
	Triggers the measurement when the current of the corresponding output passes through the specified level.
Run Key (Run/Stop Key)	Selects the Datalog Run Stop key as a trigger source.
Arb Key (Arb Run/Stop Key)	Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
On/Off (Output On/Off Key)	Selects the Output On/Off key as a trigger source.
DIO (DIO Trigger In)	Selects any configured digital IO (with Trigger Input function) as a trigger source.
Remote (Remote Command)	Selects a remote interface command as a trigger source.

Level	Specifies a trigger level if you selected a Voltage level or Current level as the trigger source. Along with the level, you must also specify a slope.
Slope	Specifies if the measurement will be triggered on the positive (up-slope) or negative (downslope) portion of the waveform.
Trigger Positions	Specifies a trigger offset. This allows the specified percent of pre-trigger data to be logged to the file. The trigger position is expressed as a percentage of the data log duration. For example, if you specified a data log duration of 30 minutes and a trigger position of 50%, the Data Logger will log 15 minutes of pre-trigger data to the file before the trigger occurs. Subsequently, 15 minutes of post-trigger data will then be logged to the data file.

| Lg MinMax | Off or On | Sets to enable or disable the Log Min/Max checkbox. Enabling the checkbox will log the minimum and maximum values to the data log file. With Log Min/Max checked, the resulting file size will triple.
Default is Off. |
| | | Action required:
Press **Lg MinMax** to toggle between Off and On. |

From the remote interface:

To enable current or voltage data logging:
SENS:DLOG:FUNC:CURR 1
SENS:DLOG:FUNC:VOLT 1

You cannot data log output power from the remote interface. To obtain power data, you need to data log both voltage and current and then calculate the power from the resulting voltage and current data.

To log the minimum and maximum values to the data log file for the enabled output:
SENS:DLOG:FUNC:MINM 1

To specify a data log of 1000 seconds on the enabled output:
SENS:DLOG:TIME 1000

To specify a sample period of 400 milliseconds between data samples on theenabled output:
SENS:DLOG:PER 0.4

To send an immediate trigger signal to the data logger:
TRIG:DLOG

To select the immediate trigger source (triggers the Data Logger immediately when initiated):
TRIG:DLOG:SOUR IMM

To select the rear panel trigger input (all connector pins that have been configured as trigger sources):
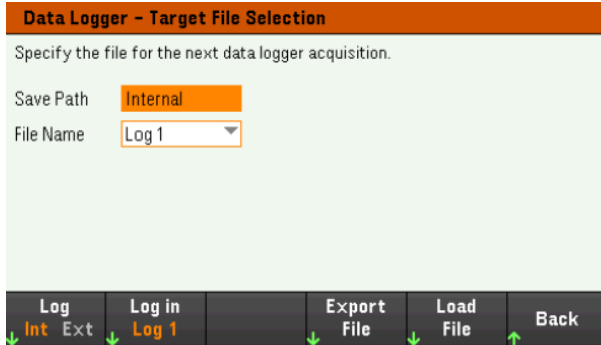TRIG:DLOG:SOUR EXT

To select a BUS trigger source:
TRIG:DLOG:SOUR BUS

Save the data log

Press **File Selection** to choose between internal logging or external logging. Select **Int** to save the data into the internal memory or **Ext** to save the data into an external USB drive.
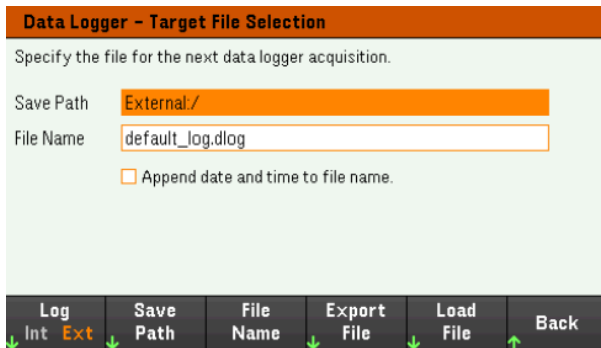
Internal logging

If you select the internal logging option, you will need to select the filename in which to save the data log — Log 1 or Log 2. Data will be logged to this filename the next time the Data Logger runs. If you do not specify a filename, the data will be logged to Log 1, which is overwritten each time the Data Logger runs.

Press **Log in** and use the arrow keys to select the desired filename (Log 1 or Log 2). Press **Log In** again to save your selection.
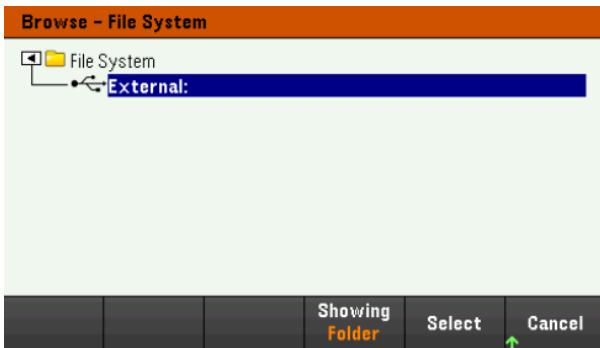
External logging

If you select the external logging option, you will need to specify a filename in which to save the data log. Data will be logged to this filename the next time the Data Logger runs. If you do not specify a filename, the data will be logged to default_log.dlog, which is overwritten each time the Data Logger runs.

Enable the **Append date and time to file name** checkbox to include timestamp information on the filename.

Press **Save Path** to browse and specify the location where the data log will be saved. Use the front-panel navigation keys to navigate through the list. The left and right arrows contract or expand a folder to hide or show its files.

To view the available folder and files in the directory, press **Showing Folder** or **Showing All**. Press **Select** once you have specified the path or **Cancel** to abort.

Press **File Name** and use the keyboard to enter the filename in the File Name field. Press **Done** to save and **Cancel** to abort.

Filename

Select the **Filename** to specify a filename in which to save the datalog. Data will be logged to this filename the next time the Data Logger runs. If you do not specify a filename, the data will be logged to default_log.dlog, which is overwritten each time the Data Logger runs.
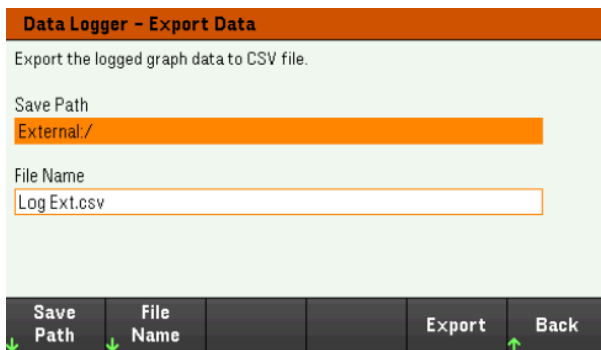

Export the data

| NOTE | To export a data log that has been saved in the USB drive, you must first load the saved file into the data logger view. |

Press **Export File** to export the data that is currently in the instrument's data log viewer to file. The exported data is in .csv format.

For details on how to specify the save location and filename, refer to Save the Data Log.
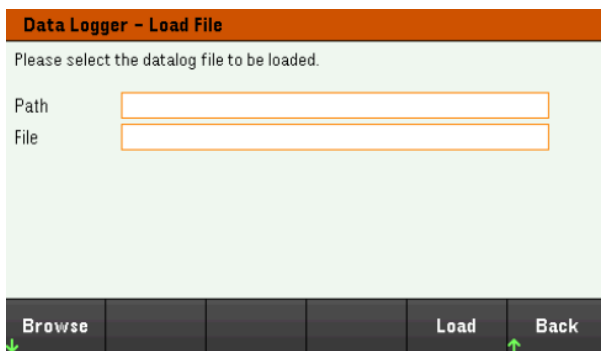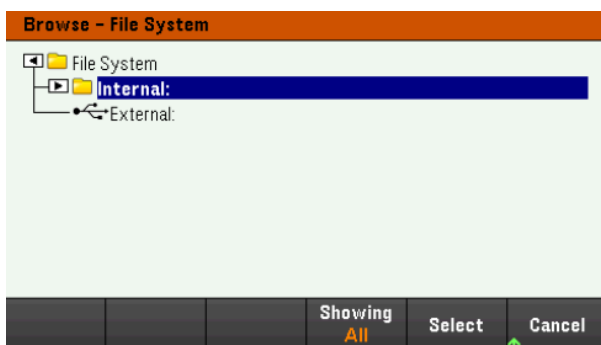
Load the data

| NOTE | The file you load must be from same instrument model. |

Press **Load File** to load the logged data to the instrument. You can load both binary files and data files in .csv format.

Press **Browse** to browse and select file from the directory. You can select from the internal memory or external memory (USB drive). Press **Select** to select the file or **Cancel** to abort.

Press **Load** to load the file.

Using the Scope Function (Option E36150ADVU)

The scope function is similar to a bench oscilloscope, displaying output voltage and current signals as a function of time. It has controls that select which outputs and functions to display, front panel knobs that adjust gain and offset, and configurable triggers and markers.

You can configure the Scope View to display voltage or current waveforms for all outputs. As explained under Horizontal Settings (Hr), the maximum sampling rate of the scope varies, depending on the number of waveforms that are displayed. Note that in the Scope View there is only one time-base and trigger configuration for all outputs.

Making measurement

In the following measurement example, an output turn-on sequence is displayed using the oscilloscope. The oscilloscope measures the actual voltage as the output turns on.

Step 1 – Program the output voltage and current values

In Meter View, set the output voltage and current to 1 V and 4 A. This is described under Controlling the Output.
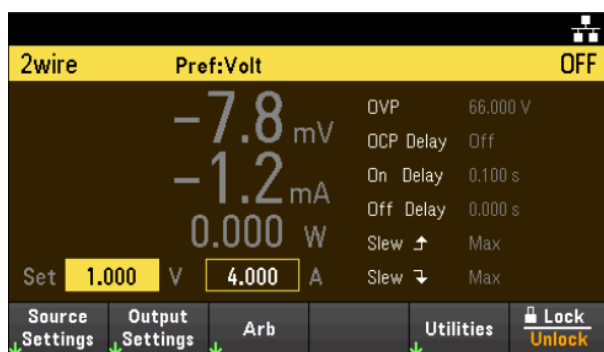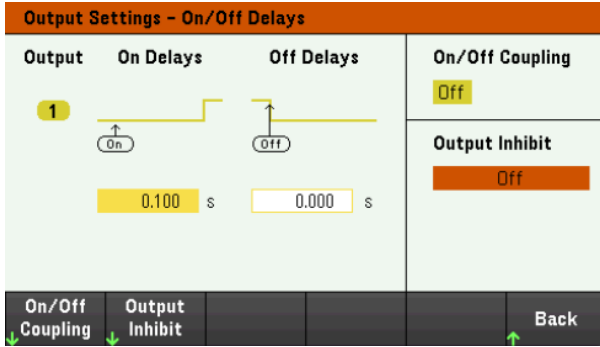

Step 2- Configure the output turn-on sequence

Configure the output turn-on sequence as described under Configuring the Output Turn-On/Turn-Off Sequence.

Note that you will only need to configure the Turn-on delays, not the turn-off delays.

The turn-on delays for the output channels are as follows:

– Output 1: 0.1 s

Step 3 – Configure the Scope View traces

– Check V1.

– Press **Knob Scale** and use the Vertical knob to set V1 to 1 V/Div.

– Press **Knob Ofs** and use the Vertical knob to set offset to 2 V.

– Press **Knob Scale** and use the Horizontal knob to set the timebase to 20 ms.
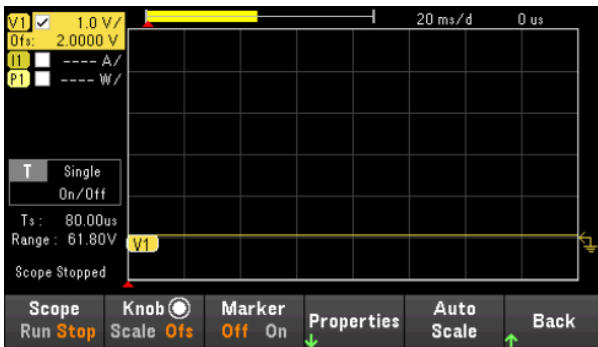
Step 4 – Configure the Scope properties:

Press **Properties** to configure the scope properties as follows:

– Press **Settings** > **Trigger Source** > **On/Off** to select On/Off key as a trigger source. Press **Back** to return to Settings menu.

– Press **Trigger Mode** >**Single** to display a single sweep measurement. Press **Back** twice to return to the Scope Properties menu.

– Set the Time Reference to Left in Horizontal Settings (Hr) window: Press **Settings** > **Time Ref Lf**.

Step 5 – Turn on the outputs and measure the voltage:

Press the **[Scope/Datalog]** key to return the display the to scope view:

– Press the **Scope Run** key to run the scope. When this key is lit, it indicates that the scope is running.

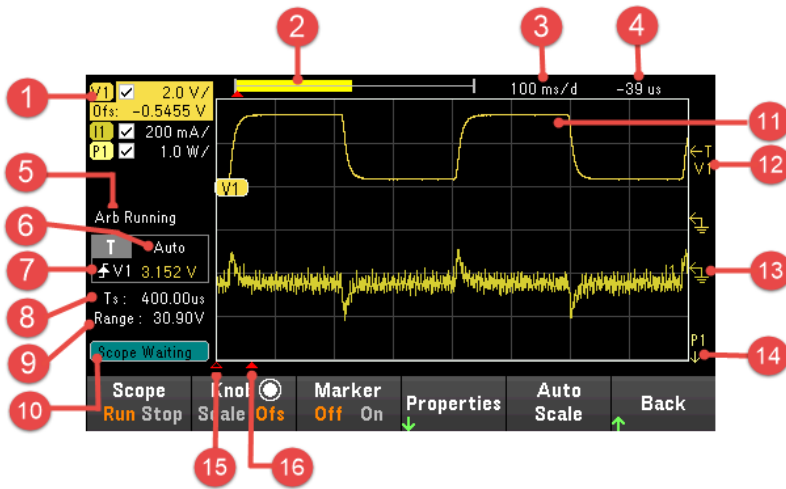– Press **[On]** key to start the output sequence and trigger the scope.

You should see the output waveform displayed as follows:
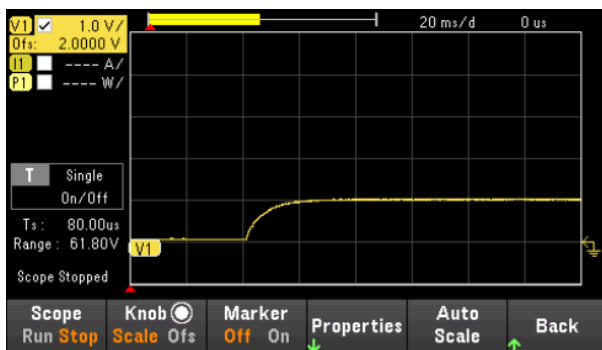
From the remote interface:

You cannot program the scope from the remote interface.

Scope View

Press **[Scope/Datalog]** key to view the scope. This key toggles between the Scope view and Data Logger view.

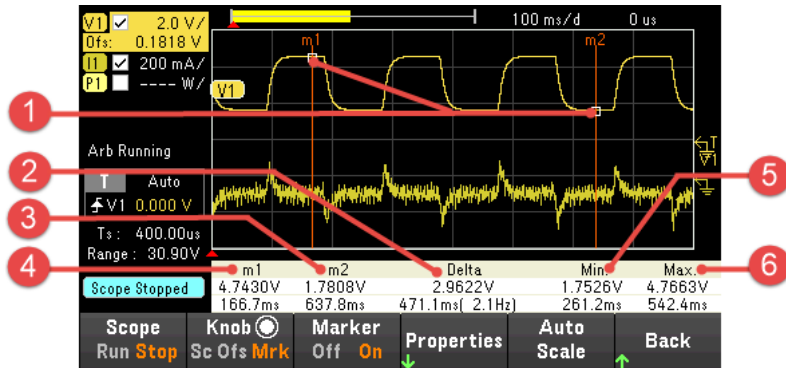| Items		Description
1	Trace controls	Identifies the voltage, current , or power that will be displayed. √ indicates the trace is on. Dashes (----) indicate the trace is off. Select the trace and press **[Enter]** to turn it on or off.
2	Data bar	The data bar represents all of the logged data. The yellow part indicates the portion of the data that is visible on the display. The black part represents the data that is not visible.
3	Time/Div	Identifies the horizontal time-base setting. This can be adjusted using the Horizontal knob after pressing **Knob Sc**.
4	Offset time	Indicates the time from the trigger point indicator to the vertical center line of the grid. Negative values indicate the center line is to the left of the trigger point. Positive values indicate the center line is to the right of the trigger point. The trigger point can be adjusted using the Horizontal knob after pressing **Knob Ofs**.
5	Arb status	Indicates the Arb is running. No indicator when Arb is idle.
6	Trigger mode	Indicates the trigger mode (Auto, Single, or Triggered).
7	Trigger Source	In the figure, the trigger source is a voltage level on output 1.
		Up trigger indicates the measurement will be triggered on the up-slope (positive).
		Down trigger indicates the measurement will be triggered on the down-slope (negative).
	Amplitude	If the trigger source is set to a voltage or current level, the amplitude of the trigger level is indicated below the trigger source. In the figure, the voltage trigger level is set to 0 V.
8	Sample period	The indicated scope sample period is based on the horizontal time/div. setting. When the time/div. setting is less than 2 ms/division, the scope will sample at its fastest rate, 10 μs.
9	Range	Range indicates the measurement range setting of the selected trace.
10	Scope status	Indicates whether the scope is Running, Stopped, or Waiting for a trigger.

Items		Description
11	Scope traces	Voltage trace label appears on the left side of the grid (V1) as shown in the display. Current trace label appears on the right side of the grid (I1). Power trace label appears on the center of the grid (P1). Press **Auto Scale** to auto-scale the data traces.
12	Trigger level	Shows the location of the voltage or current trigger level and output. In this example, the voltage trigger level of output 1 is shown. The trigger source and amplitude are shown at the left corner of the display.
13	Ground reference	The ground reference of the trace. Ground references are offset so that they do not overlap. The ground reference offset value is referenced to the horizontal center line of the grid.
14	Out of view arrows	Indicate that the trace, P1 in the figure, is out of view. Press **Knob Scale** or **Knob Ofs** and use the Vertical knob to bring the trace into view. Press **Auto Scale** to autoscale the data traces.
15	Horizontal reference	Indicates the horizontal timebase reference. In the figure, the reference is centered. Change the reference justification in the Horizontal Settings field.
16	Trigger point indicator	Shows the position of the trigger with respect to the waveform. In the figure, the trigger is offset to the left of the original point. The trigger point corresponds to the timebase reference when the offset is zero.

Menu		Description
Scope Run Stop		Run or stop data scope measurement.
Knob	Scale or Ofs	Set the function for the Vertical and Horizontal knob to adjust the vertical or horizontal waveform display. Toggle between Scale (Sc) and Offset (Ofs) for each waveform settings. See Using knob in scope view.
	Sc, Ofs, or Mrk	Marker (Mrk) only appear when Marker is enabled. Selecting **Mrk** set the function of the Vertical and Horizontal knob to adjust the m1 and m2 marker position. See Using knob in scope view.
Marker	On or Off	Enables or disables the Marker view.
Properties		Sets the scope and waveform displays properties. See Scope properties and waveform settings.
Auto Scale		Auto scales the traces on the display.

Scope marker view

Items		Description
1	m1/m2 points	Shows where the measurement markers intersect the selected waveform. Data values at the bottom of the display are referenced to the intersect locations of the markers. Calculations are based on the data points in between the intersect locations.
2	Delta	Indicates the delta or absolute difference between the markers in units (volts, amps, or watts) and in time (seconds). The value in parenthesis is the frequency, which is the reciprocal of the time (1/time).
3	m2	Indicates the m2 marker value in volts, amps, or watts at the intersection point. Also indicates the distance in time that the m2 marker is in relation to the present trigger position. If a marker is out of view, an arrow indicates the direction of the marker m2 >.
4	m1	Indicates the m1 marker value in volts, amps, or watts at the intersection point. Also indicates the distance in time of the m1 marker in relation to the present trigger position. If a marker is out of view, an arrow indicates the direction of the marker < m1.
5	Min	Indicates the minimum data value (in volts, amps, or watts) between the marker locations of the selected waveform. Also indicates the distance in time of the minimum value in relation to the present trigger position.
6	Max	Indicates the maximum data value (in volts, amps, or watts) between the marker locations of the selected waveform. Also indicates the distance in time of the maximum value in relation to the present trigger position.
7	Avg. (if selected)	Calculates the average data value (in volts, amps, or watts) between the marker locations of the selected waveform. Time indicates the time between markers over which the average value is calculated.
8	RMS (if selected)	Calculates the rms value between the marker locations.
9	Vp-p (if selected)	Calculates the difference between the maximum and minimum values. Time information is not valid for calculated p-p values.

Using the knob in scope view

The **Knob** softkey in Scope view determines the function for both Vertical and Horizontal knob. See table below for available settings.

Marker Off

Marker On

Knob control settings	Knob	Description
Scale or Sc	Vertical knob	Makes the waveform bigger or smaller vertically in relation to its ground reference. Specified in volts/division, ampere/division and watts/division on the y axis.
	Horizontal knob	Stretches or shrinks the waveform horizontally around the timebase reference. Specified in time/-division on the x axis. Applies to ALL traces.
Offset (Ofs)	Vertical knob	Moves the ground reference of the trace up or down in relation to the horizontal center line of the grid.
	Horizontal knob	Moves the waveform to the right or left of the timebase reference.
Marker (Mrk)	Vertical knob	Moves the m1 marker right or left.
	Horizontal knob	Moves the m2 marker right or left.

Using the knob for adjusting trigger level

Use the navigation keys to select the trigger level located on the left pane of scope view, as shown below.
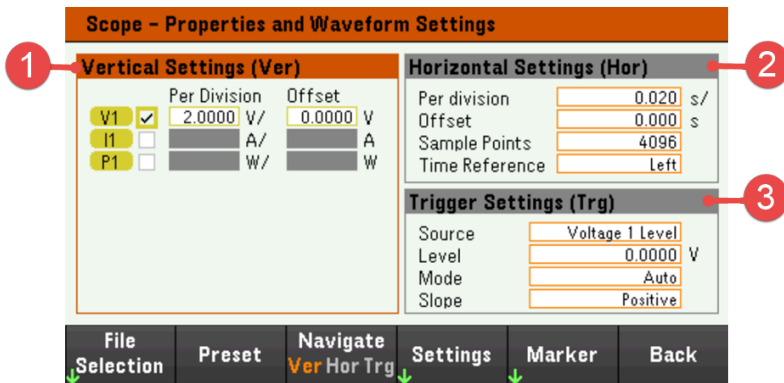
Adjusting the Vertical or Horizontal knob will adjust the trigger level for Voltage level, or Current level accordingly.
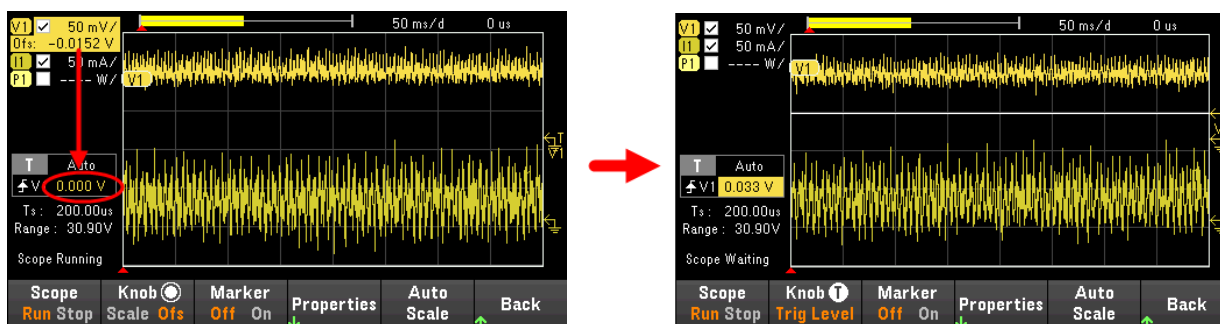
Scope properties and waveform settings

> **NOTE** There are no remote interface commands that correspond directly to the front panel Scope functions.

Items		Available settings	Description
1	Vertical Settings (Ver)	Trace checkbox	Selects the trace to display for the output. If no checkbox is enabled, no traces will be displayed . Configures the voltage/division, current/division, power/division and offsets the output.
2	Horizontal Settings (Hor)	Per division	Configures to zoom in or out of the data so that you can view waveform details. The numbers on the top of the display indicate the location of the data that is being viewed relative to the entire data log. Specified in time/division on the x axis. Applies to ALL traces.
		Offset	Configures the waveform location (right or left) of the timebase reference. The trigger point is indicated by the solid arrow ◂.
		Sample Points	Specifies the number of points in a scope trace. The maximum number of points that can be specified depends on the number of scope traces that have been enabled. The minimum number of points that can be specified is 1024. 1 traces enabled: 256 K points 2 traces enabled: 128 K points The power trace counts as 2 traces, since voltage and current must be measured to calculate power. If the voltage and current traces have already been selected, the Power trace is not counted.
		Time Reference	Specifies the reference point (right, left or center) on the scope display. This is the position of trigger if no offset has been set.
3	Trigger Settings (Trg)	Source	Specifies a trigger source. This trigger source will trigger the scope measurements on all output channels.
		Level	Specifies a trigger level if you select a Voltage level or Current level as the trigger source.
		Mode	Specifies a trigger mode.
		Slope	Specifies a trigger slope.

| Menu	Available settings	Description
File Selection	–	Specifies the file location and filename for scope data, export the file to .csv format and load the previously saved scope data file to the instrument.
Preset	–	Returns the Scope View to the power-on display settings. The vertical offset of each trace will be set to a different value. This is to prevent the traces from over-lapping. The offset is referenced to the horizontal center line of the grid.
Navigate	Ver, Hor or Trg	Selects the Vertical Settings, Horizontal Settings or Trigger Settings field. <u>Action required:</u> Press **Navigate** to toggle between Ver, Hor and Trg.

Settings	Sample Points	256k, 128k, 64k, 32k, 16k, 8192, 4098, 2048, or 1024	Specifies the number of points in a scope trace. Default is 4096. Action required: Press **Sample Points** to view and select the nine available sample points.
	Time Reference	Lf, Ctr or Rg	Specifies the reference point on the display. This is the position of the trigger if no offset has been set. Default is Lf. Action required: Press **Time Ref** to toggle between Lf, Ctr and Rg.

Lf (Left)	Lets you see the waveform after the trigger event.
Ctr (Center)	Lets you see the waveform before and after the trigger event.
Rg (Right)	Lets you see the waveform up to the trigger event

	Trigger Source	V1 Level, I1 Level, Arb Key, On/Off, DIO or Remote	Configures the trigger source. Default is V1 Level. Action required: Press **Trigger Source** to select a trigger source. This trigger source will trigger the scope measurements on all output channels.

V1 Level	Selects the voltage trigger level as trigger source. Triggers the measurement when the voltage of the corresponding output passes through the specified level.
I1 Level	Selects the current trigger level as trigger source. Triggers the measurement when the current of the corresponding output passes through the specified level.
Arb Key (Arb Run/Stop Key)	Selects the Arb Run Stop key or **[List Run/Stop]** as a trigger source.
On/Off (Output On/Off Key)	Selects the Output On/Off keys as a trigger source.
IO (DIO Trigger In)	Selects any configured digital IO (with Trigger Input function) as a trigger source.
Remote (Remote Command)	Selects a remote interface command as a trigger source.

Trigger Mode	Auto, Triggered or Single	Configures the trigger mode. Default is Auto. Action required: Press **Trigger Mode** to select a trigger mode.	
		Auto	Configures the scope to display a single-sweep measurement when a trigger is received, or automatically if a trigger is not received. The scope continues running and waits for another trigger when the measurement completes.
		Triggered	Configures the scope to display a single-sweep measurement when a trigger is received. The scope stops running when the measurement completes.
		Single	Configures the scope to display a single-sweep measurement when a trigger is received. The scope continues running and waits for the next trigger when the measurement completes.
Slope	Pos or Neg	Configures the trigger slope. Default is Positive. Action required: Press **Slope** to toggle between Pos and Neg.	
		Pos (Positive)	The measurement will be triggered on the positive (up-slope) portion of the waveform.
		Neg (Negative)	The measurement will be triggered on the negative (down-slope) portion of the waveform.
Marker	-	Select measurements to be displayed at the bottom of Marker view.	

Scope marker properties

Press **Properties** > **Marker** to access the scope marker properties.

Use the navigation keys to select the measurements that appear on the bottom of the display in Marker view. Measurements apply to the portion of the waveform between the two markers. You can only select a maximum of three measurements to be displayed.
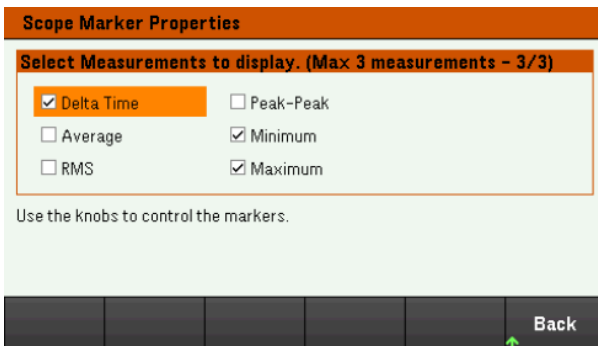
Save the scope data

Refer to **Save the data log** for information on how to save the scope data.

Locking/Unlocking the Front Panel

NOTE	If you are in a menu, you must exit the menu before locking the front panel.

1. Press and hold **Lock|Unlock** to lock the front panel. This produces lock icon(🔒) in the upper corner of the display, as shown below.
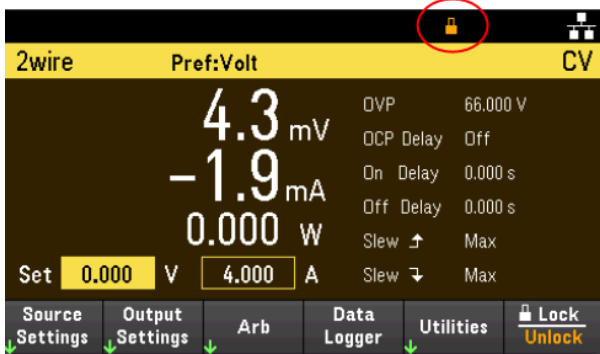
2. Press **[Lock|Unlock]** again to unlock the front panel.

From the remote interface:

To lock all front panel keys including **Lock|Unlock** key:
SYST:RWL

To lock all front panel keys except **Lock|Unlock** key:
SYST:REM

To unlock the front panel:*
SYST:LOC

Capturing a Screen

Press **[Meter View]** for more than three seconds to capture a screen. The screen that was active will be saved to the USB flash storage connected to the front USB port.

To configure the screen capture storing path, refer to Utilities Menu - Manage Files for details.

Utilities Menu

Utilities provides the following features:

Store and recall state and power on settings

View USB and LAN status as well as configure LAN, GPIB (optional), and digital IO

Perform instrument self-tests, calibration, and configures the instrument's various user settings, date and time

Displays the instrument's error queue

Manage files, including creating screen shots

Utilities Menu – Store and Recall State

The Utilities menu is shown below.

Store/Recall saves and recall states. In general, state files store volatile settings associated with measurements.

The instrument states include volatile settings such as:

- Voltage, current, OVP, OCP delay, and OCP delay start
- Voltage slew, output preference and output sense
- Output state
- Operation mode (Independent)
- Output on/off sequencing
- Arb settings
- Trigger settings
- Digital I/O output data and bus setting
- Data logger settings
- Scope settings

Store Settings

Store Settings creates folders and files (.csv format) to store the instrument's state to the external memory, or to store the instrument's state to the internal memory.

Destination: Int allows you to store an instrument's state in the instrument's internal memory. You can store up to 10 separate states in the internal memory and set any one of them as the power-on state.

Menu	Available settings	Description
Action:	Store, Folder	Allows you to either store an instrument's state or to create a new folder.
Dest.:	Int, Ext	Selects whether you want to store an instrument's state in the internal or external memory. – Internal: The instrument's state is stored in the instrument's internal memory. – External: The instrument's state is stored in the external USB drive.
Store in	State 0 to State 9	Selects the state number to store the instrument's state.
Set PwrOn	Yes, No	Select 'Yes' to load the selected stored state upon power-on.
Store	-	Stores the state.

Destination: Ext allows you to store an instrument's state in the external USB drive inserted in the front panel's USB port. You can specify the path and filename of the stored state.

Menu	Available settings	Description
Action:	Store, Folder	Allows you to either store an instrument's state or to create a new folder.
Dest.:	Int, Ext	Selects whether you want to store an instrument's state in the internal or external memory. – Internal: The instrument's state is stored in the instrument's internal memory. – External: The instrument's state is stored in the external USB drive.
Browse	-	Allows you to browse and specify the location of the external memory to save the state.
Filename		Specifies the filename. Use the virtual keyboard to enter your desired filename.
Store	-	Stores the state.

Action: Folder creates a folder in the external memory.

Menu	Description
Browse	Allows you to browse and specify the location where the folder will be placed.
Folder Name	Specifies the folder name. Use the virtual keyboard to enter your desired folder name.
Create Folder	Creates a new folder in the specified location.

Recall Settings

NOTE	The file you recall must be from the same instrument model.

Recall Settings allows you to browse to the state in the internal memory or browse to the state file (.csv format) in the external memory to be recalled.

From: Int allows you to recall an instrument's state from the instrument's internal memory.

Menu	Available settings	Description
From:	Int, Ext	Selects whether you want to recall an instrument's state from the internal or external memory. – Internal: The instrument's state is recalled from the instrument's internal memory. – External: The instrument's state is recalled from the external USB drive.
Recall	State 0 to State 9	Select the state number that you want to recall from.
Recall	-	Recall the state.

From: Ext allows you to recall an instrument's state from the external USB drive inserted in the front panel's USB port.

Menu	Available settings	Description
From:	Int, Ext	Selects whether you want to recall an instrument's state from the internal or external memory. – Internal: The instrument's state is recalled from the instrument's internal memory. – External: The instrument's state is recalled from the external USB drive.
Browse	-	Allows you to browse and specify the state file in the external memory to recall from.
Recall	-	Recall the state.

Power On Setting

Power On selects the state that will be loaded at power-up. This can be either the factory default state (Default), or user-defined states (State 0 to State 9).

Press **Set Power On** to save the setting.

Set to Defaults

Set to Defaults loads the instrument's factory default state.
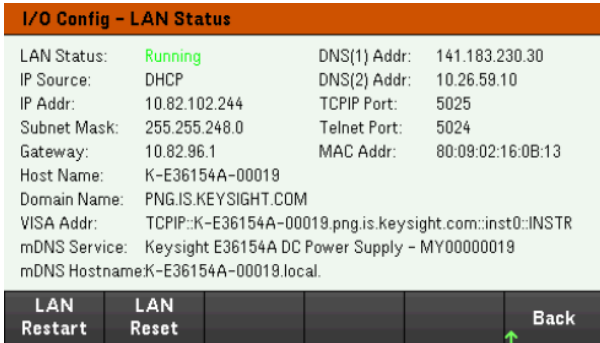
Utilities Menu – I/O Configuration

I/O Config configures the I/O parameters for remote operations over the LAN, USB, or GPIB (optional) interface.

USB Status displays the USB connect string for the instrument.

**LAN Status** displays the current LAN setting status for the instrument.

LAN Restart restarts the networking using its current LAN settings. LAN restart does not clear the user-defined Web Interface password.

LAN Reset resets the LAN using its current settings and enables DHCP and DNS. The **LAN Reset** softkey also clears any user-defined Web Interface password.

LAN Settings

LAN Settings opens the window shown below. **Set to Defaults** resets the LAN settings to their factory default values.
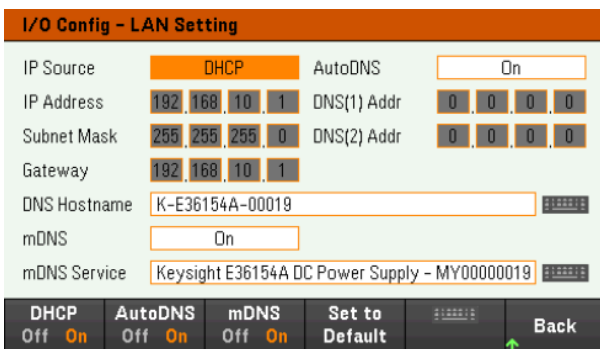
DHCP allows DHCP assignment of the instrument's IP address. It also enables the configuration of network parameters based on the protocol selected. **DHCP On** automatically assign a dynamic IP address to a LAN device.

AutoDNS allows assignment of the DNS addresses. **AutoDNS On** automatically configures the addressing of the instrument in DNS server
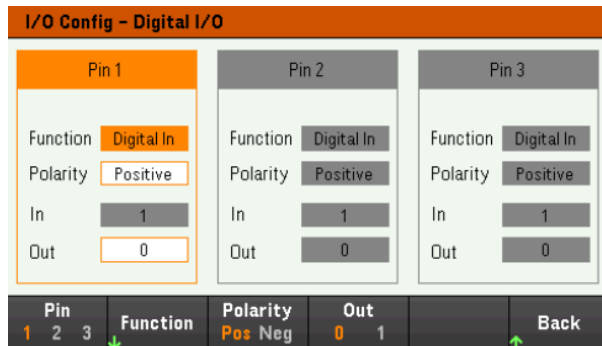
mDNS allows modification of the mDNS Service Name.

Hostname allows modification of the instrument's DNS hostname.

Digital IO

Digital IO configures the rear panel digital port's pin function, polarity and output data applied to the pin.

Pin selects the pin for configuration.

Functions configures the function for each pin as shown below.

Polarity configures the polarity to Positive (**POS**) or Negative (**NEG**) for the selected pin.

Out enables (**1**) or disables (**0**) the output data for the selected pin.

GPIB (optional)

GPIB allows you to set the GPIB address to a value from 0 to 30. After changing the address, cycle the instrument's power for the changes to take effect.

Utilities Menu – Test / Setup

| Store / Recall | I/O Config | Test / Setup | Error | Manage Files | Back |

Test / Setup provides access to calibration, self-test, as well as configures user preferences, sets the date and time, installs licenses, and accesses the help:
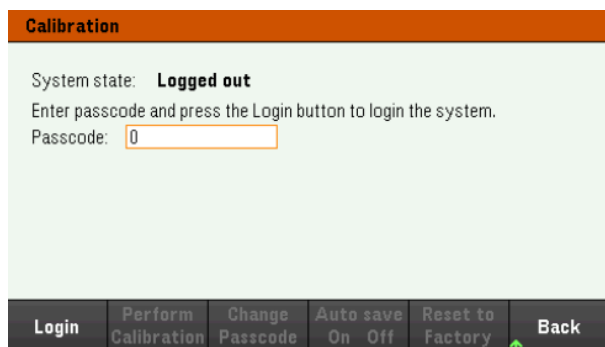
| Calibration | Self Test | User Settings | | Help | Back |

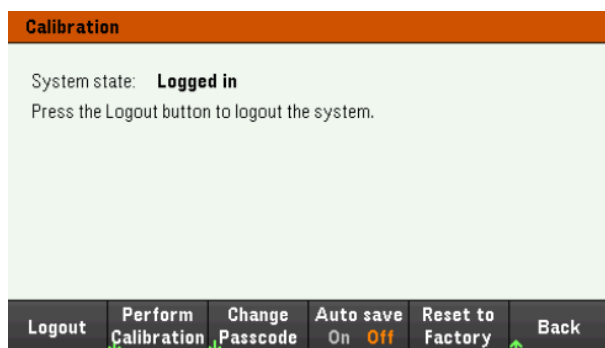> **NOTE** MEMORY SANITIZATION PROCEDURE
> Refer to the *E36150 Series Security Guide* for instructions to perform a memory sanitization procedure that sanitizes all user-accessible instrument memory and restarts the instrument.

Calibration

Calibration accesses the instrument calibration procedure.

Calibration

System state: **Logged out**
Enter passcode and press the Login button to login the system.
Passcode: 0

| Login | Perform Calibration | Change Passcode | Auto save On Off | Reset to Factory | Back |

The default security passcode is 0. Press **Login** to access the calibration options.

Calibration

System state: **Logged in**
Press the Logout button to logout the system.

| Logout | Perform Calibration | Change Passcode | Auto save On Off | Reset to Factory | Back |

Perform Calibration opens the calibration menu. Make sure you have run the self-test before performing any calibration. Refer to "Calibration Adjustment Procedures" in the Service Guide for details.

Press **Change Passcode** to change the passcode using the numeric keypad. The passcode can be set up to 9 digits.

Auto save On will automatically save the calibration data upon logout. When **Auto save** is Off, press **Cal Save** to save the calibration data.

Reset to Factory allows you to reset the power supply to factory state. (Option SEC)

Self-Test

Self Test verifies proper instrument operation.

Self-Test Procedures

A power-on self-test occurs automatically when you turn on the power supply. This limited test assures you that the power supply is operational.

Press **Utilities** > **Test / Setup** > **Self Test** to perform the complete self-test of the power supply. It takes approximately 2 seconds for the self-test to complete.

You can also perform a complete self-test from the remote interface, see the *E36150 Series Programming Guide* for details.

– If the self-test is successful, "**Self test passed**" is displayed on the front panel.

– If the self-test fails, "**!Err**" is displayed on the front panel. Record the error code and message and contact Keysight support if necessary.

– If the self-test is successful, this indicates a high chance that the power supply is operational.

User Settings

User Settings specifies user preferences that control how the user interacts with the instrument. These settings are stored in non-volatile memory.
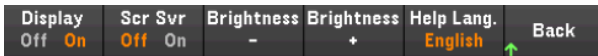

Sound Settings

Beeper enables or disables the beeper sound when an error is generated from the front panel or remote interface.

Key Click enables or disables the click heard when a front-panel key or softkey is pressed.

Display Options

Display Options configures the display.

You can enable or disable the display and screen saver.

If you turn off the display, press any front-panel key to turn it on again.

By default, the screen saver turns off and blanks the screen after 30 minutes of inactivity. You may disable this screen saver from the front panel only.

The display is enabled when power is cycled, after an instrument reset (*RST), or when you return to local (front panel) operation. Press **Lock/Unlock** or execute the SYSTem:LOCal command from the remote interface to return to the local state.

You can also adjust the brightness of the display.

Help Lang selects the help language for front-panel use: English, French, German, Japanese, Korean, or Simplified Chinese. All front-panel key help, and help topics appear in the selected language. The softkey labels are always in English.

Date / Time

Date / Time sets the instrument's real-time clock, which always uses a 24-hour format (00:00:00 to 23:59:59). There is no automatic setting of the date and time, such as to adjust for daylight savings time.

Use the front panel navigation keys to set the year, month, day, hour, and minute.

License

License enables licensed instrument features. For detailed information on how to install the license, see Installing License for Optional Features.

Menu	Description
Browse	Allows you to browse and specify the location where the licensed is placed.
Load	Load the license.

Help

Help allows you to view the quick reference help topic. Use the arrow softkeys or front panel navigation keys to navigate the desired topic. Press **Select** to view the help content.

About allows you to view the instrument's model number, description, serial number, firmware revision, and options.

Utilities Menu – Error

Error displays the instrument's error queue, which includes up to 20 errors. If there are more than 10 errors on the display, press Next to scroll to the next page.
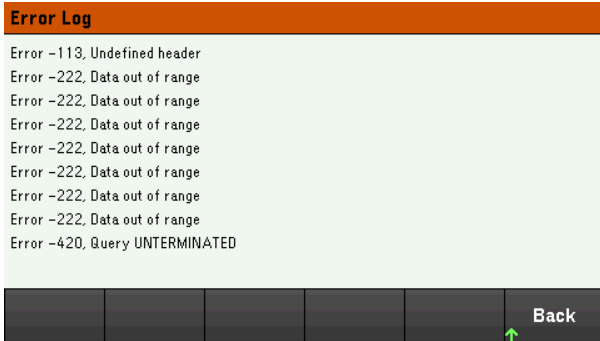
- Errors are stored in the order they are received. The error at the end of the list is the most recent error.

- If there are more than 20 errors in the queue, the last error stored is replaced with -350,"Queue overflow". No more errors are stored until you remove errors from the queue. If there are no errors, the instrument responds with +0,"No error".

- If there are more than 20 errors in the queue, the last error stored is replaced with -350,"Queue overflow". No more errors are stored until you remove errors from the queue. If there are no errors, the instrument responds with +0,"No error".

- Except for self-test errors, errors will be cleared after you have read them or after an instrument reset.

If you suspect that there is a problem with the power supply, refer to "Troubleshooting" in the Service Guide.

Utilities Menu – Manage Files

| Store / Recall | I/O Config | Test / Setup | Error | Manage Files | Back |

Manage Files allows you to create, copy, delete, and rename files and folders on a USB drive attached to the front panel. It also allows you to capture the current screen to either a bitmap (*.bmp) or portable network graphics (*.png) file. This is the default option, as shown below.

| Action: Capture | Browse | File Name | Format .bmp .png | | Back |

Action

Action specifies the action to perform. Pressing **Capture Display** saves a screen capture of the display at the moment that you pressed **[Meter View]** for more than 3 seconds.

| Delete | Folder | Capture Display | Copy | Rename | |

Delete – To delete a file or folder, press **Delete** and **Browse** to the folder or file to delete. Press **Browse** > **Perform Delete** > **Back**.

Folder – To create a folder, **Browse** to the external location for the folder, press **Folder Name**, enter a folder name and press **Done**. Press **Create Folder** > **Back**.

Copy – To copy a file, press **Copy**. **Browse** to the file to be copied and press **Select**. Press **Copy Path** and select an external path for copying. Press **Perform Copy** > **Back**.

Rename – To rename a file or folder, press **Rename**. **Browse** to the folder or file to be renamed and press **Select**. Press **New Name**, enter a new name and press **Done**. Press **Perform Rename** > **Back**.

Browse

Browse selects the file or folder upon which the action will be performed. Use the front-panel navigation keys to navigate through the list. The left and right arrows contract or expand a folder to hide or show its files.
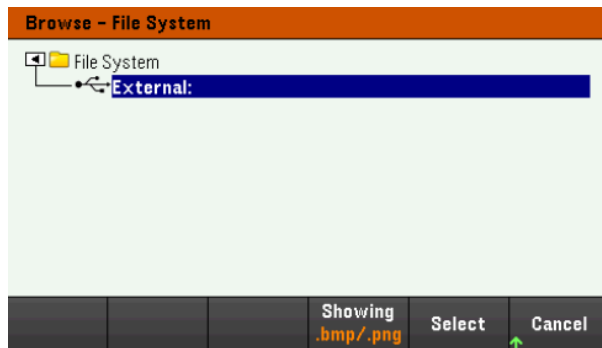
Press **Select** or **Cancel** to exit the browse window.

File Name

File Name allows you to use the front-panel arrows, the **[Enter]** key, and the softkeys to enter a filename. Use the front-panel arrows to point to a letter, and **Previous Char** and **Next Char** to move the cursor in the area where the name is entered. In the image below, there is no **Next Char** softkey because the cursor is at the end.

Press **Done** to confirm the new filename or **Cancel** to abort.

3   Characteristics and Specifications

For the characteristics and specifications of the E36150 Series autoranging DC power supplies, refer to the datasheet at https://www.keysight.com/us/en/assets/3122-1798/data-sheets/E36150-Series.pdf.

4 Service and Maintenance

NOTE	For service and maintenance related information, refer to the *E36510 Series Service Guide* at https://www.keysight.com/us/en/assets/9922-01663/service-manuals/E36150-Series-Service-Guide.pdf.

CAUTION	The service guide is intended for qualified, service-trained personnel to perform the instrument calibration, verification tests and repairs.

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