

# U2761A

## USB Modular Function/Arbitrary Waveform Generator

### Introduction

The U2761A is a 20 MHz function/arbitrary waveform generator the size of a typical novel. It flexibly operates as a standalone unit or as a modular unit in the U2781A USB modular product chassis.



## Put a Bench in Your Bag

The next time you're called out to solve tough problems in electronic products or processes, leave the bulky transit cases behind. With Keysight Technologies, Inc.'s USB modular instrument (MI) family, you can easily carry powerful test gear in your bag along with your laptop PC.

Our line of MIs includes two oscilloscopes, a DMM, a function generator with arbitrary waveform capability, a source/measure unit, and a 4x8 switch matrix. All provide USB 2.0 connectivity (with USBTMC-USB488) standard and plug-and-play simplicity for easy use on the go or on the bench.



Figure 1. Keysight USB modular instrument (MI) family

## Keysight U2761A USB Modular Function/Arbitrary Waveform Generator

The U2761A is a 20 MHz function/arbitrary waveform generator the size of a typical novel, and flexibly operates as a standalone unit or as a modular unit in the U2781A USB modular product chassis.



Figure 2. U2761A used as a standalone instrument



Figure 3. U2761A used as a modular instrument

## Features

- Sine, Square, Ramp, Triangle, and Pulse waveforms as well as DC signal
- 14-bit, 50 MSa/s Arbitrary Waveforms customizable through the arbitrary waveform editor
- Built-in modulation: AM, FM, PM, ASK, FSK and PSK
- Pulse generation up to 5 MHz with a variable period, pulse width, and amplitude parameters
- Hi-Speed USB 2.0 connectivity
- Dual-play operation: standalone and modular capability
- NEW! Control, automate, and simplify with Keysight BenchVue software. Now included
- Compatible with a wide range of Keysight Development Environments (KDEs)



### Awards and Accolades

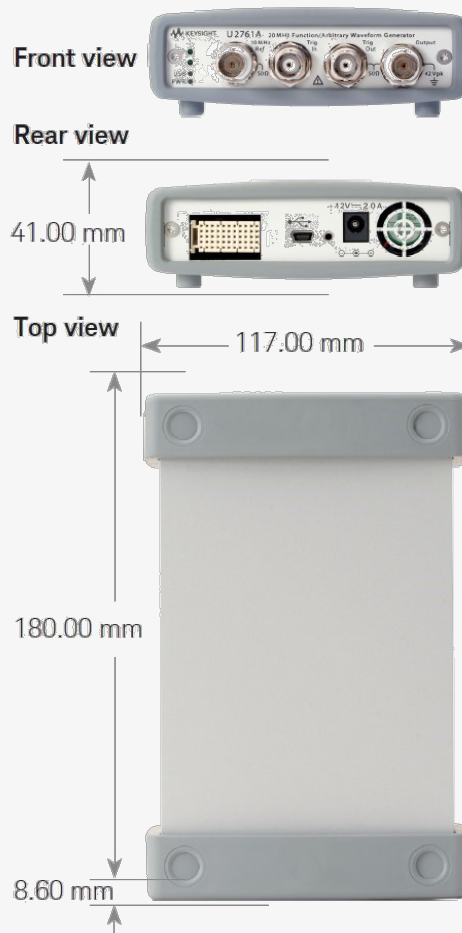
Keysight U2700A series USB Modular Instruments won Design News' Golden Mousetrap Award in the 2009 Best Products Category.

Design News' Awards Program highlights engineering innovation and product design creativity, and honors the best designs of the past year.

## Control, Automate and Simplify with BenchVue — No Programming Needed (Now included)

Keysight BenchVue software for the PC eliminates many of the issues around bench testing. By making it simple to connect, control instruments, and automate test sequences, you can quickly move past the test development phase and access results faster than ever before with just a few clicks. Dedicated instrument apps allow you to quickly configure the most commonly used measurements and setups for each instrument family. Rapidly build custom test sequences with the integrated Test Flow app to automate and visualize test results without the need for instrument programming. BenchVue supports hundreds of Keysight instrument types and models, all from one easy-to-use application. Control, Automate, Simplify with BenchVue.

### Product Outlook and Dimensions



## Product characteristics and general specifications

Specifications	
<b>Remote Interface</b>	<ul style="list-style-type: none"> <li>• Hi-Speed USB 2.0</li> <li>• USBTMC-USB488 <sup>1</sup></li> </ul>
<b>Power Consumption</b>	<ul style="list-style-type: none"> <li>• +12 VDC, 2 A</li> <li>• Isolated ELV power source</li> </ul>
<b>Operating Environment</b>	<ul style="list-style-type: none"> <li>• Operating temperature from 0 °C to +50 °C</li> <li>• Operating humidity at 20% to 85% RH (non-condensing)</li> <li>• Altitude up to 2000 meters</li> <li>• Pollution Degree 2</li> <li>• For indoor use only</li> </ul>
<b>Storage Compliance</b>	<ul style="list-style-type: none"> <li>• Storage temperature from –20 °C to 70 °C</li> <li>• Storage humidity at 5% to 90% RH (non-condensing)</li> </ul>
<b>Safety and EMC Compliance</b>	Refer to Declaration of Conformity for the latest revisions of regulatory compliance
<b>Shock and Vibration</b>	Tested to IEC/EN 60068-2
<b>IO Connector</b>	BNC connector
<b>Dimension (W × D × H)</b>	<ul style="list-style-type: none"> <li>• &gt; 60 dB at 50/60 Hz ±0.1%</li> <li>• &gt; 0 dB at 50/60 Hz ±0.1%</li> </ul>
<b>SHOCK AND VIBRATION</b>	Tested to IEC/EN 60068-2
<b>IO CONNECTOR</b>	Four banana socket terminals
<b>Module Dimension (W × D × H)</b>	<ul style="list-style-type: none"> <li>• 117.00 mm × 180.00 mm × 41.00 mm (with bumpers)</li> <li>• 105.00 mm × 175.00 mm × 25.00 mm (without bumpers)</li> </ul>
<b>Weight</b>	<ul style="list-style-type: none"> <li>• 528 g (with bumpers)</li> <li>• 476 g (without bumpers)</li> </ul>
<p>Note:</p> <p>1. Compatible with Microsoft Windows operating systems only. Requires a direct USB connection to the PC to install the appropriate driver in the USB modular instrument.</p>	

## Product specifications and measurement characteristics

Product Specifications and measurement characteristics			
<b>Waveforms</b>			
Standard	Sine, Square, Ramp, Triangle, Pulse, DC		
Built-in arbitrary	Exponential Rise, Exponential Fall, Negative Ramp		
<b>Waveform characteristics</b>			
<b>Sine</b>			
Frequency range	1 $\mu$ Hz to 20 MHz (1 $\mu$ Hz resolution)		
Amplitude flatness <sup>1</sup> (relative to 1 kHz)	< 100 kHz	0.2 dB	
	100 kHz to 1 MHz	0.35 dB	
	1 MHz to 20 MHz	0.7 dB	
Harmonic distortion <sup>2</sup>	Frequency range	< 1 Vpp	$\geq 1$ Vpp
	DC to 20 kHz	-70 dBc	-60 dBc
	20 kHz to 100 kHz	-65 dBc	-60 dBc
	100 kHz to 1 MHz	-50 dBc	-45 dBc
	1 MHz to 20 MHz	-40 dBc	-35 dBc
Total harmonic distortion <sup>2</sup>	DC to 20 kHz	0.10%	
Spurious (Non-harmonic) output <sup>3</sup>	DC to 1 MHz	-65 dBc	
	1 MHz to 20 MHz	-65 dBc + 6 dB/octave	
Phase noise (10 kHz offset)	-115 dBc/Hz (Typical)		
<b>Square</b>			
Frequency range	1 $\mu$ Hz to 20 MHz (1 $\mu$ Hz resolution)		
Rise/Fall time	< 18 ns, 10 to 90% terminated load (50 W)		
Overshoot	< 2%		
Variable duty cycle	<ul style="list-style-type: none"> <li>• 20% to 80% (up to 10 MHz)</li> <li>• 40% to 60% (up to 20 MHz)</li> </ul>		
Asymmetry (@ 50% duty)	1% of period + 5 ns		
Jitter (RMS)	<ul style="list-style-type: none"> <li>• &gt; 50 kHz = 1 ns + 100 ppm of period</li> <li>• <math>\leq</math> 50 kHz = 10 ns + 100 ppm of period</li> </ul>		
<b>Ramp, Triangle</b>			
Frequency range	1 $\mu$ Hz to 200 kHz (1 $\mu$ Hz resolution)		
Linearity	< 0.2% of peak output		
Programmable symmetry	0% to 100%		

Pulse	
Frequency range	500 $\mu$ Hz to 5 MHz (1 $\mu$ Hz resolution)
Pulse width (period $\leq$ 10 s)	40 ns minimum, 10 ns resolution
Overshoot	< 3%
Jitter (RMS)	300 ps + 0.1 ppm of period
Notes:	
1. Add 1/10th of output amplitude and offset specification per $^{\circ}$ C for operation outside the range of 18 $^{\circ}$ C to 28 $^{\circ}$ C.	
2. DC offset set to 0 V.	
3. Spurious output at low amplitude is $-70$ dBm, typical.	
Arbitrary	
Frequency range	1 $\mu$ Hz to 200 kHz (1 $\mu$ Hz resolution)
Waveform memory depth	64 kSa <sup>1</sup>
Amplitude resolution	14 bits/sample (including sign)
Sampling rate	50 MSa/s
Minimum rise/fall time	36 ns (Typical)
Linearity	< 0.2% of peak output
Settling Time	< 250 ns to 0.5% of final value
Jitter (RMS)	10 ns + 30 ppm
Common characteristics	
Amplitude	
Range	<ul style="list-style-type: none"> <li>• 40 mVpp to 5 Vpp (Into 50 <math>\Omega</math> load)</li> <li>• 80 mVpp to 10 Vpp (Into open circuit)</li> </ul>
Accuracy <sup>2</sup> (across 50 $\Omega$ load at 1 kHz)	$\pm 1\%$ of setting $\pm 5$ mV ( $\pm 10$ mV @ Hi-Z)
Units	Vpp, Vrms, dBm
Resolution	4 digits
DC offset	
Range (peak AC + DC)	<ul style="list-style-type: none"> <li>• <math>\pm 2.5</math> V (Into 50 <math>\Omega</math> load)</li> <li>• <math>\pm 5</math> V (Into open circuit)</li> </ul>
Accuracy <sup>2</sup> (across 50 $\Omega$ load)	<ul style="list-style-type: none"> <li>• <math>\pm 2\%</math> of offset setting</li> <li>• <math>\pm 1\%</math> of amplitude</li> <li>• <math>\pm 5</math> mV (<math>\pm 10</math> mV @Hi-Z)</li> </ul>
Amplitude Limit	Amplitude + Offset limit to within $\pm 2.5$ V range across 50 $\Omega$ load or $\pm 5$ V across an open circuit
Main output	
Impedance	50 $\Omega$ load (Typical)
Isolation	At least 42 Vpk to earth
Protection	Short-circuit protected, overload automatically disables the main output

Internal frequency reference	
Accuracy <sup>3</sup>	±8 ppm in 1 year
External frequency reference	
Input	
Lock range	• 10 MHz ±170 Hz
Amplitude level	• 500 mVpp to 5 Vpp
Impedance	• 50 Ω AC coupled
Lock time	• < 2 s
Output	
Frequency	• 10 MHz
Amplitude Level	• 632 mVpp (Typical)
Impedance	• Return loss 10 dB (Typical) at 10 MHz
Phase Offset	
Range	• +360° to –360°
Resolution	• 0.01°
Accuracy	• 20 ns
Notes:	
1. Maximum at 16 k points for Arbitrary waveforms when using bundled software, Keysight Measurement Manager (KMM) and 64 k points when programmed in compatible application development environments like Keysight VEE, NI LabVIEW, and Microsoft Visual Studio.	
2. Add 1/10th of output amplitude and offset specification per °C for operation outside the range of 18 °C to 28 °C.	
3. Add 1 ppm/°C (average) for operation outside the range of 18 °C to 28 °C.	
Trigger characteristics	
Trigger input	
Input Level	TTL compatible
Slope	Rising and Falling, Selectable
Pulse width	> 100 ns
Input impedance	> 10 kΩ, DC coupled
Latency	< 500 ns
Jitter (RMS)	6 ns (3.5 ns for pulse)
Trigger output	
Output Level	TTL compatible into ≥1 kΩ
Pulse width	> 400 ns
Output impedance	50 Ω (Typical)
Fanout	4 TTL
Rise time	≤ 20 ns
Modulation	
Modulation scheme	Internal, AM, FM, PM, FSK, PSK, ASK

<b>AM</b>	
Carrier waveforms	Sine, Square, Ramp, Arbitrary
Source	Internal
Internal modulation	Sine, Square, Ramp, Arbitrary (2 mHz to 20 kHz)
Depth	0.0% to 100.0%
<b>FM</b>	
Carrier waveforms	Sine, Square, Ramp, Arbitrary
Source	Internal
Internal modulation	Sine, Square, Ramp, Arbitrary (2 mHz to 20 kHz)
Deviation	1 Hz to 500 kHz
<b>PM</b>	
Carrier waveforms	Sine, Square, Ramp, Arbitrary
Source	Internal
Internal modulation	Sine, Square, Ramp, Arbitrary (2 mHz to 20 kHz)
Deviation	0.0° to 360.0°
<b>FSK</b>	
Carrier waveforms	Sine, Square, Ramp, Arbitrary
Source	Internal
Internal modulation	50% duty cycle square (2 mHz to 100 kHz)
<b>PSK</b>	
Carrier waveforms	Sine, Square, Ramp, Arbitrary
Source	Internal
Internal modulation	50% duty cycle square (2 mHz to 100 kHz)
Deviation	0.0° to 360.0°
<b>ASK</b>	
Carrier waveforms	Sine, Square, Ramp, Arbitrary
Source	Internal
Internal modulation	50% duty cycle square (2 mHz to 100 kHz)
<b>Sweep Characteristics</b>	
Waveforms	Sine, Square, Ramp, Arbitrary
Type	Linear or Logarithmic
Direction	Up or Down
Sweep time	1 ms to 500 s
Trigger	Single, External, or Internal



## USB Modular Function Generator App within BenchVue

BenchVue software for the PC makes it simple to connect, control, capture, and view multiple Keysight instruments simultaneously with no additional programming. You can derive answers faster than ever by easily viewing, logging, and exporting measurement data and screen images with a few clicks from a single environment.

- Visualize multiple measurements simultaneously
- Easily log data, screenshots, and system state
- Rapidly prototype custom test sequences
- Recall past states of your USB Modular to replicate results
- Export measurement data in the desired format fast
- Quickly access manuals, drivers, FAQs, and video



Figure 4. View measurements across USB DAQ, modular, and bench instruments all on one BenchVue interface.


The USB Modular Function Generator App within BenchVue allows you to easily configure the U2761A Function/Arbitrary Waveform Generator, set waveform properties, and load custom arbitrary waveforms from files or simply drag and drop a measured trace from an oscilloscope. Link BenchVue to the Keysight Waveform Builder Pro software will provide you with advanced custom waveform creation capabilities.



Figure 5. Controlling your function generator is as easy as point and click or drag and drop.

## Other products in the Keysight USB Modular Test Instruments Family

	<p><b>U2722A /U2723A USB modular source measure unit</b></p> <p>Features:</p> <ul style="list-style-type: none"><li>• Three-channel SMU with four-quadrant source/measure operation</li><li>• High measurement sensitivity of 100 pA with 16-bit resolution for all voltage and current ranges</li><li>• 0.1% basic accuracy</li><li>• Embedded test scripts (for U2723A)</li></ul>
	<p><b>U2741A USB modular digital multimeter (DMM)</b></p> <p>Features:</p> <ul style="list-style-type: none"><li>• Fast reading speed (up to 100 Sa/s)</li><li>• Wide range of basic measurement functions, including frequency and temperature measurements</li></ul>
	<p><b>U2701A / U2702A USB modular oscilloscope</b></p> <p>Features:</p> <ul style="list-style-type: none"><li>• High sampling rate up to 500 MSa/s, enabling accurate measurement analysis</li><li>• Up to 32 MB large memory</li><li>• Fast Fourier transfer (FFT) and waveform math functions enable easy waveform calculation</li></ul>
	<p><b>U2751A USB modular switch matrix</b></p> <p>Features:</p> <ul style="list-style-type: none"><li>• Minimal crosstalk of -30 dB at 45 MHz wide bandwidth</li><li>• High bandwidth at 45 MHz without terminal block</li><li>• Capability to test up to four devices-under-test (DUTs)</li><li>• Works with other Keysight instruments for multi-point testing</li></ul>

	<p><b>U2781A USB modular product chassis</b></p> <p>Features:</p> <ul style="list-style-type: none"> <li>• Expansion of channels for each modular product</li> <li>• Multiple instrument synchronization</li> <li>• Internal and external 10 MHz reference clock</li> <li>• High-speed USB 2.0</li> <li>• SSI/Star trigger bus synchronization between external trigger source and modules</li> </ul>
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## Ordering Information

Model	Description
U2761A	USB modular function/arbitrary waveform generator

## Optional accessories

Model	Description
U2921A-100	BNC cable
U2921A-101	USB secure cable 2 m
U2010A	Arbitrary waveform generation upgrade to 2 MHz
U2010A-1FP	Arbitrary waveform generation upgrade bundle purchase with U2761A