Keysight U1600 Series
Handheld Digital Oscilloscopes

Product discontinuance notice:
The U1401B Calibrator/Meter and all associated options will be discontinued December 1, 2017. The last date this product can be ordered is November 30, 2017.

Data Sheet

KEYSIGHT TECHNOLOGIES

Introduction

Delivering more functionality and performance with a handheld digital oscilloscope

The Keysight Technologies, Inc. U1600 Series handheld digital oscilloscope has a 4.5-inch LCD color display, which helps to clearly distinguish waveforms between two channels. This U1600 Series provides a high performance troubleshooting and quality assurance tool for technical professionals in the installation, maintenance, service, and automotive industries. The U1600 Series consists of four models: U1602B – 20 MHz oscilloscope and U1604B – 40 MHz oscilloscope. Each model has a real-time sampling rate of up to 200 MSa/s. Users can use the Dual Waveform Math (DWM) and Fast Fourier Transform (FFT) functions (in the U1604B model) to perform quick waveform analyses in both time and frequency domains.

The built-in 6000 resolution count true RMS digital multimeter (DMM) comes with an auto-range feature that gives users the flexibility to perform quick and accurate meter measurements including voltage, resistance, and auxiliary measurements. In addition, the standard versions of the U1600 Series models also contain a data logger function.

The series' latest oscilloscopes, the U1602B and U1604B come in vivid orange cases, offering capabilities and functions equivalent to the U1600A Series.

A scope, true RMS DMM, a real-time data logger in one instrument

The U1600 Series is a robust, high performance and reliable handheld waveform and meter measurement tool for today's challenging industrial environments. Not only do these instruments provide fully featured oscilloscope functions, but also a 6,000-count true RMS DMM with real-time data logger. The DMM measurement functions include a voltmeter (for DC voltage, AC voltage and true RMS AC + DC voltage measurements), an ohmmeter (for 2-wire resistance, capacitance, diode and continuity tests), and an auxiliary meter (for temperature, ampere measurement)*.

* additional accessories required and offered as optional

Features

- Three-in-one solution: Dual channel oscilloscope, True RMS DMM, and Real-Time Data Logger
- Large 4.5" color LCD display
- Up to 40 MHz bandwidth with advanced triggering
- Up to 200 MSa/s sampling rate
- Up to 125 000 points recording length
- 22 automatic scope measurement functions available
- 6,000-count DMM resolution with built-in measurement functions including voltmeter, ohmmeter, and auxiliary meter
- Zoom and Dual Waveform Math functions (additional FFT function with four windowing techniques available in U1604B)
- Full remote control and data transfer via PC Link application software
- USB 2.0 full-speed interface connectivity
- Multi-language Quick Help support

Clearly distinguish your waveform

The U1600 Series models come with a color display, which allows you to quickly and clearly identify your signal between two channels. The large LCD display – 4.5" with 320 x 240 resolution – makes it much easier for you to view more pieces of information at one glance.

Capture signal deviations, glitches and dropouts effectively

The U1600 Series offers the best product specification for users. This instrument provides a real-time sampling rate of up to 200 MSa/s. Use the U1600 Series to capture both instantaneous and repetitive signal anomalies effectively.

High-precision zoom-in capability in deep memory

With 125 kilobytes of physical memory, you can capture non-repeating signals at a higher sampling rate over a wider time base. With up to 125 000 points recording length, you can quickly zoom in the segment of interest and uncover even the most subtle details of the signal at a given time-base setting.

Isolate and analyze the signal you want to see

The U1600 Series comes with flexible triggering capabilities that allow you to isolate and capture the condition you want to characterize. The advanced triggering function includes edge, pulse width, pattern, and video signal triggering, giving you the flexibility needed to best capture your signal.

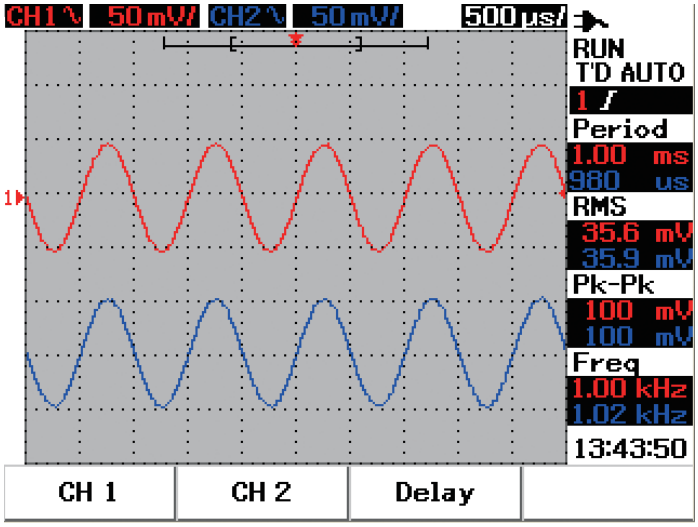
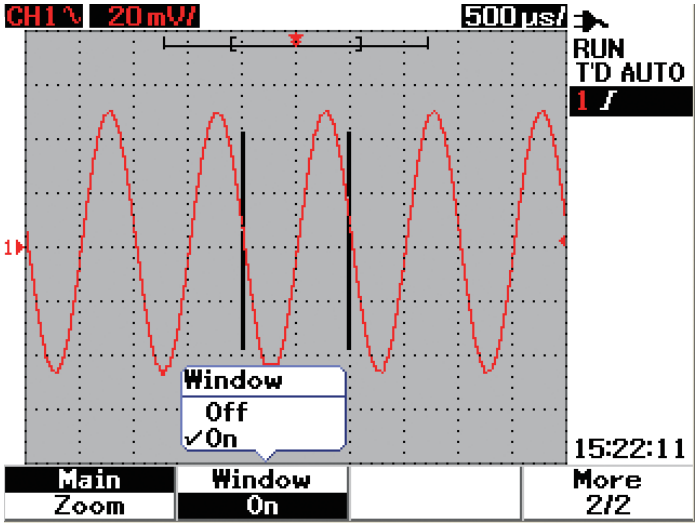
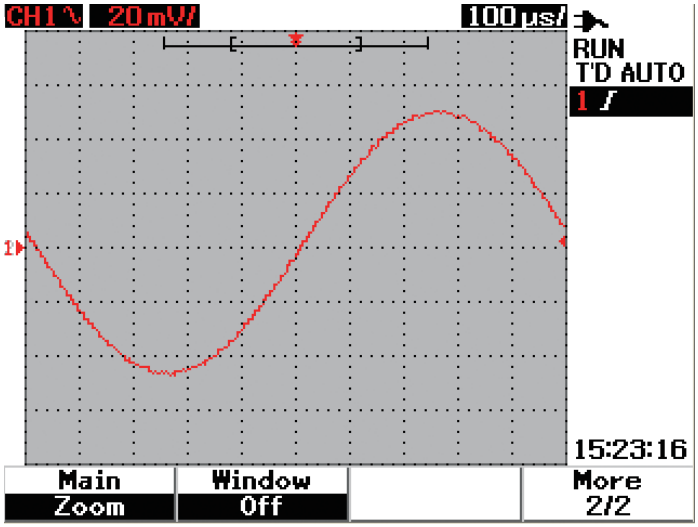


Figure 1. High-definition of color resolution in large 4.5" LCD display allows you to quickly distinguish and identify your signals and observe signal activity.



Before Zoom



After Zoom

Figure 2. With up to 125 000 points recording length, use the zoom-in function to magnify a signal to the segment of your interest and scrutinize subtle details of your signals.

FFT (U1604B only) and Dual Waveform Math functions for waveform analysis

Besides of the standard Dual Waveform Math (DWM) function in U1600 Series, the U1604B model is equipped with a FFT (Fast Fourier Transform) function. This function allows you to view the waveform in a frequency domain using four windowing techniques (Rectangular, Hanning, Hamming, Black-Harris). Use the DWM function to perform math functions for signal addition and subtraction from multiple channels.

Easy, straightforward connectivity

The U1600 Series expands the oscilloscope's capability with the PC Link application software that caters for data collection, storage and documentation needs from instrument via USB 2.0 full-speed connection. This PC Link application software is available for you to control the instrument remotely from a PC, retrieve your waveform and print it using a connected printer. User can connect to PC and/or USB flash drive to store waveform and setup, these can be done via:-

- USB 2.0 Full Speed Client for PC connectivity (Standard Option)
- USB 2.0 Full Speed Host for external storage and save waveform/setup (Option 001)

Built-in multi-lingual Quick Help menu provides instant assistance

Need assistance while operating the instrument? The built-in multi-lingual Quick Help menu helps to minimize downtime in the event that you need help to set up scope and DMM functions. The supported languages include English, German, Italian, Spanish, Portuguese, French, Korean, Traditional Chinese, Simplified Chinese, and Japanese.

Save and recall waveform and setup memories capability

Up to 10 waveform and configuration setups can be stored in the internal memory and recalled at any time for future use and reference, this feature can only be done on the instrument and data not extracted out to USB drive.

Log data for any DMM measurement

The sophisticated logger mode allows you to record and consolidate a sequence of data points for data plotting purposes.

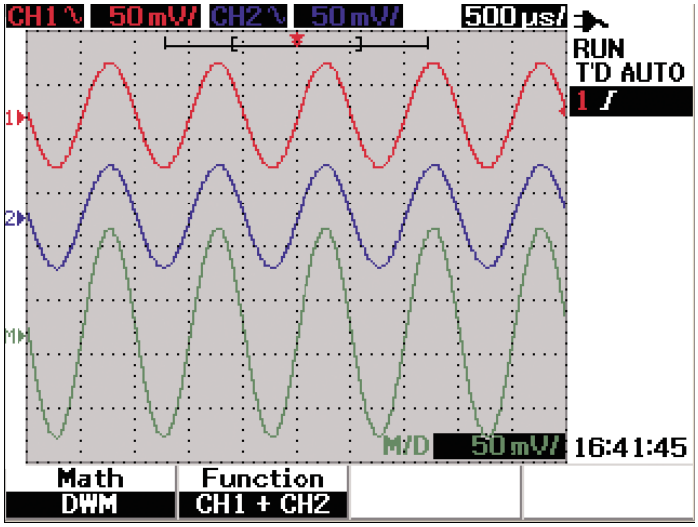


Figure 3. The U1600 Series comes equipped with DWM features, allowing you to perform spectrum analyses and evaluate signal additions and subtractions from multiple channels.

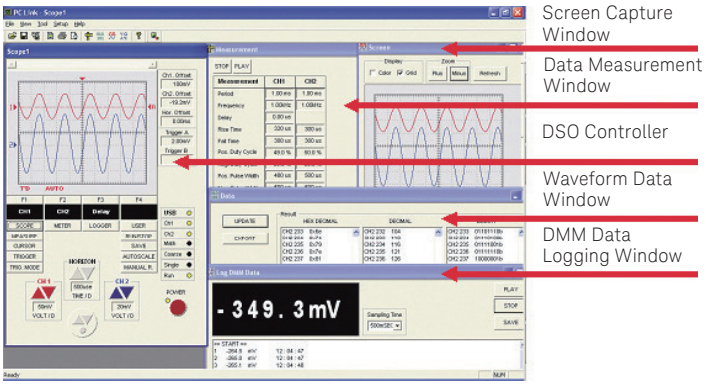


Figure 4. PC Link application software is available to enable data collection, storage and documentation needs via USB full-speed remote control from PC.

Scope Specifications[1]

Vertical System: Scope Channels	
Bandwidth (–3 dB)	U1602B: DC to 20 MHz U1604B: DC to 40 MHz
DC vertical gain accuracy	5 mV/div to 20 mV/div: ± 5% full scale 50 mV/div to 100 V/div: ± 3% full scale
Scope Channel Triggering	
Trigger sensitivity	DC to 5 MHz: 0.8 divisions U1602B: 5 MHz to 20 MHz – 1 division U1604B: 5 MHz to 40 MHz – 1 division

Scope Characteristics[2]

Acquisition: Scope Channels	
Maximum sample rate	100 MSa/s per channel (50 s/div to 250 ns/div)[3] 200 MSa/s single channel and interleaved (125 ns/div)[4]
Equivalent sample rate	U1604B: 2.5 GSa/s (125 ns/div to 10 ns/div)
Vertical resolution	8 bits
Maximum recording length:	U1602B/U1604B: Up to 125 000 points, viewable on screen with zoom function
Peak detection	5 ns
Average	Selectable in average number of 2, 4, 8, 16, 32, 64, 128, 256
Vertical System: Scope Channels	
Analog channels	Channel 1 and Channel 2 simultaneous acquisition
Bandwidth (–3 dB)	U1602B: DC to 20 MHz U1604B: DC to 40 MHz
AC coupled	< 10 Hz without probe < 1 Hz with 10 MΩ 10:1 probe
Rise time	U1602B: < 17.5 ns U1604B: < 8.8 ns
Single shot bandwidth	U1602B: 20 MHz U1604B: 40 MHz
Vertical sensitivity	5 mV/div to 100 V/div (1:1 scope probe) 50 mV/div to 1 kV/div (10:1 scope probe) 500 mV/div to 10 kV/div (100:1 scope probe)
Maximum input	CAT III 300 Vrms (up to 400 Hz) from terminal to ground
Offset/Dynamic range	± 5 div
Input impedance	1 MΩ I I < 20 pF
Coupling	AC, DC, GND

1. All specifications are warranted. Specifications are valid after a 30-minute warm-up period and within a range of ±10 °C from firmware calibration temperature.
2. All characteristics are typical performance values and are not warranted. Characteristics are valid after a 30-minute warm-up period and within a range of ±10 °C from firmware calibration temperature.
3. Maximum sampling rates are shown here. Sampling rate will vary according to selected time base. For more information, please refer to User's and Service Guide.
4. 200 MS/s sampling rate is only available at 125 ns/div timebase
5. Number of points displayed will vary according to time base selected. For more information, refer to User's and Service Guide

Probes		U1560-60001: 1:1 passive probe U1561-60001: 10:1 passive probe U1562-60001: 100:1 passive probe
Probe attenuation factors		1x, 10x, 100x
Coupling		3 Vp-p, ~ 1 kHz
Maximum probe input		1x CAT III 300 VAC 10 x, 100x CAT III 600 VAC
Noise peak-to-peak		3% of full scale or 5 mV, whichever is greater
DC vertical offset accuracy		± 0.1% div ± 2 mV ± 0.5% offset value
Single cursor accuracy		4% full scale
Dual cursor accuracy		4% full scale
Horizontal System		
Range		U1602B: 50 ns to 50 s/div U1604B: 10 ns to 50 s/div
Resolution		U1602B: 2 ns U1604B: 400 ps
Reference position		Left, center, right
Delay range (pre-trigger)		15 divisions
Delay range (post-trigger)		1000 divisions
Analog Dt accuracy		± 3% reading ± 0.4% screen
Modes		Main, XY, Roll
RMS Jitter		5% of horizontal scale or 5 ns, whichever is higher
Trigger System		
Source		Channel 1 and Channel 2
Modes		Auto, normal, single
Selections		Edge, pulse width, pattern, video
	Edge	Trigger on a rising or falling edge of any source
	Pattern	Trigger at the beginning of a pattern of high, low levels and rising or falling edge established conditions of AND, OR, NOR and NAND between the channels.
	Pulse Width	200 ns to 10 s. Trigger when a positive or negative pulse width of any source larger than, less than, equal to or not equal to duration.
	Video	Video trigger sensitivity: 0.7 division trigger level. Available to both Channel 1 and Channel 2. Analog progressive and interlaced video standards including NTSC, PAL and SECAM. Positive or negative sync pulse polarity. Modes – all fields, even fields, odd fields or line 5 – 263 within a field.
Range		± 4 divisions from center screen
Level accuracy		± 0.5 divisions
Trigger sensitivity		DC to 5 MHz: 0.8 divisions U1602B: 5 MHz to 20 MHz – 1 division U1604B: 5 MHz to 40 MHz – 1 division
Coupling		DC, AC (< 1 Hz), HF reject (> 50 kHz), LF reject (< 30 kHz), Noise reject

Measurement System	
Autoscale	Finds and displays all active scope channels, sets edge trigger mode on highest numbered channel, sets vertical sensitivity on scope channel. Requires voltage > 20 mVp-p, 0.5% duty cycle and frequency > 100 Hz.
Automatic measurement	Measurements continuously updated.
Voltage	Peak-to-peak, maximum, minimum, amplitude, top, base, +overshoot, –overshoot, preshoot, RMS, mean and one cycle mean.
Time	Frequency, period, +width, –width, and +duty cycle and –duty cycle on any channel. Rise time, fall time, delay and phase shift.
Cursors	Manually place readout of horizontal (X, ΔX) and vertical (Y, ΔY).
Waveform math	CH1 + CH2, CH1 – CH2, CH2 – CH1
FFT[1]	
Window	Rectangular, Hanning, Hamming, Blackman-Harris
Amplitude display	Selectable in amplitude displays of 1 dB, 2 dB, 5 dB, 10 dB

Digital Multimeter Specifications[1] ± (% reading + % range)

Funtion	Range	Frequency, Test Current or Burden Voltage	1 year Tcal ± 5° C
DC Voltage	600.0 mV		0.3 + 0.08
	6.000 V		0.3 + 0.08
	60.00 V		0.3 + 0.08
	600.0 V		0.3 + 0.08
AC Voltage	600.0 mV – 600.0 V	50 Hz – 1 kHz	1.0 + 0.2
		1 kHz – 30 kHz	3.0 + 0.2
AC + DC Voltage	6.000 V – 600.0 V	50 Hz – 1 kHz	1.0 + 0.2
		1 kHz – 30 kHz	3.0 + 0.2
Resistance	600.0 Ω		0.5 + 0.2
	6.000 kΩ		0.5 + 0.2
	60.00 kΩ		0.5 + 0.2
	600.0 kΩ		0.5 + 0.2
	6.000 MΩ		0.5 + 0.2
	60.00 MΩ		1.0 + 0.2
Capacitance	60.00 nF		2.0 + 0.2
	600.0 nF		2.0 + 0.2
	6.000 µF		2.0 + 0.2
	60.00 µF		2.0 + 0.2
	300.0 µF		2.0 + 0.2
Diode	1.000 V	0.5 mA	2.0 + 0.08

1. For temperatures between 0 °C to 18 °C and 28 °C to 50 °C, add 0.1% of reading + 0.02% of range for every degree Celsius.

Auxiliary Meter Specifications ± (% of reading + % of range)

Function	Range	Frequency	1 year Tcal ± 5 °C
Temperature[2], °C	600.0 °C		0.3 + 0.08
	6000 °C		0.3 + 0.08
Temperature[2], °F	600.0 °F		0.3 + 0.08
	6000 °F		0.3 + 0.08
AC Current[3]	60.00 A	50 Hz – 1 kHz	1.0 + 0.2
	600.0 A	50 Hz – 1 kHz	1.0 + 0.2
Measurement Characteristics			
Full scale reading	6,000-count		
DC voltage, True RMS AC voltage	Maximum input voltage, 600 Vrms CAT II, 300 Vrms CAT III DC coupled input coupling		
Continuity	Beeper < 60 W in 600 W range		
Data Logger			
Source	Digital multimeter measurements		
Range	10 divisions		
Record size	Up to 8800 data points (with option 001)		
Time span	Auto range 150 seconds to 20 days		
Time reference	Time from start		
Record method	Selectable minimum, maximum and average		
Display System			
Display	4.5-inch diagonal color CSTN LCD		
Resolution	320 x 240 pixels		
Control	Contrast control, infinite persistance on/off		
Built-in help system	Functional help displayed by pressing help button		
Real-time clock	Time and date (user-adjustable)		
Storage			
Save/Recall (non-volatile)	Up to 10 setups and traces		

2. U1586B temperature module is needed to make measurements and is available as option.
3. U1583B AC current clamp needed to make measurements and is available as option.

General Characteristics

Power Adapter Line voltage range 50/60 Hz, 100 – 240 VAC Output voltage 12 VDC		
Battery Ni-MH rechargeable battery pack 7.2 V, 4500 mAH Operating time: 4 hours Charging time: 5 hours, measurement unit off Allow ambient temperature during charging: 10 °C to 40 °C		
Operating Environment		
Temperature	Operating full accuracy	0 °C to 50 °C
	Non-operating	–20 °C to 70 °C
Humidity	Operating full accuracy	to 80% RH at 40 °C
Altitude	Operating full accuracy	Up to 2000 m
	Non-operating	15000 m (50000 ft)
ESD tolerance	± 4 kV	
Safety Compliance IEC 61010-1: 2001/EN61010-1: 2001 CSA C22.2 No. 61010-1: 2004 Pollution degree 2 This instrument is rated for indoor use only.		
Dimensions (HxWxD) 24.1 cm height x 13.8 cm width x 6.6 cm depth		
Weight 1.5 kg		
I/O USB 2.0 Full Speed Client - For PC connectivity (Standard Option) USB 2.0 Full Speed Host - For external USB storage (Option 001) Firmware upgrade through USB.		

Standard Shipped Items

Item	U1602B/U1604B
U1560A 1:1 Scope probe	-
U1561A 10:1 Scope probe	x (2 units)
U1580A Test leads	x
U1162A Alligator clips	x
USB cable	x
U1570A AC power adapter and cord	x
U1571A Ni-MH battery pack	x
Quick Start Guide	x
Certificate of calibration	x

Ordering Information

U1602B

U1604B

Optional Accessories

Item	Description
U1168A Standard test lead kit (with 19-mm and 4-mm probe tips)	– Test leads: CAT III 1000 V, CAT IV 600 V, 15 A – Test probes (19-mm tip): CAT II 1000 V, 15 A – Test probe (4-mm tip): CAT III 1000 V, CAT IV 600 V, 15 A (highly recommended for CAT IV environment) – Alligator clips: CAT III 1000 V, CAT IV 600 V, 15 A – Fine tip test probes: CAT II 300 V, 3 A – SMT grabber: CAT II 300 V, 3 A – Mini grabber (black only): CAT II 300V, 3 A
U1161A Extended test lead kit	– Includes two test leads (red and black), two test probes, medium sized alligator clips and 4 mm banana plugs – Test leads: CAT III 1000 V, CAT IV 600 V, 15 A – Test probes: CAT lll 1000 V, CAT lV 600 V, 15 A – Medium Sized Alligator Clips: CAT III 1000 V, CAT IV 600 V, 15 A – 4 mm Banana Plugs: CAT II 600 V, 10 A
U1162A Alligator clips	– One pair of insulated alligator clips (red and black) – Recommended for use with Keysight standard testleads – Rated CAT III 1000 V, CAT IV 600 V, 15 A
U1163A SMT grabbers	– One pair of SMT grabbers (red and black) – Recommended for use with Keysight standard test leads – Rated CAT II 300 V, 3 A
U1164A Fine-tip test probes	– One pair of insulated alligator clips (red and black) – Recommended for use with Keysight standard test leads – Rated CAT II 300 V, 3 A
U1169A Test probe leads (with 19-mm tips and 4-mm tips)	– Test leads: CAT III 1000 V, CAT IV 600 V, 15 A – Test probe (19-mm tip): CAT II 1000 V, 15 A – Test probe (4-mm tip): CAT III 1000 V, CAT IV 600 V, 15 A (highly recommended for CAT IV environment)
U1181A Immersion temperature probe	– Type-K thermocouple for use in oil and other liquids temperature measurements – Measurement range: –50 °C to 700 °C – Temperature module (U1586A) is required to connect to DMM inputs of the handheld scope – U1184A Temperature probe adapter included for use with DMMs
U1182A Industrial surface temperature probe	– Type-K thermocouple for use in still surface temperature measurements – Measurement range: –50 °C to 400 °C – Temperature module (U1586A) is required to connect to DMM inputs of the handheld scope – U1184A Temperature probe adapter included for use with DMMs
U1183A Air temperature probe	– Type-K thermocouple for use in air and non-caustic gas temperature measurements – Measurement range: –50 °C to 800 °C – Temperature module (U1586A) is required to connect to DMM inputs of the handheld scope – U1184A Temperature probe adapter included for use with DMMs

Optional Accessories, *continued*

Item	Description
U1560A 1:1 Scope probe	– Includes ground alligator and hook clips – Rated CAT III 300 V – Frequency range from 0 to 45 MHz
U1561A 10:1 Scope probe	– Includes ground alligator and hook clips – Rated CAT III 600 V – Frequency range from 0 to 250 MHz
U1562A 100:1 Scope probe	– Includes ground alligator and hook clips – Rated CAT III 600 V – Frequency range from 0 to 300 MHz
U1570A AC power adapter	– AC power adapter for handheld scope – Includes AC power based on country
U1554A Hook clip for probe tip	– Rated CAT II 1000 V, CAT III 600 V
U1571A Ni-MH battery pack	– 4500 mA, 7.2 V
U1580A DMM terminal test lead set	– Include 2 test leads, 2 test probes and 3 alligator clips – Test leads: CAT III 1000V, CAT IV 600V, 15A rating – Test probe (4-mm tips): CAT III 1000V, CAT IV 600V, 15A rating – Alligator Clips: Cat III 1000V, CAT IV 600V, 15A rating
U1583B AC current clamp	– Dual range (40 A and 400 A) – Rated CAT III 600 V – BNC-to-banana plug provided, for use with DMMs or handheld scope
U1586B Temperature module	– Measure –50°C to 1000°C/–58°F to 1832°F – K-type bead probe supplied – Can be used with U1181A, U1182A, and U1183A
U1590A Soft carrying case	– Dimensions: 9.6″ (H) x 13.0″ (W) x 4.5″ (T) – PVC leather material

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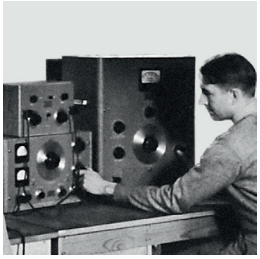

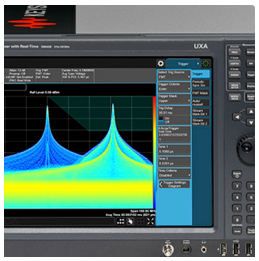

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