2015, 2015-P, 2016, 2016-P

6½-Digit THD Multimeters
6½-Digit Audio Analyzing Multimeters

The Models 2015-P and 2016-P Audio Analyzing Digital Multimeters and the Models 2015 and 2016 Total Harmonic Distortion Multimeters combine audio band quality measurements and analysis with a full-function 6½-digit DMM. Test engineers can make a broad range of voltage, resistance, current, frequency, and distortion measurements, all with the same compact, half-rack measurement instrument. The Model 2016 and 2016-P have twice the sine wave generator output of the Model 2015 for applications that require test signals greater than 8Vrms. The Model 2015-P and 2016-P offer additional processing capacity for frequency spectrum analysis.

Frequency Domain Distortion Analysis

For applications such as assessing non-linear distortion in components, devices, and systems, DSP-based processing allows the Models 2015-P, 2015, 2016, and 2016-P to provide frequency domain analysis in conventional time domain instruments. They can measure Total Harmonic Distortion (THD) over the complete 20Hz to 20kHz audio band. They also measure over a wide input range (up to 750Vrms) and have low residual distortion (–87dB). The THD reading can be expressed either in decibels or as a percentage.

In addition to THD, the Models 2015, 2015-P, 2016, and 2016-P can compute THD+Noise and Signal-to-Noise plus Distortion (SINAD). For analyses in which the individual harmonics are the criteria of greatest interest, the instruments can report any of the (up to 64) harmonic magnitudes that can be included in the distortion measurements. The user can program the actual number of harmonics to be included in a computation, so accuracy, speed, and complexity can be optimized for a specific application. (See ***Figure 1***.)

- **THD, THD+Noise, and SINAD measurements**
- **20Hz–20kHz sine wave generator**
- **Fast frequency sweeps**
- **2015-P, 2016-P: Identifies peak spectral components**
- **2015, 2015-P: 4Vrms single-ended or 8Vrms differential output**
- **2016, 2016-P: 9.5Vrms single-ended or 19Vrms differential output**
- **Individual harmonic magnitude measurements**
- **5 standard audio shaping filters**
- **13 DMM functions (6½ digits)**
- **GPIB and RS-232 interfaces**

Figure 1. Frequency Spectrum of 1kHz Square Wave

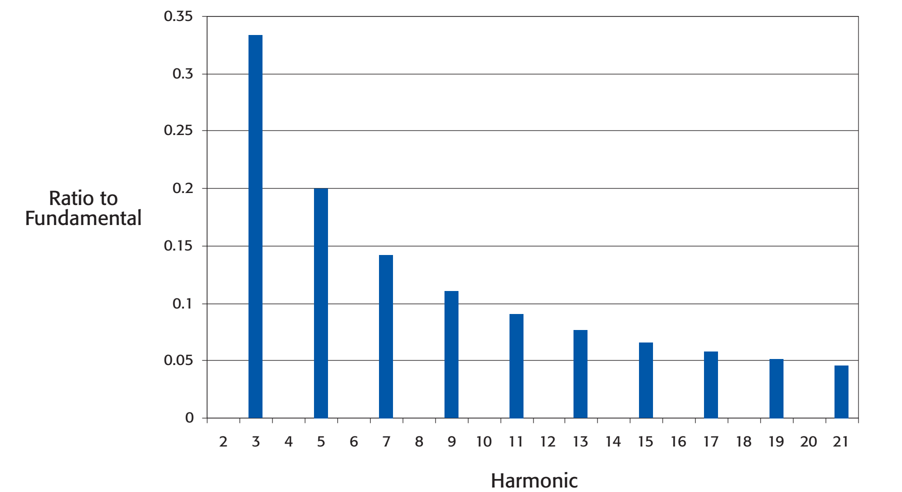

Figure 1 **shows a plot of a square wave's harmonics (frequency components) computed and transmitted to a personal computer by the Model 2015 or 2016. A square wave's spectral content consists of only odd harmonics whose magnitudes are (1/harmonic number × the magnitude of the fundamental). For example, the magnitude of the third harmonic is ⅓ the magnitude of the fundamental.**

APPLICATIONS

- **Wireless communication device audio quality testing**
- **Component linearity testing**
- **Lighting and ballast THD limit conformance testing**
- **Telephone and automotive speaker testing**

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A GREATER MEASURE OF CONFIDENCE

2015, 2015-P, 2016, 2016-P

6½-Digit THD Multimeters
6½-Digit Audio Analyzing Multimeters

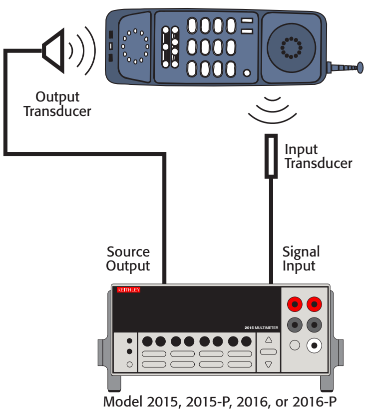
Ordering Information

2015	Total Harmonic Distortion 6½-Digit Multimeter
2015-P	Audio Analyzing DMM
2016	Total Harmonic Distortion 6½-Digit DMM w/9V Source Output
2016-P	Audio Analyzing DMM w/9V Source Output

Accessories Supplied

Model 1751 Safety Test Leads, User Manual, Service Manual.

Figure 2. Total Harmonic Distortion Analysis and Frequency Response of a Portable Wireless Telecommunication Device



Figures 2, 3, and 4 **demonstrate how the Model 2015, 2015-P, 2016, or 2016-P can provide both time domain and frequency domain measurements in a single test protocol. *Figure 2* shows a sample test system schematic with a telecommunication device in a loop back mode test. The Audio Analyzing DMM's source provides a stimulus frequency sweep, and the Audio Analyzing DMM measures the response from the microphone circuit. *Figure 3* shows the resulting frequency domain analysis of the THD and the first three harmonics as a function of frequency. *Figure 4* shows the time domain analysis of microphone circuit output voltage as a function of frequency.**

Figure 3. THD and 2nd, 3rd, and 4th Harmonics as a Function of Frequency

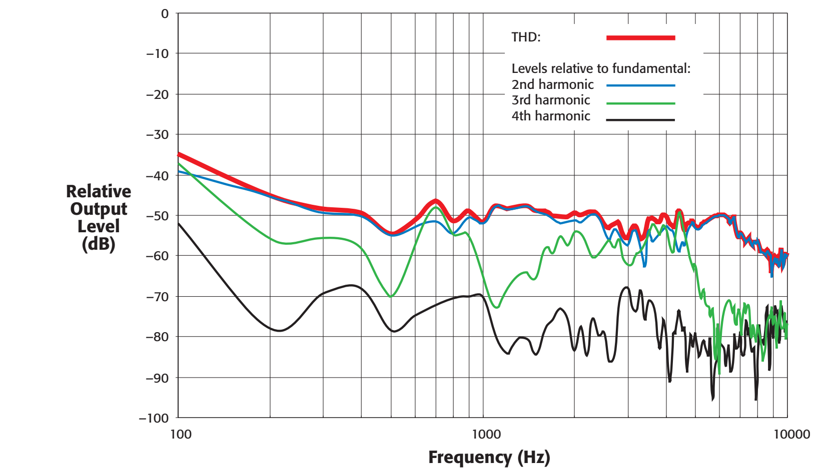
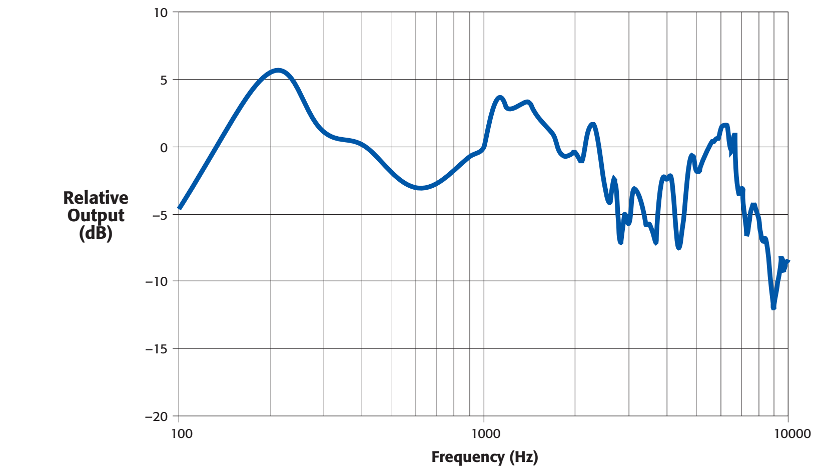


Figure 4. Frequency Response



Optimized for Production Testing

The Models 2015, 2015-P, 2016, and 2016-P can perform fast frequency sweeps for characterizing audio-band circuitry in production test systems. For example, the instruments can execute a single sweep of 30 frequencies and transmit both rms voltage readings and THD readings to a computer in only 1.1 seconds. With that data, a complete frequency response analysis and a harmonic distortion vs. frequency analysis can be performed in a very short time. Thus high speed testing of the audio performance of a high volume device such as a cellular telephone can be performed without reducing the number of tests or reducing the measurements in each test. With these instruments, which are optimized for production testing, test engineers can lower test times, in comparison to test speeds achievable with general purpose audio analyzers, without sacrificing production test quality.

Dual Output Source

The Models 2015, 2015-P, 2016, and 2016-P include an internal audio band sine wave source for generating stimulus signals. A second output, the inverse of the first output, is also available, simplifying the testing of differential input circuits for common mode or noise cancellation performance.

2015, 2015-P, 2016, 2016-P

6½-Digit THD Multimeters 6½-Digit Audio Analyzing Multimeters

Figure 5a.

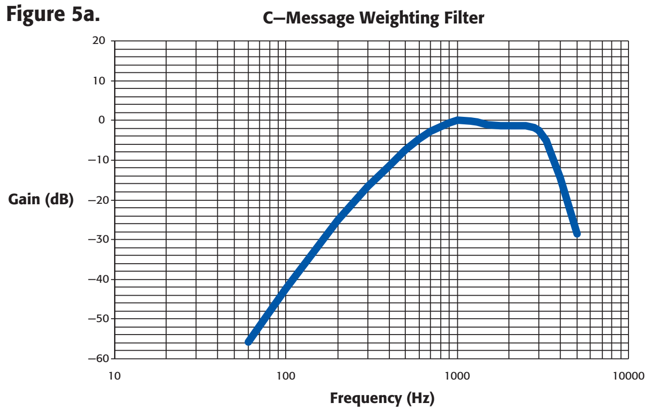


Figure 5d.

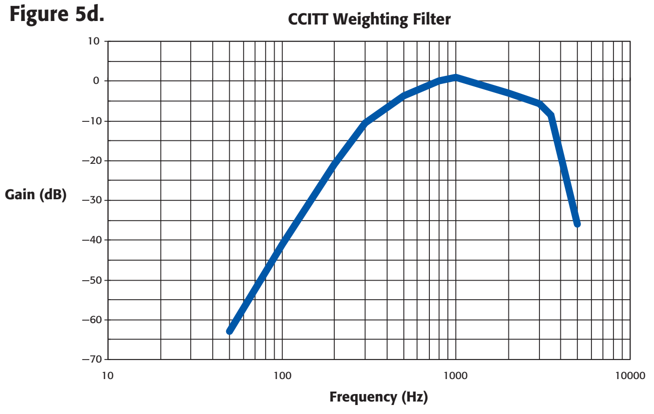


Figure 5b.

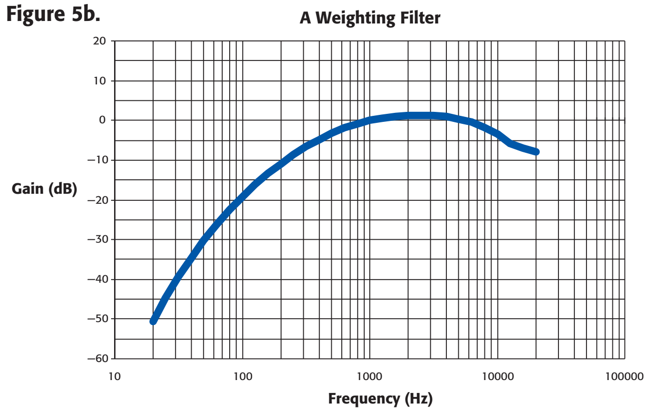


Figure 5e.

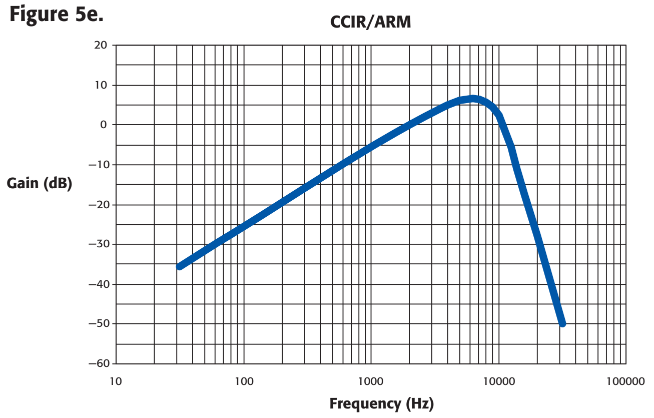
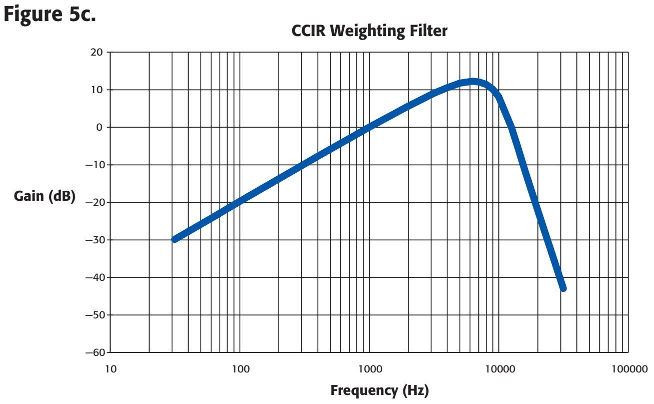


Figure 5c.



The Models 2015 and 2015-P have a 4Vrms single-ended output and 8Vrms differential source output. For tests that require a higher stimulus signal, the Model 2016 and 2016-P provide a 9.5Vrms single-ended output and a 19Vrms differential output.

Wide Selection of Audio Filters

Five industry-standard bandpass filters are provided for shaping the input signal for audio and telecommunication applications. Available filters include the CCITT weighting filter, CCIR filter, C-message filter, CCIR/ARM filter, and "A" weighting filter (see ***Figures 5a–5e***). The Models 2015, 2015-P, 2016, and 2016-P provide programmable, high cutoff (low pass) and low cutoff (high pass) filters. Furthermore, the two filters can be implemented together to form a bandpass filter. The programmable filters can be used to filter out noise generated by electromechanical machinery on the production floor or to simulate other types of system transmission characteristics.

Broad Measurement Flexibility

In addition to their THD, THD+Noise, SINAD, and individual harmonic measurement capabilities, the instruments provide a comprehensive set of DMM functions, including DCV, ACV, DCI, ACI, 2WΩ, 4WΩ, temperature, frequency, period, dB, dBm, and continuity measurements, as well as diode testing. This multi-functional design minimizes added equipment costs when configuring test setups.

2015, 2015-P, 2016, 2016-P

6½-Digit THD Multimeters 6½-Digit Audio Analyzing Multimeters

Wide Band or Narrow Band Noise Measurements

The Models 2015, 2015-P, 2016, and 2016-P are capable of measuring both wide band noise and narrow band noise. Alternatively, these instruments' DSP (digital signal processing) capabilities allow users to make frequency domain measurements of RMS voltage noise over the 20Hz–20kHz frequency audio band or a narrow portion of the band. Furthermore, noise measurements can be extracted in the presence of a stimulus signal for fast signal-to-noise computations.

Spectrum Analysis

The Model 2015-P and 2016-P have internal computational capabilities that allow them to characterize an acquired signal spectrum. These instruments can identify and report the frequency and amplitude of the highest value in a complete spectrum or within a specified frequency band. It can also identify additional peaks in descending order of magnitude (see ***Figure 6***). The Model 2015-P's and 2016-P's on-board capabilities make it simple to obtain a thorough analysis of a frequency spectrum more quickly and with little or no need for external analysis software.

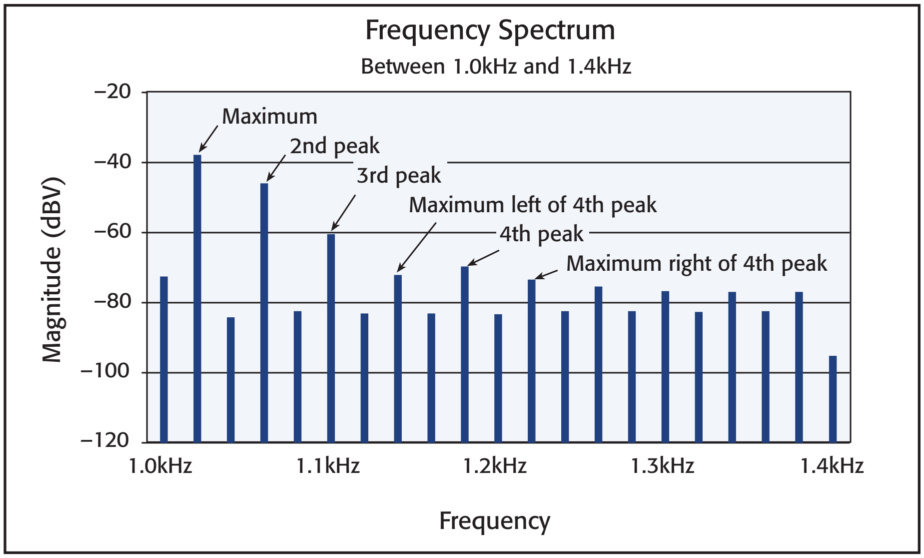
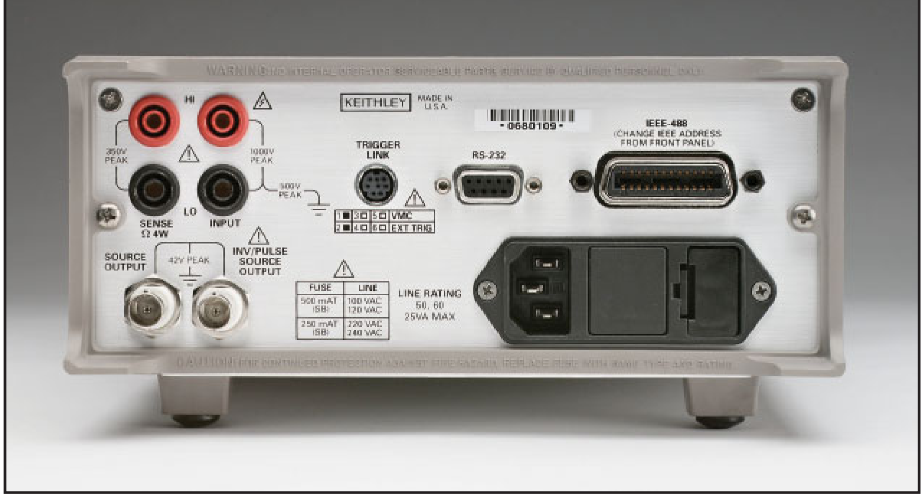


Figure 6. The Model 2015-P and 2016-P directly identify peak values of the frequency spectrum.

Figure 7. Rear panel of all models



SERVICES AVAILABLE

2015-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2015-P-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2016-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2016-P-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
C/2015-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2015, 2015-P*
C/2016-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2016, 2016-P*

*Not available in all countries

ACCESSORIES AVAILABLE

CABLES/ADAPTERS

7007-1	Shielded IEEE-488 Cable, 1m (3.3 ft)
7007-2	Shielded IEEE-488 Cable, 2m (6.6 ft)
8501-1, 8501-2	Trigger-Link Cables, 1m (3.3 ft), 2m (6.6 ft)
8502	Trigger Link Adapter Box
8503	Trigger Link Cable to 2 male BNCs, 1m (3.3 ft)
7009-5	RS-232 Cable

RACK MOUNT KITS

4288-1	Single Fixed Rack Mount Kit
4288-2	Dual Fixed Rack Mount Kit

GPIB INTERFACES

KPCI-488LPA	IEEE-488 Interface/Controller for the PCI Bus
KUSB-488B	IEEE-488 USB-to-GPIB Interface Adapter

2015, 2015-P, 2016, 2016-P

6½-Digit THD Multimeters
6½-Digit Audio Analyzing Multimeters

DISTORTION CHARACTERISTICS

VOLTAGE RANGE: 100mV, 1V, 10V, 100V, 750V (user selectable).
INPUT IMPEDANCE: 1MΩ paralleled by <100pF.
DISPLAY RANGE: 0–100% or 0–100.00dB.
RESOLUTION: 0.0001% or 0.00001dB.
FUNDAMENTAL FREQUENCY RANGE: 20Hz–20kHz.
HARMONIC FREQUENCY RANGE: 40Hz–50kHz.
FREQUENCY RESOLUTION: 0.008Hz.
FREQUENCY ACCURACY: ±0.01% of reading.
FREQUENCY TEMPERATURE COEFFICIENT: ≤100ppm over operating temperature range.

Measurement Mode	Accuracy (1 Year, 23°C ±5°C)	Residual Distortion[1]
THD and individual harmonic magnitudes	±0.8 dB, 20 Hz to 20 kHz[2]	0.004% or –87 dB 20 Hz to 20 kHz
THD + n	±1.5 dB, 100 Hz to 20 kHz[2]	0.056% or –65 dB 20 Hz to 20 kHz
SINAD	±1.5 dB 100 Hz to 20 kHz[2]	+65 dB 20 Hz to 20 kHz
AC Level V rms	±(0.13% of reading + 0.009% of range) 20 Hz to 20 kHz	

DISTORTION MEASUREMENT AUDIO FILTERS

None	C-Message
CCITT Weighting	CCIR/ARM
CCIR	"A" Weighting

NUMBER OF HARMONICS INCLUDED IN THD CALCULATION: 2 to 64 (user selectable).
HI AND LO CUTOFF FILTERS (bus settable): 20Hz–50kHz. Can be combined to form brickwall bandpass filter.

DISTORTION MEASUREMENT READING RATE[3]

Fundamental Frequency Acquisition Mode	Fundamental Frequency Range	Minimum Readings Per Second
Single acquisition or stored value	20 Hz to 100 Hz	14
	100 Hz to 1 kHz	24
	1 kHz to 20 kHz	28
Automatic	20 Hz to 30 Hz	5.5
	30 Hz to 400 Hz	6
	400 Hz to 20 kHz	6.6

FREQUENCY SWEEP READING RATE

Number of Frequencies	Time (seconds)[4]
5	0.2
30	1.1
100	3.5
200	6.9

NOTES

1. Input signal at full scale.
2. V_{IN} ≥20% of range and harmonics > –65dB.
3. Speeds are for default operating conditions (*RST), and display off, auto range off, binary data transfer, trig delay = 0.
4. Typical times: frequencies in 400–4kHz range, binary data transfer, TRIG DELAY = 0, Display OFF, Auto Range OFF. Data returned is THD measurement plus AC voltage.

GENERATOR CHARACTERISTICS

FREQUENCY RANGE: 10–20kHz.
FREQUENCY RESOLUTION: 0.007Hz.
FREQUENCY ACCURACY: ±(0.015% of reading + 0.007Hz)[1].
FREQUENCY TEMPERATURE COEFFICIENT: <100ppm over operating temperature range.

SOURCE OUTPUT:

WAVEFORM: Sinewave.
AMPLITUDE RANGE: **2015, 2015-P:** 2V rms (50Ω and 600Ω) or 4V rms (HI Z). **2016, 2016-P:** 4.75V rms (50Ω and 600Ω) or 9.5V rms (HI Z).
AMPLITUDE RESOLUTION: **2015, 2015-P:** 0.5mV rms (50Ω and 600Ω) or 1mV rms (HI Z). **2016, 2016-P:** 1.25mV rms (50Ω and 600Ω) or 2.5mV rms (HI Z).
AMPLITUDE ACCURACY: **2015, 2015-P:** ±(0.3% of setting + 2mV)[1, 4]. **2016, 2016-P:** ±(0.3% of setting + 5mV)[1, 4].
AMPLITUDE TEMPERATURE COEFFICIENT: Typically 0.015%/°C.
AMPLITUDE FLATNESS: ±0.1dB[1, 4, 5].
OUTPUT IMPEDANCE: 50Ω ± 1Ω or 600Ω ± 10Ω, user selectable.
THD: –64dB[6].
NOISE: **2015, 2015-P:** 100µV rms[2]. **2016, 2016-P:** 250µV rms[2].
DC OFFSET VOLTAGE: **2015, 2015-P:** ±1.2mV[1]. **2016, 2016-P:** ±3mV[1].

INV/PULSE OUTPUT (SINEWAVE MODE):

FREQUENCY: Same as source output.
AMPLITUDE RANGE: **2015, 2015-P:** 2V rms (50Ω and 600Ω) or 4V rms (HI Z). **2016, 2016-P:** 4.75V rms (50Ω and 600Ω) or 9.5V rms (HI Z).
AMPLITUDE RESOLUTION: **2015, 2015-P:** 0.5mV (50Ω and 600Ω) or 1mV rms (HI Z). **2016, 2016-P:** 1.25mV rms (50Ω and 600Ω) or 2.5mV rms (HI Z).
AMPLITUDE ACCURACY: **2015, 2015-P:** ±(2.0% of setting + 2mV)[1, 4]. **2016, 2016-P:** ±(2.0% of setting + 5mV)[1, 4].
AMPLITUDE FLATNESS: ±0.1dB[1, 4, 5].
OUTPUT IMPEDANCE: Same as Source Output setting.
THD: –64dB[6].
NOISE: **2015, 2015-P:** 100µV rms[2]. **2016, 2016-P:** 250µV rms[2].
DC OFFSET VOLTAGE: **2015, 2015-P:** ±1.1mV typ., ±13mV max.[1] **2016, 2016-P:** ±3mV typ., ±13mV max.[1]

INV/PULSE OUTPUT (PULSE MODE):

FREQUENCY: Same as source output.
DUTY CYCLE: 45% ±3%.
OUTPUT IMPEDANCE: Same output impedance as the source output.
AMPLITUDE: 0.0V ±0.07V to 4.9V ±0.12V pulse open circuit[1, 3]. 0.0V ±0.05V to 3.3V ±0.08V pulse 100Ω load[1, 3].
OVERSHOOT: 1.0V maximum pulse open circuit[3]. 0.2V maximum with 100Ω load pulse open circuit[3].
UNDERSHOOT: 1.1V maximum pulse open circuit[3]. 0.45V maximum with 100Ω load pulse open circuit[3].

NOTES

1. 1 year, 23°C ±5°C.
2. Measured at V_{OUT} = 0V with gain 100 amplifier and 2-pole 50kHz low pass filter, Inv/Pulse in sinewave mode, HI Z output impedance, and no load.
3. With HI Z output impedance and 1m 50Ω coaxial cable.
4. HI Z output impedance, no load.
5. 4V output.
6. THD measurement includes harmonics 2 through 5, 1V rms output, HI Z, no load.

2015, 2015-P, 2016, 2016-P

6½-Digit THD Multimeters 6½-Digit Audio Analyzing Multimeters

DC Characteristics

CONDITIONS: MED (1 PLC)[1] or SLOW (10 PLC) or MED (1 PLC) with filter of 10.

Function	Range	Resolution	Test Current or Burden Voltage (±5%)	Input Resistance	Accuracy: ±(ppm of reading + ppm of range) (ppm = parts per million) (e.g., 10ppm = 0.001%) 24 Hour [14] 23°C ± 1°	90 Day 23°C ± 5°	1 Year 23°C ± 5°	Temperature Coefficient 0°–18°C & 28°–50°C
Voltage	100.0000 mV	0.1 μV		> 10 GΩ	30 + 30	40 + 35	50 + 35	2 + 6
	1.000000 V	1.0 μV		> 10 GΩ	15 + 6	25 + 7	30 + 7	2 + 1
	10.00000 V	10 μV		> 10 GΩ	15 + 4	20 + 5	30 + 5	2 + 1
	100.0000 V	100 μV		10 MΩ ±1%	15 + 6	30 + 6	45 + 6	5 + 1
	1000.000 V [9]	1 mV		10 MΩ ±1%	20 + 6	35 + 6	45 + 6	5 + 1
Resistance [15]	100.0000 Ω	100 μΩ	1 mA		30 + 30	80 + 40	100 + 40	8 + 6
	1.000000 kΩ	1 mΩ	1 mA		20 + 6	80 + 10	100 + 10	8 + 1
	10.00000 kΩ	10 mΩ	100 μA		20 + 6	80 + 10	100 + 10	8 + 1
	100.0000 kΩ	100 mΩ	10 μA		20 + 6	80 + 10	100 + 10	8 + 1
	1.000000MΩ [16]	1 Ω	10 μA		20 + 6	80 + 10	100 + 10	8 + 1
	10.00000MΩ [11, 16]	10 Ω	700 nA // 10MΩ		300 + 6	450 + 10	600 + 10	95 + 1
	100.0000MΩ [11, 16]	100 Ω	700 nA // 10MΩ		1600 + 30	2000 + 30	2200 + 30	900 + 1
Current	10.00000 mA	10 nA	< 0.15 V		60 + 30	300 + 80	500 + 80	50 + 5
	100.0000 mA	100 nA	< 0.03 V		100 + 300	300 + 800	500 + 800	50 + 50
	1.000000 A	1 μA	< 0.3 V		200 + 30	500 + 80	800 + 80	50 + 5
	3.00000 A	10 μA	< 1 V		1000 + 15	1200 + 40	1200 + 40	50 + 5
Continuity 2W	1 kΩ	100 mΩ	1 mA		40 + 100	100 + 100	120 + 100	8 + 1
Diode Test	3.00000 V	10 μV	1 mA		20 + 6	30 + 7	40 + 7	8 + 1
	10.00000 V	10 μV	100 μA		20 + 6	30 + 7	40 + 7	8 + 1
	10.00000 V	10 μV	10 μA		20 + 6	30 + 7	40 + 7	8 + 1

DC OPERATING CHARACTERISTICS [2]

Function	Digits	Readings/s	PLCs [8]
DCV (all ranges), DCI (all ranges), 2W Ohms (<10M ranges)	6½ [3, 4]	5	10
	6½ [3, 7]	30	1
	6½ [3, 5]	50	1
	5½ [3, 5]	270	0.1
	5½ [5]	500	0.1
	5½ [5]	1000	0.04
	4½ [5]	2000	0.01

DC SYSTEM SPEEDS [2, 6]

RANGE CHANGE[3]: 50/s.
FUNCTION CHANGE[3]: 45/s.
AUTORANGE TIME[3, 10]: <30ms.
ASCII READINGS TO RS-232 (19.2K baud): 55/s.
MAX. INTERNAL TRIGGER RATE: 2000/s.
MAX. EXTERNAL TRIGGER RATE: 400/s.

DC GENERAL

LINEARITY OF 10VDC RANGE: ±(1ppm of reading + 2ppm of range).
DCV, Ω, TEMPERATURE, CONTINUITY, DIODE TEST INPUT PROTECTION: 1000V, all ranges.
MAXIMUM 4WΩ LEAD RESISTANCE: 10% of range per lead for 100Ω and 1kΩ ranges; 1kΩ per lead for all other ranges.
DC CURRENT INPUT PROTECTION: 3A, 250V fuse.
SHUNT RESISTOR: 0.1Ω for 3A, 1A, and 100mA ranges. 10Ω for 10mA range.
CONTINUITY THRESHOLD: Adjustable 1Ω to 1000Ω.
AUTOZERO OFF ERROR: Add ±(2ppm of range error + 5μV) for <10 minutes and ±1°C change.
OVERRANGE: 120% of range except on 1000V, 3A, and Diode.

SPEED AND NOISE REJECTION

Rate	Readings/s	Digits	RMS Noise 10V Range	NMRR [12]	CMRR [13]
10 PLC	5	6½	< 1.5 μV	60 dB	140 dB
1 PLC	50	6½	< 4 μV	60 dB	140 dB
0.1 PLC	500	5½	< 22 μV	—	80 dB
0.01 PLC	2000	4½	< 150 μV	—	80 dB

DC NOTES

1. Add the following to ppm of range accuracy specification based on range:1V and 100V, 2ppm; 100mV, 15ppm; 100Ω, 15ppm; 1kΩ–1MΩ, 2ppm; 10mA and 1A, 10ppm; 100mA, 40ppm.
2. Speeds are for 60Hz operation using factory default operating conditions (*RST). Autorange off, Display off, Trigger delay = 0.
3. Speeds include measurement and binary data transfer out the GPIB.
4. Auto zero off.
5. Sample count = 1024, auto zero off.
6. Auto zero off, NPLC = 0.01.
7. Ohms = 24 readings/second.
8. 1 PLC = 16.67ms @ 60Hz, 20ms @ 50Hz/400Hz. The frequency is automatically determined at power up.
9. For signal levels >500V, add 0.02ppm/V uncertainty for the portion exceeding 500V.
10. Add 120ms for ohms.
11. Must have 10% matching of lead resistance in Input HI and LO.
12. For line frequency ±0.1%.
13. For 1kΩ unbalance in LO lead.
14. Relative to calibration accuracy.
15. Specifications are for 4-wire ohms. For 2-wire ohms, add 1Ω additional uncertainty.
16. For rear inputs. Add the following to Temperature Coefficient "ppm of reading" uncertainty: 10MΩ 70ppm, 100MΩ 385ppm. Operating environment specified for 0° to 50°C, 50% RH at 35°C.

2015, 2015-P, 2016, 2016-P

6½-Digit THD Multimeters 6½-Digit Audio Analyzing Multimeters

True RMS AC Voltage and Current Characteristics

Voltage Range	Resolution	Calibration Cycle	Accuracy [1]: ±(% of reading + % of range), 23°C ±5 °C 3 Hz– 10 Hz [10]	10 Hz– 20 kHz	20 kHz– 50 kHz	50 kHz– 100 kHz	100 kHz– 300 kHz
100.0000 mV	0.1 µV	90 Days	0.35 + 0.03	0.05 + 0.03	0.11 + 0.05	0.60 + 0.08	4 + 0.5
1.000000 V	1.0 µV	1 Year	0.35 + 0.03	0.06 + 0.03	0.12 + 0.05	0.60 + 0.08	4 + 0.5
10.00000 V	10 µV						
100.0000 V	100 µV						
750.000 V	1 mV						
		Temperature Coefficient/°C [8]	0.035 + 0.003	0.005 + 0.003	0.006 + 0.005	0.01 + 0.006	0.03 + 0.01

Current Range	Resolution	Calibration Cycle	3 Hz–10 Hz	10 Hz–3 kHz	3 kHz–5 kHz
1.000000 A	1 µA	90 Day/1 Year	0.30 + 0.04	0.10 + 0.04	0.14 + 0.04
3.00000 A [9]	10 µA	90 Day/1 Year	0.35 + 0.06	0.15 + 0.06	0.18 + 0.06
		Temperature Coefficient/°C [8]	0.035 + 0.006	0.015 + 0.006	0.015 + 0.006

HIGH CREST FACTOR ADDITIONAL ERROR ±(% of reading) [7]

CREST FACTOR:	1–2	2–3	3–4	4–5
ADDITIONAL ERROR:	0.05	0.15	0.30	0.40

AC OPERATING CHARACTERISTICS [2]

Function	Digits	Readings/s	Rate	Bandwidth
ACV (all ranges), and ACI (all ranges)	6½ [3]	2s/reading	SLOW	3 Hz–300 kHz
	6½ [3]	1.4	MED	30 Hz–300 kHz
	6½ [4]	4.8	MED	30 Hz–300 kHz
	6½ [3]	2.2	FAST	300 Hz–300 kHz
	6½ [4]	35	FAST	300 Hz–300 kHz

ADDITIONAL LOW FREQUENCY ERRORS ±(% of reading)

	Slow	Med	Fast
20 Hz – 30 Hz	0	0.3	—
30 Hz – 50 Hz	0	0	—
50 Hz – 100 Hz	0	0	1.0
100 Hz – 200 Hz	0	0	0.18
200 Hz – 300 Hz	0	0	0.10
> 300 Hz	0	0	0

AC SYSTEM SPEEDS [2, 5]

FUNCTION/RANGE CHANGE [6]**:** 4/s.
AUTORANGE TIME: <3s.
ASCII READINGS TO RS-232 (19.2k baud) [4]**:** 50/s.
MAX. INTERNAL TRIGGER RATE [4]**:** 300/s.
MAX. EXTERNAL TRIGGER RATE [4]**:** 260/s.

AC GENERAL

INPUT IMPEDANCE: 1MΩ ±2% paralleled by <100pF.
ACV INPUT PROTECTION: 1000Vp.
MAXIMUM DCV: 400V on any ACV range.
ACI INPUT PROTECTION: 3A, 250V fuse.
BURDEN VOLTAGE: 1A Range: <0.3V rms. 3A Range: <1V rms.
SHUNT RESISTOR: 0.1Ω on all ACI ranges.
AC CMRR: >70dB with 1kΩ in LO lead.
MAXIMUM CREST FACTOR: 5 at full scale.
VOLT HERTZ PRODUCT: ≤8 × 10^7V·Hz.
OVERRANGE: 120% of range except on 750V and 3A ranges.

AC NOTES

1. Specifications are for SLOW rate and sinewave inputs >5% of range.
2. Speeds are for 60Hz operation using factory default operating conditions (*RST). Auto zero off, Auto range off, Display off, includes measurement and binary data transfer out the GPIB.
3. 0.01% of step settling error. Trigger delay = 400ms.
4. Trigger delay = 0.
5. DETector:BANDwidth 300, NPLC = 0.01.
6. Maximum useful limit with trigger delay = 175ms.
7. Applies to non-sinewaves >5Hz and <500Hz. (Guaranteed by design for crest factors >4.3.)
8. Applies to 0°–18°C and 28°–50°C.
9. For signal levels >2.2A, add additional 0.4% to "of reading" uncertainty.
10. Typical uncertainties. Typical represents two sigma or 95% of manufactured units measure <0.35% of reading and three sigma or 99.7% <1.06% of reading.

2015, 2015-P, 2016, 2016-P

6½-Digit THD Multimeters 6½-Digit Audio Analyzing Multimeters

Triggering and Memory

READING HOLD SENSITIVITY: 0.01%, 0.1%, 1%, or 10% of reading.

TRIGGER DELAY: 0 to 99 hrs (1ms step size).

EXTERNAL TRIGGER LATENCY: 200µs + <300µs jitter with autozero off, trigger delay = 0.

MEMORY: 1024 readings.

Math Functions

Rel, Min/Max/Average/StdDev (of stored reading), dB, dBm, Limit Test, %, and mX+b with user defined units displayed.

dBm REFERENCE RESISTANCES: 1 to 9999Ω in 1Ω increments.

Standard Programming Languages

SCPI (Standard Commands for Programmable Instruments).

Frequency and Period Characteristics [1, 2]

ACV Range	Frequency Range	Period Range	Gate Time	Resolution ±(ppm of reading)	Accuracy 90 Day/1 Year ±(% of reading)
100 mV to 750 V	3 Hz to 500 kHz	333 ms to 2 µs	1 s (SLOW)	0.333	0.01
			0.1 s (MED)	3.33	0.01
			10 ms (FAST)	33.3	0.01

FREQUENCY NOTES

1. Specifications are for square wave inputs only. Input signal must be >10% of ACV range. If input is <20mV on the 100mV range, then the frequency must be >10Hz.
2. 20% overrange on all ranges except 750V range.

Temperature Characteristics

Thermocouple [2, 3, 4]

Type	Range	Resolution	Accuracy [1] 90 Day/1 Year (23°C ±5°C) Relative to Reference Junction
J	–200 to + 760°C	0.001°C	±0.5°C
K	–200 to + 1372°C	0.001°C	±0.5°C
T	–200 to + 400°C	0.001°C	±0.5°C

TEMPERATURE NOTES

1. For temperatures <–100°C, add ±0.1°C and >900°C add ±0.3°C.
2. Temperature can be displayed in °C, K, or °F.
3. Accuracy based on ITS-90.
4. Exclusive of thermocouple error.

GENERAL

POWER SUPPLY: 100V/120V/220V/240V.

LINE FREQUENCY: 50Hz to 60Hz and 400Hz, automatically sensed at power-up.

POWER CONSUMPTION: 40VA.

VOLT HERTZ PRODUCT: ≤8 × 10^7V·Hz.

SAFETY: Conforms to European Union Low Voltage Directive.

EMC: Conforms to European Union EMC Directive.

VIBRATION: MIL-PRF-28800F Class 3 Random.

OPERATING ENVIRONMENT: Specified for 0°C to 50°C. Specified to 80% R.H. at 35°C and at an altitude of up to 2,000 meters.

STORAGE ENVIRONMENT: –40°C to 70°C.

WARMUP: 1 hour to rated accuracy.

DIMENSIONS:

Rack Mounting: 89mm high × 213mm wide × 370mm deep (3.5 in × 8.38 in × 14.56 in).

Bench Configuration (with handle and feet): 104mm high × 238mm wide × 370mm deep (4.13 in × 9.38 in × 14.56 in).

NET WEIGHT: 4.2kg (8.8 lbs).

SHIPPING WEIGHT: 5kg (11 lbs).