# 2015 6½-Digit THD Multimeter
# 2015-P 6½-Digit Audio Analyzing Multimeter

## Datasheet

The 2015-P Audio Analyzing Digital Multimeter and the 2015 Total Harmonic Distortion Multimeter 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 2015-P offers additional processing capacity for frequency spectrum analysis.

### Key Features

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

### Frequency Domain Distortion Analysis

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

In addition to THD, the 2015 and 2015-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**.)

### Optimized for Production Testing

The 2015 and 2015-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.

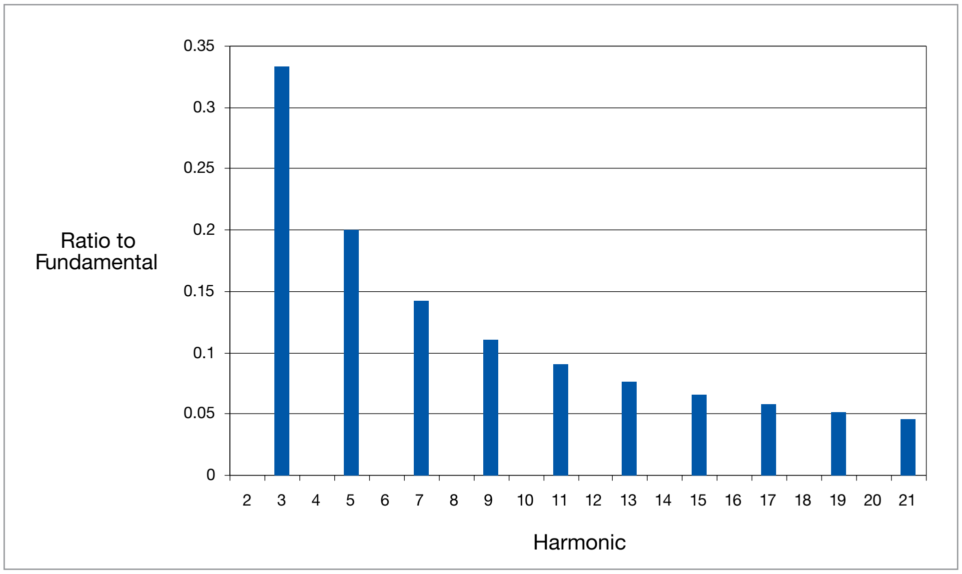


**Figure 1. Frequency Spectrum of 1kHz Square Wave. Figure 1 shows a plot of a square wave's harmonics (frequency components) computed and transmitted to a personal computer by the 2015. A square wave's spectral content consists of only odd harmonics whose magnitudes are (1/harmonic number × the magnitude of the fundamental). For example, the magnitude of the third harmonic is 1⁄3 the magnitude of the fundamental.**

**Figures 2, 3, and 4** demonstrate how the 2015 and 2015-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.

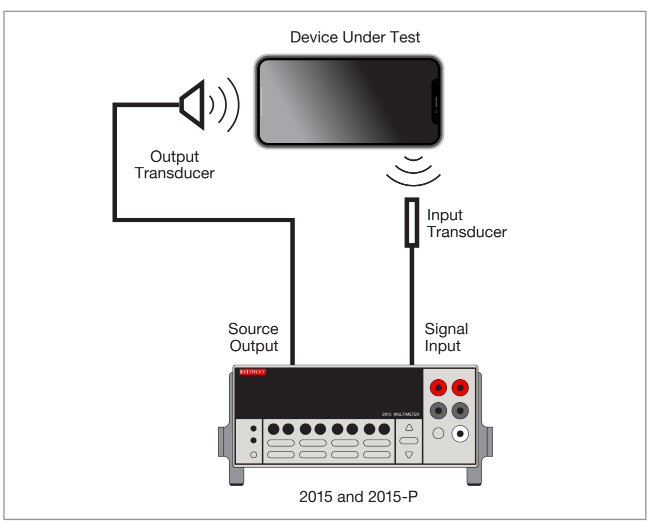


**Figure 2. Total Harmonic Distortion Analysis and Frequency Response of a Portable Wireless Telecommunication Device**

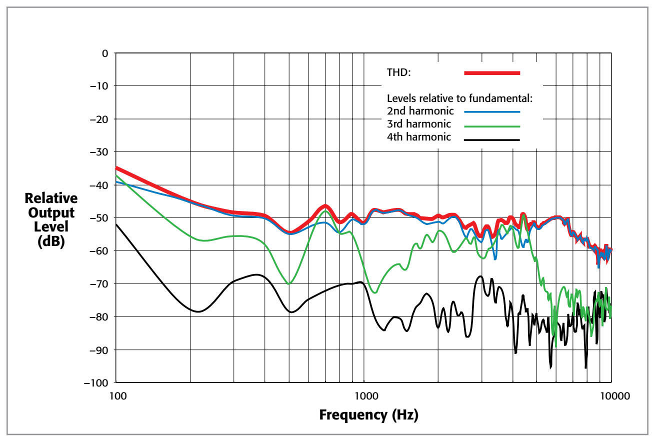


**Figure 3. THD and 2nd, 3rd, and 4th Harmonics as a Function of Frequency**

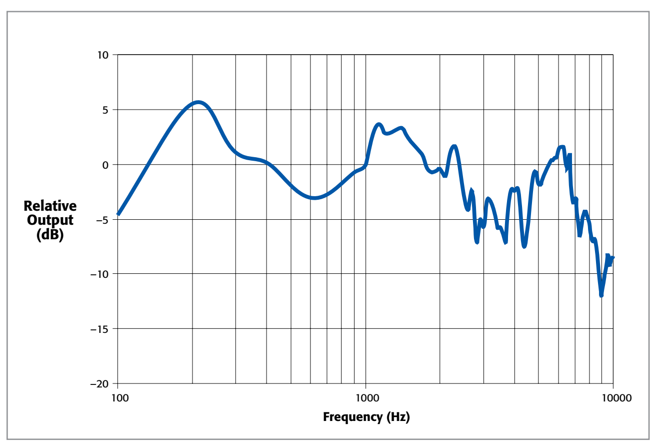


**Figure 4. Frequency Response**

## Dual Output Source

The 2015 and 2015-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. The 2015 and 2015-P have a 4 Vrms single-ended output and 8 Vrms differential source 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 2015 and 2015-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.

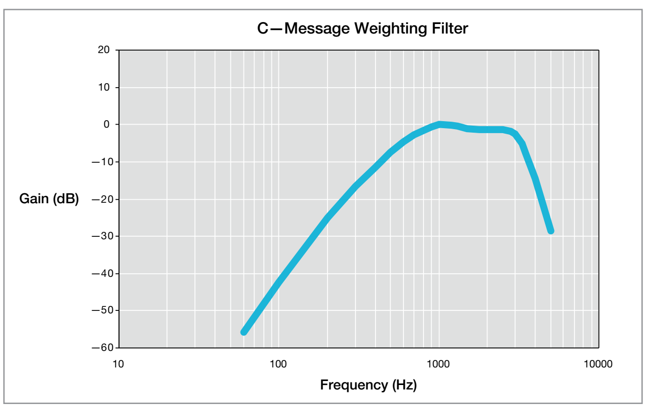


**Figure 5a.**

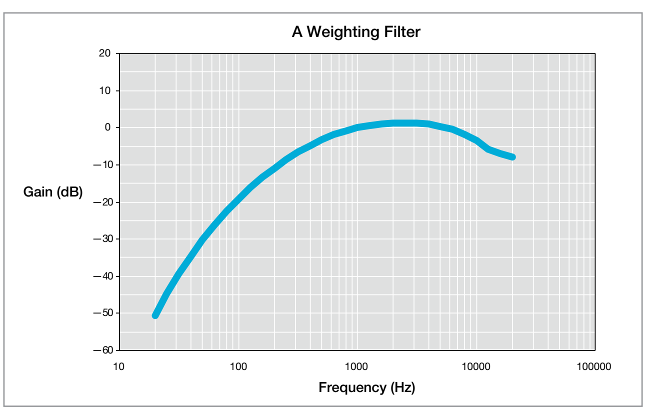


**Figure 5b.**

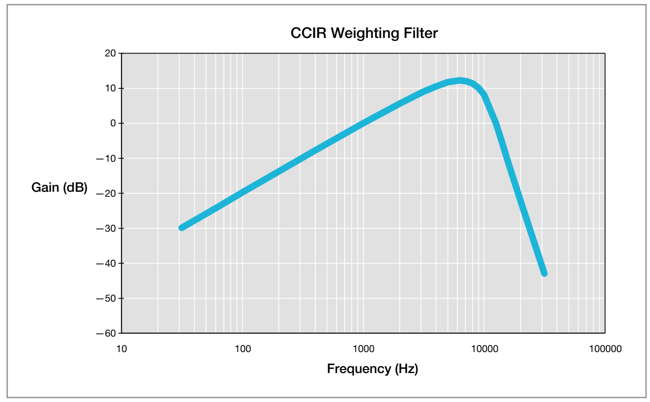


**Figure 5c.**

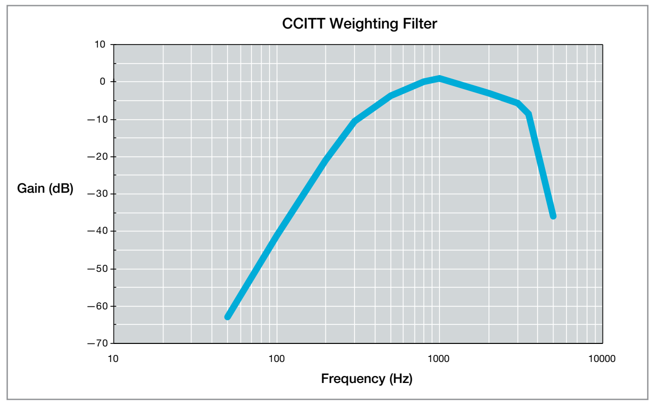


**Figure 5d.**

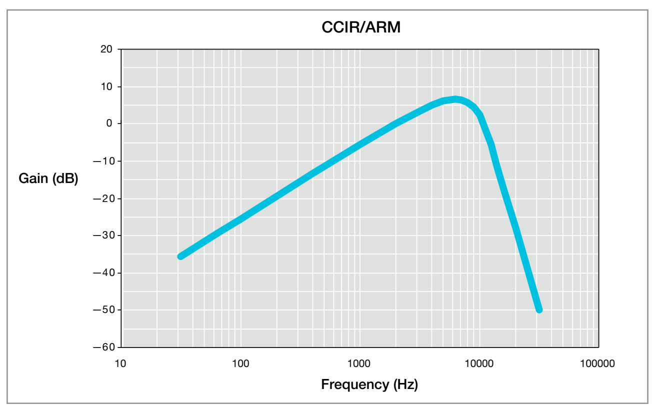


**Figure 5e.**

## 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 multifunctional design minimizes added equipment costs when configuring test setups.

## Wide Band or Narrow Band Noise Measurements

The 2015 and 2015-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 20 Hz–20 kHz 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 2015-P has internal computational capabilities that allow it to characterize an acquired signal spectrum. This instrument 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 2015-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.

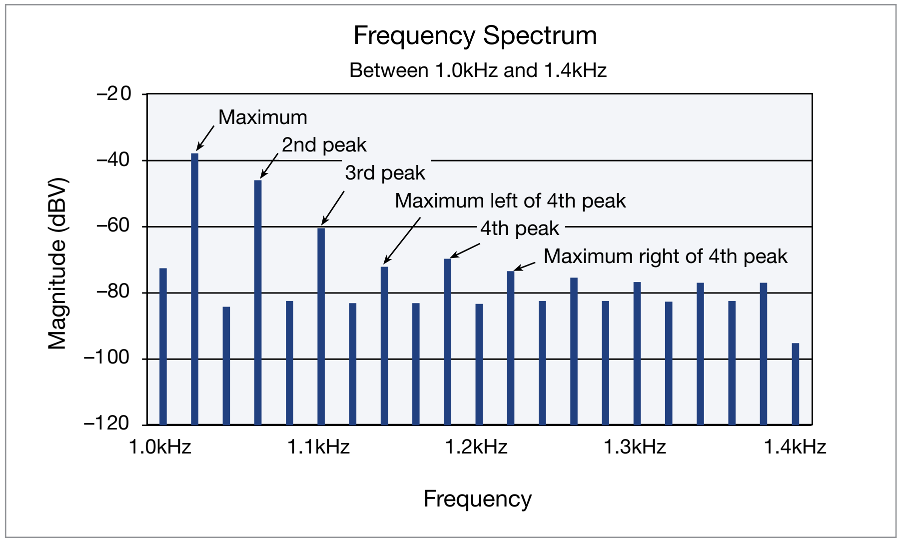


Figure 6. The 2015-P directly identifies peak values of the frequency spectrum.

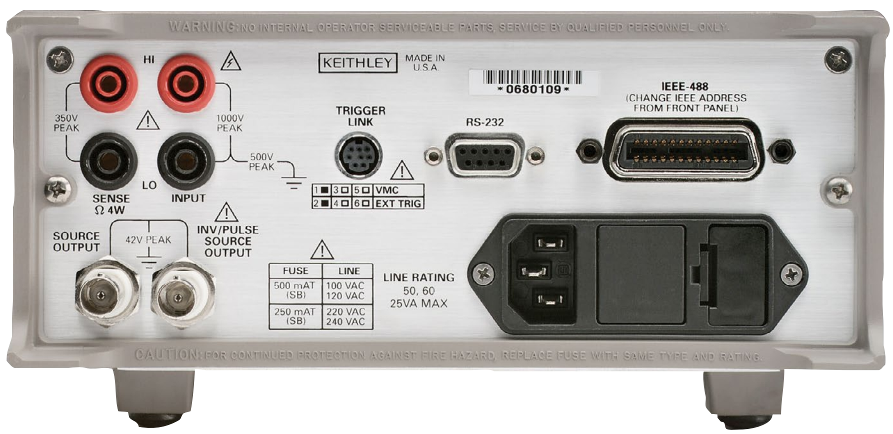


Figure 7. Rear panel of both models

### Typical Applications

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

# Specifications

## Distortion Characteristics

| | |
|---|---|
| **Voltage Range** | 100 mV, 1 V, 10 V, 100 V, 750 V (user selectable). |
| **Input Impedance** | 1 MΩ paralleled by <100 pF. |
| **Display Range** | 0–100% or 0–100.00 dB. |
| **Resolution** | 0.0001% or 0.00001 dB. |
| **Fundamental Frequency Range** | 20 Hz–20 kHz. |
| **Harmonic Frequency Range** | 40 Hz–50 kHz. |
| **Frequency Resolution** | 0.008 Hz. |
| **Frequency Accuracy** | ±0.01% of reading. |
| **Frequency Temperature Coefficient** | ≤100 ppm over operating temperature range. |

| Measurement Mode | Accuracy (1 Year, 23°C ±5°C) | Residual Distortion[1] |
|---|---|---|
| THD and individual harmonic magnitudes | ±0.8 dB<br>20 Hz to 20 kHz[2] | 0.004% or −87 dB<br>20 Hz to 20 kHz |
| THD + n | ±1.5 dB<br>100 Hz to 20 kHz[2] | 0.056% or −65 dB<br>20 Hz to 20 kHz |
| SINAD | ±1.5 dB<br>100 Hz to 20 kHz[2] | +65 dB<br>20 Hz to 20 kHz |
| AC Level V rms | ±(0.15% of reading + 0.009% of range)<br>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)**

20 Hz–50 kHz. 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 > −65 dB.
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 400–4 kHz range, binary data transfer, TRIG DELAY = 0, Display OFF, Auto Range OFF. Data returned is THD measurement plus AC voltage.

## Generator Characteristics

| | |
|---|---|
| **Frequency Range** | 10–20 kHz. |
| **Frequency Resolution** | 0.007 Hz. |
| **Frequency Accuracy** | ±(0.015% of reading + 0.007 Hz) [1]. |
| **Frequency Temperature Coefficient** | <100 ppm over operating temperature range. |

### Source Output

| | |
|---|---|
| **Waveform** | Sinewave. |
| **Amplitude Range** | 2 V rms (50 Ω and 600 Ω) or 4 V rms (HI Z). |
| **Amplitude Resolution** | 0.5 mV rms (50 Ω and 600 Ω) or 1 mV rms (HI Z). |
| **Amplitude Accuracy** | ±(0.3% of setting + 2.5 mV)[1, 4]. |
| **Amplitude Temperature Coefficient** | Typically 0.015%/°C. |
| **Amplitude Flatness** | ±0.1 dB [1, 4, 5]. |
| **Output Impedance** | 50 Ω ± 1 Ω or 600 Ω ± 10 Ω, user selectable. |
| **THD** | –64 dB[6]. |
| **Noise** | 100 µV rms[2]. |
| **DC Offset Voltage** | ±2.5 mV[1]. |

### Inv/Pulse Output (Sinewave Mode)

| | |
|---|---|
| **Frequency** | Same as source output. |
| **Amplitude Range** | 2 V rms (50 Ω and 600 Ω) or 4 V rms (HI Z). |
| **Amplitude Resolution** | 0.5 mV (50 Ω and 600 Ω) or 1 mV rms (HI Z). |
| **Amplitude Accuracy** | ±(2.0% of setting + 2.5 mV) [1, 4]. |
| **Amplitude Flatness** | ±0.1 dB [1, 4, 5]. |
| **Output Impedance** | Same as Source Output setting. |
| **THD** | –64 dB [6]. |
| **Noise** | 100 µV rms [2]. |
| **DC Offset Voltage** | ±1.1 mV typ., ±13 mV 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** | 0.0 V ±0.07 V to 4.9 V ±0.12 V pulse open circuit [1, 3].<br>0.0 V ±0.05 V to 3.3 V ±0.11 V pulse open circuit [1, 3]. |
| **Overshoot** | 1.0 V maximum pulse open circuit [3].<br>0.2 V maximum with 100 Ω load pulse open circuit [3]. |
| **Undershoot** | 1.1 V maximum pulse open circuit [3].<br>0.45 V maximum with 100 Ω load pulse open circuit [3]. |

**Notes**

1. 1 year, 23°C ±5°C.
2. Measured at $V_{OUT}$ = 0 V with gain 100 amplifier and 2-pole 50 kHz 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. 4 V output.
6. THD measurement includes harmonics 2 through 5, 1 V rms output, HI Z, no load.

# 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., 10 ppm = 0.001%) | | | Temperature Coefficient 0°–18°C & 28°–50°C |
|---|---|---|---|---|---|---|---|---|
| | | | | | 24 Hour[14] 23°C ± 1° | 90 Day 23°C ± 5° | 1 Year 23°C ± 5° | |
| Voltage | 100.0000 mV[17] | 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 |
| | 1.000000 MΩ[16] | 1 Ω | 10 µA | | 20 + 6 | 80 + 10 | 100 + 10 | 8 + 1 |
| | 10.00000 MΩ[11, 16] | 10 Ω | 700 nA // 10MΩ | | 300 + 6 | 450 + 10 | 600 + 10 | 95 + 1 |
| | 100.0000 MΩ[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 (<10 M ranges) | 6.5[3, 4] | 5 | 10 |
| | 6.5[3, 7] | 30 | 1 |
| | 6.5[3, 5] | 50 | 1 |
| | 5.5[3, 5] | 270 | 0.1 |
| | 5.5[5] | 500 | 0.1 |
| | 5.5[5] | 1000 | 0.04 |
| | 4.5[5] | 2000 | 0.01 |

## DC System Speeds[2, 6]

**Range Change**[3] 50/s.

**Function Change**[3] 45/s.

**Autorange Time**[3, 10] <30 ms.

**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 10 VDC Range** | ±(1 ppm of reading + 2 ppm of range). |
| **DCV, Ω, Temperature, Continuity, Diode Test Input Protection** | 1000 V, all ranges. |
| **Maximum 4WΩ Lead Resistance** | 10% of range per lead for 100 Ω and 1 kΩ ranges; 1 kΩ per lead for all other ranges. |
| **DC Current Input Protection** | 3 A, 250 V fuse. |
| **Shunt Resistor** | 0.1 Ω for 3 A, 1 A, and 100 mA ranges. 10 Ω for 10 mA range. |
| **Continuity Threshold** | Adjustable 1 Ω to 1000 Ω. |
| **Autozero Off Error** | Add ±(2 ppm of range error + 5 µV) for <10 minutes and ±1°C change. |
| **Overrange** | 120% of range except on 1000 V, 3 A, and Diode. |

## Speed and Noise Rejection

| Rate | Readings/s | Digits | RMS Noise 10 V Range | NMRR [12] | CMRR [13] |
|---|---|---|---|---|---|
| 10 PLC | 5 | 6.5 | < 1.5 µV | 60 dB | 140 dB |
| 1 PLC | 50 | 6.5 | < 4 µV | 60 dB | 140 dB |
| 0.1 PLC | 500 | 5.5 | < 22 µV | — | 80 dB |
| 0.01 PLC | 2000 | 4.5 | < 150 µV | — | 80 dB |

### DC Notes

1. Add the following to ppm of range accuracy specification based on range: 1 V and 100 V, 2 ppm; 100 mV, 15 ppm; 100 Ω, 15 ppm; 1 kΩ–1 MΩ, 2 ppm; 10 mA and 1 A, 10 ppm; 100 mA, 40 ppm.
2. Speeds are for 60 Hz 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 = 16.67 ms @ 60 Hz, 20 ms @ 50 Hz/400 Hz. The frequency is automatically determined at power up.
9. For signal levels >500 V, add 0.02 ppm/V uncertainty for the portion exceeding 500 V.
10. Add 120 ms for ohms.
11. Must have 10% matching of lead resistance in Input HI and LO.
12. For line frequency ±0.1%.
13. For 1 kΩ unbalance in LO lead.
14. Relative to calibration accuracy.
15. Specifications are for 4-wire ohms. For 2-wire ohms, add 1 Ω additional uncertainty.
16. For rear inputs. Add the following to Temperature Coefficient “ppm of reading” uncertainty: 10 MΩ 70 ppm, 100 MΩ 385 ppm. Operating environment specified for 0° to 50°C, 50% RH at 35°C.
17. When properly zeroed.

# 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 | | | | | | |
| 1.000000 V | 1.0 µV | 90 Days | 0.35 + 0.03 | 0.05 + 0.03 | 0.11 + 0.05 | 0.60 + 0.08 | 4 + 0.5 |
| 10.00000 V | 10 µV | | | | | | |
| 100.0000 V | 100 µV | 1 Year | 0.35 + 0.03 | 0.06 + 0.03 | 0.12 + 0.05 | 0.60 + 0.08 | 4 + 0.5 |
| 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) | 6.5 [3] | 2 s/reading | SLOW | 3 Hz–300 kHz |
| | 6.5 [3] | 1.4 | MED | 30 Hz–300 kHz |
| | 6.5 [4] | 4.8 | MED | 30 Hz–300 kHz |
| | 6.5 [3] | 2.2 | FAST | 300 Hz–300 kHz |
| | 6.5 [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** | <3 s. |
| **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** | 1 MΩ ±2% paralleled by <100 pF. |
| **ACV Input Protection** | 1000 Vp. |
| **Maximum DCV** | 400 V on any ACV range. |
| **ACI Input Protection** | 3 A, 250 V fuse. |
| **Burden Voltage** | **1 A Range:** <0.3 V rms. **3 A Range:** <1 V rms. |
| **Shunt Resistor** | 0.1 Ω on all ACI ranges. |
| **AC CMRR** | >70 dB with 1 kΩ in LO lead. |
| **Maximum Crest Factor** | 5 at full scale. |
| **Volt Hertz Product** | ≤8 × $10^7$ V·Hz. |
| **Overrange** | 120% of range except on 750 V and 3 A ranges. |

### AC Notes

1. Specifications are for SLOW rate and sinewave inputs >5% of range.
2. Speeds are for 60 Hz 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 = 400 ms.
4. Trigger delay = 0.
5. DETector:BANDwidth 300, NPLC = 0.01.
6. Maximum useful limit with trigger delay = 175 ms.
7. Applies to non-sinewaves >5 Hz and <500 Hz. (Guaranteed by design for crest factors >4.3.)
8. Applies to 0°–18°C and 28°–50°C.
9. For signal levels >2.2 A, add additional 0.4% to “of reading” uncertainty.
10. Typical uncertainties. Typical is defined as follows: Two sigma, 95% of all instruments are expected to measure <0.35% of reading; three sigma, 99.7% of all instruments are expected to measure <1.06% of reading.

## Triggering and Memory

| | |
|---|---|
| **Reading Hold Sensitivity** | 0.01%, 0.1%, 1%, or 10% of reading. |
| **Trigger Delay** | 0 to 99 hours (1 ms step size). |
| **External Trigger Latency** | 200 µs + <300 µs jitter with autozero off, trigger delay = 0. |
| **Memory** | 1024 readings. |

## Math Functions

| | |
|---|---|
| **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 9999 Ω in 1 Ω increments. |

## Standard Programming Languages

SCPI (Standard Commands for Programmable Instruments).

## Remote Interface

| | |
|---|---|
| **Remote Interface** | GPIB (IEEE-488.1, IEEE-488.2) and RS-232C. |

## 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 <20 mV on the 100 mV range, then the frequency must be >10 Hz.
2. 20% overrange on all ranges except 750V range.

## Temperature Characteristics

| Thermocouple [2, 3, 4] | | | Accuracy [1] 90 Day/1 Year (23°C ±5°C) Relative to Reference Junction |
|---|---|---|---|
| Type | Range | Resolution | |
| 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** | 100 V / 120 V / 220 V / 240 V. |
| **Line Frequency** | 50 Hz to 60 Hz and 400 Hz, automatically sensed at power-up. |
| **Power Consumption** | 40 VA. |
| **Volt Hertz Product** | $\leq 8 \times 10^7$ V·Hz. |
| **Safety** | Conforms to European Union Low Voltage Directive. |
| **EMC** | Conforms to European Union EMC Directive. |
| **Vibration** | MIL-PRF-28800F Class 3 Random. |
| **Warmup** | 1 hour to rated accuracy. |
| **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. |
| **Dimensions:** | |
| **Rack Mounting** | 89 mm high × 213 mm wide × 370 mm deep (3.5 in × 8.38 in × 14.56 in). |
| **Bench Configuration (with handle and feet)** | 104 mm high × 238 mm wide × 370 mm deep (4.13 in × 9.38 in × 14.56 in). |
| **Net Weight** | 4.2 kg (8.8 lbs). |
| **Shipping Weight** | 5 kg (11 lbs). |
| **Warranty** | 1 year. |

## Ordering Information

| | |
|---|---|
| 2015 | Total Harmonic Distortion 6½-Digit Multimeter |
| 2015-P | Audio Analyzing DMM |

## Supplied Accessories

| | |
|---|---|
| **1751** | Safety Test Leads |
| | Quick Start Guide |
| | Certificate of Calibration |

## Available Accessories

### Cables/Adapters

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

## Power Cord Options

| | |
|---|---|
| **AO** | North America Power Plug (120 V, 60 Hz) |
| **A1** | Universal Euro Power Plug (220 V, 50 Hz) |
| **A2** | United Kingdom Power Plug {240 V, 50 Hz) |
| **A3** | Australia Power Plug (240 V, 50 Hz) |
| **A4** | Chile, Italy (220 V, 50 Hz) |
| **A5** | Switzerland Power Plug (220 V, 50 Hz) |
| **A6** | Japan Power Plug (100 V, 50/60 Hz) |
| **A7** | Denmark Power Plug |
| **A8** | Israel Power Plug |
| **A9** | Argentina Power Plug |
| **A10** | China Power Plug (50 Hz) |
| **A11** | India Power Plug (50 Hz) |
| **A12** | Brazil Power Plug (60 Hz) |
| **A99** | No power cord |

# Documentation

Instruction Manuals (available at www.tek.com/tektronix-and-keithley-digital-multimeter/keithley-2015-series-thd-and-audio-analysis-multimeter )

2015/2015-P THD Multimeter User's Manual

2015, 2015-P THD Multimeters Quick Reference Guide

# Available Services

## Extended Warranties

| | |
|---|---|
| **2015-EW** | 1-Year KEITHLEYCARE Extended Warranty |
| **2015-3Y-EW** | 3-Year KEITHLEYCARE Extended Warranty |
| **2015-5YR-EW** | 5-Year KEITHLEYCARE Extended Warranty |
| **2015-P-EW** | 1-Year KEITHLEYCARE Extended Warranty |
| **2015-P-3Y-EW** | 3-Year KEITHLEYCARE Extended Warranty |
| **2015-P-5YR-EW** | 5-Year KEITHLEYCARE Extended Warranty |

## Calibration Contracts

| | |
|---|---|
| **C/2015-3Y-STD** | KEITHLEYCARE 3-Year Standard Calibration Plan |
| **C/2015-3Y-DATA** | KEITHLEYCARE 3-Year Calibration with Data Plan |
| **C/2015-3Y-17025** | KEITHLEYCARE 3-Year ISO 17025 Calibration Plan |
| **C/2015-5Y-STD** | KEITHLEYCARE 5-Year Standard Calibration Plan |
| **C/2015-5Y-DATA** | KEITHLEYCARE 5-Year Calibration with Data Plan |
| **C/2015-5Y-17025** | KEITHLEYCARE 5-Year ISO 17025 Calibration Plan |

## Calibration Data

| | |
|---|---|
| **C/NEW DATA** | Calibration Data for New 2015 or 2015-P |
| **C/NEW DATA ISO** | ISO-17025 Calibration Data for New 2015 or 2015-P |
| **C/TRACE CHART** | Calibration Traceability Chart |

GREENTEST® TECHNOLOGIES

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