2016 Total Harmonic Distortion Specifications
2016-P Audio Analyzing Digital Multimeter

DISTORTION CHARACTERISTICS

<table>
<thead>
<tr>
<th>MEASUREMENT MODE</th>
<th>ACCURACY (1 Year, 23°C ±5°C)</th>
<th>RESIDUAL DISTORTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>THD and individual harmonic magnitudes</td>
<td>±0.8dB, 20Hz to 20kHz²</td>
<td>0.004% or –67dB, 20Hz to 20kHz²</td>
</tr>
<tr>
<td>THD + n</td>
<td>±1.5dB, 100Hz to 20kHz²</td>
<td>0.056% or –65dB, 20Hz to 20kHz²</td>
</tr>
<tr>
<td>SINAD</td>
<td>±1.5dB, 100Hz to 20kHz²</td>
<td>+65dB, 20Hz to 20kHz²</td>
</tr>
</tbody>
</table>

AC Level ±(0.13% of reading + Vrms), 20Hz to 20kHz²

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 selectable): 20Hz–50kHz. Can be combined to form brickwall bandpass filter.

Distortion Measurement Reading Rate³

<table>
<thead>
<tr>
<th>FUNDAMENTAL FREQUENCY RANGE</th>
<th>FUNDAMENTAL FREQUENCY ACQUISITION MODE</th>
<th>MINIMUM READINGS PER SECOND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single acquisition or stored value</td>
<td>20 Hz to 100 Hz</td>
<td>14</td>
</tr>
<tr>
<td>100 Hz to 1 kHz</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>1 kHz to 20 kHz</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Automatic</td>
<td>20 Hz to 30 Hz</td>
<td>5.5</td>
</tr>
<tr>
<td>30 Hz to 400 Hz</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>400 Hz to 20 kHz</td>
<td>8.6</td>
<td></td>
</tr>
</tbody>
</table>

Frequency Sweep Reading Rate

<table>
<thead>
<tr>
<th>NUMBER OF FREQUENCIES</th>
<th>TIME (seconds)⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.2</td>
</tr>
<tr>
<td>30</td>
<td>1.1</td>
</tr>
<tr>
<td>100</td>
<td>3.5</td>
</tr>
<tr>
<td>200</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Notes
1. Input signal at full scale.
2. VIN ≥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). |
| FREQUENCY TEMPERATURE COEFFICIENT: Typically 0.015%/°C. |

SOURCE OUTPUT:

Waveform: Sinewave.
Amplitude Range: 4.75V rms (50Ω and 600Ω) or 9.5V rms (HI Z).
Amplitude Resolution: 1.25mV rms (50Ω and 600Ω) or 2.5mV rms (HI Z).
Amplitude Accuracy: ±(0.3% of setting + 5mV).¹ ² ³
Amplitude Temperature Coefficient: Typically 0.015%/°C.
Amplitude Flatness: ±0.1dB.¹ ² ³
Output Impedance: 50Ω ± 1Ω or 600Ω ± 1Ω, user selectable.
THD: –64dB.¹ ² ³
Noise: 250µV rms².
DC Offset Voltage: ±3mV².

INV/PULSE OUTPUT (SINEWAVE MODE):

Frequency: Same as source output.
Amplitude Range: 4.75V rms (50Ω and 600Ω) or 9.5V rms (HI Z).
Amplitude Resolution: 1.25mV rms (50Ω and 600Ω) or 2.5mV rms (HI Z).
Amplitude Accuracy: ±(2.0% of setting + 5mV).¹ ² ³
Amplitude Flatness: ±0.1dB.¹ ² ³
Output Impedance: Same as Source Output setting.
THD: –64dB.¹ ² ³
Noise: 250µV rms².
DC Offset Voltage: ±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 circuit¹ ² ³
0.0V ±0.05V to 3.3V ±0.08V pulse 100Ω load¹ ² ³
Overshoot: 1.0V maximum pulse open circuit² ³
0.2V maximum with 100Ω load pulse open circuit² ³
Undershoot: 1.1V maximum pulse open circuit² ³
0.45V maximum with 100Ω load pulse open circuit² ³.

Notes
1. 1 year, 23°C ±5°C.
2. Measured at Vin = 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.

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DC CHARACTERISTICS

CONDITIONS: MED (1 PLC) OR SLOW (10 PLC) ACCURACY: ±(PPM OF READING + PPM OF RANGE)
OR MED (1 PLC) WITH FILTER OF 10 (PPM = PARTS PER MILLION) (E.G., 10PPM = 0.001%)

TEST CURRENT OR BURDEN INPUT 24 HOUR 90 DAY 1 YEAR
TEMPERATURE 0°C–18°C & 28°C–50°C

FUNCTION RANGE RESOLUTION VOLTAGE (±5%) RESISTANCE 23°C ± 1° 23°C ± 5° 23°C ± 5° 23°C ± 5°

VOLTAGE

100.000 mV 0.1 µV > 10 QΩ 30 + 30 40 + 35 50 + 35 2 + 6
1.000000 V 1.0 µV > 10 QΩ 15 + 6 25 + 7 30 + 7 2 + 1
10.00000 V 10 µV > 10 QΩ 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 1 MΩ 10 MΩ ±1% 20 + 6 35 + 6 45 + 6 5 + 1

RESISTANCE

100.000 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 µΩ 100 µA 20 + 6 80 + 10 100 + 10 8 + 1
100.0000 kΩ 100 µΩ 10 µA 20 + 6 80 + 10 100 + 10 8 + 1
1.000000 MΩ 1000 nA 100 nA 300 + 6 450 + 10 600 + 10 95 + 1
10.00000 MΩ 1000 nA 100 nA 1600 + 30 2200 + 30 2500 + 30 900 + 1

CURRENT

10.00000 mA 10 nA < 0.15 V 50 + 30 80 + 80 100 + 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 + 300 500 + 800 800 + 800 50 + 50
3.00000 A 10 µA < 1 V 1000 + 1500 1200 + 4000 1200 + 4000 50 + 50

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

FUNCTION DIGITS READINGS/s PLCs

DCV (all ranges), 6.5 ± 1 5 10
DCI (all ranges), and 2W, 6.5 ± 1 30 1
2W Ohms (<10M range) 6.5 ± 1 50 1
0.1 PLC 500 0.1
5.5 ± 1 500 0.04
5.5 ± 1 1000 0.04
4.5 ± 1 2000 0.01

DC SYSTEM SPEEDS

RANGE CHANGE: 50 / s.
FUNCTION CHANGE: 45 / s.
AUTORANGE TIME: <30 ms.
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: TEMPERATURE, CONTINUITY, DIODE TEST INPUT PROTECTION: 1000V, all ranges.
MAXIMUM 4W 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: 0.12Ω 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.
## TRUE RMS AC VOLTAGE AND CURRENT CHARACTERISTICS

**ACCURACY**: ±(% of reading + % of range), 23°C ±5 °C

<table>
<thead>
<tr>
<th>VOLTAGE RANGE</th>
<th>RESOLUTION</th>
<th>CALIBRATION CYCLE</th>
<th>3 Hz–10 Hz&lt;sup&gt;10&lt;/sup&gt;</th>
<th>10 Hz–20 kHz</th>
<th>20 kHz–50 kHz</th>
<th>50 kHz–100 kHz</th>
<th>100 kHz–300 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>100.0000 mV</td>
<td>0.1 µV</td>
<td>90 Days</td>
<td>0.35 ± 0.03</td>
<td>0.05 ± 0.03</td>
<td>0.11 ± 0.05</td>
<td>0.60 ± 0.08</td>
<td>4 ± 0.5</td>
</tr>
<tr>
<td>1.000000 V</td>
<td>1.0 µV</td>
<td>1 Year</td>
<td>0.35 ± 0.03</td>
<td>0.06 ± 0.03</td>
<td>0.12 ± 0.05</td>
<td>0.60 ± 0.08</td>
<td>4 ± 0.5</td>
</tr>
<tr>
<td>10.00000 V</td>
<td>10 µV</td>
<td>1 Year</td>
<td>0.35 ± 0.03</td>
<td>0.06 ± 0.03</td>
<td>0.12 ± 0.05</td>
<td>0.60 ± 0.08</td>
<td>4 ± 0.5</td>
</tr>
<tr>
<td>100.0000 V</td>
<td>100 µV</td>
<td>1 Year</td>
<td>0.35 ± 0.03</td>
<td>0.06 ± 0.03</td>
<td>0.12 ± 0.05</td>
<td>0.60 ± 0.08</td>
<td>4 ± 0.5</td>
</tr>
<tr>
<td>750.000 V</td>
<td>1 mV</td>
<td>1 Year</td>
<td>0.35 ± 0.03</td>
<td>0.06 ± 0.03</td>
<td>0.12 ± 0.05</td>
<td>0.60 ± 0.08</td>
<td>4 ± 0.5</td>
</tr>
</tbody>
</table>

### HIGH CREST FACTOR ADDITIONAL ERROR ±(% of reading)<sup>7</sup>

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

### AC OPERATING CHARACTERISTICS<sup>2</sup>

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>DIGITS</th>
<th>READINGS/s</th>
<th>RATE</th>
<th>BANDWIDTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACV (all ranges), ACI (all ranges)</td>
<td>6.5&lt;sup&gt;4&lt;/sup&gt; 2/s reading</td>
<td>SLOW 3 Hz–300 kHz</td>
<td>6.5&lt;sup&gt;4&lt;/sup&gt; 1.4</td>
<td>MED 30 Hz–300 kHz</td>
</tr>
</tbody>
</table>

### ADDITIONAL LOW FREQUENCY ERRORS ±(% of reading)<sup>5</sup>

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>SLOW</th>
<th>MED</th>
<th>FAST</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 Hz – 30 Hz</td>
<td>0</td>
<td>0.3</td>
<td>—</td>
</tr>
<tr>
<td>30 Hz – 50 Hz</td>
<td>0</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>50 Hz – 100 Hz</td>
<td>0</td>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>100 Hz – 200 Hz</td>
<td>0</td>
<td>0</td>
<td>0.18</td>
</tr>
<tr>
<td>200 Hz – 300 Hz</td>
<td>0</td>
<td>0</td>
<td>0.10</td>
</tr>
<tr>
<td>&gt; 300 Hz</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### AC SYSTEM SPEEDS<sup>2,5</sup>

- **FUNCTION/RANGE CHANGE:** 4 / s.
- **AUTORANGE TIME:** <3 s.
- **ASCII READINGS TO RS-232 (19.2K BAUD):** 50 / s.
- **MAX. INTERNAL TRIGGER RATE:** 300 / s.
- **MAX. EXTERNAL TRIGGER RATE:** 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:** >75dB with 1kΩ in LO lead.
- **MAXIMUM CREST FACTOR:** 5 at full scale.
- **VOLT HERTZ PRODUCT:** <8 x 10<sup>7</sup> V·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 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 full scale settling error. Trigger delay = 400ms.
4. Trigger delay = 0.
5. DEFactor/BANDwidth 300, NPLC = 0.01.
6. Maximum useful limit with trigger delay = 175ms.
7. Applies to non-sine waves >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.
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**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)

**REMOTE INTERFACE**
- GPIB (IEEE-488.1, IEEE-488.2) and RS-232C.

**FREQUENCY AND PERIOD CHARACTERISTICS**

<table>
<thead>
<tr>
<th>ACV RANGE</th>
<th>FREQUENCY RANGE</th>
<th>PERIOD RANGE</th>
<th>GATE TIME</th>
<th>RESOLUTION 1(ppm of reading)</th>
<th>ACCURACY 2(1% of reading)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mV</td>
<td>3 Hz</td>
<td>333 ms</td>
<td>1 s</td>
<td>0.333</td>
<td>0.01</td>
</tr>
<tr>
<td>750 V</td>
<td>500 kHz</td>
<td>2 μs</td>
<td>10 ms</td>
<td>33.3</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>THERMOCOUPLE</th>
<th>90 DAY/1 YEAR (23°C ± 5°C)</th>
<th>ACCURACY 1 Relative to Reference Junction</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-200 to + 760°C</td>
<td>±0.001°C</td>
</tr>
<tr>
<td>K</td>
<td>-200 to +1372°C</td>
<td>±0.001°C</td>
</tr>
<tr>
<td>T</td>
<td>-200 to + 400°C</td>
<td>±0.001°C</td>
</tr>
</tbody>
</table>

**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.

Specifications are subject to change without notice.