

# FX100 Audio Analyzer

## Technical Specifications

Analog Generator	
<b>Number of channels</b>	2 or 4 (optional); channel independent signal level, frequency control
<b>Connectors</b> Types Configurations	XLR   BNC   Binding post (ground) Balanced   unbalanced   unbalanced grounded   common signal test
<b>Test signals</b>	Sinusoidal StepSweep (2 to 500 points; frequency   level   time sweep) GlideSweep (0.1 s to 40 s) White noise (cf = 3.646), Pink noise (cf = 3.846) IMD (acc. IEC60268/3)
<b>Level</b> Range Balanced Unbalanced Accuracy <sup>1)</sup> Balanced, unbalanced GND, CMST Unbalanced (if grounded externally) Flatness 10 Hz to 20 kHz 10 Hz to 80 kHz Setting resolution -40 dBV to +24.9 dBV < -40 dBV	-100 dBV to +21.9 dBV (10 $\mu$ V to 12.45 V) for 600 $\Omega$ load @ 24 dBu -100 dBV to +15.9 dBV (10 $\mu$ V to 6.22 V) < $\pm 0.04$ dB @ 1 kHz, output load > 2 k $\Omega$ < +0.02 / -0.06 dB @ 1 kHz, output load > 2 k $\Omega$  $\pm 0.01$ dB @ (-80 dBV to +21.9 dBV) $\pm 0.08$ dB @ (-80 dBV to +21.9 dBV)  $\pm 0.01$ dB $\pm 0.05$ dB
<b>Frequency</b> Range Resolution Accuracy <sup>2)</sup>	5 Hz to 80 kHz < 2 ppm $\pm 25$ ppm (standard version)   $\pm 2.5$ ppm (with AES option installed)
<b>Residual THD+N</b> <sup>1)</sup> 1 kHz, 0 dBV Fundamental 20 Hz to 20 kHz Fundamental 10 Hz to 80 kHz	$\leq -104$ dB typical $\leq (-101$ dB + 0.8 $\mu$ V) @ 22 kHz BW <sup>3)</sup> $\leq (-92$ dB + 1.6 $\mu$ V) @ 80 kHz BW <sup>3)</sup>
<b>IMD MOD</b> Low frequency tone range $f_1$ High frequency tone range $f_2$ Amplitude ratio Residual IMD MOD d2+d3 1:1 amplitude ratio 4:1 amplitude ratio 10:1 amplitude ratio	60 Hz to 1 kHz 2 kHz to 20 kHz, $f_2 \geq 6.1 * f_1$ 1:1, 4:1 and 10:1 typ. -101 dB @ 0 dBV, $f_1 = 60$ Hz, $f_2 = 20$ kHz, amplitude ratio 1:1 $\leq -95$ dB <sup>3), 4)</sup> @ output level > -20 dBV $\leq -90$ dB <sup>3), 4)</sup> @ output level > -20 dBV $\leq -85$ dB <sup>3), 4)</sup> @ output level > -20 dBV
<b>IMD DFD</b> Mean frequency range $f_m$ Difference frequency range $f_d$ Residual IMD DFD d2+d3	2.5 kHz to 20 kHz 80 Hz to 2 kHz typ. -108 dB @ 0 dBV, $f_m = 80$ Hz, $f_d = 20$ kHz $\leq -100$ dB <sup>3), 4)</sup> @ output level > -20 dBV
<b>IMD DIM</b> Square frequency Sine frequency Amplitude ratio Residual IMD DIM	3.15 kHz (DIM 30 or DIM 100) 15 kHz 4:1, square to sine peak-peak typ. -103 dB @ 0 dBV $\leq -95$ dB <sup>3), 4)</sup> @ output level > -20 dBV

<sup>1)</sup> For loads < 2 k $\Omega$ , the FX100 generator inward resistance (approx. 1.8  $\Omega$ ) degrades the output level accuracy.

<sup>2)</sup> Temperature range +20 to +45  $^{\circ}$ C;  $\pm 1$  ppm ageing p.a.

<sup>3)</sup> System specification includes contribution from both generator and analyzer; generator only and analyzer only contributions are typically less.

<sup>4)</sup> Applies for all FX100 units with serial number  $\geq 11221$ ; for instruments with a lower serial number, +5 dB have to be added.

<b>Wave file playback</b> Format Sampling rate Data format Word length Channels Mono Stereo Max. file size Max. play time 24 bit 16 bit Level flatness 10 Hz to 20 kHz Reconstruction filter Filter type -0.005 dB point -3 dB point Stopband attenuation Group delay Max. filter overshoot (step -1 to +1)	Microsoft RIFF wave (16 bit and 24 bit), extensible RIFF wave (24 bit only) 48 kHz Signed integer linear PCM 16 bit or 24 bit  Wave data is assigned to all FX100 channels Wave data chn1 is assigned to FX100 chn1&3; wave data chn2 is assigned to chn2&4 16 MByte  mono 116 sec.; stereo 58 sec. mono 174 sec.; stereo 87 sec. $\pm 0.015$ dB  FIR 20.0 kHz 21.18 kHz > 140 dB @ 24 kHz 150.5 samples @ 192 kHz sample rate $\pm 1.25$
<b>Maximum differential DC at output</b>	$\pm 1.0$ mV
<b>S/N ratio</b> (noise in presence of signal) 20 Hz to 20 kHz 10 Hz to 80 kHz	$\leq (-107$ dB + 0.8 $\mu$ V) $\leq (-97$ dB + 1.6 $\mu$ V)
<b>Output</b> Hum noise rejection ratio Balanced Unbalanced Common mode rejection ratio Related XTalk <sup>5)</sup> 10 Hz to 20 kHz 20 kHz to 80 kHz Impedance Current limitation Maximum protection against external voltage	   > 100 dB @ output load 10 k $\Omega$ > 80 dB @ output load 10 k $\Omega$ > 80 dB @ BW 80 kHz  $\leq (-125$ dB + 1 $\mu$ V) $\leq (-105$ dB + 1 $\mu$ V) < 0.8 $\Omega$ (servo loop) + 1 $\Omega$ shunt (overload detection) typical 35 mA <sub>p</sub> 42.4 V <sub>p</sub> (according to IEC61011)

<b>Analog Analyzer</b>	
<b>Connectors</b>	XLR   BNC   Binding post (ground)
<b>Input impedance</b> Balanced Unbalanced	100 k $\Omega$    65 pF (differential) 50 k $\Omega$    130 pF
<b>Maximum rated input</b> (overload protected) DC to 20 kHz 20 Hz to 80 kHz	200 V <sub>p</sub> (DC + AC) total symmetrical and asymmetrical 60 V <sub>p</sub> (DC + AC) total symmetrical and asymmetrical
<b>Input</b> Range Bandwidth Coupling	-6.7 dBV <sub>p</sub> to +46 dBV <sub>p</sub> DC   5 Hz to 80 kHz AC (< 3 Hz) or DC (selectable)
<b>CMRR @ 10 Hz to 20 kHz</b> <sup>6)</sup> Input range < 0 dBV <sub>p</sub> Input range 0 dBV <sub>p</sub> to 10 dBV <sub>p</sub> Input range 10 dBV <sub>p</sub> to 20 dBV <sub>p</sub> Input range 20 dBV <sub>p</sub> to 40 dBV <sub>p</sub> Input range 40 dBV <sub>p</sub> to 46 dBV <sub>p</sub>	<i>(CMRR performance below 50 Hz degrades substantially with AC coupling)</i> $\geq 88$ dB $\geq 80$ dB $\geq 72$ dB $\geq 60$ dB $\geq 56$ dB
<b>Bias supplies</b>	48 V microphone Phantom power 2 V microphone power ICP <sup>®</sup> microphone power <sup>7)</sup> DCR measurement current 100 $\mu$ A (100 k $\Omega$ range)   1.6 mA (5 k $\Omega$ range)

<sup>6)</sup> CMRR performance below 50 Hz degrades substantially with AC coupling ON.

<sup>7)</sup> ICP<sup>®</sup> is a registered trademark of PCB Piezotronics.

<sup>5)</sup> System specification includes contribution from both generator and analyzer; one generator channel muted.

<b>Measurement functions</b>	<p>Frequency [Hz ; ppmr]  Level [V ; dBV ; dBu ; dB SPL ; dBPa ; dBr ; W]  Selective level [V ; dBV ; dBu ; dB SPL ; dBPa ; dBr ; W]  Input level [V ; dBV ; dBu ; dB SPL ; dBPa ; dBr ; W]  THD+N [% ; dB ; dBV ; dBu ; dB SPL ; dBPa ; dBr ; W]  THD [% ; dB ; dBV ; dBu ; dB SPL ; dBPa ; dBr ; W]  Harmonic distortion k2 to k35 [% ; dB ; dBV ; dBu ; dB SPL ; dBPa ; dBr ; W]  IMD (acc. IEC60268/3) [% ; dB]  FFT [V ; dBV ; dBu ; dB SPL ; dBPa ; dBr ; W]  Gain [% ; dB]  Inter-channel phase [Deg ; Rad]  XTalk [% ; dB]  Signal latency [s]  PureSound™ steepness [Pa/s ; V/s] (optional)  DCV differential [V]  DCV common high (XLR pin 2-1); low (XLR pin 3-1) [V]  DCR [Ω]  Impedance [Ω] (requires SIP, SIL or SIH option)</p>
<b>Sweep modes</b>	<p>StepSweep: Frequency ; Amplitude ; Time ; Table sweep  GlideSweep: Frequency sweep</p>
<b>Level measurement</b>	<p>Range &lt; 1 μV to 200 Vp  Resolution ±0.01 dB  Accuracy ±0.04 dB @ 1 kHz  Flatness (AC coupling OFF) <sup>8)</sup>  20 Hz to 20 kHz <sup>9)</sup> ±0.015 dB  10 Hz to 80 kHz <sup>9)</sup> ±0.1 dB  Generator + analyzer 20 Hz to 20 kHz ±0.025 dB  Generator + analyzer 10 Hz to 80 kHz ±0.2 dB  Additional tolerance with AC coupling ON  -0.01 dB @ 20 Hz typical ; -0.065 dB @ 10 Hz ; -0.3 dB @ 5 Hz  Residual noise  A-weighted ≤ 1.2 μV (-118.4 dBV)  20 kHz BW ≤ 1.6 μV (-116.0 dBV)  80 kHz BW ≤ 3 μV (-110.5 dBV) ; 2.5 μV (-112 dBV) typical</p>
<b>Frequency measurement</b>	<p>Range 5 Hz to 80 kHz  Resolution &lt; 0.1 ppm  Accuracy  5 Hz to 10 Hz ≤ ±25 ppm (standard) ; ±2.5 ppm (with AES board) absolute + measurement error ±50 ppm  10 Hz to 80 kHz ≤ ±25 ppm (standard) ; ±2.5 ppm (with AES board) absolute + measurement error ±1 ppm</p>
<b>THD ; THD+N ; harmonics measurement</b>	<p>Range 0 % to 100 %  Accuracy ≤ ±0.5 dB (10 Hz to 80 kHz)  THD fundamental measurement range  Source internal generator 5 Hz to 80 kHz  Source external generator 10 Hz to 80 kHz  Minimum input level for fundamental frequency detection ≤ 0.1 mV  Analyzer residual THD / harmonics (22 kHz BW)  Fundamental 0 dBV @ 1 kHz ≤ -107 dB typical  Fundamental 20 Hz to 20 kHz <sup>10)</sup> ≤ (-104 dB + 0.5 μV)  Generator + analyzer residual THD+N <sup>11)</sup> ≤ (-104 dB + 1.7 μV) @ 1 kHz, 0 dBV, 22 kHz BW typical  Fundamental 20 Hz to 20 kHz ≤ (-101 dB + 1.7 μV) @ 22 kHz BW  Fundamental 10 Hz to 80 kHz ≤ (-92 dB + 3.4 μV) @ 80 kHz BW  Fundamental 5 Hz to 10 Hz ≤ (-90 dB + 3.4 μV) @ 80 kHz BW (source internal generator)</p>
<b>IMD MOD</b>	<p>Low frequency acceptance range <math>f_1</math> 60 Hz to 1 kHz  High frequency acceptance range <math>f_2</math> 2 kHz to 20 kHz, <math>f_2 \geq 6.1 * f_1</math>  MOD component analysis d2, d3, d2+d3, or d2 ... d5  Residual IMD MOD d2+d3 typ. -101 dB @ 0 dBV, <math>f_1 = 60</math> Hz, <math>f_2 = 20</math> kHz, amplitude ratio 1:1  1:1 amplitude ratio ≤ -95 dB <sup>3), 4)</sup> @ output level &gt; -20 dBV  4:1 amplitude ratio ≤ -90 dB <sup>3), 4)</sup> @ output level &gt; -20 dBV  10:1 amplitude ratio ≤ -85 dB <sup>3), 4)</sup> @ output level &gt; -20 dBV</p>

<sup>8)</sup> Specified for Meter and StepSweep. For GlideSweep, the length must be ≥ 0.2 s and ±0.01 dB ripple has to be added.

<sup>9)</sup> Specified by design and characterization; not production tested.

<b>IMD DFD</b> Mean frequency acceptance range $f_m$ Difference frequency acceptance range $f_d$ DFD component analysis Residual IMD DFD d2+d3	2.5 kHz to 20 kHz 80 Hz to 2 kHz d2, d3, d2+d3, or d2 ... d5 typ. -108 dB @ 0 dBV, $f_m = 80$ Hz, $f_d = 20$ kHz $\leq -100$ dB <sup>3),4)</sup> @ output level > -20 dBV
<b>IMD DIM</b> Square frequency Sine frequency DIM component analysis Residual IMD DIM	3.15 kHz (DIM 30 or DIM 100) 15 kHz u1 ... u9 or u4+u5 typ. -103 dB @ 0 dBV $\leq -95$ dB <sup>3),4)</sup> @ output level > -20 dBV
<b>Interchannel phase measurement</b> Range Accuracy <sup>12)</sup> 10 Hz to 20 kHz 20 kHz to 80 kHz	-180° to 180°  $\leq \pm 1^\circ$ $\leq \pm 3^\circ$
<b>XTalk measurement</b> Frequency range Residual XTalk <sup>13)</sup> 10 Hz to 20 kHz 20 kHz to 80 kHz	10 Hz to 80 kHz  < (-125 dB + 1 $\mu$ V) < (-105 dB + 1 $\mu$ V)
<b>Signal latency measurement</b> Range GlideSweep sync source internal GlideSweep sync source external Residual signal latency Resolution Accuracy <sup>14)</sup> DUT bandwidth $\geq 100$ Hz to 20 kHz DUT bandwidth $\geq 100$ Hz to 15 kHz DUT bandwidth $\geq 300$ Hz to 8 kHz DUT bandwidth $\geq 300$ Hz to 3.4 kHz Speaker measurements <sup>15)</sup> Max. allowed interchannel latency difference	0 s to 95 ms 0 s to 19 s $\leq 0.05$ ms 0.005 ms $\leq 0.05$ ms $\leq 0.1$ ms $\leq 0.2$ ms $\leq 0.5$ ms $\leq 0.1$ ms $\leq 40$ ms
<b>Filters</b> LowPass (real time; only one filter can be active at a time)  HighPass (real time; only one filter can be active at a time)  Weighting (real time; only one filter can be active at a time)	3.4 kHz, 12 <sup>th</sup> order (passband ripple $\pm 0.01$ dB, -3 dB point 3.484 kHz, stopband attenuation > 97 dB @ 4.08 kHz) 8 kHz, 12 <sup>th</sup> order (passband ripple $\pm 0.01$ dB, -3 dB point 8.196 kHz, stopband attenuation > 97 dB @ 9.6 kHz) 15 kHz, 12 <sup>th</sup> order (passband ripple $\pm 0.01$ dB, -3 dB point 15.364 kHz, stopband attenuation > 99 dB @ 18 kHz) 20 kHz Brickwall, compliant to AES17 (10 Hz to 20 kHz passband ripple $\pm 0.1$ dB, stopband attenuation > 60 dB @ 24 kHz) 22.4 kHz, 4-pole, compliant to DIN45405 40 kHz, 12 <sup>th</sup> order (passband ripple $\pm 0.01$ dB, -3 dB point 40.86 kHz, stopband attenuation > 100 dB @ 48 kHz) 10 Hz, 3 <sup>rd</sup> order Butterworth (-3 dB point 10 Hz, stopband attenuation > 60 dB @ 1 Hz) 22.4 Hz, 4 <sup>th</sup> order, compliant to DIN 45405 100 Hz, 4 <sup>th</sup> order Butterworth (-3 dB point 100 Hz, stopband attenuation > 80 dB @ 10 Hz) 300 Hz, 4 <sup>th</sup> order Butterworth (-3 dB point 300 Hz, stopband attenuation > 90 dB @ 20 Hz) 400 Hz, 4 <sup>th</sup> order Butterworth (-3 dB point 400 Hz, stopband attenuation > 100 dB @ 20 Hz) A-weighting, compliant to IEC 179 ; ANSI S1.4 ; IEC 61672-1 C-message weighting, compliant to ANSI/IEEE 743-1995 ; BSTM 41004
<b>Input coupling</b>	DC ; AC (-3 dB point < 3 Hz)
<b>FFT</b> Analysis Transform length Sampling rate Windows Averaging (only in frequency domain) Waveform display modes	Fully channel-independent and independent of other simultaneous measurements 512 ; 1024 ; 2048 ; ... 1048576 ; 2097152 samples 192 kHz 4-term Blackman-Harris ; Hann (Hanning) ; none Exponential ; arithmetical Frequency domain ; time domain

<sup>10)</sup> Input level has to be  $\leq 19.5$  dBV

<sup>11)</sup> System specification includes contribution from both generator and analyzer; generator only and analyzer only contributions are typically less.

<sup>12)</sup> Both analyzer inputs must have the same coupling (AC ; DC), and the automatic input range is switched OFF.

<sup>13)</sup> System specification includes contribution from both generator and analyzer; one generator channel muted.

<sup>14)</sup> Accuracy can degrade due to impulse response band limitation; Brickwall filter assumed for the specified accuracy; listed cutoff frequency @ -3 dB point

<sup>15)</sup> With sample rate adjustment turned OFF

<b>DCV measurement</b> Differential (XLR pin 2-3) Input range setting Accuracy Common (XLR pin 2-1/3-1) Range Accuracy	460 mV to 200 V ≤ ±0.6 % of input range setting 200 V (fixed) ≤ ±50 mV
<b>DCR measurement</b> Range Accuracy 4 Ω to 30 Ω 30 Ω to 100 kΩ	4 Ω to 5 kΩ ; 5 kΩ to 100 kΩ (manual Bias selection) < 4 % < 0.8 %
<b>Interfaces</b>	
<b>Communication</b> USB host USB device LAN	2*USB mass-storage device (rear and front), A-plug, protocol version 2.0 Remote control USB-TMC, B-plug, protocol version 2.0 <i>(for future use)</i>
<b>Monitor output</b> Connector Signals Maximum output power	6.3 mm (¼") Jack after the input filter stage ; after the PureSound™ bandpass 65 mW @ 32 Ω, software-controlled volume -80 dB to +40 dB
<b>Auxiliary I/O</b> Configuration Output $V_{OHmin}$ (@ $I_{OH} = +3$ mA) $V_{OLmax}$ (@ $I_{OL} = -3$ mA) Impedance Input Level range $V_{IH}$ $V_{IL}$ Impedance Min. input pulse width Max. protection against external Voltage	8 programmable general purpose digital inputs & outputs 3.3 V <sub>TTL</sub> 2.4 V 0.4 V 50 Ω typical 5 V <sub>TTL</sub> max. -0.5 to +5.5 V 2.0 V 0.8 V 10 kΩ ≥ 200 μs 42.4 Vp (according to IEC61011)
<b>General data</b>	
<b>Power supply</b>	100 ; 120 ; 230 VAC 50 ; 60 Hz
<b>Temperature range</b> Operating conditions Storage	+5° to +45°C (+41° to +113°F) -20° to +80°C (-20° to +176°F)
<b>Humidity</b>	≤ 90% R.H. (non condensing)
<b>Mechanical dimensions</b>	width 215 mm (8.5" i.e. half-rack) height 132 mm (5.25" i.e. 3 RU) length 429 mm (16.9")
<b>Weight</b> (2-channel base unit w/o options)	5.12 kg (11.3 lbs)

**FX-SIP Option**

<b>Output</b> Bandwidth Power (BW 22 kHz) <sup>16)</sup> Dual operation Bridged operation	5 Hz to 80 kHz ( $\pm 0.1$ dB relative to 1 kHz without load)  2*10 W into 2 $\Omega$ / 4 $\Omega$ or 2*5 W into 8 $\Omega$ THD < -80 dB / 0.01% 1*30 W into 2 $\Omega$ / 4 $\Omega$ or 1*20 W into 8 $\Omega$ THD < -86 dB / 0.005%
<b>Amplifier gain</b>	0 dB
<b>Output level</b> Overall Accuracy <sup>17)</sup> Added error due to amplifier inward resistance Dual Mode (R <sub>i</sub> = 50 m $\Omega$ ) Bridge Mode (R <sub>i</sub> = 80 m $\Omega$ ) Flatness <sup>17)</sup> 10 Hz to 20 kHz, load $\geq$ 2 $\Omega$ 10 Hz to 80 kHz, load $\geq$ 8 $\Omega$ 10 Hz to 80 kHz, load $\geq$ 2 $\Omega$	$\pm 0.1$ dB (no load) Loss = dB (R <sub>Load</sub> / (R <sub>Load</sub> + R <sub>i</sub> )) +0 / -0.21 dB @ 2 $\Omega$ load ; +0 / -0.11 dB @ 4 $\Omega$ load ; +0 / -0.05 dB @ 8 $\Omega$ load +0 / -0.34 dB @ 2 $\Omega$ load ; +0 / -0.17 dB @ 4 $\Omega$ load ; +0 / -0.09 dB @ 8 $\Omega$ load  $\pm 0.06$ dB +0.1 / -0.2 dB +0.1 / -0.4 dB
<b>Inward resistance R<sub>i</sub></b> Dual mode (per channel) Bridge mode	$\leq$ 50 m $\Omega$ (20 m $\Omega$ typical) $\leq$ 80 m $\Omega$ (40 m $\Omega$ typical)
<b>Damping factor</b> Dual mode Bridge mode	> 80 @ 10 Hz to 10 kHz, load $\geq$ 4 $\Omega$ > 50 @ 10 Hz to 10 kHz, load $\geq$ 4 $\Omega$
<b>THD</b> <sup>18)</sup> Dual mode (BW 22 kHz) fundamental 1 kHz fundamental 10 Hz to 20 kHz Bridge mode (BW 22 kHz) fundamental 1 kHz fundamental 10 Hz to 20 kHz	-101 dB typical (with 1 W @ 4 $\Omega$ ) $\leq$ -80 dB + 15 $\mu$ V (power 0 to 10 W, load 2 to 250 $\Omega$ )  -105 dB typical (with 5 W @ 4 $\Omega$ ) $\leq$ -86 dB + 15 $\mu$ V (power 0 to 30 W, load 2 to 250 $\Omega$ )
<b>S/N ratio</b> A-weighted BW 22.4 kHz BW 80 kHz	> 109 dB below rated power @ 4 / 8 $\Omega$ > 106 dB below rated power @ 4 / 8 $\Omega$ > 103 dB below rated power @ 4 / 8 $\Omega$
<b>XTalk</b>	< -60 dB, BW 10 Hz to 20 kHz
<b>Slew rate</b>	> 50 V/ $\mu$ s
<b>Interchannel phase accuracy</b> <sup>12) 110)</sup>	$\pm 1.3$ deg
<b>Amplifier protection</b>	Short circuit ; overcurrent shutdown and automatic retry ; thermal
<b>Maximum output</b> Level Dual mode Bridge mode Current	16.2 dBV 21.9 dBV 4.2 A (Bridge mode, 2 $\Omega$ load)
<b>Impedance measurement</b> <sup>20)</sup> Nominal speaker impedance range Measurement range Nominal shunt resistance Measurement accuracy <sup>20) 21)</sup> General accuracy Meter, StepSweep 5 Hz to 1 kHz, GlideSweep 20 Hz to 1 kHz Meter, StepSweep 5 Hz to 10 kHz, GlideSweep 20 Hz to 10 kHz Bridge mode 4-wire (sense pins used) Bridge mode 2-wire, Dual mode Additional impedance measurement error with GlideSweep < 20 Hz, 10 Hz to 10 kHz	2 $\Omega$ to 250 $\Omega$ 0 $\Omega$ to > 1 k $\Omega$ 0.2 $\Omega$ / 0.1 % (in front of amplifier feedback $\Rightarrow$ no impact on FX-SIP output level)  $\pm 5$ % with Z = 2 $\Omega$ to 150 $\Omega$ <sup>22)</sup> ; $\pm 7$ % with Z = 150 $\Omega$ to 250 $\Omega$ <sup>22)</sup> $\pm 10$ % with Z = 2 $\Omega$ to 150 $\Omega$ <sup>22)</sup> ; $\pm 15$ % with Z = 150 $\Omega$ to 250 $\Omega$ <sup>22)</sup>  $\pm 2$ % with Z = 2 $\Omega$ to 16 $\Omega$ <sup>22)</sup> $\pm 5$ % with Z = 2 $\Omega$ to 64 $\Omega$ <sup>22)</sup> +1 %

<sup>16)</sup> Duty cycle (signal ON : OFF) must not exceed 1:2

<sup>17)</sup> Including FX100 generator output level tolerance

<sup>18)</sup> The generator Chn1 and Chn2 frequencies have to be the same

<sup>110)</sup> Tolerances contain all FX100 errors including generator output phase and analyzer input phase

<sup>20)</sup> Tolerances include all errors of FX100 generator output level, analyzer input level and FX-SIP shunt & inward resistance

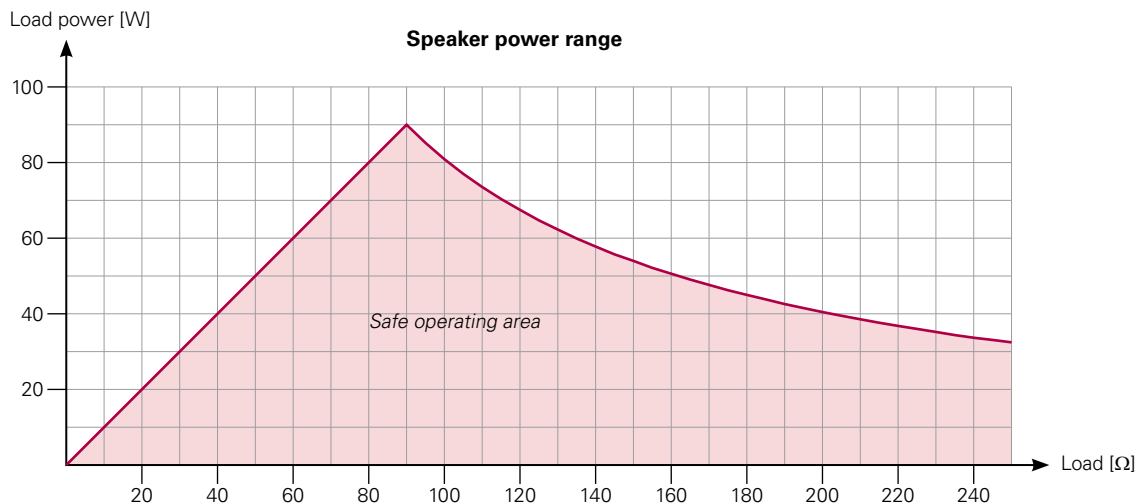
<sup>21)</sup> Frequency range: Meter, StepSweep 5 Hz to 10 kHz ; GlideSweep 20 Hz to 10 kHz

<sup>22)</sup> AC coupling OFF

<b>DCR measurement</b>	
Current source (DCR 250 Ω range)	24.925 mA / ±1 %
Range	
Dual mode	0 Ω to 500 Ω
Bridge mode	0 Ω to 1 k Ω
Accuracy resistance DCR (auto range active)	
R = 2 Ω to 4 Ω	±2.5 %
R = 4 Ω to 250 Ω	±1.2 %

### FX-SIL Option

<b>Nominal shunt resistance</b>	1 Ω ±0.1 %
<b>Recommended current range</b>	50 μA to 1 A
<b>Overcurrent detection</b>	1.4 A ±10 %
<b>Speaker power range</b>	
Minimum power	<< 1 mW
Maximum power @ 2 Ω	2 W
Maximum power @ 4 Ω	4 W
Maximum power @ 8 Ω	8 W
Maximum power @ 32 Ω	32 W
Maximum power @ 250 Ω	32 W
<b>Impedance measurement</b>	
Nominal speaker impedance range	2 to 250 Ω
Accuracy @ AC coupling OFF <sup>23), 24)</sup>	
5 Hz to 20 kHz	≤ ±1 %
Accuracy @ AC coupling ON <sup>23), 24)</sup>	
20 Hz to 20 kHz	≤ ±1 %
10 Hz to 20 kHz	≤ ±3 %
5 Hz to 20 kHz	≤ ±5 %
<b>DCR measurement</b>	
DC current source (DCR 250 Ω range)	5 mA ±1 %
Range	2 to 250 Ω
Accuracy	
R = 2 to 8 Ω	≤ ±2.5 %
R = 8 to 250 Ω	≤ ±1 %

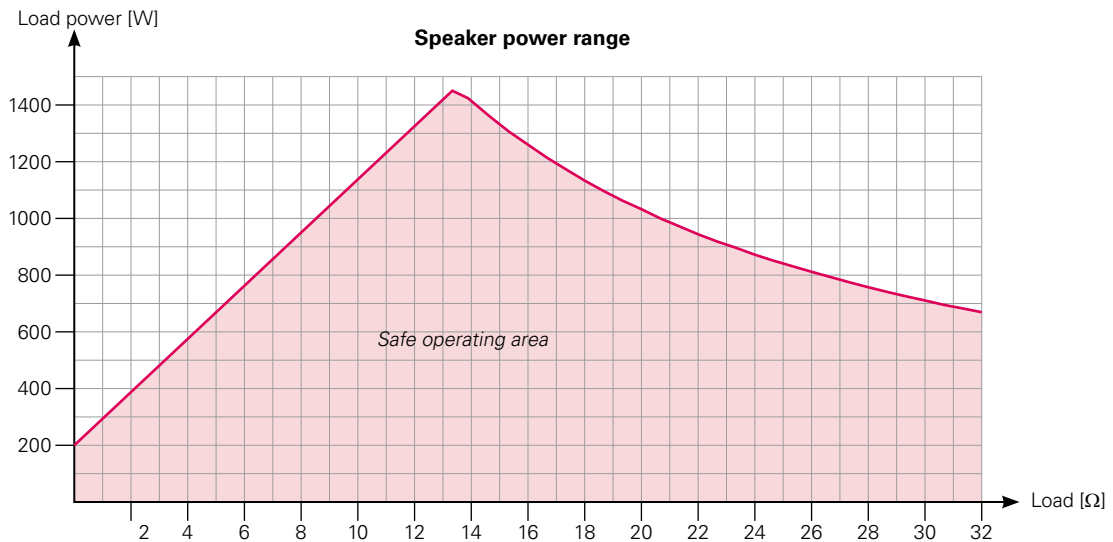


<sup>23)</sup> Cabling from amplifier to SIL, SIH in accordance to IEC 60268-12

<sup>24)</sup> Add 1% to tolerance if loudspeaker impedance is measured with 2 channels (i.e. reference @ amplifier terminal + shunt measurement)

### FX-SIH Option

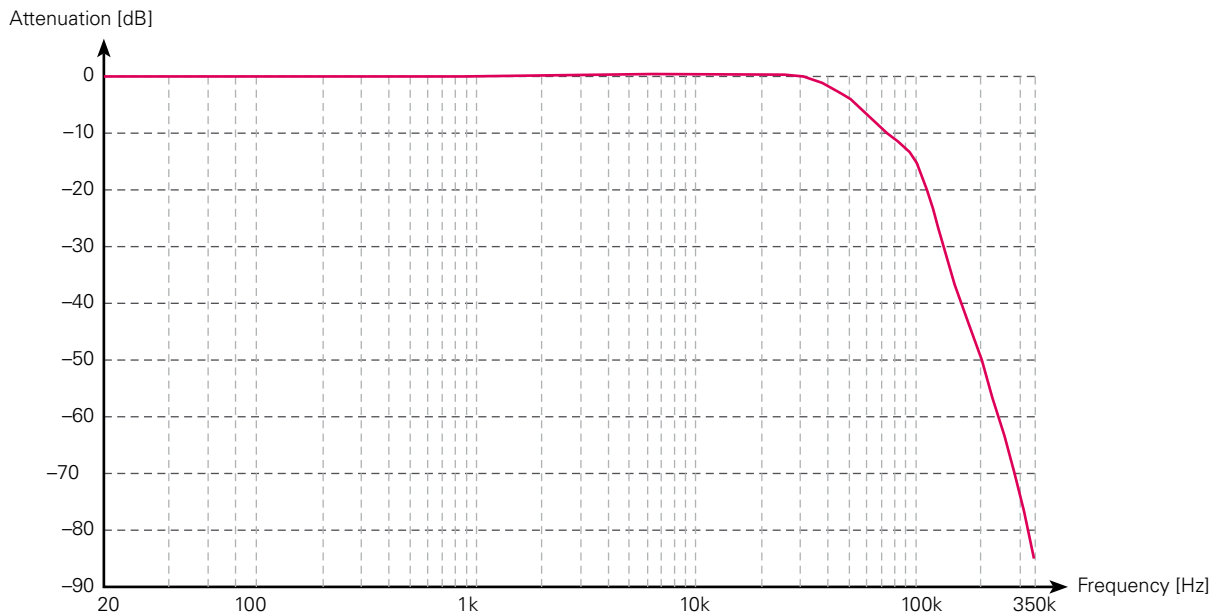
<b>Nominal shunt resistance</b>	0.1 $\Omega$ $\pm$ 0.1 %
<b>Recommended current range</b>	25 mA to 10 A
<b>Overcurrent detection</b>	12 A $\pm$ 10 %
<b>Speaker power range</b> Minimum power Maximum power @ 2 $\Omega$ Maximum power @ 4 $\Omega$ Maximum power @ 8 $\Omega$ Maximum power @ 16 $\Omega$ Maximum power @ 32 $\Omega$	< 1 W 200 W 400 W 800 W 1300 W 670 W
<b>Impedance measurement</b> Nominal speaker impedance range Accuracy @ AC coupling OFF <sup>23), 24)</sup> 5 Hz to 20 kHz Accuracy @ AC coupling ON <sup>23), 24)</sup> 20 Hz to 20 kHz 10 Hz to 20 kHz 5 Hz to 20 kHz	2 to 32 $\Omega$  $\leq \pm 1$ %  $\leq \pm 1$ % $\leq \pm 3$ % $\leq \pm 5$ %
<b>DCR measurement</b> DC current source (DCE 100 $\Omega$ range) Range Accuracy @ R = 2 to 100 $\Omega$	100 mA $\pm$ 1 % 2 $\Omega$ to 100 $\Omega$ $\leq \pm 2$ %





**FX-DF Option** <sup>25)</sup>

<b>Operation range</b>	D-class amplifier testing of up to 2 kW @ 8 Ω
<b>Maximum input voltage</b>	±200 Vp, 140 Vrms
<b>Level measurement</b> Accuracy Flatness 20 Hz to 20 kHz	±0.06 dB @ 1 kHz ±0.1 dB
<b>High-frequency rejection</b>	> 70 dB @ 300 kHz
<b>Residual DFD acc. to IEC60268</b> <sup>26)</sup> Input Level ≤ 60 Vpp Input Level ≤ 100 Vpp	< -100 dB < -96 dB
<b>Residual THD @ input level 60 Vpp</b> Typical Maximum	< -105 dB < -100 dB @ fundamental input frequency 20 Hz to 10 kHz
<b>Residual crosstalk</b>	< -100 dB
<b>Residual noise</b> <sup>27)</sup>	≤ 10 μV (-100 dBV), BW 20 kHz



<sup>25)</sup> FX-DF specifications include FX100 Analyzer & Generator specifications whenever applicable

<sup>26)</sup> Test Frequencies 18 kHz + 20 kHz, DFD products 2<sup>nd</sup> order (@ 2 kHz) / 3<sup>rd</sup> order (@ 16 and 22 kHz)

<sup>27)</sup> FX-SIP power supply disconnected

## FX-AES Option

Digital Signal Generator	
<b>Interface</b>	
Balanced	
Format	AES-EBU per AES3-2003
Connector	XLR
Carrier amplitude	2.2 Vpp ±10 % into 110 Ω
Output impedance	110 Ω
Unbalanced	
Format	S/PDIF-EIAJ per IEC60958-3 or AES3-id
Connector	BNC (S/PDIF with BNC to RCA adapter)
Carrier amplitude	0.5 Vpp (S/PDIF)   1.0 Vpp (AES3-id) ±20 % into 75 Ω
Output impedance	75 Ω
Optical <sup>28)</sup>	Toslink®, fs ≤ 192 kHz
<b>Output sample rate</b>	
Source selection	internal   digital input signal recovered   sync input
Range	22 to 220 kHz
Resolution	≤ ±0.0001 % (±1 ppm)
Accuracy <sup>29)</sup>	≤ ±0.00025 % (±2.5 ppm) using internal reference
<b>Audio data word length</b>	16   18   20   24 bit (TPDF Dither added for < 24 bit)
<b>Channel status bit setting</b>	Consumer format: channel independent selection, full implementation per IEC60958 (english language decoded) Professional format: channel independant selection of bit #0 to #21, bit #32 to #39 per IEC 60958 (english language decoded)
<b>User bits</b>	set to 0
<b>Validity bit</b>	channel independent toggling between Valid – Invalid
<b>Signals</b>	<i>same as analog output</i>
<b>Level</b>	
Range	-142 dBFS to 0 dBFS (0.0707 μFFS to 1 FFS, channel independent)
Resolution	±0.001 dB
Flatness	±0.006 dB
Anti-Aliasing cut-off <sup>30)</sup>	
-0.01 dB point	0.453 ±0.5 % * fs, typical 21.75 kHz with fs = 48 kHz
-3 dB point	0.478 ±0.5 % * fs, typical 22.98 kHz with fs = 48 kHz
Attenuation ≥ 120 dB	0.55 * fs, typical 26.2 kHz with fs = 48 kHz
<b>Frequency range</b>	5 Hz to 80 kHz
<b>Residual</b>	
Noise	≤ -128 dBFS (20 kHz BW)
Jitter <sup>31)</sup>	≤ 2 ns peak (700 Hz to 100 kHz jitter BW)
<b>Digital Signal Analyzer</b>	
<b>Interface</b>	
Balanced	
Format	AES-EBU per AES3-2003
Connector	XLR
Unbalanced	
Format	S/PDIF-EIAJ per IEC60958-3 or AES3-id, symmetrical input
Connector	BNC (S/PDIF with RCA to BNC adapter)
Input impedance Bal/Unbal	110 Ω   75 Ω   Hi-Z (> 2k Ω)
Carrier signal range	200 mVpp to 10 Vpp (covers AES3-2003   S/PDIF IEC 60958-3   AES3-id)
Optical <sup>27)</sup>	Toslink®, fs ≤ 192 kHz
<b>AES recovered input carrier sample rate</b>	22 to 220 kHz
<b>Measurement</b>	
Range	22 to 220 kHz
Resolution	≤ ±0.00005 % (±0.5 ppm)
Accuracy <sup>29)</sup>	≤ 0.00025 % (±2.5 ppm) internal reference accuracy ±0.00015 % (±1.5 ppm) frequency measurement accuracy
<b>Detection range of standard sample rate</b>	±5000 ppm
(32   44.1   48   64   88.1   96   128   176.4   192 kHz)	

<sup>28)</sup> Sampling rate fs ≤ 192 kHz for AES option installed after July 2014; otherwise fs ≤ 110 kHz

<sup>29)</sup> Specification valid for temperature range +20° to +45°C, excluding the aging (±1 ppm/year)

<sup>30)</sup> Specification valid for fs = 26 to 220 kHz

<sup>31)</sup> Specification valid for fs = 32 to 220 kHz, output source internal or SyncIn

<b>Embedded data display</b>	24 bit activity indicators of each channel
<b>Channel status bit indicators</b>	Consumer format: channel independent selection, full implementation per IEC60958 (english language decoded) Professional format: channel independant selection of bit #0 to #21, bit #32 to #39 per IEC 60958 (english language decoded) Warning highlight mode if channel status differs from received data stream (e.g. audio word length, audio data mode, sample rate etc.)
<b>User bits</b>	not displayed
<b>Validity flag</b>	displayed for each channel
<b>Carrier condition indicator</b>	parity   coding error   receiver synchronized
<b>Level</b> Range Resolution Flatness Anti-Aliasing cut-off <sup>27)</sup> -0.01 dB point -3 dB point Attenuation ≥ 120 dB	-144 to 0 dBFS ±0.001 dB ±0.007 dB 0.453 ±0.5 % * fs, typical 21.75 kHz with fs = 48 kHz 0.478 ±0.5 % * fs, typical 22.98 kHz with fs = 48 kHz 0.55 * fs, typical 26.2 kHz with fs = 48 kHz
<b>Frequency range</b> Meter, StepSweep GlideSweep	5 Hz to 0.4986 * fs 5 Hz to 0.465 * fs
<b>Residual noise</b>	< -135 dBFS, BW 20 kHz
<b>Measurements</b>	<i>same as in analog input mode, except of PureSound   DCV common   DCR Impedance</i>
<b>Sync Input Characteristics</b>	
<b>Interface</b> Format Connector Input impedance Frequency range Input amplifier range Rise / fall time	Squarewave or Video (PAL   NTSC) BNC 75 Ω   Hi-Z (> 1 k Ω) 22 to 220 kHz, 15.625 kHz (PAL)   15.734 kHz (NTSC) 200 mVpp to 5 Vpp < 500 ns
<b>Sample rate measurement</b> Range Resolution Accuracy <sup>27)</sup>	22 to 220 kHz, 15.625 kHz (PAL)   15.734 kHz (NTSC) ≤ ±0000.5 % (±0.5 ppm) ≤ 0.00025 % (±2.5 ppm) internal reference accuracy ±0.00015 % (±1.5 ppm) frequency measurement accuracy
<b>Detection range of standard sample rate</b> Video (15.625 kHz PAL   15.734 kHz NTSC) Audio (32   44.1   48   64   88.1   96   128   176.4   192 kHz)	±1500 ppm ±5000 ppm
<b>Residual jitter</b> <sup>29)</sup>	≤ 2 ns peak (700 Hz to 100 kHz jitter BW)
<b>PLL loop filter</b>	5 kHz