FX100 Audio Analyzer

Technical Specifications

Analog Generator	
Number of channels	2 or 4 (*optional*); channel independent signal level, frequency control
Connectors Types Configurations	 XLR ¦ BNC ¦ Binding post (ground) Balanced ¦ unbalanced ¦ unbalanced grounded ¦ common signal test
Test signals	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)
Level Range Balanced Unbalanced Accuracy [1] 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 µV to 12.45 V) for 600 Ω load @ 24 dBu –100 dBV to +15.9 dBV (10 µV to 6.22 V) < ±0.04 dB @ 1 kHz, output load > 2 kΩ < +0.02 / –0.06 dB @ 1 kHz, output load > 2 kΩ ±0.01 dB @ (–80 dBV to +21.9 dBV) ±0.08 dB @ (–80 dBV to +21.9 dBV) ±0.01 dB ±0.05 dB
Frequency Range Resolution Accuracy [2]	 5 Hz to 80 kHz < 0.1 Hz ±25 ppm (standard version) ¦ ±2.5 ppm (with AES option installed)
Residual THD+N [1] 1 kHz, 0 dBV Fundamental 20 Hz to 20 kHz Fundamental 10 Hz to 80 kHz	 ≤ –104 dB typical ≤ (–101 dB + 0.8 µV) @ 22 kHz BW [3] ≤ (–92 dB + 1.6 µV) @ 80 kHz BW [3]
IMD MOD 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 ≤ –95 dB [3, 4] @ output level > –20 dBV ≤ –90 dB [3, 4] @ output level > –20 dBV ≤ –85 dB [3, 4] @ output level > –20 dBV
IMD DFD 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 ≤ –100 dB [3, 4] @ output level > –20 dBV
IMD DIM 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 ≤ –95 dB [3, 4] @ output level > –20 dBV

[1] For loads < 2 kΩ, the FX100 generator inward resistance (approx. 1.8 Ω) degrades the output level accuracy.
[2] Temperature range +20 to +45 °C; ±1 ppm ageing p.a.
[3] System specification includes contribution from both generator and analyzer; generator only and analyzer only contributions are typically less.
[4] Applies for all FX100 units with serial number ≥ 11221; for instruments with a lower serial number, +5 dB have to be added.

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

Analog Analyzer	
Connectors	XLR ¦ BNC ¦ Binding post (ground)
Input impedance	
Balanced	100 kΩ || 65 pF (differential)
Unbalanced	50 kΩ || 130 pF
Maximum rated input (overload protected)	
DC to 20 kHz	200 Vp (DC + AC) total symmetrical and asymmetrical
20 Hz to 80 kHz	60 Vp (DC + AC) total symmetrical and asymmetrical
Input	
Range	–6.7 dBVp to +46 dBVp
Bandwidth	DC ¦ 5 Hz to 80 kHz
Coupling	AC (< 3 Hz) or DC (selectable)
CMRR @ 10 Hz to 20 kHz [6]	(*CMRR performance below 50 Hz degrades substantially with AC coupling*)
Input range < 0 dBVp	≥ 88 dB
Input range 0 dBVp to 10 dBVp	≥ 80 dB
Input range 10 dBVp to 20 dBVp	≥ 72 dB
Input range 20 dBVp to 40 dBVp	≥ 60 dB
Input range 40 dBVp to 46 dBVp	≥ 56 dB
Bias supplies	48 V microphone Phantom power 2 V microphone power ICP® microphone power [7] DCR measurement current 100 µA (100 kΩ range) ¦ 1.6 mA (5 kΩ range)

[6] *CMRR performance below 50 Hz degrades substantially with AC coupling ON.*
[7] *ICP® is a registered trademark of PCB Piezotronics.*
[5] *System specification includes contribution from both generator and analyzer; one generator channel muted.*

Measurement functions	Frequency	[Hz ¦ ppmr]
	Level	[V ¦ dBV ¦ dBu ¦ dBSPL ¦ dBPa ¦ dBr ¦ W]
	Selective level	[V ¦ dBV ¦ dBu ¦ dBSPL ¦ dBPa ¦ dBr ¦ W]
	Input level	[V ¦ dBV ¦ dBu ¦ dBSPL ¦ dBPa ¦ dBr ¦ W]
	THD+N	[% ¦ dB ¦ dBV ¦ dBu ¦ dBSPL ¦ dBPa ¦ dBr ¦ W]
	THD	[% ¦ dB ¦ dBV ¦ dBu ¦ dBSPL ¦ dBPa ¦ dBr ¦ W]
	Harmonic distortion k2 to k35	[% ¦ dB ¦ dBV ¦ dBu ¦ dBSPL ¦ dBPa ¦ dBr ¦ W]
	IMD (acc. IEC60268/3)	[% ¦ dB]
	FFT	[V ¦ dBV ¦ dBu ¦ dBSPL ¦ 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*)
Sweep modes	StepSweep: Frequency ¦ Amplitude ¦ Time ¦ Table sweep GlideSweep: Frequency sweep	
Level measurement		
Range	< 1 µV to 200 Vp	
Resolution	±0.01 dB	
Accuracy	±0.04 dB @ 1 kHz	
Flatness (AC coupling OFF) [8]		
20 Hz to 20 kHz [9]	±0.015 dB	
10 Hz to 80 kHz [9]	±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	
Frequency measurement		
Range	5 Hz to 80 kHz	
Resolution	< 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	
THD ¦ THD+N ¦ harmonics measurement		
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 [10]	≤ (–104 dB + 0.5 µV)	
Generator + analyzer residual THD+N [11]	≤ (–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)	
IMD MOD		
Low frequency acceptance range f_1	60 Hz to 1 kHz	
High frequency acceptance range f_2	2 kHz to 20 kHz, $f_2 \geq 6.1 * f_1$	
MOD component analysis	d2, d3, d2+d3, or d2 ... d5	
Residual IMD MOD d2+d3	typ. –101 dB @ 0 dBV, f_1 = 60 Hz, f_2 = 20 kHz, amplitude ratio 1:1	
1:1 amplitude ratio	≤ –95 dB [3), 4)] @ output level > –20 dBV	
4:1 amplitude ratio	≤ –90 dB [3), 4)] @ output level > –20 dBV	
10:1 amplitude ratio	≤ –85 dB [3), 4)] @ output level > –20 dBV	

[8] *Specified for Meter and StepSweep. For GlideSweep, the length must be ≥ 0.2 s and ±0.01 dB ripple has to be added.*
[9] *Specified by design and characterization; not production tested.*

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

[10)] Input level has to be ≤ 19.5 dBV
[11)] System specification includes contribution from both generator and analyzer; generator only and analyzer only contributions are typically less.
[12)] Both analyzer inputs must have the same coupling (AC ¦ DC), and the automatic input range is switched OFF.
[13)] System specification includes contribution from both generator and analyzer; one generator channel muted.
[14)] Accuracy can degrade due to impulse response band limitation; Brickwall filter assumed for the specified accuracy; listed cutoff frequency @ –3 dB point
[15)] With sample rate adjustment turned OFF

DCV measurement	
Differential (XLR pin 2-3)	
Input range setting	460 mV to 200 V
Accuracy	≤ ±0.6 % of input range setting
Common (XLR pin 2-1/3-1)	
Range	200 V (fixed)
Accuracy	≤ ±50 mV
DCR measurement	
Range	4 Ω to 5 kΩ ¦ 5 kΩ to 100 kΩ (manual Bias selection)
Accuracy	
4 Ω to 30 Ω	< 4 %
30 Ω to 100 kΩ	< 0.8 %

Interfaces	
Communication	
USB host	2*USB mass-storage device (rear and front), A-plug, protocol version 2.0
USB device	Remote control USB-TMC, B-plug, protocol version 2.0
LAN	(*for future use*)
Monitor output	
Connector	6.3 mm (¼") Jack
Signals	after the input filter stage ¦ after the PureSound™ bandpass
Maximum output power	65 mW @ 32 Ω, software-controlled volume –80 dB to +40 dB
Auxiliary I/O	
Configuration	8 programmable general purpose digital inputs & outputs
Output	3.3 V_{TTL}
V_{OHmin} (@ I_{OH} = +3 mA)	2.4 V
V_{OLmax} (@ I_{OL} = –3 mA)	0.4 V
Impedance	50 Ω typical
Input	5 V_{TTL}
Level range	max. –0.5 to +5.5 V
V_{IH}	2.0 V
V_{IL}	0.8 V
Impedance	10 kΩ
Min. input pulse width	≥ 200 µs
Max. protection against external Voltage	42.4 Vp (according to IEC61011)

General data	
Power supply	100 ¦ 120 ¦ 230 VAC 50 ¦ 60 Hz
Temperature range	
Operating conditions	+5° to +45°C (+41° to +113°F)
Storage	–20° to +80°C (–20° to +176°F)
Humidity	≤ 90% R.H. (non condensing)
Mechanical dimensions	width 215 mm (8.5" i.e. half-rack) height 132 mm (5.25" i.e. 3 RU) length 429 mm (16.9")
Weight (2-channel base unit w/o options)	5.12 kg (11.3 lbs)

FX-SIP Option

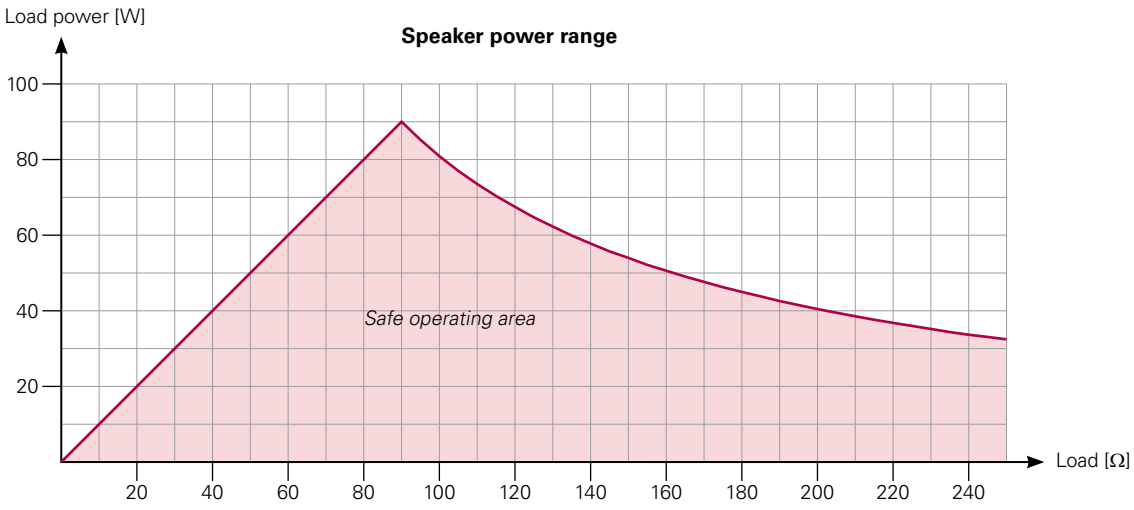
Output	
Bandwidth	5 Hz to 80 kHz (±0.1 dB relative to 1 kHz without load)
Power (BW 22 kHz) [16]	
Dual operation	2*10 W into 2 Ω / 4 Ω or 2*5 W into 8 Ω THD < –80 dB / 0.01 %
Bridged operation	1*30 W into 2 Ω / 4 Ω or 1*20 W into 8 Ω THD < –86 dB / 0.005%
Amplifier gain	0 dB
Output level	
Overall Accuracy [17]	±0.1 dB (no load)
Added error due to amplifier inward resistance	Loss = dB (R_{Load} / (R_{Load} + R_i))
Dual Mode (Ri = 50 mΩ)	+0 / –0.21 dB @ 2 Ω load ¦ +0 / –0.11 dB @ 4 Ω load ¦ +0 / –0.05 dB @ 8 Ω load
Bridge Mode (Ri = 80 mΩ)	+0 / –0.34 dB @ 2 Ω load ¦ +0 / –0.17 dB @ 4 Ω load ¦ +0 / –0.09 dB @ 8 Ω load
Flatness [17]	
10 Hz to 20 kHz, load ≥ 2 Ω	±0.06 dB
10 Hz to 80 kHz, load ≥ 8 Ω	+0.1 / –0.2 dB
10 Hz to 80 kHz, load ≥ 2 Ω	+0.1 / –0.4 dB
Inward resistance R_i	
Dual mode (per channel)	≤ 50 mΩ (20 mΩ typical)
Bridge mode	≤ 80 mΩ (40 mΩ typical)
Damping factor	
Dual mode	> 80 @ 10 Hz to 10 kHz, load ≥ 4 Ω
Bridge mode	> 50 @ 10 Hz to 10 kHz, load ≥ 4 Ω
THD [18]	
Dual mode (BW 22 kHz)	
fundamental 1 kHz	–101 dB typical (with 1 W @ 4 Ω)
fundamental 10 Hz to 20 kHz	≤ –80 dB + 15 µV (power 0 to 10 W, load 2 to 250 Ω)
Bridge mode (BW 22 kHz)	
fundamental 1 kHz	–105 dB typical (with 5 W @ 4 Ω)
fundamental 10 Hz to 20 kHz	≤ –86 dB + 15 µV (power 0 to 30 W, load 2 to 250 Ω)
S/N ratio	
A-weighted	> 109 dB below rated power @ 4 / 8 Ω
BW 22.4 kHz	> 106 dB below rated power @ 4 / 8 Ω
BW 80 kHz	> 103 dB below rated power @ 4 / 8 Ω
XTalk	< –60 dB, BW 10 Hz to 20 kHz
Slew rate	> 50 V/µs
Interchannel phase accuracy [12) 110]	±1.3 deg
Amplifier protection	Short circuit ¦ overcurrent shutdown and automatic retry ¦ thermal
Maximum output	
Level	
Dual mode	16.2 dBV
Bridge mode	21.9 dBV
Current	4.2 A (Bridge mode, 2 Ω load)
Impedance measurement [20]	
Nominal speaker impedance range	2 Ω to 250 Ω
Measurement range	0 Ω to > 1 kΩ
Nominal shunt resistance	0.2 Ω / 0.1 % (in front of amplifier feedback ⇒ no impact on FX-SIP output level)
Measurement accuracy [20) 21]	
General accuracy	
Meter, StepSweep 5 Hz to 1 kHz, GlideSweep 20 Hz to 1 kHz	±5 % with Z = 2 Ω to 150 Ω [22] ¦ ±7 % with Z = 150 Ω to 250 Ω [22]
Meter, StepSweep 5 Hz to 10 kHz, GlideSweep 20 Hz to 10 kHz	±10 % with Z = 2 Ω to 150 Ω [22] ¦ ±15 % with Z = 150 Ω to 250 Ω [22]
Bridge mode 4-wire (sense pins used)	±2 % with Z = 2 Ω to 16 Ω [22]
Bridge mode 2-wire, Dual mode	±5 % with Z = 2 Ω to 64 Ω [22]
Additional impedance measurement error if AC coupling is ON	
5 Hz to 10 kHz	+3 %
10 Hz to 10 kHz	+1 %
20 Hz to 10 kHz	+0.25 %
Additional impedance measurement error with GlideSweep < 20 Hz, AC coupling ON or OFF	
10 Hz to 10 kHz	+1 %

[16] Duty cycle (signal ON : OFF) must not exceed 1:2
[17] Including FX100 generator output level tolerance
[18] The generator Chn1 and Chn2 frequencies have to be the same
[110] Tolerances contain all FX100 errors including generator output phase and analyzer input phase
[20] Tolerances include all errors of FX100 generator output level, analyzer input level and FX-SIP shunt & inward resistance
[21] Frequency range: Meter, StepSweep 5 Hz to 10 kHz ¦ GlideSweep 20 Hz to 10 kHz
[22] AC coupling OFF

DCR measurement	
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

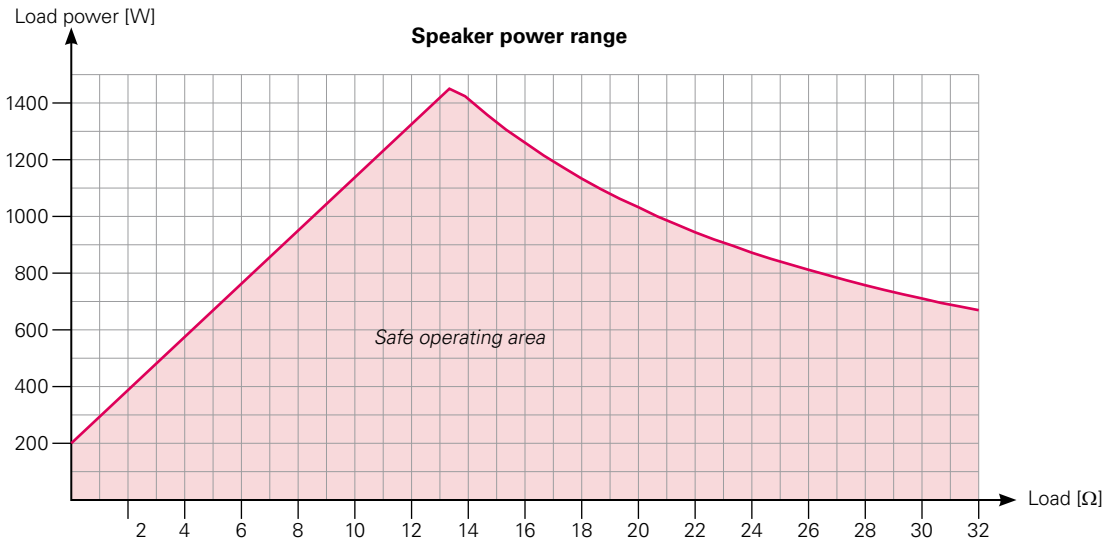
Nominal shunt resistance	1 Ω ±0.1 %
Recommended current range	50 µA to 1 A
Overcurrent detection	1.4 A ±10 %
Speaker power range	
Minimum power	<< 1 mW
Maximum power @ 2 Ω	2 W
Maximum power @ 4 Ω	4 W
Maximum power @ 8 Ω	8 W
Maximum power @ 32 Ω	32 W
Maximum power @ 250 Ω	32 W
Impedance measurement	
Nominal speaker impedance range	2 to 250 Ω
Accuracy @ AC coupling OFF [23), 24)]	
5 Hz to 20 kHz	≤ ±1 %
Accuracy @ AC coupling ON [23), 24)]	
20 Hz to 20 kHz	≤ ±1 %
10 Hz to 20 kHz	≤ ±3 %
5 Hz to 20 kHz	≤ ±5 %
DCR measurement	
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 %



[23)] *Cabling from amplifier to SIL, SIH in accordance to IEC 60268-12*
[24)] *Add 1% to tolerance if loudspeaker impedance is measured with 2 channels (i.e. reference @ amplifier terminal + shunt measurement)*

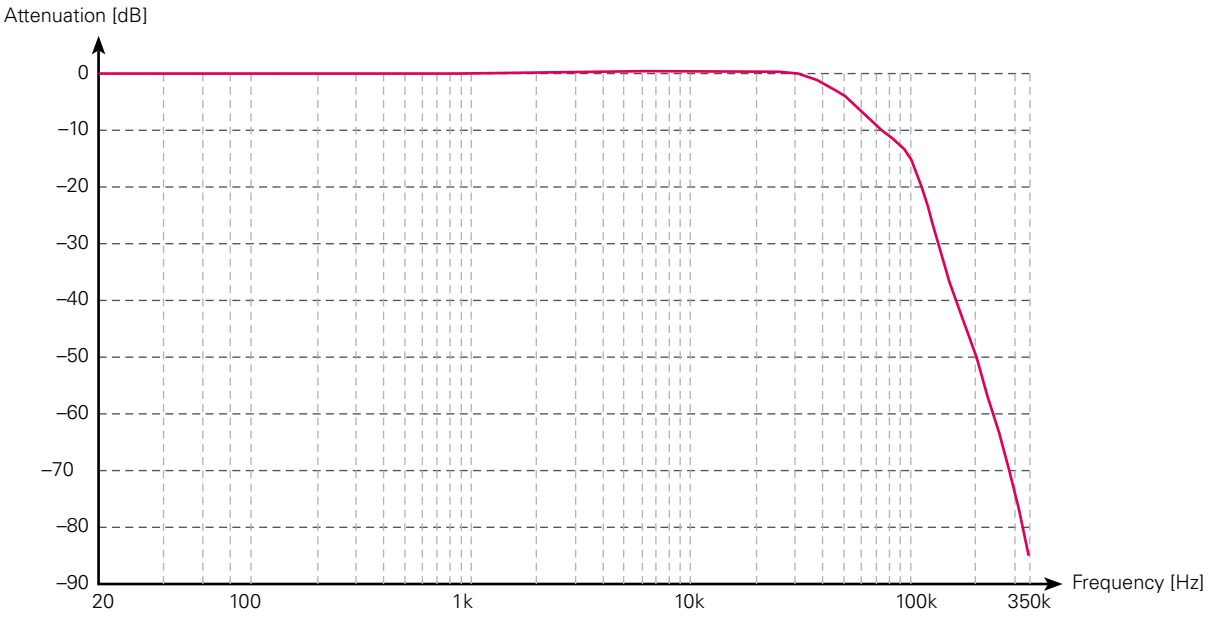
FX-SIH Option

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



FX-DF Option [25]

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



[25] *FX-DF specifications include FX100 Analyzer & Generator specifications whenever applicable*
[26] *Test Frequencies 18 kHz + 20 kHz, DFD products 2nd order (@ 2 kHz) / 3rd order (@ 16 and 22 kHz)*

FX-AES Option

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

[27] *Sampling rate fs ≤ 192 kHz for AES option installed after July 2014; otherwise fs ≤ 110 kHz*
[28] *Specification valid for temperature range +20° to +45°C, excluding the aging (±1 ppm/year)*
[29] *Specification valid for fs = 26 to 220 kHz*
[30] *Specification valid for fs = 32 to 220 kHz, output source internal or SyncIn*

Channel status bit indicators	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.)
User bits	not displayed
Validity flag	displayed for each channel
Carrier condition indicator	parity ¦ coding error ¦ receiver synchronized
Level Range Resolution Flatness Anti-Aliasing cut-off [27] –0.01 dB point –3 dB point Attenuation ≥ 120 dB	 –144 to 0 dBFS ±0.001 dB ±0.006 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
Frequency range Meter, StepSweep GlideSweep	 5 Hz to 0.4986 * fs 5 Hz to 0.465 * fs
Residual noise	< –135 dBFS, BW 20 kHz
Measurements	*same as in analog input mode, except of PureSound ¦ DCV common ¦ DCR Impedance*
Sync Input Characteristics	
Interface 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
Sample rate measurement Range Resolution Accuracy [27]	 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
Detection range of standard sample rate 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
Residual jitter [29]	≤ 2 ns peak (700 Hz to 100 kHz jitter BW)
PLL loop filter	5 kHz