

Chapter 6

Specifications

Unless otherwise noted, all analyzer specifications assume dc coupling, rms detection, autoranging on, and high resolution conversion at 65.536 kS/s. The abbreviation “SR” refers to the relevant output or input sample rate (1 kS/s = 1 kHz).

Analog Signal Generator

Waveforms

Sine Family (Normal, Var Phase, Stereo, Dual, Shaped Burst, EQ)
IMD (SMPTE/DIN 4:1, 1:1)
Square
Noise
Arbitrary Waveform (Multitone)
Special (Polarity, Pass Thru)

Sine Family Characteristics

Frequency Range	2 Hz–61.6 kHz (SR=131.072 kS/s) ¹
Frequency Resolution	0.015625 Hz
Flatness (500 Hz ref)	
20 Hz to 20 kHz	±0.01 dB
10 Hz to 50 kHz	+0.06/–0.1 dB
THD+N ² (20 Hz–20 kHz)	≤0.0009% [–101 dB] +1.6 μV
Variable Phase Range	–180.00 to +179.99 deg
Dual Sine Ratio Range	0 dB to >100 dB

Shaped Burst

Envelope	Raised cosine
Burst Interval	2 to 65536 cycles (max number of cycles may be limited at low frequencies)
Burst On Time	1 to number of interval cycles minus 1

¹ Significant alias products may appear for frequency settings above 53.5 kHz.

² System specification including contributions from both generator and analyzer, 20 kHz measurement bandwidth.

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Other Waveforms

Arbitrary Waveform (Multitone)

Sample Rates (SR)	65.536 kS/s, 131.072 kS/s, OSR (programmed output rate), or ISR (selected input sample rate)
Length	256 to 16384 points per channel
Frequency Range	DC to $0.47 \times \text{SR}$
Frequency Resolution	Sample Rate / Length
Maximum Number of Tones	(Length / 2) minus 1 [8191 with Length=16384]

IMD Test Signal (SMPTE/DIN)

LF Tone Range	40 Hz to 500 Hz
HF Tone Range	2 kHz to 60 kHz
Mix Ratio	4:1 or 1:1 (LF:HF)
Residual IMD ³	$\leq 0.0025\%$ [-92 dB]

Square wave

Frequency Range	10 Hz to 20 kHz
Risetime	Typically 2.0 μs

Noise Signal

White	Pseudo-Random, Rectangular PDF, 60 kHz BW
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Polarity Test Signal

(Sum of two sinewaves phased for reinforcement with normal polarity.)

Frequency Range	2 Hz to 30 kHz
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Pass Thru

(Passes the embedded audio signal from the rear panel Sync/Ref Input. Output Sample Rate (OSR) must be within the range of 0.334 to 3.000 of the Sync/Ref Input sample rate.)

Frequency Accuracy	$\pm 0.0002\%$ [2 PPM] internal reference, lockable to external reference
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Analog Signal Generator Outputs

Analog Output Characteristics

Source Configurations	Balanced (XLR), Unbalanced (XLR and BNC), or Common Mode Test (XLR)
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³ System specification with 60 Hz/7 kHz or 250 Hz/8 kHz test signal combinations and $V_{in} \geq 200 \text{ mV}$.

Source Impedances (R_s)	
Balanced or CMTST	Nominally 40 Ω or 150 Ω , standard configuration Nominally 40 Ω or 200 Ω , EURZ option Nominally 40 Ω or 600 Ω , 600Z option
Unbalanced	Nominally 20 Ω or 50 Ω
Amplitude Range (all Waveforms)	Each analog output is independently settable
Balanced	<250 μ Vrms to 16.00 Vrms [700 μ Vpp to 45.2 Vpp] [-70.0 dBu to +26.30 dBu]
Unbalanced or Common Mode Test	<250 μ Vrms to 8.00 Vrms [700 μ Vpp to 22.6 Vpp] [-70.0 dBu to +20.28 dBu]
Amplitude Accuracy	± 0.09 dB [± 1.0 %]
Amplitude Resolution	0.007 dB or 0.60 μ Vrms, whichever is larger
Max Output Power into 600 Ω	
Balanced	+24.1 dBm ($R_s = 40 \Omega$)
Unbalanced	+18.4 dBm ($R_s = 20 \Omega$)
Output Current Limit	Typically >50 mA
DC Offset	$\leq 0.25\%$ of Vpp setting [0.7% of Vrms setting]
Output Related Crosstalk	$\leq (-100$ dB + 3 μ V), 20 Hz to 20 kHz

Digital Signal Generator

Waveforms

Sine Family	(Normal, Var Phase, Stereo, Dual, Shaped Burst, EQ, Burst, Offset) IMD (SMPTE/DIN 4:1, 1:1) Square Noise Arbitrary Waveform (Multitone) Special (Polarity, Pass Thru, Monotonicity, J-Test, Walking Ones, Walking Zeros, Constant Value, Random)
Common Sine Family Characteristics	
Frequency Range	2 Hz to $<0.50 \times SR$
Frequency Resolution	$SR / 2^{23}$
Flatness	± 0.001 dB
Harmonics and Spurious Products	0.000001% [-160 dB]
Variable Phase Range	-180.00 to +179.99 deg
Dual Sine Ratio Range	0 dB to >100 dB
Sine + Offset Amplitude Range	Sinewave amplitude + offset amplitude < 1 FFS

Burst and Shaped Burst

Envelope	Burst signal envelope is rectangular, Shaped Burst envelope is raised cosine.
Burst Interval	2 to 65536 cycles (max number of cycles may be limited at low frequencies)
Burst On Time	1 to number of interval cycles minus 1

Squarewave

Frequency Range	2 Hz to SR / 6, in even integer sub-multiples of SR
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SMPTE/DIN Test Signal

Lower Tone Range	40 Hz to 500 Hz
Upper Tone Range	2 kHz to $0.47 \times \text{SR}$
Mix Ratio	1:1 or 4:1 (LF:HF)

Noise Signal

White	Pseudo-Random White, Rectangular PDF, Bandwidth = $0.50 \times \text{SR}$
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Special Signals

Polarity	Sum of two sinewaves phased for reinforcement with normal polarity
Pass Thru	Passes the embedded audio signal from the rear panel Sync/Ref Input. Output Sample Rate (OSR) must be within the range of 0.334 to 3.000 of the Sync/Ref Input sample rate.
Monotonicity	Staircase waveform of lowest 10 levels for D/A linearity testing
J-Test	Produces a maximum amount of data-induced jitter on low-bandwidth transmission links
Walking Ones	A single binary one value “walked” from LSB to MSB
Walking Zeros	A single binary zero value “walked” from LSB to MSB
Constant Value (Digital DC)	32-bit resolution when using triangular dither
Random	Random binary states of all bits

Arbitrary Waveform (Multitone)

Sample Rates (SR)	65.536 kS/s, 131.072 kS/s, OSR (programmed output rate), or ISR (selected input sample rate)
Length	256 to 16384 points per channel
Frequency Range	DC to $0.47 \times \text{SR}$
Frequency Resolution	Sample Rate / Length
Maximum Number of Tones	(Length / 2) minus 1 [8191 with Length = 16384]

Dither

Applies to all waveform except Monotonicity, J-Test, Walking Ones, Walking Zeros, Random

Types	None, Triangular, Rectangular, or Shaped
Amplitude	8 to 24 bit

Pre-Emphasis Filters

(Applies to all waveforms)

Filter Shapes	50/15 μ s or J17
Response Accuracy	± 0.02 dB, 10 Hz to $0.45 \times$ SR
Residual Distortion	0.00003% [–130 dB]

Digital Signal Generator Outputs

Formats

Balanced (XLR)	AES3 per AES3-1997
Unbalanced (BNC)	SPDIF-EIAJ per IEC 60958
Optical (Toslink®)	per IEC 60958-3

Digital Output Characteristics

Sample Rate Range	28.8 kHz to 108 kHz per connector
Sample Rate Accuracy	$\pm 0.0002\%$ [2 PPM] internal reference, lockable to external reference
Word Width	8 to 24 bits
Output Impedance	
Balanced (XLR)	Nominally 110 Ω
Unbalanced (BNC)	Nominally 75 Ω
Output Amplitude, balanced into 110 Ω	
Range	0 to 5.10 Vpp
Resolution	20 mV
Accuracy	$\pm(10\% + 60$ mV)
Output Amplitude, unbalanced into 75 Ω	
Range	0 to 1.275 Vpp
Resolution	5 mV
Accuracy	$\pm(8\% + 15$ mV)
Output Amplitude, Optical (Toslink®)	Nominal intensity, not variable
Channel Status Bits	Full implementation per IEC 60958, English language decoded, common to both channels
Formats	Professional or consumer; or Direct Hex source
User Bits	Set to 0
Validity Flag	Selectable—set or cleared, common to both channels

Jitter Generator

Waveform	Sine
Frequency Range	20 Hz to 200 kHz, <0.1 Hz resolution
Amplitude Range	0.05 to 0.1275 UI in 0.0005 UI steps 0.130 to 1.275 UI in 0.005 UI steps 1.30 to 12.75 UI in 0.05 UI steps
Accuracy (500 Hz)	$\pm(10\% + 2$ ns)

Flatness ⁴	±1 dB, 100 Hz to 20 kHz
Residual Jitter ⁵	≤2 ns [0.012 UI at 48 kS/s, 0.024 UI at 96 kS/s]
Spurious Jitter Products	typically <0.003 UI [-50 dBUI] or 30 dB below jitter signal, whichever is larger

Audio Analyzer

Level and Amplitude Measurement

(Independent level and amplitude meters per channel)

Measurement Range	
Analog	<1 μV rms to 140 V rms [-118 dBu to +45.1 dBu]
Digital	-120 dBFS to 0 dBFS (usable to -140 dBFS)
Accuracy (1 kHz)	
Analog	±0.09 dB [±1.0%]
Digital	±0.002 dB [±0.023%]
Flatness ⁶	
Analog	±0.01 dB, 20 Hz to 20 kHz (0.45×SR if less); ±0.10 dB, 10 Hz to 120 kHz (with performance option)
Digital	±0.002 dB, 10 Hz to 0.45×SR
Detection	RMS, FAST RMS, or QPK per IEC 468 (CCIR)

Frequency Measurement

(Two independent meters, one per channel)

Range	
Analog	<10 Hz to 30 kHz (SR = 65.536 kS/s), <10 Hz to 120 kHz (with performance option)
Digital	<10 Hz to 0.47×SR
Accuracy	±0.0002% [2 PPM]
Resolution	0.00001% of SR [0.007 Hz at 65.536 kS/s]
Minimum Input	
Analog	1 mV (S/N >40 dB)
Digital	-100 dBFS (S/N >40 dB)

Phase Measurement

Measurement Ranges	±180, -90 to +270, or 0 to +360 deg
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⁴ System specification including contributions from both analyzer and generator. Valid at 32.0, 44.1, 48.0, 65.536, 88.2, and 96.0 kS/s only. Flatness may degrade at other sample rates.

⁵ System specification valid only if (1) the jitter generator amplitude is turned off; (2) the digital input is ≥ 1.0 V_{pp} (XLR) or ≥ 250 mV_{pp} (BNC); and (3) the analyzer is set for 700 Hz–100 kHz bandwidth.

⁶ 1 kHz ref. Flatness derates above 5 kHz by an additional ±0.02 dB in the 22.4 V, 45 V, 90 V, and 200 V input ranges.

Accuracy	
Analog ⁷	±2 deg, 10 Hz to 5 kHz ±3 deg, 5 kHz to 20 kHz ±4 deg, 20 kHz to 50 kHz (with performance option)
Digital	±1 deg, 10 Hz to 0.45×SR
Resolution	0.01 deg
Minimum Input (both channels)	
Analog	1 mV (S/N >40 dB)
Digital	-60 dBFS (S/N >40 dB)

Residual Noise

(Amplitude Function only)

Analog	
A-weighted	≤1.2 μV rms
Dolby 2K	≤2.0 μV rms
IEC 468 (CCIR)	≤6.0 μV Qpk
20 kHz LP	≤1.6 μV rms
Digital	
A-weighted	≤-142 dBFS
Dolby 2K	≤-134 dBFS
IEC 468 (CCIR)	≤-127 dBFS
20 kHz LP	≤-140 dBFS

THD+N Function

Fundamental Range	10 Hz to 0.47×SR
Measurement Range	0 to 100%
Accuracy	±0.3 dB, 10 Hz to 0.45×SR (no filters selected)
Residual THD+N	
Analog	≤0.0009% [-101 dB] + 1.6 μV (with 20 kHz LP)
Digital	-138 dBFS
Minimum Input for Counter Tuning	
Analog	1 mV (S/N > 40 dB)
Digital	-65 dBFS (S/N > 40 dB)
Notch Tuning Modes	Counter Tuned, Sweep Track, Agen Track, Dgen Track, or Fixed (set by direct entry)

Amplitude & THD+N Filters

(One filter from each of the following 3 groups may be enabled for 3 filters total)

Low Pass Group	Fs/2 (no BW limiting) 20 kHz (6-pole elliptic, 0.1 dB ripple, 110 dB stopband) 15 kHz (6-pole elliptic, 0.1 dB ripple, 110 dB stopband) User defined (6-pole max)
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⁷ Both analyzer input channels must have same coupling (ac or dc) selection. Analog accuracy is valid for any input signal amplitude ratio up to ±30 dB.

High Pass Group	<10 Hz (4-pole) 22 Hz (4-pole Butterworth) 100 Hz (4-pole Butterworth) 400 Hz (4-pole Butterworth, or 10-pole elliptic if no other filters are enabled) User defined (4-pole max)
Weighting Filter Group	None ANSI-IEC "A" weighting, per IEC 179 IEC 468 (CCIR) Qpk Dolby 2K (CCIR-ARM) C-message per IEEE 743-1978 CCITT per Rec O.41 "F" weighting per 15 phon loudness contour HI-2 Harmonic weighting User defined (8-pole max)

Bandpass & Crosstalk Functions

Tuning Range	20 Hz to $0.47 \times SR$
Bandpass Response	10-pole, $Q=19$
Accuracy (at center frequency)	
Analog	± 0.2 dB
Digital	± 0.1 dB
Residual Noise	
Analog	
10 Hz to 5 kHz	$\leq 0.5 \mu V$ [-124 dBu]
5 kHz to 20 kHz	$\leq 1.0 \mu V$ [-118 dBu]
20 kHz to 50 kHz	$\leq 2.0 \mu V$ [-112 dBu]
Digital	≤ -150 dBFS

SMPTE (DIN) IMD Function

Test Signal Compatibility	Any combination of 40 Hz to 250 Hz (LF) and 2 kHz to $0.45 \times SR$ (HF), mixed in any ratio from 1:1 to 5:1 (LF:HF)
IMD Measured	Amplitude modulation products of the HF tone. Measurement bandwidth is typically 20 Hz to 750 Hz
Measurement Range	0 to 20%
Accuracy	± 0.5 dB
Residual IMD ⁸	
Analog	$\leq 0.0025\%$ [-92 dB]
Digital	$\leq 0.00003\%$ [-130 dB] at 0 dBFS $\leq 0.00003\%$ [-110 dB] at -25 dBFS

FFT Analyzer

Acquisition Length	800 to 256 k samples in 11 steps
Transform Length	256 to 32768 samples in binary steps

⁸ System specification with 60 Hz/7 kHz or 250 Hz/8 kHz test signal combinations and $V_{in} \geq 200$ mV.

Windows	None None-move-to-bin-center Hann Hamming Blackman-Harris (4 term, -92 dB sidelobes) Equiripple (AP design with -160 dB sidelobes) Flat-top Gaussian Rife-Vincent 4-term Rife-Vincent 5-term
Amplitude Accuracy (Flat-top window)	
Analog	±0.10 dB [±1.2%]
Digital	±0.001 dB [±0.012%]
Phase Accuracy	
Analog ⁹	±0.5 deg, 10 Hz to 5 kHz ±1 deg, 5 kHz to 20 kHz ±2 deg, 20 kHz to 50 kHz (with performance option)
Digital	±0.05 deg, 10 Hz to 0.45×SR
Averaging	
Number of averages	1 to 4096 in binary steps
Algorithm	Power-based (frequency domain) Synchronous (time domain)
Display Modes	
Time Domain	Normal, Interpolate, Peak, Absolute Value
Frequency Domain	Displays highest FFT bin between graph points
None-Move-to-Bin-Center Window	
Frequency Range	±4% of input frequency, 7th FFT bin (low limit) to 0.45×SR (high limit)
Spurious Products	≤120 dB
Residual Distortion	
Analog	≤-105 dB, SR=65 kS/s ≤-90 dB, SR=262 kS/s (with performance option)
Digital	≤-180 dB
Analog Alias Rejection	
Standard (High Resolution) A/D	typically >115 dB for signals >0.554×SR
Performance option A/D	typically >85 dB for signals >0.540×SR

Multitone Audio Analyzer

Acquisition Length	512 to 32768 samples in binary steps
Transform Length	512 to 32768 samples in binary steps
Measurements	Amplitude vs Frequency, Total Distortion vs Frequency, Noise vs Frequency, Phase vs Frequency, Crosstalk vs Frequency, and Masking Curve
Frequency Resolution	SR / Length [2.0 Hz with SR = 65.536 kS/s and Length = 32768]

⁹ Both analyzer input channels must have same coupling (ac or dc) selection. Analog accuracy is valid for any input signal amplitude ratio up to ±30 dB.

Frequency Correction	
Frequency Range	±4% of input frequency, 7th FFT bin (low limit) to 0.45×SR (high limit)
Spurious Products	<-120 dB
Residual Distortion	
Analog	≤-105 dB, SR=65 kS/s
Digital	≤-90 dB, SR=262 kS/s (with performance option)
	-140 dBFS

Analog Input Characteristics

Input Ranges	355 mVp to 200 Vp [250 mVrms to 140 Vrms] in binary (6.02 dB) steps
Maximum Rated Input	200 Vp, 140 Vrms (dc to 20 kHz); overload protected in all ranges
Input Impedance	
Balanced	Nominal 200 kΩ // 95 pF
Option 600Z adds	Nominal 600 Ω
Unbalanced	Nominal 100 kΩ // 185 pF
Option 600Z adds	Nominal 600 Ω
CMRR ¹⁰	
355 mVp to 5.6 Vp ranges	≥80 dB, 10 Hz to 20 kHz
11.2 Vp to 200 Vp ranges	≥50 dB, 10 Hz to 1 kHz
Input Related Crosstalk	≤(-100 dB + 3 μV) at 20 kHz

Digital Input Characteristics

Formats	
Balanced (XLR)	AES3 per AES3-1997
Unbalanced (BNC)	SPDIF-EIAJ per IEC 60958
Optical (Toslink®)	per IEC 60958-3
Sample Rates	28.8 kHz to 108 kHz per connector
Word Width	8 to 24 bits
Input impedance	
Balanced (XLR)	Nominally 110 Ω or >2.5 kΩ
Unbalanced (BNC)	Nominally 75 Ω or >3 kΩ

Digital Interface Measurements

Input Sample Rate	
Internal Reference	±0.0003% [±3 PPM]
External Reference	±0.0001% [±1 PPM]
Input Voltage	
Balanced (XLR)	200 mV to 5.10 Vpp, ±(10% + 50 mV)
Unbalanced (BNC)	100 mV to 1.275 Vpp, ±(10% + 12 mV)

¹⁰CMRR performance below 50 Hz degrades substantially with AC coupling.

Jitter Amplitude (peak calibrated)	
50 kHz–100 kHz BW	0 to 3.00 UI, $\pm(10\% + 2 \text{ ns})$
other BW selections	0 to 1.00 UI, $\pm(10\% + 2 \text{ ns})$
Jitter Flatness ¹¹	$\pm 1 \text{ dB}$, 100 Hz to 20 kHz
Residual Jitter ¹²	$\leq 2 \text{ ns}$ [0.012 UI at 48 kS/s, 0.024 UI at 96 kS/s]
Jitter Spectrum	Spurious products are typically $< 0.003 \text{ UI}$ [-50 dBUI] or 30 dB below jitter signal, whichever is larger
Channel Status Bits	Full implementation per IEC 60958, English language decoded, common to both channels
Formats	Professional or consumer, or Direct Hex source
User Bits	Not displayed
Validity Flag	Displayed for each channel
Parity	Displayed for total signal (both channels combined)
Signal Confidence	Displayed for total signal (both channels combined)
Receiver Lock	Displayed for total signal (both channels combined)
Coding Error	Displayed for total signal (both channels combined)

Sync/Reference Input Characteristics

Signal Compatibility	
AES3	AES3id 1995, SPDIF (IEC 60958); 28.8–100 kHz
Video	NTSC, PAL, or SECAM
Squarewave	8.0 kHz to 10.0 MHz
Minimum Input Amplitude	200 mVpp
Input Impedance	Nominally 75 Ω or $> 5 \text{ k}\Omega$
Lock Range	$\pm 0.0015\%$ [$\pm 15 \text{ PPM}$]

Auxiliary Signals

Monitor Outputs

Signals	Replicas of both analyzer inputs plus two additional signals depending on the measurement mode. Not guaranteed to operate with sample rates above 108 kS/s.
Typical Amplitude	0 to 4 Vpp ($R_s = 422 \Omega$)

¹¹ System specification including contributions from both analyzer and generator. Valid at 32.0, 44.1, 48.0, 65.536, 88.2, and 96.0 kS/s only. Flatness may degrade at other sample rates.

¹² System specification valid only if (1) the jitter generator amplitude is turned off; (2) the digital input is $\geq 1.0 \text{ Vpp}$ (XLR) or $\geq 250 \text{ mVpp}$ (BNC); and (3) the analyzer is set for 700 Hz–100 kHz bandwidth.

Auxiliary Control I/O

Inputs (8 bits)	5 V TTL-compatible CMOS
Absolute maximum range	−0.5 V to 5.5 V
Float State	20 kΩ pull-up to +5 V
Outputs (8 bits)	5 V TTL-compatible CMOS
Voltage Range	0 to 5 V

Trigger Input

Absolute Maximum Range	−0.5 V to 30 V
Minimum High Voltage	1.25 V
Maximum Low Voltage	0.5 V
Input Impedance	>50 kΩ
Contact resistance (for short control)	5 kΩ maximum

Trigger Output

Voltage Range	0–5 V nominal
Output Impedance	150 Ω nominal
Source	Analog Generator Digital Generator Jitter Generator External Trigger Input Line (Mains) Channel A Receive Sub-Frame Channel B Receive Sub-Frame Channel A Receive Sub-Frame De-jittered Channel B Receive Sub-Frame De-jittered Receive Block Receive Error Channel A Transmit Sub-Frame Channel B Transmit Sub-Frame Channel A Transmit Sub-Frame De-jittered Channel B Transmit Sub-Frame De-jittered Transmit Block Channel A Sync/Ref Receive Sub-Frame Channel B Sync/Ref Receive Sub-Frame Sync/Ref Receive Block Sync/Ref Receive Error

General/Environmental

Power Requirements	100/120/230/240 Vac (−10% +6%), 50–60 Hz, 75 VA max
Temperature Range	
Operating	+5°C to +45°C
Storage	−40°C to +75°C
Humidity	90% RH to +40°C (non-condensing)

Max Operating Altitude	3000 m
EMC ¹³	Complies with 89/336/EEC, CISPR 22 (class B), and FCC 15 subpart J (class B)
Dimensions	
Width	16.8 inches [42.7 cm]
Height	3.0 inches [7.6 cm]
Depth	14.2 inches [36.1 cm]
Weight	Approximately 16.2 lbs [7.4 kg] unpacked, all hardware options installed.
Safety	<p>Complies with: 73/23/EEC, 93/68/EEC, and EN61010-1 (1990) + Amendment 1 (1992) + Amendment 2 (1995). Installation Category II, Pollution Degree 2</p> <p>CAN/CSA-C22.2 No 1010.1-92, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements (Includes Amendment 1)</p> <p>CAN/CSA-C22.2 No 1010.1B-97, Amendment 2 to CAN/CSA-C22.2 No 1010.1-92, "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements"</p> <p>UL Std No 3111-1, Equipment for Measurement Use; Part I: General Requirements</p>

¹³ Emission and immunity levels are influenced by the shielding performance of the connecting cables. EMC compliance was demonstrated using Audio Precision part numbers CAB-XMF and CAB-AES2.

