

Appendix G - Specifications

ANALOG SIGNAL OUTPUTS

Low Distortion Sine Wave

Frequency Range	10 Hz to 120 kHz
Frequency Accuracy	±0.5%
Frequency Resolution	0.02%
Amplitude Range (20 Hz - 30 kHz) ¹	
Balanced	0.25 mV to 25.00 Vrms [-70 to +30.17 dBu]
Unbalanced	0.25 mV to 12.50 Vrms [-70 to +24.16 dBu]
Amplitude Range (full frequency range) ¹	
Balanced	0.25 mV to 12.28 Vrms [-70 to +24.00 dBu]
Unbalanced	0.25 mV to 6.14 Vrms [-70 to +18.00 dBu]
Amplitude Accuracy (1kHz)	±0.2dB [±2.3%]
Amplitude Resolution	0.01 dB
Flatness (1 kHz ref)	
10 Hz-20 kHz	±0.05 dB
20 kHz-120 kHz	±0.30 dB
Residual THD+N ²	
25 Hz-20 kHz	≤(0.0025% + 3 μV), 80 kHz BW [-92 dB]
10 Hz-50 kHz	≤(0.010% + 10 μV), >300 kHz BW [-80 dB]

Square Wave

Frequency Range	20 Hz-30 kHz
Frequency Accuracy	Same as Sinewave
Amplitude Range ¹	
Balanced	0.71 mVpp to 34.73 Vpp
Unbalanced	0.71 mVpp to 17.36 Vpp
Amplitude Accuracy	±0.3 dB [±3.5 %] at 400 Hz
Rise/fall time	Typically 2.5 - 3.0 μsec

Note 1 Calibration with other amplitude units is based upon an equivalent sinewave having the same Vpp amplitude.

Note 2 System specification including contributions from both generator and analyzer. Generator load must be ≥600 Ω.

SMPTE (or DIN) Test Signals *with option "P1-IMD"*

LF Tone	50, 60, 70, or 250; all $\pm 1.0\%$
HF Tone Range	7 kHz or 8 kHz ($\pm 1\%$)
Mix Ratio	4:1 (LF:HF)
Amplitude Range ¹	
Balanced	0.71 mVpp to 70.71 Vpp
Unbalanced	0.71 mVpp to 35.35 Vpp
Amplitude Accuracy	$\pm 0.3\text{dB}$ [$\pm 3.5\%$]
Residual IMD ²	0.0015% [-96.5 dB], 60+7 kHz or 250+8 kHz

OUTPUT CHARACTERISTICS

Source Configuration	Selectable balanced or unbalanced
Source Impedances	
Balanced	40 Ω ($\pm 2\Omega$), 150 Ω ³ ($\pm 2\Omega$), or 600 Ω ($\pm 2\Omega$)
Unbalanced	40 Ω ($\pm 2\Omega$)
Max Float Voltage	42 Vpp
Output Current Limit	
Balanced	Typically >75 mA
Unbalanced	Typically >150 mA
Max Output Power	
Balanced	+29.6 dBm into 600 Ω ($R_s = 40\Omega$)
Unbalanced	+23.6 dBm into 600 Ω ($R_s = 40\Omega$)
Output Related Crosstalk (10Hz-20kHz)	≤ -110 dB or 10 μV , whichever is greater

Note 1 Calibration with other amplitude units is based upon an equivalent sinewave having the same Vpp amplitude.

Note 2 System specification including contributions from both generator and analyzer. Generator load must be $\geq 600 \Omega$.

Note 3 200 Ω with option "EURZ".

ANALOG ANALYZER

ANALOG INPUT CHARACTERISTICS

Input Ranges	80 mV to 250 V in 10 dB steps
Maximum Rated Input	350 Vpk, 140 Vrms (dc to 20 kHz); overload protected in all ranges
Input Impedance	
Balanced (each side)	Nominally 100 k Ω // 150-200pF
Unbalanced	Nominally 100 k Ω // 150-200pF
Terminations	Selectable 600 Ω \pm 1%; 1 Watt [+30 dBm] maximum power
CMRR	
80mV-2.5V ranges	\geq 70 dB, 50 Hz-20 kHz
8V-250V ranges	\geq 50 dB, 50 Hz-1 kHz
Input Related Crosstalk	\leq -120 dB or 1 μ V, whichever is greater
10 Hz-20 kHz	

Level Meter Related (both channels)

Measurement Range	10 mV-140 V [-38 dBu to + 45 dBu] for specified accuracy and flatness, useable to <100 μ V
Accuracy (1 kHz)	\pm 0.1 dB + 100 μ V
Flatness (1 kHz ref)	
20 Hz-20 kHz	\pm 0.05 dB
10 Hz-50 kHz	\pm 0.2 dB
50 kHz-120 kHz	\pm 0.50 dB (-3 dB BW typically >300 kHz)

Frequency Meter Related (both channels)

Measurement Range	10 Hz-200 kHz
Accuracy	\pm 0.01% [\pm 100 PPM]
Resolution	5 digits
Minimum Input	25 mV

Phase Measurement Related

Measurement Ranges	± 180 , $+90/-270$, or $-90/+270$ deg
Accuracy	
20 Hz-20 kHz	± 2.0 deg
10 kHz-50 kHz	± 5.0 deg
Resolution	0.1 deg
Minimum Input	25 mV, both inputs

Wideband Amplitude/Noise Function

Measurement Range	$< 1 \mu\text{V}$ -140 Vrms [-118 dBu to + 45 dBu]
Accuracy (1 kHz)	± 0.2 dB [± 2.3 %] unweighted
Flatness (1 kHz ref)	
20 Hz-20 kHz	± 0.05 dB
10 Hz-50 kHz	± 0.2 dB
50 kHz-120 kHz	± 0.5 dB (-3 dB BW typically > 300 kHz)
Bandwidth Limiting Filters	
LF -3 dB	< 10 Hz, 400 Hz $\pm 5\%$ (3-pole)
HF -3 dB	22 kHz $\pm 5\%$ (5-pole) ⁴ , 30 kHz $\pm 5\%$ (3-pole), 80 kHz $\pm 5\%$ (3-pole), or > 300 kHz
Weighting filters	ANSI-IEC "A" per IEC 179 CCIR-QPK per CCIR Rec 468 CCIR-ARM per Dolby Bulletin 19/4 CCIR-1k (rms, 0 dB at 1 kHz) CCIR-2k (rms, 0 dB at 2 kHz)
Optional Filters	up to 2 (Aux 1 and Aux 2)
Detection	RMS ($\tau = 60$ msec), AVG, QPk per CCIR Rec 468,
Residual Noise	
22 Hz-22 kHz BW	$\leq 1.5 \mu\text{V}$ [-114 dBu]
A-weighted	$\leq 1.0 \mu\text{V}$ [-118 dBu]
CCIR-QPk	$\leq 5.0 \mu\text{V}$ [-104 dBu]

Note 4 Combined with 22 Hz highpass per CCIR Rec 468.

Bandpass Amplitude Function

Tuning Range (f_0)	20 Hz to 120 kHz
Tuning Accuracy	$\pm 2\%$
Bandpass Response	Q=5 (2-pole)
Accuracy (at f_0)	± 0.3 dB, 20 Hz-120 kHz
Residual Noise	
10 Hz-5 kHz	≤ 0.25 μ V [-130 dBu]
5 kHz-20 kHz	≤ 0.5 μ V [-124 dBu]
20 kHz-200 kHz	≤ 1.5 μ V [-114 dBu]

THD+N / SINAD Function

Fundamental Range	10 Hz to 100 kHz, THD+N mode 400 Hz or 1 kHz, SINAD mode
Measurement Range	<0.001%-100%
Accuracy	± 1 dB, 20 Hz-120 kHz harmonics
Measurement Bandwidth	
LF -3 dB	<10, 22 or 400 Hz
HF -3 dB	22K, 30k, 80k, or >300 kHz; option filters are also functional
Residual THD+N ⁵	
25 Hz-20 kHz	$\leq (0.0025\% + 3.0 \mu\text{V})$, 80 kHz BW [-92 dB]
10 Hz-50 kHz	$\leq (0.010\% + 10 \mu\text{V})$, >300 kHz BW [-80 dB]
Minimum Input	25 mV for specified accuracy in AUTO TUNE mode, 800 μ V [-60 dBu] in other modes.
Nulling Time	Typically 2-3 seconds above 25 Hz, Increases in a "1/V" fashion for inputs below 25 mV [-30 dBu]

Note 5 System specification including contribution from generator. Generator residual THD may limit system performance below 25 Hz if output is >20.0 Vrms balanced, or 10.0 Vrms unbalanced.

Crosstalk Function

Frequency Range	10 Hz to 120 kHz
Measurement Range	-140 dB to 0 dB
Accuracy ⁶	±0.5 dB
Residual Crosstalk ⁶	≤-120 dB at 20 kHz, R _s = 600Ω
Minimum Input	25 mV for reference channel

SMPTE (DIN) IMD Function with option “P1-IMD”

Test Signal Compatibility	Any combination of 40-250 Hz (LF) and 3 kHz-20 kHz (HF) tones, mixed in any ratio from 0:1 to 8:1 (LF:HF)
IMD Measured	Amplitude modulation products of the HF tone. -3 dB measurement bandwidth is typically 20Hz-750Hz
Measurement Range	<0.0025%-20%
Accuracy	±1 dB per SMPTE RP-120-1983, DIN 45403
Residual IMD (V _{in} ≥200mV) ⁷	≤0.0025% [-92 dB], 60 + 7 kHz or 250 + 8 kHz
Minimum Input	100 mV

Ratio Function

Measurement Range	-80 dB to +100 dB, 0.01 dB resolution
Accuracy	±0.1 dB, 20 Hz-20 kHz
Minimum Input	
Mode 1	10 mV [-38 dBu], denominator signal 10 μV [-98 dBu], numerator signal
Mode 2	10 μV [-98 dBu], denominator signal 10 mV [-38 dBu], numerator signal

AC Mains Check Function

Measurement Range	0.85-1.10 of nominal setting
Voltage Accuracy	±1 %

Note 6 Uses the 1/3 octave bandpass filter to enhance the measured range in the presence of wideband noise. Alternate (interfering) channel input must be ≥5 mV.

Note 7 System specification including contribution from generator.

Gen Load Function

Measurement Range	<1 Ω to 20 k Ω
Accuracy	$\pm[5\% + 0.5\ \Omega]$ for readings <1 k Ω Degrades rapidly above 1 k Ω or with reactive loads
Frequency Range	20 Hz - 20 kHz
Test Voltage	200 mV default. Usable from 10 mV to generator maximum

Wow & Flutter Function

Test Signal Compatibility	2.80 kHz-3.35 kHz
Measurement Range	<0.005% to 3% (single range)
Accuracy (4 Hz)	$\pm(5\%$ of reading + 0.002%)
Detection Modes	IEC/DIN (quasi-peak per IEC-386), NAB (average), JIS (per JIS 5551)
Response Selections	
Weighted	4 Hz bandpass per IEC/DIN/NAB
Unweighted	0.5 Hz-200 Hz
Residual W+F	
Weighted	$\leq 0.005\%$
Unweighted	$\leq 0.01\%$
Minimum Input	25 mV
Settling Time	
IEC/DIN or NAB	Typically 3-6 seconds
JIS	Typically 15-20 seconds

DIGITAL SIGNAL GENERATOR**DIGITAL OUTPUT CHARACTERISTICS**

Output Formats	AES/EBU (per AES3-1992) SPDIF-EIAJ Optical (Toslink [®])
Sample Rates	28.8 kHz-52.8 kHz AES/EBU 57.6 kHz-105.6 kHz with 96 kHz option
Sample Rate Resolution	1/128 Hz (approx. 0.0078 Hz)
Sample Rate Accuracy	$\pm 0.002\%$ [± 20 PPM] using internal reference, lockable to external reference

Word Width	16 to 24 bits (even values)
Output impedance	
Balanced (XLR)	110Ω
Unbalanced (BNC)	75Ω approx.

Sine Wave

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 ks/sec)
Frequency Resolution	Sample Rate $\div 2^{23}$ (typically 0.006 Hz at 48 ks/sec)
Flatness	± 0.001 dB
Residual Distortion	$\leq 0.00001\%$ [-140 dB]

Square Wave

Frequency Range	10 Hz to 1/6 sample rate (7350 Hz at 44.1 ks/sec, 8000 Hz at 48 ks/sec)
Frequencies available	$f_s \div 4096$ to $f_s \div 6$, in even integer divisors
Even Harmonic Content	$\leq 0.00001\%$ [-140 dB]

SMPTE/DIN IMD Waveform with option "P1-IMD"

Upper Tone Frequency Range	Choice of 7 kHz or 8 kHz
Lower Tone Frequency Range	Choice of 50 Hz, 60 Hz, 70 Hz, or 250 Hz
Flatness	± 0.001 dB
Amplitude Ratio	4:1 (LF:HF)
Residual Distortion	$\leq 0.00001\%$ [-140 dB] at 4:1 ratio

Random Generator Waveform

Waveform	Compatible with BITTEST.AZ1 used with System One
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Dither (Sine, IMD, and Square waveforms)

Probability Distribution	Triangular or rectangular; independent for each channel
Spectral Distribution	Flat (white) or Shaped (+6 dB/oct, triangular only)
Amplitude	Automatically tracks word width or off

AES/EBU INTERFACE GENERATION

Interface Signal

Amplitude Range	
Balanced (XLR)	0-5.12 Vpp, $\pm(10\% + 80 \text{ mV})$ into 110Ω in 5 mV steps
Unbalanced (BNC)	0 to 1.28 Vpp, $\pm(8\% + 20 \text{ mV})$ into 75Ω in 1.25 mV steps
Channel Status Bits	English language decoded, Professional or consumer formats. CRCC implemented Time of Day not implemented Sample Count not implemented
User Bits	set to 0
Validity Flag	Selectable, set or cleared

AES/EBU Impairments

Induced Jitter	Sinewave
Jitter Freq Range	40 Hz to 38.8 kHz
Jitter Freq Accuracy	$\pm 0.0020\%$ [$\pm 20 \text{ PPM}$]
Jitter Amplitude	0-1.28 UI (pk), $\pm(10\% + 0.01 \text{ UI})$ in steps of 0.005 UI or better 1.3-12.75 UI (pk), $\pm 10\%$ in steps of 0.05 UI or better
Jitter Flatness	$\pm 1 \text{ dB}$ ref 500Hz, 50 Hz to 30 kHz
Residual Jitter, peak calibrated	(total generator/analyzer)
RMS response	$\leq 0.005 \text{ UI}$ (700 Hz-30 kHz BW),
Peak response	$\leq 0.015 \text{ UI}$ (700 Hz-30 kHz BW),
Spurious Jitter Products	
Jitter & Ref Delay Off	$\leq 0.0005 \text{ UI}$
Jitter On	$\leq -30 \text{ dB}$ below jitter signal

REFERENCE INPUT CHARACTERISTICS

Input Formats	AES/EBU (per AES 3-1992)
Input Sample Rates	28.8 kHz-52.8 kHz AES/EBU (must equal desired output rate)
Minimum Input Amplitude	200 mVpp
Input Impedance	Nominally 110Ω

Lock Range	$\pm 0.0025\%$ [± 25 PPM]
Output Delay from Reference	$-64/+63.5$ UI, $\pm(5\% + 0.5$ UI), in 0.125 UI steps

DIGITAL ANALYZER

DIGITAL INPUT CHARACTERISTICS

Input Formats (Automatically selected)	AES/EBU (per AES 3-1992) SPDIF-EIAJ Optical (Toslink [®])
Sample Rates	28.8 kHz-52.8 kHz AES/EBU
Word Width	16 to 24 bits (even values)
Input Impedance	
AES/EBU	110 Ω or ≥ 2.5 k Ω
SPDIF-EIAJ	75 Ω or ≥ 3 k Ω

EMBEDDED AUDIO MEASUREMENTS

Wideband Level/Amplitude

Range	0 dBFS to -140 dBFS
Frequency Range	<10 Hz-22.0 kHz at 48 ks/sec
Accuracy	± 0.01 dB, ≥ -90 dBFS
Flatness	± 0.01 dB, 15 Hz-22 kHz, with <10 Hz high-pass filter selection
High pass Filters	22 Hz, 2-pole Butterworth 400 Hz, 2-pole Butterworth
Low pass Filters	15 kHz, 6-pole elliptic low-pass 20 kHz, 6-pole elliptic low-pass
Weighting Filters	ANSI-IEC "A" weighting, Type 0 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17
Residual Noise	-140 dBFS unweighted -142 dBFS A-weighted -134 dBFS CCIR RMS -130 dBFS CCIR QPk -139 dBFS 20 kHz LP -140 dBFS 15 kHz LP

Narrow Band Amplitude

Frequency Range	0.04% to 40% of sample rate (10 Hz-19.2 kHz at 48.0 ks/sec)
Filter Shape	10-pole, Q=19 (BW = 5.3% of f_0)
Residual Noise	≤ -150 dBFS

THD+N Measurements

Fundamental Range	0.02% to 45% of sample rate (10 Hz-22.0 kHz at 48.0 ks/sec)
Residual THD+N	≤ -138 dBFS
High pass Filters	22 Hz, 2-pole Butterworth 400 Hz, 2-pole Butterworth
Low pass Filters	15 kHz, 6-pole elliptic low-pass 20 kHz, 6-pole elliptic low-pass
Weighting Filters	ANSI-IEC "A" weighting, Type 0 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17

SMPTE (DIN) IMD Function with option "P1-IMD"

Test Signal Compatibility	Any combination of 40-250 Hz (LF) and 3 kHz-20 kHz (HF) tones, mixed in any ratio from 1:1 to 4:1 (LF:HF)
IMD Measured	Amplitude modulation products of the HF tone. -3 dB measurement bandwidth is typically 20 Hz-750 Hz
Measurement Range	$<0.0001\%$ -10%
Accuracy	± 1 dB per SMPTE RP-120-1983, DIN 45403
Residual IMD (0 dBFS)	$\leq 0.0001\%$ [-120 dB], 60 + 7 kHz or 250 + 8 kHz

Frequency Measurements

Range	5 Hz to 47% of sample rate (5 Hz-21.0 kHz at 44.1 ks/sec) (5 Hz-23.0 kHz at 48.0 ks/sec)
Accuracy	$\pm 0.01\%$ of reading or 0.0001% of sample rate, whichever is greater
Resolution	0.003% of reading or 0.0001% of sample rate, whichever is greater

Phase Measurement Related

Measurement Ranges	± 180 , $+90/-270$, or $-90/+270$ deg
Accuracy	± 2.0 deg (20 Hz-20 kHz)
Resolution	0.1 deg

BITTEST measurement

Measurement	Compatible with Random Mode of System One BITTEST.AZ1
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DIGITAL INTERFACE MEASUREMENTS

AES/EBU Impairments, real time displays

Input Sample Rate	$\pm 0.002\%$ [± 20 PPM] internal ref, $\pm 0.0001\%$ [± 1 PPM] external ref
Output to Input or Reference Input to Input Delay	Measures status propagation from the AES/EBU output to the input. Range is 0-192 samples (frames), resolution ± 60 ns.
AES/EBU Input Voltage	
Balanced	200 mV to 10.24 Vpp, $\pm(5\% + 50$ mV)
Unbalanced	100 mV to 2.56 Vpp, $\pm(5\% + 12$ mV)
Jitter Amplitude (500 Hz)	(peak sinewave calibrated) 0-5 UI, $\pm(10\% + 0.04$ UI)
Jitter Flatness	± 1.5 dB, 100 Hz-22 kHz (50 Hz HP selection, RMS detection, 48 kHz sample rate)
Residual Jitter, peak calibrated	(analyzer only)
RMS response	≤ 0.005 UI (700 Hz-30 kHz BW)
Peak response	≤ 0.015 UI (700 Hz-30 kHz BW)
Spurious Jitter Products	≤ 0.001 UI (>1.2 kHz) or <-40 dB below jitter signal
Channel Status Bits	English language decoded (Professional or Consumer)
User Bits	Not displayed
Validity Flag	Displayed for selected 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)
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AUXILIARY SIGNALS

Generator Auxiliary Signals

Analog Sync Output	LSTTL compatible signal that is intended to be used as a trigger for stable oscilloscope displays.
Digital Sync Output:	(600mVpp nominal squarewave)
Selectable from:	
Transmit Frame Sync	Squarewave at the programmed internal sample rate
Receive Frame Sync	Squarewave at the rate of the received AES/EBU signal
Xmit Clock	Squarewave at 256x the programmed internal sample rate
Rcvr Clock	Squarewave at 256x the received sample rate
Jitter Generator	Squarewave at Jitter Frequency
Digital Signal Generator	Squarewave at digital generator frequency for scope trigger
AES Interface Error	Logic low on error detection

Analyzer Signal Monitors

Input Monitor	Buffered version of the analog or digital input signal. Amplitude is typically 0-2.83 Vpp.
Reading	Buffered version of the analog or digital analyzer output signal after all filtering and gain stages. Amplitude is typically 0-2.83 Vpp.

AUDIO MONITOR

Power Output	Typically 1 Watt
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GENERAL / ENVIRONMENTAL	
Power Requirements	100/120/230/240 Vac (-10%/+6%), 50-60 Hz, 60 VA max
Temperature Range	
Operating	0°C to +40°C
Storage	-20°C to +60°C
Humidity	80% RH to at least +40°C (non-condensing)
Altitude	Up to 2000 meters
EMC ⁸	Complies with FCC subpart J - Class B Complies with 89/336/EEC, 92/31/EEC, and 93/68/EEC. EN 50081-1 (1992) Emissions Class B EN 50082-1 (1992) Immunity
Safety	Complies with 73/23/EEC and 93/68/EEC EN61010-1 (1993) - IEC 1010-1 (1990) + Amendment 1 (1992) + Amendment 2 (1995) Installation Category II - Pollution Degree 2
Dimensions	16.5 x 6.0 x 13.6 inches [41.9 x 15.2 x 34.5 cm]
Weight	Approximately 20 lbs [9.1 kg]

Available from:



Measurably better value

Thurlby Thandar Instruments Ltd. Glebe Road, Huntingdon, Cambs. PE29 7DR U.K.
Tel: 01480 412451, Fax: 01480 450409, e-mail: sales@tti-test.com
 Web: www.tti-test.com or www.tti.co.uk

Note 8 *Emission and Immunity levels are influenced by the shielding performance of the connecting cables. The shielding performance of the cable will depend on the internal design of the cable, connector quality, and the assembly methods used. EMC compliance was evaluated using Audio Precision XLR type cables, part number CAB-AES.*