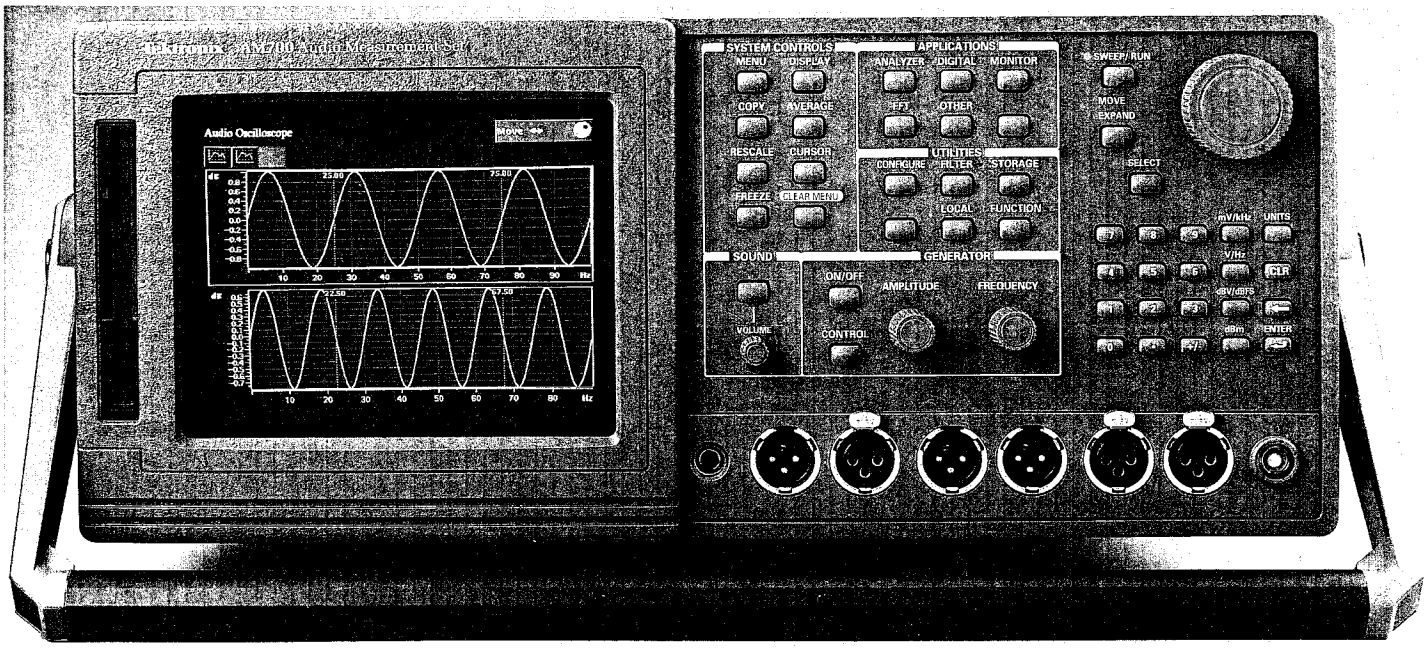
AM700 Mixed-Signal Audio Measurement Set



CAPABILITIES

- Two Channel FFT
- Graphic Plotting
- Noise Measurements
- Multitone Measurements
- Harmonic Analysis
- Distortion Analysis
- Digital Audio Analysis
- True Stereo Analyzer
- Analog Signal Generator
- Digital Signal Generator
- Graphical Pass/Fail Limits
- Min/Max Hold
- Loudspeaker
- Headphone Output
- Flexible Triggers
- Digital Audio Genlock
- GPIB Remote Control
- Hard Copy Output

The AM700 is an easy-to-use, high performance audio analyzer. It combines the capability to make conventional electronic audio measurements with more advanced measurements designed for emerging audio technologies.

The AM700 accepts balanced and unbalanced analog signals as well as AES/EBU, SPDIF and optical digital signals. Once acquired, powerful signal processing software performs filtering, analysis and calculations of test results.

Measurement capabilities include FFT, Graphical Plotting, Monitor, and Noise and Level metering.

An advanced suite of measurements permits users to examine or measure important digital audio interface parameters including eye diagram analysis, timing measurements, data format analysis and jitter measurements. The AM700's unique reference capability permits the instrument to generate or measure digital audio signals while being synchronized with a house digital reference.

The AM700 has the capability to generate test signals in both analog and digital domains. Internal analog and digital audio generators operate in "true stereo" fashion providing independent signal generating capability for each channel. Full support is provided for all conventional test signal needs.

The AM700's powerful measurement capabilities do not come at the expense of ease of use. Operation is controlled by proven, simple combinations of hardkeys, softkeys or knob motions.

The AM700 can be operated manually for R & D and service applications. Convenience features for manual operation include touch screen based controls and menus, intelligent cursors, and zoom and pan display capability. Test results may be saved on floppy disc or printed to external printers.

Automatic operation can be programmed through the AM700's keystroke learning feature. Factory test and other manufacturing applications can employ the pass/fail limits capability, automatic test result reporting and IEEE-488 remote control capability.

ANALYZER CAPABILITIES

Fast Fourier Transform Analyzer - Using any combination of analog and digital inputs the FFT analyzer produces displays of frequency domain data much like those of a Spectrum Analyzer. Signals from DC to 80 kHz are acquired with an FFT record length of 1024 bytes and displayed with a bit width resolution of 0.781 Hz (minimum span) to 156.3 Hz (maximum span). The Span (bandwidth of the FFT display) may be Zoomed (expanded or contracted horizontally) and Panned (scrolled left or right through the display). Amplitude range can be either fixed ranges or autoranging on the input signal. Users can make the optimal choice depending on the dynamic range of the signal of interest.

FFT Analyzer can display two channels simultaneously. These displays can either be on separate frequency and amplitude axes or overlaid onto the same frequency and amplitude axis. Display update rate (at full span) exceeds 10 updates per second. From 16 to 428 frequency bins are displayed depending on the amount of Zooming.

FFT Analyzer mode provides two cursors useful for marking and measuring frequency elements. Several cursor modes are supported. Several types of Averaging processes are supported. FFT Analyzer supports graphical Pass/Fail test limits providing for automatic testing in the frequency domain. Several WINDOW algorithms are supported. These are: Hann, Kaiser-Bessel, Blackman-Harris, Flattop, Uniform, and Saramaki-Rajan (a Tektronix developed window for FFT analysis). In addition, signal weighting filters, including A and C weights, may be applied to the FFT results.

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Special display modes including Spectrogram, Peak, Average, and MIN & MAX Hold are supported.

Multitone Analyzer - The Multitone Analyzer uses special test signals to measure a wide variety of audio system parameters with a burst of test signal as brief as one second or less. Multitone test signals employ mixtures of tones selected so that individual elements and their respective harmonic and intermodulation products do not coincide in the frequency domain. Differences between the known test signals and the acquired response from the system under test can be rapidly analyzed to determine frequency response, distortion and noise, and channel separation, etc. Multitone Measurements may be performed on any combination of analog or digital input signals.

Multitone Analyzer has a dictionary of recognized multitone signals. The dictionary contains standard multitone signals found in other Tektronix audio measurement products as well as user defined multitone signals. In addition, the Multitone Analyzer can "learn" to recognize new signals by simply acquiring a brief sample of the new signal. Thus, existing multitone signals can easily be added to the recognition dictionary.

Audio Analyzer - Using any combination of analog or digital input signals, the Audio Analyzer produces graphs of characteristics versus frequency, amplitude, or time. Characteristics include level, phase, distortion, IMD, crosstalk, etc. As many as four different graphs can be produced simultaneously. The Audio Analyzer automatically detects the beginning and end of sweep signals and signal sequences.

Multiple plots may be overlaid on any graph to compare to previous measurements or to group like measurements. Special analysis modes include Normal mode and Regulation Mode.

Audio Scope - Two channels of digitizing oscilloscope-like display of the selected input signals are produced by this application. Display formats can be either X-Y or amplitude versus time. Conventional oscilloscope controls for channel selection, time-base selection, and triggering are emulated. Zooming and cursor capabilities are included.

Digital Interface Tester - This analyzer application permits extensive evaluation of the electrical and data characteristics of industry standard digital audio interfaces including AES/EBU, SPDIF (also known as "consumer"), and optical consumer.

Multiple displays are supported.

The Bit Activity Display provides a graphical display of the statistical activity of all subframe bits. This application permits users to determine the following characteristics of a digital audio signal at a glance: Parity, Validity, Channel Status and User Bit states, digital audio sample length, and the presence of stuck bits.

The Channel Status Block Display permits users to examine the contents of the Channel Status blocks in either raw binary, decoded (English language), or hexadecimal forms. From this display sources of interface problems caused by data format or content can be uncovered. The appropriate decoding format (from AES/EBU standards or consumer standards) is selected automatically.

User Data Block Display permits users to examine the content of the user data channel in raw binary form.

Eye Diagram Displays provide straight forward indications of the "health" of a digital audio interface. Jitter, rise time, and interfering signal problems are all quite apparent in the Eye Diagram format.

Jitter Spectrum provides a frequency domain display of the jitter components giving an indication of possible sources of jitter such as power-line hum or switching power supply ripple.

Noise Meter - This measurement emulates a traditional audio noise meter. Its display is two analog meters (for L and R) with digital readouts. Detection methods include Quasi-peak, Average, and RMS with a wide selection of Weighting choices.

ANALOG GENERATOR CAPABILITIES

Channel Independence - The output signal on each channel is independently specified for "true stereo" operation up to 24 kHz in high resolution mode. It is possible to produce different types of signals on each channel. Channel A, for example, can produce a sine-wave signal while Channel B is producing a frequency sweep. Alternately, one channel can sweep amplitude while the other sweeps frequency. Of course, either channel may be turned off and identical signals may be generated on both channels. In high bandwidth mode, the generator produces monaural output on two channels up to 80 kHz.

Output Signals - Many types of output signals can be produced including the familiar Sine, Tone Burst, SMPTE/DIN and CCIF IMD test tones, Polarity test signals, Amplitude and Frequency Sweep signals, and Shaped Noise signal (White and Pink). Other signals include Multitone signals, Sequences of signals, Arbitrary Waveforms, and Periodic Chirp signals may also be produced.

Signal Postprocessing - Certain output signals may be modified. Emphasis mode permits the user to apply industry-standard frequency dependent amplitude modulation processing to an output signal. Watchdog mode prevents an output signal from inadvertently exceeding certain user-defined limits.

DIGITAL GENERATOR CAPABILITIES

Channel Independence - The Digital Generator shares the same characteristic as the Analog Generator, achieving "true stereo" operation. The Digital Generator always drives the front panel digital, rear panel optical, and rear panel unbalanced outputs with the same signals.

Output Signals - Within the constraints imposed by the Digital Sample Rate range (27 to 55 kilosamples per second), the Digital Generator can produce all of the signals described above for the Analog Generator. Digital audio sample length can be user-defined for 0 to 24 bits.

Postprocessing - Several different types of processing are possible for the digital output signal. A phase offset can be imposed between the output signals of the Digital Generator and the Digital Audio Reference input and output. The Digital Generator can simulate the output signal attenuation effects of long cables. Clock jitter can be added to the output signal to simulate real-world system jitter effects.

Channel Status, User Data, Validity, and Parity Bits - The VUCP bits of each subframe can be controlled by the user. Therefore, the contents of the Channel Status and User Data blocks can be varied independently of the companion subframe.

Synchronization - The Digital Generator can select the clock used in the Analog Analyzer section of the instrument as its reference. In doing so, a constant sample relationship between the two modules is established. Alternately, the generator can use the clock present on the Digital Audio Reference Input or Output as its reference. By doing so, a constant sample relationship between the Digital Generator and an external device is also possible.

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FRONT PANEL ANALOG INPUT

Connector XLR, conforms with AES14-1991
Signal Format Balanced, differential AC coupled

	MIN	TYP	MAX	UNITS	COMMENTS
Input Impedance Range (user selectable)					
600Ω	594	600	606	Ω	
150Ω	148.5	150	151.5	Ω	
200kΩ	199.8	200	200.2	kΩ	
Input Capacitance					
Per side		150		pF	
Maximum Input Voltage Range					
Input Z = 200kΩ			176	V (dc + ac peak)	
Input Z = 600Ω			24.5	Vpeak	Approximately 17.5 Vrms sinusoidal (+27 dBm in 600Ω)
Input Z = 150Ω			24.5	Vpeak	Approximately 17.5 Vrms sinusoidal (+33 dBm in 150Ω)
Full Scale Input Ranges* (selectable in 6 dB steps)	–22 0.0625		+44 125	dBu Vrms	
Crosstalk 20 Hz to 20 kHz, unused input' terminated in 600Ω		–80		dB	Measured in FFT Analyzer
Channel Separation 1 kHz, 600Ω termination on					
both channels	+80			dB	
20 Hz to 20 kHz @ 8 dBm FS		≥+80		dB	
Common-Mode Rejection Ratio (@ +8 dBu FS)					
50 to 60 Hz		80		dB	
1 kHz		80		dB	
10 kHz		70		dB	
20 kHz		70		dB	

***Full Scale Ranges are +44 dBu, +38 dBu, +32 dBu, +26 dBu, +20 dBu, +14 dBu, +8 dBu, +2 dBu, –4 dBu, –10 dBu, –16 dBu, and –22 dBu. The +8 dBu range has unity gain.**

HIGH RESOLUTION ADC MODE

	MIN	TYP	MAX	UNITS	COMMENTS
Input Bandwidth (limited by digital filter)	10		24 k	Hz	
ADC Sampling Frequency (decimated to 48 kHz)		6.144		MHz	Two channels, 64 times oversampling on each
Residual Noise Floor					
22 kHz measurement BW		1.4	2	µVrms	
Amplitude Measurements					
Accuracy					
120 Hz @ +8dBu FS			± 0.1	dB	
FS at other ranges		± 0.15		dB	
Minimum Input for ±1 dB Accuracy		1		mV	
Flatness 10 Hz to 20 kHz					
With respect to 120 Hz @ +8 dBu FS)		±0.05	± 0.1	dB	
With respect to 120 Hz at other FS ranges			±0.15	dB	
Interchannel Amplitude Accuracy					
120 Hz @ +8dBu FS		± 0.05	± 0.2	dB	
Interchannel Phase Difference					
@100 Hz		±1		deg.	
@20 kHz		±1		deg.	
Residual Harmonic Distortion + Noise					
1 kHz @ 8dBu FS			0.003		
1 kHz @ 8 dBu FS with Notch Filter		0.0003	0.0005	%	
20 Hz to 5 kHz @ 8 dBu			0.003	%	
20 Hz to 5 kHz; 8 dBu FS with Notch Filter			0.001	%	Noise limited

Note: Full Scale Ranges are +44 dBu, +38 dBu, +32 dBu, +26 dBu, +20 dBu, +14 dBu, +8 dBu, +2 dBu, –4 dBu, –10 dBu, –16 dBu, and –22 dBu. The +8 dBu range has unity gain.

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HIGH BANDWIDTH ADC MODE

	MIN	TYP	MAX	UNITS	COMMENTS
Input Bandwidth	10		80 k	Hz	Limited by 11-pole elliptic filter
ADC Sampling Frequency			192 k	Hz	
Residual Noise Floor					
Measurement BW = 22 kHz		2		µVrms	
Amplitude Measurements					
Accuracy					
120 Hz @ 8 dBu FS			± 0.1	dB	
FS at other ranges		± 0.15		dB	
Flatness with respect to 120 Hz @ 8 dBu FS					
10 Hz to 20 kHz,			± 0.1	dB	
20 kHz to 70 kHz			± 0.2	dB	
70 kHz to 80 kHz			± 0.5	dB	
Interchannel Amplitude Accuracy					
120 Hz @ +8 dBu FS		± 0.05	± 0.2	dB	
Interchannel Phase Difference					
@ 1 kHz			±1	deg.	
Residual Harmonic Distortion + Noise					
20 Hz to 20 kHz at 8dBu FS			0.01	%	
20 Hz to 20 kHz at 8 dBu FS with Notch Filter			0.003	%	Notch Filter use is limited to ≤ 20 kHz)

Note: Full Scale Ranges are +44 dBu, +38 dBu, +32 dBu, +26 dBu, +20 dBu, +14 dBu, +8 dBu, +2 dBu, –4 dBu, –10 dBu, –16 dBu, and –22 dBu. The +8 dBu range has unity gain.

REAR PANEL DIGITAL AUDIO REFERENCE INPUT CHARACTERISTICS

Connector XLR conforming to AES3-1992 and AES11-1992
Signal Format Balanced

	MIN	TYP	MAX	UNITS
Input Voltage Range				
Eye opening	0.02		10	Vp-p
Input Impedance				
Balanced	104.5	110	115.5	Ω
Digital Audio Sample Rate				
Lockup Range	27.2	48	55.2	kHz

REAR PANEL DIGITAL AUDIO REFERENCE OUTPUT CHARACTERISTICS

Connector XLR conforming to AES3-1992 and AES11-1992
Signal Format Balanced, audio bits = "0", V=U="0", P = even
Status Block Byte 4, bit 0 ="1" (Grade 2 reference), byte 23 checksum
ClockGenerator can lock to analyzer clock for constant phase

	MIN	TYP	MAX	UNITS
Output Voltage				
Fixed @ 5 Volts		5		Vp-p
Output Impedance				
Balanced	104.5	110	115.5	Ω
Digital Audio Sample Rate Generation				
Output Range	27.2	48	55.2	kHz
Output Accuracy			±10	ppm

REAR PANEL UNBALANCED DIGITAL AUDIO INPUT CHARACTERISTICS

Connector BNC, otherwise conforms electrically to EIAJ and IEC 958
Signal Format Unbalanced, 24 data bits, 4 preamble bits, C, U, V, and P bits.

	MIN	TYP	MAX	UNITS
AES/EBU Input Voltage Levels				
Unbalanced	0.05		2	Vp-p
Input Impedance				
(0.1 to 6 MHz)	71.25	75	78.75	Ω

REAR PANEL OPTICAL DIGITAL AUDIO INPUT CHARACTERISTICS

Connector FO5 snap-in type, 10 meter capability using APF (980/1000 micro-meter) optical fiber.
Signal Format Conforms to TOSLINK™ parameters.

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FRONT PANEL DIGITAL AUDIO INPUT CHARACTERISTICS

Connector XLR, conforms to AES3-1992 and EBU3250-E
Signal Format Balanced, 24 data bits, 4 preamble bits, C, U, V, and P bits
Input Equalization Corrects for up to 200 meters of typical cable (Selectable On/Off)

	MIN	TYP	MAX	UNITS
Input Voltage Range	0.2		10	Vp-p
Input Impedance				
(0.1 to 6 MHz)	104.5	110	115.5	Ω

DIGITAL AUDIO INPUTS (Input signal from XLR, BNC, or optical connector)

	MIN	TYP	MAX	UNITS
Digital Audio Sample Rate				
Lockup Range	27.2	48	55.2	kHz
Measurement Accuracy			±10	ppm
Digital Phase Difference				
Measurement Range			±50%	frame
Measurement Accuracy			±1%	frame

FRONT PANEL DIGITAL AUDIO OUTPUT CHARACTERISTICS

Connector XLR, conforms to AES3-1992
Signal Format Balanced, 24 data bits, 4 preamble bits, C, U, V, and P bits
Cable Simulation Simulates 100 meters of typical high quality digital audio cable (Selectable On/Off)

	MIN	TYP	MAX	UNITS
Output Voltage Range				
Into 110Ω	0.2		10	Vp-p
Input Impedance				
(0.1 to 6 MHz)	104.5	110	115.5	Ω

DIGITAL AUDIO OUTPUTS (Output signal from XLR, BNC, and optical connector)

	MIN	TYP	MAX	UNITS
Digital Audio Sample Rate Generation				
Output Range	27.2	48	55.2	kHz
Output Accuracy			±10	ppm
Digital Phase Difference Generation				
Output Range			±50%	frame
Generator Accuracy			±1%	frame

FRONT PANEL ANALOG GENERATOR OUTPUTS

Connectors ChA and ChB, XLR, conform to AES14-1991
Signal Format Balanced/Unbalanced switchable
Floating Output Switchable

	MIN	TYP	MAX	UNITS
Output Impedance (user selectable)				
600Ω nominal	594	600	608	Ω
150Ω nominal	148.5	150	153.5	Ω
10Ω nominal	9.5	10	10.5	Ω
Maximum Output Amplitude (balanced)				
10Ω source, 20 kHz max, ≥2 kΩ load			+30	dBu
150Ω source, 20 kHz max, 150Ω load			+30	dBm
600Ω source, 20 kHz max, 600Ω load			+24	dBm
Output Amplitude (unbalanced)				
10Ω source, 20 kHz max, ≥2 kΩ load			+24	dBu
150Ω source, 20 kHz max, 150Ω load			+24	dBm
600Ω source, 20 kHz max, 600Ω load			+18	dBm
Output Float Capability				
Range (from chassis ground)	–25		25	V
Resistance to ground		1		kΩ
Capacitance to ground		1000		pF

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HIGH RESOLUTION MODE

	MIN	TYP	MAX	UNITS
Amplitude Accuracy				
120 Hz @ +14 dBu			±0.1	dB
Amplitude Flatness				
Relative to 120 Hz @ +14 dBu				
10 Hz to 10 kHz			±0.1	dB
10 kHz to 20 kHz			±0.2	dB
Interchannel Amplitude Accuracy				
1 kHz @ +14 dBu		±0.05	±0.2	dB
Output Frequency				
Range	10		24 k	Hz
Resolution			0.01	Hz
Frequency Accuracy				
1 kHz		±0.01	±0.02	%
Interchannel Phase Difference				
@ 20 kHz		1	2	deg.
Residual Harmonic Distortion + Noise				
1 kHz @ +14 dBu; measurement BW = 22 kHz			0.0015	%FS
Crosstalk				
Measured in FFT analyzer			–80	dB
Channel Separation				
Measurement BW = 22 kHz	+80			dB
Noise Floor				
Measurement BW = 22 kHz		2		µVrms

HIGH BANDWIDTH MODE

	MIN	TYP	MAX	UNITS
Amplitude Accuracy				
120 Hz @ +14 dBu			±0.1	dB
Amplitude Flatness				
(relative to 120 Hz @ 14 dBu)				
10 Hz to 20 kHz			±0.2	dB
20 kHz to 70 kHz			±0.3	dB
70 kHz to 80 kHz			±0.5	dB
Interchannel Amplitude Accuracy				
@ 1 kHz		±0.05	±0.2	dB
Output Frequency				
Range	10		80 k	Hz
Resolution			0.01	Hz
Frequency Accuracy				
@ 1 kHz		±0.01	±0.02	%
Interchannel Phase Difference				
@ 1 kHz			±1	deg.
@ 20 kHz			±2	deg.
Crosstalk				
Measured in FFT analyzer			–70	dB
Channel Separation				
Measurement BW = 80 kHz	+70			dB