Audio Test and Measurement System — *Unmatched Performance*

Audio precision

**New AP2700 v3.30 control software**

- **USB connectivity to PC**
- **Native Windows Vista support**
- **Improved user profile management**

# 2700 Series

## Dual Domain Audio Analyzer

# High-Performance Testing with the Audio Precision 2700 Series

*The 2700 Series is the flagship model of Audio Precision's award-winning PC-controlled audio analyzers, long the recognized worldwide standard for the design and test of audio equipment. The full-featured SYS-2722 provides the unmatched distortion and noise performance required to test the latest advances in converter technology, combined with 192k digital input and output capabilities.*

*The 2722's true dual domain architecture enables uncompromised measurement of both analog and digital signals: the hardware generator and analyzer specifications surpass those of any digital configuration, while digital analysis techniques offer a wide array of precise, high-speed measurement techniques for either domain. Cross-domain work can be accomplished using the best of both worlds.*

### *The 2700 Series*

- **The unparalleled precision of a dedicated hardware instrument.**
- **Fast instrument operation and powerful analysis under sophisticated control software.**
- **Programmatic control for high-speed automation.**
- **Serial digital interface testing.**
- **Flexible configuration options.**

* **A family of auxiliary instruments for specialized testing.**

* **AES3, IEC60958 (SPDIF) and PSIA input and output sample rates at 192 kHz.**

*The 2700 Series. Proven, reliable, high-performance technology from Audio Precision, the industry's preeminent audio test and measurement company.*

## Unparalleled Precision

**Low Distortion**

*Analog system 1 kHz THD+N, 20 kHz BW* ≤ **–112 dB**
*(Typical worst case harmonic* < **–130 dB)**

*Digital generator distortion/spurious products* ≤ **–160 dB**

**High Bandwidth**

*Analog signal generation to* **204 kHz**

*Analog measurements to* **500 kHz**

*Analysis by FFTs and Multitone to* **120 kHz**

**Low Noise**

*Analog analyzer 22 Hz–22 kHz BW* ≤ **–118 dBu**

*Analog analyzer A-weighted* ≤ **–124 dBu**

**Flat Response**

*Analog system 20 Hz–20 kHz*

*Typically* ± **0.003 dB**

**Low Crosstalk**

*Analog inputs 20 Hz–20 kHz* ≤ **–140 dB**

*Analog output 20 Hz–20 kHz* ≤ **–120 dB**

**Low Jitter**

*700 Hz–100 kHz BW* ≤ **600 ps**

*50 Hz–100 kHz BW* ≤ **1.0 ns**

**FFT Acquisitions**

*Up to* **4 M Samples** *(87 s @ 48 kHz $F_s$)*

## Accredited calibration to ISO 17025 standard

Every 2700 Series is calibrated before it leaves the factory, so you know your measurements are accurate and your instrument meets the most stringent Quality System Requirements in the industry.

Audio Precision is accredited by A2LA, the American Association for Laboratory Accreditation, to perform calibrations at our Calibration Lab in Beaverton, Oregon.

*2700 Series dual domain model SYS-2722 192k*

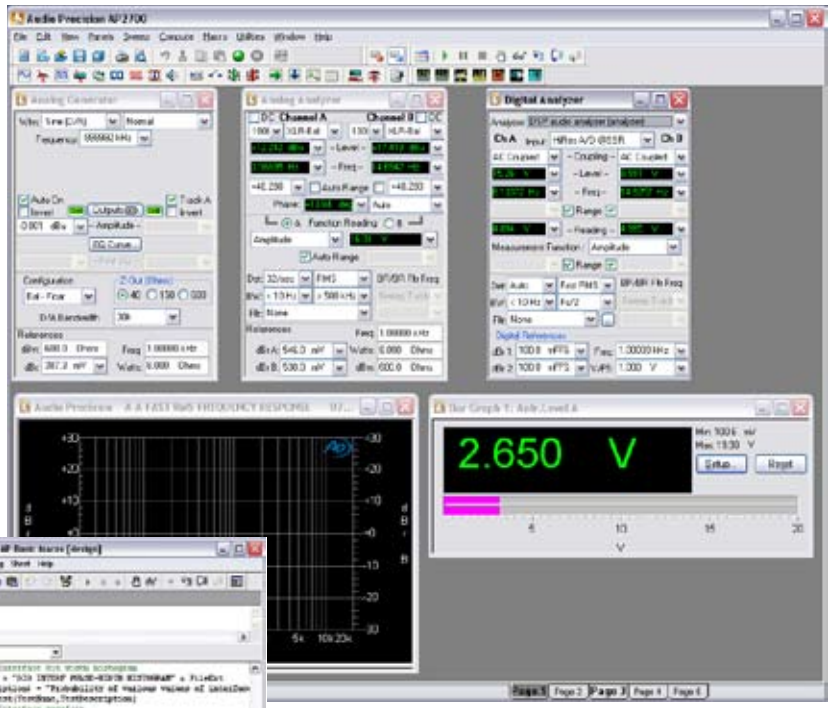
## PC Control and Programmability

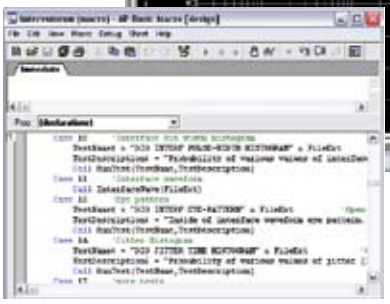
*AP2700 is the control software for the 2700 Series instruments. Running on the controlling PC, AP2700 is a powerful and sophisticated real-time interface, with hardware and software system modules and functions controlled using settings on virtual panels, and measurement results displayed in virtual meter and graph readings. Both settings and readings can be swept and plotted on X-Y graphs, modified by various algorithms, compared against limits or analyzed by DSP methods.*

*AP2700 is flexible and configurable, addressing a wide range of uses from benchtop R&D or maintenance engineering to automated production testing.*

*Test setups, measurement data, automation scripts, graphs and other test components are saved on the PC. These files can be emailed or exchanged between co-workers at any location to duplicate test setups, review test results or publish reports. Graphs and numerical data can be pasted into spreadsheets, word processors or graphics editors, and can be exported in a number of different formats.*

*AP2700 supports Microsoft Windows® Vista and Windows XP.*



*Create and edit macros and verify your code using the Step and Trace mode in the Macro Editor.*

- **GPIB versions of each 2700 Series model are available, providing an IEEE-488 interface for compatibility with third-party automated testing instruments.**

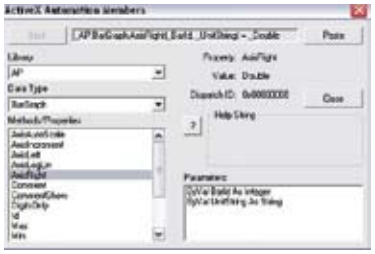
- **The entire testing process can be automated for repeatability and speed by programmatically controlling the 2700 Series instrument using AP Basic, the Audio Precision programming language included with the 2700 Series. Every setting, reading and setup parameter in the 2700 Series control software is available in the AP Basic command set. AP Basic supports complex, branched testing programs as well as simple step-by-step macros.**


- **You can create, edit and run AP Basic macros without ever leaving the control software. The Macro Editor provides complete editing, debugging and syntax help.**

- **AP Basic works with the control software using ActiveX Automation. The entire command structure is accessible to Microsoft Visual Basic®, enabling you to integrate your 2700 Series instrument with a wide variety of applications and equipment.**

- **Learn Mode is a "macro recorder" that provides a fast and convenient way to generate automated test macros, even if you have little programming experience.**

- **A Dialog Editor provides an easy way to design a custom user interface "front-end" for your automation macros. Drag-and-drop in the Dialog Editor, and the underlying code is written into the Macro Editor script.**



*Use the Object Browser to easily integrate commands and correct syntax while working in the Macro Editor.*

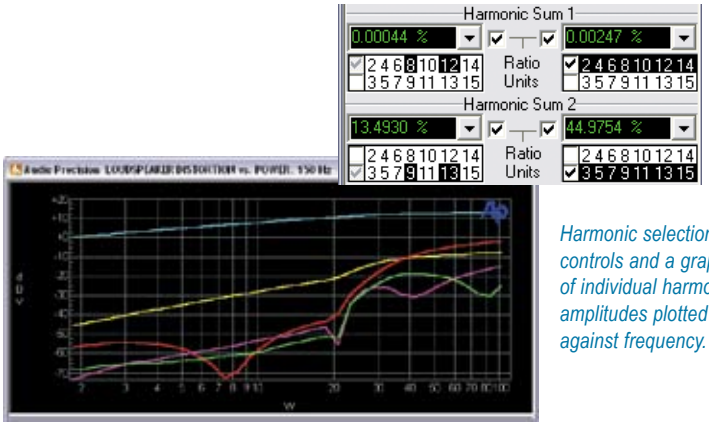

*Design professional user interface panels within your macro using the Dialog Editor.*

## Unparalleled Speed

*The 2700 Series offers an array of powerful, time-saving analysis tools to speed your testing procedures.*

***Multitone*** *Multitone testing techniques can provide response, distortion, noise, crosstalk and phase measurements — all from a single sub-second acquisition. You can address a wide variety of high-speed testing applications by choosing a standard stimulus waveform, or by making your own using the multitone creation utility. In addition to great speed, multitone analysis brings other advantages: a stimulus signal, for example, that is a rich mix of frequencies, levels and phase relationships that more closely resembles program material than conventional single stimulus tones; and the unique ability to measure noise or very low distortion products in the presence of signal.*

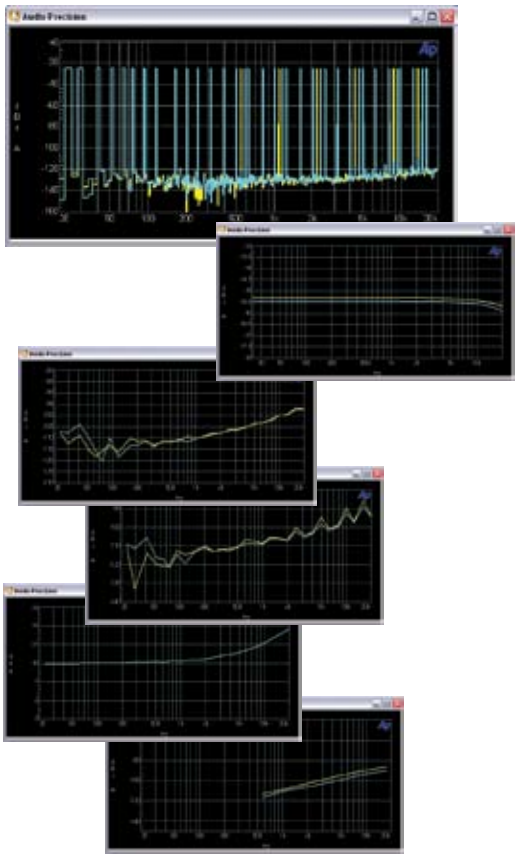
***Fast detection*** *The DSP-implemented Fast RMS Detector speeds sine wave sweeps by making measurements in as little as one cycle of the sine wave. This can provide an improvement in testing speed of an order of magnitude compared to normal RMS detector techniques.*




*Harmonic selection controls and a graph of individual harmonic amplitudes plotted against frequency.*

***Proprietary Harmonic Distortion Analyzer*** *An FFT-implemented dual-channel Harmonic Distortion Analyzer can simultaneously measure the individual amplitudes of a fundamental frequency and up to four harmonic products, selectable from the 2nd to the 15th harmonic. Sweeps using this analysis tool can rapidly characterize frequency or amplitude dependent distortion mechanisms.*

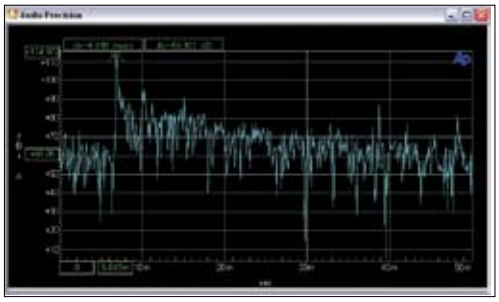

***Fast data settling*** *A sophisticated data settling algorithm enables you to optimize the inherent trade-off between testing speed and measurement accuracy in sweep tests. Individual settling parameters are stored for every measurement available in the instrument.*



*The graph at the top shows a spectrum display of a multitone stimulus. The next graphs are examples of five dual-channel parameters plotted against frequency, all produced from a single multitone stimulus lasting less than one second.*

***MLS analysis*** *Quasi-anechoic measurements of transducers and acoustic spaces can be performed using MLS (Maximum Length Sequence) signals and analysis to produce impulse, frequency and phase response graphs in less than one second.*

***Hardware and software filters*** *Make noise measurements to virtually any international standard using our extensive collection of weighting and band-limiting filters. Use optional Audio Precision hardware filters (for the Analog Analyzer) or Audio Precision software filters (for the DSP Audio Analyzer); or make your own user-downloadable software filters using the Filter Creation Utility.*



*Loudspeaker impulse response graph, showing a 6.6 ms delay before the impulse peak.*

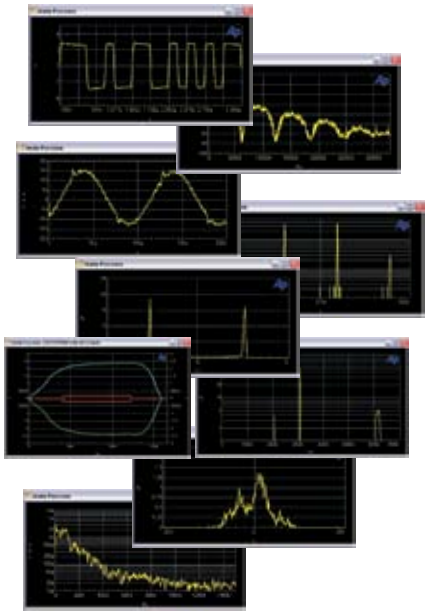
## Digital Interface Capabilities

*The 2700 Series offers both AES3 and IEC60958 serial digital interfaces, with fully configurable serial data and clock ports available via the auxiliary PSIA-2722 Programmable Serial Interface Adapter.*

*All digital input and output capabilities are functional over the full range of sample rates from 8 kHz to beyond 200 kHz.*

*The Digital Input/Output panel provides complete control and display of serial interface parameters including connector and format selection, sample rate, resolution, pulse amplitude, active data bits, error flags and received jitter amplitude. A Status Bits panel enables you to set and read interface metadata in both professional and consumer formats. Metadata is displayed in both hex and English interpretations.*

*Test the performance of AES3 or 60958 receivers with sub-standard signals by introducing impairments to the output serial interface signal. Impairments include variable sample rate, pulse amplitude and rise and fall times, the addition of noise, common-mode signals, controllable jitter and a long cable simulation.*



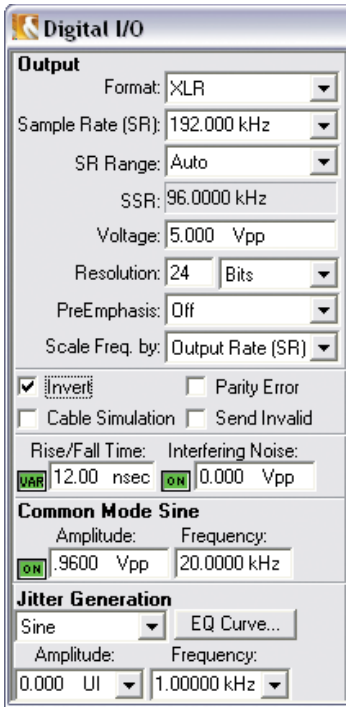
*Fully characterize a serial digital bit stream including waveforms, eye patterns, spectrums and histograms, as shown by these nine graphs.*

*Digital Input/Output panel*

### Digital Inputs and Outputs

Choose balanced XLR for the AES3 format, unbalanced BNC for the 60958 format, or a Toslink® connector for optical output or input to 192k. The second connectors can be used to switch between cables or in dual-connector mode. Rear-panel jacks provide reference, clock and trigger inputs and outputs.

*Rear panel connections*




*Selectively inject various impairments into the digital signal to test device performance.*

*Use the Digital Interface Analyzer tool to measure and display the interface signal or jitter waveform and spectrum, histograms for a number of interface measurements or to generate an eye pattern. Add jitter of various types and amplitudes to the generated bitstream and measure the effect on the receiver and the resulting audio signal.*


*Complete Status Bit metadata setting and display for either consumer or professional format.*

- **An Eye Pattern is a triggered oscilloscope view of the minimum pulse stream amplitude vs. time, computed over thousands of data cells. The eye opening provides a quick check of signal amplitude, signal-to-noise ratio, rise and fall times and jitter.**
- **Histograms display the probability distribution of pulse stream parameters like timing (jitter), amplitude, sample rate and bit width. The interface signal and the jitter waveform can be viewed either in the time domain (oscilloscope view) or the frequency domain (FFT spectrum).**

# 2700 Series Specifications Summary

## ANALOG SIGNAL OUTPUTS *(except SYS-2720)*

### Low Distortion Sine Wave Generator

Frequency Range ..... 10 Hz–204 kHz.

Frequency Accuracy
- High-accuracy mode ... ±0.03%.
- Fast mode ..... ±0.5%.

Frequency Resolution
- High-accuracy mode ... 0.005%.
- Fast mode ..... 0.025 Hz, 10 Hz–204.75 Hz, 0.25 Hz, 205 Hz–2.0475 kHz, 2.5 Hz, 2.05 kHz–20.475 kHz, 25 Hz, 20.5 kHz–204 kHz.

Amplitude Range
- Balanced ..... <10 µV–26.66 Vrms [+30.7 dBu].
- Unbalanced ..... <10 µV–13.33 Vrms [+24.7 dBu].

Amplitude Accuracy ..... ±0.7% [±0.06 dB] at 1 kHz.

Amplitude Resolution ..... 0.003 dB or 0.05 µVrms, whichever is larger.

Flatness (1 kHz ref)
- 0 Hz–20 kHz ..... ±0.008 dB (typically <0.003 dB).
- 20 kHz–50 kHz ..... ±0.03 dB.
- 50 kHz–120 kHz ..... ±0.10 dB.
- 120 kHz–200 kHz ..... +0.2 / –0.3 dB.

Residual THD+N
- At 1 kHz ..... ≤(0.00025% + 1.0 µV) [–112 dB], 22 kHz BW (valid only for analyzer inputs ≤8.5 Vrms).
- 20 Hz–20 kHz ..... ≤(0.0003% + 1.0 µV) [–110.5 dB], 22 kHz BW, ≤(0.0005% + 2.0 µV) [–106 dB], 80 kHz BW, ≤(0.0010% + 5.0 µV) [–100 dB], 500 kHz BW.
- 10 Hz–100 kHz ..... ≤(0.0040% + 5.0 µV) [–88 dB], 500 kHz BW.

### Intermodulation Distortion Test Signals *with option "IMD"*

**SMPTE (or DIN)**

LF Tone ..... 40, 50, 60, 70, 100, 125, 250, or 500 Hz; all ±1.5%.

HF Tone Range ..... 2 kHz–200 kHz.

Mix Ratio ..... 4:1 or 1:1 (LF:HF).

**CCIF and DFD**

Difference Frequency..... 80, 100, 120, 140, 200, 250, 500 or 1 kHz; all ±1.5%.

Center Frequency ..... 4.5 kHz–200 kHz.

**DIM (or TIM)**

Squarewave Frequency .. 3.15 kHz (DIM-30 and DIM-100), 2.96 kHz (DIM-B); both ±1%.

Sinewave Frequency .... 15 kHz (DIM-30 and DIM-100), 14 kHz (DIM-B).

### Special Purpose Signals *with option "BUR"*

**Sine Burst**

Frequency Range ..... 20 Hz–100 kHz.

**Square Wave**

Frequency Range ..... 20 Hz–20 kHz.

**Noise Signals**

White Noise ..... Bandwidth limited 10 Hz–23 kHz.

Pink Noise ..... Bandwidth limited 20 Hz–200 kHz.

Bandpass Noise ..... Approximately 1/3-octave (2-pole) filtered pink noise, continuously tunable from 20 Hz–100 kHz.

Generator ..... True random or pseudo-random.

Pseudo-Random Interval . Typically 262 ms (synchronized to the analyzer 4/s reading rate).

## D/A GENERATED ANALOG SIGNALS

### Common Specifications

Sample Rate
- Sine, IMD signals ..... fixed at 65.536 ks/s or 131.072 ks/s.
- Other signals ..... 8 ks/s–108 ks/s variable, or fixed at 65.536 ks/s or 131.072 ks/s.

Frequency Accuracy ..... ±0.0002% [2 PPM] internal reference, lockable to external reference.

D/A Resolution ..... 24-bit sigma-delta.

### "SINE (D/A)" Signal Family

Frequency Ranges ..... 10 Hz–30 kHz (65.536 ks/s), or 10 Hz–60 kHz (131.072 ks/s).

Flatness (1 kHz ref)
- 20 Hz–20 kHz ..... ±0.01 dB.
- 10 Hz–30 kHz ..... ±0.03 dB.
- 30 kHz–50 kHz ..... ±0.10 dB (typically –0.5 dB at 60 kHz).

THD+N (20Hz–20kHz)
- 30 kHz range ..... 0.0007% [–103 dB].
- 60 kHz range ..... 0.0014% [–97 dB].

Dual-Sine Ratio Range ... 0 dB to –100 dB, usable to –138 dB.

Shaped Burst Interval .... 2 cycles–65536 cycles.

### "IMD (D/A)" Signal Family

**SMPTE/DIN Test Signal**
- LF Tone ..... 40 Hz–500 Hz.
- HF Tone ..... 2.00 kHz–50 kHz.

**CCIF/DFD Test Signal**
- Difference Frequency .. 80 Hz–2 kHz.
- Center Frequency ..... 4.50 kHz to >50 kHz.

**DIM Test Signal**
- Squarewave Frequency . 3.15 kHz for DIM30 and DIM100, 2.96 kHz for DIMB.
- Sinewave Frequency ... 15.00 kHz for DIM30 and DIM100, 14.00 kHz for DIMB.

### Other Signals

**Arbitrary and Multitone Waveforms ("Arb Wfm")**

Signal ..... Determined by the associated file specified in the panel drop-down box.

**Maximum Length Sequence ("MLS")**

Sequences ..... Four pink, four white.

**Special Signals**

Polarity ..... Sum of two sine waves phased for reinforcement with normal polarity.

Pass Thru ..... Passes the embedded audio signal from the rear panel Reference Input. Ratio of reference rate to output Sample Rate may not exceed 8:1.

**Squarewave**

Frequency Range ..... 20 Hz–20.0 kHz.

**Noise Signal**

Pseudo-random white

## ANALOG OUTPUT CHARACTERISTICS

Source Configuration .... Selectable balanced, unbalanced, or CMTST (common mode test).

Source Impedances
- Balanced or CMTST ... 40 Ω (±1 Ω), 150 Ω (±1.5 Ω), or 600 Ω (±3 Ω).
- Unbalanced ..... 20 Ω (±1 Ω) or 600 Ω (±3 Ω).

Max Output Power into 600 Ω
- Balanced ..... +30.1 dBm (Rs = 40 Ω).
- Unbalanced ..... +24.4 dBm (Rs = 20 Ω).

Output Related Crosstalk
- 10 Hz–20 kHz ..... ≤–120 dB or 5 µV, whichever is greater.
- 20 kHz–100 kHz ..... ≤–106 dB or 10 µV, whichever is greater.

## ANALOG ANALYZER *(except SYS-2720)*

### Analog Input Characteristics

Input Ranges ..... 40 mV–160 V in 6.02 dB steps.

Maximum Rated Input .... 230 Vpk, 160 Vrms (dc to 20 kHz), overload protected in all ranges.

Input Impedance
- Balanced ..... 200 kΩ / 95 pF (differential).
- Unbalanced ..... 100 kΩ / 185 pF.

Terminations ..... Selectable 600 Ω or 300 Ω, each ±1%, 1 Watt [+30 dBm] maximum power.

**Level Meter Related**

Measurement Range .... 5 mV–160 V for specified accuracy and flatness, usable to <100 µV.

Accuracy (1 kHz) ..... ±0.5% [±0.05 dB].

Flatness (1 kHz ref)
- 20 Hz–20 kHz ..... ±0.008 dB (typically <0.003 dB).
- 15 Hz–50 kHz ..... ±0.03 dB.
- 10 Hz–120 kHz ..... ±0.10 dB.
- 120 kHz–200 kHz ..... +0.2 / –0.3 dB (typically <–0.5 dB at 500 kHz).

**Frequency Meter Related**

Measurement Range .... 10 Hz–500 kHz.

Accuracy ..... ±0.0006% [±6 PPM].

Resolution ..... 6 digits + 0.000244 Hz.

Minimum Input ..... 5 mV.

**Phase Measurement Related**

Measurement Ranges .... ±180, –90 / +270, or 0 / +360 deg.

Accuracy
- 10 Hz–5 kHz ..... ±0.5 deg.
- 5 kHz–20 kHz ..... ±1 deg.
- 20 kHz–50 kHz ..... ±2 deg.

**Wideband Amplitude/Noise Function**

Measurement Range .... <1 µV–160 Vrms.

Accuracy (1 kHz) ..... ±1.0% [±0.09 dB].

Flatness (1 kHz ref)
- 20 Hz–20 kHz ..... ±0.02 dB.
- 15 Hz–50 kHz ..... ±0.05 dB.
- 50 kHz–120 kHz ..... ±0.15 dB.
- 120 kHz–200 kHz ..... +0.2 dB / –0.3 dB (typically < –3 dB at 500 kHz).

Bandwidth Limiting Filters
- LF –3 dB ..... <10 Hz, 22 Hz per IEC468 (CCIR), 100 Hz ±5% (3-pole), or 400 Hz ±5% (3-pole).
- HF –3 dB ..... 22 kHz per IEC468 (CCIR), 30 kHz ±5% (3-pole), 80 kHz ±5% (3-pole), or >500 kHz.

Optional Filters ..... up to 7.

Detection ..... RMS (□ = 25 ms or 50 ms), Average, QPk per IEC468 (CCIR), Pk (pseudo-peak), or S-Pk (0.7071 x Pk reading).

Residual Noise
- 22 Hz–22 kHz BW ..... ≤1.0 µV [–117.8 dBu].
- 80 kHz BW ..... ≤2.0 µV [–111.8 dBu].
- 500 kHz BW ..... ≤6.0 µV [–102.2 dBu].
- A-weighted ..... ≤0.7 µV [–120.9 dBu].
- CCIR-QPk ..... ≤3.5 µV [–106.9 dBu].

**Bandpass Amplitude Function**

Tuning Range ($f_0$) ..... 10 Hz–200 kHz.

Bandpass Response ..... 1/3-octave class II (4-pole), < –32 dB at 0.5 $f_0$ and 2.0 $f_0$.

**Bandreject Amplitude Function**

Tuning Range ($f_0$) ..... 10 Hz–200 kHz.

Tuning Accuracy ..... ±2%.

Bandreject Response .... typically –3 dB at 0.73 $f_0$ & 1.37 $f_0$, –20 dB at $f_0$ ±10%, –40 dB at $f_0$ ±2.5%.

Accuracy ..... ±0.3 dB, 20 Hz–120 kHz (excluding 0.5 $f_0$–2.0 $f_0$).

**THD+N Function**

Fundamental Range ..... 10 Hz–200 kHz.

Accuracy ..... ±0.3 dB, 20 Hz–120 kHz harmonics.

Measurement Bandwidth
- LF –3 dB ..... <10, 22, 100, or 400 Hz.
- HF –3 dB ..... 22k, 30k, 80k, or >500 kHz. (Option filter selection also affects bandwidth).

Residual THD+N
- At 1 kHz ..... ≤(0.00025% + 1.0 µV) [–112 dB], 22 kHz BW (valid only for analyzer inputs ≤8.5 Vrms).
- 20 Hz–20 kHz ..... ≤(0.0003% + 1.0 µV) [–110.5 dB], 22 kHz BW, ≤(0.0005% + 2.0 µV) [–106 dB], 80 kHz BW, ≤(0.0010% + 5.0 µV) [–100 dB], 500 kHz BW
- 10 Hz–100 kHz ..... ≤(0.0040% + 5.0 µV) [–88 dB], 500 kHz BW.

Minimum Input ..... 5 mV for specified accuracy, usable to <100 µV with fixed notch tuning.

### IMD Measurements with option "IMD"

**SMPTE (DIN) IMD Function**

Test Signal Compatibility .. Any combination of 40 Hz–250 Hz (LF) and 2 kHz–100 kHz (HF) tones, mixed in any ratio from 0:1 to 8:1 (LF:HF).

**CCIF and DFD IMD Functions**

Test Signal Compatibility .. Any combination of equal amplitude tones from 4 kHz–100 kHz spaced 80 Hz–1 kHz.

**DIM (TIM) IMD Function**

Test Signal Compatibility .. 2.96 kHz–3.15 kHz squarewave mixed with 14 kHz–15 kHz sine wave (probe tone).

### Wow & Flutter Measurements with option "W&F"

Test Signal Compatibility
- Normal ..... 2.80 kHz–3.35 kHz.
- "High-band" ..... 11.5 kHz–13.5 kHz.

## DSP ANALYSIS OF ANALOG SIGNALS *( SYS-2712 and SYS-2722 only)*

### High Resolution Converter

A/D Resolution ..... 24-bit sigma-delta.

Sample Rate ($f_s$) ..... 8 ks/s–108 ks/s variable; or 65.536 ks/s fixed.

Flatness (1 kHz ref) ..... ±0.01 dB to 0.45 x SR or 20 kHz, whichever is lower.

Distortion ..... –105 dB for $f_s$ ≤65.536 ks/s, –102 dB for $f_s$ up to 100 ks/s.

### High Bandwidth Converter

A/D Resolution ..... 16-bit sigma-delta.

Sample Rate ($f_s$) ..... 16 ks/s–200 ks/s variable; or 131.072 ks/s, or 262.144 ks/s fixed.

Flatness (1 kHz ref) ..... ±0.01 dB to 20 kHz, ±0.10 dB to 120 kHz (262.144 ks/s).

Distortion ..... –92 dB for $f_s$ ≤200 ks/s, –90 dB with $f_s$ = 262.144 ks/s.

### FFT Signal Analyzer with "FFT" DSP program

Acquisition Length ..... 800 samples to 4 M samples in 15 steps.

Transform Length ..... 256–32768 samples in binary steps.

Processing ..... 48 bit.

Amplitude Accuracy ..... ±0.09 dB, 20 Hz–20 kHz.

Averaging ..... 1–4096 averages in binary steps. Averaging is power-based (frequency domain), or synchronous (time domain).

Windows. ..... Ten choices.

### DSP Audio Analyzer with "Analyzer" DSP program

**Wideband Level/Amplitude**

Accuracy (1 kHz)..... ±0.09 dB [±1.0%].

Frequency Range ..... <10 Hz to 45% of Sample Rate [10 Hz–21.6 kHz at 48 ks/s].

High pass Filters ..... <10 Hz 4-pole, 22 Hz 4-pole, 100 Hz 4-pole, 400 Hz 4-pole (4-pole Butterworth or 10-pole elliptic if no other filters are enabled).

Low pass Filters ..... $F_S$/2 (maximum bandwidth), 20 kHz (6-pole elliptic), 15 kHz (6-pole elliptic).

Weighting Filters ..... ANSI-IEC "A" weighting, per IEC Rec 179, CCIR QPk per IEC468 (CCIR), CCIR RMS per AES17, C-message per IEEE Std 743-1978, CCITT per CCITT Rec. O.41, "F" weighting corresponding to 15 phon loudness contour, HI-2 Harmonic weighting.

**Narrow Band Amplitude**

Frequency Range ..... <10 Hz to 47% of Sample Rate [10 Hz–22.56 kHz at 48 ks/s].

Filter Shape ..... 10-pole, Q=19 (BW = 5.3% of $f_0$).

**THD+N Measurements**

Frequency Range ..... <10 Hz to 47% of Sample Rate [10 Hz–22.56 kHz at 48 ks/s].

High pass Filters ..... <10 Hz (4-pole), 22 Hz (4-pole), 100 Hz (4-pole), 400 Hz (4-pole Butterworth).

Low pass Filters ..... $F_S$/2 (maximum bandwidth), 20 kHz (6-pole elliptic), 15 kHz (6-pole elliptic).

Weighting Filters ..... ANSI-IEC "A" weighting, per IEC Rec 179, CCIR QPk per IEC468 (CCIR), CCIR RMS per AES17, C-message per IEEE Std 743-1978, CCITT per CCITT Rec. O.41, "F" weighting corresponding to 15 phon loudness contour, HI-2 Harmonic weighting.

**Frequency Measurements**

| | |
|---|---|
| Range | <10 Hz to 47% of Sample Rate [10 Hz–23.0 kHz at 48 ks/s]. |
| Accuracy | ±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. |

**Quasi-Anechoic Acoustical Tester** *with "MLS" DSP program*

| | |
|---|---|
| Signals | Four pink sequences, four white sequences. |
| Frequency Range | (Sample Rate ÷ 2000) to (Sample Rate ÷ 2). |
| Frequency Resolution *(Max)* | 1.465 Hz at 48.0 ks/s. |
| Acquisition Length | 32767 or 131071 samples. |

**Multitone Audio Analyzer** *with "FASTTEST" DSP program*

| | |
|---|---|
| Measurements | Level vs frequency (Response), Total distortion vs frequency, Noise vs frequency, Phase vs frequency, Crosstalk vs frequency, Masking curve. |
| Frequency Resolution | (Sample Rate ÷ Transform Length) [1.465 Hz with $f_S$ = 48 ks/s & Transform Length = 32768]. |
| Distortion | ≤–115 dB. |

## DIGITAL SIGNAL GENERATOR *(SYS-2720 and SYS-2722 only)*

**Interface Signal Characteristics**

| | |
|---|---|
| Output Formats | Balanced XLR (AES/EBU per AES3-r1997), Dual Connector XLR, Unbalanced BNC (SPDIF-EIAJ per IEC-60958), Dual Connector BNC, Optical (Toslink®) per IEC-60958, General purpose parallel, or Serial interface to chip via optional PSIA-2722. |
| Sample Rate ("SR") | |
| Range | |
| Electrical Formats | 28 kHz–200 kHz for fully specified performance; usable from 8 kHz–216 kHz. |
| Optical Format | 28 kHz–108 kHz for fully specified performance; usable down to 8 kHz. Upper rate is limited by Toslink® technology. |
| Resolution | <0.0001 Hz. |
| Accuracy | ±0.0002% [±2 PPM], lockable to external reference. |
| Output Impedance | |
| Balanced (XLR) | Nominally 110 Ω. |
| Unbalanced (BNC) | Nominally 75 Ω. |
| Residual Jitter | ≤600 ps (700 Hz–100 kHz analyzer bandwidth), ≤1.0 ns (50 Hz–100 kHz analyzer bandwidth). |

**Embedded Signal Generation** *Encoding is selectable 8–24 bit Linear, μ-Law, or A-Law*

**Sine Family Common Characteristics** *(all sine wave variants)*

| | |
|---|---|
| Frequency Range | 10 Hz to 47% of Sample Rate [22.56 kHz at 48 ks/s]. |
| Frequency Resolution | Sample Rate ÷ $2^{23}$ [0.006 Hz at 48 ks/s]. |
| Flatness | ±0.001 dB. |
| Harmonics/Spurious Products | ≤0.000001% [–160 dB]. |

**Variable Phase Sine Wave**

| | |
|---|---|
| Phase Range | ±180 deg. |

**Sine + Offset**

| | |
|---|---|
| Offset Amplitude | Sine amplitude + \|offset amplitude\| ≤100% $F_S$. |

**Sine Burst and Shaped Sine Burst**

| | |
|---|---|
| Interval | 2 cycles–65536 cycles. |
| Burst On | 1 to (number of Interval cycles minus 1). |

**Square Wave**

| | |
|---|---|
| Frequency Range | ≤1 Hz to 1/6 Sample Rate. Frequencies are limited to even integer sub-multiples of the Sample Rate. |

**SMPTE/DIN Waveform**

| | |
|---|---|
| Upper Tone Range | 2 kHz to 47% of Sample Rate [22.56 kHz at 48 ks/s]. |
| Lower Tone Range | 40 Hz–500 Hz. |

**CCIF and DFD IMD Waveforms**

| | |
|---|---|
| Center Frequency Range | 3.00 kHz to (47% of Sample Rate –1/2 IM freq.). |
| IM Frequency Range | 80 Hz–2.00 kHz. |

**DIM IMD Waveform**

| | |
|---|---|
| Square/Sine Frequencies | Determined by Sample Rate |
| Distortion/Spurious | ≤0.000001% [–160 dB]. |
| Amplitude Ratio | 4:1 (squarewave:sinewave). |

**Noise**

| | |
|---|---|
| Types | Pink, White, Burst, USASI. |

**Special Signals**

| | |
|---|---|
| Monotonicity | Low level staircase waveform for D/A linearity testing. |
| J-Test | Produces a maximum amount of data-induced jitter on low-bandwidth transmission links. |
| Polarity | Two sinewaves phased for reinforcement with normal polarity. |
| 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 (Bittest) | Pseudo-random binary states of all bits. |
| Pass Thru | Passes the signal from the rear panel Ref Input. Accepts sample rates from 27 kHz–200 kHz and outputs at programmed sample rate. Ratio of rates may not exceed 7.75:1. |

**Quasi-Anechoic Acoustical Tester (MLS)**

| | |
|---|---|
| Signals | Four pink sequences, four white sequences. |
| Frequency Range | dc to Sample Rate ÷ 2. |
| Sequence Length | 32767 samples or 131071 samples. |

**Arbitrary and Multitone Waveforms ("Arb Wfm")**

| | |
|---|---|
| Signal | Determined by the associated file specified in the panel drop-down box. |
| Frequency Range | dc to Sample Rate ÷ 2. |
| Length | 256 points–16384 points per channel. Utility is provided to prepare waveform from user specified frequency, amplitude, and phase data. |
| Frequency Resolution | Sample Rate ÷ Length [2.93 Hz at 48 ks/s for a waveform 16384 points in length]. |
| Maximum Number of Tones | (Length / 2) –1 [8191 for Length = 16384]. |

**Dither**

| | |
|---|---|
| Probability Distribution | Triangular or rectangular; pseudo random, independent for each channel. |
| Spectral Distribution | Flat (white) or Shaped (+6 dB/oct). |
| Amplitude | 8 bit–24 bit, or OFF. |

**Pre-Emphasis Filters**

| | |
|---|---|
| Filter Shape | 50/15 μs or J17. |
| Response Accuracy | ±0.02 dB, 10 Hz to 45% of Sample Rate. |
| Residual Distortion | ≤0.00003% [–130 dB]. |

## DIGITAL ANALYZER *(SYS-2720 and SYS-2722 only)*

**Digital Interface Signal Measurements**

| | |
|---|---|
| Input Sample Rate | |
| Range | |
| Electrical Formats | 28 kHz–200 kHz for fully specified performance; typically <24 kHz kHz–216 kHz. |
| Optical Format | 28 kHz–108 kHz for fully specified performance; usable down to 24 kHz. Upper rate limited by Toslink® technology. |
| Accuracy | |
| Int. Reference | ±(0.0003% + 1 digit) [±3 PPM]. |
| Ext. Reference | ±(0.0001% + 1 digit) [±1 PPM]. |
| Input Amplitude | |
| Balanced (XLR) | 0 Vpp–10.00 Vpp, ±(5% + 25 mV). |
| Unbalanced (BNC) | 0 Vpp–2.5 Vpp, ±(5% + 6 mV). |
| Optical | Displays output voltage of Toslink® receiver (not linearly related to optical input power). |
| Output to Input Delay | Measures propagation from the rear panel AES/EBU Reference Output to the input. |
| Range | –12.7 to +115.1 UI [–10% to +90% of frame] in seconds, 60 ns resolution. |
| Residual Jitter | ≤600 ps "700 Hz–100 kHz" bandwidth, ≤1.0 ns "50 Hz–100 kHz" bandwidth. |

**Digital Interface Analyzer** *with "INTERVU" DSP program*

| | |
|---|---|
| AES/EBU Input Voltage | |
| Balanced | 0 Vpp–10.00 Vpp, ±(10% + 50 mV). |
| Unbalanced | 0 Vpp–2.5 Vpp, ±(8% + 12 mV). |
| Acquisition time / memory | 19.66 ms / 1,572,864 samples. |

**Embedded Audio Measurements** *with "ANALYZER" DSP program*

**Wideband Level/Amplitude**

| | |
|---|---|
| Range | –120 $dBF_S$ to 0 $dBF_S$ (usable to –140 $dBF_S$). |
| Frequency Range | 10 Hz to 45.8% of Sample Rate, [10 Hz–20.2 kHz at 44.1 ks/s], [10 Hz–22.0 kHz at 48 ks/s], [10 Hz–44.0 kHz at 96 ks/s]. |
| Accuracy | ±0.01 dB. |
| Flatness | ±0.01 dB, 15 Hz–22 kHz (<10 Hz high-pass filter selection). |
| High pass Filters | <10 Hz (4-pole), 22 Hz (4-pole), 100 Hz (4-pole), 400 Hz (4-pole Butterworth, or 10-pole elliptic if no other filters are enabled). |
| Low pass Filters | $F_S$/2 (maximum bandwidth), 20 kHz (6-pole elliptic), 15 kHz (6-pole elliptic). |
| Weighting Filters | ANSI-IEC "A" weighting, per IEC Rec 179, CCIR QPk per CCIR Rec. 468, CCIR RMS per AES17, C-message per IEEE Std 743-1978, CCITT per CCITT Rec. O.41, "F" weighting corresponding to 15 phon loudness contour, HI-2 Harmonic weighting. |
| Residual Noise (at 48 ks/s and 96 ks/s $f_S$) | –141 $dBF_S$ unweighted, –144 $dBF_S$ A-weighted, –140 $dBF_S$ CCIR RMS, –130 $dBF_S$ CCIR QPk, –142 $dBF_S$ 20 kHz LP, –143 $dBF_S$ 15 kHz LP, –139 $dBF_S$ "F" weighting, –152 $dBF_S$ CCITT, –151 $dBF_S$ C Message. |

**Narrow Band Amplitude**

| | |
|---|---|
| Frequency Range | 10 Hz to 40% of Sample Rate, [10 Hz–17.6 kHz at 44.1 ks/s], [10 Hz–19.2 kHz at 48 ks/s], [10 Hz–38.4 kHz at 96 ks/s] |

**THD+N Measurements**

| | |
|---|---|
| Frequency Range | <10 Hz to 47% of Sample Rate, [10 Hz–19.9 kHz at 44.1 ks/s], [10 Hz–21.6 kHz at 48 ks/s], [10 Hz–43.2 kHz at 96 ks/s]. |
| Residual THD+N | ≤–138 $dBF_S$. |
| High pass Filters | <10 Hz (4-pole), 22 Hz (4-pole), 100 Hz (4-pole), 400 Hz (4-pole Butterworth). |
| Low pass Filters | $F_S$/2 (maximum bandwidth), 20 kHz (6-pole elliptic), 15 kHz (6-pole elliptic). |
| Weighting Filters | Same as Wideband Level/Amplitude. |

**Frequency Measurements**

| | |
|---|---|
| Range | 10 Hz to 47% of Sample Rate, [10 Hz–21.0 kHz at 44.1 ks/s], [10 Hz–23.0 kHz at 48 ks/s], [10 Hz–46.0 kHz at 96 ks/s]. |

**Embedded Audio, FFT Spectrum Analyzer** *with "FFT" DSP program (48-bit processing)*

| | |
|---|---|
| Acquisition Length | 800 samples–4 M samples in 15 steps. |
| Transform Length | 256–32768 samples in binary steps. |
| Windows | Ten choices |
| Averaging | 1–4096 averages in binary steps. Averaging is power-based (frequency domain), or synchronous (time domain). |
| Distortion Products | ≤–160 dB. |

**Embedded Audio, Multitone Audio Analyzer** *with "FASTTEST" DSP program (48 bit processing)*

| | |
|---|---|
| Acquisition Length | 512–32768 samples in binary steps. |
| Transform Length | 512–32768 samples in binary steps. |
| Measurements | Level vs frequency, Total distortion vs frequency, Noise vs frequency, Phase vs frequency, Crosstalk vs frequency, Masking curve. |
| Frequency Resolution | Sample Rate ÷ $2^{15}$ [1.465 Hz with 48 ks/s]. |
| Frequency Correction Range | ±3%. |
| Distortion | ≤–140 dB. |

**Embedded Audio, Quasi-Anechoic Acoustical Tester** *with "MLS" DSP program*

| | |
|---|---|
| Signals | Four pink sequences and four white sequences, selected by triggering generator MLS setting. |

## FRONT PANEL AUXILIARY SIGNALS

| | |
|---|---|
| Generator Monitors *(all units except SYS-2720)* | Channel A; Channel B |
| Generator Auxiliary Signals *(all units except SYS-2720)* | Sync Output/ Trig/Gate Input |
| Analyzer Signal Monitors *(all units except SYS-2720)* | Channel A; Channel B; Reading |
| Digital Signal Monitors *(SYS-2720 and SYS-2722 only)* | Channel 1: Channel 2: Reading 1: Reading 2 |

## REAR PANEL AUXILIARY SIGNALS

**Reference Input ("REF IN") Characteristics**

| | |
|---|---|
| Input formats | 28 kHz–200 kHz AES/EBU, NTSC, PAL, or SECAM video, or 8 kHz–10 MHz square wave. |

**Reference Output ("REF OUT") Characteristics**

| | |
|---|---|
| Output format | AES/EBU (per AES3-r1997). |

## GENERAL / ENVIRONMENTAL

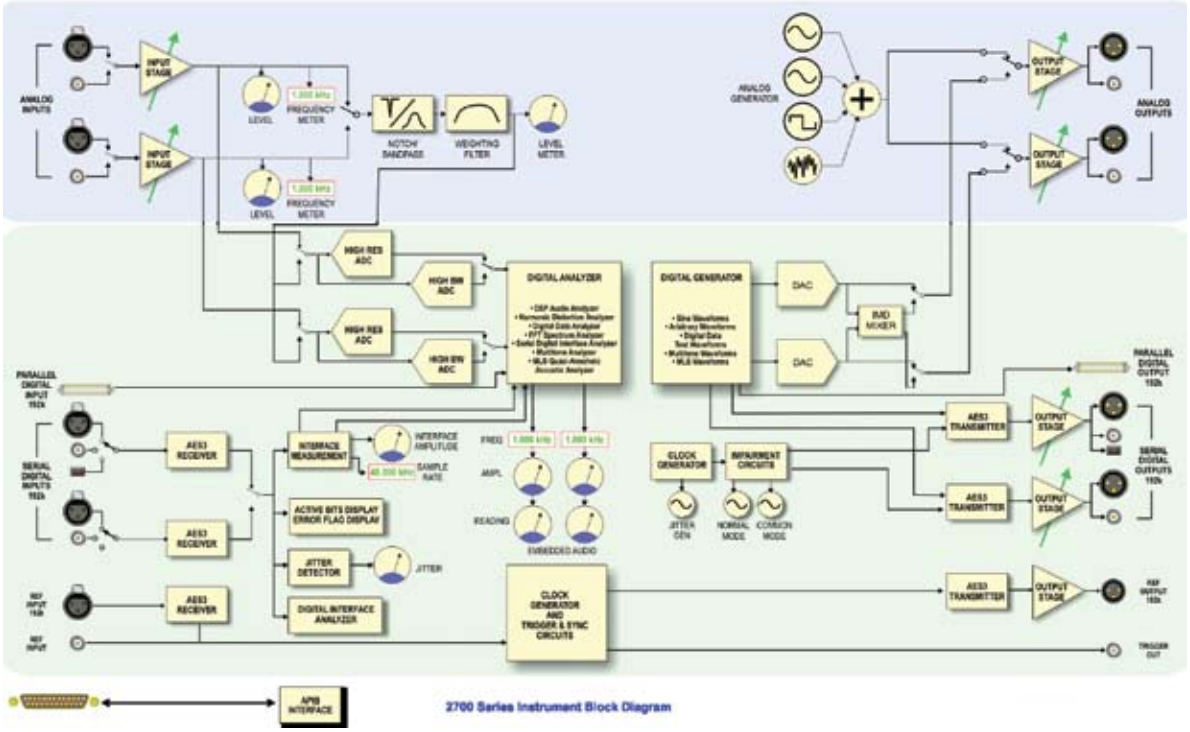
| | |
|---|---|
| Power Requirements | 100/120/230/240 Vac (–10%/+6%), 50/60 Hz, 240 VA max. |
| EMC | Complies with 89/336/EEC, CISPR 22 (class B), and FCC 15 subpart J (class B). |
| Dimensions | |
| Width | 41.9 cm [16.5 inches]. |
| Height | 14.6 cm [5.75 inches] bench-top (feet attached) 3U [5.25 inches] rack-mount. |
| Depth | 34.5 cm [13.6 inches]. |
| Weight | Approximately 15.4 kg [34 lbs]. |
| Safety | Complies with 73/23/EEC, 93/68/EEC, and EN61010-1 (1990) + Amendment 1 (1992) + Amendment 2 (1995). Installation Category II, Pollution Degree 2. |

SYS-2722

SYS-2720

SYS-2712

SYS-2702




2700 Series Instrument Block Diagram

***The 2700 Series*** *is available in four models to test analog signals, digital signals or both (dual domain).*

**SYS-2722** *offers analog and digital inputs and outputs, DSP analysis of both digital and internally-converted analog signals, DSP-generated digital and analog signals, and low-distortion, hardware-implemented generation and analysis for analog signals. It is a true dual domain instrument.*

**SYS-2720** *offers digital input and output and DSP generation and analysis of digital signals. It has no analog I/O capabilities.*

**SYS-2712** *offers analog inputs and outputs, DSP analysis of internally-converted analog signals, DSP-generated analog signals, and low-distortion hardware-implemented signal generation and analysis. It has no digital I/O capabilities.*

**SYS-2702** *offers analog input and output, with low-distortion hardware-implemented signal generation and analysis. It has no digital I/O capabilities.*

*The* **GPIB** *option adds an IEEE-488 interface to the instrument.*

*Three major internal analog options may be fitted to all instruments except the digital-only SYS-2720. Note that some BUR- and IMD-type capabilities are already provided in DSP generation and analysis for SYS-2722 and SYS-2712.*

*The* **BUR** *option adds analog-domain generation of burst sine waves with controllable burst duration, interval and amplitude between bursts. It also includes analog-generated square waves to 20 kHz, analog random and pseudorandom white and pink noise, and bandpass-filtered pink noise.*

*The* **IMD** *option tests analog-domain devices for intermodulation distortion to the SMPTE/DIN, CCIF and DIM/TIM standards.*

*The* **W&F** *option measures analog wow & flutter to the IEC/DIN, NAB, JIS, and scrape flutter standards, weighted or unweighted.*

*A 2700 Series* **APIB** *interface connects the instrument to your PC, and is included with all models, except the GPIB option. APIB is available in your choice of an USB, PCIE, PCI or PCMCIA PC card.*

*Each instrument except the digital-only SYS-2720 can accept up to seven analog filter option modules, selectable from a large assortment of lowpass, bandpass and psophometric weighting filters. Other external accessories include the* **PSIA-2722** *Programmable Serial Interface Adapter for connecting to devices that use non-standard serial interfaces, the* **SWR-2755** *family of high-performance signal switchers/multiplexers and the* **DCX-127** *DC/Ohms/low speed digital logic multifunction module.*

## 2700 SERIES ORDERING INFORMATION

| | |
|---|---|
| **Models** | |
| SYS-2722 | Analog and Digital Input and Output, with DSP. Dual domain, 192k. |
| SYS-2720 | Digital Input and Output, with DSP, 192k. |
| SYS-2712 | Analog Input and Output, with DSP. |
| SYS-2702 | Analog Input and Output. |
| **Options** | |
| BUR | Analog burst sine waves, square waves to 20 kHz, random and pseudorandom white and pink noise signals. |
| IMD | Analog Intermodulation Distortion to SMPTE/DIN, CCF and DIM/TIM standards. |
| W&F | Wow & Flutter to IEC/DIN, NAB, JIS and scrape flutter standards, weighted or unweighted. |
| OPT-2711 | Onboard Dolby* Digital (AC-3) signal generation for SYS-2722 and SYS-2720. |
| EWP2-2700 | Two-Year Extended Warranty *(adds two more years to the standard three-year warranty included with instrument).* |
| **Interface Options (selected at time of order)** | |
| USB-APIB | USB interface adapter w/USB cable, AP2700 software and instructions |
| S2-PCIE | PCIE Interface Card w/AP2700 software. |
| S2-PCI | PCI Interface Card w/AP2700 software. |
| S2-PCMCIA | PCMCIA Interface Card w/AP2700 software. |
| -G | IEEE-488 (GPIB) Interface. |
| **Filters** | |
| S-AES17 | Lowpass filter for AES17 DAC measurements. |
| OPT-2020 | Lowpass filter for DAC measurements. |
| FIL-xxx | Family of analog psophometric noise weighting filters. |
| FLP-xxx | Family of analog sharp lowpass filters. |
| FBP-xxx | Family of analog 1/3 octave bandpass filters. |
| **External Accessories** | |
| AUX-0025 | Switching Amplifier Measurement Filter. |
| PSIA-2722 | Programmable Serial Interface Adapter. |
| SWR-2755 | 12x2 switcher family expandable to 192 channels. |
| DCX-127 | Multifunction module including 4 1/2 digit DC voltmeter/ohmmeter with miscellaneous digital control ports. |
| RAK-S2 | Rackmount kit. |
| HAN-S2 | Carrying handle. |

* Dolby and the double-D symbol are trademarks of Dolby Laboratories.

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