TM 500 / 5000

MODULAR TEST INSTRUMENTS

Automated Audio Test System Advantages

- Fast, Accurate, Repeatable Measurements.
- Lower Required Operator Skill.
- Automatic, Low-cost Documentation of Test Results in Graphic or Tabular Form.

Instrument Performance Features

- Extremely low residual noise and distortion permit measurements on top-grade professional and consumer audio equipment.
- Performs all standard audio tests — THD, IMD (SMPTE, DIN, CCIF difference tone), gain/loss, signal-to-noise ratio.
- Analyzer input fully balanced, oscillator output balanced or unbalanced, floating or grounded, 50/150/600 Ω to match all types of audio equipment.
- Automatic swept measurements possible without IEEE-488 controller.
- Four-or-more digit synthesized frequency, 0.01% guaranteed accurate.
- Fully programmable filter and detector selection to meet a wide variety of measurement standards.
- High level oscillator output to test input overload clipping thresholds of line level devices.
- Ten non-volatile storage generator setups.
- Generator includes burst, square wave, and amplifier modes.

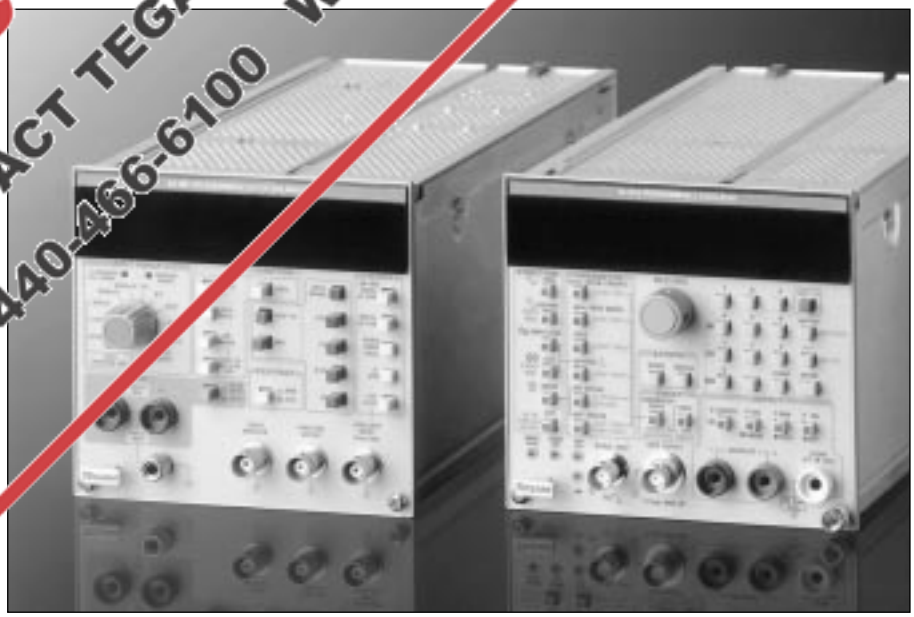
SG 5010 / AA 5001 Programmable Audio Test System

Automated Audio Test System Advantages

TEGAM SG 5010 and AA 5001 programmable instruments in a computer controlled test system will make critical audio measurements consistently, accurately, and in two to four seconds each. Even complex tests can be made by non-technically-skilled operators since the procedures are controlled by software in the controller. And, permanent graphic or tabular records of test results can be produced at very low cost.

An SG 5010/AA 5001 based system will automatically perform such industry standard tests as harmonic distortion to IHF A202, intermodulation distortion to SMPTE, DIN 45403, IEC 268.3, and IHF A202, frequency response to IHF A202 and noise or signal-to-noise ratio to IHF A202 ("A" weighting filter complies with ANSI specification S1.4 and IEC specification 179 for sound level meters). With the Option 02 capability of the AA 5001, noise measurements may be made to CCIR 468-2 and DIN 45405 standards. The SG 5010 also generates the burst signal necessary for dynamic headroom tests per IHF A202.

The basic automated system consists of the SG 5010 Programmable Oscillator, the AA 5001 Programmable Distortion Analyzer and an IEEE 488 Controller. Frequency counters, signal switchers, interface devices, disk storage, and hard copy units or plotters may be optionally added to the system.



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THE GLOBAL SOURCE FOR PROVEN TEST AND MEASUREMENT TECHNOLOGY.

Prices and specifications subject to change without notice.

Typical Applications

One ideal application for automated audio testing is the moderate-to-high volume production line for consumer and professional audio equipment. Test results can be economically logged or printed for files or to be furnished to the customer. In the engineering laboratory, characterization of complex variable devices such as parametric equalizers can be greatly speeded with automatic test equipment, and a color ink-jet printer can quickly produce highly legible results. Audio tape recorders and the audio channels of video tape, cassette, and disc machines may be tested with no special synchronization required, as can be earth stations and radio networks when a stepped tone signal is available. Performance levels of the SG 5010/AA 5001 system are consistent with new 16-bit digital system noise and distortion levels. Radio and TV broadcasting stations and networks can automate proof-of-performance tests, even running them daily at sign-on or sign-off to maintain signal quality control. Highly complex devices, such as large recording consoles with multiple inputs and outputs or large audio switchers, may be impractical to test with manual techniques and truly maintainable only via automation. Loudspeakers and microphones can be automatically characterized by the addition of reference transducers and pre-amplifiers to the system. Swept pre-emphasis, de-emphasis, or equalized signals can be easily generated since the controller has full control over both frequency and amplitude.

Other Measurement Capabilities

Features and flexibility of the AA 5001 and SG 5010 permit a variety of other measurements to be easily automated. SMPTE-like IMD measurements may be made at a variety of lower frequencies and any value of upper frequency, and at 1:1 amplitude ratios in addition to the standard 4:1 ratio. A CCIF test with the frequencies selected near the upper band limit of the device under test has been shown to be a very effective and simple-to-implement test for transient or dynamic intermodulation (TIM and DIM). Burst signals of any desired duty cycle may be generated for IHF dynamic headroom measurements and to test compressors and limiters; the between-bursts level may be selected as OFF or 20 dB below the burst level. Power measurements are made by a controller computation from a voltage measurement across a known load resistance. SINAD measurements of sensitivity of FM communications receivers are a standard capability of the AA 5001 plus an appropriate RF signal generator. The SG 5010 features an amplifier mode in which an external signal can be converted to the high level, multiple impedance, balanced and floating capability of the SG 5010 output circuitry. Fully program-selectable filters in the AA 5001 allow various choices of bandwidth for distortion measurements and weighting for noise measurements, or rejection of interfering signals. Phase measurements can be added to the system by use of the DC 5010 Universal Counter-Timer.

GPIB Controller

Since the instruments are IEEE-488 compatible, any IEEE-488 controller may be used with them.

Software Features

Both the SG 5010 oscillator and the AA 5001 analyzer feature very high level, English-like commands for their various modes and functions. LEARN mode is a standard feature, permitting instrument setups to be made at the front panel and then learned at the controller by a single keystroke. Both instruments are microprocessor-based, with the distributed intelligence of the system used to simplify the controller's task by such things as a programmable settling algorithm in the analyzer and stored setups plus logarithmic or linear sweeps of frequency or amplitude in the oscillator.

Test Result Documentation

Audio test results are obtainable in a variety of ways. Graphics of one or more measured variables versus frequency or amplitude are readily produced on the controller CRT. Tabular results can also be shown on the CRT and duplicated in hard copy. Graphic test results can also be produced even without a GPIB controller if an X-Y plotter or storage oscilloscope is available, due to the built-in sweep capabilities of the SG 5010 plus its ramp output and pen lift signal.

TM 5000/TM 500 Family

As members of the TEGAM modular TM 5000 family of programmable general purpose instruments, these new products expand the number of systems which can be configured for a variety of applications. Programmable counters, digital multimeters, power supplies, function generators, switchers, and control and sensing interface devices are available to complete systems. Even many of the TM 500 instruments, although not programmable, may appropriately be added for specific test systems needs. Examples include products such as the AM 502 Differential Amplifier and a variety of sine and function generators and dc power supplies. Details and specifications on these products are available from TEGAM.

SG 5010/AA 5001 System Specifications

Harmonic Distortion Function

Measurement Setting Time: Typically 2.5 seconds above 100 Hz, increasing by approximately 1 second per octave below 100 Hz.

Residual THD+N: (Vin≥250 mV, RMS response, all distortion, noise and nulling resources combined).

20 Hz to 20 kHz ≤0.0032%
(-90 dB) with 80 kHz filter.

10 Hz to 100 kHz ≤0.01%
(-80 dB) no filters.

Typical System Residual THD+NOISE: (Vin ≥250 mV with 80 kHz filter, RMS response).

Intermodulation Distortion Function

Measurement Setting Time: Typically <2 seconds.

Residual IMD: (Vin ≥ 250 mV, RMS response).

SMPTE and DIN tests
≤0.0032% (-90 dB) for 60 Hz and 7 kHz or 250 Hz and 8 kHz, 4:1 ratio.

CCIF difference frequency test
≤0.0018% (-95 dB) with 14 kHz and 15 kHz.

Level Function

Measurement Setting Time: Typically <2 seconds.
Flatness: ±0.1 dB 20 Hz to 20 kHz.

Environmental

Temperature Range: 0°C to +50°C.
Humidity: Up to 95% RH to +30°C.

SG 5010 Specifications

Available Functions

Sine wave, Square wave, SMPTE/DIN 4:1, SMPTE/DIN 1:1, CCIF, Sine wave Burst, IHF Burst (-20 dB instead of OFF between bursts), External Input (Amplifier Mode).

Frequency Range and Accuracy

Sine wave, Sine wave Burst.

SMPTE/DIN:
10.00 Hz to 163.80 kHz ±0.01%.

CCIF Center Frequency:
2.500 kHz to 163.80 kHz ±0.01%.

Square wave:
10.00 Hz to 16.380 kHz ±0.01%.

Resolution:
10.00 Hz to 163.80 Hz — 0.01 Hz.
163.9 Hz to 1.6380 kHz — 0.1 Hz.
1.639 kHz to 16.380 kHz — 1.0 Hz.
16.39 kHz to 163.80 kHz — 10.0 Hz.

SMPTE Lower Tone, CCIF Offset From Center Frequency Selectable From:
40 Hz, 50 Hz, 60 Hz, 80 Hz, 100 Hz
125 Hz, 250 Hz, 500 Hz, all ±2%.

Sine Distortion

(Load ≥600 Ω THD including 2nd through 5th harmonics).
20 Hz to 20 kHz: 0.001% (-100 dB).
20 kHz to 50 kHz: 0.0032% (-90 dB).
10 Hz to 20 Hz & 50 kHz to 100 kHz: 0.01% (-80 dB).
100 kHz to 163.8 kHz: 0.032% (-70 dB), any individual harmonic.

SMPTE, DIN or CCIF Distortion

See System Specifications.

Sine Flatness

20 Hz to 20 kHz: ±0.05 dB.
l0 Hz to 163.8 kHz: ±0.2 dB.

Square wave Rise time

1.5 µs ±10%.

Burst Range

1 to 65535 cycles ON.
1 to 65535 cycles OFF.
OFF level either -20 dB or zero. All switching at sine wave zero crossing. Triggered, gated, or free-running burst modes available.

Output Level Range and Accuracy

Balanced:
open circuit: 200 µV to 21.2 V RMS.
into 600 Ω: -72.45 dBm to +28.05 dBm[1].

Unbalanced:
open circuit: 200 µV to 10.6 V RMS
into 600 Ω: -72.45 dBm to +22.05 dBm[1].

[1] *R_S = 50 Ω. For maximum available output from other impedances, subtract 1.25 dB for R_S - 150 Ω and 5.35 dB for R_S = 600 Ω.*

Resolution:
0.05 dB in dBm mode, typically 0.25% or better in volts mode.

Level Accuracy (Sine wave):
20 Hz to 20 kHz ±2.0% (0.2 dB).
10 Hz to 163.8 kHz ±3.0 (0.3 dB).

Output Impedance and Configuration

50 Ω ±3%, 150 Ω ±2%, or 600 Ω ±1%, balanced or unbalanced, floating or grounded.

External Input

A floating single-ended input is provided for accessing the variable gain stage and high level output amplifier, enabling the use of custom test signals. Input impedance is approximately 20 kΩ; a 2 V RMS input (2.83 V peak maximum) provides a calibrated output.

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Sync Output

A ground referenced TTL level signal is provided which allows stable oscilloscope display of all functions. In sine and square wave modes the output is at the signal frequency. In the IM modes the sync output is at the lower or offset frequency. In both burst modes the sync signal follows the burst envelope.

Sweep Mode

Linear or logarithmic sweep of amplitude or frequency in any function. Sweep is composed of discrete steps. The following sweep functions are programmable via IEEE-488 or from the front panel: swept parameter (frequency or amplitude), linear or log sweep, number of steps up to 99, time per step from 0.1 seconds to 25 seconds, start frequency or voltage, and stop frequency or voltage. Start and stop frequencies or voltages may be anywhere within the range of the generator, and sweep direction may be upward or downward. Pen lift and ramp outputs are available for interface to an analog plotter.

Stored Setups

Ten different complete front panel setups may be stored in the nonvolatile internal memory and recalled from front panel pushbuttons or via the IEEE-488 bus. Additionally, the front panel settings at power down are retained and used at power up.

Programmability

All functions, parameters, and modes may be controlled over the IEEE-488 bus using simple English-like commands (see back page for examples). All settings may be interrogated, with the resulting response usable as a command to return the instrument to that setting (LEARN mode). The IEEE-488 address may be displayed and changed from the front panel.

IEEE-488 Interface Function Subset

SH1	Source Handshake: Complete capability.
AH1	Acceptor Handshake: Complete capability.
T6	Basic Talker: Responds to serial poll; untalk if MLA is received.
L4	Basic Listener: Unlisten if MTA is received.
SR1	Service Request: Complete capability.
RL1	Remote-Local Function: Complete capability.
PP0	Parallel Poll: No capability.
DC1	Device Clear: Complete capability.
DT1	Device Trigger: Complete capability.
C0	No controller function.

Power Requirements

Occupies two compartments of a TM 5000 mainframe. The SG 5010 is also compatible with TM 500 mainframes following several mechanical changes easily performed by any qualified service technician. IEEE-488 programmability is not available in TM 500 mainframes.

AA 5001 Programmable Distortion Analyzer Specifications

Unless otherwise noted, all specifications apply with RMS detection only.

Harmonic Distortion Function

Fundamental Frequency Range:
10 Hz to 100 kHz, automatically tuned to input frequency.

Distortion Ranges:
Auto (100%), 20%, 2%, 0.2%, and dB (autoranging).

Accuracy:
20 Hz to 20 kHz ±1 dB.
10 Hz to 100 kHz ±2 dB.
(Accuracy is limited by residual THD+N and filter selection.)

Typical Fundamental Rejection:

At least 10 dB below specified residual THD+N or actual signal THD, whichever is greater.

Minimum Input Level: 60 mV (-22 dBm)

Residual THD+N: See System Specifications.

Level Function

Autoranging digital voltmeter displays input signal level in volts, dBm, or dB ratios.

Modes: Volts, dBm (600 Ω), or dB ratio with push-to-set zero dB reference.

Level Ranges: 200 µV full scale to 200 V full scale in ten steps, manual or autoranging.

Accuracy: Frequency	Volts	dBm or dB ratio
20 Hz to 20 kHz	±2% ±1 count	±0.3 dB* ±0.5% of reading
10 Hz to 100 kHz	±4% ±2 counts	±0.5 dB* ±0.5% of reading

**Vin ≥100 µV, level ranging indicators extinguished, ±0.2 dB at 1 kHz only. Flatness is ±0.1 dB, 20 Hz to 20 kHz, and ±0.3 dB, 10 Hz to 100 kHz.*

Bandwidth: ≥300 kHz.

Residual Noise:
≤ 3.0 µV (-108 dBm) with 80 kHz and 400 Hz filters, RMS response.
≤ 1.5 µV (-114 dBm) with "A" weighting filter, RMS response (standard instrument only).
≤ 5.0 µV (-104 dBm) with CCIR weighting filter, quasi-peak response (Option 02 instrument only).

Intermodulation Distortion Function

Fully automatic SMPTE, DIN and CCIF difference tone measurements.

Minimum Input Level: 60 mV (-22 dBm).

Accuracy: ±1 dB.

SMPTE and DIN Tests

Lower Frequency Range: 50 Hz to 250 Hz.

Upper Frequency Range: Usable from 3 kHz to 163.8 kHz.

Level Ratio Range: 1:1 to 4:1 (lower:upper)

Residual IMD: See System Specifications.

CCIF Difference Frequency Test

Frequency Range: Usable from 4 kHz to 163.8 kHz.

Difference Frequency Range: 80 Hz to 1 kHz.

Residual IMD: See System Specifications.

All Functions

Display: 3 1/2 digits resolution at approximately 3 readings per second.

Detection: Average or true RMS for waveforms with crest factors ≤3. Option 02 replaces average detector with quasi-peak detector complying with CCIR Recommendation 468-2 and DIN 45405.

Filters: 400 Hz High Pass: -3 dB at 400 Hz ±5%; 18 dB/octave slope, at least 40 dB rejection at 60 Hz.

80 kHz Low Pass: -3 dB at 80 kHz ±5%; 18 dB/octave slope.

Audio Bandpass: -3 dB at 22.4 Hz and 22.4 kHz, both ±5%. Complies with CCIR Recommendation 468-2 and DIN 45405.

"A" Weighting: Meets specifications for Type 1 sound level meters (ANSI S1.4, IEC Recommendation 179). Option 02 replaces "A" weighting filter with CCIR weighting filter complying with CCIR Recommendation 468-2 and DIN 45405.

EXT: Allows connection of external filters.

Input Type: Balanced (full differential).

Input Impedance: 100 kΩ ±2%, each side to ground.

Maximum Input: 300 Vpk, 200 V RMS either side to ground or differentially. Fully protected on all ranges.

Common-Mode Rejection: ≥50 dB at 50 or 60 Hz. Typically ≥40 dB to 300 kHz.

Programmability

Function (Level or THD or IMD).

Level Mode (Volts or dBm).

Input Level and Distortion Ranges (Autorange or default to range selected by front-panel switches).

Detector Type (RMS or AVG; or RMS or Q-PK on Option 02).

Filter Selection (400 Hz Hl PASS, 80 kHz LOW PASS, AUDIO BANDPASS, "A" WEIGHT (or CCIR WTG on Option 02, EXT FILTER).

IEEE-488 Interface Function Subset

SH1	Source Handshake: Complete capability.
AH1	Acceptor Handshake: Complete capability.
T6	Basic Talker: Responds to serial poll; untalk if MLA received.
L4	Basic Listener: Unlisten if MTA is received.
SR1	Service Request: Complete capability.
RL1	Remote-Local Function: Complete capability.
PP0	Parallel Poll: No capability.
DC1	Device Clear: Complete capability.
DT0	Device Trigger: No capability.
C0	No controller function.

Front Panel Signals

Input Monitor: Provides constant amplitude version of signal applied to input. Output voltage 1 V RMS ±10% for input signals greater than 50 mV. Source impedance 1 kΩ ±5%.

Function Output: Provides a scaled sample of selected function signal. Output voltage 1 V RMS ±3% for 1000 count display. Source impedance 1 kΩ ±5%.

Auxiliary Input: Provides input to detector circuit when EXT FILTER button is depressed. Sensitivity 1 V RMS ±3% = 1000 count display. Impedance 100 kΩ ±5%, ac coupled.

Rear Interface Signals

Duplicates of all front-panel inputs and outputs are provided to allow external filter connections or oscilloscope monitoring within same mainframe without exposed cables. Detector outputs with specified scale factors also available to drive analog chart recorders, storage oscilloscopes, or similar devices.

Power Requirements

Occupies two compartments of a TM 5000 mainframe.

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IEEE-4888 Commands

There are more than 140 total programming commands in the complete command sets for the SG 5010 and AA 5001. A few examples are shown below. While the full form of the commands shown is quite acceptable and will be operated upon by the instruments, it is also possible to truncate any command down to as little as the characters shown in bold face. Each programmer may thus choose the best compromise between program readability and minimum bus traffic.

SG 5010

FUnction **SI**ne	Selects sine wave
FUnction **SQ**uare	Selects square wave
FUnction**?**	Query; instrument responds with present function
AMPlitude < num >	Sets amplitude
DBm <num>	Sets amplitude in dBm
VPp < num >	Sets amplitude in volts peak-to peak
VRms < num >	Sets amplitude in volts rms
FRequency <num>	Sets frequency
IMfreq < num >	Sets SMPTE, DIN, or CCIF offset IM frequency
ONCycles < num >	Sets number of ON cycles for burst mode
STARTFreq <num>	Sets starting frequency for sweep operation
STOPVolts < num >	Sets stop rms volts for amplitude sweep operation
NSteps < num >	Sets number of steps from start to stop for sweep operation
STEptime < num >	Sets time per sweep step
BAlance	Sets output to balanced mode
UNbalance	Sets output to unbalanced mode
FLoat or **F**Lt	Sets output floating
GRound or **GN**d	Connects output center tap (balanced) or low side (if unbalanced) to ground

AA 5001

FUnc **THDP**ct	Sets THD mode percent
FUnc **THDD**b	Sets THD mode, dB
FUnc **DB**m	Sets level mode, dBm
SENd	Returns a reading
DUs **ON**	Tells SEND command to delay until reading is settled per setting algorithm
Points < num >	Sets number of points,1 to 6, which must be within settling algorithm "window" before reading is returned
TOl <num>	Sets tolerance "window" in percent
Counts <num>	Sets ± counts term of settling algorithm
REsp **AVG**	Selects AVG detector
FIlt **HP**	Enables high-pass filter
FIlt **W**tg	Enables weighting filter
FIlt **EX**t	Enables external filter
FPset	Sets instrument to front panel settings even though under remote control
SETings	Query, returns all programmable settings
ERR	Query, returns code for most recent error reported in serial poll

Ordering Information

AA 5001	Prgm. Distortion Analyzer
AA 5001/CCIR	AA 5001 w/CCIR/DIN
SG 5010	Prgm. Oscillator
TM 5003	3 Wide Power Module Mainframe, GPIB
TM 5003/RI	TM 5003 w/Rear Interface
TM 5006A	6 Wide Power Module Mainframe, GPIB
TM 5006A/R	TM 5006A w/Rack Mount
TM 5006A/RI	TM 5006A w/Rear Interface
TM 5006A/R/RI	TM 5006A w/Rack Mt & Rear Interface
TM 5006A/EMC	TM 5006A w/EMC Shielding

Mainframe Power Plug Options

Standard	120V North American
UE220	220V Universal Euro & Switzerland
UK240	240V United Kingdom
A240	240V Australian
NA240	240V North American
S220	220V Switzerland

Warranty

One year on materials and workmanship.

Calibration Documentation

Contact TEGAM for OPTION Z540 NIST Traceable Compliance Certificate and Test Data.

Calibration & Technical Services

For warranty and remedial repair, calibration services and spare parts, or for additional information on TEGAM sales and service offices around the world, contact us at 440-466-6100 (ph) or 440-466-6110 (fx).

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