Aim TTi

Measurably better value

DESIGNED IN THE UK · MANUFACTURED IN THE UK ·

- Extensive analog and digital modulations
- Amplitude range of -127dBm to +13dBm
- High signal purity
- Fast amplitude and/or frequency sweeps




# TGR2050 SERIES

## 1.5GHz & 3GHz RF Signal Generators

aimtti.com

# COMPREHENSIVE FEATURES

- 1.5GHz and 3GHz models
- Class leading signal purity
- Internal DDS baseband generator provided as logic LF output
- Fast amplitude and/or frequency sweeps
- Amplitude range of -127dBm to +13dBm
- Phase noise <-117dBc/Hz (typ.) at 1GHz output 10kHz offset
- Extensive analog and digital modulations*
- Compatible with previous Aim-TTi RF generators




GPIB IEEE-488 USB UNIVERSAL SERIAL BUS LAN ETHERNET LXI

The TGR2051 and TGR2053 are the next generation of RF signal generators from Aim-TTi, offering both exceptional performance and new improved functionality with touch screen operation.

The high performance RF generators provide high frequency accuracy and stability, large signal amplitude range, low phase noise and flexible analog and digital* modulation capabilities making it ideal for development, test and service work.

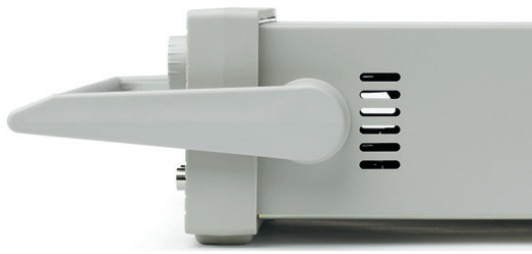
Advanced remote control accommodates sophisticated new automated systems and compatibility with Aim-TTI's previous RF instruments enables incorporation into existing systems.

With a small footprint and lightweight design and the best price point / performance ratio in its class, the TGR2050 series maintains Aim-TTi's reputation for high quality, reliable, great value products.

*Digital modulation available with option TGR-U01

## FEATURES SUMMARY

- 150kHz to 3GHz (TGR2053) and 150kHz to 1.5GHz (TGR2051) frequency range
- Frequency setting resolution of 10Hz at up to 3GHz (TGR2053) or 1.5GHz (TGR2051)
- Amplitude range of -127dBm to +13dBm
- 0.1dBm amplitude setting resolution.
  Amplitude can be set in dBm, dBµV or in linear Volts.
- High signal purity, phase noise <-117dBc/Hz (typical) at 1GHz output and 10kHz offset
- 1ppm frequency accuracy, <1ppm drift in first year
- 5ms sweep settling time
- User selectable low spur mode setting
- Internal or external analog modulations (AM, FM, PM)
- Internal or external digital modulations - ASK, OOK, FSK, 3FSK, 4FSK, GFSK, MSK, GMSK, HMSK & PSK.*
- Versatile digital modulation modes*- continuous or triggered
- Modulation Synchronisation
- Internal DDS baseband generator provided as logic LF output
- Modulation waveform output on the rear panel
- Internal waveforms include: Sine, Square, Ramp, Triangle, PRBS (various lengths) and user-defined pattern
- Fast amplitude and/or frequency sweeps with comprehensive triggering
- Simple and easy to operate with the colour and touch display
- Compatible with previous Aim-TTi RF generators
- SCPI compatible
- Programmable via USB, LAN (LXI) and GPIB (optional)
- Small case design (2U ½ rack), lightweight (3kg)







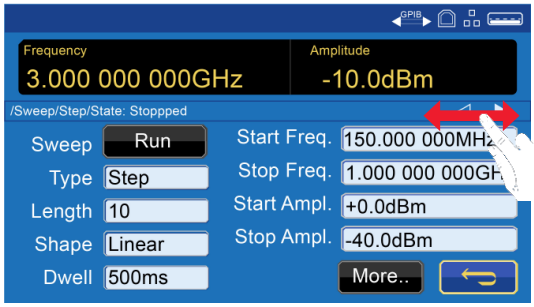


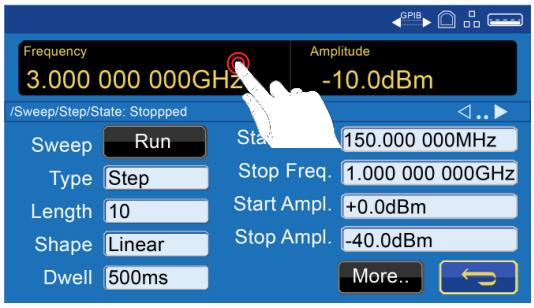
*Digital modulation available with option TGR-U01

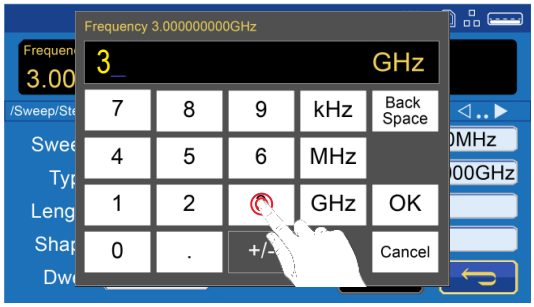
# ENHANCED FUNCTIONALITY

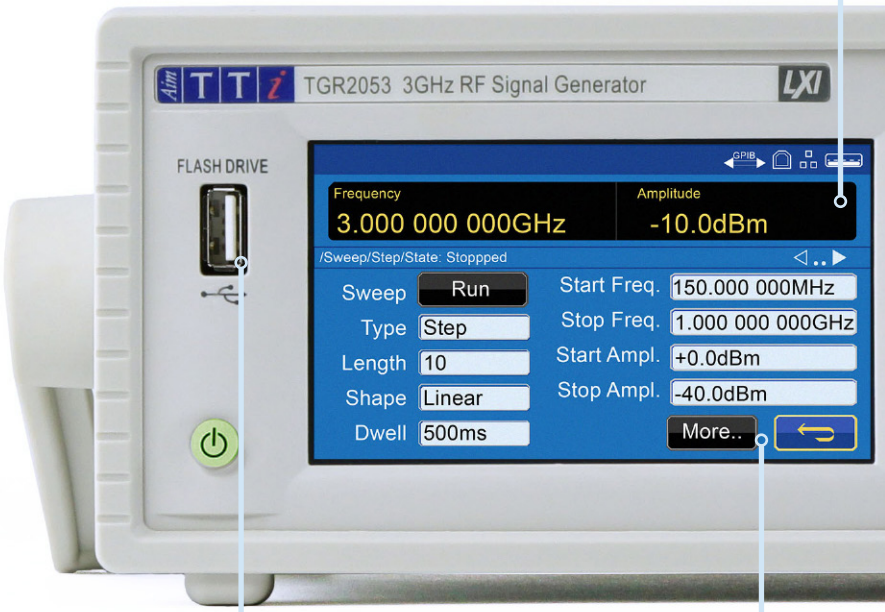
## GRAPHIC USER INTERFACE (GUI)

Both the TGR2051 and TGR2053 feature a simple and straightforward, user friendly, touch operated GUI. The 4.3 inch colour LCD screen displays key information alongside readings for added efficiency. Each parameter is directly editable from the menu screen, reducing the number of steps required to complete a setup. Parameters can also be edited using the hard keys and the rotary knob, providing ultimate flexibility.




### FLASH DRIVE

A front mounted USB flash drive allows full pre-defined complex setups, sweep lists and modulation patterns to be loaded into the instrument quickly and efficiently.

## SWEEP

The sweep function enables signals of varying frequency and/or amplitude to test a full range of input conditions, quickly and efficiently.

Step sweeps are created according to a formula over a specified number of points, in the range 2 - 1000 . Formula specifics include: start and stop values and dwell time following SYNC at each point. Sweeps can be set to run in either direction, with linear or logarithmic spacing.

Alternatively, list mode can be used to analyse the response at set frequencies and amplitude- dwelling on set values for specified amounts of time; useful for testing at known problematic frequencies within a setup.

The list can be created within the instrument or downloaded via the remote interfaces.

The sweep setups can either be run through as a single sweep or in a continuous loop and prompted by an internal, external or manual trigger.

Complex sweep triggering is available to control complete sweeps and/or each point within a sweep.




## WIDE AMPLITUDE RANGE

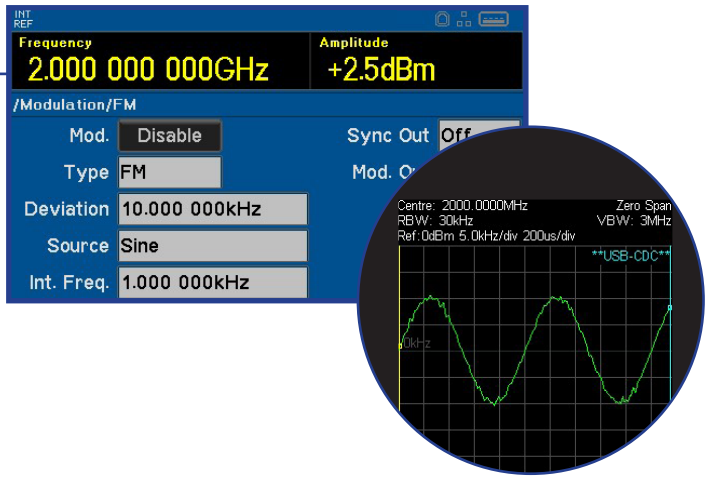
Output power levels of-127dBm to +13dBm from the N-type connector. 50V DC reverse voltage protection.

## MODULATION

### ▶ ANALOG MODULATION

A built-in DDS generator provides Sine, Square, +Ramp, -Ramp and triangle waves, these can be applied in the forms of AM, FM or PM from the internal modulation source; at frequencies ranging from 1mHz to 1MHz.

External analog modulation signals can be applied to the carrier waveform via the MOD in/out on the rear panel.




### ▶ DIGITAL MODULATION*

An extensive range of digital modulations available:

FSK, GFSK, MSK, GMSK, HMSK, 3FSK, 4FSK, PSK, ASK and OOK. Built in NRZ patterns include Square wave, 7, 9, 11 & 15-bit PRBS.

Digital modulation capabilities also include advanced filtering: Gaussian, Raised Cosine, Root Raised Cosine and Half Sine as well as Grey Code and Binary Encoding.

External digital modulation signals can be applied to the carrier waveform via the MOD in/out on the rear panel.




### ▶ INTERNAL MODULATION PATTERN

A user defined pattern generator is included, in which patterns can be created and used to modulate the carrier signal. This allows a uniquely tailored pattern of up to 16384 states to be created from the front panel, alternatively these can be imported using the digital interfaces or USB Flash drive port.

Digital modulation and modulation patterns can be continuous or triggered externally, internally, manually or remotely.

*Digital modulation available with option TGR-U01.

# INCREASED COMPATIBILITY




## SCPI COMPATIBLE

The TGR2050 series can be integrated into existing systems using the universal SCPI command set. An extensive library of commands can be used to simplify setups and automate systems, increasing productivity and reducing costs.

## LABVIEW & IVI DRIVER

An IVI-COM/IVI-C driver for Windows is included. This provides support for common high-level applications such as LabView*, LabWindows*, and Keysight VEE*.

## COMPATIBILITY

Upgrading existing test and measurement systems is simple with the new TGR2051 & TGR2053. They can seamlessly replace legacy Aim-TTi RF generators, TGR2050 and TGR1040, in an existing system using the legacy remote command sets.

## ACCESSORIES

This instrument can be rack mounted, a suitable 2U 19” rack kit is available from the manufacturers or their overseas agents.

lete setup

## STORAGE

4GB of non-volatile internal memory is provided for storing multiple setups, sweep lists, arbitrary modulation patterns and more. Up to 1000 complete setups can be stored internally.

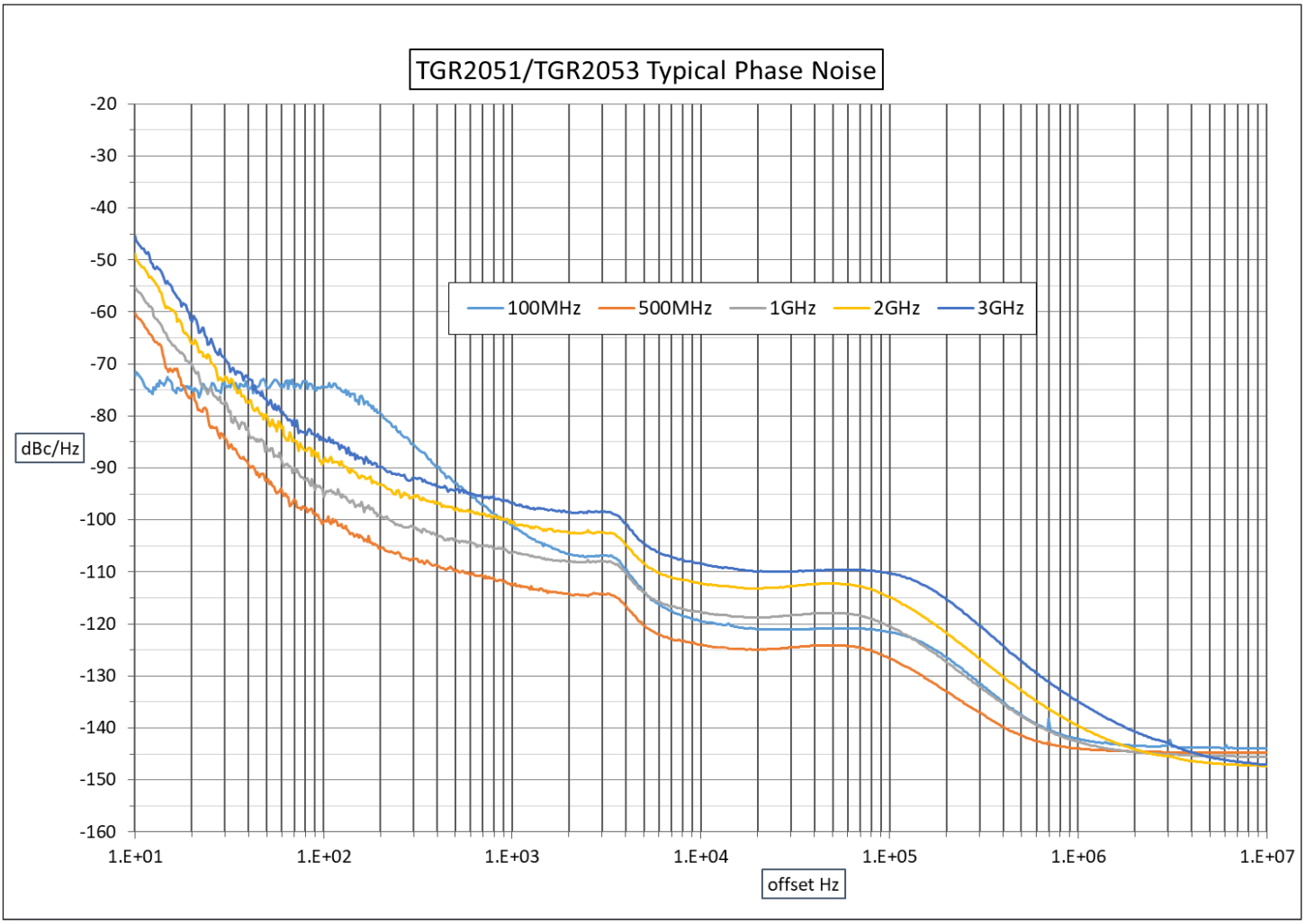
* LabView and LabWindows are trademarks of National Instruments Keysight VEE is a trademark of Keysight Technologies. Windows is a trademark of Microsoft.

** GPIB optional

# TECHNICAL SPECIFICATIONS

## FREQUENCY

| | |
|---|---|
| Frequency Range: TGR2053<br>TGR2051 | 150kHz – 3000MHz<br>150kHz – 1500MHz |
| Setting Resolution: | 10Hz |
| Setting Resolution Low Spur mode: | 1MHz |
| Accuracy/stability: | see Reference Frequency |
| Phase Noise: | 500MHz Carrier: <-124dBc/Hz (typ) @ 10KHz offset<br>1GHz Carrier: <-117dBc/Hz (typ) @ 10kHz offset<br>See chart below |
| Residual FM: | <2 Hz @ 1GHz - Equivalent peak deviation in a 300Hz to 3.4kHz bandwidth. |



# FREQUENCY

## REFERENCE FREQUENCY

| | |
|---|---|
| Internal Reference Accuracy: | <± 1ppm, 15ºC – 30ºC<br><± 2ppm, 5ºC – 40ºC |
| Internal Reference Stability: | <1ppm/year |
| Reference IN & OUT: | Both can be disabled when not required. |
| Reference IN<br>Rear Panel BNC: | 10MHz +/- 25ppm, 50Ω input impedance, 2 - 5Vpp<br>Automatic detection and selection when an external reference signal is present and Ref. Clock is selected to be EXTERNAL.<br>LCD status indicator shows when external reference is active. |
| Reference OUT<br>Rear panel BNC: | 10MHz, 50Ω output impedance, >2Vpp into 50Ω<br>The active reference signal (from internal or external source) is present when Ref. Clock Out is selected to be ON. |

## OUTPUT LEVEL

| | |
|---|---|
| Output Level Range: | –127dBm to +13dBm |
| Setting Resolution: | 0.1dB, 0.01uV –1mV |
| Accuracy: | ±1dB output levels > -53dBm<br>±2dB output levels <= -53dBm |
| Additional Uncertainty<br>AM, ASK & OOK ON: | +/-0.5dB |
| Harmonically Related Signals: | <-25dBc @ +13dBm, <-30dBc@levels <=0dBm |
| Non-harmonic Spurii: | <–50dBc >10kHz offset 1.5GHz – 3GHz<br><-56dBc > 10kHz offset 150KHz - 1.5GHz |
| Output Impedance: | 50Ω |
| VSWR: | <2.0 typ <=1.6 |
| RF Output Connector: | Type N Female |
| Reverse Voltage Protection: | 50V DC |
| Output Switch: | RF OUT On/Off switch with LED showing ON status |

# ANALOG MODULATION

## SOURCE

| | |
|---|---|
| Internal: | DDS generator providing<br>sine, square, + Ramp, - Ramp, triangle<br>1mHz – 1MHz, Resolution 1mHz |
| | Signal available at MOD IN/OUT, 150Ω source impedance |
| External: | 100Hz – 1MHz, 1dB relative to 1kHz, 1Vp-p for full scale |
| | 10kΩ input impedance AC coupled |

## FREQUENCY MODULATION

| | |
|---|---|
| Deviation: | 1mHz – 1MHz subject to carrier frequency |
| Deviation Setting Resolution: | 1mHz |
| Deviation Accuracy: | Ref freq accuracy +/- 1mHz for internal modulation<br>±2% for external modulation @ 1kHz, 1V p-p |
| Distortion: | <1% @ 1kHz modulation, 300 – 3.4kHz bandwidth. |

## PHASE MODULATION

| | |
|---|---|
| Deviation: | 0 - 25.00 rad |
| Deviation Setting Resolution: | 0.01 rad |
| Deviation Accuracy: | Ref freq accuracy ±0.1rad for internal modulation<br>±2% for external modulation @ 1kHz, 1V p-p |
| Distortion: | <1% @ 1kHz modulation, 300 – 3.4kHz bandwidth |

## AMPLITUDE MODULATION (LEVELS ≤+7DBM)

| | |
|---|---|
| Modulation Depth: | 0 – 100% |
| Setting Resolution: | 0.1% |
| Accuracy: | ±1% for internal modulation<br>±2% for external modulation @ 1kHz, 1V p-p |
| Distortion: | ≤1% @ ≤90% depth |

# DIGITAL MODULATION **

## SOURCE

| | | |
|---|---|---|
| Internal: | NRZ Patterns: | Square Wave, User Defined Pattern, 7-bit PRBS, 9-bit PRBS, 11-bit PRBS, 15-bit PRBS. |
| | User Defined Pattern: | 16384 states can be created in the instrument or downloaded via the remote interfaces. |
| | Bit rate: | 1mbits/sec – 1Mbits/sec |
| | Modulation signal available at MOD IN/OUT, 150 Ω source impedance | |
| External: | Input via MOD IN/OUT: | DC – 1Mbits/sec, >=2Vp-p, logic threshold +1.5V nominal. |
| | | 10kΩ input impedance |

## INTERNAL MODULATION PATTERN TRIGGER

| | | | |
|---|---|---|---|
| Source: | External +ve edge, External –ve edge, Manual, via remote interface or Internal. | | |
| | Internal trigger repeats at a programmable rate of 1 per 1us – 999.999999s | | |
| Modes: | Immediate: | Modulation starts immediately. | |
| | Triggered: | Modulation waits for a trigger event. | |
| Trigger Types: | Infinite: | First trigger event starts the modulation pattern, which repeats indefinitely. | |
| | Finite: | Each trigger event starts one modulation pattern (one ‘block’) or a count of bits in the modulation pattern. The bit count is programmable and can be greater than a pattern length. | |
| | | Bit count range: | 1 – 2^31 |
| Trigger Delay: | <500ns from specified edge of external trigger signal to modulation start. | | |

## INTERNAL MODULATION PATTERN SYNC

| | |
|---|---|
| Signal available from the rear panel SYNC BNC to synchronise internally produced modulation patterns. | |
| SYNC modes: | OFF, Start, Bit Rate, Bit Rate/2 |
| SYNC polarity: | High going SYNC pulse |
| Start SYNC: | SYNC pulse 1 bit period wide at the start of the modulation pattern. |
| Bit Rate SYNC: | ½-bit period wide pulses at the modulation bit rate repeated indefinitely or for a programmed repeat count from the start of the modulation pattern in triggered mode. |
| Bit Rate/2 SYNC: | As for Bit Rate SYNC but at half the modulation bit rate. |

** Digital modulations available with TGR-U01 option (see Option TGR-U01).

# DIGITAL MODULATION **

## FREQUENCY SHIFT KEYING

| | | |
|---|---|---|
| Modes: | FSK, GFSK, MSK, GMSK, HMSK, 3FSK, 4FSK<br>Continuous phase frequency modulation. | |
| Filter Settings: | None, Gaussian (BT=0.3, 0.5 or 0.7), Raised Cosine (α =0.5 or 0.7), Root Raised Cosine (α =0.5 or 0.7), Half sine. | |
| Deviation: | 1mHz – 1MHz subject to carrier frequency | |
| Deviation Setting Resolution: | 1mHz | |
| Deviation Accuracy: | Ref freq accuracy ±1mHz for internal and external modulation | |
| 4FSK Encoding: | Gray Code or Binary. | |
| Encoding Synchronisation<br>Internal Modulation Source: | 3FSK | Start SYNC output indicates the start of encoding |
| | 4FSK | Bit Rate/2 SYNC output indicates the start of encoding |
| Encoding Synchronisation<br>External Modulation Source: | 3FSK<br>4FSK | The external Trigger input can be used to define the start of encoding for both. |

## PHASE SHIFT KEYING

| | |
|---|---|
| Modes: | PSK |
| Deviation: | 0 - 25.00 rad |
| Deviation Setting Resolution: | 0.01 rad |
| Deviation Accuracy: | Ref freq accuracy ±0.1 rad for internal and external modulation |

## AMPLITUDE SHIFT KEYING (ASK)

| | |
|---|---|
| ASK Depth: | 0 - 100% |
| Setting Resolution: | 0.1% |
| Accuracy: | ±1% for internal and external modulation |
| Internal Rate: | 1mb/s - 1Mb/s |
| External Rate: | DC – 1Mb/s |

## ON-OFF KEYING (OOK) (BASIC PULSE MODULATION)

| | |
|---|---|
| On-Off Ratio: | >80dB |
| External Input: | Logic high = Carrier On |
| Internal Rate: | 1mB/s - 1Mb/s |
| External Rate: | DC – 1Mb/s |
| Rise/Fall Time: | 50ns |

** Digital modulations available with TGR-U01 option (see Option TGR-U01).

## FREQUENCY and AMPLITUDE SWEEP

| | |
|---|---|
| Frequency settling time to within 100Hz or 0.1ppm of final frequency if greater: | <5ms*, typ <2ms |
| Amplitude settling time to within 0.2dB: | <5ms*, typ <4ms |
| Rear panel SYNC pulse width (defines guaranteed settling period): | 5ms * |
| *Settling time and SYNC pulse width is extended to 15ms for all points in the sweep if the frequency crosses 250.00000MHz between any points in the sweep. | |

### STEP SWEEP

| | |
|---|---|
| Step frequency and/or amplitude according to a formula over a specified number of points. | |
| Number of Points: | 2 - 1000 |
| Formula specifies: | Sweep Start and Stop Frequencies |
| | Sweep Start and Stop Amplitudes |
| | Dwell time following SYNC at each point |
| Dwell Time: | 0.01 – 10.000sec |
| Sweep Mode: | Continuous or Single |
| Sweep Direction: | Up or Down |
| Sweep Point Spacing: | Linear or Logarithmic |
| Sweep Trigger : (Sweep start held until trigger event) | Manual, ext signal +ve or –ve edge, timed (0.01 – 999.9sec) or via remote interface |
| Point Trigger : (Sweep point stepping held until trigger event) | Manual, ext signal +ve or –ve edge, or via remote interface |
| Point Trigger timing: | >=10ms after SYNC signal |
| SYNC signal (‘output stable’): | Available after output has settled at each point until next point. Programmable high or low logic. |

### LIST SWEEP

As for Step Sweep except that a user defined table of frequency, amplitude and dwell time values defines the points. The table can be created within the instrument or downloaded via the remote interfaces.

Max 1000 points.

## TRIGGER INPUT

Rear panel BNC accepts logic trigger signal for sweeps and modulation.

Trigger logic threshold: +1.6V

## REMOTE CONTROL INTERFACES

Full digital remote control facilities are available through the USB, LAN and GPIB (optional) interfaces using a SCPI style command set.

| | |
|---|---|
| USB: | Standard USB 2.0 hardware connection. Operates as a virtual COM port. |
| LAN: | Ethernet 100/10base-T hardware connection. |
| GPIB (optional): | Conforming with IEEE488.1 and IEEE488.2 |

Settling time from remote command:

Frequency settling time to within 100Hz or 0.1ppm of final frequency if greater: <=15 ms typ <7ms

Amplitude settling time to within 0.2dB: <=15ms typ <4ms

## USB HOST INTERFACE

Front panel USB host interface for connection of USB Flash drives. Allows unlimited storage and transfer of instrument setups, sweep lists and user defined modulation patterns.

## OPTION TGR-U01

Makes available all digital modulation schemes with full trigger and SYNC capabilities listed under 'DIGITAL MODULATION'.

## GENERAL

| | |
|---|---|
| Power: | 85…264Vac, 47…63Hz, 35VA max. Installation Category II.<br>Standby <0.5W |
| Display: | 4.3 inch (10.9 cm) backlit TFT LCD, 480 x 272 pixels total, 16 colours, resistive touch screen. |
| Data Entry: | Multiple entry methods; keyboard or touch screen selection of all major functions; edit field selection by screen touch or rotary control; value entry by keyboard, rotary control or touch screen; frequency and amplitude adjustable by value entry, character scrolling, user defined step values or a combination. |
| Storage: | 4G bytes internal storage available for 1000's of instrument setups, sweep lists and user defined modulation patterns. |
| Operating Range: | +5°C to +40°C, 20 - 80% RH |
| Storage Range: | –20°C to + 60°C |
| Environmental: | Indoor use at altitudes up to 2000m, Pollution Degree 2. |
| EMC: | Complies with EN61326 |
| Safety: | Complies with EN61010-1 |
| Size: | 2U high, half rack width. |
| Weight: | 3 kg |
| Options: | 19-inch rack mounting kit. |

# RF & EMC TEST EQUIPMENT



## PSA1302

| |
|---|
| SPECTRUM ANALYSER |
| 1MHz to 1.3GHz |
| 8HRS Battery life |
| 0.56KG |
| RS-232 |



## PSA2702

| |
|---|
| SPECTRUM ANALYSER |
| 1MHz to 2.7GHz |
| 8HRS Battery life |
| 0.56KG |
| RS-232 |



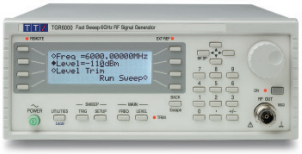
## PSA3605

| |
|---|
| SPECTRUM ANALYSER |
| 10MHz to 3.6GHz |
| 3.5HRS Battery life |
| 0.56KG |
| RS-232 |



## PSA6005

| |
|---|
| SPECTRUM ANALYSER |
| 10MHz to 6GHz |
| 3.5HRS Battery life |
| 0.56KG |
| RS-232 |



## TGR6000

| |
|---|
| RF SIGNAL GENERATOR |
| 10MHz to 6GHz |
| -110dBm to +7dBm |
| Sweep modes |
| RS232, USB, LAN, GPIB |



## TGR2051

| |
|---|
| RF SIGNAL GENERATOR |
| 150kHz to 1.5GHz |
| -127dBm TO +13dBm |
| Modulation & Sweep modes |
| RS232, USB, LAN, GPIB* |



## TGR2053

| |
|---|
| RF SIGNAL GENERATOR |
| 150kHz to 3GHz |
| -127dBm TO +13dBm |
| Modulation & Sweep modes |
| RS232, USB, LAN, GPIB* |



## HA1600A

| |
|---|
| HARMONICS ANALYSER |
| EN61000-3-2/3 TESTING |
| TABULAR & HISTOGRAM |
| PC SOFTWARE |
| RS-232, USB |



## AC1000A

| |
|---|
| LOW-DISTORTION SOURCE |
| EN61000-3-2 TESTING |
| 1kw |
| |
| - |

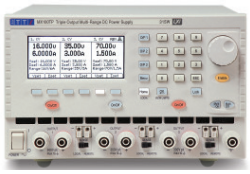
*GPIB optional

# OTHER RANGES AVAILABLE

## POWER SUPPLIES & LOADS



LINEAR POWER SUPPLIES



MIXED-MODE POWER SUPPLIES



POWERFLEX POWER SUPPLIES



ELECTRONIC DC LOADS

- 30w to 1200w Single and Multi channel PSUs for bench-top or remote control and system use.
- Flexible electronic DC loads for general purpose applications.

## WAVEFORM GENERATORS



PULSE GENERATORS



ANALOG FUNCTION GENERATORS



DIGITAL FUNCTION GENERATORS



ARBITRARY GENERATORS

- Analog and Digital (DDS) function generators with frequency capability up to 240MHz.
- Dedicated pulse generators with true pulse capability.
- True variable-clock arbitrary generators with up to four channels.

## PRECISION MEASUREMENT



MULTIMETERS



POSITIONAL CURRENT PROBES



FREQUENCY MEASUREMENT



COMPONENT MEASUREMENT

- Bench-top digital multimeters for dual display, system and logging.
- Innovative DC to 5MHz current probes for PCB tracks.
- Handheld and bench-top frequency counters up to 6GHz.
- Precision component measurements.

Visit www.aimtti.com for full ranges and further information.

## EXCELLENCE THROUGH EXPERIENCE

**Aim-TTi is the trading name of Thurlby Thandar Instruments Ltd. (TTi), one of Europe's leading manufacturers of test and measurement instruments.**

**The company has wide experience in the design and manufacture of advanced test instruments and power supplies built up over more than thirty years.**

**The company is based in the United Kingdom, and all products are built at the main facility in Huntingdon, close to the famous university city of Cambridge.**

## TRACEABLE QUALITY SYSTEMS

**TTi is an ISO9001 registered company operating fully traceable quality systems for all processes from design through to final calibration.**

bsi. ISO 9001 Quality Management

**ISO9001:2015**

**Certificate number FM 20695**

## WHERE TO BUY AIM-TTI PRODUCTS

**Aim-TTi products are widely available from a network of distributors and agents in more than sixty countries across the world.**

**To find your local distributor, please visit our website which provides full contact details.**

**www.aimtti.com**

**Designed and built in Europe by:**

TTi ltd

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