



# THURLBY THANDAR INSTRUMENTS

## TGR1040 & 2050



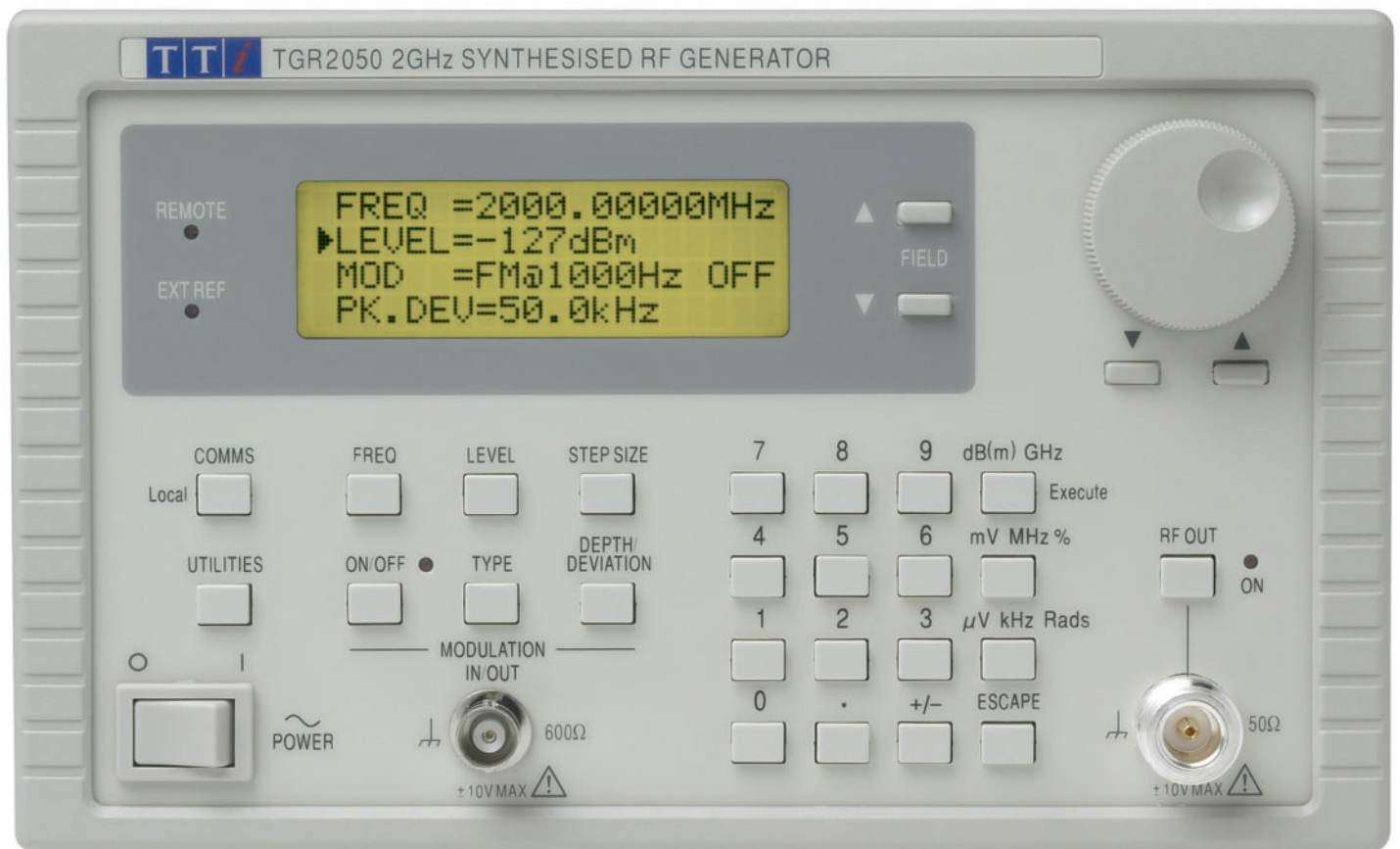
1GHz and 2GHz synthesised RF generators

*high stability and low phase noise*

*wide amplitude range and low leakage*

*flexible signal modulation capabilities*

# TGR Series low-cost synthesised RF generators



## Overview

The TGR series are low cost, synthesised RF signal generators that incorporate the essential features required for most development, test and service work; namely high frequency accuracy and stability, wide dynamic range, low phase noise and leakage, and flexible modulation capabilities.

The TGR2050 covers from 150kHz up to 2GHz and incorporates AM, FM and Phase modulation (internal and external).

The wide frequency range and comprehensive modulation capabilities make it suitable for most tasks within the 2GHz spectrum.

The TGR1040 has a more restricted frequency range of 10MHz to 1GHz and incorporates FM modulation only (internal and external). It retains the high stability and wide amplitude range of the 2050 making it suitable for many tasks including FM radio receiver sensitivity measurements, system gain measurements, receiver tuning & alignment, oscillator substitutions, EMC/antenna/field strength measurements and as a signal source for many other RF circuit and system development tasks.

Both instruments can be operated using either numeric or rotary controls, and can be remotely controlled via either an RS-232 interface or GPIB interface. Nine memories are provided for user set-ups.

## TGR Series

- ▶ *Stability of 10Hz in up to 2GHz (TGR2050)*
- ▶ *Accuracy better than 1 ppm over 15°C to 30°C*
- ▶ *Ageing better than 1 ppm over one year*
- ▶ *External frequency locking (TGR2050)*
- ▶ *Low phase noise and low leakage*
- ▶ *Amplitude range of -127dBm to +7dBm*
- ▶ *Amplitude entry in dBm or  $\mu\text{V}$  / mV*
- ▶ *Amplitude stability of 0.1dBm or 0.01 $\mu\text{V}$*
- ▶ *FM, Phase and AM modulation (TGR2050)*
- ▶ *Direct numeric entry or rotary control with user settable frequency/amplitude increments*
- ▶ *Non-volatile storage for 9 generator set-ups*
- ▶ *Full remote control via RS-232 or GPIB*
- ▶ *Unmatched price/performance ratio*

# TGR2050 - 150kHz to 2000MHz

# TGR1040 - 10MHz to 1000MHz

## Lower cost through innovative design

The TGR series sets a new price standard for high performance RF generators. Advanced design techniques utilising the latest component technologies have made this possible.

The low cost makes it possible for every engineer involved in RF design, manufacture or testing to have a generator of their own.

## High Precision and Stability

The TGR series uses a fully synthesised source locked to a temperature compensated crystal oscillator. This provides excellent signal frequency stability against temperature and ageing. The TGR2050 adds the further capability of locking to an external 10MHz source.

The frequency can be set to a resolution of 10Hz across the whole frequency range (1kHz resolution on TGR1040).

Frequency steps can be set to any value and stepping can be done with up/down keys or the rotary encoder.

The frequency stepping system makes operations such as precise amplitude response characterisation particularly easy.

## Wide Amplitude Range & Low Leakage

The TGR series provides an amplitude range of  $-127\text{dBm}$  to  $+7\text{dBm}$  ( $0.1\mu\text{V}$  to  $500\text{mV}$  into  $50\Omega$ ). Setting resolution is  $0.1\text{dBm}$  or  $0.01\mu\text{V}$ .

Output level steps can be set anywhere between  $0.1\text{dBm}$  and  $100\text{dBm}$  (or  $0.01\mu\text{V}$  to  $100\text{mV}$  depending on the entry mode). Stepping the level is useful for quick assessment of circuit linearity and dynamic range for instance.

The advanced attenuator design provide excellent flatness over the whole frequency range.

Meticulous internal screening provides very low output leakage enabling accurate low level measurements in sensitive circuits such as receivers.

## Ease of use

The TGR series incorporates a simple and straightforward user interface.

The back-lit four line display shows all the major signal parameters simultaneously. Data can be entered numerically using 0 - 9 keys or can be incremented/decremented using up/down keys or the rotary encoder. Both frequency and output level can be adjusted in steps of user programmed size.

Output level can be set either in dBm or linear units of  $\mu\text{V}$  or mV. A single button press will translate from one to the other.

The TGR series can store nine full instrument set-ups in non-volatile memory. This allows repetitive testing procedures to be undertaken quickly and accurately.

## Full remote control

The TGR series provides full remote control facilities for all its functions using both RS-232 and GPIB (IEEE-488.2) interfaces. (GPIB is an option for the TGR1040).

## Comprehensive Modulation

The TGR2050 offers AM, FM and Phase modulation using either an internal or external source.

Wide modulation range and low distortion make the TGR2050 suitable for most modulated signal test procedures.

The TGR1040 provides FM modulation only using either an internally generated modulator signal or an external signal in the range 300Hz to 50kHz.

This wide bandwidth allows for audio band demodulator testing as well as LF digital modulation.

## Technical Specifications

### TGR1040 - FREQUENCY

Frequency Range:	10MHz to 1000MHz
Setting Resolution:	1kHz by direct keyboard entry, or in user-set increments of 1kHz to 999.999MHz.
Display Resolution:	1kHz
Accuracy:	$< \pm 1$ ppm over temperature range $15^\circ\text{C}$ to $30^\circ\text{C}$ $< \pm 2$ ppm over temperature range $5^\circ\text{C}$ to $40^\circ\text{C}$ . $< \pm 1$ ppm/year ageing.
Stability:	
Phase Noise:	$-110\text{dBc/Hz}$ at 25kHz offset, 500MHz carrier.
Residual FM: (FM Off)	Equivalent peak deviation in a 300Hz to 3.4kHz bandwidth: 17Hz at 500MHz carrier.

### TGR1040 - OUTPUT LEVEL

Output Level Range:	$-127\text{dBm}$ to $+7\text{dBm}$ ( $0.1\mu\text{V}$ to $500\text{mV}$ into $50\Omega$ ).
Setting Resolution:	$0.1\text{dB}$ (or $0.01\mu\text{V}$ to $1\text{mV}$ ) by direct keyboard entry, or in user-set increments of $0.1\text{dB}$ to $100\text{dB}$ (or $0.01\mu\text{V}$ to $100\text{mV}$ ).
Accuracy:	Better than $\pm 2\text{dBm}$ , except for output levels $< -70\text{dBm}$ at 500 - 1000 MHz, $\pm 3\text{dBm}$ .
Harmonics:	Typically $< -25\text{dBc}$ , maximum $-20\text{dBc}$ , any carrier frequency, output level $< 0\text{dBm}$ .
Non-Harmonic Spuri:	$\leq -60\text{dBc}$ at $\geq 8\text{kHz}$ offset.
Carrier Leakage:	$< 0.5\mu\text{V}$ generated into a $50\Omega$ load by a 2 turn 25mm loop, at a distance of 25mm from the generator with the output set to $< -10\text{dBm}$ into a $50\Omega$ sealed load.
Output Type:	Output impedance $50\Omega$ , Type N connector, Reverse protection 50V DC.
Output Switch:	RF OUT on-off switch with LED showing ON status.

### TGR1040 - FM MODULATION

Peak Deviation:	0.5kHz to 100kHz.
Setting Resolution:	0.5kHz.
Modulation Frequency:	Internal 1kHz; External 300Hz to 50kHz
Deviation Accuracy:	$< \pm 10\%$ of setting $\pm 0.5\text{kHz}$ , excluding residual FM, for 1kHz modulation, internal or 1Vrms external.
External Modulation	
Frequency Response:	$\pm 1\text{dB}$ from 300Hz to 50kHz relative to 1kHz.
Distortion:	$< 2\%$ total harmonic distortion at 1kHz modulating frequency, 100kHz deviation and 500MHz carrier.
Input Type:	BNC connector, input impedance $100\text{k}\Omega$

### TGR1040 - FURTHER SPECIFICATIONS

Specifications for Bus Interfaces, Power Requirement, Mechanical Details etc. are given on the rear page.

# Technical Specifications (continued)

## TGR2050 - FREQUENCY

Frequency Range: 150kHz to 2000MHz  
Setting Resolution: 10Hz by direct keyboard entry, or in user-set increments of 10Hz to 999-99999MHz.  
Display Resolution: 10Hz.  
Frequency Accuracy: See Frequency Reference specifications.  
Phase Noise: -116dBc/Hz at 25kHz offset, 500MHz carrier.  
Residual FM: Equivalent peak deviation in a 300Hz to 3-4kHz bandwidth: 10Hz at 500MHz carrier.

## TGR2050 - REFERENCE FREQUENCY

Options: Internal or External (via rear panel BNC).  
Internal Accuracy:  $\leq \pm 1$  ppm over temperature range 15°C to 30°C ( $\leq \pm 2$  ppm over temperature range 5°C to 40°C).  
Internal Stability:  $\leq \pm 1$  ppm per year.  
Internal Ref. Out: 10MHz from 50Ω, amplitude 2V pk-pk into 50Ω.  
External Ref In: 10MHz into 50Ω, amplitude 2V pk-pk to 5V pk-pk.

## TGR2050 - OUTPUT LEVEL

Output Level Range: -127dBm to +7dBm (0-1μV to 500mV into 50Ω), -127dBm to +1dBm in AM mode.  
Setting Resolution: 0-1dB (or 0-01μV to 1mV) by direct keyboard entry, or in user-set increments of 0-1dB to 100dB (or 0-01μV to 100mV).  
Accuracy: Better than  $\pm 2$  dBm.  
Harmonics:  $< -25$  dBc @ +7dBm.  
Sub-Harmonics:  $< -25$  dBc at +7dBm.  
Non-Harmonic Spurious:  $< -60$  dBc at  $\geq 62.5$  MHz,  $< -50$  dBc at  $< 62.5$  MHz.  
Carrier Leakage:  $< 0.5$  μV generated into a 50Ω load by a 2 turn 25mm loop, at a distance of 25mm from the generator with the output set to  $< -10$  dBm into a 50Ω sealed load.  
Output Type: Output impedance 50Ω, Type N connector.  
Reverse Protection: 50V DC, up to 25W from 50Ω source, LED indication.  
Output Switch: RF OUT on-off switch with LED showing ON status.

## TGR2050 - MODULATION

### Modulation Source

Type: Internal from built-in sine wave generator, or external from front panel BNC.  
Internal: 400Hz or 1kHz sine, signal also available as an output.  
External: Calibrated for 1V rms sine, input impedance 600Ω.

### Frequency Modulation

Max Peak Deviation: See Table.  
Setting Resolution: 0.5 kHz.  
Deviation Accuracy:  $\leq \pm 10\% \pm 0.5$  kHz for 1kHz Internal or 1kHz / 1Vrms External Modulation.  
External Modulation: 100Hz - 300kHz ( $\pm 2$  dB relative to 1kHz).  
Distortion:  $< 2\%$  @ 1kHz modulation, max. deviation (300-3.4kHz bandwidth).

### Phase Modulation

Max Peak Deviation: See Table.  
Setting Resolution: 0.05 rads for  $< 10.0$  rads deviation, 0.1 rads for  $\geq 10.0$  rads deviation.  
Deviation Accuracy:  $\leq \pm 10\% \pm 0.05$  rads for 1kHz Internal or 1kHz / 1Vrms External Modulation.  
External Modulation: 100Hz - 10kHz ( $\pm 2$  dB relative to 1kHz).  
Distortion:  $< 2\%$  @ 1kHz modulation, max. deviation (300-3.4kHz bandwidth).

### Max. Peak Deviation versus Carrier Frequency

	Frequency Mod.	Phase Modulation
1000MHz - 2000MHz	800kHz	80.0 rads
500MHz - 1000MHz	400kHz	40.0 rads
250MHz - 500MHz	200kHz	20.0 rads
125MHz - 250MHz	100kHz	10.0 rads
62.5MHz - 125MHz	50kHz	5.0 rads
150kHz - 62.5MHz	100kHz	10.0 rads

## Amplitude Modulation

Max Mod. Depth: 100%  
Setting Resolution: 0.5%.  
Deviation Accuracy:  $\leq \pm (5\% \text{ setting} + 1\%)$  for 1kHz Internal or 1kHz / 1Vrms External Modulation.  
External Modulation: 50Hz - 200kHz ( $\pm 1$  dB relative to 1kHz).  
Distortion: 150kHz to 1GHz -  $\leq 3\%$  @ 30%,  $\leq 5\%$  @ 70%  
1GHz to 2GHz -  $\leq 5\%$  @ 30%,  $\leq 10\%$  @ 70%  
@ 1kHz modulation, max. deviation (300-3.4kHz bandwidth).

## TGR1040/2050 - BUS INTERFACES

Full remote control facilities are available through both RS232 and GPIB interfaces (RS232 included on both units, GPIB included on TGR2050 and optional on TGR1040).

RS232: Variable Baud rate, 19200 Baud maximum, 9-pin D-connector. Fully compatible with TTI ARC (Addressable RS232 Chain) system.

GPIB (IEEE-488): Conforming with IEEE488-1 and IEEE488-2.

## TGR1040/2050 - GENERAL SPECIFICATIONS

### General

Display: 20 character x 4 row backlit alphanumeric LCD  
Data Entry: Keyboard selection of frequency, amplitude, etc.; value entry direct by numeric keys or by rotary control.  
Stored Settings: Up to 9 complete instrument set-ups may be stored and recalled from battery-backed memory.

### Mechanical

Size: 130mm (3U) H; 212mm (half-rack) W; 330mm D.  
Weight: 4-6 kg. (10 lb)

### Power Requirements

220V to 240V  $\pm 10\%$  or 100V or 110V to 120V  $\pm 10\%$  50/60Hz, adjustable internally; 30VA max. Installation Category II.

### Temperature & Environmental

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.

### Safety & EMC

Safety: Complies with EN61010-1.  
EMC: Complies with EN61326.

## MODEL RANGE

**Models Available:** TGR1040 (includes RS-232 interface).  
TGR1040GP (includes RS-232 and GPIB interfaces).  
TGR2050 (includes RS-232 and GPIB interfaces).

**Options:** 19 inch rack mounting kit.

Specifications apply after 30 minute warm-up, ambient 5°C to 40°C

Thurlby Thandar Instruments Ltd. operates a policy of continuous development and reserves the right to alter specifications without prior notice.

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