Note that specifications apply to 50MHz models (TG5011A and TG5012A) and that specifications for 25MHz models (TG2511A and TG2512A), where different, are in (dark red).
For two channel models (TG5012A and TG2512A) specification apply to each output.

STANDARD WAVEFORMS

SINE

Note that purity specifications above 25MHz apply only to the TG5011A & TG5012A.

Frequency Range:	1µHz to 50MHz (1µHz to 25MHz)
Frequency Resolution:	1µHz, 14 digits
Output Level:	10mVp-p to 10Vp-p into 50 Ω
Amplitude Flatness	
Relative to 1kHz:	<100kHz 0.1dB, <5MHz 0.15dB, <25MHz 0.3dB, <50MHz 0.5dB

Harmonic Distortion:

	≤ 1 Vp-p	≥ 1Vp-p
DC to 20kHz	-65dBc	-65dBc
20kHz to 100kHz	-60dBc	-60dBc
100kHz to 1MHz	-45dBc	-45dBc
1MHz to 25MHz	-40dBc	-35dBc
25MHz to 50MHz	-40dBc	-28dBc

Non-Harmonic Spurii:	<−60dBc to 1MHz, <−60dBc + 6dB/octave 1MHz to 50MHz
Phase Noise:	-115dBc/Hz, typical (10kHz offset)

SQUARE

Frequency Range:	1µHz to 50MHz (1µHz to 25MHz)
Resolution:	1µHz, 14 digits
Output Level:	10mVp-p to 10Vp-p into 50 Ω
Rise and Fall Times:	<8ns (<13ns)
Overshoot:	<5%
Variable Duty Cycle:	20% to 80% to 20MHz, 0.1% resolution, 40% to 60% to 25 MHz, 0.1% resolution, 50% (fixed) above 25MHz
Asymmetry:	1% of period + 5ns (@ 50% duty)
Jitter (RMS):	0.5ns + 100 ppm of period

RAMP & TRIANGLE

Frequency Range:	1µHz to 1MHz (1µHz to 500kHz)
Resolution:	1µHz, 12 digits
Output Level:	10mVp-p to 10Vp-p into 50 Ω
Linearity Error:	<0.1% to 30 kHz
Variable Symmetry:	0.0 % to 100.0 %, 0.1% resolution. Single key operation of 50% (Triangle)

Note the triangle and sawtooth waveforms are also available from the arbitrary waveform menu enabling repetition rates of up to 10MHz/6MHz. Waveform quality will deteriorate at higher frequencies however.

PULSE

Frequency Range:	500 µHz to 12.5MHz (500 µHz to 6.25MHz)
Resolution:	1µHz , 14 digits
Output Level:	10mVp-p to 10Vp-p into 50 Ω
Overshoot:	<5%
Jitter:	300ps + 0.01% of period
Rise/Fall Times:	Rise and Fall times can be independently varied or can be varied together simultaneously.
Edge Range:	<8ns to 40µs (<13ns to 40µs)
Edge Resolution:	0.1ns for rise/fall time ≤100ns; 1ns for rise/fall >100ns and ≤2µs; 10ns for rise/fall >2µs and ≤40µs
Width Range:	20ns to 2000s (20ns minimum for period ≤40s; 200 ns minimum for period >40s and ≤400s; 2µs minimum for period >400s)
Width Resolution:	10ns for period ≤40s; 100ns for period >40s and ≤400s; 1µs for period >400s
Delay Range:	0ns to 2000s
Delay Resolution:	10ns for period ≤40s; 100ns for period >40s and ≤400s; 1µs for period >400s

PRBS WAVEFORMS

Sequence Length:	7, 9, 11, 15, 20, or 23 stages (127 to 8,388,607 bit length)
Bit Rate:	1µbps to 50Mbps (1µbps to 25Mbps)
Rise/Fall Times:	Rise/Fall times can be varied (rise time = fall time).
Edge Range:	<8ns to 40µs (<13ns to 40µs)

ARBITRARY WAVEFORMS

In-built Arbitrary Waveforms

Sinc, Exponential Rise, Logarithmic Rise, DC, Positive and Negative Ramps and Square waveforms are built-in and always present. Additional waveforms are supplied on disc (Cardiac, Gaussian, Exponential Fall, Logarithmic Fall).

Frequency Range:	1µHz to 10MHz (1µHz to 6MHz)

User defined Arbitrary Waveforms

Up to 4 additional or user defined waveforms may be stored in non-volatile memory. Waveforms can be defined by downloading of waveform data via USB memory stick, remote interfaces, or editing via the instrument's front panel.

Waveform Size:	2 points to 131072 points (128k).
Memory Size:	Up to 4 waveforms of up to 64k points, or 2 waveforms of up to 128k points, (or 2 of 64k points plus 1 of 128k points).
External Storage:	Up to 1,000 waveforms per USB memory stick
Vertical Resolution:	14 bits
Frequency Range:	1µHz to 10MHz (1µHz to 6MHz)
Resolution:	1µHz , 14 digits
Output Level:	10mVp-p to 10Vpp into 50 Ω
Sampling rate:	125MS/s
Output Filter:	Selects between 50MHz Elliptic or 20MHz Bessel filter depending on the waveform.

Arbitrary Waveform Creation and Editing

Waveform creation and editing is provided within the generator including point insertion, line drawing and interpolation.

WAVEFORM MANAGER PLUS

Both generators are supplied with Waveform Manager Plus. This Windows* based software provides a sophisticated tool set for the creation, editing and management of arbitrary waveforms. The waveforms can be transferred to the generator either using a USB memory stick, or by the digital interfaces.

NOISE

Gaussian White Noise can be chosen as a waveform or added to any carrier waveform except pulse, square and noise itself (note however that noise can be added to the square wave available in the arbitrary menu). The amount of noise added can be specified as 0% to 50% of the amplitude of the carrier waveform. Noise can also be used as modulating waveform.

Bandwidth (-3dB):	20MHz typical.
Crest Factor:	5.27 (Vp/Vrms)
Output Level:	10mVp-p to 10Vpp into 50 Ω

INTERNAL FREQUENCY REFERENCE

Ageing Rate:	1ppm first year
Temp. Stability:	<1ppm over the specified temperature range

MODULATION

AM

Carrier Waveforms:	Sine, Square, Ramp, PRBS, Arb
Modulation Source:	Internal/External
Internal Modulating Waveforms:	Sine, Square, Up Ramp, Down Ramp, Triangle, Noise, DC, Sinc, Exponential Rise, Logarithmic Rise, PRBS and User Defined Arbs
Internal Modulating Frequency:	1µHz to 1MHz, 1µHz resolution
Amplitude Depth:	0.0% to 120.0%, 0.1% resolution

FM

Carrier Waveforms:	Sine, Square, Ramp, PRBS, Arb
Modulation Source:	Internal/External
Internal Modulating Waveforms:	Sine, Square, Up Ramp, Down Ramp, Triangle, Noise, DC, Sinc, Exponential Rise, Logarithmic Rise, PRBS and User Defined Arbs
Internal Modulating Frequency:	1µHz to 1MHz, 1µHz resolution
Frequency Deviation:	DC to Fmax/2, 1µHz resolution

PM

Carrier Waveforms:	Sine, Square, Ramp, PRBS, Arb
Modulation Source:	Internal/External
Internal Modulating Waveforms:	Sine, Square, Up Ramp, Down Ramp, Triangle, Noise, DC, Sinc, Exponential Rise, Logarithmic Rise, PRBS and User Defined Arbs
Internal Modulating Frequency:	1µHz to 1MHz, 1µHz resolution
Phase Deviation:	-360.0 to +360.0 degrees, 0.1 degree resolution

PWM

Carrier Waveforms:	Pulse
Modulation Source:	Internal/External
Internal Modulating Waveforms:	Sine, Square, Up Ramp, Down Ramp, Triangle, Noise, DC, Sinc, Exponential Rise, Logarithmic Rise, PRBS and User Defined Arbs
Internal Modulating Frequency:	1µHz to 1MHz, 1µHz resolution
Width Deviation:	0% to 100% of pulse width, resolution same as per pulse width

SUM

Carrier Waveforms:	Sine, Ramp, Arb
Internal Modulating Waveforms:	Sine, Square, Up Ramp, Down Ramp, Triangle, Noise, DC, Sinc, Exponential Rise, Logarithmic Rise, PRBS and User Defined Arbs
Internal Modulating Frequency:	1µHz to 1MHz, 1µHz resolution
Ratio:	0% to 100%; 0.1% resolution

FSK

Carrier Waveforms:	Sine, Square, Ramp, PRBS, Arb
Source:	Internal/External (via TRIG IN)
Internal Modulation:	50% duty cycle square (2mHz to 100kHz)

BPSK

Carrier Waveforms:	Sine, Square, Ramp, PRBS, Arb
Source:	Internal/External (via TRIG IN)
Internal Modulation:	50% duty cycle square (2mHz to 100kHz)

Triggered Burst

Each active edge of the trigger signal will produce one burst of the waveform.

Carrier Waveforms:	Sine, Square, Ramp, PRBS, Arb, Pulse
Maximum Carrier Frequency:	10MHz (finite cycles), 50MHz (infinite), subject to carrier waveform.
Number of Cycles:	1 to 16,777,215 and infinite.
Trigger Rep. Rate:	2mHz to 1MHz internal dc to 1MHz external.
Trigger Source:	Internal from keyboard or trigger generator. External from TRIG IN or remote interface.
Start/Stop Phase:	-360.0 to +360.0 degrees, 0.1 degree resolution.

Gated

Waveform will run while the Gate signal is true and stop while false.

Carrier Waveforms:	Sine, Square, Ramp, PRBS, Arb, Pulse, Noise
Max. Carrier Freq.:	10 MHz, subject to carrier waveform
Trigger Rep. Rate:	2mHz to 1MHz internal, dc to 1MHz external.
Gate Signal Source:	Internal from keyboard or trigger generator. External from TRIG IN or remote interface.
Start/Stop Phase:	-360.0 to +360.0 degrees, 0.1 degree resolution, subject to carrier waveform.

Sweep

Frequency sweep capability is provided for both standard and arbitrary waveforms.

Carrier Waveforms:	All standard, PRBS and arbitrary except pulse.
Sweep Mode:	Linear or logarithmic, triggered or continuous.
Sweep Direction:	Up, down, up/down or down/up.
Sweep Range:	From 1μHz to 50MHz, (1μHz to 25MHz) subject to carrier waveform. Phase continuous. Independent setting of the start and stop frequency.
Sweep Time:	1ms to 500s (6 digit resolution).
Marker:	Variable during sweep.
Trigger Source:	The sweep may be free run or triggered from the following sources: Internal from keyboard or trigger generator. Externally from TRIG IN input or remote interface.

Trigger Generator

Internal source 2mHz to 1MHz square wave adjustable in 1μs steps, 9 digit resolution.
Also available for external use from the SYNC OUT socket.

OUTPUTS

Main Output

Output Impedance:	50 Ω
Amplitude:	20mV to 20Vp-p open circuit (10mV to 10Vp-p into 50 Ω). Amplitude can be specified open circuit (Hi Z) or into an assumed load of 50Ω or a specified impedance between 1 Ω and 10k Ω in Vpk-pk, Vrms or dBm.
Amplitude Accuracy:	2% ±1mV at 1kHz into 50 Ω.
DC Offset Range:	±10V. DC offset plus signal peak limited to ±10V from 50 Ω.
DC Offset Accuracy:	Typically 3% ±10mV.
Resolution:	3 digits or 1mV for both Amplitude and DC Offset.

Sync Out

Multifunction output user definable or automatically selected to be any of the following:
Carrier Waveform Sync: The function varies with waveform type as follows:
Sine/Ramp/Pulse - A square wave with 50% duty cycle at the waveform frequency.
Square - A square wave with same duty cycle as the main output at the waveform frequency.
Arbs - A square wave with 50% duty cycle at the waveform frequency. The sync is a TTL high when the first point of the waveform is output. Noise - No sync associated with noise.
Modulation Sync: The function varies with modulation type as follows:
AM/FM/PM/PWM - A square wave with 50% duty cycle referenced to the internal modulation waveform when modulation source is internal, or a square wave referenced to the carrier waveform when modulation source is external. No sync is associated with noise as the modulation source.
FSK - A square wave referenced to the trigger rate. The sync is a TTL high when hop frequency is the output frequency and TTL low when carrier frequency is the output frequency for positive slope and vice versa for negative slope.

Burst Sync:	A square wave that is a TTL high when the burst begins and a TTL low when burst is completed.
Trigger:	Selects the current trigger signal. Useful for synchronizing burst or gated signals.
Sweep Sync:	The function varies with marker selection as follows:

Marker Off - A square wave that is a TTL low from the midpoint of the sweep and a TTL high from the end of the sweep.
Marker On - A square wave that is a TTL low from the marker frequency and a TTL high from the end of the sweep.

Output Signal Level:	Logic level nominally 3V.

Ref Clock Output

Buffered version of the 10MHz clock currently in use (internal or external).

Output Level:	Nominally 3V logic level from 50 Ω.

INPUTS

Trig In

Frequency Range:	DC - 1MHz.
Signal Range:	Threshold nominally TTL level; maximum input ±10V.
Minimum Pulse Width: 50ns	
Polarity:	Selectable as high/rising edge or low/falling edge.
Input Impedance:	10k Ω

External Modulation Input (for AM, FM, PM, PWM)

Voltage Range:	± 5V full scale
Input Impedance:	5k Ω typical
Bandwidth:	DC to 20kHz

Ref Clock Input

Input for an external 10MHz reference clock

Voltage Range:	1Vpp – 5Vpp
Maximum Voltage:	+5V
Minimum Voltage:	-1V

TWO CHANNEL OPERATION (TG5012A & TG2512A only)

The two channels can be operated independently so as to act as entirely separate generators. Alternatively the channels can interact as follows:

Coupled Operation

Coupled Frequency:	Frequencies can be coupled such that if frequency of one channel is changed the frequency of the other channel also changes either by a fixed ratio or fixed offset. A pulse waveforms can only be frequency coupled to another pulse waveform, however sine, square, ramp or Arb waveforms can be coupled to any other waveform of that group.
Coupled Level:	-Amplitudes (and DC offsets) of the two channels can be coupled such that changing the amplitude and offset on one channel changes the amplitude and offset of both channels.
Coupled On/Off:	Coupling can be set such that switching the output on/off on one channel switches the output on/off of both channels.

Tracking Operation

When in tracking mode both channels behave as one channel. If inverse tracking is selected, both channel still behave as one channel except that the output of channel 2 is inverted.

Relative Phase

Pressing the 'align' key phase synchronises the two channels with the specified phase offset.

Phase Range:	-360.0 to +360.0 degrees
Resolution:	0.1 degree
Skew (typical):	<1ns

Cross Channel Trigger

Either channel can be triggered by the other channel to set up a complex and versatile inter channel trigger scheme.
Each channel can have its trigger output waveform set up independently. Trigger Out may be selected to be carrier waveform referenced, modulation waveform referenced, sweep referenced, burst referenced or the currently selected trigger of the channel.

Crosstalk

Channel Crosstalk:	Typically better than 80dB

Control and Display

The control of each channel is selected by the Channel Select key.
The display can be assigned either completely to the selected channel, or the upper section can display the main set-up parameters or waveforms for both channels simultaneously.

PHASE SYNC (Phase Synchronising Two Generators)

Two generators can be synchronised together to provide outputs at the same frequency (or harmonics) and with a phase difference.
The amplitude and phase of these outputs can also be modulated providing the capability to perform QAM and QPSK respectively.
In case of 2 channel generators when phase synchronising is performed the two channels of each generator are also synchronised providing four synchronous waveforms.
It is also possible to synchronise more than two generators but the precision is not guaranteed.

Carrier Waveforms:	Sine, Square, Ramp, Pulse, Arb
Phase Range:	-360.0 to +360.0 degrees
Resolution:	0.1 degree
Accuracy:	< ±5ns

BUS INTERFACES

Full digital remote control facilities are available through LAN and USB and optional GPIB interfaces.

LAN Interface:	Ethernet 100/10base – T hardware connection.
LXI Compliance:	LXI V1.2, Class C compliant.
USB Interface:	Standard USB 2.0 hardware connection. Implemented as virtual-COM port.
GPIB Interface:	Conforming with IEEE-488.1 and IEEE-488.2 (option G only)
USB Flash Drive:	Front mounted socket for waveform and setup storage/recall.

Driver Software Supplied

IVI Driver:	An IVI driver for Windows is supplied. This provides support for common applications such as LabView*, LabWindows*, HPVEE* etc.
LV/CVI Driver:	Full installation for CVI and LabVIEW instrument drivers.
USB Driver:	An installation file is supplied calling a standard Windows* USB driver.

* LabView and LabWindows are trademarks of National Instruments.
HPVEE (now Agilent VEE) is a trademark of Agilent Technologies.
* USB interface is supported for Windows 2000 and above (inc. 64-bit versions)
Windows is a trademark of Microsoft.

GENERAL SPECIFICATIONS

Display and Data Entry

Display: Type: Black on white backlit graphics display - pixel format: 256 x 112
Data Entry: Keyboard selection of mode, waveform 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 non-volatile memory. Up to 1000 set-ups can be stored per USB stick.

AC Supply

AC Input: 110-240VAC ±10% 50/60Hz; 100-120VAC ±10% 400Hz; 60VA max. Installation Category II.

Temperature & Environmental

Operating Range: +5ºC to +40ºC, 20% to 80% RH
Storage Range: -20ºC to + 60ºC
Environmental: Indoor use at altitudes up to 2000m, Pollution Degree 2.

Safety & EMC

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

Physical (one channel models)

Size: Bench top use: height 97mm (2.62"); width 250mm (9.84"); length 270mm (10.63"). Rack mounted use: height 86.5mm (3.4"); width 213.5mm (8.4"); length 244mm (9.61"); i.e. ½-rack x 2U.
Weight: 2.55 kg (5.6 lbs)

Physical (two channel models)

Size: Bench top use: height 97mm (2.62"); width 250mm (9.84"); length 295mm (11.62"). Rack mounted use: height 86.5mm (3.4"); width 213.5mm (8.4"); length 269mm (10.59"); i.e. ½-rack x 2U.
Weight: 2.7 kg (5.95 lbs)

OPTIONS

Rack Mount (RM200A)

19 inch 2U rack mount suitable for one or two generators.

GPIB Interface (Option TG-GPIB)

Retro-fittable GPIB (IEEE-488) interface card.

ORDERING INFORMATION

Four versions of the product are available as follows:

TG2511A 25MHz 1-Channel Generator.
TG5011A 50MHz 1-Channel Generator.
TG2512A 25MHz 2-Channel Generator.
TG5012A 50MHz 2-Channel Generator.

TG-GPIB Retro-fittable GPIB interface for any model.

Each product is supplied with the following:
Printed operating manual in English. PDF operating manuals on disk in English, French, German, Italian and Spanish.
IEC mains lead appropriate to the geographic market in which it is sold.
Software on disk including: Waveform Manager Plus for Windows (version 4), IVI driver, LabView driver, CVI driver, USB driver, LXI discovery tool, TCP example program.

Specifications apply for the temperature range 18°C to 28°C after 30 minutes warm-up, at maximum output into 50Ω unless otherwise stated.
Thurlby Thandar Instruments Ltd. operates a policy of continuous development and reserves the right to alter specifications without prior notice.

Available from:

Designed and built in Europe by: