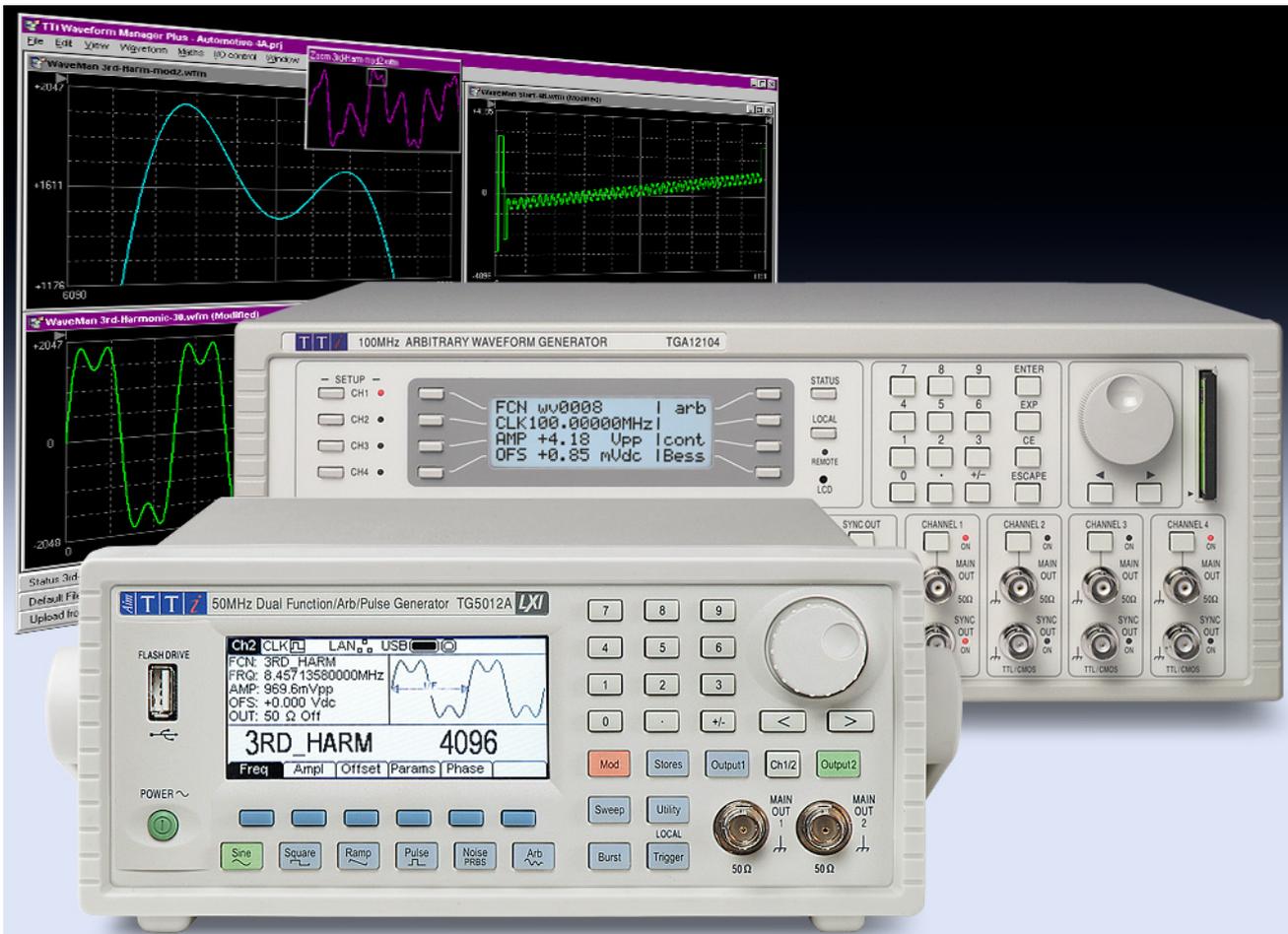




AIM & THURLBY THANDAR INSTRUMENTS

Signal and Waveform Generators

PRODUCT SUMMARY



- Analog Function Generators • Pulse Generators •
- Digital (DDS) Function Generators •
- Arbitrary Waveform Generators •
- RF Signal Generators •

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Aim-TTI

Issue 6 - 2014

Product Range

Pulse Generators - page 12

Analog 10MHz pulse generator.

Waveform Amplifiers - page 12

Wide-band amplifier with 30V pk-pk output.

Analog Function Generators - page 13

Dial-set and digital display function generators from 3MHz up to 20MHz. Models with sweep and external frequency measurement.

Digital Function Generators - page 15

DDS based function generators, with and without arbitrary capability at frequencies up to 50MHz.

Arbitrary Waveform Generators - page 18

Arbitrary waveform software, universal waveform generators (arbitrary/function/pulse) with up to four channels, and up to 100MS/s.

RF Signal Generators - page 21

Also included in the Precision Measurement & RF Test Equipment product summary brochure)

Function, Arbitrary & Pulse generators

Aim-TTI is a world leader in waveform generation with products ranging from basic analog function generators through to advanced multi-channel arbitrary generators.

Waveform quality

The success of Aim-TTI function generators has always been based around waveform quality.

Aim-TTI generators offer waveform quality not just at high output levels, but at low levels as well - a much more difficult task.

Careful analog design yields excellent waveform purity at all frequencies and levels, unlike many competitive products.

Digital architectures

Aim-TTI has been at the forefront of digital generator design with products that combine both DDS (direct digital synthesis) and variable-clock architectures in order to offer optimum performance for specific applications.



TGP110 Pulse Generator

- ▶ 0.1Hz to 10MHz pulse generator
- ▶ Very wide pulse control range



The TGP110 is an analog pulse generator that offers a very wide control range.

Its dedicated architecture enables it to generate fast rise time flat top pulses over a very large duty cycle range.

The unit offers selectable delay between trigger and pulse, or between two pulses in double pulse mode. A sync output signal provides a pulse in synchronism with the trigger.

A low impedance output of fully variable level is provided together with a TTL/CMOS output and a level inversion switch.

- ▶ 0.1Hz to 10MHz frequency range
- ▶ Independent control of pulse frequency, width and delay
- ▶ 50ns minimum pulse width
- ▶ Squarewave, double pulse and delayed pulse modes
- ▶ Free-run, gated and triggered modes
- ▶ 50 Ohm output: 0.1V to 10V amplitude
- ▶ TTL/CMOS and Sync outputs

WA301 Waveform Amplifier

- ▶ Up to 30 volts pk-pk output
- ▶ DC to 1 MHz bandwidth



The WA301 wide-band waveform amplifier is intended for extending the maximum output voltage swing of function and arbitrary generators for applications where an EMF of 20 volts pk-pk is insufficient.

- ▶ 30 V pk to pk output (15 V into terminating impedance)
- ▶ 50Ω and 600Ω outputs; full output protection
- ▶ Switchable 20dB output attenuator
- ▶ DC to 1MHz bandwidth
- ▶ High impedance input; 0dB to +20dB gain

Analog Function Generators

The function generator is a particularly versatile instrument. It can generate a variety of precision wave shapes over a range of frequencies from mHz to MHz with a wide range of controlled amplitudes from a low-impedance source, and maintain constant amplitude as the frequency is varied. Although digital function generators may offer more features, analog function generators have advantages that can make them more appropriate for certain applications.

Analog Function Generators - comparison table						
	TG310	TG315	TG320	TG330	TG550	TG120
Maximum Frequency	3MHz	3MHz		5MHz		20MHz
Minimum Frequency	0.03Hz	0.03Hz		0.005Hz		0.2Hz
Frequency Setting	Dial	Digital Readout via LCD				Dial
Waveform Functions	Sine, Square or Triangle all with variable symmetry (plus DC)					
Variable Symmetry Range	1:9 / 9:1 at frequency/10					1:6 / 6:1 *
Digital Frequency Lock	No	No		Yes		No
External Freq. Counter	No	No	Yes	Yes	Yes	No
External Sweep Input	1000:1	1000:1		1000:1		20:1
Internal Sweep Generator	No	No		Yes	Yes	No
Internal/External AM	No	No		Yes	Yes	No
Amplitude Range (pk-pk EMF)	2mV - 20V	2mV - 20V				10mV - 20V
DC Offset Range	+/- 10V (reduced by attenuator setting)					
Amplitude/Offset Display	No	Digital Readout via LCD				No
Output Impedance	50Ω and 600Ω					50Ω
Auxiliary Output	TTL / CMOS square wave in phase with main output					

Power: 230V or 115V AC nominal 50/60Hz, adjustable internally. Size & weight: TG120: 220 x 82 x 230 mm (WxHxD). 1.5 kg (3.0 lb). TG210, TG315, TG320, TG330, TG550: 260 x 88 x 235 mm (WxHxD). 1.9 kg (4.2 lb).
Notes: * TG120 symmetry applies up to 500kHz.

Function generators fall into two basic categories, analog and digital.

Analogue generators use a voltage controlled oscillator to generate a triangular waveform of variable frequency. Sinusoids and square waves are generated from this.

Digital generators use a digital to analog converter (DAC) to generate a wave shape from values stored in memory. Normally such generators only offer sine and square waves up to the maximum generator frequency. Triangle waves and other waveforms are limited to a much lower frequency.

Analogue generators offer several advantages:

1. They provide simple and instantaneous manual control of frequency and amplitude.
2. They do not have the high frequency limitations for non-sinusoidal waveforms such as triangles and ramps that digital generators do.
3. The starting price for an analog generator is generally lower than for a digital generator.

The TG310 is a basic 3MHz function generator which offers very high waveform quality at all frequencies and levels. Frequency is set using a calibrated vernier knob.

The feature set includes variable symmetry at constant frequency and variable dc offset with centre detent.

Output impedances of 50Ω and 600Ω are supported via separate output sockets.

- ▶ 0.03Hz to 3MHz frequency range
- ▶ High waveform quality at all frequencies & levels
- ▶ 2mV to 20V pk-pk from 50Ω or 600Ω
- ▶ Sine, square and triangle waveforms plus dc
- ▶ 1000:1 frequency change on each range
- ▶ Variable symmetry control
- ▶ External sweep input



TG310

- ▶ Dial-set 3MHz function generator
- ▶ High waveform quality

The TG120 uses a different waveform generation technique from that used in other Aim-TTI analog function generators.

By doing so it achieves a greatly extended maximum frequency point of 20MHz.

Although offering a slightly poorer overall specifications than other Aim-TTI generators, it represents excellent value for users who require a higher frequency waveform source.

- ▶ 0.2Hz to 20MHz frequency range
- ▶ Sine, square and triangle waveforms plus dc
- ▶ 10mV to 20V pk-pk from 50Ω
- ▶ DC offset control with zero detent
- ▶ Variable symmetry control
- ▶ External sweep input
- ▶ Excellent price/performance ratio



TG120

- ▶ Dial-set function generator
- ▶ 20MHz frequency range

TG300 series

- ▶ 3MHz function generator range
- ▶ Display of frequency and level
- ▶ 120MHz frequency counter
- ▶ Choice of three models

Further details are provided in the comparison table on the previous page. Full details are available on the web site.



Model range:

- TG315 - basic dual-display function generator.
- TG320 - as TG315 with external counter.
- TG330 - as TG320 with sweep generator and amplitude modulation.

TG320 in external frequency counter mode.

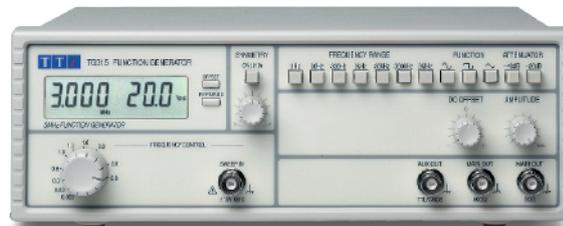
The reciprocal counting measurement technique with dual gate times is fully auto-ranging giving up to seven digits of resolution over the full frequency range of 5Hz to 120MHz.

The TG300 series are analog function generators with a digital display which provides simultaneous readout of frequency and level (amplitude pk-pk, amplitude rms or dc offset).

Two models include an external counter with 7 digit resolution (using the full width of the display) at up to 120MHz.

The top model includes a sweep generator and internal/external amplitude modulation.

- ▶ 0.03Hz to 3MHz frequency range
- ▶ Simultaneous display of frequency and amplitude
- ▶ External seven digit 120MHz counter (not TG315)
- ▶ High waveform quality at all frequencies & levels
- ▶ 2mV to 20V pk-pk from 50Ω or 600Ω
- ▶ Variable symmetry with constant frequency
- ▶ Auxiliary TTL/CMOS output
- ▶ 1000:1 freq. change by vernier or sweep voltage
- ▶ Precision internal lin/log sweep (TG330 only)
- ▶ Internal/external AM up to 100% (TG330 only)



TG550

- ▶ 5MHz function generator
- ▶ Display of frequency and level
- ▶ Digital frequency locking
- ▶ Built-in sweep generator

Further details are provided in the comparison table on the previous page. Full details are available on the web site.



The TG550 is the most advanced analog function generator in the TTI range.

It includes a digital frequency locking system which, when enabled, continuously compares the output with a crystal reference.

The TG550 has a dual display to show both frequency and level (amplitude pk-pk, amplitude rms or dc offset).

It has an external counter with 7 digit resolution (using the full width of the display) at up to 20MHz.

It also includes a sweep generator with linear and logarithmic sweep capability, and internal/external amplitude modulation.

- ▶ 0.005Hz to 5MHz frequency range
- ▶ Built-in seven digit 20MHz frequency counter
- ▶ Digital frequency lock for exceptional stability
- ▶ Simultaneous display of frequency and voltage amplitude or offset
- ▶ Internal or external AM at up to 100%
- ▶ Precision internal lin/log sweep

Digital Function Generators

Digital function generators can be divided into three broad categories:

1. DDS* Function Generators without Arbitrary - these perform a similar function to an analog function generator, but with the advantages of DDS based stability, resolution, and sinewave purity. The TG2000 falls into this category.

2. DDS Function/Arbitrary Generators - these have the ability to produce arbitrary waveforms in addition to standard waveforms, but within the limitation imposed by using a DDS system. The TG1010A and TG5011 fall into this category.

3. Universal Arbitrary Waveform Generators - these combine a DDS function generator with a variable-clock* arbitrary generator. Typically these generators incorporate more sophisticated systems for the production of arbitrary waveforms. The TGA1240 and TGA12100 series (see page 19) fall into this category. The TG4001 also has a similar architecture.

* For an explanation of DDS (direct digital synthesis) and of DDS and variable-clock architectures for generators go to our web site: www.aimtti.com/go/arb

Digital Function and Function/Arbitrary Generators - comparison table (see also TGA series - page 18)				
	TG1006	TG1000/2000	TG2511A/5011A	TG2512A/5012A
Number of Channels	One	One	One	Two
Dual Channel Operation	-	-	-	Full Independent, Coupled or Tracking modes
Frequency Range (sine)	0.001Hz to 10MHz	0.001Hz to 10/20MHz	0.001MHz to 25/50MHz	
Frequency Resolution (sine)	6 digits or 1mHz	6 digits or 1mHz	14 digits or 0.001mHz	
Waveform Generation System	DDS	DDS	DDS	
Multi-Generator Phase Lock	No	No	Yes	
Frequency Accuracy	Better than ± 10 ppm		Better than ± 1 ppm	
Waveform Functions	Sine, Square, Triangle,	Sine, Square, Triangle, +ve/-ve Pulse	Sine, Square, Ramp, Pulse, Noise, PRBS, \sin^2/x , exponential rise, logarithmic rise	
Variable Symmetry Range	20% to 80% square	20% to 80% square/pulse	0.1% - 99.9% ramp, 20% to 80% square	
Additional Pulse Generator Features			Independent period, delay, width. Variable rise/fall times	
Arbitrary Waveforms (Size)	None	None	Yes - 2 to 128K words	
Arbitrary Vertical Resolution		-	14 bits	
Arbitrary Waveform Clock		-	125MHz (DDS)	
ARB Waveform PC Software		-	Waveform Manager Plus	
Frequency Sweep (Rate/Mode)	50ms to 999s, lin or log	50ms to 999s, lin or log	1ms to 500s, lin or log	
Internal/External Modulations	FSK, AM	Tone, FSK, External AM	Internal/External AM, FM, PM, PWM, Sum, BPSK, FSK	
Internal Trigger Generator	0.001Hz to 10kHz	0.001Hz to 5kHz	0.005 Hz to 1MHz	
Gated/Triggered Burst	No	Yes/No	Yes/1 to 1048575 cycles	
Amplitude Range (pk-pk EMF)	2mV - 20V from 50/600 Ω	5mV - 20V from 50/600 Ω	20mV - 20V from 50 Ω	
DC Offset Range	± 10 V EMF	± 10 V EMF	± 10 V EMF unattenuated	
Sinewave Purity	Typically 0.1% to 20kHz <-30dBc at 10MHz	Typically 0.1% to 20kHz <-40dBc at 20MHz	<0.15% to 100kHz, typically <-35dBc at 50MHz	
Output Flatness	± 0.5 dB to 500kHz; ± 2 dB to 10MHz	± 0.2 dB to 500kHz; ± 2 dB to 20MHz	± 0.15 dB to 5MHz; ± 0.5 dB to 50MHz	
Auxiliary Output	Sync	Multi-function output for Waveform Sync, Trigger Out, Sweep Sync., Marker (not TG2000)		
Display	8 digit LCD	Dot-matrix backlit LCD	Full Graphic backlit LCD	
Digital Interfaces	None	RS232/USB (TG2000 only)	USB/LAN (GPIB option)	
Power: 230V or 115V AC nominal 50/60Hz, Size & weight: TG1006 and TG1000/2000: 260 x 88 x 235 mm (WxHxD) 2.0 kg (4.4lb) . TG2511A/5011A: 2U half-rack: 212 x 87 x 335 mm (WxHxD). 2.6 kg (5.7 lb); TG2512A/5012A: 2U half-rack: 212 x 87 x 360 mm (WxHxD). 2.7 kg (6 lb)				

N.B. The TG1010A and TG4001 are older legacy products and are not included within the comparison table above.

for more complete information:
www.aimtti.com/generator

The TG1006 is a low cost function generator using DDS frequency generation and covering the range 1mHz to 10MHz. Up to ten frequencies can be stored in a list.

Despite its price it includes a wide range of features including wide range phase continuous sweep, AM and FSK.

A seven digit frequency counter covering 3Hz to 120MHz is also incorporated.

A unique feature is manual sweep which enables any frequency range to be spanned by a quasi-analog control.

- ▶ 0.001Hz to 10MHz or 20MHz frequency range
- ▶ 6 digits or 1mHz resolution
- ▶ Simultaneous display of frequency and voltage amplitude or offset
- ▶ 1ppm stability and 10ppm one year accuracy
- ▶ Low distortion, high spectral purity sine waves
- ▶ Internal phase-continuous sweep, lin or log
- ▶ Unique manual sweep gives quasi-analog control
- ▶ AM and FSK modes, frequency list (10 steps)
- ▶ 2mV to 20V pk-pk from 50 or 600 Ohms
- ▶ Built-in seven digit 120MHz frequency counter

Further details are provided in the comparison table above. Full details are available on the web site.

TG1006

- ▶ 10MHz DDS function generator
- ▶ 120MHz frequency counter
- ▶ Sweep, AM, and FSK



NEW

TG1000 & TG2000

- ▶ 10/20MHz DDS function generator
- ▶ High stability and resolution
- ▶ USB & RS232 interfaces (TG2000)

Further details are provided in the comparison table on P15. Full details are available on the web site.



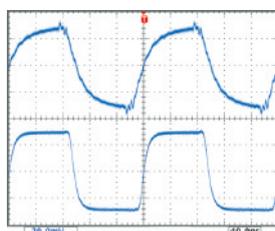
Unlike some other lower cost DDS based generators, the TG1000 and TG2000 provide digital control of all parameters and functions. This allows for the complete instrument status to be stored in the set-up memories. On the TG2000, it also enables complete control via the digital bus interfaces.

The TG2000 is a high performance DDS based function generator covering the range 1mHz to 20MHz.

It is ideal for engineers who require a high stability and high resolution function generator, but who do not require arbitrary waveforms.

The TG1000 has a lower maximum frequency of 10MHz and omits the RS232 and USB interfaces of the TG2000.

- ▶ 0.001Hz to 10MHz or 20MHz frequency range
- ▶ 6 digits or 1mHz resolution
- ▶ 1ppm stability and 10ppm one year accuracy
- ▶ Low distortion, high spectral purity sine waves
- ▶ Internal phase-continuous sweep, lin or log
- ▶ AM, FSK, gated and tone switching modes
- ▶ 5mV to 20V pk-pk from 50Ω or 600Ω
- ▶ Storage for multiple instrument set-ups
- ▶ USB and RS232 Interfaces (TG2000 only)



Waveform Quality

Ultimately what matters in a function generator is the quality of the output signal. The TG1000 and TG2000 maintain the TTI reputation for high signal quality at all frequencies and all levels.

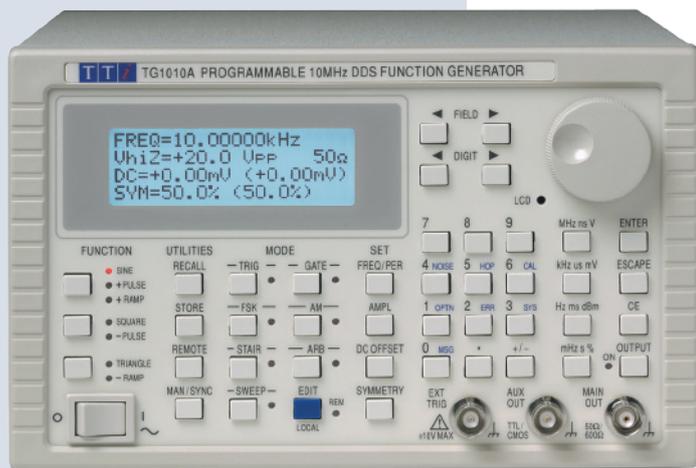
The waveform capture opposite shows just how much difference that can make. The 'scope display opposite was captured from two 5MHz square wave signals each at 60mV pk-pk level into 50 Ω.

The upper waveform is from a widely available competitive DDS generator. The lower waveform is from a TG2000.

TG1010A

- ▶ 10MHz DDS function generator
- ▶ Arbitrary waveform capability
- ▶ Wide range of modulations
- ▶ RS-232 and optional GPIB

Full details are available on the web site.



The TG1010A is a high performance 10MHz DDS function generator with extensive modulations and the added benefit of basic arbitrary waveform capabilities.

It can produce frequencies down to 0.0001 Hz and has a built-in trigger generator. Triggered bursts with variable start-stop phase is available for all waveforms.

Wide range phase-continuous sweep is available at rates from 10ms to 15 minutes. Amplitude modulation is provided for all waveforms and an internal AM source is incorporated. The frequency agility of the DDS system is used to provide FSK and Frequency Hop facilities.

Arbitrary waveforms can be loaded via the digital interfaces and then used in a similar way to the standard waveforms. In addition, the TG1010A offers numerous "complex" waveforms pre-defined in ROM. These include commonly used wave-shapes such as sine x/x, decaying sinewave, exponential rise and fall etc.

- ▶ 0.1mHz to 10MHz frequency range, 7 digit resolution.
- ▶ Eight standard waveforms, plus multiple "complex" waveforms, true arbitrary waveforms and noise.
- ▶ Powerful modulation modes including Sweep, AM, Gating, Trigger/Burst, FSK and Hop.
- ▶ Variable symmetry, variable start/stop phase.
- ▶ 20V pk-pk output from 50Ω or 600Ω (switchable).
- ▶ Storage for five Arbitrary waveforms (1024 x 10-bits).
- ▶ Fully programmable via RS-232 or optional GPIB interfaces

The TG5011A and TG2511A are high performance DDS arbitrary/function generators that utilise the latest high speed FPGA technologies to provide an exceptionally good price to performance ratio. They substantially out-perform the competition with high quality sine and square waveforms at up to 50MHz.

The full graphics display is capable of showing representative waveform information simultaneously with a comprehensive status readout. The casing is highly compact being half rack width by 2U height.

The wide range of standard waveforms is supplemented by full arbitrary waveform capability using a 125MS/s sampling rate and up to 128K word record length. Waveforms can be downloaded via the digital interfaces or loaded and saved via the front mounted USB flash drive interface.

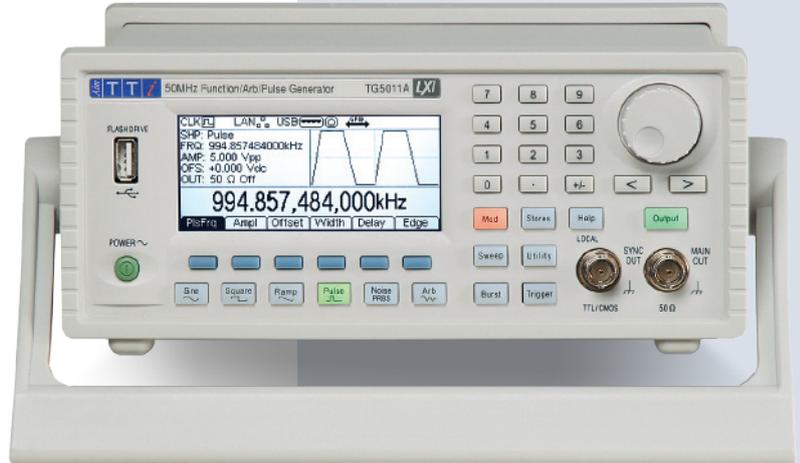
Pulse waveforms are generated by a dedicated pulse generator system with independent setting of period, width and delay. Rise and fall times are independently variable over a wide range.

A comprehensive digital modulation system is incorporated covering AM, FM, PM, PWM, FSK and Noise. Modulations can be internal or external at frequencies from DC up to 20kHz external or 1MHz internal.

A comprehensive set of interfaces includes USB and LAN (conforming with LXI) as standard plus GPIB as an option.

- ▶ 1µHz to 50MHz or 25MHz range; 14 digits or 1µHz resolution.
- ▶ Standard waveforms include sine, square, ramp, pulse, PBRS, sin(x)/x, noise, exponential and logarithmic rise.
- ▶ True pulse generator with variable delay and variable rise/fall.
- ▶ Arbitrary waveforms of up to 128K points at up to 125MS/s.
- ▶ Waveform storage using USB flash drives
- ▶ Large graphic LCD with simultaneous text and waveform display.
- ▶ Comprehensive internal and external digital modulations including AM, FM, PM, PWM, SUM, FSK and BPSK.
- ▶ 20mV to 20V pk-pk output from 50Ω ; plus multi function aux. out.
- ▶ Storage for multiple instrument set-ups in non-volatile memory.
- ▶ Waveform Manager Plus for Windows software included.
- ▶ Programmable via USB and LAN (LXI) interfaces; GPIB optional.

Further details are provided in the comparison table on page 15. Full details are available on the web site.



LAN extensions for instrumentation

TG5011A & TG2511A

- ▶ 50MHz/25MHz function generator
- ▶ High speed arbitrary waveforms
- ▶ Full pulse generator mode with variable rise/fall times
- ▶ USB, LAN and optional GPIB

The TGxx11A series is the latest and most advanced digital function generator from Aim-TTI.

It incorporates a full graphic display and offers high quality standard waveforms, high speed arbitrary waveforms, and full pulse generator facilities.

Pulses can be set-up from independent period, width and delay, with variable rise and fall times. Internal or external digital modulations are available using any waveshape.

The TG5012A and TG2512A are two channel versions of the TG5011A/2511A, detailed above) and have identical features augmented by multi-channel capabilities including coupling for frequency and/or level, full tracking, and defined phase offset.

The channels can also be used as completely independent generators and they represent excellent value for money when compared with buying two generators.

- ▶ Two channels - independent or linked with coupled/tracking modes.
- ▶ Selectable coupling of frequency (equal or offset), amplitude/dc offset.
- ▶ Inter-channel phase offset of -360° to +360° with 0.1° resolution.
- ▶ Individual channel features as TG5011A/TG2511A.

Further details are provided in the comparison table on page 15. Full details are available on the web site.



LAN extensions for instrumentation

TG5012A & TG2512A

- ▶ Dual channel function generator
- ▶ 50MHz or 25MHz max. frequency
- ▶ Independent, coupled or tracking channel operation
- ▶ USB, LAN and optional GPIB

ARB generator types

Arbitrary generator describes a class of digital generator potentially capable of reproducing any waveform shape. There are two distinctly different ways in which arbitrary waveforms can be produced - DDS and Variable Clock *.

Because each manufacturer may choose a different description for their product, it is not easy to know which underlying technology is being used.

There are three broad classes of arbitrary waveform generator:

1. Generators that use DDS (direct digital synthesis) for the production of both standard waveforms (function generator mode) and arbitrary waveforms.

These are most commonly described as either Function/Arbitrary Generators or Arbitrary/Function Generators (AFG).

2. Generators that use a variable clock architecture for the production of both standard waveforms and arbitrary waveforms. Within these generators a standard waveform is simply a specific instance of an arbitrary waveform.

These are most commonly described as Arbitrary Waveform Generators (AWG)

3. Generators that use DDS for the production of standard waveforms (function generator mode) and variable clock for generating arbitrary waveforms.

These may be described as Universal Arbitrary Waveform Generators or simply Arbitrary Waveform Generators (AWG) as in category 2.

* See the TTI web site for more information about arbitrary generator architectures.

TGA overview

Aim-TTI generators with the TGA prefix are universal arbitrary waveform generators offering a choice of one, two or four channels.

Two series are available; the TGA1240 which has a maximum clock speed of 40MHz, and the TGA12100 which has a maximum clock speed of 100MHz, greater waveform memory length, and a number of additional features.

A key feature of both series is the universal architecture which combines the advantages of true variable clock arbitrary waveform generation with the benefits of DDS (direct digital synthesis) when acting as a function generator.

The two and four channel models offer exceptional flexibility with channels that can be fully independent or linked. In independent mode each channel is a completely separate generator offering not just differing frequency, amplitude and waveform but different operational modes.

For example one channels could be used as a function generator while another is used as an arbitrary generator and a third as a pulse generator.

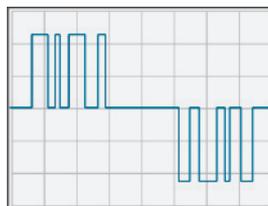
The channels can be set to provide inter-channel triggering, modulation or summing. Alternatively they can be linked to offer multi-channel phase controlled signals.

Universal Arbitrary Waveform Generators - comparison table (see also TG series - page 14)		
	TGA1240 series	TGA12100 series
Number of Channels	1, 2 or 4	1, 2 or 4
Arbitrary Waveforms		
Waveform Generation System	Variable Clock, 12 bit vertical resolution	
Clock Frequency Range	0.1Hz to 40MHz	0.1Hz to 100MHz
External ARB Clock	No	DC to 50MHz
Waveform Length	4 to 65,536 points	8 to 1,048,576 points
Internal Waveform Storage	Up to 100 waveforms	Up to 500 waveforms
Waveform Sequencing	Up to 16 waveforms	Up to 1024 waveforms
Arbitrary Waveform Editing	Internal or via Waveform Manager Plus software (supplied)	
Standard Waveforms (function generator mode)		
Waveform Generation System	DDS (Direct Digital Synthesis)	
Max. Frequency (sine/square)	16MHz/16MHz	40MHz/50MHz
Frequency Resolution (sine)	7 digits or 0.1mHz	10 digits or 0.1mHz
Minimum Frequency	0.0001Hz	0.0001Hz
Frequency Accuracy	Better than ± 10 ppm	
Waveform Functions	Sine, Square, Triangle, +ve/-ve Pulse, +ve/-ve Ramp, Pulse train, Cosine, Haversine, Haversine, Noise (not 1240 series).	
Sinewave Purity	<0.1% to 100kHz <-35dBc at 10MHz	<0.15% to 100kHz, typically <-35dBc at 40MHz
Modulations		
Frequency Sweep (Range)	1mHz to 16MHz	1mHz to 40MHz
Frequency Sweep (Rate/Mode)	30ms to 999s, lin or log	1ms to 999s, lin or log
External AM/External Sum	Yes/Yes	Yes/Yes
Internal Trigger Generator	0.005 Hz to 100kHz	
Triggered Burst	1 to 1048575 cycles	
Variable Start-Stop Phase	0.1 degree resolution	
Other Modes	Gated, Tone Switching, FSK	
Inter-channel Modes (2 and 4 channel models)		
Channel Interactions	Inter-channel Modulation, Triggering, or Analogue Summing for any number of channels	
Phase Locking	Any number of channels can be phase locked to 0.1 degree resolution plus 10ns uncertainty	
Output Characteristics		
Amplitude Range (pk-pk EMF)	5mV - 20V from 50 Ω (display corrected for Hi-Z, 50 Ω or 600 Ω termination)	
DC Offset Range	± 10 V EMF	
Output Flatness	± 0.2 dB to 200kHz; ± 1 dB to 10MHz; ± 2.5 dB to 16MHz	± 0.2 dB to 1MHz; ± 0.4 dB to 40MHz
Other Features		
Auxiliary Output(s)	Multi-function output for Waveform Sync, Trigger Out, Sweep Sync., Marker	
Reference Clock In/Out	Input for external fixed reference clock or output of internal reference clock. Can be used to phase lock two or more generators	
Instrument Set-up Storage	9 stores	Up to 500 stores
Display	4 line backlit dot-matrix LCD	
Digital Interfaces	RS232/GPIB	RS232/USB/GPIB
Power: 230V or 115V AC nominal 50/60Hz, adjustable internally except for TGA12102/4 which are 100V to 230V, 50/60/400Hz. Size and weight: TGA1241, TGA12101 and TG4001 are 3U half-rack: 212 x 130 x 335 mm (WxHxD). 4.1 kg (9 lb). TGA1242 and TGA1244 are 3U full (5/6) rack: 350 x 130 x 335 mm (WxHxD). 7.1 kg (15.6 lb) TGA12102 and TGA12104 are 3U full (5/6) rack: 350 x 130 x 335 mm (WxHxD). 6.0 kg (13.2 lb)		

Arbitrary, function and pulse

Each channel of a TGA series generator can be used as an arbitrary generator, function generator, or pulse pattern generator.

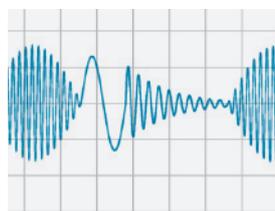
As a pulse generator a pattern of up to ten pulses can be defined with each pulse having its own amplitude, width and delay. The complete pattern can then be replayed at a user defined repetition rate.



Waveform sequencing

Sequencing enables complex waveforms to be constructed by sequencing simpler elements.

To understand the benefits of sequencing go to: www.aimtti.com/go/arb

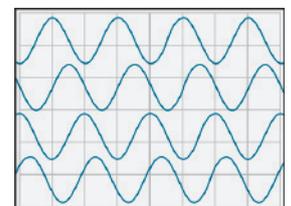


Multi-channel phase locking

Multi-channel TGA series generators can be used to generate multi-phase signals

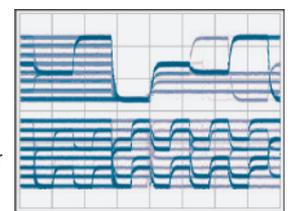
Any number of channels can be phase locked with offsets defined to a resolution of 0.1 degrees.

TGA12100 models can also be phase locked to an external clock and provide phase continuous frequency changes with a varying external signal.



Multi-channel modulation

Inter-channel modulation and summing allows the creation of complex modulation systems for simulation and testing.

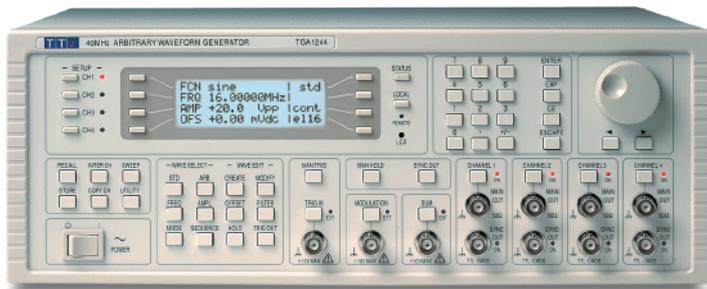


The TGA1240 series are universal arbitrary waveform generators that combine a high performance arbitrary waveform generator, pulse train generator and DDS function generator on each channel.

Variable clock architecture eliminates sampling jitter and enables complex waveforms to be created using waveform sequencing.

Multi-channel units can be operated as completely independent signal sources, phase locked sources, or interlinked sources using inter-channel triggering, modulation or summing.

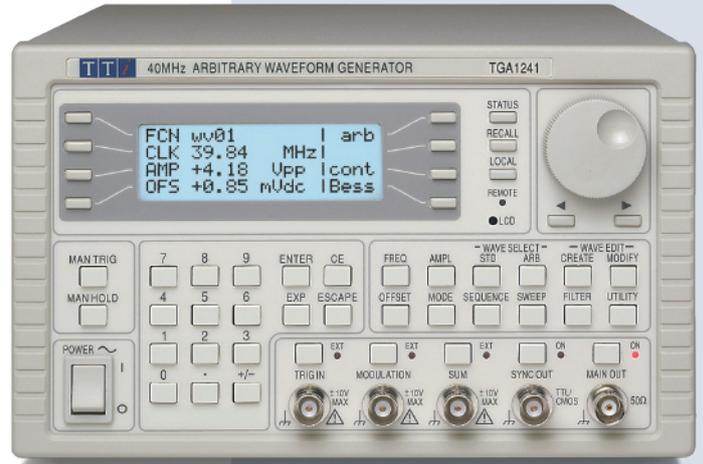
- ▶ 1, 2 or 4 waveform channels, independent or linked.
- ▶ 40MS/s maximum sampling, (0.1Hz to 40MHz variable clock).
- ▶ 65,536 point waveform memory per channel.
- ▶ Non-volatile storage for up to 100 waveforms
- ▶ Complex waveform sequencing and looping capability.
- ▶ Inter-channel triggering, summing and phase control.
- ▶ 16MHz function generator capabilities using DDS.
- ▶ Multiple 'standard' waveforms including sine, square, triangle, haversine, ramp, pulse and sin(x)/x.
- ▶ Pulse train generation for up to 10 pulses.
- ▶ Wide range sweep, AM, tone switching, signal summing.
- ▶ Tone switching facilitates precision DTMF generation.
- ▶ Built-in trigger generator, gated & triggered burst modes.
- ▶ Fully interfaceable via RS-232 and GPIB (IEEE-488.2).



Further details are provided in the comparison table opposite. Full details are available on the web site.

TGA1240 series

- ▶ 40MS/s universal arbitrary waveform generators
- ▶ One, two or four channels
- ▶ Variable clock ARB architecture
- ▶ DDS based function generator
- ▶ Independent or linked channels
- ▶ Pulse train generation
- ▶ RS-232 and GPIB interfaces



Model Range:
 TGA1241 - single channel
 TGA1242 - two channels
 TGA1244 - four channels

Model Range:
 TGA12101 - single channel
 TGA12102 - two channels
 TGA12104 - four channels



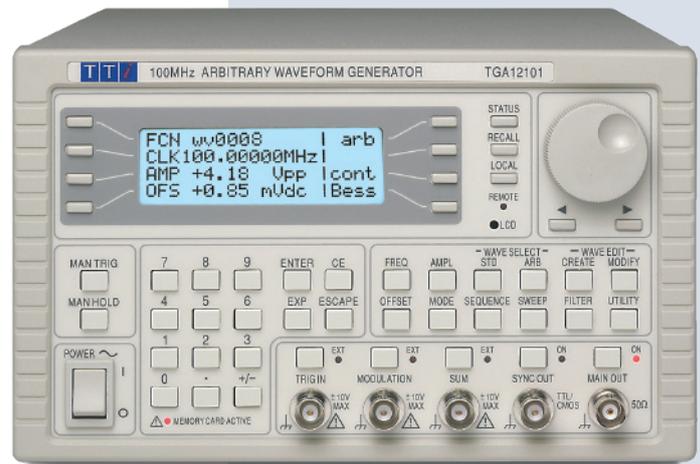
TGA12100 series

- ▶ 100MS/s universal arbitrary waveform generators
- ▶ One, two or four channels
- ▶ 1M word waveform memory
- ▶ External ARB clock input
- ▶ Storage on CF memory cards
- ▶ RS-232, GPIB and USB interfaces

The TGA12100 series offers all of the features of the TGA1240 series with extended sampling speed and memory depth.

It also includes a number of additional features such as an external ARB clock input that extends the capabilities further.

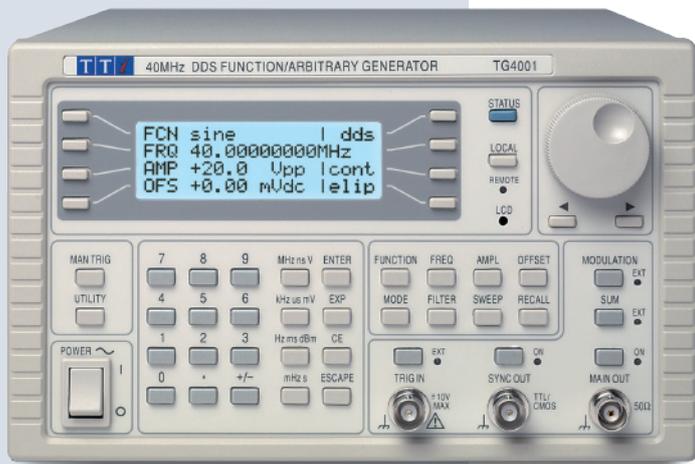
- ▶ Features as per the TGA1240 series with the following additions:
- ▶ 100MS/s maximum sampling, (0.1Hz to 100MHz variable clock).
- ▶ 1,048,576 point waveform memory per channel.
- ▶ Waveform storage using removable CompactFlash memory cards.
- ▶ 40MHz function generator capabilities using DDS.
- ▶ External ARB clock input for synchronism with external signals.
- ▶ "System clock" architecture for reduced inter-channel skew.
- ▶ Auxiliary sinewave output (3rd or 5th output) on TGA12102/4.
- ▶ RS-232 and GPIB (IEEE-488.2) and USB interfaces.



TG4001

- ▶ 40MHz DDS function generator
- ▶ High speed arbitrary waveforms
- ▶ Pulse train generation
- ▶ RS-232, USB and optional GPIB

Further details are provided in the comparison table on the previous page. Full details are available on the web site.



The TG4001 provides high purity sine waves at up to 40MHz and square waves at up to 50MHz. The output amplifier has a bandwidth approaching 100MHz ensuring that waveform quality is excellent right up to the frequency limits. Amplitude flatness is better than $\pm 0.2\text{dB}$ to 1MHz and $\pm 0.4\text{dB}$ to 40MHz.

Low noise design ensures minimum waveform aberrations and provides high waveform quality even at minimum output amplitude.

In addition to its eleven 'standard' waveforms, the TG4001 can generate arbitrary waveforms of any length between 8 and 65,536 points at speeds of up to 100MS/s. Up to four arbitrary waveforms can be stored within the instrument.

As well as standard and arbitrary waveforms, The TG4001 can generate pulse trains. A pattern of up to 10 pulses can be quickly defined with each pulse having its own amplitude, width and delay.

- ▶ 0.1MHz to 40MHz range; 10 digits or 0.1MHz resolution.
- ▶ 11 standard waveforms including sine, square, triangle, haversine, ramp, pulse, $\sin(x)/x$.
- ▶ Pulse train generation for up to 10 pulses.
- ▶ Arbitrary waveforms of up to 64K points at up to 100MS/s.
- ▶ Modulations modes of sweep, burst, gated and tone switching; built-in trigger generator.
- ▶ 5mV to 20V pk-pk output from 50Ω ; plus multi function aux. out.
- ▶ Storage for nine instrument set-ups in non-volatile memory.
- ▶ Waveform Manager Plus for Windows software included.
- ▶ Programmable via RS-232 or USB interfaces; GPIB optional.

Waveform Manager Plus software

- ▶ Waveform creation, editing, import and management
- ▶ Full waveform building tools
- ▶ Interface via RS232, USB, LAN or GPIB

Waveform Manager Plus is supplied with all TGA series generators and the TG4001 & TG251xA & TG501xA. Full details of the software capabilities are available on the web site.

Aim-TTI arbitrary generators include a built-in waveform creation/editing facility that includes point-by-point value insertion, straight line interpolation between points and standard waveform insertion between points.

However, complex arbitrary waveforms will need to be generated using sophisticated software tools outside of the instrument and transferred using a digital interface.

Waveform Manager Plus is a Windows program that offers the most comprehensive range of waveform creation and editing tools available including a full mathematical expression generator and freehand drawing tools.

Waveform Manager Plus is supplied as standard with all TGA series generators and with the TG4001 and TG251xA and TG501xA.

Waveform Manager Plus can also be used to import waveforms from other software programs or other hardware devices and to scale and crop these waveforms for compatibility with the target arbitrary generator.



- ▶ Full waveform building tools including standard waveforms, mathematical expressions, clipboard functions and freehand drawing.
- ▶ Compatible with Windows 2000 thro Windows 8.
- ▶ Vertical resolutions up to 16 bits (65536 points).
- ▶ Horizontal resolutions to over one million points.
- ▶ Waveform import/export via clipboard functions.
- ▶ Direct import from CSV files
- ▶ Download and upload via RS232, USB, GPIB, LAN.

TGR6000

- ▶ 6 GHz signal generator
- ▶ -110dBm to +7dBm
- ▶ High speed sweep
- ▶ USB, RS-232, GPIB & LAN

Note: Full technical details are available on the web site.

- ▶ 10MHz to 6000MHz frequency range
- ▶ Accuracy better than 1ppm over 15°C to 30°C
- ▶ Ageing better than 1 ppm over one year
- ▶ Low phase noise and low leakage
- ▶ -110dBm to +7dBm amplitude, 0.1dB steps
- ▶ Amplitude entry in dBm, μV / mV, or dB μV
- ▶ User compensation tables for specific test set-ups
- ▶ Fast stepping sweep with dwell times down to 10ms
- ▶ Internal or externally triggered sweep, lin or log, up or down
- ▶ List sweep of up to 1000 points of amplitude versus frequency
- ▶ Non-volatile storage for 12 generator set-ups and 16 sweep lists
- ▶ Compact half-rack 2U casing uses minimum bench space
- ▶ Full remote control through RS232, USB, GPIB and LAN
- ▶ Significantly lower cost than other 6GHz generators



The TGR6000 is a highly cost effective solution for engineers requiring a high quality generator operating up to 6GHz.

No modulations are incorporated, but rapid settling times enables a fast stepped sweep.

Level trim allows amplitude to be adjusted at various frequencies to match the requirements of specific test set-ups.

List sweep enables up to 1000 points of amplitude versus frequency to be defined.

TGR1040

- ▶ 1 GHz signal generator
- ▶ -127dBm to +7dBm
- ▶ RS-232, optional GPIB
- ▶ Low cost

Note: Full technical details are available on the web site.



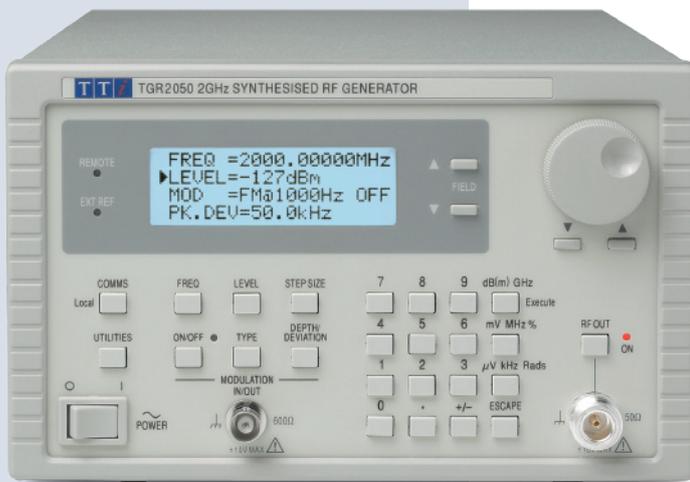
- ▶ 10MHz to 1000MHz frequency range
- ▶ Accuracy better than 1 ppm over 15°C to 30°C
- ▶ Ageing better than 1 ppm over one year
- ▶ Low phase noise and low leakage
- ▶ -127dBm to +7dBm amplitude, 0.1dB steps
- ▶ Amplitude entry in dBm or μ V / mV
- ▶ FM modulation, internal or external
- ▶ Four line back-lit dot matrix LCD display
- ▶ Keyboard and rotary encoder control
- ▶ Non-volatile storage for 9 generator set-ups
- ▶ Full remote control through RS232 or optional GPIB
- ▶ Significantly lower cost than other synthesized RF generators

The TGR1040 is the low cost solution for RF engineers who require a basic RF generator of high stability and wide amplitude range. It has good phase noise and low leakage and offers FM modulation, internal or external.

TGR2050

- ▶ 2 GHz signal generator
- ▶ -127dBm to +7dBm
- ▶ AM, FM & phase modulation
- ▶ RS-232 and GPIB standard

Note: Full technical details are available on the web site.



- ▶ 150kHz to 2000MHz frequency range
- ▶ 10Hz frequency setability
- ▶ Locking to external frequency standard
- ▶ Accuracy better than 1 ppm over 15°C to 30°C
- ▶ Ageing better than 1 ppm over one year
- ▶ Low phase noise and low leakage
- ▶ -127dBm to +7dBm amplitude, 0.1dB steps
- ▶ Amplitude entry in dBm or μ V / mV
- ▶ FM, Phase and AM modulation, internal or external
- ▶ Keyboard and rotary encoder control
- ▶ Non-volatile storage for 9 generator set-ups
- ▶ Full remote control through RS232 and GPIB
- ▶ Exceptional price/performance ratio

The TGR2050 offers a wide frequency range with a setability of 10Hz. It has 1ppm internal stability and can be locked to an external standard.

Modulation facilities of FM, Phase and AM are included.



Thurlby Thandar Instruments Ltd. (TTi) is one of Europe's leading manufacturers of test and measurement instruments.

Products have been sold under two brand names - TTI and Aim.

In the future, however, the full product range will be branded Aim-TTi.



Further Products

The preceding pages are an extract from the 36 page general Aim-TTi Product Summary brochure which also includes laboratory power supplies, precision test instruments, and RF & EMC test equipment..

The Aim-TTi Web Site

This catalogue provides only limited information on each product.

The Aim-TTi Web sites

Detailed product information is provided on the Aim-TTi web site, together with support information and price lists.

There are three web sites relating to your geographic location: international, UK and USA (see below):

The screenshot shows the Aim-TTi website interface. At the top, there is a navigation bar with the Aim-TTi logo and the tagline 'advanced electronic test instruments & power supplies'. Below this, it says 'AIM & THURLBY THANDAR INSTRUMENTS'. The main content area includes a welcome message, international site links for USA, UK, and France, and a list of languages: Français, Italiano, Deutsch, and Español. A featured product section highlights 'NEW & FEATURED PRODUCTS' for 'TG501xA & TG251xA' as 'Top value arbitrary/function/pulse generators - single or dual channel up to 50MHz sine & square'. It also mentions a '3 year warranty' and 'New 2-channel arbitrary/function/pulse generators'. Below this, there are four product categories with images: 'Laboratory Power Supplies' (Bench and Bus programmable), 'Waveform Generators' (Function, Pulse and Arbitrary), 'Precision Measurement' (DMMs, Counters, LCR, DC Loads, EMC, Current probes), and 'RF and EMC Test Equipment' (Spectrum Analysers, Generators, Power Meters, Harmonics Analysis).

aimtti.com

Thurlby Thandar Instruments Limited

Glebe Road, Huntingdon, Cambridgeshire PE29 7DR England (United Kingdom)

Contact for international customers:

Web: www.aimtti.com
 Telephone: +44 (0)1480 412451
 Faximile: +44 (0)1480 450409
 Email: info@aimtti.com

Contact for UK customers:

Web: www.aimtti.co.uk
 Telephone: 01480 412451
 Faximile: 01480 450409
 Email: info@ttid.co.uk

Contact for USA customers:

Web: www.aimtti.us
 Telephone: (585) 385-1750
 Faximile: (585) 385-1768
 Email: info@aimtti.us

Note that not all products are available in the USA.