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195 Specifications

Waveforms

Standard Waveforms

Sine, square, triangle, DC, positive ramp, negative ramp, sin(x)/x, pulse, pulse train, cosine, haversine and havercosine.

Sine, Cosine, Haversine, Havercosine

Range:	0.1mHz to 16 MHz
Resolution:	0.1mHz or 7 digits
Accuracy:	10 ppm for 1 year
Output Level:	2.5mV to 10Vp-p into 50Ω
Harmonic Distortion:	<0.1% THD to 100kHz

Square

Range:	1mHz to 16MHz
Resolution:	1mHz (4 digits)
Accuracy:	± 1 digit of setting
Output Level:	2.5mV to 10Vp-p into 50Ω
Rise and Fall Times:	<25ns

Triangle

Range:	0.1mHz to 100kHz
Resolution:	0.1mHz or 7 digits
Accuracy:	10 ppm for 1 year
Output Level:	2.5mV to 10Vp-p into 50Ω

Ramps and Sin(x)/x

Range:	0.1mHz to 100kHz
Resolution:	0.1mHz (7 digits)
Accuracy:	10 ppm for 1 year
Output Level:	2.5mV to 10Vp-p into 50Ω
Linearity Error:	<0.1% to 30 kHz

Pulse and Pulse Train

Output Level:	2.5mV to 10Vp-p into 50Ω
Rise and Fall Times:	<25ns
Period:	
Range:	100ns to 100s
Resolution:	4-digit
Accuracy:	±1 digit of setting
Delay:	
Range:	-99.99s to + 99.99s
Resolution:	0.002% of period or 25ns, whichever is greater
Width:	
Range:	25ns to 99.99s
Resolution:	0.002% of period or 25ns, whichever is greater

Note: Pulse width and absolute value of the delay may not exceed the pulse period. Pulse trains up to10 pulses may be specified, each pulse having independently defined width, delay and level. Baseline voltage is separately defined and sequence repetition rate is set by pulse train period.

Arbitrary

Up to 100 user defined waveforms may be stored in RAM. Waveforms can be defined by front panel editing controls or by downloading waveform data via RS232 or GPIB.

Memory Size:	64k points per channel.
Vertical Resolution:	12 bits
Sample Clock Range:	100mHz to 40MHz

Sequence

Up to 16 waveforms may be linked. Each waveform can have a loop count of up to 32,768. Sequence can be looped up to 1,048,575 times or continuously.

Output Filters

16MHz Elliptic, 10MHz Elliptic, 10MHz Bessel or none.

Operating modes

Triggered Burst

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

Gated

Waveform runs while the Gate signal is true and stop while false.

Sweep

Frequency sweep capability is provided for standard and arbitrary waveforms. Arbitrary waveforms are expanded or condensed to exactly 4096 points and DDS techniques are used to perform the sweep. Sweep Modes are linear or logarithmic; up or down; up/down or down/up.

Sweep time:	30ms - 999s
Sweep range:	1mHz - 16MHz in one range

Tone Switching

Capability provided for standard and arbitrary waveforms. Arbitrary waveforms are expanded or condensed to exactly 4096 points and DDS techniques are used to allow instantaneous frequency switching.

Carrier Waveforms:	All waveforms except pulse, pulse train and sequence.
Frequency List:	Up to 16 frequencies from 1mHz to 10MHz.

Trigger Generator

Internal source 0.005 Hz to 100kHz square wave. Available for external use from any SYNC OUT socket.

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Outputs

Main Output - One for each channel

Output Impedance:	50Ω
Amplitude:	5mV to 20Vp-p open circuit (2.5mV to 10Vp-p into 50Ω).
Amplitude Accuracy:	2% +/-1mV at 1kHz into 50Ω.
Amplitude Flatness:	+/-0.2dB to 200 kHz; +/-1dB to 10 MHz; +/-2dB to 16 MHz.
DC Offset Range:	+/-10V. DC offset plus signal peak limited to +/-10V from 50Ω.
DC Offset Accuracy:	Typically 3% +/-10mV, unattenuated.
Resolution:	3 digits or 1mV for both Amplitude and DC Offset.

Sync Out - One for each channel

Multifunction output user definable or automatically selected to be any of the following:

Waveform Sync: (all waveforms)	A square wave with 50% duty cycle at the main waveform frequency, or a pulse coincident with the start of an arbitrary waveform.
Position Markers: (arbitary only)	Any point(s) on the waveform may have associated marker bit(s) set high or low.
Burst Done:	Produces a pulse coincident with the last cycle of a burst.
Sequence Sync:	Produces a pulse coincident with the end of a waveform sequence.
Trigger:	Selects the current trigger signal.
Sweep Sync:	Outputs a pulse at the start of sweep to synchronize an oscilloscope or recorder.
Phase Lock Out:	Used to phase lock two generators. Produces a positive edge at the 0° phase point.
Output Signal Level:	TTL/CMOS logic levels from typically 50Ω.

Cursor/Marker Out

Adjustable output pulse for use as a marker in sweep mode or as a cursor in arbitrary waveform editing mode. Can be used to modulate the Z-axis of an oscilloscope or be displayed on a second scope channel.

Output Signal Level:	Adjustable from nominally 2V to 14V, normal or inverted; adjustable width as a cursor.
Output Impedance:	600Ω typical

Inputs

Trig In

Frequency Range:	DC - 1MHz.
Signal Range:	Threshold nominally TTL level; maximum input +/-10V.
Minimum Pulse Width:	50ns, for Trigger and Gate modes; 50us for Sweep mode.
Polarity:	Selectable as high/rising edge or low/falling edge.
Input Impedance:	10kΩ

Modulation In

Frequency Range:	DC - 100kHz.
Signal Range:	1V for 100% level change at maximum output.
Input Impedance:	Typically 1kΩ.

Sum In

Frequency Range:	DC - 8MHz.
Signal Range:	Approximately 2Vpk-pk input for 20Vpk-pk output.
Input Impedance:	Typically 1kΩ.

Hold

Holds an arbitrary waveform at its current position. A TTL low level or switch closure causes the waveform to stop at the current position and wait until a TTL high level or switch opening which allows the waveform to continue. The front panel HOLD key or remote command may also be used to control the Hold function.

Input Impedance:	10kΩ

Ref Clock In/Out

Set to Input:	Input for an external 10MHz reference clock. TTL/CMOS threshold level.
Set to Output:	Buffered version of the internal 10MHz clock. Output levels nominally 1V and 4V from 50Ω.

Inter-channel operation

Inter-channel Modulation

The waveform from any channel may be used to Amplitude Modulate (AM) or Suppressed Carrier Modulate (SCM) the next channel. Alternatively any number of channels may be Modulated (AM or SCM) with the signal at the MODULATION input socket.

Carrier frequency:	Entire range for selected waveform.
Carrier waveforms:	All standard and arbitrary waveforms.

Modulation Types

AM: Double sideband with carrier.

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SCM:	Double sideband suppressed carrier.
Modulation source:	Internal or External
Frequency Range:	DC to >100 kHz.
Internal AM:	
Depth:	0% to 105%
Resolution:	1%.
Carrier Suppression (SCM):	> -40dB.
External Modulation Signal Range:	Approximately 1V pk-pk for 100% level change at maximum output.

Inter-channel Analog Summing

Waveform Summing sums the waveform from any channel into the next channel. Alternatively any number of channels may be summed with the signal at the SUM input socket.

Carrier frequency:	Entire range for selected waveform.
Carrier waveforms:	All standard and arbitrary waveforms.
Sum source:	Internal or External
Frequency Range:	DC to 8MHz.
External Signal Range:	Approximately 5Vpk-pk input for 20Vpk-pk output.

Inter-channel Phase locking

Two or more channels may be phase locked together. One channel is assigned as the Master and the other channels as Slaves. Each Slave can have a phase angle relative to the Master. Arbitrary waveforms and waveform sequences may be phase locked but certain constraints apply to waveform lengths and clock frequency ratios.

Phase Resolution	
DDS waveforms:	0.1°
Non-DDS waveforms:	0.1° or 360°/ number of points whichever is the greater.
Phase Error	
All waveforms:	<+/-10ns

The signals from the REF IN/OUT socket and the SYNC OUT socket can be used to phase lock two instruments.

Inter-channel Triggering

Any channel can be triggered by the previous or next channel.
The previous/next connections can be used to 'daisy chain' a trigger signal from a 'start'channel, through any number of channels to an 'end' channel.
In this way, complex and versatile inter-channel trigger schemes may be set up. Each channel can have its trigger out and its output waveform set up independently.
Trigger out may be selected from Waveform End, Position Markers, Sequence Sync or Burst Done.
Using this scheme it is possible to create a sequence of up to 64 waveform segments, each channel producing up to 16 segments and all channels being summed to produce the complete waveform at the output of channel 4.

Interfaces

Full remote control facilities are available through the RS232 or GPIB interfaces.

RS232:	Variable Baud rate, 9600 Baud maximum. 9-pin D-connector.
IEEE-488:	IEEE488.1 and IEEE488.2

General

Display:	20 character x 4 row alphanumeric LCD.
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 battery-backed memory. Up to 100 arbitrary waveforms can also be stored independent of the instrument settings.
Size:	H x W x D :130 (3U) x 350 x 335mm
Weight:	7.2kg. (16lb)
Power:	230V, 115V or 100V nominal 50/60Hz, 100VA max.
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.
Option:	19 inch rack mounting kit.
Safety:	Complies with: EN 61010-1.
EMC:	Complies with EN 50081-1 and EN 50082-1.

Ordering information

Model 195	2 Channel 40MS/s Synthesized Universal Waveform Generator
Option 001	2 additional channels
Option 002	Rack mount kit
WaveForm DSP2	Arbitrary waveform creation software



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