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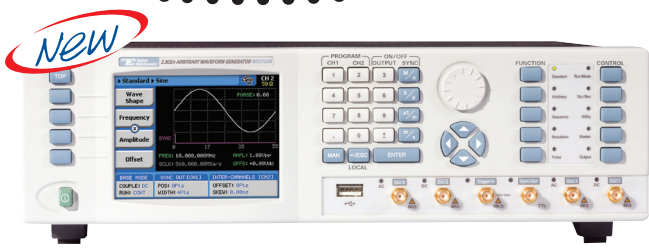
SIGNAL EXPERT

45 YEARS OF INNOVATION



MODELS SE5081/2

5GS/s Single/Dual Channel Arbitrary Waveform Generators

- Single or Dual channel 5Gs/s, 12 bit waveform generators
- Extra wide analog bandwidth up to 7GHz
- Extremely fast rise and fall time of under 150ps
- Multi-Nyquist zone operation, up to the 4th Nyquist zone
- Inter-channel control from -3ns to +3ns with 10ps resolution
- Independent or synchronized channels configurations
- 16M waveform memory and up to 64M memory optional
- AM, FM, FSK, PSK, ASK, Amp. Hop, Freq. Hop, Sweep & Chirp
- Powerful pulse composer for analog, digital and mixed signals
- Advanced sequencer for step, loop, nest and jumps scenarios
- Various output amplifier modules utilized to solve numerous applications in different domains
- Smart trigger allows: trigger hold-off, detect <=> pulse width, as well as wait-for-waveform-end or abort waveform and restart
- Built-in fast dynamic segments and sequences hop control
- Two differential markers per channel with programmable positions, width and levels
- User friendly GUI & Remote control through LAN, USB & GPIB
- Store/recall capability on memory stick or 4GB internal memory
- Multi instrument synchronization

The new Signal Expert Series sets new standards for high speed arbitrary waveform generators. With an analog bandwidth of nearly 7 GHz, the new Signal Expert Series can reach frequencies much higher than its sampling rate. Combining this vast analog bandwidth with multi Nyquist zone operation the Signal Expert Series is capable of solving applications well beyond baseband and into the microwave frequencies. This new technology combined with advanced arbitrary and sequencing capabilities, excellent spectral purity, configurable output modules, and advanced triggering make the new Signal Expert Series the highest performing and most cost effective AWG of its class and even beyond.

Multi-Nyquist Operation

Traditionally AWGs work only in the first Nyquist zone as signals in the higher Nyquist zones are suppressed, due to bandwidth and architecture limitations. But what if these signals were not suppressed? This would mean that with the proper filter it would be possible to generate signals well above the sampling rate of the AWG. Utilizing new technology, the Signal Expert Series offers different sampling modes that optimize performance according to the Nyquist zone of interest. Coupled with the proper output module users can generate signals more than 7GHz and well into the microwave C-band area, while keeping excellent signal purity.

Configurable Outputs Option

Different applications require different output paths. This is why the Signal Expert Series offers a selection of various factory configured output modules. Each output module offers a different amplifier path, utilizing benefits which would match your specific application need. For example, the High Voltage module, which offers 3Vpp into 50Ω and up to 1GHz bandwidth, is utilized for various time domain applications, while for applications that require clean, direct IF/RF generation, one can order the DAC AC output module, which has a fixed 0dBm and 6GHz of bandwidth for exceptional spectral purity. The default configuration is the High Bandwidth module, which offers 1Vpp and up yo 8GHz of bandwidth utilizing the SE5082 full 7GHz bandwidth and offering a rise and fall time below 150ps. Other output modules will be made available soon, so feel free to share with us your requirements so that we can try and meet your application needs.

Signal Integrity and Purity

One of the most important requirement in today's testing and measurement applications is high signal quality. With a typical SSB phase noise of <-115dBc at 100MHz, and <-105dBc at 1GHz, at 10 kHz carrier offset and with exceptionally good SFDR of <-70dBc at 1GHz carrier, Tabor's Signal Expert Series' unique platform delivers one of the best quality signals available on the market today, answering the ever-growing demand for clear and precise signals.

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IQ Generation
The ability to generate IQ signals is fundamental for any RF or communication engineer. With the advanced arbitrary capabilities and highly synchronized channels, the SE is ideal for generating digital modulations. The new Signal Expert Series offers excellent EVM performance even at 1.8GHz IQ bandwidth with less than 1% EVM for a 16QAM modulation, making it, by far, the best performance for price IQ source available in the market today.

Common or Separate Clocks
Need a dual or a single channel unit… why choose? With the new Signal Expert Series you can have it all. The Signal Expert Series has up to two output channels, which can either operate independently, or synchronized to share the same sample clock source. As separate channels, one has the advantage of having up to two separate instruments in one box, with each having the ability to be programmed to output different function shapes, frequency, amplitude levels and/or to operate in different run modes. Alternatively, the advantage of having synchronized channels with less than 10ps skew and skew control is very significant in applications that require an accurate and controlled phase between the channels, which is ideal for many X-Y modes and I&Q output applications.

Smart Trigger
Until now, you`ve been forced to trigger on a specific event. Tabor`s all-new SmarTrigger feature was designed to enhance the trigger capability and facilitate wider flexibility of a specific pulse event. It allows triggering on either a pulse having a larger pulse width than a programmed time value (time), or even on a pulse having a pulse width between two limits (<>time). In addition, the SmarTrigger has a hold-off function, in which the output is held idle after the first trigger and starts a waveform cycle only with the first valid trigger after a hold-off interval has lapsed, allowing you to solve endless "negotiation" scenarios.

Powerful Segmentation and Sequencing
Solving almost every complex application, powerful segmentation and sequencing produces a nearly endless variety of complex waveforms. The waveform memory can be divided into multiple waveform segments and sequenced in user-selectable fashion to create complex waveforms that have repeatable segments, jump and nest, saving you precious memory space. The Signal Expert also allows you to generate up to 1000 sequence scenarios and sequence between them to generate an even higher level of flexibility in waveform creation.

Programmable Differential Markers
The Signal Expert series is equipped with two programmable differential markers per channel. Differential simply means outstanding signal integrity for high frequencies, whereas the programmability allows you to set position, width, delay and amplitude for any required peripheral triggering need. While bench usage enables setting only one marker position, you can set multiple markers and program different marker properties for each transition instance remotely, allowing various triggering profiles.

Pulse / Pattern Creation
Generating complex pulse trains has never been easier. The Pulse Composer is a powerful built-in tool that converts the Signal Expert Series to a very sophisticated Pulse/Pattern Generator, allowing to create literally any complex pulse train / pattern, whether it's a single pulse, multi-level, linear-points, initialization or preamble pattern definition, user-defined or even standard random patterns with programmable resolution, so it doesn't matter if your application is radar communications, nanotechnology or serial bus testing, the pulse/pattern composer is the right tool for your application. Moreover, all the Signal Expert Series advanced trigger modes are applicable, hence one can choose to use the "step" mode to advance every bit independently or the "once" mode to advance a complete data block in one trigger event, enabling even more applications, such as trigger, clock and data protocols.

Dynamic Segment / Sequence Control
Working in the real-time world and need fast waveform switching? The Signal Expert series has a rear panel control designed specifically for that. Having the dynamic control feature, in effect, can serve as replacement of the sequence table where the real-time application can decide when and for how long a waveform will be generated. For much more complex applications, this same input may serve as a dynamic switch for complete sequences, creating real-life scenarios for real-time applications.

Multiple Environments to Write Your Code
The Signal Expert Series comes with a complete set of drivers, allowing you to write your application in various environments including Labview, CVI, C++, VB, Python and MATLAB. You may also link the supplied dll to other Windows-based API's or use low-level SCPI commands to program the instrument, regardless of whether your application is written for Windows, Linux or Macintosh operating systems.

Easy to Use
Large and user-friendly 4" backlit color LCD display facilitates browsing through menus, updating parameters and displaying detailed and critical information for your waveform output. Combined with numeric keypad, ten quick-link function & run mode buttons, cursor position control and a dial, the front panel controls simplify the often complex operation of an arbitrary waveform generator.

ArbConnection
ArbConnection is a powerful software package that allows you to easily design any type of waveform and control the instrument functions, modes and features via a graphical user interface (GUI). Whether you need to generate output using a built-in waveform, a hand sketched or played back waveform, a pulse pattern, a serial data string, a modulated carrier or even an equation, ArbConnection provides you the editing tool which makes virtually any application possible.

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Specification

CONFIGURATION

Output Channels 1/2, Synchronized/fully separated

STANDARD WAVEFORMS

Type: Sine, triangle, square, ramp, pulse, sin(x)/x, exponential rise, exponential decay, gaussian, noise and DC.

Frequency Range:

Sine	1Hz to 2.5GHz
Square, Pulse	1Hz to 1.25GHz
All others	1Hz to 300MHz

SINE

Start Phase: -360° to 360°
PhaseResolution: 0.01°
Harmonics Distortion (typ.)[1]**:**

	2nd harmonic	3rd harmonic
HBW*	<-55 dBc	<-50 dBc
MBW**	<-55 dBc	<-50 dBc
HV***	<-50 dBc	<-45 dBc
RF******	<-60 dBc	<-45 dBc

[1] SCLK=4.5 GS/S, 40 points sine waveform (112.5 MHz output frequency), typical values

Non-Harmonics Distortion (typ.)[2]**:**

	10 MHz	800 MHz	2200 MHz
HBW*	<-70 dBc		<-56 dBc
MBW**	<-70 dBc		<-56 dBc
HV***	<-60 dBc	<-50 dBc	
RF******	<-70 dBc		<-56 dBc

[2] NRZ mode, Amplitude=1 V, offset=0 V, SCLK=4.5 GS/s, arbitrary sine waveforms, typical values

SSB Phase Noise[1]**:** -115dBc/Hz (10kHz offset)
Flatness (AC Path):
Cross Range TBD

PULSE

Pulse Mode: Single or double, programmable
Polarity: Normal, inverted or complement
Period:
MBW/HBW Module 800ps to 1.6s
HV Module 4ns to 1.6s
Resolution:
MBW/HBW Module 200ps
HV Module 1ns
Pulse Width:
MBW/HBW Module 200ps to (1.6s-200ps)
HV Module 2ns to (1.6s-2ns)
Rise/Fall Time:
Fast
MBW/HBW Module 200ps (typical < 150ps)
HV Module 600ps (typical < 500ps)
Linear
MBW/HBW Module 200ps to (1.6s-200ps)
HV Module 1ns to (1.6s-1ns)
Delay:
MBW/HBW Module 200ps to (1.6s-200ps)
HV Module 1ns to (1.6s-1ns)
Double Pulse Delay:
MBW/HBW Module 1ns to 1s
HV Module 200ps to 1s
Amplitude Range:
MBW/HBW Module 50mVp-p to 1Vp-p into 50Ω
HV Module 50mVp-p to 2Vp-p into 50Ω

Levels	HV	HBW/MBW
Low Level	-1.5 to +1.5	-0.55 to +0.55
High Level	-1.5 to +1.5	-0.55 to +0.55

NOTES:

1. All pulse parameters, except rise and fall times, may be freely programmed within the selected pulse period provided that the ratio between the period and the smallest incremental unit does not exceed the ratio of 16,000,000 to 1.
2. Rise and fall times, may be freely programmed provided that the ratio between the rise/fall time and the smallest incremental unit does not exceed the ratio of 1,000,000 to 1.
3. The sum of all pulse parameters must not exceed the pulse period setting.

PULSE / PATTERN COMPOSER

MULTI-LEVEL / LINEAR-POINTS

Number of Levels: 1 to 1000
Dwell Time: 400ps to 1s
Transition type: Fast or Linear
Memory: 100k
Amp. Resolution: 4 digits
Time Resolution: 200ps to 100ns (auto or user)

PATTERN

Pattern Source: PRBS or user-defined
PRBS Type: PRBS7, PRBS9, PRBS11, PRBS15, PRBS23, PRBS31, USER
Data Rate: 1Bit/s to 1GBit/s
Number of Levels: 2, 3, 4, 5
High/Low Levels: ±0.6V HBW & MBW/±1.5V HV
Resolution: 4 digits
Loops: 1 to 16e6
Preamble: 1 to 16e6
Length: 1 to 16e6

ARBITRARY WAVEFORMS

Sample Rate: 10MS/s to 5GS/s (6GS/s typical)
Vertical Resolution: 12 bits
Waveform Memory: 32M/64M points optional
Min. Segment Size: 384 points
Resolution: 32 points
No. of Segments: 1 to 32k
Waveform Granularity: 1 point
Dynamic control: Software command or rear panel segment control port
Jump Timing: Coherent or asynchronous

SEQUENCED WAVEFORMS

Multi Sequence: 1 to 1,000 unique scenarios
Sequencer Steps: 3 to 49,152 steps.
Segment Loops: 1 to 16M cycles, each segment
Sequence Loops: 1 to 1M ("Once" mode only)
Step Advance Modes: Continuous, once (x "N") and stepped

SEQUENCED SEQUENCES

Sequence Scenarios: 1 Scenario
Dynamic Control: Software command or rear panel sequence control port
Table Length: 3 to 1k steps
Advance Control: Continuous, once and stepped
Sequence Loops: 1 to 1,000,000 cycles

MODULATION

COMMON CHARACTERISTICS

Carrier Waveform: Sine, square, triangle
Carrier Frequency: 10kHz to 2.5GHz
Modulation Source: Internal

FM

Modulation Shape: Sine, square, triangle, ramp
Modulation Freq.: 100Hz to 250MHz
Deviation Range: 10MHz to 1.25GHz

FSK / FREQUENCY HOPPING

FSK Baud Rate: 100mbps to 1Gbps
Hop Table Size: 2 to 256
Hop Type: Fast or Linear
Dwell Time Mode: Fixed or programmable per step
Dwell Time: 1ns to 10s
Dwell Time Res.: 1ns

SWEEP / CHIRP

Sweep Type: Linear or log
Sweep Direction: Up or down
Sweep Time: 0.5 µs to 9.999ms
Modulation Shape: Pulse
Pulse Repetition:
Range 200ns to 20s
Resolution 3 digits
Accuracy 100ppm

AM

Modulation Shape: Sine, square, triangle, ramp
Modulation Freq.: 100Hz to 100MHz
Modulation Depth: 0 to 200%

ASK / AMPLITUDE HOPPING

ASK Baud Rate: 100mbps to 1Gbps
Hop Table Size: 2 to 256
Hop Type: Fast or Linear
Dwell Time Mode: Fixed or programmable per step
Dwell Time: 1ns to 10s
Resolution 1ns

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45 YEARS OF INNOVATION

Specification

(n)PSK and (n)QAM

Modulation Type: PSK, BPSK, QPSK, OQPSK, PI/4 DQPSK, 8PSK, 16PSK, 16QAM, 64QAM, 256QAM and User Defined
Symbol Rate Range: 100mbps to 1Gbps
Symbol Accuracy: 1ppm
Table Size: 2 to 256

COMMON CHARACTERISTICS

FREQUENCY

Resolution: 12 digits
Accuracy/Stability: Same as reference

ACCURACY REFERENCE CLOCK

Internal	1 ppm from 19°C to 29°C; 1ppm/°C below 19°C or above 29°C; 1 ppm/year aging rate
External	Same as accuracy and stability of the external ref.

OUTPUTS

MAIN OUTPUTS

HBW OUTPUT MODULE

Coupling: DC-coupled
Connectors: Front panel SMAs
Impedance: 50Ω nominal, each output
Protection: Protected against temporary short to case ground
Rise/Fall Time: <150ps
Bandwidth: 4GHz, typical
Amplitude Range:
Single-ended 100mVp-p to 1.5Vp-p*
Differential 200mVp-p to 3Vp-p*
Type: Single-ended or differential
Resolution: 4 digits
Accuracy: ±(3% +5 mV), offset = 0V
Overshoot: 6%, typical
Offset Range: -100mV to + 100mV into 50Ω
Offset Resolution: 4 digits
Offset Accuracy: ±5% + 5mV
* Double into high impedance

MBW OUTPUT MODULE (DEFAULT)

Coupling: DC-coupled
Connectors: Front panel SMAs
Impedance: 50Ω nominal, each output
Protection: Protected against temporary short to case ground
Rise/Fall Time: <200ps (typical <150ps)
Bandwidth: 3GHz, typical
Amplitude Range:
Single-ended 100mVp-p to 1Vp-p*
Differential 200mVp-p to 2Vp-p*
Type: Single-ended or differential
Resolution: 4 digits
Accuracy: ±(3% +5 mV), offset = 0V
Overshoot: 6%, typical
Offset Range: -500mV to + 500mV into 50Ω
Offset Resolution: 4 digits
Offset Accuracy: ±5% + 5mV
* Double into high impedance

HV OUTPUT MODULE

Coupling: DC-coupled
Connectors: Front panel SMAs
Impedance: 50Ω nominal, each output
Protection: Protected against temporary short to case ground
Rise/Fall Time: <600ps (typical <500ps)
Bandwidth: 600MHz, typical
Amplitude Range:
Single-ended 50mVp-p to 2Vp-p*
Differential 100mVp-p to 4Vp-p*
Type: Single-ended or differential
Resolution: 4 digits
Accuracy: ±(3% +5 mV), offset = 0V
Overshoot: 6%, typical
Offset Range: -1V to + 1V into 50Ω
Offset Resolution: 4 digits
Offset Accuracy: ±5% + 5mV

RF OUTPUT MODULE

Coupling: AC-coupled
Connectors: Front panel SMAs
Impedance: 50Ω nominal, each output
Type: Single-ended or differential
Amplitude: 0 dBm
Bandwidth: 10MHz to 6GHz

MARKER OUTPUTS

Number of Markers: Two markers per channel
Type: Differential (+) and (-) outputs
Connectors: SMB
Skew Between Markers: 100ps, typical
Impedance: 50Ω
Amplitude Voltage:
Window 0V to 1.25V, single-ended; 0V to 2.5V, differential
Low level 0V to 0.8V, single-ended; 0V to 1.6V, differential
High level 0.5V to 1.25V, single-ended; 0V to 2.5V, differential
Resolution: 10mV
Accuracy: 10% of setting
Width control: 2 SCLK to segment length;
Position control:
Range 0 to (segment length-4)
Resolution 4 points
Initial delay: 3.5ns±1 sample clock (Output to marker)
Variable delay:
Control Separate for each channel
Range 0 to 3ns
Resolution 10ps
Accuracy ±(10% of setting +20ps)
Rise/Fall Time: <1ns, typical

SYNC OUTPUT

Connector: Front panel SMA
Source: Channel 1 or channel 2
Type: Single ended
Waveform Type:
Pulse 32 points width
WCOM Waveform complete
Impedance: 50Ω
Amplitude: 1.2V, typical; doubles into high impedance
Variable Position Control:
Range 0 to (segment length-32)
Resolution 32 points
Rise/Fall Time: 2ns, typical
Variable Width control:
Range 32 points to (segment length-32)
Resolution 32 points

REFRENCE CLOCK OUTPUT

Connector: Rear panel BNC
Frequency: 100 MHz if using internal reference, 10MHz or 100MHz if using external reference
Output impedance: 50Ω, typical
Output voltage: 1 Vp-p

INPUTS

TRIGGER INPUT

Connector: Front panel SMA
Input Impedance: 10kΩ or 50Ω, selectable
Polarity: Positive, negative, or both
Damage Level: ±20Vdc
Frequency Range: 0 to 15MHz
Trigger Level Control:
Range -5V to 5V into 50Ω; -10V to 10V into 1kΩ
Resolution 12 bit (2.5mV)
Accuracy ±(5% of setting + 2.5mV)
Sensitivity 0.2Vp-p
Min. Pulse Width: 10 ns

EVENT INPUT

Connector: Rear panel BNC
Input Impedance: 10kΩ typical
Polarity: Positive, negative or either
Damage Level: ±20Vdc
Frequency Range: 0 to 15MHz
Trigger Level Control:
Range -5V to 5V
Resolution 12 bit (2.5mV)
Accuracy ±(5% of setting + 2.5mV)
Sensitivity 0.2 Vp-p minimum
Min. Pulse Width: 10 ns

MODELS SE5081/2

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45 YEARS OF INNOVATION

Specification

SEQUENCE/SEGMENT CONTROL INPUT

Connectors:	Rear panel D-sub, 8 bit lines, per channel
Switching Rate:	20ns + waveform duration minimum
Input Impedance:	10kΩ, typical
Input Level:	TTL

EXTERNAL REFERENCE INPUT

Connector:	Rear panel BNC
Input Frequency:	10 MHz to 100 MHz, programmable
Input Impedance:	50Ω
Voltage Swing:	-5dBm to 5dBm
Damage Level:	10dBm

EXTERNAL SAMPLE CLOCK INPUT

Connector:	Rear panel SMA
Input Impedance:	50Ω
Voltage Swing:	0dBm to 10dBm
Input Frequency:	10kHz to 5GHz
Clock Divider:	1/1, 1/2, 1/4, 1/256, separate for each channel
Damage Level:	15dBm

RUN MODES

Continuous:	A selected output function shape is output continuously.
Self Armed:	No start commands are required to generate waveforms.
Armed:	The output dwells on a DC level and waits for an enable command and then the output waveform is output continuously; An abort command turns off the waveform.
Triggered:	A trigger signal activates a single-shot or counted burst of output waveforms and then the instrument waits for the next trigger signal.
Normal Mode	The first trigger signal activates the output; consecutive triggers are ignored for the duration of the output waveform.
Override Mode:	The first trigger signal activates the output; consecutive triggers restart the output waveform regardless if the current waveform has been completed or not.
Gated:	A waveform is output when a gate signal is asserted. The waveform is repeated until the gate signal is de-asserted. Last period is always completed.
Burst:	Upon trigger, outputs a Dual or multiple pre-programmed number of waveform cycles from 1 through 1M.

TRIGGER CHARACTERISTICS

EXTERNAL

Source:	Channel 1, channel 2, or both
System Delay:	200 SCLK periods + 50ns
Trigger Delay:	Separate for each channel
Range	0 to 8,000,000 SCLK periods
Resolution	8 points
Accuracy	Same as SCLK accuracy
Smart Trigger:	Detects a unique pulse width < pulse width, > pulse width or <>pulse width
Conditioned Trigger:	
Pulse Width Range	10ns to 2s
Resolution	2ns
Accuracy	±(5% of setting +20ns)
Trigger Hold-off:	Ignores triggers for a hold-off
Hold-off range	100ns to 2s
Resolution	2ns
Accuracy	±(5% of setting +20ns)
Trigger jitter:	8 SCLK periods

INTERNAL

Source:	Common or separate
Modes:	
Timer	Waveform start to waveform start
Delayed	Waveform stop to waveform start
Timer:	
Range	200ns to 20s
Resolution	3 digits
Accuracy	100ppm
Delay	
Range	152 to 8,000,000 SCLK periods
Resolution	Even numbers, divisible by 8

MANUAL

Source:	Soft trigger command from the front panel or remote

INTER-CHANNEL SKEW CONTROL

COARSE TUNING

Initial skew:	200ps
Control:	
Range	0 to waveform-length points; 0 to 80 points with external segment control
Resolution	8 points
Accuracy:	Same as SCLK accuracy

FINE TUNING

Initial skew:	200ps
Control:	
Range	-3ns to +3ns
Resolution	10ps
Accuracy:	(10% of setting + 20ps)

TWO INSTRUMENTS SYNCHRONIZATION

Initial Skew:	20ns + 0 to 16 SCLK
Skew Control:	-5ns to 5ns
Skew Resolution:	10ps
Offset Resolution:	8 SCLK increments
Offset Control:	0 to Waveform length; 0 to 80 points with external segment control

GENERAL

Voltage Range:	100VAC to 240VAC
Frequency Range:	50Hz to 60Hz
Power Consumption:	150VA
Display Type:	TFT LCD, 4 “, 320 x 240 pixels
Interfaces:	
USB	1 x front, USB host, (A type); 1 x rear, USB device, (B type)
LAN	1000/100/10 BASE-T
GPIB	IEEE 488.2 standard interface
Segment control	2 x D-sub, 9 pin
Dimensions:	
With Feet	315 x 102 x 425 mm (WxHxD)
Without Feet	315 x 88 x 425 mm (WxHxD)
Weight:	
Without Package	4.5kg
Shipping Weight	6kg
Temperature:	
Operating	0°C to 40°C
Storage	-40°C to 70°C
Humidity:	85% RH, non condensing
Safety:	CE Marked, IEC61010-1
EMC:	IEC 61326-1:2006
Calibration:	2 years
Warranty [1]:	5 years standard of your purchase.

ORDERING INFORMATION

MODEL	DESCRIPTION
SE5081	5GS/s Single Channel Arbitrary Waveform Generator
SE5082	5GS/s Dual Channel Arbitrary Waveform Generator

OPTIONS

Option 1:	64M Memory (per channel)
Option Module-HV:	High Voltage output module
Option Module-RF:	RF, AC coupled output module
Option Module-HBV:	High Bandwifth output module

ACCESSORIES

Sync Cable:	Multi-instrument synchronization
S-Rack Mount:	19” Single Rack Mounting Kit
Case Kit:	Professional Carrying Bag

Note: Options and accessories must be specified at the time of your purchase