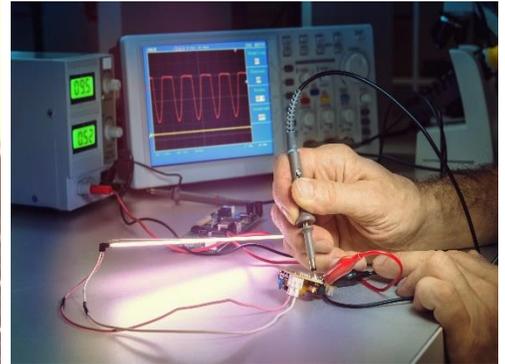
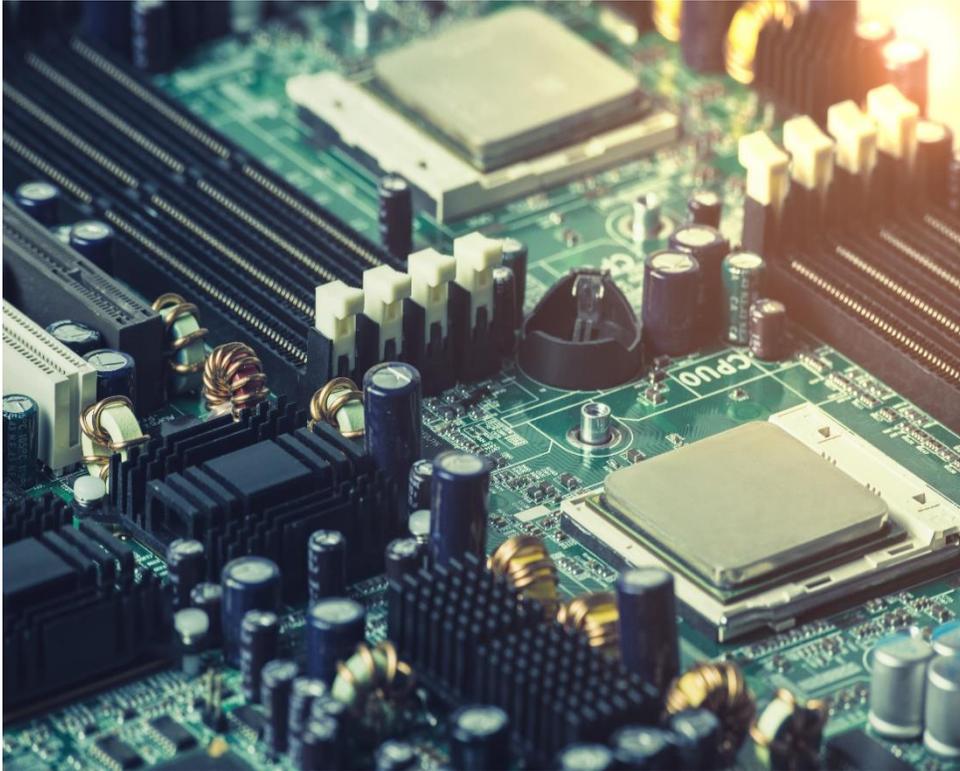


Model 685 | 2 GHz 6.16 GS/s

High Performance Arbitrary Waveform Generator and Digital Pattern Generator



Features

- 2, 4 or 8 Analog Channels
- 6.16 GS/s, 16-bit Vertical Resolution
- 180 MHz Bandwidth
- Up to 5 Vp-p Output Voltage and $\pm 2.5V$ Hardware Offset into 50 Ohm
- Up to 4 Gpts Waveform Memory per Channel
- Up to 32 Digital Channels in Synchronous with Analog Generation

Applications

- Aerospace and Defense
- Institute and University Research
- Semiconductor Tests
- Automotive
- IoT



**Model 685 | 2 GHz 6.16 GS/s
Arbitrary Waveform Generator**



Model 685 Arbitrary Waveform Generator

Model 685

Description

The Model 685 is a simple-to-use arbitrary waveform generator that operates on Windows based platform with 7" touch screen, front panel buttons and knob. The instrument has two operation modes - Simple Rider AFG (DDS AFG mode) and True Arb (variable clock Arbitrary AWG mode) which make the instrument easier to control. Model 685 supports the standard Ethernet interface for remote control and easy customized instrument programming.

The Model 685 comes with a 2 GHz arbitrary frequency generator and 8 analog channels operating up to 5 Vp-p output voltage into 50 Ω load impedance. An 32 digital output option is also available with each digital output providing up to a 1.54 Gb/s data rate in LVDS output format. The Model 685 also boasts a 1 S/s (Sample/second) to 6.16 GS/s with 16-bit vertical resolution, providing outstanding signal integrity with a rise time/fall time of less than 1 ns.

Up to 4 instruments can be synchronized together in order to obtain a 32 analog – 128 digital channel generator. A dedicated synchronization bus guarantees the intra- chassis synchronization. This feature is available on Model 685 only.

Model 685 Front



Model 685 Back





Model 685 Arbitrary Waveform Generator

Model 685

Model 685 User Interface

Simple Rider AFG: Function Generator Mode Interface

Simple Rider AFG UI is designed for touch and it has been developed to put all the capabilities of modern Waveform Generators right at your fingertips. All instrument controls and parameters are accessed through an intuitive UI that recalls the simplicity of Tablets and modern smart phones: touch features and gestures are available to engineers and scientists to create advanced waveforms or digital patterns in few touches.



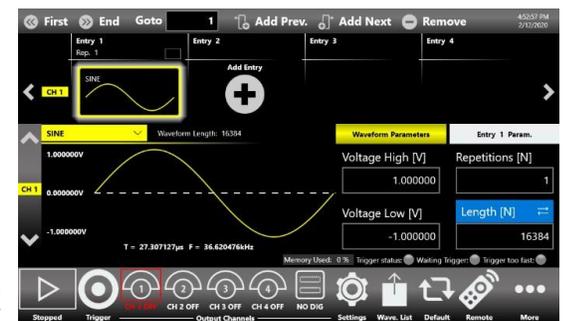
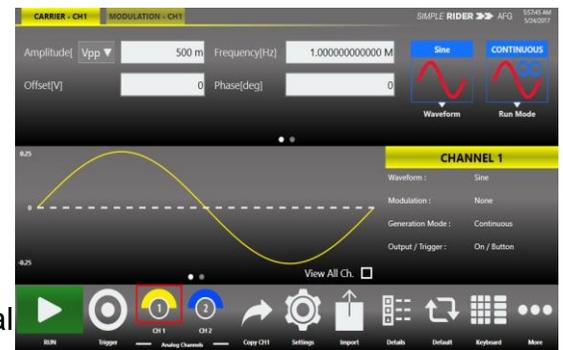
- The swipe gesture gives easy access to the output waveform parameters
- A touch-friendly virtual numeric keypad has been designed to improve the user experience on entering the data.
- Time saving shortcuts and intuitive icons simplify the instrument setup.

Simple Rider TrueArb: AWG and DPG Mode Interface

In **Simple Rider TrueArb** interface, the users can define complex waveforms with up to 16,384 sequence entries of analog waveforms and digital patterns, define their execution flow by means of loops, jumps and conditional branches.

Digital output combined and synchronized with analog output signals represent an ideal tool to troubleshoot and validate digital design. The waveform memory length of up to 4 GSamples on each channel combined with up to 16,384 and up to 4,294,967,294 repetitions, make the Model 685 the ideal generator for the most demanding technical applications.

Thanks to the intuitive and easy waveform sequencer user interface, the most complex waveform scenarios can be created with just few screen touches.





Model 685 Arbitrary Waveform Generator

Model 685

Model 685 Applications

Automotive

Today's cars are including a lot of highly sophisticated electronic control unit with very sensitive electronic components. The Model 685 combining 6.16 GSa/s with 16-bit vertical resolution, represents an ideal tool for successfully addressing the new testing challenges in automotive.

- EMI debugging, troubleshooting, and testing
- Electrical standards emulation up to 5V



IoT and Ind 4.0 Perfect RF Modulator

The Model 685 will be the iconic instrument for this application. The possibility to emulate complex RF I/Q modulation for simulation and Test vs wireless devices or working on Internet of things of industry 4.0 applications. Each engineer may use the possibility to import waveform to emulate devices under test, impose distortion on waveform (such noise) to test the ability of devices to be compliant to the standards.



Semiconductor Testing

Emulation of complex signals generated with inclusion of noise or distortions may became an excellent way to provide Compliance Components Test to help semiconductors engineers. The fast edges and pulse generation can be used to provide characterization in fast power devices.





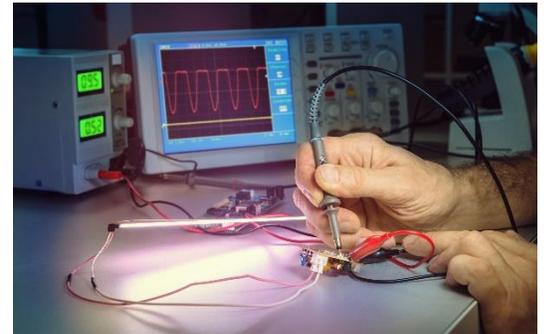
Model 685 Arbitrary Waveform Generator

Model 685

Research Applications

Research centers and universities are key users of the Model 685, which can produce complex waveforms, multilevel signals, and pulse emulation based on variable edges. The Model 685's combination of fast edge generation, excellent dynamic range and simple user interface meets the demands of scientists and engineers working on intensive experiments such as accelerators, tokamak, or synchrotrons, to emulate signals without creating specific test boards.

- Emulation of detectors
- Emulation of signal sources adding noise
- Generation/playback of real-world signals
- Emulation of long PRBS sequences
- Modulating and driving laser diode



Aerospace and Defense applications

The Model 685 works perfectly with electronic warfare signals, such as those produced by Radar or Sonar systems. This generator can also be fitted into a modular system for radio or I/Q signal modulation, as well as create pulses useful in applications such as pulse electron beams, X-ray sources, flash X-ray radiography, lightning pulse simulators, and high power microwave modulators.

- Frequency response, intermodulation distortion and noise-figure measurements
- Phase Locked Loop (PLL) pull-in and hold range characterization
- Radar base-band signals emulation





Model 685 Arbitrary Waveform Generator

Model 685 Arbitrary Waveform Generator

Model 685 Specifications

All specifications are typical unless noted otherwise. The guaranteed performances are referred to a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 5°C to 40°C and after a 45-minute warm up period. Within ±10°C after auto-calibration

General Specifications			
Number of Channels	Model 685-2C	Model 685-4C	Model 685-8C
Analog	2	4	8
Digital Out	0/8 optional	0/8/16 optional	0/8/16/32 optional
Marker Out	1	2	4
Operating Mode	AFG Mode True Arb Mode		
Amplitude			
Range (50 Ω into 50 Ω)	0 to 5 V _{p-p}		
Accuracy (1kHz sine wave, 0V offset, > 5mV _{p-p} amplitude, 50Ω load) (guaranteed)	±(1% of setting [V _{p-p}] + 5 mV)		
Resolution	<0.2 mV _{p-p} or 5 digits		
Output impedance	Single-ended: 50 Ω		
Baseline Offset			
Range (50 Ω into 50 Ω)	-2.5 V to +2.5 V		
Range (50 Ω into High Z load)	-2.5 V to +2.5 V		
Accuracy (50 Ω into 50 Ω) (guaranteed)	±(1% of setting ±5 mV)		
Resolution	<4 mV or 4 digits		
DC			
Amplitude range (50 Ω, single-ended)	-2.5 V to +2.5 V		
Amplitude accuracy (guaranteed)	±(1% of setting + 10 mV)		
AFG Mode Specifications			
Output Channels			
Connectors	SMA on front panel		
Output type	Single-ended		
Output Impedance	50 Ω		
General Specifications			
Operating mode	DDS mode		
Standard Waveforms	Sine, Square, Pulse, Ramp, more (Noise, DC, Sin(x)/x, Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine)		
Run Modes	Continuous, modulation, sweep, burst		
Arbitrary Waveforms	Vertical resolution: 16-bit Waveform length: 16,384 points		
Internal Trigger Timer	Range Resolution Accuracy		
	10.4 ns to 88 s 80 ps ±(0.1% setting + 5 ps)		
Sine Waves			
Frequency Range Sine (50 Ω into 50 Ω) ¹	1 μHz to ≤ 1 GHz: 5 V _{p-p} 1 GHz to ≤ 2 GHz: 4 V _{p-p}		
Flatness (1 V _{p-p} , relative to 1 kHz)	DC to 2 GHz: ±0.5 dB		

¹ Amplitude doubles on HiZ load



Model 685 Arbitrary Waveform Generator

Model 685

Harmonic Distortion (1 V_{p-p})	1 μ Hz to \leq 20 kHz: < -75 dBc > 20 kHz to \leq 400 MHz: < -70 dBc > 400 MHz to \leq 1 GHz: < -60 dBc > 1 GHz to \leq 2 GHz: < -55 dBc
Total Harmonic Distortion (1 V_{p-p})	10 Hz to 20 kHz: < 0.05% TBC
Spurious (1 V_{p-p}) (measured across DC to $F_s/2$)	1 μ Hz to \leq 1.5 GHz: < -65 dBc 1.5 GHz to \leq 1.7 GHz: < -55 dBc 1.7 GHz to \leq 2 GHz: < -50 dBc
Phase Noise (1 V_{p-p} , 10 kHz offset)	20 MHz: < -127 dBc/Hz typ. 100 MHz: < -123 dBc/Hz typ. 1 GHz: < -105 dBc/Hz typ.
Square Waves	
Frequency Range	1 μ Hz to \leq 770 MHz: $5V_{p-p}$
Rise/fall time (10% to 90%)	400 ps
Rise/fall time (20% to 80%)	300 ps
Overshoot (1 V_{p-p})	< 2%
Jitter (rms)	< 2 ps
Pulse Waves	
Frequency Range	1 μ Hz to \leq 770 MHz: $5V_{p-p}$
Pulse Width	500 ps to (Period - 500 ps) ²
Pulse Width Resolution	20 ps or 15 digits
Pulse Duty Cycle	0.1% to 99.9% (limitations of pulse width apply)
Leading/trailing edge transition time (10% to 90%)	400 ps to 1000 s
Leading/trailing edge transition time (20% to 80%)	300 ps to 1000 s
Transition time Resolution	2 ps or 15 digits
Overshoot (1 V_{p-p})	< 2%
Jitter (rms, with rise and fall time \geq 400 ps)	< 2 ps
Double Pulse Waves	
Frequency Range	1 μ Hz to \leq 385 MHz: $10V_{p-p}$ where $V_{p-p} = V_{p-p1} + V_{p-p2} $
Other Pulse Parameters	Same as Pulse Waves
Ramp Waves	
Frequency Range	1 μ Hz to 75 MHz
Linearity (< 10 kHz, 1 V_{p-p} , 100%)	\leq 0.1%
Symmetry	0% to 100%
Other Waves	
Frequency Range Exponential Rise, Exponential Decay Sin(x)/x, Gaussian, Lorentz, Haversine	1 μ Hz to 75 MHz 1 μ Hz to 1500 MHz
Additive Noise Bandwidth (-3 dB) Level Resolution	2 GHz 0 V to 2.5 V - carrier max value [V_{pk}] 1 mV
Arbitrary	
Number of Samples	2 to 16,384
Frequency range	1 μ Hz to \leq 770 MHz

² Below 500 ps width, the pulse amplitude will have some reduction respect to the set value



Model 685 True Arb

Model 685 Arbitrary Waveform Generator

Pulse Width Modulation (PWM)	
Carrier Waveforms	Pulse
Modulation Source	Internal or external
Internal Modulating Waveforms	Sine, Square, Ramp, Noise, ARB
Modulating Frequency	Internal: 500 μ Hz to 61 MHz, External: 10 MHz maximum
Deviation Range	0% to 50% of pulse period
Sweep	
Type	Linear, Logarithmic, staircase, and user defined
Waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Sweep Time	30 ns to 2000 s
Hold/return Times	0 to (2000 s - 30 ns)
Sweep/Hold/Return Time Resolution	15 ns or 12 digits
Total Sweep Time Accuracy	$\leq 0.4\%$
Start/Stop Frequency Range	Sine: 1 μ Hz to 2 GHz, Square: 1 μ Hz to 770 MHz
Trigger Source	Internal/External/Manual
Burst	
Waveforms	Standard waveforms (except DC and Noise), ARB
Type	Trigger or gated
Burst Count	1 to 4,294,967,295 cycles or Infinite
True Arb Mode Specifications	
Output Channels	
Connectors	SMA on front panel
Output Type	Single-ended DC coupled
Output Impedance	50 Ω
General specifications	
Operating Mode	Variable clock (True Arbitrary)
Run Modes	Continuous, Triggered Continuous, Single/Burst, Stepped, Advanced
Vertical Resolution	16 bit
Waveform Length	128 to 2G samples per channel (up to 4G samples optional)
Waveform Granularity	1 if the entry length is >416 samples 32 if entry length is ≥ 128 and ≤ 416 samples
Sequence Length	1 to 16,384
Sequence Repeat Counter	1 to 4,294,967,295 or infinite
Timer	
Range	20 ns to 1.39 s
Resolution	± 1 sampling clock period
Analog Channel to Channels skew	
Range	0 to 2.65 μ s
Resolution	≤ 100 fs
Accuracy	$\pm(1\%$ of setting + 20 ps)
Initial skew	< 20 ps
Calculated bandwidth (0.35 / rise or fall time)	≥ 2 GHz
Harmonic distortion (Sine wave 128 pts, 1 V_{p-p})	< -70 dBc (48.125MHz @ 6.16 GS/s)
Spurious (Sine wave 128 pts, 1 V_{p-p})	< -70 dBc (48.125MHz @ 6.16 GS/s)
SFDR (Sine wave 128 pts, 1 V_{p-p})	< -70 dBc (48.125MHz @ 6.16 GS/s)



Model 685

Model 685 Arbitrary Waveform Generator

Rise/fall time (1 V_{p-p} single-ended 10% to 90%)	≤ 175 ps
Rise/fall time (1 V_{p-p} single-ended 20% to 80%)	≤ 110 ps
Overshoot (1 V_{p-p} single-ended)	< 5%
Timing and Clock	
Sampling Rate	
Range	1 S/s to 6.16 GS/s
Resolution	32 Hz
Accuracy	± 2.0 ppm ± 500 ppb (Opt.)
Digital outputs (Optional)	
Output Channels	
Connectors	Mini-SAS HD connector on rear panel (custom pin-out)
Number of connectors	1, 2, 4
Number of outputs	8-bits, 16-bits, 32-bits
Output impedance	100 Ω differential
Output type	LVDS
Rise/fall time (10% to 90%)	< 1 ns
Jitter (rms)	20 ps
Maximum update rate	1.54 Gbps per channel
Memory depth	512M Samples per digital channel (up to 1G optional)
8 bit LVDS to LVTTTL Converter Probe (Optional AT-DLL8)	
Output Connector	20 position 2.54 mm 2 Row IDC Header
Output Type	LVTTTL
Output Impedance	50 Ω nominal
Output Voltage	0.8 V to 3.8 V programmable in group of 8 bits
Maximum Update Rate	125 Mbps@0.8V and 400 Mbps@3.6V
Dimensions	W 2in x H 0.9in x D 3in [52mm x 22mm x 76mm]
Input Connector	Proprietary standard
Cable Length	1 meter
Cable Type	Proprietary standard
Proprietary Mini SAS HD to SMA cable (Optional)	
Output Connector	SMA



Model 685 Waveform Generator

Model 685 Arbitrary Waveform Generator

Output Type	LVDS
Number of SMA	16 (8 bits)
Cable Type	Proprietary standard
Cable Length	1 meter
Auxiliary Input and Output Characteristics	
Sync in/out	
Connector type	Infiniband 4X connector on rear panel (custom pinout)
Master to Slave delay (typical)	TBD
Marker Output	
Connectors	SMA on front panel
Number of Connectors	1 2 4
Output Impedance	50 Ω
Output level (into 50 Ω)	
Voltage Window	-0.5V to 1.65V
Amplitude	100 mVpp to 2.15 Vpp
Resolution	1 mV
Accuracy	\pm (5% setting + 25 mV)
Max Update Rate	True Arb Mode: 6.16 Gbit, AFG Mode: 96.5 MHz (continuous mode)
Rise/fall time (10% to 90%, 2 V_{p-p})	<150 ps
Jitter (rms)	<10 ps
Marker out to analog channel skew	
Range	True Arb Mode:0 to 2.3 μ s AFG Mode:0 to 11 sec. in Contin. Mode, 0 to 2.3 μ s in Trig. Mode
Resolution	True Arb Mode:1/64 of DAC sampling period, AFG Mode: 5 ps
Accuracy	\pm (1% of setting + 5 ps)
Initial skew	< 20 ps
Trigger/Gate Inputs	
Connector	SMA on the Front Panel
Number of Trigger Inputs	2 (Trig.in 1, Trig.in 2)
Input Impedance	50 Ω /1 k Ω
Slope/Polarity	Positive or negative or both
Input Damage Level	< -15 V or > +15 V
Threshold Control Level	-10 V to 10 V
Resolution	50 mv
Threshold Control Accuracy	\pm (10% of setting + 0.2 V)
Input Voltage Swing	0.5 V_{p-p} minimum
Minimum Pulse Width (1 V_{p-p})	3 ns
Trigger/gate input to Analog Output delay	Slow (synchronous) trigger AFG mode: < 355 ns (< 405 ns in triggered sweep mode) True Arb mode: <1550 * DAC clock period(ns) + 10 ns Fast (asynchronous) trigger AFG mode: < 335 ns (< 385 ns in triggered sweep mode) True Arb mode: <1360 * DAC clock period(ns) + 27 ns
Trigger In to output jitter (rms)	AFG mode: < 20 ps True Arb mode: 0.29*Dac clock period



Model 685

Model 685 Arbitrary Waveform Generator

Maximum Frequency	AFG: 65 MTps on Rising/Falling Edge, 80 MTps on Both Edges True Arb mode: 1/ (Period of the Analog Waveform + 48 DAC Clock period) MTps = Mega Transitions per second
Reference clock input	
Connector type	SMA on rear panel
Input impedance	50 Ω, AC coupled
Input voltage range	0.2Vpp to 2Vpp
Damage level	Maximum Input voltage: -0.3V to 3.6V Maximum input power: 30 dBm (50 Ω)
Frequency range	5 MHz to 200 MHz
Frequency Resolution	1 Hz
Reference clock output	
Connector type	SMA on rear panel
Output impedance	50 Ω, AC coupled
Frequency	10 MHz TCXO 100 MHz VCOCXO (Optional)
Initial accuracy @ 25 °C	± 1.0 ppm ± 500 ppb (Opt.)
Aging	± 1.0 ppm/year ± 500 ppb/year (Opt.)
Stability vs. temperature	± 1 ppm ± 50 ppb(Opt.)
Amplitude	1.65 Vpp
Phase Noise @ 20 MHz carrier	-120 dBc/Hz at 100 Hz ; -140 dBc/Hz at 1KHz; -150 dBc/Hz at 10 KHz
Phase Noise @ 100 MHz carrier(Opt.)	-120 dBc/Hz at 100 Hz ; -145 dBc/Hz at 1KHz; -150 dBc/Hz at 10 KHz
External Clock Input	
Connector type	SMA on rear panel
Input impedance	50 Ω, AC coupled
Frequency	<u>True Arb</u> : 96.25 MHz to 192.5 MHz, 192.5 MHz to 385 MHz, 385 MHz to 770 MHz, 770 MHz to 1540 MHz (selectable) <u>AFG</u> : 192.5 MHz, 385 MHz, 770 MHz, 1540 MHz (selectable)
Input Power Range	+0 dBm to +10 dBm
Damage Level	15 dBm
Sync Clk Out	
Connector type	SMA on rear panel
Output impedance	50 Ω, AC coupled
Frequency	Sampling Frequency / N where N=16,32,64,128,256,512,1024,2048 (selectable)
Amplitude	1Vpp into 50 Ohm



Model 685 Power

Model 685 Arbitrary Waveform Generator

External Modulation input	
Connector type	SMA on rear panel
Input impedance	10 KΩ
Number of inputs	1
Bandwidth	10 MHz with 50 MS/s sampling rate
Input voltage range	-1 V to +1 V (except FSK, PSK) FSK, PSK: 3.3 V
Vertical resolution	14-bit
Pattern Jump In (optional)	
Connector type	DSUB15
Input signals	DATA[0..7] + Data Select + Load
Internal Data Width	14 bit, multiplexed using Data Select
Number of addressable entries	16384
Data Rate	DC to 1 MHz
Input Range	VIL = 0V to 0.8V / VIH= 2V to 3.3V
Impedance	Internal 1kΩ pull-up resistor to Vcc (3.3V)
Power	
Source Voltage and Frequency	100 to 240 VAC ±10% @ 45-66 Hz
Max. power consumption	Max. 185W
Environmental Characteristics	
Temperature (operating)	+41 °F to 104 °F [+5 °C to +40 °C]
Temperature (non-operating)	-4 °F to 140 °F [-20 °C to +60 °C]
Humidity (operating)	5% to 80% relative humidity with a maximum wet bulb temperature of 84°F at or below +104°F, (upper limit de-rates to 20.6% relative humidity at +104°F). Non-condensing.
Humidity (non-operating)	5% to 95% relative humidity with a maximum wet bulb temperature of 104°F at or below +140°F, upper limit de-rates to 29.8% relative humidity at +140°F. Non-condensing.
Altitude (operating)	9,842 feet (3,000 meters) maximum at or below 77°F
Altitude (non-operating)	39,370 feet (12,000 meters) maximum
EMC and Safety	
Compliance	CE compliant
Safety	EN61010-1
Main Standards	EN 61326-1:2013 – Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements
Immunity	EN 61326-1:2013
System Specifications	
Display	7", 1024x600, capacitive touch LCD
Operative System	Windows 10
External Dimensions	W 17.6 in – H 5.4 in – D 12.6 in (3U 19" rackmount) (445 mm – 135 mm – 320 mm)
Weight	26.45 lbs (12 kg) TBC
Front panel connectors	CH N OUTPUT (SMA) where N=2,4,8 depending on the model MARKER N OUT (SMA) where N=1,2,4 depending on the model TRG IN N(SMA) where N =1,2 2 USB 3.0 ports



Model 685

Model 685 Arbitrary Waveform Generator

Rear panel connectors	Ref. Clk. IN (SMA) Ref. Clk. Out (SMA) Ext. Mod. IN (SMA) Sync Clk Out (SMA) Ext Clk IN (SMA) Sync IN (Infiniband 4X) (for 8 channel model only) Sync OUT (Infiniband 4X) (for 8 channel model only) Pattern Jump In (DSUB15) (Optional) POD X[7..0] where X=A,B,C,D depending on the model (Customized Mini SAS HD) External Monitor ports (one or more) 2 USB 2.0 ports or more 4 USB 3.0 ports Ethernet port (10/100/1000BaseT Ethernet, RJ45 port) 2 PS/2 keyboard and mouse ports 2 DPI ports 1 DVI port
Hard Disk	256 GB SSD
Processor	Intel® Pentium 3.7 GHz (or better)
Processor Memory	8 GB or better