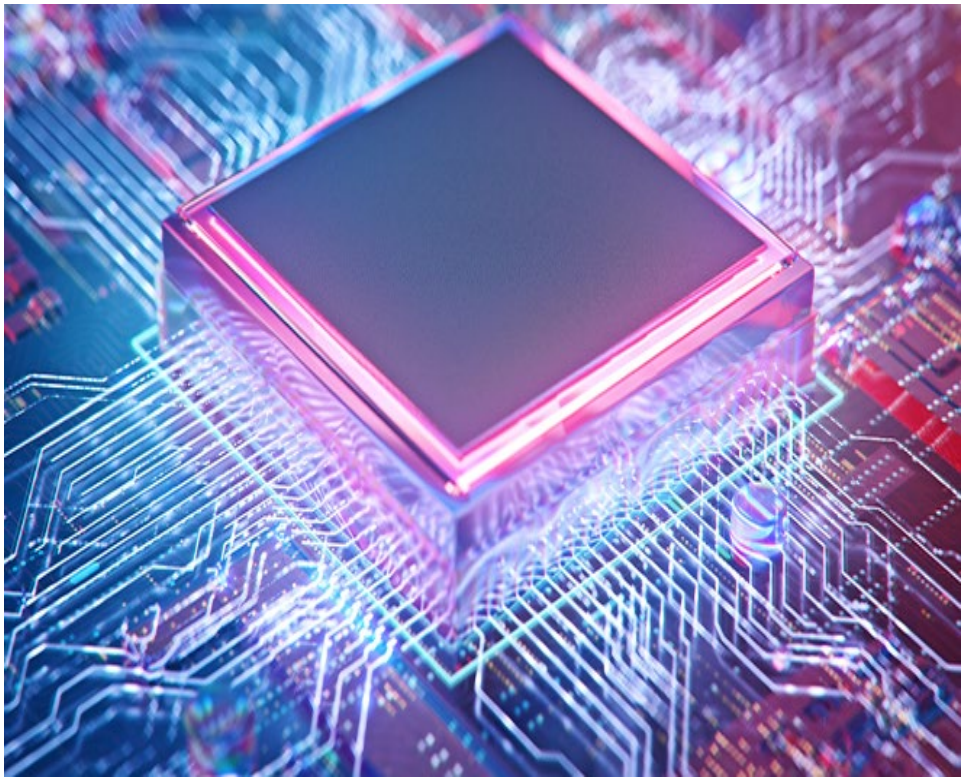
Model 685 | 6 GHz 12.32 GS/s

High Performance Arbitrary Waveform Generator

(Serial Pattern Generator and Digital Pattern Generator)



Features

- 2, 4 or 8 Analog Channels
- 6.16 GS/s (12.32 GS/s in RF mode)
- 16-bit Vertical Resolution
- Up to 6 GHz Output Frequency
- < 110 ps Rise/Fall Time
- Up to 5 Vpp Output Voltage and ± 2.5V Hardware Offset into 50 Ω
- 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 | 6 GHz 12.32 GS/s
Arbitrary Waveform Generator

Model 685 Arbitrary Waveform Generator

Features & Benefits

- Sample rate can be programmed in from 1 S/s to 6.16 GS/s (12.32 GS/s in RF mode), with 16-bit vertical resolution, ensures exceptional signal integrity.
- Arbitrary waveform memory up to 4 Gpts for each analog channel
- Mixed Signal Generation – 2, 4, or 8 Analog channels with 8, 16, or 32 synchronized Digital Channels for debugging and validating digital design.
- Three operation modes – Simple Rider AFG (DDS AFG mode), True Arb (variable clock Arbitrary AWG mode) and SPG (Serial Pattern Generator).
- Digital outputs provide up to 1.54 Gb/s data rate in LVDS format. LVDS to LVTTL adapter is available
- Advance sequencer with up to 16384 user-defined waveforms provides the possibility of generating complex signal scenarios with the most efficient memory usage
- Windows-based platform with 7in touchscreen, front panel buttons and knob
- Compact form factor, convenient for bench top and fully fit with 3U – 19” rack-mount standard
- LAN,USB-TMC and GPIB interfaces for remote control

Model 685 Front

Model 685 Back

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Model 685 User Interface

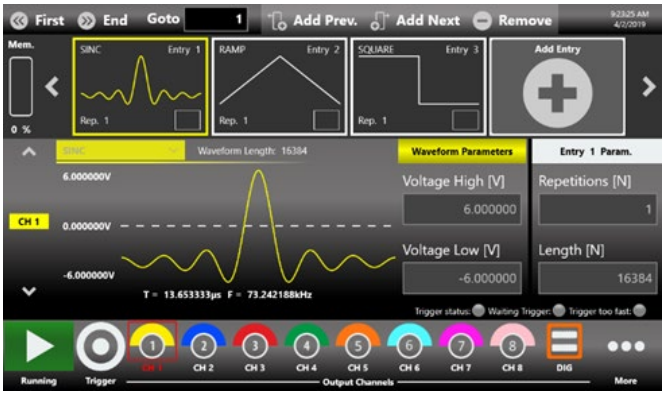
Simple Rider AFG: Function Generator Mode Interface

Simple Rider AFG UI is designed using a touchscreen interface; it has been developed to put all the capabilities of modern Waveform Generators right at your fingertips. All instrument controls and parameters are accessible through an intuitive UI that recalls the simplicity of modern tablets and smartphones. Scientists and engineers can use gestures and touch commands to create advanced waveforms or digital patterns with ease.

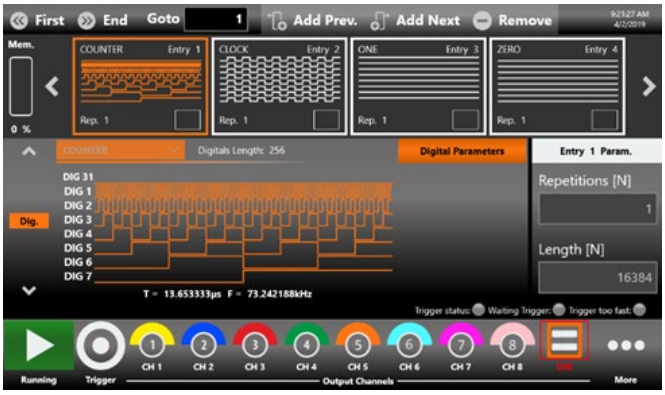
- The swipe gesture gives easy access to the output waveform parameters.
- A touch-friendly virtual numeric keypad has been designed to improve the user experience with regard to entering data.
- Time-saving shortcuts and intuitive icons simplify the instrument setup.

Simple Rider TrueArb: AWG and DPG Mode Interface

In the **Simple Rider True-Arb** 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 is an ideal tool to troubleshoot and validate the 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, you can create the most complex waveform scenarios with just a few screen touches.

Up to 4 instruments can be synchronized together in order to obtain a 32 analog – 128 digital channel generator. A dedicated synchronization bus guarantees intra-chassis synchronization.

Model 685 supports the standard Ethernet interface for remote control and easy customized instrument programming.

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Simple Rider SPG: Serial Pattern Generator (SPG) Mode Interface

The easiest touchscreen display interface allows creating patterns scenarios, only in a few screen touches.

In summary, the Data Pattern Generator provides the capability to generate PRBS patterns and up to 2MSymbols custom patterns where bit transitions can have arbitrarily user-defined shapes. The Model 685 Serial Pattern Generator can generate patterns up to 1.5Gbaud.

The software architecture provides the possibility to easily generate the patterns in different generation modalities and also gives the opportunity to modulate the patterns with internal or external signals with the purpose to generate also different effects of noise (jitter, ripple, …).

Model 685 Applications
Automotive

Today's cars include highly sophisticated and electronically controlled units with sensitive electronic components. The Model 685 combines a 6.16 GSa/s sampling rate with a 16-bit vertical resolution. It represents an ideal and a successful tool for addressing the new testing challenges in the automotive industry. It includes these features:

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

IoT and Ind 4.0 Perfect RF Modulator

The Model 685 is 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 the Internet of Things of Industry 4.0 applications. Each engineer may import waveforms to emulate devices for test purposes and impose distortion on waveforms (such as noise) to test device compliance with standards.

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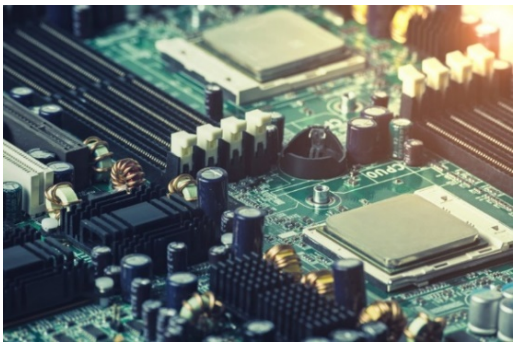
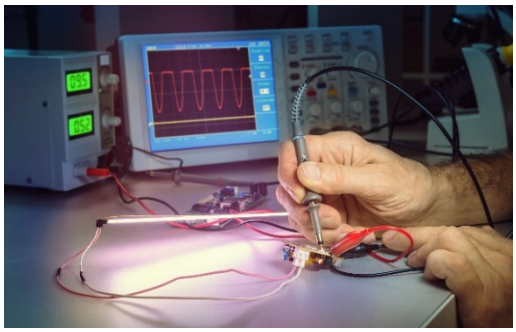
Semiconductor Testing

Emulation of complex signals generated with inclusion of noise or distortions may become 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.



Research Applications

Research centers and Universities are key users of the Model 685. Complex waveform and/or sophisticated Pulses emulation based on variable edges or multilevel could be perfectly created. The combination of fast edge generation, excellent dynamic range and easy-to-use user interface meet perfectly for scientists and engineers working on Quantum Research or on large 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. It can create pulses useful in pulse electron beams, X-ray sources, flash X-ray radiography, lightning pulse simulators, and high-power microwave modulators. These features of Model 685 are useful in the aerospace and defense industry.

- 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 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			
Operating Mode	AFG Mode True Arb Mode SPG Mode		
Number of Channels	**Model 685-2C** **Model 685-2CD**	**Model 685-4C** **Model 685-4CD**	**Model 685-8C** **Model 685-8CD**
Analog	2	4	8
Digital Out	0/8 optional	0/8/16 optional	0/8/16/24/32 optional
Marker Out	1	2	4
	Model 685-2C **Model 685-4C** **Model 685-8C**		**Model 685-2CD** **Model 685-4CD** **Model 685-8CD**
Output Channels			
Output Type	Single ended DC coupled		Differential DC coupled
Output Impedance	Single-ended: 50 Ω		Single ended: 50 Ω Differential: 100 Ω
Connectors	SMA on front panel		
DC Amplitude			
Amplitude Range	±2.5 V (into 50 Ω)		±0.75 V Se. (into 50 Ω) ±1.5 V Diff. (into 100 Ω)
Resolution	100µV (nom), 5 digits		
Amplitude Accuracy (guaranteed)	±(1% of |setting| + 5 mV)		±(0.5% of |setting| + 2 mV)
DC Baseline Hardware Offset (Common mode offset)			
Resolution	< 4 mV or 4 digits		
Range (50 Ω into 50 Ω)	-2.5 V to +2.5 V		-2 V to +2 V
Range (50 Ω into High Z load)	-2.5 V to +2.5 V		-4 V to +4 V
Accuracy (50 Ω into 50 Ω) (guaranteed)	± (1% of |setting| + 5 mV)		
AC Accuracy (1 kHz sine wave, 0 V offset, > 5 mVp-p amplitude, 50 Ω load) (guaranteed)	± (1% of setting [Vpp] + 5mV)		

True Arb - Baseband Mode Specifications	**Model 685-2C** **Model 685-4C** **Model 685-8C**	**Model 685-2CD** **Model 685-4CD** **Model 685-8CD**
General specifications		
Operating Mode	Variable clock (True Arbitrary) – Baseband mode	
Sample Rate	1 S/s to 6.16 GS/s	
Sin(x)/x	2.72 GHz @ 6.16GS/S,	
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 16384	
Sequence Repeat Counter	1 to 4294967294 or infinite	

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Timer Range Resolution	 20 ns to 1.39 seconds ± 1 sampling clock cycle	
Analog Channel to Channels skew		
Range	0 to 2.63 us	
Resolution	100 fs	
Accuracy	±(1% of setting + 20 ps)	
Initial skew	< 20 ps	
Calculated bandwidth (0.35 / rise or fall time)	≥ 2 GHz	≥ 2.2 GHz
SFDR @ 100 MHz (Fsa= 6 Gsa/s, measured across DC to Fs/2, excluding fsa - 2*fout and fsa- 3*fout and excluding harmonic)	< -80 dBc	< - 90 dBc
SFDR (Fsa= 6,16 Gsa/s, measured across DC to Fs/2, excluding fsa - 2*fout and fsa- 3*fout and excluding harmonic)[1]	1 µHz to ≤ 600 MHz: < -80 dBc 600 MHz to ≤ 1.5 GHz: < -75 dBc 1.5 GHz to ≤ 2 GHz: < -65 dBc 2 GHz to ≤ 3 GHz: < -55 dBc	1 µHz to < 100 MHz: < -90 dBc 100 MHz to ≤ 600 MHz: < -82 dBc 600 MHz to ≤ 1.5 GHz: < -75 dBc 1.5 GHz to ≤ 2 GHz: < -70 dBc 2 GHz to ≤ 3 GHz: < -62 dBc
Rise/fall time (1 Vp-p single-ended 10% to 90%) **Rise/fall time** (1 Vp-p single-ended 20% to 80%)	≤ 175 ps ≤ 110 ps	≤ 155 ps ≤ 100 ps
Overshoot (1 Vp-p single-ended)	<5%	<6%
Random jitter on clock pattern (rms, typical)	< 2 ps	

True Arb - Baseband mode specifications	**Model 685-2C Model 685-4C Model 685-8C**	**Model 685-2CD Model 685-4CD Model 685-8CD**
General specifications		
Operating Mode	Variable clock (True Arbitrary) – RF mode	
Output Sample Rate	8.5 GS/s to 12.32 GS/s	
Sin(x)/x	5.04 Ghz @ 12.32GS/S	
RF Modulation	I/Q quadrature	
RF Carrier Count per Output Channel	Single Carrier (2 components I0,Q0 for channel) Double Carrier (4 components, I0,Q0 and I1,Q1 for channel)	
RF Carrier Frequency Range	0 up to 6 GHz	
RF Carrier Frequency Resolution	1 mHz	
RF Carrier Phase	Programmable	
I/Q Component Data Rate	1/8 of the Output Sample rate	
I/Q Component Prescaler	0 to 2^32	
Run Modes	Continuous, Triggered Continuous, Single/Burst, Stepped, Advanced	
I/Q Component Vertical Resolution	16 bit	
I/Q Component Waveform Length	32M to 500M samples for component (up to 1G samples optional)	
I/Q Component Waveform Granularity	1 if the entry length is > 104 samples 8 if entry length is ≥ 32 and ≤ 104 samples	
Sequence Length	1 to 16384	
Sequence Repeat Counter	1 to 4294967294 or infinite	
Timer Range Resolution	 20 ns to 1.39 seconds ± 1 Component sampling clock cycle	

[1] For 685-2C/4C/8C models the SFDR is evaluated @ 2.5Vpp single ended nominal output amplitude. For 685-2CD/4CD/8CD models the SFDR is evaluated @ 1.5Vpp differential nominal output amplitude provided to the spectrum analyzer through a Minicircuit TC1-1-13M+ balun.

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I/Q Component to Component skew	
Range	0 to [16200 * 8/Output Sampling Clock] s
Resolution	[8/Output Sampling Clock] s
Accuracy	±(1% of setting + 20 ps)
Initial Skew	< 20 ps

AFG Mode Specifications	Model 685-2C Model 685-4C Model 685-8C	Model 685-2CD Model 685-4CD Model 685-8CD
General Specifications		
Amplitude	0 to 5 Vpp (into 50 Ω)	0 to 3 Vpp Diff. (into 100 Ω) 0 to 1.5 Vpp Se. (into 50 Ω)
Resolution	100 µV (nom), 5 digits	
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)[2]	1 µHz to ≤ 1 GHz: 5Vpp 1 GHz to ≤ 2 GHz: 4Vpp	1 µHz to ≤ 2 GHz: 3 Vpp Diff. 1 µHz to ≤ 2 GHz: 1.5 Vpp Se.
Flatness	DC to 2 GHz: ±0.5 dB (1 Vpp, relative to 1 kHz)	DC to 2 GHz: ±0.5 dB (1 Vpp diff., relative to 1 kHz)
Harmonic Distortion (1 Vp-p)	1 µHz to ≤ 20 kHz < -75 dBc 20 kHz to ≤ 400 MHz < -70 dBc 400 MHz to ≤ 1GHz < -60 dBc 1 GHz to ≤ 2 GHz < -55 dBc	
Total Harmonic Distortion (1 Vp-p)	10 Hz to 20 kHz < 0.05%	
Spurious (measured across DC to Fs/2)[3]	1 µHz to ≤ 500 MHz: < -75 dBc 500 MHz to ≤ 1.5 GHz: < -70 dBc 1.5 GHz to ≤ 2 GHz: < -55 dBc	1 µHz to ≤ 250 MHz: < -85 dBc 250 MHz to ≤ 500 MHz: < -80 dBc 500 MHz to ≤ 1.5 GHz: < -70 dBc 1.5 GHz to ≤ 2 GHz: < -60 dBc
Phase Noise (1 Vp-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 µHz to ≤ 770 MHz	1 µHz to ≤ 770 MHz
Rise/fall Time (10% to 90%)	400 ps	
Rise/fall Time (20% to 80%)	300 ps	
Overshoot (1 Vp-p)	<2%	
Jitter (rms)	<2 ps	
Pulse Waves		
Frequency Range	1 µHz to ≤ 770 MHz	1 µHz to ≤ 770 MHz
Pulse Width	500 ps to (Period – 500 ps)[4]	
Pulse Width Resolution	20 ps or 15 digits	

[2] Amplitude doubles on HiZ load
[3] For 685-2C/4C/8C models the spurious are evaluated @ 1Vpp single ended nominal output amplitude. For 685-2CD/4CD/8CD models the SFDR is evaluated @ 1Vpp differential nominal output amplitude provided to the spectrum analyzer through a Minicircuit TC1-1-13M+ balun.
[4]. Below 500 ps width, the pulse amplitude will have some reduction respect to the set value.

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Pulse Duty	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 Vp-p)	< 2%	
Jitter (rms, with rise and fall time ≥ 400ps)	<2 ps	
Double Pulse Waves		
Frequency Range	1 µHz to ≤ 385 MHz: 10 Vpp where Vpp= |Vpp1| + |Vpp2|	1 µHz to ≤ 385 MHz: 6 Vpp Diff. (1 µHz to ≤ 385 MHz: 3 Vpp Se) where Vpp= |Vpp1| + |Vpp2|
Other Pulse Parameters	Same as Pulse Waves	
Ramp Waves		
Frequency Range	1 µHz to 75 MHz	
Linearity (< 10 kHz, 1 Vp-p, 100%)	≤ 0.1%	
Symmetry	0% to 100%	
Other Waves		
Frequency Range Exponential Rise, Exponential Decay Sin(x)/x, Gaussian, Lorentz, Haversine	 1 µHz to 75 MHz 1 µHz to 150 MHz	
Additive Noise		
Bandwidth (-3 dB)	2 GHz	
Level	0 V to 2.5 V - abs(carrier max value [Vpk])	0 V to 0.75 V Single Ended - abs(carrier max value [Vpk]) 0 V to 1.5 V Differential - abs(carrier max value [Vpk])
Resolution	1 mV	
Arbitrary		
Number of Samples	2 to 16384	
Frequency Range	1 µHz to ≤ 770 MHz	
Analog Bandwidth (-3 dB)	950 MHz	
Rise/Fall Time (10% to 90%)	400 ps	
Rise/Fall Time (20% to 80%)	300 ps	
Jitter (rms)	< 2 ps	
Frequency Resolution		
Sine, Square, Pulse, Arbitrary, Sin(x)/X	1 µHz or 15 digits	
Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine	1 µHz or 14 digits	
Frequency Accuracy		
Non-ARB	± 2.0 ppm of setting | ± 500 ppb of setting (Opt.)	
ARB	± 2.0 ppm of setting ±1 µHz | ± 500 ppb of setting ±1 µHz(Opt.)	
Modulations		
Amplitude Modulation (AM)		
Carrier Waveforms	Standard waveforms (except Pulse, DC and Noise), ARB	
Modulation Source	Internal or external	
Internal Modulating Waveforms	Sine, Square, Ramp, Noise, ARB	
Modulating Frequency	Internal: 500 µHz to 61 MHz, External: 10 MHz maximum	
Depth	0.00% to 120.00%	
Frequency Modulation (FM)		
Carrier Waveforms	Standard waveforms (except Pulse, DC and Noise), ARB	

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Modulation Source	Internal or external
Internal Modulating Waveforms	Sine, Square, Ramp, Noise, ARB
Modulating Frequency	Internal: 500 µHz to 61 MHz, External: 10 MHz maximum
Peak Deviation	DC to 2 GHz
Phase Modulation (PM)	
Carrier Waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation Source	Internal or external
Internal Modulating Waveforms	Sine, Square, Ramp, Noise, ARB
Modulating Frequency	Internal: 500 µHz to 61 MHz, External: 10 MHz maximum
Phase Deviation Range	0° to 360°
Frequency Shift Keying (FSK)	
Carrier Waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation Source	Internal or external
Internal Modulating Waveforms	Square
Key Rate	Internal: 500 µHz to 61 MHz, External: 10 MHz maximum
Hop Frequency	1 µHz to 2 GHz
Number of Keys	2
Phase Shift Keying (PSK)	
Carrier Waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation source	Internal or external
Internal Modulating Waveforms	Square
Key Rate	Internal: 500 µHz to 61 MHz, External: 10 MHz maximum
Hop Frequency	0° to +360°
Number of Keys	2
Pulse Width Modulation (PWM)	
Carrier Waveforms	Pulse
Modulation Source	Internal or external
Internal Modulating Waveforms	Sine, Square, Ramp, Noise, ARB
Modulating Frequency	Internal: 500 µHz 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	≤ 0.4%
Start/Stop Frequency Range	Sine: 1 µHz to 2 GHz, Square: 1 µHz 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

Timing and Clock	
Sampling Rate	
Range	1 S/s to 6.16 GS/s (1 S/s to 12.32 GS/S in RF mode)
Resolution	32 Hz
Accuracy	± 2.0 ppm | ± 500 ppb (Opt.)

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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 LVTTL Converter Probe (Optional AT-DTLL8)	
Output Connector	20 position 2.54 mm 2 Row IDC Header
Output Type	LVTTL
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
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

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Output level (into 50 Ω)	
Voltage Window	-0.5 V to 1.65 V
Amplitude	100 mVpp to 2.15 Vpp
Resolution	1 mV
Accuracy	±(5% setting + 25 mV)
Switching characteristics	
Max Update Rate (True Arb Mode)	6.16 Gbps
Max Data Rate (True Arb Mode)	>4 Gbps @ 1Vpp swing
Max Frequency (AFG Mode)	96.5 MHz (continuous mode)
Rise/fall time (10% to 90%, 2 Vpp)	<150 ps
Jitter (rms)	<10 ps
Marker out to analog channel skew	
Range	True Arb Mode: 0 to 2.3µs AFG Mode: 0 to 100 sec. in Contin. Mode, 0 to 2.25 µs in Trig. Mode
Resolution	True Arb Mode: 1/64 of DAC sampling period, AFG Mode: 5 ps
Accuracy	±(1% of setting + 5 ps)
Initial skew	< 20 ps
Trigger/Event Inputs	
Connector	SMA on the Front Panel
Number of Trigger Inputs	2 (Trig.in 1, Trig.in 2)
Input Impedance	50 Ω / 1 kΩ
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	±(10% of |setting| + 0.2 V)
Input Voltage Swing	0.5 Vp-p minimum
Minimum Pulse Width (1 Vp-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
Trigger In Programmable Delay Range	0 ps to 2418 ps
Trigger In Programmable Delay Resolution	78 ps
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	0.2 Vpp to 2 Vpp
Damage Level	Maximum Input voltage: -0.3 V to 3.6 V Maximum input power: 30 dBm (50 Ω)
Frequency Range	5 MHz to 200 MHz
Frequency Resolution	1 Hz

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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 1 KHz; -150 dBc/Hz at 10 KHz
Phase Noise @ 100 MHz Carrier(Opt.)	-120 dBc/Hz at 100 Hz ; -145 dBc/Hz at 1 KHz; -150 dBc/Hz at 10 KHz
External Clock Input	
Connector Type	SMA on Rear Panel
Input Impedance	50 Ω, AC coupled
Frequency[5]	True Arb: SampleRate / N where: N = 4, 8, 16, 32 for SampleRate = 5.0 ÷ 6.16 GHz N = 2, 4, 8, 16, 32 for SampleRate = 3.08 ÷ 5.0 GHz AFG: 192.5 MHz, 385 MHz, 770 MHz or 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	AFG Mode: 6.16GHz / N where N=16, 32, 64, …, 2048 AWG Mode: 6.16GHz / 16 to 6.16GHz / 4096
Amplitude	1 Vpp into 50 Ohm
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: 0 V ÷ 3.3 V with 1.65V fixed threshold
Vertical Resolution	12-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 = 0 V to 0.8 V / VIH= 2 V to 3.3 V
Impedance	Internal 1 kΩ pull-up resistor to Vcc (3.3 V)
Power	
Source Voltage and Frequency	100 to 240 VAC ±10% @ 45-66 Hz

[5] When using the External Clock Input the SampleRate must be in the range 3.08 ÷ 6.16 GHz

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Max. Power Consumption	Max. 100W (Model 685-2C / 2CD) Max. 200W (Model 685-4C / 4CD) Max. 300W (Model 685-8C / 8CD)
Environmental Characteristics	
Temperature (operating)	+41 ºF to 104 ºF [+5 ºC to +40 ºC]
Temperature (non-operating)	-4 ºF to 140 ºF [-20 ºC to +60 ºC]
Humidity (operating)	5% to 80% relative humidity with a maximum wet bulb temperature of 84°F (29ºC) at or below +104°F (40ºC), (upper limit de–rates to 20.6% relative humidity at +104°F (40ºC)). Non-condensing.
Humidity (non-operating)	5% to 95% relative humidity with a maximum wet bulb temperature of 104°F (40ºC) at or below +140°F (60ºC), upper limit de–rates to 29.8% relative humidity at +140°F (60ºC). Non-condensing.
Altitude (operating)	9,842 feet (3,000 meters) maximum at or below 77°F (25ºC)
Altitude (non-operating)	39,370 feet (12,000 meters) maximum
EMC and Safety	
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	Max. 26.45 lbs (12 Kg)
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
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) Sync OUT (Infiniband 4X) Pattern Jump In (DSUB15) (685-XC-FSS opt. only) 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	1 TB SSD or better
Processor	Intel® Pentium 3.7 GHz (or better)
Processor Memory	32 GB or better

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