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SF900

SF650

SF610

Product Specifications

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Overview

This document specifies the typical performance the instruments. For a better performance, please contact the factory.

The bandwidth indicates the highest frequency at which a sine wave can be represented by the oscilloscope with a 10 dB loss. This also applies for narrow band signals. For non-periodical wide band signals the bandwidth is limited by the Nyquist criteria. For the specified real time sampling rate of 120 MHz, the bandwidth is limited to about 50 MHz.

The relevant specifications for the oscilloscope and the arbitrary generator also apply to the sweep frequency response analyzer.

The relevant specifications for the oscilloscope also apply to the spectrum analyzer, frequency and phase meter, and data recorder of the corresponding model.

The user manuals for all instruments are described at:

<http://www.analogarts.com/images/AnalogArts/PDFs/Analog%20Arts%20High%20Performance%20Instruments%20Comprehensive%20Instruction%20Manual.pdf>

These models include the following instruments.

1. Sweep Frequency Response Analyzer
2. Oscilloscope
3. Spectrum Analyzer
4. Data Recorder
5. Frequency and Phase Meter
6. Arbitrary Waveform Generator
7. Logic Analyzer
8. Pattern Generator

Frequency Response Analyzer

Model	SF900	SF650	SF610
Frequency Range			
	1 mHz - 15 MHz	1 Hz - 100 MHz	1 Hz - 10 MHz
Frequency Resolution			
	< 1 uHz	< 1 Hz	< 1 Hz
Dynamic Range			
< 1 Hz	110 dB	N.A.	N.A.
< 1 MHz	100 dB	90 dB	70 dB
< 15 MHz	95 dB	90 dB	70 dB
< 25 MHz	N.A.	85 dB	N.A.
< 50 MHz	N.A.	80 dB	N.A.
< 100 MHz	N.A.	70 dB	N.A.
Gain Accuracy			
< 1 Hz	0.02 dB	N.A.	N.A.
< 1 KHz	0.02 dB	0.05 dB	0.25 dB
< 10 KHz	0.05 dB	0.10 dB	0.50 dB
< 1 MHz	0.20 dB	0.25 dB	0.50 dB
< 15 MHz	0.25 dB	0.25 dB	1.5 dB
< 50 MHz	N.A.	1 dB	N.A.
< 100 MHz	N.A.	1.5 dB	N.A.
Phase Accuracy			
< 1 Hz	0.02°	N.A.	N.A.
< 1 KHz	0.03°	0.05°	0.25°
< 1 MHz	0.05°	0.10°	0.75°
< 15 MHz	0.075°	0.15°	1.00°
< 50 MHz	N.A.	0.20°	N.A.
< 100 MHz	N.A.	0.50°	N.A.
Common Mode Rejection Ratio			
	> 100 dB	> 90 dB	> 70 dB

Frequency Source

Internal Generator (Sine-wave)

Signal Amplitude

0.05 to 6.0 Volts peak-to-peak (Selectable)

Signal Offset

- 1 Volt to + 1 Volt (Selectable)

Sweep Type

Linear - Logarithmic

Sweep Increment

0.01 % to 10 % (Selectable)

Measurement Resolution

Up to 1 M point DFT (Selectable)

Integration Time

10 mS to 10 S (Selectable)

Oscilloscope/ Spectrum Analyzer/ Data Recorder

Model	SF900	SF650	SF610
Oscilloscope			
Bandwidth (Max at probe tip) [2]			
@ 500 mV/ Div with 10X probe	500 MHz	500 MHz	100 MHz
@ 50 mV/ Div with 1X probe	500 MHz	500 MHz	100 MHz
@ 1 V/ Div with 10X probe	500 MHz	400 MHz	75 MHz
@ 100 mV/ Div with 1X probe	500 MHz	400 MHz	75 MHz
@ 2 V/ Div with 10X probe	250 MHz	200 MHz	50 MHz
@ 200 mV/ Div with 1X probe	250 MHz	200 MHz	50 MHz
@ 5 V/ Div with 10X probe	250 MHz	200 MHz	50 MHz
@ 500 mV/ Div with 1X probe	250 MHz	200 MHz	50 MHz
@ 20 V/ Div with 10X probe	200 MHz	200 MHz	50 MHz
@ 2 V/ Div with 1X probe	200 MHz	200 MHz	50 MHz
Rise time	1.0 nS	1.0 nS	5.0 nS
Input channels	2		
Vertical resolution	8 bits		
DC accuracy	< ±3%		
Input characteristics	1 MΩ in parallel with 10 pF		
CMRR (Common Mode Rejection Ratio)	> 70 dB (@ 100 MHz)		
Channel-to-Channel Crosstalk	< -90 dB	< -80 dB	< -70 dB
Input type	Single-ended, BNC connector		
Input coupling	Software selectable AC/ DC		
Input ranges (full scale) 10x probe 1x probe	±80 mV to ±80 V in 10 ranges ±8 mV to ±8 V in 10 ranges		
Overload protection	±150 V (DC+AC peak)		
Sampling rate (each channel) Real / per channel Effective / per channel	100 GHz 125 MHz	100 GHz 125 MHz	100 MHz 25 GHz
Vertical Scaling 1x probe 10x probe	2 mV - 2 V / DIV 20 mV - 20 V / DIV		

Buffer memory size One channel in use Two channels in use	1024 KB 512 KB		
Time base	1 ns/div to 50 Seconds/div	1 ns/div to 50 Seconds/div	5 ns/div to 100 ms/div
Time base (Data Recorder)	500 nS to 365 days with data recorder		
Timing accuracy [3]	50 ppm	100 ppm	200 ppm
Trigger modes	Normal, auto, alternate, single, Ch1, CH2		
Trigger threshold Internal External	Adjustable, ± range setting (variable) 8 bits 1.2 Volts		
Basic triggers	External/ CH1/ CH2/ Alternative Rising edge/ Falling edge/ Auto/ Normal/ Single		
External trigger bandwidth	500 MHz	500 MHz	100 MHz

Model	SF900	SF650	SF610
Spectrum Analyzer			
Common features between the oscilloscope and the spectrum analyzer have the same specifications.			
Frequency Bandwidth [5]	500 MHz	500 MHz	100 MHz
Display Span (Default)	204.8 KHz to 60 MHz		
Minimum Span (at selected Display Bandwidth)	100 KHz (display bandwidth of 51.2 MHz) 5 KHz (display bandwidth of 2.56 MHz) 400 Hz (display bandwidth of 204.8 MHz)		
Resolution	$(\text{Span} / 2^{18})$ 0.78 Hz to 195 Hz		
Spectrum Flatness	1 dB		
Frequency Error [6]	25 ppm	50 ppm	200 ppm
Relative Frequency Accuracy	> 1 ppm		
Maximum number of bins	1M		
Dynamic Range	8 bits (< 65 dB)		
Spurious Free Range	< 70 dB (@ 10 MHz, 2 V range)		
Frequency Response	± 0.5 dB		
Reference Levels (10 ranges) 1x Probe 10x Probe	- 35 dBV to 25 dBV (0.6 to 5.623 VRMS) - 25 dBV to 35 dBV (0.06 to 56.23 VRMS)		
Display modes	Sampling, peak hold, average, history		
Windowing	Rectangular, Bartlett, Gaussian (2.5, 3.5, 4.5), Triangular, Blackman, Blackman–Harris, Hamming, Hanning, Welch, Kaiser Bessel, Flat Top,		

Model	SF900	SF650	SF610
Frequency and Phase Meter			
The same specifications apply to the common features of the oscilloscope and the frequency and phase analyzer in the model.			
Bandwidth [5]	500 MHz	500 MHz	100 MHz
Resolution	0.1 Hz		
Tolerance [6]	50 ppm	50 ppm	200 ppm
Relative Tolerance	0.01 ppm	0.01 ppm	1 ppm

Data Recorder			
The same specifications apply to the common features of the oscilloscope and the data recorder in the model.			
Sampling Interval	102 MHz to 10 pHz		
Time base	500 nS to 365 days		
Timing Accuracy [6]	50 ppm	100 ppm	200 ppm

Arbitrary Waveform Generator

General			
Specifications	SF900	SF650	SF610
Arbitrary waveform length	2 to 64K adjustable		
Ram (Memory)	64K (1M optional)		
Amplitude resolution	14-bits	14-bits	12-bits
Sample rate (sine wave)	300 MHz	300 MHz	100 MHz
Sample rate	100 MHz	100 MHz	50 MHz
Sample rate (Arbitrary)	1 MHz to 100 MHz	1 MHz to 100 MHz	1 MHz to 50 MHz
Frequency adjustment resolution	10 mHz (1 μ Hz optional)		
Standard waveforms	<p>DC, Sine, square, pulse, triangle, rising ramp, falling ramp, noise, rising exponent, falling exponent, sinc, cardiac, gated burst, single burst, log continuous sweep, linear continuous sweep, gated ASK, gated FSK, gated PSK</p> <p><i>AM (modulating signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms)</i></p> <p><i>FM (modulating signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms)</i></p> <p><i>burst (carrier signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms)</i></p>		

Output Amplitude (Frequencies < 5MHz) Open circuit 50 Ω (5MHz > Freq. < 15MHz) Open circuit 50 Ω (15MHz > Freq. < 50MHz) Open circuit 50 Ω (50MHz > Freq. < 100MHz) Open circuit 50 Ω (100MHz > Freq. < 150MHz) Open circuit 50 Ω Accuracy (up to 100 kHz) Adjustment resolution	0 to ±3.5V(7 Vpp) 0 to ±1.75V(3.5 Vpp) 0 to ±3.0V(6 Vpp) 0 to ±1.5V(3.0 Vpp) 0 to ±2.0V(4 Vpp) 0 to ±1.0V(2.0 Vpp) 0 to ±1.5V(3 Vpp) 0 to ±0.75V(1.5 Vpp) 0 to ±1.0V(2 Vpp) 0 to ± 0.5V(1.0 Vpp) .1% of the specified output ± 5mV 3 digits (1mv)
Output Offset Open circuit 50 Ω Accuracy Adjustment resolution	0 to ± 2.2V(7 Vpp) 0 to ± 2.2V(3.5 Vpp) 2% ± 5mV (0.1% Optional) 3 digits(1mv)
Output impedance	50 Ω (Optional: 0 to 75 Ω)
Output Current	60 mA (with the standard 50 Ω impedance)
Sync	TTL compatible

Frequencies Ranges

Sine Wave	10 mHz to 15 MHz	10 mHz to 100 MHz	10 mHz to 10 MHz
Square Pulse Triangle Ramp Sinc Noise (White) Bandwidth AM (Carrier) FM (Carrier) Sweep Burst (Burst Rate) Digital (shift keying rate) Exponent Cardiac	10 mHz to 15 MHz 10 mHz to 15 MHz 10 mHz to 100 KHz 10 mHz to 100 KHz 1 Hz to 5 MHz 25 MHz 1 Hz to 5 MHz 1 Hz to 5 MHz DC to 15 MHz 100 Hz to 2 MHz 1 kHz to 2 MHz 1 Hz to 5 MHz 1 Hz to 1 MHz	10 mHz to 5 MHz 10 mHz to 5 MHz 10 mHz to 100 KHz 10 mHz to 100 KHz 1 Hz to 1 MHz 10 MHz 1 Hz to 1 MHz 1 Hz to 1 MHz DC to 5 MHz 100 Hz to 1 MHz 1 kHz to 1 MHz 1 Hz to 1 MHz 1 Hz to 1 MHz	
Resolution	10 mHz (1 μ Hz optional)		
Accuracy	2% \pm 5mV (.1% optional) At room temperature		
Temp Coefficient	20 ppm/ $^{\circ}$ C		
Aging	10 ppm/yr		

Waveform Characteristics - 50 Ω Termination

<p>Sine Wave Output Flatness</p> <p>< 1 MHz < 15 MHz < 150 MHz</p>	<p>0.1 dB 0.5 dB -</p>	<p>0.1 dB 0.5 dB 1 dB</p>	<p>0.1 dB 0.2 dB -</p>
<p>Sine Wave (2Vpp)</p> <p>Adjustment resolution</p> <p>Harmonic Distortion DC to 100 kHz 100 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 100 MHz 100 MHz to 150 MHz</p> <p>Spurious DC to 100 kHz 100 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 100 MHz 100 MHz to 150 MHz</p> <p>Noise DC to 100 kHz 100 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 100 MHz 100 MHz to 150 MHz</p> <p>Phase noise</p>	<p>10 mHz (1 μHz optional)</p> <p>-70 dBc -65 dBc -60 dBc -55 dBc (when applicable) -50 dBc (when applicable) -45 dBc (when applicable)</p> <p>-70 dBc -60 dBc -60 dBc -55 dBc (when applicable) -55 dBc (when applicable) -50 dBc (when applicable)</p> <p>-60 dBc -60 dBc -55 dBc -50 dBc (when applicable) -40 dBc (when applicable) -35 dBc (when applicable)</p> <p>< -60 dBc in a 50 kHz band</p>		
<p>Square Wave (2Vpp)</p> <p>Frequency Adjustment resolution Rise/Fall time Overshoot Settling time Asymmetry Duty cycle adjustment resolution Jitter</p>	<p>10 mHz - 15 MHz 10 mHz (1 μHz optional) < 4 nS 1% 10 nS to .5% of final value < 2 nS 5% to 95% (1MHz) 10nS < 10pS (rms)</p>		<p>10 mHz - 5 MHz</p>

Triangle, Ramp (2Vpp) Frequency Adjustment resolution Linearity Asymmetry Duty cycle Adjustment resolution Jitter	10 mHz- 15 MHz 10 mHz (1 μ Hz optional) .1% of peak output < 2 nS 5% to 95% 10nS < 10pS (rms)	10 mHz- 5 MHz
Exponential (2Vpp) Frequency Adjustment resolution Rise/Fall time Damping factor Jitter	10 mHz- 5 MHz 10 mHz (1 μ Hz optional) < 4 nS -1,000 to 1,000 < 10pS (rms)	10 mHz- 1 MHz
Sinc (sin(x)/x) (2Vpp) Frequency Adjustment resolution Zero crossings	10 mHz- 5 MHz 10 mHz (1 μ Hz optional) 2 to 1,000	10 mHz- 1 MHz
Cardiac (2Vpp) Frequency Adjustment resolution Zero crossings	10 mHz- 1 MHz 10 mHz (1 μ Hz optional) 2 to 1,000	
Noise Type Bandwidth	White 50 MHz	White 20 MHz
AM (2Vpp) Carrier (-3dB) Modulating signal Frequency Modulation depth Source	10 mHz to 5 MHz any internal waveform including Arb 10 mHz to 1MHz 0% to 150% internal (external optional)	10 mHz- 1 MHz
External AM modulation	Optional	
FM (2Vpp) Carrier (-3dB) Modulating signal Frequency Modulation depth Source	10 mHz to 5 MHz any internal waveform including Arb 10 mHz to 1 MHz 0% to 100% internal (external optional)	10 mHz- 1 MHz
External FM modulation	Optional	

ASK (2Vpp) Frequency Modulating signal Frequency Gating signal	10 mHz to 5 MHz any internal waveform including Arb 10 mHz to 5 MHz 5 (TTL, CMOS) to 1.2 V (CMOS, TTL, LVTTL)	10 mHz - 1 MHz 10 mHz - 1 MHz
FSK (2Vpp) Frequency Modulating signal Frequency Gating signal	10 mHz to 5 MHz any internal waveform including Arb 10 mHz to 5 MHz 5 (TTL, CMOS) to 1.2 V (CMOS, TTL, LVTTL)	10 mHz - 1 MHz 10 mHz - 1 MHz
PSK (2Vpp) Frequency Modulating signal Frequency Gating signal	10 mHz to 5 MHz any internal waveform including Arb 10 mHz to 5 MHz	10 mHz - 1 MHz 10 mHz - 1 MHz
Burst (2Vpp) Carrier (-3dB) Source Rate Count Gate source Trigger	10 mHz 5 MHz any internal waveform including Arb 100 Hz to 2 MHz variable internal (external optional) single, internal rate, external(optional)	10 mHz - 1 MHz 10 mHz - 1 MHz
Sweep Type Direction Start frequency Stop frequency Sweep time	linear or log (exponential) up or down 0 to 15MHz 0 to 15MHz 1 uS to 1 mS	0 to 1 MHz 0 to 1 MHz 1 uS to 1 mS

Editing tools

Signal processing	
Math operation	addition, subtraction, multiplication, gain, clip, absolute, resize, invert, mirror, expand to fit
Filtering	smoothing, ideal low pass, first order low pass
Windowing	Gaussians, Blackman, Blackman-Harris, Cosine, Hanning, Hamming, Flat-Top, Kaiser-Bessel, Welch, Triangular
Signal library	sine, square, triangle, falling ramp, rising ramp, rising exponent, falling exponent, sinc, cardiac, noise
GUI Editors	pen, line, manual, insert
Options	save / recall in .txt & .csv format
Units	
Frequency	Hz, kHz, MHz
Amplitude	mVpp, Vpp
Offset	mV, V
Protection	short circuit
Configuration time	
Arbitrary save	10 mS
Arbitrary Recall	100 mS
Setting save	10 mS
Setting Recall	100 mS
Function	100 mS

Other

Physical Properties	
Dimensions	128.0 x 77.0 x 31.6 (mm), 5.0 x 3.0 x 1.2 (inches)
Weight	340 grams, 12 Ounces
System	
PC Requirements Recommended	Operating system: 32/ 64-bit edition of Microsoft Windows XP (SP3), Vista, Windows 7/ Windows 8/ Windows 10 Ports: USB 2.0/ 3.0 compliant port
Environmental Operating environment Temperature range Humidity Storage environment Temperature range Humidity	0 °C to 40 °C for normal operation 15 °C to 32 °C for quoted accuracy 5% to 80% RH, non–condensing -20 °C to +60 °C 5% to 95% RH, non–condensing
Software	Save setting, recall setting, save plot, recall/print plot, zoom in vertical, zoom in horizontal, pen editor, line editor, DSP, variable sampling rate