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Analog Arts

SF990

SF880

SF830

Product Specifications

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Overview

This document specifies the typical performance of the instruments. For modifications, enhancements, and application specific products, please contact the factory.

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

The relevant specifications of the oscilloscope and the arbitrary generator also apply to the sweep frequency response analyzer.
The relevant specifications of 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 at:
http://www.analogarts.com/images/AnalogArts/PDFs/Analog%20Arts%20High%20Performance%20Instruments%20Comprehensive%20Instruction%20Manual.pdf

Frequency Response Analyzer

Model	SF990	SF880	SF830
Frequency Range			
	100 uHz - 150 MHz	1 Hz - 150 MHz	1 Hz - 50 MHz
Dynamic Range			
< 1 Hz < 2 KHz < 5 MHz < 25 MHz < 50 MHz < 100 MHz < 150 MHz	110 dB 100 dB 95 dB 90 dB 85 dB 80 dB 70 dB	N.A. 100 dB 95 dB 90 dB 85 dB 80 dB 70 dB	N.A. 80 dB 80 dB 80 dB 70 dB N.A. N.A.
Gain Accuracy			
< 1 Hz < 1 KHz < 10 KHz < 1 MHz < 10 MHz < 50 MHz < 100 MHz < 150 MHz	0.01 dB 0.02 dB 0.05 dB 0.20 dB 0.25 dB 0.5 dB 1.0 dB 1.5 dB	N.A. 0.02 dB 0.05 dB 0.20 dB 0.25 dB 0.5 dB 1.0 dB 1.5 dB	N.A. 0.10 dB 0.20 dB 0.50 dB 1 dB 1.5 dB N.A. N.A.
Phase Accuracy			
< 1 Hz < 10 KHz < 1 MHz < 10 MHz < 50 MHz < 100 MHz < 150 MHz	0.02^{O} 0.02^{O} 0.05^{O} 0.075^{O} 0.10^{O} 0.15^{O} 0.20^{O}	N.A. 0.02^{O} 0.05^{O} 0.075^{O} 0.10^{O} 0.15^{O} 0.20^{O}	N.A. 0.10^{O} 0.25^{O} 0.50^{O} 0.75^{O} N.A. N.A.
Common Mode Rejection Ratio			
	> 100 dB	> 100 dB	> 80 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	SF990	SF880	SF830
Oscilloscope			
Bandwidth (Max at probe tip) [1]			
@ 500 mV/ Div with 10X probe @ 50 mV/ Div with 1X probe @ 1 V/ Div with 10X probe @ 100 mV/ Div with 1X probe @ 2 V/ Div with 10X probe @ 200 mV/ Div with 1X probe @ 5 V/ Div with 10X probe @ 500 mV/ Div with 1X probe @ 20 V/ Div with 10X probe @ 2 V/ Div with 1X probe	1 GHz 1 GHz 500 MHz 500 MHz 250 MHz 250 MHz 250 MHz 250 MHz 200 MHz 200 MHz	1 GHz 1 GHz 500 MHz 500 MHz 250 MHz 250 MHz 250 MHz 250 MHz 200 MHz 200 MHz	300 MHz 300 MHz 200 MHz 200 MHz 100 MHz 100 MHz 100 MHz 100 MHz 100 MHz 100 MHz
Rise time	0.5 nS	0.5 nS	2.5 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	< -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	125 MHz 100 GHz	125 MHz 100 GHz	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		5 ns/div to 100 ms/div
Time base (Data Recorder)	500 nS to 365 days with data recorder		
Timing accuracy	50 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	1 GHz	500 MHz	300 MHz

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

Model	SF990	SF880	SF830
Spectrum Analyzer			
Common features between the oscilloscope and the spectrum analyzer have the same specifications.			
Frequency Bandwidth [1]	1 GHz	1 GHz	300 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	(Span / 2^{18}) 0.78 Hz to 195 Hz		
Spectrum Flatness	1 dB		
Frequency Error	50 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	SF990	SF880	SF830
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 [1]	1 GHz	1 GHz	300 MHz
Resolution	0.1 Hz		
Tolerance	50 ppm	50 ppm	100 ppm
Relative Tolerance	0.01 ppm	0.01 ppm	0.1 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	50 ppm	50 ppm	200 ppm

Arbitrary Waveform Generator

General			
Specifications	**SF990**	**SF880**	**SF830**
Arbitrary waveform length	2 to 64K adjustable		
Ram (Memory)	64K (1M optional)		
Amplitude resolution	14-bits	14-bits	12-bits
Sample rate (sine wave)	400 MHz	400 MHz	200 MHz
Sample rate	100 MHz		
Sample rate (Arbitrary)	1 MHz to 100 MHz		
Frequency adjustment resolution	10 mHz (1 µHz optional)		
Standard waveforms	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 AM (*modulating signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms*) FM (*modulating signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms*) burst (*carrier signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms*)		

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) 0.1% 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 150 MHz	10 mHz to 150 MHz	10 mHz to 50 MHz
Square	10 mHz to 15 MHz (SF990 & SF880)		10 mHz to 15 MHz
Pulse	10 mHz to 15 MHz		
Triangle	10 mHz to 100 KHz		
Ramp	10 mHz to 100 KHz		
Sinc	1 Hz to 5 MHz		
Noise (White) Bandwidth	25 MHz		
AM (Carrier)	1 Hz to 5 MHz		
FM (Carrier)	1 Hz to 5 MHz		
Sweep	DC to 15 MHz (start & stop frequency)		
Burst (Burst Rate)	100 Hz to 2 MHz		
Digital (shift keying rate)	1 kHz to 2 MHz		
Exponent	1 Hz to 5 MHz		
Cardiac	1 Hz to 1 MHz		
Resolution	10 mHz (1 µHz optional)		
Accuracy	2% ±5mV (.1% optional) At room temperature		
Temp Coefficient	20 ppm/°C		
Aging	10 ppm/yr		

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

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

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

Editing tools	
Signal processing Math operation Filtering Windowing	 addition, subtraction, multiplication, gain, clip, absolute, resize, invert, mirror, expand to fit smoothing, ideal low pass, first order low pass 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 Amplitude Offset	 Hz, kHz, MHz mVpp,Vpp mV, V
Protection	short circuit
Configuration time Arbitrary save Arbitrary Recall Setting save Setting Recall Function	 10 mS 100 mS 10 mS 100 mS 100 mS

Logic Analyzer/ Pattern Generator

Model	SF990, SF880, SF830
Logic Analyzer	
Internal Clock *The internal clock makes the memory address counter follow the rising edges of the internally generated programmable clock.*	
Range	100 KHz - 100 MHz
Resolution	1 Hz
Period	10 nS - 1 uS
Period Accuracy	±0.01%
External Clock	
Range	100 KHz - 200 MHz
Logic	TTL, CMOS (1.8 V, 2.5 V, 3.3 V, 5 V)
Input Logic	TTL, CMOS (1.8 V, 2.5 V, 3.3 V, 5 V)
Maximum Sample Rate	
8 Channels	200 MHz
16 Channels	100 MHz
Minimum Sample Rate	
Internal Clock	1 MHz
External Clock	100 KHz
Minimum Detectable Pulse Width	15 nS
Input/ Output Channels	
Number of Channels	16
Input Levels	TTL, CMOS (1.8 V, 2.5 V, 3.3 V, 5 V)
Output Levels - Logic Analyzer	1.8 LVCMOS
Channel-to-Channel Skew	1 nS
Input Impedance	100 kΩ, parallel 2 pF
Maximum External Voltage	-2V to 5 V
Coupling	DC

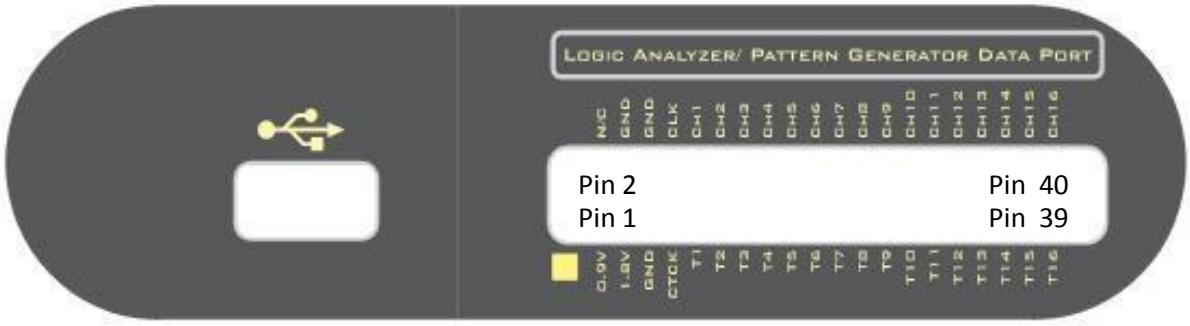
Pulse / Level Parameters Output Amplitude Accuracy Offset Accuracy Overshoot / pre-shoot / ringing Rise / Fall Time Source Impedance Short Circuit Current	 1.8 LVCMOS ± (5% Amplitude + 10 mV) ± 20 mV ± 2% ± 10 mV < 2ns 200 Ω [2] ± 30mA
Timing accuracy	100 ppm
Trigger Types	Edge, pattern, pulse width, pattern width
Memory/ Channel Parameters Number of Input Channels Data Length (16 channels) Data Length (8 channels)	 16/ 8 524 K 1048 K
Protocols	I2C, SIM, 1-Wire,SPI, Quad SPI (includes data wizard)

Pattern Generator	
Model	**SF990, SF880, SF830**
The output is a pattern event. The pattern is programmable, or may be selected from a library of pre-configured patterns. The graphical and the math editor enables the user to seamlessly create any desired pattern.	
Internal Clock *The internal clock makes the memory address counter follow the rising edges of the internally generated programmable clock.* Range Resolution Period Period Accuracy	 100 KHz - 100 MHz 1 Hz 10 nS - 1 uS ±0.01%
External Clock Range Logic	 100 KHz - 100 MHz
Input Logic	TTL, CMOS (1.8 V, 2.5 V, 3.3 V, 5 V)
Maximum Sample Rate 16 Channels	 100 MHz
Minimum Sample Rate Internal Clock External Clock	 1 MHz 100 KHz
Minimum Detectable Pulse Width	15 nS
Input/ Output Channels Number of Channels Source Impedance [2] Output Levels Input Levels	 16 200 Ω, selectable 1.8 LVCMOS TTL, CMOS (1.8 V, 2.5 V, 3.3 V, 5 V)

Channel-to-Channel Skew Input Impedance Maximum External Voltage Coupling	1 nS 100 kΩ parallel 2 pF -2V to 5 V DC
Pulse / Level Parameters Output Amplitude Accuracy Offset Accuracy Overshoot / pre-shoot / ringing Rise / Fall Time Source Impedance Short Circuit Current	 1.8 LVCMOS ± (5% Amplitude + 10 mV) ± 20 mV ± 2% ± 10 mV < 2ns 200 Ω [2] ± 30mA
Timing accuracy	100 ppm
Trigger Types	Edge, pattern, pulse width, pattern width
Memory/ Channel Parameters Number of Output Channels Data length (16 channels)	 16/ 8 524 K
Protocols	I2C, SIM, 1-Wire,SPI, Quad SPI (includes data wizard)
Editor - Pattern Generator	Graphical, Line, Math, and function

2. For other impedance values, please contact the factory.

Logic Analyzer/ Pattern Pin Assignment



Logic Analyzer/ Pattern Generator Back panel

Pin N0.	Pin Name	Pin Assignment	Pin No.	Pin Name	Pin Assignment
1	0.9V	Open	2	N/C	Ground [3] [4]
3	1.8V	Open	4	GND	Ground
5	GND	Ground	6	GND	Ground
7	CTCK	Clock In/ Out	8	CLK	Clock In/ Out
9	T1	Channel 1	10	CH1	N.C. (Reserved C17)
11	T2	Channel 2	12	CH2	N.C. (Reserved C18)
13	T3	Channel 3	14	CH 3	N.C. (Reserved C19)
15	T4	Channel 4	16	CH 4	N.C. (Reserved C20)
17	T5	Channel 5	18	CH 5	N.C. (Reserved C21)
19	T6	Channel 6	20	CH 6	N.C. (Reserved C22)
21	T7	Channel 7	22	CH 7	N.C. (Reserved C23)
23	T8	Channel 8	24	CH 8	N.C. (Reserved C24)
25	T9	Channel 9	26	CH 9	N.C. (Reserved C25)
27	T10	Channel 10	28	CH 10	N.C. (Reserved C26)
29	T11	Channel 11	30	CH 11	N.C. (Reserved C27)
31	T12	Channel 12	32	CH 12	N.C. (Reserved C28)
33	T13	Channel 13	34	CH 13	N.C. (Reserved C29)
35	T14	Channel 14	36	CH 14	N.C. (Reserved C30)
37	T15	Channel 15	38	CH 15	N.C. (Reserved C31)
39	T16	Channel 16	40	CH 16	N.C. (Reserved C32)

3. Pin 2 can be configured to be an external trigger to allow the user to synchronize the data capture with the rising edge of an external event. For further information, please contact the factory.
4. Even numbered pins from 10 to 40, are reserved for the MSO & 32-bit logic analyzer versions of this instrument.

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