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Analog Arts

SF990

SF880

SF830

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	SF990	SF880	SF830
Frequency Range			
	100 uHz - 150 MHz	1 Hz - 150 MHz	1 Hz - 50 MHz
Dynamic Range			
< 1 Hz	110 dB	N.A.	N.A.
< 2 KHz	100 dB	100 dB	80 dB
< 5 MHz	95 dB	95 dB	80 dB
< 25 MHz	90 dB	90 dB	80 dB
< 50 MHz	85 dB	85 dB	70 dB
< 100 MHz	80 dB	80 dB	N.A.
< 150 MHz	70 dB	70 dB	N.A.
Gain Accuracy			
< 1 Hz	0.01 dB	N.A.	N.A.
< 1 KHz	0.02 dB	0.02 dB	0.10 dB
< 10 KHz	0.05 dB	0.05 dB	0.20 dB
< 1 MHz	0.20 dB	0.20 dB	0.50 dB
< 10 MHz	0.25 dB	0.25 dB	1 dB
< 50 MHz	0.5 dB	0.5 dB	1.5 dB
< 100 MHz	1.0 dB	1.0 dB	N.A.
< 150 MHz	1.5 dB	1.5 dB	N.A.
Phase Accuracy			
< 1 Hz	0.02°	N.A.	N.A.
< 10 KHz	0.02°	0.02°	0.10°
< 1 MHz	0.05°	0.05°	0.25°
< 10 MHz	0.075°	0.075°	0.50°
< 50 MHz	0.10°	0.10°	0.75°
< 100 MHz	0.15°	0.15°	N.A.
< 150 MHz	0.20°	0.20°	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) [2]			
@ 500 mV/ Div with 10X probe	1 GHz	1 GHz	300 MHz
@ 50 mV/ Div with 1X probe	1 GHz	1 GHz	300 MHz
@ 1 V/ Div with 10X probe	500 MHz	500 MHz	200 MHz
@ 100 mV/ Div with 1X probe	500 MHz	500 MHz	200 MHz
@ 2 V/ Div with 10X probe	250 MHz	250 MHz	100 MHz
@ 200 mV/ Div with 1X probe	250 MHz	250 MHz	100 MHz
@ 5 V/ Div with 10X probe	250 MHz	250 MHz	100 MHz
@ 500 mV/ Div with 1X probe	250 MHz	250 MHz	100 MHz
@ 20 V/ Div with 10X probe	200 MHz	200 MHz	100 MHz
@ 2 V/ Div with 1X probe	200 MHz	200 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 [3]	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

Model	SF990	SF880	SF830
Spectrum Analyzer			
Common features between the oscilloscope and the spectrum analyzer have the same specifications.			
Frequency Bandwidth [5]	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 [6]	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 [5]	1 GHz	1 GHz	300 MHz
Resolution	0.1 Hz		
Tolerance [6]	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 [6]	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 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>AM (<i>modulating signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms</i>)</p> <p>FM (<i>modulating signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms</i>)</p> <p>burst (<i>carrier signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms</i>)</p>		

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

Frequencies Ranges			
Sine Wave	10 mHz to 150 MHz	10 mHz to 150 MHz	10 mHz to 50 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 (start & stop frequency) 100 Hz to 2 MHz 1 kHz to 2 MHz 1 Hz to 5 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 <10 MHz <150 MHz</p>	<p>0.1 dB 0.5 dB 1 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>

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)
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)
Sinc (sin(x)/x) (2Vpp) Frequency Adjustment resolution Zero crossings	10 mHz- 5 MHz 10 mHz (1 μ Hz optional) 2 to 1,000
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
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)
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)
External FM modulation	Optional

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

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 <i>The internal clock makes the memory address counter follow the rising edges of the internally generated programmable clock.</i> Range Resolution Period Period Accuracy	100 KHz - 100 MHz 1 Hz 10 nS - 1 uS ±0.01%
External Clock Range Logic	100 KHz - 200 MHz 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 16 Channels	200 MHz 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 Input Levels Output Levels - Logic Analyzer Channel-to-Channel Skew Input Impedance Maximum External Voltage Coupling	16 TTL, CMOS (1.8 V, 2.5 V, 3.3 V, 5 V) 1.8 LVCMOS 1 nS 100 kΩ, parallel 2 pF -2V to 5 V DC

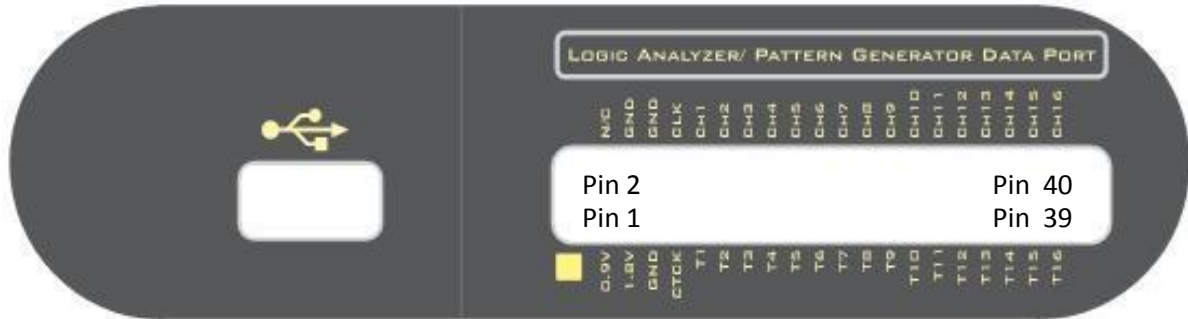
Pulse / Level Parameters Output Amplitude Accuracy Offset Accuracy Overshoot / pre-shoot / ringing Rise / Fall Time Source Impedance Short Circuit Current	1.8 LVCMOS ± (5% Amplitude + 10 mV) ± 20 mV ± 2% ± 10 mV < 2ns 200 Ω [7] ± 30mA
Timing accuracy	100 ppm
Trigger Types	Edge, pattern, pulse width, 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
<p>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.</p>	
<p>Internal Clock <i>The internal clock makes the memory address counter follow the rising edges of the internally generated programmable clock.</i></p> <p>Range Resolution Period Period Accuracy</p>	<p>100 KHz - 100 MHz 1 Hz 10 nS - 1 uS ±0.01%</p>
<p>External Clock Range Logic</p>	<p>100 KHz - 100 MHz</p>
<p>Input Logic</p>	<p>TTL, CMOS (1.8 V, 2.5 V, 3.3 V, 5 V)</p>
<p>Maximum Sample Rate 16 Channels</p>	<p>100 MHz</p>
<p>Minimum Sample Rate Internal Clock External Clock</p>	<p>1 MHz 100 KHz</p>
<p>Minimum Detectable Pulse Width</p>	<p>15 nS</p>
<p>Input/ Output Channels Number of Channels Source Impedance [7] Output Levels Input Levels</p>	<p>16 200 Ω, selectable 1.8 LVCMOS TTL, CMOS (1.8 V, 2.5 V, 3.3 V, 5 V)</p>

Channel-to-Channel Skew Input Impedance Maximum External Voltage Coupling	1 nS 100 k Ω 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 \pm (5% Amplitude + 10 mV) \pm 20 mV \pm 2% \pm 10 mV < 2ns 200 Ω [1] \pm 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

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

Logic Analyzer/ Pattern PIN ASSIGNMENT



Logic Analyzer/ Pattern Generator Back panel

Pin NO.	Pin Name	Pin Assignment	Pin No.	Pin Name	Pin Assignment
1	0.9V	Open	2	N/C	Ground [8] [9]
3	1.8V	Open	4	GND	Ground
5	GND	Ground	6	GND	Ground
7	CTCK	Clock In/ Out [9]	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)

- 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.
- 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