STANFORD RESEARCH SYSTEMS

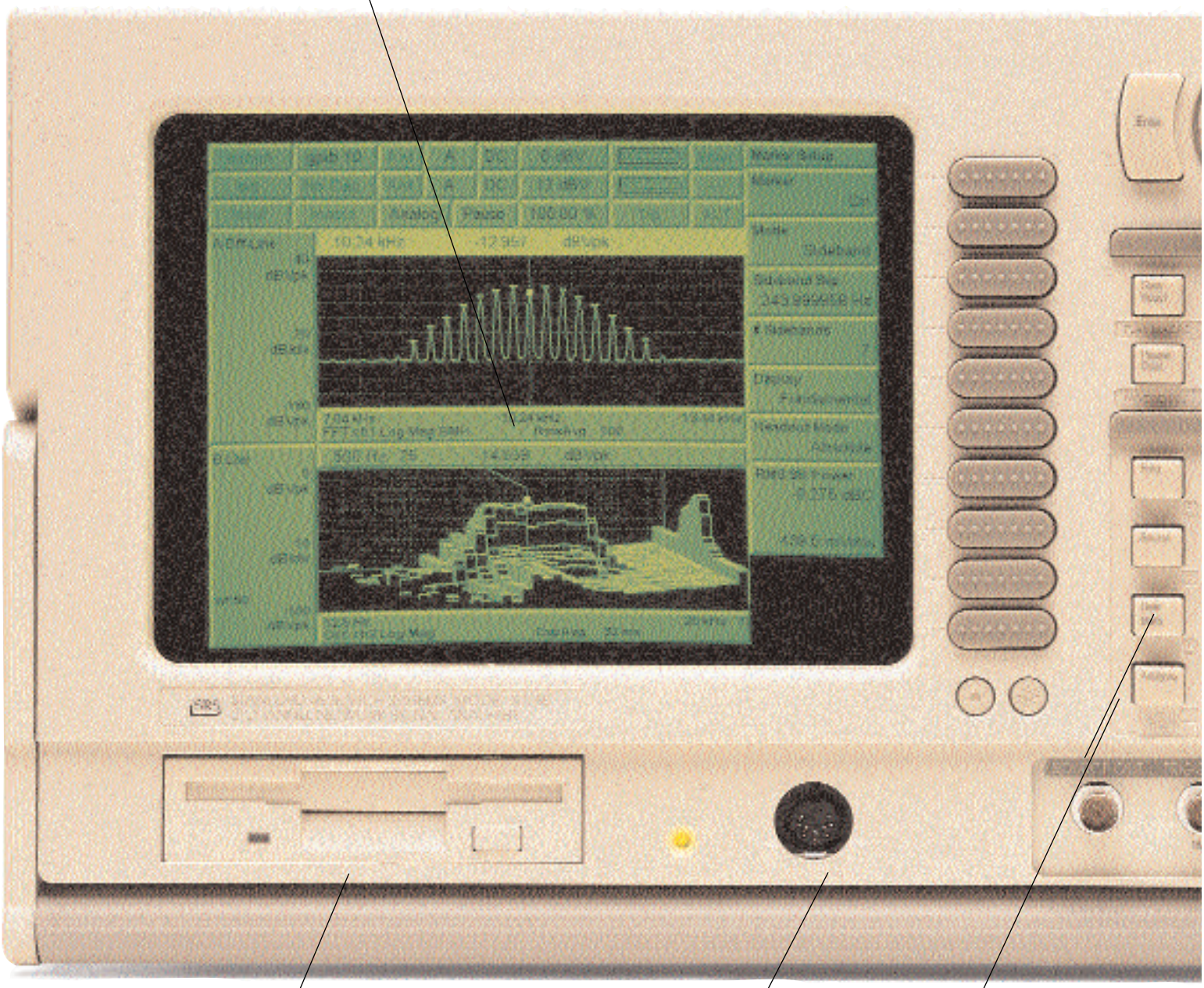
SR780
Two Channel Network Signal Analyzer

SR780 Features

Measurements	*FFT Group* FFT, Time Record, Windowed Time, Time Capture Transfer Function, Cross Spectrum, Coherence, Cross Correlation Autocorrelation, Orbit, User Math Functions *Octave Analysis Group* 1/1, 1/3, 1/12 Octave, Time Capture, User Math Functions L_{eq}, Impulse, Total Power *Swept Sine Group* Spectrum, Transfer Function, Cross Spectrum User Math Functions
Views	Log Magnitude, Linear Magnitude, Magnitude Squared Real Part, Imaginary Part, Phase Unwrapped Phase, Nichols Plot, Nyquist Plot
Displays	Single, Dual Upper/Lower, Waterfall with Skew Zoom and Pan
FFT Resolution	100, 200, 400 or 800 FFT lines
FFT Windows	Hanning, Blackman-Harris, Flattop Kaiser, Uniform, Force/Exponential User defined, ±T/2, ±T/4, T/2
Averaging	RMS, Vector, Peak Hold Linear or Exponential, Equal Confidence (Octave), Time Record Preview
Analysis	Band, Sideband, Harmonic, THD/THD+N Limit Test Pass/Fail, Data Table, Exceedance, Statistics
User Math	+, -, *, /, Conjugate, Magnitude/Phase Real/Imaginary, Sqrt, FFT/Inverse FFT jω, Log/Exp, d/dx Group Delay, A, B, C-Weighting, x/1-x
Source Outputs	Sine, Two Tone, Swept Sine White/Pink Noise, Burst Noise, Chirp Burst Chirp, Arbitrary
Trigger	Free Run, External (Analog and TTL), Internal Source, Auto/Manual Arming
Time Capture	Capture time data for later analysis (FFT or Octave) Up to 2M samples of data can be saved (standard memory).
Storage	3.5”, 1.44 Mbytes, DOS formatted disk. Save data, setups and hardcopy.
Hard Copy & Interfaces	Print to dot matrix or LaserJet printers. Plot to HPGL or Postscript plotters. Print/Plot on-line (RS232 serial, Centronics parallel or IEEE-488) or to disk file. EPSF, GIF, PCX graphic formats also available for disk storage.
Help	On screen help system provides Operating Manual and Programming Reference on-line.

SR780 front panel features and overview

Large 9" high contrast greyscale CRT
Displays measurement information up-front.
No hunting through menus is necessary.



PC keyboard input
Allows easy entry of text data.

3.5" DOS compatible 1.44 MB disk drive
Stores instrument setups, trace data, data and limit tables and plotter or printer output.

User Math
Build custom measurements by directly entering equations.

Fast, responsive marker

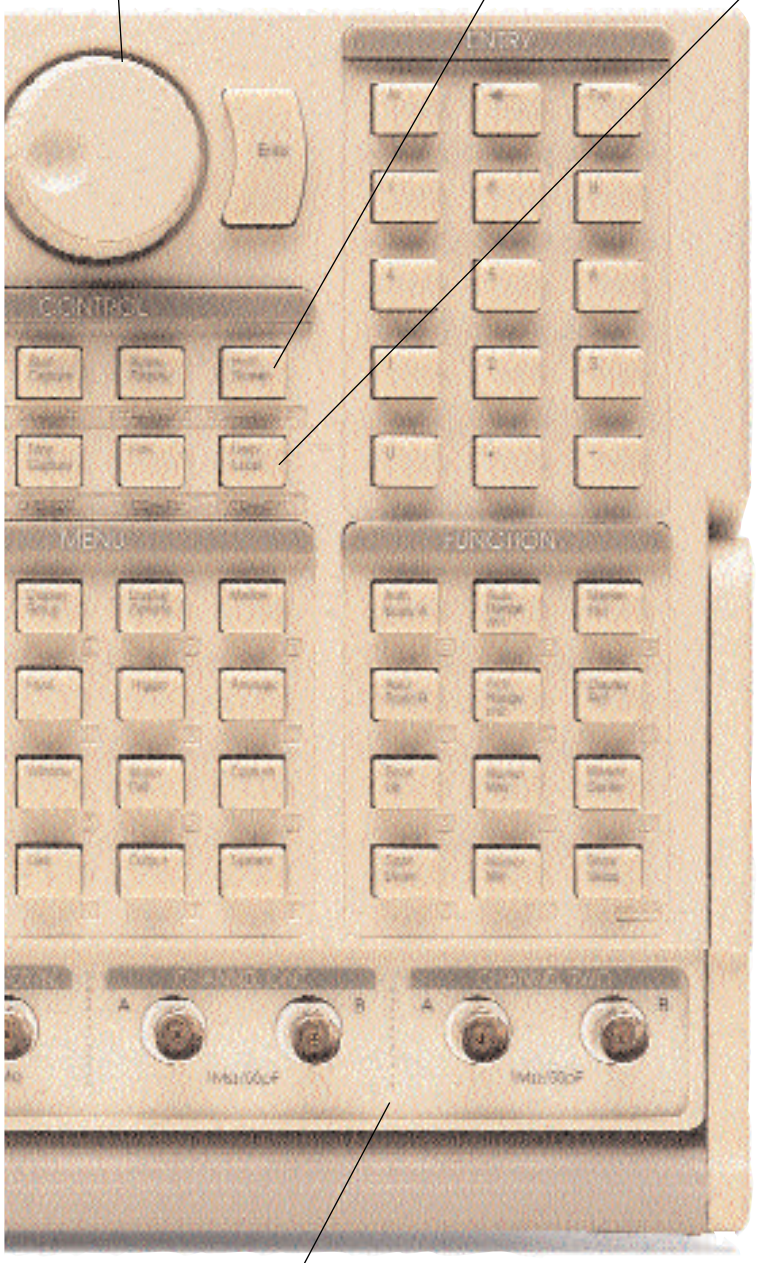
- Find Max/Min or track peaks
- Calculates THD, THD+N
- Band, sideband, harmonic power
- Absolute or relative readings

Flexible printing

Output in PCL, GIF, PCX, HPGL, and Postscript formats.

Online Hypertext Help

Gets you the information you need – fast.



Input Channels

- Dual A/Ds provide 102.4 kHz bandwidth with both channels selected.
- -60 dBV max full scale input sensitivity
- Switchable analog A-weight filters
- 90 dB FFT dynamic range, 145 dB swept-sine
- Input autoranging (up only or up/down)

Introducing the SR780

Finally, an FFT network analyzer that combines high performance, low cost, and all the features you need without forcing you to buy an array of expensive options. The SR780 offers it all: 102.4 kHz dual channel FFTs with 90 dB dynamic range, 145 dB dynamic range swept-sine measurements, realtime ANSI standard octave analysis, waterfalls, transient capture, and more, for less than half the cost of other similarly equipped analyzers.

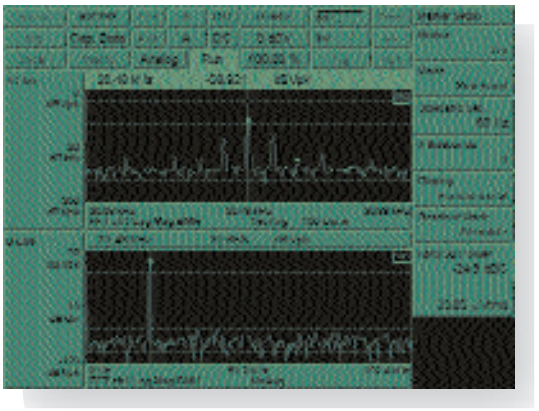
The SR780's advanced architecture gives you two analyzers in one box. You can configure each display with separate spans, center frequencies, or averaging configurations. The "link" key lets you change parameters for both displays together or separately with a single keypress.

Whether your application involves acoustic measurements, vibration testing, servo systems, or filter design, the SR780's features, performance, and low cost make it the overwhelming choice in FFT network analyzers.

Spectrum Analysis

The SR780 delivers true 2-channel 102.4 kHz FFT performance. Unlike other analyzers, the SR780 doesn't make you sacrifice 2-channel performance for bandwidth – its fast 32-bit floating point DSP processor gives the SR780 a fast 102.4 kHz realtime rate with both channels selected. Two precision 16-bit ADCs provide a 90 dB typical dynamic range in FFT mode – enough for the most demanding low-level measurements. Selectable 100 - 800 line analysis optimizes time and frequency resolution and you can zoom in on any portion of the 102.4 kHz range with a frequency span down to 191 mHz.

The SR780's unique architecture lets the two displays function as separate analyzers. You can choose separate frequency spans, starting frequencies, number of FFT lines, or averaging modes for each display. So it's no problem to look at a wideband display and zoom in on a specific feature *simultaneously*. No other spectrum analyzer lets you select from two sampling rates: 256 kHz or 262 kHz, so frequency spans come out in either a binary (102.4 KHz, 51.2 kHz,...) or decimal (100 kHz, 50 kHz, 25 kHz,...) sequence depending on your requirements.



Bottom display shows wideband FFT, top display shows a narrowband FFT of the same signal. The sideband marker has been selected for calculation of the total sideband power.

Flexible Averaging

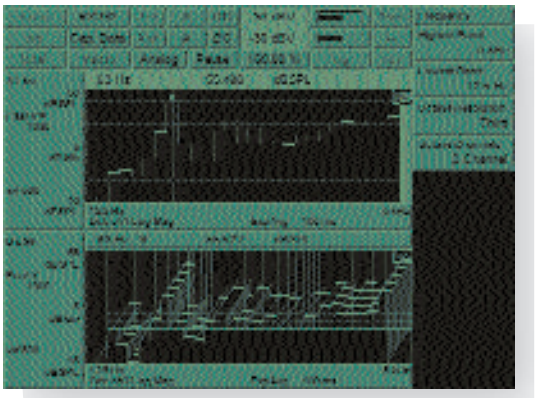
Enough averaging choices are provided for any measurement. Choose rms averaging to reduce signal fluctuations, or vector averaging to actually eliminate noise from synchronous signals. Choose linear averaging (stable averaging) for fixed signals, or exponential averaging to track drifting features. Because the SR780's 102.4 kHz realtime bandwidth lets it take data seamlessly, vector averaging can be selected for any signal that's repetitive within the time record – no trigger is necessary.

Automatic Unit Conversion

Automatic unit conversion makes translating accelerometer data easy. Enter your accelerometer conversion directly in V/EU, EU/V or dB(1V/EU). The SR780 will display results in units of meters, inches, mil, g, kg, lbs, N, dynes, pascals, bars, or dBSPL. Accelerometer data is automatically converted to velocity or displacement units. Built in ICP power means you won't have to take along an external power supply for your accelerometer.

Octave Analysis

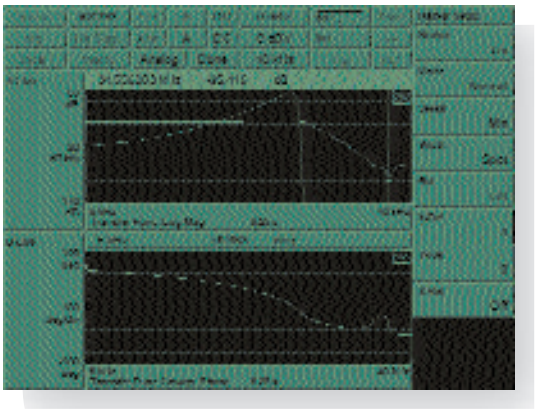
Realtime octave analysis at frequencies up to 40 kHz (single channel), or 20 kHz (2-channel) is standard on the SR780. Octave analysis is fully compliant with ANSI S1.11-1986 (Order 3, type 1-D) and IEC 225-1966. 1/1 octave, 1/3 octave, and 1/12 octave analysis are all available. Switchable analog A-weighting filters as well as built-in user math A, B, and C-weighting functions are all included. Octave averaging choices include exponential time averaging, linear time averaging, peak hold, and equal confidence averaging. IEC 651 Type 0 compliant peak hold, impulse, fast, and slow sound level measurements are all calculated.



Expensive options are a thing of the past with the SR780. Realtime octave analysis is standard on every unit.

Swept Sine Analysis

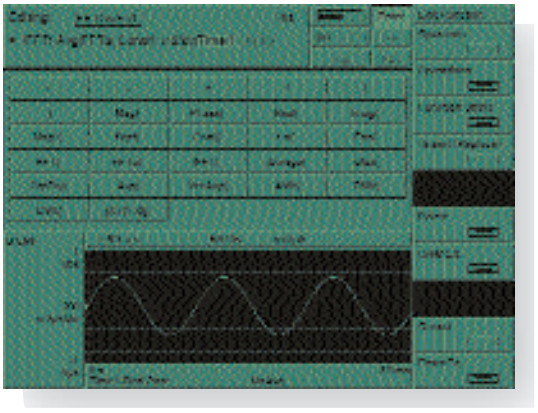
Swept-sine analysis for measurements involving high dynamic range or wide frequency intervals is also a standard feature of the SR780. Selectable auto-ranging optimizes the input range at each point in the measurement, providing up to 145 dB of dynamic range. Auto-ranging can be used with source auto-leveling to maintain a constant input or output level at the device under test. To ensure the fastest sweeps possible, auto-resolution can also be selected, providing a variable scan speed tailored precisely to the signal being measured. Choose linear sweeps for high frequency resolution or logarithmic sweeps up to 8 decades for the widest frequency coverage.



Swept-sine Bode plot of lowpass filter response. Top Display shows magnitude with an expanded view of passband response.

User Math

All three measurement groups: FFT, octave, and swept-sine, allow you to create your own measurement using the SR780's user math menu. Enter any equation involving time or frequency data, stored files, constants, or a rich array of supplied operations including the arithmetic functions, FFT, inverse FFT, jω, d/dω, exp, ln x and many others.Unlike many analyzers, the SR780 doesn't slow to a snail's pace when user math is selected. For instance, the function exp(ln(conj(Average(FFT2/FFT1))) can be calculated with a 50 kHz realtime bandwidth.



The SR780 doesn't limit you to a few preselected measurements. With user math you can create an infinite variety of measurements.

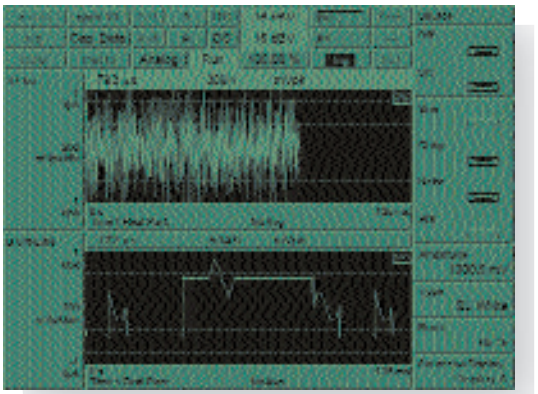
Source

Choose from one of 5 precision source types: low distortion (-80 dBc) single or two-tone sine waves, chirps, white noise, pink noise, or arbitrary waveforms. The chirp and noise sources can both be bursted to provide a source that's active only over a selected portion of the time record for FFT measurements, or to provide an impulsive noise source for acoustic measurements. The digitally synthesized source provides output levels from .1 mV to 5 V and delivers up to 100 mA of current.

Arbitrary waveform capability is standard on the SR780. Use the arbitrary source to playback a section of a captured waveform, play a selected FFT time record, or upload your own custom waveform from disk or over the remote interface.

Capture

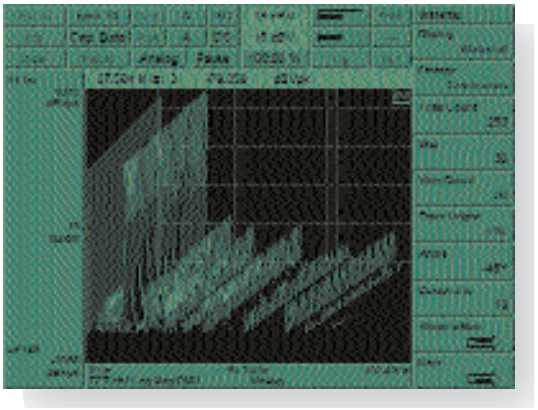
The SR780 comes with 2 Msamples of standard capture memory. Waveforms can be captured at 262 kHz or any submultiple of 262 kHz, allowing you to select the sample rate and capture length that's right for your data. Once captured, any portion of the signal can be played back in any FFT or octave measurement. The convenient "AutoPan" feature lets you display the measurement results synchronously with the corresponding portion of the capture buffer to easily identify important features. Optional memory expansion modules lets you expand the SR780's capture depth to up to 8 Msamples – that's almost 30 seconds of capture at the maximum sampling rate.



Top display shows burst noise source. Bottom display shows an arbitrary source downloaded to the SR780 via the IEEE-488 remote interface.

Waterfall

All octave and FFT measurements can be stored in the SR780's two 2k deep waterfall buffers. Waterfall storage is selectable as every n time records for FFT measurements, or you can select a storage interval in seconds (down to 4 ms) for octave measurements. While displaying waterfalls, you can adjust the skew angle to reveal important features, or change the baseline threshold to eliminate low-level clutter. Any z-axis slice or x-axis record can be saved to disk or displayed separately for individual analysis.



Two 2k deep waterfall buffers ensure you'll never miss important waterfall data.

Analysis

The SR780 includes a wide variety of built-in analysis features. Marker analysis lets you use the marker to easily measure the power contained in the harmonics, sidebands or within a given band of a frequency domain measurement. Important signal information such as THD, THD+N, sideband power relative to carrier, and total integrated power are calculated in realtime and displayed on the screen. Marker statistics quickly calculate the maximum, minimum, mean, and standard deviation of data at any point in the display.

Use data tables to display up to 100 selected data points in a tablular format. Limit tables allow you to define up to 100 upper and lower limit segments in each display for GO/NO GO testing. Data and limit table definitions can also be saved and recalled from disk for quick setup.

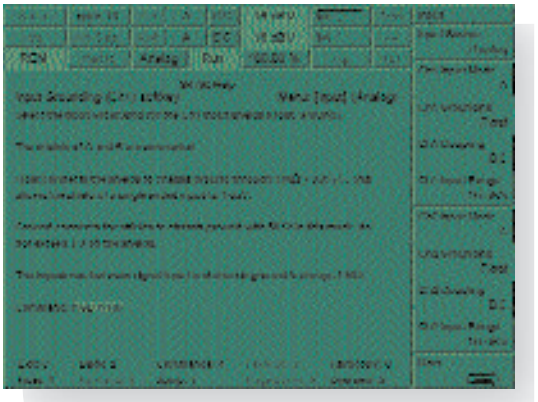
For sound level measurements, centile exceedance statistics are automatically calculated for each 1/1,1/3, or 1/12 octave band as well for Leq.

Output

The SR780's built in 3.5" 1.44 MB floppy disk, IEEE-488 and RS232 interface ports, and Centronics printer port combine to allow almost unlimited flexibility in saving, printing, plotting, or exporting your measurement data. Annotated displays can be printed or plotted to the disk, IEEE-488, RS232, or Centronics port in PCX, GIF, PCL (HP LaserJet and DeskJet), dot-matrix, Postscript, HP-GL or ASCII formats. User generated ASCII files can also be imported with a single keystroke allowing you to create your own displays for use in math functions or to compare with live data. Utilities are even included to translate your HP SDF files into SR780 format.

Help

Full, context-sensitive help screens for all SR780 features mean you will rarely have to refer to a printed manual. Hypertext links let you quickly switch between related help pages or instantly reference the remote command corresponding to any SR780 function. Use the help index to quickly locate help on any topic, jump to the online troubleshooting guide, browse a complete listing of the SR780's specifications, or examine a comprehensive description the SR780's remote commands... all from the front panel.



Extensive help is available for all the SR780's menus and keys.

SR780 Specifications

Specifications apply after 30 minutes of warm-up and within 2 hours of last auto-offset. All specifications are with 400 line FFT resolution and anti-alias filters enabled unless stated otherwise.

Frequency

Range	102.4 kHz or 100 kHz (both displays have the same range).
FFT Spans	195.3 mHz to 102.4 kHz or 191 mHz to 100 kHz. The 2 displays can have different spans and start frequencies.
FFT Resolution	100, 200, 400 or 800 lines
Real Time Bandwidth	102.4 kHz (highest FFT span with continuous data acquisition and averaging).
Accuracy	25 ppm from 20˚ C to 40˚ C

Dynamic Range

Dynamic Range	-90 dBfs typical, -80 dBfs guaranteed (FFT and Octave) 145 dB (Swept Sine) Includes spurs, harmonic and intermodulation distortion and alias products. Excludes alias responses at extremes of span.
Harmonic Distortion	<-80 dB (Single tone in band)
Intermodulation Distortion	<-80 dB (Two tones in band, each <-6.02 dBfs)
Spurious	<-80 dBfs
Alias Responses	<-80 dBfs (Single tone outside of span, < 0 dBfs, < 1 Mhz)
Full Span FFT Noise Floor	100 dBfs typical (Input grounded, Input Range > -30 dBV,Hanning window, 64 RMS averages)
Residual DC Response	< -30 dBfs (FFT with Auto Cal On)

Amplitude Accuracy

Single Channel	± 0.2 dB (excluding windowing)
Cross Channel	± 0.05 dB (dc to 102.4 kHz) (Transfer Function measurement, both inputs on the same input range, RMS averaged)

Phase Accuracy

Single Channel	± 3.0 deg relative to External TTL trigger (-50 dBfs to 0 dBfs, freq < 10.24 kHz) (Center of frequency bin, DC coupled) For Blackman-Harris, Hanning, Flattop and Kaiser windows, phase is relative to a cosine wave at the center of the time record. For Uniform, Force and Exponential windows, phase is relative to a cosine wave at the beginning of the time record.
Cross Channel	± 0.5 deg (dc to 51.2 kHz) ± 1.0 deg (dc to 102.4 kHz) (Transfer Function measurement, both inputs on the same input range, vector averaged)

Signal Inputs

Number of Inputs	2
Full Scale Input Range	-50 dBV (3.16 mVpk) to +34 dBV (50 Vpk) in 2 dB steps
Maximum Input Level	57 Vpk
Input Configuration	Single-ended (A) or True Differential (A-B)
Input Impedance	1 MΩ + 50 pF
Shield to Chassis	Floating Mode: 1 MΩ+ 0.01 mF Grounded Mode: 50Ω Shields are always grounded in differential input (A-B)
Maximum Shield Voltage	4 Vpk
AC Coupling	-3 dB rolloff at 0.16 Hz
CMRR	90 dB at 1 kHz (In. Range < 0 dBV) 80 dB at 1 kHz (In. Range <10 dBV) 50 dB at 1 kHz (In. Range ≥10 dBV)
ICP Signal Conditioning	Current Source: 4.8 mA Open Circuit Voltage +26 V
A-weight Filter	Type 0 Tolerance, ANSI Standard S1.4-1983; 10 Hz to 25.6 kHz
Crosstalk	<-145 dB below signal (Input to Input and Source to Inputs, 50Ω receiving input source impedance)
Input Noise	<10 nVrms/√Hz (< -160 dBVrms/√Hz) above 200 Hz

Trigger Input

Modes	Free run, Internal, External, or External TTL
Internal	Level adjustable to ±100% of input scale. Positive or Negative slope. Minimum Trigger Amplitude: 5% of input range
External	Level adjustable to ±5V in 40 mV steps. Positive or Negative slope. Input Impedance: 1 MΩ Max Input: ±5V Minimum Trigger Amplitude: 100 mV
External TTL	Requires TTL level to trigger (low<0.7V, high>3.0V).

Post-Trigger	Measurement record is delayed up to 8192 samples after the trigger.
Pre-Trigger	Measurement record starts up to 8192 samples prior to the trigger.

Transient Capture

Mode	Continuous realtime data recording to memory.
Maximum Rate	262,144 samples/sec for both inputs
Maximum Capture Length	2 Msamples (single input) 8 Msamples with optional memory

Octave Analysis

Standards	Conforms to ANSI standard S1.11-1986, Order 3, Type 1-D.
Frequency Range	Band centers: Single Channel 1/1 Octave 0.125 Hz - 32 kHz 1/3 Octaves 0.100 Hz - 40 kHz 1/12 Octaves 0.091 Hz - 12.34 kHz Two Channels 1/1 Octave 0.125 Hz - 16 kHz 1/3 Octaves 0.100 Hz - 20 kHz 1/12 Octaves 0.091 Hz - 6.17 kHz
Accuracy	< 0.2 dB (1 second stable average, single tone at band center)
Dynamic Range	80 dB (1/3 Octave, 2 second stable average) per ANSI S1.11-1986
Sound Level	Impulse, Peak, Fast, Slow and Leq per IEC 651-1979 Type 0

Source Output

Amplitude Range	1.0 mVpk to 5 Vpk
Amplitude Resolution	1 mVpk (output > 500 mVpk)
DC Offset:	<10.0 mV (typical)
Output Impedance	< 5Ω, ±100 mA peak output current.

Sine Source

Amplitude Accuracy	±1% of setting, 0 Hz to 102.4 kHz 0.1 Vpk to 5.0 Vpk, high impedance load.
Harmonics, SubHarm. and Spurious Signals	0.1 Vpk to 5 Vpk <-80 dBc (fundamental < 30 kHz) <-75 dBc (fundamental < 102 kHz)

Two Tone Source

Amplitude Accuracy	±1% of setting, 0 Hz to 102.4 kHz 0.1 Vpk to 5 Vpk, high impedance load.
Harmonics, SubHarm.	< -80 dBc, 0.1 Vpk to 2.5 Vpk

White Noise Source

Time Record	Continuous or Burst
Bandwidth	DC to 102.4 kHz or limited to analysis span.
Flatness	<0.25 dB pk-pk (typical), <1.0 dB pk-pk (max), 5000 rms averages

Pink Noise Source

Bandwidth	DC to 102.4 kHz
Flatness	<2.0 dB pk-pk, 20 Hz - 20 kHz (measured using averaged 1/3 Octave Analysis)

Chirp Source

Time Record	Continuous or Burst
Output	Sine sweep across the FFT span.
Flatness	±0.25 dB pk-pk, Amplitude = 1.0 Vpk

Swept Sine Source

Auto Functions	Source Level, Input Range and Frequency Resolution
Dynamic Range	145 dB

Arbitrary Source

Amplitude Range	± 5V
Record Length	2 Msamples (playback from Arbitrary Waveform memory or capture buffer). Variable output sample rate.

General

Monitor	Monochrome CRT, 800H by 600V resolution.
Interfaces	IEEE-488, RS232 and Printer interfaces standard. All instrument functions can be controlled through the IEEE–488 and RS232 interfaces. A PC (XT) keyboard input is provided for additional flexibility.
Hardcopy	Print to dot matrix and PCL compatible printers. Plot to HPGL or Postscript plotters. Print/Plot to RS232 or IEEE–488 interfaces or to disk file. Additional file formats include GIF, PCX and EPS.
Disk	3.5 inch DOS compatible format, 1.44 Mbytes capacity. Storage of displays, setups and hardcopy.
Preamp Power	Power connector for SRS preamplifiers.
Power	70 Watts, 100/120/220/240 VAC, 50/60 Hz.
Dimensions	17"W x 8.25"H x 24"D
Weight	56 lbs.
Warranty	One year parts and labor on materials and workmanship.

Ordering Information

SR780	FFT Network Analyzer including manual, disk utilities and power cord.
Option O780RM	Rack mount kit
Option O780M0	4 Msample RAM
Option O780M1	8 Msample RAM
Option O78012V	12 VDC-115 VAC converter
CT100	Instrument Cart

12 VDC Converter

Designed to power the SR780 in the field when AC power is not available.

Specifications

Input Voltage	10 VDC to 15 VDC
Ouput Voltage	115 VAC true RMS ±5%
Max Cont. Output Power	200W
Max Peak Output Power	300W
Input No Load Current	.34A

MobileCART

The SRS CT100 MobileCART instrument cart makes the SR780 truly portable. Its rugged construction and full rack-width capacity will free up your valuable work space and allow you to take the SR780 wherever you need to go.

Specifications

Tray size	17" x 22" (Tray accomodates 1 full-width rackmount instrument)
Maximum Tray Load	60 lbs.
Maximum Base Load	100 lbs.
Angular Adjustment	Horizontal to 60º
Cart Net Weight	58 lbs.

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