Introducing SR1 Dual-Domain Audio Analyzer — high performance audio analysis at a very affordable price.

SR1 is a stand-alone instrument that delivers cutting edge performance in a wide variety of audio measurements. With a versatile high-performance generator, an array of analyzers that operate symmetrically in both the analog and digital domains, and digital audio carrier measurements at sampling rates up to 192 kHz, SR1 is the right choice for the most demanding analog and digital audio applications.

User Interface

SR1 uses an integrated computer running the Windows XP embedded operating system, so operation will be immediately familiar and intuitive. Depending on the application, SR1 can be operated with an external mouse and keyboard, or by using the front-panel knob, keypad and touchpad.

Seven on-screen tabbed pages are available for arranging panels, graphs, and displays. Screen setups, data, and instrument configurations can be quickly saved and recalled to either the internal hard disk or to a flash drive connected to one of the two front-panel USB connectors. An optional 1024 × 768 XVGA monitor (opt. 02) provides better resolution and allows more information to be displayed.

While SR1’s configuration panels offer total flexibility in setting up every detail of the analyzer, at times it is useful to get a measurement going quickly, without worrying
about infrequently used parameters. That’s where QuickMeas comes in. QuickMeas gives SR1 users the ability to get up and running on many common audio measurements such as Level, SNR, Frequency Response, and Crosstalk after answering just a few simple questions about the inputs and outputs of the DUT. When the measurements are finished, the results are available in a clear, easy-to-understand report.

**Analog Signal Generator**

At the heart of SR1 is a uniquely flexible analog signal generator. All of the standard audio waveforms are available including sine, log-swept sine chirp, synchronous burst sine, noise (white, pink, and filtered), standard intermodulation test signals (SMPTE, CCIF, DIM), square waves, arbitrary waveforms (ASCII and .WAV), ramps, MLS and multitone waveforms. Many of these signals can be combined in the generator allowing you to create an unlimited number of test waveforms.

But the analog signal generator doesn’t sacrifice performance for flexibility. With a flatness of ±0.008 dB (20 Hz to 20 kHz) and a residual THD + N of –106 dB (20 Hz to 20 kHz), SR1’s **Low Distortion Sine** rivals the performance of any analyzer.

**Multitone** waveforms with up to 50 tones, each adjustable in frequency, amplitude, and phase are calculated and loaded in real-time, without having to run a cumbersome off-line program to generate arbitrary waveform tables. A convenient **FFT Chirp** waveform is automatically synchronized to the FFT analyzer allowing instant FFT measurements of frequency response (magnitude and phase).

**Digital Audio Signal Generator**

The same flexibility and performance is found in SR1’s digital audio signal generator. Almost all the same waveforms found in the analog generator are available in the digital generator with the addition of several special digital test waveforms including digital constant, walking bits, and a staircase waveform (for D/A testing).

**Timebase**

All of SR1’s sampling clocks are derived from an internal timebase with 5 ppm accuracy. For the most demanding applications, an optional atomic rubidium (PERF10) timebase is available with an accuracy at shipment of ±5 × 10^-11, and a 20-year aging specification of less than 5 ppb. Additionally, the timebase may be synchronized to an external clock, an AES11 reference signal, or any standard video signal.

**Analyzers**

The heart of SR1’s measurement abilities is its versatile set of analyzers which operate symmetrically on both analog and digital audio signals with no need to purchase additional options. Up to two analyzers can be run simultaneously on either the analog or digital inputs.
The **Time Domain Detector** makes all of the standard audio measurements including Amplitude, Crosstalk, and THD + N. Continuously variable bandwidth limiting and standard weighting filters are included. The post notch-filter distortion signal can be fed to an FFT analyzer for a live spectral display of distortion, or to the rear-panel monitor output or speaker.

The **Single-Channel FFT** and **Dual-Channel FFT** analyzers offer live spectral displays with full zoom and heterodyne capability. The full resolution of the analyzer can be applied to any frequency range down to 1/512th of the full measurement bandwidth, leading to an effective resolution of 16M FFT lines. Several averaging algorithms can be applied to bring out low level signals.

The two-channel FFT analyzer offers true single-shot frequency response measurements for the ultimate in accuracy. SR1 also has a complete set of impulse response measurements including impulse response, quasi-anechoic frequency response, and energy time-curve. Since SR1 is a true two-channel FFT, it isn’t limited to MLS waveforms, but can use virtually any waveform.

The **THD Analyzer** makes frequency selective THD measurements on two user-selectable sets of up to thirteen harmonics of the input signal.

The **IMD Analyzer** makes standard audio distortion measurements including SMPTE, CCIF, and DIM. Frequency selective analysis ensures high measurement accuracy.

The **Histogram Analyzer** displays live histograms of input signal amplitudes and probability distributions. Realtime fits to Gaussian distributions can be generated.

The **Multitone Analyzer**, in combination with the **Multitone Generator**, can be configured to make fast single-shot measurements of a variety of audio parameters including Level, Frequency Response, THD + N, THD, Total Distortion, Noise, Crosstalk, and IMD.

**Digital Audio Interface Measurements**

SR1 provides a complete set of measurements for digital interface testing. Carrier level and sampling frequency are measured directly. Status bits are fully decoded in both professional and consumer formats, and user bits are displayed as well. SR1’s Jitter Analyzer measures jitter in both the time and frequency domain, including continuously variable bandwidth limiting and weighting in both domains. For frequency domain measurements, live zoomable and heterodyned spectral displays of jitter are available. Using the jitter chirp waveform, you can characterize jitter transfer functions in under a second. With a residual jitter of only 600 ps, the performance of SR1’s jitter analyzer is unbeatable.

**Digitizer**

An optional 80 MHz transient digitizer (Opt. 01) provides additional digital audio carrier analysis. Operating on a record of up to 2M samples, the digitizer computes and displays the time record of the input signal and its jitter, input spectrum, jitter spectrum, and the probability distributions of the input and jitter amplitudes as well as the pulse width and pulse rate. Full color eye-diagrams can be generated allowing easy testing against user-configurable eye limits.

**Automation and Programming**

SR1 offers unprecedented flexibility for user scripting and remote programming. On-board scripts can be written in VBScript, Jscript, or Python with full access to all of the instrument’s capabilities as well as the ability to create simple user-interfaces for running tests. SR1 has a complete hierarchical GPIB command set, and GPIB commands can be sent over the standard IEE-488 interface, RS-232 port, or over the Ethernet on a TCP/IP network (VXI-11). Finally, SR1 has a complete COM interface allowing instrument operation to be automated from any COM capable application such as Visual Basic, LabView, or Microsoft Office.

**Learning Mode**

Learning mode is a powerful tool for quickly creating scripts without detailed knowledge of the programming environment. SR1 creates a script by recording each keystroke or user operation, and then converts the script to a VB script or Jscript program. These programs can be saved and edited like any other script, then run in the future.
### Analog Signal Generator

#### General Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplitude range (rms)</td>
<td>1 µV to 28.3 V (balanced)</td>
</tr>
<tr>
<td>(unbalanced)</td>
<td>1 µV to 14.1 V</td>
</tr>
<tr>
<td>Amplitude accuracy</td>
<td>±0.5% (±0.043 dB) at 1 kHz</td>
</tr>
<tr>
<td>Frequency range</td>
<td>10 Hz to 200 kHz</td>
</tr>
<tr>
<td>Hi BW DAC</td>
<td>10 Hz to 0.45 Fs (Fs: 128 kHz or 64 kHz fixed, 24 kHz to 216 kHz adj.)</td>
</tr>
<tr>
<td>Hi Res DAC</td>
<td>10 Hz to 200 kHz</td>
</tr>
<tr>
<td>Frequency accuracy</td>
<td>±0.0005% (5 ppm)</td>
</tr>
<tr>
<td>Frequency resolution</td>
<td>&lt;Fs/2<strong>N</strong></td>
</tr>
<tr>
<td>Output configuration</td>
<td>Balanced Ground, Balanced Float, Unbalanced Ground, Unbalanced Float, Common Mode Test</td>
</tr>
<tr>
<td>Source impedance</td>
<td>50Ω, 150Ω, 600Ω (balanced)</td>
</tr>
<tr>
<td>(balanced)</td>
<td>25Ω, 75Ω, 600Ω (unbalanced)</td>
</tr>
<tr>
<td>Max. power (600Ω load)</td>
<td>30.5 dBm</td>
</tr>
<tr>
<td>Balanced</td>
<td>24.9 dBm</td>
</tr>
<tr>
<td>Unbalanced</td>
<td>±40 V</td>
</tr>
<tr>
<td>Float voltage</td>
<td>±40 V</td>
</tr>
<tr>
<td>Crosstalk</td>
<td>10 Hz to 20 kHz −125 dB</td>
</tr>
<tr>
<td>&gt;20 kHz</td>
<td>−100 dB</td>
</tr>
</tbody>
</table>

#### Waveforms

**Low Distortion Sine**

Flatness (relative to 1 kHz)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Flatness (µV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 Hz to 20 kHz</td>
<td>±0.020 dB (typ. ±0.012 dB)</td>
</tr>
<tr>
<td>10 Hz to 64 kHz</td>
<td>±0.025 dB</td>
</tr>
<tr>
<td>10 Hz to 200 kHz</td>
<td>±0.05 dB</td>
</tr>
</tbody>
</table>

Residual THD+N

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>THD+N (µV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kHz</td>
<td>112 dB (22 kHz BW)</td>
</tr>
<tr>
<td>20 Hz to 20 kHz</td>
<td>106 dB + 1 µV (22 kHz BW)</td>
</tr>
<tr>
<td>20 Hz to 64 kHz</td>
<td>100.5 dB + 1.7 µV (80 kHz BW)</td>
</tr>
<tr>
<td>20 Hz to 200 kHz</td>
<td>97 dB + 2.5 µV (200 kHz BW)</td>
</tr>
<tr>
<td>10 Hz to 100 kHz</td>
<td>89 dB + 2.5 µV (200 kHz BW)</td>
</tr>
</tbody>
</table>

**Regular Sine**

Flatness (relative to 1 kHz, amplitude ≤4 Vrms)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Flatness (µV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 Hz to 20 kHz</td>
<td>±0.008 dB (typ. ±0.003 dB)</td>
</tr>
<tr>
<td>10 Hz to 64 kHz</td>
<td>±0.02 dB</td>
</tr>
<tr>
<td>10 Hz to 200 kHz</td>
<td>±0.03 dB</td>
</tr>
</tbody>
</table>

Residual THD+N (Hi BW DAC)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>THD+N (µV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kHz</td>
<td>86 dB (22 kHz BW)</td>
</tr>
<tr>
<td>22 Hz to 20 kHz</td>
<td>85 dB + 1 µV (22 kHz BW)</td>
</tr>
<tr>
<td>22 Hz to 64 kHz</td>
<td>84.5 dB + 1.7 µV (80 kHz BW)</td>
</tr>
<tr>
<td>22 Hz to 200 kHz</td>
<td>82 dB + 2.5 µV (200 kHz BW)</td>
</tr>
<tr>
<td>10 Hz to 100 kHz</td>
<td>75 dB + 2.5 µV (200 kHz BW)</td>
</tr>
</tbody>
</table>

Residual THD+N (Hi Res DAC, Fs=128 kHz)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>THD+N (µV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kHz</td>
<td>99 dB (22 kHz BW)</td>
</tr>
<tr>
<td>22 Hz to 20 kHz</td>
<td>98 dB + 1 µV (22 kHz BW)</td>
</tr>
<tr>
<td>22 Hz to 57.6 kHz</td>
<td>96.5 dB + 1.4 µV (57.6 kHz BW)</td>
</tr>
</tbody>
</table>

#### Digital Audio Signal Generator

**Digital Audio Carrier Characteristics**

Output amplitude

| Balanced Range | ±10% + 80 mV |
| Unbalanced Range | ±10% + 20 mV |

Output format

| Balanced XLR (AES/EBU), dual-connector XLR, unbalanced BNC (SPDIF-EIAJ), dual-connector BNC, Optical (Toslink) |

Output sample rate

| 24 kHz to 216 kHz |

Sample rate accuracy

| ±5 ppm |

Output impedance

| 110Ω (balanced) |
| 75Ω (unbalanced) |

**Digital Audio Waveforms**

**Sine**

| Frequency range | ±148 dB |

**Phased Sine**

| 0 to 360°, 0.001° resolution |

**IMD**

| SMpte/DIN, CCIF/DFD, DIM/TIM |

**Noise**

| White, Pink, Filtered White/Pink, USASI |

**Multitone**

| 1 to 50 tones |

**MLS**

| Repetition rates from 2^N to 2^20 |

**FFT Chirp**

| Equal power in each FFT bin |

**Log-sine chirp**

| Swept-sine w/ log increasing frequencies |

**Square**

| 10 Hz to 50 kHz frequency range |

**Ramp**

| Fs/N frequency range (N≥20) |

**Arbitrary**

| 256 Samples to 136k Samples |

**Polarity**

| 10 Hz to Fs/4 frequency range |

**Constant (Offset) Bursts**

| DC to 20 Vp (unbal) / 40 Vp (bal) |

**Burst types**

| Timed, ext. triggered, ext. gated, synchronous sine, shaped. |
## SR1 Specifications

### Burst Waveforms
- **Burst types**: Timed
- **Digital Test Waveforms**: Digital Constant, Count, Rotating Bits, Staircase, J-Test
- **Dither**: None, triangle and rectangular probability distribution

### Digital Audio Carrier Impairments
- **Jitter Waveforms**: Sine, square, uniform noise, BP filtered noise, chirp
- **Frequency range**: 2 Hz to 200 kHz
- **Amplitude range**:
  - Unbalanced: 0 to 637 mVpp
  - Balanced: 0 to 2.55 Vpp

### Normal Mode Noise
- **Amplitude range**:
  - Unbalanced: 0 to 637 mVpp
  - Balanced: 0 to 2.55 Vpp

### Common Mode Sine
- **Amplitude range**: 0 to 20 Vpp (balanced only)
- **Frequency range**: 10 Hz to 100 kHz
- **Cable Simulation**: Simulates 100 m of digital cable
- **Variable Rise Time**: 5 ns to 400 ns

### Signal Measurements

#### General Analog Input Characteristics
- **Input range (Vrms)**: 3.25 V to 160 V
- **Input configuration**: XLR, BNC, Generator Monitor, Digital Audio Common Mode
- **Input impedance**:
  - Balanced: 200 kΩ/95 pF
  - Unbalanced: 100 kΩ/185 pF
- **Input termination (bal)**: 300 Ω, 600 Ω, 200 kΩ
- **Cross talk**:
  - 10 Hz to 50 kHz: ≤–140 dB
  - >50 kHz: ≤–135 dB
- **Hi BW ADC**
  - **Type**: 16-bit sigma-delta
  - **Sampling freq.**: 512 kHz
  - **Frequency range**: DC to 228 kHz
- **Hi Res ADC**
  - **Type**: 24-bit sigma-delta
  - **Sampling freq.**: 128 kHz or 64 kHz (fixed), 24 kHz to 216 kHz (adj.)
  - **Frequency range**: DC to 0.45Fs

#### General Digital Input Characteristics
- **Input format**: Balanced XLR (AES/EBU), dual-connector XLR, unbalanced BNC (SPDIF-EIAJ), dual-connector BNC, Optical (Toslink)
- **Input sample rate**: 24 kHz to 216 kHz

### Analog Signal Meters

#### RMS Level Meter
- **Accuracy (1 kHz ref)**: ±0.5 % (±0.043 dB)
- **Flatness (1 kHz ref, amplitude less than 4 Vrms)**:
  - 20 Hz to 20 kHz: ≤±0.008 dB (typ. ≤±0.003 dB)
  - 10 Hz to 64 kHz: ≤±0.02 dB
  - 10 Hz to 200 kHz: ≤±0.03 dB

#### Frequency Meter
- **Range**: 8 Hz to 300 kHz
- **Accuracy**: timebase error ± (2 ppm + 10 mHz)

#### Phase Meter
- **Accuracy**: ±1.0°

### Digital Signal Meters

#### Frequency Meter
- **Range**: 10 Hz to 0.45Fs, ±100 ppm accuracy

#### Phase Meter
- **Accuracy**: ±0.05° accuracy (f ≥ 50 Hz)

### Analyzers (Analog and Digital Audio)

#### Time Domain Analyzer
- **Measurements**: Amplitude, amplitude ratio, THD + N, THD + N ratio, SINAD, Crest Factor

#### Analog Inputs:
- **Accuracy**: ±0.5 % (±0.043 dB)
- **Flatness (1 kHz ref)**:
  - 50 Hz to 20 kHz: ≤±0.008 dB (typ. ≤±0.003 dB)
  - 20 Hz to 64 kHz: ≤±0.02 dB
  - 10 Hz to 200 kHz: ≤±0.05 dB

#### Residual noise (62.5 Vrms input range, shorted input)
- **Hi Res ADC (Fs = 128 kHz)**:
  - 22 Hz to 22 kHz: ≤–117.5 dBu
  - 22 Hz to 57.6 kHz: ≤–115 dBu
  - A-Weighted: ≤–120 dBu
- **Hi BW ADC**:
  - 22 Hz to 22 kHz: ≤–118 dBu
  - 22 Hz to 80 kHz: ≤–113 dBu
  - 22 Hz to 200 kHz: ≤–110 dBu
  - A-Weighted: ≤–120 dBu

#### Residual THD + N
- **Hi Res ADC (Fs = 128 kHz)**:
  - 1 kHz, 4 Vrms: –111 dB (22 kHz BW)
  - 20 Hz to 20 kHz: –107 dB + 0.8 μV (22 kHz BW)
  - –101 dB + 1.3 μV (57.6 kHz BW)
- **Hi Res ADC (Fs = 64 kHz)**:
  - 1 kHz, 4 Vrms: –111 dB (22 kHz BW)
  - 20 Hz to 20 kHz: –107 dB + 0.8 μV (22 kHz BW)
- **Hi BW ADC**:
  - 1 kHz, 4 Vrms: –113 dB (22 kHz BW)
  - 20 Hz to 20 kHz: –109 dB + 0.8 μV (22 kHz BW)
  - –102 dB + 1.5 μV (80 kHz BW)
  - –98 dB + 2.5 μV (200 kHz BW)
  - 10 Hz to 100 kHz: –91 dB (200 kHz BW)
Digital Inputs:
Amplitude accuracy ±0.001 dB (at 1 kHz)
Flatness ±0.001 dB (15 Hz to 22 kHz)
Residual THD + N –140 dBFS

Bandwidth limiting filters
Low pass filter 4th order Butterworth, adj. from Fs/40 to 0.45Fs, 20 kHz, 40 kHz and 80 kHz fixed elliptical filters per AES17.
High pass filter 4th order Butterworth, @ 22 Hz, 100 Hz, and 400 Hz, 20 kHz, 40 kHz and 80 kHz fixed elliptical filters per AES17.

Band pass filter
Response
Hi BW ADC 1/3 Octave, Class II (4-pole)
Hi Res ADC 1/3, 1/6, 1/12, 1/24 Octave, Class III (6-pole)
Tuning range
Hi BW ADC 10 Hz to 200 kHz
Hi Res ADC 10 Hz to 0.44Fs
Tuning accur. ±2.5%
Amplitude accur. ±0.5%

Notch filters
Tuning range
Hi BW ADC 10 Hz to 200 kHz
Hi Res ADC 10 Hz to 0.44Fs
Tuning accuracy ±2.5%
Response –3 dB at 0.73 Fc and 1.37 Fc
Ampl. accuracy ±0.2 dB (20 Hz to 180 kHz, f<0.5F0 or f>2F0)

Weighting filters
A-wt, C-Msg wt, CCITT, CCIR (weighted, unweighted, 2 kHz norm)

Detector response
RMS, Peak, Quasi-Peak (CCIR-468)

Single-Channel and Dual-Channel FFT Analyzers
Frequency range
Hi BW ADC DC to 200 kHz
Hi Res ADC DC to 0.45Fs
Number of FFT lines 256, 512, ... 32k
Processing 40-bit floating point
Windows
Blackman Harris, Enhanced Blackman Harris, Hann, Hamming, Equiripple, Flattop, Gaussian, Kaiser, Uniform, Rife Vincent 4, 5 and 10 term
Zoom Span can be narrowed by up to 512x
Heterodyne Narrowed span can be centered anywhere in the measurement range

Averaging
Fixed length and continuous

Dual-channel meas.
Frequency, Impulse and Quasi-anechoic Response, Coherence, Energy Time Curve, Group Delay

THD Analyzer
Measures two independent sets of user-selectable harmonics (2× to 14×)

IMD Analyzer
SMpte/DIN, CCIF/DFD, DIM/TIM

Histogram Analyzer
Time vs. amplitude, Histogram, PDF, Gaussian fit to PDF

Multitone Analyzer
Level, Frequency Response, THD THD + N, noise, IMD, Crosstalk

Digital Audio Carrier Measurements
Measurements
Carrier amplitude, sample rate, jitter amplitude, jitter spectrum
Sample rate 24 kHz to 216 kHz
Sample rate accuracy ±5 ppm

Carrier amplitude measurements
Balanced (XLR) ±10% + 80 mV
Unbalanced (BNC) ±10% + 20 mV

Optical
Displays voltage of Toslink receiver

Output to input delay
Measures delay from Digital Audio Output or AES11 reference output to Digital Audio Input
Range –12.7 μs to +115.1 μs in seconds
Resolution 60 ns
Residual jitter
50 Hz to 100 kHz ≤600 ps

Reference
Input sources
AES11 (24 Hz to 216 kHz), sine or TTL (8 kHz to 32 MHz), video (NTSC/PAL/SECAM)
Reference Output
AES11 (24 to 216 kHz)

Optional Digitizer (Opt. 01)
Sampling rate 80 MHz
Acquisition length 4k, 8k, 16k, 128k, 256k, 512k, 1M, 2M samples
Measurements
Input vs. time, jitter vs. time, input spectrum, jitter spectrum, pulse width/rate histograms, jitter probability histogram, eye diagrams

Digital Inputs:
Amplitude accuracy ±0.001 dB (at 1 kHz)
Flatness ±0.001 dB (15 Hz to 22 kHz)
Residual THD + N –140 dBFS

Bandwidth limiting filters
Low pass filter 4th order Butterworth, adj. from Fs/40 to 0.45Fs, 20 kHz, 40 kHz and 80 kHz fixed elliptical filters per AES17.
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Reference Output
AES11 (24 to 216 kHz)

Optional Digitizer (Opt. 01)
Sampling rate 80 MHz
Acquisition length 4k, 8k, 16k, 128k, 256k, 512k, 1M, 2M samples
Measurements
Input vs. time, jitter vs. time, input spectrum, jitter spectrum, pulse width/rate histograms, jitter probability histogram, eye diagrams

General
Computer interfaces GPIB, RS-232, Ethernet, COM.
Video out VGA output for external monitor
Power <250 W, 90 to 264 VAC, 47 to 63 Hz,
Dimensions 17” × 8.5” × 20.25” (WHD)
Weight 40 lbs.
Warranty One year parts and labor on defects in materials and workmanship

Ordering Information
SR1 Audio analyzer $12,400
Option 01 80 MHz digitizer $1500
Option 02 High resolution display $600
Option 03 1 ppm TCXO timebase $250
Option 04 Precision jitter analysis $1500
O1RM Rack mount kit for SR1 $150