DSA-LX®

Digital Signal Analyzer

Nuclear Healthcare Homeland Security & Defense Labs and Education Industrial and Manufacturing

KEY FEATURES

- Integrated desktop MCA based on Digital Signal Processing (DSP)
- Excellent count rate and temperature stability
- Wide range of processing time parameters to allow precise match to detector characteristics and application requirements
- 16K Channel conversion gain/spectrum memory
- USB 2.0 interface allows simple connection to computer
- Convenient small form-factor desktop package
- Full set of front panel indicators
- Performs pulse height analysis (PHA) or multi-channel scaling (MCS)
- Advanced patented* auto pole/zero, base line restoration and digital stabilization capability
- Web-based digital oscilloscope spectrum viewer and maintenance utility
- Built-in power up diagnostics
- Supported by Genie™ 2000

*US Patent 7725281: automatic pole/zero

DESCRIPTION

The DSA-LX is a full featured 16K channel integrated Multichannel Analyzer based on advanced digital signal processing techniques (DSP). When paired with a computer running Genie 2000 software the DSA-LX becomes a complete spectroscopy workstation, capable of the highest quality acquisition and analysis. The instrument interfaces to existing detector technologies such as HPGe, NaI, Si(Li), CdTe or Cd(Zn)Te.

The DSA-LX offers cost effective, no-compromise DSP-quality spectroscopy in a very compact package. It is operated through CANBERRA's Genie 2000 spectroscopy software which provides the user with ultimate flexibility. A wide range of application specific software options are available under the Genie 2000 family.

This highly integrated instrument incorporates front end signal conditioning, a fast digitizing analog-to-digital converter (ADC), programmable digital filters, digital oscilloscope, automatic pole/zero* and base line restorer, digital fast discriminator, two groups of 16K channel spectral memory, digital stabilizer and a dual-range HVPS – all in a small, compact package. Lighted indicators are included on the front and rear panels to alert the user to power, acquisition, communication, high voltage and count rate status at a glance.

CANBERRA

The use of DSP technology improves the overall signal acquisition performance. Signal filtering functions previously implemented in traditional analog electronics are limited. DSP allows filtering functions and pulse shapes that are not realizable using conventional analog processing techniques. The result is a more efficient trapezoidal filter function, which exhibits less processing time, less sensitivity to ballistic deficit, and superior resolution. With trapezoidal filtering, the pulses can be processed more rapidly and accurately, so the spectrum resolution is enhanced while throughput is increased.

The DSA-LX offers peak gain stability at up to a factor of two to three times better than past generation analog products while Zero drift is barely measurable over the full operating temperature range of the instrument.

The DSA-LX supports both the traditional Pulse Height Analysis (PHA) mode as well as a MultiChannel scaling (MCS) mode for time varying applications. The MCS mode can display data from an external TTL input, a full spectrum integral or a Region of Interest (ROI).

The DSA-LX provides host communications via Universal Serial Bus (USB) 2.0 interface which provides full speed communications at 12 Mbit/s. USB provides the additional capability of having multiple units attached to a single host/port via a USB hub.

The DSA-LX contains includes an interface which allows the user to monitor the system status, view the spectrum, maintain and update system settings and access the built in digital oscilloscope. With the built in digital oscilloscope, the user views a graphical reconstruction of the digitized, filtered signal. Scaling and trigger functions are similar to those of an actual oscilloscope.
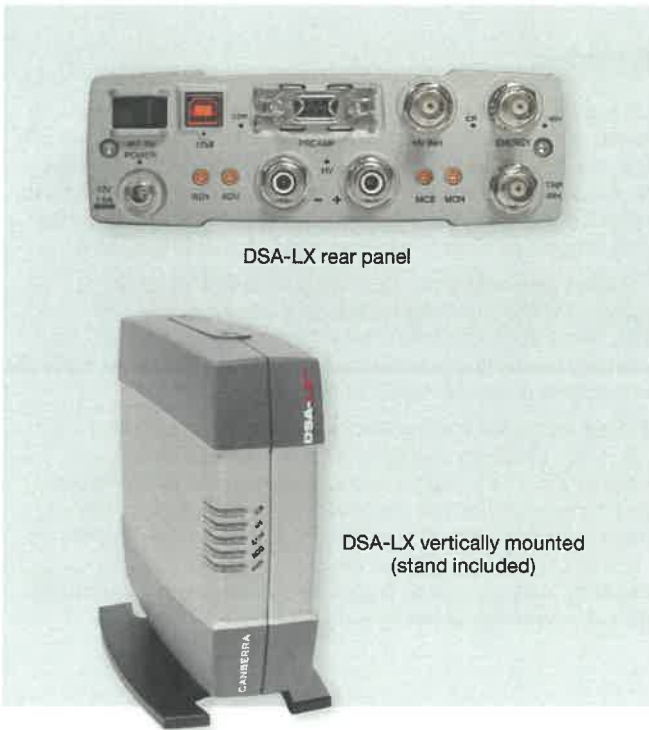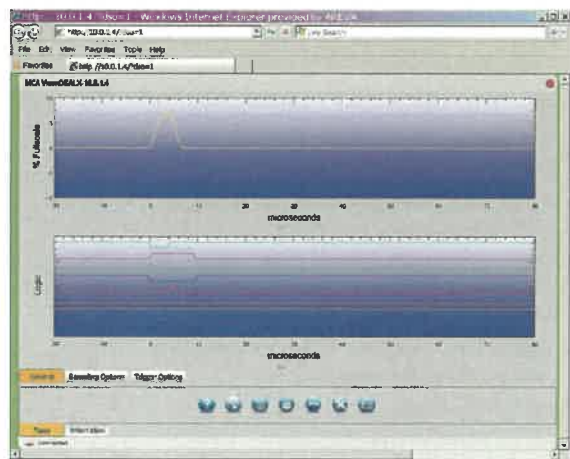

DSA-LX rear panel

DSA-LX vertically mounted
(stand included)
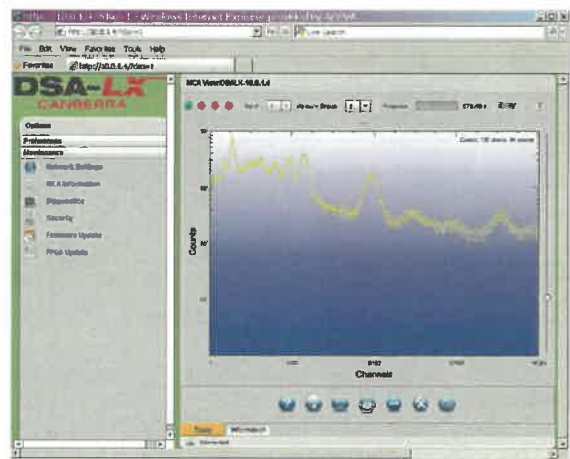
DSA-LX built in web interface (Spectrum Viewer)

DSA-LX Digital Oscilloscope

SPECIFICATIONS

INPUTS/OUTPUTS

ENERGY

Accepts positive or negative detector preamplifier signals with rise times less than the selected Rise Time + Flat Top settings and decay times of 45 µs and upwards. The input amplitude for full scale is ±2V divided by selected Gain and Attenuation settings. The input is dc coupled and the maximum input (signal +dc) for linear operation is dependent on the input Attenuator setting; Attenuator OFF (x1): ±4 V, Attenuator ON (x 0.25): ±12 V and is protected to ±24 V maximum; With the Attenuator OFF (x1) the input impedance is 575 Ω for a Coarse gain of 2 and 907 Ω for Coarse Gains greater than 2. With the Attenuator ON (x 0.25) the input impedance is 1575 Ω for a Coarse Gain of 2 and 1907 Ω for Coarse gain greater than 2; rear panel BNC connector.

TRP INH

Accepts a standard TTL Logic signal; functionality is dependent on the Reset Preamp Inhibit mode selected; disables pulse processing, extends the system dead time, resets the pileup rejector and gates off the baseline restorer; rear panel BNC connector.

Auto:

System is gated off for the greater of the external RESET signal "OR" the Internal Inhibit time.

Manual:

Functionality same as Auto mode except the signal processor is inhibited for the greater of the user selected.

Inhibit Setting "OR" the Internal Inhibit Time "OR" the external RESET signal.

Positive true or negative true signal polarities, user selectable; minimum pulse width is 100 ns; logic high ≥+2 V, logic low ≤+0.8 V; maximum input voltage +5.5 V.

HV INH

Accepts input from the detector preamplifier to shut down the HVPS in the event of a detector warm-up; polarity is user selectable to match the preamplifier; rear panel BNC connector.

Positive polarity: for all CANBERRA preamplifiers; Enable condition (cold detector) is an open circuit or active high ≥+1.2 V to +24 V; Inhibit condition (warm detector) is −24 V to <+1.2 V or ground.

Negative polarity: for all preamplifiers and LN monitors where enable condition (cold detector) is −24 V to <+1.2 V; Inhibit condition (warm detector) is open circuit or active high ≥+1.2 V to +24 V.

With Negative selected an open input will disable the high voltage.

MCS

MCS counts input; TTL compatible; maximum rate ≤1 MHz; minimum pulse width ≥50 ns; logic low ≤+0.8 V, logic high ≥+2 V; rear panel MCX connector.

POWER

DC power input from supplied ac adapter; 2.5/5.5 mm locking rear panel connector; Nominal 12 V dc at 1.0 amps.

HV

Dual range and polarity high voltage power supply; voltage range and polarity selected by software: ±200 to ±1500 V dc or ±1500 to ±5000 V dc; separate rear panel SHV connectors for positive and negative.

MON OUT

A real-time image of the internally-shaped energy signal for use with an external oscilloscope. Can be used in diagnostic mode to review the energy signal quality.

Sample Changer RDY

Accepts Sample Changer Ready signals; signal is TTL-compatible; polarity is software selectable.

Sample Changer ADV

Sample Changer Advance output provides a 150 ms TTL-compatible pulse for each sample advance command.

USB

Full Speed USB interface for host communication; rear panel USB Series B connector. The maximum cable length supported by USB is 5 m.

PREAMP

Provides ±24 V (±5%), ±12 V (±5%) and ground for standard preamplifiers; overload protected.

- +24 V at 50 mA max
- −24 V at 50 mA max
- +12 V at 100 mA max
- −12 V at 100 mA max

Rear panel 9-pin female D connector.

FRONT/REAR PANEL INDICATORS

POWER

Green LED showing presence of system power.

ACQUIRE/BSY

Multicolor LED showing acquisition and instrument status.

COMM

Green LED showing communications status. Illuminates each time the instrument is sending or receiving data over the USB communication interface.

HV

Multicolor LED indicating the state of the selected high voltage power supply output.

ICR

Multicolor LED showing Incoming Count Rate. Illuminates each time the instrument processes an incoming pulse. The intensity of the LED is proportional to the incoming count rate. Also indicates if incoming rate is within APZ range.

REAR PANEL CONTROL

POWER

Power to the DSA-LX is enabled when the switch is set ON; rocker switch located on rear panel.

PROGRAMMABLE CONTROLS

Gain

The combination of Coarse Gain and Fine Gain sets the overall system gain to match the requirements of the detector and energy application; overall gain is continuously adjustable from x1.6 to x516.6.

COARSE GAIN – x2.0 – x430.5 in 19% increments.

FINE GAIN – Range is x0.8 to x1.2 in ~0.004% increments.

GAIN ATTENUATOR – ON/OFF; When ON is selected it enables a divide by four input attenuator to minimize overload due to preamp signals with large pulse amplitudes or dc offsets and Reset Preamps with large output ramp dynamic range; When OFF is selected the signal attenuation is removed.

MCA/Input Size

PHA MODE – Selections of 256, 512, 1024, 2048, 4096, 8192 or 16 384 channels. Support for two memory groups of equal size.

MCS MODE – Selections of 256, 512, 1024, 2048, 4096, 8192 or 16 384 channels. Support for two memory groups of equal size.

LLD MODE – Selects Automatic or Manual LLD mode; AUTOMATIC: the LLD cutoff is automatically set just above the spectral noise threshold; MANUAL: allows the LLD cutoff to be set manually as a percentage of the full scale spectral size or range.

LLD SETTING

Active when the Manual LLD mode is selected, sets the minimum input acceptance level, range is 0 to 100%.

INP POLARITY

Selects either POSITIVE or NEGATIVE input polarity.

INH POLARITY

Selects either Active High or Active Low Reset Preamp Inhibit polarity.

PUR GUARD

Selects Guard Time (GT) multiplier in increments of 1.1 to 2.5 in 0.1 increments to reject trailing edge pile-up in the event of detector/preamp anomalies.

FDISC SHAPING

Selects NORMAL or LOW ENERGY to optimize the fast discriminator shaping for the selected detector type; NORMAL: The Fast Discriminator shaping is optimized for Ge detectors and general gamma spectroscopy, the fast discriminator filter rise time is set to 100 ns; LOW ENERGY: the Fast Discriminator filter rise time is set proportional to the slow shaping rise time selection.

FDISC MODE

Sets the Fast Discriminator Threshold mode. AUTO: the threshold is optimized automatically above the system noise level; MANUAL: allows threshold to be adjusted manually.

FDISC SETTING

Active when manual FDISC mode is selected; sets the Fast Discriminator threshold level, range is 0 to 100%; the front panel ICR LED serves as a user aid when manually setting the Fast Discriminator threshold.

INHIBIT MODE

Selects AUTO or MANUAL Reset Preamp Inhibit Modes; the Inhibit signal disables pulse processing, extends the system dead time, reinitializes the pileup rejector and gates off the baseline restorer.

AUTO – System is gated off for the greater of the external RESET signal "OR" the Internal Inhibit Time.

MANUAL – Functionality same as Auto mode except the signal processor is inhibited for the greater of the user selected Inhibit Setting "OR" the external RESET signal "OR" the Internal Inhibit Time.

INHIBIT SETTING

Active when the MANUAL Reset Preamp Inhibit Mode is selected, sets the Inhibit Time, range 0 to 160 μs in increments of 1 μs.

LTC MODE

ON/OFF; ON: Enables pileup rejector and live time corrector (LTC). LTC generates dead time to extend the acquisition time to compensate for events that are piled up and rejected; OFF: pileup rejector and LTC disabled.

LT TRIM

Allows adjustment of the trapezoidal pulse evolution time or dead time to optimize Live Time Correction (LTC) performance. The adjustment range is 0 to 1000; the default value of 500 provides good LTC performance for a wide range of applications.

Filter

Note: Filter output (Trapezoid Signal) may be displayed on the Host computer using the digital oscilloscope feature.

RISE TIME – Rise and fall times ranging from 0.2 to 38 μs.

FLAT TOP – Flat top time selections ranging from 0 to 3 μs.

BLR MODE – AUTO, HARD, MEDIUM, SOFT; AUTO: The baseline restorer is automatically optimized as a function of trapezoid shaping time and count rate; HARD, MEDIUM, or SOFT: Sets the baseline restorer to fixed rates as selected.

POLE/ZERO

The patented Automatic Pole/Zero function is implemented by using successive approximation technique which reduces the automatic adjustment time to 10-15 seconds (typically). The adjustment is accurate and independent of base-line offset and immune to risetime variations. Therefore no inspection of the base line is needed. Thus, the pole-zero can be adjusted precisely even at relatively high counting rates.

PREAMP TYPE

RC, RESET; selects the pole/zero mode; RC: pole/zero can be adjusted manually by computer command; range: 45 µs to infinity; RESET: Sets pole/zero at infinity for use with pulsed charged restoration (RESET) preamplifiers.

MIXED SIGNAL OSCILLOSCOPE

Allows examination of the digital trapezoid signal reconstructed in time to assist and verify instrument setup, pole/zero optimization and manual Reset Preamp INHIBIT adjustments.

Stabilizer

GAIN MODE – ON, OFF, HOLD; ON/OFF: enables or disables the Gain Mode; HOLD: disables the stabilizer Gain Mode, but maintains the current Gain correction factor; Centroid (2 to 16 376 channels), Window (1 to 128 channels), Spacing (2 to 512 channels), Ratio (0.01 to 100), Rate Div (1 to 128); Correction Range of 1% for Ge and 10% for NaI detectors.

SAMPLE CHANGER CONTROL

Sample changer advance and ready signal polarities may be set separately for positive and negative. The changer may be manually advanced via an ADVANCE CHANGER button in the software.

Multichannel Scaling

MODES –

> TTL, FDisc, ROI. Events are counted for the duration of a programmed number of sweeps. Each SWEEP incorporates a programmed number of channels. Each channel represents a DWELL duration.

> TTL – TTL-compatible pulses counted from MCS IN connector.

> FDisc – Gamma events counted from the fast discriminator.

> ROI – DSP gamma events counted if they occur within the programmed ROI window.

PROGRAMMABLE SETTINGS –

> DWELL TIME SETTINGS – From 1 µs to 999 s selectable through three ranges: 1 µs to 999 µs, 1 ms to 999 ms, 1 s to 999 s.

> DWELL TIME RESOLUTION – 1 µs for 1-999 µs range, 1 ms for 1-999 ms range and 1 s for 1-999 s range.

> SWEEP COUNTER – 1 to 4 294 967 295 or infinite sweeps.

> ROI DISC WINDOW – 1 to 16 384 channels.

> SWEEP MODE – Sweep Counter or Sweep Forever.

> MCS CHANNEL RANGE – 256 to 16 384.

> START/STOP CONTROL – through software.

PERFORMANCE

Signal Processing

SPECTRUM BROADENING – The FWHM of ^{60}Co 1.33 MeV gamma peak for an incoming count rate of 2 kcps to 100 kcps will typically change less than 6% for 2.8 µs rise/fall time, 0.8 µs flat top and proper P/Z matching. These results may not be reproducible if the associated detector exhibits an inordinate amount of long rise time signals.

INTEGRAL NON-LINEARITY – ≤±0.025% of full scale over the top 99% of selected range.

DIFFERENTIAL NON-LINEARITY – ≤±1% over the top 99% of the range including the effects from integral non-linearity.

GAIN DRIFT – ≤35 ppm/°C after 15 minutes of operation.

ZERO DRIFT – ≤3 ppm/°C after 15 minutes of operation. Typically, less than 1 channel over full temperature range (8K Spectrum).

OVERLOAD RECOVERY – Recovers to within 1% of full scale output from x1000 overload in 2.5 non overlapped pulse widths at full gain, at any shaping (processing time), and with pole/zero properly set.

Pileup Rejection/Live Time Correction

PULSE PAIR RESOLUTION – Better than 500 ns with NORMAL Fast Discriminator mode selected.

DEAD TIME CORRECTION – Extended live time correction, accuracy of reference peak area changes 5% (3% typical) at up to 50% system dead time with a setting of 5.6 µs rise time and 0.8 µs flat top.

Acquisition

DATA MEMORY GROUPS – 1–16K (PHA) Channels or 2–16K (PHA) channels; 32 bits per channel.

STORAGE MODE – PHA or MCS.

Simultaneous operation of PHA/MCS is supported.

PRESET MODES –

> PHA Mode – Live or True Time, Counts in single channel, Counts in ROI, Counts in multiple ROIs.

> MCS Mode – Sweeps, Count greater or equal to preset Counts, Count greater or equal to preset ROI Counts.

TIME RESOLUTION – 0.01 s live and real time.

PRESET TIME – 0.01 s through 42 949 000.00 s.

PRESET SWEEPS – 1 to 4 294 967 295 or infinite sweeps.

High Voltage Power Supply

All outputs are current limited and short circuit protected.

HV Inhibit input, two modes:

- Positive polarity: (for CANBERRA preamplifiers); Enable condition (cold detector) is an open circuit or active high = +1.2 V to +24 V; Inhibit condition (warm detector) is –24 V to <+1.2 V or ground.

- Negative polarity: for preamplifiers and LN monitors where enable condition (cold detector) is –24 V to <+1.2 V; Inhibit condition (warm detector) is open circuit or active high = +1.2 V to +24 V. With Negative polarity selected an open input will disable the high voltage.

NOTE: After Inhibit is removed the high voltage remains inhibited until the user acknowledges the fault condition via a reset of the high voltage supply.

Separate SHV connectors for positive and negative high range outputs.

HVPS RANGE 1: ±200 – ±1500 V at 1 mA max.

- RIPPLE – 5 mV P-P.
- TEMPERATURE COEFFICIENT – ±50 ppm/°C.
- STABILITY – 0.01%/h, 0.02%/8 h.
- ACCURACY – ±5%. ±2.5% typical.
- LOAD REGULATION – 1%.
- SETTING RESOLUTION – 12-bit (1/4096).

HVPS RANGE 2: ±1500 – 5000 V at 1 µA max.

- RIPPLE – 10 mV P-P.
- TEMPERATURE COEFFICIENT – ±50 ppm/°C.
- STABILITY – 0.01%/h, 0.02%/8 h.
- ACCURACY – ±5%. ±2.5% typical.
- LOAD REGULATION – 1%.
- SETTING RESOLUTION – 12-bit (1/4096).

CABLES

- USB (provided) –
  Used to connect the host industry standard computer USB port to the DSA-LX rear panel USB port; 3 m (10 ft); shielded cable.

- MCX to BNC, 4 pcs.

PHYSICAL

- All metal enclosure.
- SIZE – 5.58 x 16.51 x 20.95 cm (2.2 x 6.5 x 8.25 in.).
- WEIGHT – 1451 g (3.2 lb).

ENVIRONMENTAL

- OPERATING TEMPERATURE – -20 to 50 °C (-4 to 122 °F).
- OPERATING HUMIDITY – 85% non-condensing.
- Meets the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2.

ORDERING INFORMATION

- DSA-LX Digital Signal Analyzer. Requires Genie 2000 V3.3 with DSA-LX Support software, or later.
- DSA-LX-MOUNTKIT DSA-LX19" RACK MOUNT KIT Allows mounting of one or two DSA-LX MCAs in a cabinet.

CANBERRA