STANFORD RESEARCH SYSTEMS

SR430 Multichannel Scaler/ Averager

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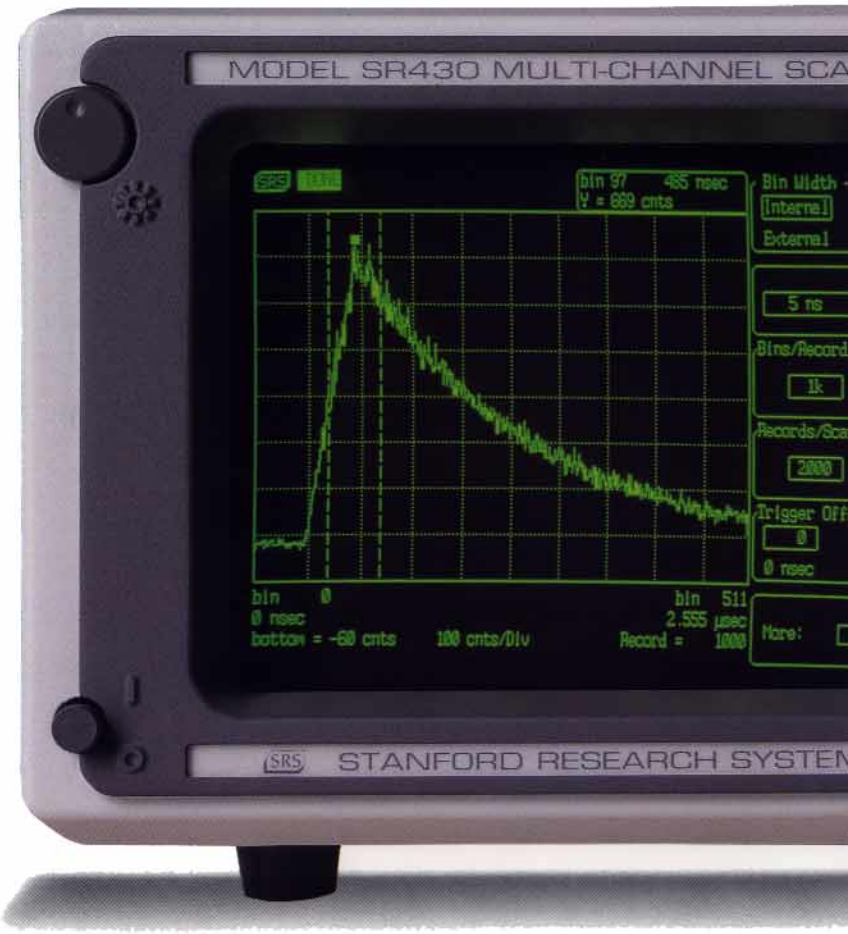


- 5 ns minimum bin width
- 1k to 32k bins per record
- 100 MHz count rate
- Built in discriminator
- Accumulate up to 64k records
- No missed counts between channels, no interchannel dead time
- Menu based user interface
- On screen data analysis
- Hardcopy output to printers and plotters
- MSDOS compatible 3.5" drive
- GPIB and RS-232 interfaces

Truly a generation ahead. Introducing the SR430 Multichannel Scaler/Averager from Stanford Research Systems. A unique instrument, capable of recording transient counting signals with **5 nanosecond resolution in a single shot.**

New Measurement capabilities -The SR430 counts input pulses in successive time bins. A trigger starts a record of up to 32,767 time bins, while the width of the bins is programmable from 5 ns to 10.5 ms. The number of signal pulses counted during each time bin is stored in memory, with no dead time between bins. Each new trigger starts a record whose data is added (or subtracted) to the bin by bin accumulation of all of the previous records. The result is a record of the sum (or net) of all counts in each time bin. Each bin can accumulate up to 32,767 counts.

Accumulate one record, one hundred records, or any number up to 65,535 records. Display the data, smooth the data, and fit a curve to the smoothed data, all at the touch of a button.

The input discriminator detects signal pulses from -300 to +300 mV with .2 mV resolution. Bin widths can be set up to 10.5 ms wide, or use your own external time base for complete flexibility.

Menu driven functions allow complete user control, with on-screen help to provide an immediate explanation of all instrument settings and functions.

Menus and frequently used functions have dedicated keypad buttons. These functions include starting and stopping scans, printing a hardcopy of the screen, auto scaling, and cursor and display adjustments.

Easy to use softkeys are used to change instrument settings or implement optional functions within a menu selection. Parameters are quickly changed using the numeric key pad or spin dial.

Powerful data acquisition, curve smoothing, curve fitting and other data reduction routines simplify data interpretation. The built-in disk drive lets you save and recall data from DOS formatted 720 Kbyte floppy disks.

Front panel BNC connectors provide signal and trigger inputs and additional timing signals to facilitate the synchronization of experiments. Two rear panel D/A's and an external subtract input provide improved control and coordination with other experiments.

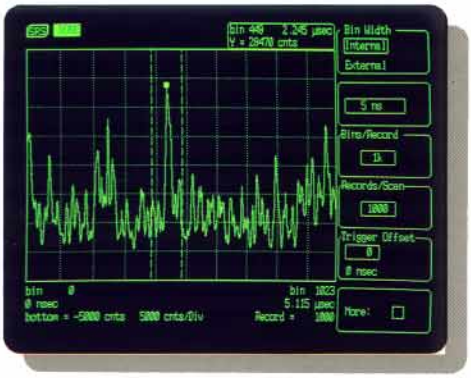
Communication with the SR430 is easy through standard GPIB and RS232 interfaces. Hardcopy is available online using the parallel printer interface or an HP-GL compatible plotter.

Designed to handle complex applications with the greatest power and flexibility, the SR430 can perform time resolved photon counting, mass spectroscopy, LIDAR, and time of flight spectra.

The SR430 Multichannel Scaler/Averager. For unparalleled performance in a single data acquisition instrument, contact Stanford Research Systems at **(408)744-9040**.

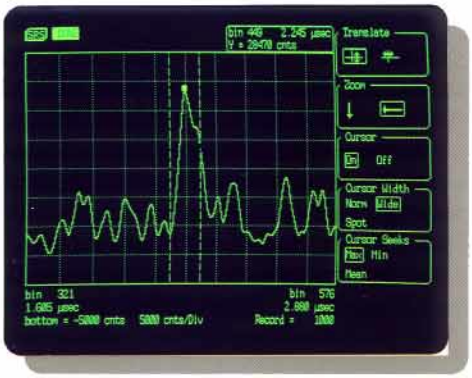
Easy to use Menus

Powerful menus allow easy access to all instrument functions and setup configurations. Top level menus are accessed by dedicated keys on the right side of the keypad, while submenus and functions within menus are activated by soft-keys located to the right of the display. Parameter changes are implemented through the use of softkeys and numeric entry, either through the keypad or the spin dial. On-line help is available for every menu item and information screens provide additional details from the user manual.

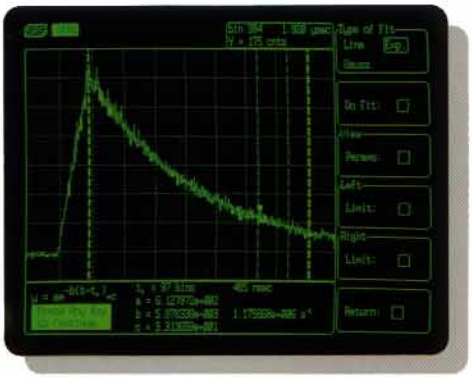


The **Modes** menu sets the data acquisition parameters. **Bin Clk Src** selects internal or external time base. **Bin Width** selects the bin width for the internal time base. **Bins/Record** is the length of each record from 1k to 16k bins in 1k increments. **Records/Scan** is the number of records taken per complete scan, and can be set from 1 to 64k. The start of each record may be delayed after the trigger by up to 16k bins using the **Trigger Offset**. **More** reveals a sub menu for setting **Accumulation** modes. Records may be added or subtracted from the accumulation. In the **Toggle** mode, accumulation toggles between add and subtract for every **Toggle Count** number of triggers.

The **Levels** menu allows the trigger and discriminator levels to be set, as well as setting the auxiliary (rear panel) voltage outputs. The **Trigger Level** can be set between ±2.000 V with 1 mV resolution, with the **Trigger Slope** set to rising or falling edge detection. **Disc. Level** selects the discriminator threshold between ±300 mV, with 0.2 mV resolution. The discriminator slope can also be set to either positive or negative edge detection. The **Aux. 1** and **2** Levels are analog voltage outputs that can be set between ±10.0V with 5 mV resolution. These outputs may be used to control other aspects of the experiment.



The **Display** menu is used to change the graphing parameters. **Translate**, **Zoom**, **Cursor** and screen controls are set through the softkeys. **Translate** moves the coordinate axis of the origin so that key areas of the data are in the display window, while **Zoom** independently expands the horizontal and vertical scales. **Cursors** can be turned on and off, set to variable width, and selected to search for a maximum, minimum or mean between cursors. The cursor is activated by a dedicated keypad key, and moved (when activated) by turning the spin knob. **Grid** turns the background grid on and off.



The **Math** menu accesses the data reduction routines through four submenus, **Smooth**, **Calc**, **Stats**, and **Fit**. **Smooth** performs Savitsky-Golay smoothing on the data with a selectable smoothing interval. **Calc**. allows a number of mathematical operations to be performed on the data; log, square root, +, -, /, and X, by a constant or on a bin by bin basis by stored data. **Stats** provides a statistical summary of the scan data, including the total number of counts, mean, standard deviation, and the area under a defined baseline. The **Fit** menu fits a Gaussian, exponential or linear model to the selected region of the data. The fitted curve is plotted and the fit parameters are displayed.

Additional menus not shown include **Setup**, **Save**, **Recall**, **Plot, Test**, and **Info** and are used to set system parameters, store and retrieve data, send data to a plotter, test features of the SR430, and display information about the instrument.

Specifications

SIGNAL INPUT

Bandwidth	dc to 250 MHz
Input impedance	50 Ω
Linear range	±300 mV (at input)
Input protection	±5 Vdc, 50 V for 1 µs
Overload recovery	5 ns for <10 µs duration overload

TRIGGER INPUT

Impedance	10 kΩ
Threshold	-2.000 V to +2.000 V in 1 mV steps
Slope	Rising or Falling
Protection	15 Vdc, 100 V for 1 µs

DISCRIMINATOR

Referred to the signal input:

Discriminator range	-300 mV to +300 mV
Resolution	0.2 mV
Slope	Rising or Falling
Accuracy	1% + 2 mV
Minimum input amplitude	10 mV
Pulse pair resolution	10 ns
DISC view output	NIM level into 50 Ω

COUNTERS/ACCUMULATION

Bins per record	1k to 32k in 1k increments (including Trigger Offset)
Maximum count rate	100 MHz
Maximum count	32,767 per bin per trigger
Records per scan	1 to 64k (or free run)
Maximum accumulation	32,767 per bin
Add/Subtract	Records may be added or added and subtracted (Toggle between add and subtract every N triggers where N is programmable). External subtract input may also control the toggle.

INTERNAL TIME BINS

Bin width	5 ns, 40 ns, 80 ns, 160 ns, 320 ns, 640 ns, 1.28 µs, 2.56 µs, ...10.5 ms (There is no 10 ns or 20 ns width)
Accuracy	1 ns + 20 ppm of width
Jitter (rms)	100 ps + 10 ppm with respect to SYNC/BUSY output (Time bins are synchronous with the SYNC/BUSY output).
Indeterminacy	2.5 ns pk-pk with respect to TRIGGER input
Insertion delay	45 ns from trigger to first bin. Rising edge of SYNC/BUSY output occurs at the beginning of the first bin.

EXTERNALLY CLOCKED TIME BINS

EXT BIN CLK Input	TTL Rising edge triggers next time bin.
Maximum frequency	4 MHz (250 ns bin width)
Minimum width high	100 ns
Minimum width low	100 ns
Insertion delay	Rising edge of SYNC/BUSY output occurs at first rising edge of EXT BIN CLK after TRIGGER. The beginning of the first bin occurs at the same time. (Time bins are synchronous with the SYNC/BUSY output)

TRIGGER RATE

Minimum period between triggers:	Tp = Record time + Accumulation time + Overhead Tp = (Number of Bins X Bin Width) +(Number of Bins X 250 ns)+150 µs SYNC/BUSY output is high for Tp after each trigger. When SYNC/BUSY returns low, the next record may be triggered. Triggers received while SYNC/BUSY is high are ignored.

ADDITIONAL INPUTS

ACCUM INHIBIT	TTL input, sampled each trigger. If high, causes the current record to be ignored (not accumulated)
SUBTRACT	TTL input, sampled each trigger. If high, causes the current record to be subtracted from the accumulation (if in external toggle mode).

OUTPUTS

DISC	Nim level into 50 Ω. Low whenever the signal input exceeds the discriminator level with correct slope.
SYNC/BUSY	TTL level. Rising edge is synchronous with the first time bin of each record. Use this edge to trigger the experiment. Remains high until re-armed for next trigger.
BIN CLK OUTPUT	Nim level into 50 Ω. Each transition is a bin boundary. Active only while a record is being acquired. Timing skew < 2 ns with respect to the DISC output.
TOGGLE	TTL level. Indicates whether the next record will be added to or subtracted from the accumulation. (Internal toggle mode)
TEST	50 MHz Nim output into 50 Ω. Use to test counters.
AUX1, AUX2	General purpose analog outputs

Full scale	±10 Vdc
Resolution	12 bits (5 mV)
Output current rating	10 mA
Output impedance	<1 Ω
Accuracy	0.1% + 10mV

GENERAL

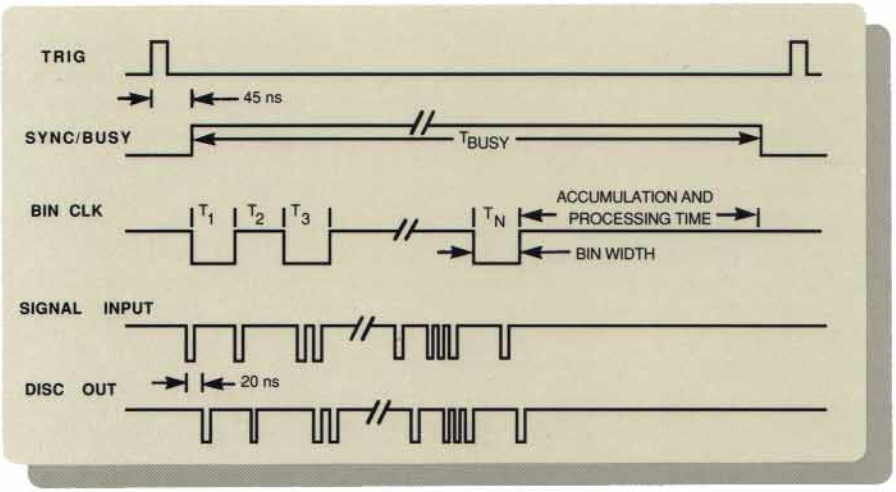
Interfaces	IEEE-488 , RS-232, and Centronics Printer standard. All instrument functions can be controlled and read through the IEEE-488 and RS-232 interfaces.
Data Rate	Transfer rate over GPIB is approximately 1K bins/25 ms.
Hardcopy	Screen dumps to dot matrix or LaserJet printers. Plots to HPGL compatible plotters (serial or IEEE-488).
Disk	3.5" MSDOS compatible format, 720 kbyte capacity. Storage of data and setups.
Power	60 Watts, 100/120/220/240 VAC, 50/60 Hz
Dimensions	17"W X 6.25"H X 16.5"L
Weight	30lbs
Warranty	One year parts and labor on materials and workmanship.

SR445 PREAMPLIFIER

Bandwidth	DC to 300 MHz.
Channels	4
Gain/Channel	5 , ±3%
Noise	50µV rms referred to the input.
Stability	10µV/°C referred to the inputs.
Offset	input ± 50 µV adjustable.
Rise/Fall Time	1.2 ns
Propagation Delay	2.2 ns per channel.
Inputs	dc coupled, 50Ω impedance
Outputs	dc coupled, 50Ω termination
Recovery Time	< 4 ns for a 20X overload.
Protection	± 3.5V dc, ± 50V transient.
Power	16W, 100/120/ 220/240 V, 50/60 Hz

Timing

The timing diagram for the SR430 is shown. A trigger starts a record of up to 32k time bins. There is 45 ns of insertion delay from the trigger to the SYNC/BUSY and first BIN CLK output, with 2.5 ns of indeterminacy. Signal inputs which arrive 25 ns after the trigger will be counted in the first bin. There is a 20 ns delay between the signal input and the DISC output so that the BIN CLK and the DISC output are synchronized. The SYNC/BUSY output should be used to trigger the experiment to eliminate the trigger indeterminacy. The BIN CLK output signals the boundaries of each time bin (T1, T2, ... TN). Each internally set time bin is of equal duration and programmable from 5 ns to 10.5 ms. During each time bin, input signal pulses are counted. A double buffered design ensures that there is no dead time between bins, and counts which arrive at a bin boundary are not missed but fall in the bin just ending or in the bin just starting.



TIMING DIAGRAM

After each record is acquired, the data is added (or subtracted) to the accumulation of all previous records. The accumulation dead time is 250 ns per bin (8 ms for 32k bins). The maximum trigger rate is equal to the accumulation dead time plus the acquisition time (Number of bins X [bin width + 250 ns]) plus a 150 µs overhead. The maximum possible trigger rate (for 1K bins of 5 ns) is approximately 2.4 kHz. After the accumulation is complete, the memory is re-armed for the next trigger. The SYNC/BUSY output remains high from the trigger until the end of accumulation. When SYNC/BUSY returns low, another trigger can be received.

Counting

The maximum count rate is 100 MHz. Therefore, short bins can only acquire a small number of counts per bin in a single record. For example, if the bin width is 40 ns, then a single record can only acquire a maximum of 4 counts per bin (4 X10 ns = 40 ns). If the bin width is 5 ns, then the maximum number of counts per bin is 1, and a count may be recorded only every other bin. The maximum count and accumulation capacity of each bin is 32,767. A transient counting signal can be captured in a single shot if there are enough counts to be statistically significant. If the count rate is very low but the signal is repetitive, then multiple records may be accumulated. Each new record is added to the accumulation of all of the previous records on a bin by bin basis. This accumulated scan is the sum of all counts in each time bin. The number of records in an accumulated scan may be programmed from 1 to 65,535.

The number of bins per record is set in 1k increments, from 1k (1,024) to 16k (16,384). 16k is the maximum number of bins which can be displayed and analyzed on the screen. The data acquisition memory can acquire and accumulate up to 32K data bins from each trigger signal. The Trigger Offset allows up to 16k bins to be skipped at the beginning of the record before data is transferred from the acquisition memory to the display memory.

Rear Panel

The rear panel of the SR430 includes standard IEEE-488 (GPIB) and RS232 interfaces for computer control or plotting, a Centronics printer port for dot matrix or Laserjet compatible hardcopy, a key board connector (IBM compatible) for text or numeric entry, as well as BNC connectors for INHIBIT IN, SUBTRACT IN, TOGGLE OUT, TEST OUT, and AUX1 and 2.

SR445 Preamplifier

The SR445 Fast Preamplifier is useful for amplifying small signals to levels that allow processing by other instruments such as the SR430 Multichannel Scaler/Analyzer. The SR445 contains four wide bandwidth, dc coupled amplifiers which may be used independently or cascaded. Each stage has a fixed gain of 5, with a maximum input level of 200 mV. The fast rise time, low noise and dc accuracy of the SR445 make it the ideal instrument for amplifying outputs of photomultiplier tubes and photodiodes.

SRS

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