Photon Counters

SR430 — 5 ns multichannel scaler/averager

SR430 Multichannel Scaler/Averager

The SR430 is the first multichannel scaler which combines amplifiers, discriminators, bin clocks, and data analysis in a single, integrated instrument. With its many features and its easy-to-use menu driven interface, the SR430 simplifies time-resolved photon counting experiments.

The SR430 Multichannel Scaler/Averager can be thought of as a photon counter that counts events as a function of time. A trigger starts the counter which segments photon count data into sequential time bins (up to 32k bins). The width of the bins can be set from 5 ns to 10 ms. The instrument records the number of photons that arrive in each bin.

The SR430 is useful in a variety of applications where it is necessary to count events as a function of time: LIDAR, time of flight mass spectroscopy, and fluorescence decay measurements are just a few examples.

Input and Discriminator

The SR430's analog input has a 50 Ω input impedance and an input range of ±300 mV. The maximum input sensitivity is 10 mV, and if your input signal level is less than this, a preamplifier (like the SR445A) is recommended. The input is followed by a discriminator with a selectable slope and a threshold adjustable between ±300 mV. A discriminator BNC output is provided at the front panel that generates a NIM level (0 to –0.7 V, active low) signal corresponding to each count.

- **5 ns to 10 ms bin width**
- **Count rates up to 100 MHz**
- **1k to 32k bins per record**
- **Built-in discriminator**
- **No interchannel dead time**
- **On-screen data analysis**
- **Hardcopy output to printers/plotters**
- **GPIB and RS-232 interfaces**

- **SR430 ... $7950** (U.S. list)

Trigger Timing

A trigger pulse starts the data acquisition cycle. The SR430 offers a choice of bin widths ranging from 5 ns to 10.486 ms. Alternatively, an external bin clock can be provided to the SR430, allowing you to define your own bin size.

The number of bins in each record is adjustable from 1k (1024) to 32k in 1k increments. Data acquisition in the SR430 is seamless—there is no dead time between bins. Once the selected number of bins has been recorded, the SR430 either adds or subtracts the result of the current record from the accumulated bin totals.

Accumulation

The SR430 can be programmed to accumulate between one and 64k records, or set to free run. Each record can be added or subtracted from the current accumulator totals. The instrument can be set to toggle between add and subtract every N records, or an external toggle input can select the polarity of the next record. A rear-panel inhibit input allows you to selectively prevent the accumulation of any given record. The screen display is updated continuously as records are accumulated, providing a live, real-time display of the data.
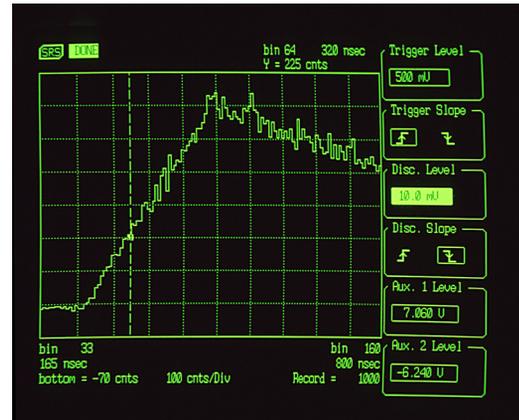
Data Display

The 7" CRT screen allows flexibility in displaying your results. Between 8 and 16k bins can be displayed on the screen at any time, and horizontal and vertical zooming and scrolling features are provided. An "Auto-scale" key quickly optimizes the screen for the current data with a single key-press. A fast, responsive, on-screen cursor lets you read the maximum, minimum or mean data value from a selected range of the graph.
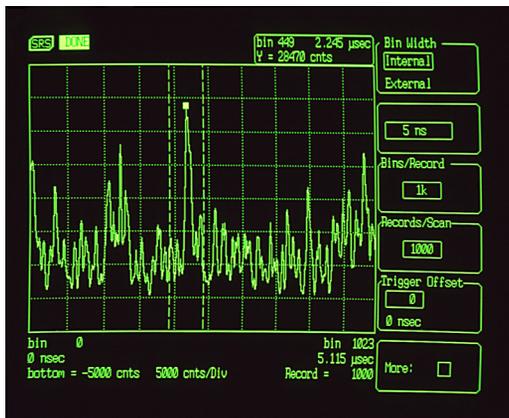
Menus and Softkeys

The SR430 is based on a simple, menu-based user interface. Each menu groups related instrument functions and defines softkeys to control those functions. The instrument settings are changed by pressing the softkeys or by turning the front-panel knob. Complete context sensitive help is provided for all menus and softkeys. The remote command list is also provided on a help screen as an aid in programming the SR430.

Data Analysis

The SR430's extensive capabilities don't stop with data acquisition. Savitsky-Golay smoothing can be applied to any portion of the data, with selectable smoothing intervals. Gaussians, exponentials or straight lines can be fit to arbitrary regions of the display, allowing you to quickly determine decay lifetimes. Basic statistical parameters can be calculated for data regions including total number of counts, mean number of counts, and variance. Basic arithmetic operations, including addition, subtraction, multiplication, division, logs and square roots, can be applied to the current data.

Built-In Disk Drive

The SR430 has a built-in 3.5" DOS-compatible disk drive to simplify data transfer between the instrument and your computer. Both data files and settings files can be stored so you can save complete instrument setups for a variety of situations and recall them instantly.

Hardcopy Output

Hardcopy output is available from the SR430 in a variety of forms. A standard Centronics printer port lets you dump the screen to dot-matrix or LaserJet compatible printers at any time. Additionally, the SR430 can plot its display on any HP-GL compatible plotter via the RS-232 or GPIB interface.

Complete Programmability

Both RS-232 and GPIB interfaces are standard on the SR430. All instrument settings and functions can be read and set via the interfaces. A complete list of all characters received and transmitted over the interfaces can be displayed on the CRT screen—an invaluable aid when debugging your programs. Numerous modes are available for downloading the count data to your computer including ASCII transfer, binary transfer, and a fast binary dump mode which transfers data continuously over the GPIB interface as it is being acquired.

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

Discriminator

Discriminator range	−300 mV to +300 mV
Resolution	0.2 mV
Slope	Positive or negative
Accuracy	2 mV + 1 %
Min. pulse amplitude	10 mV
Pulse-pair resolution	10 ns (typ.)
Discriminator output	NIM level into 50 Ω. (There is a 20 ns insertion delay from the signal input to the discriminator output.)

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

Internal Time Bins

Bin width	5 ns, 40 ns, 80 ns, 160 ns, 320 ns, 640 ns, 1.28 μs, 2.56 μs,...10.486 ms (10 ns and 20 ns are not available)
Accuracy	1 ns + 20 ppm of bin width
Jitter (rms)	100 ps + 10 ppm of delay from SYNC/BUSY output (bins are synchronous with SYNC/BUSY output)
Indeterminacy	2.5 ns with respect to trigger input
Insertion delay	45 ns from trigger to first bin. Rising edge of SYNC/BUSY output occurs at beginning of first bin. Signal pulses arriving 25 ns after the trigger will be counted in the first bin.

Externally Clocked Time Bins

EXT BIN CLK input	Rising edge triggers next time bin
Maximum frequency	4 MHz (250 ns minimum bin width)
Minimum time high	100 ns
Minimum time 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.

Counters/Accumulation

Bins per record	1k to 16k in 1k increments (1024 to 32,704 including trigger offset)
Max. count rate	100 MHz
Max. count	32,767 per bin per trigger
Records/accumulation	1 to 64k (or free run)
Max. accumulation	32,767 per bin in Add mode, ±16,383 per bin in Toggle or External mode
Add/subtract	Records may be added or toggled (add/subtract on alternating triggers). External subtract input may also control the toggle.

Trigger Rate

Minimum trigger time	$Tp = (\text{\# of bins} \times \text{bin width}) + (\text{\# of bins} \times 250\,ns) + 150\,\mu s$ 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.

Outputs

DISC	NIM level into 50 Ω. Low whenever signal input exceeds discriminator level with the correct slope.
SYNC/BUSY	TTL level. Rising edge is synchronous with first time bin of each record. Remains high until re-armed for next trigger.
BIN CLK	NIM level into 50 Ω. Each transition is a bin boundary. Active only while a record is being acquired. Timing skew relative to DISC out is <2 ns.
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
AUX1, AUX2	(General purpose analog outputs)
Full scale	±10 V
Resolution	5 mV
Output current	10 mA
Output impedance	<1 Ω
Accuracy	0.1 % + 10 mV

Inputs

SIGNAL	Analog 50 Ω input
TRIGGER	10 kΩ input
BIN CLK INPUT	TTL input (Rising edge triggers next time bin)

ACC. 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 (in external toggle mode).

General

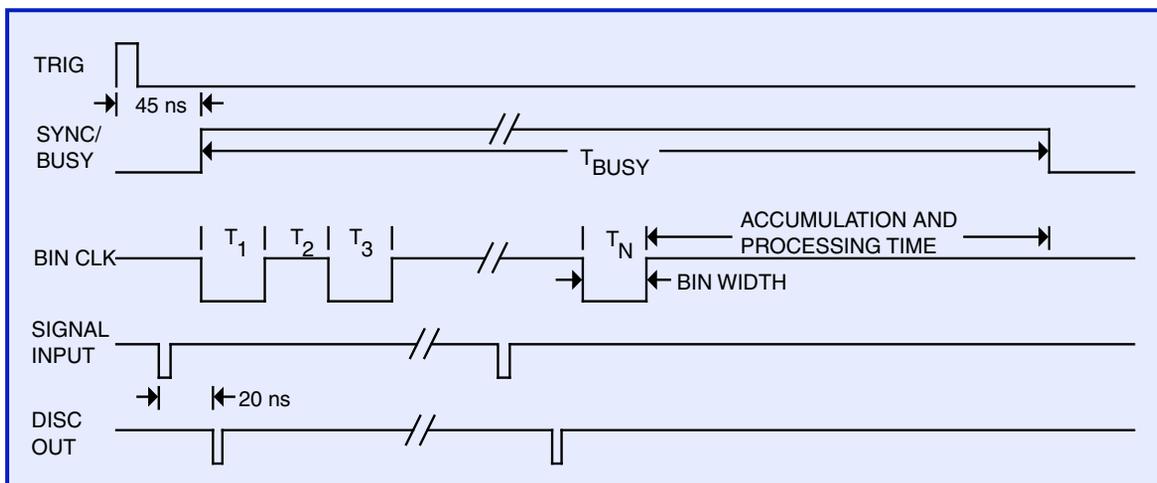| Interfaces	IEEE-488.2, RS-232, and Centronics printer interfaces are standard. All instrument functions can be controlled and read through the interfaces.
Data transfer	16k bins in 500 ms
Hardcopy	Screen dumps to Epson compatible dot-matrix or HP LaserJet printers. Plots to HP-GL compatible plotters (serial or IEEE-488.2).
Disk	3.5" DOS compatible format 720k byte capacity Storage of data and setups
Power	60 W, 100/120/220/240 VAC, 50/60 Hz
Dimensions	17" × 6.25" × 16.5" (WHD)
Weight	30 lbs.
Warranty	One year parts and labor on defects in materials and workmanship

Ordering Information

SR430	Multichannel scaler/averager with rack mount kit	$7950
SR445A	350 MHz preamplifier	$1200
O430H	Carrying handle	$100

SR430 rear panel

SR430 timing diagram