Precision Optical Chopper

SR542 — Low jitter optical chopper

SR542 Precision Optical Chopper

- · 0.4 Hz to 20 kHz chopping frequencies
- · Flexible synchronization
- · Low phase jitter
- · 0.01º phase resolution
- · 20 ppm frequency accuracy
- · Single & dual beam experiments
- · Sum & difference frequency outputs
- · Long-life brushless motor
- · USB computer interface

The SR542 Precision Optical Chopper provides a direct way to modulate laser light. The SR542 Precision Optical Chopper offers enhanced features and configurability as well as optimized chopping performance. Whether your application requires best-in-class phase jitter performance, tracking an external reference, a wide frequency range, two-wave photo mixing, or synchronization of multiple choppers, the SR542 will get the job done.

Flexible Configuration

The chopper can be synchronized to a variety of input sources including an external frequency reference (sine or TTL/CMOS), the internal clock (crystal oscillator), the VCO input (0 to +10 VDC), or the AC Line (50 Hz to 60 Hz). Long-term frequency drift is virtually eliminated. Chop rates as low as 0.4 Hz or as high as 20 kHz can be achieved (blade-dependent).

A user-programmable multiplier and divider enable chopping rates at a harmonic, sub-harmonic, or fractional harmonic of the primary frequency.

The user can select the inner slots, outer slots, or the shaft (one-pulse-per-revolution) to be phase-locked to the scaled primary reference. A phase offset is easily adjusted with 0.01° resolution, and a relative phase can be set as a zero-phase reference.

Distribution in the UK & Ireland

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Chopper Head with Shroud

Chopper Head

The chopper head employs a slotless, brushless DC motor (BLDC), which minimizes mechanical vibrations and helps keep your optical setup quiet. Furthermore, without the wear-and-tear experienced by the commutator brushes of a DC motor, the operating life of the chopper head is extended.

Precision photo-etched blackened stainless steel chopper blades come in a variety of single and dual frequency designs, plus a variable duty factor design. Tight tolerances for the blade etching ensures low phase jitter of the optically chopped signals.

The chopper head can be mounted to a standard one inch optical breadboard using the slotted base plate (two inch slot spacing) or to a half inch optical post with the included clamping knob.

A removable shroud prevents accidental collisions with the operational chopper head.

While BLDC motors are typically controlled with high frequency PWM signals, the SR542 uses an analog current amplifier with 3-phase unchopped sinusoidal drive currents to eliminate the high frequency EMI challenges of traditional PWM drivers.

Reference Outputs

Six always-available rear-panel reference outputs provide flexibility for synchronization of multiple instruments, including the ability to cascade choppers or trigger other instruments (lock-in amplifier, oscilloscope, etc.). Available outputs include Source (the primary internal clock, which is either free running, or phase-locked to the AC Line, Ext Sync, or VCO Input), Inner Slots, Outer Slots, Shaft (once-per-mechanical-revolution), Sum and Difference ($f_{outer} \pm f_{inner}$). All outputs are 0 to +5 V square waves through 50 Ω.

Intuitive Front Panel

The front panel of the SR542 controller displays a block diagram of the chopper control loop, which makes it easy and intuitive to see and adjust the instrument configuration. Numeric settings can be entered via either the number keypad or rotary knob.

Shutter Mode

The SR542 can also be operated as a simple optical shutter. With an Internal frequency set to 0 Hz, the static rotational orientation of the chopper blade can be controlled by the phase setting. By proper choice of phase, the user can alternately pass or block the optical beam.
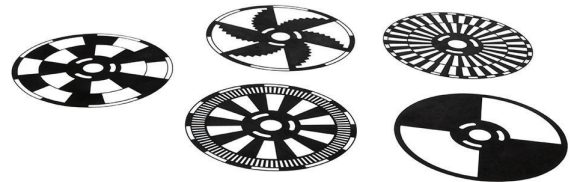
Chopper Blades
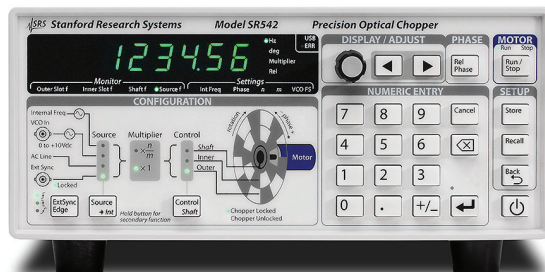
SR542 front panel

SR542 rear panel

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Frequency

Shaft (f_{shaft})	0.2 Hz to 200 Hz
Chop ($n_{slots} \times f_{shaft}$)	0.4 Hz to 400 Hz (2 slot blade)
	2 Hz to 20 kHz (10/100 slot blade)
Source (4)	Internal clock, VCO, AC line,
	or Ext Sync
Accuracy	±20 ppm
Stability	±20 ppm/year
Resolution	6 digits
Multiplier, n	Integer, 1 to 200
Divisor, m	Integer, 1 to 200

Phase

Resolution	0.01°
Jitter (°opt, rms)	[jitter (µs) / chop period (µs)] $\times$ 360°

Slot Count	at f_{min}	at $10 \times f_{min}$	at f_{max}
2	0.2° (0.4 Hz)	0.1° (4 Hz)	0.4° (400 Hz)
5	1.0° (1 Hz)	0.5° (10 Hz)	0.2° (1 kHz)
6	0.9° (1.2 Hz)	0.4° (12 Hz)	0.2° (1.2 kHz)
10	1.0° (2 Hz)	0.8° (20 Hz)	0.5° (2 kHz)
25	1.3° (5 Hz)	0.7° (50 Hz)	0.5° (5 kHz)
30	1.4° (6 Hz)	0.7° (60 Hz)	0.6° (6 kHz)
100	2.4° (20 Hz)	1.2° (200 Hz)	1.0° (20 kHz)

°mechanical = °optical / n_{slots}

360° optical
60° mechanical
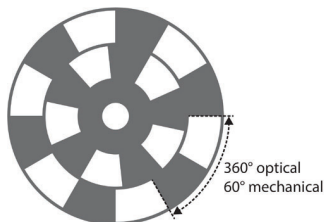
Inputs (2 BNCs)

Impedance	1 MΩ
VCO Voltage	0 to 10 VDC
VCO Accuracy	±100 ppm
Ext. Sync TTL	Minimum 2 V logic level
Ext. Sync Sine	100 mVrms to 1 Vrms signal,
	AC coupled (>1 Hz)
Edge Trigger	Rising, falling, or sinusoidal

Outputs (6 BNCs)

Voltage	+5 V through 50 Ω
Frequencies	Source, Shaft (1 PPR), Inner Slots,
	Outer Slots, Sum ($f_{outer} + f_{inner}$),
	Difference ($f_{outer} - f_{inner}$)

Operation

Control modes	Chopping: Shaft, Inner,
	or Outer; at ($n/m \times f_{source}$)
	Shutter: fixed angular position

Chopper Blades

Part No.	Slots	Max. Beam Diam. (in)	Chop Freq. (Hz)
O5422	2	1.150	0.4 – 400
O5425	5	0.873	1 – 1k
O54230	30	0.184	6 – 6k
O54256	5/6	0.626/0.500	1 – 1.2k
O5422530	25/30	0.157/0.184	5 – 6k
O54210100	10/100	0.358/0.057	2 – 20k
O542DF*	6	0.128	1.2 – 1.2k

Variable duty cycle (10% to 90%) blade

General

Remote interfaces	USB type B receptacle; serial port
	emulation, 115,200 baud
Temperature	+10 °C to +50 °C
Power	<40 W, 90–250 VAC, 50/60 Hz
Dimensions	Controller:
	8.3” $\times$ 4.08” $\times$ 9.16” (WHD)
	Head with shroud:
	4.3” $\times$ 4.65” $\times$ 3.75” (WHD)
Weight	Controller: 4.6 lbs
	Head with shroud: 1.2 lbs

Ordering Information

SR542	Precision optical chopper
O542RCH	Replacement chopper head
O5422	2-slot blade
O5425	5-slot blade
O54256	5/6-slot blade
O54230	30-slot blade
O5422530	25/30-slot blade
O54210100	10/100-slot blade
O542DF	Variable duty factor blade
O542CHS	SR542 chopper head shroud
O542RIC	Replacement 10 ft. interface cable
M542	Replacement manual for SR542

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