



**MONARCH INSTRUMENT**

*Instruction Manual*



**SPS-5/115**



**SPS-5 and SPLS-5 Series  
Self-Powered Sensors  
TTL Pulse Output**

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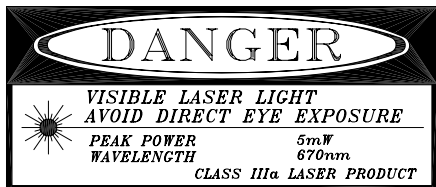
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## Safeguards and Precautions



1. **Read and follow all instructions in this manual carefully, and retain this manual for future reference.**
2. **Do not use this instrument in any manner inconsistent with these operating instructions or under any conditions that exceed the environmental specifications stated.**
3. **This instrument is not user serviceable. For technical assistance, contact the sales organization from which you purchased the product or Monarch Instrument directly.**



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# DECLARATION OF CONFORMITY

As Manufacturer:

## Monarch Instrument

Division of Monarch International Inc.  
15 Columbia Drive, Amherst NH 03031 USA

declares under Monarch's sole responsibility that the product:

**Name:** Remote Laser Self-Powered Sensor  
**Models:** SPLS-5/230 or SPLS-5/12  
with RLS-5P and R6 recharger

to which this declaration relates is in conformity with the following standards:

**EMC:** EN55011:1991 Class B  
EN50082-1:1992  
IEC 801-2: 1991  
IEC 801-3: 1994  
IEC 801-4: 1998

and therefore conforms with the requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility. The testing of this product was performed by Retlif Testing Laboratories, NH, in August/September of 1995 (File R-2544N).



17<sup>th</sup> October 1995  
Manufacturer (Amherst, NH)

Alan Woolfson, VP Engineering (Authorized Signature)

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# INTRODUCTION

**SPS and SPLS Self Powered Sensors** are self-contained, rechargeable battery powered devices for developing a TTL compatible one pulse per revolution output for triggering external equipment such as vibration analyzers, spectrum analyzers, stroboscopes, data acquisition equipment, tachometers, balancers, waveform analyzers and magnetic tape recorders.

The **SPS-5 Series** is comprised of the **SPS-IM Interface Module** which provides power to a sensor and couples the sensor to a BNC output; an input sensor with a visible red LED light source (**ROS-5P**); and a battery recharger.

The **SPLS-5 Series** is comprised of the **SPS-IM Interface Module** which provides power to a sensor and couples the sensor to a BNC output; a remote laser light input sensor (**RLS-5P**); and a battery recharger.

An optional infrared light source (**IRS-5P**) or amplified magnetic sensor (**MT-190P**) may also be combined with the **SPS-IM Interface Module** when appropriate. (See separate instructions for these configurations.)



**ROS-5P**  
Remote Optical Sensor



**RLS-5P**  
Remote Laser Sensor



**SPS-IM**  
Self-Powered Sensor  
with R-5 Recharger



**MT-190P**  
Magnetic Trigger Sensor



**IRS-5P**  
Infrared Sensor

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with ROS-5P and R6 recharger

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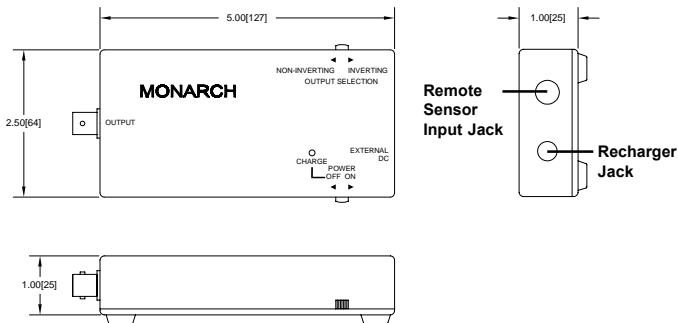
## SENSORS / OPTIONS AND ACCESSORIES

|          |   |
|----------|---|
| ROS-5P   | Remote Optical Sensor with 8 foot cable and mounting bracket  |
| RLS-5P   | Remote Laser Sensor with 8 foot cable and mounting bushing on base  |
| IRS-5P   | Infrared Sensor with 8 foot cable for use without reflective target at 0.5 inch gap (5 to 500,000 RPM)          |
| MT-190P  | Magnetic Trigger Sensor/Amplifier with 8 foot cable - 0.250 gap, 2" long x 5/8"-18NF                            |
| EC-25P   | 25 foot Extension Cable for remote sensors with male 1/8" [3.5 mm] phone plug to female 1/8" [3.5 mm] connector |
| T-5      | Reflective Tape, 5 foot [1.5 m] roll, 1/2 inch [13 mm] wide   |
| T-5WP    | Waterproof Reflective Tape (honeycomb pattern), 5 foot [1.5 m] roll, 1 inch [25 mm] wide                        |
| B-4      | Four "AA" Rechargeable NiCad batteries  |
| R-5      | Recharger, 115 Vac - 50/60 Hz   |
| R-6      | Recharger, 230 Vac - 50/60 Hz   |
| CA-SPS12 | Cable assembly with tinned leads for 5-15 Vdc operation   |

## COMPONENT SPECIFICATIONS

### SPS-IM Interface Module

|                              |  |
|------------------------------|--|
| <b>Internal Batteries:</b>   | 4 'AA' Nickel Cadmium<br>1.2 Vdc each, total 4.8 Vdc   |
| <b>Capacity:</b>             | 600 mAh  |
| <b>Operating Interval:</b>   | 8 hours typical from internal batteries  |
| <b>Continuous Operation:</b> | 115 Vac or 230 Vac using R-5 or R-6 recharger/<br>power supply, or CA-SPS12 cable for 9-13 Vdc   |
| <b>Charge Rate:</b>          | 50 mA typical  |
| <b>Charge Time:</b>          | 16 hours   |
| <b>Output:</b>               | TTL compatible pulse, Inverted (0 to 5 Vdc) or<br>Non-Inverted (5 to 0 Vdc) – switch selectable.<br>Open collector with 4.7 kΩ pull - up to 5 Volts in Inverted<br>mode, passes sensor signal straight through in Non-Inverted<br>mode (see sensor specifications) |
| <b>Current Draw:</b>         | 76mA with 10 kΩ load (operational)   |
| <b>Output Connector:</b>     | BNC Connector (female)   |
| <b>Operating Temp:</b>       | 32° F to 122° F [0° C to 50° C]  |
| <b>Dimensions:</b>           | 5.0" x 2.5" x 1" [127 mm x 64 mm x 25 mm]  |
| <b>Weight:</b>               | 10 oz. [283 grams]   |



## ROS-5P Remote Optical Sensor

**Operating Envelope:** Up to 3 feet [0.9 m] and 45° from reflective target

**Speed Range:** 1 to 250,000 RPM

**Operating Temp:** -10° F to 250° F [-23° C to 121° C]

**Illumination Source:** Visible red LED, 5 Vdc @ 30 mA

**Output Signal:** 5 to 0 Vdc TTL compatible pulse (open collector with 4.7 k pull up to 5 Vdc)

**On-Target Indicator:** Green LED on end cap

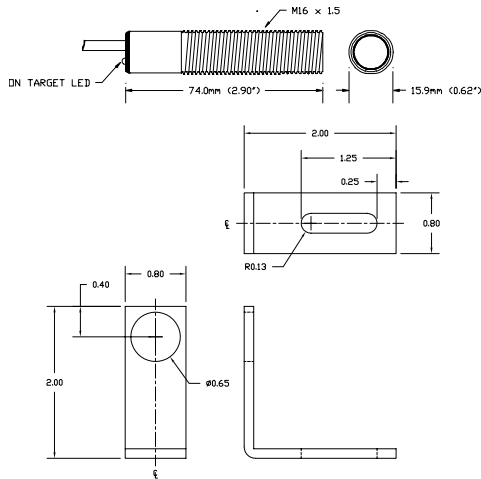
**Lens:** Acrylic plastic

**Dimensions:** Threaded Tube - 2.90" L x 0.625" diameter [M16 x 1.5 x 74 mm] supplied with two M16 jam nuts and slotted aluminum mounting bracket (2" x 2" x 0.80")

**Material:** 303 Stainless steel

**Cable Length:** 8 feet [2.5 m] Standard

**NOTE:** Optional longer cables lengths include 15, 30 or 50 feet [4.6, 9.2 or 15 m].



driving a hundred feet of coax cable. Be sure to select the direction (0 to 5 Vdc or 5 to 0 Vdc) of this signal to provide the required polarity of the leading edge to properly trigger the connected equipment.

When measurements are completed, immediately turn the "Power" switch OFF and close the shutter over the laser.



### CAUTION:

Avoid direct eye exposure to the laser beam.

## Operational Check

Correct operation of any SPS Self Powered Sensor can be checked at any time by aiming the sensor at a fluorescent light and observing  $7200 \pm 2$  counts on the instrument connected to the BNC output.

**NOTE:** In countries with a 50 Hz. Power line frequency, the instrument connected to the BNC output will read  $6000 \pm 2$ .

## Controls

The Laser Sensor can detect small changes in reflective light due to color or contrast changes, holes or slots in the surface or reflectivity of the subject. The actual sensing distance varies, and may be adjusted using the “Sensitivity” adjustment control on the Laser Sensor. For maximum distance, it is advisable to use areas of high contrast or reflective tape on the rotating object.

## Operating the SPLS-5 as a triggering source

Mount the **RLS-5P** securely on a tripod or fixed surface that can be moved for alignment purposes. For ease of alignment and reliability of operation, locate the sensor as close to the target as practical (but not within one inch). **It is recommended that you aim the sensor at a slight angle from perpendicular (approximately 15 degrees) to ensure the sensor will detect only reflected pulses.**

Turn the “Power” switch on the **SPS-IM** module to the ON position. Open the shutter on the Laser Sensor. Observe that the LASER ON LED illuminates.



### CAUTION:

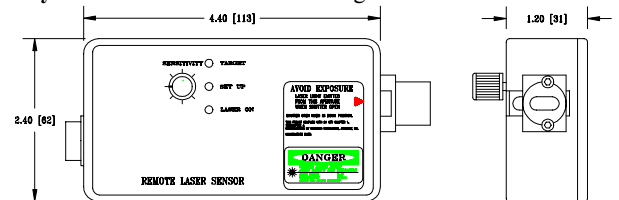
Avoid direct eye exposure to the laser beam.

Visually align the laser light with the target, ideally with the moving equipment stopped. Start the equipment, and further adjust the manual alignment and the “Sensitivity” control to maximize the brightness of the green “TARGET” LED. This will be the condition of optimum performance.

The pulse signal on the connector marked “Output” provides a sharp leading edge for reliable and repeatable triggering of the connected device. This output has a low impedance (50 ohms) and is capable of

## RLS-5P Remote Laser Sensor

- Laser:** Visible red laser diode (670 nm), 5 mW peak power
- Excitation Voltage:** 4.8 to 8 Vdc @ 75 mA
- Classification:** Normal Mode: Class IIIa Laser Product  
Setup Mode: Class II Laser Product
- Beam Divergence:** 1.5 mrad typical
- Beam Diameter:** 4 x 0.6 mm
- Laser Diode Life:** 100,000 hours typical
- Operating Range:** Up to 50 feet [15 m] with reflective target
- Min. Trigger Duration:** 50 usec (equiv to 250,000 RPM)
- Output:** 5 to 0 Vdc TTL compatible pulse (open collector with 4.7 k pull up to 5 Vdc)
- Connector:** Circular DIN Mak 4100 Socket
- Indicators:** LASER ON, SET UP and ON-TARGET LEDs
- Sensitivity Adjust:** Single turn trimmer control knob on top panel
- Modes:** Normal: Adjust sensitivity and distance from target  
Set Up: Set up for reduced power (factory preset)
- Dimensions:** Length: 5.5" [141 mm] including laser nosepiece  
Body: 4.4" x 2.4" x 1.2" [113 mm x 62 mm x 31 mm]
- Weight:** 10 oz. [283 grams]
- Mounting:** ¼ -20 UNC Bushing in base of housing for tripod mount or customer supplied bracket (can also be used to ground the Remote Laser Sensor)
- Temperature:** Operating: -5° F to 122° F [-20° C to +50° C]  
Storage: -25° F to 140° F [-30° C to +60° C]
- Humidity:** 90% RH non-condensing



## SPS CONFIGURATIONS

All SPS models consist of the SPS-IM Interface Module, an input sensor, and a means of accessing external power. The components of each configuration are shown below.

### SPS-5 Series - SPS with Remote Optical Sensor

| Model     | Interface Module | Input Sensor | External Power Source                |
|-----------|------------------|--------------|--------------------------------------|
| SPS-5/115 | SPS-IM           | ROS-5P       | R-5 Recharger/Power Supply (115 Vac) |
| SPS-5/230 | SPS-IM           | ROS-5P       | R-6 Recharger/Power Supply (230 Vac) |
| SPS-5/12  | SPS-IM           | ROS-5P       | CA-SPS12 Cable with tinned leads     |

### SPLS-5 Series - SPS with Remote Laser Sensor

| Model      | Interface Module | Input Sensor | External Power Source                |
|------------|------------------|--------------|--------------------------------------|
| SPLS-5/115 | SPS-IM           | RLS-5P       | R-5 Recharger/Power Supply (115 Vac) |
| SPLS-5/230 | SPS-IM           | RLS-5P       | R-6 Recharger/Power Supply (230 Vac) |
| SPLS-5/12  | SPS-IM           | RLS-5P       | CA-SPS12 Cable with tinned leads     |

Laser Sensor be placed at a slight angle (approximately 15 degrees) from perpendicular, so that the Laser Sensor will detect only the reflected pulses from the target. The Laser Sensor should be at least 1 inch [25 mm] and may be up to 50 feet [15 meters] from the reflective tape target, provided that the “Sensitivity” adjustment is set properly (see below). The Laser Sensor is equipped with a green LED On-Target Indicator which will blink at the input frequency when properly aimed and adjusted for “Sensitivity”.



#### CAUTION:

**Avoid direct eye exposure to the laser beam.**

There is a mechanical sliding shutter on the Laser Sensor that can be used to block the laser light for safety purposes.

**NOTE:** Open the shutter completely when using the Laser Sensor and close the shutter when it is not in use.

#### Indicators

There are three light emitting diodes (LED's) on the Laser Sensor which provide the following indications:

**LASER ON:** Green LED. When the Sensor is first powered up, there is a delay of a few seconds before the laser beam comes on. During this period, the “LASER ON” LED blinks. When the Laser comes on, the LED remains lit.

**SET UP:** Red LED. Factory use only.

**TARGET:** Green LED. Indicates that the Laser Sensor is receiving a reflected signal back from the target. The intensity of this LED should be maximized during target alignment while adjusting the “Sensitivity” knob very slowly.



The pulse signal on the connector marked “Output” provides a sharp leading edge for reliable and repeatable triggering of the connected device. This output has a low impedance (50 ohms) and is capable of driving a hundred feet of coax cable. Be sure to select the direction (0 to 5 Vdc or 5 to 0 Vdc) of this signal to provide the required polarity of the leading edge to properly trigger the connected equipment.

## SPLS-5 Series - SPS with Remote Laser Sensor

The **SPLS-5** consists of the **SPS-IM Interface Module** described on pages 6 and 7, an **RLS-5P Remote Laser Sensor** with eight foot cable and ¼-20 mounting bushing, and a **R-5** (115 Vac), **R-6** (230 Vac) or **CA-SPS12** (5 to 15 Vdc) external power connection. One foot of **T-5 Reflective Tape** is also supplied.

**NOTE:** Be sure the power on the battery interface module is OFF before connecting the Remote Laser Sensor.

### RLS-5P

The **RLS-5P Remote Laser Sensor** is capable of detecting a reflected pulse at distances of up to 50 feet [15 meters] and angles up to 75 degrees from a reflective tape target. In some applications, reflective tape is not required; the Laser Sensor will operate from contrasting colors. Due to the highly focused illumination provided by a collimated laser and the resultant narrow pulse returned to the sensor, it is critical that the Laser Sensor be carefully and securely mounted by means of the ¼-20 threaded bushing provided in order to achieve reliable results. This ¼-20 mounting bushing can also be used to ground the Laser Sensor.

Whenever possible, a 1/2" [13 mm] square piece of **T-5 Reflective Tape** should be applied to a clean area on the rotating object. The Laser Sensor should be mounted and optically aligned to illuminate the reflective tape target once per revolution. It is recommended that the

# FUNCTIONS AND OPERATION

## SPS Interface Module

The **SPS Interface Module (SPS-IM)** provides power to the input sensor, receives and processes the return pulse signal, and provides a switch selectable positive going 0 to 5 Vdc or negative going 5 to 0 Vdc TTL pulse train trigger output on a BNC connector. Connections and operation are common to all SPS models. Fully charged internal NiCad batteries will typically provide six to eight hours of continuous operation. In addition, the SPS system can be operated continuously on external power by use of the ac recharger/power supply or dc power cable provided.

**NOTE:** Before using, charge the internal NiCad batteries for a full 16 hours using the recharger/power supply or cable provided. See **Recharging the Batteries** section on page 7.

### Connections

Connect the input sensor via the 1/8" [3.5 mm] phone plug to the mating connector on the **SPS-IM**. This sensor may remain connected even when recharging the internal batteries of the **SPS-IM**.

Connect the output signal cable to the BNC connector on the opposite end of the **SPS-IM** and to the external equipment to be triggered. If operating from the recharger/power supply, connect the recharger to the connector marked “External DC” and connect the wall unit to the appropriate power source. When using the CA-SPS12 cable to provide 5 to 15 Vdc, connect the Black lead to (+) and the Black with White Stripe lead to (-) dc power.

**NOTE:** When not in operation, do not leave the **SPS-IM** continuously connected to a recharger/power supply or 5 to 15 Vdc external power for more than 16 hours as this may damage the batteries.

## Controls

The “Power” switch on the **SPS-IM** controls both the operation and the charging of the system. The unit will only charge from external power in the power OFF position. In the power ON position, the unit will operate directly from external power any time that it is being supplied. Otherwise, it functions on internal battery power.

The “Output Selection” switch determines the polarity of the leading edge of the TTL compatible output signal. In the “NON-INVERTING” position, the output signal on the BNC connector will be a negative going 5 to 0 Vdc TTL pulse derived directly from the conditioned sensor output. When the “INVERTING” position is switch selected, the BNC output signal will be a positive going 0 to 5 Vdc, TTL compatible pulse.

## Recharging the Batteries

To recharge the **SPS-IM Interface Module** batteries:

1. Connect the recharger/power supply or external power cable to the recharger input jack labeled “External DC”.
2. Connect the recharger/power supply into a working ac outlet, or the external power cable to a dc power source of 5 to 15 Vdc.
3. Be sure the “Power” switch is in the OFF (CHARGE) position. The red “CHARGE” LED will indicate that the batteries are being charged. Allow 16 hours to fully charge.
4. Remove the charging source or move the “Power” switch to the ON position once the 16 hour charge cycle is completed.

**NOTE:** When not in operation, do not leave the **SPS-IM** continuously connected to a recharger/power supply or 5 to 15 Vdc external power for more than 16 hours as this may damage the batteries.

## SPS-5 SERIES - SPS With Remote Optical Sensor

The **SPS-5** consists of the **SPS-IM Interface Module** described on pages 6 and 7, an **ROS-5P Remote Optical Sensor** with eight foot cable and mounting bracket, and a **R-5** (115 Vac), **R-6** (230 Vac) or **CA-SPS12** (5 to 15 Vdc) external power connection. One foot of **T-5 Reflective Tape** is also supplied.

### ROS-5P

When connected to the **SPS-IM** as described above, the **ROS-5P** illuminates the target with a visible red light from a high intensity LED and detects the reflected pulses from the rotating reflective tape target with an internal photo-detector. The **ROS-5P** Remote Optical Sensor is capable of detecting a reflected pulse from **T-5 Reflective Tape** targets at distances of up to 3 feet [1 meter] and angles up to 45 degrees from the target. The sensor is supplied with a set of two M16 jam nuts and a 90° angle slotted aluminum mounting bracket.

For most applications, a 1/2" [13 mm] square piece of **T-5 Reflective Tape** should be applied to a clean area on the rotating object. The sensor should be mounted and optically aligned to illuminate the reflective target once per revolution. **It is recommended that the optical sensor be placed at a slight angle (approximately 10-15 degrees) from perpendicular, so that the sensor will detect only the reflected pulses from the target.** The sensor should be at least 2 inches [50 mm] and no more than 3 feet [1 meter] from the target. The green LED On-Target Indicator on the **ROS-5P** will blink at the input frequency or be continuously illuminated when properly aimed.

### Operating the SPS-5 as a triggering source

Once the **ROS-5P** input sensor is properly mounted and aligned, further connections and operation should proceed in accordance with the functions and descriptions under the **SPS Interface Module** sections entitled ‘**Connections**’ and ‘**Controls**’ on pages 6 and 7 respectively.