MONARCH INSTRUMENT

Instruction Manual

Smart Laser Sensor

CE NIST CALIBRATION

15 Columbia Drive
Amherst, NH 03031 USA
Phone: (603) 883-3390 • Fax: (603) 886-3300
Email: support@monarchinstrument.com
Website: www.monarchinstrument.com

SAFEGUARDS AND PRECAUTIONS

DIODE LASER
Max Output Power: **<5 milliwatts**
Wavelength: **650 nanometers (visible light)**
Min. Beam Divergence: **0.5 milliradian**
Output: **Continuous (CW)**
Laser Hazard Classification: **Class 3R Caution**

LASER HAZARDS:

Eye injury from beam - Do not look into the direct or reflected beam; can cause eye injury up to 110 ft. [34 m] away.

Visual interference (glare) with pilots and drivers - Interferes with vision up to 2400 ft. [730 m] away. Can be a distraction up to 4.5 miles [7.3 km] away. ***NEVER point any laser towards aircraft or vehicles; it is unsafe and illegal.***

Safe Use Guidance:
Class 3R lasers are safe when handled carefully. Do not look into the beam. Avoid accidental exposure to the eye. Do not aim at aircraft. ***This is not a toy.*** Always supervise children.

Manufacturer:
Monarch Instrument
15 Columbia Drive
Amherst, NH 03031 USA
Country of Origin: USA
Contact info: www.monarchinstrument.com

Read and follow all instructions in this manual carefully, and retain this manual for future reference.

Do not use this instrument in any manner inconsistent with these operating instructions or under any conditions that exceed the environmental specifications stated.

This instrument is not user serviceable. For technical assistance, contact the sales organization from which you purchased the product.

WARNING: Use only the PR Universal charger supplied with the product.

Symbols on the unit and in this manual:

Warning Laser Beam
Caution Read Manual
Direct current
Alternating current

To comply with worldwide regulations such as the U.S. Environmental Protection Agency Resource Conservation and Recovery Act (RCRA) and EU Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), you must not discard this electrical/electronic product in domestic household waste. The electronic components in this device may contain environmentally harmful substances. DO NOT DISPOSE of this product as unsorted municipal waste. This product needs to be RECYCLED and disposed of in accordance with environmental regulations in the country of use; contact your local authorities for more information. This product may be returnable to your distributor for recycling; contact the distributor for details.

The Smart Laser Sensor contains nickel metal hydride batteries which must be recycled and disposed of in accordance with Federal, State, & Local Regulations. Do not incinerate. Batteries should be shipped to a reclamation facility for recovery of the metal and plastic components as the proper method of waste management. Contact the distributor for appropriate product return procedures.

Monarch Instrument's Limited Warranty applies.
See www.monarchinstrument.com for details.

Warranty Registration and Extended Warranty Coverage information is available online at www.monarchinstrument.com.

Table of Contents:

1.0 OVERVIEW

The Smart Laser Sensor (SLS) is a self-contained unit intended to be used to make non-contact speed measurements from rotating targets at distances up to 65 feet [19.8 m] or to provide non-contact reference points to balancing equipment. Refer to 5.0 OPERATION for an overview of operation. The unit will output one (TTL Compatible) pulse per revolution and has the ability to compute the RPM internally and output the ASCII values to any equipment capable of receiving an RS232 input. For best performance use reflective tape for the target.

2.0 INDICATORS AND SWITCHES

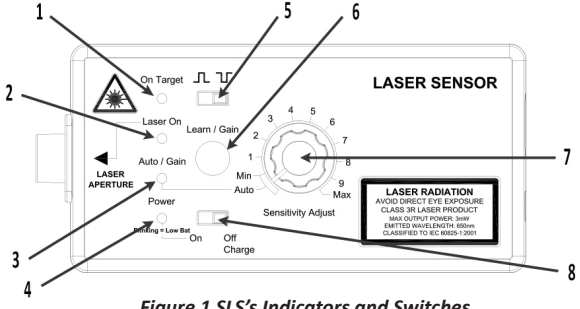


Figure 1 SLS's Indicators and Switches

1. On-Target LED Lit whenever the sensor is receiving a reflected signal back from the target. As the frequency increases, it will be on solid unless the measured frequency is not stable. This is useful in setting up the unit.

2. Laser On LED Blinks when unit is first turned on. Remains lit when the laser beam is on.

3. **Auto/Gain LED** On solid whenever the unit is in the Auto mode. It also blinks from 1 to 8 times to indicate the current gain whenever the gain is changed.

4. **Power LED** (Dependent on the Power switch location)
   On position: GREEN when the batteries are charged.
   Blinks AMBER when the batteries are low.

   Charge position: Blinks RED when fast charging for very low batteries.
   Blinks AMBER when slow charging.
   Steady AMBER when the batteries are fully charged.

5. **Polarity Switch** Selects either a positive or negative output pulse.

6. **Learn/Gain Button**
   In Auto Mode: Press and hold until the On-Target LED blinks regularly or is on solid.

   In Manual Mode: Press to change gain ranges.

7. **Sensitivity Adjust Knob** Turn fully counterclockwise to select Auto mode or manually adjust sensitivity threshold.

8. **Power Switch** Turns unit on/off. When the unit is switched to Off/Charge and a charger is plugged into the unit, the batteries will charge.

3.0 QUICK START GUIDE

Note: Refer to Figure 1 for switch and button locations.

1. Slide Power switch (8) to **On**.
2. Rotate Sensitivity Adjust knob (7) fully counterclockwise to the **Auto** position.
3. Aim the laser dot perpendicular to the target - reflective tape, contrasting color or keyway.

4. If the On Target LED (1) is not on, push and hold the red Learn/Gain button (6) until the On-Target LED (1) blinks regularly. Note that at higher RPMs the LED will be on solid.
5. If after completing step 4 the On Target LED (1) blinks erratically or not at all, rotate the Sensitivity Adjust knob (7) slowly from 1 to 9 until the LED blinks regularly or is on solid.
6. If after completing steps 1-5 the On Target LED (1) blinks erratically or not at all, do the following:
    a. Move the sensor closer to the target and ensure it is perpendicular to the target. Repeat steps 1-5.
    b. Increase the contrast/reflectivity of the target. Repeat steps 1-5.
7. Once the On Target signal is obtained, use the Polarity Switch (5) to select a compatible output pulse for your application.

4.0 CONNECTION DETAIL

The unit has an input power jack for DC power or recharging the batteries. Use only the PR Universal charger supplied.

The unit also has a five-pin DIN output socket for Pulse outputs and RS232. An 8 ft. [2.5 m] cable with a DIN plug and BNC connector is supplied. The BNC plug is connected to the SO output. A variety of optional cables are available including: tinned wire termination, 1/8 inch [3.5 mm] mono plug, or DB9 for RS232.

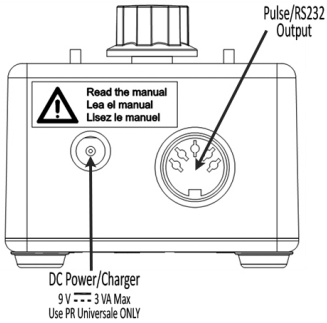


Figure 2 Connection Details

Refer to Table 1 and Figure 3 (below) for the output socket connection detail.

Pin	Description	Wire Color (of cable)
1	RS232 Receive (input to sensor)	Red
2	Common	Orange [BNC -]
3	SO (PNP Output) TTL compatible output	Yellow [BNC +]
4	RS232 Transmit (output from sensor)	White
5	OC (NPN Output)	Black

Table 1 Output Connections

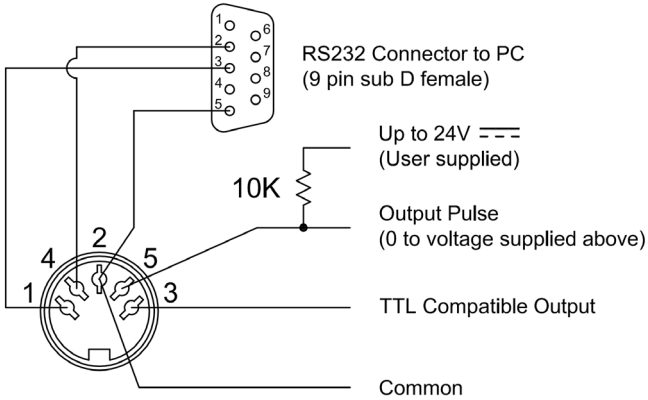


Figure 3 Pin Connections

5.0 OPERATION

Note: Refer Figure 1 for switch and button locations.

Turn the unit on by moving the Power switch (8) to the **On** position. The unit may be operated from the internal batteries and/or the charger/power supply. The internal batteries will be trickle charged when using the AC charger/power supply. To turn the unit off, slide the Power switch (8) to the **Off/Charge** position. If the charger is plugged in, the batteries will charge.

The sensor emits a laser beam, which is reflected back by a target (reflective tape/paint, keyway, contrasting colors, etc). This reflected light is sensed and amplified then compared to a threshold level (sensitivity) - the lower the threshold level, the more 'sensitive' the sensor is. Whenever the amplified signal is above the threshold, the output goes high (positive pulse) or low (negative pulse). The user can select either a positive or a negative output pulse using the Polarity switch (5).

The gain of the input amplifier and the sensitivity can be adjusted manually or automatically. This allows the unit to be used with many types of targets at various distances and contrasting color conditions. To select the Auto mode, turn the Sensitivity Adjust knob (7) fully counterclockwise, otherwise you are in the Manual mode. Reflective tape and high contrast color applications should be able to use the Auto mode.

5.1 Auto Mode

Make sure the Sensitivity Adjust knob (7) is fully counterclockwise and the Auto/Gain LED (3) is on. Aim the laser at your target. Press and hold the Learn/Gain button (6) until the On-Target LED (1) blinks regularly or is on solid (depending on the RPM of the target). Release the Learn/Gain button. The Auto/Gain LED will blink to show what gain has been selected. Refer to Table 2.

In many applications, this is all that is needed. In cases where the target is marginal, the user may need to manually adjust the sensitivity after trying the Auto mode.

Number of blinks	Gain
1 Strong Signal	X 1
2	X 2
3	X 4
4	X 5
5	X 8
6	X 10
7	X 16
8 Weak Signal - move closer	X 32

Table 2 Auto/Gain Blinks

5.2 Manual Mode

Aim the laser at your target. Turn the Sensitivity Adjust knob (7) between **Min** and **Max** until the On-Target LED (1) starts blinking or comes on solid. If you can't get a good setting, change the gain. Press and release the Learn/Gain button (6) to change the gain of the input amplifier. Each time the button is pressed, the gain is changed. The Auto/Gain LED (3) will blink to show what gain has been selected. If the button is held down, the gain will increase automatically after each LED 'blink' pattern. Refer to Table 2. The larger the gain, the weaker the signal being picked-up. Using a large gain for a strong signal is not recommended since the input will saturate.

6.0 TARGET POLARITY (ADVANCED FEATURE)

The input circuitry can be set to optimally work with two different target types: a reflective (white, shiny) target on a mostly non-reflective (black, dull) background or a non-reflective (black, dull) target or a mostly reflective (white, shiny) background. These will be referred to as a white target or a black target. When the unit is first turned on, the On-Target LED (1) will indicate which target type the sensor is set up for. While the Laser On LED (2) is blinking, the On-Target LED will be on for a white target or off for a black target. The unit will still work when set up for the "wrong" target type, but it won't have as great a range. When set for a white target, the unit triggers on the black to white transition. When set for a black target, the unit triggers on the white to black transition.

To change the setting, move the Polarity switch (5) to the left (positive pulse) for a white target or to the right (negative pulse) for a black target. Turn the Sensitivity Adjust knob (7) to **Max**. Press and hold the Learn/Gain button (6) until the Auto/Gain LED (3) blinks.

7.0 AIMING THE LASER

The proper operation of the Laser Sensor is dependent upon the alignment to and reflectivity of the target. In order to aim the beam it is necessary to stand behind the sensor and view the target along the plane of the beam. **Do not stare directly into the laser beam or the reflected light.** For targets greater than 5 feet and up to 65 feet from the sensor, mount the laser on a tripod using the ¼ - 20 bushing on the bottom of the unit and attach T-5 reflective tape to the target.

To aid in locating the laser dot over a large distance, hold a piece of white cardboard or equivalent in front of the laser. Progressively move the white surface closer to the desired target. Then adjust the aim of the laser as necessary.

In areas of high ambient light (outdoors), performance can be enhanced at long distances by slipping a piece of black tube with a minimum inner diameter of 0.6 inches, over the nose piece to act as an extension nose piece. This tube should not deflect the beam in any way.

8.0 RS232

Baud rate = 9600, 8 bits, 1 stop bit, no parity.

When the unit is turned on, it will send out: "SLS<lf><cr>Vx.x<lf><cr> 0.0<cr>". Where <lf> is the linefeed character, <cr> is a carriage return character, and x.x is the firmware version number.

The unit will send out the current RPM as a right justified 7-digit ASCII number that will always include a decimal point followed by carriage return. The update rate is a function of the speed of the target and will not exceed twice per second.

Examples:

1234.56<cr>

123456.<cr>

_ _ _ _0.0<cr> (_ = space character)

9.0 BATTERIES

The SLS is fitted with rechargeable NiMH (Nickel-Metal Hydride) batteries. These batteries contain fewer toxic metals than NiCd (Nickel Cadmium) and are currently classified "environmentally friendly". They also have 30% more capacity than NiCd batteries of the same size.

Like NiCds, NiMH batteries are prone to self-discharge - 10 to 15% of charge is lost in the first 24 hours then continues at a rate of 0.5 to 1% per day. For maximum performance, charge the batteries just prior to use.

When not in use, the batteries should be charged at least every three months, otherwise the battery capacity will be reduced or the batteries may become unusable.

Charge the batteries before use and allow 3-5 cycles of charging and discharging for batteries to reach full capacity.

The enclosure contains control electronics to properly and safely charge the batteries. Never remove the batteries from the enclosure and attempt to charge them externally. **Always use the charger supplied (PR Universal).**

9.1 Low Battery Indication

Low Battery is only indicated when the Power Switch position is in the On position. The Power LED will be GREEN when the batteries are charged and blink AMBER when the batteries are low.

9.2 Charging the Batteries

The unit may be recharged at any time. You do not need to wait until the low battery condition is indicated.

CAUTION: Use only the supplied PR-Universal charger with the sensor (see 10.1 PR Universal).

To charge the batteries, insert the stereo plug of the PR Universal into the DC Power/Charger socket on the side of the unit (see Figure 2). Select the appropriate outlet plug and insert the PR Universal into an AC outlet. Then slide the Power switch (8) to the Off/Charge position.

The Power LED (4) will blink RED when fast charging for very low batteries, blink AMBER when slow (trickle) charging batteries, and be solid AMBER when the batteries are fully charged.

Note: If the charger is plugged in when the Power switch is in the On position, the batteries will be trickle charged during operation.

9.3 Battery Disposal

DO NOT DISPOSE of the NiMH batteries as unsorted municipal waste. The batteries need to be RECYCLED in accordance with local regulations. The batteries should be sent to a recycling center or returned to the factory using appropriate shipping methods.

To remove the batteries, remove the (4) rubber feet to get to the enclosure screws. Unscrew the bottom part of the enclosure to expose the batteries. Remove the batteries from the battery holder and dispose of them properly.

10.0 CHARGER/POWER SUPPLY

The SLS can also be operated directly from the provided Charger / Power Supply (PR Universal). Simply insert the stereo plug of the PR Universal into the DC Power/Charger socket on the side of the unit (see Figure 2). Select the appropriate outlet plug and insert the PR Universal into an AC outlet. Then slide the Power Switch to the On position.

10.1 PR Universal

The PR Universal Charger/Power Supply provided with the SLS has interchangeable plugs allowing it to be used with AC outlets in different countries.

To change the plug, depress the button on the installed plug and slide the plug up and out of the power supply. Select the correct plug and slide it back into the power supply until you hear a click and the plug is seated firmly. Make sure the plug cannot slide out.

CAUTION

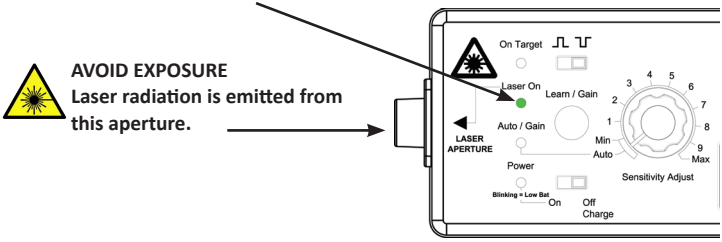
RISK OF ELECTRIC SHOCK

- **Do not insert the plugs into an AC outlet without the power supply attached**
- **Avoid touching the plug blades when inserting or removing the power supply from the AC outlet**
- **Indoor use only**

11.0 SPECIFICATIONS

Specifications*	SLS Smart Laser Sensor
Laser Specifications:	
Classification	Class 3R (per IEC 60825-1 Edition 3 2014) Complies with 21CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, date June 24, 2007.
Maximum Laser Output	<5mW
Pulse Duration	Continuous
Laser Wavelength	650 nm
Beam Divergence	< 0.5 mrad
Beam Diameter	4 x 7 mm typical at 2 m
Laser Diode Life	8,000 hours MTBF (1 year warranty)

Laser is on when this indicator is illuminated.



Specifications*	SLS Smart Laser Sensor
General:	
Operating Range:	Up to 65 feet depending on target reflectivity
1/2" reflective tape (T-5) @3600 RPM	Up to 65 ft. [19.8 m] or up to 75° from target
White/black contrast @ 3600 RPM	Up to 3 ft. [91 cm] or up to 45° from target
Black mark on dental drill	Up to 4 in. [10 cm] @ over 260,000 RPM
Maximum RPM	500,000
Min. Trigger Duration	10 µsec
Modes:	Normal (manual) or Auto, and Charging
Normal Mode	Manual adjustment of sensitivity/gain
Auto Mode	Auto learn, automatic gain control
Indicators	LEDs for On-Target, Laser On, Auto/Gain, and Power/Charge
Sensitivity Adjustment	Single turn knob on top panel in Normal mode
Voltage Requirements:	
Operational	Internal: rechargeable batteries External: +9 V ⎓ 1 VA
Charging	External: +9 V ⎓ 1 VA
Batteries	Rechargeable sealed NiMH AA 1.2V 1200 mAh
Run Time	Over 6 hours continuous operation from fully charged batteries @ 70 °F (21 °C)

Specifications*	SLS Smart Laser Sensor
General (continued):	
Charge Time	Typically less than 3 hours @ 70 °F (21 °C)
PR Universal Charger:	Check charger label for power information
Input	100-240 V ~, 50-60 Hz
Output	9 V ⎓ ; dry location use only
Pulse Output:	
Source Output (SO)	Square Wave 0 to 3.9 V typical @ 15 mA (PNP to 4.2 V, 4.7 K ohms to common) TTL Compatible
Open Collector (OC)	Switches to common, External pull up resistor to user supplied power (max 24 V ⎓) required
Polarity	Positive or Negative pulse (switch selectable)
RS232	Transmit Out – ASCII value of RPM (Accuracy ± 0.002% of reading) Settings: 9600 baud, 8 bits, 1 stop, No Parity
Connector	Circular DIN 5-Socket – Common; Outputs: SO and OC; Serial RS232: Transmit and Receive
Mounting	¼-20 UNC Bushing included (tripod mount)
Weight	10.6 oz. (300.5 g) excluding cable and charger
Dimensions (LxHxW)	5.38 in. (including snout) x 2.53 in. x 2.25 in. [13.67 cm x 6.42 cm x 5.72 cm] including knob and feet

*Specifications are subject to change without notice.

11.1 Installation Environment

Installation Category II per IEC 664

Pollution Degree Level II per IEC 61010-1

Temperature: 32 to 104 °F (0 to +40 °C) operating
14 to 158 °F (-10 to +70 °C) storage

Humidity: Maximum relative humidity of 80% for temperatures up to 88 °F (31 °C) decreasing linearly to 50% relative humidity at 104 °F (40 °C)

11.2 Compliance

Please visit our website (www.monarchinstrument.com) to download our EU Declaration of Conformity for this product.

12.0 ACCESSORIES

See the SLS Accessories webpage for details.

SLS-CA-BNC (PN: 6180-023)
Cable assembly with BNC connector (SO)

SLS-CA-W (PN: 6180-024)
Cable assembly with tinned leads

SLS-CA-P (PN: 6180-025)
Cable assembly with 1/8 inch [3.5 mm] mono plug (SO)

SLS-CA-RS232 (PN: 6180-026)
Cable assembly with DB9 connector for RS232

Mini Tripod (PN: 6180-040)
Miniature tripod with 1/4" x 20 threaded stud

PR Universal Recharger (PN: 6280-017)
Power Supply with assorted adapter plugs

T-5 Reflective Tape (6180-070)
5 ft. [1.5 m] roll, 0.5 inch wide

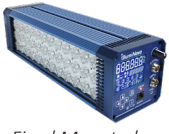
Measure • Monitor • Maintain

Monarch Instrument is committed to excellence and quality in manufacturing, sales, and service.

Portable Tachometers

Track-It™ Data Loggers

Panel Tachometers



Fixed Mounted Strobes

Portable Strobes

Frequency Converters

Speed Sensors

DataChart™ Paperless Recorders

MONARCH INSTRUMENT

15 Columbia Drive, Amherst NH 03031 USA
Tel.: (603) 883-3390 // 800-999-3300
Email: support@monarchinstrument.com
Website: www.monarchinstrument.com

 1071-4859-116 0325