



# MONARCH INSTRUMENT

*Instruction Manual*

## CSLS Compact Smart Laser Sensor



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# SAFEGUARDS AND PRECAUTIONS



## Diode Laser

Max. output power: <5 milliwatt  
Wavelength: 650 nanometers (visible light)  
Beam Divergence: <18 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 or stare into beam. Avoid accidental exposure to eyes. Do not aim at aircraft. **This is not a toy.** Always supervise children.

### Manufacturer:

Monarch Instrument  
15 Columbia Drive  
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Country of Origin: USA  
Contact info: [www.monarchinstrument.com](http://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.**



**In order to comply with EU Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE):** This product may contain material which could be hazardous to human health and the environment. **DO NOT DISPOSE** of this product as unsorted municipal waste. This product needs to be **RECYCLED** in accordance with local regulations, contact your local authorities for more information. This product may be returnable to your distributor for recycling - contact the distributor for details.

**Monarch Instrument's Limited Warranty applies.**

See [www.monarchinstrument.com](http://www.monarchinstrument.com) for details.

**Warranty Registration and Extended Warranty coverage available online at [www.monarchinstrument.com](http://www.monarchinstrument.com).**

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## 1.0 OVERVIEW

The Compact Smart Laser Sensor (CSLS) is a self-contained optical sensor intended to be used to make non-contact speed measurements from rotating targets at distances up to 65 feet (19.8 m). The sensor has both digital pulse and analog outputs to provide non-contact reference points to balancing equipment or signals to a vibration analyzer. The sensor will track surface irregularities on rotating shafts and provide pulse outputs from reflective tape, contrasting colors and keyways. Refer to section 4.0 for an overview of operation. The sensor is IP64 rated and is suitable for use in dusty damp environments. The unit has a removable plate with 1/4-20 bushing for tripod mounting.

## 2.0 INDICATOR AND BUTTON

**Status LED** A single bicolor red/green LED indicates sensor status (see operating modes for specifics)

**Push button** Short button press (less than 3 seconds) – In Auto Mode will “learn” current conditions, In manual mode will change the gain settings. (see operating modes for specifics).

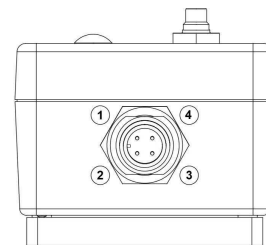
Long button press (greater than 3 seconds) – toggles between Auto and Manual Mode, LED color will indicate which mode the unit has entered (Green=Auto, Red=Manual)

## 3.0 CONNECTION DETAIL

The unit has an four-pin M12 circular male connector for power and output signals. A watertight mating connector with 9-foot [3m] molded cable is supplied.

The connector on the unit has the following connections:

Pin	Signal	Mating Cable Color
1	V+ (5 Volts)	Brown
2	Analog Out	White
3	Digital Out	Black
4	Ground	Blue



## 4.0 OPERATION

The CSLS sensor emits a laser beam, which is reflected back by the target (reflective tape/paint, keyway, contrasting colors, etc). This reflected light is sensed and amplified. The gain of the input amplifier can be adjusted automatically or manually. The amplified signal is compared against a threshold for the digital output or is simply buffered for the analog output. This allows the unit to be used with many types of targets at various distances and contrasting color conditions.

The unit has two modes: **Auto Mode** and **Manual Mode**.

### 4.1 Auto Mode

In the Auto Mode the CSLS goes through a learning process to set the gain to receive an optimum signal (LASER reflections). It tries to set the threshold up to certain level of the signal so that a periodic digital output can be extracted. If the target signal is not periodic or it cannot be analyzed by the CSLS, the unit will set the gain and threshold to some

mid range value, which can detect high-level pulses (e.g. reflective tape). If there is no moving target (no signal), the CSLS will come out of the learn process and set the gain and threshold to the same midrange values.

When the CSLS is first powered on the unit enters the Auto/Learn Mode. The Red LED will blink red several times to warn the user that the Laser is going to turn on. Once the Laser is on, the unit starts the learn process. The Green LED will blink green several times to indicate the device is trying to get an optimal signal. Once the signal is detected, the Green LED will turn off. The Green LED will then blink each time a valid input signal is detected to indicate that the Laser is on target. The Green LED will turn off if the Laser is not on target (or green LED blinks at input frequency rate).

#### **Auto/Learn Mode LED Status Indication:**

- **Red LED blinking red** = Warning before laser turns on
- **Green LED blinking green** = initially unit is trying to get optimal signal (learn process), then unit will blink green at the input frequency when the unit is properly aimed. The LED will appear on continuously at high speeds
- **Green LED off** = Laser is not on target

While in the Auto Mode, the user can press the Learn/Mode button (a quick press less than 3 seconds) to have the unit “learn” a new target.

The user can also change to the Manual Mode by holding the Learn/Mode button down for more than 3 seconds. Once the Status LED turns Red, release the Learn/Mode button and the unit is now in the Manual Mode.

## **4.2 Manual Mode**

In the Manual Mode the CSLS allows the user to set the gain manually. When the device enters the Manual Mode for the first time, it sets the gain to the maximum available value (8). The user can then decrease the gain value for optimal use.

To change the gain, first aim the laser at your target. Press and release the Learn/Mode button (less than 3 seconds) to change the gain of the input amplifier. Each time the button is pressed (for less than 3 seconds), the gain is changed. The Status LED will blink at a fixed rate to show what gain has been selected. The number of LED blinks (after button is pressed) identifies the current gain index (8 down to 1). Once the gain is at the lowest setting (gain index 1) it rolls over to highest level (gain index 8) the next time the button is pressed. The weaker the signal, the larger the gain index required. Using a large gain for a strong signal is not recommended since the input will saturate.

#### **Manual Mode LED Status Indication:**

- **Red** = indicates unit has entered Manual Mode
- **Steady/fixed blinking Green LED** = unit will blink green indicating the gain index (8 through 1)
- **Red LED blinking red** = Warning before laser turns on
- **Green LED blinking green** = unit will blink green at the input frequency when the unit is properly aimed. The LED will appear on continuously at higher input frequencies.

The user can change to the Auto Mode by holding the Learn/Mode button down for more than 3 seconds. Once the Status LED turns Green, release the Learn/Mode button and the unit is now in the Auto Mode.

## 5.0 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) or moist locations, 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.

## 6.0 CSLS SPECIFICATIONS

**Note:** Product specifications are subject to change without notice.

### 6.1 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:** <18 mrad  
**Beam Diameter:** 4 x 7 mm typical at 2 meters  
**Laser Diode Life:** 8,000 hours MTBF (1 year warranty)

**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) at over 260,000 RPM

**Max RPM:** 500,000 RPM

**Min. Trigger Duration:** 10 µsec

**Indicators:** Bicolor status LED for various operating functions - see above.

**Modes:** Auto/Normal (auto learn, automatic gain control) and Manual (manual adjustment of sensitivity / gain)

**Sensitivity Adjust:** Push button (manual mode). Auto level adjust in normal mode after “learn”.

**Power Requirements:** 5V ±5% at 30mA max.

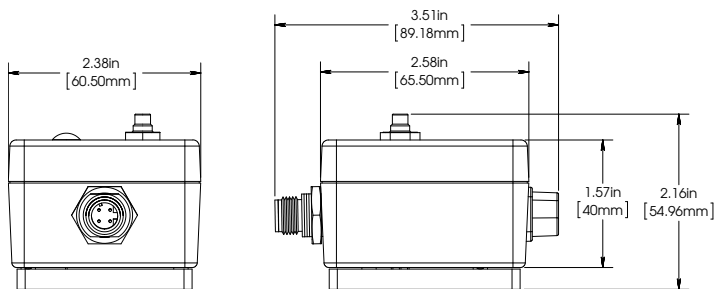
**Pulse Output:** With respect to the Common (Pin4)  
Pin 3 Digital Output - 0 to 3.0V typical @ 5mA positive going pulse (TTL Compatible)  
Pin 2 Analog Output - analog signal tracks the movement of the reflecting source (emulates an accelerometer signal)

**Connector:** M12 Circular 4-Pin Watertight Socket - Common, Power (+5V), Analog Out, Digital Out

**Mounting:** Removable plate with ¼-20 UNC Bushing included (Tripod Mount)

**Weight:** 4.8 oz (136.1 grams)

**Dimensions:** Approximately 3.5" (8.9 cm) (including 4-pin connector and laser snout) x 2.4" (6.0 cm) x 2.2" (5.5 cm) (including button and mounting pem) LxWxH



**Compliance:**

EMC: Directive 2014/30/EU - EN 61326-1:2013  
 Low Voltage: Directive 2014/35/EU  
 Electrical Safety: EN 61010-1:2010  
 Laser Safety: EN 60825-1:2014-3

**Installation Environment:**

**Installation Category II** per IEC 664  
**Pollution Degree Level III** per IEC 61010-1  
**Temperature:** 32 to 120 °F (0 to +50 °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)

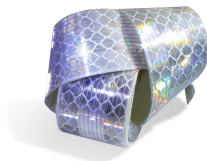
**Specifications subject to change without notice.**

## 7.0 OPTIONS / ACCESSORIES

<b>T-5 Tape</b> 6180-070	Reflective Tape, 5 foot [1.5 m] roll, ½ inch [13 mm] wide Additional lengths available
<b>T-5WP Tape</b> 6180-079	Waterproof Reflective Tape (honeycomb pattern), 5 foot [1.5 m] roll, 1 inch [25 mm] wide
<b>CSLS-CA-P</b> 6180-039	Power/Output Cable 9 foot [3 m] with molded M12 4-pin plug and 1/8" phone plug
<b>CSLS-CA-W</b>	Replacement Power/Output Cable 9 foot [3 m] with molded M12 4-pin plug and 4 tinned leads (one supplied with unit)
<b>Tripod Mini</b> 6180-040	Miniature tripod for use with Monarch tachometers and stroboscopes



T-5 Tape  
P/N: 6180-070



T-5WP Tape  
P/N: 6180-079



CSLS-CA-P  
P/N: 6180-039



CSLS-CA-W



Tripod Mini  
P/N: 6180-040

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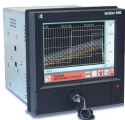
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