

## Laser Event Recorder Model LER MOD III

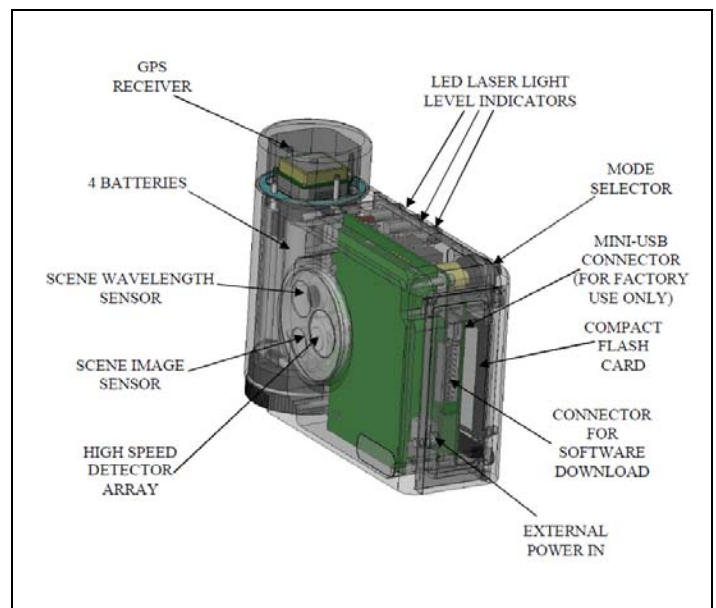
### PRODUCT DESCRIPTION

The Laser Event Recorder (LER) is a lightweight, portable and autonomous laser dosimeter designed to measure, characterize, and document laser exposures. The system will actively alert personnel working with, or exposed to, potentially hazardous laser illumination. This real time indication of laser exposure promotes the user to implement appropriate eye safety, and when necessary, seek post-exposure care.

The LER is self-powered and detects both continuous and pulsed laser sources in the visible, and near infrared portion of the spectrum. Detected irradiance levels are compared to the appropriate ANSI standard. If the exposure level is above the Maximum Permissible Exposure (MPE) level of the eye, the LER issues a visible warning to the operator via an LED on the back panel.

The system also logs time-based information pertaining to laser event exposures for cumulative evaluation. The LER detects laser energy and extracts pertinent exposure information such as irradiance level, wavelength, pulse duration, pulse repetition frequency, time and location of exposure. The LER also captures an image (JPEG) of the scene containing the laser.

The LER is approximately the size and weight of a commercial single-lens reflex camera. The recorder's size, weight and autonomy make it ideally suited for demanding applications with virtually no set-up required.



### Advantages/Uses:

- Self-Contained Design
- On-Board Data Storage
- Unattended Operation
- Detection and Characterization of Laser Illumination Events
- Illuminations Compared to ANSI Standards
- Day/Night/Night-NVG Warning Lights
- GPS Time/Location



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## Laser Event Recorder Model LER MOD III

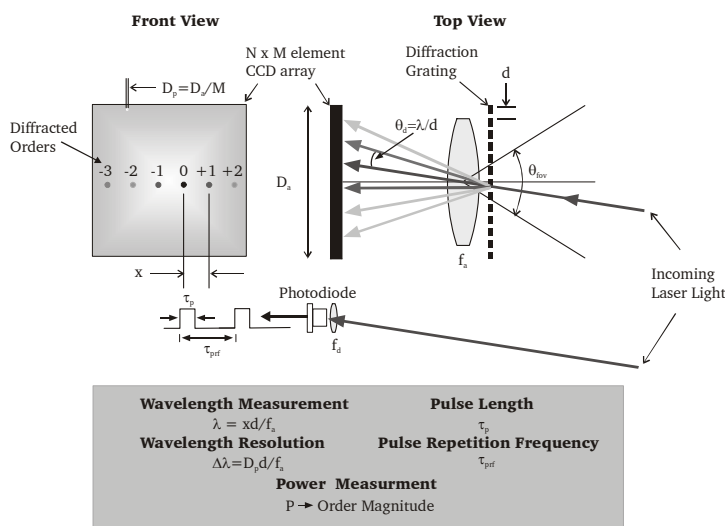
### TECHNICAL SPECIFICATIONS

In the cumulative event evaluation mode, multiple laser events can be analyzed. The laser event recorder is designed to detect and record laser exposures at levels that are high enough to be a threat to vision. The sensor identifies the laser threats, and records information to help identify the laser point source. The adjacent table provides the performance specifications of the LER MOD III.

Laser Event Recorder MOD III Specifications	
Wavelength Range	400 to 1100 nm
Wavelength Accuracy	+/- 10 nm
Exposure Duration	10 ns to CW
Detection Threshold (@ 532nm)	150 nJ/cm <sup>2</sup> (pulsed) 5 μW/cm <sup>2</sup> (continuous)
Dynamic Range	10 <sup>4</sup> :1
FOV	42 (H) x 24 (V) degrees
Pulse Duration	≥10 ns
Pulse Repetition Rate	0.5 Hz to 20 kHz
Data Storage/Format	Compact Flash Card, Text File
Image Format	JPEG
Memory Capacity	>100 Events
Power	4 AA Batteries
Operating Time	Up to 6 hours (Lithium batt.) Up to 4 hours (Alkaline batt.)
Weight (without batteries)	0.9 lbs (400 g)
Size	3.9 x 5.0 x 1.6 inches (9.8 x 12.6 x 4.3 cm)

### MEASUREMENT PRINCIPLE

The LER uses a diffraction grating to encode the wavelength information as an angular separation between diffracted orders. The multiple orders of the laser are imaged onto a detector array in the focal plane of the grating collection lens, which transforms the angular separation between the diffracted orders into a spatial separation between the diffracted images of the laser point source. The irradiance and wavelength information is obtained by extracting the order magnitude and separation using an onboard embedded processor operating in real time. The pulse length and Pulse Repetition Frequency (PRF) are obtained from a photodiode, and a separate, co-aligned imaging sensor is used to collect scene information.



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### WARNING INDICATION

In addition to collecting detailed, quantitative data on the laser source, the recorder presents the user with a qualitative, real-time indication of the presence and level of eye hazard of laser illumination. The Laser Event Recorder contains three indicator Night Vision Goggle (NVG) compatible LEDs on the back panel, each conveying different information to the user. The adjacent table describes the meaning of each color illuminated LED.

Laser Event Recorder LED Warning Indication	
Green	System is functioning and ready to collect data.*
Yellow	The device is detecting laser energy below the MPE
Red	The laser exposure is above the MPE

\* Note that the green LED will flash momentarily at the conclusion of a laser event while the event information is being saved to the CompactFlash card.

### OPERATING MODES

The laser event recorder provides warning indication for a variety of ambient lighting conditions. Lighting options are selected via the rotary switch on the back of the unit. The adjacent table provides a description of the available operating modes.

Laser Event Recorder Mode Selection	
Off	Off position
Day	Bright sunlight
Night	Night and dark light
NVG	Compatible with the military NVGs

### DATA RECORDING

Specific data collected by the LER is saved on the compact flash card. The event text file name is itextX01.txt, where X corresponds to the run number from 1 – 9. A run is terminated when the recorder is powered down. After 9 runs the card must be cleared for proper initialization. The adjacent table describes each data field collected.

The image file name is imageXY.jpeg, where Y corresponds to the event number from 01 – 99. No images are saved after 99 recorded events for a given run, however, the text file continues to log the event data.

Laser Event Recorder Text File Data	
Image#	JPEG event image number
Type	C – CW exposure; P – Pulsed exposure
Xloc	Array column location of laser; 1 – Left side of image
Yloc	Array row location of laser; 1 – Top of image
Lambda	Wavelength (nm)
Jin_sum	Event summed irradiance (J/cm <sup>2</sup> )
Pulselength	Pulse length (s)
Prf	Pulse repetition frequency (Hz)
Npulses	Number of pulses measured during event
MPE Red	Y – Event above MPE; N – Event below MPE
Duration	Event duration (s)
Lat	Latitude of LER during event
Long	Longitude of LER during event
Alt	Altitude of LER during event
Date	Date of event
Time	Time of event (Greenwich Mean Time)

## **OPERATING INSTRUCTIONS**

### **1. Inspect Package Contents**

The LER is shipped with 4 AA batteries and a 256 MB flash memory card. If either of these items is missing from the package, notify the manufacturer immediately.

### **2. Connect Power**

Option #1 (Using Batteries): Unscrew and remove the battery door on the bottom of the unit. Install the 4 AA batteries in accordance with the polarity indicated on the device and reinstall the battery cover.

Option #2 (Using DC Power): Open the side cover to the recorder and connect the supplied DC power cable to the “External Power In” port on the LER.

### **3. Install flash card**

Open the side access panel by sliding the door downward and lifting to reveal the CompactFlash card socket. Insert the flash card and re-secure the panel.

### **4. Power up Laser Event Recorder**

Rotate the mode selector on the back panel to the appropriate setting for the current lighting conditions. Upon power up, all three LEDs illuminate indicating initialization of the LER. Upon completion of initialization, the yellow and red LED will turn off and the green LED will remain on. If all three LEDs turn off, this indicates a problem with the LER set-up. If this error occurs, consult the troubleshooting section at the end of the manual.

### **5. Collect Data**

Shine a laser pointer with known characteristics at the wavelength sensor (see figure on first page of the manual), while monitoring the indicator LEDs. If the yellow or red LEDs light up when the sensor is illuminated, the LER has detected the laser exposure and will record an event.

### **6. Power down Laser Event Recorder**

After collecting data on the laser pointer, turn off the LER by rotating the mode selector knob to the OFF position.

### **7. Download and Review Data**

Open the side access panel and remove the memory card by depressing the tab adjacent to the memory card socket. The event data is obtained from this card by inserting it into a flash media drive or adapter on a personal computer. Consult the Data Recording section of this manual to determine what data is being reported in the text file.

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### INTERACTIVE PROCESSING

Optionally the recorder can be connected to a standard PC or laptop (with an available serial port) for real-time streaming of the recorder data. First verify proper operation of the recorder by successfully completing the Operating Instructions section of this manual. Interactive streaming of data can be accomplished by opening the side cover to the recorder and connecting the supplied serial cable from the “Software Download” port on the LER to the PC/laptop’s serial port. Use Windows’ Hyperterminal feature (or some other serial interface software tool) and configure the PC/laptop’s serial port for 9600, (baud rate) 8 (data bits), 1 (stop bit), n (no parity), no flow control.

On power up, the recorder executes its initialization and self test. The Hyperterminal window will display the status of these processes with the following.

```
Initializing ...
  Debug Stuff ... Passed
  HiSpeed Electronics ... Passed
  Autosave selected
  Memory ... Passed
  Timers ... Passed
  Interrupts ... Passed
  Gio ... Passed
  DMA ... Passed
  GPS ... Passed
  VideoIn ... Passed
  DSP ... Passed
  CompactFlash ... Passed
    Size = 260MB
Initialization Passed

Performing Self Test ...
  Memory ... Passed
  Timers ... Passed
  Interrupts ... Passed
  Gio ... Passed
  DMA ... Passed
  VideoIn ... Passed
  GPS ... Passed
  HiSpeed Electronics ... Passed
  DSP ... Passed
  CompactFlash ... Passed
Self Test Passed

O P T R A Laser Event Recorder
0-7 = Mode Setting
  0=Autosave 1=DataStream 2=TextStream
  5=Alignment 6=Bad Pixel 7=TargetOutput
C = Scenery camera   c = Wavelength camera (Def)
M = Save Me One     m = Save Me One OFF (Def)
G = Get HiSpeed Data
```

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S = Save Image and Text  
 Q or q = Quit

Processing ...

Once initialization and self test complete successfully, the user is presented with various options to control the recorder processing and output options. These user selectable settings are described as follows:

Mode	Name	Description
0	Autosave	The default operating mode of the system where annotated images are stored to imageXYY.jpg and data is stored to itextXYY.txt as previously described.
1	Data Stream	Factory only
2	TextStream	This mode stores data at a 30 Hz update rate during a laser event to a text file of the format itextXYY.bin for debug and analysis.
5	Alignment	Factory only
6	Bad Pixels	Factory only
7	TargetOutput	This mode outputs at a 30 Hz update rate during a laser event to the serial port interface.
C, c	-	Factory only
M, m	-	Factory only
G	-	Factory only
S, s	-	Factory only
Q, q	-	End processing (same as turning the power switch to the OFF position)

An example of a Mode 7 (TargetOutput) Hyperterminal output portion is shown below. “A” refers to the angle of incidence of the laser event, “lm” the wavelength, and “E” is the irradiance.

```
A=-0.8deg lm=648nm E=2.97e-07
A=-0.7deg lm=648nm E=5.81e-07
A=-0.6deg lm=653nm E=5.06e-06
A=-0.4deg lm=651nm E=4.95e-06
```

## MOUNTING INSTRUCTIONS

The LER contains a standard 1/4-20 threaded screw hole on the bottom of the unit for mounting to a tripod or other custom assembly.

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### TROUBLESHOOTING INSTRUCTIONS

Problem	Solution
No indicator LEDs are illuminated when mode selector is turned to an operating position.	Install/Change batteries. Verify power.
All three indicator LEDs remain illuminated (for more than 10s) after system start-up	Change batteries
All three indicator LEDs turn off after system start-up	This symptom can reflect one of several issues. Follow the steps listed below, in order, to correct this problem: <ul style="list-style-type: none"><li>◦ Check that the flash memory card is properly inserted by reseating the card in its slot.</li><li>◦ Verify flash memory card is not greater than 256MB and it is formatted with the FAT file system (not FAT32 or NTSC).</li><li>◦ Check to see how many laser event files are on the flash memory card. If there are 10 text files, you will need to empty the card before collecting more data. If you choose to reformat the card to empty it, use the FAT file system (not FAT32 or NTSC)</li><li>◦ Contact OPTRA for assistance.</li></ul>

### MAINTENANCE INSTRUCTIONS

#### Change batteries

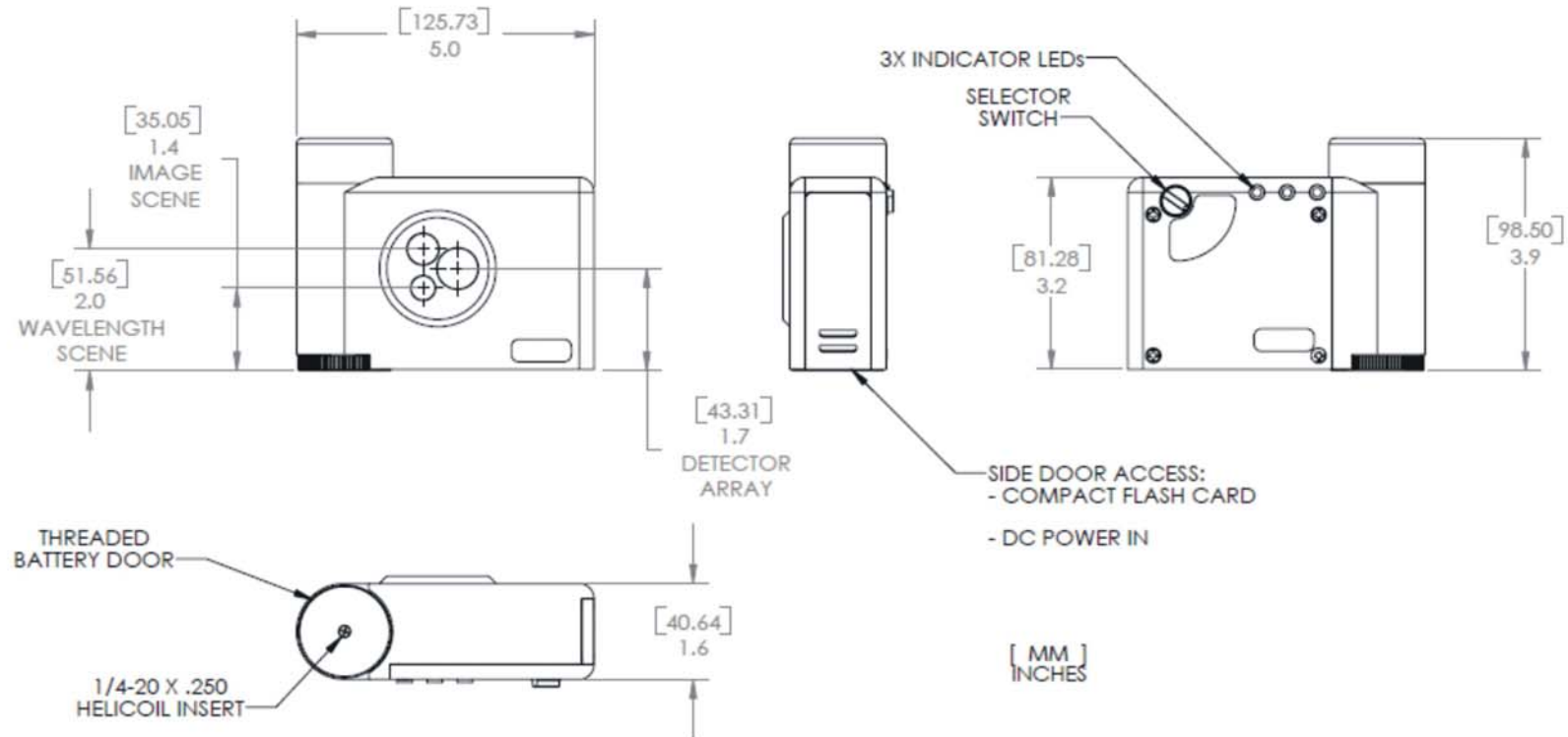
A set of 4 AA lithium batteries will allow the laser event recorder to run for up to 6 hours. The batteries should be changed when the operating time approaches 6 hours.

#### Clean window

For optimal performance, a clean sensor window must be maintained. If dirt, dust or finger oils are visible on the window, begin by flushing the substance off of the window using either compressed air or water. Follow with a methanol or acetone rinse, by applying either liquid to a cotton swab and gently wiping the swab across the entire window surface. Finally, dry the surface using a piece of lens tissue. If methanol or acetone is not readily available, Windex can be substituted. Similarly, in the absence of lens tissue, Kleenex can be substituted.

## Laser Event Recorder Model LER MOD III

### MECHANICAL DETAILS





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--- Notes ---