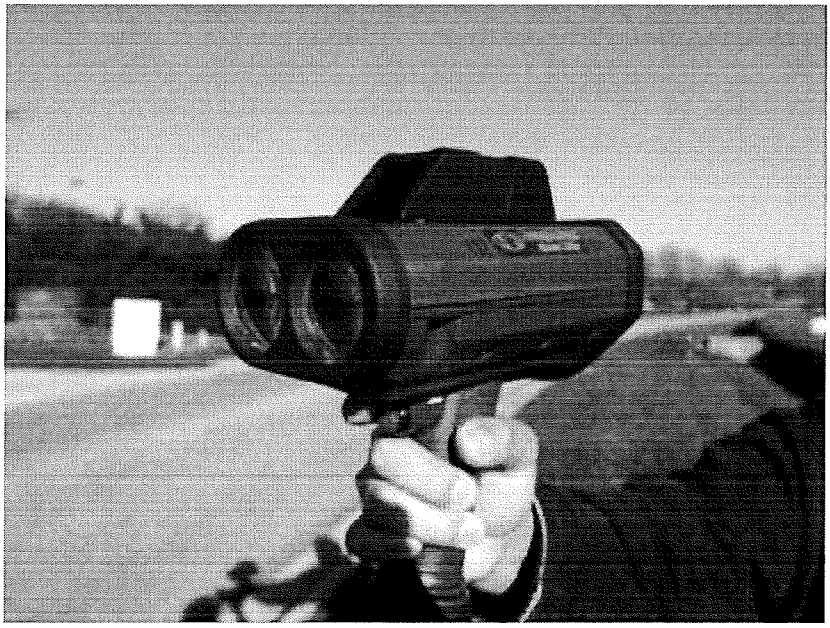
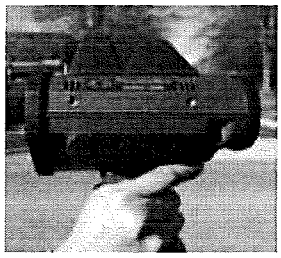
DragonEye
SPEED LIDAR®





Operator Manual

Canadian OPP Version

Doc: 30508 Rev. 02

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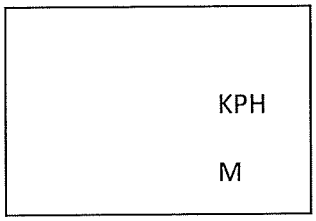
Introduction

Thank you for purchasing a DragonEye Technology product.

The DragonEye Speed LIDAR® is a high performance electro-optical product providing accurate speed and distance measurements custom designed for the law enforcement community. The LIDAR provides pinpoint target identification via its clear head up display targeting system and fast target acquisition using sophisticated, robust data processing algorithms. The DragonEye Speed LIDAR was designed for light-weight operation and long battery life. It provides numerous useful settings and features including advanced ECCM

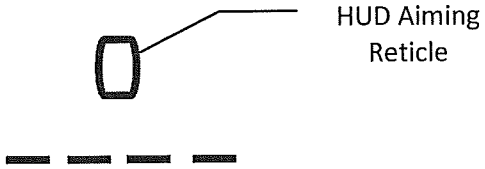
Selecting Speed Mode

The LIDAR will normally power up in "Speed" mode, unless it was recently used in a different mode. If "Speed" mode is not displayed on power up, simply press  until the back panel displays:



Using the HUD Sighting System

The Head-Up display provides a precision aiming reticle, speed reading, and other status information. To find the sighting reticle, click the trigger to wake up the LIDAR and look directly through the HUD letting your eyes focus on a target well in front of the LIDAR unit. If you haven't used a HUD device before, it might take a minute or two for your eyes to adjust the first time.



(Note: Make sure the LIDAR's brightness setting is on medium or high if working in daylight.)

The LIDAR's laser beam is invisible, but will be contained within the aiming reticle. This is your aim point for target vehicles.

Roadside Setup

When first learning to use the DragonEye Speed LIDAR®, it is best to select a straight stretch of roadway with a line of sight of 150 metres or more.(or follow your provincial program)

Approaching or receding vehicles should be targeted such that your line of sight through the HUD is as parallel as possible to the path of the target vehicle. This will minimize the "cosine effect" as described in Appendix A of this manual. *(Note: The cosine effect applies to both RADAR and LIDAR systems and always results in a slightly lower than actual reading.)* A good rule of thumb for approximately straight roadways is to target a vehicle at a range which is at least ten times the operator's perpendicular distance to the vehicles lane of travel. For example, if the operator is 9 metres from the vehicle's lane of travel, the vehicle should be targeted at 300 feet (90m), or greater. This would result in a measured speed reading which was approximately 0.5% less than actual.

Measuring Vehicle Speeds

For approaching targets, aim the LIDAR's reticle at the front grill or front license plate of the vehicle. Good targets for receding vehicles are the license plate or tail lights. Use the boundaries of the reticle pattern to ensure only the intended vehicle is being targeted. Squeeze and hold the laser fire trigger while maintaining your aim.

You may hear an intermittent audible tone as the LIDAR searches for a valid target signal. You will also see "----"displayed in the HUD indicating the laser is firing and a reading is being acquired. Once target vehicle data is identified, the LIDAR will produce a continuous

lower frequency tone. When the data from the vehicle reaches an acceptable accuracy level, audible tone will switch to a continuous, higher frequency and the vehicle speed reading will be displayed in the HUD and on the back panel.

Note: At typical distances the above acquisition sequence can happen very quickly and you may simply hear the high frequency tone and see the speed display immediately.

A positive speed reading will be shown for an approaching vehicle, while receding vehicles are indicated with a negative reading. *(Note: Both the HUD and the back panel will show a "-" sign for receding vehicles.)*

The DragonEye Speed LIDAR® will continuously update the target's speed reading at an approximate rate of 3 times per second as long as the trigger is depressed and the data quality is acceptable. While not required, it is recommended to track the vehicle for at least 1 second to establish robust confidence in the speed reading.

Speed Display Lock

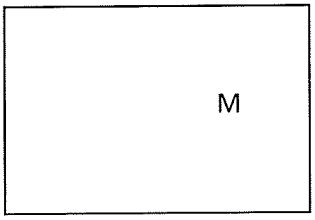
Once a desired speed reading is acquired, the operator can "lock" the speed reading on the rear panel display by simply releasing the laser fire trigger. If a speed reading is lost after tracking a vehicle, the last speed reading will flash for approximately two seconds, giving the operator an opportunity to lock in the vehicle's speed. *Note: The flashing speed reading will be immediately over written if the operator acquires a new speed reading.*

Speed Display Lock Retention

Once a speed is locked into the rear display, it will be retained there for up to 20 minutes. If the laser fire trigger is depressed within 30 seconds after the speed is locked, the display will clear and prepare for a new reading. If no buttons are pressed for 30 seconds after the speed reading is locked, the unit will go into a sleep mode, turning off the HUD and displaying "Power-Save" on the rear panel along with the locked reading. In the Power-Save state, a first laser trigger pull will "wake" the LIDAR but retain the locked reading. A second pull will then clear the reading. This feature is intended to aid in preventing the operator from accidentally clearing the locked reading.

Range Mode

The LIDAR system can be used to measure distances to a variety of targets. To enter Range Mode, press the Mode Button  until the rear panels displays:



Use the aiming reticle in the HUD to select your desired target. Squeeze and hold the trigger until a range reading is displayed in the HUD and on the rear panel display. The trigger may be continuously held as the unit is moved from target to target for quickly checking multiple ranges. The last range reading in the display is locked when the trigger is released. Range readings are displayed in tenths of a

foot on the rear panel and in the HUD up to 999.9 metres. Above this, range readings are displayed to the nearest integer foot or meter.

The maximum target distance is 1828 metres which can be obtained from highly reflective surfaces such as retro-reflective road signs or vehicle tail lights. The range to non-retro-reflective targets will vary depending upon their infrared reflectivity. Typical ranges are >548 metres from a tree with green foliage, >610 metres to a white concrete building and 305metres from a very black, non-reflective target. The minimum range (in "Normal" Weather/Obstruction Mode) is 3 metres.

Advanced Controls and Modes

Weather and Obstruction Modes

The  button is used to select one of three environmental operating modes:

1. Normal Mode
2. Weather Mode
3. Obstruction Mode

To select a particular Weather/Obstruction mode simply press the  button. The rear panel will display the current mode of operation. Continue to press the  button to toggle through the three modes selecting the desired mode as described below:

Normal Mode

In Normal Mode, the LIDAR has no additional restrictions placed upon the minimum distance at which a target can be acquired (besides the normal minimum range specification). If rain, snow, fog or other obstacles are present in the line of sight to the target, it is possible the LIDAR will receive signals from these objects preventing a reading from being displayed on the targeted vehicle. To select Normal Mode, toggle through the three modes and select "Normal". Wait for a couple of seconds and the LIDAR will return to Range or Speed mode. No special icons will be displayed.

Weather Mode

Select Weather Mode to improve the LIDAR's ability to shoot through rain, snow, fog, or other airborne particulates such as heavy dust or sand. After pressing  , toggle through the three modes to select Weather Mode; wait for a couple of seconds and the LIDAR will return to Range or Speed mode with the Weather mode activated. The Weather indicator  will be displayed in both the HUD and the rear panel display. ***In Weather mode, the LIDAR will not acquire any targets within 76 metres. However, due to its smart target-lock capability, the LIDAR will continue to track oncoming cars inside the 76 metre, provided they were initially acquired outside of this range.***

Obstruction Mode

Select Obstruction Mode to allow the LIDAR to detect targets beyond small obstructions such as tree limbs, wires or see through fence material. Toggle through the three modes using the  button and stop on Obstruction Mode. Wait for a couple of seconds and the LIDAR will prompt you to "shoot the obstruction" or press the Menu

button  to exit without effecting changes. If Obstruction Mode is desired, aim at the obstruction and pull the trigger to measure the distance to the obstruction. The distance will be displayed in the rear panel. If you are not sure you hit the correct object, simply pull the trigger to acquire another range. Once you are satisfied with the range reading, press the Enter  button to accept. The obstruction symbol will be displayed in the HUD and on the back panel. The LIDAR will now ignore all objects up to and slightly beyond the obstruction.

Note: You must have at least a partially clear line of sight to the target beyond the obstruction. Also please note that Obstruction Mode is designed for overcoming one, fairly well defined obstruction. It is not intended to function with multiple obstructions at differing distances along the line of sight.

Minimum and Maximum Ranges (Range Window)

While in Speed mode, The Minimum and Maximum Range settings are used to set limits (or a range window) outside of which, speed readings will not be displayed.

To adjust either of these settings, press the menu button  and then use the up/down arrows  to display "Minimum Range" or "Maximum Range". Press the Enter button  to select. The display will give you the option to use the up/down arrows to set the range or "shoot object" to use the LIDAR's range function to set the range limit. To manually set the range, simply

use the up/down arrow buttons to set the desired limiting distance. If the arrow buttons are held down, the units will change in larger increments after about 10 seconds. When the desired range value is in the display, press the Enter button  to accept.

Note, once the operator begins to use the up/down arrow buttons to set the range limit, the "shoot" option will no longer be available.

Alternatively, the Minimum and/or Maximum range values may be set by "shooting" a target that represents the particular range limit (such as a school zone or work zone sign). To shoot the Minimum or Maximum range, enter the desired menu and instead of using the up/down arrows, pull and hold in the LIDAR trigger and aim at the target that represents the Minimum or Maximum range. You may range to the target multiple times until you are positive the correct target has been selected. Press the Enter button  to confirm the value. Once the Minimum and/or Maximum range values are set, the LIDAR will display only speeds between these values. If a vehicle is acquired outside of this range window, a target acquired audible tone will be heard but dashes (- - - -) will be displayed in the HUD and on the rear display in the speed reading area. Also the word "window" will be displayed to indicate the target was acquired outside of the allowable range window. To quickly remove the Range Window settings, use the Menu button, then use the arrow buttons to select "Load Defaults". Press the Enter button to reset all user settings to default values. *Note: The adjustable Maximum Range Menu may not be available on some units where jurisdictions may fix the maximum range allowed for the LIDAR devices.*

Direction Filter

The DragonEye Speed LIDAR® allows the user to set the system to display speeds on: 1) Only approaching Vehicles, 2) Only receding Vehicles or 3) Both approaching and receding vehicles. The default value is set for both approaching and receding vehicles.

To set the Direction Filter, press the Menu button  then use the up/down arrows   until "Direction Filter" is displayed on the rear panel. Press the Enter button  and then use the up/down arrows to display the desired filter setting: APPROACH, RECEDE, or BOTH. Press Enter  to accept the setting.

The LIDAR will return to the current operating mode (range or speed).

Note: If a vehicle is targeted in a direction opposite that of the Filter selection, the LIDAR will still output the solid audible tone, however the HUD and rear panel will show "----" in the speed display area. The rear panel will also display the indication "Approach" or "Recede" to indicate that a vehicle has been targeted traveling in a direction opposite to that of the Filter.

Differential Distance: LIDAR in Metric Units (KPH)

The (KPH) Differential Distance Test uses two fixed targets separated by a precisely known distance. Using the LIDAR's range function to determine the separation between the targets, the KPH Differential Distance test provides a quick check of the LIDAR's ability to measure the distance between two targets.

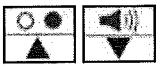
Use two flat targets, approximately 0.5m x 0.5m square, painted flat white. Place the targets at precise distances from a "zero" point where the LIDAR will be positioned. The targets should be set at integer feet values from the LIDAR zero point and should be approximately 10 metres apart. Recommended target distances are 20.0 metres and 30.0 metres from the LIDAR unit. Please note, minimum range capability is 3 metres. Ensure the front end of the LIDAR unit is positioned exactly at the zero point, using a tripod if necessary.

On the LIDAR unit, press the Menu button  then use the up/down arrows until "Diff Distance" is displayed. Press Enter  . Carefully obtain a range reading from the first target and then press Enter  . Carefully obtain a range reading from the second target and then press Enter  . The LIDAR will then display the distance between the two targets on the rear display. The distance should be within 0.5 metres of the actual distance between the targets.

If the LIDAR does not pass the test, carefully recheck the distances and reposition the targets and LIDAR if necessary then repeat the test. If the unit continues to fail the test, please contact customer service.

Timed Distance Mode

The Timed Distance Mode allows the LIDAR unit to be used to determine a vehicle's average speed over a known distance between two visible reference objects along the roadway.

To enter the Timed Distance Mode, press Menu  and then use the up/down arrows  to display "Timed Distance" on the rear display. Press Enter  . The rear panel will display:

Timed Distance
200
▲ ▼

or
Shoot Object

The operator may now enter the reference distance in metres between the two reference objects using the up/down arrows   . Alternatively, the operator may shoot the two reference points to determine the distance to be traveled.

Note: The reference distance must be at least 60 Metres.

Note: If the operator elects to shoot the distance to the reference objects, please ensure both reference points are on one side of the operator and in a straight line with the operator's position. The LIDAR will subtract the two readings to determine the distance.

To shoot the distances, simply aim at the longer range reference object first and pull the trigger to obtain a distance reading. Release the trigger to lock in the distance reading. If you are not satisfied

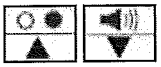
with the reading, you may simply aim and shoot the first reference object again. Once you are satisfied with the reading, press Enter  . The unit will prompt you to shoot the second reference object. If the second reference object is located where you are standing with the LIDAR, simply press Enter  . Otherwise shoot the second reference object and press Enter  when satisfied with the distance reading. The unit will show the distance between the reference objects.

At this point you have either entered the reference distance or determined it by shooting the reference objects. If the reference distance is acceptable, Press Enter  . Otherwise press the Menu  button to "escape" from the menu system.

Once the reference distance is accepted, the rear display will show the reference distance and instructions to "Click Trigger to Start". Click the trigger when a vehicle crosses the first reference object point to start the timer. Click the trigger a second time to stop the timer. The unit will display the average speed of the vehicle on the rear panel.

To measure the average speed of additional vehicles, simply click the trigger once to clear the old reading and timer is re-armed for a new reading.

Load Defaults

The factory default settings for the LIDAR can be restored at any time by pressing  then selecting "Load Defaults" using the up/down arrows  and pressing Enter  . This command restores default brightness and audio levels as well as settings for Minimum and Maximum range values.

ECCM Control

The ECCM menu allows the operator to temporarily disable the LIDAR's Electronic Counter-Counter Measure (anti-jamming) system. To activate or disable the ECCM, press  then use the up/down arrows  to select "ECCM" and press  . Then use the up/down arrows to select "Active" or "Disabled" and press  to confirm your selection. If ECCM is disabled, the LIDAR unit will return to ECCM "Active" if it is not in use for a few hours, if the batteries are replaced, or if "Load Defaults" is selected.

Note: While the DragonEye is fully functional with ECCM set to "Disabled", the ECCM setting should be left in the "Active" state during normal operation to give the full protection against laser detectors and jammers.

Input / Output Port

An eight pin DIN style connector is located on the right side of the unit. This connector can be used to collect speed and range

measurement data during operation using a special USB cable provided by DragonEye Technology. Contact the manufacturer for further details regarding use of the I/O port.

Recommended Daily Test

The DragonEye Speed LIDAR ® system is designed to provide years of service with limited maintenance. The unit uses sophisticated digitally locked electronics to ensure continued accuracy. However we recommend performing the following system checks before each shift that the operator is going to use the DragonEye Speed LIDAR ® for enforcement purposes. This will ensure operator confidence in the instrument:

Daily Recommended Test

Initiate the system Daily Test by pressing the  button. All critical internal timing electronics and software components are checked. In the HUD will be displayed "888.8", the Battery indicator, the Aiming Reticule and the Obstruct / Weather indictor. If all are illuminated the operator must press the  button to verify. The unit will commence a series of internal tests of the check sum, firmware, personality, battery voltage and unit temperature.

Fixed Target Distance

The DragonEye Speed LIDAR® uses time of flight laser distance measurement as its core technology in determining vehicle speed. Therefore a quick check of unit's ranging accuracy is suitable for daily confidence checks.

Next the unit will require the operator to perform the short range test, which must be a minimum of 3 metres using an integer meter value. Once the measurement is completed and verified, the operator must press  . The unit will then prompt the operator to perform a long range test. The long range test must be at least 10 metres or greater in integer meter value. Once that measurement is completed and verified, the operator must press  .

The front of the LIDAR unit is the datum point; carefully obtain range readings from the target. Verify the readings are within +/- 0.3 metres of the actual range.

If the unit does not pass both of the above tests, carefully check your setup and perform the test again. If the unit still does not pass, please contact your specified service representative.

Alignment Test

The operator will be prompted to complete a horizontal and vertical alignment test of the HUD aiming reticle by selecting a target with straight boundaries such as a telephone pole or road sign at a distance of 30 metres or greater. While holding the trigger in, slowly pan the aim point on and off the target edge, verifying the range reading in the HUD changes as the reticle passes onto the target. The preceding verifies horizontal alignment. Rotate the unit 90° onto its side while continuing to look through the HUD and repeat the above test to verify vertical alignment. This will allow the operator to confirm that the Infrared energy is contained within the aiming reticule and the Lidar will confirm the range selected to perform this test. The operator will again be prompted to press the  button.

The internal Self Test will also initiate automatically anytime the LIDAR is turning on from an "off" state such as a change in batteries or after the LIDAR is idle for a few hours.

Certification

An optional recertification program is available upon request. Please contact your distributor for further information.

Maintenance and General Care

Your DragonEye Speed LIDAR® is designed to keep performing with very little user maintenance. Besides replacing the batteries, there are no user serviceable parts and the unit should NOT be disassembled.

Cleaning

Periodic cleaning of the front lenses or HUD glass is only necessary if they acquire significant dirt or other debris that limits optical transmission. If cleaning is necessary, use compressed air or a soft brush to remove loose debris first. Then use a soft tissue with water or isopropyl alcohol, wiping from the center of the lens outward in a spiral motion. The HUD glass may be cleaned with a cotton swab to facilitate reaching the surfaces. *Note: If you encounter a stain or speck that cannot be removed with gentle pressure, do not increase the cleaning pressure as this may damage the lens coatings. Small scratches and stains during the lifetime of a unit are normal and will not noticeably affect the performance of the LIDAR.*

If necessary, the main body of the LIDAR can be cleaned with soapy water or mild household cleaning solutions. Avoid the use of acetone or ammonia.

Storage

When not in use, the DragonEye Speed LIDAR® should be stored in moderate temperature, dry environments. Avoid leaving the unit in excessively hot or cold areas such as the dashboard of a car in summer or in the trunk on extremely cold nights. When storing the LIDAR in holsters or other containers used on motorbikes or vehicles, do not hard mount the LIDAR to the container; instead use a cushioned container. Hard mounting to vehicle frames can couple excessive vibration into the LIDAR unit resulting in damage to internal components.

General Handling

The DragonEye Speed LIDAR® is built to be rugged and endure many types of accident impacts and drops. However, please remember that much like a camera, the LIDAR is a precision optical instrument that should be handled with reasonable care. Avoid dropping or throwing the unit into the patrol car as hard surfaces can scratch or break the glass components.

LIMITED WARRANTY

We warrant that our DragonEye Speed LIDAR® System will be free from defects in workmanship and material for a period of 24 months from the date of purchase by the original purchaser. If any defect is discovered through normal and proper use of the unit during this period, the defect will be repaired or the unit will be replaced at our factory or at one of our authorized service centers at no cost to the purchaser. The purchaser must return the defective unit to the factory or one of our authorized service centers, freight prepaid. We will pay for shipping charges for the return of the unit. This warranty applies only to structural defects in the external housing and defects in a unit's internal electro-optical components and circuitry, and is void as to units that have been opened without prior authorization, have experienced unauthorized repairs, or have had unauthorized modifications. This warranty does not cover the following:

- Normal wear and tear on the unit such as batteries, broken connectors, or scratched or broken exterior components including optical components.
- Damage caused by operator abuse or neglect.
- Damage caused by incorrect use of the unit, carelessness, unauthorized alterations to the unit, improper storage of the unit or unauthorized service, installation or repairs made to the unit.
- Damage caused by fire, flood, lightning, vandalism, collision, Acts of God, or other events beyond the reasonable control of DragonEye Technology, Inc. or the purchaser.

- Damage to external parts of the unit such as buttons, connectors, wires, and cables, etc.
- Damage from use of the unit in hostile operating environments.

We reserve the right to charge for repairs to a unit during the warranty period made necessary because of any of the foregoing causes at our standard rates for repair of units not under warranty. The purchaser assumes all risk of use from its purchase and use of the unit. Harmful personal contact with a unit might occur in the event of violent maneuvers, collisions, or similar circumstances, even if the unit was properly deployed and used. We are not responsible for, and we specifically disclaim any liability for injury caused by a unit in such circumstances.

THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THIS STATEMENT. ALL IMPLIED WARRANTIES ARE DISCLAIMED, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT, FITNESS FOR A PARTICULAR PURPOSE, AND WARRANTIES IMPLIED FROM A COURSE OF DEALING, COURSE OF PERFORMANCE OR USAGE OF TRADE. THE PURCHASER'S SOLE AND EXCLUSIVE REMEDY FOR A WARRANTY CLAIM WILL BE THE REPAIR OR REPLACEMENT OF A UNIT.

Troubleshooting and Service

Symptom	Possible Causes
Unit will not power up when trigger is pulled	1. Replace batteries. 2. Check that batteries are inserted correctly.
Head Up Display is not visible	Check HUD brightness setting
Audio tone indicates an acquired speed, but the displays show dashes	1. Speed is less than 8 KPH. 2. Speed was acquired outside the set range windows or direction filter. Adjust Min/Max Ranges or Direction settings in Menu.
Unit has difficulty acquiring speed reading	1. Use Weather or Obstruction Mode if necessary. 2. Steady LIDAR for better aiming.
Unit will not obtain readings at close ranges	1. Disable Weather Mode if on. 2. Disable Obstruction Mode if on. 3. Minimum Range in Speed Mode is 15 Metres.

Specifications

Weight:	1.14 kg with batteries	
Dimensions:	(11.4 x 17.1 x 24.8 cm)	
Acquisition Time:	1/3 Second	
Speed Accuracy:	+/- 1 Unit of Measure (One Sigma Standard Error)	
Minimum Range:	Speed Mode Range Mode Weather Mode	15 m 3 m 76 m
Speed Max/Min:	8 to 320 KPH	
Speed Mode:	True, Full time, Continuous Tracking History	
Distance Accuracy:	+/- 15.0 cm (to one sigma Standard Error)	
Distance Resolution:	3.0 cm	
Beam Divergence:	2.5 milliradians	
Laser Source:	Diode, 905 +/- 10 nm	
Eye Safety:	FDA CDRH Class 1	
Temperature Range:	-30° C to +60°C	
Power Source:	Two C-cells; High Quality Alkaline or NiMH Rechargeable	

Battery Life:	Up to 32 Hours of Operation (Alkaline C- cell)
Environmental:	Waterproof to IP67
Additional Features:	Timed Distance (Stopwatch) Mode
	Obstruction Mode
	Advanced Anti-Jamming ECCM

Appendix A – Cosine Effect

The term "Cosine Effect" as typically used in law enforcement speed measurement refers to the reduction of a vehicle's measured speed using Radar or Laser systems as compared to the actual vehicle speed, when targeting the vehicle at an angle. The diagram below shows the line "V" as the vehicle's travel direction and the LIDAR operator's line of sight "O" to the target vehicle. The angle between these two lines is labeled theta "Θ" . Motion of the vehicle along "Line V" is projected onto the LIDAR operator's line of sight "Line O". Using standard trigonometry, this projected motion can be shown to be:

$$\Delta O = \Delta V \times \cos\Theta$$