TABLE OF CONTENTS

GENERAL INFORMATION

INTRODUCTION

Congratulations! You have invested in one of the most technologically advanced instruments available for speed detection and other law enforcement uses. In a compact, handheld package, the **ProLaser** offers the versatility of direct range and speed measurement.

Operators who are familiar with the use of conventional traffic safety radar systems will find it a simple matter to become accustomed to the **ProLaser**, since it comes from a company with years of experience in the industry. Similarly, first-time operators will be surprised at how easy it is to operate, because the technology employed overcomes some of the drawbacks and operational idiosyncrasies of conventional traffic radar.

UNPACKING

When you first receive your **ProLaser**, carefully inspect the shipping carton for signs of damage. Any damage evident should be immediately reported to the carrier. Kustom Signals, Inc. is not responsible for damage sustained during shipping.

Upon opening the carton, check the contents against the following list of included items:

1 **ProLaser** lidar speed detection system
1 Heavy-duty locking carrying case w/2 keys
1 Operator's Manual
1 **ProLaser** lens cover
1 Eyesafety certification statement
1 Shoulder stock

If any of the above are missing, contact the Kustom Signals Customer Service department at 800-835-0156. Having the order number from your packing list will expedite the call.

FUNCTIONAL DESCRIPTION

The **ProLaser** is a versatile instrument that measures both the range and velocity of selected targets. The advanced technology on which the **ProLaser** is based provides pinpoint aiming capability, allowing the operator to isolate a single vehicle out of a group. In addition, operation of the **ProLaser** is completely invisible to conventional radar detectors, used by many motorists to avoid enforcement.

Rather than microwave transmission employed by traditional traffic radar systems, the **ProLaser** uses invisible light waves that are much higher in frequency. Because the wavelength of these light waves is so much shorter than microwaves, they can readily be **collimated** (or focused) into an extremely narrow beam for absolute target identification. The signal transmitted by the **ProLaser** travels in a straight line of sight, as opposed to the "fringing" effect that is characteristic of microwave emissions.

The technology used by the **ProLaser** to measure distances and speeds is referred to as **lidar**, which stands for *li*ght *d*etection *a*nd *r*anging. When the trigger is pulled, the **ProLaser** sends out hundreds of invisible infrared laser light pulses per second. As each pulse is transmitted, a timer is started, and when the energy of a laser pulse is reflected from a target and received by the **ProLaser**, the timer is stopped. From the elapsed time taken for the laser pulse to strike and return from the target, the distance to the object is calculated with the known speed of light through the atmosphere. If the

target is moving with respect to the **ProLaser**, a sophisticated algorithm is used to derive the speed of the target from a successive number of range calculations. This speed determination is then displayed to the operator.

CONTROL LOCATIONS

Operation of the **ProLaser** involves a number of various controls. Figure 1 illustrates the location of the various controls that are used to operate the instrument. These controls are briefly described as follows:

A. Power switch: turns on and off primary power.

B. Trigger: activates the range/speed measurement function, and locks and releases speed and range displays.

C. Speed control: sets the minimum threshold for displaying speeds and for activating the external output signal.

D. Range control: sets the maximum range for obtaining a speed display and for activating the external output signal.

E. Audio volume: sets the level of the audio signal used for the aiming tone and the error tones.

F. Brightness/Test: sets the intensity of the LED displays, and initiates an instrument self-test sequence.

G. Power Indicator: illuminates when the unit is receiving primary power.

H. Laser Indicator: illuminates when laser pulses are being transmitted.

I. Speed Display: indicates the velocity and direction of a moving target.

J. Range display: indicates the range of a stationary or moving target.

K. Heads-Up-Display (HUD): displays the sighting reticle and the speed or range of a moving target.

L. I/O Connector: contains conductors for the external signal output and optional RS-232 port.

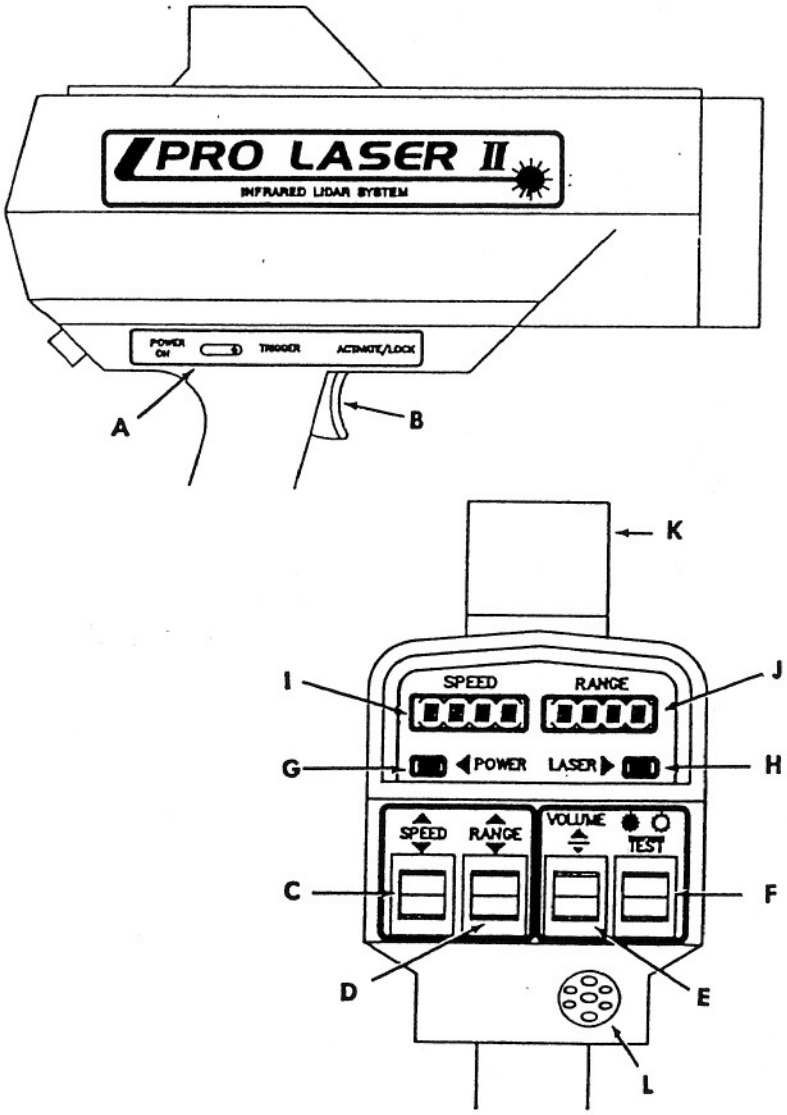

Figure 1

CONTROL DESCRIPTIONS

The preceding section of this Operator's Manual introduced you to the locations of the operating controls on the **ProLaser**. This section will provide detailed descriptions of the function of each control.

CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. Adherence to the instructions contained in this manual will eliminate the risk of hazardous exposure.

Power

The power switch is used to turn off and on primary power to the **ProLaser**. No current is drawn when the switch is turned off.

Trigger

The trigger of the **ProLaser** performs two functions. When the trigger is pulled, it activates the firing of laser pulses, and the range and speed measurement functions of the system. When the trigger is released, the last displayed range and speed readings obtained are retained on the displays. The brightness of the displayed locked readings alternates back and forth between high and low intensity. The locked range and speed displays can be cleared by momentarily depressing the trigger a second time.

Speed

The speed selector control is used only in conjunction with the external signal output. The speed control sets the minimum speed at which the external signal output will be activated. When the speed control is momentarily pressed in either direction, the speed display will read "MINS" (for *MIN*imum *S*peed) and the range display will indicate the current speed setting.

Pressing the speed selector switch up will increment the speed setting, and pressing it down decrements the setting. When the switch is initially pressed, the speed setting will increase/decrease in 1 mph (or 1 km/h) steps. As the switch is held continuously in one position, the speed setting will begin to increase/decrease in 5 mph (or 5 km/h) increments, and if held further, in 10 mph (10 km/h) increments. This feature minimizes the amount of operator time involved in setting an exact speed threshold.

The speed selector threshold can be set at any value between 5 and 299 mph. Each time the **ProLaser** is powered up, the speed selector setting will default to a value of 5, and bidirectional traffic.

Range

The range selector control is used in conjunction with the external signal output, as well as with the **ProLaser's** speed displays. The range control sets the maximum range at which target vehicle speeds will be displayed, and at which the external signal output will be activated. When the range control is momentarily pressed in either direction, the speed display will read **"MAXR"** (for *MAX*imum *R*ange) and the range display will indicate the current range setting. Target ranges will be displayed in the rear panel range readout (and also in the HUD, if set for this mode of display), regardless of the setting of the range selector control.

When setting range values, the range control switch will increase/decrease the setting in 5, 10, or 100 foot (meter) steps depending upon how long the switch is pressed, similar to the way the speed control switch operates. The range can be set at any value from 15 to 4500 feet. Above 4500 feet, the range control function is inhibited, and the rear displays will display **"MAXR" "MAX"**. At this setting, any target that provides an adequate signal return will be displayed, up to a maximum range of 4500 feet. The **ProLaser** will not display ranges or speeds of targets when the distance to the target is less than 15 feet (5 m). Each time the **ProLaser** is powered up, the range control setting will default to a setting of 4500 feet.

Direction

The **ProLaser** is capable of discriminating between different directions of vehicular traffic. When the speed selector control is momentarily pressed, the speed threshold value in the range display window will be preceded by a "+", a "-", or no sign. A "+" indicates that the **ProLaser** will measure only the speeds of approaching traffic; a "-" indicates that it will measure only the speeds of receding traffic; and no sign indicates that it will display speeds of all traffic regardless of direction.

To select the desired direction of traffic to be monitored, simultaneously press the speed selector switch (far left switch) in either direction (as if to increase or decrease the speed threshold value) and the test switch (far right switch) down. Doing this repeatedly will sequence the direction sensing feature from approaching traffic, to receding traffic, to both directions, and then repeat. As you do this, the rear panel speed and range displays will read **"TRGT APPR"**, **"TRGT RECD"**, and **"TRGT BOTH"**, respectively. When you release the speed and range selector switches, the instrument will only process and display speeds corresponding to the last selected direction of travel. Ranges of both static and moving targets will continue to be displayed, regardless of the direction mode set.

Setting of the direction criteria also affects triggering of the external signal output. In other words, if the system is set for "+65", the external signal output will be activated only by oncoming traffic travelling at 65 mph or higher.

Audio Volume

The three-position rocker switch adjusts the volume of the aiming and error tone transducer. The upper position of the switch is high volume, the lower position represents low volume, and the center position turns the audio off completely.

The aiming tone provides audible feedback to the operator, to assist in aiming the **ProLaser**. The aiming tone is activated only when the instrument is aimed at a moving target. When the **ProLaser** is aimed at a stationary target, or is not properly aimed upon a moving target, no tone is heard. As the **ProLaser's** beam is aimed in the vicinity of a moving target, but not closely enough to assure reliable speed processing, an intermittent tone is heard. As the **ProLaser** is aimed squarely at a moving target, and signal returns are of sufficient quality to enable a valid speed determination, the aiming tone becomes a steady sound. Only then is a speed reading displayed.

The audio transducer is also used to alert the operator to certain conditions such as an internal test failure, or the existence of low voltage or RFI.

Brightness

The upper position of the extreme right rocker switch is used to adjust the intensity of the rear panel and HUD displays. There are eight selectable brightness levels from 7 through 0, with level 7 being the brightest. Pressing and releasing the brightness control decreases the display intensity one step; after level 0 is reached, the next switch activation starts the sequence over at level 7.

As the brightness control is activated, the current level is displayed on the rear panel speed and range readouts as "**BRT " " 5**", and on the HUD readout as a simple numeral.

The brightness control should be adjusted to allow comfortable viewing of the displays, and sufficient illumination of the aiming reticle for targeting purposes. Upon being powered on, the **ProLaser** will automatically default to the brightness level set at the factory.

Test

The lower position of the extreme right rocker switch is used to initiate an instrument self-test sequence. This test sequence consists of the following checks that are automatically performed in order:

A. Memory test: performs a check of the contents of the memory chips in which the microprocessor programs reside.

B. Accuracy test: performs a comparison between two independent timing circuits to verify that the range and speed determination circuits are operating properly.

C. Display segment test: briefly illuminates all segments of the HUD numeric displays, the rear panel speed and range dot matrix displays, and the separate power and laser LED indicators.

D. Software version: the installed version of operating software will be displayed in the rear panel speed and range displays, in the form "**SPD3**" "**X.XX**", where X.XX represents a numerical release code.

E. Units of measure: displays the units of measure for which the **ProLaser** is programmed in the rear panel speed and range displays. The displays will indicate **"MPH" "FEET"** for English units, or **"KM/H" " M "** for metric units.

F. HUD display mode: indicates whether the HUD is programmed to display speed or range data, by reading either **" HUD" "SPED"** or **" HUD" "RNG"**, respectively.

If the instrument detects a failure during any of the preceding tests, it will display the word **"HELP"** in the HUD display, and an error code reading **"FAIL" "XXXX"** in the rear panel speed and range displays. The XXXX code is used by a factory service technician to diagnose the particular type of failure that was detected.

The test sequence can be initiated by the operator at any time by pressing the test switch. If a speed or range display has been locked prior to activating the test, the locked readings will be recalled following successful completion of the test sequence. The test sequence also runs automatically every time the **ProLaser** is initially powered up.

If a test failure occurs, cycle power off and on and attempt the test a second time. If continued failures occur, a notation should be made of the fail code indicated, and the unit should be taken out of service and returned to the factory for repair.

DISPLAYS AND INDICATORS

Several displays and indicators are located on the rear panel of the **ProLaser**. They are all solid-state, high-brightness LED (light emitting diode) type, for long life and maximum legibility.

Power Indicator

The power indicator LED is located in the lower left corner of the rear panel. It is illuminated whenever the **ProLaser** is connected to a source of DC power, and the power switch is in the "on" position.

Laser Indicator

The laser indicator LED is located in the lower right corner of the rear panel. It is illuminated whenever the **ProLaser** is powered up and the trigger is pulled, as an indication that laser pulses are being transmitted.

Speed Display

The target speed readout is a four-character alphanumeric display located in the upper left corner of the rear panel. Speeds of moving targets are displayed in this window, preceded by a "+" sign if the target is approaching, or by a "-" sign if the target is receding. After initial acquisition of a target speed, the display will be updated approximately three to four times per second with the current speed. The units of measurement are either miles per hour or kilometers per hour, depending upon how the instrument was programmed at the factory. The programmed units of measure are displayed momentarily at the conclusion of a test sequence.

Range Display

The target range readout is a four-character alphanumeric display located in the upper right corner of the rear panel. After initial acquisition of a range measurement, the display will be updated approximately three to four times per second with the current range. The units of measurement are either feet or meters, depending upon how the instrument was programmed at the factory. The programmed units of measure are displayed momentarily at the conclusion of a test sequence.

Status Messages

The speed and range displays are also used to alert the operator to various conditions affecting the **ProLaser**. As mentioned earlier, results of the internal test sequence are displayed on these readouts. In addition, messages about external conditions that could affect the performance of the instrument are indicated here.

The **ProLaser** contains an internal voltage monitoring circuit which constantly checks the incoming power supply voltage for the proper level. If this circuit senses that the supply voltage has dropped below the level necessary for proper operation, it will shut down the range and speed measurement functions, and display the message **"LOWV"** in the rear panel range display. This message will go away, and the instrument will resume normal operation, once the low voltage condition has been corrected. In addition, any range or speed displays that were locked prior to the onset of the low voltage condition, will also be recalled.

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The **ProLaser** has a sensitive receiver circuit, which monitors for the presence of strong external RFI (radio frequency interference) sources that could adversely affect the system's performance. If such RFI fields are detected, the **ProLaser** will inhibit range and speed measurement functions, and display the **" RFI"** message in the rear panel range display. This message will go away, and the instrument will resume normal operation, once the RFI condition is no longer present. In addition, any range or speed displays that were locked prior to the onset of the RFI condition will be recalled.

HEADS-UP-DISPLAY

The Heads-Up-Display, or HUD, performs two critical functions in the operation of the **ProLaser**. First, it provides the aiming reticle by which the instrument is aimed at the desired target. Secondly, it displays the current speed or range of the target as the operator continues to observe the target, creating a tracking history that is vital for admissible court evidence.

The aiming reticle is an illuminated circle with an apparent diameter of about one-quarter inch as viewed by the operator. As seen from the rear of the instrument, the aiming reticle is located in the center of the HUD reflecting glass, and defines the area where the laser pulses are transmitted. The reticle is illuminated whenever the **ProLaser** is powered up. The intensity of the reticle is adjusted along with the intensity of the displays, by the rear panel brightness control.

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These indications on the HUD allow the operator to track vehicle speeds, and to monitor critical operating conditions, without having to divert attention from the target vehicle and its surroundings.

When the **ProLaser** is first powered up, the HUD is programmed to display target speeds. For applications where the operator is primarily interested in range information, the **ProLaser** can be set to display the target range in the HUD, instead of the speed. To select this mode of operation, simultaneously press the range selector switch up (as if to increase the maximum range limit) and the test switch (far right switch) down. Doing so repeatedly will toggle the instrument back and forth between displaying speed or range in the HUD. As this occurs, the rear panel speed and range displays will read **"HUD" "SPED"** or **" HUD" "RNG"** to indicate the display mode currently selected.

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OPERATION

SETUP

There are several factors to be taken into account when setting up to make speed measurements with the **ProLaser**. They have to do with the location of the instrument relative to the roadway upon which traffic is moving, and with the actual setup in or around the patrol car.

In selecting a location for monitoring traffic, be aware that the **ProLaser** is subject to the *cosine effect* in the same manner as conventional microwave radar. The cosine effect is a principle which states that the apparent measured speed of a target will be decreased from its actual speed, depending upon the angle between the direction of observation and the true direction of travel. The amount of error is defined by a trigonometric relationship known as the cosine. From a judicial standpoint, the measurement inaccuracy introduced by the cosine effect (known as *cosine error*) is always in favor of the motorist, since it has the effect of reducing the measured speed.

The greater the angle between the **ProLaser** and the direction of traffic, the greater the cosine error produced. For small angles, the cosine effect is relatively insignificant. For examples, at angles of less than 8°, the cosine error is under 1%, and at angles of less than 14°, the error is under 3%. As a general guideline, if you select a location where the distance to the target vehicle is at least ten times greater than the **ProLaser**'s perpendicular distance from the roadway, this corresponds to an angle of 5.7° or less, and the amount of cosine error will not exceed

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1/2%. For example, setting up 20 feet off the roadway and measuring targets at a range of 200 feet or greater, will assure that the cosine effect produces no more than 1/2% error in the speed measurement. Again, it is important to remember that any cosine error introduced always reduces the indicated speed reading, thus favoring the motorist.

Another factor in selecting a setup location is that you must have a clear line of sight to the target vehicle during the entire measurement interval. Intervening objects such as signposts, utility poles, and tree branches, will prevent the instrument from gathering sufficient valid measurement data to display a speed reading. It will also assist in setup if you select a location where minimum movement of the **ProLaser** is required in order to keep it aimed on the desired target.

Visibility conditions also affect the performance of the **ProLaser**. Although the laser emissions used by the device are not in the visible spectrum, they are close enough in wavelength that atmospheric or climatic conditions that impair vision also adversely affect the operation. Consequently, rain, smoke, fog, and airborne dust particles will reduce the effective range of the system, and if sufficiently dense, may prevent its operation. The instrument is not affected by ambient light conditions, however, and equivalent performance should be obtained whether operating in bright daylight or in total darkness.

At the setup location, the instrument should ideally be positioned so that it is not operating through any glass in the patrol vehicle. The oblique angles of most windshields will often reduce the effective range of the system, and in addition, some windshields are treated with a coating that

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blocks the infrared emissions, making operation impossible. Operation through the side glass is preferable to operation through the windshield, although this may also result in some loss of range.

Due to the extremely narrow beamwidth of the **ProLaser** that makes precise target identification possible, it may be difficult to aim at long ranges if operated handheld. For situations where long range target acquisition is desired, use of a monopod or tripod to assist in stabilizing the instrument is recommended.

SPEED MODE

To make a speed measurement, after having first determined a suitable setup location, remove the **ProLaser** from its case, remove the protective lens cover, and insert the power cord plug into a power source, either the patrol vehicle's cigarette lighter receptacle or a portable battery pack. Turn the power switch to the "on" position and allow the instrument to complete the self-test sequence. You are now ready to make range and speed measurements.

Aim the **ProLaser** toward the traffic flow in as nearly a parallel direction to traffic flow as the setup location permits. This provides two advantages: it minimizes the amount of cosine error introduced into the measurement, and it reduces the amount of instrument movement that will be necessary to track the target vehicles. Aim the **ProLaser** at the desired target, and pull the trigger. You will immediately see the four dashes "----" in the HUD directly below the aiming reticle, indicating that the laser pulses are being transmitted and the range and speed processing circuits are operating. If the aiming tone is

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enabled by the setting of the volume switch, you will hear an intermittent tone when the instrument is beginning to receive sufficient reflected laser pulses to accurately process speed readings. When the instrument is squarely aimed at a moving target and is processing valid speed data, the tone will become constant. At this point the target speed will be presented on the HUD in place of the dashes, and on the rear panel in the speed display window. The speed indication will be preceded by a "-" sign if the target is receding, and by a "+" sign (in the rear panel display) or no sign (in the HUD) if the target is approaching.

To display range data rather than speed in the HUD, simultaneously press the test switch down and the range selector switch up. The displays will now read "**HUD**" "**RNG**". Now range rather than speed data will be displayed in the HUD. To return to speed display in the HUD, press the switches again.

As long as the trigger is pulled, the **ProLaser** will continue to update the displayed target speed with the most recently determined value. This allows the operator to correlate the displayed target speed with visual observations of the target vehicle, thus establishing the tracking history needed for introduction of the evidence into court. At the same time speed information is being displayed, the distance to the target will continue to be updated on the rear panel display. While the speed reading is still being displayed, releasing the trigger will lock the speed and range readings on the displays, and they will begin flashing. If no speed reading is displayed when the trigger is released, only range information will be locked

on the display (assuming a valid range reading was present at the time the trigger was released).

When aiming the **ProLaser** at vehicular targets, some parts of cars present better targets than others. Keep in mind that at a distance of 500 feet, the diameter of the **ProLaser**'s transmitted beam is approximately 2 feet. This requires precise aiming in order to track the target vehicle. The best reflective surfaces on receding vehicles are usually the license plate or the tail light reflectors. For oncoming traffic, the best place to aim is normally the front license plate (if equipped), the headlights, or the turn signal reflectors. Generally, receding vehicles provide much better return signals and consequently greater range; it is not unusual to get twice the range to receding targets as to approaching targets.

The time it takes to acquire a target vehicle's speed is inversely related to the speed at which the target is travelling. A target moving at 60 mph can be clocked in approximately 0.3 seconds. Slower targets require the instrument be aimed on them slightly longer before displaying a speed, and faster targets slightly less time. Once a vehicle's speed and range have been locked on the displays, pulling the trigger again clears the displays and allows new measurements to be taken.

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RANGE MODE

To make a range measurement, remove the **ProLaser** from its case, remove the protective lens cover, and insert the power cord plug into a power source, either the patrol vehicle's cigarette lighter receptacle or a portable battery pack. Turn the power switch to the "on" position, and allow the instrument to complete the self-test sequence. Set the unit to Range Mode by simultaneously pressing the test switch and range selector switches down until **"MODE" "RNG"** appears in the displays. When the switches are released, **"RNG"** will appear in the speed display. You are now ready to make range measurements.

Holding the **ProLaser** as stationary as possible, use the aiming reticle to aim the instrument at the desired target, and pull the trigger. You will see a series of four dashes "----" directly below the aiming reticle while the laser is firing and range measurements are being made. After perhaps a quarter second, the distance to the target will appear both in the HUD and rear panel range display. Distances will be displayed to the nearest 6 in. (.2 m) in the HUD and to the nearest foot (m) in the range display. Release the trigger to lock in the displays. Simply aim and pull the trigger again to make additional range measurements.

Since the infrared pulses used by the **ProLaser** are close to the visible spectrum, you will find the target objects that best reflect light also provide maximum range from the instrument. If you experience trouble getting a range reading to a certain part of a distant object, try a different, flatter surface of the object that may have superior reflective characteristics.

If the instrument is aimed at a fairly large, distant object, and then "panned" or swept across the surface of the structure, you may occasionally hear the intermittent aiming tone sound. This occurs because the **ProLaser** is attempting to interpret a series of changing range measurements as a velocity. Normally, no speed reading will be displayed because this erratic motion does not fulfill the accuracy criteria of the speed determination process.

Keep in mind that when making range measurements, the instrument does not measure distances shorter than 15 feet. Aiming the **ProLaser** at objects closer than 15 feet will not produce a range or speed display.

STOPWATCH MODE

The stopwatch mode of the **ProLaser** is used to calculate average speed based on the elapsed time taken by a vehicle to travel a predetermined distance. To use the stopwatch mode, remove the **ProLaser** from its case, remove the protective lens cover, and insert the power cord plug into a power source. Turn the power switch to the "on" position and allow the instrument to complete the self-test sequence. Select the stopwatch mode by simultaneously pressing the test and range switches down twice. The rear panel displays will read **"MODE" "RNG"**, then **"MODE" "STPW"**, then change to **"SETP" "STPW"** after the switches are released.

There are three possible stopwatch options: 1) Measure a further distance then a closer distance; the **ProLaser** subtracts the distances to get the stopwatch distance. 2) Measure a further distance and use your location as the

second point. 3) Set a predetermined distance into the **ProLaser.**

To measure the stopwatch distance, depress the range switch down after **"SETP" "STPW"** is displayed. The displays will read **"STPW" "MEAS"**. Press the test switch down one time; the displays will now read **"DIS1" "MEAS"**. Position yourself in a direct line with the targets' direction of travel, aim at the furthest reference point, and pull and release the trigger to acquire the distance measurement. Depress the test switch to accept this reading and to bring up **"DIS2" "MEAS"**. Now aim at the closer reference point, pull and release the trigger, then press the test switch once again to accept the second reading and calculate the distance. (If you are using your own location for the second reference point, do not pull the trigger for **"DIS2" "MEAS"**, just press the test switch.) The displays will now read **"DIST" "XXXX"**, where "XXXX" is the calculated distance between the two points.

NOTE: A minimum distance of 300 feet (100 meters) is required. In addition, care should be taken to avoid any error on either distance reading due to height above the target such as standing on a bridge overpass aiming at the road below.

Depress the test switch one last time. **"STPW" "RDY"** will be displayed. When the target passes the first reference point, press and release the trigger once. When it passes the second reference point, press the trigger a second time to stop the timing function. The calculated average speed will be shown in the speed window and the time (in tenths of a second) will be shown in the range

window. (Time is rounded up to the next tenth second and the calculated speed is rounded down to give the motorist the maximum benefit.)

In addition, during the timing cycle, the time is shown in the HUD and after the timing cycle, the speed is shown. This allows you to actually "track" the target vehicle through the HUD while using the stopwatch.

Pulling the trigger a third time will clear the time and speed displays and reset the **ProLaser** for another timing cycle.

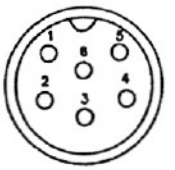
To enter a predetermined distance into the unit, press the range switch down twice after the **"SETP" "STPW"** display. The displays will show **"STPW" "MEAS"**, then **"STPW" "SET"**. Press the test switch down and **"DIST" "NEW"** will be displayed. Depress the range switch either up or down to increment or decrement the default setting of 1320 feet. The minimum distance is 300 feet and the maximum is 4500. When the proper distance setting is reached, depress the test switch once and **"STPW" "RDY"** will be displayed.

Stopwatch calculations are made in the same way as for measured distances.

At any time during stopwatch setting or measuring, the system can be reset to **"SETP" "STPW"** by pressing the speed switch down.

EXTERNAL OUTPUT SIGNAL

The I/O connector on the back of the **ProLaser** provides a means to connect an external device to the instrument. In a typical application, this might be used to trigger a camera shutter release. Figure 2 identifies the pin locations within this connector; pin 6 is the external output signal line, and pin 1 is a system electrical ground. The connector used for this signal is a 6-pin DIN-style circular connector; if you have trouble obtaining a compatible plug locally, the mating part can be ordered through Kustom Signals' Customer Service Department, as Part Number 030-2150-01.



The active state of the external output signal is a transistor-switched signal to electrical ground. This output provides a current sink of up to 50 mA with a saturation voltage of 0.2 V. The maximum external DC voltage that can be imposed without damage on this signal line is 40V.

Whenever *both* the preset minimum speed and maximum range criteria are met, the external output signal becomes active for a period of 100 milliseconds. After activating once, the external output signal resets when the **ProLaser** loses a valid speed reading (resulting from the vehicle that originally produced the activation). Any subsequent measurements meeting the trigger criteria will also activate the output signal.

When the range threshold is set to **"MAX"**, any vehicle meeting or exceeding the speed threshold setting, regardless of the range, will activate the output. Note that the speed criteria is a minimum value, and the range criteria is a maximum value. Target vehicles *at* or *above* the set *speed* threshold, and *at* or *below* the set *range* threshold, are required to activate the external output signal.

OPTIONAL CHECKS

Although the internal test performs a complete check of the **ProLaser's** range and speed processing circuitry, you may occasionally want to test the instrument against an external standard. The easiest way to do this is to take range measurements to one or more known, fixed distances. For example, you may wish to set up targets with bicycle-type reflectors on them at 250 and 500 feet from a fixed point. The ranges displayed on the **ProLaser** should agree with the measured distance within +/- 1 foot.

A second test can be made to check the alignment of the HUD aiming reticle. Select an isolated target about 200 feet away, such as a stop sign or utility pole. Sweep the **ProLaser** across the target and observe that the proper range is displayed only when the target is within the reticle area, indicating lateral alignment. Rotate the **ProLaser** so that it is at right angles to its normal operating position, and repeat the process to verify vertical alignment.

REGULATORY COMPLIANCE

Manufacture and operation of the **ProLaser** is subject to the regulations of two governmental agencies, the Center for Devices and Radiological Health (or CDRH), and the Federal Communications Commission. The following sections describe the requirements of these two agencies, and the manner in which the **ProLaser** complies with their regulations.

EYE SAFETY

CDRH is an agency of the federal Food and Drug Administration that has the responsibility of ensuring the safety of all laser products sold in the US. The **ProLaser** is certified as a Class I device in accordance with the safety standards of CDRH. Class I is the lowest classification of laser product in terms of relative potential risk. A good description of this category is provided by the Laser Institute of America as follows:

Class I - A Class I laser is considered safe based upon current medical knowledge. This class includes all lasers or laser systems which cannot emit levels of optical radiation above the exposure limits for the eye, under any exposure conditions inherent in the design of the laser product. There may be a more hazardous laser embedded in the enclosure of the Class I product, but no harmful laser radiation can escape the enclosure.

While the **ProLaser** is certified as a Class I laser device and is inherently eyesafe, certain reasonable precautions should be taken in its operation. As in the case of a movie projector, a person should not stare directly into the beam for extended periods of time. Since the beam is so narrow, normal random eye movements will generally prevent this from occurring. A person should also not stare directly into the beam within 50 feet of the instrument using binoculars, telescope, or other optical gain devices for any extended period of time. Prescription eyeglasses, bifocals, and so on are not considered optical gain devices, because they serve only to correct the focus of the eye to normal human vision. In all respects of normal operation, excluding intentional abuse, the **ProLaser** is completely safe for human exposure.

Persons interested in receiving further information regarding laser safety regulations are encouraged to contact one of the following organizations for assistance:

Laser Institute of America
12424 Research Parkway
Suite 130
Orlando, FL 32826

US Department of Health and Human Sciences
Center for Devices and Radiological Health
Food and Drug Administration
Rockville, MD 20852

American Conference of Governmental Industrial Hygienists
P.O. Box 1937
Cincinnati, OH 45201

FCC INFORMATION

Since the **ProLaser** is not designed to transmit RF (radio frequency) radiation, an FCC station license is not required for operation of the device. However, the **ProLaser** does employ internal high frequency digital circuitry to perform its functions, and therefore is classified as a Class A digital device in accordance with Part 15 of FCC Rules and Regulations.

The **ProLaser** has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. However, the RFI detector circuit in the **ProLaser** will prevent any received interference from causing an erroneous display.

CARE AND MAINTENANCE

The **ProLaser** is designed and constructed so that only a minimal amount of normal maintenance is required. Maintenance consists of periodic cleaning of the external optical surfaces. This should be done only when necessary, as evidenced by degradation in performance of the unit or by visible contamination on the optics surfaces.

CAUTION: The external optical surfaces are coated glass. Extreme care must be taken when cleaning these surfaces to prevent scratching which will lead to performance degradation.

Surfaces that may be cleaned include the laser output aperture, the HUD combiner glass, and the HUD lens. Gently brush loose debris from the optical surface to be cleaned. Then, using a clean, lint-free cloth or lens cleaning tissue dampened with low-residue isopropyl alcohol, gently wipe the optical surface with a circular motion. A cotton swab may facilitate cleaning of the HUD lens and the lower surface of the HUD combiner glass. Repeat the cleaning procedure if necessary.

Note: During the lifetime of the instrument, scratches, pits, and stains may occur on the optical surfaces, which cannot be removed by cleaning. Excess rubbing should not be used to attempt to clean these marks; further damage may result. The **ProLaser** will operate satisfactorily with a limited amount of cosmetic optical defects.

Despite its rugged construction, the **ProLaser** is still a precision electronic instrument. Some common-sense handling and storage procedures will help prolong the useful life of the product.

1. Whenever the instrument is not in use, the protective lens cap should be installed and, ideally, the device should be kept in its heavy-duty carrying case.
2. When momentarily laying the instrument down, care should be taken to keep the optical surfaces from contacting other objects such as seat upholstery, belt buckles, and so on, which could scratch the lenses.
3. The instrument should never intentionally be pointed directly at the sun or any other source of intense light. Doing so may cause degradation of the sensitive receiver, resulting in loss of performance.

TROUBLESHOOTING PROCEDURES

In the event of suspected instrument malfunction, double-check the setup and operational procedures, as well as the power source. If all these appear satisfactory, and the **ProLaser** still does not perform properly, it should be returned to the Kustom Signals factory for service. The instrument should be returned in its carrying case with all accessories, in the original shipping container, and should be accompanied by a note describing the problem and the circumstances under which it occurs.

There are no user-serviceable parts within the **ProLaser**. Furthermore, attempts to service the instrument by removing the top cover and defeating safety interlocks, could expose the service technician to Class III levels of laser radiation, which are potentially hazardous to eye safety.

SPECIFICATIONS

GENERAL

Power Requirement	10.8 - 16.5 VDC, 1.25 A max
Operating Temperature	-30 to +60°C (-20 to +140°F)
Dimensions	10"L x 3.3"W x 10"H, including handle and head-up-display
Weight	4 lb 4 oz
Eye Safety	CDRH Class One Eyesafe

OPERATIONAL

Speed Range	5 to 299 mph (8 to 480 km/h)
Speed Display Accuracy	+/- 1 mph (+/- 2 km/h)
Target Range	15 feet minimum, up to 4500 feet
Range Display Accuracy	+/- 12 inches (+/- .3 m)
Beam Width	4 feet at range of 1000 feet
Acquisition Time	0.3 second for 60 mph target
Auxiliary Output	Activates when preset speed and range thresholds are met