AS600 Hybrid Series Installation and User Manual

This Manual includes all AS600 Hybrid Series Scanners

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OSI LaserScan
An OSI Optoelectronics Division

AS600 Hybrid Series Installation and User Manual

Revision Record

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1.0	May 2019	Initial Draft
1.1	June 2020	Change Classification message for 1° and 30° pixels. Update Self-Test bit descriptions.
1.2	June 2020	Added Contact information and corrected minor references.
1.3	February 2022	Modified IAW new IEC-62368 standard testing compliance.

Disclaimer
The Publication No. 19479201 is subject to change without notice.

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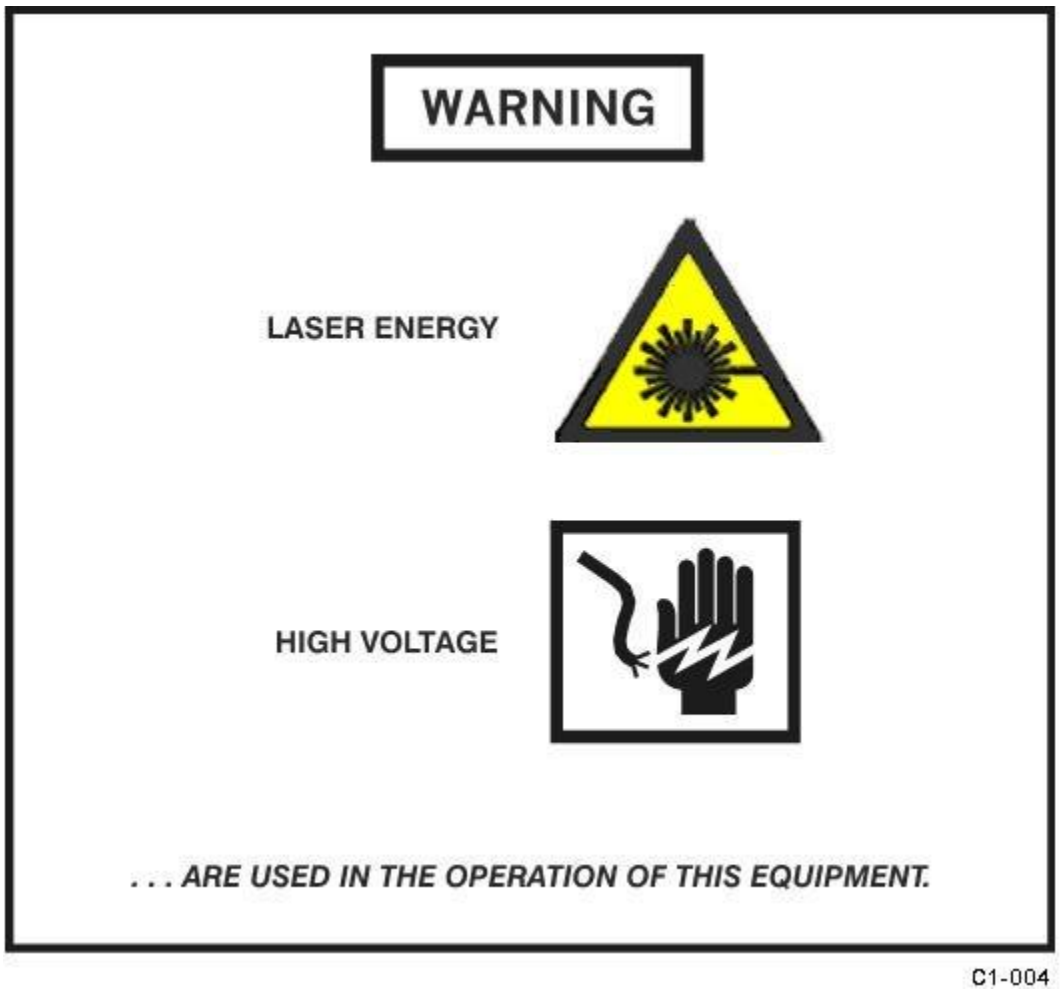


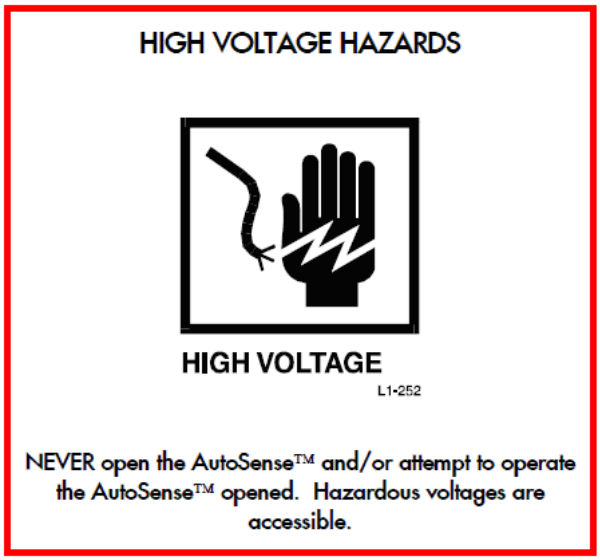
LASER CERTIFICATION

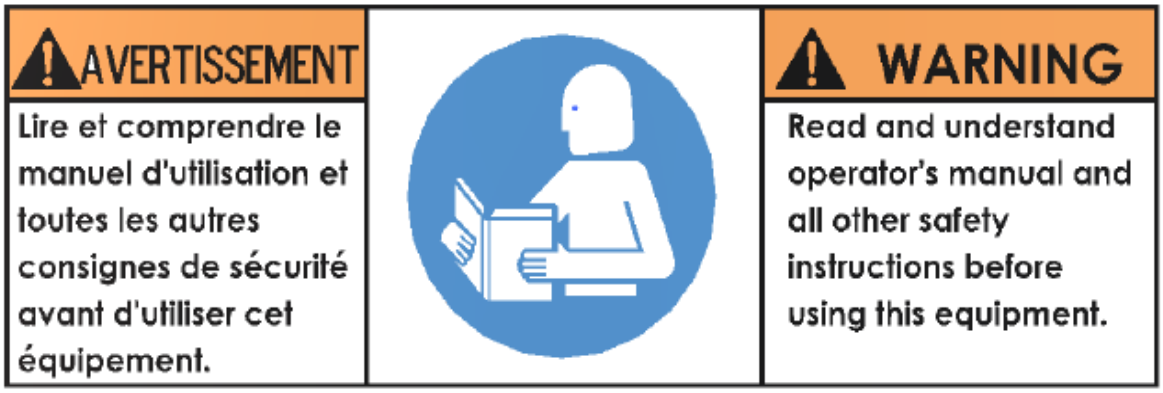
OSI LaserScan certifies that all of the AutoSense™ infrared vehicle sensors are Class I laser products in compliance with U.S. standard 21 CFR §1040.10 and Class 1 laser products in compliance with the European laser product standards IEC 60825-1 2007. Lasers so classified by either standard are not considered to be hazardous.

SAFETY CERTIFICATION

OSI LaserScan certifies that all the AutoSense™ infrared vehicle sensors are certified to the IEC-62368-1:2018.

WARNING SUMMARY





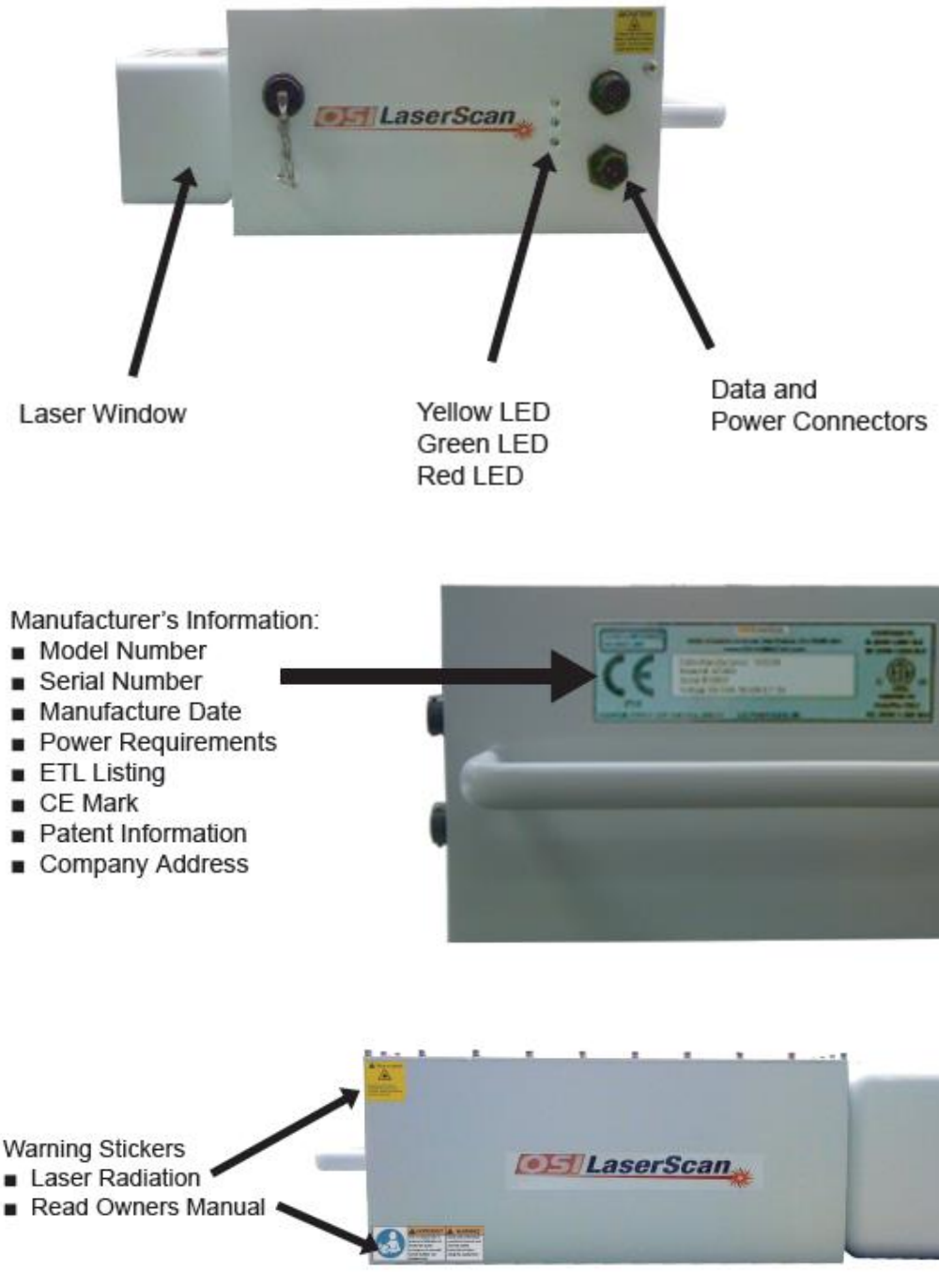


Figure 1: Equipment Label and Interface Locations

Warnings/Personal Safety Precautions

AVERTISSEMENT/ ***PRECAUTIONS*** POUR VOTRE SECURITE

The AutoSense™ contains voltages that can be **FATAL** and invisible laser radiation that may cause permanent eye damage if opened. Service must be performed **ONLY** by trained, experienced OSI authorized personnel. Do not attempt to open or access the inside of the AutoSense™. Read and obey all **WARNINGS** contained in the text of this User's Guide.

The AutoSense™ is equipped with several safety features designed to protect the operator under normal operating conditions. The following **WARNINGS** are contained in the text of this User's Guide:

L'AutoSense™ contient des tensions electriques qui peuvent être **FATALE** ainsi qu'un rayonnement laser invisible qui pourâit causer des degats permanents aux yeux si le dispositif est ouvert. Les revisions et reparations doivent être effectué **SEULEMENT** par un personnel qualifié, experimenté et autorisé par **OSI**. Prier de ne pas tenter d'ouvrir ou d'acceder a l'interieur de l'AutoSense™. Lire et respecter toutes les consignes de securité figurant dans le mode d'emploi.

L'AutoSense™ est equipé de plusieurs dispositifs de securite conçu pour protegér l'operateur dans des conditions normales d'utilisation. Les **AVERTISSEMENTS** suivantes font parties du manuel de mode d'emploi:

WARNINGS AVERTISSEMENTS

DO NOT OPEN THE AUTOSENSE™ AND/OR ATTEMPT TO OPERATE THE AUTOSENSE™ OPENED. OPERATION WITH THE AUTOSENSE™ OPENED, MAY RESULT IN EXPOSURE TO INVISIBLE CLASS 3B LASER RADIATION, AND WILL PROVIDE ACCESS TO VOLTAGE THAT CAN KILL.
NE PAS OUVRIR L'AUTOSENSE™ ET/OU TENTER DE FAIRE FONCTIONNER L'AUTOSENSE™ OUVERT. TOUT FONCTIONNEMENT DE L'AUTOSENSE™ OUVERT, PEUT ENTRAINER UNE EXPOSITION AU RAYONNEMENT LASER INVISIBLE DE CLASSE 3B, ET DONNERA ACCESS A UNE TENSION POUVANT ENTRAINER LA MORT.

DO NOT ATTEMPT TO SERVICE OR REPAIR THE AUTOSENSE™. SERVICE WILL REQUIRE ACCESS TO HARMFUL VOLTAGE THAT CAN KILL, AND MAY RESULT IN EXPOSURE TO INVISIBLE CLASS 3B LASER RADIATION. SERVICE AND REPAIR OF THE AUTOSENSE™ MUST BE PERFORMED ONLY BY OSI AUTHORIZED MAINTENANCE TECHNICIANS.
NE PAS TENTER DE FAIRE L'ENTRETIEN OU REPARER L'AUTOSENSE™. LE SERVICE D'ENTRETIEN EXIGE L'ACCES AUX TENSIONS NUISIBLES POUVANT ETRE FATALE, ET PEUT PROVOQUER L'EXPOSITION AU RAYONNEMENT LASER INVISIBLE DE CLASSE 3B. L'ENTRETIEN ET REPARATION DE L'AUTOSENSE™ DOIT ETRE EFFECTUE SEULEMENT PAR UN TECHNICIEN QUALIFIE DE OSI.

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General Equipment Precautions
Precautions General Concernant L'Equipment

PREFACE

PURPOSE

This User's Guide provides familiarization and reference information regarding the AutoSense™ Hybrid scanners only. It is intended for use by qualified Technicians and Engineers for the purpose of installing, configuring and maintaining the AS600 Hybrid Series Laser Scanners.

HOW TO USE THIS USER'S GUIDE

First, become familiar with the **GENERAL INFORMATION** in the front part. Then read the summary of each section, before using the Table of Contents.

The Table of Contents may be used to locate related information on any titled subject. Titled subjects are listed by their Heading paragraphs, tables, figures, and page numbers within each section.

SUMMARY

Section 1, **INTRODUCTION**, is an overview of the AutoSense™, a general physical description of components and a list of optional equipment.

Section 2, **GETTING STARTED**, describes removal of the AutoSense™ from the shipping container, power requirements, interface signals, and cable requirements.

Section 3, **OPERATION OF THE AUTOSENSE™**, provides a general functional description of the AutoSense™, including sample messages, and typical installation procedures.

Section 4, **MESSAGE PROTOCOLS OF THE AUTOSENSE™**, provides tables, describing the various messages.

Section 5, **TROUBLESHOOTING THE AUTOSENSE™**, provides fault symptom troubleshooting procedures, if you suspect the AutoSense™ is not operating properly.

Section 6, **MAINTENANCE INSTRUCTIONS**, provides instructions for packing and shipping the AutoSense™ to an authorized service center, if so required. Information for contacting an authorized service center is also provided. There is no authorized corrective maintenance of the AutoSense™ by the user.

TRADEMARKS

Product names mentioned in this User's Guide may be trademarks and are used for identification only.

LIMITED ONE (1) YEAR WARRANTY

OSI LaserScan (OSI) warrants each AutoSense™ unit for one (1) year from the date of shipment according to the following terms.

Any part of the AutoSense™ unit manufactured or supplied by OSI and found in the reasonable judgment of OSI to be defective in material or workmanship will be repaired or replaced by OSI without charge for parts or labor.

The AutoSense™ unit, including any defective part, must be returned to OSI within the warranty period. All shipping expenses for warranty repair will be paid for by the buyer. OSI's responsibility with respect to warranty claims is limited to making the required repairs or replacements, and no claim of breach of warranty shall be cause for cancellation or rescission of the contract of sale of any AutoSense™ unit.

This warranty does not cover any AutoSense™ unit that has been subject to misuse, negligence or accident. This warranty does not apply to any damage to the AutoSense™ unit that is the result of improper use or maintenance. The warranty does not cover any AutoSense™ unit that has been altered or modified so as to change its intended use or for which repairs have been attempted and seals have been broken without OSI's approval. In addition, the warranty does not extend to repairs made necessary by the use of parts, system interface or accessories, which are either incompatible with the unit or adversely affect its operation.

The AutoSense™ laser components require a dry environment that is maintained by the use of dry nitrogen and desiccant internal to the sealed unit. If the dry environment is not maintained by following the instructions specified in the operation and maintenance manual the warranty will be void.

OSI reserves the right to change or improve the design of any laser system or accessory without assuming any obligation to modify any system previously manufactured.

The foregoing Express Warranty is in lieu of all warranties, express or implied

OSI's OBLIGATION UNDER THIS WARRANTY IS STRICTLY AND EXCLUSIVELY LIMITED TO THE REPAIR OR REPLACEMENT OF DEFECTIVE PARTS. OSI ASSUMES NO RESPONSIBILITY FOR INCIDENTAL, CONSEQUENTIAL OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED TO: LOSS OR DAMAGE TO PROPERTY, LOSS OF REVENUE, LOSS OF USE OF THE UNIT, LOSS OF TIME OR INCONVENIENCE.

DESCRIPTION OF OPERATION

A schematic diagram of the AutoSense™ system is shown in Figure 2. The AutoSense™ laser rangefinder employs a transmitter and a receiver in a side-by-side configuration. The transmitter consists of the diode laser and its driver circuit and a collimating lens. The optical receiver is comprised of an objective lens, narrow-band optical filter, detector/amplifier, and threshold detector.

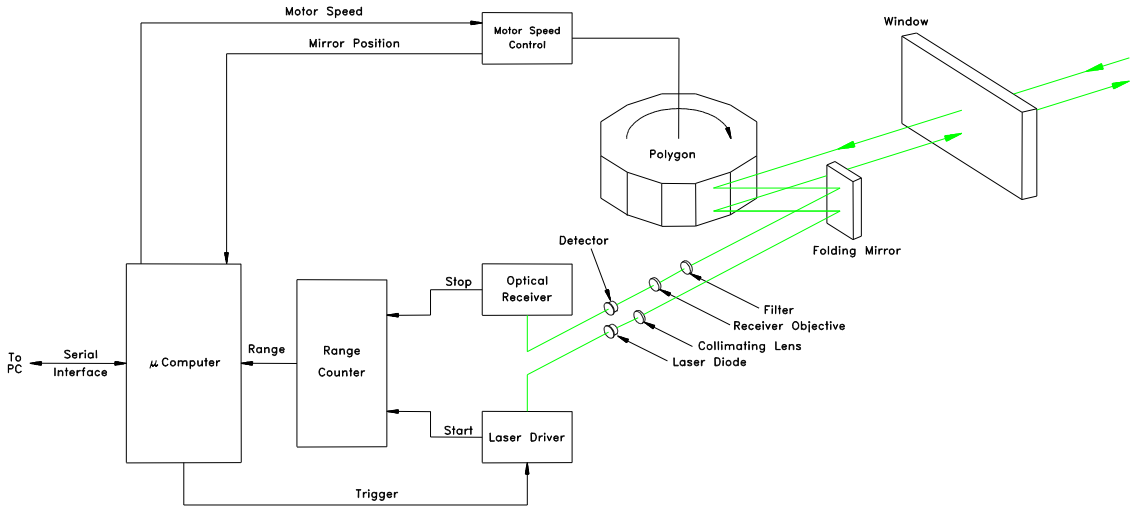


Figure 2: ***AutoSense™*** **System Schematic Diagram**

The laser diode is driven by a diode driver to produce a pulsed output. A trigger pulse from the scanner control circuit triggers the laser at the proper scan angles. The 904-nm laser emission is at an ideal wavelength for the silicon APD receiver used.

The AutoSense™ employs a rotating polygon to line scan the diode-laser rangefinder across a lane of the highway. The polygon scanner rotates continuously in one direction at a constant speed. The angle between each facet and the base of the polygon alternates between 87.50° and 92.50° for adjacent facets; as a result, successive scans are made with an angular separation of 10°, which provides the two separate beams needed for speed measurements. As shown in Figure 6, the laser pulse illuminates a 3.6 mm (0.14”) by 120 mm (4.56”) stripe on the pavement that provides good in-lane resolution and optimum cross-lane coverage when the laser is pulsed once every 1 degree of scan angle.

The optical detection circuitry converts optical radiation reflected from the vehicle/road to first, an equivalent electrical analog of the input radiation and finally, a logic-level signal. The logic-level signals are processed within the range counter logic to yield digital range data, which is read by the microprocessor.

The Hybrid utilizes an ultrafast digital ranging technique known as a Time-to Digital Converter (TDC). The TDC device utilized in the AutoSense™ Hybrid unit has an accuracy of ± .5% of measured range and a resolution of ±0.6 cm (±0.24 in).

The pulsed time-of-flight range measurements are read by a Digital Signal Processor and converted into distance measurements. When no vehicles are present, the range measurements are equal to the range to the road. When a vehicle is present beneath the sensor, the distance to the top surface of the vehicle is measured and provides a transverse height profile of the vehicle on each scan. The vehicle speed, determined by the time interval between the interceptions of the two laser beams by the vehicle is used to space the transverse profile appropriately by straightforward geometric transformation to obtain the full three-dimensional vehicle profile. This vehicle profile is processed by the sensor to provide detection details and to classify the vehicle into the designated classification categories.

The narrow laser beam height permits the detection of closely spaced vehicles moving at high speed; even a two-inch-wide tow bar can be detected. The AutoSense™ is ideal for applications involving electronic toll collection from vehicles at freeway speeds, where very high detection and classification accuracy is required. The AutoSense™ relies on an inherent laser characteristic – narrow angular beam width – to provide the high resolution required for accurate vehicle profiling. The AutoSense™ beam-scan geometry is shown in Figure 3. The system scans two narrow laser beams, at a 10° fixed angular separation, across the width of a lane at a rate of 720 scans per second (sps), (360sps for each beam). Pulsed time-of-flight range measurements provide accurate profiles of a vehicle for each scan. An algorithm, similar to those developed for military target recognition, is applied to the three-dimensional profile for vehicle-classification purposes.

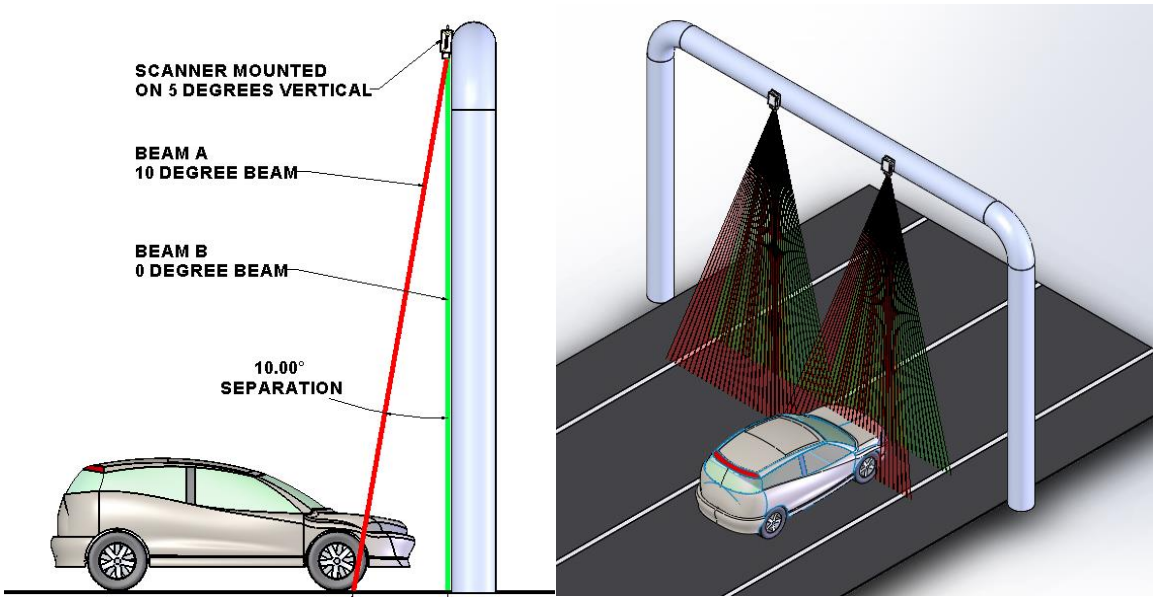


Figure 3: AutoSense™ Beam Scan Geometry

An example of the AutoSense™ three-dimensional profiling capability is shown below of a van pulling a boat traveling at a speed of 45 mph. The video capture in Figure 4 and resultant range image is shown in Figure 5. Each color pixel in Figure 5 represents a single laser pulse range measurement. The pixel spacing resulting from the 1° scan resolution across the road is more than adequate for vehicle identification purposes.

Figure 4: Video Image of Van Pulling Boat

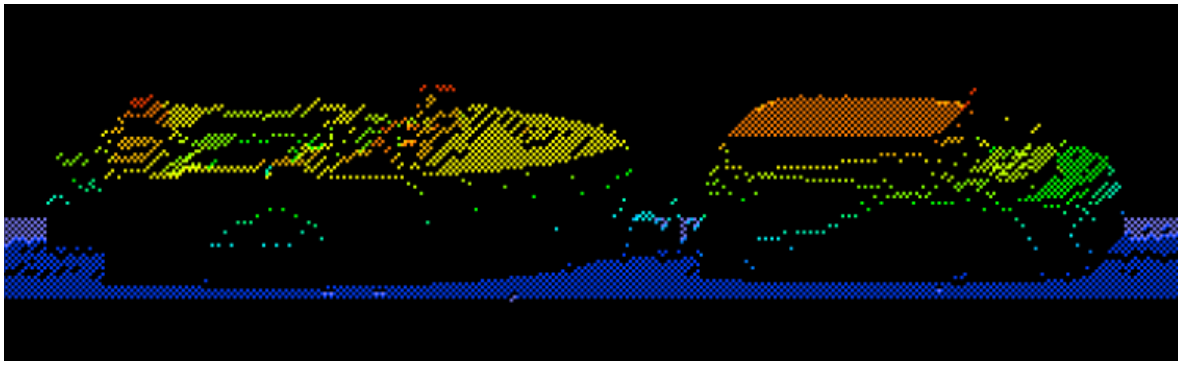


Figure 5: 3-D Range Image of Van Towing Boat

When mounted 7 meters (23 feet) above the roadway, each pulse of the laser illuminates a stripe on the pavement, as shown in Figure 6, that provides an approximate 3.92 meter (12.86 feet) total coverage. The three-dimensional profile generated for this coverage area is processed by the sensor to provide vehicle detection details and to classify the vehicle into the designated classification categories.

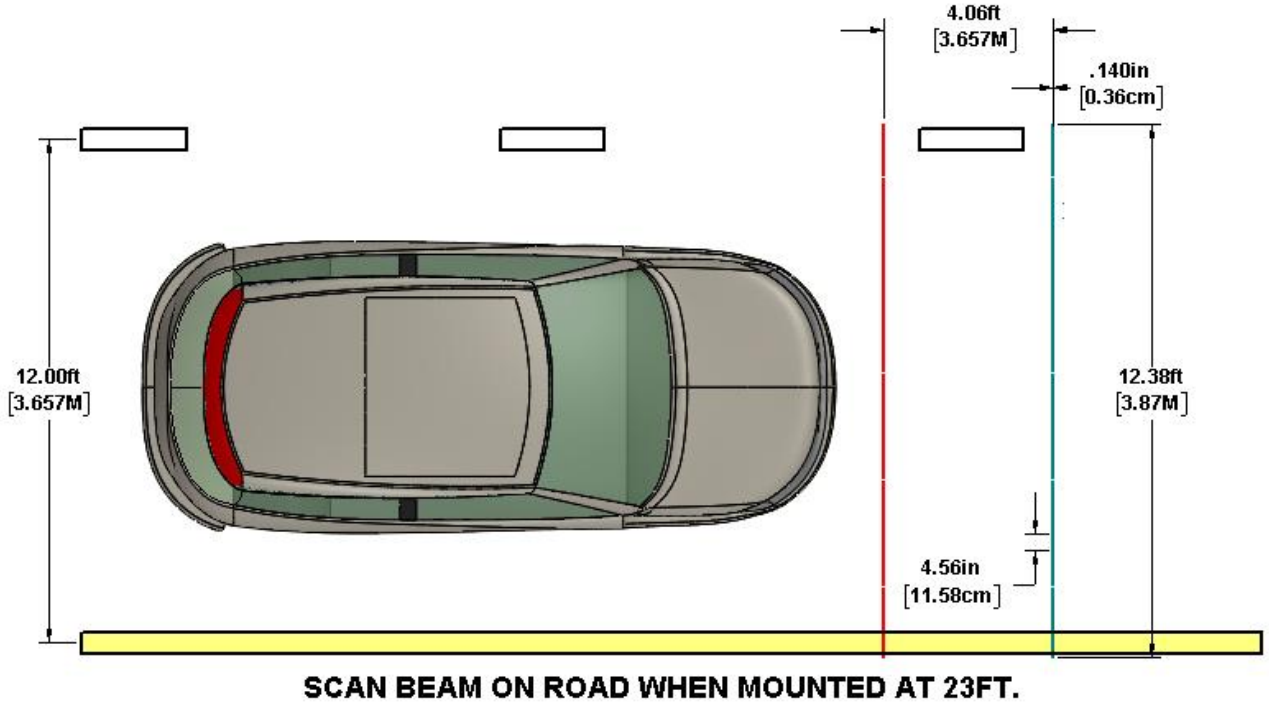


Figure 6: Laser Beam Footprint on Road Surface

The AutoSense™ AS600 Series scanners transmit five messages when operating in the detection mode for each vehicle detected within its field of

view. In normal circumstances, each message and the order in which it is transmitted is listed below:

#1 First Beam Vehicle Detection Message

#2 Second Beam Vehicle Detection Message

#3 First Beam End of Vehicle Message

#4 Second Beam End of Vehicle Message

#5 Vehicle Classification Message

An illustration of the vehicle's position for each message is shown in Figure 7. The first four messages uniquely identify the vehicle and its position in the lane. The fifth message is the final message for the vehicle that includes vehicle classification, classification confidence percentage, height, length, width and speed.

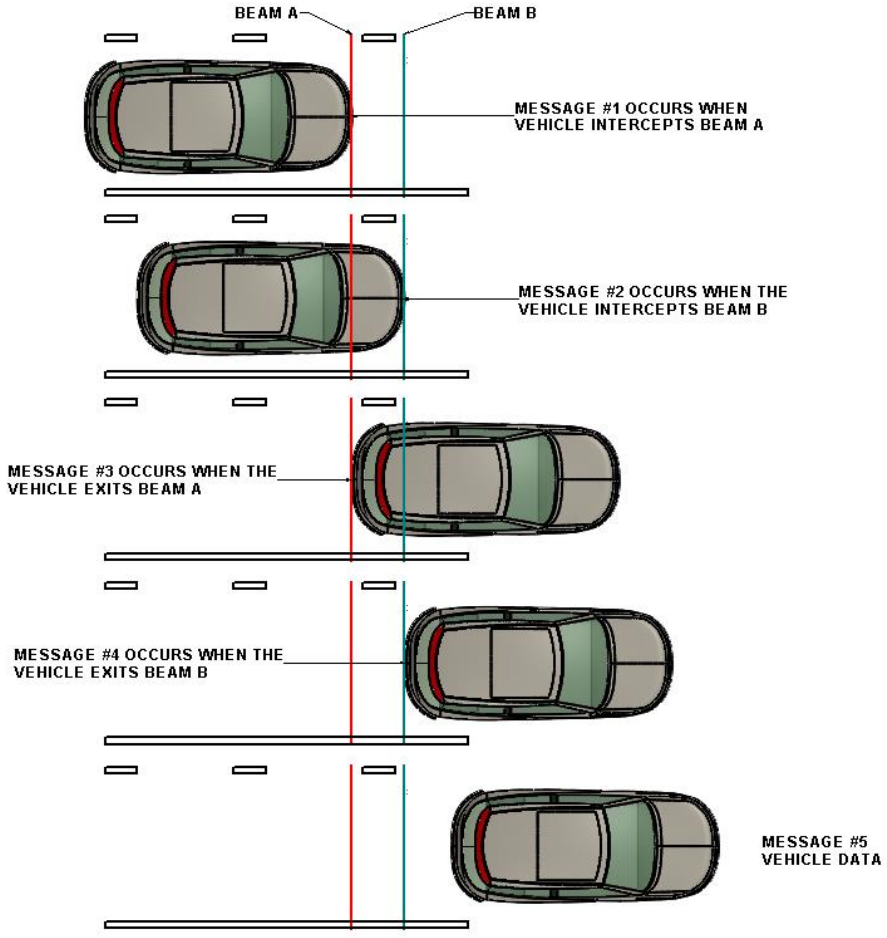


Figure 7: AutoSense™ Output Message

Interface Modes

Serial Data Links

The AutoSense™ provides two RS-422 serial interface ports. The RS-422 Messaging port has a user selectable data rate of 19.2, 38.4 or 57.6 kilobits per second, 8 data bits, 1 start, 1 stop, no parity. The default data rate for normal operation is 57.6 Kilobits per second. The second RS-422 port is a high-speed port for streaming raw Range and Intensity data at 1.2MHz for data capture and troubleshooting.

Ethernet Port

In addition to the Standard RS-422 communication ports, the AS600 Hybrid Series also provides a 10/100baseT Ethernet port that is capable of multiple Ethernet channels for redundant communication.

Vehicle Detection Trigger

The AutoSense™ provides a real time signal to facilitate the triggering of camera's or vehicle enforcement systems. The Logic Level Detect (LLDet) trigger can be configured for front or rear vehicle detection. In addition, the sensor also generates a trigger report as part of serial message #4.

Auxiliary Trigger

The AutoSense™ can provide a second real time signal as an option. This second trigger allows triggering of camera's or vehicle enforcement systems at both ends of a vehicle. The TTL trigger can be configured for front or rear vehicle detection or as a presence signal.

Relay Driver

The communication interface also provides a Solid State Relay output for driving external relays in a variety of configurations.

Test, Calibration and Adaptation

Self-Test

The AS600 Series has continuous self-test capabilities. The self-test checks include Memory test, Motor Control, Internal Humidity and moisture ingress, 3 Internal Temperature sensors, System Voltage Converters and Threshold levels.

Automatic Calibration

The AutoSense™ performs an automatic calibration upon power up. The calibration accuracy is not compromised by vehicles passing through the AutoSense™ field of view.

Automatic Site Adaptation

The AutoSense™ has automatic calibration at varying installation sites under the following conditions.

Less than 9% Slope

Less than 7% Grade

10% Road Reflectivity

Also adapts to Barriers and Guard Rails

Additional adjustments have been made available that may be fine-tuned to improve performance under certain conditions. These manual adjustments are described in detail under **Appendix G, Using the ASMgr to Modify the FLASH Parameters.**

SECTION 1: INTRODUCTION

SCOPE

The AS600 Hybrid Series AutoSense™ vehicle detection and classification sensor is a class I laser system that is ideally suited to providing toll and traffic management authorities with vehicle detection, presence, separation and classification information. A single sensor can be mounted overhead of travel lanes on either a Gantry, pole arm or toll plaza roof structure. Please see Section 3 and Appendix E for detailed installation information.

The AutoSense™ scans the roadway beneath the sensor, taking range measurements across the width of the road at two locations beneath the sensor. These measurements are processed to generate messages that uniquely detect and classify each vehicle, and give its speed and position in the lane. The AutoSense™ automatically initializes the vehicle detection process upon power-up, and its self-calibration process eliminates the need for any field adjustments.

This User's Guide covers safe and correct setup and operation of the AutoSense™.

Physical Description

The descriptions provided here are limited to support understanding of how to use and operate the AutoSense™. For a detailed description, refer to Appendix A, Specification. There is no authorized corrective maintenance of the AutoSense™ for user/operator performance. Access to the inside of the case is restricted to OSI-trained and authorized personnel. No description of the inside of the case is contained in this User's Guide. Figure 8 shows the AutoSense™ in the fully operational configuration.

Case

The AutoSense™ laser and control system are housed in a durable weather proof case classified as IPx4 and purged with Dry Nitrogen to evacuate all moisture. In the event any damage occurs to the enclosure that allows ingress of outside air, the unit must be returned to OSI LaserScan for repair before internal damage is sustained.

Power Input Connector (3-Pin)

Located on the side of the case is the 3-pin power input connector. The connector provides for connection of the power input cable. Functional details of the connector are provided in paragraph 2.6.1.

Communication Connector (10-Pin)

Located above the power input connector is the 10-pin communication connector. The connector provides for connection of the RS422 Message communication and Logic Level connection cable. Functional details of the connector are provided in paragraph 2.6.2.

High-Speed Communication Connector (10-Pin)

Located adjacent to the widow shroud is the 10-pin high speed data communication connector. The connector provides for connection to the High Speed RS422 and Ethernet Data Port for data capture and analysis.

LED Indicators

Located next to the connectors are Yellow, Red and Green LED indicators. The Red and Green indicators flash when the AutoSense™ performs self-test at start up and indicate status during operation. The Yellow LED indicates AC power is applied.

Laser Output Window

Located at the front of the housing, the laser output window protects the AutoSense™ components from the environment, and allows the laser to scan the traffic lane. The window is coated with an ITO film that is a transparent current carrying film that heats the window to eliminate condensation during cold weather.

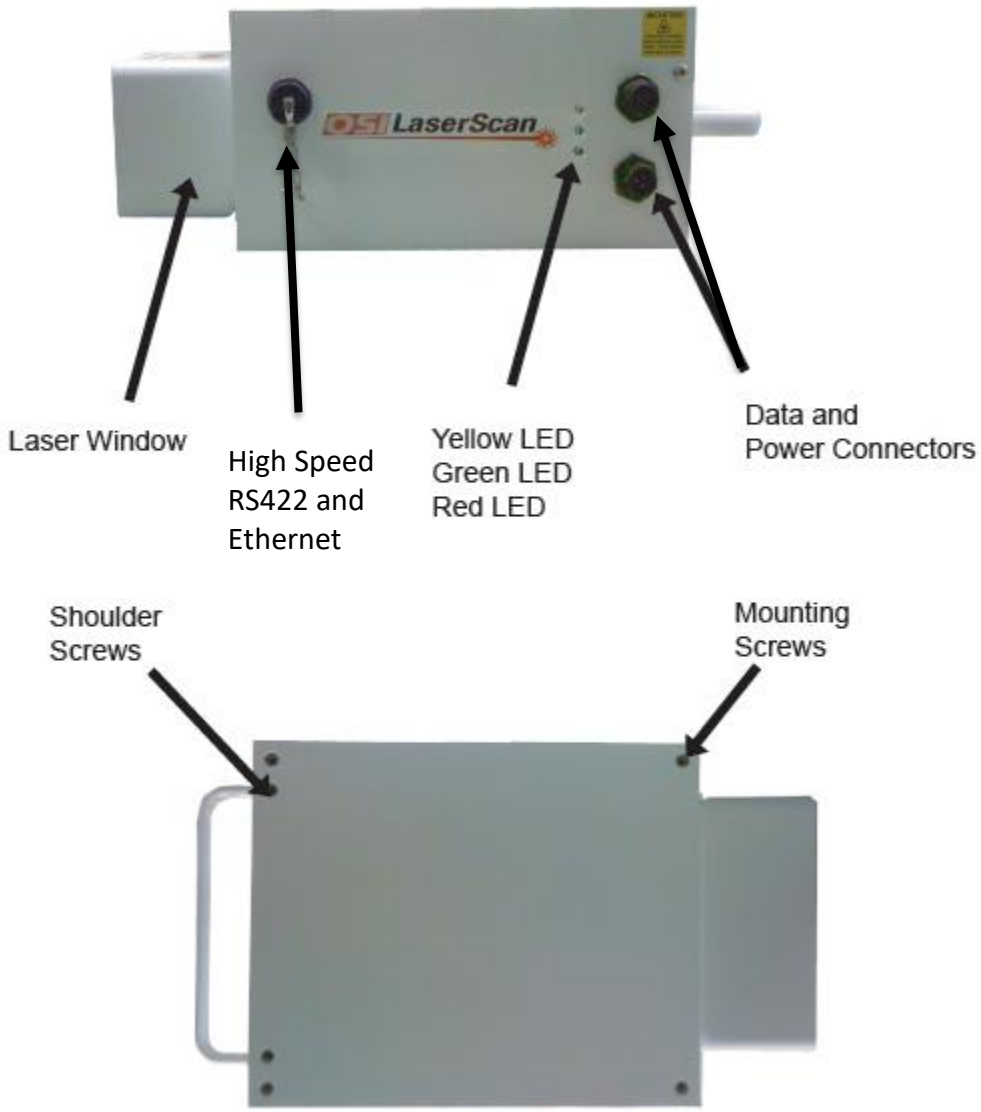


Figure 8: AutoSense™ Enclosure Detail

Carrying Handle

Located on the case, the carrying handle is used to transport the AutoSense™ and assist in the mounting procedures.

Mounting Hardware

The mounting hardware consists of; four each, 1/4-20 bolts with lock washers and flat washers; and 2 each 1/4-20 shoulder screws. The mounting hardware is used to secure and align the case to the mounting plate.

The hardware included with the AutoSense™ is for use with the AutoSense™ Mounting Plate sold by OSI, Inc. If any other mounting arrangement is to be

used, care must be taken not to break through the case by using mounting screws that are too long.

OPTIONAL EQUIPMENT

The following optional equipment is available for the AutoSense™:

Description	Part Number	
Power Cable xxx = length in feet For LSZH Cables Order	120 Volt 9291011-9-xxx 9291011-19-xxx	240 Volt 9291111-9-xxx 9291111-19-xxx
Communications Cable xxx = length in feet SEE APPENDIX B FOR DETAILS	RS422 Message and LLDET = 9291010-29-xxx RS422 High Speed Data = 9291010-79-xxx Ethernet 10/100 Data = 9291010-59-xxx	
RS-422 to USB Converter	SeaLevel 2106 CommFront USB-422-1	
RS-422 to RS-232 Opto-Isolated Converter	CommFront CVT-422-3	
Beam Finder	9301000-9	
Start-up Kit CD Rom User's Manual Software Warranty Certificate	19471024-9 19479201 19479601 19479201	19471024-9 19479201 19479601 19479201
Mounting Kit Mounting plate Mounting hardware and tools Connector, Data Connector, Power	19471022-9 19476022-1 19471023-9 PW06P-12-10S PW06P-12-3S	19471022-19 19476022-1 19471023-9 PW06P-12-10S PW06P-12-3SY

SECTION 2: GETTING STARTED

SCOPE

The following procedures provide instructions for unpacking, inspection, and general interface and power requirements of the AutoSense™.

WARNING: Installation of the AutoSense units must be performed by qualified and trained technicians.

UNPACKING AND INSPECTION OF PARTS

The AutoSense™ is shipped in a container. Inside the container, extra protection of the equipment is provided by foamed inserts. The items used with the AutoSense™ are embedded in the foam inserts. Unpack the AutoSense™, as follows:

- Place the shipping container down on a flat surface. Open the lid.
- Ensure the following components are in the shipping container; check Packing List against components:
- AutoSense™, Unit
- Two Shoulder Screws
- Four 1/4-20 Bolts MAX Length .75in, four Lock Washers, four Flat Washers
- Optional Items, as shown on the Packing List
- Packing List.
- Remove the items from the shipping container; place on a flat work surface (table or bench), and inspect for damage.

POWER REQUIREMENTS

The AutoSense™ is configured for one of two power requirements, as follows:

120 V, 50/60 Hz, 2.0 A

240 V, 50/60 Hz, 3.5 A.

CAUTION
Check the AutoSense™ power requirements label on the case, prior to applying power.
AVERTISSEMENT
Vérifiez l'étiquette d'alimentation électrique AutoSense ™ sur le boîtier avant de mettre sous tension.

INTERFACE SIGNALS

The AutoSense™ AS600 Hybrid Series default serial interface is RS-422 as previously described and is full duplex. The AS600 Series Hybrid units also contain 10/100BaseT Ethernet Signals. The specifications for each of the interfaces are presented in Table 2-1.

	Description	Specification
STANDARD CONFIGURATION	RS-422 *	
	Function	Message Data Communication
	Mode of Operation	Differential Full Duplex
	Configuration	No Parity, 8 data bits, 1 stop bit
	Baud Rate	19.2, 38.4, 57.6 Kbaud
	Maximum Cable Length	Dependent upon data rate, ≅ 3300 feet @ 57.6 Kbaud
Obsolete	RS-232 (EIA 232D)	No longer supported
HIGH SPEED STANDARD CONFIGURATION	RS422 High Speed Port	
	Function	Raw Data Collection
	Mode of Operation	Differential
	Configuration	No Parity, 8 data bits, 1 stop bit
	Baud Rate	1.25 Mbaud
	Maximum Cable Length	Dependent upon cable capacitance, 2500 pF Max, 165 feet typical
ASX00 HYBRID ETHERNET	10/100baseT Ethernet Port	AVAILABLE ON HYBRID SERIES ONLY
	Function	Message Data and High Speed Data
	Mode of Operation	Full Duplex
	Maximum Cable Length	Typical Specification of 328ft (100m)
***Note: These are factory settings only.**		

Table 2- 1. AutoSense™ Interface Signals

DIMENSIONS

The dimensions of the AutoSense™ are listed below. Figure 2-1 shows the mounting holes on the base of the case.

a. Height: 6.1 inches (15.5 cm)
b. Width: 9.6 inches (24.4 cm)
c. Depth: 17.9 inches (45.5 cm)
d. eight 21 pounds (9.5 kg).

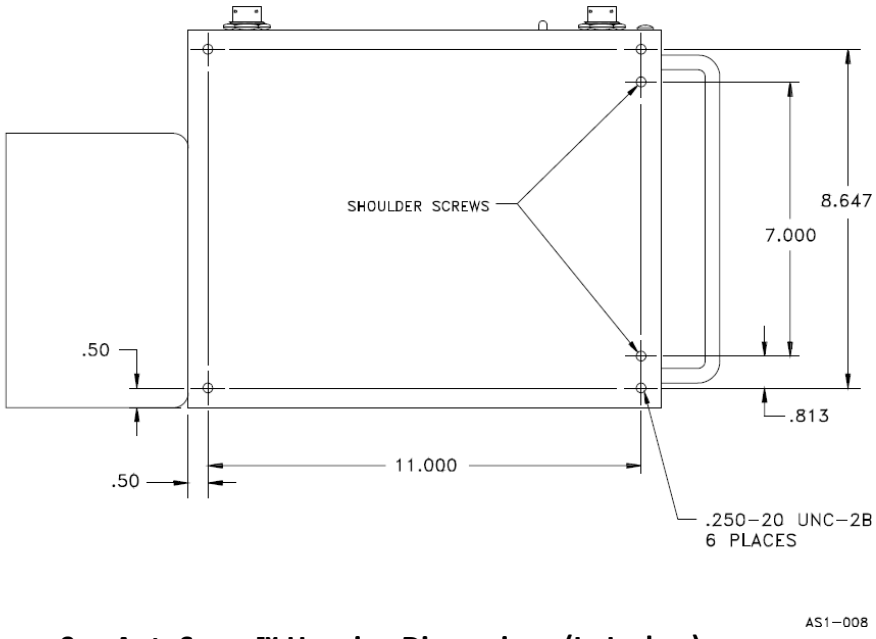


Figure 9: AutoSense™ Housing Dimensions (In Inches)

CABLE REQUIREMENTS

Power Cable

Input Power Connector pin functions are described in Table 2-2. The three-conductor power cable should be shielded and have a minimum wire size of 18 AWG. Alpha 5163/1C is an acceptable, recommended cable. Although it is not rated as an outdoor cable, more than 20 years of history has shown it to be very reliable in a typical gantry installation. OSI provides an environmentally sealed cable as an accessory. See page 10.

Pin	Function
A	AC
B	Neutral TN Style
C	Earth Ground

Table 2- 2. Input Power Connector Pin Functions

For proper installation, the AutoSense unit power must be permanently connected to a Breaker Box or Fuse Panel with all three conductors connected to the specified power and ground connections. DO NOT use any type of quick

connect or temporary plugs or receptacles. A fuse or circuit breaker MUST be placed between the AutoSense™ unit and the source of power. Make sure that the Earth Ground conductor is properly terminated to provide stated IP Ratings.

The cable shield is to be grounded on the Scanner connector end of the cable ONLY and MUST NOT be connected to the earth ground in the breaker box.

CAUTION
For proper installation, it is necessary to connect all three conductors to the specified power and ground connections. A fuse or circuit breaker must be used between the AutoSense™ unit and the source of power. DO NOT USE A FUSE OR CIRCUIT BREAKER IN THE EARTH GROUND LINE.
MISE EN GARDE
Pour une installation correcte, il est nécessaire de connecter les trois conducteurs aux connexions d'alimentation et de terre spécifiées. Un fusible ou un disjoncteur doit être utilisé entre l'unité AutoSense ™ et la source d'alimentation. NE PAS UTILISER DE FUSIBLE OU DE DISJONCTEUR DANS LA LIGNE DE MISE À LA TERRE.

Connect the power cable plug to the AutoSense™ power input connector, as shown in Figure 10: Autosense Power Connector

Figure 10: Autosense Power Connector

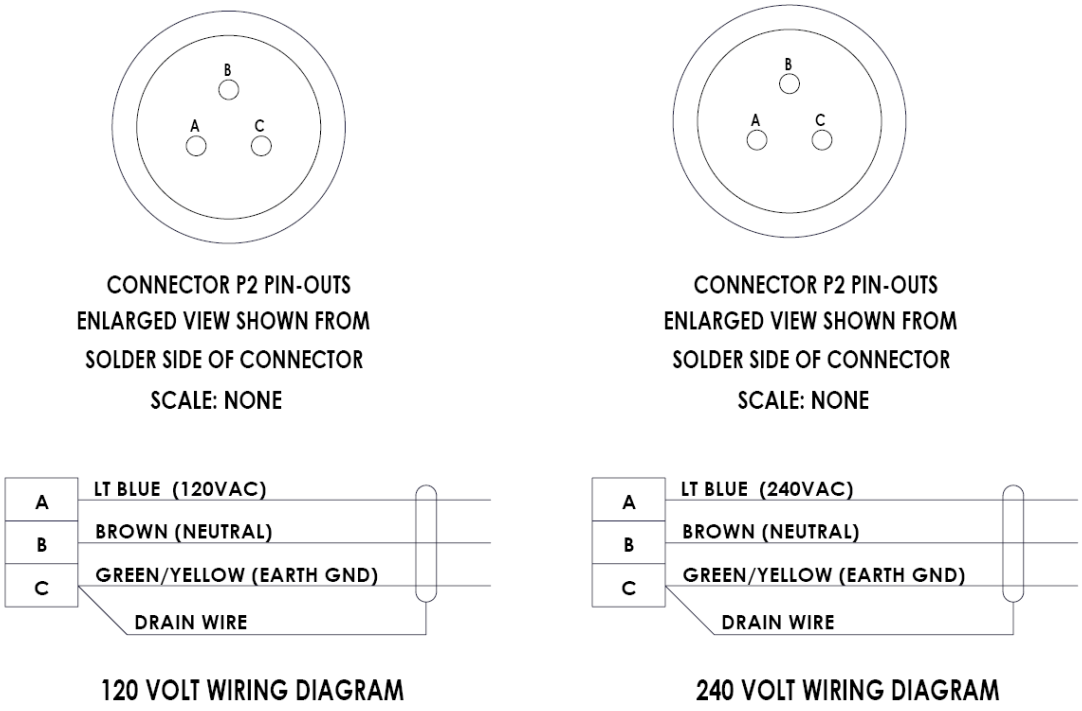


Figure 11: Power Cable Pinout

The 120V and the 240V connectors appear to be identical however, the 240V connector is keyed so the pins are offset to the 120V connector. The two cables cannot be interchanged.

Communication Cable

Communication Data Connector pin functions for the AutoSense™ are described in Table 2-3. The cable used should be a shielded, low-capacitance, polyethylene type, such as BELDEN 9807. For RS-422 operation, maximum cable length for reliable operation is determined by data rate. OSI provides an environmentally sealed cable as an accessory. See page 10.

AutoSense™ also has a high-speed (1.25 Mbps) RS-422 interface capability. The high-speed interface is used in applications requiring transmission of the sensor's raw range and intensity data. A connection diagram for a high-speed RS-422 interface is presented in Appendix B.

Connect the communication cable to the AutoSense™ communication connector, as shown in Figure 12: Communication Cable Connection

Figure 12: Communication Cable Connection

ORDERING INFORMATION

The AS600 Series Hybrid Scanners are available with multiple options ranging from 120 Volt to 240 Volt Supply's and Communication Protocols including RS422 for backward compatibility and Ethernet 10/100 Base-T. There is also the capability of capturing RAW range and intensity data via the RS422 High Speed Port. The options for ordering the configuration desired is show in Table below.

AS	615-	U	D	K	-H
AS	Function	Voltage	RS422 Service Port	Communication Pinout	Hybrid
	615=30° Scan 618=35° Scan 625=Truck Body Classifier	U=120V E=240V	D=All available communication and Logic Level Outputs	K = Ethernet, RS422 & GND, N.O. & COM Relay Control, AUX1	

Table 2.3 Example: AS615-UDK-H = 30° Scan, 120 VAC input, RS422 High Speed RAW Data Port & Ethernet.

SECTION 3: OPERATION OF THE AUTOSENSE™

FUNCTIONAL DESCRIPTION

The AS600 Series AutoSense™ provides timing, position, speed, length, and dimensional classification of vehicles passing through its field-of-regard. The AS600 Series AutoSense™ is designed to be installed on a gantry, pole arm or

roof structure in a toll plaza scanning across the traffic lane. The AutoSense™ is designed to communicate with a roadside computer through its serial data connector, using either RS-422 or Ethernet. It also provides a camera trigger signal as a discrete signal through the same connector. For each vehicle passing through its field-of-regard, the AutoSense™ will output five serial data messages and a camera trigger, as shown and described in Figure 3-1 and Table 3-1. A Vehicle ID number assigned by the unit will be used to identify the passing vehicle for all five messages.

Regardless of the installation location (i.e., open road or toll plaza) the AutoSense™ will provide vehicle detection, separation and camera trigger information. However, accurate classification information is best obtained in an environment where vehicle speeds are maintained above 20 mph (32kph). Below 20 mph (32kph) the confidence factor associated with the vehicle classification will be degraded.

Message Detail

When enough pixels per scan find an object for enough consecutive scans of the first beam of the AutoSense™, the unit will detect the presence of the vehicle, assign a Vehicle ID number, and send a “1st Beam Vehicle Detection” message to the roadside computer.

When enough pixels per scan find an object for enough consecutive scans of the second beam, the AutoSense™ will send a “2nd Beam Vehicle Detection” message to the roadside computer. This message contains the Vehicle ID number, the vehicle speed and the vehicle’s left-edge and right-edge positions in the 1st beam.

When no object has been found for enough consecutive scans under the first beam, the unit will send a “1st Beam End of Vehicle” message to the roadside computer. This message contains the Vehicle ID number, left-edge and right-edge positions in the 2nd beam.

When no object has been found for enough consecutive scans under the second beam, the AutoSense™ outputs a camera-trigger signal and sends a “2nd Beam End of Vehicle” message to the roadside computer. This message contains only the Vehicle ID number. The camera trigger is generated as a discrete output on pin K of the Communications Data Connector. It is a complementary 5 Volt digital signal, 1 µsec in length.

The AutoSense™ compiles the accumulated data for the vehicle, generates a classification for this vehicle and sends this data along with the Vehicle ID number, vehicle length, vehicle width and speed to the roadside computer. This is the “Classification Message” and is the last message the AutoSense™ will send regarding the vehicle.

In addition, the AutoSense™ runs self-tests on a periodic basis and will report any detected failures by sending a Self-Test Message to the roadside computer.

NOTE: Refer to Section 4, Message Protocol, for a complete list of output messages.

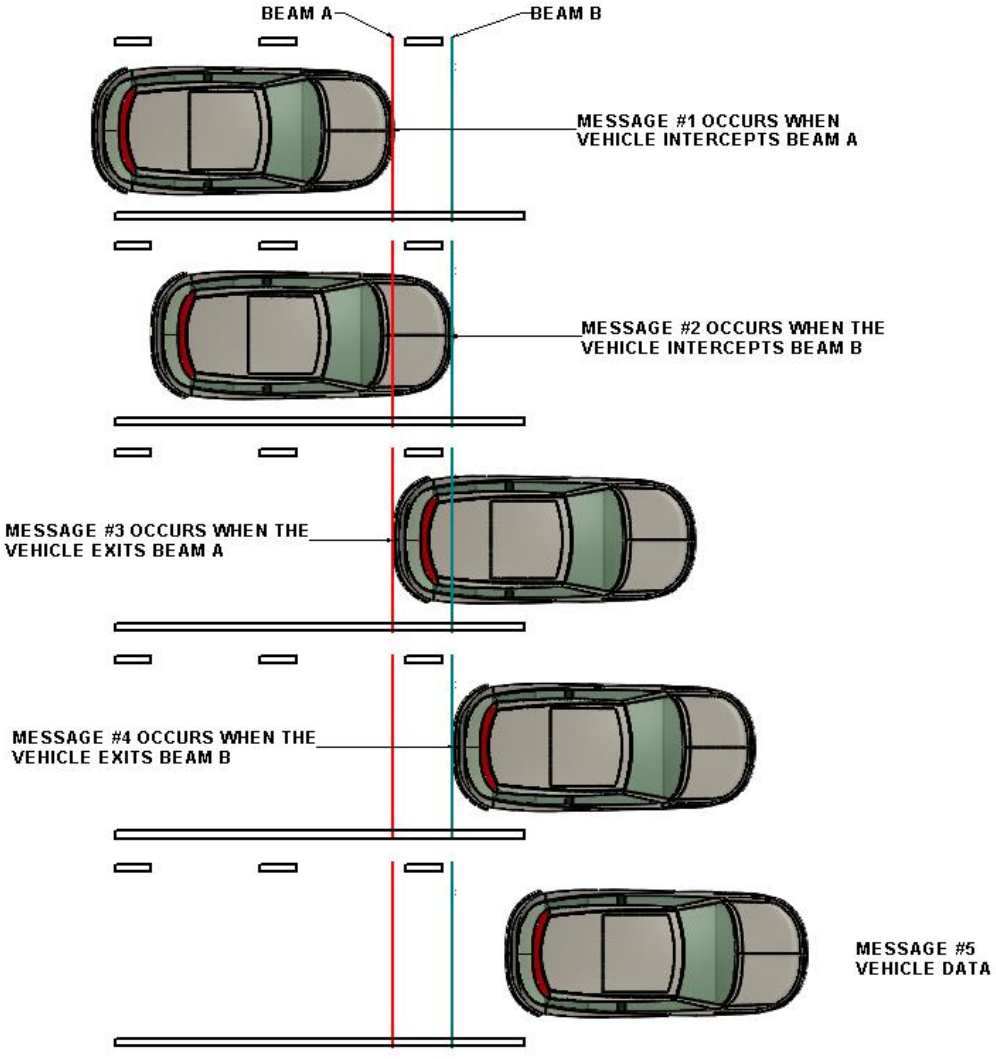


Figure 13: AutoSense™ Output Messages versus Vehicle Location.

Number	Message
1 of 5	1st Beam Vehicle Detection ID = 49
2 of 5	2nd Beam Vehicle Detection ID = 49 Speed (mph): 6
3 of 5	1st Beam End of Vehicle ID = 49
4 of 5	2nd Beam End of Vehicle ID = 49 Trigger on Pin K
5 of 5	Classification Message ID = 49 Passenger car: 95% Height: 5.45 ft. Length: 18.25 ft. Width: 9 Degrees Speed (mph): 6

TABLE 3-1. AutoSense™ Sample Output Messages.

As described in Table 3-1, The AutoSense™ will transmit 5 messages for each vehicle that is detected within its field of view. In normal circumstances, each message and the order in which it is transmitted is listed below.

#1 First Beam Vehicle Detection Message

#2 Second Beam Vehicle Detection Message

#3 First Beam End of Vehicle Message

#4 Second Beam End of Vehicle Message

#5 Vehicle Classification Message

Each message will include a corresponding vehicle ID. For a vehicle to be validated, messages #1 through #5 must be received when the same vehicle ID. If any message is not received, or if all of the messages do not have the same vehicle ID, then the vehicle is not valid and should not be counted.

Normal Vehicle Message Sequence:

[Msg#1, ID=1] [Msg#2, ID=1] [Msg#3, ID=1] [Msg#4, ID=1] [Msg#5, ID=1]

However, if the AutoSense™ unit is installed incorrectly and the 10 degree laser beam is not pointing into the oncoming flow of traffic, the AutoSense™ will transmit messages out of the normal sequence. Likewise, if a vehicle were to back-up through the detection zone (i.e., travel in the opposite direction of traffic, the AutoSense™ will also transmit the messages out of sequence. This

will allow the roadside computer system to identify and filter this detection as an invalid detection.

Reverse Vehicle Message Sequence:

[Msg#2, ID=1] [Msg#1, ID=2] [Msg#4, ID=2] [Msg#5, ID=2] [Msg#3, ID=1]

TYPICAL INSTALLATION

Typically, the AutoSense™ is mounted between 6 and 7 meters height (19.5 and 23 feet), centered above the traffic lanes, as shown in Figure 3-2. The AutoSense™ has mounting holes located at each corner of the base. Mounting bolts are supplied with each unit. A mounting plate is also available that allows the sensor to be mounted to horizontal poles with a diameter from 2 to 3.5 inches (50 to 90 mm). The maximum mounting height is 7.6 meters (25.0 feet). Please reference APPENDIX E for nominal installation information.

Look Down Angle

The *AutoSense™* will meet the specifications as defined herein when mounted with the correct look down angle. The recommended look down angle is 10 degrees for the first beam and 0 degrees for the second beam. These beam angles are achieved by mounting the sensor at a 5-degree forward tilt as shown in Figure 14: Typical Mounting Specifications.

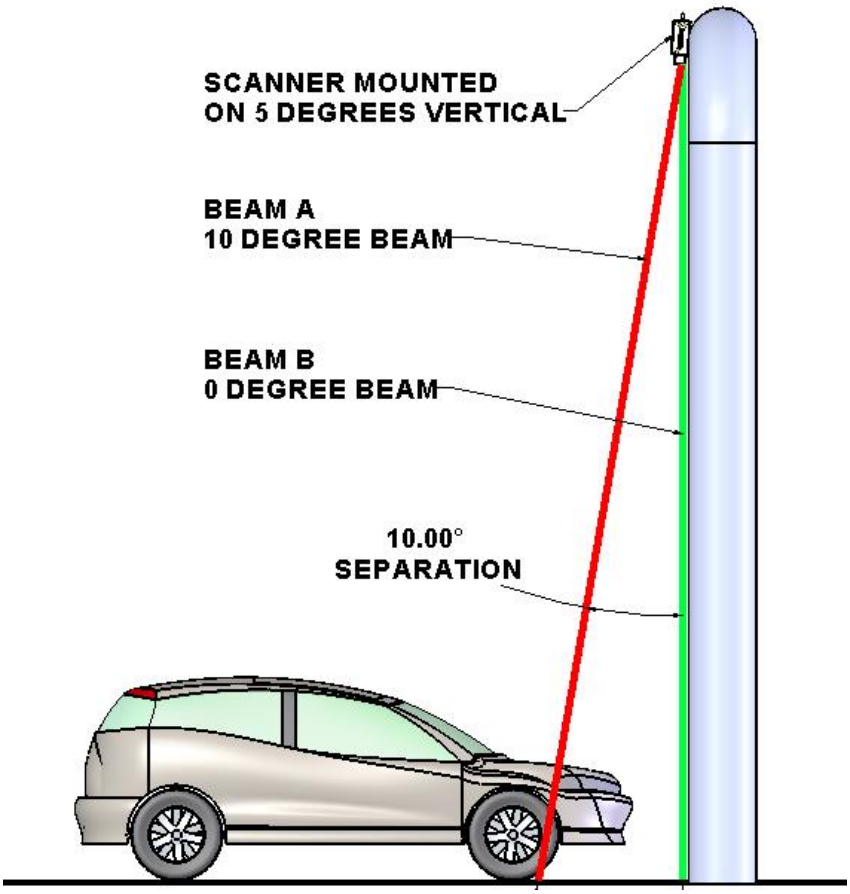


Figure 14: Typical Mounting Specifications

SECTION 4: MESSAGE PROTOCOL OF THE AUTOSENSE™

DATA FRAME FORMAT

For normal operation, the AutoSense™ is configured for 57.6 Kbps, no parity, 8 data bits, and 1 stop bit. No hardware or software handshaking is used. The AutoSense™ will send messages as it detects vehicles. Each data frame will consist of a 2 byte synchronization header, followed by the message/command, and ending with a 1 byte checksum, as shown in the following table. The sections that follow describe the message blocks for each of the AutoSense™ messages. All multi-byte data is transferred low byte first.

Name	Descriptions	Size	Value
Frame Sync	First byte of a two byte synchronization header.	1 Byte	A5 hex
Frame Start	Second byte of a two byte synchronization header.	1 Byte	5A hex
Message Block	The message/command data will be inserted into this location.	1 – N bytes	See 4.2 to 4.13
Checksum	Byte-wise exclusive-OR of Message block	1 Byte	to FF hex

MESSAGE SUMMARY

Command	Message ID	Response	Description
Power-On Message	6	N/A	Power-up Report
1st Beam Detection	1	N/A	1st beam vehicle detect
2nd Beam Detection	2	N/A	2nd beam vehicle detect
1st Beam End of Vehicle	3	N/A	1st beam end vehicle detect
2nd Beam End of Vehicle	4	N/A	2nd beam end vehicle detect
Vehicle Classify	5	N/A	Vehicle Classify
Command Acknowledge	8	N/A	Command Acknowledge
Test Data Output Message	9	N/A	Test Data Output Message
Self-Test Message Block	7	N/A	Self-Test Status Message
Heartbeat Message	12	N/A	Periodic communication.
Detection Clear Message	13	N/A	No Vehicle Present
Version Report	29	N/A	Version Report

Power-On Message Block

This message will be sent after the AutoSense™ unit has powered up and completed initial calibration.

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Message ID	Defines the start of a message	Byte	1	6	N/A	N/A
Self-Test Results	Any faults detected by the internal self-test routines. A set bit indicates a failure. All bits are defined in the Self-Test Message Description	Word	1	0-7FFh	N/A	N/A
Firmware Major Revision	The primary version level of AS600 Series Firmware	Byte	1	0-99	1	N/A
Firmware Minor Revision	The secondary version level of the AS600 Series Firmware	Byte	1	0-99	1	N/A
Firmware Patch Revision	The patch version level of the AS600 Series Firmware	Byte	1	0-99	1	N/A
Range to Road Beam #2	The range from the AS600 Series to the road for every degree of the scan for Beam #2	Byte	30	0-255	0.25	¼ Feet
Range to Road Beam #1	The range from the sensor to the road for every degree of the scan for Beam #1	Byte	30	0-255	0.25	¼ Feet

Message Data

(Message #1) First Beam Vehicle Detection Message Block:

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Message ID	Defines this as a First Beam Vehicle Detection Message	Byte	1	1	N/A	N/A
Vehicle ID	Unique number assigned by the sensor upon detection of a new vehicle	Byte	1	0-255	1	N/A
* Vehicle Left Edge Position	Defines where the left edge (with respect to the sensor) of the vehicle is positioned within the lane (pixels).	Byte	1	0-29	1	Degree
* Vehicle Right Edge Position	Defines where the right edge (with respect to the sensor) of the vehicle is positioned within the lane (pixels).	Byte	1	0-29	1	Degree
* Optional data: these bytes are sent only if the “Extra Message Bytes Enable” option is set in FLASH Parameters. **This adds 2 bytes to the length of the message.**						

(Message #2) Second Beam Vehicle Detection Message Block:

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Message ID	Defines this as a Second Beam Vehicle Detection Message	Byte	1	2	N/A	N/A
Vehicle ID	Unique number assigned by the AS600 Series corresponding to Message #1 for the same vehicle.	Byte	1	0-255	1	N/A
Vehicle Left Edge Position	Defines where the left edge (with respect to the sensor) of the vehicle is positioned within the lane	Byte	1	0-29	1	Degrees
Vehicle Right Edge Position	Defines where the right edge (with respect to the sensor) of the vehicle is positioned within the lane	Byte	1	0-29	1	Degrees
* Vehicle Left Edge Range	Defines the range at the left edge (with respect to the sensor) of the vehicle (¼ feet).	Byte	1	0-255	1	¼ feet
* Vehicle Right Edge Range	Defines the range at the right edge (with respect to the sensor) of the vehicle (¼ feet).	Byte	1	0-255	1	¼ feet
Vehicle Speed	Speed at the leading edge of the Vehicle, MPH.	Byte	1	0-120	1	MPH
* Optional data: these bytes are sent only if the “Extra Message Bytes Enable” option is set in FLASH Parameters**. This adds 2 bytes to the length of the message**.						

(Message #3) First Beam End of Vehicle Detection Message Block:

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Message ID	Defines this as a First Beam End of Vehicle Detection Message	Byte	1	3	N/A	N/A
Vehicle ID	Unique number assigned by the AS600 Series corresponding to Messages #1 and #2 for the same vehicle	Byte	1	0-255	1	N/A
Vehicle Left Edge Position	Defines where the left edge (with respect to the sensor) of the vehicle is positioned within the lane	Byte	1	0-29	1	Degrees
Vehicle Right Edge Position	Defines where the right edge (with respect to the sensor) of the vehicle is positioned within the lane	Byte	1	0-29	1	Degrees
* Vehicle Left Edge Range	Defines the range at the left edge (with respect to the sensor) of the vehicle (¼ feet).	Byte	1	0-255	1	¼ feet
* Vehicle Right Edge Range	Defines the range at the right edge (with respect to the sensor) of the vehicle (¼ feet).	Byte	1	0-255	1	¼ feet
* Optional data: these bytes are sent only if the “Extra Message Bytes Enable” option is set in FLASH Parameters. **This adds 2 bytes to the length of the message**.						

(Message #4) Second Beam End of Vehicle Detection Message Block:

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Message ID	Defines this as a Second Beam End of Vehicle Message	Byte	1	4	N/A	N/A
Vehicle ID	Unique number assigned by the AS600 Series corresponding to Messages #1, #2, and #3 for the same vehicle	Byte	1	0-255	1	N/A

(Message #5) Vehicle Classification Message Block:

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Message ID	Defines this as a Vehicle Classification Message	Byte	1	5	N/A	N/A
Vehicle ID	Unique number assigned by the sensor corresponding to previous messages for the same vehicle	Byte	1	0-255	1	N/A
Vehicle Classification	A number which represents the class of a vehicle	Byte	1	0-11	1	N/A
	0 = Unknown 1 = Motorcycle 2 = Motorcycle with trailer 3 = Passenger Car 4 = Passenger Car w/trailer 5 = Pickup/Van/Sport Utility 6 = Class 5 w/trailer 7 = Single Unit Truck/Bus 8 = Class 7 w/trailer 9 = Tractor w/ 1 trailer 10 = Tractor w/2 trailers 11 = Tractor w/3 trailers					
Classification Confidence	A number which represents the probability that the Vehicle Classification is accurate	Byte	1	0-100	1	Percent
Feature Data	Vehicle Height	Byte	1	0-255	0.25	Feet
Feature Data	Vehicle Length	Byte	1	0-255	0.25	Feet
Feature Data	Vehicle Width	Byte	1	0-29	1	Degree
Feature Data	Spare	Byte	5	0	N/A	N/A
Vehicle Speed	Speed at leading edge	Byte	1	0-255	1	MPH

Command Acknowledged Block

This message will be sent in response to the AutoSense™ unit receiving a Reset Command (4.2.17) or any command requiring an Acknowledge response.

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Message ID	Defines the start of a message	Byte	1	8	N/A	N/A

Test Data Output Command Block

This command can be sent by the roadside computer to receive range and intensity data from the AutoSense™ unit. The Test Data Output Message (4.2.9) will be sent in response to this command.

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Command ID	Defines this as a Test Data Output Command	Byte	1	17	N/A	N/A

Test Data Output Message Block

This message will be sent after the AutoSense™ unit has received the Test Data Output Command (4.2.8).

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Message ID	Defines the start of a message	Byte	1	9	N/A	N/A
Range to Road Beam #2	The range to the road for every degree of the scan for Beam #2	Byte	30	0-255	0.25	Feet
Intensity of Road Beam #2	The Pulse Width (signal strength) for every degree of the scan for Beam #2	Byte	30	0-127	1	N/A
Range to Road Beam #1	The range to the road for every degree of the scan for Beam #1	Byte	30	0.255	0.25	Feet
Intensity of Road Beam #1	The Pulse Width (signal strength) for every degree of the scan for Beam #1	Byte	30	0-127	1	N/A

Self-Test Command Block

This command can be sent by the roadside computer to initiate a self-test by the AutoSense™. The Self-Test Message (4.2.11) will be sent in response to this command.

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Command ID	Defines this as a Self-Test Command	Byte	1	7	N/A	N/A

Self-Test Message Block

This message will be sent in response to receiving a Self-Test Command (4.2.10) or when the AutoSense™ detects a failure.

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Message ID	Defines the start of a message	Byte	1	7	N/A	N/A
Faults	Any faults detected by the internal self-test routines. A set bit indicates a failure. See SELF-TEST RESULTS FLAGS (section 4.2.12.1) for a description of each item.	Word	1	0-FFFFh	N/A	N/A
	Bit 0 = EPROM Checksum Bit 1 = EEPROM Checksum Bit 2 = - 5 Volt Error Bit 3 = External RAM Bit 4 = Motor Control Bit 5 = + 5 Volt Supply Bit 6 = APD Temperature Bit 7 = Air Temperature Bit 8 = Range Calibration Bit 9 = Threshold Bit 10 = APD High Voltage Bit 11 = High Humidity in Enclosure Bit 12 = Too Many SPORT Resyncs Bit 13 = 3 Volt Error Bit 14 = 24 Volt Error Bit 15 = UART Error					

SELF TEST RESULT FLAGS

Bit	Name	Description
0	Application Image	This test checks the CRC checksum of the application image in FLASH. A failure of this test will prevent the application code from running. (Only the Bootloader will operate if this test fails).
1	Parameters Image	Parameter Settings FLASH image Checksum. This test will fail if the parameters in FLASH are corrupted. This failure requires reloading of the parameter image for the unit from an archive. (Only the Bootloader will operate if this test fails)
2	- 5 Volt	Negative 5 Volt supply out of range.
3	External RAM	External SRAM Read/Write test.
4	Motor Control	Indicates the motor speed is out of tolerance.
5	+ 5 Volt	Positive 5 Volt supply out of range.
6	APD Temperature	Laser receiver APD temperature reading out of acceptable limits. Possibly defective temperature sensor.
7	Air Temperature	The window temperature sensor value is not within the acceptable limits (0.02 to 3.00 volts.)
8	Calibration	Indicates the laser range calibration numbers are out of acceptable limits.
9	THRESHOLD	Laser receiver threshold setting test. A failure indicates a problem in the Low Voltage control electronics.
10	High Voltage	Laser receiver APD High voltage gain setting out of range. A failure indicates a problem in the High Voltage control electronics.
11	High Humidity	Higher than normal humidity reading within enclosure due to loss of seal.
12	SPORT Resync	Too Many Resync errors in SPORT connecting Blackfin to SHARC.
13	3 Volt Error	3 Volt supply out of range.

Bit	Name	Description
14	24 Volt Error	24 Volt supply out of range
15	UART Error	Error in RS422 Serial communications UART

Heartbeat Message

This message will be sent periodically to indicate that the system is operating nominally. The message will be sent only if no other message has been sent during the defined time interval.

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Heartbeat	Indicates Status of Sensor	Byte	1	12	N/A	N/A
Beam #0 Detection	Indicates Detection Active on Beam #2	Byte	1	0-255	N/A	N/A
Beam #1 Detection	Indicates Detection Active on Beam #1	Byte	1	0-255	N/A	N/A

Detection Cleared Message

This message will be sent to indicate that there is no vehicle currently in detection.

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Field of View Clear	Indicates all vehicles have cleared the sensor.	Byte	1	13	N/A	N/A

Version Report

This message is sent in response to receiving a Version Report Request message (4.2.15).

Name	Description	Type	Size	Range/ Value	Precision	Unit of Measure
Command ID	Defines this as a Version Report message.	Byte	1	29	N/A	N/A
Operating mode	Non-zero indicates the application firmware is running.	Byte	1	0-FFh	N/A	N/A
Boot Loader Firmware Major Revision	The primary version level of Boot Loader Firmware.	Byte	1	0-99	1	N/A
Boot-Loader Firmware Minor Revision	The secondary version level of the Boot Loader Firmware.	Byte	1	0-99	1	N/A

Boot-Loader Firmware Patch Revision	The patch version level of the Boot Loader Firmware.	Byte	1	0-99	1	N/A
Reserved	Boot loader development number.	Byte	1	0-255	1	N/A
Application Firmware Major Revision	The primary version level of Application Firmware.	Byte	1	0-99	1	N/A
Application Firmware Minor Revision	The secondary version level of the Application Firmware.	Byte	1	0-99	1	N/A
Application Firmware Patch Revision	The patch version level of the Application Firmware.	Byte	1	0-99	1	N/A
Reserved	Application Firmware development number.	Byte	1	0-255	1	N/A
Serial Number	The sensor serial number.	32-bit Word	1	0-FFFFFFFFh	1	N/A

Sensor Input Message (Commands)

The sensor accepts the following messages from the Controller via the 57.6 kbps RS-422 Interface.

Command	Message ID	Response	Description
Heart-Beat Configure/Request	12	Heart-beat message (5.1.10).	Time, in seconds, allowed to elapse with no message before a Heart-Beat report will be sent. 255 = disable. This value will only be retained until the sensor is reset. To permanently change the value, Change the setting in the FLASH Parameters.
Reset Command Block	16	Command Acknowledge (5.1.7)	Resets the unit.
Test Data Output Command	17	Test Data output (5.1.8)	Test Data Output Command
Self-Test Command Block	7	Self-Test Message (5.1.9)	Self-Test Status Request Command
Version Request	29	Version Report (5.1.12)	Defines this as a Version Request Command.
Soft Reset Command	15	Command Acknowledge (5.1.7)	Restarts the application without running the boot-loader.
Comm Check Command	21	Detection messages 1, 2, 3, 4, 5	Communication interface test.

Heart-Beat Configure/Request

Request a heart-beat report from the sensor. Optionally enables / disables the heart-beat report until the next power or RESET event.

Name	Description	Type	Size	Range/ Value	Precision	Unit of Measure
Command ID	Defines this as a Heart-beat request Command.	Byte	1	12	N/A	N/A
Heart-beat period	Time, in seconds, allowed to elapse with no message before a Heart-Beat report will be sent. 255 = disable. This value will only be retained until the sensor is reset. To permanently change the value, Change the setting in the FLASH Parameters.	Byte	1	10 – 254, 255 = disable	1	seconds

Reset Command Block

This command can be sent by the off-board computer to reset the AS600 Series unit.

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Command ID	Defines this as a Reset command	Byte	1	16	N/A	N/A

Test Data Output Command Block

This command can be sent by the roadside computer to receive range and intensity data from the AS600 Series unit. The Test Data Output Message (4.2.9) will be sent in response to this command.

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Command ID	Defines this as a Test Data Output Command	Byte	1	17	N/A	N/A

Self-Test Status Command Block

This command can be sent by the roadside computer to request a self-test status from the AS600 Series unit. The Self-Test Message (4.2.11) will be sent in response to this command.

Name	Descriptions	Type	Size	Range/ Value	Precision	Unit of Measure
Command ID	Defines this as a Self-Test Command	Byte	1	7	N/A	N/A

Version Request

This message is sent to the sensor to request a Version Report message (4.2.14).

Name	Description	Type	Size	Range/ Value	Precision	Unit of Measure
Command ID	Defines this as a Version Request Command.	Byte	1	13	N/A	N/A

Soft Reset

The Soft Reset command causes the sensor to reload and initialize the Application. This differs from the Reset command (0x10) by bypassing the Boot Loader mode. The sensor responds with the Command Acknowledge Response message.

Name	Description	Type	Size	Range/ Value	Precision	Unit of Measure
Command ID	Defines this as a Soft Reset Command message.	Byte	1	15	N/A	N/A

Communications Check

This command used to test communication with sensor. It requests a simulated detection event sequence from the sensor. The sensor responds with a 5 message sequence (msg 1,2,3,4 & 5) simulating a vehicle detection. Also the trigger outputs are inverted for 0.5 seconds.

Name	Description	Type	Size	Range/ Value	Precision	Unit of Measure
Command ID	Defines this as a Communications Check Command message.	Byte	1	21	N/A	N/A

SECTION 5: MAINTENANCE OF THE AUTOSENSE™

CAUTION
DO NOT ATTEMPT TO OPEN THE AUTOSENSE™ HOUSING! The AutoSense™ housing is nitrogen purged and hermetically sealed prior to shipping, and should only be opened in a laboratory environment by OSI authorized personnel. All of the screws in the main housing are seal screws and should not be loosened. All calibration and internal alignment adjustments are set during final test, and no field adjustments are required. Opening the housing could damage the unit and will void the warranty.
MISE EN GARDE
N'ESSAYEZ PAS D'OUVRIR LE BOÎTIER AUTOSENSE ™! Le boîtier AutoSense ™ est purgé à l'azote et scellé hermétiquement avant l'expédition, et ne doit être ouvert dans un environnement de laboratoire que par du personnel autorisé OSI. Toutes les vis du boîtier principal sont des vis d'étanchéité et ne doivent pas être desserrées. Tous les ajustements d'étalonnage et d'alignement interne sont définis pendant le test final, et aucun ajustement sur le terrain n'est requis. L'ouverture du boîtier pourrait endommager l'appareil et annulerait la garantie.

PREVENTIVE MAINTENANCE

The AutoSense™ is designed to require very little maintenance. The only maintenance requirement for the AutoSense™ is keeping the window clean. When the window becomes dirty, range errors may occur. The window should be cleaned with optical lens tissue to avoid possible scratches and damaging the window. This should be done at intervals of approximately six months, or as conditions require.

CORRECTIVE MAINTENANCE

There is no authorized repair or service of the AutoSense™ by the user/operator. Should the AutoSense™ need service or repair, contact OSI per the contact information provided on page i of this User's Guide. Any unauthorized repairs performed on the AutoSense™ will void the equipment warranty.

For all repairs and services, contact OSI per the contact information provided on page i of this User's Guide. Obtain a Return Material Authorization (RMA) number and directions for shipping the AutoSense™.

PACKING THE AutoSense™ FOR SHIPMENT

Pack the AutoSense™ in a suitable shipping container along with a brief description of the problem and the RMA number. DO NOT pack any accessories unless instructed to do so by your OSI service representative.

Be sure the AutoSense™ is surrounded on all sides by 2 to 3 inches (50 to 75 mm) of packing material and is restrained from movement. The unit contains sensitive optical and electrical components which may be damaged by rough handling.

Label and ship the unit per the instructions of your OSI representative. Be sure the RMA number is displayed on the outside.

SECTION 6: TROUBLESHOOTING THE AUTOSENSE™

PROBLEM: AutoSense™ does not power-up.

CORRECTIVE ACTIONS

Ensure the main power cable is properly plugged into the power in receptacle and into the facility outlet with appropriate power available. Refer to paragraph 2.3 for input power requirements.

Ensure the main power supply is on.

Should the problem still exist, go to paragraph 6.2.

PROBLEM: AutoSense™ does not function.

CORRECTIVE ACTIONS

Check the power to the sensor and ensure that normal current is drawn. Refer to paragraph 2.3 for input power requirements.

Confirm that the sensor is mounted at least 4.00 Feet (1.2 Meters) from any surface.

Refer to Software User's Manual to run the Communication Self-check and view the range and signal strength.

In the event that these tests fail to remedy the fault, it is recommended that the unit be returned to the supplier or to OSI LaserScan. (Go to paragraph 6.2.)

PROBLEM: AutoSense™ messages indicate that vehicle speed and length are always "0".

CORRECTIVE ACTIONS

Confirm that AutoSense™ is mounted so that the 1st beam intercepts the vehicle before the 2nd beam.

APPENDIX A - SPECIFICATIONS

The following specifications are subject to change without notice:

Performance

Vehicle Detection Accuracy	>99.9% (one vehicle in field-of-view)
Vehicle Classification Categories	Motorcycle, Motorcycle + trailer, Car, Car + trailer, Pickup/Van/Sport Utility, Pickup + trailer, Single Unit Truck/Bus, Single Unit Truck/Bus + trailer, Tractor + 1 trailer, Tractor + 2 trailers, Tractor + 3 trailers
Vehicle Classification Accuracy	>95% (into 6 Vehicle Classes)
Vehicle Spacing Resolution	10 feet at 125 mph (3 m at 200 kph) 4 feet at 62 mph (1.2 m at 100 kph) 1.5 feet at 10 mph (.35m @ 18.2 kph)
Trailer Tow Bar Detection	>2 inches wide, >2 feet long up to 125 mph (>5 cm wide, >60 cm long up to 200 kph)
Side-by-Side Vehicle Spacing	3 degrees minimum between vehicles
End-of-Vehicle Detection Signal	~1 foot (0.3 M) after vehicle exits 2nd beam
Minimum Height Detection	2 feet (0.6 m)
Lane Width Coverage	12.3 feet at 23 feet mounting height (3.8 m at 7 m)
Maximum Mounting Height	25 feet (7.6 meters)
Minimum Mounting Height	19.5 feet (5.9 meters)
Hybrid Vehicle Height Accuracy	± .5 inches MAX (± 12.7 mm)
Vehicle Speed Accuracy	± 10% (based on the assumption that the vehicle is travelling at constant speed while passing under the AutoSense™ vehicle detector / classifier)

Physical

Power Input	120 V, 50-60 Hz, 1.5A, or 240 V, 50-60 Hz, 3.5A
Power Consumption	35 watts nominal, 157 watts maximum (motor startup and heaters on)
Dimensions	17.9 x 9.6 x 6.1 inches (Length x Width x Height) (45.5 x 24.4 x 15.5 cm)
Weight	21 pounds (9.5 Kg)

Laser Output

Wavelength	904 nm nominal at 22°C
Pulse Width (Typical)	8 nanoseconds
Energy per pulse (Typical)	60 Nano joules

Data Interface

RS-422	19.2, 38.4, 57.6 Kbps (User selectable) 8 data bits, 1 start, 1 stop, no parity
Ethernet	10/100base-T

Environmental

Temperature	-40 to +158°F (-40 to +70°C) with sun loading
Thermal Shock	60°F (15.56°C) /minute
Humidity	0 to 100% condensing
Rain	0.8 inches/hour (20 mm/hour) operating 4 inches/hour (100 mm/hour) maximum
Snow Loading	20 lb./ft^2 (98 Kg/m^2)
Ice Loading	Accumulation to 0.6 inches (15 mm)
Wind Loading	43 knots steady, 73 knots gusts
Dust	1g/m^3 with particles 10-100 micrometer diameter
Vibration	5 to 30 Hz, 0.5 G for 3 minutes in each axis
Shock	10 G in each axis
Electrostatic Discharge	2,000 volts
Reliability	>35,000 hours (Mean Time Between Failures)
Maintainability	15 minutes (Mean Time To Replace)
IP Rating	IPx4, IP67 Per IEC-62368-1: 2018
Certifications	CE Mark, UL, CSA, CB Scheme

APPENDIX B

Hybrid Communication Port Pin Assignment:

AutoSense™ RS422 to Communications Adapter (Rear Connector) pin assignments.

AutoSense Signal	AutoSense Connector (PT06P-12-10S)		PC Signal	SeaLevel 2106 9-pin D
TX+	B (white)	Twisted Pair	RXD+	1
TX-	C (black)		RXD-	2
RX+	F (green)	Twisted Pair	TXD+	4
RX-	G (black)		TXD-	3
GND	A(black)	Twisted Pair	GND	5
LL DET	K(red)		Programmable Logic Level Detect Signal	
COM	H(blue)	Twisted Pair	Solid State Relay Control Common	
N.O.	J(black)		Solid State Relay Control Normally Open	
Cable Shield	D	Drain Wire	The cable shield drain wire must never be connected on Customer end. Leave Unterminated and isolated from all ground sources.	
AUX LL1	E(YEL)		Programmable Auxiliary Logic Level Signal	

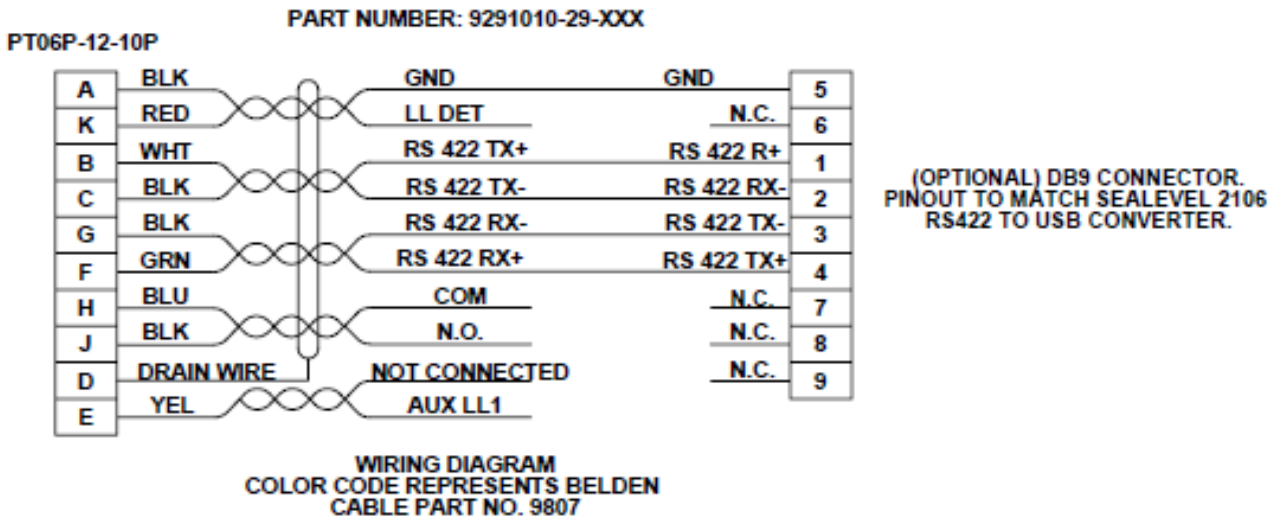


Figure 15: RS422 Message Data Communications Cable Schematic

Front Communication Port details.

The High Speed Front Connector contains both the HS RS422 and the 10/100 Ethernet signals. All signals for both data protocols are available in the bulkhead connector. However, the mating cables should typically be made up with one or the other as shown below. In the case both High Speed RS422 and Ethernet are desired it will be required that a CAT5e or CAT6 cable and a 6 twisted pair cable be attached within the same connector. Contact the LaserScan engineering department for schematics and parts list if desired.

AutoSense™ High Speed RS422 to Communications Adapter (Front Connector) pin assignments.

AutoSense Signal	AutoSense Connector (PT06P-12-10S)		PC Signal	SeaLevel 2106 9-pin D
TX+	B (white)	Twisted Pair	RXD+	1
TX-	C (black)		RXD-	2
RX+	F (green)	Twisted Pair	TXD+	4
RX-	G (black)		TXD-	3
GND	A(black)		GND	5
Cable Shield	D		The cable shield drain wire must never be connected on Customer end. Leave Unterminated and isolated from all ground sources.	

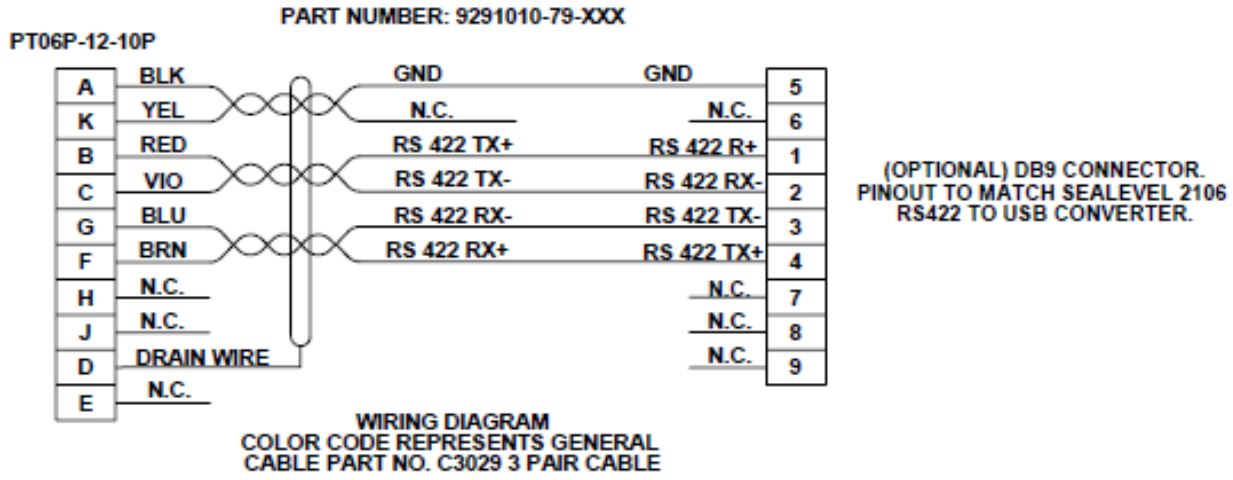


Figure 16: Front Port RS422 High Speed Data Communications Cable Schematic

AutoSense™ 10/100 ETHERNET to Communications Adapter (Front Connector) pin assignments.

AutoSense Signal	AutoSense Connector (PT06P-12-10S)		PC Signal	SeaLevel 2106 9-pin D
ETH RX-	K(ORG)	CAT6 Twisted Pair	ETH TX-	These connections must be made using a CAT5e or CAT6 cable. Color Code represents TIA/EIA 568A standards
ETH RX+	H(WHT/ORG)		ETH TX+	
ETH TX-	J(GRN)	CAT6 Twisted Pair	ETH RX-	
ETH TX+	E(WHT/GRN)		ETH RX+	
Cable Shield	D		The cable shield drain wire must never be connected on Customer end. Leave Unterminated and isolated from all ground sources.	

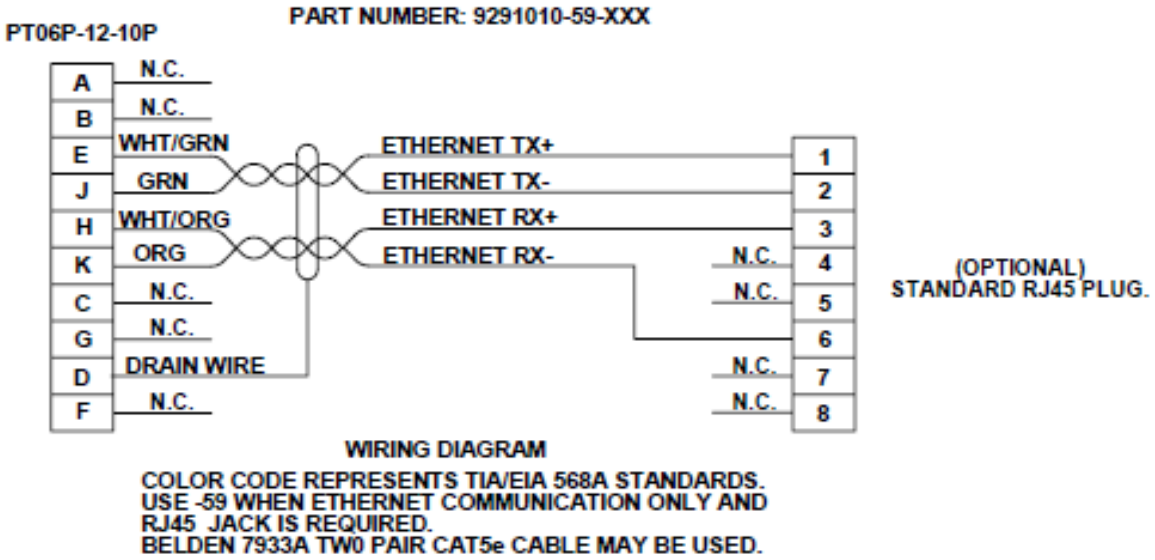
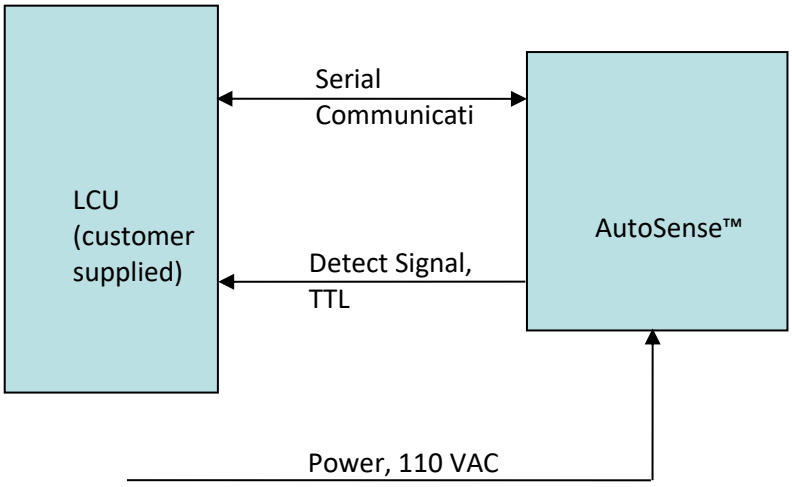


Figure 17: Front Port Ethernet Data Communications Cable Schematic

APPENDIX C – AutoSense™ Quick Start Guide to Operation



Serial Communication

- Detection Messages
  - Beam #1 Detection
  - Beam #2 Detection
  - Beam #1 End-of-Detection
  - Beam #2 End-of-Detection
  - Vehicle Classification
  - FoV Clear
- Self-Test

Detect Signal, TTL

- Vehicle Presence
- End-of-Vehicle Trigger
  - May be used to trigger camera
- Vehicle Detection Trigger

Figure C.1 AutoSense™ Interface

AutoSense™ Test Software

The ASMgr.exe program, supplied with each sensor via “ASMgr Installer.msi”, is used to set up and verify the operation of the AutoSense™. This software, which runs on a computer running Windows 2000, XP Pro, Windows 7 and Windows 8 is used to control AutoSense™ and to display message data in the standard operating mode. The standard operating mode outputs a series of 5 messages for each vehicle detected. The messages are sent via RS-422 serial interface at a rate of 57.6 Kbps. The AS600 Hybrid has both RS-422 and Ethernet at a rate of 10/100BaseTX.

Getting Started

Mount the AutoSense™ as shown in Figure 0.2 such that the distance from the front of the sensor to the tallest anticipated vehicle within the field of view, is at least 1.3 meters (~4 feet).

Now apply power to the AutoSense™. The Green LED will flash while the Boot-loader checks the application image and parameters. After 15 seconds the boot-loader will load and start the application software.

While the application software initializes the system and waits for the motor to spin up, the RED and GREEN LED’s will flash alternately. This may take up to 120 seconds at cold temperatures.

At the end of the initialization period the Green LED will remain on and the RED LED will remain off indicating road calibration.

Once road calibration is complete the RED LED will turn ON and remain ON unless a system fault is detected. The GREEN LED will turn OFF when a vehicle is detected.

In cold environments, heaters are turned on prior to initialization. In these circumstances, initialization can take up to 30 minutes. The following sequence of events will occur within this time period. After power is applied to the unit, if the temperature is below 15 degree C, the onboard heaters will be activated. Power to the processor is removed if the ambient temperature is below 0 degrees C. Once the temperature reaches 0 degrees C and the processor is active, the heated window is turned on and the system waits until the ambient temperature reaches 10 degrees C or 10 minutes has passed, whichever comes first. This allows for the window to clear before the unit begins scanning. Once the system is active the normal startup sequence is followed.

Now run the ASMgr.EXE. (For extended information on ASMgr, see "ASMgr_User Guide.doc".) Select the Configure Software option from the Setup Menu. Select the serial communication port that the AutoSense™ is connected to on the PC. Select the device model.

After the correct serial port and device model are selected, press the **Save &Exit** button so that the software will always default to the correct serial port where the AutoSense™ is connected.

The default data rate is fixed at 57.6 Kbps. However, other data rates are supported.

The **Configure Software** menu also provides the user with the option of saving all of the data to an ASCII text file. The file name field is large enough to allow the data to be redirected to another drive. For automatically opening a new log file each day, enter the directory path for the data file in the "**Data Path:**" entry. In this case the filename will be **ASyyyymmdd.txt**, where "yyyymmdd" is the current date.

After making changes, press the **Save & Exit** button so that the software will always use the selected settings.

What You Should See

The AutoSense™ will send a power-on message approximately 45 - 60 seconds after the unit is powered on. The power-on message will contain the self-test results, firmware version number, and the measured range to the road for each sample in both beams. If the road reference point for the AutoSense™ is not found initially, the power-on message may be delayed up to 2 minutes as the unit continually self-calibrates.

At the bottom of the screen there are function buttons. The operation of these buttons is described below.

Reset

Sends a Reset command to the AutoSense™. The AutoSense™ should respond with a Command Accepted message. After 45 - 60 seconds, the unit will send a Power-On message.

Test Data

Sends a Test Data Output command. The response will include the range and intensity data for 30 samples in both beams. The top section of the response

will show the range data (displayed in feet) for the second beam. The next section shows the corresponding intensity data for the second beam. The numbers will be in the range of 0 to 127. The next two sections are the range and intensity for the first beam.

Self-Test

Sends a Self-Test Status Command to the AutoSense™. The response will include a pass / fail status for each test.

Comm Check

Runs a communication self-check to test that the serial port, cables, 422 Converter, and the AutoSense™ are all configured properly. When the button is pressed, the following message will be displayed in yellow ***"Send Communication Check Command"***. If everything is working correctly, the AutoSense™ will respond with a sample set of the 5 vehicle detection messages that it sends for each vehicle. These detection messages will immediately be displayed on the screen. If no messages are displayed, then all components of the communication interface will have to be verified before proceeding any further.

Version Info

Sends a Version Info command to the Sensor. The response from the Sensor will include the Boot Loader Version, the Application Version, and the Sensor's Serial Number.

Diagnostics

Sends a System Status command to the Sensor. The Response from the sensor will include the Application Version, the Sensor's Serial Number and diagnostic configuration settings.

Testing with Vehicles

The AutoSense™ will transmit as many as 5 messages for each vehicle that is detected within its field of view. In normal circumstances, each message and the order in which it is transmitted is listed below.

#1 First Beam Vehicle Detection Message

#2 Second Beam Vehicle Detection Message

#3 First Beam End of Vehicle Message

#4 Second Beam End of Vehicle Message

#5 Vehicle Classification (Axle Count) Message

Please refer to Section 4.0 for details on the information contained within each message.

AutoSense™ LED Indicators

Message Mode

Power Up

On initial power-up the RED and GREEN LEDs are both turned off.

Boot-loader

The boot-loader indicates that a valid application image and parameters were found by flashing the GREEN LED continuously.

System Initialization and Motor spin-up

After a 15 second delay for boot-loading the RED and GREEN indicators blink alternately for up to 120 seconds to indicate application initialization and motor spin-up.

Initial Road Calibration

During initial road calibration the GREEN LED is turned ON and the RED LED is turned OFF. The RED LED is turned on when calibration is completed. This can be from a couple of seconds up to a couple of minutes.

Normal Operation

The RED LED remains ON during normal operation.

The GREEN LED indicates vehicle presence, as defined below.

Detection Idle

Used when no vehicle is detected in beam 2. Both LEDs remain ON.

Vehicle Present

GREEN LED turns OFF when a vehicle is detected in beam 2.

End-of-Vehicle

GREEN LED turns ON when an end-of-vehicle is detected in beam 2.

System Check

When the "Comm Check" command is processed the GREEN LED is inverted for ½ second.

Error Conditions

A flashing RED LED indicates error conditions.

Power-up (Boot Mode)

Invalid application or parameters

Red LED flashes steadily.

Operating (Application running)

Non-critical System failure

A non-critical failure condition may affect the performance of the system. It is indicated by the RED LED flashing once every 2 seconds.

Critical System Failure

If a critical system failure occurs, which prevents the system from operating properly, the RED LED will flash 4 times every 2 seconds.

LED Indications Tables

Mode	Step	LED			Indication	Description
		YELLOW	GREEN	RED		
Power Up		ON	OFF	OFF		Initial power-up
Boot Loader	Running Self-Test	ON	FLASH	OFF	Self-Test OK	Self-test is running and passed so far.
			OFF	FLASH	Self-Test Failure	A failure has been detected during Self-Test. System will not be initialized (remains in boot loader interface).
	Boot loader Interface mode.	ON			System OK	
				FLASH	Self-Test Failure	The system failed the boot-loader Self-Test.
System Initialization	Init	ON	ALTERNATING			System is initializing. Waiting for system to stabilize and motor to spin-up.
	Road Calibration		ON	OFF	Road Cal Active	The initial road calibration is being performed.
Normal Operation	Detection Idle	ON	ON	ON		No vehicle detected in 0º beam.
	0º Detect	ON	OFF		Vehicle Detection	Vehicle detected in 0º beam.
	0º End-of-Detect	ON	ON		End-of-Vehicle	Vehicle exited 0º beam.
System Test	Comm-Check	ON	OFF ½ second	ON	Comm check	When a “Comm Check” command is received the GREEN indicator switches for ½ second. The Logic-Level Detect signal is also switched at the same time.
Error Conditions	Non-Critical	ON	No change	1 FLASH every 2 seconds	Non-Critical Failure	A non-critical failure has been detected. The condition may affect performance of the system but does not prevent it from running.
	Critical	ON	TBD	4 FLASHES every 2 seconds.	Critical Failure	A critical failure has been detected. The condition prevents the system from functioning properly.

AutoSense™ – Trigger Signals

Purpose

This section explains the function of the LL_DET (Trigger) signal of the AutoSense™ (AS). All descriptions of the Trigger signal also apply to the optional Auxiliary Trigger signal.

Application

The LL_DET mode selected has no effect on the vehicle detection and classification operation of the AutoSense™.

Interface

The LL_DET signal is an active low (default) TTL level signal located on pin K of the communications interface connector of the AutoSense™. The Auxiliary Trigger signal is an optional TTL level signal located on pin E of the communications interface connector. These signals are referenced to the ground pin (pin A) of the communications interface connector.

Function

The LL_DET signal activates to indicate a detection event. The event which activates the signal is selected by configuration parameters contained within the system EEPROM parameters. The event can be End-of-Vehicle Trigger, Vehicle Detection Trigger or Vehicle Presence.

NOTE: The LL_DET mode selected has no effect on the vehicle detection and classification operation of the AutoSense™.

Trigger Mode

In Trigger Mode the LL_DET signal pulses active. The trigger can be configured to occur either at the end-of-vehicle (trailing) or at vehicle detection (leading). It can also be configured to occur on either the leading or trailing beam. The trigger defaults on active low pulse of one microsecond. The pulse width and active level are programmable.

End-of-Vehicle Trigger

For End-of-Vehicle Trigger mode the LL_DET pulse occurs when the end-of-vehicle is detected on the selected beam. This pulse occurs just prior to

message 3 or 4 being sent. The end-of-vehicle occurs approximately one foot after the vehicle exits the beam.

Detection Trigger

For Detection Trigger mode the LL_DET pulse occurs when a vehicle is detected on the selected beam. This pulse occurs just prior to message 1 or 2 being sent. The vehicle detection occurs when a vehicle is detected in the first beam for 8 consecutive scans.

When Detection Trigger mode is selected the first beam detection message (message 1), second beam detection message (message 2) and end-of-vehicle message (message 3) contain two extra bytes. Message 1 defines the left and right edges of the vehicle at detection. Messages 2 and 3 define the range to the left and right edges of the vehicle.

Presence Mode

For Presence mode the LL_DET signal goes active (low) when a vehicle is detected in the second beam. It goes inactive (high) when the vehicle is no longer detected in the second beam. The active edge corresponds with message 2, while the inactive edge corresponds to message 4.

Summary

Mode	Signal Type	Signal Activation	Signal De-Activation	Multi-Vehicle Behavior
End-of-Vehicle (Trailing)	1µs Pulse (or variable width Pulse)	1st or 2nd beam end-of-detection.	N/A	A pulse for each vehicle.
Detection (Leading Edge)	1µs Pulse	1st or 2nd beam vehicle detection	N/A	A pulse for each vehicle.
Presence	Active level	2nd beam vehicle detection	2nd beam end-of-detection.	The presence signal is active as long as any vehicle is in the 2nd beam.

Vehicle Detection Criteria

The vehicle detection criteria explain the thresholds used by the AutoSense™ to determine vehicle detection and end-of-vehicle detection. **These criteria**

are completely independent of the LL_DET mode of operation. This information is included in this document for completeness only.

Vehicle Detection

Vehicle detection occurs for a beam (1st or 2nd) if an object is detected for 8 consecutive scan lines. Scan lines occur at a rate of 360 per second for each beam. The table below shows the distance the vehicle travels from when it breaks a beam until it is detected.

Speed (mph)	Speed (fps)	Detection Distance (feet)	Detection Time (ms)
20	29.3	0.64	22.2
30	44.0	0.98	22.2
45	66.0	1.47	22.2
60	88.0	1.95	22.2
80	117.3	2.60	22.2
120	176.0	3.91	22.2

End-of-Vehicle

End-of-Vehicle detection for each beam (1st of 2nd) is speed dependent and is calculated to occur one foot beyond the last detection. The table below shows the number of scans and time for end-of-vehicle determination at different speeds.

Speed (mph)	EoV Scans == 1 foot	Time (ms)
Minimum	120	333
20	12	33
30	8	22
45	5	14
60	4	11
80	3	8
120	2	6
Maximum	2	6

Trigger Mode Configuration

The Selection of Trigger mode between Detection (Leading Edge) or End-of-Vehicle (Trailing Edge) is performed at the factory at production time. The trigger mode can also be configured by editing the FLASH Parameters using the ASMgr Windows-based application (setup -> Flash Parameters -> Application Settings).

Troubleshooting

Weather Related

In inclement weather conditions (heavy rain, dense fog or snow) or when the road surface under the sensor is very wet (pooling water) the LL_DET signal may fail to pulse at the end of the vehicle. In Detection mode the signal may remain active (low). This can be verified by observing the message data and observing whether or not the corresponding message (message 4) is occurring.

Slow Vehicles (Barrier Lane)

When a vehicle is moving very slowly (less than 20mph) under the sensor, multiple detection messages may occur as the vehicle passes through the beams. This may result in additional trigger pulses in Trigger mode or early deactivation of the presence signal in Presence mode.

Software Application Installation Procedure (Using ASMgr)

If necessary a new version of the AutoSense Firmware can be loaded into the sensor over the Message data serial interface. In order to do this the sensor must be reset and set to “boot mode”.

Equipment Required

- Windows Computer with a USB interface.
- AutoSense™ Manager application (ASMgr).
- AutoSense™ application (supplied by OSI LaserScan).
- SeaLevel 2106 USB to RS-422 converter).
- AutoSense™ Ethernet Communications Cable (P/N 9291020-9-xxx).
- AutoSense™ RS422 Communications Cable (P/N 9291010-29-xxx).
- AutoSense™ Power Cable (P/N 9291011-9-xxx).

Setup

- Connect the 2106 USB to RS-422 converter to the ASxxx Hybrid Series device (AS600, AS7xx, AS8xx) 9291010-29 comm cable with the optional DB9 Connector as shown below.
- Connect the USB connector on the 2106 adapter to a USB Port on the PC.
- Power up the computer.
- Power up the AutoSense™ unit.
- Start ASMgr.exe.
- Select the Setup->"Configure Software" menu item.
- Select the device model.
- Select the COM port to which the AS600 Series device is connected.
- Select the "Baud Rate" menu item. Select the baud rate the ASxxx device is configured for (default is **57.6**).
- Press the "Save and Exit" to save the configuration.

Application Installation

- Create a directory and copy the ASxxx (.ldr) file supplied by OSI LaserScan to the directory.
- Select the **Boot Loader -> Write App** menu item. Select the application from the location from step 1.
- When the application has been written, select the **Boot Loader-> Valid Prog Test** menu item. The response should be **"Valid Program Test: OK"**.
- Press the **"Self-Test"** button and verify that the **"Application"** test is **"OK"**.
- Select the **Boot Loader -> Run Application** menu item. Wait for the Power up message to be displayed and the version number is correct.
- The new Application is now installed.

APPENDIX D - Instructions for High Speed Data Collection

The AutoSense™ 600/700 Series sensor is capable of transmitting both message data and high speed (raw) data simultaneously. The message data interface is typically transmitted via the RS422 interface. The high speed data is transmitted at 1.25Mbs over a dedicated RS422 interface. In order to access this information, the AutoSense™ unit must be connected to a computer running the AutoSense™ Manager "High Speed Capture" software application. This appendix provides an overview of setting up the high speed data capture system.

Overview

In order to establish the high-speed data capture, the AutoSense™ 600/700 will need to be interfaced to a Windows 7 or 10 based PC running the AutoSense™ High Speed Capture software program. In addition, several required hardware elements are required as listed in Table D-1 below.

Running the High-speed (raw) Data Capture Program

The High-Speed (Raw) data capture program is a Windows-based application.

If the computer has not been setup for the high speed data capture follow the instructions in section D.2 Setup and Configuration to install the hardware and software required.

- Start "AutoSense High Speed Capture".
- Verify that the communications settings seen in the status bar match the computer's current settings. Update them via the "Comm" tab of the Configuration->Settings menu as necessary.

- ❖ Verify that the Device model in the title bar matches the current sensor. The device model selection may be updated via the “Device” tab of the Configuration->Settings menu item.
- ❖ Press the “Connect” button to start capturing data.

The application will now automatically capture vehicle images in the raw data. When a new file is captured text line above the “Display” group will be updated for the new file name.

When finished, press the “Disconnect” button.

Multiple instances of AutoSense High Speed Capture may be run simultaneously to capture data from additional sensors. The configuration settings are stored in a file (ASMgr.ini) in the directory from which the application is started. Each instance must be started from a different directory to prevent overwriting of settings. Also, be sure to designate a different capture directory for the different COM ports (See section “D.2.2 Installation and Setup of AutoSense High Speed Capture application” for setup instructions).

Manufacturer	Part Number	Qty	Description	Comments
Any	-	1	≥1GHz Windows 2000 to Windows 7 Pro machine with 2GB (256MB for XP) ram.	≥ 2.6 GHz Pentium 4 for connection to 2 sensors.
SeaLevel Systems	2106	1	RS422 to USB converter	Use if AutoSense™ data cable terminated with the optional DB9 connector.
OSI LaserScan	19471010 – X-XXX	1	AutoSense™ Communications Cable (XXX – denotes length)	

Table D-1. Hardware required for setup High Speed Data Capture

Manufacturer	Part Number	Qty	Description	Comments
OSI LaserScan	19471010 - X-XXX	1	AutoSense™ Communications Cable (XX – denotes length)	

Table D-2 – Alternate High-Speed Capture Serial Port Solutions

Setup and Configuration

High-speed (Raw) data capture requires the installation of a special RS422 serial communications card in a Windows based PC.

Installation and Setup of AutoSense™ high-speed capture application:

Multiple instances of AutoSense High Speed Capture may be run simultaneously to capture data from additional sensors. The configuration settings are stored in a file (ASMgr.ini) in the directory from which the application is started. Each instance must be started from a different directory to prevent overwriting of settings. Also, be sure to designate a different capture directory for the different COM ports.

Use Control Panel->Add/Remove Programs to remove any previously installed “AutoSense High Speed Capture” or “AutoSense Manager” application.

Install the new AutoSense High Speed Capture application, “AutoSense High Speed Capture Install.msi”.

Create a directory to start AutoSense High Speed Capture from. This directory will contain a configuration file “ASMgr.ini” which will contain the configuration settings. It is recommended that this directory is created as a sub-directory in the in the install directory (default install directory is “C:\Program Files\OSI LaserScan\AutoSense High Speed Capture”).

Create a shortcut for starting AutoSense High Speed Capture.

Open Windows Explorer and change to the install directory (default is “C:\Program Files\OSI LaserScan\AutoSense High Speed Capture”).

Right-click the “AutoSense High Speed Capture.exe” file and select “Create Shortcut”.

Rename the shortcut to something descriptive of the sensor it will be connected to (i.e. “right-lane High Speed Capture on Com5”).

Right-click on the short-cut and select “Properties”. Then select the “Shortcut” tab and, in the “Start in:” entry, enter the path to the directory created in step 3 above.

Copy the shortcut to the desktop by right-clicking on the shortcut and selecting copy. Then right-click on the desktop and select paste.

Start “AutoSense High Speed Capture” by double-clicking on the shortcut created in the previous step.

The first window to pop up will be the Configuration Settings window.

From the “Device” tab, select the proper Device (i.e. AS615).

From the “Packet Parameters” tab select ‘Has Channel Info’ if the sensor is sending channel data.

From the Comm tab select the COM port for the first system (default would be COM5).

In the “Saved File Directory” box at the bottom of the window enter a unique path for this channel (i.e. “d:\as2dat\leftlane\”). Then press the “Accept” button.

If multiple sensors will be connected to this computer at the same time, repeat steps 3 through 10 for the other com port (COM6). In step 3, use a different directory name. In step 4, use a different name for the shortcut. In step 10, use a different path than for the other COM port (i.e. “d:\as2dat\rightlane\”).

Each high speed application will now save to the directory associated with that configuration.

APPENDIX E - NOMINAL INSTALLATION INFORMATION

As was previously described in Section 3.0, the AutoSense™ 600 is intended to be mounted between 6 and 7 meters (19.5 and 23 feet), centered above the traffic lane. The maximum recommended mounting height is 7.6 meters (25 feet). If the recommended minimum mounting height cannot be achieved, please contact OSI for additional information on mounting options.

To ensure optimal performance of the unit, it is imperative that when determining the overhead mounting location, the respective field of view for the AutoSense™ 600 unit is free of any non-stationary objects, such as cables, flags, banners, moving gate arms, etc... This is imperative because the AutoSense™ 600 unit will detect the movement of the objects if the movement occurs within the detection zone beneath the unit and generate associated detection messages.

Overhead Mounting and Look Down Angle

When installing the AutoSense™ 600 it is recommended that the Mounting Plate, when affixed to the appropriate support element, be canted with a 5 degree forward tilt as shown in FIGURE E-1. This will ensure that the two laser beams emitted by the AutoSense™ 600 unit are at the specified angle to the road, 10 degrees and 0 degrees respectively.

Beam Separation and Lane Coverage versus Mounting Height.

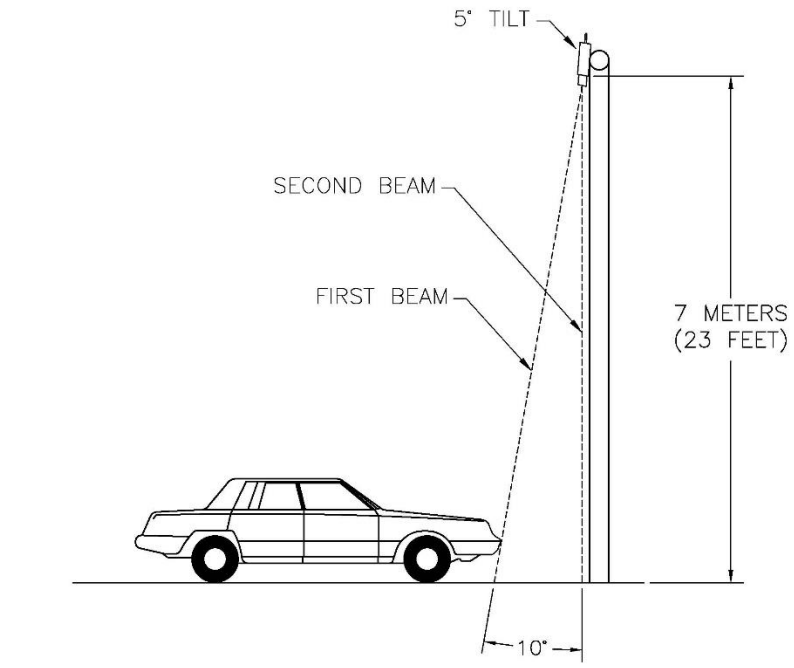
The AutoSense™ 600 will meet coverage specifications when mounting height is as shown on Table E-1.

Vehicle Separation versus Speed

The AutoSense™ 600 is designed to detect, separate and classify vehicles that pass within the detection zone beneath the sensor. Detection and subsequent separation of the successive vehicles is dependent on the speed with which the vehicles are traveling. Graph E-1 below defines the required separation distance between vehicles at various speeds.

Typical AutoSense™ 600 Installation

To facilitate the initial design and installation of the AutoSense™ 600 units, please refer to Figures E-2, E-3, E-4, and E-5. These figures are intended to serve as a reference only, as variability's in toll plaza designs exist.



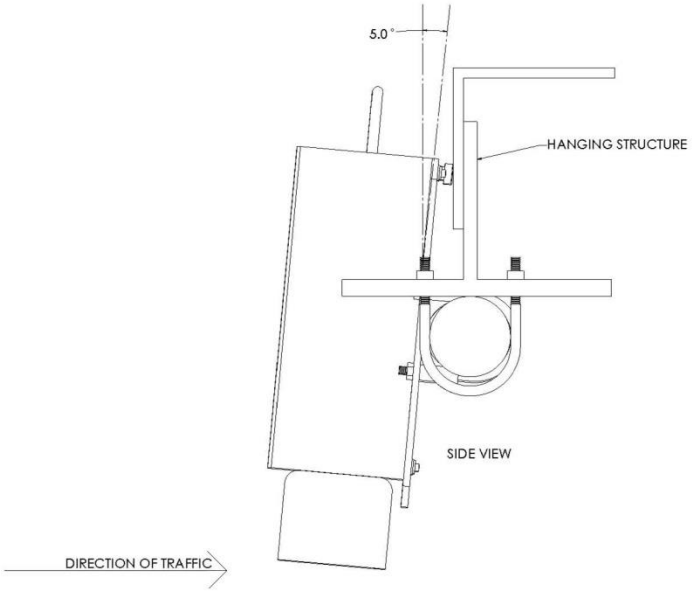


Figure E-1. Overhead Mounting and Look Down Angle

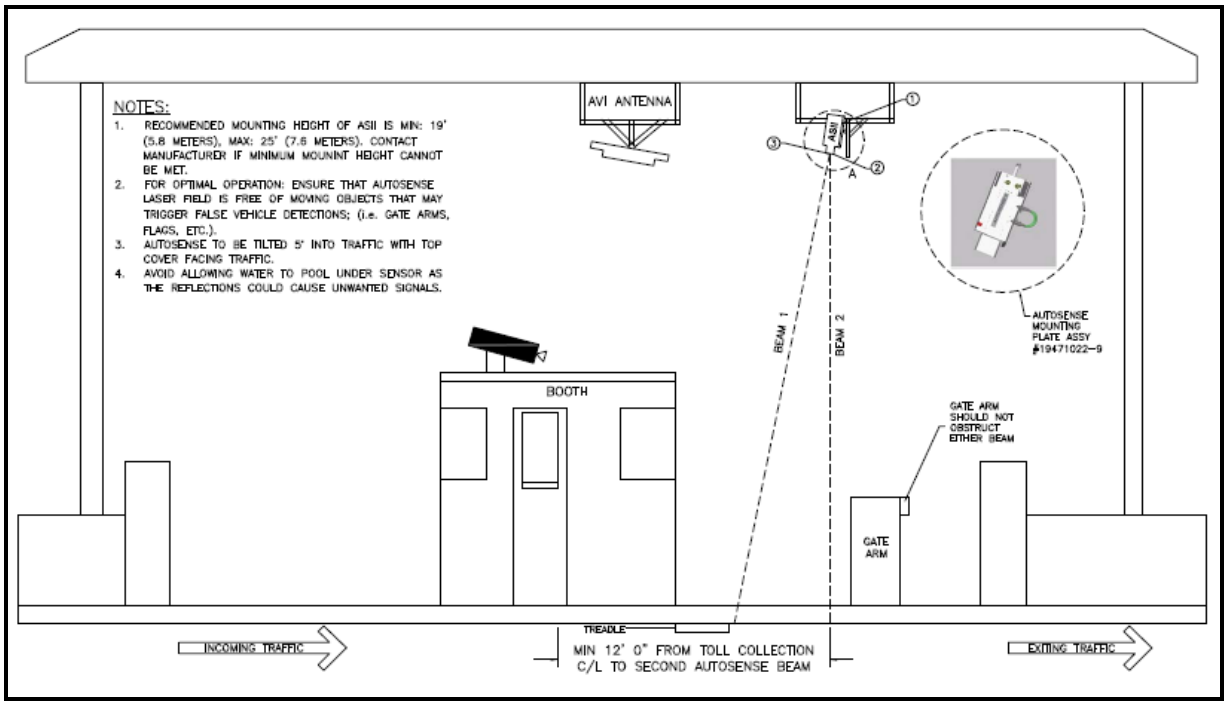


Figure E- 2 Elevation of Typical AutoSense Toll Plaza Installation

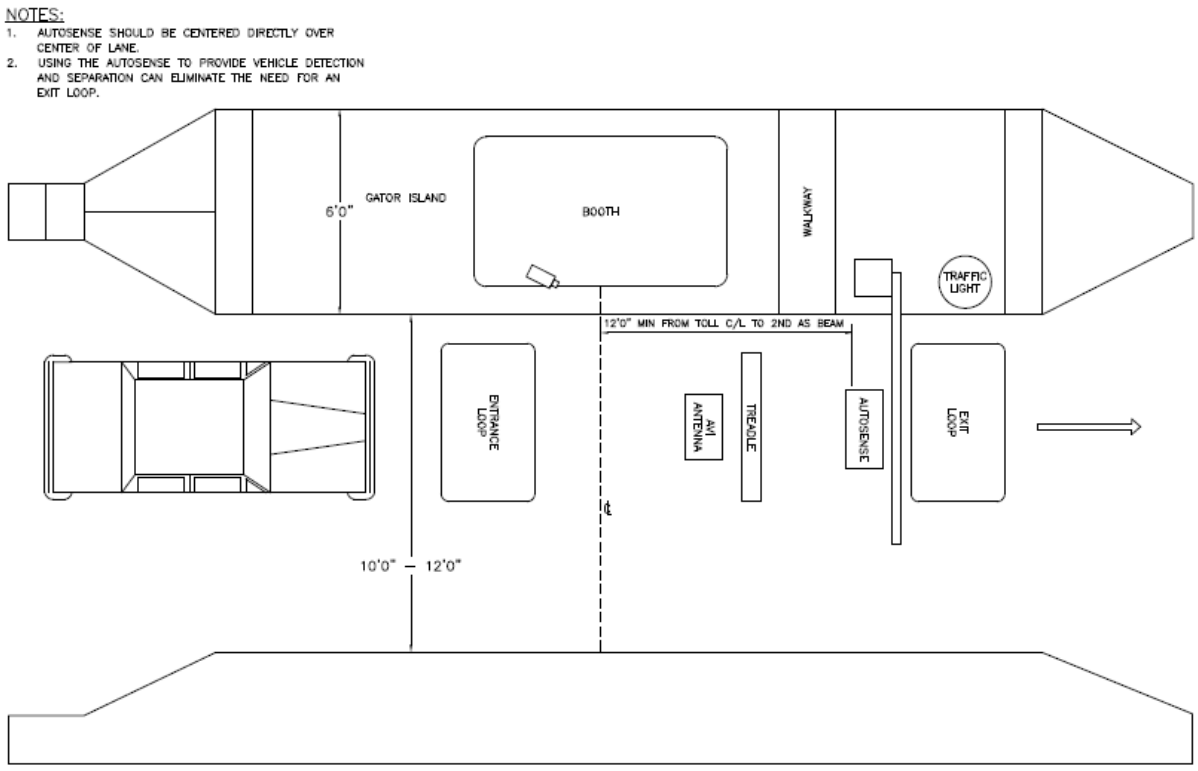


Figure E-3 Plan of Typical AutoSense Toll Plaza Installation

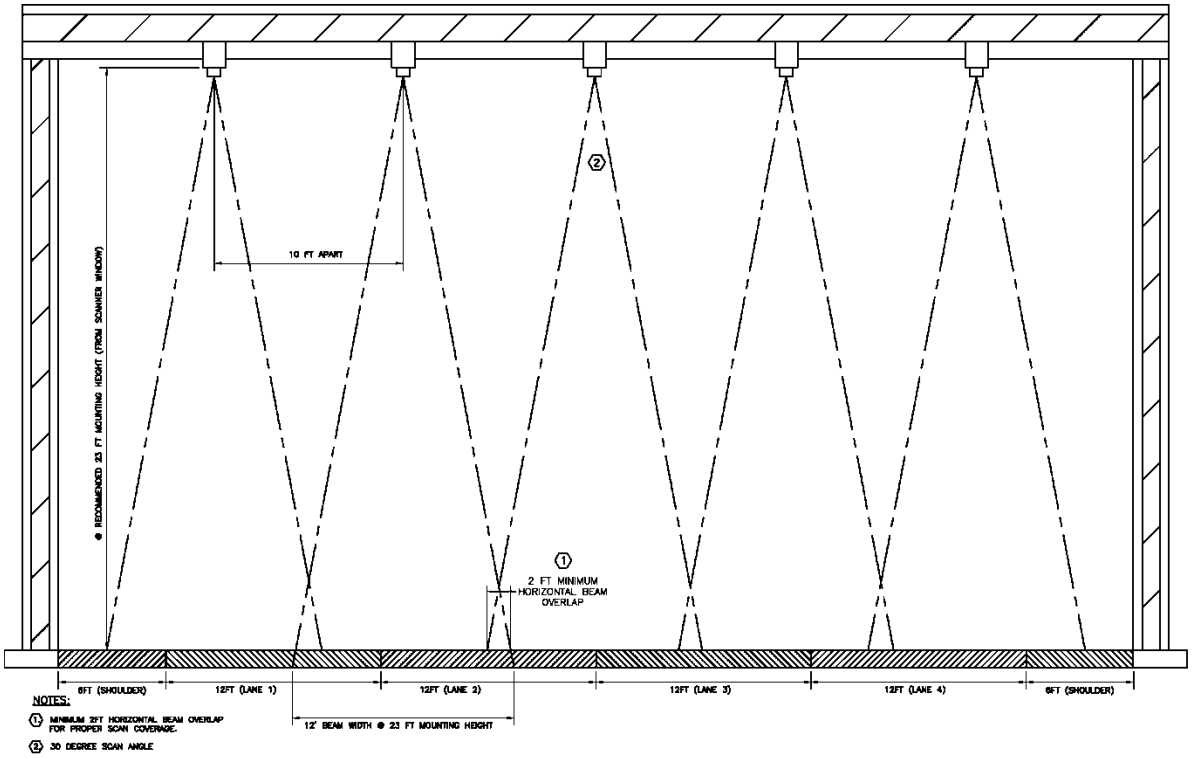


Figure E- 4 Elevation of Typical AutoSense Open Road Installation with Shoulder Coverage

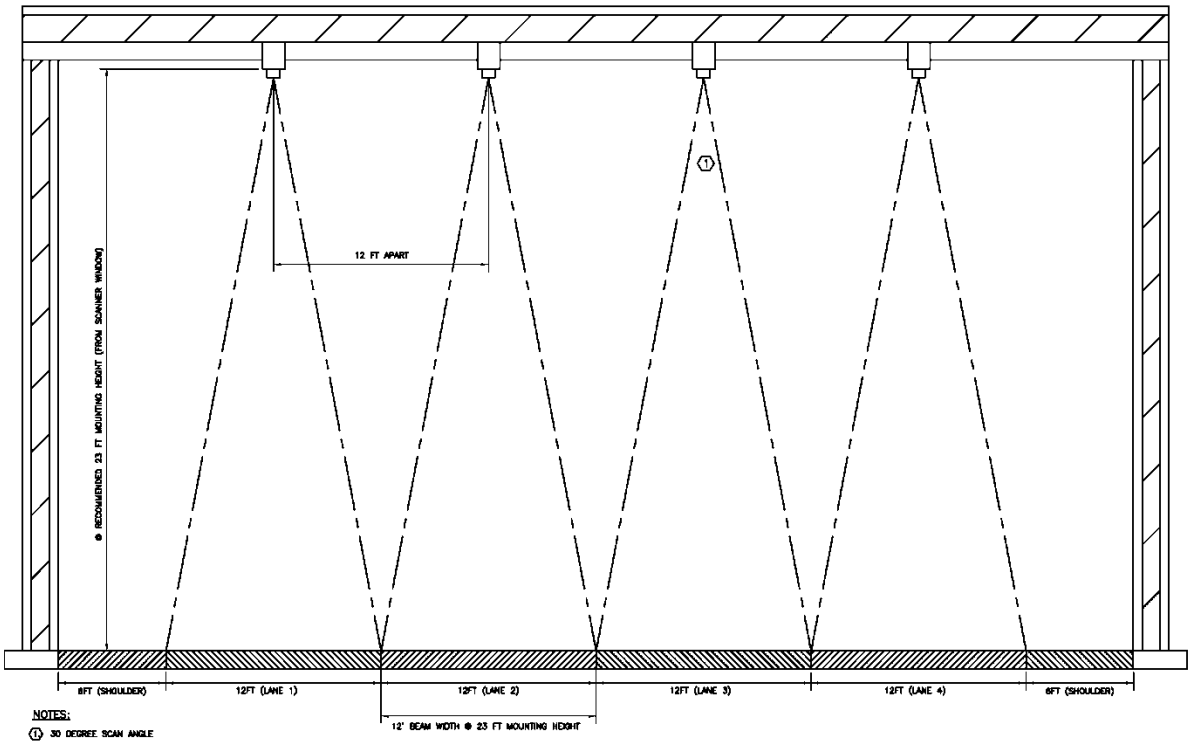
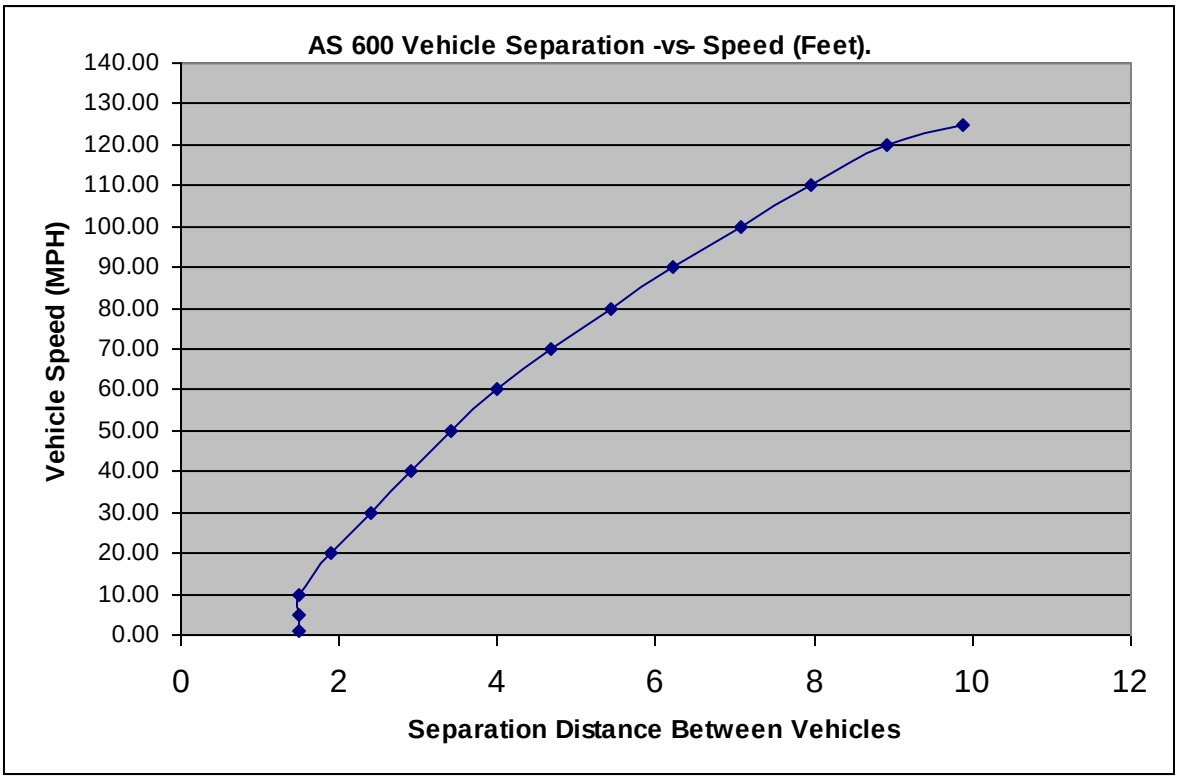


Figure E-5 Elevation of Typical AutoSense Open Road Installation at Center of Lane

Mount Height		0° & 10° Beam Separation Distance		Horizontal Beam Width		Beam Coverage Area	
(ft.)	(m)	(ft.)	(m)	(ft.)	(m)	(Sq. ft.)	(sq. m)
19.00	5.79	3.35	1.02	10.18	3.10	34.11	3.17
19.25	5.87	3.39	1.03	10.32	3.14	35.02	3.25
19.50	5.94	3.44	1.05	10.45	3.18	35.93	3.34
19.75	6.02	3.48	1.06	10.58	3.22	36.86	3.42
20.00	6.10	3.53	1.08	10.72	3.27	37.80	3.51
20.25	6.17	3.57	1.09	10.85	3.31	38.75	3.60
20.50	6.25	3.61	1.10	10.99	3.35	39.71	3.69
20.75	6.32	3.66	1.12	11.12	3.39	40.69	3.78
21.00	6.40	3.70	1.13	11.25	3.43	41.67	3.87
21.25	6.48	3.75	1.14	11.39	3.47	42.67	3.96
21.50	6.55	3.79	1.15	11.52	3.51	43.68	4.06
21.75	6.63	3.84	1.17	11.66	3.55	44.70	4.15
22.00	6.71	3.88	1.18	11.79	3.59	45.73	4.25
22.25	6.78	3.92	1.19	11.92	3.63	46.78	4.35
22.50	6.86	3.97	1.21	12.06	3.68	47.84	4.44
22.75	6.93	4.01	1.22	12.19	3.71	48.91	4.54
23.00	7.01	4.06	1.24	12.33	3.76	49.99	4.64
23.25	7.09	4.10	1.25	12.46	3.80	51.08	4.75
23.50	7.16	4.14	1.26	12.59	3.84	52.18	4.85
23.75	7.24	4.19	1.28	12.73	3.88	53.30	4.95
24.00	7.32	4.23	1.29	12.86	3.92	54.43	5.06
24.25	7.39	4.28	1.30	13.00	3.96	55.57	5.16
24.50	7.47	4.32	1.32	13.13	4.00	56.72	5.27
24.75	7.54	4.36	1.33	13.26	4.04	57.88	5.38
25.00	7.62	4.41	1.34	13.40	4.08	59.06	5.49
25.25	7.70	4.45	1.36	13.53	4.12	60.25	5.60
25.50	7.77	4.50	1.37	13.67	4.17	61.44	5.71
25.75	7.85	4.54	1.38	13.80	4.21	62.65	5.82
26.00	7.92	4.58	1.40	13.93	4.24	63.88	5.93

Table E- 1 AutoSense 0° to 10° Beam Separation & Lane Coverage: Unit Angled 5° into Traffic

To achieve vehicle separation, the AutoSense™ unit needs a maximum of 48 laser scans (at 5 MPH) and a minimum of 2 laser scans (at 120mph) on the road surface to separate vehicles. Graph E-1 below presents the intervehicle spacing required for vehicles traveling between 5 MPH and 125 MPH.



Graph E-1. Vehicle Separation versus Speed

APPENDIX F - ROAD AUGMENTATION FOR REFLECTIVITY

Purpose:

The AutoSense™ products utilize an eye-safe laser to detect and classify vehicles. In order for the AutoSense™ unit to function properly, the unit must be able to detect a "Reflected" laser pulse from either an object (i.e., car) or the road. Since many road surfaces do not provide a consistent reflective pattern for the laser, augmentation of the surface may be required in order to ensure adequate reflectivity for the laser.

Road reflectivity is best on "clean" concrete road surfaces and worse on newly installed black asphalt. Over time, the dark non-reflective surface of black asphalt will fade, thereby improving reflectivity, however, until such time, the performance of the AutoSense™ may be impaired. To minimize the impact of poor road reflectivity, OSI LaserScan recommends that an application of either, Hot Tape, System 300 Thermoplastic and 400 Cold Plastic or Sherwin Williams durable paint in the color specified below be applied to the road surface where the AutoSense™ laser strikes the road.

Location of Stripe(s):

The goal is to apply the road striping where the laser beam contacts the road. The distance between the beams on the road is based on the mounting height and the 10 degree beam separation. At a height of 7 meters, the beams are separated by 1.23 meters. For 2 stripes, they need to be separated by 1.23 meters. The laser beam diameter is less than 5mm, so 2 stripes with a width of 152mm or 6 inches will be sufficient. For specific beam separation information, please see Appendix E, Table E-1. To locate the beams, an AutoSense™ BeamFinder should be used.

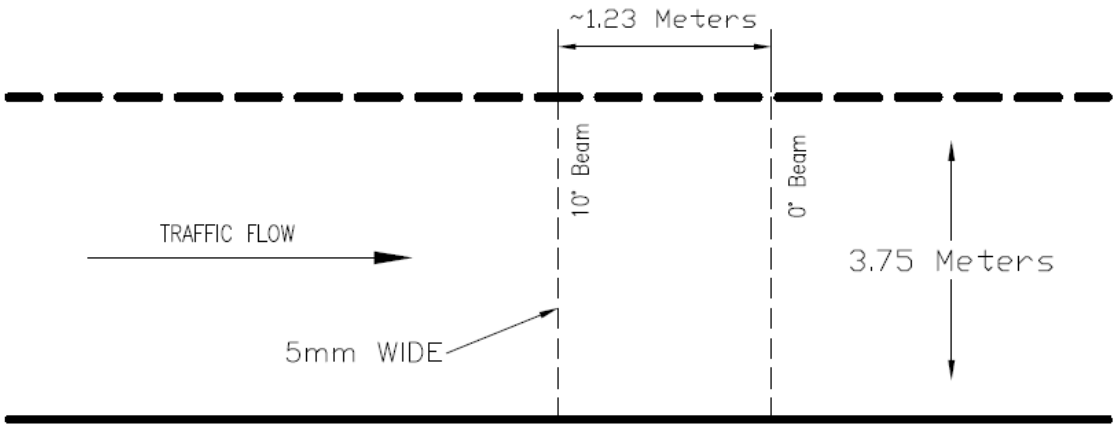


Figure F-1: Location of Stripe(s)

Paint Color

A semi-reflective surface with the following color hues has shown to provide adequate reflectivity. The specification for both color hues is given below.

Hue = 160 Lum = 160	Hue = 160 Lum = 181
Dark Color Specification 6% cold gray Pantone PMS-429U 3.9% black 2.3% reference blue 93.8% white Equiv: Sherwin Williams #SW1232	Light Color Specification 3% cold gray Pantone PMS-428U 1.9% black 1.1% reference blue 97.0% white Equiv: Sherwin Williams SW1234

Various Customer Approved Road Marking Products

OSI LaserScan has received confirmation from various customers that the following products have been tested and approved for use with the AutoSense™ units.

Part Number	Description	Manufacturer
Hot Tape™,	Hot Tape™, Grey Sample Width: 6 inch (101.6 mm) Thickness: 125 mil	Ennis-Flint. 115 Todd Court Thomasville, NC 27360

T404600	A quick drying, solvent based Alkyd Traffic Paint with Glass Beads	Phone: 336-475-6600 Fax: 336-475-7900 http://www.ennisflintamericas.com
System 300 Thermoplastic	Highly durable plastic road marking material	Lafrentz Zone 4, 1-26228, Township Rd 530A Acheson, AB T7X 5A7 Phone: (780) 962 7800 Toll-free: 1(800) 859 2947 Fax: (780) 960-1666 Email: info@lafrentz.ca http://lafrentz.ca/
System 400 Cold Plastic	Flexible, UV-stable, ISO-certified methyl methacrylate (MMA) durable road marking material	

Note:

Due to the variations in climatic conditions, traffic loads, the effects of road salt and chemical deicing agents, it is difficult to predict how often the paint stripe will need to be applied. However, empirical evidence has indicated that using a traditional road stripe epoxy in the color hues specified above, the paint stripe provided sufficient reflectivity for a period of 2 years without maintenance.

APPENDIX G Using the ASMgr to Modify the FLASH Parameters

PURPOSE

This document provides the LaserScan Customers technical staff with all the necessary information regarding the modification of FLASH parameters within the AutoSense Products.

LASERSCAN SOFTWARE

In order to perform the following procedures a copy of the OSI LaserScan ASMgr application software must be installed on the computer that will be used to communicate with the AutoSense unit to be modified.

INTRODUCTION

Each OSI AutoSense unit has unique settings within a FLASH RAM chip that stores parameters to allow the end user to custom tune the unit to fit the intended application. At times it may become necessary for the end user to modify one or more of these parameters. The following procedures are intended to guide the technical staff through the modification process and assure proper operation. All procedures must be followed very carefully. Please be sure to use the “Read” button of the “FLASH Parameters” dialog box when a different sensor is connected to the ASMgr application before attempting to modify any FLASH parameters and using the “Apply” button to write the modified FLASH parameters to the sensor. The “Archive” button will reread the sensor’s current FLASH parameters and create a unique filename to store to disk. The “Restore” button will write the contents of a previously created FLASH parameters archive file to the FLASH memory of the sensor. The “Done” button will close the FLASH parameters dialog box. The values of the fields that are grayed out are not settable with the User’s version of the ASMgr application distributed to customers of the AutoSense products. Each of the user modifiable fields has extended descriptions which can be displayed by placing the mouse pointer over the field’s text description to the left of the

field's data entry area. Once the new FLASH parameter values are written to the FLASH memory, the sensor must be reset for the new values to be read and used by the AutoSense firmware's algorithm.

FLASH Parameters

Modification Procedures

To modify the FLASH parameters of the OSI AutoSense, first reset the sensor and enter "Boot Mode." This can be done using the ASMgr application's drop down menu for "Boot Loader -> Boot Mode". This selection will perform an automatic sequence of commands which sends a "Reset" command to the sensor, waits for a short delay, and then sends the "Enter Boot Mode" command. If the sensor is communicating with the ASMgr application correctly, you will see the response from the sensor as a "Command Acknowledged . . . . . ." for the commands sent to it.

Once the sensor is in Boot Mode, use the drop down menu for "Setup -> Flash Parameters". You will see the current parameters being read from the FLASH of the sensor and the "FLASH Parameters" dialog box will appear.

General Tab

The first tab of the "FLASH Parameters" dialog box is the "General" settings.

The user modifiable fields include the low speed communications port's baud rate and data protocol. The default baud rate is 57600 bps and the ASMgr application must configure its baud rate to the same value as the sensor for proper communication to occur. Slower baud rates may be chosen but you should remember that detection and classification messages from the sensor will be sent out in real time and slower baud rates will take more time to transmit the messages from the sensor. The higher baud rate setting may be used but it should be noted that the OSI AutoSense products use a 20.000 MHz crystal and the divisor used to create the desired baud rate may not match the 18.432 MHz crystal that is the standard used on most PC comm ports. The 20.000 MHz crystal was selected to give the higher 1.25 Mb baud rate necessary for the high speed port to stream the raw range data at 720 scans/second. The low speed communications port is next to the power connector on the sensor, and if 10-pin connectors are used, the high speed communications port is near the front of the sensor by the shroud which protects the glass.

The Message Data Protocol field is set to a default of RS422 since the +/- twisted pair will allow for longer communication cable lengths.

Application Settings Tab

The second tab under the “FLASH Parameters” dialog box is “Application Settings”. This Contains a number user modifiable fields which can be used to customize the behavior of the AutoSense product.

Heartbeat_Period

The “Heartbeat_Period” field sets a value which defines the number of seconds of no object detection activity required before the AutoSense will send out a message to indicate that the sensor is still operational but no vehicle activity has been found. When a vehicle is seen, the algorithm will reset the countdown timer to the number of seconds of this value. This may be used instead of polling the sensor with a command such as the “Self Test” to determine that the sensor is still in an operating state. The default value of 255 turns off this Heartbeat function in the AutoSense product.

TriggerMode

The “TriggerMode” field determines the function of the “LL_det” output signal of the sensor. This logic level (5 volts) signal can be configured to provide a pulse at the front or back of the vehicle or can be configured to provide a presence signal while an object is detected under the sensor. Further configuration allows for setting this output signal to track detection in the first beam, second beam, or to show presence of an object in either beam. The default setting is a pulse at the exit of detection from the second beam. This output signal is typically connected as a trigger for an external camera used to take pictures for optical character recognition of license plates on the vehicle. There is also an optional solid state relay which is available instead of the “LL_det” output signal.

ActiveHighTrigger

The “ActiveHighTrigger” field sets the “LL_det” signal to either an Active High (5 volts) or an Active Low (0 volts) output signal. The default setting is Active Low.

TriggerPulseDuration

The “TriggerPulseDuration” field will set a longer duration of the “LL_det” active pulse as a value which represents the number of scans (1.38

milliseconds per scan at 720 scans/sec) the pulsed signal is held active. The default value of the field is “0” and this setting will create a 1 microsecond duration pulse. This field is not used when “LL_det” is configured for Presence Mode.

AuxTriggerMode

The “AuxTriggerMode” field determines the function of the “Aux_LL_det” output signal of the sensor. This output signal is offered as a second output trigger for an external camera when required to find license plates at both the front and back of the vehicle. The settings for this field are the same as the “TriggerMode” field described above.

AuxActiveHighTrig

The “AuxActiveHighTrig” field sets the “Aux_LL_det” signal to either an Active High (5 volts) or an Active Low (0 volts) output signal. The default setting is Active Low.

AuxTrigPulseDuration

The “AuxTrigPulseDuration” field will set a longer duration of the “Aux_LL_det” active pulse as a value that represents the number of scans the pulsed signal is held active. The default value of the field is “0” and this setting will create a 1 microsecond duration pulse. This field is not used when “Aux_LL_det” is configured for Presence Mode.

FoVClearMsg_ena

The “FoVClearMsg_ena” field will control whether the sensor will send out a special Field of View Clear Message after all objects have exited both beams. The default value for this field is “Disable.”

ExtraMsgData_ena

The “ExtraMsgData_ena” field controls the format and length of the detection messages by adding extra information when enabled. If this FLASH parameter is enabled, be sure to check “ExtraMsgBytes” field in the ASMgr application to ensure that all detection messages are decoded and displayed correctly. Specifically, Message 1 (Vehicle Entry Beam 1) will be modified to include 2 bytes for the Left Edge and Right Edge of vehicle detection after the VID byte and before the checksum byte. Message 2 (Vehicle Entry Beam 2) will be modified to include 2 bytes for the range measurement at the Left Edge and the range measurement at the Right Edge of vehicle detection after the Right

Edge byte and before the vehicle speed byte. Message 3 (Vehicle Exit Beam 1) will be modified to include 2 bytes for the range measurement at the Left Edge and the range measurement at the Right Edge of vehicle detection after the Right Edge byte and before the checksum byte. The default value of this field is "Disable."

Vehicle Detection Height

The "Vehicle Detection Height" field is set to the desired height for an object under either beam to generate vehicle detection messages. The default value is set to 2.00 feet.

Intensity Scale Factor

The "Intensity Scale Factor" field is a value which is set to create an analogous value of the intensity amplitude from the previous generation of the AS615 using the Pulse width information generated in the hybrid sensor. The default value is set by the technicians at OSI and is usually around 19 to 20 nanoseconds.

nScanLines

The "nScanLines" field represents the length (number of consecutive scans of an object present) that will trigger the vehicle entry messages 1 and 2 on each beam. The default value for this field is "8" scans and allows for vehicles to be detected correctly up to 120 mph. Detection of vehicles at greater speeds would require that the value of this field be smaller. Making this value too small may cause objects such as large birds or gusts of precipitation to be detected.

nPulses

The "nPulses" field represents the minimum width (number of consecutive pixels of detection) within a single scan to cause an object to be detected and tracked within each beam. The default value for this field is "2" pixels of width. Making this value too large may cause smaller vehicles such as motorcycles to not be detected correctly.

nEoVPulses

The "nEoVPulses" field represents the maximum limit for the calculated number of scans to exit vehicle detection. Vehicle speed is measured as the front of the vehicle is detected under both beams. The vehicle speed is used to calculate the number scans required to exit vehicle detection assuming 1.5

feet of vehicle separation to prevent joining two vehicles together as one detection. A typical value calculated would be 6 scans at 60 mph. Vehicles travelling at slower speeds would require more scans to exit detection. Decreasing the value of this field will cause the vehicle detection to end more quickly at slower speeds but may have adverse effects on tow bar and trailer detection.

MinIntens

The “MinIntens” field represents the minimum intensity threshold for accepting the range measurement as a valid pixel of data for processing by the algorithm. New improvements in the hardware have allowed valid range measurements by the AutoSense products down to the weakest of returned energy. The intensity associated with each pixel of range measurement is a scaled value from 0 to 127. It represents the strength of the reflected laser energy when the range measurement is made. The default value is set to ”1”.

MinValidRng

The “MinValidRng” field represents the minimum distance measured by the sensor to the road surface that will produce valid road training for the sensor to send out the Power On Message and begin detecting vehicles. If the minimum distance is not met, the Power On Message will show range measurements equal to the value of this field and the sensor may enter a permanent detection immediately. When the AutoSense product is mounted as suggested, the actual road will be at a greater range measurement than the value of this “MinValidRng” field. The default value is set to “12” feet.

Sensor Beam Direction

The “Sensor Beam Direction” field represents the startup direction of the vehicle detection under the sensor. A value of “0” represents the forward direction where vehicles enter from the side of the sensor where the lid is attached and exit from the side where the sensor is mounted to the gantry. A value of “1” will reverse the direction of the beams allowing for vehicle entry on the back side where the sensor is mounted to the gantry and exit from the side where the lid is attached. The default value is “0” which specifies the forward direction.

Features Tab

The third tab under the "FLASH Parameters" dialog box is "Features". This contains a number user modifiable fields which can be used to customize the behavior of the AutoSense product.

Enable LS in HS

The **"Enable LS in HS"** field represents a switch that will allow the capture of the low speed communications with the sensor as special messages embedded within the high speed data stream. The default of this field is "0" indicating the feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable Reverse Beams

The **"Enable Reverse Beams"** field represents a switch that will allow commands/responses that can change the direction of vehicle detection from forward to reverse, reverse to forward or check the current state of the direction of vehicle detection. The default value for this field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable Tall Edge Detect

The **"Enable Tall Edge Detect"** field represents a switch that will modify the detection of objects under the sensor to avoid creating messages at the edges of the field of view of the sensor for an object that is below 10 feet. This feature will allow for filtering of detection messages generated by pedestrians at the side of the road but will allow for the detection of full vehicle width for vehicles above 10 feet. The default value of this field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Start Pixel

The **"Start Pixel"** field represents the first pixel where normal vehicle detection will begin from the left side of the sensor's field of view. This field is used when either the "Enable Tall Edge Detect" or the "Enable LL_det FOV Limit" field is set to a value of "1" to activate this feature.

Stop Pixel

The **"Stop Pixel"** field represents the lastt pixel where normal vehicle detection will begin from the right side of the sensor's field of view. This field is used when either the "Enable Tall Edge Detect" or the "Enable LL_det FOV Limit" field is set to a value of "1" to activate this feature.

Start Pixel and End Pixel

The **"Start Pixel" and "End Pixel"** fields will only be used by the AutoSense product if special logic is added to the algorithm to pull in the edges of the field of view of the sensor. This was added to facilitate multi-lane integration where pixels of data which reflect from the road surface of adjacent lanes will not affect the LL_det output signals. The serial vehicle detection messages will still be generated using the full number of pixels for the specific AutoSense product. The Right Edge and Left Edge values in the detection messages can be used to filter out

vehicle detections in adjacent lanes that can occur at the edges of the field of view of the sensor. Please contact the OSI LaserScan engineering staff to request that the weather logic be added to the firmware of the AutoSense product as the normal algorithm will not use these "Start Pixel" and "End Pixel" FLASH parameters.

Enable LL_det FOV Limit

The **"Enable LL_det FOV Limit"** field represents a switch theat the will modify the detection of objects to prevent setting the LL_det as active at the edges of the field of view of the sensor. This feature allows the sensor's LL_det output signal to represent a typical loop detector. The Start Pixel and Stop Pixel fields values allow object detections to be limited to the middle of the field of view to prevent concurrent object detection in adjacent lanes in the overlap area of the laser output of adjacent sensors. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable Tow Bar 6 Inches

The **"Enable Tow Bar 6 Inches"** field represents a switch that changes the height of tow bar detection for a vehicle pulling a trailer from the standard 9 inches to 6 inches. This feature should be enabled with great caution. Modifying the tow bar detection height can have an adverse effect on the ability of the algorithm to properly detect the normal end of vehicle in poor weather conditions and may cause the false detection at the end of vehicle. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable Bad Weather Logic

The **"Enable Bad Weather Logic"** field represents a switch the enables logic that will trigger a different set of vehicle detection parameters when changes in the road training indicate adverse weather conditons. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

nScanLines_Rain

The **"nScanLines_Rain"** field represents the length (number of consecutive scans of an object present) that will trigger the vehicle entry messages 1 and 2 on each beam. The default value for this field is "12" scans as setting a greater number of scans to enter a vehicle detection will allow for better filtering of gusts of snow and rain in bad weather conditions to prevent false detections due to precipitation. The larger the value, the better the precipitation filtering but if set too large, smaller vehicles may not be detected correctly at higher speeds.

nPulses_Rain

The **"nPulses_Rain"** field represents the minimum width (number of consecutive pixels of detection) within a single scan to cause an object to be detected and tracked within each beam. The default value for this field is "12" pixels of width as setting a greater number of scans to enter a vehicle detection will allow for better filtering of gusts of snow and rain in bad weather conditions to prevent false detections due to precipitation. The larger the value, the better the precipitation filtering, but setting this value too large may cause smaller vehicles such as motorcycles to not be detected correctly.

nEoVPulses_Rain

The **"nEoVPulses_Rain"** field represents the maximum limit for the calculated number of scans to exit vehicle detection. To ensure a quick exit from vehicle detection the maximum limit is set to be a default value of "4" so that a few scans behind the vehicle which cause detection due to precipitation will not excessively delay the exit of vehicle detection.

Weather Threshold

The **"Weather Threshold"** field represents a value that will trigger a change in the vehicle detection parameters used by the algorithm when the measured standard deviation of the road training data reaches or surpasses this threshold value. The normal weather state uses the nScanLines, nPulses, and nEoVPulses values described above to enter and exit vehicle detection. The bad weather state uses the nScanLines_Rain, nPulses_Rain, and nEoVPulses_Rain values described below to enter and exit vehicle detection. The measured standard deviation will be a unique value for each sensor due the analog components within each sensor and the road environment which each sensor is mounted above. The Weather Threshold's value should be set by adding 7 to the measured standard deviation for the road training of the mounted sensor. The ASMgr application provides a special command to get the measured standard deviation from each sensor while running in normal weather conditions.

Enable Height Request Logic

The **"Enable Height Request Logic"** field represents a switch that enables logic that will allow for special commands to be sent to the sensor to request the current height of the vehicle on the second beam after message 2 "Beginning of Vehicle" has been received and before message 4 "End of Vehicle" has been received. The message to request vehicle height must contain an active VID to allow the logic to know which for which vehicle the current height is being requested. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable Ignore Edges Logic

The **"Enable Ignore Edges Logic"** field represents a switch that enables logic that will cause the algorithm to ignore creating vehicle detection messages for objects that are detected only within the first or last 6 pixels of the sensor's field of view. This logic was added to allow the sensor to ignore vehicles in a lane adjacent to where the sensor is deployed. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable Traffic Data Logic

The **"Enable Traffic Data Logic"** field represents a switch that enables logic that will cause the algorithm to suppress creating vehicle detection messages for all vehicles and will enable a special command that can poll the sensor to return information of the number of vehicle detections per class and the average speed per class of each of the 12 vehicle classifications. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable Max Edge Match Logic

The **"Enable Max Edge Match Logic"** field represents a switch that enables logic that will cause the algorithm to use the maximum right and left edge values of a vehicle detection in the detection messages as opposed to the current right and left edge values. This logic was added to allow the sensor to perform optimally in single lane applications simulating a loop replacement. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable VID Merge Messages

The **"Enable VID Merge Messages"** field represents a switch that enables logic that will cause the algorithm to create new VID merge messages where multiple VIDs in "Beginning of Vehicle" messages may be assigned to a single vehicle and after processing more scans of the vehicle, the algorithm determines that one VID needs to be eliminated and merged into the primary VID for that vehicle detections. The messages are generated from the first and second beam vehicle detection and tell the lane controller which VID is valid and which VID will no longer produce detections messages during the sequence of messages from that vehicle detection. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable Beam 2 Lost Detect Message

The **"Enable Beam 2 Lost Detect Message"** field represents a switch that enables logic that will cause the algorithm to send out a special message when detection of the vehicle exits on the second beam while the vehicle is still being detected from the first beam. This logic was added to allow the lane controller to know that there may be some problems in detecting the vehicle and possibly a trailer towed by the vehicle. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable Zero Intensity Ranges

The **"Enable Zero Intensity Ranges"** field represents a switch that enables logic that will cause the algorithm to use the a range measurement created by the sensor on a pixel that has a very low or zero intensity if the range is a valid value and not the maximum range given when that sensor sees no return from the laser pulse.. This logic was added to allow the sensor to perform optimally in wet road conditions where the color of the road surface is very dark and provides very little reflectivity. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Enable Stop and Go Logic

The **"Enable Stop and Go Logic"** field represents a switch that enables logic that will cause the algorithm to accept new commands to turn off/on the processing of scans on the second beam when the lane controller uses a separate sensor such as a camera that can detect a vehicle that is stopped under the sensor during vehicle detection. This logic was added to allow the sensor to perform optimally in stop and go traffic situations to improve the length measurement used in vehicle classification. The default value of field is set to "0" indicating this feature is not enabled. Setting this field to a value of "1" will enable this feature.

Classification Tab

The fourth tab under the "FLASH Parameters" dialog box is "Classification". This contains a number user modifiable fields which can be used to customize the maximum height, width and length values used in assigning the vehicle classification, Odd numbered classes are vehicles without a trailer and the next even number assigns that vehicle class with a trailer.

Class 1 Max Height

The **"**Class 1 Max Height**"** field represents the maximum height in feet used to assign the Motorcycle classification. The default value is set to 3 feet.

Class 1 Max Length

The **"**Class 1 Max Length**"** field represents the maximum length in feet used to assign the Motorcycle classification. The default value is set to 10 feet.

Class 1 Max Width

The **"**Class 1 Max Width**"** field represents the maximum number of pixels used to assign the Motorcycle classification. The default value is set to 10 but this may need to be adjusted due to mounting height of the sensor. The lower the sensor is mounted the more pixels of width should be allowed for proper classification.

Class 3 Max Height

The **"**Class 3 Max Height**"** field represents the maximum height in feet used to assign the Passenger Car classification. The default value is set to 5.25 feet.

Class 3 Max Length

The **"**Class 3 Max Length**"** field represents the maximum length in feet used to assign the Passenger Car classification. The default value is set to 20 feet.

Class 3 Max Width

The **"**Class 3 Max Width**"** field represents the maximum number of pixels used to assign the Passenger Car classification. The default value is set to 30 pixels but this may need to be adjusted due to mounting height of the sensor. The lower the sensor is mounted the more pixels of width should be allowed for proper classification.

Class 5 Max Height

The **"**Class 5 Max Height**"** field represents the maximum height in feet used to assign the Pickup/Van/SUV classification. The default value is set to 7 feet.

Class 5 Max Length

The **"**Class 5 Max Length**"** field represents the maximum length in feet used to assign the Pickup/Van/SUV classification. The default value is set to 25 feet.

Class 5 Max Width

The **"**Class 5 Max Width**"** field represents the maximum number of pixels used to assign the Pickup/Van/SUV classification. The default value is set to 30 but this may need to be adjusted due to mounting height of the sensor. The lower the sensor is mounted the more pixels of width should be allowed for proper classification.

Class 7 Max Height

The **"**Class 7 Max Height**"** field represents the maximum height in feet used to assign the Box Truck/Lorry classification. The default value is set to 12 feet.

Class 7 Max Length

The **"**Class 7 Max Length**"** field represents the maximum length in feet used to assign the Box Truck/Lorry classification. The default value is set to 46 feet.

Class 7 Max Width

The **"**Class 7 Max Width**"** field represents the maximum number of pixels used to assign the Box Truck/Lorry classification. The default value is set to 30.

Class 9 Max Height

The **"**Class 9 Max Height**"** field represents the maximum height in feet used to assign the Tractor Trailer classification. The default value is set to 16 feet.

Class 9 Max Length

The **"**Class 9 Max Length**"** field represents the maximum length in feet used to assign the Tractor Trailer classification. The default value is set to 64.99 feet. This is the maximum value of length returned by the sensor in Message 5 although the vehicle may exceed this length.

Class 9 Max Width

The **"**Class 9 Max Width**"** field represents the maximum number of pixels used to assign the Tractor Trailer classification. The default value is set to 30 pixels.

4.6. The tab under the "FLASH Parameters" dialog box is "Scan Control".

The first field is the "Z-offset". This value sets the delay involved to control the timing to begin firing the first laser pulse on the correct mirror facet of the spinning polygon to ensure the logical first beam (also called the 10 degree beam) will be projected out of the sensor's window toward the top (lid) of the sensor. The second beam (also called the 0 degree or perpendicular beam when the sensor is mounted at 5 degrees into traffic) will project out of the sensor's window toward the bottom (mounting base) of the sensor. The "Z-offset" can be modified at the direction of OSI technical support to reverse the logical first and second beams as processed by the algorithms but this should not be necessary if the sensor is mounted as directed in the AutoSense manual.

The next user modifiable field under the “Scan Control” tab is the “1-degree pulses” field. The default value for the single lane overhead sensors is 30 pulses which creates 30 pixels of range measurement per scan. This value should only be modified at the direction of OSI technical support as changing this value will require a modification to the algorithm to ensure the number of pixels per scan that are expected to be processed by the algorithm matches this setting.

FLASH Parameter Modification

The “Report Pattern” fields specify the spacing between adjacent pixels within a scan of data. These are configured by the OSI technical staff and are set to default 1 degree spacing for the overhead sensors. This field has been allowed to be user modifiable due to the custom settings required for the side firing axle counter product offered as the AS7x5 series. Once again, these values should only be modified at the direction of the OSI technical support.