



LaserSpeed LS9000

INSTRUCTION HANDBOOK

- installation, setup and technical reference -
(for qualified personnel only)

www.betalasermike.com

Declaration of Conformity



Declaration of Conformity

For products which fall under the scope of the Low Voltage (2006/95/EC)
and EMC (2004/108/EC) Directives

Conformity is declared to the essential requirements/objectives of the
directives

Manufacturer's Name: Beta LaserMike USA
Manufacturer's Address: 8001 Technology Blvd, Dayton OH 45424

Equipment: LaserSpeed Model LS4000-3, LS8000-3, LS9000-3

Safety Standards: EN 61010-1:2010

EMC Standards: EN 61326-1:2006
EN 61000-6-2:2005, EN 61000-6-4:2006-07

Limitations as to use: Heavy Industrial Environment

We, the undersigned, hereby declare that the equipment specified above conforms to EMC
Directive 2004/108/EC and Low Voltage Directive 2006/95/EC.

Manufacturer

Signature	
Full Name	Dan Norris
Position	Director of Engineering
Date	21 February 2013

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Proprietary Statement

Manufacturer/Distributor

Beta LaserMike, 8001 Technology Blvd., Dayton, OH 45424, USA

About This Manual

This manual contains descriptions, drawings, and specifications for a Beta LaserMike product. Equipment or products made prior to or subsequent to the publication date of this manual may have parts, features, options, or configurations that are not covered by this manual. Specifications contained herein are subject to change by Beta LaserMike without prior notice. Beta LaserMike is not responsible for errors or omissions that may be contained herein or for incidental or consequential damages in connection with the furnishing or use of this information.

Comments or suggestions for possible improvements to the manual are appreciated. Please email us at manualfeedback@betalasermike.com.

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Limited Warranty

Beta LaserMike will correct by repair, or at Beta LaserMike's option, by replacement, F.O.B Beta LaserMike's plant, any defect in workmanship or material in any equipment manufactured by Beta LaserMike which appears under normal and proper use within twelve months from the date of shipment (eighteen months for OEM's), provided Beta LaserMike is given reasonable opportunity to inspect the alleged defective equipment at the place of its use and under conditions of its use.

EXCLUSIONS: This warranty does not cover products which have been modified, altered, or repaired by any other party than Beta LaserMike or its authorized agents. Furthermore, any product which has been, or is suspected of being damaged as a result of negligence, misuse, incorrect handling, servicing, or maintenance; or has been damaged as a result of excessive current/voltage or temperature; or has had its serial number(s), any other markings, or parts thereof altered, defaced, or removed will also be excluded from this warranty.

WARRANTY SERVICE AT CUSTOMER SITE: Warranty service performed at the customer's facility will be free of charge for parts and labor; however, the customer will be liable for transportation and living expenses of personnel dispatched to effect such repair. A purchase order or other written confirmation of the acceptance of these charges, signed by an authorized individual, will be required prior to commencement of repairs. Additional charges may be assessed the customer if: 1) The equipment is not made available on a timely basis, 2) The equipment is found to be without fault, and/or 3) It is determined the equipment is not under warranty, whether by expiration of the warranty or any act which voids the warranty.

OTHER THAN AS SET FORTH HEREIN, BETA LASERMIKE MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, OF MERCHANTABILITY AS TO THE EQUIPMENT MANUFACTURED BY IT, AND THERE ARE NO EXPRESSED OR IMPLIED WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE THEREOF. Beta LaserMike's obligation to correct defects in such equipment by repair or replacement in accordance with the foregoing provisions is in lieu of any other warranties, expressed or implied, and in no event shall Beta LaserMike be liable for incidental or consequential damages. No service of Beta LaserMike's equipment is permitted during the warranty period without the specific written consent of Beta LaserMike.

*Note:
For
information
about
servicing and
returning your
equipment,
see the
section at the
end of this
manual.*

European Commission Requirements



This equipment is intended for use in a heavy industrial environment. The equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other equipment. There is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to other equipment the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orientate or relocate the equipment.
- Increase the separation between the pieces of equipment.
- Connect the pieces of equipment on separate mains circuits.
- Ensure that the relevant items of equipment are properly and securely earthed to a common earth point using adequately sized cable or other means of connection.

Where supplied or specified, shielded interconnection cables must be employed with this equipment to ensure compliance with the pertinent RF limits. Changes or modifications not expressly approved by the company could void the user's authority to operate the equipment.

This product has been rigorously tested to comply with the European EMC (Electromagnetic Compatibility) Directive. With regard to this, Beta LaserMike recommends that any non-Beta LaserMike peripheral equipment is CE marked for the Heavy Industrial environment (EN50082-2). Beta LaserMike also recommends that any cables not supplied by Beta LaserMike, but used for powering Beta LaserMike equipment, be built using good EMC practices (i.e. cables with braided shield, and connectors with 360° termination of the braid to a metal/metalised shell connector at both ends). If you have any questions regarding this, contact the Beta LaserMike Service Department.

Safety Information

- Under NO circumstances should the earth safety connections be broken – internal damage to sensitive electronic components may occur and at worst electrocution to personnel may result.
- This equipment must be earthed/grounded.
- Relays and associated wiring are rated for SELV levels i.e. 60 VDC & 30 VAC RMS. These levels must not be exceeded.
- Maintenance, repairs and electrical connections should be performed by a suitably qualified person for the country of installation.
- Input power to the equipment is of direct current type designated by the symbol on equipment housing and shown below.



Reference: IEC 60417-5031

- The equipment contains a slow blow type fuse to protect against input power overloads and is not user replaceable.

Intended Use

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Laser Classification

The Model LS9000 Non-contact Length and Speed Gauge (Model LS9000) is classified as a IIIb laser device. This category contains infrared and visible laser devices with powers up to 500 mW. The optical gauge in the system uses a 50 mW solid-state laser device operating between 760 and 800 nm (near infrared region of the spectrum).

A class IIIb product must have the following safety features:

- A 5-second delay after power-up before laser radiation is emitted from the gauge.
- An indicator light to inform personnel near the gauge that laser radiation is being emitted.
- A mechanical device to physically block the laser beam from exiting the gauge.
- An interlock circuit to shut off the laser when the circuit is opened.
- All hazards must be properly identified with warning labels.

These basic safety features are incorporated to promote safe operation of the laser.

A class IIIb laser must also have a key switch to power the laser, ensuring that only trained personnel can operate the instrument. Because the location of the gauge can often make it difficult to access a key switch, the key switch needs to be installed by the final user. It should be placed in a location that will be readily accessible to the operators. For more information on installing the laser key switch, see the [Installing the System](#) section.

The user of a laser device must comply with a different set of regulations. Many countries and individual states have passed legislation regarding the use of laser products.



The following system specifications will help establish appropriate safety measures.

Maximum Laser Power	0.050 watt
Laser Wavelength	0.785 micrometer
Minimum Laser Spot Size (Elliptical)	5 x 3 millimeters
Beam Divergence	0.5 milliradians
Pulse Rate	Continuous wave
Maximum radiance (power divided by spot-size area)	0.050 Watt / 0.1 cm ² [0.5 W/cm ²]

Laser Safety Precautions

The laser beam in the optical gauge is very powerful and can permanently damage eyes not protected by laser safety glasses. To avoid exposing yourself to hazardous radiation, you must take these precautions:

- **Never look into the laser beam. If you must look at the beam, view it from an angle and in the direction in which the beam is travelling.**
- **The beams emitted from the Model LS9000 are invisible to the unaided eye. Return the beam shutter to the closed position when the system is not in use or during setup.**
- **Ensure that all direct reflections are blocked.**
- **Remove all rings, watches, or jewellery from your hands when working on or near the gauge—can cause hazardous reflections.**
- **Never install the instrument at eye level.**
- **Operate the system only with people who have been instructed in laser safety.**
- **Post warning signs and lights that are active when laser is operating.**

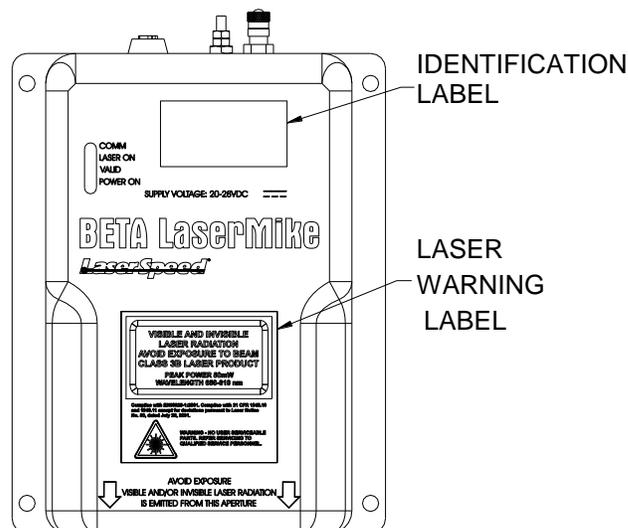
If your country or state has no regulations governing the safe use of lasers, Beta LaserMike recommends that you follow the guidelines specified by the American National Standard for the safe use of lasers (ANSI Z136.1–1986). For a copy of this document, write to:

Laser Institute of America
13501 Ingenuity Drive, Suite 128
Orlando, Florida 32826
1-800-345-2737

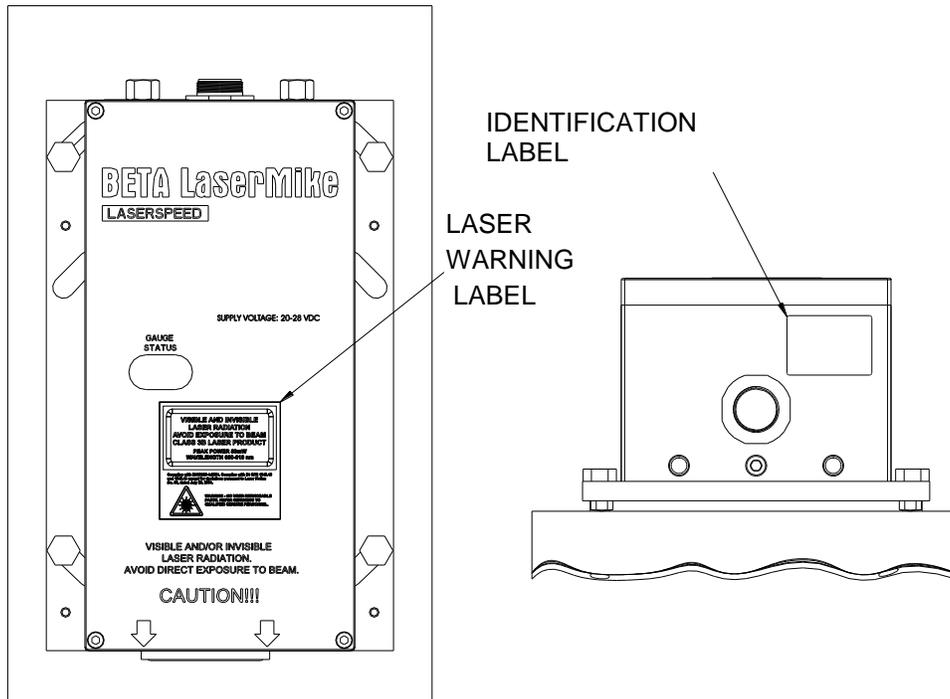
Labels and Safety Features

This section acquaints you with the advisory and identification labels on the instrument and the safety features incorporated into the design of the instrument. The following figures show the advisory and identification labels on the Model LS9000.

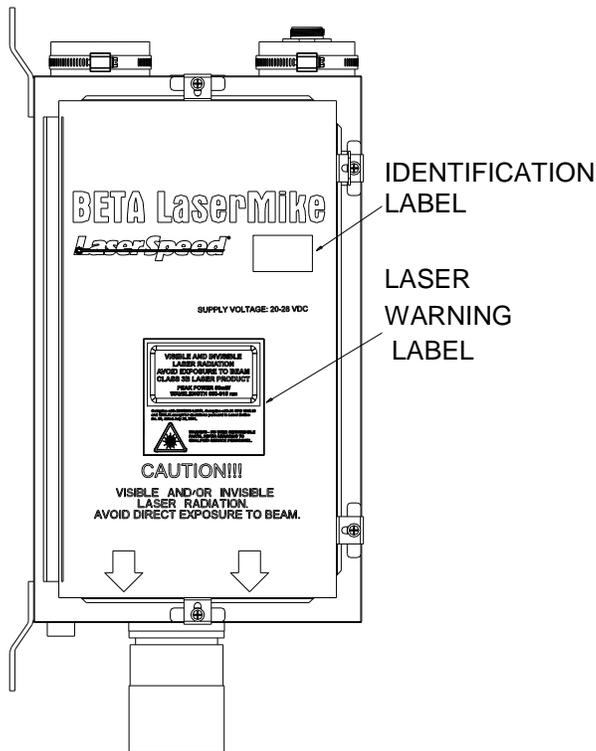
LS9000 Labels



LS9000E Labels



LS9000X Labels



Introduction

This manual describes the installation and setup of the LaserSpeed 9000 gauge. For daily routine usage, see the LaserSpeed 9000 Operator Guide.

The Model LS9000 LaserSpeed® Non-contact Length and Speed gauge is an industrial, Laser-Doppler based instrument that measures the velocity and length of material. Due to the nature of the laser-based measurement, there is no physical contact with the material. This eliminates the problems of wheel wear and slippage that plague mechanical/encoder based length measurement systems.

The LS9000 gauge has the ability to measure in both positive and negative directions, as well as zero-speed. The LS9000 is specifically designed to work in applications where the material to be measured stops and reverses direction, or moves very slowly. The LS9000 can also measure material moving at very high speed.

System Overview

The Model LS9000 is a stand-alone instrument that requires only 24 VDC input power to operate. The system has a variety of industrial outputs. Also, a variety of information including length, velocity, system operating parameters, and setup parameters can be read and configured using the communications interfaces.

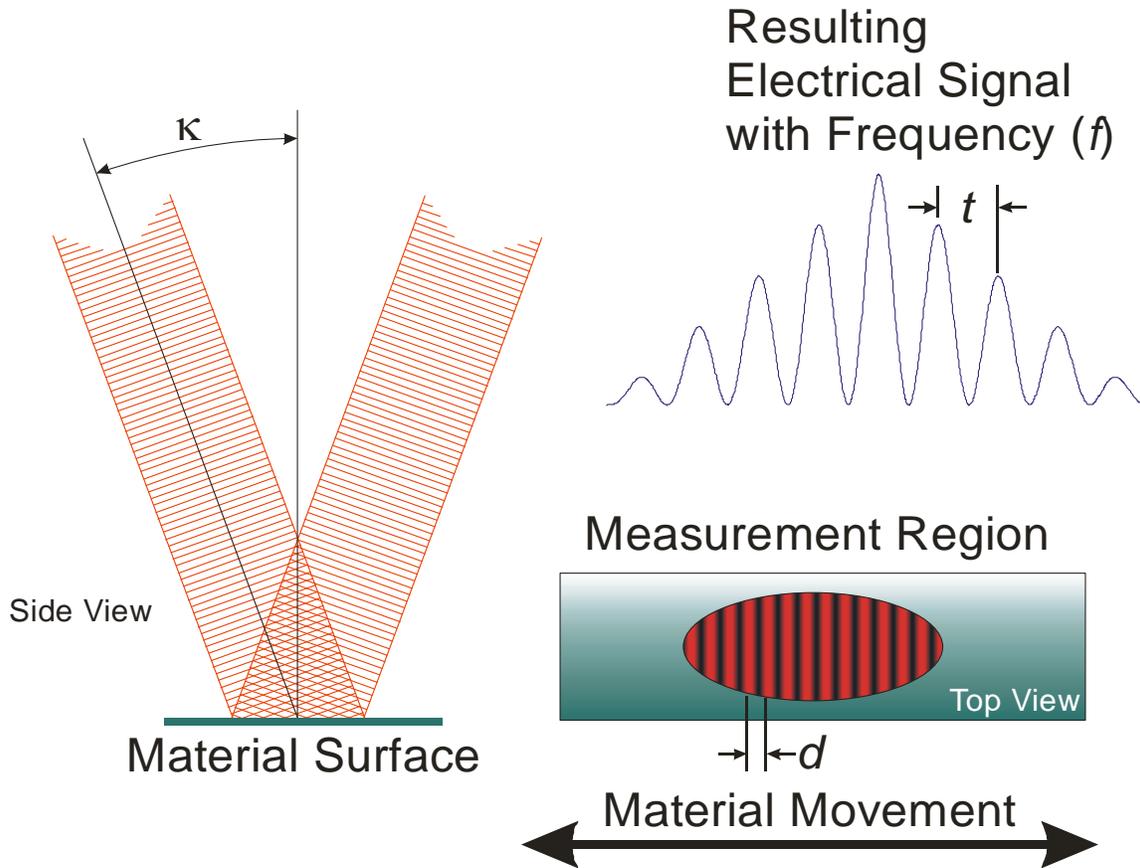
The LS9000 is permanently calibrated to a NIST traceable standard at the factory. Aside from periodic cleaning of the optical window, the LS9000 does not require maintenance.

See the [Specifications](#) section at the end of this manual.

Principle of Operation

LaserSpeed utilizes dual-beam interferometer technology to provide accurate velocity readings. The measured velocity is integrated over time to measure the length of moving objects. The opto-electronic portion of the LS9000 generates a laser beam that is split and then crossed in space. The two crossing beams interact, producing a fringe pattern that is orthogonal to the plane of the two beams.

Light is scattered when material passes through the measurement region. This scattered light is collected by the gauge and converted to electrical signals. The frequency of the electrical signal contains information with regards to the velocity of the material. The signal processor converts the electrical signals to frequency information that is directly proportional to the velocity of the material moving through the laser beams. The signal processor converts the frequency information into velocity information and updates user outputs. In order to determine if there is an object in the measurement area, the gauge measures the amount of reflected laser light.



Fringe distance (d) is a function of laser wavelength (λ) and beam angle (κ):

$$d = \frac{\lambda}{2 \sin \kappa}$$

Period is the inverse of frequency:

$$t = \frac{1}{f}$$

Velocity is distance divided over time:

$$v = \frac{d}{t}$$

Velocity is integrated to find Length

$$L = \int_0^T v \cdot dt$$

Installing the System

This section describes mounting, alignment and other installation concerns for the LS9000.

The installation can be broken down into five steps:

- Mounting the gauge
- Aligning the gauge
- Connecting power to the gauge
- Connecting to the outputs
- Maximizing gauge performance

Mounting the Gauge

The LS9000 must be placed at the correct standoff distance from the moving material. A series of LaserSpeed gauges provide a variety of standoff distances and depths of field.

Model	Standoff Distance	Depth of Field
LS9000-303	300mm (11.8 in)	35mm (1.4 in)
LS9000-306	600mm (23.6 in)	50mm (2.0 in)
LS9000-310	1000mm (39.4 in)	100mm (3.9 in)
LS9000-315	1500mm (59.0 in)	200mm (7.9 in)
LS9000-320	2000mm (78.7 in)	200mm (7.9 in)
LS9000-325	2500mm (98.4 in)	200mm (7.9 in)

Please refer to the following Appendices for mounting dimensions and installation drawings:

Model	Section
LS9000	Appendix A
LS9000E	Appendix B
LS9000X	Appendix C

Mounting Distance

When the material is within the depth of field, the gauge makes accurate measurements. Since the best signal comes from the center of the depth of field, the center is the source of the best measurements. This is because the two laser beams totally overlap at the center of the beam crossings and all of the laser power is used to form fringes.

At the edges of the depth of field, however, some beam-crossing areas overlap and some do not. The areas that overlap form fringes and thus yield useful Doppler signals; the areas that do not overlap do not form fringes; rather, they produce only noise with no Doppler signals. Any measurements made outside the depth of field may not be reliable.

Laser Safety

When mounting of the gauge, ensure that the laser beams are blocked by machinery or beam blocks when material is not present in the measurement area.

Environmental Conditions

Ambient Temperature

All LaserSpeed gauges have a built-in cooling system for applications in which ambient temperatures exceed 45°C.

Cooling fluids can be routed through the gauge using the 1/8-inch NPT fittings (1/4" NPT on LS9000E and LS9000X) on the back of the gauge. Typical flow rates of 1.5 litres/minute for water and 50 liters/minute for air are sufficient. There is minimal pressure drop through the gauge, so supply pressure can be very low.

Ensure that the water temperature is above the condensation temperature or dew point, to prevent condensation from collecting on the front window of the gauge. If water condenses on the optical window, the laser beams could be blocked, resulting in reduced performance or loss of function.

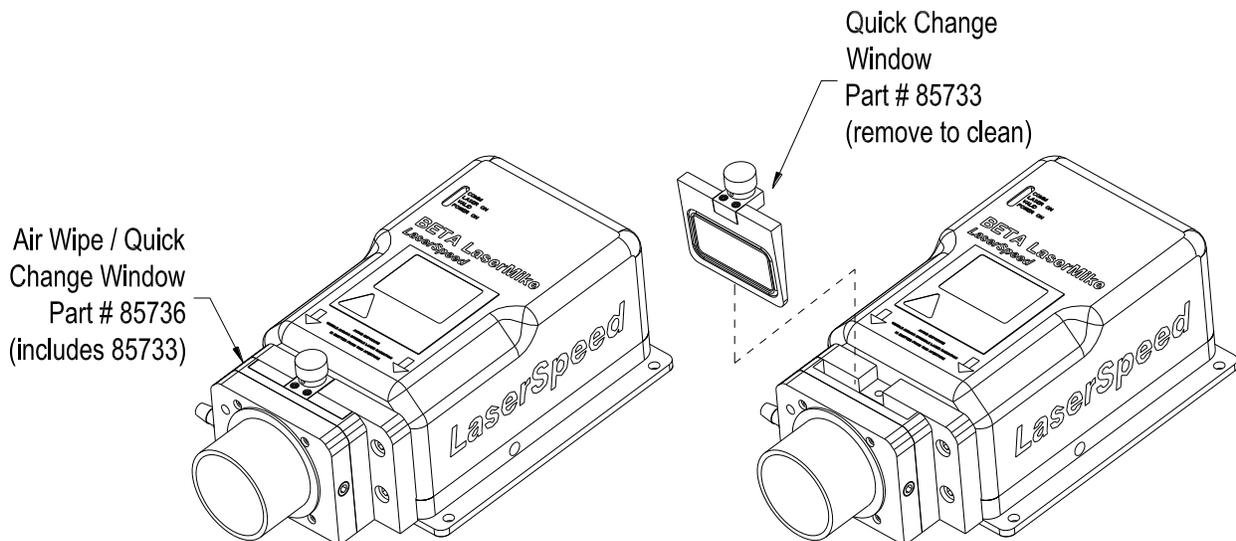
Coolant

In applications with coolants on the material, an air jet may be required to remove the coolant from the measurement area. Since the speed of the coolant is generally different from that of the material, erroneous measurements could result. When incorporating an air jet, be sure to blow the coolant from the measurement volume at 90° from the material's motion. If the

coolant is blown off in the same direction the material is moving, the air velocity can add or subtract from the material's velocity; this too may cause erroneous measurements.

Air Wipe / Quick Change Window

To prevent dust, dirt, and moisture from accumulating on the optical window the gauge can be fitted with an Air Wipe/Quick Change Window. Clean, instrument grade air (see [Specifications](#) section for details) is blown at low pressure over the window to keep it clean. The window can be removed for easy cleaning. A clean, soft cloth should be used to clean the window. If an abrasive cloth is used, the optical coating may be damaged, leading to poor measurements. When replacing the window, put a small amount of vacuum grease on the O-Ring.



For measurements and details about removing the Air Wipe/Quick Change Window, see [Appendix A](#).

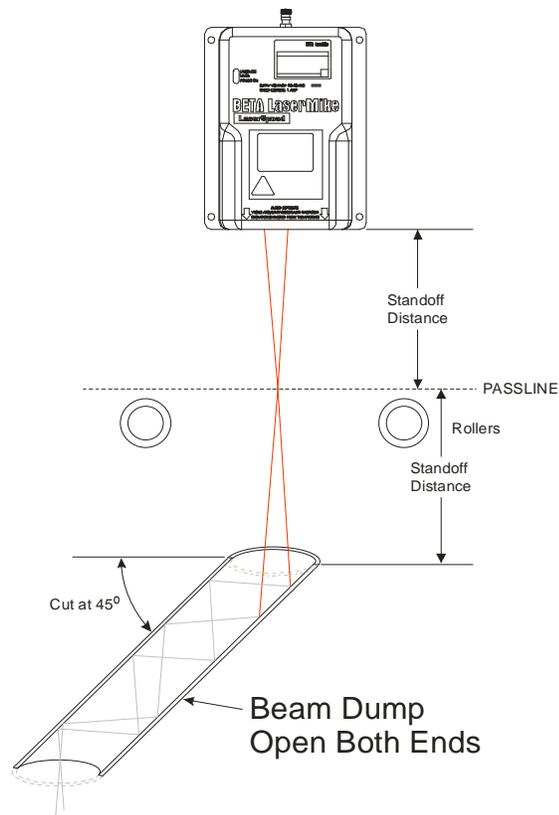
Steam & Mist

Steam or mist is sometimes present in some applications. The air-wipe is not designed to clear steam or mist between the gauge and material, but only to keep contaminants from depositing on the optics window. Another means of removing steam or mist may need to be used. The steam or mist may be light enough to allow the laser beams to pass through without interference. If this is not true, a fan may be used to clear out the steam or mist between the gauge and housing. If a fan is not adequate or practical, an “air purge” can be installed to clear the beam path. Contact your Beta LaserMike representative for more details. When mounting the gauge, be aware of the environment in which the gauge is operating. Steam, mist, coolant on the material, ambient temperature, scale and slag may all affect the performance of the gauge. These environmental conditions may need to be modified as mentioned above in order to maximize the performance of the gauge.

Mounting Location

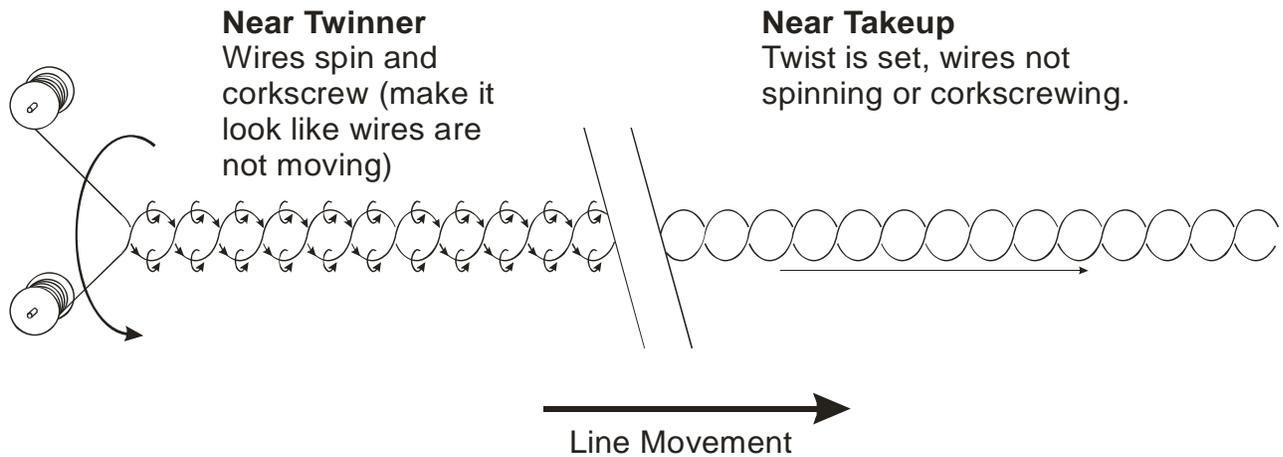
When mounting the gauge over the material, be sure the gauge is not directly over a roller or some other device. If the laser beam from the gauge strikes an object, it may detect a false Material Present. In this case, the gauge will not be able to detect when the actual material is *not* in the measurement volume.

A device that captures most of the laser light is called a *beam dump* and may be required (see figure). A suitable beam dump is a large-diameter pipe, 150 millimeters (6 inches) or larger, angled at 45° from the laser beams. A rusty pipe is an excellent beam dump. If scale can deposit in the base of the beam dump, the pipe may need to be cleaned periodically to prevent false Material Present readings. The beam dump should be far enough from the gauge that it cannot be measured. If it is too close, the LS9000 may measure its speed (normally zero, but may be non-zero because of vibration) when there is nothing else to measure. Placing the beam dump at least double the standoff distance from the gauge will ensure that the gauge cannot measure it.



Twinner Lines

When mounting the gauge on a twinner line, the gauge should be positioned far enough from the twinner that the twist is set. If the gauge is placed close to the twinner, it may not be able to measure due to excessive vibration and the spin imparted on the wire due to the twisting motion. Moving the gauge down the line farther from the twinner may improve the gauge's ability to make measurements.



Default Line Direction

By default, when looking at the top of the LS9000, with the laser beams pointed toward the floor, and the connectors pointed toward the ceiling, positive velocity is movement to the right. The direction for positive velocity can easily be reversed by changing the Direction Inversion Switch in LaserTrak or by connecting the Measurement Direction Input to 5-24V.



Aligning the Gauge

Once the gauge is mounted at the proper standoff distance, the critical alignment angles need to be checked. To obtain accurate results, the LS9000 must be mounted so the surface being measured is perpendicular to the optical axis. The best method to ensure this is to place a level alongside the gauge. The material being measured should be parallel to the front face of the gauge and the material motion should be parallel to the base of the gauge.

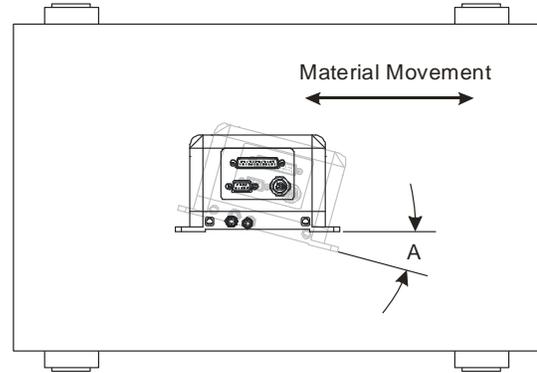
The velocity measurement, which is made in the plane of the two laser beams, is the rate at which the material passes the fringes of the beams. When the motion of the material is perpendicular to the fringes, the velocity measurement is considered calibrated. If the fringes are at an angle to the motion of the material (*angular rotation*), measurement errors occur. The measured velocity equals the actual velocity multiplied by the cosine of the angle by which the alignment deviates from the direction of material movement.

Three types of misalignment are possible. Two of the three are responsible for measurement errors: rotation about the optical axis and tilt in the plane of the beams. The errors are proportional to the sine of the misalignment angle. Misalignment will always make the gauge measure velocities and lengths that are too low.

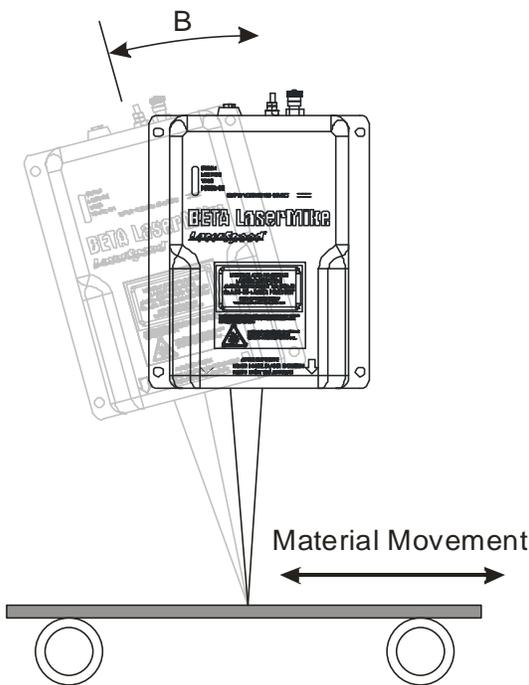
Types of Gauge Misalignment

$$\text{Measured Velocity} = \text{Actual Velocity} \times \cos(A) \times \cos(B)$$

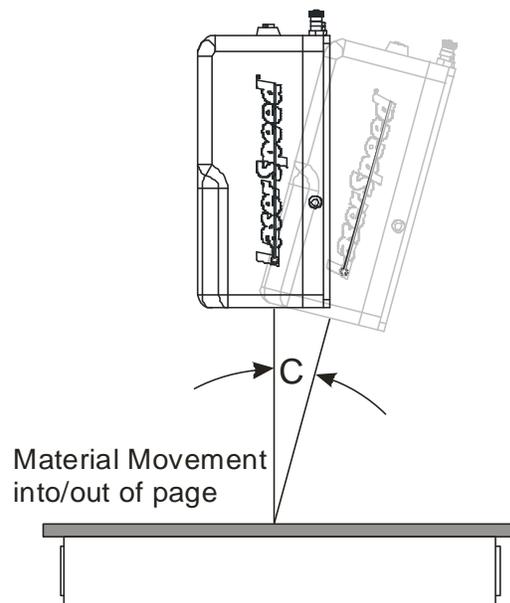
Error Angle (Degrees)	Cosine	Speed and Length Error (%)
0	1	0
0.25	0.99999	-0.001
0.50	0.99996	-0.004
0.75	0.99991	-0.009
1.0	0.99985	-0.015
2.0	0.99939	-0.061
3.0	0.99863	-0.137
4.0	0.99756	-0.244
5.0	0.99619	-0.381



Rotation About Optical Axis
- Causes Measurement Error



Not perpendicular to Material Motion
- Causes Measurement Error

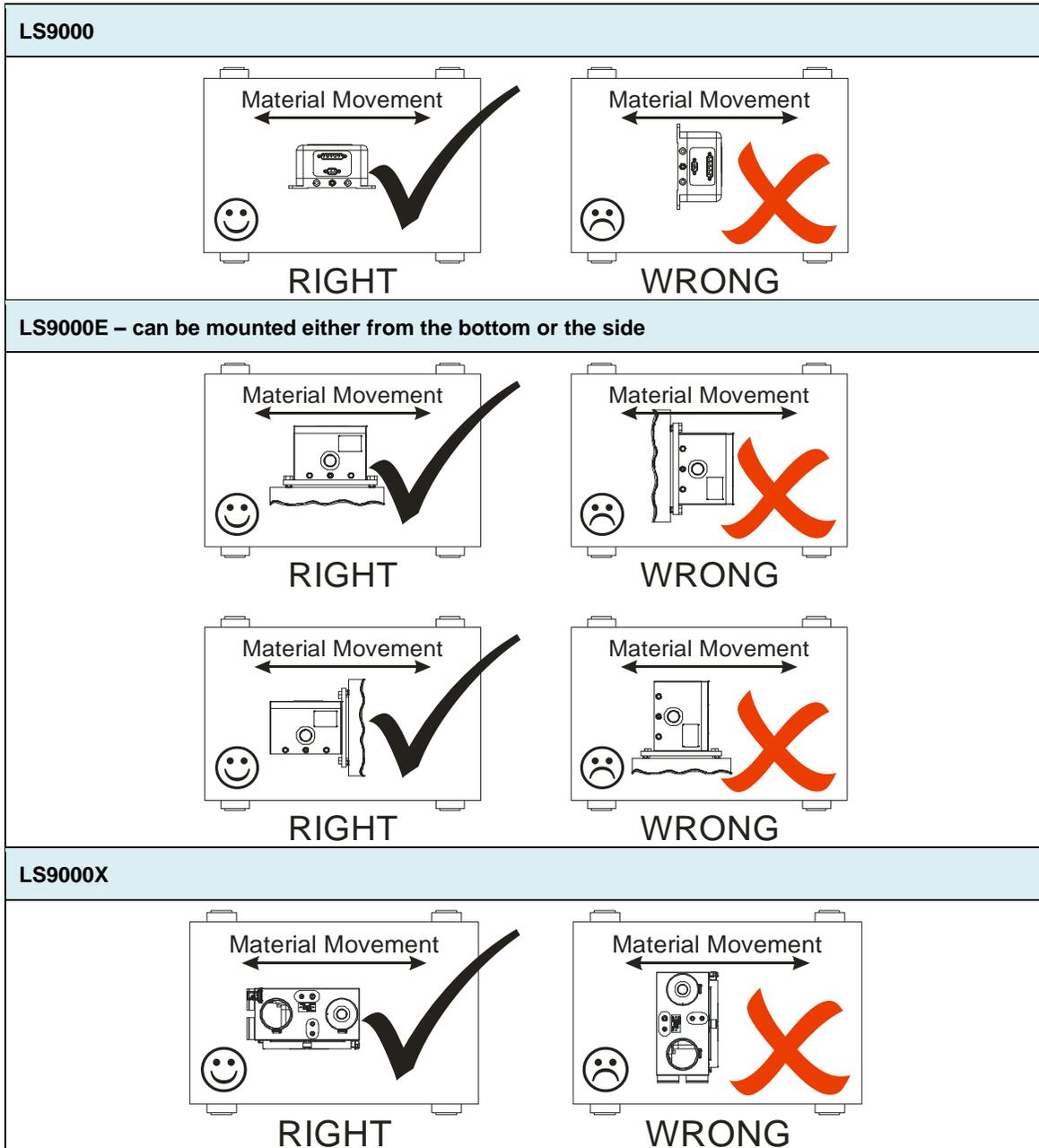


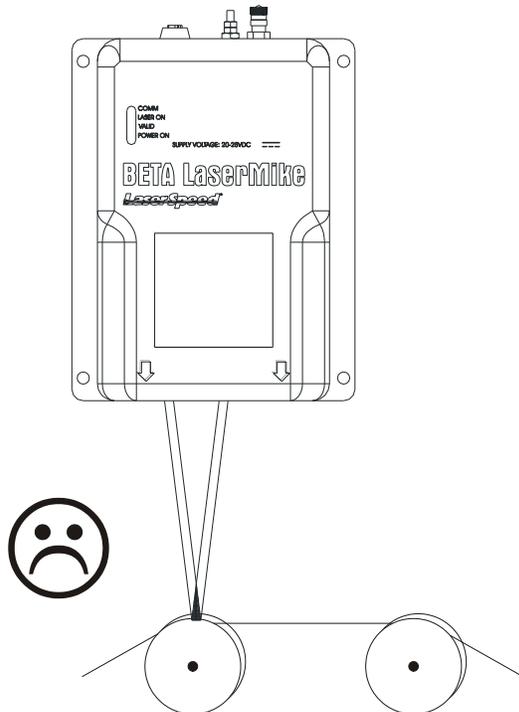
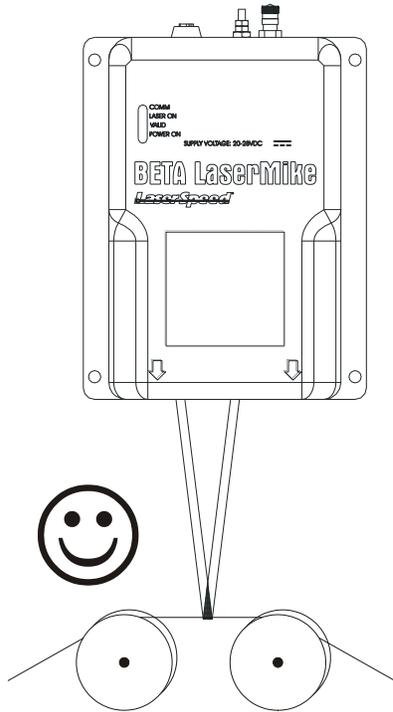
Not perpendicular to material edges
- No measurement error

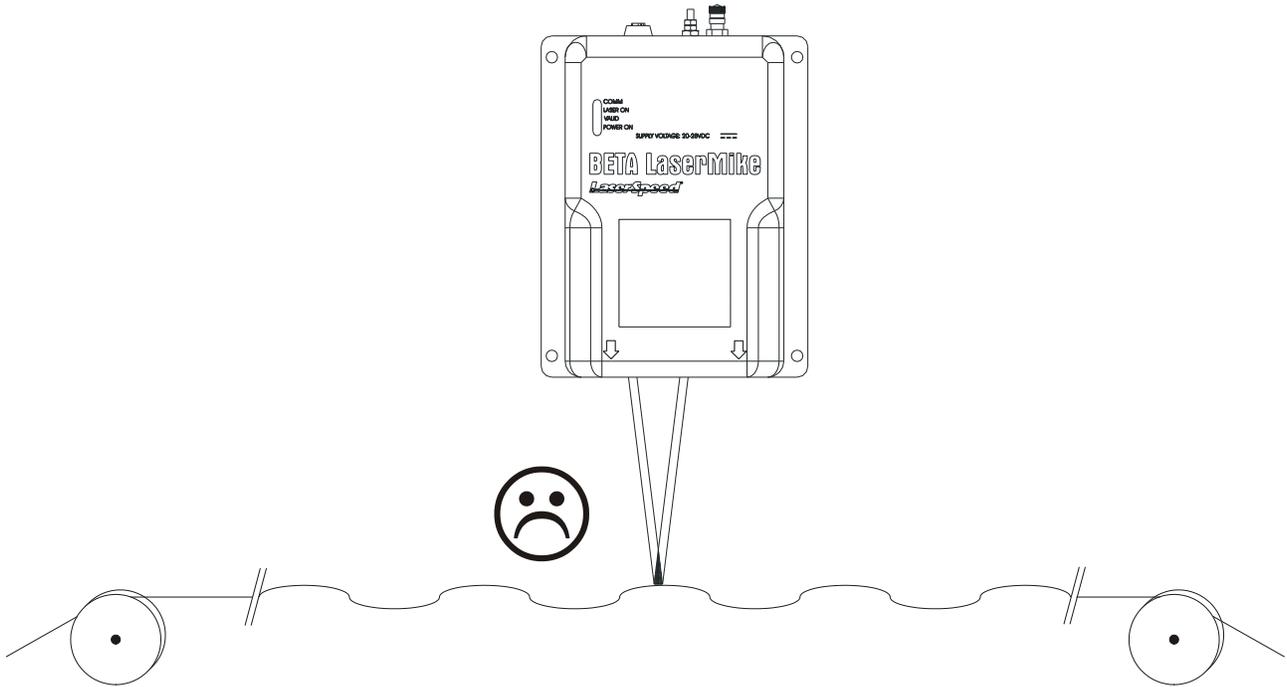
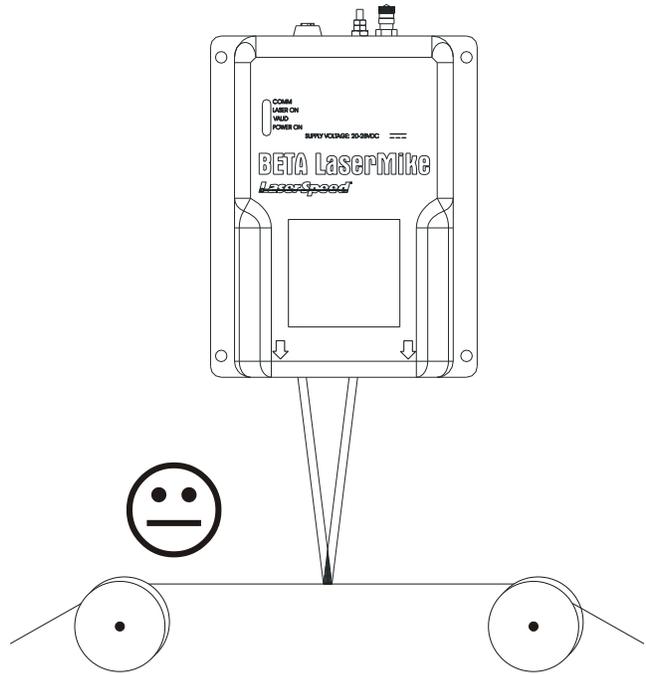
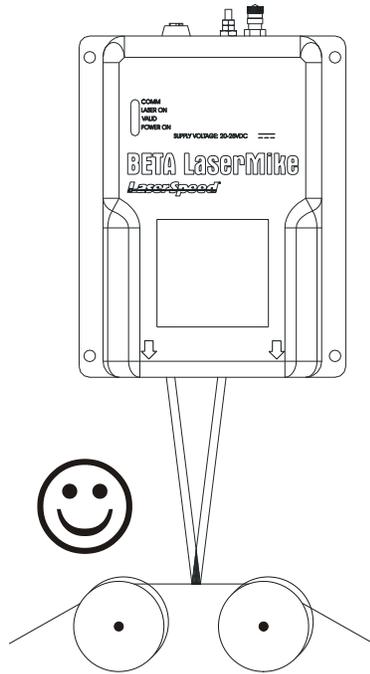
Under normal conditions, the gauge should be mounted perpendicular (angles A,B=90°±1°) to the direction of travel. Correct for any alignment errors in the gauge configuration. For shiny material, the gauge can be mounted up to 6 degrees from perpendicular in the transverse direction to travel (angle C.) Use the smallest angle possible to eliminate direct reflections back into the gauge. Usually 3 degrees from the perpendicular is optimal for shiny materials.

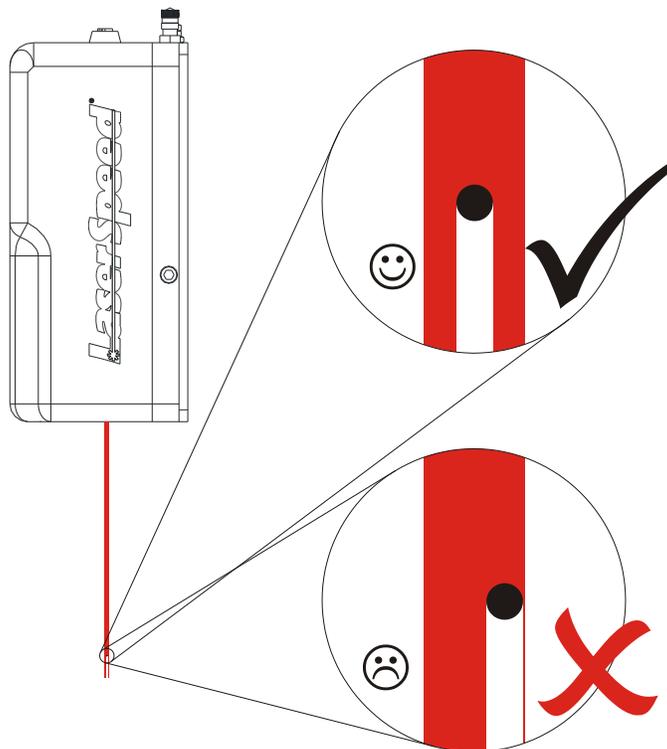
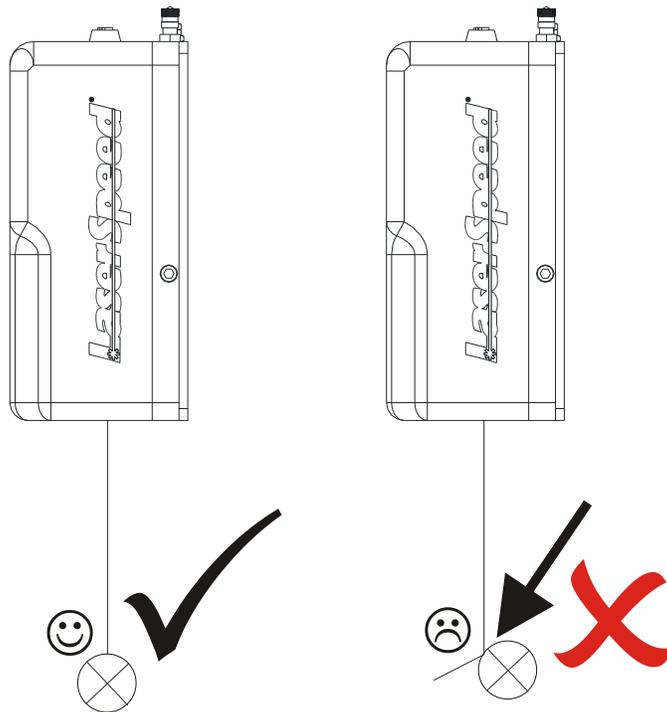
Gauge Orientation

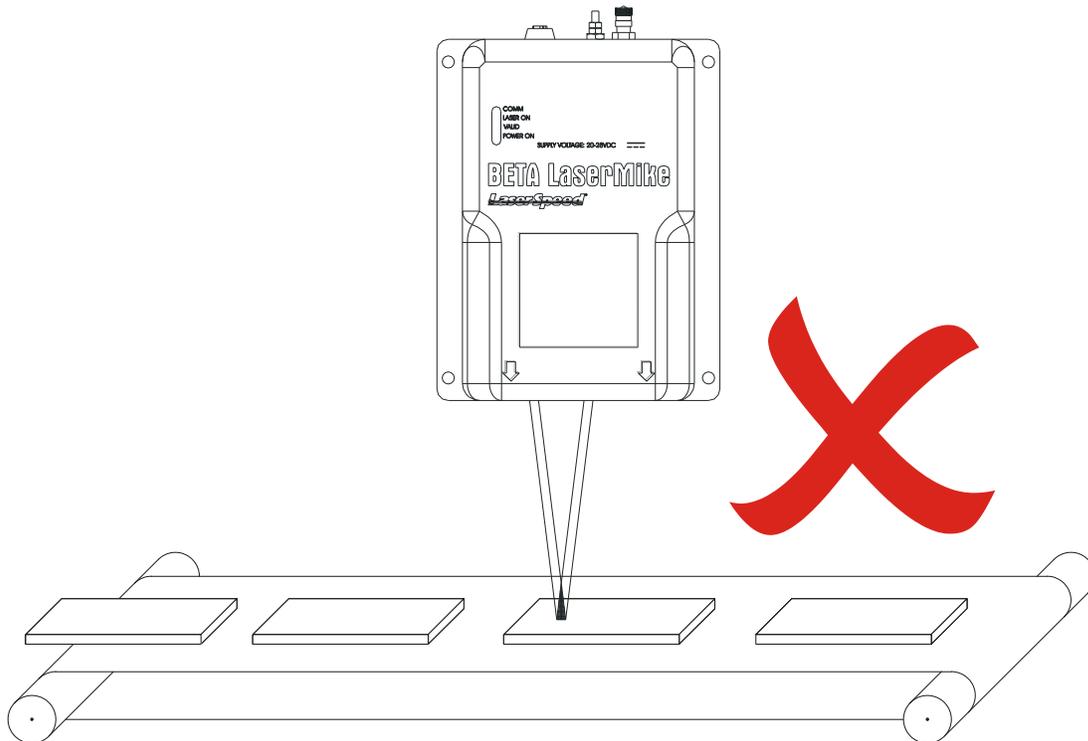
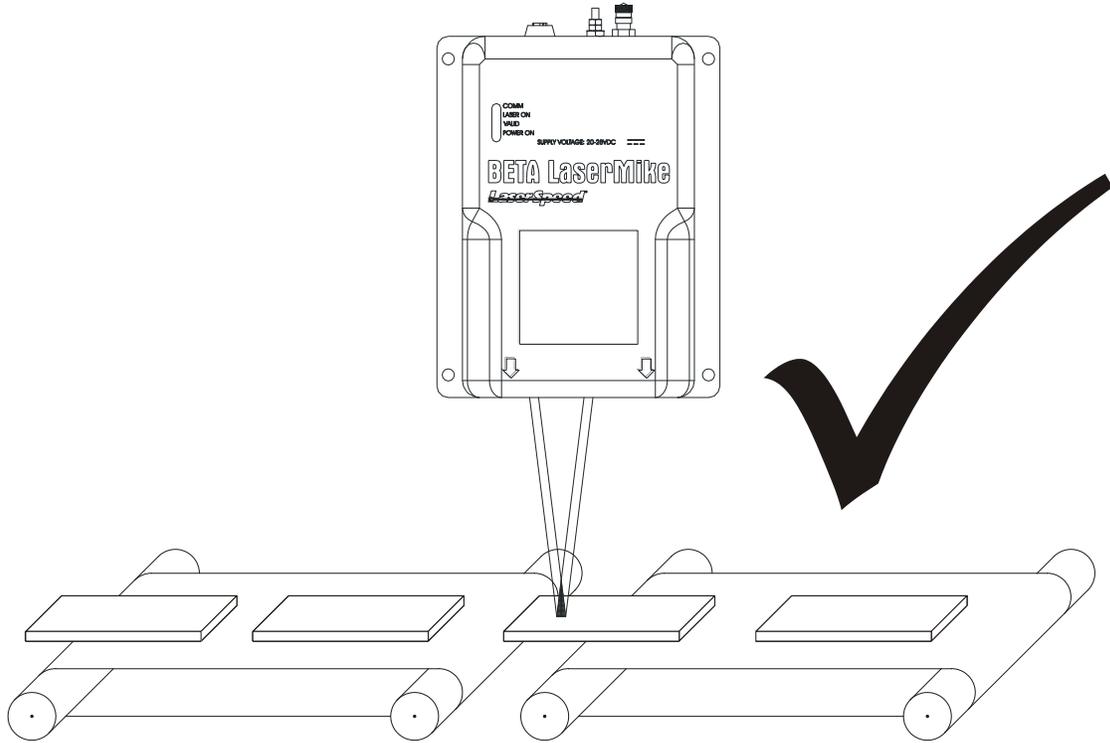
The LaserSpeed gauge must be mounted such that the material to be measured moves in a direction parallel to the bottom of the LS9000, as shown below.

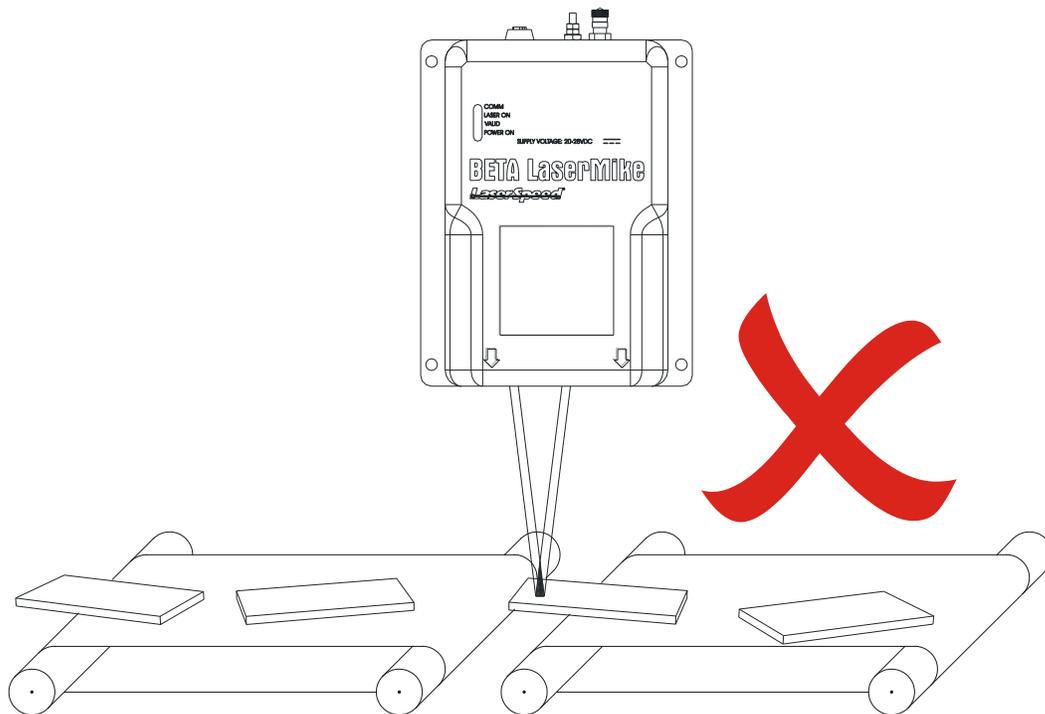
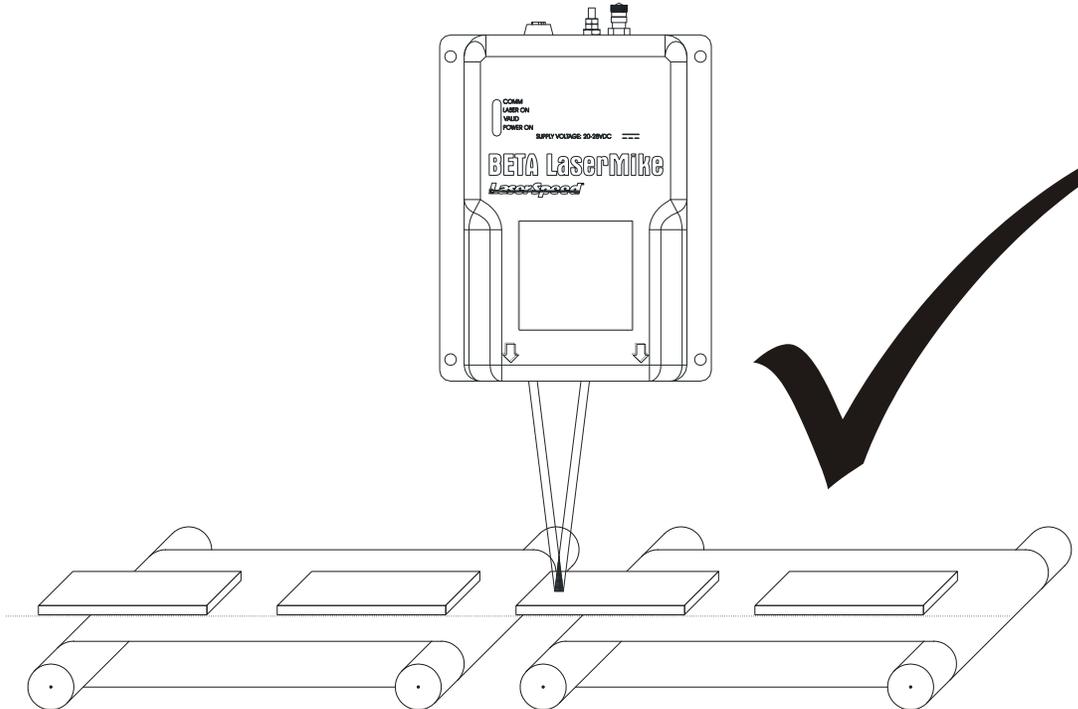












Connecting Power to the Gauge

The gauge requires a 20–28 VDC (nominal 24 VDC) supply to be connected to Pin 24 and/or Pin 25 with the corresponding ground to Pin 12 and/or Pin 13 of the 25-pin D-sub connector. The supply should be able to drive at least 2 Amps. For detailed information on supplying power to the gauge, see [Appendix D](#).

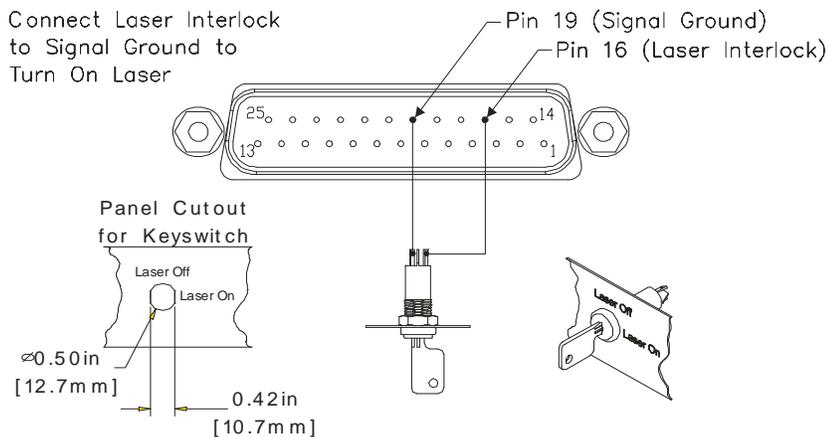
Notes: Do not attach wires to the gauge while power is applied. Make all wiring connections with power turned off. The gauge contains internal fusing (3A, 125 V) on the 24 VDC supply line. This fuse is not user serviceable.

The LS9000 is classified as a kit, according to CDRH regulations. It is your responsibility to install a key switch to control the operation of the device. The key switch should be installed as shown in the following figure. It is in line with the 24-volt supply line that will service to power the device. The recommended key switch can be found in the accessory kit. The key switch should be mounted in a convenient location that does not require exposure to the laser beams. After installation, label the panel as to which position corresponds to “Laser On” and “Laser Off.”

The following figure shows the correct installation of the recommended switch (C&K Components part number YM06132C205NQ). If another type of key switch is used, it should be verified that the key is removable only in the “Laser Off” position.

For more information on laser safety issues, refer to the [Safety](#) section at the beginning of this manual.

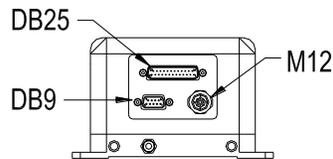
Warning: A key switch must be installed and labelled correctly to ensure proper protection of personnel working with the laser.



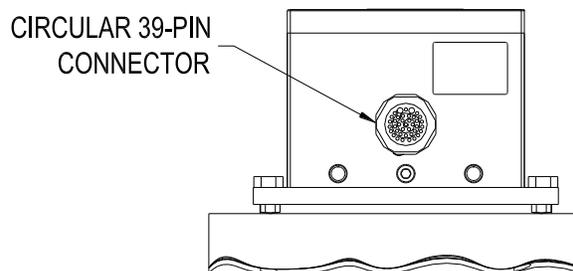
Connecting to Outputs

On the LS9000 model, the outputs of the gauge are contained on the 9-pin and 25-pin D-sub connectors, and the M12 D-Coded Ethernet connector. On the LS9000E and LS9000X, all outputs are contained on a 39-pin circular connector. Their pin values are shown in the following tables. Each signal is explained in detail in the Interfacing with the LS9000 section.

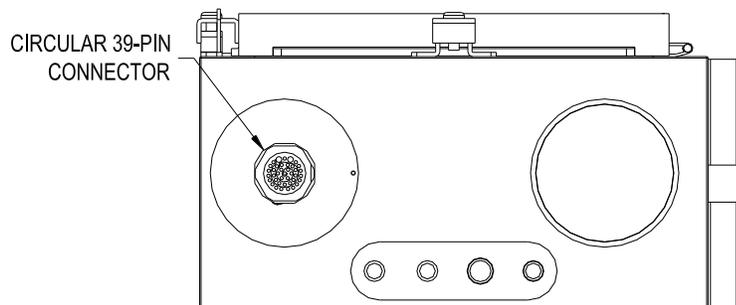
Note: In order for the LS9000 to be operational, pins 16 and 17 must be connected to signal ground. These signals operate the internal laser shutter and the laser interlock. When these connections are open, the laser will not turn on and the shutter will not open. You must provide the correct signals to operate the gauge.



LS9000

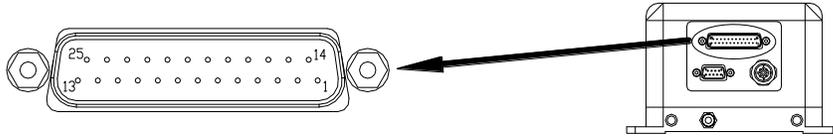


LS9000E



LS9000X

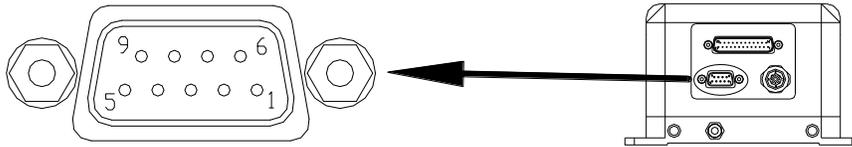
LS9000 25-Pin (Male) Connector Pinout



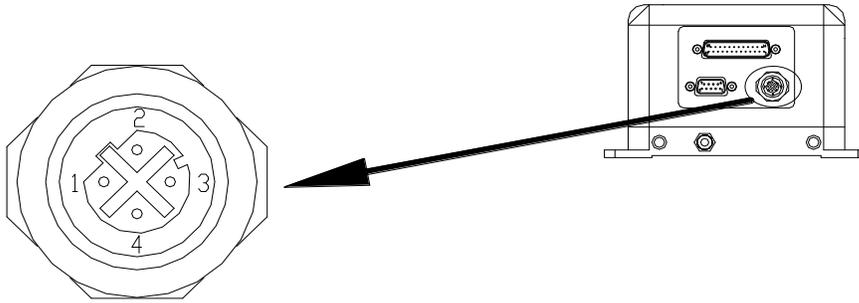
Pin	Description
1	RS-232 Transmit (from LS9000 to host)
2	RS-232 Receive (from host to LS9000)
3	Phase A True – High Speed Output (RS-422 Drivers)
4	Phase A False – User Scaleable (5-24V Output)
5	Phase A False – High Speed Output (RS-422 Drivers)
6	Phase B True – User Scaleable (5-24V Output)
7	Phase B True – High Speed Output (RS-422 Drivers)
8	Phase B False – User Scaleable (5-24V Output)
9	Phase B False – High Speed Output (RS-422 Drivers)
10	Material Present Input (5-24V Input)
11	Signal Ground for Inputs/Outputs/Serial
12	Power Ground for 24V Input
13	Power Ground for 24V Input
14	Measurement Direction Input (5-24V Input)
15	Phase A True – User Scaleable (5-24V Output)
16	Laser Interlock (Connect to Signal Ground to Turn On Laser)
17	Shutter Control (Connect to Signal Ground to Open Shutter)
18	Length Reset Input (5-24V Input)
19	Signal Ground for Inputs/Outputs/Serial
20	User V_{IN} – Voltage input for Isolated Pulse Outputs (5 to 28V DC). The voltage supplied will be the voltage level of the pulse outputs supplied by the LS9000. If a Voltage is not supplied, the pulse outputs will be approximately 4.5V.
21	Signal Ground for Inputs/Outputs/Serial
22	Index Pulse True - User Scaleable (5-24V Output)

23	Index Pulse False - User Scaleable (5-24V Output)
24	24V Fused Input
25	24V Fused Input

LS9000 9-Pin (Male) Connector Pinout



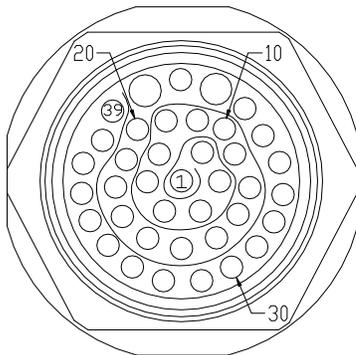
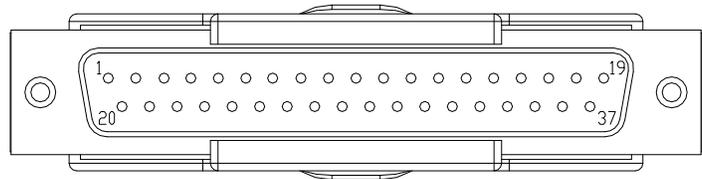
Pin	Description
1	RS-422 Transmit + (from LS9000 to host)
2	RS-422 Transmit - (from LS9000 to host)
3	RS-422 Receive + (from host to LS9000)
4	RS-422 Receive - (from host to LS9000)
5	Signal Ground for Inputs/Outputs/Serial
6	Analog Output Voltage
7	Analog Output Ground
8	Measurement Synchronization Input +
9	Measurement Synchronization Input -

LS9000 M12 Connector Pinout

Pin	Description
1	Ethernet TX+ (from LS9000 to host/switch)
2	Ethernet RX+ (from host/switch to LS9000)
3	Ethernet TX- (from LS9000 to host/switch)
4	Ethernet RX- (from host/switch to LS9000)

LS9000E/LS9000X Connector Pinout

The LS9000E/LS9000X cables have a circular 39-pin military connector on the gauge end and a DB37 connector on the opposite end. The pinouts of both connectors are listed below. Pins 21 and 23 of the circular connector are not internally connected. The 39-pin military connector is internally connected to the LS9000 DB25, DB9, and M12 connectors. These connections are listed in the following table.

**LS9000E/X Circular Connector****DB37 Cable Connector Pin Locations**

LS9000 Connector Pin	DB37	39-Pin	Description	
DB25	1	1	RS232 Transmit (from LS9000 to host)	
	2	2	RS232 Receive (from host to LS9000)	
	3	3	Phase A True – High Speed Output (RS-422 Drivers)	
	4	4	Phase A False – User Scaleable (5-24V Output)	
	5	5	Phase A False – High Speed Output (RS-422 Drivers)	
	6	6	Phase B True – User Scaleable (5-24V Output)	
	7	7	Phase B True – High Speed Output (RS-422 Drivers)	
	8	8	Phase B False – User Scaleable (5-24V Output)	
	9	9	Phase B False – High Speed Output (RS-422 Drivers)	
	10	10	Material Present Input (5-24V Input)	
	11	11	Signal Ground for Inputs/Outputs/Serial	
	12	12	Power Ground for 24V Input	
	13	13	Power Ground for 24V Input	
	14	14	Measurement Direction Input (5-24V Input)	
	15	15	Phase A True – User Scaleable (5-24V Output)	
	16	16	Laser Interlock (Connect to Signal Ground to Turn On Laser)	
	17	17	Shutter Control (Connect to Signal Ground to Open Shutter)	
	18	18	Length Reset Input (5-24V Input)	
	19	19	Signal Ground for Inputs/Outputs/Serial	
	20	20	20	User V _{IN} – Voltage input for Isolated Pulse Outputs (5 to 28V DC). The voltage supplied will be the voltage level of the pulse outputs supplied by the LS9000. If a Voltage is not supplied, the pulse outputs will be approximately 4.5V.
	21	21	22	Signal Ground for Inputs/Outputs/Serial
	22	22	24	Index Pulse True - User Scaleable (5-24V Output)
	23	23	25	Index Pulse False - User Scaleable (5-24V Output)
	24	24	26	24V Fused Input
	25	25	27	24V Fused Input
DB9	1	26	28	RS422 Transmit + (from LS9000 to host)
	2	27	29	RS422 Transmit – (from LS9000 to host)
	3	28	30	RS422 Receive + (from host to LS9000)
	4	29	31	RS422 Receive – (from host to LS9000)
	6	30	32	Analog Output Voltage
	7	31	33	Analog Output Ground
	8	32	34	Measurement Synchronization Input +
	9	33	35	Measurement Synchronization Input -
M12	1	34	36	Ethernet TX+
	2	35	37	Ethernet RX+
	3	36	38	Ethernet TX-
	4	37	39	Ethernet RX-

LS9000E/LS9000X Breakaway Cable Pinout

LaserSpeed breakaway cables have 39-pin military connectors on both ends (male on one end and female on the other) and have pinouts identical to the standard gauge cable.

39-Pin Male	39-Pin Female	Description
1	1	RS232 Transmit (from LS9000 to host)
2	2	RS232 Receive (from host to LS9000)
3	3	Phase A True – High Speed Output (RS-422 Drivers)
4	4	Phase A False – User Scaleable (5-24V Output)
5	5	Phase A False – High Speed Output (RS-422 Drivers)
6	6	Phase B True – User Scaleable (5-24V Output)
7	7	Phase B True – High Speed Output (RS-422 Drivers)
8	8	Phase B False – User Scaleable (5-24V Output)
9	9	Phase B False – High Speed Output (RS-422 Drivers)
10	10	Material Present Input (5-24V Input)
11	11	Signal Ground for Inputs/Outputs/Serial
12	12	Power Ground for 24V Input
13	13	Power Ground for 24V Input
14	14	Measurement Direction Input (5-24V Input)
15	15	Phase A True – User Scaleable (5-24V Output)
16	16	Laser Interlock (Connect to Signal Ground to Turn On Laser)
17	17	Shutter Control (Connect to Signal Ground to Open Shutter)
18	18	Length Reset Input (5-24V Input)
19	19	Signal Ground for Inputs/Outputs/Serial
20	20	User V_{IN} – Voltage input for Isolated Pulse Outputs (5 to 28V DC). The voltage supplied will be the voltage level of the pulse outputs supplied by the LS9000. If a Voltage is not supplied, the pulse outputs will be approximately 4.5V.
22	22	Signal Ground for Inputs/Outputs/Serial
24	24	Index Pulse True - User Scaleable (5-24V Output)
25	25	Index Pulse False - User Scaleable (5-24V Output)
26	26	24V Fused Input
27	27	24V Fused Input
28	28	RS422 Transmit + (from LS9000 to host)
29	29	RS422 Transmit – (from LS9000 to host)
30	30	RS422 Receive + (from host to LS9000)
31	31	RS422 Receive – (from host to LS9000)
32	32	Analog Output Voltage
33	33	Analog Output Ground
34	34	Measurement Synchronization Input +
35	35	Measurement Synchronization Input -
36	36	Ethernet TX+
37	37	Ethernet RX+
38	38	Ethernet TX-
39	39	Ethernet RX-

Maximizing Performance

The system is now at the point where it can be powered on and the laser activated so beams are emitted from the front of the gauge. Be sure that the laser interlock and shutter control circuits are functioning properly.

- When Pin 16 is connected to GND (Pin 11, 19, or 21), the laser becomes operational.
- When Pin 17 is connected to GND (Pin 11, 19, or 21), the shutter will open.
- Check the key switch to verify the laser power can be controlled.

Warning: **Avoid exposure to the beam.** Never look directly into the laser beams, even when wearing protective eyewear. Eye damage could result.

Note: There may be some delay time between when the system is powered on, and when the laser comes on. There is a 7 second delay after power is applied to the laser (key switch on, laser interlock closed) before the laser turns on. The laser will also not turn on until the laser temperature controller stabilizes. This may take a few minutes after power is initially applied.

Note: **After the laser reaches the temperature set point, there is a 60 second delay before the laser is turned on.**

The configuration and setup of the gauge can be verified and/or changed using the supplied LaserTrak Software or directly using the serial commands listed in the [Communication Protocol](#) section. Utilizing either one of these approaches requires a computer with an RS-232 serial port connected to pins 1 and 2 of the 25-pin D-sub connector, or an RS-422 serial port connected to pins 1-4 of the 9-pin D-sub connector.

Quality Factor

Once proper communication is established (see the See the LaserTrak Software section for help), it is recommended to check the Quality Factor (QF). QF can be checked using LaserTrak, and viewing the chart recorder screen. Quality Factor is an indication of how well the gauge is making measurements. If the QF is 0, then the gauge is not able to measure at all, and if the QF is 15, the gauge is able to measure very well. On most products, the QF should be 15 most of the time with occasional drops to lower values. If the QF is repeatedly dropping to zero, there may be a problem with guiding or with the standoff distance.

If the QF is below 15, try to move the product or the gauge slightly (adjust the standoff) and look for improvements in QF. Once QF is maximized, change the line speed and look for a corresponding velocity change on the chart recorder.

Alternatively, the analog port can be configured to output QF on a 0–1 V scale. The QF can then be monitored by connecting a panel meter to the analog output and displaying the voltage. A third method of monitoring the Quality Factor is to reassign one of the pulse outputs to output the Quality Factor as a frequency output.

To ensure quality measurements, the laser beams must maintain “contact” with the product. If the product exhibits large movements during operation, it should be stabilized with external roller guides. Beta LaserMike offers optional product guides. Contact your local Beta LaserMike sales representative or the factory for additional information.

Standoff Distance

The standoff distance is the distance between the front of the gauge and the center of the measurement region. The standoff distance can be verified by using a business card or sheet of white paper. Both beams can be viewed and the area where the beams overlap is the active measurement region. The location where the overlap of the beams is smallest is the center of the measurement region. This location corresponds to the standoff distance and is where the beams should intersect the product. See Appendices A-C for mounting dimensions.

Material Present Adjustment

The intensity of the light reflected from the measurement area can be used to determine whether material is in the measurement zone or not. To compensate for varying reflectivity of different materials, it is often necessary to adjust the threshold of the light detection circuit. This adjustment can be made with a serial command or by using the LaserTrak software.

Material Present Dropout Time Selection

If you are taking measurements and the Material Present signal is lost for less than the selected Material Present dropout time, the loss is considered to be a momentary loss of signal and is ignored. If the signal is lost for longer than the selected Material Present dropout time, it is considered the end of the material. This function is very useful when making length measurements on poor reflecting material.

Validation Time Limit Selection

The validation time limit is used to start making length calculations. Two conditions are necessary to start a length measurement: Material Present and valid velocity data. When material enters the measurement volume, the system determines the time between the Material Present signal and the first valid data. If the time is less than or equal to the validation time limit (selectable via LaserTrak or [‘G’ command](#)), then the start-up length-correction is calculated and a length measurement is initialized. If the time between the Material Present signal and the first valid velocity data is longer than the validation limit, then the length calculation is aborted and an error or fault is sent. This error is sent by setting the length output in [Final Length Mode](#) to all 9's.

Starting/Ending Length Correction

The Validation Time Limit feature is used because the Material Present signal tells the gauge that material is indeed moving through the measurement zone. If valid velocity measurements cannot be made, then a small amount of length will not be accumulated which, in turn, will cause a length error. This may or may not be a problem, depending on the velocity of the material when it passes through the measurement volume during this time. The start-up length-correction is executed to obtain a more accurate length reading. Each measurement update is divided into small subintervals. When the Material Present signal is received within an update period, the time it was received is recorded with a subinterval clock. The length is calculated by using valid velocity and integrating over the time measured with the subinterval clock. For example, if the material speed is 10 meters per minute and material enters the measurement volume in the middle of the 1-millisecond update period, the subinterval time of 0.5ms is used to calculate length rather than the 1-millisecond period. In this case, a 0.083 mm correction would be made. The same type of correction is made when the material leaves the measurement volume.

If problems are encountered during any of the installation steps, contact Beta LaserMike for assistance.

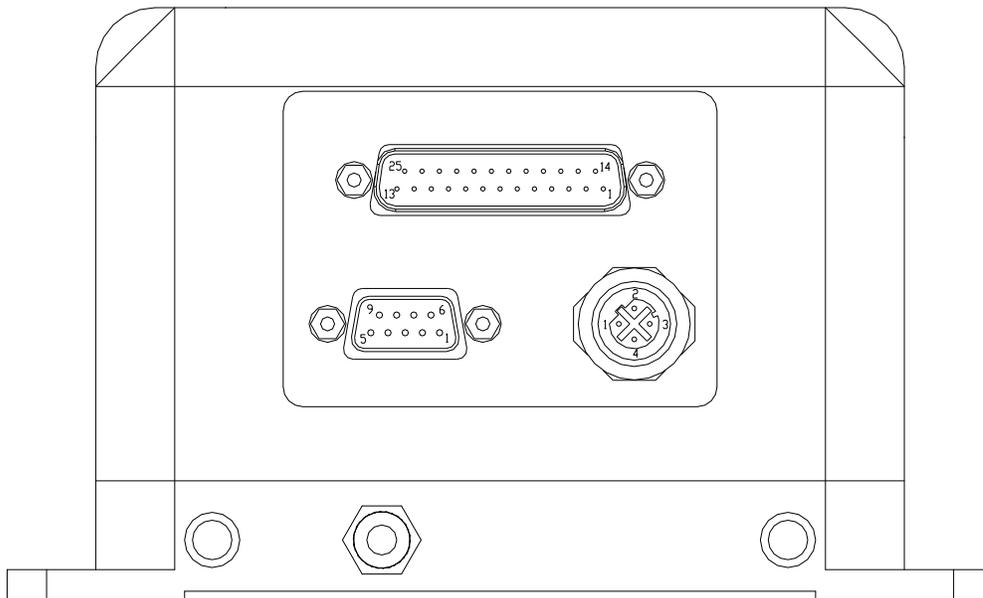
Interfacing with the LS9000

The LS9000 has a variety of outputs that allow length and velocity data to be transmitted to external devices or control algorithms. All of these signals are located on the connector(s) on the back of the instrument.

LS9000 Interface Connectors

The LS9000 has three interface connectors:

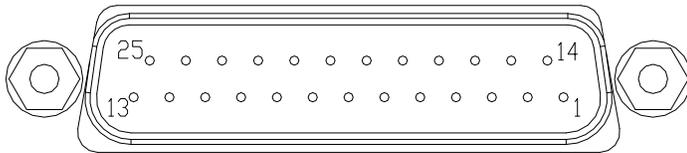
Connector	Gender	Signals
DB25	Male	Quad Pulses, RS-232, Interlocks, Power
DB9	Male	RS-422, Analog, Measurement Synchronization
M12	Female D-Coded	Ethernet



LS9000 Rear Panel Connectors

DB25 Connector

The 25-pin interface port contains pins which deliver the quadrature pulse outputs, RS-232 serial communications, safety interlock signals, and the 24 V supply required to power the gauge. Several inputs are available for operation of the instrument. The connector is a standard 25-Pin male D-Sub connector. The connector is shown below looking at the gauge's rear panel with the gauge base plate down.



Pin	Description
1	RS232 Transmit (from LS9000 to host)
2	RS232 Receive (from host to LS9000)
3	Phase A True – High Speed Output (RS-422 Drivers)
4	Phase A False – User Scaleable (5-24V Output)
5	Phase A False – High Speed Output (RS-422 Drivers)
6	Phase B True – User Scaleable (5-24V Output)
7	Phase B True – High Speed Output (RS-422 Drivers)
8	Phase B False – User Scaleable (5-24V Output)
9	Phase B False – High Speed Output (RS-422 Drivers)
10	Material Present Input (5-24V Input)
11	Signal Ground for Inputs/Outputs/Serial
12	Power Ground for 24V Input
13	Power Ground for 24V Input
14	Measurement Direction Input (5-24V Input)
15	Phase A True – User Scaleable (5-24V Output)
16	Laser Interlock (Connect to Signal Ground to Turn On Laser)
17	Shutter Control (Connect to Signal Ground to Open Shutter)
18	Length Reset Input (5-24V Input)
19	Signal Ground for Inputs/Outputs/Serial
20	User V_{IN} – Voltage input for Isolated Pulse Outputs (5 to 28V DC). The voltage supplied will be the voltage level of the pulse outputs supplied by the LS9000. If a Voltage is not supplied, the pulse outputs will be approximately 4.5V.
21	Signal Ground for Inputs/Outputs/Serial
22	Index Pulse True - User Scaleable (5-24V Output)
23	Index Pulse False - User Scaleable (5-24V Output)
24	24V _{DC} Fused Input
25	24V _{DC} Fused Input

RS-232 Transmit and Receive (Pins 1-2)

The LS9000 has an RS-232 serial port which can be used to receive measurement data, or to configure settings. The LS9000 will connect to any DB9 RS-232 port with a straight-through cable. A null modem is not required. Connections between the gauge and Industry standard pin outs for RS232 serial are given in the following tables:

RS-232 Serial Pinouts – LS9000 to Computer DB9 Connector

Gauge DB25 Pin Number	Gauge Signal Description	Computer DB9 Pin Number	Computer Signal Description
1	RS-232 Transmit	2	RS-232 Receive
2	RS-232 Receive	3	RS-232 Transmit
11, 19, or 21	Signal Ground	5	Signal Ground

RS-232 Serial Pinouts – LS9000 to Computer DB25 Connector

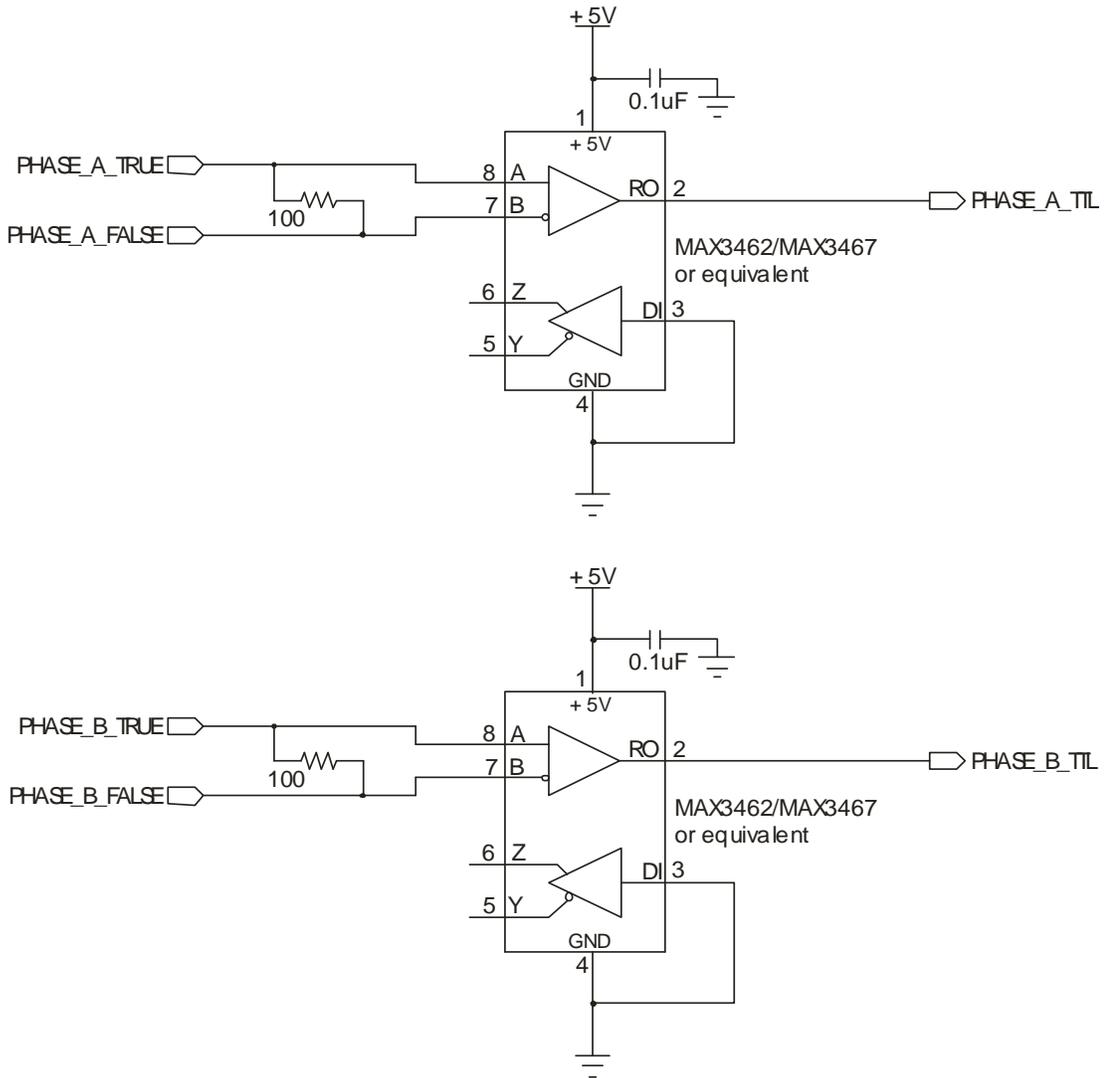
Gauge DB25 Pin Number	Gauge Signal Description	Computer DB25 Pin Number	Computer Signal Description
1	RS-232 Transmit	3	RS-232 Receive
2	RS-232 Receive	2	RS-232 Transmit
11, 19, or 21	Signal Ground	7	Signal Ground

LaserTrak can be used to communicate with the LS9000 over the RS-232, RS-422, and Ethernet ports. Please see the RS232/RS422 Communication section for details on the [Communication Protocol](#).

High Speed Pulse Output (Pins 3, 5, 7, 9)

This quadrature pulse output is a high-speed RS-422 drive output with an output rate up to 5MHz. This pulse output uses an RS-422 transceiver to generate its output signals, and so should be connected to an RS-422 transceiver on the receiving end. These pulse outputs can be connected to a PLC high speed counter card for fine length resolution and high-speed velocity measurement.

If you need to convert the differential RS-422 level pulse signals to TTL levels, Beta LaserMike recommends that you use the following circuit:



The High Speed Pulse Output can be reconfigured to output several different status outputs using the [High Speed Pulse Output Configuration](#) setting.

User Scaleable Pulse Output (Pins 15, 4, 6, 8)

This pulse output is a user-defined 5-24V voltage output with output rates up to 250 kHz. The output voltage is derived from the User V_{IN} input. The pulse outputs are opto-isolated signals with a voltage level determined by the voltage supplied on Pin 20 (referenced to User-Ground (pin 11, 19, or 21.) An isolated TTL level signal (3.7-5V) will be supplied if no external voltage is connected. The output drivers can handle from 5 to 24 VDC. The external supply requirements are 5–24 volts DC at 300 mA.

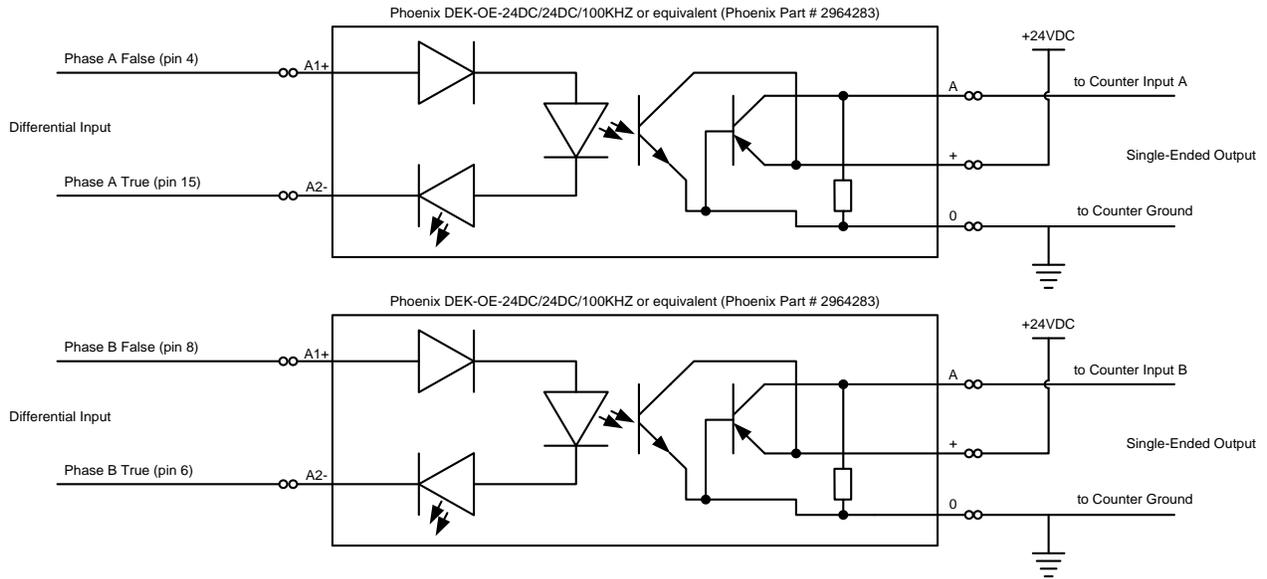
The Low Speed Pulse Output can be reconfigured to output several different status outputs using the [Low Speed Pulse Output Configuration](#) setting.

Differential vs. Single Ended Pulse Outputs

The LS9000 Pulse Outputs are available as both differential and single-ended outputs. Using a counter with differential inputs will provide the best noise immunity, so Beta LaserMike recommends that the outputs are used in this configuration.

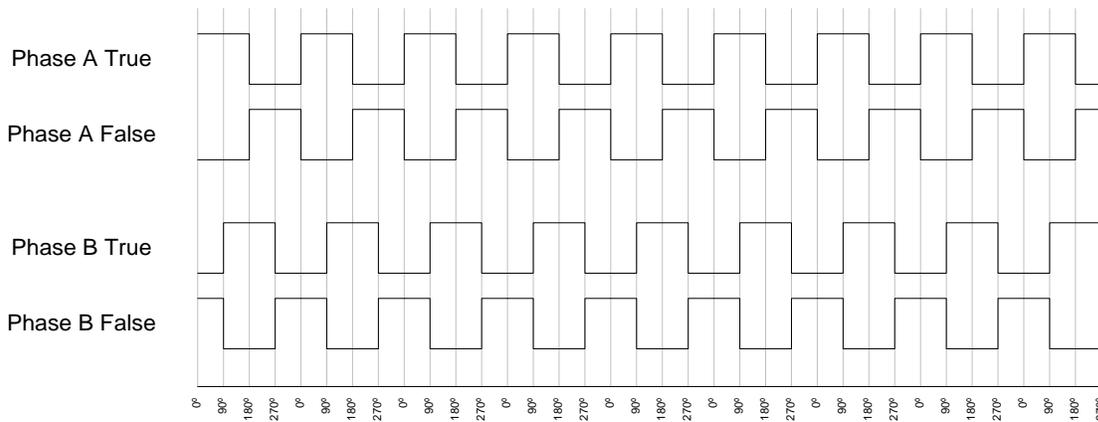
Unfortunately, many counters do not have differential inputs. The pulse outputs can be used as single ended inputs by connecting Phase A True and Phase B True to the counter inputs, and connecting the counter ground to User Ground (pins 11, 19, 21). Leave the Phase A False and Phase B False outputs unconnected when connecting for single ended output. If extra counts occur when the line is not moving, or when the LS9000 is powered down, then noise is getting into the cable and triggering the counter. In this case, using a conversion circuit to convert from differential to single ended outputs may correct the problem.

Because the opto-isolator in the circuit has a relatively slow response time compared with the LaserSpeed's maximum pulse output frequency, when using this circuit, keep the LaserSpeed's pulse output frequency below 20kHz.

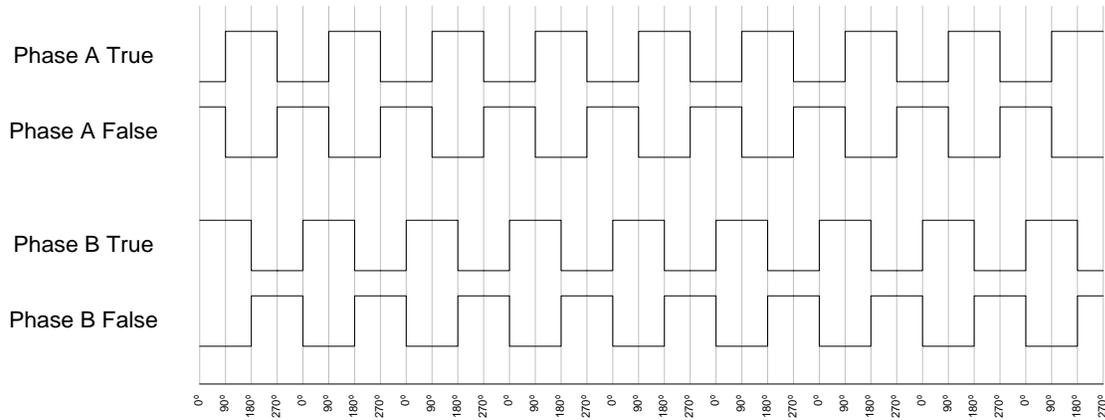


Quadrature Output Phase Relationships

The phase relationship of the quadrature outputs is determined by the direction of the measured velocity. If the velocity is a positive number, Phase A rising edge will lead Phase B rising edge, and if the velocity is negative Phase B will lead Phase A rising edge. For more information on the direction input, see Operational Inputs.



Typical Full Quadrature Pulse Train with Positive Velocity

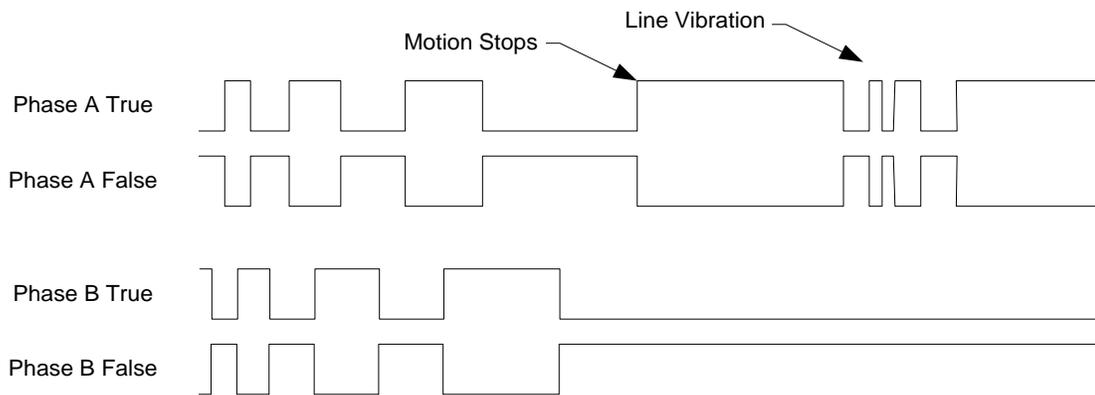


Typical Full Quadrature Pulse Train with Negative Velocity

Note: If excessive or erratic counts are noticed, the main cause is usually improper termination of the pulse signals. It is recommended you look at the signals (while connected to the external counter) with an oscilloscope to determine if excessive ringing or rounding of the pulse train is present. **A 100Ω resistor can be used between true and false signals for differential output.**

Quadrature Outputs at or near Zero Speed

When the velocity is at zero, vibration in the product being measured can cause the LS9000 to measure small velocities in both the positive and negative directions. This causes the quadrature outputs to reverse phase as shown in the figure below. The LS9000 will accurately track the line position when vibration is present.



Full Quadrature Pulse Train Showing Pulses due to Vibration

On a full quadrature counter, the pulses due to line vibration will cause it to count up and down by one count, which may cause the displayed length to dither by one digit. This should not cause the length to accumulate. If the counter length accumulates when the line is stopped, this is usually caused by one of the following problems:

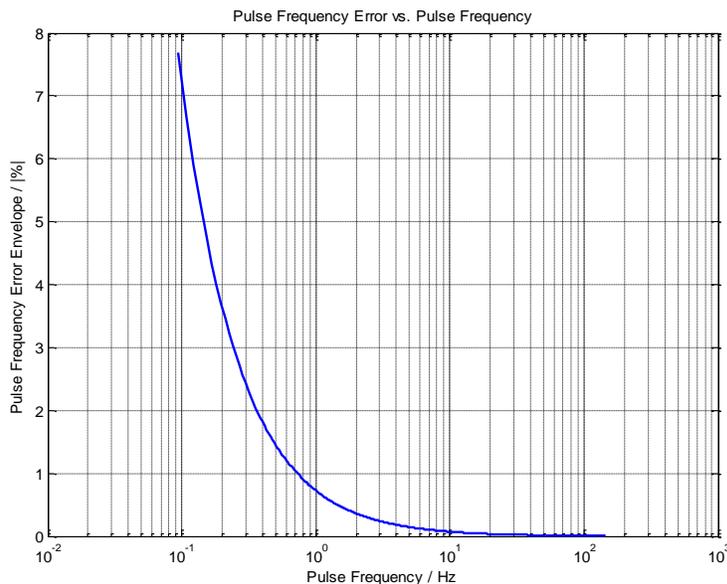
- The counter is not a full quadrature counter. Some counters only look at the rising edge of one phase of the quadrature signal, and then count either up or down depending on the state of the other phase. The counter needs to look at each edge of the signal so that it can count both up and down.
- The counter is a full quadrature counter, but there is a setting that must be set to look at all edges. This setting usually changes the counter's maximum input frequency, so be sure to check the counter specifications to make sure you don't exceed the maximum frequency.

Quadrature Outputs at Extremely Low Pulse Frequencies

Note: This section only applies to the pulse outputs—the length and speed available over the RS-232, RS-422, and Ethernet ports are not affected.

The LS9000 uses a DDS (Direct Digital Synthesis) circuit to generate the quadrature outputs. Due to the nature of DDS technology, the frequency output is not continuously variable, but occurs in steps of about 0.015Hz. Normally, relative to the output frequency, this step size is so small that it is impossible to measure. However, if both a very low speed is measured, and a

very low pulse resolution is used, the pulse output frequency will be frequency low enough for the step size to cause noticeable errors in measurement. The following graph shows the envelope of the pulse output frequency error as the pulse output frequency approaches zero.



The error decreases very rapidly as the frequency increases, becoming insignificant at pulse output frequencies higher than 15Hz. For this reason, the pulse output resolution should be set such that the minimum production line speed produces a pulse output frequency higher than 15Hz.

The following equations can be used to calculate the minimum pulse output resolution.

Definitions:

R = Minimum Recommended Pulse Output Resolution

X = Minimum Production Linespeed

Measurement Units	Minimum Pulse Output Resolution
m/s	$R = \frac{15 \text{ pulse/s}}{X \text{ m/s}} = \frac{15}{X} \text{ pulse/m}$
ft/s	$R = \frac{15 \text{ pulse/s}}{X \text{ ft/s}} = \frac{15}{X} \text{ pulse/ft}$
ft/min	$R = \frac{15 \text{ pulse/s}}{X \text{ ft/min}} \cdot \frac{60s}{\text{min}} = \frac{900}{X} \text{ pulse/ft}$
m/min	$R = \frac{15 \text{ pulse/s}}{X \text{ m/min}} \cdot \frac{60s}{\text{min}} = \frac{900}{X} \text{ pulse/m}$
in/min	$R = \frac{15 \text{ pulse/s}}{X \text{ in/min}} \cdot \frac{60s}{\text{min}} = \frac{900}{X} \text{ pulse/in}$
mm/min	$R = \frac{15 \text{ pulse/s}}{X \text{ mm/min}} \cdot \frac{60s}{\text{min}} = \frac{900}{X} \text{ pulse/mm}$
mm/s	$R = \frac{15 \text{ pulse/s}}{X \text{ mm/s}} = \frac{15}{X} \text{ pulse/mm}$
yards/min	$R = \frac{15 \text{ pulse/s}}{X \text{ yard/min}} \cdot \frac{60s}{\text{min}} = \frac{900}{X} \text{ pulse/yard}$
yards/s	$R = \frac{15 \text{ pulse/s}}{X \text{ yard/s}} = \frac{15}{X} \text{ pulse/yard}$

Pulse Output Delay

The pulse output uses a DDS circuit to generate the pulse output. The speed of the product being measured is obtained by measuring the speed of the product up to 100,000 times per second. This measurement rate is higher than any process control device can handle. Therefore, the measurements are gathered in 1 ms increments and averaged together to provide a speed measurement every 1 ms. The speed measurements are sent to the digital output and to the DDS to update the pulse generator with new speed data every 1 ms. For most cases, a 1 ms response time is too fast for most process controllers. Process controllers are used to taking the speed information from a mechanical encoder. The mechanical encoder has a certain amount of mechanical inertia that mechanically slows down the response to fast speed changes or smooths out any fast changes in the speed of the product. Since the LaserSpeed gauge makes its measurement via an optical measurement, there is no mechanical smoothing of the speed information.

Electronic smoothing of the speed measurements have been added to the digital data in order to simulate the mechanical smoothing of the mechanical encoder. The mechanical inertia and the electronic smoothing of the data introduce a delay in the data as well as the smoothing of the data. For the LaserSpeed gauge the delay is equal to ½ the smoothing amount. For encoders the delay is determined by the amount of mechanical mass of the encoder wheel or roller.

The LaserSpeed gauge implements a forward running average to achieve data smoothing. The forward running average is depicted by the following formula:

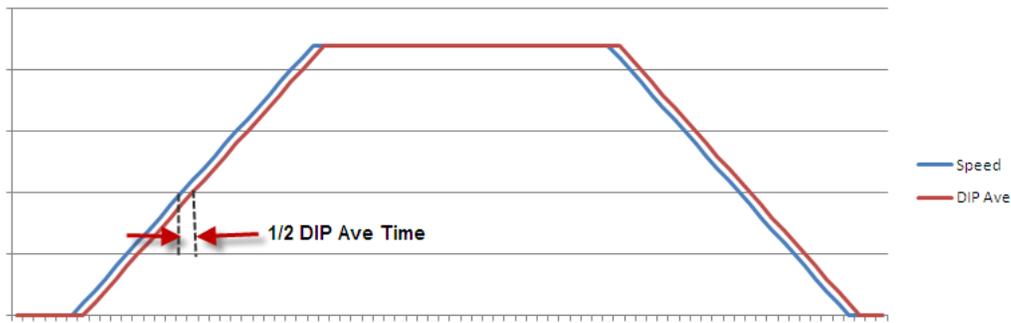
$$S_{DIP} = 1/n \sum_{i=1}^n S_i$$

Where:

S_{DIP} = Average speed (smoothed speed)

N = the number of Speed measurements used in the average (DIP)

S = Individual Speed measurements from the 1 ms average



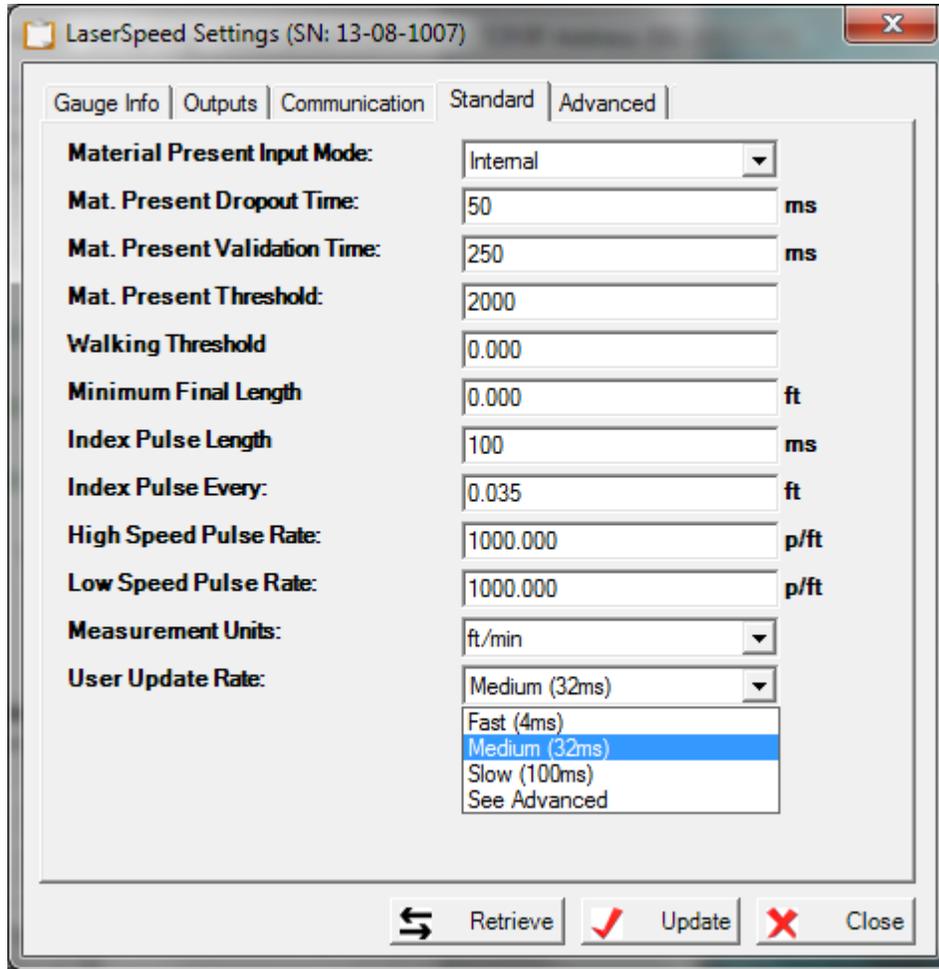
Line Speed Delayed by the DIP Averaging Time

The Graph above shows the delay in the speed measurement caused by the smoothing algorithm. The delay causes the average speed to lag during acceleration and lead on deceleration. The average speed is fed to the pulse generator to generate the pulse output. Therefore, obtaining length by counting the pulses will give a length error according to the following formula:

$$L_{err} = (\text{Starting Speed} - \text{ending Speed}) \times \frac{1}{2} \text{DIP Average}$$

If the Length measurement is used to obtain length for a line that starts and ends at zero speed then there is no Length error caused by the smoothing algorithm. If the Length measurement is used for cutting or marking of short lengths during acceleration or deceleration periods then there will be a length error during the acceleration and deceleration of the line. The error can be calculated according to the formula above.

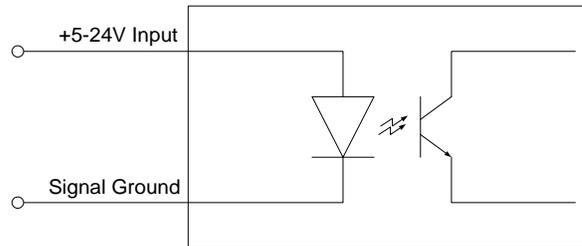
To minimize the length error caused by the smoothing algorithm, select a smaller DIP averaging time in the Configuration tab of the LaserTrak Software. The configuration Standard Tab has three selections for the [User Update Rate](#). If you select one of these settings the software will automatically select the best DIP averaging time. The three selections are; Fast, Medium and Slow. For operation that needs to calculate the length during the acceleration or deceleration select Fast for the User Update rate. The default setting is Medium and this selection should be used for most applications. For production lines that move very slowly, use the Slow selection.



Caution: When using the Advance Tab to custom select the DIP average and User Update Rate, the DIP average **CANNOT** be set to a value less than the User Update Rate. If the DIP Average is set to a value less than the User Update Rate the Gauge will automatically reset the DIP Average to the User Update Rate value. The Gauge will not report this change to the LaserTrak Software. The LaserTrak software will report the value that was entered in the DIP Average Selection window not the actual value.

Material Present Input (Pin 10)

This is an optically isolated input that can be used to externally control the Material Present feature of the LS9000. The input requires a voltage high (5 to 24V) to activate. The input level should be the same as the voltage connected to the User V_{IN} input (Pin 20) or 5V if there is nothing connected to the User V_{IN} input.



Optically Isolated Input Schematic

The LS9000 can internally sense Material Present, but there are situations where it is advantageous to determine this externally. This input can also be used to start and stop length measurements. This input is typically used in the following situations:

- Continuous Processes such as Cold Mills, where there is always metal in front of the gauge. The input can be used both to start/stop length measurements, and to prevent the LS9000 from sending speed data/pulses to the PLC while the line is stopped. The LS9000 can be configured to clear the measured velocity to 0 and hold the pulse outputs when the Material Present input is in the "Material Not Present" state.
- Discrete Part Length applications can take advantage of this input to increase the precision of length measurements. Two material detection gauges (such as optical make/break gauges) can be mounted on either side of the LS9000

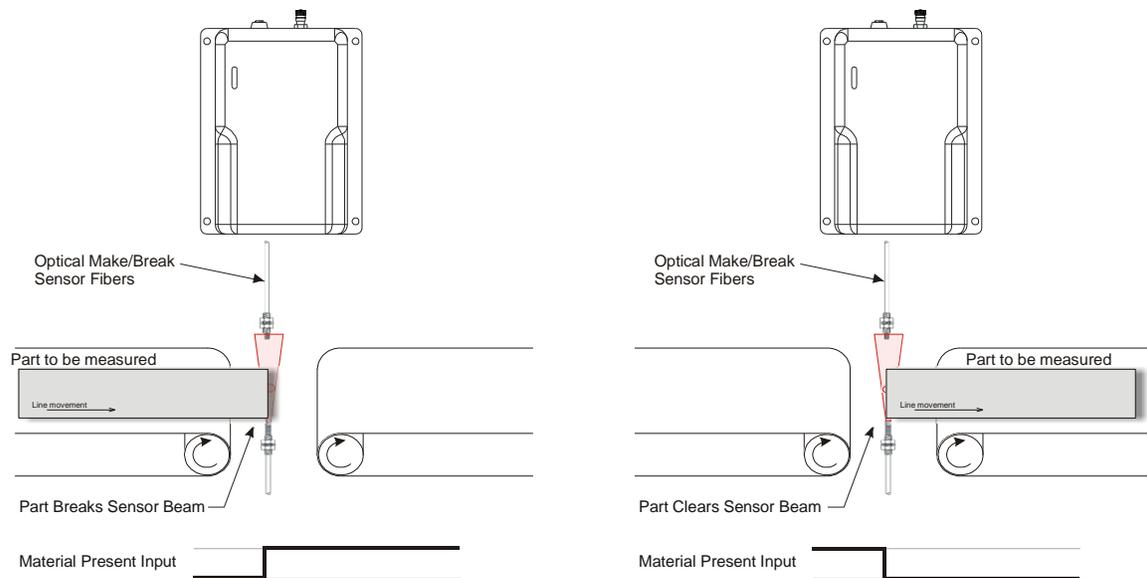
This input is functional only when the [Material Present Input Mode](#) has been set to External Mode. Activating this input causes a new measurement to begin. This resets the current length, and resumes counting at 0. Deactivating this input causes the current measurement to end, which causes the length to hold at the current value. If in [Final Length Mode](#), the final length will be output on the RS-232/RS-422/Ethernet port. The functionality of this input varies with the Material Present Input Mode. The Material Present Input Mode is configurable through LaserTrak, or by using the ["S" serial command](#).

Material Present Input Mode	Material Present		Transition Effect	
	High (5-24V)	Low (0V)	Low→High	High→Low
0 (Internal)	N/A	N/A	No Effect	No Effect
1 (External Active Low)	No ("Material Not Present")	Yes ("Material Is Present")	Ends Current Measurement	Starts New Measurement
2 (External Active High)	Yes ("Material Is Present")	No ("Material Not Present")	Starts New Measurement	Ends Current Measurement

Note: If Material Present functionality isn't required, and you want Material Present to always be on, then set the LS9000's Material Present Input Mode to External Active Low, and leave the Material Present Input disconnected.

Example 1:

You are using an external make/break optical switch to begin and end the measurement. The optical gauge has a smaller spot size than the LS9000, so it will more exactly detect the edge of the product. When the part enters the measurement area the switch outputs a Low (0V) signal, and when there is a part in the measurement area, the switch outputs a High (24V) signal. So, when the part enters the measurement area, a Low→High transition occurs, and when the part exits the measurement area, a High→Low transition occurs. This configuration requires that you set the [Material Present Input Mode](#) to 2 (External/Active High). When the part enters the measurement area (Low→High) a measurement begins, and when the part exits the measurement area (High→Low) the measurement ends. If the LS9000 is in [Final Length Mode](#), the elapsed length will be transmitted over the serial port when the part exits the measurement area.

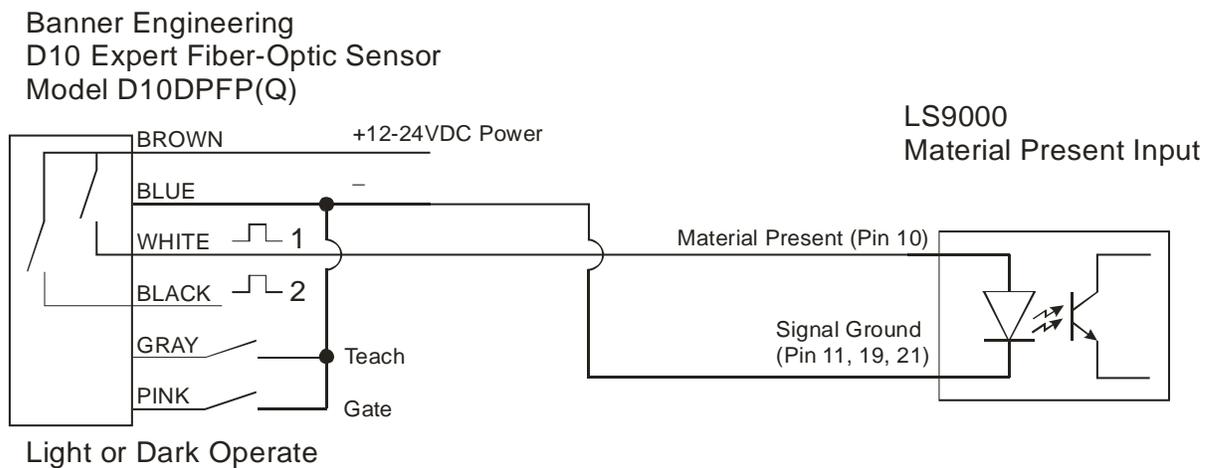


Connecting Material Present Switches

This section shows how to connect a commonly used Material Present detector.

Single Switch Configuration

The D10 is a make/break optical switch. When connecting one optical switch, it should be aligned with the LS9000's measurement spot. This configuration can be used in order to more precisely detect the edge of the material. The fiber optic elements are much smaller than the LS9000 spot size, so repeatability is improved by more consistent edge detection.



The switch can be configured for either Light Operate or Dark Operate. When in Light Operate mode, the switch will output a voltage high when there is not an object blocking the beam, and when in Dark Operate mode, the switch will output a voltage high when there *is* an object blocking the beam. Also, the switch should be configured for Super High Speed (SHS) mode in order to minimize latency.

Optical Switch Mode	LS9000 Material Present Mode
Light Operate	External Active Low
Dark Operate	External Active High

When the product enters the measurement area and triggers the switch, the Material Present signal should activate. This causes the LS9000 to start counting length at 0. When the product leaves the measurement area and the Material Present signal deactivates, the LS9000 will calculate the final length and the measurement is complete. If in Final Length mode, the LS9000 will transmit the Final Length over the serial/Ethernet ports.

Dual Switch Configuration

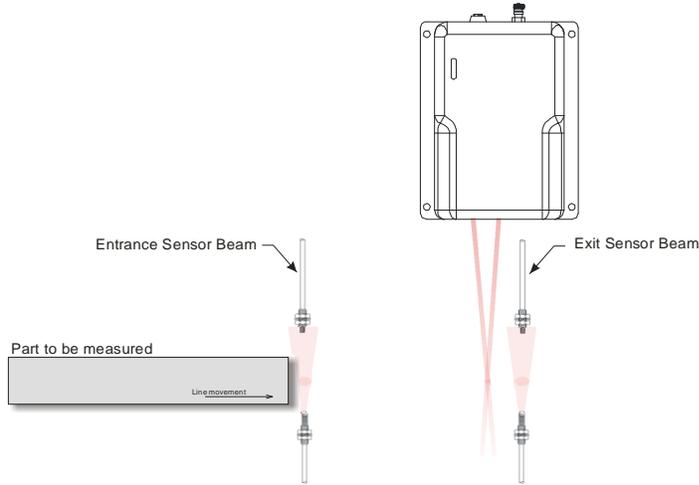
Two optical switches can be connected in parallel in order to further increase the precision of part-length measurements. This configuration is typically used on discrete part measurements that are long and have a very tight length specification. The LS9000 repeatability specification is $\pm 0.02\%$ of the measured length.

Example:

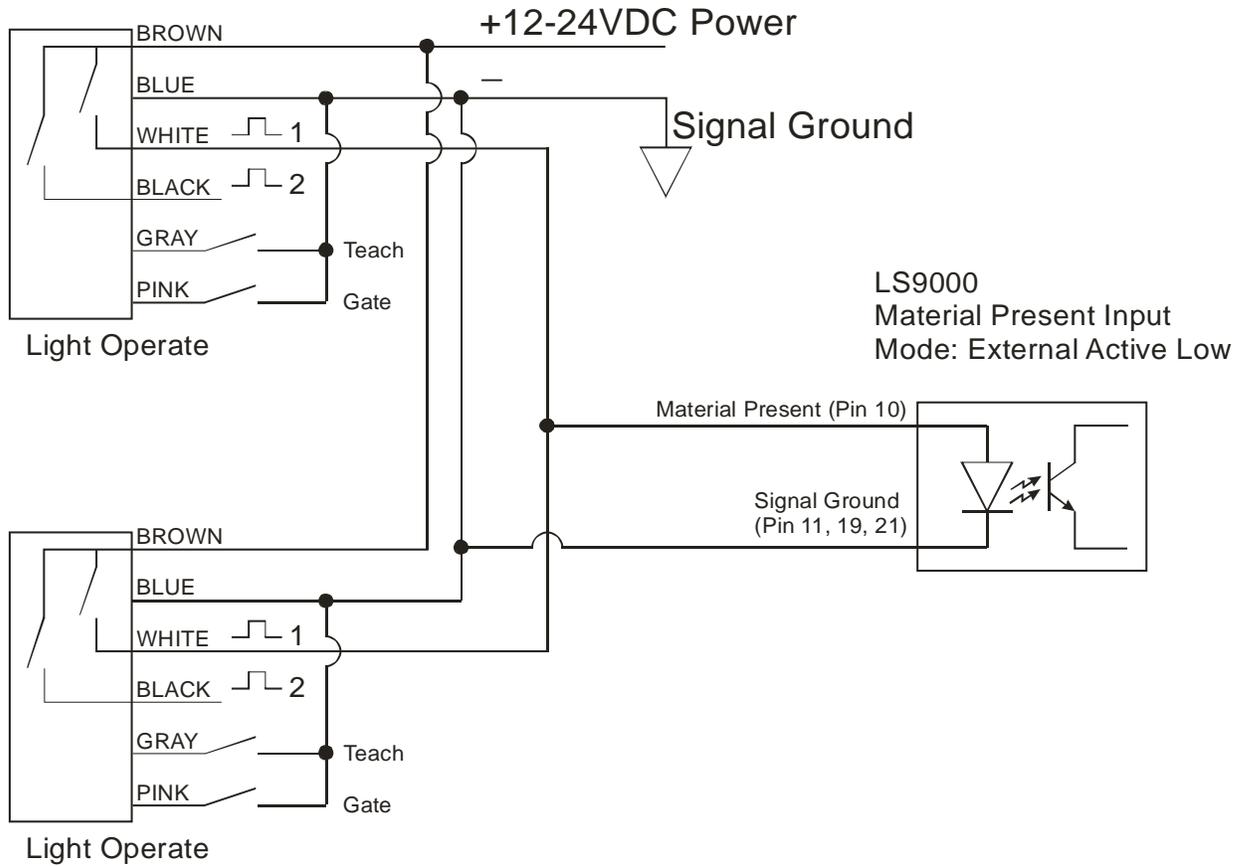
A cut-to-length application has a product that varies from 14 ft. (4.27m) to 16 ft. (4.88m) in length, and has a tolerance of $\pm 1/8$ inch (± 0.125 in./ ± 3.2 mm.) The LS9000 repeatability specification for a 16 ft. length is a little more than $\pm 1/32$ inch (± 0.97 mm.) While this is better than the length specification, the measurement variation is only about $1/4$ the length specification. Ideally, a measurement instrument's variation should be 10X smaller than the specification it is required to measure.

In order to improve repeatability, the LS9000's measured length can be reduced by using two optical switches to gate the LS9000's measurements. The LS9000 will only measure while the product blocks both optical switches. In this case, since the minimum part length is 14 ft (4.27m), the switches could be placed 13 ft (3.96m) apart. This will reduce the length that the LS9000 measures to between 1 and 3 feet. The repeatability will then be $\pm 0.02\%$ of 1-3ft instead of $\pm 0.02\%$ of 12-16ft. The new repeatability would then be ± 0.0072 inch (0.18mm.) Because the distance between the two switches is fixed, this value can be added to each length measurement that the LS9000 produces using the [Length Reset Value Setting \(\\$R configuration setting\)](#).

The optical switches should be arranged and wired as shown below:



Banner Engineering
 D10 Expert Fiber-Optic Sensor
 Model D10DPFP(Q)

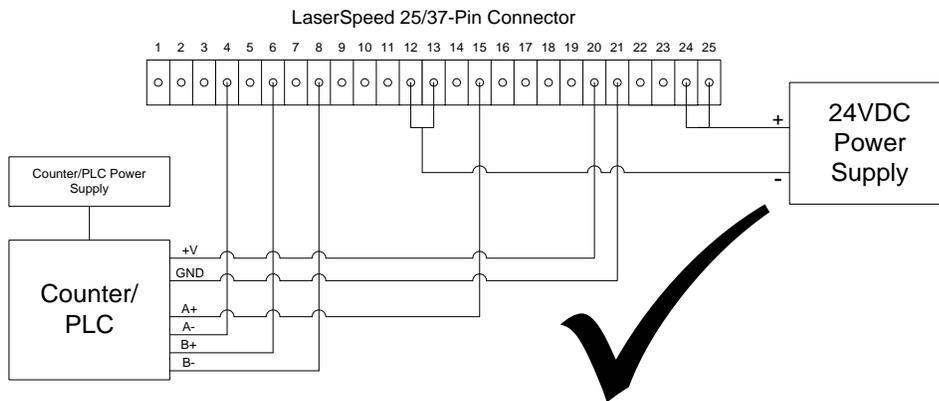


Signal Grounds (Pins 11, 19, 21)

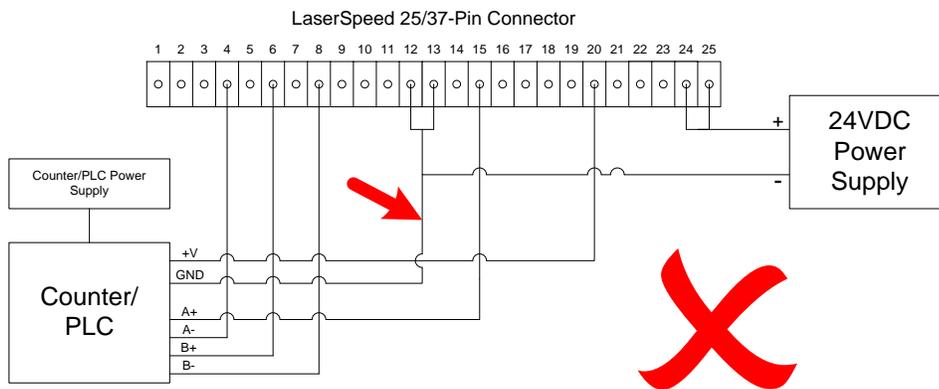
Multiple ground inputs have been supplied for the pulse outputs (High Speed, User Scaleable, and Index) to provide good references for cabling. Additionally, two power input pins (24 and 25, 24 VDC) and power input ground pins (12 and 13) have been provided for cabling ease.

The Signal Grounds (pins 11, 19, and 21) are internally isolated from the Power Ground (pins 12, 13). The Signal Ground pins are internally connected. All input and output signals should be referenced to the Signal Grounds, not the Power Ground. The Power Ground and the Signal Ground can be tied together if isolation is not required for the application.

Isolation Required between Power Supply and I/O

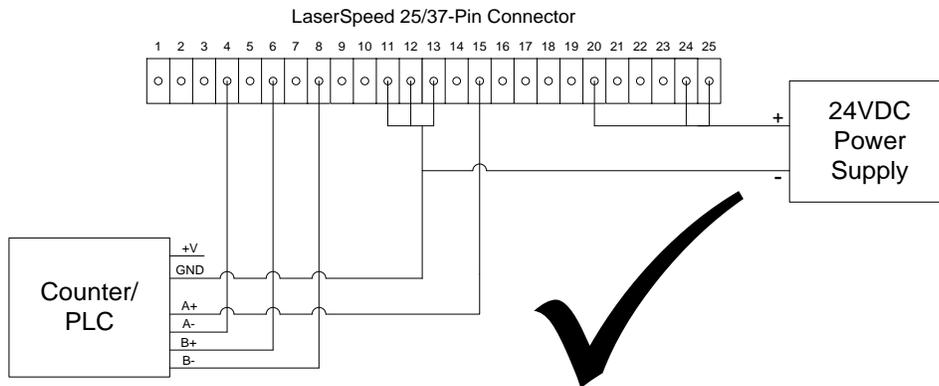


Right - Counter/PLC Ground connected to Signal Ground

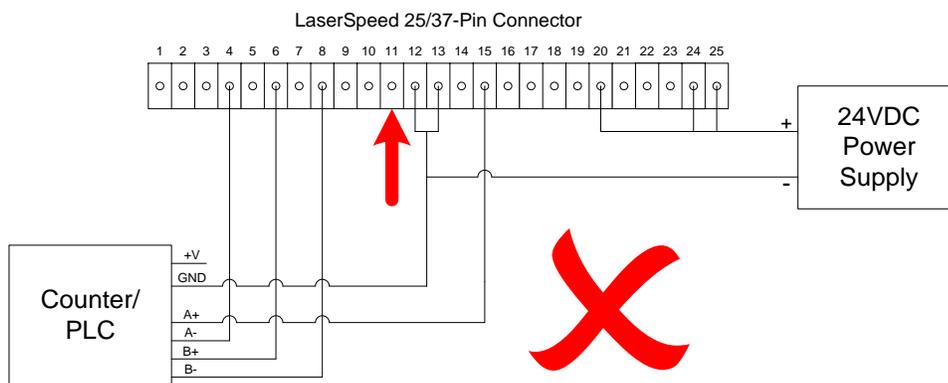


Wrong - Counter/PLC Ground connected to Power Ground

Isolation Not Required between Power Supply and I/O



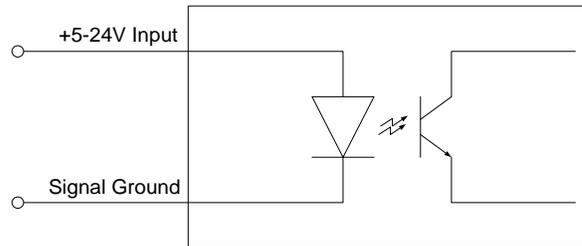
Right - 24V Connected to User V_{IN} ,
 - Counter/PLC Ground, Signal Ground, and Power Ground connected together.



Wrong - Signal Ground Not Connected

Measurement Direction Input (Pin 14)

This is an optically isolated input that can be used to externally control the Measurement Direction feature of the LS9000. The input requires a voltage high (5 to 24V) to activate. The input level should be the same as the voltage connected to the User V_{IN} input (Pin 20) or 5V if there is nothing connected to the User V_{IN} input.



Optically Isolated Input Schematic

Depending on how the LS9000 is mounted, either movement direction may be what is considered the Positive direction. There are two ways to reverse the direction of the LS9000's measurements:

- Modify the Direction Inversion setting with LaserTrak (or using the ["A" serial command](#))
- Connect 5-24V to the Measurement Direction Input

This input is normally not required on the LS9000, and is present for compatibility with existing LS4000 and LS8000 wiring. Changing the Direction Inversion setting with LaserTrak to invert the direction has the same effect as changing the state of this input.

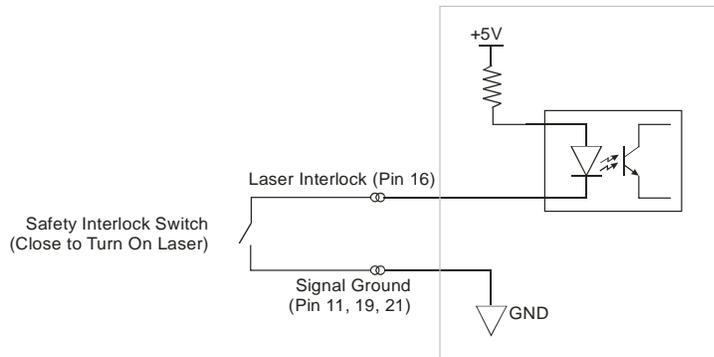
Note: If the Direction Inversion setting is set to "Reverse +/- Directions" and the Measurement Direction Input is high, they will cancel each other out and the LS9000 will operate in the default manner.

Direction Inversion Setting	Measurement Direction Input	LS9000 Direction
Normal	Low (Disconnected or 0v)	Normal
Normal	High (5-24V)	Reversed
Reversed	Low (Disconnected or 0v)	Reversed
Reversed	High (5-24V)	Normal

Laser Interlock (Pin 16)

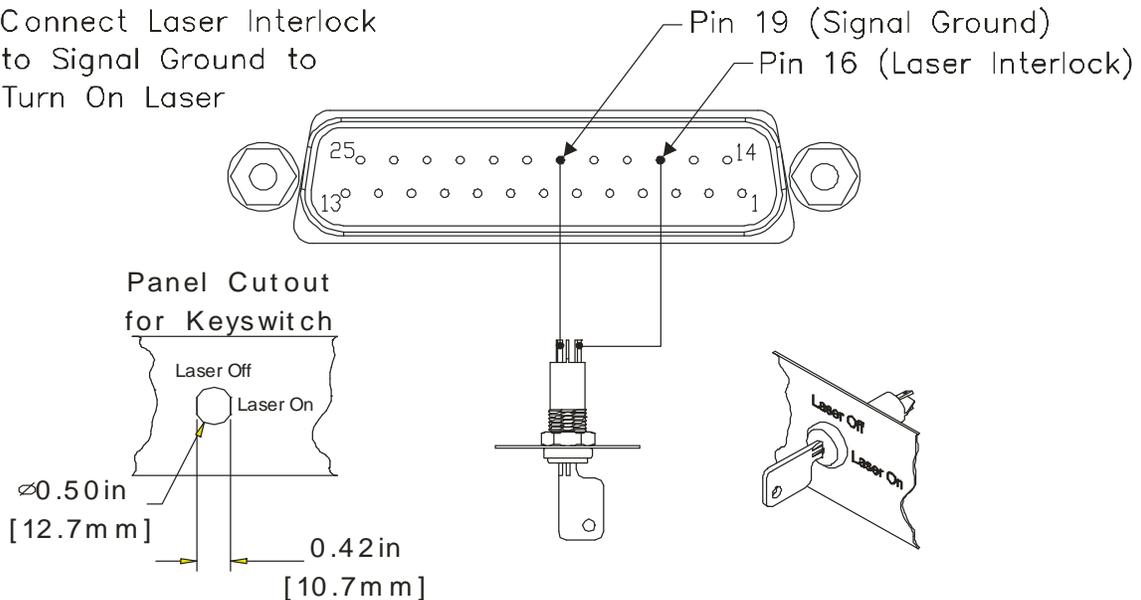
The Laser Interlock input will switch off the laser power when the connection to ground is broken. This is commonly used with external switches for laser safety. When the interlock pin is connected to ground, the laser is operational. When the interlock circuit is opened (break the connection to ground), power to the laser is switched off. The power to the rest of the LS9000 is not affected.

Note: To enable laser operation, connect the laser interlock pin (Pin 16) to ground (Pin 11, 19, or 21). There is a delay of several seconds from the time the Laser On light turns on to the time that laser radiation is emitted.



Laser Interlock Input Circuit

Connect Laser Interlock to Signal Ground to Turn On Laser

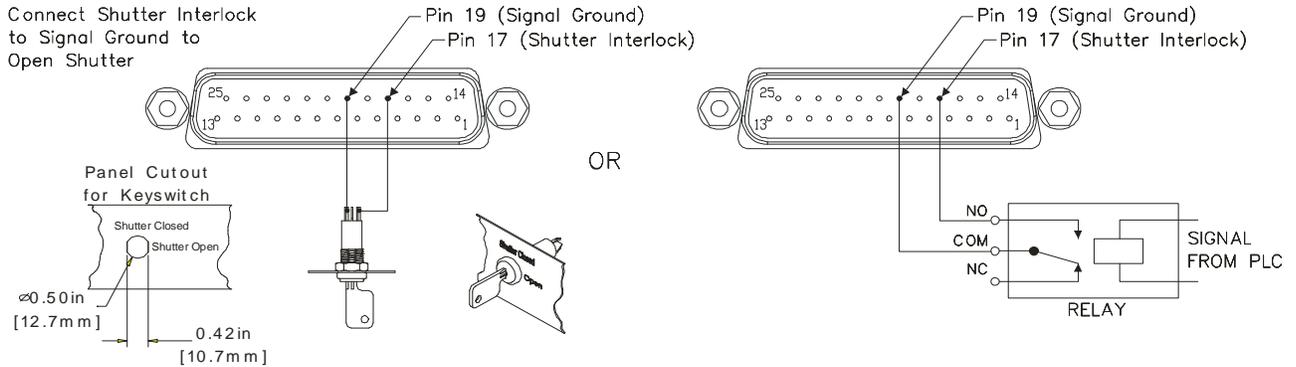


Laser Interlock Keyswitch Connection

Shutter Control (Pin 17)

All Class 3B laser products are required to have a shutter to terminate the laser beams before exiting the product. The LS9000 uses a spring-loaded rotary solenoid as a laser shutter. The spring-loaded action ensures that when power is not applied to the shutter circuit, the shutter remains closed.

Note: To open the shutter, connect the shutter control pin (Pin 17) to ground (Pin 11, 19, or 21).



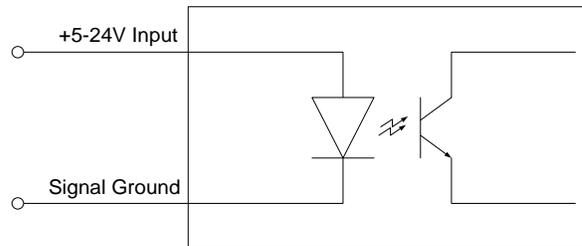
Shutter Interlock Examples

Length Reset Input (Pin 18)

This is an optically isolated input that can be used to externally control the Length Reset feature of the LS9000. The input requires a voltage high (5 to 24V) to activate. The input level should be the same as the voltage connected to the User V_{IN} input (Pin 20) or 5V if there is nothing connected to the User V_{IN} input.

The Length Reset input is used to reset the current length count to zero. This is the length that is reported over RS-232, RS-422, and Ethernet. The pulse outputs are not affected by this input.

This can also be accomplished through the ["R" command](#) of the serial command set.

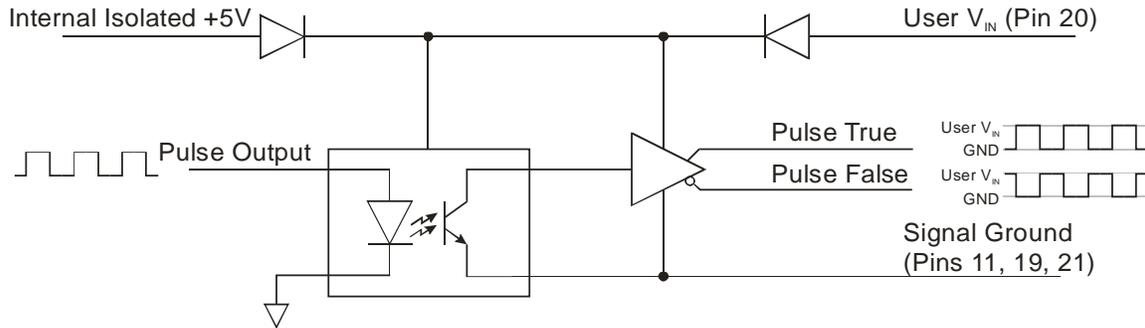


Length Reset Input Circuit

The Length Reset Input Action configuration setting affects how this input resets the length. The input can be configured to reset the length on level and edges. See the [Length Reset Input Action](#) command description for details.

User V_{IN} (Pin 20)

Voltage input for Isolated Pulse Outputs, and the Index Pulse Output. Connecting a voltage from 5-28VDC to this input allows you to control the pulse amplitude of the LS9000 Scaleable Pulse Outputs (Pins 15, 5, 6, 8), and the Index Pulse Output (Pins 22 and 23.) The voltage supplied will be the voltage level of the pulse outputs supplied by the LS9000. If a voltage is not supplied, the pulse outputs will be approximately 4.5V.



User V_{IN} Schematic

Index (Printer) Pulse Output (Pins 22-23)

Also referred to as a Once-Per-Rev (OPR) pulse, this output can be configured to output pulses at specified length intervals. This output can be used to control a cutter or a printer.

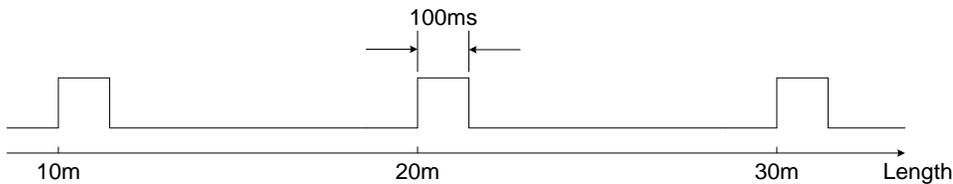
For example, if you use LaserTrak to set the “Index Pulse Every X m” setting to 10m, the gauge would output a single pulse every 10m of product movement.

The Index pulse will only trigger when the line is moving in the (+) direction. If the Index Pulse triggers at a certain length, and then the line backs up and passes that point again, the Index Pulse will not be repeated.

The Index Pulse is asserted for a configurable amount of time. This time can be configured by changing the [Index Pulse Length](#) setting.

Example:

- Index Pulse Length = 100ms
- Index Pulse Interval = 10m



Index Pulse Output Example

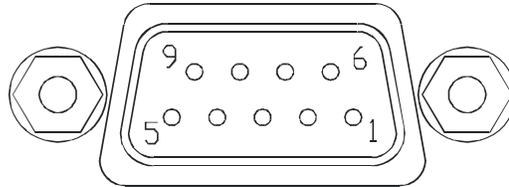
The Index Pulse Output can be reconfigured to output several different status outputs using the [Index Pulse Output Function](#) setting.

+24V_{DC} Power Input (Pins 24-25) and Power Grounds (Pins 12-13)

Two Power Input pins and two Power Ground pins are supplied to reduce voltage drop in long cables. Please see the [Connecting Power to the Gauge](#) section and [Appendix D](#) for details concerning power wiring. Pins 24 and 25 and pins 12 and 13 are internally connected in the LS9000.

DB9 Connector

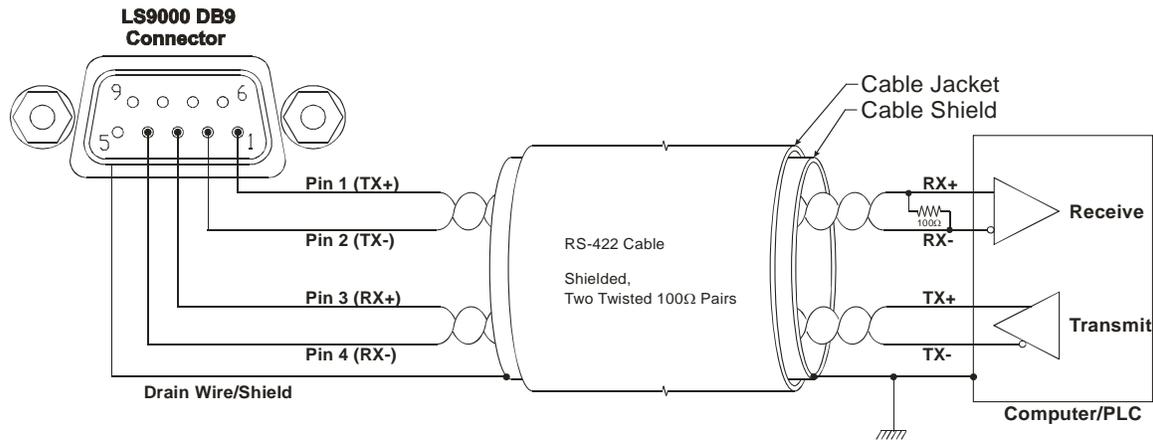
The 9-pin interface port contains the RS-422 interface pins for high speed, long distance communication with the LS9000, the Analog Output, and the Measurement Synchronization Input pins. The connector is a standard 9-Pin male D-Sub connector. It is shown below looking at the gauge's rear panel with the gauge baseplate down.



Pin	Description
1	RS-422 Transmit + (from LS9000 to host)
2	RS-422 Transmit - (from LS9000 to host)
3	RS-422 Receive + (from host to LS9000)
4	RS-422 Receive - (from host to LS9000)
5	Signal Ground for Inputs/Outputs/Serial
6	Analog Output Voltage
7	Analog Output Ground
8	Measurement Synchronization Input +
9	Measurement Synchronization Input -

RS-422 Transmit (+/-) and Receive (+/-) (Pins 1-4)

These pins comprise the RS-422 interface port. The RS-422 communications port can be used at speeds up to 230kbaud over long distances. The transmission cable should be a shielded, twisted pair cable. RS-422 uses balanced pairs for both transmission and reception, so the +/- lines for the Transmit and Receive pairs should be paired as shown. To minimize reflections, the transmit lines from the gauge should be terminated with a resistor matching the characteristic impedance of the cable (100Ω) as shown below. The cable shield or drain wire should be attached to the chassis ground at both ends of the cable. At the gauge end, a DB9 connector with a metal backshell should be used, and the cable shield should be terminated to the backshell. The cable jacket should be suitable for the environment to which the cable will be exposed.



RS-422 Serial Pinouts

Gauge DB9 Pin Number	Gauge Signal Description	Computer Pin Number	Computer Signal Description
1	RS422 Transmit +	varies	RS422 Receive + (B)
2	RS422 Transmit -	varies	RS422 Receive - (A)
3	RS422 Receive +	varies	RS422 Transmit + (B)
4	RS422 Receive -	varies	RS422 Transmit - (A)
5	Signal Ground	varies	Signal Ground

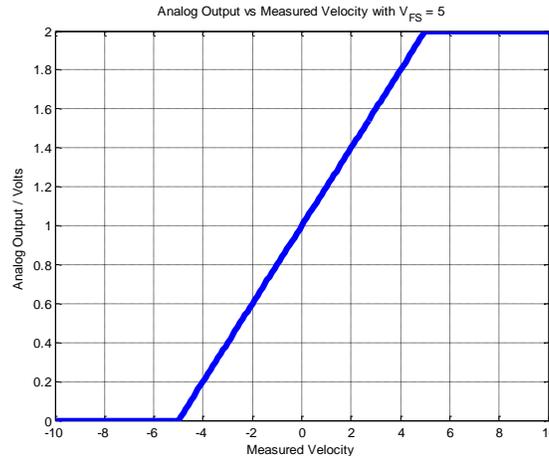
The computer RS-422 pinout can vary with the RS-422 card used. The signal descriptions listed above should be matched to the signal descriptions listed in the documentation provided with the RS-422 adapter.

Analog Output Voltage/Ground (Pins 6-7)

Analog Output Specifications	
Voltage Range	0-2V
Resolution	12-bit
Minimum ΔV (Step Size)	0.5mV
Load	1kΩ minimum
Filtering	0.1μF Capacitor Recommended across Output to Signal Ground

Analog velocity data can be obtained in a 0–2 V format. An optional selectable voltage/current output module which will convert the 0–2 V signal supplied by the gauge to all of the common voltage/current levels is available.

The analog output indicates both speed and direction. When the LS9000 is measuring a velocity of zero, the output sits at 1V. When the speed is negative, the voltage drops below 1V proportional to the speed until it reaches a minimum of 0V. When the speed is positive, the voltage increases above 1V until it reaches a maximum of 2V. The [Analog Full Scale Velocity](#) value can be set via serial commands or the supplied LaserTrak software.

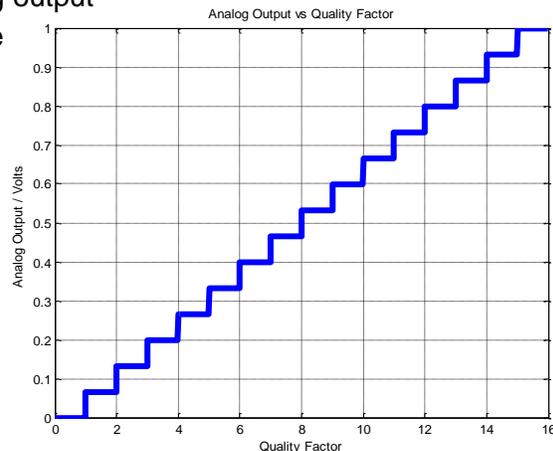


The LS9000's indicated velocity can be calculated with the following equation:

$$Velocity = \begin{cases} (Voltage - 1) \times V_{FS} & 0V < Voltage < 2V \\ \leq -V_{FS} & \text{when } Voltage = 0V \\ \geq V_{FS} & Voltage = 2V \end{cases}$$

Note that when the output voltage is at either limit, the exact velocity cannot be determined. If the exact velocity is always required, be sure to set the Full Scale Velocity setting to a value higher than what can normally be encountered.

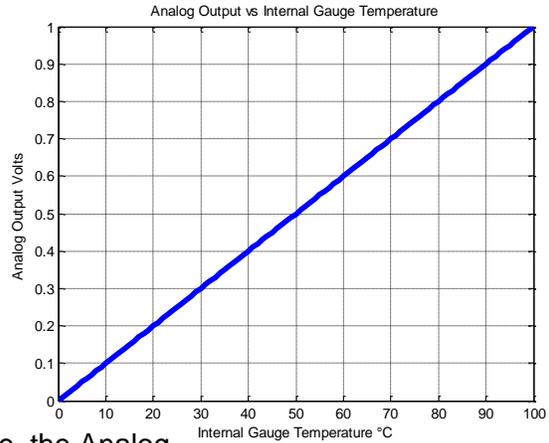
The analog port can also be configured to output the QF on a 0–1 V scale by setting the [Analog Full Scale Velocity](#) to zero using a serial command or LaserTrak software. In this case, the analog output reads 0V when the QF is 0 and 1V when the QF is 15.



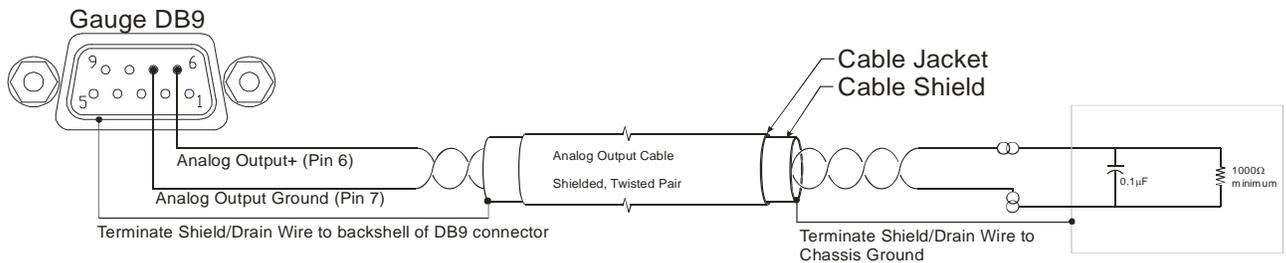
When the Analog Output is configured to output Quality Factor, the Quality Factor can be calculated with the following equation:

$QualityFactor = Voltage \times 15$

The analog port can also be configured to output the gauge internal temperature on a 0-1 V scale by setting the [Analog Full Scale Velocity](#) to one using a serial command or LaserTrak software. In this case, the analog output reads 0V when the gauge internal temperature is 0°C and 1V when the internal gauge temperature is 100°C.



When connecting to the Analog Output Voltage, the Analog Output Voltage and Analog Output Ground should be on a separate twisted pair inside of a shielded cable. Connect a 0.1 μF capacitor across the load end of the cable (the end opposite the gauge) to reduce noise caused by other signals in the cable. See the following wiring example:



Analog Output Wiring Example

Measurement Synchronization Input (Pins 8-9)

In many AGC applications, particularly mass flow control, it is desirable to synchronize the sampling periods of all gauges in the system. This is done by connecting an LS9000 I/O Module to each LS9000 in the system (for elongation), or by connecting the LS9000 gauges together in a daisy-chain configuration (for synchronization only.)

Using the LS9000 I/O Module (one I/O Module per LS9000) easily allows multi-channel synchronization and elongation measurement. The I/O Module has rear panel Sync connectors that can be connected to other I/O Modules for synchronization. For details about synchronizing multiple gauges using the LS9000 I/O Module, refer to the LS9000 I/O Module Instruction Handbook. For details about how to connect multiple LaserSpeed gauges together for synchronization, see the [Gauge-Gauge Synchronization](#) section.

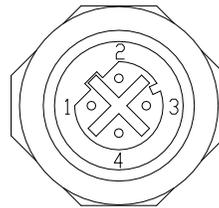
When two or more systems are synchronized, the speed *data* is synchronous, although there will be minor variations in the actual output times from one I/O Module to the next. This means that all processors sample over exactly the same time period, but due to minute differences in internal processing times, the output from each processor may arrive a few microseconds earlier or later than the outputs of the other I/O Modules.

M12 Ethernet Connector

The LS9000 Ethernet Connector is a Female, M12, D-Coded Ethernet connector compatible with most industrial Ethernet patch cables.

LS9000 M12 Connector Pinout

Pin	Description
1	Ethernet TX+ (from LS9000 to host/switch)
2	Ethernet RX+ (from host/switch to LS9000)
3	Ethernet TX- (from LS9000 to host/switch)
4	Ethernet RX- (from host/switch to LS9000)



Beta LaserMike offers a variety of Ethernet cables that can be used to connect the LS9000 to any RJ-45 network jack. Please see the Ethernet Cables section for a list. To connect directly to a computer, without using an Ethernet hub or switch, you must use a crossover patch cable.

Please see the [Ethernet Communication](#) section for details about the LS9000's Ethernet communication protocol.

LS9000 Interface Cables

DB25 Cables

These cables connect the LS9000 25-Pin connector, and are available in lengths from 3 to 50m. These cables are compatible with all LS4000, LS8000, and LS9000 LaserSpeed gauges. For cables compatible with the E/X models, see the [Heavy Industrial Cables](#) section.

Part Number	Length	Cable Description
240211-3M	3m (9.8 ft)	CABLE GAUGE-DB25/DB25 3M
240211-10M	10m (32.8 ft)	CABLE GAUGE-DB25/DB25 10M
240211-20M	20m (65.6 ft)	CABLE GAUGE-DB25/DB25 20M
240211-30M	30m (98.4 ft)	CABLE GAUGE-DB25/DB25 30M
240211-50M	50m (164 ft)	CABLE GAUGE-DB25/DB25 50M

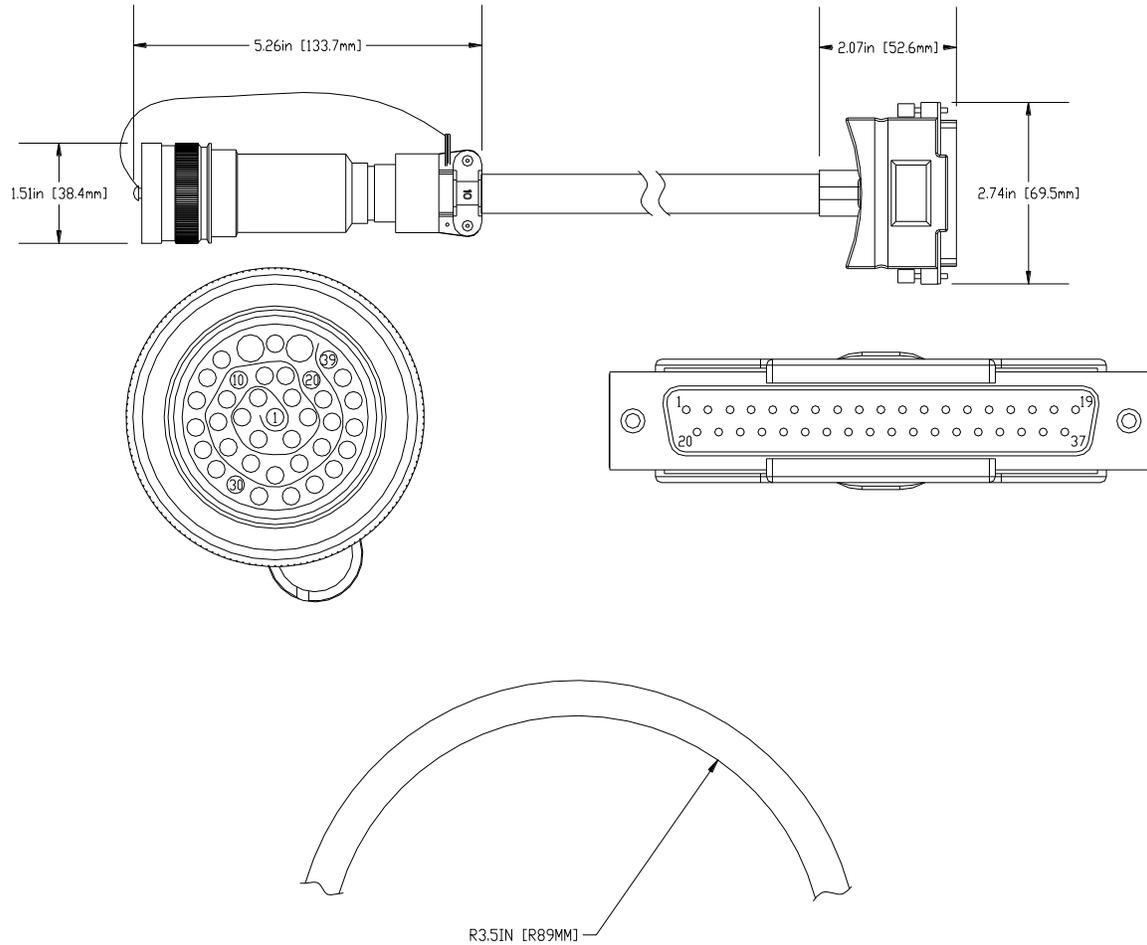
Ethernet Cables

These cables connect the LS9000 M12 Ethernet connector to any standard Ethernet RJ45 connection.

Part Number	Length	Cable Description
62458 ¹	2m (6.6 ft)	CABLE XOVER CAT5E M12 MALE TO RJ45 2M
62410-3M	3m (9.8 ft)	CABLE STRANDED CAT5E M12 MALE TO RJ45 - 3M
62410-10M	10m (32.8 ft)	CABLE STRANDED CAT5E M12 MALE TO RJ45 - 10M
62411-20M	20m (65.6 ft)	CABLE SOLID CAT5E M12 MALE TO RJ45 - 20M
62411-30M	30m (98.4 ft)	CABLE SOLID CAT5E M12 MALE TO RJ45 - 30M
62411-50M	50m (164 ft)	CABLE SOLID CAT5E M12 MALE TO RJ45 - 50M
62411-100M	100m (328 ft)	CABLE SOLID CAT5E M12 MALE TO RJ45 - 100M

¹ This is a crossover cable that can be used to connect the LS9000 directly to a PC. This cable should not be used if connecting to a hub/switch.

Heavy Industrial Cables



MINIMUM CABLE BEND RADIUS

LaserSpeed heavy industrial cables are designed for use in heavy industrial environments where high temperatures and heavy coolant spray are encountered. They have an extremely durable outer jacket, and are impervious to industrial lubricants, coolants, and solvents.

Never pull the cable by the connector. Always attach the pulling cable to the cable itself. Pulling the cable by the connector may damage the connector pins. The circular connector has a protective end cap that should be screwed over the cable pins when pulling through conduit, or any time the cable is disconnected from the LS9000.

The cable must be screwed onto the LS9000 connector until it fully seated—the yellow stripe on the LS9000 connector is not visible when the cable is fully tightened.

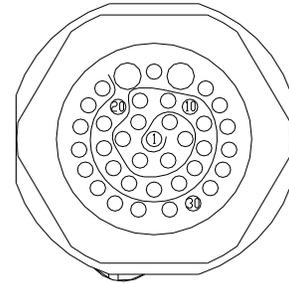
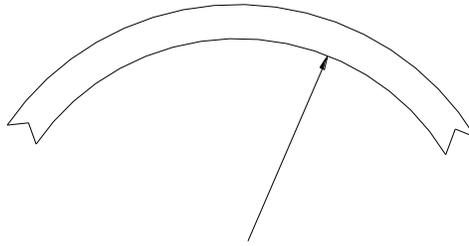
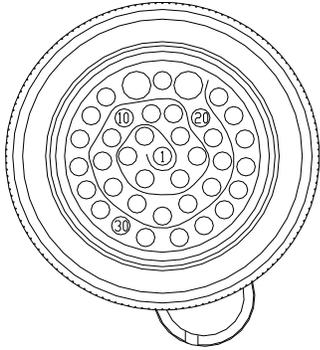
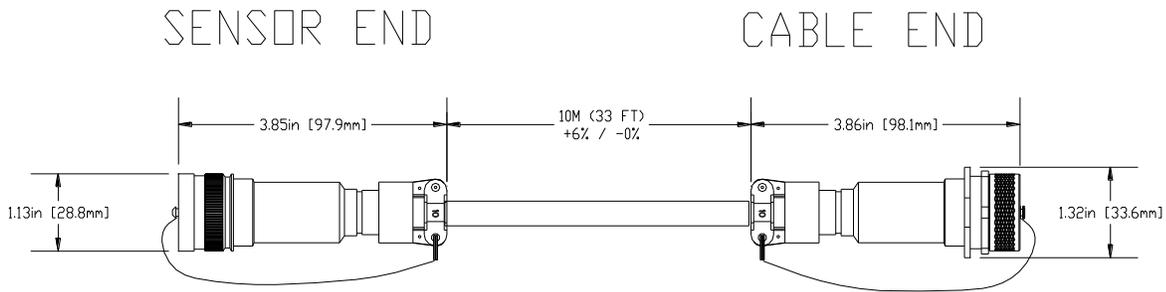
Part Number	Length	Cable Description
85277-10M	10m (32.8 ft)	CABLE LS3 E/X HSNG CIR/DB37 10M 90°C
85277-25M	25m (82 ft)	CABLE LS3 E/X HSNG CIR/DB37 25M 90°C
85277-50M	50m (164 ft)	CABLE LS3 E/X HSNG CIR/DB37 50M 90°C
85277-75M	75m (246 ft)	CABLE LS3 E/X HSNG CIR/DB37 75M 90°C
85277-100M	100m (328 ft)	CABLE LS3 E/X HSNG CIR/DB37 100M 90°C
85277-110M	110m (361 ft)	CABLE LS3 E/X HSNG CIR/DB37 110M 90°C
85277-120M	120m (394 ft)	CABLE LS3 E/X HSNG CIR/DB37 120M 90°C
85277-130M	130m (427 ft)	CABLE LS3 E/X HSNG CIR/DB37 130M 90°C
85277-140M	140m (459 ft)	CABLE LS3 E/X HSNG CIR/DB37 140M 90°C
85277-150M	150m (492 ft)	CABLE LS3 E/X HSNG CIR/DB37 150M 90°C
85277-160M	160m (525 ft)	CABLE LS3 E/X HSNG CIR/DB37 160M 90°C
85277-170M	170m (558 ft)	CABLE LS3 E/X HSNG CIR/DB37 170M 90°C
85277-180M	180m (591 ft)	CABLE LS3 E/X HSNG CIR/DB37 180M 90°C
85277-190M	190m (623 ft)	CABLE LS3 E/X HSNG CIR/DB37 190M 90°C
85277-200M	200m (656 ft)	CABLE LS3 E/X HSNG CIR/DB37 200M 90°C

Breakaway Cables

For mills where cobbles, fires, or other conditions may damage the LaserSpeed cable, a breakaway cable may be appropriate. If the breakaway cable is damaged, it can be replaced without having to replace the entire cable.

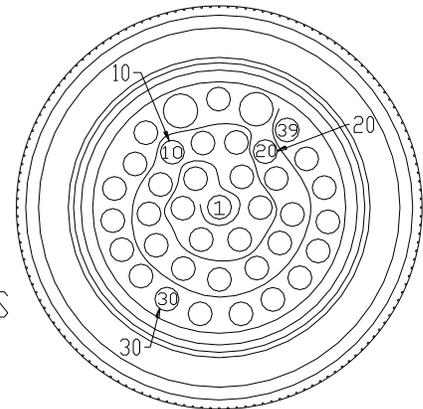
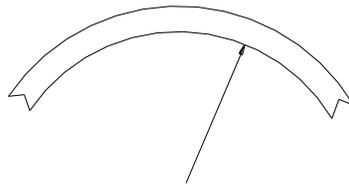
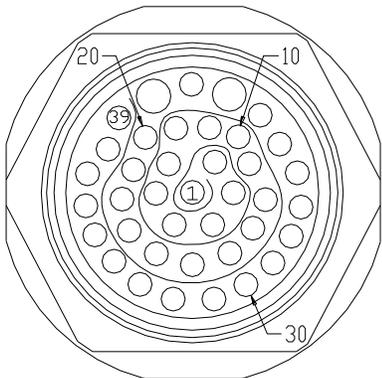
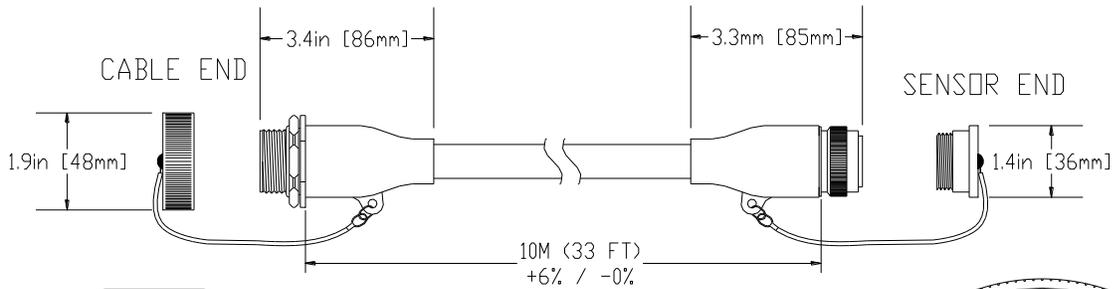
The LS9000 has both a high temperature and low temperature breakaway cable. The low temperature cable is rated to 90°C, and is made of the same construction as the Heavy Industrial Cable. The high temperature cable is rated to 250°C, and constructed of special high temperature conductors and insulation.

Part Number	Length	Cable Description
85305	10m (32.8 ft)	CABLE LS3 E/X LO TEMP BRKAWAY 10M 90°C
85281	10m (32.8 ft)	CABLE LS3 E/X HIGH TEMP BRKAWAY 10M 250°C



R3.5in [R88mm]
MINIMUM CABLE BEND RADIUS

Low Temperature Breakaway Cable



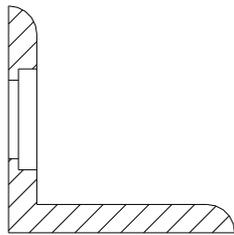
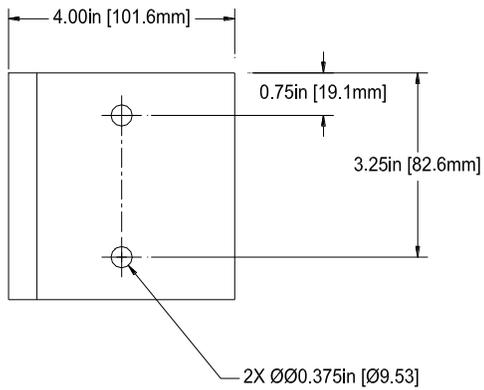
R3.5in [R88mm]
MINIMUM CABLE BEND RADIUS

High Temperature Breakaway Cable

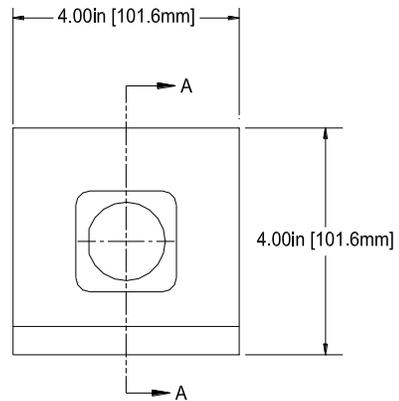
Breakaway Cable Mounting Bracket

Beta LaserMike Part #: 2306588

The breakaway cable end fastens to this heavy duty bracket to provide support for the connection between the breakaway cable and the main cable.



SECTION A-A



LS9000 Breakout Assemblies

For easy interfacing, Beta LaserMike offers several different I/O breakout kits that connect directly to LaserSpeed cables. These interface blocks are DIN rail mountable, or can be bolted into a cabinet. Four M5x16 hex head screws are included.

There are several different options available. The DB25 versions are compatible with standard LS9000 gauges, and the DB37 versions are compatible with the LS9000E/X gauges. Powered and unpowered versions of both configurations are available. Powered versions have a 24VDC 100W universal power supply with an input voltage range of 85-264VAC at 47-63Hz. The power supply can be connected to a standard IEC 320 power cord.

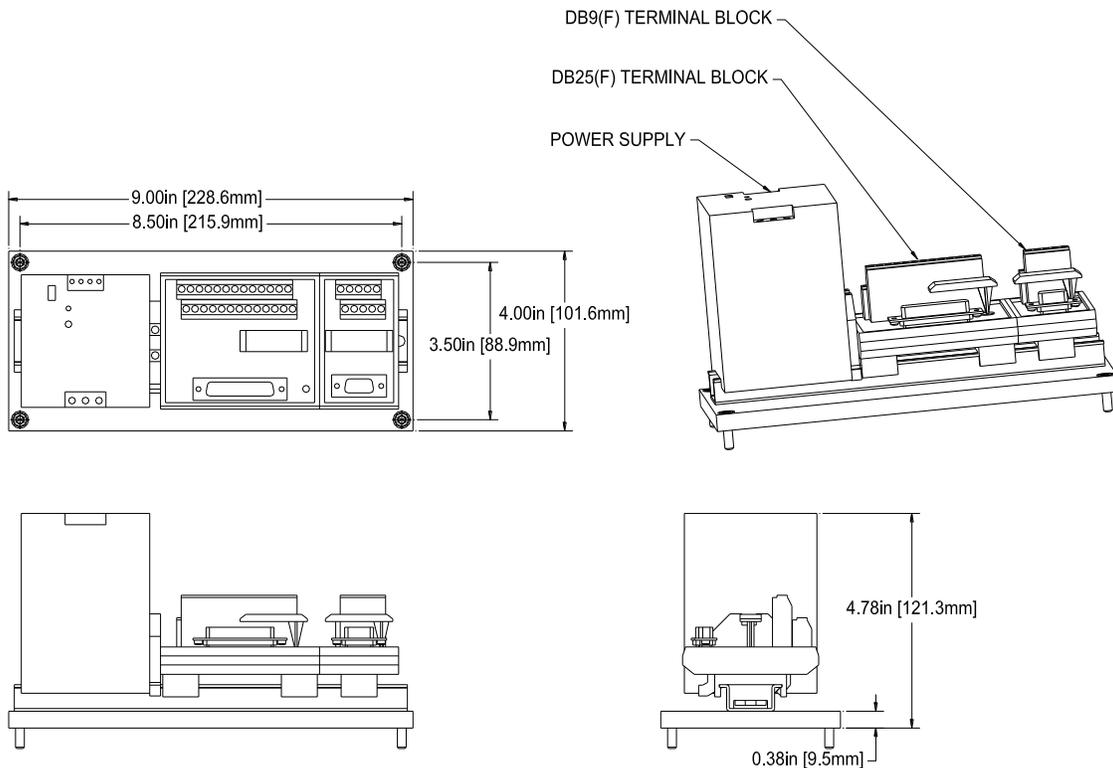
Model	Description	Compatible With	Base Size
85328	ASSY BREAKOUT DB25 LASERSPEED	LS9000	4" x 9" (102 x 229mm)
85329	ASSY BREAKOUT DB25 LASERSPEED POWERED	LS9000	4" x 9" (102 x 229mm)
85321	ASSY BREAKOUT DB37 LASERSPEED	LS9000E/X	4" x 12.5" (102 x 318 mm)
85322	ASSY BREAKOUT DB37 ETHERNET LASERSPEED	LS9000E/X	4" x 12.5" (102 x 318 mm)
85323	ASSY BREAKOUT DB37 LASERSPEED POWERED	LS9000E/X	4" x 12.5" (102 x 318 mm)
85324	ASSY BREAKOUT DB37 ETHERNET LASERSPEED POWERED	LS9000E/X	4" x 12.5" (102 x 318 mm)

DB25 Breakout Assemblies

Mounting Dimensions for: 85328, 85329

Part Number 85329 is shown in the drawing below. The mounting dimensions for 85328 and 85329 are identical, with the exception of the height. Part Number 85328 does not have a power supply, so it has a lower profile. Wiring is not shown in the drawing.

Part Number	Interface/Feature		
	LS9000 (DB25F)	RS-232 (DB9F)	Power Supply
85328	✓	✓	
85329	✓	✓	✓

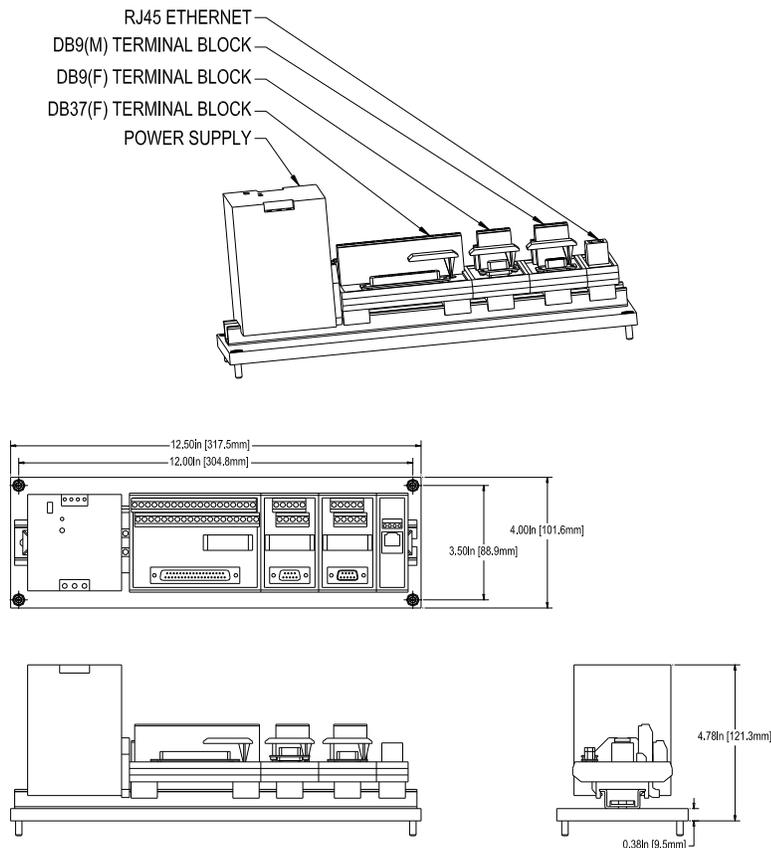


DB37 Breakout Assemblies

Mounting Dimensions for: 85321, 85322, 85323, 85324

Part Number 85324 is shown in the drawing below. The mounting dimensions for 85321, 85322, 85323, and 85324 are identical, with the exception of the height. Part Numbers 85321 and 85322 do not have power supplies, so they have lower profiles.

Part Number	Interface/Feature ²				
	LS9000E/X (DB37F)	RS-232 (DB9F)	RS-422 (DB9M)	Ethernet (RJ45)	Power Supply
85321	✓	✓	✓		
85322	✓	✓	✓	✓	
85323	✓	✓	✓		✓
85324	✓	✓	✓	✓	✓



Breakout Assembly Pinouts

The pinouts for the breakout assembly connectors are listed below. Because the LaserSpeed cable connects directly to the DB25/DB37 cable, the pinout for this connector is identical to the gauge cable pinout. See the [Connecting to Outputs](#) section for details.

RS-232 Connector

This Female DB9 connector can be connected to any PC serial port using a straight-through serial cable with a male connector on one end and a female connector on the other end. A null modem is not required.

Pin	Description	DB25/DB37 Pin
2	RS-232 Transmit (from LS9000 to host)	1
3	RS-232 Receive (from host to LS9000)	2
5	Signal Ground	19

RS-422 Connector

This Male DB9 connector can be connected to an RS-422 input on a PLC, or an RS-422 converter connected to a PC. Because there is no standard pinout for RS-422, you may wish to rewire this terminal block to match your cable.

Pin	Description	DB37 Pin
1	RS422 Transmit + (from LS9000 to host)	26
2	RS422 Transmit – (from LS9000 to host)	27
3	RS422 Receive + (from host to LS9000)	28
4	RS422 Receive – (from host to LS9000)	29

² In this table, an 'F' suffix indicates a Female connector, and an 'M' suffix indicates a Male connector.

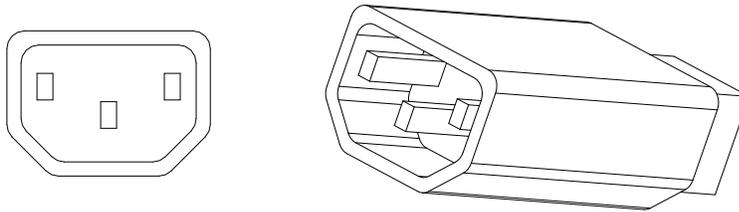
Ethernet Connector

This RJ45 connector can be connected to any Ethernet hub or switch. A crossover cable is not required when connecting to a hub or switch, but *is* required if connecting directly to a PC.

Pin	Description	DB37 Pin
1	Ethernet TX+	34
3	Ethernet TX-	35
2	Ethernet RX+	36
6	Ethernet RX-	37

Breakout Assembly A/C Power Connector

The powered versions of the breakout assembly have a "kettle plug" style power connector (IEC 320 sheets C13-14.) This power connector is the most common in the world, and can be used with most line cords.



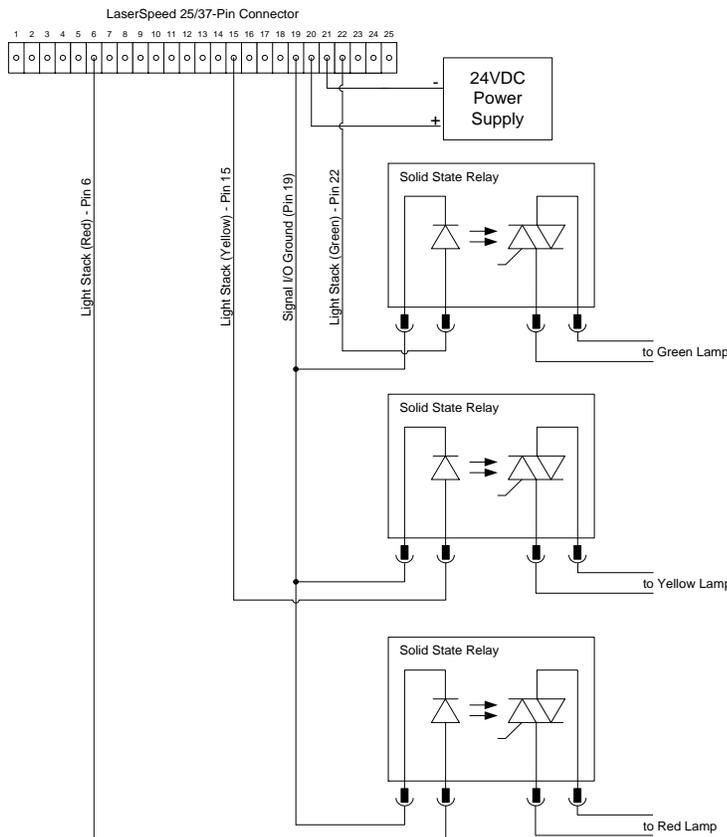
Application Interfaces

Light Stack Interface

The LS9000 User Scaleable Pulse Outputs and Index Pulse output can be reconfigured and connected to a light stack in order to indicate the current state of the laser in order to warn people in the area of laser radiation. The pulse outputs can be reconfigured into a light stack interface by setting the following settings:

Setting	Value	Command
Index Pulse Output Function	Light Stack (Green)	#9<CR>
User Scaleable Pulse Output Configuration	Light Stack (Yellow/Red)	\$L9<CR>

The outputs can then be connected to solid state relays in order to drive a light stack as shown below. This will provide a contact closure for each lamp. The maximum current that can be driven by this interface will depend on the selected relay.



The LS9000 operates the light stack in the following manner:

Light Stack Lamp	Meaning	Laser Radiation Emitted?
Green	Laser is Off	No
Yellow	Laser is On Shutter is Closed	No
Red	Laser is On Shutter is Open	Yes

The light stack should be placed in a conspicuous location near the gauge so that anyone who may be exposed to laser radiation can easily look at the light stack to see gauge is emitting laser radiation. The gauge also has an indicator light labelled "LASER ON" that indicates when the laser is turned on.

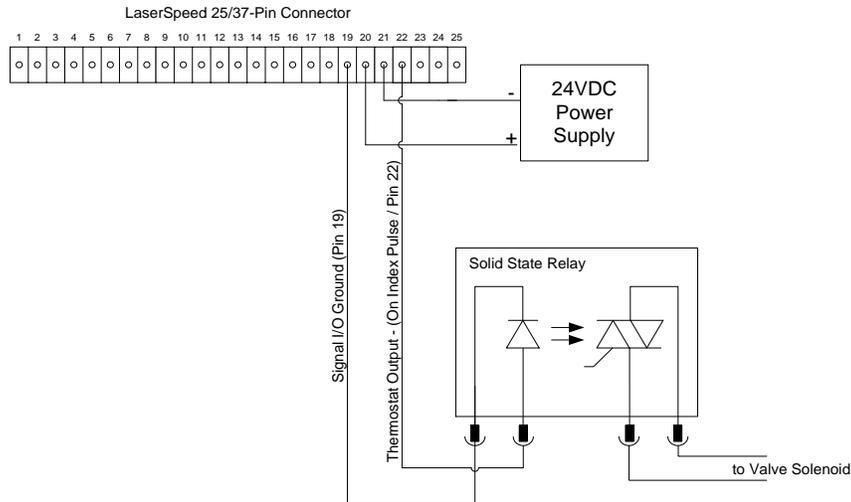
Thermostat Interface

In order to extend the ambient temperature range of LaserSpeed gauges, you can provide water or air cooling/heating. This is often accomplished by connecting the gauge to a recirculating heater/chiller, but can also be accomplished by using the gauge's thermostat output. LaserSpeed gauges monitor their internal temperatures, and can provide an output indicating when cooling/heating is required. This output can be connected to a valve or a PLC in order to control the flow of coolant. The thermostat output is available as an alternate configuration of the Index Pulse Output Function, the High Speed Pulse Output (Phase B), and the User Scaleable Pulse Output (Phase B.)

Output	How To Configure	Output Pin	Voltage Level
Index Pulse	Set Index Pulse Output Function to <i>Thermostat Output</i>	DB25/DB37 pin 22	5-24V, depending on User Input Voltage
High Speed Pulse	Set High Speed Pulse Output Configuration to either: System Ready/Thermostat Output or Valid/Thermostat Output	DB25/DB37 pin 7 & DB25/DB37 pin 9	RS-422 Output (2V-5V Differential)
User Scaleable Pulse	Set User Scaleable Pulse Output Configuration to either: System Ready/Thermostat Output or Valid/Thermostat Output	DB25/DB37 pin 6	5-24V, depending on User Input Voltage

The Thermostat Output turns on (voltage high) when the internal gauge temperature rises above 40°C, and turns off when the internal gauge decreases below 35°C.

The output can be connected to an electrically operated valve as shown.



Index Pulse & Length Thresholds

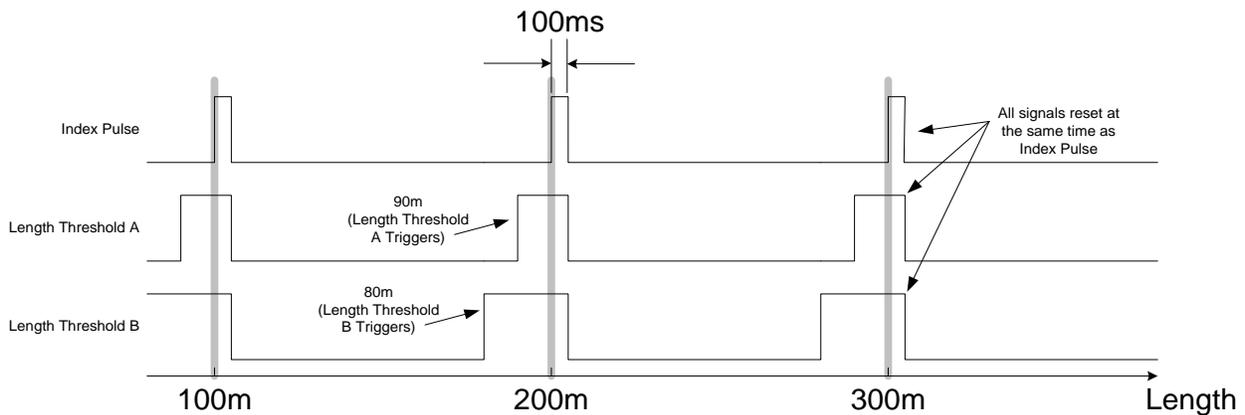
The Index Pulse and Length Thresholds can be used to control a cutter and provide pre-cut queues to the process control system so, for example, the line can be slowed prior to a cut. The Index Pulse is configured to trigger at a specified length interval, and the Length Thresholds can be configured to trigger at preset lengths before the Index Pulse triggers. The Length Threshold outputs remain high until the Index Pulse triggers and resets. The index pulse automatically resets the Length Threshold outputs—no external wiring is required.

Another way to reset these outputs is to set the Index Pulse Setting to a high value and reset the threshold outputs by asserting the Length Reset Input.

The Length Thresholds are available as an alternate output function of the [User Scaleable Pulse Output](#).

Example:

Setting	Value
Index Pulse Setting	100 m
Index Pulse Length	100 ms
Length Threshold A	90 m
Length Threshold B	80 m



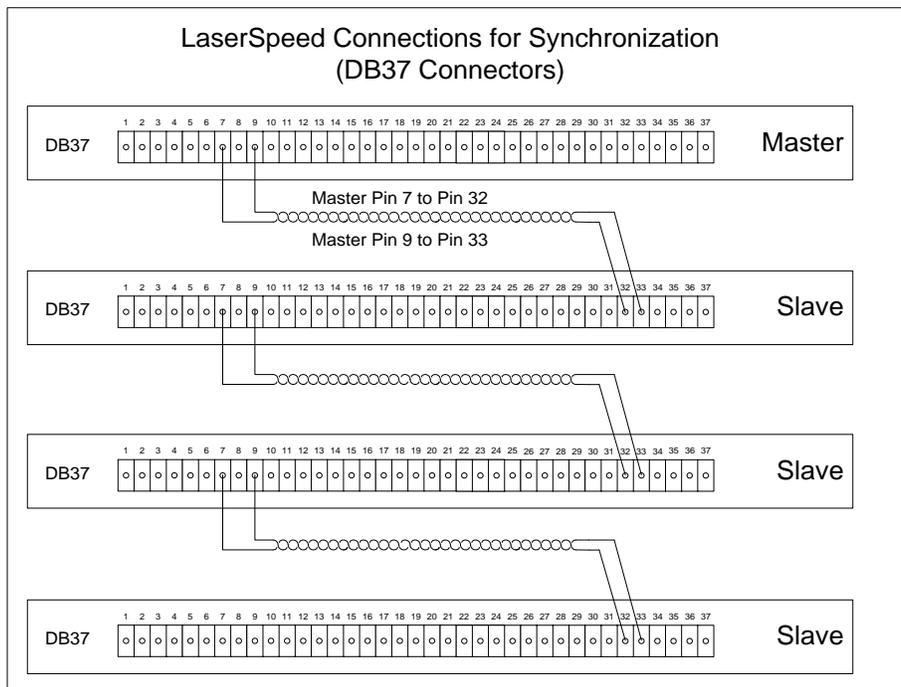
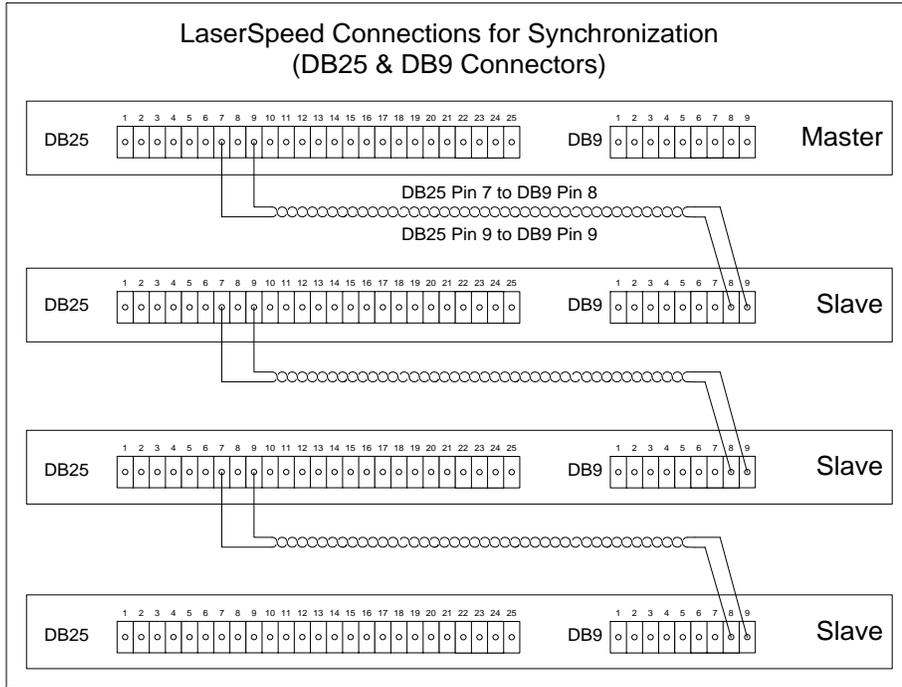
Gauge-Gauge Synchronization

LaserSpeed LS9000 and LS8000 gauges can be synchronized so that their sampling periods are synchronized, and so they update their outputs at the same time.

The simplest method for synchronizing gauges is to connect each gauge to a LaserSpeed I/O module and connect the I/O Modules' synchronization connects together. The I/O Modules will automatically synchronize the gauges and calculate elongation, which can be output in a variety of different ways.

Another method for synchronization is to reconfigure the gauges' High Speed Pulse Output ports and connect the gauges together in a daisy-chain configuration. The gauges will synchronize to each other, but will not calculate elongation. If an elongation calculation is required, the RS232, RS422, or Ethernet output data from each gauge must be collected and calculated in an external PLC or computer.

To configure the High Speed Pulse Output to output the synchronization signal, use LaserTrak to set the [High Speed Pulse Config](#) option "**A= Pulse Phase A, B= Sync Out**". This will replace the pulse output phase B with the synchronization output, and will leave Phase A available for connection to a counter.



Banner D10 Through Beam Switch



Configuration Notes:

- LaserSpeed [Material Present Input Mode](#) should be set to *External Active Low*
- For One Banner sensor set module to Dark
- For Two banner sensors set both modules to Light
- If you are using the screw on lens extender then it must be on the transmit side (not on the receive side)
- To change the settings hold both the + and – buttons down at the same time
- (-) button advances to the next selection
- (+) button cycles through the options

D10 Settings

- lo for light or do for dark (One sensor do, Two sensors lo)
- t 0 (for time delay of 0)
- Set Display Selection to 1234 (not 123P)
- SHS (for Super High Speed)

Note: To put modules in Dynamic mode (hold +button to teach, you must move product through sensors a few times. The sensor should say pass if acceptable with values of 500+ being excellent)

Single Through Beam

Signal	D10	LaserSpeed
Power (+12 v to +24v)	Brown	See Note
Material Present	White	10
Signal Ground	Blue	11
Signal Ground	Gray	11
N/A	Black	N/A
N/A	Pink	N/A

Notes:

- You can power the banner switch from the LaserSpeed power supply (pin 25) but you will need to connect pins 11 and 12 on the LaserSpeed breakout together.
- Use with a LaserSpeed 4000-2, 8000-2, 8000-3 or 9000-3
- See the [Connecting Material Present Switches](#) section for wiring
- Program the LaserSpeed for material present “external – active high”
- Program the D10 module for Super High Speed output
- You may have to teach the D10 light and dark levels (refer to D10 manual)

Dual Through Beam (uses two D10 modules)

Signal	D10	LaserSpeed
Power (+12 v to +24v)	Brown	See Note
Material Present	White	10
Signal Ground	Blue	11
Signal Ground	Gray	11
N/A	Black	N/A
N/A	Pink	N/A

Notes:

- You can power the banner switch from the LaserSpeed power supply (pin 25) but you will need to connect pins 11 and 12 on the LaserSpeed breakout together.
- Use with a LaserSpeed 4000-2, 8000-2, 8000-3 or 9000-3
- See the [Connecting Material Present Switches](#) section for wiring
- Program the D10 module for Super High Speed output
- Program the LaserSpeed for material present “external – active low”
- You may have to teach the D10 light and dark levels (refer to D10 manual)
- The distance between the switch pairs needs to be added to the length reported by the LaserSpeed

Banner Retroreflective Switch (Picodot)



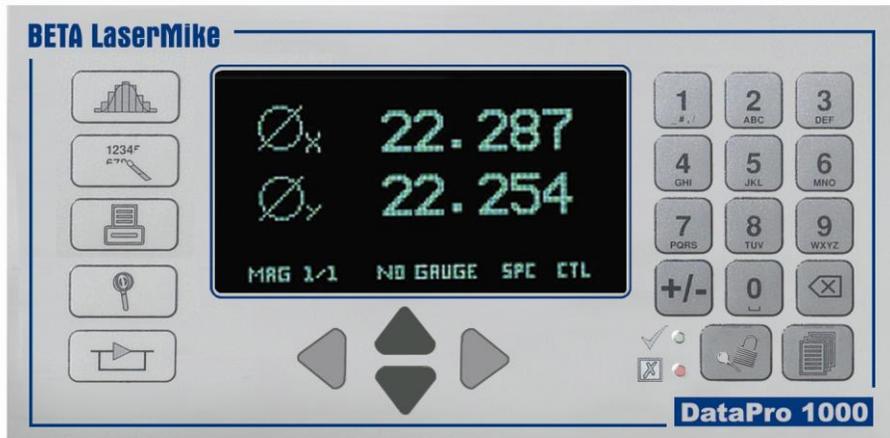
Pinout

Signal	PD45	LaserSpeed
Power (+10 v to +30v)	Brown	See below
Material Present	White	10
Signal Ground	Blue	11
Pullup (4.7K)	White (LS pin 10)	24
Laser enable	Grey	11

Notes:

- You can power the banner switch from the LaserSpeed power supply (pin 25) but you need to connect pins 11 and 12 on the Laserspeed breakout together.
- Use with a LaserSpeed 4000-2, 8000-2, 8000-3 or 9000-3
- Program the LaserSpeed [Material Present Input Mode](#) to “external – active high”

DataPro 1000



Quadrature Pinout

Signal	DP1K	LaserSpeed
Signal A	36	15
Signal A-	34	4
Signal B	32	6
Signal B-	30	8
Signal Ground	25	11
User Voltage	27	20

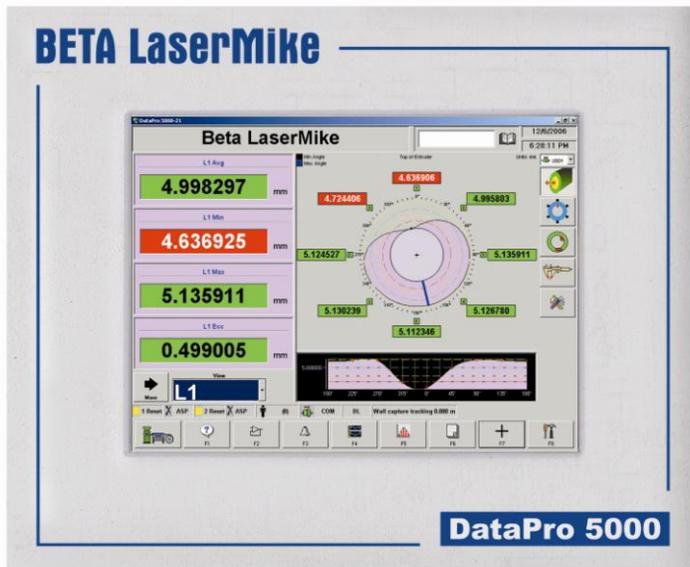
Pulsed Pinout

Signal	DP1K	LaserSpeed
Signal A	28	15
Signal A-	26	4
Signal Ground	25	11
User Voltage	27	20

Notes

- Configure the LaserSpeed pulse per unit length
- Remove jumpers JL6, JL7, JL10 and JL11 if required in differential-input configuration

DataPro 5000 BB



Quadrature Pinout

Signal	DP5K	LaserSpeed
Signal A	22	15
Signal A-	23	4
Signal B	24	6
Signal B-	25	8
Signal Ground	28	11
User Voltage	29	20

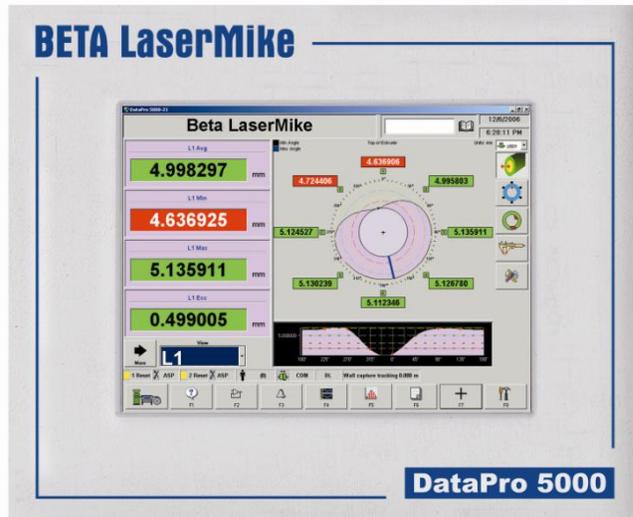
Pulsed Pinout

Signal	DP5K	LaserSpeed
Signal A	5	15
Signal A-	23	4
Signal Ground	28	11
User Voltage	29	20

Notes:

- Configure the LaserSpeed pulse per unit length

DataPro 5000 DN



Quadrature Pinout

Signal	DP5K	LaserSpeed
Signal A	J1-1	15
Signal A-	J1-2	4
Signal B	J2-1	6
Signal B-	J2-2	8
Signal Ground	12	11
User Voltage	25	20

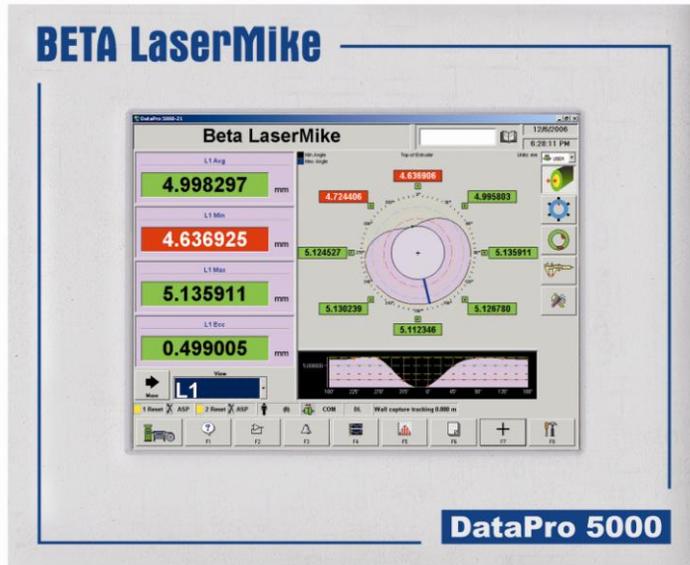
Pulsed Pinout

Signal	DP5K	LaserSpeed
Signal A	J3-1	15
Signal A-	J3-2	4
Signal Ground	12	11
User Voltage	25	20

Notes:

- Configure the LaserSpeed pulse per unit length

DataPro 5000 DN – Beckhoff I/O



Quadrature Pinout

Signal	KL5101-A	LaserSpeed
Signal A	(KL5101-A) 1	15
Signal A-	(KL5101-A) 5	4
Signal B	(KL5101-A) 2	6
Signal B-	(KL5101-A) 6	8
Signal Ground	(DP5K I/O) 12	11
User Voltage	(DP5K I/O) 25	20

Pulsed Pinout

Signal	KL5111-A	LaserSpeed
Signal A	(KL5111-A) 5	15
Signal Ground	(DP5K I/O) 12	11
User Voltage	(DP5K I/O) 25	20

Notes:

- Configure the LaserSpeed pulse per unit length

Domino A Series



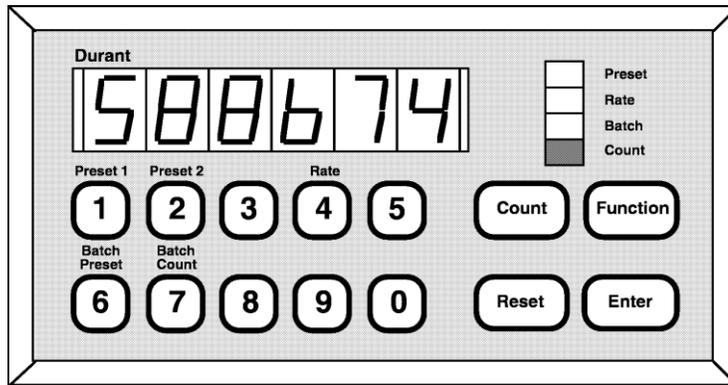
Pinout

Signal	Domino A200	LaserSpeed
Signal A	2	15
Print Go	3	22
Signal Ground	1	11
User Voltage	4	20

Notes:

- Configure the LaserSpeed for the appropriate pulse per unit length. The index pulse should be set to trigger at the appropriate rate (every 2 feet, every 1 meter, etc), and with a 20 ms pulse width.
- On the Domino A-Series printer, the Strobe Divide should be set to 1.
- There are two ports that are in parallel so it doesn't matter which one is used. The other port would not be used. The printer should be set for EXTERNAL print and the REPEAT PRINTING should be turned off.

Durant President Series



Quadrature Pinout

Signal	Durant	LaserSpeed
Signal A	14	15
Signal B	10	6
Signal Ground	12	11
User Voltage	20	20

Pulsed Pinout

Signal	Durant	LaserSpeed
Signal A	14	15
Signal Ground	12	11
User Voltage	20	20

Notes:

- Configure the LaserSpeed pulse per unit length
- Set scaling in the Durant counter
- Set count mode in the Durant (single, quad, quad x2...)

Durant President Settings	
Func #	Value
5	0.001
60	2
62	1
63	1
64	0.6000.0
LaserSpeed must be configured for 1000 pulses per unit (ft or m)	

Hengstler 723.1



Quadrature Pinout

Signal	Hengstler	LaserSpeed
Signal A	30	15
Signal B	29	6
Signal Ground	31	11
User Voltage	32	20

Pulsed Pinout

Signal	Hengstler	LaserSpeed
Signal A	30	15
Signal Ground	31	11
User Voltage	32	20

Notes:

- Configure the LaserSpeed pulse per unit length
- Set scaling in the Hengstler counter
- Set count mode in the Hengstler counter (single, quad, quad x2...)

Imaje S4/S8

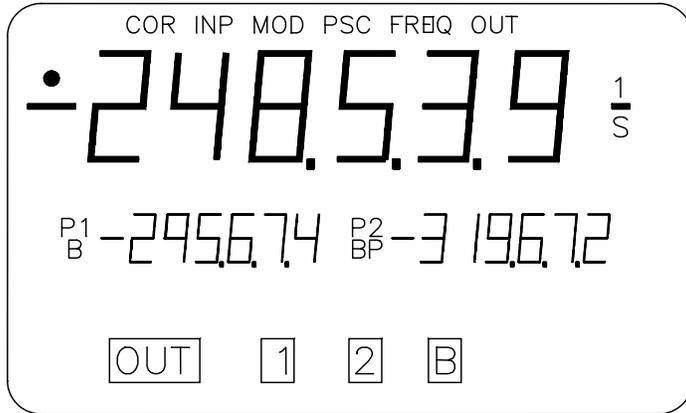
Pinout

Signal	Imaje S4/S8	LaserSpeed
Signal A	T1-8	8
Print Go	T1-4	22
Signal Ground	T1-1 and T1-3	11
User Voltage	T1-7	20

Notes:

- The programmable pulse output of the LaserSpeed needs to be set to 5000 or 10000 pulses/m depending on the setting in the Imaje printer.
- The Index Pulse Output from the LaserSpeed needs to be set to 1 pulse per meter.

MI800



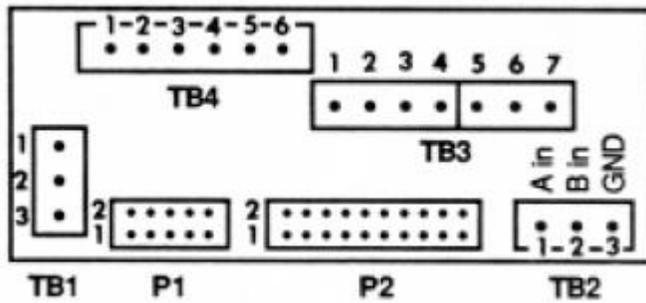
Quadrature Pinout

Signal	MI800	LaserSpeed
Signal A	B	15
Signal B	C	6
Signal Ground	A	11
User Voltage	D	20

Notes:

- Configure the LaserSpeed pulse per unit length

Newport P6000A



Pulsed Pinout

Signal	Newport	LaserSpeed
Signal A	TB2 1	15
Signal Ground	TB2 3	11
User Voltage	P2 8	20

Notes:

- Configure the LaserSpeed pulse per unit length
- Set scaling in the Newport counter
- Set count mode in the Newport counter (single, quad, quad x2...)

Red Lion PAXI



Quadrature Pinout

Signal	PAXI	LaserSpeed
Signal A	5	15
Signal B	6	6
Signal Ground	4	11
User Voltage	3	20

Pulsed Pinout

Signal	PAXI	LaserSpeed
Signal A	5	15
Signal Ground	4	11
User Voltage	3	20

Notes:

- Configure the LaserSpeed pulse per unit length.
- Set scaling in the PAXI.
- Set count mode in the PAXI (single, quad, quad x2...).

Siemens Counter Module 450-1



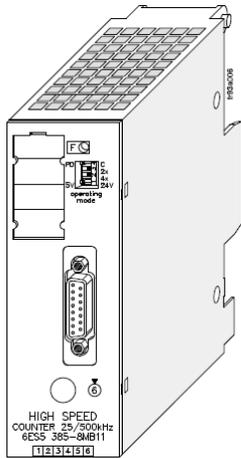
Quadrature Pinout

Signal	450-1	LaserSpeed
Signal A	23	15
Signal B	24	6
Signal Ground	26	11
User Voltage	28	20

Notes:

- Configure the LaserSpeed pulse per unit length
- Set scaling in the 450-1

Siemens Counter Module 6ES5 385-8MB11



Quadrature Pinout

Signal	Siemens	LaserSpeed
Signal A	7	15
Signal A-N	6	4
Signal B	9	6
Signal B-N	10	8
Signal Ground	3	11
User Voltage	1	20

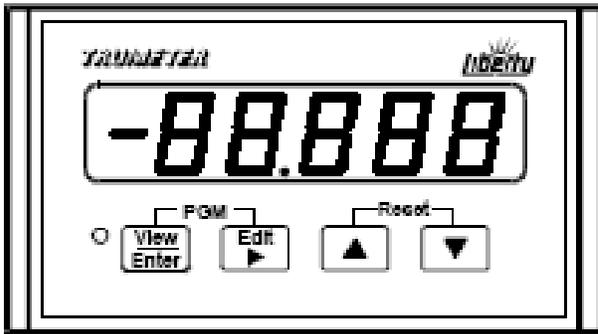
Pulsed Pinout

Signal	Siemens	LaserSpeed
Signal A	7	15
Signal A-N	6	4
Signal Ground	3	11
User Voltage	1	20

Notes:

- Configure the LaserSpeed pulse per unit length
- Set scaling in the Siemens counter
- Set count mode in the Siemens counter (single, quad, quad x2...)

TrueMeter



Quadrature Pinout

Signal	TrueMeter	LaserSpeed
Signal A	3	15
Signal B	2	6
Signal Ground	1	11
User Voltage	4	20

Pulsed Pinout

Signal	TrueMeter	LaserSpeed
Signal A	3	15
Signal Ground	1	11
User Voltage	4	20

Notes

- Configure the LaserSpeed pulse per unit length
- Set scaling in the TrueMeter counter
- Set count mode in the TrueMeter counter (single, quad, quad x2...)

LaserTrak Software

LaserTrak® is a Windows®-based software program, which allows you to acquire and display the Length, Velocity, Quality Factor, and Gauge Status in real time. The LaserTrak software configures the respective gauge's operating parameters, displays data, and collects data, which can be stored to a computer hard drive. This LaserSpeed series of non-contact speed and length gauges provide a set of versatile tools that are applicable for a wide variety of process measurement schemes. LaserTrak allows you to take full advantage of this versatility in a straightforward, easy to understand manner.

There are several features available with the LaserTrak software. LaserTrak mimics a chart recorder output on the screen and monitor the speed, length and Quality Factor in real time and presents a time history depiction of the data. LaserTrak can acquire and store data, and load and display stored data from a previously acquired data file.

LaserTrak for Windows

Note: LaserTrak Version 4.0 or later must be used with the LS9000 gauge.

Installing the LaserTrak Software

This section includes the information you need to install and begin using your copy of LaserTrak:

System Requirements

- 500 MHZ Pentium Computer Minimum (2 GHz Pentium Computer recommended)
- Windows 98, NT, 2000, XP or Win7 (Windows 2000 or XP recommended)
- 256 MB RAM
- 15" Monitor or bigger
- 50 MB of Hard Drive Space

®Windows 98, NT 2000, XP and Windows 7 are registered trademarks of Microsoft Corporation.

Software Installation Procedure

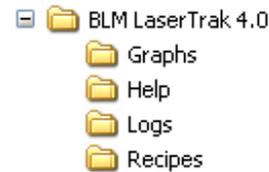
Complete the following steps to install the LaserTrak software:

- 1) Insert the LaserTrak for Windows Setup CD into your CD-ROM drive.
- 2) From the Start menu select Run.
- 3) Browse to the LaserTrak_4_Setup.exe program on the CD-ROM Drive and select it.
- 4) Press OK.

The setup program installs the software into the default directory “**c:\Program Files\BLM LaserTrak 4.0**”. The install program gives you a chance to accept the default directory or install it in a directory of your own choosing.

For users running Windows 7, it is strongly

recommended that LaserTrak be installed in the root of the C: drive “**C:\BLM LaserTrak 4.0**”.



The setup program does the following:

- 1) Creates a folder and group for the LaserTrak program and files and puts the LaserTrak program icon into your desktop.
- 2) BLM LaserTrak 4.0 is added to the Windows **Start→Programs** menu under **BLM LaserTrak 4.0**



Starting LaserTrak

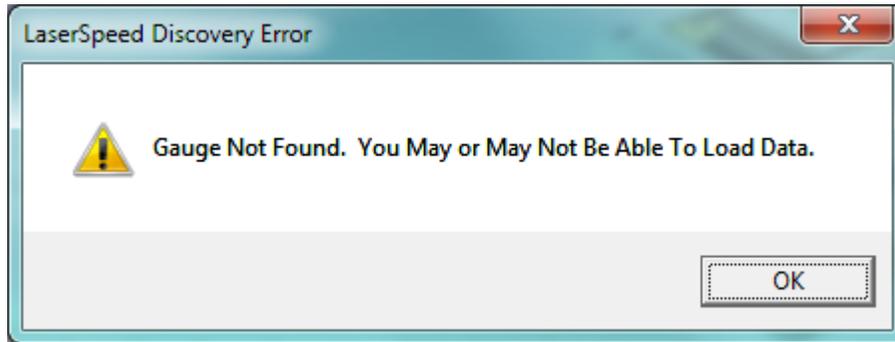
Once the LaserTrak software has been installed the LaserTrak software will automatically start. If LaserTrak does not automatically start, go to the Start Menu and click on the LaserTrak program...



... or double click the LaserTrak Icon on your desktop.



Note: Make sure that the LaserSpeed gauge is connected to the computer via RS232, RS422 or Ethernet before starting the LaserTrak software. The first thing the LaserTrak software does is establish communication between the LaserSpeed gauge and the computer. If no gauge is connected, communication will not be established and you will see the following screen.

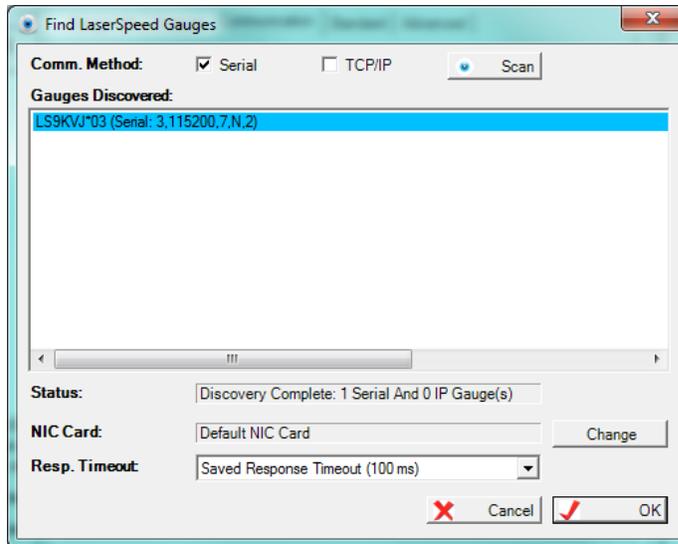


If you get the Gauge Not Found message, you can still run LaserTrak by recalling and displaying stored data.

LaserTrak will display the following screen when starting up if communication has been established between the gauge and the software.



The Communication screen will then be displayed showing the COM port and BAUD rate and communication parameters it found to communicate with the gauge.



Click the OK button to go to the Chart Recorder Screen. The Chart Recorder screen will acquire Speed, Length, Quality Factor and Status data from the LaserSpeed gauge and display it. The Speed and Quality Factor will be displayed graphically and the Length and Status information will be displayed in a table format.



Press the Start Readings button to acquire data from the gauge. The Start Readings button will change to Stop Readings button. Press the Stop Readings button to stop acquiring data from the gauge. The graph, Graph Info and Gauge Status will only be active when acquiring data from the gauge, and the Stop Reading Button is being displayed. All the data will be frozen on the Chart Recorder screen when the Stop Readings button is pressed and the button changes back to Start Readings again.

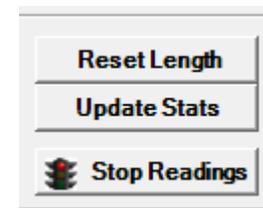
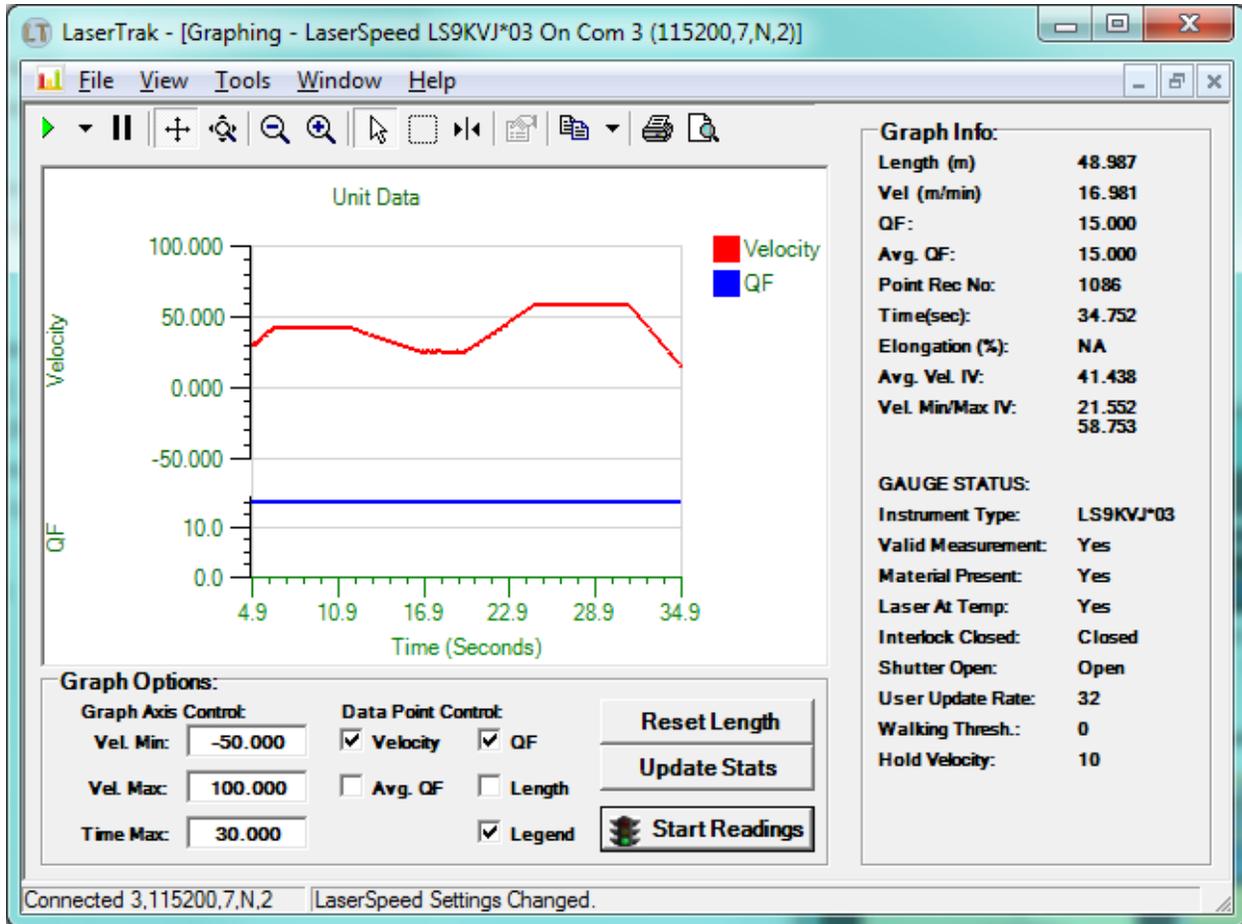


Chart Recorder Screen



Gauge Info

Length (m) – the length on the LaserSpeed gauge’s length counter. The length is accumulation from the last time the gauge was reset. Length is displayed in the units set during gauge Configuration.

Vel (m/min) – the instantaneous speed measured by the LaserSpeed gauge. The speed is displayed in the units set during gauge Configuration.

QF – the instantaneous Quality Factor measured by the LaserSpeed gauge. QF is displayed as a number between 0 and 15, where 15 represents the best and 0 represents no measurements being made.

Average QF – the average of all the QF readings since the LaserTrak software started acquiring data from the gauge. This value is reset every time data acquisition is restarted. Note: This is not the average of the QF on the display.

Point Record Number- is the number data points acquired since the data acquisition began.

Time in Sec – the amount of time since the data acquisition began.

Elongation % – .

Avg. Vel. IV – the average velocity in view (IV) on the velocity graph

Vel. Min/Max IV – the minimum/maximum velocity in view (IV) on the velocity graph

Gauge Status

Instrument Type – the type of gauge from which LaserTrak is acquiring data.

Valid Measurement – Yes, if the gauge is making valid measurement, and No, if it is not making valid measurements.

Material Present – Yes, if material present is detected and No, if material present is not detected.

Laser At Temp – Yes, if the Laser is within the allowed temperature range, and No if the Laser is outside its temperature range. The LS9000 will turn off its Laser if it is outside the allowed temperature range.

Interlock Closed- Yes, if the interlock is closed and No if the interlock is open. The Laser will only be on if the interlock is closed.

Shutter Open – Yes, if the internal shutter is open and No if the internal shutter is close. If the shutter is closed, the Laser beam will be blocked and no measurements will be made.

User Update Rate – Displayed in Milliseconds: Indicates how fast the gauge will output readings via RS232, RS422, and Ethernet

Walking Threshold – the gauge will not increment the internal length counter or output pulses if the speed is below this Walking Threshold value. The Walking Threshold is set during gauge Configuration. Set the Walking Threshold to 0 to disable this feature.

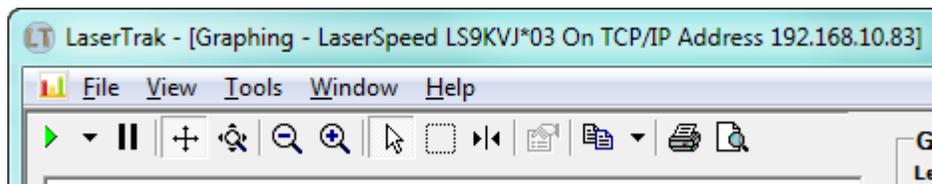
Hold Velocity – Sets the velocity value above which, the last valid reading is held when no measurements are made, and below which the LS9000 outputs a zero for the velocity and stops counting length when no valid measurements are made. The Hold Velocity is set during gauge Configuration. Set the "Hold Velocity if Above" setting to a large value (like 900,000.000) to disable this feature.

LaserTrak Toolbar

Top line of Chart Recorder Screen- shows the Gauge type and the COM port parameters



or Ethernet parameters



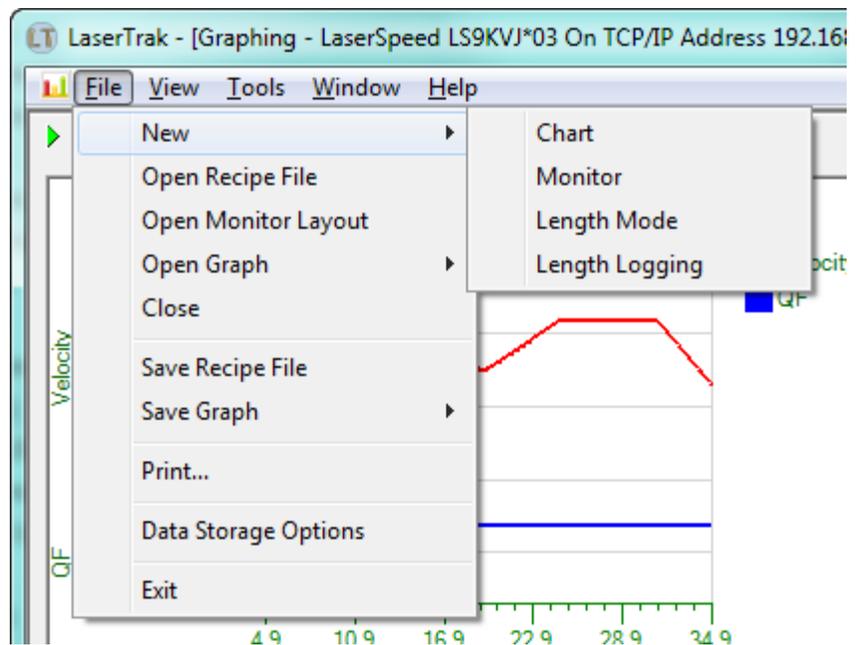
LaserTrak Menus

File Menu

New- selects between the Chart Recorder Screen, Monitor Screen, Length Mode Screen or Length Logging Screen

Open Recipe File- opens a previously stored recipe file that holds the operating parameters for the gauge.

Open Graph- opens a previously stored graph or graph configuration.



Close- closes the window

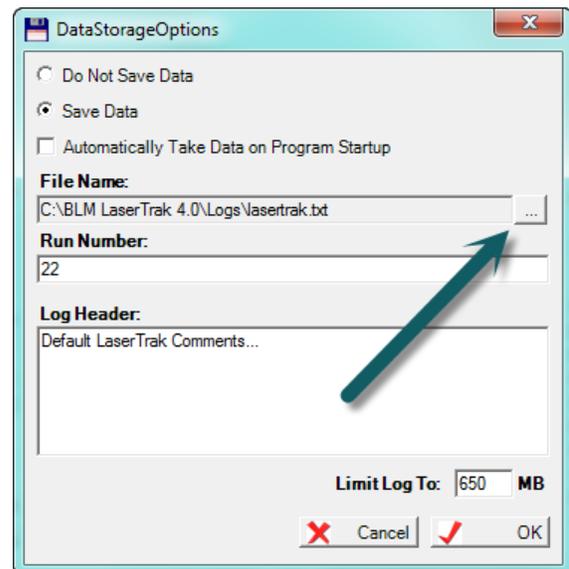
Save Recipe File- Stores a recipe file that contains all the current operating parameters of the gauge.

Save Graph- Stores the data displayed in the graph, a picture of the graph, or the current graph configuration.

Print- prints a copy of the current screen that is being displayed

Data Storage Options— allows data acquired from the gauge to be stored in a file to be recalled later back into LaserTrak or imported into an Excel work sheet. The path and file name can be selected by pushing the browser button (indicated with arrow.)

When **Save Data** is selected LaserTrak will save all the data to the file listed in **File Name**. The **Run Number** will be appended to the file name. Each time new data is saved the Run Number will automatically be incremented by 1. Data is saved starting when the "Start Readings" button is clicked, and stopping when the "Stop Readings" button is clicked.

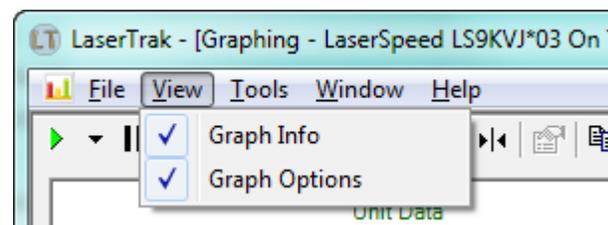


Exit- will exit the program and save current program settings.

View Menu

Graph Info - Allows the Graph Info pane to be turned on or off. The check mark turns on the option.

Graph Options - Allows the Graph Options pane to be turned on or off. The check mark turns on the option.



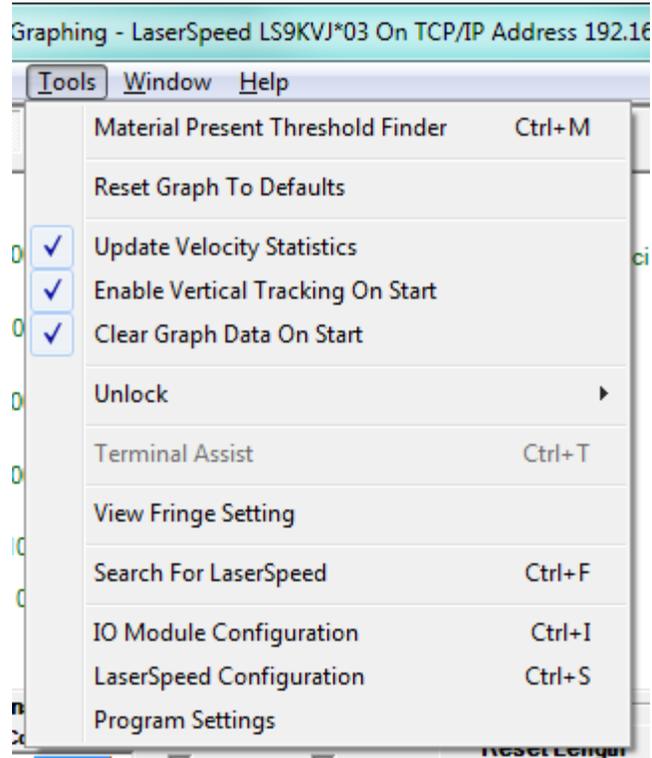
Tools Menu

Reset Graph to Defaults – Resets all the graph parameters to factory default settings. Use this when the graph is not working correctly and you want to go back to a known operating condition.

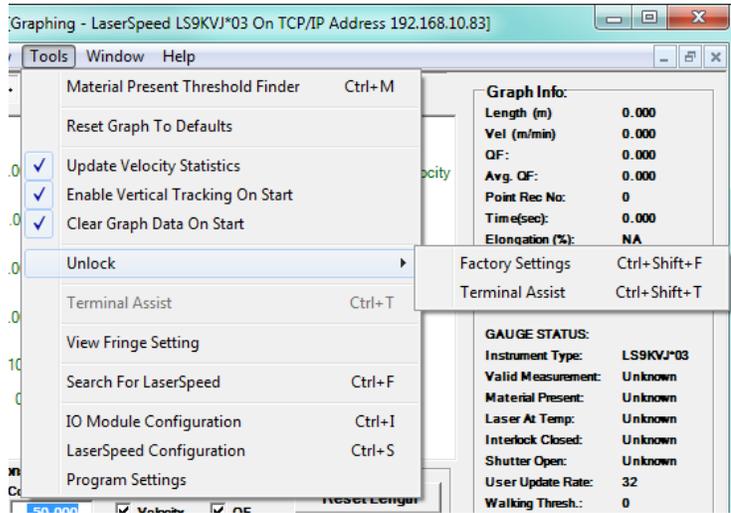
Update Velocity Statistics- when checked, the Avg, Min and Max Velocity IV will be automatically updated. If unchecked, these parameters will not be automatically updated, but can be manually updated by pushing the **Update Stats** button next to the Start Readings button.

Enable Vertical Tracking On Start- When checked, autoscaling on the vertical axis will automatically be turned on each time the Start Readings button is pressed.

Clear Graph Data On Start- When checked, the graph data is cleared each time the Start Readings button is pressed. If the item is not checked new data is simply appended to the data chart each time the Start reading button is pressed.

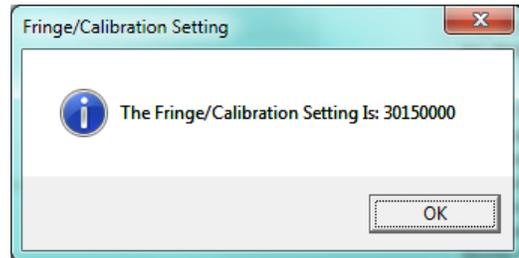


Unlock- Unlocks the **Factory Setting** or the **Terminal Assist**. Factory Settings and Terminal Assist are both password protected. The Factory Setting should only be accessed by authorized personnel. Terminal Assist can be used to manually send commands (like when using HyperTerminal) to help diagnose communication problems. The password for Terminal Assist is "laser1".



Note: You must unlock the gauge settings with the "*LOCKED=0" command before settings can be changed with Terminal Assist.

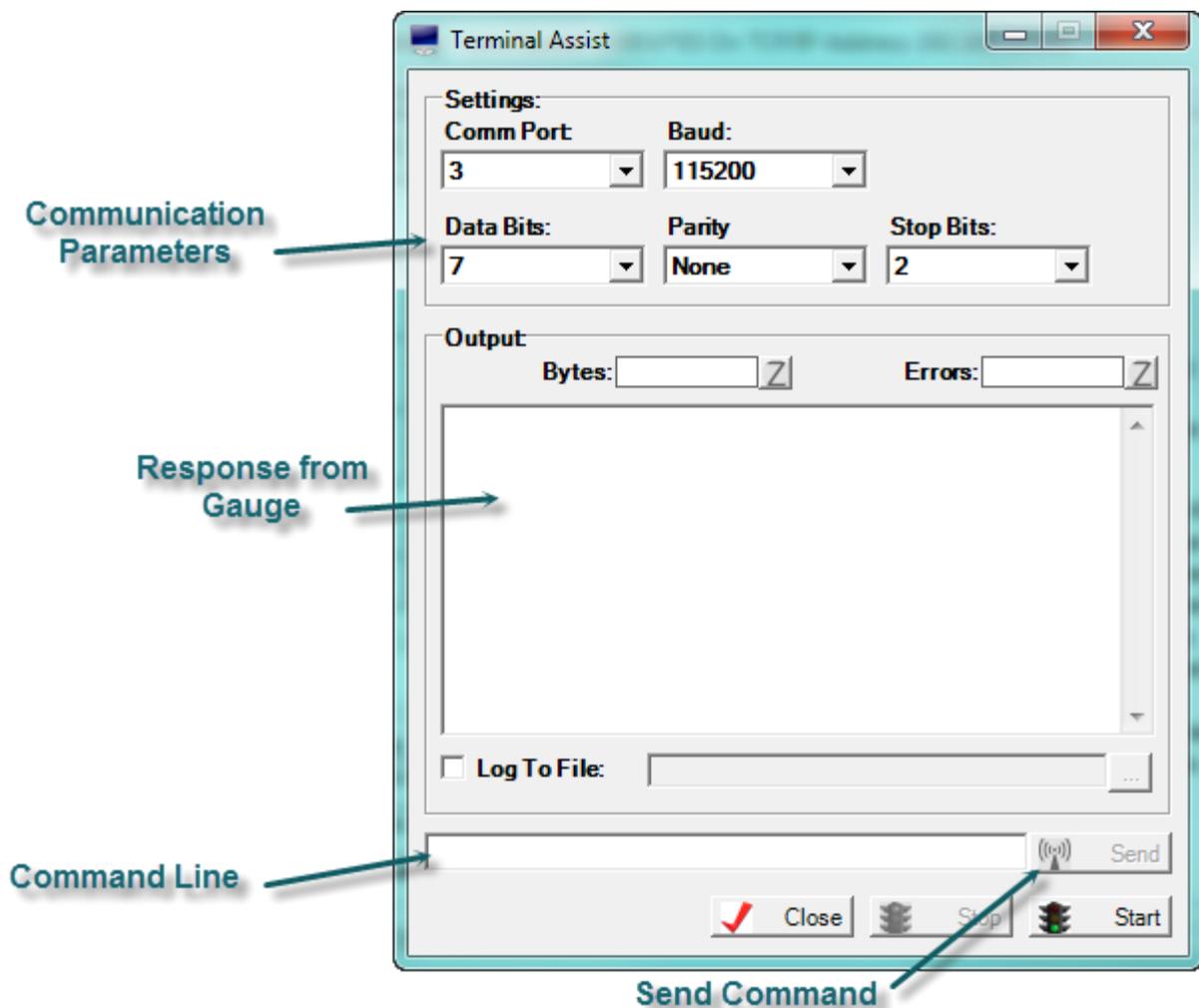
View Fringe Setting- Displays the calibration value for the fringe spacing of the gauge.



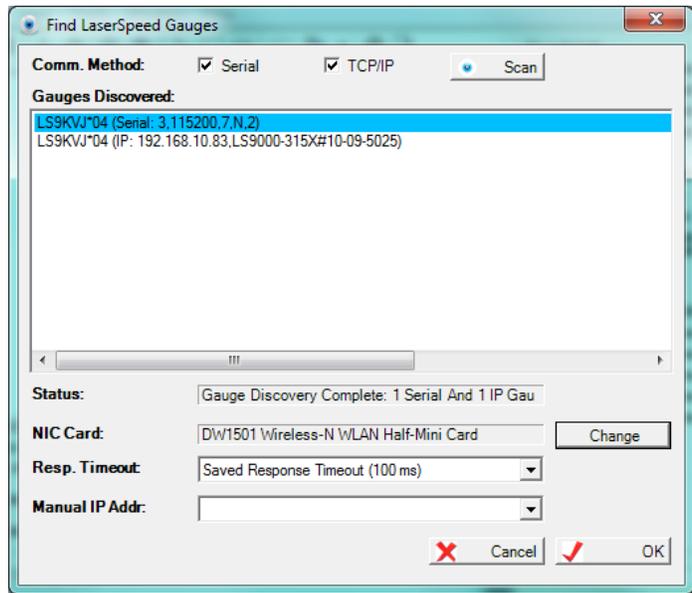
Terminal Assist Screen

This screen can be used to manually send commands to the gauge. The Terminal Assist Screen supports serial (RS232/RS422) communications only. To use this screen:

- 1) Enter the Communication Parameters that the gauge is using, and click Start
- 2) Type the command into the Command Line box, and then click the Send button to transmit.
- 3) The gauge's responses are displayed on the screen as they are received.



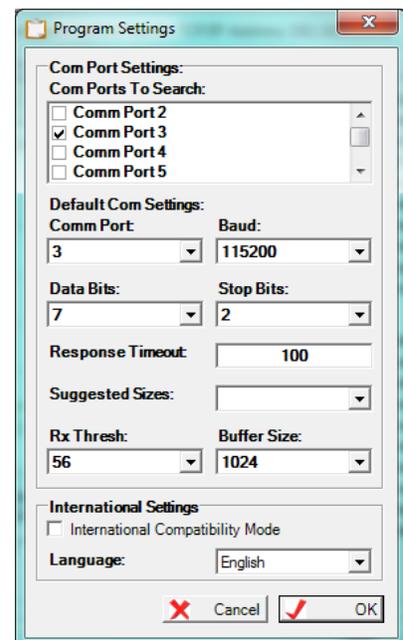
Search For LaserSpeed- initiates a search for the LaserSpeed gauge to establish communication between LaserTrak and the gauge. If the Serial checkbox is checked, the enabled serial ports will be searched. If the TCP/IP box is checked, then the local network will be searched for gauges. If no gauges are found, make sure that the serial port is enabled under **Program Settings**. If the TCP/IP box is checked and the PC has multiple network adapters, be sure to click the Change button and select the network adapter specifically connected to the LaserSpeed network. Firewall settings can prevent LaserTrak from generating the UDP Broadcast messages necessary to discover gauges on the network (See [UDP Discovery Beacon](#)). If this is the case and IT administration prevents you from adding a firewall exception for LaserTrak, you can manually enter the IP Address of the gauge.



IO Module Configuration- opens the IO Module Configuration screen.

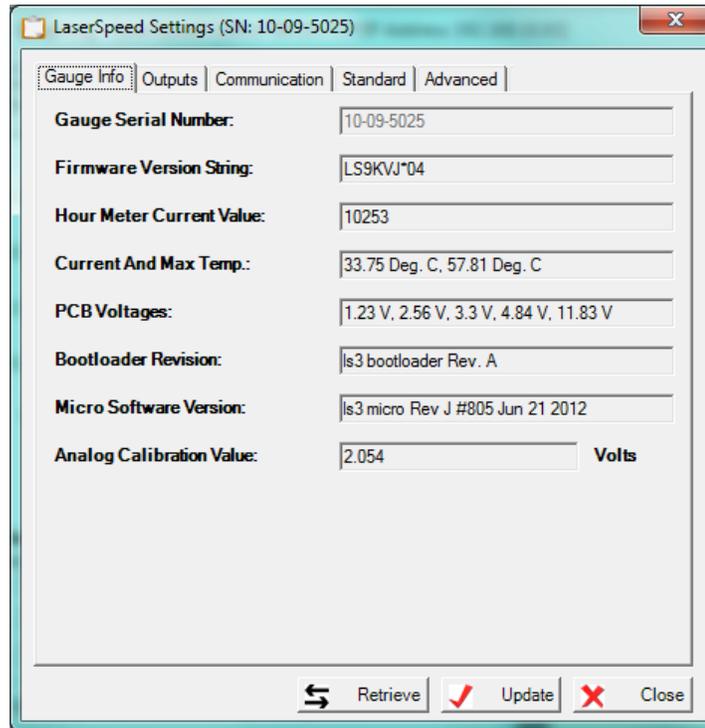
LaserSpeed Configuration- opens the operating parameter configuration screen. There are five tabs to the [LaserSpeed Configuration](#) screen.

Program Settings- Shows the active COM Ports. Only COM Ports that are checked will be searched during the communication search. Also shows the default COM Port and operating parameters the software will use to communicate with the LaserSpeed gauge. Only the checked serial ports will be searched for LaserSpeed gauges. If a new serial port is added to the computer, it must be selected in this screen before it can be used with LaserTrak.



LaserSpeed Configuration Screens

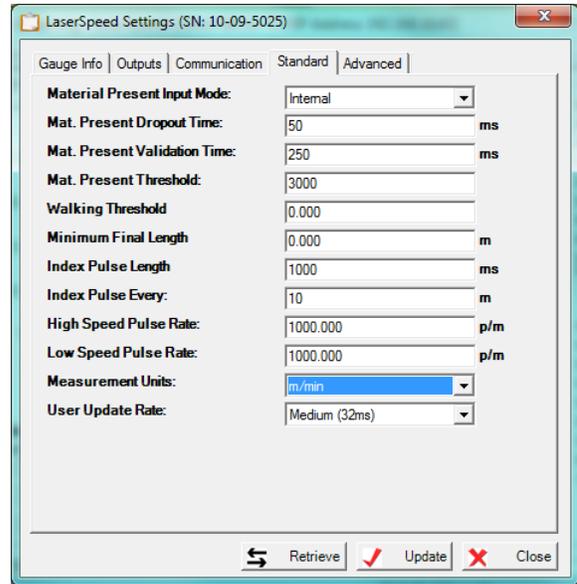
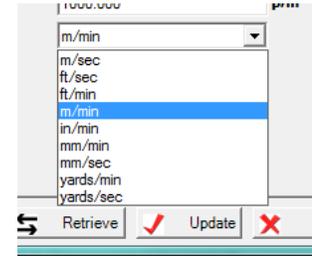
Gauge Info Tab- Screen displays gauge information.



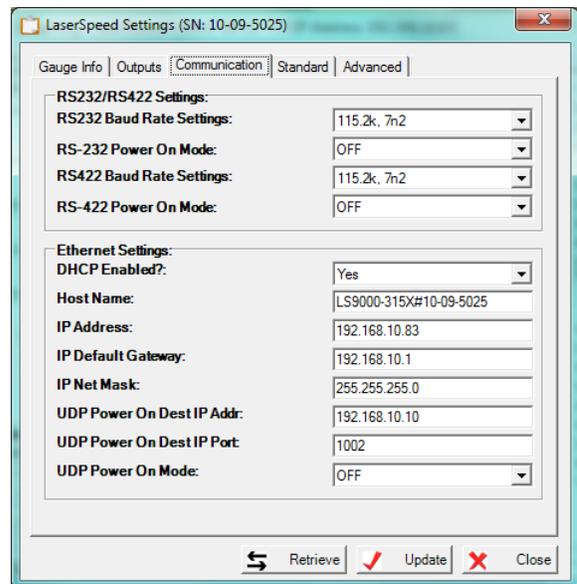
This tab displays general information about the gauge.

Standard Tab- shows common operating parameters for the LaserSpeed gauge. These parameters can be used to tailor the gauge operation to fit a specific application. The entry fields are either direct entry or a pull-down menu. Once all the operating parameters are set, press the Update button to update the parameters in the gauge. A tool tip will indicate the range of numbers valid for that entry field when the cursor is placed over a direct entry field for a few seconds. For the direct entry field the number can be entered without a carriage return. Just enter the number and move to the next field.

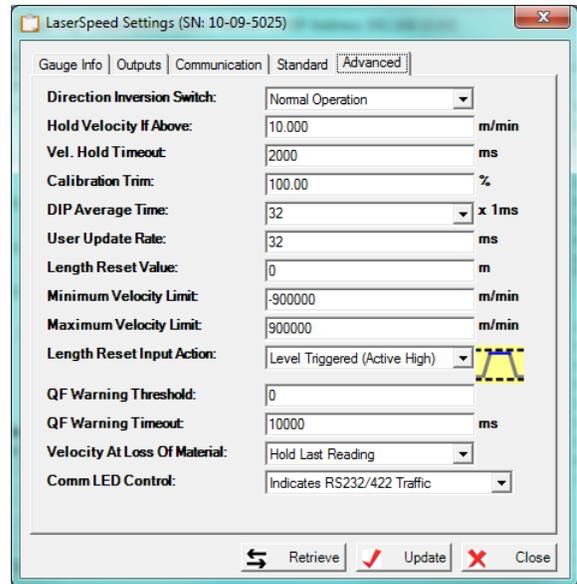
Once the parameters in the gauge have been updated to the gauge, they are permanently stored in the gauge until a different set of operating parameters are Updated to the gauge.



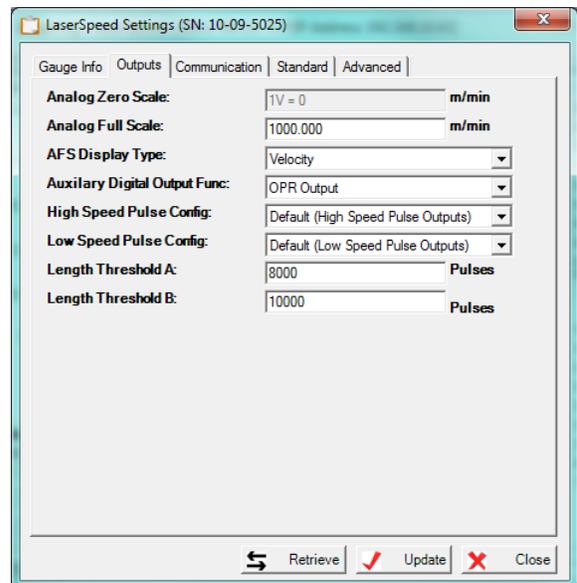
Communication Tab- screen shows the communication parameters used by the gauge to communicate via RS232, RS422 and Ethernet.



Advanced Tab- screen shows advanced operating parameters settings for the gauge. These are operating parameters that can be use to tailor the gauge to a specific application. The parameters in the advanced screen should only be changed by a knowledgeable person. The advanced parameters only need to be changed for difficult application.



Outputs Tab- screen shows settings that affect the operation of the gauge's analog and digital outputs.



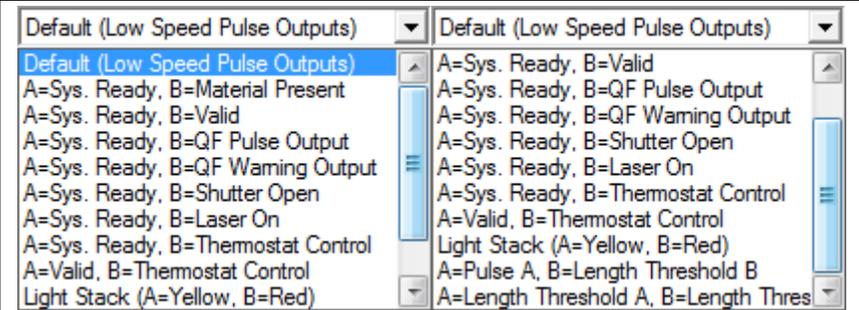
Standard Operating Parameters

<u>Material Present Input Mode</u>	Controls how the gauge determines Material Present. The sensor can use either the amount of reflected laser light (Internal), or it can use an external input signal (Active Low/Active High).
<u>Material Present Dropout Time</u>	Sets the time that Material Present can be lost before the sensor triggers the end of a measurement. If you are taking measurements and the Material Present signal is lost for less than the selected Material Present dropout time, the loss is considered to be a momentary loss of signal and is ignored. If the signal is lost for longer than the selected Material Present dropout time, it is considered the end of the material. This function is very useful when making length measurements on poor reflecting material.
<u>Material Present Validation Time</u>	Sets the maximum time that can elapse between the detection of Material Present and the acquisition of valid velocity readings. If the acquisition of valid velocity readings exceeds this time limit the gauge will consider the length measurement to be invalid and output 999999.999 as a length.
<u>Material Present Threshold</u>	A value from 0 to 4095 that indicates the relative reflected laser light threshold level of the Material Present signal. A setting of 0 would take very little reflected light to trigger Material Present. A setting of 4096 will take a lot of light on the detector to trigger MP. A good starting place is in the center of the range. This setting is only applicable when the Material Present Input Mode is set to Internal.
<u>Walking Threshold</u>	The velocity value below which, the output is forced to zero regardless of whether or not valid readings are obtained. This setting is useful for eliminating accumulation of length when the material is vibrating while stationary in the measurement zone. Setting this value to 0 disables the setting. The range is 0 to 999,999.999
<u>Minimum Final Length</u>	When in Final Length mode, sets the minimum length that will be reported. This is useful for ignoring momentary glitches in Material Present caused by outside disturbances such as water droplets or spray passing through the measurement area. Any measured length less than this setting will not be reported as a Final Length. The range is 0 to 999,999.999.
<u>Index Pulse Length</u>	Sets the Index pulse length in 10 ms increments. The range is from 10ms to 2 seconds.
<u>Index Pulse Every</u>	Sets the distance between index pulses in the selected measurement units.
<u>High Speed Pulse Rate</u>	Sets the number of pulses per unit length for the high speed pulse output. The unit length can be configured by setting the Units of Measurement setting. The gauge is capable of transmitting pulse rates as high as 5MHz on this pulse output. Select a Pulse Rate setting that will produce a frequency lower than 5MHz at the maximum expected line speed. The range is 0.001 to 100,000.
<u>Low Speed Pulse Rate</u>	Sets the number of pulses per unit length for the adjustable voltage pulse output. The unit length can be configured by setting the Units of Measurement setting. The sensor is capable of transmitting pulse rates as high as 250kHz on this pulse output. Select a Pulse Rate setting that will produce a pulse rate lower than 250kHz at the maximum expected line speed. For example, if the maximum line speed was 1000 m/min, a setting of 10,000 pulses/meter would produce an output frequency of about 167kHz. (1000 m/min x 1min/60sec x 10,000 pulses/m = 166,667 1/s). The range is 0.001 to

	100,000.
<u>Measurement Units</u>	<p>Sets the units that the length and speed will be measured in. Available choices are:</p> <ul style="list-style-type: none">Feet/secFeet/minuteMeters/secMeters/minInches/minMillimeters/minMillimeters/secYards/minYards/sec <p>Length will be in m, feet, mm, in or yards, depending on the selected value.</p>
<u>User Update Rate</u>	<p>The core period determines how often the LaserSpeed sensors provide the LaserTrak software with an updated speed and length measurement. Available choices are Fast (4ms), Medium (32ms) and Slow (100ms) in the Standard settings. For the advanced settings the available choices are 1 to 2000 ms in 1 ms increments.</p> <p>The Recommended User Update Rate is 32 ms.</p>

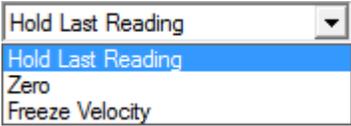
Output Configuration Parameters

<p>Analog Zero Scale</p>	<p>This setting does not apply to the LS9000.</p>
<p>Analog Full Scale</p>	<p>Sets the speed equal to the analog full scale. See the Analog Output Voltage section for details.</p>
<p>AFS Display Type</p>	<p>Sets the analog full scale output mode. The default is Velocity. When set to velocity the Analog Full Scale setting above has relevance. If QF or Temperature is selected, then the full scale value is fixed and the Analog Full Scale setting above is not settable.</p> <div data-bbox="743 590 1156 716" style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>Velocity ▾</p> <p>Velocity</p> <p>QF</p> <p>Temperature</p> </div>
<p>Auxiliary Digital Output Func.</p>	<p>Sets the operation of the Auxiliary output. The choices are show on the pop up menu.</p> <div data-bbox="743 846 1156 1150" style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>OPR Output ▾</p> <p>OPR Output</p> <p>Material Present Output</p> <p>Valid Measurement Output</p> <p>QF Pulse Output</p> <p>QF Warning Output</p> <p>Shutter Open</p> <p>Laser On</p> <p>System Ready</p> <p>Thermostat Output (40/35C)</p> <p>Light Stack Interface Green</p> </div>
<p>High Speed Pulse Config</p>	<p>The high speed pulse output defaults to outputting pulse according to the High Speed Pulse Rate set in the standard Configuration Tab. The pulse output can be configured to output gauge status if the high speed pulse output is not needed. The choices are shown in drop down menu.</p> <div data-bbox="743 1339 1156 1640" style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>Default (High Speed Pulse Outputs) ▾</p> <p>Default (High Speed Pulse Outputs)</p> <p>A=Sys. Ready, B=Material Present</p> <p>A=Sys. Ready, B=Valid</p> <p>A=Sys. Ready, B=QF Pulse Output</p> <p>A=Sys. Ready, B=QF Warning Output</p> <p>A=Sys. Ready, B=Shutter Open</p> <p>A=Sys. Ready, B=Laser On</p> <p>A=Sys. Ready, B=Thermostat Control</p> <p>A=Valid, B=Thermostat Control</p> <p>A=Pulse Phase A, B=Sync Out</p> </div>
<p>Low Speed Pulse Config</p>	<p>The low speed pulse output defaults to outputting pulse according to the Low Speed Pulse Rate set in the standard Configuration Tab. The pulse output can be configured to output gauge status if the low speed pulse output is not needed. The choices are shown in the table.</p>

	
<p>Length Threshold A</p>	<p>Indicates when the current length has exceeded the Length Threshold A set point. This output is reset when the Index Pulse resets. See the Index Pulse/Length Thresholds section for details about length thresholds.</p>
<p>Length Threshold B</p>	<p>Indicates when the current length has exceeded the Length Threshold B set point. This output is reset when the Index Pulse resets. See the Index Pulse/Length Thresholds section for details about length thresholds.</p>

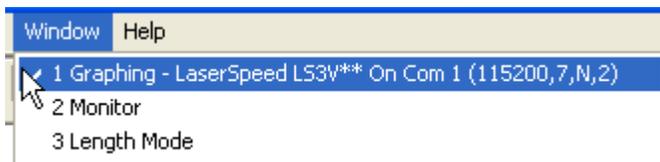
Advanced Operating Parameters

<p><u>Direction Inversion Switch</u></p>	<p>Changes the Positive direction of travel with respect to the gauge orientation.</p> <p>When Normal Direction is selected the gauge will measure a Positive Velocity when the material is moving in the direction show by the arrow.</p> <p>When Reverse +/- Direction is selected the gauge will measure a Positive Velocity when the material is moving in the opposite direction show by the arrow.</p>	 <p>The diagram shows the front view of the BETA LaserMike LaserSpeed 9000 gauge. It features a central display area with a warning label that reads 'VISIBLE AND INVISIBLE LASER RADIATION TO BEAM CLASS II LASER PRODUCT'. Below the gauge, there is a right-pointing arrow labeled '+Velocity'.</p>
<p><u>Hold Velocity If Above</u></p>	<p>The gauge will hold the last valid velocity reading above the value set in Hold Velocity If Above when the gauge stops making valid measurements. Set this to a high value to disable this function. This is useful if the product cannot be guided well enough to keep the product in the measuring region of the gauge. The range is 0 to 999,999.999.</p>	
<p><u>Velocity Hold Timeout</u></p>	<p>Configures how long the gauge will hold the last reading when measurements are not being made. (See the Hold Velocity if Above Setting). This setting can be set to any value from 0 to 65535 milliseconds. A setting of 1ms is the minimum hold time. A setting of 0 disables the timeout and causes the gauge to hold the last reading forever.</p>	
<p><u>Calibration Trim</u></p>	<p>When set to 100.00% the gauge will use the factory calibration. The Factory calibration is multiplied by the Calibration Trim percentage to modify the calibration of the gauge. This can be used to compensate for shrinkage, stretch or misalignment of the gauge. The range is 50% to 200%.</p>	
<p><u>DIP Average Time</u></p>	<p>Normally set to Factory Default. When not set to Factory Default, the range is 1 to 2047. The DIP is a forward running average applied to the Velocity output. Use this to smooth the Velocity output of the gauge. The bigger the number the more smoothing will occur.</p>	
<p><u>User Update Rate</u></p>	<p>Sets the rate the RS232, RS422 and Ethernet will be automatically updated. The range is 1ms to 2s in 1ms increments.</p>	
<p><u>Length Reset Value</u></p>	<p>Configures the starting length when the length reset occurs. This setting can be used to introduce a constant offset (positive or negative) to the measured length readings. For example, when using two optical detectors to trigger the external Material Present input, this setting would be set to the distance between the sensors. This setting affects only the internal length output over the serial port or over Ethernet—it does not affect the pulse outputs. For most applications, this value should be set to 0.</p>	
<p><u>Minimum Velocity Limit</u></p>	<p>Sets the minimum (most negative) measureable velocity. When a velocity is measured below this value, it will be ignored. Can be any positive or negative value. To disable, set to a large negative value.</p>	
<p><u>Maximum Velocity Limit</u></p>	<p>Sets the minimum (most positive) measureable velocity. When a velocity is</p>	

	measured above this value, it will be ignored. Can be any positive or negative value. To disable, set to a large positive value.
<u>Length Reset Input Action</u>	<p>This configures the Length Reset input function. The Graphic on the side of the pop up menu shows the action required to reset the internal length counter of the gauge. For example: Rising Edge Triggered is selected and the graphic shows an arrow on the rising edge of the pulse to indicate that the length counter will be reset on the rising edge of the reset pulse.</p> 
<u>QF Warning Threshold</u>	Sets the Quality Factor value below which the Quality Factor Warning is asserted.
<u>QF Warning Timeout</u>	Configures the amount of time that the indicated Quality Factor must be below the QF Warning Threshold before the Quality Factor Warning output is asserted.
<u>Velocity At Loss Of Material</u>	
<u>COMM LED Control</u>	<p>Indicates traffic on either RS232/RS422 or Ethernet. The light will turn blue when the gauge is transmitting, turn orange when the gauge is receiving and white when both transmit and receiving are happening at the same time.</p> <p>The COMM light in conjunction with the Valid Light indicate the BAUD Rate and control parameters for RS232/RS422 communication.</p> <p>The COMM light will blink n times when the gauge is power up to indicate the BAUD rate the gauge is set to.</p> <p>The Valid light will be off during the power up sequence if the number of data bits, parity and number of stop bit is set to 7-n-2 and on during power up sequence when set to 8-n-1.</p>

Middle line of Chart Recorder Screen- shows the program control line

Window – Once the Graphing, Monitor and Length windows have been opened, Window allows switching between each window.



Help- Brings up the about LaserTrak screen. The About screen shows the Date, part number, and software version number of the software.

Chart Recorder Toolbar

The Chart Recorder graphs the velocity and quality factor data acquired from the LaserSpeed gauge. The Tool bar functions allow the user to configure the graph for each application.



	Resumes tracking or makes the graph active again. If the arrow is greyed out the graph will not scroll. Click on the arrow to make the graph active. The arrow will turn green the active scrolling is enable.
	Freezes the graph but the software continues to acquire data, use resume to make graph active again.
	Axis scroll control. Allows the cursor to grab the axis increase or decrease the scale.
	Axis Zoom control, allows the cursor to grab the axis and zoom in or out.
	Zooms Out
	Zooms In
	Selects Objects
	Zoom Box, draws a box around data that will be zoomed in on
	Data Cursors
	Edit graph parameters, password protected and greyed out when not active
	Copies an image of the graph, or the raw data to the clipboard.
	Prints graph image
	Print Preview

Displaying Data

There are three main ways to display data. They are the Chart Recorder, Length and Speed Monitor and the Length Histogram. To select a the type of data display click File, then position the cursor over New on the drop down menu to bring up the selection tab with the three choices. Select Chart, Monitor or Length Mode by clicking on the drop down selection menu.

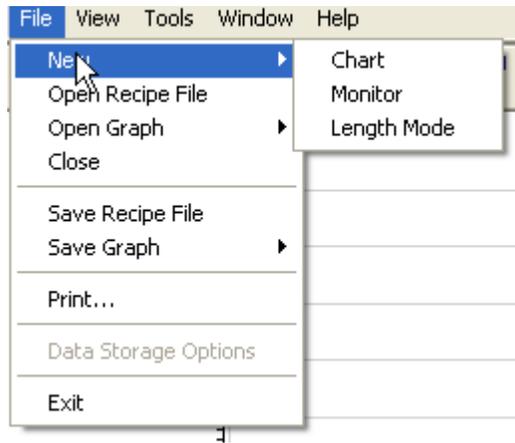
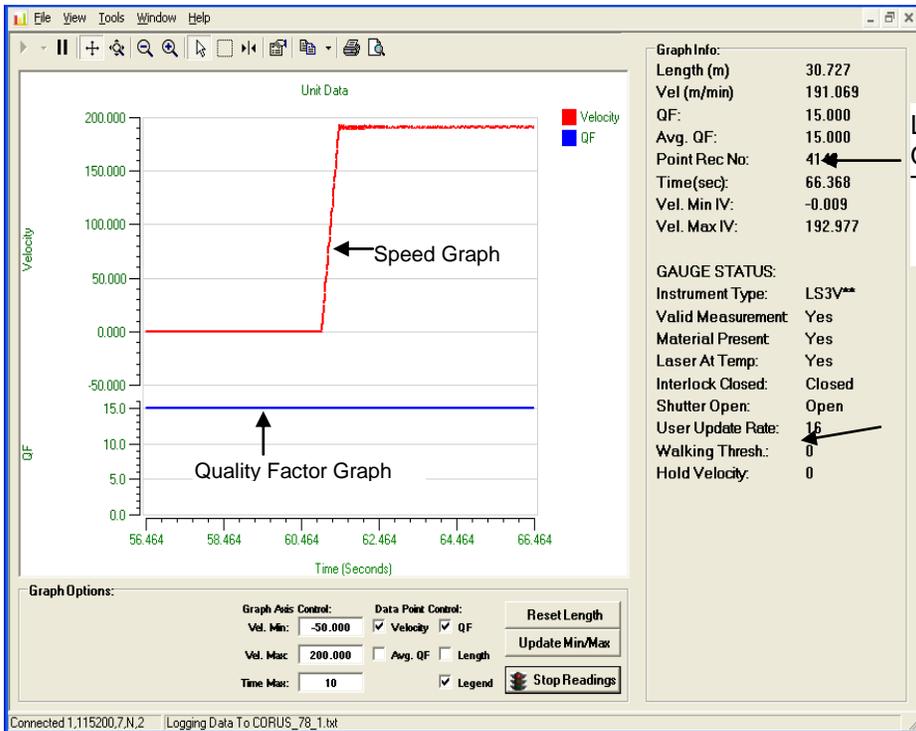


Chart Display



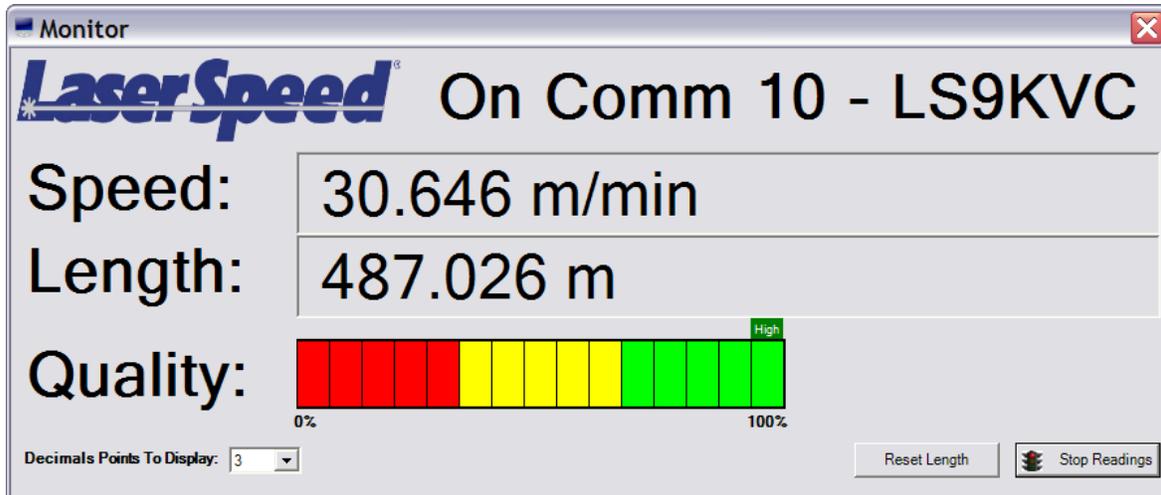
Length, Vel, Quality Factor Table

Gauge Info. Table

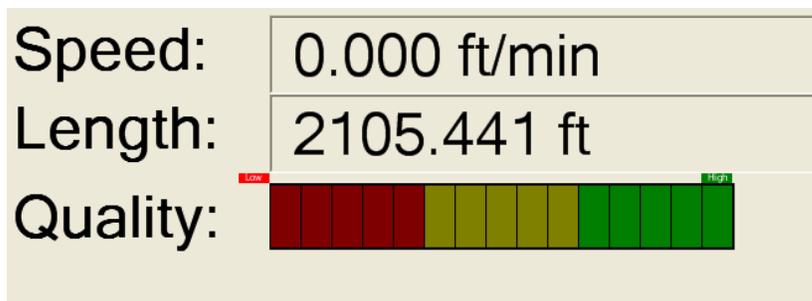
The Chart Recorder screen will acquire Speed, Length, Quality Factor and Status data from the LaserSpeed gauge and display it. The Speed and Quality Factor will be displayed graphically and the Length and Status information will be displayed in a table format. Press the Start Readings button to acquire data from the gauge. When the Start Readings button is pushed, the Start Readings button will change to a Stop Readings button.

Press the Stop Readings button to stop acquiring data from the gauge. The graph, Graph Info and Gauge Status will only be active when acquiring data from the gauge and the Stop Reading Button is being displayed. All the data will be frozen on the Chart Recorder screen when the Stop Readings button is pressed and the button changes back to Start Readings again.

Monitor Display

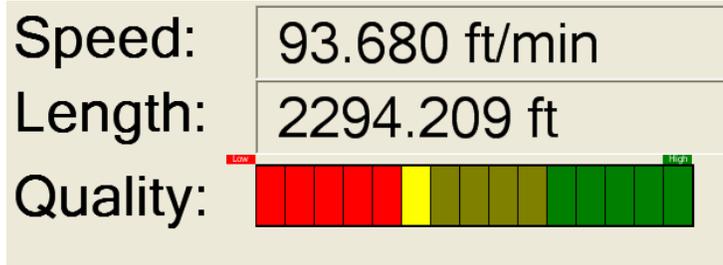


The Monitor Display shows the Speed and Length in a number format and the Quality Factor as a Bar Graph. The Quality Factor Bar Graph shows the Quality Factor as a lighted bar. All the bars are lighted when the Quality Factor is 100%. None of the bars are lighted when Quality Factor is 0. The High (green square), Low (red square) above the bar graph indicate the max and minimum Quality Factor readings since the start of data acquisition. To rest these marks press Stop Readings twice.



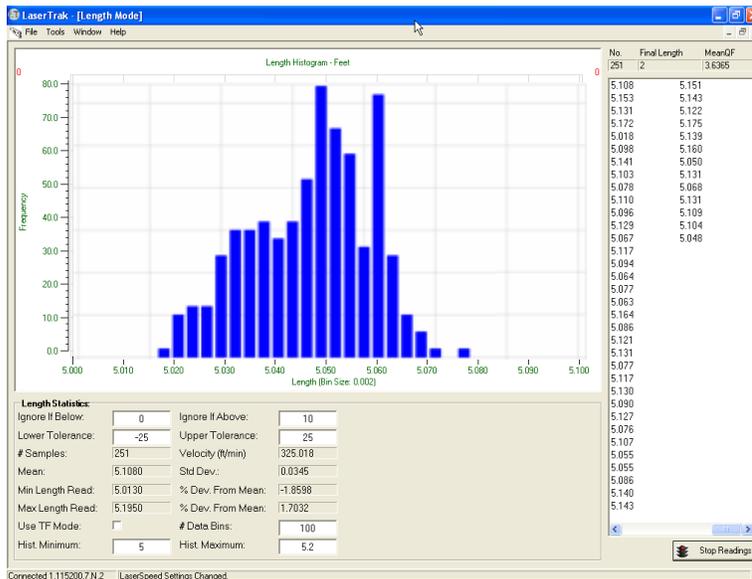
The Quality Factor Bar Graph can indicate different operating conditions of the gauge depending on what the Quality Factor is doing. This can help diagnose problems with the setup of the gauge or with the conditions under which the gauge is operating.

For example, the Quality Factor that indicates the gauge is measuring a poor light scattering surface when the Quality Factor is relatively constant but lower than 15. The Gauge will measure accurately under these conditions as long as the QF stays in the yellow and Green areas.



When the Quality Factor is jumping from 0 to 15 or from the red to the green area quickly, this typically indicates that the product is moving in and out of the measuring region of the gauge or there is something interfering with the Laser beams hitting the surface of the material being measured. The gauge can not make measurements if the Laser beam does not have a clear path between the gauge and the surface being measured. This would be indicated by a Quality Factor equal to zero or in the red zone on the bar graph.

Length Mode Display



The Length Mode Screen Has two modes of operation, the Successive Reading mode and Final Length mode. Successive Reading mode allows discrete lengths to be measured and displayed in the form of a Histogram. The software will acquire the final length measured after the length counter has remained at the same length for 4 successive User Update Periods.

This can be accomplished by making the speed go to zero thereby freezing the length counter or by using the Material present signal to freeze length readings. The length must remain the same for a minimum of 80 ms. In the Successive Reading mode the software is continually reading the length, speed and Quality factor from the gauge every User Update period.

Final Length mode uses the TF command in the gauge. The TF command sets the gauge to output only the final length and average Quality Factor at the end of each part being measured. The gauge only outputs one data point per length measurement. The Material present signal determines when the length measurement starts and stops. The minimum time that Material Present can be off is 4 ms for the gauge to act on the Material present signal and output the final length and Quality factor.

The bin size of the histogram is determined by the Hist. Minimum, Hist. Maximum settings and #Data Bins shown in Length Statistics. The bin size lumps all length measurements within a bin size into one bin and considers them at one length. This can be set to minimum of 0.001. The Hist. Minimum and Hist Maximum set the upper and lower limit of lengths that will be used in the histogram. Lengths outside these values will be shown on the table on right side of the screen but not used in the histogram. In addition a Red number will appear in the upper right and left corner of the graph to indicate how many length readings are larger then the Hist. Maximum and smaller then the Hist. Minimum.

The length readings are also displayed in a tabular format on the right hand side of the display.

Length statistics are shown at the bottom of the screen.

Length Statistics:			
Ignore If Below:	<input type="text" value="-50"/>	Ignore If Above:	<input type="text" value="10000"/>
Lower Tolerance:	<input type="text" value="-25"/>	Upper Tolerance:	<input type="text" value="25"/>
# Samples:	<input type="text" value="278"/>	Velocity (in/min)	<input type="text" value="10099.78"/>
Mean:	<input type="text" value="16.4325"/>	Std Dev.:	<input type="text" value="0.0149"/>
Min Length Read:	<input type="text" value="16.4210"/>	% Dev. From Mean:	<input type="text" value="-0.0700"/>
Max Length Read:	<input type="text" value="16.6020"/>	% Dev. From Mean:	<input type="text" value="1.0315"/>

Ignore if Below: allows the user to reject measurements below this threshold

Ignore if Above: allows the user to reject measurements above this threshold

Lower Tolerance: allows the user to alarm on measurements below this threshold

Upper Tolerance: allows the user to alarm on measurements above this threshold

of Samples: indicates how many samples are used in the calculations

Velocity displays the speed of the parts being measured

Mean: shows the mean statistic of all lengths included in the measurement

Std Dev: is the standard deviation of all parts included in the measurement

Min Length Read displays the shortest length measured

% Dev from Mean: displays the percent of deviation of the shortest length from the mean

Max Length Read: displays the longest length measured

% Dev from Mean: displays the percent of deviation of the longest length from the mean

RS-232/RS-422 Communication

The LS9000 gauge has a full set of serial commands which you can use to configure and read data from the instrument. In order to interface serially, you will need to connect the RS-232/RS-422 receive and transmit signals on the gauge to the serial port on your computer. If you are using a LaserSpeed Breakout Assembly, you can connect a straight-through RS-232 cable from the connector labelled **RS-232** to any PC serial port. If you change the baud rate to 230.4k and can no longer communicate with the LS9000, follow the procedure in the [Automatic Baud Rate Detection](#) section to recover.

When changing settings, the gauge settings must be unlocked before settings can be modified. See the [*LOCKED](#) and [*LOCKEN](#) commands for details.

If you are not using a LaserSpeed Breakout Assembly, see the [Connecting to Outputs](#) section for wiring details.

Baud Rate & Framing

The LS9000 supports baud rates from 4800 to 230.4k, and supports both 7n2 and 8n1³ framing. Flow control is not supported. The baud rate and framing for the RS-232 and RS-422 ports are individually configurable. The configuration can be changed with LaserTrak, or with a serial command. Be careful when setting the baud rate to 230.4kBaud, because PC's typically do not support this baud rate. You may have to purchase an add-on high speed serial card or USB serial converter to use this baud rate.

Note: If you change the baud rate or framing for the port you are currently using, you will have to change the local baud rate to match the LS9000 after sending the command. LaserTrak handles this change automatically.

Serial Commands to set Baud Rate & Framing

Configuration Setting	Serial Command
RS-232 Baud Rate & Framing	"J"
RS-422 Baud Rate & Framing	"@"

³ "7n2" = 7 Data Bits, No Parity, 2 Stop Bits, "8n1" = 8 Data Bits, No Parity, 1 Stop Bit

Baud Rate & Framing Settings

Setting	Baud Rate	Framing
1	230.4k	7n2
2	115.2k	7n2
3	57.6k	7n2
4	38.4k	7n2
5	19.2k	7n2
6	9600	7n2
7	4800	7n2
11	230.4k	8n1
12	115.2k	8n1
13	57.6k	8n1
14	38.4k	8n1
15	19.2k	8n1
16	9600	8n1
17	4800	8n1

RS-232 Maximum Cable Lengths

Beta LaserMike recommends the following cable lengths based on the chosen RS232 baud rate. (These recommendations do not apply to RS-422, which is designed for long distances communications.)

RS-232 Baud Rate	Recommended Maximum Cable Length
230400	10m
115200	10m
57600	20m
38400	50m
19200	100m
9600	200m
4800	200m

If you experience problems at high baud rates when using RS-232 over a long cable, try decreasing the baud rate or switching to RS-422. The RS-422 port is designed for long distances at high baud rates. Beta LaserMike recommends that the RS-422 port be used for high speed, long distance communications.

Note: High-baud rates are only required when acquiring length and speed data over the serial port. If you are using the pulse outputs, and are only using the serial port for configuration and/or diagnostics, you do not need a high baud rate. The maximum baud rate that will work for a particular application is dependent on the length of the cable and the amount of electrical noise in the environment. If you are using a high baud rate and are having problems communicating, try using LaserTrak to switch to a slower rate.

Baud Rate Indication on Power Up

The LS9000 indicates the selected baud rate setting for both the RS-232 and RS-422 ports at power-on, whenever a baud rate setting is changed, and when the auto-baud feature causes a baud rate change on one of the ports. The COMM LED flashes a number of times, indicating the selected baud rate. While the COMM LED is blinking, the Valid LED indicates the selected framing (OFF for 7N2 and ON for 8N1.)

Number of COMM LED Blinks	Baud Rate
1	230.4k
2	115.2k
3	57.6k
4	38.4k
5	19.2k
6	9600
7	4800

Valid LED State	Framing
OFF	7 Data Bits, No Parity, 2 Stop Bits
ON	8 Data Bits, No Parity, 1 Stop Bit

The COMM LED indicates the baud rate for each port 4 times. Each series of blinks is separated by a pause of a few seconds. The RS-232 baud rate is indicated by blinking Orange, and the RS-422 baud rate is indicated by blinking Blue.

For example: if the RS-232 port is configured for 38.4kBaud, 7N2, and the RS-422 baud rate is set to 115.2k, 8N1, the COMM light will blink 4 sets of 4 Orange blinks with the Valid LED turned OFF, followed by 4 sets of 2 Blue blinks with the valid LED turned ON.

Automatic Baud Rate Detection

The LS9000 can automatically detect the baud rate and framing that you are using during the first 20 seconds after power is applied to the gauge. This is to make it possible to recover if you set the baud rate to a rate too high for your PC to support, or if the RS-232 baud rate is too high for the length of cable you are using. The Autobaud feature operates on both the RS-232 and RS-422 serial ports independently.

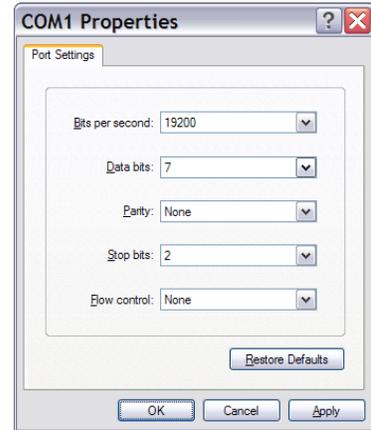
At power-on, the LS9000 loads the Baud Rate & Framing settings for the RS-232 and RS-422 serial ports from non-volatile memory and listens for commands. For the first 20 seconds after power-on, the serial port is monitored for activity, and the baud rate is measured. If a carriage return (hex 0x0d) is received during this time, the gauge ignores the baud rate stored in non-volatile memory, and switches to the measured baud rate. The gauge will use this baud rate until the power is cycled again, or a configuration setting is changed, at which point it will revert to the last stored setting. After communications are established, you can change the stored setting by configuring it with LaserTrak, or by sending a command with a terminal program such as HyperTerminal. To ensure that communications is not lost again, the baud rate should be set before attempting to change any other parameters.

Method 1

- 1) Turn off power to the LS9000
- 2) Start LaserTrak, but don't click the Search button yet
- 3) Turn on the LS9000, and wait for the COMM light to start flashing (or wait for 10 seconds if you can't see the light)
- 4) Click Search—the LS9000 should be found automatically
- 5) In LaserTrak, click Tools→LaserSpeed Configuration
- 6) Select the Communication tab
- 7) Select a new baud rate, and click Update

Method 2

- 1) Start HyperTerminal (or any other terminal program) and set to 19200, 7, N, 2 (or the baud rate you want to use later). HyperTerminal is installed with Windows 2000/XP, and can be found in Start Menu→Programs→Accessories→Communications
- 2) Cycle the gauge power.
- 3) Hit the Enter key 3 times, or transmit three Carriage Returns (hex 0x0d).
- 4) Use the "Z" command to verify gauge is communicating.
- 5) Use the "J" command to set the RS-232 baud rate or the "@" command to set the RS-422 baud rate.
- 6) Reconfigure HyperTerminal to the new baud rate if different from that in step 1.



Communication Protocol

This section lists the commands used to configure the LS9000, and to read measurement data. Throughout this section, <CR> is used to denote a carriage return, and <LF> is used to indicate a linefeed.

Notation	Description
<CR>	Carriage Return character ASCII Value: 13
<LF>	Linefeed character ASCII Value: 10
<N>	Integer Value (variable length) Indicates an integer value with length from 1 to 9 characters. When sending a command to set a configuration setting, the transmitted value can contain leading zeros, but they are not required. When reading a configuration setting, the LS9000 will not transmit leading zeros in its response. Example Notation: L<N><CR> Example Command: L100000<CR>
<IP>	IP Address Example Notation: *IPADDR=<IP><CR> Example Command: *IPADDR=192.168.10.246

In this section, characters sent to or received from the LS9000 are indicated with a different font. This is to differentiate between the description of the command or response and the command/response itself. Any text that appears in `mono-space font` is text that is sent to or from the LS9000.

Text	Example Font
Descriptive Text	High Speed Pulse Setting
Command/Response Text	L1000000

All commands sent to the LS9000 and all responses from the LS9000 end in a `<CR>`. If commands are sent to the LS9000 ending in `<CR><LF>` (Carriage Return followed by a Linefeed), the LS9000 will not process the commands properly. All responses are terminated with only a `<CR>`, not a `<CR><LF>`.

There are two different types of command syntaxes that the LS9000 uses. The first type is backward compatible with legacy LaserSpeed 4000/8000 systems, and consists of one or two characters. In general, these commands affect the LS9000's measurements or data processing. The other type consists of longer commands, such as the `*IPADDR` command, which affect communications, or are informational commands. These commands always start with an asterisk character (*).

Communication Protocol: Command Descriptions

@ [RS-422 Baud Rate & Framing](#)

@<CR> Read
 Response Format: <N>

@<N><CR> Set
 <N> is an integer from 1-7, or 11 to 17 specifying the RS-422 baud rate and framing. If using binary output mode (see the [TB command](#)), the framing must be set to 8n1.

Setting	Baud Rate	Framing	
1	230.4k	7n2	
2	115.2k	7n2	Factory Default
3	57.6k	7n2	
4	38.4k	7n2	
5	19.2k	7n2	
6	9600	7n2	
7	4800	7n2	
11	230.4k	8n1	
12	115.2k	8n1	
13	57.6k	8n1	
14	38.4k	8n1	
15	19.2k	8n1	
16	9600	8n1	
17	4800	8n1	

Where:

7n1: 7 data bits, no parity, 2 stop bits

8n1: 8 data bits, no parity, 1 stop bit

Note: After this setting is changed, the COMM LED and Valid LED will flash, indicating the new configuration.

J

RS-232 Baud Rate & Framing

J<CR> Read

Response Format: <N>

J<N><CR> Set

<N> is an integer from 1-7, or 11 to 17 specifying the RS-232 baud rate and framing. If using binary output mode (see the [TB command](#)), the framing must be set to 8n1.

Setting	Baud Rate	Framing	
1	230.4k	7n2	
2	115.2k	7n2	Factory Default
3	57.6k	7n2	
4	38.4k	7n2	
5	19.2k	7n2	
6	9600	7n2	
7	4800	7n2	
11	230.4k	8n1	
12	115.2k	8n1	
13	57.6k	8n1	
14	38.4k	8n1	
15	19.2k	8n1	
16	9600	8n1	
17	4800	8n1	

Where:

7n1: 7 data bits, no parity, 2 stop bits

8n1: 8 data bits, no parity, 1 stop bit

Note: After this setting is changed, the COMM LED and Valid LED will flash, indicating the new configuration.

&**Quality Factor Warning Threshold**

&<CR>

Read

Response Format: <N>

&<N><CR>

Set

Factory Default: 0 Minimum: 0 Maximum: 15

<N> is an integer specifying the threshold at which the Quality Factor Warning Output will turn on. If the QF goes below this value for longer than the Quality Factor Warning Timeout, the output will turn on. To turn back off again, the QF must go above the threshold for longer than the timeout.

Voltage High: QF is less than the Warning Threshold

Voltage Low: QF is greater than or equal to the Warning Threshold

This output is available on either pulse output, or on the Index Pulse output, as an alternate configuration. See the [%](#), [\\$H](#), and [\\$L](#) commands for details.

<**Quality Factor Warning Timeout**

<<CR>

Read

Response Format: <N>

<<N><CR>

Set

Factory Default: 10000 Minimum: 0 Maximum: 65535

<N> is an integer specifying the number of milliseconds that the QF must be below the Quality Factor Warning Threshold before the warning output will trigger.

The default value is 10,000, which is 10 seconds. This means that the QF must be below the threshold for 10 seconds before the output will trigger. This setting should be kept fairly large to avoid nuisance alarms.

A	<u>Direction Inversion Switch</u>
----------	--

A<CR> Read
 Response Format: <N>

A<N><CR> Set
 Factory Default: 0
 <N> is an integer, either 0 or 1.

Value	Line Direction
0	Default – When looking at the top of the gauge, with the laser beams pointed at the floor, positive velocity is movement to the right.
1	Reversed

Note: If both the Measurement Direction Input and this setting are used, the line direction will revert to the default direction.

B	<u>Hold Velocity If Above</u>
----------	--------------------------------------

B<CR> Read
 Response Format: <N>

B<N><CR> Set
 Factory Default: 50000000 Minimum: 0 Maximum: 999999999
 <N> is the velocity value * 1000 with the units being the same as the units set with the U command.

Sets the velocity value above which, the last valid reading is held when no measurements are made, and below which the LS9000 outputs a zero for the velocity and stops counting length when no valid measurements are made.

When holding the last speed, length will continue to count, and the pulse output will hold at a constant frequency.

If you do not want the speed to hold if measurements are lost, then set the value to a very high velocity (well above the normal speed range.)

Example:

If the units are ft/min (U setting is 2), the command B500000<CR> would cause the velocity to hold above 500 ft/min.

Note: Changing this setting will cause a reset, will reset the indicated length, and will cause the pulse outputs to be momentarily interrupted. Do not change this setting during normal operation.

\$T	<u>Hold Velocity Timeout</u>
------------	-------------------------------------

\$T<CR> Read
 Response Format: <N>

\$T<N><CR> Set
 Factory Default: 0 Minimum: 0 Maximum: 65535

<N> is the number of milliseconds to hold the current velocity when no measurements are made, if the last velocity was above the [Hold Velocity if Above](#) value.

To disable this timeout and hold the velocity forever, set this value to 0.

Example:

To set the Hold Velocity Timeout to 5 seconds, send the command:

\$T5000<CR>

C	<u>Calibration Trim</u>
----------	--------------------------------

C<CR> Read
 Response Format: <N>

C<N><CR> Set
 Factory Default: 10000 Minimum: 5000 Maximum: 20000

<N> is a number between 5000 and 20000, corresponding to 50% to 200%. This allows the calibration number to be adjusted by the values from 0.5000 to 1.9999. The factory calibration will be adjusted by (Calibration Trim/10000).

This value should normally be left at 10000 (100%). Do not change this setting unless you know exactly how it will affect your process. LaserSpeed gauges are permanently factory calibrated to a NIST standard, and should not require trimming.

Example: If a calibration product of length 1000m is run through the LS9000 and the LS9000 measures 999m due to an alignment error, the trim adjustment should be set to:

$$C = 10000 \times \frac{Actual}{Measured}$$

$$C = 10000 \times \frac{1000}{999} = 10010$$

The command C10010<CR> would set the value to the 100.10%.

Note: Changing this setting will cause a reset, will reset the indicated length, and will cause the pulse outputs to be momentarily interrupted. Do not change this setting during normal operation.

D Analog Full Scale Velocity

D<CR> Read
Response Format: <N>

D<N><CR> Set
Factory Default: 200000 Minimum: 0 Maximum: 2147483647

<N> is the velocity value * 1000 corresponding to the full scale output of the 0-2V analog output. The Analog Output is described in detail in the Analog Output Voltage section.

When this setting is set to 0, the Analog Output represents the Quality Factor on a 0-1V scale.

When this setting is set to 1, the Analog Output represents the internal gauge temperature (0-100°C) on a 0-1V scale.

Note: Changing this setting will cause a reset, will reset the indicated length, and will cause the pulse outputs to be momentarily interrupted. Do not change this setting during normal operation.

S Material Present Input Mode

S<CR> Read
Response Format: <N>

S<N><CR> Set
Factory Default: 1

<N> is an integer indicating one of the Material Present Input Mode settings outlined in the table below.

Value	Description
0	Use Internal Material Present
1	External Material Present (Active Low) MP High→Low transition starts a measurement MP Low→High transition ends measurement
2	External Material Present (Active High) MP Low→High transition starts a measurement MP High→Low transition ends measurement

Note: To disable the Material Present feature and have Material Present on all the time, set the Material Present Input Mode to External Active Low and leave the Material Present input disconnected.

F**Material Present Dropout Time**

F<CR> Read

Response Format: <N>

F<N><CR> Set

Factory Default: 50 Minimum: 0 Maximum: 511

<N> is an integer specifying the Material Present Dropout Time in milliseconds.

If you are taking measurements and the Material Present signal is lost for less than the selected Material Present dropout time, the loss is considered to be a momentary loss of signal and is ignored. If the signal is lost for longer than the selected Material Present dropout time, it is considered to be end of the material. This function is very useful when making length measurements on poor reflecting material.

G**Material Present Validation Time**

G<CR> Read

Response Format: <N>

G<N><CR> Set

Factory Default: 250 Minimum: 0 Maximum: 511

<N> is an integer specifying the Material Present Validation Time Limit in milliseconds.

When material enters the measurement volume, the system determines the time between the Material Present signal and the first valid data. If the time is less than or equal to the validation time limit (selectable via LaserTrak or the G command), then the start-up length-correction is calculated and a length measurement is initialized. If the time between the Material Present signal and the first valid velocity data is longer than the validation limit, then the length calculation is aborted and an error or fault is sent. This error is signalled by setting the length output in [Final Length Mode](#) output to a value of all 9's.

M**Material Present Threshold Level**

M<CR> Read

Response Format: <N>

M<N><CR> Set

Factory Default: 2000 Minimum: 0 Maximum: 4095

<N> is an integer that specifies relative threshold level of the Material Present (MP) signal. When using Internal Material Present, the LS9000 determines if there is something in the measurement area by measuring the amount of reflected light. This measurement is compared to the threshold.

A setting of 0 would take very little light back on the detector to trigger MP. A setting of 4095 will take a lot of light on the detector to trigger MP. A good starting place is in the center of the range.

TP	<u>Velocity at Loss of Material</u>
-----------	---

TP<CR> Read
 Response Format: <N>

TP<N><CR> Set
 Factory Default: 1

<N> is an integer indicating one of the Velocity at Loss of Material settings outlined in the table below.

This setting can be used to force the measured Velocity and QF to 0 if Material Present is in the "Material Not Present" state. This can be used, for example, to force the pulse outputs to stop counting in some situations.

By default, the LS9000 Velocity and Quality Factor outputs are not affected by Material Present.

Value	Description
0	<p>Hold Last Reading</p> <p>Velocity and Quality Factor are not affected by Material Present state. The gauge will continue to measure if possible, and will output the measured velocity. If measurements are lost, and the last velocity was above the Hold Velocity if Above setting, then the velocity output will be held at this value.</p>
1	<p>Zero</p> <p>Velocity and Quality Factory are both forced to zero when in the "Material Not Present" state, regardless of whether measurements are being made.</p>
2	<p>Freeze Velocity</p> <p>Quality Factory is forced to zero when in the "Material Not Present" state, regardless of whether measurements are being made. Velocity is also forced to zero when in the "Material Not Present" state unless the gauge was in a velocity hold condition. (see the Hold Velocity If Above setting)</p>

H	<u>Hour Meter Current Value</u>
----------	---

H<CR> Read Only Command
 Response Format: <N>

This command returns the total number hours that the gauge has been running.

I**Current & Max Temperature**

I<CR>

Read Only Command

Response Format: <N>, <N>

This command returns both the current internal temperature, and the maximum temperature that has been recorded. Both temperatures are in Celsius. The values returned from the LS9000 must be divided by 100 to get the temperature.

The normal temperature rise from ambient to internal is 10-15°C.

Example:

Command: I<CR>

Response: 3225, 4538<CR>

Meaning: Internal Temperature: 32.25°C

Maximum Internal Temperature: 45.38°C

K**Averaging Time**

K<CR>

Read

Response Format: <N>

K<N><CR>

Set

Factory Default: 32 Minimum: 0 Maximum: 2047

<N> is an integer that indicates the number of milliseconds of averaging for the LS9000's measurements. A value of zero enables automatic averaging where the averaging time equals the [User Update Rate](#).

The LS9000 generates a new velocity and length measurement, updates the pulse output frequencies, and updates the analog output every 1ms. This setting controls the length of the moving average used to calculate the 1ms reading.

O [User Update Rate](#)

O<CR> Read
 Response Format: <N>

O<N><CR> Set

Factory Default: 32 Minimum: 1 Maximum: 2047

<N> is an integer that specifies, in milliseconds, how often the LS9000 transmits data over the serial/Ethernet port. For example, an O setting of 32 would cause the LS9000 to transmit data every 32 milliseconds. Some typical update rates are:

O	Rate	Command
4 ms	Fast	O4<CR>
32 ms	Medium	O32<CR>
100 ms	Slow	O100<CR>

Depending on the baud rate, when using fast update rates, it may not be possible for the LS9000 to complete transmission of an entire measurement update before it is time to transmit the next one. If this occurs, the late measurement will not be transmitted. See the serial [Real-Time Data Timing](#) section for further details.

Q [Quality Factor Current Value](#)

Q<CR> Read Only Command
 Response Format: <N>

<N> is an integer from 0 to 15 indicating the current Quality Factor. A QF of 0 indicates that the gauge is not currently making measurements, and a QF of 15 indicates that the gauge is making excellent measurements.

This command returns the same value as you would normally receive from the [TE data](#), or in a response to the [V command](#).

R [Reset Internal Length Count](#)

R<CR> or Command
 R0<CR>

This command causes the LS9000 to reset its internal length count, and to reset the Index Pulse location to 0.

Note: For older versions of firmware (micro revision H and earlier), it was required that the gauge be unlocked (see [Setting Lock](#)) to accept the R0 command.

Ⓜ

Length Reset Input Action

Ⓜ<CR> Read

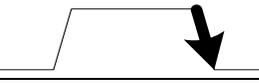
Response Format: <N>

Ⓜ<N><CR> Set

Factory Default: 0

<N> is an integer specifying the Length Reset Input Action mode. It can be any of the values in the table below.

This setting controls when the length reset input resets the length. Depending on the type of output you have connected to the LS9000, you may wish to reset on either rising or falling edge, or on a level. The dark lines in the figure below indicate where the length is reset. Using an edge-triggered mode allows an instantaneous reset, and using a level triggered mode allows you to reset the length and hold it at zero for a period of time.

Value	Mode	Example
0	Level Triggered (Active High) Input High = Reset, Input Low = Not Reset	
1	Level Triggered (Active Low) Input Low = Reset, Input High = Not Reset	
2	Rising Edge Triggered Reset on Low→High Transition	
3	Falling Edge Triggered Reset on High→Low Transition	
4	Toggle Edge Triggered Reset on High→Low or on Low→High	
5	Length Reset Input Disabled	Input is ignored

\$R	<u>Length Reset Value</u>
------------	----------------------------------

\$R<CR> Read
 Response Format: <N>

\$R<N><CR> Set
Factory Default: 0 Minimum: -999999999 Maximum: 999999999

<N> is a positive or negative integer specifying the Length Reset Value scaled by 1,000.

This setting can be used to introduce a constant offset into the length measurement. This is useful when measuring discrete parts using multiple external Material Present detectors. The Length Reset Value can be set to the distance between the sensors in order to automatically add the length onto each measurement. See the [Connecting Material Present Switches](#) section for details.

Example:

If using two external Material Present detectors and the detectors are mounted 4 feet apart, you would set the Length Reset Value to 4 feet to automatically add 4 feet to each measurement.

Assuming that the gauge's measurement units are in feet, to set the value to 4.000 ft, you would send the command:

\$R4000<CR>

U	<u>Measurement Units</u>
----------	---------------------------------

U<CR> Read
 Response Format: <N>

U<N><CR> Set
Factory Default: 2 (USA) or 3 (for all other countries)

<N> is an integer specifying the Measurement Units. When changing the measurement units, be sure to update the Pulse/Length settings (L and P) if you want to maintain the same pulse output frequency for a given speed.

Value	Units
0	m/s
1	ft/s
2	ft/min
3	m/min
4	in/min
5	mm/min
6	mm/s
7	yards/min

8	yards/s
---	---------

Note: Changing this setting will cause a reset, will reset the indicated length, and will cause the pulse outputs to be momentarily interrupted. Do not change this setting during normal operation.

W	<u>Walking Threshold</u>
----------	--

W<CR> Read
 Response Format: <N>

W<N><CR> Set
 Factory Default: 0 Minimum: 0 Maximum: 999999999

<N> is an integer that is the walking velocity value multiplied by 1000.

When valid velocity measurements are made below this value, the velocity output and pulse output will be forced to zero. When the velocity measurements are above this value, it has no effect. The LS9000 compares the absolute value of the measured velocity to this threshold. For example, say the W value is set to 1000, and the measurement units are feet/minute. If the LS9000 measures velocities between -1 and +1 feet/minute, it will output zero for the speed, and will not output pulses. If the velocity exceeds ± 1 foot/minute, the LS9000 will output measurements normally.

Setting this value to 0 disables the threshold.

This setting is used to prevent the LS9000 from sending velocity measurements and pulses when the velocity is close to zero. If the product being measured is stopped, but vibrating, the LS9000 will measure small velocities, both positive and negative. This setting can be used to suppress those measurements.

Note: Changing this setting will cause a reset, will reset the indicated length, and will cause the pulse outputs to be momentarily interrupted. Do not change this setting during normal operation.

\$N	<u>Minimum Velocity Limit</u>
------------	---

\$N<CR> Read
 Response Format: <N>

\$N<N><CR> Set
 Factory Default: -999999999 Minimum: -999999999 Maximum: 999999999

<N> is an integer that is the minimum velocity scaled by 1,000.

When velocity measurements are made below this value, the measurements will be considered to be invalid, and will be ignored. This setting can be used to make the LS9000 ignore water droplets and foreign material that can sometime pass into the measurement region.

Because any value, positive or negative, can be used for this setting, caution should be used to make sure that the speed chosen for the limit is well outside the possible speed range for the product. The LS9000 will not make measurements below this speed.

Examples:

To set the default value for this setting, of -999,999.999:

\$N-999999999<CR>

To set the setting to -100.000 (any velocity in the rage <-∞,-100> will be invalid)

\$N-100000<CR>

To set the setting to +2.000 (any velocity in the rage <-∞,+2> will be invalid)

\$N2000<CR>

\$X	<u>Maximum Velocity Limit</u>
------------	--------------------------------------

\$X<CR>

Read

Response Format: <N>

\$X<N><CR>

Set

Factory Default: 999999999 Minimum: -999999999 Maximum: 999999999

<N> is an integer that is the maximum velocity scaled by 1,000.

When velocity measurements are above this value, the measurements will be considered to be invalid, and will be ignored. This setting can be used to make the LS9000 ignore water droplets and foreign material that can sometime pass into the measurement region.

Because any value, positive or negative, can be used for this setting, caution should be used to make sure that the speed chosen for the limit is well outside the possible speed range for the product. The LS9000 will not make measurements above this speed.

Examples:

To set the default value for this setting, of 999,999.999:

\$N999999999<CR>

To set the setting to +100.000 (any velocity in the rage <+100,+∞> will be invalid)

\$N-100000<CR>

To set the setting to -2.000 (any velocity in the rage <-2,+∞> will be invalid)

\$N2000<CR>

X	<u>Minimum Final Length</u>
----------	------------------------------------

X<CR>

Read

Response Format: <N>

X<N><CR>

Set

Factory Default: 0 Minimum: 0 Maximum: 999999999

<N> is an integer that is the minimum final length value multiplied by 1000.

When a final length measurement completes, and the measured length is less than this value, no final length will be transmitted over the serial port.

#	<u>Index Pulse Output Function</u>
----------	---

#<CR> Read
 Response Format: <N>

#<N><CR> Set

Factory Default: 0

<N> is an integer specifying the function of the Index Pulse output. This command reconfigures the Index Pulse Output to be a status output.

Value	Index Pulse Output Function
0	(Default) Index (OPR) Pulse Output
1	Material Present Output
2	Valid Measurement Output
3	QF Pulse Output
4	QF Warning Output
5	Shutter Open
6	Laser On
7	System Ready
8	Thermostat Output (on @ 40C, off @ 35C)
9	Light Stack Green
10	Length Threshold A

Material Present Output

This output reflects the Material Present status. It is the same as the Material Present bit in the status word of the serial output data.

Voltage High: Material is present

Voltage Low: Material is not present

Valid Measurement Output

This output indicates if the LS9000 is making valid measurements. The output is the same as the Valid LED on the gauge.

Voltage High: Valid Measurements are being made

Voltage Low: No measurements are being made

QF Pulse Output

This output is a frequency output that indicates the current Quality Factor. A frequency of 100Hz indicates a QF of 0, and a frequency of 1kHz indicates a QF of 15. The frequency of the output increases by 60Hz with each increase of 1 in the QF (100, 160, 220, 280, 340, ..., 940, 1000)

QF Warning Output

This output indicates when the QF has decreased below a threshold. This can be used as a warning indicator to alert the user that the optics window may need to be cleaned, or other maintenance may need to be performed. The QF threshold is configured with the [& command](#), and the QF Warning Timeout is configured with the [< command](#).

Voltage High: QF is below threshold

Voltage Low: QF is at or above threshold

Shutter Open

Indicates if the beam shutter is open or closed. This is the same as the Shutter Open status bit in the serial output message.

Voltage High: Beam Shutter is Open

Voltage Low: Beam Shutter is Closed

Laser On

Indicates if the gauge is emitting laser radiation. This is the same as the Laser On status bit in the serial output message, and the Laser On LED.

Voltage High: Laser is On

Voltage Low: Laser is Off

System Ready

Indicates if the LS9000 is ready for operation. This status bit is on if all the following conditions are met:

- Laser is On – Laser Interlock (Pin 16) must be connected Signal Ground (Pin 11, 19, or 21)
- Beam Shutter is Open – Shutter Interlock (Pin 17) must be connected to Signal Ground (Pin 11, 19, or 21)
- Laser is at temperature

Thermostat Output

This output can be used to regulate the LS9000 temperature by using it to control a valve for coolant. This output turns on when the internal gauge temperature increases above 40°C, and turns back off when the internal temperature decreases below 35°C.

Voltage High: LS9000 Temperature > 40°C (Turn on coolant)

Voltage Low: LS9000 Temperature < 35°C (Turn off coolant)

Light Stack (Green)

This output can be used to drive a solid-state relay to turn on the green light in a light stack. The green light is illuminated when the laser interlock is open, indicating that the LS9000 is not emitting laser radiation. See the [Light Stack Interface](#) section for details.

Voltage High: Green lamp should be illuminated

Voltage Low: Green lamp should *not* be illuminated

Length Threshold A

Indicates when the current length has exceeded the [Length Threshold A](#) set point. This output is reset when the Index Pulse resets. See the [Index Pulse & Length Thresholds](#) section for details about length thresholds.

Voltage High: Length Threshold A Exceeded

Voltage Low: Length Threshold A Not Exceeded

Y [Index \(OPR\) Pulse Length](#)

Y<CR> Read
 Response Format: <N>

Y<N><CR> Set
 Factory Default: 10 Minimum: 0 Maximum: 255

<N> is an integer from 0 to 255 that is the length of the Index (OPR) pulse in 10ms increments.

Example:

You want to set the OPR Pulse length to 180ms.

Y = 180ms/10ms = 18.

Command: Y18<CR>

The time that the pulse is asserted does not vary with the measured velocity. When setting this value, be sure to set the pulse length to a value less than the time that will elapse between OPR pulses.

! [Index Pulse \(OPR\) Setting](#)

!<CR> Read
 Response Format: <N>

!<N><CR> Set
 Factory Default: 10000 Minimum: 1 Maximum: 999999999

<N> is an integer specifying the number of User Scaleable Pulses per Index Pulse.

Example:

Assume that the User Scaleable Pulse Rate (configurable with the P command) has been set to 1,000 pulses/foot.

To get an index pulse every 10 ft:

! = User Scaleable Pulse Rate (pulses/ft) x Desired Index Pulse Spacing (ft)

! = (1,000 pulses/ft) x 1 ft = 1,000 pulses

The command to set the correct value is !1000<CR>

To get an index pulse every 0.5 ft:

! = (1000 pulses/ft) x (0.5 ft) = 500 pulses

Command to set the correct value: !500<CR>

\$A**Length Threshold A**

\$A<CR>

Read

Response Format: <N>

\$A<N><CR>

Set

Factory Default: 8000 Minimum: 0 Maximum: 999999999

<N> is an integer specifying the number of User Scaleable Pulses for Length Threshold A. The Length Threshold A output will be asserted when this number of pulses has been output, and will be reset when the Index Pulse triggers. This output can be used to perform some operation prior to a cut.

Example:

Assume that the User Scaleable Pulse Rate (configurable with the [P command](#)) has been set to 1000 pulses/foot, and Index Pulse is configured to output every 200 ft.

To assert the Length Threshold A output after 180 ft:

! = User Scaleable Pulse Rate (pulses/ft) x Length Threshold A setting (ft)

! = (1,000 pulses/ft) x 180 ft = 180,000 pulses

The command to set the correct value is \$A180000<CR>

The output will clear when the length reaches 200ft, and the Index Pulse triggers. See the [Index Pulse & Length Thresholds](#) section for timing details.

\$B**Length Threshold B**

\$B<CR>

Read

Response Format: <N>

\$B<N><CR>

Set

Factory Default: 9000 Minimum: 0 Maximum: 999999999

<N> is an integer specifying the number of User Scaleable Pulses for Length Threshold B. The Length Threshold B output will be asserted when this number of pulses has been output, and will be reset when the Index Pulse triggers. This output can be used to perform some operation prior to a cut.

Example:

Assume that the User Scaleable Pulse Rate (configurable with the [P command](#)) has been set to 1000 pulses/foot, and Index Pulse is configured to output every 200 ft.

To assert the Length Threshold B output after 190 ft:

! = User Scaleable Pulse Rate (pulses/ft) x Length Threshold A setting (ft)

! = (1,000 pulses/ft) x 190 ft = 190,000 pulses

The command to set the correct value is \$B190000<CR>

The output will clear when the length reaches 200ft, and the Index Pulse triggers. See the [Index Pulse & Length Thresholds](#) section for timing details.

\$H

High Speed Pulse Output Configuration

\$H<CR> Read

Response Format: <N>

\$H<N><CR> Set

Factory Default: 0

<N> is an integer that specifies the function of the High Speed Pulse Output.

Value	Pulse Output Function	
	Phase A	Phase B
0	Default (High Speed Pulse Outputs)	
1	System Ready	Material Present
2	System Ready	Valid
3	System Ready	QF Pulse Output
4	System Ready	QF Warning Output
5	System Ready	Shutter Open
6	System Ready	Laser On
7	System Ready	Thermostat Control
8	Valid	Thermostat Control
9	Pulse Phase A	Sync Output

Note: Some of the above outputs were previously described under the [Index Pulse Output Function](#) setting.

Sync Output

Gauge-Gauge Synchronization Output that can be connected between multiple gauges in order to synchronize measurements. See the [Gauge-Gauge Synchronization](#) section for details.

L	<u>High Speed Pulse Rate</u>
----------	-------------------------------------

L<CR> Read
 Response Format: <N>

L<N><CR> Set
 Factory Default: 1000000 Minimum: 0 Maximum: 999999999

<N> is an integer that is the number of pulses per unit length scaled by 1000.

The High Speed Pulse Output can output pulses at rates higher than 5MHz. Caution should be used to ensure that the maximum line speed encountered during operation does not cause the pulse output frequency to exceed the maximum frequency of the counter. If the pulse frequency exceeds the counter maximum frequency, the counter may behave erratically.

Example:

Want 5750 pulses/meter
 Measurement Units are meters/minute
 Pulses/Length = 5750 x 1000 = 5750000
 Command to set the value is: L5750000<CR>

Note: Changing this setting will cause a reset, will reset the indicated length, and will cause the pulse outputs to be momentarily interrupted. Do not change this setting during normal operation.

\$L	<u>User Scaleable Pulse Output Configuration</u>
------------	---

\$L<CR> Read
 Response Format: <N>

\$L<N><CR> Set
 Factory Default: 0

<N> is an integer that specifies the function of the User Scaleable Pulse Output.

Value	Pulse Output Function	
	Phase A	Phase B
0	Default (Low Speed Pulse Outputs)	
1	System Ready	Material Present
2	System Ready	Valid
3	System Ready	QF Pulse Output
4	System Ready	QF Warning Output
5	System Ready	Shutter Open

6	System Ready	Laser On
7	System Ready	Thermostat Control
8	Valid	Thermostat Control
9	Light Stack (Yellow)	Light Stack (Red)
10	Pulse Phase A	Length Threshold B
11	Length Threshold A	Length Threshold B

Note: Some of the above outputs were previously described under the [Index Pulse Output Function](#) setting.

Light Stack (Yellow)

This output can be used to drive a solid-state relay to turn on the yellow light in a light stack. The yellow light is illuminated when the LS9000 laser is turned on, but the beam shutter is closed, indicating that the LS9000 is not emitting laser radiation. See the [Light Stack Interface](#) section for details.

Voltage High: Yellow lamp should be illuminated

Voltage Low: Yellow lamp should *not* be illuminated

Light Stack (Red)

This output can be used to drive a solid-state relay to turn on the red light in a light stack. The red light is illuminated when the LS9000 laser is turned on, and the beam shutter is open, indicating that the LS9000 is emitting laser radiation. See the [Light Stack Interface](#) section for details.

Voltage High: Red lamp should be illuminated

Voltage Low: Red lamp should *not* be illuminated

Length Threshold A

Indicates when the current length has exceeded the Length Threshold A set point. This output is reset when the Index Pulse resets. See the [Index Pulse/Length Thresholds](#) section for details about length thresholds.

Voltage High: Length Threshold A Exceeded

Voltage Low: Length Threshold A Not Exceeded

Length Threshold B

Indicates when the current length has exceeded the Length Threshold B set point. This output is reset when the Index Pulse resets. See the [Index Pulse/Length Thresholds](#) section for details about length thresholds.

Voltage High: Length Threshold A Exceeded

Voltage Low: Length Threshold A Not Exceeded

P

User Scaleable Pulse Rate

P<CR> Read

Response Format: <N>

P<N><CR> Set

Factory Default: 1000000 Minimum: 0 Maximum: 999999999

<N> is an integer that is the number of pulses per unit length scaled by 1000.

The User Scaleable Pulse Output can output pulses at rates higher than 250kHz. Caution should be used to ensure that the maximum line speed encountered during operation does not cause the pulse output frequency to exceed the maximum frequency of the counter. Many counters have surprisingly low maximum frequency specifications. If the pulse frequency exceeds the counter maximum frequency, the counter may behave erratically.

Example:

Want 100 pulses/inch

Measurement Units are inches/minute

Pulses/Length = 100 x 1000 = 100000

Command to set the value is: P100000<CR>

Note: Changing this setting will cause a reset, will reset the indicated length, and will cause the pulse outputs to be momentarily interrupted. Do not change this setting during normal operation.

\$D

High-Speed Pulse Count At Last Reset

\$D<CR> Read Only

Response Format: <N><CR>

Where <N> is a hexadecimal (base-16) value representing the number of high-speed output pulses generated up to the last length reset received by the gauge. The length reset can be an external hardware reset or a software command reset of the length.

\$E

Low-Speed Pulse Count At Last Reset

\$E<CR> Read Only

Response Format: <N><CR>

Where <N> is a hexadecimal (base-16) value representing the number of low-speed output pulses generated up to the last length reset received by the gauge. The length reset can be an external hardware reset or a software command reset of the length.

Z

[Read Firmware Version](#)

Z<CR>

Read Only Command

Response Format: LS9KV*<CR>

Where * is a capital letter indicating the firmware version.

\$C

[COM LED Function](#)

\$C<CR>

Read

Response Format: <N>

\$C<N><CR>

Set

Factory Default: 0

<N> is either 0 or 1. This setting controls the function of the COM LED on the LS9000. This is a Blue-Orange LED on top of the gauge that indicates communications status. This value should be set to 0 if your LS9000 does not have the Ethernet option installed.

Value	COM LED
0	RS-232/RS-422 Traffic
1	Ethernet Status/Traffic

RS-232/RS-422 Traffic

The Orange LED blinks when the LS9000 sees activity on the RS-232 or RS-422 receive lines. This does not indicate that the LS9000 understood the message, only that it saw the voltage change (the baud rate may be incorrect.) This is a diagnostic feature to allow easy wiring verification.

The Blue LED blinks when the LS9000 transmits on either the RS-232 or RS-422 ports. If the light is continuously blue, then the LS9000 is transmitting continuously.

When orange and blue are lit at the same time, the LED is white.

Ethernet Status/Traffic

LED Status	Meaning
OFF	No Connection
Orange	Link
Blue	Activity
White	Collision

MVER*Micro Version*****MVER?<CR>**

Read

Response Format: ls3 micro Rev * #nnn MMM DD YYY<CR>

Where * is a capital letter indicating the firmware version

Where nnn is the build number

Where MMM is the build month (ex. Jan, Feb, Mar, ...)

Where DD is the build day of month

Where YYYY is the build year

LOCKED*Setting Lock*****LOCKED?<CR>**

Read

Response Format: *LOCKED=<N><CR>

***LOCKED=<N><CR>**

Set

Factory Default: 1 Minimum: 0 Maximum: 1

<N> is either 0 or 1. This setting controls the Settings Lock. In order to prevent accidental changes to the LS9000's configuration settings, you must explicitly unlock the settings before any changes can be made.

Unlock Command: *LOCKED=0<CR>

Relock Command: *LOCKED=1<CR>

After unlocking the settings with *LOCKED=0<CR>, you can change settings. If you try to change setting without unlocking the LS9000, the changes will be ignored.

The LS9000 will automatically re-arm the Setting Lock after 1 minute.

LOCKEN*Setting Lock Enabled*****LOCKEN?<CR>**

Read

Response Format: *LOCKEN=<N><CR>

***LOCKEN=<N><CR>**

Set

Factory Default: 1 Minimum: 0 Maximum: 1

<N> is either 0 or 1. If you are manually changing many settings over a period of time, the Settings Lock can become a nuisance, so you may wish to disable it. Before the Settings Lock can be disabled, however, the settings must be unlocked:

To disable Settings Lock:

*LOCKED=0<CR>

*LOCKEN=0<CR>

To re-enable Settings Lock:

*LOCKEN=1<CR>

The Settings Lock should be re-enabled after configuration is completed, and the LS9000 is to be placed into normal operation.

GINFO*Gauge Model and Serial Number**

*GINFO?<CR> Read Only Command

Response Format: *GINFO=<LS9000-3XXX#XXXX-XXX-XXXX><CR>

This read-only command can be used to read back the LS9000 model number and serial number. The text before the # character indicates the Model Number, and the text after the # character indicates the Serial Number.

Example:

Command: *GINFO?

Response: *GINFO=LS9000-310X#1234-567-890

This response indicates a model number of "LS9000-310X", and a serial number of "1234-567-890"

ETHERNET*Ethernet Enabled**

*ETHERNET?<CR> Read Only Command

Response Format: *ETHERNET=<S><CR>

This is a read-only command that returns ENABLED if the Ethernet option is installed, and DISABLED if the Ethernet option is not installed.

If the Ethernet option is not installed, then all Ethernet settings can be disregarded.

***LINK**

Ethernet Link Status

*LINK?<CR> Read Only Command

Response Format: *LINK=<N1>, <N2><CR>

This is a read-only command that returns the status of the Ethernet link and the status of the DHCP connection. The command returns two values, <N1> and <N2>. The first value indicates the status of the Ethernet link, and the second value indicates the status of the DHCP client. If the DHCP option is not currently enabled, the second value can be ignored.

If the Ethernet link is connected and the DHCP client was able to get an address from the DHCP server, the normal return value is “*LINK=1,9”.

N1 Value	Ethernet Link State
0	Ethernet link is not available. Make sure that the cable is plugged in and is not damaged.
1	Ethernet link is available for communication.

N2 Value	DHCP Client State
0	DHCP Dead: DHCP Client is unable to get an address from the DHCP server.
1	DHCP Discover: Gauge is currently sending DHCP Discover broadcast messages in order to locate a DHCP server. The gauge will repeatedly attempt to find a DHCP server until one is located.
2	DHCP Offer: DHCP Server has been located and it has offered the gauge an available address.
3	DHCP Request: Gauge is requesting the offered address from the DHCP Server.
4	DHCP Decline: The gauge's DHCP client has discovered that the IP address offered by the server is already in use by some other device on the network.
5	DHCP Ack: DHCP Server has approved the gauge's DHCP client's use of the requested address.
6	DHCP Nak: The DHCP server has withdrawn it's offered address, and the client must retry for a new address.
7	DHCP Release: The DHCP client is releasing its IP address and returning to the server for use by other devices on the network.
8	DHCP Inform:
9	DHCP Ok: DHCP is working normally – this is the normal operating value for the DHCP status.
10	DHCP Renewing: The DHCP Client is trying to renew its leased address. The gauge will send DHCP Request messages to the DHCP server that originally gave it the address currently in use.

11	DHCP Rebinding: The DHCP client has failed to renew the address with the original DHCP server, and will retry, using any server available.
V	DHCP is disabled

If the Ethernet option is not installed, then all Ethernet settings can be disregarded.

*MACID	<u>Ethernet Hardware ID</u>
---------------	---

*MACID?<CR> Read Only Command

Response Format: *MACID=<XX:XX:XX:XX:XX:XX><CR>

This read-only command returns the Ethernet hardware ID. Each LS9000 is assigned a unique identifier, even if the Ethernet option is not installed.

This setting can be disregarded if the Ethernet option is not installed.

*DHCP	<u>DHCP Enable/Disable</u>
--------------	--

*DHCP?<CR> Read

Response Format: *DHCP=<N><CR>

*DHCP=<N><CR> Set

Factory Default: 0 Minimum: 0 Maximum: 1

<N> is an integer, either 0 or 1. This controls whether or not the gauge attempts to connect to a DHCP (Dynamic Host Configuration Protocol) server and receive a network address automatically. If you are connecting directly to a PC with a crossover cable, this option should be disabled.

If this setting is changed, the new value will take effect after a power cycle.

Value	Effect	IP Address
0	DHCP Disabled The LS9000 will not attempt to automatically obtain an address from a DHCP server. The IP Address, Netmask, and Default Gateway will be read from non-volatile memory.	Read from Non-Volatile Memory
1	DHCP Enabled The LS9000 will attempt to automatically obtain an address from the DHCP server. The IP Address, Netmask, and Default Gateway will be read from the server, and the settings stored in non-volatile memory will be ignored.	Automatic

If you are unsure as to whether or not you have a DHCP server on your network, contact your system administrator.

This setting can be disregarded if the Ethernet option is not installed.

Note: This setting will take effect after a power-cycle.

***NAME**Gauge Name

*NAME?<CR> Read
 Response Format: *NAME=<NAME><CR>
*NAME=<NAME><CR> Set

Factory Default: Copy of the *GINFO string Maximum Length: 30 characters

<NAME> is a user-selectable name (spaces NOT permitted) that you can assign to the LS9000. This setting can be used to name the gauge for informational purposes.

In gauges manufactured before June 2009, this setting was used to store the Host Name that was advertised to the DHCP server. This feature is no longer supported.

***IPADDR**IP Address

*IPADDR?<CR> Read
 Response Format: *IPADDR=<IP><CR>
*IPADDR=<IP><CR> Set

Factory Default: 192.168.10.246

Where <IP> is an IP Address, such as "192.168.10.246". This command can be used manually set the IP Address, or to read back the IP Address assigned by the DHCP server.

If the DHCP option is enabled, the value stored for this setting is ignored, and the IP Address read from the DHCP server is returned. If there was an error contacting the DHCP server, then the IP Address is returned as 0.0.0.0.

If DHCP is disabled, then this command is used to manually set the IP Address.

Example: (DHCP disabled)

To set the IP Address:

Command: *IPADDR=192.168.0.213<CR>

...and then read it back

Command: *IPADDR?<CR>

Response: *IPADDR=192.168.0.213<CR>

This setting can be disregarded if the Ethernet option is not installed.

Note: This setting will take effect after a power-cycle.

IPDEFGW*Default Gateway Address**

*IPDEFGW?<CR> Read

Response Format: *IPDEFGW=<IP><CR>

*IPDEFGW=<IP><CR> Set

Factory Default: 192.168.10.2

Where <IP> is an IP Address, such as "192.168.10.246". This command can be used manually set the IP Address of the Default Gateway, or to read back the IP Address assigned by the DHCP server.

If the DHCP option is enabled, the value stored for this setting is ignored, and the IP Address read from the DHCP server is returned. If there was an error contacting the DHCP server, then the IP Address is returned as 0.0.0.0.

If DHCP is disabled, then this command is used to manually set the Default Gateway Address.

Example: (DHCP disabled)

To set the Default Gateway Address:

Command: *IPDEFGW=192.168.0.213<CR>

...and then read it back

Command: *IPDEFGW?<CR>

Response: *IPDEFGW=192.168.0.213<CR>

This setting can be disregarded if the Ethernet option is not installed.

Note: This setting will take effect after a power-cycle.

IPNETMSK*Netmask**

*IPNETMSK?<CR> Read

Response Format: *IPNETMSK=<IP><CR>

*IPNETMSK=<IP><CR> Set

Factory Default: 255.255.255.0

Where <IP> is the netmask, formatted as an IP Address, such as "255.255.255.0". This command can be used manually set the netmask, or to read back the value assigned by the DHCP server.

If the DHCP option is enabled, the value stored for this setting is ignored, and the IP Address read from the DHCP server is returned. If there was an error contacting the DHCP server, then the value is returned as 0.0.0.0.

If DHCP is disabled, then this command is used to manually set the Netmask.

Example: (DHCP disabled)

To set the Netmask:

Command: *IPNETMSK=255.255.255.0<CR>

...and then read it back

Command: *IPNETMSK?<CR>

Response: *IPNETMSK=255.255.255.0<CR>

This setting can be disregarded if the Ethernet option is not installed.

Note: This setting will take effect after a power-cycle.

DATAPORT*UDP Data Port**

*DATAPORT?<CR> Read

Response Format: * DATAPORT=<N><CR>

*DATAPORT=<N><CR> Set

Factory Default: 1002

This configures the port on the destination system where UDP data packets will be sent. Gauges shipped before June 2009 did not have this command and always sent data to port 1002 on the destination computer. Newer gauges are shipped with this setting set to 1002 by default. You can change this setting to cause each gauge on your network to transmit UDP data to a different port on the receiving computer, which allows you to use a different UDP socket for each gauge.

Generally, this port should be set to a value higher than 1024 so that it doesn't interfere with standard network interfaces.

Example:

To set the Data Port:

Command: *DATAPORT=1002<CR>

...and then read it back

Command: *DATAPORT?<CR>

Response: *DATAPORT=1002<CR>

This setting can be disregarded if the Ethernet option is not installed.

TF**Final Length Mode**

TF<CR>

Data Output Command

Data Format: <+LLLLLL.LLL,QF><CR>

This command places the LS9000 into Final Length Mode. This mode only affects the communication port over which the command is sent. For example, if the command is sent over RS-232, only the RS-232 port will transmit Final Length readings—the RS-422 and Ethernet ports will not change operation.

The LS9000 will output a fixed length (15 bytes) serial message at the end of each piece part (loss of material present) containing final length, and the average Quality Factor over the piece part.

In the data format above, <+LLLLLL.LLL> is the final length of the part, including starting and ending length correction. <QF> is the average Quality Factor that was measured over the part. Each time Material Present is lost, the LS9000 will output a Final Length reading if the measured length is larger than the Minimum Final Length.

Length values of +999999.999 indicate expiration of the [Material Present Validation Time](#).

Example Data:

+000023.011,15<CR>

+000023.012,15<CR>

+000023.011,15<CR>

To remove the gauge from this mode, send a <CR>, or send the [Stop Real-Time Output](#) command.

TE

Text Output Mode

TE<CR>

Data Output Command

Data Format: <L, V, QF, ST><CR>

This command places the LS9000 into Text Output Mode. This mode only affects the communication port over which the command is sent. For example, if the command is sent over RS-232, only the RS-232 port will transmit measurement data—the RS-422 and Ethernet ports will not change operation.

The LS9000 will output a serial message at an interval determined by the [User Update Rate](#) (O setting). This rate can vary from 1ms to 2.047s. If using a fast update rate, it may not be possible to transmit every reading at lower baud rates. Refer to the [Real-Time Data Timing Considerations](#) section for details.

The measurement data is a comma delimited list of the current measurement data outputs. The response string is always 28 characters. All fields are zero-padded to form a constant length string.

Format:

```
±LLLLLLLLLL,±VVVVVVVV, QF, ST<CR>
1234567890123456789012345678
      1           2
```

Value	Format	Description	Examples
L	Integer x 1000 (Signed)	Current Length	+000001209 ← (+1.209) -000000342 ← (-0.342)
V	Integer x 1000 (Signed)	Current Velocity	+000120321 ← (+120.321) -000034131 ← (-34.131)
QF	Integer	Quality Factor	15 04
ST	Integer	Status	63 47

The Status value is a bit field that has the following format:

Bit	Status Field	Convention
0	Laser @ Temperature	Yes=1 / No=0
1	Laser Interlock Open/Closed	Closed=1 / Open=0
2	Shutter Open/Closed	Open=1 / Closed = 0
3	Material Present	Yes=1 / No=0
4	Valid Measurement	Yes=1 / No=0
5	System Ready (Indicates Interlock Closed, Shutter Open, and Laser @ Temperature)	Yes=1 / No=0

Example TE Data Output:

```
+000006090,+000144950,15,63<CR>
+000006100,+000145292,15,63<CR>
+000006110,+000146965,15,63<CR>
+000006120,+000148606,15,63<CR>
+000006130,+000149265,15,63<CR>
+000006140,+000149183,15,63<CR>
+000006150,+000148663,15,63<CR>
+000006159,+000147472,15,63<CR>
+000006169,+000145500,15,63<CR>
```

To remove the gauge from this mode, send a <CR>, or send the [Stop Real-Time Output](#) command.

V**Read One Line of Measurement Data**

V<CR> Read Only Command

Response Format: <L, V, QF, ST><CR>

The response is a comma delimited list of the current measurement data outputs. The response string is always 28 characters. All fields are zero-padded to form a constant length string.

The data output is identical to the data transmitted when transmitting data in response to the [TE command](#).

TB**Binary Output Mode**

TB<CR> Data Output Command

Data Format: 16-Byte Binary Message

This command places the LS9000 into Binary Output Mode. This mode only affects the communication port over which the command is sent. For example, if the command is sent over RS-232, only the RS-232 port will transmit measurement data—the RS-422 and Ethernet ports will not change operation.

The LS9000 will output a serial message at an interval determined by the [User Update Rate](#) (○ setting). This rate can vary from 1ms to 2.047s. If using a fast update rate, it may not be possible to transmit every reading at lower baud rates. Refer to the [Real-Time Data Timing Considerations](#) section for details.

This measurement mode is designed to interface directly to a computer or PLC, and does not produce a human readable text format that can be used in a terminal program. In this mode, the LS9000 sends measurement data in a binary format that is more compact than the text output message. This lowers the number of bytes per output message, and allows 1ms updates at 115.2k or 230.4kBaud.

The output message is a fixed length 16 byte message. To determine where the start of a message is in the data, the receiving software should look for a string of 5 FF values, followed by a value that is not FF. The bytes are ordered in the message such that it is impossible for this sequence to occur except at the beginning of the message.

	Byte	Value
Synchronization	0	FF (hex)
	1	FF (hex)
	2	FF (hex)
	3	FF (hex)
	4	FF (hex)
	5	QF (0-15) ← can't be FF
	6	Length Byte 3 (MSB)
	7	Length Byte 2
	8	Length Byte 1
	9	Length Byte 0 (LSB)
	10	Status (0-63)
	11	Velocity Byte 3 (MSB)
	12	Velocity Byte 2
	13	Velocity Byte 1
	14	Velocity Byte 0 (LSB)
	15	Checksum (8-bit sum of all bytes)

Note: If reading data over RS-232 or RS-422 the framing **MUST** be set to 8n1 for this mode to work properly.

The Length and Velocity values are both 2's complement 32-bit integers that represent the current length and speed multiplied by 1000. The QF and Status are unsigned bytes. The Checksum value is the 8-bit sum of all the bytes including the 5 FF's used for synchronization.

Data Processing Procedure:

- 1) Wait for 5 sequential FF values
- 2) If the next value is not FF, store it as the QF, else go to #1
- 3) Read and store 10 more bytes
- 4) Check the last byte read (the checksum) to make sure it was correct
- 5) Process/Store Verified Reading
- 6) Repeat from step 1

To remove the gauge from this mode, send a <CR>, or send the [Stop Real-Time Output](#) command.

TT

Configurable Text Output Mode

TT<CR> Data Output Command
 Response Format: Variable

TT<N><CR> Set

<N> specifies the output format. The value can be set with a command such as TT15<CR> (sets the format to 15). To start receiving data, send the command TT<CR>. This output mode allows you to turn on and off parts of the serial output message, which can make the data simpler to process and reduce the number of bytes being transmitted.

Value	Format
6	<TT, V, Q><CR>
15	<TT, L, V, Q, S><CR>
13	<TT, L, Q, S><CR>
14	<TT, V, Q, S><CR>
77	<TT, L, Q, S, T><CR>
78	<TT, V, Q, S, T><CR>
79	<TT, L, V, Q, S, T><CR>

Where:

Notation	Description	Length (Bytes)
TT	Current Value of TT Setting	Varies
L	Length * 1000	10
V	Velocity * 1000	10
Q	Quality Factor	2
S	Status	2
T	Temperature * 100	4

Example:

To set TT to 79, and then start receiving data:

- 1) Send TT79<CR>
- 2) Send TT<CR>

The LS9000 will start transmitting data in this format:

```
79,+000000370,000012348,15,63,3125<CR>
79,+000000494,000012347,15,63,3125<CR>
79,+000000617,000012345,15,63,3125<CR>
79,+000000741,000012344,15,63,3125<CR>
```

79,+000000864,000012342,15,63,3125<CR>

These readings indicate the length increasing from +0.370 to 0.864, with a velocity near +12.345, a Quality Factor of 15, Status of 63, and an internal gauge temperature of 31.25°C.

To remove the gauge from this mode, send a <CR>, or send the [Stop Real-Time Output](#) command.

TV	<u>Read One Line of TT Data</u>
-----------	--

TV<CR> Data Output Command

Response Format: Variable (Depends on TT Value)

This command will cause the LS9000 to transmit one line of data in the format configured by the TT command. See the [TT command](#) for details.

	<u>Stop Real-time Output</u>
--	---

.<CR> Command

This command stops the LS9000 from sending real-time measurement data. This command has the same effect as just sending a <CR>.

*AUTO232	<u>RS-232 Power-On Data Transmission Mode</u>
-----------------	--

*AUTO232?<CR> Read

Response Format: *AUTO232=<S><CR>

*AUTO232=<S><CR> Set

Factory Default: OFF

Where <S> is one of the values listed in the table below.

This command configures the type of data that the gauge will begin transmitting over the RS-232 port at power-on. The gauge can be configured to output nothing at power-on, can be configured to output any of the continuous data output modes, or can be configured to resume transmission of whatever type of data was being transmitted at power-off. If the gauge is configured to output data at power-up, it can be stopped with a carriage return, or with the [Stop Real-Time Output](#) command and other commands can be sent for configuration or diagnostic purposes. If configured for TE, TF, TT, or TB modes, the next time the gauge powers on, it will start transmitting data again, as configured. If configured for KEEP mode, then the gauge will remember what type of data it was last transmitting, and will resume transmitting that same type of data when powered on again. For details about the format of the output data, see the descriptions of the various data output modes described previously in this section.

Value	Description
OFF	(Default) Outputs nothing at power-on, and waits for commands.
TE	Outputs Text Data (TE mode) data at power-on.
TF	Outputs Final Length Data (TF mode) data at power on. Each

AUTOADDR*UDP Power-On Data Destination IP Address**

*AUTOADDR?<CR>

Read

Response Format: *AUTOADDR=<IP><CR>

*AUTOADDR=<IP><CR>

Set

Factory Default: 192.168.10.1

Where <IP> is an IP Address, such as "192.168.10.246". This command configures the destination IP address for UDP output data. If the gauge is not configured to output UDP data on start-up, then this setting is not used.

AUTOPORT*UDP Power-On Data Destination Port**

*AUTOPORT?<CR>

Read

Response Format: *AUTOPORT=<IP><CR>

*AUTOPORT=<N><CR>

Set

Factory Default: 1002

Where <N> is an IP port number, such as 1234. This command configures the destination Port for UDP output data. If the gauge is not configured to output UDP data on start-up, then this setting is not used. This port should be set to a value higher than 1024 so that it doesn't interfere with standard network interfaces.

E**Filter Range Enables**

E<CR>

Read

Response Format: <N>

E<N><CR>

Set

Factory Default: 31

<N> is an integer that should normally be set to 31.

This setting should be left at 31 and should not be modified. The LS9000 will not work properly if this setting is set to a value other than 31.

Only change this setting if specifically instructed to do so by a Beta LaserMike Service Engineer.

TO [Delta Length Calculation Mode](#)

TO<CR> Read
 Response Format: <N><CR>

TO<N><CR> Set
 Factory Default: 0

<N> is an integer 0, 1 or 2 indicating the Delta Length Calculation mode.
 This setting can be used to alter the method for integrating the length measurements.
 Only change this setting if specifically instructed to do so by a Beta LaserMike Service Engineer.

Value	Description
0	Normal (1ms) Internal length values are incremented by the instantaneous velocity measurement * 1ms
1	Caster Mode (Avg) Internal length values are incremented by the running (DIP) averaged velocity measurement * 1ms
2	Discrete Part (Avg + Lag Corrected) Internal length values are incremented by the running (DIP) averaged velocity measurement with lag correction applied * 1ms

TS [Signal Threshold Settings](#)

TS<CR> Read
 Response Format: <N><CR>

TS<N><CR> Set
 Factory Default: 0

Where <N> can be the summation of one or more values described below.
 Only change this setting if specifically instructed to do so by a Beta LaserMike Service Engineer.

Value	Description
0	Normal mode – all other options described below are disabled
1	Low Correlation Threshold
2	Low Correlation Threshold for Range 2 Only
4	Range 2 Voting

8	Tracking Hits 10
16	Lag Corrected Low-Speed Pulse Output Mode
32	Lag Corrected High-Speed Pulse Output Mode
64	Disable Laser Temperature Stabilization Delay

TU [Shift Frequency](#)

TU<CR> Read
 Response Format: <N><CR>

TU<N><CR> Set
Factory Default: 0

Where <N> is one of the setting values shown in the table below. This setting changes the frequency shift applied to the Doppler signal being processed by the gauge.

Only change this setting if specifically instructed to do so by a Beta LaserMike Service Engineer.

Value	Description
0	50kHz Shift Frequency
1	5kHz Shift Frequency
2	10kHz Shift Frequency
3	50kHz Shift Frequency
4	100kHz Shift Frequency
5	500kHz Shift Frequency

\$Z [Reversal Zone Hits](#)

\$Z<CR> Read
 Response Format: <N><CR>

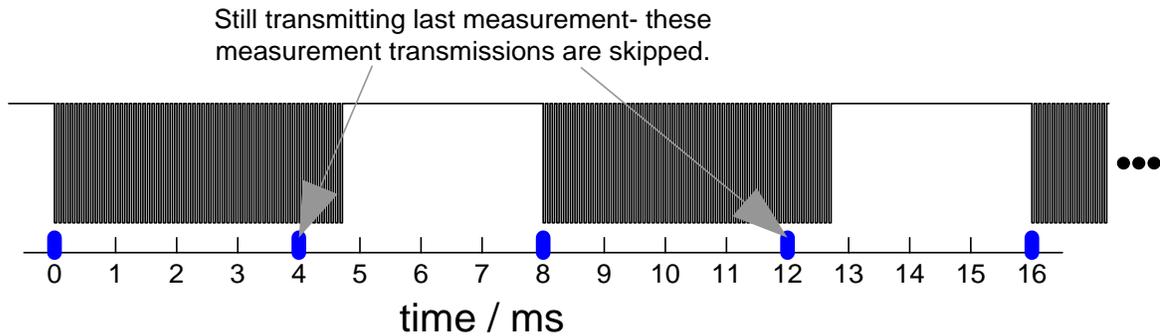
\$Z<N><CR> Set
Factory Default: 10 Minimum: 1 Maximum: 100

Where <N> is a value in milliseconds that implements a filter for instantaneous direction changes measured by the gauge.

Only change this setting if specifically instructed to do so by a Beta LaserMike Service Engineer.

Real-Time Data Timing

When transmitting data at fast update rates, consideration must be given to the amount of time that it takes to transmit a single message. If the transmission time exceeds the update rate, it is impossible for the LS9000 to transmit all data. Ethernet UDP is fast enough that this does not occur, but it can occur over RS-232 and RS-422. For example, if the RS-232 baud rate were set to 57.6k, a TE data reading would take 4.86ms to transmit. If the User Update Rate is set to 4ms, this will result in every other message being skipped, resulting in an actual update rate of 8 ms. The gauge's measurements will not be affected by this—it will still produce accurate measurements.



The following table lists the fastest update rate possible for each baud rate. If using TB mode, the framing must be set to an 8n1 mode.

Baud Rate	Transmission Time			Fastest Update Rate	
	1 Byte	TE	TB	TE	TB
230.4k	43.4µs	1.22ms	694µs	2ms	1ms
115.2k	86.8µs	2.43ms	1.39ms	3ms	2ms
57.6k	173µs	4.86ms	2.78ms	5ms	3ms
38.4k	226µs	7.29ms	4.16ms	8ms	5ms
19.2k	521µs	14.6ms	8.33ms	15ms	9ms
9600	1.04ms	29.2ms	16.7ms	30ms	17ms
4800	2.08ms	58.3ms	33.3ms	59ms	34ms

When sending real-time data over Ethernet, you can either use the UDP or TCP protocols, but UDP is recommended. The TCP protocol has so much overhead that the maximum update rate will be on the order of 200ms. The UDP protocol has very little overhead, so it is easily able to transmit data every 1ms.

Communication Protocol: Command List

@	RS-422 Baud Rate & Framing
J	RS-232 Baud Rate & Framing
&	Quality Factor Warning Threshold
<	Quality Factor Warning Timeout
A	Direction Inversion Switch
B	Hold Velocity If Above
\$T	Hold Velocity Timeout
C	Calibration Trim
D	Analog Full Scale Velocity
S	Material Present Input Mode
F	Material Present Dropout Time
G	Material Present Validation Time
M	Material Present Threshold Level
TP	Velocity at Loss of Material
H	Hour Meter Current Value
I	Current & Max Temperature
K	Averaging Time
O	User Update Rate
Q	Quality Factor Current Value
R	Reset Internal Length Count
%	Length Reset Input Action
\$R	Length Reset Value
U	Measurement Units
W	Walking Threshold
\$N	Minimum Velocity Limit
\$X	Maximum Velocity Limit
X	Minimum Final Length
#	Index Pulse Output Function
Y	Index (OPR) Pulse Length
!	Index Pulse (OPR) Setting
\$A	Length Threshold A

\$B	Length Threshold B
\$H	High Speed Pulse Output Configuration
L	High Speed Pulse Rate
\$L	User Scaleable Pulse Output Configuration
P	User Scaleable Pulse Rate
\$D	High Speed Pulse Count at Last Reset
\$E	Low Speed Pulse Count at Last Reset
Z	Read Firmware Version
\$C	COM LED Function
*MVER	Micro Version
*LOCKED	Setting Lock
*LOCKEN	Setting Lock Enabled
*GINFO	Gauge Model and Serial Number
*ETHERNET	Ethernet Enabled
*LINK	Ethernet Link Status
*MACID	Ethernet Hardware ID
*DHCP	DHCP Enable/Disable
*NAME	Gauge Name
*IPADDR	IP Address
*IPDEFGW	Default Gateway Address
*IPNETMSK	Netmask
*DATAPORT	UDP Data Port
TF	Final Length Mode
TE	Text Output Mode
V	Read One Line of Measurement Data
TB	Binary Output Mode
TT	Configurable Text Output Mode
TV	Read One Line of TT Data
.	Stop Real-time Output
*AUTO232	RS-232 Power-On Data Transmission Mode
*AUTO422	RS-422 Power-On Data Transmission Mode
*AUTOUDP	UDP Power-On Data Transmission Mode
*AUTOADDR	UDP Power-On Data Destination IP Address

*AUTOPOINT	UDP Power-On Data Destination Port
	For Trained Personnel Only
E	Filter Range Enables
TO	Delta Length Calculation Mode
TS	Signal Threshold Settings
TU	Shift Frequency
\$Z	Reversal Zone Hits

Ethernet Communication

The LS9000 has an optional Ethernet port that can be used to collect data and configure settings. Measurement data and configuration settings are available over both the TCP and UDP protocols. For ease of use, the LS9000 can act as a DHCP client, automatically obtaining a network IP address from a DHCP server. Also, it supports host name advertisement, so that the gauge can be addressed on the network without actually knowing the IP address.

Supported Protocols

In general, TCP should be used for configuration settings and UDP for real-time measurement data. All data and configuration commands are available over both protocols, but UDP has much lower overhead, so it is better suited for continuous, high-speed, data output. TCP is a slower protocol that guarantees delivery of each packet, so it is better suited for configuring settings. TCP and UDP can be used concurrently.

COM LED

The COM light on top of the LS9000 can be configured to indicate Ethernet activity by setting the COM LED Function ([\\$C command](#)) setting to 1. This is a blue-orange LED that can have the following states:

Ethernet State	COM LED
No Connection	Off
Connection OK	Orange
Activity Detected	Blue
Collision	White

Configuration Settings

This table lists the configuration settings relevant to Ethernet communications.

Setting	Configuration Command	Read/Write
Ethernet Enabled	*ETHERNET	Read Only
Ethernet Hardware ID	*MACID	Read Only
DHCP Enable/Disable	*DHCP	Read/Write
Host Name	*NAME	Read/Write
IP Address	*IPADDR	Read/Write
Default Gateway Address	*IPDEFGW	Read/Write
Network Mask	*IPNETMSK	Read/Write
UDP Data Port	*DATAPORT	Read/Write
Link Status	*LINK	Read Only
COM LED Function	\$C	Read/Write
UDP Power-On Data Transmission Mode	*AUTOUDP	Read/Write
UDP Power-On Data Destination IP Address	*AUTOADDR	Read/Write
UDP Power-On Data Destination IP Port	*AUTOPORT	Read/Write

IP Address Configuration

The LS9000 can automatically obtain a network address using DHCP (Dynamic Host Configuration Protocol), or it can use a manually configured IP Address. If DHCP is enabled, then the LS9000 will reports its IP Address as 0.0.0.0 until an address is acquired, at which time it will report the address obtained from the DHCP server. This process usually only takes a few seconds, but the time will depend on the DHCP server's responsiveness. If the IP Address stays at 0.0.0.0 for more than 5 minutes, this means that the LS9000 was unable to acquire a network address, and you should either use a manual IP Address, or contact your network administrator to determine the cause.

DHCP

If the LS9000 is configured to use DHCP (Dynamic Host Configuration Protocol,) when the gauge powers on, it will read its IP address from the DHCP server instead of using the IP address configured with the [*IPADDR command](#).

The LS9000 requests a lease time of 10 hours from the DHCP server. The server may respond with a different lease time, including an infinite lease time. After half the lease time has expired, the LS9000 will request a DHCP Refresh from the server and will renew its IP address. Usually, the same IP Address will be returned by the DHCP server, but this is not guaranteed. If you are reading measurements from the LS9000 over Ethernet, you may want to permanently fix the IP Address by assigning it manually.

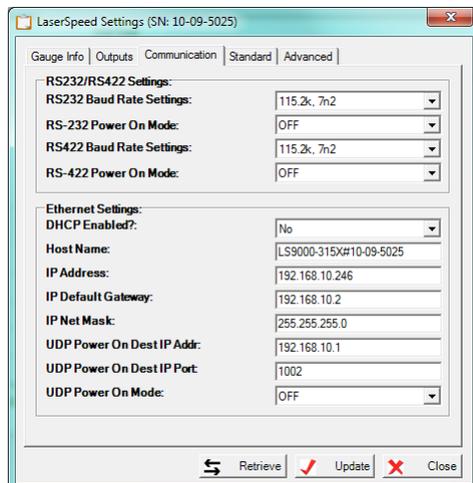
If you are not familiar with Ethernet protocols and DHCP, leave DHCP disabled and manually fix the IP address using the [*IPADDR command](#).

Gauges manufactured after June 2009 do not support the DHCP Host Name Option. For more information about the Host Name Option, see RFC 2132.

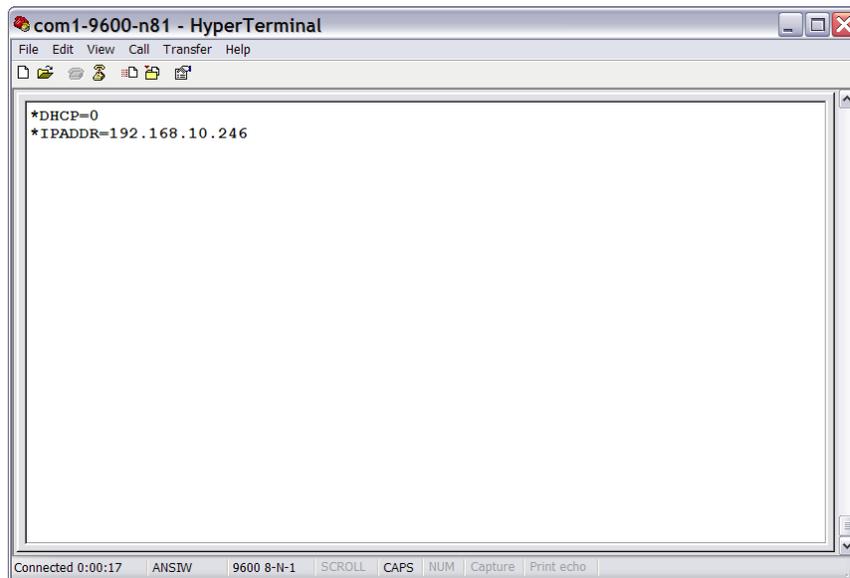
Manually Configured IP Address

To manually assign an IP Address, disable DHCP, then set the IP Address. This can be done with LaserTrak, or by entering commands over the RS-232 or RS-422 ports. If you are using a LAN, contact your system administrator to reserve an IP Address, or a block of addresses for use with instrumentation.

Configuring the IP Address with LaserTrak



Configuring the IP Address with HyperTerminal



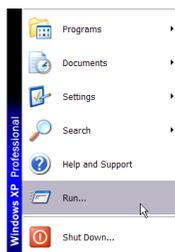
Ping / ICMP

The LS9000 will respond to Ping/ICMP messages. This is an easy way to check the Ethernet connection, and can be done by any computer on the network.

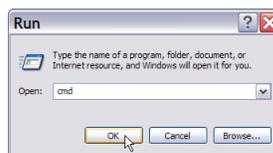
Ping Example using Manual IP Address

- DHCP Disabled
- IP Address = 192.168.10.246

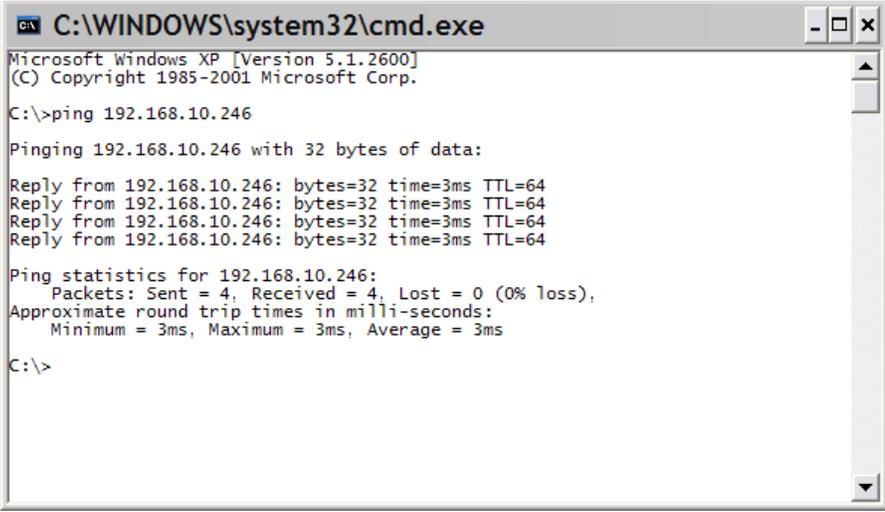
1 Start→Run



2 Type "cmd" and click OK



3 At the command prompt, type: "ping 192.168.10.246" <ENTER> (or use the IP Address you assigned)



```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\>ping 192.168.10.246

Pinging 192.168.10.246 with 32 bytes of data:

Reply from 192.168.10.246: bytes=32 time=3ms TTL=64

Ping statistics for 192.168.10.246:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 3ms, Maximum = 3ms, Average = 3ms

C:\>
```

TCP Communications

The LS9000 accepts TCP (Transfer Control Protocol) connections on port 23 (Telnet) and port 1003. The Telnet port (Port 23) can be used by a telnet client such as the one included with Windows to manually type commands. On this port, commands can be sent a single character at a time, and must be terminated with a carriage return. Port 1003 is designed to interface to a computer or PLC. This port accepts whole commands (not a single character at a time) and does not require a carriage return at the end of each command.

Note: When using a telnet application to access the gauge, it is typically necessary to enable the KEEPALIVE option on the telnet terminal application to prevent the gauge from closing the socket connection after 15 seconds of inactivity. The same restriction applies to PC applications or PLCs that hold the TCP socket (either port 23 or 1003) open for more than 15 seconds with no activity. The application or PLC must enable the KEEPALIVE socket option to transmit NOP packets during periods of inactivity on the socket connection.

The commands entered on the Telnet port are identical to the RS-232/RS-422 commands. See the [Communication Protocol](#) section for a complete listing of commands.

UDP Communications

UDP is a connectionless protocol that has much less overhead than TCP. This allows a much higher data rate for measurements. There are two ports used in UDP communications, ports 1001 and 1002. Port 1001 is used to receive commands and send responses to commands, and port 1002 is used to send real-time measurement data.

The destination port for UDP messages (responses or real-time data) from the LS9000 is the same as the source port of the message that initiated the response. All responses to commands, such as responses to settings request messages, are received on and sent from port 1001. All real-time data is sent from port 1002 to the port number configured with the [*DATAPORT](#) command. This separation allows you to create two separate sockets on the host, one socket to send and receive commands, and a separate socket to receive real-time data.

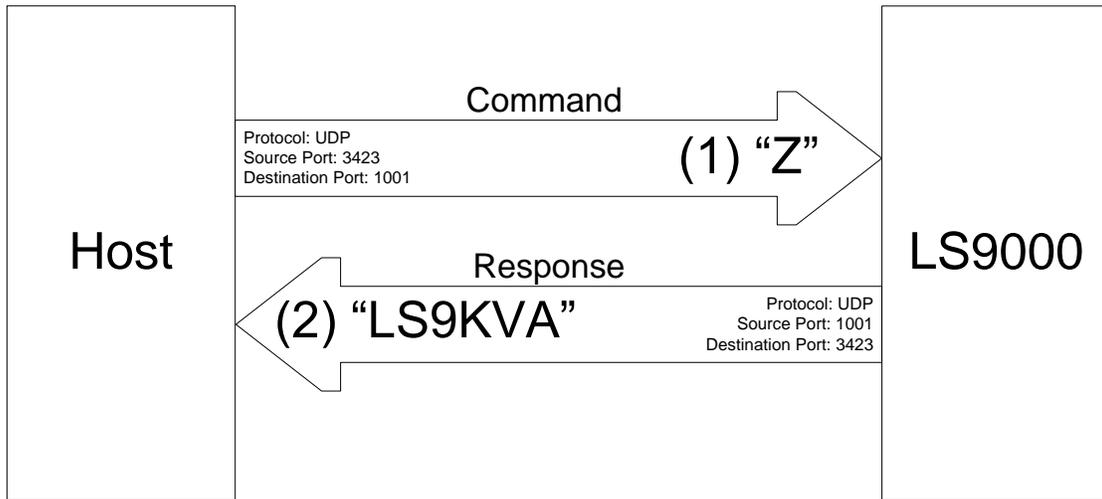
Commands sent to the command port (1001) of the LS9000 gauge must be wholly contained in a single UDP packet with only one command per packet. No carriage return characters are permitted. UDP commands terminated with a <CR> character will be ignored by the gauge.

Commands responses sent from the LS9000 gauge will be wholly contained in a single UDP packet with only one response per packet. Responses are not terminated with <CR> or <NULL> characters. The valid response length can be derived from the byte length stored in the header of the UDP packet.

UDP Command Example

Sending a command to the LS9000 via UDP

- Host Port: 3423 (Can be any port #)
- LS9000 Port: 1001

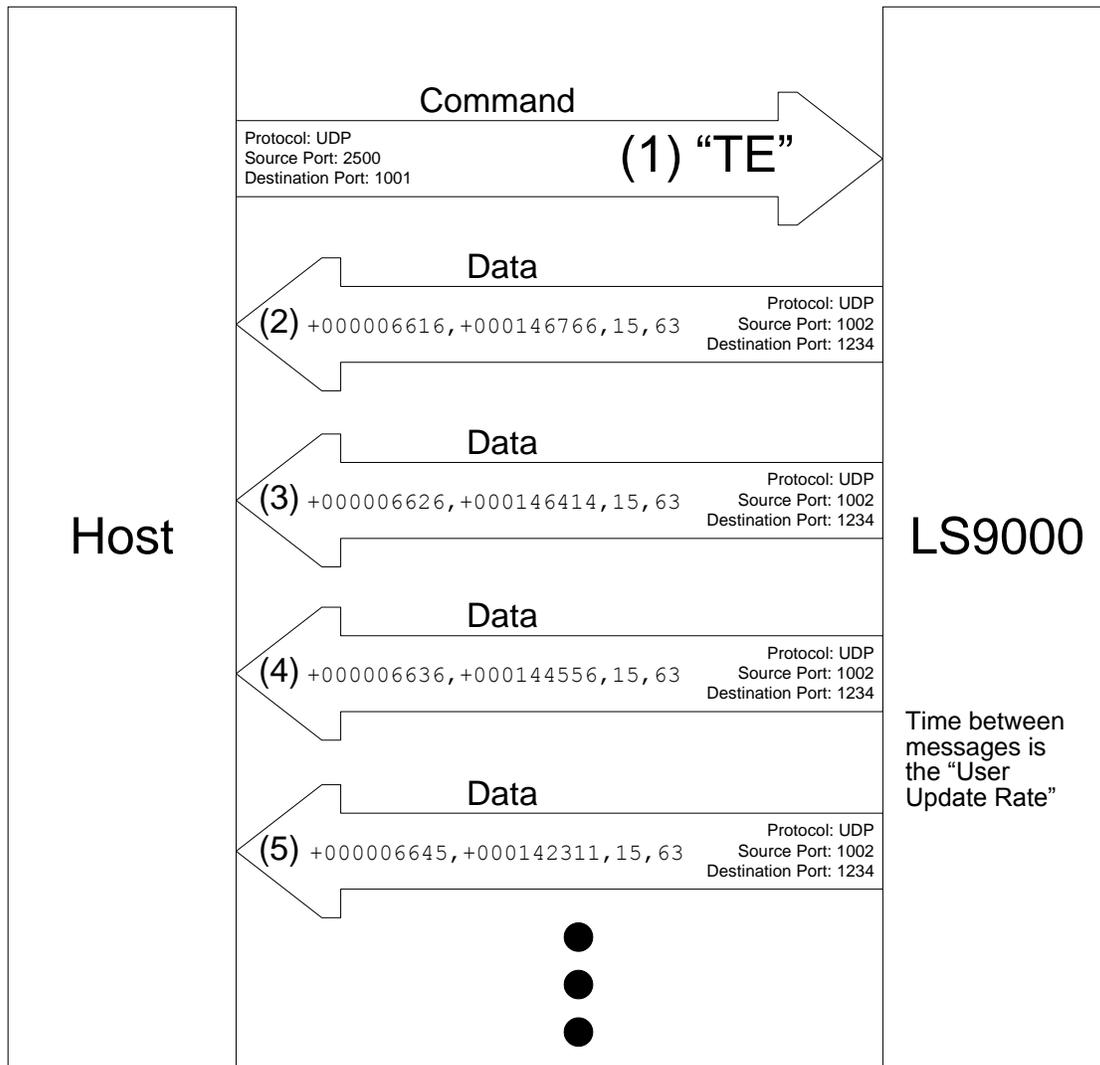


UDP Real-Time Measurement Example

Starting real-time measurement data output

- Host Port: 2500 (Can be any port #)
- LS9000 Command Port: 1001
- LS9000 Data Output Port: 1002

In the example below, note that the **TE** command from the host is sent *to* port 1001, but data from the LS9000 is sent *from* port 1002. In this example, the LS9000 sends real-time data from local port 1002 to remote port 1234 in response to a **TE** command. The remote port (1234 in this example) can be configured with the ***DATAPORT** command.



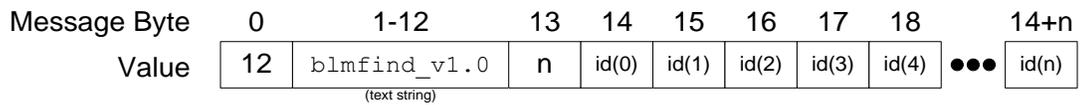
UDP Discovery Beacon

The LS9000 supports a protocol that allows a host to find all LaserSpeed gauges connected to a network. This protocol is initiated by a host sending a UDP broadcast message, referred to as a Discovery Beacon. Each LaserSpeed that receives the message will respond to it.

The discovery beacon has a configurable format that specifies what information should be in the response message. The message is composed of a list of identifiers, each one specifying a value that is being requested. The LaserSpeed's response consists of a list of values, each one giving the value of a requested parameter. The values listed in the response are in the same order as the identifiers are listed in the discovery beacon. If an identifier in the discovery beacon is not recognized, then it is omitted from the response. If an identifier is sent out in the beacon, but a gauge omits it from its response, it should be assumed that the gauge does not recognize the identifier.

Discovery Beacon Format

- Protocol: UDP Broadcast
- Host Port: Any
- Destination Port: 10003



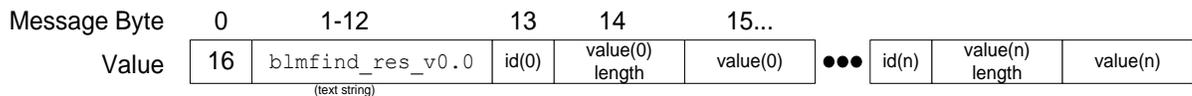
Byte	Description
0	The length of the protocol version. This byte should always be 12.
1-12	The protocol version string. This string should be set to "blmfind_v1.0"
13	n specifies the number of identifiers in the list.
14 to 14+n	Each byte specifies the identifier of a value that should be returned in the beacon response.

Identifier	Value	Response Length (Bytes)
0	Blank	0 – These id's are ignored
1	IP Address	4
2	Ethernet Hardware ID	6
3	DHCP Enabled/Disabled	1 (either 1 or 0)
4	Gauge Model	Varies (Text String)
5	Serial Number	Varies (Text String)
6	Host Name	Varies (Text String)
7	Boot Loader Revision	Varies (Text String)
8	Software Revision	Varies (Text String)
9	Firmware Revision	Varies (Text String)
10	Web Server Revision	Varies (Text String)
others	Reserved	

Discovery Beacon Response Format

- Protocol: UDP Broadcast
- Source Port: 10003
- Destination Port: Same as Discovery Beacon

The device response format is a UDP message to the same port from which the discovery beacon originated. The response consists of a version string, followed by a list of values in response to the list identifiers in the beacon message. Each response consists of three parts: the identifier, the length of the value (in bytes), and the value. This sequence is repeated for each value.



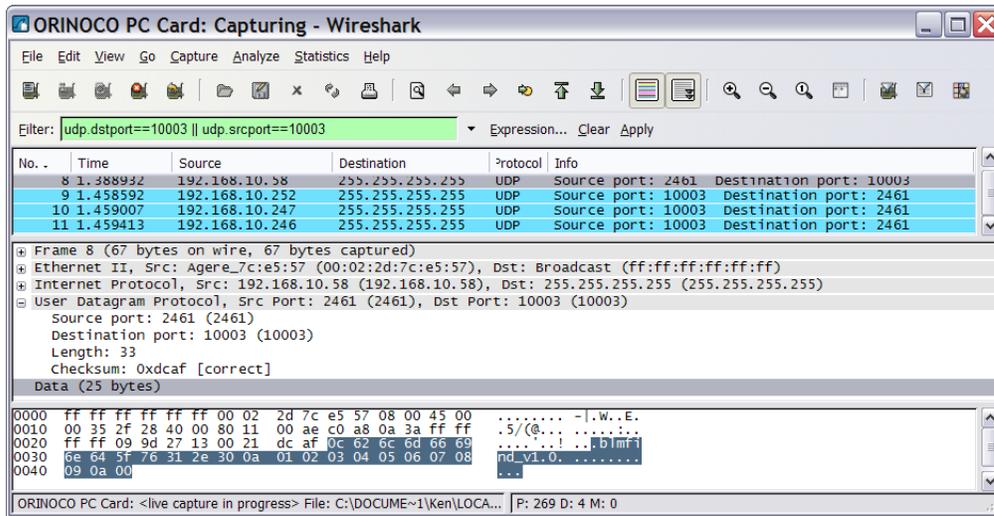
The last byte of the value is followed immediately by the next identifier. Identifier bytes that are 0 are padding, and should be ignored.

UDP Discovery Beacon Example

This example shows the transmission of a Discovery Beacon, followed by responses from three different LS9000 gauges.

Transmitted Discovery Beacon

A transmitted beacon (sent from a PC at IP Address 192.168.10.58) is shown below:

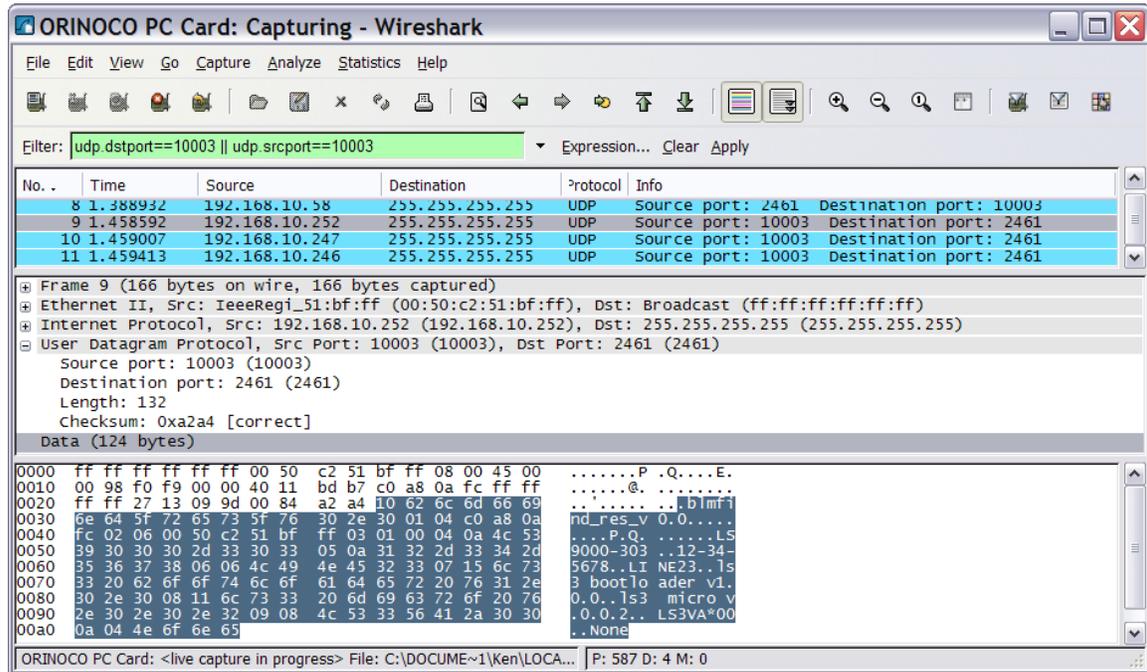


This beacon message requests 10 values, identifiers 1 to 10. The UDP data in the message consists of the following bytes:

Bytes (Hex)	0c	62	6c	6d	66	69	6e	64	5f	76	31	2e	30	0a	01	02	03	04	05	06	07	08	09	0a	00
Meaning	"blm_find_v1.0"													10	1	2	3	4	5	6	7	8	9	10	0
	Protocol Version													# Identifiers	Identifier List						Padding				

Received Discovery Beacon Responses

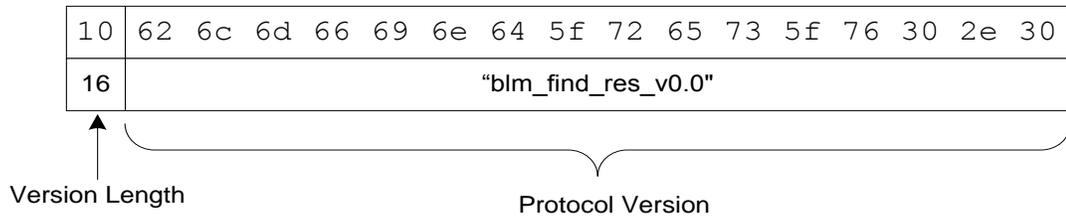
The first beacon response was received from IP Address 192.168.10.252.
 The first several components of this response will be shown in detail. The other two responses (from 192.168.10.246 and 192.168.10.247) are similar.



The highlighted section of the UDP message is shown above. The first part of a beacon response (highlighted) indicates the protocol revision.

```

0000  ff ff ff ff ff ff 00 50 c2 51 bf ff 08 00 45 00  ....P.Q....E.
0010  00 98 f0 f9 00 00 40 11 bd b7 c0 a8 0a fc ff ff  ....@.....
0020  ff ff 27 13 09 9d 00 84 a2 a4 10 62 6c 6d 66 69  ..'.....blmfi
0030  6e 64 5f 72 65 73 5f 76 30 2e 30 01 04 c0 a8 0a  nd_res v0.0....
0040  fc 02 06 00 50 c2 51 bf ff 03 01 00 04 0a 4c 53  ....P.Q.....LS
0050  39 30 30 30 2d 33 30 33 05 0a 31 32 2d 33 34 2d  9000-303..12-34-
0060  35 36 37 38 06 06 4c 49 4e 45 32 33 07 15 6c 73  5678..LINE23..ls
0070  33 20 62 6f 6f 74 6c 6f 61 64 65 72 20 76 31 2e  3 bootloader v1.
0080  30 2e 30 08 11 6c 73 33 20 6d 69 63 72 6f 20 76  0.0..ls3 micro v
0090  2e 30 2e 30 2e 32 09 08 4c 53 33 56 41 2a 30 30  .0.0.2..LS3VA*00
00a0  0a 04 4e 6f 6e 65  ..None
    
```

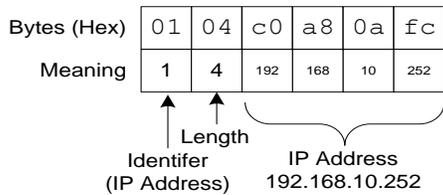


After the last byte of the protocol revision, each value is listed in the same format.

Value 1 – IP Address

```

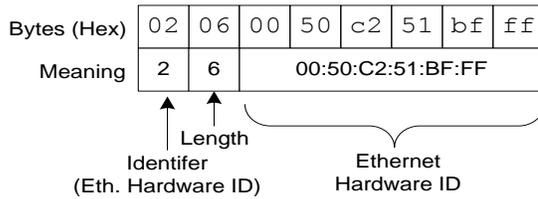
0000  ff ff ff ff ff ff 00 50 c2 51 bf ff 08 00 45 00  ....P.Q....E.
0010  00 98 f0 f9 00 00 40 11 bd b7 c0 a8 0a fc ff ff  ....@.....
0020  ff ff 27 13 09 9d 00 84 a2 a4 10 62 6c 6d 66 69  ..'.....blmfi
0030  6e 64 5f 72 65 73 5f 76 30 2e 30 01 04 c0 a8 0a  nd_res v0.0....
0040  fc 02 06 00 50 c2 51 bf ff 03 01 00 04 0a 4c 53  ....P.Q.....LS
0050  39 30 30 30 2d 33 30 33 05 0a 31 32 2d 33 34 2d  9000-303..12-34-
0060  35 36 37 38 06 06 4c 49 4e 45 32 33 07 15 6c 73  5678..LINE23..ls
0070  33 20 62 6f 6f 74 6c 6f 61 64 65 72 20 76 31 2e  3 bootloader v1.
0080  30 2e 30 08 11 6c 73 33 20 6d 69 63 72 6f 20 76  0.0..ls3 micro v
0090  2e 30 2e 30 2e 32 09 08 4c 53 33 56 41 2a 30 30  .0.0.2..LS3VA*00
00a0  0a 04 4e 6f 6e 65  ..None
    
```



Value 2 – Ethernet Hardware ID

```

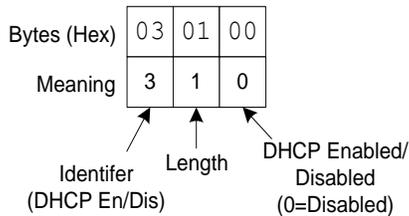
0000  ff ff ff ff ff ff 00 50 c2 51 bf ff 08 00 45 00  .....P.Q....E.
0010  00 98 f0 f9 00 00 40 11 bd b7 c0 a8 0a fc ff ff  .....@.....
0020  ff ff 27 13 09 9d 00 84 a2 a4 10 62 6c 6d 66 69  ..'.....blmfi
0030  6e 64 5f 72 65 73 5f 76 30 2e 30 01 04 c0 a8 0a  nd_res_v0.0.....
0040  fc 02 06 00 50 c2 51 bf ff 03 01 00 04 0a 4c 53  ....P.Q.....LS
0050  39 30 30 30 2d 33 30 33 05 0a 31 32 2d 33 34 2d  9000-303..12-34-
0060  35 36 37 38 06 06 4c 49 4e 45 32 33 07 15 6c 73  5678..LINE23..ls
0070  33 20 62 6f 6f 74 6c 6f 61 64 65 72 20 76 31 2e  3 bootloader v1.
0080  30 2e 30 08 11 6c 73 33 20 6d 69 63 72 6f 20 76  0.0..ls3 micro v
0090  2e 30 2e 30 2e 32 09 08 4c 53 33 56 41 2a 30 30  .0.0.2..LS3VA*00
00a0  0a 04 4e 6f 6e 65  ..None
    
```



Value 3 – DHCP Enabled/Disabled

```

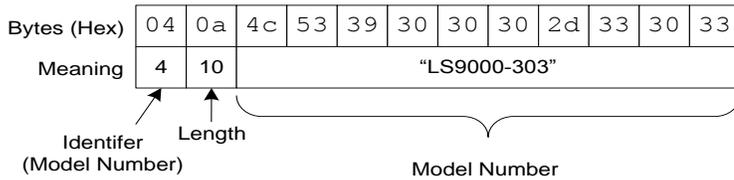
0000  ff ff ff ff ff ff 00 50 c2 51 bf ff 08 00 45 00  .....P.Q....E.
0010  00 98 f0 f9 00 00 40 11 bd b7 c0 a8 0a fc ff ff  .....@.....
0020  ff ff 27 13 09 9d 00 84 a2 a4 10 62 6c 6d 66 69  ..'.....blmfi
0030  6e 64 5f 72 65 73 5f 76 30 2e 30 01 04 c0 a8 0a  nd_res_v0.0.....
0040  fc 02 06 00 50 c2 51 bf ff 03 01 00 04 0a 4c 53  ....P.Q.....LS
0050  39 30 30 30 2d 33 30 33 05 0a 31 32 2d 33 34 2d  9000-303..12-34-
0060  35 36 37 38 06 06 4c 49 4e 45 32 33 07 15 6c 73  5678..LINE23..ls
0070  33 20 62 6f 6f 74 6c 6f 61 64 65 72 20 76 31 2e  3 bootloader v1.
0080  30 2e 30 08 11 6c 73 33 20 6d 69 63 72 6f 20 76  0.0..ls3 micro v
0090  2e 30 2e 30 2e 32 09 08 4c 53 33 56 41 2a 30 30  .0.0.2..LS3VA*00
00a0  0a 04 4e 6f 6e 65  ..None
    
```



Value 4 – Gauge Model

```

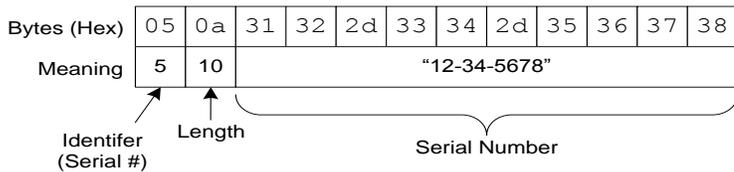
0000  ff ff ff ff ff ff 00 50 c2 51 bf ff 08 00 45 00  .....P.Q....E.
0010  00 98 f0 f9 00 00 40 11 bd b7 c0 a8 0a fc ff ff  .....@.....
0020  ff ff 27 13 09 9d 00 84 a2 a4 10 62 6c 6d 66 69  ..'.....blmfi
0030  6e 64 5f 72 65 73 5f 76 30 2e 30 01 04 c0 a8 0a  nd_res_v0.0....
0040  fc 02 06 00 50 c2 51 bf ff 03 01 00 04 0a 4c 53  ....P.Q.....LS
0050  39 30 30 30 2d 33 30 33 05 0a 31 32 2d 33 34 2d  9000-303..12-34-
0060  35 36 37 38 06 06 4c 49 4e 45 32 33 07 15 6c 73  5678..LINE23..ls
0070  33 20 62 6f 6f 74 6c 6f 61 64 65 72 20 76 31 2e  3 bootloader vl.
0080  30 2e 30 08 11 6c 73 33 20 6d 69 63 72 6f 20 76  0.0..ls3 micro v
0090  2e 30 2e 30 2e 32 09 08 4c 53 33 56 41 2a 30 30  .0.0.2..LS3VA*00
00a0  0a 04 4e 6f 6e 65  ..None
    
```



Value 5 – Serial Number

```

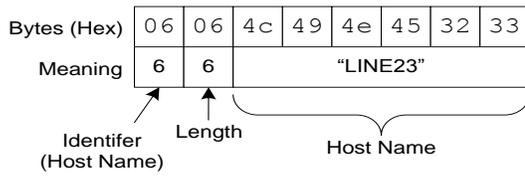
0000  ff ff ff ff ff ff 00 50 c2 51 bf ff 08 00 45 00  .....P.Q....E.
0010  00 98 f0 f9 00 00 40 11 bd b7 c0 a8 0a fc ff ff  .....@.....
0020  ff ff 27 13 09 9d 00 84 a2 a4 10 62 6c 6d 66 69  ..'.....blmfi
0030  6e 64 5f 72 65 73 5f 76 30 2e 30 01 04 c0 a8 0a  nd_res_v0.0....
0040  fc 02 06 00 50 c2 51 bf ff 03 01 00 04 0a 4c 53  ....P.Q.....LS
0050  39 30 30 30 2d 33 30 33 05 0a 31 32 2d 33 34 2d  9000-303..12-34-
0060  35 36 37 38 06 06 4c 49 4e 45 32 33 07 15 6c 73  5678..LINE23..ls
0070  33 20 62 6f 6f 74 6c 6f 61 64 65 72 20 76 31 2e  3 bootloader vl.
0080  30 2e 30 08 11 6c 73 33 20 6d 69 63 72 6f 20 76  0.0..ls3 micro v
0090  2e 30 2e 30 2e 32 09 08 4c 53 33 56 41 2a 30 30  .0.0.2..LS3VA*00
00a0  0a 04 4e 6f 6e 65  ..None
    
```



Value 6 – Host Name

```

0000  ff ff ff ff ff ff 00 50 c2 51 bf ff 08 00 45 00  .....P.Q....E.
0010  00 98 f0 f9 00 00 40 11 bd b7 c0 a8 0a fc ff ff  .....@.....
0020  ff ff 27 13 09 9d 00 84 a2 a4 10 62 6c 6d 66 69  ..'.....blmfi
0030  6e 64 5f 72 65 73 5f 76 30 2e 30 01 04 c0 a8 0a  nd_res_v0.0.....
0040  fc 02 06 00 50 c2 51 bf ff 03 01 00 04 0a 4c 53  ....P.Q.....LS
0050  39 30 30 30 2d 33 30 33 05 0a 31 32 2d 33 34 2d  9000-303..12-34-
0060  35 36 37 38 06 06 4c 49 4e 45 32 33 07 15 6c 73  5678[..LINE23]..ls
0070  33 20 62 6f 6f 74 6c 6f 61 64 65 72 20 76 31 2e  3 bootloader vl.
0080  30 2e 30 08 11 6c 73 33 20 6d 69 63 72 6f 20 76  0.0..ls3 micro v
0090  2e 30 2e 30 2e 32 09 08 4c 53 33 56 41 2a 30 30  .0.0.2..LS3VA*00
00a0  0a 04 4e 6f 6e 65  ..None
    
```



Servicing and Returning Your Equipment

Your instrument was carefully inspected electrically and mechanically prior to shipment. It should be free of surface mars and scratches, and it should be in perfect working order upon receipt. If any indication of damage is found, file a claim with the carrier immediately, prior to using the instrument. If no damage is apparent, proceed by using this manual to install and setup this instrument.

Save the shipping carton and packing material for future storing or shipment of the instrument. If, at some future time, the instrument must be returned to the factory for service, include a full description of the instrument failure and the mode of operation the instrument was in at the time of failure. Also include a contact person to discuss the instrument failure.

When returning equipment for service, it is important to first obtain a Return Material Authorization (RMA) number. The RMA number is needed for proper handling of returned equipment.

- To obtain an RMA, go to www.betalasermike.com
- Select Service
- Select Equipment Return / RMA from the drop-down menu. Follow the instructions to obtain an RMA.

Ship the instrument in the original carton, or, if the original carton is unavailable, ship in a carton providing sufficient protection. Send the instrument to the Asia, Europe, or USA office (addresses listed in the supplied Contacts/CE Compliance Manual), whichever is closest to you or to the office indicated by your sales engineer. Place the RMA number on the outside of the carton, and include a purchase order number and any other information specific to your instrument. Field warranty service is available, if the customer pays travel expenses by advance purchase order. All service operations should be performed by skilled electronics technicians, who have been trained by Beta LaserMike.

Specifications

General Specifications

Accuracy Depth of Field < 75 mm Depth of Field > 75 mm	< ± 0.05% of reading < ± 0.10% of reading	
Repeatability	± 0.02% of reading	
Measurement Rate	100,000/s	
Acceleration Rate	500 m/s ²	
Starting/Ending Length Correction	Yes	
Serial I/O	RS-232 and RS-422	
Data Available	Speed, Length, Quality Factor, Status	
Baud Rate	230.4k, 115.2k, 57.6k, 38.4k, 19.2k, 9600, 4800	
Framing	7n2 or 8n1	
Ethernet (Optional)	10Mbit, UDP, TCP/IP, DHCP Speed, Length, Quality Factor, Status	
Status via Serial I/O or Optional Ethernet	Laser at Temperature Laser Interlock Shutter Position Valid Measurements Material Present System Ready	
Quadrature Pulses	Output 1 5kV Isolation Scaleable Pulse Amplitude (5-24V) Selectable Pulses/Unit 250kHz Maximum Pulse Rate Output 2 RS-422 Drivers Selectable Pulses/Unit 5MHz Maximum Pulse Rate	
Gauge Power	24VDC (± 4VDC) @ 2.0 Amp 30VDC Absolute Maximum Input Voltage	
Ambient Temperature	LS9000	5 to 45 °C (41 to 113°F)
	LS9000E	-10 to 150 °C (14 to 302°F)
	LS9000X	-10 to 200 °C (14 to 392°F)
Relative Humidity	Non-condensing	
Degree of Protection	IP-67	

LS9000 Specifications

Gauge Size -303, -303L, -306, -310 -315, -320	203 X 159 X 95.2 mm (8.0 X 6.25 X 3.75 in.) 229 X 159 X 95.2 mm (9.0 X 6.25 X 3.75 in.)
Gauge Weight -303, -303L, -306, -310 -315, -320	3.4 kg (7.5 lbs) 3.8 kg (8.3 lbs)
Ambient Temperature	5 to 45 °C (41 to 113 °F) Cooling/Heating is Required for Temperatures Outside this Range
Relative Humidity	Non-condensing
Compressed Air	Quality: ⁴ ISO 8573-1, Class 1 Particle, Class 1 Oil Air Wipe Fittings: 1/4" Brass Hose Barb with 1/8" NPT threads Pressure: 0.1 to 1.0 Bar (2-15 PSI) Flow Rate: 50 l/min (1.8 SCFM) Typical 142 l/min (5 SCFM) Maximum
Air Cooling	Fittings: 1/8" NPT Pressure: Less than 70 kPa (< 10 PSI) Flow Rate: 50 l/min (2 SCFM) Typical
Water Cooling	Fittings: 1/8" NPT Pressure : Less than 207 kPa (< 30 PSI) Flow Rate: 1.0 to 3.8 l/min (0.26 to 1 gpm) 1.5 l/min (0.4 gpm) Typical Coolant Temp: 5 to 45 °C (41 to 113 °F)
Degree of Protection	IP67

⁴ Beta LaserMike offers Air Services Cabinets and Air Services Panels that meet these requirements.

LS9000E Specifications

Gauge Size	362 X 229 X 154 mm (14.25 X 9.0 X 6.0 in.)
Gauge Weight	18 kg (40 lbs) (Approximate – varies depending on Air Wipe or Air Purge)
Ambient Temperature	-10 to 150°C (14 to 302°F) Cooling required above 40°C
Water Cooling	Fittings: ¼" NPT (¼" ISO Adapters Included) Flow Rate: 3.8 to 10 l/min (1.0 to 2.6 gpm) 3.8 l/min (1.0 gpm) Typical Coolant Temp: 5 to 45 °C (41 to 113 °F)
Compressed Air	Quality: ⁵ ISO 8573-1, Class 1 Particle, Class 1 Oil Air Wipe Fittings: 1/4" NPT (1/4" ISO Adapters Included) Pressure: 0.1 to 1.0 Bar (2-15 PSI) Flow Rate: 50 l/min (1.8 SCFM) Typical 142 l/min (5 SCFM) Maximum Air Purge Fittings: 3/8" NPT (3/8" ISO Adapters Included) Pressure: 6.3 to 8.3 Bar 90-120 PSI Flow Rate: 1200 l/min (45 SCFM)
Relative Humidity	Non-condensing
Degree of Protection	IP67

⁵ Beta LaserMike offers Air Services Cabinets and Air Services Panels that meet these requirements.

LS9000X Specifications

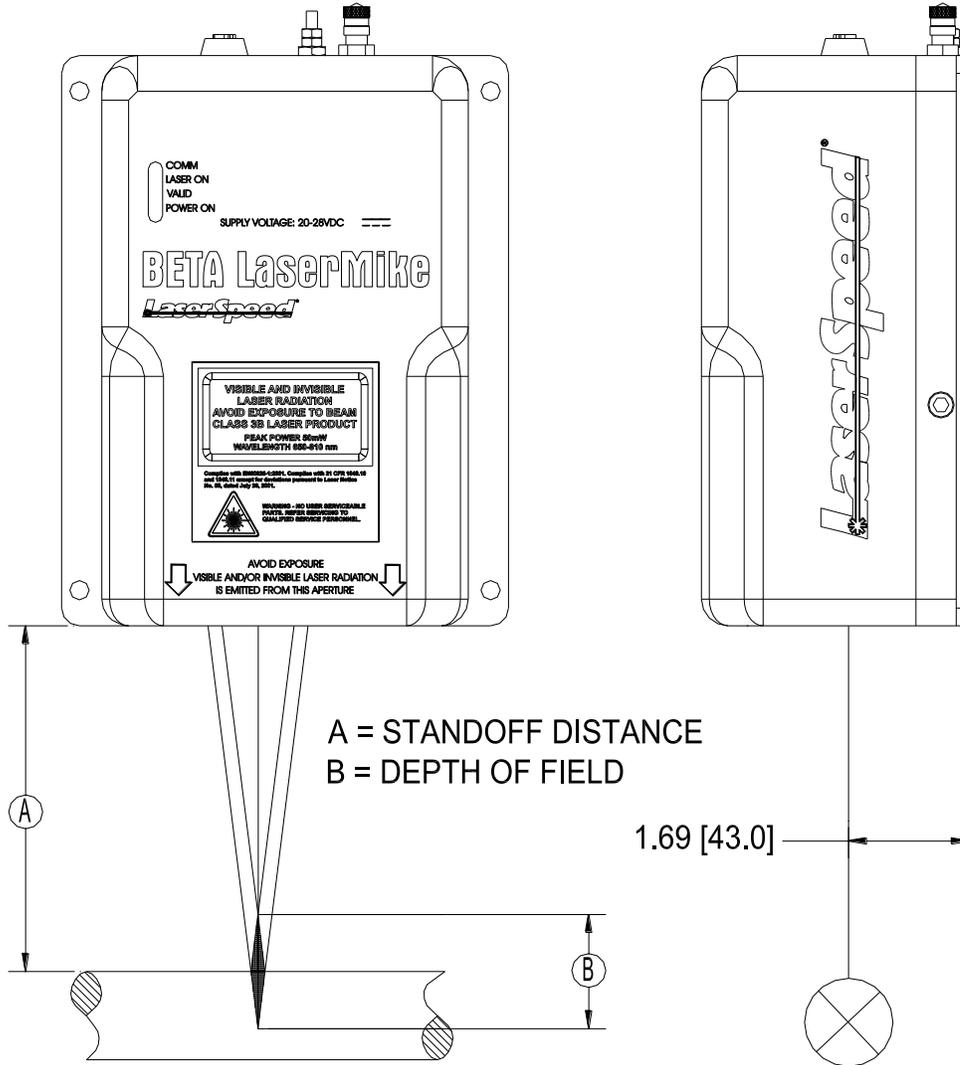
Gauge Size	508 X 327 X 186 mm (20 X 12.9 X 7.3 in.)
Gauge Weight	24.9 kg (55 lbs)
Ambient Temperature	-10 to 200°C (14 to 392°F) Cooling required above 40°C
Water Cooling	Fittings: ¼" NPT (¼" ISO Adapters Included) Flow Rate: 3.8 to 10 l/min (1.0 to 2.6 gpm) 3.8 l/min (1.0 gpm) Typical Coolant Temp: 5 to 45 °C (41 to 113 °F)
Compressed Air	Quality: ⁶ ISO 8573-1, Class 1 Particle, Class 1 Oil Air Wipe Fittings: 1/4" NPT (1/4" ISO Adapters Included) Pressure: 0.1 to 1.0 Bar (2-15 PSI) Flow Rate: 50 l/min (1.8 SCFM) Typical 142 l/min (5 SCFM) Maximum Air Purge Fittings: 3/8" NPT (3/8" ISO Adapters Included) Pressure: 6.3 to 8.3 Bar 90-120 PSI Flow Rate: 1200 l/min (45 SCFM)
Relative Humidity	Non-condensing
Degree of Protection	IP67

⁶ Beta LaserMike offers Air Services Cabinets and Air Services Panels that meet these requirements.

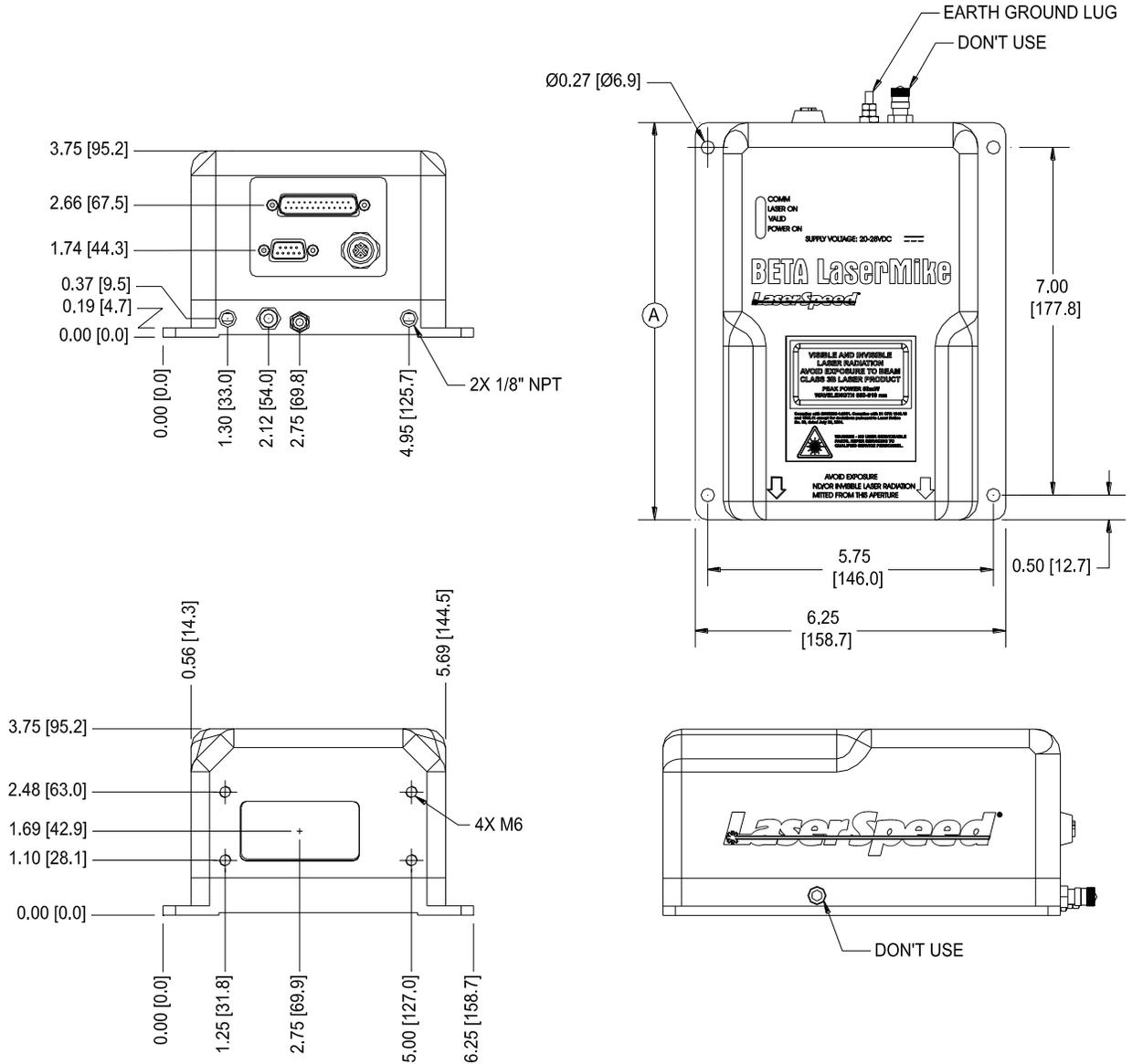
LS9000 Features

Zero Speed/Reversing	Standard
Fast Update Rate	Configurable from 1ms to 2s
Input Power	20-28VDC @ 2A (max)
RS-232	4800-230.4kBaud, with 7n2 or 8n1 framing
RS-422	4800-230.4kBaud, with 7n2 or 8n1 framing
Ethernet	Optional Feature: 10MBit, DHCP, TCP/IP, UDP
Quadrature Outputs	Two Configurable Resolution Differential Outputs 5-24V Adjustable Voltage Output, up to 250kHz RS-422 Pulse Output, up to 5MHz
Index Pulse Output	5-24V Adjustable Voltage Output
Analog Output	0-2V Output, translatable to: 0-10V, +/- 10V, 0-20mA, or 4-20mA Can indicate either Speed or Quality Factor
Synchronization	Multiple gauges' measurements can be synchronized for high speed control applications.
Material Present Detection	Automatically starts counting length when a part enters the measurement area.
Laser Safety Interlocks	Remotely operated Laser Interlock and Beam Shutter Interlock
Visual Status Indicators	Power On, Valid Measurements, Laser On, and COM Status

Appendix A: LS9000 Dimensions & Installation Drawings



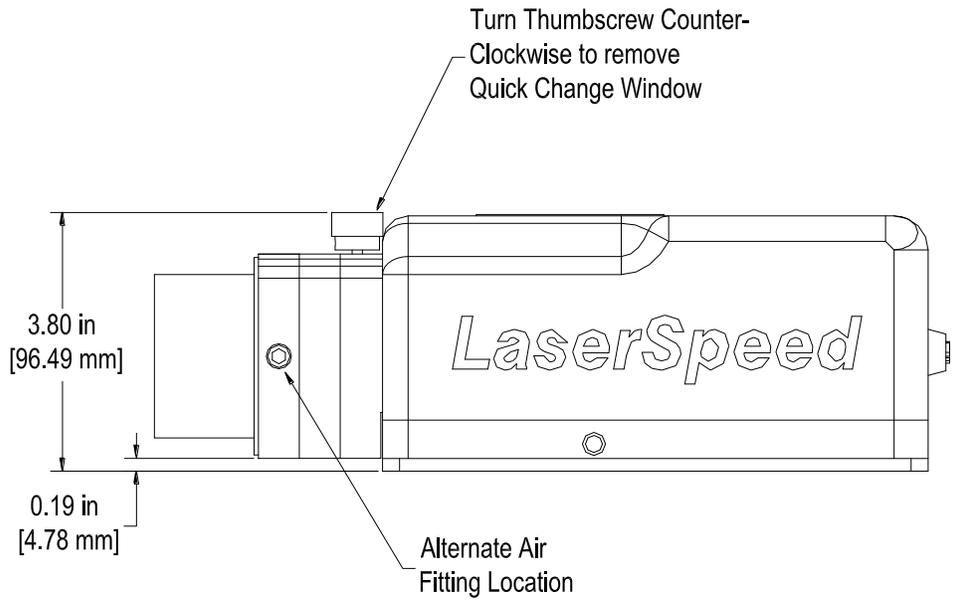
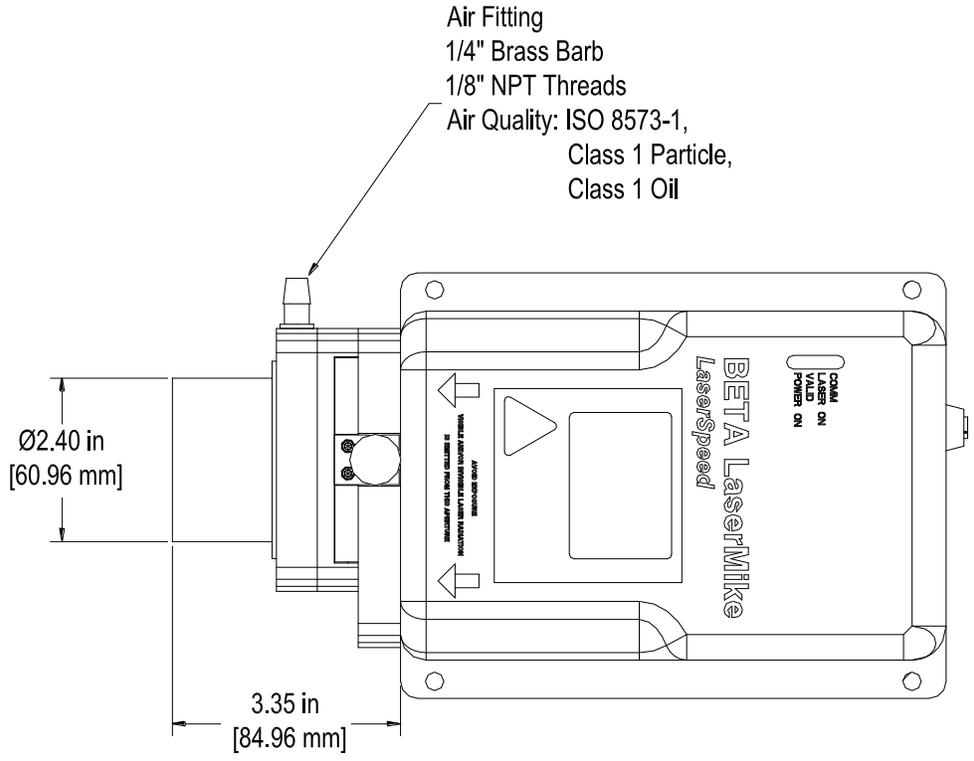
STANDOFF DISTANCE & DEPTH OF FIELD		
MODEL	DIM 'A' STANDOFF DIST.	DIM 'B' DEPTH OF FIELD
LS9000-303	11.8in (300mm)	1.4in (35mm)
LS9000-303L	11.8in (300mm)	1.4in (35mm)
LS9000-306	23.6in (600mm)	2.0in (50mm)
LS9000-310	39.4in (1000mm)	3.9in (100mm)
LS9000-315	59.1 (1500mm)	7.9in (200mm)
LS9000-320	78.7in (2000mm)	7.9in (200mm)
LS9000-325	98.4in (2500mm)	7.9in (200mm)



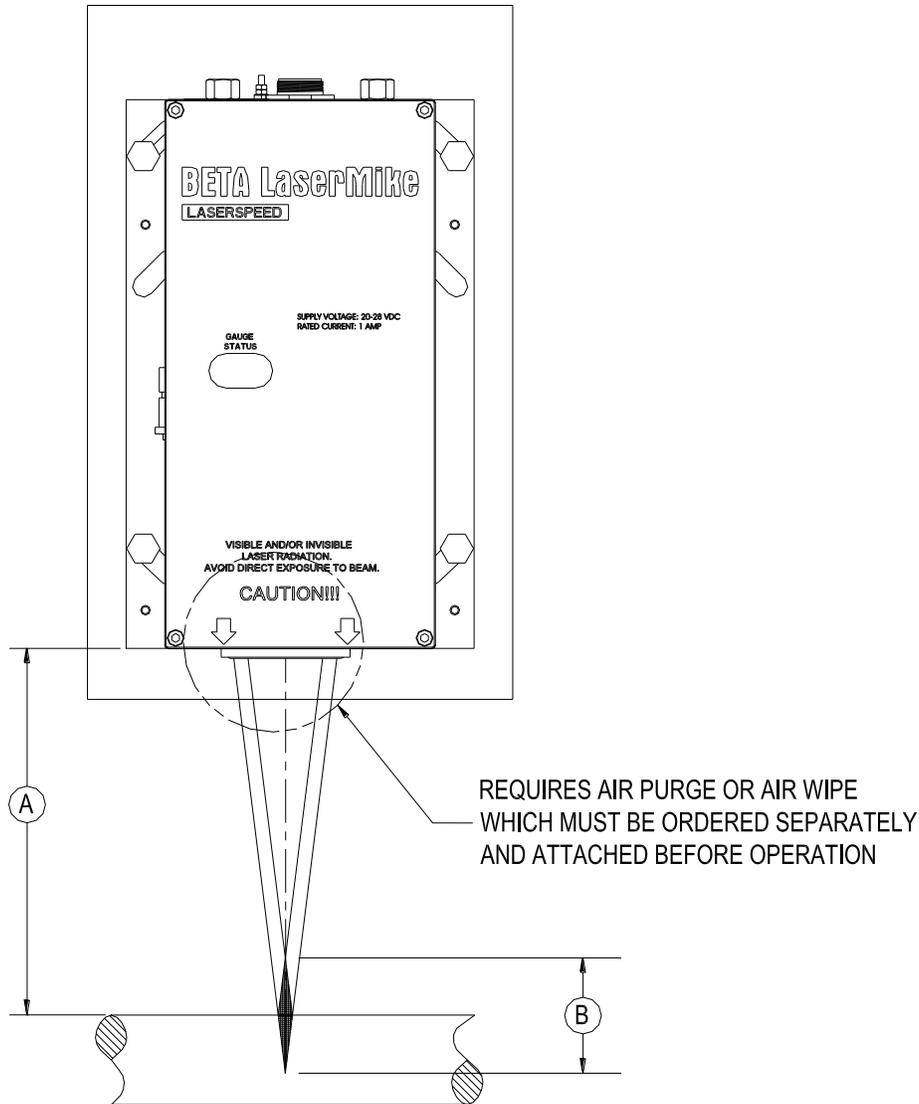
REQUIREMENTS FOR COOLING (FOR AMBIENT TEMP > 45°C (113°F))			
AIR	FLOW RATE	2 SCFM TYPICAL	50 L/MIN TYPICAL
	PRESSURE	LESS THAN 10PSI	LESS THAN 70 kPA
LIQUID	FLOW RATE	0.4 GPM TYPICAL	1.5 L/MIN TYPICAL
	PRESSURE	LESS THAN 30 PSI	LESS THAN 207 kPA
	COOLANT TEMP	41°F TO 113°F	5°C TO 45°C

GAUGE LENGTH	
GAUGE MODEL	DIMENSION 'A'
LS9000-303	8.00 [203.2]
LS9000-303L	8.00 [203.2]
LS9000-306	8.00 [203.2]
LS9000-310	8.00 [203.2]
LS9000-315	9.00 [228.6]
LS9000-320	9.00 [228.6]
LS9000-325	9.00 [228.6]

Air Wipe / Quick Change Window (optional)

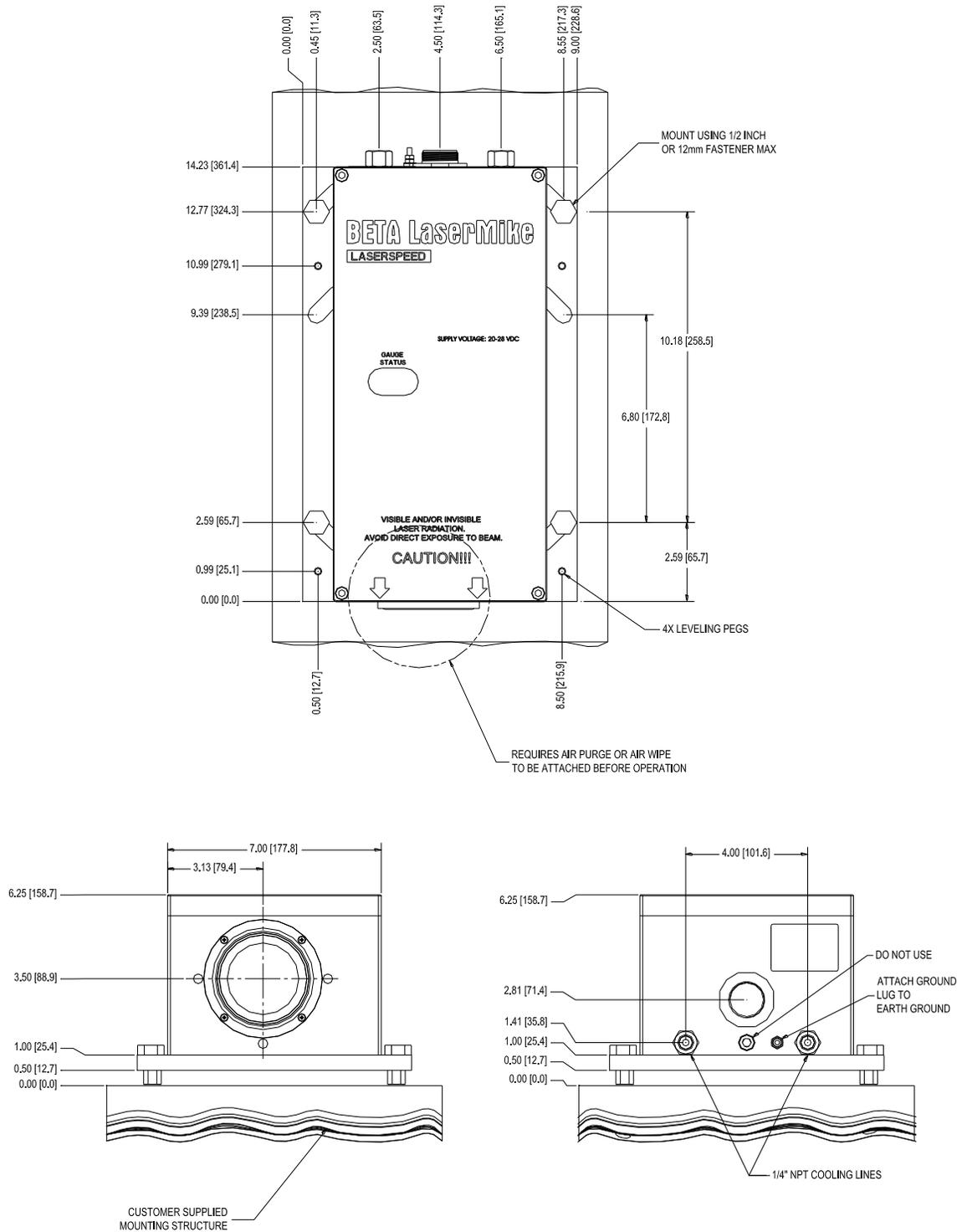


Appendix B: LS9000-E Dimensions & Installation Drawings

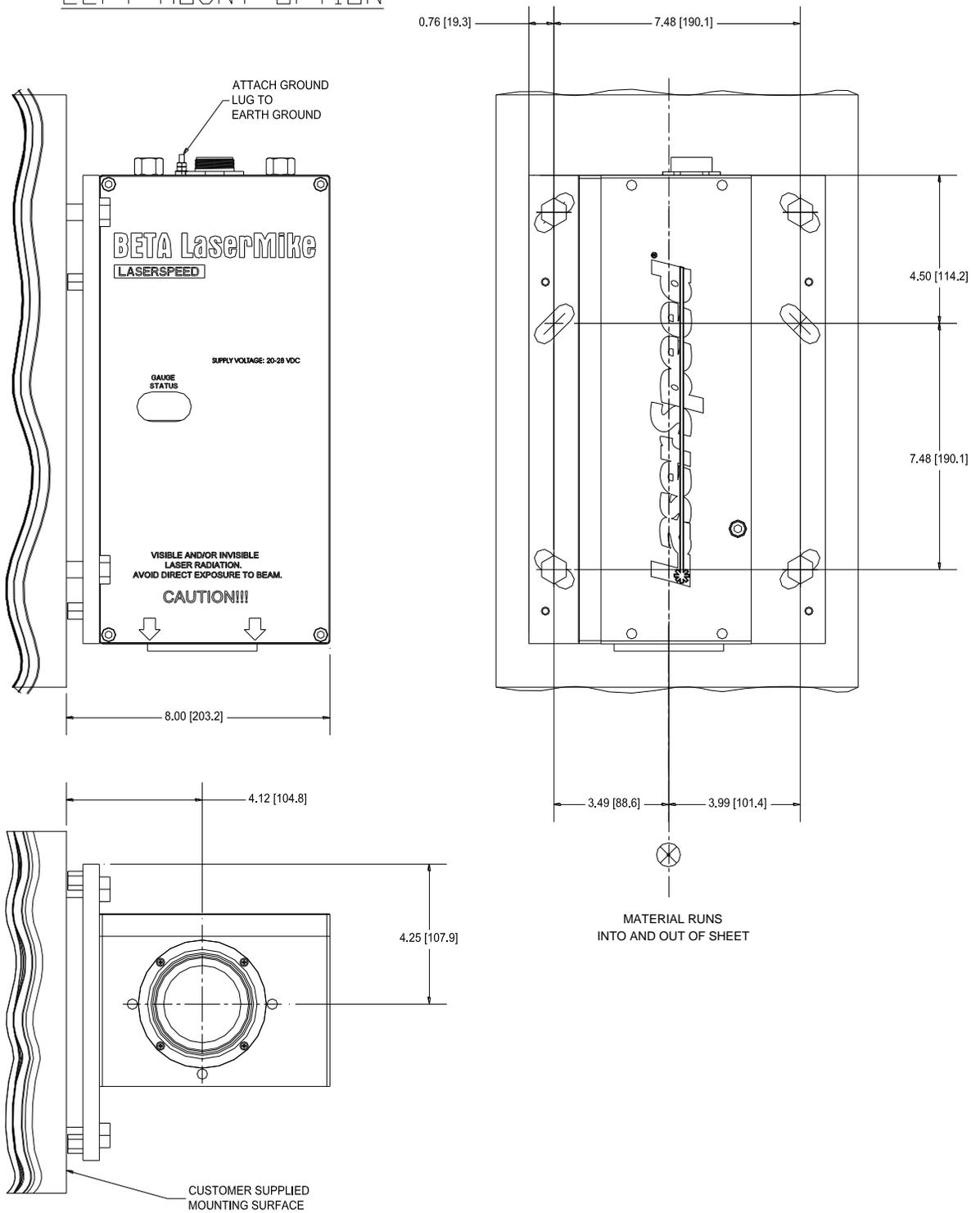


STANDOFF DISTANCE & DEPTH OF FIELD		
MODEL	DIM 'A' STANDOFF DIST.	DIM 'B' DEPTH OF FIELD
LS9000-306E	22.5 in (572 mm)	2.0 in (50 mm)
LS9000-310E	38.3 in (972 mm)	3.9 in (100 mm)
LS9000-315E	57.9 in (1472 mm)	7.9 in (200 mm)
LS9000-320E	77.6 in (1972 mm)	7.9 in (200 mm)
LS9000-325E	97.3 in (2472 mm)	7.9 in (200 mm)
LS9000-330E	117.0 in (2972 mm)	7.9 in (200 mm)

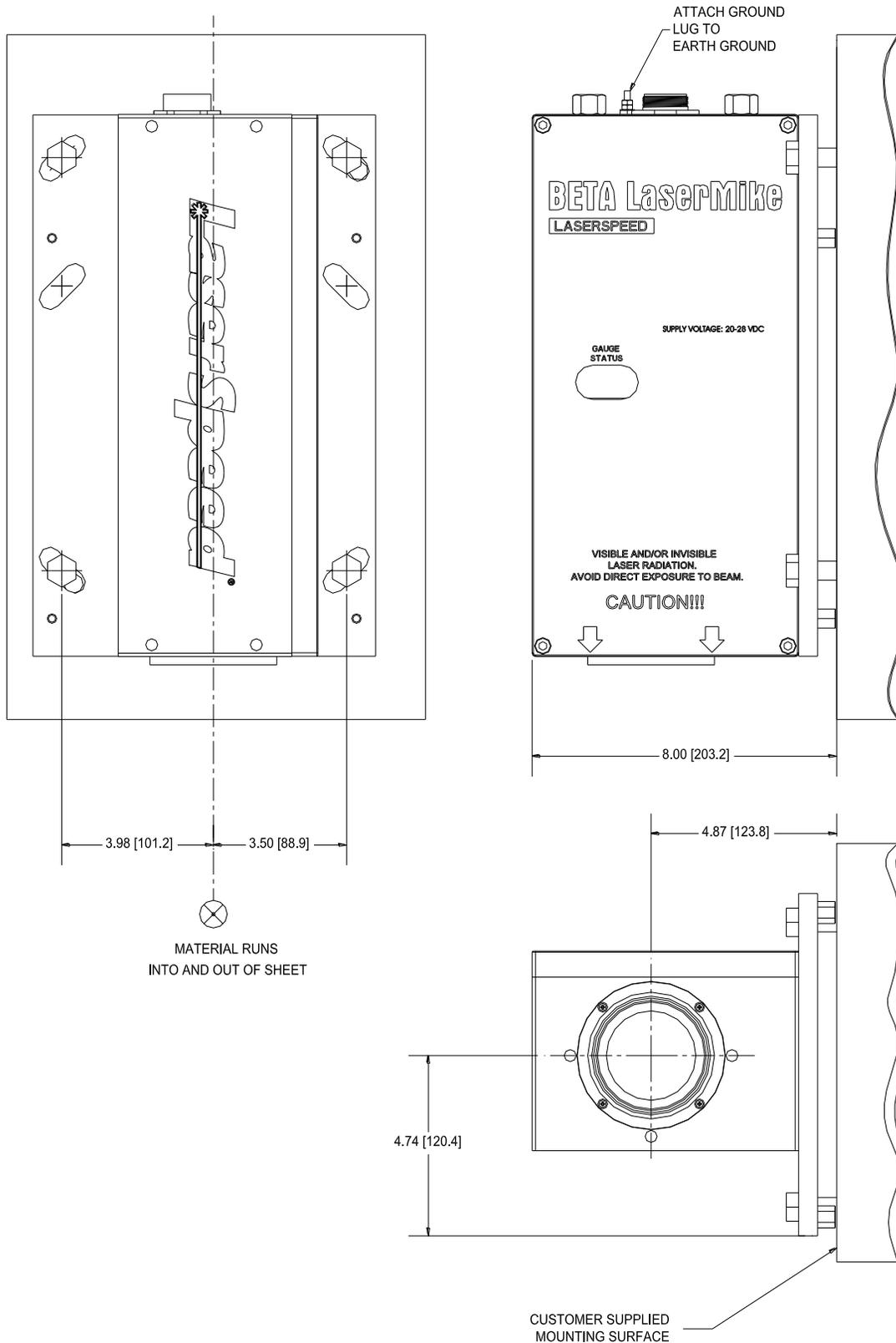
CENTER MOUNT OPTION



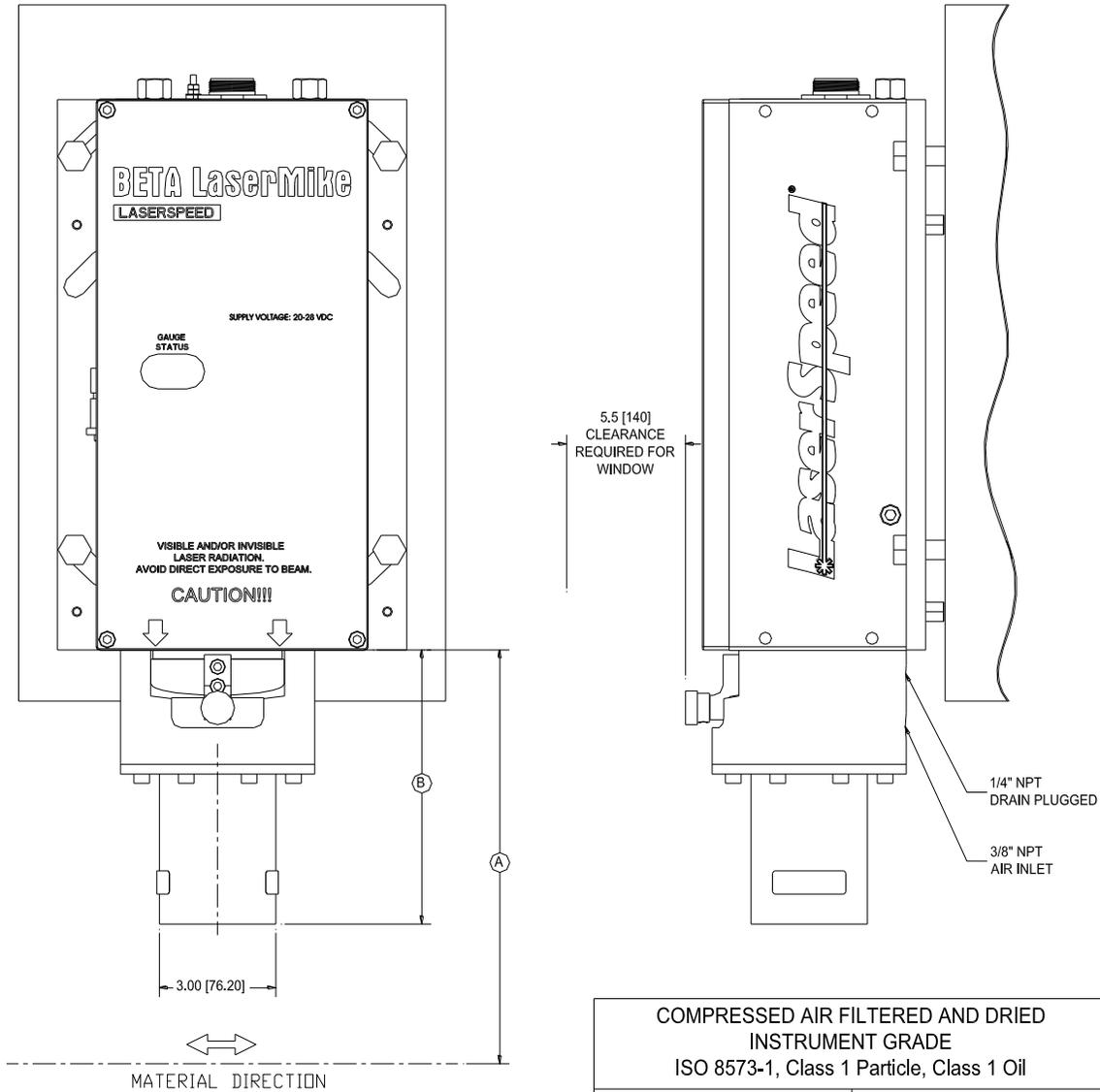
LEFT MOUNT OPTION



RIGHT MOUNT OPTION



LS9000-E WITH AIR WIPE (SEE TABLE)

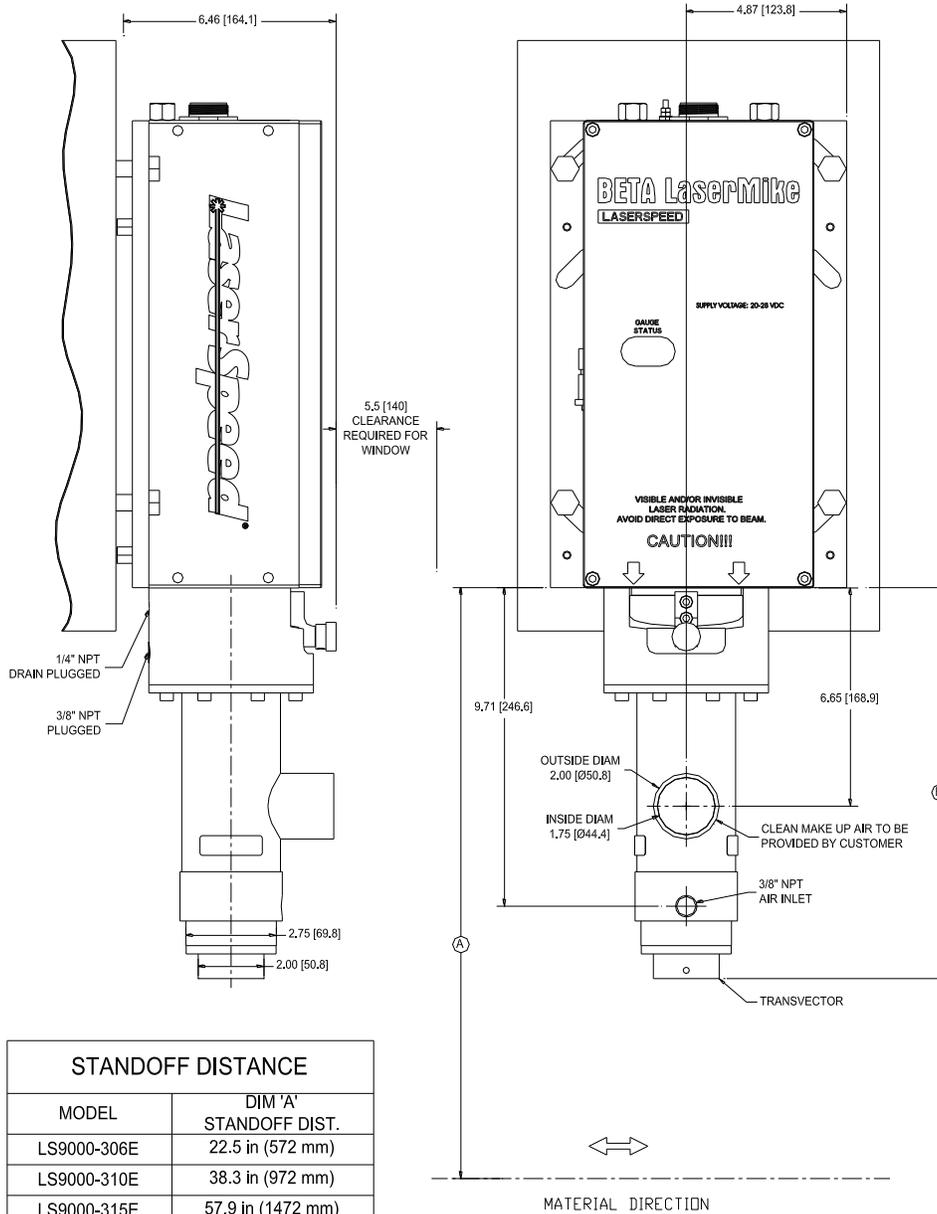


COMPRESSED AIR FILTERED AND DRIED INSTRUMENT GRADE ISO 8573-1, Class 1 Particle, Class 1 Oil	
2-15 PSI	0.1-1.0 BAR
5 SCFM MAX	141.6 L/MIN

STANDOFF DISTANCE	
MODEL	DIM 'A' STANDOFF DIST.
LS9000-306E	22.5 in (572 mm)
LS9000-310E	38.3 in (972 mm)
LS9000-315E	57.9 in (1472 mm)
LS9000-320E	77.6 in (1972 mm)
LS9000-325E	97.3 in (2472 mm)
LS9000-330E	117.0 in (2972 mm)

AIR WIPE LENGTH		
AIR WIPE MODEL	DESCRIPTION	DIM 'B' AIR WIPE LENGTH
230015	SHORT AIR WIPE	7.08in (180mm)
85002	LONG AIR WIPE	14.95in (380mm)

LS9000-E WITH AIR PURGE (SEE TABLE)

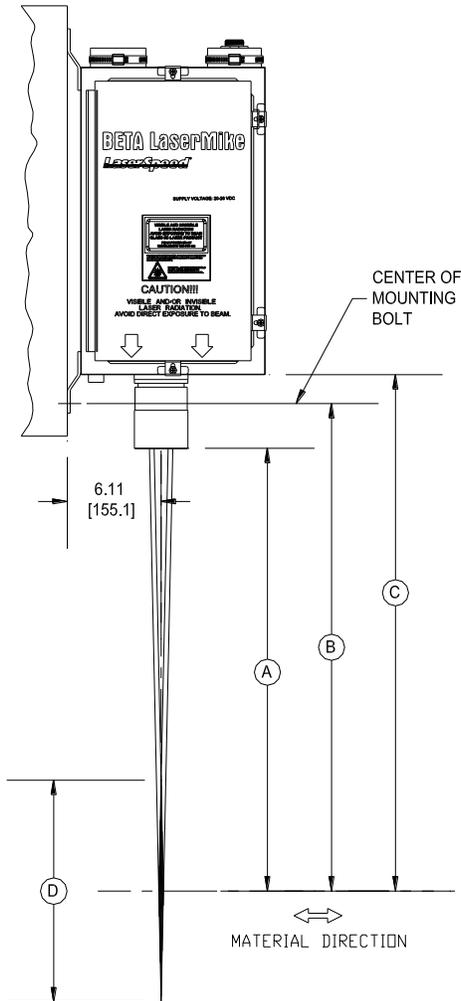


STANDOFF DISTANCE	
MODEL	DIM 'A' STANDOFF DIST.
LS9000-306E	22.5 in (572 mm)
LS9000-310E	38.3 in (972 mm)
LS9000-315E	57.9 in (1472 mm)
LS9000-320E	77.6 in (1972 mm)
LS9000-325E	97.3 in (2472 mm)
LS9000-330E	117.0 in (2972 mm)

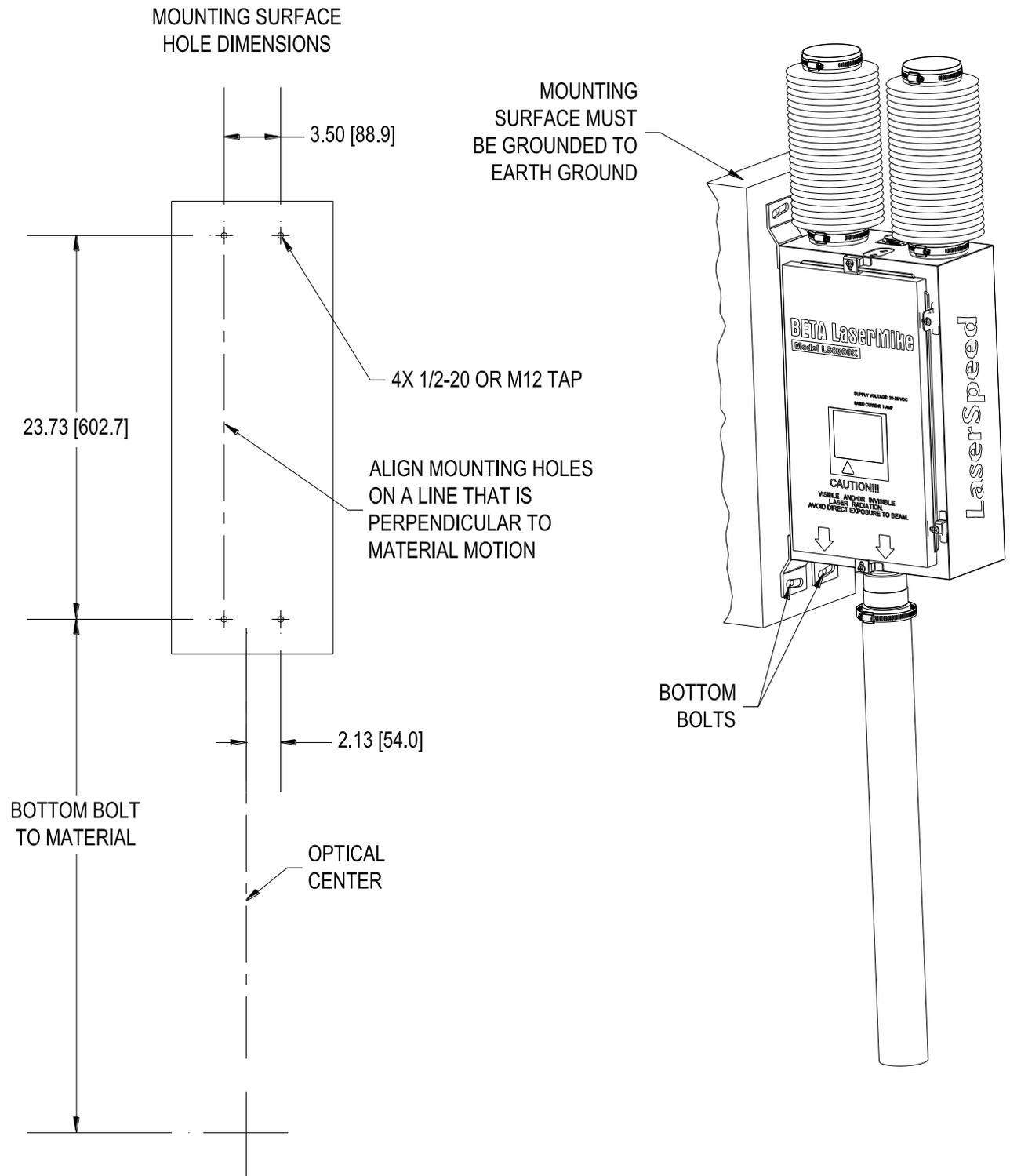
AIR PURGE LENGTH		
AIR PURGE MODEL	DESCRIPTION	DIM 'B'
982725	SHORT AIRPURGE	11.9in (302.3mm)
982726	MEDIUM AIRPURGE	15.2in (386.1mm)
982727	LONG AIRPURGE	25.4in (645.2mm)

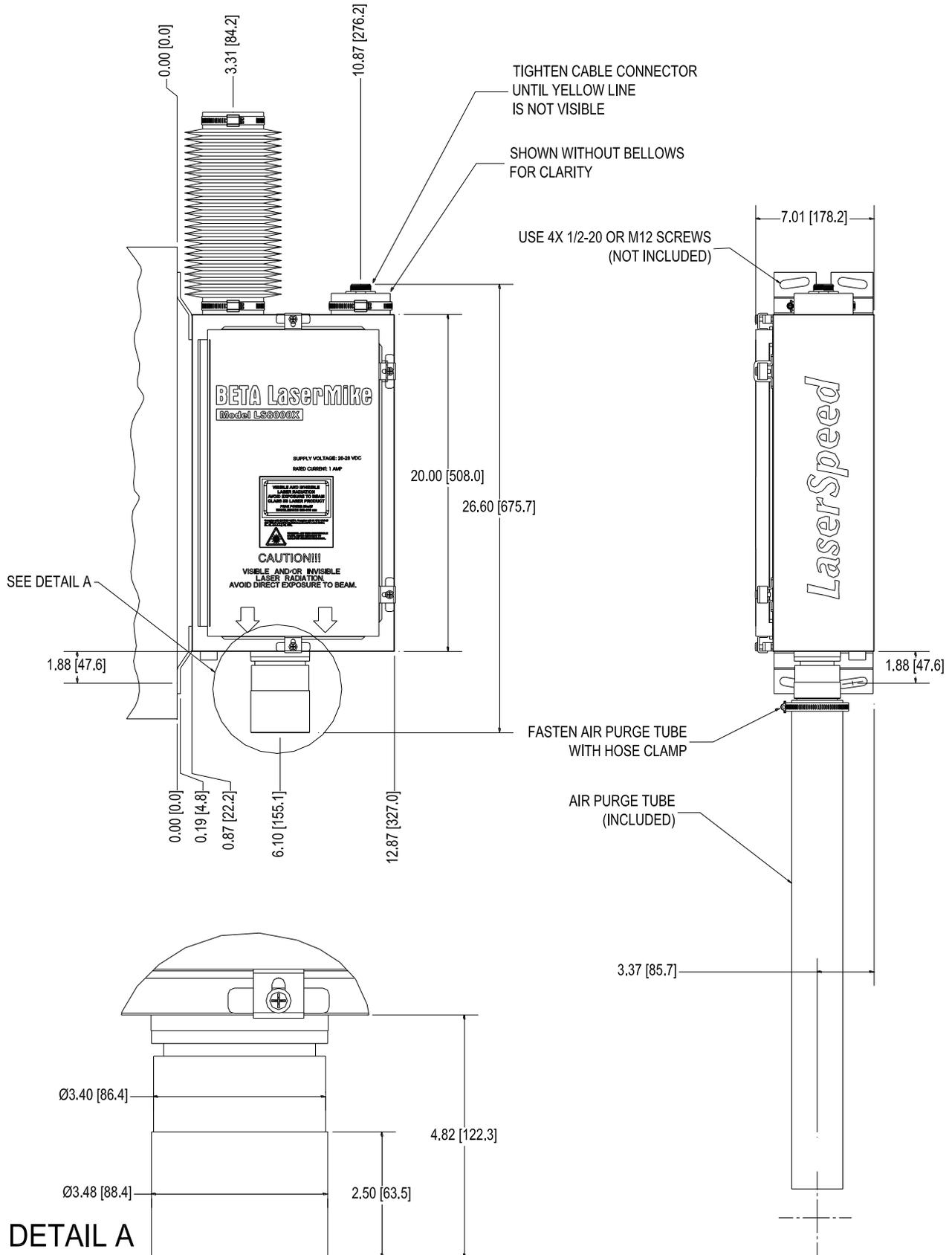
REGULATED, FILTERED COMPRESSED AIR FOR TRANSVECTOR	
60-100 PSI	4.1-6.8 BAR
15-45 SCFM	7.1-21.2 L/SEC

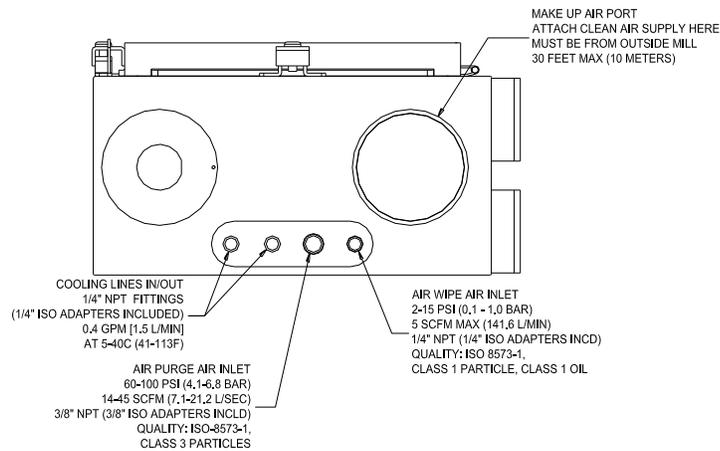
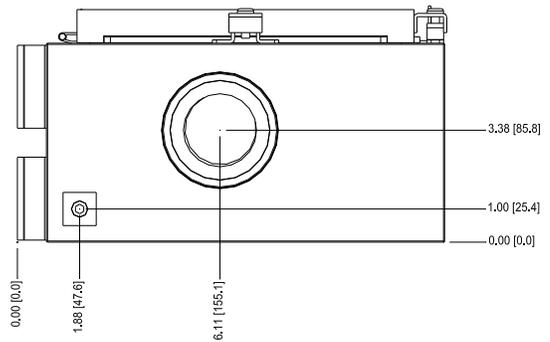
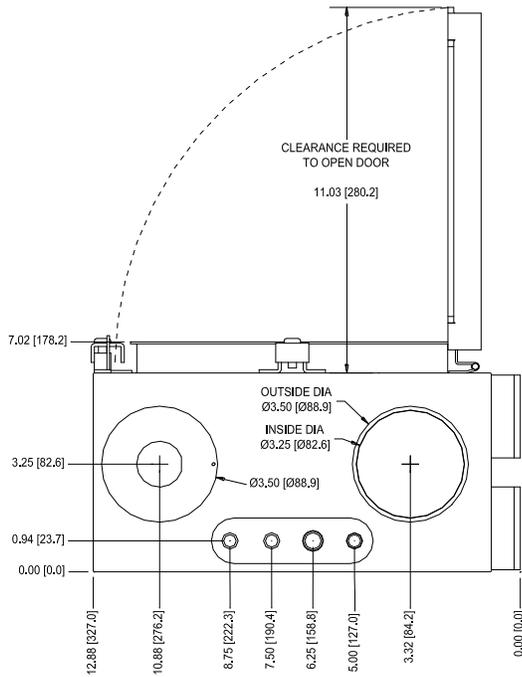
Appendix C: LS9000-X Dimensions & Installation Drawings



STANDOFF DISTANCE & DEPTH OF FIELD				
MODEL	DIM 'A' CLEARANCE	DIM 'B' BOTTOM BOLT TO MATERIAL	DIM 'C' STANDOFF DISTANCE	DIM 'D' DEPTH OF FIELD
LS9000-306X	13.1 in (332 mm)	16.0 in (406 mm)	17.9 in (453 mm)	2.0in (50mm)
LS9000-310X	28.8 in (732 mm)	31.7 in (806 mm)	33.6 in (853 mm)	3.9in (100mm)
LS9000-315X	48.5 in (1232 mm)	51.4 in (1306 mm)	53.3 in (1353 mm)	7.9in (200mm)
LS9000-320X	68.2 in (1732 mm)	71.1 in (1806 mm)	73.0 in (1853 mm)	7.9in (200mm)
LS9000-325X	87.9 in (2232 mm)	90.8 in (2306 mm)	92.7 in (2353 mm)	7.9in (200mm)
LS9000-330X	107.6 in (2732 mm)	110.5 in (2806 mm)	112.3 in (2853 mm)	7.9in (200mm)







Appendix D: Supply Voltage Requirements

The LS9000 gauge requires a supply voltage of 20 to 28 Volts DC **at the gauge**. Because the gauge can draw over 2A of current, Voltage drop across long cable distances may be a problem. The LS9000 normally only demands this high current just after power on, or when the ambient temperature is near the upper limit. This is when the gauge is cooling the internal optical components with the most power. If you are using cables not purchased from Beta LaserMike, please review this section before designing the cable interface to the gauge.

The LS9000 gauge has two power input pins (pins 24 and 25) and two power ground pins (pins 12 and 13). Cabling wires to all four pins (Quad Conductor Supply) will allow you to use smaller wire diameters while avoiding voltage drop problems. Cabling wires to only two pins (one power, one ground—called Dual Conductor Supply) requires larger wire diameters. This manual section will discuss how to size your supply wires correctly to eliminate voltage drop problems.

Dual Conductor Supply

If you are using two conductors (one supply wire, one return wire), the following table will help you determine your total voltage drop across the cable.

Wire Size (AWG)	Wire Size (mm ²)	Voltage Drop per Foot (@2.0A)	Voltage Drop per Meter (@2.0A)
26	0.129	0.16	0.54
24	0.205	0.10	0.34
22	0.326	0.065	0.21
20	0.518	0.041	0.13
18	0.823	0.026	0.083
16	1.31	0.016	0.053
14	2.08	0.010	0.033
12	3.31	0.0064	0.021

Voltage Drop using Single Supply/Single Return

Example: Your power supply is 200 feet (61 meters) away from the LS9000. You are using a single 20 AWG wire to supply power to pin 24, and a single 20 AWG wire as a ground (connected to pin 12). Your voltage drop in the cable will be:

$$\text{Voltage Drop} = \# \text{Feet} * \text{Voltage Drop/Foot} = 200 * 0.041 = 8.2 \text{ volts}$$

In order to deliver at least 20 volts to the LS9000, your power supply will need to be greater than 28.2 volts. The supply should not be higher than 30VDC, or damage may occur.

Quad Conductor Supply

If you are using four conductors (two supply, two return wires), the following table will help you determine your total voltage drop across the cable.

Wire Size (AWG)	Wire Size (mm ²)	Voltage Drop per Foot (@2.0A)	Voltage Drop per Meter (@2.0A)
26	0.129	0.082	0.27
24	0.205	0.051	0.17
22	0.326	0.032	0.11
20	0.518	0.020	0.067
18	0.823	0.013	0.042
16	1.31	0.008	0.026
14	2.08	0.005	0.017
12	3.31	0.0032	0.010

Example: Your power supply is 200 feet (61 meters) away from the LS9000 gauge. You are using two 20 AWG wires to supply power to pin 24 and 25, and two 20 AWG wire as a ground (connected to pins 12 and 13). Your voltage drop in the cable will be:

$$\text{Voltage Drop} = \text{\#Feet} * \text{Voltage Drop/Foot} = 200 * .020 = 4 \text{ volts}$$

In order to deliver at least 20 volts to the LS9000, your power supply will need to be at least 24 volts.

Note: All Beta LaserMike supplied cables have connections for quad conductor supply. In order to take advantage of all conductors, you need to be sure to supply power to both pins 24 and 25, and tie the two ground pins (12 and 13) together. The wires are not necessarily tied together inside the cable.

LaserSpeed Cables

The following table contains the wire conductor sizes for various Beta LaserMike cables.

Cable	Description	Power Wires
240211-3M	CABLE GAUGE-DB25/DB25 3M	Quad 24 AWG
240211-10M	CABLE GAUGE-DB25/DB25 10M	Quad 24 AWG
240211-20M	CABLE GAUGE-DB25/DB25 20M	Quad 24 AWG
240211-30M	CABLE GAUGE-DB25/DB25 30M	Quad 24 AWG
240211-50M	CABLE GAUGE-DB25/DB25 50M	Quad 24 AWG
85277-10M	CABLE LS9000/8000-3 E/X 10M	Dual 12 AWG
85277-25M	CABLE LS9000/8000-3 E/X 25M	Dual 12 AWG
85277-50M	CABLE LS9000/8000-3 E/X 50M	Dual 12 AWG
85277-75M	CABLE LS9000/8000-3 E/X 75M	Dual 12 AWG
85277-100M	CABLE LS9000/8000-3 E/X 100M	Dual 12 AWG
85277-110M	CABLE LS9000/8000-3 E/X 110M	Dual 12 AWG
85277-120M	CABLE LS9000/8000-3 E/X 120M	Dual 12 AWG
85277-130M	CABLE LS9000/8000-3 E/X 130M	Dual 12 AWG
85277-140M	CABLE LS9000/8000-3 E/X 140M	Dual 12 AWG
85277-150M	CABLE LS9000/8000-3 E/X 150M	Dual 12 AWG
85277-160M	CABLE LS9000/8000-3 E/X 160M	Dual 12 AWG
85277-170M	CABLE LS9000/8000-3 E/X 170M	Dual 12 AWG
85277-180M	CABLE LS9000/8000-3 E/X 180M	Dual 12 AWG
85277-190M	CABLE LS9000/8000-3 E/X 190M	Dual 12 AWG
85277-200M	CABLE LS9000/8000-3 E/X 200M	Dual 12 AWG
85281	CABLE E/X HIGH TEMP BRKAWAY 10M 250C	Dual 16 AWG
85305	CABLE E/X LO TEMP BRKAWAY 10M 90C	Dual 12 AWG

Appendix E: 50M+ Option Cable Buffer Board

Introduction

The LaserSpeed cable buffer assembly improves the signal integrity of LaserSpeed pulse outputs when the gauge is used with a DB-25 cable that is 50 meters or greater in length.

It was designed to buffer the gauge's scalable signals when the gauge is attached to a high speed counter card in a Programmable Logic Controller. These counter cards frequently have a fairly low input resistance, and the resulting current flow in long cables can create a magnetic field of sufficient strength to cause crosstalk between the pulse outputs. When this occurs, false counts may be registered by the counter card.

The twisted pairs used to transfer the signals in the cable cannot be individually shielded because the additional capacitance distorts the rising and trailing edges of the waveform.

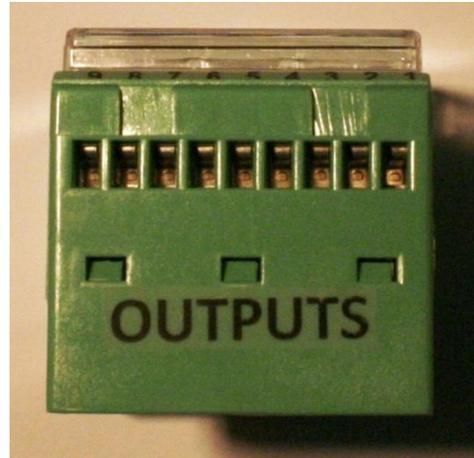
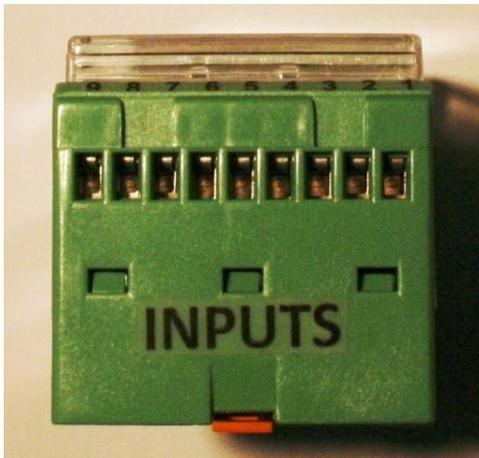
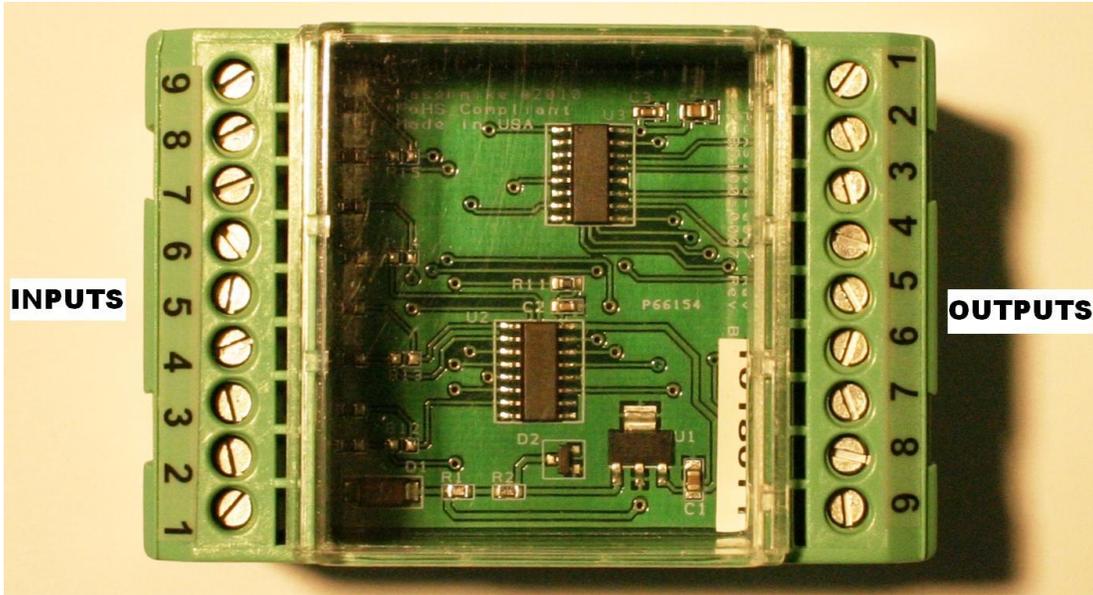
Applications

The LaserSpeed cable buffer assembly may be used to accomplish the following:

- 1) Improve User Scaleable Pulse Output signal integrity when long cables greater to or equal to 50 meters are used.
- 2) Convert High Speed Pulse Outputs(RS422) to User Scaleable Pulse Outputs (5-24V). This can be implemented if required for PLC input card compatibility. The use of the RS422 signal outputs can be used for long distances and then the conversion of the pulse outputs is accomplished by the buffer card in the plc cabinet or in close proximity to the plc input card.
- 3) Provide multiple outputs for each pulse output. The buffer card provides for 4 inputs and 4 outputs. For example, if a pulse output pair is wired to 2 inputs each, each pulse will be driven on 2 outputs. Therefore, each pulse output can be wired to 2 separate input cards or instruments. In this case the buffer is used to provide signal fan out. The buffer card accepts 4 pulse outputs on its input channels and drives 4 outputs.

Installation of the Buffer Board

The cable buffer is attached to the DIN rail adjacent to the DB-25 breakout connector, and the gauge outputs are wired to its inputs. The outputs of the buffer assembly are then wired to the high speed counter card installed in the PLC. Any of the differential inputs may be used on the buffer, with the corresponding output signals connected to the counter installed in the PLC. The inputs to the buffer board are on the same side of the housing as the DIN rail release clamp as shown below.





Note: Signal Ground and Buffer (Power) Ground must be tied together for buffer board operation.

As an example, this would be an acceptable method of wiring the User Scaleable and High Speed (RS422) pulse signals:

Signal	Gauge Breakout	Cable Buffer Input	Cable Buffer Output
ØA Scalable True	Pin 15	Pin 2 (A+)	Pin 8 (ABUF+)
ØA Scalable False	Pin 4	Pin 3 (A-)	Pin 7 (ABUF-)
ØB Scalable True	Pin 6	Pin 4 (B+)	Pin 6 (BBUF+)
ØB Scalable False	Pin 8	Pin 5 (B-)	Pin 5 (BBUF-)
ØA Hi Speed(RS422) True	Pin 3	Pin 6 (C+)	Pin 4 (CBUF+)
ØA Hi Speed(RS422) False	Pin 5	Pin 7 (C-)	Pin 3 (CBUF-)
ØB Hi Speed(RS422) True	Pin 7	Pin 8 (D+)	Pin 2 (DBUF+)
ØB Hi Speed(RS422) False	Pin 9	Pin 9 (D-)	Pin 1 (DBUF-)
Buffer Vin +	Pins 24, 25	Pin 1 (Buffer VIN)	
Ground, Buffer Vin -	Pins 21, 13		Pin 9 GND

Application Instructions

IMPORTANT NOTE!

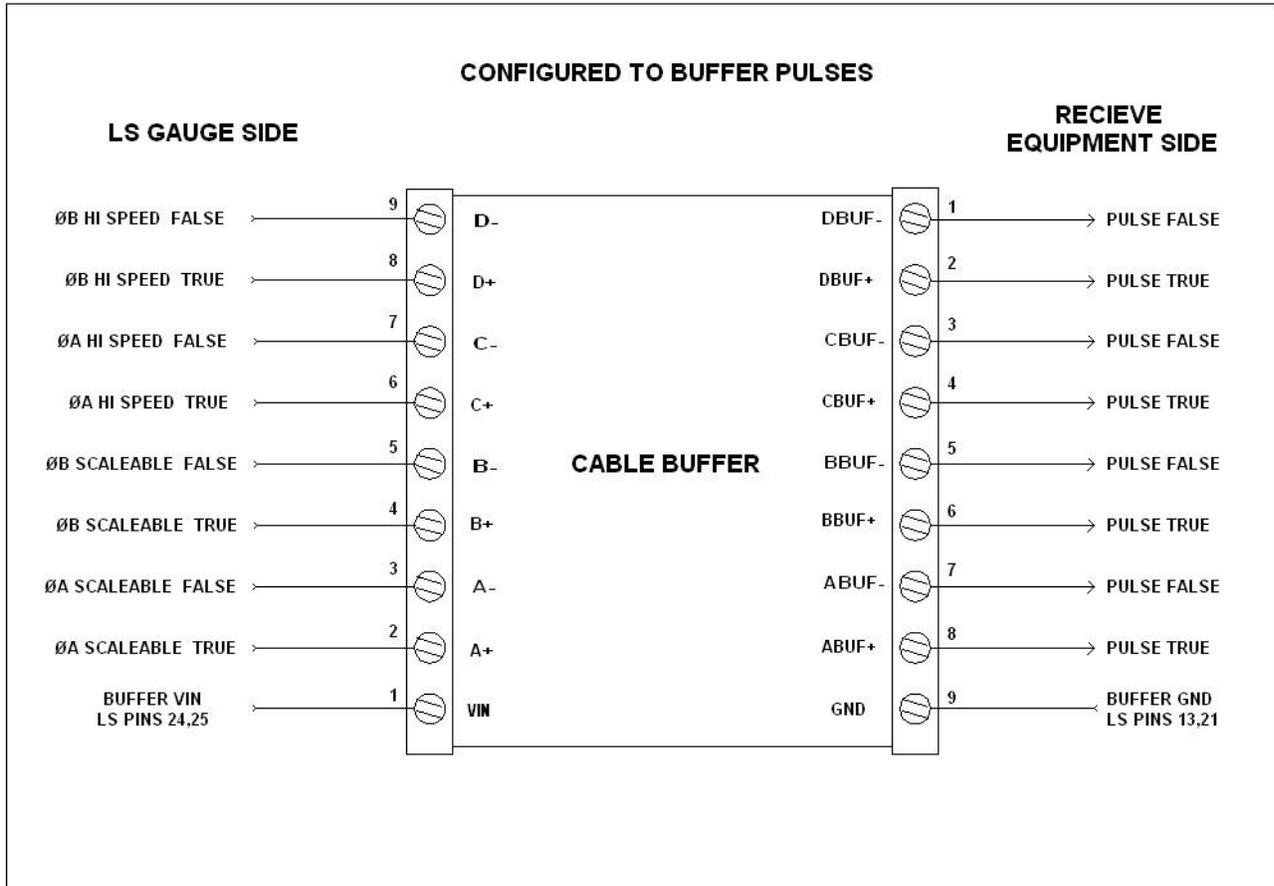
The desired Buffer Vin voltage is applied to pin 1 on the input side of the buffer assembly, with the GND pin opposing it tied to the return on the User power supply. The Buffer Vin supply determines the output signal amplitude applied to the high speed counter card in the PLC.

Typically, the LS Power Supply will be used for this if +24VDC output pulse amplitudes are needed. However, a user provided power supply can be used to scale the output pulses to between 5.0 and +24VDC levels, if desired.

It is recommended to leave pin #20 (User Vin) on the DB-25 breakout connector to the gauge disconnected, which will result in 5V signals from the gauge on the differential output pairs. If 24V is mistakenly applied to pin #20 on the gauge and the output signal swing is 24V into the buffer, the cable buffer will not be damaged, but some crosstalk between pulse outputs may still occur.

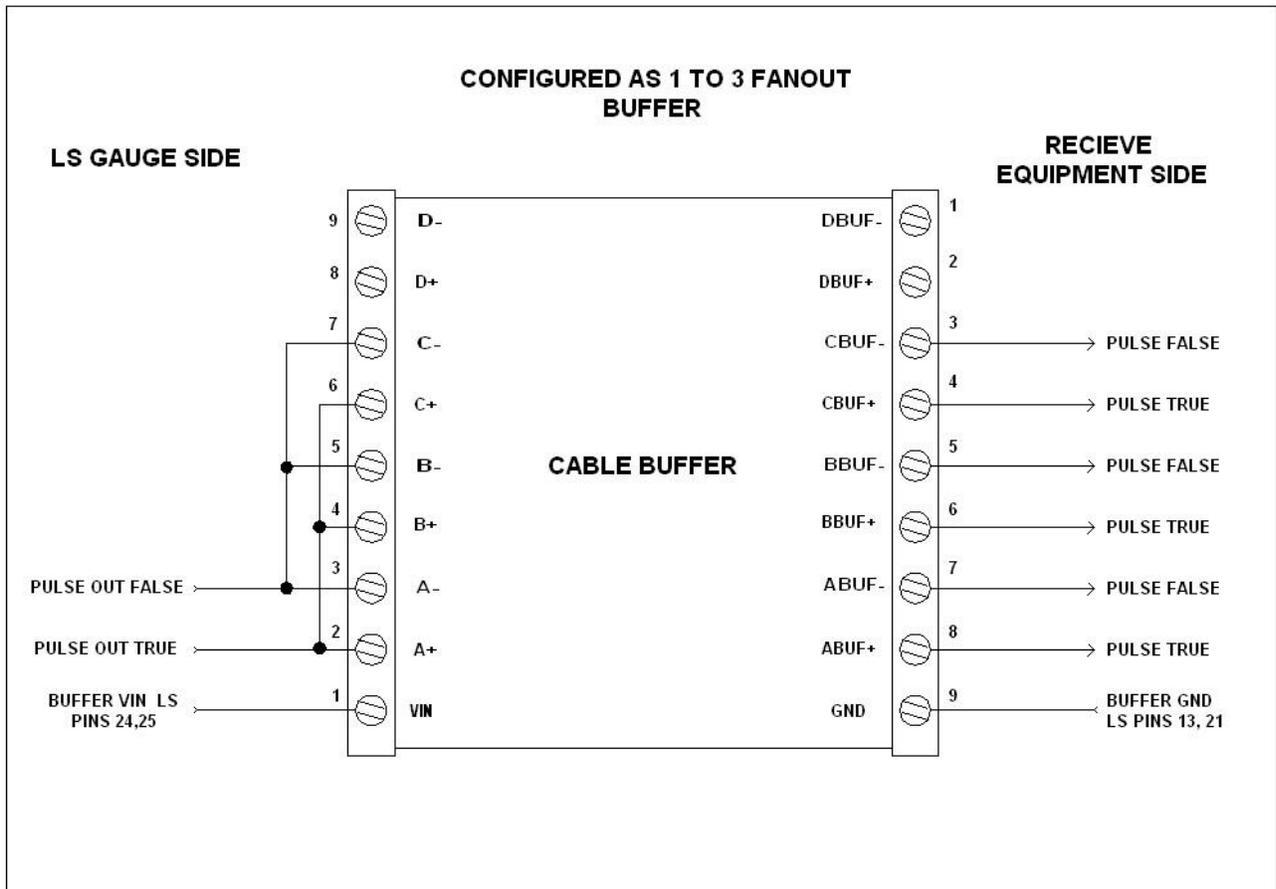
Application Example #1

The following shows the Cable Buffer Assembly used to Buffer the Pulse Outputs at the end of a long cable.



Application Example #2

The following shows the Cable Buffer Assembly used to increase the fan out of the Pulse Outputs – allowing the same pulse outputs to be connected to multiple input cards or instrumentation.

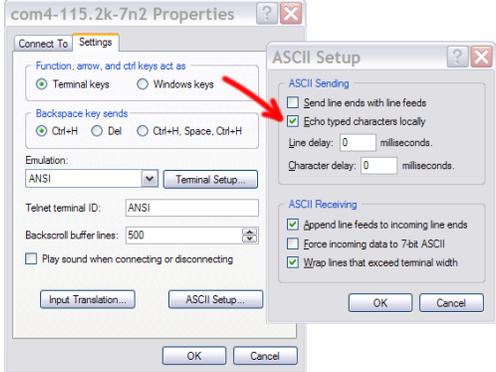


Specifications

Component Ratings

The following ratings apply to the components used in the Cable Buffer.

- Buffer Vin range: 5.0 to 28.0 VDC
- Operating Temperature: -40C to 115C
- Maximum Pulse Frequency: 800 kHz
- Maximum output voltage is within 2V of User Vin (typical)
- Output current is rated at 20mA sink/source for each output signal
- Outputs are short circuit protected.
- Outputs are protected by current limiting and thermal shutdown.
- Buffer Vin is protected against the application of reverse voltage.

	<p>If using RS-232 over a long cable, the baud rate may be too high.</p> <p>Switch to RS-422 for communications.</p>	<p>are typing while pins 2 and 3 are connected. If no characters appear on the screen, the cable or computer serial port may be faulty.</p> <p>See the Automatic Baud Rate Detection section to reset the baud rate to a lower rate, or connect a shorter cable.</p> <p>RS-422 uses differential signals that have much better noise immunity than RS-232. USB to RS-422 converters are commercially available.</p>
<p>The gauge is communicating, but I can't see what I'm typing in HyperTerminal.</p>	<p>Terminal Settings</p>	<p>The gauge does not echo the characters you are typing, so you must configure your terminal program to echo. Turn on the "Echo typed characters locally" setting in HyperTerminal. Adjust terminal settings to match the following:</p> 
<p>Time scale in LaserTrak looks wrong</p>	<p>LaserTrak is missing data points.</p>	<p>The X axis in LaserTrak is drawn based on the gauge's User Update Rate setting. If the gauge is configured to output data very fast, but baud rate is such that there is not enough time to send each reading, some readings will be dropped. To correct this problem:</p> <ol style="list-style-type: none"> 1. Change the User Update Rate to output data less often --- or--- 2. Switch to a faster baud rate.
<p>LaserTrak detects gauge on the wrong com port.</p>	<p>Computer has virtual serial ports or a modem.</p> <ol style="list-style-type: none"> 1. If using LaserTrak 4: Disable the virtual 	<p>User Software sometimes creates virtual com ports that LaserTrak searches for a LaserSpeed gauge.</p> <ol style="list-style-type: none"> 1. Cancel the "Find LaserSpeed Gauges" screen if it appears when

	<p>serial ports</p> <p>2. If using LaserTrak 3.x</p>	<p>you start LaserTrak</p> <ol style="list-style-type: none"> 2. When LaserTrak starts, under the Tools menu, click Program Settings 3. Place check marks next to only the serial ports that should be searched (usually only COM1.) <ol style="list-style-type: none"> 1. Check data COMM LED to determine the correct baud rate. 2. Start LaserTrak, but do not push the search button. Push the OK button. 3. Go to Configuration, then to Communication. 4. Adjust to the correct baud rate at the real physical existing com port (usually COM1) and press OK. 5. Push the read button to read the configuration. 6. Start the visualisation and check that the time on the right upper corner is running correctly. <p>--- or ---</p> <ol style="list-style-type: none"> 1. Start HyperTerminal and connect to the COM port on which LaserTrak is incorrectly detecting a gauge. 2. Start LaserTrak and have it search for gauges. Since HyperTerminal has the offending port already open, LaserTrak won't be able to search it.
<p>Settings changed on gauge</p>	<p>Switching between different gauges.</p> <p>If communicating with HyperTerminal, or with a PLC, settings may be changed due to faulty command.</p>	<p>When using LaserTrak, never read the configuration of one gauge and update the parameter settings to another gauge.</p> <p>Enabling the settings lock will prevent serial commands from changing settings. To lock the settings, send the command: *LOCKEN=1<CR></p>
<p>When using a terminal program, the gauge doesn't respond to commands immediately after power-on.</p>	<p>Gauge is initializing.</p> <p>Incorrect Baud Rate</p>	<p>The LS9000/LS4000-3/LS8000-3 models will respond to commands approximately 5-10 seconds after power is applied. You can send a repeated Z<CR> command to determine when the gauge is ready to receive and respond to commands.</p> <p>Make sure you are using the same baud rate and framing as the gauge. At power on, the gauge will auto-baud to whatever commands you are sending, but it takes a</p>

		few commands to lock into the new baud rate.
When using a terminal program, all the data from the gauge prints on the same line.	Terminal Program Settings	<p>The gauge terminates all transmissions with a carriage return. Both a carriage return and a linefeed are required for HyperTerminal to start printing the next transmission on a new line.</p> <p>Enable the "Append line feeds to incoming line ends" option in HyperTerminal.</p>
When using a terminal program, only the first command after the gauge is turned on returns a response.	Terminal Program Settings	<p>The gauge expects all commands to end with a carriage return. If you have the "Send line feeds with line ends" setting checked in HyperTerminal, when you type the command, you are transmitting "Z<CR><LF>" instead of "Z<CR>", where <CR> is a carriage return, and <LF> is a linefeed. The gauge expects all commands to end with a <CR>.</p> <p>When you transmit: Z<CR><LF> Z<CR><LF> Z<CR><LF> Z<CR><LF></p> <p>The gauge sees it as: Z<CR> ← ok, gauge responds <LF>Z<CR> ← ignored <LF>Z<CR> ← ignored <LF>Z<CR> ← ignored</p> <p>Because the first character in the received command is invalid, each command after the first one is ignored.</p> <p>Disable the "Send line feeds with line ends" option in HyperTerminal to fix.</p>
Communciation problems: Bad characters, intermittent failures, etc...	<p>Wiring</p> <p>If using RS-232 over a long cable, the baud rate may too high.</p> <p>Switch to RS-422 for</p>	<p>Make sure you are connected to the User Ground (pin 11,19,21) and not the Power Ground (pin 12,13).</p> <p>Switch to a lower baud rate</p> <p>RS-422 uses differential signals that have</p>

	communications.	much better noise immunity than RS-232. USB to RS-422 converters are commercially available.
Can't change any settings with HyperTerminal or custom program, but can change them with LaserTrak	Settings are locked	<p>The gauge settings are locked, and must be unlocked before they can be changed. To unlock the settings, send the command:</p> <p>*LOCKED=0<CR></p> <p>This will unlock the settings for 60 seconds, after which time, the settings will become locked again.</p> <p>To permanently unlock the gauge settings, send the commands:</p> <p>*LOCKED=0<CR> *LOCKEN=0<CR></p> <p>This will disable the settings lock feature.</p>

Quality Factor/Valid Measurements

<p>Poor Quality Factor on round product</p>	<p>Product not well guided</p>	<p>Check guiding and product vibration. Try to keep the laser spot within +/- 10% percent of the product diameter. This is more critical on clear or shiny products.</p> <p>If the product begins to vibrate at higher line speeds, guide rollers may need to be placed closer to the laser spot.</p>
<p>Poor Quality Factor on product with liquid/coolant</p>	<p>Too much coolant on product</p> <p>Steam or spray in the beam path</p> <p>Quick-Change Window</p>	<p>LaserSpeed gauges can measure on thin coatings of liquid but may not work well on thick or flowing coatings.</p> <p>Install a fan to blow steam away from the beam path to see if the QF improves. Purchase and install a beam purge on the gauge.</p> <p>Remove and inspect the Quick-Change Window. Clean with a clean cloth. Replace the window if it's scratched or damaged.</p>
<p>Valid LED is not illuminated</p> <p>-- or --</p> <p>The gauge is not measuring</p>	<p>Something is affecting the laser beams</p>	<p>Check that the sensor is emitting two laser beams and that they are elliptical in shape. Measure the laser power if possible and report value to Beta LaserMike.</p> <p>Result of Laser beam inspection:</p> <p>Result A: The sensor emits two laser beams but they are not elliptically shaped.</p> <p>Action:</p> <ol style="list-style-type: none"> 1. Check quick change window for contamination 2. Clean or exchange quick change window. <p>Result B: The sensor emits two laser beams and they elliptically shaped.</p> <ol style="list-style-type: none"> 1. Check distance to the product and verify that the gauge is at the correct standoff distance. 2. Verify that the gauge is mounted in the correct orientation. 3. Check the E setting – must be set to

	<p>Environmental Conditions (i.e. roll coolant, or coolant mist, spray and fume) are adversely affecting the measurement.</p>	<p>31 to enable all signal ranges.</p> <p>4. Check Minimum and Maximum Velocities, and set to large negative and positive values respectively.</p> <p>Result C: The gauge emits no (zero) laser beams.</p> <ol style="list-style-type: none"> 1. Make sure the laser interlock is closed, and that the LASER ON LED is illuminated. 2. Make sure the shutter interlock is closed, and that LaserTrak indicates that the beam shutter is open. 3. Check the gauge temperature, and connect coolant lines if required. 4. "Ring-out" the cable to make sure it isn't damaged. <p>Result D: The gauge emits only one laser beam.</p> <ol style="list-style-type: none"> 1. Contact Beta LaserMike for assistance. <ol style="list-style-type: none"> 1. Inspect the environmental conditions at the measurement area. 2. Check the operating conditions of the compressed air utilities. 3. If using a beam path air purge, check the clean make-up air duct for any damage (holes and tears) that may be drawing in contaminated make-up air from the mill environment. 4. Install proper beam path air purge and/or air wiping (air knife) system to keep optical beam path and measured surface clear and clean.
<p>Valid LED is not illuminated</p>	<p>Incorrect sensor orientation</p>	<p>Rotate the sensor so that it matches the diagram in the Aligning the Gauge section.</p>
<p>"Valid Data" LED is flickering ON and OFF</p>	<p>Dirty quick change window</p> <p>Environmental Conditions (i.e. roll coolant, or coolant mist, spray and fume) are</p>	<ol style="list-style-type: none"> 1. Check the quick change window for contamination. 2. Clean or exchange quick change window. <ol style="list-style-type: none"> 1. Inspect the environmental conditions at the measurement area.

	<p>adversely affecting the measurement.</p> <p>Measured material is moving in and out of the measurement region.</p>	<ol style="list-style-type: none"> 2. Check the operating conditions of the compressed air utilities. 3. If using a beam path air purge, check the clean make-up air duct for any damage (holes and tears) that may be drawing in contaminated make-up air from the mill environment. 4. Install proper beam path air purge and/or air wiping (air knife) system to keep optical beam path and measured surface clear and clean. <p>Check material pass line with respect to the sensor standoff distance and depth-of-field. Adjust the sensor or control the material pass line if necessary.</p>
<p>Gradual drop of Quality Factor (QF)</p>	<p>Dirty quick-change window</p> <p>Low laser power</p>	<ol style="list-style-type: none"> 1. Check the quick change window for contamination. 2. Clean or exchange quick change window. 1. Measure laser power if possible and report value to Beta LaserMike 2. Exchange sensor with spare unit or swap with another sensor nearby. If QF value returns to normal operating value (15), contact Beta LaserMike for evaluation and repair.
<p>Quality Factor "Hunting." The quality factor appears unstable or fluctuating. Such condition might also report quality factor at a very low value.</p>	<p>Environmental Conditions (i.e. roll coolant, or coolant mist, spray and fume) are adversely affecting the measurement.</p> <p>Measured material is moving IN and OUT of the measurement region.</p>	<ol style="list-style-type: none"> 1. Inspect the environmental conditions at the measurement area. 2. Check the operating conditions of the compressed air utilities. 3. If using a beam path air purge, check the clean make-up air duct for any damage (holes and tears) that may be drawing in contaminated make-up air from the mill environment. 4. Install proper beam path air purge and/or air wiping (air knife) system to keep optical beam path and measured surface clear and clean. 1. Check material pass line with respect to the sensor standoff distance and depth of field. 2. Adjust the sensor or control the material pass line if necessary.

		<p>Make sure that the Minimum Velocity Limit (\$N command) is set to a speed lower (more negative) than speeds you wish to measure, and that the Maximum Velocity Limit (\$X command) is set to a speed higher (more positive) than speeds you wish to measure.</p> <p>To disable the Minimum and Maximum Velocity Limits, set to them to large values using LaserTrak or send the following commands via HyperTerminal: *LOCKED=0<CR> \$N-999999999<CR> \$X999999999<CR></p>
<p>Gauge used to work, but now can't get any valid readings, even though everything else is correct.</p> <p>--- or ---</p> <p>Valid measurements at some speeds but not other speeds, or never get valid readings.</p>	<p>E setting has been changed.</p> <p>Minimum or Maximum Velocity Limit settings incorrectly configured.</p>	<p>For the LS9000, the E setting must always be set to 31. Never change this setting unless specifically directed to do so by Beta LaserMike.</p> <p>The Minimum Velocity Limit and Maximum Velocity Limit settings will prevent the gauge from producing measurements if the speed goes outside this range. If the gauge measures speeds outside of this range, it will consider them to be invalid, and will ignore them.</p> <p>Make sure that the Minimum Velocity Limit (\$N command) is set to a speed lower (more negative) than speeds you wish to measure, and that the Maximum Velocity Limit (\$X command) is set to a speed higher (more positive) than speeds you wish to measure.</p> <p>To disable the Minimum and Maximum Velocity Limits, set to them to large values using LaserTrak or send the following commands via HyperTerminal: *LOCKED=0<CR> \$N-999999999<CR> \$X999999999<CR></p>
<p>Poor Quality Factor, or won't measure on twinner line</p>	<p>Too close to twinner</p>	<p>Move gauge farther from twinner to a location where the wires aren't spinning.</p>
<p>There is no laser coming out of</p>	<p>Something is blocking the</p>	<p>Verify that the Power LED is on, and that</p>

<p>the gauge</p>	<p>laser, the beam shutter is closed, or the laser interlock is open.</p>	<p>the LASER ON LED is on.</p> <p>Verify no laser by blocking the beam with a white business card or IR detector.</p> <p>Use LaserTrak to verify the following:</p> <ul style="list-style-type: none"> • Laser Interlock is closed • Beam Shutter interlock is closed. • Laser At Temp <p>Verify that nothing is covering the gauge's optical window.</p>
<p>The valid light turns off after I change a setting.</p>	<p>Valid light is indicating serial port framing.</p>	<p>This is normal. When you change settings that affect measurements, or when you change one of the baud rate/framing settings, the gauge will re-indicate the current baud rate settings. The COMM light flashes to indicate the baud rate setting, and the Valid light turns on or off to indicate the framing. When the valid light is off while the COMM light is indicating the baud rate, it indicates that the serial port is configured for 7n2 framing. See the Baud Rate Indication setting for details.</p>

Measurements

<p>Non accurate length measurements when using final length measurement.</p>	<p>Starting and Ending length correction disabled</p> <p>Product poorly guided</p> <p>Not using external optical switches</p> <p>External optical switches misaligned</p> <p>Gauge misalignment</p>	<p>Set Material Present dropout time to a value > 0.</p> <p>Presenting each part to the measurement system consistently is critical.</p> <p>Install external optical switches.</p> <ol style="list-style-type: none"> 1. Verify that the optical switches are properly aligned. 2. If using transmissive sensors, verify that the transmitter is pointed directly at the receiver. 3. Install a lens on the transmitter to focus the light better onto the receiver. <p>Make sure the gauge is aligned to the product properly as described in the Aligning The Gauge section.</p>
<p>Part Length Readings are always 999999.999</p>	<p>Material Present settings improperly adjusted.</p>	<p>Increase the Material Present Validation Time.</p>
<p>Material Present not detected</p> <p>--or--</p> <p>Material Present flickering on and off</p> <p>Note: <i>The laser must be turned ON.</i></p>	<p>Object interfering with beam path</p> <p>Dirty quick change window</p> <p>Environmental conditions (i.e. roll coolant, or coolant mist, spray and fume) may be interfering with the optical path)</p>	<p>Inspect laser beam path and remove object or obstruction</p> <ol style="list-style-type: none"> 1. Check Quick change window for contamination 2. Clean or exchange quick change window. <ol style="list-style-type: none"> 1. Check for coolant mist, spray and fume in optical path of gauge. (Purchase and install Beta LaserMike beam path air purge if currently not using such a device.) 2. Check and adjust air pressure utilities supplied to beam path air purge 3. If roll coolant is gathering (collecting) on the measured surface beneath the LaserSpeed gauge, install a proper air wipe (air knife) system to

	<p>Measured Material is moving outside the measurement region, or the material is changing angle and moving laterally. Note: For tube length measurement applications, Beta LaserMike recommends that the lateral movement of the tube with respect to the sensor be no greater than 1/5th (20%) the diameter of the tube.</p> <p>Material Present sensitivity not adjusted correctly</p>	<p>blow off such coolant.</p> <ol style="list-style-type: none"> 1. Check to make sure that the laser spot is properly hitting the material. Adjust the sensor or material if necessary. 2. Check the position of the material with respect to the sensor depth of field. Adjust sensor standoff if necessary. 3. Check the movement of the material with respect to the gauge. The material should be kept perpendicular to the gauge. 4. Stabilize or guide the movement of the material at measurement location. <p>The Material Present threshold must be properly adjusted so that the gauge can determine whether or not material is present. Use LaserTrak to adjust the Material Present Threshold. This threshold is a number between 0 and 1023. Raising the threshold will make the gauge less sensitive, and will require more reflected light to turn on Material Present. Lowering the threshold will make the gauge more sensitive and will require less light to turn on Material Present. Adjusting the value to too low a number may result in false Material Present readings.</p>
<p>Counter isn't counting, but everything looks fine in LaserTrak</p>	<p>Wiring</p> <p>Configuration</p>	<ol style="list-style-type: none"> 1. Verify that voltage and ground are both connected between the counter and the LaserSpeed. 2. If using a counter with single-ended inputs, verify that Phase A False and Phase B False are not connected to ground. <p>Check scaling on pulse output and in counter, make sure that maximum frequency of the counter is not exceeded.</p>
<p>Length is still counting even though material is not in front of gauge, and QF is zero.</p> <p>--- or ---</p> <p>Counter continues to count after material exits measurement area.</p>	<p>Velocity Hold</p>	<p>When the velocity is above the "Hold Velocity if Above" setting, and the gauge loses measurements, it will continue to output pulses and count length.</p> <p>To disable this feature, use LaserTrak to set the Hold Velocity if Above setting to a large value like 50,000.000.</p>

<p>Pulses are only 4-4.5V, even though I've connected 24V to User Input Voltage (pin 20).</p>	<p>Signal Ground not connected.</p> <p>Connected to the wrong pulse output</p>	<p>The pulse output ground is isolated from the power ground. Make sure the +24V supply for the pulse outputs is connected to both User V_{IN} (Pin 20) and Signal Ground (pin 21.)</p> <p>The LS9000 has two pulse outputs, one that is voltage scaleable, and one that is not. Make sure you are connected to the User Scaleable Pulse Output, not the High Speed Pulse Output. The High Speed output is always 5V, as it uses RS-422 drivers.</p>
<p>Pulses look funny on an oscilloscope.</p> 	<p>Wiring</p>	<p>The pulse outputs should look something like the picture:</p> <p>In this picture: User $V_{IN} = +24V_{DC}$ Channel 1: Phase A True Channel 2: Phase A False Channel 3: Phase B True Channel 4: Phase B False</p> <p>If the pulses don't look like this, then the oscilloscope may not be connected properly, or the pulses/counter may be wired incorrectly.</p> <ul style="list-style-type: none"> • Check that you are connected to the correct pins • Check that the scope ground leads are connected to Signal Ground, and not Phase A False and Phase B False. • Check that Phase A False and Phase B False are not connected to signal ground.

Miscellaneous

<p>Gauge resets itself, (Laser On flashing, shutter opening/closing)</p>	<p>Power Supply voltage is too low on a long cable</p>	<p>Check +24VDC supply. Adjust up to +29VDC if necessary.</p> <p>See Appendix D for more information</p>
<p>Laser is flashing</p>	<p>Ambient temperature is too high (or low.)</p>	<p>If the ambient temperature is too high, the gauge may not be able to properly control the laser temperature.</p> <p>Connect air or water coolant to reduce the gauge temperature. See the Specifications section for details.</p>
<p>System Status Indicator is OFF</p>	<p>Laser At Temperature</p> <p>Laser Interlock</p> <p>Shutter Open</p> <p>Material Present</p>	<p>If in a hot environment, cooling may be required for the gauge to maintain the proper laser temperature. See the specifications section for details.</p> <p>The Laser Interlock (Pin 16) must be connected to User Ground (Pin 11,19,21) for the laser to turn on. Check wiring connections.</p> <p>The Laser Interlock (Pin 17) must be connected to User Ground (Pin 11,19,21) for the laser to turn on. Check wiring connections.</p> <p>Check setting in LaserTrak for Internal/External Material Present</p> <p>Internal: Adjust Material Present threshold level until Material Present bit changes.</p> <p>External Active Low: Disconnect Material Present (Pin 10), or connect to User Ground to turn Material Present On, and Connect to +5-24V_{DC} to turn Material Present Off.</p> <p>External Active High: Disconnect Material Present (Pin 10) to turn OFF Material Present, and connect to +5-24V_{DC} to turn ON Material Present. Make sure you reference the voltage input to the User Ground (Pin 11,19,21).</p> <p>System Ready bit is a combination of</p>

	System Ready	the Laser On, Shutter Open, and Laser At Temp status bits. These three bits must all be ON for the System Ready bit to be on.
Nothing illuminated on gauge (i.e. no LED lights, and laser is off)	Loss of Power Power Supply Failure	The POWER ON Led should always be illuminated when the gauge has power. Check electrical connections, fuses, and power switch <ol style="list-style-type: none">1. Check power supply voltage2. Replace Power Supply

Ethernet

<p>Can't get Ethernet to work.</p>	<p>Check the Ethernet link status</p> <p>No Connection</p> <p>Gauge doesn't have Ethernet option.</p> <p>Wiring</p> <p>Configuration</p>	<p>Connect to the gauge's serial port and send the *LINK? Command. This will tell you if the gauge is connected to an Ethernet network, and if you are using DHCP, it will tell you the DHCP state. You can also read the gauge's IP address over the serial port.</p> <p>Check the Link status light on the router to see if the connection is ok. Set the gauge's COMM LED to indicate Ethernet traffic.</p> <p>Send the gauge the *ETHERNET?<CR> command to see if the gauge supports Ethernet. If disabled, contact your Beta LaserMike sales representative to order the option.</p> <p>Verify that the wiring matches the wiring listed in the manual. The LS9000 Instruction Handbook revision A contained an error in the 37-pin cable pinout, where the Ethernet pinout was incorrect.</p> <p>Use the serial port to configure the gauge's IP Address, Default Gateway, and Subnet mask. Contact your network administrator for the appropriate settings.</p>
<p>How do I know if the gauge is communicating on my network?</p>	<p>Send a ping message</p>	<p>The gauge will respond to ping messages up to 64 bytes in length. If this works, then you should be able to use telnet to connect to the gauge.</p>
<p>TCP/IP connection was refused.</p>	<p>Already connected from a different host, or did not close last connection properly.</p>	<p>Over TCP, the gauge supports one Telnet (port 23) connection and one TCP (port 1003) connection. Close the current connection before opening a new one.</p>
<p>LaserTrak can't find the gauge over Ethernet, but I can ping it and connect with telnet.</p>	<p>Different subnets</p>	<p>Try setting the IP Address and subnet mask to the same subnet. LaserTrak searches for LaserSpeed gauges via a UDP broadcast message. Ethernet switches do not forward UDP broadcasts, so LaserTrak cannot search outside of the local subnet.</p>

Can send UDP commands and receive responses, but don't receive real-time data (TE/TB/TT/TF data).	Command responses and real-time data are transmitted on different ports.	UDP commands are received on port 1001, and responses to commands are transmitted from port 1001. All real-time continuous output data is transmitted from port 1002.
Getting CRC Errors on switch, which leads to loss of connection	Bit rate too high	The gauge will first attempt to connect at 100Mbit/half duplex, and if this fails will switch to 10Mbit. It does not continuously renegotiate the network speed. 100Mbit is sometimes more susceptible to noise and packet loss. Configure the switch to communicate at 10Mbit/half duplex only.

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