ACCUSCAN
4012 /5012 /5025 /5040 /5080

INSTRUCTION HANDBOOK

- installation, setup and technical reference -

www.ndc.com/betalasermike

Measured by Commitment

BETA LaserMike

Manual Part Number: MAN/E1530-7686
Manual Drawing Number: n/a

Contents

Proprietary Information

Manufacturer/Distributor

NDC Technologies Inc., 8001 Technology Blvd., Dayton, OH 45424, USA

About This Manual

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EXCLUSIONS: This warranty does not cover products which have been modified, altered, or repaired by any other party than NDC Technologies 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.

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

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.

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European Commission Requirements

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to 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, NDC Technologies recommends that any non-NDC Technologies peripheral equipment is CE marked. NDC Technologies also recommends that any cables not supplied by NDC Technologies, but used for powering NDC Technologies 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 NDC Technologies Service Department.

Introduction

This manual describes the installation and setup of the AccuScan 4000/5000 range of laser gauges. The last 2 digits represent the maximum measurable product diameter. There are 4 hardware versions: an RS232 version (-R), a ProfiBus version (-P), an Analog version (-A) and a PI Control version (-K). The analog and RS232 version can be ordered with a DeviceNet software option.

All AS4000/5000 gauges have the option of a display. The display (pod) for the AS5012 gauge can be retrofitted if required.

If using Beta LaserMike external 24V Power Supply, see the 24V Power Supply Instruction Handbook. Part numbers for US and EU/UK power supply versions are also shown in Spare parts section in this manual.

Keep this manual for later reference.

Safety Information

- **Electrical installations must be carried out by a suitable technician for the country of installation.**
- **This equipment must be earthed/grounded.**
- **Relays and associated wiring are rated for SELV levels i.e. 60vdc & 30vac rms. These levels must not be exceeded.**
- **If using the AS5012 with special pressurised chamber, eye protection should be worn by all persons in close proximity to the gauge. (The optional air-wipe system keeps the optics clean in harsh and polluted environments. Dust particles are ejected from the cable inlet and outlet nozzles)**

The gauge is a class 2 laser product. For laser specifications see Specification.

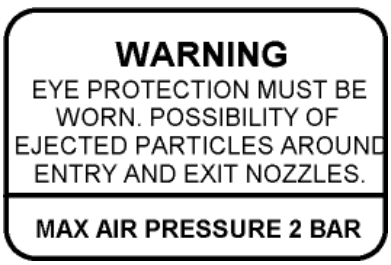
The gauge is non-hazardous during normal operation with all the covers in place. However, under certain fault conditions, or improper use, with the covers removed the laser beams could present a hazard to the eye. The following safety precautions should be observed:

- **Do not insert tools capable of giving a specular reflection into the measurement chamber (gate area) while the power is on.**
- **Do not look directly into the laser beam.**
- **Do not remove the main cover of the equipment housing. The main cover should only be removed by suitably qualified personnel. There are no user serviceable parts inside.**

Warning Labels

AS4012 / AS5012 Warning Labels

Optional Label (AS5012 with optional pressurised chamber):



AS5025 / 5040 Warning Labels

AS5080 Warning Labels

Intended Use

The gauge is a self-contained non-contact, laser micrometer capable of measuring and monitoring the diameter and Ovality of wires, cables, and similar products on a continuous production line. If the equipment is not used in a manner specified by the manufacturer, the protection provided by the equipment may be impaired.

Mechanical Installation

This section describes mechanical installation of the gauge. Note that there are many gauge models and options (height stand, guide rollers etc) to consider and you will have to refer to various parts of this section to install the gauge successfully.

For Installation categories/degrees and IP ratings see Specification/ Environmental conditions.

General Installation Procedure (all gauges)

1. Refer to the relevant Dimension drawings below. Note also that if you have an external 24V Power Supply, you may chose to attach it to the height stand stem (see 24V Power Supply manual for details or Spare parts section at back of this manual).

2. Find best location for gauge and height stand (if used) on production line.

   If the gauge is to be installed on a plastic extrusion line, it is recommended that it be located at one of the following sites:

   - Between extruder and cooling trough (i.e. before the product/cable enters the cooling trough).
   - Following the cooling trough but after a good quality airwipe.
   - Following the cooling trough but after an airwipe and preferably after a Sparktester, if fitted.

   If the gauge is fitted directly to host machinery, it should not be subjected to excessive vibration during operation, as this might impair the accuracy or stability of the measurements. The use of a height stand is recommended; this has the added advantage of isolating the gauge from vibration. Beta LaserMike can supply an adjustable height-stand if needed.

3. Secure height stand base to floor.

4. If using guide rollers, see relevant sections below.

5. Obtain the correct bolts for fixing the gauge to the height stand. See dimension drawings in relevant section below.

6. Fix the gauge to height stand. Do not exceed a tightening torque of 1 Newton meter (8.8in-lb_f).

7. **Ensure an assistant (or two assistants in the case of AS5080) is supporting the gauge before proceeding**. Unlock height stand stem and secure and correct height (the gauge should be securely fixed in position so that the products pass through the centre of the gate).

AS4012 - Mechanical Installation

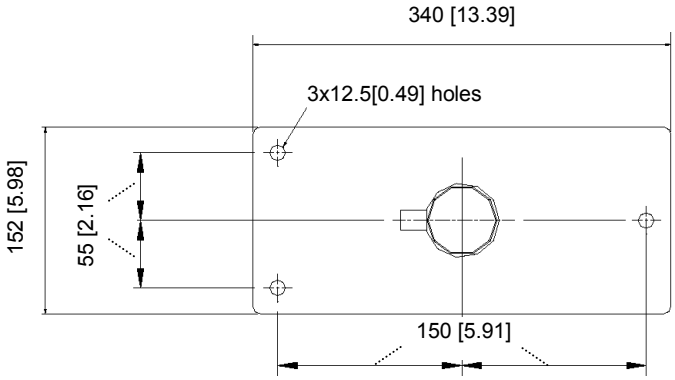
Before fixing the gauge to the height stand, ensure the height stand is firmly bolted or clamped to the floor or other rigid structure.

Before proceeding see General Installation Procedure at the beginning of section “Mechanical Installation”.

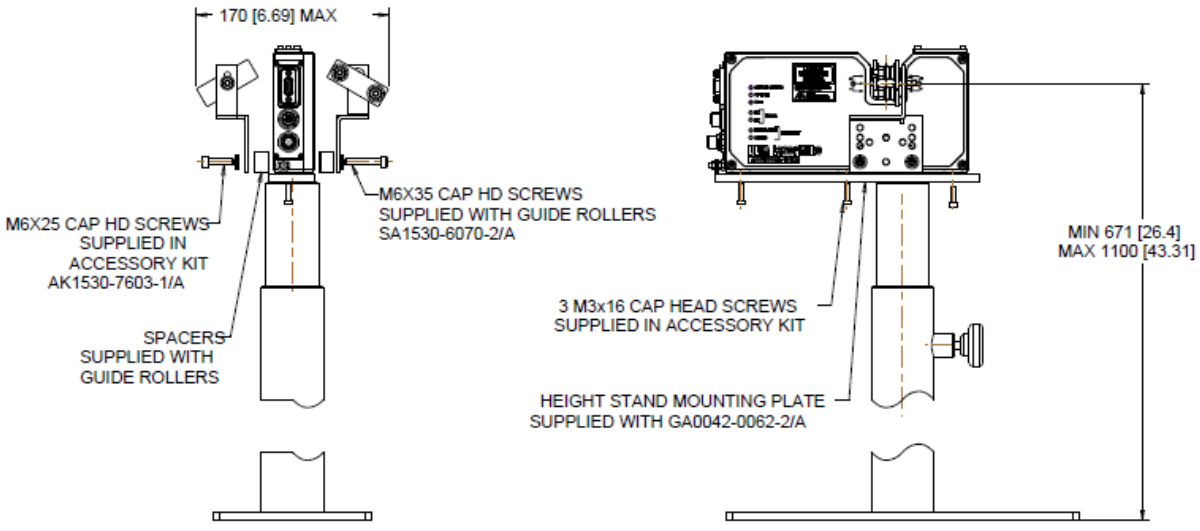
AS4012 Height Stand and Guide Rollers

Note: height stand and guide rollers are optional.

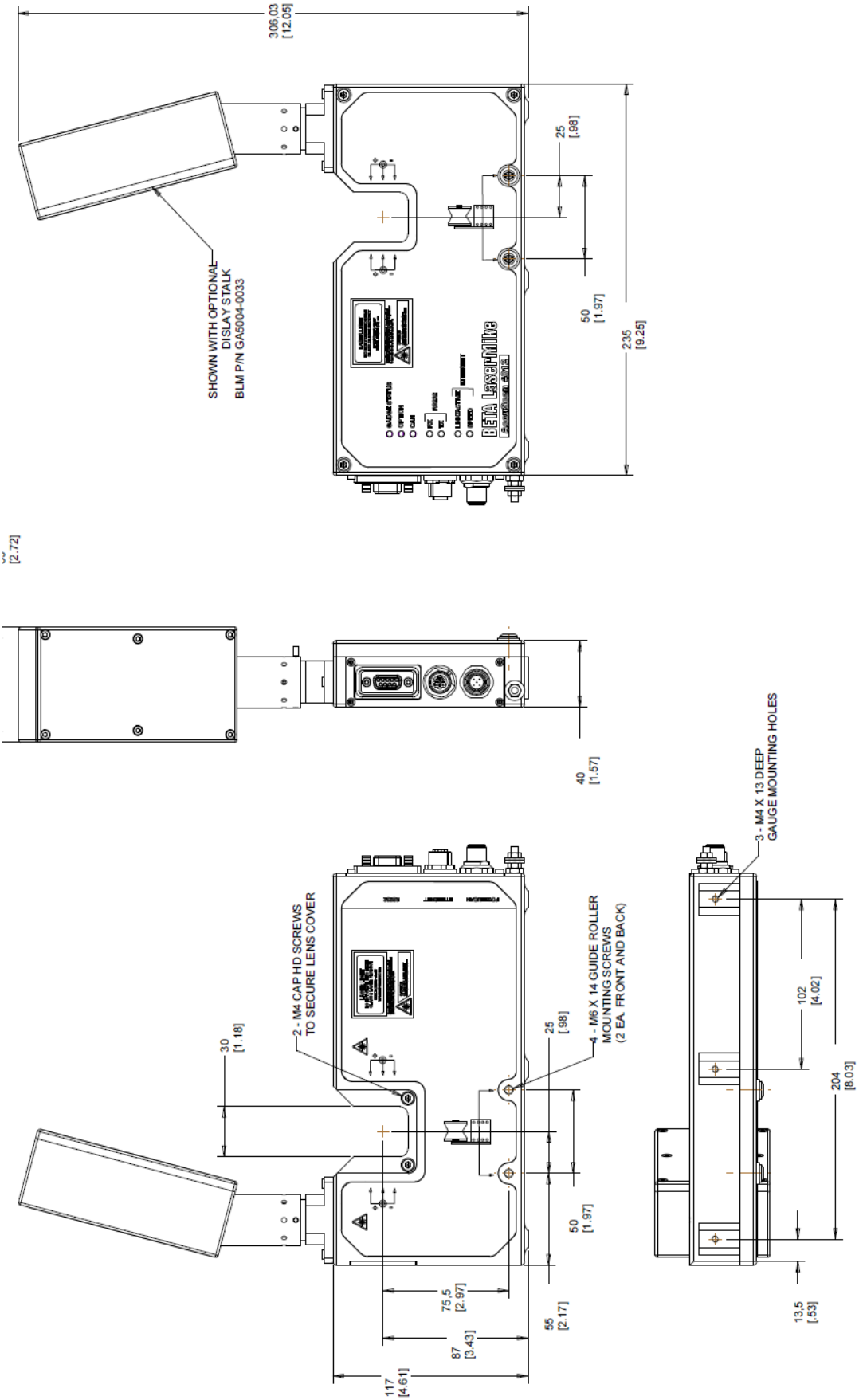
Base Plate for Height Stand:



Guide rollers for product ∅ 0-5mm(0.20in):



AS4012 Dimensions - mm [inches]



AS5012 - Mechanical Installation

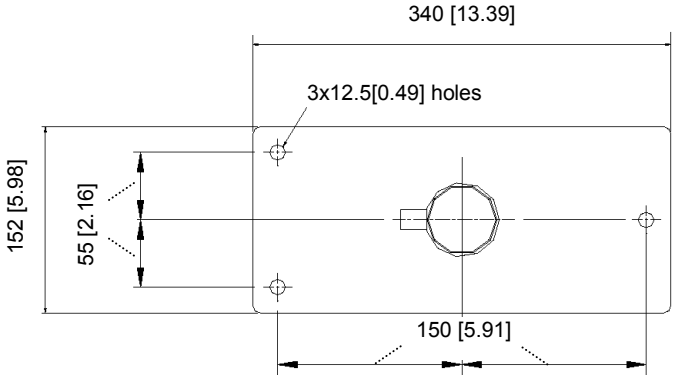
Before fixing the gauge to the height stand, ensure the height stand is firmly bolted or clamped to the floor or other rigid structure.

Before proceeding see General Installation Procedure at the beginning of section “Mechanical Installation”.

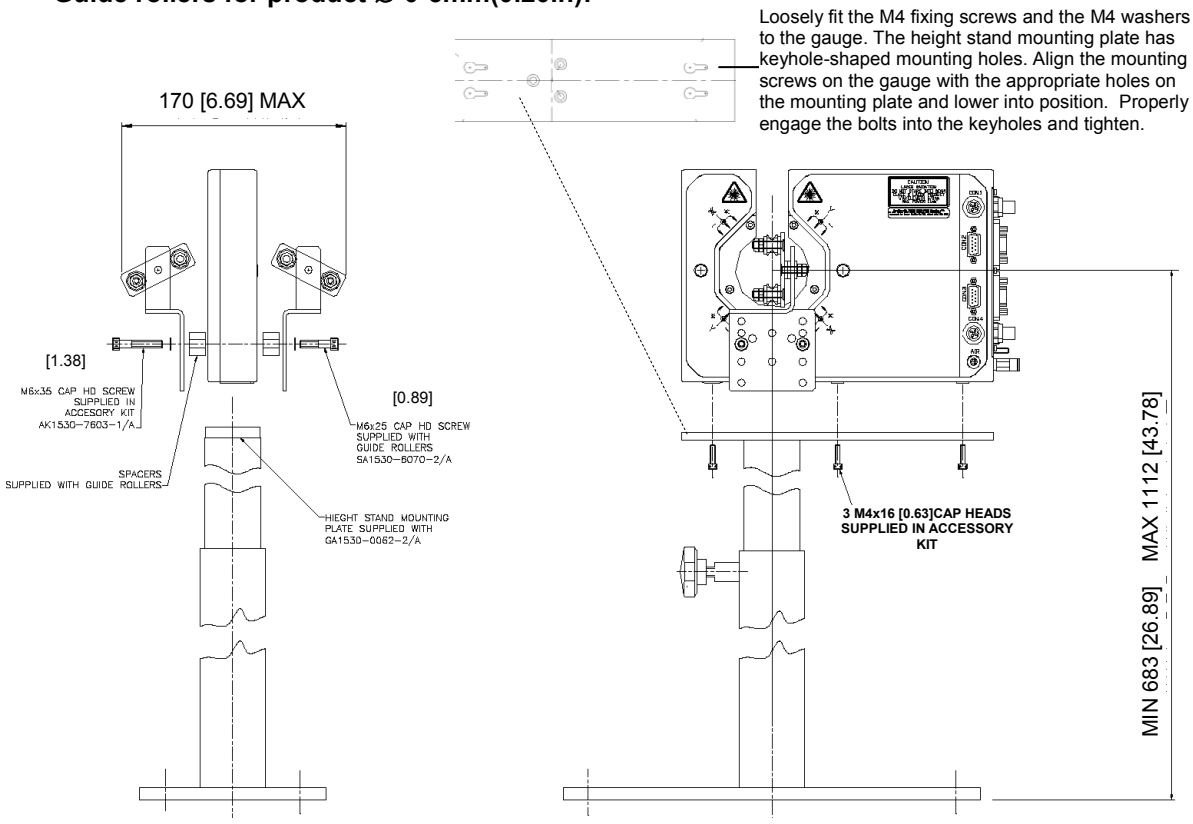
AS5012 Height Stand and Guide Rollers

Note: height stand and guide rollers are optional. Guide rollers are not required if optional air purge chamber is used.

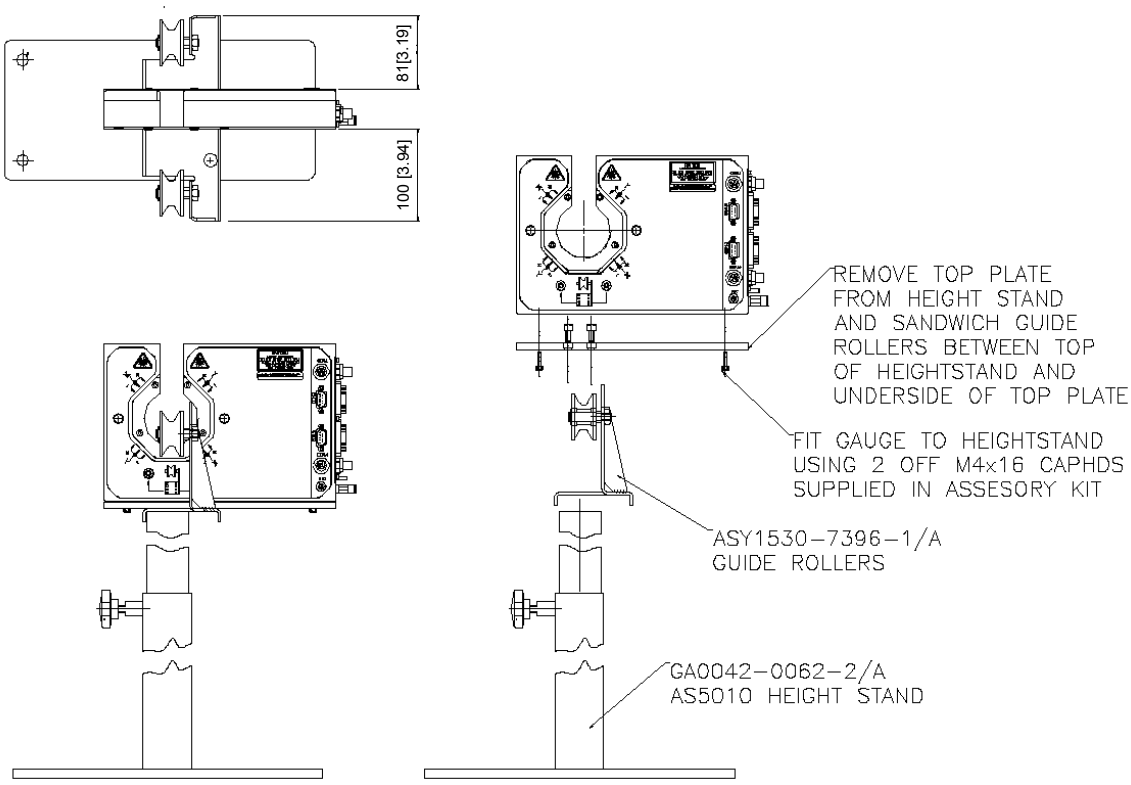
Base Plate for Height Stand:



Guide rollers for product ∅ 0-5mm(0.20in):

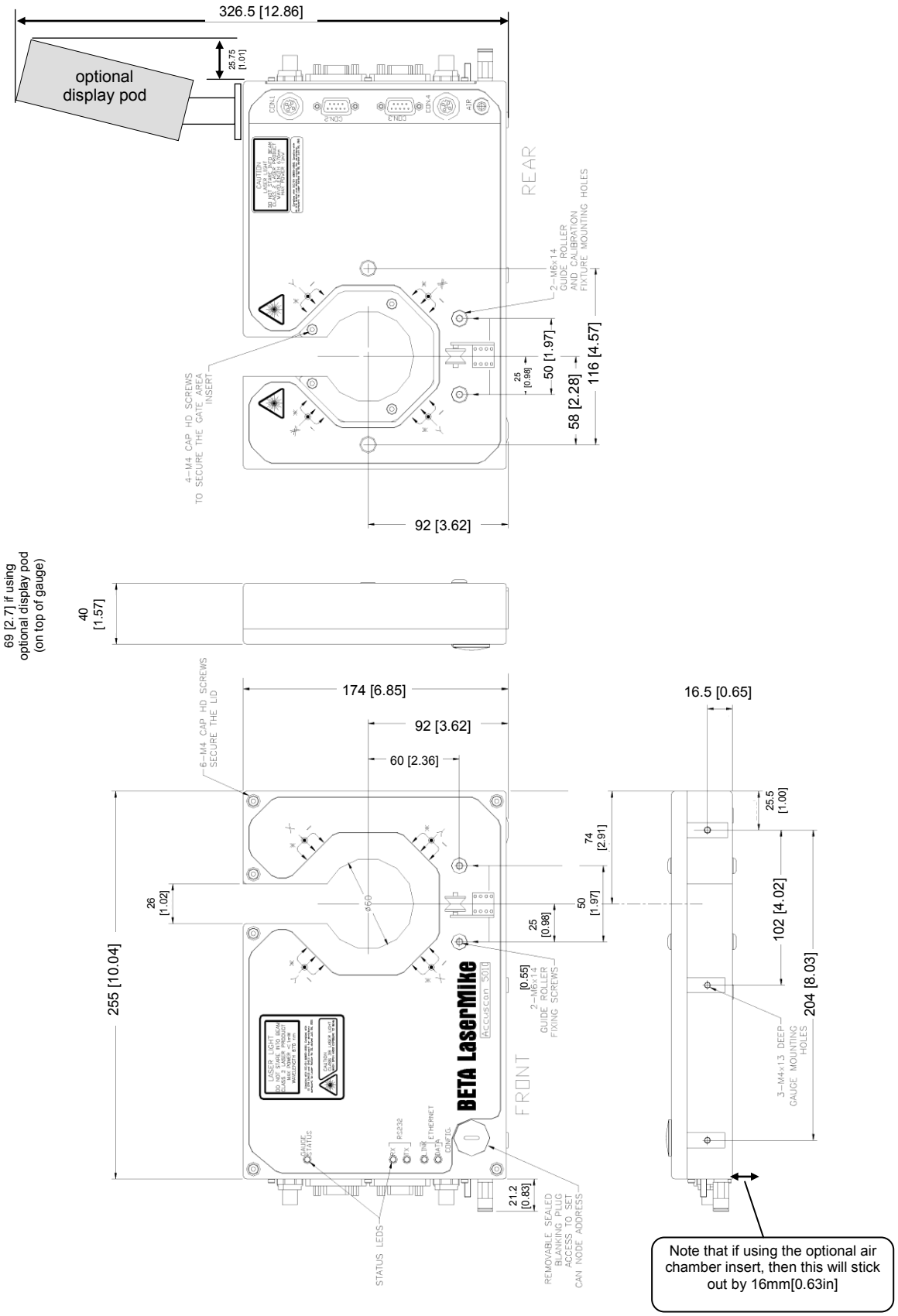


Guides for Product ∅ 5-10mm (0.20-0.39in):



For other guide roller sizes see section Product Guide Rollers.

AS5012 Dimensions - mm [inches]



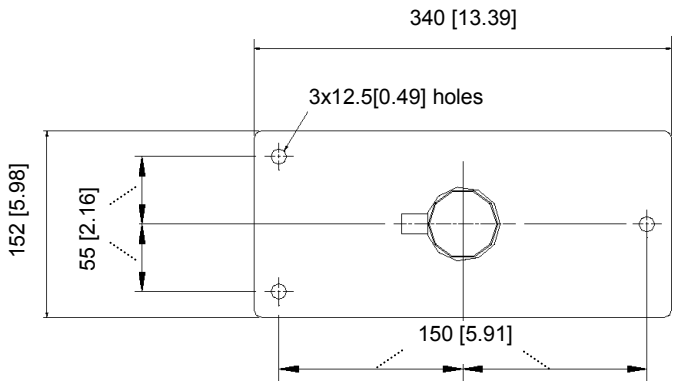
AS5025 and AS5040 - Mechanical Installation

Before fixing the gauge to the height stand, ensure the height stand is firmly bolted or clamped to the floor or other rigid structure.

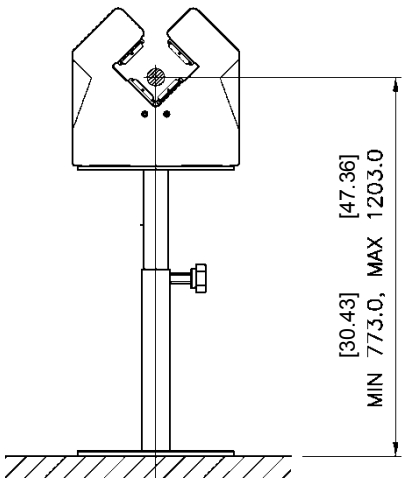
Before proceeding see General Installation Procedure at the beginning of section “Mechanical Installation”.

For guide roller installation instructions use the AS5012 section AS5012 Height Stand and Guide Rollers, as it is the same in principle.

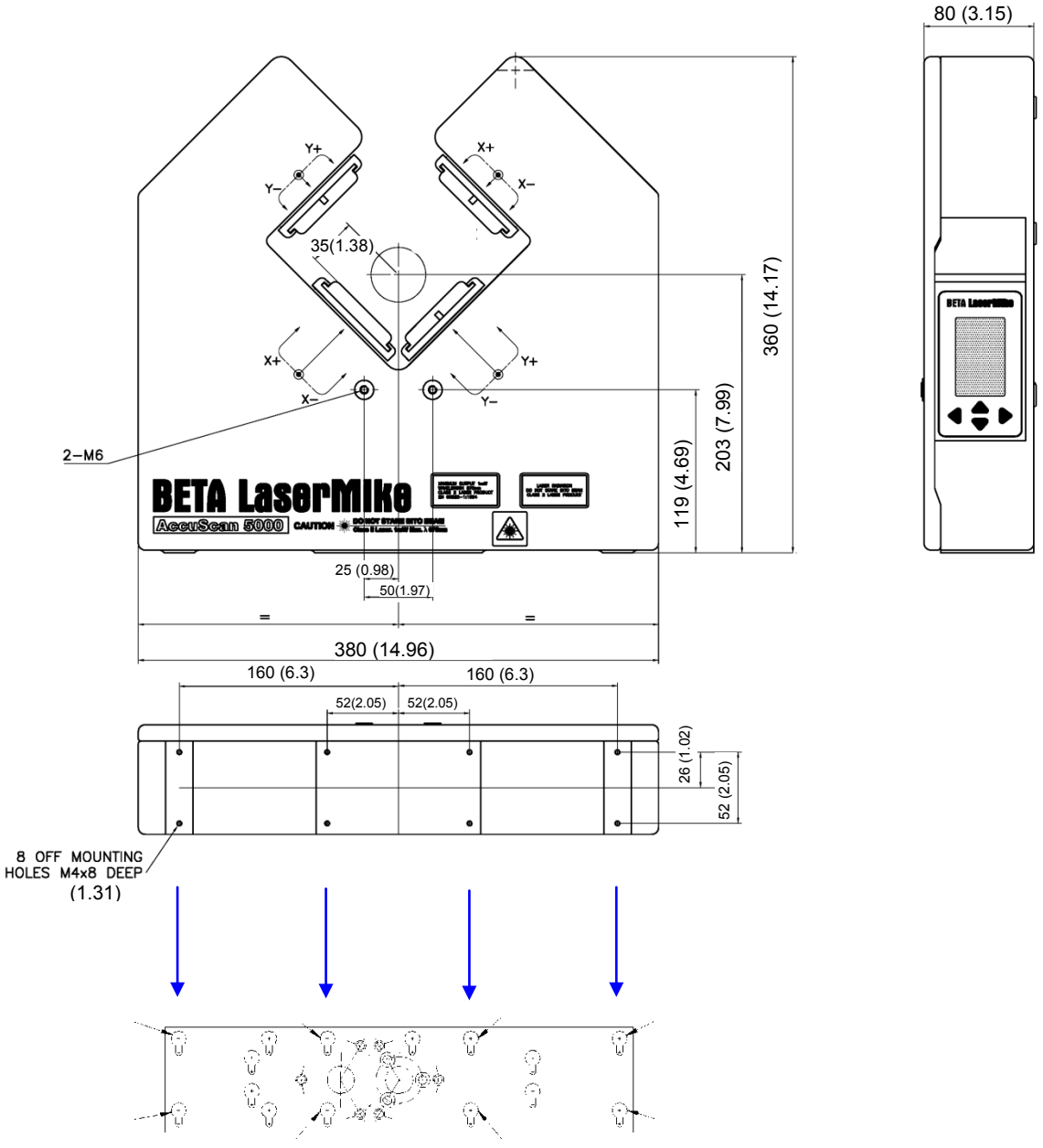
AS5025 and AS5040 - Height Stand Base



Line Height



AS5025 / AS5040 Dimensions - mm (inches)



Height stand adaptor plate.

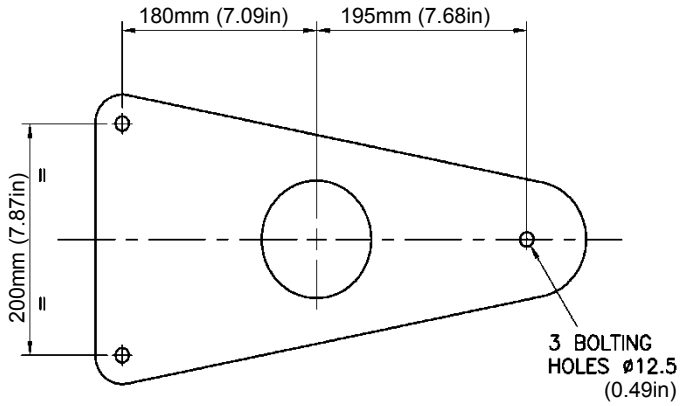
Loosely fit the M4 fixing screws and the M4 washers to the gauge. The height stand mounting plate has keyhole-shaped mounting holes. Align the mounting screws on the gauge with the appropriate holes on the mounting plate and lower into position. Properly engage the bolts into the keyholes and tighten.

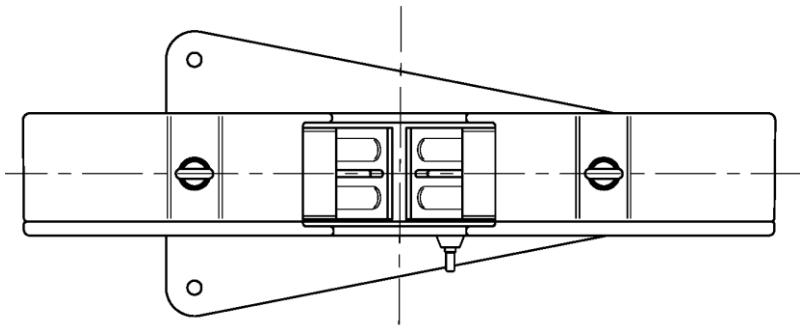
AS5080 - Mechanical Installation

Before fixing the gauge to the height stand, ensure the height stand is firmly bolted or clamped to the floor or other rigid structure.

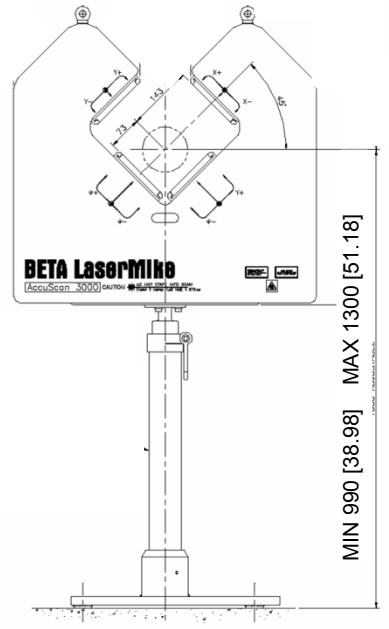
Before proceeding see General Installation Procedure at the beginning of section “Mechanical Installation”.

AS5080 Height Stand Base and View from Above

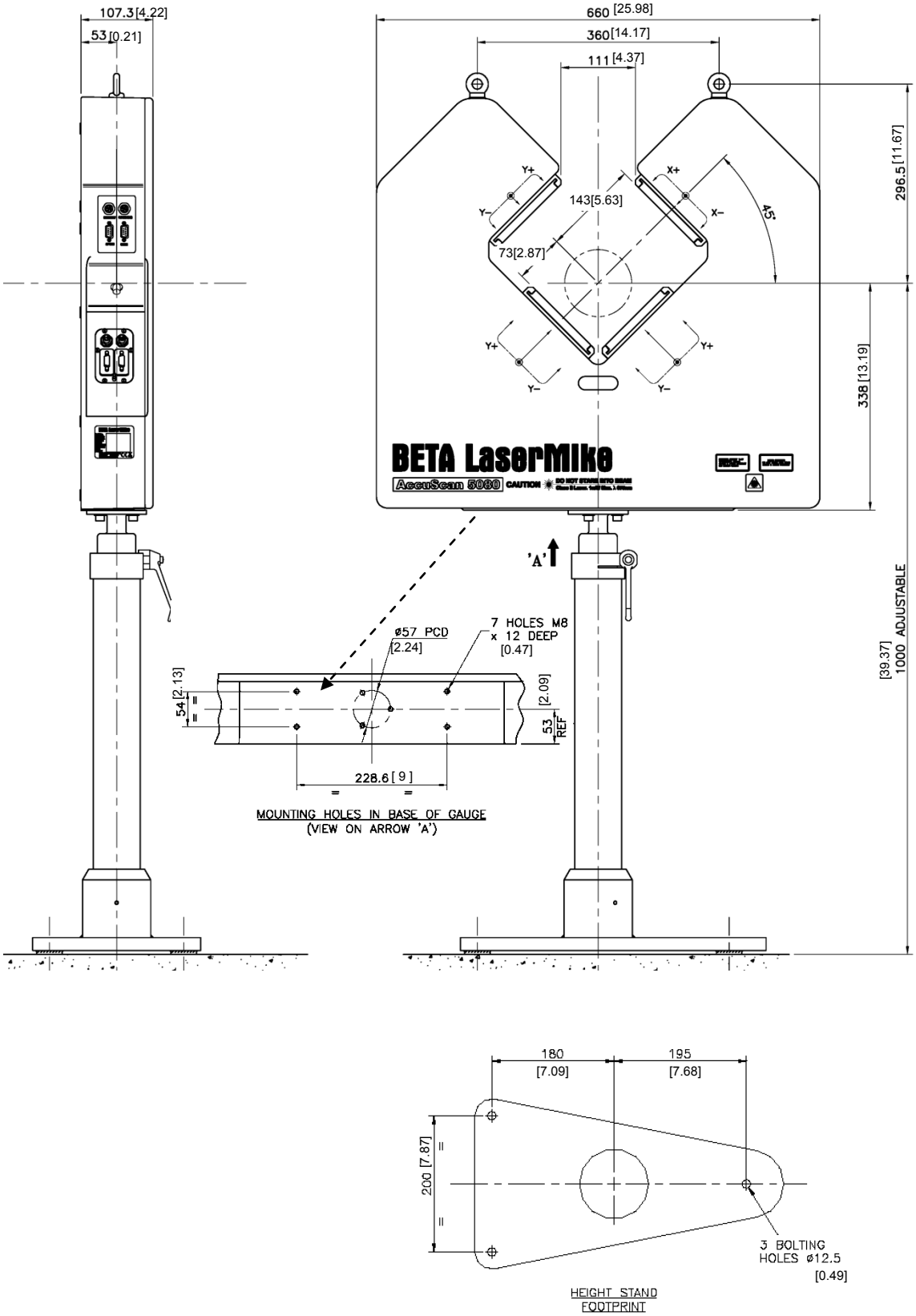




Line Height



AS5080 Dimensions - mm (inches)



Product Guide Rollers (optional)

In the majority of installations it is necessary to use external wire guides. In installations where there are long wire runs between associated machinery and the gauge, whereby the wire is likely to oscillate, external wire guides will be necessary to stabilize the wire before entry into the gauge.

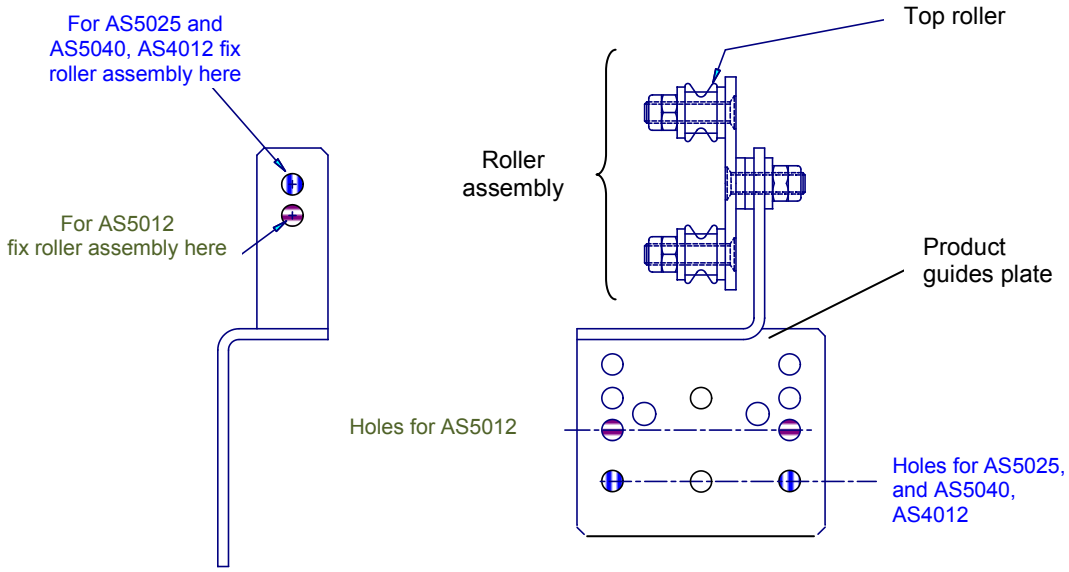
Adapter Plate for Guide Rollers – mm [inches]

If guide rollers are to be used, a special adapter plate will need to be fixed onto the stem of the height stand. Tighten screws to about 3 Nm. The guide plates below have been designed to fit a number of gauges. See diagrams below to find relevant fixing holes.

Guide roller drawings are shown below. For more installation instructions see section Height Stand and Guide Rollers. The section shows a AS5012 gauge but the installation instructions can be applied to a AS5025 and AS5040.

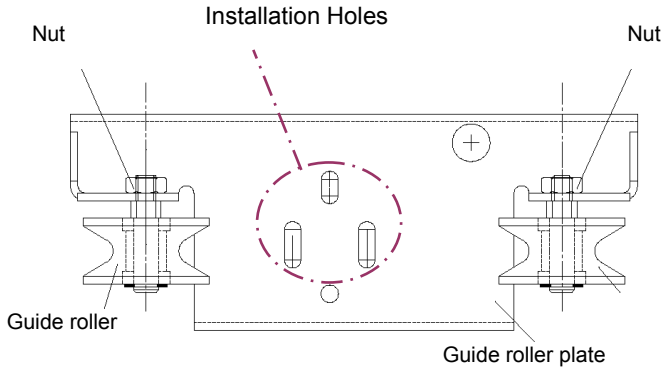
Guide for Product ∅ 0-5mm (0.20in)

These guide rollers are attached to the side of the gauge.



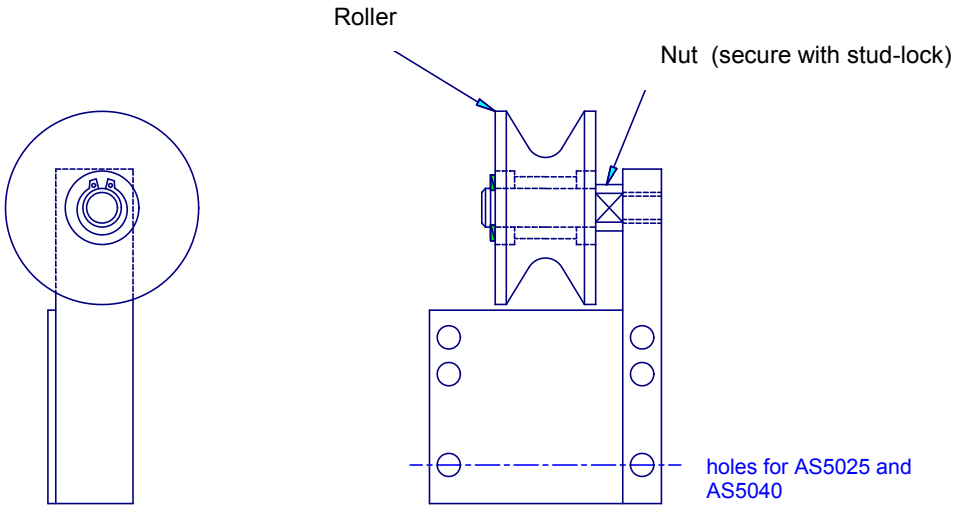
Guides for Product ∅ 5-10mm (0.20-0.39in)

These guide rollers are attached directly to the top of the height stand stem.



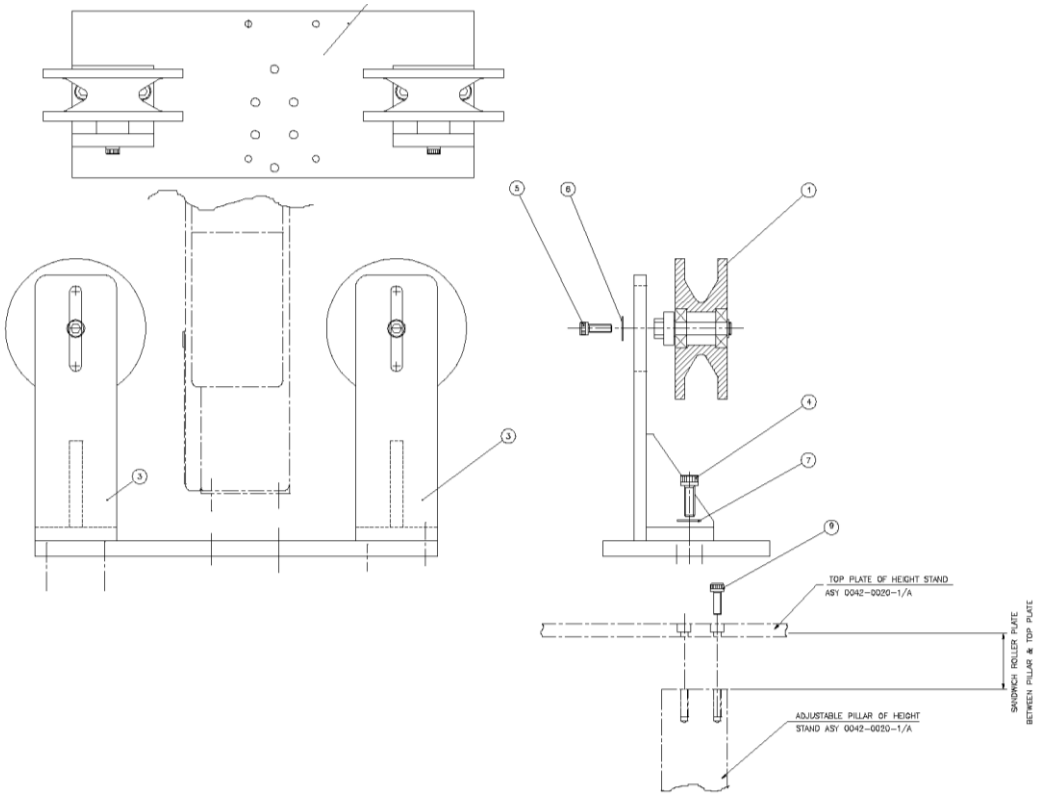
Guide Rollers for Product ∅ 5-15mm (0.20-0.59in)

These guide rollers are attached to the side of the gauge.



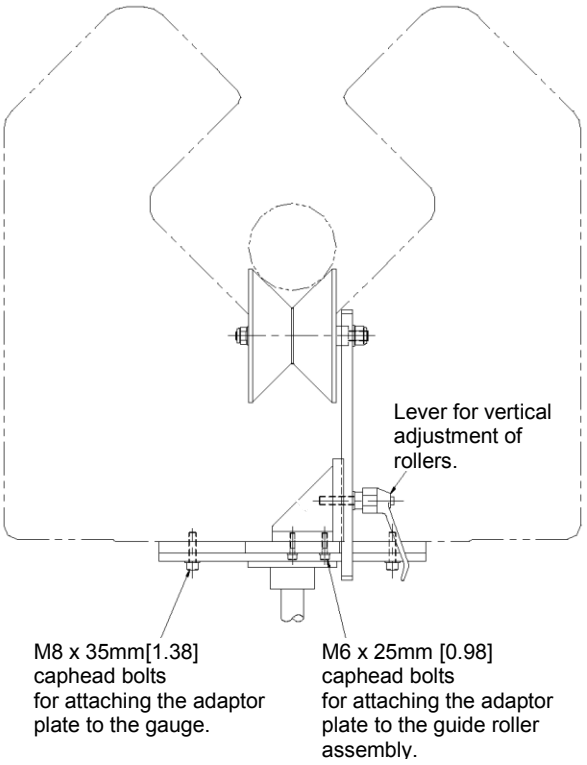
Guide Rollers for Product ∅ up to 25mm (0.98in) and up to 40mm (1.57in)

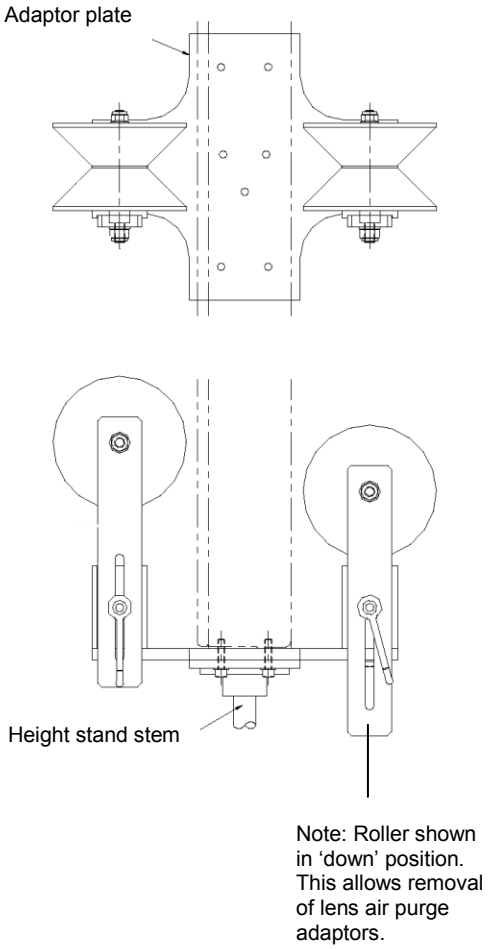
The guide roller assembly for “up to 25mm” guides and “up to 40mm” guides are similar, they just have different roller wheel sizes. Ignore numerical callouts in this diagram.



Guide Rollers for AS5080

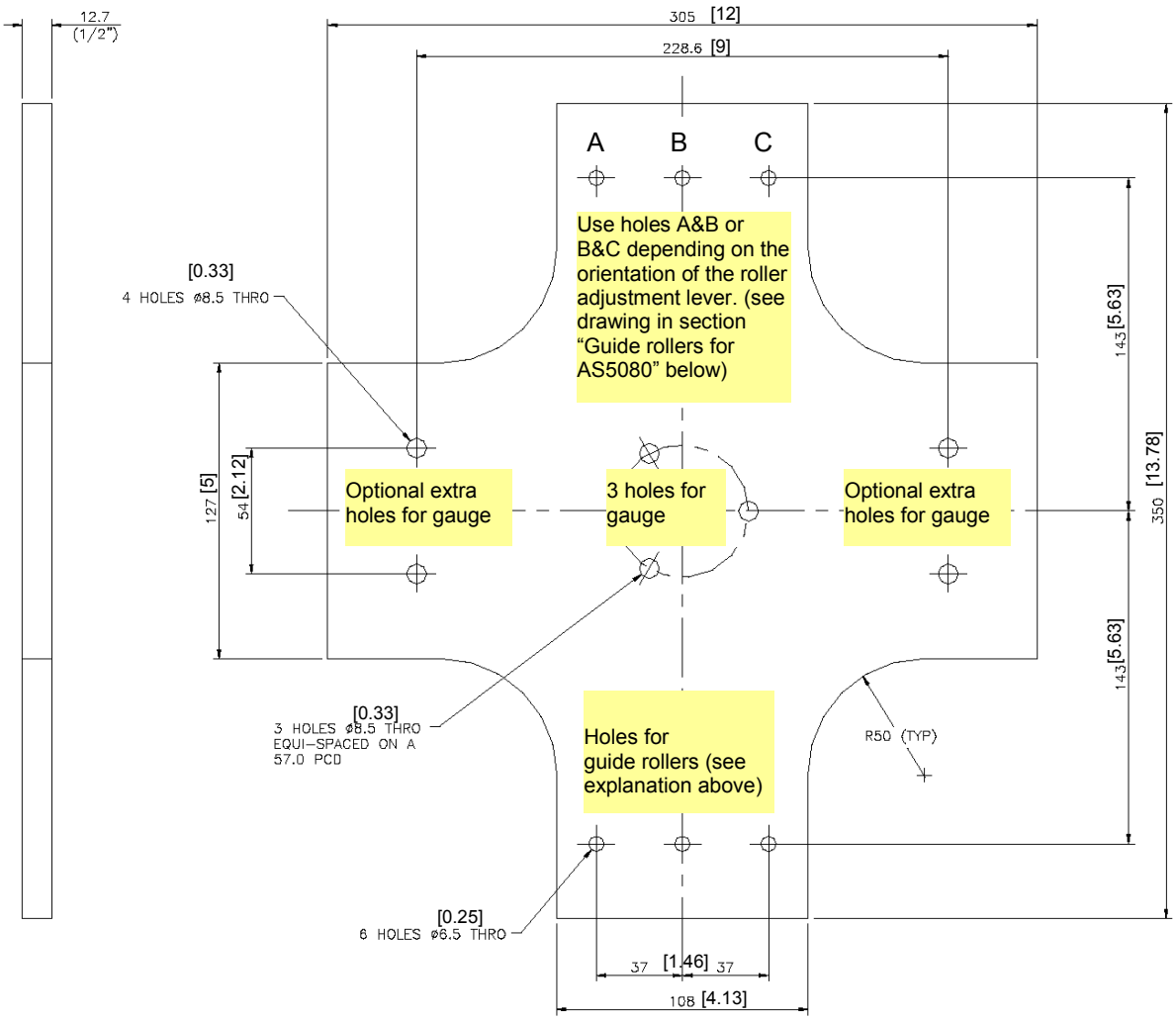
A modified base plate (see Adapter plate for external wire guide for drawing) needs to be attached to the top of the height stand mounting plate. The guides can then be attached onto the plate.





AS5080 Adapter plate for Guide Rollers – mm [inches] :

If guide rollers are to be used, a special adapter plate will need to be fixed onto the stem of the height stand.



Display Pod (optional for AS4012 and AS5012)

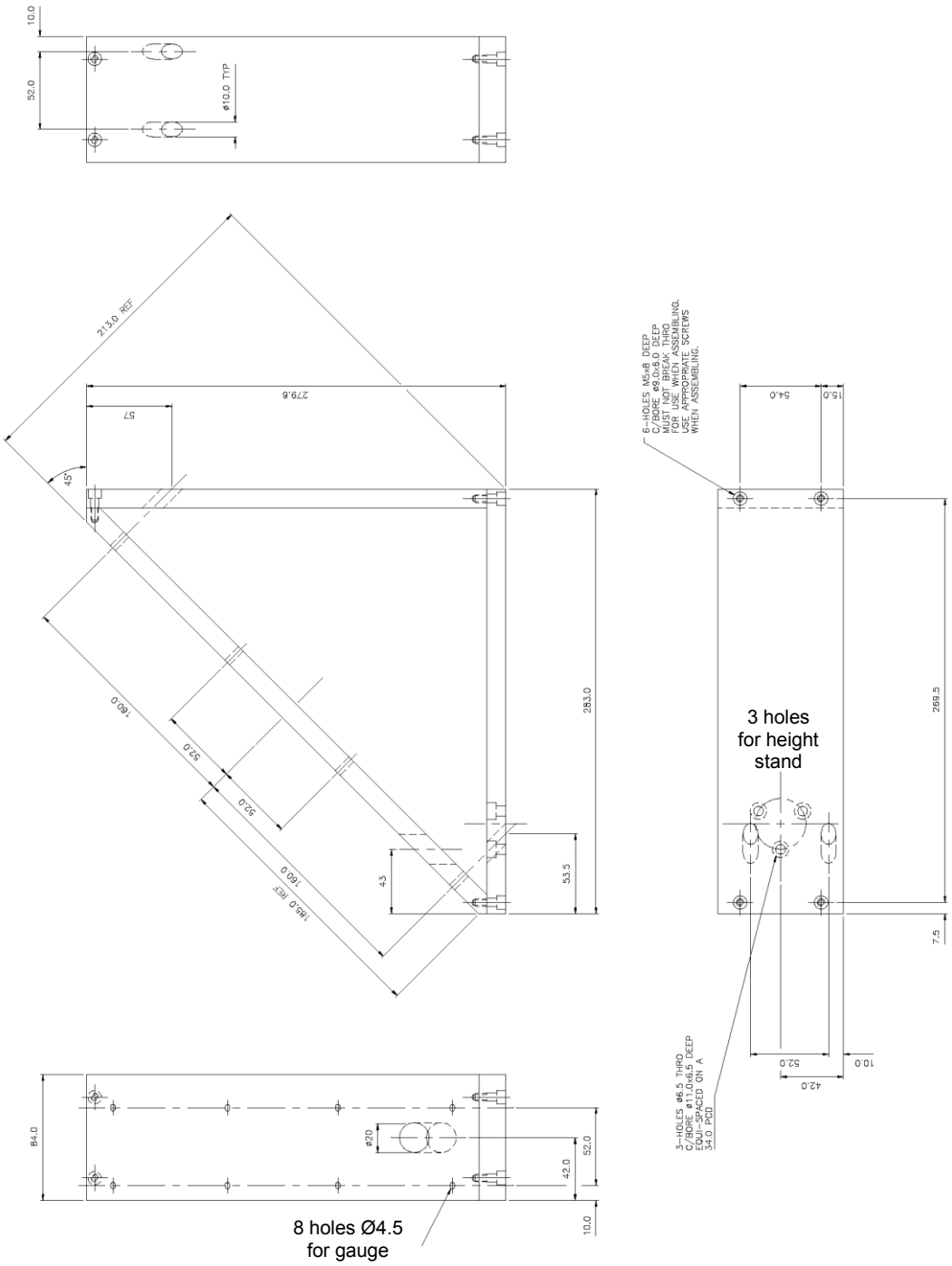
To install the display pod, remove the blanking plate at the top of the gauge (by removing 3 screws), then insert the pod and tighten the screws.

A display is also optional for the other gauges, but it must be pre-ordered and cannot be retro-fitted.

45° Gauge Bracket (optional for AS5025 and AS5040)

If products with an irregular cross-section are measured (e.g. ribbon cables) it may be beneficial to angle the gauge so that the laser beams measure the product from a different angle.

The bracket is triangular in shape and is installed directly onto the height stand stem. A dimension drawing (metric units) of the bracket with installation holes is shown below.



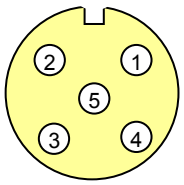
Electrical Installation

For Installation category/degree and IP rating see Specification.

If using Beta LaserMike external 24V Power Supply, see the 24V Power Supply Instruction Handbook. Part numbers for US and EU/UK power supply versions are also shown in Spare parts section in this manual.

- **Electrical installations must be carried out by a suitable technician for the country of installation**
- **Connectors must be correctly terminated. Inadequate termination can degrade equipment performance and may lead to equipment damage.**
- **This equipment must be earthed/grounded.**
- **Relays and associated wiring are rated for SELV levels i.e. 60vdc & 30vac rms. These levels must not be exceeded.**

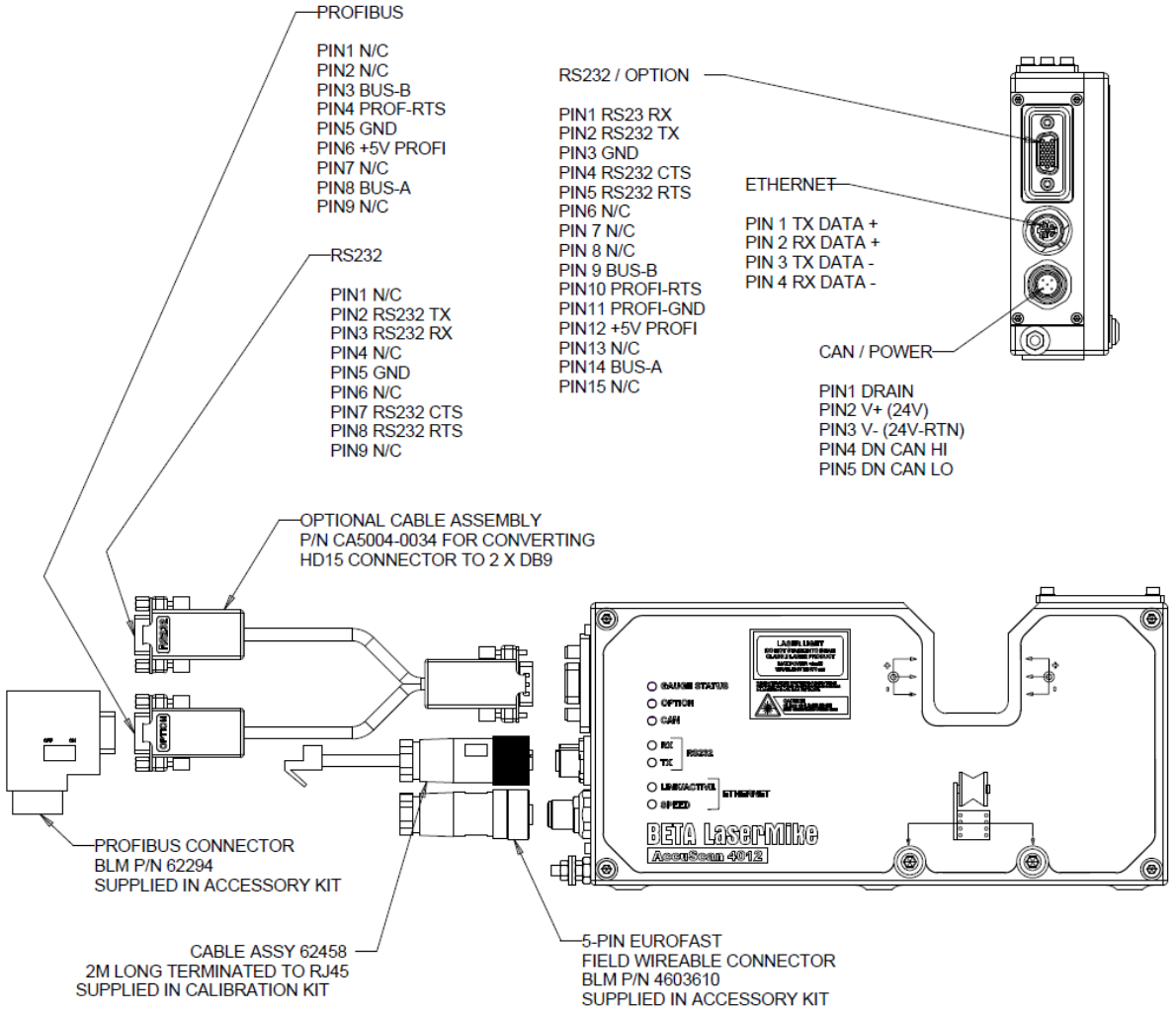
Finding pin numbers on Eurofast connector:



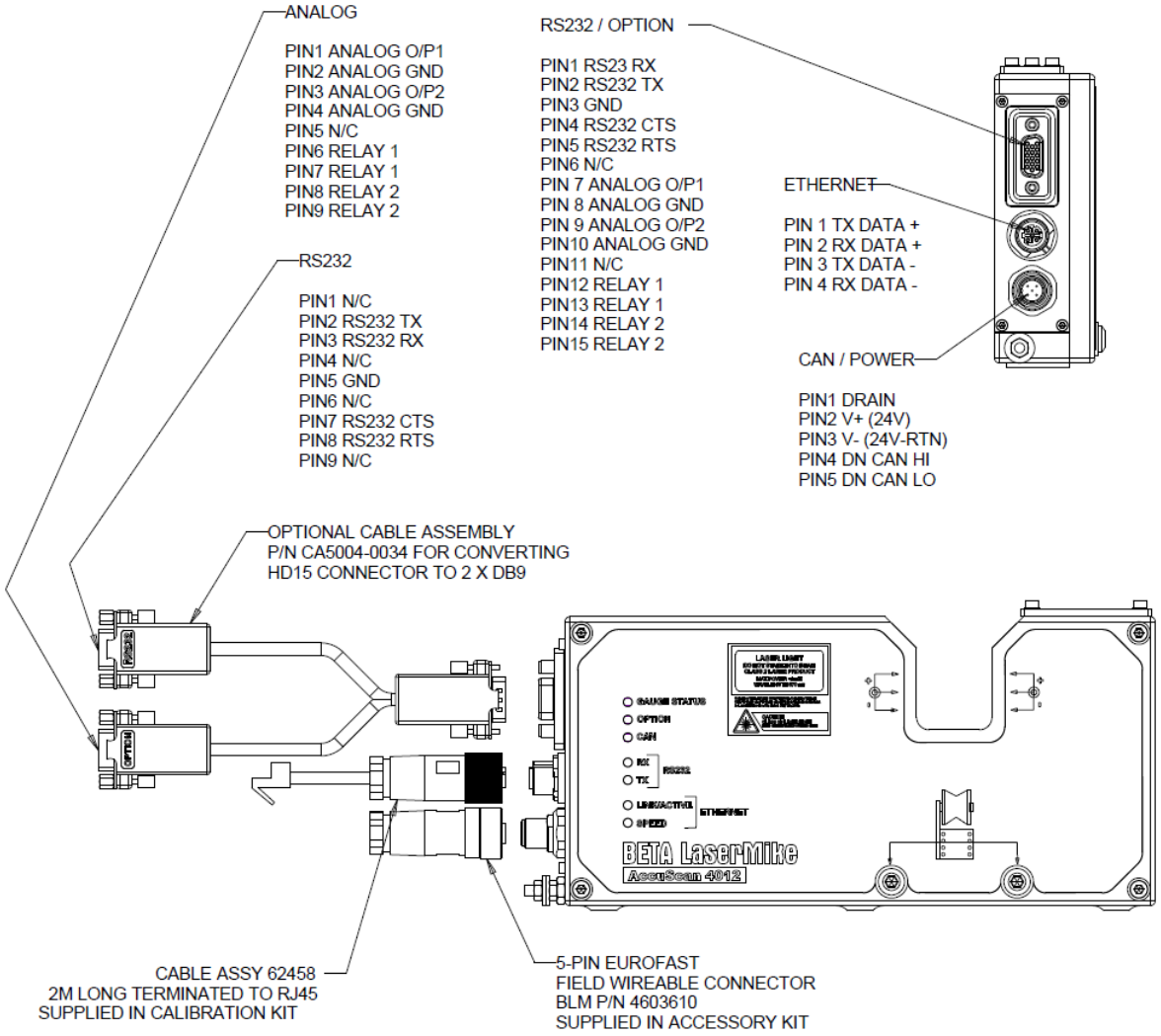
AS4012 Connector Panel

Note: The earth stud is located at the bottom of the panel.

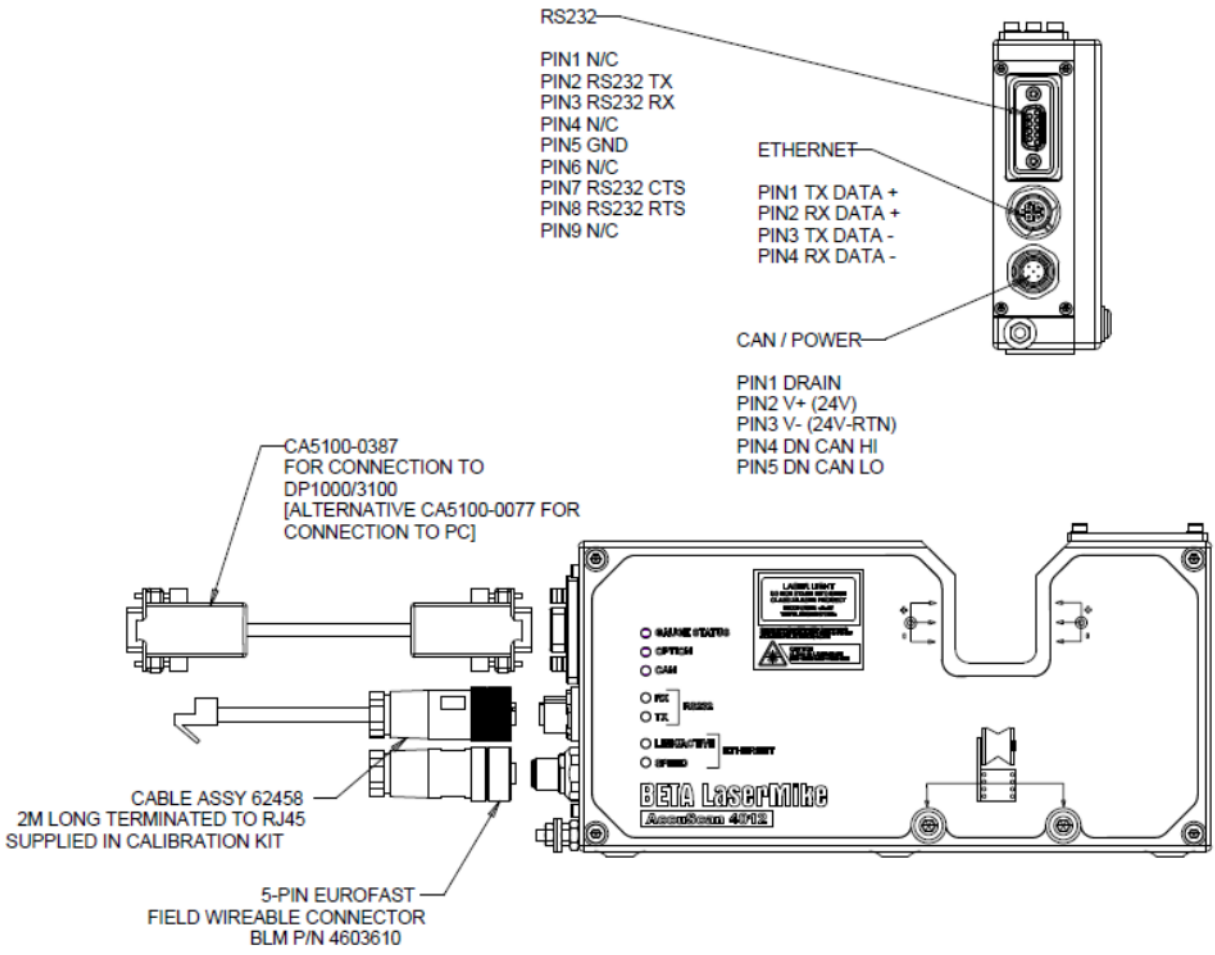
AS4012-P (Profibus Version)



AS4012-A (Analog Version)



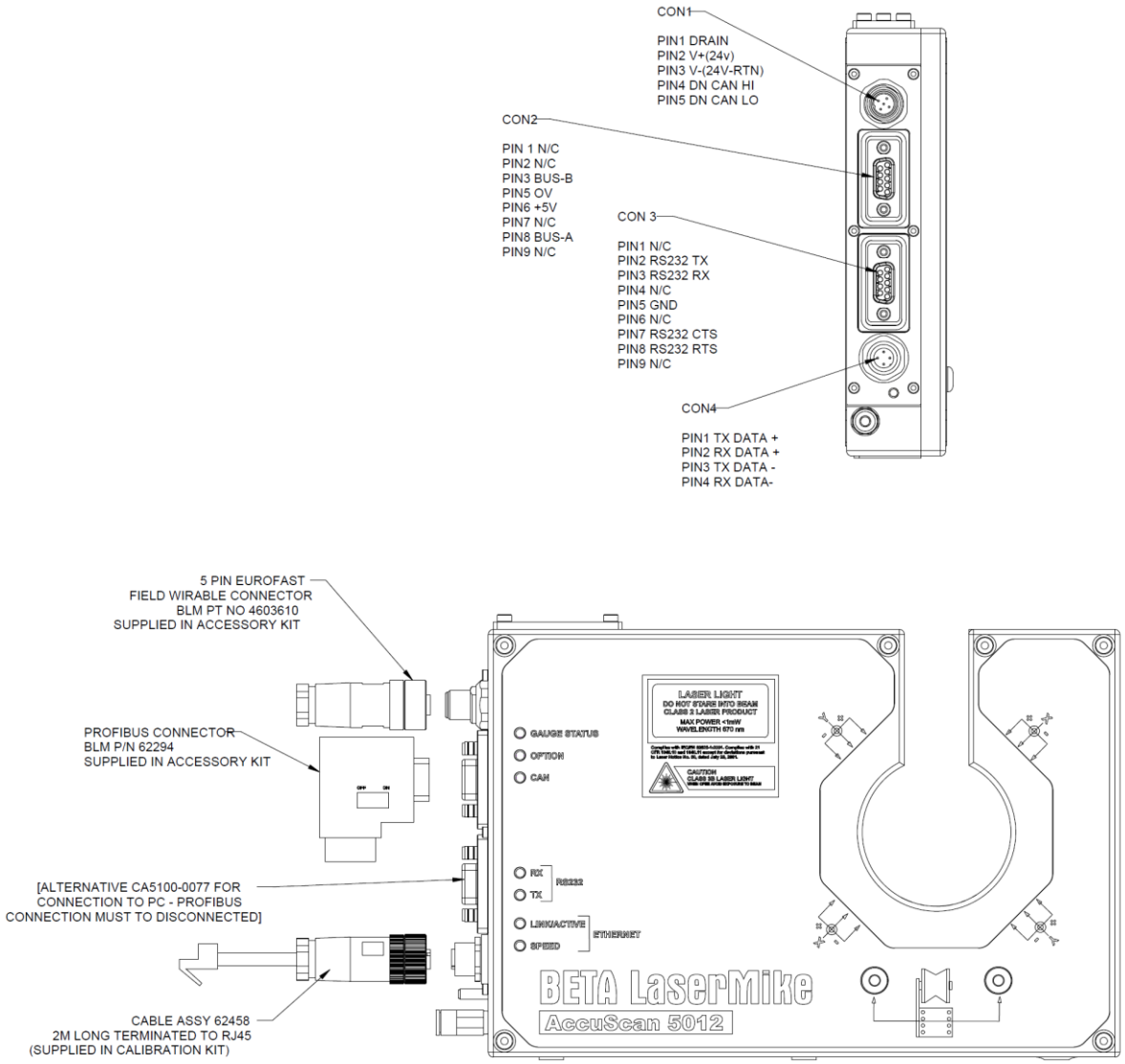
AS4012-R (RS232 Version)



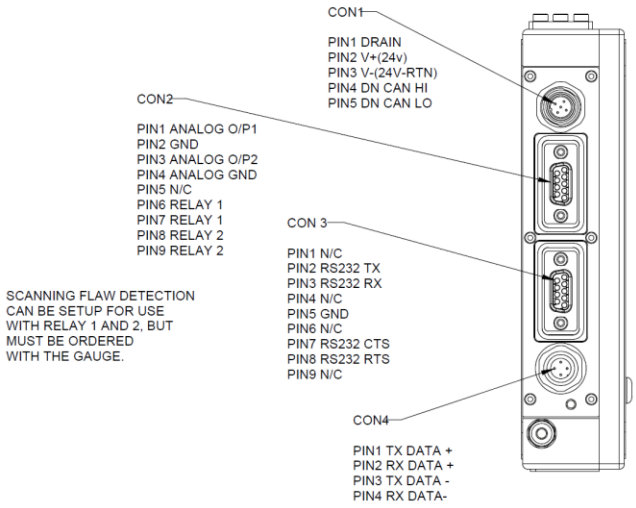
AS5012 Connector Panel

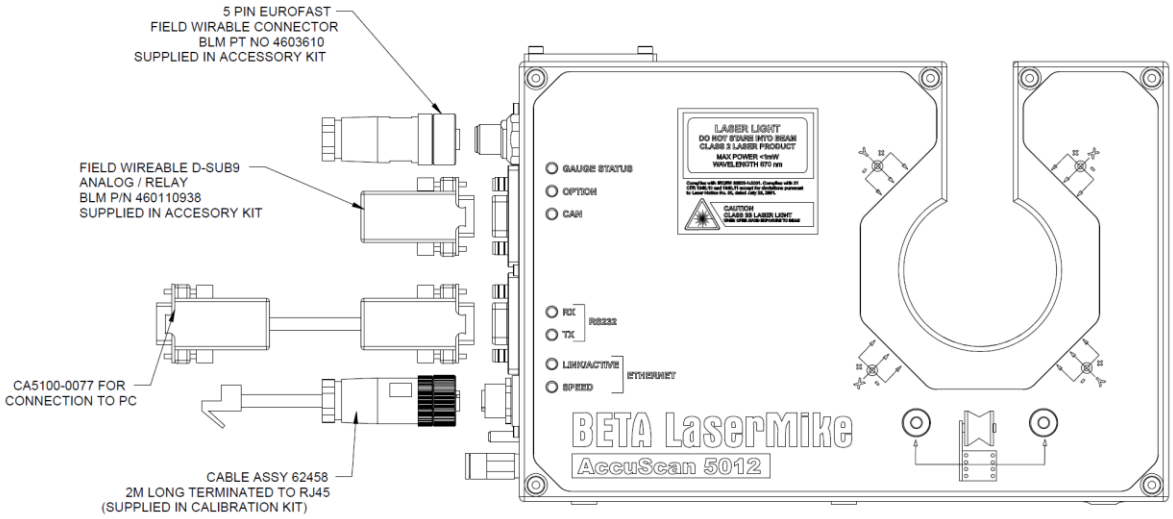
Note: The earth stud is located at the bottom of the panel.

AS5012-P (Profibus Version)

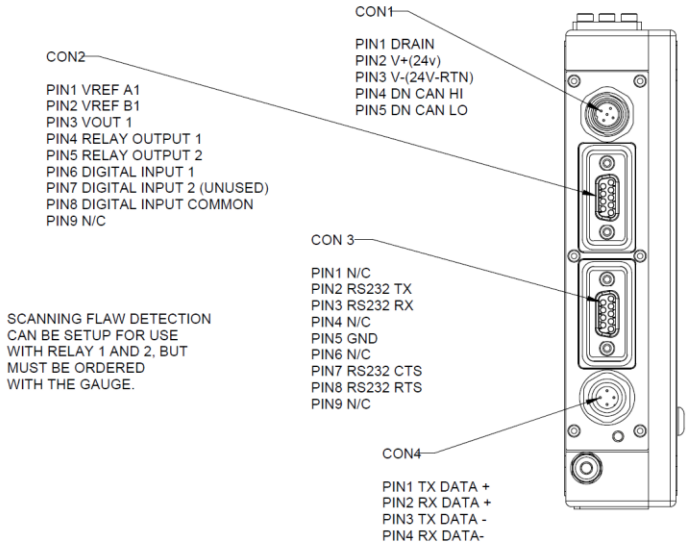


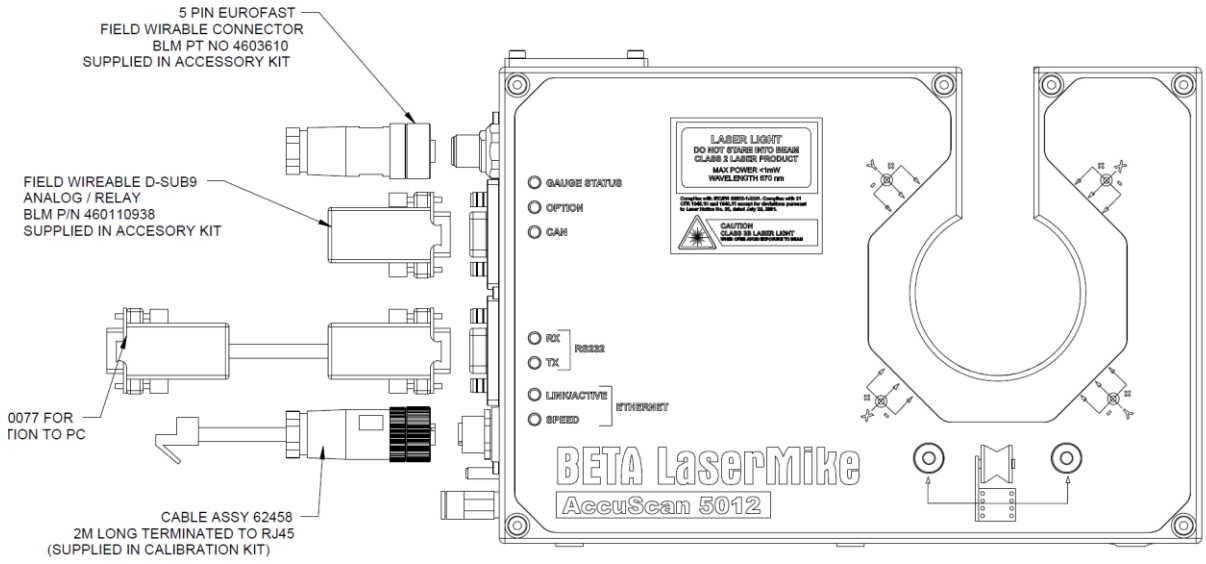
AS5012-A (Analog Version)



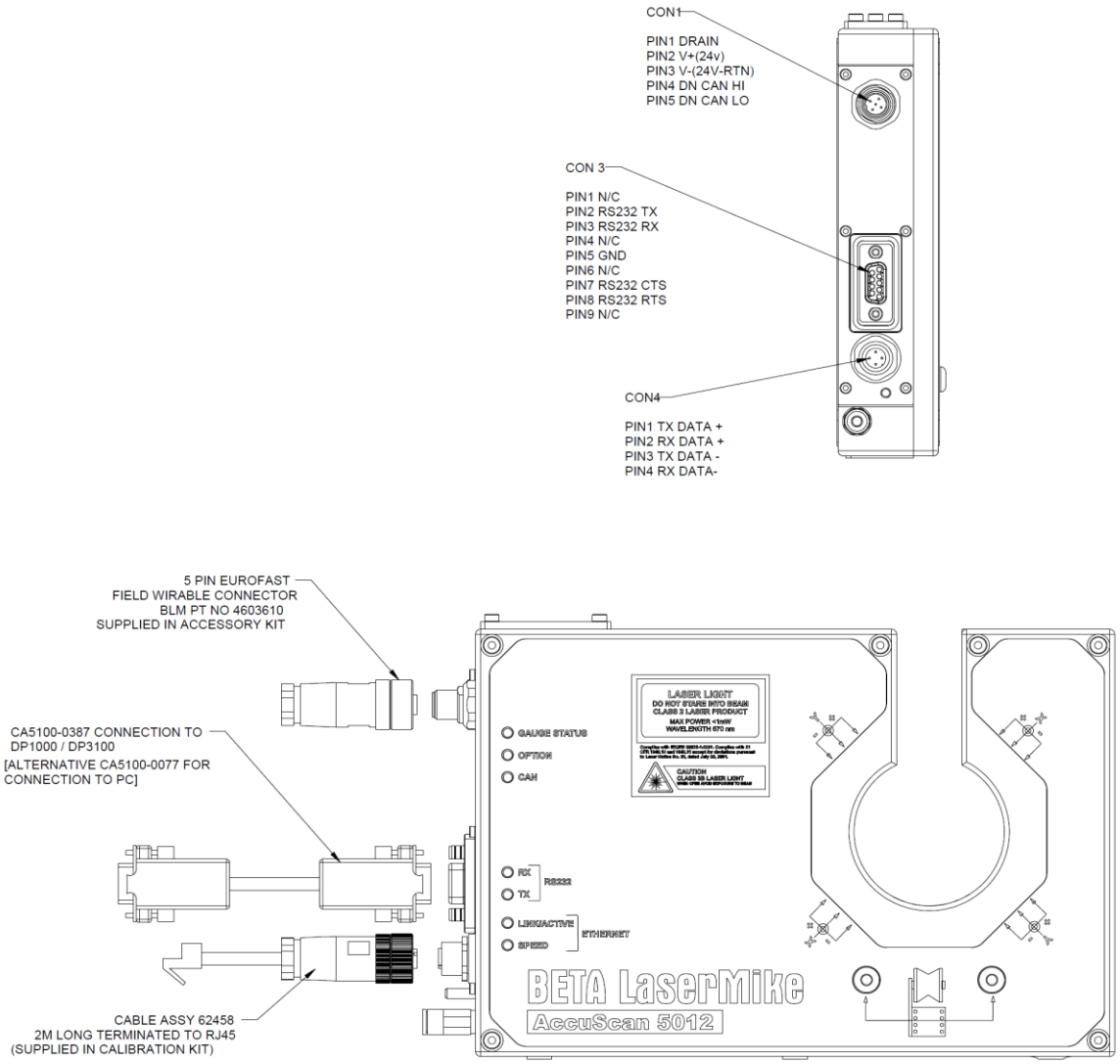


AS5012-K (PI Control Version)





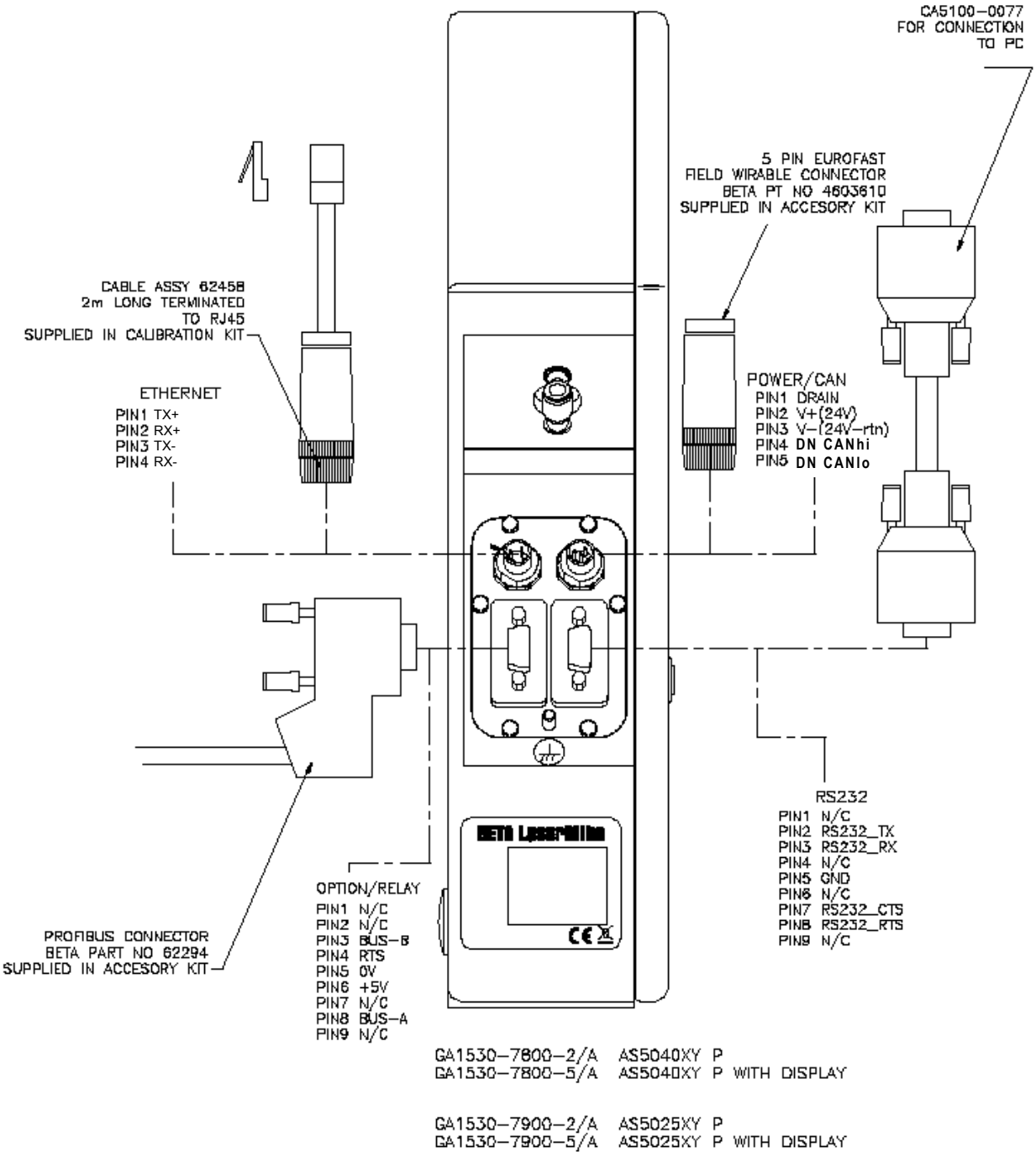
AS5012-R (RS232 Version)



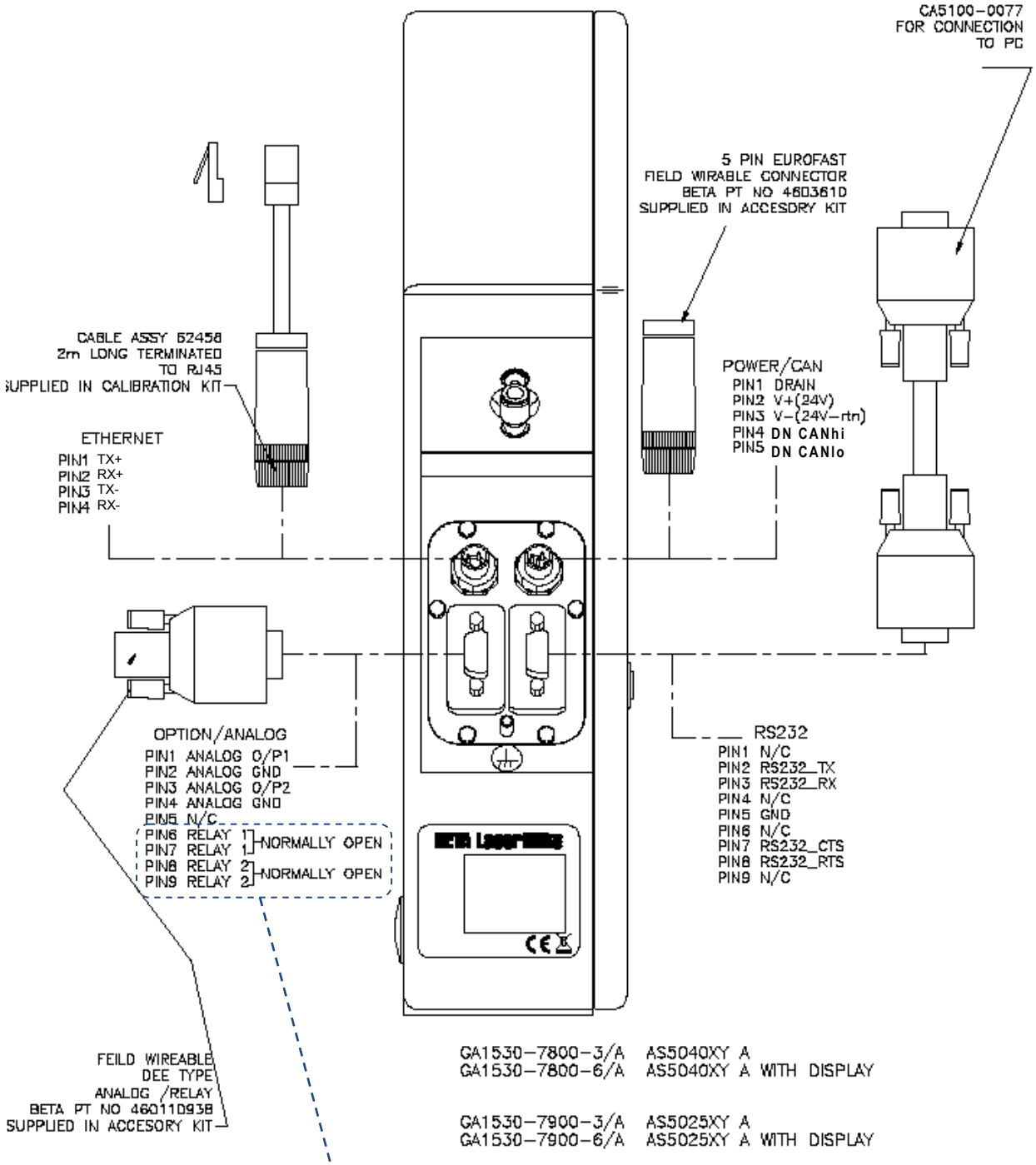
AS5025 / 5040 Connector Panel

Note: The earth stud is located at the bottom of the panel.

AS5025-P/ AS5040-P (Profibus Version)

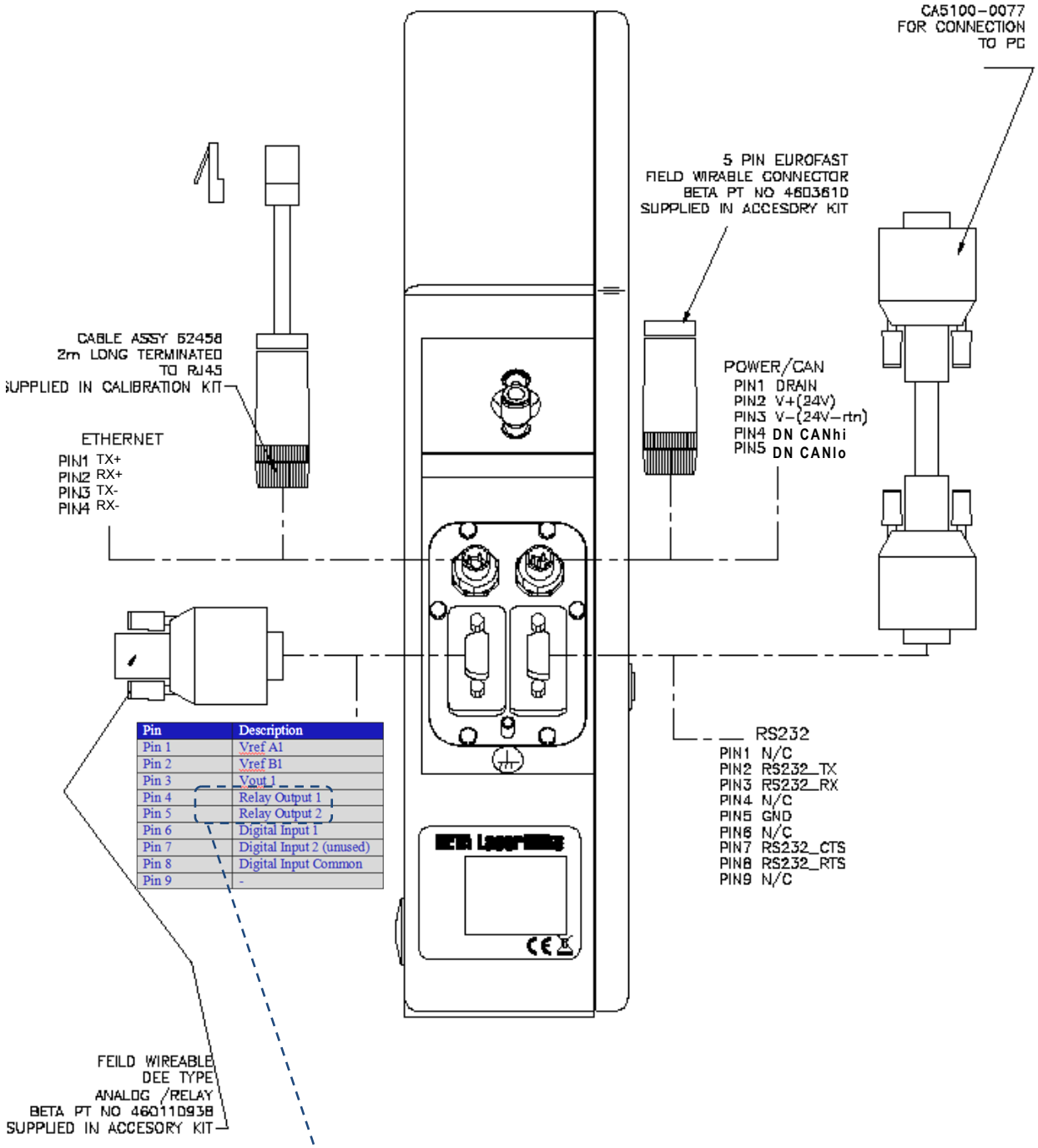


AS5025-A/ AS5040-A (Analog Version)



Scanning flaw detection can be setup for use with these pinouts, but must be ordered with the gauge.

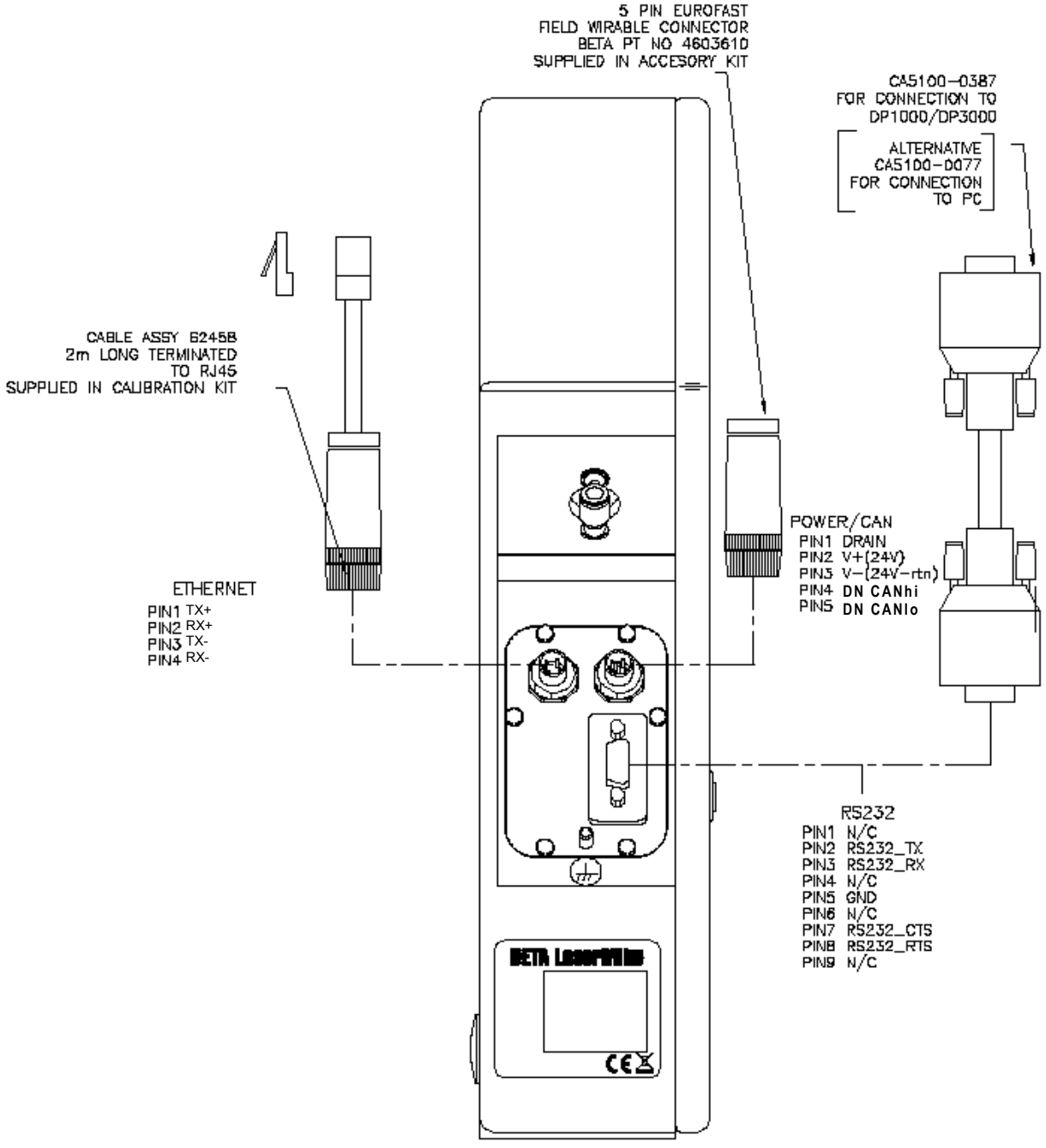
AS5025-K/ AS5040-K (PI Control Version)



Pin	Description
Pin 1	Vref A1
Pin 2	Vref B1
Pin 3	Vout 1
Pin 4	Relay Output 1
Pin 5	Relay Output 2
Pin 6	Digital Input 1
Pin 7	Digital Input 2 (unused)
Pin 8	Digital Input Common
Pin 9	-

Scanning flaw detection can be setup for use with these relay pinouts, but must be ordered with the gauge.

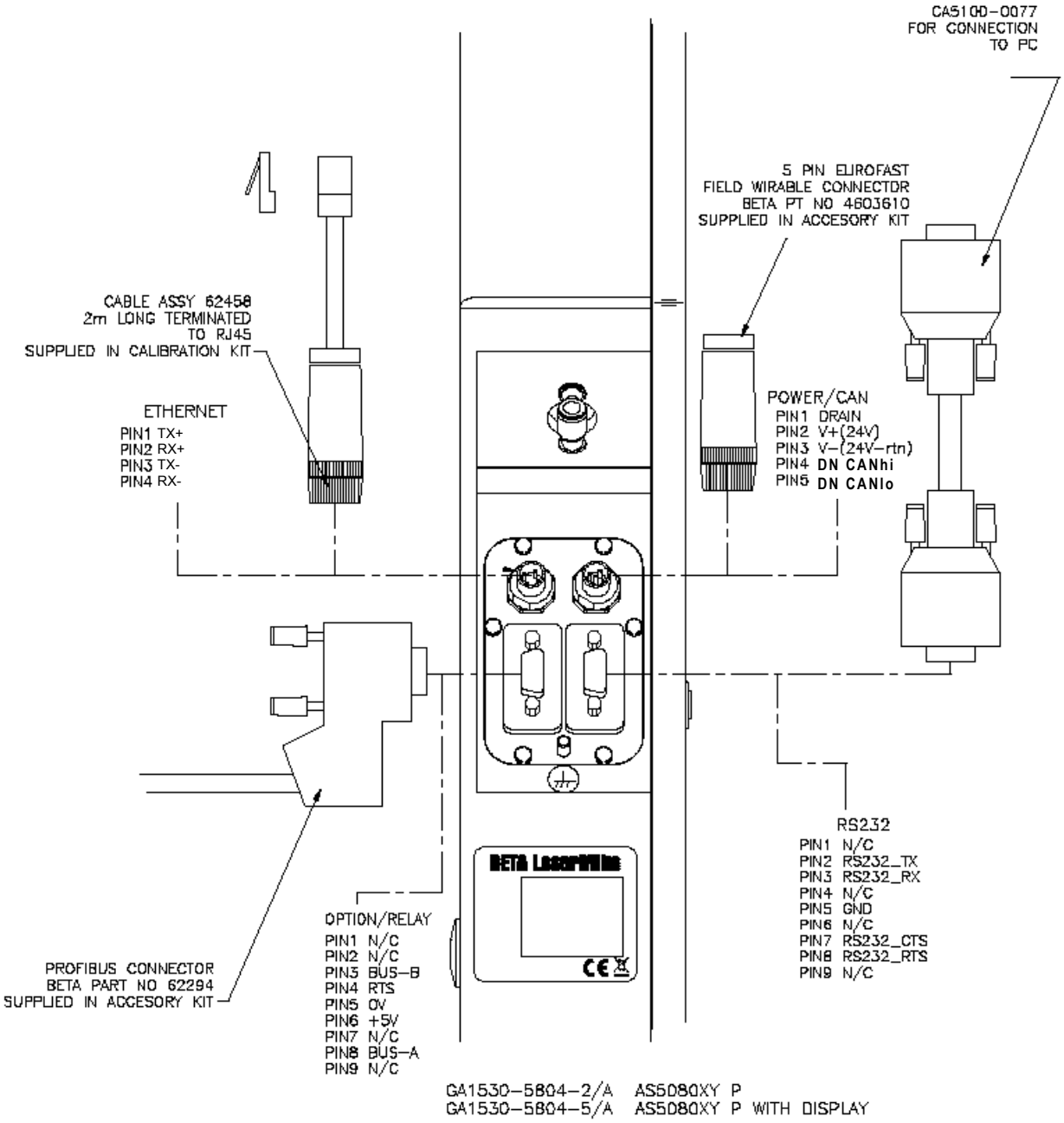
AS5025-R/ AS5040-R (RS232 Version)



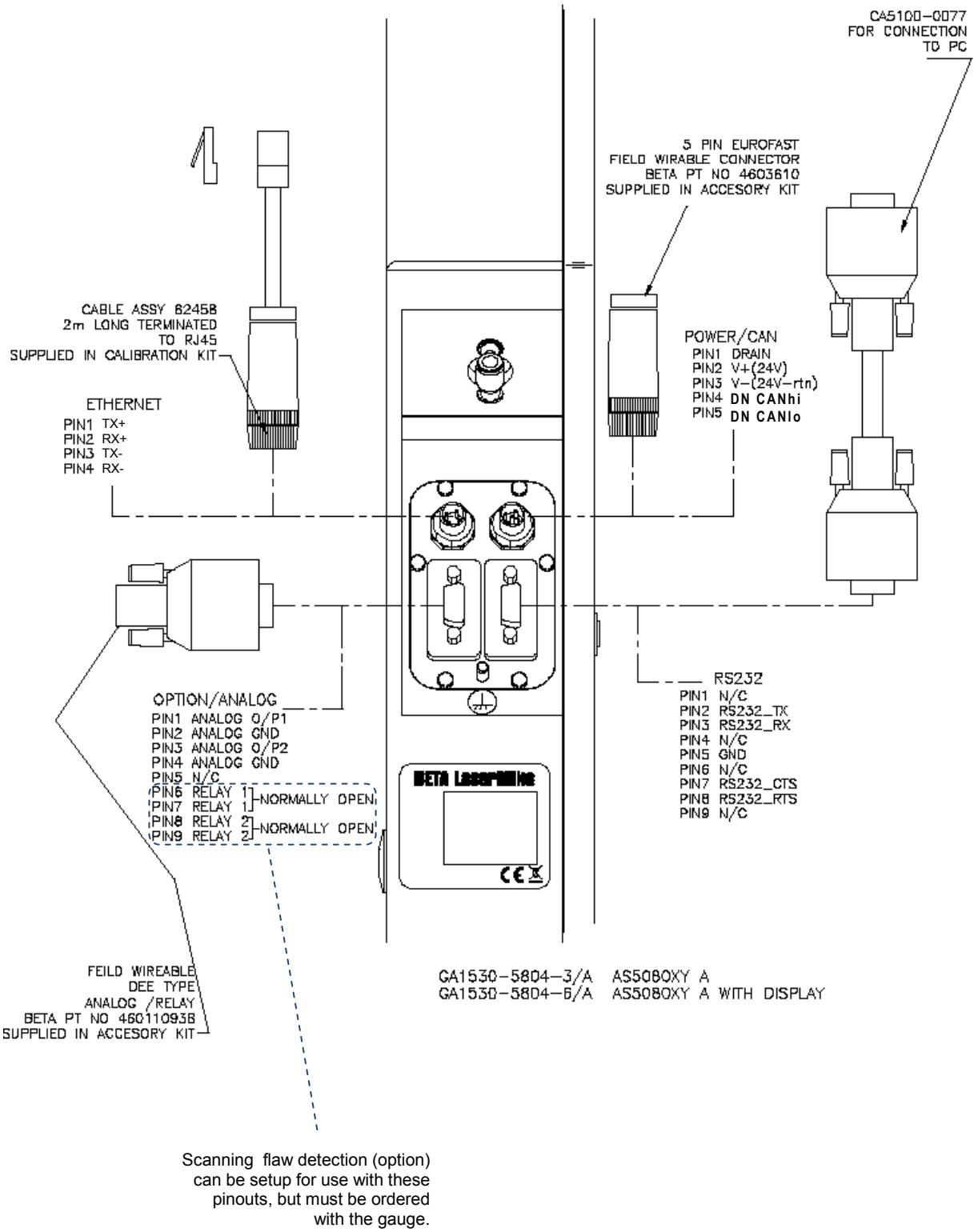
AS5080 Connector Panel

Note: The earth stud is located at the bottom of the panel.

AS5080-P (Profibus Version)

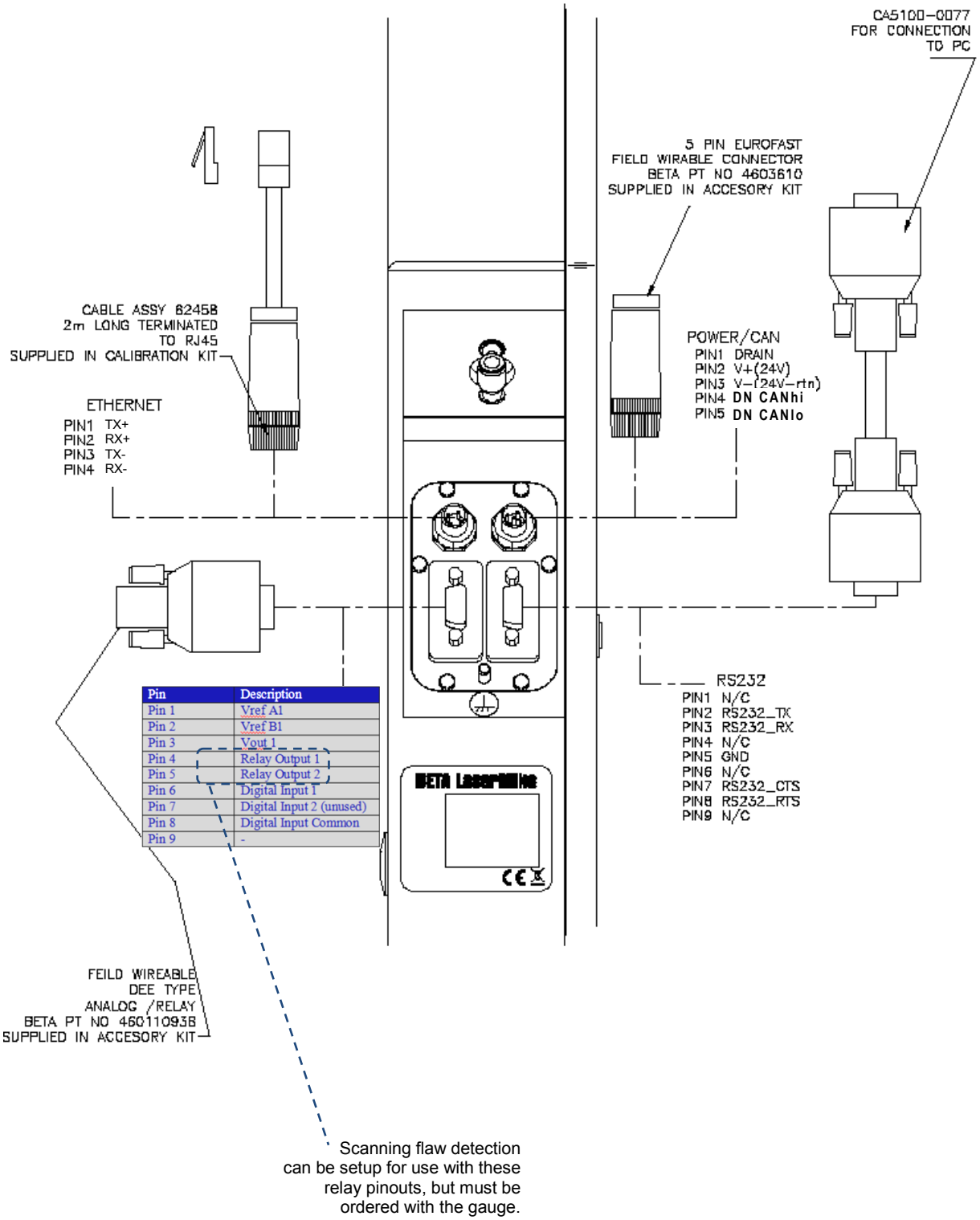


AS5080-A (Analog Version)



Scanning flaw detection (option) can be setup for use with these pinouts, but must be ordered with the gauge.

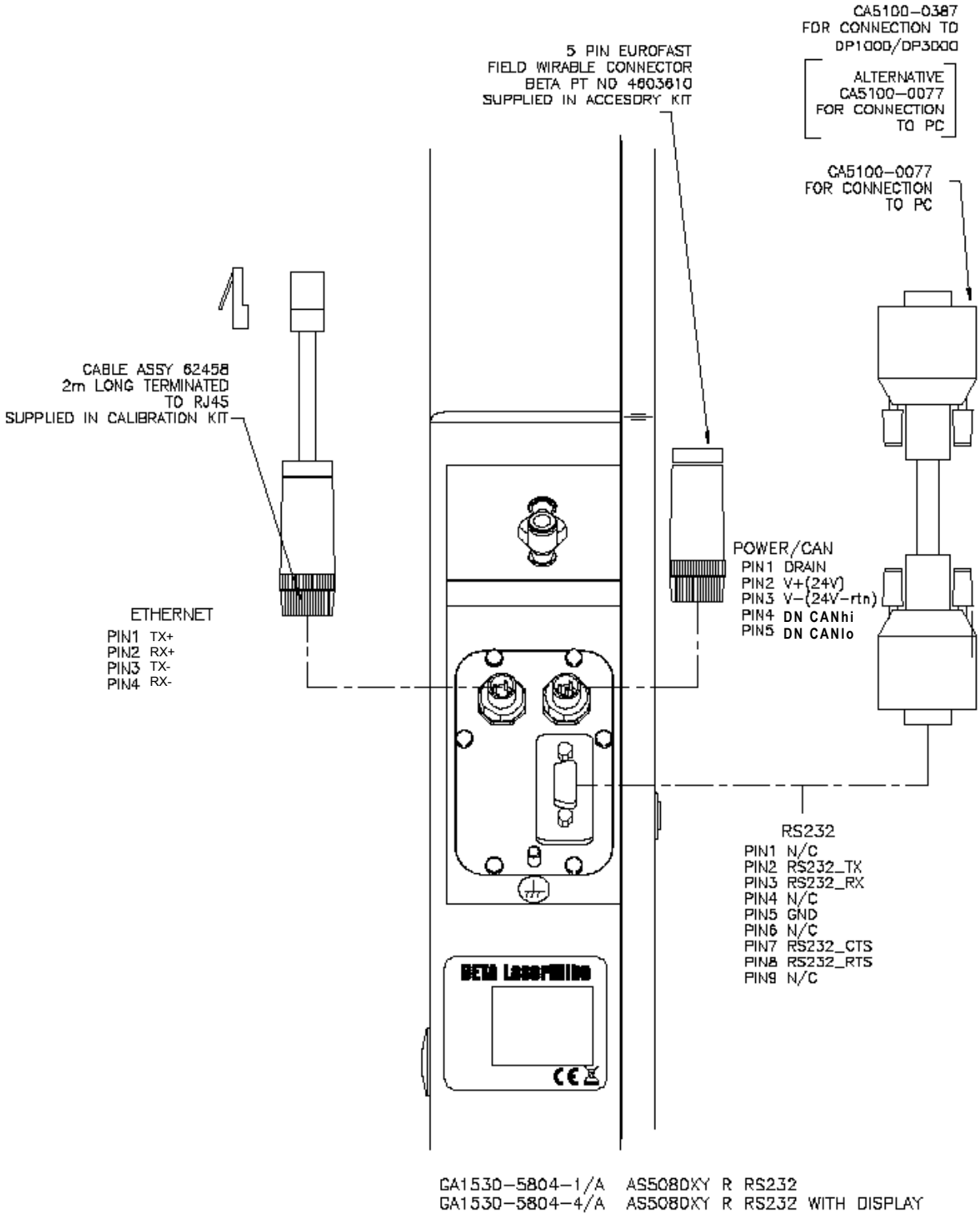
AS5080-K (PI Control Version)



Pin	Description
Pin 1	Vref A1
Pin 2	Vref B1
Pin 3	Vout 1
Pin 4	Relay Output 1
Pin 5	Relay Output 2
Pin 6	Digital Input 1
Pin 7	Digital Input 2 (unused)
Pin 8	Digital Input Common
Pin 9	-

Scanning flaw detection can be setup for use with these relay pinouts, but must be ordered with the gauge.

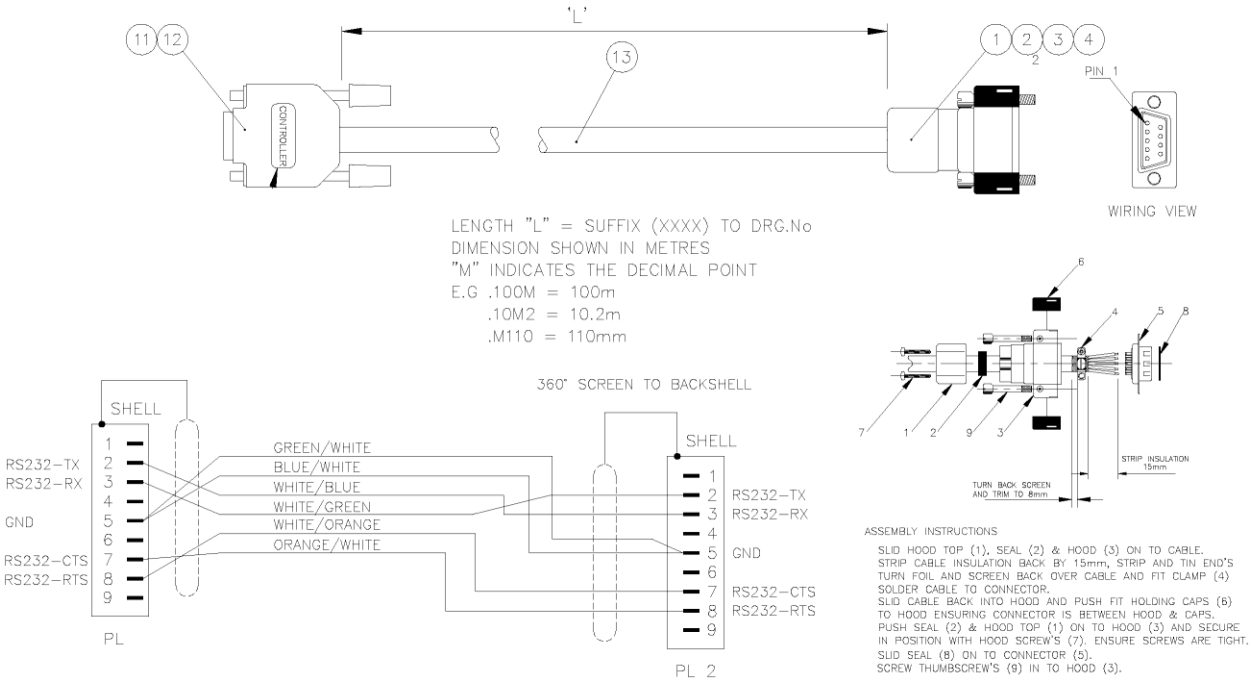
AS5080-R (RS232 Version)



Connection to External Displays / Controllers

Connection to DATAPRO1000 / DATAPRO3100 / DATAPRO5000BB

Use shielded RS232 cable (DB9 male to DB9 male, part number 62147) as shown below (twisted serial connection).



Connection to PC

Use shielded RS232 Cable (DB9 male to DB9 female, part number 62146) with all pins wired straight through.

RS232 Communication

See also DeviceNet Configuration via RS232 under heading DeviceNet Communications.

RTS and CTS

RTS is the standard RS232 Request To Send signal. The output from the gauge is usually high (+9V nominal). The signal will go low if the gauge cannot accept any more RS232 characters, but this will only occur if the characters are sent at high baud rate continuously over a long period. The computer sending the characters must stop until this signal goes high again otherwise some characters will be lost.

CTS is the standard RS232 Clear To Send signal. The input to the gauge is usually high (+9V nominal). If the signal is pulled low (-9V nominal) the Gauge will not send characters to the computer. This line should be used if the computer cannot accept data as fast as the Gauge can send it. The characters are not forgotten while this signal is low and will be transmitted when the signal becomes high again. The signal is pulled high inside the Gauge so if this signal is not required the signal can be left unconnected. If this pin is left low and characters are still sent to request data, the RTS line will eventually go low to tell the sending computer that it can no longer remember all of the characters waiting to be sent. Some characters must be read by pulling CTS high before RTS will go high to allow more characters to be accepted by the Gauge.

Connecting Gauge to a Computer or Terminal

No matter the configuration, the RS232 serial port is always available. The factory default settings are 9600, 7n2. ie 9600 bps, 7 data bits, no parity, 2 stop bits. These settings can be changed by altering cells 2 and 4 (see Non-continuous data transmission). A standard, shielded, straight-through serial cable can be purchased from Beta LaserMike to make the connection to a PC or terminal. Optionally, a custom cable can be manufactured to the following requirement.

RS232 port pins (see Electrical installation for details)	Connect to	**Computer** or **Terminal** pins (see computer manual for pinouts)
RX	→	TXD
TX	→	RXD
RTS*	→	CTS It may also be necessary to connect this to the DSR (Data set ready) and/or CD (carrier detect) line.
		DSR
		CD
CTS*	→	RTS

* Problems may occur with longer cables. Refer to Specification/RS232 cable length.

Non-continuous Data Transmission

The Non-continuous Data Table defines the data, which may be written to or read from the gauge via the RS232 serial communications port. Two protocols are available, the new database cell protocol below and the old 'ASCII protocol'. The new protocol is recommended as it features enhanced functionality (however, the old protocol must still be used for enabling envelope/helix mode)

Database Cell Protocol

Reading data

Data is requested from the gauge by sending the ?J0/ command (upper case letter "j" and zero).
A linefeed, carriage return or both must follow, i.e:
?J0/<#><CR>
?J0/<#><LF>
?J0/<#><CR><LF>
?J0/<#><LF><CR>
In response to a request for data the gauge will reply with data in the following format:

*J0/<#>=<X> <CR>	For all data except cable position
OR	
*J0/<#><+/- xx> <CR>	For cable position data

where:

<#>	is a 1 to 3 digit database cell number
<X>	is a floating point numerical value in ASCII of not more than six digits plus decimal point. The decimal point position is floating (Unit code determines units and decimal position).
<+/-xx>	is a two digit numerical value in ASCII preceded by a + or –
<CR>	is an ASCII carriage return character
<LF>	is an ASCII line feed character

Writing data

Data may be written to the gauge in the following formats:
=J0/<#>=<X><CR>
=J0/<#>=<X><LF>
=J0/<#>=<X><CR><LF>
=J0/<#>=<X><LF><CR>
In response to a write request the gauge will reply with data in the following format:

*J0/<#>=<X> <CR>	For all data except cable position

where:

<#>	is a 1 to 3 digit database cell number
<X>	is a floating point, numerical value in ASCII of no more than 7 digits plus decimal point. The decimal point position is floating (Unit code determines units and decimal position)
<LF>	is an ASCII line feed character.
<CR>	is a carriage return character.

Old 'ASCII' Protocol

The ASCII code protocol is included in this manual mainly for backward compatibility reasons and may be phased out in future generations of the product. It is recommended you use the new Database cell protocol (under section Non-continuous transmission above).

Reading data

Data is requested from the gauge by sending the upper case ASCII character corresponding to the required parameter. A linefeed, carriage return or both may optionally, follow the character, i.e:
<A>
<A><CR>
<A><LF>
<A><CR><LF>
<A><LF><CR>
In response to a request for data the gauge will reply with data in the following format:
<A><xxxxx> <CR> For all data except cable position

OR
<A><+/- xx> <CR> For cable position data

where:

<A>	is an upper case ASCII Read character
<xxxxx>	is a five-digit numerical value in ASCII. The decimal point position is implied*.
<+/-xx>	is a two digit numerical value in ASCII preceded by a + or –
<CR>	is an ASCII carriage return character
<LF>	is an ASCII line feed character.

* Unit code determines the units and implied decimal position.

Writing data

Data may be written to the gauge in the following formats:

<a><xxxxx>
<a><Y><CR>
<a><Y><LF>
<a><Y><CR><LF>
<a><Y><LF><CR>

where:

<a>	is a lower case ASCII Write character corresponding to the data being written.
<xxxxx>	is a five-digit numerical value in ASCII. The decimal point position is implied.
<Y>	is a numerical value in ASCII of less than five digits
<LF>	is an ASCII line feed character.
<CR>	is a carriage return character.

* Unit code determines the units and implied decimal position.

Unit code	Units	Format [1]	RS232 resolution [2]
0	Metric	xxx.xx mm	1 x 10^{-5} metres
1	Imperial	xxxxx mils	1 x 10^{-3} inches
2	Metric	xx.xxx mm	1 x 10^{-6} metres
3	Imperial	xxxx.x mils	1 x 10^{-4} inches
4	Metric	x.xxxx mm	1 x 10^{-7} metres
5	Imperial	xxx.xx mils	1 x 10^{-5} inches
6	Metric	xxx.xx μm	1 x 10^{-8} metres
7	Imperial	xx.xxx mils	1 x 10^{-6} inches
8	Metric	xx.xxx μm	1 x 10^{-9} metres
9	Imperial	x.xxxx mils	1 x 10^{-7} inches
10	Metric	xxxxx μm	1 x 10^{-6} metres
11	Imperial	xxx.xx in	1 x 10^{-2} inches
12	Metric	xxxx.x μm	1 x 10^{-7} metres
13	Imperial	xx.xxx in	1 x 10^{-3} inches
14	Metric	xxx.xx cm	1 x 10^{-4} metres
15	Imperial	x.xxxx in	1 x 10^{-4} inches
16	Metric	xx.xxx cm	1 x 10^{-5} metres
17	Imperial	.xxxxx in	1 x 10^{-5} inches
18	Metric	x.xxxx cm	1 x 10^{-6} metres
19	Imperial	._xxxxx in	1 x 10^{-6} inches

[1] The gauge will display 99999 when the value is greater than the maximum display value of a given Unit code. For example, diameter of a 12.345mm sample will be displayed as 99999 when Unit code is set to 4. The Unit code should be changed accordingly to display the correct value. In this case, if it is set to 2 the gauge would display according to the display format of Unit code 2; i.e.12345. The Unit code can also be set using ASCII protocol (command p). Use even Unit codes for metric and odd for imperial.

A write to a cell is ignored if the user tried to write a value that is beyond the acceptable range for a given cell. For example, trying to write 70mm as Preset diameter on a diameter gauge with 50mm gate size would be rejected.

[2] The resolution of the RS232 output can be changed independently of the gauge's measurement resolution by setting the 'p' variable to one of the following unit codes. The number of digits is always 5 when using ASCII command such as D or H. The decimal point is calculated, but never displayed.

Non-continuous Data Table

ASCII codes		D/base Cell	Description
Read	Write		
	!	n/a	Enable Continuous Envelope mode (Use Old ASCII protocol)
	>	n/a	Enable Continuous Helix mode (Use Old ASCII protocol)
	H	0	Enable Continuous Mode (Database code: =J0/0=2)
	I	0	Disable Continuous Mode (Database code: =J0/0=0)
P	p	1	RS232 Units/Resolution Selection Code (see Unit code table in section Database cell protocol or Old protocol below)
(J)	(j)	2	RS232 Baud rate code: 0=4800, 1=9600 (default), 2=19200, 3=38400, 4=56000, 5=115200
-	-	3	Multidrop ID
X	x	4	RS232 format; 0=7n2 (default), 1=8n1
[B]	[b]	5	RS232 Emulation mode. 0 = Normal (default mode) 1 = excludes optics & resolution (resolution is fixed: metric 3dp,imperial 4dp) 2 = as 1 with resolution of: mm 4dp, mils 2dp 3 = as 1 with resolution of: mm 2dp, mils 0dp 4 = MFG packet, resolution depends on RS232 units parameter (D/base Cell 1, old protocol letter P). Note: Unit codes (cell 2) values greater than 9 are undefined and unsupported for emulation modes other than Normal.
|T|	|t|	6	time, current time
|D|	|d|	7	date, current date
<C>	<c>	10	CAN baud rate code: 0=125K (default), 1=250K, 2=500K
[X]	[x]	13	Profibus address (0..126) (default = 70)
[Y]	[y]	16	DeviceNet MacID (0..63) or CANopen Node ID (1..127) (default = 63)
<U>	<u>	19	Battenfeld Fieldbus profile emulation (normally 0, non-zero for 'specials')
M		20	Microcontroller software version (ex. 177 = v1.77)
{X}	{x}	23	Reset gauge – writing any value to this cell will initiate a watchdog reset of the gauge
{Y}		24	Gauge Configuration – see section Determining which options have been purchased
{Z}	{z}	28	Option switch. 0 = Standard diameter (default) 1 = FFT 2 = Scanning flaw detection 3 = STAC logic (formerly known as helix mode). See heading 'Software Options'
{C}		30	FPGA firmware version
(D)		31	Gauge capabilities
{F}		32	Gauge Serial number
L		33	Gauge type: 5012=25, 5025=7, 5040=8, 5080=80
Y		34	Max. measurement size - mm (inches): 0=10(0.39), 1=25(0.98), 2=40(1.57), 3=80(3.15)
|S|		39	Scan rate – indicates the current scanning rate in scans per second per axis
O	o	50	Preset diameter (target / nominal)
Q	q	53	Number of scans for gauge to average. Range: 1-6000. Gauge has 8 internal mirrors so setting this value to multiples of 8 will result in more accurate readings)
<F>	<f>	54	Measurement logic. 0 = Normal mode (default) 1 = Glass Logic

Diameter modes	Config. number
XY plane + Normal	48
XY plane + Glass	80
XY plane + STAC	144
XY plane + Normal + STAC	176
XY plane + Glass + STAC	208
Normal + STAC	160
Glass logic + STAC	192

ASCII codes		D/base Cell	Description
Read	Write		
		55	Fieldbus Units (0 - Metric, 1 - Imperial)
<R>	<r>	57	Analog channel 1 Scaling Factor
<S>	<s>	58	Analog channel 2 Scaling Factor
D		60	Diameter X
E		61	Diameter Y
F		64	Position in X Gate as percentage of gate size
G		65	Position in Y Gate as percentage of gate size
<D>		66	X Optics Condition – percentage of total scans that are good
<E>		67	Y Optics Condition – percentage of total scans that are good
A		68	(X + Y) / 2 Diameter – Average of X and Y diameter measurements
V		69	Ovality | X-Y |
J		70	Gauge status codes 0 = Gauge OK, 1 = Gate empty (less than 4 edges detected), 2 = Gate obscured (no edges detected), 3 = Dirty reading (more than 4 focused edges detected), 4 = Too many edges (cables) (Odd number of edges detected) 5 = Gauge too hot inside casing 6 = Wrong motor speed (measured scan time is outside of expected limits) 7 = Measured width of gate is less than 90% of expected width for gauge type) 8 = Wrong gauge type (the detected reference pulses or DSP board do not match expected configuration for the gauge type L) [3] 9 = No scan (no reference pulses detected) 10= Down corners not found (could not detect corners of waveform down edge) 11= Down Edge out of focus (width of down edge too slow) 12= Up corners not found (could not detect corners of waveform up edge) 13= Up edge out of focus (width of up edge too slow) 14= Facet synchronization error 15= Gauge requires calibration.
(N)		80	X plane Negative Offset Correction
(O)		81	X plane Positive Offset Correction
(P)	(p)	82	X plane Gain (linear) correction
(Q)	(q)	83	X plane Offset (small) cable correction
(R)		85	Y plane Negative Offset Correction
(S)		86	Y plane Positive Offset Correction
(T)	(t)	87	Y plane Gain (linear) Correction
(U)	(u)	88	Y plane Offset (small) cable correction
B	b	90	First (large) calibration pin diameter
S	s	91	Second (small) calibration pin diameter
W		95	Calibration status 0 = Waiting for 1st calibration pin size to be entered. 1 = Calibration with 1st pin OK. Waiting for second pin size to be entered. 2 = Calibration with 2nd pin OK. Calibration complete. 3 = Error occurred during calibration.
(V)	(v)	96	Analog Output 1 Zero Adjustment
(W)	(w)	97	Analog Output 1 Full Scale Adjustment
(Y)	(y)	98	Analog Output 2 Zero Adjustment
(Z)	(z)	99	Analog Output 2 Full Scale Adjustment

[3] This error occurs if the gauge type set by the 'L' command does not match the detected configuration. Use the 'L' command to read the gauge type (See ASCII code table above, code L).

<table>
<tr><th colspan="2">ASCII codes</th><th rowspan="2">D/base Cell</th><th rowspan="2">Description</th></tr>
<tr><th>Read</th><th>Write</th></tr>
<tr><td>[A]</td><td></td><td>100</td><td>Number of Lump Faults</td></tr>
<tr><td>[Z]</td><td></td><td>101</td><td>Number of neck faults</td></tr>
<tr><td>[E]</td><td></td><td>102</td><td>Total Number of Faults</td></tr>
<tr><td>[M]</td><td>[m]</td><td>103</td><td>Relay contact 1 closure time in milliseconds
Valid range: 0, 20-999999; 0=Relay remain closed until alarms are cleared by user (default value = 0)
Minimum contact closure time: 20 milliseconds</td></tr>
<tr><td>[T]</td><td>[t]</td><td>104</td><td>X (or XY) Lump Fault Threshold</td></tr>
<tr><td>[U]</td><td>[u]</td><td>105</td><td>Y Lump Fault Threshold</td></tr>
<tr><td>[V]</td><td>[v]</td><td>106</td><td>X (or XY) Neck Faults Threshold</td></tr>
<tr><td>[W]</td><td>[w]</td><td>107</td><td>Y Neck Fault Threshold</td></tr>
<tr><td>{T}</td><td>{t}</td><td>108</td><td>Preset X Diameter Target</td></tr>
<tr><td>{U}</td><td>{u}</td><td>109</td><td>Preset Y Diameter Target</td></tr>
<tr><td>{V}</td><td>{v}</td><td>110</td><td>X (or XY) Over Tolerance level (or Combined Over Tolerance and Lump Threshold)</td></tr>
<tr><td>{W}</td><td>{w}</td><td>111</td><td>Y Over Tolerance level</td></tr>
<tr><td>{M}</td><td>{m}</td><td>112</td><td>X (or XY) Under Tol. level (or Combined Under Tolerance and Neck Threshold)</td></tr>
<tr><td>{N}</td><td>{n}</td><td>113</td><td>Y Under Tolerance level</td></tr>
<tr><td>{O}</td><td>{o}</td><td>114</td><td>Flaw processing mode
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>V1</td><td>V0</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>M1</td><td>M0</td></tr>
</table>
V1: V0 = A two bit binary number setting the FG/MFG version as defined below:
00 = Separate diameter and fault tolerances for X and Y planes (ribbon mode)
01 = Combined diameter and fault tolerances
10 = Separate diameter and fault tolerances
11 = Separate diameter and fault tolerances for X and Y planes (ribbon mode)

M1:M0 = A two bit binary number to set the absolute or relative flaw mode
00 = No flaw detection (default)
01 = Absolute mode
10 = Relative mode

Possible Combinations:
<table>
<tr><th>Flaw processing mode</th><th>hexadecimal</th><th>decimal</th></tr>
<tr><td>Combined tolerances + absolute</td><td>0x4001</td><td>16385</td></tr>
<tr><td>Combined tolerances + relative</td><td>0x4002</td><td>16386</td></tr>
<tr><td>Separate tolerances + absolute</td><td>0x8001</td><td>32769</td></tr>
<tr><td>Separate tolerances + relative</td><td>0x8002</td><td>32770</td></tr>
<tr><td>Ribbon + absolute</td><td>0xC001</td><td>49153</td></tr>
<tr><td>Ribbon + relative</td><td>0xC002</td><td>49154</td></tr>
</table></td></tr>
<tr><td>{P}</td><td>{p}</td><td>115</td><td>Flaw Control Word
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>ZO</td><td>EO</td><td>EN</td><td>EL</td><td>ET</td><td>ZT</td><td>TH</td><td>ZF</td><td>ZN</td><td>ZL</td></tr>
</table>
ZO = Zeros Ovality alarm for a 0 to 1 transition of this bit
EO = Enable Ovality Alarms
EN = Enable Neck Alarms
EL = Enable Lump Alarms
ET = Enable Diameter Tolerance Alarms
ZT = Zero Diameter Tolerance Alarms
TH = Suppress gauge status codes to code 0 whilst threading (not applicable to RS232)
ZF = Zeros the lump and neck fault counts for a 0 to 1 transition of this bit
ZN = Zeros neck counts and alarm for a 0 to 1 transition of this bit
ZL = Zero lump counts and alarm for a 0 to 1 transition of this bit</td></tr>
</table>

<table>
<tr><td>{Q}</td><td></td><td>116</td><td>Flaw Status Word
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>r</td><td>OVA</td><td>NA</td><td>LA</td><td>UA</td><td>OA</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td></tr>
</table>
OA = Diameter Over Tolerance Alarm. Remains latched until cleared by ZT
UA = Diameter Under Tolerance Alarm. Remains latched until cleared by ZT
LA = Lump Fault Alarm. Remains latched until cleared by ZL
NA = Neck Fault Alarm. Remains latched until cleared by ZN
OVA = Ovality Over Tolerance Alarm. Remains latched until cleared by ZO.</td></tr>
<tr><td>[R]</td><td>[r]</td><td>117</td><td>Flaw Relay Output Control Word
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>r</td><td>r</td><td>r</td><td>OV2</td><td>NR2</td><td>LR2</td><td>UR2</td><td>OR2</td><td>r</td><td>r</td><td>r</td><td>OV1</td><td>NR1</td><td>LR1</td><td>UR1</td><td>OR1</td></tr>
</table>
OV# = Enable relay output number # for Ovality over tolerance alarms
NR# = Enable relay output number # for neck fault alarms
LR# = Enable relay output number # for lump fault alarms
UR# = Enable relay output number # for diameter under tolerance alarms
OR# = Enable relay output number # for diameter over tolerance alarms

NOTE: Relay output #2 defaults to the function of a ‘status relay’ if not enabled for any of the functionality of the Flaw Relay Output Control Word (shown above).
In a ‘status relay’ mode of operation, the relay will close when the gauge status is GAUGE_OK and open when the status is not GAUGE_OK</td></tr>
<tr><td>n/a</td><td>n/a</td><td>118</td><td>Ovality Over Tolerance level</td></tr>
<tr><td>n/a</td><td>n/a</td><td>119</td><td>Relay contact 2 closure time in milliseconds
Valid range: 0, 20-999999; 0=Relay remain closed until alarms are cleared by user (default value = 0)
Minimum contact closure time: 20 milliseconds</td></tr>
<tr><td>{J}</td><td>{j}</td><td>120</td><td>STAC Logic Mode
0 = Disable (default mode)
1 = Enable MAXMIN packet (old envelope mode)
2 = Enable MEANMAXMIN packet (old helix mode)
3 = Enable MAX packet (envelope mode)
4 = Enable MIN packet (envelope mode)</td></tr>
<tr><td>|A|</td><td>|a|</td><td>121</td><td>STAC measurement time (0.1s to 16.0s)</td></tr>
<tr><td>{L}</td><td>{l}</td><td>122</td><td>Form Factor (0.5000 – 2.0000)
Only applicable to MAX diameter. The form factor is a number, which increases or decreases the measured diameter to facilitate measurement of external envelope diameter (2 cables or more).</td></tr>
<tr><td>C</td><td></td><td>123</td><td>X Maximum STAC Diameter</td></tr>
<tr><td><L></td><td></td><td>124</td><td>X Minimum STAC Diameter</td></tr>
<tr><td>K</td><td></td><td>125</td><td>X Mean STAC Diameter</td></tr>
<tr><td>T</td><td></td><td>126</td><td>Y Maximum STAC Diameter</td></tr>
<tr><td><M></td><td></td><td>127</td><td>Y Minimum STAC Diameter</td></tr>
<tr><td>U</td><td></td><td>128</td><td>Y Mean STAC Diameter</td></tr>
<tr><td><N></td><td></td><td>129</td><td>X Max. Rejection Filter *</td></tr>
<tr><td><O></td><td></td><td>130</td><td>X Min. Rejection Filter *</td></tr>
<tr><td><P></td><td></td><td>131</td><td>Y Max. Rejection Filter *</td></tr>
<tr><td><Q></td><td></td><td>132</td><td>Y Min. Rejection Filter *</td></tr>
<tr><td>n/a</td><td>n/a</td><td>135</td><td>PI Proportional Trim % ; 0 to 200 %</td></tr>
<tr><td>n/a</td><td>n/a</td><td>136</td><td>PI Integral Trim % ; 0 to 200 %</td></tr>
<tr><td>n/a</td><td>n/a</td><td>137</td><td>PI Direct-Reverse acting control setting ; 0 = direct(default) , 1 = Reverse</td></tr>
<tr><td>n/a</td><td>n/a</td><td>138</td><td>PI Average Time setting ; 0 to 600 in increments of 100 milliseconds</td></tr>
<tr><td>n/a</td><td>n/a</td><td>139</td><td>PI Summing/No Summing control setting ; 0 = No Summing (default), 1 = Summing</td></tr>
<tr><td>N</td><td></td><td>140</td><td>Edge/Segment 1 Measurement</td></tr>
</table>

<table>
<tr><td>n/a</td><td>n/a</td><td>141</td><td colspan="2">Dirty Threshold setting default = 4, should be an even number

Number of edges that must be exceeded before the gauge displays the dirty lens error. The default setting is 4 (start of the gate, part leading edge, part trailing edge, and end of the gate). However you can change this value from either HyperTerminal or the display. You can set values up to 10 without affecting the accuracy of the gauge. Higher values could be used, but the accuracy may be affected.</td></tr>
<tr><td>(E)</td><td></td><td>145</td><td colspan="2">Power up diagnostics status
<table>
<tr><td>Value</td><td>8</td><td>4</td><td>2</td><td>1</td></tr>
<tr><td>Fault</td><td>Profibus ASIC</td><td>DSP data</td><td>DSP prog.</td><td>Ext. RAM</td></tr>
</table>
0 =OK
1 =External RAM
2 =DSP prog
3 =Ext RAM & DSP prog
4 =DSP data
5 =Ext RAM & DSP data
6 = DSP prog/data
7 = DSP prog/data & Ext RAM
8 = Profibus ASIC
9 = Ext RAM & Profibus ASIC
10= DSP prog & Profibus ASIC
11= DSP prog & Profibus ASIC & Ext RAM
12= DSP data & Profibus ASIC
13= DSP data & Profibus ASIC & Ext RAM
14= DSP data/prog & Profibus ASIC
15= DSP data/prog & Profibus ASIC & Ext RAM</td></tr>
<tr><td>|E|</td><td>|e|</td><td>195</td><td>Analog output 1.</td><td rowspan="2">See relevant heading in this manual for more details.
0 = Calibration mode (default)
1 = Average diameter(X+Y)/2
2 = X diameter
3 = Y diameter
4 = Average deviation (X+Y)/2
5 = X deviation
6 = Y deviation</td></tr>
<tr><td>|F|</td><td>|f|</td><td>196</td><td>Analog output 2.</td></tr>
<tr><td></td><td>|h|</td><td>203</td><td colspan="2">X Maximum Averaged Diameter</td></tr>
<tr><td></td><td>|i|</td><td>204</td><td colspan="2">Y Maximum Averaged Diameter</td></tr>
<tr><td></td><td>|j|</td><td>205</td><td colspan="2">X Minimum Averaged Diameter</td></tr>
<tr><td></td><td>|k|</td><td>206</td><td colspan="2">Y Minimum Averaged Diameter</td></tr>
<tr><td>|L|</td><td>|l|</td><td>207</td><td colspan="2">Reset X/Y Min/Max Averaged Diameter Cells 203-206
0 = Last reset successful
1 = Set X and Y Min/Max to current X and Y Diameter</td></tr>
<tr><td>|M|</td><td>|m|</td><td>208</td><td colspan="2">Clear Diameter Measurement
0 = Normal operation
1 = Clear diameter measurement when no cable detected</td></tr>
<tr><td>n/a</td><td>n/a</td><td>210</td><td colspan="2">Display Menu Lock password ;0 = no password</td></tr>
<tr><td>n/a</td><td>n/a</td><td>212</td><td colspan="2">Display Software version (ex. 103 = v1.03) If the optional vacuum florescent display is not attached, this cell will return a value of 0.</td></tr>
<tr><td>n/a</td><td>n/a</td><td>213</td><td colspan="2">Display Units/Resolution Selection Code
(see Unit code table in section Database cell protocol or Old protocol below)</td></tr>
</table>

n/a	n/a	215	PI software auto/manual mode 0 = manual 1 = auto (default)
n/a	n/a	216	PWM duty cycle manual setting (range 0 – 65535)
n/a	n/a	217	PI Mode 0 = P only (default) 1 = I only 2 = PI
n/a	n/a	218	IP address of gauge
n/a	n/a	219	Netmask of gauge
n/a	n/a	220	Gateway IP address of gauge
n/a	n/a	221	DHCP setting 0 = do not use DHCP (default) 1 = use DHCP
n/a	n/a	222	Decay Filter The Decay Filter will limit the frequency at which the code checks for a lump or neck occurrence by a complete revolution of the mirror. For example: If the decay filter is set to 10 the code will check for a lump or neck occurrence every 10 revolutions of the mirror (66 ms) instead of every scan (832 us). Default value = 0.
n/a	n/a	224	Telnet refresh rate for continuous mode The RS232 continuous mode cmd 'H' is normally updated at a 100ms rate. Under a telnet connection this rate can be set to refresh from 100ms to 1 second in increments of 100 ms. Default value = 100ms

Note: All undefined codes are reserved and should not be used.

* STAC rejection filter = Dynamic filtering of spurious faults. Measurements deviating too much from the min STAC diameter will be ignored. See STAC logic diagram in section Options.

Continuous Data Transmission

Packets of information are transmitted every 100 msec.

Mode	Enabling Continuous data mode	Disabling Continuous data mode
	Send:	Send:
Standard	< **H** > < CR >	< I > < CR >
STAC logic -helix	< **>** > < CR >	< I > < CR >
STAC logic -envelope	< **!** > < CR >	< I > < CR >

Packet for STANDARD mode:

$< Gauge type >< Diameter >< Status >< Position in Gate >< CR >< LF>< Measuring Units>< X/Y >
< Optics Condition >< RS232 Units/Resolution Selection Code >

MAX PACKET (STAC logic-envelope mode):

!<Gauge Type><STAC Maximum Diameter><Status><Position in Gate><CR><LF> <Measuring Units>
<X|Y> < Optics Condition >< RS232 Units/Resolution Selection Code >

MIN PACKET (STAC logic-envelope mode):

!<Gauge Type><STAC Minimum Diameter><Status><Position in Gate><CR><LF><Measuring Units>
<X|Y>< Optics Condition >< RS232 Units/Resolution Selection Code >

MAXMIN PACKET (STAC logic-envelope mode)

!<Gauge Type><STAC Maximum diameter><STAC Minimum diameter><Status><Position in Gate>
<CR><LF><Measuring Units><X|Y><Optics Condition >< RS232 Units/Resolution Selection Code >

MEANMAXMIN PACKET (STAC logic -helix mode):

<Gauge type><STAC Mean Diameter><STAC Maximum Diameter><STAC Minimum Diameter>
<Status> <Position in Gate><CR><LF><Measuring Units><X|Y>< Optics Condition >
< RS232 Units/Resolution Selection Code >

NOTE: The following parameters will not be added to the end of the packets if the RS232 emulation mode is set to 1 < Optics Condition >< RS232 Units/Resolution Selection Code >

NOTE: The carriage return (CR) and Linefeed (LF) occur in the middle of the packet after <Position in gate>. Thus when using a terminal program to view the message, the <Measuring Units><X|Y>< Optics Condition >< RS232 Units/Resolution Selection Code > appear on the next line from the respective $< Gauge type >< Diameter >< Status >< Position in Gate > as showed by the shading in the example below:

Example data packet for AS5012 in STANDARD mode & in default emulation mode (=0):

MX982$I147090+15
MY992$I147070+16
etc.

Data packet parameter	Value	Number of characters
$ for standard mode > for STAC logic - helix ! for STAC logic - envelope	Start character	1
< Gauge type >	5012=I, 5025=7, 5040=8, 5080=~	1
< Diameter > (see STAC diameter below)	RS232 units / Resolution selection code. See Unit code table in section Database cell protocol or Old protocol .	5
<STAC mean diameter> <STAC max diameter> <STAC min diameter>	xx.xxx mm or x.xxxx inches Note: decimal point is not actually shown on indicator display.	
< Status >	0 = Gauge OK, 1 = No cable (less than 4 edges detected), 2 = Gate obscured (no edges detected), 3 = Dirty reading (more than 4 focused edges detected), 4 = Too many edges (cables) 5 = Gauge too hot inside casing 6 = Wrong motor speed (measured scan time is outside of expected limits) 7 = Measured width of gate is less than 90% of expected width for gauge type) 8 = Wrong gauge type (the detected reference pulses or DSP board do not match expected configuration for the gauge type L) [2] . 9= No scan (no reference pulses detected) [3] Down corners not found (could not detect corners of waveform down edge)[3] Edge out of focus (width of down edge too slow) [3] Up corners not found (could not detect corners of waveform up edge) [3] Up edge out of focus (width of up edge too slow) [3] Facet synchronization error [3] Gauge requires calibration [3]	1
< Position in gate >	+/-nn%	3
< CR >	Carriage return	1
< LF >	Line feed	1
< Measuring units >	M = Metric, I = Imperial See Unit code table in section Database cell protocol or Old protocol)	1
< X/Y >	X = X plane, Y = Y plane	1
< Optics condition > [1]	nn % =Percentage of good readings. A good reading is a measurement with error codes of GAUGE OK (0) or DIRTY (3).	2
<RS232 Units/Resolution Selection code> [1]	0 – 9 See Unit code table in section Database cell protocol or Old protocol)	1

[1] This will only appear if it is set via RS232. 100% will be represented by 99.
See ASCII code table above, code [B] .

[2] Wrong Gauge Type – This error occurs if the gauge type set by the 'L' command does not match the detected configuration. Use the 'L' command to read the gauge type (See ASCII code table above, code L).

[3] **Continuous mode does not support 2 digits, so status 9 can mean any one of listed errors**. To find out which error is being reported read the status cell (See ASCII code table above, code J).

Ethernet (Telnet) Communications

The AS4000/5000 provides a telnet server on port 23 that is capable of replicating the existing RS232 Communication command set. Once a connection is made the user can enter the same commands as found in the AS4000/5000 instruction handbook under RS232 Communications.

The AS4000/5000 is capable of acquiring an IP address from a DHCP server or an IP address may be entered manually. In the latter case the IP address would initially be entered via the RS232 link and via Telnet or RS232 after that.

Using DHCP

The AS4000/5000 has a database entry for specifying if the Ethernet should get its IP address from the DHCP or not. This database entry is cell 221. In order to change the value of the database cell enter the following commands via RS232 or Telnet:

```
=J0/221=0          ;do not use DHCP
=J0/221=1          ;use DHCP
```

Once the database cell is changed the AS4000/5000 gauge needs to be re-booted.

If the database cell was set to 1 (use DHCP), the IP address, the Subnet Mask and the Gateway address will be obtained from the DHCP server and stored in non-volatile memory.

If the database cell was set to 0 (do not use DHCP) the IP address, the Subnet Mask and Gateway address will be obtained from non-volatile memory. In order to change the IP address, the Subnet Mask and Gateway address values that are stored in non-volatile memory, enter the following commands via RS232 or Telnet:

```
=J0/218=192.168.10.200          ;example of an IP address
=J0/219=255.255.255.0           ;example of a Subnet Mask
=J0/220=192.168.10.2            ;example of a Gateway address
```

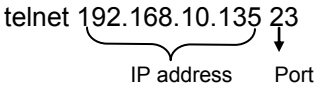
Again, after changing these values the AS4000/5000 gauge will need to be re-booted in order for the changes to take effect.

Telnet Continuous Mode Refresh Rate

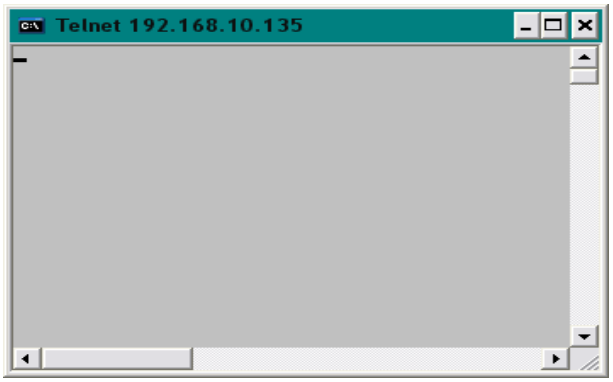
One of the commands supported by the telnet connection is the continuous mode (‘H’) where packets of information are transmitted at the default rate of 100 msec. A database cell (cell 222) can be configured to obtain a refresh rate from 100 msec to 1 second in increments of 100 msec. The refresh rate can be written via a serial HyperTerminal connection (=J0/222=100 to 1000) or if the gauge is configured with an optional display, via the menu system.

Connecting to the Telnet server

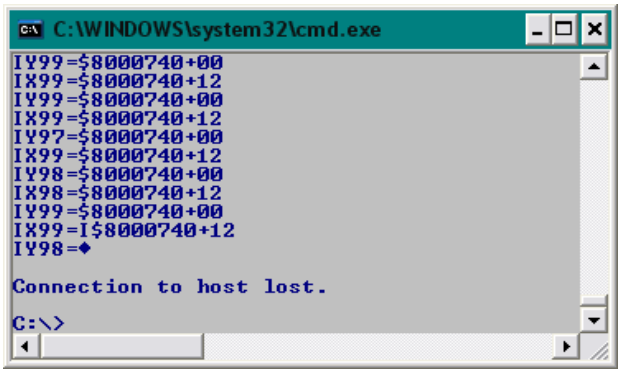
In order to start a telnet session, enter the following command at a DOS prompt:



Once connected there will be a blinking prompt and then commands can be entered.



In order to end a Telnet session enter the '^D' (Ctrl + D keys pressed at the same time) character at the prompt.



Software Options

ALL OPTIONS LISTED BELOW ARE PURCHASED OPTIONS

Fieldbus options are listed separately. See ProfibusCommunication, DeviceNet_Communication, CANopen_Communications, or EthernetIP_Communications.

Determining which Options have been Purchased

The configuration of any gauge can be checked using the RS232 calibration port by reading the {Y} parameter, or ?J0/24. The parameter will be a combination of the flags, shown below, written as a decimal number.

Configuration Word

20	19	18	17 - 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Ethernet/IP	PI	Eccentricity	reserved	ProfiNet	2400 scans	12-sided	STAC Logic	Glass Logic	Max Object	XY Plane	CANopen	RS232	Device Net	PROFIBUS	Flaw Detect	Analog	FFT	Unused

```
The prefix 0x represents hexadecimal notation

// Options
FFT_OPTION      =       0x0000 0002,
ANALOG          =       0x0000 0004,
FLAW_DETECT     =       0x0000 0008,
ETHERNET/IP     =       0x0010 0000,
// Model
PROFIBUS        =       0x0000 0010,
DEVICE_NET      =       0x0000 0020,
RS232           =       0x0000 0040,
CANopen         =       0x0000 0080,
Eccentricity    =       0x0004 0000,
PI              =       0x0008 0000,
// Diameter modes
XY_PLANE        =       0x0000 0100,
MAX_OBJECT      =       0x0000 0200,
GLASS_LOGIC     =       0x0000 0400,
STAC_LOGIC      =       0x0000 0800
```

Example:

A Profibus, dual plane, maximum object, diameter gauge with the FFT option will be configured as follows:
FFT_OPTION + PROFIBUS + XY_PLANE + MAX_OBJECT
= 0x00000002 + 0x00000010 + 0x00000100 + 0x00000200
= 0x00000312
= 786 decimal

FFT

Fast **F**ourier **T**ransform is an algorithm for calculating frequency information (e.g. waveforms) from time based signals. The FFT option is only accessible via the DeviceNet/Profibus output. The FFT status bit (in the data input word) is set when the FFT calculation is complete (i.e. fresh data).

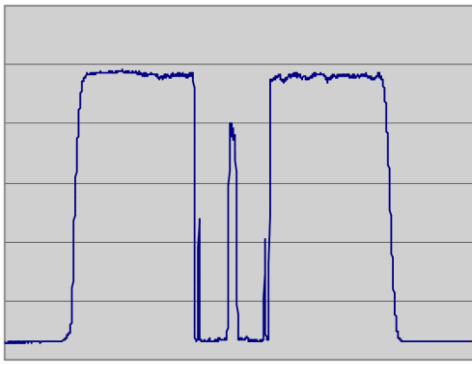
For details see DeviceNet communication or Profibus communication.

Fast Analog

See section Analog_Outputs.

Glass Logic

Glass Logic is only available if ordered with the gauge – refer to "Determining which options have been purchased". Once the gauge has been configured for Glass logic, it can be enabled by using UniCalib PC software or via RS232 by sending <f>1 and disabled with <f>0.



Transparent objects produce extra edges from the light bleed through as shown. Glass logic is used to filter out these extra edges allowing the gauge to measure the actual diameter of the object. Since extra edges are ignored, the gauge will no longer detect a dirty status condition (more than 4 edges).

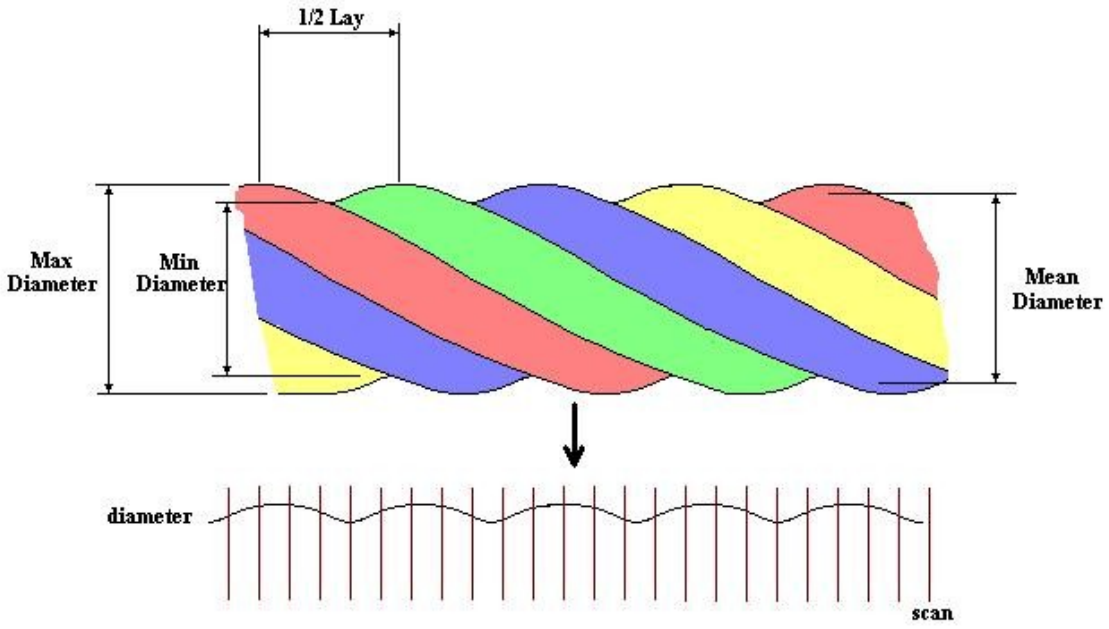
Scanning Flaw Detection

See Scanning_Flaw_Detection

STAC Logic

STAC Logic is a special mode enabling measurement of **S**tranded, **T**wisted, **A**rmoured and **C**orrugated (STAC) products. The STAC Logic configuration is flexible so backward compatibility can be kept for users of the existing Helix and Envelope modes. To enable this feature, use cell 120 (or ASCII code {J}) (see section RS232 communications – Non-continuous transmission) or use the PC software UniCalib.

STAC Logic uses single scan information to ensure fast and accurate diameter measurement of helical cable. Minimum, maximum, and mean calculations are made based on the most recent measurements taken within the "measurement period" set by the user.



1 Each scan reading is fed into a table.
2 The table size depends on the measuring period.
3 The top 2% of readings are averaged to get STAC Max
4 The bottom 2% of readings are averaged to get STAC Min.
5 Dynamic rejection filter ensures only 'real' measurements are used.

STAC max (cell 123): The top 2% of the readings within the measurement period are averaged to find the maximum diameter.

STAC min (cell 124): The bottom 2% of the readings within the measurement period are averaged to find the minimum diameter.

STAC mean (cell 125): The mean value of all of the readings within the measurement period.

Additionally, a dynamic rejection filter works on the data to ensure that only 'real' readings are used when calculating the maximum or minimum. All non-product measurements e.g. paper fibres are rejected.

Mode Set Up

The STAC logic option provides various types of measurement. The measurement type required depends on the product, which measurements are needed, and how the gauge is to transmit the data. The STAC MODE parameter in cell 120 is used to select the measurement type.

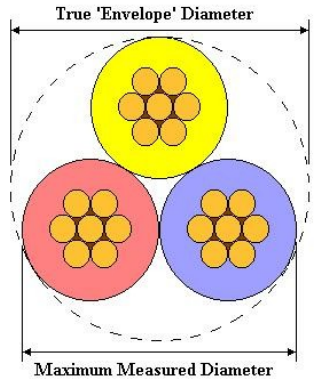
STAC MODE	Measurement	Non-continuous Data	RS232 Continuous Data	Profibus/DeviceNet
0	**Max object measurement**	STAC data not enabled	Standard continuous message applies	Standard Profibus profile applies
1	**STAC max/min** Maximum & Minimum measurement	The Max & Min Diameter cells will have active information. The others will be set to 0.	Continuous message initiated by " ! " command. Message is designed for communicating with a new CI1000 or BB1000.	Only the Max and Min Diameter fields in the profile will have active information. Mean Diameter will be set to 0
2	**STAC max/min/mean** Maximum, Minimum & Mean measurement	All cells will have active information.	Continuous message initiated by " > ". (Message is the same as the old Helix mode in the LD/MLD gauge)	All fields in the profile will have active information. (Profile is the same as the old Helix profile in the LD/MLD gauge).
3	**STAC max** Maximum measurement	Only the Max Diameter cell will have active information. The others will be set to 0.	Continuous message initiated by " ! ". (Message is the same as the old Max Envelope mode in the LD/MLD gauge)	Only the Max Diameter field in the profile will have active information. The others will be set to 0.
4	**STAC min** Minimum measurement	Only the Min Diameter cell will have active information. The others will be set to 0.	As above except the Min. Diameter is sent instead of the Max. (Message is the same as the old Min Envelope mode in the LD/MLD gauge)	Only the Min Diameter field in the profile will have active information. The others will be set to 0.

Measurement Period Set Up

The user selects a measurement period that covers at least two complete cyclical variations (e.g. two twists on a stranded product, two corrugations on a corrugated product). STAC logic will compile all of the scan readings within this period into a table to generate the mean/min/max statistics. The measurement period can be set between 0.1 and 16 seconds. This is accomplished by writing a value of 1 through 160 (tenths of a second) to cell 121.

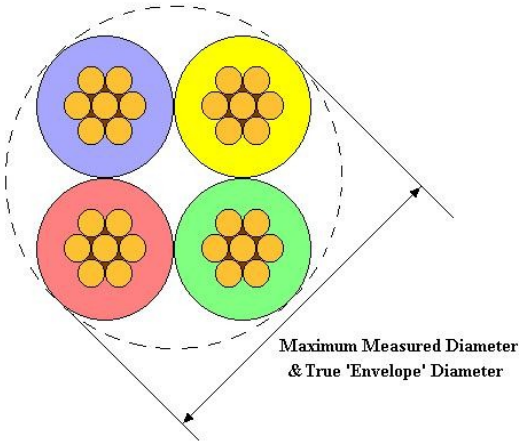
Form Factor Set Up

For a cable with multiple stands it is necessary to apply a form factor to the **STAC max** measurement. This factor ensures that the correct 'envelope' measurement is made (see below).



Odd number of wires

Form factor is applied to the measurement to give true 'Envelope' diameter



Even number of wires

Form factor not required as measured diameter = 'Envelope' diameter

For even numbers of stands the form factor should be set to 1. For odd numbers of strands the factor will be greater than 1. See the following chart for setting the form factor in cell 122:

# of Strands	Form Factor	Cell 122
EVEN	1.0000	10000
3	1.0774	10774
5	1.0318	10318
7	1.0178	10178
9	1.0115	10115
11	1.0080	10080
13	1.0059	10059
15	1.0046	10046
17	1.0036	10036
19	1.0029	10029
21	1.0024	10024
23	1.0021	10021
25	1.0018	10018
27	1.0015	10015
29	1.0013	10013
31	1.0012	10012

Once this factor is set the resulting maximum diameter in cell 123 will be automatically corrected.

Rejection Filter Setup

No manual input is required to set rejection levels. STAC logic will dynamically set the rejection level to the optimum for the product being measured. The values can be read from cells 129 and 130.

Switching and Combining Options

Several software options are available for AccuScan 4000/5000 gauges, but not all options are able to operate concurrently with others. Three such options that require exclusive operation are FFT, Scanning flaw detection and STAC logic. The database parameter 'Option switch' can be set to switch on one of the options at a time. It is set via the RS232 interface using code {Z} (See ASCII code table).

Where Profibus/DeviceNet is being used for field communications the Profibus/DeviceNet profile will change accordingly:

Option	RS232 code	Profibus GSD reference (& description)	DeviceNet object
Standard diameter	{z}0	LD/MLD Plus gauge (AS4000/5000 without FFT)	not available
FFT	{z}1	LD/MLD Plus gauge with FFT (AS4000/5000 with FFT)	Assembly object instance 1 consumption data
Scan flaw detection	{z}2	FG/MFG Diameter & Fault gauge (AS4000/5000 with SFD)	not available
STAC logic	{z}3	LD/MLD gauge in Helix mode (AS4000/5000 with Helix)	not available

Note: to complete the Profibus profile change, the master must send the AccuScan 4000/5000 slave new parameterization and configuration telegrams.

Non-concurrent options are shown in the following table.

Compatibility of Options

	Max object	FFT	Scan Flaw Detect.	STAC	Glass
Max object		✓	✓	✓	x
FFT	✓		x	x	✓
Scan Flaw Detect.	✓	x		x	✓
STAC	✓	x	x		✓
Glass	x	✓	✓	✓	

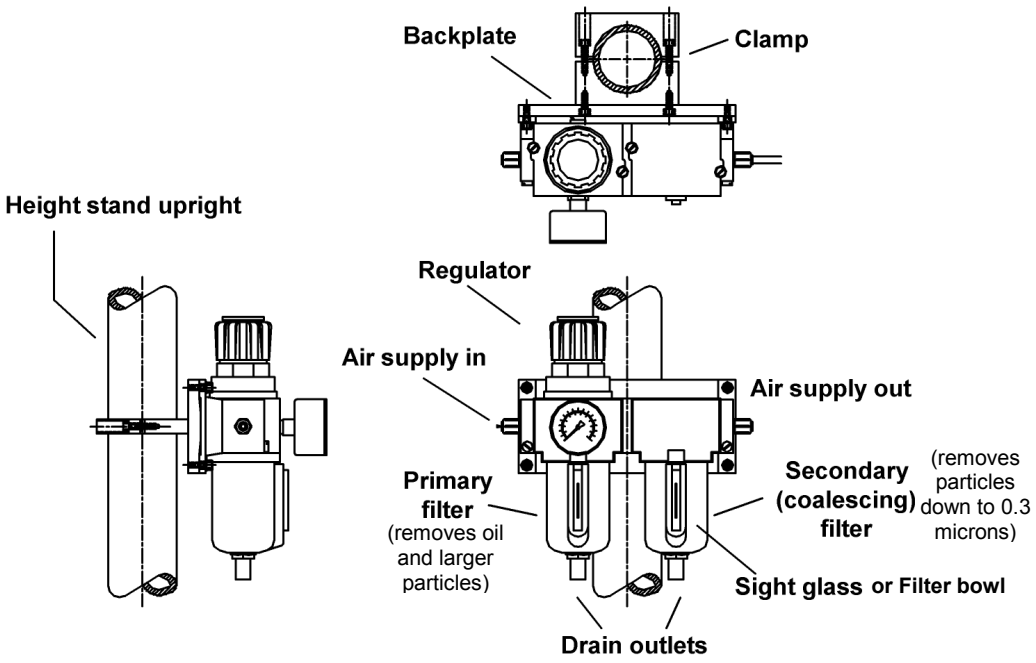
Hardware Options

Apart from the air cleaner described below, the other hardware options are Product guide rollers, Display pod and the Angle bracket. These are discussed under the main heading "Mechanical Installation".

Air Cleaner and Airwipe

The gauge rear panel has an integral connection for connecting an air cleaner (see air cleaner below). The air cleaner inputs clean air into the rear panel connection; the air then gets directed to the gauge airwipe, which helps deflect dust from the gauge windows by maintaining an air curtain over the face of the lenses. The air going into the airwipe should be clean and free of oil. Note that it should also not exceed air pressure limits as stated below.

Both air purity and air pressure can be controlled by the air cleaner. The Beta LaserMike air cleaner (AC1000, part # SA 0042-0044-1/A) is shown below. It can purify air down to 0.3 micron particle size.



The AC1000 air cleaner consists of a combination pressure regulator, dual filter and coalescing moisture traps. It is supplied complete with a back-plate, 1m(3.3ft) push-fit, polyurethane tubing and a clamp for upright mounting. It can also be directly fixed to the post of a light duty Beta LaserMike height stand.

AC1000 Installation

- Cut tube end
- Push the tube into the fitting (the spring collet allows the tube to pass through it and up to the tube stop). Note: Application of pressure or pulling the tube causes the gripping edge to grip the tube. The tube is now both gripped and sealed.
- To remove depress the spring collet and remove tubing.

Connections to factory air supply:

Via a 6 or 8mm (0.24 or 0.31in) OD push fit connector. If preferred, push-fit connector can be removed to expose a female 0.25in BSP thread.

Note that the AC1000 is capable of regulating air pressure (output) from 0.4 – 8 bar (5.8-116psi). Air pressure input should not exceed 17 bar (247psi).

Connections to Beta LaserMike gauge:

Via 5, 6 or 8mm (0.2, 0.24 or 0.31in) push-fit connectors. For optimal airwipe pressure range see Specification under AS5012, AS5025/AS5040, or AS5080. Turn regulator (see drawing above) to adjust output air pressure.

Maintenance

Cleaning / replacing the filters

Warning: Before attempting to clean or replace the filter elements, ensure that the AC1000 is not pressurized.

When performance from the AC1000 drops noticeably, check the filters and clean or replace as required. The second (coalescing) filter is more likely to need cleaning/replacing. Contact Beta LaserMike for replacements.

Removal of filter bowl/ filters:

- The filter bowl is removed by turning in a clockwise direction when viewed from above and pulling downwards.
- The primary (course) filter can be simply unscrewed from the bowl and removed.
- To remove the secondary filter unscrew the small nut situated on the bottom end.

Disposal of Expelled Water

The air cleaner has an automatic drain system of the diaphragm type. The drain outlets on the filter bowls will periodically eject the moisture removed from the air. This will usually happen when the water in the filters is about half full, when the pressure is reduced to zero, or when the air supply is switched off. If the ejected moisture presents a safety (slide or slip) hazard to passers-by or is inconvenient for other reasons, flexible tubing can be connected to the drain outlets and the moisture safely ducted elsewhere.

Hardware + Software Options

"Hardware-only" and "software-only" options are discussed in a separate section. The following describes an option which includes both hardware and software.

Scanning Flaw Detection

Scanning **F**law **D**etection (SFD) is used to detect faults in the measured product. The gauge analyses the measurements taken after each scan and compares it to high and low limits entered by the user. If the measurement is above or below the limits, an "alarm" is latched in the Flaw Status Register. The alarm remains latched until zeroed by the using the respective bits in the Flaw Control Word.

Two types of flaw detection operate simultaneously: lump/neck detection and over/under tolerance detection. Lump/Neck detection uses single scan data to detect faults whilst tolerance checking uses the running average data. The averaging period is set in cell 53 (ASCII code Q) and is the same period used for the measurement averaging.

Two relay contacts can be programmed to close if the tolerance limits and/or the lump/neck thresholds have been exceeded. The relay can be programmed to operate when any combination of the 4 thresholds have been exceeded. See database cell 117 and cell in the RS232 Communications section for details.

Enabling

SFD is only available for -A (Analog version), but has to be ordered with the gauge.

Once the gauge has been configured for flaw detection, this option can be enabled and disabled by setting the FLAW mode bit to one / zero in the Option_Switch cell 28.

Since Scanning Flaw Detection cannot operate concurrently with the FFT and STAC options, the user must set the option switch {z} accordingly for SFD to work.

Additionally, the alarms can be individually enabled/disabled by using the respective bits in the Flaw Control word. The lump and neck fault counters operate regardless if the respective lump and neck alarms are enabled.

Relay Output

The relay output can be configured to close for a specified period during an alarm state. The closure time in milliseconds is specified using Cell_103 for relay 1 and Cell_119 for relay 2. By setting the relay closure time to zero, the relay contacts remain closed until the alarm is cleared by the user. After the relay closure time has expired, the relay cannot be re-triggered until the enabled alarms in the Flaw Status Word are cleared by the user.

Lump and Neck Detection

There are two operating modes for selecting the nominal size used in single scan lump and neck detection. In ABSOLUTE mode, the lump and neck limits are determined by adding or subtracting the thresholds (entered by the user) to/from the preset diameter. In RELATIVE mode, the lump and neck limits are determined by adding or subtracting the thresholds (entered by the user) to/from the running average diameter. The mode is selected by setting the M1 and M0 bits in the flaw processing mode as shown in the following table.

M1	M0	Description	Nominal X	Nominal Y
0	0	FLAW_MODE_DISABLED	N/A	N/A
0	1	FLAW_MODE_ABSOLUTE	Preset X Diameter - cell 108	Preset Y Diameter - cell 109
1	0	FLAW_MODE_RELATIVE	Average X Diameter – cell 60	Average Y Diameter – cell 61

For backward compatibility the gauge supports the three different versions of the predecessor MFG gauge. The COMBINED version uses the same thresholds for both lump/neck detection and tolerance checking. In the SEPARATE version, the lump/neck thresholds are separate from the over/under tolerance thresholds. And lastly, the ribbon version uses separate thresholds for X and Y planes.

In both the COMBINED and SEPARATE versions the faults are detected on the XY average whilst the RIBBON version detects faults on X and Y planes individually.

The version is set by the V1:V0 bits in the Flaw processing mode word (cell 114) as outlined in the following table:

V1	V0	Description	Detects Single Scan Faults on	Uses thresholds
0	1	COMBINED	XY Average	XY Over/Lump (110), XY Under/Neck(112)
1	0	SEPARATE	XY Average	XY Lump(104),XY Neck(106)
1	1	RIBBON	X Diameter Y Diameter	X Lump(104),X Neck(106), Y Lump(105),Y Neck(107)
0	0	Default - RIBBON	“	“

Each lump flaw is counted in cell 100 (if the lump alarm is enabled), and each neck flaw is counted in cell 101 (if the neck alarm is enabled). The total lump and neck counts are contained in cell 102. Each flaw event is only counted once as opposed to every scan. The lump and neck counters can be zeroed by writing a 1 to the ZL and ZF bits respectively in the Flaw Control Word. Writing a 1 to the ZF bit simultaneously clears both lump and neck counters (and therefore the total fault count). A lump or neck event can also be indicated via the LA and NA alarm bits respectively in the Flaw Status Word.

Over and Under Tolerance Detection

OD tolerance checking analyses the running average OD measurement calculated each scan and compares it to high and low limits set by the user. The limits are set by specifying the amount the OD measurement can vary over and under the nominal. The OD nominal is determined by the FLAW mode as explained above and the over and under amounts are set using cells 110/111 and 112/113.

An OD over or under tolerance condition is indicated via the OA and UA alarm bits in the Flaw Status Word if the enabled. To enable OD tolerance alarms, a '1' must be written to the ET bit in the Flaw Control Word. The OD alarm bits remain latched until cleared by the user by writing a '1' to the ZT bit in the Flaw Control Word.

Over tolerance checking is also available for Ovality calculations. A preset is not provided as the nominal Ovality is understood to be 0. The over tolerance value for Ovality is set using cell 118. The over tolerance condition is indicated via the OVA alarm bit in the Flaw Status Word if the enabled. To enable Ovality tolerance alarms, a '1' must be written to the EO bit in the Flaw Control Word. The Ovality alarm bit remain latched until cleared by the user by writing a '1' to the ZO bit in the Flaw Control Word.

Under and Over Tolerance detection

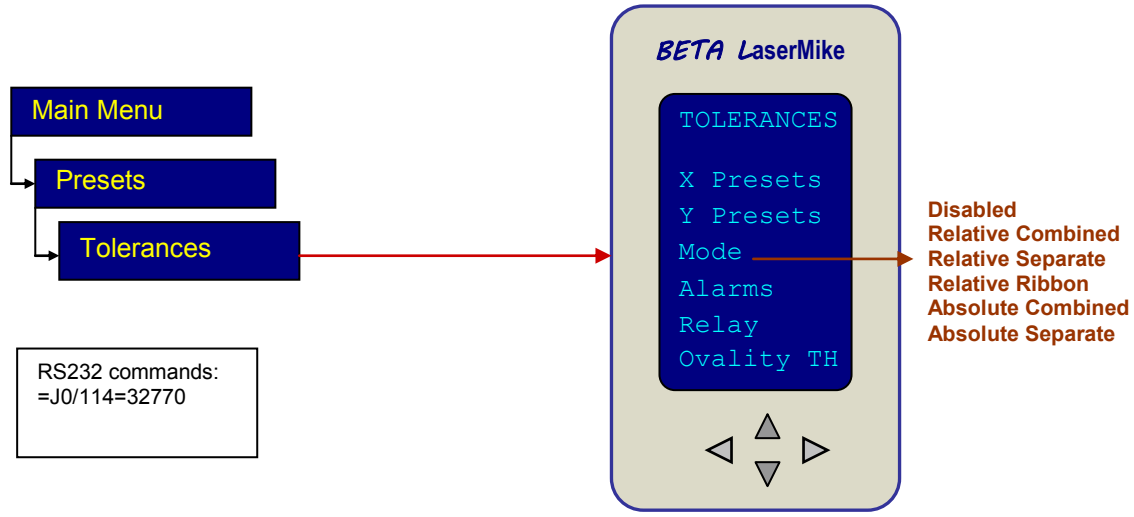
Setup example using the optional Display

For this example the AS4000/5000 gauge will be set up to alarm when the measured averaged diameter exceeds a set threshold of 0.1 mm for over tolerance and under tolerance.

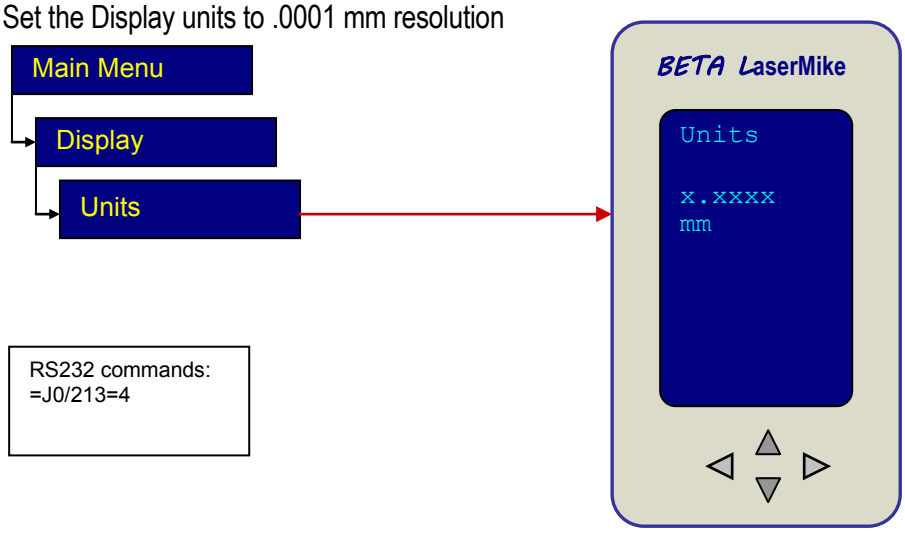
Nominal part size → 5.0 mm

Over Tolerance threshold offset setting for X → 0.1mm, **Under** Tolerance threshold offset setting for X → 0.1mm
Over Tolerance threshold offset setting for Y → 0.1mm, **Under** Tolerance threshold offset setting for Y → 0.1mm

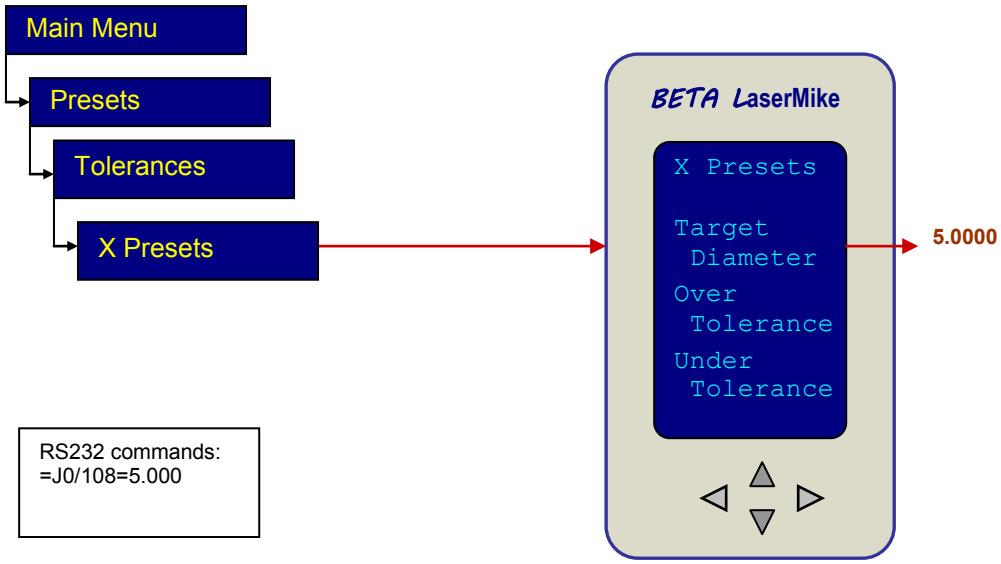
1) Set the Flaw processing mode (relative with separate over/under thresholds)



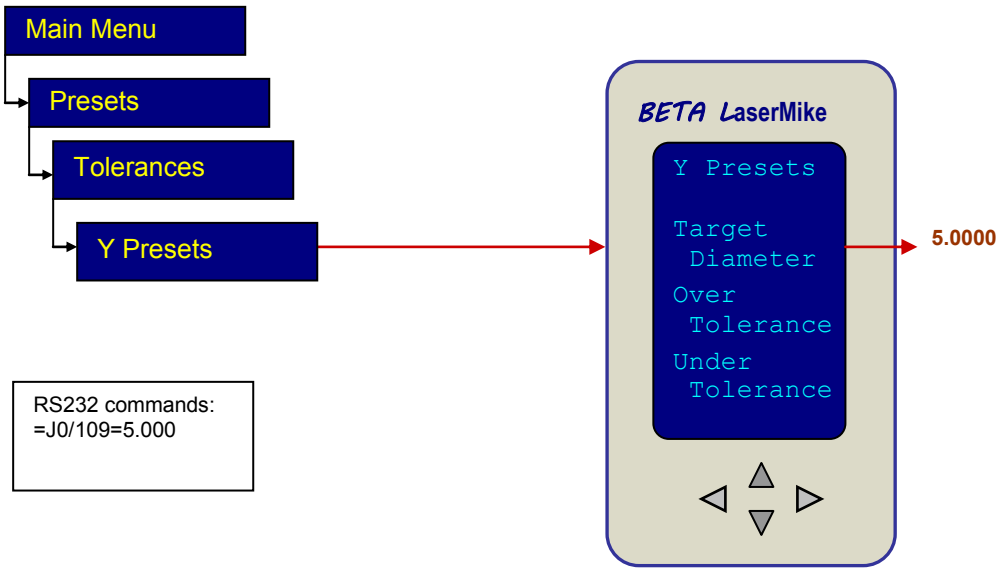
2) Set the Display units to .0001 mm resolution



3) Set the nominal part size to 5 mm

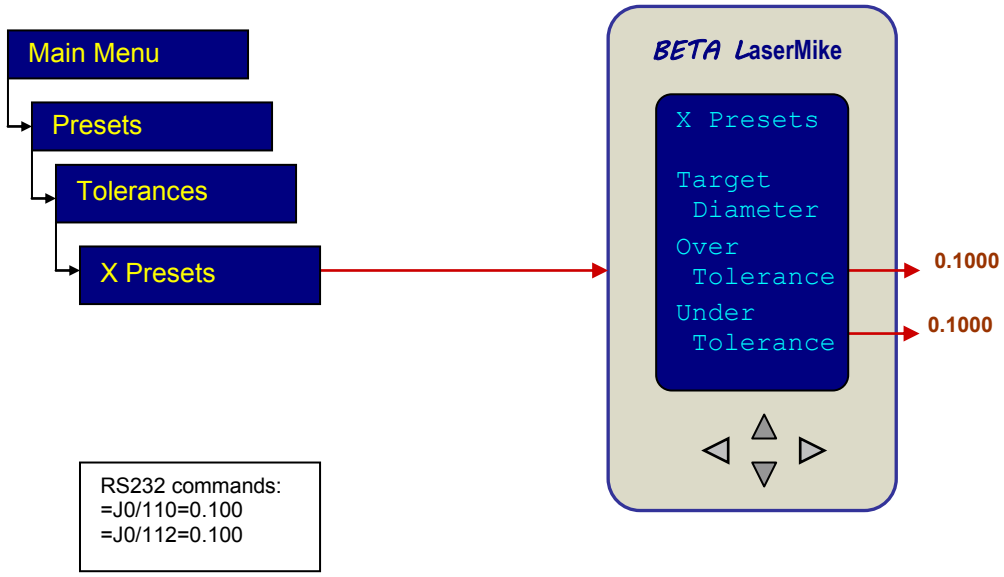


RS232 commands:
=J0/108=5.000

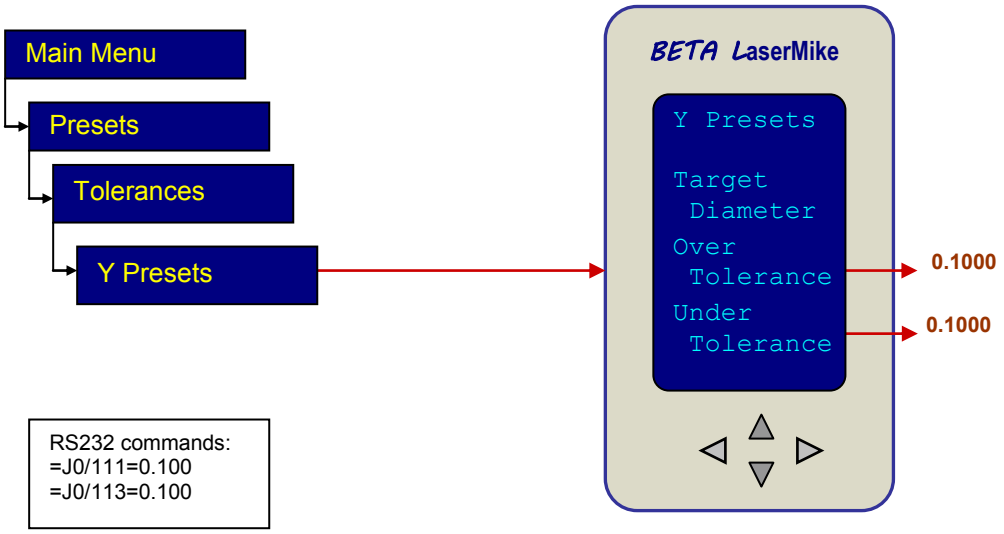


RS232 commands:
=J0/109=5.000

4) Set the over and under tolerance thresholds to .1 mm

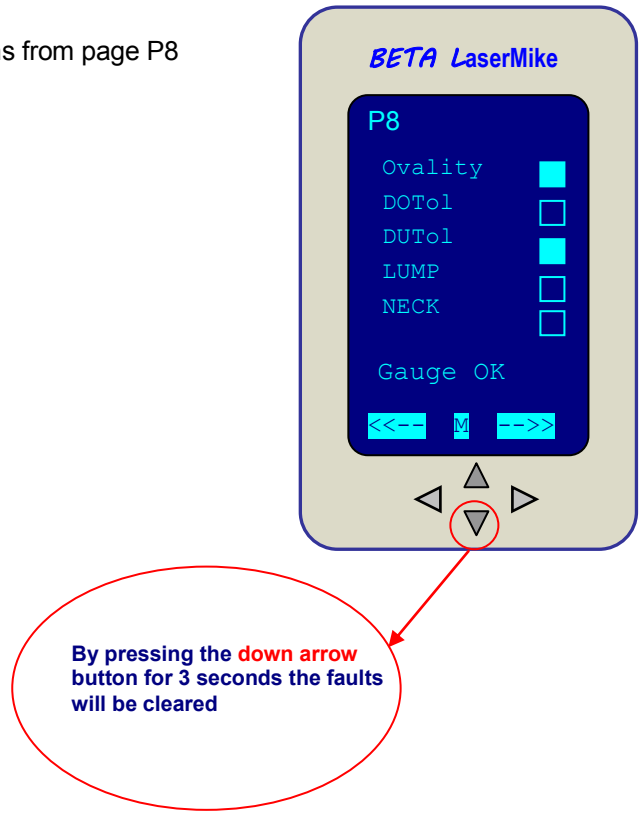


RS232 commands:
=J0/110=0.100
=J0/112=0.100

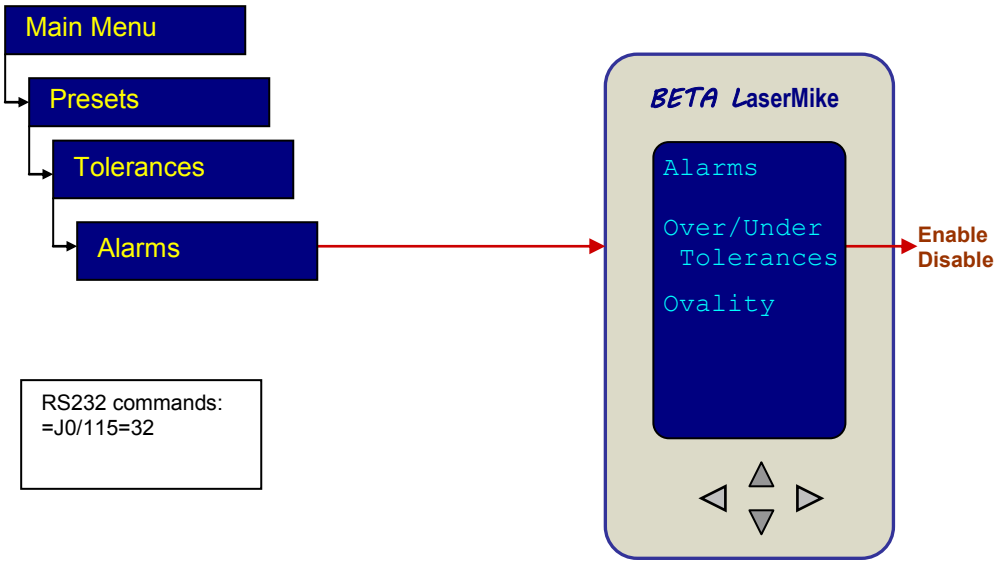


RS232 commands:
=J0/111=0.100
=J0/113=0.100

5) Clear the alarm indications from page P8

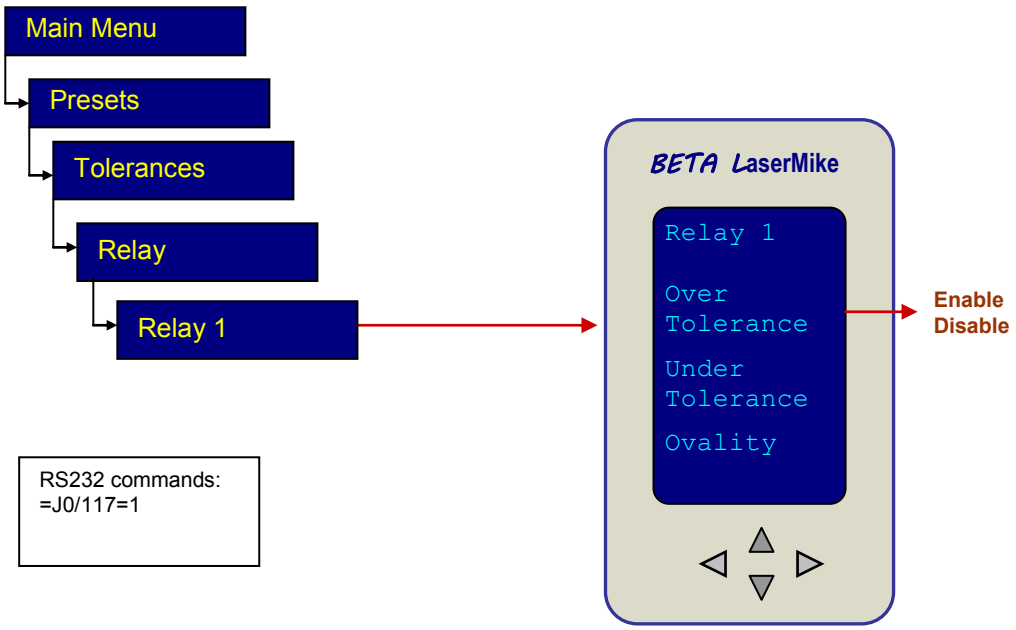


6) Enable the over and under tolerance alarm



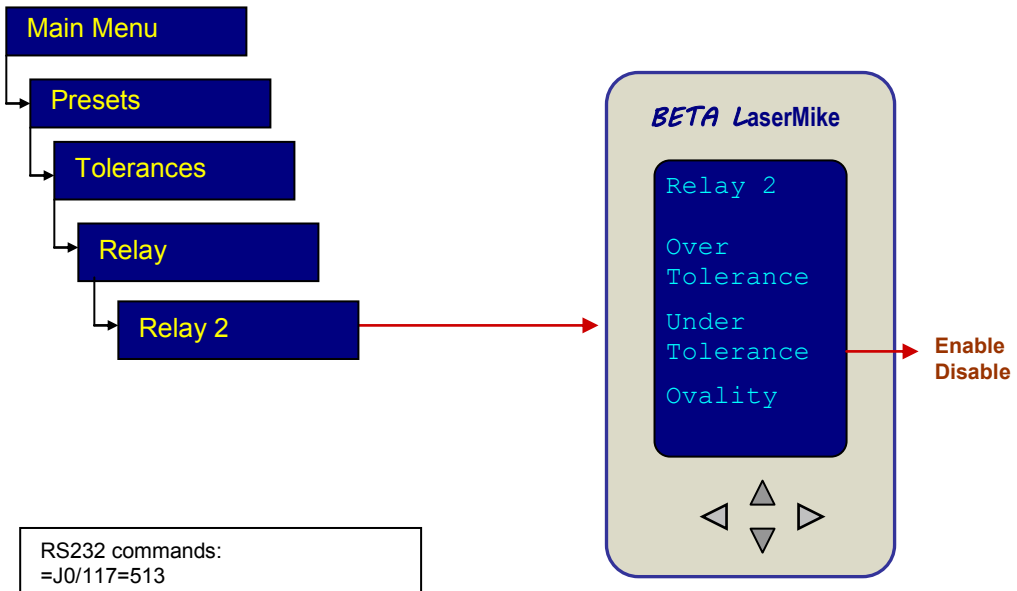
7) If desired and if configured with the optional relay card, the relays can be set to close when an alarm occurs.

For over tolerance use relay 1



RS232 commands:
=J0/117=1

For under tolerance use relay 2



RS232 commands:
=J0/117=513
*cell 117 is used to control relay 1 and cell 119 is used to control relay 2

Single Scan Neck and Lump detection

Setup example using the optional Display and optional Single Scan Flaw Detection software

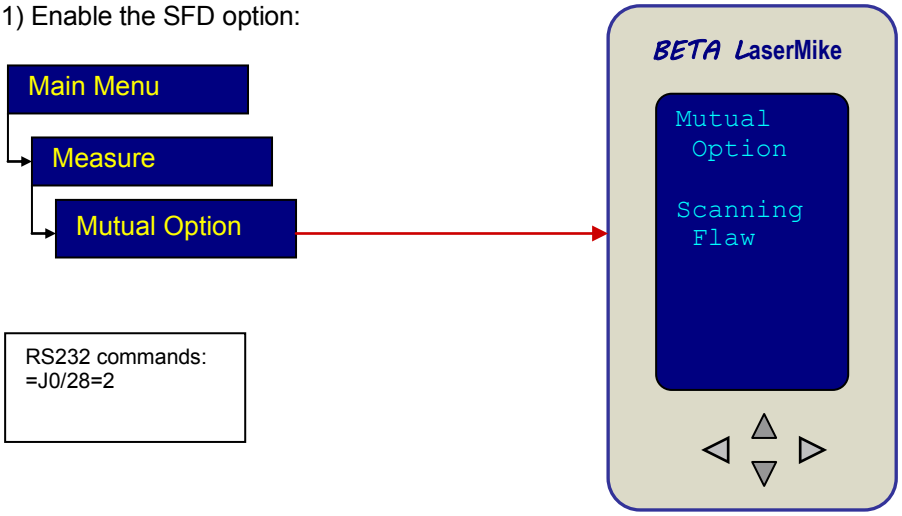
Count and generate an alarm for any necks that deviate more than 0.02mm from the measured diameter.

Data:

Nominal part size → 5.0 mm

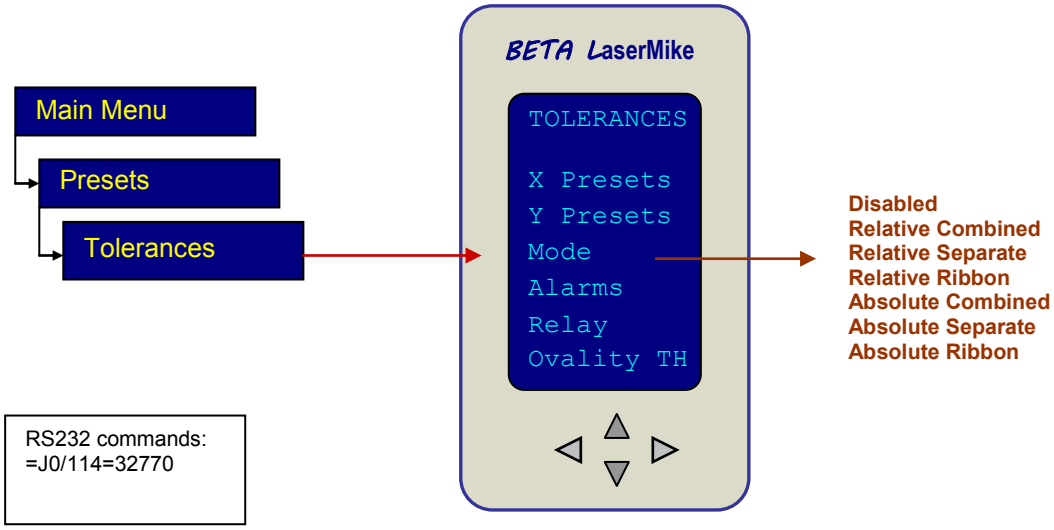
Neck threshold offset setting for X → 0.02mm, Neck threshold offset setting for X → 0.02mm

1) Enable the SFD option:



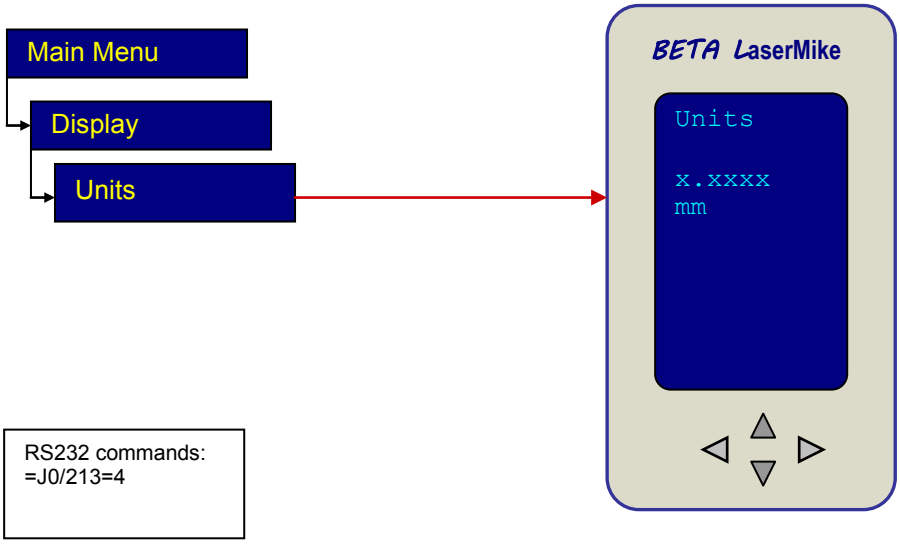
RS232 commands:
=J0/28=2

2) Set the Flaw processing mode (relative with separate lump/neck and over/under thresholds)



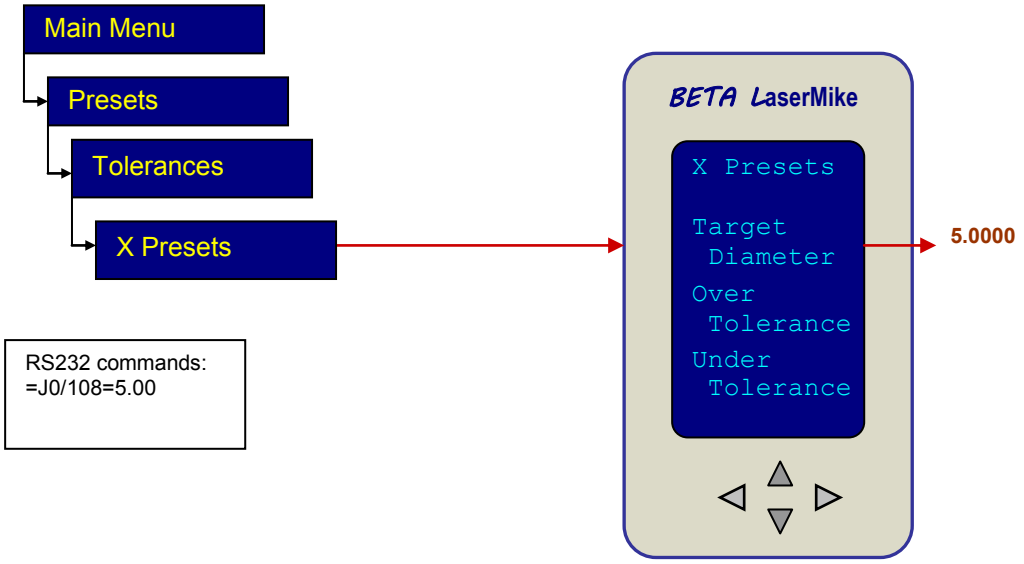
RS232 commands:
=J0/114=32770

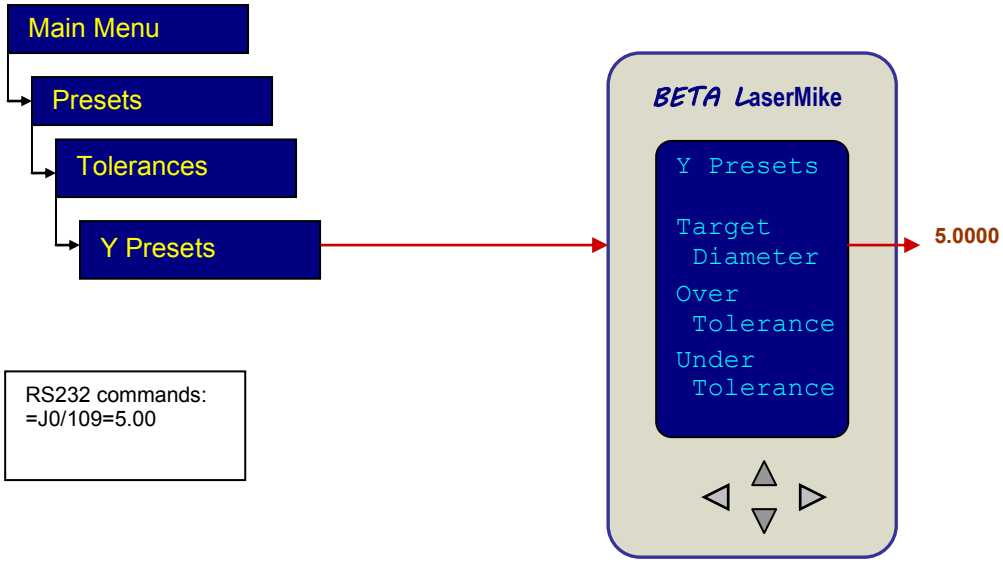
3) Set the Display units to .0001 mm resolution



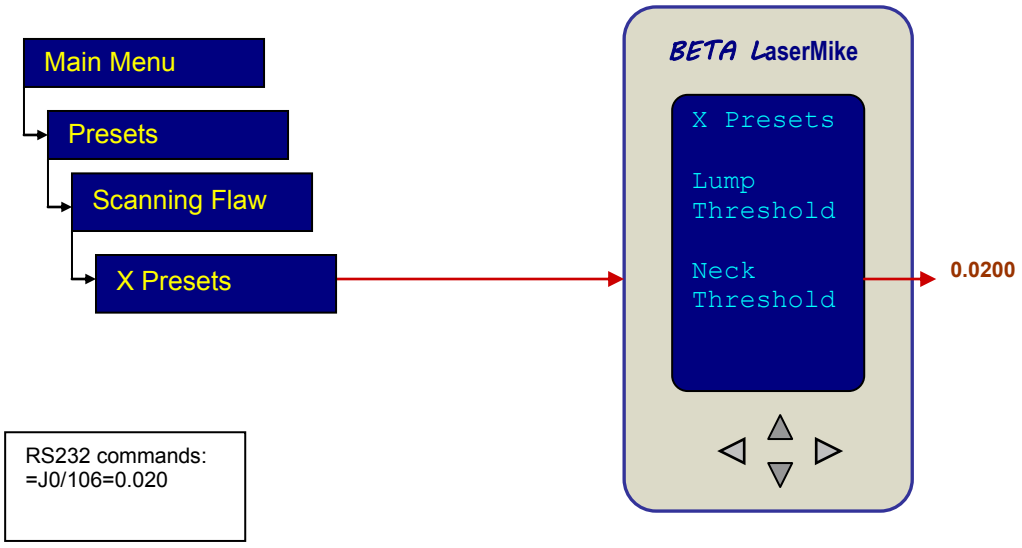
RS232 commands:
=J0/213=4

4) Set the nominal part size to 5 mm

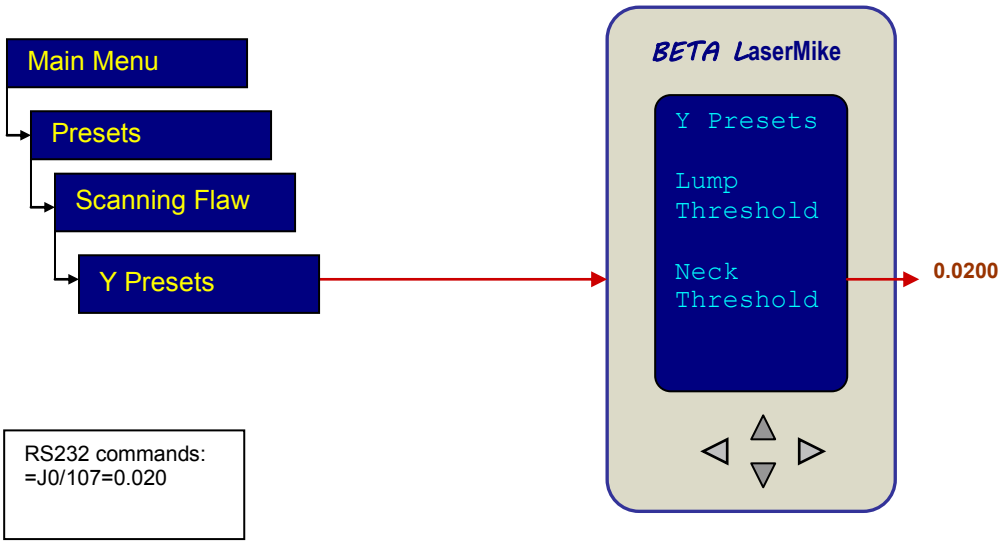




5) Set the neck threshold to .02 mm

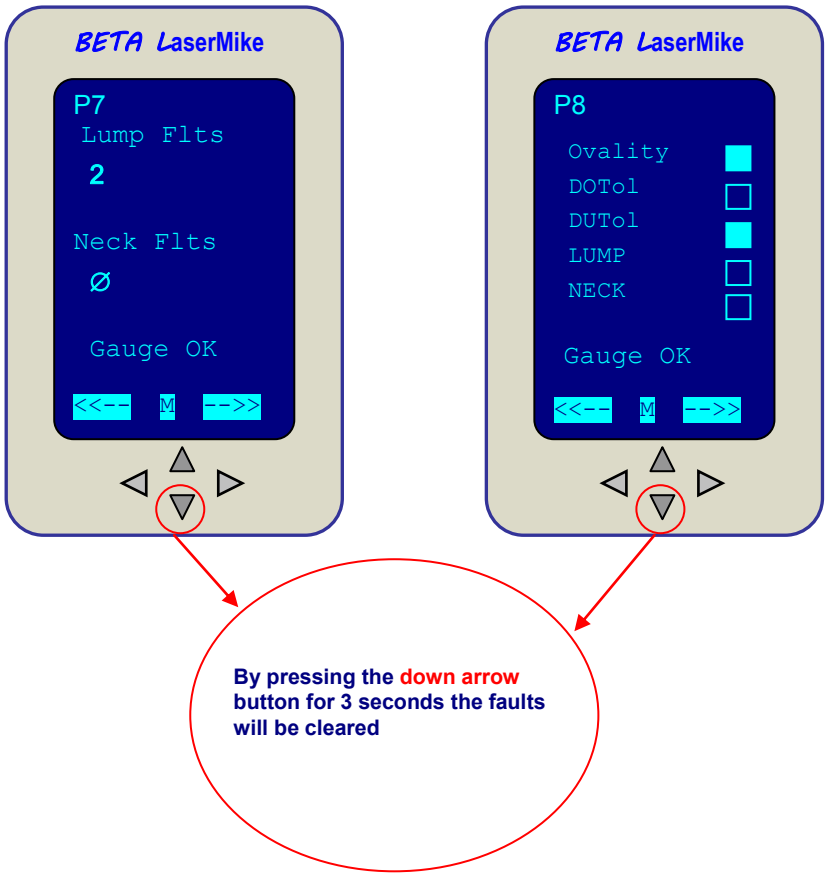


RS232 commands:
=J0/106=0.020

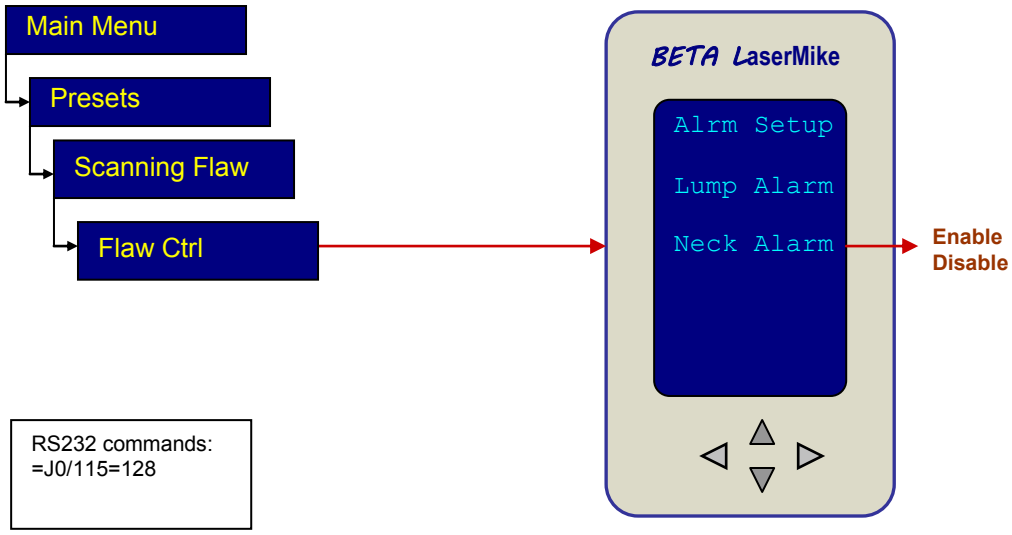


RS232 commands:
=J0/107=0.020

6) Clear the fault counts and alarms from page P7 or P8

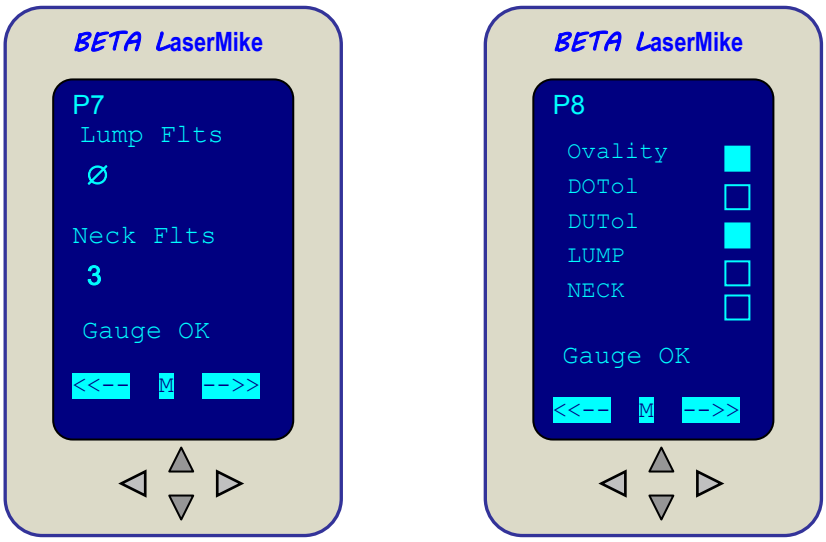


7) Enable the neck alarm



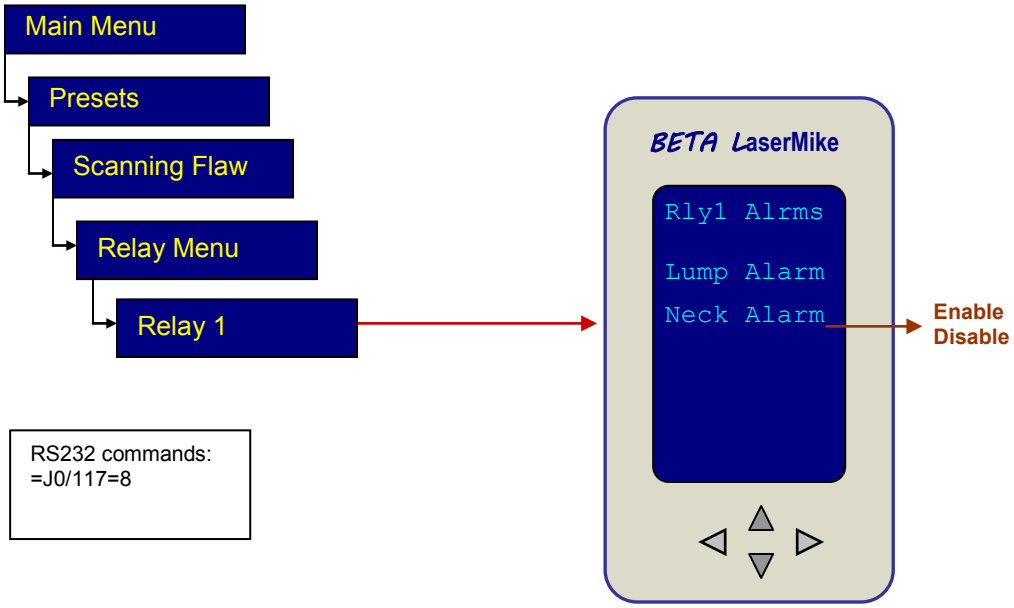
RS232 commands:
=J0/115=128

8) Monitor Page P7 or P8 for alarms



9) If desired and if configured with the optional relay card, the relays can be set to close when an alarm occurs.

For the Neck Alarm:



Understanding the SSF Modes

The Tolerance Measurement and Single Scan flaw detection option calculates the thresholds based on the entries for SSF Mode, nominal values and upper and lower thresholds.

- SSF Mode → cell 114 Combined **Absolute** = 16385
  Combined **Relative** = 16386
  Separate **Absolute** = 32769
  Separate **Relative** = 32770
  Ribbon **Absolute** = 49153
  Ribbon **Relative** = 49154
  Disabled = 0
- Nominal value for X → cell 108
- Nominal value for Y → cell 109
- Lump threshold for X → cell 104
- Neck threshold for X → cell 106
- Lump threshold for Y → cell 105
- Neck threshold for Y → cell 107
- Over Tolerance for X → cell 110
- Under Tolerance for X → cell 112
- Over Tolerance for Y → cell 111
- Under Tolerance for Y → cell 113

Determining Thresholds

Based on the user entries the thresholds are calculated as shown below.

LUMP & NECK

Absolute*+*Combined Mode:
X Lump Threshold = X Nominal(cell 108) + X Over Tolerance setting (cell 110)
X Neck Threshold = X Nominal(cell 108) - X Under Tolerance setting (cell 112)
Y Lump Threshold = X Nominal(cell 108) + X Over Tolerance setting (cell 110)
Y Neck Threshold = X Nominal(cell 108) - X Under Tolerance setting (cell 112)

Absolute*+*Separate Mode:
X Lump Threshold = X Nominal(cell 108) + X Lump Thresholds setting (cell 104)
X Neck Threshold = X Nominal(cell 108) - X Neck Thresholds setting (cell 106)
Y Lump Threshold = X Nominal(cell 108) + X Lump Thresholds setting (cell 104)
Y Neck Threshold = X Nominal(cell 108) - X Neck Thresholds setting (cell 106)

Absolute*+*Ribbon Mode:
X Lump Threshold = X Nominal(cell 108) + X Lump Thresholds setting (cell 104)
X Neck Threshold = X Nominal(cell 108) - X Neck Thresholds setting (cell 106)
Y Lump Threshold = Y Nominal(cell 109) + Y Lump Thresholds setting (cell 105)
Y Neck Threshold = Y Nominal(cell 109) - Y Neck Thresholds setting (cell 107)

Relative*+Combined Mode:*
X Lump Threshold = X running average + X Over Tolerance setting (cell 110)
X Neck Threshold = X running average - X Under Tolerance setting (cell 112)
Y Lump Threshold = Y running average + X Over Tolerance setting (cell 110)
Y Neck Threshold = Y running average - X Under Tolerance setting (cell 112)

Relative*+Separate Mode:*
X Lump Threshold = X running average + X Lump Threshold setting (cell 104)
X Neck Threshold = X running average - X Neck Threshold setting (cell 106)
Y Lump Threshold = Y running average + X Lump Threshold setting (cell 104)
Y Neck Threshold = Y running average - X Neck Threshold setting (cell 106)

Relative*+Ribbon Mode:*
X Lump Threshold = X running average + X Lump Threshold setting (cell 104)
X Neck Threshold = X running average - X Neck Threshold setting (cell 106)
Y Lump Threshold = Y running average + Y Lump Threshold setting (cell 105)
Y Neck Threshold = Y running average - Y Neck Threshold setting (cell 107)

UNDER & OVER TOLERANCE

For the under and over tolerance settings the Mode settings are not used in determining the thresholds. The thresholds are determined as follows:

The X Nominal(cell 108) + X Over Tolerance setting (cell 110)
The X Nominal(cell 108) - X Under Tolerance setting (cell 112)
The Y Nominal(cell 109) + Y Over Tolerance setting (cell 111)
The Y Nominal(cell 109) - Y Under Tolerance setting (cell 113)

Determining Faults

Faults are determined by comparing the measured diameter values against the determined thresholds. Again the Mode settings play a part as shown below:

For LUMP & NECK

Absolute*+Combined Mode:*
Absolute*+Separate Mode:*
Relative*+Combined Mode:*
Relative*+Separate Mode:*
The fault is determined by comparing the current X scan against the X plane threshold determined for that particular mode ***and*** the current Y scan against the X plane threshold determined for that particular mode.

Absolute*+Ribbon Mode:*
Relative*+Ribbon Mode:*
The fault is determined by comparing the current X scan against the X plane threshold determined for the particular mode ***and*** the current Y scan against the Y plane threshold determined for the particular mode.

For UNDER & OVER TOLERANCE

Absolute*+Combined Mode:*
Absolute*+Separate Mode:*
Relative*+Combined Mode:*
Relative*+Separate Mode:*
The fault is determined by comparing XY average of the running average $\left(\frac{Average[x]+Average[y]}{2}\right)$ against the X plane threshold determined for the particular mode.

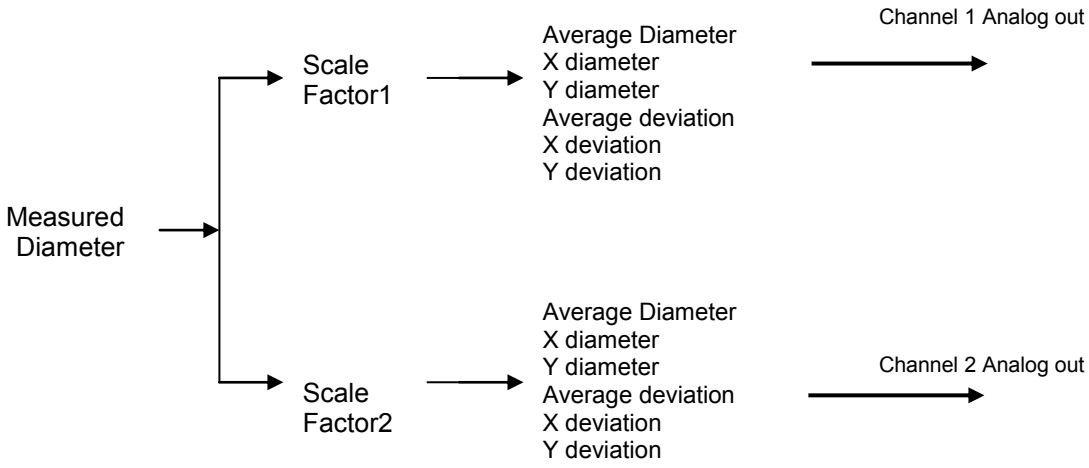
Absolute*+Ribbon Mode:*
Relative*+Ribbon Mode:*
The fault is determined by comparing the average scan against the X plane ***and*** Y plane thresholds determined for the particular mode:

Analog Outputs

Two Analog outputs are available via an optional Analog I/O daughter board. In addition there is an optional software package named “Fast Analog”.

Both Analog outputs are updated on every scan e.g. 1200 times/sec. If the Fast Analog option has been selected, the value that is output is the value derived from the current scan. If the Fast Analog option is **not** selected, then the value that is output is the value derived from the averaged diameter value.

The Analog outputs are designed as follows:



The diameter measurement can either be the deviation from the target diameter or absolute diameter. In the latter case, the output range can only be positive from 0-10V. The target diameter can be set via the RS232 port, field bus or the display keypad (if fitted).

The channel 1 output voltage is scaled over the ±10V range using the value in database cell 57. Likewise, the channel 2 output voltage is independently scaled over the ±10V range using the value in database cell 58. The range represents the full-scale diameter or deviation measurement. Stated another way, it is the deviation or diameter at which the voltage will be full scale.

The Analog outputs convert diameter measurements to an Analog voltage and have a 16-bit resolution (1 part in 65536) over the range of ±10V.

Each output can represent several values selected from the following list.

Database Cell Value	Output Value
0	Calibration mode
1	(x+y) / 2 diameter
2	x diameter
3	y diameter
4	(x+y) / 2 deviation
5	x deviation
6	y deviation

The selection is controlled by the value in the database cells 195 and 196 for outputs 1 and 2 respectfully.

Typical Operation Using a Terminal

- Set the RS232 resolution to desired units (see Resolution table) using cell 1.
- Set the required output type using cell 195 for channel 1 and cell196 for channel 2..
- If measuring deviation, set the diameter target/nominal using cell 50.
- Set the full scale range with cell 57 (scale factor 1) and cell 58 (scale factor 2).

Example 1:

To configure the outputs for x and y deviation from a 5 mm target with scaling of 10V=1mm.
-Enter p2 to set the RS232 resolution to 10^{-6} m.
-Enter |e|5 or =J0/195=5 and |f|6 or =J0/196=6 to set output 1 for x deviation and output 2 for y deviation.
-Enter o5000 (or =J0/50=5.000) to set target/nominal to 5.000mm
-Enter <r>1000 (or =J0/57=1.000) to set the range to +/-1.000mm

A product diameter of 4.5mm will give an output voltage of –5.00V (10V * (4.500 – 5.000) mm/ 1.000mm) whilst a product diameter of 5.4mm will give an output voltage of +4.00V (10V * (5.400 – 5.000)mm/ 1.000mm).

Example 2:

To configure the outputs for absolute x and y diameter with scaling of 10V=10mm:
-Enter p2 to set the RS232 resolution to 10^{-6} m.
-Enter |e|2 or =J0/195=2 and |f|3 or =J0/196=3 to set output 1 for x diameter and output 2 for y diameter.
-Enter <r>10000 (or =J0/57=10.000) to set the full scale range to 10.000mm

A product diameter of 4.0 mm will give an output voltage of 4.000V (10V * 4.000mm/ 10.000mm)

Analog Output Calibration

For main gauge diameter calibration procedure, see heading Calibration. This calibration procedure requires the use of a terminal program such as Hyperterminal and a DMM to monitor the DC output voltage. When complete, the output voltage range will be -10.000V to +10.000V.

1. Use a DMM to monitor the Analog output voltage of output 1. Refer to the Analog Version connector panel view for pinouts.
2. Start by setting the analog output 1 to calibration mode (=J0/195=0).
3. Adjust the zero scale offset up or down until the voltage is zero volts. (start with =J0/96=32775).
4. Adjust the full scale offset up or down until the voltage is 10.000V. (start with =J0/97=64800).
5. Now move the DMM probes to measure output voltage 2.
6. Set the analog output 2 to calibration mode (=J0/196=0).
7. Adjust the zero scale offset up or down until the voltage is zero volts. (start with =J0/98=32775).
8. Adjust the full scale offset up or down until the voltage is 10.000V. (start with =J0/99=64800).

PI Control

The AS4000/5000 PI control option is a combination of hardware and software that will give the user standard Proportional - Integral closed loop control functionality.

In a typical continuous process such as an extruder the stability of diameter of extruded product can vary as process variables change. In a typical extrusion line, the diameter of final product can be controlled by varying either the rate of compound pumped out by the extruder or the speed that the product moves through the process (line speed). Higher the volume of compound pumped, larger the diameter of the final product. On the other hand faster the product pulled through the process (line speed) smaller the final diameter of the final product becomes.

On an extruder line without automatic control, typically the operator adjusts the final product diameter by controlling a reference voltage (typically by a potentiometer) to a control so that the rate of extruder or the speed of the puller can be changed to keep the diameter at a reasonable tolerance. Depending on the level of experience of the operator, and the stability of the system product diameter varies.

By replacing the operator intervention with an automated PI (Proportional, Integral) Controller this process can be much more predictable and stable. We can do that by implementing a PI control option to AS4000/5000.

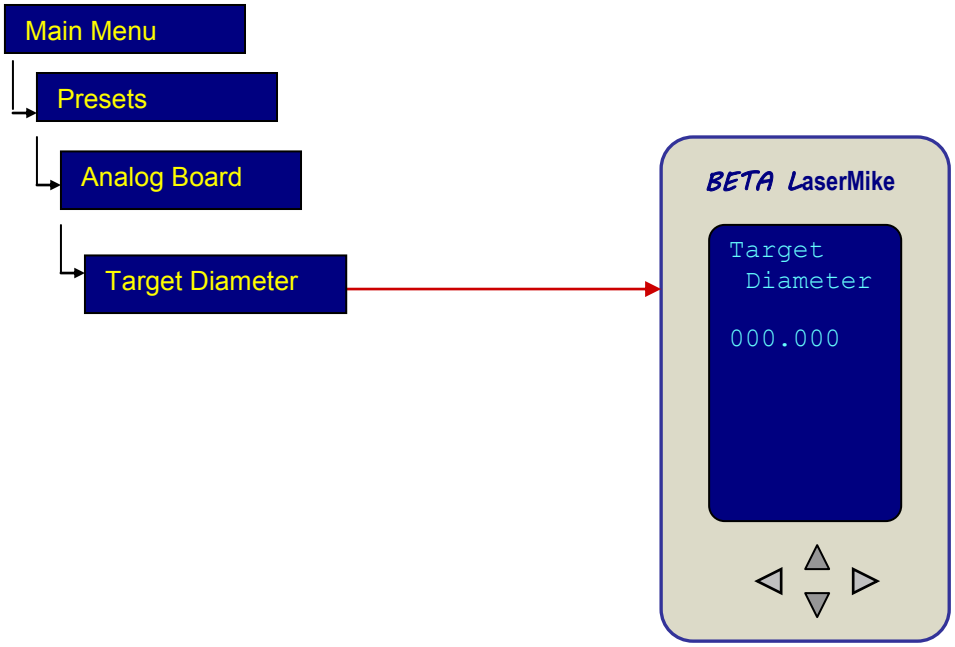
The AS4000/5000 gauges implement an optional Proportional Integral Controller based on the dependant or standard PI algorithm. The input or Processed Variable (PV) to the loop is the measured Average diameter of X and Y (X+Y/2). The output (CO) is an analog voltage that is typically connected to the line speed controller or extruder control.

PI Control Features

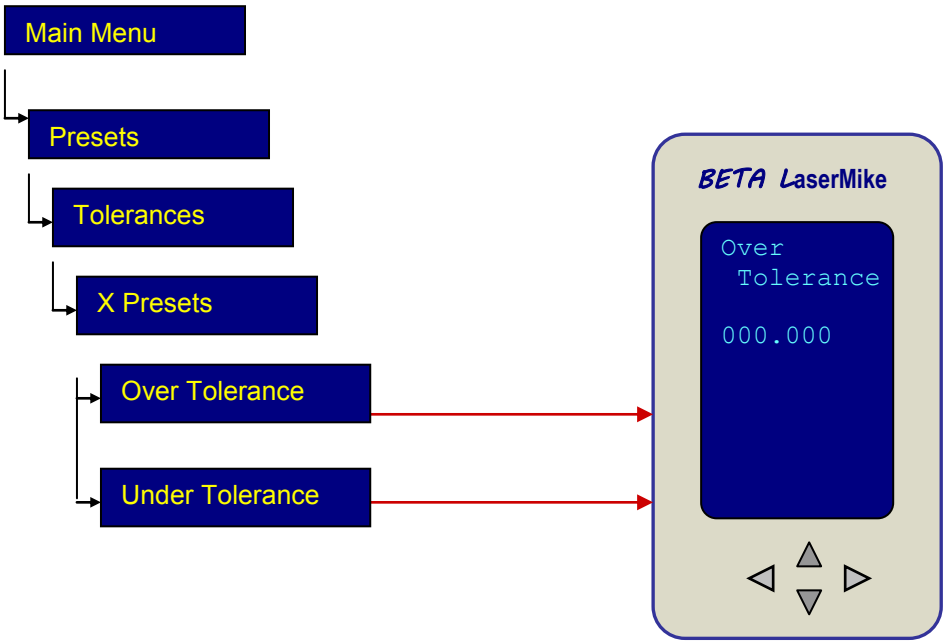
- Solid State Analog Control (Analog Junction)
- V-Ref: Analog reference voltage (0 to 10 volts) input to the control circuit.
- Error = Set Point (Desired Diameter) – Processed Variable (Measured Diameter)
- Proportional Gain is adjustable (via trimming)
- Integral Gain is adjustable (via trimming)
- Averaging time can be set from .5 sec to 1 minute
- Controller can be configured as Summing Junction or Non-Summing Junction
- Controller can be configured as Direct Acting or Reverse Acting
- Hardware Auto-Manual Mode, via switch input
- Bumpless transfer
- Uses DB 9 pin socket for external connections
- Control output, this is the analog voltage: +/- 50% of reference voltage or +/- 50% of reference + reference, depending on summing or non-summing connection.
- Relays: same functionality as the relays used in the analog/relay option of the gauge.

Setup via Display Menu

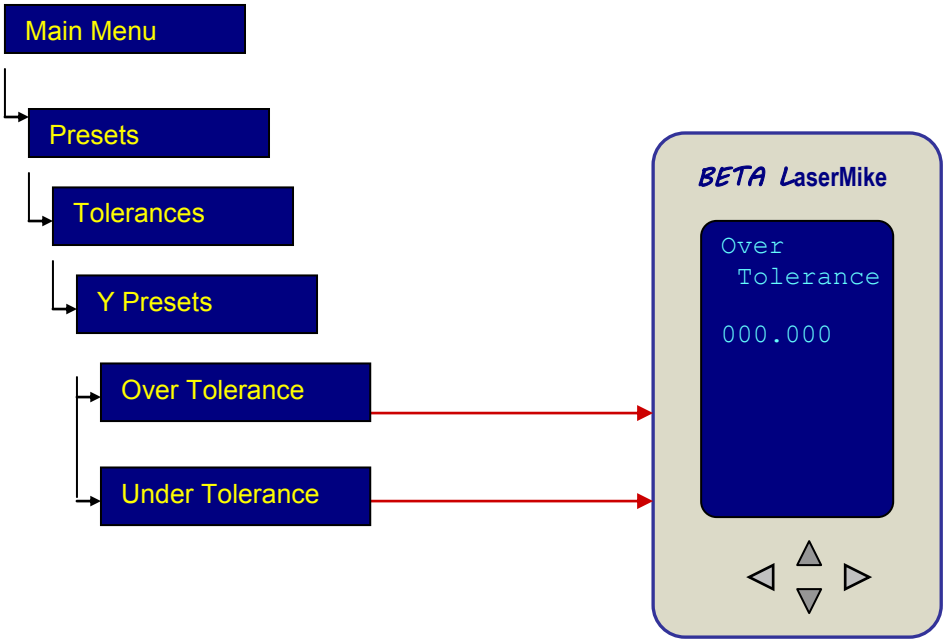
Setting the Set Point (SP)



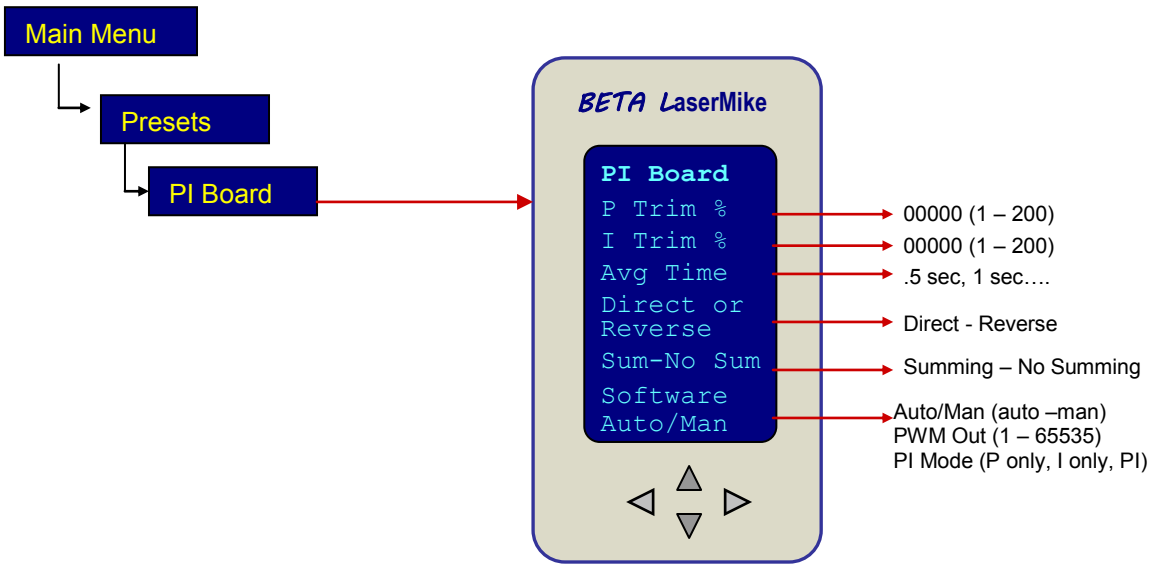
Setting the X plane Tolerancing Thresholds



Setting the Y plane Tolerancing Thresholds



The PI Board Menu is accessed via the Display interface. From any one of the Main Pages P1 – P8 press the up arrow key which will go to the Main Menu.



Setup via Serial Link

If there is no Display option with the Gauge the above parameters can be set through the RS-232 port using Hyper Terminal.

Parameter	Read Command	Write Command	Value
Set Point	?J0/50	=J0/50=Value	Desired diameter xxx.xxxx
Upper Tolerance X	?J0/110	=J0/110=Value	Desired diameter xxx.xxxx
Lower Tolerance X	?J0/112	=J0/112=Value	Desired diameter xxx.xxxx
Upper Tolerance Y	?J0/111	=J0/111=Value	Desired diameter xxx.xxxx
Lower Tolerance Y	?J0/113	=J0/113=Value	Desired diameter xxx.xxxx
P Trim %	?J0/135	=J0/135=Value	1 to 200 (default = 100)
I Trim %	?J0/136	=J0/136=Value	1 to 200 (default = 100)
Averaging Time	?J0/138	=J0/138=Value	0 to 600 in increments of 100 milliseconds 1 = 100 milliseconds 600 = 1 minute
Direct or Reverse Acting	?J0/137	=J0/137=Value	0 = Direct (default) 1 = Reverse
Summing or Non-Summing Junction	?J0/139	=J0/139=Value	0 = No-Summing (default) 1 = Summing

PI Tolerancing

By using the X Over and Under Tolerance settings (cells 110 and 112) and the Y Over and Under tolerance settings (cells 111 and 113) an “envelope “ can be created in where PI control is active. If the PV exceeds the envelope, the gauge stops controlling the process and the CO voltage will remain frozen at the last value before the envelope settings were exceeded. Once the PV is back within the envelope threshold settings, PI control will resume. The “envelope” is set at 2x the tolerance settings.

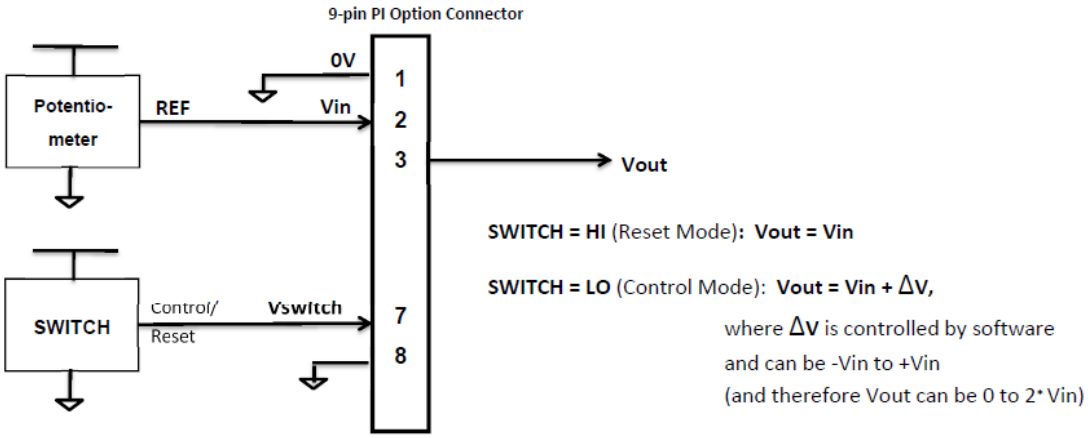
External Connection

The PI Control signals are routed through a DB9 external options connector. The table below shows the pin-out of the connector.

Pin	Description
Pin 1	Vref A1
Pin 2	Vref B1
Pin 3	Vout 1
Pin 4	Relay Output 1
Pin 5	Relay Output 2
Pin 6	Digital Input 1 (unused)
Pin 7	Digital Input 2
Pin 8	Digital Input Common
Pin 9	-

The Control Output (CO) goes out on pin 3. The digital input on pin 7 is the manual/auto switch input. A high on pin 7 will set a manual setting while a low on pin 7 sets the auto setting.

Summing mode:

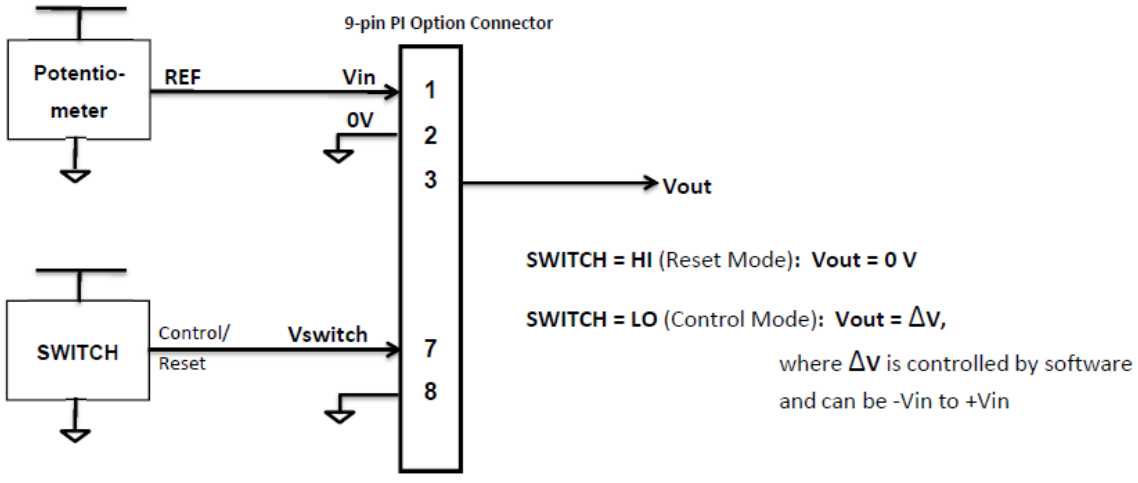


SWITCH = HI (Reset Mode) when **Vswitch** > 3.5V
Vswitch must not exceed +18V

SWITCH = LO (Control Mode) when **Vswitch** < 0.5V

Electrical specs: **Vin** must be greater than -14V and less than +14V at all times.
Vswitch must be greater than -3V and less than +18V at all times.

Non-summing mode:



SWITCH = HI (Reset Mode) when **Vswitch** > 3.5V
Vswitch must not exceed +18V

SWITCH = LO (Control Mode) when **Vswitch** < 0.5V

Electrical specs: **Vin** must be greater than -14V and less than +14V at all times.
Vswitch must be greater than -3V and less than +18V at all times.

Relay Output

The PI board contains two solid-state relays. The relay outputs can be configured to close for a specified period during an alarm state. The closure time in milliseconds is specified using cell 103. By setting the relay closure time to zero, the relay contacts remain closed until the user clears the alarm. After the relay closure time has expired, the relay cannot be re-triggered until the user clears the enabled alarms in the Flaw Status Word.

Operation

In a normal control operation these are the steps taken to set up and operate the gauge:

1. Controller should be in manual mode. This mode is set via an external Auto/Manual switch
2. Set the desired Set Point (SP) by entering the value into database cell 50. This can be done via the Display Menu or the RS232 connection using a HyperTerminal connection.
3. Set the desired threshold values by entering the values into database cells 110 (upper tolerance for X), 112 (lower tolerance for X), 111 (upper tolerance for Y) and 113 (lower tolerance for Y). This can be done via the Display Menu or the RS232 connection using a HyperTerminal connection.
4. Using an external potentiometer dial in the reference voltage so it is close to the value of the set point.
5. Put the Controller in Auto mode via the external Auto/Manual switch.

If the Gauge encounters an error condition, the output of the controller is maintained at the last value before the error condition was encountered. Once the error is cleared, the output value is updated normally.

FieldBus Options

ProfiBus Communication (option)

Note that the AS4000/5000-P (i.e. ProfiBus version) must be ordered to enable ProfiBus functionality.

General ProfiBus Information

This section is provided for background information for ProfiBus communication to **all** the current Beta LaserMike gauges that support it. Some of the information in this section may not be relevant for gauges with built in ProfiBus such as the AccuScan 4000/5000 range of products.Specific information for the product covered by this manual can be found separately in a later section.

Note that all Beta LaserMike gauges can read data as consistent data. Non consistent data will not work with Beta LaserMike gauges.

GSD software installation

Copy the file specified on Diskette (provided by Beta LaserMike) to the directory specified in ProfiBus System Documentation.

Configuration via DP Master

The gauge must be dynamically configured by the DP master using the parameterization and configuration telegrams. However, as the protocol covers many different Beta LaserMike gauges, the information contained in the telegrams is not always relevant, nevertheless the telegrams must always be present.

The DP parameterization telegram can contain the information for determining:

The baud rate to use for communication with an RS232 gauge

The Centigrade / Fahrenheit jumper settings for the Preheater/Rotatemp

A flag to indicate if DP profile parameters are to be stored to EEPROM (if this is disabled the DP master must update all DP parameters after the start of every DP session).

The provided ‘SGDP332.GSD’ file contains the necessary information to allow the selection and entry of the above information using the point-and-click facilities available in the Siemens “COM PROFIBUS” database creation utility.

The DP configuration telegram is used to select the profile / gauge type being used. It is up to the user to select the correct gauge being used. Only a single profile / gauge type is allowed, and the configuration information must be understood by the gauge. Again, the ‘SGDP332.GSD’ contains the necessary information to allow the selection of profile type using the point-and-click facilities available in the Siemens “COM PROFIBUS” database creation utility.

The gauge may reject a configuration request for any other profile than its own.

Data Format and Units

All data is received and transmitted in network byte order. Multi-byte values are ordered with the most significant byte lowest in memory, and the least significant byte higher in memory.

Wherever possible values are represented using unsigned words, but some values are represented using 32-bit floating-point numbers. This means that some parameter lists are a mix of word and floating point representations.

All measured values and parameters are specified in standard units:

	Metric	Imperial
Voltage	Volts	volts
Current	Amps	amps
Percent	Percent	percent
Rotational speed	revs/minute	revs/minute
Frequency	Hz	Hz
Tension	Newtons	Newtons
Diameter	Metres	inches
Eccentricity (linear)	Metres	inches
Capacitance	pF/meter	pF/foot
Linear speed	Metres/minute	feet/minute
Temperature	Degrees Centigrade	degrees Fahrenheit

Communication

The gauge supports freeze and sync requests. It is unlikely that using freeze and sync will be of any real value to a DP master, but the facilities are provided nevertheless.

The gauge supports ‘Set Slave Address’ telegrams. The ‘Slave Address’ and ‘No Address Change’ information may also be configured via RS232.

The gauge provides no additional diagnostic data. All gauge status information is provided within the normal input data.

Input Data

The input data is provided by the gauge and passed to the DP master on every data-exchange.

The length and meaning of the input data depends on the gauge being used. The PKW header is always present, and is followed by the gauge data for the configured profile.

Output Data

The output data is provided by the DP master and passed to the gauge on every data-exchange.

The length and meaning of the output data depends on the gauge being used. The PKW header is always present, and is followed by the output control word for the configured profile. As with all data, the output control word is in network byte order. Some bits in the output control word are common/reserved for all profile types. The following table shows the common output control bits:

Mnemonic	Bit	Description	Profile Types
	0	Reserved	
OCF_START	1	Machine on/off	CS, CPH, Analog ST, Analog PH, Analog RT
OCF_ZERO	2	Zero fault counts impulse	KI, FG, LN, ST
OCF_THREADING	3	Line threading - suppress gauge status	All except CPH

The output control word contains additional bits that apply to individual profile types. Please refer to the gauge profile description for the meaning of these bits.

The OCF_START bit functions as described in the following table:

OCF_START	Description
0	Analog PH / RT / ST off. Manual on/off of RS232 machine possible.
↑	Analog RT / ST on. Analog PH on pulse generated. Single ‘on’ request sent to RS232 machine.
1	Analog RT / ST on. Manual on/off of RS232 machine possible.
↓	Analog PH / RT / ST off. Several ‘off’ requests sent to RS232 machine.

Each machine has safety interlocks such that the DP master cannot turn it on if the lid is open etc. However, it is possible that a machine can be started, as a result of a request from the DP master, if the gauge interlocks are correct, and it is therefore very important to ensure operators are clear of machines before issuing ‘on’ requests from the DP master.

The OCF_ZERO bit in the output control word uses impulses from the DP master to reset fault counts for a DP profile:

OCF_ZERO	Description
↑	Analog gauge: fault count reset. RS232 gauge: counter reset request sent
other	No change, fault counting continues.

The OCF_THREADING bit in the output control word is used to suppress non-fatal gauge errors whilst the line is being threaded. This facility is provided only as a means of assisting the DP master in alarm handling. There is no requirement to use the facility.

Gauge Parameters

The gauge attempts to recover DP parameters from EEPROM each time it is configured at the start of a DP session, but only if EEPROM storage was enabled as part of the DP parameterization. Each parameter may only be recovered if a CCITT 32-bit CRC and the profile type used at the time the parameter was stored are correct.

If the UNITS parameter could not be recovered from EEPROM, then it will be internally marked as 'not valid'. In this case the gauge status will remain as SGDP_GST_DATA_INVALID because the gauge does not know the type of units to use for DP communication. The SGDP_GSF_PARAMS_OK flag will also be reset.

Parameters that are sensitive to units selection cannot be recovered from EEPROM if the units parameter was not recovered, or if the recovered units do not match the units in use at the time the sensitive parameter was stored.

When writing to parameters, the DP master must update a gauge's UNITS parameter first. If this is not done the gauge will ignore write requests to parameters that are sensitive to units, and the SGDP_GSF_PARAMS_OK flag will remain reset. It is recommended that the DP master updates all write-enabled parameters in ascending numerical order.

For simple control systems it is recommended that whenever the SGDP_GSF_PARAMS_OK bit is clear then the DP master writes to all write-enabled parameters in numeric order.

The gauge status is only set to a number lower than SGDP_GST_DATA_INVALID when the units [and Centerscan measurement-type] have been recovered or written by the master and, if required, the relevant input data has been obtained from the RS232 gauge. Whenever the master writes the units [or measurement type] the SGDP_GST_DATA_INVALID status will prevail until new data has been obtained using the new units.

The SGDP_GSF_PARAMS_OK status bit is zero until all parameters have been recovered from EEPROM or the master has (re)written all parameters that are write-enabled.

If a parameter has not been recovered from EEPROM or written by the master, then the corresponding gauge value is regularly polled and stored to the parameter, and can be read by the master if required. This also allows valid data and units sensitive parameters to be read by the master after the master has selected or changed the measurement units [and/or measurement type]. In these circumstances the SGDP_GSF_PARAMS_OK bit will remain reset as not all parameters have been written by the master.

Parameters are stored to EEPROM only after they have been written by the DP master (and not subsequently altered for 30 seconds), and if EEPROM storage is enabled as part of DP parameterization.

Reading and Writing Parameters

Parameters are updated/monitored using the parameter control headers in the output/input data respectively. The header, in either direction, is referred to as PKW. The first word within PKW is referred to as PKE and contains information regarding request/response type and parameter number. The second and third words contain the read/write parameter data or a response error code and are referred to as PWE1 and PWE2 respectively.

	PKW DATA WORDS															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
PKE BASE+0	AK				SPN	PRM										
PWE1 BASE+1	Parameter value MSW															
PWE2 BASE+2	Parameter value LSW															

AK Task/reply identifier, detailed in tables below
SPN Spontaneous bit, reserved for future use.
PRM Parameter number within profile position

Requests are issued by the DP master using the following AK request codes in the PKW header within the 'outputs' telegram:

AK task codes (Master → Slave)	Description
0	No task. The DP master is making no request and the PKW interface is idle. The gauge makes no use of PRM and therefore this value may be zero.
1	Request to read a parameter value.
2	Request to write a word parameter.
3	Request to write a float parameter.

The DP master recognizes the response to a request when PRM in the PKW header within the input data matches that requested. The gauge will respond with the same PRM value, even if the PRM value was not valid.

Responses to requests are acknowledged by the gauge using the following AK response codes in the PKW header within the input data:

AK response codes (Slave → Master)	Description
0	No reply. Issued in response to 'no task'.
1	Cannot complete task. An error code is provided in PWE2. PWE1 is zero. See subsequent table for a description of response error codes.
2	Response to a read or write request for a word parameter. The word parameter value (after the write operation) is contained in PWE2, and PWE1 is zero.
3	Response to a read or write request for a float parameter. The float parameter value (after the write operation) is contained in PWE1 and PWE2.

For an AK response code of 1, ‘task cannot be completed’, the following error codes are returned in PWE2:

AK error codes	Description
0	No error. Issued in response to ‘no task’.
1	AK request code is invalid.
2	Reserved.
3	PRM does not specify a valid parameter number for the configured profile.
4	Cannot write parameter: it is read-only.
5	Cannot write parameter: the value provided by the master is outside of limits imposed by the gauge.
6	Cannot write parameter: the data type (AK request code) is not compatible with the parameter.
7	Cannot write parameter: the parameter is sensitive to units selection and the master has not written to the units parameter.
8	Cannot read parameter, the gauge has not yet received any valid value for the parameter from the DP master or the gauge.

Profibus Communication Specific to AS4000/5000 series

For STAC logic and Scan flaw detection profiles see respective headings below.

Basic Profibus profile & FFT profile

	OUTPUT CONTROL WORD															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Base+3	r	SF	r	r	r	r	r	r	r	r	r	r	TH	r	r	r

r Bit is reserved, and should be set to zero by DP master.

TH If set, the gauge will convert gauge status codes to code 0, thereby suppressing non-fatal errors during threading.

SF This bit is used to start a FFT operation:
New data will be sampled and a FFT will be started on a 0 to 1 transition of this bit, all other states or transitions of this bit are ignored. If a 0 to 1 transition occurs before the current FFT operation is finished new data will be sampled and a new FFT will be started.

	INPUT DATA WORDS															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Base+3	0	0	FC	0	0	0	XY	PO	STATUS							
Base+4	X diameter MSW (bits 31...16 of float)															
Base+5	LSW (bits 15...0 of float)															
Base+6	Y diameter MSW (bits 31...16 of float), valid for dual plane gauges only															
Base+7	LSW (bits 15...0 of float), valid for dual plane gauges only															
With FFT option only:																
Base+8	Frequency of FFT result, at index – 8*block number[4] + 0															
Base+9	Amplitude[5] of FFT result, at index – 8*block number + 0															
Base+10	Amplitude[8] of FFT result, at index – 8*block number + 1															
Base+11	Amplitude[8] of FFT result, at index – 8*block number + 2															
Base+12	Amplitude[8] of FFT result, at index – 8*block number + 3															
Base+13	Amplitude[8] of FFT result, at index – 8*block number + 4															
Base+14	Amplitude[8] of FFT result, at index – 8*block number + 5															
Base+15	Amplitude[8] of FFT result, at index – 8*block number + 6															
Base+16	Amplitude[8] of FFT result, at index – 8*block number + 7															

XY Bit set if gauge is dual plane, bit reset if gauge is single plane.

PO Bit set if all parameters are OK and have been written by the master, bit reset if at least one parameter must be re-written.

FC This bit is used to indicate the completion of a FFT calculation. This bit is cleared when a new FFT is started and set when a FFT has been completed. FFT result data is only valid when this bit is set. After a gauge reset this bit will be set and all FFT result data will be 0.

STATUS Status code, 0..255. One of the gauge status codes as listed under Non-continuous transmission – see ASCII code J

Note: The input data words are collected as three blocks of consistent data. The first block contains the 3 word PKW header, the second block of 5 words contains the measurement data held in Base+3 to Base+7 and the third block of 9 words contains a block of FFT data, if requested.

[4] Block number is the reference number for the block requested by parameter 104 – FFT Block transfer number

[5] Amplitude is a fixed point 16 bit word with resolution as selected by parameter 103 – FFT Amplitude resolution

PARAMETERS		
Param.	Type	Description
1	Word	DP units: 0=metric, 1=imperial
2	Word	X gate position: -99 … +99, read only
3	Word	Y gate position: -99 … +99, read only (valid for dual plane gauges only)
4	Word	Number of scans for gauge to average: 1 … 6000
5	Float	Preset diameter
6	Float	Preset tolerance
16	Word	X optics condition: 0 … 100, read only
17	Word	Y optics condition: 0 … 100, read only
100	Word	Number or FFT samples - 0 to 4 represents 256, 512, 1024, 2048, and 4096.
102	Word	Code representing the FFT sampling frequency: 0 = 0.6Hz, 1 = 1.2Hz, 2 = 3Hz, 3 = 6Hz, 4 = 12Hz, 5 = 30Hz, 6 = 60Hz, 7 = 120Hz, 8 = 300Hz, 9 = 600Hz, 10 = 1.2kHz.
103	Word	FFT Amplitude resolution - 0 or 1 representing 0.01um or 0.1μm / 0.001 mills or 0.01 mills
104	Word	FFT Block transfer number – 0 to 255
105	Word	Average FFT 'spike' amplitude (fixed point integer set by parameter 103), read only
106	Word	FFT Scaling factor: 1 through 1000, default = 118
107	Word	FFT Detrending (0=off or 1=on)
110	Two 16 bit words	Largest FFT 'spike', 1st word = frequency (fixed point 0.01 Hz - 655.35 Hz), 2nd word = amplitude (fixed point int set by parameter 103), read only
↓	↓	(Parameters 111 to 128 have the same format but are ordered in decreasing amplitude)
129	Two 16 bit words	20th largest FFT spike, 1st word = frequency (fixed point 0.01 Hz - 655.35 Hz), 2nd word = amplitude (fixed point int set by parameter 103), read only

Example of a typical FFT operation

1) Select the required FFT sampling frequency (parameter 102), and the number of FFT points (parameter 100).
2) To start the FFT operation set the SF bit in the output control word to 1. NB it is advised to wait a few master cycles before resetting this bit to ensure the start command was recognized.
3) Wait for the FC bit in the input data word base+3 to be set. This indicates that the FFT operation has been completed and the data is ready.
4) Valid data can now be read from parameters 105 and 110 to 129 indicating the largest 20 amplitudes. Also, all of the FFT result data can be read in blocks using parameter 104 to control the transfer see below.

Block transfer of FFT data

When FFT data is valid it can be read out from the gauge in blocks of 9 words at a time. This data is located in the input data words base+8 to base+16. The data in this area does not change until a new block is requested. A block of data is requested by outputting the PKW data words (PKE/base+0 to PWE2/base+2) set up to write parameter 104 with the required block number as the parameter value (PWE2/base+2). The request is completed when the input PKW data indicates a response to the write word request and the required block number is returned as the parameter value (PWE2/base+2). When the request is completed the input data words base+8 to base+16 will contain the requested FFT data block.

STAC Logic Profibus Profile (formerly helix profile)

The STAC logic Profibus profile replaces the former helix/envelope Profibus profile.

	OUTPUT CONTROL WORD															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Base+3	r	r	r	r	r	r	r	r	r	r	r	r	TH	r	r	r

r Bit is reserved, and should be set to zero by DP master.
TH If set, the gateway will convert gauge status codes to code 0, thereby suppressing non-fatal errors during threading.

	INPUT DATA WORDS															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Base+3	0	0	0	0	0	0	XY	PO	STATUS							
Base+4	0								0							
Base+5	Max X diameter MSW (bits 31...16 of float)															
Base+6	LSW (bits 16...0 of float)															
Base+7	Min X diameter MSW (bits 31...16 of float)															
Base+8	LSW (bits 16...0 of float)															
Base+9	Mean X diameter MSW (bits 31...16 of float)															
Base+10	LSW (bits 16...0 of float)															
Base+11	Max Y diameter MSW (bits 31...16 of float), valid for dual plane gauges only															
Base+12	LSW (bits 16...0 of float), valid for dual plane gauges only															
Base+13	Min Y diameter MSW (bits 31...16 of float), valid for dual plane gauges only															
Base+14	LSW (bits 16...0 of float), valid for dual plane gauges only															
Base+15	Mean Y diameter MSW (bits 31...16 of float), valid for dual plane gauges only															
Base+16	LSW (bits 16...0 of float), valid for dual plane gauges only															

XY Bit set if gauge is dual plane, bit reset if gauge is single plane.
PO Bit set if all parameters are OK and have been written by the master, bit reset if at least one parameter must be re-written
STATUS Status code, 0..255. One of the status codes as listed under Non-continuous transmission –see ASCII code J

A maximum diameter is the maximum diameter within the helix table for the corresponding plane (see the description of the helix table size parameter below). A minimum diameter is the minimum diameter within the helix table for the corresponding plane. The mean diameters are the average of the mean diameters within the helix table.

Note: The input data words are collected as 2 blocks of consistent data. The first block contains the 3 word PKW header, the second block of 14 words contains the measurement data held in Base+3 to Base+16.

PARAMETERS		
Parameter	Type	Description
1	Word	DP/RS232 units: 0=metric, 1=imperial
2	Word	X gate position: -99 … +99, read only
3	Word	Y gate position: -99 … +99, read only (valid for dual plane gauges only)
4	Word	Number of scans for gauge to average: 1 … 6000. Note that this has no effect on helix measurements, but may affect locally displayed diameters or analog output only
5	Float	Preset (target) diameter: range according to gauge, affects gauge relay output only
6	Float	Diameter tolerance: range according to gauge, affects gauge relay output only
13	Word	STAC Logic Mode. 0 = Disable 1 = Enable. MAXMIN packet (Old Envelope mode format packet). 2 = Enable. MEANMAXMIN packet (Old Helix mode format packet). 3 = Enable. MAX packet (Envelope mode format packet). 4 = Enable. MIN packet (Envelope mode format packet).
14	Word	STAC Logic Measurement Time. 0 … 160 (representing 0.1s to 16s)
15	Word	STAC Form Factor. Only applicable to STAC Logic MAX diameter value. 5000 … 20000 (representing 0.5000 to 2.0000).
16	Word	X optics condition: 0 … 100, read only
17	Word	Y optics condition: 0 … 100, read only

Scanning Flaw Detection Profibus Profile

The provided 'SGDP332.GSD' file contains the necessary information to allow the selection and entry of Flaw Detection information using the point-and-click facilities available in the Siemens "COM PROFIBUS" database creation utility.

The DP configuration telegram is used to select the profile / gauge type. Only a single profile / gauge type is allowed.

	OUTPUT CONTROL WORD															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Base+3	not used				r	r	ZO	EO	EN	EL	ET	ZT	TH	ZF	ZN	ZL

r Bit is reserved, and should be set to zero by DP master.
ZO Zeros Ovality alarm for a 0 to 1 transition of this bit
EO Enable Ovality Alarms
EN Enable Neck Alarms
EL Enable Lump Alarms
ET Enable Diameter Tolerance Alarms
ZT Zero Diameter alarms for a 0 to 1 transition of this bit
TH Suppress gauge status codes to code 0 whilst threading
ZF Zeroes the lump and neck fault counts for a 0 to 1 transition of this bit
ZN Zeros neck counts and alarm for a 0 to 1 transition of this bit
ZL Zeros lump counts and alarm for a 0 to 1 transition of this bit

	INPUT DATA WORDS															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Base+3	V1	V0	NA	LA	UA	OA	XY	PO	STATUS							
Base+4	X diameter MSW (bits 31...16 of float)															
Base+5	X diameter LSW (bits 15...0 of float)															
Base+6	Y diameter MSW (bits 31...16 of float)															
Base+7	Y diameter LSW (bits 15...0 of float)															
Base+8	Number of lump faults, unsigned word															
Base+9	Number of neck faults, unsigned word															

XY Normally set, but will be 0 if the gauge has not responded since Gauge restart.
PO Bit set if all parameters are OK and have been written by the master, bit reset if at least one parameter must be re-written
V1:V0 A two bit binary number representing the FG/MFG version requested as part of DP parameterization:
1. Combined diameter and fault tolerances.
2. Separate diameter and fault tolerances.
3. Separate diameter and fault tolerances for X and Y planes (ribbon version).

NA Neck Fault Alarm. Remains latched until cleared by ZN.
LA Lump Fault Alarm. Remains latched until cleared by ZL.
UA Diameter Under Tolerance Alarm. Remains latched until cleared by ZA.
OA Diameter Over Tolerance Alarm. Remains latched until cleared by ZA.

STATUS Status code, 0..255. One of the gauge status codes as listed under Non-continuous transmission – ASCII code J

PARAMETERS			
Parameter #	Type	Version	Description
1	word	1 2 3	DP/RS232 units: 0=metric, 1=imperial
2	word	1 2 3	X gate position: -99 … +99, read only
3	word	1 2 3	Y gate position: -99 … +99, read only
4	word	1 2 3	Number of scans for gauge to average: 1 … 6000
5	float	1 2 3	X Preset diameter
6	float	1 2 3	X Diameter over tolerance
7	float	1 2 3	X Diameter under tolerance
8	float	2 3	X Lump threshold
9	float	2 3	X Neck threshold
10	float	3	Y Preset diameter
11	float	3	Y Diameter over tolerance
12	float	3	Y Diameter under tolerance
13	float	3	Y Lump threshold
14	float	3	Y Neck threshold
15	word	1 2 3	Flaw processing mode: 0 = None, 1 = Absolute, 2 = Relative
16	word	1 2 3	X optics condition: 0 … 100, read only
17	word	1 2 3	Y optics condition: 0 … 100, read only

Note that the PO bit in the input state word will remain clear until all parameters have been set.

DeviceNet Communication (option)

Note that the DeviceNet Software Option must be ordered to enable DeviceNet functionality.

DeviceNet Configuration via RS232

Only two DeviceNet attributes are available via RS232 protocol: CAN baud rate and DeviceNet MacID.

Function	Request	Gauge Response	Description
Read MacID	J0/<16><CR>	*J0/<16>=<nnnnnn><CR>	Read the DeviceNet MacID, where 'nnnnnn' is the MacID in decimal notation between '000000' and '000063'. Note that this item is shared with CANopen, and therefore the value may lie outside the allowable range – in such circumstances the DeviceNet protocol will not be initialized.
Set MacID	=J0/<16>=<nnnnnn><CR>	*J0/<16>=<nnnnnn><CR>	Set DeviceNet MacID where 'nnnnnn' is the new MacID in decimal notation and of between 1 and 6 characters (leading zeroes are not required). Requests to set values outside the range 0 through 127 are ignored. Note that this item is shared with CANopen – if the value is set outside of the range 0 through 63, the DeviceNet protocol will not be initialized.
Read CAN Baud Rate	J0/<10><CR>	*J0/<10>=<nnnnnn><CR>	Read the CAN baud rate code, where 'nnnnnn' is the baud rate code in decimal notation between '000000' and '000002'. 0=125k, 1=250k, 2=500k.
Set CAN Baud Rate	=J0/<10>=<nnnnnn><CR>	*J0/<10>=<nnnnnn><CR>	Set CAN baud rate where 'nnnnnn' is the new baud rate in decimal notation and of between 1 and 6 characters (leading zeroes are not required). Requests to set values outside the range 0 through 2 are ignored.

When changing values it is necessary to allow the gauge a few seconds to store the new settings to EEPROM. After approximately 5 seconds the gauge must be restarted for the new settings to take effect.

Data Format and Units

All data is received and transmitted in DeviceNet network byte order – 'little endian'. Multi-byte values are ordered with the least significant byte first.

Data is produced and consumed in a variety of formats and units. The actual representation chosen for each value is based on a knowledge of the likely range of the value, keeping the interface consistent regardless of gauge measurement capabilities, and likely future enhancements to gauges.

Thus, for example, diameters are transmitted as floating point values representing metres or inches, regardless of the gauge size. Any DeviceNet master is then free to display the values in metres, millimetres, microns, inches, mills, etc. as it chooses.

In other cases a floating-point representation is used even though an integer may seem appropriate. Linespeed, for example, is sent to the gauge in metres/minute or feet/minute as a floating point number, even though this is used internally as a 16-bit integer between 0 and 65535 m/min or ft/min. The use of a floating point value keeps the interface consistent should gauges or software be extended for use with very slow speed lines where use of an integer value reduces accuracy (e.g. 1.25m/min).

Wherever possible values and parameters are specified in standard units:

Measurement Type	Metric	Imperial
Voltage	volts	volts
Current	amps	amps
Percent	percent	percent
Rotational speed	revs/minute	revs/minute
Frequency	Hz	Hz
Tension	Newtons	Newtons
Diameter	metres	inches
Eccentricity (linear)	metres	inches
Capacitance	pF/meter	pF/foot
Linear speed	metres/minute	feet/minute
Temperature	degrees Centigrade	degrees Fahrenheit

Identity Object (DeviceNet Class = 1)

The Beta LaserMike implementation supports the standard identity object class/instance attributes and services required for the pre-defined master/slave connection set.

The following identity object instance attributes are supported:

Identity Object Instance Attributes (instance = 1)	
Attribute	Description
1 VENDOR_ID 16-bit UINT read-only	The vendor Id. This is currently set to 732.
2 DEVICE_TYPE 16-bit UINT read-only	Always returns 0x0000 to indicate a generic device type (no standard profile is applicable).
3 PRODUCT_CODE 16-bit UINT read-only	The vendor specific product code: 0x0000 generic/invalid 0x0001 AccuScan 5000/3000/1000 gauge 0x0002 CapScan 2000
4 REVISION USINT:USINT read-only	The implementation revision. The 'major' revision is the first 8-bit byte, and the 'minor' revision is second 8-bit byte (as a 16-bit number the revision is in big-endian format, which is contrary to all other DeviceNet values). The major revision number will be changed whenever there is a significant change to the 'fit, form, or function' of the product. Only values 1 through 127 are allowed. The minor revision number will be changed for bug-fixes, minor functional changes, build differences, etc. Only values 1 through 255 are allowed.
5 STATUS 16-bit WORD read-only	Currently only bit 0 is defined. Bit 0 is set to 1 when the gauge is assigned to a master (part of the pre-defined master/slave connection set has been allocated).
6 SERIAL_NUM 32-bit UDINT read-only	The Beta LaserMike assigned gauge serial number. Serial numbers should be unique across all products produced by Beta LaserMike.
7 PRODUCT_NAME short string read-only	The descriptive product name.

In addition to the 'get attribute' service, the identity object also supports the 'reset' service. The 'reset' service only resets the DeviceNet protocol stack within the gauge, and does not affect the gauge's measurement functions.

DeviceNet Object (DeviceNet Class = 3)

The Beta LaserMike implementation supports the standard DeviceNet object class/instance attributes and services required for the pre-defined master/slave connection set.

The following DeviceNet object instance attributes are supported:

DeviceNet Object Instance Attributes (instance = 1)	
Attribute	Description
1 MACID 8-bit USINT read/write	The MacID used by the device, between 0 and 63 inclusive. Writing to this value causes the gauge to store the new MacID and then reset the DeviceNet stack using the new value (behaviour defined in the DeviceNet specification). There is no guarantee that the gauge will be able to resume communication using the new MacID (it may be in use by another gauge or device).
2 BAUD_RATE 8-bit USINT read/write	The CAN baud rate code. 0=125k, 1=250k, 2=500k. As defined by the DeviceNet specification, changing this value has no immediate effect. To make the new baud rate take effect the gauge must be physically reset (after allowing a few seconds for the value to be stored to non-volatile memory), the 'MACID' must be updated, or the 'reset' service issued to the identity object.
3 BUS_OFF_INTERRUPT 8-bit BOOL read/write	Set this value to 0 to hold the gauge CAN controller in reset when a bus-off interrupt occurs. Set this value to 1 to cause the gauge to reset and restart DeviceNet communication when a bus-off interrupt occurs.
4 BUS_OFF_COUNTER 8-bit USINT read/write	Reading this attribute returns the number of bus-off events detected by the device since it was powered up. The counter never increments beyond 255. If the 'BUS_OFF_INTERRUPT' attribute is set to 0, then this value will only increment to 1, but since the device's CAN controller will be held in reset, it will not be possible to read the new value. Writing any value to this attribute causes the attribute to be reset to 0.
5 ALLOC_INFO 8-bit BYTE **and** 8-bit USINT read-only	Returns the pre-defined master/slave connection set allocation bits and currently assigned master as detailed in the DeviceNet specification.

Assembly Object (DeviceNet Class = 4)

1. Assembly object production (input) data
Input data is produced by the gauge. It is supplied to the DeviceNet master over one or more IO connections and/or using the explicit message connection 'get attribute' service.

All input data is produced from DeviceNet assembly object instances. The length and meaning of the input data depends on the gauge and connection types. With the DeviceNet pre-defined master/slave connection set the gauge is able to simultaneously produce data from the polled, bit-strobe, and COS/Cyclic connections. Although it is possible to produce data from different assembly object instances for the polled and COS/Cyclic connections, no sensible benefit could be derived from such an arrangement for the current gauge types. Production for bit-strobe connections is usually from a different assembly object instance as bit strobe connections are restricted to producing up to 8-bytes of input data.

Currently each connection type is associated with a fixed assembly object instance:

Connection Type	Assembly Object Instance	Produced Connection Path
Polled IO	1	0x20,0x04,0x24,0x01,0x30,0x03
Bit-Strobe IO	2	0x20,0x04,0x24,**0x02**,0x30,0x03
COS/Cyclic IO	1	0x20,0x04,0x24,**0x01**,0x30,0x03

The 'produced connection path' attribute describes the connection as producing data from the assembly object, the relevant instance, and the assembly object 'data' attribute.

Please note that at the current time the produced connection path is fixed. However, future implementations may provide further assembly objects (e.g. instances 3, 4, 5, 6, etc) that provide additional data, or data in alternate formats. These assembly objects could be dynamically selected, and therefore developers of master applications should consider checking the instance number within the produced connection path attribute to ensure that the data they are receiving is from the expected assembly object.

The DeviceNet master may obtain input data over the explicit message connection by using the 'get attribute' service specifying the assembly object class ID (0x04), the relevant instance number, and the 'data' attribute number (0x03). It is therefore possible to implement a master application that does not require the use of IO connection types.

The assembly objects available for each gauge type are described in more detail in subsequent sections.

2. Assembly object consumption (output) data

The output data is consumed by the gauge. It is produced by the DeviceNet master, and is supplied to the gauge over the polled connection or using the explicit message connection 'set attribute' service.

Note that if the master instantiates a COS/Cyclic connection that, as per the DeviceNet specification, the master's output data is actually transmitted over the polled connection, but with a different production trigger mechanism. This is perhaps a detail with which most programmers need not be concerned, but it highlights the point that the gauge can only sensibly use the same assembly object instance for consuming the master's polled or COS/Cyclic output data.

All output data is consumed by DeviceNet assembly object instances. The length and meaning of the output data depends on the gauge and connection types. Currently each connection type is associated with a fixed assembly object instance:

Connection type	Assembly object instance	Consumed connection path
Polled or COS/Cyclic IO	1	0x20,0x04,0x24,0x01,0x30,0x03
Bit-Strobe IO	2	0x20,0x04,0x24,**0x02**,0x30,0x03

The 'consumed connection path' attribute describes the connection as consuming data to the assembly object, the relevant instance, and the assembly object 'data' attribute.

Please note that at the current time the produced connection path is fixed. However, future implementations may provide further assembly objects (e.g. instances 3, 4, 5, 6, etc) that consume additional data, or data in alternate formats. These assembly objects could be dynamically selected, and therefore developers of master applications should consider checking the instance number within the consumed connection path attribute to ensure that they are sending data to the gauge in the format expected by the consuming assembly object.

The DeviceNet master may supply output data over the explicit message connection by using the 'set attribute' service specifying the assembly object class ID (0x04), the relevant instance number, and the 'data' attribute number (0x03). It is therefore possible to implement a master application that does not require the use of IO connection types. However, it should be noted that if the master is also using polled or COS/Cyclic connections that providing simultaneous output data through an IO connection and explicit message connection could cause repeated artificial triggering of the transition sensitive bits in the Output Control Word (see later sections).

The assembly objects available for each gauge type are described in more detail in subsequent sections.

Connection Object (DeviceNet Class = 5)

The Beta LaserMike gauges fully implement the DeviceNet 'group 2 only, pre-defined master/slave connection set'.

Each gauge fully supports **concurrent** explicit message, polled IO, bit-strobe IO, and Change-Of-State (COS) / Cyclic connections.

COS/Cyclic connections may be acknowledged or unacknowledged, and all the associated production/consumption paths, path lengths, production triggers, and initial communication characteristics are configured appropriately as per the pre-defined master/slave connection set instantiation rules.

Please note the following points regarding the DeviceNet pre-defined master/slave connection set specification:

- COS/Cyclic connections are mutually exclusive (they are the same connection but with a different production trigger mechanism).
- The master can only produce output data over the polled connection, but may do so using the polled, change-of-state, or cyclic mechanisms according to how the connection was instantiated.
- When the polled connection and the COS/Cyclic connection are instantiated at the same time, or the polled connection is instantiated followed by the COS/Cyclic connection, then the master supplies output data to the gauge using the polled connection, and the gauge provides input data to the master using both the polled connection **and** the COS/Cyclic connection. This is behaviour defined in the DeviceNet specification.
- The bit-strobe connection provides 1 bit of output data from the master to each slave. The Beta LaserMike gauges make no use of this bit, but will respond with appropriate bit-strobe input data (each response is limited to 8-bytes, as per the DeviceNet specification).

Normally the master control computer's DeviceNet drivers/library will take care of establishing connections according to parameters supplied. See the DeviceNet specification for exact details regarding attributes of the connection class and connection instances. However, it is worth mentioning here that the Beta LaserMike DeviceNet implementation fully supports the following connection instance attributes (where appropriate to the connection type):

1. Expected packet rates: to a 10ms resolution.
2. ACK retry limit – for acknowledged COS/Cyclic connections.
3. ACK timeout: for acknowledged COS/Cyclic connections, to a 10ms resolution.
4. Production inhibit time: for COS connections, to a 10ms resolution.
5. Watchdog timeout action: including: time out (IO only), auto-delete, auto-reset (IO only), and deferred delete (explicit message only).

Parameter Object (DeviceNet Class = 15)

The Beta LaserMike implementation supports the standard DeviceNet 'parameter' class.

When setting the non-volatile 'value' attribute for parameter instances, the new values are effective immediately, but please allow a few seconds for the value to be placed in non-volatile storage before turning off the gauge.

The actual parameters supported by each gauge type are described in later sections.

The following table describes the attributes supported at the class level of the parameter object:

Parameter Class Attributes (instance = 0)	
Attribute	Description
2 MAX_INSTANCE 16-bit UINT read only	Returns the maximum instance number of parameter object supported by the gauge. Because instance numbers are 1-based, this can also be thought of as the number of supported parameters.
8 CLASS_DESCRIPTOR 16-bit UINT read only	Describes the way in which parameters are handled by the gauge. Currently this always returns a fixed class descriptor value of 0x000B, that describes: Support is provided for parameter instances. Support is provided for full parameter instance attributes. There is no requirement for the master to issue a save command. Parameters are stored in non-volatile storage.
9 CONFIG_ASMBLY_INSTANCE 16-bit UINT read only	Returns 0 to indicate that there is no associated assembly object instance that can accept configuration data.

The following table describes the attributes supported at the instance level of the parameter object:

Parameter Class Attributes (instance = n)	
Attribute	Description
1 VALUE size/type/permissions depends on parameter instance	The parameter value. The size and type of the parameter can be determined by reading the 'DATA TYPE' and/or 'DATA SIZE' attribute of the same parameter object instance. The value may be read/write or read-only, depending on the 'read-only' bit on the instance's 'DESCRIPTOR' attribute. Attempts to write to a read-only parameter value, to set an invalid parameter value, or that do not supply sufficient data according to the data type will fail with an appropriate DeviceNet error code.
2 LINK_PATH_SIZE 8-bit USINT read only	Always returns 0 to indicate that there is no link path.
3 LINK_PATH array of 8-bit USINT read only	Always returns an empty array to indicate that there is no link path.
4 DESCRIPTOR 16-bit UINT read only	Only two bits are of interest: bit 4 (0x0010) If set parameter value is read-only. bit 5 (0x0020) If set parameter is a 'monitor' parameter (i.e. its value constantly changes to reflect a gauge measurement).

5 DATA_TYPE 8-bit USINT read only	Returns the parameter object data-type code as defined in the DeviceNet specification. Supported parameter object data type codes are: 1 WORD (16-bit bit-string) 2 UINT (16-bit unsigned integer) 3 INT (16-bit signed integer) 4 BOOL (8-bits with value in bit 0) 5 SINT (8-bit signed short integer) 6 DINT (32-bit signed integer) 8 USINT (8-bit unsigned integer) 9 UDINT (32-bit unsigned integer) 11 REAL (32-bit floating point format IEEE 754) 24 BYTE (8-bit bit-string) 25 DWORD (32-bit bit-string). The above data-type mnemonics are those defined by DeviceNet – do not confuse these with similar mnemonics used by Microsoft and other compiler vendors for Windows programming.
6 DATA_SIZE 8-bit USINT read only	Returns the parameter value size in bytes. The gauge only ever returns sizes of 1, 2, or 4 bytes.
7 NAME_STRING short string read only	Describes the parameter instance. The ‘short string’ is a DeviceNet standard that specifies an 8-bit length followed by the corresponding number of characters. No null terminator is provided. The NAME_STRING is a maximum of 16 characters (not including the length byte). Example name strings provided are "SamplesToAverage", "BarePtchThrshld", “Units”, etc. These try to best describe the parameter instance while keeping within the DeviceNet imposed 16-character limit.
8 UNITS_STRING short string read only	A short string, as described for ‘NAME_STRING’, but with a limit of 4 characters. Example units strings are: “” (empty – when no units are applicable), “m”, “inch”, “ohms”, “V”, “A”, etc, and try to best describe the parameter units while keeping within the DeviceNet imposed 4-character limit.
9 HELP_STRING short string read only	A short string, as described for ‘NAME_STRING’, but with a limit of 64 characters. The Beta LaserMike implementation always returns a short-string of length zero.
10 MIN_VALUE size/type depends on parameter instance read-only	The minimum value of the parameter’s ‘value’ attribute.
11 MAX_VALUE size/type depends on parameter instance read-only	The maximum value of the parameter’s ‘value’ attribute.
12 - DFLT_VALUE 13 – SCALING_MULTIPLIER 14 – SCALING_DIVISOR 15 – SCALING_BASE 16 - SCALING_OFFSET 17 – MULTIPLIER_LINK 18 – DIVISOR_LINK 19 – BASE_LINK 20 – OFFSET_LINE	**These attributes are not supported and will return an ‘attribute not supported’ error.**
21 DECIMAL_PRECISION 8-bit USINT read-only	Returns the number of decimal places to which the parameter’s ‘value’ attribute should be shown. Most parameter instances will return 0 to indicate that no decimal places are appropriate (e.g. ‘Units’, ‘Samples To Average’, etc). However, certain parameters will return non-zero values for floating point parameters e.g. a parameter measuring diameter may return a value of -7 (metric) or -5 (imperial) indicating that the parameter is measured to a precision of $1x10^{-7}$ or $1x10^{-5}$ inch respectively.

FFT Object (DeviceNet Class = 100)

To simplify control of the FFT process, and to facilitate retrieval of FFT results in the format required by different DeviceNet master applications, a separate FFT object exists.

To simplify the DeviceNet interface, FFT calculations are started by a zero to one transition on the 'Start FFT' bit in the master's 'Output Control Word' (bit 14 of output word 0 / bit 6 of output byte 1). The FFT completion status is indicated by the 'FFT Complete' bit in the gauge's 'Gauge State' flags (bit 13 of input word 0 / bit 5 of input byte 1).

Apart from 'FFT Start' and 'FFT Complete', all other aspects of the FFT process are controlled through instance attributes of the FFT object.

FFT Object Attributes (instance = 1)	
Attribute	Description
1 FFT_SIZE_IDX 8-bit USINT non-volatile read/write	Code representing the number of FFT points (FFT size): 0 = 256, 1 = 512, 2 = 1024, 3 = 2048, 4 = 4096
2 FFT_FREQ_IDX 8-bit USINT non-volatile read/write	Code representing the FFT sampling frequency: 0 = 0.6Hz, 1 = 1.2Hz, 2 = 3Hz, 3 = 6Hz, 4 = 12Hz, 5 = 30Hz, 6 = 60Hz, 7 = 120Hz, 8 = 300Hz, 9 = 600Hz, 10 = 1.2kHz.
3 FFT_RESOLUTION_IDX 8-bit USINT non-volatile read/write	Code representing amplitude resolution. This affects the quality of the FFT calculation, and the scaling of results obtained using integer access methods. Only use the x10 setting if this will not cause over-flow within the FFT calculations (depends on product being measured). Diameter: 0 = 0.01μm or 0.001 mills 1 = 0.1μm or 0.01mills
4 FFT_MEMBER_IDX 16-bit UINT volatile read/write	Should a DeviceNet master application not have access to the 'get member' services, then this 16-bit attribute is used to determine the starting member for 'get attribute' service requests directed to array based attributes. This value is not range checked when written. Invalid values will cause a subsequent 'get attribute' request for an array based attribute to fail with a 'bad parameter' error code. Member indices are from 1 to half the FFT size (2048 max). **Member index 0 is not valid.**
5 FFT_MEMBER_COUNT 8-bit USINT volatile read/write	Should a DeviceNet master application not have access to the 'get member' services, then this 8-bit attribute is used to determine the number of members to return for 'get attribute' service requests directed to array based attributes. This value is not range checked when written. Invalid values will cause a subsequent 'get attribute' request for an array based attribute to fail with a 'bad parameter' error code.
6 FFT_SCALING_FACTOR 16-bit UINT non-volatile read/write	Scaling factor applied to FFT results. 1 through 1000, default 118
7 FFT_DETRENDING 8-bit USINT non-volatile read/write	Selection of FFT de-trending algorithm. 0 = de-trending off, 1= de-trending on

10 FFT_SPIKE_REAL array of REAL:REAL volatile read-only	The array of sorted peak FFT spikes. Use the 'get member' service to read a single result or 'get member extended' service to read multiple consecutive results. If these member services are unavailable and cannot be encoded within a generalized explicit message function, then use the FFT_MEMBER_IDX and FFT_MEMBER_COUNT attributes in association with a 'get attribute' request. Member range: 1...20 Each member is returned as two **reals** (2 * 4 bytes per member) with the following byte offsets (0 = lowest memory address): 0 LSB of spike frequency 1 2 3 MSB of spike frequency 4 LSB of spike amplitude 5 6 7 MSB of spike amplitude The spike frequency is returned in Hz. The amplitude is returned in the standard gauge units of metres or inches as appropriate. Spike results will only be returned up to the end of the spike array (e.g. a request to read 4 spike results starting at index 19 will only return 2 spike results).
11 FFT_SPIKE_UINT Array of UINT:UINT volatile read-only	Exactly the same as FFT_SPIKE_REAL, except each member is returned as two **unsigned 16-bit integers** (2 * 2 bytes per member) with the following byte offsets (0 = lowest memory address): 0 LSB of spike frequency 1 MSB of spike frequency 2 LSB of spike amplitude 3 MSB of spike amplitude The unsigned 16-bit frequencies are in the range 0 through 65535 representing 0.00Hz to 655.35Hz. Because of encoding restrictions, there is a lack of precision in the representation of frequencies for FFTs performed with slow sample rates and/or large FFT sizes. Use FFT_SPIKE_REAL in preference. The unsigned 16-bit amplitudes are returned in μm or mills as appropriate, the number of decimal places being determined by the value of FFT_RESOLUTION_IDX when the FFT calculation was started.
12 FFT_AVG_SPIKE_REAL 32-bit REAL volatile read-only	The average amplitude of the 20 values in the spike array. This value is returned as a **real** (4 bytes) in the same units as FFT_SPIKE_REAL.
13 FFT_AVG_SPIKE_UINT 16-bit UINT volatile read-only	The average amplitude of the 20 values in the spike array. This value is returned as an **unsigned 16-bit integer** (2 bytes) using the same encoding as the amplitudes returned for FFT_SPIKE_UINT.
20 FFT_DISCRETE_REAL Array of REAL volatile nread-only	The array of FFT amplitude results. Use the 'get member' service to read a single result or 'get member extended' service to read multiple consecutive results. If these member services are unavailable and cannot be encoded within a generalized explicit message function, then use the FFT_MEMBER_IDX and FFT_MEMBER_COUNT attributes in association with a 'get attribute' request. Member range: 1...half the FFT size (2048 max) Each member is returned as an **real** (4 bytes per member) with the following byte offsets (0 = lowest memory address): 0 LSB of amplitude 1 2 3 MSB of amplitude The amplitude is returned in the standard gauge units of metres, inches as appropriate. Discrete results will only be returned up to the end of the valid discrete FFT results array (half the FFT size). For example, a request to read 64 discrete values starting at index 250 will only return 7 results if the FFT size was 512 points.

21 FFT_DISCRETE_UINT Array of UINT volatile read-only	Exactly the same as FFT_DISCRETE_UINT, except each member is returned as an **unsigned integer** (2 bytes per member) with the following byte offsets (0 = lowest memory address): 0 LSB of amplitude 1 MSB of amplitude The unsigned 16-bit amplitudes are returned in μm, mills as appropriate, the number of decimal places being determined by the value of FFT_RESOLUTION_IDX when the FFT calculation was started.
22 FFT_DISCRETE_FREQ_REAL Array of REAL volatile read-only	A virtual array of frequencies, one for each of the discrete FFT results points. The **real** values are returned in Hz, and no decoding by the master is necessary. The virtual array of frequencies is provided as an FFT attribute for convenience, and is accessed using the same member indices and services as the FFT_DISCRETE_REAL and FFT_DISCRETE_UINT attributes. The master control computer can easily calculate these frequencies. For example, with an FFT sampling frequency of 0.6Hz, and when using 4096 FFT points, the interval frequency for each of the discrete FFT points is 0.6 / 4096 = 0.146e-3 Hz approximately. Note that there are only half as many results for an FFT calculation as there are FFT points. Results, etc are obtained over DeviceNet using member indices 1 through 2048 (for DeviceNet protocol reasons), but are easier to use in calculations as zero based indices 0 through 2047. Thus, for example, the frequency of the result with a member index 'm' for a 4096 sized FFT for which the data was collected at 0.6Hz is ((m – 1) * 0.6) / 4096. Note that member index 1 always returns 0.0, and member index 2 returns the frequency interval between discrete FFT results points.
23 FFT_DISCRETE_FREQ_UINT Array of UINT volatile read-only	Exactly as FFT_DISCRETE_FREQ_UINT, except the frequencies are returned as **unsigned integers** encoded as Hz * 100 (two inferred decimal places).

Attempting to access a member at index 0 for any of the FFT arrays will return an 'invalid parameter error'. DeviceNet reserves member index 0 for an alternative use not supported by the Beta LaserMike gauges.

A read request for zero members will return an 'invalid parameter' error.

A read request for which the starting index is beyond the end of the spike array or beyond the end of the discrete arrays will return an ''invalid parameter' error.

Attempting to read from the discrete arrays before an FFT has been performed will return an 'invalid parameter' error. It is possible to begin reading the FFT data as soon as the first FFT has started, but the returned data will be meaningless; wait for the 'FFT complete' bit to transition from a 0 to a 1 before beginning collection of FFT results. It is possible to read spike information before an FFT has been performed, but the returned data will be all zero.

A master application should use the 'get member extended' service (or 'get attribute' in association with the FFT_MEMBER_IDX and FFT_MEMBER_COUNT attributes), according to the maximum number of bytes that can be accepted by the master in an explicit message response. Remember to account for any explicit message header and 'get member extended' protocol response bytes when calculating the maximum number of

values that may be requested. The gauge will respond with a maximum of 64 FFT results for a single request, no matter what format they are requested in.

When determining how many values to obtain in a single request, the system designer should take the master's response buffer size and CAN bus priorities and bandwidth into account. Requesting large blocks of data from the gauge may prevent devices with higher MacID's from transmitting IO data. Because each explicit message fragment must be acknowledged by the master, the gauge cannot transmit blocked FFT results in a back-to-back manner and therefore the impact on other DeviceNet servers may not be as significant as might otherwise be expected. Internally, the AccuScan 4000/5000 gauge assigns higher priority to IO data production than to explicit message production and therefore any solicited or Cyclic / Change-Of-State IO messages will be transmitted in-between the explicit message fragments forming the blocked FFT results.

Note that a request to start an FFT (using the 'Output Control Word') may appear to fail if there is no product within the measuring gate of the gauge. This is normal gauge behaviour and not a function of the DeviceNet protocol implementation.

Database Object (DeviceNet Class = 101)

Should the available DeviceNet parameters be insufficient for a particular task, it is possible to access the entire gauge database using this object.

Manufacturer specific DeviceNet service codes are used to provide the required functionality. This enables the accesses to be as efficiently as possible.

There are three instances of the database. Each instance is used to access the same underlying functionality, but the metric/imperial units of communication are determined by the instance number:

Database Object (DeviceNet Class = 101)	
Object Instance	Description
1	Use instance 1 for metric database access units
2	Use instance 2 for imperial database access units
3	Use instance 3 if the database access units are to be the same units as those currently used for DeviceNet IO data etc. These 'fieldbus master units' may be controlled using the relevant DeviceNet parameter, or through this database object. The value of 'fieldbus master units' affects other DeviceNet communication (e.g. DeviceNet IO data and DeviceNet FFT data) as well as this object.

For each instance of the database there are a number of DeviceNet explicit messaging services defined:

Database Object (DeviceNet Class = 101)	
Service Code	Description
70	**Enumerate database item(s)** The Master's service code data is two words (4 bytes) Word 0 : The maximum number of items in the response Word 1 : The starting database ID for enumeration The gauge's enumeration response is a multiple of two words: Word 0 : The next highest implemented database item ID Word 1 : The enumeration flags for this item Thus a request to enumerate up to 20 items will return from 1 to 20 items, (4 to 80 bytes) in ascending numerical ID order, depending on how many database items were available with an ID greater than or equal to the starting database ID in the request. If the requested number of items has not been satisfied, but there are no more database items, then the response data is 'terminated' with a final item having an ID of 0xFFFF. The following enumeration flags are defined (bitwise OR): 0x0001 Database item can be read 0x0002 Database item can be written 0x0004 Database item is non-volatile 0x0008 Database item is a floating point value Note that if an item is marked as floating point, then it is assumed that all database accesses to that item are in IEEE floating point format.

71	**Get min/max range for database item(s)** The Master's service code data is a number of words (2-bytes per word), where each word defines a database item ID for which the minimum and maximum values are required. The gauge's response is 8-bytes per item as: 32-bit minimum value, integer or floating point as appropriate 32-bit maximum value, integer or floating point as appropriate It is possible to request a mix of integer and floating point types in a single access. To be able to interpret each item's response data, a master must have an implicit knowledge of each item's data type, or have previously enumerated the items to determine their data types.
72	Read database item(s) The Master's service code data is a number of words (2-bytes per word), where each word defines a database item ID for which the item's value is required. The gauge's response is 4-bytes per item as: 32-bit value, integer or floating point as appropriate It is possible to request a mix of integer and floating point types in a single access. To be able to interpret each item's value, a master must have an implicit knowledge of each item's data type, or have previously enumerated the items to determine their data types.
73	Write database item(s) The Master's service code data is 6-bytes per item to be written: 16-bit database item ID 32-bit value, integer or floating point as appropriate The gauge's response is 4-bytes per item as: 32-bit value, integer or floating point as appropriate Where the response value is the value of the database item after performing the write request. It is possible to request a mix of integer and floating point types in a single access. To be able to interpret each item's value, a master must have an implicit knowledge of each item's data type, or have previously enumerated the items to determine their data types.

NB: For each service code, the operation will fail if the Master requests responses for too many items, or if the Master writes to too many items, or if the master supplies an amount of service code data that does not form a precisely valid request.

DeviceNet Communication Specific to AS4000/5000

Assembly Object Instance 1 Consumption Data

Assembly object instance 1 is normally associated with the polled and/or COS/Cyclic IO connections. The following table describes the bytes consumed by the assembly object:

	Assembly Object Instance 1 Consumption Data							
	7	6	5	4	3	2	1	0
Byte 0	OCW7 EN	OCW6 EL	OCW5 ET	OCW4 ZT	OCW3 Threading	OCW2 ZF	OCW1 ZN	OCW0 ZL
Byte 1	OCW15	OCW14 Start FFT	OCW13	OCW12	OCW11	OCW10	OCW9 ZO	OCW8 EO
Byte 2	Linespeed LSB (bits 7...0 of REAL) metres/minute or feet/minute							
Byte 3	Linespeed (bits 15...8 of REAL)							
Byte 4	Linespeed (bits 23...16 of REAL)							
Byte 5	Linespeed MSB (bits 31...24 of REAL)							

Total size = 6 bytes.

The 'Output Control Word' bits currently defined for diameter gauges are:

OCW0	ZL	Scanning Flaw mode only. A 0 to 1 transition of this bit zeros lump counts and lump alarms.
OCW1	ZN	Scanning Flaw mode only. A 0 to 1 transition of this bit zeros neck counts and neck alarms.
OCW2	ZF	Scanning Flaw mode only. A 0 to 1 transition of this bit zeros lump and neck fault counts.
OCW3	Threading	If this bit is set the gauge will convert gauge status codes to code 0, thereby suppressing non-fatal errors during line threading. Status codes for 'gauge over-temperature' and 'gauge fault' are not affected.
OCW4	ZT	Scanning Flaw mode only. A 0 to 1 transition of this bit zeros diameter tolerance alarms.
OCW5	ET	Scanning Flaw mode only. Diameter tolerance alarms are enabled if this bit is set.
OCW6	EL	Scanning Flaw mode only. Lump alarms are enabled if this bit is set.
OCW7	EN	Scanning Flaw mode only. Neck alarms are enabled if this bit is set.
OCW8	EO	Scanning Flaw mode only. Ovality over tolerance alarms are enabled if this bit is set.
OCW9	ZO	Scanning Flaw mode only. A 0 to 1 transition of this bit zeros Ovality tolerance alarms.
OCW14	Start FFT	FFT mode only. A 0 to 1 transition on this bit triggers the start of an FFT calculation. Steady state values or a 1 to 0 transition are ignored. A master control computer application should probably monitor the returned 'FFT Complete' bit in the gauge state bits to determine when the 'Start FFT' transition has been recognized by the gauge.

All other OCW bits are reserved for future use and should be set to zero to ensure future compatibility.

The Linespeed information is optional. Although a connection's consumption path size will be set to 6 bytes, the master may produce only the first two bytes if the linespeed is not required by the gauge (some masters may not allow this). If the linespeed value is supplied, but all bits of the linespeed value are set to 1 (i.e. if each byte is 0xFF), then the gauge will ignore the linespeed value.

Assembly object instance 1 production data for STD and FFT modes

Assembly object instance 1 is normally associated with the polled and/or COS/Cyclic IO connections. The following table describes the bytes produced by the assembly object when the gauge is operating in STD or FFT mode:

	Assembly Object Instance 1 Production Data (STD and FFT mode)							
	7	6	5	4	3	2	1	0
Byte 0	Status (bits 7...0 of USINT) see below							
Byte 1	ST7 0	ST6 0	ST5 FFT	ST4 0	ST3 0	ST2 0	ST1 XY	ST0 0
Byte 2	X diameter LSB (bits 7...0 of REAL) metres or inches							
Byte 3	X diameter (bits 15...8 of REAL)							
Byte 4	X diameter (bits 23...16 of REAL)							
Byte 5	X diameter MSB (bits 31...24 of REAL)							
Byte 6	Y diameter LSB (bits 7...0 of REAL) metres or inches							
Byte 7	Y diameter (bits 15...8 of REAL)							
Byte 8	Y diameter (bits 23...16 of REAL)							
Byte 9	Y diameter MSB (bits 31...24 of REAL)							
Byte 10	**X gate position**(bits 7...0 of SINT) -99 to +99 (percent)							
Byte 11	**Y gate position**(bits 7...0 of SINT) -99 to +99 (percent)							

Total size = 12 bytes.

The following ‘state’ bits are currently defined:

ST1 XY Bit set if gauge is dual plane, bit reset if gauge is single plane.

ST5 FFT FFT mode only.
Bit set if the FFT algorithm is complete. The FFT complete bit will transition to 0 when an FFT is started and transition back to a 1 when the FFT is complete. The gauge sets this bit to 1 after power-up, thereby simplifying the detection of the first FFT start event. Attempting to collect FFT data before the first FFT has been started will return an error.

For a list of status codes see Non-continuous transmission – ASCII code J
Status codes may be suppressed by setting the ‘threading’ bit in the output data.

Assembly object instance 1 production data for Scanning Flaw mode

Assembly object instance 1 is normally associated with the polled and/or COS/Cyclic IO connections. The following table describes the bytes produced by the assembly object when the gauge is operating in Scanning Flaw mode:

	Assembly Object Instance 1 Production Data (Scanning Flaw mode)							
	7	6	5	4	3	2	1	0
Byte 0	**Status** (bits 7...0 of USINT) see below							
Byte 1	ST7 **V1**	ST6 **V0**	ST5 **NA**	ST4 **LA**	ST3 **UA**	ST2 **OA**	ST1 **XY**	ST0 **OVA**
Byte 2	**X diameter** LSB (bits 7...0 of REAL) metres or inches							
Byte 3	X diameter (bits 15...8 of REAL)							
Byte 4	X diameter (bits 23...16 of REAL)							
Byte 5	X diameter MSB (bits 31...24 of REAL)							
Byte 6	**Y diameter** LSB (bits 7...0 of REAL) metres or inches							
Byte 7	Y diameter (bits 15...8 of REAL)							
Byte 8	Y diameter (bits 23...16 of REAL)							
Byte 9	Y diameter MSB (bits 31...24 of REAL)							
Byte 10	**X gate position**(bits 7...0 of SINT) -99 to +99 (percent)							
Byte 11	**Y gate position**(bits 7...0 of SINT) -99 to +99 (percent)							
Byte 12	**Lump fault count** LSB (bits 7..0 of UINT)							
Byte 13	Lump fault count MSB (bits 15..8 of UINT)							
Byte 14	**Neck fault count** LSB (bits 7..0 of UINT)							
Byte 15	Neck fault count MSB (bits 15..8 of UINT)							

Total size = 16 bytes.

The following ‘state’ bits are currently defined:

ST0	OVA	Ovality tolerance Alarm. Latched: cleared by 0 to 1 transition of ZO.
ST1	XY	Bit set if gauge is dual plane, bit reset if gauge is single plane.
ST2	OA	Over tolerance Alarm. Latched: cleared by 0 to 1 transition of ZT.
ST3	UA	Under tolerance Alarm. Latched: cleared by 0 to 1 transition of ZT.
ST4	LA	Lump fault Alarm. Latched: cleared by 0 to 1 transition of ZL.
ST5	NA	Neck fault Alarm. Latched: cleared by 0 to 1 transition of ZN.
ST7/ST6		Version A two-bit number representing the Scanning Flaw ‘Version’: 0 = none / invalid 1 = combined diameter and lump/neck tolerances 2 = separate diameter and lump/neck tolerances 3 = separate X/Y diameter and X/Y lump/neck tolerances (ribbon mode)

For a list of status codes see Non-continuous transmission – ASCII code J
Status codes may be suppressed by setting the ‘threading’ bit in the output data.

Assembly object instance 1 production data for STAC mode

Assembly object instance 1 is normally associated with the polled and/or COS/Cyclic IO connections. The following table describes the bytes produced by the assembly object when the gauge is operating in STAC mode:

	Assembly Object Instance 1 Production Data (STAC mode)							
	7	6	5	4	3	2	1	0
Byte 0	**Status** (bits 7...0 of USINT) see below							
Byte 1	ST7 0	ST6 0	ST5 0	ST4 0	ST3 0	ST2 0	ST1 **XY**	ST0 0
Byte 2	**X gate position** (bits 7...0 of SINT) -99 to +99 (percent)							
Byte 3	**Y gate position** (bits 7...0 of SINT) -99 to +99 (percent)							
Byte 4	**Max X diameter** LSB (bits 7...0 of REAL) metres or inches							
Byte 5	Max X diameter (bits 15...8 of REAL)							
Byte 6	Max X diameter (bits 23...16 of REAL)							
Byte 7	Max X diameter MSB (bits 31...24 of REAL)							
Byte 8	**Max Y diameter** LSB (bits 7...0 of REAL) metres or inches							
Byte 9	Max Y diameter (bits 15...8 of REAL)							
Byte 10	Max Y diameter (bits 23...16 of REAL)							
Byte 11	Max Y diameter MSB (bits 31...24 of REAL)							
Byte 12	**Min X diameter** LSB (bits 7...0 of REAL) metres or inches							
Byte 13	Min X diameter (bits 15...8 of REAL)							
Byte 14	Min X diameter (bits 23...16 of REAL)							
Byte 15	Min X diameter MSB (bits 31...24 of REAL)							
Byte 16	**Min Y diameter** LSB (bits 7...0 of REAL) metres or inches							
Byte 17	Min Y diameter (bits 15...8 of REAL)							
Byte 18	Min Y diameter (bits 23...16 of REAL)							
Byte 19	Min Y diameter MSB (bits 31...24 of REAL)							
Byte 20	**Mean X diameter** LSB (bits 7...0 of REAL) metres or inches							
Byte 21	Mean X diameter (bits 15...8 of REAL)							
Byte 22	Mean X diameter (bits 23...16 of REAL)							
Byte 23	Mean X diameter MSB (bits 31...24 of REAL)							
Byte 24	**Mean Y diameter** LSB (bits 7...0 of REAL) metres or inches							
Byte 25	Mean Y diameter (bits 15...8 of REAL)							
Byte 26	Mean Y diameter (bits 23...16 of REAL)							
Byte 27	Mean Y diameter MSB (bits 31...24 of REAL)							

Total size = 28 bytes.

The following ‘state’ bits are currently defined:

ST1 XY Bit set if gauge is dual plane, bit reset if gauge is single plane.

For a list of status codes see Non-continuous transmission – ASCII code J
Status codes may be suppressed by setting the ‘threading’ bit in the output data.

Assembly object instance 2 consumption data

Assembly object instance 2 is normally associated with the bit-strobe IO connection. There is only 1 bit of output data associated with this assembly instance, and that bit is currently ignored, but should be set to zero to ensure future compatibility.

Assembly object instance 2 production data

Assembly object instance 2 is normally associated with the bit-strobe IO connection. DeviceNet imposes a limit of 8-bytes on bit-strobe production data.

	Assembly Object Instance 2 Production Data							
	7	6	5	4	3	2	1	0
Byte 0	**X diameter** LSB (bits 7...0 of REAL) metres or inches							
Byte 1	X diameter (bits 15...8 of REAL)							
Byte 2	X diameter (bits 23...16 of REAL)							
Byte 3	X diameter MSB (bits 31...24 of REAL)							
Byte 4	**Y diameter** LSB (bits 7...0 of REAL) metres or inches							
Byte 5	Y diameter (bits 15...8 of REAL)							
Byte 6	Y diameter (bits 23...16 of REAL)							
Byte 7	Y diameter MSB (bits 31...24 of REAL)							

Total size = 8 bytes.

For STD, FFT, and Scanning Flaw modes, the X and Y diameters are the current X and Y diameters.

For the STAC mode, the X and Y diameters are the mean diameters from the STAC algorithm.

Parameter Object Instances

The following table describes the currently supported parameter object instances for AccuScan 4000/5000 gauges. The available parameters reflect those required for all gauge operating modes: it is possible to access parameters not relevant to the current operating mode, but they will only take effect after the gauge has been restarted in the relevant mode.

The size/type/attributes of these instances may all be obtained from the parameters' description attributes (as described in an earlier section), or the master control computer application can use information detailed below:

Diameter Gauge Parameter Object Instances				
Instance	Type	Size	Value Access	Description
1	USINT	1 byte	read/write	Units. 0=metric, 1=imperial This parameter value determines the units used for all production and consumption data, and for any other parameters that are sensitive to units selection.
2	UINT	2 bytes	read/write	Scans to average. 1 - 6000
3	SINT	1 byte	read only	X optics condition. 0 - 100
4	SINT	1 byte	read only	Y optics condition. 0 - 100
5	REAL	4 bytes	read/write	Preset diameter
6	REAL	4 bytes	read/write	Preset tolerance
7	UINT	2 bytes	read/write	Flaw processing mode 0 = none, 1 = Absolute, 2 = Relative
8	REAL	4 bytes	read/write	Flaw preset X diameter (flaw modes 1, 2, 3)
9	REAL	4 bytes	read/write	Flaw preset Y diameter (flaw mode 3)
10	REAL	4 bytes	read/write	Flaw over tolerance X (flaw modes 1, 2, 3)
11	REAL	4 bytes	read/write	Flaw over tolerance Y (flaw mode 3)
12	REAL	4 bytes	read/write	Flaw under tolerance X (flaw modes 1, 2, 3)
13	REAL	4 bytes	read/write	Flaw under tolerance Y (flaw modes 1, 2, 3)
14	REAL	4 bytes	read/write	Flaw lump threshold X (flaw modes 2, 3)
15	REAL	4 bytes	read/write	Flaw lump threshold Y (flaw mode 3)
16	REAL	4 bytes	read/write	Flaw neck threshold X (flaw modes 2, 3)
17	REAL	4 bytes	read/write	Flaw neck threshold Y (flaw mode 3)
18	UINT	2 bytes	read/write	STAC processing mode 0 = Disable 1 = MAXMIN. 2 = MEANMAXMIN. 3 = MAX. 4 = MIN.
19	UINT	2 bytes	read/write	STAC measurement time 0 … 160 (representing 0.1s to 16s)
20	UINT	2 bytes	read/write	STAC form factor 5000 … 20000 (representing 0.5000 to 2.0000)

Ethernet - IP Communication (option)

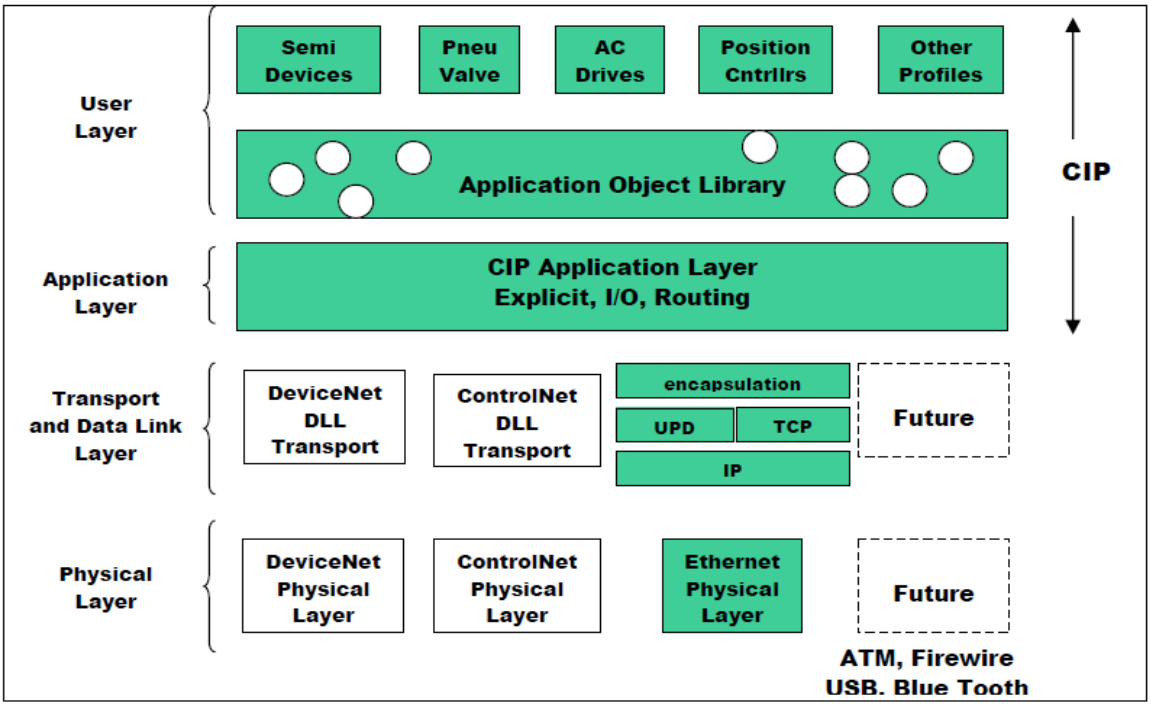
Note that the Software Option for Ethernet/IP must be ordered to enable Ethernet/IP functionality.

General Ethernet/IP information

Ethernet/IP is a high-level industrial application layer protocol for industrial automation applications. Built on the standard TCP/IP protocol suite, Ethernet/IP uses all the traditional Ethernet hardware and software to define an application layer protocol that structures the task of configuring, accessing and controlling industrial automation devices. Ethernet/IP classifies Ethernet nodes as predefined device types with specific behaviors. The set of device types and the Ethernet/IP application layer protocol is based on the Control and Information Protocol (CIP) layer used in both DeviceNet™ and Control Net.

The Communications and Information Protocol (CIP) is a communications protocol for transferring automation data between two devices. In the CIP Protocol, every network device represents itself as a series of objects. Each object is simply a grouping of the related data values in a device.

The following diagram illustrates the relationship between CIP, EtherNet/IP, and TCP/IP.



Configuring Ethernet/IP settings via RS232 serial port

Only five Ethernet/IP attributes are available via RS232 protocol: IP address, Subnet Mask, Default Gateway, DHCP and Units.

Function	Request	Gauge Response	Description
Read IP address	?J0/218 <CR>	*J0/218=nnn.nnn.nnn.nnn	Read the gauge Ethernet/IP IP address, where 'nnn.nnn.nnn.nnn' is the IP address in decimal notation.
Set IP address	=J0/218=nnn.nnn.nnn.nnn <CR>	*J0/218=nnn.nnn.nnn.nnn	Set the gauge Ethernet/IP IP address, where 'nnn.nnn.nnn.nnn' is the IP address in decimal notation.
Read Subnet Mask	?J0/219 <CR>	*J0/219=nnn.nnn.nnn.nnn	Read the gauge Ethernet/IP Subnet Mask, where 'nnn.nnn.nnn.nnn' is the Mask in decimal notation.
Set Subnet Mask	=J0/219=nnn.nnn.nnn.nnn <CR>	*J0/219=nnn.nnn.nnn.nnn	Set the gauge Ethernet/IP Subnet Mask, where 'nnn.nnn.nnn.nnn' is the Mask in decimal notation.
Read Default Gateway	?J0/220 <CR>	*J0/220=nnn.nnn.nnn.nnn	Read the gauge Ethernet/IP Default Gateway, where 'nnn.nnn.nnn.nnn' is the Gateway in decimal notation.
Set Default Gateway	=J0/220=nnn.nnn.nnn.nnn <CR>	*J0/220=nnn.nnn.nnn.nnn	Set the gauge Ethernet/IP Default Gateway, where 'nnn.nnn.nnn.nnn' is the Gateway in decimal notation.
Read DHCP setting	?J0/221 <CR>	*J0/221=n	Read the gauge Ethernet/IP DHCP setting, where 'n' is the setting in decimal notation. '0'=disabled, '1'=enabled.
Set DHCP setting	=J0/221=n <CR>	*J0/221=n	Set the gauge Ethernet/IP DHCP setting, where 'n' is the setting in decimal notation. '0'=disabled, '1'=enabled.
Read the Units setting	?J0/55<CR>	*J0/55=n	Read the gauge Ethernet/IP Units setting, where 'n' is the setting in decimal notation. '0'=Metric(meters), '1'=Imperial(inches).
Set the Units setting	=J0/55=n<CR>	*J0/55=n	Set the gauge Ethernet/IP Units setting, where 'n' is the setting in decimal notation. '0'=Metric(meters), '1'=Imperial(inches).

When changing values it is necessary to allow the gauge a few seconds to store the new settings to EEPROM. After approximately 5 seconds the gauge must be restarted for the new settings to take effect.

Data format and units

All data is received and transmitted in Ethernet/IP network byte order – 'little endian'. Multi-byte values are ordered with the least significant byte first.

Data is produced and consumed in a variety of formats and units. The actual representation chosen for each value is based on knowledge of the likely range of the value, keeping the interface consistent regardless of gauge measurement capabilities, and likely future enhancements to gauges.

Thus, for example, diameters are transmitted as floating point values representing meters or inches, regardless of the gauge size. Any Ethernet/IP controller is then free to display the values in meters, millimeters, microns, inches, mills, etc. as it chooses.

In other cases a floating-point representation is used even though an integer may seem appropriate. Line speed, for example, is sent to the gauge in meters/minute or feet/minute as a floating-point number, even though this is used internally as a 16-bit integer between 0 and 65535 m/min or ft/min. The use of a floating-point value keeps the interface consistent should gauges or software be extended for use with very slow speed lines where use of an integer value reduces accuracy (e.g. 1.25m/min).

Wherever possible values and parameters are specified in standard units:

Measurement Type	Metric	Imperial
Voltage	Volts	Volts
Current	Amps	Amps
Percent	Percent	Percent
Rotational speed	Revs/minute	Revs/minute
Frequency	Hz	Hz
Tension	Newtons	Newtons
Diameter	Meters	Inches
Eccentricity (linear)	Meters	Inches
Capacitance	pF/meter	pF/foot
Linear speed	Meters/minute	Feet/minute
Temperature	Degrees Centigrade	Degrees Fahrenheit

Identity Object (class code 0x01hex)

The Beta LaserMike implementation supports the standard identity object class/instance attributes and services required for the pre-defined master/slave connection set.

The following identity object instance attributes are supported:

Identity Object Instance Attributes (instance = 1)	
Attribute	Description
1) VENDOR_ID 16-bit UINT read-only	The vendor Id. This is currently set to 732.
2) DEVICE_TYPE 16-bit UINT read-only	Always returns 0x0000 to indicate a generic device type (no standard profile is applicable).
3) PRODUCT_CODE 16-bit UINT read-only	The vendor specific product code: 0x0000 generic/invalid 0x0001 AccuScan 1000/3000/4000/5000 gauge 0x0002 CapScan 2000
4) REVISION USINT:USINT read-only	The Ethernet/IP stack implementation revision. The 'major' revision is the first 8-bit byte, and the 'minor' revision is second 8-bit byte (as a 16-bit number the revision is in big-endian format, which is contrary to all other Ethernet/IP values). The major revision number will be changed whenever there is a significant change to the 'fit, form, or function' of the product. Only values 1 through 127 are allowed. The minor revision number will be changed for bug-fixes, minor functional changes, build differences, etc. Only values 1 through 255 are allowed.
5) STATUS 16-bit WORD read-only	Currently only bit 0 is defined. Bit 0 is set to 1 when the gauge is assigned to a master (part of the pre-defined master/slave connection set has been allocated).
6) SERIAL_NUM 32-bit UDINT read-only	The MAC ID of the product. MAD Ids must be unique across all products produced by Beta LaserMike.
7) PRODUCT_NAME short string read-only	The descriptive product name. "BLM AS5000"

In addition to the 'get attribute' service, the identity object also supports the 'reset' service. The 'reset' service only resets the Ethernet/IP protocol stack within the gauge, and does not affect the gauge's measurement functions.

Assembly Object (Class Code 0x04)

1. Assembly object production (input) data

The gauge produces input data. It is supplied to the Ethernet/IP master over one or more IO connections and/or using the explicit message connection 'get attribute' service. All input data is produced from Ethernet/IP assembly object instances. The length and meaning of the input data depends on the gauge and connection types. With the Ethernet/IP pre-defined master/slave connection set the gauge is able to simultaneously produce data from the polled, bit-strobe, and COS/Cyclic connections. Although it is possible to produce data from different assembly object instances for the polled and COS/Cyclic connections, no sensible benefit could be derived from such an arrangement for the current gauge types. Production for bit-strobe connections is usually from a different assembly object instance as bit strobe connections are restricted to producing up to 8-bytes of input data.

Currently each connection type is associated with a fixed assembly object instance:

Connection Type	Assembly Object Instance	Produced Connection Path
Ethernet/IP	1	0x20,0x04,0x24,0x01,0x30,0x03

The 'produced connection path' attribute describes the connection as producing data from the assembly object, the relevant instance, and the assembly object 'data' attribute.

Please note that at the current time the produced connection path is fixed. However, future implementations may provide further assembly objects (e.g. instances 3, 4, 5, 6, etc) that provide additional data, or data in alternate formats. These assembly objects could be dynamically selected, and therefore developers of controller applications should consider checking the instance number within the produced connection path attribute to ensure that the data they are receiving is from the expected assembly object.

The Ethernet/IP controller may obtain input data over the explicit message connection by using the 'get attribute' service specifying the assembly object class ID (0x04), the relevant instance number, and the 'data' attribute number (0x03). It is therefore possible to implement a controller application that does not require the use of IO connection types.

The assembly objects available for each gauge type are described in more detail in subsequent sections.

2. Assembly object consumption (output) data

The gauge consumes the output data. It is produced by the Ethernet/IP controller, and is supplied to the gauge over the polled connection or using the explicit message connection 'set attribute' service.

Note that if the master instantiates a COS/Cyclic connection that, as per the Ethernet/IP specification, the master's output data is actually transmitted over the polled connection, but with a different production trigger mechanism. This is perhaps a detail with which most programmers need not be concerned, but it highlights the point that the gauge can only sensibly use the same assembly object instance for consuming the master's polled or COS/Cyclic output data.

All output data is consumed by Ethernet/IP assembly object instances. The length and meaning of the output data depends on the gauge and connection types. Currently each connection type is associated with a fixed assembly object instance:

Connection type	Assembly object instance	Consumed connection path
Polled or COS/Cyclic IO	1	0x20,0x04,0x24,0x01,0x30,0x03
Bit-Strobe IO	2	0x20,0x04,0x24,**0x02**,0x30,0x03

The 'consumed connection path' attribute describes the connection as consuming data to the assembly object, the relevant instance, and the assembly object 'data' attribute.

Please note that at the current time the produced connection path is fixed. However, future implementations may provide further assembly objects (e.g. instances 3, 4, 5, 6, etc) that consume additional data, or data in alternate formats. These assembly objects could be dynamically selected, and therefore developers of controller applications should consider checking the instance number within the consumed connection path attribute to ensure that they are sending data to the gauge in the format expected by the consuming assembly object.

The Ethernet/IP controller may supply output data over the explicit message connection by using the 'set attribute' service specifying the assembly object class ID (0x04), the relevant instance number, and the 'data' attribute number (0x03). It is therefore possible to implement a controller application that does not require the use of IO connection types. However, it should be noted that if the master is also using polled or COS/Cyclic connections that providing simultaneous output data through an IO connection and explicit message connection could cause repeated artificial triggering of the transition sensitive bits in the Output Control Word (see later sections).

The assembly objects available for each gauge type are described in more detail in subsequent sections.

Connection Object (Class Code 0x05hex)

The Beta LaserMike gauges fully implement the Ethernet/IP ‘group 2 only, pre-defined master/slave connection set’. Each gauge fully supports concurrent explicit message, polled IO, bit-strobe IO, and Change-Of-State (COS) / Cyclic connections. COS/Cyclic connections may be acknowledged or unacknowledged, and all the associated production/consumption paths, path lengths, production triggers, and initial communication characteristics are configured appropriately as per the pre-defined master/slave connection set instantiation rules. Please note the following points regarding the Ethernet/IP pre-defined master/slave connection set specification: COS/Cyclic connections are mutually exclusive (they are the same connection but with a different production trigger mechanism).

The master can only produce output data over the polled connection, but may do so using the polled, change-of-state, or cyclic mechanisms according to how the connection was instantiated. When the polled connection and the COS/Cyclic connection are instantiated at the same time, or the polled connection is instantiated followed by the COS/Cyclic connection, then the master supplies output data to the gauge using the polled connection, and the gauge provides input data to the master using both the polled connection and the COS/Cyclic connection. This is behavior defined in the Ethernet/IP specification.

The bit-strobe connection provides 1 bit of output data from the master to each slave. The Beta LaserMike gauges make no use of this bit, but will respond with appropriate bit-strobe input data (each response is limited to 8-bytes, as per the Ethernet/IP specification).

Normally the master control computer’s Ethernet/IP drivers/library will take care of establishing connections according to parameters supplied. See the Ethernet/IP specification for exact details regarding attributes of the connection class and connection instances. However, it is worth mentioning here that the Beta LaserMike Ethernet/IP implementation fully supports the following connection instance attributes (where appropriate to the connection type):

1. Expected packet rates: to a 10ms resolution.
2. ACK retry limit – for acknowledged COS/Cyclic connections.
3. ACK timeout: for acknowledged COS/Cyclic connections, to a 10ms resolution.
4. Production inhibit time: for COS connections, to a 10ms resolution.
5. Watchdog timeout action: including: time out (IO only), auto-delete, auto-reset (IO only), and deferred delete (explicit message only).

Parameter Object (Class Code 0x0F$_{hex}$)

The Beta LaserMike implementation supports the standard Ethernet/IP 'parameter' class.

When setting the non-volatile 'value' attribute for parameter instances, the new values are effective immediately, but please allow a few seconds for the value to be placed in non-volatile storage before turning off the gauge.

The actual parameters supported by each gauge type are described in later sections.

The following table describes the attributes supported at the class level of the parameter object:

Parameter Class Attributes (instance = 0)	
Attribute	Description
2 MAX_INSTANCE 16-bit UINT read only	Returns the maximum instance number of parameter object supported by the gauge. Because instance numbers are 1-based, this can also be thought of as the number of supported parameters.
8 CLASS_DESCRIPTOR 16-bit UINT read only	Describes the way in which parameters are handled by the gauge. Currently this always returns a fixed class descriptor value of 0x000B, that describes: Support is provided for parameter instances. Support is provided for full parameter instance attributes. There is no requirement for the controller to issue a save command. Parameters are stored in non-volatile storage.
9 CONFIG_ASMBLY_INSTANCE 16-bit UINT read only	Returns 0 to indicate that there is no associated assembly object instance that can accept configuration data.

The following table describes the attributes supported at the instance level of the parameter object:

Parameter Class Attributes (instance = n)	
Attribute	Description
1 VALUE size/type/permissions depends on parameter instance	The parameter value. The size and type of the parameter can be determined by reading the 'DATA TYPE' and/or 'DATA SIZE' attribute of the same parameter object instance. The value may be read/write or read-only, depending on the 'read-only' bit on the instance's 'DESCRIPTOR' attribute. Attempts to write to a read-only parameter value, to set an invalid parameter value, or that do not supply sufficient data according to the data type will fail with an appropriate Ethernet/IP error code.
2 LINK_PATH_SIZE 8-bit USINT read only	Always returns 0 to indicate that there is no link path.
3 LINK_PATH array of 8-bit USINT read only	Always returns an empty array to indicate that there is no link path.
4 DESCRIPTOR 16-bit UINT read only	Only two bits are of interest: bit 4 (0x0010) If set parameter value is read-only. bit 5 (0x0020) If set parameter is a 'monitor' parameter (i.e. its value constantly changes to reflect a gauge measurement).

5 DATA_TYPE 8-bit USINT read only	Returns the parameter object data-type code as defined in the Ethernet/IP specification. Supported parameter object data type codes are: 1 WORD (16-bit bit-string) 2 UINT (16bit unsigned integer) 3 INT (16bit signed integer) 4 BOOL (8-bits with value in bit 0) 5 SINT (8-bit signed short integer) 6 DINT (32-bit signed integer) 8 USINT (8-bit unsigned integer) 9 UDINT (32-bit unsigned integer) 11 REAL (32-bit floating point format IEEE 754) 24 BYTE (8bit bit-string) 25 DWORD (32-bit bit-string). The above data-type mnemonics are those defined by Ethernet/IP – do not confuse these with similar mnemonics used by Microsoft and other compiler vendors for Windows programming.
6 DATA_SIZE 8-bit USINT read only	Returns the parameter value size in bytes. The gauge only ever returns sizes of 1, 2, or 4 bytes.
7 NAME_STRING short string read only	Describes the parameter instance. The 'short string' is a Ethernet/IP standard that specifies an 8-bit length followed by the corresponding number of characters. No null terminator is provided. The NAME_STRING is a maximum of 16 characters (not including the length byte). Example name strings provided are "SamplesToAverage", "BarePtchThrshld", "Units", etc. These try to best describe the parameter instance while keeping within the Ethernet/IP imposed 16-character limit.
8 UNITS_STRING short string read only	A short string, as described for 'NAME_STRING', but with a limit of 4 characters. Example units strings are: "" (empty – when no units are applicable), "m", "inch", "ohms", "V", "A", etc, and try to best describe the parameter units while keeping within the Ethernet/IP imposed 4-character limit.
9 HELP_STRING short string read only	A short string, as described for 'NAME_STRING', but with a limit of 64 characters. The Beta LaserMike implementation always returns a short-string of length zero.
10 MIN_VALUE size/type depends on parameter instance read-only	The minimum value of the parameter's 'value' attribute.
11 MAX_VALUE size/type depends on parameter instance read-only	The maximum value of the parameter's 'value' attribute.
12 - DFLT_VALUE 13 – SCALING_MULTIPLIER 14 – SCALING_DIVISOR 15 – SCALING_BASE 16 - SCALING_OFFSET 17 – MULTIPLIER_LINK 18 – DIVISOR_LINK 19 – BASE_LINK 20 – OFFSET_LINE	**These attributes are not supported and will return an 'attribute not supported' error.**
21 DECIMAL_PRECISION 8-bit USINT read-only	Returns the number of decimal places to which the parameter's 'value' attribute should be shown. Most parameter instances will return 0 to indicate that no decimal places are appropriate (e.g. 'Units', 'Samples To Average', etc). However, certain parameters will return non-zero values for floating point parameters e.g. a parameter measuring diameter may return a value of -7 (metric) or -5 (imperial) indicating that the parameter is measured to a precision of $1x10^{-7}$ or $1x10^{-5}$ inch respectively.

TCP/IP Interface Object (class code 0xF5hex)

The Beta LaserMike implementation supports the standard Ethernet/IP TCP/IP object class/instance attributes and services required for the pre-defined master/slave connection set.

The following TCP/IP object instance attributes are supported:

<table>
<tr><th colspan="2">TCP/IP Object Instance Attributes (instance = 1)</th></tr>
<tr><td>Attribute</td><td>Description</td></tr>
<tr><td>1
STATUS
32-bit DWORD
read</td><td>The Status attribute is a bitmap that shall indicate the status of the TCP/IP network interface

<table>
<tr><th>Bit(s):</th><th>Called:</th><th colspan="2">Definition:</th></tr>
<tr><td>0-3</td><td>Interface configuration status</td><td>Indicates the status of the interface configuration attribute</td><td>0 = The attribute has not been configured
1 = The attribute has valid configuration data from BOOTP, DHCP, or non-volatile storage
2 = The attribute has valid configuration data obtained from hardware settings
3-15 are reserved</td></tr>
<tr><td>4</td><td>Mcast Pending</td><td colspan="2">Indicates a pending configuration change in the TTL value and/or Mcast config attributes. This bit shall be set when either the TTL value or Mcast config attribute is set, and shall be cleared the next time the device starts</td></tr>
<tr><td>5-31</td><td>Reserved</td><td colspan="2">Reserved for future use and shall bet set to zero</td></tr>
</table></td></tr>
<tr><td>2
CONFIGURATION CAPABILITY
32-bit DWORD
read</td><td>The Configuration Capability attribute is a bitmap that indicates the device’s support for optional network configuration capability

<table>
<tr><th>Bit(s):</th><th>Called:</th><th>Definition:</th></tr>
<tr><td>0</td><td>BOOTP client</td><td>1(TRUE) shall indicate that this device is capable of obtaining its network configuration via BOOTP</td></tr>
<tr><td>1</td><td>DNS client</td><td>1(TRUE) shall indicate that this device is capable of resolving host names by querying a DNS server.</td></tr>
<tr><td>2</td><td>DHCP client</td><td>1(TRUE) shall indicate that this device is capable of obtaining its network configuration via DHCP</td></tr>
<tr><td>3</td><td>DHCP-DNS update</td><td>1(TRUE) shall indicate that this device is capable of sending its host name in the DHCP request</td></tr>
<tr><td>4</td><td>Configuration Settable</td><td>1(TRUE) shall indicate that the Interface Configuration attribute is settable</td></tr>
<tr><td>5-31</td><td>Reserved</td><td>Reserved for future use and shall bet set to zero</td></tr>
</table></td></tr>
<tr><td>3
CONFIGURATION CONTROL
32-bit DWORD
read/write</td><td>The Configuration Control attribute is a bitmap used to control network configuration options.

<table>
<tr><th>Bit(s):</th><th>Called:</th><th colspan="2">Definition:</th></tr>
<tr><td>0-3</td><td>Start-up Configuration</td><td>Determines how the device shall obtain its initial configuration at start-up</td><td>0 = The device shall use the interface configuration values previously stored.
1 = The device shall obtain its interface configuration values via BOOTP
2 = The device shall obtain its interface configuration values via DHCP at start-up
3-15 are reserved</td></tr>
<tr><td>4</td><td>DNS enable</td><td colspan="2">1(TRUE) shall indicate that this device shall resolve host names by querying a DNS server.</td></tr>
<tr><td>5-31</td><td>Reserved</td><td colspan="2">Reserved for future use and shall bet set to zero</td></tr>
</table></td></tr>
<tr><td>4
PHYSICAL LINK OBJECT
8-bit USINT
read/write</td><td>This attribute identifies the object associated with the underlying physical communications interface.</td></tr>
<tr><td>5
INTERFACE CONFIGURATION</td><td>This attribute contains the configuration parameters required to operate as a TCP/IP node.</td></tr>
</table>

<table>
<tr>
<td>8-bit BYTE and
8-bit USINT
read-only</td>
<td>
<table>
<tr><th>Name</th><th>Meaning</th></tr>
<tr><td>IP Address</td><td>The device's IP address</td></tr>
<tr><td>Network mask</td><td>The device's network mask. The network mask is used when the IP network has been partitioned into subnets.</td></tr>
<tr><td>Gateway Address</td><td>The IP address of the device's default gateway. When a destination IP address is on a different subnet, packets are forwarded to the default gateway for routing to the destination subnet.</td></tr>
<tr><td>Name Server</td><td>The IP address of the primary name server. The name server is used to resolve host names.</td></tr>
<tr><td>Name Server 2</td><td>The IP address of the secondary name server. The secondary name server is used when the primary is not available, or unable to resolve a host name.</td></tr>
<tr><td>Domain Name</td><td>The default domain name. The default domain name is used when resolving host names that are not fully qualified.</td></tr>
</table>
</td>
</tr>
<tr>
<td>6
HOST NAME</td>
<td>This attribute contains the device's host name. The host name attribute is used when the device supports the DHCP-DNS Update capability and has been configured to use DHCP upon start up.</td>
</tr>
</table>

Ethernet/IP Communication Specific to AS4000/5000

Assembly Object Instance 112 Consumption Data

Assembly object instance 1 is normally associated with the polled and/or COS/Cyclic IO connections. The following table describes the bytes consumed by the assembly object:

	Assembly Object Instance 112 Consumption Data							
	7	6	5	4	3	2	1	0
Byte 0	OCW7 EN	OCW6 EL	OCW5 ET	OCW4 ZT	OCW3 Threading	OCW2 ZF	OCW1 ZN	OCW0 ZL
Byte 1	OCW15	OCW14 Start FFT	OCW13	OCW12	OCW11	OCW10	OCW9 ZO	OCW8 EO
Byte 2	Linespeed LSB (bits 7...0 of REAL) meters/minute or feet/minute							
Byte 3	Linespeed (bits 15...8 of REAL)							
Byte 4	Linespeed (bits 23...16 of REAL)							
Byte 5	Linespeed MSB (bits 31...24 of REAL)							

Total size = 6 bytes.

The 'Output Control Word' bits currently defined for diameter gauges are:

OCW0 ZL Scanning Flaw mode only.
A 0 to 1 transition of this bit zeros lump counts and lump alarms.

OCW1 ZN Scanning Flaw mode only.
A 0 to 1 transition of this bit zeros neck counts and neck alarms.

OCW2 ZF Scanning Flaw mode only.
A 0 to 1 transition of this bit zeros lump and neck fault counts.

OCW3 Threading If this bit is set the gauge will convert gauge status codes to code 0, thereby suppressing non-fatal errors during line threading. Status codes for 'gauge over-temperature' and 'gauge fault' are not affected.

OCW4 ZT Scanning Flaw mode only.
A 0 to 1 transition of this bit zeros diameter tolerance alarms.

OCW5 ET Scanning Flaw mode only.
Diameter tolerance alarms are enabled if this bit is set.

OCW6 EL Scanning Flaw mode only.
Lump alarms are enabled if this bit is set.

OCW7 EN Scanning Flaw mode only.
Neck alarms are enabled if this bit is set.

OCW8 EO Scanning Flaw mode only.
Ovality over tolerance alarms are enabled if this bit is set.

OCW9 ZO Scanning Flaw mode only.
A 0 to 1 transition of this bit zeros Ovality tolerance alarms.
OCW14 Start FFT FFT mode only.
A 0 to 1 transition on this bit triggers the start of an FFT calculation. Steady state values or a 1 to 0 transition are ignored. A master control computer application should probably monitor the returned 'FFT Complete' bit in the gauge state bits to determine when the 'Start FFT' transition has been recognized by the gauge.

All other OCW bits are reserved for future use and should be set to zero to ensure future compatibility.
The Linespeed information is optional. Although a connection's consumption path size will be set to 6 bytes, the controller may produce only the first two bytes if the linespeed is not required by the gauge (some controllers may not allow this). If the linespeed value is supplied but all bits of the linespeed value are set to 1 (i.e. if each byte is 0xFF), then the gauge will ignore the linespeed value.

Assembly object instance 120 production data for STD and FFT modes

The following table describes the bytes produced by the assembly object when the gauge is operating in STD or FFT mode:

	Assembly Object Instance 120 Production Data (STD and FFT mode)							
	7	6	5	4	3	2	1	0
Byte 0	Status (bits 7...0 of USINT) see below							
Byte 1	ST7 0	ST6 0	ST5 FFT	ST4 0	ST3 0	ST2 0	ST1 XY	ST0 0
Byte 2	X gate position (bits 7...0 of SINT) -99 to +99 (percent)							
Byte 3	Y gate position (bits 7...0 of SINT) -99 to +99 (percent)							
Byte 4	X diameter LSB (bits 7...0 of REAL) meters or inches							
Byte 5	X diameter (bits 15...8 of REAL)							
Byte 6	X diameter (bits 23...16 of REAL)							
Byte 7	X diameter MSB (bits 31...24 of REAL)							
Byte 8	Y diameter LSB (bits 7...0 of REAL) meters or inches							
Byte 9	Y diameter (bits 15...8 of REAL)							
Byte 10	Y diameter (bits 23...16 of REAL)							
Byte 11	Y diameter MSB (bits 31...24 of REAL)							

Total size = 12 bytes.

The following 'state' bits are currently defined:

ST1 XY Bit set if gauge is dual plane, bit reset if gauge is single plane.
ST5 FFT FFT mode only.
Bit set if the FFT algorithm is complete. The FFT complete bit will transition to 0 when an FFT is started and transition back to a 1 when the FFT is complete. The gauge sets this bit to 1 after power-up, thereby simplifying the detection of the first FFT start event. Attempting to collect FFT data before the first FFT has been started will return an error.

For a list of status codes see Non-continuous transmission – ASCII code J
Status codes may be suppressed by setting the 'threading' bit in the output data.

Assembly object instance 130 production data for Scanning Flaw mode

The following table describes the bytes produced by the assembly object when the gauge is operating in Scanning Flaw mode:

	Assembly Object Instance 130 Production Data (Scanning Flaw mode)							
	7	6	5	4	3	2	1	0
Byte 0	**Status** (bits 7...0 of USINT) see below							
Byte 1	ST7 **V1**	ST6 **V0**	ST5 **NA**	ST4 **LA**	ST3 **UA**	ST2 **OA**	ST1 **XY**	ST0 **OVA**
Byte 2	X gate position (bits 7...0 of SINT) -99 to +99 (percent)							
Byte 3	Y gate position (bits 7...0 of SINT) -99 to +99 (percent)							
Byte 4	X diameter LSB (bits 7...0 of REAL) meters or inches							
Byte 5	X diameter (bits 15...8 of REAL)							
Byte 6	X diameter (bits 23...16 of REAL)							
Byte 7	X diameter MSB (bits 31...24 of REAL)							
Byte 8	Y diameter LSB (bits 7...0 of REAL) meters or inches							
Byte 9	Y diameter (bits 15...8 of REAL)							
Byte 10	Y diameter (bits 23...16 of REAL)							
Byte 11	Y diameter MSB (bits 31...24 of REAL)							
Byte 12	Lump fault count LSB (bits 7..0 of UINT)							
Byte 13	Lump fault count MSB (bits 15..8 of UINT)							
Byte 14	Neck fault count LSB (bits 7..0 of UINT)							
Byte 15	Neck fault count MSB (bits 15..8 of UINT)							

Total size = 16 bytes.

The following 'state' bits are currently defined:

ST0 OVA Ovality tolerance Alarm. Latched: cleared by 0 to 1 transition of ZO.

ST1 XY Bit set if gauge is dual plane, bit reset if gauge is single plane.

ST2 OA Over tolerance Alarm. Latched: cleared by 0 to 1 transition of ZT.

ST3 UA Under tolerance Alarm. Latched: cleared by 0 to 1 transition of ZT.

ST4 LA Lump fault Alarm. Latched: cleared by 0 to 1 transition of ZL.

ST5 NA Neck fault Alarm. Latched: cleared by 0 to 1 transition of ZN.

ST7/ST6 Version A two-bit number representing the Scanning Flaw 'Version':
0 = none / invalid
1 = combined diameter and lump/neck tolerances
2 = separate diameter and lump/neck tolerances
3 = separate X/Y diameter and X/Y lump/neck tolerances (ribbon mode)

Parameter Object Instances

The following table describes the currently supported parameter object instances for AccuScan 4000/5000 gauges. The available parameters reflect those required for all gauge operating modes: it is possible to access parameters not relevant to the current operating mode, but they will only take effect after the gauge has been restarted in the relevant mode.

The size/type/attributes of these instances may all be obtained from the parameters' description attributes (as described in an earlier section), or the master control computer application can use information detailed below:

Diameter Gauge Parameter Object Instances				
Instance	Type	Size	Value Access	Description
1	USINT	1 byte	read/write	Units. 0=metric, 1=imperial This parameter value determines the units used for all production and consumption data, and for any other parameters that are sensitive to units selection.
2	UINT	2 bytes	read/write	Scans to average. 1 - 6000
3	SINT	1 byte	read only	X optics condition. 0 - 100
4	SINT	1 byte	read only	Y optics condition. 0 - 100
5	REAL	4 bytes	read/write	Preset diameter
6	REAL	4 bytes	read/write	Preset tolerance *not used on AS5000
7	UINT	2 bytes	read/write	Flaw processing mode: cell 114 Relative + Combined = 0x4002(hex) or 16386(dec) Relative + Separate = 0x8002(hex) or 32770(dec) Relative + Ribbon = 0xC002(hex) or 49154(dec) Absolute + Combined = 0x4001(hex) or 16385(dec) Absolute + Separate = 0x8001(hex) or 32769(dec) Absolute + Ribbon = 0xC001(hex) or 49153(dec)
8	REAL	4 bytes	read/write	Flaw preset X diameter cell 108
9	REAL	4 bytes	read/write	Flaw preset Y diameter cell 109
10	REAL	4 bytes	read/write	Flaw over tolerance X cell 110
11	REAL	4 bytes	read/write	Flaw over tolerance Y cell 111
12	REAL	4 bytes	read/write	Flaw under tolerance X cell 112
13	REAL	4 bytes	read/write	Flaw under tolerance Y cell 113
14	REAL	4 bytes	read/write	Flaw lump threshold X cell 104
15	REAL	4 bytes	read/write	Flaw lump threshold Y cell 105
16	REAL	4 bytes	read/write	Flaw neck threshold X cell 106
17	REAL	4 bytes	read/write	Flaw neck threshold Y cell 107
21	REAL	4 bytes	read/write	Ovality threshold cell 118

Basic settings for Ethernet-IP communications

1. IP address: The ip address is stored in database cell 218. Typing "?J0/218<enter>" in a HyperTerminal connection screen will give you the gauges' current ip address. Typing

"=J0/218=192.168.10.34<enter>" will set the gauges' ip address to 192.168.10.34. Reset the gauge.

2. The above is valid for the Subnet Mask(cell 219) and the default Gateway(cell 220).
3. DHCP: If the network that the gauge is connecting to has a DHCP server and the user wishes to have the DHCP server assign an ip address to the gauge, then set the DHCP (cell 221) to 1. Type "=J0/221=1<enter>". Also change the ip address and Subnet mask to zero. Reset the gauge.
4. Connection Parameters: The PLC will expect connection parameters for input, output and configuration. Below the connection parameters for the AS4000/5000 are summarized.

Standard Production Data		
	Instance	Size(in bytes)
Input	120	12
Output	112	6
Configuration	128	0
Data Produced		
Byte Number	Data	
Byte # 0	Status Data	
Byte # 1	State bits	
Byte # 2	X gate position	
Byte # 3	Y gate position	
Bytes # 4 - 7	X Diameter	
Bytes # 8 – 11	Y Diameter	
Data Consumed		
Byte # 0	Control Word 1	
Byte # 1	Control Word 2	
Bytes # 2 - 5	Linespeed(optional)	

Scanning Flaw Production Data		
	Instance	Size(in bytes)
Input	130	16
Output	112	6
Configuration	128	0
Data Produced		
Byte Number	Data	
Byte # 0	Status Data	
Byte # 1	State bits	
Byte # 2	X gate position	
Byte # 3	Y gate position	
Bytes # 4 – 7	X Diameter	
Bytes # 8 – 11	Y Diameter	
Bytes # 12 – 13	Lump fault count	
Bytes # 14 – 15	Neck fault count	
Data Consumed		
Byte # 0	Control Word 1	
Byte # 1	Control Word 2	
Bytes # 2 – 5	Linespeed(optional)	

5. Setting Individual parameters: The PLC uses a connection known as "explicit messaging" to set individual parameters on a one-shot(non-cyclic) basis. In order to send explicit messages the PLC has to know the following: Message type, Service type,Service code, class, instance and attribute. For the AS4000/5000 gauges the following table shows the values for those parameters.

Parameter Objects							
Message Type	Service Type	Service Code (in hex)	Class (in hex)	Instance	Attribute	Data (in hex)	Description
CIP generic	Parameter write	0x10	0xf	7	1	01 C0	This command sets(writes) the Flaw Mode to Absolute+Ribbon
CIP generic	Parameter read	0xe	0xf	10	1		This command gets(reads) the X over tolerance setting

Use the **Diameter Gauge Parameter Object Instances** table in the "Ethernet/IP Addendum to AS50xx Instruction Handbook" document for assembling explicit messages. The Class value will always be 0xf(15) and the Attribute value will always be 1.

Settings/values available through Parameter Object instances:

- Units (imperial(inches) or Metric(meters))
- Diameter averaging
- Optical condition for X and Y axis
- Diameter preset for analog i/o
- Flaw processing mode
- Diameter preset(nominal) for fault detection
- Under/over threshold settings
- Lump/neck threshold settings

With Ethernet-IP the data is transferred according to the IEEE-754 standard. The cell that determines the units for Ethernet-ip packets is cell 55. This cell has two allowable values, 0 for Metric(millimeters) and 1 for Imperial (inches). Depending on cell 55 the diameters will be in inches or meters.

Example for setting the units value via Ethernet-ip

- The information needed by the PLC will be Message type, Service type, Service code, Class, Instance, attribute and data
- The Message type = CIP Generic
- The Service type = Parameter Write
- Service code = 0x10
- Class = 0xf
- Instance = 1
- Attribute = 1
- Data = 0 (for meters), 1 (for inches)
- Have the PLC send this data as an explicit message

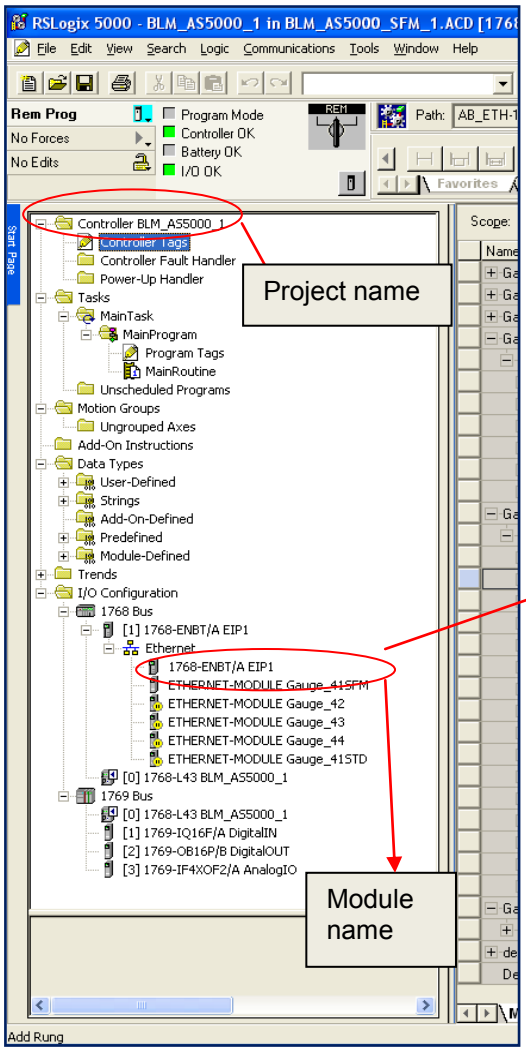
Example for setting the Flaw Detection mode to Absolute + Separate

- The information needed by the PLC will be Message type, Service type, Service code, Class, Instance, attribute and data
- The Message type = CIP Generic
- The Service type = Parameter Write
- Service code = 0x10
- Class = 0xf
- Instance = 7
- Attribute = 1
- Data = 0x0180→lsb goes first
- Have the PLC send this data as an explicit message

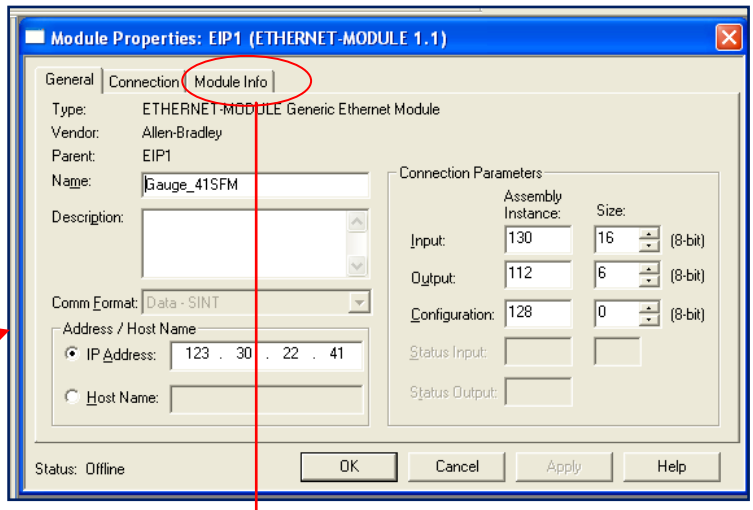
PLC Controller Setup example

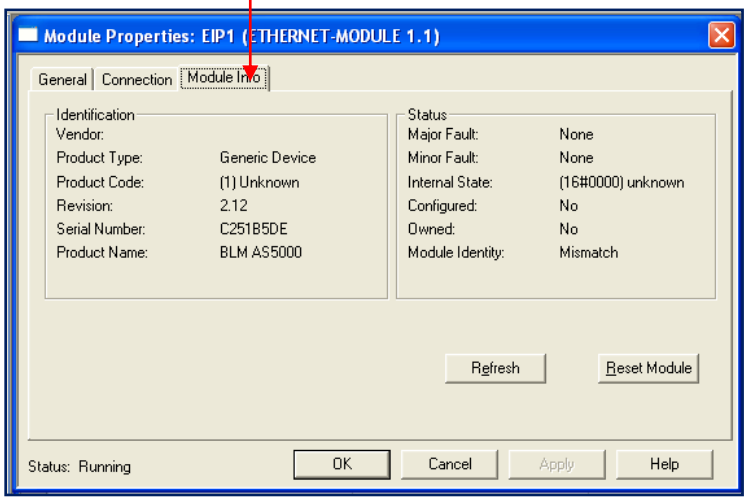
Of the various Ethernet/IP capable controllers in the commercial market, Allen Bradley / Rockwell controllers are prevalent. This example shows how to implement the scanning flaw object using Rockwell RSLogix 5000 software that was controlling an Allen Bradley Compact Logix L43 controller. The setup and configuration of the RSLogix 5000and L43 controller is beyond the scope of this handbook but it will show the setup of the module assembly and the tags.

This example has created a project named BLM_AS5000_1. Within the Project's I/O configuration folder a generic Ethernet module named Gauge_41SFM was created. As shown below the module's Properties

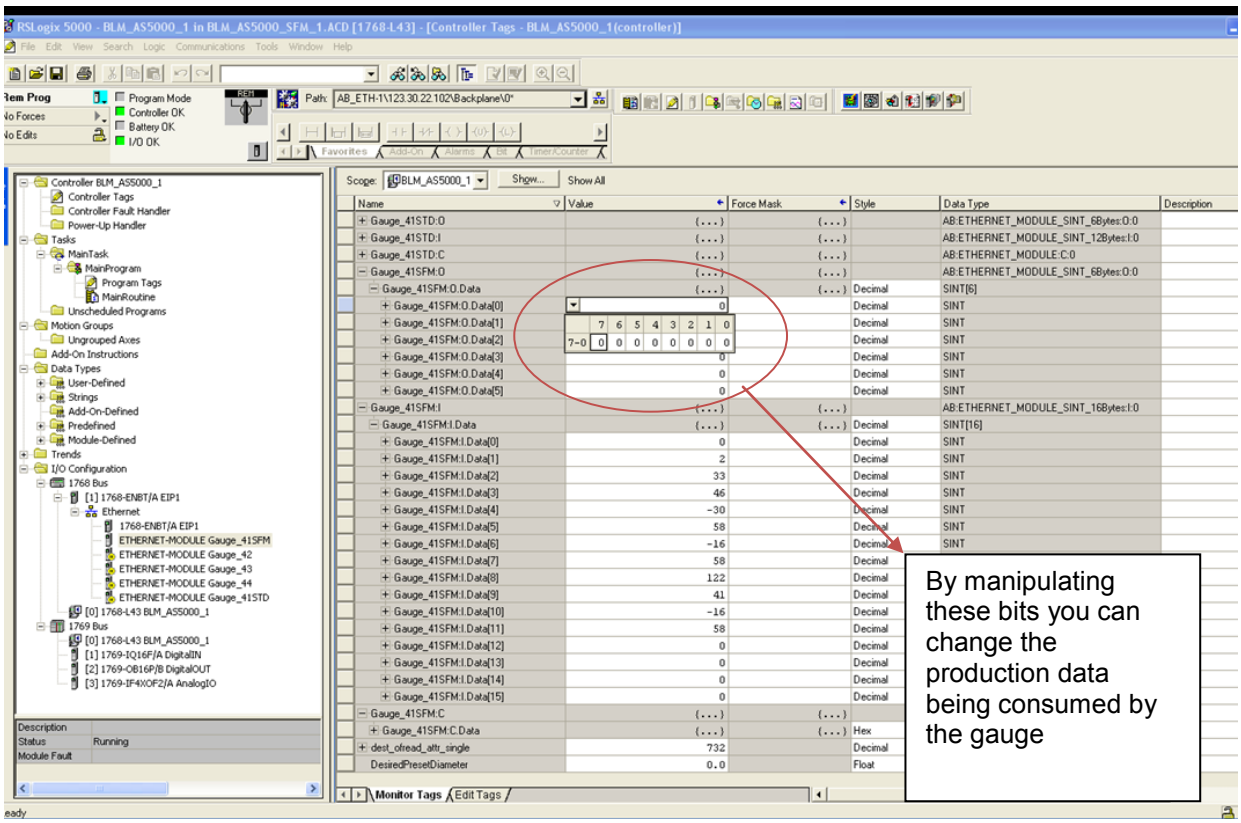


Window allows the module's IP address and connection parameters to be entered. It also allows the user to view the module's identity object and in the Connections tab (not shown) to adjust packet interval timing.

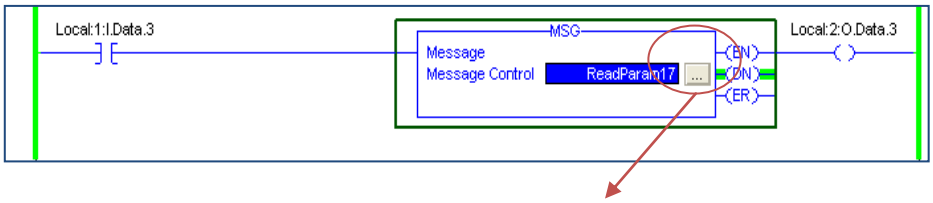


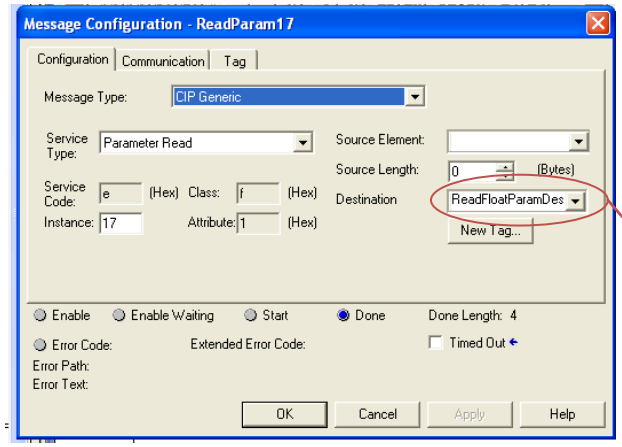


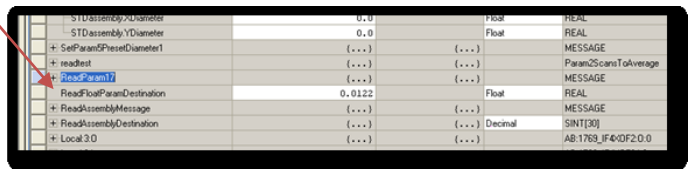
In order to view the data being exchanged between the PLC controller and the gauge, RXLogix 5000 allows for the creation of Controller or Program “tags”. For this example two Controller tags have been created to show the data for Assembly Object Instance 112 Production data and for Assembly Object Instance 130 Consumption data. The screen capture below shows the two controller tags. The raw data being exchanged between controller (PLC) and slave (gauge) can be monitored.



In addition to the above examples, the RXLogix 5000 software allows for the creation of explicit messages via which individual or groups of parameters can be read or written. By using the RXLogix 'ladder logic' this example has created an explicit message that reads Parameter Object instance 17, "Flaw neck threshold Y setting". Shown below is a screen capture of the ladder logic, the properties window and the tag that shows the value.







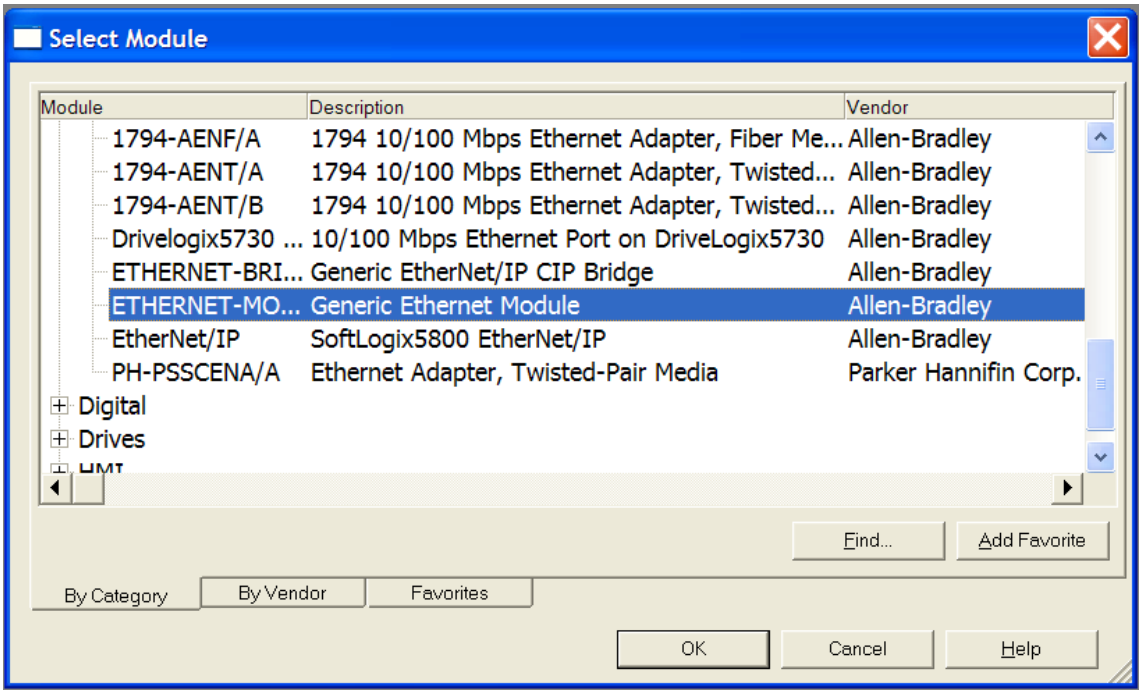
Additional PLC Controller Setup example

There are 2 different setups. Standard Production Data and Scanning Flaw Production Data. Scanning Flaw mode provides 2 extra data points (Lump and Neck faults).

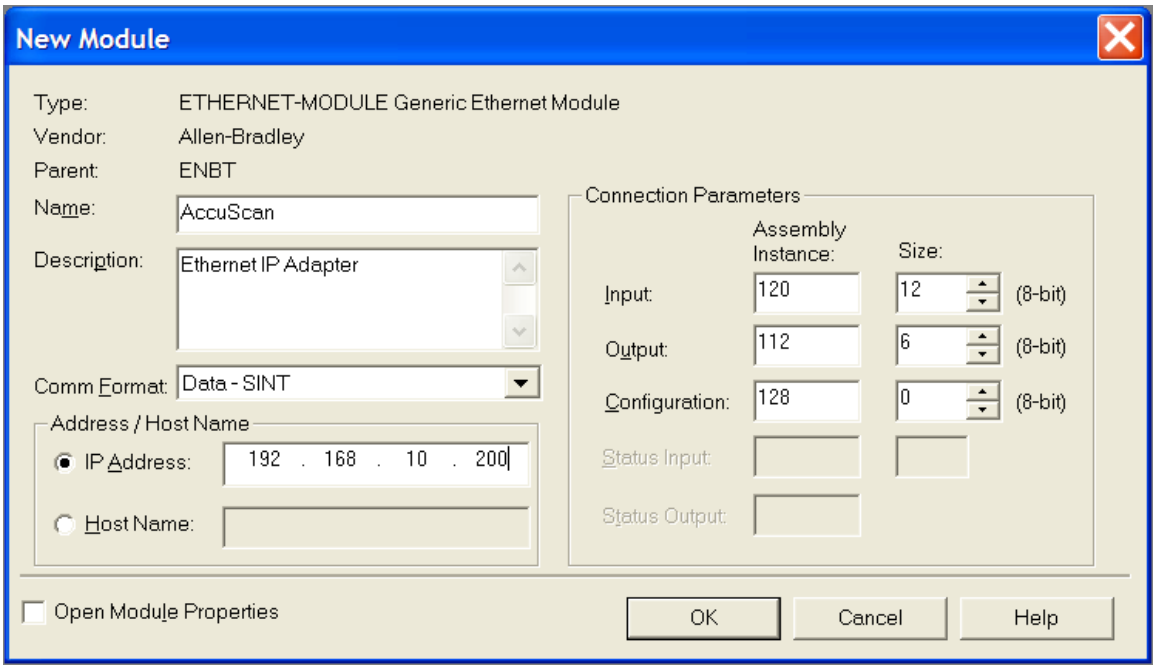
Standard Production Data		
	Instance	Size
Input	120	12
Output	112	6
Configuration	128	0
Data Produced		
Byte Number	Data Name	
Byte # 0	Status Data	
Byte # 1	State bits	
Byte # 2	X gate position	
Byte # 3	Y gate position	
Bytes # 4 - 7	X Diameter	
Bytes # 8 – 11	Y Diameter	
Data Consumed		
Byte # 0	Control Word 1	
Byte # 1	Control Word 2	
Bytes # 2 - 5	Linespeed(optional)	

Scanning Flaw Production Data		
	Instance	Size
Input	130	16
Output	112	6
Configuration	128	0
Data Produced		
Byte Number	Data Name	
Byte # 0	Status Data	
Byte # 1	State bits	
Byte # 2	X gate position	
Byte # 3	Y gate position	
Bytes # 4 - 7	X Diameter	
Bytes # 8 – 11	Y Diameter	
Bytes # 12 –15	Lump fault count	
Bytes # 14 –15	Neck fault count	
Data Consumed		
Byte # 0	Control Word 1	
Byte # 1	Control Word 2	
Bytes # 2 - 5	Linespeed(optional)	

When adding a gauge to the I/O tree use the Generic Ethernet Module.

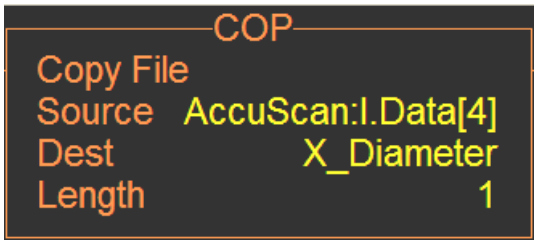


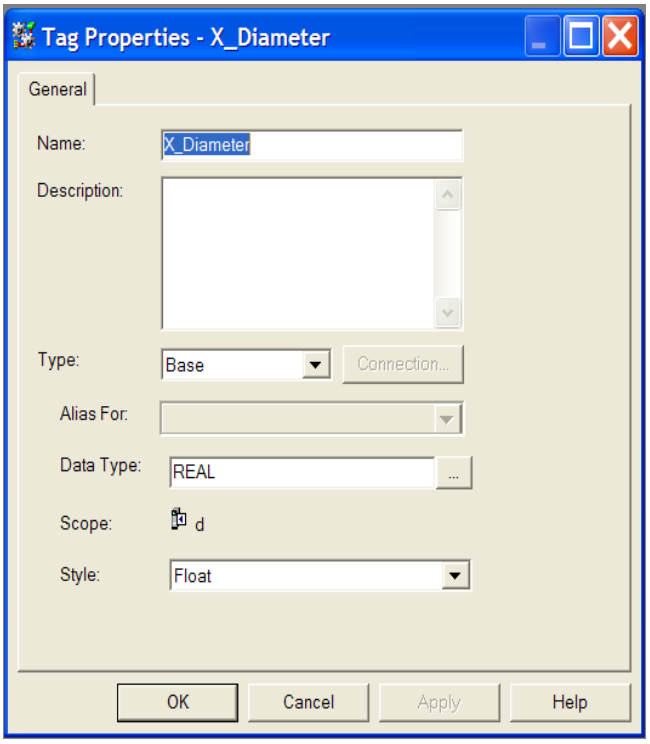
In this example we are using Standard Production Mode. This is indicated by the Input Assembly Instance of 120 and a size of 12.



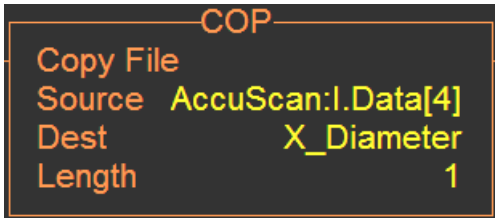
Important NOTE the Comm Format is **Data-SINT**.

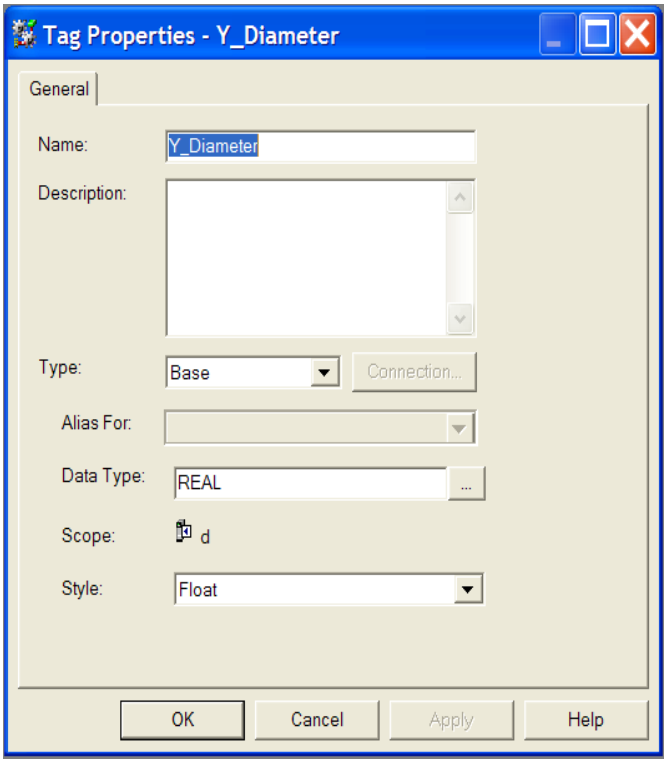
Changing the data from SINT to Real (Floating Point). Is as simple as using a COP. In this case we are reading the 4 Bytes of data that represent the X Diameter and convert it to a single Real (Floating Point) number.





The same needs to be done to the Y Diameter.





Calibration of Diameter

For calibration of analogs see under heading Options – Analog Output.
For part numbers of calibration sets see Spare Parts table.

When a laser gauge is manufactured, it is aligned and calibrated to NIST-traceable standards. It is then tested to ensure that it meets all stated performance specifications. See Specification. Calibration should be performed once per year or any time the ambient measurement temperature deviates more than 2°C from the calibration temperature.

Calibration requires a large and a small gauge pin known to .1μm (.000004 inches) accuracy or better. The range in size represented by the two master parts should 1) not be less than 25% of the measurement range of the scanner and 2) should cover the range of product sizes being measured. Calibration also requires a stable temperature environment and no air movement around the gate area.

Calibration is best performed using UniCalib software (a calibration kit is available from Beta LaserMike comprising calibration samples, a sample holder, UniCalib CD/manuals and connection cables). However, a calibration procedure using serial commands is provided below.

Calibration Fixture

Note that if you are using the optional AS5012 pressurised air chamber, then the insert will have to be removed to enable attachment of the calibration fixture.

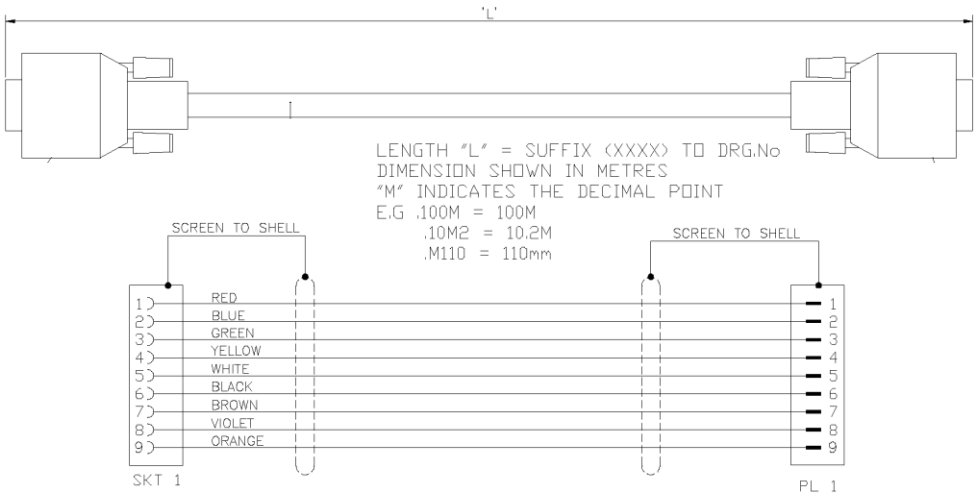
Affix calibration fixture on the AS5012 as shown on photo below.

Please contact BLM Service for information on calibration fixtures for AS5025/40/80.

AS4000/5000 Gauge to PC (RS232 Connection)

Use D-type calibration cable CA5100-0077.

- Connect the D-type socket connector to a free COM port on the PC/laptop.
- Connect the D-type plug connector to socket on rear panel (See heading Overview of Connections for connection diagram.



AS4000/5000 gauge to PC (Ethernet Connection)

Use the supplied Ethernet cable (part number 62458).

See heading Overview of Connections for connection diagram.

Calibration Using UniCalib

Two-pin (2 samples) calibration is also supported in UniCalib. Refer to the UniCalib manual for the procedure.

Calibration Using Serial Commands

Commands for both protocols (new database cell protocol and the old 'ASCII' protocol) are given. (for AS4012, use only X plane commands)

1. Place the first (large) pin in the centre of the gate. Use database cell 64 (X plane) & 65 (Y plane) to find position
2. Check that gauge status J = 0. If not, correct error before calibrating.
3. Enter the exact size of the sample using the first (large) calibration pin command (b or =J0/90=).
   Use precision of 0.1μm, i.e. resolution of 0.0001mm. This is set by database cell 1 (or ASCII: P=4).
   For pins over 9.9999mm [0.39in] the ASCII codes cannot be used as they have only 5 digit resolution. The database cell reference must be used for values having 6 significant figures e.g. =J0/90=10.0001.
4. Query the CAL STATUS parameter (W or ?J0/95) until it returns a '1'. If a '3' is returned, an error has occurred as indicated in the GAUGEHEAD STATUS 'J' parameter and must be corrected before the gauge can be calibrated.
5. Calibration can be aborted by writing 0 to the CAL STATUS parameter
6. Place the second (small) pin in the centre of the gate
7. Check that gauge status J = 0. If not, correct error before calibrating.
8. Enter the exact size of the sample using the second (small) calibration pin command (s or =J0/91=). Use appropriate precision as needed for the resolution setting (P).
9. Query the CAL STATUS parameter (W or ?J0/95) until it returns a '2'. Again, if a '3' is returned, an error has occurred as indicated in the GAUGEHEAD STATUS 'J' parameter and must be corrected before the gauge can be calibrated

Spare Parts

Description	Part number
AS5012 pressurised air chamber (option)	SA1530-7681-1/A = 2.8mm [0.11in] entry and exit nozzles. SA1530-7681-2/A = 4.8mm [0.19in] entry and exit nozzles. SA1530-7681-3/A = 7.8mm [0.31in] entry and exit nozzles. SA1530-7681-4/A = 12.8mm [0.50in] entry and exit nozzles.
Display pod (option)	AS4012: GA5004-0033-?/? AS5012: SA1530-7767-1/A
24V Power supply	US version: GA5301-0083/? EU/UK version: GA5301-008201-0082/3
Lens cleaning kit	21019
Lens cleaning fluid	21025
External guide rollers	AS4012/5012: SA1530-6070-2/A 0-5mm [0.2in] AS4012/5012: SA1530-6074-1/A 5-12mm [0.2-0.47in] AS5025/5040: SA1530-6634-1/A 15-25mm [0.59-0.98in] AS5080: SA1530-9436-1/A to 80mm [to 3.15in]
Spare rollers for SA1530-6070	0050101
Air-cleaner fine filter element	1584902
Complete air cleaner assembly	SA0042-0044 -1/A
Height stand	AS4012/5012: GA0042-0062-2/A AS5025/5040: GA0042-0029-1/A AS5080: HEI042-0001
Calibration set	AS4012/5012: GA1530-7691 AS5025/5040: GA1530-7839 AS5080: GA1530-9419
Calibration cables	Please also refer to section Calibration of Diameter.

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.

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.For more information see under heading Proprietary Information at the beginning of this manual.

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 get an RMA,

- Go to www.betalasermike.com
- Select “Service”
- Select “Equipment Return / RMA” from the drop-down menu and follow the instructions.

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 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.

Disposal / Recycling

Please check the following before disposing of your equipment:

- Is the equipment worth repairing? If in doubt, contact Beta LaserMike Service.

- Does the equipment contain any hazardous materials? If you are aware of any hazardous materials in your equipment, ensure **qualified personnel** take responsibility for its disposal. Some examples of hazardous substances are lead, mercury, cadmium, chromium VI, flame retardants, fluorescent tubes, monitors containing cathode ray tubes and products containing capacitors.

- Can you re-use or recycle any constituent parts?. For example, if the housing/chassis is made of metal, it can be recycled by your local authority. Ensure **qualified personnel** take responsibility for dismantling the equipment.

If the equipment does need to be disposed of, please dispose of it in a way that doesn't harm the environment.

Specification

All Gauges

For dimensions please refer to drawings in sections AS5012 Mech. Installation, AS5025 and AS5040 - Mech. Installation, AS5080 Mech. Installation.

RS232 connection	
General	Non-isolated 5 wire port: Rx, Tx RTS, CTS, 0V. Only 3 wires used for calibration. Full duplex. Baud rates: 4800 – 115200. 1 start, 7 data, 2 stop bits OR 1 start, 8 data, 1 stop bit.
Cable length	15m (50ft) for baud rate of 9600bps. Longer cables may work but this will depend on capacitance and quality of cable. If problems occur with longer cables, a RS232/RS422 converter box can be purchased from Beta LaserMike to overcome this.
Network connection - Profibus (option)	
Cable length	500m (1640ft) at 12MBps with 4 repeaters (longer cables are possible at a slower data rate and with more repeaters)
Data rate	up to 12 MBps (dependent on cable length and repeaters)
Max. number of nodes	32
Network connection - DeviceNet (option)	
Cable length	39m* (128ft) at 500 KBps 78m* (256ft) at 250 KBps * accumulative distance of branches 156m* (512ft) at 125 KBps
Data rate	125/250/500 kbits/s (depends on cable length)
Max. number of nodes	64
Electrical	
Power consumption	7W nominal, 9W nominal with optional display pod.
Power cable	16/0.2 2 core screened cable.
Voltage (External power supply is available from Beta LaserMike)	Nominal: 24 Vdc ±10% (voltage fluctuations) Range: 13-25V (to avoid permanent damage do not exceed this range)
Max supply level for relay contacts	60 Vdc and 30 Vac rms.
Analog output impedance	50Ω
Analog output min. load resistance	5000Ω
Analog output range	±10V max
Analog output resolution	1mV
Analog output update rate	1200 /sec
Laser power	0.5mW
Performance (common)	
Resolution	0.00001mm (0.0000004in)
Scan rate	2400 scans /sec /plane
Note: For other performance specs see relevant gauge section.	
Environmental Conditions	
Altitude	Up to 2000m (6560 ft)
Ambient operating temp.	5-45°C (41-113°F)
Ambient storage temp.	-20 to 45°C (-4 to 113°F)
Max relative humidity	80% for temperature up to 31°C or 88°F (decreasing linearly to approx. 50% relative humidity at 50°C or 122°F)
Installation category	Installation category 2
Pollution degree	Pollution degree 1 (Equipment has been designed for operation with a level of pollution of its internal micro-environment, which corresponds with the definition of Pollution Degree in BSEN 61010-1:1993)
IP rating	IP65 (as defined in BSEN 60529) In order to maintain the sealing rating, keep the free plugs and sockets physically connected to the unit even if they are not electrically connected to other units.
Noise	< 70 dBa

AS4012/AS5012 Specification

Performance	
Measurement range	0.1 – 12 mm (0.004 – 0.47 in)
Gate size	16mm (0.63in)
Accuracy	±0.0005mm (0.00002in) + 0.02% Ø
Scan flaw detection update	Flaw counts are updated every 1200s. Parameters are updated every sec.
Noise	< 70 dBa
Laser	
Class	Class 2 during operation (Class 3B during servicing i.e. with cover off)
Type	Solid state laser diode. Visible (λ=675nm), focused
Duration	Continuous (scanned)
Scan velocity	212 m/sec (82ft / sec)
Focal point	Embedded / Internal
Other	
Power	Nominal < 6W; Peak Current at startup 0.9A; Startup Time < 4s
DeviceNet current rating	Nominal: 245mA; Peak: 1.1A
Weight	3kg (6.61lb.)
Max airwipe input pressure	2 bar, 30 psi

AS5025/40/80 Specifications

Specification Specific to AS5025 / 5040

	General
Power	Nominal < 9W; Peak Current at startup 1A; Startup Time < 20s
Weight	10Kg (22 lb)
Laser	Solid state laser diode. Class 2 laser 1mW max. λ = 675 nm.
DeviceNet current rating	Nominal: 375mA; Peak: 700mA
Airwipe input pressure	3 bar (43.5psi) typical, 5 bar (72.5psi) max
Performance	
Measurement range	AS5025: 0.2 - 25 mm (0.008 - 1in) AS5040: 0.2 - 40 mm (0.008 - 1.5in)
Gate size	52mm (2.05in)
Accuracy	±0.001mm (0.00004in) ±0.02% Ø. Typically at 20°C (68°F) with product centralised.
Scan flaw detection update	Flaw counts are updated every 10ms. Parameters are updated every sec.

Specification Specific to AS5080

	General
Power	Nominal < 10W; Peak Current at startup 1A; Startup Time < 8s
Weight	31Kg (67 lb)
Laser	Solid state laser diode. Class 2 laser, 1mW max. λ = 670 nm.
DeviceNet current rating	Nominal: 465mA; Peak: 1.5A
Airwipe input pressure	30-50 psi (2-3.45 bar)
Dimensions	Refer to Dimension ie Outline drawing
Performance	
Measurement range	1.27-80mm (0.05-3.15in)
Gate size	104mm (4.09in)
Accuracy	0.002mm (0.00008in) ± 0.01% of max measurable size
Scan flaw detection update	Flaw counts updated every 10ms. Parameters updated every sec.

APPENDIX

Display - Screen Navigation

Note that the display is an optional extra.

After switching ON, the gauge will default to the startup screen (shown below), which will display the current average diameter and Ovality of the product.

The functions of a display buttons will depend on which screen is currently on view. The startup screen is shown below.

Display - Pages

Page 1

Average diameter/Ovality

Page 2

X diameter and Y diameter

Page 3

X diam, X position in gate

Page 4

Y diam, Y position in gate

Page 5

X and Y position in gate

Page 6

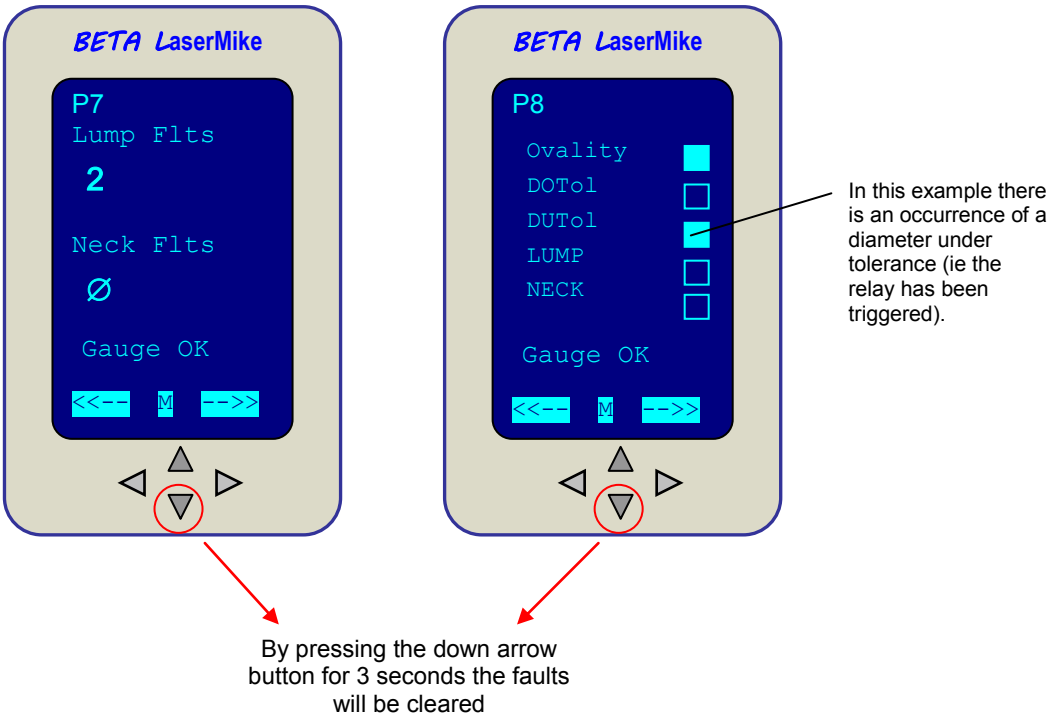
X and Y Optics (windows) condition

Page 7

Lump/Neck Fault Count

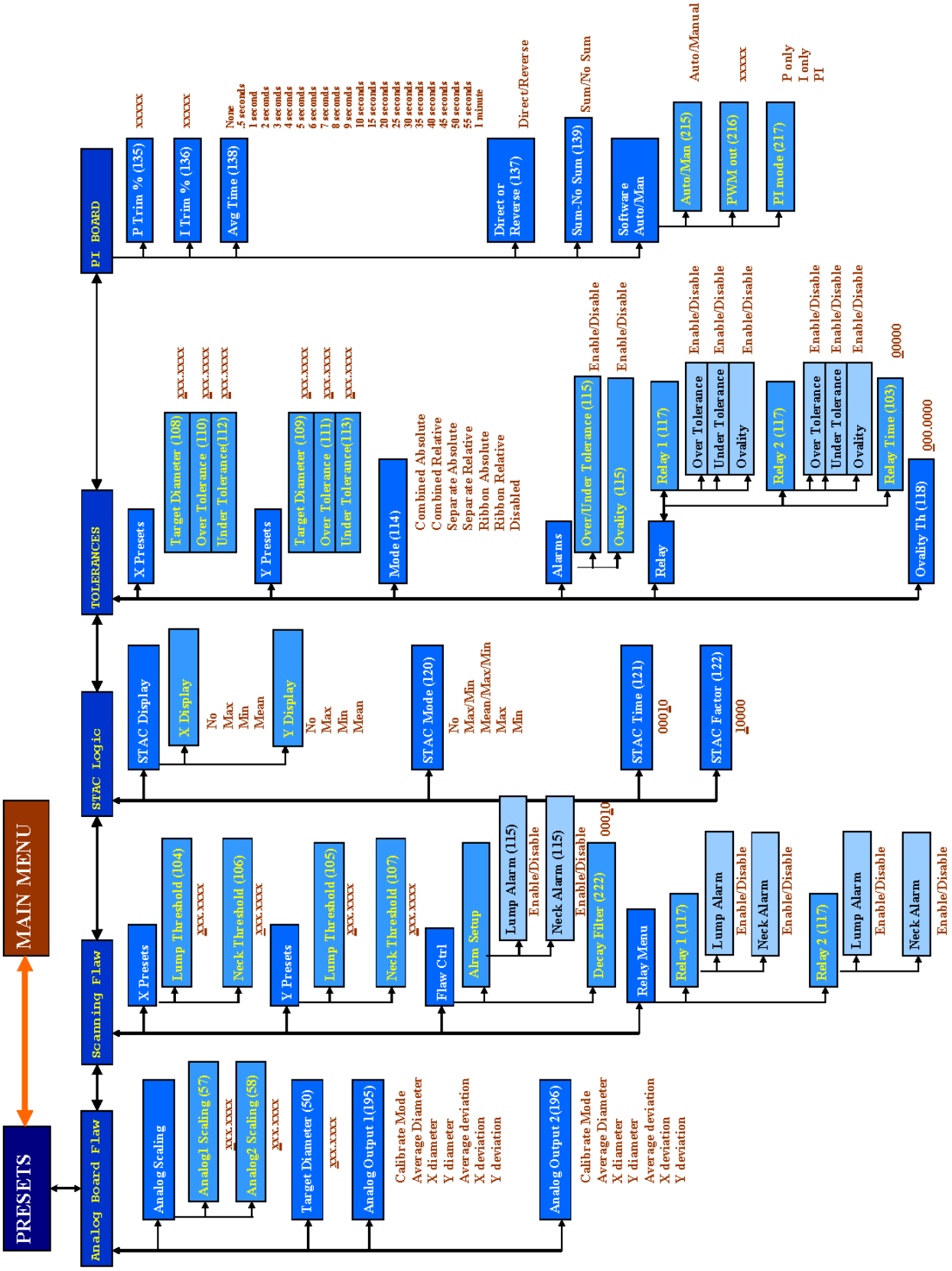
Page 8

Diameter Over/Under Tolerance and Lump/Neck faults

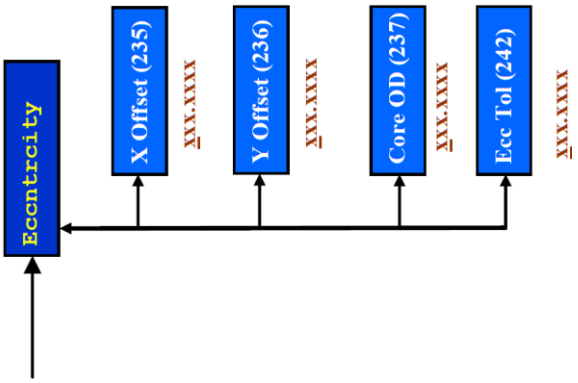


Display - Input Screens

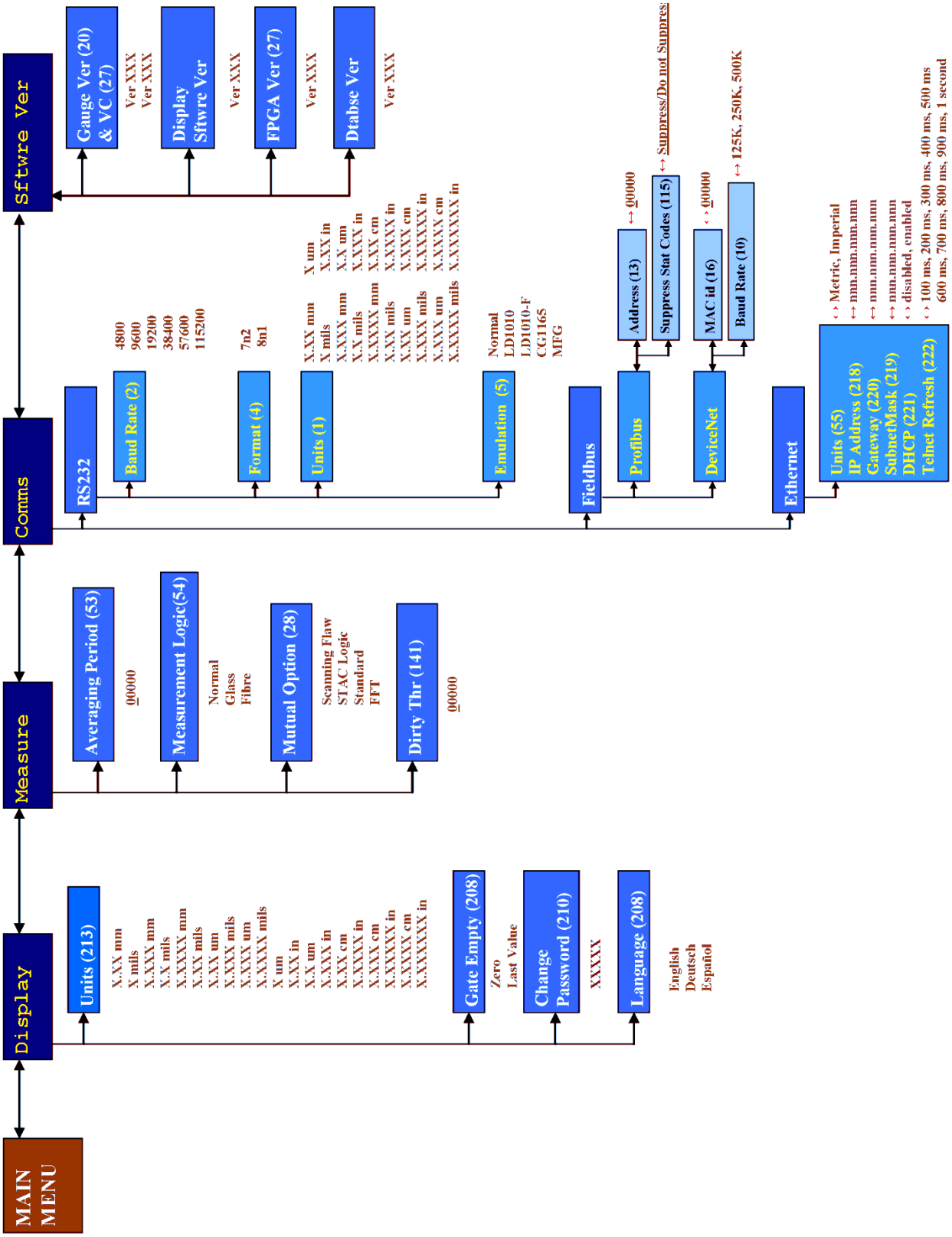
Presets submenu PART1



Presets submenu PART2



Other submenus



Passwords / Menu Lockout

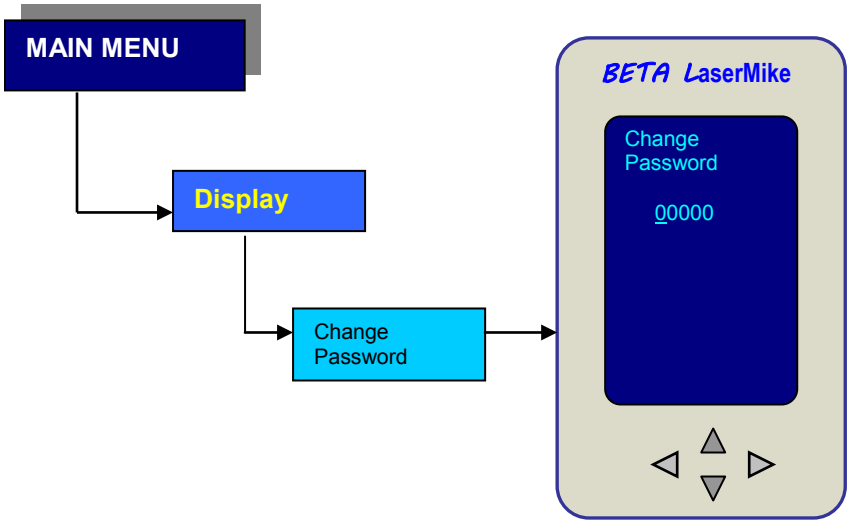
The Display software allows for the menu system to be locked so no changes can be made to the various parameters of the gauge. The menu can be locked via the setting of a user password. Once this password is entered the user can lock and unlock the menu using the password.

Entering the Password

Initially the password is set to 00000. When the password is at zero the menu is automatically unlocked. To enter a password navigate the menu as follows:

Starting from any of the main pages (P1 through P8) press the up arrow key to get into the Main Menu.

In the Main Menu press the down arrow key once and the right arrow key once to get to the Display Menu. In the Display menu press the down arrow key twice (or the up arrow key once) and the right arrow key once to get into the Change Password Menu as shown below:



Using the arrow keys, position the cursor under the number to be changed. A **valid** password will consist of any combination of 5 digits of 1 to 4.

i.e.

- 12342
- 11111
- 14234
- 43213

Valid Passwords

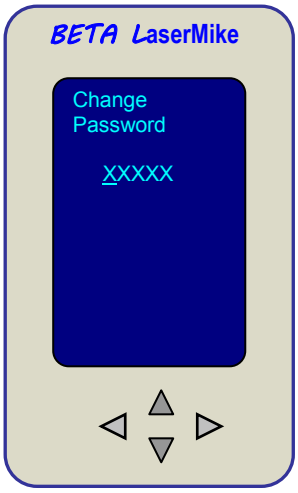
- 34201
- 15752
- 94230

Invalid Passwords

Once a valid password is set, exit the Change Password menu and the menu system will automatically lock within one minute of not detecting any key activity.

Once the menu is locked the menus can be traversed as usual and the different parameter values can be seen but cannot be changed. The menu system will be in a “read-only” mode with the exception being the Menu Lock/Unlock Page.

Also when the menu is locked the Change Password menu will display “XXXXX” instead of the password as shown.



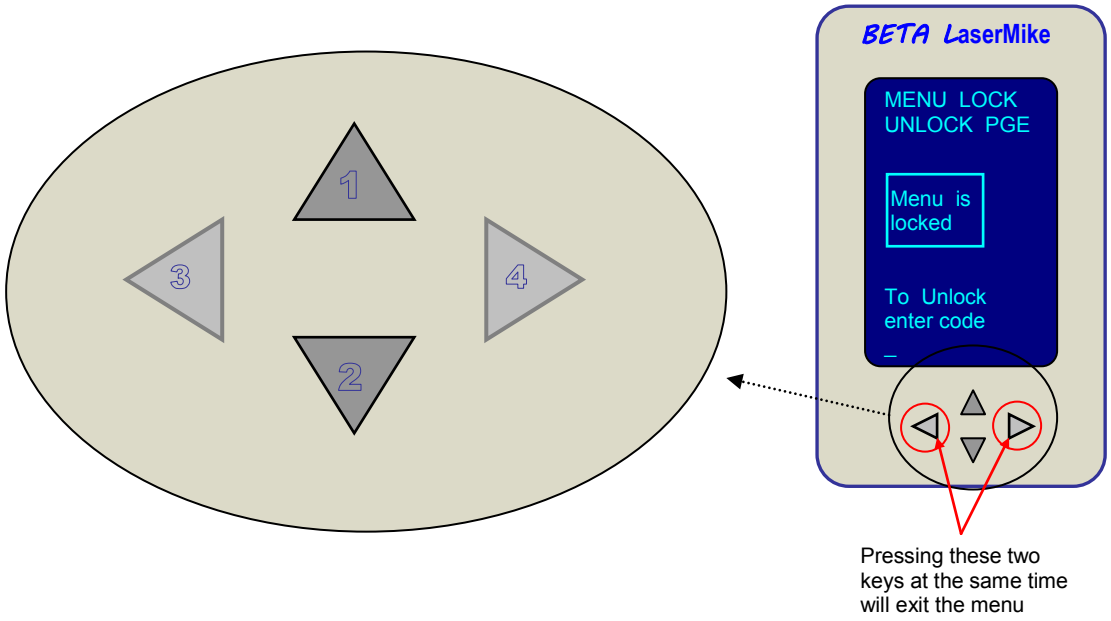
Unlocking/Locking the Menu

Once a valid password has been set and the menu is locked there is one way to unlock the menu.

Use the Menu lock/Unlock menu

From the main page menus (P1 through P6) press and hold the down arrow key for about 3 seconds. The following menu should appear:

Using the arrow keys, enter the 5-digit password. For the purpose of entering the password the arrow keys have the following values associated with them:



Once the password has been successfully entered a '*Success*' banner will appear in the display for about 1 second and the display will show the menu page from where the lock/unlock menu was entered.

Note: After 1 minute of not detecting any key press activity the menu will be automatically locked again.

Changing the Password

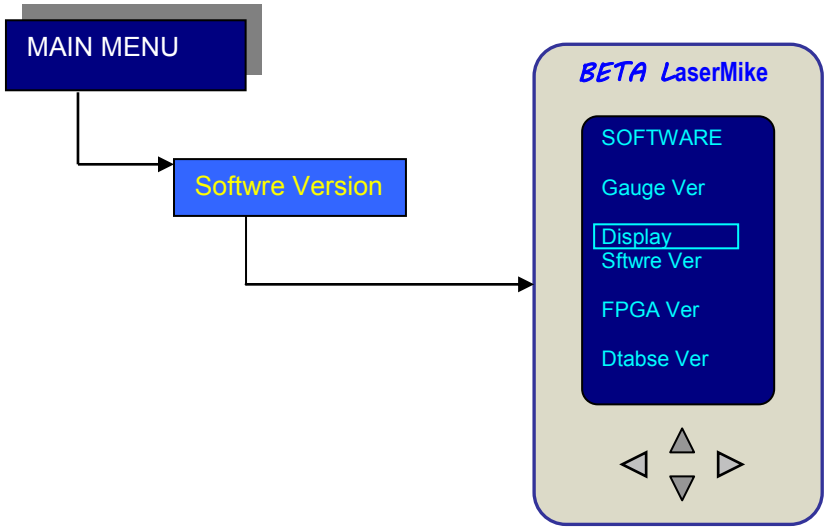
If it desired to change an existing password the menu must first be unlocked as described above. Navigate to the Change Password menu and enter a new password as described in the Entering Password paragraph.

Viewing the Software Version

A menu has been dedicated to display the versions of the different software packages that compromise the AccuScan gauge. There are four software packages:

- The Gauge microprocessor software
- The Display microcontroller software
- The Gauge FPGA software
- The Menu Database version

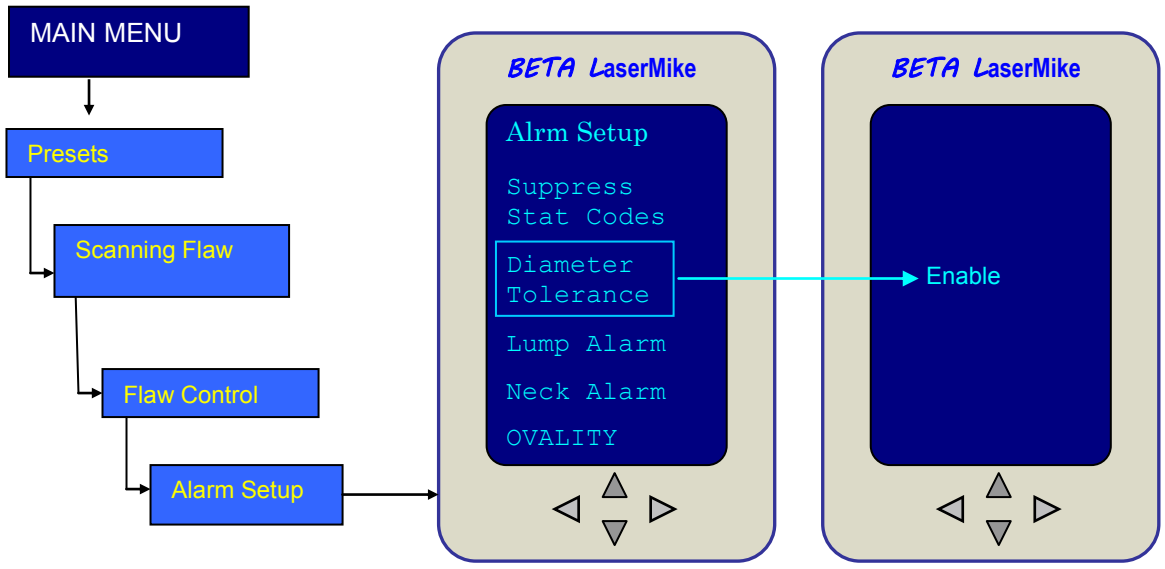
The Software Version menu can be reached by navigating the menu system as shown below:

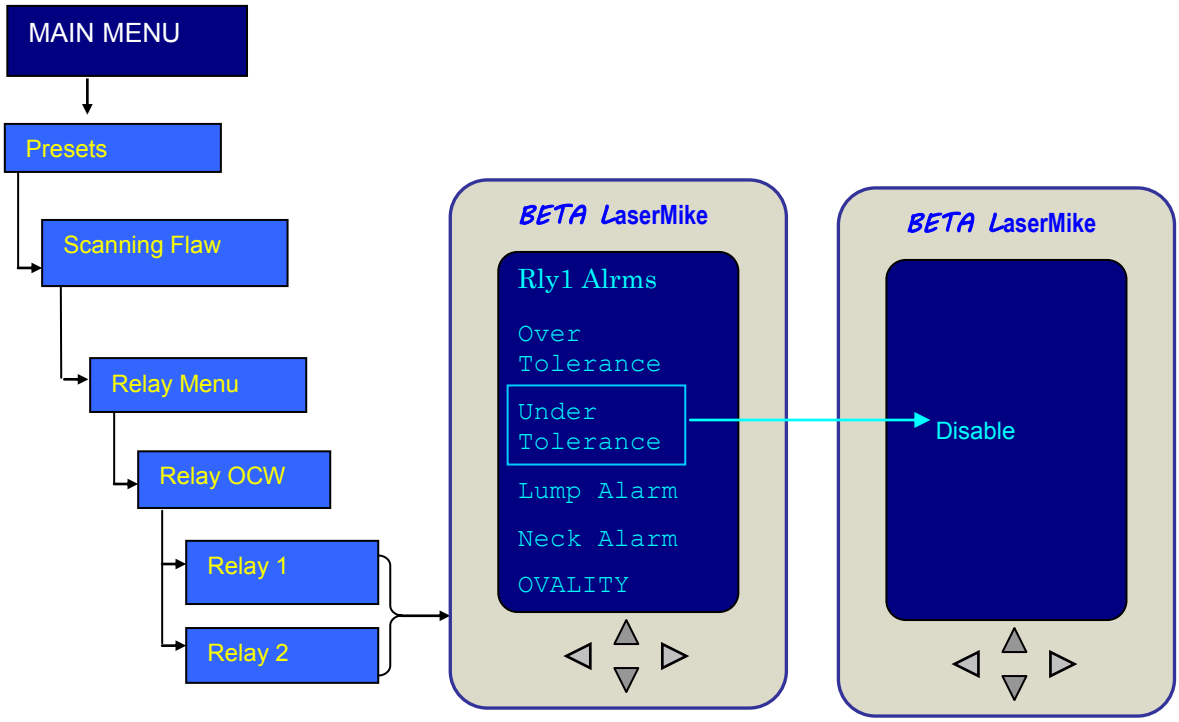


In order to view the version of each software package, select the package using the up and down arrow keys and press the right arrow key to view the version of the selected package.

Bit Field Manipulation for Bits in the Relay OCW and FCW Cells

The menu allows for the individual bits to be enabled or disabled in the Relay OCW (Output Control Word) cell and FCW (Flaw Control Word) cell.

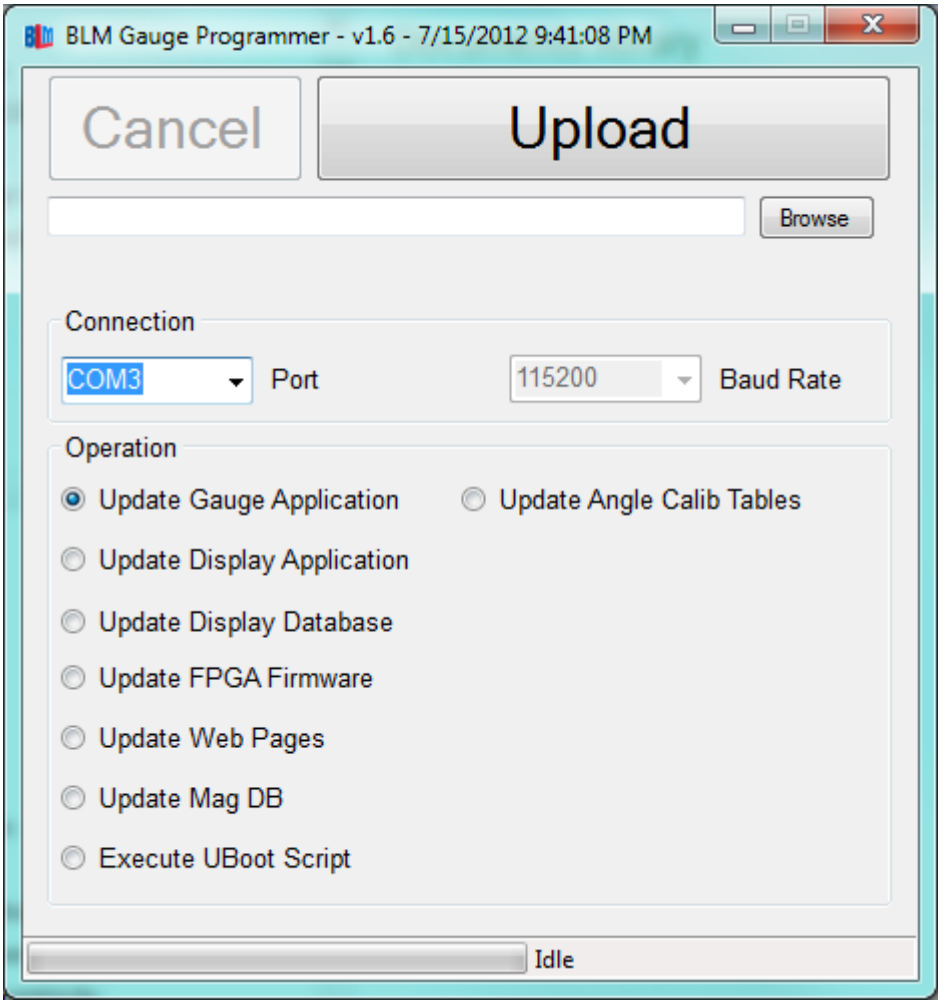




Software/Firmware Update Instructions

This section describes how to upgrade the software in the AccuScan AS4000/5000 range of gauges (AS50xx) via RS232.

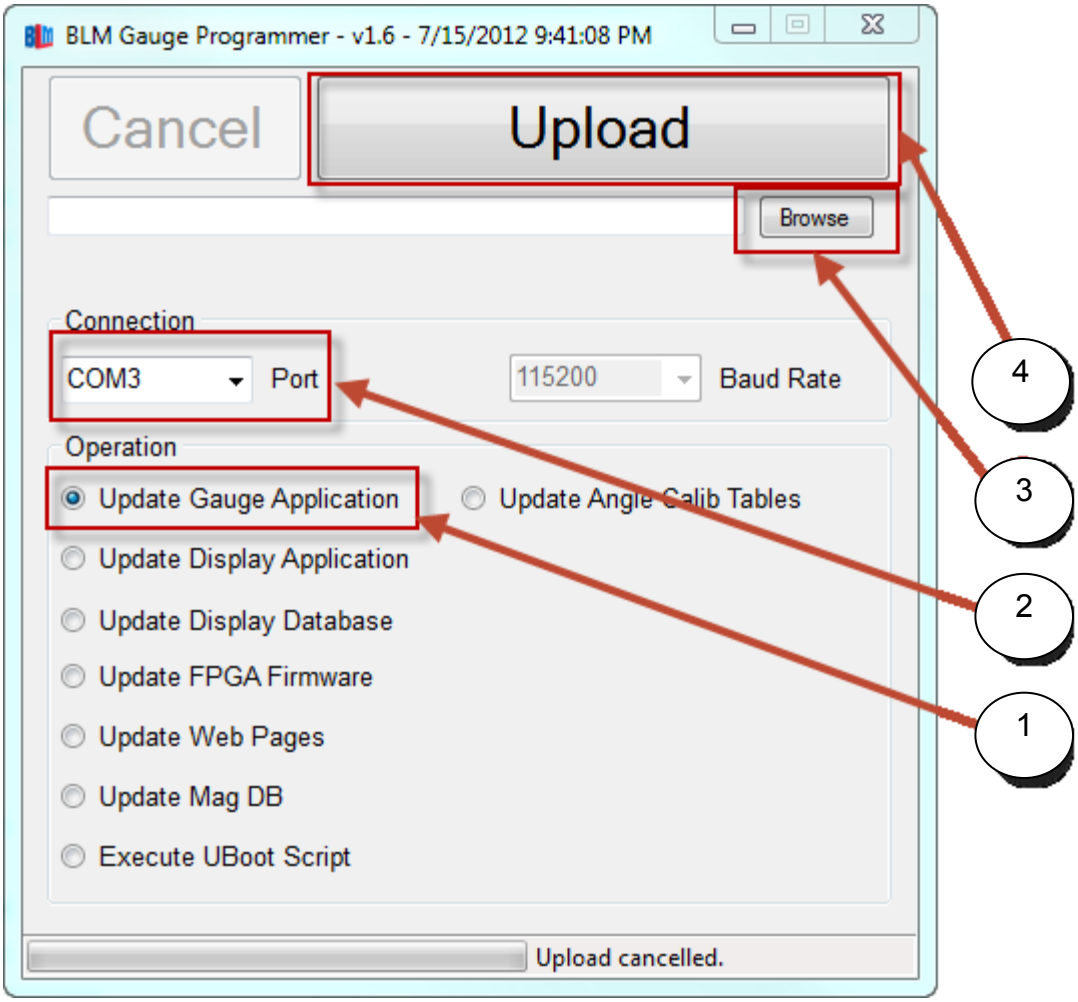
Software / Firmware Update



Utility Installation

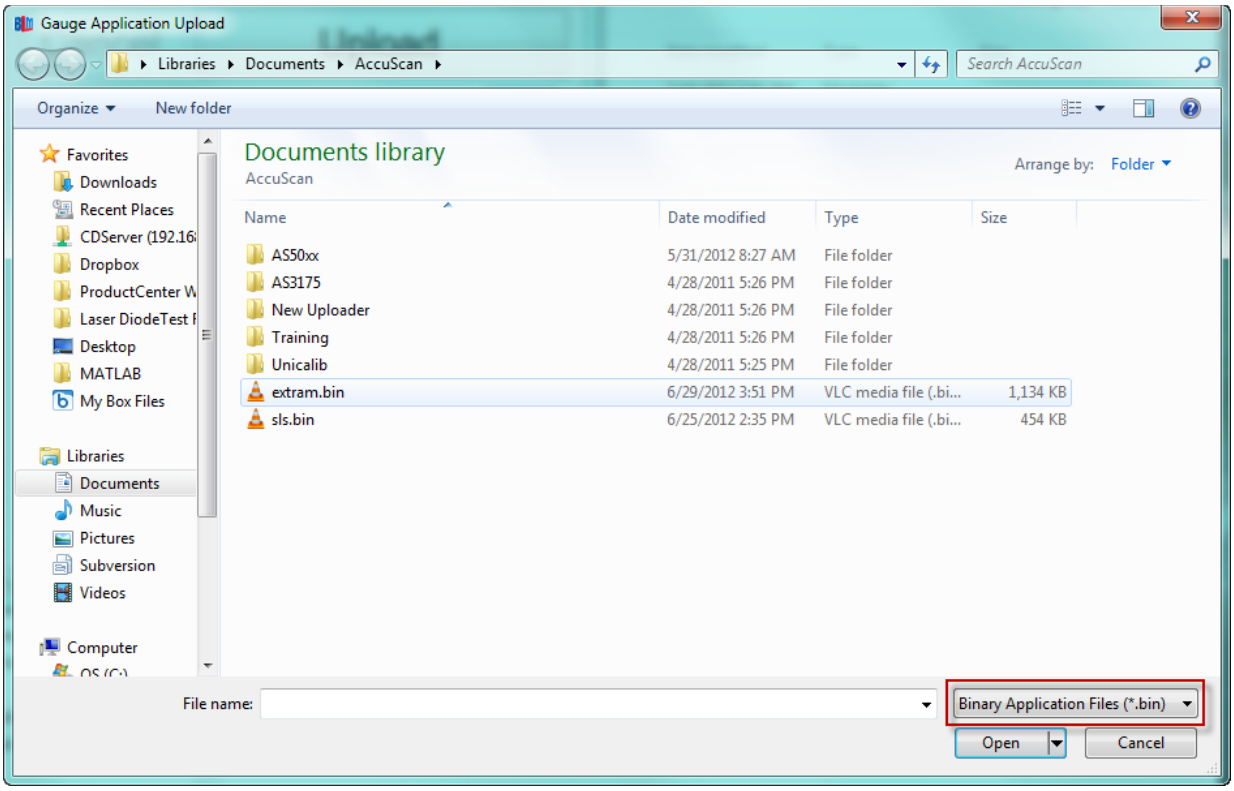
The utility is installed using the BLMGaugeProgrammer_setup.exe program. It installs by default to the “C:/Program Files/Beta LaserMike/BLM Gauge Programmer” folder.

Application Programming



New AS50xx gauges utilize the Freescale MPC5125 processor
For new AS50xx gauges utilizing the Freescale MPC5125 processor, a single ".bin" file is provided and required to update the gauge application. Follow the steps 1-4 outlined in the drawing above.

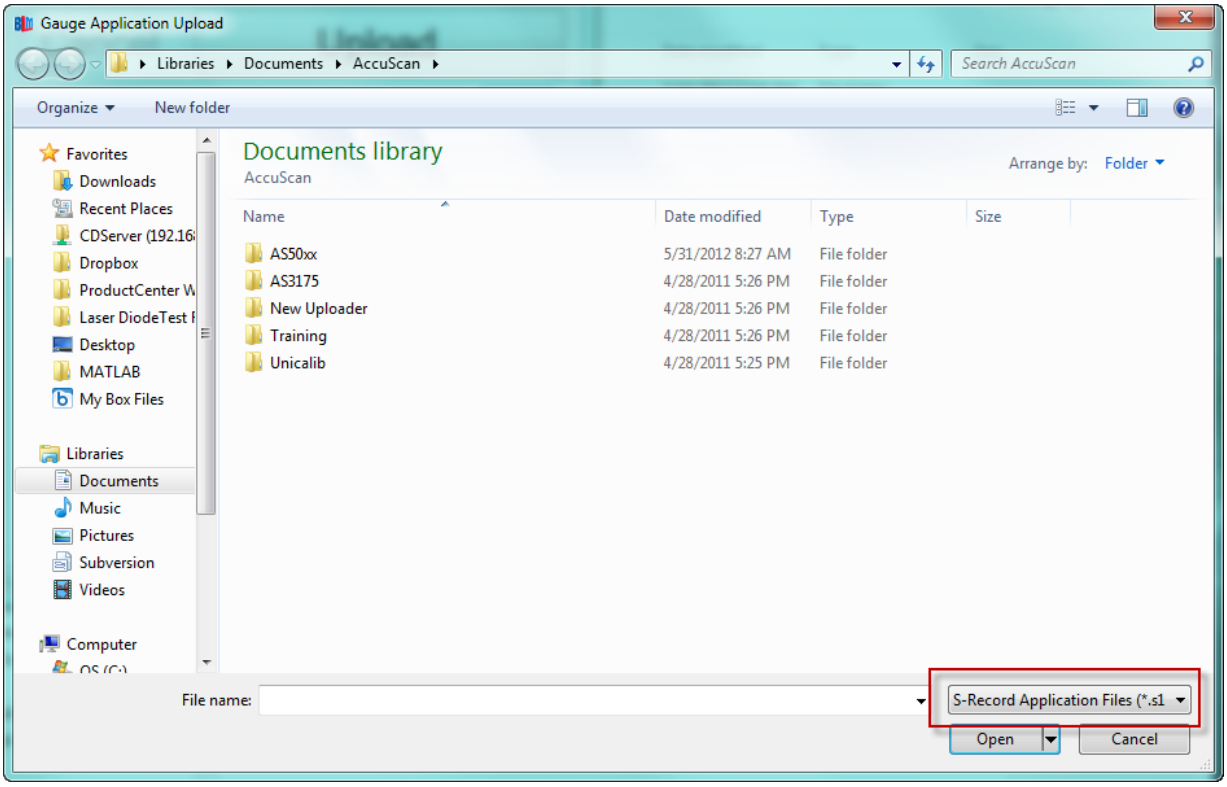
When the Browse button is clicked, a file dialog appears. The file filter should default to the “Binary Application Files (*.bin)” filter. If it does not, then select the “Binary Application Files” filter and then select the appropriate file.



Click the Upload button to ready the utility for upload. The utility status bar will indicate “Waiting for target reset”. At this point power-cycle the gauge and the upload should start automatically.

AS50xx gauges utilizing the NIOS II processor
For Legacy AS50xx gauges utilizing the NIOS II processor, a single “.s19” file is provided and required to update the gauge application. Follow the steps 1-4 outlined in the drawing above.

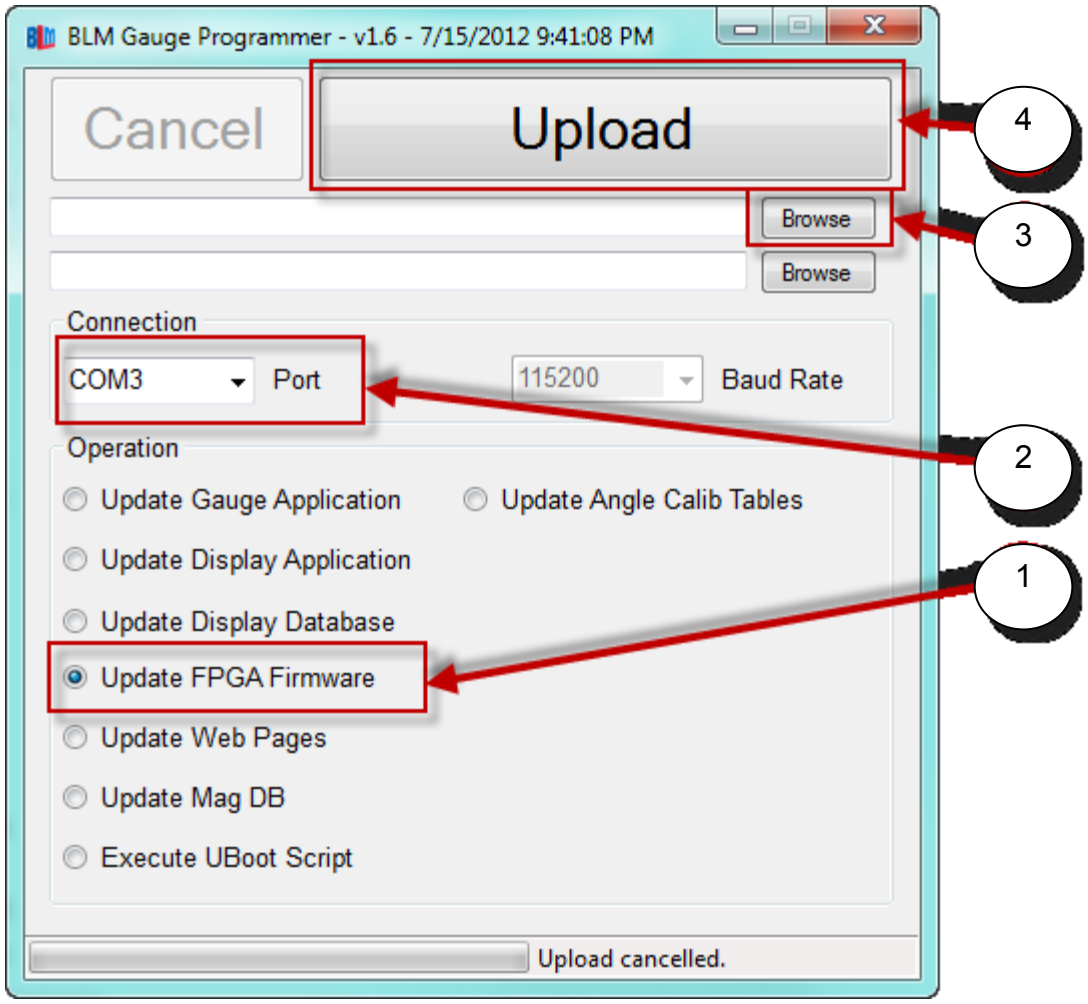
When the Browse button is clicked, a file dialog appears. Change the file filter to the “S-Record Application Files (*.s19)” filter and then select the appropriate file.



After clicking the “Upload” button, the utility status bar will indicate “Waiting for target reset”. At this point, power-cycle the gauge and the upload should start automatically.

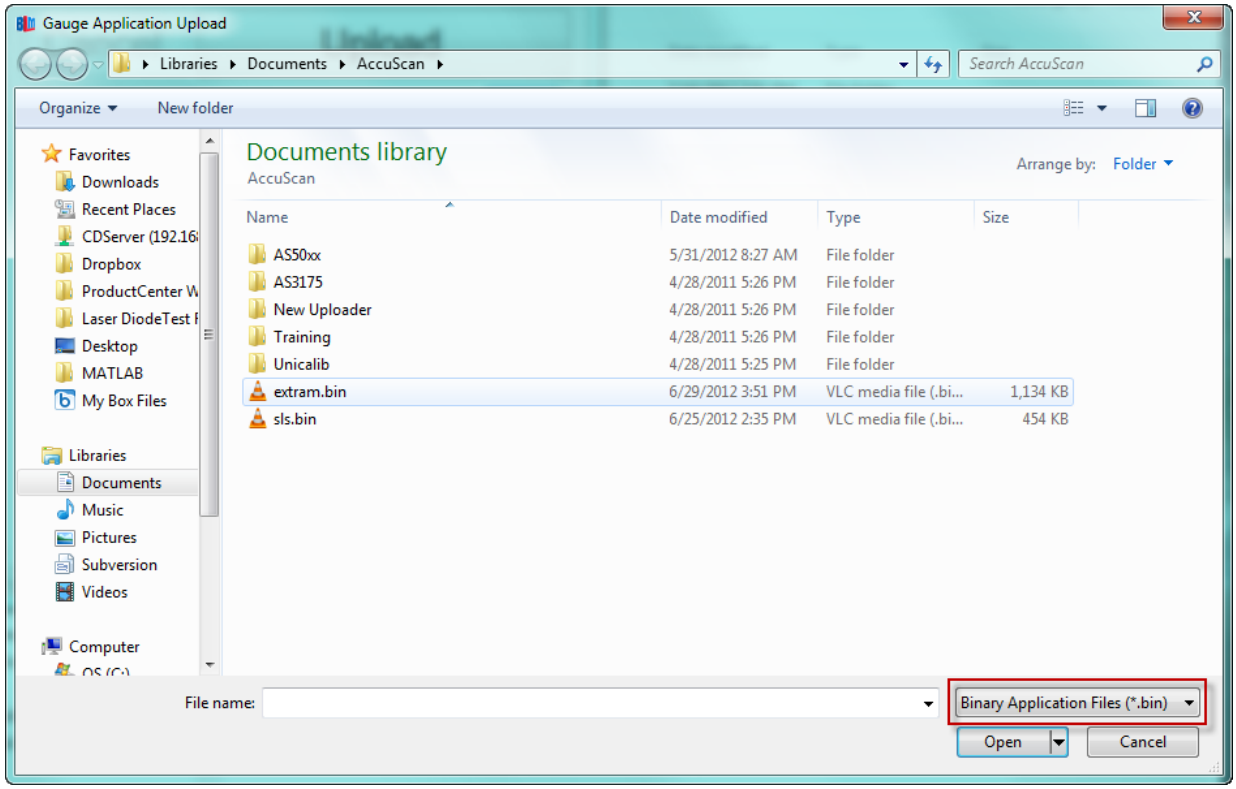
FPGA Programming

New AS50xx gauges utilizing the Freescale MPC5125 processor



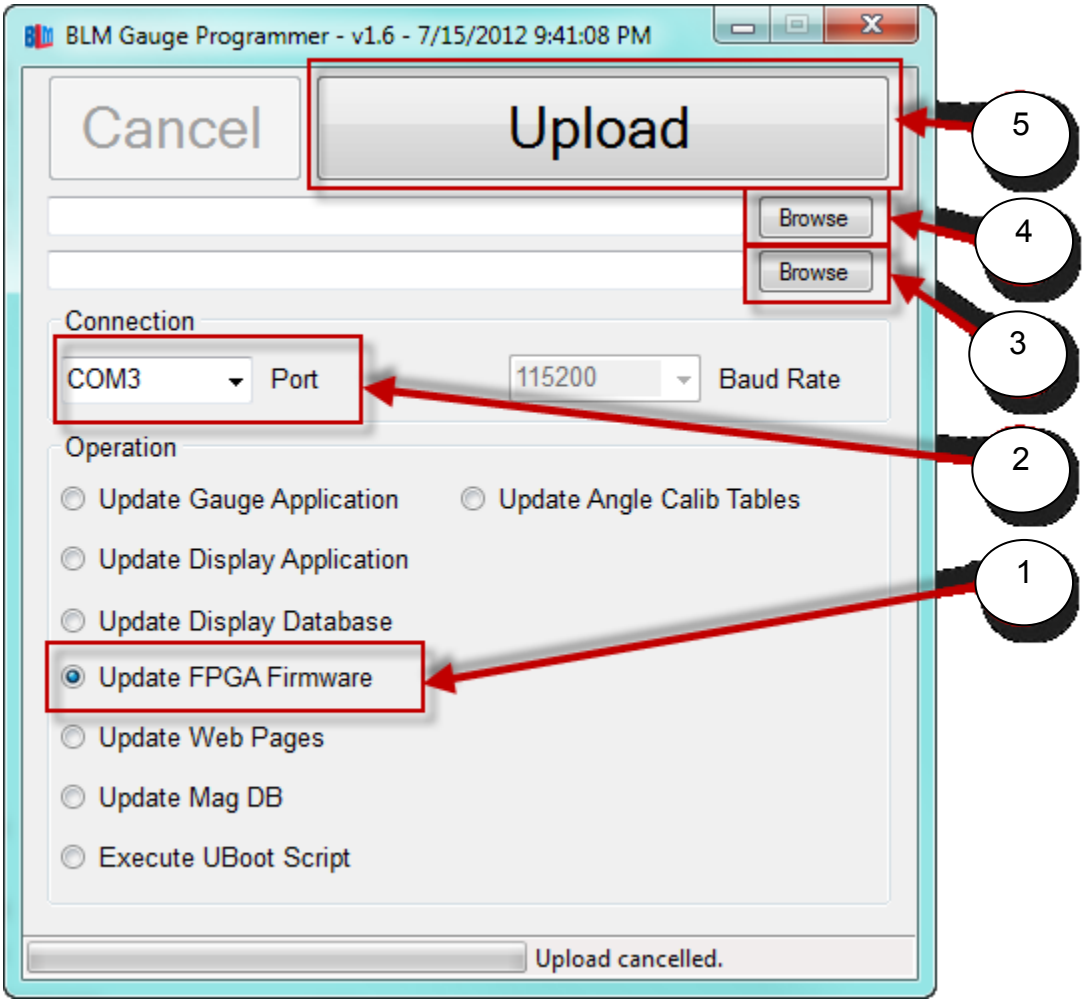
For new AS50xx and LN30xx gauges utilizing Freescale MPC5125 processor, a single ".bin" file is provided and required to update the FPGA. Follow the steps 1-4 outlined in the drawing above.

When the Browse button in step 3 is clicked, a file dialog appears. The file filter should default to the "Binary Application Files (*.bin)" filter. If it does not, then select the "Binary Application Files" filter and then select the appropriate FPGA programming file.



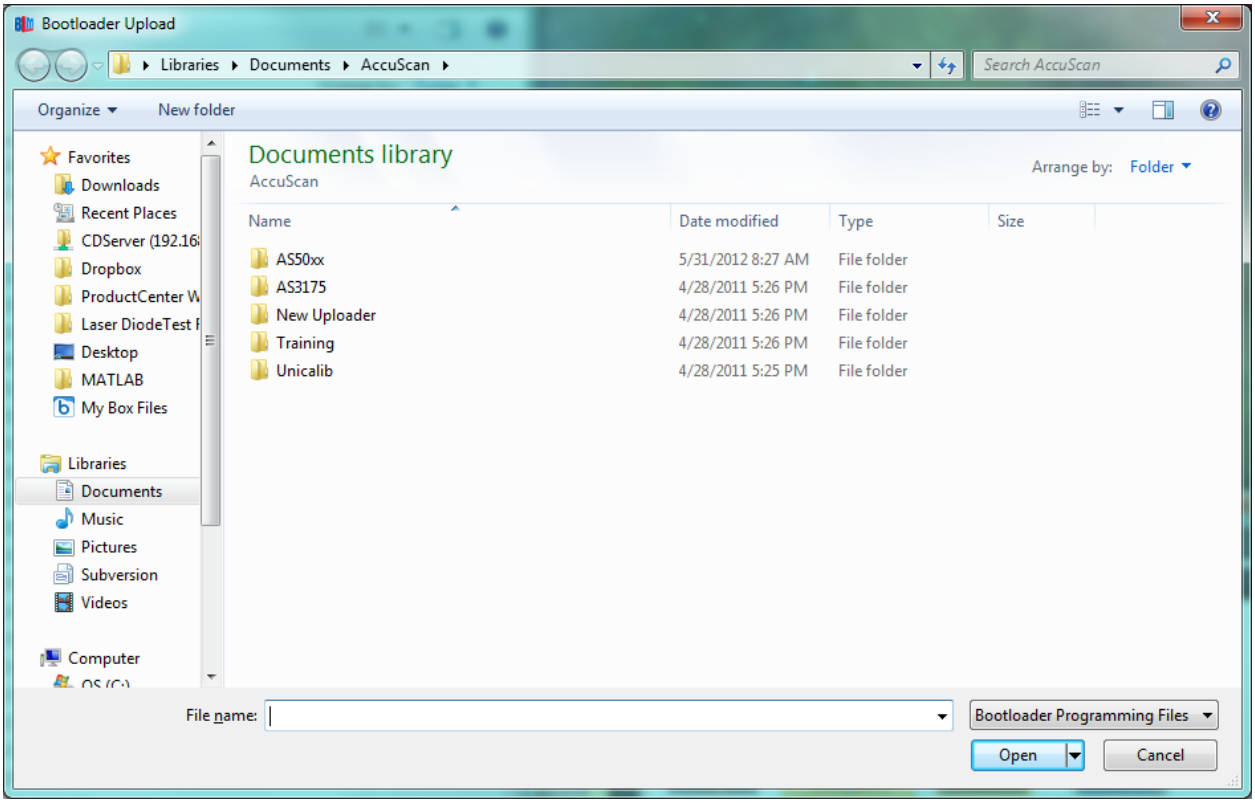
After clicking the “Upload” button, the utility status bar will indicate “Waiting for target reset”. At this point, power-cycle the gauge and the upload should start automatically.

Legacy AS50xx gauges utilizing the NIOS II processor

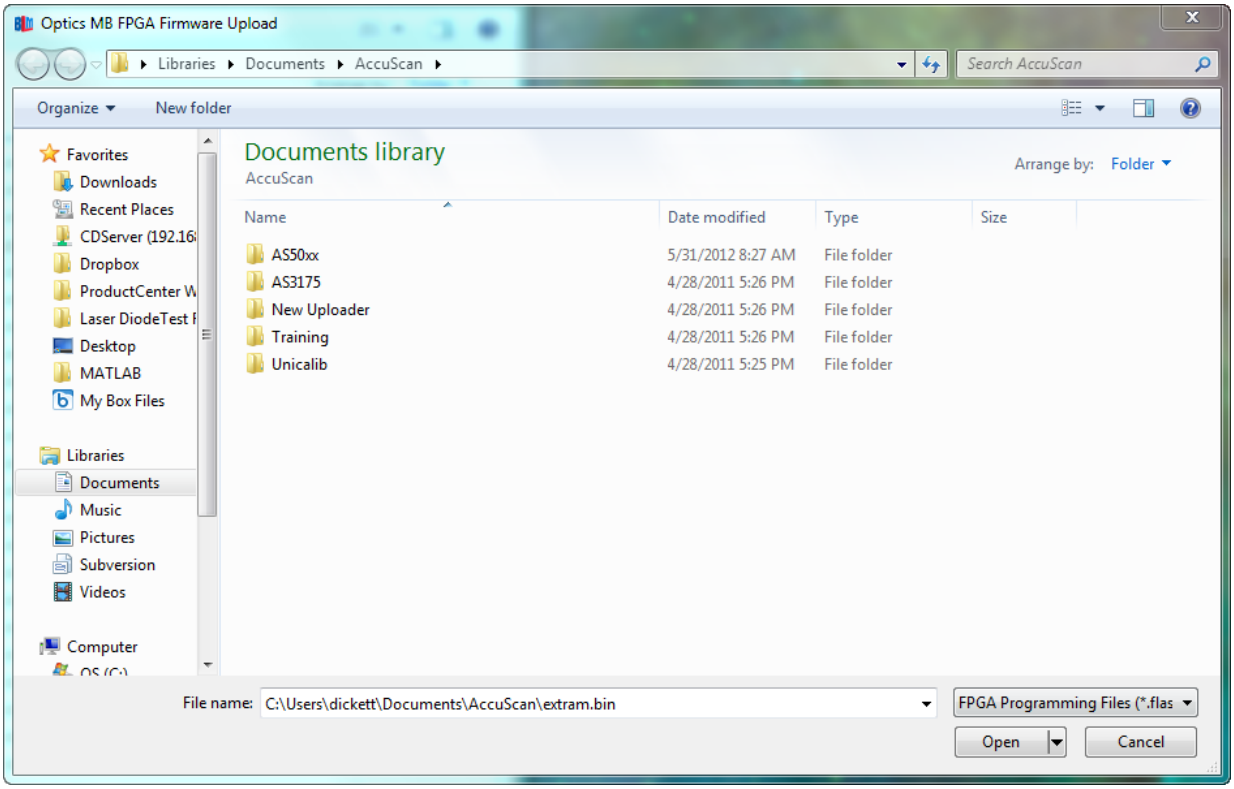


For Legacy AS50xx gauges utilizing the NIOS II processor, 2 files are required – an FPGA image ".flash" file is provided and a bootloader image ".elf" file. Follow the steps 1-5 outlined in the drawing above.

When the Browse button in step 3 is clicked, a file dialog appears. Change the file filter to the "Bootloader Programming Files (*.elf)" filter and then select the appropriate file.



When the Browse button in step 4 is clicked, a file dialog appears. Change the file filter to the “FPGA Programming Files (*.flash)” filter and then select the appropriate file.



After clicking the “Upload” button, the utility status bar will indicate “Waiting for target reset”. At this point, power-cycle the gauge and the upload should start automatically.

3) To program the Display processor, select "Update Display Application" in the Utility. You will need 1 file, a .hex file. Put the Gauge in bootload mode. Select this file and press upload. The Utility will program the display processor.
4) To program the Display Database, select "Update Display Database" in the utility. You will need one file, a .xmodem file. Put the Gauge in Xmodem mode. Select this file and press upload. The Utility will program the display database.

NOTE:
The Java Platform standard edition 6 must be installed on the host computer.
http://www.java.com/en/download/index.jsp
Microsoft .Net 2.0 (or higher) must be installed on the host computer
Download details: .NET Framework Version 2.0 Redistributable Package (x86)

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