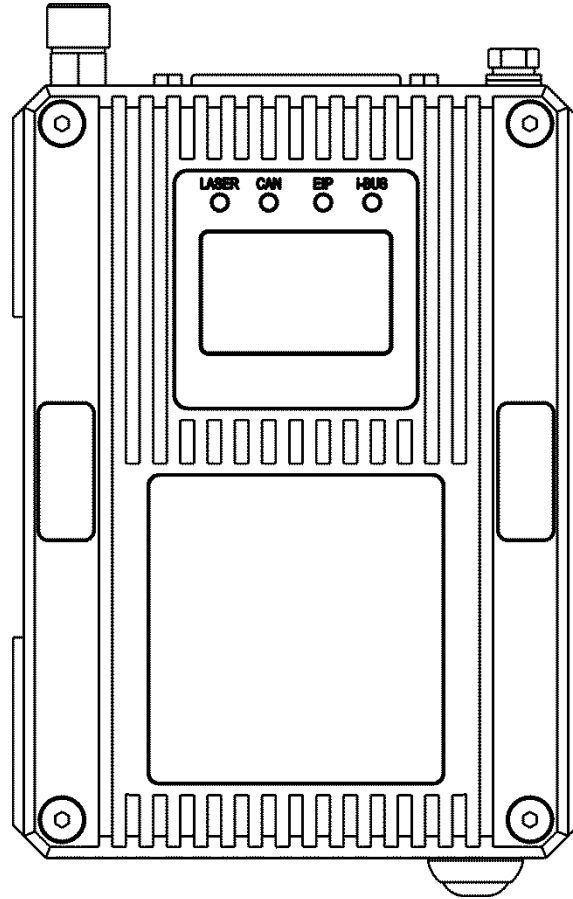


Instruction Manual

SL mini-i4 W and SLR mini-i4 W Series Speed and Length Gauges



Issue 3p
27 October 2023

Proton Products Co. Ltd.
10 Aylesbury End
Beaconsfield
Buckinghamshire HP9 1LW
England

www.protonproducts.com

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DECLARATION OF CONFORMITY (CE)

Manufacturer's name: Proton Products International Ltd
 Manufacturer's address: 10 Aylesbury End
 Beaconsfield
 Bucks, UK

EMC Standards Applied: EN IEC 61326-1:2021
 Low Voltage Standards Applied: EN61010-1:2010+A1:2019 (Scientific and measuring instruments)

Laser used is 658Nm maximum power output for each beam 20mW (two are emitted from a single source).

Laser Safety Compliance to: BS EN 60825-1:2014/A11:2021
 Limitations to use: Heavy Industrial Environment

Compliance with EMC directives was by the standards route.

It is declared for and on behalf of Proton Products Ltd that the equipment specified below conforms to EC directives EMC: 2014/30/EU and Low Voltage: 2014/35/EU and Laser Safety BS EN 60825-1:2014/A11:2021

Equipment Covered

Product name	Description	Part number
SL mini 1220-i4 W	Unidirectional non-contact speed and length gauge (stand-off distance: 120mm, depth-of field: 20mm)	00060MC011
SL mini 3060-i4 W	Unidirectional non-contact speed and length gauge (stand-off distance: 300mm, depth-of field: 60mm)	00060MC012
SLR mini 1220-i4 W	Bidirectional non-contact speed and length gauge (stand-off distance: 120mm, depth-of field: 20mm)	00060MC015
SLR mini 3060-i4 W	Bidirectional non-contact speed and length gauge (stand-off distance: 300mm, depth-of field: 60mm)	00060MC016
PSU-BOB i4	Break out box for the 25 pin terminal strip on the gauge head combined with power supply	00060MC050
SiDi-CDi4	Touch screen display module	00049MC021

These products carry the CE Mark:



The manufacturer of the above named equipment is:

Proton Products International Limited
 10 Aylesbury End
 Beaconsfield
 Bucks
 HP9 1LW
 ENGLAND

Proton Products is an ISO9001:2015 registered company.

The declaration is signed by:



Paul Sives

DECLARATION OF CONFORMITY (CSA)



This is to certify that the following equipment has been manufactured in compliance with the standards for Machine Safety and Workplace Electrical Safety according to the CSA (Canadian Standards Association).

Equipment Covered

Product name	Description	Part number
SL mini 1220-i4 W	Unidirectional non-contact speed and length gauge (stand-off distance: 120mm, depth-of field: 20mm)	00060MC011
SL mini 3060-i4 W	Unidirectional non-contact speed and length gauge (stand-off distance: 300mm, depth-of field: 60mm)	00060MC012
SLR mini 1220-i4 W	Bidirectional non-contact speed and length gauge (stand-off distance: 120mm, depth-of field: 20mm)	00060MC015
SLR mini 3060-i4 W	Bidirectional non-contact speed and length gauge (stand-off distance: 300mm, depth-of field: 60mm)	00060MC016
PSU-BOB i4	Break out box for the terminal strip on the gauge head combined with power supply	00060MC050
SiDi-CDi4	Touch screen display module	00049MC021

The manufacturer of the above named equipment is:

Proton Products International Limited
10 Aylesbury End
Beaconsfield
Bucks
HP9 1LW
ENGLAND

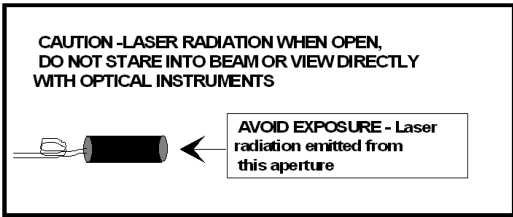
Proton Products is an ISO9001:2015 registered company.

The declaration is signed by:

Paul Sives



LASER SAFETY PARAMETERS



Proton Products SL mini-i4 W and SLR mini-i4 W series laser speed and length gauges emit laser radiation with the following parameters:

Parameter	Minimum	Typical	Maximum	Units
Wavelength	650	658	670	nm
Beam diameter			3	mm
Spot size at standoff distance			3	mm
Beam divergence			1.5	mrad
Total emitted power			40	mW
Emitted power per beam (2 beams are emitted)			20	mW
Power density at gauge window			280	mW/cm ²
Power density at standoff distance			560	mW/cm ²
Nominal hazard zone (NHZ) distance (diffuse surface reflection)*	20 to 100			mm
Nominal hazard zone (NHZ) distance (specular / reflective surface reflection)	150			m

*this distance is highly dependent on the nature and type of diffuse surface.

This product complies with DHHS Rule 21 CFR chapter I subchapter J in effect at date of manufacture.
 This item complies with 21 CFR 1040.10 and 1040.11.
 Manufacturer: Proton Products International Ltd.
 Address: 10 Aylesbury End Beaconsfield Buckinghamshire HP9 1LW England.

Manufacturer signature:

Paul Sives: 

Proton Products is an ISO9001:2015 registered company.



INTRODUCTION

The Proton Products SL mini-i4 W and SLR mini-i4 W series of laser speed and length gauges provide highly-accurate, non-contact speed and length measurement.

SL mini-i4 W series gauges offer speed and length measurement for unidirectional production lines.

SLR mini-i4 W series gauges offer speed and length measurement for bidirectional production lines. The gauge senses the direction of motion and will automatically increment or decrement the length accordingly. SLR mini-i4 W gauges are thus suitable for production lines that undergo direction reversals or stationary (zero speed) periods.

Compared to traditional contact wheel encoders, SL mini-i4 W / SLR mini-i4 W non-contact speed and length gauges offer the following advantages:

- Capable of measurement at much higher speeds and accelerations
- No slippage
- Greater accuracy
- No wear or damage to the measured object
- Solid state design results in higher reliability and MTBF

RS-232, RS-422, RS-485, Ethernet, industrial standard communication interfaces (PROFIBUS, EtherNet/IP or PROFINET) and WiFi communication interfaces are installed as standard for straightforward connection to computers or PLCs.

User configurable digital inputs are provided as standard to reset gauge measurements and trigger printing. User configurable digital outputs are provided as standard to signal gauge status and preset length reached.

PRINCIPLE OF OPERATION

SL mini-i4 W series unidirectional speed and length gauges illuminate the measured surface with a precisely pitched interference pattern created by the intersection of two laser beams. The alternating bright and dark interference fringes modulate the light scattered by the object with a frequency proportional to the object speed. This scattered light is detected by a photodiode and the electrical signal digitally processed to determine the frequency and hence the speed. Object length is then calculated by integrating the speed measurement over time.

SLR mini-i4 W series bidirectional speed and length gauges extend this principle by using a high-frequency Bragg cell modulator to illuminate the measured surface with a scanning interference pattern, which generates an oscillating light signal even when the object is stationary. Direction of motion is determined by whether the scattered light frequency is higher or lower than the stationary frequency.

PRINCIPLE OF OPERATION

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

- Fringe spacing is a function of laser wavelength and beam angle.

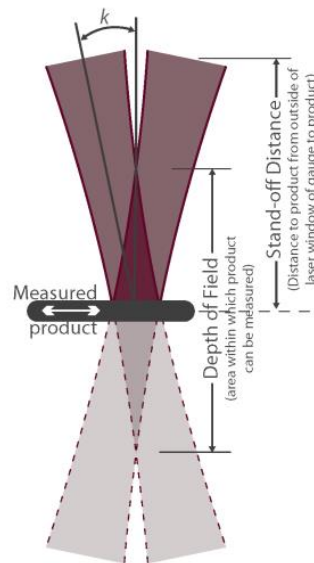
$$f \propto \frac{v}{d}$$

- Doppler frequency is proportional to speed and inversely proportional to fringe spacing.

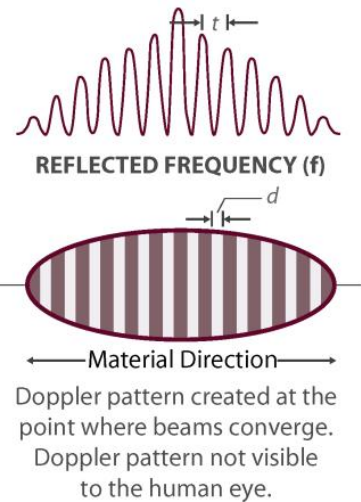
$$L = \int_0^T v dt$$

- Speed is integrated to measure length.

LASER BEAMS: SIDE VIEW



LASER DOPPLER PATTERN



SPECIFICATIONS

MODEL-SPECIFIC SPECIFICATIONS

Specification	Unidirectional – SL mini-i4 W		Bidirectional – SLR mini-i4 W		Units
	1220	3060	1220	3060	
Minimum speed* (Low speed enabled)	0.15	0.25	0	0	m/min
Minimum speed** (Low speed disabled)	0.4	1.1	0	0	m/min
Maximum speed	2000	3000	±2000	±3000	m/min
Maximum measurable length***	2 ³¹ ×length resolution		± 2 ³¹ ×length resolution		m
Nominal stand-off distance	120	300	120	300	mm
Depth of field	20	60	20	60	mm

*Minimum measurable speed when low speed measurement is enabled on CDI4 measurement page.

** Minimum measurable speed when low speed measurement is disabled on CDI4 measurement page (i.e. SL gauge will stop measuring object speed when below this speed value).

***Maximum measurable length is dependent on the setting of length resolution on CDI4 Measurement page. If the length resolution is set to 0.1, the maximum measurable length is 2³¹×0.1=214748364.8 m; if the length resolution is set to 0.0001, the maximum measurable length is 2³¹×0.0001=21474.8 m.

COMMON SPECIFICATIONS

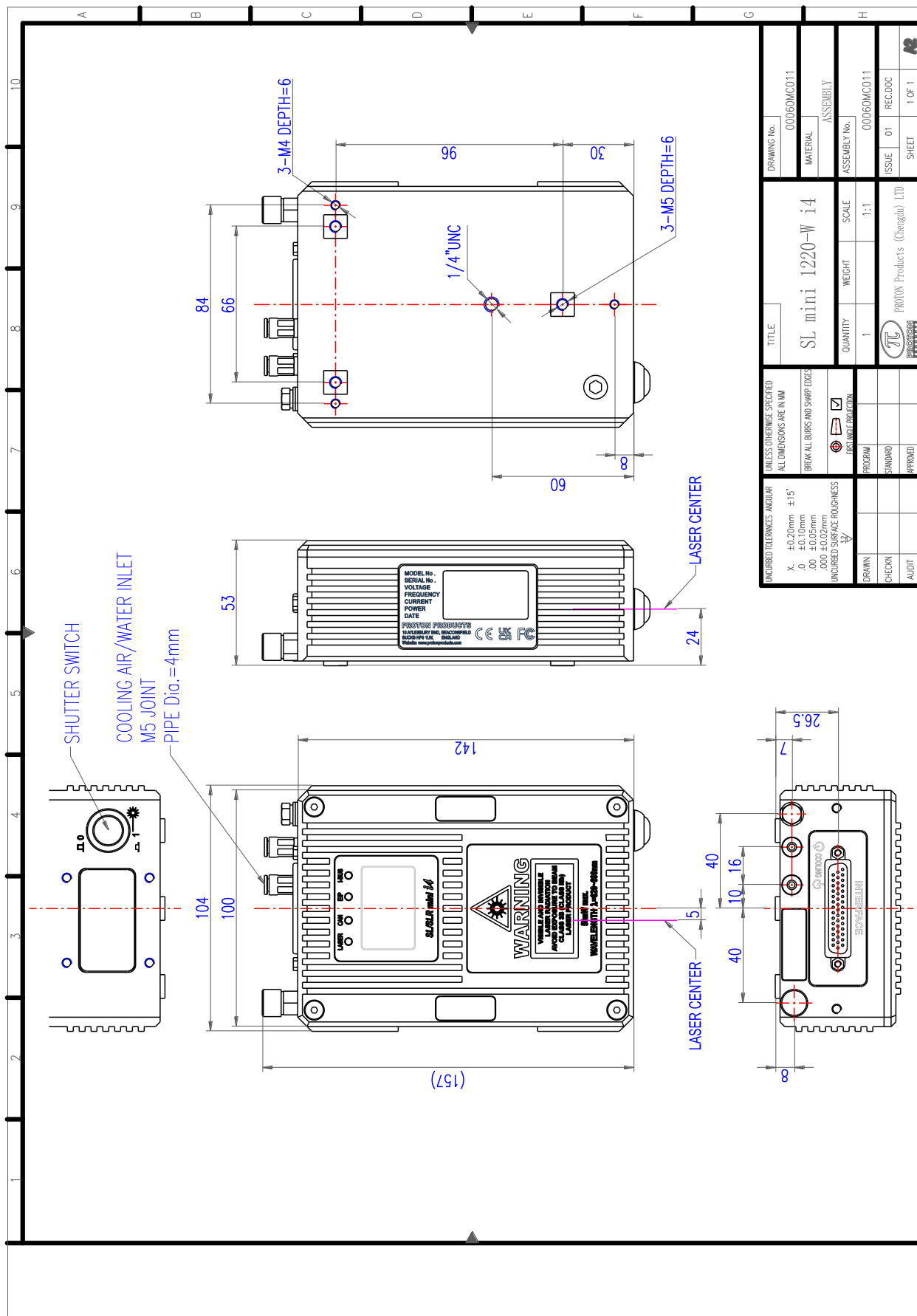
Specification	Minimum	Typical	Maximum	Units
Accuracy	-0.05		0.05	%
Repeatability	-0.02		0.02	%
Acceleration			500	m/s ²
Measurement update time			40	µs
Laser beam diameter			3	mm
Laser classification			3B	-
Operating temperature	+5		+40	°C
Environmental protection			IP67	-
Power supply voltage	18	24	30	VDC
Power consumption			15	W

Length			142	mm
Width			104	mm
Height			53	mm
Measurement display	Integrated backlit LCD			
Pulse outputs	3x RS-422 compliant differential pair outputs with maximum pulse rate 2 MHz (cable length dependent), end-user configurable as:			
	6x independent pulse outputs		3x quadrature output	
Laser safety	Laser enable input		Open shutter input	
	Shutter status output			
3x Logic inputs (end-user configurable functions)	Reverse Direction		Length Hold	
	Reset		Speed Hold	
	End of Reel		Display Hold	
2x Logic outputs (end-user configurable functions)	Gauge OK		Gauge too hot	
	Good reading		Object detected	
	Preset length 1 / Batch length reached			
	Preset length 2 / Batch number reached			
	Gauge measuring speed			
Standard communications interfaces	RS-232*		CANbus**	
	Ethernet TCP/IP (Modbus protocol), WIFI, OPC UA.			
	PROFIBUS	PROFINET	EtherNet/IP	

*An optional RS-232-to-USB converter cable is available for connection to USB equipped computers.

**CAN-bus protocol is proprietary and reserved for connection to other Proton Products equipment such as a CDI4 interface display unit.

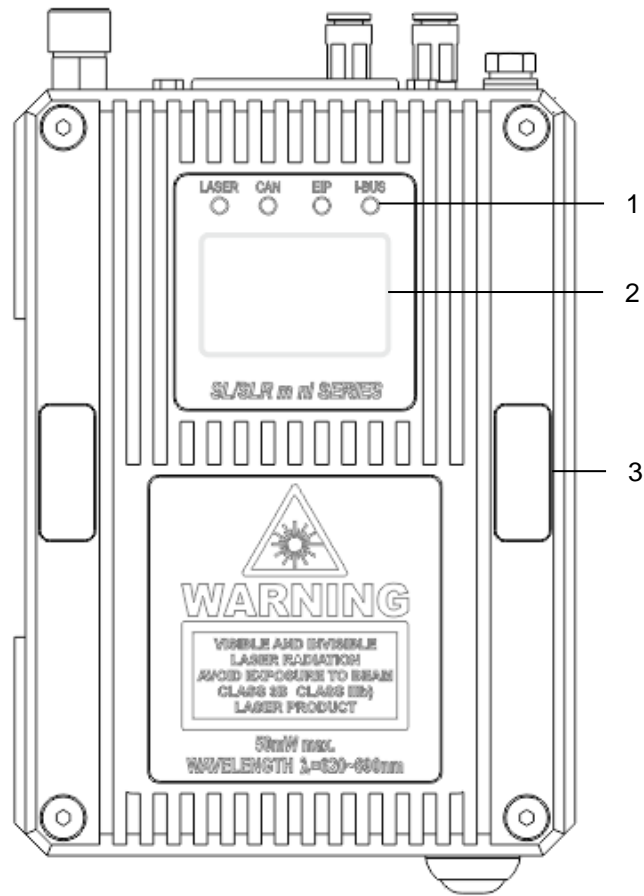
DIMENSIONAL DRAWINGS



DRAWING No.	00060MCO11
MATERIAL	ASSEMBLY
ASSEMBLY No.	00060MCO11
ISSUE	01
REC.DOC	
SHEET	1 OF 1
TITLE	SL mini 1220-W i4
QUANTITY	1
WEIGHT	
SCALE	1:1
PROGRAM	
STANDARD	
APPROVED	
DRAWN	
CHECKED	
AUDIT	
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MM. BREAK ALL BURRS AND SHARP EDGES. FIRST ANGLE PROJECTION. UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MM.	
UNCURED TOLERANCES: ANGULAR ±15° X ±0.20mm D ±0.10mm D ±0.05mm D ±0.02mm UNCURED SURFACE ROUGHNESS	
PROTON PRODUCTS (Chengde) LTD	

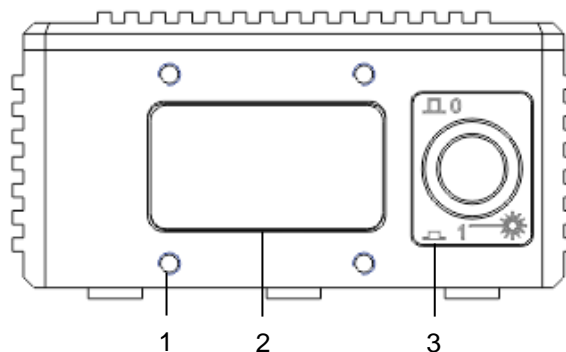
ANNOTATED DRAWINGS

TOP VIEW



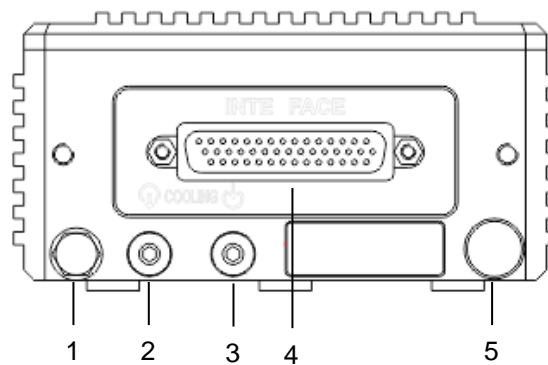
Label	Description
1	LED indicators
2	LCD display
3	Tamper-evident seal (x2; damage to or removal will invalidate the product warranty)

FRONT VIEW



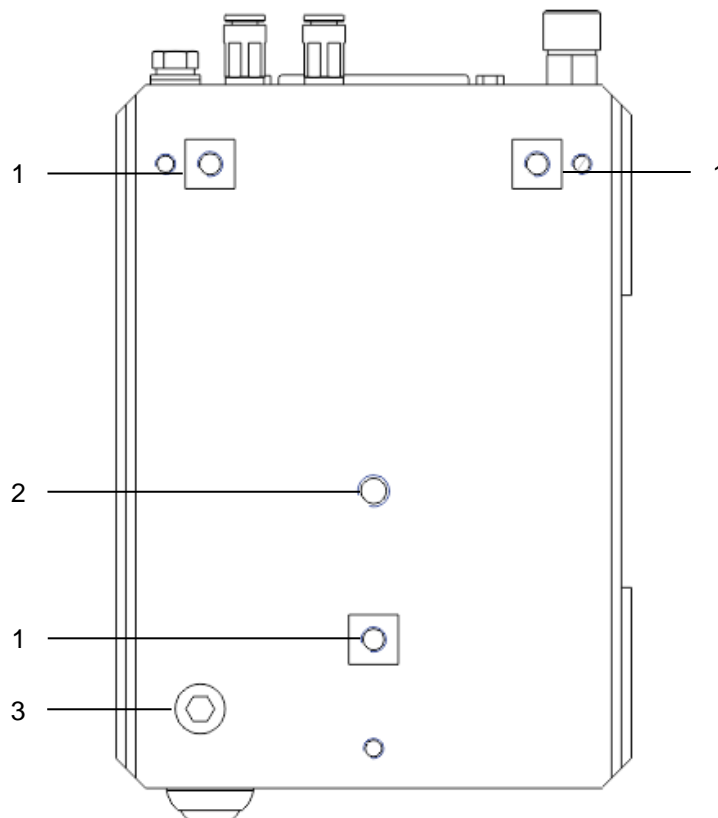
Label	Description		
1	Optional air wipe / beam enclosure tube mounting holes (x4)		
2	Optical window		
3	Laser shutter control switch		
	Switch status	Laser shutter status	Laser beam status
	Out	Closed	Blocked
	In	Open	Emitting

REAR VIEW



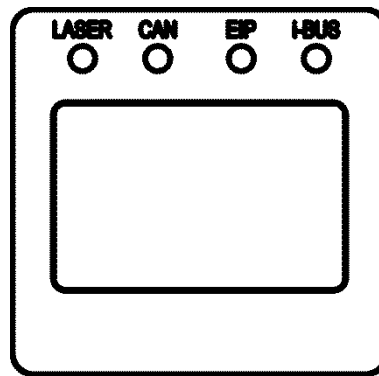
Label	Description
1	Earth bolt
2	Cooling air / water outlet
3	Cooling air / water inlet
4	"INTERFACE" connector port
5	Nitrogen gas purge port (for factory use only; any attempt to open or connect to this port will invalidate the product warranty)

UNDERSIDE VIEW



Label	Description
1	M5 threaded mounting hole (x3)
2	1/4"-20 UNC threaded tripod mounting hole
3	Nitrogen gas purge port (for factory use only; any attempt to open or connect to this port will invalidate the product warranty)

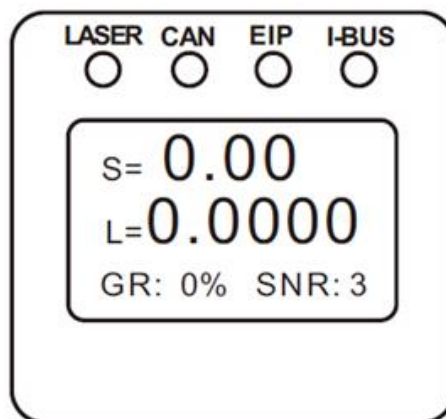
LED INDICATORS



Label	Condition	Description
LASER	Extinguished	No laser emission
	Yellow	Laser emission
	Flashing	Laser shutter is closed, whilst laser diode is on.
CAN	Extinguished	No CANbus connection
	Green	CANbus communicating
EIP	Extinguished	No Ethernet connection
	Green	Ethernet connected
	Flashing red	Ethernet data transmission
i-BUS	Extinguished	Optional PROFIBUS / PROFINET / EtherNet/IP not connected
	Green	Optional PROFIBUS / PROFINET / EtherNet/IP connected

ON-GAUGE LCD DISPLAY





The SL mini-i4 W and SLR mini-i4 W gauges are fitted with a backlit, on-gauge LCD which displays the following information:




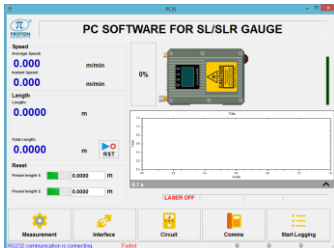
Label	Description
S	Measured speed
L	Measured length
GR	Good Readings percentage
SNR	Signal-to-Noise Ratio

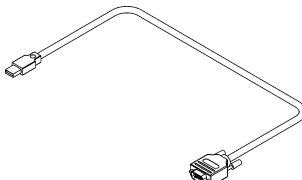
OPTIONAL ACCESSORIES

COMMUNICATIONS

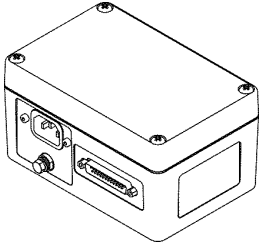
CDi4	Touch screen display module
	<ul style="list-style-type: none"> • Touch screen display. • Connects via the CAN-bus port. • Displays measured speed and length. • Provides menu-based setting of all parameters. • Mounts directly on the gauge body or remotely via an extension cable.
Proton part number	00049MC021
Panel Mounting Kit (CDi4)	CDi4 mounting kit module
	<p>The CDi4 Panel Mount can be used when fixing the CDi4 to a surface such as a control panel or cabinet. The Panel Mount has a machined aluminum frame finished with a black anodize. The hidden rear bracket is made from stainless steel.</p>
Proton part number	00049MC043
CDI3	Touch screen display module
	<p>The CDI3-SL is a color display interface. The display can be fitted to the gauge head utilizing the gauge mounting bracket (option) or panel mounted (panel mounting option). Various critical parameters are displayed and can be selected via the button entry pad below the display.</p>
Proton part number	00049MC003
Panel Mounting Kit (CDi4)	CDi4 mounting kit module
	<p>The CDi4 Panel Mount can be used when fixing the CDi4 to a surface such as a control panel or cabinet. The Panel Mount has a machined aluminum frame finished with a black anodize. The hidden rear bracket is made from stainless steel.</p>
Proton part number	00049MC043

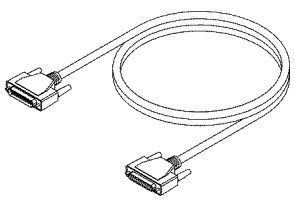
CAN-bus cable			
	Name	Length / m	Proton part number
	CAN 9DD_003M	3	00041CB003
	CAN 9DD_005M	5	00041CB005
	CAN 9DD_010M	10	00041CB010
	CAN 9DD_020M	20	00041CB020
	CAN 9DD_030M	30	00041CB030
	CAN 9DD_040M	40	00041CB040

PCiS_SL/SLR mini	PC Interface Software
	<ul style="list-style-type: none"> • PC-based software package. • User-friendly graphical user interface. • Displays all measurements. • Provides menu-based setting of all parameters. • Provides trending, data logging, presets and alarms. • Gauge to PC connection via RS-232 or Ethernet
Proton part number	00060SW001

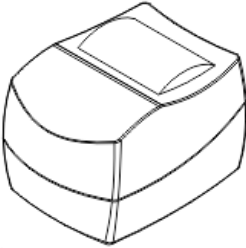
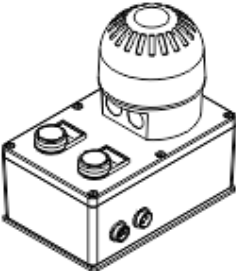
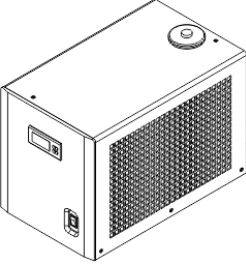
USB-RS232 Cable	
	<ul style="list-style-type: none"> • For connecting the RS232 port of the PSU-BOB to the 7" Touch Screen PC. • Length: 1.8m.
Proton part number	GP00000624

POWER

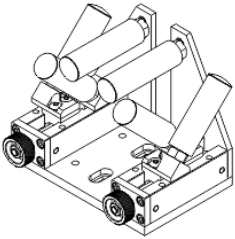
PSU-BOB	Power supply and mini break out box
	<ul style="list-style-type: none"> • Connects via the DB44 "INTERFACE" connector. • Supplies 24VDC electrical power to the gauge. • Provides screw terminal access to all electrical interfaces. • Provides DB9 connectors for access to the CANbus, RS232 and industrial bus communications interfaces. • Provides a RJ45 socket for the Ethernet interface. • End user cables are sealed with three cable glands. • Input voltage range: 90 – 260 VAC @ 45 – 65 Hz. • Select the required length of DB44 cable from below.
Proton part number	00060MC050

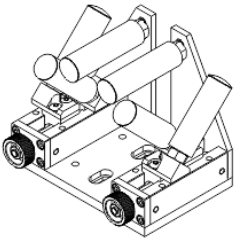
DB44 "INTERFACE" port to PSU-BOB cable			
	Name	Length / m	Proton part number
	DB44_003m(9.8ft) Cable	3	00053CE001
	DB44_005m(16ft) Cable	5	00053CE002
	DB44_010m(32ft) Cable	10	00053CE003
	DB44_020m(64ft) Cable	20	00053CE004
	DB44_030m(98ft) Cable	30	00053CE005

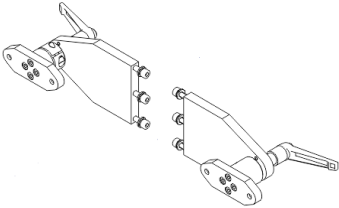
ALARM AND REPORT


Zebra Label Printer	
	<p>Zebra GK888T Desktop Label Printer offer a comprehensive choice of Direct Thermal and Thermal Transfer printing method- each with distinctive characteristics to ensure your specific application is fully satisfied.</p> <p>Printer Specifications: Resolution : 203dpi / 8 dots per mm Memory: Standard 8MB SDRAM; 8MB Flash Print Width: 4.09"/104mm Print Length: 39"/990mm Print Speed: 4" per sec/102mm per sec Media Sensors: Transmissive and reflective</p>
Proton part number	00043MC033
A1 Alarm Unit	
	<p>The A1 audio and visual alarm unit is used to alert operators when the product exceeds tolerance levels and to indicate gauge operation states. The A1 Alarm unit connects via the relay contacts to the gauge head or BOB for alarm activation.</p>
Proton part number	00025MC001
TC300 (Temperature Control)	
	<p>TC300 is a water temperature control system which is designed to regulate the temperature of the gauge using a continuous water flow. It is typically used in elevated temperature environment to maintain gauge temperature within specified range.</p>
Proton part number	00039MC002


GUIDE ROLLER

V20 ADJ. Roller	
	<p>This guide system is a triple roller, where the upper roller is fixed in position to ensure the top of the cable is always at the correct height for the Proton length measuring units. The V rollers then adjust by means of a hand wheel and come together to push the cable or tube product up to touch the upper guide roller. A very effective solution to maintain product height for optimum length measurement performance. The V20 Adj. roller can be used in conjunction with the PHA2 mounting system.</p>
Proton part number	00009MC220

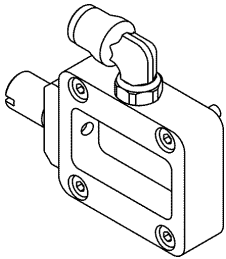
V20 ADJ. Roller	
	<p>This guide system is a triple roller. the upper roller is fixed in position to ensure the top of the cable is always at the correct height for the Proton length measuring units. The V rollers then adjust by means of a hand wheel and come together to push the cable or tube product up to touch the upper guide roller. A very effective solution to maintain product height for optimum length measurement performance. The V20 Adj. roller can be used in conjunction with the PHA2 mounting system.</p>
Proton part number	00009MC220

GRB-30-PHA2	
	<p>The GRB-30-PHA2 Gauge Mounting Bracket (two are provided as a set) is fitted one on the input and other on the output side off the PHA2 on which is also fitted the optional Guide rollers (GR30VC or GR40VCHS).</p>
Proton part number	00009MC670

GR30-VC	
	<p>The GR30-VC is a Zirconia coated V-shaped Aluminium roller with a max product diameter of 30mm (1.18 Inch), incorporating twin race bearings for long life performance. Max linear line speed for this roller type is 500m/min. The roller comes together with the mounting spigot for ease of replacement and must be combined with the mounting bracket, either GRB or GRG types.</p>
Proton part number	00009MC123

GR40-VCHS	
	<p>The GR40-VCHS is a solid ceramic V-shaped roller with a max product diameter of 40mm (1.58 Inch), incorporating twin race bearings for long-life performance. Max linear line speed for this roller type is 1500m/min. The roller comes together with the mounting spigot for ease of replacement. It must be combined with the mounting bracket, either GRB or GRG types.</p>
Proton part number	00009MC250

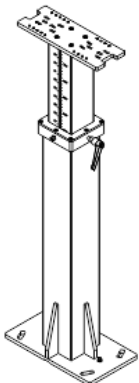
PROTECTION

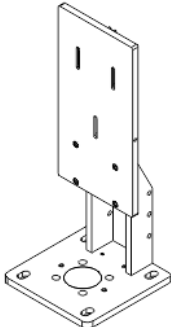
Air wipe	
	<ul style="list-style-type: none"> • High-efficiency, air-wiped protection window for dusty/steamy environments with a quick-change window release mechanism. • Provides an 8 mm push fit tube fitting to connection to a clean air source.
Proton part number	00050MC034

Air quality must meet or exceed ISO 8573.1:2001 Class 1.3.1 (solids.water.oil):

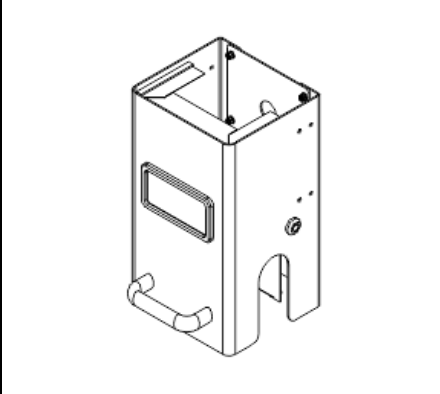
Specification	Maximum	Units	Class
0.1 - 0.5 µm solid particle count	100	/ m ³	1
0.5 - 1 µm solid particle count	1	/ m ³	
1 - 5 µm solid particle count	0	/ m ³	
Water vapour pressure dew point	-20	°C	3
Oil aerosol and vapour	0.01	mg / m ³	1

STANDS AND GUARDS

HST3	
	<p>The Heavy Duty Adjustable Height Stand is designed for use on the full range of IntelliSENS products. Construction is of an aluminium box tube and plate, with fixing holes for floor mounting and adaptor plate for fixing of gauges.</p>
Proton part number	00050MC037

PHA2 (SL/SLR mini1220)	
	<p>PHA-2(SL/SLR mini1220) is a mounting system for the SL/SLR1220mini. It is designed for use in cable or tube applications to mount the SL system pointing downwards towards the cable or tube surface. The standard fixing of the SL/SLRmini1220 gives a 120mm stand off and can be adjusted for different product diameters. Additionally a laser guard can be purchased which will mount to the PHA-2mini for protection against accidental viewing of the laser beam.</p>
Proton part number	00020MC401

PHA2 Laser Guard (SL/SLR mini1220)

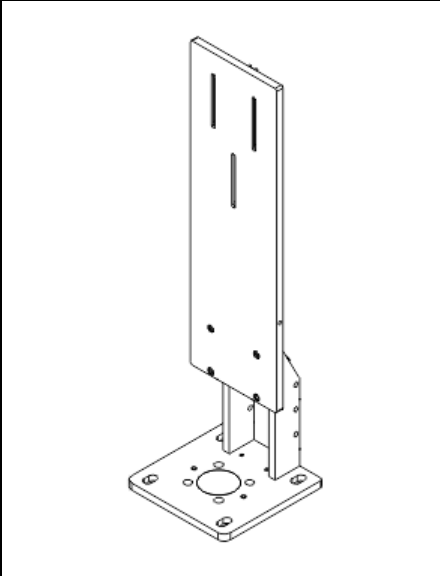


The PHA2 Laser Guard (SL/SLR mini1220) is designed to be used in conjunction with a PHA2 (SL/SLR mini1220). The laser Guard is a cover which surrounds the SL/SLR mini protecting against accidental viewing of the laser beam. The Guard cover is fitted on vertical slides, when lifted the laser is automatically switched off. A product viewing window is included, This window is laser safe for 650nm lasers and is CE approved.

Proton part number

00020MC402

PHA2 (SL/SLR mini3060)

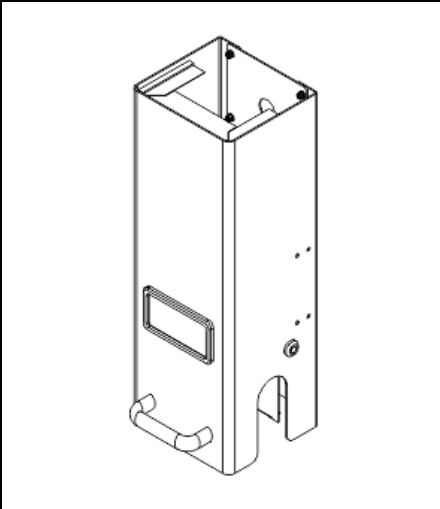


PHA-2(SL/SLR mini3060) is a mounting system for the SL/SLR3060mini. It is designed for use in cable or tube applications to mount the SL system pointing downwards towards the cable or tube surface. The standard fixing of the SLK/SLRmini3060 gives a 300mm stand off and can be adjusted for different product diameters. Additionally a laser guard can be purchased which will mount to the PHA-2mini for protection against accidental viewing of the laser beam this item.

Proton part number

00020MC405

PHA2 Laser Guard (SL/SLR mini3060)



The PHA2 Laser Guard (SL/SLR mini3060) is designed to be used in conjunction with a PHA2 (SL/SLR mini3060). The laser Guard is a cover which surrounds the SL/SLR mini protecting against accidental viewing of the laser beam. The Guard cover is fitted on vertical slides, when lifted the laser is automatically switched off. A product viewing window is included, This window is laser safe for 650nm lasers and is CE approved.

Proton part number

00020MC406

MEETING LASER SAFETY REGULATIONS "User Part":

The SLmini-i4 W units are Laser Class IIIB devices. We wish to reiterate that all Laser Doppler sensors manufactured by PROTON meet all requirements of EN60825-1 "manufacturers part".

As to help complying our clients with EN60825-1 "users' part", Proton recommends the SLmini-i4 W type sensor is mounted onto the PHA2mini Mount, fitted with a "slide-Up" Laser Guard. This arrangement is assuring:

- the useful travel of the laser beam is terminated (by the bottom plate of the PHA2mini mount.

- It is made impossible that anyone can look directly into the laser beam, this by the design and by the fact the SLmini-i4 W laser cannot emit laser with open "Laser Guard". The Laser Guard being a guard made from metal must be properly closed before the laser is emitting.

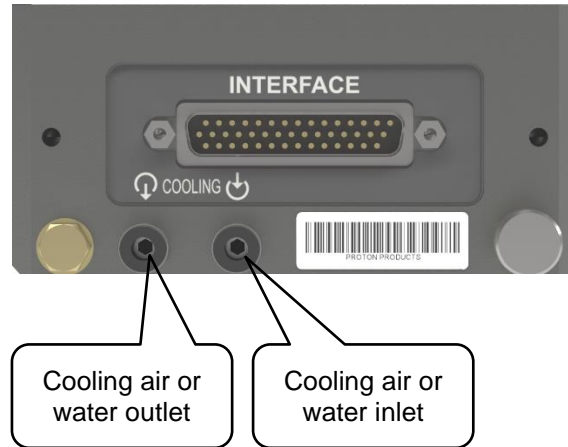
It is the Laser Guard that is activating a Hall sensor that on its turn is activating the Laser Shutter. To allow operator inspection to inspect proper adjust of the (optional) wire guides, on the front of the Laser Guard, a filter is incorporated that reduces the laser emission by a factor near 100 times (similar to laser safety goggles).

To reduce the risk of stray light being reflected outside the guard through the left hand and right hand openings of the Laser Guard (for wire/cable passage), both openings have been provided with bristles. Also the gaps between where the Laser Guard envelopes the laser cover have been reduced to near zero, again to stop reflected laser light exiting through these gaps.

Hundreds of Laser Units type SLmini-i4 W Series fitted with the PHA2mini Mount with Laser Guard have been assessed by Laser Safety officers within the EU and USA, and in each and every case (without exception) the set-up has been found to meet EN/BS 60825-1 for what concerns "Laser Safety users' part".

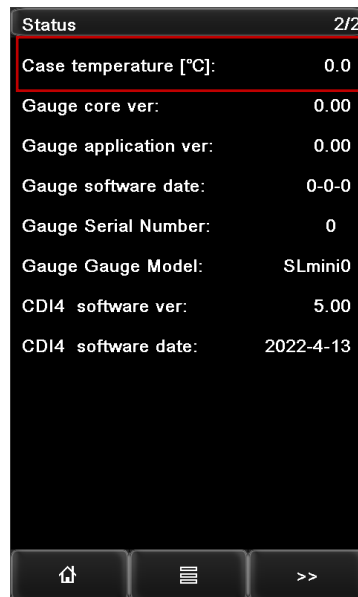
OPTIONAL COOLING SYSTEM

For hot environments, air or water may be pumped through the base of the gauge for cooling.



Note: cooling is required if the case temperature of the gauge exceeds 50°C.

The case temperature of the gauge can be viewed on the Status page 2 on CDI4.



Air cooling

- The gauge may be air-cooled using factory air regulated with a reducer valve to a pressure of 1.5 ~2.5 bar fed to the cooling inlet.
- The cooling air travels only in the embedded cooling channel in the base of the gauge; it does not come into contact with the internal workings of the gauge.
- Waste air is vented from the cooling outlet; to reduce its acoustic noise, a silencer (e.g. from Norgren or Martonair) may be fitted downstream of the cooling outlet.

Water cooling

Cooling water specification	Minimum	Typical	Maximum	Units
Water temperature	5		25	°C
Speed of water flow		1.2		m/s
Water pressure	0.1		0.5	M/Pa
Water flow rate			15	L/h

INSTALLATION

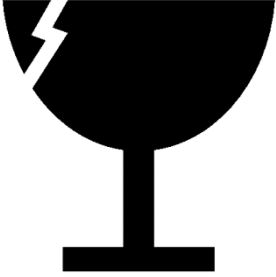


PRECAUTIONS

Operating and storage temperature

Specification	Minimum	Typical	Maximum	Units
Operating temperature	+5		+40	°C
Storage temperature	0		+45	°C

- Do not store or operate the gauge in temperatures outside of the specified ranges.
- Do not install the gauge near high temperature surfaces or objects which may cause it to overheat.
- Storage or operation of the gauge outside the specified temperature range may result in degraded measurement accuracy, malfunction or damage to the gauge.
- All gauges are fitted with internal temperature sensors which will permanently log any over-temperature condition that invalidates the warranty.

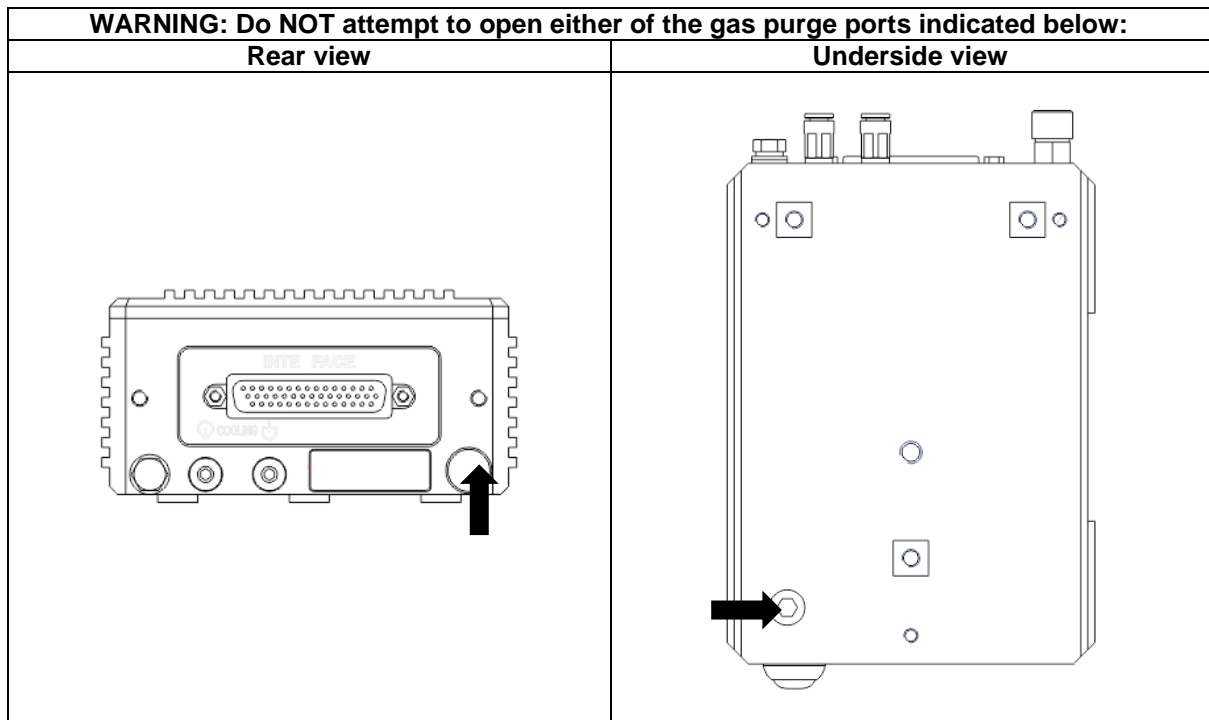
Protect from impact

		
Fragile	Do not drop	Protect from impact and mechanical shock

- The gauge contains delicate optical and electronic assemblies and must never be dropped or struck by other objects.
- Only install the gauge on its mounting/stand when all machining, assembly and transportation of the mounting/stand has been completed.
- Do NOT strike, move or perform machining operations on the mounting/stand with the gauge installed.
- Damage incurred by the gauge as a result of impact, mechanical shock or rough handling is NOT covered by the manufacturer's warranty.

Do not open or disassemble

- The gauge contains no user serviceable components.
- Loosening the gauge screws or removing its cover will invalidate the gauge warranty.
- Damage to or removal of any of the anti-tamper stickers will invalidate the gauge warranty.
- The gauge is factory-purged with dry nitrogen gas to prevent condensation on the internal optics; opening of the gas purge ports (indicated below) will invalidate the gauge warranty.




Periodic maintenance

- The physical condition of the gauge, optional accessories and connecting cables should be checked periodically; if any damage is suspected, then the unit should be taken out of service for inspection and repair or replacement of damaged parts.

Laser radiation hazard

- This product emits class 3B laser radiation; do not view the laser beams emitted by the gauge either directly or by specular reflection.
- For all class 3B laser devices, the safety measures below **MUST** be provided. Some measures are the responsibility of the device manufacturer (Proton Products), whilst other measures are the responsibility of the end-user.
- For further information on laser safety, please refer to European standard BS EN 60825-1:2007 "Safety of laser products; Part 1: Equipment classification, requirements and user's guide".

Safety Measure	Description	Provided by
Laser Safety Officer	A Laser Safety Officer (LSO) must be appointed by the end-user organisation and is responsible for ensuring that both the equipment and staff comply with laser safety regulations.	End-user
Laser safety training	The end-user organisation must provide appropriate laser safety training for all operators and maintenance personnel working in close proximity to the gauge.	End-user
Laser enable key-switch	A key-switch to disable the laser diode should be wired to the LSR_EN input. The laser safety officer should be responsible for the key and must withhold it during system maintenance or if the system fails to comply with laser safety regulations.	End-user
	A laser enable key-switch is provided on the optional PSU-BOB-mini.	Proton

Safety Measure	Description	Provided by
Contain and terminate beam path	Terminate the laser beams at the end of their useful length (behind the measured object) with a beam block.	End-user
	Contain laser beam paths with laser guards which have closure switches wired to the SHUT_EN input so that the laser shutter is closed if any guard is opened.	
	Do NOT permit the laser beams to be directed into open space.	
Prevent specular (mirror-like) reflections	Never direct the laser beams at specular (mirror-like) reflectors.	End-user
	Remove all reflective objects such as jewellery or wristwatches before working near the laser beams.	
Emission indicator	Illumination of the "LASER" LED on the gauge indicates laser emission.	Proton
	An external laser emission warning light may be triggered by the SHUT_ST output.	End-user
Laser shutter switch	The switch to the side of the laser window opens or closes the laser shutter which blocks laser emission.	Proton
	If the gauge is to be mounted in an inaccessible location, then this switch should be set to the open position and a remote, external laser shutter switch wired to the SHUT_EN input.	End-user
Laser protection eyewear	Laser protection eyewear rated with the Optical Density (OD) rated for Class 3B lasers must be worn whenever there is a risk of eye exposure to the laser, for example during gauge alignment (see the "Laser Safety Parameters" section for information on laser wavelength, power and power densities).	End-user
Laser warning signs	Class 3B laser warning signs must be displayed in the working area; precautions on the warning signs must be followed.	End-user
	Example class 3B laser warning signage:	
		

Optical windows

- Do not allow smoke, water, steam, dust or other debris to come into contact with any of the optical window.
- Obstruction of the optical window may degrade measurement accuracy or inhibit measurement.
- If the optical window appears to be damaged or misaligned, then the unit should be sent to a Proton Products authorised service agent for repair.
- If the optical window requires cleaning, then refer to the cleaning procedure detailed below to minimise the risk of scratching the windows.

Optical window cleaning procedure

- The optical window is manufactured from anti-reflection coated optical glass; it must be treated with the same level of care as a high-performance camera lens.
- **Before inspecting or cleaning the optical window, ensure that the gauge is powered off, the LSR_EN key-switch is locked out and no laser light is emitted.**

Required items	Notes
Small blower brush	Such as the type used to remove dust from camera lenses.
Lens cleaning tissues or micro-fibre lens cleaning cloth	Do NOT use facial tissues as these can scratch delicate optics.
Lens cleaning solution	Such as the type specified for cleaning camera lenses.

1. Use the small blower brush to remove any visible dust on the optical window.
2. Apply a few drops of lens cleaning solution to a fresh lens cleaning tissue or a clean micro-fibre lens cleaning cloth.
3. Gently wipe the optical window from the centre outwards; apply only light pressure to the tissue or cloth when wiping the optical window.
4. Repeat as necessary with fresh tissues or a clean section of cloth until the optical window is clean and free of all smears and smudges.

INSTALLATION SEQUENCE

Unpack the gauge and check for missing accessories and shipping damage.

Mechanical installation:

1. Mount the gauge securely either on a user supplied mount or on an optional Proton Products mounting plate.

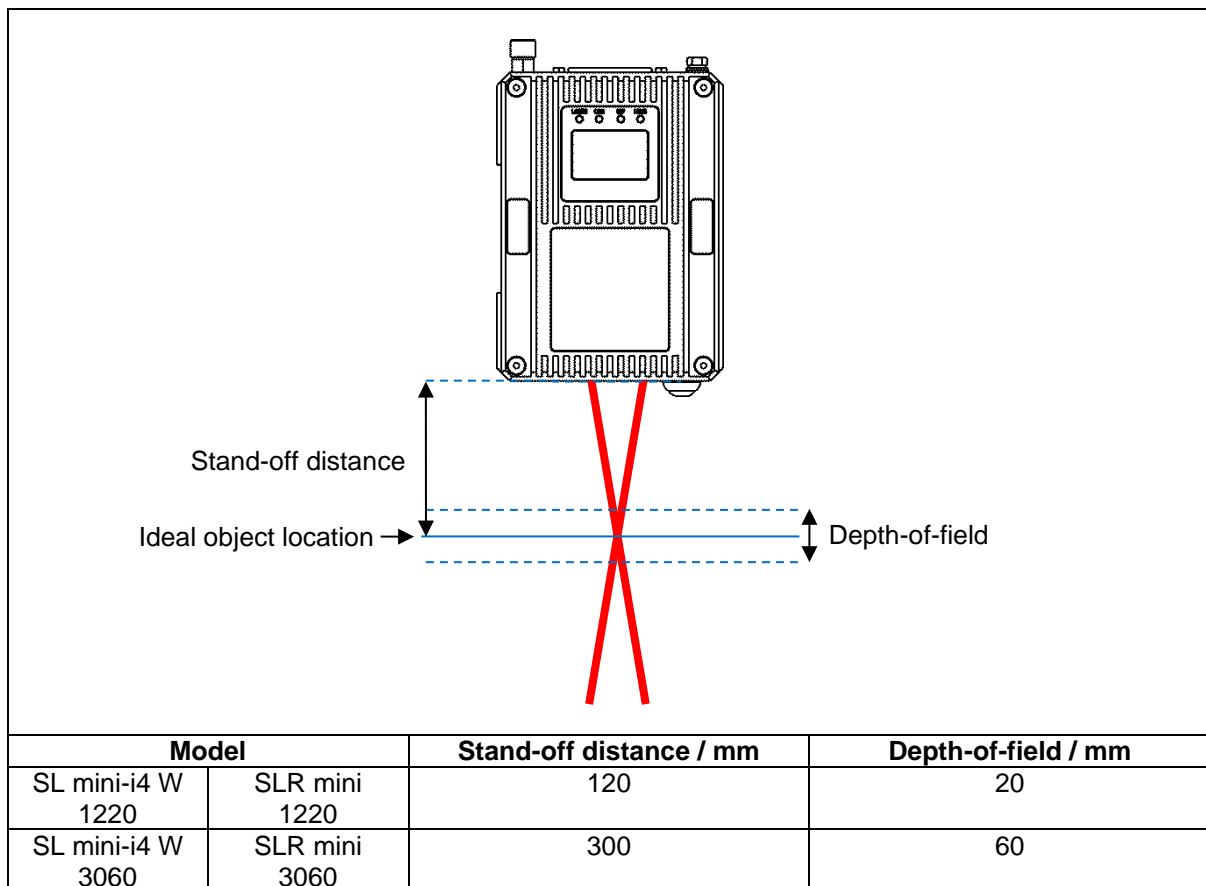
Electrical installation:

1. Install earth connections.
2. Connect the gauge to an optional Proton Products PSU-BOB power supply and break-out box.
3. Install laser safety connections (laser enable, shutter enable and shutter status).
4. Install communications interface connections (RS-232, Ethernet or optional PROFIBUS, PROFINET or EtherNet/IP).
5. Install electrical interface connections (logic inputs, logic outputs, pulse outputs) using the optional Proton Products PSU-BOB breakout box or terminal strip.
6. Connect a PC installed with the PCiS_SLmini software to the gauge via the RS-232, Ethernet or optional PROFIBUS or EtherNet/IP communications interface.
7. Configure the gauge using the PCiS_SLmini software.

MECHANICAL INSTALLATION

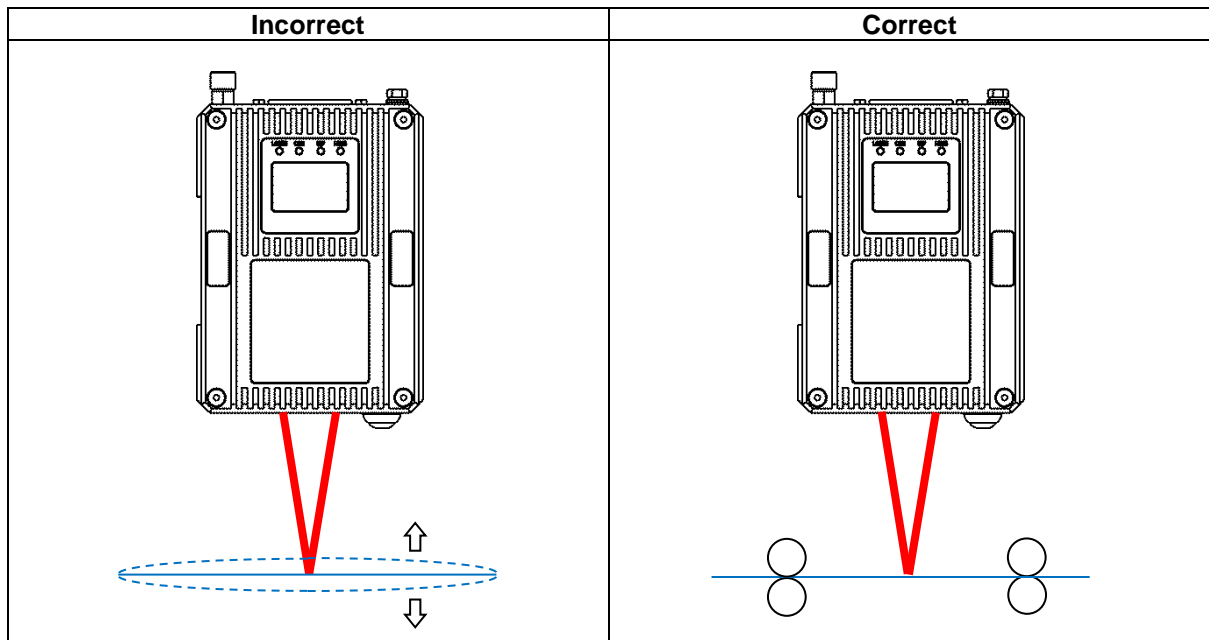
Stand-off distance and depth-of-field

- For best accuracy, locate the measured object at the specified stand-off distance to the gauge.
- Speed and length measurement is possible for objects located away from the specified stand-off distance but still within the depth-of-field; however the measurement accuracy may be degraded by the reduced signal strength.



Object stabilisation

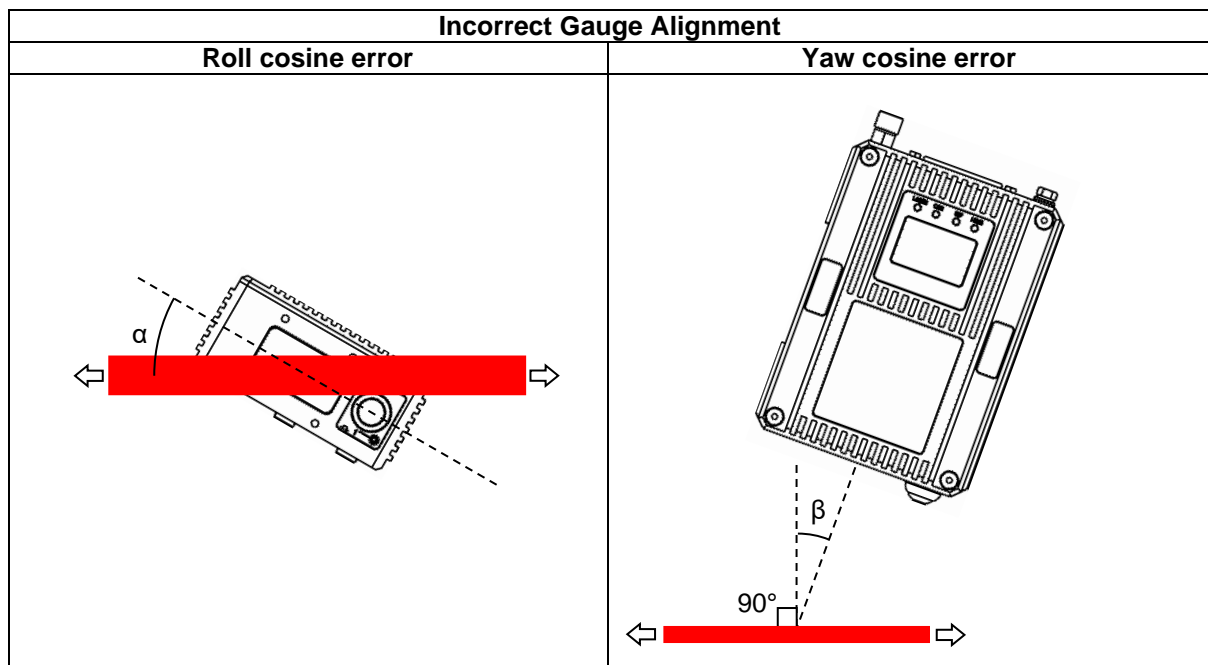
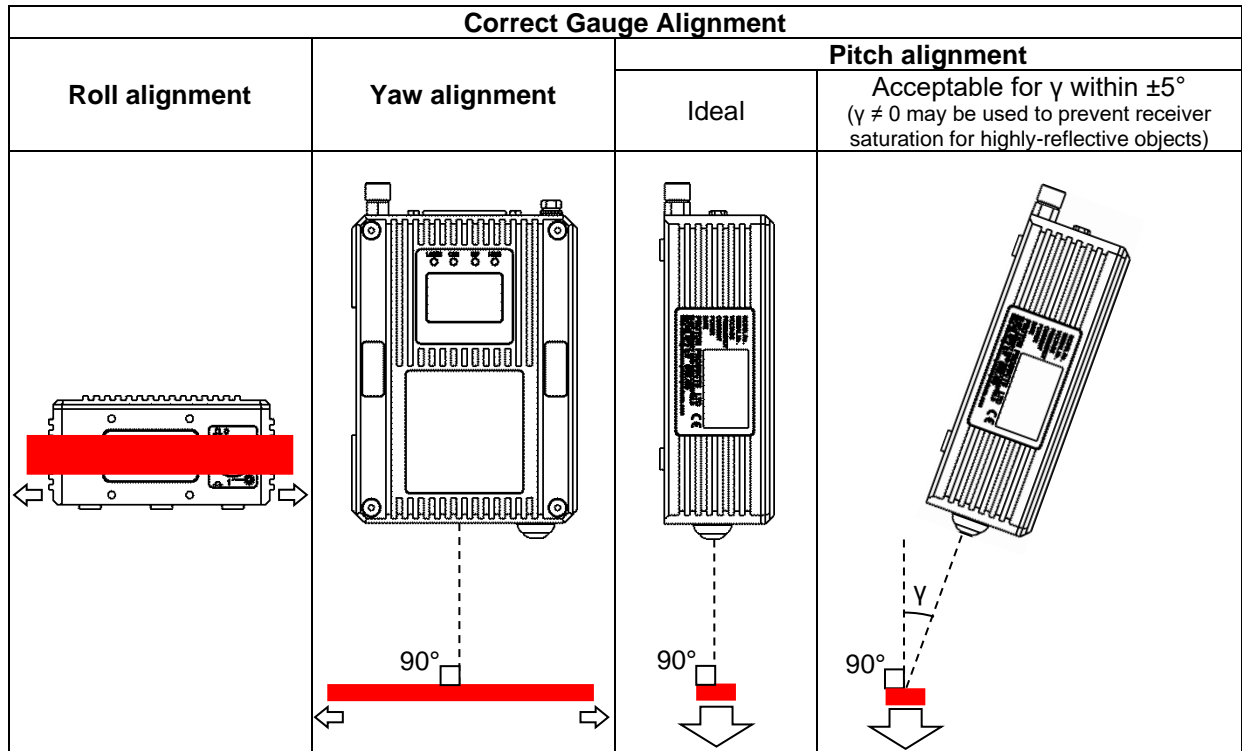
For accurate speed and length measurements, the distance between the measured object and the gauge must be kept constant; the measured object must be guided to prevent flutter:



The end-user must provide suitable mechanisms for guiding and stabilising the motion of the measured object.

Optical alignment

Non-perpendicular alignment of the speed and length gauge to the measured object will degrade measurement accuracy; it is recommended the gauge is installed and aligned by technicians with metrology experience who understand the implications of even a small angular misalignment.



Compounded roll and yaw cosine error

$$\text{Measured speed} = (\text{True object speed}) \times \cos(\alpha) \times \cos(\beta)$$

Error angle α or β / degrees	$\cos(\alpha)$ or $\cos(\beta)$	Measurement error / %
0	1.000000	0.000
0.25	0.999990	-0.001
0.50	0.999962	-0.004
0.75	0.999914	-0.009
1.0	0.999848	-0.015
2.0	0.999391	-0.061
3.0	0.998630	-0.137
4.0	0.997564	-0.244
5.0	0.996195	-0.381
10	0.984808	-1.519

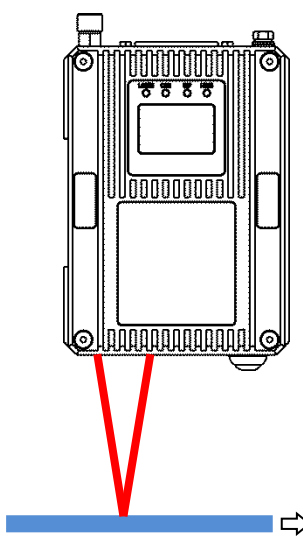
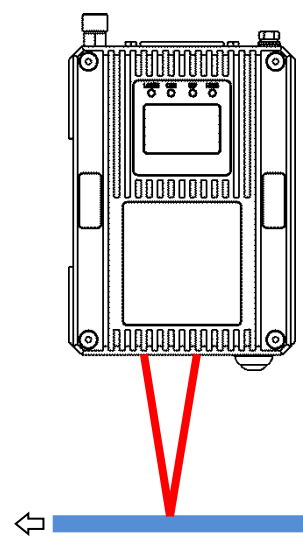
Measurement Direction

SL mini-i4 W Unidirectional Speed and Length Gauge

The unidirectional SL mini-i4 W speed and length gauge interprets motion in either direction as a positive speed and an increase in length, thus correct length accumulation requires that the object must only move in one direction (reverse motion will incorrectly cause the length to increment, not decrement).

Length measurements during line stoppage may exhibit a positive error due to microscopic vibration of the object; hence it is recommended that the “Length hold” function on the SL mini-i4 W logic input is activated by the line controller when the line is stationary to temporarily suspend speed measurement and length accumulation.

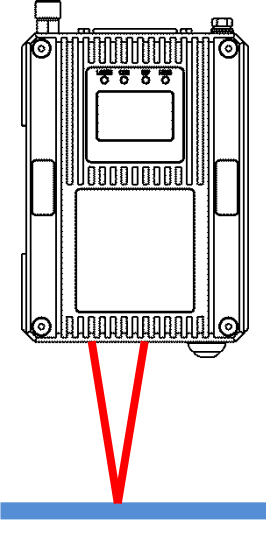
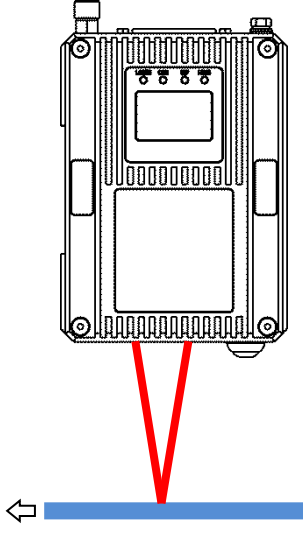
For production lines that require correct length accumulation during direction reversals or line stoppage (without using the “Length hold” function), it is recommended that the SLR mini-i4 W is used.

SL mini-i4 W		Left to right		Right to left	
Object motion direction					
		Count	Rev Direction logic input	Speed	Length
[Up]	Inactive	Positive	Incrementing	Positive	Incrementing
Down	Active	Negative	Decrementing	Negative	Decrementing

[] factory-default setting

SLR mini-i4 W Bidirectional Speed and Length Gauge

The bidirectional SLR mini-i4 W speed and length may be used for production lines that exhibit bidirectional motion and line stoppage.

SLR mini-i4 W			Left to right		Right to left	
Object motion direction						
[Up]	[0]	Inactive	Negative	Decrementing	Positive	Incrementing
Down	1	Active	Positive	Incrementing	Negative	Decrementing

[] factory-default setting

Mechanical mounting

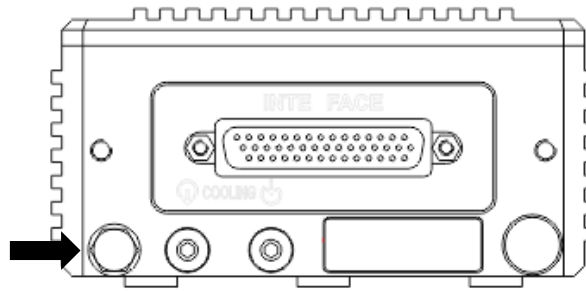
It is preferable for the gauge to be mounted in isolation from the machine or production line using a precision base plate fitted to a mounting arm (if this is not possible then the gauge must be mounted on rubber vibration isolation mounts). The mounting arm should be kept as short as possible to avoid vibration or twisting.

- Please see the dimensional drawings for mounting hole locations.
- Three M5 tapped holes are provided in the base of the gauge; select appropriate length screws which do not bottom out in these holes.

Specification	Minimum	Typical	Maximum	Unit
Mounting surface flatness (machined flat and even)			0.15	mm
M5 mounting hole depth (do not allow bolts to bottom out)			6	mm
M5 mounting bolt torque			6	Nm

ELECTRICAL INSTALLATION

Earth connection



Connector type: M5 bolt

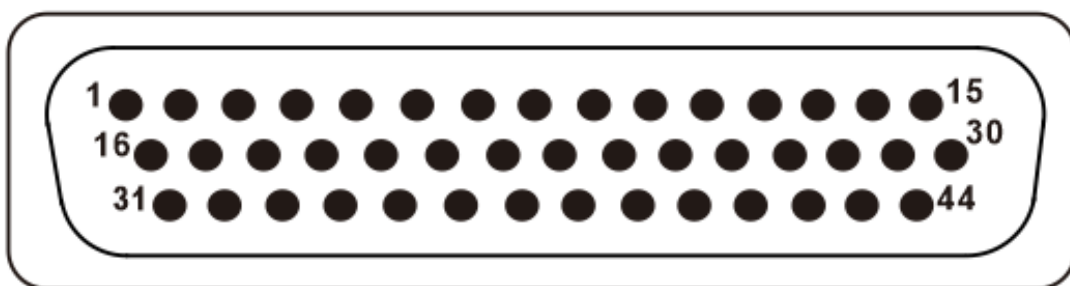
- An earth wire of at least 6mm² must be attached via a crimp on ring terminal to the dedicated M5 earth bolt on the case of the gauge.
- Do not rely on the mounting bolts to provide a reliable earth path.
- If a height stand is used then it must also be earthed via its own dedicated earth wire.
- All earth wires should be kept as short as possible.

Shielded Cables

- Use shielded cable for all signal connections.
- Ensure that all cable shields are correctly clamped and electrically connected to their connectors and metal connector shells at both ends.
- Ensure that the shields of cables connecting to the end user's equipment are clamped to earth at their destination.

LASER ENABLE

- The laser enable input is provided for compliance with laser safety regulations.
- The laser diode in the gauge may be energised only if the “LSR_EN” pin (pin 29) is connected (via an external user-supplied switch contact) to any one of the “DGND” pins (pins 3, 4, 15, 28, 34, 44).
- The gauge requires a few minutes for the laser temperature to stabilise and for valid measurement after “LSR_EN” is connected to “DGND”. For this reason, it is recommended that the laser enable input is connected to a safety interlock that is active infrequently, such as a maintenance lock-out key switch.
- Safety interlocks that are frequently activated and require the gauge to immediately resume measurement upon deactivation (such as a machine guard door) should be connected to the shutter enable input (“SHUT_EN”) described in the next section.

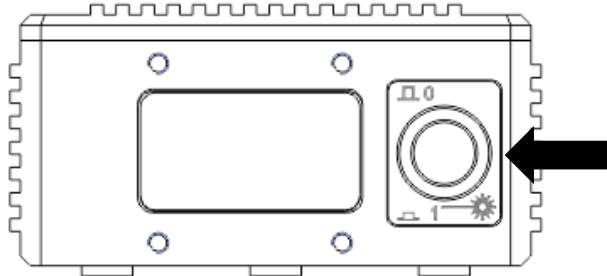


Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes	
Shield	S	Shield	Shield	Connect to cable and plug shields	
Power supply and signal ground	1	+24V SUPPLY	+24V power supply		
	2				
	3	DGND	Power supply and signal ground (0V)		
	4				
28					
Laser enable	29	LSR_EN	Laser enable	Connection	Laser diode state
				Open	Off (no emission)
				Connected to DGND	On (emission)

SHUTTER CONTROL SWITCH, SHUTTER ENABLE INPUT AND SHUTTER STATE OUTPUT

The shutter control switch (located on the front of the gauge), the shutter enable input (SHUT_EN) and shutter status output (SHUT_ST) are provided for compliance with laser safety regulations.

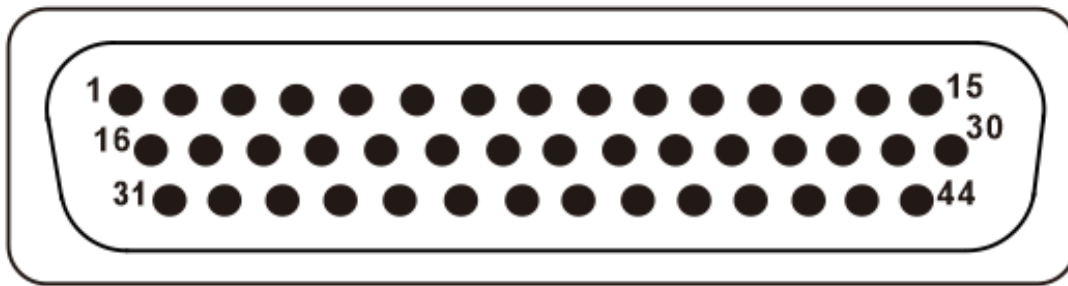


The SHUT_EN input and the shutter control switch operate in conjunction as follows:

SHUT_EN input	Shutter control switch position	Shutter state	Laser output
Open	O	Closed	Blocked
Open	I	Closed	Blocked
Shorted to DGND	O	Closed	Blocked
Shorted to DGND	I	Open	Emitting

- The shutter control switch and SHUT_EN input blocks laser beam emission without switching off the laser diode, thus no warm up time is required when the shutter is opened and the gauge may be used immediately for measurements.
- The SHUT_EN input is intended for connection to a safety interlock switch that may be frequently opened, such as on a machine guard or laser safety shield.
- The SHUT_ST output is electrically independent of the SHUT_EN input; the SHUT_ST signal is taken directly from an optical sensor in the path of the shutter, thus it indicates the shutter state even in the event of shutter actuator failure.

SHUT_EN input electrical specifications



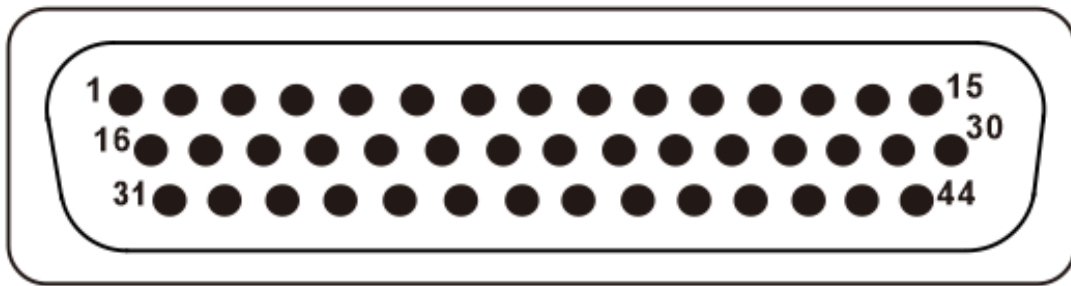
Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes		
Shield	S	Shield	Shield	Connect to cable and connector shields		
Power supply and signal ground	1	+24V SUPPLY	+24V power supply			
	2					
	3	DGND	Power supply and signal ground (0V)			
	4					
	44					
Shutter control	30	SHUT_EN	Shutter control input	Connection	Shutter	Laser
				Low state (logic 0) / connected to DGND	Open	Emitting
				High state (logic 1) / unconnected	Closed	Blocked

- The SHUT_EN input is NOT isolated from earth.
- The input is internally pulled up to +15V via an 8.2kΩ resistor and will default to the high state if left unconnected.
- The input will source a minimum current of 3mA when externally pulled down to the low state.

Specification	Minimum	Typical	Maximum	Units
Low state (logic 0) input voltage			3	V
High state (logic 1) input voltage	10.5			V
Absolute input voltage	-30		30	V
Low state source current	3			mA

SHUT_ST output electrical specifications



Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes		
Shield	S	Shield	Shield	Connect to cable and connector shields		
Power supply and ground	1	+24V SUPPLY	+24V power supply			
	2					
	3	DGND	Power supply and signal ground (0V)			
	4					
	28					
Shutter control	27	SHUT_ST	Shutter status output	Signal	Shutter	Laser
				Pulled down to DGND	Closed	Blocked
				Floating	Open	Emitting

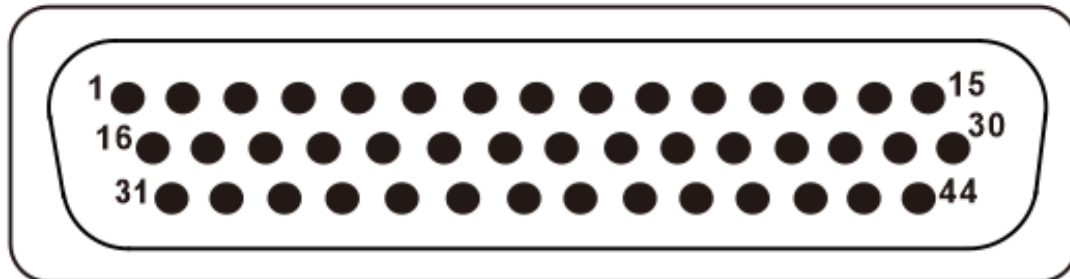
- The SHUT_ST output is NOT isolated from earth.
- The SHUT_ST output must NOT be used to directly drive high-current or inductive loads.
- It is recommended that the SHUT_ST output is used to drive an opto-isolated solid-state relay.

Specification	Minimum	Typical	Maximum	Units
Logic output to DGND voltage			+25	VDC
Current			0.1	A

POWER SUPPLY

Specification	Minimum	Typical	Maximum	Units
Power supply voltage*	18	24	30	VDC
Power consumption			15	W

*If a long power supply cable with a significant voltage drop is used, then ensure that the voltage at the gauge connector does not fall below the minimum value.



Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes
Shield	S	Shield	Shield	
Power supply	1	+24V	+24V power supply	
	2	SUPPLY		
	3	DGND	Power supply ground (0V)	
	4			

Powering on the gauge

The gauge has no power switch; as soon as power is applied it will power up and perform some self-tests. Measurement will begin after a warm-up period of a few minutes required for the temperature of internal components to stabilise.

Powering off the gauge

The gauge has no power switch; it may be powered off by switching off or disconnecting the power supply to the unit.

CONFIGURATION VIA CDI4

POWER ON SCREEN



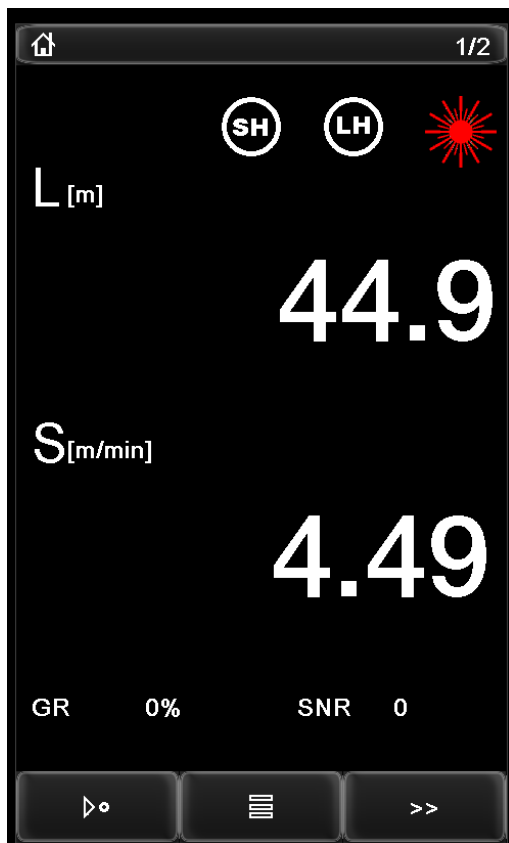
When the gauge is powered on, the Proton welcome screen will be displayed momentarily.

Touch screen calibration

If the CDI4 touch screen can be calibrated using the following procedure:

1. Press the “Click to calibrate touch screen” message during gauge power on to access the screen calibration function.
2. Tap the screen as directed, the screen will be calibrated.

HOME PAGE 1 (NORMAL MODE)



Home page 1 (in normal mode) displays:

Speed hold / Length hold / Laser status

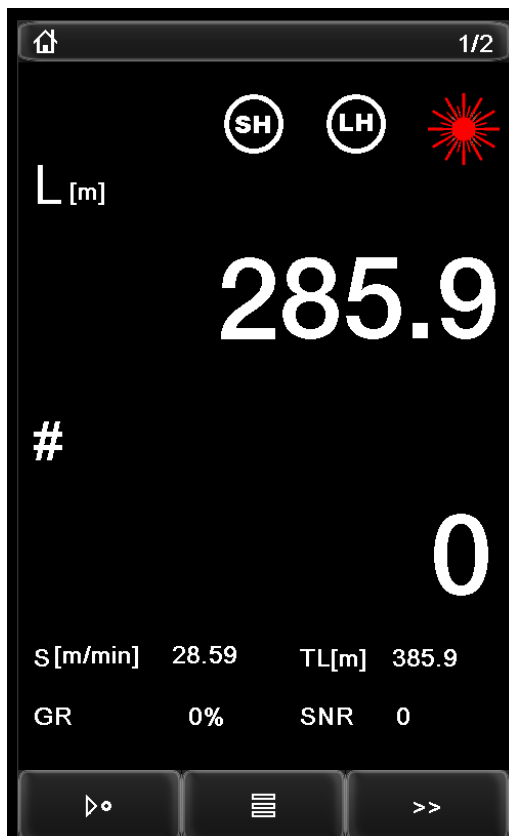
- Current measured total length

- Current measured speed

- GR: Good readings level

- SNR: Signal-to-Noise Ratio

HOME PAGE 1 (BATCH MODE)



Home page 2 (in batch mode) displays:

Speed hold / Length hold / Laser status

- Current measured batch length


- Current batch number

- Current measured speed

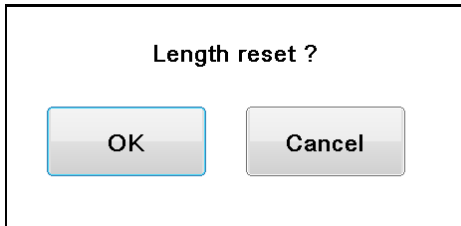
- Current measured total length

- GR: Good readings level


- SNR: Signal-to-Noise Ratio


Press the  button to reset the current measured length to zero.

A pop-up window will appear after pressing this button:



Press the "OK" button to reset the length to zero, or press the "Cancel" button to cancel the operation.

Press the  button to access the function menu page.

Press the  button to advance to the next page.



Speed hold: the symbol will appear on the home page 1 when the logic input is set to Speed



Length hold: the symbol will appear on the home page 1 when the logic input is set to Length Hold.




Laser status: the symbol will appear on the home page 1 when the gauge laser diode is power on. When the diode is power off, the symbol will flash.


HOME PAGE 2 (NORMAL AND BATCH MODE)



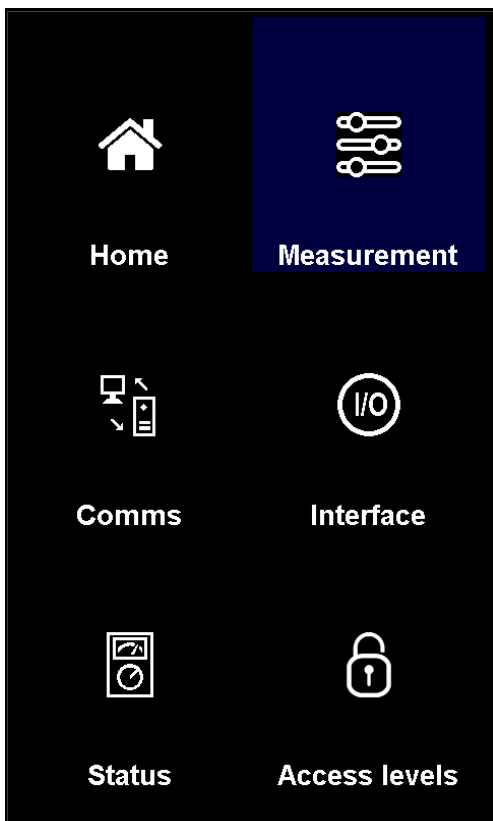
Home page 2 displays:


- The proportion of which has currently been measured relative to the value of preset length 1, up to 100%.
- The value of Preset Length 1
Adjust Preset Length 1 by clicking on the value, entering the new value and clicking the “OK” button.
- The proportion of which has currently been measured relative to the value of preset length 2, up to 100%.
- The value of Preset Length 2
Adjust Preset Length 2 by clicking on the value, entering the new value and clicking the “OK” button.
- Set the required x-Box height ranging from 0–200mm (only if the x-Box is installed and enabled).
- Current x-Box height display.

Press the  button to access the function menu page.

Press the  button to return to “Home Page 1”.

FUNCTION MENUS



Press the  button on the home page to access this page.

Press the **Home** icon to return to the home page; or press the other icons to access the parameter configuration pages.

MEASUREMENT

Measurement 1/3

Operation mode: Normal

Measurement unit: m/min,m

Length resolution: 0.0001

Speed D.P.: 1

Length D.P.: 0.0001

Object detect switch: ON

O.D. threshold [%] : 0

Object detect mode: DC Level

Home icon, List icon, Right arrow icon

Press the **Measurement** icon on the home page to access the Measurement page 1.

- Select the operation mode from options: Normal; Batch

- Select the measurement unit from options: m/min, m; ft/min, ft; ft/min, yds; ft/min, inch; yds/min, yds.

- Select the length resolution from options: 0.1&0.0001;


- Select the speed decimal place.


- Select the length decimal place.


- Select the object detect switch from options: OFF; ON.

- Set the object detection threshold.

- Select the object detect mode: DC level; Zero speed

Press the  button to return to the home page.

Press the  button to access the function menu page.

Press the  button to advance to the next page.

Operation Mode: Normal / Batch mode

In Normal mode, the SL gauge is used to measure one continuous product.

In Batch mode, the SL gauge is used to measure many items of similar length in a batch of a particular amount. For example, it may be a batch of 4000x 3-metre lengths of cable, with the SL(R)M gauge emitting a pulse output every 3 metres to an inkjet printer.

Measurement Unit: m/min,m; ft/min,ft; ft/min,yds; ft/min,inch; yds/min,yds

If the measurement unit is changed (for example from metres to feet or yards), the pulse and analogue outputs will be changed accordingly.

Length resolution: 0.1; 0.0001

This affects the actual length and speed readings, and the readings sent to an CDI4 display, or via any of the communications options.

Speed D.P: 1; 0.1; 0.01; 0.001

Adjust the decimal place of the speed reading.

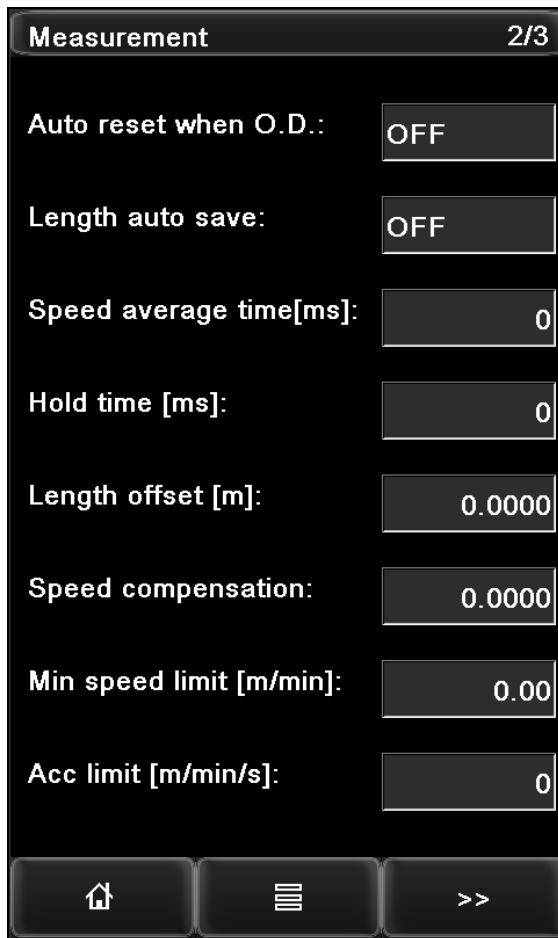
Length D.P: 0.1; 0.01; 0.001; 0.0001

Adjust the decimal place of the length reading.

Object detect switch: OFF / ON

If "ON" is selected, then the measured length is reset to zero on detection of a new object.

If "OFF" is selected, then the measured length continues to accumulate from the previous value on detection of a new object.



- Select auto reset switch from options: OFF; ON.

- Select the length auto save switch from options: OFF; ON.

- Set the value of speed average time.


- Set the value of hold time.


- Set the value of length offset.


- Set the value of speed compensation.

- Set the value of minimum speed limit.

- Set the value of acceleration limit: 1~9999

Press the  button to return to the home page.

Press the  button to access the function menu page.

Press the  button to advance to the next page.

Auto reset when O.D: OFF / ON

If “ON” is selected, then the measured length is reset to zero on detection of a new object.

If “OFF” is selected, then the measured length continues to accumulate from the previous value on detection of a new object.

Length auto save: OFF / ON

If “ON” is selected, when the gauge is powered off, the current length will be stored in memory, and length count will continue from that point on subsequent power-on.

If “OFF” is selected, when the gauge is powered off, the current length will NOT be stored in memory, and length count will begin from 0 (zero) on subsequent power-on.

Speed average time: 0~5000ms

If set to 0 (zero), the speed reading is not averaged. If set to a value from 1~4999 ms, the average speed is calculated at that interval.

The speed averaging time affects the pulse output as well as the analogue output, although the outputs can be based on the immediate speed (non-averaged speed) or the averaged speed.

A long speed averaging time means that the pulse output is more stable, but less sensitive to small and sudden changes in measured velocity.

Hold time: 1ms ~ 5000ms

Hold time is the short period of time (typically 2 seconds) for which the current speed is held while the gauge is unable to make a reading. This allows, for example, for momentary movements of the object surface outside the measuring field. A long hold time is a disadvantage when the end of a product passes out of the gauge’s measuring field, and measurement length continues to accumulate until the hold time is over.

If a minimum speed limit is set and the speed falls below this limit, the gauge records a speed of 0. It is possible to set the hold time to 0, but it is not recommended.

Length offset: 0 ~ 3276.7m

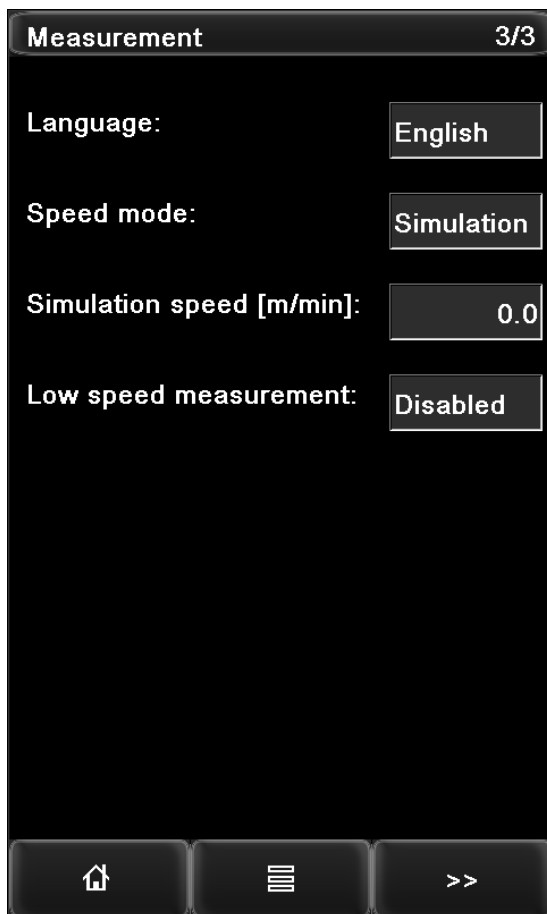
This is used if a product is threaded through a production line before the production line is started, particularly if the gauge is sited at the beginning of the line. A positive length (Length offset) can be added to compensate for the unmeasured length.

Speed Compensation: 0.0001 ~ 6.5535

Set a value other than the default value of 1.0000 to apply a compensation factor to the measured speed.

Min speed limit: 0 ~ 6553.5 m/min

If the speed falls below this limit, the gauge will show zero speed and stop accumulating measured length. This feature is useful where the product is not completely stationary when the production line is stopped. Since the gauge can measure very low speeds and does not distinguish between forward and backward movement, the gauge's measured length reading may continue accumulating. However, if a minimum speed is set, this problem is prevented. If the speed falls below the minimum speed limit, the gauge records a speed of 0. To disable this function, set the minimum speed limit to zero.




- Select the CDI4 software language from options: English; Chinese


- Select the speed mode from options: Normal; Simulation

- Set the simulation speed if the speed mode above is set to "simulation" mode.

- Set the "Low speed measurement" switch.

Press the  button to return to the home page.

Press the  button to access the function menu page.

Press the  button to advance to the next page.

Low speed measurement: when low speed measurement function is disabled, the gauge will stop measuring the object running at low speed (please refer to the specification table for the specific speed value for each model).

COMMUNICATIONS

Comms 1/4

RS232 baudrate:

RS232 protocol:




RS422/485 baudrate:

RS422/485 protocol:




CAN Baudrate:

Gauge CAN address:

CDI4 CAN address:

- Select RS232 baud rate from options: 4800; 9600; 19200; 38400; 115200.
- Select RS232 protocol from options: Modbus; PROTON; ZM400 Printer.
- Select RS422/485 baud rate from options: 4800; 9600; 19200; 38400; 115200.
- Select RS422/485 protocol from options: Modbus; PROTON; ZM400 Printer.
- Select CAN baud rate from options: 250K; 500K; 1000K.
- Set the gauge CAN address.
- Set the CDI4 CAN address.

Press the  button to return to the home page.
 Press the  button to access the function menu page.
 Press the  button to advance to the next page.

Comms-Ethernet 2/4

Modbus ID:




DHCP:

IP Addr: . . .




Subnet: . . .

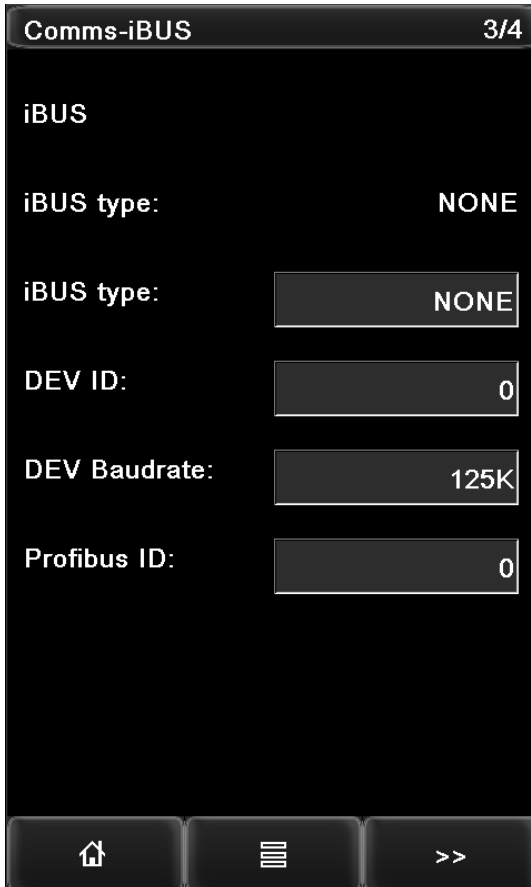
Gateway: . . .

MAC Addr: 00-00-00-00-00-00




  

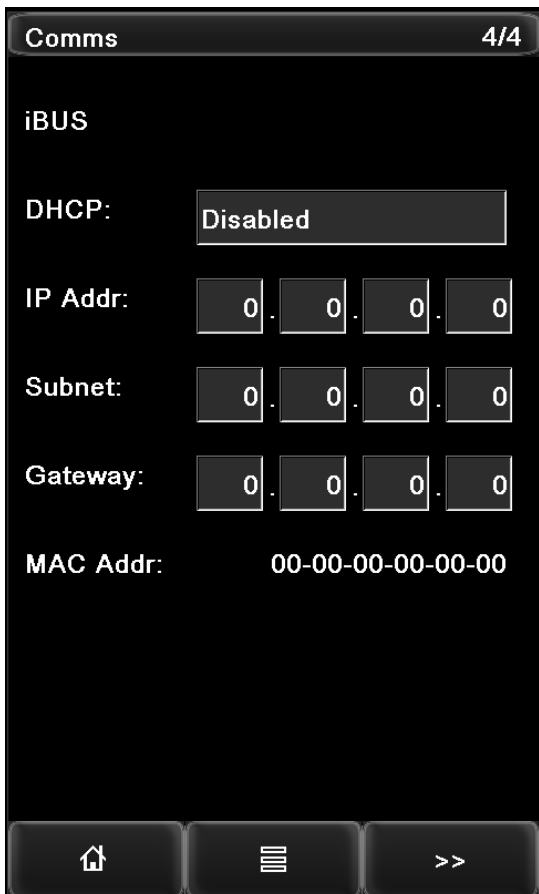
- Enter the Modbus ID of the gauge.
- Enable or disable the DHCP function.
- Set the IP address of the gauge head then click the "OK" button to confirm
- Set the Subnet Mask of the network then click the "OK" button to confirm.
- Set the Gateway IP address of the network then click the "OK" button to confirm.
- The MAC address of the gauge.

Press the  button to return to the home page.
 Press the  button to access the function menu page.
 Press the  button to advance to the next page.






- Select the industrial communication bus type.
Note that if the iBUS type is changed, the gauge must be reboot to take effect.
- Set the device ID of the gauge.
- Select the DeviceNet baud rate from options: 125K; 250K; 500K.
- Set the Profibus ID of the gauge then click the “OK” button to confirm.

Press the  button to return to the home page.
 Press the  button to access the function menu page.
 Press the  button to advance to the next page.



- Enable or disable the DHCP function.
- Enter the IP address assigned to the gauge.
- Enter the subnet mask for the network.
- Enter the gateway IP address for the network.

Press the  button to return to the home page.
 Press the  button to access the function menu page.
 Press the  button to advance to the next page.

COMMUNICATIONS

Comms 1/4

RS232 baudrate: 4800

RS232 mode: Modbus

RS422 baudrate: 4800

RS422 mode: Modbus

CAN Baudrate: 250K




Gauge CAN address: 0

CDI4 CAN address: 0

CDI4 CAN terminator: OFF

Home Menu Next

- Select RS232 baud rate from options: 4800; 9600; 19200; 38400; 115200.
- Select RS232 mode from options: PROTON; Modbus.
- Select RS422 baud rate from options: 4800; 9600; 19200; 38400; 115200.
- Select RS422 mode from options: PROTON; Modbus.
- Select CAN baud rate from options: 250K; 500K; 1000K.
- Set the gauge CAN address.
- Set the CDI4 CAN address.
- Set the CDI4 CAN terminator ON or OFF.

Press the  button to return to the home page.
 Press the  button to access the function menu page.
 Press the  button to advance to the next page.

Comms / Ethernet 2/4

Modbus ID: 0

DHCP: Disabled

IP address: 0 . 0 . 0 . 0

Subnet mask: 0 . 0 . 0 . 0

Gateway: 0 . 0 . 0 . 0




MAC address F8-95-50-01-00-06

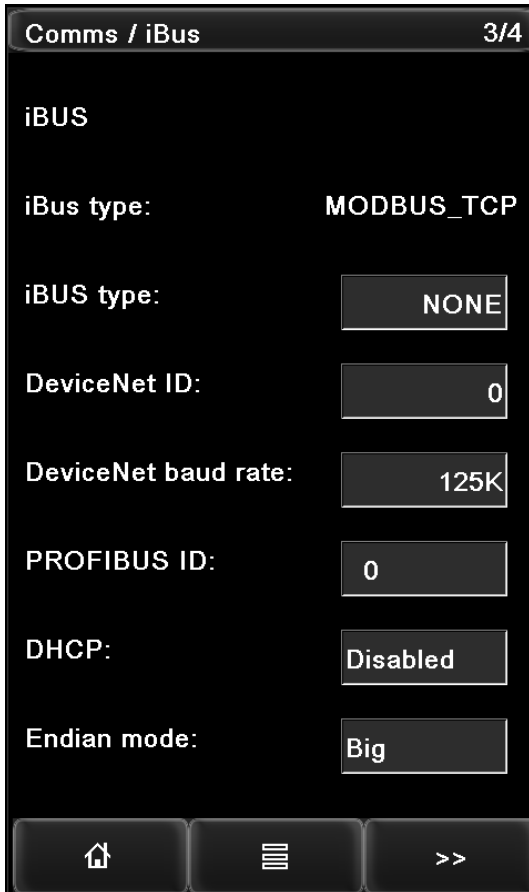
UDP IP: 192.168.0. 0

Interval time of UDP[ms]: 0




Home Menu Next

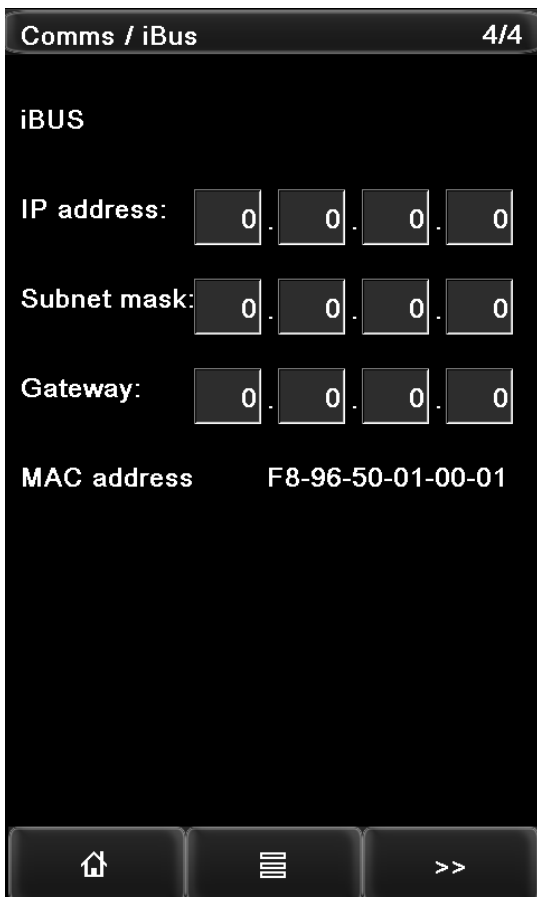
- Set the Modbus ID.
- Enable or disable the DHCP function.
- Set the IP address of the gauge head then click the "OK" button to confirm.
- Set the Subnet Mask of the network then click the "OK" button to confirm.
- Set the Gateway IP address of the network then click the "OK" button to confirm.
- The MAC address of the gauge.
- Set the UDP IP address.
- Set the Interval time of UDP.

Press the  button to return to the home page.
 Press the  button to access the function menu page.
 Press the  button to advance to the next page.






- Select the industrial communication bus type.
Note that if the iBUS type is changed, the gauge must be reboot to take effect.
- Set the device ID of the gauge.
- Select the DeviceNet baud rate from options: 125K; 250K; 500K.
- Set the Profibus ID of the gauge then click the “OK” button to confirm.
- Enable or disable the DHCP function.
- Set the Endian mode.

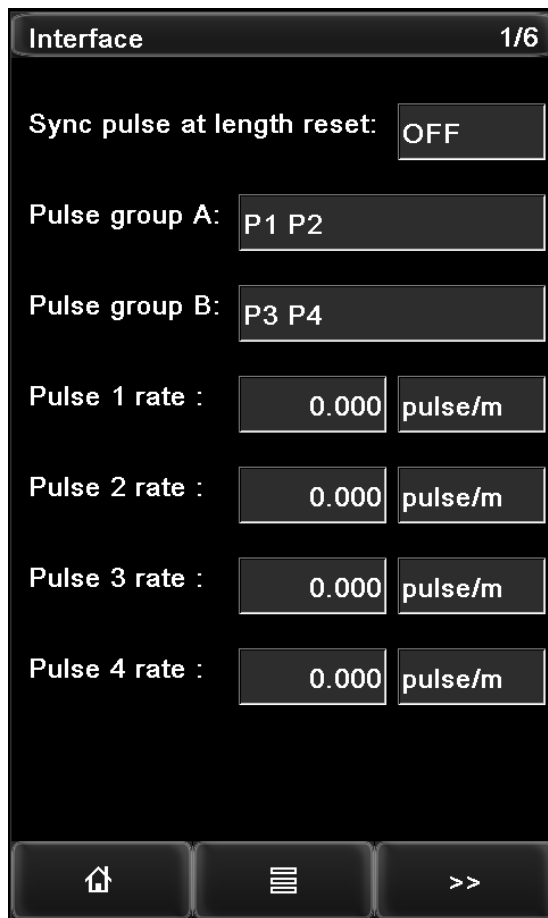
Press the  button to return to the home page.
 Press the  button to access the function menu page.
 Press the  button to advance to the next page.



- Enter the gauge IP address.
- Enter the subnet mask of the network.
- Enter the gateway IP address of the network.

Press the  button to return to the home page.
 Press the  button to access the function menu page.
 Press the  button to advance to the next page.

INTERFACE



Press the **Interface** icon on the function menu page to access the Interface page 1.

- Switch ON or OFF the pulse reset during length reset.

- Select the pulse 1, 2 output mode.


- Select the pulse 3, 4 output mode.


- Set the required pulse rate for pulse output 1.


- Set the required pulse rate for pulse output 2.

- Set the required pulse rate for pulse output 3.

- Set the required pulse rate for pulse output 4.

Press the  button to return to the home page.

Press the  button to access the function menu page.

Press the  button to advance to the next page.

Sync pulse at reset: OFF / ON

Select ON to have pulse outputs reset during a length reset.

Pulse group A: P1 P2; P1=/P2; P1=Quad P2; P1/2=Quad P3/4

Select "P1 P2" mode to configure pulse output 1 and pulse output 2 with separate and independent pulse rates.

Select "P1=/P2" mode to couple together pulse output 1 and pulse output 2 as a differential pair, with pulse rate set under "Pulse 1 rate"

Select "P1=Quad P2" mode to couple together pulse output 1 and pulse output 2 as a quadrature pair, with pulse rate set under "Pulse 1 rate".

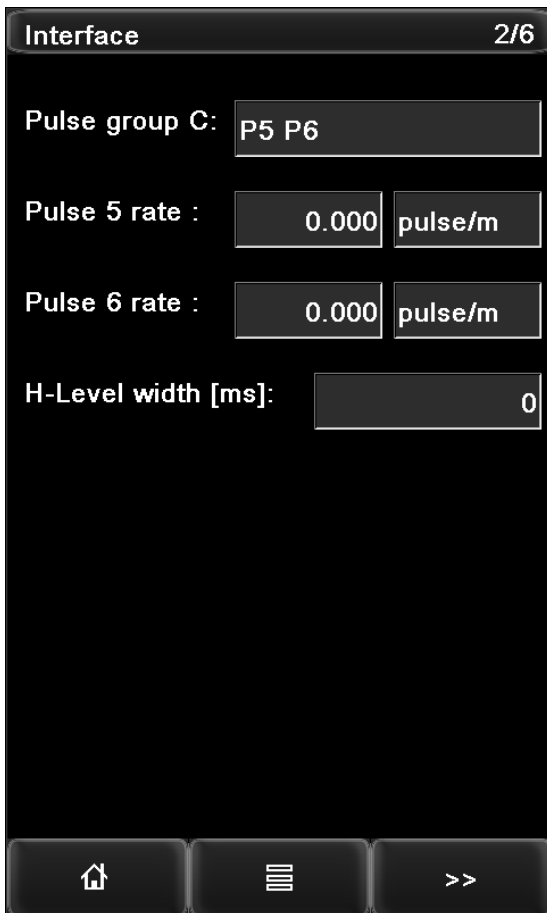
Select "P1/2=Quad P3/4" mode to configure "Pulse 1", "Pulse 2" and "Pulse 3", "Pulse 4" as a quadrature pair, with pulse rate set under "Pulse 1 rate".

Pulse group B: as per "Pulse group A" above.

Pulse 1, 2, 3, 4 rate

Set the required pulse rate for "Pulse 1, 2, 3, 4 rate" in pulses/unit, where the unit is the "Measurement" unit" (metres, feet, inch or yards) set on the "Measurement" page.

Note: When the "Pulse A" is set to "P1=Quad P2", the "Pulse 2 rate" field is disabled and the "Pulse 1 rate" sets the rate for the quadrature pulse output across both "Pulse output 1" and "Pulse output 2".





- Select the pulse 5, 6 output mode


- Set the required pulse rate for pulse output 5.

- Set the required pulse rate for pulse output 6.

- Set the H-level width of the pulse rates.

Press the  button to return to the home page.

Press the  button to access the function menu page.

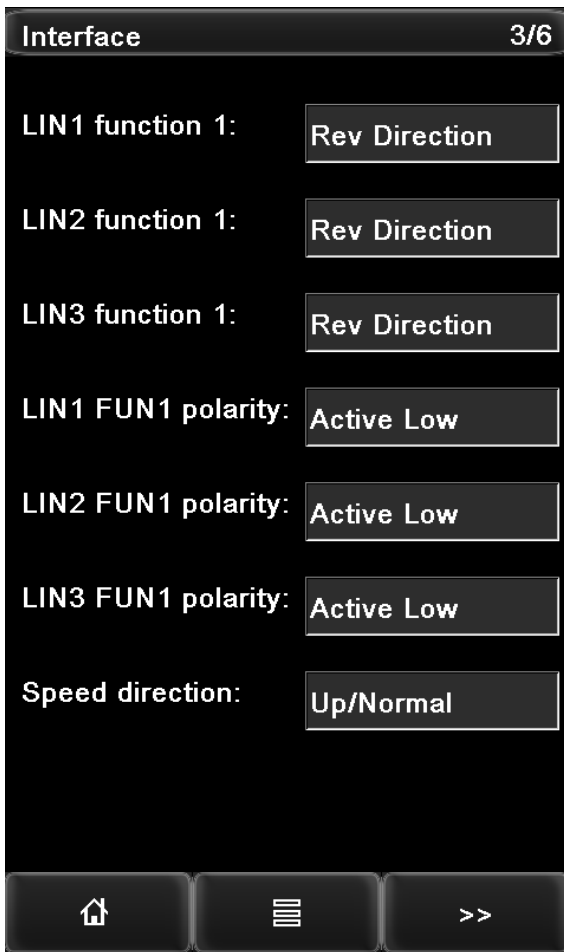
Press the  button to advance to the next page.

Pulse group C: as per “Pulse group A” above.

Pulse 5, 6 rate

Set the required pulse rate for “Pulse 5, 6 rate” in pulses/unit, where the unit is the “Measurement” unit” (metres, feet, inch or yards) set on the “Measurement” page.

Note: When the “ Pulse C” is set to “P5=Quad P6”, the “Pulse 6 rate” field is disabled and the “Pulse 5 rate” sets the rate for the quadrature pulse output across both “Pulse output 5” and “Pulse output 6”.



- Select the logic input 1 function 1.

- Select the logic input 2 function 1.


- Select the logic input 3 function 1.


- Select the logic input 1 function 1 polarity from options: Active Low; Active High.


- Select the logic input 2 function 1 polarity from options: Active Low; Active High.

- Select the logic input 3 function 1 polarity from options: Active Low; Active High.

- Set the direction of the line speed from options: Up/Normal; Down/Invert.

Press the  button to return to the home page.

Press the  button to access the function menu page.

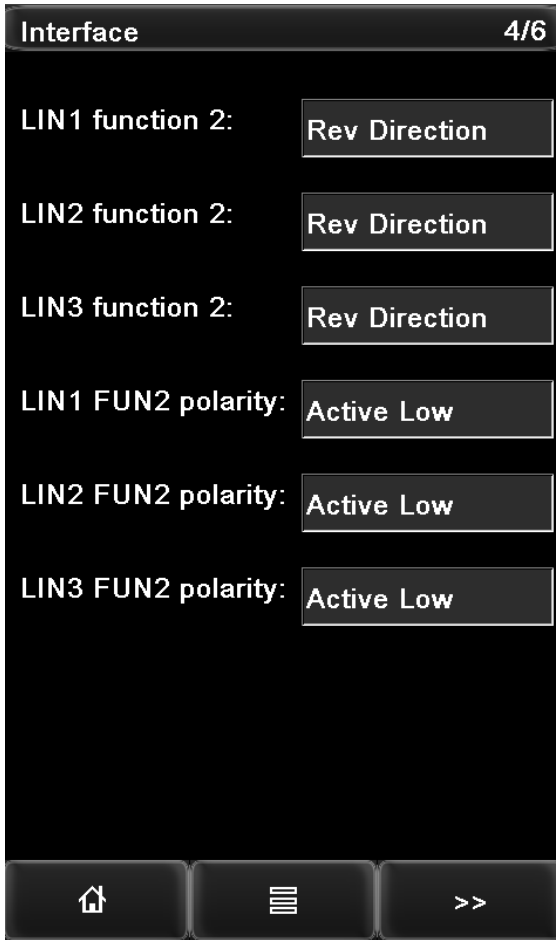
Press the  button to advance to the next page.

LIN 1 / 2 / 3 function 1:

Select from the following options:
 Rev Direction;
 Length Hold;
 Display Hold;
 Speed Hold;
 Reset Total Length;
 End of Reel / Batch Length Reset;
 None.

LIN 1 / 2 / 3 FUN1 polarity: Active Low; Active High

Pulling the logic input low (logic 0) or logic input high (logic 1) activates the configured function.



- Select the logic input 1 function 2.

- Select the logic input 2 function 2.


- Select the logic input 3 function 2.


- Select the logic input 1 function 2 polarity from options: Active Low; Active High.


- Select the logic input 2 function 2 polarity from options: Active Low; Active High.

- Select the logic input 3 function 2 polarity from options: Active Low; Active High.

- Set the direction of the line speed from options: Up/Normal; Down/Invert.

Press the  button to return to the home page.

Press the  button to access the function menu page.

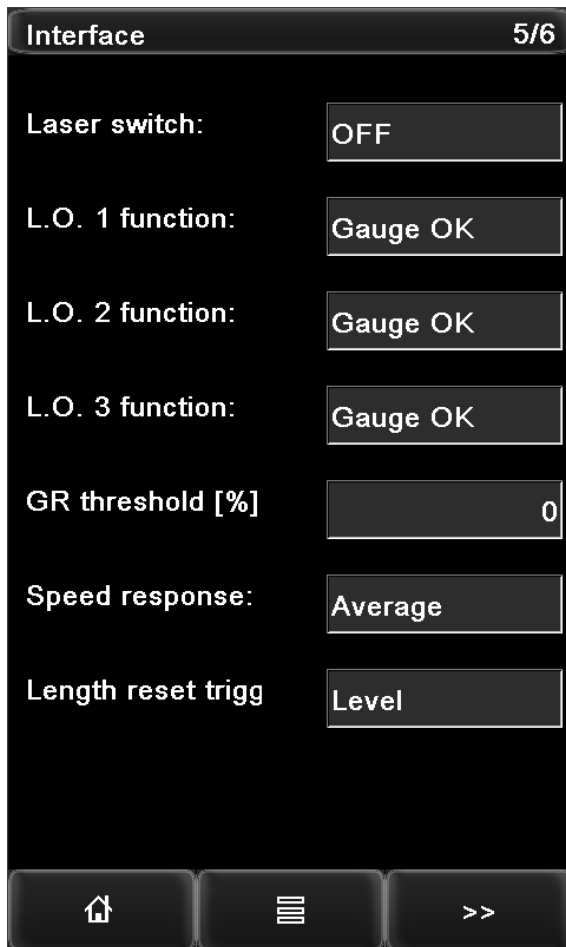
Press the  button to advance to the next page.

LIN 1 / 2 / 3 function 2:

Select from the following options:
 Rev Direction;
 Length Hold;
 Display Hold;
 Speed Hold;
 Reset Total Length;
 End of Reel / Batch Length Reset;
 None.

LIN 1 / 2 / 3 FUN2 polarity: Active Low; Active High

Pulling the logic input low (logic 0) or logic input high (logic 1) activates the configured function.



- Switch the laser ON or OFF.

- Select the logic output 1 function.


- Select the logic output 2 function.


- Select the logic output 3 function.


- Set the Good Readings threshold for logic output.

- Select whether the speed reading used should be averaged. Options: Average; Instant.

- Select the length reset trigger mode: Level; Edge.

Press the  button to return to the home page.

Press the  button to access the function menu page.

Press the  button to advance to the next page.

L.O. 1 / 2 / 3 function

Select the logic output function from the following options:

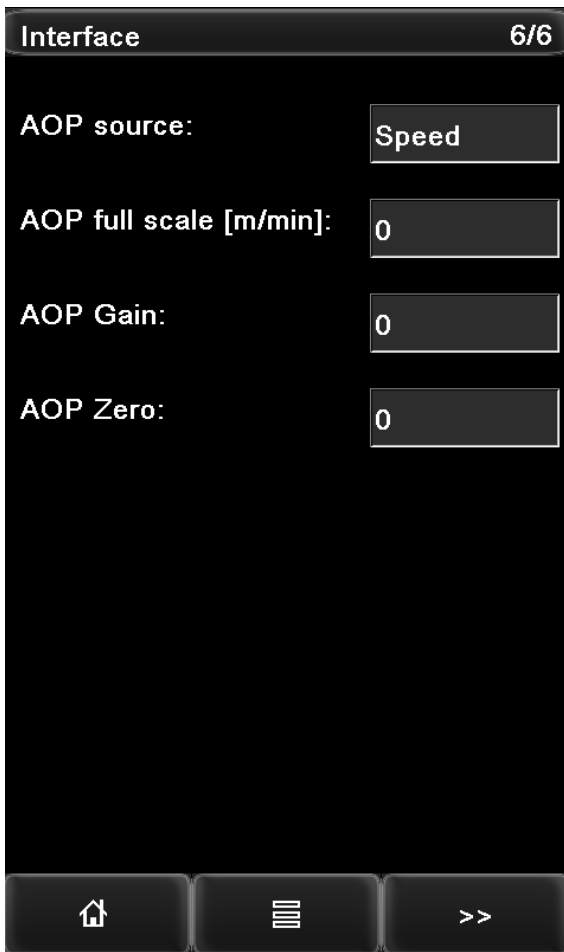
Gauge OK; Measuring speed;
 Preset length 1; Preset length 2;
 Good reading; Object Detected;
 Gauge Hot

GR threshold: 0~ [60] ~100%

Set the threshold above which the “Good Readings” percentage will trigger pull-down of any logic output configured to the “Good readings” condition.

Speed response: Average; Instant

Select whether the speed reading used should be averaged or not.





- Select the analogue output source: Speed; Good reading.


- Set the analogue output full scale value.

- Set the analogue output gain.

- Set the analogue output zero.

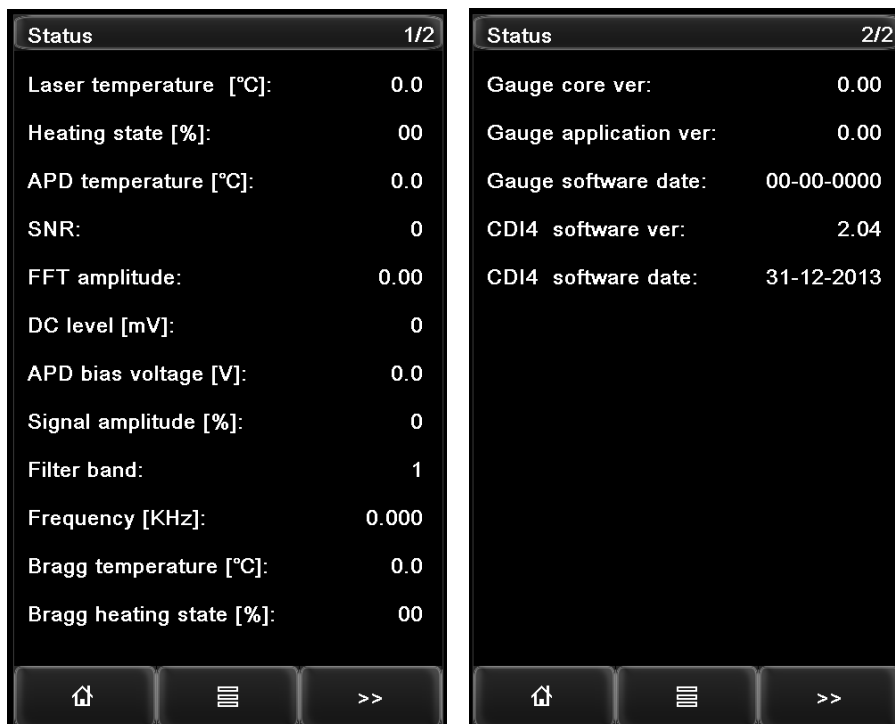
Press the  button to return to the home page.

Press the  button to access the function menu page.

Press the  button to advance to the next page.

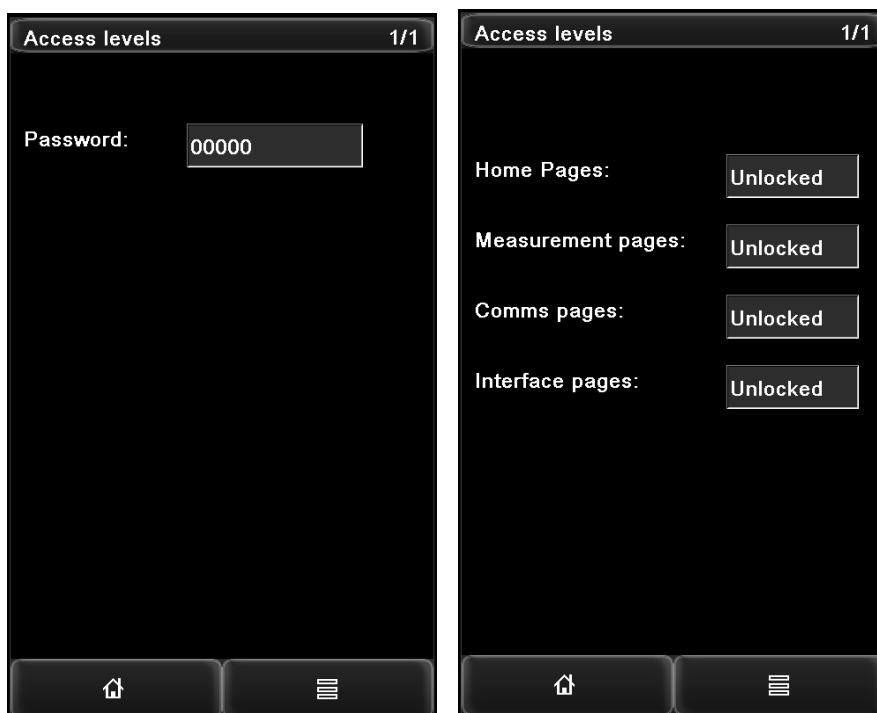
STATUS

Press the **Status** icon on the function menu page to access the Status page. This page displays read-only diagnose information on the gauge.



ACCESS LEVELS

Press the **Access levels** icon on the function menu page to enter the access levels page 1. Input the password "18018" to enter the access levels page 2 then select to lock or unlock the respective pages.



STANDARD COMMUNICATIONS INTERFACES

CAN-BUS COMMUNICATIONS

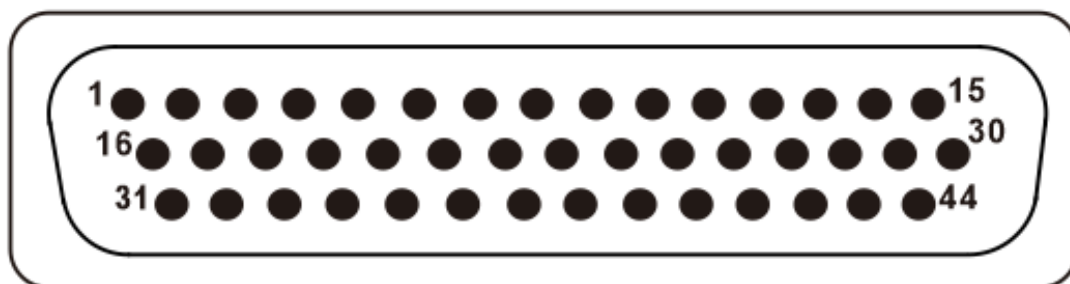
This CAN-bus interface is fitted as standard. It operates independently of the other communications interfaces and may be accessed at the same time as them.

The CAN-bus interface uses a proprietary Proton Products protocol. It is exclusively used to communicate between the unit and other Proton Products modules. The unit automatically detects connection to other modules and configures the bus appropriately; it is not normally necessary to manually configure this interface.

The CAN-bus interface is not intended for use with an external CAN-bus network.

CAN-bus interface


The CAN-bus interface may be accessed through the following pins:



Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes
Shield	S	Shield	Shield	Ensure that the cable shield is connected to the plug shield connection.
Power supply and signal ground	1	+24V SUPPLY	+24V power supply	
	2			
	3	DGND	Signal ground (0V)	
	4			
CANbus	5	CAN H	CANbus high	
	6	CAN L	CANbus low	

CAN-bus LED indicator

CAN		LED status	Indication
		Flashing green	Online
CAN-bus communications		Flashing red	Communication error
		Extinguished	No communication

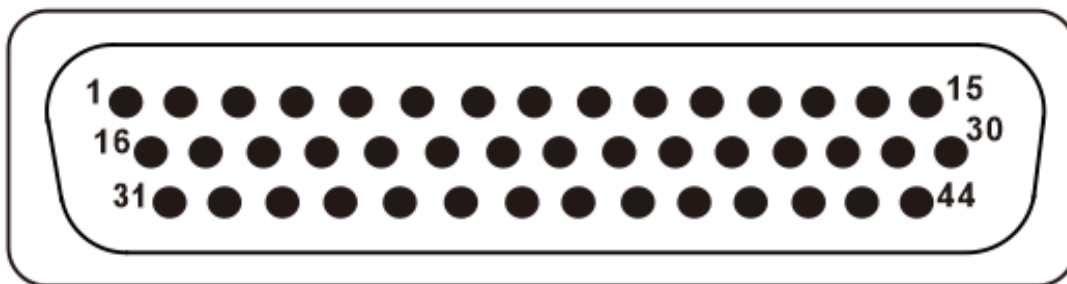
RS-232 COMMUNICATIONS

This RS-232 interface is fitted as standard. It operates independently of the other communications interfaces and may be accessed at the same time as them.

If the RS-232 interface “Mode” is set to “ZM400 Printer”, then a Zebra ZM400 printer may be connected to the port to print reel report tickets when triggered by the “End of Reel” logic input.

RS-232 interface

The RS-232 interface may be accessed through the following pins:



Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes	PC DB9 serial port pin
Shield	S	Shield	Shield	Connect to cable and connector shields	Shield
Power supply and signal ground	1	+24V SUPPLY	+24V power supply		5
	2				
	3				
	4	DGND	Power supply and signal ground (0V)		
RS-232	15				
	11	RXD	RS-232 receive		3
	12	TXD	RS-232 transmit		2
	13	CTS			
	14	RTS			

The above table also shows the configuration of a cable for connection to a personal computer (PC) type DB9 serial port.

The maximum baud rate depends on the cable capacitance and length. For low-cost overall shielded cable with total capacitance of shield to core-plus-core to core of 300pF per metre, the maximum recommended baud rates are as follows:

Cable length range / m	Maximum Baud rate / s	
0	3	115200
3	10	38400
10	20	19200
20	40	9600
40	80	4800

RS-232 Printing

If the RS-232 interface “Mode” is set to “Print”, then a Zebra ZM400 printer may be connected to the port to print End of Reel report tickets when triggered by the “End of Reel” logic input (see the “Logic Inputs” section for connection and configuration information).

Ensure that the RS-232 baud rate is configured to the same value as set on the printer (9600 by default).

Zebra ZM400 Cable

The gauge may either be directly connected to the printer via the DB44M “INTERFACE” port or via the DB9F RS-232 port on an optional PSU-BOB:

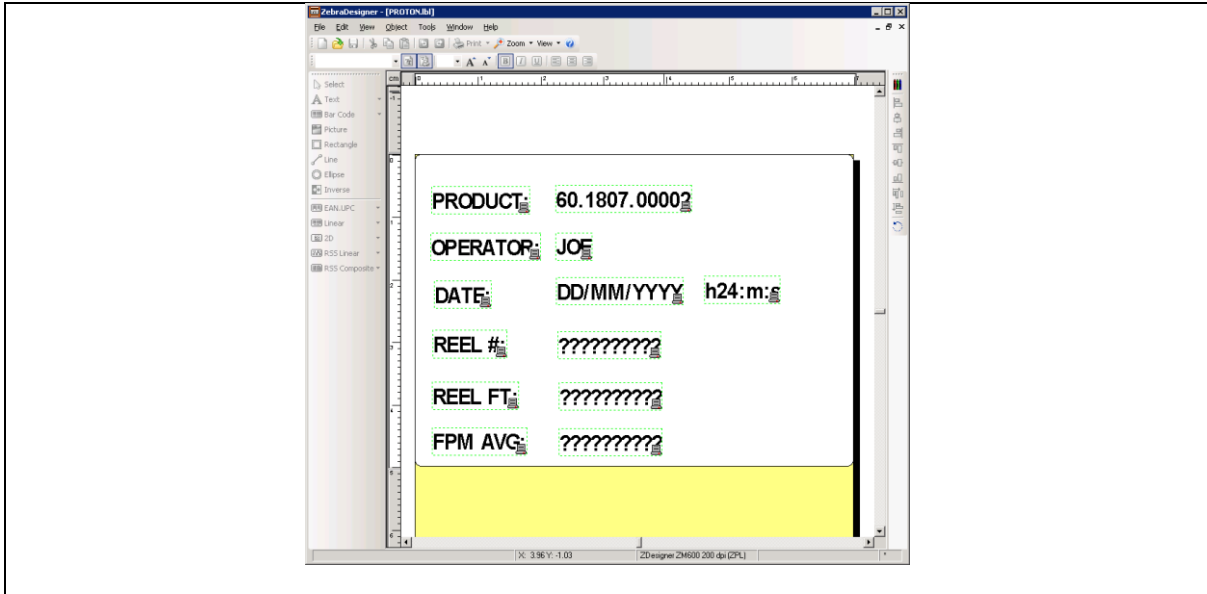
SL / SLR mini-i4 W INTERFACE port		Zebra ZM400 RS-232 port	
Required cable connector: DB44M		Required cable connector: DB9M	
Designation	Pin	Pin	Designation
Shield	Shield	Shield	Shield
DGND	15	5	DGND
RXD	11	3	TXD
TXD	12	2	RXD

PSU-BOB RS-232 port		Zebra ZM400 RS-232 port	
Required cable connector: DB9M		Required cable connector: DB9M	
Designation	Pin	Pin	Designation
Shield	Shield	Shield	Shield
DGND	5	5	DGND
RXD	2	3	TXD
TXD	3	2	RXD

Zebra ZM400 Printer Configuration

The Zebra ZM400 printer must be configured with the layout of the End of Reel report ticket using the following procedure:

1	Install the “Zebra Designer” software onto a suitable PC.
2	Install the Zebra printer drivers onto the PC (the drivers are supplied on a CD-ROM with the Zebra ZM400 printer and may also be downloaded from www.zebra.com).
3	Connect the PC to the Zebra ZM400 printer using the USB cable supplied with the printer.
4	Run the “Zebra Designer” software and open the “PROTON.lbl” sample label layout file:

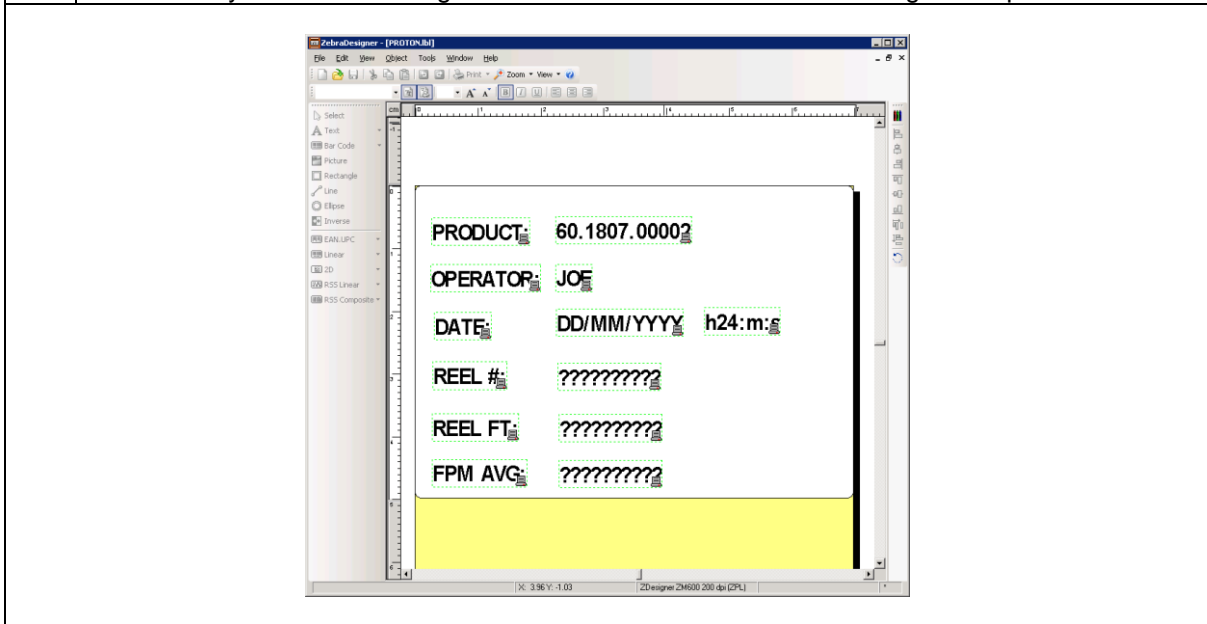


5

The gauge will send 3 strings in the following sequence to the Zebra ZM400 printer:

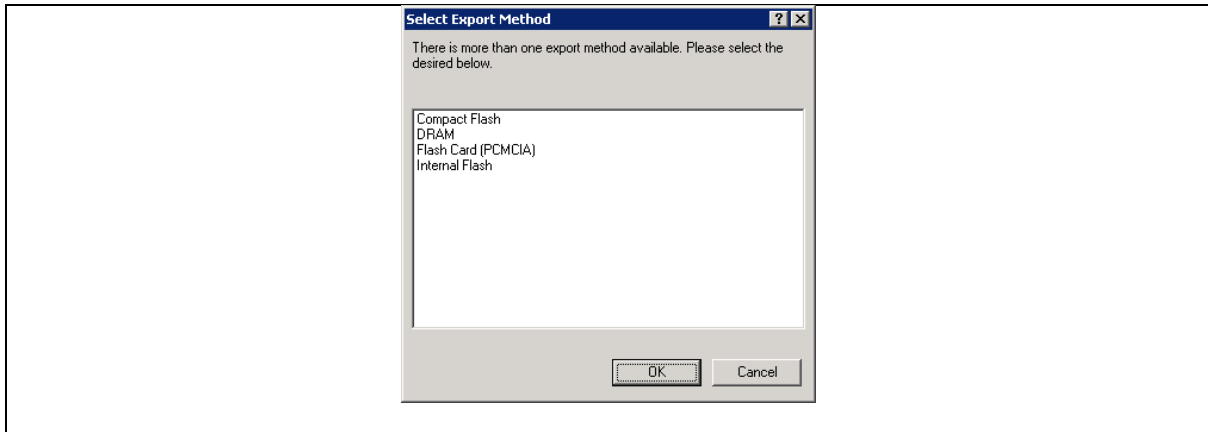
- String no.1: Reel number
- String no.2: Length
- String no.3: Average speed

The label layout must be designed to accommodate the above 3 strings in sequence:



6

Export the “PROTON.lbl” file to the Zebra ZM400 printer by clicking “File → Export to Printer” in the “Zebra Designer” software and then selecting “Internal Flash” and clicking the “OK” button:



7 | The Zebra ZM400 printer may be triggered to print a ticket by activating the “End of Reel” logic input on the SL / SLR mini-i4 W gauge.

Proton standard RS232 parameter access protocol

This uses a protocol to access individual parameters or blocks of parameters and is typically used in a production line environment where the gauge is connected to a PLC or similar device.

Notes

- The parameters are split into 'Input' and 'Output' groups, the 'Input' parameters can be both read and written, and the 'Output' parameters can only be read
- The parameter number is the same as the word address used for Profibus data; refer to the 'PROFIBUS Master to Gauge and RS232 Input Parameter List' for the parameter numbers
- For 'Input' data: when a word is defined as bits then four hexadecimal characters are required to form the bits 15~0; when a word is defined as a data value then only sufficient characters to define the value in decimal format, with the decimal point where appropriate, are needed; where the data is of double word length then only the first word address is used
- For 'Output' data: when a word is defined as bits then four hexadecimal characters will be sent; when a word is defined as a data value it is converted to a decimal number with the decimal point but without leading zeros; where a double word is used then only the first word address is used to request the data, the data in both words is automatically converted to a single value
- If a PC keyboard is being used to enter the codes then the 'carriage return' plus 'line feed' are replaced by the Enter key

SET THE VALUE OF AN 'INPUT' PARAMETER

Write Format:

&
Input Parameter number
Space
Value without decimal point [0.5m = 50]
Carriage return
Line feed

REQUEST VALUE ONCE FOR ONE OR A RANGE OF 'INPUT' PARAMETERS

Request Format 1: (e.g.: ?2 'ENTER')

?
Input Parameter number
Carriage return
Line feed

Request Format 2: (e.g.: ?2 2 'ENTER')

?
Input Parameter number
Space
Length of string
Carriage return
Line feed

REQUEST CONTINUOUSLY REPEATING VALUES FOR ONE OR A RANGE OF 'OUTPUT' PARAMETERS

The repartition rate is the maximum possible and only limited by the data length and baud rate. The parameters must be consecutive when requesting multiple parameters.

Request Format 1:

Parameter number
Carriage return
Line feed

Request Format 2:

First parameter number
Space
Number of parameters
Carriage return
Line feed

Reply Format 1:

Parameter value
Carriage return
Line feed

Reply Format 2:

First output parameter value
Carriage return
Line feed
Second output parameter value
Carriage return
Line feed
Third output parameter and so on, until the end of the range.

REQUEST VALUE ONCE FOR ONE OR A RANGE OF 'OUTPUT' PARAMETERS

The request and reply format is identical to the # format given below except that # is replaced by ~.

Modbus parameter access protocol

This protocol provides access to individual parameters or blocks of parameters and is typically used in a production environment where the Proton Products instrument is connected to a computer, Modbus connected PLC or similar device.

The parameters consist of 16-bit words (DW) and are divided into input and output groups:

- Input parameters may be read from and written to and are used to configure the instrument.
- Output parameters are read only and provide access to instrument status and measurement data.

1 word (DW) consists of 2 bytes
1 byte consists of 8 bits
4 bits are expressed by 1 hexadecimal digit (0-9, A-F)

Proton Products instruments use the following Modbus format:

Modbus format	RTU (Remote Terminal Unit)
Error check	CRC (Cyclic Redundancy Check)

The Modbus RTU frame format is as follows:

Modbus RTU frame format			
Name	Length	Function	
Start	> 3.5 characters	>3.5 characters of silence	
Address	1-byte	Slave (instrument) Modbus address	*
Function	1-byte	Modbus function code determines read or write operation	*
Data	Multiple bytes	Length and data dependent on function	*
CRC	2-bytes	Cyclic Redundancy Check for errors (not required for Modbus TCP)*	
End	> 3.5 characters	>3.5 characters of silence	

*Please refer to Modbus Protocol Standards documentation for the CRC error check field calculation. For Modbus protocol communications over TCP/IP networks via the Ethernet port (also known as **Modbus TCP**), the CRC error check field is not required as error checking is handled by the TCP/IP protocol.

For brevity, only the fields marked * are shown in the subsequent examples.

Proton Products instruments support the following Modbus functions:

Modbus function			Instrument operation
Code		Name	
Dec	Hex		
03	03	Read Holding Registers	Read data from a block of consecutive input parameters.
06	06	Preset Single Register	Write data to a single input parameter.
16	10	Preset Multiple Registers	Write data to a block of consecutive input parameters.
04	04	Read Input Registers	Read data from a block of consecutive output parameters.

For Modbus protocol communications via the RS-232 serial port, the RS-232 data format is:

Number of data bits	Parity	Number of stop bits	Flow control	Default baud rate
8	None	1	None	115200 bit / s

Read data from a block of consecutive input parameters

Use Modbus function “03” (Read Holding Registers) to read from a block of consecutive input parameters.

Modbus query format		Hex
Slave Modbus address (Gauge Modbus address)		01
Modbus function code		03
Starting address (Starting input parameter address)	High byte	00
	Low byte	08
Number of points (Input parameter word count)	High byte	00
	Low byte	04

Modbus response format		Hex
Slave Modbus address (Gauge Modbus address)		01
Modbus function code		03
Byte count $N = (2 \times \text{Number of points})$		08
Data word 0 (corresponds to input DW8)	High byte	01
	Low byte	F4
Data word 1 (corresponds to input DW9)	High byte	01
	Low byte	F4
Data word 2 (corresponds to input DW10)	High byte	01
	Low byte	F4
Data word $[(N/2) - 1] = 3$ (corresponds to input DW11)	High byte	01
	Low byte	F4

The response contains the input parameter values requested in the query; its length is dependent on the number of input parameters requested.

Write data to a single input parameter

Use Modbus function “06” (Preset Single Register) to read from a block of consecutive input parameters.

Modbus query format		Hex
Slave Modbus address (Gauge Modbus address)		01
Modbus function code		06
Register address (Input parameter address)	High byte	00
	Low byte	06
Preset data (Input parameter value)	High byte	03
	Low byte	E8

Modbus response format		Hex
Slave Modbus address (Gauge Modbus address)		01
Modbus function code		06
Register address (Input parameter address)	High byte	00
	Low byte	06
Preset data (Input parameter value)	High byte	03
	Low byte	E8

The response is an echo of the query.

Write data to a block of consecutive input parameters

Use Modbus function “16 (10 Hex)” (Preset Multiple Registers) to write to a block of consecutive input parameters.

Modbus query format		Hex
Slave Modbus address (Gauge Modbus address)		01
Modbus function code		10
Starting address (Starting input parameter address)	High byte	00
	Low byte	01
Number of registers (Input parameter word count)	High byte	00
	Low byte	03
Byte count N = (2 × Number of registers)		06
Data word 0 (corresponds to input DW1)	High byte	1F
	Low byte	40
Data word 1 (corresponds to input DW2)	High byte	1F
	Low byte	40
Data word [(N/2) – 1] = 2 (corresponds to input DW3)	High byte	1F
	Low byte	40

Modbus response format		Hex
Slave Modbus address (Gauge Modbus address)		01
Modbus function code		10
Starting address (Starting input parameter address)	High byte	00
	Low byte	01
Number of registers (Input parameter word count)	High byte	00
	Low byte	03

The response contains the starting input parameter address and the count of input parameter words written.

Read data from a block of consecutive output parameters

Use Modbus function “04” (Read Input Registers) to write to a block of consecutive input parameters.

Modbus query format		Hex
Slave Modbus address (Gauge Modbus address)		01
Modbus function code		04
Starting address (Starting output parameter address)	High byte	00
	Low byte	02
Number of points (Output parameter word count)	High byte	00
	Low byte	03

Modbus response format		Hex
Slave Modbus address (Gauge Modbus address)		01
Modbus function code		04
Byte count N = (2 × Number of points)		06
Data word 0 (corresponds to output DW2)	High byte	07
	Low byte	D0
Data word 1 (corresponds to output DW3)	High byte	05
	Low byte	DC
Data word 2 [(N/2) – 1] (corresponds to output DW4)	High byte	09
	Low byte	C4

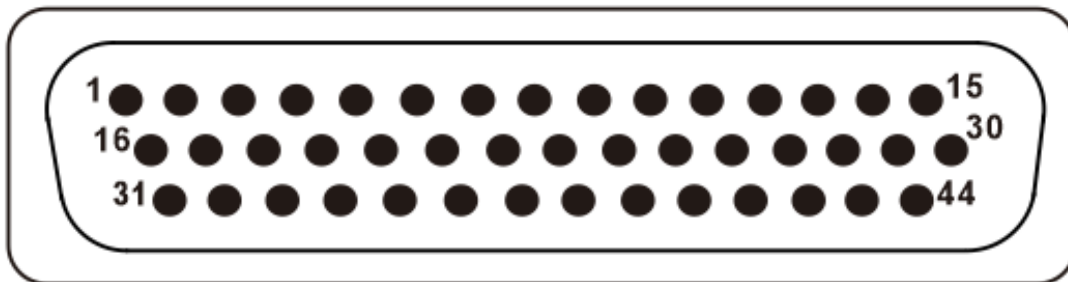
The response contains the output parameter values requested in the query; its length is dependent on the number of output parameters requested.

PROFIBUS COMMUNICATIONS

This communications interface operates independently of the other communications interfaces and may be used at the same time as them.

PROFIBUS interface

The PROFIBUS interface may be accessed through the following pins:




Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes
Shield	S	Shield	Shield	Connect to cable and plug shields
PROFIBUS Industrial bus	9	Vbus	+5V	
	10	GNDbus	GND	I-bus ground reference
	7	PROFI A / RS485 B*	A	
	8	PROFI B / RS485 A*	B	

*The I-BUS interface may also be used as RS485 MODBUS & PROTON protocol communication interface when PROFIBUS is not used.

PROFIBUS LED indicator

i-BUS		LED status	Indication
PROFIBUS communications		Continuous green	Online
		Continuous red	Communication error
		Extinguished	No communication

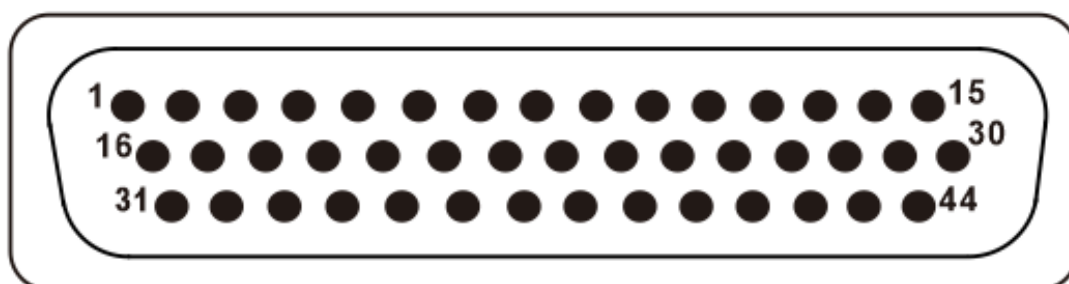
ETHERNET / IP OR PROFINET COMMUNICATIONS

The Ethernet/IP interface is compatible with PLCs fitted with an Ethernet/IP interface that supports the CIP (Common Industrial Protocol).

This communications interface operates independently of the other communications interfaces and may be used at the same time as them.

EtherNet / IP or PROFINET interface


The EtherNet / IP or PROFINET interface may be accessed through the following pins:



Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes
Shield	S	Shield	Shield	Connect to cable and plug shields
Ethernet/IP or PROFINET Industrial bus	16	ETH TX+	TX+	
	17	ETH TX-	TX-	
	18	ETH RX+	RX+	
	19	ETH RX-	RX-	

EtherNet / IP or PROFINET LED indicator

i-BUS		LED status	Indication
		EtherNet / IP or PROFINET communications	Continuous green
		Continuous red	Communication error
		Extinguished	No communication

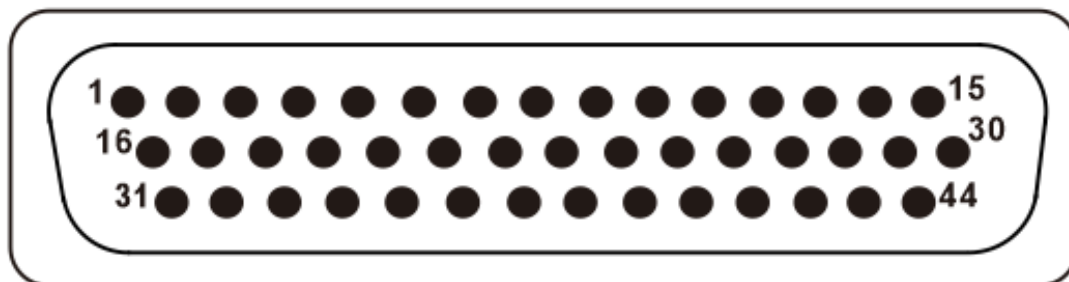
ETHERNET COMMUNICATIONS

This Ethernet interface is fitted as standard. It operates independently of the other communications interfaces and may be accessed at the same time as them.

If an optional industrial bus interface (Ethernet/IP, PROFIBUS or Profinet) has been installed in the gauge, then the Ethernet interface is substituted by the industrial bus interface.

Ethernet interface


The Ethernet interface may be accessed through the following pins:



Connector type: DB44 male (socket)

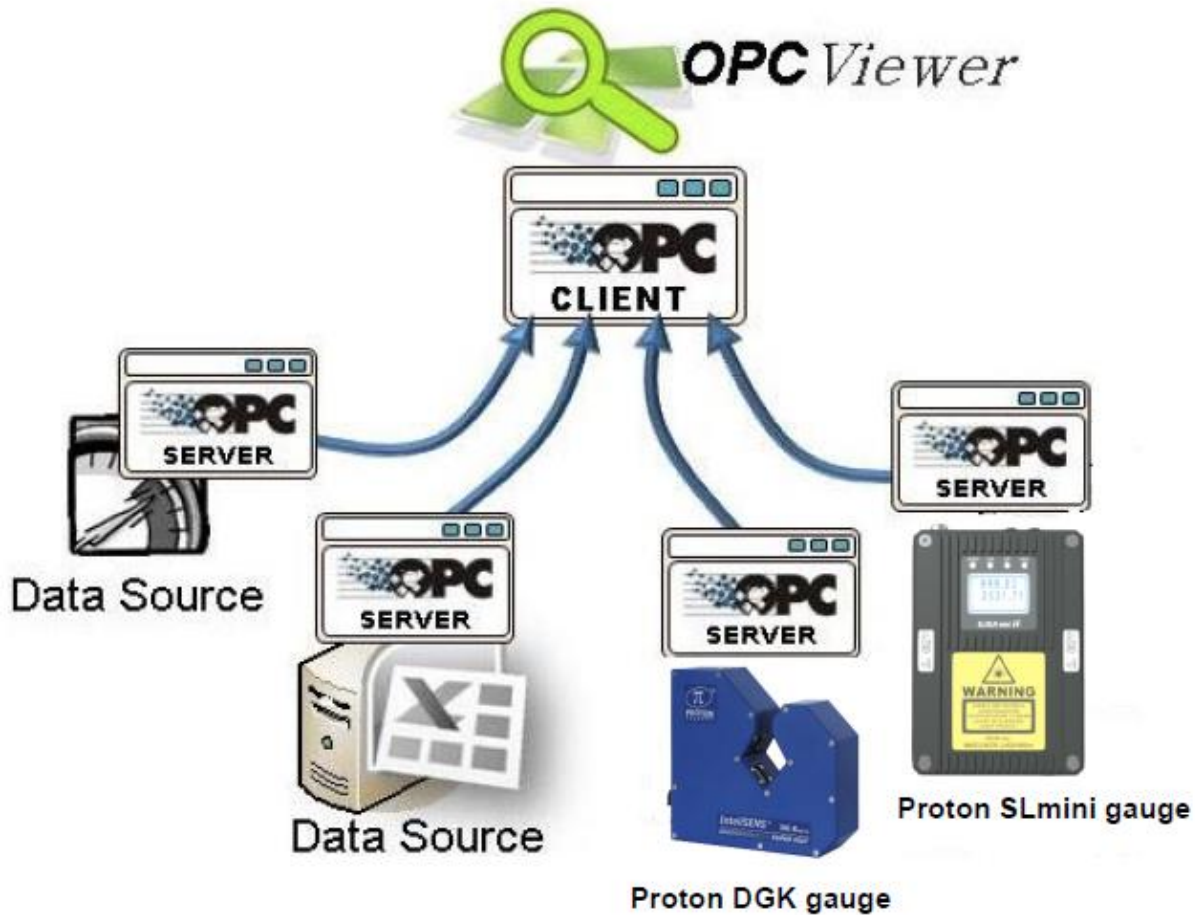
Functional group	Pin	Designation	Description	Notes
Shield	S	Shield	Shield	Connect to cable and plug shields
Ethernet	16	TX+		
	17	TX-		
	18	RX+		
	19	RX-		

Ethernet LED indicator

EIP		LED status	Indication
		Ethernet communications	Continuous green
		Flashing green	Online but not connected

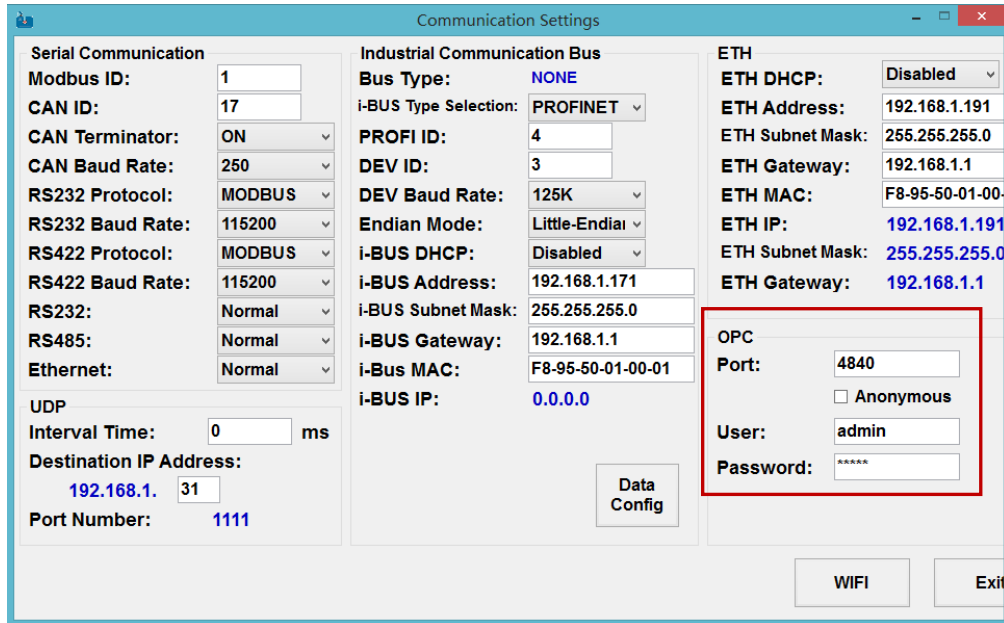
OPC UNIFIED ARCHITECTURE (UA)

OPC UA is a central element of Industry 4.0 providing seamless communication between IT and industrial production systems. OPC UA 1.03 has been supported on Proton SLmini gauge as a standard interface. The OPC Client can exchange data (read / write) with SLmini gauge (OPC Server) to real-time monitor and manage the gauge.



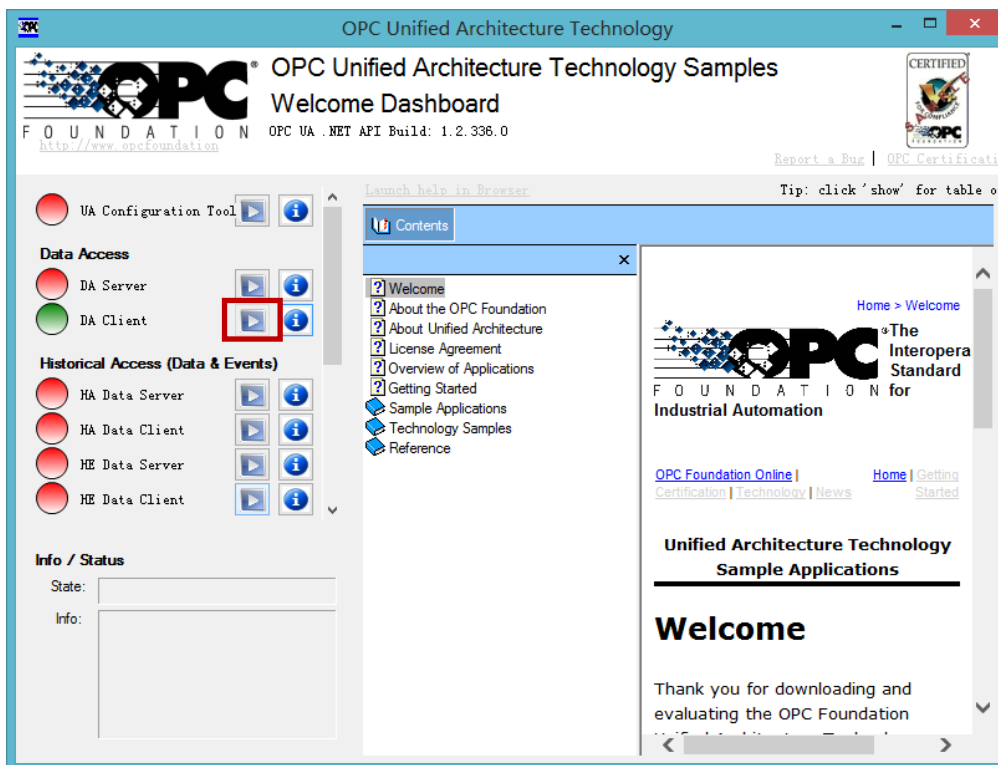
To connect to the SLmini gauge (OPC Server) from an OPC Client software, please use the following procedure:

1. Set up the OPC port number, user name and password on PCIS.
Main page > Comms (password: 65000) > OPC

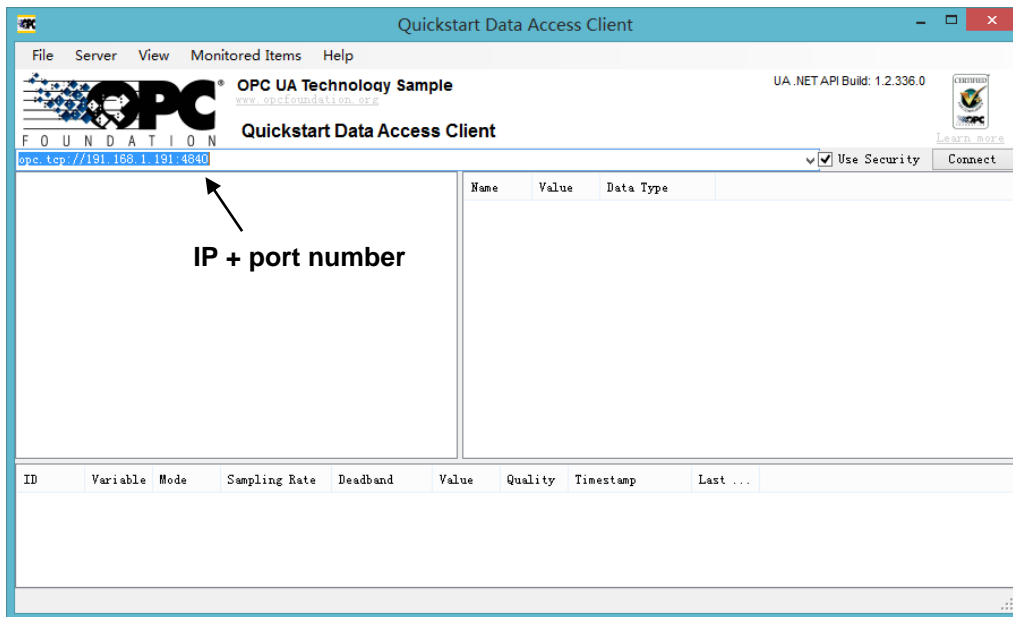


Enter the OPC port number (default: 4840), user name (default: admin) and password (default:admin). If “Anonymous” is ticked, the OPC Client will log in the gauge anonymously.

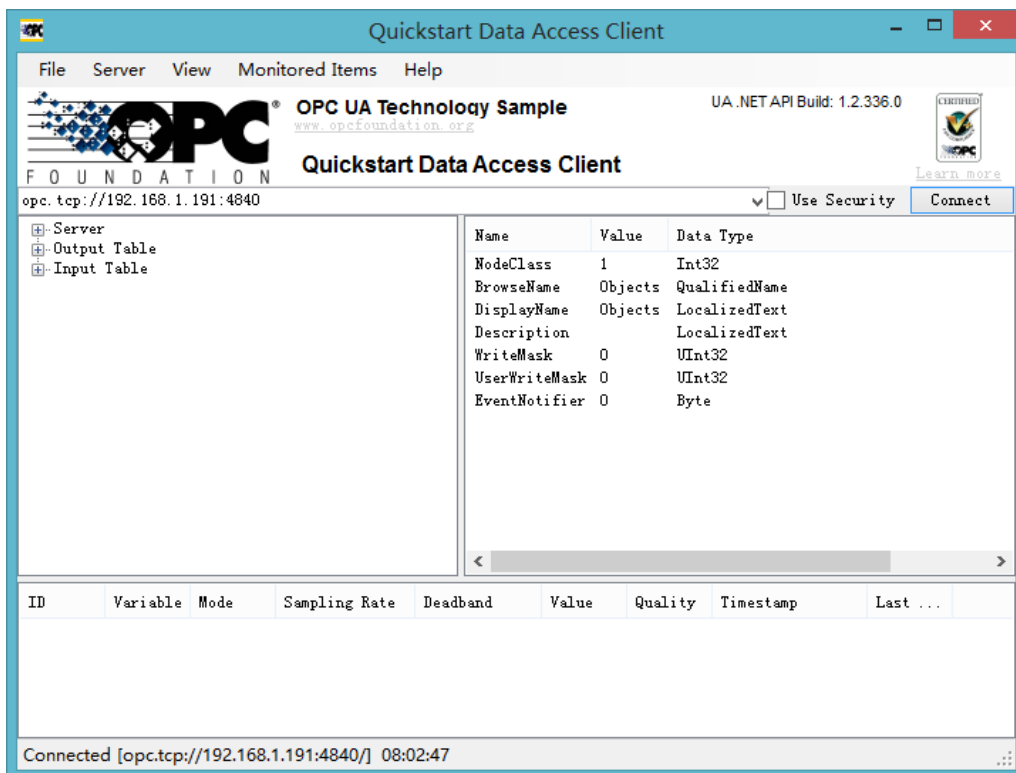
2. Configuration on the OPC Client (take OPC UA Dashboard” as an example. It’s similar for other OPC Client software). Note that only one OPC Client can connect to the gauge at the same time.



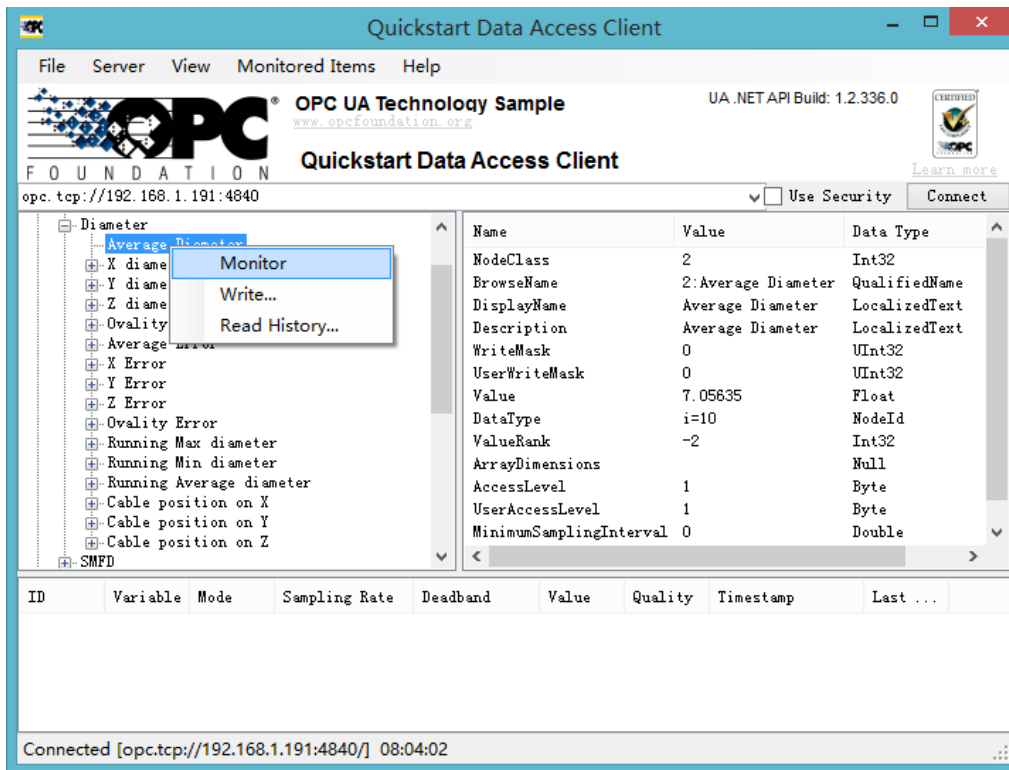
3. Click “DA Client” button to enter the Data Access page.



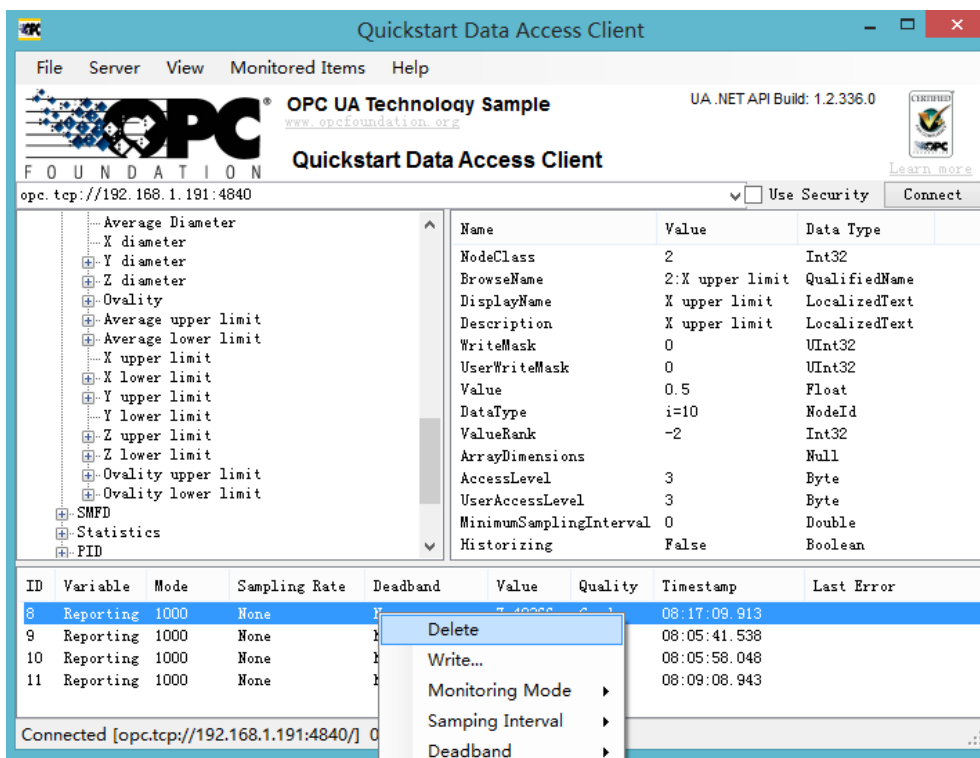
Enter the gauge IP address and port number then click “Connect” button. Note that the IP address should be the same as the one configured on PCIS.



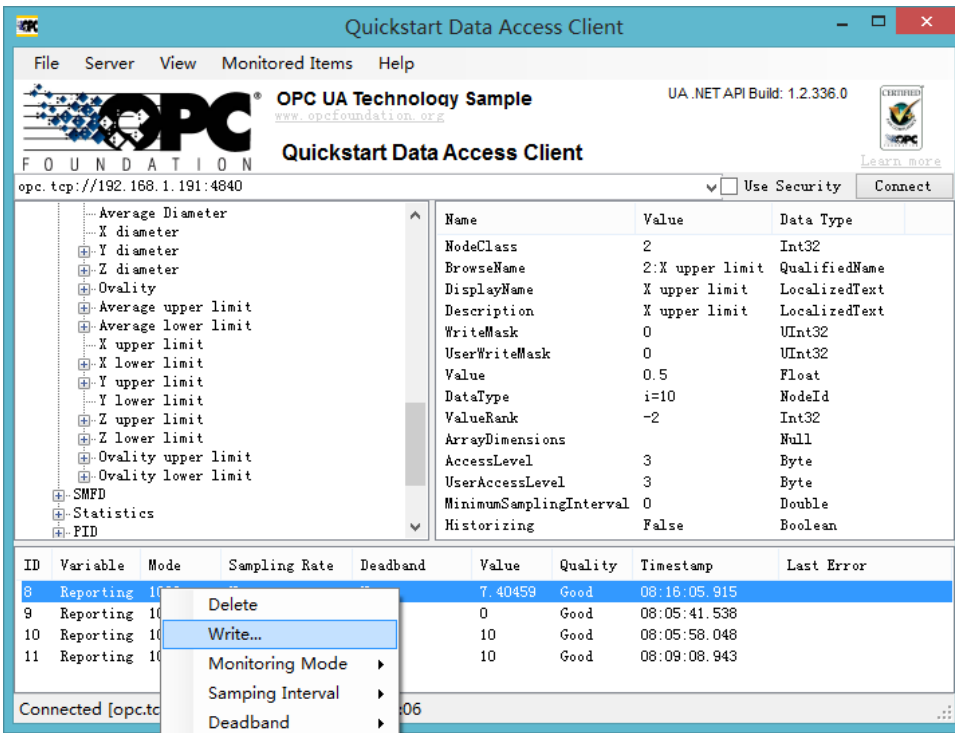
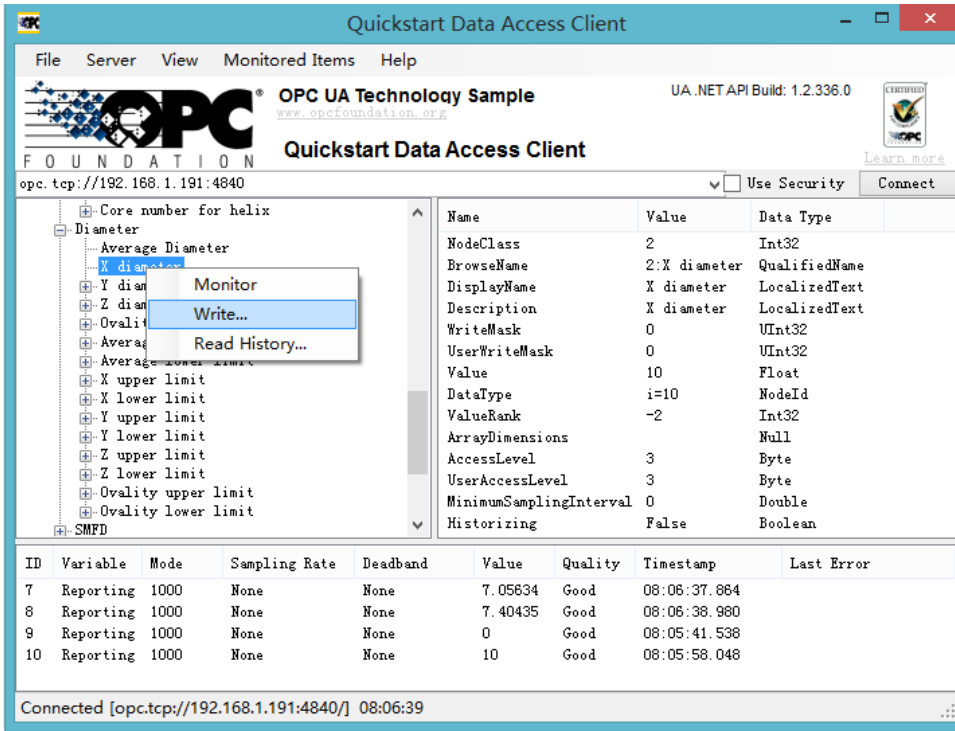
Unfold the parameter list on the left side of the page, right-click and select **Monitor** on the pop-up menu, for example, Average diameter, the parameter will appear in the monitoring list



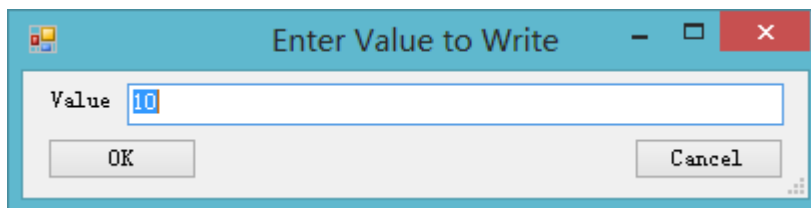
Right-click on the monitored parameter and select **Delete** on the pop-up menu to stop monitoring the parameter.



Right-click and select **Write** on the pop-up menu to write a parameter to the gauge.



Enter the parameter value on the pop-up menu then click "OK" button to confirm.

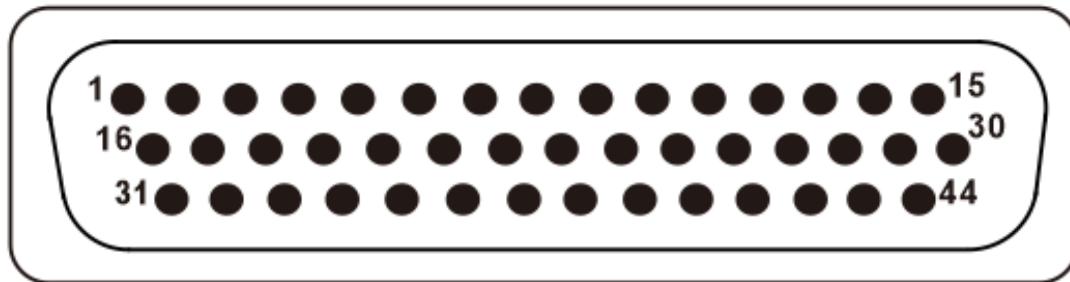


STANDARD ELECTRICAL INTERFACES

LOGIC INPUTS

Logic inputs connection

Three logic inputs are fitted as standard and may be accessed through the following pins:



Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes
Shield	S	Shield	Shield	Connect to cable and plug shields
Digital ground	34	DGND	Signal ground (0V)	Logic input ground reference
Logic inputs	31	LIN1	Logic input 1	Low state (logic 0) voltage < +3V High state (logic 1) voltage > +10.5V Maximum input voltage ±30V
	32	LIN2	Logic input 2	
	33	LIN3	Logic input 3	

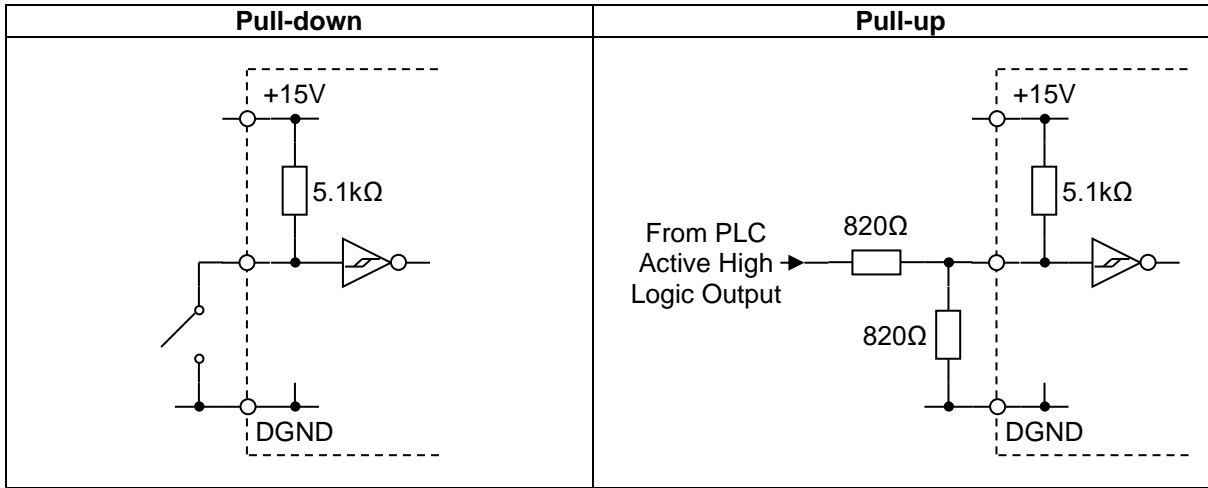
Logic inputs electrical specification

- Logic inputs are NOT isolated from earth.
- Inputs are internally pulled up to +15V via 8.2kΩ resistors; unconnected inputs default to the high state.
- Inputs will source a minimum current of 3mA when externally pulled down to the low state.

Specification	Minimum	Typical	Maximum	Units
Low state (logic 0) input voltage			3	V
High state (logic 1) input voltage	10.5			V
Absolute input voltage	-30		30	V
Low state source current	3			mA

Logic inputs can be connected to different types of signal sources as follows:

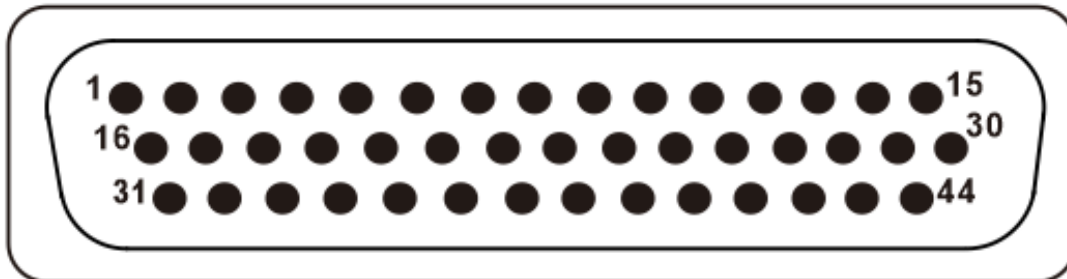
Signal source	Connection method
Mechanical or solid state relay contact	Connect between logic input and DGND.
Pull-down	Connect the pull-down signal to the logic input and ground to DGND.
Pull-up	<ul style="list-style-type: none"> • Connect an 820Ω resistor between the logic input and DGND to pull the input down to 2.5V. • Connect the pull-up signal source to the logic input and ground to DGND. • For 24V signals (such as from a PLC), the power dissipation in the 820Ω resistor can be reduced by connecting another 820Ω in series between the pull-up signal source and logic input.



LOGIC OUTPUTS

Logic outputs connection

Three outputs are fitted as standard and may be accessed through the following pins:



Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes	
Shield	S	Shield	Shield	Connect to cable and plug shields	
Digital ground	28	DGND	Signal ground (0V)	Floating (inactive) or pull-down to DGND (active)	
Logic outputs	24	LOP1	Logic output 1	State	Output
				Inactive	Floating
				Active	Pulled down to DGND
	25	LOP2	Logic output 2	State	Output
				Inactive	Floating
				Active	Pulled down to DGND
26	LOP3	Logic output 3	State	Output	
			Inactive	Floating	
			Active	Pulled down to DGND	

Logic outputs electrical specifications

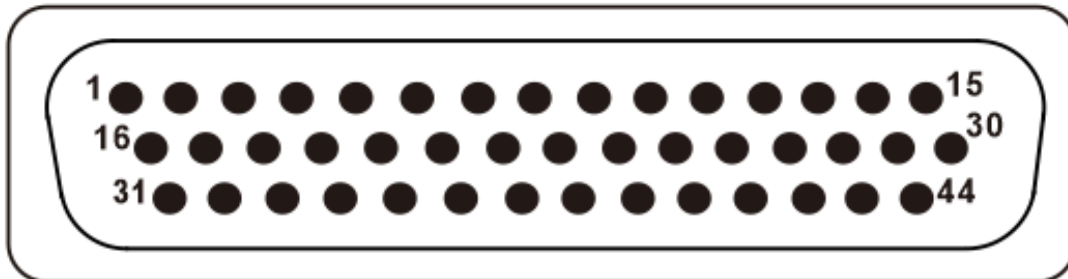
- The logic outputs must NOT be used to directly drive high-current or inductive loads.
- It is recommended that the logic outputs are used to drive opto-isolated solid-state relays.

Specification	Minimum	Typical	Maximum	Units
Logic output to DGND voltage			+25	VDC
Current			0.1	A

PULSE OUTPUTS

Pulse outputs connection



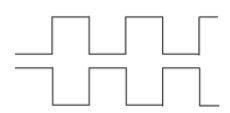
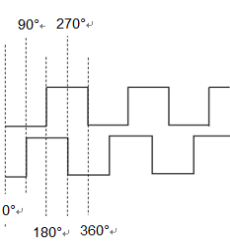
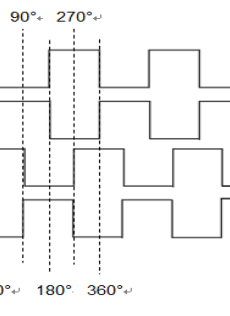


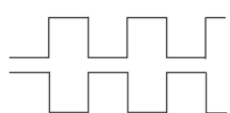
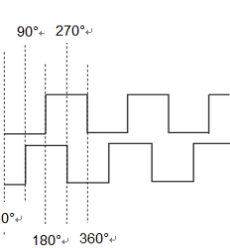
Four pulse outputs are fitted as standard and may be accessed through the following pins:



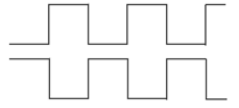
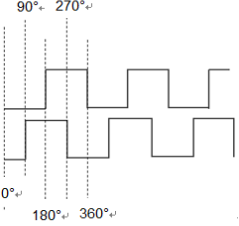


Connector type: DB44 male (socket)

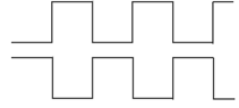

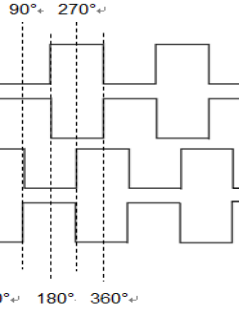
Functional group	Pin	Designation	Description	Notes
Pulse outputs	43	POUT +V	Pulse output external power supply	If no external power supply is connected, then the pulse outputs default to the internal +5V supply. Maximum voltage: +24V
	37	P1	Pulse output 1	RS-422 compliant differential pair pulse outputs.
	38	P2	Pulse output 2	
	39	P3	Pulse output 3	RS-422 compliant differential pair pulse outputs.
	40	P4	Pulse output 4	
	41	P5	Pulse output 5	RS-422 compliant differential pair pulse outputs.
42	P6	Pulse output 6		
Power supply and ground	1	+24V	Power supply	For 24V pulse outputs, connect this pin to POUT +V.
	2			
	3	DGND	Power supply ground reference	
4				
Shield	S	Shield	Shield	Connect to cable and plug shields

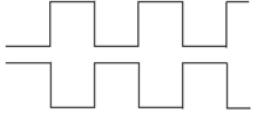
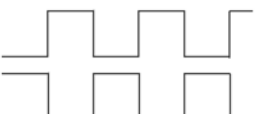
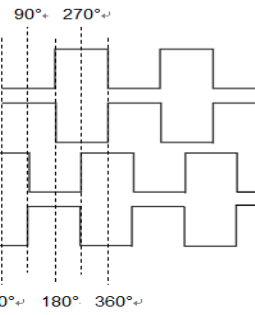
PULSE OUTPUTS ON SL MINI-I4 W AND ON PSU-BOB

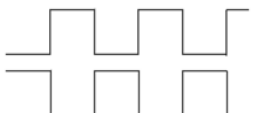

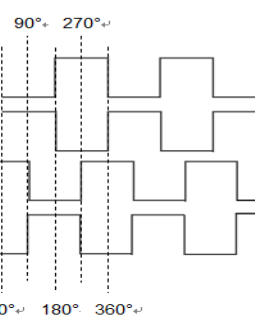
Pulse outputs on SL mini-i4 W gauge					
Options		Pulse outputs		Pulse rate set	
Pulse Group A	Single end	P1	Single end		P1
		P2	Single end		P2
	Differential (P1&P2)	P1	Differential		P1
		P2			
	Single end Quadrature (P1, P2)	P1	Single end Quadrature		P1
		P2			
	*Differential Quadrature (P1&P2, P3&P4)	P1	Differential		P1
		P2			
P3		Differential			
P4					
Pulse Group B	Single end	P3	Single end		P3
	Single end	P4	Single end		P4
	Differential (P3&P4)	P3	Differential		P3
		P4			
Single end Quadrature (P3, P4)	P3	Single end Quadrature		P3	

Pulse Group C	Single end	P5	Single end		P5
	Single end	P6	Single end		P6
	Differential (P5&P6)	P5	Differential		P5
		P6			
Single end Quadrature (P5, P6)	P5	Single end Quadrature		P5	

Pulse outputs on PSU-BOB

Options		Pulse outputs			Pulse rate set		
Pulse Group A	Single end	P1	Differential		P1		
		/P1					
		P2	Differential				P2
		/P2					
	Differential (P1&P2)	Used when PSU-BOB is not provided					
	Single end Quadrature (P1, P2)	P1	Differential	Differential Quadrature			
		/P1					
P2		90° Differential					
/P2							
Differential Quadrature (P1&P2, P3&P4)	Used when PSU-BOB is not provided						

Pulse Group B	Single end	P3	Differential			P3
		/P3				
		P4	Differential			P4
		/P4				
	Differential (P3&P4)	Used when PSU-BOB is not provided				
Single end Quadrature (P3, P4)	P3	Differential	Differential Quadrature		P3	
	/P3					
	P4	90°Differential				
	/P4					

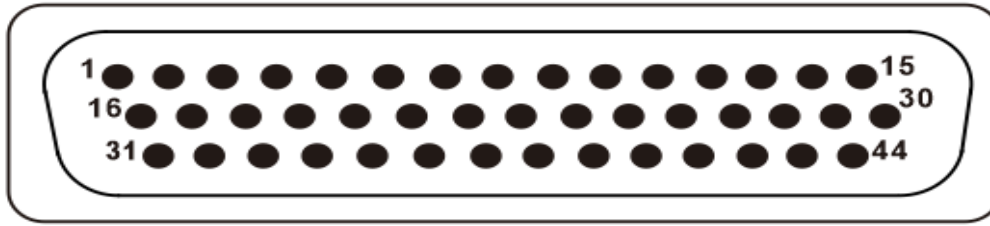
Pulse Group C	Single end	P5	Differential			P5
		/P5				
		P6	Differential			P6
		/P6				
	Differential (P5&P6)	Used when PSU-BOB is not provided				
Single end Quadrature (P3, P4)	P5	Differential	Differential Quadrature		P5	
	/P6					
	P5	90°Differential				
	/P6					

Pulse outputs electrical specifications

Specification	Minimum	Typical	Maximum	Units
Pulse output external power supply (POUT +V)	+5		+25	VDC
Pulse output frequency			1*	MHz

* reduced with increasing cable length in accordance with RS-422 standards.

CONNECTOR PIN OUTS



Connector type: DB44 male (socket)

Functional group	Pin	Designation	Description	Notes
Logic inputs	31	LIN1	Logic input 1	Low < +3V; High > +10.5V; Max $\pm 30V$ User configurable function.
	32	LIN2	Logic input 2	
	33	LIN3	Logic input 3	
Logic outputs	24	LOP1	Logic output 1	Floating or pull-down; user configurable function.
	25	LOP2	Logic output 2	
	26	LOP3	Logic output 3	
CANbus	5	CAN H	CANbus high	For connection to Proton Products accessories.
	6	CAN L	CANbus low	
Laser safety	27	SHUT_ST	Shutter status	Pulled down to DGND when the shutter is open.
	30	/SHUT_EN	Shutter control	Pull down to DGND to open the laser shutter.
	29	/LSR_EN	Laser enable	Pull down to DGND to enable the laser diode.
RS-232	11	RXD	RS-232 receive	
	12	TXD	RS-232 transmit	
	13	CTS	Not used	
	14	RTS	Not used	
Ethernet EtherNet/IP	16	TX+	Ethernet / EtherNet/IP communications	
	17	TX-		
	18	RX+		
	19	RX-		
PROFIBUS	7	PROFI A	A	
	8	PROFI B	B	
	9	VBUS	+5V	
	10	GNDBUS	GND	
Pulse outputs	43	POUT +V	Pulse output external power supply	If no external power supply is connected, then the pulse outputs default to the internal +5V supply.
	37	P1	Pulse output 1	RS-422 compliant differential pair outputs.
	38	P2	Pulse output 2	
	39	P3	Pulse output 3	
	40	P4	Pulse output 4	
	41	P5	Pulse output 5	
	42	P6	Pulse output 6	
Power supply and ground reference	1	+24V	Power supply	Operating voltage: 15 to 28VDC Power consumption: 15W
	2			
	3	DGND	Power supply and signal ground reference	
	4	DGND		
	15	DGND		
	28	DGND		
34	DGND			
	44	DGND		
Shield	S	Shield	Shield	Connect to cable and plug shields

INPUT PARAMETERS

1 DW word = 2 bytes

DW	Bit	Comments	Unit	Range/Remark	Default value	
DW0		Reset				
	0	Total length reset				
	1	Batch length reset				
	2	Reel number reset				
DW1		Laser switch		0=OFF;1=ON	1	
DW2		Preset length 1 / Preset batch length	1=0.0001m{ft}{yds}	0~2 ³¹	1000000 0	
DW3			1=0.1m{ft}{yds}			
DW4		Preset length 2 / Preset batch number	1=0.0001m{ft}{yds}	0~2 ³¹	2000000 0	
DW5			1=0.1m{ft}{yds}			
DW6		Rate of pulse output 1	1=0.001p/m{ft}{yds}	0~2 ³¹	1000	
DW7						
DW8		Rate of pulse output 2		0~2 ³¹	1000	
DW9						
DW10		Rate of pulse output 3		0~2 ³¹	1000	
DW11						
DW12		Rate of pulse output 4		0~2 ³¹	1000	
DW13						
DW14		Rate of pulse output 5		0~2 ³¹	1000	
DW15						
DW16		Rate of pulse output 6		0~2 ³¹	1000	
DW17						
DW18		Pulse output mode				
	0~2	Puulse output group A mode			0=Single end(P1)(P2); 1=Differential(P1=/P2); 2=Quadrature(P1=Quad P2); 3=Differential Quadrature(P1/2=Quad P3/4)	0
	3~5	Puulse output group B mode			0=Single end(P3)(P4); 1=Differential(P3=/P4); 2=Quadrature(P3=Quad P4);	0
	6~8	Puulse output group C mode			0=Single end(P5)(P6); 1=Differential(P5=/P6); 2=Quadrature(P5=Quad P6);	0
	9	Pulse ouptut 1 rate mode			0=pulse/m{ft}{yds};1=m{ft}{yds}/ pulse	0
	10	Pulse ouptut 2 rate mode		0		
	11	Pulse ouptut 3 rate mode		0		
	12	Pulse ouptut 4 rate mode		0		
	13	Pulse ouptut 5 rate mode		0		
	14	Pulse ouptut 6 rate mode		0		

DW	Bit	Comments	Unit	Range/Remark	Default value				
	15								
DW19		Logic input							
	0	LIN1 function		0=Direction (count down); 1=Length hold; 2=Display hold; 3=Speed hold; 4=Total length reset; 5=Batch length reset/End of reel; 6=None	4				
	1								
	2								
	3	LIN2 function			0=Direction (count down); 1=Length hold; 2=Display hold; 3=Speed hold; 4=Total length reset; 5=Batch length reset/End of reel; 6=None	1			
	4								
	5								
	6	LIN3 function				0=Direction (count down); 1=Length hold; 2=Display hold; 3=Speed hold; 4=Total length reset; 5=Batch length reset/End of reel; 6=None	2		
	7								
	8								
	9	LIN1 polarity					0=Active low; 1=Active high	0	
	10	LIN2 polarity							
	11	LIN3 polarity							
12	Speed direction (available only when no logic input for direction)		0=Up/Normal; 1=Down/Invert				0		
DW20		Logic output function							
	0	LOP 1 function		0=Gauge OK; 1=Gauge measuring speed; 2=Preset length1 / Batch length; 3=Preset length 2 / Batch number; 4=Good reading; 5=Object detected 6=Gauge too hot; 13=User 1;14=User 2;15=User 3			0		
	1								
	2								
	3	LOP 2 function			0=Gauge OK; 1=Gauge measuring speed; 2=Preset length1 / Batch length; 3=Preset length 2 / Batch number; 4=Good reading; 5=Object detected 6=Gauge too hot; 13=User 1;14=User 2;15=User 3		2		
	4								
	5								
	6	LOP 3 function				0=Gauge OK; 1=Gauge measuring speed; 2=Preset length1 / Batch length; 3=Preset length 2 / Batch number; 4=Good reading; 5=Object detected 6=Gauge too hot; 13=User 1;14=User 2;15=User 3	3		
	7								
	8								
	9						0=Gauge OK; 1=Gauge measuring speed; 2=Preset length1 / Batch length; 3=Preset length 2 / Batch number; 4=Good reading; 5=Object detected 6=Gauge too hot; 13=User 1;14=User 2;15=User 3		
	10								
	11								
	12								
	13	User I/P 1						0=OPEN;1=CLOSE	0
14	User I/P 2		0=OPEN;1=CLOSE						
15	User I/P 3		0=OPEN;1=CLOSE						
DW21		Full scale for analogue O/P	1=1m/min{ft/min}	0~65535				1000	
DW22		Minimum speed limit	1=0.01m/min{ft/min}	0~65535				0	
DW23									
DW24		Length offset	1=0.0001m{ft}{yds}	-2 ³¹ ~+(2 ³¹ -1)	0				
DW25									
DW26		Averaging time	1=1ms	1~5000	1000				
DW27		Hold time after speed drop out	1=1ms	1~5000	100				
DW28		Reserved							
DW29		Good reading threshold for logic output	1=1%		60%				

DW	Bit	Comments	Unit	Range/Remark	Default value
DW30		Measurement Unit		0=m/min,m;1=ft/min,ft;2=ft/min,yds;3=ft/min,inch;4=yds/min,yds	0
DW31					
DW32	System settings				
	0	Measurement mode		0=Normal;1=Batch	0
	1	Resolution of length output		0=length 0.0001;1=length 0.1	0
	2	Speed reponse for pulse and analogue output		0=Averaged;1=Instant	0
	3	Analogue output source		0=Speed;1=Good Reading	0
	4	Hold length reading after power off(length auto save)		0=OFF;1=ON	0
	5	Object detection SW		0=OFF;1=ON	0
	6	Automatic reset length after object detected		0=OFF;1=ON	0
	7				
	8	Object detection mode	available only on SL(R)	0=DC Level;1=Zero Speed	0
	9	Pulse reset syn to length reset		0=OFF;1=ON	0
	10	Length reset trigger		0=Level;1=edge	0
	11				
12					
DW33		Pulse width in m{ft}{yds}/pulse mode	1=1ms	0~5000(0=fixed to 50% duty cycle)	0
DW34		Object detection threshold	1=1%	0~100	15
DW35					
DW36		Preset case temperature for water solenoid control	1=0.1℃	0~1000	650
DW37		SLX-HA Height	1=1mm(1=0.01inch)	-200mm~+200mm	0
DW38	Logic input second function				
	0				
	1	LIN1 function 2			6
	2				
	3	LIN2 function 2			6
	4				
	5				
	6	LIN3 function 2			6
	7				
	8				
	9	LIN1 function 2 polarity			
	10	LIN2 function 2 polarity			
	11	LIN3 function 2 polarity			
12					
DW39		Low speed measurement (Band 10)		1=Enabled; 0=Disabled	0
DW40					
DW41					
DW42					
DW43					
DW44					

DW	Bit	Comments	Unit	Range/Remark	Default value
DW45		Modbus ID	1=1	0~255	1
DW46		Profibus ID	1=1	0~125	7
DW47		CANBUS address	1=1	0~255	14
DW48		CANBUS baud rate		0=250;1=500;2=1000;other=500	0
DW49		CAN terminator	1=1	0=OFF;1=ON	1
DW50		RS232 baud rate		0=4800;1=9600;2=19200;3=38400;4=115200	4
DW51		RS232 protocol		0=Modbus;1=Proton;2=ZM400 Printer	0
DW52		RS422/RS485 protocol		0=Modbus;1=Proton	0
DW53		RS422/RS485 baud rate		0=4800;1=9600;2=19200;3=38400;4=115200;5=230400;6=460800;7=921600	4
DW54					
DW55		Ethernet protocol		not used	0
DW56		ETH DHCP		0=Disabled;1=Enabled	0
DW57		iBus DHCP		0=Disabled;1=Enabled	0
DW58		ETH IP address	xx.xx.xx.xx		C0A8016E(192.168.1.110)
DW59					
DW60		ETH subnet mask	xx.xx.xx.xx		FFFFFF00(255.255.255.0)
DW61					
DW62		ETH gateway	xx.xx.xx.xx		C0A80101(192.168.1.1)
DW63					
DW64		iBus IP address	xx.xx.xx.xx		C0A8016F(192.168.1.111)
DW65					
DW66		iBus subnet mask	xx.xx.xx.xx		FFFFFF00(255.255.255.0)
DW67					
DW68		iBus gateway	xx.xx.xx.xx		C0A80101(192.168.1.1)
DW69					
DW70		Destination IP address for UDP (last section only)		Port number fixed to 1111	2
DW71		Interval time of UDP data output	1=1ms	0~5000(0=disable UDP output)	0
DW72		DeviceNet address		0~63	7
DW73		DeviceNet baud rate		0=125K;1=250K;2=500K	0
DW74		Little Endian/Big Endian		1=Little Endian;0=Big Endian	1
DW75					
DW76		Gain of analogue O/P	1=0.0001	0~65535	10000
DW77		Zero of analogue O/P	1=0.0001	-32768~32767	0
DW78		Speed simulation		0=Normal;1=Simulation mode	0
DW79		Simulation speed	1=0.1m{ft}/min	0~6553.5	500
DW80		Speed compensation coefficient	1=0.0001		10000
DW81		Acceleration limit	1=1m{ft}/min/s	1~9999	9999
DW82		Default parameters to factory		63000=default to factory;other=invalid	

OUTPUT PARAMETERS

1 DW word = 2 bytes

DW	Bit	Comments	Units	Range/Remark
DW0	0	Measurement mode		0=Normal;1=Batch
	1	Resolution of length output		0=length 0.0001;1=length 0.1
	2	Speed reponse for pulse and analogue output		0=Instant;1=Averaged
	3			
	4			
	5			
	6			
	7			
	8	Measured length > Preset1		1=>Preset
	9	Measured length > Preset2		1=>Preset
	10			
	11	Laser Status		1= ON;0=OFF
	12	Speed reading valid		1=Valid;0=Invalid
	13	Object detected		1=Object detected;0=No object
	14	Good reading status		1=Lower than threshold;0=OK
15				
DW1	0	Gauge OK		1=OK;0=Failed
	1	Laser temperature too high		1=Too high;0=OK
	2	Laser temperature too low		1=Too low;0=OK
	3	Case temperature too high		1=Too high;0=OK
	4	Case temperature too low		1=Too low;0=OK
	5	Light reflection too strong		1=Too high;0=OK
	6	Gauge too hot		1=Too hot;0=OK
	7			
	8			
DW2		Averaged speed	1=0.001m/min{ft/min}	0~±2 ³¹
DW3				
DW4		Instant speed		
DW5				
DW6		Total length	1=0.0001/1=0.1m{ft}{yds}	0~±2 ³¹
DW7				
DW8		Batch length		
DW9				
DW10		Last length before reset		0~2 ³¹
DW11				
DW12		Reel number	1=1	0~2 ³²
DW13				
DW14		Batch number	1=1	0~65535
DW15		Good reading	1=1%	0~100

DW	Bit	Comments	Units	Range/Remark
DW16		SNR	1=1	0~65535
DW17		SLX current height	1=1mm{1=0.01inch}	±200mm
DW18				
DW19				
DW20		Logic input		
	0	LIN1 status		1=Active
	1	LIN2 status		1=Active
	2	LIN3 status		1=Active
	3			
	4	Length reset		1=Active
	5	Length hold		1=Active
	6	Display hold		1=Active
	7	Speed hold		1=Active
	8			
	9			
	10	Length counting direction		0=counting up;1=counting down
DW21				
DW22		Measurement Unit		0=m/min,m; 1=ft/min,ft;2=ft/min,yds;3=ft/min,inch; 4=yds/min,yds
DW23				
DW24				
DW25				
DW26				
DW27				
DW28				
DW29				
DW30		Communication Bus Type		0=NONE;1=PROFIBUS;2=PROFINET;3=Ethernet/IP;
DW31		Not used		
DW32		IP address for ETH	xx.xx.xx.xx	
DW33				
DW34		IP address for iBUS	xx.xx.xx.xx	
DW35				
DW36		Sub net Mask for ETH	xx.xx.xx.xx	
DW37				
DW38		Gateway for ETH		
DW39				

CONTACT DETAILS FOR ENQUIRIES, SALES AND SERVICE

WEB SITE: www.protonproducts.com

ENQUIRIES AND SALES

USA office:

Proton Products Inc.

9272 Jeronimo Road
Suite 110
Irvine, 92618,
California, USA

Tel: 949-981-1909

Email: grantlatimer@protonproducts.us

European head office:

Proton Products Europe N.V.
Terspelt Business Park,
Koeweideblock C13,
B-1785 Merchtem,
Belgium

Tel: +32 (0) 52 466 311

Fax: +32 (0) 52 466 313

Email: europa@protonproducts.com

Asia head office:

Proton Products Chengdu Ltd.,

Room 401, Building G3(TianFu Software
Park Zone G), No.1800 Central YiZhou
Avenue, Chengdu, 610041,
CHINA

Tel. +86 (0) 28 8439 3112

Fax: +86(0) 28 65717677

Email: asia@protonproducts.com

Global head office:

Proton Products International Ltd.,

10 Aylesbury End,
Beaconsfield,
Buckinghamshire,
ENGLAND

Email: contact@protonproducts.com

SERVICE ENQUIRIES

Please contact your local Proton Products agent for service enquiries (please see www.protonproducts.com for agent contact details) or email:

America: americas.service@protonproducts.com

Asia: asiapac.service@protonproducts.com

Europe: europa.service@protonproducts.com

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