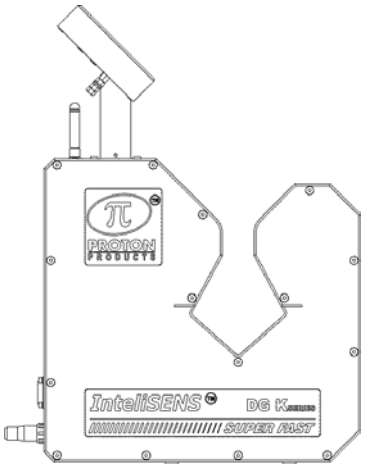
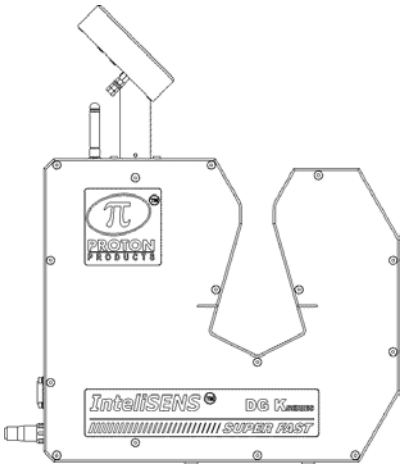
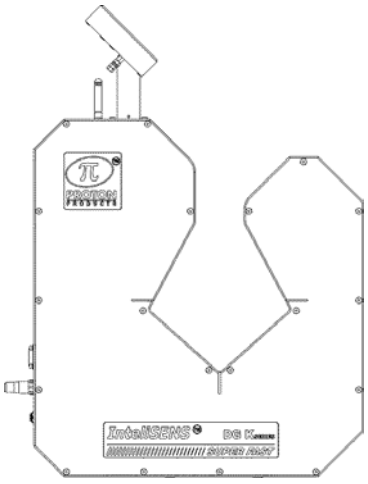
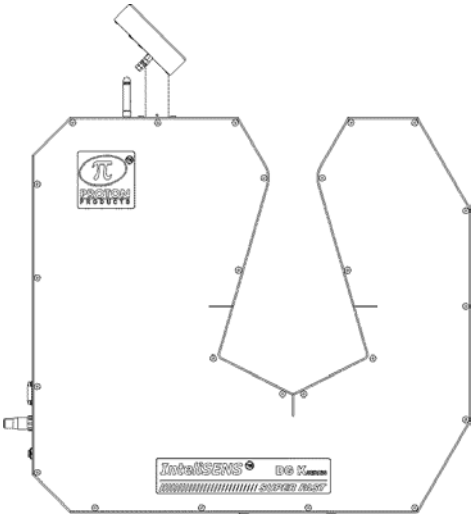
Instruction Manual

InteliSENS DG-k (mk II) Series Diameter Gauges

Diameter	Dual Axis	Triple Axis
30mm	DG2030-5/10k	DG3030-5/10k
		
60mm	DG2060-5/10k	DG3060-5/10k
		

Units shown fitted with optional AiG2 interface display unit and optional Bluetooth or WiFi antenna

Issue 1y
11 November 2015

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

www.protonproducts.com

Table of Contents

DECLARATION OF CONFORMITY

Equipment Covered

This is to certify that the following equipment conforms to the requirements of CE including EMC to the heavy industrial standard Class A.

Product name	Description	Part number
DG2030-5K_DC	30mm Dual Axis Diameter Gauge (scan rate: 5000 scan / s / axis; DC power supply version)	00047MC023
DG2030-5K_AC	30mm Dual Axis Diameter Gauge (scan rate: 5000 scan / s / axis; AC power supply version)	00047MC013
DG2030-10K_DC	30mm Dual Axis Diameter Gauge (scan rate: 10000 scan / s / axis; DC power supply version)	00047MC024
DG2030-10K_AC	30mm Dual Axis Diameter Gauge (scan rate: 10000 scan / s / axis; AC power supply version)	00047MC014
DG3030-5K_DC	30mm Triple Axis Diameter Gauge (scan rate: 5000 scan / s / axis; DC power supply version)	00047MC025
DG3030-5K_AC	30mm Triple Axis Diameter Gauge (scan rate: 5000 scan / s / axis; AC power supply version)	00047MC015
DG3030-10K_DC	30mm Triple Axis Diameter Gauge (scan rate: 10000 scan / s / axis; DC power supply version)	00047MC026
DG3030-10K_AC	30mm Triple Axis Diameter Gauge (scan rate: 10000 scan / s / axis; AC power supply version)	00047MC016
DG2060-5K_DC	60mm Dual Axis Diameter Gauge (scan rate: 5000 scan / s / axis; DC power supply version)	00047MC027
DG2060-5K_AC	60mm Dual Axis Diameter Gauge (scan rate: 5000 scan / s / axis; AC power supply version)	
DG2060-10K_DC	60mm Dual Axis Diameter Gauge (scan rate: 10000 scan / s / axis; DC power supply version)	
DG2060-10K_AC	60mm Dual Axis Diameter Gauge (scan rate: 10000 scan / s / axis; AC power supply version)	
DG3060-5K_DC	60mm Triple Axis Diameter Gauge (scan rate: 5000 scan / s / axis; DC power supply version)	00047MC029
DG3060-5K_AC	60mm Triple Axis Diameter Gauge (scan rate: 5000 scan / s / axis; AC power supply version)	00047MC019
DG3060-10K_DC	60mm Triple Axis Diameter Gauge (scan rate: 10000 scan / s / axis; DC power supply version)	00047MC030
DG3060-10K_AC	60mm Triple Axis Diameter Gauge (scan rate: 10000 scan / s / axis; AC power supply version)	00047MC020
AiG2-DG	Diameter Gauge interface display unit (gauge mounted)	00047MC045

The manufacturer of the above named equipment is:

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

Proton Products is an ISO9001:2008 registered company.

The declaration is signed by:

Paul Sives ……

INTRODUCTION

The InteliSENS DG series of dual and triple axis diameter gauges provide super fast and highly accurate non-contact diameter measurement of cables or other objects manufactured in a continuous process.

Unlike traditional laser diameter gauges which use a mechanically scanned laser beam, the InteliSENS DG diameter gauge uses an entirely solid state technique. For each measurement axis, a LED is used to generate a broad, collimated beam of light which fully illuminates the measurement zone. The shadow generated by an object inserted into this light beam is imaged by a CCD and the resulting electrical signal digitally processed to yield a diameter reading. This solid state approach results in the following advantages over traditional laser diameter gauges:

- Much higher measurement speeds (not limited by mechanical scan time).
- Higher reliability and MTBF of the gauge as it suffers no wear from moving parts.
- No laser precautions required as a non-laser light source is used.

When fitted with the optional AiG2 interface display unit, the InteliSENS DG diameter gauge can operate as a standalone unit.

RS-232, RS-422, RS-485 and Ethernet communication interfaces are installed as standard for straightforward connection to computers or PLCs. Optional industrial standard communication interfaces (PROFIBUS, EtherNet/IP or DeviceNET and Bluetooth or WiFi) can be specified for installation at time of manufacture.

Analogue and pulsed line speed inputs are fitted as standard to provide line speed data to the gauge for optional PI feedback control and SMFD (Single Measurement Flaw Detection). Proton Products range of SL and SLR laser speed gauges offer excellent speed measurement performance and are directly compatible with the DG diameter gauge speed inputs.

User configurable digital inputs are provided as standard to reset gauge measurements and trigger printing. User configurable relay outputs are provided as standard to signal gauge status, lump and neck detection and measurements exceeding preset error limits.

Optional analogue outputs can be specified for installation at time of manufacture for output of diameter and error measurements as analogue voltages.

An optional auto-adaptive PI feedback controller can be specified for installation at time of manufacture to allow the gauge to control insulation extruders or capstan drives for diameter control.

DC or AC powered models may be specified at time of ordering.

SPECIFICATIONS

DG2030-5/10K, DG3030-5/10K 30MM DIAMETER GAUGES

Model	DG2030-5K	DG2030-10K	DG3030-5K	DG3030-10K	Units
Number of axes	2	2	3	3	-
Scan rate	5000	10000	5000	10000	scan/s/axis
Cumulative scan rate	10000	20000	15000	30000	scan/s
Update time	200	100	200	100	µs
Maximum weight	5		6.5		kg

Specification	Minimum	Typical	Maximum	Units
Object diameter	0.2		30	mm
Optical gate diameter			32	mm
Accuracy*	-1		+1	µm
Output resolution			1	µm

**For a < 15mm diameter object centred in the optical gate. Accuracy is ±3µm for a 15 to 30mm diameter object centred in the optical gate. Add an additional 0.05% for objects not centred in the optical gate.*

DG2060-5/10K, DG3060-5/10K 60MM DIAMETER GAUGES

Model	DG2060-5K	DG2060-10K	DG3060-5K	DG3060-10K	Units
Number of axes	2	2	3	3	-
Scan rate	5000	10000	5000	10000	scan/s/axis
Cumulative scan rate	10000	20000	15000	30000	scan/s
Update time	200	100	200	100	µs
Maximum weight					kg

Specification	Minimum	Typical	Maximum	Units
Object diameter	0.3		60	mm
Optical gate width			64	mm
Accuracy			± (3µm + 0.01% of object diameter)	-
Output resolution			1	µm

COMMON SPECIFICATIONS

Specification	Min	Typical	Max	Units
Operating temperature	+5		+45	°C
Environmental protection			IP65	
For DC power supply models only:				
DC Power supply voltage	15	24	30	VDC
DC Power consumption (with optional AiG2 interface display unit)			30	W
For AC power supply models only:				
AC Power supply voltage	100		240	VAC
AC Power supply frequency	50		60	Hz
AC Power consumption (with optional AiG2 interface display unit)			30	W

Light source	LED	
Air wipe	Integrated air wipe system	
Measurement units (user configurable)	millimetres (line speed: millimetres / minute, length: metres)	
	inches (line speed: feet / minute, length: feet)	
Measurement modes	Solid	Solid object diameter
	Glass	Transparent object diameter
	Helix	Twisted / braided multi-core cable envelope diameter

STANDARD INTERFACES

2x digital inputs	User configurable function	Reset, Print Activation	
	Maximum input voltage	24 Vdc	
4x relay outputs	User configurable function	Gauge OK, Upper tolerances exceeded, Lower tolerances exceeded, Single Measurement Flaw Detection (SMFD)	
	Isolated contact rating	Maximum voltage	24 Vdc
		Maximum current	1 A
Line speed inputs	Required for Helix mode or optional PI feedback controller operation		
	Analogue input	0 - 10 Vdc, user scalable	
	Speed pulse input	250 kHz max frequency, 30 V or 50 V max pulses (on two distinct inputs), user scalable	
Communication interfaces	RS-232*, RS-422, RS-485, CAN-bus**, Ethernet		

**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 an AiG2 interface display unit.*

OPTIONAL INTERFACES

Must be specified for installation at time of manufacture, cannot be retrofitted.

3x Analogue outputs	±10 Vdc output of diameters or errors, user scalable
Communication interfaces	Choice of any one of: Bluetooth* or WiFi* Choice of any one of: PROFIBUS, EtherNet/IP or DeviceNET

**Wireless interfaces are not available in units destined for European markets.*

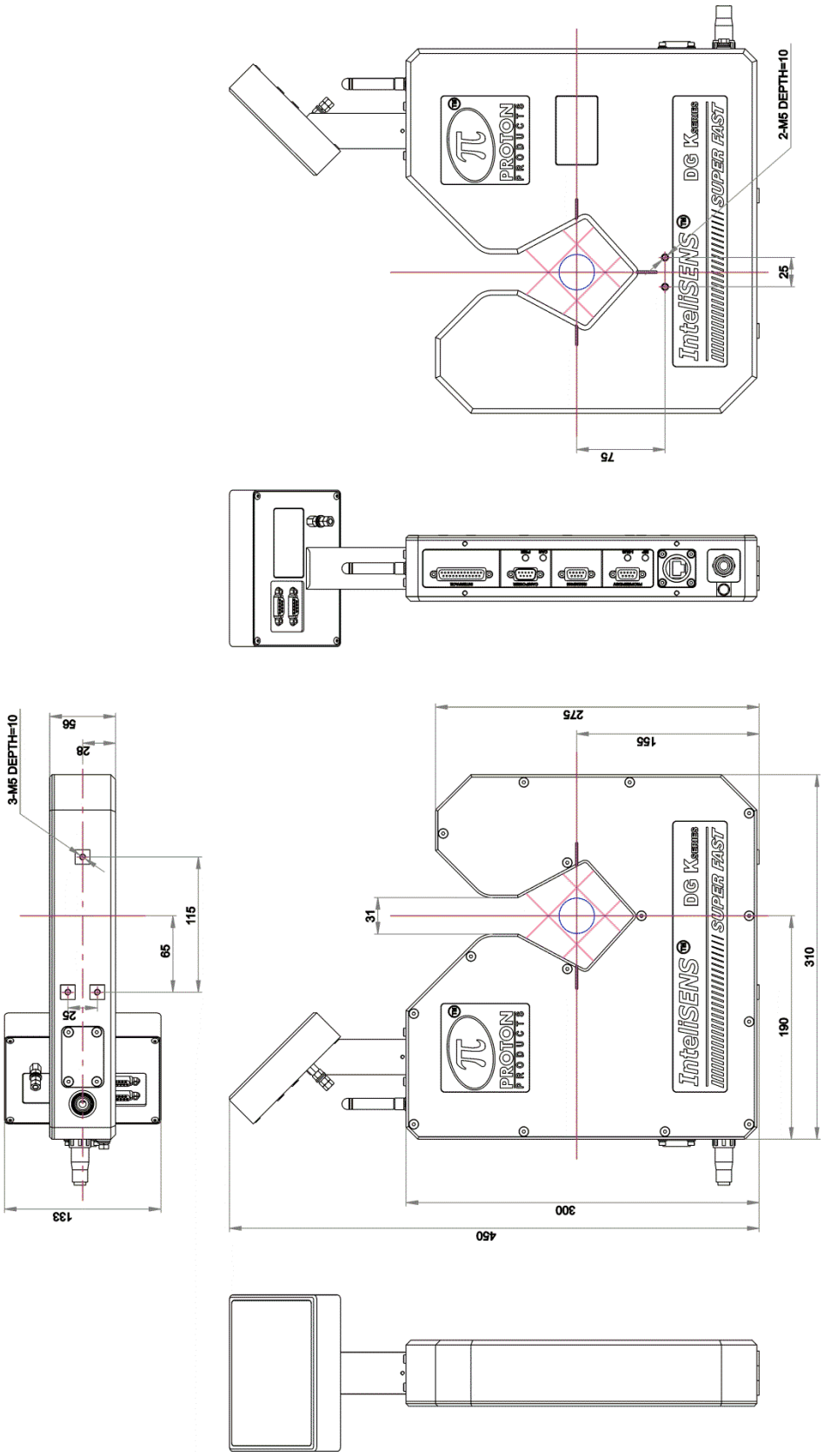
OPTIONAL FUNCTIONALITY

Must be specified for installation at time of manufacture, cannot be retrofitted.

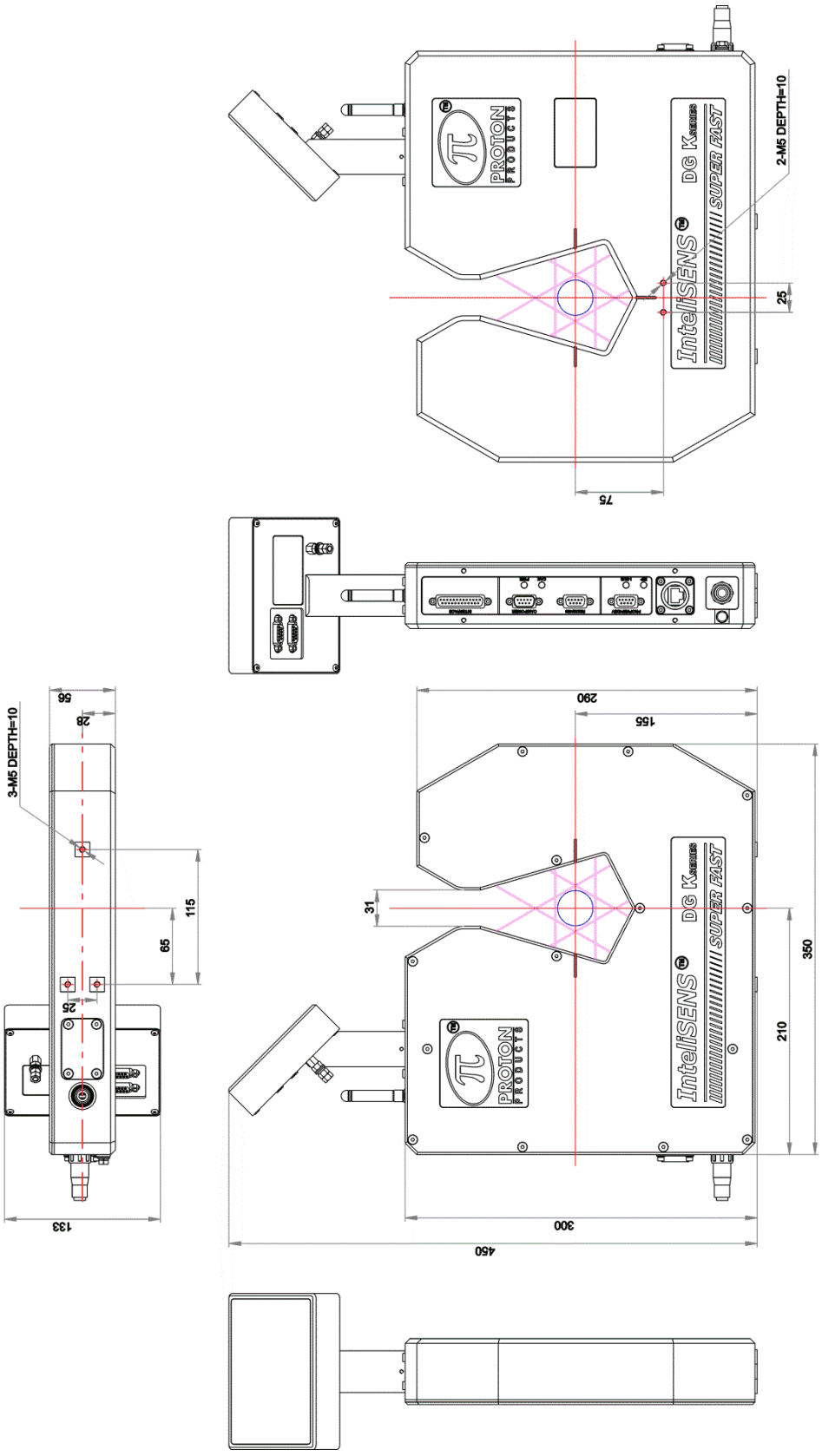
PI feedback controller	Proportional Integral feedback controller
Statistics	Maximum, minimum, mean, standard deviation, C_p, C_{pk}
SPC	Statistical Process Control automatic set point for PI feedback controller (requires PI feedback controller option)
FFT	Fast Fourier Transform analysis for amplitude and frequency of periodic diameter variations
SMFD	Single Measurement Flaw Detection (Lump and Neck detection)

DIMENSIONAL DRAWINGS

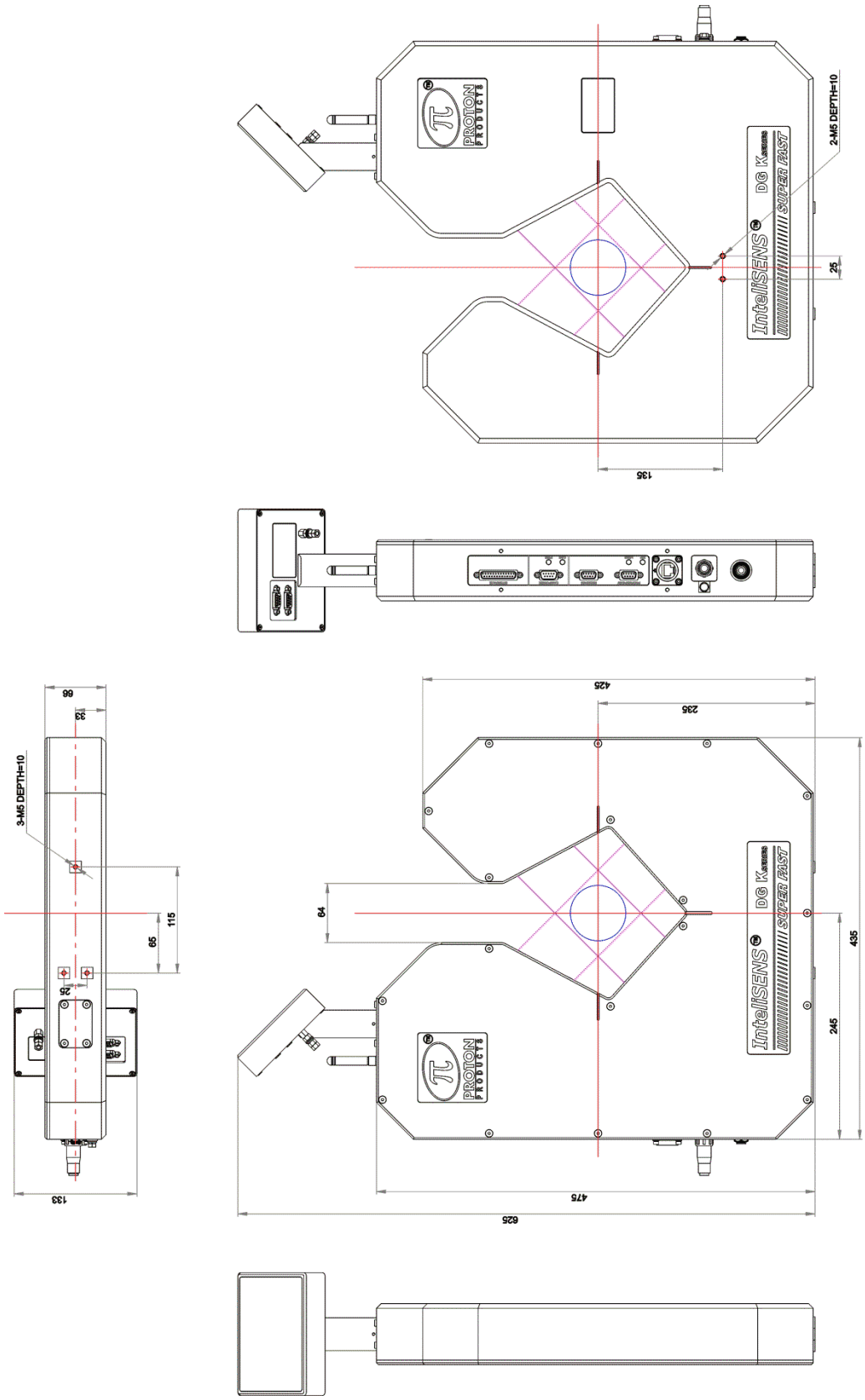
DG2030-5/10K SERIES



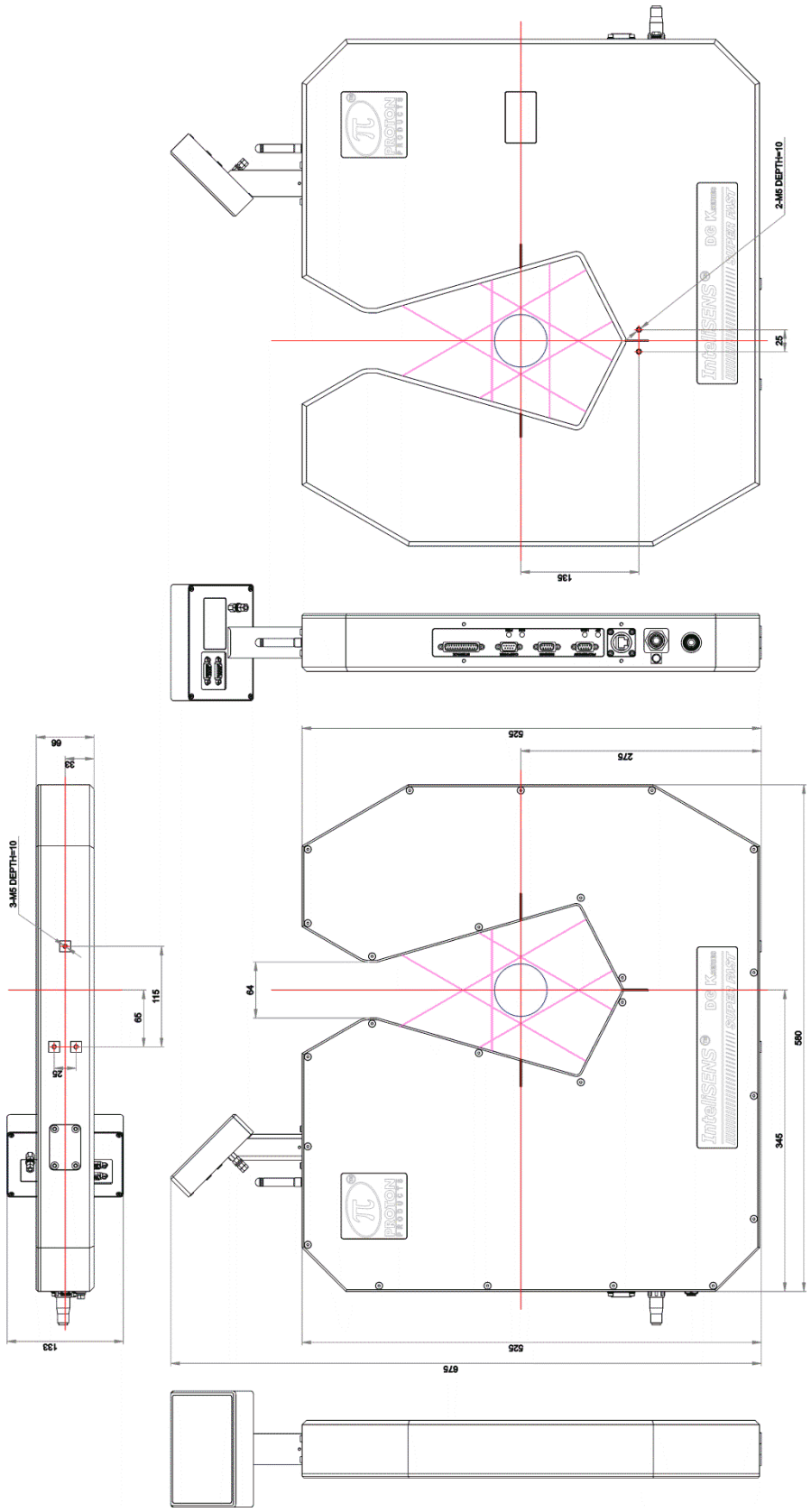
DG3030-5/10K SERIES



DG2060-5/10K SERIES

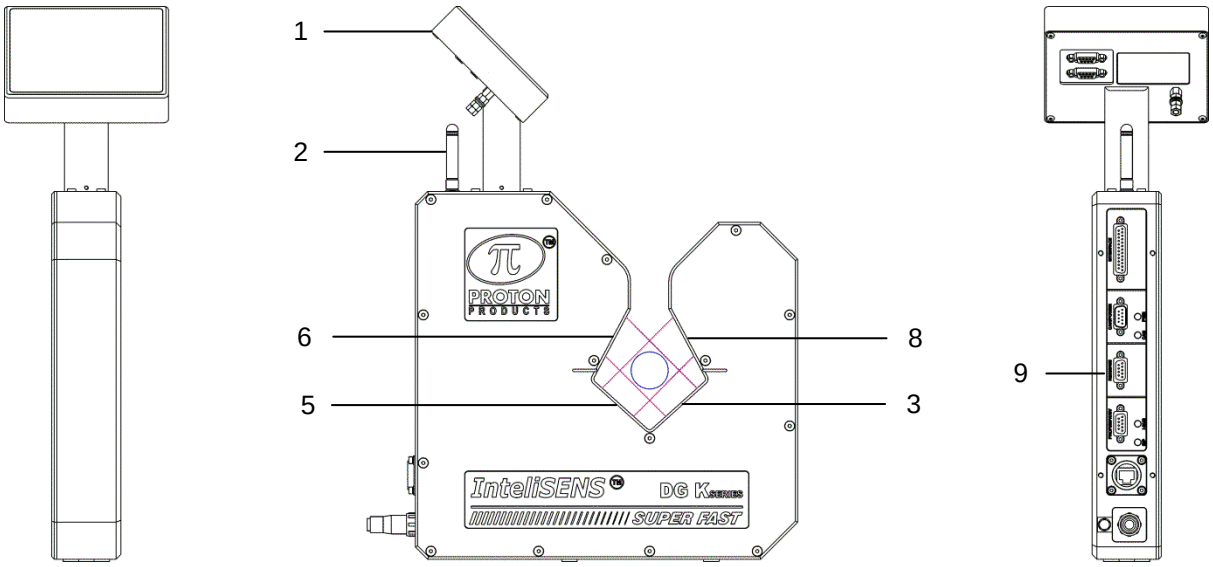


DG3060-5/10K SERIES

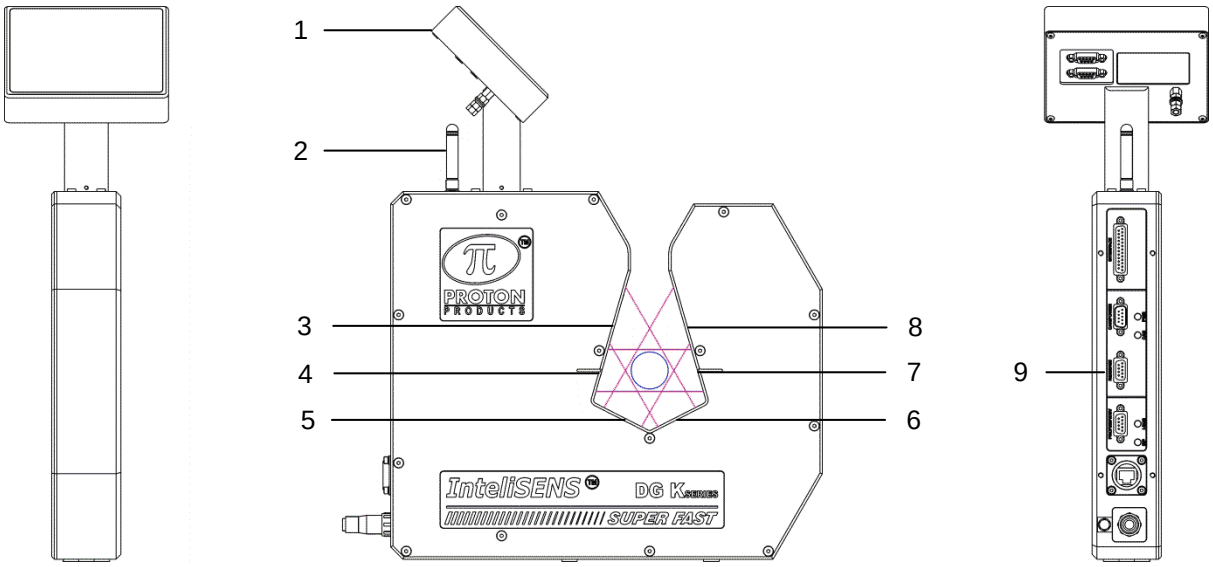


ANNOTATED DRAWINGS

DG2030-5/10K SERIES

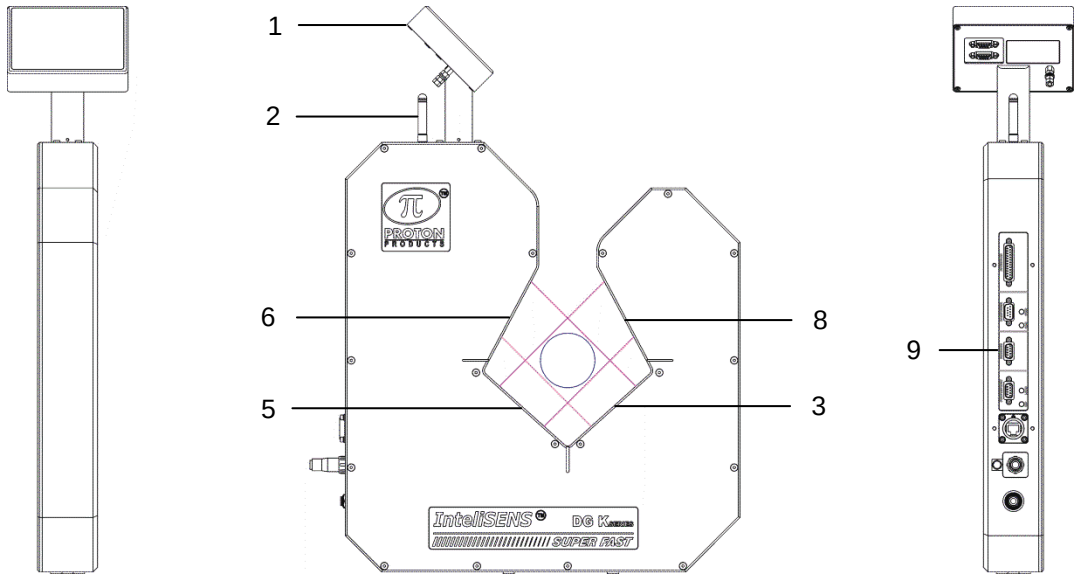


DG3030-5/10K SERIES

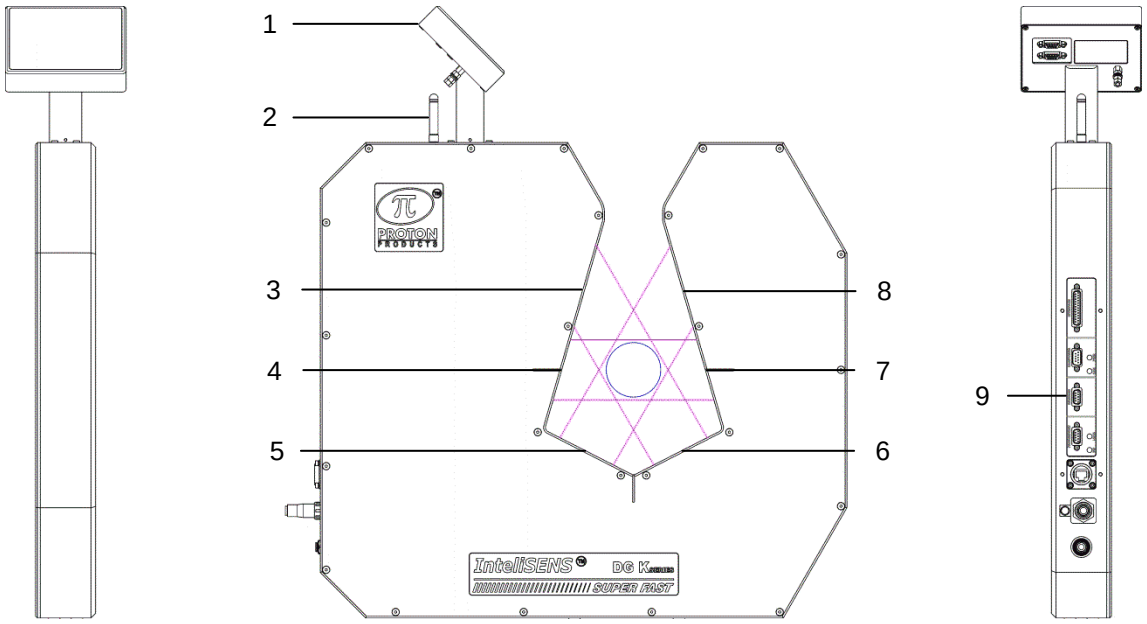


Label	Description
1	Optional AiG2 interface display unit.
2	Bluetooth or WiFi antenna.
3	Y-axis source window.
4	Z-axis detector window (DG3060 only).
5	X-axis detector window.
6	Y-axis light detector window.
7	Z-axis light source window (DG3060 only).
8	X-axis light source window.
9	Connector panel.

DG2060-5/10K SERIES



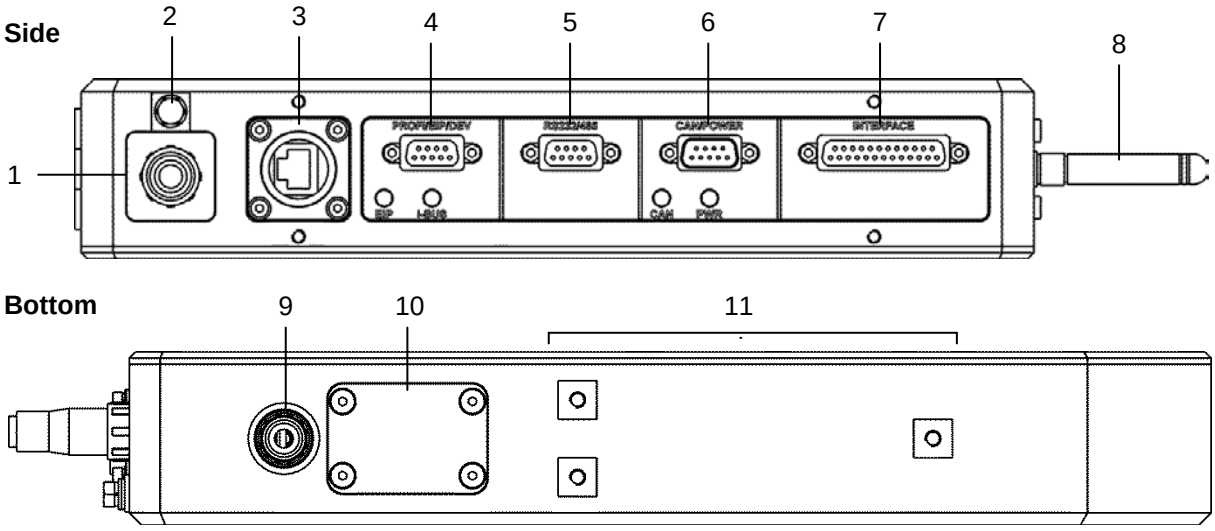
DG3060-5/10K SERIES



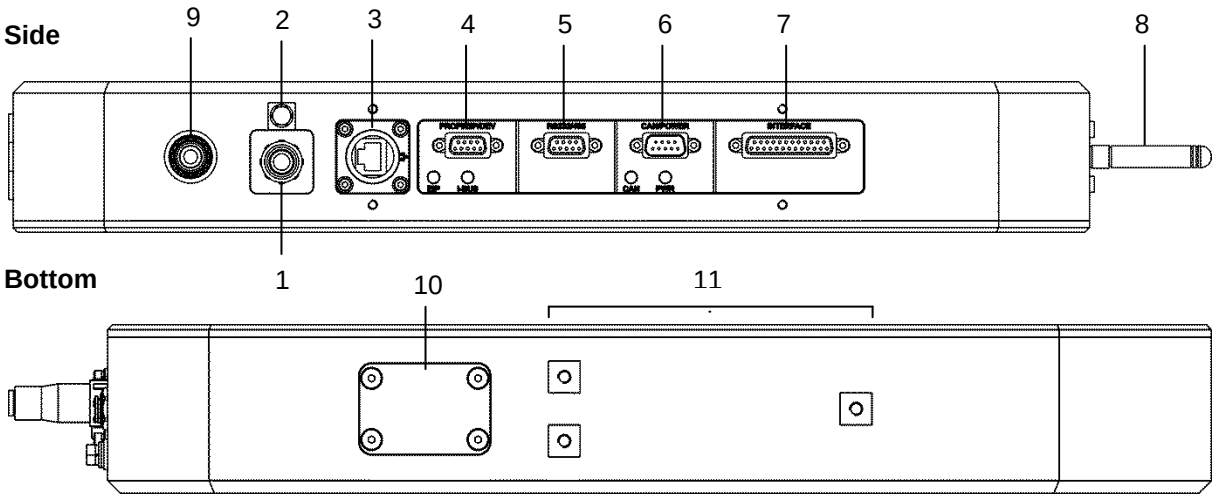
Label	Description
1	Optional AiG2 interface display unit.
2	Bluetooth or WiFi antenna.
3	Y-axis source window.
4	Z-axis detector window (DG3060 only).
5	X-axis detector window.
6	Y-axis light detector window.
7	Z-axis light source window (DG3060 only).
8	X-axis light source window.
9	Connector panel.

CONNECTORS

DG2030/3030-5/10k Series

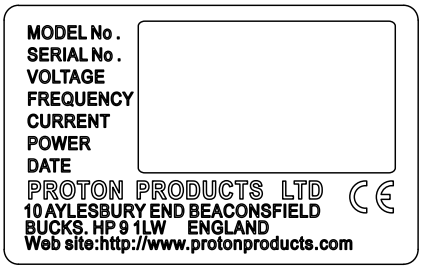


DG2060/3060-5/10k Series



	Designation	Connector type	Description
1	AC power inlet	PX0413 / 03P	Suitable mating connector: Bulgin PX0410 / 03S
2	Earth bolt	M5 bolt	Earth point for the gauge enclosure
3	Ethernet	RJ45 socket	Ethernet communications interface
4	PROFI / EIP / DEV	DB9 female	Optional PROFIBUS, EtherNet/IP, DeviceNET communications interfaces
5	RS232 / 485	DB9 female	RS-232, RS-422/485 communications interface.
6	CAN / POWER	DB9 male	CAN-bus communications interface and DC power input
7	INTERFACE	DB25 female	Logic and speed pulse inputs, relay outputs, optional analogue input, optional PI feedback controller I/O
8	Bluetooth or WiFi antenna	SMA male	Bluetooth wireless communications interface (not available in units destined for European markets)
9	Air wipe air inlet	6mm push-fit	Air wipe air inlet for optical windows
10	AiG2 mounting port	5-pin aerospace	AiG2 mounting port for inverted operation of the gauge
11	Mounting holes	M5 x 10 mm	Securely mount the gauge before operation.

PRODUCT INFORMATION LABEL



Serial numbers are 6 digits long followed by one or more suffixes to indicate installed options:

Suffix	Installed option	Option part number
S	Standard configuration	-
B	Bluetooth wireless interface	
W	WiFi wireless interface	
D	DeviceNet interface	00043MC006
IP	EtherNet/IP interface	00043MC005
PR	PROFIBUS interface	00043MC022
A	Analogue outputs	00047MC062
PI	Proportional Integral feedback controller	00047MC061
ST	Statistical analysis	
SP	Statistical Process Control (SPC)	00047SW202
FT	Fast Fourier Transform (FFT)	00047SW201
FD	Single Measurement Flaw Detection (SMFD)	00047SW200

Combinations of suffixes indicate multiple installed options e.g. XXXXXX – B.D indicates both Bluetooth and DeviceNet interfaces are installed.

Power supply requirements (voltage, frequency, current and power) indicated on this label override those indicated in this manual.

OPTIONAL ACCESSORIES

OPTIONAL INTERFACES

Only one of the following 2 wireless interfaces may be specified for installation at time of order placement; cannot be field-retrofitted.

Bluetooth wireless interface	
Bluetooth®	• For wireless configuration and monitoring of the gauge from smart phones, tablet and laptop PCs.
Proton part number	

WiFi wireless interface	
Wi Fi™	• For wireless configuration and monitoring of the gauge from smart phones, tablet and laptop PCs.
Proton part number	

Industrial bus interfaces

Only one of the following 3 industrial bus interfaces may be specified for installation at time of order placement; cannot be field-retrofitted.

DeviceNet interface	
DeviceNet™	• For connection to PLCs and other process control instrumentation via an industry-standard DeviceNet network.
Proton part number	00043MC006

PROFIBUS interface	
PROFI PROCESS FIELD BUS BUS	• For connection to PLCs and other process control instrumentation via an industry-standard PROFIBUS network.
Proton part number	00043MC022

PROFINET interface	
PROFI INDUSTRIAL ETHERNET NET	• For connection to PLCs and other process control instrumentation via an industry-standard PROFINET network.
Proton part number	00043MC031

EtherNet/IP interface	
EtherNet/IP™	• For connection to PLCs and other process control instrumentation via an industry-standard EtherNet/IP network.
Proton part number	00043MC005
RJ45 to DB9 converter	• For connecting a RJ45 8P8C terminated network cable to

	the DB9 industrial bus port. • Comes as a pair for connecting to either type A or type B terminated network cables.
Proton part number	00041MC048

Electrical interfaces

Must be specified for factory installation at time of ordering; cannot be field-retrofitted.

Analogue outputs	
	• 3x analogue (±10V) outputs. • Independently programmable functions for X, Y, Z (DG3030/3060 only) diameters, average diameter, diameter errors from preset value, ovality and ovality error.
Proton part number	00047MC062

Proportional Integral (PI) feedback controller	
	• PI feedback diameter control via adjustment of insulation extruders or capstan drives. • Isolated ±20V analogue input and ±10V analogue output for connection to insulation extruders or capstan drives.
Proton part number	00047MC061

OPTIONAL FIRMWARE

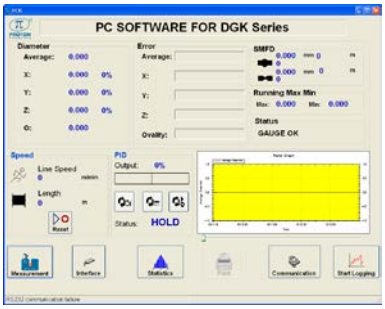
Optional firmware may be end-user enabled through the purchase of a license key. Some optional firmware functions are dependent on the presence of optional interfaces.

Fast Fourier Transform (FFT) Analysis	
FFT	• Calculates FFT frequency spectra of measured diameters. • Identifies periodically occurring diameter fluctuations caused by production line problems. • Essential for telecommunications cable lines where periodic diameter fluctuations can degrade cable bandwidth.
Proton part number	00047SW201

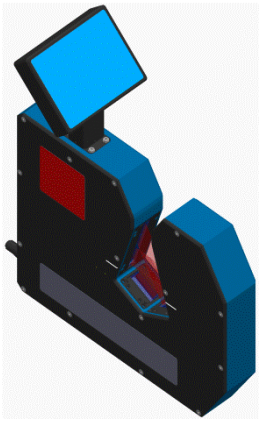
Statistical Process Control (SPC) automatic set point control	
	• Minimises insulation material consumption whilst holding the insulation diameter in tolerance. • **Requires the PI feedback controller interface option (00047MC061) to be installed.**
Proton part number	00047SW202

Single Measurement Flaw Detection (SMFD)	
	• High-speed lump and neck flaw detection.
Proton part number	00047SW200

PC SOFTWARE

PCIS_DGK	PC Interface Software
	• PC-based software package. • User-friendly graphical user interface. • Displays all measurements. • Provides menu-based setting of all parameters. • Provides data logging, presets and alarms. • Connection via RS-232, Ethernet or EtherNet/IP.

INTERFACE DISPLAY MODULES

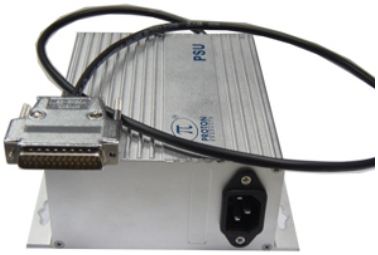
AiG2-DG	Interface display module
	• Displays measured diameters. • Provides menu-based setting of all parameters. • Bright vacuum fluorescent dot matrix display. • Two mounting options: o Directly-mounted on gauge body using a mounting pillar (no separate CAN-bus cable required). o Remotely-mounted via a CAN-bus extension cable to the CAN-bus port.
Proton part number	00047MC045

CAN-bus extension cable	Name	Length / m	Proton part number
	DG_SL-AIG2-005	5	00041CN005
	DG_SL-AIG2-010	10	00041CN010
	DG_SL-AIG2-015	15	00041CN015
	DG_SL-AIG2-020	20	00041CN020
	DG_SL-AIG2-030	30	00041CN030
	DG_SL-AIG2-050	50	00041CN050

HEIGHT STANDS

HST3	**Heavy-duty adjustable height stand**
	• For all DG gauges. • Heavy-duty steel tube and plate construction. • Must be bolted to the floor via four fixing holes. • Adjustable range for top of HST3: 700mm-1100mm
Proton part number	00009MC001

POWER SUPPLIES AND CONNECTIVITY

PSU-UNI	**Mains power adapter**
	• Connects via the DB25 “INTERFACE” connector. • Supplies electrical power to the gauge. • Input voltage range: 90 – 260 VAC @ 45 – 65 Hz.
Proton part number	0001MC264

PSU-BOB-DG	**Power supply and break-out box**
	• Connects via the DB25 “INTERFACE” connector. • Supplies 24VDC electrical power to the gauge. • Provides screw terminal access to all “INTERFACE” connector input and output pins. • End user cables are sealed with three cable glands. • Input voltage range: 90 – 260 VAC @ 45 – 65 Hz. • Select the required length of DB25 cable from below.
Proton part number	00047MC360

<table>
<tr><td>Terminal Strip-DIN</td><td rowspan="2">Breaks out the DB25 “INTERFACE” connector to a DIN rail mountable set of screw terminals.
Select the required length of DB25 cable from below.</td></tr>
<tr><td>  </td></tr>
<tr><td>Proton part number</td><td>00041MC730</td></tr>
<tr><td colspan="2">DB25 “INTERFACE” port to PSU-BOB-DG, Terminal Strip-DIN or CS1G-SL cable</td></tr>
<tr><td>  </td><td>
<table>
<tr><th>Name</th><th>Length / m</th><th>Proton part number</th></tr>
<tr><td>SLMKII-BOB-003</td><td>3</td><td>00043MC021</td></tr>
<tr><td>SLMKII-BOB-005</td><td>5</td><td>00041CT005</td></tr>
<tr><td>SLMKII-BOB-010</td><td>10</td><td>00041CT010</td></tr>
<tr><td>SLMKII-BOB-020</td><td>20</td><td>00041CT020</td></tr>
<tr><td>SLMKII-BOB-030</td><td>30</td><td>00041CT030</td></tr>
</table>
</td></tr>
</table>

INSTALLATION

PRECAUTIONS

Operating temperature

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

- Do not operate the gauge in temperatures outside of the specified range.
- Do not install the gauge near high temperature surfaces or objects which may cause it to overheat.
- Operation of the gauge outside the specified temperature range may result in degraded measurement accuracy, malfunction or damage to the gauge.

Protect from impact

- The gauge contains delicate optical and electronic assemblies and must never be dropped or struck by other objects.
- The gauge must be securely mounted by its base to prevent toppling.
- Measured objects threaded through the optical gate cavity must be secured against contact with the optical windows or catching upon the gauge body. For cable production line applications, Proton Products can supply optional adjustable cable guides for securing the passage of a cable through the optical gate cavity.

Do not open or disassemble

- The gauge contains no user serviceable components.
- Loosening the gauge screws or removing its cover will invalidate the product warranty.

Periodic maintenance

- The physical condition of the gauge, optional AiG2 interface display unit 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.

Optical windows

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

OPTICAL WINDOW CLEANING PROCEDURE

- The optical windows are manufactured from anti-reflection coated optical glass; they must be treated with the same level of care as a high-performance camera lens.
- **Before inspecting or cleaning the optical windows, ensure that the gauge is powered off and no 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 height stand.
2. Install optional Proton Products cable guides.
3. Install air wipe air supply.

Electrical installation:

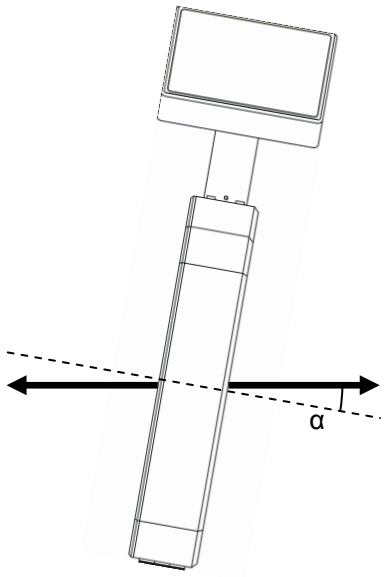
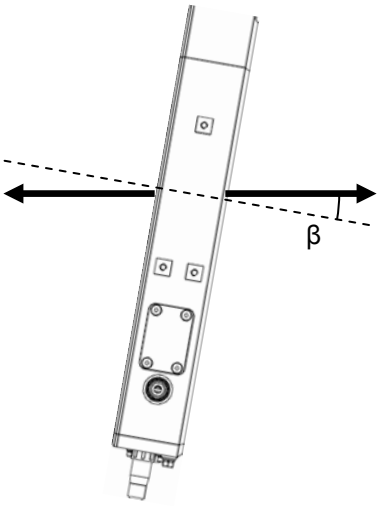
1. Install earth connections.
2. Install optional AiG2 interface display unit.
3. Depending on the model, install either an AC power cable or DC power supply (such as an optional Proton Products PSU-UNI, PSU-BOB or PSU-CAN power supply).
4. Install interface connections (RS-232, RS-422/485, Ethernet or optional PROFIBUS, EtherNet/IP, DeviceNET, Bluetooth or WiFi antenna).
5. Install speed input (analogue or pulse).
6. Install optional electrical interfaces (Logic inputs, Relay outputs, Analogue outputs, PI feedback controller connections) using the optional Proton Products PSU-BOB breakout box or terminal strip.
7. Configure the gauge either via an optional AiG2 interface display unit or any of the above interfaces.

MECHANICAL INSTALLATION

The gauge must be securely mounted by its base to a fixed surface. It can either be secured to an end user supplied mount or to an optional Proton Products adjustable height stand.

Model	Distance between optical gate centre and mounting surface / mm
DG2030-5/10k DG3030-5/10k	155
DG2060-5/10k	235
DG3060-5/10k	275

- In dusty or wet environments, the gauge may be mounted upside down to an overhead mounting surface to reduce the risk of window contamination by falling debris.
- If the bottom mounting AiG2 port or air wipe air inlet (DG2030 only) is to be used, then the mounting surface must be sized to clear these ports.
- Optimum measurement accuracy is achieved if the object is centred in the optical gate cavity.
- Misalignment of the gauge measurement axis relative to the object will result in the measured diameter being larger than the true diameter; for optimum accuracy, ensure that the pitch (α) and yaw (β) angles are as close to 0° as possible; this will correspond to the position for the minimum measured diameter:

Front view	Underside view
	

Pitch (α) or yaw (β) angle misalignment cosine error

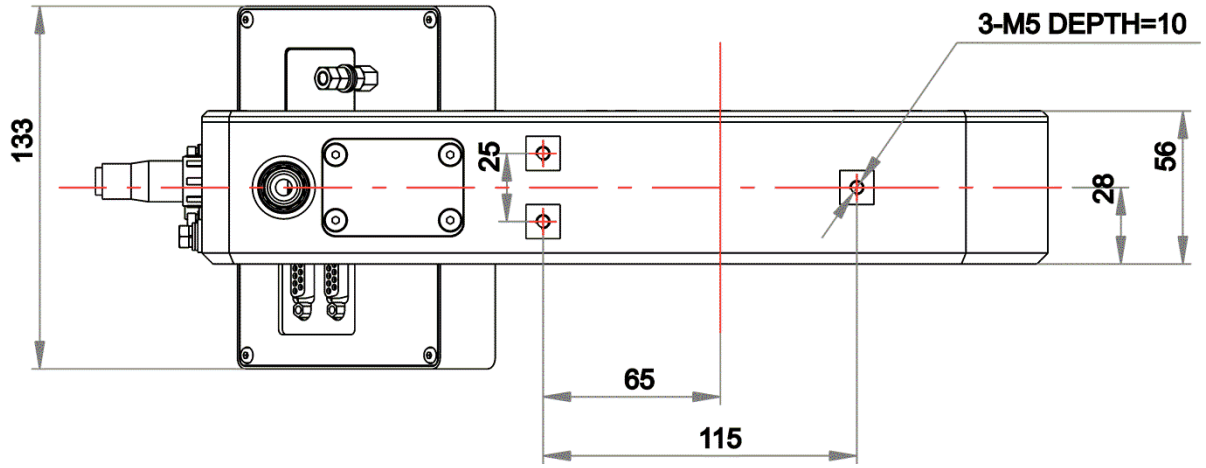
$$\text{Measured diameter} = \frac{\text{True object diameter}}{\cos(\alpha \text{ or } \beta)}$$

Pitch (α) or yaw (β) angle / °	(cos α or β)	Diameter error / %
0	1.000000	0
0.25	0.999990	+0.001
0.5	0.999962	+0.004
0.75	0.999914	+0.009
1	0.999848	+0.015
2	0.999391	+0.061
3	0.998630	+0.137
4	0.997564	+0.244
5	0.996195	+0.382
10	0.984808	+1.543

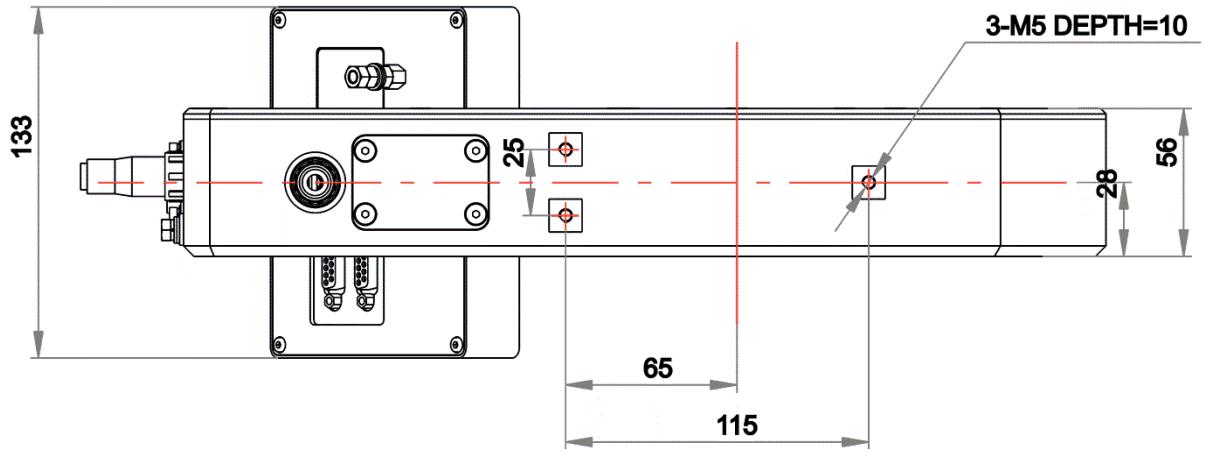
- Three M5 x 10 mm depth tapped holes are provided in the base of the gauge; select appropriate length screws which do not bottom out in these holes:

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)			10	mm
M5 mounting bolt torque			6	Nm

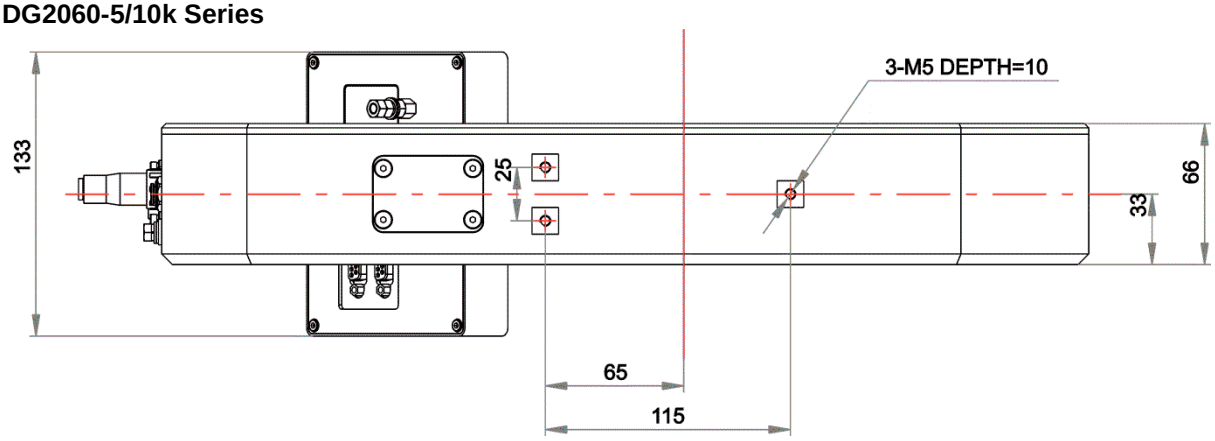
DG2030-5/10k Series



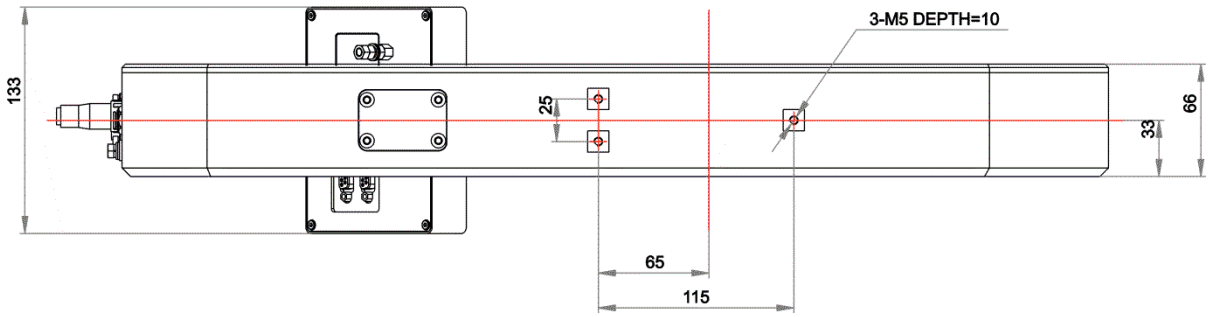
DG3030-5/10k Series



DG2060-5/10k Series



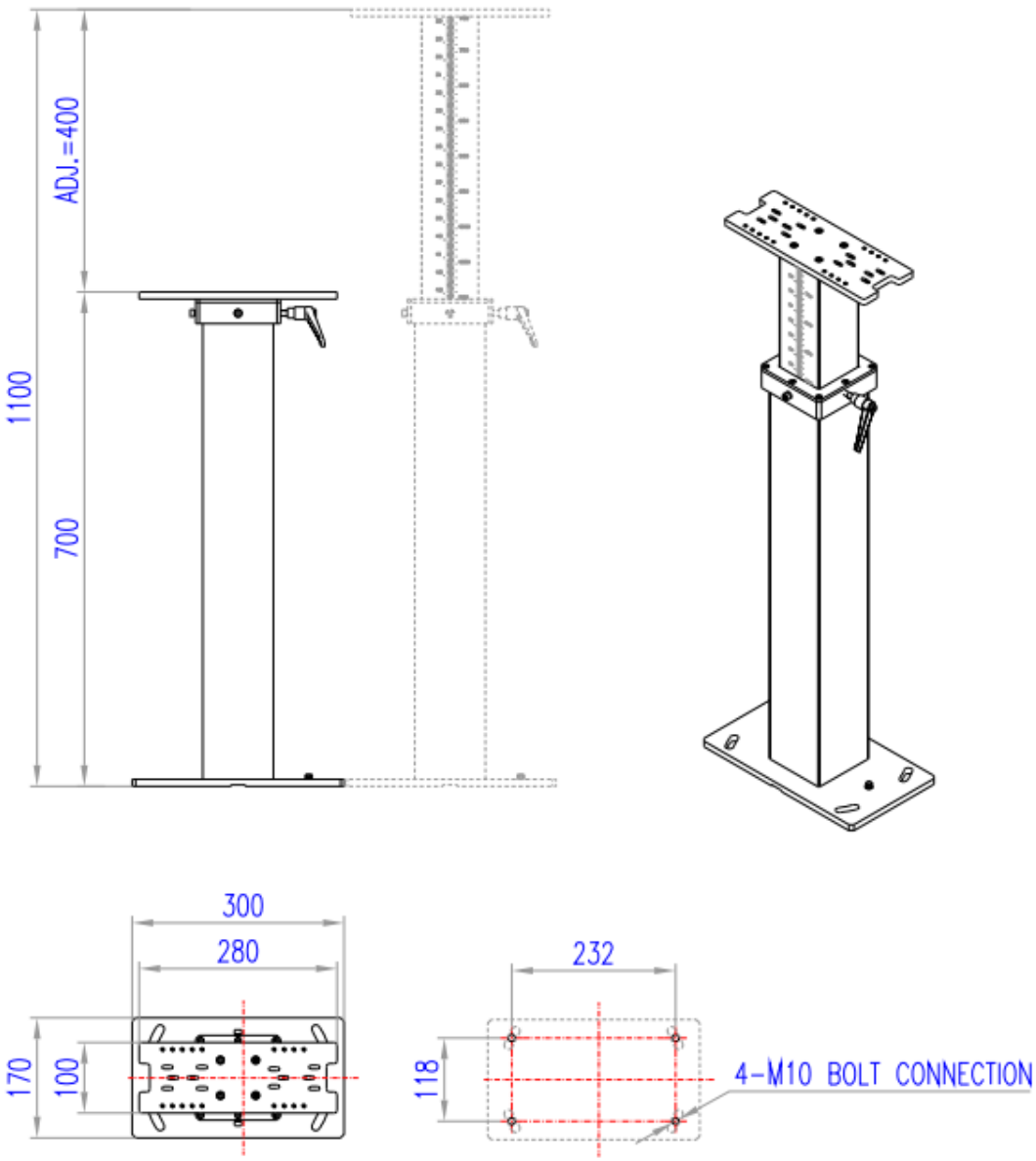
DG3060-5/10k Series



Installation on an optional Proton Products height stand

Proton Products can supply an optional HST3 adjustable height stand which can position the measurement axis of the gauge within the following height range:

Gauge model	Optical gate centre height (mounted on HST3 adjustable height stand) / mm	
	Minimum	Maximum
DG2030-5/10k DG3030-5/10k	855	1255
DG2060-5/10k	935	1335
DG3060-5/10k	975	1375



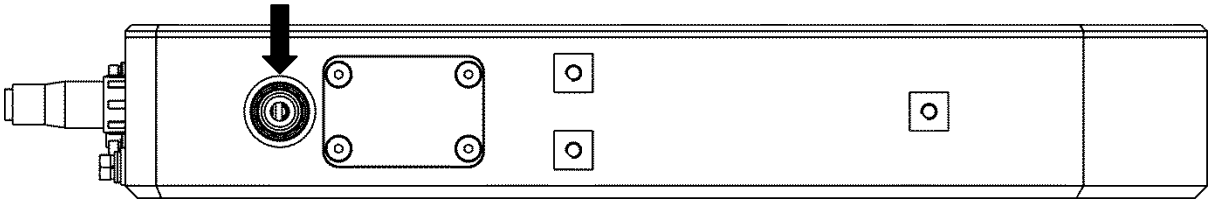
1. Mark and drill four holes into the floor for securing the base of height stand (appropriate floor mounting hardware is to be supplied by the end-user).
2. Securely bolt the height stand to the floor (the height stand is not designed for stable free standing operation).
3. Earth the height stand with an earth wire of at least 6mm^2 attached via a crimp on ring terminal to the M5 earth bolt on the base of the stand.
4. Fully extend height stand by pulling out the inner tube as far as possible.
5. Tighten the LOWER clamp collar (at the base of the height stand) using the 8 mm bar supplied (do NOT tighten the lower clamp collar with the inner tube in the lowered position as this may cause the inner tube to become jammed).
6. Temporarily tighten the upper clamp collar so that the inner tube is locked in position.
7. Attach the gauge to the stand using the three M5 x 16 mm screws supplied (do not exceed a torque of 6 Nm when tightening these screws).
8. Loosen the upper clamp collar and adjust the height and alignment of the gauge to the object being measured.
9. Tighten the upper clamp collar to lock the position of the height stand.

The height stand cannot withstand any sideways loads above 400 N; ensure that the measured object does not catch on either the gauge or the stand.

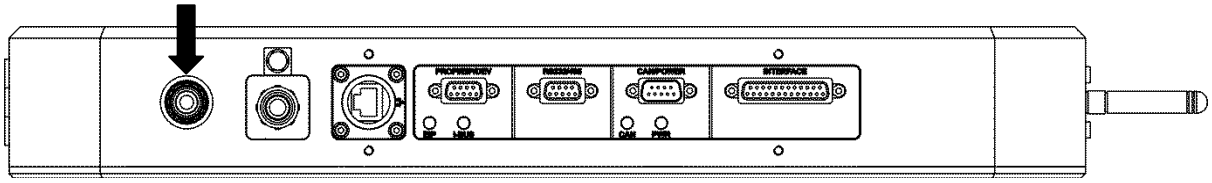
Air wipe air supply installation

The air wipe system delivers a constant flow of clean air over the external surface of each optical window to keep it clear of dust, moisture and debris.

DG2030/3030-5/10k Series (bottom)



DG2060/3060-5/10k Series (side)



Connector type: 6mm push fit

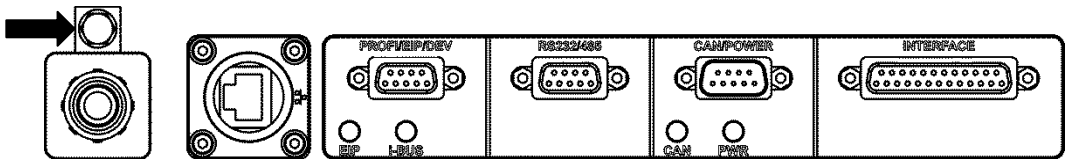
Specification	Minimum	Typical	Maximum	Units
Pressure		2	5	bar
Flow rate			140	litres / minute

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

ELECTRICAL INSTALLATION

Earth connection



Connector type: M5 bolt

- An earth wire of at least 6mm^2 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 practical.

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.

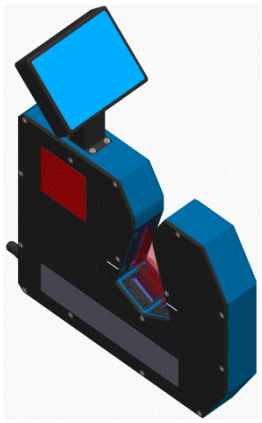
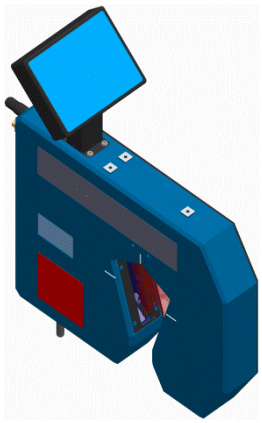
Optional AiG2 interface display unit installation

The AiG2 interface display unit is a recommended optional accessory with the following features:

- Menu based user interface for configuring the gauge and displaying measurements and error messages.
- Two versions of the AiG2 interface display are available: one version that mounts directly on the gauge body and one version that can be connected remotely via a CAN-bus extension cable.
- The DG gauge provides two direct mounting positions for the AiG2 unit for normal and inverted orientation operation.
- The remote AiG2 interface display unit can also power DC powered gauges through a CAN-bus port connected power supply.

Installing a gauge mounted AiG2 interface display unit:

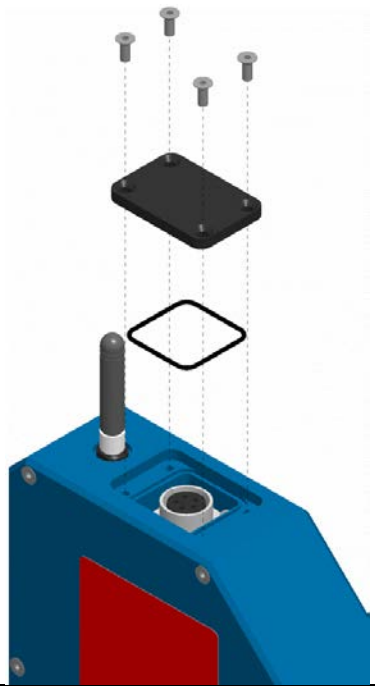
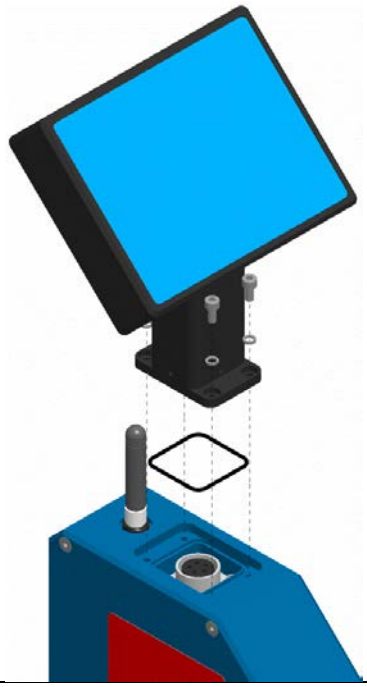
Depending on the orientation of the gauge, an AiG2 unit may be mounted on either one of the two mounting ports:

<table>
<tr><th colspan="2">Normal orientation (standard model)</th><th colspan="2">Inverted orientation (must be specified for connector installation at order placement)</th></tr>
<tr><td colspan="2">  </td><td colspan="2">  </td></tr>
<tr><td>1</td><td>Unscrew the four screws and remove the AiG2 port blanking plate.

Retain the rubber O-ring for the next step.

Store the blanking plate and four countersunk screws for future use.</td><td>2</td><td>Place the rubber O-ring in the groove.

Align the AiG2 connector mating key with the port socket and insert.

Secure the AiG2 unit with four spring washers and M4 cap head screws.</td></tr>
<tr><td colspan="2">  </td><td colspan="2">  </td></tr>
</table>

Installing a remote AiG2 interface display unit:

1. Connect the remote AiG2 interface display unit to the CAN/POWER connector using a CAN-bus extension cable.
2. Connect an optional PSU-CAN mains power supply unit to the second CAN-bus port on the remote AiG2 interface display unit.

POWER SUPPLY

DC or AC power supplies must be specified at time of ordering; DC and AC models are not interchangeable in their power supply requirements.

DC Power supply (for DC powered models only)

Specification	Minimum	Typical	Maximum	Units
Power supply voltage*	15	24	30	VDC
Power consumption (with optional AiG2 display unit)			30	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.

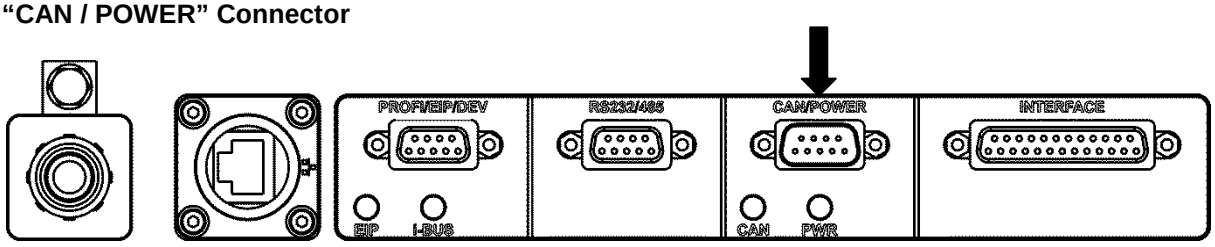
Power may be supplied to the gauge via the following optional accessories:

- Remote AiG2 interface display unit connected to the “CAN / POWER” connector.
- PSU-CAN Power supply unit connected to the “CAN / POWER” connector.
- PSU-UNI Power supply unit connected to the “INTERFACE” connector.
- PSU-BOB Power supply unit and break out box connected to the “INTERFACE” connector.

Alternatively, power may be directly supplied to the gauge via either of the following connectors:

- “CAN / POWER” connector.
- “INTERFACE” connector.

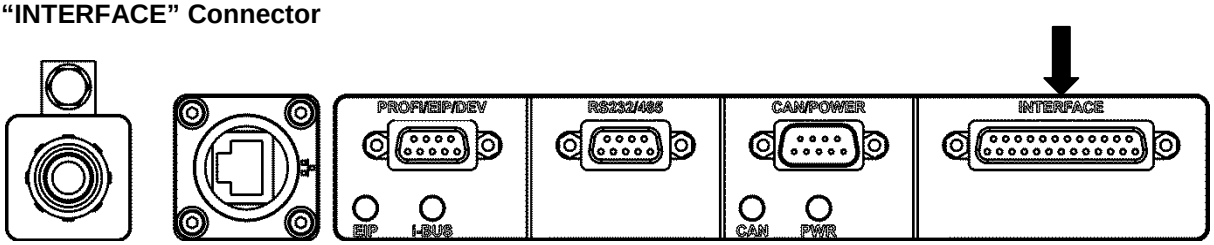
“CAN / POWER” Connector



Connector type: DB9 male (plug)

Pin	Designation	Description	Notes
3	REG.GND	Power supply ground (0 V)	
9	+24V	+24 V power supply	
S	Shield		Ensure that the cable shield is connected to this via the plug shield connection.

“INTERFACE” Connector

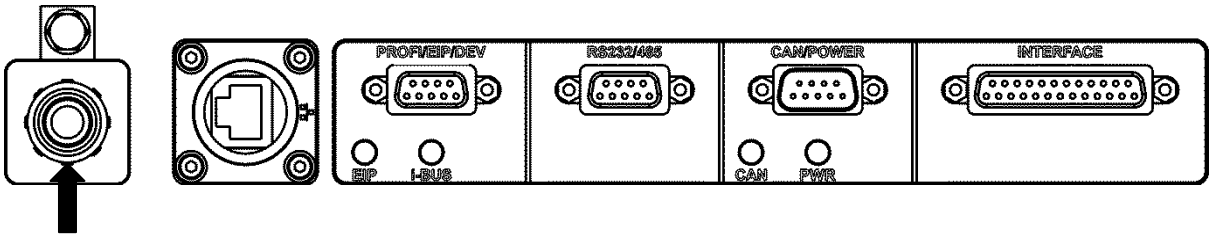


Connector type: DB25 female (socket)

Pin	Designation	Description	Notes
24	REG.GND	Power supply ground (0 V)	
25	+24V	+24 V power supply	
S	Shield		Ensure that the cable shield is connected to this via the plug shield connection.

AC power supply (for AC powered models only)

Specification	Min	Typical	Max	Units
AC Power supply voltage	85		264	VAC
AC Power supply frequency	47		63	Hz
AC Power consumption (with optional AiG2 interface display unit)			40	W



Connector type: Bulgin Buccaneer 400 Series PX0413 / 03P

Pin	Designation	Description	Notes
E	Earth	Earth	
L	Live	Live	
N	Neutral	Neutral	

Suitable mating connector: Bulgin Buccaneer 400 Series Flex Body PX0410 / 03S (preassembled AC power cables are available from Proton Products)

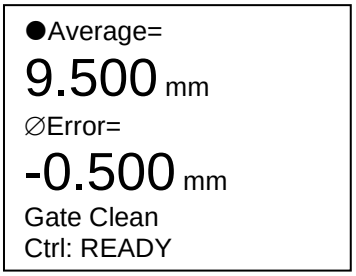
Powering on the gauge

The gauge has no power switch; as soon as power is applied it will power up, perform self tests and then commence measurement.

Power indications

PWR		**LED status**	**Indication**
		Continuous red	Gauge is powered on
Power		Extinguished	Gauge is powered off

If an optional AiG2 interface display is attached to the gauge, then correct power up is indicated by the display of the “PROTON PRODUCTS LTD.” message for 5 seconds, followed by the “Basic Ø Data” page:



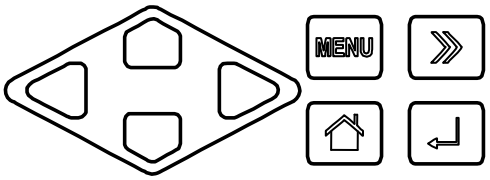
Powering off the gauge

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

CONFIGURATION

CONFIGURATION USING AN OPTIONAL AIG2 INTERFACE DISPLAY UNIT

Key functions



Key	Name	Function
MENU	Menu	Opens the “MENU”.
	Page	Steps through pages.
	Home	Opens the first “Basic Ø Data” page.
	Select	When a “MENU” item is highlighted: display first page of that menu item.
		When setting a parameter: save parameter and advance to the next parameter.
	Left	Step one digit left through numerical parameters.
	Right	Step one digit right through numerical parameters.
	Up	Step up through menu items.
		Step up through fixed option parameters.
		Increment numerical digits.
	Down	Step down through menu items.
		Step down through fixed option parameters.
		Decrement numerical digits.

To set a numerical value (e.g. 180018):

	User Action	Result
1	Press to step right and highlight the 1st digit.	**0**00000
2	Press to increment the value of the 1st digit to 1.	**1**00000
3	Press to step right and highlight the 2nd digit.	1**0**0000
4	Press 2 times to decrement the value of the 2nd digit to 8.	1**8**0000
5	Press 3 times to step right and highlight the 5th digit.	18000**0**
6	Press to increment the value of the 5th digit to 1.	18001**0**
7	Press to step right and highlight the 6th digit.	180010
8	Press 2 times to decrement the value of the 6th digit to 8.	180018
9	Press to enter or save the numerical value.	180018

Press at any time in the above process to step left and highlight any digits that require correction.

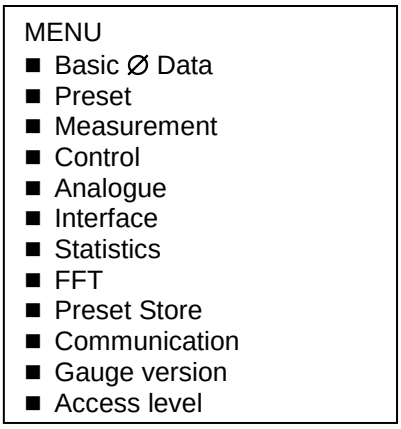
Error messages

If an optional AiG2 interface display is attached to the gauge, then the following error messages may be displayed:

Message	Reason	Remedy
No Communication to gauge head	Bad electrical connection between the gauge and AiG2 interface display unit.	Check and rectify the connection between the gauge and AiG2 interface display unit.

MENU

Pressing the MENU key at any time will open the “MENU” page, from which all functions and parameters of the gauge can be accessed:



The “Access level” menu page is a password protected page which restricts the setting of parameters under other “MENU” pages. ***It is necessary to unlock the relevant menus before their parameters can be set via an optional AiG2 interface display unit.***

“Basic ∅ Data” menu pages display measured diameters, ovality, errors, Single Measurement Flaw Detection (SMFD) data, running maximum / minimum diameters, line speed and length. The optional PI feedback controller may also be run, held or reset from the first page.

“Preset” menu pages are for setting diameter and ovality presets and tolerances, SMFD tolerances and shrinkage compensation.

“Measurement” menu pages are for setting the measurement mode (solid or glass mode), number of displayed digits, measurement and SMFD averaging time, measurement units (mm or inch) and diameter compensation. The gauge parameters may also be restored to factory defaults via a page under this group.

“Control” menu pages are for the configuration, fine tuning and operation of the optional PI feedback controller function. ***Instructions for these pages may be found under the section describing the PI feedback controller.****

“Analogue” menu pages are for the configuration of optional analogue outputs. Measured diameters and errors may be output as analogue voltages. ***Instructions for these configuration pages may be found under the section describing the Analogue Outputs.****

“Interface” menu pages are for the configuration of the analogue input, speed pulse input, logic input and relay output functions. ***Instructions for these configuration pages may be found under the sections describing the associated interfaces.***

“Statistics” menu pages are for the configuration and operation of the optional statistical analysis and Statistical Process Control (SPC) functions.*

“FFT” menu pages are for the configuration and operation of the optional Fast Fourier Transform function for the analysis of periodic diameter variations.*

The “Preset Store” menu page permits the storage of a complete set of gauge parameters in one of 50 non-volatile memory locations for easy subsequent recall. It is intended for storing different sets of gauge configurations for different product “recipes”.

“Communications” menu pages are for the configuration of the CANbus, RS-232, RS-422/485, Ethernet, or optional PROFIBUS, EtherNet/IP, DeviceNET, Bluetooth or WiFi communications interfaces. ***Instructions for these configuration pages may be found under the sections describing the associated communications interfaces.***

The “Gauge version” menu page displays the gauge hardware and software version numbers.

**Optional function; units not installed with this function may not display this “MENU” entry.*

ACCESS LEVEL

The “Access level” menu is a password protected menu which controls which parameters may be adjusted by the operator via an optional AiG2 interface display unit.

- Parameters under specific “MENU” groups or all parameters may be locked or unlocked for adjustment.
- A parameter cannot be adjusted on an optional AiG2 interface display unit unless its “MENU” group is unlocked.
- It is recommended that “MENU” groups are re-locked after configuration to prevent unwanted changes being made during production.
- Adjustment of parameters via RS-232, RS-422, RS-485, Ethernet, PROFIBUS, EtherNet/IP, DeviceNet Bluetooth or WiFi communications interfaces are not subject to access level restrictions.

To open the “Access level” menu and lock or unlock parameter groups:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Access level”.	Access level
3	Press ↵ to display the “ACCESS LEVEL” page.	ACCESS LEVEL To access the preset lock selector page, enter code & press ↵ 000000
4	Press ⌂ or ⌄ followed by ⌂ or ⌄ to highlight and edit individual digits in the password entry field and set it to “180018”.	180018
5	Press ↵ to submit the password.	
	If an incorrect password has been entered, then the “PASSWORD ERROR” page is displayed. Press ↵ to re-enter the password. Press MENU to exit and return to the “MENU” menu.	PASSWORD ERROR To retry press Enter Key, To return to menu Press MENU key
	If the correct password has been entered, then the “PRESET LOCK 1” menu is displayed. “Lock” indicates a locked parameter group that cannot be adjusted by the operator. “Unlock” indicates an unlocked parameter group that may be adjusted by the operator.	PRESET LOCK 1 Preset Lock Measurement Lock Control Lock Analogue Lock Interface Lock Preset Store Lock Communication Lock
	Press ⌂ to advance to the “PRESET LOCK 2” menu.	PRESET LOCK 2 Statistics Lock
To lock or unlock a “MENU” group of parameters:		
1	Press ⌂ or ⌄ to highlight the required “MENU” group.	Analogue Lock
2	Press ↵ to toggle between “Lock” and “Unlock”. The selected state remains unchanged if the power is cycled.	Analogue Unlock

3	Press MENU or ⌂ to exit.	

PRESET LINE SPEED CONFIGURATION

If a real time analogue or pulsed line speed signal is not available, then a fixed preset line speed may be set from which the gauge will calculate:

- Length.
- Position of lump and neck flaws.
- Helix mode envelope diameter.

A real time line speed signal (analogue or pulse) is required for:

- Accurate Helix mode operation.
- PI feedback controller operation.
- Statistical Process Control (SPC) operation.

If using a real time line speed signal, then refer to either the analogue input or speed pulse input sections for configuration information.

Configuration via an optional AiG2 interface display unit:

	User Action	**Result**
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Interface”.	Interface
3	Press ↵ to open the “Interface” group of pages.	
4	Press → to advance to the “SPEED” page. The displayed “Speed” is either the preset or measured line speed (read only).	**SPEED** Speed: 0000 m/min Source: Pulse Pulse Gain: 1000 p/m
5	Press ⌂ or ⌄ to set “Source” to “Preset”.	Source: Preset
6	Press ↵ to save the “Source” setting and advance to “Preset Speed” (the parameter shown here depends on the “Source” setting).	**SPEED** Speed: 0000 m/min Source: Preset Preset Speed: 0100 m/min
7	Press ⌂ or ⌄ followed by ⌂ or ⌄ to highlight and edit individual digits in the “Preset Speed” setting.	Preset Speed: 0200 m/min
8	Press ↵ to save the “Preset Speed” setting and return to the “Source” parameter.	**SPEED** Speed: 0200 m/min Source: Preset Preset Speed: 0200 m/min
9	Press MENU or ⌂ to exit.	

Note: “Metric” measurement units shown; for “Imperial” measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Configuration via input parameters:

The “Preset Speed” may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
28		Line speed source		0=Preset 1=Pulse 2=Analogue	0

DW	Bit	Comments	Unit	Range/Remark	Default value
29		Preset line speed	1=1m/min {1=1ft/min}	0~65535	100

BASIC Ø DATA

The “Basic Ø Data” pages display:

1. Average measured diameter and error (the state of the PI feedback controller may be set on this page).
2. Measured X, Y, Z (DG3030/3060 only) diameters.
3. Measured X diameter, error and optical gate location.
4. Measured Y diameter, error and optical gate location.
5. Measured Z diameter, error and optical gate location (DG3030/3060 only).
6. Measured ovality and error.
7. Single Measurement Flaw Detection (SMFD) measurements.
8. Running maximum and minimum diameters.
9. Line speed and length.

To access the “Basic Ø Data” pages:

	User Action	Result
1	Press to display the first “Basic Ø Data” page.	
Or		
1	Press MENU to display the “MENU”.	MENU
2	Press or to highlight “Basic Ø Data”.	Basic Ø Data
3	Press to open the first “Basic Ø Data” page.	
4	Press to step through the various “Basic Ø Data” pages.	
5	Press MENU to return to the “MENU”.	

The following icons indicate the “Measurement mode” (configured under the “Measurement” pages):

Icon	Mode	Description
●	Solid	Measures opaque objects.
○	Glass	Measures transparent objects such as glass tube (detection of outermost edges).
⁂	Helix	Measures the envelope that encloses a twisted or braided multi-core cable.

Average measured diameter and error

Page 1	Label	Value	Comment	DW
● Average= 9.500 mm ∅Error= -0.500 mm Gate Clean Ctrl: READY	Average	0 ~ 65.535 mm {6.5535 in}	Average of measured X, Y, Z (DG3030/3060 only) diameters.	Out: 2
	∅Error	0 ~ 65.535 mm {6.5535 in}	(Average diameter) – (Preset average diameter)	Out: 7
	Gate	Clean	Normal operation.	Out 1.3:
		Dirty	Contamination of the optical window is detected as a reduction in overall received light intensity or multiple small objects.	
	Ctrl	RESET	Reset PI feedback controller output to zero.	Out: 35
		READY	PI feedback controller output at zero and ready.	
		ON	Run PI feedback controller output.	
		HOLD	Hold PI feedback controller output at current value.	
	Output %	0 ~ ±50 %	PI feedback controller output (displayed only in ON and HOLD mode).	Out: 36

Note: "Metric" measurement units shown; for "Imperial" measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

The state of the PI feedback controller output may be set as follows:

	User Action		Result
1	Press ↵ to highlight the PI feedback control mode "Ctrl" parameter.		Ctrl: READY
2	Press ⌂ or ⌄ to step through the control mode options.		Ctrl: ON
	RESET	Resets the controller output voltage to zero.	
	ON	Runs the controller output.	
	HOLD	Holds the controller output voltage constant at its current value.	
3	Press ↵ to engage the selected PI feedback control mode.		

The PI feedback controller mode may be set by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
31	0~7	Control switch		0=HOLD 1=ON 2=RESET	0
	8	Control output polarity		0=Normal 1=Reverse	0

Measured X, Y, Z (DG3030/3060 only) diameters

Page 2	Label	Value	Comment	DW
●X=9.400 mm ●Y=9.600 mm ●Z=9.500 mm ↓↑X=00% ↓↑Y=00% ↓↑Z=00%	X	0 ~ 65.535 mm {6.5535 in}	Measured X diameter (time averaged).	Out: 3
	Y	0 ~ 65.535 mm {6.5535 in}	Measured Y diameter (time averaged).	Out: 4
	Z	0 ~ 65.535 mm {6.5535 in}	Measured Z diameter (time averaged; DG3030/3060 only).	Out: 5
	↓↑X	0 ~ ±100 %	Object position in X-axis optical gate (0% indicates object centred).	Out: 20
	↓↑Y	0 ~ ±100 %	Object position in Y-axis optical gate (0% indicates object centred).	Out: 21
	↓↑Z	0 ~ ±100 %	Object position in Z-axis optical gate (0% indicates object centred; DG3030/3060 only).	Out: 22

Note: "Metric" measurement units shown; for "Imperial" measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Measured X diameter, error and optical gate location

Page 3	Label	Value	Comment	DW
●X= 9.400 mm ∅Error= -0.600 mm ↓↑=00%	X	0 ~ 65.535 mm {6.5535 in}	Measured X diameter (time averaged).	Out: 3
	∅Error	0 ~ 65.535 mm {6.5535 in}	(Measured X diameter) – (Preset X diameter)	Out: 8
	↓↑	0 ~ ±100 %	Object position in X-axis optical gate (0% indicates object centred).	Out: 20

Note: "Metric" measurement units shown; for "Imperial" measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Measured Y diameter, error and optical gate location

Page 4	Label	Value	Comment	DW
●Y= 9.600 mm ∅Error= -0.400 mm ↓↑=00%	Y	0 ~ 65.535 mm {6.5535 in}	Measured Y diameter (time averaged).	Out: 4
	∅Error	0 ~ 65.535 mm {6.5535 in}	(Measured Y diameter) – (Preset Y diameter)	Out: 9
	↓↑	0 ~ ±100 %	Object position in Y-axis optical gate (0% indicates object centred).	Out: 21

Note: "Metric" measurement units shown; for "Imperial" measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Measured Z diameter, error and optical gate location (DG3030/3060 only)

Page 5(DG3030/3060 only)	Label	Value	Comment	DW
●Z= 9.500 mm ∅Error= -0.500 mm ↓↑=00%	Z	0 ~ 65.535 mm {6.5535 in}	Measured Z diameter (time averaged).	Out: 5
	∅Error	0 ~ 65.535 mm {6.5535 in}	(Measured Z diameter) – (Preset Z diameter)	Out: 10
	↓↑Z	0 ~ ±100 %	Object position in Z-axis optical gate (0% indicates object centred).	Out: 22

Note: "Metric" measurement units shown; for "Imperial" measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Measured ovality and error

Page 6	Label	Value	Comment	DW
Ovality= 0.200 mm ∅Error= 0.100 mm	Ovality	0 ~ 65.535 mm {6.5535 in}	Ovality = max(X, Y, Z) – min(X, Y, Z)	Out: 6
	∅Error	0 ~ 65.535 mm {6.5535 in}	(Measured Ovality) – (Preset Ovality)	Out: 11

Note: "Metric" measurement units shown; for "Imperial" measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Single Measurement Flaw Detection (SMFD) measurements

Page 7	Label	Value	Comment	DW
FLAW DETECTION Lump= 00.050 mm POS= 0025m Count= 007 Neck= 00.050 mm POS= 0008 m Count= 003	Lump	0 ~ 65.535 mm {6.5535 in}	Size of the last lump flaw.	Out 12:
	POS	0 ~ 65535 m {65535 ft}	Position of last lump flaw.	Out: 13
	Count	0 ~ 65535	Lump flaw count.	Out: 16
	Neck	0 ~ 65.535 mm {6.5535 in}	Size of the last neck flaw.	Out: 14
	POS	0 ~ 65535 m {65535 ft}	Position of last neck flaw.	Out: 15
	Count	0 ~ 65535	Neck flaw count.	Out: 17
	Press ◁ and ▷ together to reset all flaw detection measurements to zero.*			

Note: "Metric" measurement units shown; for "Imperial" measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Running average, maximum and minimum diameters

Page 8	Label	Value	Comment	DW
Running average= 11.900 mm Max=12.500 mm Min=11.300 mm Press <> to reset	Running average	0 ~ 65.535 mm {6.5535 in}	Running average of measured diameter*.	Out: 37
	Max	0 ~ 65535 mm {6.5535 in}	Running maximum diameter*.	Out: 18
	Min	0 ~ 65.535 mm {6.5535 in}	Running minimum diameter*.	Out: 19
	Press ◁ and ▷ together to reset running average, maximum and minimum diameters to zero.*			In: 25

Note: “Metric” measurement units shown; for “Imperial” measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Running average, maximum and minimum diameters may be accumulated from either instantaneous or time-averaged diameter measurements; this setting may be configured under the “**Interface** → **ANALOGUE & RELAY O/P** → **Response**” menu item.

***Note: Pressing ◁ and ▷ together resets ALL of the following measurements to zero, regardless of which page is currently displayed:**

- All flaw detection measurements.
- Running average, maximum and minimum diameters.
- Length.

Line speed and length

Page 9	Label	Value	Comment	DW
Speed= 0060 m/min Length= 00087 m Press <> to reset	Speed	0 ~ 65535 m/min {65535 ft/min}	Line speed from one of the following sources: • Preset line speed. • Measured line speed from the speed pulse inputs. • Measured line speed from the analogue input.	Out: 23
	Length	0 ~ 65535 m {65535 ft}	Cumulative length of product.	Out: 24
	Press ◁ and ▷ together to reset “Length” to zero.*			In: 25

Note: “Metric” measurement units shown; for “Imperial” measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

***Note: Pressing ◁ and ▷ together resets ALL of the following measurements to zero, regardless of which page is currently displayed:**

- All flaw detection measurements.
- Running average, maximum and minimum diameters.
- Length.

Error messages

The following error message pages may be displayed during normal operation:

Error page 1	Label		Comment	DW
NO OBJECT Gate clean Control READY	NO OBJECT		Indicates no object detected by the receiver: • No object present in the optical gate light beams. • Object diameter less than minimum measurable diameter specification.	Out: 1.2
	Gate	clean	Normal operation.	Out: 1.3
		dirty	Indicates that the receiver has detected: • Reduced overall light intensity. • Multiple small objects. Clean the optical window according to the procedure detailed in this manual.	
	Control	READY	PI feedback controller output at zero and ready.	Out: 35
		HOLD	PI feedback controller output held at previous value.	
		RESET	PI feedback controller output reset to zero.	

Error page 2	Label		Comment	DW
NO READING Gate very dirty or obstructed Control READY	NO READING		Indicates no light detected: • Object is wider than the optical gate. • Optical window is fully obscured by dirt.	Out: 1.1
	Gate very dirty or obstructed		Indicates no light detected; if the optical window is dirty, then clean it according to the procedure detailed in this manual.	Out: 1.3
	Control	READY	PI feedback controller output at zero and ready.	Out: 35
		HOLD	PI feedback controller output held at previous value.	
		RESET	PI feedback controller output reset to zero.	

The above error message pages will be displayed for as long as the error condition persists.

Pressing either the MENU or ⌂ keys will close the error message page and ignore the error even if it continues to cause erroneous measurement or operation.

In a “NO OBJECT” or “NO READING” condition:

- Single Measurement Flaw Detection (SMFD) lump and neck flaw reporting is suspended.
- Relay outputs are held at the same state as just prior to the “NO OBJECT” or “NO READING” condition.
- If the PI feedback controller is “ON” just prior to the “NO OBJECT” or “NO READING” condition, then the controller will automatically switch to the “HOLD” state and maintain its previous output voltage. When diameter readings resume, the PI feedback controller will revert to the “ON” state.

PRESET

The “Preset” pages are used to configure:

1. Preset average diameter and tolerances and preset core diameter.
2. Preset ovality and tolerances.
3. Single Measurement Flaw Detection (SMFD) tolerances.
4. Shrinkage compensation (for measurements made on hot objects).

Relay output contacts can be configured to close when measured readings fall outside the range defined by the preset value and its respective upper and lower tolerances.

- Upper tolerances add to the preset value.
- Lower tolerances subtract from the preset value.

Example:

For the following preset average diameter and upper (+Tol) and lower (- Tol) tolerance settings:

- Tol / mm	**Average diameter / mm**	**+Tol / mm**
0.500	10.000	0.500

Relay outputs can be configured to close if the measured average diameter falls outside the following range:

Specification	**Minimum**	**Target**	**Maximum**	**Units**
Average diameter	9.500	10.000	10.500	mm

To access the “Preset” pages and set parameters:

	User Action	**Result**
1	Press MENU to display the “MENU”.	MENU
2	Repeatedly press ⌂ or ⛉ to highlight “Preset”.	Preset
3	Press ↵ to open the first “Preset” page.	
4	Press ⏭ to step through the various “Preset” pages.	
1	Press ⌂ or ⛉ to step through parameter options.	
2	Press ▷ or ◁ followed by ⌂ or ⛉ to highlight and edit individual digits in numerical parameters.	
3	Press ↵ to save the parameter and advance to the next parameter on the page.	
4	Press MENU or ⌂ to exit.	

Note: Values or settings (i.e. input parameters) shown on the following example pages are the factory default values.

Preset average diameter, tolerances and core diameter

Page 1 (Default values shown)	Label	Value	Comment	DW
PRESET 1 Average = 10.000 mm +Tol = 00.500 mm - Tol = 00.500 mm Core = 08.000 mm	Average	0 ~ 65.535mm {6.5535 in}	Preset average diameter (also preset diameter for the optional PI feedback controller). DG2030 Average diameter = (X + Y) / 2 DG3030 Average diameter = (X + Y + Z) / 3	In: 1
PRESET 1 Average = 1.0000 in +Tol = 0.0500 in - Tol = 0.0500 in Core = 0.8000 in	+Tol	0 ~ 65.535mm {6.5535 in}	Preset average diameter upper tolerance.	In: 6
	- Tol	0 ~ 65.535mm {6.5535 in}	Preset average diameter lower tolerance.	In: 7
	Core	0 ~ 65.535mm {6.5535 in}	Preset core diameter (required for PI feedback controller operation).	In: 18

- The gauge also has individual preset and tolerance settings for each of the X, Y and Z (DG3030 only) axis diameters.
- When the “Average” preset diameter and tolerances (“+Tol” and “–Tol”) are set on an AiG2 interface display unit, the values are automatically copied to each of the individual X, Y and Z axis preset diameters and tolerances.
- The X, Y and Z axis preset diameters and tolerances may be independently set via the communications interfaces or using the optional PCiS_DGK software running on a PC connected to the RS-232, Ethernet or optional Ethernet/IP interfaces.

Input parameters

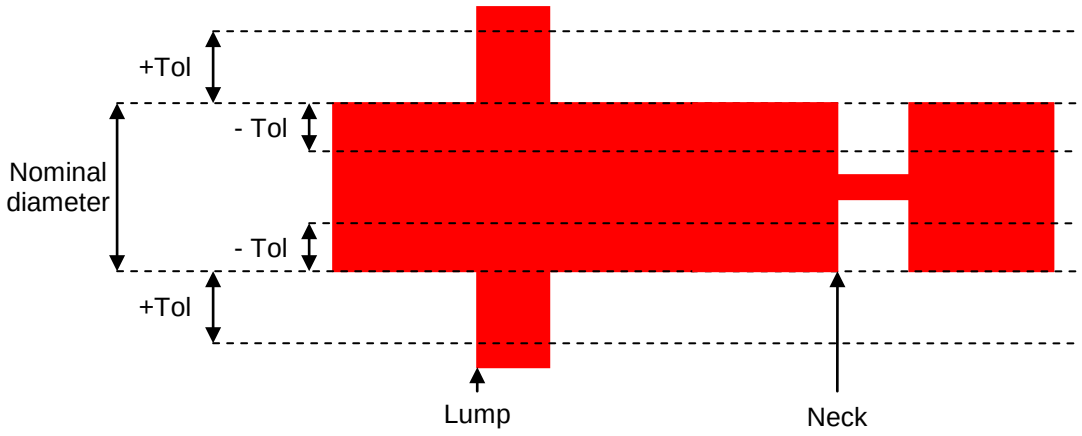
DW	Bit	Comments	Unit	Range / Remark	Default
1		Preset average diameter	1=1um {1=0.1mil}	0~65535	10000
2		Preset X diameter	1=1um {1=0.1mil}	0~65535	10000
3		Preset Y diameter	1=1um {1=0.1mil}	0~65535	10000
4		Preset Z diameter	1=1um {1=0.1mil}	0~65535	10000
6		Preset average upper limit	1=1um {1=0.1mil}	0~65535	500
7		Preset average lower limit	1=1um {1=0.1mil}	0~65535	500
8		Preset X upper limit	1=1um {1=0.1mil}	0~65535	500
9		Preset X lower limit	1=1um {1=0.1mil}	0~65535	500
10		Preset Y upper limit	1=1um {1=0.1mil}	0~65535	500
11		Preset Y lower limit	1=1um {1=0.1mil}	0~65535	500
12		Preset Z upper limit	1=1um {1=0.1mil}	0~65535	500
13		Preset Z lower limit	1=1um {1=0.1mil}	0~65535	500
18		Preset core diameter	1=1um {1=0.1mil}	0~65535	8000

Preset ovality and tolerances

Page 2 (Default values shown)	Label	Value	Comment	DW
PRESET 2 Ovality = 00.100 mm +Tol = 00.050 mm - Tol = 00.050 mm	Ovality	0 ~ 65.535 mm {6.5535 in}	Preset Ovality. Ovality = max(X, Y, Z) – min(X, Y, Z) (for DG2030: Z = 0)	In: 5
PRESET 2 Ovality = 0.0100 in +Tol = 0.0050 in - Tol = 0.0050 in	+Tol	0 ~ 65.535 mm {6.5535 in}	Preset Ovality upper tolerance.	In: 14
	- Tol	0.001 ~ 65.535 mm {6.5535 in}	Preset Ovality lower tolerance.	In: 15

Single Measurement Flaw Detection (SMFD) tolerances

Page 3 (Default values shown)	Label	Value	Comment	DW
SMFD Mode: ABS +Tol = 00.500 mm - Tol = 00.500 mm	Mode	ABS	Set the SMFD (Single Measurement Flaw Detection) tolerances as absolute thresholds relative to the nominal diameter.	In: 0.5
		Percent	Set the SMFD (Single Measurement Flaw Detection) tolerances as percentage thresholds relative to the nominal diameter.	
	+Tol	0 ~ 65.535 mm {6.5535 in}	Preset SMFD absolute upper tolerance (for Mode = ABS).	In: 16
		00.0 ~ 99.9 %	Preset SMFD percent upper tolerance (for Mode = Percent).	
SMFD Mode: ABS +Tol = 0.0500 in - Tol = 0.0500 in	- Tol	0 ~ 65.535 mm {6.5535 in}	Preset SMFD absolute lower tolerance (for Mode = ABS).	In: 17
		00.0 ~ 99.9 %	Preset SMFD percent lower tolerance (for Mode = Percent).	



Shrinkage compensation

Page 4 **(Default values shown)**	**Label**	**Value**	**Comment**	**DW**
SHRINKAGE Mode: Percent Shrinkage: 00.0%	Mode	Percent	Percent shrinkage scales the averaged measured diameter by the Shrinkage. Output diameter =(Measured diameter) x [1–(Shrinkage/100)]	In: 0.4
		Absolute	Absolute shrinkage mode deducts the Shrinkage from the averaged measured diameter. Output diameter =(Measured diameter) – (Shrinkage)	
	Shrinkage	0	Zero disables shrinkage compensation.	In: 20
		0 ~ 10.000 mm {1.0000 in}	Set absolute shrinkage.	
		0.1 ~ 100 %	Set percentage shrinkage (values above 20% are relatively unusual).	

MEASUREMENT

The “Measurement” pages are used to configure:

1. Measurement mode (solid, glass or helix).
2. Diameter averaging time.
3. Measurement units.
4. Diameter compensation.
5. Restore to factory defaults.
6. Single Measurement Flaw Detection (SMFD).

To access the “Measurement” pages and set parameters:

	User Action	**Result**
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Measurement”.	Measurement
3	Press ↵ to open the first “Measurement” page.	
4	Press ⏭ to step through the various “Measurement” pages.	
1	Press ⌂ or ⌄ to step through parameter options.	
2	Press ▷ or ◁ followed by ⌂ or ⌄ to highlight and edit individual digits in numerical parameters.	
3	Press ↵ to save the parameter and advance to the next parameter on the page.	
4	Press MENU or ⌂ to exit.	

Note: Values or settings (i.e. input parameters) shown on the following example pages are the factory default values.

Measurement mode

Page 1 **(Default values shown)**	**Label**	**Value**	**Comment**	**DW**
MEASURING Mode: ●Solid	Mode	●Solid	Measure opaque objects.	In: 0
		○Glass	Measure transparent objects such as glass tube (outermost edge detection).	
For “Mode: ⁂Helix” only:				
MEASURING Mode: ⁂Helix Number of cores: 3 Pitch length: 010.00 mm	Mode	⁂Helix	Measure the envelope that encloses a twisted or braided multi-core cable. • Requires provision of line speed. • Flaws are NOT measured in Helix mode.	In: 0
MEASURING Mode: ⁂Helix Number of cores: 3 Pitch length: 0.1000 in	Number of cores	2, 3, 4, 7, 13, 19, >19	Set the multi-core cable core count.	In: 0.8
	Pitch length	0.01 ~ 655.35 mm {0.0001 ~ 6.5535 in}	Set the multi-core cable pitch length.	In: 21

Number of displayed digits

Page 2 (Default values shown)	Label	Value	Comment
D.P. DISPLAY Set decimal point position displayed: Display: 0.0000	Display	0.0000 0.000 0.00 0.0 0	Set the number of digits displayed for measured values. **Applies only to values *displayed* on an optional AiG2 interface display unit; values read from communications interfaces will have the full number of digits.**

Diameter measurement averaging time

Page 3 (Default values shown)	Label	Value	Comment	DW
AVERAGING Diameter: 1000 ms	Diameter	1 ~ 5000 ms	Set the time window over which diameter measurements are averaged.	In: 19

Measurement units

Page 4 (Default values shown)	Label	Value	Comment	DW
UNITS Set units: Metric	Set units	Metric	Millimetre (mm) / metre (m) measurement units.	In: 0.3
		Imperial	Inch (in) / feet (ft) measurement units.	

Diameter compensation

Page 5 (Default values shown)	Label	Value	Comment	DW
COMPENSATION Diameter Compensation: 1.0000	Diameter Compensation	0 ~ 6.5535	All measured diameter values are multiplied by this “Diameter Compensation” factor before display or reading through a communications interface.	In: 70

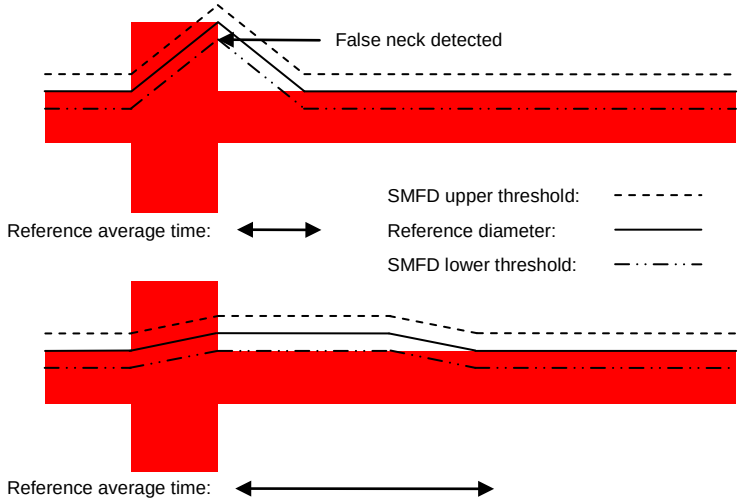
Restore to factory defaults

Page 6	Label	Value	Comment	DW
FACTORY DEFAULT Password: 00000 Incorrect password	Password	63000	Enter a password of “63000” to restore all gauge input parameters to factory defaults. Successful restoration to factory defaults is indicated by the “Correct password” message.	In: 71

Single Measurement Flaw Detection (SMFD)

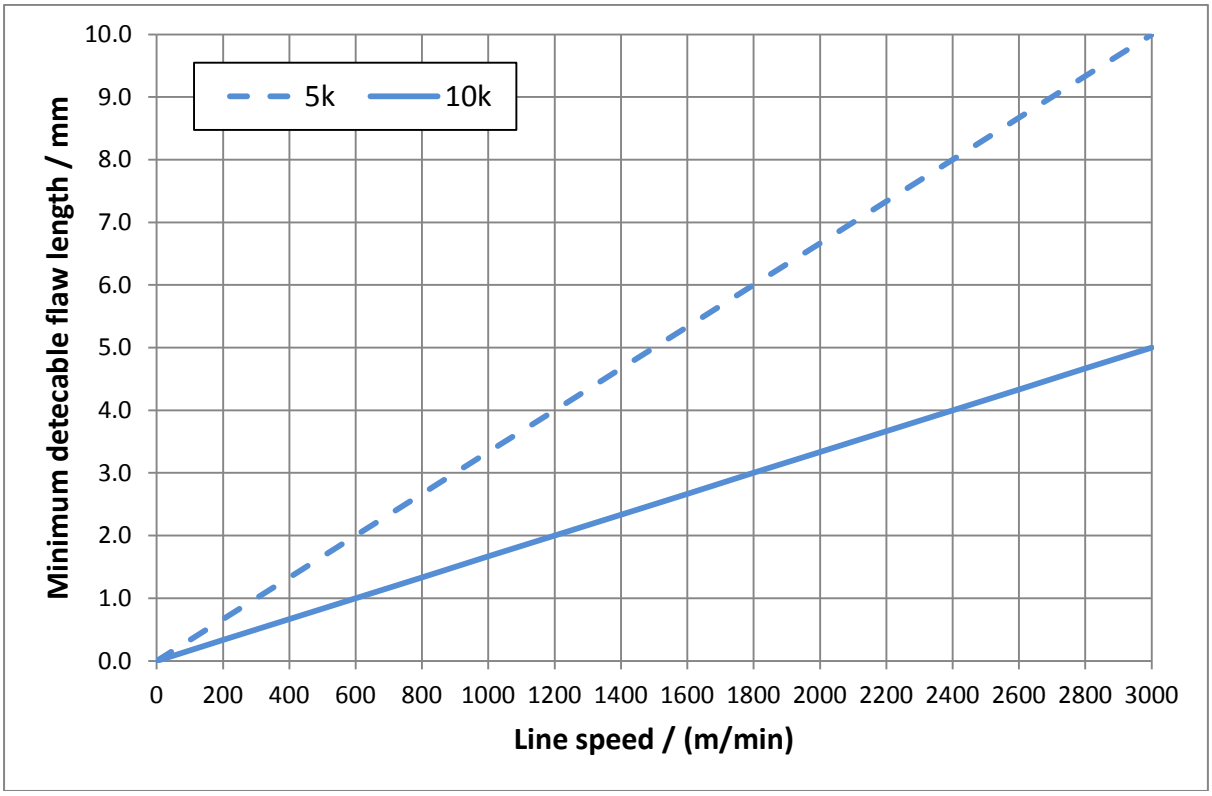
Page 7 (Default values shown)	Label	Value	Comment	DW
SMFD Measurement Average Time: 0001 ms Reference Average Time: 0100 ms Start Speed: 0000 m/min	Measurement Average Time	0.1 ~ 10 ms	Set the time window over which diameter measurements are averaged to generate the "Measurement Diameter".	In: 46
	Reference Average Time	1 ~ 1000 ms	Set the time window over which diameter measurements are averaged to generate the "Reference Diameter". A flaw is detected if the above "Measurement Diameter" deviates from this "Reference Diameter" by more than the preset upper or lower SMFD flaw limits.	In: 22
SMFD Measurement Average Time: 0001 ms Reference Average Time: 0100 ms Start Speed: 0000 ft/min	Start Speed	0 ~ 65535 m/min {65535 ft/min}	Set the minimum line speed above which SMFD is enabled. Setting a minimum "Start Speed" prevents the SMFD function from logging flaws during line start-up and shutdown.	In: 47

- Flaws are detected when the "Measurement Diameter" deviates from the "Reference Diameter" by more than the preset upper or lower SMFD flaw limits.
- The "Measurement Average Time" should be set to smooth out any short duration noise on the measurement; it may be left at its default value of 1ms unless measurement noise is large.
- The "Reference Average Time" should be set to approximately 100 times the time duration of the longest expected flaw.
- If the "Reference Average Time" is set to too short a duration (i.e. close to the time duration of the flaws), then the flaws will significantly affect the value of the "Reference Diameter" and may result in the detection of false flaws.
- If the gauge has just been powered on or a cable has just been inserted into the empty optical gate, then the calculated "Reference Diameter" will only be valid after the "Reference Average Time" has elapsed. During this period, multiple false neck flaws will be detected. Hence the "Reference Average Time" should not be set to an excessively large value in order to minimise the ramp up time for the "Reference Diameter".



Minimum flaw length (for 100% flaw detection rate) versus line speed (metric)

The minimum flaw length (for 100% flaw detection rate) increases with increasing line speed:



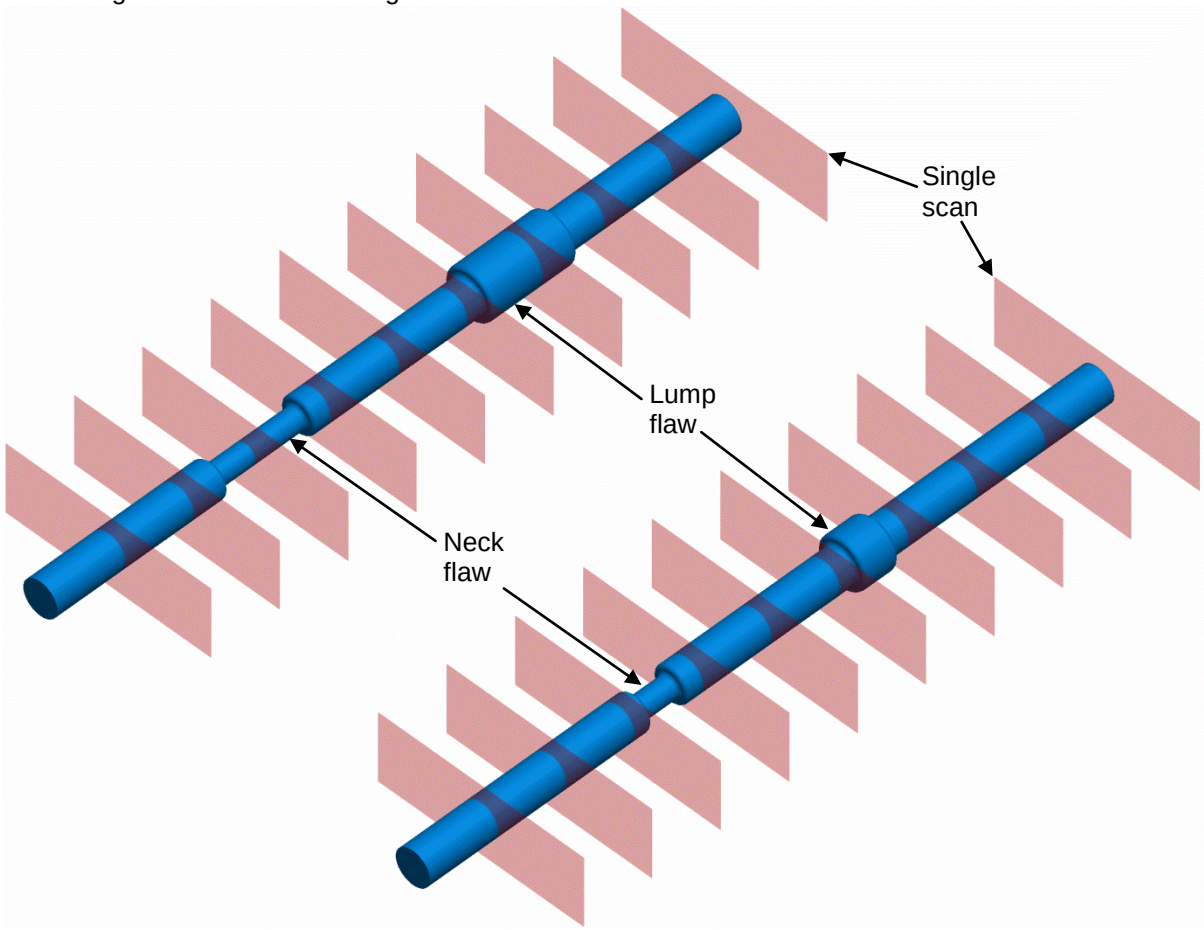
Line speed / (m/min)	Minimum flaw length (100% flaw detection rate) / mm	
	5k	10k
0	0.00	0.00
200	0.67	0.33
400	1.33	0.67
600	2.00	1.00
800	2.67	1.33
1000	3.33	1.67
1200	4.00	2.00
1400	4.67	2.33
1600	5.33	2.67
1800	6.00	3.00
2000	6.67	3.33
2200	7.33	3.67
2400	8.00	4.00
2600	8.67	4.33
2800	9.33	4.67
3000	10.00	5.00

For a particular line speed, flaws shorter than the corresponding minimum flaw length have a reduced detection rate:

$$\textbf{Flaw detection rate}\ (\%) = \mathbf{100} \times \frac{\boldsymbol{Flaw\ length\ (mm)}}{\boldsymbol{Minimum\ flaw\ length\ for\ 100\%\ detection\ rate\ (mm)}}$$

E.g. for a DG 10k and a line speed of 600m/min, the minimum flaw length is 1mm. From the above formula, 50% of 0.5mm length flaws will be detected.

Flaw length > Minimum flaw length for 100% flaw detection

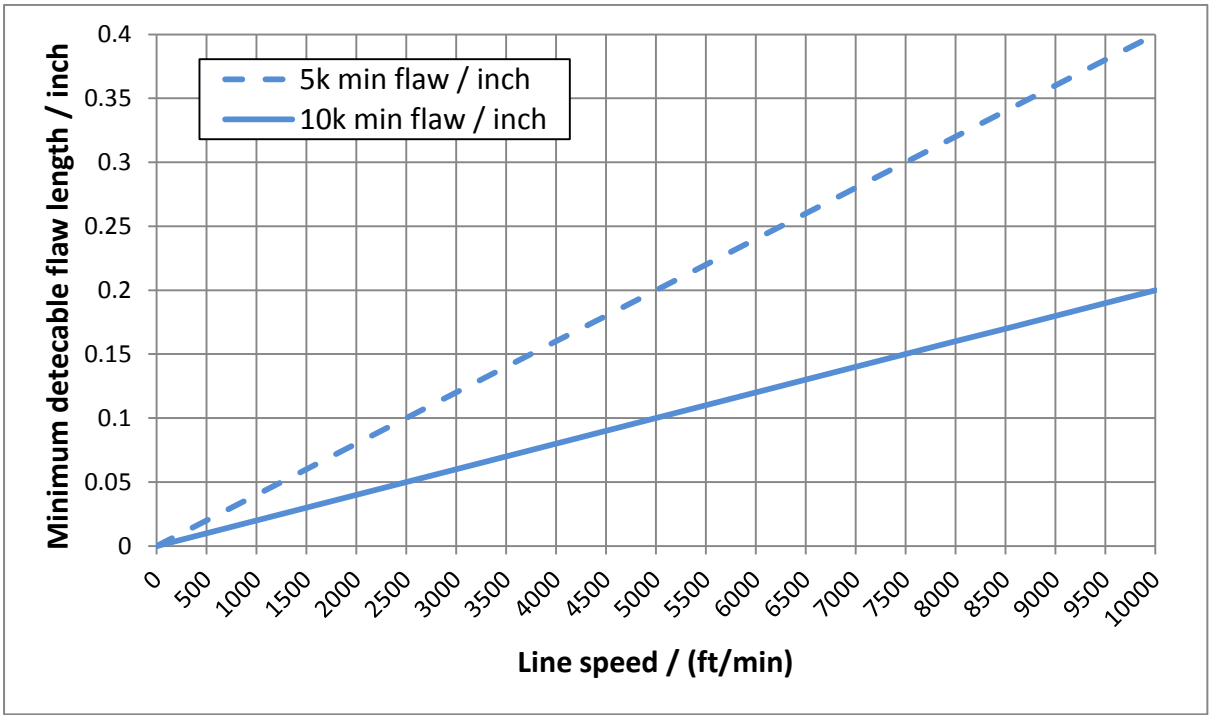


Flaw length < Minimum flaw length for 100% flaw detection

Page 8 **(Default values shown)**	**Label**	**Value**	**Comment**	**DW**
SMFD Interval Mode: Time Interval: 0100 ms	Interval Mode	Time Length	Within the time or length “Interval” set below, after detection of a flaw, subsequent detected flaws are ignored (subsequent flaws are effectively counted as part of the first flaw).	In: 0.6
SMFD Interval Mode: Time Interval: 0100 ms	Interval	1 ~ 5000 ms	Within this time period after detection of a flaw, subsequent detected flaws are ignored (subsequent flaws are effectively counted as part of the first flaw).	In: 23
			Within this length after detection of a flaw, subsequent detected flaws are ignored (subsequent flaws are effectively counted as part of the first flaw).	

Minimum flaw length (for 100% flaw detection rate) versus line speed (US units)

The minimum flaw length (for 100% flaw detection rate) increases with increasing line speed:



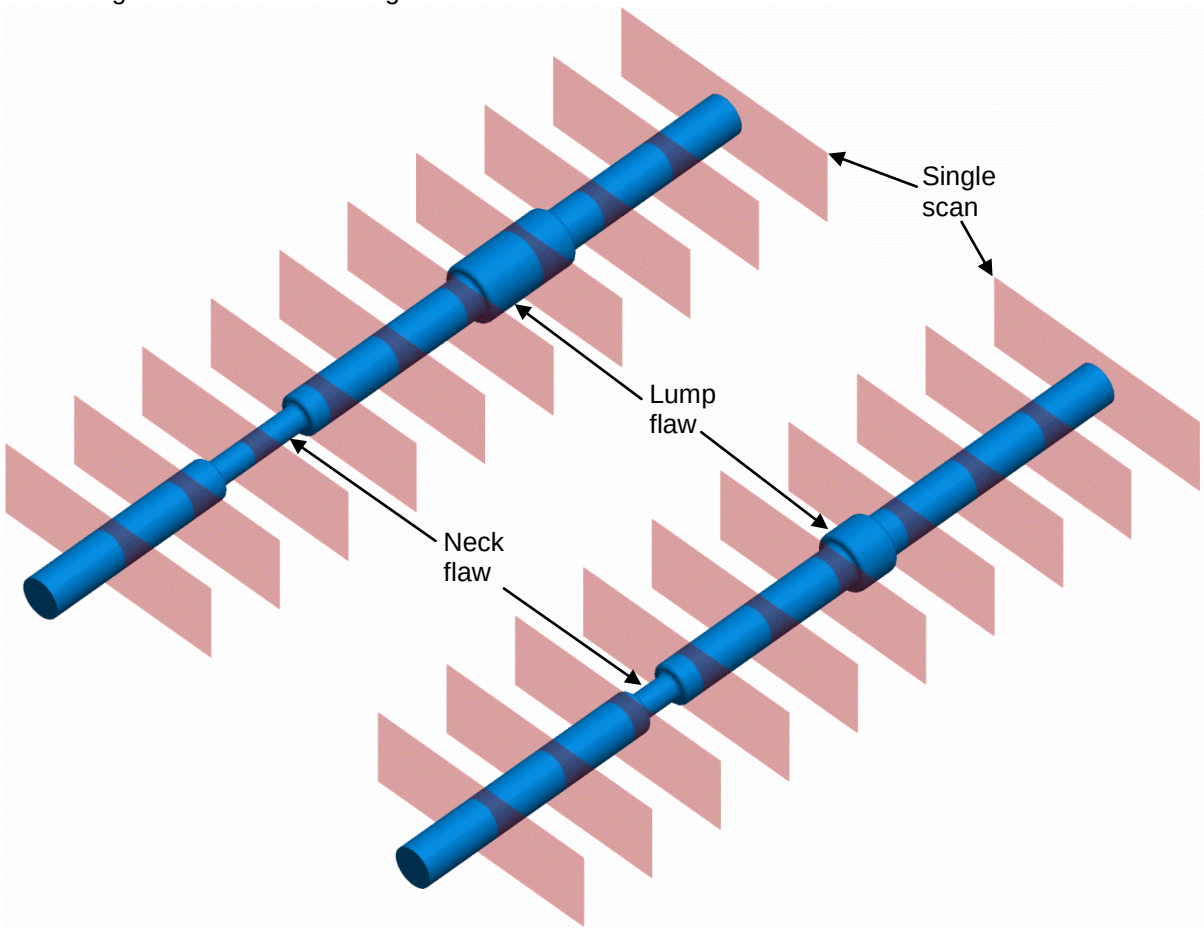
Line speed / (ft/min)	Minimum flaw length (100% flaw detection rate) / inch	
	5k	10k
0	0	0
500	0.02	0.01
1000	0.04	0.02
1500	0.06	0.03
2000	0.08	0.04
2500	0.1	0.05
3000	0.12	0.06
3500	0.14	0.07
4000	0.16	0.08
4500	0.18	0.09
5000	0.2	0.1
5500	0.22	0.11
6000	0.24	0.12
6500	0.26	0.13
7000	0.28	0.14
7500	0.3	0.15
8000	0.32	0.16
8500	0.34	0.17
9000	0.36	0.18
9500	0.38	0.19
10000	0.4	0.2

For a particular line speed, flaws shorter than the corresponding minimum flaw length have a reduced detection rate:

$$\textbf{Flaw detection rate}\ (\%) = \mathbf{100} \times \frac{\boldsymbol{Flaw\ length\ (inch)}}{\boldsymbol{Minimum\ flaw\ length\ for\ 100\%\ detection\ rate\ (inch)}}$$

E.g. for a DG 10k and a line speed of 6000 ft/min, the minimum flaw length is 0.12". From the above formula, 50% of 0.06" length flaws will be detected.

Flaw length > Minimum flaw length for 100% flaw detection



Flaw length < Minimum flaw length for 100% flaw detection

STATISTICS

"Statistics" is an optional software function that may be enabled by the end-user using a license key code; for further information see the chapter on "Enabling optional software functions".

The "Statistics" function calculates the mean, maximum, minimum and standard deviation (σ) of the diameter measurements.

- The statistics function is only available in Solid and Glass measuring modes; it is not available in Helix mode.
- The statistics function runs continuously and updates its results at the end of each sampling window period.
- Each sample collected is the average of the X, Y and Z (DG3030/3060 only) axis diameters measured from a single scan.

To configure statistics:

<table>
<tr><th></th><th colspan="2">User Action</th><th>Result</th></tr>
<tr><td>1</td><td colspan="2">Press MENU to display the "MENU".</td><td>MENU</td></tr>
<tr><td>2</td><td colspan="2">Press ⌂ or ⌄ to highlight "Statistics".</td><td>Statistics</td></tr>
<tr><td>3</td><td colspan="2">Press ↵ to enter the "STATISTICS" page.</td><td>STATISTICS
Mode: Time
Time: 00000s
Std Dev: 00.000mm
Max Dia: 00.000mm
Mean: 00.000mm
Min Dia: 00.000mm
Remain: 00000s</td></tr>
<tr><td rowspan="4">4</td><td colspan="2">Press ⌂ or ⌄ to select the required sampling window "Mode".</td><td rowspan="4">Mode: Cable Length</td></tr>
<tr><td>Time</td><td>Set the sampling window as a time period.</td></tr>
<tr><td>Cable Length</td><td>Set the sampling window as a line length.</td></tr>
<tr><td>One Reel</td><td>Set the sampling window as the period between two resets. A reset may be triggered by:
• Pressing ◁ and ▷ together on an optional AiG2 interface display unit connected to the gauge.
• Applying a reset pulse to an appropriately configured logic input on the gauge.</td></tr>
<tr><td>5</td><td colspan="2">Press ↵ to save the "Mode" and advance to the sampling window parameter (either "Time", "Length" or none depending on the "Mode" setting).</td><td></td></tr>
<tr><td rowspan="4">6</td><td>Mode</td><td>Action</td><td>Display</td></tr>
<tr><td>Time</td><td>Press ▷ or ◁ followed by ⌂ or ⌄ to highlight and edit individual digits in the "Time" parameter to the required sampling time window (valid range: 1 to 65535s).</td><td>STATISTICS
Mode: Time
Time: 00010s</td></tr>
<tr><td>Cable Length</td><td>Press ▷ or ◁ followed by ⌂ or ⌄ to highlight and edit individual digits in the "Length" parameter to the required sampling length window (valid range: 1 to 65535m).</td><td>STATISTICS
Mode: Cable Length
Length: 00100m</td></tr>
<tr><td>One Reel</td><td>No sampling window is displayed or needs to be configured.</td><td>STATISTICS
Mode: Cable Length</td></tr>
</table>

<table>
<tr><td>7</td><td colspan="2">Press ↵ to save the “Time” or “Length” parameter and return to the “Mode” parameter.</td><td>STATISTICS
Mode: Time</td></tr>
<tr><td rowspan="7">8</td><td colspan="2">The statistics are valid for the current sampling window when “Remain” has counted down to 0.</td><td rowspan="7">STATISTICS
Mode: Time
Time: 00010s
Std Dev: 00.050mm
Max Dia: 10.100mm
Mean: 10.000mm
Min Dia: 09.000mm
Remain: 00000s</td></tr>
<tr><td>Field</td><td>Description</td></tr>
<tr><td>Std Dev</td><td>Standard deviation of all diameters sampled in the sampling window.</td></tr>
<tr><td>Max Dia</td><td>Maximum diameter sampled in the sampling window.</td></tr>
<tr><td>Mean</td><td>Mean of all diameters sampled in the sampling window.</td></tr>
<tr><td>Min Dia</td><td>Minimum diameter sampled in the sampling window.</td></tr>
<tr><td>Remain</td><td>Count down of the remaining sampling window time or length until the next statistics result.</td></tr>
</table>

The “Statistics” function may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range / Remark	Default
43		Statistics time	1=1s	1~5000	10

The “Statistics” output may be read from the following output parameters:

Output parameters

DW	Bit	Comments	Units	Range/Remark
25		Statistics		
	0	Normal distribution		0=No 1=Yes
	1	Statistics available		0=No 1=Yes
	2	SPC running		0=No 1=Yes
26		Statistics remaining time	1=1s	0~65535
27		Standard deviation	1=1um {1=0.1mil}	0~65535
28		Maximum diameter	1=1um {1=0.1mil}	0~65535
29		Minimum diameter	1=1um {1=0.1mil}	0~65535
30		Mean diameter	1=1um {1=0.1mil}	0~65535

FFT (FAST FOURIER TRANSFORM)

"FFT" (Fast Fourier Transform) is an optional software function that may be enabled by the end-user using a license key code; for further information see the chapter on "Enabling optional software functions".

The "FFT" function calculates the frequency spectrum of the measured diameter. It may be used for determining the presence and frequency of periodic diameter variations which may adversely affect the performance of high-frequency cables such as RF coaxial cable or twisted-pair data transmission cable.

To configure statistics:

	User Action		**Result**
1	Press MENU to display the "MENU".		MENU
2	Press ⌂ or ⌄ to highlight "Statistics".		FFT
3	Press ↵ to enter the "STATISTICS" page.		FFT Sample Rate: OFF
4	Press ⌂ or ⌄ to select the required "Sample Rate".		FFT Sample Rate: 30Hz
	OFF	Select to disable FFT calculation.	
	1Hz / 3Hz / 10Hz / 30Hz / 100Hz / 300Hz / 1kHz	Select the required sample rate; the maximum frequency that will be displayed by the FFT is: 0.5 × "Sample Rate"	
5	Press ↵ to save the selected "Sample Rate".		
6	Press ⏭ to advance to the FFT display page.		A.A TTTTs 0 XXX
7	**Label**	**Description**	A.A TTTTs
	A.A	Largest diameter variation amplitude	
	TTTT	Count down until the next FFT update	
	XXX	Maximum frequency (0.5 × "Sample Rate")	0 XXX

The "FFT" function may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range / Remark	Default
45		FFT Sampling rate		0=OFF 1=1Hz 2=3Hz 3=10Hz 4=30Hz 5=100Hz 6=300Hz 7=1KHz	0

The "FFT" output data may only be read out using either an optional AiG2 interface display unit or the optional PCiS_SL PC software.

PRESET STORE

The “Group” displayed on the “Preset Store” page is the current active group of input parameter values.

- Unmodified groups have all input parameters preset to factory default values.
- Input parameter values modified via an optional AiG2 interface display unit or via any other communications interface are automatically stored in non-volatile memory in the current active group.
- 00 to 99 numbered groups are available.

To change the active group and recall input parameter values from the new group:

	User Action	**Result**
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ▽ until “Preset Store” is highlighted.	Preset Store
3	Press ↵ to enter the Preset store menu.	PRESET STORE Select Group number: 00
4	Press ▷ or ◁ followed by ⌂ or ▽ to highlight and edit individual digits in the “Group number” to the group required (between 00 and 99).	Select Group number: 15
5	Press ↵ to change the active group and recall the input parameter values from the new group.	
6	Press MENU or ⌂ to exit.	

GAUGE VERSION

To display information on the hardware and software version:

	User Action	**Result**
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ▽ until “Gauge version” is highlighted.	Gauge version
3	Press ↵ to enter the “GAUGE HARDWARE” page. The hardware version number is displayed as a read only parameter.	GAUGE HARDWARE Ver: 1.00
4	Press ⏭ to advance to the “GAUGE SOFTWARE” page. The software version numbers and release dates are displayed as read only parameters (dates are displayed in the YYYY-MM-DD format).	GAUGE SOFTWARE Ver: 1.00 Date: 2012-01-01 AiG2 SOFTWARE Ver: 1.00 Date: 2012-01-01
5	Press MENU or ⌂ to exit.	

STANDARD COMMUNICATIONS INTERFACES

CAN-BUS COMMUNICATIONS

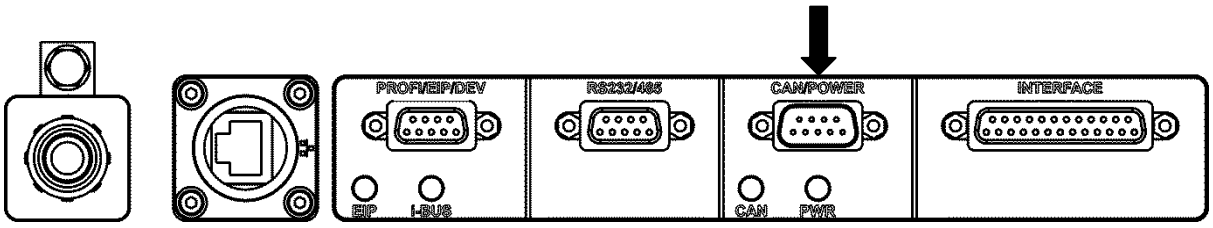
This CAN-bus interface is fitted as standard. It operates independently of the other communications interfaces and may be accessed at the same time as them.

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 “CAN / POWER” connector.



Connector type: DB9 male (plug)

Pin	Designation	Comment
2	CANL	
3	GND	Ground reference (isolated from earth / shield).
5	Shield	Ensure that the cable shield is connected to this via the plug shield connection.
7	CANH	
9	+24V	+24VDC power input (the gauge may be powered via this pin).
S	Shield	Ensure that the cable shield is connected to the plug shield connection.

CAN-bus LED indicator

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

CAN-bus configuration

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Communication”.	Communication
3	Press ↵ to open the “Communication” menu.	

4	Press ⊡ to advance to the “CANBUS” page.	CANBUS Desc Address: 017 Sour Address: 014 Speed: 1M Terminator: ON BLUETOOTH Mode: Modbus
5	Press ▷ or ◁ followed by ⌂ or ▽ to highlight and edit individual digits in the “Desc Address” to correspond to the ***DG gauge*** CAN-bus address.	Desc Address: 005
6	Press ↵ to save the “Desc Address” and advance to “Sour Address”.	Sour Address: 014
7	Press ▷ or ◁ followed by ⌂ or ▽ to highlight and edit individual digits in the “Sour Address” to correspond to the ***AiG2 interface display unit*** CAN-bus address.	Sour Address: 002
8	Press ↵ to save the “Sour Address” and advance to “Speed”.	Speed: 1M
9	Press ⌂ or ▽ to select the required “Speed” (Options are: 250K, 500K or 1M).	Speed: 250K
10	Press ↵ to save the “Speed” and advance to “Terminator”.	Terminator: ON
11	Press ⌂ or ▽ to select if the ***AiG2 interface display unit*** provides the CAN-bus termination resistor (Options are: ON or OFF).	Terminator: OFF
12	Press ↵ to save the “Terminator” setting.	
13	Press MENU or ⌂ to exit.	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
51		CAN address	1=1	0~255	17
52		CAN baud rate		0=250 1=500 2=1000 other=500	2
68		CAN termination	1=1	0=OFF 1=ON	1

CAN-bus parameter range

Range of input parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	87	88

1x 16-bit word = 2x 8-bit bytes

Range of output parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	52	53

1x 16-bit word = 2x 8-bit bytes

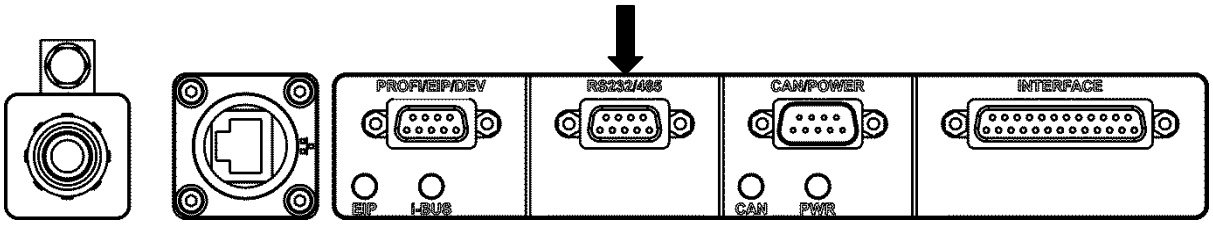
RS-232 COMMUNICATIONS

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 “Print”, then an “Epson TM-U220D” or compatible printer may be connected to the port and configured to print fault and reel report tickets.

RS-232 interface

The RS-232 interface may be accessed through the “RS232/485” connector.



Connector type: DB9 female (socket)

Pin	Designation	Comment	PC DB9 serial port pin
2	TXD1		2
3	RXD1		3
5	GND_R	Ground reference is not isolated from earth.	5
7	CTS1		Not used
8	RTS1		Not used
S	Shield	Ensure that the cable shield is connected to this via the plug shield connection.	Shield

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 Communications configuration

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Communication”.	Communication
3	Press ↵ to open the “Communication” menu.	

4	Press ⊡ to advance to the “RS232 PORT” page.	RS232 PORT Baud: 9600 Mode: Modbus RS422/485 PORT Baud: 9600 Mode: Modbus
5	Press ⌂ or ⌄ to select the required “Baud” rate (Options are: 4800, 9600, 19200, 38400 or 115200).	RS232 PORT Baud: 19200 Mode: Modbus
6	Press ↵ to save the “Baud” rate and advance to “Mode”.	RS232 PORT Baud: 19200 Mode: Modbus
7	Press ⌂ or ⌄ to select the required “Mode” (Options are: “Modbus”, “Proton”, “SLP” or “Print”).	RS232 PORT Baud: 19200 Mode: Proton
8	Press ↵ to save the “Mode”.	
9	Press MENU or ⌂ to exit.	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
53		RS232 baud rate		0=4800 1=9600 2=19200 3=38400 4=115200	1
54		RS232 mode		0=Modbus 1=Proton 2=SLP 3=Print	0

RS-232 parameter range

Range of input parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	87	88

1x 16-bit word = 2x 8-bit bytes

Range of output parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	52	53

1x 16-bit word = 2x 8-bit bytes

RS-232 Printing

If the RS-232 mode is set to “Print” (input DW54 set to “2”), then an “Epson TM-U220D” or compatible printer may be connected to the RS-232 port for real-time printing of fault and reel report tickets.

Ensure that the RS-232 baud rate (input DW53) is configured to the same value as set on the printer.

Fault report

Fault report printing may be triggered by internal (diameter tolerance error or SMFD lump/neck flaws) or external events (logic inputs). Printing occurs in real-time on an event-by-event basis.

Internal Printing Events

Internal printing events are triggered by errors or fault in the diameter measurement:

Type	Description
D+	Diameter over-tolerance error.
D-	Diameter under-tolerance error.
Lump	SMFD (Single Measurement Flaw Detection) lump flaw detected.
Neck	SMFD (Single Measurement Flaw Detection) neck flaw detected.

External Printing Events

The two logic inputs on the DG-k gauge may be configured to print an alarm message whenever they are activated; please refer to the “Logic Inputs” chapter for configuration information.

Type	Description
EXT-ALARM	EXT-ALARM logic input activated.
ST-ALARM	ST-ALARM logic input activated (this logic input may be connected to a spark tester to log the occurrence and position of spark faults).

Example Fault Report

FAULT REPORT				Description
No.	Size(mm)	Type	Pos(m)	
0001	-0.9450	Neck	15	-0.9450mm neck flaw detected at 15m
0002	+0.9870	Lump	35	+0.9870mm lump flaw detected at 35m
----		D+	50(Start)	Diameter over-tolerance starting at 50m Diameter over-tolerance (+0.6210mm) ended at 75m
0003	+0.6210	D+	50-75	
----		D-	95(Start)	Diameter under-tolerance starting at 95m Diameter under-tolerance (-0.8450mm) ended at 110m
0004	-0.8450	D-	95-110	
0005	ST-ALARM		125	ST-ALARM logic input activated at 125m
0006	EXT-ALARM		145	EXT-ALARM logic input activated at 145m

Reel Report

If the “Statistics” mode is set to “One Reel”, then a reel report is printed at the end of the reel which is signalled by either:

- Activating a logic input on the gauge that has been configured to the “Reset” function.
- Pressing ◁ and ▷ together on an optional AiG2 interface display unit connected to the gauge.

Please refer to the “Statistics” chapter for configuration information.

Example Reel Report

REEL REPORT		Description
Reel No.:	231	Reel number (may be set using PC-based PCiS-DGk software)
Max Dia :	4.6540 mm	Maximum measured diameter on this reel.
Min Dia :	4.4070 mm	Minimum measured diameter on this reel.
Avg Dia :	4.4270 mm	Average measured diameter on this reel.
No. of Faults		
Total Faults:	27	Total number of faults on this reel.
Dia Faults :	4	Number of diameter tolerance errors on this reel.
Lumps :	8	Number of lump flaws on this reel.
Necks :	6	Number of neck flaws on this reel.
ST Alarms :	7	Number of spark tester alarms (ST-ALARM) on this reel.
EXT Alarms :	2	Number of external alarms (EXT-ALARM) on this reel.

RS-232 SINGLE LETTER PROTOCOL (SLP)

The DG-k series diameter gauges support the legacy Single Letter Protocol (SLP) for communications over the RS-232 interface.

The SLP RS-232 data format is:

Number of data bits	Parity	Number of stop bits	Flow control	Default baud rate
7	None	2	None	9600 bit / s

RS-232 Communications Interface Configuration

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the "MENU".	MENU
2	Press ⌂ or ⌄ to highlight "Communication".	Communication
3	Press ↵ to open the "Communication" menu.	
4	Press ⌦ to advance o the "RS232 PORT" page.	RS232 PORT Baud: 9600 Mode: Modbus RS422/485 PORT Baud: 9600 Mode: Modbus
5	Press ⌂ or ⌄ to select the required "Baud" rate (Options are: 4800, 9600, 19200, 38400 or 115200; baud rate is limited by RS-232 cable length).	RS232 PORT Baud: 19200 Mode: Modbus
6	Press ↵ to save the "Baud" rate and advance to "Mode".	RS232 PORT Baud: 19200 Mode: Modbus
7	Press ⌂ or ⌄ to set the "Mode" to "SLP".	RS232 PORT Baud: 19200 Mode: SLP
8	Press ↵ to save the "Mode".	
9	Press MENU or ⌂ to exit.	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
53		RS232 baud rate		0=4800 1=9600 2=19200 3=38400 4=115200	1
54		RS232 mode		0=Modbus 1=Proton ***2=SLP*** 3=Print	0

Reading Data

Read		Write		Maximum number of characters	Description	
ASCII character	Output DW	ASCII character	Input DW			
A	2	-	-	5	Diameter (single axis models only)	
B	20	-	-	± sign and 2 digits	Object position in gate (expressed as ±%, single axis models only)	
C	2	-	-	5	XY average diameter	
D	3	-	-	5	X-axis diameter	
E	4	-	-	5	Y-axis diameter	
F	20	-	-	± sign and 2 digits	X-axis object position in gate (expressed as ±%)	
G	21	-	-	± sign and 2 digits	Y-axis object position in gate (expressed as ±%)	
V	6	-	-	5	Ovality |X - Y|	
J	1	-	-	5	**Gauge status**	**ASCII character**
					OK	0
					Fault	1
K	35	k	31	5	**Control mode**	**ASCII character**
					Reset	6
					Hold	7
					Run	8
					Ready [read only]	9
N	-	n	6	5	Preset positive error limit	
O	-	o	1	5	Preset diameter	
Q	-	q	19	5	Diameter averaging time (1 ~ 5000ms)	
S	-	s	7	5	Preset negative error limit	

Data may be read from the gauge by sending an ASCII string formatted as follows:

`<Upper case read character><CR>`

where <CR> is the Carriage Return character.

The gauge will respond using the following formats:

Read operation	Response format
A, C, D, E, V, J, K, N, O, Q, S	`<Upper case read character><XXXXX><CR><LF>`
B, F, G	`<Upper case read character><±XX><CR><LF>`

where X represents a single numerical digit character and <LF> is the Line Feed character.

The 5-digit, no decimal point numerical fields for read operations A, C, D, E, V, J, N, O, S are scaled as per the following table:

Gauge measurement units setting	Scaling factor
Metric	00.001mm
Imperial	0.0001”

Example 1: To read the diameter, send the following ASCII string to the gauge:

`A<CR>`

For a 05.000mm object diameter, the gauge will respond with the following ASCII string:

`A05000<CR><LF>`

Example 2: To read the X-axis object position in gate, send the following ASCII string to the gauge:

F<CR>

For an object positioned at +20% of the gate, the gauge will respond with the following ASCII string:

F+20<CR><LF>

Writing Data

Read		Write		Maximum number of characters	Description	
ASCII character	**Output DW**	**ASCII character**	**Input DW**			
K	35	k	31	5	**Control mode**	**ASCII character**
					Reset	6
					Hold	7
					Run	8
					Ready [read only]	9
N		n	6	5	Preset positive error limit	
O		o	1	5	Preset diameter	
Q		q	19	5	Diameter averaging time (1 ~ 5000ms)	
S		s	7	5	Preset negative error limit	

Data may be written to the gauge by sending an ASCII string formatted in any ONE of the formats shown below:

<Lower case write character>XXXXX
<Lower case write character>Z<CR>
<Lower case write character>Z<LF>
<Lower case write character>Z<CR><LF>

where X represents a single numerical digit character; Z represents a 1 to 5 numerical digit string, <CR> is the Carriage Return character and <LF> is the Line Feed character.

The 5-digit, no decimal point numerical fields for write operations k, n, o, q, s are scaled as per the following table:

Gauge measurement units setting	Scaling factor
Metric	00.001mm
Imperial	0.0001”

Example 1: To set the “Preset diameter” to 05.000mm, send any ONE of the following ASCII strings to the gauge:

o05000
o5000<CR>
o5000<LF>
o5000<CR><LF>

Example 2: To set the “Control mode” to “Run”, send any ONE of the following ASCII strings to the gauge:

k00008
k8<CR>
k8<LF>
k8<CR><LF>

Continuous Data Output

The continuous data output mode continuously outputs measurement data approximately every 100ms.

Continuous data output is enabled by sending the following ASCII string to the gauge:

H<CR>

Continuous data output is disabled by sending the following ASCII string to the gauge:

I<CR>

where <CR> is the Carriage Return character.

When continuous data output mode is enabled, the gauge will continuously output measurement data approximately every 100ms as an ASCII string formatted as follows:

$(Gauge type)(Diameter)(Status)(Position in gate)<CR><LF>(Units)(Axis)				
Field	**Number of characters**	**Value / range**	**Description**	
$	1	$	Start character	
Gauge type	1	8	DG1030, DG2030, DG1060 or DG2060	
		A	DG1100 or DG2100	
Diameter	5	00000 ~ 99999	**Measurement units**	**Scaling factor**
			Metric	00.001mm
			Imperial	0.0001”
Status	1	0	OK	
		1	No object	
		3	Gate dirty	
		5	No reading	
Position in gate	3	-99 ~ +99	Object position in gate is expressed as ±%	
<CR>	1	<CR>	Carriage Return character	
<LF>	1	<LF>	Line Feed character	
Units	1	M	Metric (millimetres)	
		I	Imperial (inches)	
Axis	1	X	X-axis measurement	
		Y	Y-axis measurement	

Example continuous data output string:

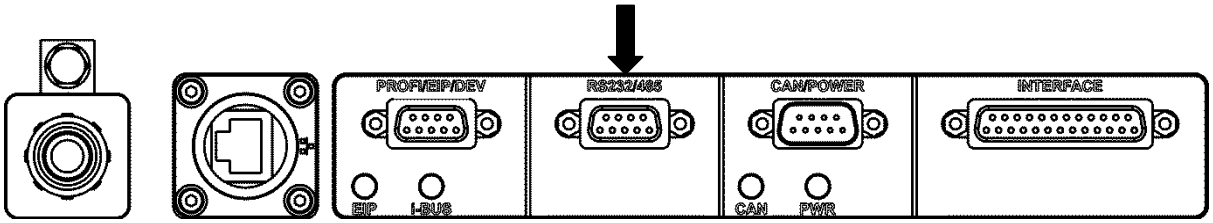
$8050000+10<CR><LF>MY								
$	8	05000	0	+10	<CR>	<LF>	M	Y
Start character	**Gauge type**	**Diameter**	**Status**	**Position in gate**	**Carriage Return**	**Line Feed**	**Units**	**Axis**
	DG1030, DG2030, DG1060 or DG2060	05.000 mm	Gauge OK	+10%			Metric (millimetres)	Y

RS-422 / RS-485 COMMUNICATIONS

This RS-422 / RS-485 interface is fitted as standard. It operates independently of the other communications interfaces and may be accessed at the same time as them.

RS-422 / RS-485 interface

The RS-422 / RS-485 interface may be accessed through the “RS232/485” connector.



Connector type: DB9 female (socket)

Pin	RS-422 Designation	Comment	RS-485 two wire operation		
			Link	Link	Designation
1	RS422_A		●		A+
4	RS422_B			●	B-
5	GND_R				GND
6	RS422_Y		●		
9	RS422_Z			●	
S	Shield	Ensure that the cable shield is connected to this via the plug shield connection.			Shield

The four-wire RS-422 interface may be converted to two-wire RS-485 operation by installation of the 2 shorting links shown above.

RS-422 / RS-485 configuration

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Communication”.	Communication
3	Press ↵ to open the “Communication” menu.	
4	Press ↵ to advance to the “RS232 PORT” page.	RS232 PORT Baud: 9600 Mode: Modbus RS422/485 PORT Baud: 9600 Mode: Modbus
	Press ↵ twice to advance back to the “RS422/485 PORT” “Baud” rate.	RS422/485 PORT Baud: 9600 Mode: Modbus
5	Press ⌂ or ⌄ to select the required “Baud” rate (Options are: 4800, 9600, 19200, 38400 or 115200).	RS422/485 PORT Baud: 19200 Mode: Modbus

6	Press ↵ to save the “Baud” rate and advance to “Mode”.	RS422/485 PORT Baud: 19200 Mode: Modbus
7	Press ⌂ or ⌄ to select the required “Mode” (Options are: Proton, Modbus or SLP).	RS422/485 PORT Baud: 19200 Mode: Proton
8	Press ↵ to save the “Mode” and advance back to the “Baud” rate.	RS422/485 PORT Baud: 19200 Mode: Proton
9	Press MENU or ⌂ to exit.	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
55		RS422/RS485 mode		0=Modbus 1=Proton 2=SLP	0
56		RS422/RS485 baud rate		0=4800 1=9600 2=19200 3=38400 4=115200 5=250K 6=500K 7=1M	1

RS-422 / RS-485 parameter range

Range of input parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	87	88

1x 16-bit word = 2x 8-bit bytes

Range of output parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	52	53

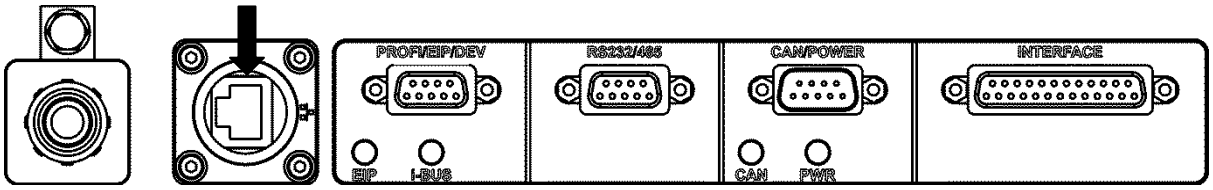
1x 16-bit word = 2x 8-bit bytes

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.

Ethernet interface

The Ethernet interface may be accessed through the RJ45 connector.



Connector type: RJ45 8P8C female (socket)

Pin	Designation	Comments
1	LAN TX+	
2	LAN TX-	
3	LAN RX+	
6	LAN RX-	
S	Shield	Ensure that the cable shield is connected to this via the plug shield connection.

Ethernet LED indicator

		LED status	Indication
EIP		Continuous green	Online and connected
Ethernet communications		Flashing green	Online but not connected
		Continuous red	Critical link failure
		Flashing red	Connection timeout

Ethernet configuration

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Communication”.	Communication
3	Press ↵ to open the “Communication” menu.	
4	Press ⏭ to advance to the first “MODBUS ETHERNET” page. Note: The “MAC ADDRESS” parameter is read only.	MODBUS ETHERNET Enable DHCP: Disable MAC ADDRESS 1A-2B-3C-4D-5E-6F
If using automatic IP address assignment by a DHCP server on the network:		
1	Press ⌂ or ⌄ to set “Enable DHCP” to “Enable”.	Enable DHCP: Enable
2	Press ↵ to save the “Enable DHCP” setting.	Enable DHCP: Enable
3	Press MENU or ⌂ to exit	
If using manual IP address assignment:		
1	Press ⌂ or ⌄ to set “Enable DHCP” to “Disable”.	Enable DHCP: Disable

2	Press ↵ to save the “Enable DHCP” setting.	Enable DHCP: Disable
3	Press ⏭ to advance to the second “MODBUS ETHERNET” page.	MODBUS ETHERNET IP Address: 192.168.001.100 Sub net mask: 255.255.000.000 Gateway: 192.168.001.001
4	Press ▷ or ◁ followed by △ or ▽ to highlight and edit individual digits in the “IP Address”.	IP Address: 192.168.001.103
5	Press ↵ to save the “IP Address” setting and advance to the “Sub net mask”.	Sub net mask: 255.255.000.000
6	Press ▷ or ◁ followed by △ or ▽ to highlight and edit individual digits in the “Sub net mask”.	Sub net mask: 255.255.255.000
7	Press ↵ to save the “Sub net mask” setting and advance to the “Gateway”.	Gateway: 192.168.001.001
8	Press ▷ or ◁ followed by △ or ▽ to highlight and edit individual digits in the “Gateway”.	Gateway: 192.168.001.002
9	Press ↵ to save the “Gateway” setting and advance back to the “IP Address”.	IP Address: 192.168.001.103
10	Press MENU or ⌂ to exit	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Comments	Unit	Range/Remark	Default value
58	Ethernet DHCP		0=Disable 1=Enable	0
60 61	MODBUS IP address	xx.xx.xx.xx		C0A80164 (192.168.1.100)
64 65	Subnet mask	xx.xx.xx.xx		255.255.0.0
66 67	Gateway	xx.xx.xx.xx		C0A80101 (192.168.1.1)

Ethernet protocol parameter range

Range of input parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	87	88

1x 16-bit word = 2x 8-bit bytes

Range of output parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	52	53

1x 16-bit word = 2x 8-bit bytes

UDP Output configuration

If continuous UDP output is required, then the destination machine “IP Address” and “Update Time” can be configured as follows:
Configuration via an optional AiG2 interface display unit:

	User Action	**Result**
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Communication”.	Communication
3	Press ↵ to open the “Communication” menu.	
4	Press ⏭ to advance to the “UDP” page.	UDP IP Address: 192.168.001.002 Update Time: 0000 ms
5	Press ▷ or ◁ followed by ⌂ or ⌄ to highlight and edit individual digits in the ***last 3 digits*** of the UDP destination “IP Address” (the first 9 digits of this address are fixed to the same value as the above “MODBUS ETHERNET” “IP Address”).	IP Address: 192.168.001.004
6	Press ↵ to save the “IP Address” setting and advance to the “Update Time”.	Update Time: 0000 ms
7	Press ▷ or ◁ followed by ⌂ or ⌄ to highlight and edit individual digits in the UDP “Update Time” to a value between 0 to 5000 ms. **A value of 0 disables the UDP output.** **Note: the UDP destination port number is fixed to 1111.**	Update Time: 0020 ms
8	Press ↵ to save the “Update Time” setting and advance back to the “IP Address”.	IP Address: 192.168.001.004
9	Press MENU or ⌂ to exit.	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Comments	Unit	Range/Remark	Default value
72	UDP data output time interval	1=1ms	0~5000 (0=disable UDP output)	0
81	UDP destination IP address (last octet only)		Port number fixed to 1111	2

OPTIONAL COMMUNICATIONS INTERFACES

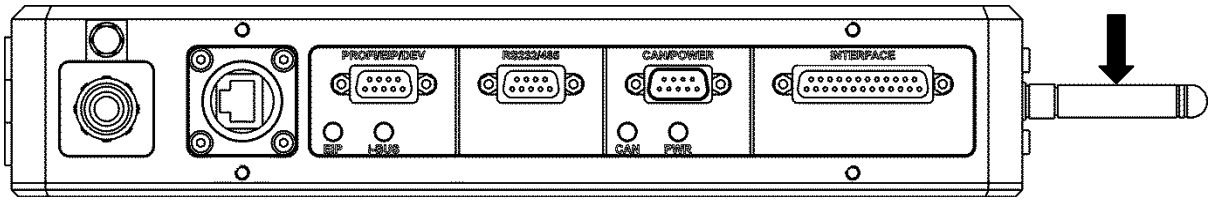
BLUETOOTH WIRELESS COMMUNICATIONS

The Bluetooth wireless interface is an optional extra that must be ordered for installation during manufacture; it cannot be retrofitted to the unit.

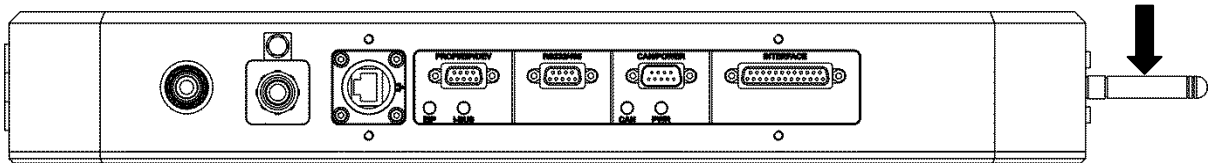
This communications interface operates independently of the other communications interfaces and may be used at the same time as them.

Bluetooth interface

DG2030/3030-5/10k Series



DG2060/3060-5/10k Series



Connector type: SMA female (install the supplied 2.4 GHz antenna on this connector).

Bluetooth configuration

Configuration via an optional AiG2 interface display unit:

	User Action	**Result**
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Communication”.	Communication
3	Press ↵ to open the “Communication” menu.	
4	Press ↵ to advance to the “CANBUS” page.	CANBUS Desc Address: 017 Sour Address: 014 Speed: 250K Terminator: ON BLUETOOTH Mode: Modbus
5	Press ↵ repeatedly to advance to “BLUETOOTH Mode”	BLUETOOTH Mode: Modbus
6	Press ⌂ or ⌄ to select the required “Mode” (Options are: Modbus or Proton).	Mode: Proton
7	Press ↵ to save the “Mode” setting.	
8	Press MENU or ⌂ to exit.	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
69		Bluetooth mode		0=Modbus 1=Proton	0

Bluetooth parameter range

Range of input parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	87	88

1x 16-bit word = 2x 8-bit bytes

Range of output parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	52	53

1x 16-bit word = 2x 8-bit bytes

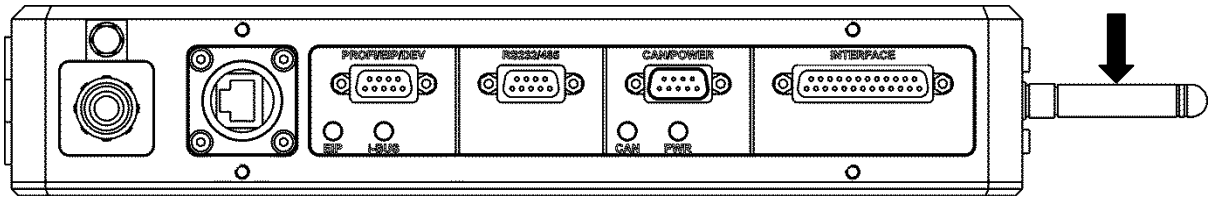
WiFi Wireless Communications

The WiFi wireless interface is an optional extra that must be ordered for installation during manufacture; it cannot be retrofitted to the unit.

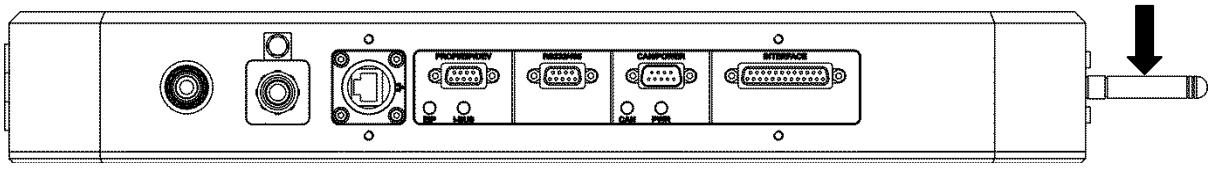
This communications interface operates independently of the other communications interfaces and may be used at the same time as them.

WiFi interface

DG2030/3030-5/10k Series



DG2060/3060-5/10k Series



Connector type: SMA female (install the supplied 2.4 GHz antenna on this connector).

WiFi configuration

The WiFi interface is factory-configured as an Access Point (AP mode) with DHCP (Dynamic Host Configuration Protocol) server enabled (the wireless interface will automatically assign an IP address to DHCP-enabled devices connected to it).

A WiFi-equipped device such as a PC, tablet computer or smart phone may connect wirelessly to the WiFi interface using the following factory default SSID and encryption settings:

SSID	YYYYYY_XXXXXXX (Example: DG2030_47A1245)	Where: YYYYYY is the gauge model number XXXXXXX is the gauge serial number
Encryption type	WEP	
Encryption key (ASCII)	12345	

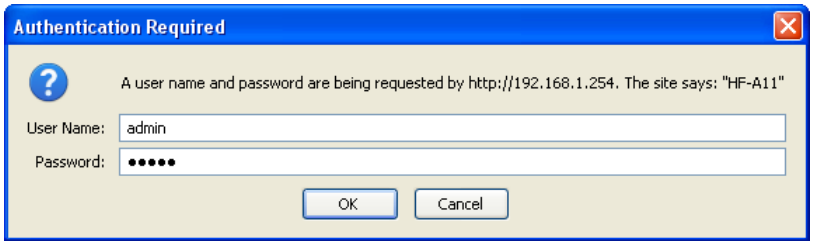
For configuration purposes, a **wired** Ethernet connection to the gauge Ethernet port may also be used to access the WiFi configuration web pages.

Once a connection has been established, a web browser (e.g. MS Internet Explorer or Mozilla Firefox) may be used to open the WiFi configuration webpage located at the following IP address:

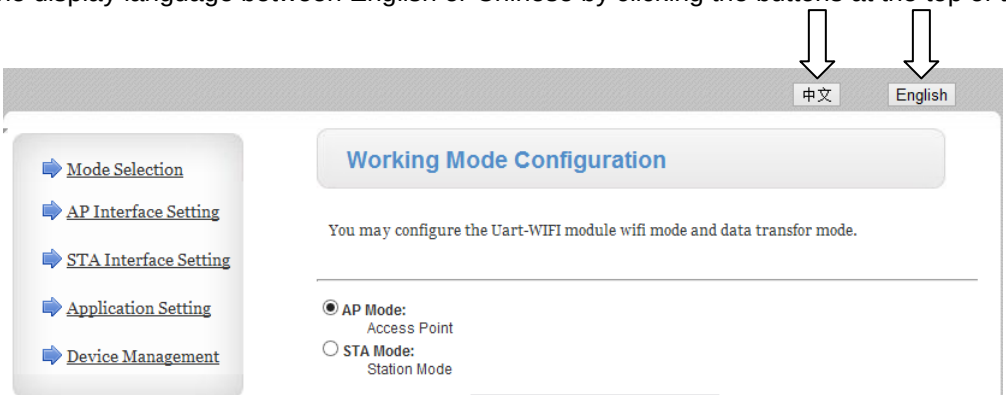
Default WiFi configuration webpage IP address	http://192.168.1.254

Enter the following username and password at the popup dialog:

Default username	admin
Default password	admin



Toggle the display language between English or Chinese by clicking the buttons at the top of the page:



Mode configuration and mode selection

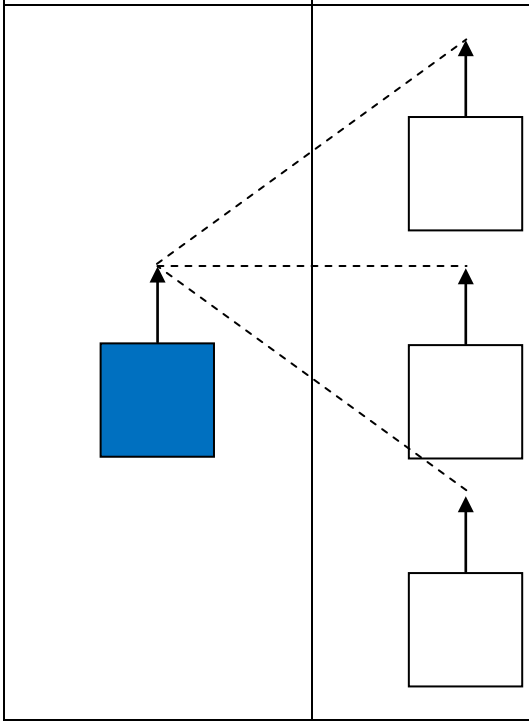
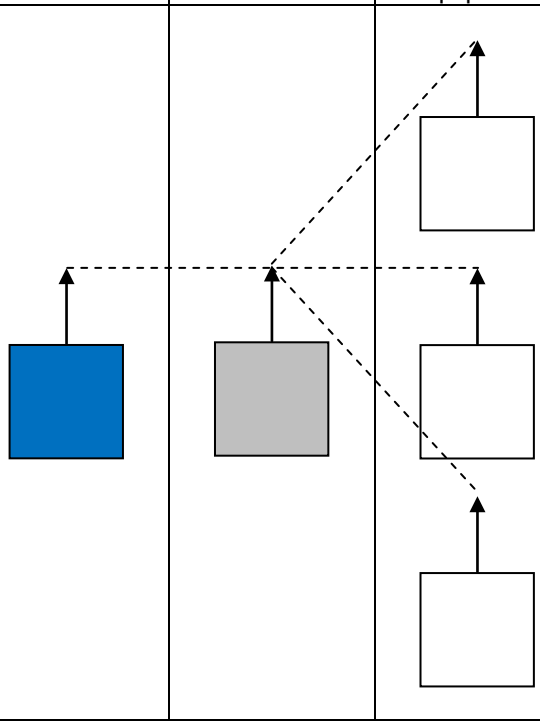
The gauge WiFi interface may be configured to operate either in AP (Access Point) mode or STA (Station or client mode).

The factory default mode is AP mode with DHCP (Dynamic Host Configuration Protocol) server enabled (the wireless interface will automatically assign an IP address to DHCP-enabled devices connected to it).

The WiFi interface mode should be selected depending on the end-user wireless network configuration:

<table>
<tr><th colspan="2">AP (Access Point) mode</th><th colspan="3">STA (Station) mode</th></tr>
<tr><td colspan="2">End-user network does NOT have a wireless router or Access Point.

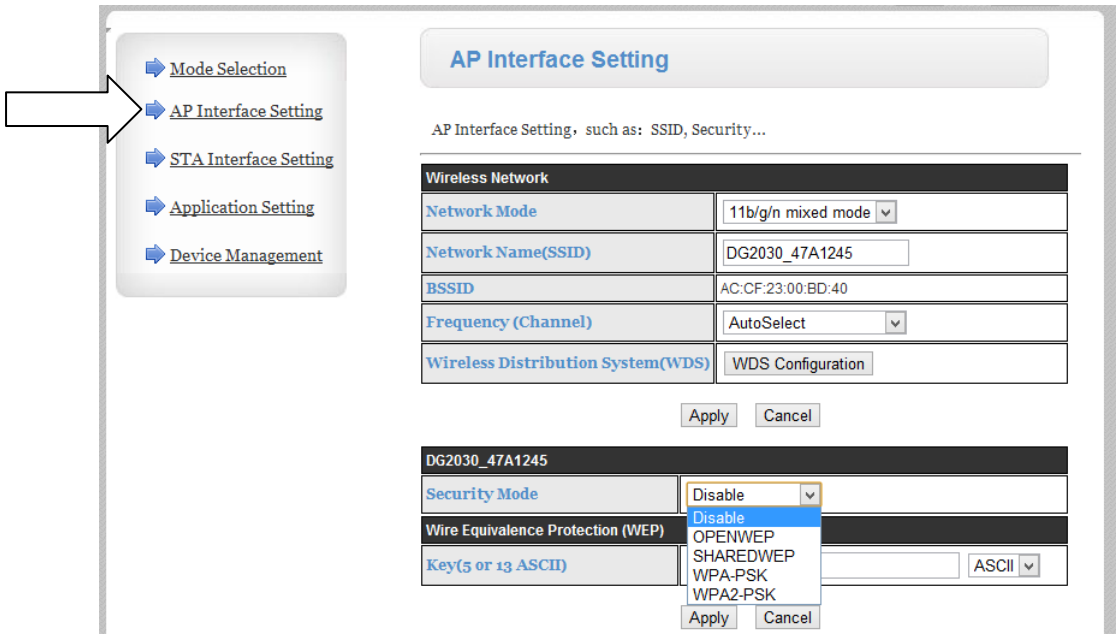
• The gauge acts as the wireless AP for the network.
• End-user devices connect directly to the gauge.
• The gauge may be responsible for assigning IP addresses to end-user devices (if DHCP is enabled).</td><td colspan="3">End-user network has an Access Point (AP) or wireless router.

• The gauge is a station/client on the network.
• End-user devices are also stations/clients on the network.
• End-user devices connect to the gauge via the wireless router or Access Point.
• The wireless router or Access Point may be responsible for assigning IP addresses to all stations/clients on the network (if DHCP is enabled).</td></tr>
<tr><td>Proton gauge</td><td>End-user equipment</td><td>Proton gauge</td><td>End-user AP / wireless router</td><td>End-user equipment</td></tr>
<tr><td colspan="2">  </td><td colspan="3">  </td></tr>
</table>

In the tables below, default dropdown menu settings are shown with a **grey background**.

Configuring the WiFi interface to AP (Access Point) mode

If the WiFi interface is to be configured for Access Point (AP) mode operation, then click on “AP Interface Setting” on the left-side of the web page to open the “AP Interface Setting” page:



Configure the wireless network, security credentials and IP address assignment on this page:

Wireless Network		
Network Mode	**11b/g mixed mode** **11b only** **11g only** **11b/g/n mixed mode** **11n only(2.4G) only**	Select the required WiFI network mode.
Network Name(SSID)	**YYYYYY_XXXXXXX**	Enter the wireless SSID that will be broadcast by the AP: Default: YYYYYY is the gauge model number XXXXXXX is the gauge serial number
BSSID		Displays the wireless BSSID (MAC) address.
Frequency (Channel)	**AutoSelect** **2412MHz(channel 1)** **~** **2462MHz(channel 11)**	Set to “**AutoSelect**” to allow the AP to automatically select the frequency channel. Manually set the frequency channel if it is necessary to avoid interference with frequencies already in use.
Wireless Distribution System(WDS)	**WDS Configuration**	Click this button to open the “**WDS Configuration**” page.

Click the “**Apply**” button to save all changes or the “**Cancel**” button to abort all changes.

SSID		
Security mode	**Disable** **OPENWEP** **SHAREDWEP** **WPA-PSK** **WPA2-PSK**	Select the required encryption mode or select “**Disable**” to disable encryption (not recommended).

The following fields appear only if “**Security mode**” is set to “**OPENWEP**” OR “**SHAREDWEP**”:

Wire Equivalence Protection (WEP)				
Key	**(5 or 13 ASCII)** **(10 or 26 HEX)**	Enter the encryption key here. Default: **12345**	**ASCII** **HEX**	Select the key format.

The following fields appear only if “**Security mode**” is set to “**WPA-PSK**” OR “**WPA2-PSK**”:

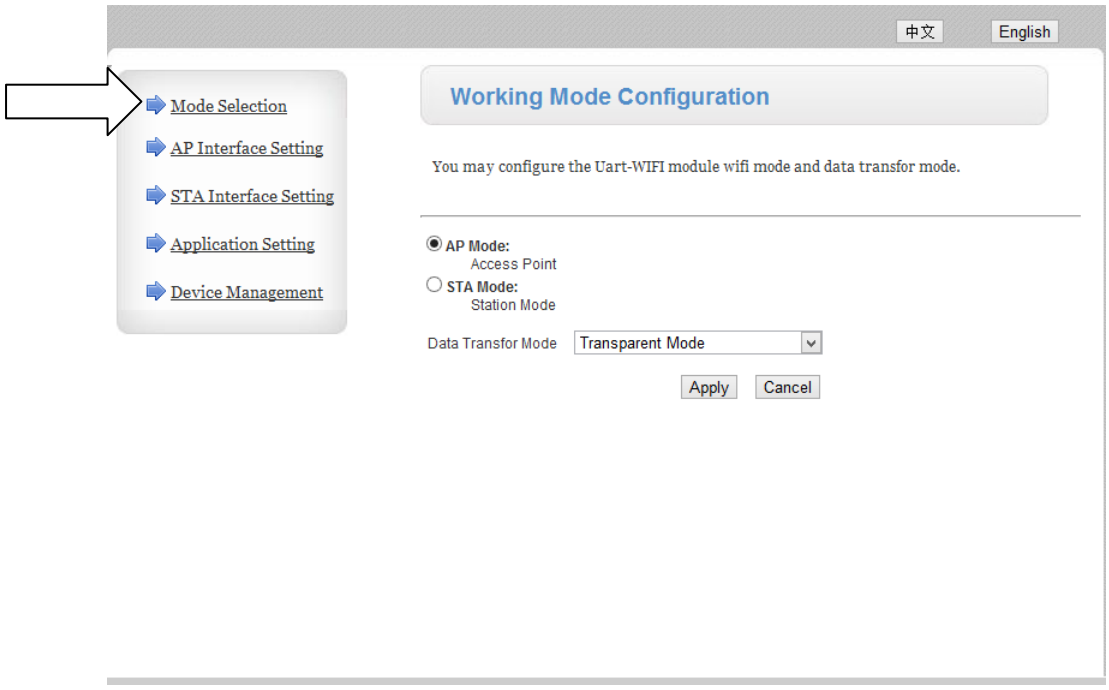
WPA				
WPA Algorithms	**TKIP**	**AES**	**TKIPAES**	Select the required encryption key type.
Pass Phrase	**12345678**			Enter the encryption key here.

Click the “**Apply**” button to save all changes or the “**Cancel**” button to abort all changes.

LAN Setup		
IP Address(Default DHCP Gateway)	**192.168.1.254**	Enter the required IP address for the DHCP server and this configuration webpage.
Subnet Mask	**255.255.255.0**	Enter the required subnet mask.
DHCP Type	**Disable**	Select to disable the DHCP server (if another DHCP server is on the network or IP addresses are manually assigned)
	Server	Select to enable the DHCP server and allow the AP to assign IP addresses.

Click the “**Apply**” button to save all changes or the “**Cancel**” button to abort all changes.

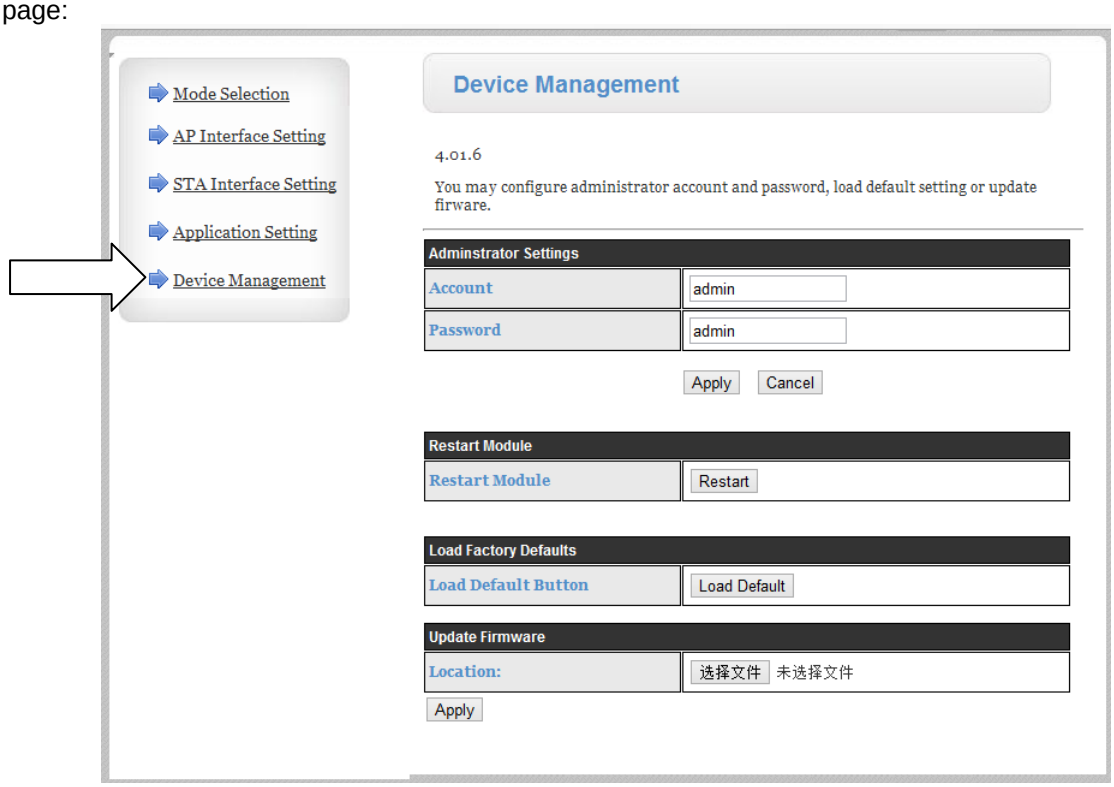
Click on “**Mode Selection**” on the left-side of the web page to open the “**Mode Selection**” page:



Select “**AP Mode**” and click the “**Apply**” button to save all changes or the “**Cancel**” button to abort all changes.

Do NOT alter the “**Data Transfer Mode**” setting from “**Transport Mode**”.

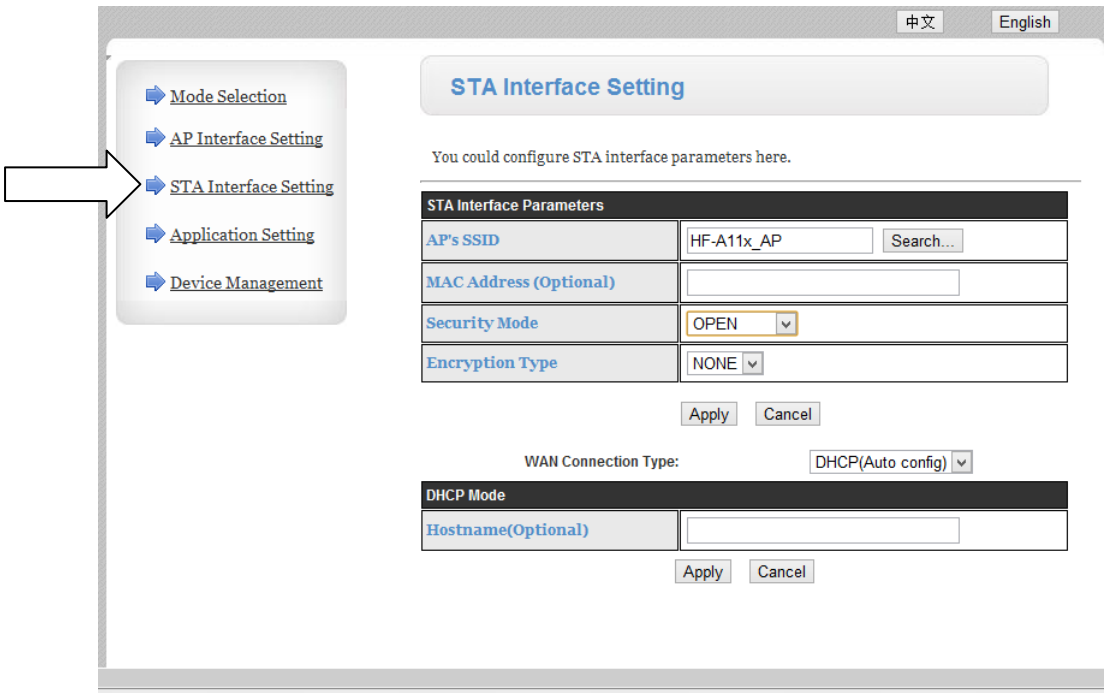
Click on “**Device Management**” on the left-side of the web page to open the “**Device Management**” page:



Under the “**Restart Module**” section, click the “Restart” button to restart the WiFi interface.

Configuring the WiFi interface to STA (Station) or client mode

If the WiFi interface is to be configured for Station (STA) or client mode operation, then click on “STA Interface Setting” on the left-side of the web page to open the “STA Interface Setting” page:



Configure the wireless network, security credentials and IP address assignment on this page:

STA Interface Parameters		
AP’s SSID	**HF-A11x_AP**	Enter the SSID for the wireless network to which to connect.
MAC Address(Optional)		
Security Mode	**OPEN** **SHARED** **WPAPSK** **WPA2PSK**	Select the required WiFi encryption mode or select “**OPEN**” to disable WiFi encryption (not recommended).

The following fields appear only if “**Security mode**” is set to “**OPEN**”:

Encryption Type	**NONE** **WEP**	Select the required WiFi encryption type.	
Key **(5 or 13 ASCII)** **(10 or 26 HEX)**	Enter the encryption key here. Default: 12345	**ASCII** **Hex**	Select the key format.

The following fields appear only if “**Security mode**” is set to “**SHARED**”:

Encryption Type	**WEP**		
Key **(5 or 13 ASCII)** **(10 or 26 HEX)**	Enter the encryption key here. Default: **12345**	**ASCII** **Hex**	Select the key format.

The following fields appear only if “**Security mode**” is set to “**WPAPSK**” or “**WPS2PSK**”:

Encryption Type	**TKIP** **AES**	Select the required WiFi encryption key type.
Pass Phrase	**12345678**	Enter the encryption key here.

Click the "**Apply**" button to save all changes or the "**Cancel**" button to abort all changes.

WAN Connection Type:	**STATIC(fixed IP)**	Select to manually assign an IP address.
	DHCP(Auto config)	Select to allow a DHCP server on the network to automatically assign an IP address.

The following fields appear only if "**WAN Connection Type**" is set to "**STATIC(fixed IP)**":

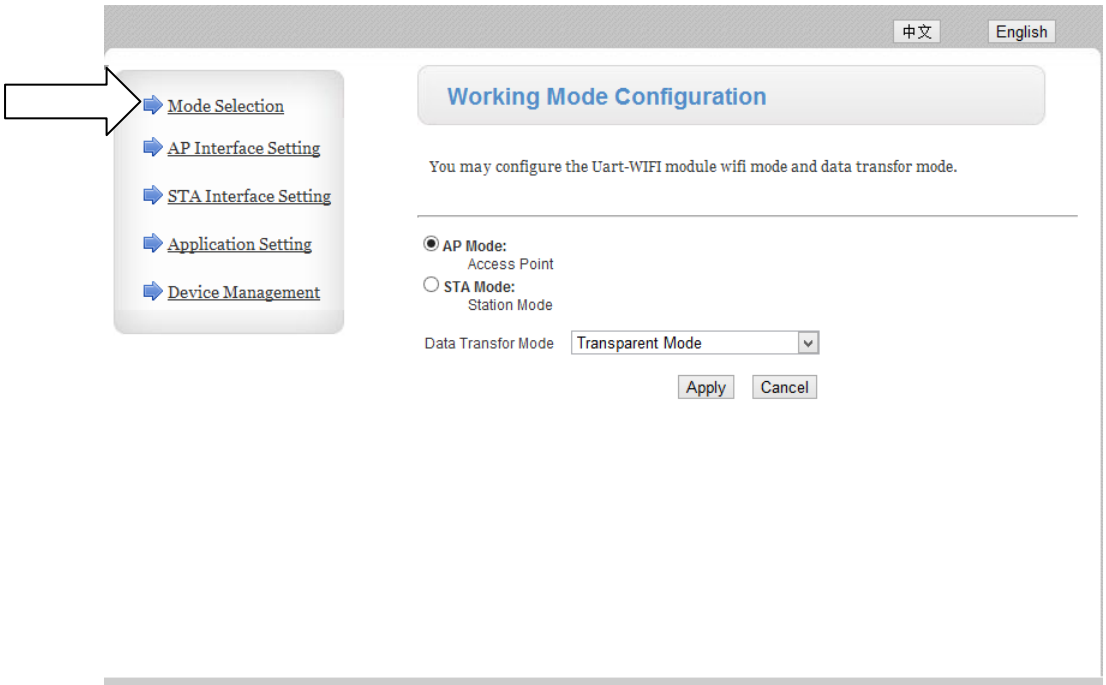
Static Mode		
IP Address	**0.0.0.0**	Enter the assigned IP address.
Subnet Mask	**0.0.0.0**	Enter the subnet mask.
Default Gateway	**0.0.0.0**	Enter the default gateway IP address.

The following fields appear only if "**WAN Connection Type**" is set to "**DHCP(Auto config)**":

DHCP Mode	
Hostname(Optional)	Enter the DHCP server hostname (optional).

Click the "**Apply**" button to save all changes or the "**Cancel**" button to abort all changes.

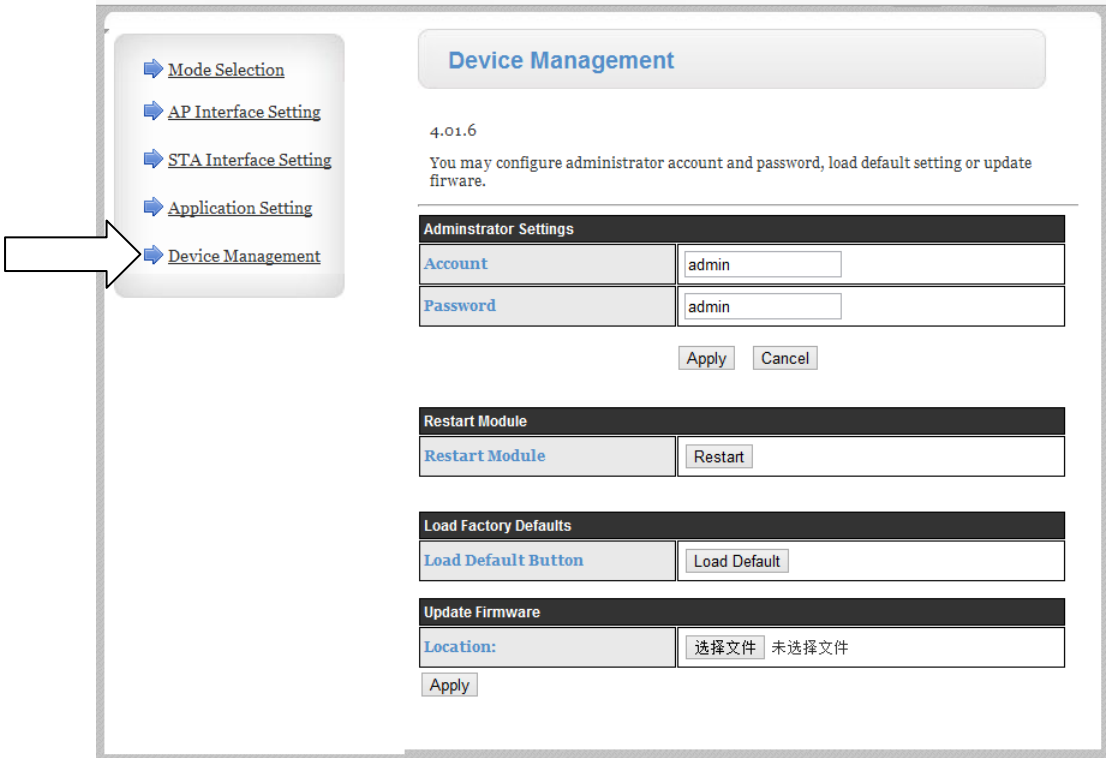
Click on "**Mode Selection**" on the left-side of the web page to open the "**Mode Selection**" page:



Select "**STA Mode**" and click the "**Apply**" button to save all changes or the "**Cancel**" button to abort all changes.

Do NOT alter the "**Data Transfer Mode**" setting from "**Transport Mode**".

Click on “**Device Management**” on the left-side of the web page to open the “**Device Management**” page:



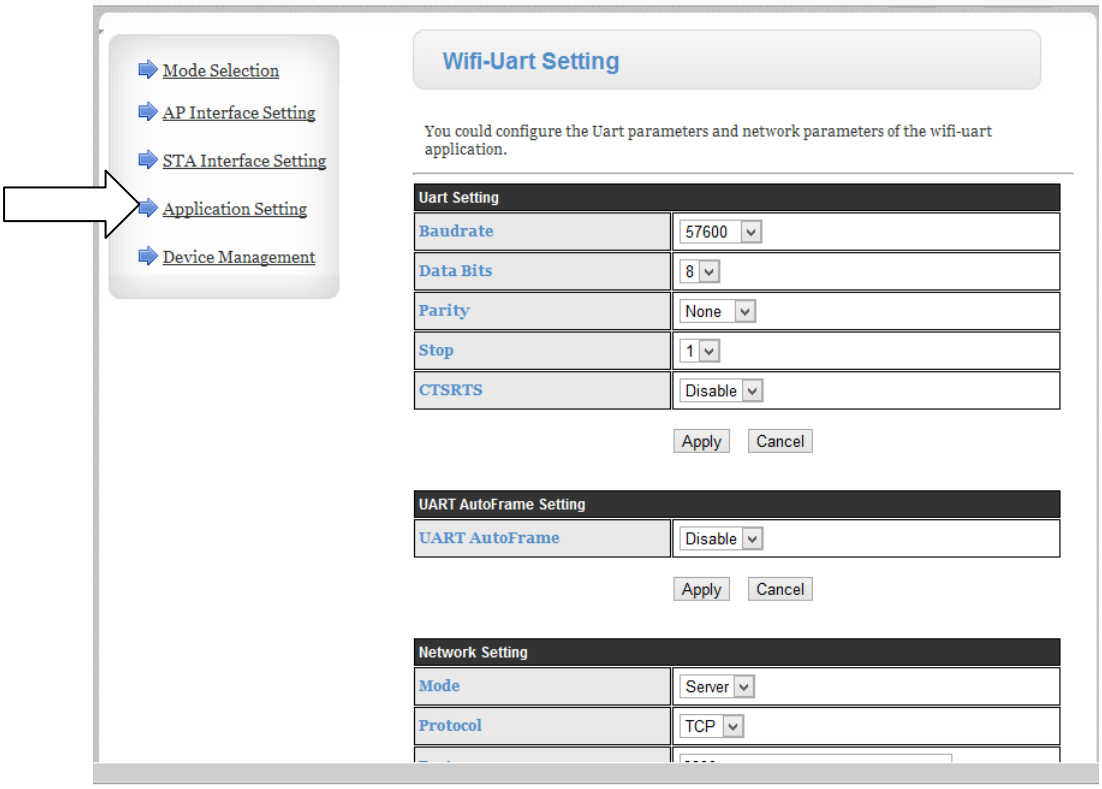
Under the “**Restart Module**” section, click the “Restart” button to restart the WiFi interface.

Application Setting

Click on “**Application Setting**” on the left-side of the web page to open the “**Application Setting**” page.

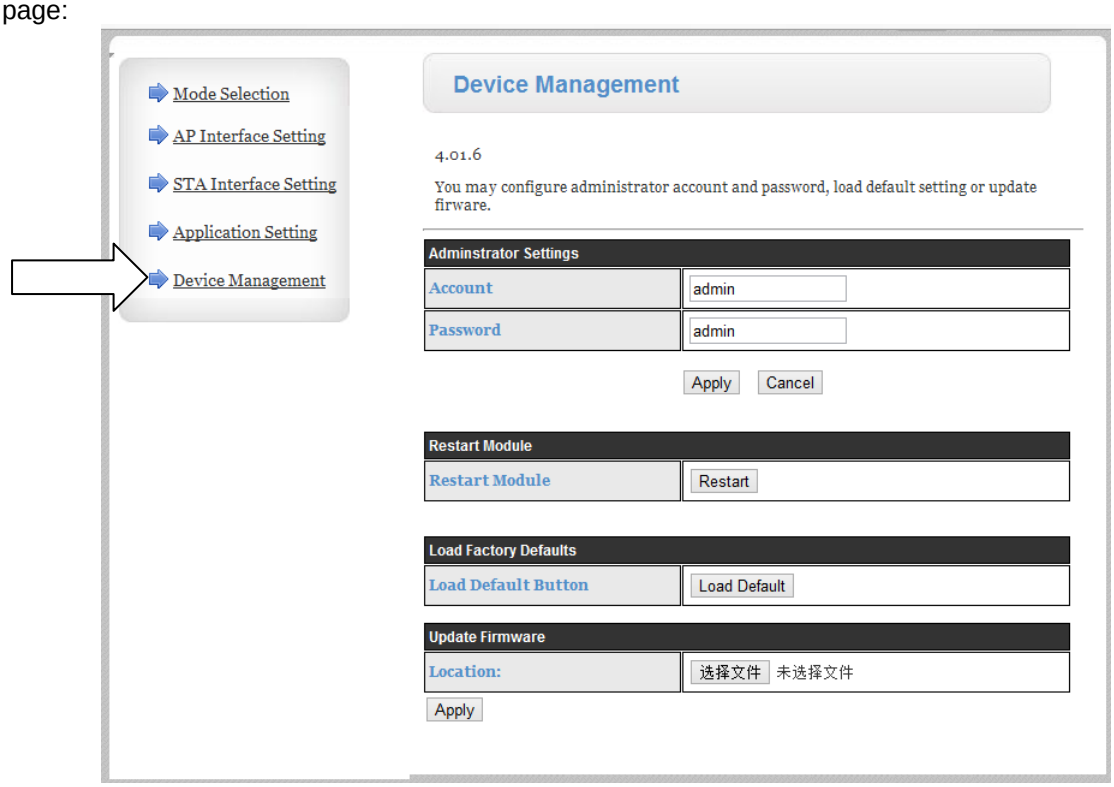
This page is for configuring the connection between the gauge and the WiFi interface module.

The end-user must **NOT** change any of the settings on this page unless instructed to do so by Proton Products authorized service personnel.



Device Management

Click on “**Device Management**” on the left-side of the web page to open the “**Device Management**” page:



Administrator Settings		
Account	**admin**	Enter a new administrator account name as required.
Password	**admin**	Enter a new administrator account password as required.

Click the “**Apply**” button to save all changes or the “**Cancel**” button to abort all changes.

Restart Module		
Restart Module	**Restart**	Click this button to restart the WiFi interface.

Load Factory Defaults		
Load Default Button	**Load Default**	Click this button to restore the WiFI interface configuration to factory defaults. The end-user must **NOT** click this button unless instructed to do so by Proton Products authorized service personnel.

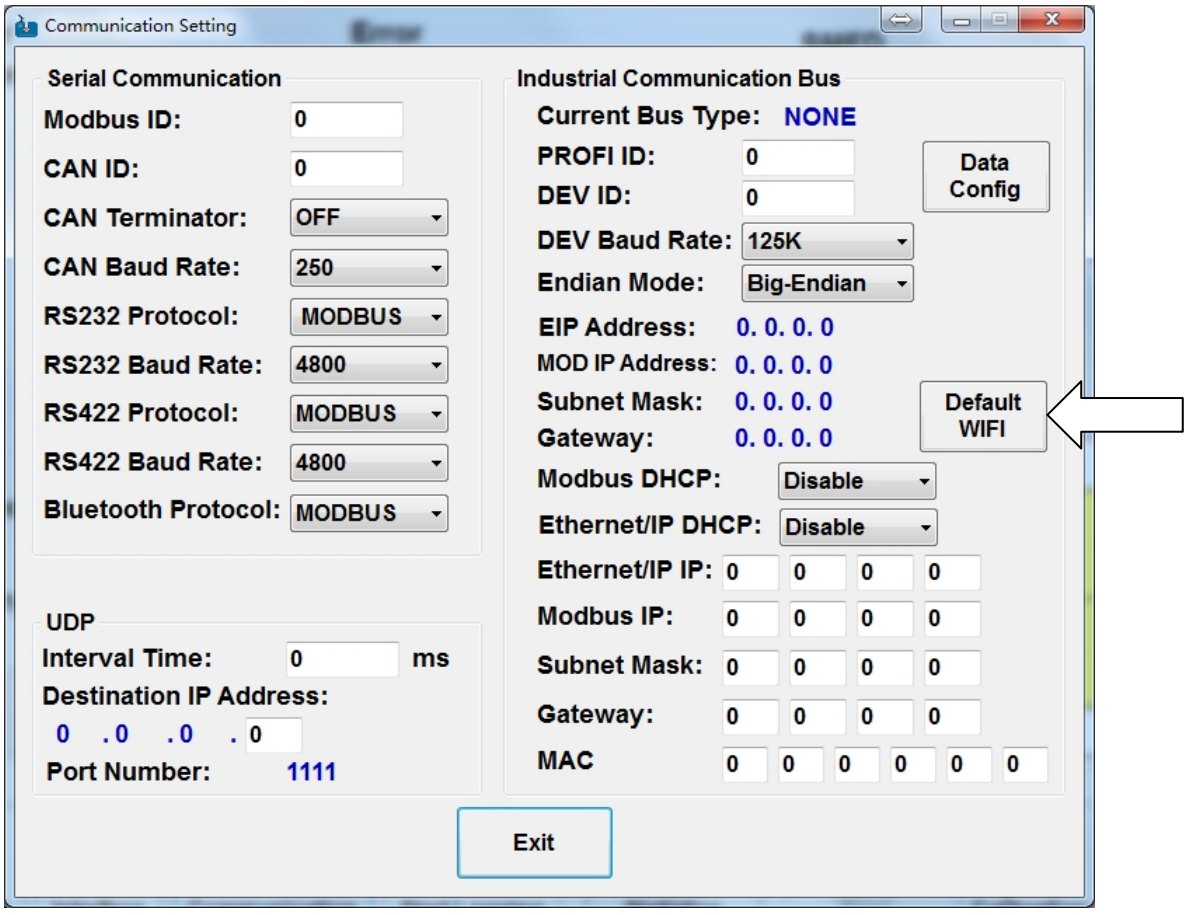
Update Firmware			
Location:	Enter the path for a WiFi interface firmware update file here.	**Browse**	Click this button to browse for a WiFi interface firmware update file.

Click the “**Apply**” button to update the WiFi module firmware from the specified file (the end-user must **NOT** update the WiFi interface firmware unless instructed to do so by Proton Products authorized service personnel).

Restoring Wifi interface configuration from PCiS software

In the event that the WiFi interface configuration webpage becomes inaccessible (due to mis-configuration or lost passwords or encryption keys), the WiFi interface configuration may be restored to factory defaults using the PCiS software.

On the "**Communications Settings**" page of the PCiS software, click the "**Default WiFi**" button to restore the WiFi interface configuration to factory defaults:



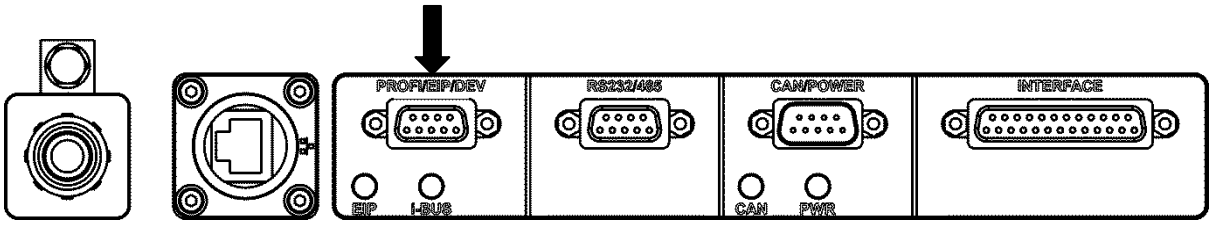
PROFIBUS COMMUNICATIONS

The PROFIBUS interface is an optional extra that must be ordered for installation during manufacture; it cannot be retrofitted to the gauge.

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 “PROFI/EIP/DEV” connector.



Connector type: DB9 female (socket)

Pin	PROFIBUS	Comments
3	B	
4	RTS	
5	GND	
6	+5V	
8	A	
S	Shield	Ensure that the cable shield is connected to this via the plug shield connection.

PROFIBUS LED indicator

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

PROFIBUS configuration

The gauge head is configured as a PROFIBUS slave.

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Communication”.	Communication
3	Press ↵ to open the “Communication” menu.	
4	Press ↵ to advance to the “INDUSTRIAL BUS” page.	INDUSTRIAL BUS Bus Type: PROFI Profibus Addr: 004 DeviceNet Addr: 10 DeviceNet Baud: 500K Modbus Addr: 001
5	Verify that the “Bus Type” is “PROFI”.	Bus Type: PROFI
6	Press ⌂ or ⌄ followed by ⌂ or ⌄ to highlight and edit	Profibus Addr: 008

	individual digits in the “Profibus Addr” as required.	
7	Press ↵ to save the “Profibus Addr”.	
8	Press MENU or ⌂ to exit.	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters:

DW	Bit	Comments	Unit	Range/Remark	Default value
50		PROFIBUS address	1=1	0~125	4

PROFIBUS parameter range

The gauge head is configured as a PROFIBUS slave.

Range of input parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
PROFIBUS / EtherNet/IP / DeviceNet (Master to Slave)	0	49	50

1x 16-bit word = 2x 8-bit bytes

Range of output parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
PROFIBUS / EtherNet/IP / DeviceNet (Slave to Master)	0	39	40

1x 16-bit word = 2x 8-bit bytes

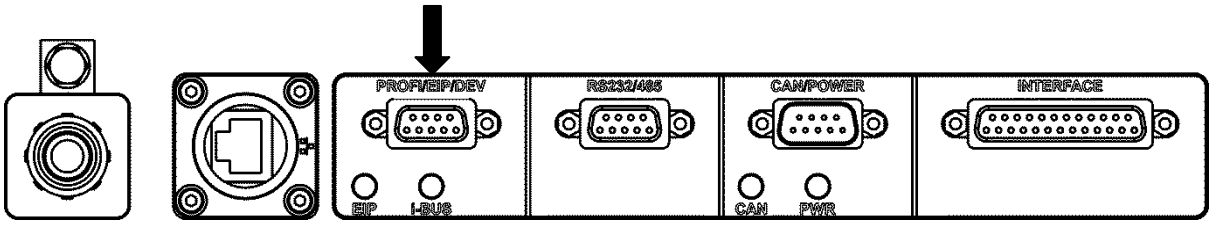
PROFINET COMMUNICATIONS

The PROFINET interface is an optional extra that must be ordered for installation during manufacture; it cannot be retrofitted to the unit.

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

PROFINET interface

The PROFINET interface may be accessed through the “PROFI/EIP/DEV” connector.



Connector type: DB9 female (socket)

Pin	PROFINET	Comments
1	LAN TX-	
2	LAN TX+	
7	LAN RX-	
9	LAN RX+	
S	Shield	Ensure that the cable shield is connected to this via the plug shield connection.

PROFINET LED indicator

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

PROFINET configuration

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Communication”.	Communication
3	Press ↵ to open the “Communication” menu.	
4	Press ⊡ to advance to the “INDUSTRIAL BUS” page.	INDUSTRIAL BUS Bus Type: PROFINET Profibus Addr: 004 DeviceNet Addr: 10 DeviceNet Baud: 500K Modbus Addr: 001
5	Verify that the “Bus Type” is “PROFINET”.	Bus Type: EtherNet/IP
6	Press ⊡ to advance to the “PROFINET” page.	PROFINET Enable DHCP: Disable IP Address: 192.168.001.101

If using automatic IP address assignment by a DHCP server on the network:		
1	Press ⌂ or ⌄ to set “Enable DHCP” to “Enable”.	Enable DHCP: Enable
2	Press ↵ to save the “Enable DHCP” setting and advance to the “IP Address”.	IP Address: 192.168.001.001
3	Press MENU or ⌂ to exit	
If using manual IP address assignment:		
1	Press ⌂ or ⌄ to set “Enable DHCP” to “Disable”.	Enable DHCP: Disable
2	Press ↵ to save the “Enable DHCP” setting and advance to the “IP Address”	IP Address: 192.168.001.001
3	Press ⌂ or ⌄ followed by ⌂ or ⌄ to highlight and edit individual digits in the “IP Address”.	IP Address: 192.168.001.005
4	Press ↵ to save the “IP Address” setting and advance back to “Enable DHCP”.	Enable DHCP: Disable
5	Press MENU or ⌂ to exit	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters:

DW	Bit	Comments	Unit	Range/Remark	Default value
23		DHCP_EIP		0=Disable 1=Enable	0
26		IP address for Anybus	xx.xx.xx.xx		C0A801A0 (192.168.1.160)
27					

PROFINET parameter range

Range of input parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
PROFIBUS / EtherNet/IP / PROFINET / DeviceNet (Master to Slave)	0	49	50

1x 16-bit word = 2x 8-bit bytes

Range of output parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
PROFIBUS / EtherNet/IP / PROFINET / DeviceNet (Slave to Master)	0	39	40

1x 16-bit word = 2x 8-bit bytes

To enable a PLC to communicate with the gauge, the PLC should be configured as follows:

	Assembly instance	Size / words
Input	100	40
Output	150	50
Configuration	1	0 (zero)

1 word = 2 bytes

ETHERNET / IP COMMUNICATIONS

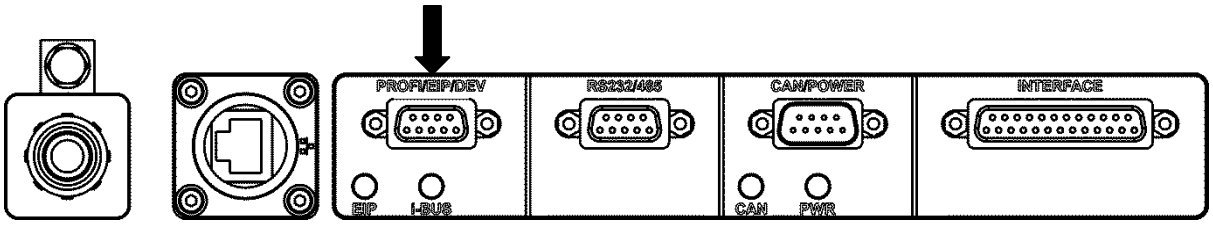
The EtherNet / IP interface is an optional extra that must be ordered for installation during manufacture; it cannot be retrofitted to the gauge.

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 interface

The EtherNet / IP interface may be accessed through the “PROFI/EIP/DEV” connector.



Connector type: DB9 female (socket)

Pin	EtherNet/IP	Comments
1	LAN TX-	
2	LAN TX+	
7	LAN RX-	
9	LAN RX+	
S	Shield	Ensure that the cable shield is connected to this via the plug shield connection.

EtherNet / IP LED indicator

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

EtherNet / IP configuration

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Communication”.	Communication
3	Press ↵ to open the “Communication” menu.	
4	Press ⊡ to advance to the “INDUSTRIAL BUS” page.	INDUSTRIAL BUS Bus Type: EtherNet/IP Profibus Addr: 004 DeviceNet Addr: 10 DeviceNet Baud: 500K Modbus Addr: 001
5	Verify that the “Bus Type” is “EtherNet/IP”.	Bus Type: EtherNet/IP
6	Press ⊡ to advance to the “ETHERNET/IP” page.	ETHERNET/IP Enable DHCP: Disable

		IP Address: 192.168.001.101
If using automatic IP address assignment by a DHCP server on the network:		
1	Press ⌂ or ⌄ to set “Enable DHCP” to “Enable”.	Enable DHCP: Enable
2	Press ↵ to save the “Enable DHCP” setting and advance to the “IP Address”.	IP Address: 192.168.001.001
3	Press MENU or ⌂ to exit	
If using manual IP address assignment:		
1	Press ⌂ or ⌄ to set “Enable DHCP” to “Disable”.	Enable DHCP: Disable
2	Press ↵ to save the “Enable DHCP” setting and advance to the “IP Address”	IP Address: 192.168.001.001
3	Press ⌦ or ⌫ followed by ⌂ or ⌄ to highlight and edit individual digits in the “IP Address”.	IP Address: 192.168.001.005
4	Press ↵ to save the “IP Address” setting and advance back to “Enable DHCP”.	Enable DHCP: Disable
5	Press MENU or ⌂ to exit	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters:

DW	Bit	Comments	Unit	Range/Remark	Default value
59		EIP DHCP		0=Disable 1=Enable	0
62		Anybus IP address	xx.xx.xx.xx		C0A80165 (192.168.1.101)
63					

EtherNet / IP protocol parameter range

Range of input parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
PROFIBUS / EtherNet/IP / DeviceNet (Master to Slave)	0	49	50

1x 16-bit word = 2x 8-bit bytes

Range of output parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
PROFIBUS / EtherNet/IP / DeviceNet (Slave to Master)	0	39	40

1x 16-bit word = 2x 8-bit bytes

To enable a PLC to communicate with the gauge, the PLC should be configured as follows:

	Assembly instance	Size / words
Input	100	40
Output	150	50
Configuration	1	0 (zero)

1 word = 2 bytes

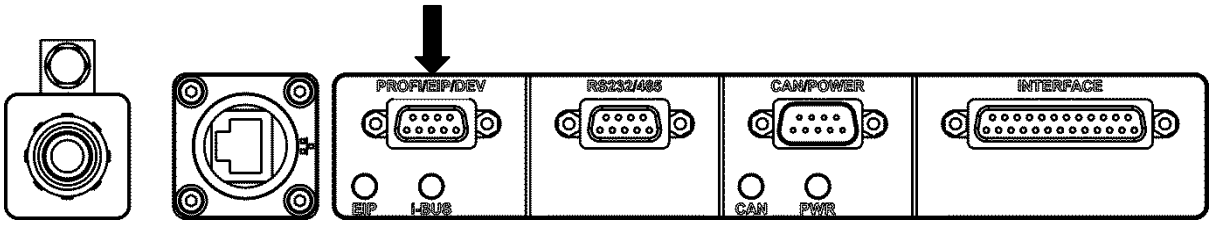
DEVICENET COMMUNICATIONS

The DeviceNet interface is an optional extra that must be ordered for installation during manufacture; it cannot be retrofitted to the gauge.

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

DeviceNet interface

The DeviceNet interface may be accessed through the “PROFI/EIP/DEV” connector.



Connector type: DB9 female (socket)

Pin	DeviceNet	Wire colour	Comment
1	SHIELD	Bare wire	
3	CANL	Blue	
5	V-	Black	
6	V+	Red	
8	CANH	White	
S	Shield		Ensure that the cable shield is connected to this via the plug shield connection.

DeviceNet LED indicator

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

DeviceNet configuration

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Communication”.	Communication
3	Press ↵ to open the “Communication” group.	
4	Press ↵ to advance to the “INDUSTRIAL BUS” page.	INDUSTRIAL BUS Bus Type: DEV Profibus Addr: 004 DeviceNet Addr: 10 DeviceNet Baud: 500K Modbus Addr: 001
5	Verify that the “Bus Type” is “DEV”.	Bus Type: DEV
6	Press ↵ repeatedly to advance to “DeviceNet Addr”.	DeviceNet Addr: 10
7	Press ⌂ or ⌄ followed by ⌂ or ⌄ to highlight and edit	DeviceNet Addr: 01

	individual digits in the “DeviceNet Addr” as required.	
8	Press ↵ to save the “DeviceNet Addr” and advance to “DeviceNet Baud”.	DeviceNet Baud: 500K
9	Press ⌂ or ▽ to select the required “DeviceNet Baud” rate (Options are: 125K, 250K or 500K).	DeviceNet Baud: 250K
10	Press ↵ to save the “DeviceNet Baud”.	
11	Press MENU or ⌂ to exit.	

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters:

DW	Bit	Comments	Unit	Range/Remark	Default value
79		DeviceNet address		0~63	10
80		DeviceNet baud rate		0=125K 1=250K 2=500K	2

DeviceNet parameter range

Range of input parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
PROFIBUS / EtherNet/IP / DeviceNet (Master to Slave)	0	49	50

1x 16-bit word = 2x 8-bit bytes

Range of output parameters accessible by interface			
Interface	**Lowest DW**	**Highest DW**	**Length / words**
PROFIBUS / EtherNet/IP / DeviceNet (Slave to Master)	0	39	40

1x 16-bit word = 2x 8-bit bytes

STANDARD ELECTRICAL INTERFACES

SPEED PULSE INPUT

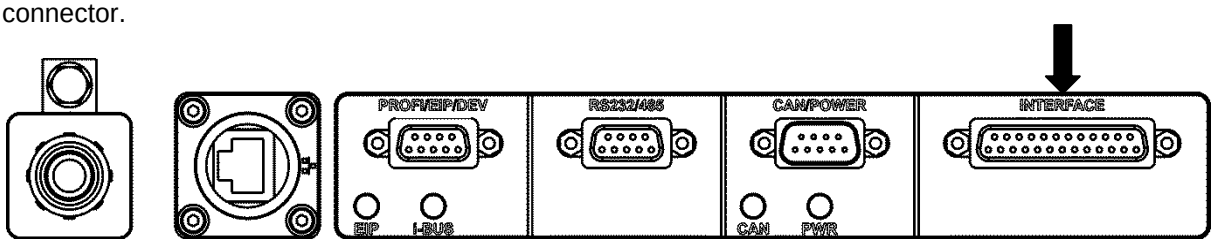
The speed pulse input may be connected to a line speed gauge (such as a Proton Products SL or SLR series non-contact laser speed and length gauge).

Measured line speed input is required for:

- Helix mode operation.
- PI feedback controller operation.
- Statistical Process Control (SPC) operation.

Speed pulse input connection

The speed pulse input is fitted as standard and may be accessed through the “INTERFACE” connector.



Connector type: DB25 female (socket)

Pin	Designation	Description	Notes
11	DGND	Digital ground	Ground reference for SPD1 and SPD2.
12	SPD2	Speed pulse input 2	For low voltage speed pulses (e.g. 5V TTL).
13	SPD1	Speed pulse input 1	For high voltage speed pulses (e.g. 12 ~ 24V speed encoders).
S	Shield		Ensure that the cable shield is connected to this via the plug shield connection.

Speed pulse input electrical specification

- A choice of two speed pulse inputs are available: one input is for high voltage pulses and one input is for low voltage pulses; only one input should be selected for use.
- The ground reference (GND) for the speed pulse inputs is not isolated from earth.

Specification		Min	Typ	Max	Units
SPD1 (pin13) High voltage (e.g. 12 ~ 24V speed encoders)	Low state (logic 0) input voltage			+5	V
	High state (logic 1) input voltage	+9			V
	Absolute input voltage	-50		+50	V
SPD2 (pin 12) Low voltage (e.g. 5V TTL)	Low state (logic 0) input voltage			+2	V
	High state (logic 1) input voltage	+4			V
	Absolute input voltage	-30		+30	V
Pulse frequency				250	kHz

Speed pulse input configuration

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU

2	Press ⌂ or ⌄ to highlight “Interface”.	Interface
3	Press ↵ to open the “Interface” group of pages.	
4	Press » to advance to the “SPEED” page. The displayed “Speed” is either the preset or measured line speed (read only).	**SPEED** Speed: 0100 m/min Source: Preset Preset Speed: 0100 m/min
5	Press ⌂ or ⌄ to set “Source” to “Pulse”.	**SPEED** Speed: 0000 m/min Source: Pulse Preset Speed: 0100 m/min
6	Press ↵ to save the “Source” setting and advance to “Pulse Gain” (the parameter shown here depends on the “Source” setting).	**SPEED** Speed: 0000 m/min Source: Pulse Pulse Gain: 1000 p/m
7	Press ⌂ or ⌄ followed by ⌂ or ⌄ to highlight and edit individual digits in the “Pulse Gain” setting. The pulse gain is measured in pulses / metre.	Pulse Gain: 2000 p/m
8	Press ↵ to save the “Pulse Gain” setting.	
9	Verify the measured “Speed” corresponds to the true line speed.	Speed:0050 m/min
10	Press MENU or ⌂ to exit.	

Note: “Metric” measurement units shown; for “Imperial” measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
28		Line speed source		0=Preset 1=Pulse 2=Analogue	0
30		Line speed full scale/gain	1=1m/min {1=1ft/min) Or 1=1pulse/m {1=1pulse/ft)	0~65535	1000

The measured line speed may be read from the following output parameter:

Output parameters

DW	Bit	Comments	Units	Range/Remark
23		Line speed	1=1m/min {1=1ft/min}	0~65535

ANALOGUE INPUT

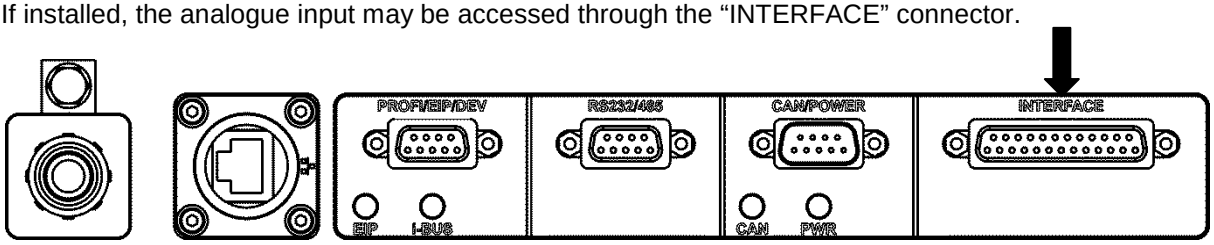
The analogue input may be connected to a 0 to +10V signal from a line speed gauge.

Measured line speed input is required for:

- Helix mode operation.
- PI feedback controller operation.
- Statistical Process Control (SPC) operation.

Analogue input connection

If installed, the analogue input may be accessed through the “INTERFACE” connector.



Connector type: DB25 female (socket)

Pin	Designation	Description	Notes
9	AGND	Analogue input ground	Isolated ground reference for AIP
22	AIP	Analogue input	
S	Shield		Ensure that the cable shield is connected to this via the plug shield connection.

Analogue input electrical specifications

- The analogue input and its ground reference are isolated from earth.

Specification	Minimum	Typical	Maximum	Units
Input voltage measurement range	0		+10	V
Input voltage absolute range	-35		+35	
Input-to-earth voltage	-50		+50	V
Input resistance	8			kΩ

Analogue input configuration

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Interface”.	Interface
3	Press ↵ to open the “Interface” group of pages.	
4	Press ↵ to advance to the “SPEED” page. The displayed “Speed” is either the preset or measured line speed (read only).	**SPEED** Speed: 0100 m/min Source: Preset Preset Speed: 0100 m/min
5	Press ⌂ or ⌄ to set “Source” to “Analogue”.	**SPEED** Speed: 0000 m/min Source: Analogue Preset Speed: 0100 m/min

6	Press ↵ to save the “Source” setting and advance to “Full Scale” (the parameter shown here depends on the “Source” setting).	**SPEED** Speed: 0000 m/min Source: Analogue Full Scale: 1000m/min Gain: 1.0000 Zero: 0.0000
7	Press ▷ or ◁ followed by △ or ▽ to highlight and edit individual digits in the “Full Scale” value. • The “Full Scale” value is the maximum speed (in m/min) that corresponds to the +10V maximum input.	Full Scale: 1000m/min
8	Press ↵ to save the “Full Scale” setting and advance to “Gain”.	Gain: 10000
9	Press ▷ or ◁ followed by △ or ▽ to highlight and edit individual digits in the “Gain” setting. • The “Gain” setting is for calibrating the internal analogue-to-digital converter; it may be adjusted if the gauge displays an incorrect measured line “Speed”.	Gain: 10000
10	Press ↵ to save the “Gain” setting and advance to “Zero”.	Zero: 00000
11	Press ▷ or ◁ followed by △ or ▽ to highlight and edit individual digits in the “Zero” setting. • The “Zero” setting is for calibrating the internal analogue-to-digital converter; it may be adjusted if the gauge displays a non-zero measured line “Speed” when the line is stationary.	Zero: 00000
12	Press ↵ to save the “Zero” setting.	
13	Verify the measured “Speed” corresponds to the true line speed.	Speed:0050 m/min
14	Press MENU or ⌂ to exit.	

Note: “Metric” measurement units shown; for “Imperial” measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
28		Line speed source		0=Preset 1=Pulse 2=Analogue	0
30		Line speed full scale/gain	1=1m/min {1=1ft/min) Or 1=1pulse/m {1=1pulse/ft)	0~65535	1000
84		Analogue input gain	1=0.0001		10000
85		Analogue input zero	1=0.0001		0

The measured line speed may be read from the following output parameter:

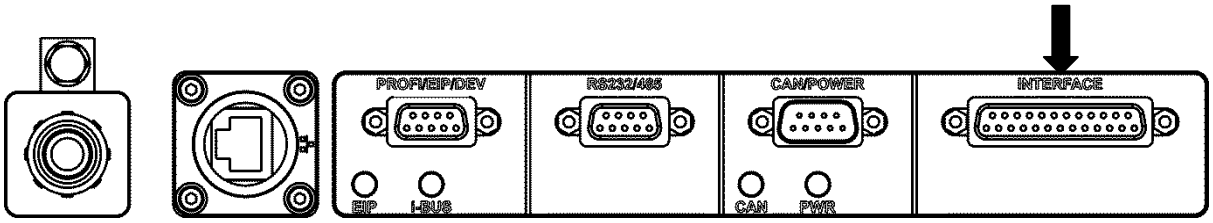
Output

DW	Bit	Comments	Units	Range/Remark
23		Line speed	1=1m/min {1=1ft/min}	0~65535

LOGIC INPUTS

Logic inputs connection

Two logic inputs are fitted as standard and may be accessed through the “INTERFACE” connector.



Connector type: DB25 female (socket)

Pin	Designation	Description	Notes
10	LIN2	Logic input 2	
11	DGND	Digital ground	Ground reference for LIN1 and LIN2.
23	LIN1	Logic input 1	
S	Shield		Ensure that the cable shield is connected to this via the plug shield connection.

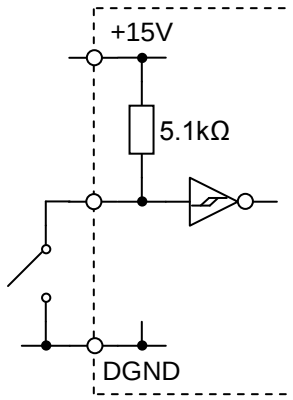
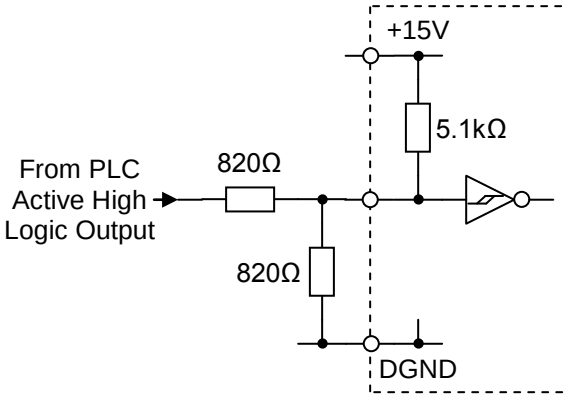
Logic inputs electrical specification

- Logic inputs are not isolated from earth.
- Inputs are internally pulled up to +15 V via 5.1kΩ 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 (pin 11).
Pull-down	Connect the pull-down signal to the logic input and ground to DGND (pin 11).
Pull-up	• Connect an 820Ω resistor between the logic input and DGND (pin 11) to pull the input down to 2.5V. • Connect the pull-up signal source to the logic input and ground to DGND (pin 11). • 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.

Pull down	Pull up
	

Logic inputs configuration

Each individual logic input can be independently configured for both active state polarity and function:

Function bit setting	Logic input function		
	Function	**Inactive**	**Active**
0	**Reset**	**-**	Reset all flaw detection measurements to zero.
			Reset all running maximum and minimum diameters to zero.
			Reset length to zero.
1	**Ext Alarm 1**	Set output parameter bit DW1.8 = 0	Print "**EXT-ALARM-1**" message to a printer connected to the RS-232 port.
			Set output parameter bit DW1.8 = 1
2	**Ext Alarm 2**	Set output parameter bit DW1.9 = 0	Print "**EXT-ALARM-2**" message to a printer connected to the RS-232 port.
			Set output parameter bit DW1.9 = 1

Input DW logic input polarity bit setting	Logic input active state
0	Active low
1	Active high

Configuration via an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the "MENU".	MENU
2	Press ⌂ or ⌄ to highlight "Interface".	Interface
3	Press ↵ to open the "Interface" group of pages.	
4	Press ↵ to advance to the "LOGIC I/P" page.	**LOGIC I/P** LIN1 Function: Reset Polarity: Active Low LIN2 Function: Ext Alarm 1 Polarity: Active Low
5	Press ⌂ or ⌄ to select the required "Function" for "LIN1".	LIN1 Function: Reset
6	Press ↵ to save the "Function" for "LIN1" and advance to the "Polarity" for "LIN1".	LIN1 Function: Reset

		Polarity: Active Low
7	Press ⌂ or ⌄ to select the required “Polarity” for “LIN1”.	LIN1 Function: Reset Polarity: Active High
8	Press ↵ to save the “Polarity” for “LIN1” and advance to the “Function” for “LIN2”.	LIN2 Function: Ext Alarm 1
9	Press ⌂ or ⌄ to select the required “Function” for “LIN2”.	LIN2 Function: Reset
10	Press ↵ to save the “Function” for “LIN2” and advance to the “Polarity” for “LIN2”.	LIN2 Function: Reset Polarity: Active Low
11	Press ⌂ or ⌄ to select the required “Polarity” for “LIN2”.	LIN2 Function: Reset Polarity: Active High
12	Press ↵ to save the “Polarity” for “LIN2” and return to the “Function” for “LIN1”.	LIN1 Function: Reset
13	Press MENU or ⌂ to exit.	

Configuration by input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
26		Logic input			
	0	Logic input 1 function		0=Reset 1=External Alarm 1 2=External Alarm 2	0
	1				
	2	Logic input 2 function		0=Reset 1=External Alarm 1 2=External Alarm 2	1
	3				
	4	Logic input 1 polarity		0=Active low 1=Active high	0
	5	Logic input 2 polarity		0=Active low 1=Active high	0

Interrogating External Alarm 1 and External Alarm 2 Logic Input Status

The status of logic inputs assigned with the “External Alarm 1” and “External Alarm 2” functions can be interrogated via output parameter bits DW1.8 and DW1.9 respectively:

Output parameters

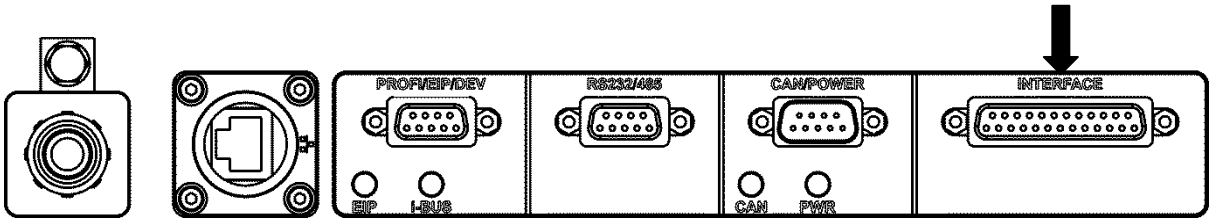
DW	Bit	Comments	Units	Range/Remark
1	0	Res		
	1	No reading		0=OK 1=No Reading
	2	No object		0=OK 1=No Object
	3	Lens dirty		0=OK 1=Lens Dirty
	4	Line speed too low for helix mode		0=OK 1=Too Low
	5	Line speed too high for helix mode		0=OK 1=Too High

	6	Gauge overheat		0=OK 1=Gauge overheat
	7			
	8	External alarm 1		0=OK 1=Alarm
	9	External alarm 2		0=OK 1=Alarm
	10~ 15			

RELAY OUTPUTS

Relay outputs connection

Four relay outputs are fitted as standard and may be accessed through the “INTERFACE” connector.



Connector type: DB25 female (socket)

Pin	Designation	Description	Notes
17	NO1	Relay 1 normally open contact	
5	COM1	Relay 1 common	
18	NO2	Relay 2 normally open contact	
6	COM2	Relay 2 common	
19	NO3	Relay 3 normally open contact	
7	COM3	Relay 3 common	
20	NO4	Relay 4 normally open contact	
8	COM4	Relay 4 common	
S	Shield	Shield	Ensure that the cable shield is connected to this via the plug shield connection.

Relay outputs electrical specifications

- All contacts are isolated and voltage free.
- If the relay contacts are used to switch inductive loads, then suppressors must be fitted to clamp voltage spikes.

Specification	Minimum	Typical	Maximum	Units
DC voltage between contacts			24	VDC
Contact-to-earth voltage			50	V
Current			1	A
On resistance (at a current of 10mA)			0.1	Ω

Relay outputs configuration

Each individual relay output can be independently configured to close (short) their contacts upon any one of the following conditions:

	Relay output function		Relay output function
0	***Gauge OK***		
1	***Over any limit*** (excluding ovality limits)	2	***Under any limit*** (excluding ovality limits)
3	***Flaw*** (Lump & Neck)		
4	***Lump***	5	***Neck***
6	***Over Average Upper limit***	7	***Under Average Lower limit***
8	***Over X Upper limit***	*9*	***Under X Lower limit***
10	***Over Y Upper limit***	*11*	***Under Y Lower limit***
12	***Over Z Upper limit*** (DG3030/3060 only)	13	***Under Z Lower limit*** (DG3030/3060 only)
14	***Over Ovality Upper limit***	*15*	***Under Ovality Lower limit***

- The contact closure time duration for all relays has a default value of 100 ms and may be configured to any value up to 5000 ms.
- For an event of duration less than the contact closure time duration setting, the relay contacts will close for ONE contact closure time duration e.g. if contact closure time duration is set to 100 ms and a flaw is detected for 50 ms, then the relay contacts will be closed for 100 ms.
- For an event of duration greater than the contact closure time duration setting, the relay contacts will close for the duration of the event plus ONE contact closure time duration e.g. if contact closure time duration is set to 100 ms and a flaw is detected for 500 ms, then the relay contacts will be closed for 600 ms.
- All relay contacts are configured together to respond to either instantaneous or averaged diameter measurements.

Configuration via an optional AiG2 interface display unit:

To configure relay output functions:

	User Action	Result
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Interface”.	Interface
3	Press ↵ to open the “Interface” group of pages.	
4	Press » to advance to the “RELAY” page.	**RELAY** Relay 1:Gauge OK Relay 2:Over ave Relay 3:Under ave Relay 4:Flaw Closure time: 0100 ms
5	Press ⌂ or ⌄ to select the required function for “Relay 1”.	Relay 1:Lump
6	Press ↵ to save the function for “Relay 1” and advance to “Relay 2”.	Relay 2:Over ave
7	Press ⌂ or ⌄ to select the required function for “Relay 2”.	Relay 2:Neck
8	Press ↵ to save the function for “Relay 2” and advance to “Relay 3”.	Relay 3:Under ave
9	Press ⌂ or ⌄ to select the required function for “Relay 3”.	Relay 3:Over X
10	Press ↵ to save the function for “Relay 3” and advance to “Relay 4”.	Relay 4:Flaw
11	Press ⌂ or ⌄ to select the required function for “Relay 4”.	Relay 4:Under X
12	Press ↵ to save the function for “Relay 4” and advance to “Closure time”.	Closure time: 0100 ms
13	Press ⌂ or ⌄ followed by ⌂ or ⌄ to highlight and edit individual digits in the “Closure time”.	Closure time: 0500 ms

14	Press ↵ to save the “Closure time” and return to “Relay 1”.	Relay 1: Lump
15	Press MENU or ⌂ to exit.	

To configure relay output response type (note that this parameter also applies to the analogue output response type):

	User Action		Result
1	Press MENU to display the “MENU”.		MENU
2	Press ⌂ or ⌄ to highlight “Interface”.		Interface
3	Press ↵ to open the “Interface” group of pages.		
4	Press » to advance to the “ANALOGUE & RELAY O/P” page.		**ANALOGUE & RELAY O/P** Response: Instant
5	Press ⌂ or ⌄ to select the required “Response” type that applies to all analogue and relay outputs:		**ANALOGUE & RELAY O/P** Response: Average
	Response	**Description**	
	“Instant”	Relays respond to each individual measured diameter.	
	“Averaged”	Relays respond to the average measured diameter (averaging time set under the “Measurement → AVERAGING → Diameter” parameter; input parameter DW19).	
6	Press ↵ to save the “Response” setting.		
7	Press MENU or ⌂ to exit.		

Configuration by input parameters:

This interface may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
24		Relay Closure time	1=1ms	1~5000	100
27		Relays			
	0	Relay 1 function		0=Gauge OK 1=Over any limit (excluding ovality limits) 2=Under any limit (excluding ovality limits) 3=Flaw 4=Lump 5=Neck 6=Over average upper limit 7=Under average lower limit 8=Over X upper limit 9=Under X lower limit 10=Over Y upper limit 11=Under Y lower limit 12=Over Z upper limit 13=Under Z lower limit 14=Over ovality upper limit 15=Under ovality lower limit	0
	1				
	2				
	3				
	4	Relay 2 function			6
	5				
	6				
	7				
	8	Relay 3 function			7
	9				
	10				
	11				
	12	Relay 4 function			3
	13				
	14				
	15				
38	15	Response speed		0=Instant 1=Averaged	0

OPTIONAL ELECTRICAL INTERFACES

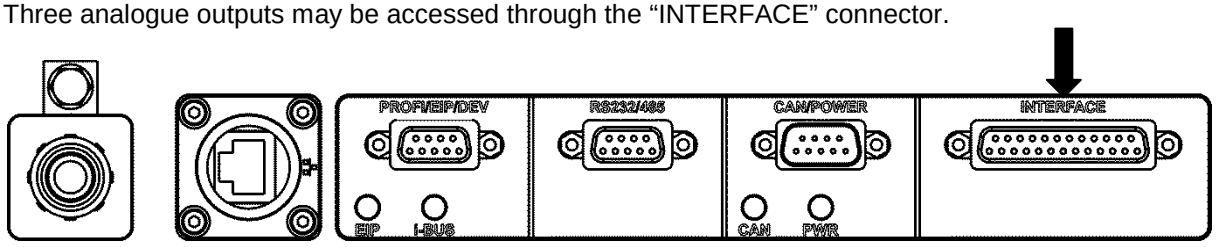
ANALOGUE OUTPUTS

Analogue outputs are an optional extra that must be ordered for installation during manufacture; they cannot be retrofitted to the gauge.

The analogue outputs may be configured to output diameter or error measurements as an analogue output voltage.

Analogue outputs connection

Three analogue outputs may be accessed through the “INTERFACE” connector.



Connector type: DB25 female (socket)

Pin	Designation	Description	Notes
3	AOUT1	Analogue output 1	
4	AOUT3	Analogue output 3	
15	Agnd	Analogue output ground	Isolated ground reference for AOUT1, AOUT2 and AOUT3.
16	AOUT2	Analogue output 2	
S	Shield		Ensure that the cable shield is connected to this via the plug shield connection.

Analogue outputs electrical specifications

- Analogue outputs and their shared ground reference are isolated from earth.
- Analogue outputs are short circuit proof.

Specification	Minimum	Typical	Maximum	Units
Output voltage	-10		10	V
Output-to-earth voltage			50	V
Load resistance	3.3			kΩ

Analogue outputs configuration

- Each individual analogue output can be independently configured to output a voltage corresponding to the following measurements:

Unipolar (0 to +10 V) outputs		Bipolar (-10 to + 10 V) outputs	
0	***Average*** of X, Y, Z (DG3030/3060 only) diameters	5	***Average error*** of X, Y, Z (DG3030/3060 only) diameters
1	***X*** diameter	6	***X error***
2	***Y*** diameter	7	***Y error***
3	***Z*** diameter (DG3030/3060 only)	8	***Z error*** (DG3030/3060 only)
4	***Ovality***	9	***Ovality error***

- Each analogue output can be independently configured for full scale range and calibrated for gain and zero.

- All analogue outputs are configured together to output either instantaneous or averaged measurements (with the averaging time set under the “Measurement → AVERAGING → Diameter” parameter; input parameter DW19).

Configuration via an optional AiG2 interface display unit:

To configure analogue output functions:

	User Action	**Result**
1	Press MENU to display the “MENU”.	MENU
2	Press ⌂ or ⌄ to highlight “Analogue”.	Analogue
3	Press ↵ to open the “ANALOGUE O/P1” page.	**ANALOGUE O/P1** Function:Average Full Scale: 10.000mm Gain: 10000 Zero: 00000
4	Press ⌂ or ⌄ to select the required “Function”. Options are: Average, X, Y, Z (DG3030/3060 only), Ovality, Average Error, X Error, Y Error, Z Error (DG3030/3060 only), Ovality Error.	**ANALOGUE O/P1** Function:X Error Full Scale: 10.000mm Gain: 10000 Zero: 00000
5	Press ↵ to save the “Function” setting and advance to “Full scale”.	**ANALOGUE O/P1** Function:X Error Full Scale: 10.000mm Gain: 10000 Zero: 00000
6	Press ⌂ or ⌂ followed by ⌂ or ⌄ to highlight and edit individual digits in the “Full scale” voltage. • The “Full Scale” value is the maximum measured diameter or most positive error for a +10 V output voltage. • It may be set to any value from 0 to 65.535 mm. • For unipolar outputs, a zero measured diameter corresponds to a 0 V output voltage. • For bipolar outputs, the most negative measured error corresponds to a -10 V output voltage.	**ANALOGUE O/P1** Function:X Error Full Scale: 20.000mm Gain: 10000 Zero: 00000
7	Press ↵ to save the “Full scale” voltage setting and advance to “Gain”.	**ANALOGUE O/P1** Function:X Error Full Scale: 20.000mm Gain: 10000 Zero: 00000
8	Press ⌂ or ⌂ followed by ⌂ or ⌄ to highlight and edit individual digits in the “Gain” setting. The “Gain” setting is for calibrating the internal digital-to-analogue converter; it may be adjusted if the gauge outputs an incorrect measured diameter or diameter error.	**ANALOGUE O/P1** Function:X Error Full Scale: 20.000mm Gain: 10000 Zero: 00000
9	Press ↵ to save the “Gain” setting and advance to “Zero”.	**ANALOGUE O/P1** Function:X Error Full Scale: 20.000mm Gain: 10000 Zero: 00000

10	Press ▷ or ◁ followed by △ or ▽ to highlight and edit individual digits in the “Zero” setting. The “Zero” setting is for calibrating the internal digital-to-analogue converter; it may be adjusted if the gauge outputs a non-zero voltage for a zero measured diameter error.	**ANALOGUE O/P1** Function:X Error Full Scale: 20.000mm Gain: 10000 Zero: 00000
11	Press ↵ to save the “Zero” setting.	
12	Press ⏭ to advance to the “ANALOGUE O/P2” page and enter settings in the same way as for “ANALOGUE O/P1”.	**ANALOGUE O/P2** Function:Average Full Scale: 10.000mm Gain: 10000 Zero: 00000
13	Press ⏭ to advance to the “ANALOGUE O/P3” page and enter settings in the same way as for “ANALOGUE O/P1”.	**ANALOGUE O/P3** Function:Average Full Scale: 10.000mm Gain: 10000 Zero: 00000
14	Press MENU or ⌂ to exit.	

Note: “Metric” measurement units shown; for “Imperial” measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

To configure analogue output response type (note that this parameter also applies to the relay output and “Running maximum / minimum” diameter response type):

	User Action		**Result**
1	Press MENU to display the “MENU”.		MENU
2	Press △ or ▽ to highlight “Interface”.		Interface
3	Press ↵ to open the “Interface” group of pages.		
4	Press ⏭ to advance to the “ANALOGUE & RELAY O/P” page.		**ANALOGUE & RELAY O/P** Response: Instant
5	Press △ or ▽ to select the required “Response” type that applies to all analogue and relay outputs and “Running maximum / minimum” diameters:		**ANALOGUE & RELAY O/P** Response: Average
	Response	**Description**	
	“Instant”	Outputs the measured value per individual scan.	
	“Averaged”	Outputs the time averaged measured value (averaging time set under the “Measurement → AVERAGING → Diameter” parameter; input parameter DW19).	
6	Press ↵ to save the “Response” setting.		
7	Press MENU or ⌂ to exit.		

Configuration via input parameters:

This interface may be configured by writing to the following input parameters:

DW	Bit	Comments	Unit	Range/Remark	Default value
38		Analogue output			
	0	Analogue output 1		0=Average 1=X	0
	1				

DW	Bit	Comments	Unit	Range/Remark	Default value
	2			2=Y 3=Z (DG3030/3060 only) 4=Ovality 5=Average error 6=X error 7=Y error 8=Z error (DG3030/3060 only) 9=Ovality error	
	3				
	4	Analogue output 2			1
	5				
	6				
	7				
	8	Analogue output 3			2
	9				
	10				
	11				
	12				
	13				
	14				
	15	Response speed		0=Instant 1=Averaged	0
39		Analogue output 1 full scale	1=1um {1=0.1mil}	0~65535	10000
40		Analogue output 2 full scale	1=1um {1=0.1mil}	0~65535	10000
41		Analogue output 3 full scale	1=1um {1=0.1mil}	0~65535	10000
73		Analogue output 1 gain	1=0.0001		10000
74		Analogue output 1 zero	1=0.0001		0
75		Analogue output 2 gain	1=0.0001		10000
76		Analogue output 2 zero	1=0.0001		0
77		Analogue output 3 gain	1=0.0001		10000
78		Analogue output 3 zero	1=0.0001		0

PI FEEDBACK CONTROLLER

The PI feedback controller is an optional extra that must be ordered for installation during manufacture; it cannot be retrofitted to the gauge.

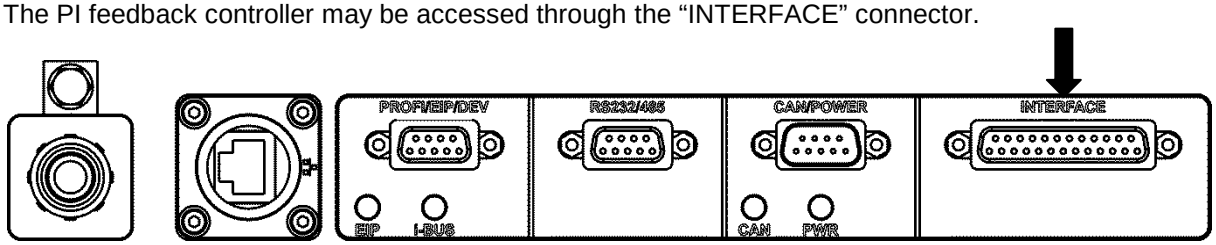
The DG gauge can output an analogue control signal based on the proportional and integral value of the difference between the measured diameter and the ∅ preset diameter. This signal can be used to control an insulation extruder or capstan driver with ∅ preset as the target diameter of the product.

For PI feedback controller operation, the gauge requires the following prerequisites:

- A calibrated, real time line speed measurement provided to the gauge either as an analogue or pulse input signal.
- ∅ preset and ∅ core diameters set in the Basic ∅ Data page.

PI feedback controller connection

The PI feedback controller may be accessed through the “INTERFACE” connector.



Connector type: DB25 female (socket)

Pin	Designation	Description	Notes
1	P0V	PI feedback controller ground reference	Isolated from earth.
2	POUT	PI feedback controller output	
14	PIN	PI feedback controller input	
S	Shield		Ensure that the cable shield is connected to this via the plug shield connection.

PI feedback controller electrical specifications

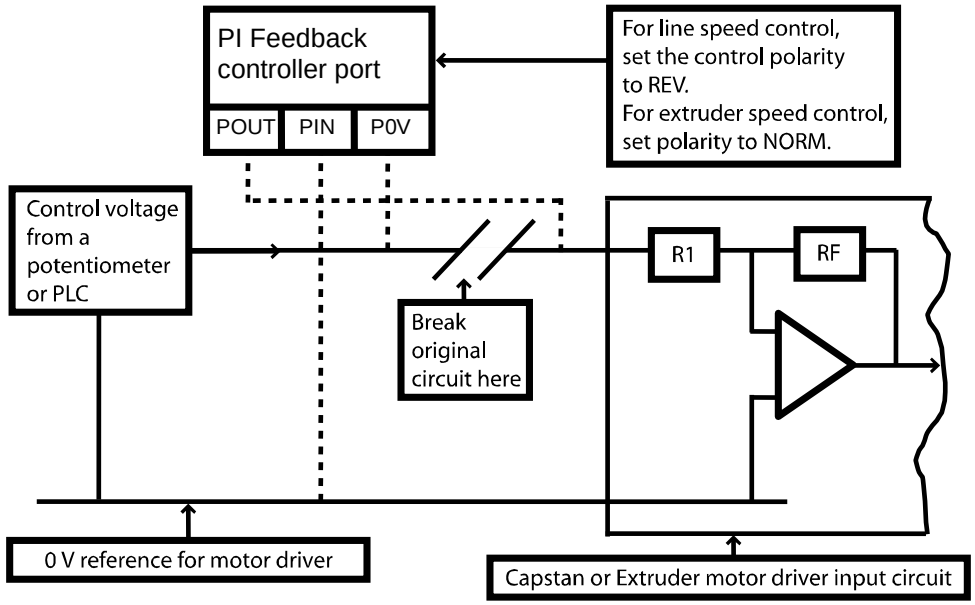
- The ground reference for the PI feedback controller input (PIN) and output (POUT) is isolated from earth.
- POUT is short circuit proof.
- The PI feedback controller output (POUT) voltage range is limited to a user configurable maximum of 50 % of the PI feedback controller input (PIN) voltage range.

Specification	Minimum	Typical	Maximum	Units
PIN input voltage	-20		+20	V
PIN input voltage (absolute)	-50		+50	V
PIN input to earth voltage	-50		+50	V
PIN input impedance	20			kΩ
POUT output voltage	-10		+10	V
POUT output voltage (absolute forced)	-25		+25	V
POUT output to earth voltage	-50		+50	V
POUT output current			10	mA
POUT output impedance			10	Ω

PI feedback controller connection to production equipment

The connection of the PI feedback controller depends on the configuration of the insulation extruder or capstan drive control inputs.

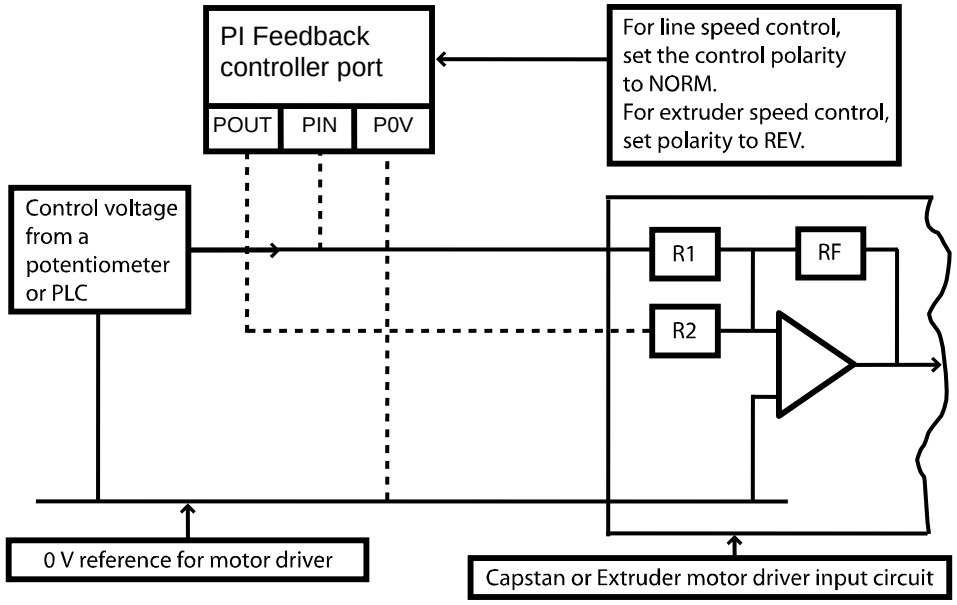
Connection 1



In this configuration, the PI feedback controller output voltage is added in series with a fixed control voltage from a potentiometer or PLC. The fixed control voltage sets the capstan or extruder operating midpoint and the PI feedback controller output drives the capstan or extruder above or below this operating midpoint.

Note that the PI feedback controller ground reference (0V) is not connected to the 0V reference of the controlled equipment; this is possible as the PI feedback controller ground reference is isolated from earth.

Connection 2



In this configuration, the PI feedback controller output voltage is added to a fixed control voltage from a potentiometer or PLC via the auxiliary control input on the extruder or capstan driver. The fixed

control voltage sets the capstan or extruder operating midpoint and the PI feedback controller output drives the capstan or extruder above or below this operating midpoint.

Note that the PI feedback controller output connects to an auxiliary control input (through R2) with the same scaling as the primary control input (through R1) of the controlled equipment (i.e. R1 = R2). If the scaling between the two control inputs is different, then the PI feedback controller gain must be adjusted accordingly. For example, if R2 = 2 × R1, then the gain of the auxiliary control input is half of the primary control input, so the PI feedback controller gain setting must be doubled to compensate and the control range must also be similarly increased. The system cannot function if R2 > 5 × R1 since the maximum control range will be < 10%, which is normally not sufficient.

PI feedback controller set up

Basic parameters for the PI feedback controller may be configured by:

Using an optional AiG2 interface display unit:

	User Action	**Result**
1	Press MENU to display the MENU.	MENU
2	Press ⌂ or ▽ to highlight Control.	Control
3	Press ↵ to open the CONTROL SET-UP page.	SET-UP Mode: RESET Range: 00% Delay: 001s Distance: 001m Start: 0050m/min Polarity: Rev
4	Press ⌂ or ▽ to step through parameter options.	
5	Press ▷ ◁ ⌂ ▽ to edit numerical parameters.	
6	Press ↵ to save the parameter and advance to the next parameter on the page.	
7	Press MENU or ⌂ to exit.	

Page 1	**Parameter**	**Value**	**Comment**			**DW**
SET-UP Mode: HOLD Range: 50% Delay: 001s Distance: 001m Start: 0050m/min Polarity: Rev	Mode	RESET	Resets the controller output voltage to zero.			In: 31
		ON	Runs the controller output.			
		HOLD	Holds the controller output voltage constant at its current value.			
	Range	0 ~ 50 %	Maximum controller output voltage range.			In: 33
	Delay	0 ~ 999 s	Response time of the controlled equipment (extruder or capstan); a typical value is 1 s.			In: 34
	Distance	0.1 ~ 1000m {1000 ft}	Distance of the wire path between the gauge and the controlled equipment (extruder or capstan).			In: 35
	Start	0 ~ 65535 m/min {65535 ft/min}	Minimum line speed for controller operation.			In: 32
			Line speed	< Start	> Start	
			Controller state	HOLD	ON / Ready	
	Polarity	Norm	Normal controller output polarity (see “PI feedback controller connection to production equipment” diagram for details).			In: 31.8
		Rev	Reverse controller output polarity (see “PI feedback controller connection to production equipment” diagram for details).			

The state of the controller and its output may also be viewed or changed from the “Basic ∅ Data” page:

	User Action	Result
1	Press to display the Basic ∅ Data pages.	●Average= 18.764mm ∅Error= -0.011mm Gate Clean Ctrl: HOLD +00%
2	Press to highlight the control mode “Ctrl” for editing.	Ctrl: HOLD +00%
3	Press or to step through the control mode options.	Ctrl: ON +00%
4	Press to engage the selected control mode.	

Note: “Metric” measurement units shown; for “Imperial” measurement unit operation, substitute millimetres (mm) with inches (in) and metres (m) with feet (ft).

Configuration via input parameters:

The PI feedback controller may be configured by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
31	0~7	Control switch		0=HOLD 1=ON 2=RESET	0
	8	Control output polarity		0=Normal 1=Reverse	0
32		PID start speed			50
33		Controller maximum output range	1=1%	0~50%	50
34		Extruder response time	1=1s	0~999s	1
35		Gauge head to extruder distance	1=0.1m {1=0.1ft}	1~10000	10

The controller output voltage “Range” is user configurable up to a maximum value of 50% of the input range (-20 V to +20 V), hence the maximum output voltage range is -10 V to + 10 V. In practice, a smaller range of 20% is normally sufficient for most applications where the controller output voltage is added to the fixed control voltage of the controlled equipment.

PI Feedback controller control states

When the gauge is initially powered up, the controller is forced to the RESET state (feedback control inactive, output voltage forced to zero).

- If ∅ core is > 96 % of ∅ preset, then the controller will not be permitted to switch to the ON state; the controller will be forced to the HOLD state if it was previously in the ON state.
- If the controller is in the ON state and the line speed drops below the “Start” speed, then the controller will automatically switch to the HOLD state and hold its output voltage constant. It will automatically revert to the ON state when the line speed exceeds the “Start” speed.
- If the controller is in the ON state and a NO READING, NO OBJECT or GATE DIRTY error condition occurs, then the controller will automatically switch to the HOLD state and hold its output voltage constant at the value immediately before the error condition. The controller will automatically revert back to the ON state whenever the error condition clears and the gauge is able to make diameter measurements.

PI feedback controller tuning

The PI feedback controller performance can be fine tuned to improve response time or suppress oscillations or instability by:

Using an optional AiG2 interface display unit:

	User Action	Result
1	Press MENU to display the MENU.	MENU
2	Press ⌂ or ⛉ to highlight Control.	Control
3	Press ⏭ to advance to the CONTROL TUNING page.	CONTROL TUNING ∅ Error = +00.000mm Loop O/P = +00% Mode: RESET I Gain: 50% P Gain: 50%
4	Press ⌂ or ⛉ to step through parameter options.	
5	Press ▷ ◁ ⌂ ⛉ to edit numerical parameters.	
6	Press ↵ to save the parameter and advance to the next parameter on the page.	
7	Press MENU or ⌂ to exit.	

Page 2	Parameter	Value [Default]	Comment	DW
CONTROL TUNING ∅ Error = +00.000mm Loop O/P = +00% Mode: RESET I Gain: 00% P Gain: 00%	∅Error		Diameter error (read only).	Out: 7
	Loop O/P		Controller output value (read only).	Out: 36
	Mode	RESET	Resets the controller output voltage to zero.	In: 31
		ON	Runs the controller output.	
		[HOLD]	Holds the controller output voltage constant at its current value.	
	I gain	0 ~ 100 % [50 %]	Diameter error integral gain	In: 37
	P gain	0 ~ 100 % [50 %]	Diameter error proportional gain	In: 36

Configuration via input parameters:

The PI feedback controller may be fine tuned by writing to the following input parameters:

Input parameters

DW	Bit	Comments	Unit	Range/Remark	Default value
31	0~7	Control switch		0=HOLD 1=ON 2=RESET	0
36		I gain	1=1%	0~100	50
37		P gain	1=1%	0~100	50

The error and PI feedback controller output may be read from the following output parameters:

Output parameters

DW	Bit	Comments	Units	Range/Remark
7		Average error	1=1um {1=0.1mil}	0~65535
36		Control output	1=1%	0~±50%

The proportional (P) and integral (I) gains have factory default values of 50 %. Fine adjustments of the P-gain and I-gain may be made to improve response time or suppress oscillations or instability, with the following considerations:

- Faster response can be achieved by increasing P and I gains, up to a maximum value of 100%; however this may result in unacceptable diameter oscillations or instability.
- Low speed production lines with large insulation wall thicknesses may require a reduction in the P-gain until diameter oscillations or instability is minimised. A reduction in the P-gain will require a corresponding reduction in the I-gain.
- Low speed production lines with a large distance between the DG gauge and the extruder may require a reduction in the I-gain until diameter oscillations or instability is minimised.

SPC (Statistical Process Control)

Statistical Process Control (SPC) is an optional software function on gauges fitted with the PI feedback controller option. It may be enabled by the end-user using a license key code; for further information see the chapter on "Enabling optional software functions".

SPC automatically adjusts the preset diameter for the PI feedback controller to minimise insulation diameter (and material consumption) whilst keeping the insulation diameter within the lower tolerance limit.

A short SPC sampling window is required for responsive adjustment of the preset diameter. The SPC sampling window is fixed at:

$$SPC\ sampling\ window = 3 \times \left(\frac{Distance}{Line\ speed} + Delay\right)$$

Distance is the extruder-to-DG gauge distance (as set on the "PID" pane of the "Interface" window).
Delay is the extruder response delay time (as set on the "PID" pane of the "Interface" window).

SPC requires that the measured diameter samples are normally-distributed. A chi-squared (χ^2) test of the data set is calculated to determine closeness to a normal distribution.

- The chi-squared value is normalised to a value of 100% for a distribution error at the upper limit of acceptability.
- A normalised chi-squared value exceeding 100% indicates non-normal diameter distribution.

The SPC function also calculates process capability indicators C_p and C_{pk} (valid only for normally-distributed diameter measurements), which should approach 100% in ideal manufacturing processes.

To configure and engage SPC:

	User Action	**Result**
1	Press MENU to display the "MENU".	MENU
2	Press ⌂ or ⌄ to highlight "Statistics".	Statistics
3	Press ↵ to enter the "STATISTICS" page.	STATISTICS Mode: Time Time: 00000s Std Dev: 00.000mm Max Dia: 00.000mm Mean: 00.000mm Min Dia: 00.000mm Remain: 00000s
4	Press ⌦ to advance to the "SPC" page.	SPC SPC: OFF Cp: 0100% Cpk: 0100%

				Chi: 00060 Available: No
4	Press ⌂ or ⌄ to select turn “SPC” on or off:			SPC SPC: ON
	OFF	Disable Statistical Process Control.		
	ON	Enable Statistical Process Control.		
5	Press ↵ to save the “SPC” state.			
6	If “SPC” is set to “ON”, then Statistical Process Control will be engaged when sufficient, normally-distributed data has been collected; this is indicated when the “Available” field displays “Yes”.			SPC SPC: ON Cp: 0100% Cpk: 0100% Chi: 00060 Available: Yes
	Field	**Description**		
	Cp	Process capability C_p.		
	Cpk	Process capability C_{pk}.		
	Chi	X^2 normal distribution test result.		
	Available	No	SPC suspended*.	
		Yes	SPC running.	

*SPC will only run (Available = Yes) if all of the following conditions are true:

- Sufficient number of diameter measurements collected.
- X^2 test indicates that diameter measurements are normally distributed.
- 1.5 x (Measured diameter) > Preset diameter > 0.5 x (Measured diameter)
- Core diameter < 0.9 x (Preset diameter)
- (Upper diameter limit) + (Lower diameter limit) > 6.18 x (Diameter standard deviation)

SPC may be configured by writing to the following input parameters:

Input parameters

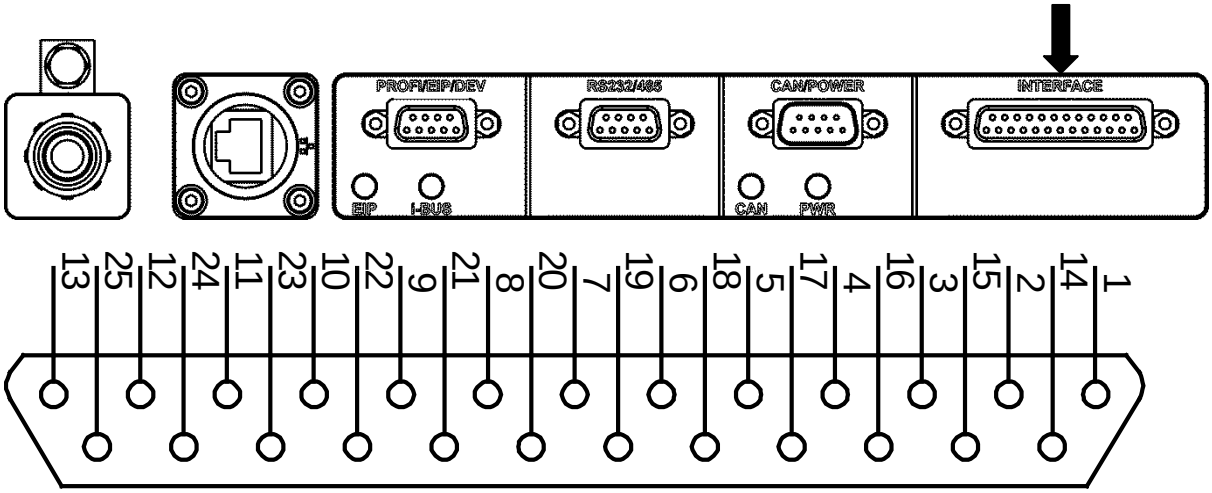
DW	Bit	Comments	Unit	Range / Remark	Default
42		SPC switch		0=OFF 1=ON	0

SPC data may be read from the following output parameters:

Output parameters

DW	Bit	Comments	Units	Range/Remark
25		Statistics		
	0	Normal distribution		0=No 1=Yes
	1	Statistics available		0=No 1=Yes
	2	SPC running		0=No 1=Yes
31		Chi of normal distribution	1=1%	
32		Cp	1=1%	
33		Cpk	1=1%	

INTERFACE CONNECTOR PIN OUTS



Connector type: DB25 female (socket)

Pin	Designation	Functional group	Description	Notes
1	P0V	PI feedback controller	PI feedback controller ground	Isolated ground
2	POUT	PI feedback controller	PI feedback controller output	±10V isolated output
3	AOUT1	Analogue outputs	Analogue output 1	±10V full scale isolated output
4	AOUT3	Analogue outputs	Analogue output 3	±10V full scale isolated output
5	COM1	Relay outputs	Relay 1 common	Maximum 1A / 24VDC
6	COM2	Relay outputs	Relay 2 common	Maximum 1A / 24VDC
7	COM3	Relay outputs	Relay 3 common	Maximum 1A / 24VDC
8	COM4	Relay outputs	Relay 4 common	Maximum 1A / 24VDC
9	AGND	Analogue input	Analogue input ground	Isolated ground
10	LIN2	Logic inputs	Logic input 2	Low < +3 V; High > +10.5 V; Max ±30 V
11	DGND	Logic inputs	Digital ground	For logic and speed pulse inputs, NOT isolated
12	SPD2	Speed pulse inputs	Speed input 2 (Low voltage)	Low < +2 V; High > +4 V; Max ±30 V
13	SPD1	Speed pulse inputs	Speed input 1 (High voltage)	Low < +5 V; High > +9 V; Max ±50 V
14	PIN	PI feedback controller	PI feedback controller input	Max ±20V isolated input
15	Agnd	Analogue outputs	Analogue output ground	Isolated ground
16	AOUT2	Analogue outputs	Analogue output 2	±10V full scale isolated output
17	NO1	Relay outputs	Relay 1 normally open contact	Maximum 1A / 24VDC
18	NO2	Relay outputs	Relay 2 normally open contact	Maximum 1A / 24VDC
19	NO3	Relay outputs	Relay 3 normally open contact	Maximum 1A / 24VDC
20	NO4	Relay outputs	Relay 4 normally open contact	Maximum 1A / 24VDC
21	-	-	-	Not connected
22	AIP	Analogue input	Analogue input	0–10 V full scale isolated input
23	LIN1	Logic inputs	Logic input 1	Low < +3 V; High > +10.5 V; Max ±30V
24	REG.GND	Power supply	Power supply ground (0 V)	
25	+24V	Power supply	+24 V power supply	
S	Shield			

PROTON STANDARD PARAMETER ACCESS PROTOCOL

This protocol provides access to individual parameters or blocks of parameters and is typically used in a production environment where the gauge is connected to a computer, 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 and written and are used to configure the gauge.
- Output parameters are read only and provide access to gauge status and measurement data. They may be requested to stream continuously from the gauge.

The Proton standard protocol RS-232 data format is:

Number of data bits	Parity	Number of stop bits	Flow control	Default baud rate
8	None	1	None	9600 bit / s

PARAMETER WORD FORMATS

Bit pattern words

Words defined as a bit pattern are formatted as 4 characters representing bits 15 – 0 in hexadecimal (0 – 9; A – F in capitals only), with bit 15 as the most significant bit. Unused or reserved bits are set to binary zero.

Example:

Input parameters

DW	Comments	Range	Bit	Example configuration	Value	Weight	Hexadecimal value
	System Function						
0	Measurement mode	0=Solid 1=Glass 3=Helix 4=Multi-wire	0	1=Glass	1	1	9
			1		0	2	
			2		0	4	
	Unit	0=Metric 1=Imperial	3	1=Imperial	1	8	
	Shrinkage mode	0=Percent 1=Abs	4	1=Abs	1	1	1
			5		0	2	
			6		0	4	
			7		0	8	
	Core number for helix	0=3 cores 1=others	8	0=3 cores	0	1	0
			9		0	2	
			10		0	4	
			11		0	8	
			12		0	1	0
			13		0	2	
			14		0	4	
			15		0	8	

For a gauge configured for Glass Measurement mode, Imperial Units and Absolute Shrinkage Mode, the “System Function” (DW0) input parameter value is 0019.

Numerical value words

Words defined as a numerical value are formatted as a string of characters representing the value in decimal format, complete with sign where appropriate, but with no decimal point and leading zeros suppressed.

Example 1:

Output parameters

DW	Comments	Units	Range
3	X diameter	1=1um {1=0.1mil}	0~65535

For a gauge measuring an object X diameter of 25.400 mm, the “X diameter” (DW3) output parameter value is 25400 (as can be seen from the “Units” column, the units for this parameter are defined in micrometres and hence a decimal point is unnecessary).

Example 2:

Output parameters

DW	Comments	Units	Range
20	Cable position on X axis	1=1%	0~±100

For a gauge measuring an object located at -15 % off centre of the X-axis optical gate, the “Cable position on X axis” (DW20) output parameter value is -15.

Double length words

Double word length parameters are accessed by the address of the first word only. The data in both words is formatted together as a single string.

Example:

Input parameters

DW	Comments	Unit	Default value
60 61	IP address for MODBUS	xx.xx.xx.xx	C0A80001 (192.168.0.1)

For a gauge configured with a MODBUS IP address of decimal 192.168.0.1, the double length “IP address for MODBUS” (DW60 - 61) input parameter value is C0A80001. When reading or writing this parameter, it is addressed by the first parameter word only, i.e. 60.

READING INPUT PARAMETERS

If a PC-based terminal program (such as MS Windows HyperTerminal) and keyboard is being used for RS-232 communication with the gauge, then the carriage return followed by line feed (<CR><LF>) sequence of commands can be replaced by a single press of the 'Enter ↵' key.

Reading a single input parameter

Use the following request format to read a single input parameter value:

Request format	?[Input parameter number]<CR><LF>
Response format	[Input parameter value]<CR><LF>

Example:

Input parameters

DW	Comments	Unit	Range/Remark	Default value
6	Preset average upper limit	1=1um {1=0.1mil}	0~65535	500

To read the value of the "Preset average upper limit" (DW6) input parameter, send the following request:

?6<CR><LF>

Response:

500<CR><LF>

This response indicates a "Preset average upper limit" (DW6) value of 500 um.

Reading a block of input parameters

Use the following request format to read a contiguous block of input parameter values:

Request format	?[Input parameter number][Space][Number of parameters]<CR><LF>
Response format	[Input parameter value]<CR><LF>

Only consecutive parameter values may be requested in a block parameter request.

Example:

Input parameters

DW	Comments	Unit	Range/Remark	Default value
8	Preset X upper limit	1=1um {1=0.1mil}	0~65535	500
9	Preset X lower limit	1=1um {1=0.1mil}	0~65535	500
10	Preset Y upper limit	1=1um {1=0.1mil}	0~65535	500

DW	Comments	Unit	Range/Remark	Default value
11	Preset Y lower limit	1=1um {1=0.1mil}	0~65535	500

To read the 4 consecutive input parameter values beginning with the “Preset X upper limit” (DW8) input parameter, send the following request:

?6 4<CR><LF>

Response:

500<CR><LF>
500<CR><LF>
500<CR><LF>
500<CR><LF>

This response indicates “Preset X upper limit” (DW8), “Preset X lower limit” (DW9), “Preset Y upper limit” (DW10) and “Preset Y lower limit” (DW11) values of 500 um, 500 um, 500 um and 500 um respectively.

WRITING INPUT PARAMETERS

Writing a single input parameter

Use the following request format to write a single input parameter value:

Request format	&[Input parameter number][Space][Input parameter value]<CR><LF>
Response format	[Input parameter value]<CR><LF>

The response is the post-write value of the input parameter; therefore a successful write is indicated by a response value that is identical to write request value.

Example:

Input parameters

DW	Comments	Unit	Range/Remark	Default value
6	Preset average upper limit	1=1um {1=0.1mil}	0~65535	500

To write a value of 1000 um to the “Preset average upper limit” (DW6) input parameter, send the following request:

&6 1000<CR><LF>

Response:

1000<CR><LF>

This response indicates that the “Preset average upper limit” (DW6) input parameter value has been successfully set to1000 um.

READING OUTPUT PARAMETERS

If a PC-based terminal program (such as MS Windows HyperTerminal) and keyboard is being used for RS-232 communication with the gauge, then the carriage return followed by line feed (<CR><LF>) sequence of commands can be replaced by a single press of the 'Enter ☐☐' key.

Reading a single output parameter

Use the following request format to read a single output parameter value:

Request format	~[Output parameter number][Space][Number of parameters]<CR><LF>
Response format	[Output parameter value]<CR><LF>

Example:

Output parameters

DW	Comments	Units	Range/Remark
3	X diameter	1=1um {1=0.1mil}	0~65535

To read the value of the "X diameter" (DW3) output parameter, send the following request:

~3<CR><LF>

Response:

25400<CR><LF>

This response indicates that the gauge has measured an "X diameter" (DW3) value of 25400 um.

Reading a block of output parameters

Use the following request format to read a contiguous block of output parameter values:

Request format	~[Output parameter number][Space][Number of parameters] <CR><LF>
Response format	[Output parameter value]<CR><LF>

Only consecutive parameter values may be requested in a block parameter request.

Example:

Output parameters

DW	Comments	Units	Range/Remark
2	Average diameter	1=1um {1=0.1mil}	0~65535
3	X diameter	1=1um {1=0.1mil}	0~65535
4	Y diameter	1=1um {1=0.1mil}	0~65535

To read the consecutive 3 output parameter values beginning with the "Average diameter" (DW2) output parameter, send the following request:

~6 3<CR><LF>

Response:

10000<CR><LF>
9000<CR><LF>
11000<CR><LF>

This response indicates that the gauge has measured “Average diameter” (DW2), “X diameter” (DW3) and “Y diameter” (DW4) values of 10000 um, 9000 um and 11000 um respectively.

Reading a continuous stream of a single output parameter

Use the following request format to read a single output parameter value as a continuous stream:

Request format	#[Output parameter number]<CR><LF>
Response format	[Output parameter value]<CR><LF>

The update rate for streaming output parameter values depends on both the data transfer rate and the data length. For a data transfer rate of 1200 bit / s and a data length of seven 8-bit characters per parameter value, approximately 10 individual parameter values can be transferred per second.

The data stream can be terminated by sending an escape character to the gauge (ASCII code decimal 27 or the ‘Esc’ key or the ‘Ctrl’’[‘ key combination on a PC keyboard).

Example:

Output parameters

DW	Comments	Units	Range/Remark
3	X diameter	1=1um	0~65535

To read the value of the “X diameter” (DW3) output parameter as a continuous stream, send the following request:

#3<CR><LF>

Response:

25400<CR><LF>
25395<CR><LF>
25390<CR><LF>
25385<CR><LF>
25380<CR><LF>
25375<CR><LF>
25370<CR><LF>
25365<CR><LF>
25360<CR><LF>

This response indicates that the gauge has measured an object whose “X diameter” (DW3) value has tapered down from 25400 um to 25360 um.

The data stream can be terminated at by sending an escape character to the gauge (ASCII code decimal 27 or the ‘Esc’ key or the ‘Ctrl’’[‘ key combination on a PC keyboard).

Reading a continuous stream of a block of output parameters

Use the following request format to read a contiguous block of output parameter values as a continuous stream:

Request format	#[Output parameter number][Space][Number of parameters]<CR><LF>
Response format	[Output parameter value]<CR><LF>

Only consecutive parameter values may be requested in a block parameter request.

The update rate for streaming output parameter values depends on both the data transfer rate and the data length. For a data transfer rate of 1200 bit / s and a data length of seven 8-bit characters per parameter value, approximately 10 individual parameter values can be transferred per second.

The data stream can be terminated by sending an escape character to the gauge (ASCII code decimal 27 or the 'Esc' key or the 'Ctrl''[' key combination on a PC keyboard).

Example:

Output parameters

DW	Comments	Units	Range/Remark
2	Average diameter	1=1um	0~65535
3	X diameter	1=1um	0~65535
4	Y diameter	1=1um	0~65535

To read the consecutive 3 output parameter values beginning with the "Average diameter (DW2)" output parameter, send the following request:

#6 3<CR><LF>

Response:

10000<CR><LF>
9000<CR><LF>
11000<CR><LF>
11000<CR><LF>
10000<CR><LF>
12000<CR><LF>
12000<CR><LF>
11000<CR><LF>
13000<CR><LF>
13000<CR><LF>
12000<CR><LF>
14000<CR><LF>

This response indicates that the gauge has measured an object whose "X diameter" (DW3) value has increased from 9000 um to 12000 um and "Y diameter" (DW4) value has increased from11000 um to 14000 um. The "Average diameter" (DW3) has increased from 9000 um to 12000 um accordingly.

The data stream can be terminated by sending an escape character to the gauge (ASCII code decimal 27 or the 'Esc' key or the 'Ctrl''[' key combination on a PC keyboard).

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.
10	16	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	9600 bit / s

PARAMETER WORD FORMATS

Modbus protocol functions express the binary data stored in input and output registers in hexadecimal format:

Decimal and binary equivalents for hexadecimal digits

Hexadecimal (hex)	Decimal (dec)	Binary (bin)			
		8	**4**	**2**	**1**
0	0	0	0	0	0
1	1	0	0	0	1
2	2	0	0	1	0
3	3	0	0	1	1
4	4	0	1	0	0
5	5	0	1	0	1
6	6	0	1	1	0
7	7	0	1	1	1
8	8	1	0	0	0
9	9	1	0	0	1
A	10	1	0	1	0
B	11	1	0	1	1
C	12	1	1	0	0
D	13	1	1	0	1
E	14	1	1	1	0
F	15	1	1	1	1

Bit pattern parameters

Words defined as a bit pattern have bit 15 as the most significant (highest value) bit. They are expressed as four hexadecimal digits. Unused or reserved bits are set to binary zero.

Example:

Input parameters

DW	Comments	Range	Bit	Example configuration	Value (bin)	Weight	Value (hex)	Byte
0	Measurement mode	0=Solid 1=Glass 3=Helix 4=Multi-wire	0	1=Glass	1	1	9	Low byte
			1		0	2		
			2		0	4		
	Unit	0=Metric 1=Imperial	3	1=Imperial	1	8		
	Shrinkage mode	0=Percent 1=Abs	4	1=Abs	1	1	1	
			5		0	2		
			6		0	4		
			7		0	8		
	Core number for helix	0=3 cores 1=others	8	0=3 cores	0	1	0	High byte
			9		0	2		
			10		0	4		
			11		0	8		
			12		0	1	0	
			13		0	2		
			14		0	4		
			15		0	8		

For a gauge configured for Glass Measurement mode, Imperial Units and Absolute Shrinkage Mode, the “System Function” (DW0) input parameter value is hexadecimal 0019.

Unsigned (positive only) numerical value parameters

Unsigned values (positive only) are represented internally in the parameter word as a **natural binary number** i.e. the 16-bit parameter word represents a range of decimal 0 to 65535.

Example:

Output parameters

DW	Comments	Units	Range	Example value (dec)	Example value (hex)	
3	X diameter	1=1um {1=0.1mil}	0 ~ 65535	15000	High byte	3A
					Low byte	98

For a gauge measuring an object X-axis diameter of 15000um (or 15.000mm), the “X diameter” (DW3) output parameter value in hexadecimal is 3A98.

Hexadecimal to unsigned decimal conversion

Example: To convert hexadecimal “3A98” to unsigned decimal:

1. Write the hexadecimal and equivalent binary for each hexadecimal digit in the table below:

Hex																
Bin																
Dec	**32768**	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**

⇩

Hex	3				A				9				8			
Bin	0	0	1	1	1	0	1	0	1	0	0	1	1	0	0	0
Dec	**32768**	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**

2. Sum together all decimal values marked with a binary “1”:

   8192 + 4096 + 2048 + 512 + 128 + 16 + 8 = 15000

Unsigned decimal to hexadecimal conversion

Example: To convert unsigned decimal “15000” to hexadecimal:

1. In the table below, proceeding from left-to-right along the “**Bin**” row, mark a “1” against the corresponding “**Dec**” values that add up to decimal 15000:

Dec ⇨	**32768**	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
Bin																
Hex																

⇩

Dec ⇨	15000															
	32768	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
Bin			1	1	1		1		1			1	1			
Hex																

   8192 + 4096 + 2048 + 512 + 128 + 16 + 8 = 15000

2. Fill in any blank “**Bin**” cells with “0” and then convert each group of 4 binary bits to its equivalent hexadecimal digit:

Dec	15000															
	32768	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
Bin	0	0	1	1	1	0	1	0	1	0	0	1	1	0	0	0
Hex	3				A				9				8			

Signed (positive and negative) numerical value parameters

Signed values (both positive and negative) are represented internally in the parameter word as a **2's complement binary number** i.e. the 16-bit parameter word represents a range of decimal -32768 to 32767.

Example:

Output parameters

DW	Comments	Units	Range	Example value (dec)	Example value (hex)	
20	Cable position on X axis	1=1%	0 ~ ±100	-15%	High byte	FF F1
					Low byte	

For a gauge measuring an object located at -15 % off centre of the X-axis optical gate, the "Cable position on X axis" (DW20) output parameter value in hexadecimal is FFF1.

Hexadecimal to signed decimal conversion

Example: To convert hexadecimal "FFF1" to signed decimal:

1. Write the hexadecimal and equivalent binary for each hexadecimal digit in the table below:

Hex																
Bin																
Dec	**-32768**	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**

⇩

Hex	F				F				F				1			
Bin	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1
Dec	**-32768**	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**

1. Sum together all decimal values which have a binary "1" next to them:

   -32768 + 16384 + 8192 + 4096 + 2048 + 1024 + 512 + 256 + 128 + 64 + 32 + 16 + 1 = -15

Signed decimal to hexadecimal conversion

Example: To convert signed decimal "-15" to hexadecimal:

1. In the table below, proceeding from left-to-right along the "**Bin**" row, mark a "1" against the corresponding "**Dec**" values that add up to decimal -15:

Dec																
⇨	**-32768**	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
Bin																
Hex																

⇩

Dec	-15															
⇨	**-32768**	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
Bin	1	1	1	1	1	1	1	1	1	1	1	1				1
Hex																

-32768 + 16384 + 8192 + 4096 + 2048 + 1024 + 512 + 256 + 128 + 64 + 32 + 16 + 1 = -15

2. Fill in any blank "**Bin**" cells with "0" and then convert each group of 4 binary bits to its equivalent hexadecimal digit:

Dec	-15536															
	-32768	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
Bin	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1
Hex	F				F				F				1			

Double word parameters

Double word parameters (such as IP addresses) extend across two parameter addresses and are two words in length; when formatting these parameters for the Modbus protocol; **care must be taken to sequence the two words in the correct order.**

Example:

Input parameters

DW	Comments	Units	Default value (dec)		Example value (hex)	
60	IP address for MODBUS	xxx.xxx.xxx.xxx	192.168.0.1	1	Low byte	01
				0	High byte	00
61				168	Low byte	A8
				192	High byte	C0

For a gauge configured with an "IP address for MODBUS" of decimal 192.168.0.1:

- Input parameter DW60 has a hexadecimal value of 0001.
- Input parameter DW61 has a hexadecimal value of C0A8.

The "IP address for MODBUS" parameter may be read / written in a block read / write operation with DW60 as the start parameter address and a parameter word count of 2.

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.

Example: To read the 4 consecutive input parameters starting with “Preset X upper limit” (DW8) from a gauge with Modbus address 1, send the following Modbus query:

Input parameters

DW	Comments	Unit	Range	Default value (dec)	Default value (hex)	
8	Preset X upper limit	1=1um {1=0.1mil}	0 ~ 65535	500	High byte	01
					Low byte	F4
9	Preset X lower limit	1=1um {1=0.1mil}	0 ~ 65535	500	High byte	01
					Low byte	F4
10	Preset Y upper limit	1=1um {1=0.1mil}	0 ~ 65535	500	High byte	01
					Low byte	F4
11	Preset Y lower limit	1=1um {1=0.1mil}	0 ~ 65535	500	High byte	01
					Low byte	F4

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 × 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.

Example: To write a value of 1000um to the “Preset average upper limit” (DW6) input parameter to a gauge with Modbus address 1, send the following Modbus query:

Input parameters

DW	Comments	Unit	Range	Target value (dec)	Target value (hex)	
6	Preset average upper limit	1=1um {1=0.1mil}	0 ~ 65535	1000	High byte	03
					Low byte	E8

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.

Example: To write the target values listed below to a continuous block of input parameters starting with “Preset average diameter” (DW1) to a gauge with Modbus address 1, send the following Modbus query:

Input parameters

DW	Comments	Unit	Range	Target value (dec)	Target value (hex)	
1	Preset average diameter	1=1um {1=0.1mil}	0 ~ 65535	8000	High byte	1F
					Low byte	40
2	Preset X diameter	1=1um {1=0.1mil}	0 ~ 65535	8000	High byte	1F
					Low byte	40
3	Preset Y diameter	1=1um {1=0.1mil}	0 ~ 65535	8000	High byte	1F
					Low byte	40

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.

Example: To read the 3 consecutive output parameter starting with “Average diameter” (DW2) from a gauge with Modbus address 1, send the following Modbus query:

Output parameters

DW	Comments	Units	Range	Example value (dec)	Example value (hex)	
2	Average diameter	1=1um {1=0.1mil}	0 ~ 65535	2000	High byte	07
					Low byte	D0
3	X diameter	1=1um {1=0.1mil}	0 ~ 65535	1500	High byte	05
					Low byte	DC
4	Y diameter	1=1um {1=0.1mil}	0 ~ 65535	2500	High byte	09
					Low byte	C4

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.

INPUT PARAMETERS

(2013.08.26)

Range of input parameters accessible by Interface			
Interface	**Lowest DW**	**Highest DW**	**Length/words**
PROFIBUS/DeviceNet /EtherNet/IP Master to Slave	0	49	50
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	87	88

1 word = 2 bytes

DW	Bit	Comments	Unit	Range / Remark	Default
0		System Function			
	0	Measurement Mode		0=Solid 1=Glass 3=Helix 4=Multi-wire	0
	1				
	2				
	3	Unit		0=Metric 1=Imperial	0
	4	Shrinkage mode		0=Percent 1=Abs	0
	5	SMFD tolerance mode		0=Absolute 1=Percentage	0
	6	SMFD flaw interval mode		0=Time 1=Length	0
	7				
	8	Core number for helix		0=3 cores 1=others	
1		Preset average diameter	1=1um {1=0.1mil}	0~65535	10000
2		Preset X diameter	1=1um {1=0.1mil}	0~65535	10000
3		Preset Y diameter	1=1um {1=0.1mil}	0~65535	10000
4		Preset Z diameter	1=1um {1=0.1mil}	0~65535	10000
5		Preset Ovality	1=1um {1=0.1mil}	0~65535	100
6		Preset average upper limit	1=1um {1=0.1mil}	0~65535	500
7		Preset average lower limit	1=1um {1=0.1mil}	0~65535	500
8		Preset X upper limit	1=1um {1=0.1mil}	0~65535	500
9		Preset X lower limit	1=1um {1=0.1mil}	0~65535	500
10		Preset Y upper limit	1=1um {1=0.1mil}	0~65535	500
11		Preset Y lower limit	1=1um {1=0.1mil}	0~65535	500
12		Preset Z upper limit	1=1um {1=0.1mil}	0~65535	500
13		Preset Z lower limit	1=1um {1=0.1mil}	0~65535	500
14		Preset Ovality upper limit	1=1um {1=0.1mil}	0~65535	50
15		Preset Ovality lower limit	1=1um {1=0.1mil}	0~65535	50
16		Preset SMFD upper limit	1=1um {1=0.1mil}	0~65535	500

17		Preset SMFD lower limit	1=1um {1=0.1mil}	0~65535	500
18		Preset core diameter	1=1um {1=0.1mil}	0~65535	8000
19		Diameter Average time	1=1ms	0~5000	1000
20		Shrinkage	1=1um {1=0.1mil} Or 1=0.1%	0~10000	0
21		Helix pitch	1=10um {1=0.1mil}	1~65535	1000
22		SMFD reference average time	1=1ms	1~1000	100
23		Flaw interval setting	1=0.001s 1=0.001m {1=0.001ft}	1~65535	100
24		Relay closure time	1=1ms	1~5000	100
25		Reset length, running maximum/minimum and flaws		1=Reset other=Invalid	0
26		Logic input			
	0 1	Logic input 1 function		0=Reset 1=External Alarm 1 2=External Alarm 2	0
	2 3	Logic input 2 function		0=Reset 1=External Alarm 1 2=External Alarm 2	1
	4	Logic input 1 polarity		0=Active low 1=Active high	0
	5	Logic input 2 polarity		0=Active low 1=Active high	0
27		Relays			
	0 1 2 3	Relay 1 function		0=Gauge OK 1=Over any limit (excluding ovality limits) 2=Under any limit (excluding ovality limits) 3=Flaw 4=Lump 5=Neck 6=Over average upper limit 7=Under average lower limit 8=Over X upper limit 9=Under X lower limit 10=Over Y upper limit 11=Under Y lower limit 12=Over Z upper limit 13=Under Z lower limit 14=Over ovality upper limit 15=Under ovality lower limit	0
	4 5 6 7	Relay 2 function			6
	8 9 10 11	Relay 3 function			7
	12 13 14 15	Relay 4 function			3

28		Line speed source		0=Preset 1=Pulse 2=Analogue	0
29		Preset line speed	1=1m/min {1=1ft/min}	0~65535	100
30		Line speed full scale/gain	1=1m/min {1=1ft/min) Or 1=1pulse/m {1=1pulse/ft)	0~65535	1000
31	0~7	Control switch		0=HOLD 1=ON 2=RESET	0
	8	Control output polarity		0=Normal 1=Reverse	0
32		PID start speed	1=1m/min {1=1ft/min}	0~65535	50
33		Controller maximum output range	1=1%	0~50%	50
34		Extruder response time	1=1s	0~999s	1
35		Gauge head to extruder distance	1=0.1m {1=0.1ft}	1~10000	10
36		I gain	1=1%	0~100	50
37		P gain	1=1%	0~100	50
38		Analogue output			
	0	Analogue output 1		0=Average 1=X 2=Y 3=Z 4=Ovality 5=Average error 6=X error 7=Y error 8=Z error 9=Ovality error	0
	1				
	2				
	3				
	4	Analogue output 2			1
	5				
	6				
	7				
	8	Analogue output 3			2
	9				
	10				
	11				
	12				
	13				
	14				
	15	Response speed		0=Instant 1=Averaged	0
39		Analogue output 1 full scale	1=1um {1=0.1mil}	0~65535	10000
40		Analogue output 2 full scale	1=1um {1=0.1mil}	0~65535	10000
41		Analogue output 3 full scale	1=1um {1=0.1mil}	0~65535	10000
42		SPC switch		0=OFF 1=ON	0
43		Statistics time	1=1s	1~5000	10
44		FFT sampling rate		1=1Hz	10000
45					
46		SMFD measurement average time	1=0.1ms	1~100	10
47		Start speed for SMFD detection	1=1m/min {1=1ft/min}	1~65535	0
48					

49					
50		PROFIBUS address	1=1	0~125	4
51		CAN address	1=1	0~255	17
52		CAN baud rate		0=250 1=500 2=1000 other=500	2
53		RS232 baud rate		0=4800 1=9600 2=19200 3=38400 4=115200	1
54		RS232 mode		0=Modbus 1=Proton 2=SLP 3=Print	0
55		RS422/RS485 mode		0=Modbus 1=Proton 2=SLP	0
56		RS422/RS485 baud rate		0=4800 1=9600 2=19200 3=38400 4=115200 5=250K 6=500K 7=1M	1
57		Modbus address	1=1	0~255	1
58		Ethernet DHCP		0=Disable 1=Enable	0
59		EIP DHCP		0=Disable 1=Enable	0
60		MODBUS IP address	xx.xx.xx.xx		C0A80164 (192.168.1.100)
61					
62		Anybus IP address	xx.xx.xx.xx		C0A80165 (192.168.1.101)
63					
64		Subnet mask	xx.xx.xx.xx		255.255.0.0
65					
66		Gateway	xx.xx.xx.xx		C0A80101 (192.168.1.1)
67					
68		CAN termination	1=1	0=OFF 1=ON	1
69		Bluetooth mode		0=Modbus 1=Proton	0
70		Diameter compensation coefficient	1=0.0001		10000
71		Restore parameters to factory defaults		63000=restore to factory defaults other=invalid	
72		UDP data output time interval	1=1ms	0~5000 (0=disable UDP output)	0
73		Analogue output 1 gain	1=1		10000
74		Analogue output 1 zero	1=1		0
75		Analogue output 2 gain	1=1		10000
76		Analogue output 2 zero	1=1		0
77		Analogue output 3 gain	1=1		10000
78		Analogue output 3 zero	1=1		0
79		DeviceNet address		0~63	10

80		DeviceNet baud rate		0=125K 1=250K 2=500K	2
81		UDP destination IP address (last octet only)		Port number fixed to 1111	2
82		Endianess		1=Little endian 0=Big endian	0
83		Parameter group		0~99	0
84		Analogue input gain	1=1		10000
85		Analogue input zero	1=1		0
86					
87					

OUTPUT PARAMETERS

(2013.08.26)

Range of output parameters accessible by Interface			
Interface	**Lowest DW**	**Highest DW**	**Length/words**
PROFIBUS/DeviceNet /EtherNet/IP Slave to Master	0	39	40
CAN-bus / RS-232 / RS-422/485 / Ethernet / Bluetooth	0	52	53

1 word = 2 bytes

DW	Bit	Comments	Units	Range/Remark
0	0 1 2	Measurement Mode		0=Solid 1=Glass 3=Helix 4=Multi-wire
	3	Unit		0=Metric 1=Imperial
	4	Shrinkage mode		0=Percentage 1=Abs
	5	Diameter resolution		0=Standard 1=High-resolution
	6	Over average upper limit		0=OK 1=Over limit
	7	Under average lower limit		0=OK 1=Over limit
	8	Over X upper limit		0=OK 1=Over limit
	9	Under X lower limit		0=OK 1=Over limit
	10	Over Y upper limit		0=OK 1=Over limit
	11	Under Y lower limit		0=OK 1=Over limit
	12	Over Z upper limit		0=OK 1=Over limit
	13	Under Z lower limit		0=OK 1=Over limit
	14	Over ovality upper limit		0=OK 1=Over limit
	15	Under ovality lower limit		0=OK 1=Over limit
1	0	Res		
	1	No reading		0=OK 1=No Reading
	2	No object		0=OK 1=No Object

	3	Lens dirty		0=OK 1=Lens Dirty
	4	Line speed too low for helix mode		0=OK 1=Too Low
	5	Line speed too high for helix mode		0=OK 1=Too High
	6	Gauge overheat		0=OK 1=Gauge overheat
	7			
	8	External alarm 1		0=OK 1=Alarm
	9	External alarm 2		0=OK 1=Alarm
	10~15			
2		Average diameter / envelope	1=1um {1=0.1mil}	0~65535
3		X diameter	1=1um {1=0.1mil}	0~65535
4		Y diameter	1=1um {1=0.1mil}	0~65535
5		Z diameter	1=1um {1=0.1mil}	0~65535
6		Ovality	1=1um {1=0.1mil}	0~65535
7		Average error / envelope error	1=1um {1=0.1mil}	0~65535
8		X error	1=1um {1=0.1mil}	0~65535
9		Y error	1=1um {1=0.1mil}	0~65535
10		Z error	1=1um {1=0.1mil}	0~65535
11		Ovality error	1=1um {1=0.1mil}	0~65535
12		Latest lump value	1=1um {1=0.1mil}	0~65535
13		Latest lump position	1=1m {1=1ft}	0~65535
14		Latest neck value	1=1um {1=0.1mil}	0~65535
15		Latest neck position	1=1m {1=1ft}	0~65535
16		Lump count	1=1	0~65535
17		Neck count	1=1	0~65535
18		Running maximum diameter	1=1um {1=0.1mil}	0~65535
19		Running minimum diameter	1=1um {1=0.1mil}	0~65535
20		X axis cable position	1=1%	0~±100
21		Y axis cable position	1=1%	0~±100
22		Z axis cable position	1=1%	0~±100
23		Line speed	1=1m/min {1=1ft/min}	0~65535
24		Length	1=1m {1=1ft}	0~65535
25		Statistics		
	0	Normal distribution		0=No 1=Yes

	1	Statistics available		0=No 1=Yes
	2	SPC running		0=No 1=Yes
26		Statistics remaining time	1=1s	0~65535
27		Standard deviation	1=1um {1=0.1mil}	0~65535
28		Maximum diameter	1=1um {1=0.1mil}	0~65535
29		Minimum diameter	1=1um {1=0.1mil}	0~65535
30		Mean diameter	1=1um {1=0.1mil}	0~65535
31		Chi of normal distribution	1=1%	
32		Cp	1=1%	
33		Cpk	1=1%	
34		FFT remaining time	1=1s	
35		Control status		0=OFF 1=ON 2=Reset 3=Ready
36		Control output	1=1%	0~±50%
37		Running average diameter	1=1um {1=0.1mil / 1=0.01mil}	0~65535
38				
39				
40		Communications bus type		0=NONE 1=PROFIBUS 2=DEV 3=EtherNet/IP 4=PROFINET
41		Res		
42		Res		
43		Res		
44		MODBUS IP address	xx.xx.xx.xx	
45				
46		AnyBus IP address	xx.xx.xx.xx	
47				
48		Subnet Mask	xx.xx.xx.xx	
49				
50		Gateway	xx.xx.xx.xx	
51				
52		Gauge temperature	1=0.1°C	

APPENDIX 1: EXAMPLE PROFINET TO PLC CONNECTION CONFIGURATION PROCEDURE

This section illustrates the configuration of a Siemens S7 PLC using the Siemens Simatic Step7 PLC programming software for PROFINET communications with a Proton Products PROFINET-enabled gauge; for other makes and models of PLC, please consult your PLC user manual.

Configuring the gauge to communicate with a PLC over PROFINET consists of:

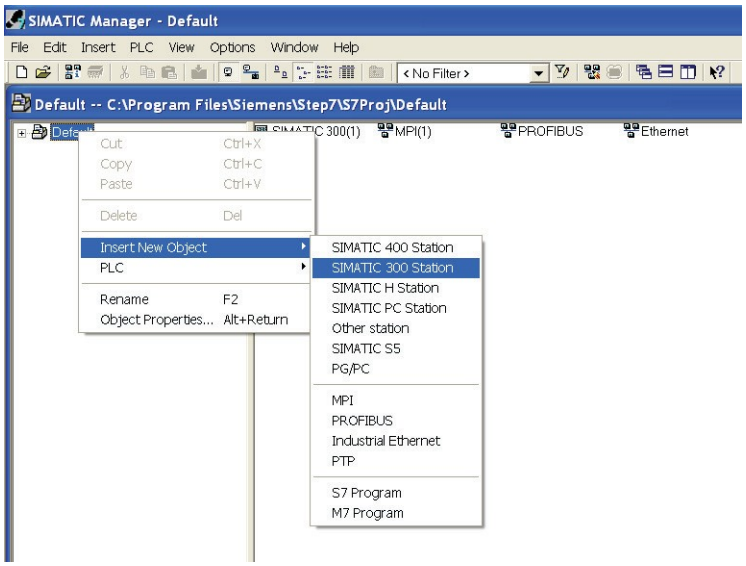
1. **PLC and PLC PROFINET interface setup**
2. **PLC PROFINET interface configuration**
3. **Connection testing**

PLC AND PROFINET INTERFACE SETUP

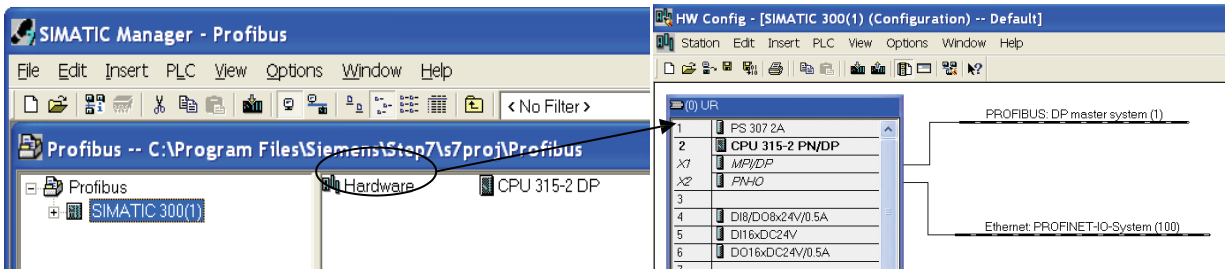
In the following example, a Siemens S7315-2 CPU, a 2A power supply and a standard rack will be setup using the Siemens Simatic Step7 software:

1. Start the Simatic software and create a new project.

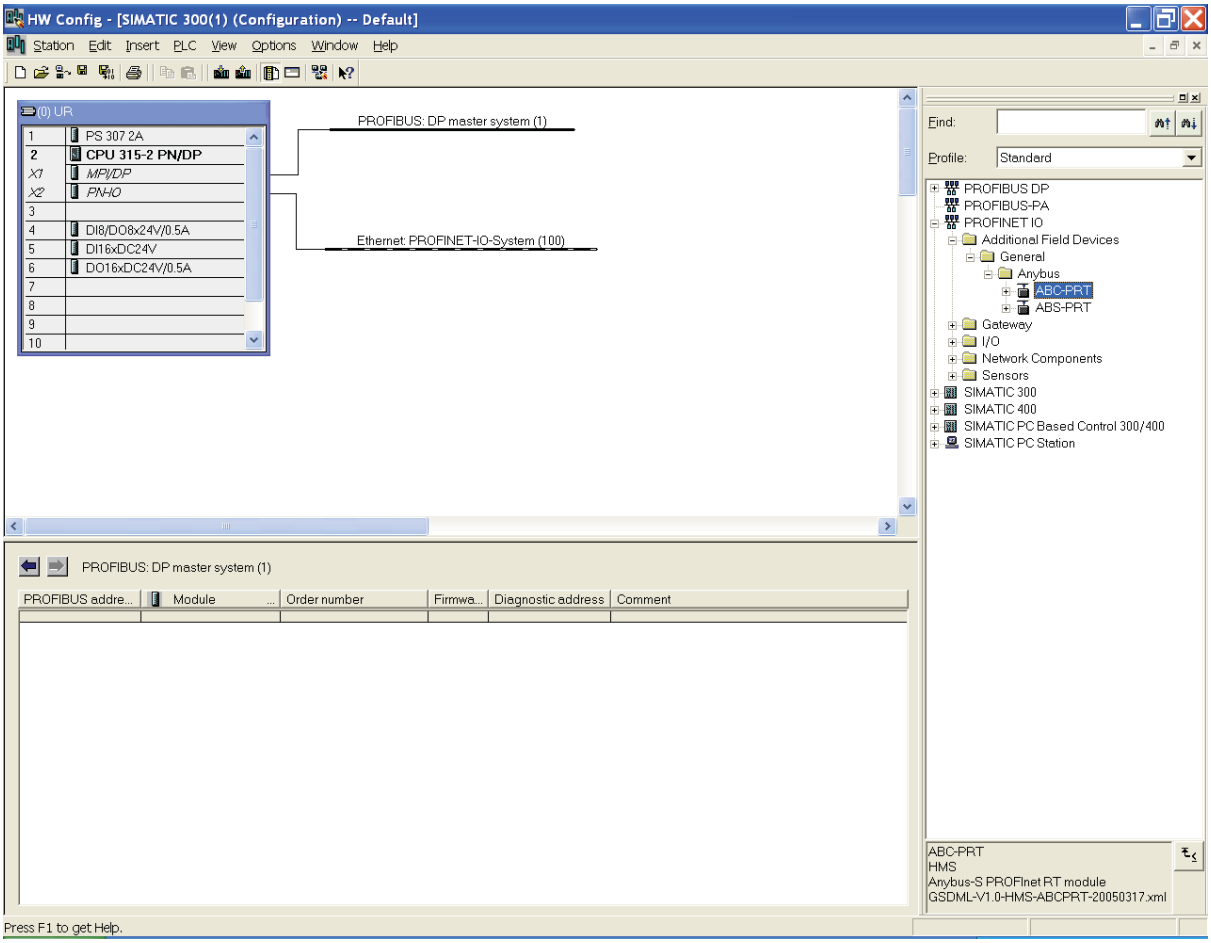
2. Right-click on the project name (in this case “Default”) and insert a “SIMATIC 300 Station” as shown:



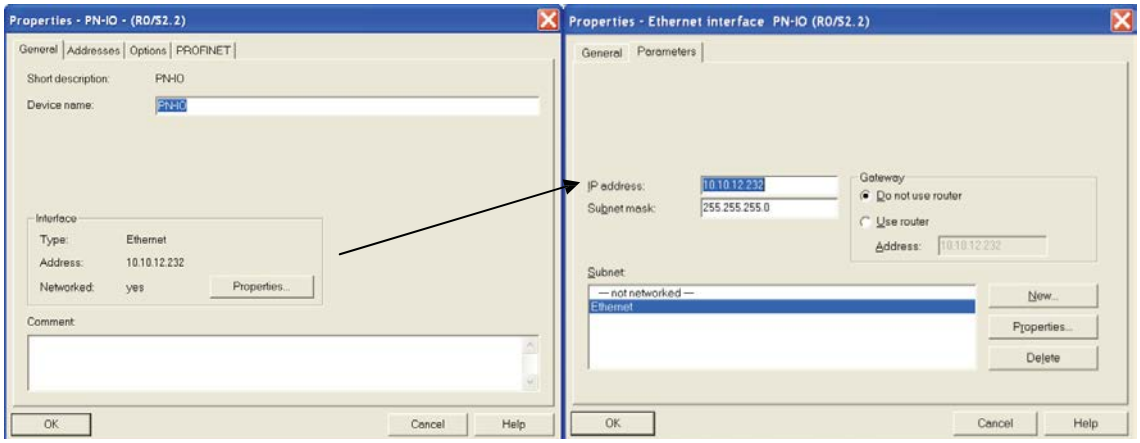
3. Double-click the “SIMATIC 300 Station” and then double-click “Hardware” to open the “HW Config” page:



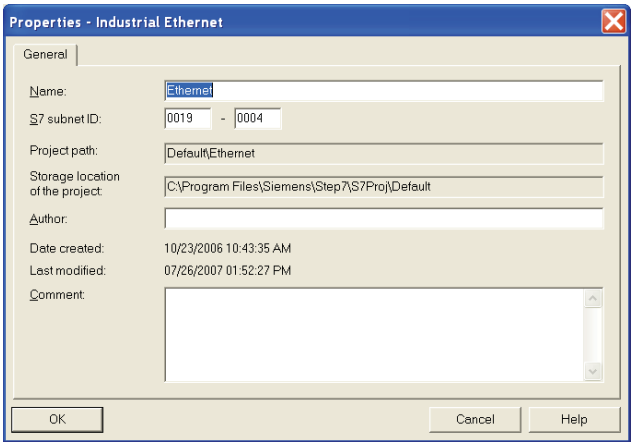
4. Add a rail, power module, PLC and PROFINET module as shown below (in this example the PLC is configured for both PROFINET and PROFIBUS and slots 4 to 6 are used for I/O modules):



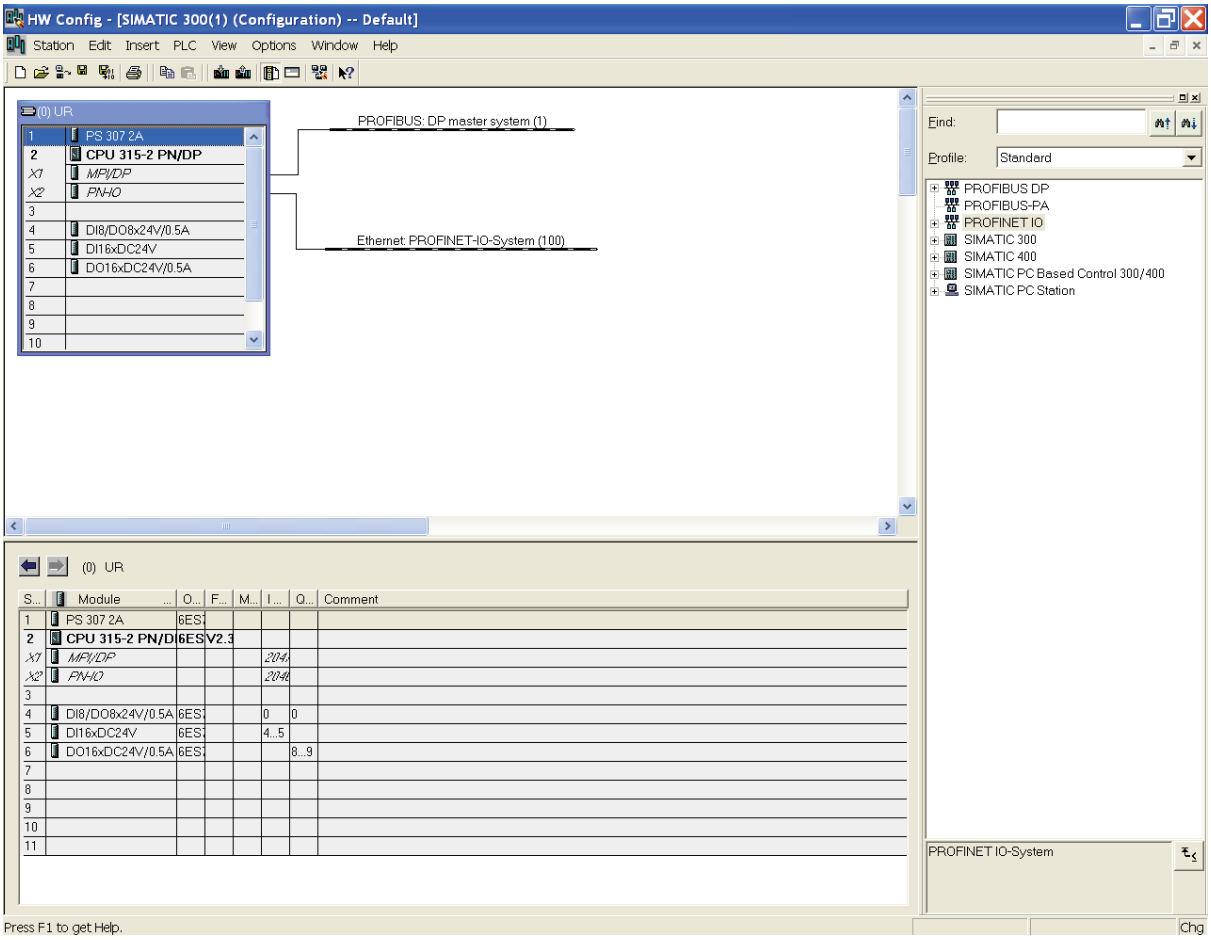
5. Double-click “PN-IO”, then click “Properties…” and then click “New…” to define a new network:



6. Enter the required settings and click “OK”:

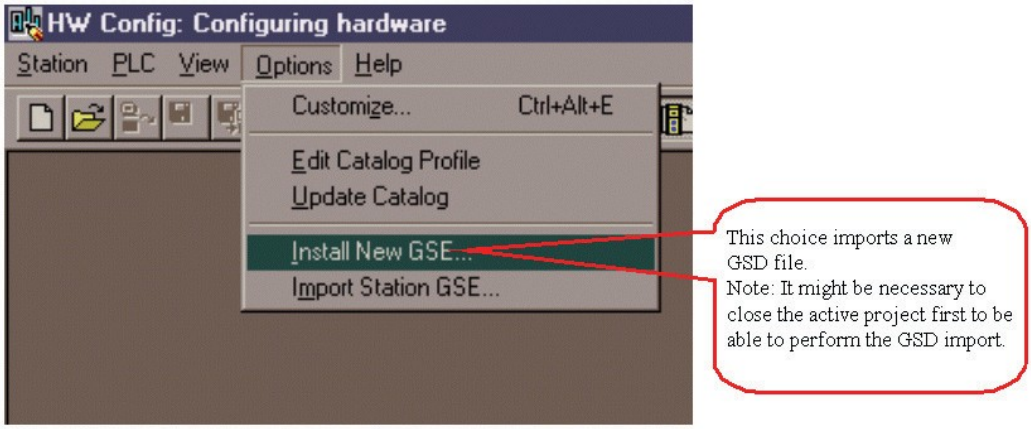


7. When the PLC hardware is set up, it will appear similar to below (in this example the PLC is configured for both PROFINET and PROFIBUS):

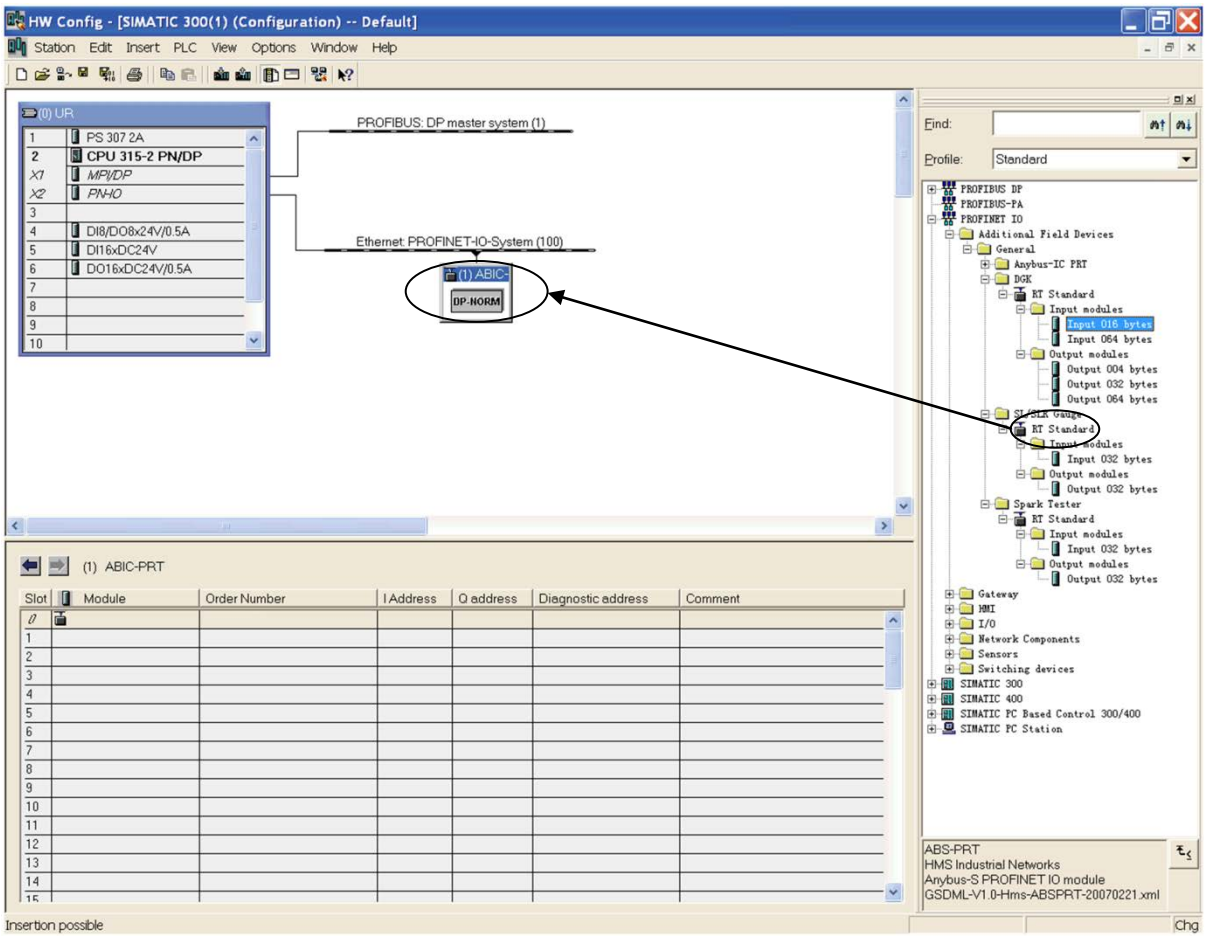


PLC PROFINET INTERFACE CONFIGURATION

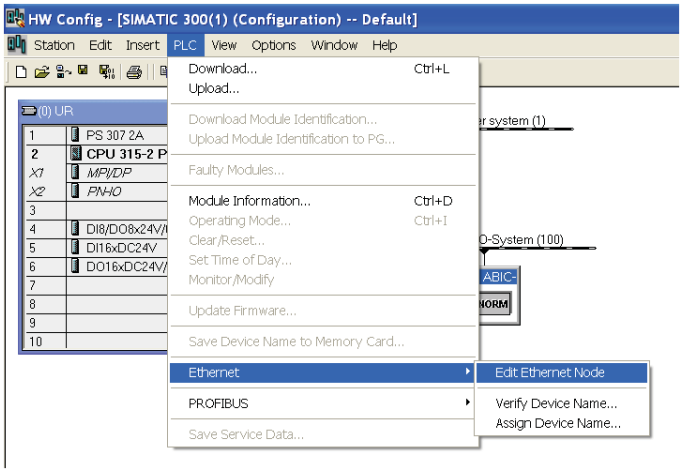
1. Click “Options” -> ”Install New GSE…” to import the .GSD file for the Proton Products gauge (**Note**: .GSD files for Proton Products gauges may be obtained from your Proton Products authorized service representative. It may be necessary to first save and close the active project in order to import the .GSD file.):



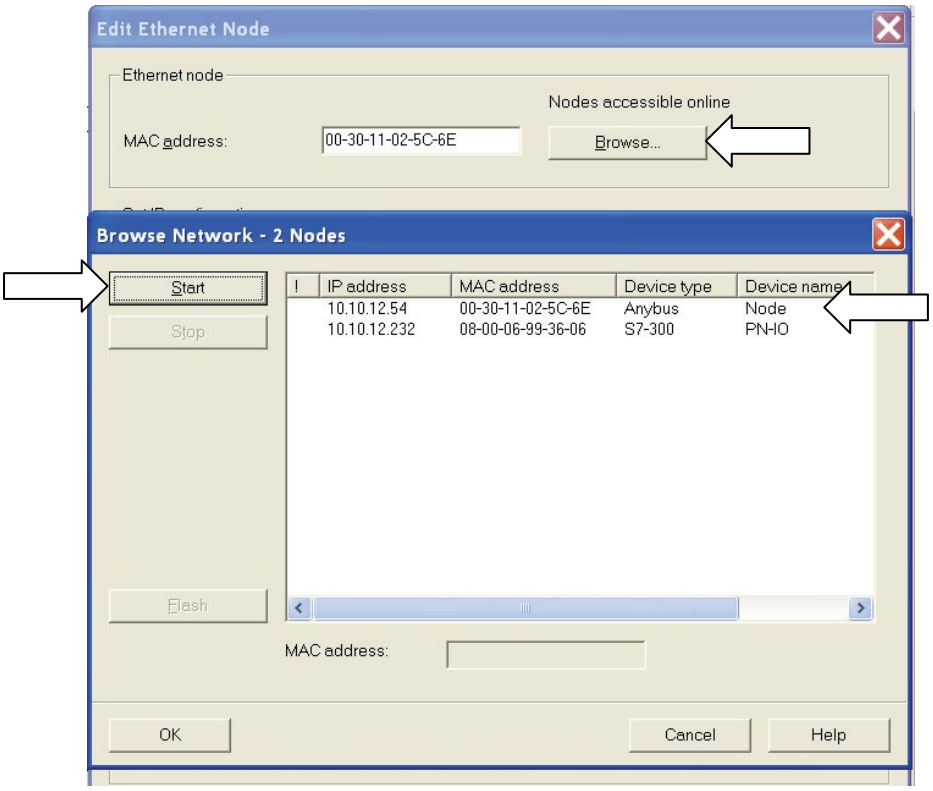
2. Add the Proton Products gauge to the PROFINET network by clicking and dragging the “RT Standard” module of the relevant Proton Products gauge from the hardware catalogue onto the PROFINET network (in this example a SL / SLR gauge is being added):



3. Configure the IP address for the Ethernet Node by clicking on “PLC” -> “Ethernet” -> “Edit Ethernet Node”:



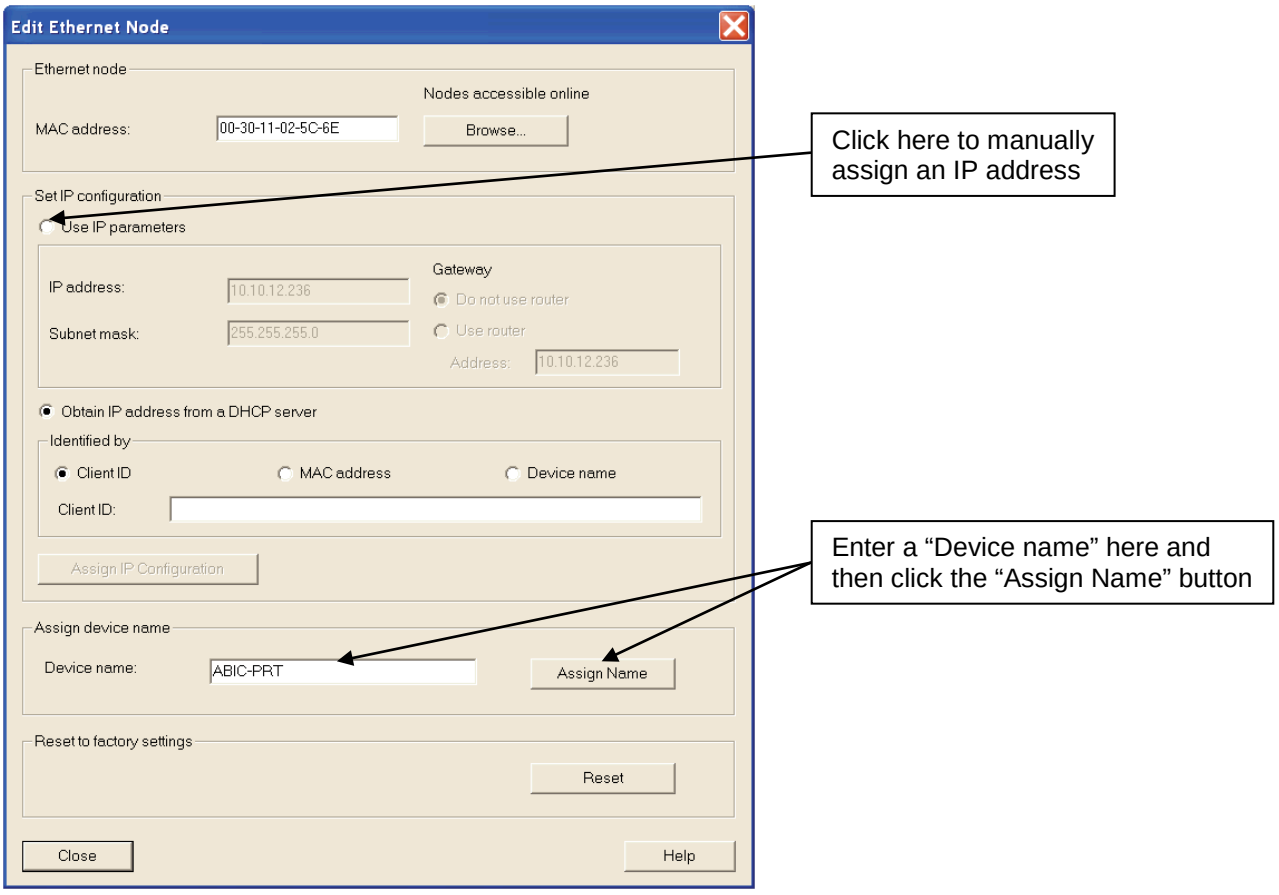
4. Click the “Browse” button followed by the “Start” button to scan the network for all devices:



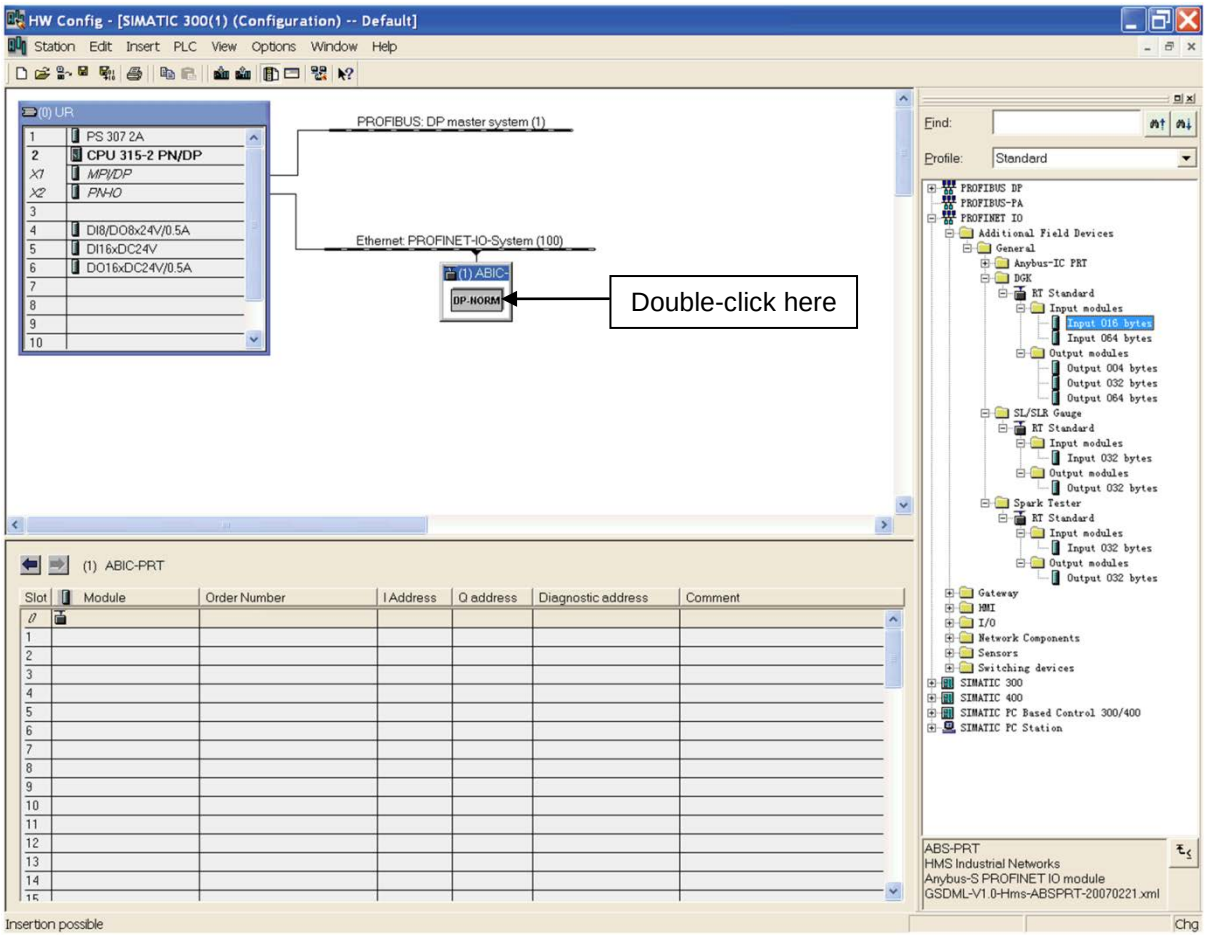
5. Click to highlight the gauge (Proton Products gauges use an “Anybus” module to implement the PROFINET interface, see the “Device type” column) and then click OK.

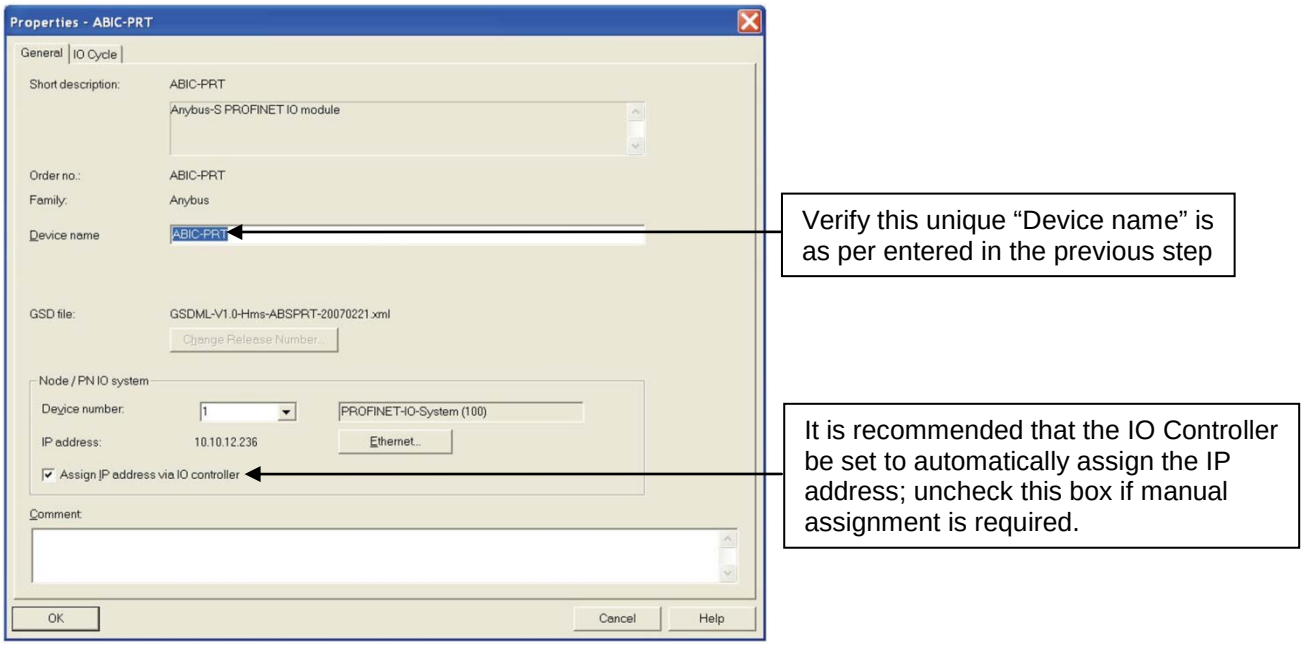
6. Set the “Use IP parameters” radio-button and then enter the “IP address”, “Subnet mask” and “Gateway” (if required) for the gauge PROFINET interface (Proton Products gauges are shipped with DHCP disabled by default and may need to be manually configured with an IP address first, please see the gauge instruction manual for this procedure).

7. Enter a unique “Device name” for the gauge and then click the “Assign Name” button (in this example the gauge has been named “ABIC-PRT”):

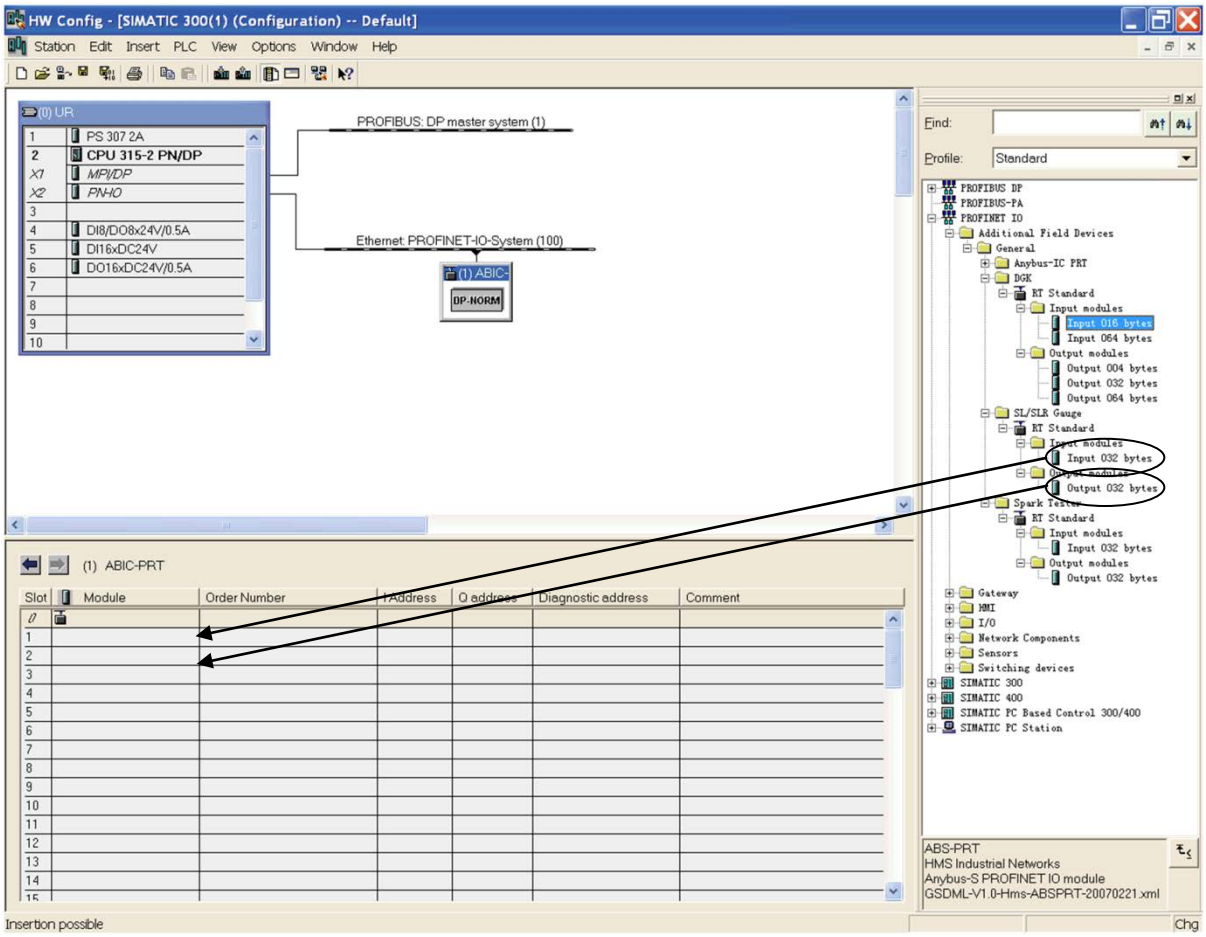


8. Double-click the gauge module to open the “Properties” window and then verify that the “Device name” is the same as that set in the previous step:

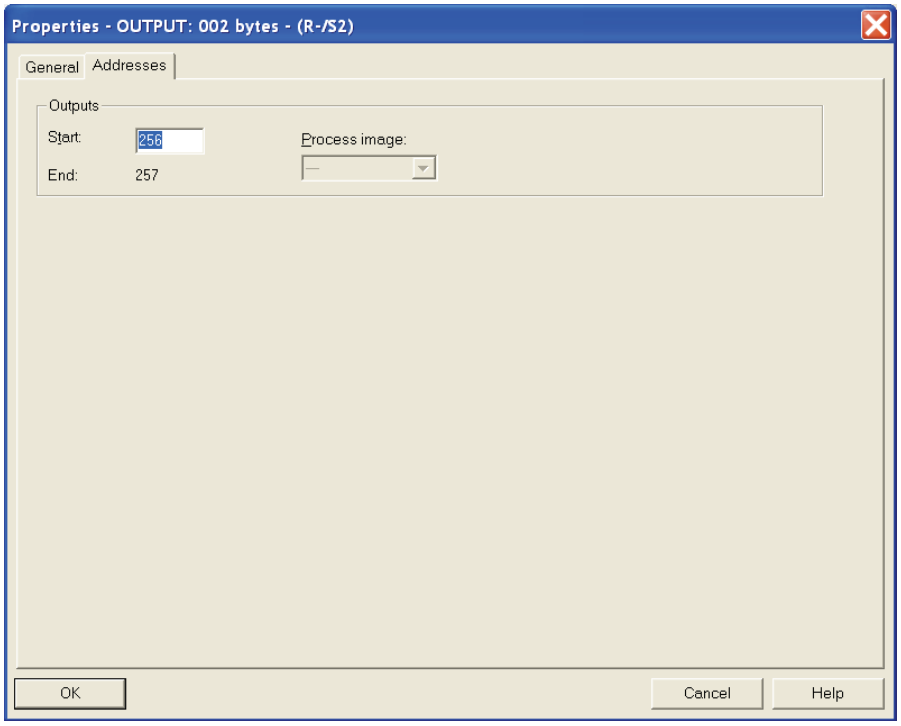




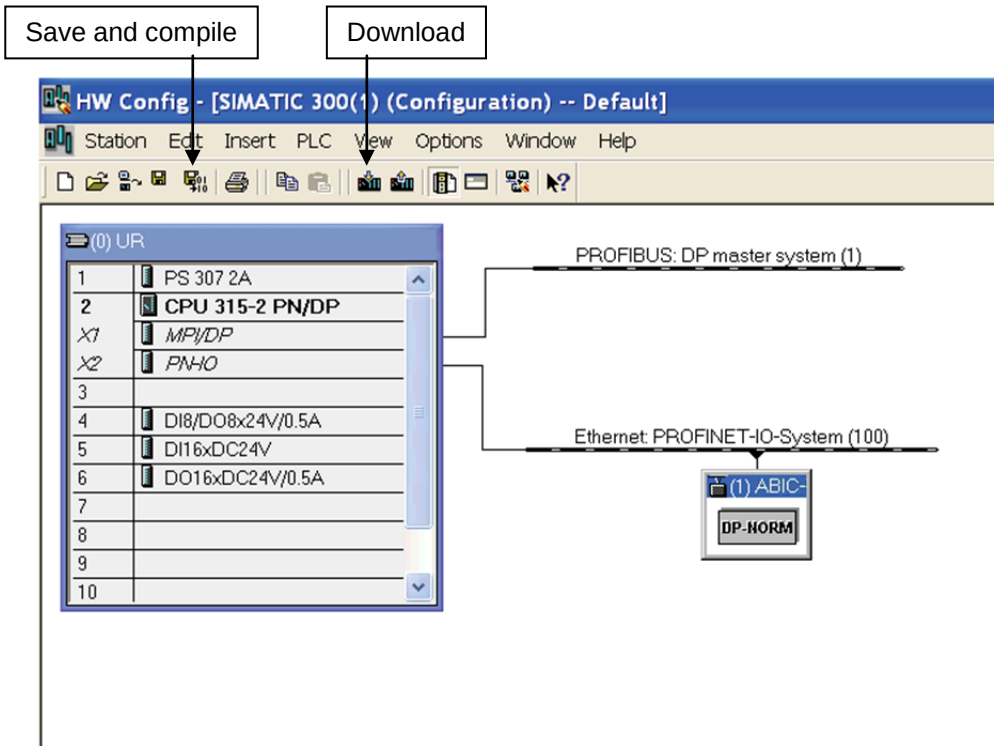
9. Drag the required input and output modules to the module list as shown (if multiple input or output modules are shown, such as for the DGK gauge, then drag the as many modules as required to the module list):


HW Config - [SIMATIC 300(1) (Configuration) -- Default]
Station Edit Insert PLC View Options Window Help
(0) UR
1 PS 307 2A
2 CPU 315-2 PN/DP
X1 MPI/DP
X2 PN-IO
3
4 DI8/DO8x24V/0.5A
5 DI16xDC24V
6 DO16xDC24V/0.5A
7
8
9
10
PROFIBUS: DP master system (1)
Ethernet: PROFINET-IO-System (100)
(1) ABIC
DP-NORM
Find:
Profile: Standard
PROFIBUS DP
PROFIBUS-PA
PROFINET IO
Additional Field Devices
General
Anybus-IC PRT
DGK
RT Standard
Input modules
Input 016 bytes
Input 064 bytes
Output modules
Output 004 bytes
Output 032 bytes
Output 064 bytes
SL/SLR Gauge
RT Standard
Input modules
Input 032 bytes
Output modules
Output 032 bytes
Spark Tester
RT Standard
Input modules
Input 032 bytes
Output modules
Output 032 bytes
Gateway
HMI
I/O
Network Components
Sensors
Switching devices
SIMATIC 300
SIMATIC 400
SIMATIC PC Based Control 300/400
SIMATIC PC Station
(1) ABIC-PRT
Slot Module Order Number I Address Q address Diagnostic address Comment
ABS-PRT
HMS Industrial Networks
Anybus-S PROFINET IO module
GSDML-V1.0-Hms-ABSPRT-20070221.xml
Insertion possible
Chg

10. Double-click the input or output module in the module list to configure the offset address:



11. Compile and download the configuration to the PLC by clicking the “Save and compile” button followed by the “Download” button:

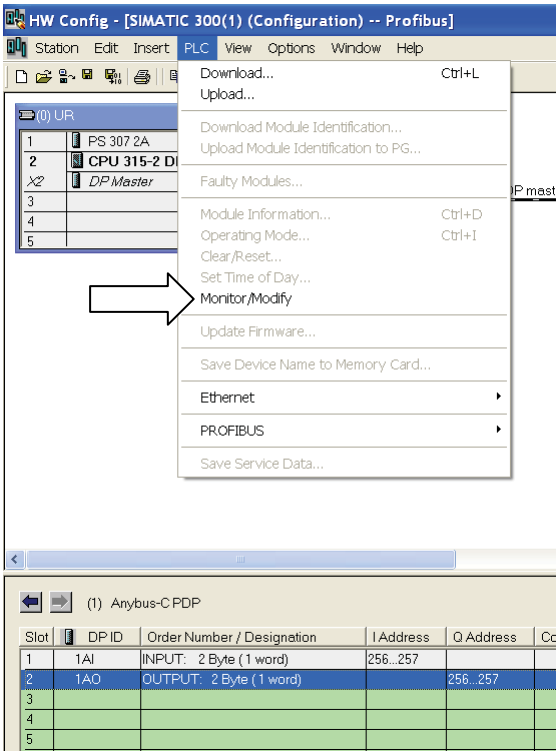


12. The bus will go online and commence data exchange when the PLC is set to run mode.

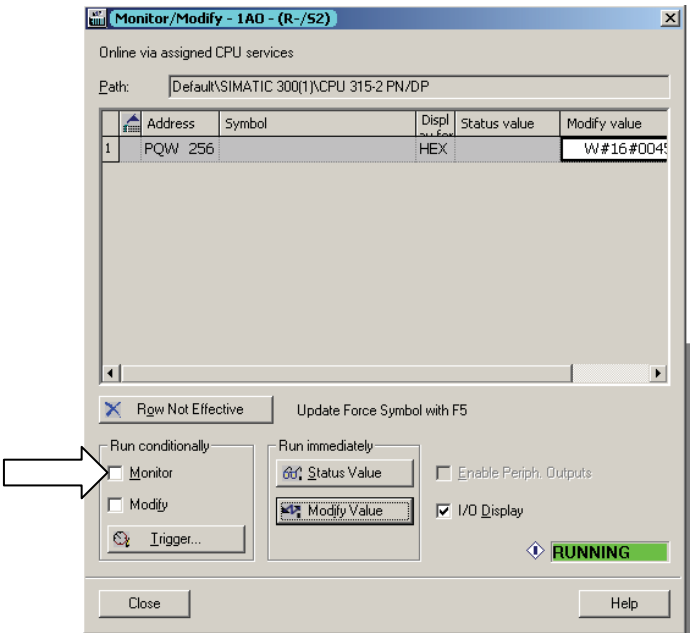
CONNECTION TESTING

To monitor live data transferred from the gauge to the PLC and verify correct PROFINET operation:

1. Click on the required input or output module in the module list and then click on “PLC” -> “Monitor/Modify”:



2. Tick the “Monitor” checkbox to commence monitoring of gauge data; verify that the gauge data is correct and follows real-time changes in the measurement:



CONTACT DETAILS FOR ENQUIRIES, SALES AND SERVICE

WEB SITE

www.protonproducts.com

ENQUIRIES AND SALES

USA head office:

Weber and Scher,
P.O. Box 366,
1231 U.S. Highway 22 East,
Lebanon Borough,
New Jersey,
U.S.A.

Tel: +1 (908) 236 8484
Fax: +1 (908) 236 7001
Email: usa@protonproducts.com

European head office:

Proton Products Europe N.V.,
Nieuwbaan 81,
B-1785,
Merchtem-Peizegem,
BELGIUM

Tel: +32 (0) 52 466 311
Fax: +32 (0) 52 466 313
Email: europe@protonproducts.com

Asia head office:

Proton Products Chengdu Ltd.,
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: europe.service@protonproducts.com

MANUAL FEEDBACK AND COPYRIGHT

Please email feedback on this manual to: manuals@protonproducts.com

- This manual contains details of equipment and software manufactured and supplied by Proton Products.
- Equipment, products and related features made or introduced before or after the issue of this manual may not be included in this manual.
- Specifications and information contained within this publication are subject to change without notice.
- Proton Products is not responsible for any errors or omissions contained within this manual.
- Proton Products is not responsible for consequential or incidental damage related to the provision or use of the information contained in this manual.
- The information contained in this manual is the property of Proton Products and may not be circulated or distributed to third parties.
- This manual may be copied in accordance with the following conditions:
  Printed manual: no part of the manual may be reproduced or converted to electronic format (such as by scanning) without the prior express written permission of Proton Products.
  Manual in electronic format (e.g. CD-ROM): one electronic copy and one printout may be made for storage and use at the site of product use.