



Solartron  
Metrology

AMETEK®

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# DISPLACEMENT MEASURING



CREATE THE OPTIMUM MEASUREMENT  
SOLUTION FOR YOUR APPLICATION

“Working with our customers and partners to provide complete precision linear measurement solutions”

“配合客户和合作伙伴提供完整的精密线性测量解决方案”

“Travailler avec nos clients et partenaires pour fournir des solutions de mesures linéaires précises et complètes”

“Zusammenarbeit mit Kunden und Partnern für die Bereitstellung präziser Messlösungen”

“Lavoriamo con i nostri clienti e partner per fornire soluzioni di misura lineare complete ed accurate”

“お客様へ高精度のリニア測定を実現するためのソリューションを提供します。”

“Trabalhando com nossos clientes e parceiros para fornecer soluções precisas em medição linear”

“Сотрудничество с клиентами и партнерами обеспечивает наилучшие комплексные решения в области высокоточных систем линейных измерений”

“Trabajamos con nuestros clientes y socios para proporcionarles soluciones completas en medidas lineares de precisión”

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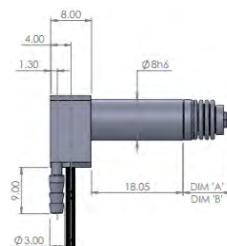
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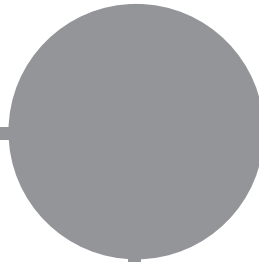


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# PERFORMANCE PRODUCTS WITH A TWIST

Configure our standard range to create the optimum measurement solution for your application...



To create the perfect package for your application...

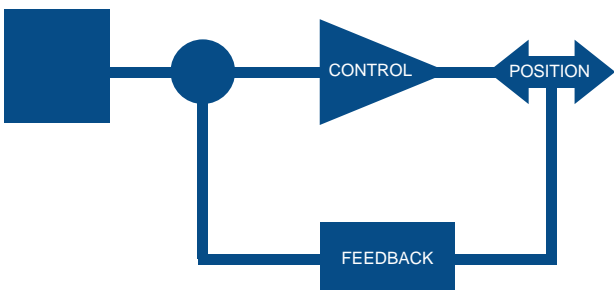


...combine high performance digital and analogue data collection...



The culmination of Solartron's 50+ years of experience manufacturing LVDT displacement sensors is a deep understanding of the need to match the performance of a sensor precisely to the demands of the application and environment.

The cost and performance advantage in matching the best sensor to the requirement is clear, this can only be done with a company that has both an extensive range of sensors, accessories and electronics in conjunction with a philosophy of designing LVDT to customers specific requirements.



CONTROL

POSITION

...with powerful, flexible and resilient data processing...

...for precision linear measurement whatever your industry...



An extensive range of analogue and digital sensors requires an equally extensive range of electronics and signal conditioning.

The ability to transfer fast reliable data from a sensor even in harsh environments is made possible by Solartron's well proven Orbit3 Sensor Network.

Orbit3 introduces the ability to network third party sensors such as pressure, force, strain and temperature using a common protocol.

Solartron precision measurement solutions perform vital tasks in a diverse range of products throughout industries including...

Aerospace, pharmaceutical, medical, power generation, oil and gas, paper making, civil engineering, tunneling, semiconductor manufacturing, mining, glass making, water treatment, chemical processing, steel production...

The list is endless.

FEEDBACK

# QUALITY TO THE CORE

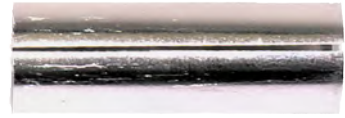
Simplicity of operation is the main strength of an LVDT, but to produce a reliable and stable sensor requires meticulous attention to detail in its design and manufacture.



Highly stable and clean signal conditioning is essential to get the best performance from an LVDT sensor.



Precision wound coils on highly stable bobbins provide excellent linearity and temperature coefficients.



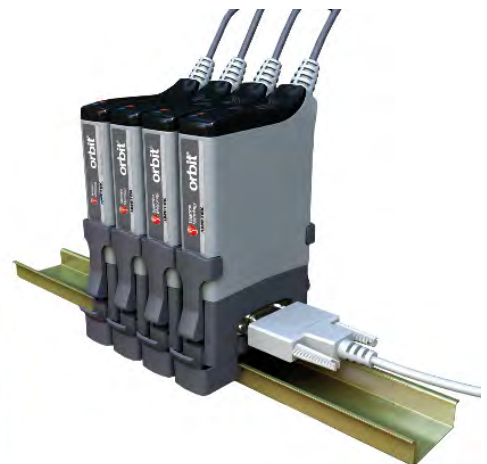
MuMetal screening gives improved protection against electromagnetic fields on some models.



Solartron's sensor bodies, core carriers and end caps are made from high grade stainless steel.

## A UNIVERSAL TRUTH: DATA IS ONLY OF TRUE VALUE WHEN IT IS PROCESSED FROM A RELIABLE SOURCE...

Integral electronics, high performance external electronics, single or multichannel digital communication from absolute displacement sensors provide the ultimate in system performance.



# CORE TECHNOLOGY

## PRINCIPLE OF OPERATION

An LVDT Displacement Sensor works by moving the core through the body. The position of the core within the body is detected by coils wound on the bobbin.

The coils are supplied with an AC signal and return an AC signal. This signal is then processed by conditioning electronics to provide a measure of the core position.

The body is normally mounted on the static part of an element and the core attached to the moving part.

## CORE BENEFITS

### ABSOLUTE POSITIONING

Unlike incremental sensors an LVDT does not lose position during a power down and does not suffer from over speeding, making it ideal for closed loop control.

### RUGGEDNESS

With good choice of materials and design the Displacement Sensor is perfect for harsh environments.

### REPEATABLE

Submicron repeatability provides perfect limit or close loop control.

### DYNAMIC RESPONSE

Free core sensors, fitted with low mass cores provide excellent dynamic response up to several kHz when used with Solartron's precision signal conditioning.

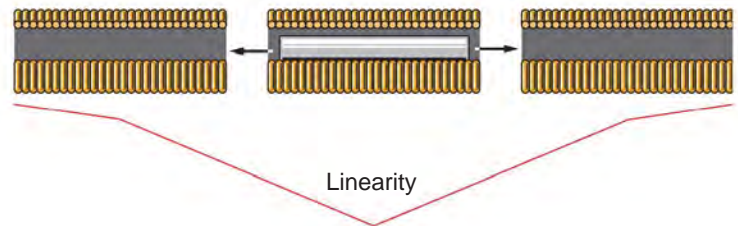
### FLEXIBILITY

Solartron's design engineers can design sensors to fit your application.

## CONVENTIONAL LVDT

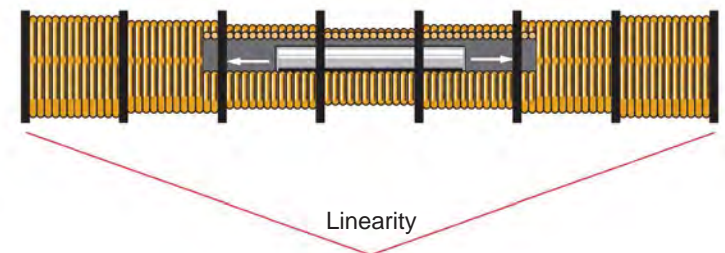
When the core is in a central position, the coupling from the primary (V<sub>EXC</sub>) to each secondary is equal, so  $V_A = V_B$  and the output  $V_{OUT} = 0$ .

As the core is displaced  $V_A$  differs from  $V_B$ , and the output  $V_{OUT}$  changes in magnitude and phase in proportion to the movement.



## SOLARTRON LVDT

Solartron Metrology's continuous development of precision bobbin mouldings and multi chambered coil windings ensure excellent linearity and thermal stability throughout the range.



## SOLARTRON ORBIT® DIGITAL SENSORS

Solartron Metrology digital sensors are calibrated using a traceable interferometer and are issued with a calibration certificate.

All digital sensors are fitted with integrated electronics, which store information such as probe ID, range, calibration error, etc. Digital sensors provide superior performance compared to traditional analogue sensors.

Performance figures quoted in this catalogue include all mechanical errors within the probe head together with any errors in the electronics interface modules.





# APPLICATIONS IN INDUSTRY

## POSITION FEEDBACK



### ENERGY

Power Generation  
Wind Turbine  
Oil and Gas



### TRANSPORT

Aerospace  
Rail  
Off-highway  
Automotive  
Drones



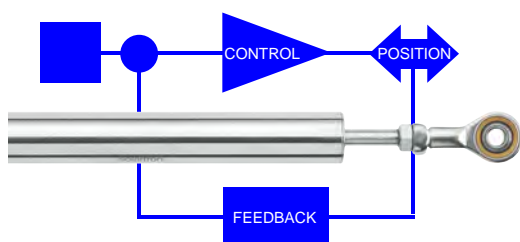
### AUTOMATION

Assembly  
Robotics  
Electronics  
Mechatronics  
Metal Forming



### FLUID POWER

Hydraulics  
Servo valves  
Pneumatics  
Solenoids



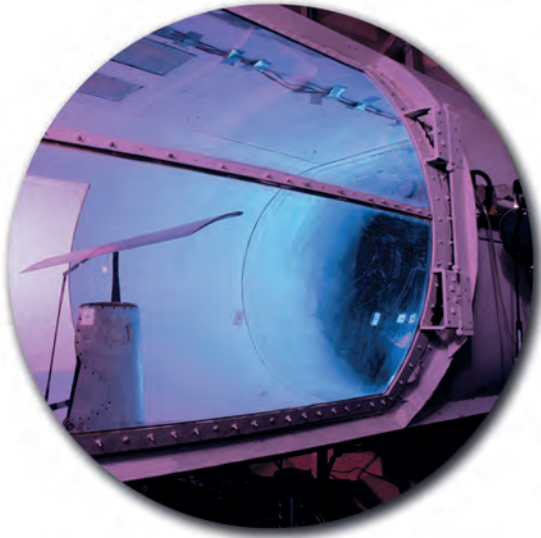
## EXAMPLES

- ▶ Position feedback
- ▶ Level measurement
- ▶ Machine alignment
- ▶ Assembly checking
- ▶ Injection monitoring
- ▶ Close loop control
- ▶ Tool positioning
- ▶ Movement control



# APPLICATIONS IN LABORATORY AND TEST

## DISPLACEMENT MEASUREMENT



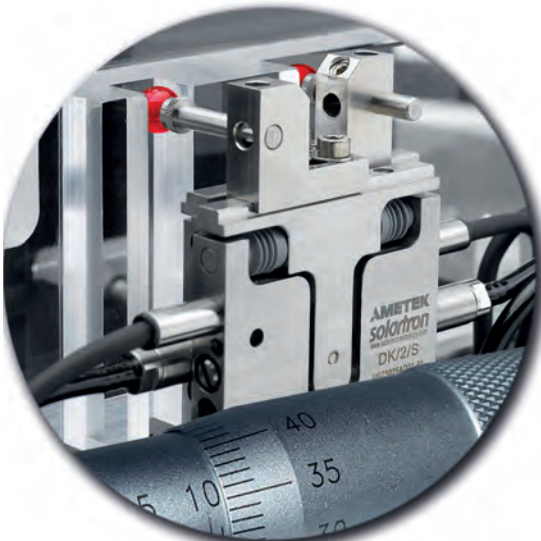
### TEST MACHINES

Traction  
Compression  
Creep & Stress



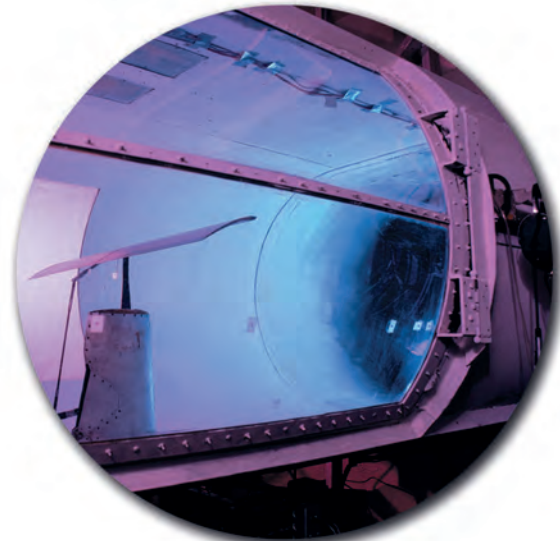
### STRUCTURES

Building  
Bridge  
Barrage  
Cracks  
Soil



### METROLOGY

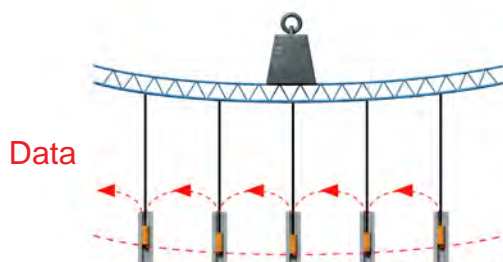
Hardness  
CMM  
Calibrators  
Dimension



### BENCH TEST

Wood  
Metal  
Aerospace  
Agronomy  
Automotive

## EXAMPLES



- ▶ Cracks monitoring
- ▶ Structure monitoring
- ▶ Alignment measurement
- ▶ Deformation measurement
- ▶ Expansion displacement
- ▶ Contraction displacement
- ▶ Crush displacement
- ▶ Deflection measurement

# S-SERIES

## HIGH PERFORMANCE DISPLACEMENT SENSORS

- ▶ Linearity better than 0.2%
- ▶ 19 mm diameter stainless steel body
- ▶ IP65 and IP67 options
- ▶ Excellent measuring range to body length
- ▶ Multiple output options with integrated electronics
- ▶ Large bore to core clearance for ease of installation
- ▶ Excellent magnetic screening
- ▶ Wide range of signal conditioning and instrumentation



The S-Series Displacement Sensor is the culmination of many years experience gained from Solatron's pedigree a history of excellent displacement sensors coupled with attention to market feedback. The result is a large range of sensors both "off the shelf" and "customer specials" that is better able to satisfy today's demanding manufacturing and research applications.

The S base series has been expanded to include the SR (Rugged range).



### STANDARD OUTPUT OPTIONS

- ▶ LVDT
- ▶  $\pm 5$  VDC
- ▶  $\pm 10$  VDC
- ▶ 0-5 VDC
- ▶ 5-0 VDC
- ▶ 0-10 VDC
- ▶ 10-0 VDC
- ▶ 4-20 mA
- ▶ 20-4 mA
- ▶ Solatron Orbit® (Digital)
- ▶ TTL

### MECHANICAL OPTIONS

- ▶ Free Core
- ▶ Free Core / Carrier
- ▶ Guided Core
- ▶ Tip
- ▶ Spring
- ▶ Universal Joints

### CONNECTION OPTIONS

- ▶ Cable (wire ends)
- ▶ Cable + Connector
- ▶ Axial Connector
- ▶ PIE (Orbit® digital only)

GENERIC SENSOR TYPES										
LVDT	AS/2.5	AS/5	AS/7.5	AS/10	AS/15	AS/25	AS/50	AS/75	AS/100	AS/150
Voltage Output ( $\pm$ DC Bipolar)	VS/2.5	VS/5	VS/7.5	VS/10	VS/15	VS/25	VS/50	VS/75	VS/100	VS/150
Voltage Output (DC Unipolar)	VS/5	VS/10	VS/15	VS/20	VS/30	VS/50	VS/100	VS/150	VS/200	VS/300
Current Output (4-20 mA)	IS/5	IS/10	IS/15	IS/20	IS/30	IS/50	IS/100	IS/150	IS/200	IS/300
Digital Output (Orbit®)	DS/5	DS/10	DS/15	DS/20	DS/30	DS/50	DS/100	DS/150	DS/200	DS/300
MEASUREMENT										
Measurement Range (LVDT/ $\pm$ DC) (mm)	$\pm$ 2.5	$\pm$ 5	$\pm$ 7.5	$\pm$ 10	$\pm$ 15	$\pm$ 25	$\pm$ 50	$\pm$ 75	$\pm$ 100	$\pm$ 150
Measurement Range (4-20 mA/DC/ORBIT) (mm)	5	10	15	20	30	50	100	150	200	300
Pre-travel $\pm$ 0.5 mm (Guided Versions only)	2.0	3.0	1.5	2.5	5	7.0	5.0	5.0	9.0	16.5
Post Travel $\pm$ 0.5 mm (Guided Versions only)	4.5	5.5	4.0	5.75	9.25	9.5	7.5	7.4	11.25	18.5
Linearity (% FSO)	<0.20									<0.25
Resolution $\mu$ m <i>Note 1</i>	<0.1	<0.1	<0.1	<0.2	<0.2	<0.3	<0.5	<0.7	<1.0	<2.0
Temperature Coefficients (%FSO/ $^{\circ}$ C) LVDT	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.015	<0.01	<0.01
Temperature Coefficients (%FSO/ $^{\circ}$ C) DC/4-20mA	<0.01									
MECHANICAL										
Body Diameter (mm)	19.00 (+0.0, -0.2)									
Case Material	300 Series Stainless Steel									
Core Material	Nickel Iron									
Tip Force $\pm$ 20% (Horizontal at middle of range) N	1.1	1.0	1.0	1.1	1.2	1.5	2.1	1.9	2.3	2.6
Cable Type	FEP									
Standard Cable Length (m)	3									
Standard Cable Style	B									
Nominal Mass (g) LVDT	58	66	67	80	92	110	153	167	243	344
Nominal Mass (g) (4-20 mA/DC)	72	80	81	94	106	124	167	181	257	358
Nominal Mass of Core (g)	2.8	5.0	5.9	7.1	6.8	7.0	9.1	9.1	9.1	9.1
Nominal Mass of Mounting Parts (g) <i>Note 2</i>	20	25	27	30	34	40	55	71	85	122
ENVIRONMENT										
Temperature (Standard LVDT) ( $^{\circ}$ C)	-40 to +120									
Temperature (HT LVDT) ( $^{\circ}$ C)	-40 to +200									
Operating/Storage Temperature (4-20 mA/DC) ( $^{\circ}$ C)	0 to +65 / -20 to +85									
Sealing	IP65 or IP67									
Vibration Sinusoidal	1 to 10 g rms linear 10 to 50 Hz & 10g rms 50 Hz to 1 kHz									
Vibration Random	DO160F Curve D									
Shock	Drop test from 1m onto hard surface									
ELECTRICAL INTERFACE (LVDT)										
Energising Voltage	1-10 (Vrms)									
Energising Current at 5 kHz (mA/V)	1.0	2.6	2.2	0.7	1.5	0.5	0.6	2.5	1.65	1.83
Sensitivity at 5 kHz $\pm$ 10% mV/V/mm	144	178	121	76	60	21.5	15	10.5	6.9	3.9
ELECTRICAL INTERFACE (4-20 mA & DC)										
Input	10 to 30 V or 4-20 mA loop powered									
Noise (DC Output) Measured in 500 Hz	<0.2 % FSO									
Output Change with Power Supply Variation	<0.5 mV									
Bandwidth (-3dB)	500 Hz									
ELECTRICAL INTERFACE (ORBIT®)										
Bandwidth	Up to 460 Hz (selectable)									
Output	Solartron Orbit®									
Power (VDC)	5 $\pm$ 0.25 @ 0.06 A									
Sealing	IP43									
Probe Interface Electronics. Weight (g)	52									
T Connector Weight (g)	46									

- ▶ Note 1: Resolution specification is only applicable to Orbit® digital sensors. The resolution of LVDT sensors is effectively infinite and is only limited by the conditioning electronics.
- ▶ Note 2: Moving parts are core and carrier assembly for standard guided product including 2 x M4 nuts and 2 x M4 washers.
- ▶ **Cable Style A** comprises of individual twisted cores.
- ▶ **Cable Style B** comprises a sheathed and screened cable



# OPTIMUM SERIES

## COMPACT AND ACCURATE LVDT SENSORS

- ▶ Good measurement range to body length ratio
- ▶ Small body diameter
- ▶ Larger radial bore clearance
- ▶ Rugged Construction



The Optimum Series of LVDT sensors is an ideal choice for process control and research applications. The free core variants are designed for precise linear positioning and measurement of moving parts where zero friction and hysteresis is required within a restricted space.

The free core version is available with an optional lightweight core for mounting on to small, rapidly moving structures without affecting their performance and integrity - important in some control applications.

The lightweight core has a 1.9 mm diameter, which improves core to bore clearance, making alignment easier. A light titanium core carrier can be supplied on request.

The Optimum is also available as a guided product and with universal joints either as an LVDT or Digital product for use in applications where it is not possible to mount the core and carrier on to the moving part.

- ▶ Note: the Optimum can be wired as either differential output or ratiometric (except OP/10 and OP/25)



<b>SENSOR</b>					
LVDT Free Core	OP/1.5/F	OP/6/F	OP/10/F	OP/12.5/F	OP/25/F
LVDT Guided	OP/1.5/G	OP/6/G	OP/10/G	OP/12.5/G	OP/25/G
Digital Output (Orbit)	DO/3	DO/12	DO/20	DO/25	DO/50
<b>MEASUREMENT</b>					
Measurement Range (LVDT/Orbit) (mm)	±1.5 / 3	±6 / 12	±10 / 20	±12 / 24	±25 / 50
Pre-travel ±0.25 mm (Guided Versions only)	1.75	1.5	1.5	2.25	2.00
Post Travel ±0.25 mm (Guided Versions only)	1.75	1.5	1.5	2.25	2.25
Linearity (% FSO)	<0.25				
Resolution µm <i>Note 1</i>	0.015	0.025	0.08	0.1	0.2
Temperature Coefficient (%FSO/C°)	<0.05				
<b>MECHANICAL</b>					
Body Diameter (mm)	9.512 (+ 0.0 to - 0.062)				
Case Material	400 Series Stainless Steel				
Core Material	Nickel Iron				
Tip Force ±20% (Horizontal at middle of range) N	0.9	0.8	0.7	0.9	0.5
Cable Type	FEP				
Standard Cable Length (m)	5 (max)				
Standard Cable Style	A or B				
Nominal Mass (g) LVDT	7	12	12	20	20
Nominal Mass of Core (g) ø2,8 M2 Threaded	0.3	0.9	0.6	1.6	0.8
Nominal Mass of Moving Parts (g) <i>Note 2</i>	1.5	2.5	2.4	4.0	3.5
<b>ENVIRONMENT</b>					
Temperature (Standard LVDT) (°C)	-40 to +150				
Operating/Storage Temperature (4-20 mA/DC) °C	-40 to +150				
Sealing	IP65				
<b>ELECTRICAL INTERFACE (LVDT)</b>					
Energising Voltage	1-5 (Vrms)				
Energising Current at 5 kHz (mA/V)	6	4.5	3.2 at 20 kHz	7	1.25
Sensitivity at 5 kHz ±10% mV/V/mm	108	78	85 at 20kHz	69	25
Zero Phase Frequency (kHz)	13.1	24.1	>30	24.8	14
<b>ELECTRICAL INTERFACE (ORBIT®)</b>					
Bandwidth	Up to 460 Hz (selectable)				
Output	Solartron Orbit®				
Power (VDC)	5±0.25 @ 0.06 A				
Sealing	IP43				
Probe Interface Electronics Weight (g)	52				
T connector weight (g)	46				

- ▶ Note 1: Resolution specification is only applicable to Orbit® digital sensors. The resolution of LVDT sensors is effectively infinite and is only limited by the conditioning electronics.
- ▶ Note 2: Moving parts are core and carrier assembly for standard guided product including 2 x M2 Nuts and 2 x M2 Washers.

**Cable Style A** comprises of individual twisted cores

**Cable Style B** comprises a sheathed and screened cable

# SM / MD / DF

## MINIATURE DISPLACEMENT SENSORS



### SM

- ▶ Rugged construction
- ▶ Short body length
- ▶ Good performance

SM sensors cover two standard types in two measurement ranges  $\pm 1$  mm and  $\pm 3$  mm. They are designed for measuring displacement in applications where infinite resolution and precise repeatability is required in a very small size.

The coils are wound on a PPS (40% GL) former and housed in a stainless steel case. The epoxy bonded construction makes the device suitable for operation in wet and oily environments and in applications with high levels of mechanical stress.

The core carrier assembly moves friction free within the sensor an alternative option where the core is provided threaded at both ends is available allowing the user to manufacture their own carrier interface. Recommended carrier material is titanium.



### MD

- ▶ Small diameter
- ▶ Right angle cable outlet option
- ▶ Low core weight
- ▶ Screened cable

The small case diameter (6 mm and 8 mm) allows for easy installation in confined spaces. A right angle output facility is available as a retrofit for the 8 mm version.

The low core weight makes this range ideal for use in low inertia systems. Cross talk is prevented by the screened cable, which also allows for multiple use of these sensors in close proximity.



### DF

- ▶ Measurement range to 10 mm
- ▶ High Output
- ▶ Excellent repeatability
- ▶ Low power

The DF DC miniature displacement sensor has a friction-free core and the DFg has a free guided core incorporating Delrin bearings. All types incorporate a linear variable differential transformer (LVDT) as the measuring source together with oscillator, demodulator and filter providing a self-contained unit accepting a DC input and providing a DC output relative to armature position.

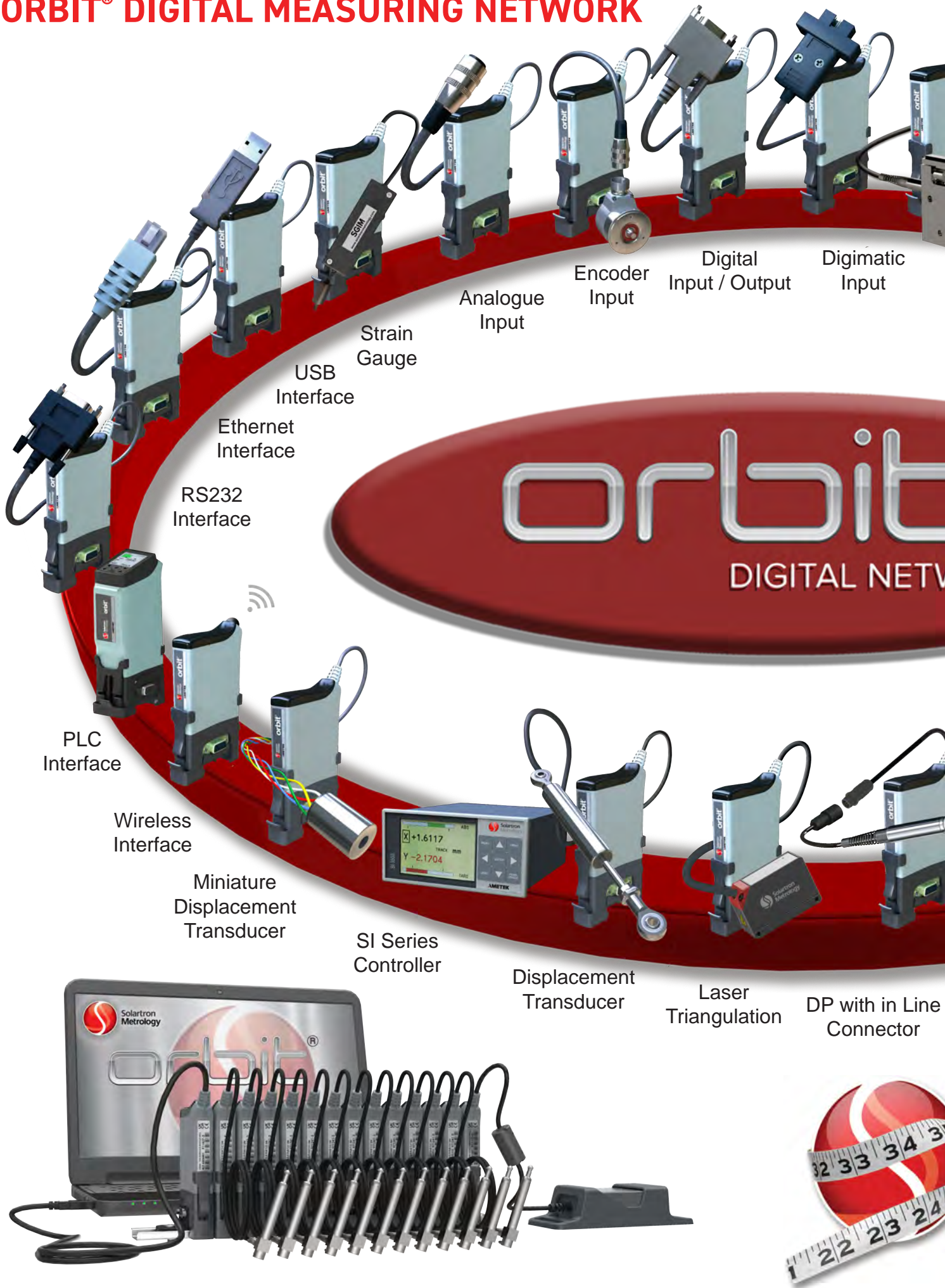
With high linearity and low mass of moving parts, these are ideally suited to applications in civil, mechanical, chemical and production engineering. Also, when mounted in a suitable load-sensitive member such as a proof ring or diaphragm, they can provide load or pressure measurement.



SENSOR										
LVDT	SM1	SM3	M6D/1	MD/1	MD/2.5	MD/5	MD/10	-		
Half Bridge	-		M6DH/1	MDH/1	MDH/2.5	MDH/5	MDH/10	-		
DC Output with Free Core	-						DF1	DF2.5	DF5	
DC Output with Guided Core	-						DFg1	DFg2.5	DFg5	
MEASUREMENT										
Measurement Range (mm)	±1	±3	±1	±1	±2.5	±5	±10	±1	±2.5	±5
Linearity (% FSO)	0.25		-				0.50			
Linearity (% Reading)	-		0.5				-			
Resolution µm see <i>Note 1</i>	0.01	0.025	0.01	0.01	0.02	0.04	0.08	see <i>Note 1</i>		
Temperature Coefficients (%FSO/°C)	<0.03%		<0.01%				<0.025%			
MECHANICAL										
Body Diameter (mm)	9.52 (+0.0 to -0.062)		6h6	8h6			19.0 (+0.0 to -0.2)			
Case Material	400 Stainless Steel									
Core Material	Nickel Iron									
Cable Type	PUR									
Standard Cable Length (m)	0.5		2				3			
Standard Cable Style	A		B							
Nominal Mass (g)	6.0	8.0	2.6	5.0	7.6	8.5	13.0	26.0	26.0	30.0
Nominal Mass of Core (g)	0.25	0.5	0.1	0.2	0.25	0.35	0.4	N/A	N/A	N/A
Nominal Mass of Moving Parts <i>Note 2</i>	0.7	1.0	0.6	0.7	0.9	1.0	1.1	1.0	1.0	1.1
ENVIRONMENT										
Operating Temperature (°C)	-40 to +85		-10 to + 80				-5 to +70			
Storage Temperature (°C)	-40 to +100		-40 to + 105				-10 to +80			
Sealing	IP60									
ELECTRICAL INTERFACE										
Energising Voltage	1-10 (Vrms)						10-24 (VDC)			
Energising (LVDT) Current at 5 kHz (mA/V)	3.8	1.8	3.0	1.8	2.0	1.0	0.6	-		
Energising Current (HB) at 10 kHz (mA/V)	-		1.2	1.0	-	1.2	-	-		
Energising Current (DC) at 10 V (mA)	-						10	13		
Frequency Response (-3 db) Hz	Depends on Conditioning Electronics						50	75		
Sensitivity at 10 VDC ±10% mV/V/mm	-						75	54		
Sensitivity at 5 kHz ±10% mV/V/mm	147	136	269	210	150	105	33	-		
Sensitivity (HB) at 10 kHz ±10% mV/V/mm	-		88	83	82	51	33	-		

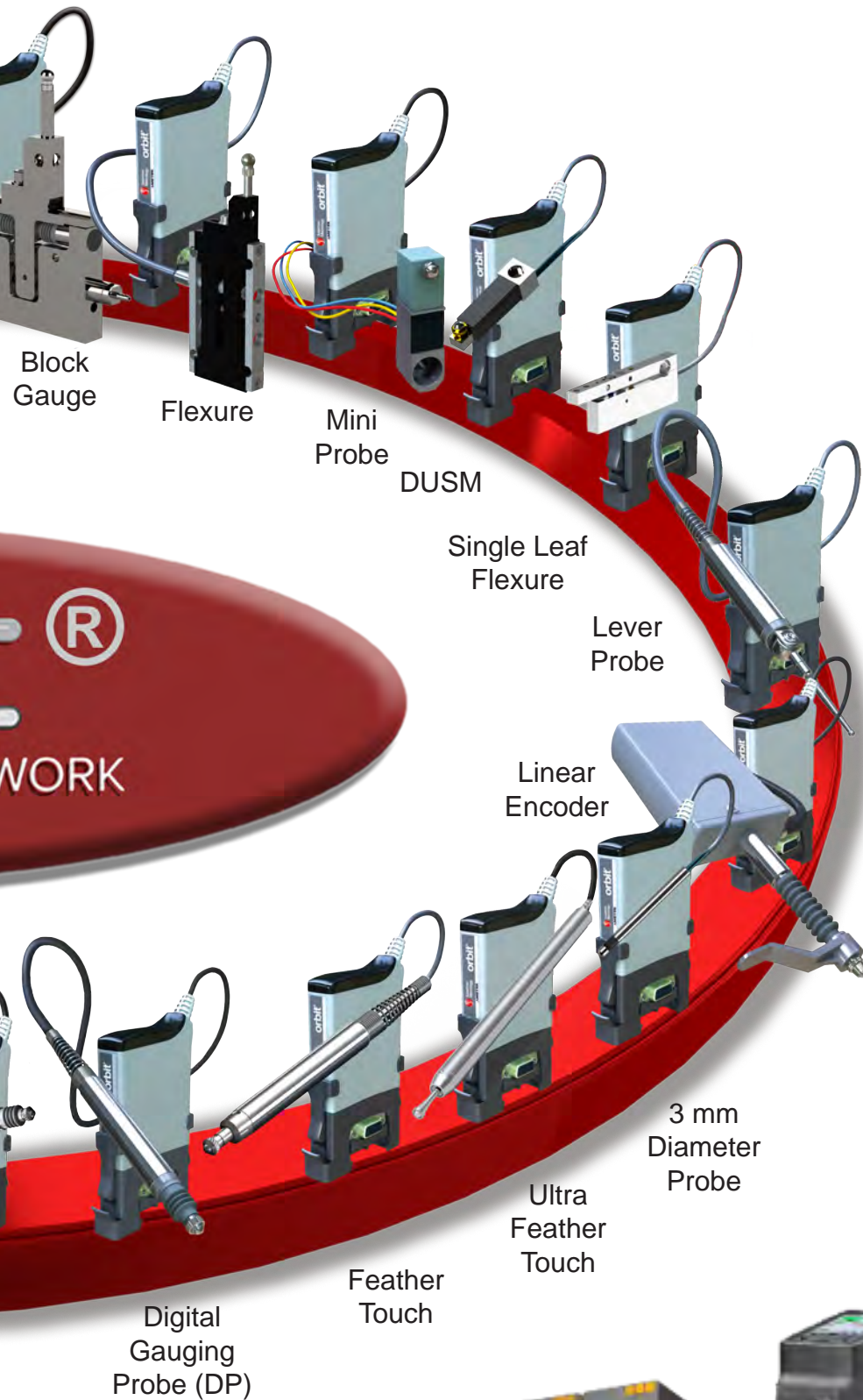
- ▶ Note 1: Resolution specification is only applicable to Orbit® digital sensors. The resolution of LVDT sensors is effectively infinite and is only limited by the conditioning electronics.
- ▶ Note 2: Moving parts are core and carrier assembly for standard guided product including M2 Stud, 2 x M2 Nuts and 2 x M2 Washers
- ▶ **Cable Style A** comprises of individual twisted cores
- ▶ **Cable Style B** comprises a sheathed and screened cable

# ORBIT® DIGITAL MEASURING NETWORK





orbit®



**Higher performance does not mean higher costs.**

Quality standards in industry and research are becoming tighter, while demands for cost savings continue to increase. Orbit® provides the way forward for all precision measurement or positioning needs, whether on the production line or in the laboratory.

Orbit® provides a complete solution for integrating different measurement position and control sensors smoothly and simply into network solutions.

The Orbit® system architecture consists of a rugged mechanical design coupled with a high degree of electrical protection and excellent noise immunity, ensuring valid accurate data when it is needed.

All Solartron products have undergone rigorous testing to ensure a long and productive life.





# CONDITIONING ELECTRONICS

Conditioning electronics must often be added to a LVDT or Half Bridge sensor to interface with real world environments.

Solartron Metrology's range of conditioning electronics offers users the ability to connect and configure LVDT and Half Bridge inductive sensors into an almost infinite number of combinations. Outputs include voltage, current loops (4-20 mA) and TTL.

For optimum performance in terms of transducers and electronics please consider Solartron Metrology's Orbit®3 Digital Measurement System which outperforms the conventional analogue LVDT and Half Bridge sensors in all aspects.



## OD SERIES

The OD series of conditioning units is used to interface with Solartron's sensors to provide different functions to suit different applications. The OD2 is a two wire 4-20 mA signal conditioner. It is designed for signal transmission over long distances due to low noise susceptibility. The OD4 (OD5 is a mains powered equivalent) is powered from a single 10 to 30 V DC supply. The outputs are fully adjustable for offset and gain.

## DRC

The DRC is a DIN rail mounted version of the OD4 and provides all the features plus the convenience of a DIN rail mount.



## BICM IN LINE MODULE

The BICM provides a simple low cost in line conditioning unit. This is ideal when the transducer set up is unlikely to require adjustment.

For use in harsh environments, an IP67 version is available.

MODULE	ATM TTL CONVERTER
<b>MEASUREMENT</b>	
Sensor Types	All Solartron Displacement Sensors
Accuracy(%FSO)	<0.25
Resolution (x4 interpolation)	0.1
Repeatability	Sensor Dependent
<b>ELECTRICAL</b>	
Power	+5 ±0.25 VDC @ 100 mA
Output Signal	A & B, / A and / B TTL square waves RS422 levels
Output frequency (kHz)	50, 100, 125, 250 & 500 (factory selectable)
Bandwidth	100 Hz
<b>ENVIRONMENTAL (ELECTRONICS)</b>	
Sealing	IP43
Operating Temperature(°C)	0 to +60
Storage temperature(°C)	-20 to +70

## ATM TTL CONVERTER

TTL RS 232 Differential Quadrature is one of the most commonly used methods of communication between Linear Displacement Sensors and Control or Data Acquisition Systems. Its simplicity of Interfacing with programmable systems also makes Solartron's ATM one of the most cost effective.



Refer to product manual 502724 for details of operation - contact sales office

# TECHNICAL SPECIFICATIONS

MODULE	OD2	OD4	OD5	DRC	BICM	
<b>POWER REQUIREMENTS</b>						
Input Voltage VDC	13-42	10-30	N/A	10-30	±15	24 (Note 5)
Input Voltage VAC	N/A	N/A	90-264	N/A	N/A	N/A
Input Current (mA)	<30	140-50	250-100	160-70	±12	24
Frequency (Hz)	-	-	47-63	-	-	-
<b>SENSOR EXCITATION</b>						
Primary Voltage (Vrms)	0-9	3			1.2 - 21	
Primary Frequency (kHz)	5 or 13	2.5 or 5	-	5, 10 or 13	5	
<b>SIGNAL INPUT</b>						
Input Range	30-530 mV (Note 1)	55 to 5000 mV LVDT full range			up to 3.5	
Input Load (kΩ)	2	2, 10, 100		2, 100	100	
Options	-	Forward and reverse polarity, half bridge		see (Note 2)	-	
<b>SIGNAL OUTPUT (Note 4)</b>						
Voltage Output VDC	-	Up to ±10				
Current Output mA	4-20	Up to ±20 into 150 Ω load			-	
Output Ripple	<38 μA rms	<1 mV rms	-		<14 mV	
Output Offset	Up to 100% on maximum gain (coarse and fine adjustment)					
Temperature Coefficient Gain (%FSO/°C)	<0.01				<0.03	
Temperature Coefficient Offset (%FSO/°C)	<0.01				<0.02	
Warm Up (minutes)	15 Minutes					
Linearity (%FSO)	<0.02				<0.1	
Bandwidth (-3 dB) (Hz)	25	500, 1 k			250	
<b>ENVIRONMENTAL (Note 3)</b>						
Storage Temperature (°C)	-40 to +80	-20 to +80				
Operating Temperature (°C)	0 to +60					
IP Rating	65	40	None		40/67	40
<b>MECHANICAL</b>						
Sensor Connections	Terminals	Din Connector	-	Terminals	Solder or factory fit for IP67	
Power Connections	Terminals	-	IEC320 C14	-	-	
Weight						
Material	ABS	Painted Aluminium Box		Plastic	Plastic or Stainless Steel (IP67)	
Mounting	Holes			DIN rail	-	

- ▶ Note 1: For transducers with sensitivity >250 mV, an attenuator is required - contact sales
- ▶ Note 2: Transducer connected via external screw terminal. User can therefore configure options
- ▶ Note 3: For higher environmental levels (and other custom options) contact sales office
- ▶ Note 4: For custom options contact Sales office
- ▶ Note 5: 24 V BICM not available in IP67

## OUTPUTS

The correct selection of outputs is critical to accurate noise free transmission. All analogue signals are more prone to interference than digital transmission methods such as TTL. Use of current as a transmission method can offer significant advantages over long cable runs. With all external conditioning it is possible to adjust both the offset voltage and the gain to give numerous output combinations and to increase sensitivity over a predefined measurement range.

# SI 3000 SERIES

## TWIN AXIS DISPLAYS & CONTROLLERS

- ▶ Intuitive menu
- ▶ 2 channel 7 digit colour displays
- ▶ 2 channel analogue colour displays
- ▶ Auto colour change for in/out range
- ▶ Auto course / fine resolution
- ▶ Peak hold facility
- ▶ Data logging facility
- ▶ RS232 output
- ▶ Discrete I/O
- ▶ 4-20 mA or DC output

Specifically designed for use with Solartron's high performance Orbit® network, the SI 3500 features an intuitive, menu driven-twin axis display which can be programmed to display

readings, set Limits/Alarms, Peak Hold, Track, or act as a Data Logger for inputs from one or two sensors.



### LCD DISPLAY

Digital	2 x colour
Analogue	2 x colour horizontal bars
Update Speed	40 Hz
Display length (mm)	± xx.xxxxx (user selectable)
Display length (ins)	± xx.xxxxx (user selectable)
Resolution mm	Down to 0.05 µm (user selectable)
Resolution ins	Down to 0.000005" (user selectable)

### KEYPAD

Membrane type with 9 keys	Print, Zero, Up, Down, Left, Right, Enter, Peak Hold / Track, Menu
Measurement type	A, B, A+B, A-B, (A+B/2), (A-B/2), (B-A/a) X und Y
Data Logging	A, B, A+B, A-B, (A+B/2), (A-B/2), (B-A/a) X and Y 10,000 readings via switch or 1 ms to 24 hr time interval
Indications	mm/inch, Lower & Upper Limits, Out of Range, Measurement Mode
Power requirement	+24 VDC ± 10%

### EXTERNAL I/O

Serial	RS232 serial port (for printer or PC)
Discrete Output	2 x 3 isolated
Analogue Output	2 channels DC or 4-20 mA

### ENVIRONMENTAL

Front Panel	IP65
Case	IP51
Rear Connection	IP51
EMC	Immunity: EN61000-6-2 Emissions: EN61000-6-3
Storage Temperature (°C)	-20 to +50
Operating Temperature (°C)	0 to +50

### MECHANICAL

Mounting	Bench top or panel mount
Dimensions WxHxD (mm)	Without Bezel 134 x 65 x 160 With Bezel 144 x 74 x 175



# ORBIT® DIGITAL MEASURING SENSORS

## WIRELESS HAND TOOLS

The freedom to roam with **Solartron's WiGauge™** brings increased efficiency to gauging stations and work practices. The ability to work without cables means that the gauging process is not restricted by cable length and routing, or the risk of cable damage.

### WIGAUGE™ SINGLE CHANNEL

- ▶ Fit Wi Gauge with bore heads to check inner diameters
- ▶ M10 & M6 mm fixing threads, which fit most common bore heads
- ▶ LCD Screen option
- ▶ < 0.1 µm resolution (user selectable)
- ▶ Multiple WiGauges™ can connect to a single system
- ▶ 10 hours battery life (based on continuous data transmission)
- ▶ Inductive and Plug-In Charging options
- ▶ IP65 protection
- ▶ Pass/fail range lamps
- ▶ Audio indication of data transmission

wigauge™



### WIGAUGE™ MULTI CHANNEL

- ▶ Handle can be integrated with up to 8 Solartron transducers to form multifunctional wireless gauges, such as snap gauges or multi-sensor bore gauges
- ▶ Mounting plate on end of handle to attach custom tooling
- ▶ < 0.1 µm resolution
- ▶ 5 hours battery life (based on continuous data transmission) off charger.
- ▶ Inductive battery charging system
- ▶ IP65 protection (Handle)
- ▶ Audio indication of data transmission



Multi Channel™ used with Mini probes for bore measurement



Multi Channel WiGauge™ used with narrow body probes to create a crank gauge

### WIGAUGE™ WIRELESS CONNECTION MODULE

Use the Wireless Connection Module to output WiGauges™ directly into the Orbit Network. The Wi Gauges can then be run with Orbit GCS and others. Up to 6 WiGauge™ units can be connected to a WCM at once, and all data be saved and synchronized with other Solartron Sensors.

## ORBIT® NON-CONTACT - LASER TRIANGULATION

For applications where a contact gauging sensor is unsuitable, Solartron offers a range of high performance, low cost Non-Contact Laser Triangulation Sensors. This solution is fully compatible with the Orbit® Measurement Network, which can synchronise up to 200 sensors at once.

### LT2

- ▶ High precision for metallic and reflective surfaces
- ▶ Linearity up to 6 µm, with repeatability up to 0.1 µm
- ▶ Sample rate up to 4 khz
- ▶ "Oval" spot that is ideal for checking metallic surfaces
- ▶ "Adaptive Surface Adjustment:" Laser automatically adjusts beam intensity based on surface for optimum repeatability
- ▶ Software Drivers offer different measurement modes and averaging adjustments for peak repeatability

### LT1

- ▶ 25 and 100 mm ranges
- ▶ Linearity up to 12 µm, with repeatability of up to 1 µm
- ▶ Sample rate up to 1 khz
- ▶ Excellent price/performance ratio

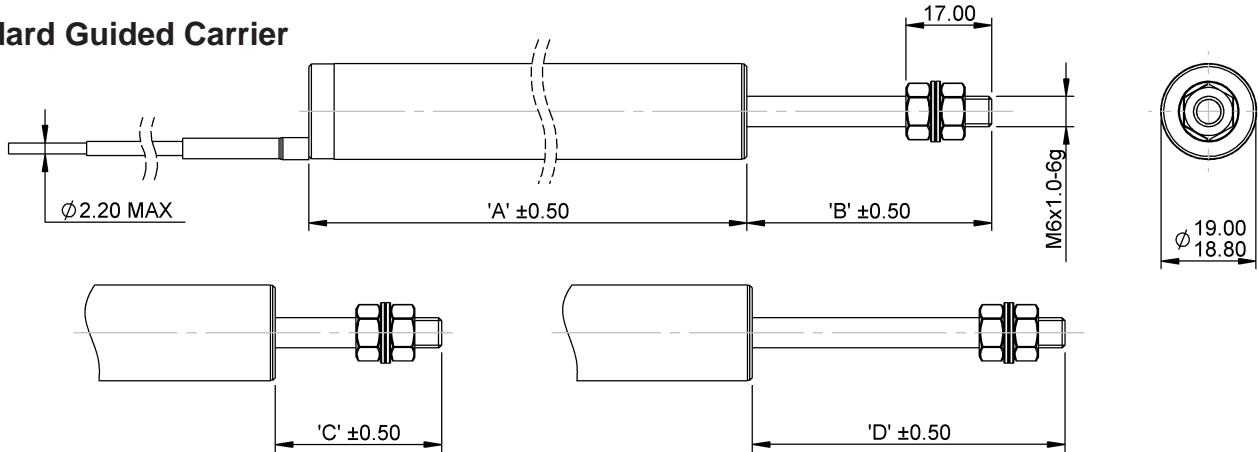
orbit™



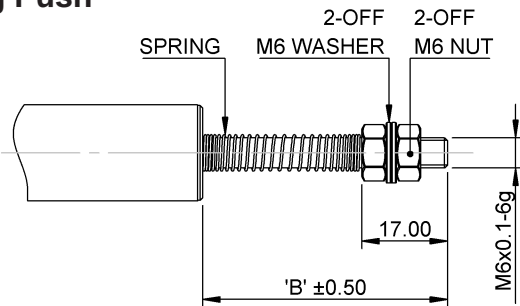
# S SERIES

## DIMENSIONS (mm)

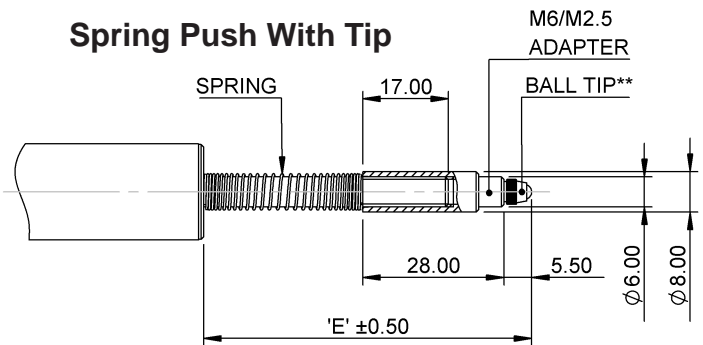
### Standard Guided Carrier



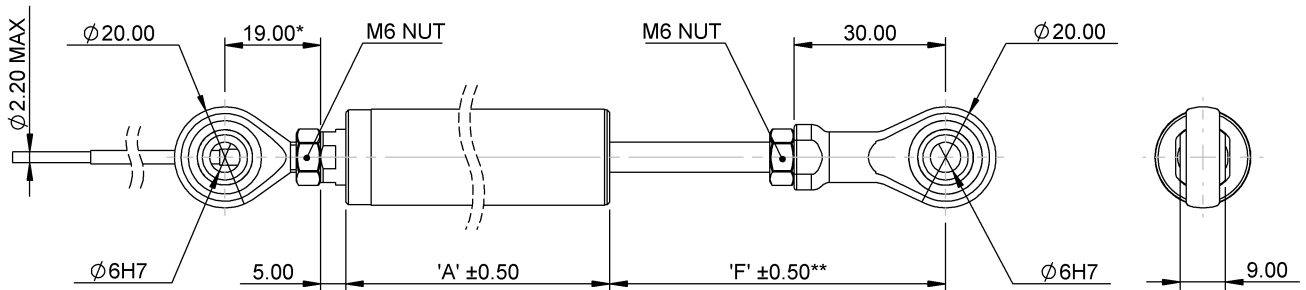
### Spring Push



### Spring Push With Tip



### Universal Joint



- A = Body length including end plates
- B = Carrier protrusion at mid calibration/null position
- C = Fully retracted carrier
- D = Fully extended carrier

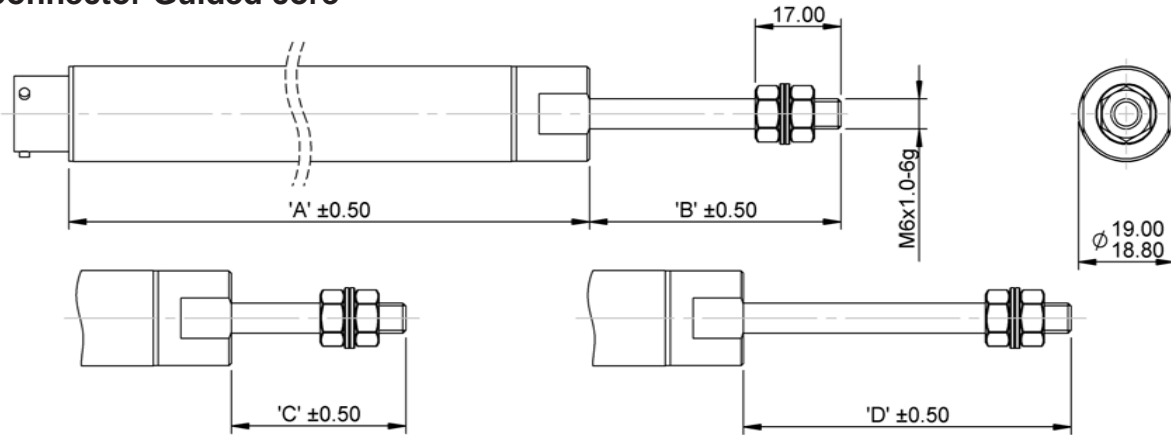
- E = Carrier protrusion at mid calibration/null position with adapter and ball tip fitted
- F = Distance from centre of universal joint at mid calibration/null position
- \* = Components are in fully screwed position
- \*\* = Other tip variants available

Range (mm)		Guided core, Spring Return and Universal Joints						
LVDT	DC & 4-20 mA	LVDT	DC & 4-20 mA	All				
		A	A	B	C	D	E	F
$\pm 2.5$	0-5	55.00	94.00	31.50	24.50	36.00	48.00	49.50
$\pm 5.0$	0-10	74.50	113.50	39.00	28.50	47.00	55.50	57.00
$\pm 7.5$	0-15	81.50	120.50	41.75	30.50	51.00	58.25	59.75
$\pm 10.0$	0-20	96.00	135.00	48.50	33.00	62.00	65.00	66.50
$\pm 15.0$	0-30	110.50	149.25	58.25	34.00	80.00	74.75	76.25
$\pm 25.0$	0-50	132.00	171.00	71.00	36.50	103.00	87.50	89.00
$\pm 50.0$	0-100	189.50	228.50	106.00	48.50	161.00	122.50	124.00
$\pm 75.0$	0-150	240.00	278.50	151.75	69.00	232.00	168.25	169.75
$\pm 100.0$	0-200	297.50	336.00	183.00	71.50	292.00	199.50	201.00
$\pm 150.0$	0-300	412.50	451.00	291.25	122.50	458.00	307.75	309.25

# S SERIES

## DIMENSIONS (mm)

### Axial Connector Guided core



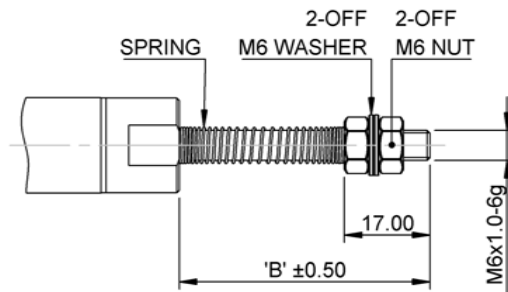
### Standard Temperature Plug

MIL-C-26482 Series 1

-40 °C + 120 °C



### Axial Connector Spring Push



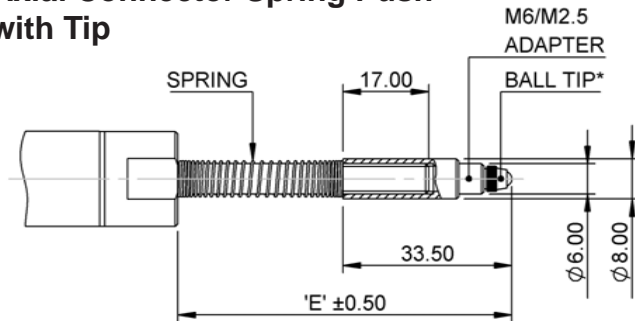
### High Temperature Plug

MIL-C-26482 Series 2

-40 °C + 200 °C



### Axial Connector Spring Push with Tip



**A** = Body length including end plates

**B** = Carrier Protrusion at mid calibration/null position

**C** = Fully retracted carrier

**D** = Fully extended carrier

**E** = Carrier protrusion at mid calibration/null position with adapter and ball tip fitted

**C** = Fully retracted carrier

\* = Other tip variants available

Range (mm)	
LVDT	DC & 4-20 mA
± 2.5	0-5
± 5.0	0-10
± 7.5	0-15
± 10.0	0-20
± 15.0	0-30
± 25.0	0-50
± 50.0	0-100
± 75.0	0-150
± 100.0	0-200
± 150.0	0-300

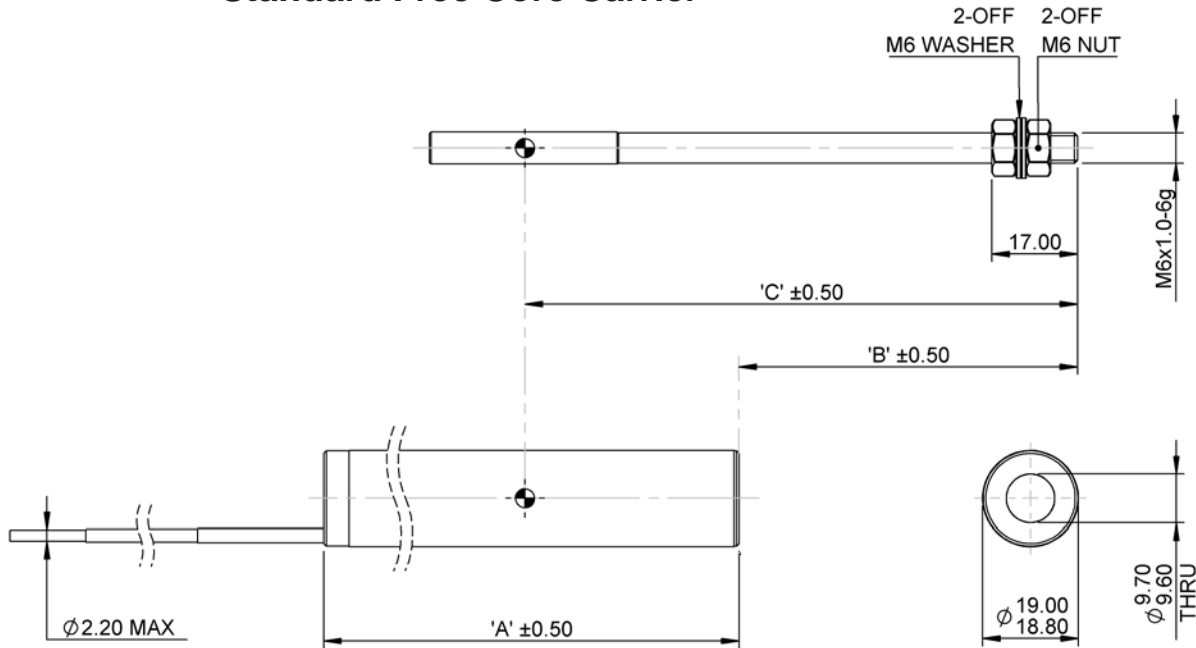
Guided core, Spring Return and Universal Joints					
LVDT	DC & 4-20 mA	All			
A	A	B	C	D	E
68.50	101.50	32.50	27.25	39.00	49.00
87.80	118.50	40.00	30.25	50.00	56.50
94.50	128.00	43.00	32.00	54.00	59.50
109.50	142.50	49.75	34.75	65.00	66.25
124.50	156.50	59.25	35.75	83.00	75.75
145.50	178.50	72.00	38.25	160.00	88.50
202.50	235.50	107.10	50.25	164.00	123.50
253.50	286.50	153.00	71.00	235.00	169.50
309.50	341.50	184.25	73.50	295.00	200.75
424.50	456.50	292.75	124.50	461.00	309.25



# S SERIES

## DIMENSIONS (mm)

### Standard Free Core Carrier



### Standard Free Core



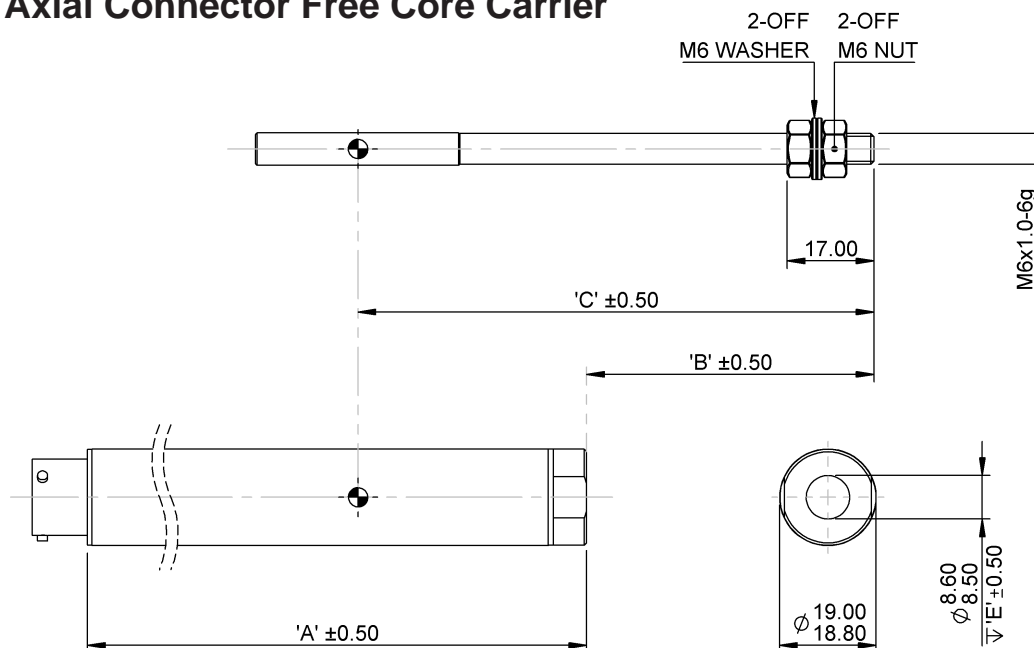
- A** = Body length including end plates
- B** = Carrier Protrusion at mid calibration/null position
- C** = Null point to end of the carrier at mid calibration/null position
- D** = Core length
- \* = Cores shorter than 24.00 mm are threaded thru

Range (mm)		Guided core, Spring Return and Universal Joints				
LVDT	DC & 4-20 mA	LVDT	DC & 4-20 mA	All		
		A	A	B	C	D
± 2.5	0-5	33.50	72.50	40.75	55.25	16.50*
± 5.0	0-10	53.00	92.00	48.25	72.50	29.00
± 7.5	0-15	60.00	99.00	51.25	79.00	34.00
± 10.0	0-20	74.50	113.50	58.00	93.00	40.00
± 15.0	0-30	89.00	128.00	67.50	109.75	37.50
± 25.0	0-50	110.50	149.50	80.25	133.25	38.50
± 50.0	0-100	168.00	206.75	115.25	197.00	50.00
± 75.0	0-150	218.50	257.00	161.00	268.00	50.00
± 100.0	0-200	276.00	314.50	192.25	328.00	50.00
± 150.0	0-300	391.00	429.50	300.75	494.00	50.00

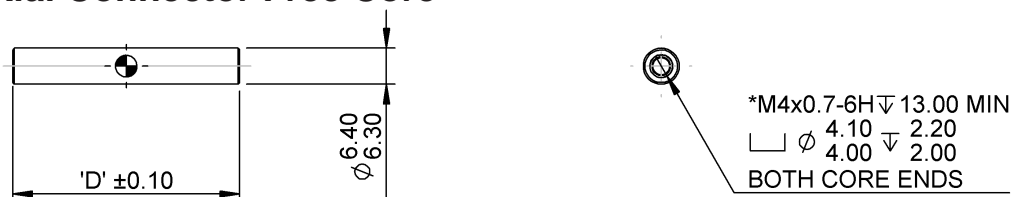
# S SERIES

## DIMENSIONS (mm)

### Axial Connector Free Core Carrier



### Axial Connector Free Core



### High Temperature Plug

MIL-C-26482 Series 2

-40 °C +200 °C



### Standard Temperature Plug

MIL-C-26482 Series 1

-40 °C +120 °C



**A** = Body length including end plates

**B** = Carrier Protrusion at mid calibration/null position

**C** = Null point to end of the carrier at mid calibration/null position through

**D** = Core length

**E** = Bore depth

\* = Cores shorter than 24.00 mm are threaded

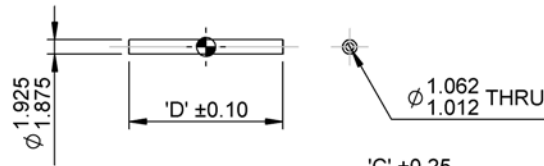
Range (mm)	
LVDT	DC & 4-20 mA
± 2.5	0-5
± 5.0	0-10
± 7.5	0-15
± 10.0	0-20
± 15.0	0-30
± 25.0	0-50
± 50.0	0-100
± 75.0	0-150
± 100.0	0-200
± 150.0	0-300

Guided core, Spring Return and Universal Joints								
LVDT	DC & 4-20 mA	All			LVDT	DC & 4-20 mA		
A	A	B	C	D	E	E		
60.50	93.50	39.00	63.25	16.50*	41.75	73.75		
79.50	110.50	46.50	80.50	29.00	62.50	93.50		
86.50	120.00	49.50	87.00	34.00	69.50	100.50		
101.50	134.50	56.25	101.00	40.00	84.00	115.00		
116.50	148.50	65.75	117.75	37.50	98.25	129.25		
137.50	170.50	78.50	141.25	38.50	120.00	151.00		
194.50	227.50	113.50	205.00	50.00	177.25	208.25		
245.50	278.50	159.50	276.00	50.00	227.50	258.50		
301.50	333.50	190.75	336.00	50.00	285.00	316.00		
146.50	448.50	299.25	502.00	50.00	400.00	431.00		

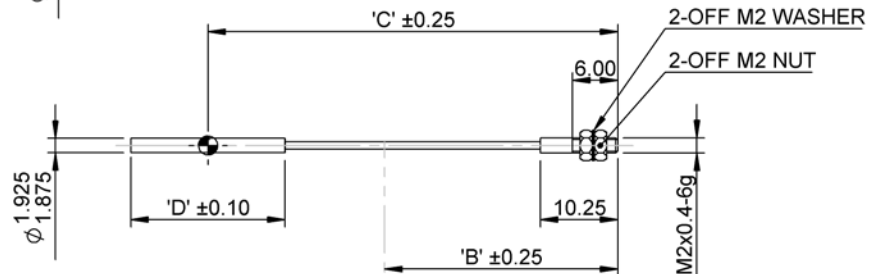
# OPTIMUM SERIES

## DIMENSIONS (mm)

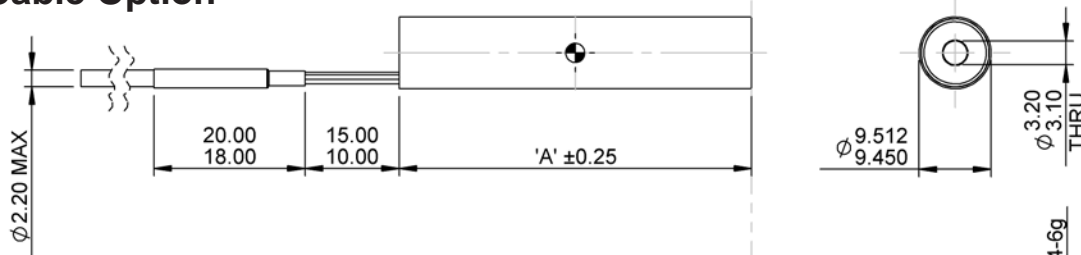
### Standard Free Core



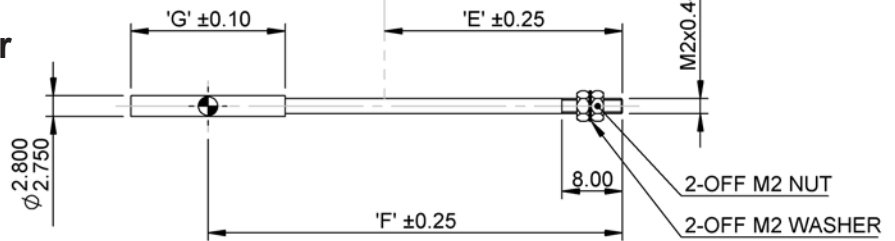
### Standard Free Core/Carrier



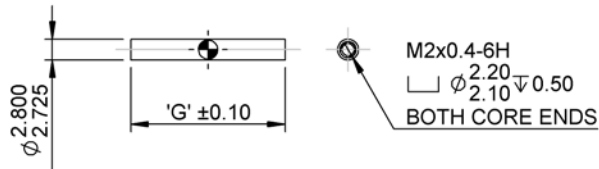
### 5 Way Cable Option



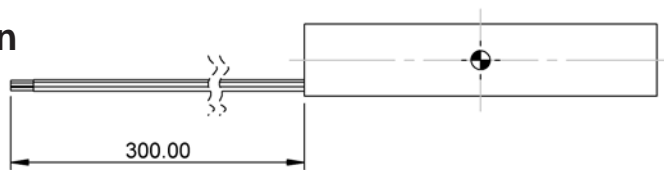
### Reinforced Free Core/Carrier



### Threaded Free Core



### 5 Wire Option



A = Body length  
 B = Stud protrusion at mid calibration/null position  
 C = Null point to end of the stud at mid calibration/null position  
 D = Ø1.90 core length

E = Carrier protrusion at mid calibration/null position  
 F = Null point to end of the carrier at mid calibration/null position  
 G = Ø2.75 core length

Range (mm)		A	B	C	D	E	F	G
LVDT	Digital							
± 1.5	0-3	20.60	14.75	25.00	12.00	16.00	26.50	11.00
± 6.0	0-12	46.50	23.00	46.25	28.40	23.00	46.25	28.40
± 10.0	0-20	46.50	31.00	54.25	20.40	31.50	54.75	20.40
± 12.5	0-25	83.30	34.00	75.50	50.80	34.00	75.50	50.80
± 25.0	0-50	83.30	51.00	80.00	26.00	51.00	80.00	26.00

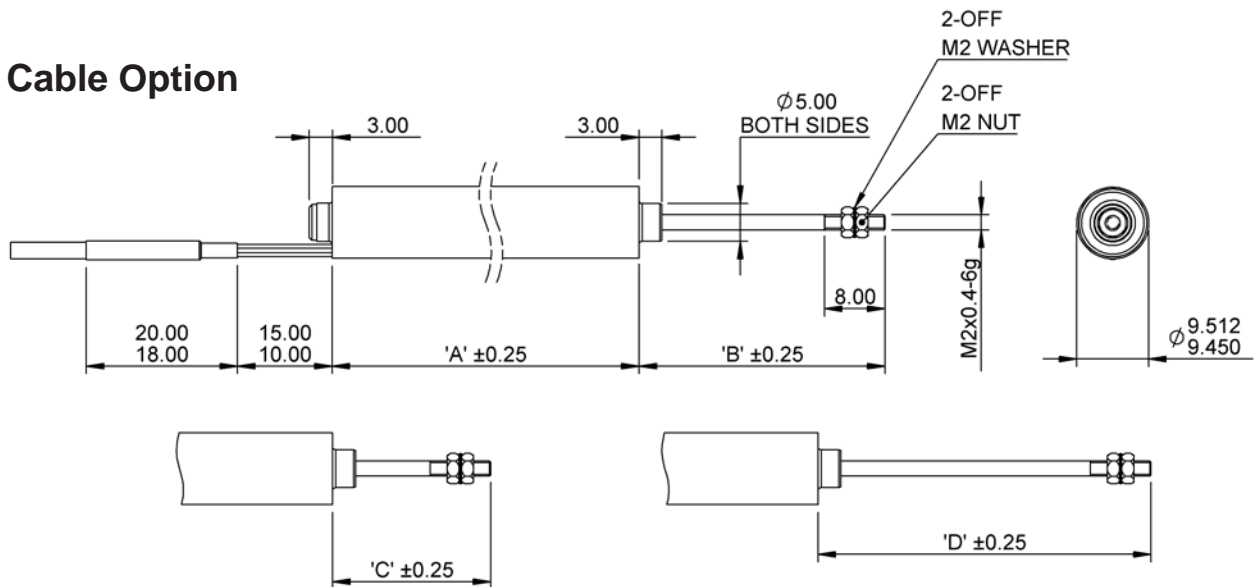


# OPTIMUM SERIES

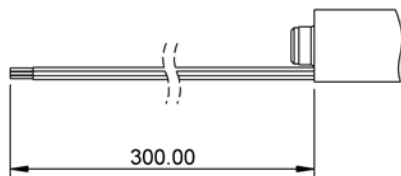
## DIMENSIONS (mm)

### Standard Guided Core/Carrier

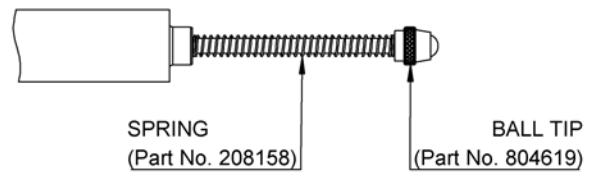
#### 5 Way Cable Option



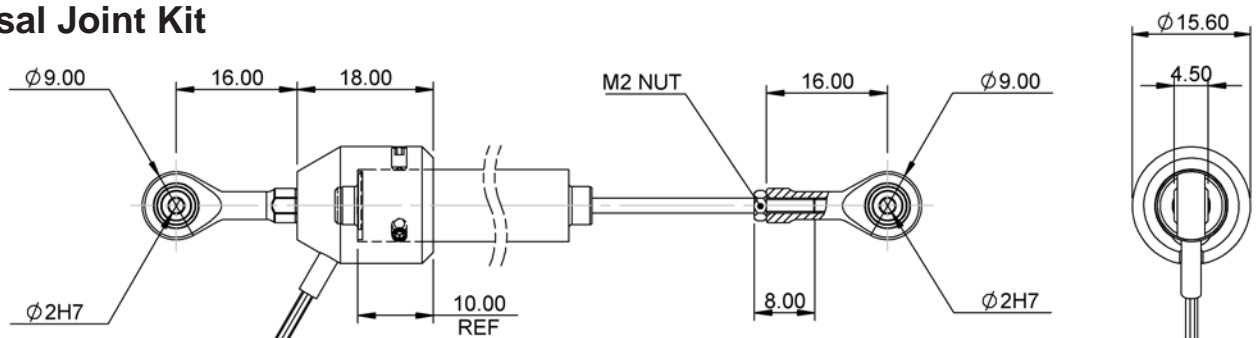
#### 5 Wire Option



#### OP - Series Accessories



#### Universal Joint Kit



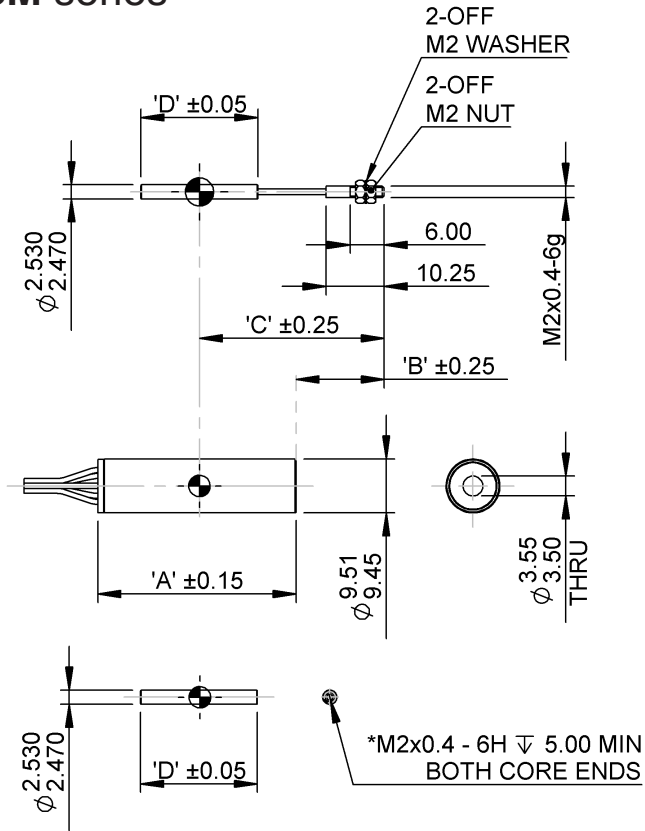
- A = Body length
- B = Carrier protrusion at mid calibration/null position
- C = Fully retracted carrier
- D = Fully extended carrier

Range (mm)		A	B	C	D
LVDT	Digital				
± 1.5	0-3	20.50	17.75	14.50	21.00
± 6.0	0-12	46.50	24.50	17.00	32.00
± 10.0	0-20	46.50	32.50	21.00	44.00
± 12.5	0-25	83.50	34.00	19.25	48.75
± 25.0	0-50	83.50	52.00	25.00	79.00

# SM / DF(G)

## DIMENSIONS (mm)

### SM series



### FREE CORE/CARRIER

Type	Range (mm)	A	B	C	D
SM/1	±1.0	15.15	12.75	20.00	9.70
SM/3	±3.0	35.00	15.50	32.50	20.60

A - Body length including end caps

B - Stud protrusion at mid calibration/null position

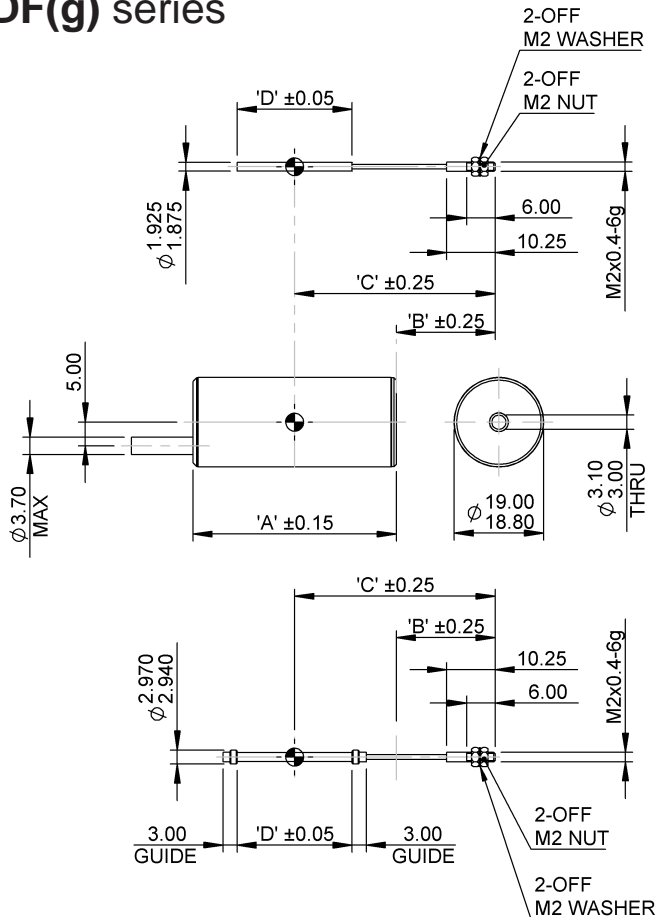
C - Null point to end of the stud at mid calibration/null position

D - Core length

\* - Cores shorter than 12.00 mm are threaded through

### FREE CORE

### DF(g) series



### DF-SERIES CORE/CARRIER ASSEMBLY

Type	Range (mm)	A	B	C	D
DF/1.0	±1.0	37.00	21.75	40.25	20.00
DF/2.5	±2.5	37.00	21.75	40.25	20.00
DF/5.0	±5.0	43.00	21.00	42.50	24.30
DFg/1.0	±1.0	37.00	21.75	40.25	20.00
DFg/2.5	±2.5	37.00	21.75	40.25	20.00
DFg/5.0	±5.0	43.00	21.00	42.50	24.30

A - Body length including end caps

B - Carrier protrusion at mid calibration/null position

C - Null point to end of the stud at mid calibration/null position

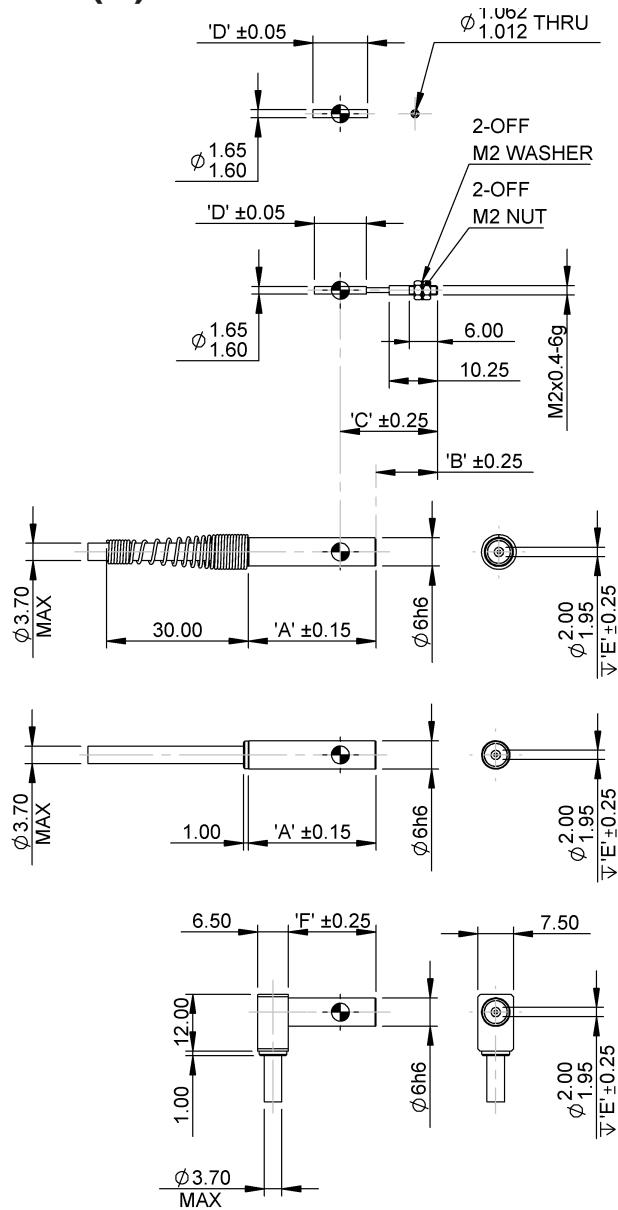
D - Core length

### DFg-SERIES CORE/CARRIER ASSEMBLY

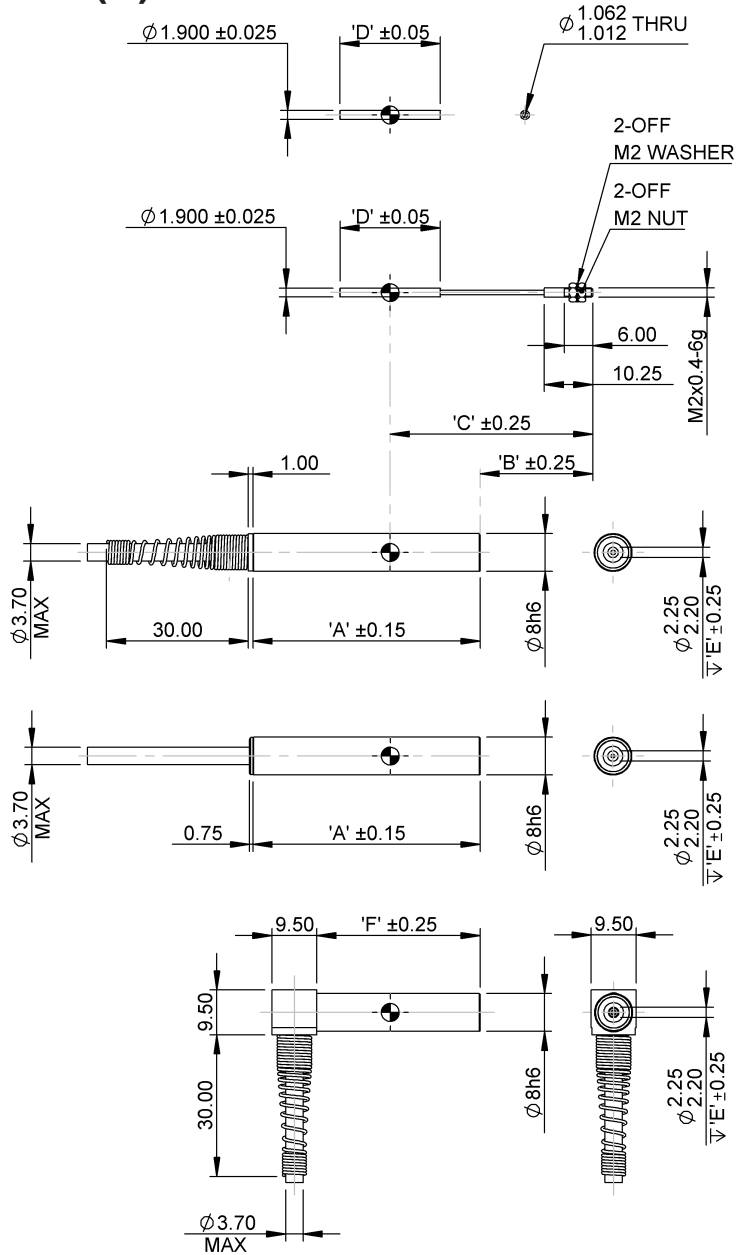
# M6D(H) / MD(H)

## DIMENSIONS (mm)

### M6D(H) series



### MD(H) series



Type	Range (mm)	A	B	C	D	E
M6D/1.0	±1.0	27.00	13.00	20.50	11.00	16.25
M6DH/1.0	±1.0	27.00	13.00	20.50	10.25	16.25
MD/1.0	±1.0	27.00	11.75	20.25	11.00	16.50
MDH/1.0	±1.0	27.00	11.75	20.25	8.85	16.50
MD/2.5	±2.5	40.00	20.25	35.00	15.70	29.00
MDH/2.5	±2.5	40.00	20.25	35.00	15.00	29.00
MD/5.0	±5.0	48.00	23.75	42.75	21.20	37.50
MDH/5.0	±5.0	48.00	23.75	42.75	18.40	37.50
MD/10.0	±10.0	67.00	30.00	58.50	24.40	56.75
MDH/10.0	±10.0	67.00	30.00	58.50	28.80	56.75

Type	Range (mm)	F
M6DR/1.0	±1.0	18.50
M6DHR/1.0	±1.0	18.50
MDR/1.0	±1.0	13.50
MDHR/1.0	±1.0	13.50
MDR/2.5	±2.5	26.00
MDRH/2.5	±2.5	26.00
MDR/5.0	±5.0	34.50
MDHR/5.0	±5.0	34.50
MDR/10.0	±10.0	54.00
MDHR/10.0	±10.0	54.00

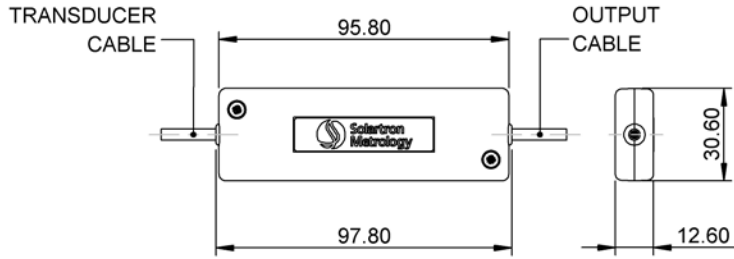
- A - Body length including end caps
- B - Carrier portrusion at mid calibration/null position
- C - Null point to end of the stud at mid calibration/null position

- D - Core length
- E - Bore depth
- F - Short exposed length

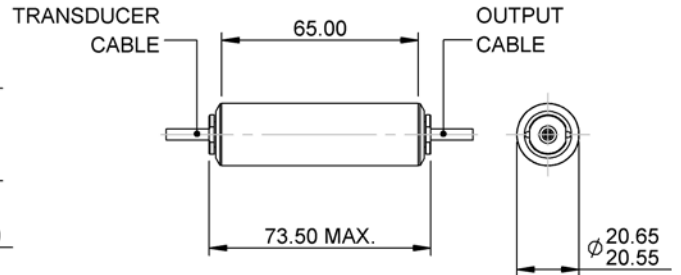
# SIGNAL CONDITIONING MODULES

## DIMENSIONS (mm)

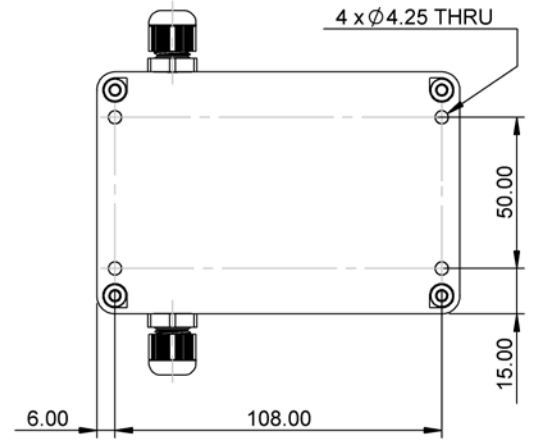
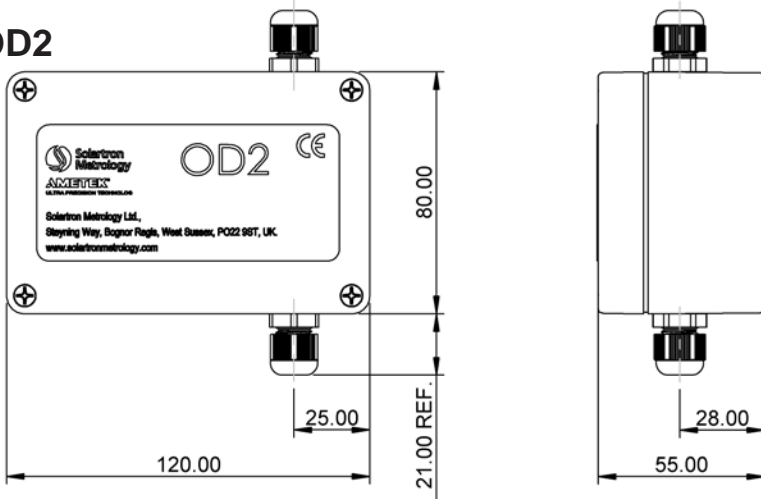
### BICM IP40 in line module



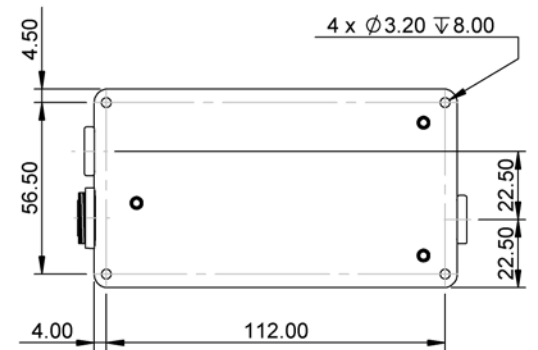
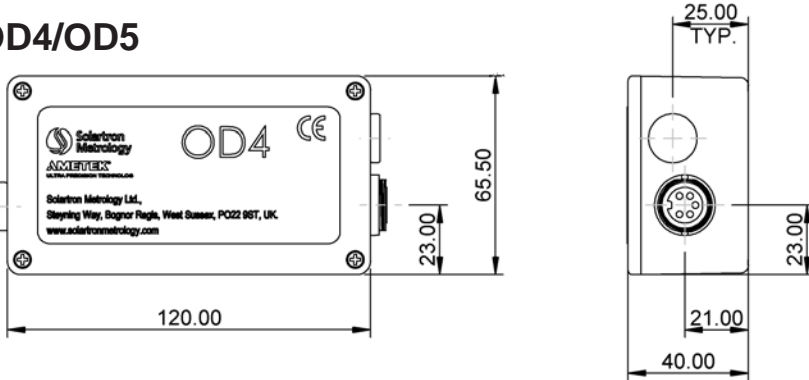
### BICM IP67 in line module



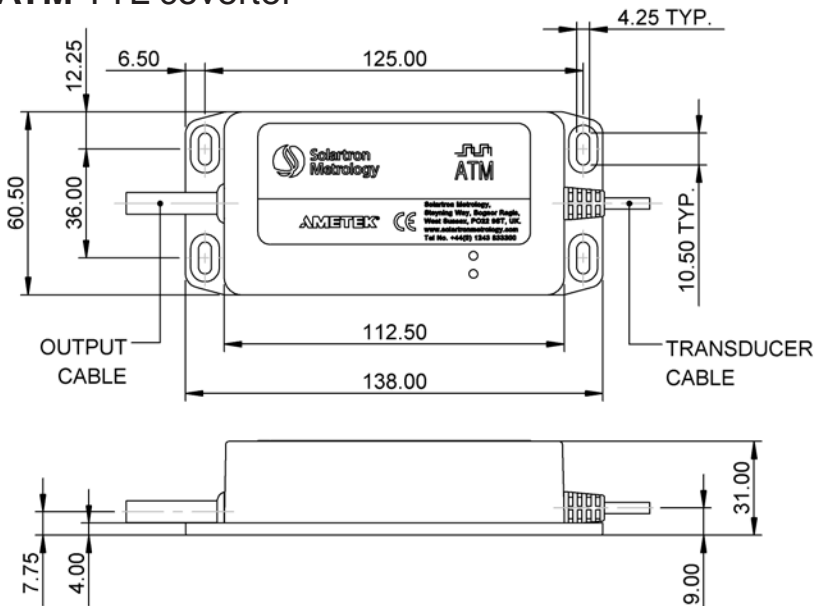
### OD2



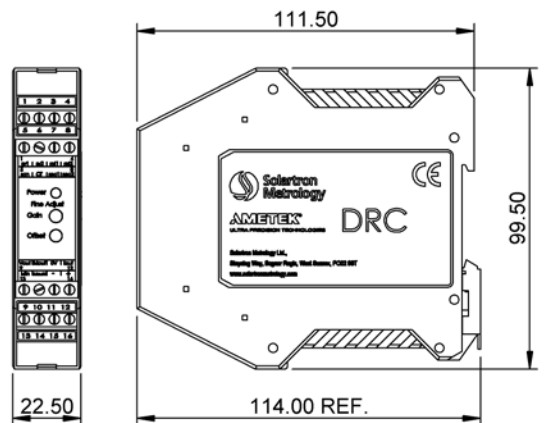
### OD4/OD5



### ATM TTL coverter



### DRC DIN rail module





# GLOSSARY OF TERMS

## ACCURACY

The accuracy of all Solartron Metrology Digital Displacement Sensors, Gauge Probes and Displacement Transducers is quoted as a % of the linear displacement measurement., which is the method that is least open to interpretation (as opposed, for example, to best fit).

## DIRECTION OF LINEAR DISPLACEMENT MEASUREMENT

- ▶ Outward movement is linear displacement from the body of the displacement sensor or displacement transducer.
- ▶ Inward movement is linear displacement towards the body of the displacement sensor or displacement transducer.

## DISPLACEMENT SENSOR TIP FORCE

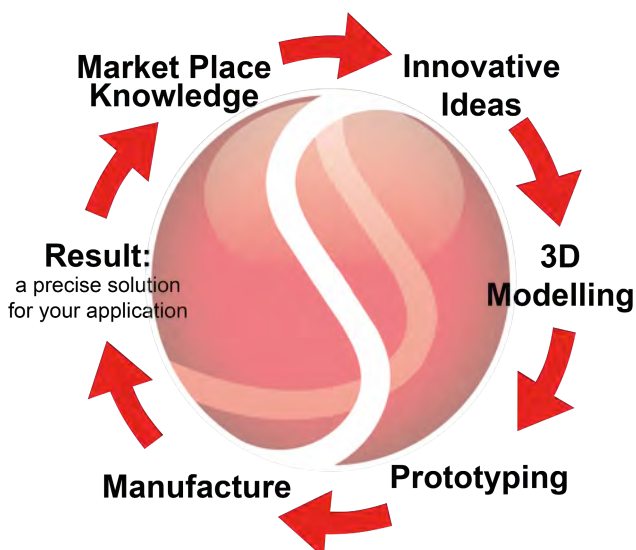
The tip force of the linear displacement transducer is defined as the force exerted on the item being measured at the mid-point of the displacement transducer measuring range.

## HYSTERESIS

Hysteresis of a gauge probe is the difference from the true measurement when the direction of measurement is reversed.

## TRIED, TESTED AND APPROVED...

Quality and customer satisfaction have been central to the relationships that we have developed with our metrology & measurement customers over a period of many years. We are committed to providing the highest standards of sensor technology and service levels to all our metrology & measurement customers worldwide.



## LVDT

Linear Variable Differential Transformer Displacement Sensor or Gauge Probes are devices that measure linear displacement. This type of displacement transducer has a reputation for long life with reliable measurements providing a cost-effective solution for many measuring applications. LVDT transducers or gauge probes are used wherever fast and accurate linear measurements are required to ensure good process control.

## REPEATABILITY

Repeatability is defined as the ability of a sensor to provide measurements within a close distribution on the same measure and carried out in the same direction. Solartron uses a method of establishing repeatability where a side load is applied in four directions to reflect how sensors are used in most applications. Methods of establishing repeatability without applying a side load may produce better results but may not be representative of real life applications.

## SENSITIVITY

This is the specified magnitude of the output with respect to displacement (mm) and energising voltage (V) for an LVDT sensor or Half Bridge displacement transducer. It is expressed in mV/V/mm.

bsi.



## Certificate of Registration

QUALITY MANAGEMENT SYSTEM - ISO 9001:2015

This is to certify that: Solartron Metrology Limited  
Steyning Way  
Southern Cross Industrial Estate  
Bognor Regis  
PO22 9ST  
United Kingdom

Holds Certificate Number: Q 09540

and operates a Quality Management System which complies with the requirements of ISO 9001:2015 for the following scope:

The design, development and manufacture of position sensors (lvdt and other types) for industrial and aerospace applications. Associated signal conditioning equipment is included. Supplier of "factored" sensors and instrumentation products.

For and on behalf of BSI:

Andrew Launn, EMEA Systems Certification Director

Original Registration Date: 1990-02-26  
Latest Revision Date: 2021-02-03

Effective Date: 2021-03-10  
Expiry Date: 2024-03-09



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## REAL PRECISION. REAL SOLUTIONS.

In the laboratory, on the shop floor or in the field, Solartron Metrology's products provide precise linear measurements for quality control, test and measurement and machine control.

Solartron Metrology is a world leader in the innovation, design and manufacture of precision digital and analogue dimensional LVDT gauging probes, displacement sensors, optical linear encoders and associated instrumentation.



**Solartron  
Metrology**

**AMETEK**

Solartron Metrology pursues a policy of continuous development. Specifications in this document may therefore be changed without notice.



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