



# MOTORSPORT MEASUREMENT & CONTROL SENSORS

# INNOVATION IN MOTION

For more than 50 years, Penny+Giles has provided creative solutions for position measurement and control. Our success in world markets results from innovative technology, creative design, manufacturing excellence and interactive customer support.

Our experience in providing control and feedback solutions across a wide applications spectrum from aerospace, automotive and motorsport, mining and process control to medical science, broadcasting and recording allows our customers to specify Penny + Giles equipment knowing that it is industry proven in thousands of applications throughout the world.

Penny+Giles sensors are manufactured using state-of-the-art production facilities, which include cell assembly systems, ensuring products are delivered rapidly to meet customers needs.

## Custom design

Using the Penny+Giles partnership approach integrates our design and product expertise with your design team, enabling a free flow of ideas to provide the most reliable and cost effective product solution.

## Standard build

Specify from our wide range of position measurement and control products - many available from stock.

## Motorsport

Success in motor racing depends on hundreds of components working together at peak performance under the most extreme conditions. Position sensors are essential for the control and monitoring systems that supply information to race engineers to help trim precious seconds off the lap times.

Penny+Giles have pioneered developments in motorsport position sensors by using experience gained in aerospace applications, where reliability under extremely hostile conditions are paramount.

Penny+Giles sensors have become a benchmark standard in motor racing and have helped every winning team in the Formula 1 championship since 1986.

## Aerospace Products

Penny+Giles design and manufacture position sensors for civil and military applications on fixed and rotary wing aircraft and satellite launch vehicles. These products are sold under the Curtiss-Wright Controls, Integrated Sensing brand.



## Industrial products

Penny + Giles industrial products are key components throughout the industrialised world providing control and position feedback in a wide range of applications as diverse as construction vehicles and leisure simulators.

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**EMC**

The products detailed on pages 3 to 12 have been tested to the requirements of EN50081-1 (Emissions) and EN50082-2 (Immunity).



### Quality Assurance

Penny+Giles are accredited to BS EN ISO9001:2000. Quality is at the heart of all our systems ensuring the reliability of our products from initial design to final despatch.

Certificate No LRQ 0924881

# LINEAR POTENTIOMETERS

The Penny+Giles SLS and MLS range of linear potentiometers have been designed with motorsport applications in mind. They utilise established hybrid track technology to provide low electrical noise and high accuracy output over long operating life in the most extreme environments. With a sealing system tested to IP66 and a choice of mountings, these potentiometers have become the benchmark in suspension data acquisition systems for single seat, saloon car, motorcycle and truck racing.



## Features

- Compact body to stroke length
- Sealing to IP66 and corrosion resistant rod-end bearings
- Integrally moulded rear cable assembly
  - Rotatable shaft
  - Reduced weight
  - Rapid despatch
  - CE approved

## Benefits

- Reduced installation space
- Can be used in hostile environments
- Excellent cable strain relief with secure sealing
- Easy installation
- Ideal for motorsport applications
- Eliminates customer inventory
- Confidence in EMC performance

# SLS095 LINEAR DISPLACEMENT SENSOR

SLS095 is designed to provide maximum performance benefits within an extremely compact body diameter of 9.5mm, with stroke lengths from 10 to 100mm. The miniature size of this sensor makes it ideal for applications in robotics, animatronics, medical equipment and motorsport data acquisition.

## PERFORMANCE

Electrical stroke E	mm	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>75</b>	<b>100</b>	
Resistance $\pm 10\%$	k $\Omega$	0.4 <sup>†</sup>	0.8	1.2	1.6	2.0	3.0	4.0	<sup>†</sup> $\pm 15\%$ for SLS 095/10
Independent linearity	$\pm\%$	0.5	0.35	0.25	0.25	0.25	0.15	0.15	
Power dissipation at 20°C	W	0.2	0.4	0.6	0.8	1.0	1.5	2.0	
Applied voltage maximum	Vdc	8.9	17.9	26	40	44	67	74	
Resolution		Virtually infinite							
Hysteresis (repeatability)		Less than 0.01mm							
Operational temperature	°C	-30 to +100							
Output smoothness		To MIL-R-39023 grade C 0.1%							
Insulation resistance		Greater than 100M $\Omega$ at 500Vdc							
Operating mode		Voltage divider only - see Circuit Recommendation below							
Wiper circuit impedance		Minimum of 100 x track resistance or 0.5M $\Omega$ (whichever is greater)							
Operating force maximum									
sealed	gf	300 in horizontal plane							
unsealed	gf	100 in horizontal plane							
Life at 250mm per second		Typically greater than 100 million operations (50 x 10 <sup>6</sup> cycles) at 25mm stroke length							
Dither life		200 million operations (100 x 10 <sup>6</sup> cycles) at $\pm 0.5$ mm, 60Hz							
Sealing		IP50 standard - IP66 see options							
Shaft seal life		20 million operations (10 x 10 <sup>6</sup> cycles)							
Shaft velocity maximum	m/s	2.5							
Vibration		RTCA 160D 10Hz to 2kHz (random) @ 4.12g (rms) - all axes							
Shock		40g 6mS half sine							

## CIRCUIT RECOMMENDATION

Hybrid track potentiometers feature a high wiper contact resistance, therefore operational checks should be carried out only in the voltage divider mode. Hybrid track potentiometers should be used only as voltage dividers, with a minimum wiper circuit impedance of 100 x track resistance or 0.5M $\Omega$  (whichever is greater). Operation with wiper circuits of lower impedance will degrade the output smoothness and affect the linearity.

## OPTIONS

IP 66 sealing  
Mounting

Designed to accept integral shaft seal to give IP66 rating  
Can be supplied with self aligning bearings or a plain body for use with body clamps or flange mounting kit.

## ACCESSORIES

Mounting kits ———— Body clamp kit - SA200841  
Flange kit - SA200842

## AVAILABILITY

All standard configurations can be supplied rapidly from the factory - check with your local supplier for more details

## ORDERING CODES

SLS095/...../...../...../.....

Electrical stroke ———— Resistance

Sealing 50 = IP50, 66 = IP66  
Mounting option R = Self aligning bearing  
P = Plain



# SLS130 LINEAR DISPLACEMENT SENSOR

The SLS130 range is designed to provide performance benefits within a compact, lightweight package in stroke lengths from 25 to 200mm. With a choice of mounting options and accessories, this sensor is ideally suited to a wide range of industrial applications.

## PERFORMANCE

		25	50	75	100	125	150	175	200
Electrical stroke E	mm	25	50	75	100	125	150	175	200
Resistance $\pm 10\%$	k $\Omega$	1	2	3	4	5	6	7	8
Independent linearity									
guaranteed	$\pm\%$	0.25	0.25	0.15	0.15	0.15	0.15	0.15	0.15
typical	$\pm\%$	0.15	0.15	0.15	0.10	0.10	0.07	0.07	0.07
Power dissipation at 20°C	W	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Applied voltage maximum	Vdc	22	44	67	74	74	74	74	74
Electrical output		Minimum of 0.5% to 99.5% applied volts							
Resolution		Virtually infinite							
Hysteresis (repeatability)		Less than 0.01mm							
Operational temperature	°C	-30 to +100 (tested to +130 for 12 hours duration)							
Output smoothness		To MIL-R-39023 grade C 0.1%							
Insulation resistance		Greater than 100M $\Omega$ at 500Vdc							
Operating mode		Voltage divider only - see Circuit Recommendation below							
Wiper circuit impedance		Minimum of 100 x track resistance or 0.5M $\Omega$ (whichever is greater)							
Operating force maximum									
sealed	gf	500 in horizontal plane							
unsealed	gf	250 in horizontal plane							
Life at 250mm per second		Typically greater than 100 million operations (50 x 10 <sup>6</sup> cycles) at 25mm stroke length							
Dither life		200 million operations (100 x 10 <sup>6</sup> cycles) at $\pm 0.5$ mm, 60Hz							
Sealing		IP50 standard - IP66 see options							
Shaft seal life		20 million operations (10 x 10 <sup>6</sup> cycles) - replaceable							
Shaft velocity maximum	m/s	10							
Vibration		RTCA 160D 10Hz to 2kHz (random) @12.6g (rms) - all axes							
Shock		Less than 0.04% output change @2500g - all axes							

## CIRCUIT RECOMMENDATION

Hybrid track potentiometers feature a high wiper contact resistance, therefore operational checks should be carried out only in the voltage divider mode. Hybrid track potentiometers should be used only as voltage dividers, with a minimum wiper circuit impedance of 100 x track resistance or 0.5M $\Omega$  (whichever is greater). Operation with wiper circuits of lower impedance will degrade the output smoothness and affect the linearity.

## OPTIONS

Compact shaft	Compact shaft will reduce dimension D by 25mm
Integral shaft seal - IP 66	Designed to accept integral shaft seal to give IP66 rating
Extended cable length	10m output cable can be specified
Mounting	Body clamp, flange or quick release balljoint mounting kits can be supplied
Protective sleeve	For all stroke lengths - self aligning bearings only. See ordering code
Spring loaded shaft kit	For stroke lengths 25 to 150mm with /L shaft option and /50 sealing option only

## ACCESSORIES

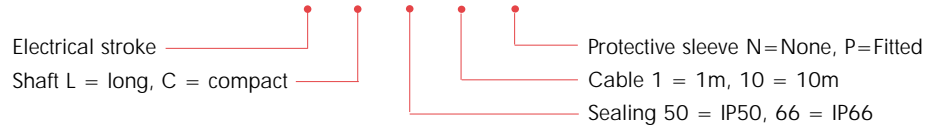
Mounting kits	<ul style="list-style-type: none"> <li>— Body clamp kit - SA200264, Flange kit - SA200266</li> <li>— Quick release balljoint (Heim) - SA200337</li> </ul>
Protective sleeve - SA202984/...../.....	<ul style="list-style-type: none"> <li>— Shaft L=Long, C=Compact</li> <li>— Electrical stroke (select to match SLS130 sensor)</li> </ul>
Spring loaded shaft kit - SA200265/stroke	(For use with option L/50 units only)

## AVAILABILITY

All standard configurations can be supplied rapidly from the factory - check with your local supplier for more details

## ORDERING CODES

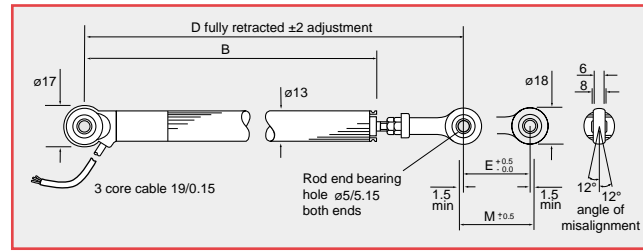
SLS130/...../...../...../...../.....



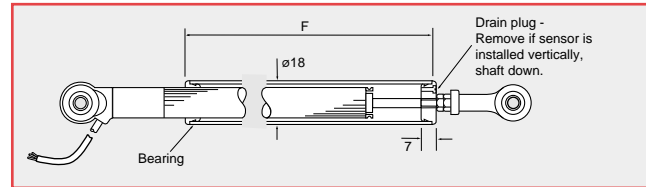
## DIMENSIONS AND MOUNTING OPTIONS

Note: drawings not to scale

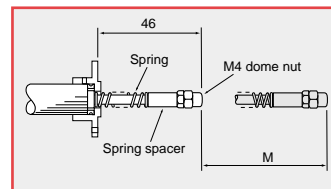
### SELF ALIGNING BEARING MOUNTING



### PROTECTIVE SLEEVE OPTION - P

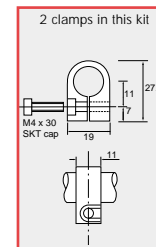


### SPRING RETURN OPTION †

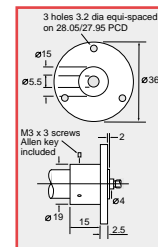


SA200265/stroke  
(25 to 150mm stroke lengths and /L/50 options only)

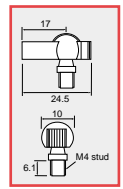
### MOUNTING OPTIONS



Body clamp  
SA200264



Flange mounting  
SA200266

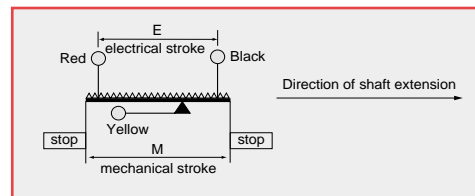


Quick release ball joint  
SA200337

Electrical stroke E	mm	25	50	75	100	125	150	175	200
Mechanical stroke M	mm	29	54	79	104	129	154	179	204
Body length B	mm	110.5	135.5	160.5	185.5	210.5	235.5	260.5	285.5
Between centres D									
standard sensor (L)	mm	173.6	198.6	223.6	248.6	273.6	298.6	323.6	348.6
compact shaft sensor (C)	mm	148.6	173.6	198.6	223.6	248.6	273.6	298.6	323.6
Sleeve length F									
standard sensor (L)	mm	102	127	152	177	202	227	252	277
compact shaft sensor (C)	mm	77	102	127	152	177	202	227	252
Weight approximate									
standard sensor (L)	g	64	71	78	85	92	99	106	113
compact shaft sensor (C)	g	60	67	74	81	88	95	102	109

## ELECTRICAL CONNECTIONS

3 core cable: PUR sheathed 1m long with ETFE insulated 19/0.15 cores.



† Body clamp or flange mounting options should be ordered separately

# MLS 130 LINEAR DISPLACEMENT SENSOR

The MLS130 sealed linear sensor is designed to provide superior performance within a compact, lightweight package in stroke lengths from 25 to 200mm. With a choice of mounting options, including metal rod end bearings, and an optional protective sleeve for extreme environmental conditions, this sensor is ideally suited to motorsport data acquisition applications on suspension and throttle position feedback, where high performance and reliability with competitive pricing and rapid despatch are vital. The sensor is supplied fully sealed to IP66, with an integrally moulded DR25 sheathed multicore cable.

## PERFORMANCE

		25	50	75	100	125	150	175	200
Electrical stroke E	mm	25	50	75	100	125	150	175	200
Resistance $\pm 10\%$	k $\Omega$	1	2	3	4	5	6	7	8
Independent linearity									
guaranteed	$\pm\%$	0.25	0.25	0.15	0.15	0.15	0.15	0.15	0.15
typical	$\pm\%$	0.15	0.15	0.15	0.10	0.10	0.07	0.07	0.07
Power dissipation at 20°C	W	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Applied voltage maximum	Vdc	22	44	67	74	74	74	74	74
Electrical output		Minimum of 0.5% to 99.5% applied volts							
Resolution		Virtually infinite							
Hysteresis (repeatability)		Less than 0.01mm							
Operational temperature	°C	-30 to +100 (tested to +130 for 12 hours duration)							
Output smoothness		To MIL-R-39023 grade C 0.1%							
Insulation resistance		Greater than 100M $\Omega$ at 500Vdc							
Operating mode		Voltage divider only - see Circuit Recommendation below							
Wiper circuit impedance		Minimum of 100 x track resistance or 0.5M $\Omega$ (whichever is greater)							
Operating force maximum	gf	500 in horizontal plane							
Sealing		IP66							
Shaft seal life (replaceable)		20 million operations (10 x 10 <sup>6</sup> cycles)							
Sensor track life at 0.25m/s		Greater than 100 million operations (50 x 10 <sup>6</sup> cycles) at 25mm stroke length							
Sensor track dither life		200 million operations (100 x 10 <sup>6</sup> cycles) at $\pm 0.5$ mm, 60Hz							
Shaft velocity maximum	m/s	10							
Vibration		RTCA 160D 10Hz to 2kHz (random) @ 12.6g (rms) - all axes							
Shock		Less than 0.04% output change @ 2500g - all axes							

## CIRCUIT RECOMMENDATION

Hybrid track potentiometers feature a high wiper contact resistance, therefore operational checks should be carried out only in the voltage divider mode. Hybrid track potentiometers should be used only as voltage dividers, with a minimum wiper circuit impedance of 100 x track resistance or 0.5M $\Omega$  (whichever is greater). Operation with wiper circuits of lower impedance will degrade the output smoothness and affect the linearity.

## OPTIONS

Mounting	Metal rod end bearings, quick release balljoints or plain M4 stud
Protective sleeve	Available for all stroke lengths

## ACCESSORIES

For maximum installation flexibility the following parts are available to purchase separately:

Metal rod end (rear)	P202605
Metal rod end (shaft)	P202604
Quick release balljoint assembly	SA200337
Locknut, M4	X63 - 072 - 340
Protective sleeve assembly	SA202984/stroke/C

A suitable stud lock compound should be used to secure the rear rod end or balljoint assembly. Use Loctite™ activator 7471 and Loctite™ 648 on metal rod end. Use Loctite™ 382 on quick release balljoint.

## AVAILABILITY

All standard configurations can be supplied rapidly from the factory - check with your local supplier for more details



## ORDERING CODES

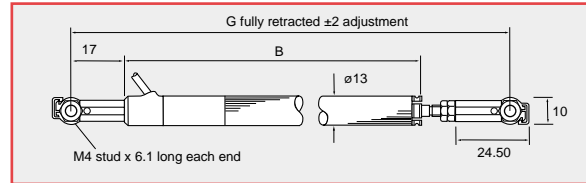
MLS130/...../...../.....

Electrical stroke \_\_\_\_\_ Protective sleeve N=None, P=Fitted  
 Mounting \_\_\_\_\_  
 Q=Quick release balljoints, R=Metal rod end bearings, S=M4 studs

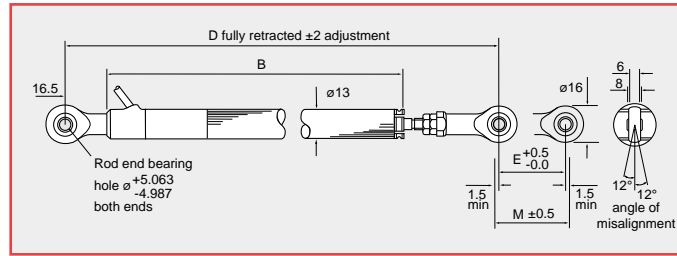
## DIMENSIONS AND MOUNTING OPTIONS

Note: drawings not to scale

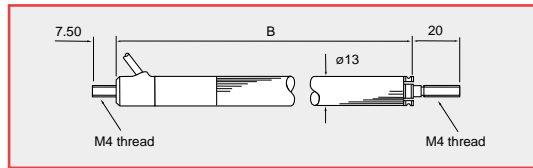
### QUICK RELEASE BALLJOINTS (Q)



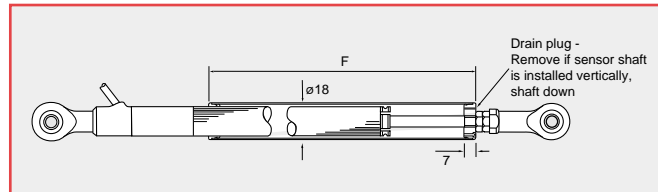
### METAL ROD END BEARINGS (R)



### M4 STUD END (S)



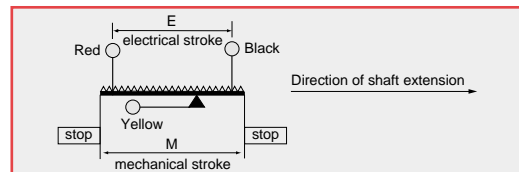
### PROTECTIVE SLEEVE (P)



Electrical stroke E	mm	25	50	75	100	125	150	175	200
Mechanical stroke M	mm	29	54	79	104	129	154	179	204
Body length B	mm	110.8	135.8	160.8	185.8	210.8	235.8	260.8	285.8
Between centres D	mm	164.5	189.5	214.5	239.5	264.5	289.5	314.5	339.5
Between centres G	mm	153.6	178.6	203.6	228.6	253.6	278.6	303.6	328.6
Sleeve length F	mm	77	102	127	152	177	202	227	252
Weight approximate	g	80	87	94	101	108	115	122	129

## ELECTRICAL CONNECTIONS

3 core cable: DR25 sheathed 1m long with ETFT insulated 19/0.15 cores.



# SLS190 LINEAR DISPLACEMENT SENSOR

The SLS190 range is designed to provide maximum performance benefits within a compact package in stroke lengths from 25 to 350mm. With a choice of mounting options and accessories, this sensor is ideally suited to a wide range of general purpose industrial applications, for medium stroke linear position sensing.

## PERFORMANCE

		25	50	75	100	125	150	175	200	225	250	275	300	325	350	
Electrical stroke E	mm	25	50	75	100	125	150	175	200	225	250	275	300	325	350	
Resistance $\pm 10\%$	k $\Omega$	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Independent linearity																
guaranteed	$\pm\%$	0.25	0.25	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
typical	$\pm\%$	0.15	0.15	0.15	0.10	0.10	0.07	0.07	0.07	0.07	0.05	0.05	0.05	0.05	0.05	
Power dissipation at 20°C	W	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	
Applied voltage maximum	Vdc	22	44	67	74	74	74	74	74	74	74	74	74	74	74	
Electrical output		Minimum of 0.5% to 99.5% applied volts														
Resolution		Virtually infinite														
Hysteresis (repeatability)		Less than 0.01mm														
Operational temperature	°C	-30 to +100 (tested to +130 for 12 hours duration)														
Output smoothness		To MIL-R-39023 grade C 0.1%														
Insulation resistance		Greater than 100M $\Omega$ at 500Vdc														
Operating mode		Voltage divider only - see Circuit Recommendation below														
Wiper circuit impedance		Minimum of 100 x track resistance or 0.5M $\Omega$ (whichever is greater)														
Operating force maximum																
sealed	gf	500 in horizontal plane														
unsealed	gf	250 in horizontal plane														
Life at 250mm per second		Typically greater than 100 million operations (50 x 10 <sup>6</sup> cycles) at 25mm stroke length														
Dither life		200 million operations (100 x 10 <sup>6</sup> cycles) at $\pm 0.5$ mm, 60Hz														
Sealing		IP50 standard - IP66 see options														
Shaft seal life		20 million operations (10 x 10 <sup>6</sup> cycles) - replaceable														
Shaft velocity maximum	m/s	10														
Vibration		RTCA 160D 10Hz to 2kHz (random) @ 12.6g (rms) - all axes														
Shock		Less than 0.04% output change @ 2500g - all axes														

## CIRCUIT RECOMMENDATION

Hybrid track potentiometers feature a high wiper contact resistance, therefore operational checks should be carried out only in the voltage divider mode. Hybrid track potentiometers should be used only as voltage dividers, with a minimum wiper circuit impedance of 100 x track resistance or 0.5M $\Omega$  (whichever is greater). Operation with wiper circuits of lower impedance will degrade the output smoothness and affect the linearity.

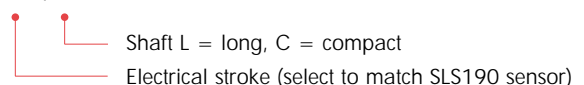
## OPTIONS

Compact shaft	Compact shaft will reduce dimension D by 25mm
Integral shaft seal - IP 66	Designed to accept integral shaft seal to give IP66 rating
Extended cable length	10m output cable can be specified
Mounting	Body clamp or flange mounting kits can be supplied
Protective sleeve	For all stroke lengths - self aligning bearings only. See ordering code

## ACCESSORIES

Mounting kits ————  Body clamp kit - SA59019  
Flange kit - SA59020

Protective sleeve - SA202986/...../.....

 Shaft L = long, C = compact  
Electrical stroke (select to match SLS190 sensor)

## AVAILABILITY

All standard configurations can be supplied rapidly from the factory - check with your local supplier for more details

## ORDERING CODES

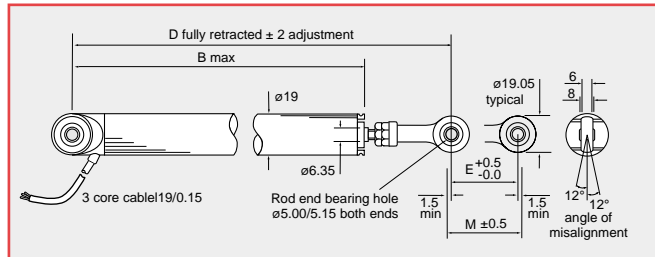
SLS190/...../...../...../...../.....

Electrical stroke \_\_\_\_\_ Protective sleeve N=None, P=Fitted  
 Shaft L = long, C = compact \_\_\_\_\_ Cable 1 = 1m, 10 = 10m  
 Sealing 50 = IP50, 66 = IP66

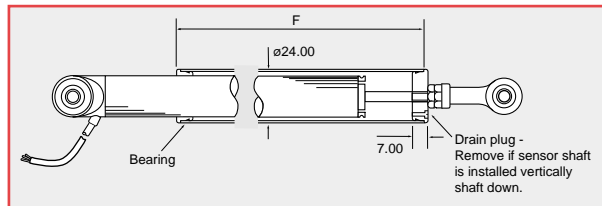
## DIMENSIONS AND MOUNTING OPTIONS

Note: drawings not to scale

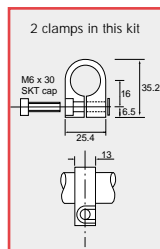
### SELF ALIGNING BEARING MOUNTING



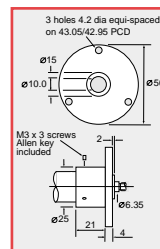
### PROTECTIVE SLEEVE OPTION - P



### MOUNTING OPTIONS



**Body clamp**  
SA59019

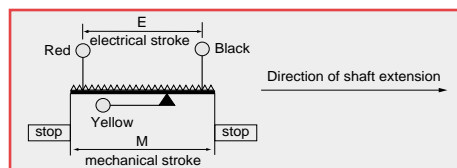


**Flange mounting**  
SA59020

Electrical stroke E	mm	25	50	75	100	125	150	175	200	225	250	275	300	325	350
Mechanical stroke M	mm	29	54	79	104	129	154	179	204	229	254	279	304	329	354
Body length B	mm	110.5	135.5	160.5	210.5	235.5	260.5	285.5	310.5	333.5	360.5	385.5	435.5	460.5	485.5
Between centres D															
standard sensor (L)	mm	173.6	198.6	223.6	273.6	298.6	323.6	348.6	373.6	398.6	423.6	448.6	498.6	523.6	548.6
compact shaft sensor (C)	mm	148.6	173.6	198.6	248.6	273.6	298.6	323.6	348.6	373.6	398.6	423.6	473.6	498.6	523.6
Sleeve length F															
standard sensor (L)	mm	100	125	150	200	225	250	275	300	325	350	375	425	450	475
compact shaft sensor (C)	mm	75	100	125	175	200	225	250	275	300	325	350	400	425	450
Weight approximate															
standard sensor (L)	g	109	126	144	161	179	196	214	231	249	266	284	301	319	336
compact shaft sensor (C)	g	103	120	138	155	173	190	208	225	246	260	278	295	316	330

## ELECTRICAL CONNECTIONS

3 core cable: PUR sheathed 1m long with ETFE insulated 19/0.15 cores.



Penny+Giles - one of the world's major suppliers of measurement and control sensors



throttle pedal position

gear select position indication



hydraulic reservoir level

front and rear suspension movement



throttle actuator position

steering angle position



gearbox actuator position

clutch pedal position



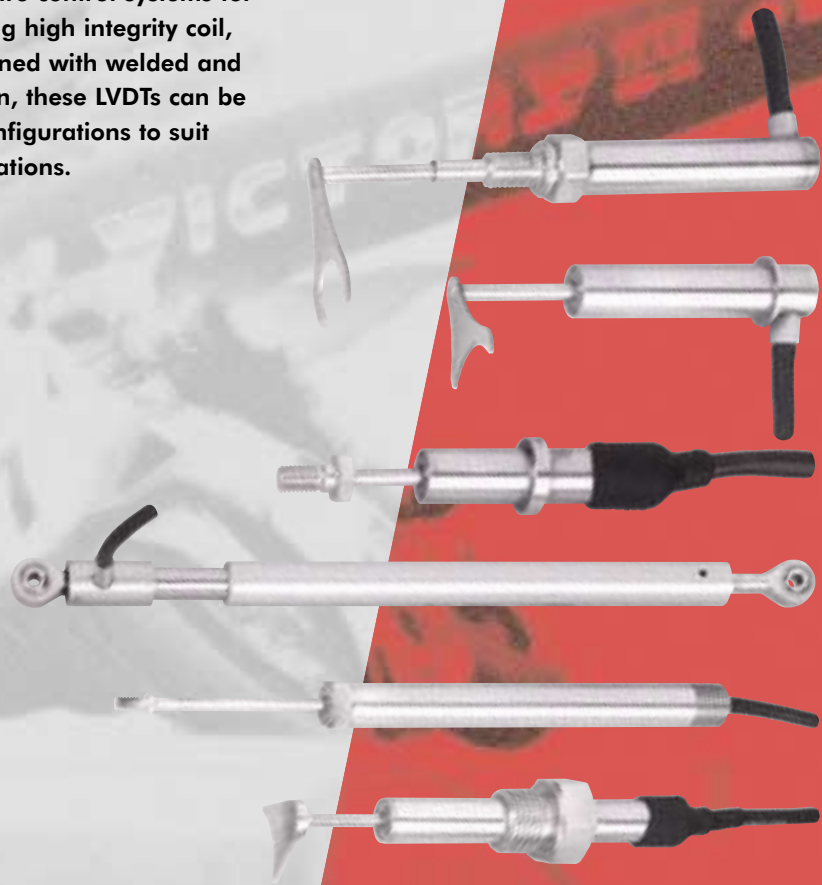
clutch actuator position

brake balance measurement

brake pad/disc wear indication

# LVDT DISPLACEMENT TRANSDUCERS

The Penny+Giles high performance ratiometric LVDTs benefit from our extensive experience in fly-by-wire control systems for flight critical aerospace applications. Using high integrity coil, screen and connection assemblies, combined with welded and vacuum brazed stainless steel construction, these LVDTs can be supplied in a range of shaft and body configurations to suit clutch, gearbox, engine and brake applications.



## Features

- No contact between the sensing elements
  - Infinite resolution
- Small transducer body length to stroke ratio
- Welded and vacuum brazed stainless steel construction
  - Sealed to IP66
  - Temperature range -55 to +200°C
- High integrity coil, screen and connection assemblies
  - Screened and sheathed interface cable
  - Temperature error less than 35ppm/°C

## Benefits

- Virtually infinite life and fast dynamic response
- All displacement will be sensed
- Minimal operational footprint and weight
- Maximum reliability in hostile environments
- High performance in electrically noisy environments
- Maximises system accuracy

# AF111 LVDT

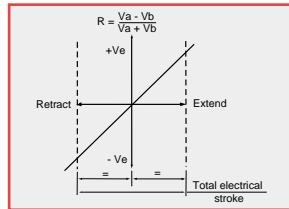
The AF111 range of high accuracy LVDT displacement transducers have been designed primarily for use in the ratiometric configuration and have a compact size, with stroke lengths from 5mm to 150mm. Suitable for clamp mounting, the AF111 range has a threaded, unguided core assembly to simplify installation. Suited to numerous applications, such as vehicle research, and test rigs.

## PERFORMANCE

<b>Electrical stroke E</b>	mm	<b>5</b>	<b>15</b>	<b>25</b>	<b>50</b>	<b>75</b>	<b>100</b>	<b>125</b>	<b>150</b>
	±	<b>2.5</b>	<b>7.5</b>	<b>12.5</b>	<b>25.0</b>	<b>37.5</b>	<b>50.0</b>	<b>62.5</b>	<b>75.0</b>
<b>Input voltage and frequency</b>		1 to 10VRMS at 400Hz to 12.5kHz (sinewave)							
<b>Insulation resistance</b>		Greater than 100MΩ at 500Vdc							
<b>Operational temperature</b>	°C	-35 to +125							
<b>Storage temperature</b>	°C	-55 to +135							
<b>Vibration</b>		RTCA/DO - 160C, Section 8, Fig 8 - 1 Curve C (Random), 10 - 2000Hz, 4.12g rms RTCA/DO - 160C, Section 8, Fig 8 - 3 Curve L (Sine), 10 - 2000Hz, 3g rms							
<b>Environmental protection</b>		IP66							
<b>Electrical output R proportional to position</b>		$R = \frac{V_a - V_b}{V_a + V_b}$							
<b>Electrical output R at extremes from null ±1% total stroke</b>		0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.6
<b>Non-linearity ±% total stroke</b>		0.25	0.25	0.25	0.25	0.25	0.125	0.125	0.125
<b>Secondary coil output voltage</b>		3.3VRMS maximum							
<b>Input impedance</b>		Greater than 300Ω							
<b>Load resistance (per coil)</b>		Greater than 50kΩ (non reactive)							
<b>Temperature error maximum % total stroke/°C</b>		0.0012	0.0012	0.0012	0.0018	0.0018	0.0035	0.0030	0.0030

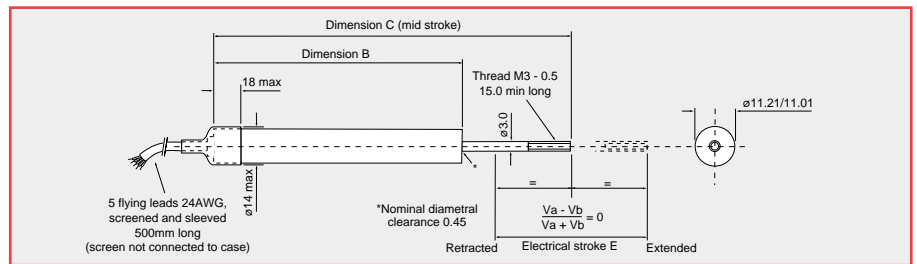
## OUTPUT SCHEMATIC

Ratiometric configuration



## DIMENSIONS

Note: drawings not to scale



<b>Electrical stroke E</b>	mm	<b>5</b>	<b>15</b>	<b>25</b>	<b>50</b>	<b>75</b>	<b>100</b>	<b>125</b>	<b>150</b>
<b>Mechanical stroke M (non captive shaft)</b>	mm	<b>9</b>	<b>19</b>	<b>29</b>	<b>54</b>	<b>79</b>	<b>104</b>	<b>129</b>	<b>154</b>
<b>Dimension B</b>	mm	55	65	80	105	150	175	215	240
<b>Dimension C</b>	mm	75	90	110	147.5	205	242.5	295	332.5
<b>Weight (maximum)</b>	g	45	50	55	67	90	100	120	140

## AVAILABILITY

Normally available from stock

## ORDERING CODE

**AF111/.....**

Electrical stroke (total) mm

## ELECTRICAL CONNECTIONS

See AF145 page 15

# AF145<sup>LVDT</sup>

The AF145 range of high accuracy LVDT displacement transducers have been designed primarily for use in the ratiometric configuration, and have a compact size, with stroke lengths from 5mm to 150mm. The AF145 has self-aligning rod end bearing mounting, with an outer sliding sleeve which protects the movable core whilst enhancing the rigidity of the transducer during operation. Suited to harsh automotive and industrial environments.

## PERFORMANCE

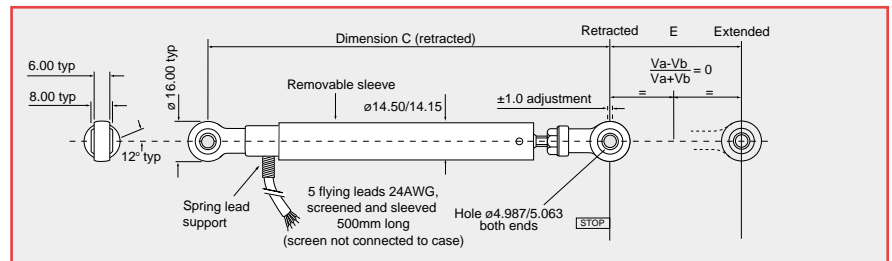
<b>Electrical stroke E</b>	<b>mm</b>	<b>5</b>	<b>15</b>	<b>25</b>	<b>50</b>	<b>75</b>	<b>100</b>	<b>125</b>	<b>150</b>
	<b>±</b>	<b>2.5</b>	<b>7.5</b>	<b>12.5</b>	<b>25.0</b>	<b>37.5</b>	<b>50.0</b>	<b>62.5</b>	<b>75.0</b>
<b>Input voltage and frequency</b>		1 to 10VRMS at 400Hz to 12.5kHz (sinewave)							
<b>Insulation resistance</b>		Greater than 100MΩ at 500Vdc							
<b>Operational temperature</b>	<b>°C</b>	-35 to +125							
<b>Storage temperature</b>	<b>°C</b>	-55 to +135							
<b>Vibration</b>		RTCA/DO - 160C, Section 8, Fig 8 - 1 Curve C (Random), 10 - 2000Hz, 4.12g rms RTCA/DO - 160C, Section 8, Fig 8 - 3 Curve L (Sine), 10 - 2000Hz, 3g rms							
<b>Environmental protection</b>		IP66							
<b>Electrical output R proportional to position</b>		$R = \frac{V_a - V_b}{V_a + V_b}$							
<b>Electrical output R at extremes from null</b>	<b>±1% total stroke</b>	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.6
<b>Non-linearity</b>	<b>±% total stroke</b>	0.25	0.25	0.25	0.25	0.25	0.125	0.125	0.125
<b>Secondary coil output voltage</b>		3.3VRMS maximum							
<b>Input impedance</b>		Greater than 300Ω							
<b>Load resistance (per coil)</b>		Greater than 50kΩ (non reactive)							
<b>Temperature error maximum</b>	<b>% total stroke/°C</b>	0.0012	0.0012	0.0012	0.0020	0.0020	0.0030	0.0030	0.0030

## OUTPUT SCHEMATIC

See AF111 page 14

## DIMENSIONS

Note: drawings not to scale



<b>Electrical stroke E</b>	<b>mm</b>	<b>5</b>	<b>15</b>	<b>25</b>	<b>50</b>	<b>75</b>	<b>100</b>	<b>125</b>	<b>150</b>
<b>Mechanical stroke M (non captive shaft)</b>	<b>mm</b>	<b>9</b>	<b>19</b>	<b>29</b>	<b>54</b>	<b>79</b>	<b>104</b>	<b>129</b>	<b>154</b>
<b>Dimension C retracted</b>	<b>mm</b>	100	110	125	150	195	220	260	285
<b>Weight (maximum)</b>	<b>g</b>	65	80	90	115	155	175	200	220

## AVAILABILITY

Normally available from stock

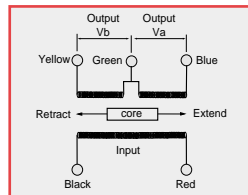
## ORDERING CODE

**AF145/.....**

Electrical stroke (total) mm \_\_\_\_\_

## ELECTRICAL CONNECTIONS

5 flying leads 24AWG, screened and sleeved 500mm long



## Phasing notes

With blue and black leads common, the output on the yellow lead will be in-phase with the red lead (input) as the shaft retracts from the null position.

# Ø8 mm LVDT SPECIAL

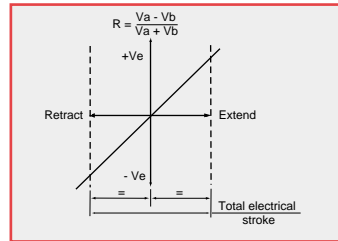
This specially developed ac LVDT is an example of our capability in producing an extremely compact size (8mm diameter) with a minimal footprint (20mm stroke within a 44mm body length). This LVDT is also suitable for continuous operation at temperatures up to +200°C and is ideally suited for use in clutch position and brake caliper position measurement in the premier classes of motor sport. For optimum performance this LVDT is designed to operate in the ratiometric configuration.

## PERFORMANCE

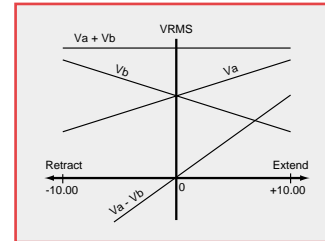
<b>Electrical stroke E</b>	<b>mm</b>	<b>20</b>
	<b>±</b>	<b>10</b>
<b>Input voltage and frequency</b>		3VRMS at 5kHz (sinewave)
<b>Insulation resistance</b>		Greater than 20MΩ at 500Vdc
<b>Operational temperature</b>	<b>°C</b>	-55 to +200
<b>Environmental protection</b>		IP66
<b>Electrical output R proportional to position</b>		$R = \frac{V_a - V_b}{V_a + V_b}$
<b>Electrical output R at extremes from null</b>	<b>±1% total stroke</b>	0.441
<b>Non-linearity</b>	<b>±% total stroke</b>	1
<b>Ratiometric sensitivity per mm</b>	<b>±3%</b>	0.0441
<b>Summed output voltage (Va+Vb)</b>	<b>±20%</b>	0.7V/V
<b>Total stroke ratio</b>		0.882
<b>Input impedance</b>		Greater than 150Ω
<b>Load resistance (per coil)</b>		Greater than 50kΩ (non reactive)
<b>Temperature error maximum</b>	<b>% total stroke/°C</b>	0.0030

## OUTPUT SCHEMATIC

### Ratiometric configuration



### ac output schematic



## AVAILABILITY

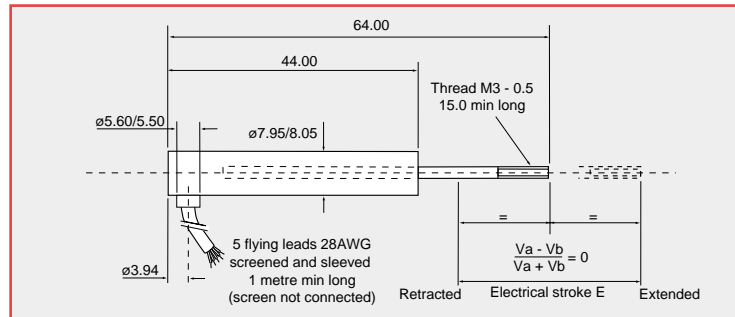
Please consult our sales office for details

## ORDERING CODE

Please consult our sales office for details

## DIMENSIONS

Note: drawings not to scale



<b>Electrical stroke E</b>	<b>mm</b>	<b>20</b>
<b>Mechanical stroke M (non captive shaft)</b>	<b>mm</b>	<b>22</b>
<b>Weight (maximum)</b>	<b>g</b>	47 (15g for sensor and core only)



# Ø11mm LVDT SPECIAL

This high accuracy LVDT displacement transducer has been designed for use in the ratiometric configuration and has a compact size, with stroke lengths from 25mm to 75mm. This design has self-aligning rod end bearing mounting and features an outer sliding sleeve which protects the movable core whilst enhancing the rigidity of the transducer during operation. Suited to suspension and throttle position feedback applications in premier classes of motorsport.

## PERFORMANCE

<b>Electrical stroke E</b>	<b>mm</b>	<b>25 50 75</b>
	<b>±</b>	<b>12.5 25.0 37.5</b>
<b>Input voltage and frequency</b>		3VRMS at 2.5kHz (sinewave)
<b>Insulation resistance</b>		Greater than 20MΩ at 500Vdc
<b>Operational temperature</b>	<b>°C</b>	-30 to +130
<b>Storage temperature</b>	<b>°C</b>	-55 to +135
<b>Environmental protection</b>		IP66
<b>Electrical output R proportional to position</b>		$R = \frac{V_a - V_b}{V_a + V_b}$
<b>Electrical output R at extremes from null</b>	<b>±1% total stroke</b>	0.5 0.5 0.5
<b>Non-linearity</b>	<b>±% total stroke</b>	0.5 0.5 0.5
<b>Ratiometric sensitivity per mm</b>		0.04 0.02 0.0133
<b>Summed output voltage (Va+Vb)</b>	<b>±20%</b>	0.641 0.872 0.761
<b>Input impedance</b>		Greater than 200Ω
<b>Load resistance (per coil)</b>		Greater than 50kΩ (non reactive)
<b>Temperature error maximum</b>	<b>% total stroke/°C</b>	0.0030

## OUTPUT SCHEMATIC

See Ø8mm Special LVDT output schematic, page 16

## AVAILABILITY

Please consult our sales office for details

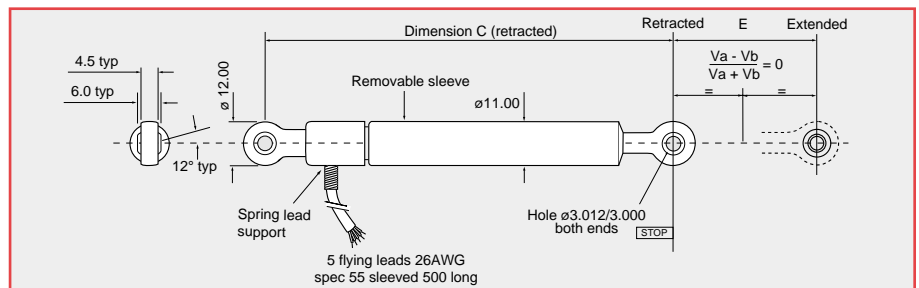
## ORDERING CODE

**D45371/.....**

Electrical stroke (total) mm

## DIMENSIONS

Note: drawings not to scale



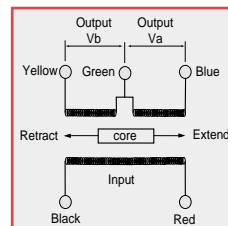
<b>Electrical stroke E</b>	<b>mm</b>	<b>25 50 75</b>
<b>Mechanical stroke M (non captive shaft)</b>	<b>mm</b>	<b>27 52 77</b>
<b>Dimension C retracted</b>	<b>mm</b>	115 135 180
<b>Weight (maximum)</b>	<b>g</b>	42 52 68

## ELECTRICAL CONNECTIONS SPECIAL Ø8mm

5 flying leads 28AWG, screened and sleeved 1000mm long

## SPECIAL Ø11mm

5 flying leads 26AWG, screened and sleeved 500mm long



## Ratiometric connection configuration

### Phasing notes

With blue and black leads common, the output on the yellow lead will be in-phase with the red lead (input) as the shaft retracts from the null position.



# CONTACTLESS ROTARY POSITION SENSORS

## Innovative, rugged designs - superior protection

All models in our range have been designed to offer the best combination of materials and mounting styles that ensure survivability in the most rugged applications. We use sealing systems and cable connections that offer superior protection against the most hostile of operating conditions.

## Impressive environmental capability

Designed with 21st century applications in mind most of our models can withstand operating temperatures from -40°C to +140°C (+170°C for 72 hours with our NRH and TPS models) and have been tested to withstand severe shock and vibration. All sensors have protection to at least IP68 rating, with some models offering protection to IP69K. With an EMC immunity of 100V/m, these position sensors are ready for the harshest applications.

## Superior performance

This range of sensors has an impressive performance specification and most can operate from a 5Vdc regulated or 9 – 30Vdc supply.

Outputs can be PWM or analog voltage (nominal 0.5 - 4.5Vdc) over the measurement range, with clockwise or anticlockwise shaft rotation. A choice of 341 different electrical angles from 20° to 360° are possible. 12 bit resolution (0.025%) is available over the selected measuring range, with a non-linearity better than  $\pm 0.4\%$  and temperature stability better than  $\pm 50\text{ppm}/^\circ\text{C}$ . The sensor's analog output option has a very low output noise level of less than 1mV rms.

## World leading availability

All models have been 'designed for manufacture' which enables assembly in state-of-the-art manufacturing cells. This means that we can supply any of the configurations possible from the options offered, in a matter of days from ordering. This allows OEMs to reduce or eliminate their inventory, and call on Penny+Giles to supply 'on demand'.

## Performance assured\*

Penny+Giles product development process includes exhaustive qualification testing to ensure that performance specifications published in our product brochures and technical data sheets are backed by real-life test evidence. This is our assurance to you that our designs have been tested at these parameters.

\* The qualification and suitability of these products in any customer specific application is the responsibility of the customer, unless otherwise agreed with Penny+Giles.

## Selection Guide

Penny+Giles offers the widest choice of options to suit your unique application. We can also offer a custom design service if one of our standard models does not suit your requirements.

### NRH280DP



- Dual output
- 6.5mm deep with metal flange
- Separate magnet assembly
- Sealed to IP69K
- Raychem™ DR25 cable

### NRH285DR



- Dual input/dual output version of NRH280DP
- 5Vdc operation only

### SRH220DR



- Dual input/dual output
- 28 x 38mm body with crush proof flange
- Sealed to IP68
- Integrated connector

### SRH280P



- Single output
- 28mm body with crush proof flange
- Three shaft styles
- Sealed to IP68

### SRH280DP



- Dual output
- Raychem™ DR25 cable
- 28mm body with crush proof flange
- Three shaft styles
- Sealed to IP68

### TPS280DP



- Dual output
- D drive
- Sealed to IP68
- 25mm body with crush proof flange
- Raychem™ DR25 cable+connector

### SRH501P



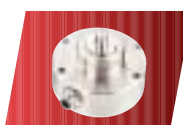
- Single output
- 87.5mm mounting flange
- Marine grade alloy housing
- Sealed to IP69K

### SRH502P



- Dual output
- 87.5mm mounting flange
- Marine grade alloy housing
- Sealed to IP69K

### SRH880P



- Single output
- 88 mm body
- Aluminum or stainless steel housing
- Sealed to IP68M

# NRH280DP

dual output no contact rotary sensor



## PERFORMANCE

### ELECTRICAL

Measurement range	°	20 to 360 in 1° increments
Supply voltage	Vdc	9 to 30 (unregulated) and 5 ±0.5 (regulated)
Over voltage protection	Vdc	Up to 40 (-40 to +60°C)
Maximum supply current	mA	<25
Reverse polarity protection		Yes
Short circuit protection		
Output to GND		Yes
Output to supply		In 5V regulated mode only
Power-on settlement time	S	<1
Resolution	%	0.025 of measurement range (12 bit)
Non-linearity*	%	< ±0.4
Temperature coefficient	ppm/°C	< ±30 in 5V supply mode; < ±90 in 9-30V supply mode

\*Non-linearity is measured using the least-squares method on a computerised calibration system

### Analog Output (order code A1, A4) – see graph on page 31

Voltage output range		
9-30V supply	Vdc	Absolute voltage, 0.5 to 4.5 (A1) or 0.1 to 4.9 (A4) over measurement range (±3%)
5V supply	Vdc	Ratiometric output voltage - 10 to 90% (A1) or 2 to 98% (A4) of Vs over measurement range (±1%)
Monotonic range	Vdc	0.25 (5%) and 4.75 (95%) nominal (A1)
	Vdc	0.05 (1%) and 4.95 (99%) nominal (A4)
Load resistance	Ω	10k minimum (resistive to GND)
Output noise	mVrms	<1
Input/output delay	mS	<2

### PWM Output (order code Pn) – see output characteristics on page 31

PWM frequency	Hz	244 (P1); 500 (P2); or 1000 (P3) ±20% over temperature range
PWM levels 9-30V supply	Vdc	0 and 5 nominal (±3%)
5V supply	Vdc	0 and Vs (±1%)
Duty cycle	%	10 to 90 over measurement range
Monotonic range	%	5 and 95 nominal
Load resistance	Ω	10k minimum (resistive to GND)
Rise/fall time	µS	<15

### MECHANICAL

Mechanical angle	°	360, continuous
Maximum rotational speed	°/sec	3600
Weight	g	<55 (with bolt type magnet carrier)
Mounting		Use 2 x M4 socket head cap screws and M4 washer - maximum tightening torque 2Nm. Bolt (B) or plug (P) type magnet holders are available for the customer to assemble to their own equipment. We also offer a magnet only (M) option for OEM's to integrate into their design.
Phasing		When magnet ident mark is facing toward the sensor and cable exit, output is at mid travel. The sensor housing allows for ±10° adjustment via the mounting flange slots.

## ENVIRONMENTAL

<b>Protection class</b>		IP68 (to 2m depth for 2 hours) and IP69K
<b>Life</b>		This product has no contacting parts.
<b>Dither life</b>		Contactless - no degradation due to shaft dither
<b>Operational temperature<sup>1</sup></b>	°C	-40 to +140 (5V supply) and +170°C for 72 hours -40 to +135.2 (9V supply option) Derate upper temperature limit by 1.7°C for every 1V increase in supply; e.g. -40 to +100 @30V
<b>Storage temperature</b>	°C	-55 to +140
<b>Vibration</b>		BS EN 60068-2-64:1995 Sec 8.4 (31.4gn rms) 20 to 2000Hz Random
<b>Shock</b>		3m drop onto concrete and 2500g
<b>EMC Immunity level</b>		BS EN 61000-4-3:1999, to 100V/m, 80MHz to 1GHz and 1.4GHz to 2.7GHz (2004/108/EC)

<sup>1</sup> See Maximum Operating Temperature – derating graph on page 30.

If the maximum operating temperature is exceeded, the voltage regulator will shut down to protect the device from overheating

## OPTIONS

<b>Measurement range (angle)</b>		Select from 20° to 360° in 1° increments (factory programmed) for each output channel
<b>Output</b>		Analog voltage (An) or PWM (Pn)
<b>Output direction</b>		Both clockwise, both anticlockwise or one CW, one ACW
<b>Magnet holder</b>		Bolt (B) or plug (P) types, or magnet only (M)
<b>Cable length</b>	m	0.5
<b>OEM options</b>		Outputs can be programmed to provide: non linear laws; switch outputs; clamp voltages; different output phasing CH1/CH2; faster input/output delay; extended analog range; and output mapping for potentiometer replacements.

## AVAILABILITY

All standard configurations can be supplied rapidly from the factory – check with your local supplier for more details

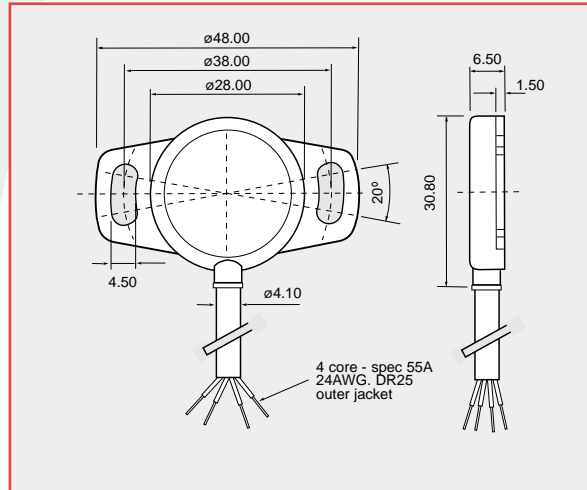
## ORDERING CODES

		<b>NRH280DP/...../...../...../...../...../.....</b>
Measurement range	CH1 = angle in °	_____●
Measurement range	CH2 = angle in °	_____●
Output	A1 = Analog 0.5-4.5Vdc A4 = Analog 0.1-4.9Vdc P1 = PWM, 244Hz P2 = PWM, 500Hz P3 = PWM, 1000Hz	_____●
Direction	3 = Both clockwise 4 = Both anticlockwise 5 = CH1 CW; CH2 ACW	_____●
Magnet holder	B = Bolt type P = Plug type M = Magnet only	_____●
Cable length	P5 = 0.5m	_____●

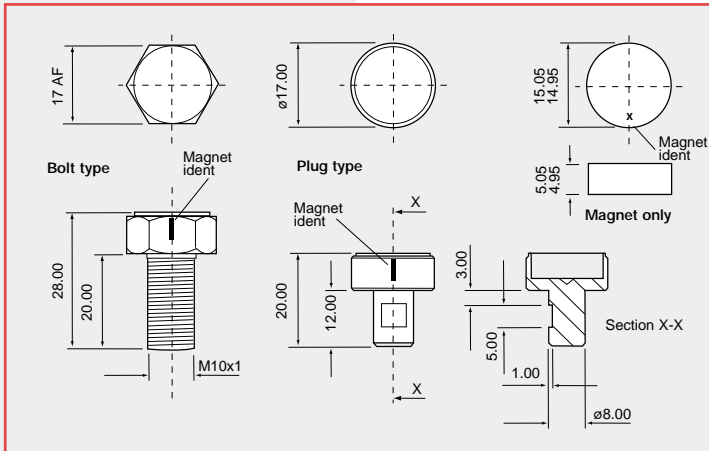
# NRH280DP

## DIMENSIONS

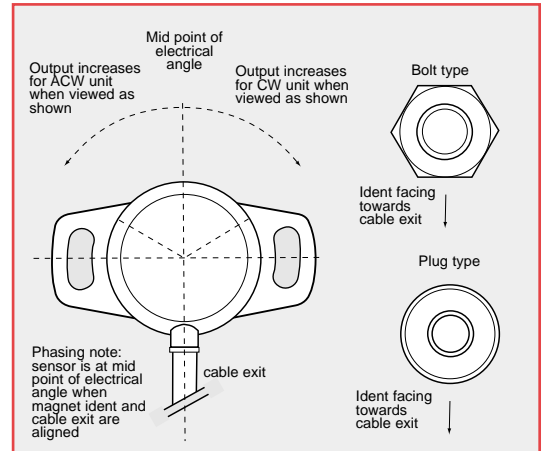
Note: drawings not to scale



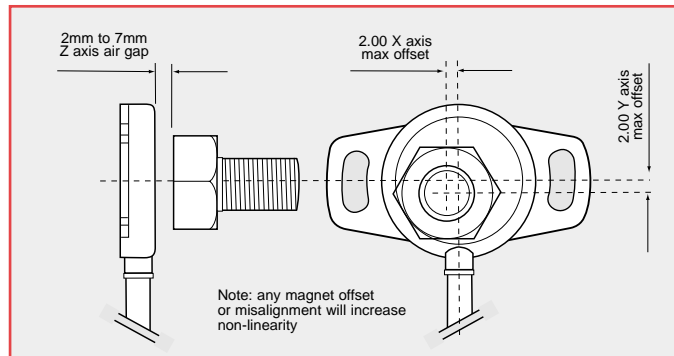
## MAGNET HOLDER OPTIONS



## ELECTRICAL ANGLE



## MAGNET MISALIGNMENT



## ELECTRICAL CONNECTIONS

500mm of 4-core cable: FDR-25 sheathed, with 55A spec (24AWG) cores

Cable colour	Description
Red	+V Supply
Yellow	Output 1
White	Output 2
Black	0V Supply (GND)

When connecting the sensor, care should be taken with the correct connections. The sensor is provided with reverse polarity protection and short circuit protection between outputs (Yellow & White) to GND (Black), **but if the outputs (Yellow & White) are connected to the supply this will result in device failure.**

Output increases with CW or ACW rotation viewed on sensor face - depending on selected order code

# NRH285DR DUAL REDUNDANT OUTPUT

no contact rotary sensor – 5Vdc operation only



## PERFORMANCE

### ELECTRICAL

Measurement range	°	20 to 360 in 1° increments
Supply voltage	Vdc	5 ±0.5 (regulated) to each independent sensor channel
Over voltage protection	Vdc	Up to 10 (-40 to +60°C)
Maximum supply current	mA	< 12.5 each independent supply (< 25 total)
Reverse polarity protection		Yes
Short circuit protection		
Output to GND		Yes
Output to supply		Yes
Power-on settlement time	S	< 1
Resolution	%	0.025 of measurement range (12 bit)
Non-linearity*	%	< ±0.4
Temperature coefficient	ppm/°C	< ±30

\* Non-linearity is measured using the Least-Squares method on a computerised calibration system

### Analog Output (order code A1, A4) – see graph on page 31

Voltage output range	Vdc	Ratiometric output voltage - 10 to 90% (A1) or 2 to 98% (A4) of Vs over measurement range (±1%)
Monotonic range	Vdc	0.25 (5%) and 4.75 (95%) nominal (A1)
	Vdc	0.05 (1%) and 4.95 (99%) nominal (A4)
Load resistance	Ω	10k minimum (resistive to GND)
Output noise	mVrms	< 1
Input/output delay	mS	< 2

### PWM Output (order code Pn) – see output characteristics on page 31

PWM frequency	Hz	244 (P1); 500 (P2); or 1000 (P3) ±20% over temperature range
PWM levels 5V supply	Vdc	0 and Vs (±1%)
Duty cycle	%	10 to 90 over measurement range
Monotonic range	%	5 and 95 nominal
Load resistance	Ω	10k minimum (resistive to GND)
Rise/fall time	µS	< 15

### MECHANICAL

Mechanical angle	°	360, continuous
Maximum rotational speed	°/sec	3600
Weight	g	< 55 (with bolt type magnet carrier)
Mounting		Use 2 x M4 socket head cap screws and M4 washer - maximum tightening torque 2Nm. Bolt (B) or plug (P) type magnet holders are available for the customer to assemble to their own equipment. We also offer a magnet only (M) option for OEM's to integrate into their design.
Phasing		When magnet ident mark is facing toward the sensor and cable exit, output is at mid travel. The sensor housing allows for ±10° adjustment via the mounting flange slots.

# NRH285DR

## ENVIRONMENTAL

<b>Protection class</b>		IP68 (to 2m depth for 2 hours) and IP69K
<b>Life</b>		This product has no contacting parts.
<b>Dither life</b>		Contactless - no degradation due to shaft dither
<b>Operational temperature*</b>	°C	-40 to +140 and +170°C for 72 hours
<b>Storage temperature</b>	°C	-55 to +140
<b>Vibration</b>		BS EN 60068-2-64:1995 Sec 8.4 (31.4gn rms) 20 to 2000Hz Random
<b>Shock</b>		3m drop onto concrete and 2500g
<b>EMC Immunity level</b>		BS EN 61000-4-3:1999, to 100V/m, 80MHz to 1GHz and 1.4GHz to 2.7GHz (2004/108/EC)

\* If the maximum operating temperature is exceeded, the voltage regulator will shut down to protect the device from overheating

## OPTIONS

<b>Measurement range (angle)</b>		Select from 20° to 360° in 1° increments (factory programmed) for each output channel
<b>Output</b>		Analog voltage (An) or PWM (Pn)
<b>Output direction</b>		Both clockwise, both anticlockwise or one CW, one ACW
<b>Magnet holder</b>		Bolt (B) or plug (P) types, or magnet only (M)
<b>Cable length</b>	m	0.5
<b>OEM options</b>		Outputs can be programmed to provide: non linear laws; switch outputs; clamp voltages; different output phasing CH1/CH2; faster input/output delay; extended analog range; and output mapping for potentiometer replacements.

## AVAILABILITY

All standard configurations can be supplied rapidly from the factory – check with your local supplier for more details

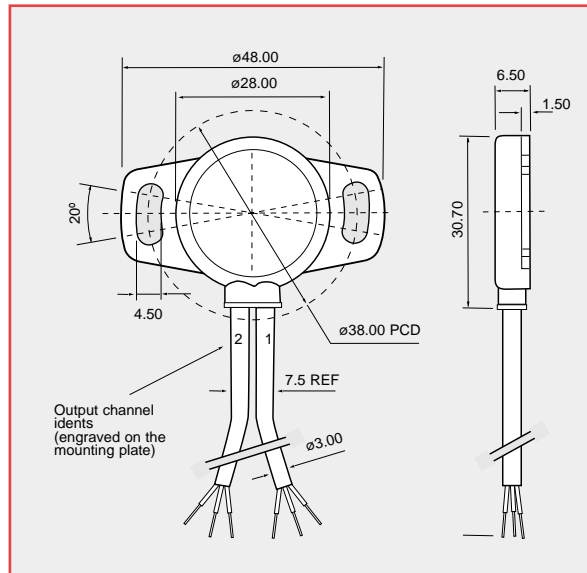
## ORDERING CODES

			<b>NRH285DR/...../...../...../...../...../.....</b>
Measurement range	CH1 = angle in °		
Measurement range	CH2 = angle in °		
Output	A1 = Analog 0.5-4.5Vdc A4 = Analog 0.1-4.9Vdc P1 = PWM, 244 Hz P2 = PWM, 500 Hz P3 = PWM, 1000 Hz		
Direction	3 = Both clockwise 4 = Both anticlockwise 5 = CH1 CW; CH2 ACW		
Magnet holder	B = Bolt type P = Plug type M = Magnet only		
Cable length	P5 = 0.5m		

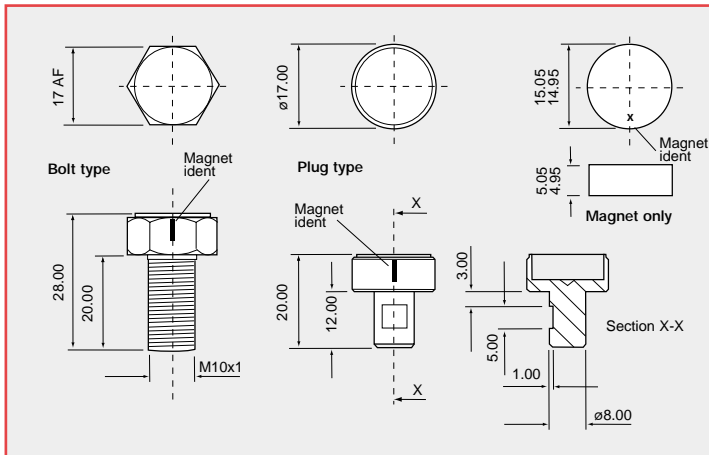


## DIMENSIONS

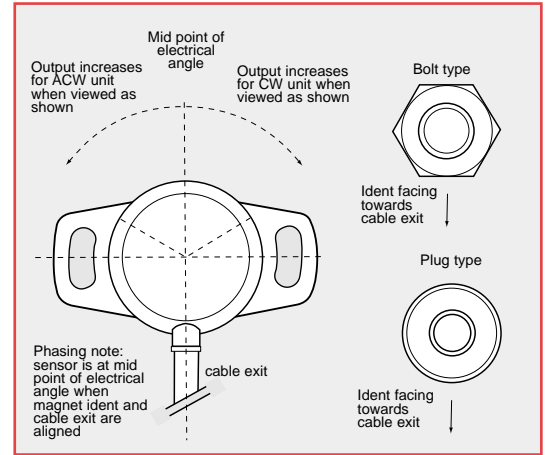
Note: drawings not to scale



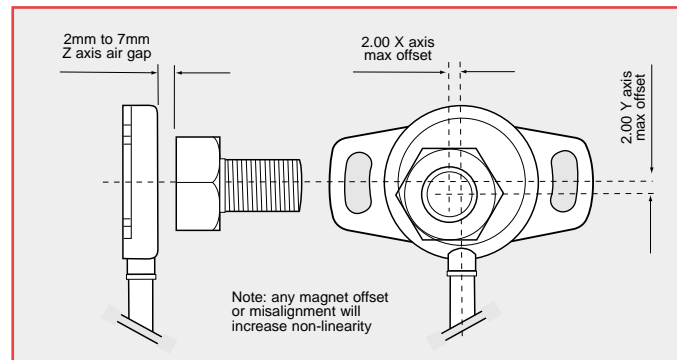
## MAGNET HOLDER OPTIONS



## ELECTRICAL ANGLE



## MAGNET MISALIGNMENT



## ELECTRICAL CONNECTIONS

2 x 500mm of 3-core cable: FDR-25 sheathed, with 55A spec (24AWG) cores

Cable colour *	Description
Red	+V Supply
Yellow	Output 1+2
Black	0V Supply (GND)

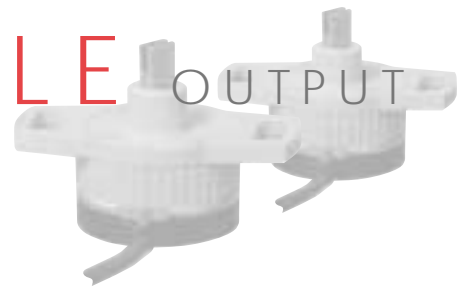
Output increases with CW or ACW rotation viewed on sensor face - depending on selected order code

\*Cables are identified on the mounting plate. 1 = CH1, 2 = CH2

When connecting the sensor, care should be taken with the correct connections. The sensor is provided with reverse polarity protection and short circuit protection between outputs (Yellow) to GND (Black) and outputs to supply (Red) on NRH 285DR model only.

# SRH 280P SINGLE OUTPUT

## contactless rotary sensor



### PERFORMANCE

#### ELECTRICAL

Measurement range	°	20 to 360 in 1° increments
Supply voltage	Vdc	9 to 30 (unregulated) and 5 ±0.5 (regulated)
Over voltage protection	Vdc	Up to 40 (-40 to +60°C)
Maximum supply current	mA	<12.5
Reverse polarity protection		Yes
Short circuit protection		
Output to GND		Yes
Output to supply		In 5V regulated mode only
Power-on settlement time	S	<1
Resolution	%	0.025 of measurement range (12 bit)
Non-linearity*	%	< ±0.4
Temperature coefficient	ppm/°C	< ±50

\*Non-linearity is measured using the least-squares method on a computerised calibration system

#### Analog Output (order code A1, A4) - see graph on page 31

##### Voltage output range

9-30V supply	Vdc	Absolute voltage, 0.5 to 4.5 (A1) or 0.1 to 4.9 (A4) over measurement range (±3%)
5V supply	Vdc	Ratiometric output voltage - 10 to 90% (A1) or 2 to 98% (A4) of Vs over measurement range (±1%)
Monotonic range	Vdc	0.25 (5%) and 4.75 (95%) nominal (A1)
	Vdc	0.5 (1%) and 4.95 (99%) nominal (A4)
Load resistance	Ω	10k minimum (resistive to GND)
Output noise	mVrms	<1
Input/output delay	mS	<2

#### PWM Output (order code P) - See output characteristics on page 31

PWM frequency	Hz	244 (P1); 500 (P2); or 1000 (P3) ±20% over temperature range
PWM levels 9-30V supply	Vdc	0 and 5 nominal (±3%)
5V supply	Vdc	0 and Vs (±1%)
Duty cycle	%	10 to 90 over measurement range
Monotonic range	%	5 and 95 nominal
Load resistance	Ω	10k minimum (resistive to GND)
Rise/fall time	µS	<15

#### MECHANICAL

Mechanical angle	°	360, continuous
Operating torque - maximum		
sealed shaft IP68	g-cm	120
unsealed shaft IP50	g-cm	100
Shaft velocity maximum	°/sec	3600
Weight	g	<35
Mounting		Use 2 x M4 socket head cap screws and M4 washer - maximum tightening torque 2Nm
Phasing		When shaft flat (or shaft ident mark) is facing toward the cable exit, output is at mid travel. The sensor housing allows for ±10° adjustment via the mounting flange slots.

# SRH280P

## ENVIRONMENTAL

<b>Protection class</b>		IP68 (to 2m depth for 1 hour) or IP50
<b>Life</b>		20 million operations (10x10 <sup>6</sup> cycles) of ±75° Sensing element life is essentially infinite (contactless); the SRH280P life figure refers to the operating shaft seal. Mechanical load (axial and radial) on the shaft should also be considered.
<b>Dither life</b>		Contactless - no degradation due to shaft dither
<b>Operational temperature<sup>†</sup></b>	°C	-40 to +140 (5V supply) -40 to +137 (9V supply) Derate upper temperature limit by 0.57°C for every 1V increase in supply: e.g. -40 to +125 @30V
<b>Storage temperature</b>	°C	-55 to +140
<b>Vibration</b>		BS EN 60068-2-64:1995 Sec 8.4 (14gn rms) 20 to 2000Hz Random
<b>Shock</b>		3m drop onto concrete
<b>EMC Immunity level</b>		BS EN 61000-4-3:1999, to 100V/m, 80MHz to 1GHz and 1.4GHz to 2.7GHz (2004/108/EC)

<sup>†</sup> See Maximum Operating Temperature – Derating graph on page 30  
If the maximum operating temperature is exceeded, the voltage regulator will shut down to protect the device from overheating

## OPTIONS

<b>Measurement range (angle)</b>		Select from 20° to 360° in 1° increments (factory programmed)
<b>Output</b>		Analog voltage (An) or PWM (Pn)
<b>Output direction</b>		Clockwise or Anticlockwise shaft rotation with increasing output
<b>Shaft style</b>		D section, sprung shaft (S) or 2.4mm blade shaft (H)
<b>Shaft sealing</b>		IP50 or IP68
<b>Cable length</b>	m	0.2, 0.5 or 2.0
<b>Custom housing</b>		Synchro mount style with ball race bearings - ask our technical sales team for details
<b>OEM options</b>		Output can be programmed to provide: non linear law; switch output; clamp voltages; faster input/output delay; extended analog range; and output mapping for potentiometer replacements

## AVAILABILITY

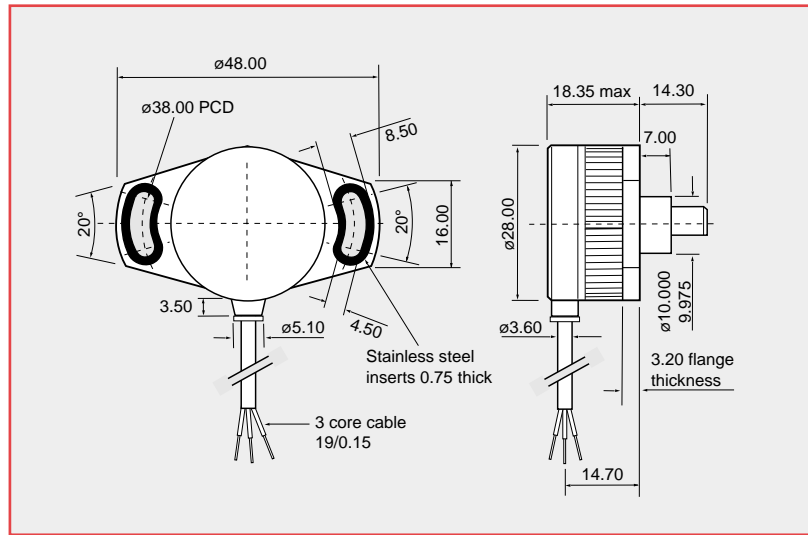
All standard configurations can be supplied rapidly from the factory - check with your local supplier for more details

## ORDERING CODES

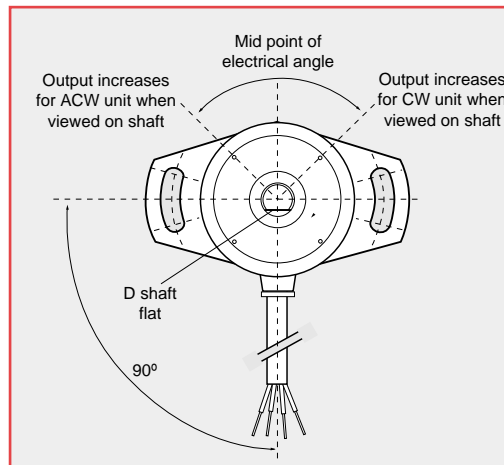
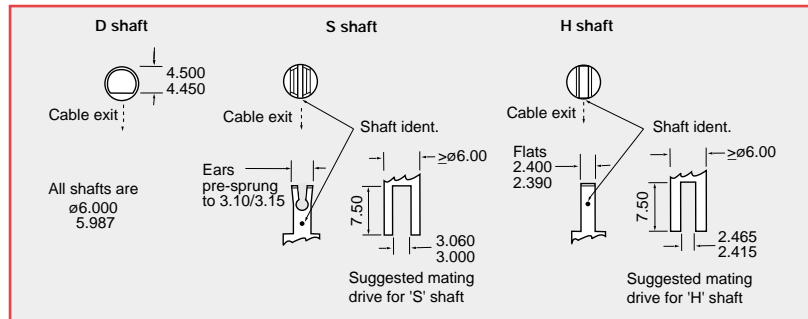
			<b>SRH280P/...../...../...../...../...../.....</b>
Measurement range	= angle in °		
Output	A1 = Analog 0.5-4.5Vdc A4 = Analog 0.1-4.9Vdc P1 = PWM, 244 Hz P2 = PWM, 500 Hz P3 = PWM, 1000 Hz		
Direction	1 = Clockwise 2 = Anticlockwise		
Shaft style	D = D shaft S = Sprung shaft H = 2.4mm blade shaft		
Shaft sealing	50 = IP50 68 = IP68		
Cable length	P2 = 0.2m P5 = 0.5m O2 = 2.0m		

## DIMENSIONS

Note: drawings not to scale



## SHAFT OPTIONS



## ELECTRICAL CONNECTIONS

200, 500 or 2000mm of 3-core cable: PUR sheathed, with PTFE insulated 19/0.15 cores

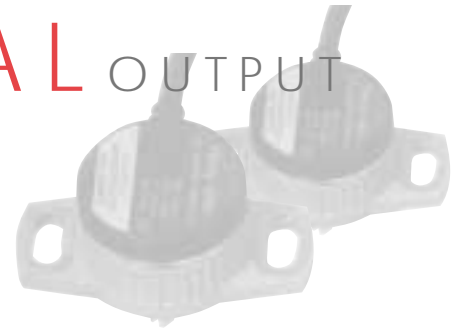
Cable colour	Description
Red	+V Supply
Yellow	Output
Black	0V Supply (GND)

When connecting the sensor, care should be taken with the correct connections. The sensor is provided with reverse polarity protection and short circuit protection between output (Yellow) to GND (Black), **but if the output (Yellow) is connected to the supply it will result in device failure.**

Output increases with CW or ACW rotation viewed on shaft - depending on selected order code

# SRH280DP DUAL OUTPUT

## contactless rotary sensor



### PERFORMANCE

#### ELECTRICAL

Measurement range	°	20 to 360 in 1° increments
Supply voltage	Vdc	9 to 30 (unregulated) and 5 ±0.5 (regulated)
Over voltage protection	Vdc	Up to 40 (-40 to +60°C)
Maximum supply current	mA	<25
Reverse polarity protection		Yes
Short circuit protection		
Output to GND		Yes
Output to supply		In 5V regulated mode only
Power-on settlement time	S	<1
Resolution	%	0.025 of measurement range (12 bit)
Non-linearity*	%	<±0.4
Temperature coefficient	ppm/°C	<±30 in 5V supply mode; <±90 in 9-30V supply mode

\* Non-linearity is measured using the least-squares method on a computerised calibration system

#### Analog Output (order code A1, A4) – see graph on page 31

Voltage output range		
9-30V supply	Vdc	Absolute voltage, 0.5 to 4.5 (A1) or 0.1 to 4.9 (A4) over measurement range (±3%)
5V supply	Vdc	Ratiometric output voltage - 10 to 90% (A1) or 2 to 98% (A4) of Vs over measurement range (±1%)
Monotonic range	Vdc	0.25 (5%) and 4.75 (95%) nominal (A1)
	Vdc	0.05 (1%) and 4.95 (99%) nominal (A4)
Load resistance	Ω	10k minimum (resistive to GND)
Output noise	mVrms	<1
Input/output delay	mS	<2

#### PWM Output (order code Pn) – see output characteristics on page 31

PWM frequency	Hz	244 (P1); 500 (P2); or 1000 (P3) ±20% over temperature range
PWM levels	9-30V supply Vdc	0 and 5 nominal (±3%)
	5V supply Vdc	0 and Vs (±1%)
Duty cycle	%	10 to 90 over measurement range
Monotonic range	%	5 and 95 nominal
Load resistance	Ω	10k minimum (resistive to GND)
Rise/fall time	µS	<15

#### MECHANICAL

Mechanical angle	°	360, continuous
Operating torque - maximum		
sealed shaft IP68	g-cm	120
unsealed shaft IP50	g-cm	100
Shaft velocity maximum	°/sec	3600
Weight	g	<35
Mounting		Use 2 x M4 socket head cap screws and M4 washer - maximum tightening torque 2Nm
Phasing		When shaft flat (or shaft ident mark) is facing toward the cable exit, output is at mid travel. The sensor housing allows for ±10° adjustment via the mounting flange slots.

## ENVIRONMENTAL

<b>Protection class</b>		IP68 (to 2m depth for 1 hour) or IP50
<b>Life</b>		20 million operations (10 x 10 <sup>6</sup> cycles) of ±75° Sensing element life is essentially infinite (contactless); the SRH280DP life figure refers to the operating shaft seal. Mechanical load (axial and radial) on the shaft should also be considered.
<b>Dither life</b>		Contactless - no degradation due to shaft dither
<b>Operational temperature<sup>†</sup></b>	°C	-40 to +140 (5V supply) -40 to +135.7 (9V supply) Derate upper temperature limit by 1.7°C for every 1V increase in supply; e.g. -40 to +100 @30V
<b>Storage temperature</b>	°C	-55 to +140
<b>Vibration</b>		BS EN 60068-2-64:1995 Sec 8.4 (31.4gn rms) 20 to 2000Hz Random
<b>Shock</b>		3m drop onto concrete
<b>EMC Immunity level</b>		BS EN 61000-4-3:1999, to 100V/m, 80MHz to 1GHz and 1.4GHz to 2.7GHz (2004/108/EC)

<sup>†</sup> See Maximum Operating Temperature – derating graph on page 30.

If the maximum operating temperature is exceeded, the voltage regulator will shut down to protect the device from overheating








## OPTIONS

<b>Measurement range (angle)</b>		Select from 20° to 360° in 1° increments (factory programmed) for each output channel
<b>Output</b>		Analog voltage (An) or PWM (Pn)
<b>Output direction</b>		Both clockwise, both anticlockwise or one CW, one ACW
<b>Shaft style</b>		D section, sprung shaft (S) or 2.4mm blade shaft (H)
<b>Shaft sealing</b>		IP50 or IP68
<b>Cable length</b>	m	0.2 or 0.5
<b>Custom housing</b>		Synchro mount style with ball race bearings - ask our technical sales team for details
<b>OEM options</b>		Outputs can be programmed to provide: non linear laws; switch outputs; clamp voltages; different output phasing CH1/CH2; faster input/output delay; extended analog range; and output mapping for potentiometer replacements

## AVAILABILITY

All standard configurations can be supplied rapidly from the factory - check with your local supplier for more details

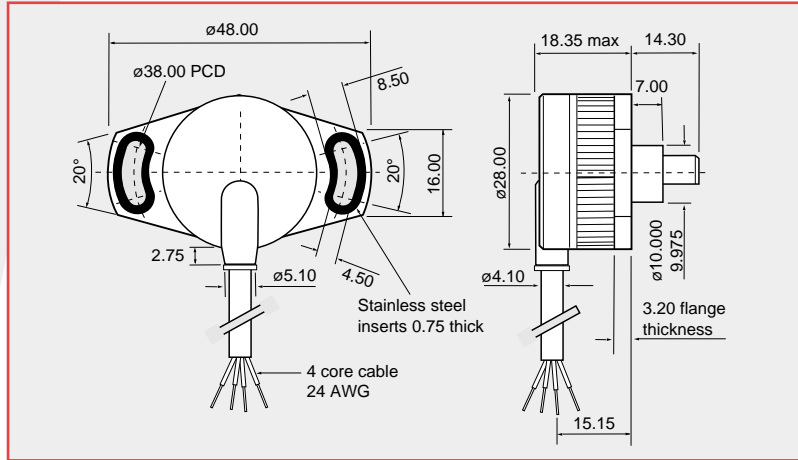
## ORDERING CODES

		<b>SRH280DP/...../...../...../...../...../...../.....</b>
Measurement range	CH1 = angle in °	
Measurement range	CH2 = angle in °	
Output	A1 = Analog 0.5-4.5Vdc A4 = Analog 0.1-4.9Vdc P1 = PWM, 244 Hz P2 = PWM, 500 Hz P3 = PWM, 1000 Hz	
Direction	3 = Both clockwise 4 = Both anticlockwise 5 = CH1 CW; CH2 ACW	
Shaft style	D = D shaft S = Sprung shaft H = 2.4mm blade shaft	
Shaft sealing	50 = IP50 68 = IP68	
Cable length	P2 = 0.2m P5 = 0.5m	

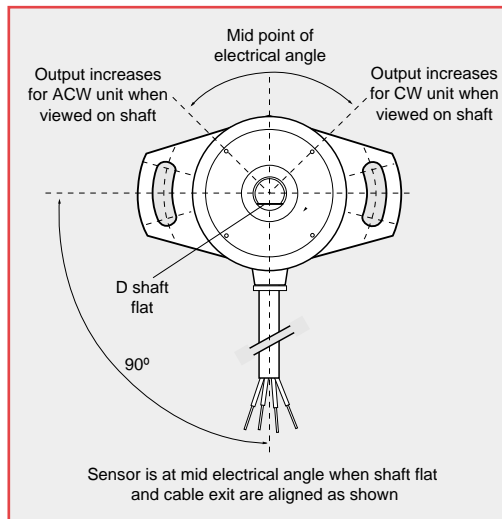
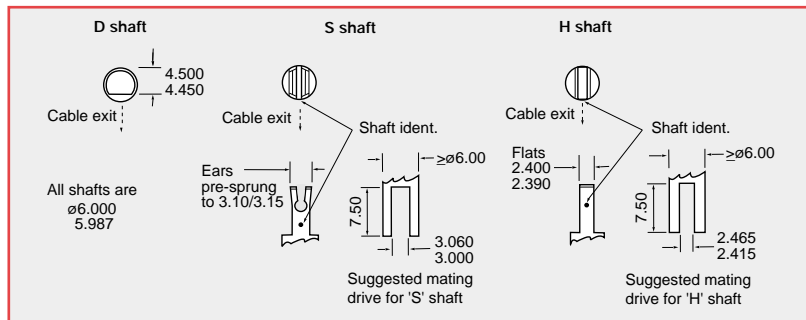
# SRH280DP

## DIMENSIONS

Note: drawings not to scale



## SHAFT OPTIONS



## ELECTRICAL CONNECTIONS

200 or 500mm of 4-core cable: FDR-25 sheathed, with 55A spec (24AWG) cores

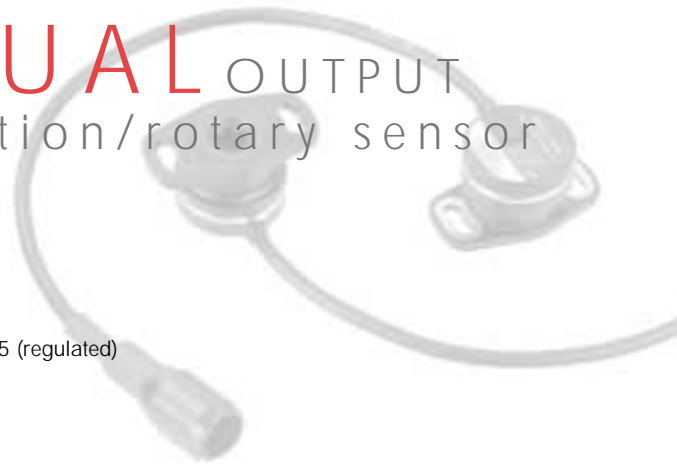
Cable colour	Description
Red	+V Supply
Yellow	Output 1
White	Output 2
Black	0V Supply (GND)

When connecting the sensor, care should be taken with the correct connections. The sensor is provided with reverse polarity protection and short circuit protection between outputs (Yellow & White) to GND (Black), **but if the outputs (Yellow & White) are connected to the supply this will result in device failure.**

Output increases with CW or ACW rotation viewed on shaft - depending on selected order code.

# TPS280DP DUAL OUTPUT

contactless throttle position/rotary sensor



## PERFORMANCE

### ELECTRICAL

Measurement range	°	20 to 360 in 1° increments
Supply voltage	Vdc	9 to 30 (unregulated) and 5 ±0.5 (regulated)
Over voltage protection	Vdc	Up to 40 (-40 to +60°C)
Maximum supply current	mA	<25
Reverse polarity protection		Yes
Short circuit protection		
Output to GND		Yes
Output to supply		In 5V regulated mode only
Power-on settlement time	S	<1
Resolution	%	0.025 of measurement range (12 bit)
Non-linearity*	%	<±0.4
Temperature coefficient	ppm/°C	<±30 in 5V supply mode; <±90 in 9-30V supply mode

\*Non-linearity is measured using the Least-Squares method on a computerised calibration system

### Analog Output (order code A1, A4) – see graph on page 31

Voltage output range		
9-30V supply	Vdc	Absolute voltage, 0.5 to 4.5 (A1) or 0.1 to 4.9 (A4) over measurement range (±3%)
5V supply	Vdc	Ratiometric output voltage - 10 to 90% (A1) or 2 to 98% (A4) of Vs over measurement range (±1%)
Monotonic range	Vdc	0.25 (5%) and 4.75 (95%) nominal (A1)
	Vdc	0.05 (1%) and 4.95 (99%) nominal (A4)
Load resistance	Ω	10k minimum (resistive to GND)
Output noise	mVrms	<1
Input/output delay	mS	<2

### PWM Output (order code Pn) – see output characteristics on page 31

PWM frequency	Hz	244 (P1); 500 (P2); or 1000 (P3) ±20% over temperature range
PWM levels	9-30V supply Vdc	0 and 5 nominal (±3%)
	5V supply Vdc	0 and Vs (±1%)
Duty cycle	%	10 to 90 over measurement range
Monotonic range	%	5 and 95 nominal
Load resistance	Ω	10k minimum (resistive to GND)
Rise/fall time	µS	<15

### MECHANICAL

Mechanical angle	°	360, continuous
Operating torque	g-cm	10
Maximum rotational speed	°/sec	3600
Weight	g	<30
Mounting		Use 2 x M4 socket head cap screws and M4 washer - maximum tightening torque 2Nm
Phasing		When shaft drive detail is aligned as shown in Electrical Angle Diagram (page 21), output is at mid travel. The sensor housing allows for ±10° adjustment via the mounting flange slots.



# TPS280DP

## ENVIRONMENTAL

<b>Protection class</b>		IP68 (to 2m depth for 1 hour) and IP69K
<b>Life</b>		60 million operations (30 x 10 <sup>6</sup> cycles) of ±75°; Sensing element life is essentially infinite (contactless)
<b>Dither life</b>		Contactless - no degradation due to shaft dither
<b>Operational temperature†</b>	°C	-40 to +140 (5V supply) and +170°C for 72 hours -40 to +135.7 (9V supply option) Derate upper temperature limit by 1.7°C for every 1V increase in supply; e.g. -40 to +100 @30V
<b>Storage temperature</b>	°C	-55 to +140
<b>Vibration</b>		BS EN 60068-2-64:1995 Sec 8.4 (31.4gn rms) 20 to 2000Hz Random
<b>Shock</b>		3m drop onto concrete and 2500g
<b>EMC Immunity level</b>		BS EN 61000-4-3:1999, to 100V/m, 80MHz to 1GHz and 1.4GHz to 2.7GHz (2004/108/EC)

† See Maximum Operating Temperature – Derating graph on page 30.  
If the maximum operating temperature is exceeded, the voltage regulator will shut down to protect the device from overheating

## OPTIONS

<b>Measurement range (angle)</b>		Select from 20° to 360° in 1° increments (factory programmed) for each output channel
<b>Output</b>		Analog voltage (An) or PWM (Pn)
<b>Output direction</b>		Both clockwise, both anticlockwise or one CW, one ACW
<b>Cable length</b>	m	0.2 or 0.5
<b>Connector</b>		Not fitted (C0) or Mini Sure Seal MSS4R fitted (C1)
<b>OEM options</b>		Outputs can be programmed to provide: non linear laws; switch outputs; clamp voltages; different output phasing CH1/CH2; faster input/output delay; extended analog range; and output mapping for potentiometer replacements.

## AVAILABILITY

All standard configurations can be supplied rapidly from the factory – check with your local supplier for more details

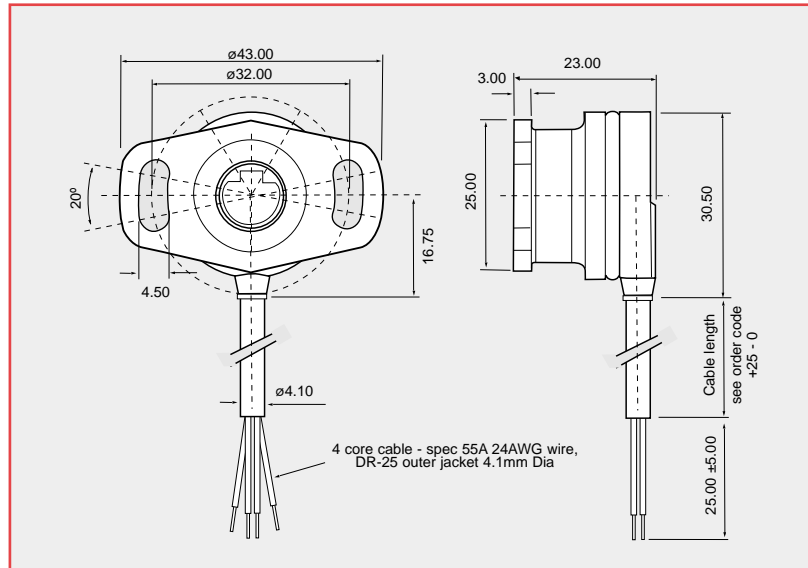
## ORDERING CODES

			<b>TPS280DP/...../...../...../...../...../.....</b>
Measurement range	CH1 = angle in °	_____	
Measurement range	CH2 = angle in °	_____	
Output	A1 = Analog 0.5-4.5Vdc A4 = Analog 0.1-4.9Vdc P1 = PWM, 244 Hz P2 = PWM, 500 Hz P3 = PWM, 1000 Hz	_____	
Direction	3 = Both clockwise 4 = Both anticlockwise 5 = CH1 CW; CH2 ACW	_____	
Cable length	P2 = 0.2m P5 = 0.5m	_____	
Connector	C0 = No connector C1 = Mini Sure Seal MSS4R	_____	

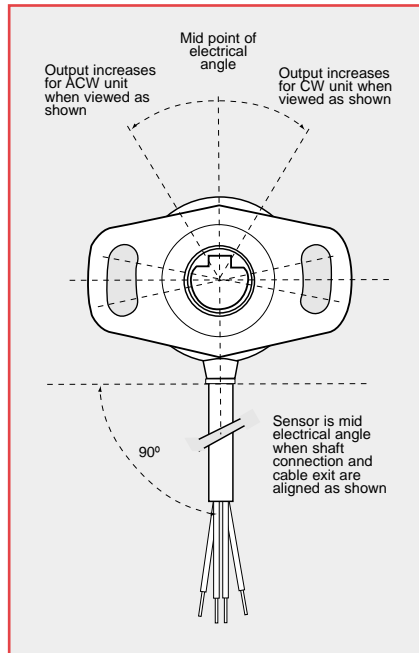
**Accessories** (order all items separately)  
Mating connector – X61-227-002 Mini Sure Seal MSS4P  
X61-227-201 PIN contact (2off required)  
X61-227-202 SOCKET contact (2off required)

## DIMENSIONS

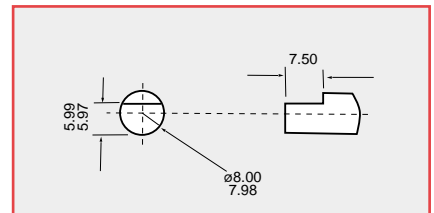
Note: drawings not to scale



## ELECTRICAL ANGLE



## RECOMMENDED MATING DRIVE



## ELECTRICAL CONNECTIONS

**Option C0** - 200 or 500mm of 4-core cable: FDR-25 sheathed, with 55A spec (24AWG) cores

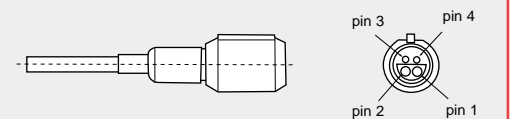
**Option C1** - Mini sure seal MSS4R fitted to cable

Cable colour	Description
Red	+V Supply
Black	0V Supply GND
Yellow	CH1 Output
White	CH2 Output

Output increases with CW or ACW rotation viewed on shaft drive - depending on selected order code

### C1 Connector option

Pin 1 = V+ Supply      Pin 3 = CH1 Output  
Pin 2 = 0V Supply GND      Pin 4 = CH2 Output

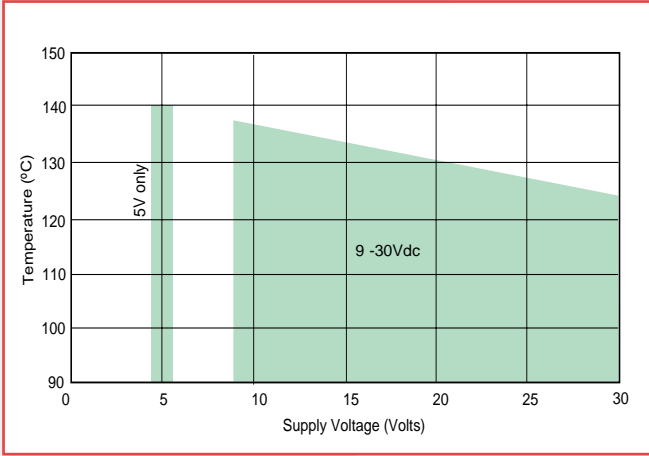


When connecting the sensor, care should be taken with the correct connections. The sensor is provided with reverse polarity protection and short circuit protection between outputs (Yellow & White) to GND (Black), **but if the outputs (Yellow & White) are connected to the supply this will result in device failure.**

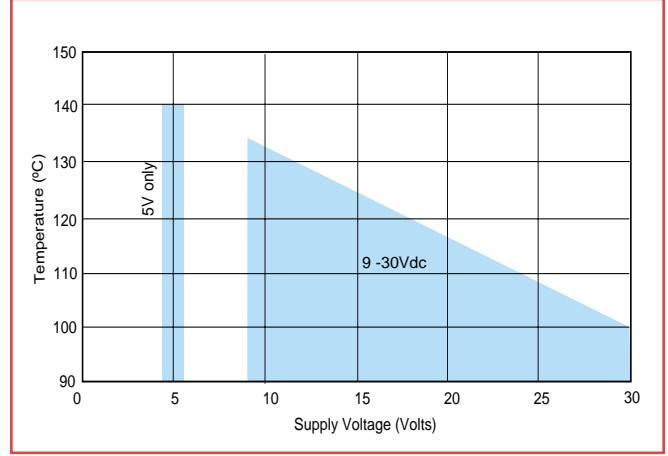
# TEMPERATURE AND OUTPUT GRAPHS

## MAXIMUM OPERATING TEMPERATURE - DERATING GRAPHS

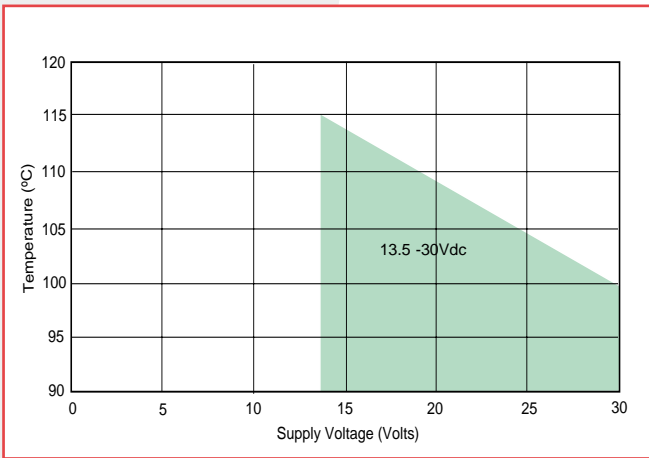
SRH280P



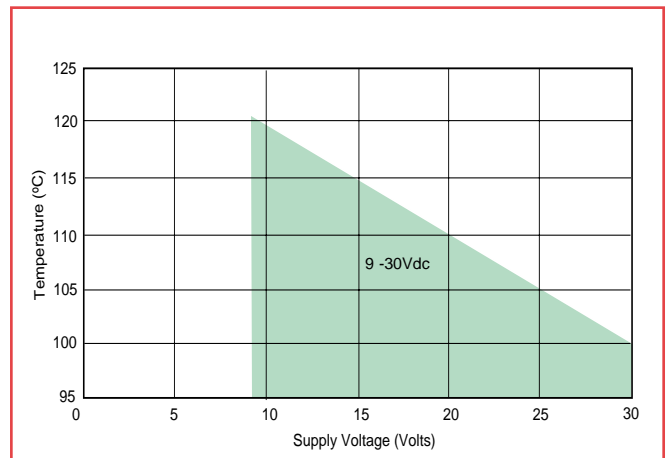
SRH280DP, NRH280DP, TPS280DP, SRH220DR  
SRH501P/502P (not A2 & A3 options)



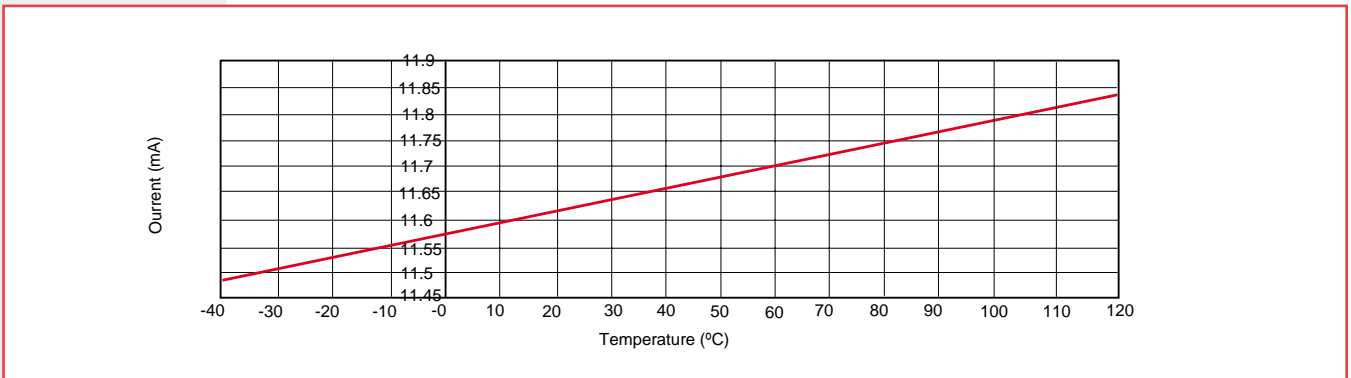
SRH220DR, SRH501P/502P - OUTPUT A2



SRH501P/502P - OUTPUT A3

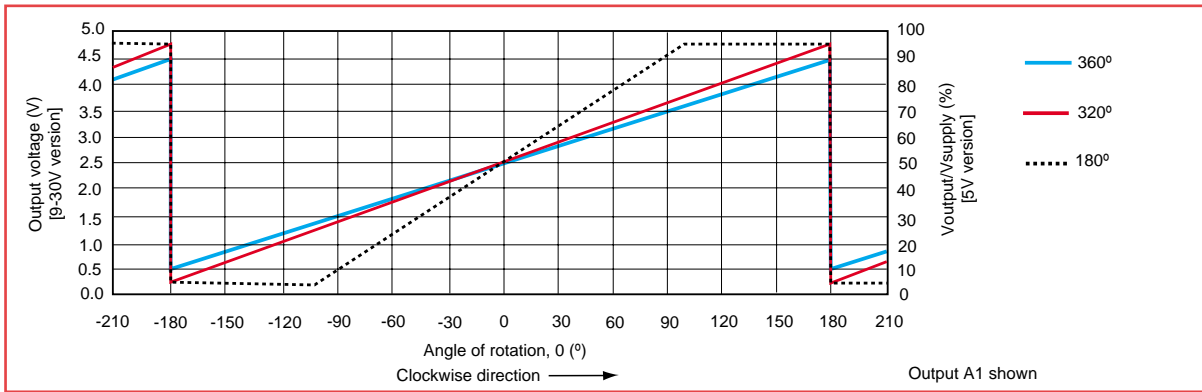


A3 Typical temperature slope characteristic (can be used for compensation)

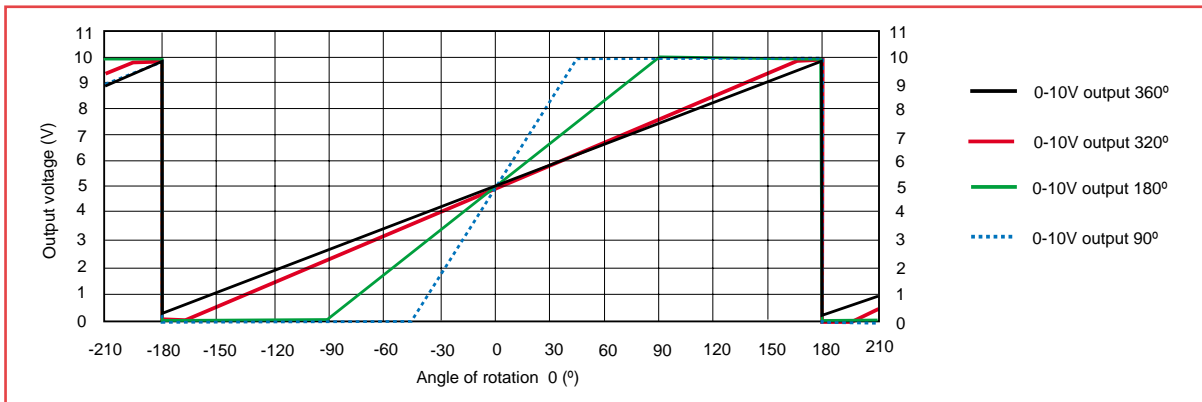


## SENSOR OUTPUT GRAPH- examples for three different angles

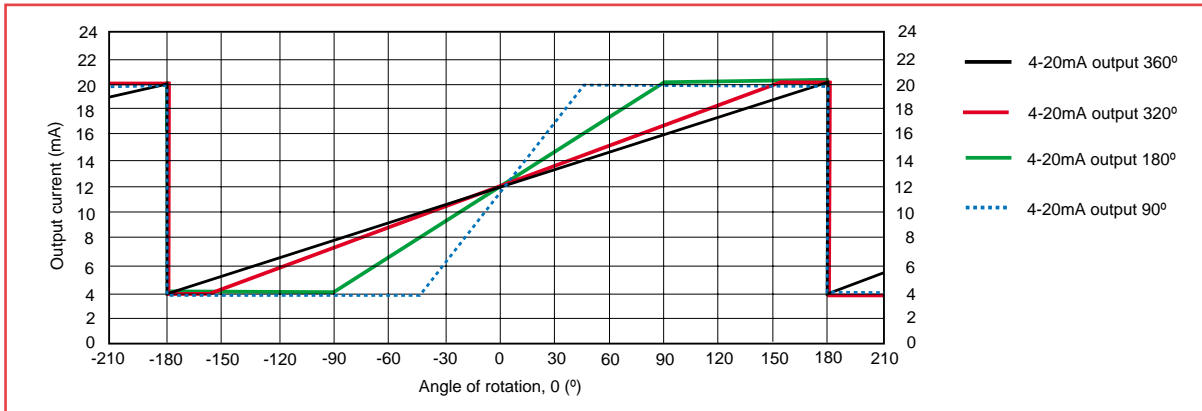
SRH280P, SRH280DP, NRH280DP, NRH285DR, TPS280DP, SRH220DR - OUTPUT A1  
 SRH501P/502P - OUTPUT A1  
 SRH880P - OUTPUT A



SRH220DR, SRH501P/502P - OUTPUT A2 (0-10Vdc)

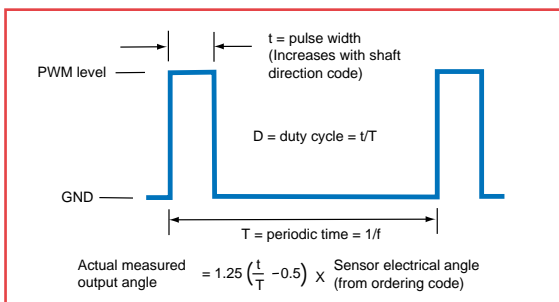


SRH501P/502P - OUTPUT A3 (4-20mA)



## PWM OUTPUT CHARACTERISTICS

SRH280P, SRH280DP, NRH280DP, NRH285DR, TPS280DP, SRH220DR - OUTPUT P1, P2, P3  
 SRH501P/502P - OUTPUT P1, P2, P3  
 SRH880P - OUTPUT P



PWM levels = zero volt and 5V ( $\pm 3\%$ ) for 9-30V supply  
 = zero volt and  $V_S$  ( $\pm 1\%$ ) for 5V supply

# ROTARY POTENTIOMETERS

Penny+Giles high durability potentiometer track technology provides virtually infinite resolution, low electrical noise and high stability under extremes of temperature, humidity, vibration and shock over a long operating life.

These potentiometers are ideally suited and race proven in providing data acquisition systems with clean, robust signals for throttle angle, steering angle and gear select position indication.



## Features

- Corrosion resistant stainless steel shaft
  - Duplex shaft bearing support
  - Choice of shaft attachments
- Hybrid and conductive plastic tracks
  - Electrical angles from 10° to 350°
  - Rugged mechanical design
  - Sealing to IP68 (SRS280)
- Rapid despatch of any option (SRS280)
  - CE Approved (SRS280)

## Benefits

- Accurate drive location in hostile environments
- Optimum performance under vibration
- Interchangeable with existing installations
- Stable output signal over a long life
- Maximum sensitivity in all applications
- Operation in high shock and vibration environments
- Operation in hostile environments
- Eliminates customer inventory
- Confidence in EMC performance

# SRS 280 SEALED ROTARY SENSOR

## PERFORMANCE

### ELECTRICAL

Electrical angle $\pm 2$	°	10 to 350 in 10° increments
Resistance $\pm 20\%$	$\Omega$	14.3 per degree
Hysteresis (repeatability)	°	< 0.03
Accuracy		< 1 degree (e.g. $\pm 0.3\%$ over 330°, $\pm 1\%$ over 100°)
Power dissipation at 20°C	W	0.003 W per angular degree
Applied voltage maximum	Vdc	0.2 per angular degree
Resolution		Virtually infinite
Output smoothness		To MIL-R-39023 grade C 0.1%
Insulation resistance		Greater than 100M $\Omega$ at 500Vdc
Operating mode		Voltage divider only - see Circuit Recommendation below
Wiper circuit impedance		Minimum of 100 x track resistance or 0.5M $\Omega$ (whichever is greater)

### MECHANICAL

Mechanical angle	°	360, continuous
Mounting		Use 2 x M4 socket head cap screws and M4 washer - maximum tightening torque 2Nm
Operating torque maximum		
unsealed shaft IP50	gm cm	100
sealed shaft IP68	gm cm	120
Shaft velocity maximum	°/sec	3000
Weight	g	32 (cable option A), 64 (cable option B)
Phasing		When shaft flat (or shaft ident mark) is facing the cable exit, wiper is at mid travel The sensor housing allows for $\pm 10^\circ$ adjustment via the mounting flange slots

### ENVIRONMENTAL

Life		
unsealed shaft IP50		Exceeds 20 million operations (10 x 10 <sup>6</sup> cycles) of $\pm 75^\circ$
sealed shaft IP68		20 million operations (10 x 10 <sup>6</sup> cycles) of $\pm 75^\circ$
Dither life		200 million operations (100 x 10 <sup>6</sup> cycles) of $\pm 3^\circ$ , 60Hz
Operational temperature	°C	-40 to +130 (continuous)
Vibration		RTCA-DO160D, 10Hz to 2000Hz (random), 12.61g rms - all axes
Shock		Survival to 2500g - all axes

### CIRCUIT RECOMMENDATION

Hybrid track potentiometers feature a high wiper contact resistance, therefore operational checks should be carried out only in the voltage divider mode. Hybrid track potentiometers should be used only as voltage dividers, with a minimum wiper circuit impedance of 100 x track resistance or 0.5M $\Omega$  (whichever is greater). Operation with wiper circuits of lower impedance will degrade the output smoothness and affect the linearity.

### OPTIONS

Electrical angle	Can be supplied from 10° to 350° in 10° increments
Shaft style	D section, sprung shaft (S) or 2.4mm blade shaft (H)
Shaft sealing	IP50 or IP68
Cable length	0.5m or 2m

### AVAILABILITY

All standard configurations can be supplied rapidly from the factory - check with your local supplier for more details

## ORDERING CODES

SRS280/...../...../...../.....

Electrical angle

Shaft style D = D shaft

S = Sprung shaft

H = 2.4mm blade shaft

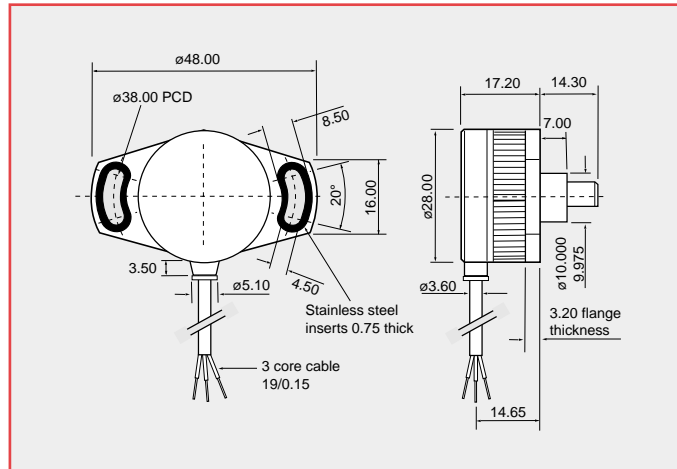
Cable A = 0.5m, B = 2m

Shaft sealing 50 = IP50

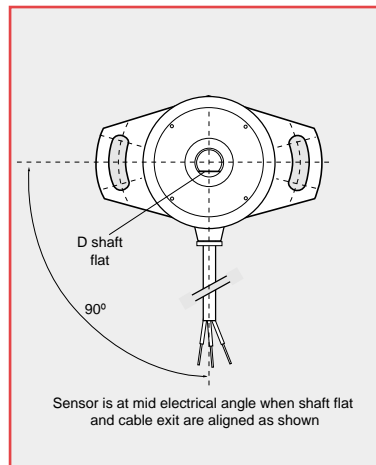
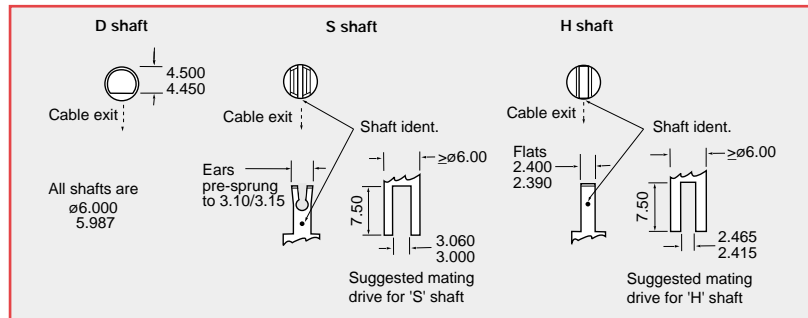
68 = IP68

## DIMENSIONS

Note: drawings not to scale

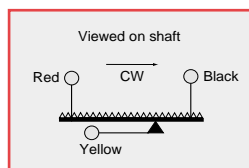


## SHAFT OPTIONS



## ELECTRICAL CONNECTIONS

3 core cable: PUR sheathed, with PTFE insulated 19/0.15 cores.



# RCP11/2S

This specially developed RCP11 has dual electrical output and facilitates low electrical noise and virtually infinite resolution over exceptionally long operating life under extreme operating conditions. This potentiometer is ideally suited and race proven in providing data acquisition systems with clean, robust signals for gear select position indication.

## PERFORMANCE

<b>Electrical angle <math>\pm 1</math></b>	$^{\circ}$	350
<b>Resistance <math>\pm 10\%</math></b>	<b>k<math>\Omega</math></b>	1
<b>Independent linearity</b>	$\pm\%$	0.25
<b>Power dissipation at 20°C</b>	<b>W</b>	1.5
<b>Dielectric strength</b>	<b>Vrms</b>	750
<b>Applied voltage - maximum Vdc</b>		38
<b>Resolution</b>		Virtually infinite
<b>Output smoothness</b>		To MIL-R-39023 grade C 0.1%
<b>Insulation resistance</b>		Greater than 100M $\Omega$ at 500Vdc
<b>Phasing between tracks <math>\pm 1^{\circ}</math></b>		at 50% applied voltage
<b>Operating mode</b>		Voltage divider only - see Circuit Recommendation below
<b>Maximum wiper current</b>	<b>mA</b>	10
<b>Mechanical angle</b>	$^{\circ}$	360 continuous
<b>Starting torque - maximum gm cm</b>		16
<b>Shaft run out - TIR</b>	<b>mm</b>	0.025
<b>Lateral run out - TIR</b>	<b>mm</b>	0.051
<b>Pilot run out - TIR</b>	<b>mm</b>	0.025
<b>Shaft end play - maximum</b>	<b>mm</b>	0.076
<b>Weight</b>	<b>g</b>	25
<b>Life</b>		Greater than 50 million rotations
<b>Operational temperature</b>	$^{\circ}\text{C}$	-65 to +130

## CIRCUIT RECOMMENDATION

The RCP11 range of potentiometers feature a high wiper contact resistance, therefore operational checks should be carried out only in the voltage divider mode. These potentiometers should be used only as voltage dividers, with a minimum wiper circuit impedance of 100 x track resistance or 0.5M $\Omega$  (whichever is greater). Operation with wiper circuits of lower impedance will degrade the output smoothness and affect the linearity.

## OPTIONS

<b>Electrical angle</b>	Non standard angles can be specified
<b>Resistance</b>	Non standard resistance values can be specified
<b>Single gang output</b>	Single gang output only can be specified
<b>Mounting</b>	Custom mounting configurations can be specified

## AVAILABILITY

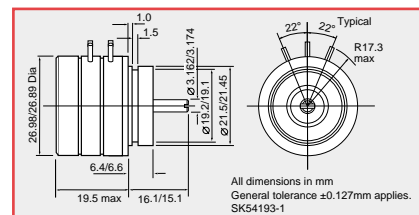
Please consult our sales office for details

## ORDERING CODE

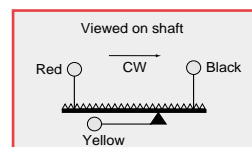
**RCP11/2S D150397**

## DIMENSIONS

Note: drawings not to scale

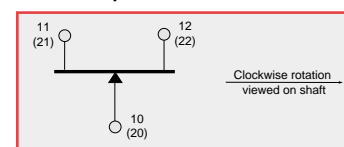


## ELECTRICAL CONNECTIONS SRS280



3 core cable:  
PUR sheathed,  
with PTFE  
insulated  
19/0.15 cores

## RCP11/2S



6x terminals,  
gold plated



# RVDT DISPLACEMENT TRANSDUCERS

The Penny+Giles rugged, high integrity RVDT displacement transducer is designed for operation in harsh automotive and motorsport environments. The design elements employed have evolved from the technology and experience gained over 40 successful years in the aerospace/military sensor market, where performance and reliability under extreme operating conditions are paramount

## High accuracy system performance

This ac operated RVDT displacement transducer has been designed primarily for use in the 'difference over sum' (ratiometric) configuration to provide high system accuracy performance where the output is virtually unaffected by temperature and supply changes. Using high integrity coil and rotor designs, combined with a titanium housing, this RVDT can be supplied with a choice of shaft and mounting flanges to suit high performance, high temperature engine control applications.



## Features

- No contact between the sensing elements
  - Precision low torque bearings
  - Infinite resolution
- Temperature range -40° to +180°C
- High integrity coils, screen and connection assemblies
  - Corrosion resistant stainless steel drive shaft
- Rugged mechanical design with titanium housing

## Benefits

- Virtually infinite life and fast dynamic response
- Long trouble free life
- All displacement will be sensed
- Maximum reliability in hostile environments
- Maximum reliability in hostile environments
- Accurate drive location in hostile environments
- Maximum reliability in high shock and vibration environments

# RVDT AC OPERATED

## PERFORMANCE

<b>Electrical angle</b>	°	±60 (120 total)
<b>Mechanical angle</b>	°	360 continuous
<b>Input voltage</b>	<b>V<sub>rms</sub></b>	3
<b>Input frequency</b>	<b>kHz</b>	2
<b>Insulation resistance</b>		Greater than 50MΩ at 250Vdc
<b>Resolution</b>		Virtually infinite
<b>Operational temperature</b>	<b>°C</b>	-40 to +180
<b>Operating mode</b>		Ratiometric
<b>Electrical output R proportional to position</b>		$R = \frac{V_a - V_b}{V_a + V_b}$
<b>Electrical output R at ±60°</b>		±0.504
<b>Non-linearity (0 to ±50°)</b>	±%	1
<b>(±50° to ±60°)</b>	±%	2
<b>Input impedance</b>		Greater than 150Ω at 2kHz
<b>Load resistance (per coil)</b>		Greater than 100kΩ
<b>Phasing</b>		With black, white and yellow leads common, the output on blue and green leads shall be in anti-phase with the red input for all shaft positions Please consult the factory for details
<b>Temperature error</b>	<b>ppm/°C</b>	85
<b>Weight (maximum)</b>	<b>g</b>	

## OPTIONS

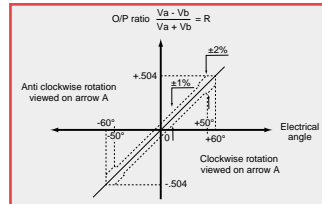
**Mounting** Custom mounting configurations can be specified

## ORDERING CODE

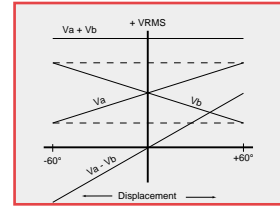
## OUTPUT SCHEMATICS

### RVDT D45600

#### Output Vs angle



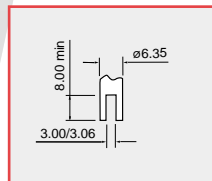
#### Individual output voltage schematic



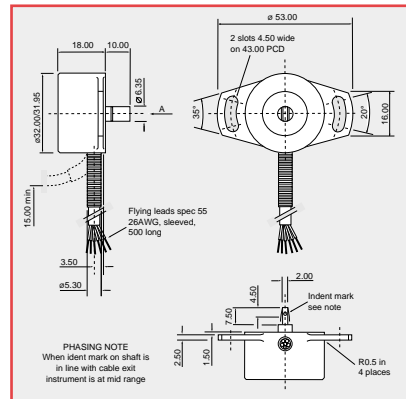
## DIMENSIONS

Note: drawings not to scale

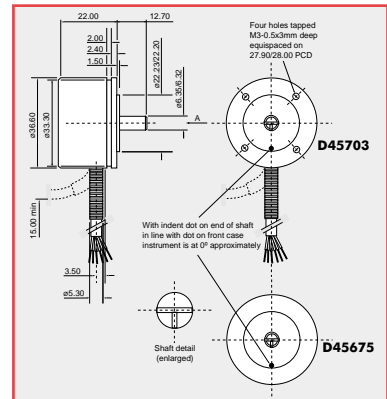
### Suggested driving slot for shaft



### RVDT D45600

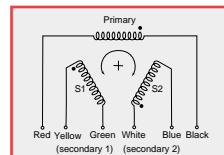


### Alternative mounting styles



## ELECTRICAL CONNECTIONS

6 flying leads 26 AWG, sleeved 500mm long



Penny+Giles - one of the world's major suppliers of measurement and control sensors



throttle pedal position

gear select position indication



hydraulic reservoir level

front and rear suspension movement



throttle actuator position

steering angle position



gearbox actuator position

clutch pedal position



clutch actuator position

brake balance measurement

brake pad/disc wear indication



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**Penny & Giles**

Position sensors, joysticks and solenoids for commercial and industrial applications.

15 Airfield Road  
Christchurch  
Dorset BH23 3TG  
United Kingdom  
+44 (0) 1202 409409  
+44 (0) 1202 409475 Fax  
sales@pennyandgiles.com

36 Nine Mile Point Industrial Estate  
Cwmfelinfach  
Gwent NP11 7HZ  
United Kingdom  
+44 (0) 1495 202000  
+44 (0) 1495 202006 Fax  
sales@pennyandgiles.com

665 North Baldwin Park Boulevard  
City of Industry, CA 91746  
USA  
+1 626 480 2150  
+1 626 369 6318 Fax  
us.sales@pennyandgiles.com

Straussenlettenstr. 7b  
85053 Ingolstadt,  
Germany  
+49 (0) 841 885567-0  
+49 (0) 841 885567-67 Fax  
info@penny-giles.de

3-1-A, Xiandai Square,  
No 333 Xingpu Rd,  
Suzhou Industrial Park, 215126  
China  
+86 512 6287 3380  
+86 512 6287 3390 Fax  
sales@pennyandgiles.com.cn

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Innovation In Motion

