Zettlex

Precision in the Extreme

Product Guide

IncOder™

Inductive Angle Encoders

Revision 4.06 December 2012

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- ☑ No contacts
- ☑ No bearings
- ☑ No couplings
- ☑ No maintenance
- ☑ Absolute
- ☑ Compact
- ☑ Easy installation
- ☑ Accurate
- ☑ Robust
- ☑ Integral electronics
- ☑ Digital output
- ☑ Economical
- ☑ Global support

……..it ticks all the boxes





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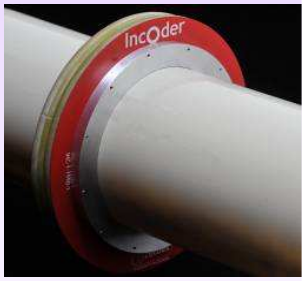
Zettlex IncOders are non-contact devices for precisely measuring absolute angle. They work like a transformer, using a unique inductive technique. IncOders can be considered as an inductive encoder.



IncOders are ideally suited to harsh environments - where electrical contacts, optical or capacitive devices would prove unreliable.

IncOders have 2 main parts – a Stator and a Rotor. Each is shaped like a flat ring. The large through-bore makes it easy to accommodate shafts, slip-rings, optic-fibres, pipes, cables etc.

The Stator is powered and the Rotor is passive. The Stator contains all the electronics necessary to receive power and generate a digital output signal. The output signal from the Stator shows the absolute position of the Rotor relative to the Stator right from power up.

There is no need for compliant or special couplings and the Rotor & Stator can simply be screwed to the host product. Precise mechanical mounting is not required and there are no bearings.

Operation is unaffected by condensation or dust. Robust, anodized aluminium alloy housings and monolithic constructions are used for both Rotor and Stator.

There are no contacting, delicate or wearing parts and so there is no need for periodic replacement, service or maintenance.

IncOders are used in a wide variety of applications including:-

- Rotary joints & gimbals
- Actuator servos & motor encoders
- Electro-optic & infra-red camera systems
- Heliostats & solar equipment
- Robotic arms & CNC machine tools
- Test & calibration equipment
- Light & heavy calibre weapons systems
- Targeting systems & range finders
- Antenna pointing devices & telescopes
- Packaging & laboratory automation
- Medical scanners & surgical equipment
- Cranes & telescopic manipulators.

IncOders have a solid track record in safety related applications including airborne equipment and weapons systems.

IncOders are made in the United Kingdom, contain no ITAR restricted components and do not require an arms export licence unless they are >1000mm diameter.

1. Product Options

The IncOder range offers a wide variety of options. The options are specified using the IncOder product code when you order (***see Section 10***). Each IncOder contains one Stator and one Rotor. Stators & Rotors are not matched pairs – in other words, either element may be swapped out for replacement, if necessary. The range of options are:-

Mechanical Format Option: Various mechanical formats featuring screw or servo clamp stators with screw format, set screw and plain rotors – see Section 5.

IncOder Size: stated as outer diameter: 75, 100, 125, 150, 175, 200, 225 & 250mm.

Resolution Options: 14, 16, 18, 19, 20 & 21 bits.

Communication Interface Options : SSI (types 1 – 8) , SPI or asynchronous serial data interface (ASI). *Optimal choice depends on the nature of the resident, host control system. All these Communication Interface options cost the same. For new applications, we recommend asynchronous serial interface.*

Connector Options : axial, radial or integral axial cable.

Voltage Options : 5, 12 or 24VDC. Product Code 24VCT is used to specify an IncOder suitable for cold operating temperatures below -40Celsius.

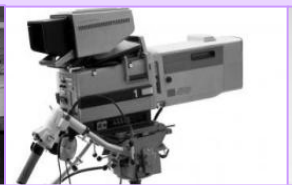
2. Product Accessories

Accessories can be purchased separately from the main IncOder.

Cable : supplied with 2m long PVC sheathed and shielded cable with a plug connector (with 2 jack screws) to match IncOder's socket connector on the Stator.

Servo Clamp : aluminium (Alocrom plated) suitable for M2,5 screw. Supplied in a pack of 3.

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3. Customized Products

Zettlex regularly customize IncOders to specific OEM requirements. Options include alternative:-

- size (up to 570mm outer diameter)
- mechanical mounts and materials including stainless steel
- voltage supplies
- electrical outputs
- measurement performance (up to 24 bit resolution)
- connectors & cables
- surface finish – clear anodized, chromate, black anodized, natural, painted or Surtec650
- temperature range – notably to -55Celsius
- low weight or low inertia
- ATEX certified.

Consult Zettlex or your local representative for further information. Typically, custom products are an economical option for OEMs in volumes of >50 units/year. Engineering or tooling charges may apply depending on order quantity. The images below show some examples of customized products:-

End of shaft arrangement with black anodized custom housing & military style connector for fighting vehicles. Suitable for extreme shock & vibration requirements.

Custom housing with chromate surface finish & integral cable for remotely controlled gimbal.

Ultra lightweight unit for airborne application.

Extra large diameter unit for slip ring.

4. Manufacturing & Quality

IncOders are designed, made, tested and shipped by Zettlex's facility in Cambridge, UK. Commercial and technical support is provided by the same site or through our international network of partners.

Design

Development

Procurement

Assembly

Quality Control

Shipping

IncOder's manufacturing processes are well established, having been perfected over a number of years and by the production of thousands of products. Every IncOder is tested according to a rigorous production acceptance test procedure, before packing and shipping.

Certificates of conformity against this Product Guide are available as well as RoHS compliance certificates.

IncOders are not ITAR restricted and contain no ITAR components Typically, a UK government export license for military equipment is not required for devices of <1000mm diameter.

All design, manufacturing and customer processes are controlled by a comprehensive IS0-9001:2008 quality management system developed by Zettlex engineers. The Zettlex quality management system is subject to regular internal and external audit – including an annual audit by a UKAS accredited, independent authority. Zettlex is also certified for the design and manufacture of intrinsically safe sensors under BS EN 13980. A copy of our IS0-9001 certificate is shown below:-

DAS CERTIFICATION

DAS CERTIFICATION

Quality Management System

Certificate of Approval

This is to certify that the QMS of

Zettlex UK Ltd
Newton Court, Newton
Cambridge, CB22 7PE, UK

Has been assessed and found to meet the requirements of

ISO9001:2008

This certificate is valid for the following scope of operations:

Design and manufacture of electronic sensors and associated services

Authorised by:

Stan Wright
Chief Executive

Date of Certificate Issue: 26 October 2012
Certificate Valid until: 25 October 2015

Recertification audit before 26 September 2015 Certified since October 2009
This certificate is the property of DAS Certification and remains valid
Subject to satisfactory annual Surveillance audits

DAS Certification

Certificate Number: 64757/GB/Q9001

Registration House,
22b Church Street
Rushden, Northamptonshire,
NN10 9YT, UK
Tel: 01933 381859
email: info@dascertification.co.uk
Web: www.dascertification.co.uk

Company number: 03384526

Zettlex Quality Certificate

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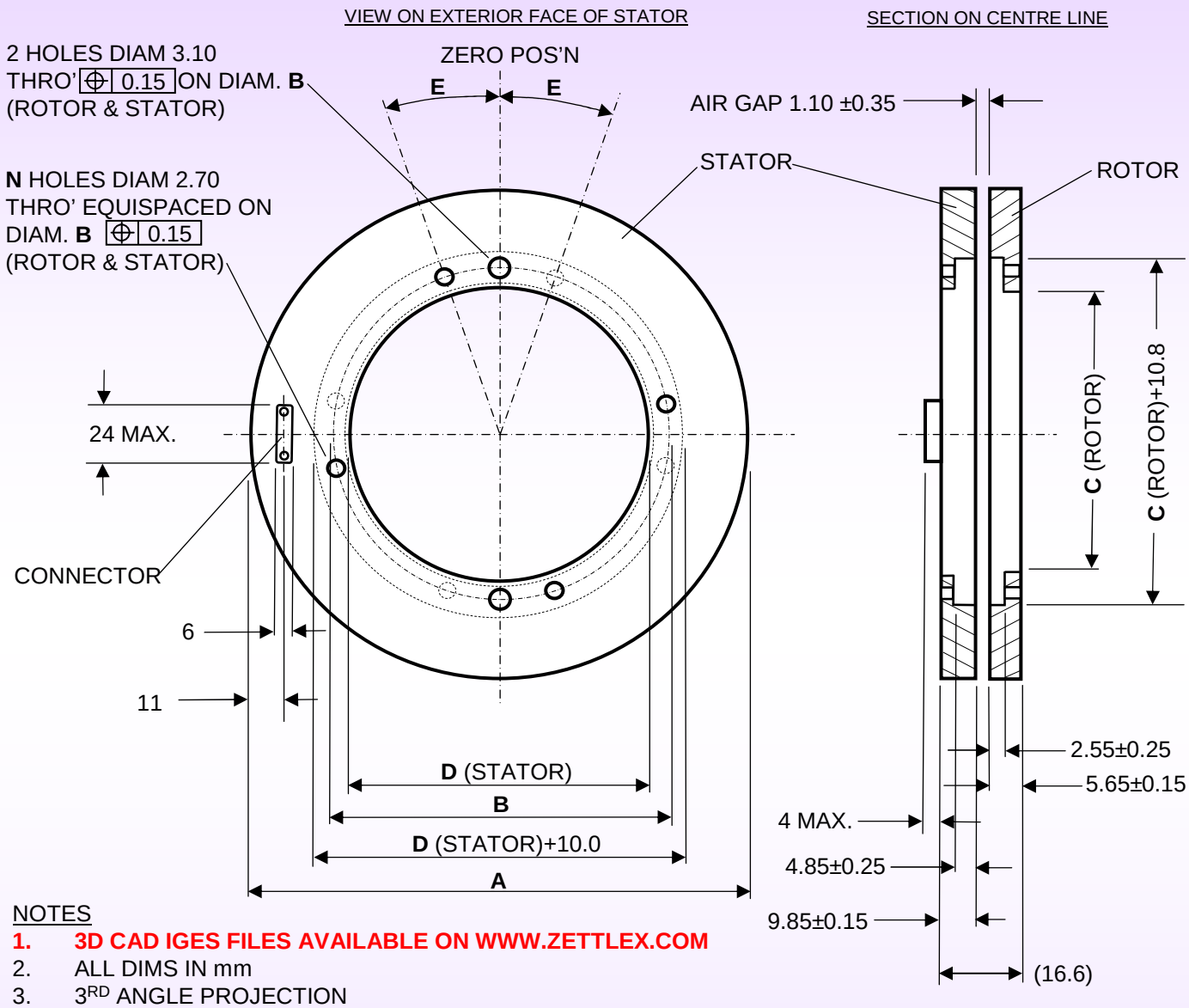
5.1 Screw Mount Stator & Screw Mount Rotor Format – INC-3 Product Code



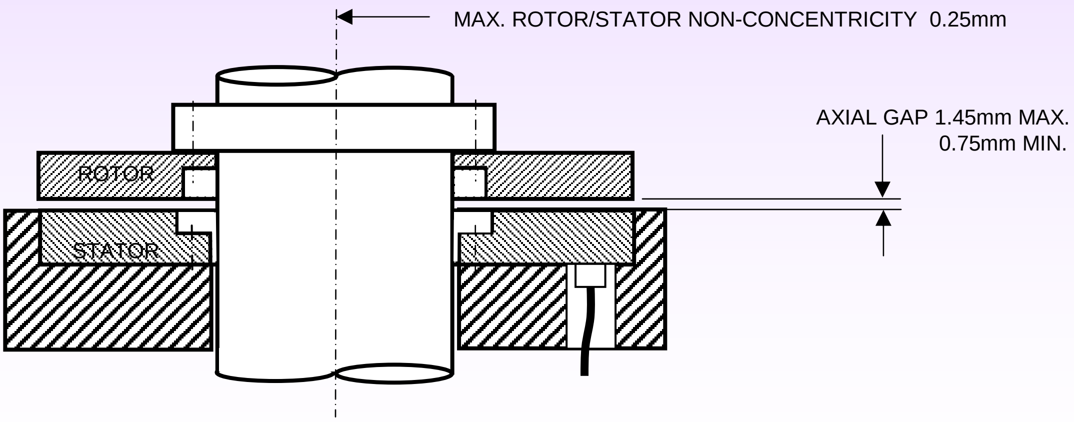
NOTES

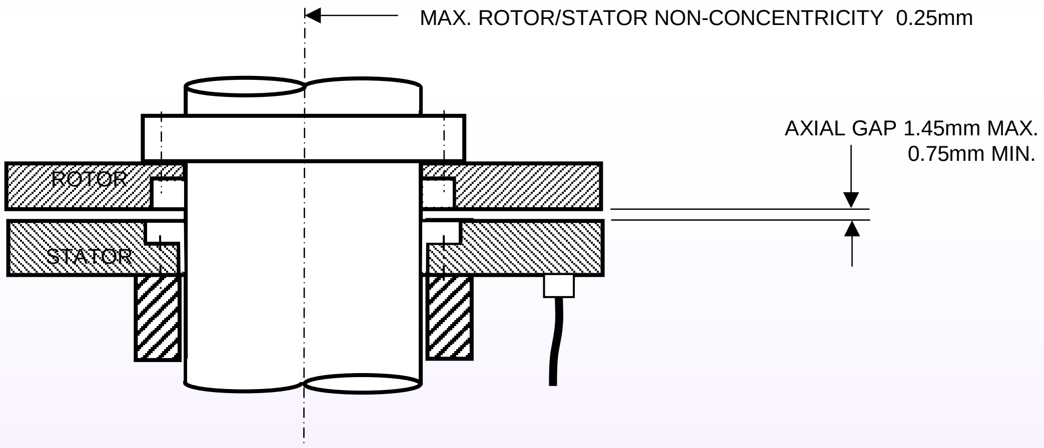
1. **3D CAD IGES FILES AVAILABLE ON WWW.ZETTLEX.COM**
2. ALL DIMS IN mm
3. 3RD ANGLE PROJECTION
4. TOLERANCES:- 0 DECIMAL PLACES = ±0.5
   1 DECIMAL PLACES = ±0.2
   2 DECIMAL PLACES = ±0.1

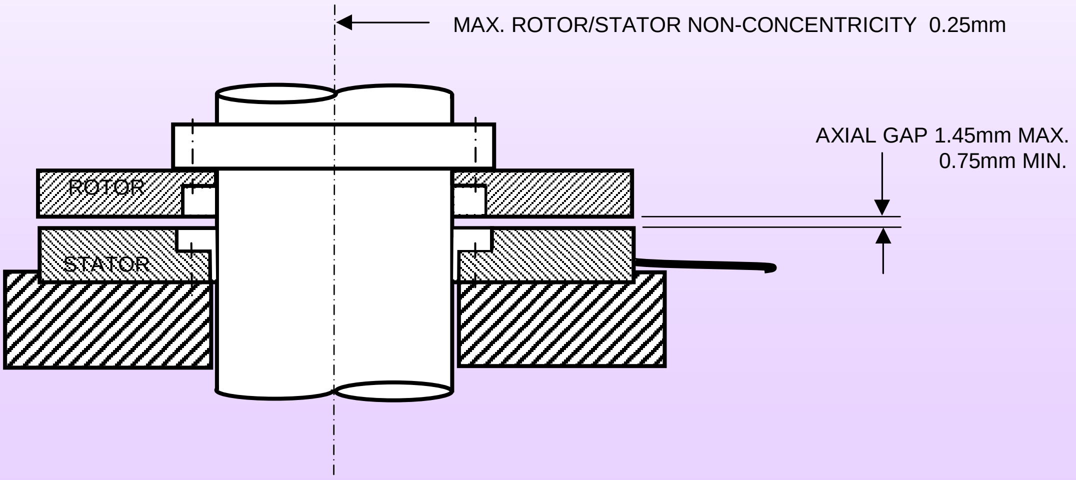
UNIT SHOWN WITH AXIAL CONNECTOR (AC1)

	INC-3-75	INC-3-100	INC-3-125	INC-3-150	INC-3-175	INC-3-200	INC-3-225	INC-3-250	
Dim. A - Stator / Rotor Body O.D.	75 ± 0.1	100 ± 0.1	125 ± 0.1	150 ± 0.1	175 ± 0.1	200 ± 0.1	225 ± 0.1	250 ± 0.1	mm
Dim. B. - Pitch Circle Diameter	30.5	55.5	80.5	105.5	130.5	155.5	180.5	205.5	mm
Dim. C. - Rotor I.D.	25 ± 0.1	50 ± 0.1	75 ± 0.1	100 ± 0.1	125 ± 0.1	150 ± 0.1	175 ± 0.1	200 ± 0.1	mm
Dim. D. - Stator I.D.	25.8 ± 0.1	50.8 ± 0.1	75.8 ± 0.1	100.8 ± 0.1	125.8 ± 0.1	150.8 ± 0.1	175.8 ± 0.1	200.8 ± 0.1	mm
Dim E - Offset Angle from T.D.C.	30	30	30	30	30	30	30	20	degrees
N Number of screw clearance holes	4	4	4	6	6	6	6	8	
Max. radial misalignment	0.25								mm
Rotor & stator fixings	Steel screws cap head M2.5 & steel dowels M3								

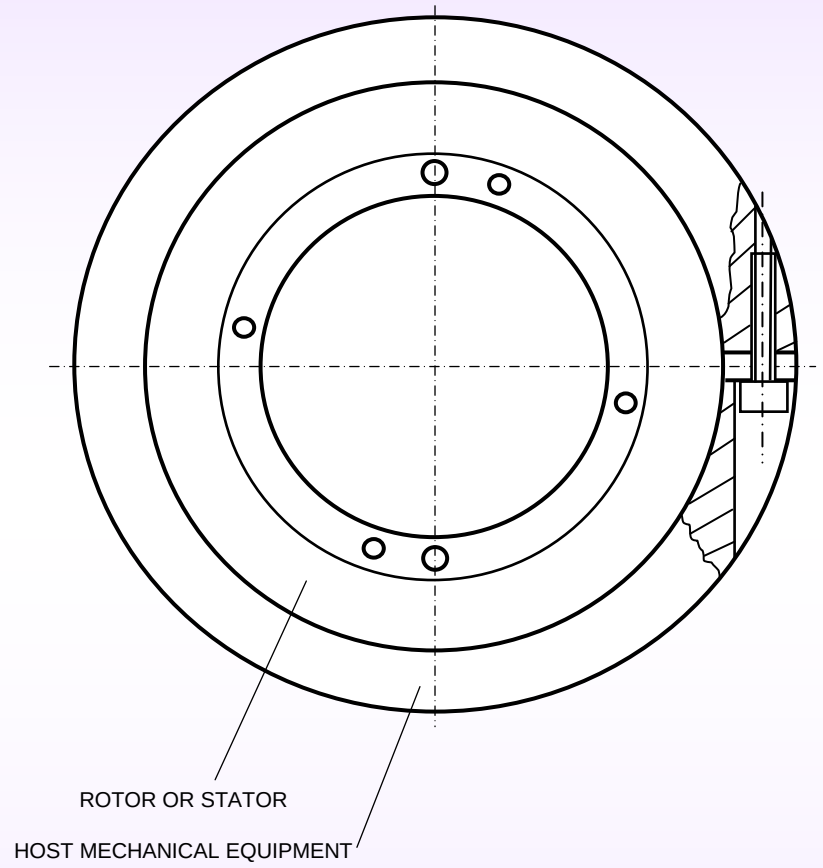
Screw Mount Format IncOders can be installed in a wide variety of arrangements. The following shows just a few examples. Provided the axial gap and concentricity tolerances are maintained on installation, then the stated measurement performance will be maintained.







All formats of IncOder can be installed using a circumferential clamp in the host equipment. This applies to both Rotor and Stator. The preferred arrangement is to use a C-ring whose gap is closed by a screw.



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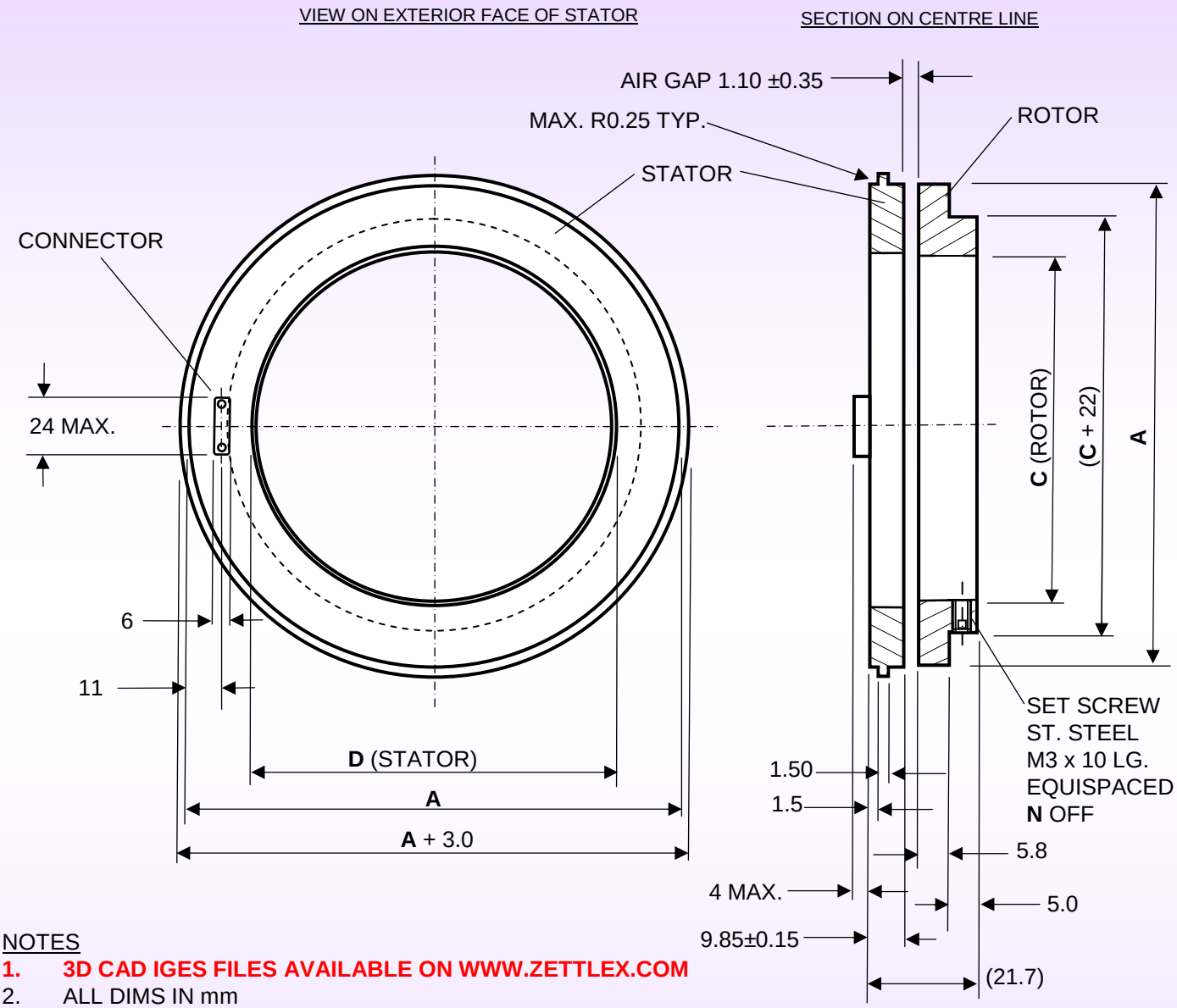
5.2 Servo Clamp Stator & Set Screw Rotor - INC-4 Product Code



NOTES

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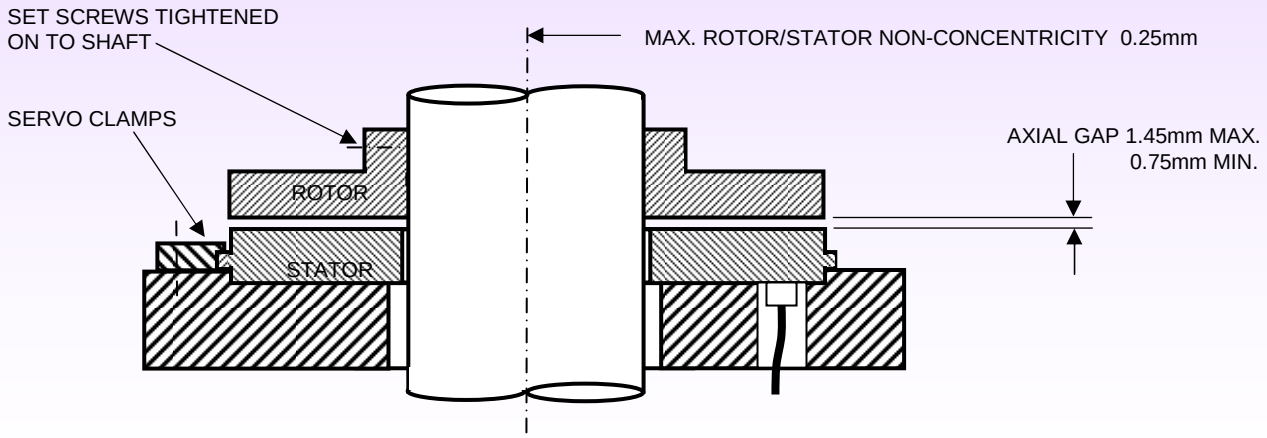
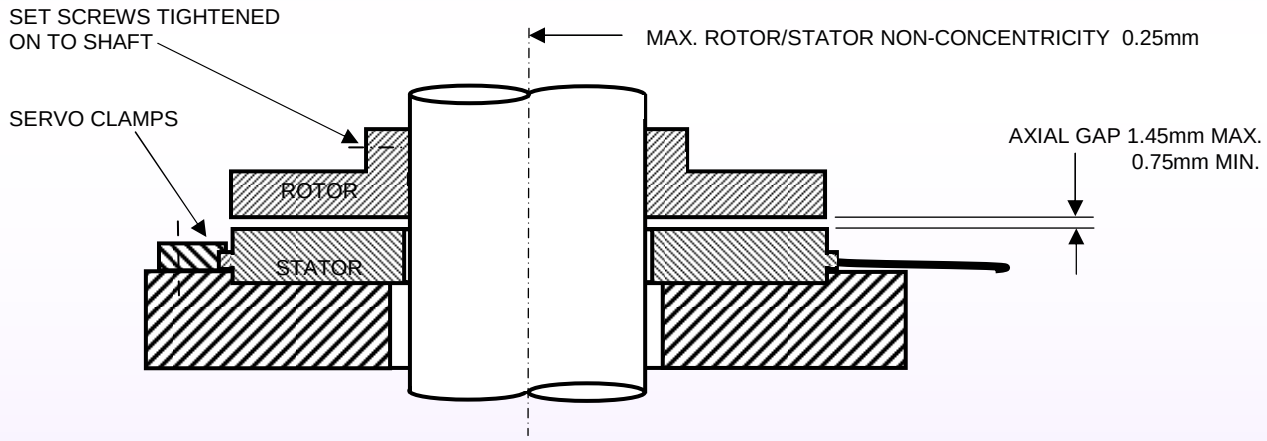
4. TOLERANCES:- 0 DECIMAL PLACES = ±0.5
   1 DECIMAL PLACES = ±0.2
   2 DECIMAL PLACES = ±0.1

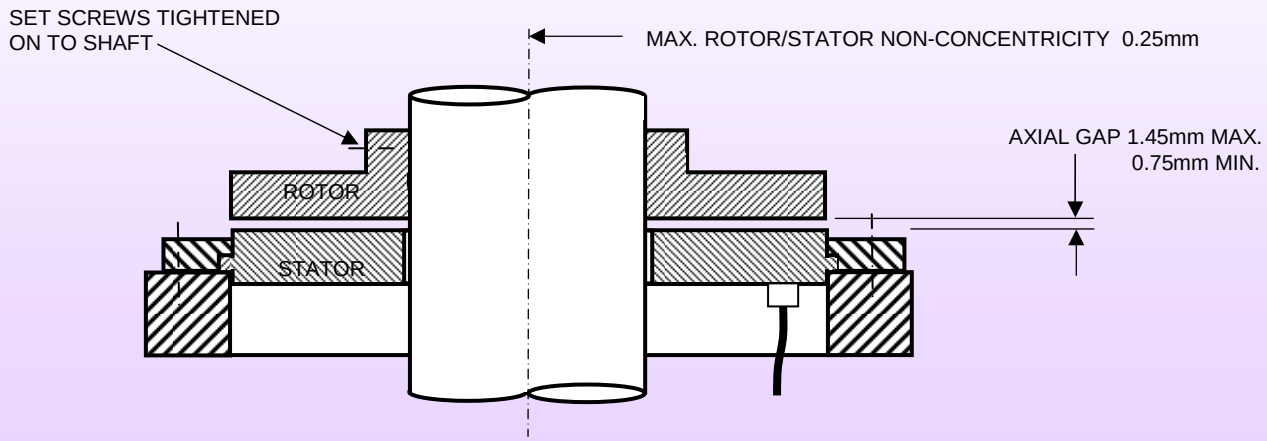
UNIT SHOWN WITH AXIAL CONNECTOR AC1

	INC-4-75	INC-4-100	INC-4-125	INC-4-150	INC-4-175	INC-4-200	INC-4-225	INC-4-250	
Dim. A - Stator / Rotor Body O.D.	75 ± 0.1	100 ± 0.1	125 ± 0.1	150 ± 0.1	175 ± 0.1	200 ± 0.1	225 ± 0.1	250 ± 0.1	mm
Dim. C. - Rotor I.D.	35 ± 0.1	60 ± 0.1	85 ± 0.1	110 ± 0.1	135 ± 0.1	160 ± 0.1	185 ± 0.1	210 ± 0.1	mm
Dim. D. - Stator I.D.	35.8 ± 0.1	60.8 ± 0.1	85.8 ± 0.1	110.8 ± 0.1	135.8 ± 0.1	160.8 ± 0.1	185.8 ± 0.1	210.8 ± 0.1	mm
N Number of Set Screws	3	3	3	3	4	4	6	6	
Max. radial misalignment	0.25								mm
Rotor & stator fixings	Rotor by Set Screws St. Steel (supplied). Stator by Servo Clamps (see Accessories) or host equipment								

Servo Mount Format IncOders can be installed in a wide variety of arrangements. The following shows just a few examples. Provided the axial gap and concentricity tolerances are maintained on installation, then the stated measurement performance will be maintained.







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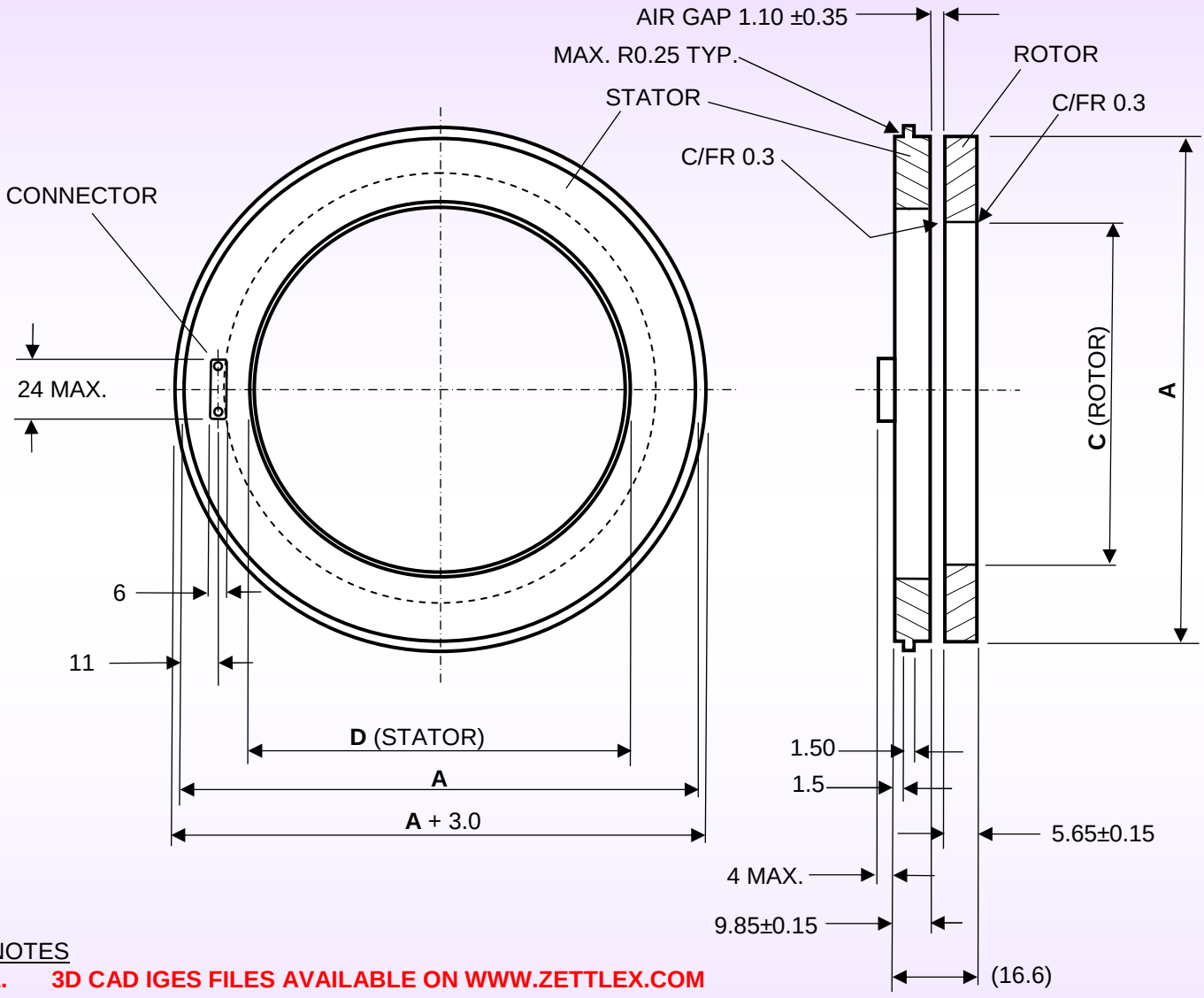
5.3 Servo Clamp Stator & Plain Rotor - INC-6 Product Code

Most popular format

VIEW ON EXTERIOR FACE OF STATOR

SECTION ON CENTRE LINE



NOTES

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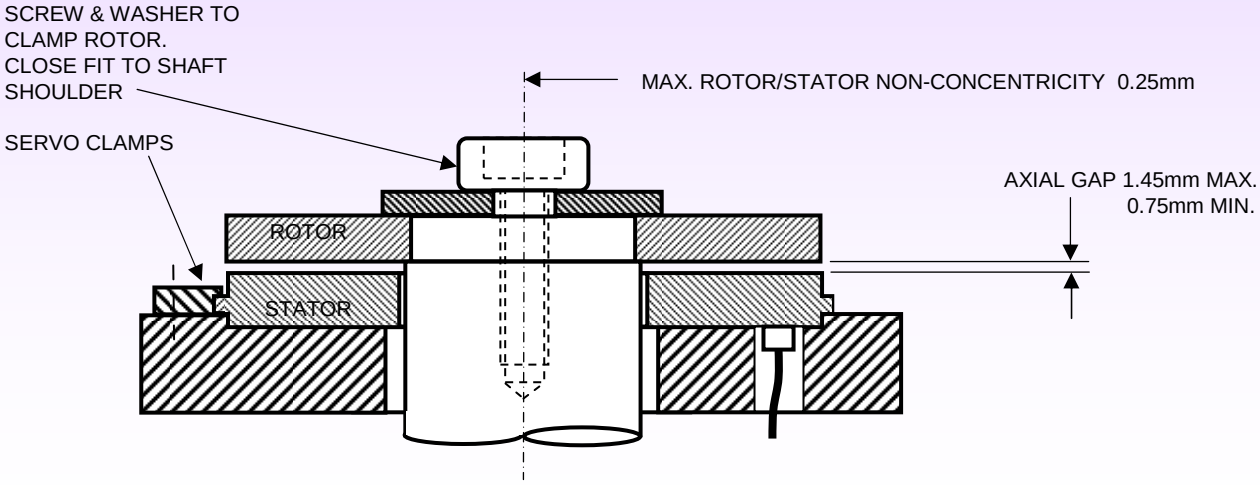
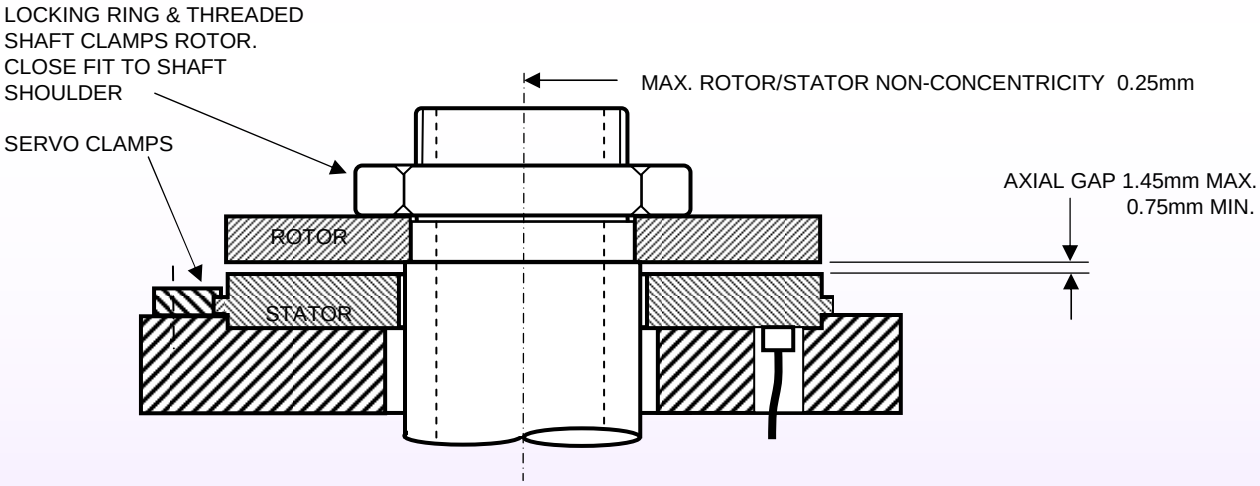
   1 DECIMAL PLACES = ±0.2
   2 DECIMAL PLACES = ±0.1

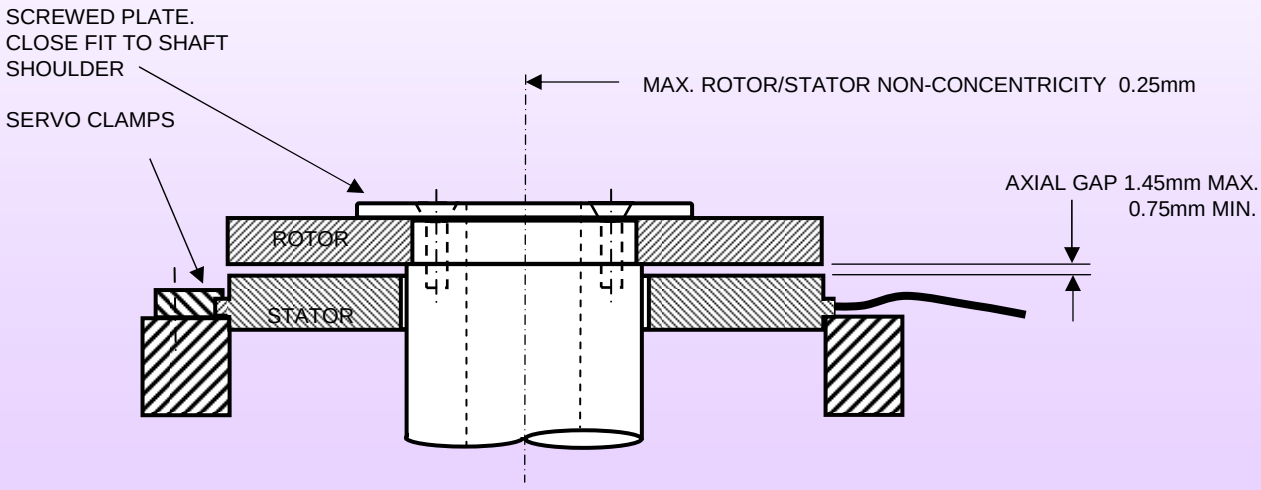
UNIT SHOWN WITH AXIAL CONNECTOR AC1

	INC-6-75	INC-6-100	INC-6-125	INC-6-150	INC-6-175	INC-6-200	INC-6-225	INC-6-250	
Dim. A - Stator / Rotor Body O.D.	75 ± 0.1	100 ± 0.1	125 ± 0.1	150 ± 0.1	175 ± 0.1	200 ± 0.1	225 ± 0.1	250 ± 0.1	mm
Dim. C. - Rotor I.D.	30 ± 0.1	55 ± 0.1	80 ± 0.1	105 ± 0.1	130 ± 0.1	155 ± 0.1	180 ± 0.1	205 ± 0.1	mm
Dim. D. - Stator I.D.	35.8 ± 0.1	60.8 ± 0.1	85.8 ± 0.1	110.8 ± 0.1	135.8 ± 0.1	160.8 ± 0.1	185.8 ± 0.1	210.8 ± 0.1	mm
Max. radial misalignment	0.25								mm
Rotor & stator fixings	Rotor by host equipment and Stator by Servo Clamps (ordered separately - see Accessories) or host equipment								

IncOders with Servo Clamp Stators & Plain Rotors are the most popular form. They can be installed in a variety of arrangements and some examples are shown below. Provided the axial gap and concentricity tolerances are maintained on installation, then the stated measurement performance will be maintained.







5.4 Other Mechanical Forms

If INC-3, INC-4 or INC-6 formats do not suit your preferred arrangement then a combination of different Stators and Rotors may suit.

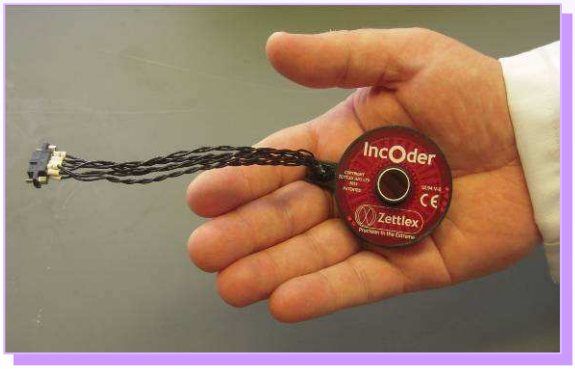
For Screw Mount Stator with Set Screw Rotor use Product Code INC-7.

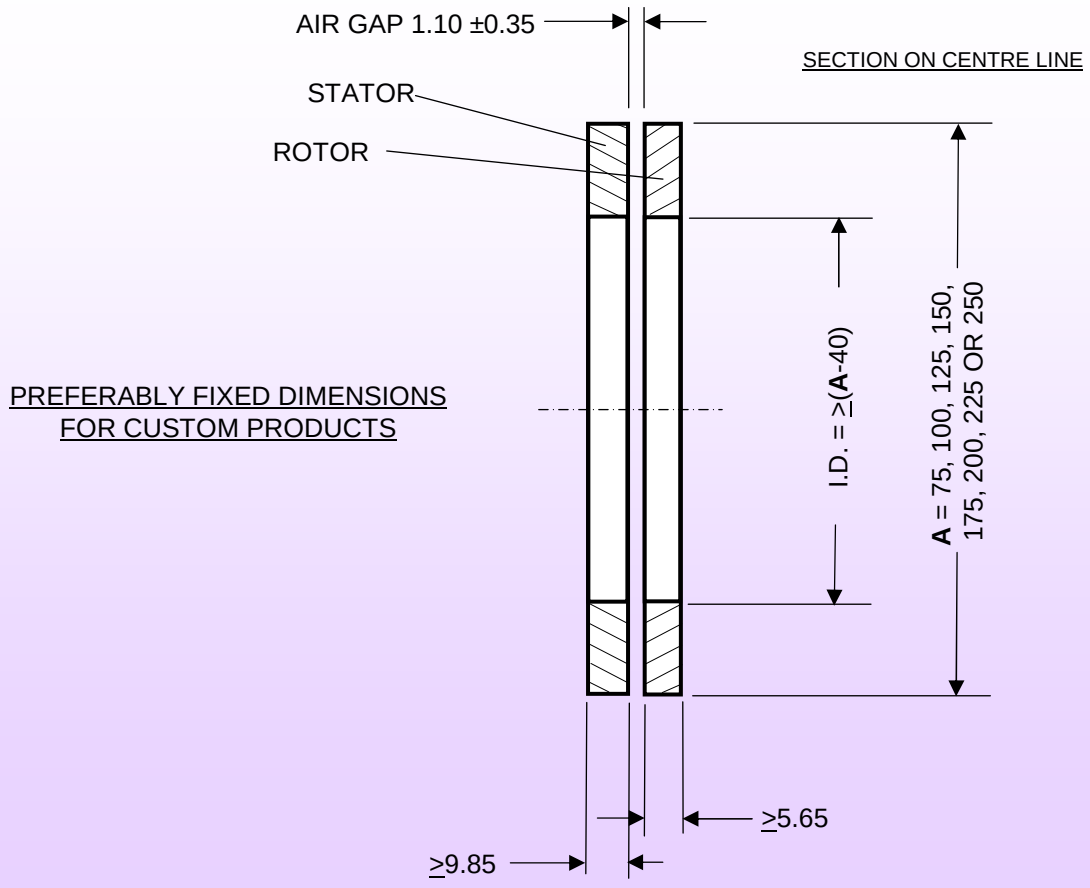
For Screw Mount Stator with Plain Rotor use Product Code INC-8.

For Servo Clamp Stator with Screw Mount Rotor use Product Code INC-9.

3D CAD IGS for all Stators & Rotors are available from www.zettlex.com

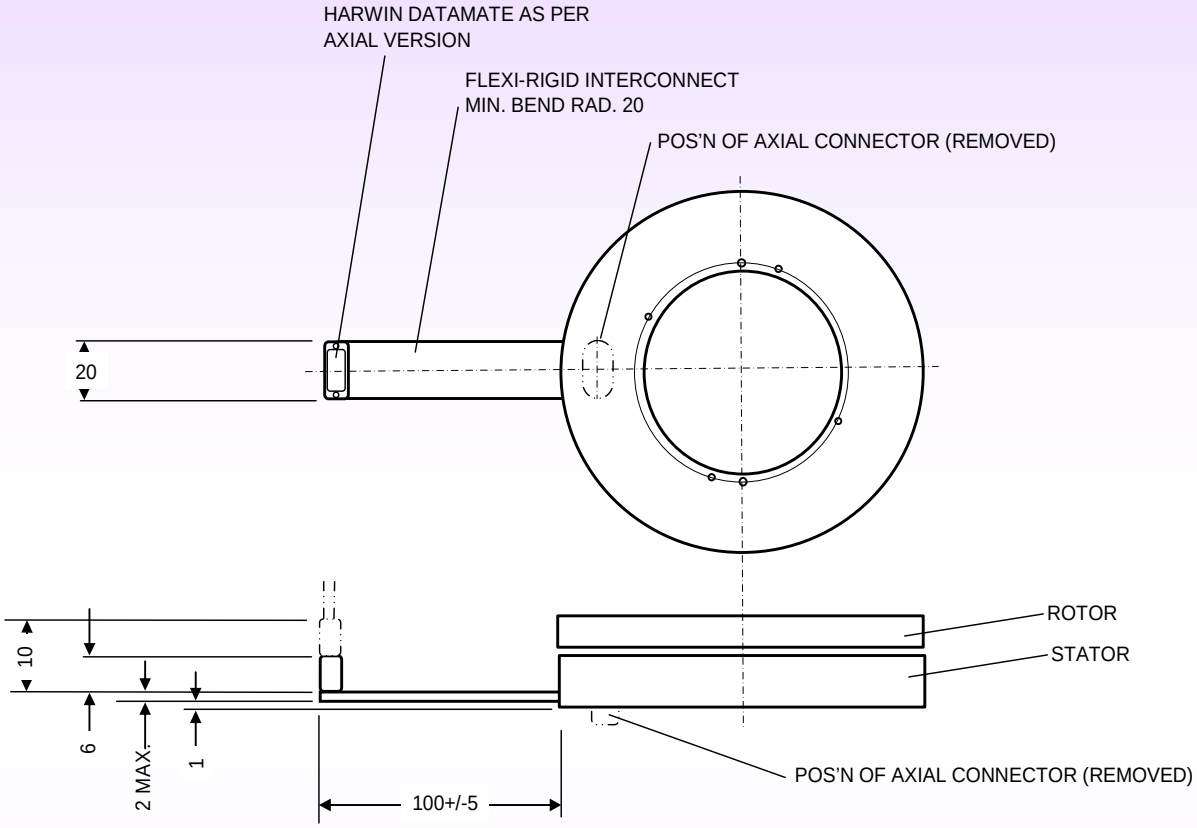
If you are an equipment manufacturer and none of the above standard formats suit, then a custom mechanical form may suit. Zettlex make lots of different custom housings and these are often an economical solution if unit volumes are >50 units/year. In order to keep tooling charges to a minimum it is a good idea to keep the nominal outer diameter of Stator & Rotor to one of the standard sizes:- 75, 100, 125, 150, 175, 200, 225 and 250mm. Furthermore, the thickness of the Stator and Rotor should not be less than the standard dimensions shown below:-





5.5 Radial Connector Option – RFC1 Product Code

Specify RFC1 in part number when space constraints require radial connection.



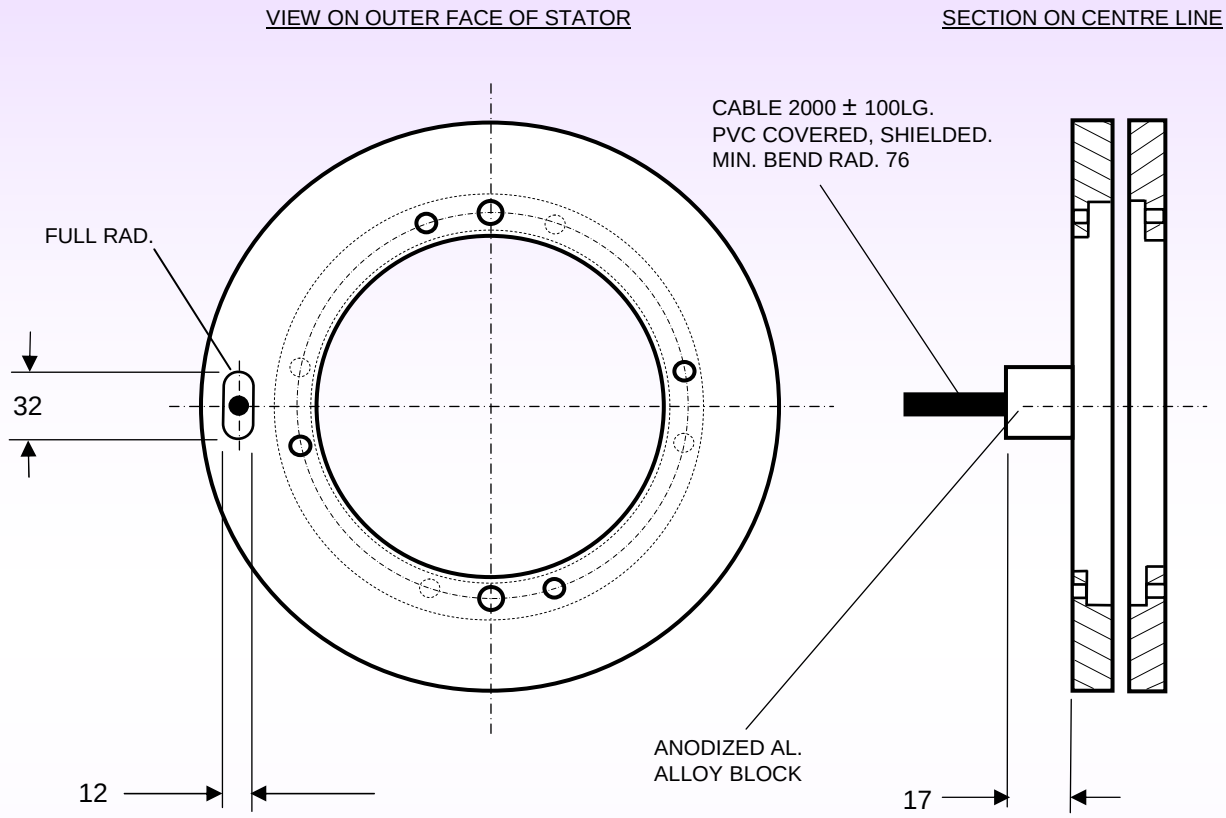
Notes

- All dims in mm
- General tolerance on stated dims = ±1mm unless otherwise stated
- All other dims as per IncOder Product Guide
- Specified using RFC1 in part number INC-X-XXX-XXXXXX-XXXX-**RFC1**-X-XX
- Output from connector as per Section 8.

Photo of IncOder type INC-3-125 with Radial Connector.
Rotor shown out of position for clarity.

5.6 Integral Axial IP67 Cable Option – AFL1 Product Code

Specify AFL1 in part number when environmental conditions require ingress protection against temporary immersion (IP67) or where harsh or prolonged shock/vibration may cause cable/connector failure.



Unit illustrated is INC-3 mechanical format. Integral axial cable available in all mechanical formats and on all sizes.

Notes

- All dims in mm
- General tolerance on stated dims = ±1mm unless otherwise stated
- All other dims as per IncOder Product Guide
- Specified using AFL1 in part number INC-X-XXX-XXXXXX-XXXX-**AFL1**-X-XX
- Wire colours:-

Pair No.	Colour	Signal
1	Black	Data B
1	Green	Data A
2	Black	Clk B
2	Blue	Clk A
3	Black	0V
3	Red	+V
4	Black	ZeroSet
4	Yellow	ZeroReset
5	Black	Not used – do not connect
5	White	Not used – do not connect

5.7 Cold Temperature Option – 24VCT Product Code

The default minimum operating temperature limit for IncOders is -40Celsius.

Such units have been successfully used at temperatures below -40Celsius but for prolonged or frequent operation at temperatures below -40Celsius, a cold temperature version should be used.

A cold temperature version with operating temperature of -55Celsius can be specified using the 24VCT Product Code in the voltage supply section of the Product Code. Cold temperature versions are only available in 24VDC supply option.

For operating temperatures below -55Celsius consult Zettlex or local representative.

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Materials	INC-x-75	INC-x-100	INC-x-125	INC-x-150	INC-x-175	INC-x-200	INC-x-225	INC-x-250	
Rotor & Stator Housings	Exposed Surfaces:- Clear anodized aluminium alloy. Sensor surfaces: FR4 grade epoxy Contact Zettlex for non-standard surface finishes such as black anodized, chromate or Surtec650 finish								
Connector (Axial - AC1 product code)	PPS with Stainless Steel Screw Fixings and Gold & Tin Electrical Connections								
Connector (Radial - RFC1 product code)	PPS with Stainless Steel Screw Fixings and Gold & Tin Electrical Connections and Polyimid Flexi								
Connector (Axial - AFL1 product code)	Exposed surfaces :- Anodized aluminium & PVC sheathed cable								
Measurement Performance									
Measurement	Absolute over Full-Scale of 360°. Note this is true absolute - no motion required at start up								
Resolution (140101 product code)	14 (16,384)								bits (counts per rev.)
Resolution (140101 product code)	79								arc-seconds
Resolution (140101 product code)	384								micro-radians
Resolution (160101 product code)	16 (65,536)								bits (counts per rev.)
Resolution (160101 product code)	20								arc-seconds
Resolution (160101 product code)	96								micro-radians
Resolution (180101 product code)	18 (262,144)			n/a					bits (counts per rev.)
Resolution (180101 product code)	4.94			n/a					arc-seconds
Resolution (180101 product code)	23.95			n/a					micro-radians
Resolution (190101 product code)	n/a			19 (524,288)					bits (counts per rev.)
Resolution (190101 product code)	n/a			2.47					arc-seconds
Resolution (190101 product code)	n/a			11.97					micro-radians
Resolution (200101 product code)	20 (1,048,576)			n/a					bits (counts per rev.)
Resolution (200101 product code)	1.24			n/a					arc-seconds
Resolution (200101 product code)	6.01			n/a					micro-radians
Resolution (210101 product code)	n/a			21 (2,097,152)					bits (counts per rev.)
Resolution (210101 product code)	n/a			0.62					arc-seconds
Resolution (210101 product code)	n/a			3.00					micro-radians
Repeatability (measured at 1kHz)	≤1								Least sig. bit
Accuracy over Full-Scale	≤130	≤100	≤80	≤65	≤60	≤50	≤45	≤40	arc-seconds
Accuracy over Full-Scale	≤0.63	≤0.49	≤0.39	≤0.32	≤0.29	≤0.24	≤0.22	≤0.20	milliradians
Internal Position Update Period	<1.0								millisecond
Thermal Drift Coefficient	≤0.25								ppm/K full-scale
Thermal Drift Coefficient	≤0.20								arc-secs/K full-scale
Thermal Drift Coefficient	≤1.30								urad/K full-scale
Max. speed for angle measurement	1000	800	650	550	500	500	500	500	r.p.m.
Max. physical speed	10,000								r.p.m.
Electrical interface									
Data Outputs	RS422 Compatible, supports SSI (Serial Synchronous Interface), asynchronous serial interface or SPI.								
Power Supply	5VDC±5% or 12VDC (8-15VDC) or 24VDC (15-29VDC)								VDC
Current Consumption	<100 (typically 75)								milliAmp
Reverse Polarity	PSU Reverse polarity protected to max. supply voltage								VDC
Connector (AC1 product code)	Harwin Data Mate Vertical Plug 10 Way with 2 Jack Screw Sockets Type M80-500-10-42								
Connector (RFC1 product code)	Harwin Data Mate Vertical Plug 10 Way with 2 Jack Screw Sockets Type M80-510-10-42 For alternative connectors such as integral cable or military shell type contact Zettlex								
Connections (AFL1 product code)	Refer to Section 5.6								
Mating Connector (AC1 & RFC1)	Harwin Data Mate Vertical Socket Type M80-461-10-42 (alternative M80-461-10-05) for either connector option.								
Zero Setting	Via Connector Pin (AC1 or RFC1) or integral cable (AFL1) - see details for set and reset in Sections 5.6 or 8.0								
Zero Position Variation	≤1								LSBit
Power Up Time To 1st Measurement	<75								millisecond

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Precision in the Extreme

	INC-x-75	INC-x-100	INC-x-125	INC-x-150	INC-x-175	INC-x-200	INC-x-225	INC-x-250	
Environmental									
Operating Temp.	Minus 40 to +85 (Minus 55 to +85 for 24VCT product code) Operation outside limits to be qualified by user. At temperatures >85Celsius, duration should be minimized. Options available below minus 55 Celsius operation: contact Zettlex or local representative for details								Celsius
Storage Temp.	Minus 55 to +125								Celsius
Temperature Shock:	MIL-STD-810G, Method 503.5, Procedure I-B (T1=-40 °C, T2=55 °C.)								
IP Rating - Rotor & Stator	IP67 for 30 minutes & 1m depth (Installed with mechanically protected connector or AFL1 product code) IncOders for long term immersion applications are feasible - contact Zettlex								
IP Rating - Connector	IP50 (AC1 or RFC1 product code). IP67 for AFL1 product code. For long term immersion applications contact Zettlex or your local representative								
Humidity	RH 0-99% non-condensing - *but unaffected by occasional condensation*								
Salt Fog	(Installed with protected cable/connector or AFL1) Complies with DEF STAN 00-35 Pt. 3 Iss. 4, Test CN2 Salt Mist Test								
Bio Hazards	(Installed with protected cable/connector or AFL1) Complies with DEF-STAN 00-35 Pt. 4 Iss. 4 Section 11 (Hazards)								
Induced Dust & Sand	Complies with DEF STAN 00-35 Part 3 Issue 4, Test CL25 (Turbulent Dust) Cat 1								
Mechanical Impact Resistance	IK07 - *suitable for mechanical impacts from objects of >200gramms from 1m height*								
Shock	IEC 60068-2-6 100g for 11ms - *suitable for airborne, marine & armoured vehicles* MIL-STD-810G, Method 516.6, Procedure I-Functional Shock, 40 g 11 ms, sawtooth waveform In all high shock environments connecting cable must be locally strain relieved. For extreme shock conditions contact Zettlex for alternative cable/connectors or specify AFL1 product code								
Vibration	IEC 60068-2-6 20g for 10-2000Hz - *suitable for high vibration & airborne environments* MIL-STD-810G, Method 514.6, Procedure I, Category 20, for tracked vehicles In all high vibration environments connecting cable must be locally strain relieved. For extreme vibration conditions contact Zettlex for alternative cable/connectors or specify AFL1 product code								
Environmental pressure range	0 to 4 *(in other words vacuum to 4)*								Bar
Max. permissible press. change rate	1								Bar/second
EMC Susceptibility	(Installed) Complies with IEC 6100-6-2 - *suitable for fitment in harsh EMC environments*								
EMC Emissions	(Installed) Complies with IEC 6100-6-4 - *suitable for fitment adjacent to EMI sensitive devices*								
Miscellaneous									
Mass Screw Mount Rotor (max.)	50	70	90	110	130	150	170	192	grams
Mass Set-Screw Rotor (max.)	75	105	135	165	195	225	255	287	grams
Mass Plain Rotor (max.)	45	63	81	99	117	135	153	172	grams
Mass Screw Mount Stator (AC1 & RFC1)	83	117	150	184	217	250	284	319	grams
Mass Servo Clamp Stator (AC1 & RFC1)	79	111	143	174	206	238	270	303	grams
Mom. of Inertia Screw Mount Rotor (max.)	4.8E-05	1.3E-04	2.5E-04	4.4E-04	7.5E-04	1.2E-03	1.8E-03	2.5E-03	Kgm^2
Mom. of Inertia Set-Screw Rotor (max.)	7.2E-05	1.9E-04	3.7E-04	6.6E-04	1.1E-03	1.8E-03	2.7E-03	3.8E-03	Kgm^2
Mom. of Inertia Plain Rotor (max.)	4.3E-05	1.2E-04	2.2E-04	3.9E-04	6.8E-04	1.1E-03	1.6E-03	2.3E-03	Kgm^2
MTBF	0.22 failures per 1M hours based on MIL-HBK-217+ method for ground military vehicles at 20Celsius average								
MTBF	0.35 failures per 1M hours based on MIL-HBK-217+ method for naval sheltered at 35Celsius average								
Hazardous materials	Not used								
Outgassing materials	Complies with NASA classification of low outgassing materials for spacecraft with TML of <1% and CVCM of <0.1% measured at 125C over 24hours in vacuum according to ASTM E-595-90								
ITAR classification	Not ITAR controlled								
ITAR Restricted Components	Not used								
Approvals	Flammability Rating UL94V-0 ; RoHS Compliant. RoHS certificate avialable								
Marking	Zettlex, logo, CE & UL94V-0 printed on Rotor & Stator faces; Serial No. labelled on exterior diameter of Stator housing								
Country of Manufacture	UK								
Packaging	Primary pack of ESD bubble bag & printed label. Secondary pack of cardboard carton. All non-returnable.								
Export Licence Requirements	Not required for products of <1000mm diameter								

6. Communication Interfaces

6.1 Output Resolution

The IncOder range offers various options for the resolution of the output data.

The required resolution is simply specified using the Product Code – see Section 10:-

INC - X – XXX – XXXXXX – XXXX – XXXX – X – AN

Resolution measured in bits.
(14 Bits all sizes) **140101**
(16 Bits all sizes) **160101**
(18 Bits sizes ≤ 125mm) **180101**
(19 Bits sizes ≥150mm) **190101**
(20 Bits sizes ≤ 125mm) **200101**
(21 Bits sizes ≥150mm) **210101**

6.2 Multi-Turn or Single Turn

The default electrical output from an IncOder is absolute over 360 degrees (1 revolution).

For multi-turn devices please contact Zettlex or your local representative (see Section 11).

The IncOder range offers the possibility to count how many turns from the zero datum have been made.

Most IncOders do not use this function but simply measure angle over a single revolution.

It is possible for the IncOder's output data to 'count' how many revolutions have been made.

Note that angle is only measured absolutely over a single revolution. The data regarding the number of revolutions from a datum point will be lost if power to the device is interrupted.

The IncOder range offers various options for the Communication Interface:-

- Synchronous Serial Interface (SSI) – see Section 6.3 for the various formats (SSI1-8)
- Asynchronous Serial Interface (ASI) – see Section 6.4
- Serial Peripheral Interface (SPI) – see Section 6.5

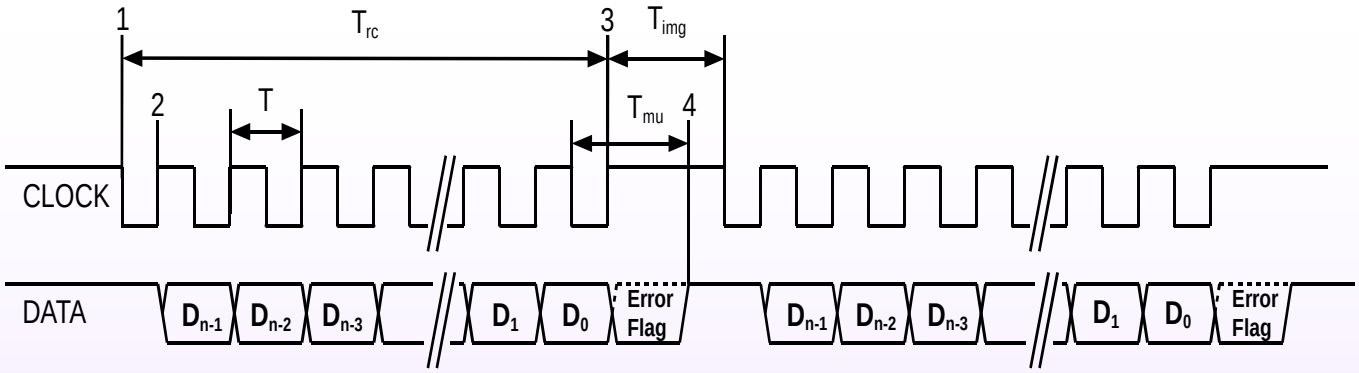
All Communications Interfaces conform to the RS422 Standard. Note that for all Communications Interfaces DATA and CLOCK inputs are not terminated with load resistors.

6.3 Synchronous Serial Interface (SSI) – Product Codes SS1-SSI8

6.3.1 Generic Protocol Definition– Product Codes SS1-SSI8

SSI is a widely used serial interface between position sensors and controllers. It implements a differential output for the DATA and a differential input for the CLOCK. Note that DATA outputs and CLOCK inputs are not terminated with load resistors.

Synchronous SSI uses a clock sequence from a controller to initiate the transmission of position data from the sensor (a Read Cycle), with the latest position data (see page 9 for position update rate) available for transmission after each SSI Read Cycle is completed. See timing information below:-



T: Clock Period (1/T = 100 kHz to 1 MHz)
Trc: Read cycle time: This is defined as (n x T) + (0.5 x T)
Tmu: Message Update time. The time from last falling edge of clock to when new data is ready for transmission. Tmu = 20us +/- 1 us. The DATA line will be HIGH after this time indicating a new Read Cycle can be started.
Timg: Intermessage Gap time. Must be > Tmu otherwise position data will be indeterminate.
n: The number of bits in the message (not including the Error Flag).
In idle state CLOCK and DATA are both HIGH

Notes:

1. The first falling edge after Tmu starts the Read Cycle and the transfer of data.
2. Each rising edge of the CLOCK transmits the next data bit of the message, staring with Dn-1.
3. After the last rising edge of the clock sequence, the data line is set by the Error Flag (if supported) for the period Tmu – 0.5xT
4. After Tmu, the latest position data is now available for transmission in the next Read Cycle – see page 9 for position update rate.

6.3.2 SSI – Specific Protocol Definition – Product Codes SS1-SSI8

SSI can support a variety of protocols in which data is transmitted depending on the requirements of the SSI controller. **IncOder can be supplied with any of the following protocols – just choose what you need by using the relevant Product Code when ordering (see Section 10)**. If the protocol you require is not listed here then please consult Zettlex or your local representative.

SSI1 (n = 24)

D23	PV	Position Valid Flag. Set to 1 when data is valid, otherwise 0 (the inverse of the ERROR FLAG).
D22	ZPD	Zero Point Default. Set to 1 when the Zero Point is at Factory Default, otherwise 0
D21-D0	PD[21:0]	Binary position data. If resolution of device is less than 22 bits, then the MSBs of this field are set to 0. The LSB of this field is in D0. When PV is 0, PD[21:0] value is not defined.

SSI2 (n = 24)

D23-D2	PD[21:0]	Binary position data. If resolution of device is less than 22 bits, then the MSBs of this field are set to 0. The LSB of this field is in D2. When Alarm bit is 1, PD[21:0] value is not defined.
D1	P	Parity Bit 0 indicates an even number of 1's in data (D23-D2), 1 indicates an odd number of 1's in data.
D0	A	Alarm Bit – 0 indicates normal operation, 1 indicates error condition.

SSI3 (n = 16)

D15-D0	PD[15:0]	Binary position data. When ERROR FLAG is 1, PD[15:0] value is not defined.

SSI4 (n = 32)

D31	PV	Position Valid Flag. Set to 1 when position data is valid, otherwise 0 (the inverse of the ERROR FLAG).
D30	ZPD	Zero Point Default. Set to 1 when the Zero Point is at Factory Default, otherwise 0
D29-D11	PD[18:0]	Binary position data. If resolution of device is less than 19 bits, then the MSBs of this field are set to 0. The LSB of this field is in D11. When PV is 0, PD[18:0] value is not defined.
D10-D0	TS[10:0]	Time stamp data. The value of the Time Stamp counter when the position was measured. This data is always valid. The Time Stamp counter is a continuously incrementing counter in the range: 0.00ms to 20.47ms (at which point it restarts at 0.00ms). It has a resolution of 10us, with an accuracy better than 1% (based on the system oscillator).

SSI5 (n = 16)

D15-D0	PD[15:0]	Gray code, position data. When ERROR FLAG is 1, PD[15:0] value is not defined.

SSI6 (n = 32)

D31-D24	CRC[7:0]	CRC-8: To verify transmission, calculate the CRC of the bottom 24 bits of the message. The resulting CRC should be the same as the received CRC field. The following parameters define CRC-8: Polynomial 0x97 Initial data 0x00 MSB First (not reversed) No final XOR calculation
D23	PV	Position Valid Flag. Set to 1 when position data is valid, otherwise 0 (the inverse of the ERROR FLAG).
D22	ZPD	Zero Point Default. Set to 1 when the Zero Point is at Factory Default, otherwise 0
D21-D0	PD[21:0]	Binary position data. If resolution of device is less than 22 bits, then the MSBs of this field are set to 0. The LSB of this filed is in D0. When PV is 0, PD[21:0] value is not defined.

SSI7 (n = 30)

D29-D24	-	Data always 0.
D23-D2	PD[21:0]	Binary position data. If resolution of device is less than 22 bits, then the MSBs of this field are set to 0. The LSB of this field is in D2. When Alarm bit is 1, PD[21:0] value is not defined.
D1	P	Parity Bit 0 indicates an even number of 1's in data (D23-D2) 1 indicates an odd number of 1's in data.
D0	A	Alarm Bit – 0 indicates normal operation, 1 indicates error condition.

SSI8 (n = 18)

D17-D0	PD[17:0]	Gray code, position data. When ERROR FLAG is 1, PD[17:0] value is not defined.

6.4 Asynchronous Serial Interface – Protocol Definition – Prod. Code ASI1

This section describes the communications interface for IncOders specified with ASI1 serial protocol.

Data is transmitted by the IncOder continuously formatted into Frames. Each Frame consists of a number of 8 bit data words. Each 8 Bit data word (or byte) is transmitted from a standard UART using N-8-1 (no parity, 8 data bits, 1 stop bit) with a Baud rate of 230400. See below for the data format of each transmitted data word.

The following is the Asynchronous Serial Data protocol specified as ASI1 when ordering (see Section 10).

Each frame is defined as 6 bytes and the data format is defined as follows:
First byte (transmitted first):

D7	D6	D5	D4	D3	D2	D1	DO
1	PV	ZPD	0	0	PD[21:19]		

D7	D6	D5	D4	D3	D2	D1	DO
0	PD[18:12]						

D7	D6	D5	D4	D3	D2	D1	DO
0	PD[11:5]						

D7	D6	D5	D4	D3	D2	D1	DO
0	PD[4:0]					CRC[15:14]	

D7	D6	D5	D4	D3	D2	D1	DO
0	CRC[13:7]						

D7	D6	D5	D4	D3	D2	D1	DO
0	CRC[6:0]						

Data Definition for Asynchronous Serial Interface

PV	Position Valid flag. Set to 1 when data is valid, otherwise set to 0
ZPD	Zero Point Default. Set to 1 when the Zero Point is at Factory Default, otherwise set to 0.
PD[21:0]	IncOder Position Data. If resolution of device is less than 22 bits then the MSBs of this field are set to 0.
	When PV is 0, PD[21:0] value is not defined.
CRC[15:0]	CRC-16: To verify transmission, calculate the CRC of all 48 bits of the message but with CRC[15:0] set to 0.
	The resulting 16 bit CRC result should be the same as the received CRC[15:0].
	Use the following CRC-16 parameters:
	Polynomial 0x8005
	Initial data 0x0000
	MSB first (not reversed)
	No final XOR calculation.

6.5 Serial Peripheral Interface – Protocol Definition– Product Code SPI1

This section describes the communications interface for IncOders specified with SPI1 serial protocol.

The IncOder is available with SPI (Serial Peripheral Interface) data interface, which conforms to the RS422 hardware specification. Note that the DATA outputs and the CLOCK inputs are not terminated with load resistors. The following section defines the communication protocol.

SPI is a widely used serial interface between micro processors/controllers and peripherals. SPI uses a clock sequence from a master to control the transmission of data from the IncOder.

The IncOder protocol specifies that each data frame consists of six bytes of data (each of 8 bits, 48 bits in total) containing the position, status flags and CRC (see timing diagram on the following page).

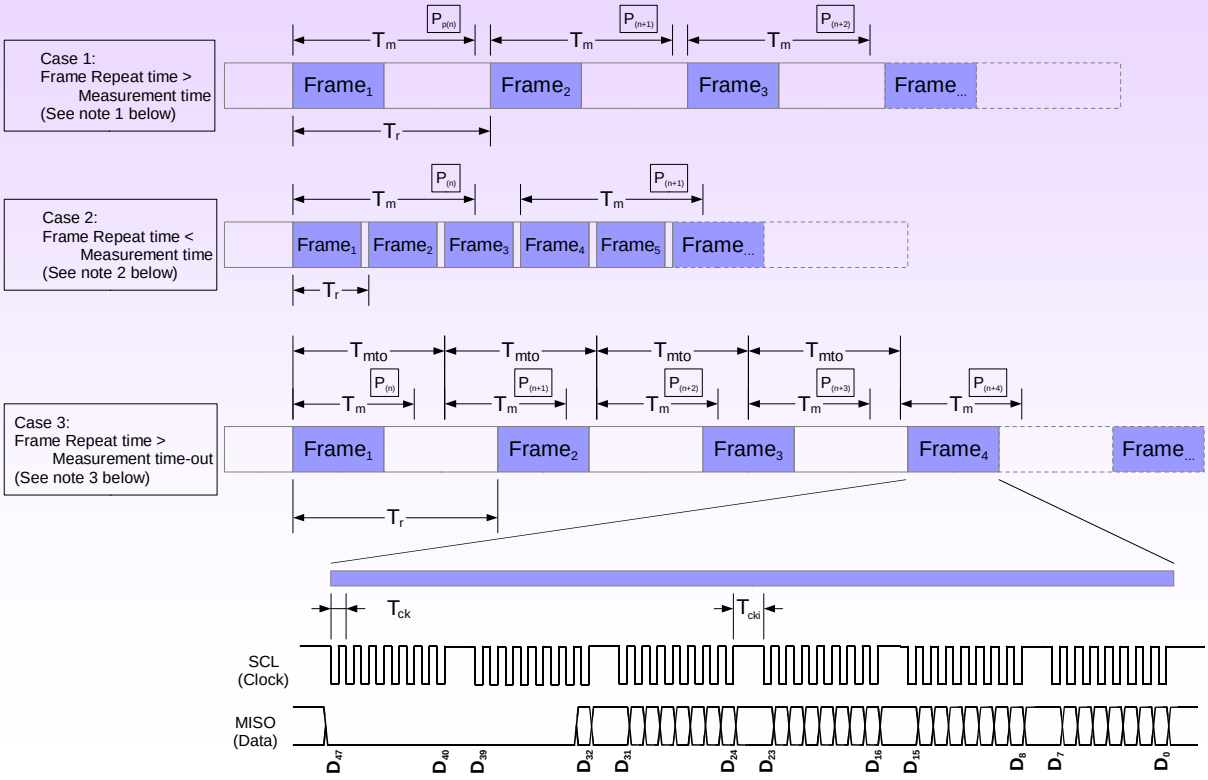
The SPI Clock Polarity is defined so that the CLOCK idle state is HIGH and the Clock Phase is defined so that the data is captured on the falling edge of CLOCK, and the data is propagated on the rising edge of CLOCK. This is commonly depicted as CPOL=1, CPHA=0 (also depicted as UCCKPL=1, UCCKPH=1).

The minimum clock rate is 100kHz and the maximum clock rate is 5MHz.

Data Definition for IncOder SPI Protocol

D47-D33	SBZ	These bits will always be Zero.
D32	ZPD	Zero Point Default flag. Set to 1 when the Zero Point is at Factory Default, otherwise 0
D31	PV	Position Valid Flag. Set to 1 when position data is valid, otherwise 0.
D30	PS	Position Synchronised flag. Set to 1 when the position measurement was triggered by a previous SPI Frame. Set to 0 when the position measurement was triggered by a Measurement Time-out (see note 3 overleaf). Use this flag to ensure that the IncOder has synchronised position measurements to the SPI Frames (Case 1, overleaf).
D29-D8	PD[21:0]	Binary position data. If resolution of device is less than 22 bits, then the most significant bits of this field are set to 0. The LSB of this field is in D0. When PV is 0, PD[21:0] value is not defined.
D7	SD	Stale Data flag. Set to 1 when the position data has been transmitted at least once before. Set to 0 when the position data has not been transmitted before. Use this flag to detect when a new measurement has been completed (Case 2, overleaf).
D6-D0	CRC[6:0]	Cyclic Redundancy Checksum. 7 Bit CRC: Polynomial 0x5B, Initial data 0x0000, MSB first (not reversed), No Final XOR.

SPI Timing information



Timings determined by the Controller (SPI Master):

- T_{ck} Clock period (1/T = 100kHz to 5MHz).
- T_{cki} Clock Idle Period. Time between bytes during which CLOCK is idle. T_{cki} should be $<T_{ckimax}$ = 100µs
- T_r Frame Repetition period.

Timings defined by the IncOder (SPI Slave):

- T_m Position Measurement time. The time from the start of a position measurement to when the position and status is ready for transmission. 850 µs ≤ T_m ≤ 900µs
- T_{mto} Position Measurement Time-out. The time after a position measurement has been triggered that the IncOder will automatically trigger a new measurement. 1250µs ≤ T_{mto} ≤ 1270µs.

Notes:

1. The IncOder will always attempt to trigger a new position measurement when a new SPI frame is started by the host. This will always be the case when T_r is greater than T_m and less than T_{mto}.
2. If a position measurement has already been triggered when a new SPI frame is started by the host, then a new position measurement will not be re-triggered. This may be the case when T_r is less than T_m
3. If the Host does not start a new SPI frame within time T_{mto} from the previous frame (the case when T_r is greater than T_{mto}), then the IncOder will automatically trigger a new position measurement.
4. In all cases, the IncOder will transmit the most recently completed measured position and status (see table below).
5. When CLOCK is idle for at least T_{ckimax}, then the IncOder SPI interface will reset. The first falling edge on CLOCK after T_{ckimax} will start the transmission of a new frame. This can be useful if the SPI host and slave (IncOder) lose Frame/Byte synchronisation (detected by invalid CRC).

Frame Number	Position transmitted (case 1)	Position transmitted (case 2)	Position transmitted (case 3)
Frame 1	$P_{(n-1)}$	$P_{(n-1)}$	$P_{(n-1)}$
Frame 2	$P_{(n)}$	$P_{(n-1)}$	$P_{(n)}$
Frame 3	$P_{(n+1)}$	$P_{(n-1)}$	$P_{(n+1)}$
Frame 4		$P_{(n)}$	$P_{(n+3)}$
Frame 5		$P_{(n)}$	

7. Zero Point, Zero Set & Zero Reset.

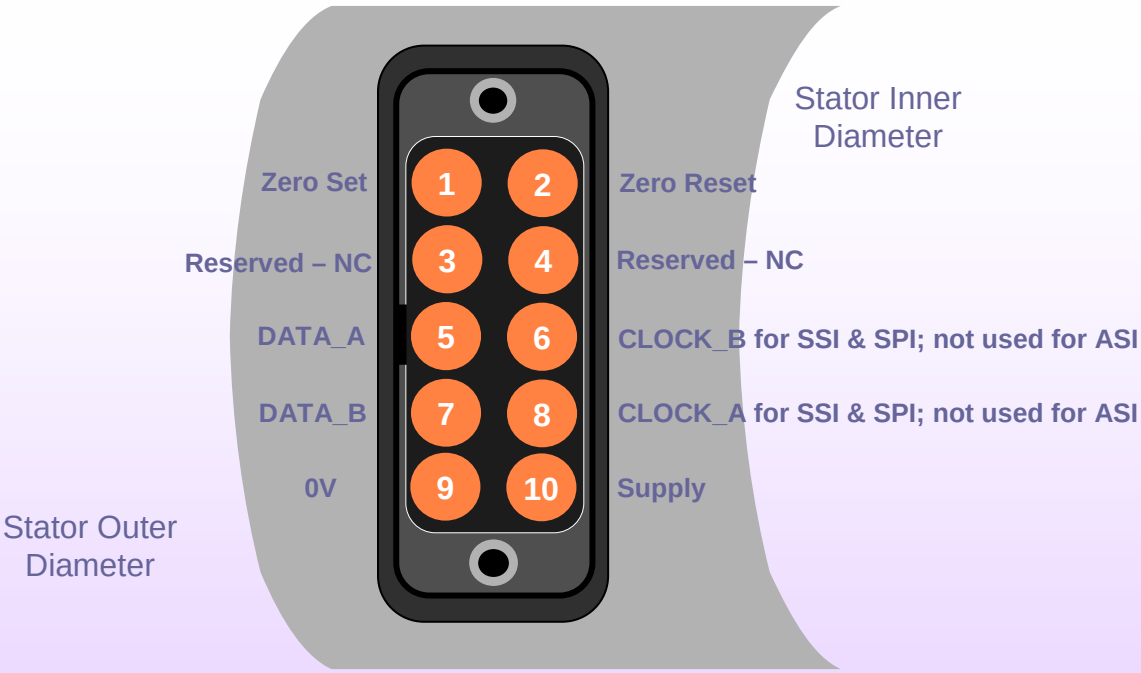
The Zero Point is the datum from which angle is measured. As supplied, the IncOder carries a factory Zero Point setting. For the Screw Mount format products the Zero Point lies within a range of +/-5º with the Rotor and Stator dowel positions at 12 o'clock. The Zero Point can be changed using the Zero Set and Zero Reset lines on the IncOder's Connector (Product Code AC1 or RFC1) or its Integral Cable (Product Code AFL1).

The Zero Set signal will set the current IncOder position as the Zero Point (this is maintained in memory when power is removed).

The Zero Reset signal will reset the Zero Point to the factory setting (this is maintained in memory when power is removed).

To use these signals, the relevant connection should be connected to 0V for at least 1 second at power up. These lines should be left unconnected during normal operation.

8. Connector Pin Diagram for AC1, RFC1 options



9. Frequently Asked Questions:-

9.1. How do IncOders work?
IncOders work in a similar way to rotary transformers – usually referred to as resolvers. The IncOder Stator receives a DC power source and produces a low power AC electromagnetic field between the Stator & Rotor. This field is modified as the Rotor rotates. The field is sensed by the Stator and the rotation angle computed. Unlike resolvers, IncOders use laminar circuits rather than wound wire spools. This enables IncOder's compact form, low mass, low inertia and high accuracy without high precision installation.

9.2. Is IncOder measurement truly absolute?
Yes. Measurement will be the same before and after a power interruption. No motion is required.

9.3. Does measurement performance vary with Rotor concentricity?
Resolution, repeatability & linearity will be as specified, provided Rotor concentricity is within +/-0.25mm. One might expect that accuracy would degrade substantially with concentricity but because IncOders use the full faces of both Rotor & Stator, any error effects are nulled out by diametrically opposing factors. This is quite different to other encoders where performance is highly dependent on tightly toleranced concentricity.

9.4. Can IncOders be used outside the stated operating temperature limits?
Operating temperature limits are set by some of IncOder's electronic parts rather than the basic technique. Standard IncOders are rated -40 or 85Celsius operation but with a cold option (Product Code 24VCT) for -55Celsius operation. IncOders can be used outside these limits following qualification by the user. Contact Zettlex or your local representative for extended range options. At temperatures >85Celsius the duration of any elevated temperature should be minimized. At temperatures at or below the stated lower limit, it is recommended to leave the unit powered or allow an extended powered period (>1 minute) before operation.

9.5. What happens if the Rotor or Stator get wet or dirty?
Measurement performance is unaffected by humidity, condensation, dirt, dust, mud or sand. IncOders will survive temporary immersion (<0.5 hour) to depths of 1m in salt or fresh water. Extended or frequent exposure to liquids should be avoided. Consult Zettlex in such applications for liquid immersion units.

9.6. How can an IncOder be calibrated?
Calibration is only relevant for some ultra high accuracy applications such as astronomical telescopes. Readings from an IncOder are stored and compared to a reference in a look-up table in the host system. Such an arrangement will negate any non-linearity due to inherent non-linearity or installation tolerances. Resolution & repeatability are unaffected by calibration.

9.7. Can IncOder be used for airborne applications?
Yes. IncOders are used in military manned and unmanned aerial vehicles.

9.8. Can we route the cable out radially rather than axially?
Yes – simply order radial connection option.

9.9. Can an IncOder run with a different electrical output such as A/B pulses or 0-10V?
Contact Zettlex or your local representative (see Section 11).

9.10. At what Baud rate can the Data interface operate at and does this effect cable length?.
The longer the transmission distance (Cable Length), the slower the recommended Baud Rate. This table shows recommended Baud Rates vs. Cable Length.

Baud Rates For Data Transmission				
Cable Length (m)	<30	<60	<120	<250
*Baud Rate**	<400 kHz	<300 kHz	<200kHz	<100 kHz

9.11. Are there lightweight IncOder versions?
Contact Zettlex or your local representative (see Section 11).

9.12. Are IncOders suitable for use in harsh electromagnetic fields?
Yes. Many IncOders are used in close proximity to powerful sources of electromagnetic noise such as motors or transformers. IncOder's aluminium housing produces a Faraday cage effect around the internal electronics and the IncOder's basic technology is purposefully designed so that any incoming electromagnetic radiation is either filtered out or self cancelling.

9.13. Are IncOders affected by magnets?
No. Magnets produce DC fields. IncOder's operation is based on the detection of AC electro-magnetic fields at a specific frequency.

9.14. Do IncOders produce electromagnetic emissions?
Any radiated emissions are small and limited to the internal sensor faces of an IncOder. The aluminium IncOder housing has a Faraday cage effect. IncOders are regularly used in close proximity to sensitive devices such as navigation aids.

9.15. What if we need to earth the IncOder casing?
Some applications require an electrical connection or earthing strap to the IncOder casework. The standard IncOder housing finish is clear anodized which is non-conductive. A connection can be made using an earthing strap with a crinkle washer which penetrates the anodized surface. Alternatively, remove the anodized surface in the immediate vicinity of the strap (usually located using one of the attaching screws) using a file or abrasive. Alternatively, conductive finishes such as Alocrom or Surtec650 may be requested for custom products.

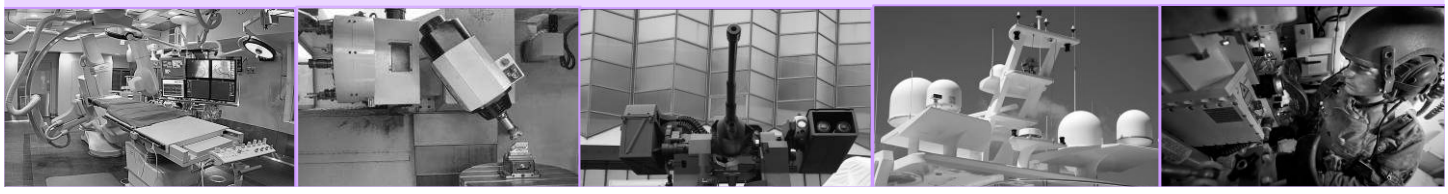
9.16. Can IncOders be used as a motor encoder?
Yes. The IncOder version specified in this Product Guide is suitable for motor encoders of up to 1000r.p.m. For higher speeds please contact Zettlex for alternative higher speed outputs such as A/B pulses or 1V peak to peak sin/cos.

9.17. Does measurement performance vary with Rotor to Stator gap?
Resolution, repeatability & linearity will be as specified, provided gap is within 1.10+/-0.35mm.

Within limits, the IncOder's measurement resolution and repeatability are independent of air gap. If the air-gap tolerance is increased from ±0.35mm to ±0.50mm the *quoted* measurement non-linearity will double. For example, if a 250mm IncOder has an air-gap tolerance of ±0.50mm the *quoted* linearity will increase from +/-40 arc-seconds to +/-80 arc-seconds.

If the quoted linearity is required then the specified air-gap tolerance should be maintained. This is most easily achieved by using the Servo Clamp format Rotor. Preferably the Rotor's inner diameter should be a close fit to the through shaft. If vibration conditions are extreme then a screw through the shaft or a roll pin (sometimes referred to as a 'spring pin') should be used to lock the Rotor in to position. In some applications, the Rotor may also be bonded on to the shaft once the gap is set.

9.18. Are ATEX rated versions of IncOder available?
Contact Zettlex or your local representative (see Section 11).



9.19. How do we fit the Set Screw Rotor with a Servo Clamp Stator?

- Fit IncOder Stator & Rotor around the shaft
- Fit IncOder Stator using servo clamp screws – gradually tightening opposite screws
- Place 1,1mm thick plastic Setting Pieces between faces of Stator and Rotor/Collar assembly
- Abut the Rotor to the Setting Pieces
- Secure Collar using grub screws – gradually tightening opposite screws
- Remove the Setting Pieces
- Check that gap is within the range 1.45mm to 0.75mm.

9.20. Do IncOders carry out self checking?

Yes. IncOders carry out 10 self checks. If any of the self checks indicate an internal error then an error signal is generated (see earlier description of Communications Interfaces). The 10 self checks are:-

- Stator Continuity/Damage
- Presence of Rotor
- Rotor Continuity/Damage
- Out of range Rotor
- Gross electromagnetic malfunction
- Window watchdog timer - this is reset multiple times per internal measurement cycle
- Power on reset
- Power brownout reset
- SSI timeout implemented for SSI clock input
- Internal flash data memory value check and read/write timeouts (applies to Zero Set & Reset).

9.21. Are IncOders RoHS Compliant?

Yes. We can supply a RoHS Compliance Certificate on request.

9.22. Do IncOders outgas?

IncOder housings are anodized aluminium which produce no outgassing. The epoxies and other materials used inside the devices comply with NASA's classification of low outgassing materials for spacecraft with TML of <1% and CVM of <0,1% measured at 125Celsius over 24 hours in vacuum according to ASTM E-595-90. IncOders are successfully used with sensitive optical devices without residues from the IncOder affecting the lenses.

9.23. How can we specify a custom IncOder variant?

Use this data sheet as a basis and simply specify any differences. The majority of custom variants require a different mechanical interface in order to suit specific host arrangements. As a general guide it's a good idea to keep to a standard outer diameter 'A' dimension (i.e. 75, 100, 125, 150mm etc.) and to specify an inner diameter of not greater than ('A' - 40)mm – see Section 5.4. This usually enables us to use regular sensor components but produce an alternative mechanical format to suit.

9.24. What's the largest IncOder you can build?

573mm outer diameter.

9.25. Are IncOders available with alternative metal finishes?

Yes. Contact Zettlex or your local representative. Previous non-standard, alternative metal finishes include black anodized, Alocrom, Surtec650 or powder coat.

9.26. Do IncOders require an Export License?

Not usually. IncOders are classified under Annex I to Council Regulation (EC) No. 428/2009, as amended [EU Dual-Use List] and only require an export license if accuracy is less than or equal to 1 arc-second or diameter is greater than or equal to 1000mm.

10. Product Codes & Ordering Information:-

Note 1 IncOder includes 1 Stator & 1 Rotor but excludes other accessories

INC- X – XXX – XXXXXX – XXXX – XXXX – X – AN

Mechanical Format
Screw Mount - **3**
Servo Clamp - **4**
Servo + Plain - **6**
Screw + Set Screw - **7**
Screw + Plain - **8**
Servo + Screw - **9**

Outer Diameter
75
100
125
150
175
200
225
250

Resolution measured in bits.
(14 Bits all sizes) **140101**
(16 Bits all sizes) **160101**
(18 Bits sizes ≤ 125mm) **180101**
(19 Bits sizes ≥150mm) **190101**
(20 Bits sizes ≤ 125mm) **200101**
(21 Bits sizes ≥150mm) **210101**

Communications Interface
ASI1 *(for Asynchronous Serial Interface)*
SSI1 *(for Synchronous SSI Type 1)*
SSI2 *(for Synchronous SSI Type 2)*
SSI3 *(for Synchronous SSI Type 3)*
SSI4 *(for Synchronous SSI Type 4)*
SSI5 *(for Synchronous SSI Type 5)*
SSI6 *(for Synchronous SSI Type 6)*
SSI7 *(for Synchronous SSI Type 7)*
SSI8 *(for Synchronous SSI Type 8)*
SPI1 *(Serial Peripheral Interface)*

Connector
AC1 *(for axial connector)*
RFC1 *(for radial connector)*
AFL1 *(integral axial cable)*

Supply Voltage
5
12
24
24CT (cold temp.)

Finish
Clear anodized

Examples:-

INC - 3 – 075 – 180101 - SSI1 - AC1 – 12 - AN
Screw mount, 75mm diameter, 18 bit resolution, SSI1, axial connector, 12V, clear anodized.

INC – 4 – 150 – 190101 - ASI1 - RFC1 – 24 - AN
Servo clamp, 150mm diam., 19 bit resolution, asynch. serial data, radial connector, 24V, clear anodized.

INC – ACME – 508 – 140102 - 10V - AB – 10 - ALOCROM
Example of fully custom version for ACME Inc.
ACME design mechanical format, 508mm diam., 14 bit resolution, data output over 2 revs, 0-10V output, MIL. connector, 10V supply, ALOCROM finish.

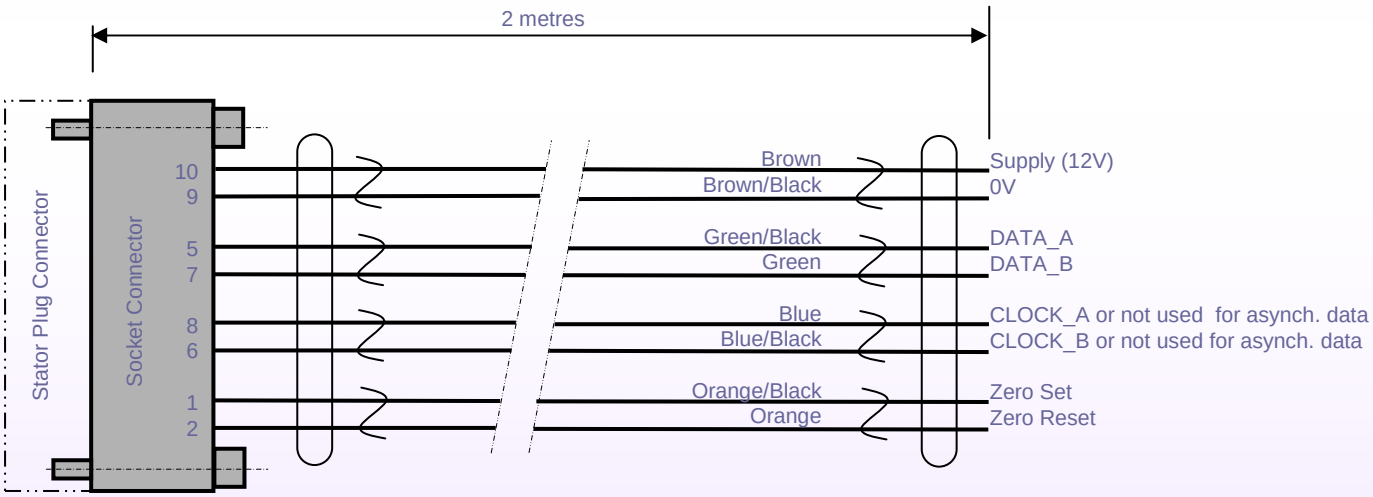
10.1 Product Codes for Accessories

10.1.1 Cable

Mating connector and tinned wires on other end

INC – CAB3 - X

Cable length
in metres
2
Contact Zettlex for alternative length

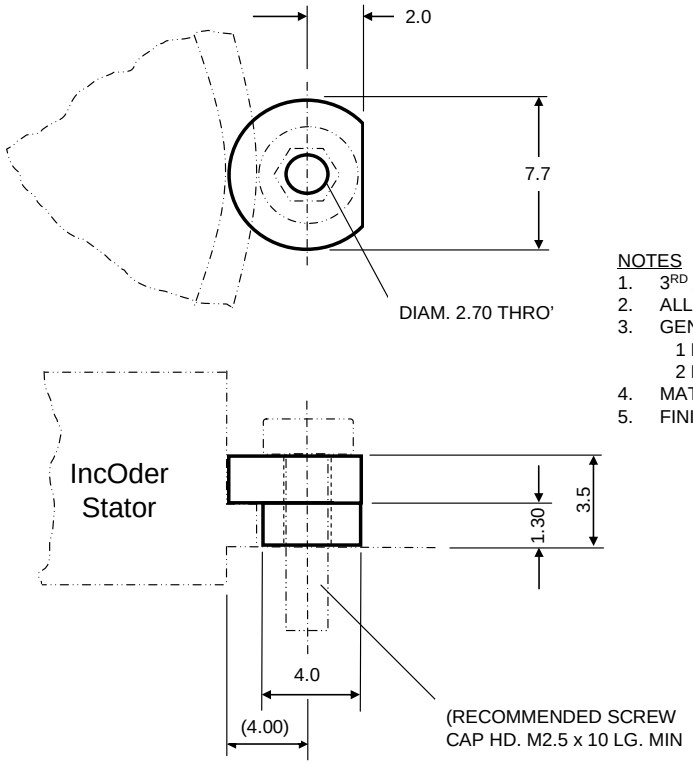


Socket Connector = Harwin DataMate J-Tek 10-way with 2 jack screws, part number M80-461-10-42
Cable diameter = 6mm
Cable sheath = PVC
Conductor Insulation = Polyethylene
Cable type = 4 twisted pairs (26 AWG), overall screen

10.1.2 Servo Clamp

INC – CLAMP1

For use with Servo Clamp format IncOder Stators. *These clamps are sometimes referred to as 'Clamp Cleat' or 'Screw Clamp'.* Zettlex recommends the use of at least 3 Clamps to be used with each Stator. Zettlex recommends the Clamps fasten in to at least 3 M2.5 locations equispaced on a P.C.D. of IncOder dimension (**A** + 8.00). Supplied in a pack of 3 clamps.



NOTES
1. 3RD ANGLE PROJECTION
2. ALL DIMS IN mm
3. GEN. TOL. :-
   1 D.P. = ±0.2mm
   2 D.P. = ±0.1mm
4. MATL. = AL.ALLOY
5. FINISH = CHROMATE

11. Contact

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All products available via your local reseller or from the Zettlex web-site at
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Message from Mark Howard, Zettlex General Manager:

Ours is a simple business ethic: hard work, honesty & great customer service. I hope you will find our products useful.

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Revision History

Revision 4.04 to 4.05

- SPI, SSI6, SSI7 & SSI8 communication options added.
- Erratum in Asynchronous Serial Interface Protocol Definition corrected
- Final page added with Revision History and legal notices.
- Giza added as representative for Spain and Portugal, Maccon removed
- Data table updated with power up time, internal read rate and IP rating of connector
- Minor typographical changes throughout

Revision 4.05 to 4.06

- New Manufacturing & Quality section added
- -55 Celsius option added
- INC-6 format added – Servo Clamp Stator with Plain Rotor.
- INC-7, INC-8 and INC-9 formats added – combinations of other formats.
- Data on custom sizes added
- Integral axial cable option added
- 14010, 160101, 200101 & 210101 options added
- Installation drawings added for each mechanical format
- 10kHz frequency removed from data table for clarity
- Data table updated with 140101, 160101 etc.
- Availability of IGES files for CAD models noted
- DEF STANS added as reference to data table
- Tables formatted on pages 23-25, no changes other than box spacing

While Zettlex provides application assistance personally, through our literature, web-site and international representatives, it is the customer's responsibility to determine the suitability of the product in the application.

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WARNING. PERSONAL INJURY.

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