

FACTORY AUTOMATION

# 2007 ROTARY ENCODER CATALOG

## NORTH AMERICAN EDITION

**STEVEN**  
ENGINEERING

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# SPOTLIGHT on Rotary Encoders

## RVI25

The RVI25 is a rugged, industry-standard, 2.5" incremental encoder with a wide variety of options. With resolutions up to 5,000 ppr available, this encoder is ready for most applications. Multiple flange types and connection options, including mil-spec connectors, make it simple to integrate. Available with 1/4" and 3/8" shaft sizes.

*See pages 18-19*



## TVI40

This is our smallest, most economical incremental encoder. With a diameter of only 40 mm (1.57") it can fit in the tightest of spaces. The tangential cable exit allows the cable to be positioned either axially or radially. This unit also features a metal pulse disc and Opto-ASIC technology for high reliability. Output resolutions are available up to 1,024 ppr.

*See pages 20-21*



## RHI58

This small, hollow shaft encoder is now available with resolutions up to 100,000 ppr for extremely precise positioning applications. Shaft bore sizes include 10 mm, 12 mm, 15 mm and 1/2". The encoder is held in place by the included torque rest.

*See pages 34-35*



## RHI90

This large, hollow shaft incremental encoder can be used for shaft sizes ranging from 16 mm to 45 mm, including 5/8", 3/4", 7/8" and 1". With a metal pulse disc these encoders are engineered to take abuse. Designed for high shock and vibration. They provide resolutions up to 2,500 ppr.

*See pages 38-39*



## DVS/DVM58

DeviceNet absolute encoders now have up to 30-bit resolution: up to 16-bit for single-turn and 14-bit for multi-turn. They are designed for the most precise positioning applications with 65,536 steps per turn. Diagnostic LEDs are integrated into the removable housing cover to make troubleshooting quick and easy.

*See pages 80-83*



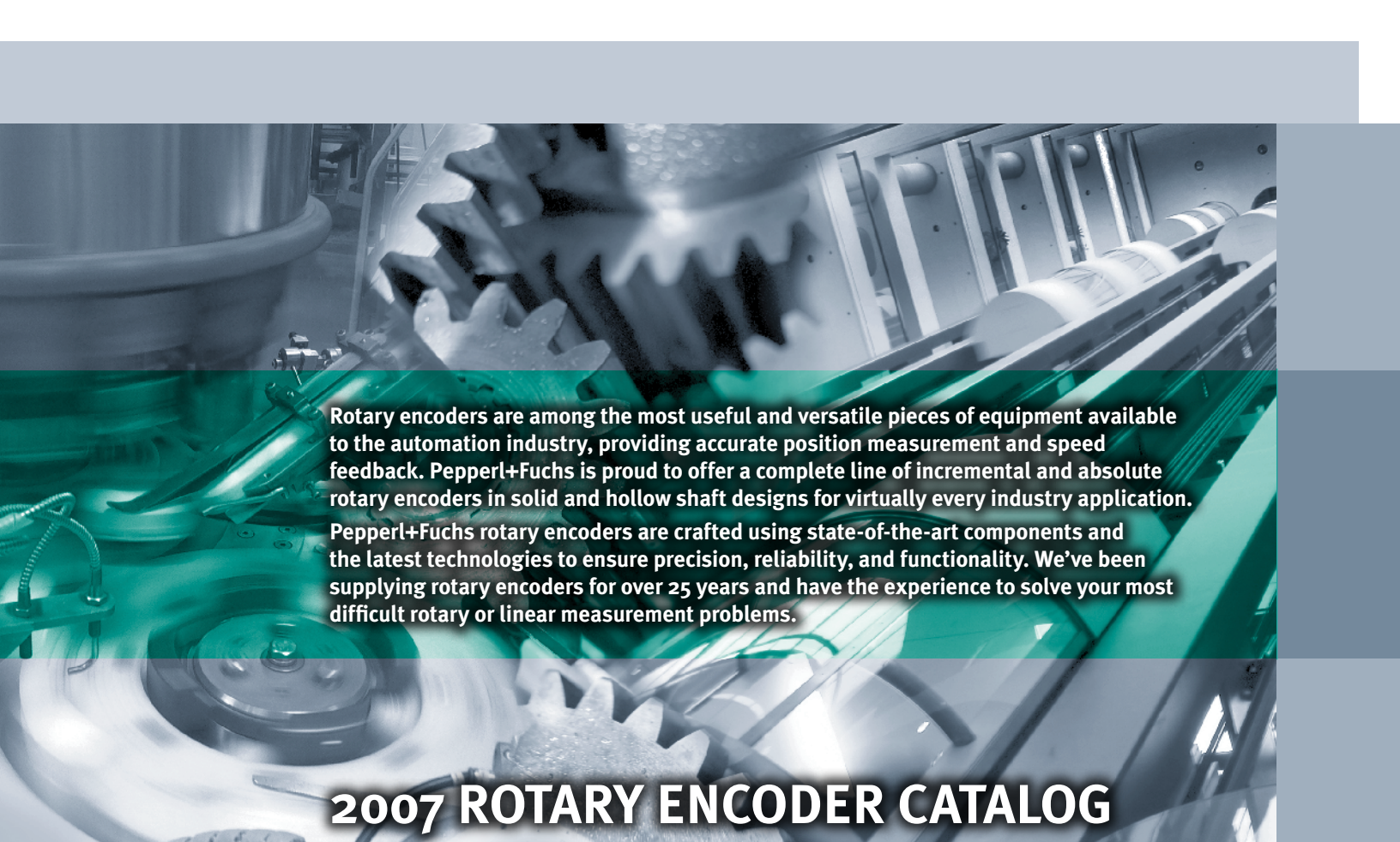
## EVS/EVM58

The newest additions to our encoder portfolio are Ethernet TCP/IP absolute encoders. They provide resolutions up to 16-bit for single-turn and 30-bit for multi-turn units. Programming and setup are easily achieved through the built-in web server that allows access through any Internet browser.

*See pages 88-90*







Rotary encoders are among the most useful and versatile pieces of equipment available to the automation industry, providing accurate position measurement and speed feedback. Pepperl+Fuchs is proud to offer a complete line of incremental and absolute rotary encoders in solid and hollow shaft designs for virtually every industry application. Pepperl+Fuchs rotary encoders are crafted using state-of-the-art components and the latest technologies to ensure precision, reliability, and functionality. We've been supplying rotary encoders for over 25 years and have the experience to solve your most difficult rotary or linear measurement problems.







## **2007 ROTARY ENCODER CATALOG**

### **NORTH AMERICAN EDITION**

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## Incremental Rotary Encoders

						
	<b>RVI25</b>	<b>TVI40</b>	<b>TVI50</b>	<b>RVI50</b>	<b>TVI58</b>	<b>RVI58</b>
See Page	18	20	22	24	26	28
Highlights	<ul style="list-style-type: none"> <li>• Industry standard 2.5" housing</li> </ul>	<ul style="list-style-type: none"> <li>• Smallest incremental encoder</li> </ul>	<ul style="list-style-type: none"> <li>• Metal disk for durability</li> </ul>	<ul style="list-style-type: none"> <li>• Small housing</li> </ul>	<ul style="list-style-type: none"> <li>• Metal disk for durability</li> </ul>	<ul style="list-style-type: none"> <li>• Available with 10,000 pulses per revolution</li> </ul>
Diameter	2.5"	40 mm	50 mm	50 mm	58 mm	58 mm
Solid Shaft Diameter	1/4" or 3/8"	8 mm	8 mm	8 mm	6 mm or 10 mm	6 mm or 10 mm
Hollow Shaft						
Recessed Hollow Shaft						
Flange type	Square, Clamping, Servo	Clamping	Clamping	Clamping	Clamping, Servo	Clamping, Servo
Max. Shaft Speed	12,000 RPM	6,000 RPM	6,000 RPM	10,000 RPM	6,000 RPM	12,000 RPM
Max. Shaft Load Axial/Radial*	40 lbs/40 lbs	20 lbs/20 lbs	20 lbs/20 lbs	32 lbs/33 lbs	20 lbs /20 lbs	40 lbs/40 lbs
Pulses per Revolution	5,000	1,024	1,024	2,500	1,500	10,000
Operating Voltage	5 or 10-30 VDC	4.75 to 30 VDC	4.75 to 30 VDC	5 or 4.75-30 VDC	4.75 to 30 VDC	5 or 10-30 VDC
Output Type	RS-422 or Push-Pull	Push-Pull	Push-Pull	RS-422 or Push-Pull	Push-Pull	RS-422 or Push-Pull
Max. Output Frequency	100 kHz	100 kHz	100 kHz	160 kHz	100 kHz	200 kHz
Connection Type	MS connector or shielded cable	0.5 m or 2 m shielded cable	0.5 m or 2 m shielded cable	12-pin connector or 0.5 m shielded cable	0.5 m or 2 m shielded cable	12-pin connector or 1 m shielded cable
Protection Rating	IP54 or IP65	IP54	IP40 or IP54	IP50	IP54	IP65

\* Shaft load ratings based on bearing lifetime of 10<sup>8</sup> revolutions. Reduced shaft loads will increase bearing life. See individual data sheets for more information.



Machine tools use rotary encoders to precisely control cutters or to position indexing tables.



Elevators use rotary encoders to determine what floor they are on and to level the elevator car when the door opens.











Conveyors have rotary encoders built into them to track the speed and distance of objects moving on the conveyor and to position items for additional work.



Robotics use rotary encoders to provide critical data on tool location and actuator movement.



							
<b>TSI40</b>	<b>THI58</b>	<b>RHI58</b>	<b>RSI58</b>	<b>RHI90</b>	<b>Series 30</b>	<b>RVI78</b>	<b>RVI84</b>
30	32	34	36	38	40	42	44
• Smallest recessed hollow shaft encoder	• Economical hollow shaft encoder	• Hollow shaft	• Recessed hollow shaft	• Largest hollow shaft	• Rugged housing for tough environments	• Designed for severe shaft loading	• Intrinsically safe, up to 25 pulses per revolution
40 mm	58 mm	58 mm	58 mm	87 mm	90 mm	78 mm	78 mm
					12 mm	10 mm	10 mm
	10 mm, 12 mm, 15 mm or 5/8 in.	10 mm, 12 mm, 15 mm or 1/2 in.		16 to 45 mm, 5/8 in., 3/4 in., 7/8 in. or 1 in.			
4 mm, 6 mm or 1/4 in.			10 mm or 12 mm				
Torque Rest	Torque Rest	Hollow Shaft	Hollow Shaft	Torque Rest	Servo	Clamping	Clamping
6,000 RPM	6,000 RPM	6,000 RPM	12,000 RPM	3,500 RPM	6,000 RPM	6,000 RPM	3,000 RPM
					61 lbs/54 lbs	50 lbs/68 lbs	50 lbs/68 lbs
1,024	1,500	100,000	5,000	2,500	5,000	5,000	1 - 25
4.75 to 30 VDC	4.75 to 30 VDC	5 or 10-30 VDC	5 or 10-30 VDC	5 or 10-30 VDC	5 or 10-30 VDC	10-30 VDC	8 VDC (NAMUR)
Push-Pull	Push-Pull	RS-422 or Push-Pull	RS-422 or Push-Pull	RS-422 or Push-Pull	RS-422 or Push-Pull	Push-Pull	NAMUR
100 kHz	100 kHz	200 kHz	200 kHz	120 kHz	100 kHz	100 kHz	5 kHz
0.5 m or 2m shielded cable	0.5 m shielded cable	1 m shielded cable	12-pin connector or 1 m shielded cable	12-pin connector or 1 m shielded cable	12-pin connector or 2 m shielded cable	6-pin connector or 2 m shielded cable	2 m cable
IP54	IP54	IP54	IP54	IP65	IP65	IP65	IP65

## Typical Applications:

- Machine tools
- Printing presses
- Packaging machines
- Conveyors
- Elevators
- Robotics
- Wind generators
- Overhead cranes

## Want more information?

Simply go to: **[www.trustpf.com/encoder](http://www.trustpf.com/encoder)**

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## Absolute Rotary Encoders



	<b>FVS58</b>	<b>FSS58</b>	<b>AVS58</b>	<b>ASS58</b>	<b>BVS58</b>	<b>BSS58</b>	
<i>Single-Turn</i>	<b>FVM58</b>	<b>FSM58</b>	<b>AVM58</b>	<b>ASM58</b>	<b>BVM58</b>	<b>BSM58</b>	
<b>See Page</b>	48	52	56	60	64	68	
<b>Highlights</b>	• Parallel output	• Recessed hollow shaft with parallel output	• Up to 28 bits of resolution	• Recessed hollow shaft up to 28 bits	• AS-Interface encoder utilizes up to 16 slave addresses	• Recessed hollow shaft	
<b>Interface</b>	Parallel	Parallel	SSI	SSI	AS-Interface	AS-Interface	
<b>Diameter</b>	58 mm	58 mm	58 mm	58 mm	58 mm	58 mm	
<b>Solid Shaft Diameter</b>	6 mm or 10 mm		6 mm or 10 mm		6 mm or 10 mm		
<b>Hollow Shaft</b>							
<b>Recessed Hollow Shaft</b>		10, 12 or 15 mm		10 mm or 12 mm		10 mm or 12 mm	
<b>Flange Type</b>	Clamping or Servo	Torque Rest	Clamping or Servo	Torque Rest	Clamping or Servo	Straight Pin Torque Rest	
<b>Max. Shaft Speed</b>	12,000 RPM	12,000 RPM	12,000 RPM	12,000 RPM	12,000 RPM/ 6,000 RPM	10,000 RPM/ 6,000 RPM	
<b>Max. Shaft Load Axial Radial*</b>	40 lbs/40 lbs		40 lbs/40 lbs		40 lbs/40 lbs		
<b>Operating Voltage</b>	10-30 VDC	10-30 VDC	10-30 VDC	10-30 VDC	from AS-Interface	from AS-Interface	
<b>Max. Single-Turn Resolution</b>	8,192	8,192	65,536	65,536	8,192	8,192	
<b>Max. Multi-Turn Resolution</b>	4,096	4,096	16,384	16,384	4,096	4,096	
<b>Connection Type</b>	19-pin connector, 26-pin connector, or 2 m shielded cable	19-pin connector, 26-pin connector or 2 m shielded cable	12-pin connector or 1 m shielded cable	12-pin connector or 1 m shielded cable	4-pin micro DC connector	4-pin micro DC connector	
<b>Protection Rating</b>	IP65	IP65	IP65	IP65	IP65	IP65	



Overhead cranes are positioned by rotary encoders, which also measure crane speed to prevent accidents and overruns.



Wind generators have adjustable vanes to take advantage of any wind, no matter how slight, and rotary encoders make it possible.











Packaging machines measure the size of an item and track the amount of material used to pack it with rotary encoders.



Printing presses track the amount of paper on a roll and measure where to cut using rotary encoders.



							
<b>CANopen</b>	<b>CANopen</b>	<b>DeviceNet</b>	<b>DeviceNet</b>			<b>PROFIBUS</b>	<b>PROFIBUS</b>
<b>CVS58</b> <b>CVM58</b>	<b>CSS58</b> <b>CSM58</b>	<b>DVS58</b> <b>DVM58</b>	<b>DSS58</b> <b>DSM58</b>	<b>EVS58</b> <b>EVM58</b>	<b>ESS58</b> <b>ESM58</b>	<b>PVS58</b> <b>PVM58</b>	<b>PSS58</b> <b>PSM58</b>
72	76	80	84	88	91	93	96
• Up to 30 bits of resolution	• Recessed hollow shaft for CANopen	• Diagnostic LEDs	• Up to 30 bit, recessed hollow shaft	• Configuration via web browser	• Recessed hollow shaft with configuration via web browser	• Built-in programmable limit switch	• Recessed hollow shaft
CANopen	CANopen	DeviceNet	DeviceNet	Ethernet TCP/IP	Ethernet TCP/IP	PROFIBUS	PROFIBUS
58 mm	58 mm	58 mm	58 mm	58 mm	58 mm	58 mm	58 mm
6 mm or 10 mm		6 mm or 10 mm		6 mm or 10 mm		6 mm or 10 mm	
	10, 12 or 15 mm		10, 12 or 15 mm		10, 12 or 15 mm		10, 12 or 15 mm
Clamping or Servo	Torque Rest	Clamping or Servo	Torque Rest	Clamping or Servo	Torque Rest	Clamping or Servo	Torque Rest
12,000 RPM	12,000 RPM	12,000 RPM	12,000 RPM	12,000 RPM	12,000 RPM	12,000 RPM	12,000 RPM
40 lbs/40 lbs		40 lbs/40 lbs		40 lbs/40 lbs		40 lbs /40 lbs	
10-30 VDC	10-30 VDC	10-30 VDC	10-30 VDC	10-30 VDC	10-30 VDC	10-30 VDC	10-30 VDC
65,536	65,536	65,536	65,536	65,536	65,536	65,536	65,536
16,384	16,384	16,384	16,384	16,384	16,384	16,384	16,384
Removable terminal housing with PG glands	Removable terminal housing with PG glands	Removable terminal housing with PG glands	Removable terminal housing with PG glands	(3) M12 x 1 connectors	(3) M12 x 1 connectors	Removable terminal housing with PG glands	Removable terminal housing with PG glands
IP65	IP65	IP65	IP65	IP65	IP65	IP65	IP65

### Typical Applications:

- Machine tools
- Printing presses
- Packaging machines
- Conveyors
- Elevators
- Robotics
- Wind generators
- Overhead cranes

### Want more information?

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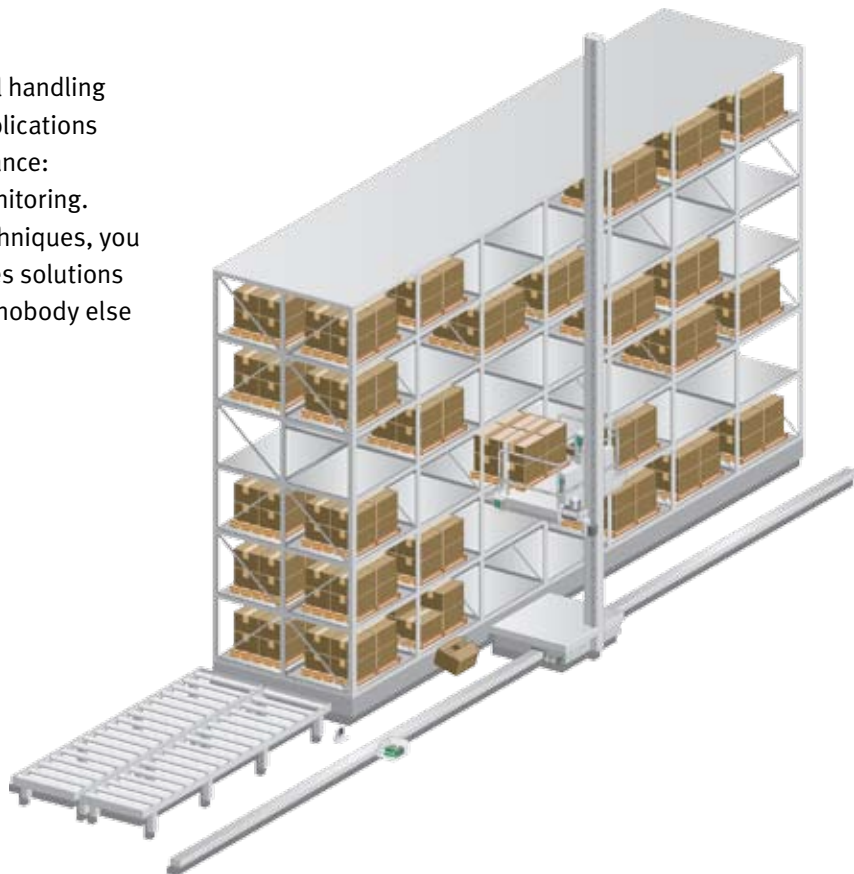
# Rotary Encoders for the Material Handling Industry



## Material Handling

In a world of continuous movement, material handling links many diverse pieces of equipment. Applications demand outstanding rotary sensor performance: absolute position verification and speed monitoring. With our experience in material handling techniques, you can be confident that Pepperl+Fuchs provides solutions for your entire operation with products that nobody else can match.

- Pallet and container positioning
- Position of stacker and gantry cranes
- Hoist monitoring
- Forklift speed/direction monitoring





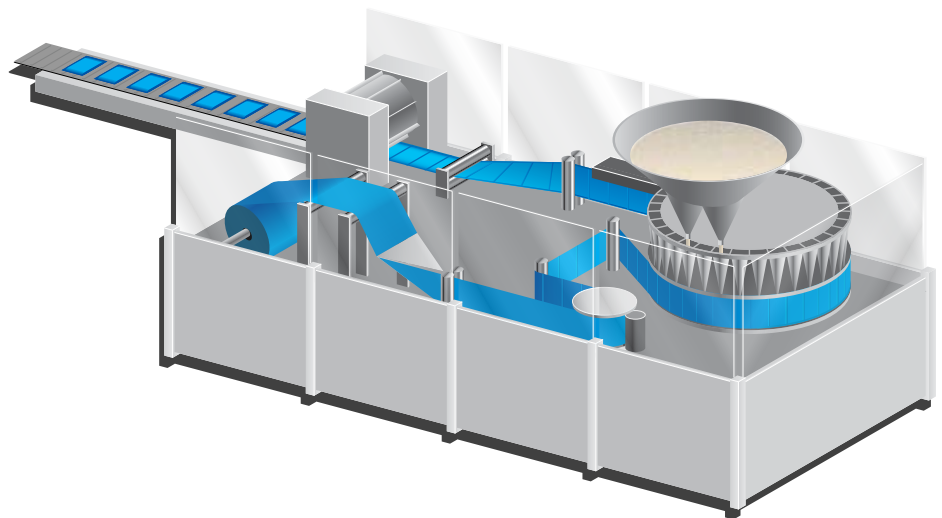
# Rotary Encoders for the Packaging Industry



## Packaging

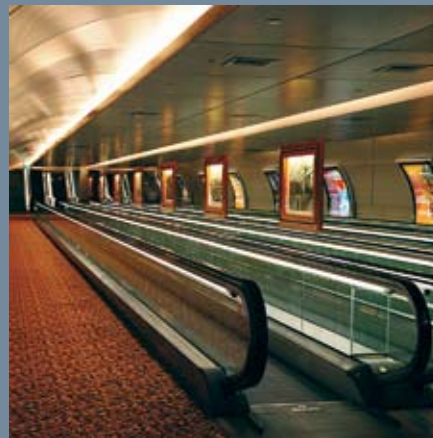
From level control, to empty pouch detection, to glue pattern verification, you want rugged and reliable sensors with precise positioning and ultrafast response times that offer quick changeover times on the plant floor. When speed, accuracy and reliability are vital, Pepperl+Fuchs is the only sensor supplier you'll ever need.

- **Precise product positioning**
- **Measure roll diameter**
- **Low roll detection**
- **Measure item size**
- **Verify material length**
- **Cut-to-length measurement**
- **Monitor conveyor speed & distance**





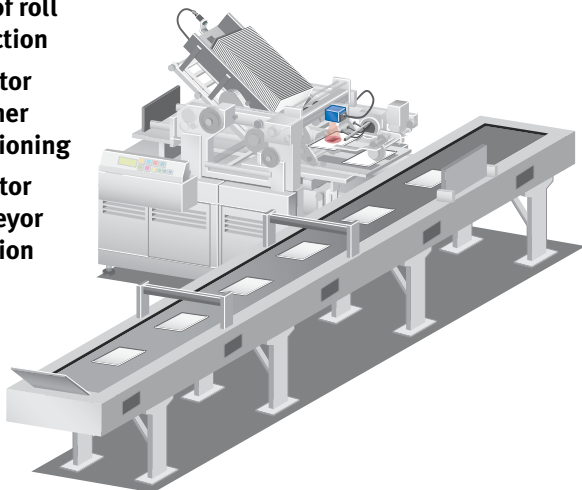
# Rotary Encoders for the Printing and Elevator/Escalator Industry



## Printing

Pepperl+Fuchs knows printing: every segment, every step in the process. In the printing industry, sensors need to be robust, versatile enough to perform in a variety of machines, and rugged enough to withstand vigorous plant floor environments. P+F has those sensors. In fact, we have the largest and most diverse selection of sensing technologies in the world. P+F is expanding the limits of sensing technology.

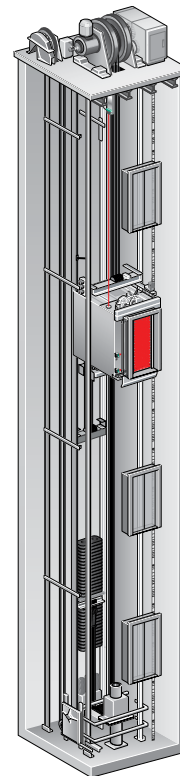
- Measure roll diameter
- Web measurement and alignment
- Monitor sheet length
- End of roll detection
- Monitor finisher positioning
- Monitor conveyor position



## Doors, Gates, Elevators & Escalators

Pepperl+Fuchs has been a trusted sensor supplier to the elevator/escalator industry for over 25 years. Developed to optimize performance and minimize downtime, our encoders are used to monitor critical speed, synchronization, and absolute positioning. Offering proven solutions, Pepperl+Fuchs has the experience you've come to trust in both industrial and commercial applications.

- Door positioning
- Cab positioning
- Handrail-to-stair synchronization
- Rotation direction monitoring
- Slip monitoring





# Rotary Encoders

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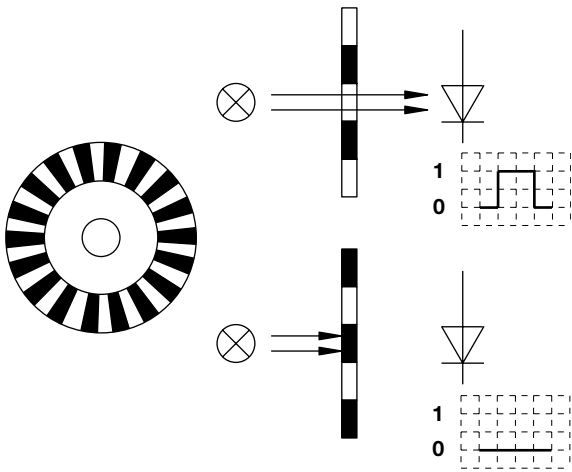


# Principles of Rotary Encoders

## Introduction

In automation applications, rotary encoders are used as sensors for angle, position, speed and acceleration. By using spindles, gear racks, measuring wheels or cable pulls, linear movements can also be monitored by a rotary encoder. Rotary encoders convert a mechanical rotation value into an electrical signal that can be processed by counters, tachometers, logic controllers and industrial PCs.

Rotary encoders use a glass or plastic disc with alternating transparent and opaque fields, with a light source on one side and a light-sensitive sensor on the other. As the disc rotates, the light source is alternately blocked and revealed to the sensor. Whenever the light source hits the sensor, the encoder transmits an electric pulse that can be interpreted by a controller. The pulse ends when an opaque field on the disc blocks the light source. Rotation of the disc results in a square-wave pulse output.



Most rotary encoders use an infrared light-emitting diode as a light source, and photodiodes or phototransistors as receivers.

If no other functions are added to the encoder, the only output is a square wave that indicates that the disc is rotating. The direction of rotation and absolute position cannot be determined from a square wave output alone. Therefore, additional components are added to many rotary encoders to provide additional data about the rotation.



## Types of Encoders

### Incremental Rotary Encoders

Incremental rotary encoders supply a certain number of pulses for each shaft revolution. Measuring the cycle duration, or counting the number of pulses during a pre-determined unit of time determines rotational speed. If the pulses are measured after a reference point is added, the calculated value represents a parameter for a scanned angle or the distance covered.

Two-channel encoders (those with a phase shift of 90°) enable the controller to determine the direction of rotation and can enable bi-directional positioning. Three-channel incremental encoders provide a “zero signal” for each revolution, giving a fixed point of reference.

For more information, please refer to the section titled “Operating Instructions for Incremental Rotary Encoders” on pages 14-15.

### Absolute Rotary Encoders

Absolute encoders provide a uniquely coded numerical value for each shaft position. Absolute rotary encoders eliminate the need for expensive input components in a positioning application because they have built-in reference data. In addition, reference runs after a power failure or when the machine is switched off are not required because the encoder provides the current position value immediately.

Single-turn absolute encoders divide the shaft into a defined number of steps. The maximum resolution is 16 bits, which means that up to 65,536 positions can be defined.

By using a multi-step gear, multi-turn absolute encoders not only provide the angular position within a revolution, but also the number of revolutions. Multi-turn encoders have a 14-bit resolution to indicate the number of turns, which means that up to 16,384 revolutions can be identified. Overall resolution is 30 bits (16 bits per turn + 14 bits for the number of turns) or 1,073,741,824 measuring steps.

Parallel absolute encoders transmit the position value to external analyzing electronics through multiple wires, one for each bit.

In the case of serial absolute encoders, the output data can be transmitted by means of standardized interfaces and protocols. In the past, point-to-point wiring was used for serial data; today, fieldbus systems are becoming increasingly popular.

For more information on encoder operation, please refer to the section titled “Operating Instructions for Absolute Encoders” on page 16.



## Encoder Design

### Solid Shaft Encoders

Solid shaft encoders feature a solid drive shaft that must use an additional coupling to link the encoder shaft to the application's drive shaft. The spring-based coupling compensates for misalignment. Belts, pinions, measuring wheels and cable pulls can also be mounted to the solid drive shaft. Depending on the type of coupling used, it is important to observe the maximum shaft load, since excessively high radial or axial forces can damage the encoder.



Advantages of solid shaft encoders:

- Simple construction
- Higher environmental protection rating
- Can be mechanically and electronically disengaged from the application, depending on coupling



### Clamping Flange

The encoder can be mounted using the clamping flange, which ensures that the rotational axis is centered. The threaded holes on the encoder face can also be used.



### Servo Flange (synchro flange)

The encoder can be mounted using the synchro groove with mounting components, by using the threaded holes on the encoder face, or by using a mounting bracket.

### Hollow Shaft Encoders

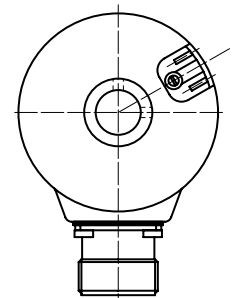
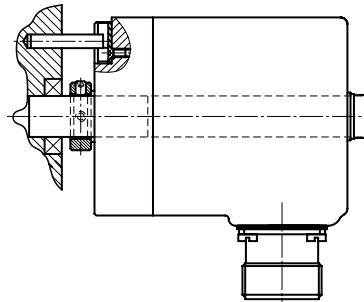
Hollow shaft encoders use a continuous borehole or a blind hole (recessed hollow shaft encoder) which houses the drive shaft. Integrated hub and shaft connections make linking the encoder and the drive simple and easy. Built-in torque rests compensate for axial misalignment of the encoder and drive, making a compensating coupling unnecessary.



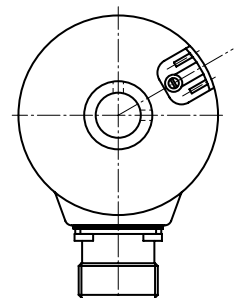
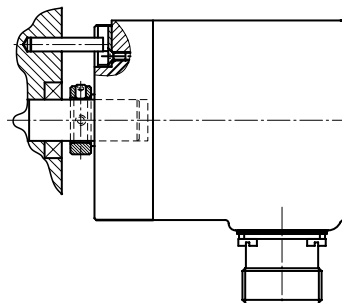
With hollow shaft encoders, the shaft and hub connection is already integrated, but it is vital to mount the encoder so that the correct torque is transmitted to the drive shaft and not to the body of the encoder. Typically, hollow shaft encoders are mounted in such a way that the weight of the encoder is placed on the drive shaft, while a pin securing the body of the encoder prevents it from rotating around the drive shaft as torque is applied. Encoder motion should not be restricted in any other way, as it could affect the accuracy of the encoder.

Recessed hollow shaft encoders are identical in all ways to standard hollow shaft encoders except that the hole is bored only partly through the encoder housing. Mounting techniques for recessed encoders are also the same.

Hollow shaft encoder



Recessed hollow shaft encoder



Advantages of hollow shaft encoders:

- Simple mounting
- Quick installation



# Principles of Rotary Encoders

## Shaft Load

Pepperl+Fuchs encoder shafts are mounted using two ball bearings. The encoder's service life is directly dependent upon the bearing's structural integrity, which is, in turn, dependent upon five main components:

- Speed
- Temperature
- Axial load
- Radial load
- Load location (on the shaft)

Pepperl+Fuchs specifies maximum encoder shaft loading and bearing service life based upon "worst case" permissible conditions (i.e. maximum speed, temperature and shaft forces, where the load is centered/applied on the shaft end).

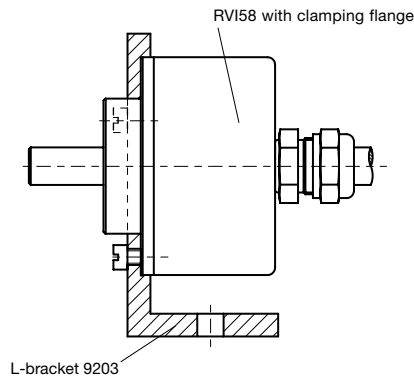
With proper encoder mounting and selection of shaft couplings, P+F encoders will provide a service life beyond the stated value. Conversely, if mechanical loading is increased beyond the catalog-specified limits, an encoder's working life will be reduced.

Example: At 6,000 rpm, with axial and radial shaft loads of 40 lbs, the RVI25's specified service life is  $2 \times 10^8$  revolutions. If the axial and radial shaft loads are reduced to 13 lbs and 9 lbs respectively, the guaranteed service life increases to  $2 \times 10^{10}$  revolutions.

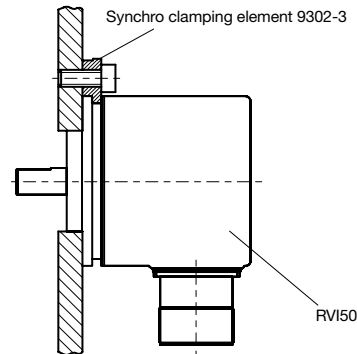
## Mounting Instructions

### Mounting Encoders

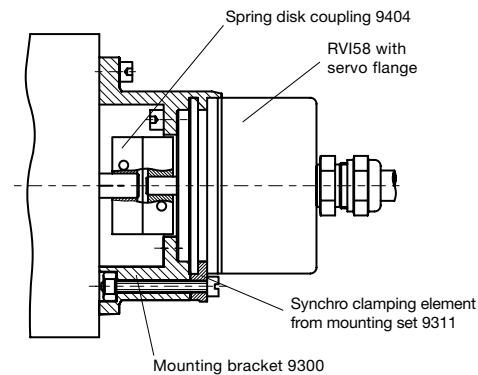
Mounting a solid shaft encoder using an L-bracket



Mounting a solid shaft encoder using an eccentric clamp



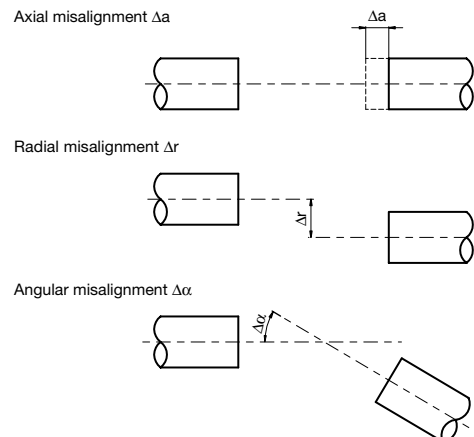
Mounting a solid shaft encoder with a mounting bracket



### Use of Couplings

To prevent excessive loads on the encoder bearings, the encoder and drive shaft must be linked with a flexible coupling. Without a flexible coupling, slight misalignment of the encoder and drive shaft or changes in alignment due to temperature fluctuation can generate excessive axial or radial forces. In a rigidly mounted system, this can destroy the encoder. However, a coupling with high torsional rigidity will reduce the torsional error between the encoder and drive shaft.

For data on maximum radial, axial or angular misalignment, please refer to the encoder data sheets.





## Installation Instructions

### Anti-interference Measures

Because of the sensitive nature of today's electronics, a consistently applied anti-interference and wiring protocol should be designed into any encoder system. The following procedures should be followed whenever mounting an encoder in a normal industrial environment (please note that no two environments are the same—if you have questions, please contact your local P+F representative for a detailed analysis of your application).

- Terminate a serial line with a 120Ω resistor at the controller and the last encoder in the loop. The resistor should be installed between the Receive/Transmit terminals.
- Keep encoder wiring away from power cables and conduit. If crossing power cables is necessary, make sure the wires are perpendicular, not parallel.
- Make sure your cable's shield has a cross section of at least 12 AWG (4 mm<sup>2</sup>).
- Make sure your cable's wire has a cross section of at least 26 AWG (0.14 mm<sup>2</sup>).
- Do not kink or bend the cables.
- Do not exceed the minimum bending radius as shown on the cable data sheet. Avoid tensile and shearing loads on the cable.

### Operating Instructions

Every encoder manufactured by Pepperl+Fuchs is tested before leaving the factory. To ensure continued operation, please observe the following precautions:

- Do not strike or hammer on the encoder housing or shaft.
- Do not overload the encoder shaft, either axially or radially.
- The accuracy and service life of the encoder is guaranteed only if a suitable coupling is used.
- Power to the encoder and controller must be applied at the same time.
- Do not service wiring with power applied to the system
- Do not exceed maximum operating voltage.

### Notes on Electrical Shielding

- Apply shielding on both sides to a common ground.
- The shield has to be installed behind the insulation and must be clamped to a large surface below the strain relief.
- With screw-type cable connections, the strain relief must be grounded.
- Use only metallic plugs (such as sub-D plugs with metallic housings).

## Safety Instructions



**Warning**

Please observe the national safety and accident prevention regulations as well as the subsequent safety instructions in these operating instructions when working on encoders.

If failures cannot be remedied, the device must be shut down and secured against accidental operation.

Repairs may be carried out only by the manufacturer.

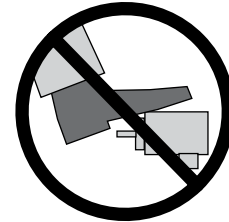
Entry into and modifications of the device are not permissible.



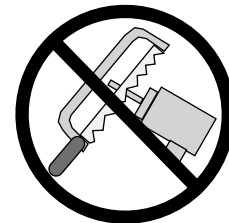
**Caution**

Tighten the clamping ring only, if a shaft has been fitted in the area of the clamping ring (hollow shaft encoders).

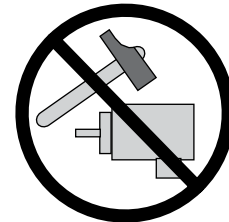
Tighten all screws and plug connectors prior to operating the encoder.



**Do not stand on the encoder!**



**Do not remachine the drive shaft!**



**Avoid impact!**



**Do not remachine the housing!**



# Principles of Rotary Encoders

## Operating Instructions for Incremental Rotary Encoders

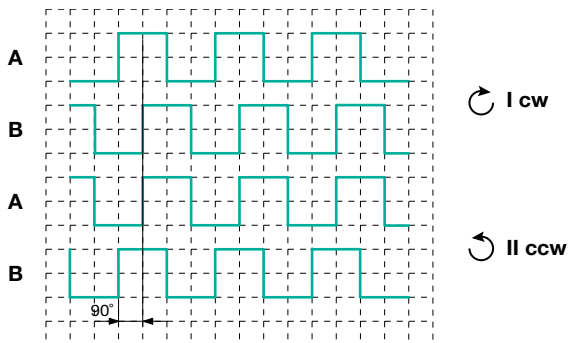
Incremental rotary encoders emit pulses as the shaft is rotated, and the number of pulses is used to calculate angular position. The resolution (Z) of an incremental encoder is the number of pulses per revolution. The signal frequency is used to determine the angular speed ( $\omega$ ) and the change in position for a given period of time is used to calculate the angular acceleration ( $\alpha$ ).

### Rotational Direction Monitoring in Incremental Rotary Encoders

In order to determine the direction of rotation of a movement, the scanning principle is used on both channel A and channel B. The direction of rotation can be determined by evaluating the two signals, which are phase-shifted by 90 degrees.

In the first figure below (I cw), channel A precedes channel B. This indicates clockwise rotation. II ccw shows counter-clockwise rotation. The direction of rotation is determined by viewing the encoder shaft head-on.

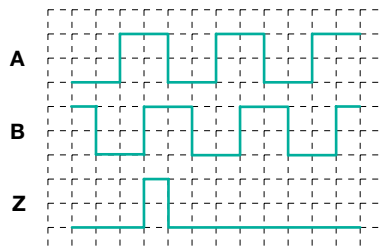
Depending on the type of incremental rotary encoder, channel A or channel B is the leading channel. For more information, refer to the encoder data sheet.



### Zero Signal

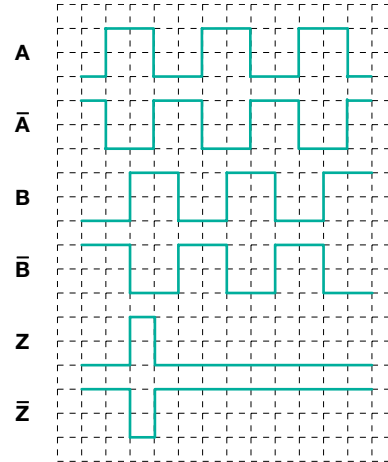
Determining the frequency of the pulses is the job of the controller, PLC or tachometer. The zero signal is a pulse that occurs once per revolution at a fixed point and is transmitted using a third channel (often called channel 0 or Z). The zero signal is usually used as a reference signal for positioning.

The diagram below illustrates the output of a 3-channel incremental rotary encoder.

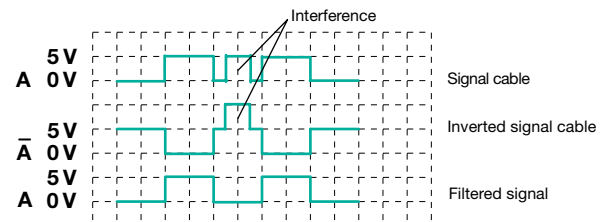


### Inverted Channels

Inverted signals are transmitted in addition to channels A, B and Z to improve signal quality. Inverted signals are a standard feature in RS-422 interfaces and are optional on push-pull outputs.



The advantage of normal and inverted signal transmissions is that filtering of unwanted signals is possible. If a noise pulse occurs, it will be induced equally on all channels. Subtracting the normal and inverted encoder signals from each other eliminates the noise pulse. The figure below illustrates how this is done.



### Pulse Multiplication

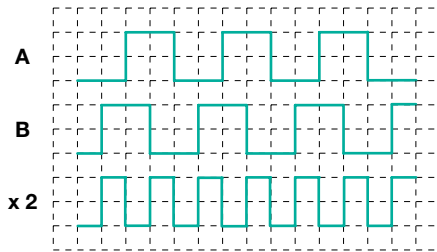
Pulse multiplication is used to increase the number of measuring steps or to reduce the output frequency of an incremental rotary encoder. The signals of an incremental rotary encoder can be doubled or quadrupled by linking channels A and B.

For example, an application may need 20,000 measuring steps for each revolution at a speed of 3000 RPM. If the control unit (PLC, counter or tachometer) provides the option to quadruple the signal, then an inexpensive rotary encoder with 5000 pulses can be used. In addition, the output frequency of the incremental rotary encoder is reduced.

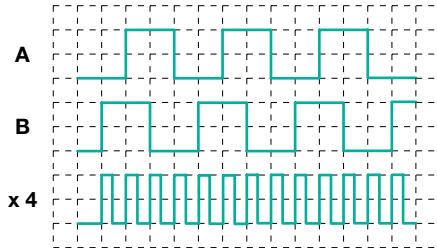
- Without quadruple multiplication: 1 MHz (this frequency is too high for most control units)
- With quadruple multiplication: 250 kHz



## Doubling of signals



## Quadrupling of signals

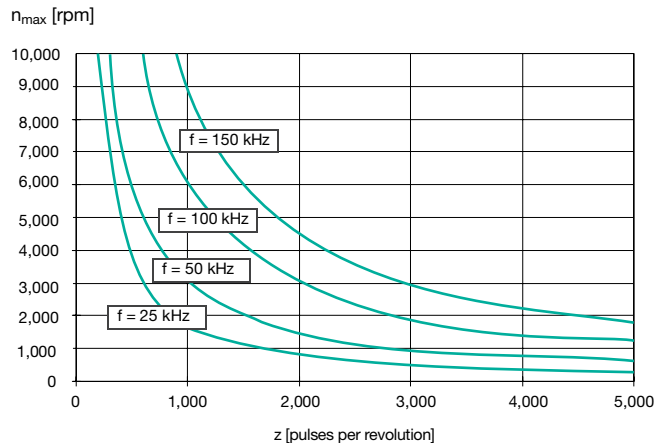


NOTE: By linking channels A and B, rotation direction data is lost.

## Relationship Between Speed and Output Frequency

$$f = \frac{n}{60 \text{ s}} \times Z \quad (n \text{ in rpm})$$

$$n_{\max} = \frac{n_{\max} \times 60 \text{ s}}{Z} \quad (f_{\max} \text{ in Hz, } n_{\max} \text{ in rpm})$$

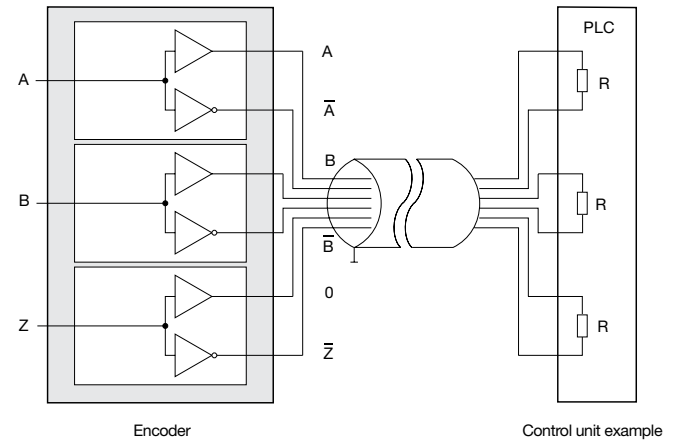


## Interfaces

### Line Driver (RS-422)

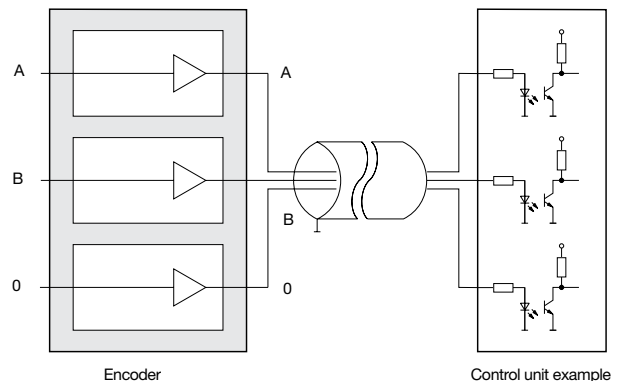
This symmetrical interface is recommended for use whenever a longer cable length is required. The corresponding core pairs must be twisted for maximum interference resistance.

This interface can also be used as a replacement for the TTL interface. In this case, the inverted outputs are not used.



### Push-Pull Output

The push-pull output is a combination of NPN and PNP outputs. Compared to open collector outputs, the push-pull output features an improved square wave. In addition, interference resistance is improved. No external wiring is required as in NPN or PNP outputs. Push-pull also offers inverted channels. The main applications of push-pull are within the range of median switching frequencies. The open collector outputs can be replaced by push-pull by using only the non-inverted outputs.





# Principles of Rotary Encoders

## Operating Instructions for Absolute Rotary Encoders

Absolute encoders do not generate pulses, but entire data strings. The sampling unit in an absolute encoder reads the code disk to determine the shaft position and the data is transmitted by parallel or serial interface.

### Single-turn

In single-turn absolute rotary encoders, each revolution of the encoder (360°) is divided into a maximum of 65,536 measuring steps (16 bit). After each complete revolution, the count begins again at the initial value. A single turn absolute rotary encoder does not count the number of revolutions.

### Multi-turn

In addition to the coded disk in a single-turn encoder, a multi-turn encoder adds a gear that counts up to 16,384 revolutions (14 bit). Overall resolution amounts to 16 bit (single-turn resolution) plus 14 bit (multi-turn resolution) for a total of 30 bits of resolution. The resulting 1,073,741,824 measuring steps can be used to divide very long linear distances into small measuring steps.

### Interfaces

The Pepperl+Fuchs encoder line includes the industry's largest range of interfaces for absolute encoders:

#### SSI-Interface:

The Synchronous Serial Interface (SSI) has been developed to transfer output data to a controller. The controller sends a bundle of timer pulses and the absolute encoder responds with the position value.

#### Parallel Interface:

With a parallel interface, data is sent directly from the Gray-coded encoder measurement. A parallel interface's primary advantage is data transfer speed.

#### AS-Interface:

AS-Interface uses a multi-slave solution to provide real-time encoder data transfer.

#### DeviceNet:

Encoders are available with fully integrated DeviceNet interfaces that support all DeviceNet functions.

#### PROFIBUS:

PROFIBUS operation is supported in accordance with Class 1 and Class 2, and satisfies the PROFIBUS profile for encoders.

#### CAN:

Pepperl+Fuchs offers encoders with a recessed hollow shaft and solid shaft design in single- and multi-turn versions. Each model is in accordance with the CAN standard DSP406 (Class 1 and Class 2).

#### Ethernet:

These encoders are available with Ethernet TCP/IP interface. The Ethernet interface is programmable via any web browser.

## Types of Code

### Binary Code

Binary code is a dual number system, consisting of the numbers 0 and 1. When using binary code, it is important to note that several bits may change at the same time from step to step. For example, counting from seven to eight, the bits 0, 1, 2 and 3 change. In order to ensure high transmission integrity, P+F recommends using a code which changes only one bit at each step. The evaluating control can then be used to determine whether the data string is accurate.

$2^4$																				
$2^3$																				
$2^2$																				
$2^1$																				
$2^0$																				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

### Gray Code

Gray code is a unit-distance code; only one bit changes from step to step. To use this code for distance calculation, it must be converted to a binary code. Gray code is recommended for encoders because the data can be transmitted by a serial interface. To check the unit-distance, every code change has to be detected by the test logic.

2 <sup>4</sup>																				
2 <sup>3</sup>																				
2 <sup>2</sup>																				
2 <sup>1</sup>																				
2 <sup>0</sup>																				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

### Gray Excess Code

The Gray excess code is extracted from the complete Gray code. In the process, clipping takes place symmetrically, permitting the use of even sections only. The idea is that a different number of measuring steps other than those given by a power of 2 can be used. Frequently it is necessary to reduce a 9-bit value (512 measuring steps) to 360 measuring steps. The unit distance remains unaffected.

## Intrinsic Safety Devices

### Ignition Protection Class "Intrinsic Safety" (Ex i) DIN EN 50020

By using the latest technology, it is possible to incorporate a binary switching behavior in the sensor (with simultaneous switch condition change on the sensor and amplifier), while retaining the standardized voltage and current values. The characteristic values of voltage and current are kept so low that a NAMUR sensor can be used in an explosive area (ignition protection class "Intrinsic safety").

NAMUR sensors are mounted to external amplifiers which convert the current changes into a binary output signal. P+F offers a large number of amplifiers for intrinsic safety applications.

### NAMUR Sensors, Two-wire

NAMUR sensors in accordance with IEC 60947-5-6 are two-wire sensors.



# Incremental Rotary Encoders

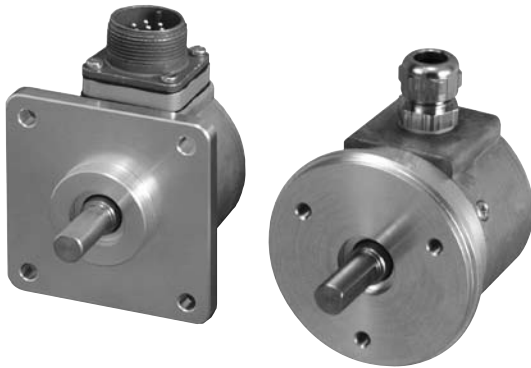
<b>RVI25 Series</b>	2.5" Housing, Solid Shaft .....	<b>18-19</b>
<b>TVI40 Series</b>	40 mm Housing, Solid Shaft .....	<b>20-21</b>
<b>TVI50 Series</b>	50 mm Housing, Solid Shaft .....	<b>22-23</b>
<b>RVI50 Series</b>	50 mm Housing, Solid Shaft .....	<b>24-25</b>
<b>TVI58 Series</b>	58 mm Housing, Solid Shaft .....	<b>26-27</b>
<b>RVI58 Series</b>	58 mm Housing, Solid Shaft .....	<b>28-29</b>
<b>TSI40 Series</b>	40 mm Housing, Recessed Hollow Shaft .....	<b>30-31</b>
<b>THI58 Series</b>	58 mm Housing, Hollow Shaft .....	<b>32-33</b>
<b>RHI58 Series</b>	58 mm Housing, Hollow Shaft .....	<b>34-35</b>
<b>RSI58 Series</b>	58 mm Housing, Recessed Hollow Shaft .....	<b>36-37</b>
<b>RHI90 Series</b>	87 mm Housing, Hollow Shaft .....	<b>38-39</b>
<b>Series 30</b>	90 mm Housing, Solid Shaft .....	<b>40-41</b>
<b>RVI78 Series</b>	78 mm Housing, Solid Shaft .....	<b>42-43</b>
<b>RVI84 Series</b>	78 mm Housing, Solid Shaft .....	<b>44-45</b>



# Incremental Rotary Encoders

## RVI25 Series Solid Shaft

- Outputs up to 5000 ppr
- Square or servo flange styles
- Mil-Spec connectors
- Heavy-duty size 25 housing (2.5")
- 10-30 VDC and 5 VDC outputs
- 1/4" or 3/8" diameter shafts



The RVI25 series is Pepperl+Fuchs' industry standard size 25 (2.5") encoder. This encoder is well-suited for many applications with its rugged, industrial housing and variety of options. Standard mounting configurations include 1/4" and 3/8" shafts and servo or face mounts. Electrical options include push-pull and RS-422 outputs with either Mil-Spec connectors or cables. An optional shaft seal protects the encoder and gives it a protection rating of IP65.

### Order Code

**RVI25** - **□□□□□□□□** **N** - **□□□□**

#### Housing

- N** Normal IP54  
**P** With shaft seal IP65

#### Shaft options

- 06** Ø 3/8" x 0.875"  
**11** Ø 1/4" x 0.875"

#### Flange style

- D** Square flange 2.65" x 2.65"  
**E** Servo flange Ø 2.625"  
**F** Servo flange Ø 2.5"  
**G** Servo flange Ø 2.5"  
**H** Servo flange Ø 2.5"

#### Connection type

- AR** MS3102A16S-1P M16 7-pin connector  
**AS** MS3102A18-1P M18 10-pin connector  
**K2** Cable 2 m  
**K5** Cable 5 m

#### Pulse count

- 100, 360, 500, 512, 1000, 1024,  
1250, 2048, 2500, 3600, 4096, 5000

#### Output switching

- 1** 10-30 VDC, push-pull  
**6** 5 VDC, RS-422\*  
**X** 10-30 VDC, RS-422\*  
\* must choose signal output 6

#### Signal output

- 3** A + B + Z  
**6** A + B + Z and  $\bar{A} + \bar{B} + \bar{Z}$

#### Exit position

- A** Axial  
**R** Radial

Example: RVI25N-06DK2R61N-1024

## Technical Specifications

### Electrical

<b>PULSE COUNT</b>	≤ 5,000 ppr
<b>OUTPUT FREQUENCY</b>	≤ 100 kHz
<b>SUPPLY VOLTAGE</b>	10-30 VDC 5 VDC
<b>OUTPUT</b>	10-30 VDC, push-pull 10-30 VDC, RS-422 5 VDC, RS-422
<b>CURRENT CONSUMPTION</b>	<i>10-30 VDC</i> ≤ 60 mA <i>5 VDC</i> ≤ 70 mA
<b>LOAD CURRENT PER CHANNEL</b>	<i>Push-pull</i> ≤ 40 mA, short-circuit protected <i>RS-422</i> ≤ 20 mA
<b>VOLTAGE DROP</b>	<i>Push-pull</i> < 3 V <i>RS-422</i> —
<b>RESPONSE TIME</b>	<i>Push-pull</i> 400 ns <i>RS-422</i> 100 ns
<b>CERTIFICATES</b>	<i>UL</i> No. NMTR.E223176 <b>CE</b> Yes

### Mechanical

<b>MATERIAL</b>	<i>Housing</i> Die-cast zinc <i>Flange</i> Aluminum <i>Shaft</i> Stainless steel <i>Pulse disc</i> Plastic (0-1,500 ppr) Glass (1,501-5,000 ppr)
<b>WEIGHT</b>	≈ 14 oz
<b>ROTATIONAL SPEED</b>	≤ 12,000 rpm
<b>MOMENT OF INERTIA</b>	≤ 3.5 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>	<i>w/shaft seal</i> ≤ 2.1 in-oz <i>wo/shaft seal</i> ≤ 1.4 in-oz
<b>SHAFT LOADING</b>	<i>Axial</i> 40/9.8 lbs (6,000/12,000 rpm) <i>Radial</i> 40/13.3 lbs (6,000/12,000 rpm)
<b>BEARING WORKING LIFE</b>	> 2 x 10 <sup>8</sup> revolutions

### Environmental

<b>STORAGE TEMPERATURE</b>	<i>Plastic disc</i> -40°C to +70°C (-40°F to +158°F) <i>Glass disc</i> -40°C to +100°C (-40°F to +212°F)
<b>OPERATING TEMPERATURE</b>	<i>Plastic disc</i> -20°C to +60°C (-4°F to +140°F) <i>Glass disc</i> -20°C to +80°C (-4°F to +170°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 3 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	<i>w/shaft seal</i> IP54 <i>wo/shaft seal</i> IP65

### Connection Types

<b>CONNECTOR</b>	Type MS3102A16S-1P, 7-pin Type MS3102A18-1P, 10-pin
<b>CABLE</b>	Ø7.8 mm, 12 x #26 AWG, 2 or 5 m length



# Incremental Encoders RV125 Series

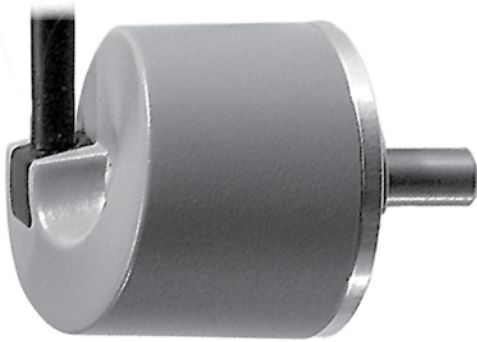
Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com



# Incremental Rotary Encoders

## TVI40 Series Solid Shaft

- Smallest incremental encoder size
- 6 mm and 8 mm shaft diameters
- Outputs up to 1024 ppr
- RS-422 functionality at 5 V operation
- IP54



With a small outside diameter of 40 mm, the solid-shaft TVI40 is ideal for use in industrial areas where very little space is available. Electrical options include push-pull and RS-422 outputs. Opto-ASIC technology and a sturdy metal code disk provide a more efficient and economical performance. The TVI40 comes in a 40 mm plastic housing with a tangential cable outlet, which enables the user to lay the cable radially or axially.

### Order Code

TVI40N-□□-T□□T6TN-□□□□

#### Shaft options

- 14 Shaft Ø 6 mm x 15 mm  
09 Shaft Ø 8 mm x 15 mm

#### Pulse count

50, 100, 200, 360,  
400, 500, 1000, 1024

#### Connection type

- K0 Cable, 0.5 m  
K2 Cable, 2 m

Example: TVI40-TK0T6TN-1024

### Technical Specifications

#### Electrical

PULSE COUNT	≤ 1,024 ppr
OUTPUT FREQUENCY	≤ 100 kHz
SUPPLY VOLTAGE	4.75-30 VDC 5 VDC for RS-422 functionality
OUTPUT	Push-pull (RS-422)
CURRENT CONSUMPTION	≤ 55 mA
LOAD CURRENT PER CHANNEL	≤ 30 mA
VOLTAGE DROP	≤ 2.5 V
RESPONSE TIME	980 ns (225 ns)
CERTIFICATES	No. NMTR.E223176
CE	Yes

#### Mechanical

MATERIAL	Housing	Polycarbonate
	Flange	Aluminum
	Shaft	Stainless steel
	Pulse disc	Nickel
WEIGHT		≈ 5.8 oz
ROTATIONAL SPEED		≤ 6,000 rpm
MOMENT OF INERTIA		≤ 6.1 x 10 <sup>-5</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 0.3 in-oz
SHAFT LOADING	Axial	4.5 lbs
	Radial	6.7 lbs
BEARING WORKING LIFE		≥ 2 x 10 <sup>9</sup> revolutions

#### Environmental

STORAGE TEMPERATURE	-25°C to +85°C (-13°F to +185°F)
OPERATING TEMPERATURE	-10°C to +70°C (-14°F to +158°F)
HUMIDITY	No moisture condensation
SHOCK RESISTANCE	100 g for 6 ms
VIBRATION RESISTANCE	10 g, 10-2,000 Hz
ENCLOSURE RATING	IP54

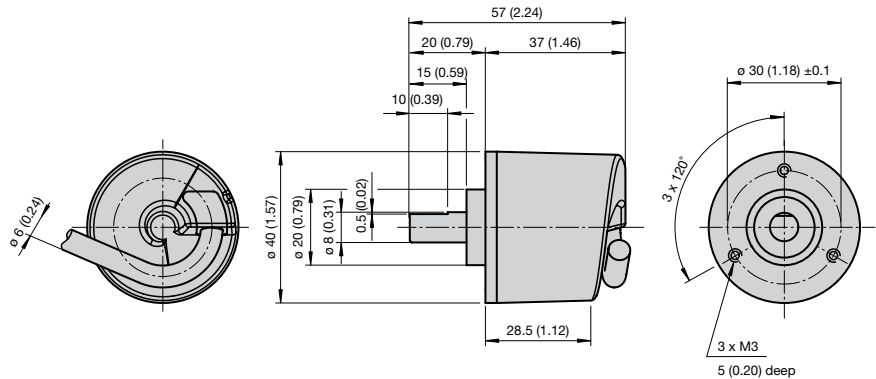
#### Connection Types

CABLE	Ø6 mm, 8 x #26 AWG, 0.5 m or 2 m length
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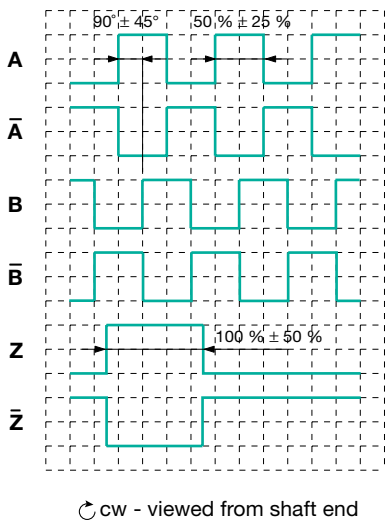


## Dimensions

mm (in.)



## Output Waveform



## Electrical Connection

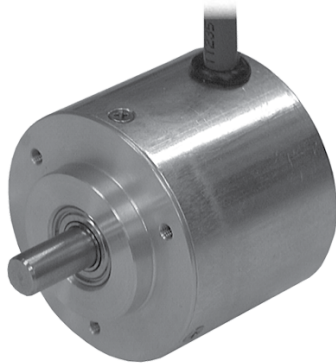
Signal	Ø 6 mm cable
Power Source $U_B$	Brown
GND	Blue
A	Black
B	White
Z	Orange
$\bar{A}$	Violet
$\bar{B}$	Gray
$\bar{Z}$	Yellow



# Incremental Rotary Encoders

## TVI50 Series Solid Shaft

- Outputs up to 1024 ppr
- RS-422 functionality at 5 V
- Withstands higher shaft loads
- Sturdy and compact design
- 4.75 V to 30 V with short-circuit proof, push-pull output



The cost-effective TVI50 has an aluminum housing with an outside diameter of 50 mm; ideal for smaller spaces. It is insensitive to ambient temperature changes and is useful in applications that require high resolution. The TVI50 comes with Opto-ASIC technology and a sturdy metal code disk that withstands higher shaft loading.

### Order Code

**TVI50**  **-09B**    **6TN-**

#### Housing

**N** Aluminum, IP40  
**T** Aluminum, IP54

#### Pulse count

50, 100, 200, 360  
400, 500, 1000, 1024

#### Connection type

**K0** Cable, 0.5 m  
**K2** Cable, 2 m

#### Exit position

**A** Axial  
**R** Radial

Example: TVI50N-09BK0A6TN-1024

## Technical Specifications

### Electrical

PULSE COUNT	≤ 1,024 ppr
OUTPUT FREQUENCY	≤ 100 kHz
SUPPLY VOLTAGE	4.75-30 VDC 5 VDC for RS-422 functionality
OUTPUT	Push-pull (RS-422)
CURRENT CONSUMPTION	≤ 55 mA
LOAD CURRENT PER CHANNEL	≤ 30 mA
VOLTAGE DROP	≤ 2.5 V
RESPONSE TIME	980 ns (225 ns)
CERTIFICATES CE	No. NMTR.E223176 Yes

### Mechanical

MATERIAL	Housing	Aluminum
	Flange	Aluminum
	Shaft	Stainless steel
	Pulse disc	Nickel
WEIGHT		≈ 7.8 oz
ROTATIONAL SPEED		≤ 6,000 rpm
MOMENT OF INERTIA		≤ 7.1 x 10 <sup>-5</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 0.7 in-oz
SHAFT LOADING	Axial	4.5 lbs
	Radial	9.0 lbs
BEARING WORKING LIFE		≥ 2 x 10 <sup>9</sup> revolutions

### Environmental

STORAGE TEMPERATURE	-40°C to +80°C (-40°F to +176°F)
OPERATING TEMPERATURE	-10°C to +70°C (-14°F to +158°F)
HUMIDITY	No moisture condensation
SHOCK RESISTANCE	100 g for 6 ms
VIBRATION RESISTANCE	10 g, 10-2,000 Hz
ENCLOSURE RATING	Without shaft seal
	IP40
	With shaft seal
	IP54

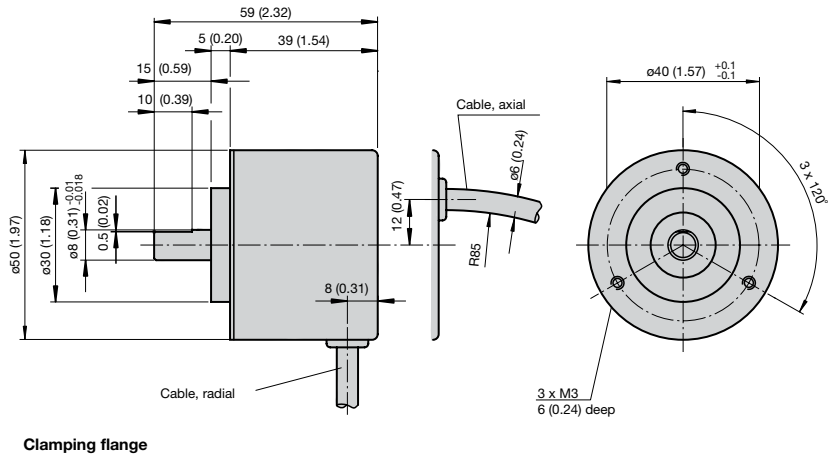
### Connection Types

CABLE	Ø6 mm, 8 x #26 AWG, 0.5 m or 2 m length
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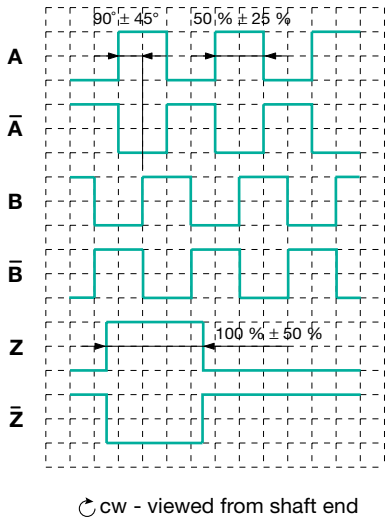


## Dimensions

mm (in.)



## Output Waveform



## Electrical Connection

Signal	Ø 6 mm cable
Power Source $U_B$	Brown
GND	Blue
A	Black
B	White
Z	Orange
A-bar	Violet
B-bar	Gray
Z-bar	Yellow



# Incremental Rotary Encoders

## RVI50 Series Solid Shaft

- Compact 50 mm diameter housing
- Outputs up to 2500 ppr
- 160 kHz maximum output frequency
- Push-pull or RS-422 outputs
- 8 mm diameter shaft



Series RVI50 encoders are a streamlined alternative to standard 58 mm models. At just 50 mm, the compact housing fits into tight spaces, yet is rugged enough for the toughest application. Standard models are available with either a cable or round connector. Either 3 or 6 outputs are available with a maximum frequency of 160 kHz for high-speed applications.

### Order Code

**RVI50N-09B**      **N-**

Connection type, exit position,  
signal output, output switching

- AAA3T** Connector type 9416, 12-pin, axial,  
A + B + Z, 4.75-30 VDC, push-pull
- AAA66** Connector type 9416, 12-pin, axial,  
A + B + Z and  $\bar{A}$  +  $\bar{B}$  +  $\bar{Z}$ , 5 VDC, RS-422
- K0A3T** Cable, 0.5 m, axial, A + B + Z,  
4.75-30 VDC, push-pull


Pulse count

30, 60, 90, 100, 180, 200, 250, 300,  
314, 360, 400, 500, 600, 720, 900,  
1000, 1024, 1200, 1250, 1440,  
1500, 1800, 2000, 2048, 2400, 2500

Example: RVI50N-09BAAA66N-500

### Technical Specifications

#### Electrical

PULSE COUNT	$\leq 2,500$ ppr
OUTPUT FREQUENCY	$\leq 160$ kHz
SUPPLY VOLTAGE	4.75-30 VDC 5 VDC
OUTPUT	4.75-30 VDC, push-pull 5 VDC, RS-422
CURRENT CONSUMPTION	4.75-30 VDC 5 VDC
	$\leq 80$ mA $\leq 150$ mA
LOAD CURRENT PER CHANNEL	Push-pull RS-422
	$\leq 40$ mA, short-circuit protected $\leq 20$ mA
VOLTAGE DROP	Push-pull RS-422
	$< 4$ V —
RESPONSE TIME	Push-pull RS-422
	250 ns 100 ns
CERTIFICATES	 No. NMTR.E223176 CE Yes

#### Mechanical

MATERIAL	Housing Flange Shaft Pulse disc	Powder-coated aluminum Aluminum Stainless steel Plastic (0-600 ppr) Glass (601-2,500 ppr)
WEIGHT		$\approx 8$ oz.
ROTATIONAL SPEED		$\leq 10,000$ rpm
MOMENT OF INERTIA		$\leq 7.1 \times 10^{-5}$ oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		$\leq 2.1$ in-oz
SHAFT LOADING	Axial Radial	32 lbs 33 lbs
BEARING WORKING LIFE		$> 5 \times 10^8$ revolutions

#### Environmental

STORAGE TEMPERATURE	Plastic disc Glass disc	-40°C to +60°C (-40°F to +140°F) -40°C to +70°C (-40°F to +158°F)
OPERATING TEMPERATURE	Plastic disc Glass disc	-20°C to +60°C (-4°F to +140°F) -20°C to +70°C (-4°F to +158°F)
HUMIDITY		No moisture condensation
SHOCK RESISTANCE		100 g for 3 ms
VIBRATION RESISTANCE		10 g, 10-2,000 Hz
ENCLOSURE RATING		IP50

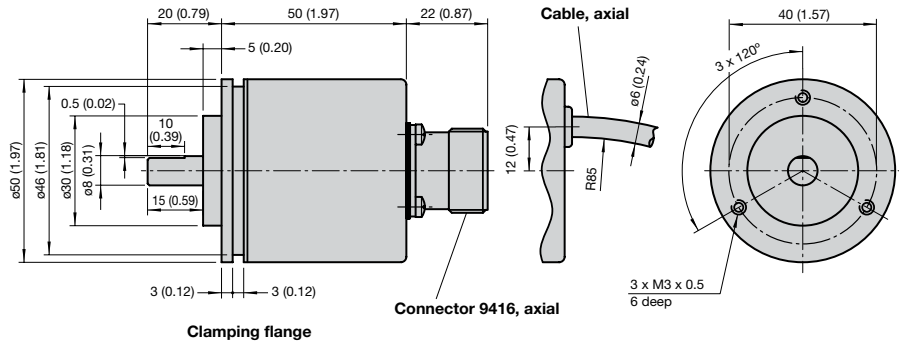
#### Connection Types

CONNECTOR	Type 9416, 12-pin
CABLE	$\varnothing 6$ mm, 5 x #22 AWG, 0.5 m length

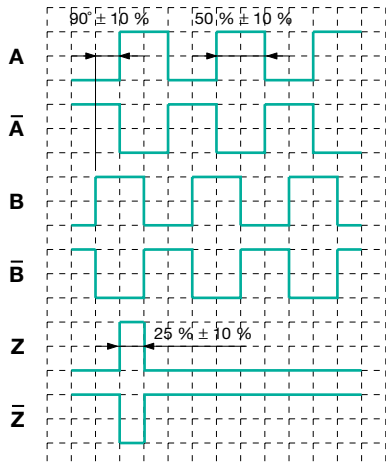


## Dimensions

mm (in.)



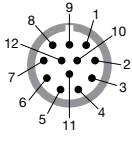
## Output Waveform



↻ cw - viewed from shaft end

## Electrical Connection

Signal	Type 9416, 12-pin quick disconnect	5-conductor cable, Ø 6 mm
Power Source $U_B$	7	Red
GND	8	Black
A	1	Green
B	3	White
Z	5	Yellow
$\bar{A}$	2	—
$\bar{B}$	4	—
$\bar{Z}$	6	—
Shield	Housing	—





# Incremental Rotary Encoders

## TVI58 Series Solid Shaft

- Outputs up to 1500 ppr
- Loadable metal disk
- Opto-ASIC technology
- IP54



The TVI58 is Pepperl+Fuchs' industry standard 58 mm solid shaft encoder. Opto-ASIC technology adds reliability and provides superior noise immunity. The TVI58 is equipped with a heavy-duty metal disk for durability and high loads. Shaft diameters are available in 6 mm or 10 mm. Operating voltages range from 4.75 VDC to 30 VDC with a short-circuit proof, push-pull output.

### Order Code

**TVI58N-□□□□□□6TN-□□□□**

#### Shaft option/Flange style

- 01N** Shaft Ø 10 mm x 20 mm, clamping flange  
**032** Shaft Ø 6 mm x 20 mm, servo flange

#### Pulse count

- 100, 125, 250, 360, 500,  
512, 600, 1000, 1024, 1500

#### Connection type

- K0** Cable, 0.5 m  
**K2** Cable, 2 m

#### Exit position

- A** Axial  
**R** Radial

**Example: TVI58N-01NK0A6TN-1024**

## Technical Specifications

### Electrical

PULSE COUNT	≤ 1,500 ppr
OUTPUT FREQUENCY	≤ 100 kHz
SUPPLY VOLTAGE	4.75-30 VDC 5 VDC for RS-422 functionality
OUTPUT	Push-pull (RS-422)
CURRENT CONSUMPTION	≤ 55 mA
LOAD CURRENT PER CHANNEL	≤ 30 mA
VOLTAGE DROP	≤ 2.5 V
RESPONSE TIME	980 ns (225 ns)
CERTIFICATES	No. NMTR.E223176
CE	Yes

### Mechanical

MATERIAL	Housing	Aluminum
	Flange	Aluminum
	Shaft	Stainless steel
	Pulse disc	Nickel
WEIGHT		≈ 7.8 oz
ROTATIONAL SPEED		≤ 6,000 rpm
MOMENT OF INERTIA		≤ 2.8 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 0.7 in-oz
SHAFT LOADING	Axial	4.5 lbs
	Radial	9.0 lbs
BEARING WORKING LIFE		≥ 2 x 10 <sup>9</sup> revolutions

### Environmental

STORAGE TEMPERATURE	-40°C to +80°C (-40°F to +176°F)
OPERATING TEMPERATURE	-10°C to +70°C (-14°F to +158°F)
HUMIDITY	No moisture condensation
SHOCK RESISTANCE	100 g for 6 ms
VIBRATION RESISTANCE	10 g, 10-2,000 Hz
ENCLOSURE RATING	IP54

### Connection Types

CABLE	Ø6 mm, 8 x #26 AWG, 0.5 m or 2 m length
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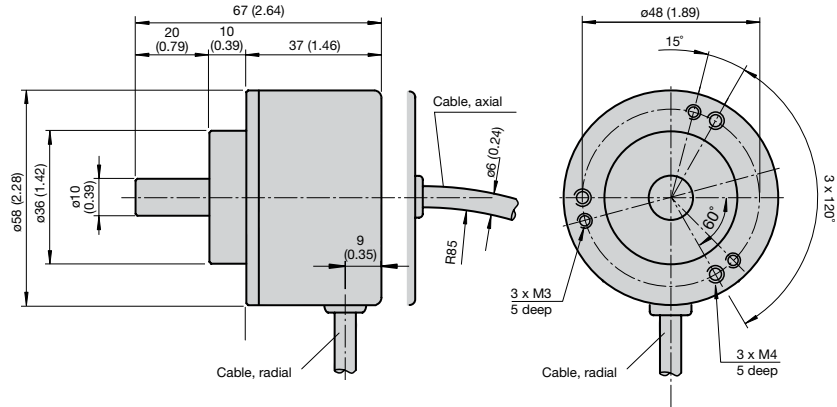
# Incremental Rotary Encoders

## Dimensions

mm (in.)

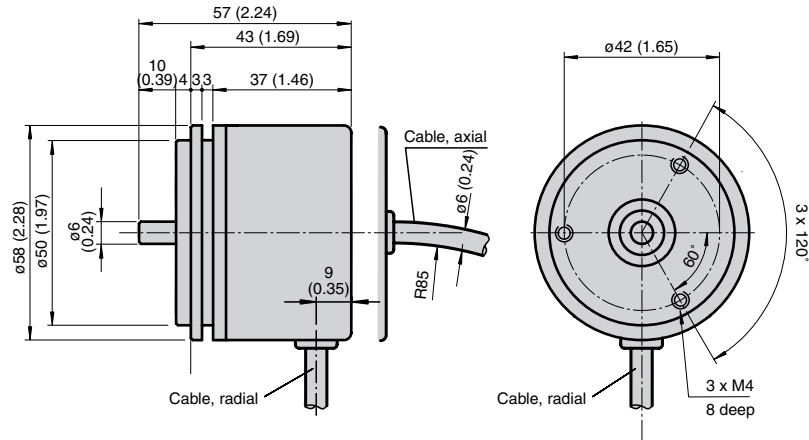
### Shaft option/flange style Ø1N

Ø10 mm x 20 mm with clamping flange

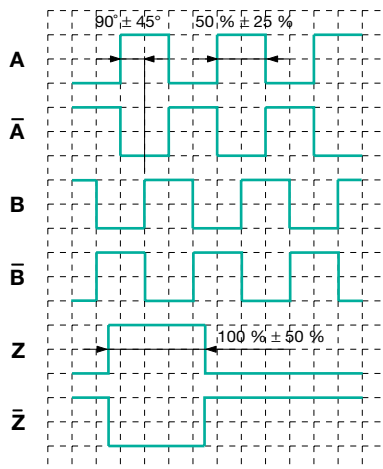


### Shaft option/flange style Ø32

Ø6 mm x 20 mm with servo flange



## Output Waveform



↻ cw - viewed from shaft end

## Electrical Connection

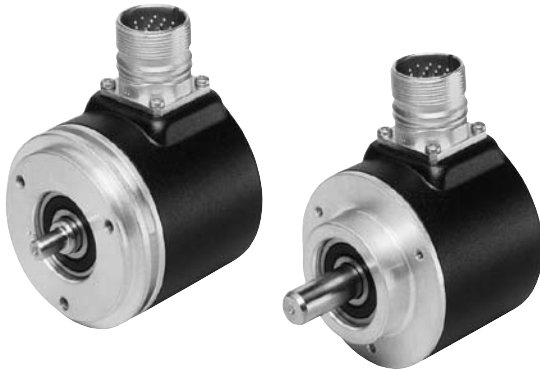
Signal	0 8-conductor cable, Ø 6 mm
Power Source $U_B$	Brown
GND	White
A	Green
B	Gray
Z	Blue
$\bar{A}$	Yellow
$\bar{B}$	Pink
$\bar{Z}$	Red



# Incremental Rotary Encoders

## RVI58 Series Solid Shaft

- Industry standard 58 mm diameter housing
- Outputs up to 10,000 ppr
- Servo or clamping flange
- IP65 protection rating
- 6 mm or 10 mm diameter shaft
- 10-30 VDC or 5 VDC powered



The RVI58 encoder series feature an IP65 rated 58 mm diameter aluminum housing. Outputs up to 10,000 ppr allow it to be used in applications that require the highest resolutions. Standard models are available with either a cable or round connector, with quadrature and index outputs or quadrature and index plus complementary outputs.

### Order Code

**RVI58N-□□□□□□□□N-□□□□**

#### Shaft option/flange style

- 011** Ø 10 mm x 20 mm with clamping flange
- 021** Ø 12 mm x 20 mm with clamping flange
- 032** Ø 6 mm x 10 mm with servo flange

#### Connection type

- AA** Type 9416, 12-pin connector\*
- AB** Type 9416L, 12-pin connector
- K1** Cable, 1 m

\* up to 5,000 ppr only

#### Exit position

- A** Axial
- R** Radial

#### Pulse count

- 100, 360, 500, 512, 1000, 1024, 1250, 2048, 2500, 3600, 4096, 5000, 6000, 6400, 8192, 9000, 10000

#### Output switching

- 1** 10-30 VDC, push-pull
- 6** 5 VDC, RS-422
- X** 10-30 VDC, RS-422


#### Signal output

- 6** A + B + Z and  $\bar{A} + \bar{B} + \bar{Z}$

Example: RVI58N-011AAR6XN-1250

### Technical Specifications

#### Electrical

<b>PULSE COUNT</b>	≤ 10,000 ppr
<b>OUTPUT FREQUENCY</b>	≤ 200 kHz
<b>SUPPLY VOLTAGE</b>	10-30 VDC 5 VDC
<b>OUTPUT</b>	10-30 VDC, push-pull 10-30 VDC, RS-422 5 VDC, RS-422
<b>CURRENT CONSUMPTION</b>	<i>Up to 5,000 ppr</i> ≤ 60 mA (10-30 VDC) ≤ 70 mA (5 VDC) <i>Above 5,000 ppr</i> ≤ 150 mA
<b>LOAD CURRENT PER CHANNEL</b>	<i>Push-pull</i> ≤ 40 mA, short circuit, reverse polarity protected <i>RS-422</i> ≤ 20 mA
<b>VOLTAGE DROP</b>	<i>Push-pull</i> < 3 V <i>RS-422</i> –
<b>RESPONSE TIME</b>	<i>Push-pull</i> 400 ns <i>RS-422</i> 100 ns
<b>CERTIFICATES</b>	 No. NMTR.E223176
<b>CE</b>	Yes

#### Mechanical

<b>MATERIAL</b>	<i>Housing</i> Powder-coated aluminum <i>Flange</i> Aluminum <i>Shaft</i> Stainless steel <i>Pulse disc</i> Plastic (0-1,500 ppr) Glass (1,501-10,000 ppr)
<b>WEIGHT</b>	≈ 12.5 oz
<b>ROTATIONAL SPEED</b>	≤ 12,000 rpm
<b>MOMENT OF INERTIA</b>	≤ 3.5 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>	≤ 2.1 in-oz
<b>SHAFT LOADING</b>	<i>Axial</i> 40/9.8 lbs (6,000/12,000 rpm) <i>Radial</i> 40/13.3 lbs (6,000/12,000 rpm)
<b>BEARING WORKING LIFE</b>	> 2 x 10 <sup>9</sup> revolutions

#### Environmental

<b>STORAGE TEMPERATURE</b>	<i>Plastic disc</i> -40°C to +70°C (-40°F to +158°F) <i>Glass disc</i> -40°C to +100°C (-40°F to +212°F)
<b>OPERATING TEMPERATURE</b>	<i>Plastic disc</i> -20°C to +60°C (-4°F to +140°F) <i>Glass disc</i> -20°C to +80°C (-4°F to +170°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 3 ms
<b>VIBRATION RESISTANCE</b>	<i>Up to 5,000 ppr</i> 10 g, 10-2,000 Hz <i>Above 5,000 ppr</i> 10 g, 55-2,000 Hz
<b>ENCLOSURE RATING</b>	IP65

#### Connection Types

<b>CONNECTOR</b>	Type 9416, 12-pin (up to 5,000 ppr only) Type 9416L, 12-pin
<b>CABLE</b>	Ø7.8 mm, 12 x #26 AWG, 1 m length



# Incremental Encoders RV158 Series

Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com



# Incremental Rotary Encoders

## TSI40 Series Recessed Hollow Shaft

- Outputs up to 1024 ppr
- Smallest incremental encoder size
- Push-pull, RS-422 outputs available
- IP54
- Tangential cable outlet



The TSI40 features a 40 mm housing that is suitable for installation in even the most restrictive spaces. It has a recessed hollow shaft with shaft bore dimensions of 4 mm and 6 mm, and a depth of 15 mm. The TSI40 comes with the new, tangential cable outlet, designed by Pepperl+Fuchs, which enables the user to lay the cable radially or axially.

### Order Code

**TSI40N-□□□□T6TN-□□□□**

**Shaft dimension/Flange version**  
**16A** Recessed hollow shaft Ø 4 mm x 15 mm  
**14A** Recessed hollow shaft Ø 6 mm x 15 mm

**Pulse count**  
50, 100, 200, 360,  
400, 500, 1000, 1024

**Connection type**  
**K0** Cable, 0.5 m  
**K2** Cable, 2 m

**Example: TSI40N-16AK0T6TN-1024**

### Technical Specifications

#### Electrical

PULSE COUNT	≤ 1,024 ppr
OUTPUT FREQUENCY	≤ 100 kHz
SUPPLY VOLTAGE	4.75-30 VDC 5 VDC for RS-422 functionality
OUTPUT	Push-pull (RS-422)
CURRENT CONSUMPTION	≤ 55 mA
LOAD CURRENT PER CHANNEL	≤ 30 mA
VOLTAGE DROP	≤ 2.5 V
RESPONSE TIME	980 ns (225 ns)
CERTIFICATES CE	No. NMTR.E223176 Yes

#### Mechanical

MATERIAL	Housing	Polycarbonate
	Flange	Aluminum
	Shaft	Stainless steel
	Pulse disc	Nickel
WEIGHT		≈ 6.3 oz
ROTATIONAL SPEED		≤ 6,000 rpm
MOMENT OF INERTIA		≤ 6.1 x 10 <sup>-5</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 0.3 in-oz
SHAFT LOADING	Angle offset	1°
	Axial offset	≤ 1 mm
BEARING WORKING LIFE		≥ 2 x 10 <sup>9</sup> revolutions

#### Environmental

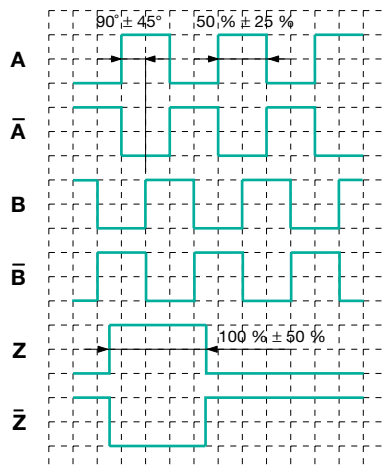
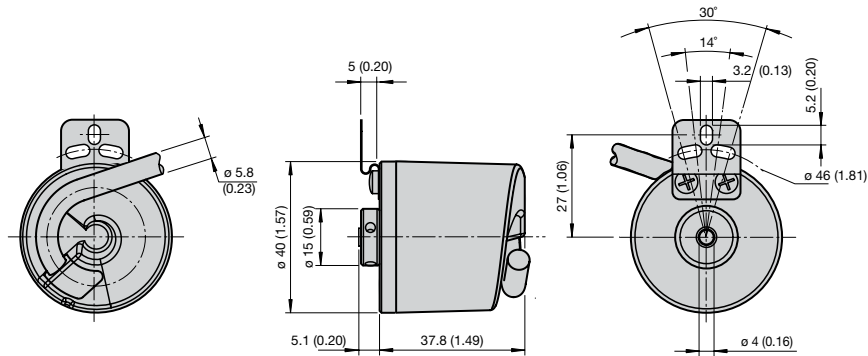
STORAGE TEMPERATURE	-25°C to +85°C (-13°F to +185°F)
OPERATING TEMPERATURE	-10°C to +70°C (-14°F to +158°F)
HUMIDITY	No moisture condensation
SHOCK RESISTANCE	100 g for 6 ms
VIBRATION RESISTANCE	10 g, 10-2,000 Hz
ENCLOSURE RATING	IP54

#### Connection Types

CABLE	Ø6 mm, 8 x #26 AWG, 0.5 m or 2 m length
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# Incremental Encoders TS/40 Series



Signal	Ø 6 mm cable
Power Source $U_B$	Brown
GND	Blue
A	Black
B	White
Z	Orange
$\bar{A}$	Violet
$\bar{B}$	Gray
$\bar{Z}$	Yellow



# Incremental Rotary Encoders

## TH158 Series Hollow Shaft

- Outputs up to 1500 ppr
- Push-pull, RS-422 outputs available
- Insensitive to ambient temperature
- Loadable metal disc
- Opto-ASIC technology
- Sturdy, compact design



The cost-effective TH158 is a hollow shaft incremental encoder in an industry standard 58 mm housing diameter. It includes a more robust metal disc code, rather than a glass or plastic code, for rugged applications. The TH158 has shaft sizes of 10 mm, 12 mm, 15 mm or 5/8"; and provides up to 1500 ppr.

### Order Code

**TH158N-□□AK0R6TN-□□□□**

#### Shaft dimensions

- 0A** Hollow shaft Ø 10 mm (clamping ring on flange side)
- 0B** Hollow shaft Ø 12 mm (clamping ring on flange side)
- 0T** Hollow shaft Ø 15 mm (clamping ring on flange side)
- 0W** Hollow shaft Ø 5/8" (clamping ring on flange side)
- 1A** Hollow shaft Ø 10 mm (clamping ring on cover side)
- 1B** Hollow shaft Ø 12 mm (clamping ring on cover side)
- 1T** Hollow shaft Ø 15 mm (clamping ring on cover side)

#### Pulse count

- 100, 125, 250, 360, 500,
- 512, 600, 1000, 1024, 1500

**Example: TH158N-0AAK0R6TN-1024**

## Technical Specifications

### Electrical

PULSE COUNT	≤ 1,500 ppr
OUTPUT FREQUENCY	≤ 100 kHz
SUPPLY VOLTAGE	4.75-30 VDC 5 VDC for RS-422 functionality
OUTPUT	Push-pull (RS-422)
CURRENT CONSUMPTION	≤ 55 mA
LOAD CURRENT PER CHANNEL	≤ 30 mA
VOLTAGE DROP	≤ 2.5 V
RESPONSE TIME	980 ns (225 ns)
CERTIFICATES CE	No. NMTR.E223176 Yes

### Mechanical

MATERIAL	Housing	Aluminum
	Flange	Aluminum
	Shaft	Stainless steel
	Pulse disc	Nickel
WEIGHT		≈ 10.2 oz
ROTATIONAL SPEED		≤ 6,000 rpm
MOMENT OF INERTIA		≤ 5.7 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 3.5 in-oz
SHAFT	Angle offset	1°
LOADING	Axial offset	≤ 1 mm
BEARING WORKING LIFE		> 2 x 10 <sup>9</sup> revolutions

### Environmental

STORAGE TEMPERATURE	-40°C to +80°C (-40°F to +176°F)
OPERATING TEMPERATURE	-10°C to +70°C (-14°F to +158°F)
HUMIDITY	No moisture condensation
SHOCK RESISTANCE	100 g for 6 ms
VIBRATION RESISTANCE	10 g, 10-2,000 Hz
ENCLOSURE RATING	IP54

### Connection Types

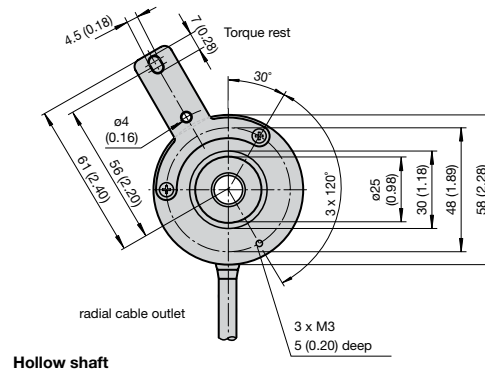
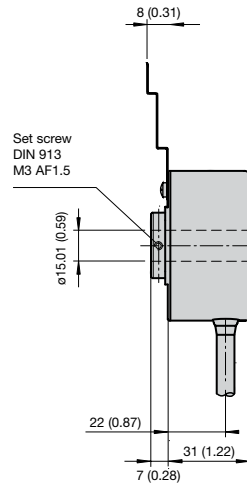
CABLE	Ø6 mm, 8 x #26 AWG, 0.5 m length
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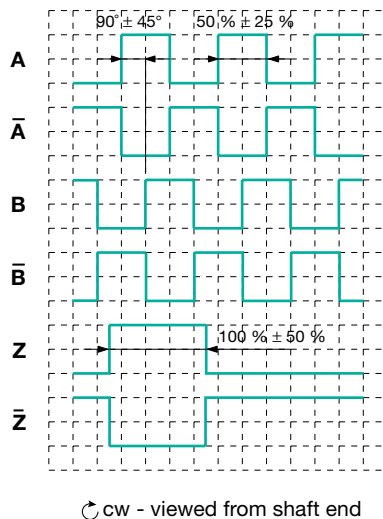
# Incremental Rotary Encoders

## Dimensions

mm (in.)



## Output Waveform



## Electrical Connection

Signal	0 8-conductor cable, Ø 6 mm
Power Source $U_B$	Brown
GND	White
A	Green
B	Gray
Z	Blue
$\bar{A}$	Yellow
$\bar{B}$	Pink
$\bar{Z}$	Red

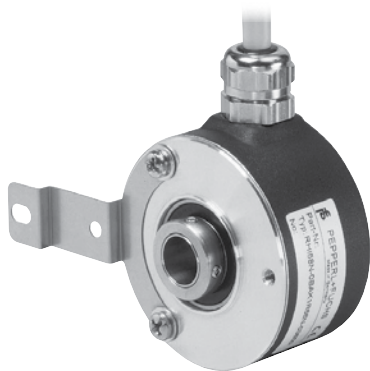
Incremental Encoders TH158 Series



# Incremental Rotary Encoders

## RHI58 Series Hollow Shaft

- Standard 58 mm diameter housing
- Outputs up to 100,000 ppr
- 10 mm, 12 mm, 15 mm or 1/2" diameter shaft bore
- 10-30 VDC or 5 VDC powered



Series RHI58 encoders are the hollow shaft, 58 mm diameter European industrial standard. The encoder fits in tight locations thanks to a mounting profile less than 2 inches. The hollow shaft design allows the encoder to be mounted directly to the application while the torque rest prevents it from rotating. Models are available with pulse outputs up to 100,000 ppr and a maximum frequency of 300 kHz. It is offered with 6 outputs and a cable connection.

### Order Code

**RHI58N-□□AK1R□□N-□□□□**

#### Shaft options

- 0A** Hollow shaft ø 10 mm
- 0B** Hollow shaft ø 12 mm
- 0T** Hollow shaft 15 mm (100 ppr and 360 ppr not available)
- 0S** Hollow shaft 1/2"

#### Signal output

**6** A + B + Z and  $\bar{A}$  +  $\bar{B}$  +  $\bar{Z}$

#### Output switching

- 1** 10-30 VDC, push-pull
- 6** 5 VDC, RS-422
- X** 10-30 VDC, RS-422


#### Pulse count

100, 360, 500, 512, 1000, 1024, 1250, 2000, 2048, 2500, 2560, 3600, 4000, 4096, 5000, 5120, 6250, 8000, 8192, 10000, 10240, 12500, 16000, 20000, 25000, 32000, 40000

Example: RHI58N-0BAK1R61N-2048

### Technical Specifications

#### Electrical

PULSE COUNT		≤ 100,000 ppr
OUTPUT FREQUENCY		≤ 300 kHz
SUPPLY VOLTAGE		10-30 VDC 5 VDC
OUTPUT		10-30 VDC, push-pull 10-30 VDC, RS-422 5 VDC, RS-422
CURRENT CONSUMPTION	10-30 VDC	≤ 60 mA
	5 VDC	≤ 70 mA
LOAD CURRENT PER CHANNEL	Push-pull	≤ 40 mA, short circuit, reverse polarity protected
	RS-422	≤ 20 mA
VOLTAGE DROP	Push-pull	< 3 V
	RS-422	—
RESPONSE TIME	Push-pull	400 ns
	RS-422	100 ns
CERTIFICATES CE		No. NMTR.E223176
		Yes

#### Mechanical

<b>MATERIAL</b>	Housing	Powder-coated aluminum
	Flange	Aluminum
	Shaft	Stainless steel
	Pulse disc	Glass
<b>WEIGHT</b>		≈ 10 oz.
<b>ROTATIONAL SPEED</b>		≤ 6,000 rpm
<b>MOMENT OF INERTIA</b>		≤ 5.7 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>		≤ 2.1 in-oz
<b>SHAFT LOADING</b>	Angle offset	1°
	Axial offset	≤ 1 mm
<b>BEARING WORKING LIFE</b>		> 2 x 10 <sup>10</sup> revolutions

#### Environmental

<b>STORAGE TEMPERATURE</b>	≤ 5,000 ppr	-40°C to +100°C (-40°F to +212°F)
	> 5,000 ppr	-40°C to +80°C (-40°F to +170°F)
<b>OPERATING TEMPERATURE</b>		-20°C to +80°C (-4°F to +170°F)
<b>HUMIDITY</b>		No moisture condensation
<b>SHOCK RESISTANCE</b>		100 g for 3 ms
<b>VIBRATION RESISTANCE</b>		10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>		IP54

#### Connection Types

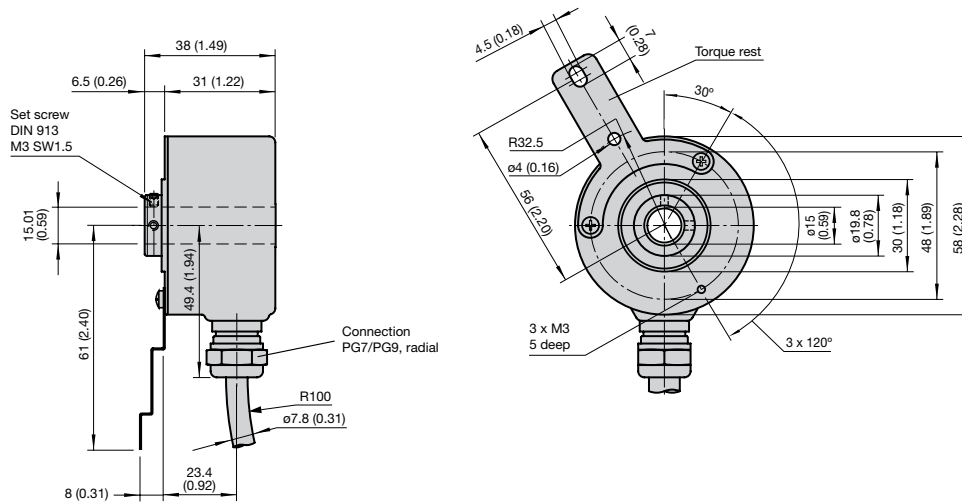
<b>CABLE</b>	Ø7.8 mm, 12 x #26 AWG, 1 m length
--------------	-----------------------------------



# Incremental Rotary Encoders

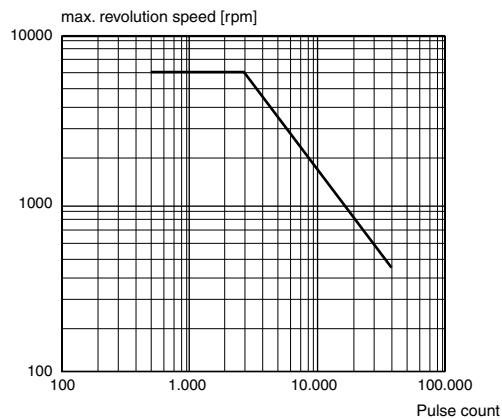
## Dimensions

mm (in.)

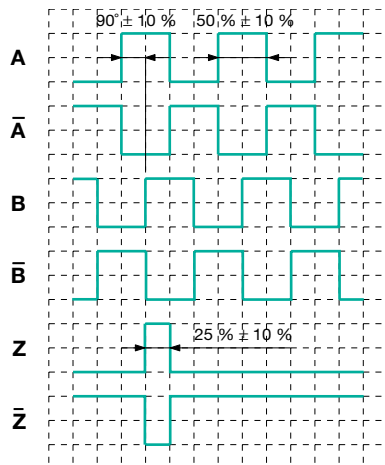


## Maximum Revolution Speed

### Pulse/revolution speed diagram



## Output Waveform



↻ cw - viewed from shaft end

## Electrical Connection

Signal	12-conductor cable, Ø 7.8 mm
Power Source $U_B$	Brown
GND	White
A	Green
B	Gray
Z	Blue
$\bar{A}$	Yellow
$\bar{B}$	Pink
$\bar{Z}$	Red
GND Sens*	Black
$U_B$ Sens*	Violet
Shield	—

\*Only for devices with 5 V supply and RS-422 interface

Incremental Encoders RH158 Series



# Incremental Rotary Encoders

## RSI58 Series Recessed Hollow Shaft

- Standard 58 mm diameter housing
- Outputs up to 5000 ppr
- 10 mm or 12 mm diameter shaft bore
- 10-30 VDC or 5 VDC powered



Series RSI58 encoders are the recessed hollow shaft, 58 mm diameter European industrial standard. Unlike standard hollow shafts, the recessed hollow shaft hole is only 21 mm deep. This design allows the encoder to have an axial mounted connector. The encoder can be mounted directly to the application while the torque rest prevents the encoder from rotating. Models are available with pulse outputs up to 5000 ppr and a maximum frequency of 200 kHz. It is offered with 6 outputs and a cable or connector.

### Order Code

**RSI58N-□□A□□□□□N-□□□□**

#### Shaft options

- 01** Recessed hollow shaft Ø 10 mm x 20 mm  
**02** Recessed hollow shaft Ø 12 mm x 20 mm

#### Connection type

- AA** Type 9416, 12-pin connector  
**K1** Cable, 1 m

#### Exit position

- A** Axial  
**R** Radial

#### Pulse count

- 100, 360, 500, 512, 1000, 1024,  
1250, 2048, 2500, 3600, 4096, 5000

#### Output switching

- 1** 10-30 VDC, push-pull  
**6** 5 VDC, RS-422  
**X** 10-30 VDC, RS-422

#### Signal output

- 6** A + B + Z and  $\bar{A}$  +  $\bar{B}$  +  $\bar{Z}$

**Example: RSI58N-01AAAR6XN-1250**

### Technical Specifications

#### Electrical

<b>PULSE COUNT</b>	≤ 5,000 ppr
<b>OUTPUT FREQUENCY</b>	≤ 200 kHz
<b>SUPPLY VOLTAGE</b>	10-30 VDC 5 VDC
<b>OUTPUT</b>	10-30 VDC, push-pull 10-30 VDC, RS-422 5 VDC, RS-422
<b>CURRENT CONSUMPTION</b>	<i>10-30 VDC</i> ≤ 60 mA <i>5 VDC</i> ≤ 70 mA
<b>LOAD CURRENT PER CHANNEL</b>	<i>Push-pull</i> ≤ 40 mA, short circuit, reverse polarity protected <i>RS-422</i> ≤ 20 mA
<b>VOLTAGE DROP</b>	<i>Push-pull</i> < 3 V <i>RS-422</i> –
<b>RESPONSE TIME</b>	<i>Push-pull</i> 400 ns <i>RS-422</i> 100 ns
<b>CERTIFICATES</b>	<i>UL</i> No. NMTR.E223176 <b>CE</b> Yes

#### Mechanical

<b>MATERIAL</b>	<i>Housing</i> Powder-coated aluminum <i>Flange</i> Aluminum <i>Shaft</i> Stainless steel <i>Pulse disc</i> Plastic (0-1,500 ppr) Glass (1,501-5,000 ppr)
<b>WEIGHT</b>	≈ 10 oz
<b>ROTATIONAL SPEED</b>	≤ 12,000 rpm
<b>MOMENT OF INERTIA</b>	≤ 5.0 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>	≤ 1.4 in-oz
<b>SHAFT LOADING</b>	<i>Angle offset</i> 1° <i>Axial offset</i> ≤ 1 mm
<b>BEARING WORKING LIFE</b>	> 2 x 10 <sup>10</sup> revolutions

#### Environmental

<b>STORAGE TEMPERATURE</b>	<i>Plastic disc</i> -40°C to +70°C (-40°F to +158°F) <i>Glass disc</i> -40°C to +100°C (-40°F to +212°F)
<b>OPERATING TEMPERATURE</b>	<i>Plastic disc</i> -20°C to +60°C (-4°F to +140°F) <i>Glass disc</i> -20°C to +80°C (-4°F to +170°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 3 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP54

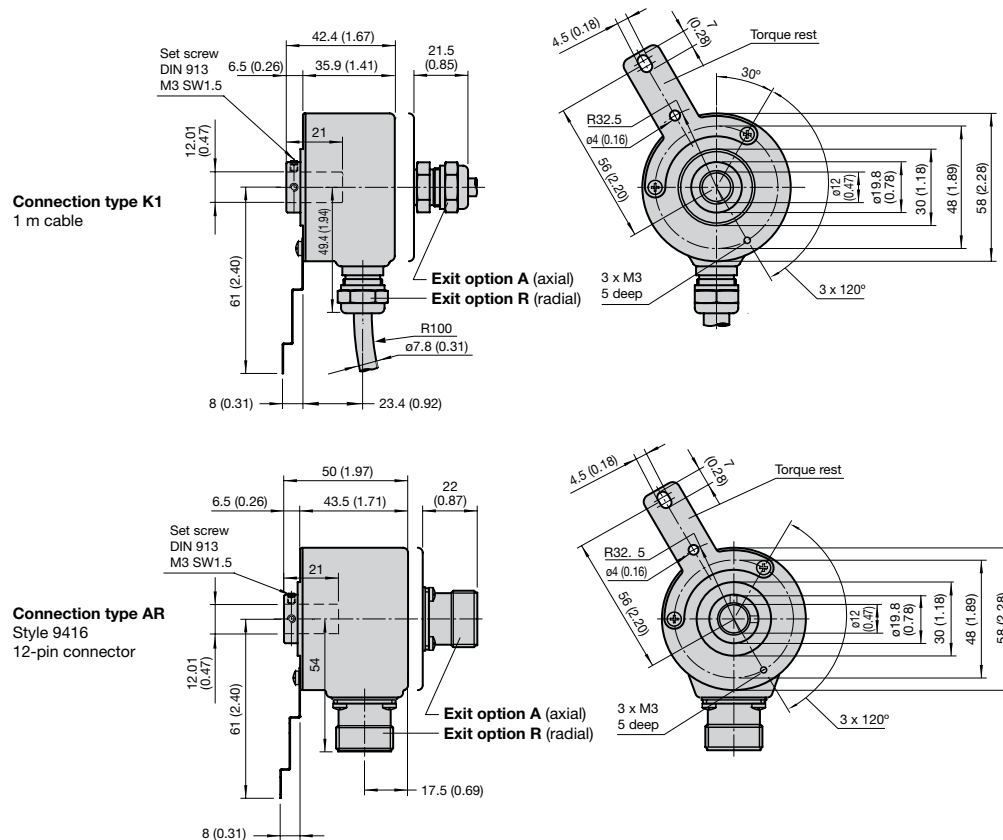
#### Connection Types

<b>CONNECTOR</b>	Type 9416, 12-pin
<b>CABLE</b>	Ø7.8 mm, 12 x #26 AWG, 1 m length

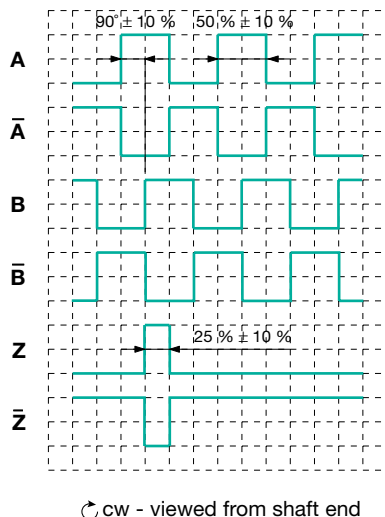


## Dimensions

mm (in.)

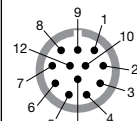


## Output Waveform



## Electrical Connection

Signal	AA Type 9416, 12-pin quick disconnect	K1 12-conductor cable, Ø 7.8 mm
Power Source $U_B$	12	Brown
GND	10	White
A	5	Green
B	8	Gray
Z	3	Blue
$\bar{A}$	6	Yellow
$\bar{B}$	1	Pink
$\bar{Z}$	4	Red
No Connection	7	Gray/Pink
GND Sens*	11	Black
$U_B$ Sens*	2	Violet
Shield	Housing	—



\*Only for devices with 5 V supply and RS-422 interface



# Incremental Rotary Encoders

## RHI90 Series Hollow Shaft

- Compact and rugged housing design
- Variable hollow shaft, 16 mm to 45 mm
- Outputs up to 2500 ppr
- Loadable metal disc
- 5 or 10-30 VDC



The RHI90 is specifically designed for mechanical drive and lift engineering. A rugged metal code disc assures that the encoder can be used for applications with extreme shock and vibration stress. With up to 2500 pulses it is ideal for applications that require high accuracy. Additional shaft bore sizes are available. Contact your P+F representative for details. Its relatively small outside diameter allows it to be used even if little mounting space is available.

### Order Code

**RHI90N-□□A□□R6□N-□□□□**

#### Shaft dimensions

**OE** Hollow shaft Ø 16 mm  
**OF** Hollow shaft Ø 20 mm  
**OG** Hollow shaft Ø 24 mm  
**OH** Hollow shaft Ø 25 mm  
**OI** Hollow shaft Ø 30 mm  
**OL** Hollow shaft Ø 38 mm  
**ON** Hollow shaft Ø 45 mm  
**OZ** Hollow shaft Ø 1"

#### Connection type

**AA** Plug connector type 9416, 12-pin  
**AB** Plug connector type 9416L, 12-pin  
**K1** Cable, 1 m

#### Pulse count

100, 360, 500, 512, 1000,  
1024, 1250, 2048, 2500


#### Output switching

**1** 10-30 VDC, push-pull  
**6** 5 VDC, RS-422

Example: RHI90N-0EAK1R61N-1024

### Technical Specifications

#### Electrical

<b>PULSE COUNT</b>	≤ 2,500 ppr
<b>OUTPUT FREQUENCY</b>	≤ 120 kHz
<b>SUPPLY VOLTAGE</b>	10-30 VDC 5 VDC
<b>OUTPUT</b>	10-30 VDC, push-pull 5 VDC, RS-422
<b>CURRENT CONSUMPTION</b>	≤ 70 mA
<b>LOAD CURRENT PER CHANNEL</b>	<i>Push-pull</i> ≤ 40 mA, short circuit, reverse polarity protected <i>RS-422</i> ≤ 20 mA
<b>VOLTAGE DROP</b>	<i>Push-pull</i> < 2.5 V <i>RS-422</i> —
<b>RESPONSE TIME</b>	980 ns
<b>CERTIFICATES</b>	 No. NMTR.E223176
<b>CE</b>	Yes

#### Mechanical

<b>MATERIAL</b>	<i>Housing</i> Aluminum <i>Flange</i> Aluminum <i>Shaft</i> Stainless steel <i>Pulse disc</i> Nickel
<b>WEIGHT</b>	≈ 2.0 lbs
<b>ROTATIONAL SPEED</b>	≤ 3,500 rpm
<b>STARTING TORQUE AT 20°C</b>	≤ 8.5 in-oz
<b>SHAFT LOADING</b>	<i>Angle offset</i> 1° <i>Axial offset</i> ≤ 1 mm
<b>BEARING WORKING LIFE</b>	≥ 2 x 10 <sup>9</sup> revolutions

#### Environmental

<b>STORAGE TEMPERATURE</b>	-40°C to +80°C (-40°F to +176°F)
<b>OPERATING TEMPERATURE</b>	-20°C to +70°C (-4°F to +158°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 6 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP65

#### Connection Types

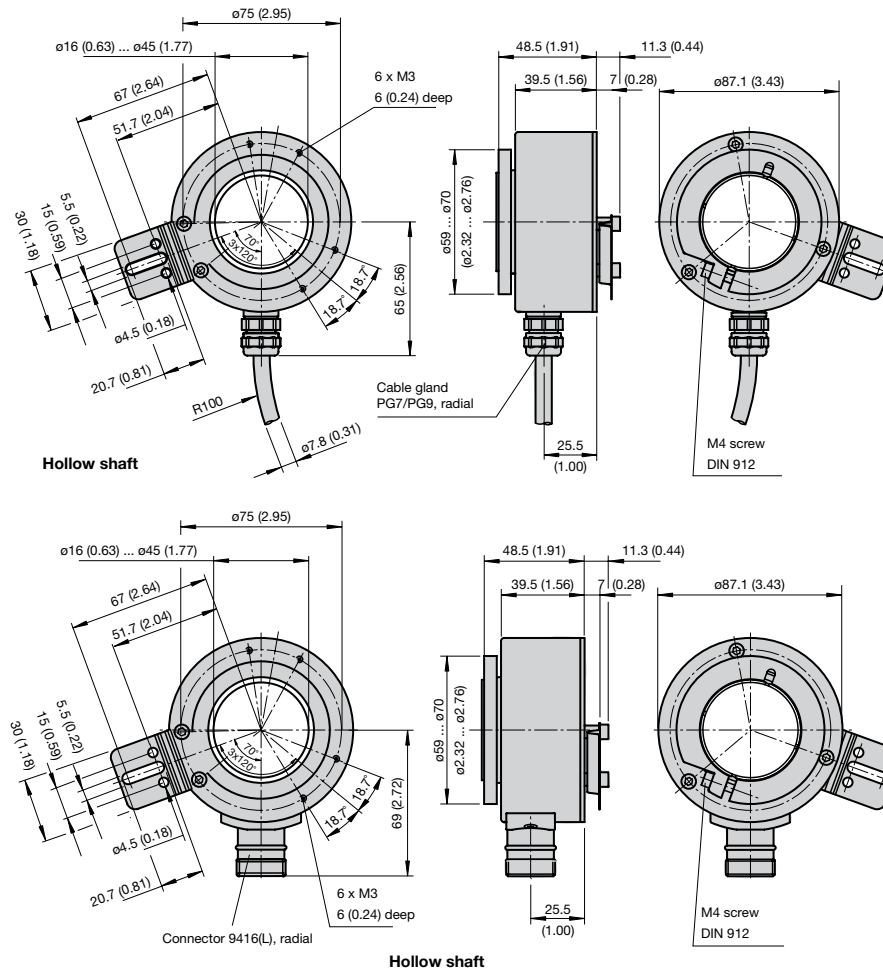
<b>CONNECTOR</b>	Type 9416, 12-pin Type 9416L, 12-pin
<b>CABLE</b>	Ø7.8 mm, 8 x #26 AWG, 1 m length



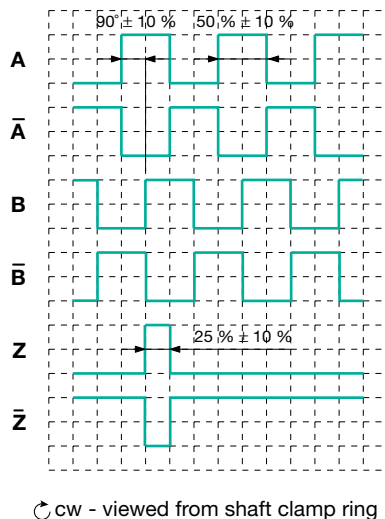
# Incremental Rotary Encoders

## Dimensions

mm (in.)



## Output Waveform



## Electrical Connection

Signal	AA Type 9416, 12-pin quick disconnect	AB Type 9416L, 12-pin quick disconnect	K1 8-conductor cable, Ø 7.8 mm
Power Source $U_B$	12	12	Brown
GND	10	10	White
A	5	5	Green
B	8	8	Gray
Z	3	3	Blue
$\bar{A}$	6	6	Yellow
$\bar{B}$	1	1	Pink
$\bar{Z}$	4	4	Red
Shield	Housing	Housing	—
No Connection	2, 7, 9, 11	2, 7, 9, 11	—



# Incremental Rotary Encoders

## Series 30 Solid Shaft

- Heavy-duty steel housing
- Designed for high shock and vibration applications
- Outputs up to 5000 ppr
- 100 kHz maximum output frequency
- Push-pull or RS-422 outputs
- 12 mm diameter shaft



Series 30 encoders are Pepperl+Fuchs' most heavy-duty models. Standard models feature steel housings, a choice of 3 or 6 outputs with either a cable or a round connector. A stainless steel version is available for the harshest environments.

### Order Code

30-□□□□□A-□□□□□

#### Signal output

36 A + B + Z and  $\bar{A}$  +  $\bar{B}$  +  $\bar{Z}$   
42 A + B + Z

#### Connection type

0 Cable, 2 m  
4 Type 9416, 12-pin connector

#### Output switching

1 10-30 VDC, push-pull  
6 5 VDC, RS-422\*

\* must choose signal output 36

#### Pulse count

60, 100, 120, 180, 200, 250, 256,  
300, 314, 360, 400, 500, 512, 600,  
720, 900, 1000, 1024, 1200, 1250,  
1500, 1800, 2000, 2048, 2400, 2500,  
3000, 3600, 4000, 4096, 5000

#### Housing material

Blank Steel  
I Stainless steel

Example: 30-4241A-1500

### Technical Specifications

#### Electrical

PULSE COUNT		≤ 5,000 ppr
OUTPUT FREQUENCY		≤ 100 kHz
SUPPLY VOLTAGE		10-30 VDC 5 VDC
OUTPUT		10-30 VDC, push-pull 5 VDC, RS-422
CURRENT CONSUMPTION	10-30 VDC	≤ 80 mA
	5 VDC	≤ 150 mA
LOAD CURRENT PER CHANNEL	Push-pull	≤ 40 mA, short circuit, reverse polarity protected
	RS-422	≤ 20 mA
VOLTAGE DROP	Push-pull	< 4 V
	RS-422	—
RESPONSE TIME	Push-pull	250 ns
	RS-422	100 ns
CERTIFICATES	UL	No. NMTR.E223176
CE		Yes

#### Mechanical

MATERIAL	Housing	Steel (standard) Stainless steel (option I)
	Flange	Aluminum (standard) Stainless steel (option I)
	Shaft	Stainless steel
	Pulse disc	Plastic (0-1,500 ppr) Glass (1,501-5000 ppr)
WEIGHT		≈ 44 oz (standard) ≈ 78 oz (option I)
ROTATIONAL SPEED		≤ 6,000 rpm
MOMENT OF INERTIA		≤ 3.8 x 10 <sup>-3</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 7.1 in-oz
SHAFT LOADING	Axial	61 lbs
	Radial	54 lbs
BEARING WORKING LIFE		> 2 x 10 <sup>8</sup> revolutions

#### Environmental

STORAGE TEMPERATURE	Plastic disc	-40°C to +60°C (-40°F to +140°F)
	Glass disc	-40°C to +70°C (-40°F to +158°F)
OPERATING TEMPERATURE	Plastic disc	-20°C to +60°C (-4°F to +140°F)
	Glass disc	-20°C to +70°C (-4°F to +158°F)
HUMIDITY		95% RH non-condensing at 40°C (104°F) for 4 days
ENCLOSURE RATING		IP65

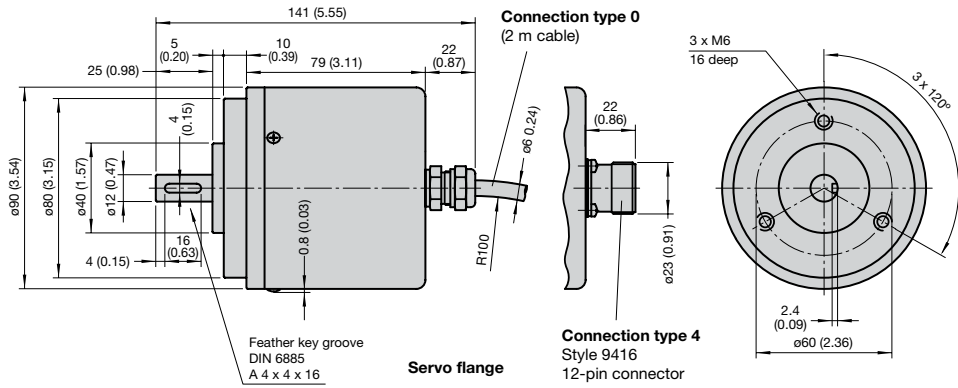
#### Connection Types

CONNECTOR	Type 9416, 12-pin
CABLE	Ø6 mm, 8 x #26 AWG, 2 m length

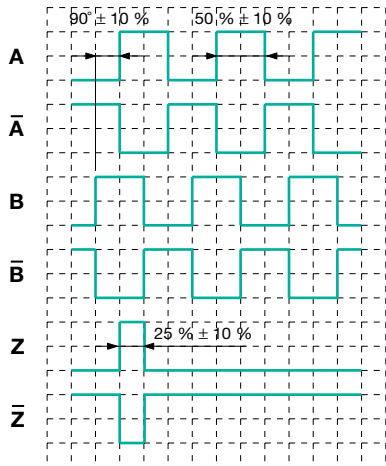


## Dimensions

mm (in.)



## Output Waveform



↻ cw - viewed from shaft end

## Electrical Connection

Signal	4 Type 9416, 12-pin quick disconnect	0 8-conductor cable, Ø 6 mm
Power Source $U_B$	2	Brown
GND	1	White
A	3	Green
B	4	Gray
Z	7	Blue
$\bar{A}$	5	Yellow
$\bar{B}$	6	Pink
$\bar{Z}$	8	Red

Pinout diagram for the 12-pin quick disconnect connector, showing the pin numbers 1 through 12 and their corresponding signal assignments.



# Incremental Rotary Encoders

## Incremental Encoders RVI78 Series

### RVI78 Series Solid Shaft

- Heavy-duty 78 mm diameter housing
- Outputs up to 5000 ppr
- IP65 protection rating
- 10 mm diameter shaft
- 10-30 VDC powered



Pepperl+Fuchs' Series RVI78 encoder is a heavy-duty aluminum model designed to withstand severe shaft loading. The unique mounting flange is a combination clamping/servo style that allows it to be face or side-mounted. Standard models are available with either a cable or round connector.

#### Order Code

**RVI78N-10C□□A31N-□□□□**

##### Connection type

**AL** Type 42306, 6-pin connector  
**K2** Cable, 2 m

##### Pulse count

60, 100, 120, 200, 250, 256, 300, 314, 360,  
400, 500, 512, 600, 720, 900, 1000, 1024,  
1200, 1250, 1500, 1800, 2000, 2048, 2400,  
2500, 3000, 3600, 4000, 4096, 5000

**Example: RVI78N-10CK2A31N-512**

#### Technical Specifications

##### Electrical

PULSE COUNT	5,000 ppr
OUTPUT FREQUENCY	≤ 100 kHz
SUPPLY VOLTAGE	10-30 VDC
OUTPUT	Push-pull
CURRENT CONSUMPTION	≤ 80 mA
LOAD CURRENT PER CHANNEL	≤ 40 mA, short circuit, reverse polarity protected
VOLTAGE DROP	< 4 V
RESPONSE TIME	250 ns
CERTIFICATES	No. NMTR.E223176
CE	Yes

##### Mechanical

MATERIAL	Housing	Powder-coated aluminum
	Flange	Aluminum
	Shaft	Stainless steel
	Pulse disc	Plastic (0-1,500 ppr) Glass (1,501-5,000 ppr)
WEIGHT		≈ 22 oz
ROTATIONAL SPEED		≤ 6,000 rpm
MOMENT OF INERTIA		≤ 1.4 x 10 <sup>-3</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 2.1 in-oz
SHAFT LOADING	Axial	50 lbs
	Radial	68 lbs
BEARING WORKING LIFE		> 1.2 x 10 <sup>8</sup> revolutions

##### Environmental

STORAGE TEMPERATURE	Plastic disc	-40°C to +60°C (-40°F to +140°F)
	Glass disc	-40°C to +70°C (-40°F to +158°F)
OPERATING TEMPERATURE	Plastic disc	-20°C to +60°C (-4°F to +140°F)
	Glass disc	-20°C to +70°C (-4°F to +158°F)
HUMIDITY		95% RH non-condensing at 40°C (104°F) for 4 days
SHOCK RESISTANCE		100 g for 3 ms
VIBRATION RESISTANCE		10 g, 10-2,000 Hz
ENCLOSURE RATING		IP65

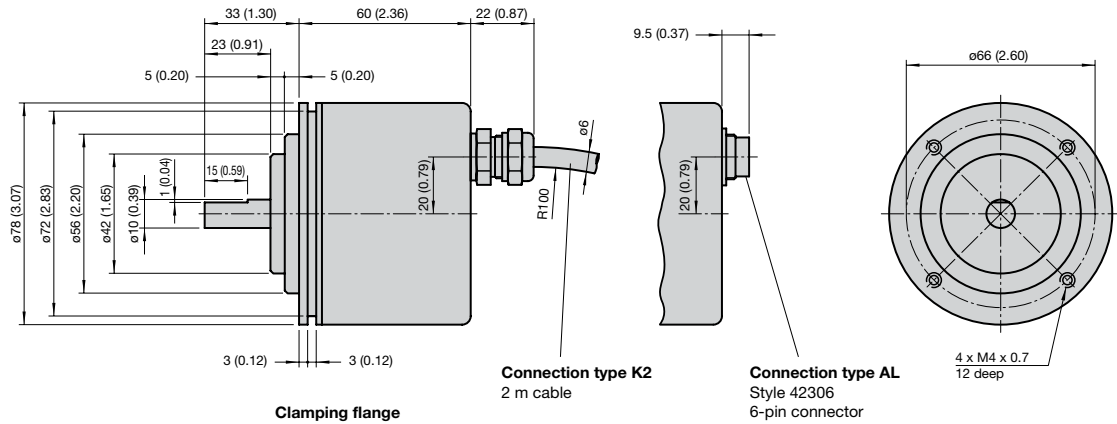
##### Connection Types

CONNECTOR	Type 42306, 6-pin
CABLE	Ø6 mm, 5 x #22 AWG, 2 m length

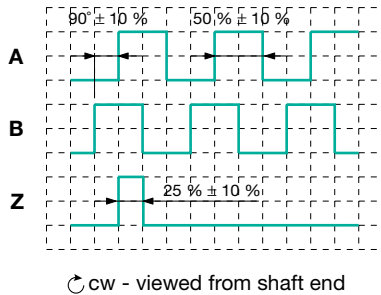


## Dimensions

mm (in.)



## Output Waveform



## Electrical Connection

Signal	AL	K2
	Type 42306, 6-pin quick disconnect	5-conductor cable, $\phi 6$ mm
Power Source $U_B$	4	Red
GND	5	Black
A	1	Green
B	2	White
Z	3	Yellow
Shield	Housing	—

Diagram of the 6-pin connector showing pin numbers 1 through 6.



# Incremental Rotary Encoders

## RVI84 Series Solid Shaft

- Intrinsically safe
- Outputs up to 25 ppr
- IP65 protection rating
- 10 mm diameter shaft
- NAMUR interface



Pepperl+Fuchs' Series RVI84 encoder is a heavy-duty aluminum model designed for use in hazardous areas. Quadrature outputs are used with an intrinsic safety barrier to provide up to 25 pulses per revolution. The unique mounting flange is a combination clamping/servo style that allows it to be face or side-mounted.

### Order Code

**RVI84N-10CK2A2NN-□□**

Pulse count  
1, 2, 5, 10, 20, 25

Example: RVI84N-10CK2A2NN-25

### Technical Specifications

#### Electrical

PULSE COUNT	≤ 25 ppr
OUTPUT FREQUENCY	≤ 5 kHz
SUPPLY VOLTAGE	8 VDC
OUTPUT	NAMUR, in accordance with DIN EN 60947-5-6
LOAD CURRENT PER CHANNEL	≤ 3 mA short-circuit protected
CERTIFICATES	No. NMTR.E223176 TB 99 ATEX 2219 II 2 G EEx ia IIC T6
CE	Yes

#### Mechanical

MATERIAL	Housing	Aluminum
	Flange	Aluminum
	Shaft	Stainless steel
	Pulse disc	Plastic
WEIGHT		≈ 22 oz
ROTATIONAL SPEED		≤ 3,000 rpm
MOMENT OF INERTIA		≤ 1.4 x 10 <sup>-3</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 7.1 in-oz
SHAFT LOADING	Axial	50 lbs
	Radial	68 lbs
BEARING WORKING LIFE		> 1.2 x 10 <sup>8</sup> revolutions

#### Environmental

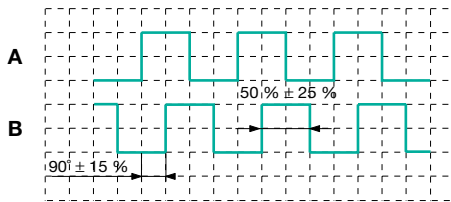
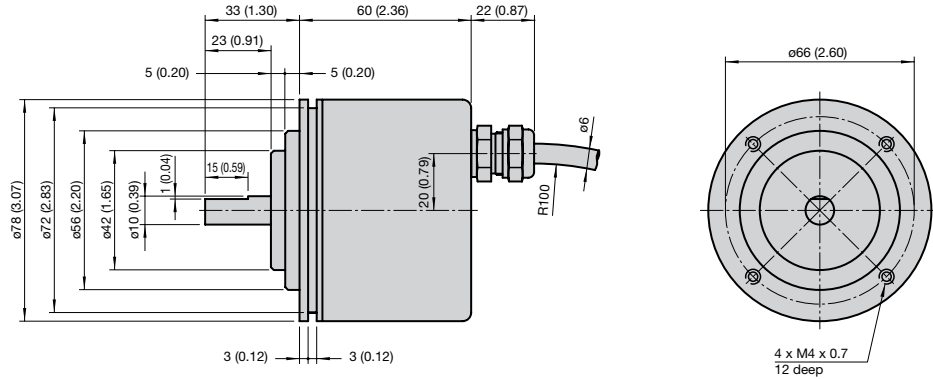
STORAGE TEMPERATURE	-25°C to +85°C (-13°F to +185°F)
OPERATING TEMPERATURE	-20°C to +60°C (-4°F to +140°F)
HUMIDITY	95% RH non-condensing at 40°C (104°F) for 4 days
SHOCK RESISTANCE	100 g for 3 ms
VIBRATION RESISTANCE	10 g, 10-2,000 Hz
ENCLOSURE RATING	IP65

#### Connection Types

CABLE	Ø6 mm, 4 x #22 AWG, 2 m length
-------	-----------------------------------



# Incremental Encoders *RV184 Series*



Signal	4-conductor cable, Ø 6 mm
A <sub>NAMUR+</sub>	Brown
A <sub>NAMUR-</sub>	Blue
B <sub>NAMUR+</sub>	White
B <sub>NAMUR-</sub>	Black



# Incremental Rotary Encoders

Incremental Encoders

Notes



# Absolute Rotary Encoders

<b>FVS58/FVM58 Series</b>	Parallel Interface, Solid Shaft .....	<b>48-51</b>
<b>FSS58/FSM58 Series</b>	Parallel Interface, Recessed Hollow Shaft .....	<b>52-55</b>
<b>AVS58/AVM58 Series</b>	SSI Interface, Solid Shaft .....	<b>56-59</b>
<b>ASS58/ASM58 Series</b>	SSI Interface, Recessed Hollow Shaft .....	<b>60-63</b>
<b>BVS58/BVM58 Series</b>	AS-Interface, Solid Shaft .....	<b>64-67</b>
<b>BSS58/BSM58 Series</b>	AS-Interface, Recessed Hollow Shaft .....	<b>68-71</b>
<b>CVS58/CVM58 Series</b>	CANopen Interface, Solid Shaft .....	<b>72-75</b>
<b>CSS58/CVM58 Series</b>	CANopen Interface, Recessed Hollow Shaft ....	<b>76-79</b>
<b>DVS58/DVM58 Series</b>	DeviceNet Interface, Solid Shaft .....	<b>80-83</b>
<b>DSS58/DSM58 Series</b>	DeviceNet Interface, Recessed Hollow Shaft ...	<b>84-87</b>
<b>EVS58/EVM58 Series</b>	Ethernet Interface, Solid Shaft .....	<b>88-90</b>
<b>ESS58/ESM58 Series</b>	Ethernet Interface, Recessed Hollow Shaft .....	<b>91-92</b>
<b>PVS58/PVM58 Series</b>	PROFIBUS Interface, Solid Shaft .....	<b>93-95</b>
<b>PSS58/PSM58 Series</b>	PROFIBUS Interface, Recessed Hollow Shaft ..	<b>96-98</b>



## FVS58/FVM58 Series Parallel Interface

- Extremely fast data transfer
- Short-circuit, push-pull output
- Standard 58 mm diameter housing
- Inputs for counting direction, LATCH & PRESET
- Solid shaft design



The FVS58 and FVM58 series absolute encoders are designed for very fast data transfer with a code change frequency up to 400 kHz. Position data is read directly from the Gray code disc. These solid shaft encoders are available in single- (13-bit resolution) or multi-turn (25-bit resolution) versions and are available with a clamping flange or a servo flange.

### Order Code

**FV□58□-□□□□□□3□N-□□13**

<b>Type</b>	<b>Housing</b>	<b>Shaft option/flange style</b>	<b>Connection type</b>	<b>Exit position</b>	<b>Number of revolutions</b>	<b>Code</b>
S Single-turn M Multi-turn	N Aluminum (standard) I Stainless steel	011 Ø 10 mm x 20 mm with clamping flange 032 Ø 6 mm x 10 mm with servo flange	AE Type 9426, 26-pin connector* AD Type 9424, 19-pin connector K2 Cable, 2 m * Axial only	A Axial R Radial	00 1 (single-turn) 12 4096 (multi-turn)* 08 256 (multi-turn) * K2 connection only	B Binary G Gray

Example: FVS58N-011AEA3GN-0013

### Technical Specifications

#### Electrical

<b>SUPPLY VOLTAGE</b>	10-30 VDC
<b>CURRENT CONSUMPTION</b>	≤ 140 mA
<b>POWER CONSUMPTION</b>	FVS58: ≤ 2 W; FVM58: ≤ 2.5 W; without output drivers
<b>OUTPUT CODE</b>	Gray or binary
<b>LINEARITY</b>	± 0.5 LSB
<b>COUNTING DIRECTION</b> (Shaft End View)	Clockwise ascending (factory preset, adjustable)
<b>CODE PREPARATION TIME</b>	0.3 ms
<b>INTERFACE TYPE</b>	Push-pull, parallel
<b>RESOLUTION</b> Bits/steps per turn Bits/number of turns	13-bit / 8192 12-bit / ≤ 4096
<b>OVERALL RESOLUTION</b>	Single-turn: 13-bit; Multi-turn: 25-bit
<b>OPERATING CURRENT</b>	40 mA
<b>VOLTAGE DROP</b>	≤ 2.5 V
<b>SIGNAL VOLTAGE</b>	High: $U_H$ - voltage drop; Low: ≤ 2.8 V
<b>RESPONSE TIME</b>	300 ns
<b>CODE CHANGE FREQUENCY</b>	400 kHz
<b>INPUT 1</b> Type Signal duration Switch-on/off delay	Selection of counting direction (V/R) ≥ 10 ms ≥ 1 ms
<b>INPUT 2</b> Type Signal duration Switch-on/off delay	Temporary storage (LATCH) ≥ 100 µs < 0.1 ms
<b>INPUT 3</b> Type Signal duration Switch-on delay	Preset ≥ 10 ms < 1 ms
<b>INPUT SIGNAL VOLTAGE</b>	High: 10-30 V; Low: 0-2 V
<b>INPUT CURRENT</b>	< 6 mA
<b>CERTIFICATES</b> CE	Yes

#### Mechanical

MATERIAL	Housing	Powder-coated aluminum
	Flange	Aluminum
	Shaft	Stainless steel
	Code disc	Plastic
WEIGHT	FVS58: ≈ 7.1 oz; FVM58: ≈ 14.1 oz	
ROTATIONAL SPEED	≤ 12,000 rpm	
MOMENT OF INERTIA	≤ 4.2 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>	
STARTING TORQUE AT 20°C	≤ 7.1 in-oz	
SHAFT LOADING	Axial: 9.0 lbs; Radial: 24.7 lbs	
BEARING WORKING LIFE	> 4 x 10 <sup>10</sup> revolutions	

#### Environmental

<b>STORAGE TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>OPERATING TEMPERATURE</b>	-30°C to +70°C (-22°F to +158°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 6 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP65

#### Connection Types

<b>CONNECTOR</b>	FVS58 FVM58	Type 9424, 19-pin Type 9426, 26-pin
<b>CABLE</b>	FVS58 FVM58	Ø7 mm, 24 x #26 AWG, 2 m length Ø9 mm, 30 x #26 AWG, 2 m length



## Dimensions

mm (in.)

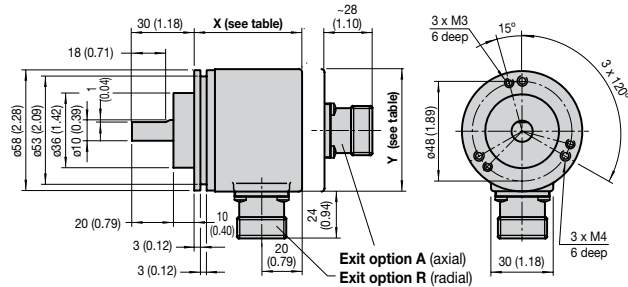
### Shaft option/flange style 011

Ø 10 mm x 20 mm with clamping flange

#### Connection type AD or AE

Style 9424 — 19-pin connector

Style 9426 — 26-pin connector (axial only)



#### Dimension X

	Axial exit	Radial exit
Single-turn	42* (1.65)	53 (2.08)
Multi-turn	62 (2.44)	62 (2.44)

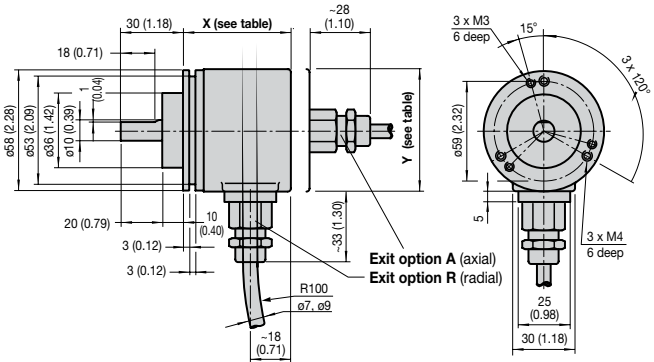
\*Stainless Steel 53 (2.08)

#### Dimension Y

	Housing Diameter
Aluminum	59 (2.32)
Stainless Steel	61 (2.40)

#### Connection type K2

2 m cable



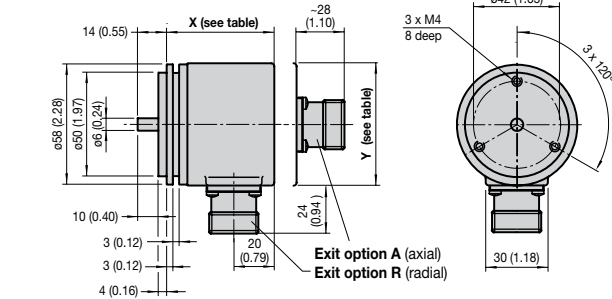
### Shaft option/flange style 032

Ø 6 mm x 10 mm with servo flange

#### Connection type AD or AE

Style 9424 — 19-pin connector

Style 9426 — 26-pin connector (axial only)



#### Dimension X

	Axial exit	Radial exit
Single-turn	42* (1.65)	53 (2.08)
Multi-turn	62 (2.44)	62 (2.44)

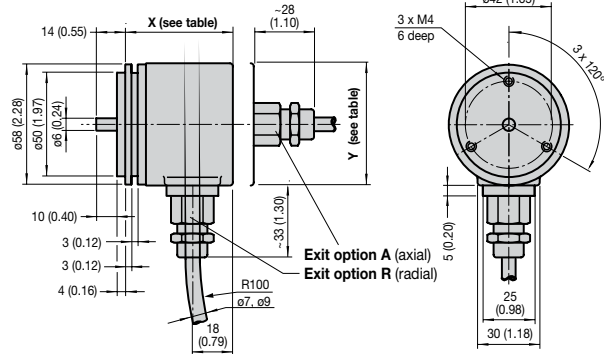
\*Stainless Steel 53 (2.08)

#### Dimension Y

	Housing Diameter
Aluminum	59 (2.32)
Stainless Steel	61 (2.40)

#### Connection type K1

1 m cable





# Absolute Rotary Encoders

## Electrical Connection

Signal	FVS58		FVM58		Description
	K2 24-conductor cable, Ø 7 mm	AD Type 9424, 19-pin quick disconnect	K2 30-conductor cable, Ø 9 mm	AE Type 9426, 26-pin quick disconnect	
Power Source U <sub>B</sub>	Brown	12	Brown	2	Power supply
GND	White	6	White	1	Power supply
Bit 1	Green	1	Green	3	Data output
Bit 2	Yellow	2	Yellow	4	Data output
Bit 3	Gray	3	Gray	5	Data output
Bit 4	Pink	4	Pink	6	Data output
Bit 5	Blue	5	Blue	7	Data output
Bit 6	Red	7	Red	8	Data output
Bit 7	Black	8	Black	9	Data output
Bit 8	Violet	9	Violet	10	Data output
Bit 9	Gray/Pink	10	Gray/Pink	11	Data output
Bit 10	Red/Blue	11	Red/Blue	12	Data output
Bit 11	White/Green	13	White/Green	13	Data output
Bit 12	Brown/Green	14	Brown/Green	14	Data output
Bit 13	White/Yellow	15	White/Yellow	15	Data output
Bit 14	–	–	Yellow/Brown	16	Data output
Bit 15	–	–	White/Gray	17	Data output
Bit 16	–	–	Gray/Brown	18	Data output
Bit 17	–	–	White/Pink	19	Data output
Bit 18	–	–	Pink/Brown	20	Data output
Bit 19	–	–	White/Blue	21	Data output
Bit 20	–	–	Brown/Blue	22	Data output
Bit 21	–	–	White/Red	23	Data output
Bit 22	–	–	Brown/Red	–	Data output
Bit 23	–	–	White/Black	–	Data output
Bit 24	–	–	Brown/Black	–	Data output
Bit 25	–	–	Pink/Green	–	Data output
V/R	White/Pink	16	Gray/Green	25	Input for selection of counting direction
LATCH	Pink/Brown	17	Yellow/Gray	24	Temporary storage input
PRESET	Brown/Blue	18	Yellow/Pink	26	Zero setting input
NO CONNECTION	Gray/Brown	19			N/A
NO CONNECTION	Brown/Red	–			N/A
NO CONNECTION	White/Gray	–			N/A
NO CONNECTION	White/Blue	–			N/A
NO CONNECTION	White/Red	–			N/A
					



## Programming

### Inputs

#### Input Level

"0" : 0 V to 2 V

"1" : 10 V to 30 V

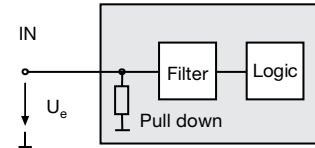
$I_e$  : < 6 mA

#### LATCH Input (temporary storage)

With the latch input high, the position data on the parallel interface is "frozen." This allows for the position to be read without errors due to changing bits. If this input is not used its value is "0." Pulse duration  $T > 100 \mu s$ .

Input level: "0" or unused = Position data operating normally at the output, possibly changing.  
 "1" = Position data saved and stable at the output.

LATCH  
PRESET



#### PRESET Input (zero setting)

The encoder can be electronically set to position 0 with the PRESET input.

Response time:  $T > 10 ms$

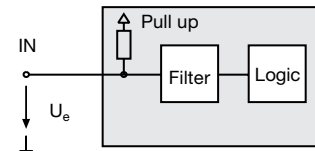
Input level: "0" or unused = Inactive  
 "1" = Output word is set to 0

#### V/R Input (selection of counting direction)

The counting direction of the encoder (when looking at the shaft end) is defined as clockwise rising or declining. The counting direction can be reversed with the V/R input. If the input is not used, the counting direction is rising by default, the level is at "1." Pulse duration  $T > 10 ms$ .

Input level: "1" or unused = rising code value for clockwise rotation.  
 "0" = declining code value for clockwise rotation.

V/R





## FSS58/FSM58 Series Parallel Interface

- Extremely fast data transfer
- Recessed hollow shaft design
- Economical mounting option
- Short-circuit protected, push-pull output
- Standard 58 mm diameter housing
- Inputs for counting direction, LATCH & PRESET



The FSS58 and FSM58 series absolute encoders are designed for very fast data transfer with a code change frequency up to 400 kHz. Position data is read directly from the Gray code disc. These recessed hollow shaft encoders are available in single- (13-bit resolution) or multi-turn (25-bit resolution) versions.

The FSS58 and FSM58 provide a simple and cost-effective mounting solution. The shaft hub connection is already integrated into the rotary encoder. The rotary encoder is held in place by the included torque rest.

### Order Code

**FS□58□-□□□□□□3□N-□□13**

- Type**  
**S** Single-turn  
**M** Multi-turn
- Housing**  
**N** Aluminum (standard)  
**I** Stainless steel
- Shaft dimension/flange style**  
**F1A** Recessed hollow Ø 10 mm x 30 mm  
**F2A** Recessed hollow Ø 12 mm x 30 mm  
**F3A** Recessed hollow Ø 15 mm x 30 mm
- Connection type**  
**AE** Type 9426, 26-pin connector\*  
**AD** Type 9424, 19-pin connector  
**K2** Cable, 2 m  
 \* Axial only
- Number of revolutions**  
**00** 1 (single-turn)  
**12** 4096 (multi-turn)\*  
**08** 256 (multi-turn)  
 \* K2 connection only
- Code**  
**B** Binary  
**G** Gray
- Exit position**  
**A** Axial  
**R** Radial

**Example: FSS58N-F1AAEA3GN-0013**

## Technical Specifications

### Electrical

<b>SUPPLY VOLTAGE</b>	10-30 VDC
<b>CURRENT CONSUMPTION</b>	≤ 140 mA
<b>POWER CONSUMPTION</b>	<i>FSS58</i> : ≤ 2 W; <i>FSM58</i> : ≤ 2.5 W; without output drivers
<b>OUTPUT CODE</b>	Gray or binary
<b>LINEARITY</b>	± 0.5 LSB
<b>COUNTING DIRECTION</b> (Shaft End View)	Clockwise ascending (factory preset, adjustable)
<b>CODE PREPARATION TIME</b>	0.3 ms
<b>INTERFACE TYPE</b>	Push-pull, parallel, short-circuit proof
<b>RESOLUTION</b> <i>Bits/steps per turn</i> <i>Bits/number of turns</i>	13-bit / 8192 12-bit / ≤ 4096
<b>OVERALL RESOLUTION</b>	<i>Single-turn</i> : 13-bit; <i>Multi-turn</i> : 25-bit
<b>OPERATING CURRENT</b>	20 mA
<b>VOLTAGE DROP</b>	≤ 2.5 V
<b>SIGNAL VOLTAGE</b>	<i>High</i> : $U_b$ - voltage drop; <i>Low</i> : ≤ 2.8 V
<b>RESPONSE TIME</b>	300 ns
<b>CODE CHANGE FREQUENCY</b>	400 kHz
<b>INPUT 1</b> <i>Type</i> <i>Signal duration</i> <i>Switch-on/off delay</i>	Selection of counting direction (V/R) ≥ 10 ms ≥ 1 ms
<b>INPUT 2</b> <i>Type</i> <i>Signal duration</i> <i>Switch-on/off delay</i>	Temporary storage (LATCH) ≥ 100 µs < 0.1 ms
<b>INPUT 3</b> <i>Type</i> <i>Signal duration</i> <i>Switch-on delay</i>	Preset ≥ 10 ms < 1 ms
<b>INPUT SIGNAL VOLTAGE</b>	<i>High</i> : 10-30 V; <i>Low</i> : 0-2 V
<b>INPUT CURRENT</b>	< 6 mA
<b>CERTIFICATES</b> <b>CE</b>	Yes

### Mechanical

<b>MATERIAL</b> <i>Housing</i> <i>Flange</i> <i>Shaft</i> <i>Code disc</i>	Powder-coated aluminum Aluminum Stainless steel Plastic
<b>WEIGHT</b>	<i>FSS58</i> : ≈ 7.1 oz; <i>FSM58</i> : ≈ 14.1 oz
<b>ROTATIONAL SPEED</b>	≤ 12,000 rpm
<b>MOMENT OF INERTIA</b>	≤ 4.2 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>	≤ 7.1 in-oz
<b>SHAFT LOADING</b> <i>Angle offset</i> <i>Axial offset</i> <i>Radial offset</i>	± 0.9° Static: ± 0.3 mm; Dynamic: ± 0.1 mm Static: ± 0.5 mm; Dynamic: ± 0.2 mm
<b>BEARING WORKING LIFE</b>	> 4 x 10 <sup>10</sup> revolutions

### Environmental

<b>STORAGE TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>OPERATING TEMPERATURE</b>	-30°C to +70°C (-22°F to +158°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 6 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP65

### Connection Types

<b>CONNECTOR</b> <i>FSS58</i> <i>FSM58</i>	Type 9424, 19-pin Type 9426, 26-pin
<b>CABLE</b> <i>FSS58</i> <i>FSM58</i>	Ø7 mm, 24 x #26 AWG, 2 m length Ø9 mm, 30 x #26 AWG, 2 m length



# Absolute Encoders FSS58/FSM58 Series

Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com



# Absolute Rotary Encoders

## Electrical Connection

Signal	FSS58		FSM58		Description
	K2 24-conductor cable, Ø 7 mm	AD Type 9424, 19-pin quick disconnect	K2 30-conductor cable, Ø 9 mm	AE Type 9426, 26-pin quick disconnect	
Power Source U <sub>B</sub>	Brown	12	Brown	2	Power supply
GND	White	6	White	1	Power supply
Bit 1	Green	1	Green	3	Data output
Bit 2	Yellow	2	Yellow	4	Data output
Bit 3	Gray	3	Gray	5	Data output
Bit 4	Pink	4	Pink	6	Data output
Bit 5	Blue	5	Blue	7	Data output
Bit 6	Red	7	Red	8	Data output
Bit 7	Black	8	Black	9	Data output
Bit 8	Violet	9	Violet	10	Data output
Bit 9	Gray/Pink	10	Gray/Pink	11	Data output
Bit 10	Red/Blue	11	Red/Blue	12	Data output
Bit 11	White/Green	13	White/Green	13	Data output
Bit 12	Brown/Green	14	Brown/Green	14	Data output
Bit 13	White/Yellow	15	White/Yellow	15	Data output
Bit 14	–	–	Yellow/Brown	16	Data output
Bit 15	–	–	White/Gray	17	Data output
Bit 16	–	–	Gray/Brown	18	Data output
Bit 17	–	–	White/Pink	19	Data output
Bit 18	–	–	Pink/Brown	20	Data output
Bit 19	–	–	White/Blue	21	Data output
Bit 20	–	–	Brown/Blue	22	Data output
Bit 21	–	–	White/Red	23	Data output
Bit 22	–	–	Brown/Red	–	Data output
Bit 23	–	–	White/Black	–	Data output
Bit 24	–	–	Brown/Black	–	Data output
Bit 25	–	–	Pink/Green	–	Data output
V/R	White/Pink	16	Gray/Green	25	Input for selection of counting direction
LATCH	Pink/Brown	17	Yellow/Gray	24	Temporary storage input
PRESET	Brown/Blue	18	Yellow/Pink	26	Zero setting input
NO CONNECTION	Gray/Brown	19			N/A
NO CONNECTION	Brown/Red	–			N/A
NO CONNECTION	White/Gray	–			N/A
NO CONNECTION	White/Blue	–			N/A
NO CONNECTION	White/Red	–			N/A
					



## Programming

### Inputs

#### Input Level

"0" : 0 V to 2 V

"1" : 10 V to 30 V

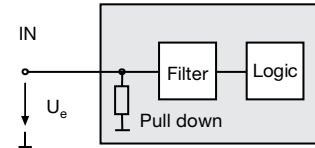
$I_e$  : < 6 mA

#### LATCH Input (temporary storage)

With the latch input high, the position data on the parallel interface is "frozen." This allows for the position to be read without errors due to changing bits. If this input is not used its value is "0." Pulse duration  $T > 100 \mu s$ .

Input level: "0" or unused = Position data operating normally at the output, possibly changing.  
 "1" = Position data saved and stable at the output.

LATCH  
PRESET



#### PRESET Input (zero setting)

The encoder can be electronically set to position 0 with the PRESET input.

Response time:  $T > 10 ms$

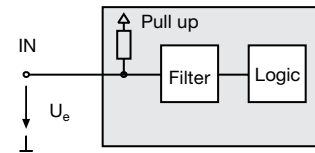
Input level: "0" or unused = Inactive  
 "1" = Output word is set to 0

#### V/R Input (selection of counting direction)

The counting direction of the encoder (when looking at the shaft end) is defined as clockwise rising or declining. The counting direction can be reversed with the V/R input. If the input is not used, the counting direction is rising by default, the level is at "1." Pulse duration  $T > 10 ms$ .

Input level: "1" or unused = rising code value for clockwise rotation.  
 "0" = declining code value for clockwise rotation.

V/R





# Absolute Rotary Encoders

## AVS58/AVM58 Series SSI Interface

- Industrial standard 58 mm diameter housing
- Single or multi-turn
- IP65
- 6 or 10 mm diameter shaft



Pepperl+Fuchs' AVS58 and AVM58 series absolute encoders communicate via SSI (synchronous serial interface). These encoders feature unbreakable plastic code discs, making them ideal for applications with heavy shock and vibration. They are available in either single-turn with 16-bit max resolution, or multi-turn with 30-bit max resolution versions. These encoders are rated IP65 and feature a rugged aluminum housing.

### Order Code

**AV** **58** **-** **□□□□□□□□** **N** **-** **□□□□**

**Type**  
S Single-turn  
M Multi-turn

**Housing**  
N Aluminum (standard)  
I Stainless steel\*  
\* axial exit position only

**Shaft option/flange style**  
011 Ø 10 mm x 20 mm with clamping flange  
032 Ø 6 mm x 10 mm with servo flange

**Connection type**  
AA Type 9416, 12-pin connector  
AB Type 9416L, 12-pin connector  
K1 Cable, 1m

**Exit position**  
A Axial  
R Radial

**Steps per revolution**  
12 4096 (standard)  
13 8192  
16 65536

**Number of revolutions**  
00 1 (single-turn)  
12 4096 (multi-turn, standard)  
14 16,384 (multi-turn)

**Code**  
B Binary\*  
G Gray  
\* Processor option 0 only

**Processor option**  
0 With microprocessor (standard)  
H No microprocessor

Example: AVS58N-011AAR0GN-0013

### Technical Specifications

#### Electrical

SUPPLY VOLTAGE	10-30 VDC
CURRENT CONSUMPTION	≤ 180 mA
OUTPUT CODE	Gray or binary
LINEARITY	± 2 LSB at 16-bit, ± 1 LSB at 13-bit, ± 0.5 LSB at 12-bit
COUNTING DIRECTION (Shaft End View)	Clockwise descending (factory preset, adjustable)
INTERFACE	SSI
Transfer rate	0.1-2.0 MBaud
Monoflop time	20 ± 10 µs
VOLTAGE DROP	≤ 2.5 V
STANDARD CONFORMITY	RS-422
RESOLUTION	Bits/steps per turn 16-bit / 65536 Bits/number of turns 14-bit / ≤ 16,384
OVERALL RESOLUTION	Single-turn 16-bit Multi-turn 30-bit
OUTPUT SIGNAL VOLTAGE	High: $U_b$ - voltage drop; Low: ≤ 2.8 V
INPUT 1	Type Selection of counting direction (V/R) Signal duration ≥ 10 ms Switch-on delay < 0.001 ms
INPUT 2	Type PRESET Signal duration ≥ 10 ms Switch-on delay < 100 ms
INPUT SIGNAL VOLTAGE	High: 10-30 V; Low: 0-2 V
INPUT CURRENT	< 6 mA
CERTIFICATES CE	Yes

#### Mechanical

MATERIAL	Housing	Powder-coated aluminum
(Standard Model)	Flange	Aluminum
	Shaft	Stainless steel
	Code disc	Plastic
MATERIAL	Housing	Stainless steel
(Stainless Model)	Flange	Stainless steel
	Shaft	Stainless steel
	Code disc	Plastic
WEIGHT	Standard	≈ 1 lb
	Stainless steel	≈ 1.8 lbs
ROTATIONAL SPEED		≤ 12,000 rpm
MOMENT OF INERTIA		≤ 7.1 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 7.1 in-oz
SHAFT LOADING	Axial	9 lbs
	Radial	24.7 lbs
BEARING WORKING LIFE		4 x 10 <sup>10</sup> revolutions

#### Environmental

STORAGE TEMPERATURE	-40°C to +85°C (-40°F to +185°F)
OPERATING TEMPERATURE	-40°C to +85°C (-40°F to +185°F)
HUMIDITY	No moisture condensation
SHOCK RESISTANCE	100 g for 3 ms
VIBRATION RESISTANCE	10 g, 10-2,000 Hz
ENCLOSURE RATING	IP65

#### Connection Types

CONNECTOR	Type 9416, 12-pin Type 9416L, 12-pin
CABLE	Ø7 mm, 12 x #26 AWG, 1 m length

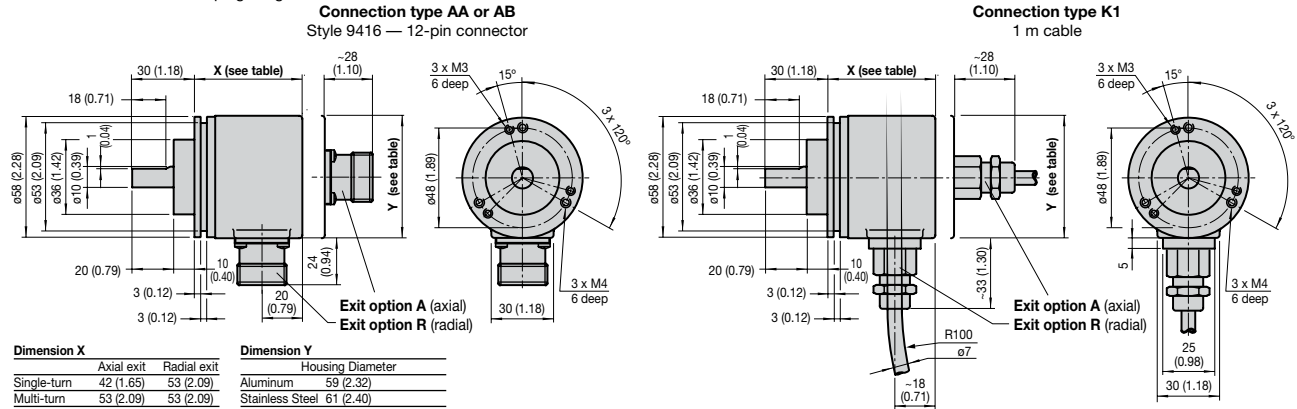


## Dimensions

mm (in.)

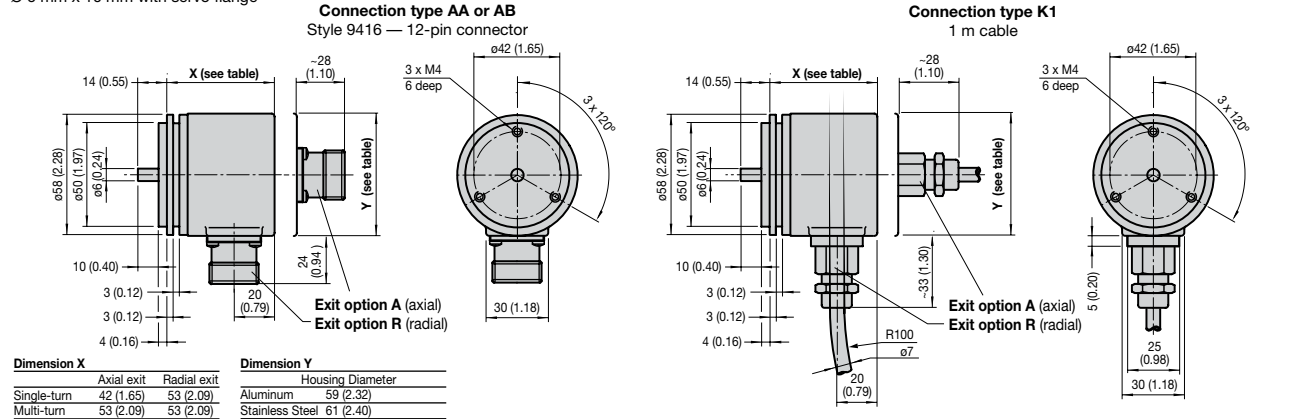
### Shaft option/flange style 011

Ø 10 mm x 20 mm with clamping flange



### Shaft option/flange style 032

Ø 6 mm x 10 mm with servo flange



## Electrical Connection

Signal	AA Type 9416, 12-pin quick disconnect	AB Type 9416L, 12-pin quick disconnect	K1 12-conductor cable, Ø 7 mm	Description
Power Source U <sub>B</sub>	2	8	Brown	Power supply
GND	1	1	White	Power supply
Clock (+)	3	3	Green	Positive cycle line
Clock (-)	4	11	Yellow	Negative cycle line
Data (+)	5	2	Gray	Positive transmission data
Data (-)	6	10	Pink	Negative transmission data
Reserved	7	12	Blue	Not wired, reserved
V/R	8	5	Red	Input for selection of counting direction
PRESET (w/ microprocessor only)	9	9	Black	Zero setting input
Reserved	10	4	Violet	Not wired, reserved
Reserved	11	6	Gray/Pink	Not wired, reserved
Reserved	12	7	Red/Blue	Not wired, reserved



# Absolute Rotary Encoders

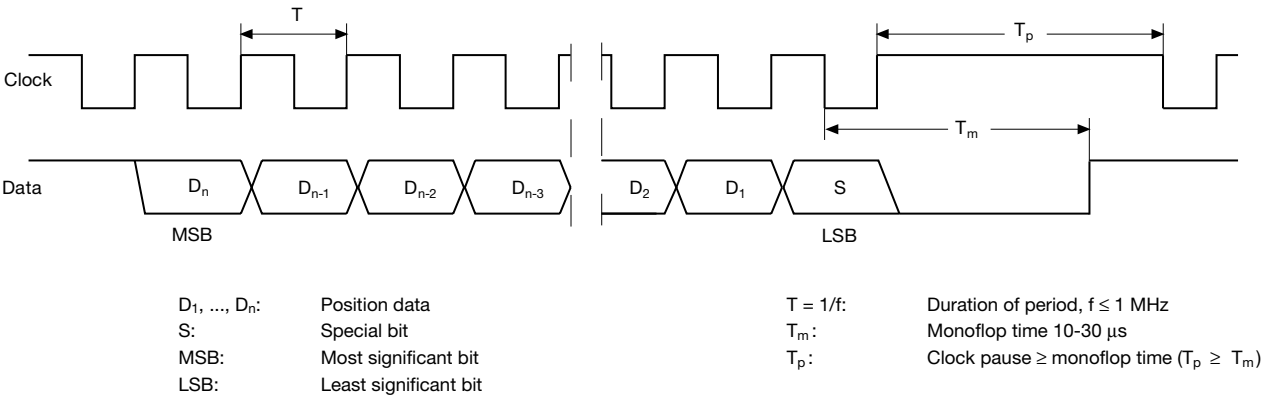
## Programming

### Description

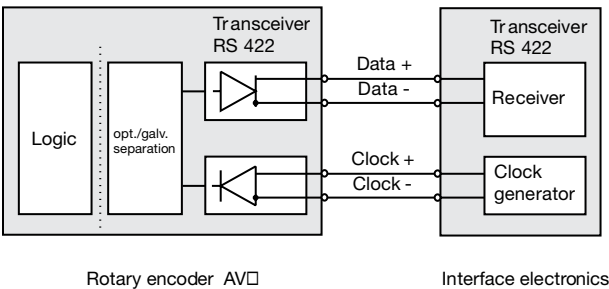
The synchronous serial interface was specially developed for transferring the output data of an absolute encoder to a control device. The control module sends a clock signal and the absolute encoder responds with the position value.

Thus only 4 lines are required for the clock and data, regardless of the rotary encoder resolution. The RS-422 interface is galvanically isolated from the power supply.

#### SSI Data Transfer



#### Block Diagram



#### Line Length

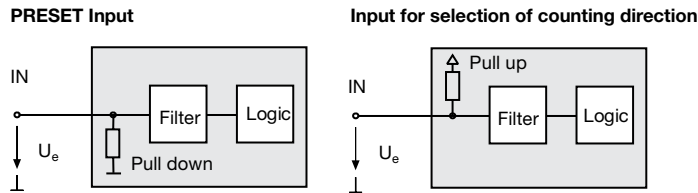
Line length in m	Baud rate in kHz
<50	<400
<100	<300
<200	<200
<400	<100



## Programming (continued)

### Inputs

The selection of the counting direction input is activated with 0-level. The PRESET input is activated with 1-level.



### Clock Input (2-wire):

Optically and galvanically isolated clock input in accordance with I/O Standard RS-422. The control module clock synchronizes the data transfer between the encoder and the interface electronics. A terminating resistor with a resistance of 120  $\Omega$  is incorporated between the clock lines "Clock +" and "Clock -".

### SSI Output Format Standard

- At idle status, signal lines "Data +" and "Clock +" are at high level (5 V).
- The first time the clock signal switches from high to low, the data transfer in which the current information (position data (Dn) and special bit (S)) is stored in the encoder is introduced.
- The highest order bit (MSB) is applied to the serial data output of the encoder with the first rising pulse edge.
- The next successive lower order bit is transferred with each following rising pulse edge.
- After the lowest order bit (LSB) has been transferred the data line switches to low until the monoflop time  $T_m$  has expired.
- No subsequent data transfer can be started until the data line switches to high again or the time for the clock pause  $T_p$  has expired.
- After the clock sequence is complete, the monoflop time  $T_m$  is triggered with the last falling pulse edge.
- The monoflop time  $T_m$  determines the lowest transmission frequency.

### SSI Output Format Ring Slide Operation (Multiple Transmission)

- In ring slide operation, multiple transmission of the same data word over the SSI interface makes it possible to offer the possibility of detecting transmission errors.
- In multiple transmission, 25 bits are transferred per data word in standard format.
- If the clock change is not interrupted after the last falling pulse edge, ring slide operation automatically becomes active. This means that the information that was stored at the time of the first clock change is generated again.
- After the first transmission, the 26th pulse controls data repetition. If the 26th pulse follows after an amount of time greater than the monoflop time  $T_m$ , a new current data word will be transmitted with the following pulses.



If the pulse line is exchanged, the data word is generated offset. Ring slide operation is possible up to max. 13 bits.



### ASS58/ASM58 Series SSI Interface

- Industrial standard 58 mm diameter housing
- Single or multi-turn
- IP65
- 10 or 12 mm diameter shaft



Pepperl+Fuchs' ASS58/ASM58 series absolute encoders feature recessed hollow shafts and communicate via SSI (synchronous serial interface). The encoder is mounted directly to the shaft using set screws. The torque rest is used to prevent the encoder from rotating. Available in either single-turn with 16-bit resolution, or multi-turn with 30-bit resolution versions. These encoders are rated IP65 and feature a rugged aluminum housing.

#### Order Code

**AS** **58** **-** **□□□□□□□□** **N** **-** **□□□□**

- Type**  
**S** Single-turn  
**M** Multi-turn
- Housing**  
**N** Aluminum (standard)  
**I** Stainless steel\*  
\* axial exit position only
- Shaft option**  
**F1A** Recessed hollow shaft Ø 10 mm x 30 mm  
**F2A** Recessed hollow shaft Ø 12 mm x 30 mm  
**F3A** Recessed hollow shaft Ø 15 mm x 30 mm
- Connection type**  
**AA** Type 9416, 12-pin connector  
**AB** Type 9416L, 12-pin connector  
**K1** Cable, 1m
- Exit position**  
**A** Axial  
**R** Radial
- Steps per revolution**  
**12** 4096 (standard)  
**13** 8192  
**16** 65536
- Number of revolutions**  
**00** 1 (single-turn)  
**12** 4096 (multi-turn, standard)  
**14** 16,384 (multi-turn)
- Code**  
**B** Binary\*  
**G** Gray  
\* Processor option 0 only
- Processor option**  
**0** With microprocessor (standard)  
**H** No microprocessor

Example: ASS58N-F3AAAR0GN-0013

#### Technical Specifications

##### Electrical

<b>SUPPLY VOLTAGE</b>	10-30 VDC
<b>CURRENT CONSUMPTION</b>	≤ 180 mA
<b>OUTPUT CODE</b>	Gray, binary
<b>LINEARITY</b>	± 2 LSB at 16-bit, ± 1 LSB at 13-bit, ± 0.5 LSB at 12-bit
<b>COUNTING DIRECTION</b> (Shaft End View)	Clockwise declining (factory preset, adjustable)
<b>STANDARD CONFORMITY</b>	RS-422
<b>INTERFACE</b>	Type SSI
	Transfer rate 0.1-2.0 Mbaud
	Monotop time 20 ± 10 µs
<b>RESOLUTION</b>	Bits/steps per turn 16-bit / 65536
	Bits/number of turns 14-bit / ≤ 16,384
<b>OVERALL RESOLUTION</b>	Single-turn 16-bit
	Multi-turn 30-bit
<b>OUTPUT SIGNAL VOLTAGE</b>	High: $U_b$ - voltage drop; Low: ≤ 2.8 V
<b>INPUT 1</b>	Type Selection of counting direction (V/R)
	Signal duration ≥ 10 ms
	Switch-on delay < 0.001 ms
<b>INPUT 2</b>	Type PRESET
	Signal duration ≥ 10 ms
	Switch-on delay < 100 ms
<b>INPUT SIGNAL VOLTAGE</b>	High: 10-30 V; Low: 0-2 V
<b>INPUT CURRENT</b>	< 6 mA
<b>CERTIFICATES</b> CE	Yes

##### Mechanical

<b>MATERIAL</b> (Standard Model)	Housing Flange Shaft Code disc	Powder-coated aluminum Aluminum Stainless steel Plastic
<b>MATERIAL</b> (Stainless Model)	Housing Flange Shaft Code disc	Stainless steel Stainless steel Stainless steel Plastic
<b>WEIGHT</b>	Standard Stainless steel	≈ 1 lb ≈ 1.8 lbs
<b>ROTATIONAL SPEED</b>		≤ 12,000 rpm
<b>MOMENT OF INERTIA</b>		≤ 7.1 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>		≤ 7.1 in-oz
<b>SHAFT LOADING</b>	Angle offset Axial offset Radial offset	± 0.9° Static: ± 0.3 mm; Dynamic: ± 0.2 mm Static: ± 0.5 mm; Dynamic: ± 0.2 mm
<b>BEARING WORKING LIFE</b>		4 x 10 <sup>10</sup> revolutions

##### Environmental

<b>STORAGE TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>OPERATING TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 3 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP65

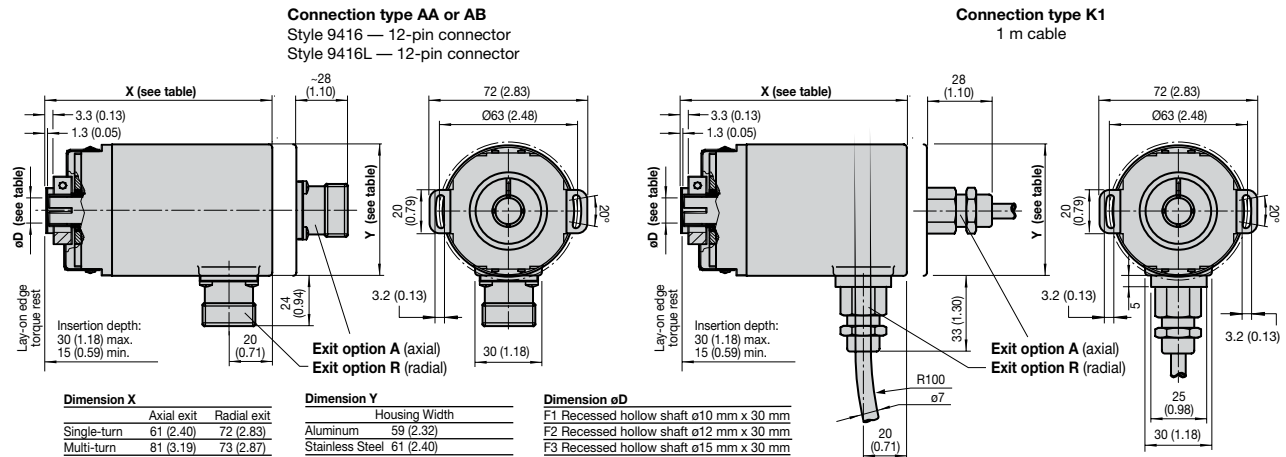
##### Connection Types

<b>CONNECTOR</b>	Type 9416, 12-pin Type 9416L, 12-pin
<b>CABLE</b>	Ø7 mm, 12 x #26 AWG, 1 m length



## Dimensions

mm (in.)



## Electrical Connection

Signal	AA Type 9416, 12-pin quick disconnect	AB Type 9416L, 12-pin quick disconnect	K1 12-conductor cable, Ø 7 mm	Description
<b>Power Source U<sub>B</sub></b>	2	8	Brown	Power supply
<b>GND</b>	1	1	White	Power supply
<b>Clock (+)</b>	3	3	Green	Positive cycle line
<b>Clock (-)</b>	4	11	Yellow	Negative cycle line
<b>Data (+)</b>	5	2	Gray	Positive transmission data
<b>Data (-)</b>	6	10	Pink	Negative transmission data
<b>Reserved</b>	7	12	Blue	Not wired, reserved
<b>V/R</b>	8	5	Red	Input for selection of counting direction
<b>PRESET (w/ microprocessor only)</b>	9	9	Black	Zero setting input
<b>Reserved</b>	10	4	Violet	Not wired, reserved
<b>Reserved</b>	11	6	Gray/Pink	Not wired, reserved
<b>Reserved</b>	12	7	Red/Blue	Not wired, reserved



# Absolute Rotary Encoders

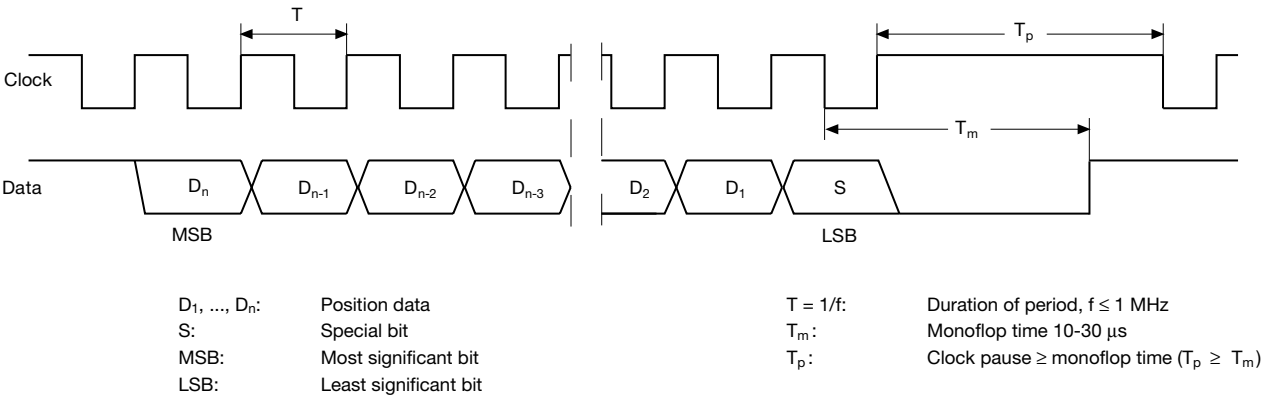
## Programming

### Description

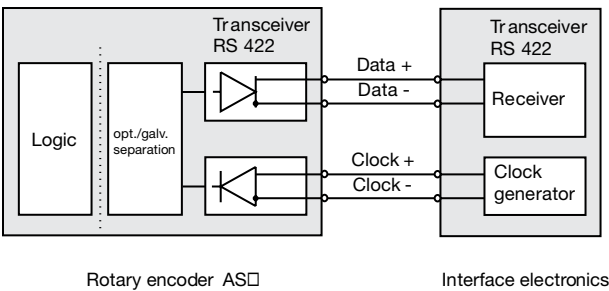
The synchronous serial interface was specially developed for transferring the output data of an absolute encoder to a control device. The control module sends a clock signal and the absolute encoder responds with the position value.

Thus only 4 lines are required for the clock and data, regardless of the rotary encoder resolution. The RS-422 interface is galvanically isolated from the power supply.

#### SSI Data Transfer



#### Block Diagram



#### Line Length

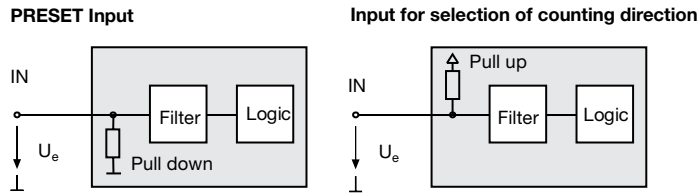
Line length in m	Baud rate in kHz
<50	<400
<100	<300
<200	<200
<400	<100



## Programming (continued)

### Inputs

The selection of the counting direction input is activated with 0-level. The PRESET input is activated with 1-level.



### Clock Input (2-wire):

Optically and galvanically isolated clock input in accordance with I/O Standard RS-422. The control module clock synchronizes the data transfer between the encoder and the interface electronics. A terminating resistor with a resistance of 120  $\Omega$  is incorporated between the clock lines "Clock +" and "Clock -".

### SSI Output Format Standard

- At idle status, signal lines "Data +" and "Clock +" are at high level (5 V).
- The first time the clock signal switches from high to low, the data transfer in which the current information (position data (Dn) and special bit (S)) is stored in the encoder is introduced.
- The highest order bit (MSB) is applied to the serial data output of the encoder with the first rising pulse edge.
- The next successive lower order bit is transferred with each following rising pulse edge.
- After the lowest order bit (LSB) has been transferred the data line switches to low until the monoflop time  $T_m$  has expired.
- No subsequent data transfer can be started until the data line switches to high again or the time for the clock pause  $T_p$  has expired.
- After the clock sequence is complete, the monoflop time  $T_m$  is triggered with the last falling pulse edge.
- The monoflop time  $T_m$  determines the lowest transmission frequency.

### SSI Output Format Ring Slide Operation (Multiple Transmission)

- In ring slide operation, multiple transmission of the same data word over the SSI interface makes it possible to offer the possibility of detecting transmission errors.
- In multiple transmission, 25 bits are transferred per data word in standard format.
- If the clock change is not interrupted after the last falling pulse edge, ring slide operation automatically becomes active. This means that the information that was stored at the time of the first clock change is generated again.
- After the first transmission, the 26th pulse controls data repetition. If the 26th pulse follows after an amount of time greater than the monoflop time  $T_m$ , a new current data word will be transmitted with the following pulses.



If the pulse line is exchanged, the data word is generated offset. Ring slide operation is possible up to max. 13 bits.



# Absolute Rotary Encoders

## BVS58/BVM58 Series AS-Interface

- Industrial standard 58 mm diameter housing
- Single or multi-turn
- Uses 4 AS-Interface slaves
- IP65
- Servo flange and 6 mm shaft or clamping flange and 10 mm shaft



Pepperl+Fuchs' BVS58 and BVM58 series absolute encoders communicate via AS-Interface. They are available in either single-turn with 13-bit resolution, or multi-turn with 16-bit resolution versions. The position value is output to the master within a single cycle via the 4 integrated AS-Interface chips. Each slave address can be individually set. These encoders are rated IP65 and feature a rugged aluminum housing.

### Order Code

**BV□58N-□□□AVRONN-□□□□**

Type  
**S** Single-turn  
**M** Multi-turn

#### Shaft option/flange style

**011** Ø 10 mm x 20 mm with clamping flange  
**032** Ø 6 mm x 10 mm with servo flange

Resolution			
Single-turn	Number of	Steps per	
	Revolutions	Revolutions	
0013	1	8192	
Multi-turn	Number of	Steps per	
	Revolutions	Revolutions	
	0313	8	8192
	0412	16	4096
	0511	32	2048
	0610	64	1024
	0709	128	512
	0808	256	256
	0907	512	128
	1006	1024	64
	1105	2048	32
1204	4096	16	

Example: BVS58N-032AVRONN-0013

### Technical Specifications

#### Electrical

SUPPLY VOLTAGE	29.5-31.6 VDC
CURRENT CONSUMPTION	Starting ≤ 155 mA
	Operational ≤ 65 mA
OUTPUT CODE	Programmable gray or binary
LINEARITY	±1 LSB
COUNTING DIRECTION (Shaft End View)	Programmable
INTERFACE	Type AS-Interface
	Transfer rate ≤ 0.167 MBaud
RESOLUTION	Bits/steps per turn 13-bit / ≤ 8192
	Bits/number of turns 12-bit / ≤ 4096
OVERALL RESOLUTION	Single-turn 13-bit
	Multi-turn 16-bit
STANDARD CONFORMITY	AS-Interface
CERTIFICATES CE	Yes

#### Mechanical

MATERIAL	Housing	Powder-coated aluminum
	Flange	Aluminum
	Shaft	Stainless steel
	Code disc	Glass
WEIGHT	BVS58	≈ 12 oz
	BVM58	≈ 13 oz
ROTATIONAL SPEED	BVS58	≤ 12,000 rpm
	BVM58	≤ 6,000 rpm
MOMENT OF INERTIA		≤ 4.3 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 2.1 in-oz
SHAFT LOADING	Axial - BVS	9.8 lbs at 12,000 rpm
		40 lbs at 6,000 rpm
	Radial - BVS	13.3 lbs at 12,000 rpm
		40 lbs at 6,000 rpm
BEARING WORKING LIFE		> 4 x 10 <sup>8</sup> revolutions

#### Environmental

STORAGE TEMPERATURE	-25°C to +85°C (-13°F to +185°F)
OPERATING TEMPERATURE	-20°C to +70°C (-4°F to +158°F)
HUMIDITY	98% RH non-condensing
SHOCK RESISTANCE	100 g for 3 ms
VIBRATION RESISTANCE	10 g, 10-2,000 Hz
ENCLOSURE RATING	IP65

#### Connection Types

CONNECTOR	Type V1, M12, 4-Pin
-----------	---------------------

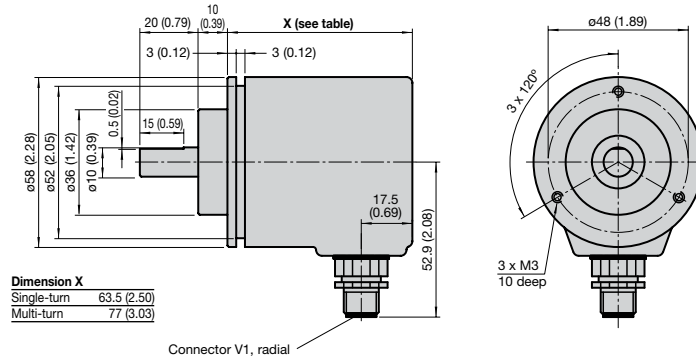


## Dimensions

mm (in.)

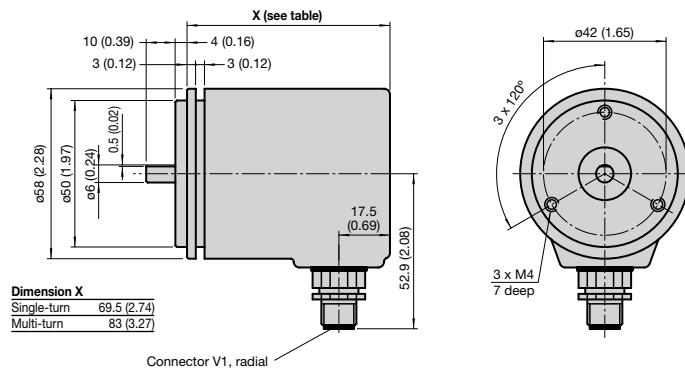
### Shaft option/flange style 011

Ø 10 mm x 20 mm with clamping flange



### Shaft option/flange style 032

Ø 6 mm x 10 mm with servo flange



## Electrical Connection

Signal	Type V1, 4-pin quick disconnect	Description
AS-i +	1	
Reserved	2	Not wired
AS-i -	3	
Reserved	4	Not wired



# Absolute Rotary Encoders

## Programming

### Addresses

	Slave A	Slave B	Slave C	Slave D
Preset address	1	2	3	4
IO code	7	0	0	0
IO code	F	F	F	F



When using an AS-Interface master or handheld programmer to change the slave addresses, it is absolutely essential to assign a different address to each of the four slaves.

### Parameter Bits

The four parameter bits of slave A are used to set the parameters of the encoder. The parameter bits of slave B, C and D are not used.

Status of parameter bit	Slave A			
	P0	P1	P2	P3
0	Gray code	Transfer with flag bits	Count down with clockwise rotation	Not used
1	Binary code	Transfer without flag bits	Count up with clockwise rotation	Not used

### Data Bits

#### From the AS-Interface master to the encoder

Data from the AS-Interface master is transferred to the encoder via slave A, which works bidirectionally. Slaves B, C and D operate unidirectionally and can only send data.

When data bits D2 and D3 are changed from 01 to 10 or vice-versa, the position data is saved in the encoder.

Status of D0/D1 or D2/D3	Slave A	
	D0/D1	D2/D3
00	Normal mode	Position data is not saved
01	Rotary encoder is set to 1/4 of the single turn resolution	Position data is saved
10	Rotary encoder is set to 0	Position data is saved
11	Normal mode	Position data is not saved

#### From the encoder to the AS-Interface master

Parameter bit P1 of slave A is used to determine if the encoder transfers data to the AS-Interface master with or without flag bits.

P1 = 1: Transfer without flag bits

Slave A				Slave B				Slave C				Slave D			
D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3
Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Bit 9	Bit 10	Bit 11	Bit 12	Not used!		

P1 = 0: Transfer with flag bits MA, MB, MC, MD

Slave A				Slave B				Slave C				Slave D			
D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3
Bit 0	Bit 1	Bit 2	MA	Bit 0	Bit 1	Bit 2	MB	Bit 0	Bit 1	Bit 2	MC	Bit 0	Bit 1	Bit 2	MD



## Programming (continued)

### Operating Modes

#### Address assignments for the four slaves

The AS-Interface master accesses all slaves sequentially within an AS-Interface cycle to transfer output data to slave A or to read input data from the slaves. The single-turn absolute encoder uses four AS-Interface chips to transfer a position of 13 bits using 4 slave addresses.

These four slaves are queried sequentially and data may originate from any one of four different sampling times. To minimize this effect, sequential addresses (n, n+1, n+2 and n+3) should be assigned to slaves A, B, C and D.

In addition, slave A is responsible for controlling the encoder's functions. If the order of slaves is changed (D=n, C=n+1, B=n+2, A=n+3), the output word, which is supposed to be transmitted by the function control module of the absolute encoder, will not be transmitted until slaves D, C and B have been read in. A memory command would then only take effect for slave A. The command would not affect the slaves that had already been read until the next read cycle. This change of slave order will result in data inconsistency.

#### Temporary storage and transfer with flag bits

If any data from the rotary encoder is interrupted during transmission, it is possible that some of the data transferred to the controller originates from a different position in the data word. The controller can check the data integrity for a single data word by comparing the four flag bits. Each slave can transfer one flag bit making it possible for the control module to check which position data set an individual data set belongs to by comparing the 4 bits. Data bit D2 is used for this purpose. Using the flag bits reduces the size of the usable data from 16 bits to 12 bits.

Cycle	Slave A Data bit D2	Position data			
		Slave A	Slave B	Slave C	Slave D
1	0	XXX0	XXX0	XXX0	XXX0
2	1	XXX1	XXX1	XXX1	XXX1
3	0	XXX0	XXX0	XXX0	XXX0
4	1	XXX1	XXX1	XXX1	XXX1
etc.					



# Absolute Rotary Encoders

## BSS58/BSM58 Series AS-Interface

- Industrial standard 58 mm diameter housing
- Single or multi-turn
- Uses 4 AS-Interface slaves
- IP65
- 10 mm or 12 mm recessed hollow shaft



Pepperl+Fuchs' BSS58 and BSM58 series absolute encoders feature recessed hollow shafts and communicate via AS-Interface. Available in either single-turn with 13 bit resolution, or multi-turn with 16 bit resolution versions. The position value is output to the master within a single cycle via the 4 integrated AS-Interface chips. Each slave address can be individually set. These encoders are rated IP65 and feature a rugged aluminum housing.

### Order Code

**BS□58N-□□□AVRONN-□□□□**

Type  
**S** Single-turn  
**M** Multi-turn

#### Shaft option

**01A** Ø 10 mm x 21 mm recessed hollow shaft  
**02A** Ø 12 mm x 21 mm recessed hollow shaft

#### Resolution

Single-turn	Number of Revolutions	Steps per Revolutions
<b>0013</b>	1	8192
Multi-turn	Number of Revolutions	Steps per Revolutions
<b>0313</b>	8	8192
<b>0412</b>	16	4096
<b>0511</b>	32	2048
<b>0610</b>	64	1024
<b>0709</b>	128	512
<b>0808</b>	256	256
<b>0907</b>	512	128
<b>1006</b>	1024	64
<b>1105</b>	2048	32
<b>1204</b>	4096	16

Example: BVS58N-032AVRONN-0013

### Technical Specifications

#### Electrical

<b>SUPPLY VOLTAGE</b>	29.5-31.6 VDC
<b>CURRENT CONSUMPTION</b>	<i>Starting</i> ≤ 155 mA <i>Operational</i> ≤ 65 mA
<b>OUTPUT CODE</b>	Programmable gray or binary
<b>LINEARITY</b>	±1 LSB
<b>COUNTING DIRECTION</b> (Shaft End View)	Programmable
<b>INTERFACE</b>	<i>Type</i> AS-Interface <i>Transfer rate</i> ≤ 0.167 MBaud
<b>RESOLUTION</b>	<i>Bits/steps per turn</i> 13-bit / ≤ 8192 <i>Bits/number of turns</i> 12-bit / ≤ 4096
<b>OVERALL RESOLUTION</b>	<i>Single-turn</i> 13-bit <i>Multi-turn</i> 16-bit
<b>STANDARD CONFORMITY</b>	AS-Interface
<b>CERTIFICATES</b> CE	Yes

#### Mechanical

<b>MATERIAL</b>	<i>Housing</i> Powder-coated aluminum <i>Flange</i> Aluminum <i>Shaft</i> Stainless steel <i>Code disc</i> Glass
<b>WEIGHT</b>	≈ 12 oz
<b>ROTATIONAL SPEED</b>	<i>BSS58</i> ≤ 10,000 rpm <i>BSM58</i> ≤ 6,000 rpm
<b>MOMENT OF INERTIA</b>	≤ 4.3 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>	≤ 2.1 in-oz
<b>SHAFT LOADING</b>	<i>Angle offset</i> 1° <i>Axial offset</i> ≤ 1 mm
<b>BEARING WORKING LIFE</b>	> 4 x 10 <sup>10</sup> revolutions

#### Environmental

<b>STORAGE TEMPERATURE</b>	-25°C to +85°C (-13°F to +185°F)
<b>OPERATING TEMPERATURE</b>	-20°C to +70°C (-4°F to +158°F)
<b>HUMIDITY</b>	98% RH non-condensing
<b>SHOCK RESISTANCE</b>	100 g for 3 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP65

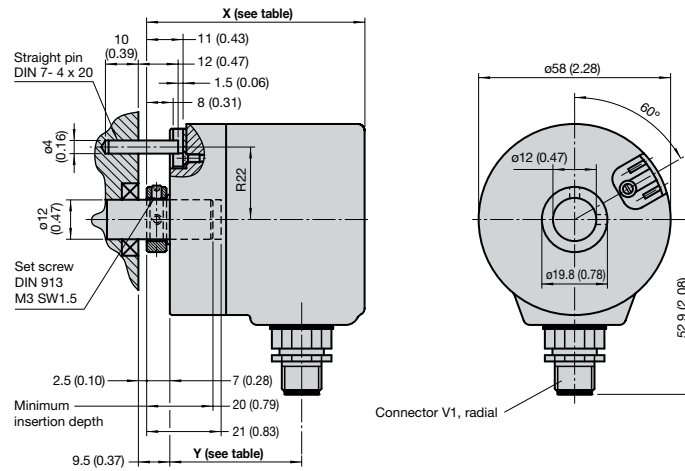
#### Connection Types

<b>CONNECTOR</b>	Type V1, M12, 4-Pin
------------------	---------------------




## Dimensions

mm (in.)



	Dimension X	Dimension Y
Single-turn	67 (2.64)	41 (1.61)
Multi-turn	94 (3.70)	68 (2.68)

## Electrical Connection

Signal	Type V1, 4-pin quick disconnect	Description
AS-i +	1	
Reserved	2	Not wired
AS-i -	3	
Reserved	4	Not wired
		



# Absolute Rotary Encoders

## Programming

### Addresses

	Slave A	Slave B	Slave C	Slave D
Preset address	1	2	3	4
IO code	7	0	0	0
IO code	F	F	F	F



When using an AS-Interface master or handheld programmer to change the slave addresses, it is absolutely essential to assign a different address to each of the four slaves.

### Parameter Bits

The four parameter bits of slave A are used to set the parameters of the encoder. The parameter bits of slave B, C and D are not used.

Status of parameter bit	Slave A			
	P0	P1	P2	P3
0	Gray code	Transfer with flag bits	Count down with clockwise rotation	Not used
1	Binary code	Transfer without flag bits	Count up with clockwise rotation	Not used

### Data Bits

#### From the AS-Interface master to the encoder

Data from the AS-Interface master is transferred to the encoder via slave A, which works bidirectionally. Slaves B, C and D operate unidirectionally and can only send data.

When data bits D2 and D3 are changed from 01 to 10 or vice-versa, the position data is saved in the encoder.

Status of D0/D1 or D2/D3	Slave A	
	D0/D1	D2/D3
00	Normal mode	Position data is not saved
01	Rotary encoder is set to 1/4 of the single turn resolution	Position data is saved
10	Rotary encoder is set to 0	Position data is saved
11	Normal mode	Position data is not saved

#### From the encoder to the AS-Interface master

Parameter bit P1 of slave A is used to determine if the encoder transfers data to the AS-Interface master with or without flag bits.

P1 = 1: Transfer without flag bits

Slave A				Slave B				Slave C				Slave D			
D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3
Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Bit 9	Bit 10	Bit 11	Bit 12	Not used!		

P1 = 0: Transfer with flag bits MA, MB, MC, MD

Slave A				Slave B				Slave C				Slave D			
D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3
Bit 0	Bit 1	Bit 2	MA	Bit 0	Bit 1	Bit 2	MB	Bit 0	Bit 1	Bit 2	MC	Bit 0	Bit 1	Bit 2	MD



## Programming (continued)

### Operating Modes

#### Address assignments for the four slaves

The AS-Interface master accesses all slaves sequentially within an AS-Interface cycle to transfer output data to slave A or to read input data from the slaves. The single-turn absolute encoder uses four AS-Interface chips to transfer a position of 13 bits using 4 slave addresses.

These four slaves are queried sequentially and data may originate from any one of four different sampling times. To minimize this effect, sequential addresses (n, n+1, n+2 and n+3) should be assigned to slaves A, B, C and D.

In addition, slave A is responsible for controlling the encoder's functions. If the order of slaves is changed (D=n, C=n+1, B=n+2, A=n+3), the output word, which is supposed to be transmitted by the function control module of the absolute encoder, will not be transmitted until slaves D, C and B have been read in. A memory command would then only take effect for slave A. The command would not affect the slaves that had already been read until the next read cycle. This change of slave order will result in data inconsistency.

#### Temporary storage and transfer with flag bits

If any data from the rotary encoder is interrupted during transmission, it is possible that some of the data transferred to the controller originates from a different position in the data word. The controller can check the data integrity for a single data word by comparing the four flag bits. Each slave can transfer one flag bit making it possible for the control module to check which position data set an individual data set belongs to by comparing the 4 bits. Data bit D2 is used for this purpose. Using the flag bits reduces the size of the usable data from 16 bits to 12 bits.

Cycle	Slave A Data bit D2	Position data			
		Slave A	Slave B	Slave C	Slave D
1	0	XXX0	XXX0	XXX0	XXX0
2	1	XXX1	XXX1	XXX1	XXX1
3	0	XXX0	XXX0	XXX0	XXX0
4	1	XXX1	XXX1	XXX1	XXX1
etc.					



## CVS58/CVM58 Series CANopen Interface

- Galvanically isolated CAN interface
- Cam function
- Programmable modes & parameters
- LED status indication
- Aluminum or stainless steel housings

### CANopen



The CVS58 and CVM58 series absolute encoders interface with CANopen. The bus electronics are integrated into the removable housing cover, making it possible to mount or replace new rotary encoders and the matching bus electronics separately during installation or service.

These solid shaft encoders are available with 6 mm or 10 mm solid shaft diameters, and in single- (16-bit resolution) or multi-turn (30-bit resolution) versions. They are available with a clamping flange or a servo flange.

### Order Code

CV□58□-□□□□□R0BN-□□□□

#### Type

- S Single-turn
- M Multi-turn

#### Housing

- N Aluminum
- I Stainless steel

#### Shaft dimension/flange style

- 011 Ø 10 mm x 20 mm with clamping flange
- 032 Ø 6 mm x 10 mm with servo flange

#### Connection type

- AG Removable housing cover with terminal compartment
- AZ Removable housing cover with M12 x 1 connectors

#### Steps per revolution

- 12 4096 (standard)
- 13 8192
- 16 65536

#### Number of revolutions

- 00 1 (single-turn)
- 12 4096 (multi-turn, standard)
- 14 16384 (multi-turn)

Example: CVS58N-011AGR0BN-0012

## Technical Specifications

### Electrical

SUPPLY VOLTAGE	10-30 VDC
CURRENT CONSUMPTION	≤ 350 mA
OUTPUT CODE	Binary
LINEARITY	± 2 LSB at 16-bit, ± 1 LSB at 13-bit, ± 0.5 LSB at 12-bit
COUNTING DIRECTION (Shaft End View)	Programmable
INTERFACE	Interface type Transfer rate Standard conformity
	CANopen ≤ 1 Mbit/s DSP 406, Class 1 and 2
RESOLUTION	Bits/steps per turn Bits/number of turns
	16-bit / 65536 14-bit / ≤ 16384
OVERALL RESOLUTION	Single-turn Multi-turn
	≤ 16-bit ≤ 30-bit
CERTIFICATES CE	Yes

### Mechanical

MATERIAL	Housing	Powder-coated aluminum
(Standard Model)	Flange	Aluminum
	Shaft	Stainless steel
	Code disc	Plastic
MATERIAL	Housing	Stainless steel
(Stainless Model)	Flange	Stainless steel
	Shaft	Stainless steel
	Code disc	Plastic
WEIGHT	CVS - Standard	≈ 1.2 lbs
	CVS - Optional Stainless Steel	≈ 2.2 lbs
	CVM - Standard	≈ 1.5 lbs
	CVM - Optional Stainless Steel	≈ 2.6 lbs
ROTATIONAL SPEED		≤ 12,000 rpm
MOMENT OF INERTIA		≤ 7.1 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 7.1 in-oz
SHAFT LOADING	Axial	9.0 lbs
	Radial	24.7 lbs
BEARING WORKING LIFE		> 4 x 10 <sup>10</sup> revolutions

### Environmental

STORAGE TEMPERATURE	-40°C to +85°C (-40°F to +185°F)
OPERATING TEMPERATURE	-40°C to +85°C (-40°F to +185°F)
HUMIDITY	No moisture condensation
SHOCK RESISTANCE	100 g for 6 ms
VIBRATION RESISTANCE	10 g, 10-1,000 Hz
ENCLOSURE RATING	IP65

### Connection Types

TERMINAL CONNECTOR	Terminal compartment with 3 x PG9 cable glands
--------------------	---

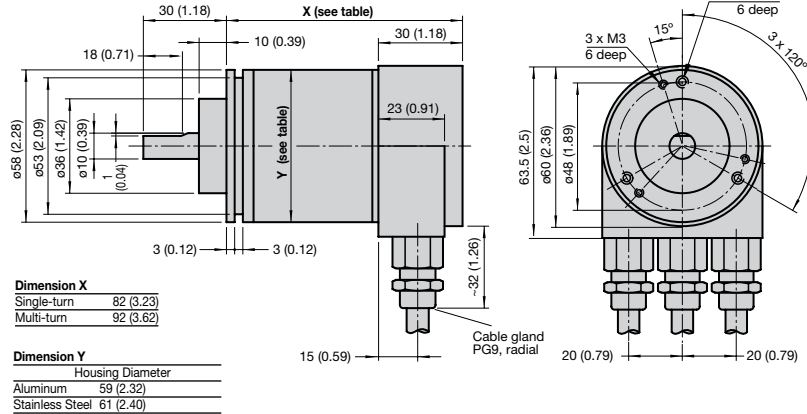


## Dimensions

mm (in.)

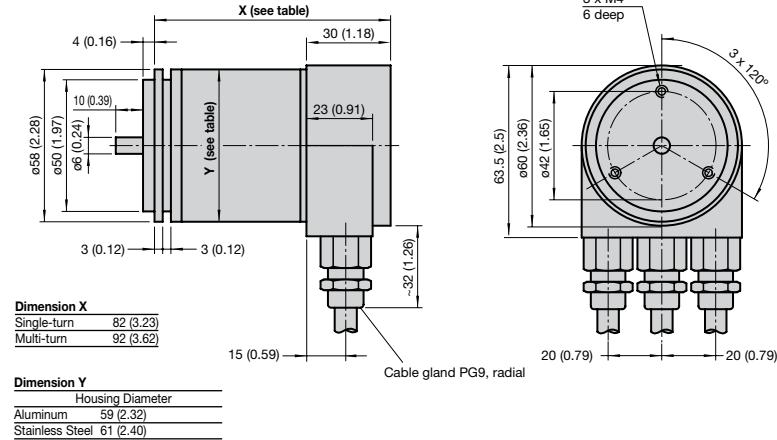
### Shaft option/flange style 011

Ø 10 mm x 20 mm with clamping flange



### Shaft option/flange style 032

Ø 6 mm x 10 mm with servo flange



## Electrical Connection

Terminal	Cable	Description
⊥	-	Ground connection for power supply
(+)	Red	Power supply
(-)	Black	Power supply
CG	-	CAN ground
CL	Blue	CAN low
CH	White	CAN high
CG	-	CAN ground
CL	Blue	CAN low
CH	White	CAN high

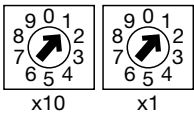


# Absolute Rotary Encoders

## Configuration

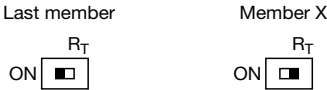
### Setting the member address

The member address can be set with the rotary switches. The address can be defined between 1 and 96, and may be assigned only once. The addresses 97 to 99 are reserved.



### Adjusting the terminating resistor

The terminating resistor  $R_T$  (121  $\Omega$ ) can be switched into the circuit with the switch:

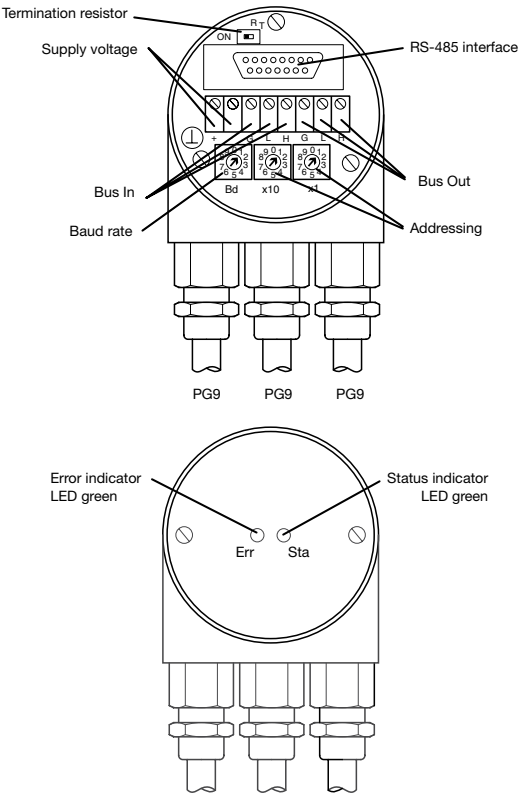


### Adjusting the baud rate

Baud rate in kBit/s	Rotary switch
20	0
50	1
100	2
125	3
250	4
500	5
800	6
1000	7
Reserved	8-9

### LED indicators

LED red	LED green	Meaning
off	off	No voltage supply
off	on	Encoder ready, boot-up message not transmitted yet. Possible reasons: <ul style="list-style-type: none"><li>no further participant present</li><li>wrong baud rate</li><li>encoder in prepared status</li></ul>
flashing	on	Boot-up message transmitted. Device configuration possible.
on	on	Normal operation mode, encoder in operational status.





## Programming

### Programmable CAN operating modes

Mode	Description
Polled mode	The connected host requests the current actual position value via a telegram. The absolute encoder reads in the current position, calculates all parameters that may have been set and then sends back the actual process value.
Cyclic mode	The absolute encoder sends the current actual process value cyclically, without being prompted by the host. The cycle time can be programmed in milliseconds for values between 1 ms and 65,536 ms.
Sync mode	After the sync telegram has been received by the host, the absolute encoder sends the current actual process value. If multiple nodes should respond to the sync telegram, the individual nodes report one after the other according to their CAN identifier. There is no programming of an offset time. The sync counter can be programmed so that the rotary encoder does not transmit until after a defined number of sync telegrams.

### Programmable rotary encoder parameters

#### CVS58

Parameter	Description
Operating parameter	The direction of rotation (complement) can be specified as the operating parameter. This parameter determines the direction of rotation in which the output code will be rising or declining.
Resolution per revolution	The "Resolution" parameter is used to program the rotary encoder so that a desired number of steps can be implemented in reference to a revolution.
Preset value	The preset value is the desired position value that must be achieved for a specific physical setting of the axis. The preset value parameter is used to set the actual position value to the desired actual process value.
Min. and max. limit switch	A total of two positions can be programmed. The absolute encoder sets one bit to high state in the 32 Bit actual process value if a value falls outside the range between two positions.
Cam	A freely programmable cam can be set within the overall resolution. This produces the functionality of a mechanical cam shifting mechanism.

#### CVM58

Parameter	Description
Operating parameter	The direction of rotation (complement) can be specified as the operating parameter. This parameter determines the direction of rotation in which the output code will be rising or declining.
Resolution per revolution	The "Resolution" parameter is used to program the rotary encoder so that a desired number of steps can be implemented in reference to a revolution.
Overall resolution	This parameter indicates the desired number of measurement units of the entire travel length. This value must not exceed the overall resolution of the absolute encoder.
Preset value	The preset value is the desired position value that must be achieved for a specific physical setting of the axis. The preset value parameter is used to set the actual position value to the desired actual process value.
Min. and max. limit switch	A total of two positions can be programmed. The absolute encoder sets one bit to high state in the 32 Bit actual process value if a value falls outside the range between two positions.
Cam	A freely programmable cam can be set within the overall resolution. This produces the functionality of a mechanical cam shifting mechanism.



## CSS58/CSM58 Series CANopen Interface

- Galvanically isolated CAN interface
- Cam function
- Programmable modes & parameters
- LED status indication
- Aluminum or stainless steel housings
- Recessed hollow shaft

### CANopen



The CSS58 and CSM58 series absolute encoders interface with CANopen. The bus electronics are integrated into the removable housing cover, making it possible to mount or replace new rotary encoders and the matching bus electronics separately during installation or service.

These recessed hollow shaft encoders are available with 10 mm, 12 mm, or 15 mm shaft diameters, and in single- (16-bit resolution) or multi-turn (30-bit resolution) versions.

### Order Code

**CS** **58** **-** **□□□□** **ROBN** **-** **□□□□**

#### Type

- S** Single-turn
- M** Multi-turn

#### Housing

- N** Aluminum
- I** Stainless steel

#### Shaft dimension/flange style

- F1A** Recessed hollow Ø 10 mm x 30 mm
- F2A** Recessed hollow Ø 12 mm x 30 mm
- F3A** Recessed hollow Ø 15 mm x 30 mm

#### Connection type

- AG** Removable housing cover with terminal compartment
- AZ** Removable housing cover with M12 x 1 connectors

#### Steps per revolution

- 12** 4096 (standard)
- 13** 8192
- 16** 65536

#### Number of revolutions

- 00** 1 (single-turn)
- 12** 4096 (multi-turn, standard)
- 14** 16384 (multi-turn)

Example: CSS58N-F1AAGROBN-0012

## Technical Specifications

### Electrical

<b>SUPPLY VOLTAGE</b>	10-30 VDC
<b>CURRENT CONSUMPTION</b>	≤ 230 mA at 10 V DC, ≤ 100 mA at 24 V DC
<b>OUTPUT CODE</b>	Binary
<b>LINEARITY</b>	± 2 LSB at 16-bit, ± 1 LSB at 13-bit, ± 0.5 LSB at 12-bit
<b>COUNTING DIRECTION</b> (Shaft End View)	Programmable
<b>INTERFACE</b>	Interface type Transfer rate Standard conformity
	CANopen ≤ 1 Mbit/s DSP 406, Class 1 and 2
<b>RESOLUTION</b>	Bits/steps per turn Bits/number of turns
	16-bit / 65536 14-bit / ≤ 16384
<b>OVERALL RESOLUTION</b>	Single-turn Multi-turn
	≤ 16-bit ≤ 30-bit
<b>CERTIFICATES</b> CE	Yes

### Mechanical

<b>MATERIAL</b> (Standard Model)	Housing Flange Shaft Code disc	Powder-coated aluminum Aluminum Stainless steel Plastic
<b>MATERIAL</b> (Stainless Model)	Housing Flange Shaft Code disc	Stainless steel Stainless steel Stainless steel Plastic
<b>WEIGHT</b>	CSS - Standard CSS - Optional Stainless Steel CSM - Standard CSM - Optional Stainless Steel	≈ 1.2 lbs ≈ 2.4 lbs ≈ 1.3 lbs ≈ 2.6 lbs
<b>ROTATIONAL SPEED</b>		≤ 12,000 rpm
<b>MOMENT OF INERTIA</b>		≤ 4.2 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>		≤ 4.2 in-oz
<b>SHAFT LOADING</b>	Angle offset Axial offset Radial offset	± 0.9° Static: ± 0.3 mm; Dynamic: ± 0.1 mm Static: ± 0.5 mm; Dynamic: ± 0.2 mm
<b>BEARING WORKING LIFE</b>		> 4 x 10 <sup>10</sup> revolutions

### Environmental

<b>STORAGE TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>OPERATING TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 6 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-1,000 Hz
<b>ENCLOSURE RATING</b>	IP64

### Connection Types

<b>TERMINAL CONNECTOR</b>	Terminal compartment with 3 x PG9 cable glands
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# Absolute Encoders CSS58/CSM58 Series

Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com

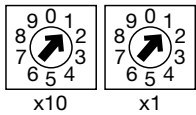


# Absolute Rotary Encoders

## Configuration

### Setting the member address

The member address can be set with the rotary switches. The address can be defined between 1 and 96, and may be assigned only once. The addresses 97 to 99 are reserved.



### Adjusting the terminating resistor

The terminating resistor  $R_T$  (121  $\Omega$ ) can be switched into the circuit with the switch:

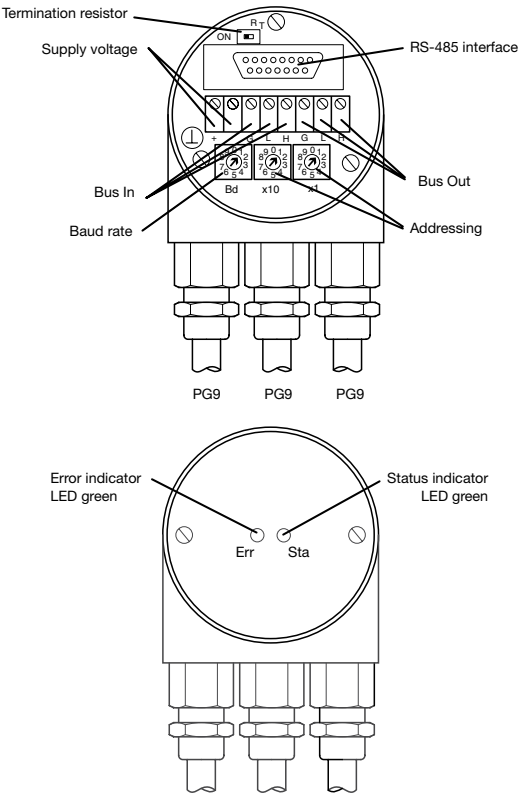


### Adjusting the baud rate

Baud rate in kBit/s	Rotary switch
20	0
50	1
100	2
125	3
250	4
500	5
800	6
1000	7
Reserved	8-9

### LED indicators

LED red	LED green	Meaning
off	off	No voltage supply
off	on	Encoder ready, boot-up message not transmitted yet. Possible reasons: <ul style="list-style-type: none"><li>no further participant present</li><li>wrong baud rate</li><li>encoder in prepared status</li></ul>
flashing	on	Boot-up message transmitted. Device configuration possible.
on	on	Normal operation mode, encoder in operational status.





## Programming

### Programmable CAN operating modes

Mode	Description
Polled mode	The connected host requests the current actual position value via a telegram. The absolute encoder reads in the current position, calculates all parameters that may have been set and then sends back the actual process value.
Cyclic mode	The absolute encoder sends the current actual process value cyclically, without being prompted by the host. The cycle time can be programmed in milliseconds for values between 1 ms and 65,536 ms.
Sync mode	After the sync telegram has been received by the host, the absolute encoder sends the current actual process value. If multiple nodes should respond to the sync telegram, the individual nodes report one after the other according to their CAN identifier. There is no programming of an offset time. The sync counter can be programmed so that the rotary encoder does not transmit until after a defined number of sync telegrams.

### Programmable rotary encoder parameters

#### CSS58

Parameter	Description
Operating parameter	The direction of rotation (complement) can be specified as the operating parameter. This parameter determines the direction of rotation in which the output code will be rising or declining.
Resolution per revolution	The "Resolution" parameter is used to program the rotary encoder so that a desired number of steps can be implemented in reference to a revolution.
Preset value	The preset value is the desired position value that must be achieved for a specific physical setting of the axis. The preset value parameter is used to set the actual position value to the desired actual process value.
Min. and max. limit switch	A total of two positions can be programmed. The absolute encoder sets one bit to high state in the 32 Bit actual process value if a value falls outside the range between two positions.
Cam	A freely programmable cam can be set within the overall resolution. This produces the functionality of a mechanical cam shifting mechanism.

#### CSM58

Parameter	Description
Operating parameter	The direction of rotation (complement) can be specified as the operating parameter. This parameter determines the direction of rotation in which the output code will be rising or declining.
Resolution per revolution	The "Resolution" parameter is used to program the rotary encoder so that a desired number of steps can be implemented in reference to a revolution.
Overall resolution	This parameter indicates the desired number of measurement units of the entire travel length. This value must not exceed the overall resolution of the absolute encoder.
Preset value	The preset value is the desired position value that must be achieved for a specific physical setting of the axis. The preset value parameter is used to set the actual position value to the desired actual process value.
Min. and max. limit switch	A total of two positions can be programmed. The absolute encoder sets one bit to high state in the 32 Bit actual process value if a value falls outside the range between two positions.
Cam	A freely programmable cam can be set within the overall resolution. This produces the functionality of a mechanical cam shifting mechanism.



### DVS58/DVM58 Series DeviceNet Interface

- Industrial standard 58 mm diameter housing
- Single or multi-turn
- Addressable
- IP65
- Servo or clamping flange

DeviceNet™



Pepperl+Fuchs' DVS58 and DVM58 series absolute encoders interface with DeviceNet. Available in either single-turn with 16-bit resolution, or multi-turn with 30-bit resolution versions. Each unit is individually addressable from 0 to 63 using the switches in the removable housing cover. The encoder operates in 3 modes: polled, change of state or cyclic. These encoders are rated IP65 and feature a rugged aluminum housing.

#### Order Code

DV□58□-□□□□□R0BN-□□□□

Type  
S Single-turn  
M Multi-turn

Housing  
N Aluminum  
I Stainless steel

Shaft dimension/flange style  
011 Ø 10 mm x 20 mm with clamping flange  
032 Ø 6 mm x 10 mm with servo flange

Connection type  
AG Removable housing cover with terminal compartment  
AZ Removable housing cover with M12 x 1 connectors

Steps per revolution  
12 4096 (standard)  
13 8192  
16 65536

Number of revolutions  
00 1 (single-turn)  
12 4096 (multi-turn, standard)  
14 16384 (multi-turn)

Example: DVS58N-011AGR0BN-0012

#### Technical Specifications

##### Electrical

SUPPLY VOLTAGE	10-30 VDC
CURRENT CONSUMPTION	≤ 350 mA
OUTPUT CODE	Binary
LINEARITY	± 2 LSB at 16-bit, ± 1 LSB at 13-bit, ± 0.5 LSB at 12-bit
COUNTING DIRECTION (Shaft End View)	Programmable
INTERFACE	Type DeviceNet
Transfer rate	≤ 0.5 MBaud
RESOLUTION	Bits/steps per turn 16-bit / 65,536 Bits/number of turns 14-bit / ≤ 16,384
OVERALL RESOLUTION	Single-turn 16-bit Multi-turn 30 bit
CERTIFICATES CE	Yes

##### Mechanical

MATERIAL	Housing	Powder-coated aluminum
(Standard Model)	Flange	Aluminum
	Shaft	Stainless steel
	Code disc	Plastic
MATERIAL	Housing	Stainless steel
(Stainless Model)	Flange	Stainless steel
	Shaft	Stainless steel
	Code disc	Plastic
WEIGHT	DVS - Standard	≈ 1.1 lbs
	DVS - Optional Stainless Steel	≈ 2.2 lbs
	DVM - Standard	≈ 1.1 lbs
	DVM - Optional Stainless Steel	≈ 2.4 lbs
ROTATIONAL SPEED		≤ 12,000 rpm
MOMENT OF INERTIA		≤ 7.1 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
STARTING TORQUE AT 20°C		≤ 7.1 in-oz
SHAFT LOADING	Axial	40 lbs
	Radial	40 lbs
BEARING WORKING LIFE		> 4 x 10 <sup>8</sup> revolutions

##### Environmental

STORAGE TEMPERATURE	-40°C to +85°C (-40°F to +185°F)
OPERATING TEMPERATURE	-40°C to +85°C (-40°F to +185°F)
HUMIDITY	98% RH non-condensing
SHOCK RESISTANCE	100 g for 6 ms
VIBRATION RESISTANCE	10 g, 10-2,000 Hz
ENCLOSURE RATING	IP65

##### Connection Types

TERMINAL CONNECTOR	Terminal compartment with 3 x PG9 cable glands
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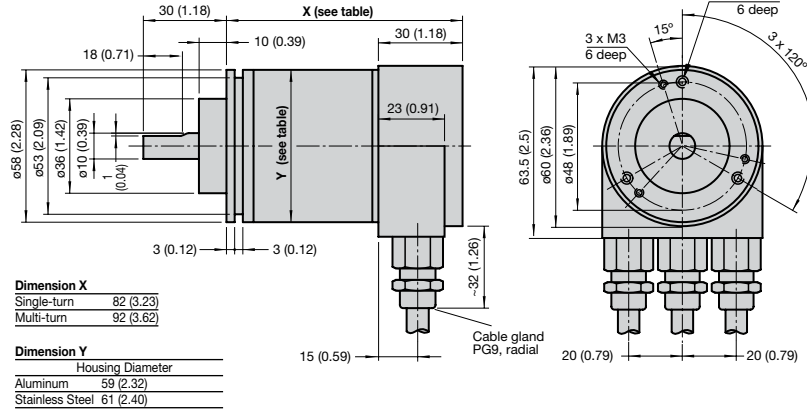


## Dimensions

mm (in.)

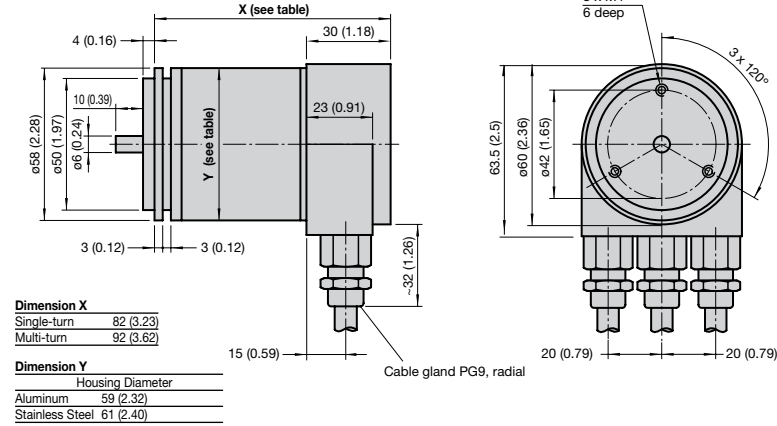
### Shaft option/flange style 011

Ø 10 mm x 20 mm with clamping flange



### Shaft option/flange style 032

Ø 6 mm x 10 mm with servo flange



## Electrical Connection

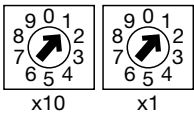
Terminal	Cable	Description
⊥	-	Ground connection for power supply
(+)	Red	Power supply
(-)	Black	Power supply
CG	-	CAN ground
CL	Blue	CAN low
CH	White	CAN high
CG	-	CAN ground
CL	Blue	CAN low
CH	White	CAN high



Configuration

Setting the member address

The member address can be set with the rotary switches. The address can be defined between 1 and 63, and each address may only be assigned once.



Adjusting the terminating resistor

The terminating resistor  $R_T$  (121  $\Omega$ ) can be switched into the circuit with the switch:

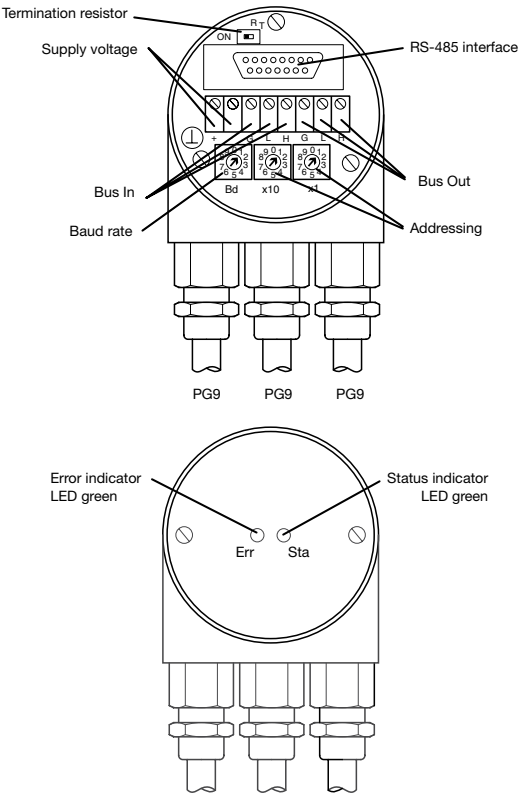


Adjusting the baud rate

Baud rate in kBit/s	Rotary switch
125	0
250	1
500	2
125	3
Reserved	4-9

LED indicators

LED red	LED green	Meaning
off	off	No voltage supply
off	on	Encoder ready, boot-up message not transmitted yet. Possible reasons: <ul style="list-style-type: none"><li>no further participant present</li><li>wrong baud rate</li><li>encoder in prepared status</li></ul>
flashing	on	Boot-up message transmitted. Device configuration possible.
on	on	Normal operation mode, encoder in operational status.





## Programming

### Programmable CAN operating modes

Mode	Description
Polled mode	The connected host requests the current actual position value via a telegram. The absolute encoder reads in the current position, calculates all parameters that may have been set and then sends back the actual process value.
Cyclic mode	The absolute encoder sends the current process value depending on a programmable timer. This can cause the bus load to be reduced since the member on the network only sends a message after a specific amount of time without a prompt from the master.
Change of state mode	The absolute encoder monitors the current process value and transfers the current value by itself if there is any change in the value. This can cause the bus load to be reduced, since the member on the network only sends a message if there has been a change.

### Programmable rotary encoder parameters

#### DVS58

Parameter	Description
Operating parameter	The direction of rotation (complement) can be specified as the operating parameter. This parameter determines the direction of rotation in which the output code will be rising or declining.
Resolution per revolution	The "Resolution" parameter is used to program the rotary encoder so that a desired number of steps can be implemented in reference to a revolution.
Preset value	The preset value is the desired position value that must be achieved for a specific physical setting of the axis. The preset value parameter is used to set the actual position value to the desired actual process value.

#### DVM58

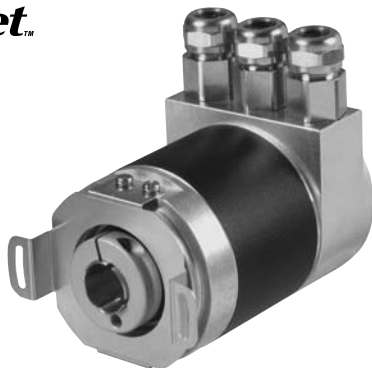
Parameter	Description
Operating parameter	The direction of rotation (complement) can be specified as the operating parameter. This parameter determines the direction of rotation in which the output code will be rising or declining.
Resolution per revolution	The "Resolution" parameter is used to program the rotary encoder so that a desired number of steps can be implemented in reference to a revolution.
Overall resolution	This parameter indicates the desired number of measurement units of the entire travel length. This value must not exceed the overall resolution of the absolute encoder.
Preset value	The preset value is the desired position value that must be achieved for a specific physical setting of the axis. The preset value parameter is used to set the actual position value to the desired actual process value.



### DSS58/DSM58 Series DeviceNet Interface

- IP67
- Programmable modes & parameters
- LED status indication
- Recessed hollow shaft with torque rest
- Aluminum or stainless steel housing

DeviceNet™



The DSS58 and DSM58 series absolute encoders interface with DeviceNet. The bus electronics are integrated into the removable housing cover, making it possible to mount or replace new rotary encoders and the matching bus electronics separately during installation or service.

These recessed hollow shaft encoders are available in single- (16-bit resolution) or multi-turn (30-bit resolution) versions. They mount directly onto the application shaft without any coupling. The rotary encoder is held in place by a torque rest.

#### Order Code

**DS** **58** **-** **ROBN** **-**

##### Type

- S** Single-turn
- M** Multi-turn

##### Housing

- N** Aluminum
- I** Stainless steel

##### Shaft dimension/flange style

- F1A** Recessed hollow Ø 10 mm x 30 mm
- F2A** Recessed hollow Ø 12 mm x 30 mm
- F3A** Recessed hollow Ø 15 mm x 30 mm

##### Connection type

- AG** Removable housing cover with terminal compartment
- AZ** Removable housing cover with M12 x 1 connectors

##### Steps per revolution

- 12** 4096 (standard)
- 13** 8192
- 16** 65536

##### Number of revolutions

- 00** 1 (single-turn)
- 12** 4096 (multi-turn, standard)
- 14** 16384 (multi-turn)

Example: DSS58N-F1AAGR0BN-0012

#### Technical Specifications

##### Electrical

<b>SUPPLY VOLTAGE</b>	10-30 VDC
<b>CURRENT CONSUMPTION</b>	≤ 230 mA at 10 V DC, ≤ 100 mA at 24 V DC
<b>OUTPUT CODE</b>	Binary
<b>LINEARITY</b>	± 2 LSB at 16-bit, ± 1 LSB at 13-bit, ± 0.5 LSB at 12-bit
<b>COUNTING DIRECTION</b> (Shaft End View)	Programmable
<b>INTERFACE</b>	Interface type: DeviceNet Transfer rate: ≤ 0.5 Mbit/s
<b>RESOLUTION</b>	Bits/steps per turn: 16-bit / 65536 Bits/number of turns: 14-bit / ≤ 16384
<b>OVERALL RESOLUTION</b>	Single-turn: 16-bit Multi-turn: 30-bit
<b>CERTIFICATES</b> CE	Yes

##### Mechanical

<b>MATERIAL – STANDARD</b>	Housing: Powder-coated aluminum Flange: Aluminum Shaft: Stainless steel
<b>MATERIAL – OPTIONAL</b>	Housing: Stainless steel Flange: Stainless steel Shaft: Stainless steel Code disc: Plastic
<b>WEIGHT</b>	DSS - Standard: ≈ 1.2 lbs DSS - Optional Stainless Steel: ≈ 2.4 lbs DSM - Standard: ≈ 1.3 lbs DSM - Optional Stainless Steel: ≈ 2.6 lbs
<b>ROTATIONAL SPEED</b>	≤ 12,000 rpm
<b>MOMENT OF INERTIA</b>	≤ 4.2 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>	≤ 4.2 in-oz
<b>SHAFT LOADING</b>	Angle offset: ± 0.9° Axial offset: Static: ± 0.3 mm; Dynamic: ± 0.1 mm Radial offset: Static: ± 0.5 mm; Dynamic: ± 0.2 mm
<b>BEARING WORKING LIFE</b>	> 4 x 10 <sup>10</sup> revolutions

##### Environmental

<b>STORAGE TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>OPERATING TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 6 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP64

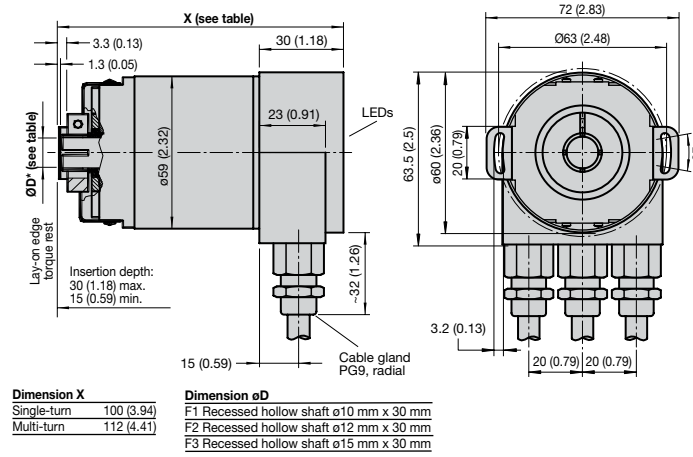
##### Connection Types

<b>TERMINAL CONNECTOR</b>	Terminal compartment with 3 x PG9 cable glands
---------------------------	--



## Dimensions

mm (in.)



## Electrical Connection

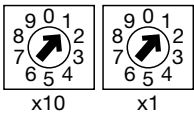
Terminal	Cable	Description
⊥	–	Ground connection for power supply
(+)	Red	Power supply
(–)	Black	Power supply
CG	–	CAN ground
CL	Blue	CAN low
CH	White	CAN high
CG	–	CAN ground
CL	Blue	CAN low
CH	White	CAN high



Configuration

Setting the member address

The member address can be set with the rotary switches. The address can be defined between 1 and 63, and each address may only be assigned once.



Adjusting the terminating resistor

The terminating resistor  $R_T$  (121  $\Omega$ ) can be switched into the circuit with the switch:

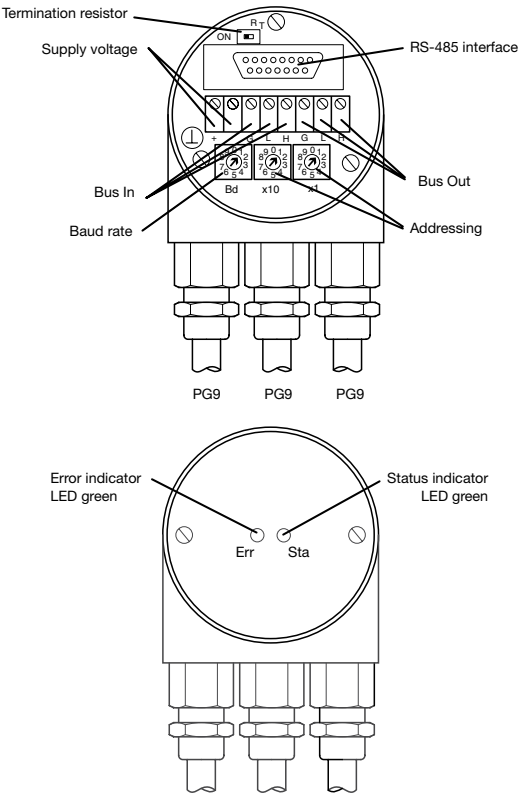


Adjusting the baud rate

Baud rate in kBit/s	Rotary switch
125	0
250	1
500	2
125	3
Reserved	4-9

LED indicators

LED red	LED green	Meaning
off	off	No voltage supply
off	on	Encoder ready, boot-up message not transmitted yet. Possible reasons: <ul style="list-style-type: none"><li>no further participant present</li><li>wrong baud rate</li><li>encoder in prepared status</li></ul>
flashing	on	Boot-up message transmitted. Device configuration possible.
on	on	Normal operation mode, encoder in operational status.





## Programming

### Programmable CAN operating modes

Mode	Description
Polled mode	The connected host requests the current actual position value via a telegram. The absolute encoder reads in the current position, calculates all parameters that may have been set and then sends back the actual process value.
Cyclic mode	The absolute encoder sends the current process value depending on a programmable timer. This can cause the bus load to be reduced since the member on the network only sends a message after a specific amount of time without a prompt from the master.
Change of state mode	The absolute encoder monitors the current process value and transfers the current value by itself if there is any change in the value. This can cause the bus load to be reduced, since the member on the network only sends a message if there has been a change.

### Programmable rotary encoder parameters

#### DSS58

Parameter	Description
Operating parameter	The direction of rotation (complement) can be specified as the operating parameter. This parameter determines the direction of rotation in which the output code will be rising or declining.
Resolution per revolution	The "Resolution" parameter is used to program the rotary encoder so that a desired number of steps can be implemented in reference to a revolution.
Preset value	The preset value is the desired position value that must be achieved for a specific physical setting of the axis. The preset value parameter is used to set the actual position value to the desired actual process value.

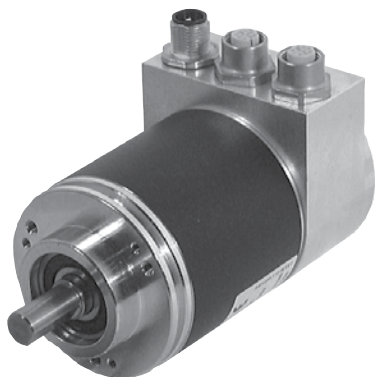
#### DSM58

Parameter	Description
Operating parameter	The direction of rotation (complement) can be specified as the operating parameter. This parameter determines the direction of rotation in which the output code will be rising or declining.
Resolution per revolution	The "Resolution" parameter is used to program the rotary encoder so that a desired number of steps can be implemented in reference to a revolution.
Overall resolution	This parameter indicates the desired number of measurement units of the entire travel length. This value must not exceed the overall resolution of the absolute encoder.
Preset value	The preset value is the desired position value that must be achieved for a specific physical setting of the axis. The preset value parameter is used to set the actual position value to the desired actual process value.



### EVS58/EVM58 Series Ethernet Interface

- Ethernet interface with TCP/IP
- Programmable via any web browser
- IP64
- Addressable via set switch
- Clamping or servo flange



The EVS58 and EVM58 series absolute encoders interface with Ethernet and support TCP/IP protocol. The integrated web server enables setup via any web browser. IP addresses are adjusted simply via rotary switches in the removable housing cover. They can operate in 3 modes: polled, change-of-state, or cyclic.

These solid shaft encoders are available in single- (16-bit resolution) or multi-turn (30-bit resolution) versions. They are available with a clamping flange or a servo flange.

#### Order Code

**EV** **58N** - **011** **TZR0BN** - **0013**

**Type**  
**S** Single-turn  
**M** Multi-turn

**Shaft dimension/flange style**  
**011** Ø 10 mm x 20 mm with clamping flange  
**032** Ø 6 mm x 10 mm with servo flange

**Number of revolutions**  
**00** 1 (single-turn)  
**12** 4096 (multi-turn, standard)  
**14** 16384 (multi-turn)

**Steps per revolution**  
**13** 8192 (standard)  
**16** 65536

**Example: EVS58N-011TZR0BN-0013**

#### Technical Specifications

##### Electrical

<b>SUPPLY VOLTAGE</b>	10-30 VDC
<b>POWER CONSUMPTION</b>	≤ 4 W
<b>OUTPUT CODE</b>	Binary
<b>LINEARITY</b>	± 0.5 LSB at 12-bit
<b>COUNTING DIRECTION</b> (Shaft End View)	Programmable
<b>INTERFACE</b>	Interface type: Ethernet TCP/IP Transfer rate: 10 Mbit/s / 100 Mbit/s
<b>RESOLUTION</b>	Bits/steps per turn: 16-bit / ≤ 65536 Bits/number of turns: 14-bit / ≤ 32768
<b>OVERALL RESOLUTION</b>	Single-turn: ≤ 16-bit Multi-turn: ≤ 30-bit
<b>CERTIFICATES</b> CE	Yes

##### Mechanical

<b>MATERIAL</b>	Housing: Powder-coated aluminum Flange: Aluminum Shaft: Stainless steel Code disc: Plastic
<b>WEIGHT</b>	EVS: ≈ 1.2 lbs EVM: ≈ 1.5 lbs
<b>ROTATIONAL SPEED</b>	≤ 12,000 rpm
<b>MOMENT OF INERTIA</b>	≤ 4.2 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>	≤ 4.2 in-oz
<b>SHAFT LOADING</b>	Axial offset: 9.0 lbs Radial offset: 24.7 lbs
<b>BEARING WORKING LIFE</b>	> 4 x 10 <sup>10</sup> revolutions

##### Environmental

<b>STORAGE TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>OPERATING TEMPERATURE</b>	0°C to +60°C (+32°F to +140°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 6 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP64

##### Connection Types

<b>ETHERNET</b>	2 female connectors M12 x 1, 4-pin, D-coded
<b>SUPPLY</b>	1 male connector M12 x 1, 5-pin, A-coded

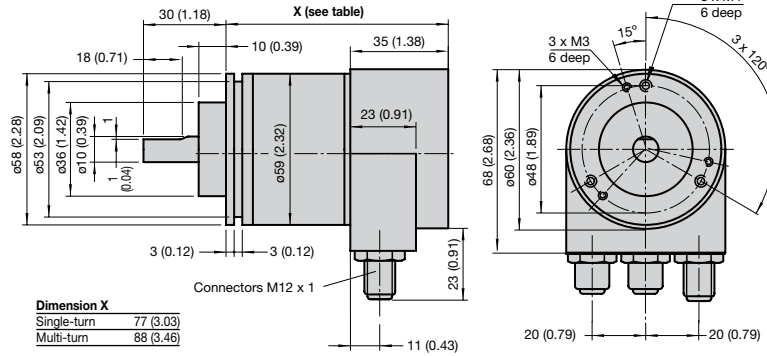


## Dimensions

mm (in.)

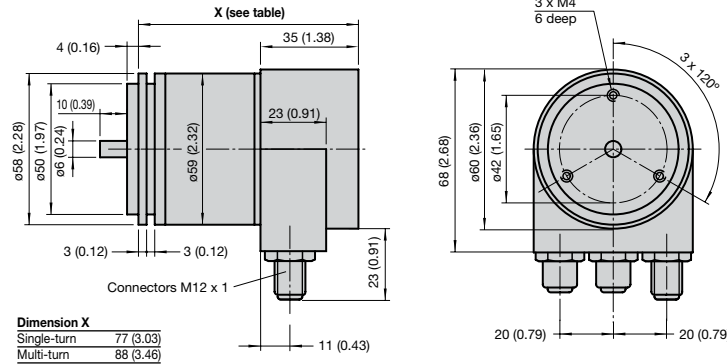
### Shaft option/flange style 011

Ø 10 mm x 20 mm with clamping flange



### Shaft option/flange style 032

Ø 6 mm x 10 mm with servo flange



## Electrical Connection

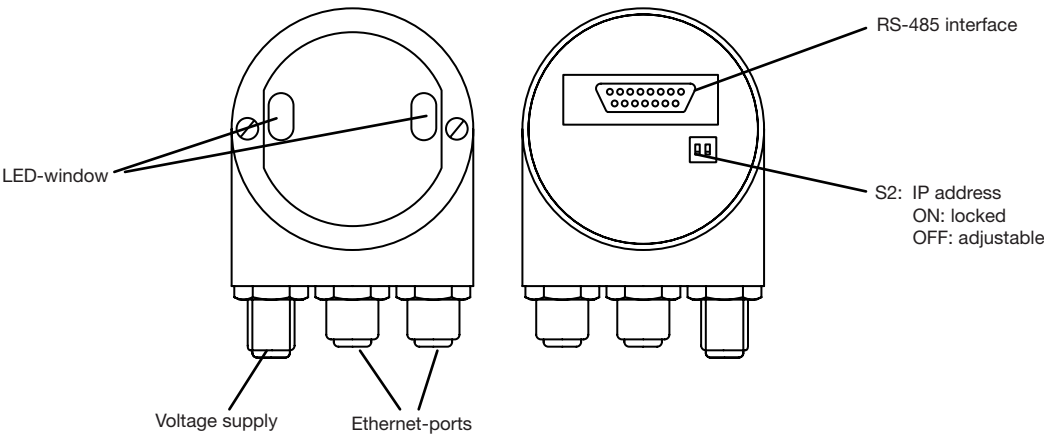
Pin	Male connector M12 x 1, 5-pin, A-coded	Female connector M12 x 1, 4-pin, D-coded	Female connector M12 x 1, 4-pin, D-coded
1	+ 24 V	Rx +	Rx +
2	+ 24 V	Tx +	Tx +
3	0 V	Rx -	Rx -
4	0 V	Tx -	Tx -
5	Ground		



Configuration

Setting the Member Address

Set switch S2 to position OFF to adjust the IP address. In switch position ON, the IP address is blocked to avoid unintentional changes. The rotary switches and switch S1 have no function.



LED indicators

LED	Color	Meaning
Rx1	yellow	Data traffic on port 1
Link1	green	Connection to another Ethernet device on port 1
Col1	red	Bus collision on port 1
Rx2	yellow	Data traffic on port 2
Link2	green	Connection to another Ethernet device on port 2
Col2	red	Bus collision on port 2
Err	red	Internal error



## Technical Specifications

### Electrical

SUPPLY VOLTAGE	10-30 VDC	
POWER CONSUMPTION	≤ 4 W	
OUTPUT CODE	Binary	
LINEARITY	± 0.5 LSB at 12-bit	
COUNTING DIRECTION (Shaft End View)	Programmable	
INTERFACE	Interface type	Ethernet TCP/IP
	Transfer rate	10 Mbit/s / 100 Mbit/s
RESOLUTION	Bits/steps per turn	16-bit / ≤ 65536
	Bits/number of turns	14-bit / ≤ 32768
OVERALL RESOLUTION	Single-turn	≤ 16-bit
	Multi-turn	≤ 30-bit
CERTIFICATES CE	Yes	

### Mechanical

<b>MATERIAL</b>	<i>Housing</i>	Powder-coated aluminum
	<i>Flange</i>	Aluminum
	<i>Shaft</i>	Stainless steel
	<i>Code disc</i>	Plastic
<b>WEIGHT</b>	<i>ESS</i>	≈ 1.2 lbs
	<i>ESM</i>	≈ 1.5 lbs
<b>ROTATIONAL SPEED</b>	≤ 12,000 rpm	
<b>MOMENT OF INERTIA</b>	≤ 4.2 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>	
<b>STARTING TORQUE AT 20°C</b>	≤ 4.2 in-oz	
<b>SHAFT LOADING</b>	<i>Angle offset</i>	± 0.9°
	<i>Axial offset</i>	Static: ± 0.3 mm; Dynamic: ± 0.1 mm
	<i>Radial offset</i>	Static: ± 0.5 mm; Dynamic: ± 0.2 mm
<b>BEARING WORKING LIFE</b>	> 4 x 10 <sup>10</sup> revolutions	

### Environmental

<b>STORAGE TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>OPERATING TEMPERATURE</b>	0°C to +60°C (+32°F to +140°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 6 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP64

### Connection Types

<b>ETHERNET</b>	2 female connectors M12 x 1, 4-pin, D-coded
<b>SUPPLY</b>	1 male connector M12 x 1, 5-pin, A-coded

## ESS58/ESM58 Series Ethernet Interface

- Ethernet interface with TCP/IP
- Programmable via any web browser
- IP64
- Addressable via rotary switch
- Recessed hollow shaft



The ESS58 and ESM58 series absolute encoders interface with Ethernet and support TCP/IP protocol. The integrated web server enables programming via any web browser. IP addresses are adjusted simply via rotary switches in the removable housing cover. They can operate in 3 modes: polled, change-of-state, or cyclic.

These recessed hollow shaft encoders are available in single- (16-bit resolution) or multi-turn (30-bit resolution) versions with a 10 mm, 12 mm, or 15 mm shaft bore.

### Order Code

**ES□58N-□□□TZR0BN-□□□□**

#### Type

- S** Single-turn
- M** Multi-turn

#### Shaft dimension/flange style

- F1A** Recessed hollow Ø 10 mm x 30 mm
- F2A** Recessed hollow Ø 12 mm x 30 mm
- F3A** Recessed hollow Ø 15 mm x 30 mm

#### Steps per revolution

- 13** 8192 (standard)
- 16** 65536

#### Number of revolutions

- 00** 1 (single-turn)
- 12** 4096 (multi-turn, standard)
- 14** 16384 (multi-turn)

**Example: ESS58N-F1ATZR0BN-0013**

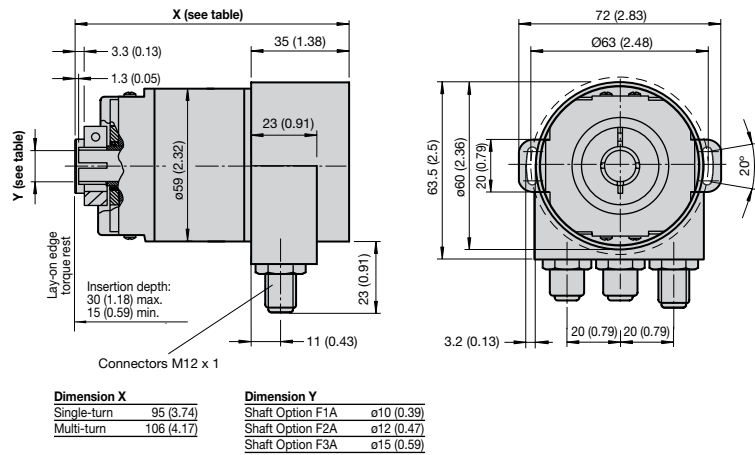


# Absolute Rotary Encoders

Absolute Encoders ESS58/ESM58 Series

## Dimensions

mm (in.)



## Electrical Connection

Pin	Male connector M12 x 1, 5-pin, A-coded	Female connector M12 x 1, 4-pin, D-coded	Female connector M12 x 1, 4-pin, D-coded
1	+ 24 V	Rx +	Rx +
2	+ 24 V	Tx +	Tx +
3	0 V	Rx -	Rx -
4	0 V	Tx -	Tx -
5	Ground		

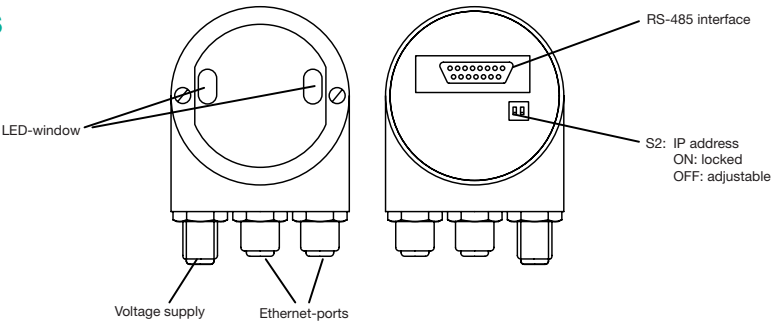
Pin diagrams for the electrical connection table:

- Male connector (A-coded): 5-pin, 1-5
- Female connector (D-coded): 4-pin, 1-4

## Configuration

### Setting the Member Address

Set switch S2 to position OFF to adjust the IP address. In switch position ON, the IP address is blocked to avoid unintentional changes. The rotary switches and switch S1 have no function.



## LED indicators

LED	Color	Meaning
Rx1	yellow	Data traffic on port 1
Link1	green	Connection to another Ethernet device on port 1
Col1	red	Bus collision on port 1
Rx2	yellow	Data traffic on port 2
Link2	green	Connection to another Ethernet device on port 2
Col2	red	Bus collision on port 2
Err	red	Internal error



## Technical Specifications

### Electrical

<b>SUPPLY VOLTAGE</b>	10-30 VDC
<b>CURRENT CONSUMPTION</b>	≤ 230 mA at 10 VDC, ≤ 100 mA at 24 VDC
<b>OUTPUT CODE</b>	Binary
<b>LINEARITY</b>	± 2 LSB at 16-bit, ± 1 LSB at 13-bit, ± 0.5 LSB at 12-bit
<b>COUNTING DIRECTION</b> (Shaft End View)	Programmable
<b>INTERFACE</b>	PROFIBUS
<b>TRANSFER RATE</b>	≤ 0.00096 to 12 Mbits/s
<b>RESOLUTION</b>	Single-turn 16-bit / 65,536 Multi-turn 14-bit / ≤ 16,384
<b>OVERALL RESOLUTION</b>	Single-turn 16-bit Multi-turn 30-bit
<b>STANDARD CONFORMITY</b>	PNO profile 3.062, RS-485
<b>CERTIFICATES</b> CE	Yes

### Mechanical

<b>MATERIAL</b> (Standard Model)	Housing	Powder-coated aluminum
	Flange	Aluminum
	Shaft	Stainless steel
	Code disc	Plastic
<b>MATERIAL</b> (Stainless Model)	Housing	Stainless steel
	Flange	Stainless steel
	Shaft	Stainless steel
	Code disc	Plastic
<b>WEIGHT</b>	PVS - Standard	≈ 1.2 lbs
	PVS - Optional Stainless Steel	≈ 2.4 lbs
	PVM - Standard	≈ 1.3 lbs
	PVM - Optional Stainless Steel	≈ 2.6 lbs
<b>ROTATIONAL SPEED</b>		≤ 12,000 rpm
<b>MOMENT OF INERTIA</b>		≤ 7.1 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>		≤ 7.1 in-oz
<b>SHAFT LOADING</b>	Axial	9.0 lbs
	Radial	24.7 lbs
<b>BEARING WORKING LIFE</b>		> 4 x 10 <sup>10</sup> revolutions

### Environmental

<b>STORAGE TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>OPERATING TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 6 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP64

### Connection Types

<b>TERMINAL CONNECTOR</b>	Terminal compartment with 3 x PG9 cable glands
---------------------------	--

## PVS58/PVM58 Series PROFIBUS Interface

- Industrial standard 58 mm diameter housing
- Single or multi-turn
- Servo flange and 6 mm diameter shaft or clamping flange and 10 mm diameter shaft
- Velocity output
- Inputs for counting direction, preset, and limit switches
- LED indication of operational mode, bus errors and wiring faults



Pepperl+Fuchs' PVS58 and PVM58 series absolute encoders interface with PROFIBUS and are available in either single-turn with 16-bit resolution, or multi-turn with 30-bit resolution versions. These models also feature a velocity output and programmable limit switches. Each encoder is individually addressable between 0 and 63 and has an IP65 aluminum housing.

### Order Code

**PV□58□-□□□□□R0BN-□□□□**

**Type**  
S Single-turn  
M Multi-turn

**Housing**  
N Aluminum  
I Stainless steel

**Shaft option/flange style**  
011 Ø 10 mm x 20 mm with clamping flange  
032 Ø 6 mm x 10 mm with servo flange

**Connection type**  
AG Removable housing cover with terminal compartment  
AZ Removable housing cover with M12 x 1 connectors

**Steps per revolution**  
13 8192 (standard)  
16 65536

**Number of revolutions**  
00 1 (single-turn)  
12 4096 (multi-turn, standard)  
14 16384 (multi-turn)

**Example: PVS58N-011AGR0BN-0012**



# Absolute Rotary Encoders

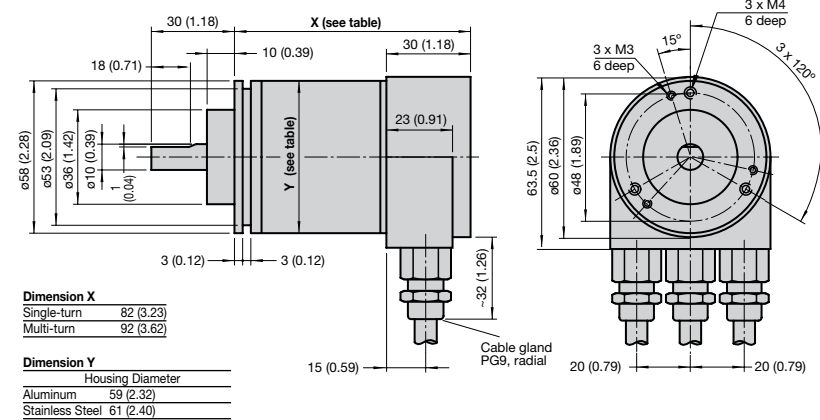
Absolute Encoders PVS58/PVM58 Series

## Dimensions

mm (in.)

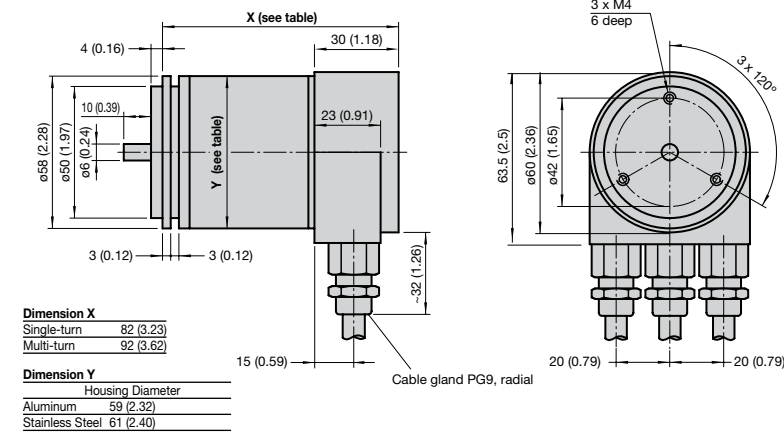
### Shaft option/flange style 011

Ø 10 mm x 20 mm with clamping flange



### Shaft option/flange style 032

Ø 6 mm x 10 mm with servo flange



## Electrical Connection

Terminal	Description
⊥	Ground connection for power supply
B (left)	Data line B (pair 1), Bus In
A (left)	Data line A (pair 1), Bus In
(-)	0 VDC
(+)	10 V ... 30 V
B (right)	Data line B (pair 2), Bus Out
A (right)	Data line A (pair 2), Bus Out
(-)	0 V
(+)	10 V ... 30 V
The supply lines need to be connected only once (regardless to which terminal). The outgoing bus is uncoupled while the termination resistor is on.	



## Programming

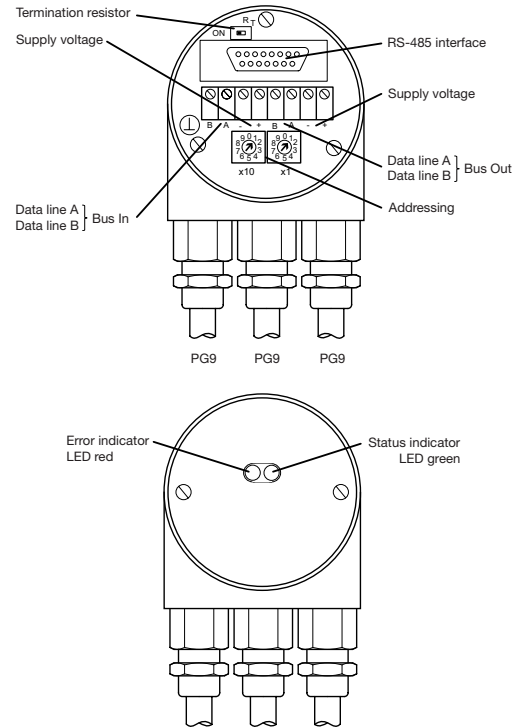
### Installation

The rotary encoder is connected with two or three cables depending on whether the power supply is integrated into the bus cable or connected separately. If the power supply is integrated into the bus cable, one of the cable glands can be plugged. The cable glands are suitable for cable diameters from 5.5 to 9 mm.

The PROFIBUS device address is set via the two rotary switches located within the removable housing cover. Any address from 1 to 99 is allowed but each can only be used once. Termination resistors are integrated into the housing cover and must be switched on if the encoder is connected at the beginning or end of the bus.

There are 2 sets of power supply terminals but it is only necessary to connect power to one set. The outgoing bus lines are disconnected if the terminating resistor is switched on.

On the back of the housing cover are 2 LEDs, which are used for device status and diagnostics.



### Programmable Parameters

The PROFIBUS-DP interface supports Class 1 and Class 2 functionality per the encoder profile. In addition to these standard functions, the GSD file supports additional features such as software limit switches. The following parameters can be programmed directly via the PROFIBUS-DP network without any extra devices:

Parameter	Description
Counting direction	Determines the counting direction and whether the output code increases or decreases.
Resolution per revolution	Programs the desired number of steps per revolution. Any value between 1 and 65,536 can be used.
Total resolution	Programs the desired number of steps over the total measuring range of the encoder. This value cannot exceed the total physical resolution of the encoder.
Preset value	A desired position value (i.e., 0) to be set at a certain physical position of the axis. The position value is set to the desired process value via this parameter. This parameter is used to "zero" the encoder at any time to start at a reference point.
Velocity	The software can also output the current velocity. This value is given in a 16-bit binary code after the process value. It is possible to choose between four different units: steps per 10 ms, per 100 ms, per 1 s and revolutions per minute.
Software limit switches	Sets the minimum and maximum values. Two software limit switches can be set. If these values are exceeded, a bit in the output word is set.
Teach-in	A special mode for setting up the encoder that changes parameters while the encoder transfers data. For continuous operation a second mode is available in which parameters are protected against unintentional changes.

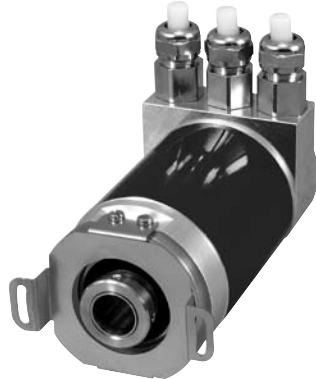
### LED Indicators

LED Red	LED Green	Meaning
Off	Off	No voltage supply.
On	On	Encoder ready, no configuration data received. Possible reasons: <ul style="list-style-type: none"> <li>Wrong address adjusted</li> <li>Wrong bus wiring</li> </ul>
On	Flashing	Parameter or configuration error — encoder received data of incorrect length or inconsistent data. Possible reason: <ul style="list-style-type: none"> <li>Adjusted encoder resolution exceeded</li> </ul>
Flashing	On	Encoder ready, no communication (i.e. wrong address adjusted).
On	Off	Data timeout (> 40 s) (i.e., data lines interrupted).
Off	On	Normal operation, Data Exchange Mode.
Off	Flashing	Installation mode in Data Exchange Mode.



### PSS58/PSM58 Series PROFIBUS Interface

- Industrial standard 58 mm diameter housing
- 10 mm or 12 mm bore diameter recessed hollow shaft
- Single or multi-turn
- Velocity output
- Inputs for counting direction, preset, and limit switches
- LED indication of operational mode, bus errors and wiring faults



Pepperl+Fuchs' PSS58 and PSM58 series absolute encoders feature recessed hollow shafts and interface with PROFIBUS. Available in either single-turn with 16-bit resolution, or multi-turn with 30-bit resolution versions. These models also feature a velocity output and programmable limit switches. Each encoder is individually addressable between 0 and 63 and has an IP65 aluminum housing.

#### Order Code

**PS□58□-□□□□□R0BN-□□□□**

**Type**  
S Single-turn  
M Multi-turn

**Housing**  
N Aluminum  
I Stainless steel

**Shaft dimension/flange style**  
F1A Recessed hollow Ø 10 mm x 30 mm  
F2A Recessed hollow Ø 12 mm x 30 mm  
F3A Recessed hollow Ø 15 mm x 30 mm

**Steps per revolution**  
13 8192 (standard)  
16 65536

**Number of revolutions**  
00 1 (single-turn)  
12 4096 (multi-turn, standard)  
14 16384 (multi-turn)

**Connection type**  
AG Removable housing cover with terminal compartment  
AZ Removable housing cover with M12 x 1 connectors

Example: PSS58N-F1AAGR0BN-0012

#### Technical Specifications

##### Electrical

<b>SUPPLY VOLTAGE</b>	10-30 VDC
<b>CURRENT CONSUMPTION</b>	≤ 230 mA at 10 V DC, ≤ 100 mA at 24 V DC
<b>OUTPUT CODE</b>	Binary
<b>LINEARITY</b>	± 2 LSB at 16-bit, ± 1 LSB at 13-bit, ± 0.5 LSB at 12-bit
<b>COUNTING DIRECTION</b> (Shaft End View)	Programmable
<b>INTERFACE</b>	Interface type Transfer rate
	PROFIBUS ≤ 0.5 Mbit/s
<b>RESOLUTION</b>	Bits/steps per turn Bits/number of turns
	16-bit / 65536 14-bit / ≤ 16384
<b>OVERALL RESOLUTION</b>	Single-turn Multi-turn
	16-bit 30-bit
<b>CERTIFICATES</b> CE	Yes

##### Mechanical

<b>MATERIAL – STANDARD</b>	Housing Flange Shaft	Powder-coated aluminum Aluminum Stainless steel
<b>MATERIAL – OPTIONAL</b>	Housing Flange Shaft Code disc	Stainless steel Stainless steel Stainless steel Plastic
<b>WEIGHT</b>	DSS - Standard DSS - Optional Stainless Steel DSM - Standard DSM - Optional Stainless Steel	≈ 1.2 lbs ≈ 2.4 lbs ≈ 1.3 lbs ≈ 2.6 lbs
<b>ROTATIONAL SPEED</b>		≤ 12,000 rpm
<b>MOMENT OF INERTIA</b>		≤ 4.2 x 10 <sup>-4</sup> oz-in-sec <sup>2</sup>
<b>STARTING TORQUE AT 20°C</b>		≤ 4.2 in-oz
<b>SHAFT LOADING</b>	Angle offset Axial offset Radial offset	± 0.9° Static: ± 0.3 mm; Dynamic: ± 0.1 mm Static: ± 0.5 mm; Dynamic: ± 0.2 mm
<b>BEARING WORKING LIFE</b>		> 4 x 10 <sup>10</sup> revolutions

##### Environmental

<b>STORAGE TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>OPERATING TEMPERATURE</b>	-40°C to +85°C (-40°F to +185°F)
<b>HUMIDITY</b>	No moisture condensation
<b>SHOCK RESISTANCE</b>	100 g for 6 ms
<b>VIBRATION RESISTANCE</b>	10 g, 10-2,000 Hz
<b>ENCLOSURE RATING</b>	IP64

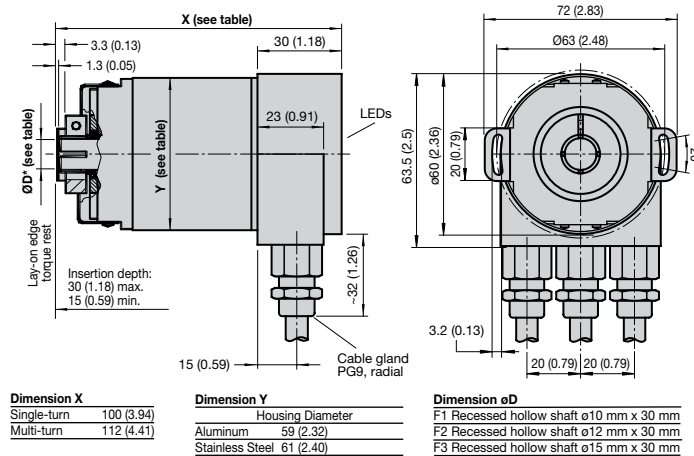
##### Connection Types

<b>TERMINAL CONNECTOR</b>	Terminal compartment with 3 x PG9 cable glands
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## Dimensions

mm (in.)



## Electrical Connection

Terminal	Description
⊥	Ground connection for power supply
B (left)	Data line B (pair 1), Bus In
A (left)	Data line A (pair 1), Bus In
(-)	0 VDC
(+)	10 V ... 30 V
B (right)	Data line B (pair 2), Bus Out
A (right)	Data line A (pair 2), Bus Out
(-)	0 V
(+)	10 V ... 30 V
	The supply lines need to be connected only once (regardless to which terminal). The outgoing bus is uncoupled while the termination resistor is on.



Programming

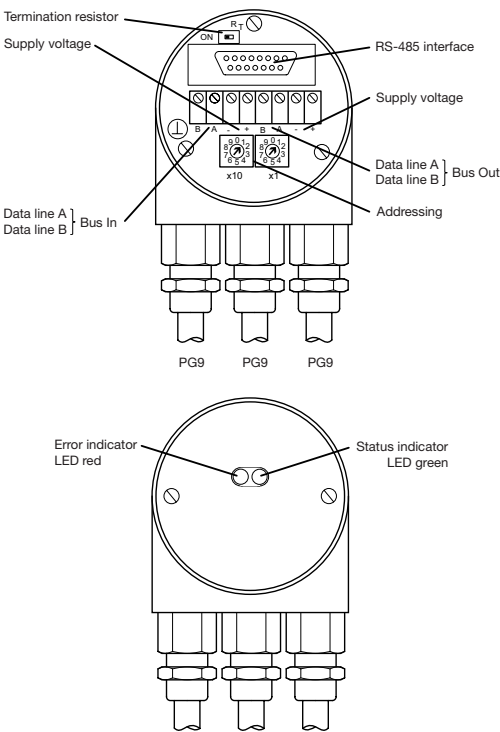
Installation

The rotary encoder is connected with two or three cables depending on whether the power supply is integrated into the bus cable or connected separately. If the power supply is integrated into the bus cable, one of the cable glands can be plugged. The cable glands are suitable for cable diameters from 5.5 to 9 mm.

The PROFIBUS device address is set via the two rotary switches located within the removable housing cover. Any address from 1 to 99 is allowed but each can only be used once. Termination resistors are integrated into the housing cover and must be switched on if the encoder is connected at the beginning or end of the bus.

There are 2 sets of power supply terminals but it is only necessary to connect power to one set. The outgoing bus lines are disconnected if the terminating resistor is switched on.

On the back of the housing cover are 2 LEDs, which are used for device status and diagnostics.



Programmable Parameters

The PROFIBUS-DP interface supports Class 1 and Class 2 functionality per the encoder profile. In addition to these standard functions, the GSD file supports additional features such as software limit switches. The following parameters can be programmed directly via the PROFIBUS-DP network without any extra devices:

Parameter	Description
Counting direction	Determines the counting direction and whether the output code increases or decreases.
Resolution per revolution	Programs the desired number of steps per revolution. Any value between 1 and 65,536 can be used.
Total resolution	Programs the desired number of steps over the total measuring range of the encoder. This value cannot exceed the total physical resolution of the encoder.
Preset value	A desired position value (i.e., 0) to be set at a certain physical position of the axis. The position value is set to the desired process value via this parameter. This parameter is used to “zero” the encoder at any time to start at a reference point.
Velocity	The software can also output the current velocity. This value is given in a 16-bit binary code after the process value. It is possible to choose between four different units: steps per 10 ms, per 100 ms, per 1 s and revolutions per minute.
Software limit switches	Sets the minimum and maximum values. Two software limit switches can be set. If these values are exceeded, a bit in the output word is set.
Teach-in	A special mode for setting up the encoder that changes parameters while the encoder transfers data. For continuous operation a second mode is available in which parameters are protected against unintentional changes.

LED Indicators

LED Red	LED Green	Meaning
Off	Off	No voltage supply.
On	On	Encoder ready, no configuration data received. Possible reasons: <ul style="list-style-type: none"><li>• Wrong address adjusted</li><li>• Wrong bus wiring</li></ul>
On	Flashing	Parameter or configuration error — encoder received data of incorrect length or inconsistent data. Possible reason: <ul style="list-style-type: none"><li>• Adjusted encoder resolution exceeded</li></ul>
Flashing	On	Encoder ready, no communication (i.e. wrong address adjusted).
On	Off	Data timeout (> 40 s) (i.e., data lines interrupted).
Off	On	Normal operation, Data Exchange Mode.
Off	Flashing	Installation mode in Data Exchange Mode.



# Accessories

<b>Connectors and Cordsets .....</b>	<b>100</b>
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## Connectors and Cordsets

Model Number	Cable Length	No. of Pins	Type	Protection	Color Code	For Series
V1-G	Connector only*	4	Female	IP67	1 Brown 2 White 3 Blue 4 Black	BVS58/BVM58, BSS58/BSM58
V1-G-YE2M-PVC	2 m, molded					
V1-G-YE5M-PVC	5 m, molded					
V15-G	Connector only*	5	Female	IP67	1 Brown 2 White 3 Blue 4 Black 5 Gray	EVS58/EVM58, ESS58/ESM58, PVS58/PVM58, PSS58/PSM58
V15-G-YE2M-PVC	2 m, molded					
V15-G-YE5M-PVC	5 m, molded					
42306A	Connector only*	6	Female	IP67	1 Green 2 White 3 Yellow 4 Red 5 Black 6 N.C.	RVI78
42306A-02M-05P-RVI50/78	2 m					
42306A-05M-05P-RVI50/78	5 m					
42306B	Connector only*	6	Right-angle Female	IP67	1 Green 2 White 3 Yellow 4 Red 5 Black 6 N.C.	RVI78
42306B-02M-05P-RVI50/78	2 m					
42306B-05M-05P-RVI50/78	5 m					
42306C	Connector only*	6	Male	IP67	—	Mating connector for 92306
MS3106A16S-1S	Connector only*	7	Female	IP67	A Green B Black C Blue D Brown	RVI25 (type AR)
MS16-10FT	10 ft				E Red F White G Shield	
MS16-20FT	20 ft					
MS3106A18-1S	Connector only*	10	Female	IP67	A Green B Black C Blue D Brown E Red	RVI25 (type AS)
MS18-10FT	10 ft				F White G Shield H Yellow I Violet J Gray	
MS18-20FT	20 ft					
9416	Connector only*	12	Female	IP68	1 Pink 2 Violet 3 Blue 4 Red 5 Green 6 Yellow	RVI58 (type AA), RVI50, Series 30, RSI58, AVS58/AVM58 (type AA), ASS58/AVS58 (type AA), RHI90
9416-02M-12P-RXI58	2 m				7 Gray/Pink 8 Gray 9 N.C. 10 White 11 Black	
9416-05M-12P-RXI58	5 m					
9416L	Connector only*	12	Female	IP68	1 Pink 2 Violet 3 Blue 4 Red 5 Green 6 Yellow	RVI58 (type AB), AVS58/AVM58 (type AB), ASS58/AVS58 (type AB), RHI90
9416L-02M-12P-RXI58	2 m				7 Gray/Pink 8 Gray 9 N.C. 10 White 11 Black	
9416L-05M-12P-RXI58	5 m					
9416C	Connector only*	12	Male	IP68	—	Mating connector for 9416
9424	Connector only*	19	Female	IP68	1 Green 2 Yellow 3 Gray 4 Pink 5 Blue 6 Brown 7 Red	FVS58/FSS58
9424-02M-24P-SCS	2 m				8 Black 9 Violet 10 Gray/Pink 11 Red/Blue 12 White 13 White/Green 14 Brown/Green	
9424-05M-24P-SCS	5 m				15 White/Yellow 16 White/Pink 17 Pink/Brown 18 Brown/Blue 19 Brown/Red	
9426	Connector only*	26	Female	IP67	1 White 2 Brown 3 Green 4 Yellow 5 Gray 6 Pink 7 Blue 8 Red 9 Black	FVM58/FSM58
9426-02M-32P-SCM	2 m				10 Violet 11 Gray/Pink 12 Red/Blue 13 White/Green 14 Brown/Green 15 White/Yellow 16 Yellow/Brown 17 White/Gray 18 Gray/Brown	
9426-05M-32P-SCM	5 m				19 White/Pink 20 Pink/Brown 21 White/Blue 22 Brown/Blue 23 Gray/Green 24 Yellow/Gray 25 Pink/Green 26 Yellow/Pink	
9426C	Connector only*	26	Male	IP67	—	Mating connector for 9426

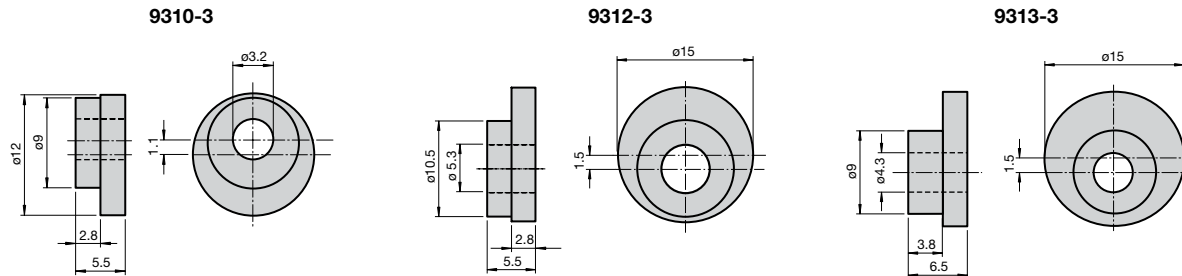
\* Field-attachable connector—cable provided by customer.





## Synchro Clamping Elements (set of 3)

Model Number	For Series
9310-3	AV□58, BV□58, CV□58, DV□58, EV□58, FV□58, PV□58, RVI58, TVI58
9312-3	RVI50, RVI78, RVI84
9313-3	RVI50



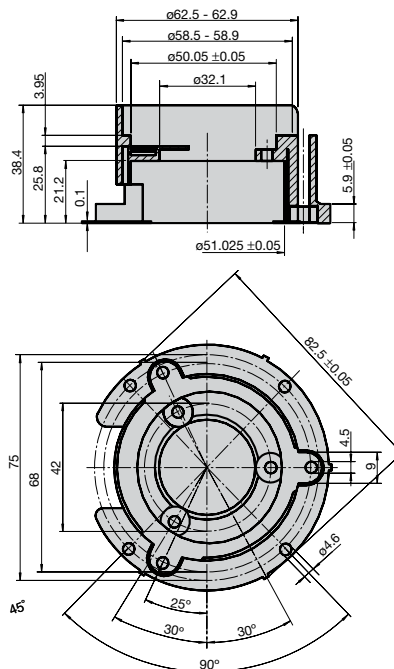
## Mounting Brackets

### Mounting Bracket for Servo Flange

Model Number	For Series
9300	AV□58, BV□58, CV□58, DV□58, EV□58, FV□58, PV□58, RVI58, TVI58



9300



### Mounting Set for Bracket 9300

Model Number	For Series
9311	AV□58, BV□58, CV□58, DV□58, EV□58, FV□58, PV□58, RVI58, TVI58



9311

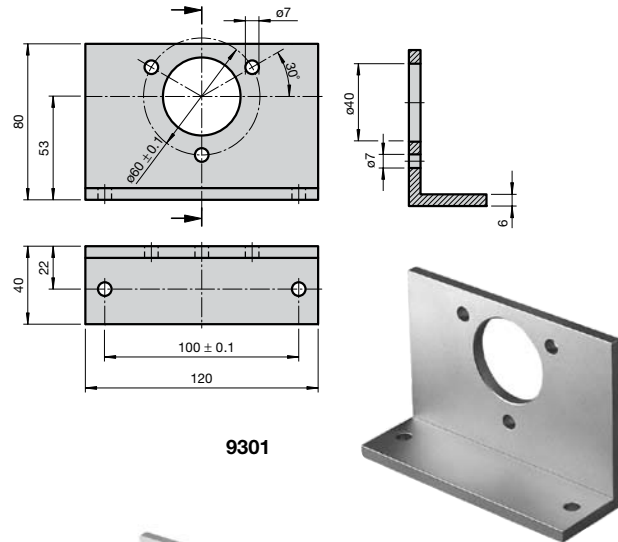
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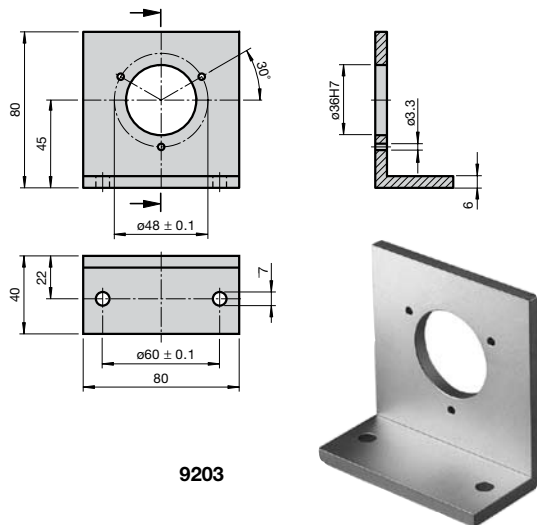
## Mounting Brackets (cont.)

### Mounting Bracket for Clamping Flange

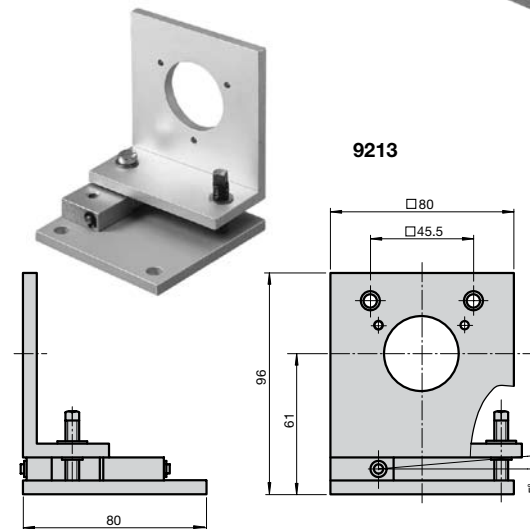
Model Number	For Series
9301	30
9203	AV□58, BV□58, CV□58, DV□58, EV□58, FV□58, PV□58, RVI58, TVI58
9213	AV□58, BV□58, CV□58, DV□58, EV□58, FV□58, PV□58, RVI58, TVI58
9250	RVI50, TVI50
9278	RVI78



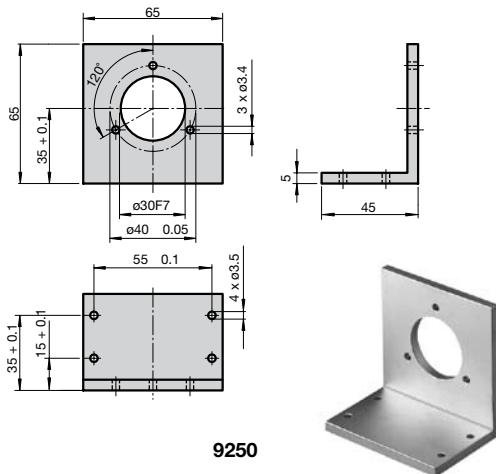
9301



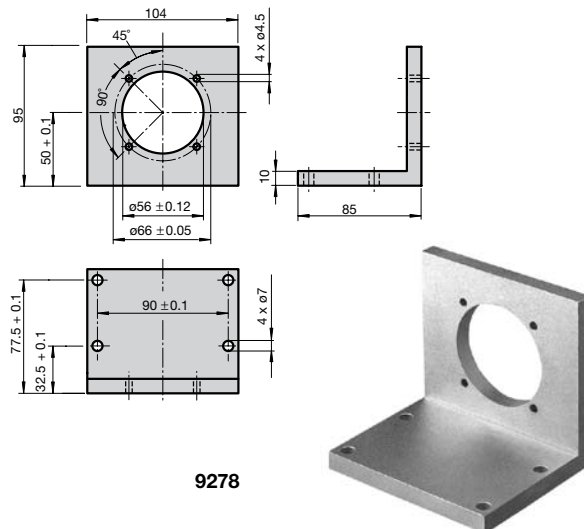
9203



9213



9250

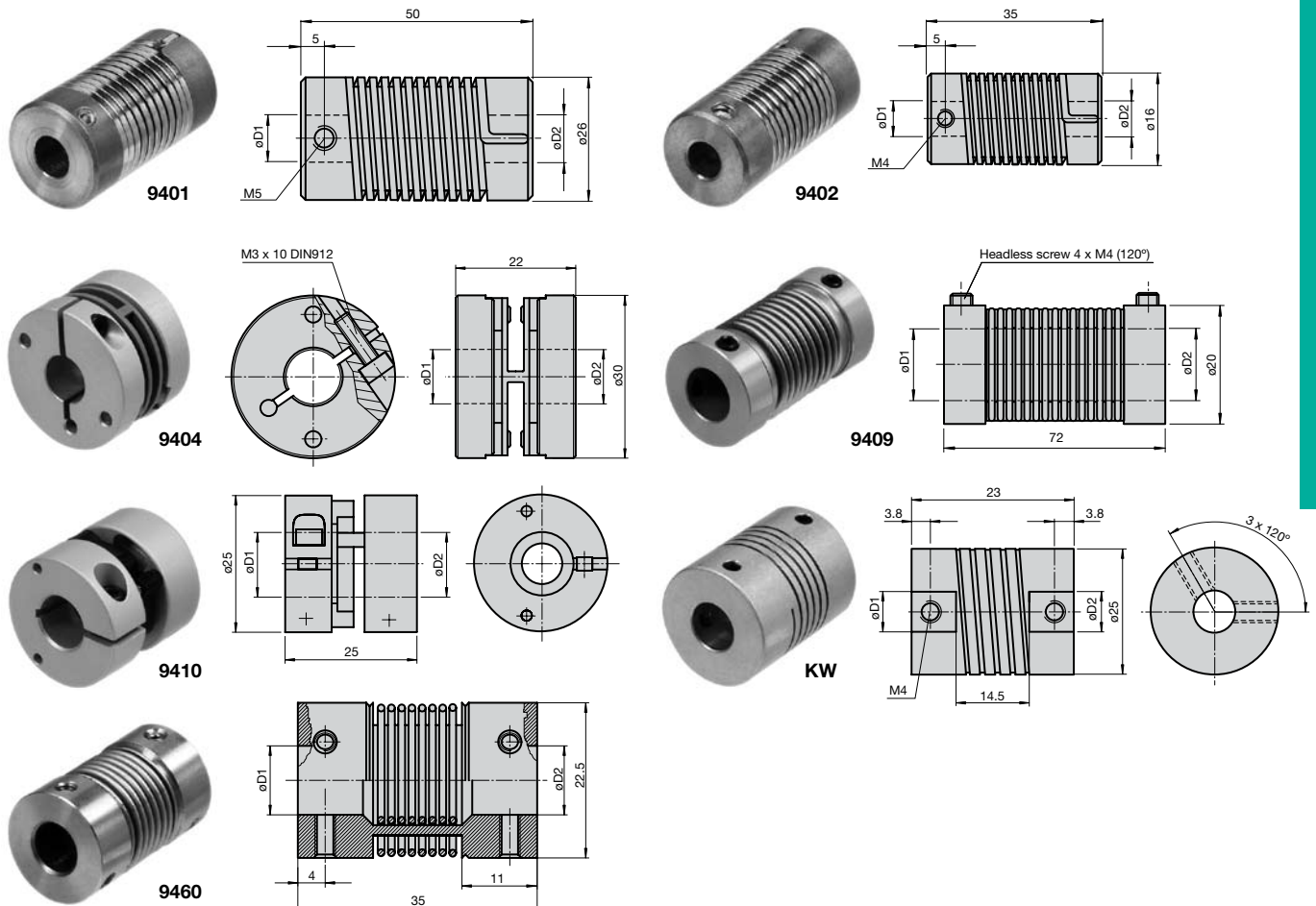


9278



## Couplings

Model Number	Dimension D1*	Dimension D2*	Type	Max. Speed	Rated Torque	Max. Radial Misalignment	Max. Axial Misalignment	Max. Angular Error	Max. Torque	Material
9401 6 x 6	6 mm	6 mm	Spring steel	3000 rpm	13.3 in-lb	±1.5 mm	±1 mm	±5°	10.6 in-lb	Nickel-coated spring steel
9401 8 x 8	8 mm	8 mm								
9401 10 x 10	10 mm	10 mm								
9401 12 x 12	12 mm	12 mm								
9401 9.52 x 9.52	3/8 in.	3/8 in.								
9401 6.35 x 6.35	1/4 in.	1/4 in.								
9402 6 x 6	6 mm	6 mm	Spring steel	3000 rpm	4.4 in-lb	±1 mm	±1 mm	±5°	–	Nickel-coated Spring steel, die-cast zinc
9402 8 x 8	8 mm	8 mm								
9402 9.52 x 9.52	3/8 in.	3/8 in.								
9402 6.35 x 6.35	1/4 in.	1/4 in.								
9404 6 x 6	6 mm	6 mm	Spring disk	12000 rpm	5.3 in-lb	±0.3 mm	±0.4 mm	±2.5°	–	Flanges: aluminum spring disks: plastic
9404 10 x 10	10 mm	10 mm								
9404 12 x 12	12 mm	12 mm								
9409 6 x 6	6 mm	6 mm	Bellows	8000 rpm	7.1 in-lb	±0.3 mm	±0.4 mm	±5°	10.6 in-lb	Nickel-coated zinc
9409 10 x 10	10 mm	10 mm								
9409 12 x 12	12 mm	12 mm								
9410 6 x 6	6 mm	6 mm	Precision	15000 rpm	8.9 in-lb	±0.5 mm	±0.3 mm	±2.5°	11.5 in-lb	Delrin, aluminum alloy, hard-coated
9410 10 x 10	10 mm	10 mm								
9410 12 x 12	12 mm	12 mm								
KW 6 x 6	6 mm	6 mm	Helical	8000 rpm	7.1 in-lb	±0.3 mm	±0.5 mm	±4°	13.3 in-lb	Nickel-coated zinc
KW 8 x 8	8 mm	8 mm								
KW 10 x 10	10 mm	10 mm								
9460 6 x 6	6 mm	6 mm	Bellows	7000 rpm	8.9 in-lb	±0.2 mm	±0.6 mm	±3°	–	Stainless steel
9460 10 x 10	10 mm	10 mm								
9460 12 x 12	12 mm	12 mm								

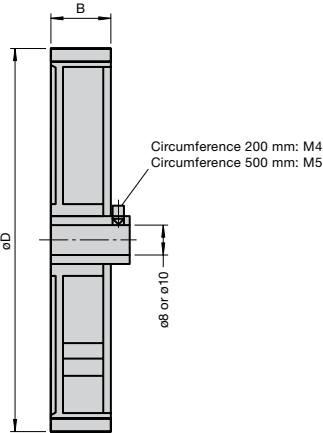




Measuring Wheels

Measuring wheels attach directly to the encoder's shaft using setscrews and are designed to roll along the surface of moving objects. As material moves beneath the wheel, the wheel turns the encoder shaft. A larger wheel will provide higher resolution. All of P+F's measuring wheels are designed to mount on a standard 8 or 10 mm diameter shaft.

Model Number		Material	Circumference	Diameter D	Width B
8 mm Shaft	10 mm Shaft				
9101, 8	9101, 10	Hytrel	500 mm	159 mm	25 mm
9102, 8	9102, 10	Dimpled rubber Nitril (NBR)			
9103, 8	9103, 10	Knurled aluminum			
9112, 8	9112, 10	Knurled Hytrel			
9108, 8	9108, 10	Hytrel	200 mm	64 mm	12 mm
9109, 8	9109, 10	Dimpled rubber Nitril (NBR)			
9110, 8	9110, 10	Knurled aluminum			
9113, 8	9113, 10	Knurled Hytrel			



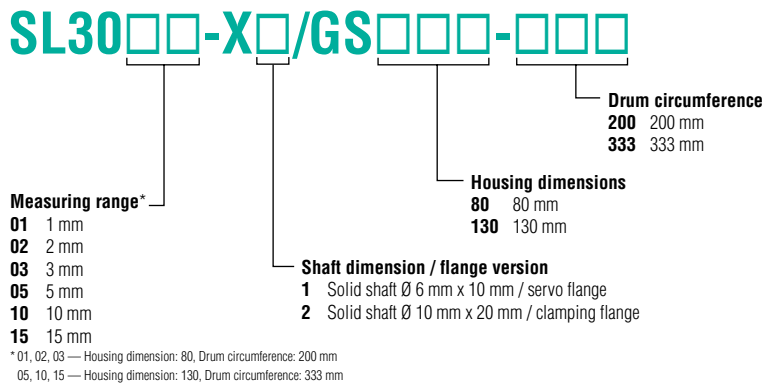


## Cable Pulls

Cable pulls enable a rotary encoder to measure linear motion by providing a cable that is pulled in a straight line by the application. Internally, the cable is wrapped around a spring-loaded drum that turns the encoder's shaft when the cable is extended. A standard 58 mm diameter encoder mounts to the adapter with synchro mounting elements. Different lengths are available for a wide variety of applications.

Technical Data	SL3001-X1 / GS80-200	SL3002-X1 / GS80-200	SL3003-X1 / GS80-200	SL3005-X1 / GS130-333	SL3010-X1 / GS130-333	SL3015-X1 / GS130-333
<b>General Specifications</b>						
Measuring Range (cable length)	1 m	2 m	3 m	5 m	10 m	15 m
Maximum Travel Speed	8 m/s	8 m/s	8 m/s	10 m/s	8 m/s	7 m/s
Acceleration	40 m/s <sup>2</sup>	40 m/s <sup>2</sup>	40 m/s <sup>2</sup>	70 m/s <sup>2</sup>	40 m/s <sup>2</sup>	30 m/s <sup>2</sup>
Drum Circumference	200 mm	200 mm	200 mm	333 mm	333 mm	333 mm
Linearity Error (typical)	0.1% / 0.5%	0.1% / 0.5%	0.1% / 0.5%	0.1% / 0.5%	0.1% / 0.5%	0.1% / 0.5%
Resolution	200 mm / encoder resolution	200 mm / encoder resolution	200 mm / encoder resolution	333 mm / encoder resolution	333 mm / encoder resolution	333 mm / encoder resolution
<b>Ambient Conditions</b>						
Shock Resistance	25 g	25 g	25 g	25 g	25 g	25 g
<b>Mechanical Specifications</b>						
Cable Diameter	1.35 mm	1.35 mm	1.35 mm	1.35 mm	1.35 mm	1.35 mm
Tension Force on Cable	5-9 N	5-12 N	5-15 N	10-21 N	10-21 N	10-21 N
Lifetime	10 <sup>6</sup> cycles	10 <sup>6</sup> cycles	10 <sup>6</sup> cycles	10 <sup>6</sup> cycles	10 <sup>6</sup> cycles	10 <sup>6</sup> cycles
Weight	2 lbs	2.6 lbs	3.3 lbs	5.5 lbs	7.7 lbs	11.0 lbs

### Order Code



**Example: SL3001-X1/GS80-200**



SL3001  
SL3002



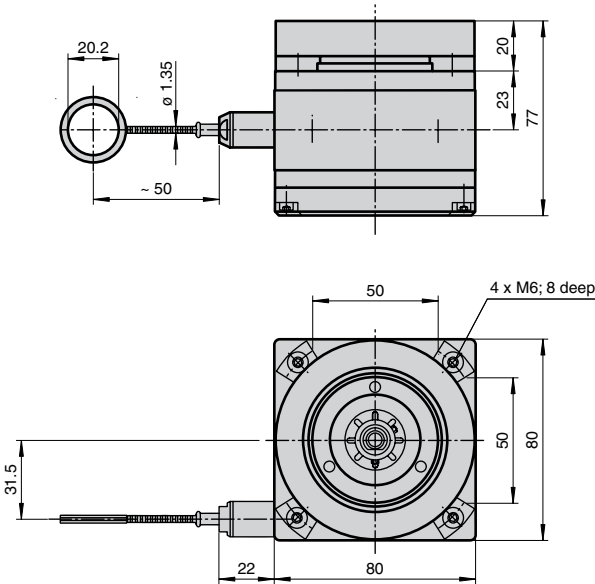
SL3005  
SL3010  
SL3015

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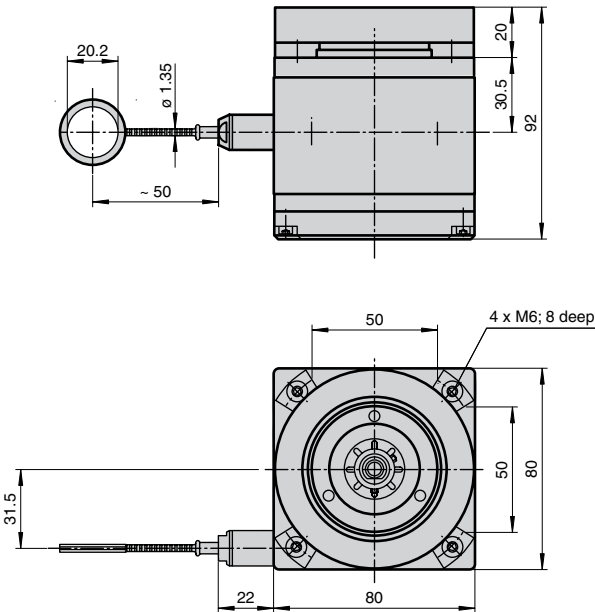


Cable Pulls (cont.)

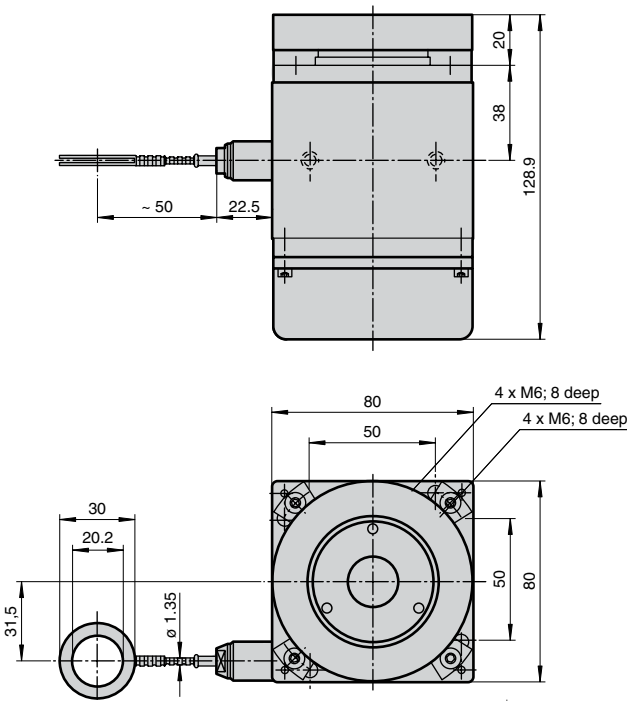
SL3001



SL3002



SL3003

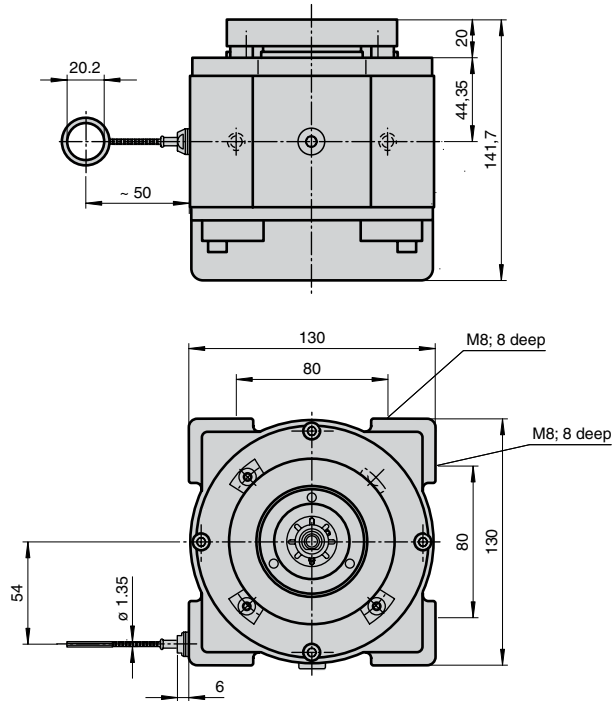


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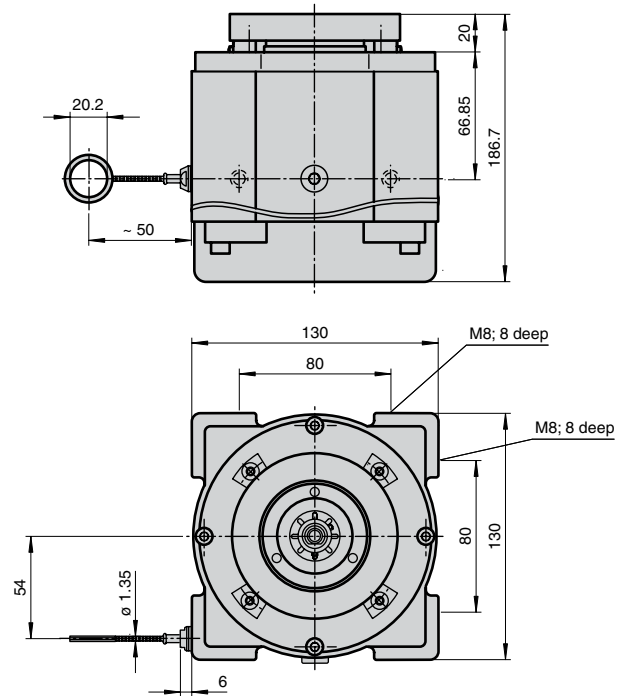


### Cable Pulls (cont.)

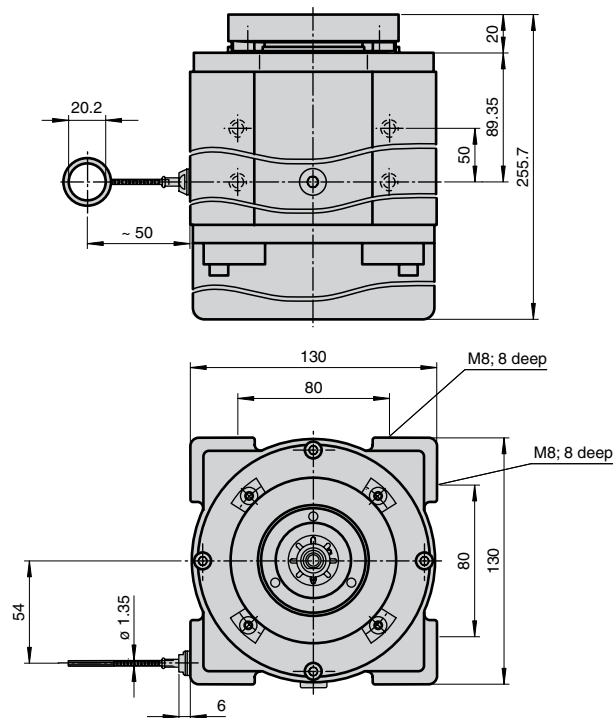
SL3005



SL3010



SL3015





## Glossary

### Absolute encoder

Absolute encoders provide a distinctly coded numerical value for each shaft position. The internal material measure permits the read-out of an absolute measured value after a supply voltage has been applied. A reference run is not required.

### Binary code

Code based on binary digits 0 and 1, which is used by absolute encoders.

### Changeable code frequency

Maximum number of measuring step changes per second.

### Channel

Signal trace of the incremental rotary encoder.

### Code progression

See *Selection of count direction*.

### Fall time

Duration for an electrical signal to change from high to low level.

### Gray code

Code similar to binary code in which only one bit changes from step to step. Higher data safety due to one-unit-distance and cyclical code. This code has to be converted into the binary code for data processing.

### Gray excess code

This code is an extract of Gray code, which is used for the representation of angular steps.

Example: 360 steps

In this case 9 bits are required, which corresponds to 512 steps. The extract of the code is symmetrical. It starts at 76 and ends at 436. The difference between the beginning and end is 360 steps.

### Incremental encoder

These encoders supply a frequency proportional to the speed or a number of electrical pulses proportional to the angle. A reference run should be carried out after a loss of voltage.

### LATCH

Storage function: By activating this input of the absolute encoder the present value measured is "frozen". The output will not change despite the shaft rotating.

If the input is deactivated, every new step measured is output (transparent latch).

### LSB

Least Significant Bit.

### MSB

Most Significant Bit.

### Multiturn

An absolute encoder which counts the number of shaft revolutions of the shaft.

### No load current

Power consumption of the encoder without load connected.

### Number of pulses

Resolution of the incremental rotary encoder. This resolution indicates the number of pulses per revolution.

### Offset

Value which is continuously added to a value measured.

### Open Collector (OC)

Open collectors are differentiated according to OC-PNP and OC-NPN output stages. The latter inverts the output signals.

OC output stages are replaced by the push-pull output stage in incremental and absolute encoders.

The inverted behavior of the OC/NPN output stage has to be observed in absolute encoders.

### Operating current

Indicates the permissible current load of the channel.

### Operating temperature

Temperature range in which an encoder can be used, as long as the values and tolerances mentioned in the data sheet are maintained.

### Operating voltage

Voltage supply of the encoder ( $U_b$ ).

### Output frequency

The maximum signal frequency of the encoder, which comprises the number of pulses and the rotation speed.

### Overall resolution

Addition of single-turn and multi-turn resolutions. This is expressed in number of bits.

### Parity

Control bit to recognize failures in data transmission.

### Phase position

Misalignment of the flanks of channels A and B of an incremental rotary encoder.

### PRESET 1

Reset of the control input. This action is used for electronic adjustment of the absolute encoder output to zero.

### PRESET 2

Control input used to set the value measured to a quarter of the single-turn resolution. This is used for electronic adjustment of the absolute encoder. In case of programmable absolute encoders, a value other than one quarter of the single-turn resolution can be entered.

### Push-pull output

The push-pull output is a combination of NPN and PNP outputs.



## Resolution

Number of measuring steps per revolution or number of revolutions of an absolute encoder.

## Rise time

Duration for an electrical signal to change from low to high level.

## RS-232

Asymmetrical, serial, unidirectional interface between PC and programmable absolute encoder.

## RS-422

Symmetrical, serial, bidirectional interface. This interface is used in incremental rotary encoders to transmit anti-valent pulse channels: A, A, B, B, Z, Z. In case of absolute encoders with SSI interface for the transmission of cycles and data: cycle(+), cycle(-), data(+), data(-). Each signal pair is passed through twisted pair cables.

## RS-485

Symmetrical, serial, bidirectional interface. Basis for many fieldbus systems.

## Scaling

The number of steps per revolution. The number of revolutions of a multi-turn can be set to between 1 and 4,096 depending on the type of encoder.

## Selection of count direction

This control input can be used to define whether the absolute encoder is to generate increasing values when the shaft rotates clockwise (CW) or counter clockwise (CCW). The shaft is always viewed from the shaft end.

## Sense (-)

Used for the measurement of the effective encoder supply voltage together with Sense+. Permits automatic compensation of the power drop due to the encoder cable.

## Sense (+)

Used for the measurement of the effective encoder supply voltage together with Sense-. Permits automatic compensation of the power drop due to the encoder cable.

## Shaft load

The maximum permissible axial and radial force on the encoder shaft. The force contact point is the center of the shaft stub. If these forces are exceeded, the service life of the bearing can be greatly reduced. Furthermore, there is a danger of causing irreparable damage to the encoder.

## Single-turn

Absolute encoder that delivers a defined number of measuring steps within one revolution. After completion of the revolution, the measured value returns from the maximum to the minimum value (ex. 8192 to 0).

## Speed

The speed indicates the mechanical load limit of the encoder. If this limit is exceeded, the service life of the bearing can be negatively affected. In addition, the signal generation can be disturbed.

## SSI

Synchronous Serial Interface. Used with absolute encoders.

## Starting torque

Torque required to accelerate the encoder shaft from standstill.

## Storage temperature

Permissible temperature limit values for an encoder that is neither electrically connected nor mechanically stressed.

## Track

See *Channel*.

## Transmission rate

Speed of data transmission in absolute encoders.

## Tristate

Absolute encoders with a parallel interface can be set to a high-resistance state with using tristate input. This permits multiplex operation, allowing several encoders to be connected to one I/O point.

## Voltage drop

Difference between supply voltage  $U_b$  and the maximum high level.

## V/R input

See selection of count direction.

## Zero setting

See *PRESET 1*.



IP Ratings

Definition:

The first numeral defines the amount of protection against penetration of solid objects into the housing.

The second numeral defines the amount of protection against liquids penetrating the housing.

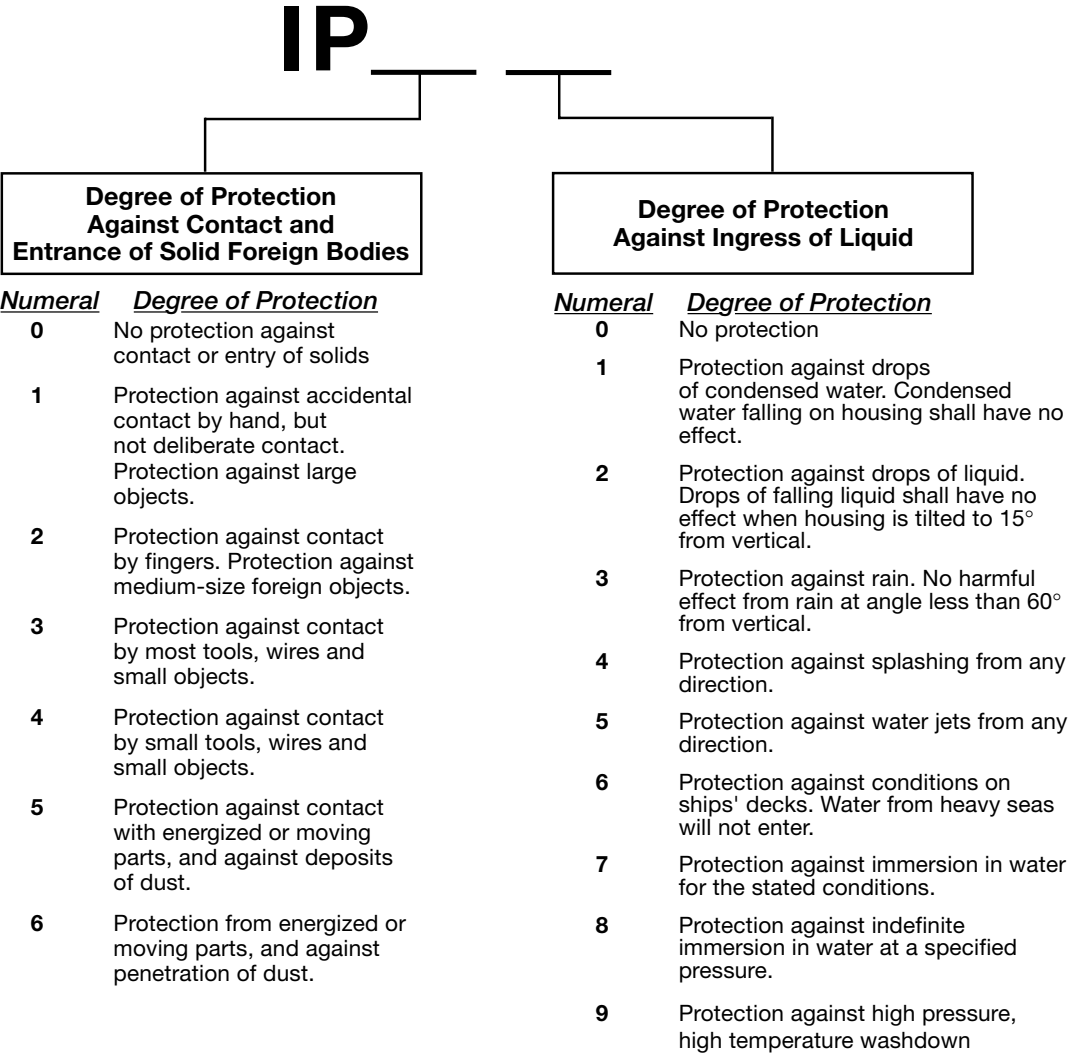
Additional information on ratings can be found in the following chart or the 1976 IEC Publication, Classification of Degrees of Protection Provided by Enclosures.

Example: What is IP67?

Complete protection of live parts. Protection against the penetration of dust. Additionally, it will be protected while immersed in water.

Testing Criteria:

- 1. Test Class: IP67 test  
Conditions: 1m head of water over the test piece for a duration of 30 minutes. Room temperature  $\pm 5^{\circ}\text{C}$   
Test: Insulation and operation
- 2. Test Class: IP68 test (Encapsulated products)  
Conditions: 1m head of water over the test piece for 24 hours of operation under water, with cyclical activation and deactivation under nominal loading  
Cycle time 2 hours  
Room temperature  $\pm 5^{\circ}\text{C}$   
Test: Insulation and operation





## Pepperl+Fuchs Warranty Terms and Conditions

### STANDARD 18-MONTH WARRANTY

Subject to the conditions and requirements set forth herein, P+F warrants the products covered by the respective warranties to be free from defects in material and workmanship under normal and proper usage for the respective time periods listed above from the date of shipment from P+F (or from an authorized representative or distributor of P+F). In addition, certain specific terms apply to various warranties.

THESE EXPRESS WARRANTIES ARE IN LIEU OF AND EXCLUDE ALL OTHER REPRESENTATIONS MADE — BOTH EXPRESS AND IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR THAT THE PRODUCTS ARE FREE OF ANY CLAIM OF ANY THIRD PERSON BY WAY OF INFRINGEMENT OR THE LIKE, and are also in lieu of and exclude any promise, description, affirmation of fact, sample model or representation, oral or written, which may be part of an order or made by a representative of P+F or otherwise. This WARRANTY shall not apply to any product which has been subject to misuse, negligence, or accident, or to any product which has been modified or repaired, improperly installed, altered or disassembled (except according to P+F's written instructions) or any product if the machinery, equipment, or production line to which the product is originally connected or on which the product is originally installed is abandoned, changed, substituted, moved or replaced or if the product is removed from such machinery, equipment or production line or other original application.

This WARRANTY is subject to the following conditions:

- 1) This WARRANTY is limited to the electronic and mechanical performance only, as expressly detailed in the product specifications and NOT to cosmetic performance.
- 2) This WARRANTY shall not apply to any cables attached to, or integrated with the product. However, it shall apply to cables sold separately by P+F.
- 3) This WARRANTY shall not apply to any products which are stored, or utilized, in harsh environmental or electrical conditions outside P+F's written specifications.
- 4) The WARRANTY is applicable only to products shipped from P+F subsequent to January 1, 1992.
- 5) All claims under this WARRANTY must be made in writing within thirty (30) days of the date on which the defect is (or, with reasonable diligence, should have been) discovered.

### PRODUCTS TO WHICH STANDARD 18-MONTH WARRANTY APPLIES

Ultrasonic sensors, level controls, photoelectric sensors, read-write ID systems, encoders, counters, signal conditioners and all products with electromechanical relays or circuit breakers.

### CONSIDER SAFETY AND PROTECTION PRECAUTIONS

P+F takes great care to design and build reliable and dependable products; however, some products can fail eventually. You must take precautions to design your equipment to prevent property damage and personal injury in the unlikely event of failure. As a matter of policy, P+F does NOT recommend the installation of electronic controls as the sole device FOR THE PROTECTION OF PERSONNEL in connection with power driven presses, brakes, shears and similar equipment and, therefore, the customer should build in redundancy or dual control using approved safety devices for these applications.

### DELIVERY

Pepperl+Fuchs® Inc. will deliver its products F.O.B. from its warehouse, place of manufacture or other place from which the products are actually shipped within the U.S.A.

Freight charges will be prepaid and added to invoice.



# Appendix

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