

POSITION TRANSDUCERS/DECODERS

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POSITION TRANSDUCERS

A HISTORICAL PERSPECTIVE



Since its inception in 1975 Autotech Controls division of AVG Automation has been in the forefront of developing resolver based technology for the industry. Through continuous innovation and by virtue of its vertical integration AVG Automation is able to bring to you the ruggedness and noise immunity of resolver based technology for the cost of optical encoders. Over half a million AVG resolvers are in use all over the world to provide position/motion feedback to such controls as PLCs, CNCs, computer based controls and definite purpose OEM controls.

Back in 1985, AVG Automation revolutionized the encoder market by introducing the Digisolver; industry's first resolver based digital encoder that combined the ruggedness of a resolver with the reliability of solid-state circuitry.

In late 80's Autotech introduced the concept of resolver decoder module that plugs directly into the PLCs eliminating the need of stand alone decoder module. In the world of proprietary PLCs and racks, these modules called BusModules provide the only "Universal" solution. These modules are universal as the same module can be used in any of the supported PLC racks offering a common user interface (for a function) across different PLCs.

Today AVG Automation offers the broadest line of resolver based encoders in the industry:

- 4" housing; 5/8" shaft
- 2.5" housing; 3/8" shaft
- 2.5" housing; 1/4" shaft
- 1.1" housing
- Hollow shaft
- Pancake resolvers
- Single turn
- Single turn geared
- Multi-turn geared
- NEMA4/NEMA4X/NEMA13/NEMA6P
- Class 1, Div 1, groups B, C and D
- FM approved
- Intrinsically safe
- Explosion proof
- Binary/BCD/Gray Code outputs
- PC handshake
- Analog Velocity
- PLC back plane mounted resolver encoders for:
 - AB 1771
 - Modicon 800
 - Modicon 984-A120
 - GE 9070
 - TI 505
- Network resolvers:
 - DeviceNet
 - Profibus
 - Interbus

SELECTING THE RIGHT POSITION TRANSDUCER FOR YOUR APPLICATION

Even though the position transducers are the most critical parts in a motion control system, many times they are left towards the end to be designed in. A control design engineer can save himself a lot of headache by considering the transducer features and trade-offs at *the beginning* of the project. The following discusses various types of position transducers and the factors to consider when making a selection.

Many industrial control systems need position and speed feedback. Until a few years ago, tachometers provided the speed and limit switches provided the position information. However, with new requirements of higher accuracies, faster machine speeds, and greater reliability combined with technological breakthrough in the field of electronics, a variety of new designs of position transducers emerged. These transducers made it possible to know the machine position at all times, rather than waiting for a limit switch to give position indication at a predetermined point. This permitted faster machine operation and increased throughputs.

In the initial stages, the position transducers consisted of potentiometers, brush encoders, magnetic encoders and rarely optical encoders and resolvers. Each device had certain limitations. The potentiometers and magnetic encoders had limited resolution. The brush encoders required frequent maintenance. The optical encoders used incandescent lamps, which were large in size and had limited life expectancy. The resolvers could offer better resolution and accuracy, but were very expensive due to the decoding electronics required.

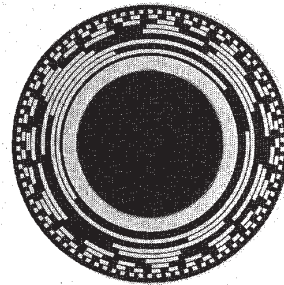
The recent technological developments have brought some improvements in the initial models. Today optical encoders and resolvers are more commonly used in industry. The magnetic and magnetoresistive encoders find applications less frequently.

We will focus on two of the more popular types of position transducers: **Optical Encoders** and **Resolvers**.

Optical encoders and resolvers are available in two major categories: **Absolute** and **Incremental**. The incremental encoder, when it rotates, generates pulses, which are counted to give position information relative to a known point, whereas an absolute encoder provides a unique value at each position and retains actual shaft position even if power fails. Multi-turn units with built-in gear trains are available for linear application where it takes several revolutions of the encoder shaft to complete one machine cycle.

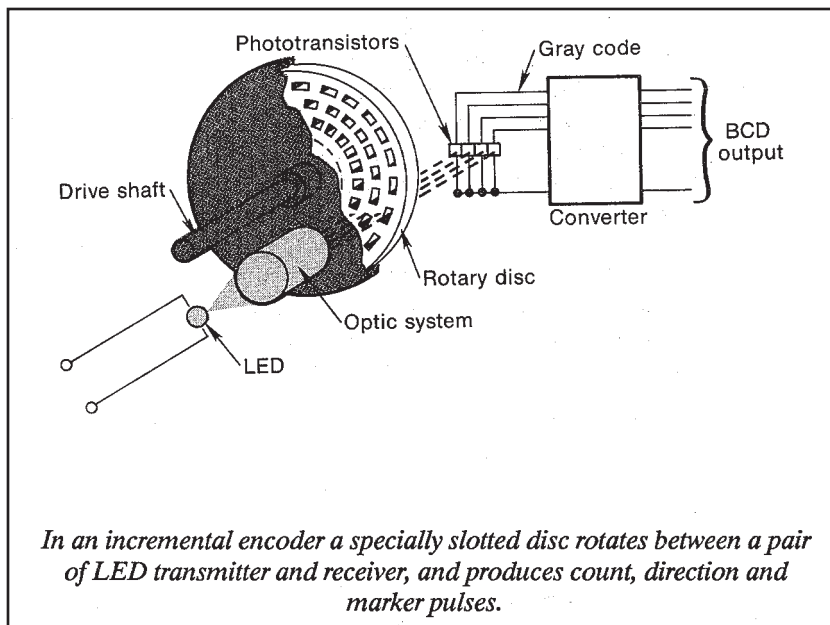
Optical Encoders

The Optical Encoders typically consist of a rotating and a stationary member. The rotor is usually a metal, glass, or a plastic disc mounted on the encoder shaft. The disc has some kind of optical pattern, which is electronically decoded to generate position information. The rotor disc in **absolute optical encoder** uses opaque and transparent segments arranged in a gray-code pattern. The stator has corresponding pairs of LEDs and phototransistors arranged so that the LED light shines through the transparent sections of the rotor disc and received by phototransistors on the other side. See figure below. Depending upon the shaft position, the phototransistor output is modulated in a gray-code pattern, which can be converted internally to binary or BCD. Typically CMOS, TTL-, PNP-, and NPN-type outputs with 8- or 10-bit Gray-code, binary, or BCD formats are available.



Optical absolute encoders use a coded disc to give shaft position in gray-code, which is then converted to BCD or Binary.

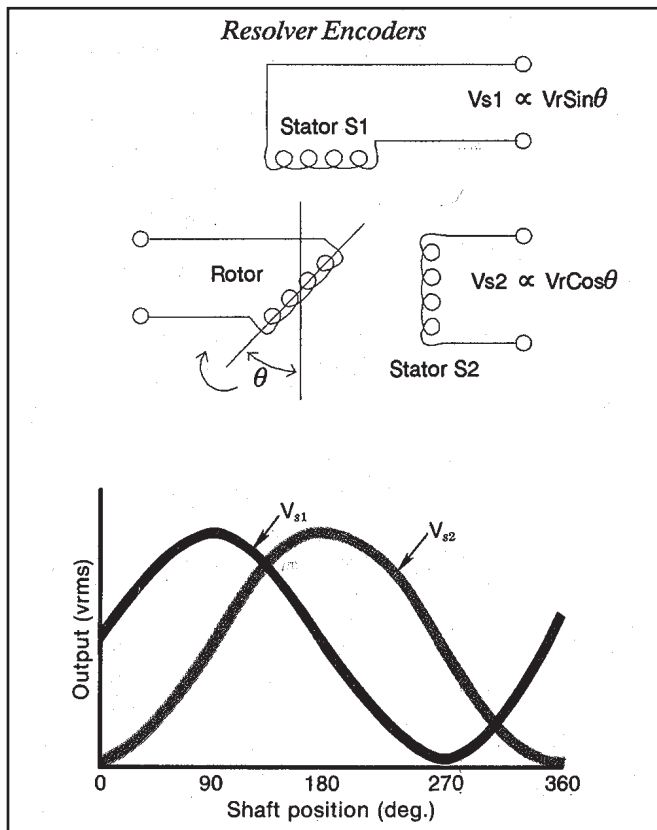
The **incremental optical encoders** (figure 1) use a much simpler disc pattern. This slotted rotor disc alternately interrupts the light beam between the LED transmitter-receiver pair and thus produces a pulse output. The number of pulses depends on the number of slots on the disc. The pulses are then fed to a counter, where they are counted to give position information. The pulse rate indicates shaft speed. An additional LED pair can also determine the direction of rotation. Some modules also provide a marker pulse output, which is generated once every revolution at a fixed shaft position and can be used to mark a zero reference point. Many different pulse configurations are available, but the most commonly known are the quadrature encoders, where two square wave pulses 90 degrees apart from each other are generated.



(Figure 1)

Resolver Encoders

Resolvers are essentially a rotary transformer, having one rotor winding and two stator windings. The stator windings are located 90 degrees apart. Either rotor or stator winding can be used as primary. Typically, the rotor winding is driven by a reference voltage at a frequency ranging from 400 Hz to several KHz.



(Figure 2)

As the shaft rotates, the output voltages of the stator windings vary as the sine and cosine of the shaft angle. See figure 2.

$$V_{s1} \propto V_r \sin \theta$$

and

$$V_{s2} \propto V_r \cos \theta$$

The two induced stator voltages are a measure of the shaft angle and are converted to a digital signal in resolver-to-digital decoder. Among various R/D decoding methods available, the two most commonly used are:

- Ratiometric Tracking Converter
- Phase Method Converter.

Ratiometric Tracking Converter

(A typical block diagram for a Ratiometric Tracking Converter is shown in figure 3.)

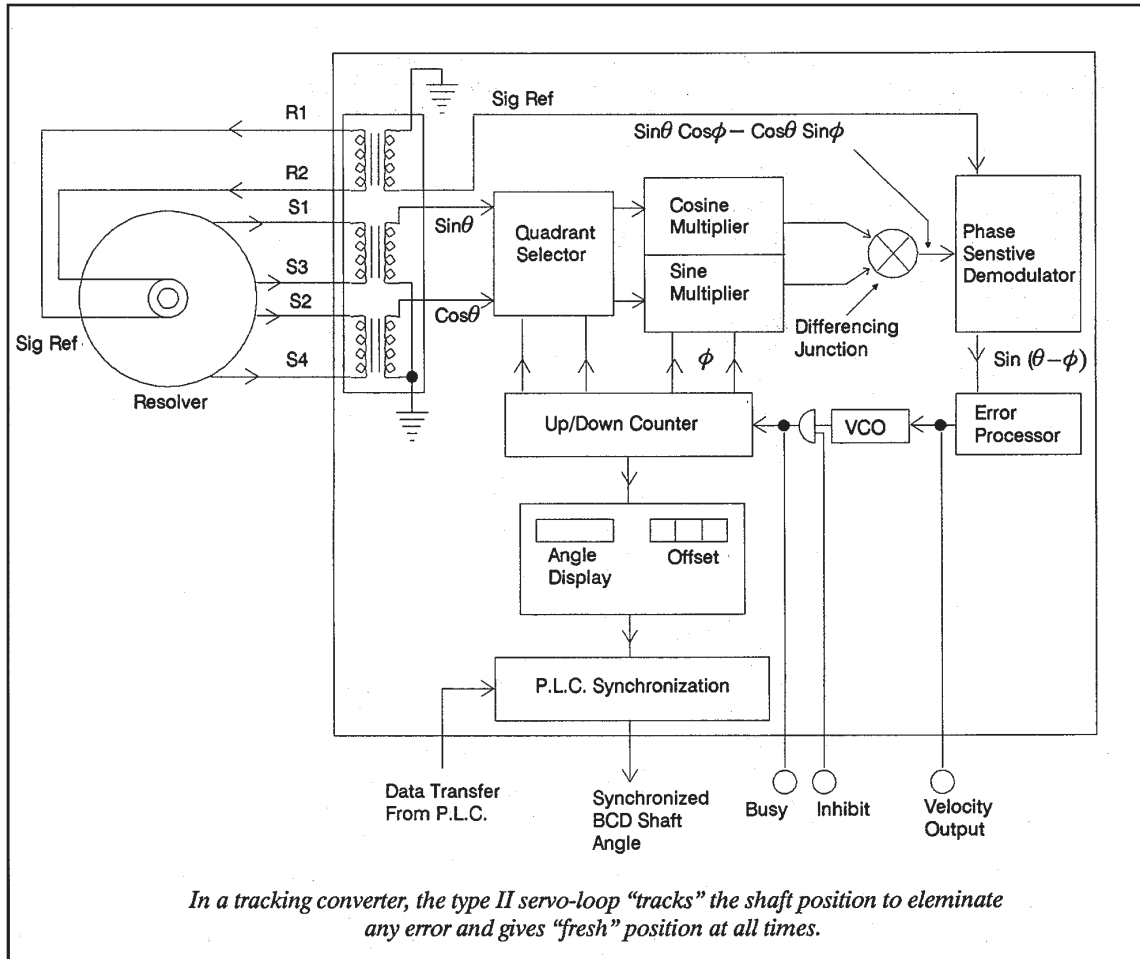
The circuit features a Type II servo-loop that comprises of sine/cosine multiplier and an error amplifier together with phase sensitive demodulator, error processor, voltage controlled

$$\frac{V_{s1}}{V_{s2}} = \frac{V_r \sin \theta}{V_r \cos \theta} = \tan \theta; \therefore \theta = \tan^{-1} = \frac{(V_{s1})}{(V_{s2})}$$

oscillator (VCO) and an up/down counter. Since the VCO is controlled by an error integrator, greater the lag between the actual shaft angle and the digital angle in the counter, faster will the counter be called upon to "catch-up" or "track" and eliminate the error.

The information produced by this type of converter is always "fresh", being continually updated and always available at the output. As an added bonus, additional outputs, such as, an analog output proportional to the shaft RPM to eliminate external tachometers and a busy signal pulse for incremental pulse applications, are also available. The basis of determining the shaft angle in a ratiometric converter is the ratio between the two stator signals:

From this relationship it can be noted that the angle is no longer a function of the induced rotor voltage V_r , but rather the ratio of V_{s1} and V_{s2} . Therefore, variations in the rotor voltage V_r , frequency and temperature are no longer factors in a ratiometric converter. This results in a highly accurate and repeatable resolver-to-digital converter.



(Figure 3)

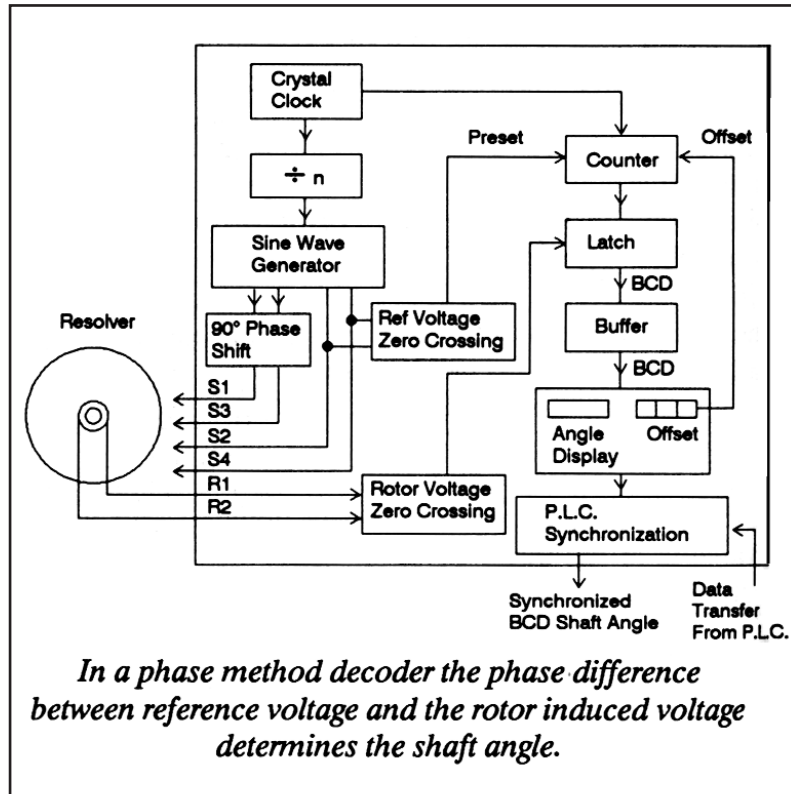
Phase Method Decoder

(A block diagram of a typical Phase Method Decoder is shown in figure 4.)

The principle of operation is based on the fact that the phase difference between reference voltage and the voltage induced in the rotor is a direct measure of the shaft position. The stator windings are excited by two 90° phase-shifted voltages generated by a sine/cosine generator. The counter is preset to zero at zero crossing of the reference voltage and latched at zero crossing of the rotor voltage, and the difference between preset and latch gives the shaft angle. The phase method decoders do not have the environmental immunity of the ratiometric converters. The trade-off is the relatively lesser cost of the phase method decoders.

The output of R/D converters can be offset, displayed and synchronized to interface with programmable controllers.

The ratiometric decoder, though hooked-up to a simple single-turn resolver, can be programmed to operate in single-turn or multi-turn mode. Simple front panel set-up of counts per turn eliminates any mechanical gear trains. With program stored in non-volatile EEROM memory, it is presettable, prescalable, and still absolute (over half a turn). Parallel BCD output with built-in PC-Handshake and serial link facilitates direct interface to programmable controllers and computers.



(Figure 4)

Factors to be considered for Selection of Position Transducers

For an efficient control system, the right selection of a position transducer is as important as the signal processing itself. Here are some of the features and trade-Off to be considered to match the position transducer to your application.

Optical Encoder vs. Resolver

This decision is primarily based on the operating environment. The environmental integrity of a brushless resolver is unchallenged. Being simple rotary transformers, the resolvers can take much more abuse than optical encoders and exhibit no significant wear or aging. Especially, if the operating temperature is below freezing or above 150 °F, there is no other choice, but to go for resolvers. Operating temperature range of resolvers is typically between -67 °F to +248 °F. In extremely hostile environment such as continuous mechanical shock and vibrations, humidity, oil mist, coolants and solvents, resolver is the best choice.

Incremental vs. Absolute

Can you afford to lose position in case of power failure? If the answer is no, then you must use an absolute encoder. An incremental encoder simply generates pulses proportional to the position, whereas an absolute encoder generates a unique code for each position. After a power outage, with an absolute encoder the machine operation will pick up from where it had left off. In an incremental encoder the pulses generated are counted in a counter and at power loss it will lose the count and consequently you will have to home the machine before you can start the operation. Also, an incremental encoder is generally more susceptible to electrical noise. The absolute encoders are more expensive than the incremental encoders are. Therefore, a price/feature trade-off may be worth considering.

Single-Turn vs. Multi-Turn

In a single-turn encoder, the encoder shaft makes one revolution for one complete cycle of machine operation, where as in a multi-turn application, the encoder shaft makes more than one revolutions to complete one machine cycle. Angular rotation of a crankshaft in a punch press or rotary indexing table are typical examples of single-turn applications. In linear positioning, where the encoder shaft makes several turns to complete total travel, a multi-turn encoder will be required. Absolute multi-turn encoders and resolvers are available with various built-in gear ratios. Incremental encoders can be used both in single-turn and multi-turn applications.

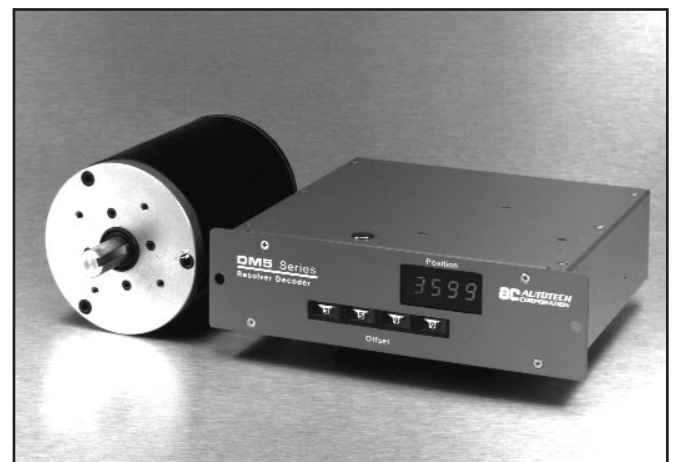
Ratiometric vs. Phase Method Decoder

The ratiometric converters can track the shaft movements faster and can be mounted at a greater distance from resolvers as compared to phase method decoders. They are also more immune to electrical noise and variations of voltage, frequency, temperature, etc. Due to the more complex circuitry involved, the ratiometric converters are usually more expensive than phase method decoders. In general, for more reliable operation, the ratiometric converter should be used. In some applications, where wiring run is short and well shielded, system speed is slow or slow reacting outputs like electromechanical relays are used and the installation is relatively free of electrical noise, the phase method decoder may be considered for a cost effective design.

Built-in vs. Remote Decoder

Usually, resolver-to-digital decoders are housed in a separate enclosure, but resolvers with built-in decoders are also available. The units with decoder circuitry packaged inside a resolver-housing combine the ruggedness of a resolver with simplicity of an optical encoder. However, due to the electronics present in the same housing, the operating temperature range is considerably reduced as compared to a resolver with separate decoder.

The foregoing discussion is helpful in determining as to what type of transducer will be suitable for a particular application. But before one can finalize a transducer selection, one needs to obtain additional mechanical and electrical requirements of the system. Mechanical parameters to be determined are housing size, shaft size and loading requirements, mounting style, NEMA or explosion proof rating needed and system resolution. Electrical requirements are the power supply voltage and current, output type (TTL, CMOS, sinking, sourcing, etc), Analog or Digital outputs, output format (BCD, Binary, or Grey) etc.



ROTARY POSITION TRANSDUCERS

ABSOLUTE POSITION BRUSHLESS RESOLVERS:

Single-Turn, Geared Single-Turn and Dual (Multi-turn) resolvers

- ◆ Absolute shaft position
- ◆ No internal electronics
- ◆ Brushless resolver
- ◆ High-resistance to shock and vibrations
- ◆ NEMA 13 housing provides protection against water, mist, oil, and dust
- ◆ Broad temperature range, -67 °F to 248 °F (-55 °C to 120 °C)
- ◆ Remote ratiometric resolver decoder provides highly noise-immune encoder



- ◆ Choice of heavy-duty, medium-duty and explosion-proof FM-approved housings

RESOLVERS—RUGGED AND RELIABLE

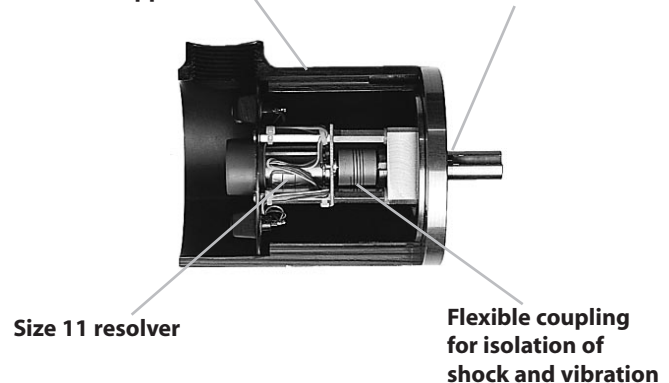
The resolver is a highly accurate and highly dependable device for absolute position shaft encoding. Resolvers have a reliable track record of applications in aerospace, military, and industry, where they have been used for decades for position sensing. Some of the common applications are radar antenna position sensing, missile guidance systems, NC machine position feedback, automotive stamping presses, 2-piece-can manufacturing presses and packaging machines. The resolver is designed to operate reliably under extremely hostile environments such as continuous mechanical shock, vibration, extreme temperature and humidity changes, oil mist, coolants, and solvents. The resolver is a passive transducer. It is a brushless rotary transformer with one rotor and two stator windings. The stator windings are electrically 90° out-of-phase with each other. As the shaft rotates, the relative position of the rotor and the stator windings change. Either the rotor or the two stator windings together can be used as the primary of the rotary transformer and the secondary will then produce an analog-voltage corresponding to the shaft position.

RL100 Resolver—The Workhorse of the Industry

AVG Automation's model RL100 resolver is the most rugged resolver in the industry today. AVG Automation has over 25,000 of these resolvers operating with extreme reliability in highly demanding applications in automotive, can-manufacturing and packing industries. Rugged, industrial housing, heavy-duty, double-row, ball bearing and an internal flexible coupling lend to an extremely reliable design.

Rugged enclosure for industrial application

Shaft seal against oil and water, etc.



Built-In Gear Train for Multi-Turn Application

Various resolver models from AVG Automation are available with a built-in precision gear train. The resolver makes one turn for many turns (see How to Order for gear ratios available) of the input shaft.

Explosion-Proof, FM-Approved

AVG Automation's series E8R resolver has FM approved, explosion-proof housing and meets the requirements as per Division 1, Class 1, Groups B, C, and D.



Dual-Resolvers for Multi-Turn Application

A multi-turn resolver consists of two resolvers coupled to each other through a gear train. One of the resolvers, called the fine resolver, is coupled to the machine shaft in such a way that it turns at the same rpm as the machine, while the other resolver, called the coarse resolver, is geared down by the gear ratio used. As the shaft of the multi-turn resolver turns with the machine movement, the coarse resolver keeps track of the number of revolutions and the fine resolver keeps track of the shaft position in each revolution. Thus, the combination of the two resolver-signals gives the absolute machine position. The gear train uses an antibacklash gear to eliminate backlash errors.



Electrical:				
Frequency:	2250 Hz	Rotor Impedance with stator open circuit Zro:	180 + j256 ohms	
Input Volatage:	1.88 V	Input Current:	6 mA	
DC Resistance (Rotor):	18.3 ohms	Input Power:	6.5 mW	
Output Voltage (Stator):	2.63 V ±5%	Transformation Ratio:	1.400:1	
Mechanical:				
Resolver	SAC-RL100 SAC-RL210	E8R-RL101 E8R-RL210-xxxMC	E7R-RL101	SAC-RL101
Housing	Size 40 4.0" dia.(101.6 mm)	Size 40 explosion-proof 4.0" dia. (101.6 mm)	Size 25 2.5" dia. (63.5 mm)	Size 11 1.1" dia. (27.94 mm)
Max. Starting Torque oz. in. @ 77 °F: (gm/cm @ 25 °C):	8 (576.1)	8 (576.1)	5 (360.04)	0.07 (5.04)
Moment of Inertia (gm/cm2):	45	45	45	3.3
Max. Slew Speed: (RPM)	5000	5000	5000	3600
Shaft Size:	5/8" (15.88 mm)	5/8" (15.88 mm)	3/8" (9.53 mm)	0.120" (3.05 mm)
Max. Shaft Loading Axial: Radial:	50 lb. (22.68 kg) 100 lb. (45.36 kg)	50 lb. (22.68 kg) 100 lb. (45.36 kg)	40 lb. (18.14 kg) 36 lb. (16.33 kg)	0.3 lb. 0.7 lb.(0.32 kg)
Bearing Life at Max. Mfr. Spec. (Rev.)	2 x 10 ⁹	2 x 10 ⁹	2 x 10 ⁸	2 x 10 ⁹
Approx. Weight:	6 lb. (2.72 kg)	8 lb. (3.62 kg)	1 lb. (0.45 kg)	0.25 lb. (0.11 kg)
Environmental				
Shock:	200 g for 11 ms			50 g for 11 ms
Vibration:	20 g to 2000 Hz			15 g to 2000 Hz
Temperature:				
Operating:	-67 °F to +248 °F (-55 °C to +120 °C)			
Storage:	-85 °F to + 302 °F (-65 °C to +150 °C)			
Enclosure:	NEMA 13	NEMA 4X (Div. I, Class 1, Groups B, C, and D)	NEMA 13	NEMA 1

MOUNTING

Autotech resolvers are designed to operate reliable under extremely hostile environments, such as: continuous mechanical shock, vibration, extreme temperature and humidity changes, oil mist, coolant and solvents. Still ordinary precautions to prevent damage to bearings of any rotation device should be followed to prolong their life.

1. It is recommended that the Autotech encoder mounting bracket (MMB-EM359-010) be used, wherever possible, for size 40 resolvers.

The servo-mount resolvers may be mounted either with traditional servo-clamps or through the four threaded mounting holes on the face of the resolver.

The flange-mount resolvers are mounted using four mounting holes in the square flange.

2. If the resolver is to be axially shaft driven, be sure that the shafts are aligned. Misaligned shafts can destroy resolver bearings.
3. If a pulley, coupling or sprocket is mounted to the resolver shaft, DO NOT hammer or press on the shaft. DO NOT force fit anything on to or off of the resolver shaft.

4. If the resolver is belt-driven or chain-driven, DO NOT OVERTIGHTEN the drive belt or chain. Too much side loading (radial) can destroy the resolver bearings. Side loading is not allowed for E6R and RL101 (size 11) resolvers.

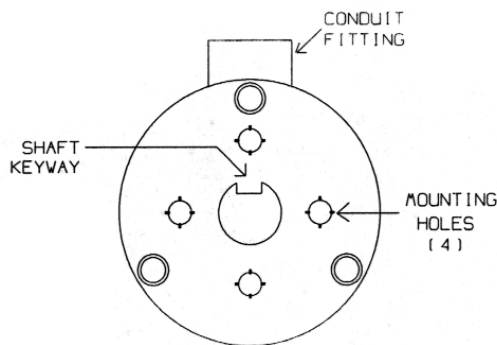
5. To maintain the NEMA 13 rating of the resolver, the following precautions must be taken: a) sealing compound must be used when fitting the conduit pipe; b) the bearing seal must be checked once every six months and replaced if necessary. Lubricating the bearing seal periodically prolongs its life.

6. Zero Reference: For most resolver types, the approximately zero reference may be located by aligning the shafts as shown in the figures below.

CAUTION:

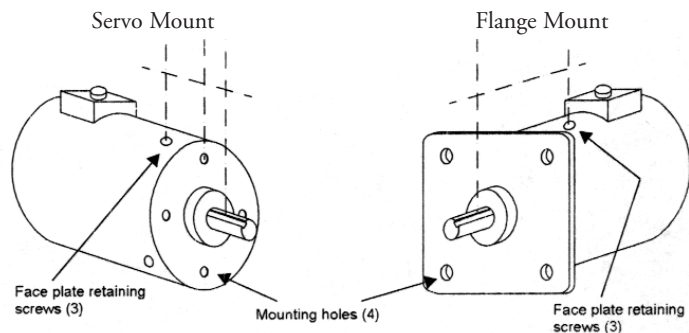
RL101 (size 11) resolvers must be coupled to an external shaft using a flexible coupling. See "How to Order" page.

Zero Reference-Size 40 resolvers (SAC-RL100, E8R and SAC-RL210)



Size 40 resolvers are at approximately zero when the shaft key way is aligned with mounting hole and conduit fitting.

Zero Reference-Size 25 resolvers (E7R)



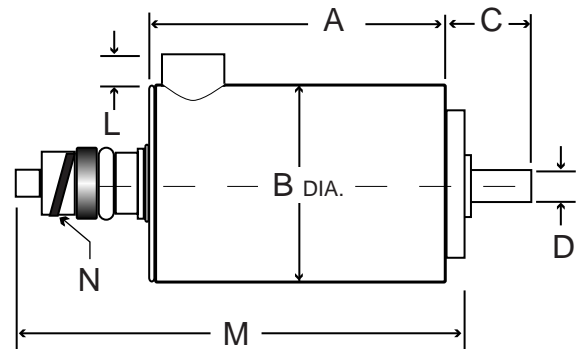
Servo mount resolvers: Align shaft keyway with the face plate retaining screw which is in line with a mounting hole.

Flange mount resolver: Align shaft keyway with the face plate retaining screw that lies midway between two mounting holes.

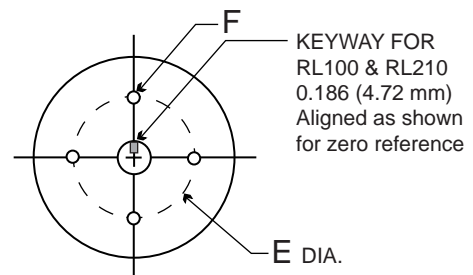
MOUNTING SPECIFICATIONS

Resolver Mounting Table						
Resolver Part Number:	SAC-RL100-XXX SAC-RL100-GXXX X	E8R-RL101-XXXMC E8R-RL210-XXXMC	SAS-RL210-GXXX X SAC-RL210-GXXX X	E1R-RL101-000 X X	E7R-RL101-00 X X	E9R-RL101-000 X X
MEASUREMENTS (inches & mm)						
A	5.50 (139.7)	8.56 (217.5)	6.50 (165.1)	3.57 (90.7)	3.87 (98.3)	3.57 (90.7)
B (dia.)	4.0 (101.6)		2.50 (63.5)			
C	Servo Mount	1.25 (31.8)		1.18 (30.0)		
	Flange Mount	—		1.06 (26.8)	1.18 (30.0)	1.06 (26.8)
D (dia.)	0.625 (15.9)		0.38 (9.5)			
E (dia.)	2.50 (63.5)		—	2.00 (63.5)	—	
F	10-32 UNF		—	4-40 UNC	—	
G	—		1.03 (26.2)			
H (sq.)	—		2.06 (52.3)			
I	—		1.33 (33.8)			
J (sq.)	—		2.66 (67.6)	2.65 (67.3)	2.66 (67.6)	
K	—		0.22 (5.54)			
L	0.625 (15.9)		—			
M	7.60 (193.0)	—	8.60 (218.4)	—	5.98 (151.8)	—
N	*	—	*	—	*	—

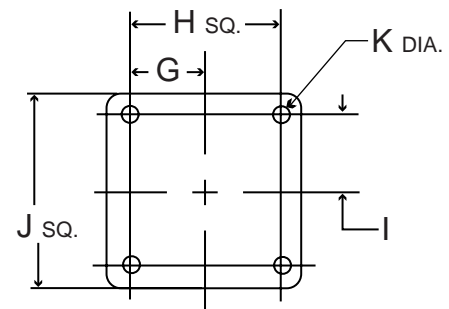
* **MS-CONNECTORS**
MS3116F-12-10S
MS3112F-12-10P



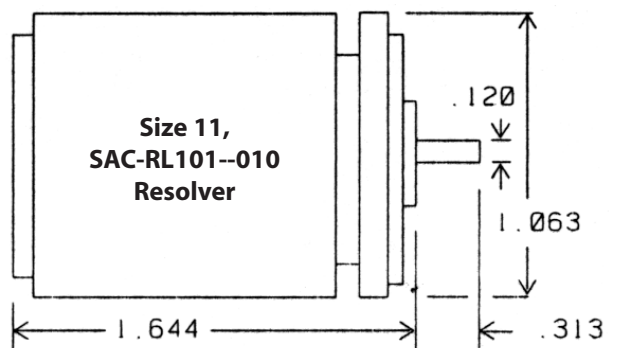
SECTION
A



Servo Mount



Flange Mount



RL500 HOLLOW SHAFT RESOLVER

- ◆ Fits on $\frac{5}{8}$ " (15.88 mm) dia. Shafts
- ◆ Comes with $\frac{3}{8}$ " (9.53 mm) Liquid-Tite Conduit



RL500

The RL500 Hollow Shaft Resolver is intended for those applications where there is a projecting $\frac{5}{8}$ " (15.88 mm) diameter shaft (machine shaft, double-ended motor shaft, etc.) available at the point where the user wishes to take rotational readings. Instead of having to make provisions to install a traditional resolver,

which has to be installed with a bracket and coupled to a shaft on the machine, as long as there is a 3" (76.2 mm) shaft projection, the RL500 can be mounted directly to the machine.

RL500 SPECIFICATIONS

ELECTRICAL:

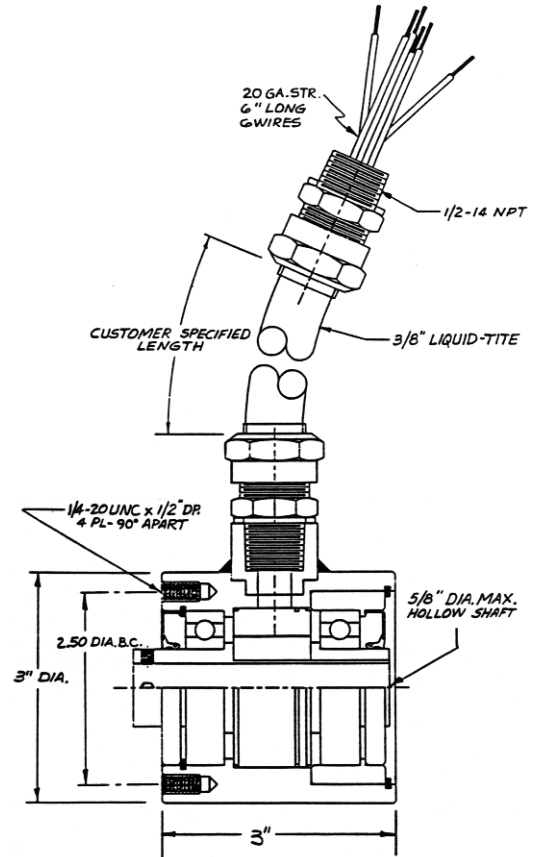
Frequency: 2250 Hz
Input Voltage: 1.88 V
Input Current: 6 mA
Input Power: 6.5 mW
Open Circuit Z_{ro}: 180+j256 Ω
DC Resistance(Rotor): 18.3 Ω
Output Voltage (Stator): 2.63 V ±5%
Transformation Ratio: 1.400:1

MECHANICAL:

Max. Slew Speed: 5000 RPM
Max. Shaft Loading:
 Axial: 50 lb. (22.68 kg)
 Radial: 100 lb. (45.36 kg)
Bearing Life at Max. Mfr. Spec. (Rev): 2 x 10⁹
Approx. Weight: 7 lb. (3.18 kg)
Diameter: 3" (76.2 mm)
Height: 3" (76.2 mm)
Internal Diameter: 0.708"(18.0 mm)

ENVIRONMENTAL:

Shock: 200 g for 11 ms
Vibration: 20 g to 2000 Hz
Operating Temperature:
 -67 °F to +248 °F (-55 °C to +120 °C)
Storage Temperature:
 -85 °F to +302 °F (-65 °C to +150 °C)
Enclosure Rating: NEMA 13



SECTION A

RL501 "PANCAKE" RESOLVER

- ◆ Fits on $\frac{1}{2}$ " (12.7 mm) dia. Shafts
- ◆ Designed for use in "cramped" quarters, where installation space is at a premium.

The RL501 Pancake Resolver is intended for those applications where there is a projecting $\frac{1}{2}$ " (12.7 mm) diameter shaft (machine shaft, double-ended motor shaft, etc.) available at the point where the user wishes to take rotational readings. Only 1" (25.4 mm) thick, the RL501 can be installed in applications where space is very constricted. Instead of having to make provisions to install a traditional resolver which has to couple to a shaft on the machine, as long as there is a 1" (25.4 mm) shaft projection, the RL501 can be mounted directly to the machine.



RL501 SPECIFICATIONS

ELECTRICAL:

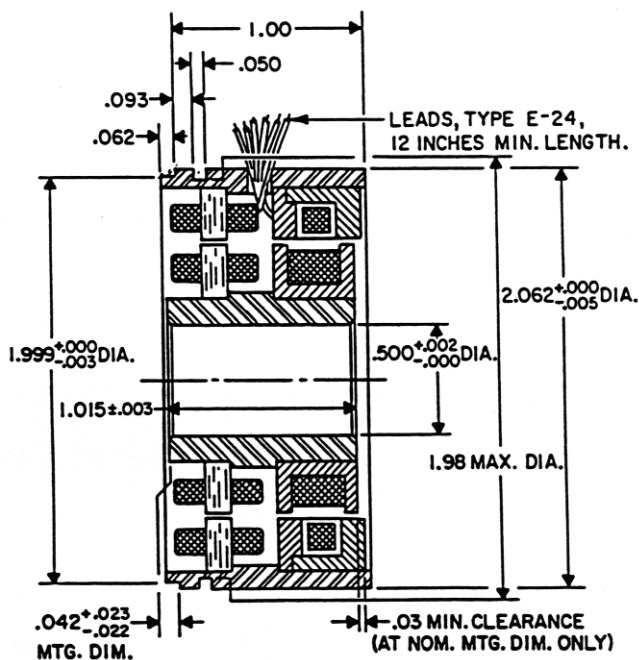
Frequency: 2250 Hz
 Input Voltage: 1.88 V
 Input Current: 6 mA
 Input Power: 6.5 mW
 Open Circuit Zro: $180+j256 \Omega$
 DC Resistance (Rotor): 18.3Ω
 Output Voltage (Stator): $2.63 V \pm 5\%$
 Transformation Ratio: 1.400:1

MECHANICAL:

Max. Slew Speed: 5000 RPM
 Max. Shaft Loading:
 Axial: 50 lb. (22.68 kg)
 Radial: 100 lb. (45.36 kg)
 Bearing Life at Max. Mfr. Spec. (Rev): 2×10^9
 Approx. Weight: 7 lb. (3.18 kg)
 Diameter: 2.062" (52.37 mm)
 Height: 1.062" (26.97 mm)
 Internal Diameter: 0.500" (12.7 mm)

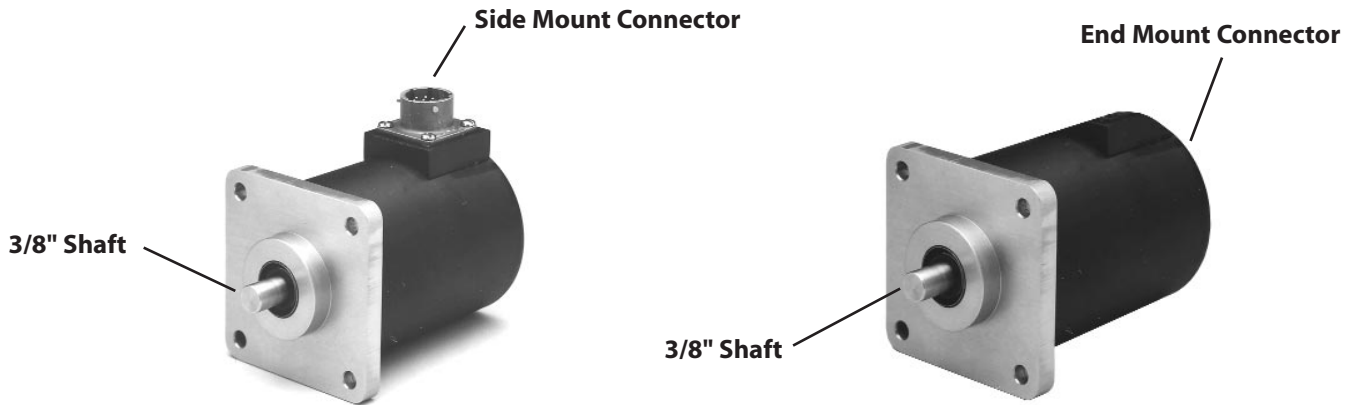
ENVIRONMENTAL:

Shock: 200 g for 11 ms
 Vibration: 20 g to 2000 Hz
 Operating Temperature:
 -67 °F to +248 °F (-55 °C to +120 °C)
 Storage Temperature:
 -85 °F to +302 °F (-65 °C to +150 °C)
 Enclosure Rating: NEMA 13



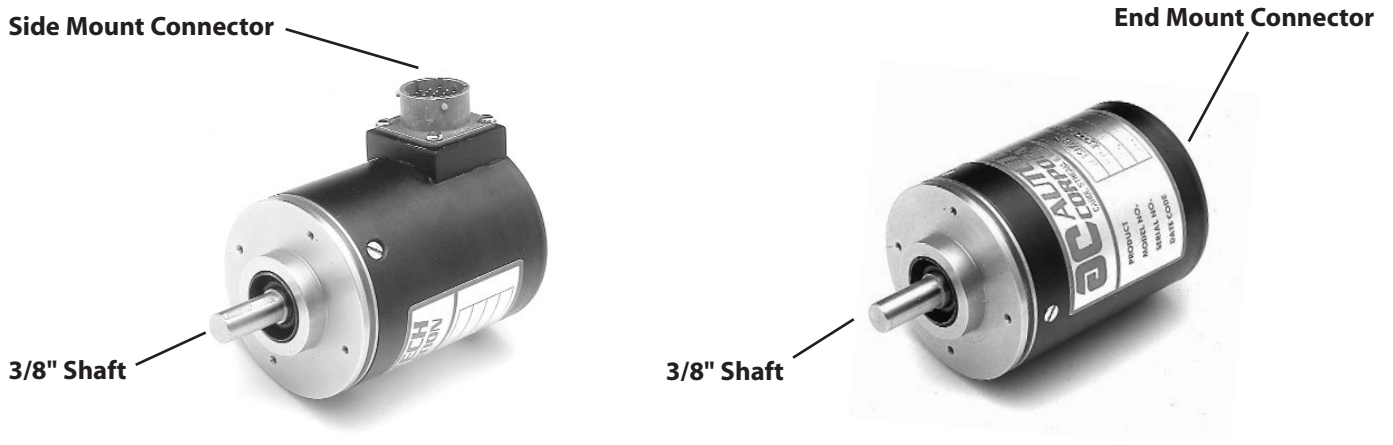
MOUNTING & HOUSING STYLES

SIZE 25, FLANGE MOUNT (2.5" diameter)



SECTION
A

SIZE 25, SERVO MOUNT (2.5" diameter)

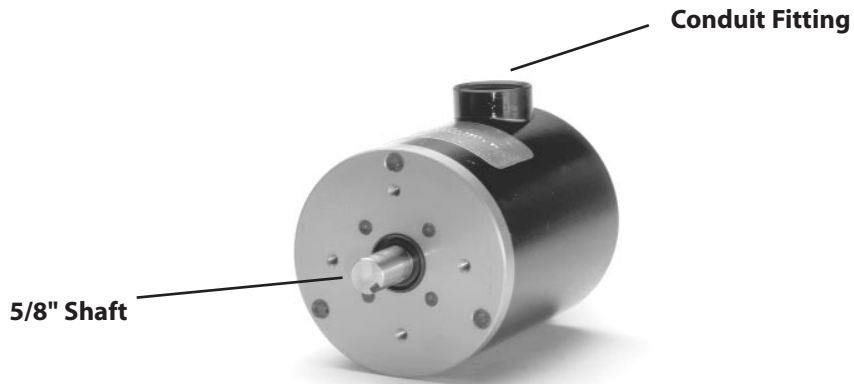


SIZE 11 (1.1" diameter housing)



MOUNTING & HOUSING STYLES

SIZE 40 (4" diameter)



SIZE 40 (4" diameter)



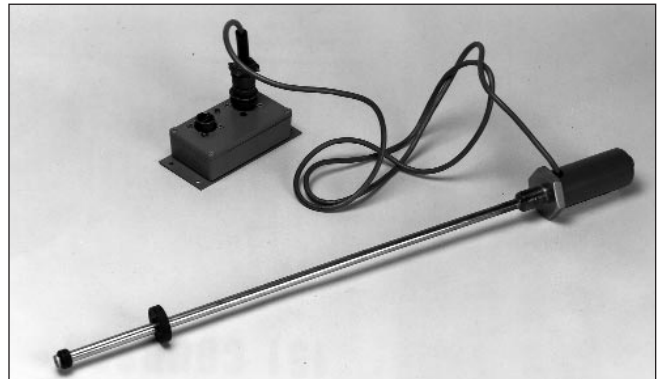
SIZE 40, EXPLOSION PROOF (4" diameter)



LT140 LINEAR ULTRASONIC POSITION TRANSDUCER

ABSOLUTE POSITION TRANSDUCER

- ◆ Absolute linear position
- ◆ Ultrasonic position sensing; no moving parts
- ◆ Easy to install
- ◆ Accurate to 0.001" (0.025 mm)



LT140

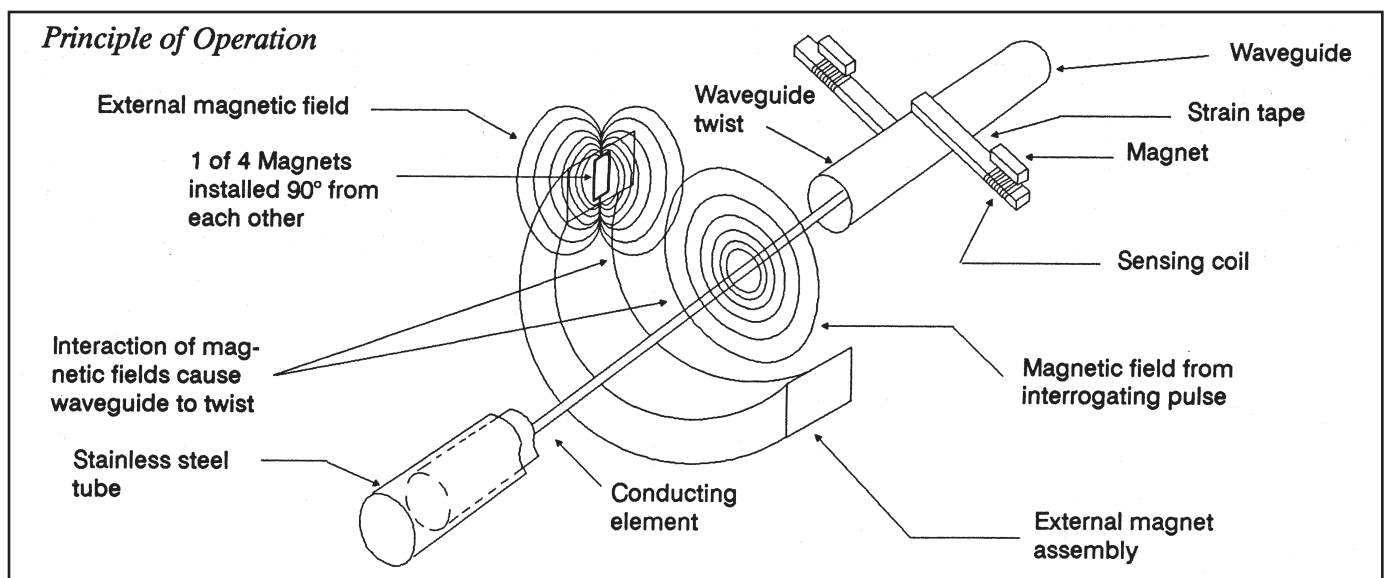
Principle of Operation

An ultrasonic linear transducer consists of an interface control module, a nonmagnetic stainless steel rod with sensing head and a "doughnut" magnet. An electrical interrogating pulse, generated in the interface control module, creates a magnetic field around the conducting element housed inside a waveguide which in turn is enclosed in the nonmagnetic stainless steel transducer rod. The "doughnut-shaped" permanent magnet, mechanically representative of machine position, reacts with this generated field producing a mechanical force at right angle to the conducting element. This force causes a twist (torsional strain) which travels back the length of the rod. These strain pulses arrive at a fixed reference a certain time interval

later and this time delay from the interrogating pulse indicates the linear position of the "doughnut" magnet. These precise time-based pulses are then converted to digital output inside a linear decoder or a linear PLS.

Magnetic fields normally generated by 60 or 400 Hz equipment will not affect the operation because these frequencies will be rejected by the narrow bandwidth detector used.

Normally the transducer rod is fixed and the "doughnut" magnet moves with the moving part of the machine. However, this can be reversed if desired. The relative displacement between the two parts provides the output signal.



LT140 SPECIFICATIONS

Working stroke length: 12-108" (304.8-2743.2 mm) in 1-foot (304.8 mm) increment

Scan rate: 3.5 ms up to 100" (2540 mm) length;
7 ms above 100" (2540 mm) length.

Linearity: 0.05% of full stroke

Repeatability: 0.002% of full stroke

Temperature coefficient: 0.0005% per °F of reading

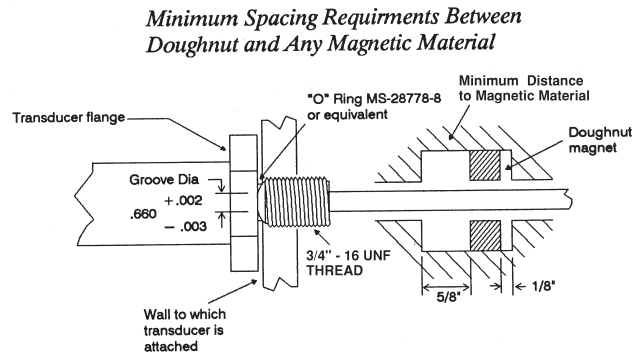
Resolution: 0.001" (0.025 mm) over 100" (2540 mm) length

Operating temperature: 0 °F to 185 °F (-17.8 °C to +85 °C)

Mechanical zero Reference: Approximately 2" (50.4 mm) from mounting surface

Over all rod length: Stroke length +7" (177.8 mm)

Rod material: Nonabrasive stainless steel



INTERFACING ABSOLUTE POSITION DECODERS TO PLCs AND MICROCOMPUTERS

Microcomputers and PLCs are sequential logic devices. In contrast to a real-time hardware logic, which can perform many operations at the same time, a PLC can perform only a single operation before proceeding to the next logical step. The

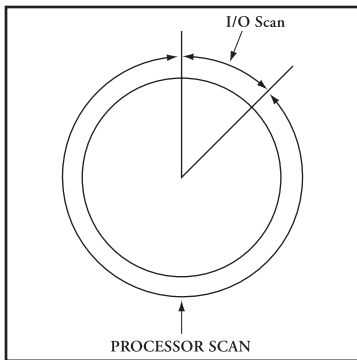


figure describes the logical operation of a PLC, which is cyclic in nature. During the I/O scan, the PLC looks at the input data available at the input terminals and activates the outputs based on the ladder logic. During the processor scan, the new input data is processed by

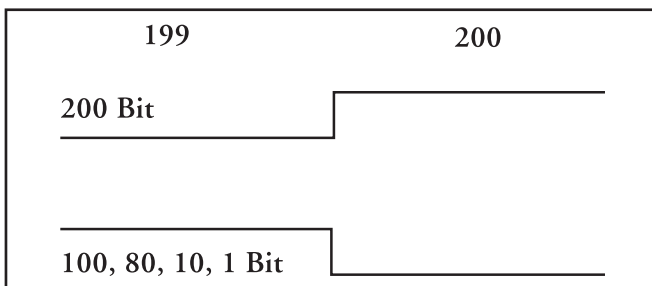
the Central Processing Unit (CPU) according to the ladder program and the outputs are updated during the next I/O scan. This cycle repeats again and again.

The expression "garbage in, garbage out" fits very well to the PLC. If the input data is invalid or incorrect, the corresponding machine operation will also be incorrect. Therefore, it is very important that when the PLC reads the decoder input during the I/O scan, the decoder data is valid and free of any ambiguities.

There are two main inherent characteristics of electronic devices that could cause wrong decoder data into the PLC:

a) PLC Reading the Changing Bit Pattern:

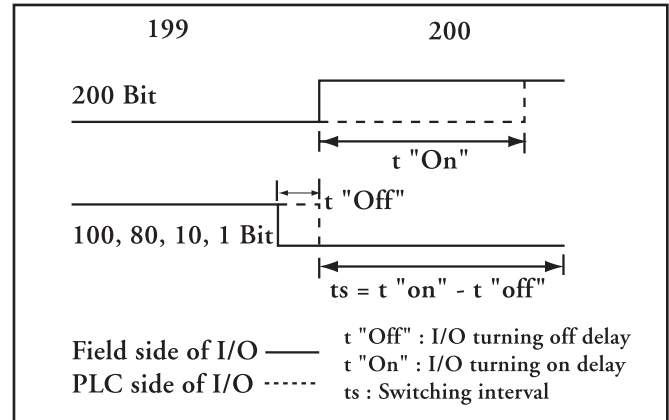
As we all know, a BCD, binary, or gray code number is composed of various bits that change state when decoder position passes from one number to the next. Inherently, in Gray Code only 1 bit changes state when changing from one number to the next, while in BCD or Binary data more than one bits may change for each number change. Let us consider the example of changing decoder position from 199° to 200°. In



a BCD code, for this 1° change of position, 6 bits will change state, i.e., 100, 80, 10, 8, and 1 bits will go LOW and 200 bit will go HIGH. And, due to the reaction time of electronic components, all these bits do not change state at the same time. At a given time when PLC reads the data, some bits might have gone LOW while others may still be HIGH. Therefore, while reading the above changing bit pattern the PLC is liable to read a wrong number.

b) Reaction Time of PLC Input Modules:

PLC I/O modules, even the TTL compatible ones, have lengthy and inconsistent time delays when they change their logic state. This inconsistency gets further compounded by long wiring runs between the decoder and the PLC, and also the limited current drive capability of the decoder outputs. In the above example, when the input to the I/O module goes from 199° to 200°, the output may stay at 000 for a time, depending on the I/O module reaction time.



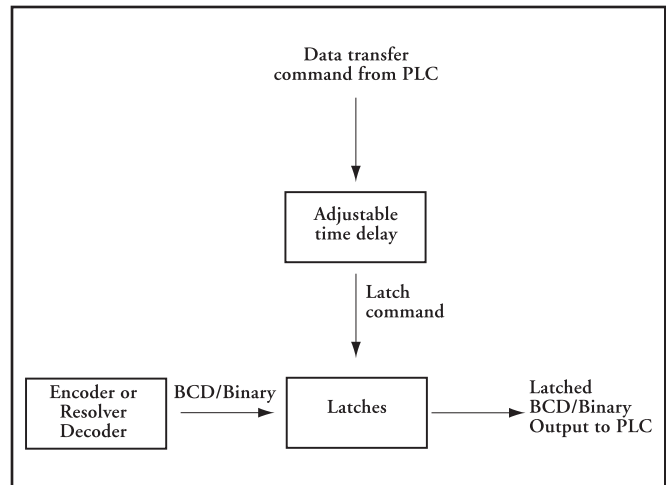
An I/O scan during this time (2 to 10 ms in typical installations) will read false data to the PLC. The solid line is the field side of the I/O module and the dashed line the PLC side. During the switching time (TS), the decoder information as seen on the PLC side is 0, which is invalid.

Even dedicated microprocessor controls with faster scan times are faced with the above two problems, though to a lesser degree. In microprocessors the TS is in microseconds (μs) instead of milliseconds (ms) and software can be designed to ignore inconsistent data. If your microprocessor does not have this software provision or if you are using a PLC, the hardware synchronization described below must be used to assure the integrity of the incoming decoder data.

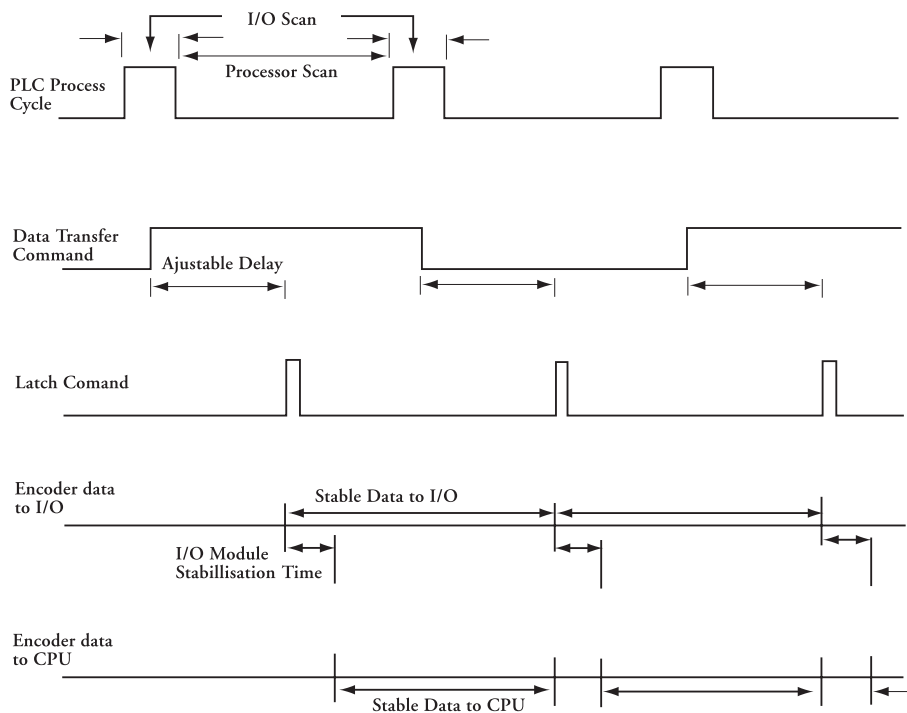
PLC Synchronization (PC-Handshake):

Whenever the PLC scans the decoder input, it must see stable data. In order to ensure this, the PLC gives a data transfer command and a predetermined time later the PLC synch circuit stabilizes the data for the PLC to read. This time is adjustable on some AVG Automation units (2 μ s to 30 ms), where as it is fixed on others (50 μ s, 100 μ s, etc.). The variable time feature, when available, can be used to provide the most fresh data to the PLC.

For example, the time interval between the data transfer and read commands might be 12 ms and say the time delay is set at 5 ms. After 5 ms of the data transfer command the stable data is available to the input modules of the PLC and when the PLC commands the data to be read 12 ms later, it is stable and valid.

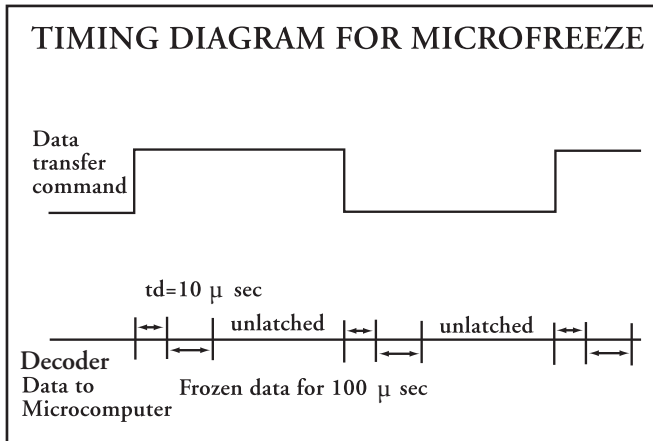


Timing Diagram for the PLC Handshake Circuit



Microcomputer Synchronization (Microfreeze):

The Microfreeze can also be called as transparent PC-Handshake. This feature is particularly useful when interfacing data directly to a microcomputer where speed of operation is much higher. In this case the decoder position data is continuously updated at full speed. The data are frozen for $100\ \mu\text{s}$ $\pm 10\%$ after a delay of $10\ \mu\text{s}$ from either transition edge of data transfer command. The microcomputer can read stable data during these $100\ \mu\text{s}$ and it automatically unlatches.



Software Filtering:

The problem of synchronizing BCD data to a PLC can also be addressed by software filtering. Software filtering is usually done in one of the following two ways:

1. A window is created around the last correct reading based on the known operating speed of the decoder. If new position is outside of this window, the data is rejected.
2. Three samples of position data are taken, of which two must agree before data is accepted.

Either of these approaches will increase the scan time of the PLC. Since scan time is an important factor in system speed and resolution, the software approach is usually not a viable approach.

Notes:

- 1) The synchronization problem does not exist when using Gray Code absolute decoders because only one bit changes state at a time.
- 2) The synchronization process described above does not result in faster machine operation. The system resolution and permissible decoder speed will still be limited by the PLC scan time. As a rule of thumb, a PLC with $16.67\ \text{ms}$ (One AC cycle) scan time will permit 1° resolution at 10 RPM (The rule of 10:1:1).

DM2 SINGLE-TURN RESOLVER DECODER

SNAP TRACK MOUNT

Models DM2-STRAK-xxxxx and DS2-STRAK-xxxxx

- ◆ Decoder for single twin resolver
- ◆ Short circuit proof resolver interface
- ◆ Broken resolver cable indication
- ◆ PNP sourcing, NPN sinking or TTL outputs
- ◆ Short circuit protected outputs and output shorted indicator (only with P & N type of outputs)



DESCRIPTION

Autotech's Single Resolver Decoder model DM2-STRAK-xxxxx is a snap track mounted single resolver decoder especially designed for OEMs. The unit can be ordered with PNP sourcing, NPN sinking (high or low true logic), or with TTL type of outputs. It operates from an 11-28 VDC input power. The decoder provides complimentary quadrature phase outputs.

The unit has built-in diagnostics for broken resolver cable and for shorted outputs (P and N outputs only). Two LED indicators provide positive indication of a properly working unit. The resolver interface is short circuit proof.

DM2 SNAP TRACK MOUNT SINGLE RESOLVER DECODER SPECIFICATIONS

Input Power: 11-28 VAC, 6 W

Operating Temperature: -10 °F to +130 °F (-23 °C to +55 °C)

Position Transducer: AVG Automation's single turn resolver such as RL100, RL101, RL500, RL501, E1R, E7R, E8R, or E9R series

Maximum Cable Length between Resolver and DM2: 2500 ft, shielded

Output Formats: Factory scale quadrature

Output Type:

P: PNP sourcing:

Logic TRUE: Transistor ON, 1.7 V drop @ 100 mA

Logic FALSE: Transistor OFF, 0.2 mA leakage @ 50 VDC

N: NPN sinking (LOW TRUE LOGIC):

Logic TRUE: Transistor ON, 1.1 V max. @ 100 mA

Logic FALSE: Collector open, 0.1 mA leakage @ 50 VDC

C: NPN sinking (HIGH TRUE LOGIC):

Logic TRUE: Collector open, 0.1 mA leakage @ 50 VDC

Logic FALSE: 1.1 V drop @ 100 mA

T: TTL output, 5V logic with multiplexing:

Logic TRUE: 3.00 mA max, 2V min.

Logic FALSE: 24.0 mA max, 0.8V max

Transparent: Output data is continuously updated. The data is latched for 100 +/- 10 usec within 30 usec of a transfer input.

PC Handshake: Edge triggered (Low to high as well as high to low); 30 usec minimum strobe width; The data is stabilized within 100 usec of any triggering edge, and remains frozen until next triggering edge comes in.

Slave Systems: Slave units must be used in conjunction with an Autotech Master Unit. They cannot be used as stand-alone units. Up to seven slaves may be added to one master unit. The slave shares the position transducer with the master.

DM2 DUAL RESOLVER DECODER

SNAP TRACK MOUNT

- ◆ Decoder for dual resolver
- ◆ Field selectable 16:1, 32:1, 64:1 or 128:1 gear ratio
- ◆ Field selectable Binary, BCD or Gray Code output
- ◆ 1024 counts per turn (1000 in case of BCD)
- ◆ Short circuit proof resolver interface
- ◆ Broken resolver cable indication
- ◆ PNP sourcing, NPN sinking or TTL outputs
- ◆ Short circuit protected outputs and output shorted indicator (only with P & N type of outputs)



- ◆ Field selectable PC Handshake or transparent operation

DESCRIPTION

Autotech's Dual Resolver Decoder model DM2-DTRAK-0X is a snap track mounted dual resolver decoder especially designed for OEMs. The unit can be ordered with PNP sourcing, NPN sinking, or with TTL type of outputs, and operates from 11-28 VDC input power. The standard unit supports gear ratios of 16:1, 32:1, 64:1 and 128:1 between fine and coarse resolvers. The decoder provides BCD, Binary or Gray code outputs. The outputs are updated transparently

or by an external data transfer input. The gear ratio, output code and the output update method are field selectable by dip switches.

The unit has built-in diagnostics for broken resolver cable and for shorted outputs (P and N outputs only). Two LED indicators provide positive indication of a properly working unit. The resolver interface is short circuit proof.

DM2 DUAL RESOLVER DECODER SPECIFICATIONS

Input Power: 11-28 VAC, 6 W

Operating Temperature: -10 °F to +130 °F (-23 °C to +55 °C)

Position Transducer: AVG Automation's RL210 dual resolvers.

Maximum Cable Length between Resolver and DM2: 2500 ft, shielded

Standard gear ratios: Field selectable 16:1, 32:1, 64:1, and 128:1

Output Formats: Field selectable BDC, Binary or Gray

Output data update: Switch selectable between transparent and PC Handshake

Output Type:

P: PNP sourcing:

Logic TRUE: Transistor ON, 1.7 V drop @ 100 mA

Logic FALSE: Transistor OFF, 0.2 mA leakage @ 50 VDC

N: NPN sinking:

Logic TRUE: Transistor ON, 1.1 V max. @ 100 mA

Logic FALSE: Collector open, 0.1 mA leakage @ 50 VDC

C: NPN sinking (HIGH TRUE LOGIC):

Logic TRUE: Collector open, 0.1 mA leakage @ 50 VDC

Logic FALSE: 1.1 V drop @ 100 mA

T: TTL output:

Logic TRUE: -300 mA max

Logic FALSE: 24.0 mA max

PC Handshake: Edge triggered (Low to high as well as high to low); 30 usec minimum strobe width; The data is stabilized within 100 usec of any triggering edge, and remains frozen until next triggering edge comes in.

Transparent: Output data is continuously updated. The data is latched for 100 +/- 10 usec within 30 usec of a transfer input.

Data transfer input: 10-28 VDC input

DM5 RESOLVER DECODER SINGLE-TURN, SINGLE-CHANNEL

- ◆ Resolver based, single-turn, absolute position. No loss of position under any situation
- ◆ Programmable full scale zero offset for easy set-up
- ◆ Variety of outputs, built-in PC-Handshake, permit interfacing to any PLC
- ◆ Multiplexing capability
- ◆ Up to 8192 counts-per-turn resolution at 1800 rpm
- ◆ Highly noise-immune ratiometric tracking converter
- ◆ Extremely rugged and reliable resolver as position transducer



- ◆ Optically isolated outputs

THE DM5 DECODER

Principle of Operation

The DM5 series resolver decoder provides an absolute encoder system in conjunction with any one of the AVG Automation's single-turn resolvers. As shown in the diagram on the next page, the resolver rotor winding is excited from a reference sinusoidal generator inside the DM5 unit. The analog output signals from the resolver stator windings, after signal conditioning in the buffer amplifiers, are decoded to digital format in the Ratiometric Tracking Converter. The zero offset, set by the front panel thumbwheels, is continuously added to this value and the resultant position is displayed on the front panel of the unit. The position information is also made available in a parallel format for external devices, such as PLCs, remote displays etc.

Programmable Full Scale Offset for Easy Set-Up

You can mount the resolver on the machine without any concern for mechanically matching the resolver zero to the machine zero. Once the resolver is coupled to the machine shaft, the only thing you have to do is to bring the machine to

a known position, say home position, and set an offset number using the front panel thumbwheel switches until the display reads zero. Now the resolver zero is aligned with the machine zero. This is especially useful during initial start-up in that it reduces the set-up time. The offset can also be used to compensate for any wear on the machine.

Variety of Outputs, Built-in PC-Handshake, permit Interface to any PLC

BCD, natural Binary, or Gray Code output formats are available with a choice of TTL, PNP (sourcing) transistor or NPN (sinking) transistor outputs. Optional PLC synchronization circuit provides an error-free method of interfacing BCD position data from the decoder to any PLC in the market. Upon receipt of a data transfer command from the PLC, the stable data is latched and made available to the PLC

Multiplexing Capability

The TTL type of outputs have multiplexing capability, which allows more than one decoder to be connected to the same control unit for multi-axis applications. For multiplexing PNP or NPN type outputs, consult the factory.

Up to 8192 Counts-per-turn Resolution at 1800 RPM

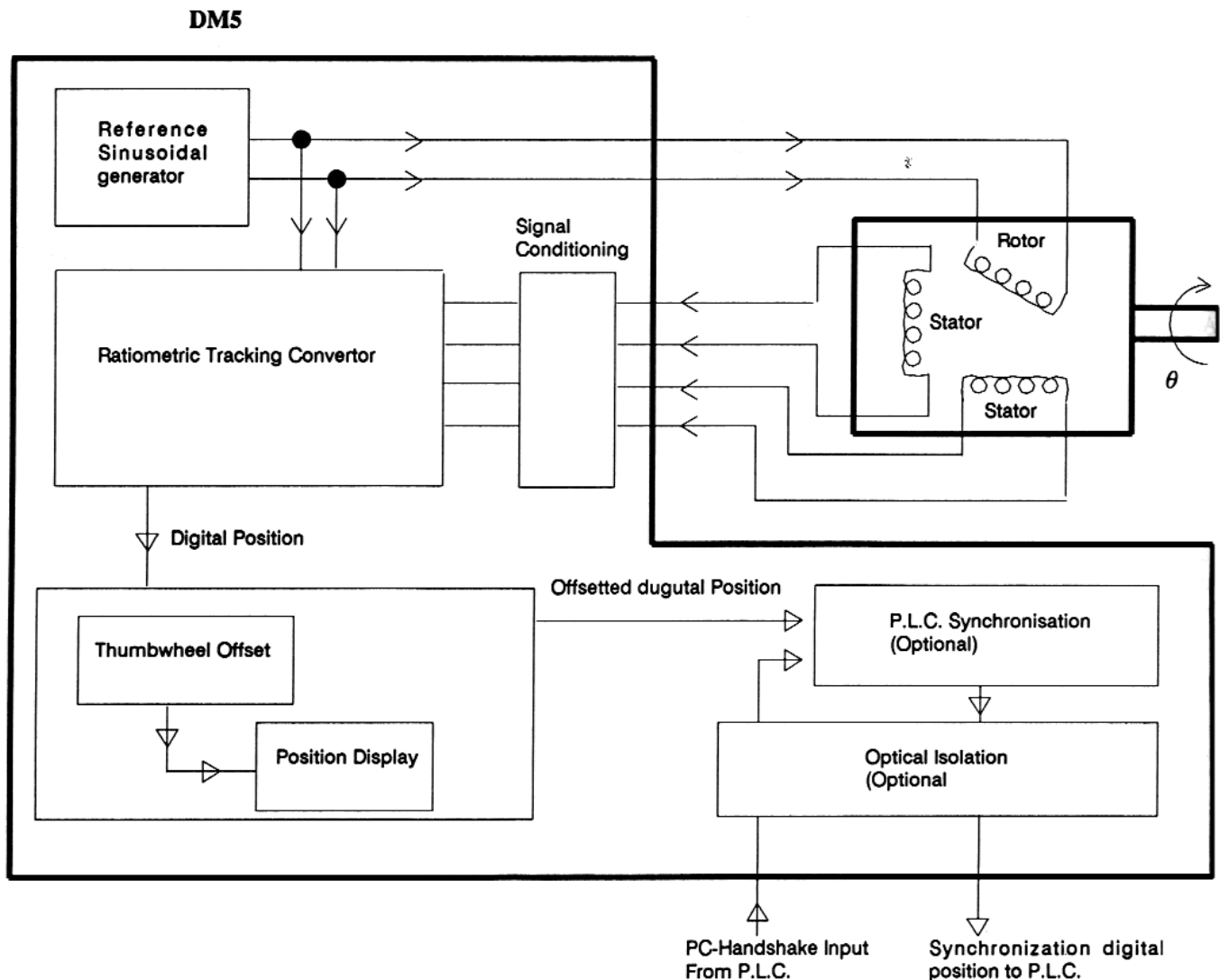
The DM5 series resolver decoders are available with resolutions ranging from 256 to 8192 counts-per-turn to match unlimited control needs. The high-performance ratiometric-tracking converter assures exacting performance at speeds up to 1800 rpm.

Highly Noise-immune Circuitry

The ratiometric tracking converter technique employed for resolver-to-digital (R/D) decoding provides the best protection against electrical noise generated by power line transients, radio frequency interference, and varying ground potentials. A ratiometric converter is practically immune to temperature variations and line frequency changes. Optional optical isolation adds another layer of protection and enhances system integrity.

Extremely Rugged and Reliable Resolver as Position Transducer

The DM5 series of resolver decoders combines the ruggedness of a resolver and reliability of an advanced solid-state control. The rugged heavy-duty NEMA 13 (IP54) resolver can be mounted on a machine shaft in any hostile industrial environment, such as mechanical shock, vibrations, extreme humidity and temperature changes, oil mists, coolants, solvents, etc.; and the resolver-to-digital decoder can be mounted up to 2500 ft (762 m) away in a control panel.



DM5 SPECIFICATIONS

Input Power:

AC: 105-135 VAC or 210-270 VAC, 50/60 Hz, 5 W
 DC: 8-30 VDC @ 0.25 A exclusive of load (without optical isolation, an external power supply is needed only for PNP outputs)

Operating Temperature: -10 °F to +130 °F (-23 °C to +55 °C)

Position Transducer: AVG Automation's RL100, E7R, E8R, or RL101 single-turn resolvers.

Output Format and Resolution:

BCD: 0360, 1000 or 3600 counts-per-turn
 Natural Binary: 1000, 1024, 3600, 4096, or 8192 counts-per-turn
 Gray code: 0256, 0360, 0512, 1000, 1024, 3600, 4096, or 8192 counts-per-turn

Maximum Cable Length between Resolver and DM5: 2500 ft, shielded

Resolver shaft speed: 3600 RPM (max.)

Resolver-to-digital decoder tracking speed: 1800 RPM

Display: 3- or 4-digits, 0.3" (7.62 mm) LEDs

Offset Capability: Programmable full scale

PLC Synch Circuit (optional):

Input Logic: 0 to 24 VDC logic

Logic False: 0 to 0.8 V @ 3.2 mA

Logic True: 2.4 V @ 0.4 mA, Positive- and negative-edge triggered.

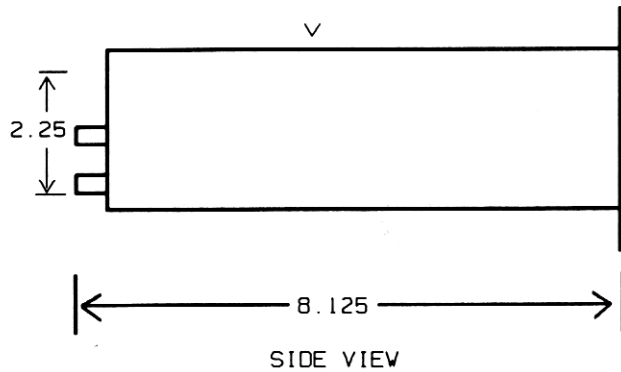
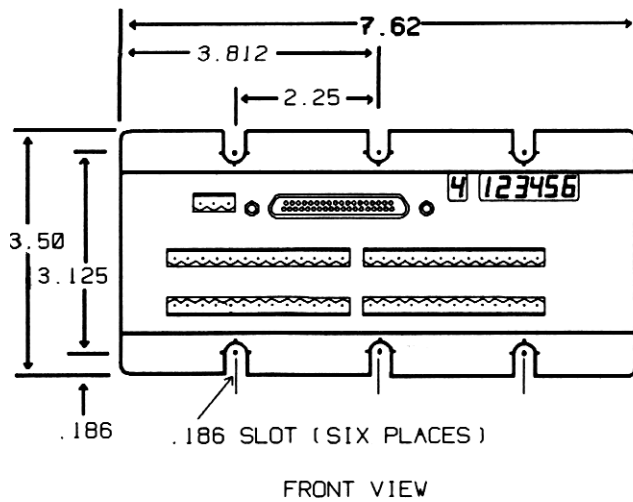
PC Handshake strobe: 30 µs minimum width

Data Latch Delay: Adjustable 200 µs to 30 ms. Factory set at 3 ms ±20%

Optical Isolation (optional): 2500 Volts, on all I/Os except resolver

Output Type	T:TTL * (74LS645)	P: PNP Source Transistor (Sprague UDN-2981A)	N: NPN Sink Transistor Low TRUE (Sprague ULN-2803A)	C: NPN Sink Transistor High TRUE (Sprague ULN-2803A)
Logic TRUE	2 VDC @ 15 mA 2.4 V @ 3 mA (20 µA leakage when Tristated)	Transistor ON 1.7 V drop @ 100 mA	Transistor ON 1.1 V @ 100 mA	Collector Open 0.1 mA leakage @ 50 VDC
Logic FALSE	0.35 V @ 24 mA (0.4 mA leakage when Tristated)	Transistor OFF 0.2 mA leakage @ 50 VDC	Collector Open 0.1 mA leakage @ 50 VDC	Transistor ON 1.1 V @ 100 mA

* Note: Multiplexing or Tristating Input = Low active TTL level (i.e., Logic TRUE: 0-0.8 V; Logic FALSE: 2 VDC)



DM7 PROGRAMMABLE RESOLVER DECODER

SINGLE-TURN, SINGLE-CHANNEL

The most versatile resolver-to-digital decoder

- ◆ Fully absolute position, no loss of position under any situation
- ◆ Incredibly small size; only 9 sq.in. panel space
- ◆ Full-scale programmable zero offset for easy set-up
- ◆ Programmable resolution; 20-4096 counts-per-turn
- ◆ Front panel selectable output formats: BCD, Binary, or Gray code
- ◆ Built-in PC sync circuit permits interface to any PLC
- ◆ Built-in digital tach and over-, under-speed switch
- ◆ Direction output and zero marker pulse
- ◆ Self-diagnostics with fault output
- ◆ Optically isolated outputs



- ◆ Highly noise immune ratiometric tracking converter
- ◆ Extremely rugged and reliable resolver as position transducer

THE DM7 DECODER

Principle of operation

The DM7 series resolver-to-digital decoder provides an absolute encoder system in conjunction with any one of AVG Automation's single-turn resolvers. As shown in the diagram on the next page, the resolver rotor winding is excited from a reference sinusoidal generator inside the DM7 unit. The analog output signals from the resolver stator windings, after signal conditioning in the buffer amplifiers, are decoded to digital format in the ratiometric-tracking converter. The zero-offset entered from the front panel keypad is continuously added to this digital value. The offset digital data is scaled, converted to the digital format as selected from the keypad and displayed on the front panel of the unit. The position information is also made available in a parallel format for external devices, such as PLC remote displays, etc.

Versatile

Programmable Full-Scale Offset for Easy Set-Up

The resolver can be mounted on the machine without any concern for mechanically aligning the resolver zero to the machine zero. Once the resolver is coupled to the machine

shaft, the only thing you have to do is to bring the machine to a known position, say home position, and set an offset number from the front panel keypad until the display reads zero position. This is especially useful during initial start up in that it reduces the set-up time. The offset can also be used to compensate for any machine wear.

Programmable Resolution: 20-4096 Counts-per-Turn

The programmable scale factor feature provides you the flexibility of selecting the resolution in the field. Now you do not have to worry about defining the resolution at the time of ordering the unit. The scale factor can be programmed from the front panel and can be any number between 19 and 4095 resulting in resolution of 20 to 4096 counts per turn. This feature allows you to scale the position to desired engineering units (inches, mm, etc.), if required.

Front-Panel-Selectable Output Formats: BCD, Binary, or Gray Code

The DM7 is an extremely versatile resolver to digital decoder. Now you do not have to define the output format at the time of ordering the unit. Depending upon your application, the output format such as BCD, Natural Binary, or Gray code can simply be selected from the front panel keypad. This means one unit for various applications.

Built-in PC synchronization

PC synchronization is built in as standard in DM7 resolver-to-digital decoder. Depending upon the application it can be selected from the front panel keypad to operate with or without PLC synch circuit. When selected to operate with PLC synch circuit, it provides an error-free method of interfacing BCD or binary position data from the decoder to any PLC in the market. Upon receipt of a data transfer command from the PLC the stable data is latched and made available to the PLC.

When selected to operate without PLC synch circuit (transparent or Microfreeze mode), the position data is continuously updated. At the data transfer command from a microcomputer, the data is latched for $100 \pm 10 \mu s$ to enable the microcomputer to read the information.

Self-Diagnostics with Fault Output

The DM7 is provided with an internal self-check circuit that continuously monitors if the microprocessor is not in reset, input 120 VAC power, DC power supplies, resolver cable, and output enable circuit. In case a fault occurs in any one of the above critical functions, the unit goes into fault mode and a transistor output changes state from ON to OFF. For failsafe operation, the fault output is ON for normal operation and turns OFF when a fault occurs. During the fault mode all outputs are disabled automatically.

Highly Noise Immune Circuitry

The ratiometric tracking converter technique employed for resolver-to-digital decoding provides the best protection against electrical noise generated by power line transients and varying ground potentials. This decoding method is inherently

immune to temperature changes and line frequency variations. The optical isolation adds an additional layer of protection against electrical noise and enhances the environmental integrity of the system.

Built-in Tachometer & Over/Under Speed Switch

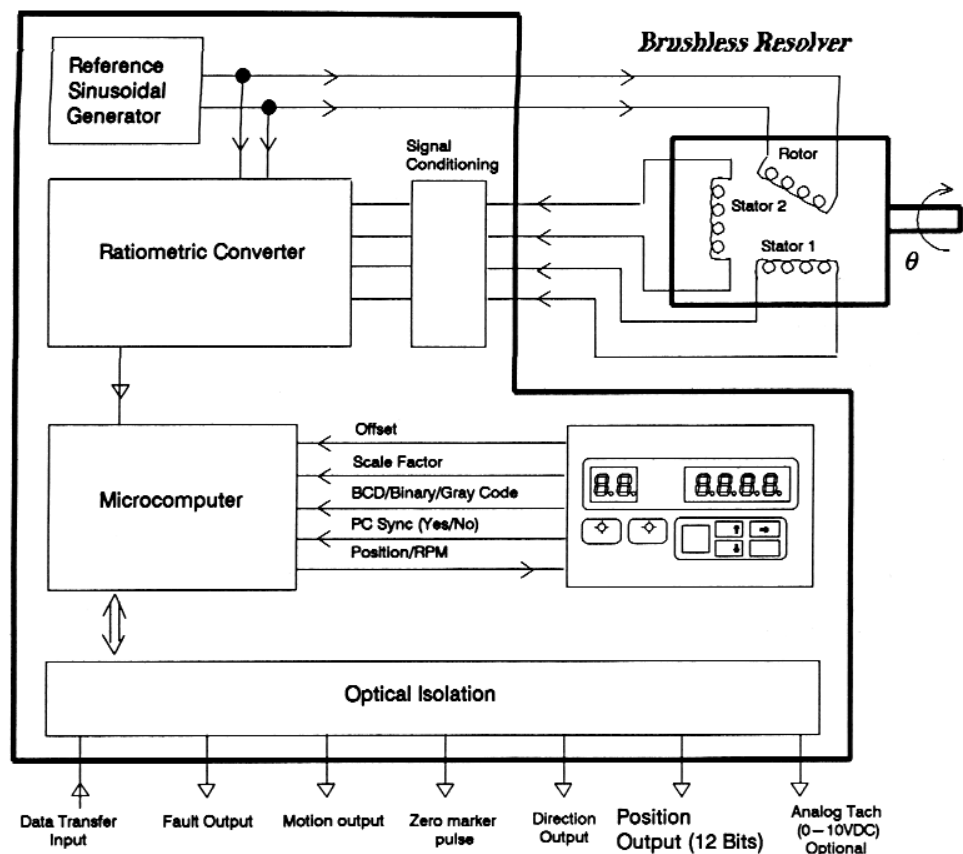
The shaft RPM is continuously displayed on the front panel. Two additional outputs, one over-speed and the other under-speed, are provided. The reference speed values are entered from the front panel.

Program Security

A supervisory input is needed to make any changes to the program to protect against unauthorized tampering.

Rugged and Reliable Resolver as Position Transducer

The DM7 series of resolver decoder combines the ruggedness of a resolver and reliability of an advanced solid-state control. The rugged, heavy-duty NEMA 13 IP54 resolver can be mounted on a machine in any hostile industrial environment such as mechanical shock vibrations, extreme humidity and temperature changes, oil mist, coolants, solvents, etc. And the resolver-to-digital decoder can be mounted up to 2500 feet away in a control panel.



DM7 SPECIFICATIONS

Input Power:

AC: 105 to 135 VAC, 7 VA; Optional 220, 240 VAC
 DC: 11 to 28 VDC, 100 mA (typical) exclusive of load

Operating Temperature: -10 °F to +130 °F (-23 °C to +55 °C)

Position Transducer: AVG Automation's series RL100, E7R, E8R, or RL101 resolvers

Signal Resolution: 4096 counts/turn

Scale Factor: 20 to 4096, programmable

Output Update rate: 200 μ s

Programmable Offset: Full revolution

Decimal Point: Programmable after any digit

Resolver Cable length: 2500 ft. (762 m) max., shielded

Outputs:

(All outputs have to be same type)

Type of Outputs:

Output Interface: T, P, N, or C

T: LS TTL (74LS645):

Logic TRUE: 2 VDC @ 15 mA, 20 mA leakage when tristated

Logic FALSE: 0.35 V @ 24 mA, 0.4 mA leakage when tristated

MUX Input: Low active TTL level

Logic TRUE: 0-0.8 V

Logic FALSE: 2-5 V

P: PNP source transistor:

Logic TRUE: Transistor ON, 1.7 V drop @ 100 mA

Logic FALSE: Transistor OFF, 0.2 mA leakage @ 50 V

N: NPN sink transistor:

Logic TRUE: Transistor ON, 1.1 V max. @ 100 mA

Logic FALSE: Transistor OFF, 0.1 mA leakage @ 50 V

C: NPN sink transistor:

Logic TRUE: Transistor OFF, 0.1 mA leakage @ 50 V

Logic FALSE: Transistor ON, 1.1 V max. @ 100 mA

Position Output Format: Front panel selectable BCD, Gray code, Binary

Motion Outputs: Two; Over-speed & Under-speed; active high

Direction Output: Logic TRUE for increasing position

Marker Pulse: Zero crossing pulse 200 μ s min. to 1.0 ms max.

Output Isolation: All outputs optically isolated up to 2500 Volts

Inputs:

Program Enable, Output Enable, and Data Transfer Logic of inputs determined by output option.

For P-type units:

Enable or TRUE: 11.0 to 28.0 VDC @ 13.5 mA max.

or tied to V_{s+}

Disable or FALSE: 2.0 VDC @ 0.2 mA max. or open circuit

For N-type units:

Enable or TRUE: 1.0 VDC @ -3.0 mA max. or tie to V_{s-}

Disable or FALSE: 3.8V DC to 28 VDC Max @ -0.2 mA max. or open circuit

Data Transfer Input:

0-24 VDC logic: Edge-triggered (i.e., data transfer on both rising and falling edges)

Low-Level: 0 to 0.8 V @ 3.2 mA

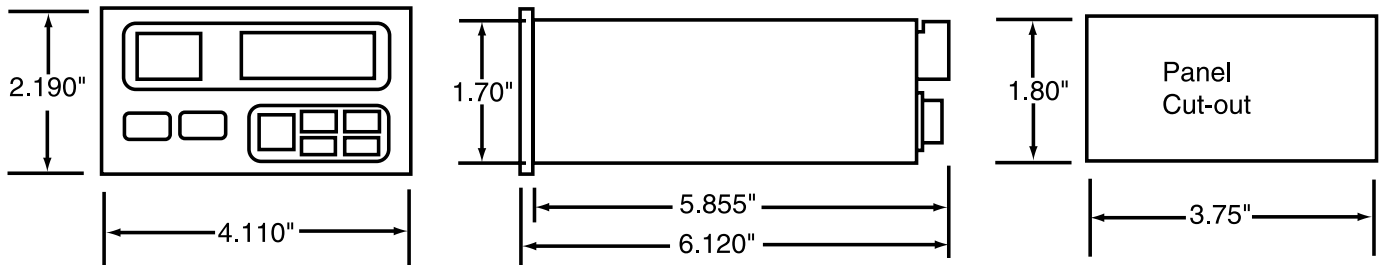
High-Level: 2.4 V @ 0.4 mA

Minimum pulse width: 30 μ s

Timing: Depends upon the PC sync option selected from keyboard:

PC Synchronization mode: Updates position output within 150 μ s of a transition edge (LOW-to-HIGH, or HIGH-to-LOW) at data transfer input.

Transparent Mode/Microfreeze: Output data is continuously updated at full speed. The data is latched for 100 μ s \pm 10% within 10 μ s of a transition (HIGH-to-LOW or LOW-to-HIGH) at data transfer input.



DM960 RESOLVER DECODER: MULTI-TURN, SINGLE-CHANNEL

- ◆ Resolver-based, multi-turn, absolute position. No loss of position under any situation
- ◆ Programmable full scale zero offset for easy set-up
- ◆ Variety of outputs, built-in PC-Handshake, permit interface to any PLC
- ◆ Multiplexing capability
- ◆ High resolution; Up to 17-bits over total travel
- ◆ Highly noise immune ratiometric tracking converter
- ◆ Extremely rugged and reliable resolver as a position transducer
- ◆ Optically isolated outputs



THE DM960

Principle of Operation

The DM960 resolver decoder provides an absolute multi-turn encoder in conjunction with AVG Automation's RL210 series multi-turn resolver, which has two resolvers: coarse and fine. The fine resolver is driven directly from the RL210 shaft, which in turn is directly coupled to the machine shaft. The coarse resolver is coupled to the main shaft through a 64:1 or 128:1 gear train. The gear train uses an antibacklash precision gear to assure full accuracy over the entire range. Thus the coarse resolver makes one revolution for 64 or 128 turns of the fine resolver. The coarse resolver counts the number of turns, while the fine resolver keeps track of the position in the last revolution and the two signals combined give absolute linear position over multiple revolutions. As shown in the diagram, the coarse and fine resolver rotor windings are excited from a common reference sinusoidal generator. The resolver analog output signals from the stator windings, after signal conditioning in the buffer amplifiers, are decoded to digital format in two independent Ratiometric Tracking Converters. The digital information from coarse (i.e., number of revolutions) and fine (i.e., position in the last revolution) resolvers is then superimposed in the coarse-fine alignment circuitry to determine the actual absolute position. The zero offset set by the front panel thumbwheels is continuously added to this value and the

resultant position is, displayed on the front panel display. The position information is also made available in a parallel format for external devices such as PLC's remote displays etc.

Programmable Full Scale Offset for Easy Set-Up

You can mount the resolver on the machine without any concern for mechanically matching the resolver zero to the machine zero. Once the resolver is coupled to the machine shaft, the only thing you have to do is to bring the machine to a known position, say home position, and set an offset number using the front panel thumbwheel switches until the display reads zero. Now the resolver zero is aligned with the machine zero. This is especially useful during initial start-up in that it reduces the set-up time. The offset can also be used to compensate for any wear on the machine.

Variety of Outputs, Built-In PC-Handshake Permit Interface to Any PLC

BCD, natural Binary, or Gray Code output formats are available with a choice of TTL, PNP (sourcing) transistor, or NPN (sinking) transistor outputs. Optional PLC synchronization circuit provides an error-free method of interfacing BCD position data from the decoder to any PLC in the market. Upon

receipt of a data transfer command from the PLC, the stable data is latched and made available to the PLC. The PC-Handshake, being an edge-triggered device, allows stable data to be read every scan by a PLC.

Multiplexing Capability

The TTL-type of outputs have multiplexing capability, which allows more than one decoder to be connected to the same control unit for multi-axis applications. For multiplexing PNP- or NPN-type outputs, consult the factory.

High-Resolution, Up to 17-bit Total

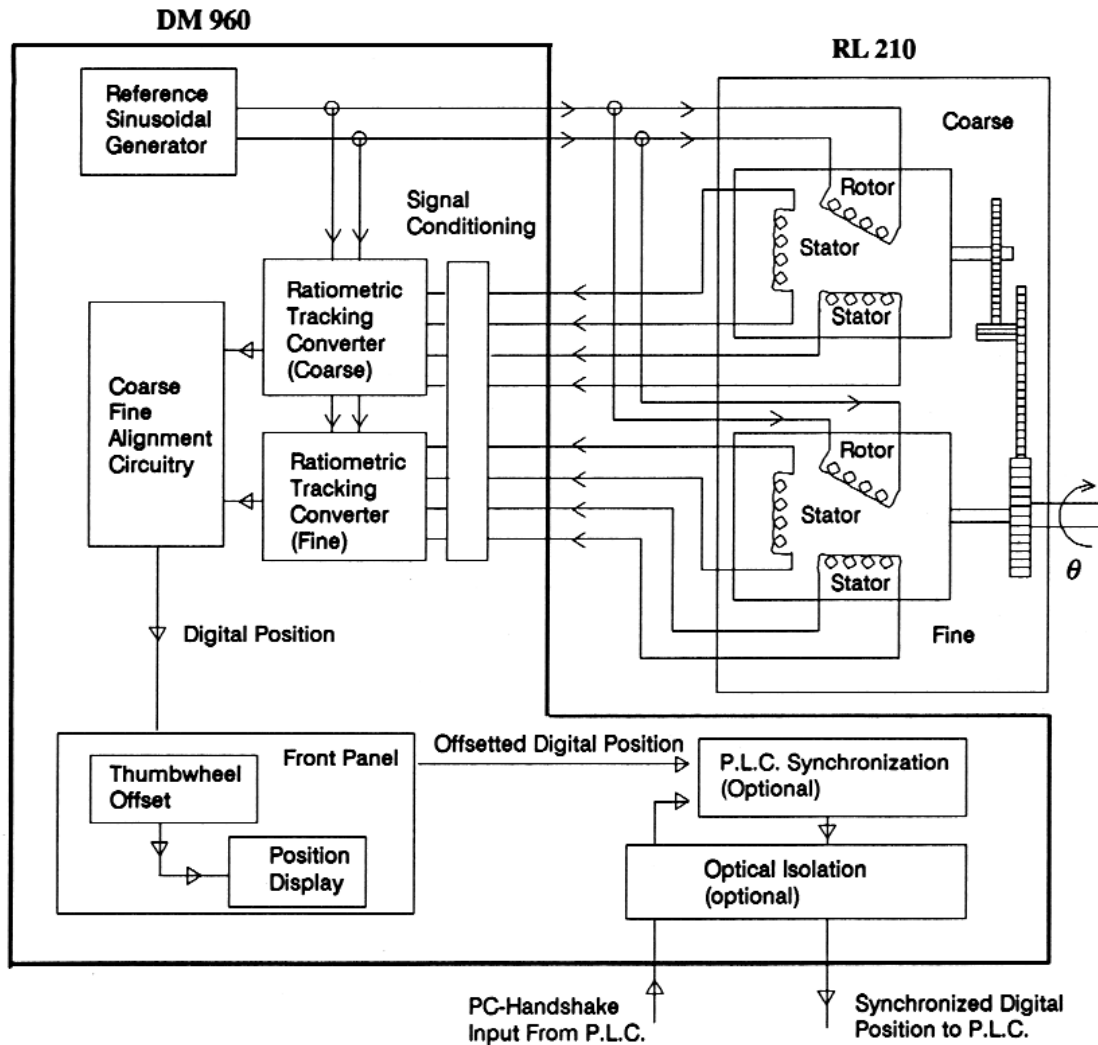
The DM960 is a multi-turn system with a resolution of 10-bits-per-turn over 64 or 128 turns. This means 17-bit resolution over total travel with 128-turn system or 16-bit resolution with 64-turn system. The high-speed ratiometric-tracking converter utilized in the DM960 decoder series permits operation at speeds up to 1800 rpm and still assures 1 part in 1000 per turn resolution.

Highly Noise Immune Circuitry

Ratiometric tracking converter technique employed for resolver-to-digital decoding provides the best protection against electrical noise generated by power line transients, radio frequency interference, and varying ground potentials. A ratiometric converter is practically immune to temperature variations and line frequency changes. Optional optical isolation adds another layer of protection and enhances system integrity.

Extremely Rugged and Reliable Resolver as Position Transducer

The DM960 resolver decoder combines the ruggedness of resolver and reliability of an advanced solid-state control. The rugged heavy-duty NEMA 13 (IP54) resolver can be mounted on a machine shaft in any hostile industrial environment, such as mechanical shock, vibrations, extreme humidity and temperature changes, oil mists, coolants, solvents, etc. And the resolver-to-digital decoder can be mounted up to 2500 ft (762 m) away in a control panel.



DM960 SPECIFICATIONS

Input Power:

AC: 105-135 VAC or 210-270 VAC, 50/60 Hz, 5 W
 DC: 8-30 VDC @ 0.25 A exclusive of load without optical isolation, an external power supply is needed only for PNP (sourcing) outputs

Operating Temperature:

-10 °F to 130 °F (-23 °C to 55 °C)

Position Transducer:

AVG Automation's RL210-G128 (128 Turns) or RL210-G064 (64 Turns)

Resolution: 10-bit-per-turn, 17-bits total over 128 turns

Output Format: BCD, Natural Binary, or Gray code

Maximum Cable Length between Resolver and DM960: 2500 ft (762 m) shielded

Resolver shaft speed: 3600 RPM (Max)

Resolver-to-digital decoder tracking speed: 1800 RPM

Display: 6-digit, 0.3" (7.62 mm) LEDs

Offset Capability: up to 128000 counts

PLC Synch Circuit (optional):

Input Logic: 0 to 24 VDC logic

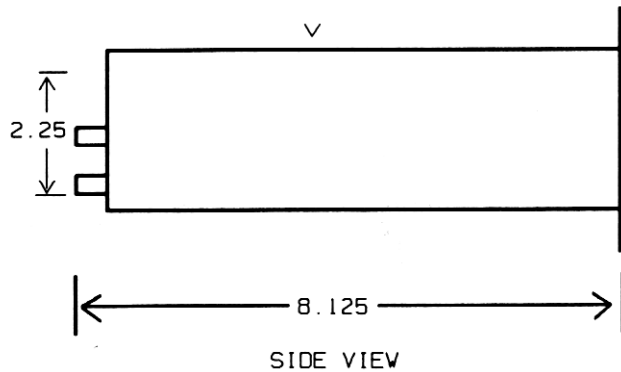
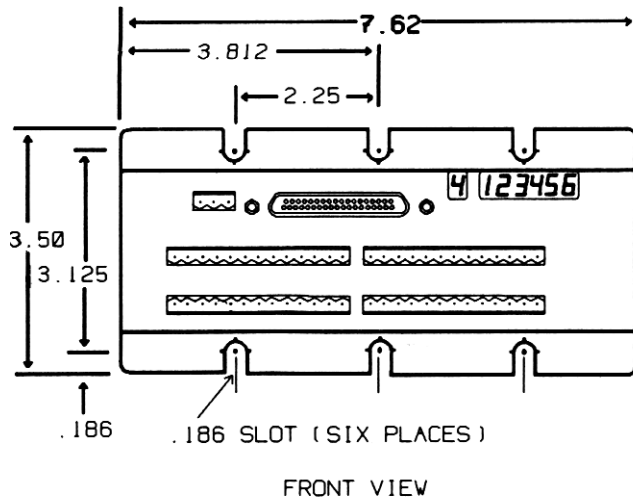
Logic False: 0 to 0.8 V @ 3.2 mA

Logic True: 2.4 V @ 0.4 mA; Positive- and negative-edge triggered.

PC Handshake strobe: 30-µs minimum width.

Data Latch Delay: Adjustable 200 µs to 30 ms. Factory set at 3 ms ±20%

Optical Isolation (optional): 2500 Volts, on all I/Os except resolver



DMM MULTI-AXIS MULTI-TURN RESOLVER DECODERS

THE DMM

Principle of Operation

The DMM decoders are available with either output or input multiplexing. The resolver analog signals are converted to the output digital format by a tracking resolver-to-digital converter. With input multiplexing, the analog signals are multiplexed to a single digital converter. In output multiplexing, multiple decoders are multiplexed to the parallel digital output port. The binary code at the input selects a particular resolver for output, as well as the gear ratio for the selected resolver. Output multiplexing allows for a fast response and is recommended for high-speed operations. In the input multiplexing versions, there is a 100 msec settling time after a change in resolver selection before the data is stable. The output multiplexing has only 15 μ s settling time.

Variety of Outputs, Built-in PC-Handshake permit Interface to any PLC

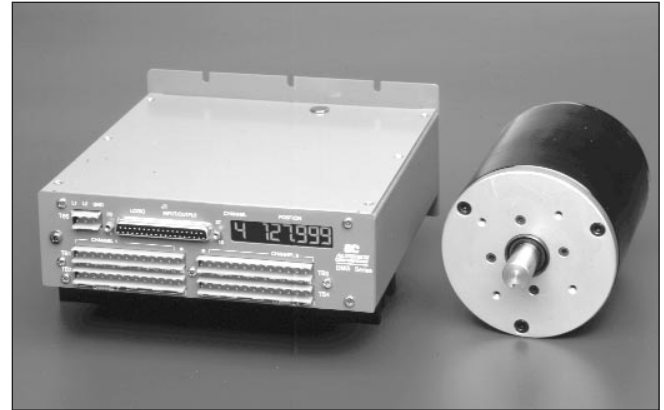
BCD, natural Binary, or Gray Code output formats are available with a choice of TTL, PNP (sourcing) transistor, or NPN (sinking) transistor outputs. Optional PLC synchronization circuit provides an error-free method of interfacing output position data from the decoder to any PLC. Upon receipt of a data transfer command from the PLC, the stable data is latched and made available to the PLC.

Multiplexing Capability

The TTL-type of outputs have multiplexing capability, which allows more than one decoder to be connected to the same control unit for multi-axis applications. For multiplexing PNP- or NPN-type outputs, consult the factory.

Up to 1024 Counts-per-Turn Resolution at 1800 RPM

The DMM series resolver decoders are available with resolutions of 1000 or 1024 counts-per-turn to match many control needs. The high-performance ratiometric-tracking converter assures exacting performance at speed up to 1800 rpm.



Selectable Resolver Gear Ratios

All DMM series resolver decoders are equipped with a standard, user-selectable resolver gear ratio feature. This allows resolvers with differing gear ratios to be connected to a single DMM, providing maximum machine application flexibility. Resolver gear ratios supported by the DMM include 16:1, 32:1, 64:1, and 128:1.

Highly Noise-Immune Circuitry

The ratiometric-tracking converter technique employed for resolver-to-digital decoding provides the best protection against electrical noise generated by power line transients, radio frequency interference, and varying ground potentials. The ratiometric converter is practically immune to temperature variations and line frequency changes.

Optional optical isolation adds another layer of protection and enhances system integrity.

Extremely Rugged and Reliable Resolver as Position Transducer

The DMM series of resolver decoders combines the ruggedness of a resolver and reliability of an advanced solid-state control. The rugged, heavy-duty NEMA 13 (IP54) resolver can be mounted on a machine shaft in any hostile industrial environment, such as mechanical shock, vibrations, extreme humidity and temperature changes, oil mists, coolants, solvents, etc. The DMM decoder can be mounted up to 2500 ft (762 m) from the resolver in a control panel.

DMM SPECIFICATIONS

Input Power:

AC: 105-135 V or 210-270 V, 50/60 Hz, 5 W
 DC: 8 -30 VDC @ 0.25 A, exclusive of load (without using optical isolation, an external power supply is needed only for PNP outputs)

Operating Temperature: -10 °F to +130 °F (-2 °C to +55 °C)

Position Transducer: AVG Automation's RL100, E7R, E8R, or RL101 single-turn resolvers.

Maximum Cable Length between Resolver and DMS: 2500 ft (762 m), shielded twisted-pair

Output Format and Resolution:

BCD: 360, 1000, or 3600 counts-per-turn
 Natural Binary: 1000, 1024, 3600 or 4096 counts-per-turn
 Gray code: 256, 360, 512, 1000, 1024, 3600, or 4096 counts-per-turn

Resolver shaft speed: 3600 RPM (max.)

Resolver-to-digital decoder tracking speed: 1800 RPM

Display: 3 or 4 digits, 0.25" (6.35 mm) LEDs

PLC Sync. Input: (option)

Positive-edge: (LOW to HIGH) and
 Negative-edge: (HIGH to LOW) triggered.
 (See Input Logic for Voltage and Current specification:)

PC-handshake strobe: 30 µs minimum width

Strobe Delay to Latch Data: 100 µs

Transparent Mode/Microfreeze (Standard):

Output data is continuously updated at full speed. The data is latched for $100 \pm 10 \mu s$ within $30 \mu s$ of a transition (HIGH to LOW or LOW to HIGH) at data transfer input.

Optical Isolation (Optional): 2500 Volts, on all I/Os except resolver

Input Logic (Channel Select, PLC Sync; Gear Select): 28 VDC Max:

P-type:

Logic FALSE: 0 to 0.8 V @ 4 mA;
 Logic TRUE: 2.4 V @ 3.2 mA

N-type:

Logic FALSE: 3.8 V @ 0.4 mA;
 Logic TRUE: 0 to 0.8 V @ 3.2 mA

C-type:

Logic FALSE: 0 to 0.8 V @ 3.2 mA;
 Logic TRUE: 3.8 V @ 0.4 mA

0 to 5 VDC Logic:

T-type:

Logic FALSE: 0 to 0.8 V @ 3.2mA;
 Logic TRUE: 2.4 V @ 0.4 mA

Channel Select Timing:

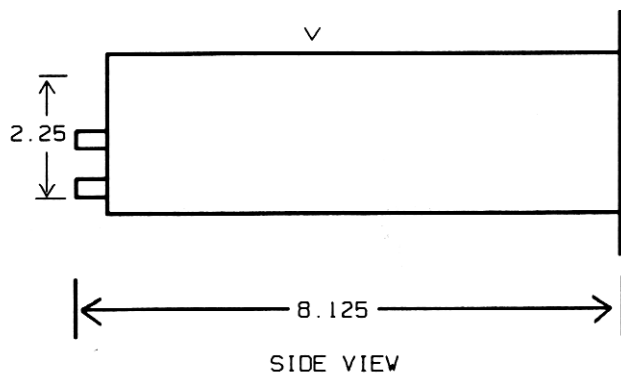
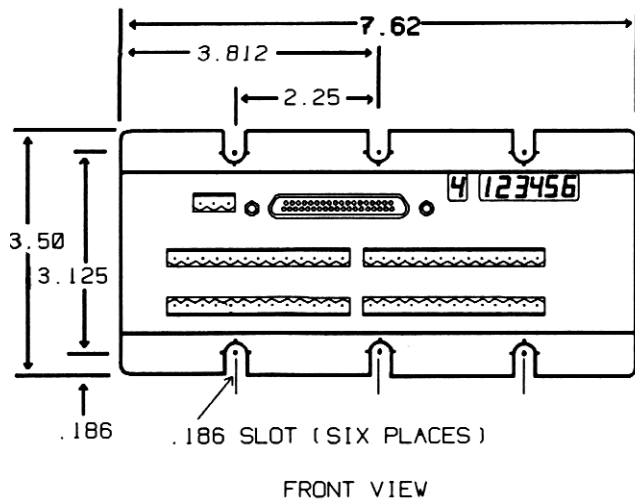
Input Multiplexing: 100 ms from channel select

Output Multiplexing: 15 µs from channel select

Gear Select Timing: 15 µs from gear ratio select input

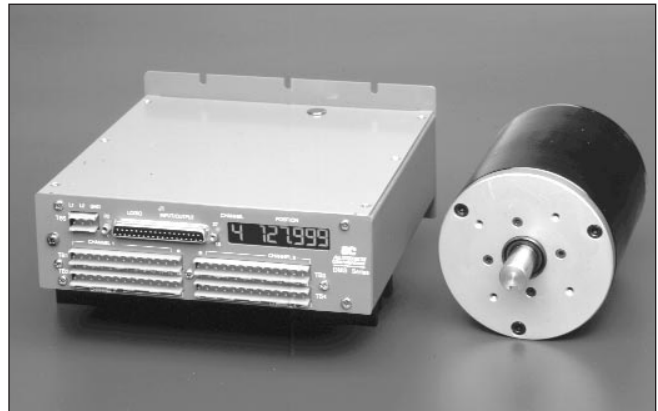
Output Type	T: TTL * (74LS645)	P: PNP Source Transistor (Sprague UDN-2981A)	N: NPN Sink Transistor Low TRUE (Sprague ULN-2803A)	C: NPN Sink Transistor High TRUE (Sprague ULN-2803A)
Logic TRUE	2 VDC @ 15 mA 2.4 V @ 3 mA (20 µA leakage when Tristated)	Transistor ON 1.7 V drop @ 100 mA	Transistor ON 1.1 V @ 100 mA	Collector Open 0.1 mA leakage @ 50 VDC
Logic FALSE	0.35 V @ 24 mA (0.4 mA leakage when Tristated)	Transistor OFF 0.2 mA leakage @ 50 VDC	Collector Open 0.1 mA leakage @ 50 VDC	Transistor ON 1.1 V @ 100 mA

* Note: Multiplexing or Tristating Input = Low active TTL level (i.e., Logic TRUE: 0-0.8 V; Logic FALSE: 2 VDC)



DMS MULTI-AXIS SINGLE-TURN RESOLVER DECODERS

- ◆ **Single-turn, Multiplexed, Absolute-position Resolver Decoder**
- ◆ **8-axis single-turn, accepts up to eight resolver inputs**
- ◆ **Reduce cost and save space by interfacing multiple axes to one computer or PLC card**
- ◆ **Optically isolated outputs available**
- ◆ **High-resolution: Up to 4096 counts/turn**
- ◆ **Position display for easy setup and troubleshooting**
- ◆ **Variety of outputs and PC-handshake allow-interface to any PLC or computer**
 - **Optional PLC synchronization**
 - **Optional Microfreeze for computer interface**
 - **BCD, Binary, or Gray Code output formats**
 - **TTL, PNP (sourcing), or NPN (sinking) transistor output drivers**



- ◆ **Fast: Operation to 1800 rpm**
- ◆ **Rugged and Reliable: The DMS series resolver decoders combine the ruggedness of a resolver and reliability of an advanced solid-state control**

THE DMS

The DMS decoders are available with either output or input multiplexing. The resolver analog signals are converted to the output digital format by a tracking resolver-to-digital converter. With input multiplexing, the analog signals are multiplexed to a single digital converter. In output multiplexing, multiple decoders are multiplexed to the parallel digital output port. The binary code at the input selects a particular resolver for output. Output multiplexing allows for a fast response and is recommended for high-speed operations. In the input multiplexing versions, there is a 100 ms settling time after a change in resolver selection before the data is stable. The output multiplexing has only 15 μ s settling time.

Variety of Outputs, Built-in PC-Handshake Permit Interface to Any PLC

BCD, natural Binary, or Gray Code output formats are available with a choice of TTL, PNP (sourcing) transistor, or NPN (sinking) transistor outputs. Optional PLC synchronization circuit provides an error-free method of interfacing output

position data from the decoder to any programmable controller. Upon receipt of a data transfer command from the PLC, the stable data is latched and made available to the PLC

Multiplexing Capability

The TTL type of outputs have multiplexing capability, which allows more than one decoder to be connected to the same control unit for multi-axis applications. For multiplexing PNP (sourcing)- or NPN (sinking)-type outputs, consult the factory.

Up to 4096 Counts-per-Turn Resolution at 1800 RPM

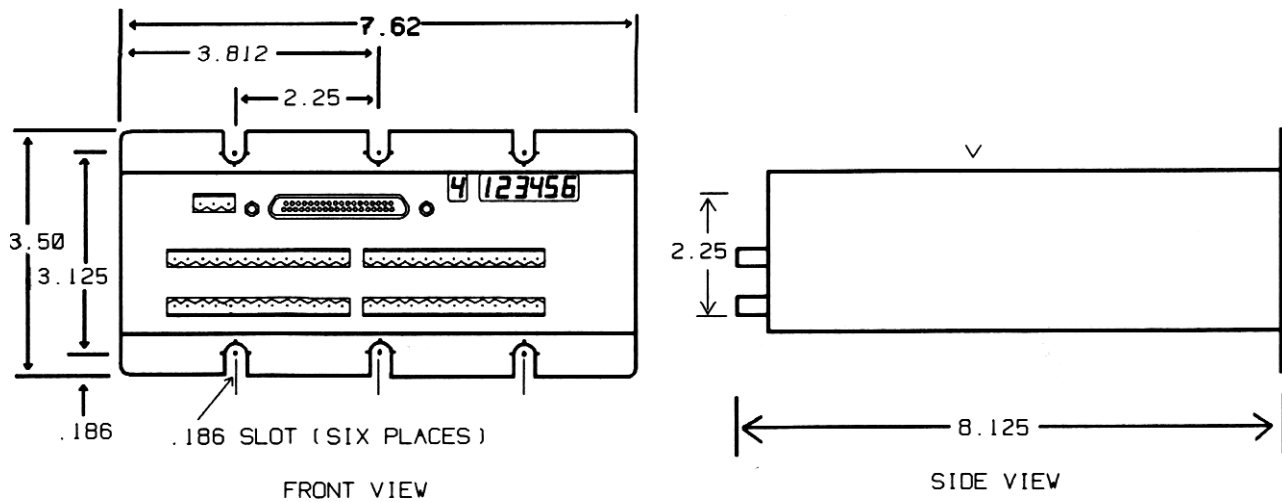
The DMS series resolver decoders are available with resolutions ranging from 256 to 4096 counts-per-turn to match unlimited control needs. The high-performance ratiometric-tracking converter assures exacting performance at speed up to 1800 rpm.

Highly Noise Immune Circuitry

The ratiometric tracking converter technique employed for resolver-to-digital decoding provides the best protection against electrical noise generated by power line transients, radio frequency interference, and varying ground potentials. The ratiometric converter is practically immune to temperature variations and line frequency changes. Optional optical isolation adds another layer of protection and enhances system integrity.

Extremely Rugged and Reliable Resolver As Position Transducer

The DMS series of resolver decoders combines the ruggedness of a resolver and reliability of an advanced solid-state control. The rugged heavy-duty NEMA 13 (IP54) resolver can be mounted on a machine shaft in any hostile industrial environment, such as mechanical shock, vibrations, extreme humidity and temperature changes, oil mists, coolants, solvents, etc. The DMS decoder can be mounted up to 2500 ft (762 m) from the resolver in a control panel.



DMS SPECIFICATIONS

Input Power:

AC: 105-135 V or 210-270 V, 50/60 Hz, 5 W
 DC: 8 -30 VDC @ 0.25 A, exclusive of load (without using optical isolation, an external power supply is needed only for PNP outputs)

Operating Temperature: -10 °F to +130 °F (-2 °C to +55 °C)

Position Transducer: AVG Automation's RL100, E7R, E8R, or RL101 single-turn resolvers.

Maximum Cable Length between Resolver and DMS: 2500 ft (762 m), shielded twisted-pair

Output Format and Resolution:

BCD: 360, 1000, or 3600 counts-per-turn
 Natural Binary: 1000, 1024, 3600 or 4096 counts-per-turn
 Gray code: 256, 360, 512, 1000, 1024, 3600, or 4096 counts-per-turn

Resolver shaft speed: 3600 RPM (max.)

Resolver-to-digital decoder tracking speed: 1800 RPM

Display: 3 or 4 digits, 0.25" (6.35 mm) LEDs

PLC Sync. Input: (option)

Positive-edge: (LOW to HIGH) and
Negative-edge: (HIGH to LOW) triggered.
 (See *Input Logic for Voltage and Current specification:*)

PC-handshake strobe: 30 µs minimum width

Strobe Delay to Latch Data: 100 µs

Transparent Mode/Microfreeze (Standard):

Output data is continuously updated at full speed. The data is latched for 100 ±10 µs within 30 µs of a transition (HIGH to LOW or LOW to HIGH) at data transfer input.

Optical Isolation (Optional): 2500 Volts, on all I/Os except resolver

Input Logic (Channel Select, PLC Sync):

28 VDC Max:

P-type:

Logic FALSE: 0 to 0.8 V @ 4 mA;

Logic TRUE: 2.4 V @ 3.2 mA

N-type:

Logic FALSE: 3.8 V @ 0.4 mA;

Logic TRUE: 0 to 0.8 V @ 3.2 mA

C-type:

Logic FALSE: 0 to 0.8 V @ 3.2 mA;

Logic TRUE: 3.8 V @ 0.4 mA

0 to 5 VDC Logic:

T-type:

Logic FALSE: 0 to 0.8 V @ 3.2mA;

Logic TRUE: 2.4 V @ 0.4 mA

Channel Select Timing:

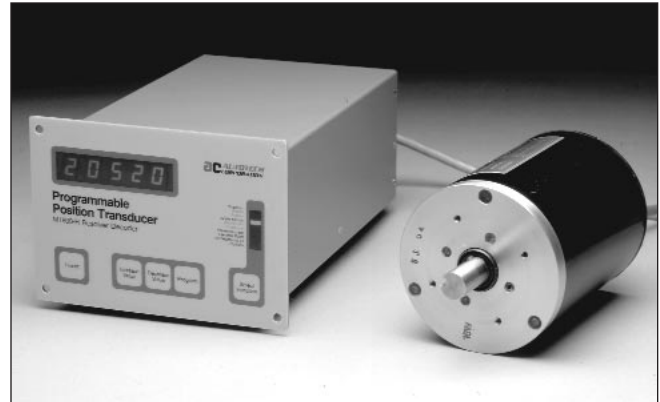
Input Multiplexing: 100 ms from channel select

Output Multiplexing: 15 µs from channel select

Output Type	T:TTL * (74LS645)	P: PNP Source Transistor (Sprague UDN-2981A)	N: NPN Sink Transistor Low TRUE (Sprague ULN-2803A)	C: NPN Sink Transistor High TRUE (Sprague ULN-2803A)
Logic TRUE	2 VDC @ 15 mA 2.4 V @ 3 mA (20 µA leakage when Tristated)	Transistor ON 1.7 V drop @ 100 mA	Transistor ON 1.1 V @ 100 mA	Collector Open 0.1 mA leakage @ 50 VDC
Logic FALSE	0.35 V @ 24 mA (0.4 mA leakage when Tristated)	Transistor OFF 0.2 mA leakage @ 50 VDC	Collector Open 0.1 mA leakage @ 50 VDC	Transistor ON 1.1 V @ 100 mA
* Note: Multiplexing or Tristating Input = Low active TTL level (i.e., Logic TRUE: 0-0.8 V; Logic FALSE: 2 VDC)				

M1890 PROGRAMMABLE POSITION TRANSDUCER AND PROGRAMMABLE SELSYN INDICATOR

- ◆ M1890-R Programmable absolute position sensor, resolver input, 5-digit BCD output
- ◆ M1890-S Solid-state replacement for electromechanical Selsyn systems
- ◆ Prescalable, presettable; yet absolute
- ◆ Simple front panel programming of counts-per-turn, no mechanical gear trains
- ◆ No batteries, nonvolatile EEROM memory
- ◆ PC handshake for PLC synchronization
- ◆ Reliable under extreme environments, splash-proof oil-tight front plate
- ◆ 1 Part in 100,000 resolution and repeatability



- ◆ Add limit settings externally
- ◆ Optional serial link to computers or remote displays

THE M1890-R

AVG Automation would like to introduce you to a unique position encoder, the Programmable Position Transducer or PPT. The PPT is an absolute position sensing device which accepts resolver inputs, converts position data to 5-digit BCD output, and is prescalable and presettable over a wide-range of electronic gear ratios. It operates in a single-or multi-turn mode with high-accuracy and can resolve linear distances of 1 part in 100,000 whether it be 0.001" (0.025 mm) over 100" (2540 mm) or 1 foot (304.8 mm) over 18.93 miles (30.46 km) of travel. The versatile electronic design assures simple interface to other limit setting or control devices.

The PPT consists of two parts, one is a position sensor mounted on the machine shaft and the other is a programmable unit mounted in the machine control panel. The position data from the sensor is converted to binary data by an internal ratiometric converter in the programmable unit, processed in the microprocessor together with other program variables and displayed on the front panel display. A parallel BCD output is also made available to provide information to other systems requiring positional data.

Prescalable, Presettable; Yet Absolute

A wide-range of easy to set programmable scale factors eliminates the need of mechanical gear trains and prescales the display to readout directly in engineering units. Any preset number can be jammed into the position "counter" by a front panel switch or an external signal, thus "offsetting" or "rezeroing" the machine in no time.

The PPT is unique in that it can be prescaled and preset and still is absolute over the entire-range in single-turn operation. In multi-turn applications it keeps track of the true position, if the resolver movement does not exceed half-a-revolution (<180°) after power loss.

Simple Front-Panel Programming

The PPT is fully front-panel programmable for all variables, and yet secure against any unauthorized program changes. Opening of an external user-provided keyswitch inhibits any program changes on the front panel.

No Batteries, Nonvolatile Memory

Nonvolatile EEROM memory retains information indefinitely after power loss or machine shutdown, eliminating batteries and related hazards.

Replacing Electromechanical Selsyn Systems

In new installations, the M1890-R together with AVG Automation's brushless resolver series RL100 is a 100% solid-state replacement for electromechanical Selsyn systems. In existing Selsyn installations, the model M1890-S can be used.

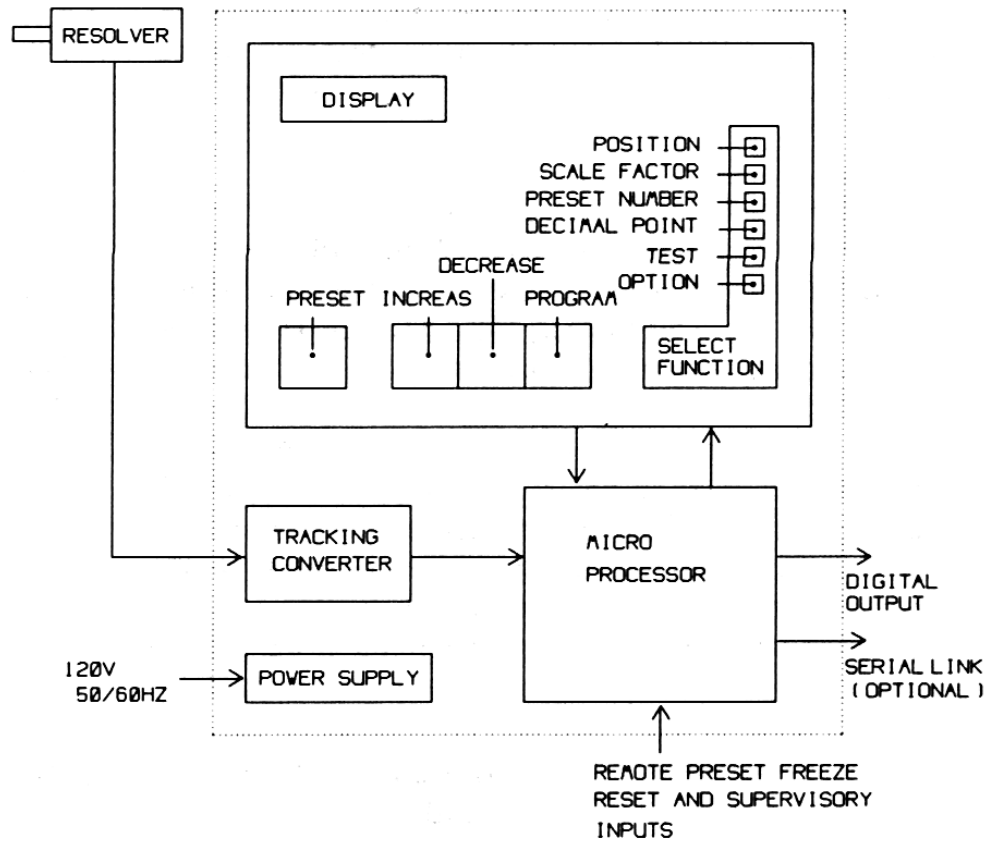
PC-Handshake for PLC Synchronization

On an external command, such as data transfer command from a PLC, the digital shaft-angle position can be "frozen" at the input of the PC in order to ensure that the data is not sampled during transition from one angle to the next, and that the PLC always reads a valid data.

Reliable Under Extreme Environments

The PPT combines the ruggedness of a brushless resolver and reliability of a solid-state control. The resolver can be mounted on a machine shaft in any hostile environments such as mechanical shock, vibrations, extreme humidity and temperature changes, oil mists, coolants, solvents, etc., and the programmable unit M1890 can be mounted up to 2500 ft (762 m) away in control panel. The splash-proof, oil-tight front plate of the M1890 unit guarantees perfect operation even in unfavorable conditions like steel mills. The ratiometric converter assures high-tracking speed (1800 RPM) and high-noise immunity. The power-interruption relay with 1 Form C contact can be used for remote indication, alarm or trip. The operation mode (single- or multi-turn) and resolution (8-, 10-, or 12-bit) can be selected from the front panel "Select Function Switch."

M1890-R block diagram



Add Limit Settings Externally

A parallel BCD output for AVG Automation's 1855 bus is provided, which permits setting of limits or trip points externally using 1855 series limit modules as shown in the accompanying diagram.

Options

The following optional features provide additional versatility to the unit:

- Serial link options (RS-232C, RS-422A or others) for remote display, remote command panel, or computer interface are available.
- Additional parallel port in either BCD, or BINARY, or GRAY Code format with choice of sourcing, sinking or the TTL-type outputs.

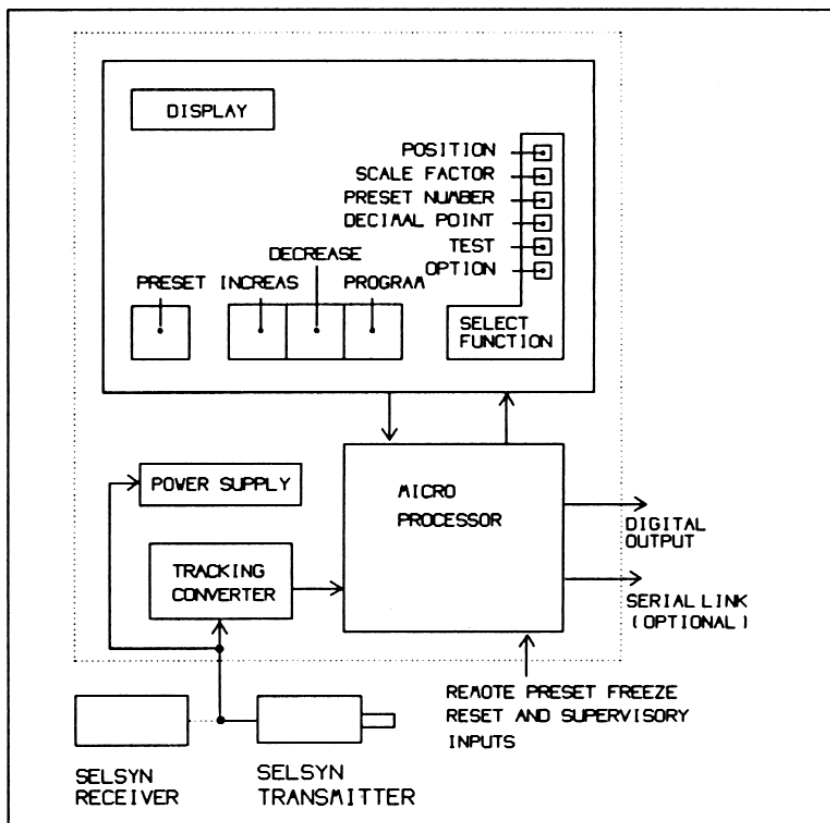
Remote Display, 1890-D

This unit connects to the master 1890-R/1890-S unit via RS-422A or RS-232C serial port to provide remote indications if needed.

The M1890-S

Replacing Electromechanical Selsyn Systems

AVG Automation's M1890-S Programmable Selsyn Indicator (PSI) is designed to replace electromechanical Selsyn torque receivers driving mechanical production meters. It is completely solid-state and fully compatible with existing Selsyn systems. It can be connected directly to Selsyn transmitter, differential pair, or in parallel with mechanical indicators without loading and needs no changes in the existing cables. The PSI derives its power from the Selsyn reference voltage. The position information from the Selsyn transmitter is converted to binary data by an internal ratiometric converter and processed in the microprocessor together with other program variables like scale factor, preset number, etc. The actual position is then displayed on the front panel 5-digit display and parallel BCD output is made available to provide information to other systems requiring positional data.



M1890-S Block diagram

All the features described for 1890-R are also available for 1890-S model.

M1890 SPECIFICATIONS

Input Power:

105-135 V; 50/60 Hz, 35 VA max.

Operating Temperature:

-10 °F to +130 °F (-23.3 °C to 54.4 °C)

INPUT SIGNAL:

M1890-R: Resolver Input

AVG Automation's RL100, E7R, E8R, or RL101 series

M1890-S: Selsyn Input

Signal: 3-wire, 148 kΩ impedance, 48-90 V, L-L

Reference: 2-wire, 105-135 V, 50/60 Hz, 35 VA max.

Tracking Speed: 1800 RPM max

Resolution: 8-, 10-, or 12-bits-per-revolution; 1 part in 100,000 total

PROGRAMMING:

Scale Factors: 0.001 to 65,535.999 in increments of 0.001

Preset Numbers:

Multi-turn: 0 to 99,999

Single-turn: 0 to (Scale factor-0.001)

Decimal Point: After any digit

Freeze, Preset, Reset, and Supervisory Inputs:

Contact closure to signal reference or 5 V logic

Logic TRUE: 0-1 VDC (4.7 kΩ internal pull-up resistors)

Logic FALSE: 4-5 VDC

Power Interruption and Watch-dog Relay:

1 Form C contact, 120 VAC, 1 A

PARALLEL POSITION OUTPUTS:

a) 1855 Parallel Bus (Standard):

Compatible with AVG Automation's 1855 bus; 5-digit BCD; 5 V CMOS logic; Fan out of 1 driving LS TTL load; High Logic TRUE

Logic TRUE: 2.4 V @ 1.6 mA PNP (sourcing) current

Logic FALSE: 0.4 V @ 1.6 mA NPN (sinking) current

Output Supply Current:

100 mA @ 5 VDC for logic

750 mA @ 12 VDC for limit outputs

Data Update Rate: 4 ms; Data on 1855 Bus is frozen when freeze input goes TRUE (30 ms).

Maximum distance between M1890 and 1855 limit modules:

3 ft (914.4 mm) ribbon (isolated from other wiring) and 100 ft (30.48 m) shielded cable (with CBL-E34MF)

b) Additional Parallel Output (Optional):

Output Format: BCD, Binary, or Gray Code

Output Interface: T, P, N, or C

T: LS TTL (74LS645):

Logic TRUE: 2 VDC @ 15 mA, 20 mA leakage when tristated;

Logic FALSE: 0.35 V @ 24 mA, 0.4 mA leakage when tristated

MUX Input: Low-active TTL-level (i.e., Logic TRUE: 0-0.8 V max; Logic FALSE: 2-5V)

P: PNP source transistor:

Logic TRUE: Transistor ON, 1.7 V drop @ 100 mA

Logic FALSE: Transistor OFF, 0.2 mA leakage @ 50 V max.

N: NPN (sinking) transistor:

Logic TRUE: Transistor ON, 1.1 V max @ 100 Ma

Logic FALSE: Transistor OFF, 0.1 mA leakage @ 50 V max.

C: NPN sink transistor:

Logic TRUE: Transistor OFF, 0.1 mA leakage @ 50V

Logic FALSE: Transistor ON, 1.1 V max. @ 100 mA

Data Update Rate: 4 ms

Data Transfer Signal:

Logic HIGH: 4 to 5 V

Logic LOW: 0 to 1 V (edge-triggered)

Transmission Distance: 50 feet (max.)

c) Serial Output (Optional):

Output-types: RS-232C or RS-422A

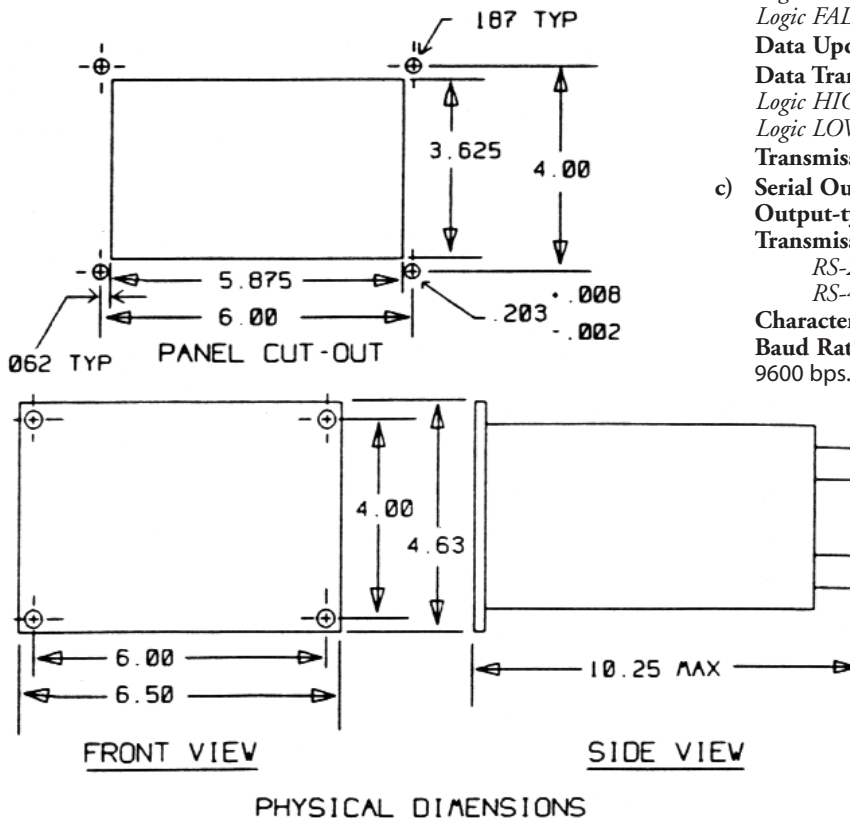
Transmission Distance:

RS-232C: 50 ft (15.24 m) max.

RS-422A: 2000 ft (609.6 m) max., with shielded cable.

Character Protocol: User-Definable

Baud Rate: Field-selectable 300, 600, 1200, 2400, 4800, and 9600 bps.



M1150-M10 PROGRAMMABLE RESOLVER DECODER MULTI-TURN WITH LIMITS

- ◆ Programmable semiabsolute position encoder, resolver input, 6-digit BCD output
- ◆ Built-in two PLS outputs
- ◆ Motion output
- ◆ Solid-state replacement for electromechanical Selsyn systems
- ◆ Prescalable, presettable
- ◆ Simple, front panel programming of counts-per-turn, no mechanical gear trains
- ◆ No batteries, nonvolatile EEROM memory
- ◆ PC-handshake for PLC synchronization
- ◆ 1 part in 1,000,000 resolution and repeatability
- ◆ Extremely small $\frac{1}{8}$ - DIN package, reliable under extreme environments, splash-proof oil-tight front plate



- ◆ System security to prevent against program tampering
- ◆ Optically isolated outputs-provide high-system-integrity under noise conditions
- ◆ Self-diagnostics
- ◆ Tachometer

M1150-M10

The M1150-M10 is a multi-turn programmable decoder. It takes the input from a single turn resolver like AVG Automation's series RL100, which is mounted on the shaft of the rotating machinery. The M1150-M10 decodes the resolver signals using highly noise immune ratiometric decoding technique, scales the digital data based on the programmed Scale Factor and displays it on the front panel. The position information is also made available to the output port in BCD format for connecting to a remote display or a PLC. The position information is continuously compared to two programmable preset limits and the outputs are activated when limit conditions are satisfied. All outputs of the M1150-M10 are optically isolated and the resolver inputs are differential, insuring extremely reliable operation of the unit even in the harshest of industrial conditions.

The M1150-M10 will decode the shaft angle to $\frac{1}{4096}$ th of a revolution (12-bits) and keep track of multiple revolutions. The decoder also features tachometer and motion detector, fractional scaling, preprogrammed preset value with an external trigger, two channels of PLS outputs, full decimal point control, and PLC synchronization/handshaking for the BCD outputs.

Prescalable, Presettable; Yet Absolute

A wide-range of easy-to-set programmable Scale Factors (0.3-4095.999) eliminates the need of mechanical gear trains and prescales the display to readout directly in engineering units. Any preset number can be jammed into the position "counter" by an external signal, thus "offsetting" or "rezeroing" the machine in no time.

The M1150-M10 is unique in that it can be prescaled and preset and still is absolute over the entire range in single-turn operation. In multi-turn applications it keeps track of the TRUE position, if the resolver movement does not exceed half a revolution after power loss.

Simple, Front Panel Programming

The M1150-M10 is fully front panel programmable for all variables, yet secure against any unauthorized program changes. Opening of an external user-provided keyswitch inhibits any program changes on the front panel.

No Batteries, Nonvolatile Memory

Nonvolatile EEROM memory retains information indefinitely after power loss or machine shutdown, eliminating batteries and related hazards.

Replacing Electromechanical Selsyn Systems

In new installations, the M1150-M10, together with AVG Automation's brushless resolver series RL100, is a 100% solid-state replacement for electromechanical Selsyn systems.

PC-Handshake for PLC Synchronization

On an external command, such as data transfer command from a PLC, the digital shaft angle position can be "frozen" at the input of the PLC. This ensures that the data are not sampled during transition from one angle to the next, and that the PLC always reads valid data. The unit may be set-up in transparent mode using keyboard commands.

Reliable Under Extreme Environments

The M1150-M10 combines the ruggedness of a brushless resolver and reliability of a solid-state control. The resolver can be mounted on a machine shaft in any hostile environments such as mechanical shock, vibrations, extreme humidity and temperature changes, oil mists, coolants, solvents, etc. And the programmable unit, M1150-M10, can be mounted up to 2500 ft (762 m) away in control panel. The splash-proof oil-tight front plate of the M1150-M10 unit guarantees perfect operation even in unfavorable conditions like steel mills. The ratiometric converter assures high tracking speed (700 RPM) and high noise immunity.

Built-in Tachometer and Motion Detector

The shaft RPM is displayed continuously on the front panel. The motion detector output is energized when the shaft is rotating within programmed motion limits.

M1150-M10 SPECIFICATIONS

Input Power:

AC: 120 VAC ±10%, 7 VA; Optional 220, 240 VAC
 DC: 11-28 VDC, 100 mA (typical) exclusive of load

Operating Temperature: -10 °F to 130 °F (-23 °C to 55 °C)

Position Transducer: AVG Automation's series RL100, E6R, E7R, E8R, or RL101 resolvers

Signal Resolution: 4096 counts/turn

Scale Factor: 0.300-4095.999, programmable

Output Update rate: 1.4 ms

Preset: 6 digits

Decimal Point: Fully Programmable

Resolver Cable length: 2500 ft. (762 m) max., shielded

OUTPUTS: (All outputs have to be same type)

Type of Outputs: T, P, N, or C

T: LS TTL (74LS645):

Logic TRUE: 2 VDC @ 15 mA, 20 mA leakage, when tristated

Logic FALSE: 0.35 V @ 24 mA, 0.4 mA leakage, when tristated

MUX Input: Low active TTL level

Logic TRUE: 0-0.8 V

Logic FALSE: 2-5 V

P: PNP (sourcing) transistor:

Logic TRUE: Transistor ON, 1.7 V drop @ 100 mA

Logic FALSE: Transistor OFF, 0.2 mA leakage @ 50

N: NPN (sinking) transistor:

Logic TRUE: Transistor ON, 1.1 V max. @ 100 mA

Logic FALSE: Transistor OFF, 0.1 mA leakage @ 50 V

C: NPN (sinking) transistor:

Logic TRUE: Transistor OFF, 0.1 mA leakage @ 50 V

Logic FALSE: Transistor ON, 1.1 V max. @ 100 mA

Output Format: BCD

Motion Outputs: Logic TRUE when shaft within programmed limits

Output Isolation: All outputs optically isolated up to 2500 V

INPUTS:

Program Enable Input, Preset Input, Output Enable Input

N, C, T:

Enable: 0.8 V max. @ 5 mA

Disable: 4-28 VDC

P:

Enable: 11 to 28 VDC max. @ 13.5 mA max.

Disable: 2 V or open-circuit

Data Transfer Input: 0 to 28 VDC logic; Edge triggered (i.e., data transfer on both rising and falling edges)

Low Level: 0 to 0.8 V @ 3.2 mA

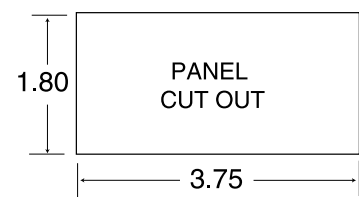
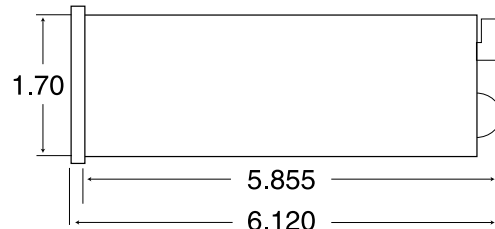
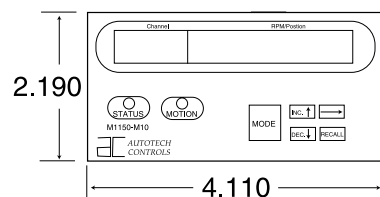
High Level: 2.4 V @ 0.4 mA

Minimum pulse width: 30 μs

Timing: Depends upon the PC sync option selected from keyboard

PC Synchronization mode: Updates position output within 150 μs of a transition edge (LOW-to-HIGH, or HIGH-to-LOW) at data transfer input.

Transparent Mode/Microfreeze: Output data are continuously updated at full speed. The data are latched for 100 μs ±10% within 10 μs of a transition (HIGH-to-LOW or LOW-to-HIGH) at data transfer input.



M1151-M10A PROGRAMMABLE RESOLVER DECODER

MULTI-TURN PROGRAMMABLE RESOLVER DECODER WITH LIMITS

- ◆ Fully absolute position; no loss of position under power loss
- ◆ Multi-turn (dual) resolver as position sensor
- ◆ Programmable gear ratio (8, 16, 32, 64, 128, or 256:1 gear ratio)
- ◆ Fail-safe broken resolver cable fault output
- ◆ Ideal for shut-height indication on process
- ◆ Very-easy-to-calibrate—no calculations required
- ◆ Fail-safe upper- and lower-safety-limit outputs
- ◆ Three PLS outputs
- ◆ Two Safety Limit outputs
- ◆ Motion output



THE M1151-M10A

The M1151-M10A is a multi-turn programmable decoder. It takes the input from multi-turn resolver like AVG Automation's series RL210, which is mounted on the shaft of the rotating machinery. The M1151-M10A decodes the resolver signals using highly noise-immune ratiometric-decoding; scales the digital data, based on the programmed scale factor; and displays it on the front panel.

The position information is also made available to the output port in BCD format for connecting to a remote display or a PLC. In each of the three PLS channels, the position information is continuously compared to programmable ON and OFF limits called "setpoints". The outputs are activated when limit-conditions are satisfied. All outputs of the M1151-M10A are optically isolated and the resolver inputs are differential, insuring extremely reliable operation of the unit even in the harshest of industrial conditions.

The M1151-M10A will decode the shaft angle to 1/4096th of a revolution (12-bit resolution) and turns up to gear ratio. The decoder also features motion detection, three channels of PLS outputs, two safety limit outputs, and PLC synchronization/handshaking for the BCD outputs, upper- and lower-safety-limit to outputs.

Simple Front-Panel Programming

The M1151-M10A is fully front-panel programmable for all variables and yet secure against any unauthorized program changes. Opening of an external user-provided keyswitch inhibits any program changes on the front panel.

No Batteries, Nonvolatile Memory

Nonvolatile EEROM memory retains information indefinitely after power loss or machine shutdown, eliminating batteries and related hazards.

Replacing Electromechanical Selsyn Systems

In new installations, the M1151-M10A together with AVG Automation's brushless resolver series RL210 is a 100% solid-state replacement for electromechanical Selsyn systems.

PC-Handshake for PLC Synchronization

On an external data transfer command from a PLC, the digital shaft angle position can be "frozen" at the input of the PLC in order to ensure that the data is not sampled during transition from one angle to the next and that the PLC always reads valid data.

Reliable Under Extreme Environments

The M1151-M10A combines the ruggedness of a brushless resolver and reliability of a solid-state control. The resolver can be mounted on a machine shaft in any hostile environment, such as mechanical shock, vibration, extreme humidity and temperature changes, oil mists, coolants, solvents, etc., and the programmable unit M1151-M10A can be mounted up to 2500 ft (762 m) away in a control panel. The ratiometric converter assures high-tracking-speed and high-noise-immunity.

Self-Diagnostics with Healthy Output

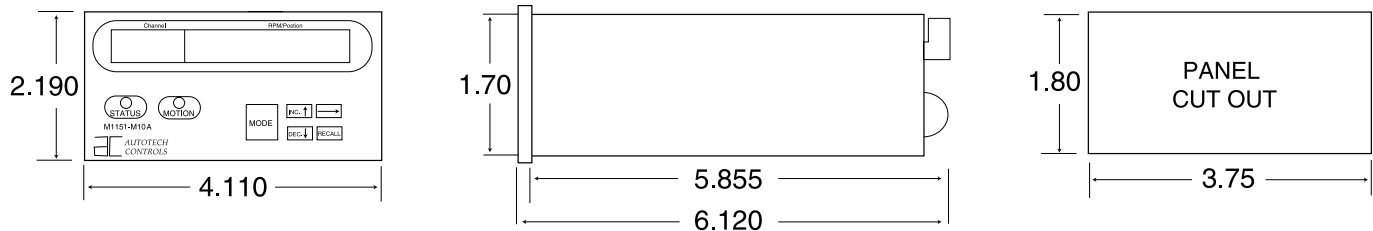
The M1151-M10A is provided with an internal self-check circuit that continuously monitors if the microprocessor is not in reset, input 120 VAC power, DC power supplies, resolver cable, and output-enable circuit. In case a fault occurs in any one of the above critical functions, the unit goes into fault mode and a transistor output changes state from ON to OFF. For fail-safe operation, the healthy output is ON for normal operation and OFF when a fault occurs.

Built-in Motion Detector

Motion detector output is energized when the shaft is rotating in excess of 5 RPM.

Ideal Solution for Shut Height Indication

The M1151-M10A, along with a dual-resolver, provides an ideal solution for shut-height indication. Because of absolute nature of the resolver, the position is retained even during power loss.



M1151-M10A SPECIFICATIONS

Input Power:

AC: 120 VAC \pm 10%, 7 VA: Optional 220, 240 VAC
DC: 11-28 VDC, 100 mA (typical) exclusive of load, for outputs and control input

Operating Temperature: -10 °F to +130 °F (-23 °C to +55 °C)

Position Transducer: AVG Automation's dual-resolver series, such as RL210.

Max. Resolution: 4096 counts/turn

Scale Factor: automatic

Output Update Rate: 1.4 ms

Display Range: 6 digits (000.000 to 999.999)

Decimal Point: fixed

Position Sensor: Multi-turn (dual) resolver with gear ratio 4, 8, 16, 32, 64, 128, or 256:1, such as AVG Automation's RL210

Resolver Cable Length: 2500 ft. (762 m) max., shielded

OUTPUTS:

All outputs must be the same type; control inputs depend upon the type of outputs

Type of Outputs: P & N

P: PNP (sourcing) transistor:

Logic TRUE: Transistor ON, 1.7 V drop @ 100 mA
Logic FALSE: Transistor OFF, 0.2 mA leakage @ 50 V

N: NPN (sinking) transistor:

Logic TRUE: Transistor ON, 1.1 V, max. @ 100 mA
Logic FALSE: Transistor OFF, 0.1 mA leakage @ 50 V

Position Output Format: BCD

PLS Outputs: 3 channels, 1 setpoint pair per channel

Motion Outputs:

Logic TRUE: When shaft exceeds 5 RPM

Output Isolation: All outputs optically isolated up to 2500 V

Upper- and Lower-Safety-Limits Output:

TRUE: When press ram is positioned within the safe range (between the programmed upper- and lower-safety-limits)

FALSE: When the press ram is positioned above or below the programmed upper- or lower-safety-limits

Control Inputs:

Program Enable, Data Transfer, Output Enable Inputs

ELECTRICAL SPECIFICATIONS:

For units with P-Type output:

TRUE: 10-28 VDC max. @ 13.5 mA max.

FALSE: <2 V or open circuit

For units with N-Type output:

TRUE: <2 V @ 13.5 max.; or contact closure to DC common

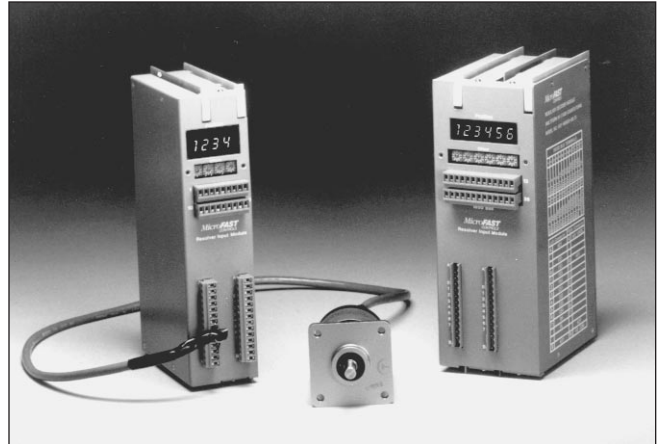
FALSE: 10-28 VDC or open circuit

Data Transfer Input: Edge-triggered (*i.e., data transfer on both rising- and falling-edges*) Minimum 500 μ s pulse-width output updates within 5 ms of transition (<1 ms, typ.)

M8000 RESOLVER DECODER INPUT MODULES

Allen-Bradley 1771 Rack Compatible

- ◆ Fully absolute position; No loss of position under any situation
- ◆ Choice of 360, 1,000, or 3,600 counts-per-turn for single-turn models
- ◆ Choice of 16-bit or 17-bit resolution for multi-turn models
- ◆ Built-in offset for quick set-up
- ◆ Bright LED position display
- ◆ BCD position output for external devices
- ◆ Highly noise immune ratiometric decoder, ensures optimum performance under noisy conditions



- ◆ Rugged resolver as input device, can be mounted 2,500 ft (762 m) away

THE SERIES 8000 MODULES

The series 8000 Single-Turn and Multi-turn (dual) Resolver Decoder Input Modules use state-of-the-art CMOS circuits to provide high-noise-immunity and low-backplane-current requirement. These modules are used to decode resolver signals and provide decoded digital position information to an Allen-Bradley PLC*.

Single and Multi-Turn

The single-turn module decodes resolver signals into 3 or 4-digit BCD rotary position and the multi-turn module provides 6-digit BCD linear position. All models feature digital static-offset thumbwheels to facilitate aligning resolver zero during machine set-up. In addition, these modules have a bright-LED display, a built-in BCD remote display driver bus for each digit (compatible with AVG Automation 1855D remote display).

Allen-Bradley-Compatible

The Resolver Decoder Input Modules are fully Allen-Bradley-compatible and plug directly into any A-B 1771 I/O rack. The single-turn modules use single-turn resolvers such as the AVG Automation RL100, RL101, E7R, or E8R.

The multi-turn modules use multi-turn (dual) resolvers such as the AVG Automation SAC-RL210. The single-turn 3 and 4-digit input modules occupy two I/O slots (1 word) and the multi-turn 6-digit input modules occupy three I/O slots (1½ words).

Fully Absolute Rugged Encoder

Series 8000 resolver decoder, in conjunction with AVG Automation's resolvers, provides a fully absolute encoder. Even if a machine moves during power outage the resolver always knows its true position when the power is restored. The NEMA 13 resolver can withstand hostile environment such as mechanical shock, vibration, extreme humidity & temperature changes, oil mists, coolants, solvents, and can be mounted 2,500 ft (762 m) away from the decoder. The ratio-metric converter assures high tracking speed of 1,800 RPM and very-high noise-immunity.

Variety of Models

A variety of resolver decoder input models are available to meet the requirements of different application needs.

Single-Turn Models:

ASY-M8000-D360: 3-digit with resolution of 360 counts/turn of resolver shaft

ASY-M8000-D360T: 3-digit with resolution of 360 BCD counts-per-turn of resolver shaft with built-in tach

ASY-M8000-D1000: 3-digit with resolution of 1000 counts/turn of resolver shaft

ASY-M8000-D3600: 4-digit with resolution of 3600 counts/turn of resolver shaft

Multi-Turn Models:

ASY-M8000-D6,10: 6-digit with 64:1 gear ratio with 1000 counts/turn of resolver shaft (64,000 total counts)

ASY-M8000-D7,10: 6-digit with 128:1 gear ratio with 1000 counts/turn of resolver shaft (128,000 total counts)

Note: Allen-Bradley is a trademark of Rockwell Automation. Rockwell Automation does not warrant or support this product, nor has this product been technically approved by Rockwell Automation for use in the 1771 system.

M8000 MODULE SPECIFICATIONS**M8000 Resolver Decoder Input Modules:****Customer Power Input Requirements:****Single-Turn Models:**

ASY-M8000-D360T: 8-28 VDC, 0.14 A @28 VDC input, 0.43 A @8 VDC

ASY-M8000-D360, D1000, D3600: 12 VDC \pm 10%, (10.8-13.2 VDC), 0.4 Ampere Typical

Multi-Turn (dual) Models:

ASY-M8000-D6,10, -D7,10: 12 VDC \pm 10%, (10.8-13.2 VDC), 0.6 Ampere Typical

Chassis Power Requirements:

Single-Turn Models: 0.17 Ampere Typical

Multi-Turn (dual) Models: 0.23 Ampere Typical

Number of Digits:

M8000-D360, M8000-D360T, M8000-D1000: 3-digits (3/4 full word)

M8000-D3600: 4-digits (1 full word)

M8000-D6, 10 and M8000-D7, 10: 6-Digits (11/2 full words)

Remote Display Bus:

BCD 5 VDC logic (TTL Level), positive TRUE Logic, for each digit. Compatible with AVG Automation M1855D remote display.

Tachometer Update Time:

(ASY-M8000-D360T—Only) Varies with resolver shaft RPM. Approx. 1 ms @ 120 RPM, 120 μ s @ 999 RPM. Update time = 60 \div (RPM x 512)

Front Panel Thumbwheel Offsets:

Full-scale thumbwheel programmable.

Rotor Excitation Voltage:

2.5 VAC at 2.5 kHz Typical

Stator Signals:

2.5 VAC sine-cosine, typical

Ambient Temperature:

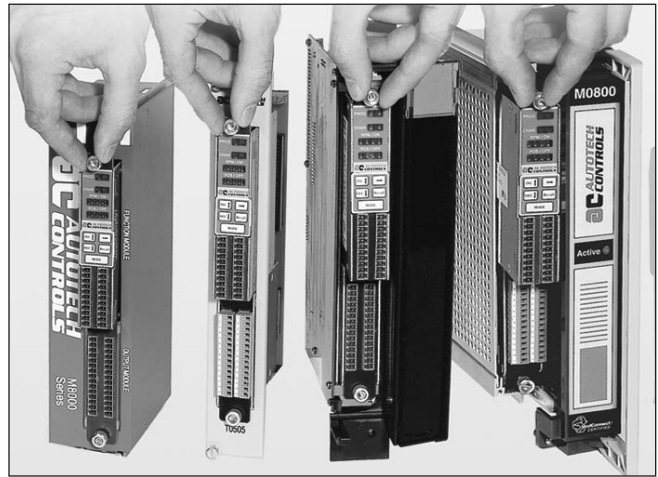
32 to 131 °F (0 to 55 °C)

Humidity:

5 to 95% noncondensing

M8350 RESOLVER DECODER BUSMODULE

- ◆ Fully Absolute Position; No Loss of Position Under Any Situation
- ◆ Programmable scale up to 4096
- ◆ Programmable Offset for Quick Set-Up
- ◆ Bright LED Position Display
- ◆ Highly Noise Immune Ratiometric Decoder, Ensures Optimum Performance Under Electrically Noisy Conditions
- ◆ Cradles for popular PLC's



BUSMODULES

AVG Automation has continuously set the standard for speed, precision, reliability, and product features in the resolver decoder and programmable limit switch (PLS) marketplaces.

In the past, to implement such functions, the user purchased a stand-alone Resolver Decoder or PLS, and connected it to the machine. With the advent of the programmable logic controller (PLC), users now want to integrate such functionality with their PLCs.

Also, users don't want to tie-up their PLC's CPU with the necessity of performing all the data processing, calculation, signal conditioning, and scaling of a resolver's input in order to implement motion control actions.

Now, users of Allen-Bradley 1771 I/O, GE Fanuc 9070 VMEbus, and Siemens TI-505 PLCs can simply plug such functionality directly into their PLCs—forever freeing the PLC's CPU to perform other control functions.

RESOLVER DECODER FUNCTION MODULE

The M8350-010 Resolver Decoder Module is an intelligent I/O module used with PLCs. All the parameters contained within the Resolver Decoder can be accessed or programmed through a series of commands. These commands can be easily implemented by users in Relay Ladder Logic.

The M8350 Resolver Decoder communicates with the PLC through INPUT and OUTPUT registers. To read information from the M8350, or to write information to the M8350, the PLC issues a command by writing to output registers. If a response is required, it is read from the input registers.

Features include:

- Self-Monitoring Diagnostics with Fault Output
- Broken resolver wire detection
- Hardware-based microprocessor monitoring
- Simultaneous display of RPM and Position data
- Position and output status available to backplane every 700 μ s
- Programmable motion detector (under-/over-speed switch)
- Fully absolute position; no loss of position under any condition
- Programmable resolution; 20-4096 counts-per-turn
- Uses input from single-turn resolver



Function Module

SPECIFICATIONS

A complete functional Decoder consists of a Cradle (specific to the programmable controller type), a Decoder Module (ASY-M8350-010), and a Filler Module (ASY-M8250-FIL). If fault and/or motion outputs need to be directly wired to field devices, an output module (such as, ASY-M8250-XOUT) must be used in place of the filler module. Consult Autotech for specifications on output module.

Card Location: Uses one or two slots (any location) in an I/O rack.

PLC Communication: Command-based communication using standard program controller logic.

Power Requirements:

Backplane: 5 VDC @ 650mA

Customer (Input Power): 24 VDC \pm 100mA

Environment Conditions:

Operating Temperature: -10° to +130° F (-23° to +55° F)

Relative Humidity: 5 to 95% non-condensing

RESOLVER INTERFACE:

Position Transducer: Autotech's series RL 100, E7R, E8R, or RL101, RL500 or equivalent resolvers.

Cable Length between Resolver and M8350: 2500 feet max, shielded.

Resolver Cable: Overall foil shielded, twisted pair, such as Autotech's cable (CBL-10T22-xxxx).

PROGRAMMING:

All features programmable from keypad or through backplane.

Scale Factor: Programmable from 19 to 4095 (Resolution 20-4096 counts per turn).

Offset: Programmable from 0 to scale factor value.

OUTPUTS:

RPM Format: Binary

Fault Detector: —TRUE (active) on power-up —FALSE if broken resolver wire or internal fault is detected.

Motion Detector: —Low and high motion limits are programmable from 0 to 1999 RPM —motion detector is TRUE when the machine's RPM is within the programmed limits — motion detector's status is available on the backplane.

Direction: CW (clockwise) or CCW (counterclockwise) indication. On is CCW, Off is CW.

RESPONSE TIMES:

Tach Update Time: 15ms

Position, Tach and Output Status available to Backplane:
Every 700 μ s typical

CONTROL INPUTS:

Program Enable (PE): PE must be TRUE for programming.

ELECTRICAL SPECIFICATIONS:

Optical Isolation: 2500 VAC RMS

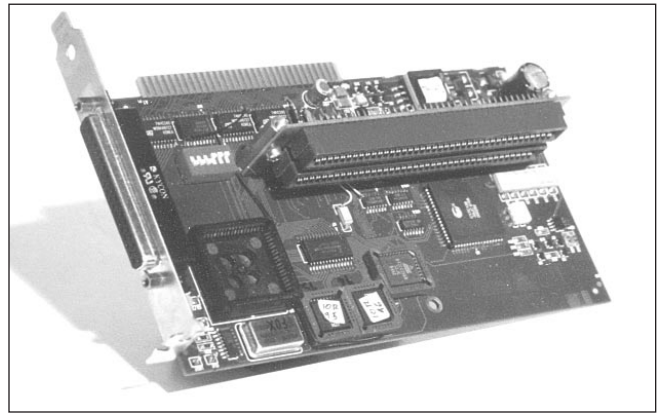
Input Current: 3mA typical @ 24 VDC

Logic Levels: —TRUE: 21 to 27 VDC (not to exceed V+ relative to V-) —FALSE: <1 VDC

PC(ISA-Bus) RESOLVER DECODER BUSMODULE

BRING MACHINE CONTROL FUNCTIONS TO YOUR IBM PC, OR EQUIVALENT

- ◆ 8-bit ISA bus interface
- ◆ Cradle covers 2 ISA slots
- ◆ Protocol for ISA bus-to-cradle communications emulates PGI-to-cradle protocol
- ◆ Cradle supports 2 C-bus slot connections (function module and I/O card)
- ◆ All function and I/O module field connections are via 37-pin female sub D connector



With the increasing use of industrial PCs (IPCs) for machine control, has come a need for PLS, resolver decoder, shut-height, die protection, and tonnage functions. Now, AVG Automation brings these functions to the industrial IBM PC (or equivalent) platform. Covering 2 ISA slots in width, users can now take advantage of these proven technologies on their IPCs.

AVG Automation's C-Bus is a series of function and output modules. This offers the user flexibility by allowing them to customize their plug-in cards by mixing and matching the function module and output module to meet their application's unique requirements.

Resolver Decoder:

A resolver decoder is an analog-to-digital (A/D) converter that converts the resolver signals corresponding to shaft position into digital data. AVG Automation's resolver decoders use Ratiometric decoding.

Resolver Decoder features include:

- Fully absolute position; no loss of position under any condition
- Programmable resolution:
 - Single-turn: 20-1024 counts-per-turn
 - Multi-turn: 0-127 (coarse) and 0-1023 (fine) counts per turn
- Programmable motion detector (under/over speed switch)
- Fully isolated I/O
- Full scale electronic offset for easy machine setup
- Broken resolver wire detection
- Hardware-based microprocessor monitoring

PC(ISA-Bus) RESOLVER DECODER SPECIFICATIONS

ISA bus Interface: 8 bit, 4k byte window at a switch selectable address between A0000 to FF000

ISA slots: 2

Connections: All function and I/O module field connections are through a 37-pin female sub D connector

Dimensions: <13.345" (338.96 mm) long and <4.2" (106.68 mm) high

Resolution: 10-bit, single-turn resolver decoder (fully absolute)