

AVG AUTOTECH CONTROLS

Networkable, Resolver Based
Position Sensors & PLS Controls



Position Sensors & PLS Controls for Every Need
Resolvers-Decoders-Resolver Based Encoders
PLS - Touch PLS - NPRLS
Press Monitoring Products - Motion Detectors

A Brief Overview...

AVG, an American Group of companies, is vertically integrated to design and manufacture state-of-the-art electronic products, cost effectively, for the best Return On Investment for our customers.

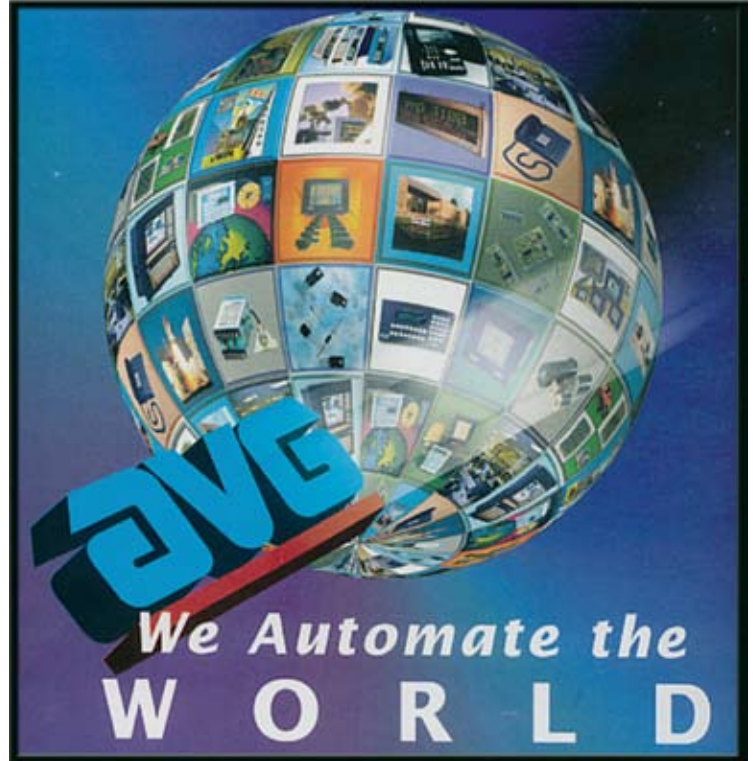
Significant Highlights & Core Competencies....

- ◆ Established in 1975, AVG has introduced more than 500 innovative new products.
- ◆ Extensive hardware, firmware, and software design capability in Illinois & Iowa.
- ◆ Hold 20+ Patents & 7 new ones pending.
- ◆ Has an installed base of over \$1 Billion in fortune 500 companies such as Ford, GM, P&G, Abbot, Miller, & IBM.
- ◆ PCB fabrication.
- ◆ 3 EMS Plants for complete turnkey assembly and box build.
- ◆ Thick Film Hybrids.
- ◆ One of the largest semiconductor FABs.
- ◆ Known for "Uticor Tough", high reliability, HALT-HASSED products, designed to operate in harsh industrial environments.
- ◆ In the forefront of High Technology such as BGA and controlled impedance high density board products.



Industry Leadership

AVG Products are featured on the front cover of New Equipment Digest and IAN.



Since the early 1970's, Autotech has been a pioneer in Resolver and PLS technology. In fact, Autotech invented the world's first microprocessor-based Programmable Limit Switch (PLS) in 1975. With over 100,000 systems installed throughout the world, Autotech has become an industry leader in position sensor and control technology.



Autotech is famous for its four traits:

- Highest processing speed.
- Highest processing power and features per cubic inch.
- Simplest Human interface.
- Highest immunity to a hostile environment.

Autotech's products are "built like a tank" to perform in some of the harshest working environments on the planet ranging from extreme temperatures, to shock and vibration, to exposure to oil mist, coolants and solvents. It's no wonder so many Fortune 500 companies rely on Autotech for Resolver and PLS needs.

Broadest & Most Advanced Line of Resolver Based Encoders & PLS Controls.

Unmatched environmental immunity against extreme temperatures, coolants, mists, shock and vibration.

No need for “Express Encoders” as Autotech Resolver-based Encoders are field configurable, modular and off the shelf.

NEMA4X, Class 1, Div. 1, explosion-proof and submersible models.

Great connectivity to practically all control networks.



8 different Mechanical configurations with several shaft and housing sizes.

Smart Encoders with self-diagnostics and field-programmability.

Over 200 different models of Single-turn, Multi-turn Geared and Dual Resolvers.

“Cheetah-like” response to product customization!



8 different series of PLSs from the world's smallest PLS to Touchscreen PLS.

Resolver and PLS Technology

- **Most Robust**
- **High Accuracy**
- **Absolute Positioning**
- **Field-Configurable Counts and Outputs**

Autotech has 25-plus years of experience in applying Resolvers and PLSs in some of the roughest environments in the world. Autotech invented the first microprocessor-based Programmable Limit Switch (PLS) in 1975 to replace electromechanical cam banks. As such, the position transducer had to work reliably in outdoor settings from Alaska to the Mohave desert or get mounted on an End Conversion Press in a two-piece can manufacturing plant, where the shock and vibration during those days was such that even the plant floor had to be rebuilt every six months. The PLS also had to be highly accurate and super fast in its response time.

Against this background, Autotech has continuously enhanced its Resolver and PLS technology and is a world leader in these products with an installed base of over 100,000 systems worldwide.

Resolver Encoders

A Resolver is 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.

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

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

and

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

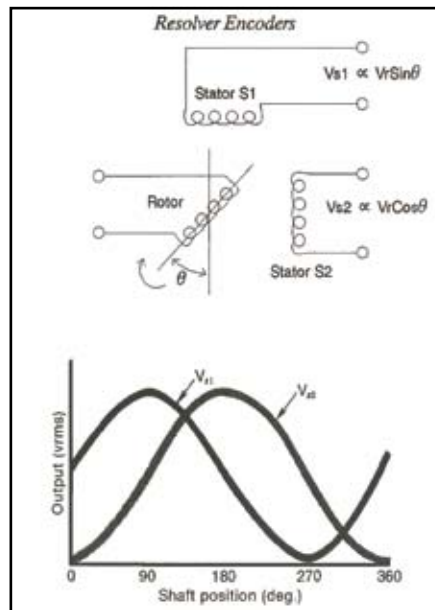
The two induced stator voltages are a measure of the shaft angle and are converted to a digital signal in resolver-to-digital decoder. Among various R/D decoding methods available, the two most commonly used are:

- Ratiometric Tracking Converter
- Phase Method Converter

Ratiometric Tracking Converter

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

oscillator and an up/down counter. Since the VCO is controlled by an error integrator, the greater the lag between the actual shaft and the digital angle in the counter, the 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. The basis of determining the shaft angle in a ratiometric converter is the ratio between the two stator signals.

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

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.

The phase method converter used by some of our competitors lacks the noise-immunity and speed of a Ratiometric converter and as such is not used by Autotech.

Resolver and PLS Technology

- EZ to Program
- EZ Integration to Control Networks
- High Speed
- 20-200 μ s Scan Time
- Cost Effective

Optical Encoder Vs. Resolver

As shown to the right, an Optical Encoder has a rotary disc mounted on its shaft, an LED block, and a phototransistor block to read the code on the rotary disc. **Having only passive rotary transformers, the resolvers can take much more abuse than optical encoders and exhibit no significant wear or aging.** Operating temperature range for resolvers is typically between -67 °F to +248 °F. In extremely hostile environments such as temperature extremes, continuous shock and vibration, humidity, oil mist, coolants and solvents, resolvers are the best choice.

Absolute vs. Incremental

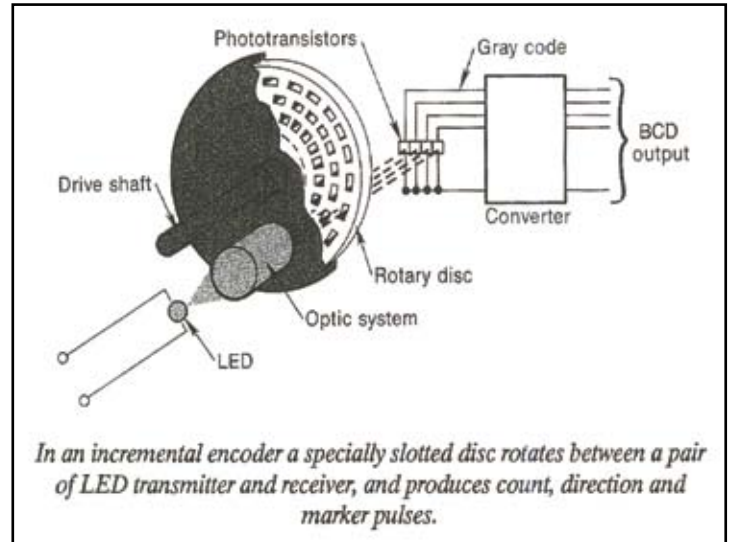
An incremental encoder simply generates pulses as its shaft rotates, whereas an absolute encoder generates a unique code for each position. With an absolute encoder, the machine operation will pick up from where it had left off after a power outage. With an incremental encoder, the system counter will lose the shaft position, particularly if it moved after power loss, and consequently you will have to home the machine before you start the operation. Also, an incremental encoder is generally more susceptible to electrical noise.

The uCoder™

Now Autotech is taking the resolver technology to great new heights. The uCoder™ is a resolver that can be configured or programmed to become the exact encoder for your application, thus eliminating the need for stocking different types of encoders on the plant floor.

PLS Technology

Autotech's patented PLS technology allows it to read a three-digit resolver position, solve 20,000 setpoints, and turn on 40 different outputs in 57 microseconds while filtering out electrical noise generated by the likes of RF Welders, 440v motors and starters, etc.



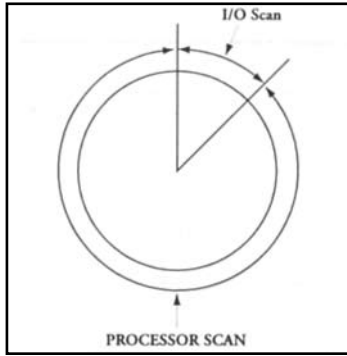
Advanced PLS Functions Include:

- Touchscreen graphical PLS settings.
- Less than 30 μ s response time.
- 4096 bit resolution, better than 0.1 degree of accuracy.
- Unlimited number of programs, on board as well as downloadable from PLC stored on field-replaceable flash modules.
- Leading or Trailing Edge speed compensation for each channel programmed in milliseconds.
- Angle On/ Time Off programming.
- Pulse Programming.
- Four ModZ functions to rezero position upon external input.
- PLS settings and machine data totally integrated with your PLC.
- Built-in Productivity Monitor (optional).
- Can even be the Operator Interface for your PLC.



Interfacing Absolute Position Decoders

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 cyclical in nature. During the I/O scan, the PLC looks 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.

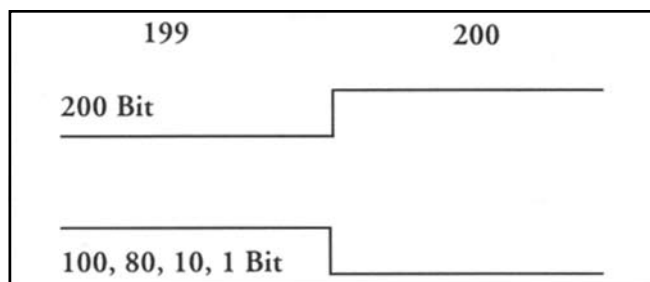


The expression “garbage in, garbage out” fits very well with the PLC. If the input data is invalid or incorrect, the corresponding machine operation will also be incorrect. Therefore, it is very important that when the PLC reads the decoder input during the I/O scan, the decoder data is valid and free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

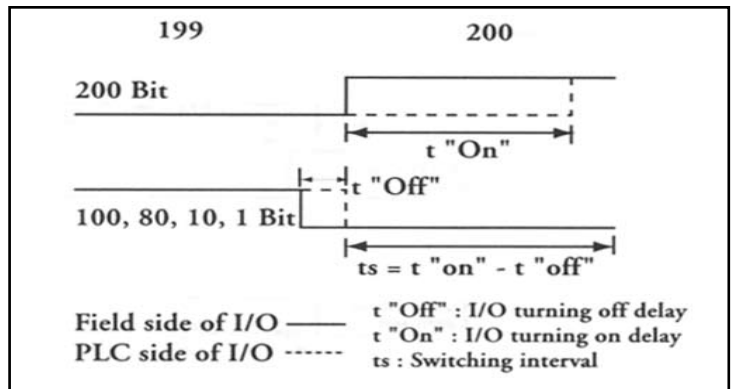
As we all know, a BCD, binary, or gray code number is composed of various bits that change state when decoder position passes from one number to the next. Inherently, in Gray Code only 1 bit changes state when changing from one number to the next, while in BCD or Binary data more than one bits may change 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 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 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 modules 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 is 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 (μ s) 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.

to PLCs and Microcomputers

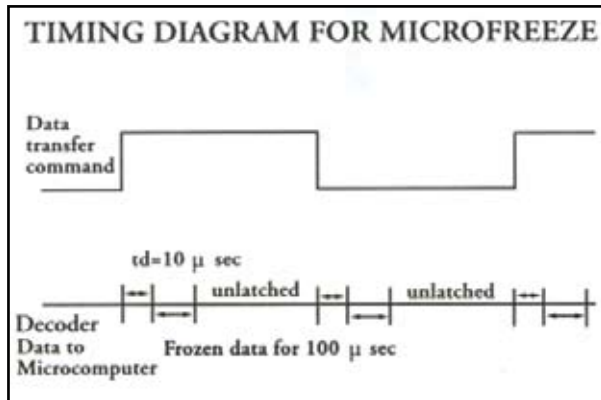
PLC Synchronization (PC-Handshake):

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), whereas 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.

Microcomputer Synchronization (Microfreeze):

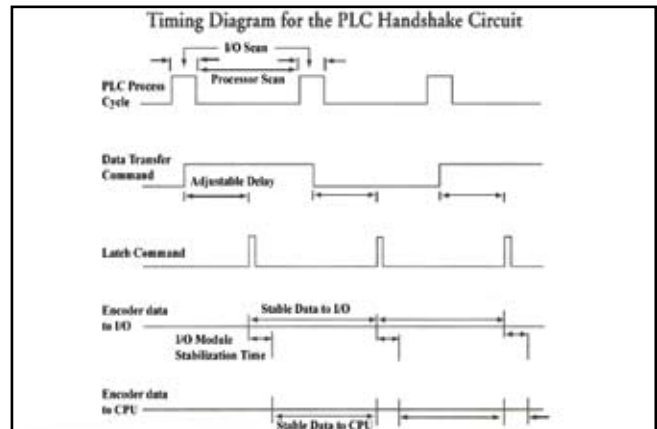
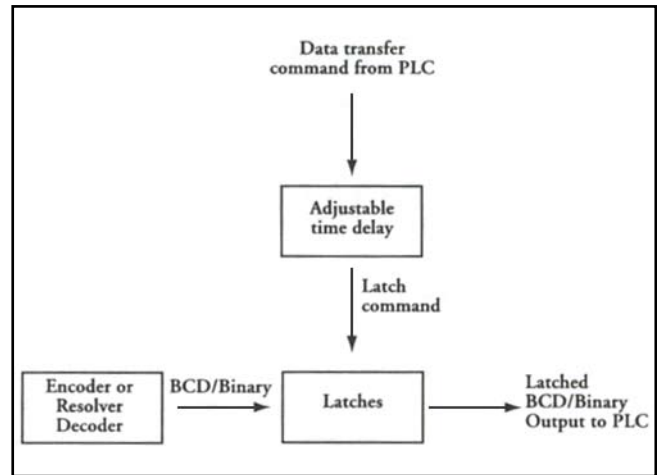
The Microfreeze can also be called as transparent PC-Handshake. This feature is particularly useful when interfacing data directly to a microcomputer where speed of operation is much higher. In this case the decoder position data is continuously updated at full speed. The data are frozen for 100 μ s +/- 10% after a delay of 10 μ s from either transition edge of data transfer command. The microcomputer can read stable data during these 100 μ 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 ms (One AC cycle) scan time will permit 1° resolution at 10 RPM (The rule of 10:1:1).
3. **The Synchronization issues do not apply to Networkable Resolvers/Encoders because of built-in handshake.**

The Industry Standard Absolute Encoder Industry, Brick Presses, and others.

Potted
Electronics

Multi-turn, 18-bit Binary or
15-bit BCD and Gray Code
absolute output.

Short-circuit-proof
outputs.

Gear Ratios

2:1
3:1
4:1
5:1
8:1
10:1
12:1
16:1
20:1
24:1
32:1
38:1
40:1
48:1
60:1
64:1
80:1
100:1

No optics, MIL-grade
Resolver and Potted
Electronics.

Flexible options of
counts-per-turn.

Single-turn, 13-bit Binary,
Gray Code, or BCD
absolute output.

Operating Temperature -10 °C to
85 °C, NEMA13, Submersible,
or NEMA4X, Class 1, Div. 1
Explosion-Proof Models.



**DigiSolver™ Specifications on pages 24*

for Rough Environments such as the Tire Resolvers with built-in Ratiometric Decoder.

Analog Angle, Analog Velocity, Direction, and Ripple outputs.



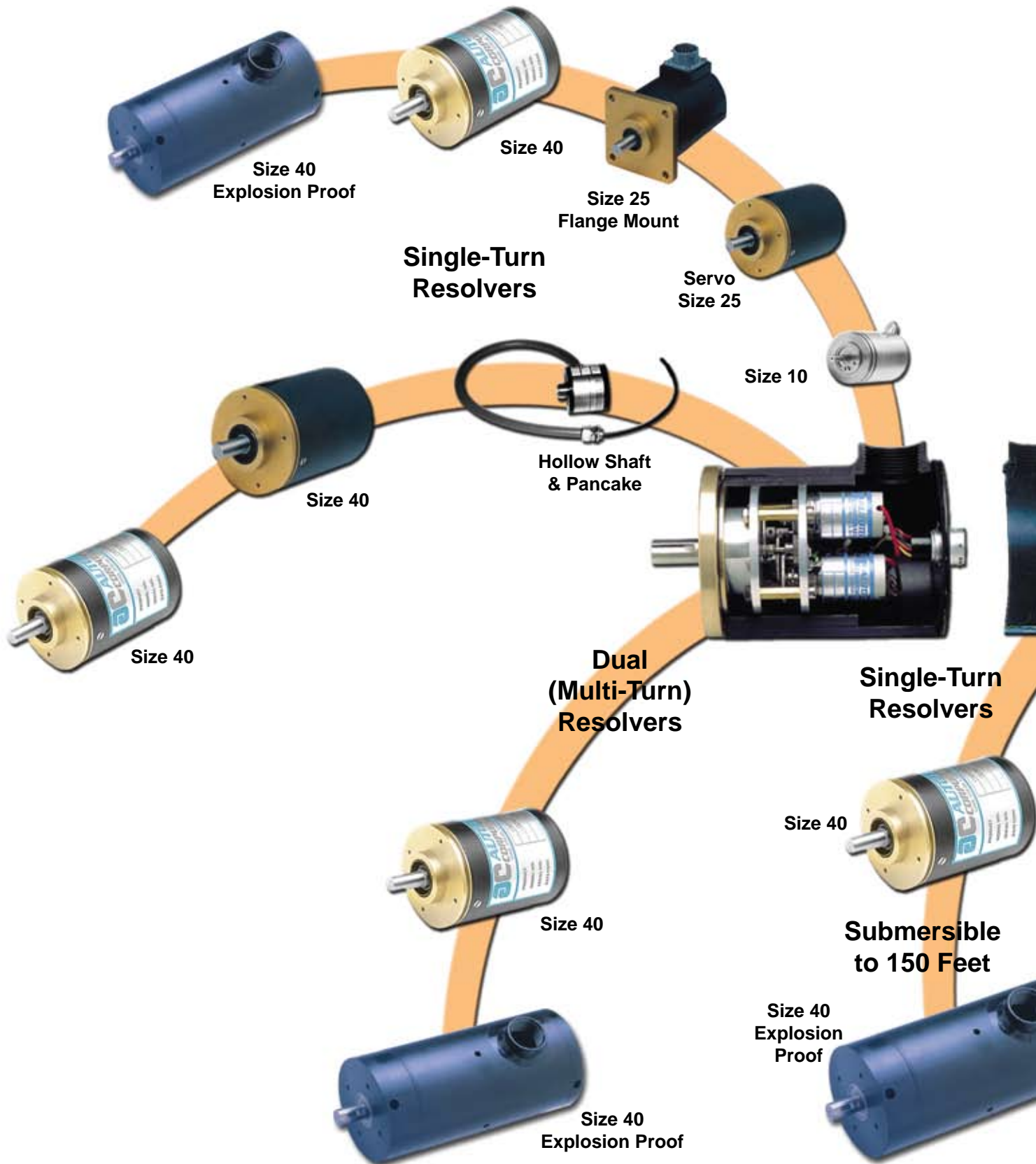
Choice of mounting styles and enclosures.

Built-in Synchronization for PLCs.

8-30 VDC voltage range.

Resolvers

The Most Rugged Position Transducer in Submersible under water, can



**the Industry -55 °C to 120 °C, 200g shock,
be 2500 ft. away from Decoder**

Resolver Specifications:

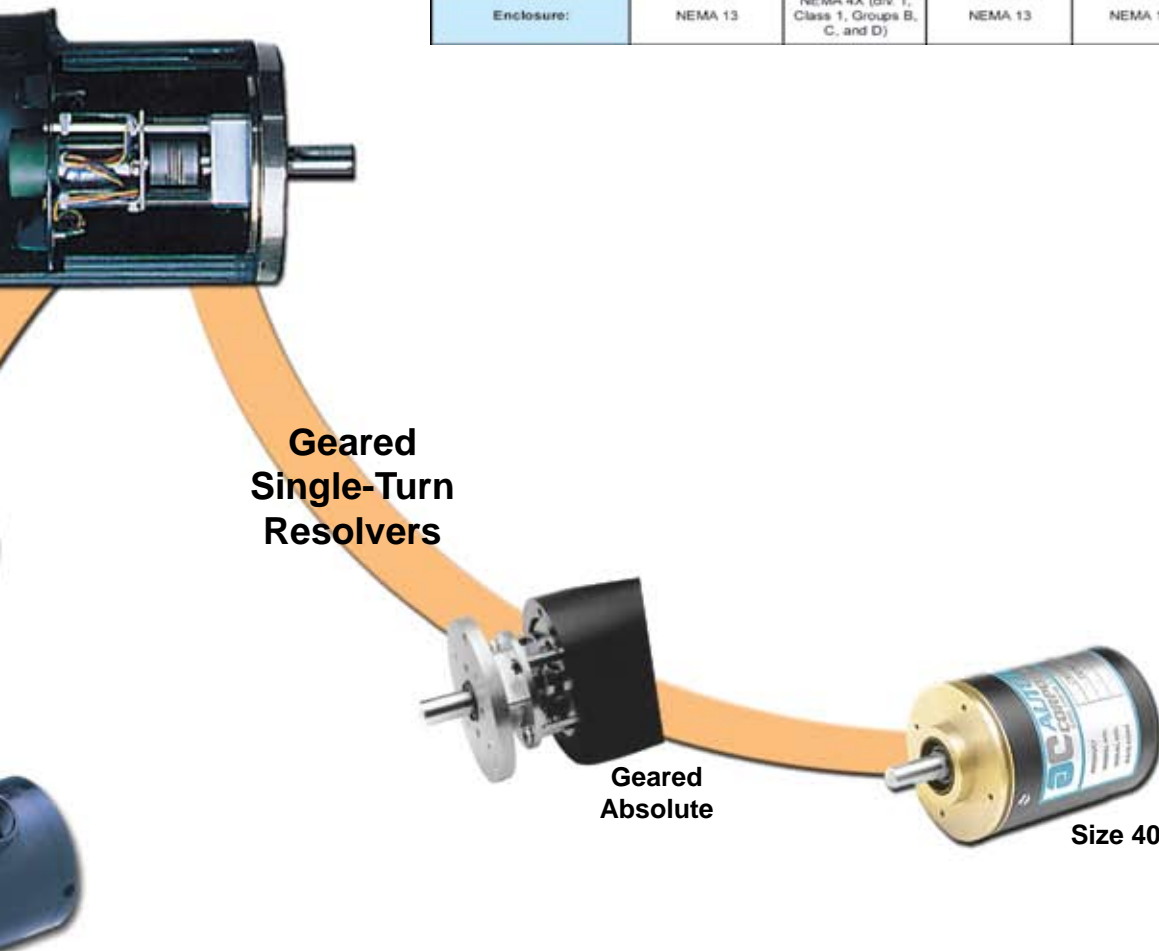
Electrical:				
Frequency:	2250 Hz	Rotor Impedance with stator open circuit Zro:	180 + 256ohms	
Input Voltage:	1.88 V	Input Current:	6 mA	
DC Resistance (Rotor):	18.3 ohms	Input Power	6.5 mW	
Output Voltage (Stator):	2.63 V +/- 5%	Transformation Ratio:	1.400 : 1	
Environmental:				
Resolver	SAC-RL100 SAC-RL-210	EBR Series	ETR Series	SAC-RL101
Shock:	200 g for 11 ms			50 g for 11 ms
Vibration:	20 g to 2000 Hz			15 g to 2000 Hz
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. 1, Class 1, Groups B, C, and D)	NEMA 13	NEMA 1

Single-Turn Gear Ratios

- 2:1
- 3:1
- 4:1
- 5:1
- 8:1
- 10:1
- 12:1
- 16:1
- 20:1
- 24:1
- 32:1
- 38:1
- 40:1
- 48:1
- 60:1
- 64:1
- 80:1
- 100:1

Multi-Turn Resolver Gear Ratios

- 4:1
- 8:1
- 16:1
- 32:1
- 64:1
- 128:1



**Additional Specifications on page 23*

DM7 Programmable Resolver Decoder

Single-Turn, Single-Channel: The Most Decoder—up to 16384 Counts

Extremely rugged and reliable resolver as position transducer

Incredibly small size; only 9 square-inch panel space

Full-scale programmable zero offset for easy setup and programmable resolution; 20-16384 counts-per-turn

Direction output and zero marker plus

Built-in PC synch circuit permits interface to any PLC along with built-in digital tach and over-, under-speed switch



**Additional Specifications on page 22*

DM7 Programmable Resolver Decoder

Versatile Small Footprint Resolver-to-Digital Per Turn, Fully Absolute

Fully absolute position means no loss of position under any situation



Highly noise-immune ratiometric tracking converter

Optically isolated outputs and Self-Diagnostics with fault output

Front panel selectable output formats: BCD, Binary, or Gray Code

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, 16384 optional

Scale Factor: 20 to 4096, programmable

Output Update Rate: 200µs

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 the same)

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 200µs 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 @ mA max. or tied to Vs+

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 Vs-

Disable or FALSE: 3.8 VDC 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: 30µs

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

PC Synchronization mode: Updates position output within 150µs 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 100µs +/- 10% within 10µs of a transition (HIGH-to-LOW or LOW-to-HIGH) at data transfer input.

M1150, M10, & M10A

Programmable Resolver Decoder Multi-Turn with Limits

Prescalable, Presetable,
and Solid-state replacement for elec-
tromagnetical Selsyn systems.

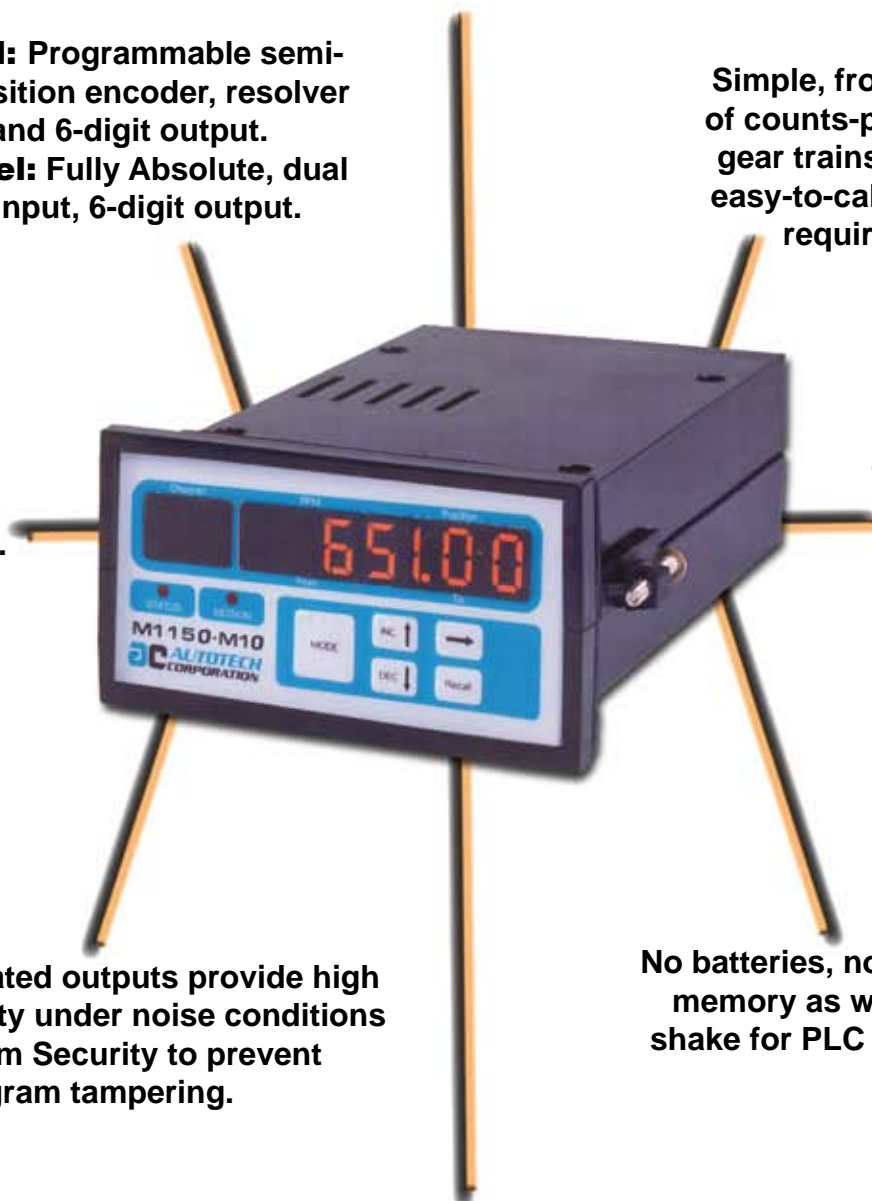
M10 Model: Programmable semi-absolute position encoder, resolver input, and 6-digit output.

M10A Model: Fully Absolute, dual resolver input, 6-digit output.

Simple, front panel programming of counts-per-turn, no mechanical gear trains. **M10A Model:** Very easy-to-calibrate, no calculations required for gear ratios.

Tachometer and Self-Diagnostics.

Two built-in PLS outputs and Motion output.



Optically-isolated outputs provide high system integrity under noise conditions and System Security to prevent program tampering.

No batteries, nonvolatile EEROM memory as well as PC-handshake for PLC synchronization.

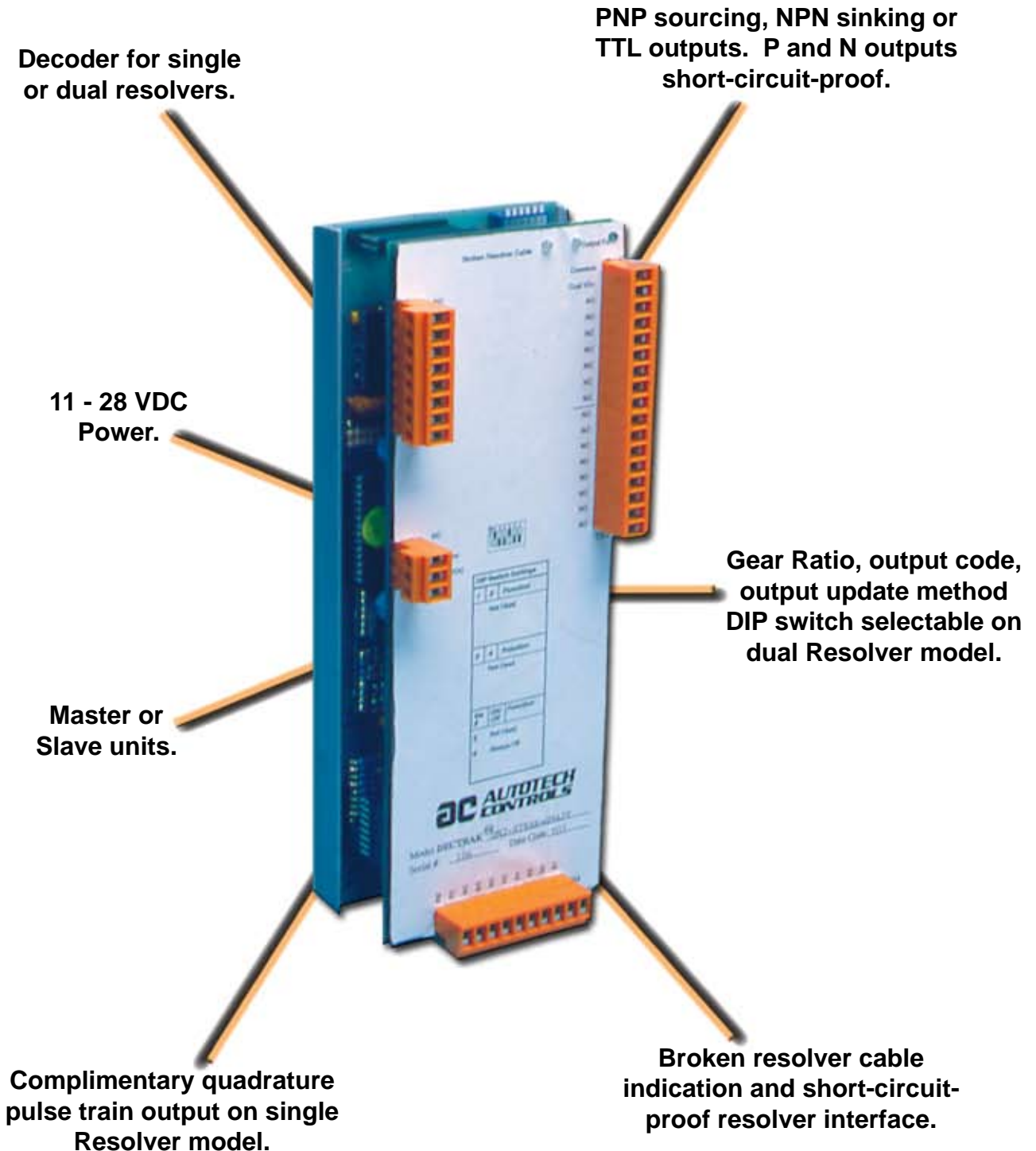
Extremely small 1/8" DIN package, reliable under extreme environments, splash-proof oil-tight front plate.

**M1150-M10 Specifications on page 22*

DM2 Resolver Decoder

Snap Track Mount

Models DM2-STRAK-xxxx and DS2-STRAK-xxxx



***Consult factory for price and availability.**

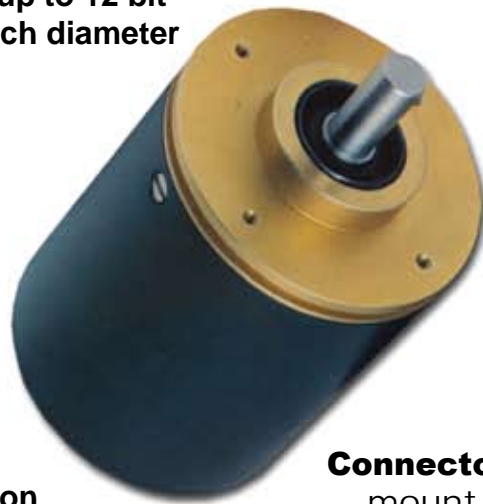
The Universal, Field Configurable Incremental/Quadrature and Absolute Increase Design Flexibility - Reduce Eliminate the need for

High Resolution in Small Compact Housing
The single-turn uCoder™ provides up to 12 bit Binary, Gray Code or BCD in a 2.5-inch diameter size (size 25) housing.

Short-Circuit-Proof
P or N Outputs



Single-Turn Operation
Keeps track of the exact shaft position even during power outage or switching off the machine.



Servo Mount

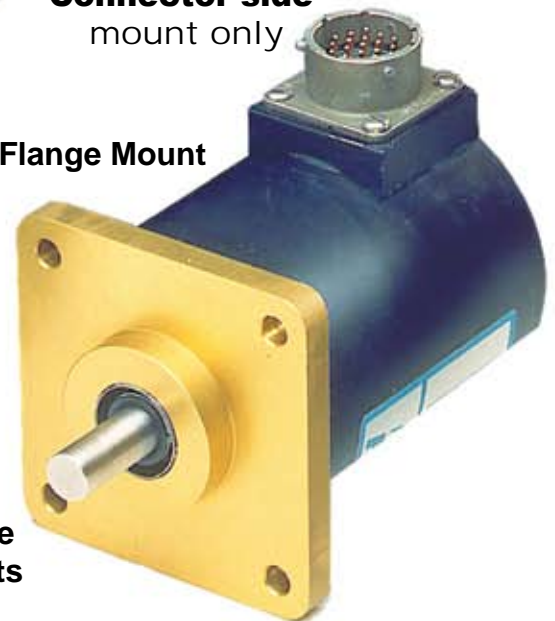


Connector side-mount only



Flexible Programming of Counts Per Turn R to D converter makes it possible to program any number of scaled counts per revolution.

Flange Mount



10-28VDC Power,
Operating Temperature
-10 °C to 60 °C.

***Check with Factory for low cost custom configurations of uCoder™ encoders for OEM applications.**

Resolver-Encoder Digital Outputs in the same unit! Stock Room Inventory to “Express Encoders”

Variety of field-configurable outputs:

Standard: 10 different Absolute BCD, Binary, and Gray Code configurations (See Table B).

Custom: 16 different Incremental and/or Absolute configurations (customer-specified).



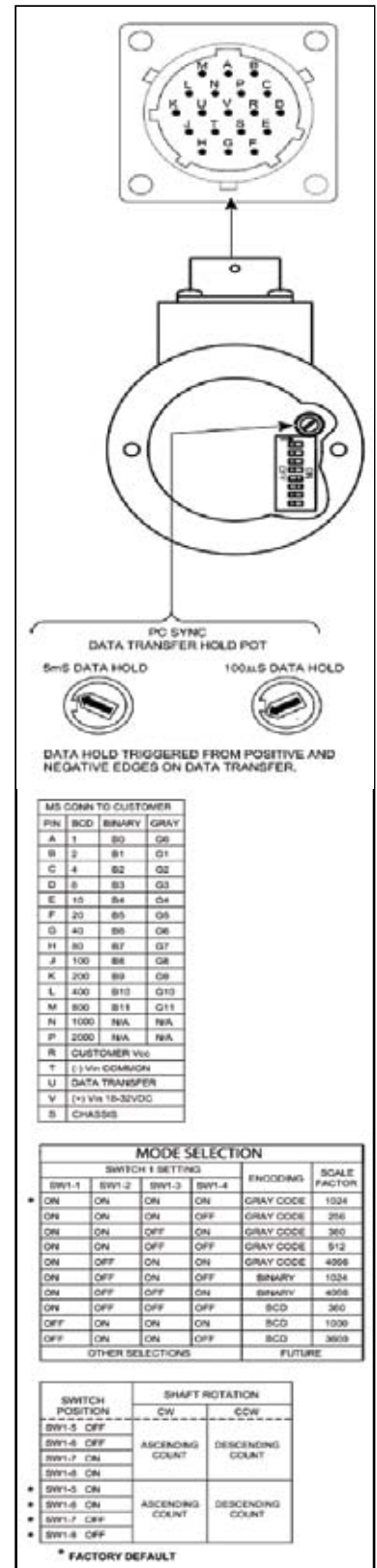
No Optics, Mil-Grade Resolver
There is no optical disc or similar component used in the uCoder™.
NEMA13, Resistant to High Shock & Vibration, Coolant & Oil Mists.



Built-in PC Synchronization
An optional synchronization circuit is provided to ensure reliable data transfer to programmable controllers or embedded controllers.

**For output driver and timing specifications see page 24 of DigiSolver Specs.
For mechanical and environmental specifications, see pages 23 and 24.*

Standard Configuration



Network Resolvers

Putting Resolvers on a Device-Level Network and Lowers Installed Costs • DeviceNet

Device-Level Networks reduce the complexity of the control system in terms of hardware outlay. PLC I/O hardware requirements are substantially reduced = cost savings!

Gear
Single-Turn Ratios

2:1
3:1
4:1
5:1
8:1
10:1
12:1
16:1
20:1
24:1
32:1
36:1
38:1
40:1
48:1
60:1
64:1
80:1
100:1

DeviceNet Resolvers (slave) powered from Network. 5 Pin DeviceNet miniconnector. 125K, 250K, or 500K Baud Rates. Strobe, Polling, and COS modes. Programmable counts per turn over Network.

Network Programmable DeviceNet Resolvers formats (Binary, BCD, Gray Code). Single and Geared Models. 12 Bit (4096) resolution up to 2500 RPM. 2 Frame sizes 25 (2.5" diameter) & 40 (4" diameter).

Profibus Resolvers (DP slave). Network Programmable formats Binary, BCD, and Gray Code. Single and Geared models. 12 Bit (4096) resolution up to 2500 RPM. Two Frame sizes 25 (2.5" diameter) and 40 (4" diameter). 9.6 kbps to 12 Mbps transmission speeds. Programmable counts per turn over Network. 16-32 VDC Power.



*Check for availability of Multi-Turn DeviceNet and Profibus resolvers.

Network Resolvers

Increases Reliability, Adds Diagnostics, •Profibus•Modbus Plus•InterBus

Network Resolvers are a slave on the network so they do not effect network speed.

Available in NEMA13 submersible NEMA4X,
Class 1, Div.1 Explosion-Proof Housings.



Interbus Decoder in a compact
9 square inch panel display.
Programmable offset and 20-4096
counts/turn.

Modbus Plus Resolver
Redundant Single-Turn Dual Resolver
Output format binary 360 only. One
resolver analog output (mil connector).
Second resolver Modbus Plus Output.
Size 40 frame only. 16-28 VDC Power.

Operating temperature
-10 °C to 70 °C

Interbus Multi-turn Resolver
128:1 Dual-gear Resolvers. 17-Bit,
128-Turn, 1024 counts/turn Gray Code output.
10-30 VDC Power.

Interbus Resolvers Network Programmable formats
Binary, BCD, and Gray Code. Single and Geared models. 12
Bit (4096) resolution up to 2500 RPM. Two Frame sizes 25
(2.5" diameter) and 40 (4" diameter). Programmable counts
per turn over Network. 10-30 VDC Power

NPRLS™ Networkable, Programmable

This represents a major advance Encoders on a plant

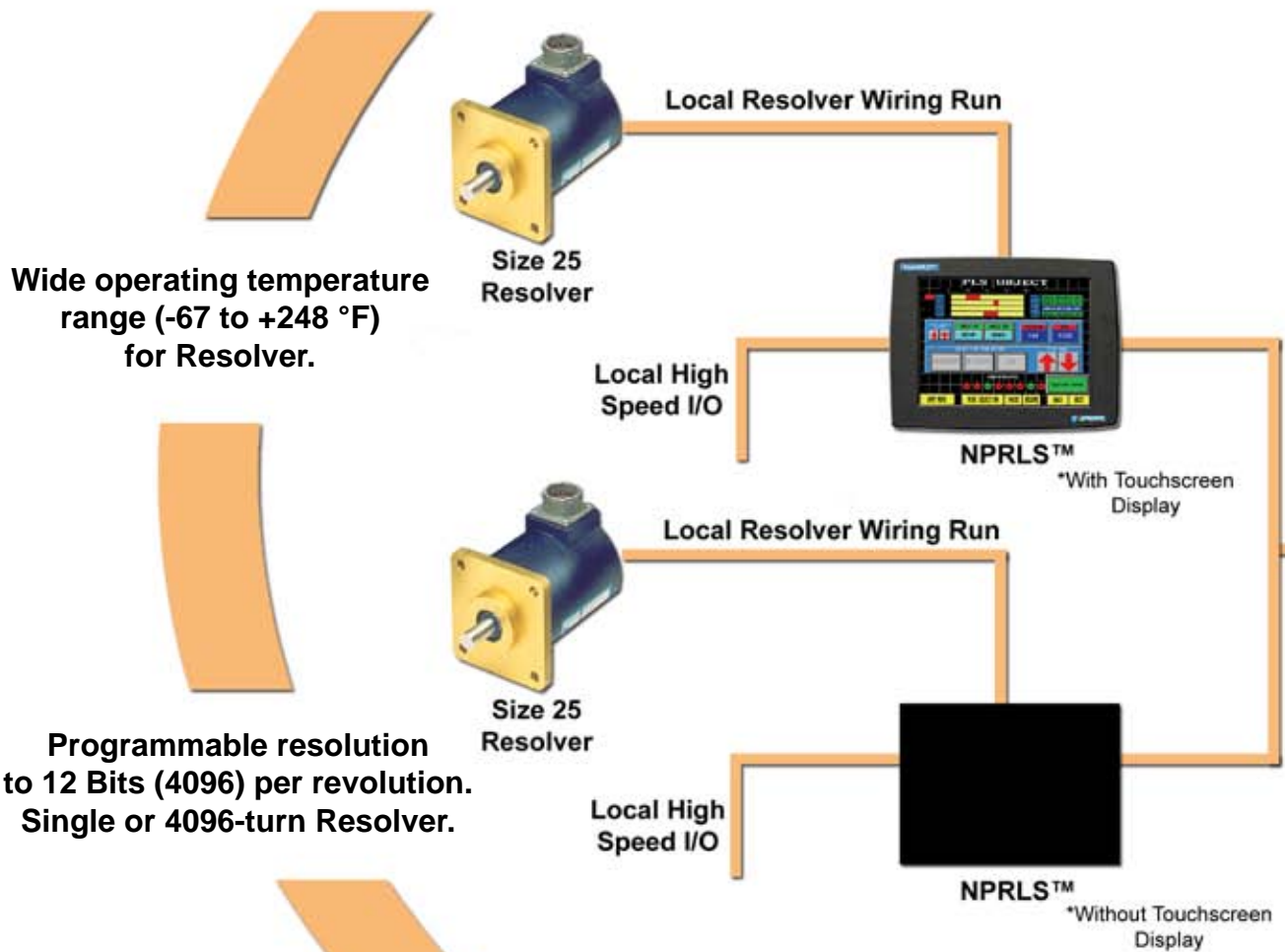
Machine position Encoder and high speed counter control
programmed over Ethernet in a Windows environment,

No wiring length limitation
along with your choice of housing.

Wide operating temperature
range (-67 to +248 °F)
for Resolver.

Programmable resolution
to 12 Bits (4096) per revolution.
Single or 4096-turn Resolver.

Rugged Resolver (No optics or LED)
with great environmental immunity
and Programmable Limit Switch with
high speed response (50µs).



**NPRLS Specifications on page 22.*

in the state-of-the-art for floor, resulting in:

connected over Fieldbus. The NPRLS™ can be easily to become the exact Encoder and Control you need.

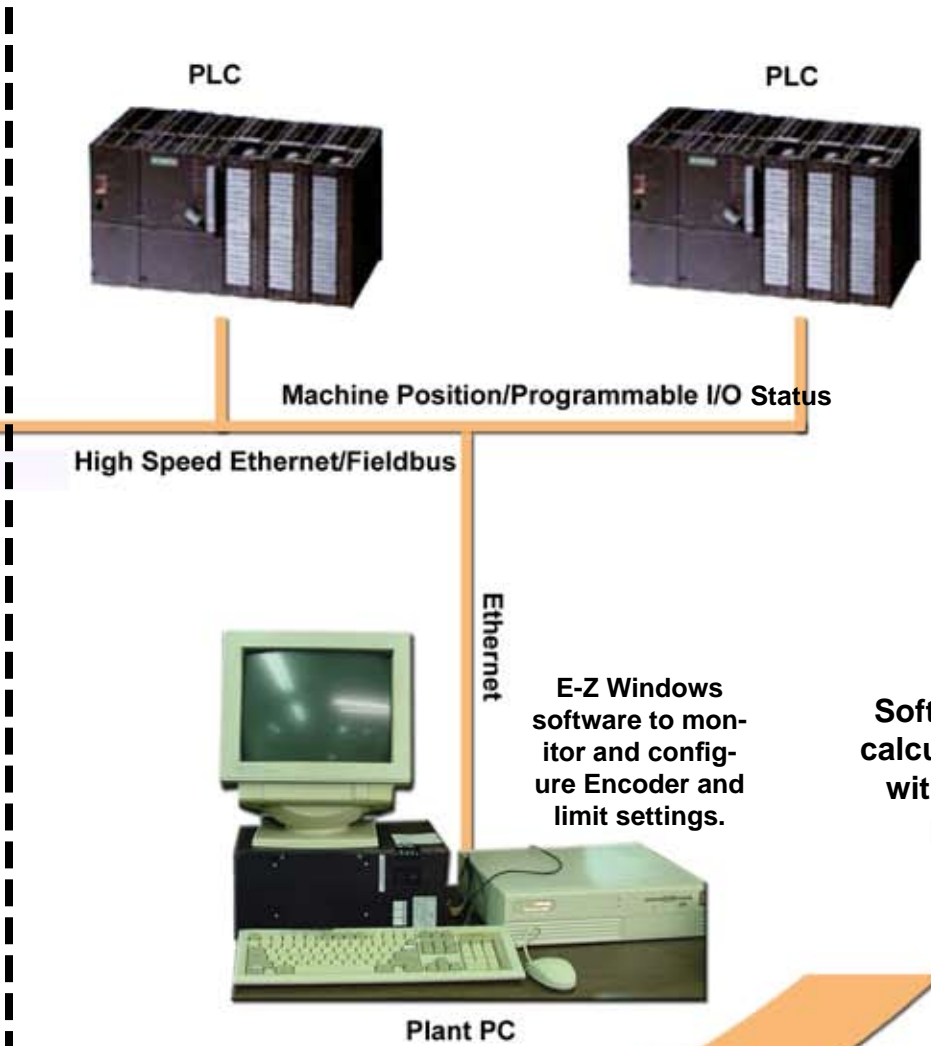
- Eliminates the traditional cumbersome Encoder wiring
- Eliminates the need to stock different Encoders with different counts
- Eliminates the need to program cumbersome counter cards
- Cost effective



Reduces machine wiring dramatically and eliminates the need for cumbersome counter cards in your PLC.



Software automatically calculates scaling, along with a smart machine position sensor over Fieldbus.



NPRLS is mounted right on the machine and connected to PLC over Ethernet hundreds of feet away.

*Check Factory for Product Availability

Resolver Decoder Features

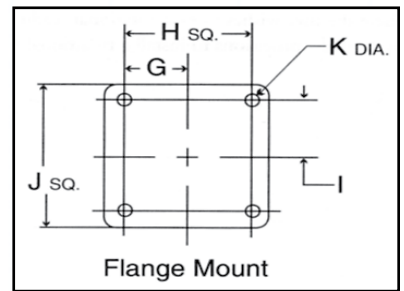
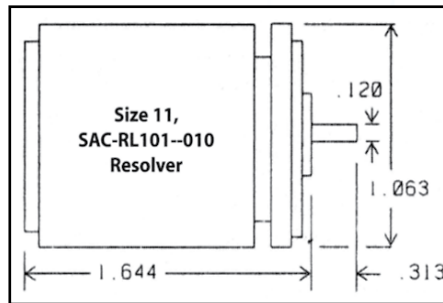
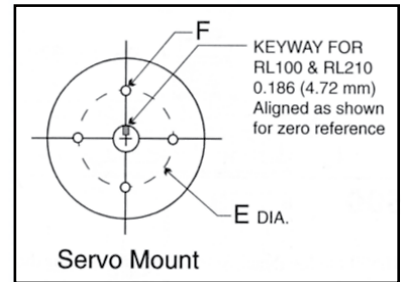
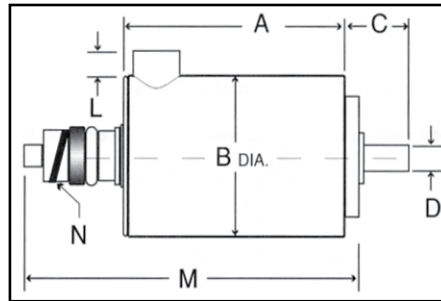
“THE LEADER AND INNOVATOR IN CONTROL SOLUTIONS”

FEATURES	DM7	DigiSolver	M1150-M10	M1151-M10A	NPRLS	uCoder™	Network Resolvers
Application:	Single-Turn Resolver	Single or Multi-Turn Resolver	Multi-Turn with Single-Turn Resolver Input	Multi-Turn with dual Resolver Inputs	Multi-Turn with Single-Turn Resolver	Single-Turn Resolver	Single-Turn Resolver Standard (Check factory for Multi-Turn)
Position Input Device:	MIL-Grade Resolver	MIL-Grade Resolver	MIL-Grade Resolver	MIL-Grade Resolver	MIL-Grade Resolver	MIL-Grade Resolver	MIL-Grade Resolver
Absolute:	Fully Absolute	Fully Absolute	Absolute as long as shaft does not move over 1/2 turn with power off	Fully Absolute	Absolute as long as shaft does not move over 1/2 turn with power off	Fully Absolute	Fully Absolute
Output Update Rate:	200 µs	< 1 µs, hardwired	1.4 ms	1.4 ms	Depends on Network Speed	Depends on Network Speed	Depends on Network Speed
Resolution: (counts/turn)	Programmable, 20-4096 (12-Bits)	Up to 8192 (13-Bits per turn) 18-Bits (multi-turn) Check factory for more than 18 Bits	1 part in 1,000,000 over total travel, 12-Bit/turn	4096 max per turn 128 Total turns	1 part in 1,000,000 over total travel, 12-Bit/turn	Programmable, 20-4096 (12-Bits)	Programmable, 20-4096 (12-Bits) for Single-Turn
Zero Offset:	YES, Programmable	NO	YES, Programmable	NO	YES, Programmable	NO	YES, Programmable
Prescalable:	YES, keyboard	NO	YES, keyboard	NO, calibration required	YES	Limited DIP Switch	YES
Front Panel Display:	YES, 4-digit	NO	YES, 6-digit	YES, 8-digit	YES, Optional	NO	NO
Output Format:	Field-Selectable BCD, Binary, or Gray Code	BCD, Binary, Gray Code, or Analog, 0-10 V or 4-20 mA	BCD, Binary, or Gray Code	BCD	Network	BCD, Binary, or Gray Code, DIP Selectable	Network
Output Type:	TTL, PNP, & NPN	TTL, PNP, & NPN	TTL, PNP, & NPN	TTL, PNP, & NPN	PNP or NPN	PNP or NPN	Network
Optical Isolation: Outputs: Inputs:	YES YES	NO NO	YES YES	YES YES	YES	NO	YES
Self Diagnosis:	YES	NO	YES	YES	YES	NO	YES
Integral/Remote Decoder	Remote	Built-in Decoder	Remote	Remote	Remote	Built-in	Built-in
Decoder Type:	Highly noise immune ratiometric	Highly noise immune ratiometric	Highly noise immune ratiometric	Highly noise immune ratiometric	Highly noise immune ratiometric	Highly noise immune ratiometric	Highly noise immune ratiometric
PC-Synchronization:	YES, Programmable	YES, Optional	YES, Programmable	YES, Programmable	Not Applicable	YES	Not Applicable
Short-Circuit-Proof Resolver Construction:	YES	YES	YES	YES	YES	YES	YES
Serial Link:	NO	NO	NO	NO	YES	NO	YES
NEMA Rating:	NEMA 12 face plate	NEMA 13 or explosion-proof	NEMA 12 face plate	NEMA 12 face plate	NEMA 4X face plate	NEMA 13	NEMA 13
Physical Size, in. (mm) Height: Width: Depth:	2.19" (55.63mm) 4.11" (104.39mm) 6.21" (155.45mm)	Size 40-4" dia. (101.6mm) Size 25-2.5" dia. (63.5mm)	2.19" (55.63mm) 4.11" (104.39mm) 6.21" (155.45mm)	2.19" (55.63mm) 4.11" (104.39mm) 6.21" (155.45mm)	Different models - Check factory	Size 25 2.5" dia. Connector Side Mount Only	Size 40-4" dia. (101.6mm) Size 25-2.5" dia. (63.5mm)
Field-Selectable CW CCW:	YES	YES	YES	YES	YES	YES	YES
Page:	12, 13	8, 9	14	14	20, 21	16, 17	18, 19

Note: Update rate described as: PC Hand: 30 µs minimum width, strobe delay to latch 100 µs.

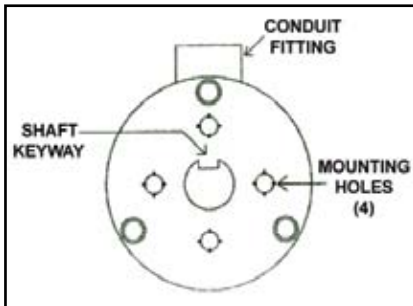
Resolver & Resolver Encoder Specifications

Resolver and Resolver Encoder Mounting Table					
Resolver Part Number:	SAC-RL100-XXX SAC-RL100- GXXX X	E8R Series	SAS-RL210-GXXX X SAC-RL210-GXXX	E1R-RL101-000 X X	E7 Series
MEASUREMENTS (inches & mm)					
A	5.50 (139.7)	8.56 (217.5)	6.50 (165.1)	3.57 (90.7)	3.87 (98.3)
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)	
D (dia.)	0.625 (15.9)		0.38 (9.5)		
E (dia.)	2.50 (63.5)		2.00 (50.8)		
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)	
K	-		0.22 (5.54)		
L	0.625 (15.9)		-		
M	7.60 (193.0)	-	8.60 (218.4)	-	5.98 (151.8)
N	-	-	-	-	-

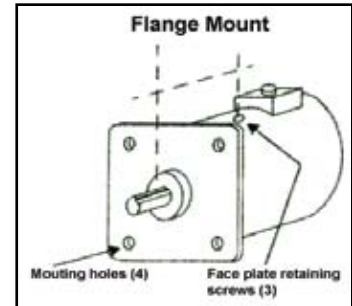
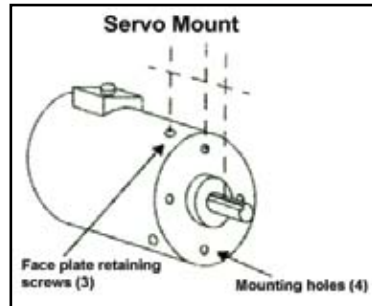


***MS-CONNECTORS**
MS3116F-12-10S
MS3112F-12-10P

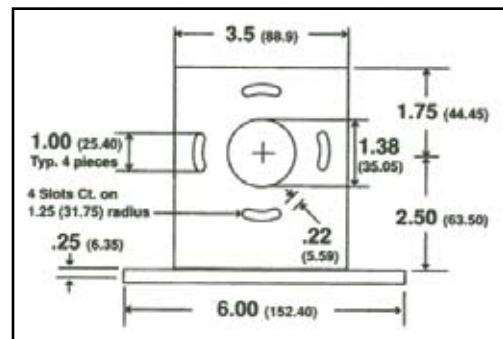
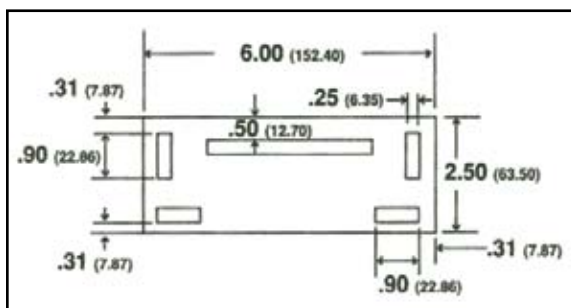
Zero Reference-Size 40 Resolvers
(SAC-RL100, E8 Series and SAC-RL210)



Zero Reference-Size 25 Resolvers
(E7R)



E5 Series and E8 Series Mounting
Bracket Dimensions



DigiSolver Specifications

ELECTRICAL

Input Power:

Voltage: 5 VDC +/- 5%, or 8-30 VDC

Current: 0.55 A, Single-turn; 0.75 A, Multi-turn

Power-on Settling Time:

For 130 ms after power is turned ON, the encoder output is frozen as follows:

T & N: all zeros

P & C: all ones

After 130 ms, the DigiSolver reads the TRUE position.

POSITION OUTPUT:

Output Format and Number of Words/Counts:

a) Single-turn and Geared Single-turn Units:

Gray Code (G): 256, 512, 1024, 4096, and 8192

Binary (B): 1024, 4096, and 8192

BCD (D): 360, 100, and 3600

(Custom Counts available consult factory)

Analogue (A): 4-20 mA (sinking or sourcing) or 0-10 VDC output, 0.1% Repeatability, 1% Accuracy of full scale.

(Consult factory for higher accuracy models)

Built-in Gear Ratios: 2:1, 3:1, 4:1, 8:1, 12:1, 16:1, 20:1, 24:1, 32:1, 36:1, 40:1, 48:1, 60:1, 64:1, 80:1, 100:1

b) Multi-turn Units:

18-bit Binary over 64 turns , 12-bit per revolution, 6-bits for 64 turns. 15-bit BCD or Gray Code over 32 turns, 10-bits per revolution, 5-bits for 32 turns, Built-in gear train of 64:1 or 32:1

OUTPUT DRIVERS:

T: Tristate (Multiplexing): TTL (74LS 645), high logic TRUE
Logic True: 2V @ 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

P: Source Transistor: Vmax = 30 V, high Logic TRUE (Sprague UDN-2981A)

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

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

On ES the P-type outputs are short-circuit-proof and are rated 20 mA @ 50 VDC

N: Sink Transistor: Vmax = 30V, low Logic TRUE (Sprague ULN-2803A)

Logic TRUE: Transistor ON, 1.1 V drop @ 100 mA

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

C: Sink Transistor: Vmax = 30 V, high Logic TRUE (Sprague ULN-2803A)

Logic TRUE: Transistor OFF, 0.1 mA leak. @ 50 V

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

OUTPUT TIMING:

P: PLC Synchronization Option: Encoder position data is latched 50 µs to 3 ms (factory set at 3 ms, field-adjustable) after either transition edge of data transfer command from PLC (Nonretriggerable during timing period).

O: Transparent/Microfreeze Option: Encoder position data is continuously updated at full speed. The data is frozen (Microfreeze) for 100 +/- 10% µs within 10 µs of either transition edge of data transfer command. Data transfer command is not required if Microfreeze is not needed.

Data Transfer Command:

TTL compatible, 2200 internal pull-up to 5 V, high Logic TRUE, edge-triggered.

High level: 3.5 to 30 VDC

Low level: 0 to 1 VDC

Pulse width: Minimum 10 µs

OPTIONAL OUTPUTS:

Analog Tach Output: 100 RPM/Volt for 0 to +10 VDC (0 Volt = 0 RPM) or 100 RPM/1.6 mA for 4-20 mA (4 mA = 0 RPM).

Direction Output: TTL, HIGH = CCW, LOW = CW

Revolution Count (Marker Pulse): Negative pulse, TTL, pulse width 0.3, 3.0 µs.

Environmental Specifications of Resolver Encoders:

	E5N	E7N	E8N	Network Resolvers	uCoder
Maximum Starting Torque @ 25°C (oz.-in.):	8.0	5.0	8.0	E5, E7, and E8 Model Dependent	5.0
Moment of Inertia (gm/cm ²)	45	45	45	E5, E7, and E8 Model Dependent	45
Shaft Sizes:	5/8"	3/8"	5/8"	E5, E7, and E8 Model Dependent	3/8"
Maximum Shaft Load Axial (lbs): Radial (lbs):	50 100	40 36	50 100	E5, E7, and E8 Model Dependent	40 36
Bearing Life at Max. Mfr. Spec. (Rev.):	2 x 10	2 x 10	2 x 10	E5, E7, and E8 Model Dependent	2 x 10
Weight (lb.)	4.5	2	6.5	E5, E7, and E8 Model Dependent	2
Shock:	200 g for 11 ms				
Vibration:	20 g to 2000 Hz				
Operating Temperature (Ambient):	-10°C to 85°C	-10°C to 85°C	-10°C to 85°C	-10°C to 70°C	-10°C to 60°C
Storage Temperature:	-85°F to +302°F				
Enclosure:	NEMA 13	NEMA 13	NEMA 4X Div. 1, Class 1, Groups B, C, and D	Depends on Model	NEMA 13

M1020 Programmable Limit Switch

This simple low-cost replacement for Electromechanical cam/limit switches is the most economical PLS in the industry.



M1020 PLS

AVG automation, your Programmable Limit Switch (PLS) specialist, has now made it possible to *simply make electromechanical cam/limit switches obsolete!* In spite of numerous limitations, such as cam bounce, limited life, and high maintenance, industrial use of electromechanical switches has continued due to their low cost. *The M1020-PLS from AVG Automation has broken down the last barrier...the price.* It offers solid-state reliability at the cost of electromechanical cam switches.

Programmable Zero Offset

The M1020-PLS allows for quick initial setup, while matching "machine zero" to "resolver zero" or compensating for machine-wear-induced speed changes. After the resolver is mounted on the machine shaft, simply align the machine to a mechanical zero reference and enter the required offset number read to zero.

Programmable Limit Settings - 8 Outputs

The "ON/OFF" setpoints for each output can be programmed simply by the touch of a key from the front panel. The AVG Automation patented key sequence in the M1020-PLS is incredibly simple and easy to use.

Fine-Tuning in Motion

An additional advantage of the M1020-PLS is that you can *fine-tune* your limit settings while the machine is running. *This increase in machine productivity pays for the PLS within months.*

Rugged, Reliable for Hostile Environments

The M1020-PLS combines the ruggedness of a brushless resolver and the reliability of an advanced solid-state control. The rugged, heavy-duty, NEMA 13 (IP54)-rated resolver can be mounted on a machine shaft in hostile environments, such as mechanical shock, vibration, extreme humidity and temperature changes, oil mist, coolant sprays, solvents, etc., and the programmable control unit, M1020-PLS, can be mounted up to 2500 feet away in a control panel. The splash-proof, oil-tight front plate permits the unit to be installed directly on the machine itself, if so required. The ratiometric converter used in the M1020-PLS assures high noise immunity and short-circuit-proof resolver wiring.

Fully Absolute Position

Unlike some other attempts to replace cam switches with incremental encoders, and/or counter modules in a PLC, the M1020-PLS maintains one crucial feature of cam switches... it is totally absolute.

The M1020-PLS will give you reliable limit settings, irrespective of power outages, machine movement during a power outage, as well as during severe electrical noise!

Detachable Operator Interface for Program Security and Cost Savings

Once the setpoints are programmed using the front-panel-programming interface, you can detach it from the main unit, making the program inaccessible to any unauthorized personnel. While this feature makes the M1020-PLS tamper-proof, it also saves you money by using the same programmer to program various other AVG Automation PLSs in your plant.



Operator Interface can be Hot-Plugged.

The Incredibly Versatile PLS Family - The compact 1/8 DIN size Programmable Limit has

Smallest Programmable Limit Switch (PLS); 8 or 16 outputs in 1.8" x 3.6" x 5.7" housing with NEMA 12 faceplate.

Individual Speed Compensation for each PLS output channel.

Four or Eight PLS programs reduce change-over time. Simple creative keyboard.

Simultaneous display of machine channel number, ON and OFF setpoints.

Simultaneous display of machine speed and position.



**M1151™ Specifications on pages 22*

High Versatility in a small Package the features found in advanced PLSs on the market.

Rugged reliable resolver as position transducer; optically isolated outputs and inputs enhance system reliability.

Patented arrow keys to adjust offset and setpoints in full motion.

High-speed operation, 120 μ s (8-channel), 200 usec (16-channel) scan time with Built-in tachometer and motion detector.

Optional Shift Register PLS Channels, Brake Monitor, and Dynamic Zeroing ModZ Model.

Specifications

AC Power: 105-135 VAC, 50/60 Hz, 8W exclusive of load (optional 220 VAC)
DC Interface Power: 11 to 28 VDC, 100mA (exclusive to load)
Operating Temperature: -10 °F to +130 °F (-23 °C to 55 °C)
System Resolution: 10 Bits
Scale Factor: Programmable, 16 to 999
Offset: Programmable, "0" to full revolution
Scan Time for Complete System Execution: 300 microseconds. Add 162 microseconds for each shift register channel used.
Position Signal: Autotech's Series RL100, E1, E6R, E7R, or E8R Resolvers
Cable Length between Resolver and M1151: 2500 feet shielded
Resolver Cable: Autotech's CBL-10T22-xxxx
Maximum Resolver Shaft Speed: 3600 RPM
Resolver-to-Digital Decoder Tracking Speed: 1800 RPM

Outputs:

Types of Outputs:

P:Pnp Source Transistor:

Logic True: Transistor On, 1.7v Drop @ 100 mA;

Logic False: Transistor Off, 0.2 Ma Leakage @ 50v

N:Npn Sink Transistor:

Logic True: Transistor On, 1.1v Max @ 100 mA;

Logic False: Transistor Off, 0.1 Ma Leakage @ 50v

Number of PLS Outputs: 16 including 1 motion detector output

Number of Slave Units: 7 for total of 112 outputs

Dimension: 2.2" H x 4.2" W x 6.2" D

Panel Cutout: 1.8" x 3.75"

Number of ON/OFF Setpoints per channel: Channel #1; one dual setpoint; *All other channels:* Count per rev/2

Motion Detector:

Low Setpoint: up to 998 RPM max

High Setpoint: up to 999 RPM max

Optical Isolation: 1500Vrms standard on all I/O (except resolver and analog velocity signals)

Remote Power Relay Outputs

For Cam and Motion outputs requiring higher current ratings, use the Remote Power Relay chassis (Autotech's part number ASY-RLYCH-xxxx). This chassis is connected to a unit having N type of outputs using a pre-wired cable.
of outputs: 8 or 16 cam outputs plus one motion output.

Unit required: N type

Cable: Prewired with DB15 connector on both ends.

Relays: Relay chassis is available for EM or solid state relays.

Electromagnetic relays (Part #KSD-012DC-10A): 120VAC @ 10Amp, SPST.

Solid State AC relays (Part #KSS-120AC-3Amp): 24-280VAC @ 0.2-3Amp, zero crossover switch triac output relay, optically isolated.

Solid State DC relays (Part #KSS-60VDC-3Amp): 9-60VDC @ 3Amp, optically isolated; (Part #KSS-200VDC-1Amp): 0-200VDC at 1Amp, optically isolated.

Input:

Program Enable, Output Disable, ModZ, & Shift Register

For "P" Type units:

Enable or True = 11.0 to 28.0 VDC @ 13.5 mA max. or tied to terminal #9 on the terminal block (terminal 9 is internally wired to Vs + for type units).

Disable or False = 2.0 VDC @ 0.2 mA max or open circuit

For "N" Type units:

Enable or True = 11.0 to 28.0 VDC @ 13.5 mA max. or tie to terminal #9 on the terminal Block (terminal 9 is internally wired to Vs - for N type units).

Disable or False = 3.8 VDC to 28 VDC max. @ -0.2 mA max. or open circuit.

The M1050 Family of High-

The High-Performance Self-Contained Includes Power Output Relays

SPECIFICATIONS

Power Requirements: 105 - 135 VAC, 50/60 Hz, 20 W or 220-260 VAC, 50/60 Hz, 20 W (option)

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

PROGRAMMING:

Number of PLS Programs:

M1050A, M1051, M1053: Eight selectable from keyboard or externally via three program-selected inputs (PS0-PS2).

M1050-M10: 60 programs with 8 channel outputs or 30 programs with 16 channel outputs.

M1052: 16 selectable from keyboard or externally via 5 program selected inputs (PS0-PS3 and EP).

PLS Setpoints:

M1050-M10: 256 per PLS program for 60 total programs or 512 per PLS program for 30 total programs.

M1050A: 80 per PLS Program, 640 total, 80 setpoints in a program can be assigned to the eight PLS outputs in any manner.

M1051, M1053: 160 per PLS program, 1280 total

M1052: 120 per PLS program, (60 for channels 1-8 and 60 for channels 9-16) 1920 total.

Scale Factor:

M1050A, M1051, M1052, M1053: Programmable from 16 to 999, common to all PLS programs (resolution 17 to 1000 counts/turn).

M1050-M10: Programmable from 2.56" (65.0 mm) to 40.00" (1016 mm) per resolver revolution. Maximum machine travel = 16 x scale factor. Scale factor is common to all PLS programs.

Offset:

M1050A, M1051, M1052, M1053: Programmable from 0 to Scale Factor Value, common to all PLS programs.

Speed Compensation:

M1050A: Programmable in Scale Factor units-per-100 rpm, up to full Scale Factor Value.

M1051: Programmable in Scale Factor units-per-100 rpm, up to full Scale Factor Value. Each PLS channel has its own speed compensation. 16 speed compensation zones for channels 1-4.

M1052: Programmable leading and lagging speed compensation for channels 1-5. Each speed compensation is programmable in increments of 1 ms.

M1053: Programmable in Scale Factor units-per-10 rpm, up to full Scale Factor Value divided by 10. Each of the first 8 PLS channels (1-8) has its own speed compensation.

Motion Detector Setpoints: Two, one LOW and one HIGH, common to all PLS programs. Programmable from 0 to 999 rpm.

Registration Pulse Width Resolution:

M1053: 14.7 ms

Eight PLS Outputs, Motion Output, and Fault Output in compact chassis. No external power relay chassis or customer supply needed. (Selected models do not use relay rack, except for expansion greater than 8 outputs).

Built-in speed compensation for all PLS Outputs, plus all inputs and outputs are fully isolated.

Eight PLS programs can be remotely or keyboard selected to simplify job change-over.

Simple creative keyboard with setpoints-per-program: 8-channel units--80, 16-channels units--160.

Programmable resolution from 17-1000 divisions-per-revolution.

- M1050A:** 8 outputs, Brake Monitor, ModZ
- M1051:** 16 outputs, 8 Power, 8 NPN Sink, Brake Monitor, ModZ, RS422/485 Serial Port
- M1051-R10:** 16 Electromechanical Relays, Rest standard 1051
- M1052:** "Glue Gun Control" PLS, with 3 gun control inputs read during programmable resolver windows
- M1053:** "Registration Control" PLS, with advance and Retard pulse outputs
- M1056:** "Press" PLS, with Anti Repeat and motion detection disable features
- M1050-M10:** Semi Absolute positioning for multi-turn applications



Performance PLS Products

Programmable Limit Switch in the Same Chassis

High-speed operation (100 μ s scan time)
and patented arrow keys for fine-tuning,
even with machine in full motion.



Brake monitor option and
built-in tachometer and
Motion Detector.

Rugged, reliable, resolver as
position transducer can be
mounted up to 2500 ft.
(762 m) away.

Simultaneous display of program
number, channel number, ON and
OFF setpoints, and output status.

Low Motion Enable:

M1052: Low Motion Enable, common to channels 1-5 associated with enable inputs EN1, EN2, EN3. Programmable from 0 to 999.

New Cycle Position:

M1052: Programmable from 0 to scale factor value. Common to channels 1-5 associated with enable inputs EN1, EN2, EN3.

Optional Brake Wear Monitor Limits: M1050A and M1051, Two, one Caution and one Danger. Programmable from 0 to 9.99 seconds.

SPECIFICATIONS (Continued)

RESOLVER INTERFACE:

Position Transducer: Single-Turn Resolver, AVG Automation Series RL 100, E7R, E8R, RL101, or equivalent

Cable Length Between Resolver and M1050 Series: 2500 ft. (762 m) max., shielded

Resolver Cable: AVG Automation CBL-10T22-XXX

Maximum Resolver Shaft Speed: 3600 RPM

Resolver Decoder: Ratiometric, tracks resolver shaft angle to 1800 RPM.

CONTROL INPUTS:

Electrical Specifications: (All Inputs)

Optical Isolation: 1500 V

Input Impedance: 1800 ohms

Logic Levels: TRUE: 1 to 28 VDC sourcing

FALSE: 0 to 0.8 VDC

Enable EN1, EN2, EN3:

M1052: TRUE enables selected channel (1 to 5).

Program Enable (PE): When TRUE, enables Programming, and (if EP input is also TRUE) External Program Number Select.

Program Enable 2 (PE2):

M1051: When TRUE, enables setpoint and setup (scale factor, offset, program number, etc).

Output Enable (OE): When TRUE, PLS Channel outputs enable, (Both, Fault, and Motion always enabled).

Fault Check Enable (FCE): When TRUE, disables PLS and Motion Detector Outputs whenever Resolver Broken Wire Fault or M1050-M10, M1051 internal fault occurs.

Registration Control (RC):

M1053: On FALSE to TRUE transition, the resolver position is captured and used for error calculations.

Operator Push-buttons (PB1 and PB2):

M1053: On FALSE to TRUE transitions, PB1 increments ref., retarding the timing of the motor while PB2 decrements ref., advancing the timing of the motor.

First Cycle Inputs (FCI) and Enable Inputs (EN1-EN3):

M1052: Channels 1 to 5 can be individually associated with either of the enable inputs EN1 to EN3. This association is user programmable from the keypad. Any channel 1 to 5 with an enable (EN1-EN3) programmed into. It is also controlled by the first cycle input and the programmed new cycle position.

Brake Input (BI): When TRUE, starts Brake Monitor Operation (For details, consult factory).

Supervisory (SUP):

M1050-M10: When TRUE, all programming modes enabled. When FALSE: only default, program number change, and setpoint modes enabled.

Modified Zero (ModZ):

M1050A, M1051, M1050-M10, M1053: On FALSE to TRUE transition, the resolver position is captured and used to zero the position for that cycle.

All ON:

M1050-M10: When TRUE, all output channels are energized. When FALSE, outputs are normal PLS control.

**Additional Specifications on page 38*

The M1250, M1450, and

A Fast, Highly-Versatile Family designed to Single-turn Rotary, Single-turn Linear, Multi-turn Linear,

40 Channels in 6.25" x 4.5" x 7.25" compact enclosure plus 57-85µs scan time assures high repeatability.

Standard PLS for "Canning" industry 57 Microsecond Scantime

Programmable Rate Offset (ROF) for automatic speed compensation and Dynamic Zeroing-ModZ-to modify the zero point for selected channels (M1450).

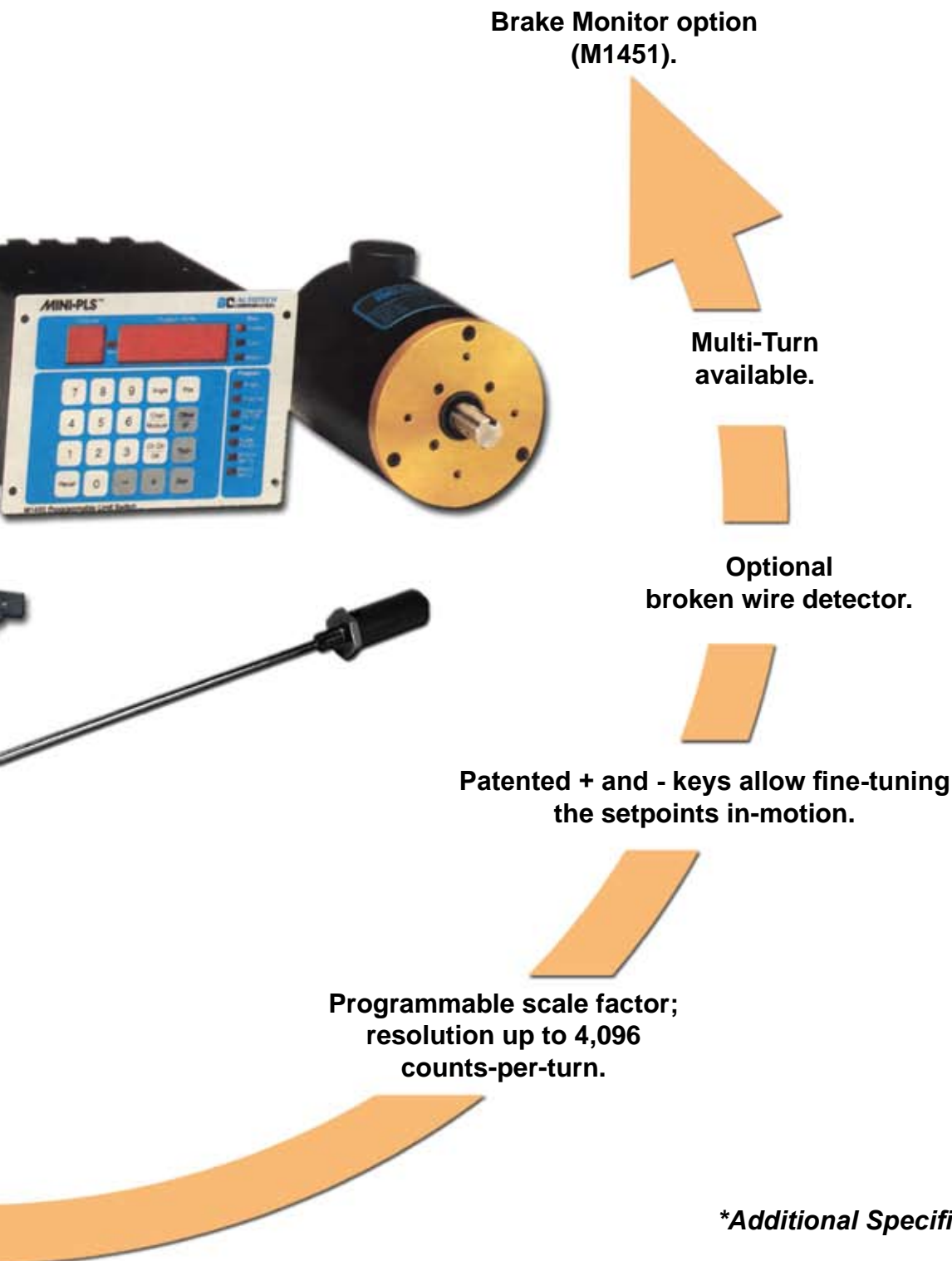
EEPROM transportable plug-in output modules make maintenance easy and Auto-Zero for zero offset.

Rugged reliable resolver or ultrasonic linear transducer inputs and Optically isolated power or logic outputs.



M1451 Mini PLS™ Family

be Applied to a Wide Variety of Applications
Linear Ultrasonic, Multi-turn Rotary, 40 PLS Outputs



**Additional Specifications on pages 34*

I² PLS M1950, The Most Compact PLS

80 PLS outputs with advanced functionality
2 Line 20 channel LCD, 4 digit LED, Hot Keys
100 jobs' storage, 100-280 microsecond scantime
All in a compact 6" x 4" x 10" Compact Control
***Die Protection modules also available**

The M1950 PLS

Introduction

Autotech's PLS and Mini-PLS families have continually set the standard for speed, precision, reliability, and product features in the Programmable Limit Switch marketplace. While retaining the key features and high standards of other Autotech products, the M1950 combines 80 power outputs, fault detection and indication, hundred user-defined PLS programs, and simple, easy-to-learn programming in one compact unit with a NEMA 12 front panel. In addition, each of the hundred PLS programs supports up to 20 ON/OFF setpoint pairs which may be used in any combination of 10 each on the low and high 8 channels, per PLS card. Also included are a fault output that indicates the source of the fault on the display for fast, easy troubleshooting and a motion detector that energizes when the resolver is rotating between motion limits.

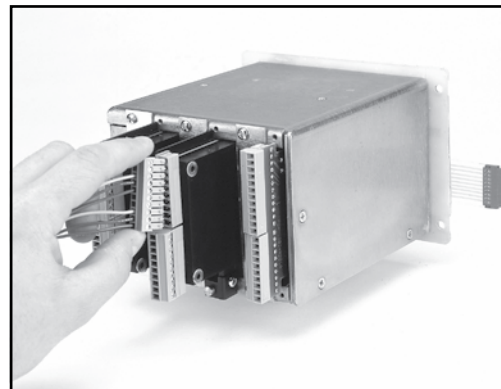
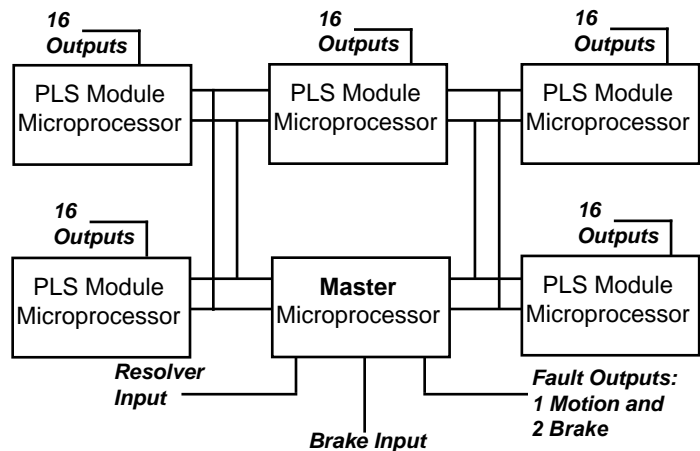
Intelligence of 6 Microprocessors in Unison

As shown in the block diagram below, the M1950 PLS has up to 6 microprocessors performing 6 logically independent tasks, yet working in unison.

Because of the power of 6 microprocessors, the M1950 PLS can process all 80 PLS outputs in a mere 280 microseconds at 600 RPM, simultaneously.

Advanced PLS Card

16 PLS output based upon selectable Angle On/Angle Off or Angle On/Time Off. All channels have their own individual leading edge and trailing edge speed compensation for those who like to tailor reaction time at different speeds for the On Time and Off Time. There are also two Modification to Zero (ModZ) inputs available. ModZ is used for dynamic zeroing the zero reference point of the resolver position upon input from your device. Upon external input signal, the resolver position is reset for the particular ModZ channel. Thereafter, the position is incremented as the resolver rotates forward and outputs are turned "on" and "off" at the programmed limit settings. This feature is ideal for gluing applications, where the glue-gun must be activated at a certain position after the detection of an upcoming product.



M1200 DPLS, The Most Popular Die Protection and PLS System

12 Sensor Inputs, Batch-Quality-Total-Tool Counters Bright VFD display: 2 Lines 20 Character, Hot Keys, Motion Detector, Brake Monitor, 6 PLS Power, 8 PLS Transistor Outputs, Advanced E-Stop, T-Stop, Slug-Detect Delay Programmability

Advanced DPLS Functionality

The M1200 DPLS monitors input sensors to ensure that proper conditions are established (as far as material progression is concerned) before the die makes a hit. Up to 12 sensor inputs are monitored within user-programmed position dwells. The position information comes from an Autotech resolver, such as the RL100. Each input can be monitored for a variety of events, such as rising edge, falling edge, position high, position low, or pulse events on input, within the programmed dwell. Absence of an event triggers a fault.

Each sensor input is programmed to deactivate either an immediate fault relay (E-Stop), or a T-Stop fault relay to synchronize with a programmable top stop angle. The fault relays are NO type and are held closed (energized) under normal condition, and opened (de-energized) under fault conditions.

Programmable engagement stop angle disables the E-Stop output from stopping the press at the bottom of the press stroke. This prevents sticking at the bottom.

Multiple Setup Storage

The M1200 can store setup information for up to 60 dies. A name of up to 8 characters identifies each setup.

Counters

The M1200 has 4 counter standards:

1. Batch counter is programmable to top stop the press when the preset number of parts are counted.
2. Quality counter is programmable to output allowing a part quality check.
3. Total counter is an upward counter that counts the total number of press hits.
4. Tool counter is an upward counter counting the number of hits made by the tooling.

Brake Monitor & Motion Detector

In addition, the M1200 has built-in brake monitor and motion detector. M1200 has programmable limits for press stop-time & motion, for these features.



Easy to Use

The software provides user-friendly menu driven programming and simple English language messages. The two-row 20 character vacuum fluorescent display offers clear visibility in plant environments. The unit has a review mode making programming of dwells for the sensors very easy. Like for setups, the unit supports 8 character names for sensor inputs. For convenience, a library of commonly used sensor names is provided in the unit. Hot keys allow quick access to desired functions.

14 Channel PLS

The M1200 has a PLS with power relay outputs built into the unit. The PLS offers 6 Relay outputs and 8 Transistor outputs. Each output offers speed compensation. PLS outputs can be used for press automation.

TouchPLS™ Fastest PLS on Ethernet,

Advanced PLS and Touchscreen Technologies combine to create a new breed of Programmable Limit Switches

From the Inventor of the Programmable Limit Switch comes a new concept, TouchPLS™.

When Autotech first invented the microprocessor PLS (Model M1000) in 1975, we had the following design objectives in mind:

1. The PLS had to be able to simulate the cam settings of rotary cam switches that were drawn in electrical diagrams used by engineers.
2. The PLS had to be able to fine-tune the cam settings while in motion.
3. The M1000 had to be accurate to 1° at 1800 RPM.

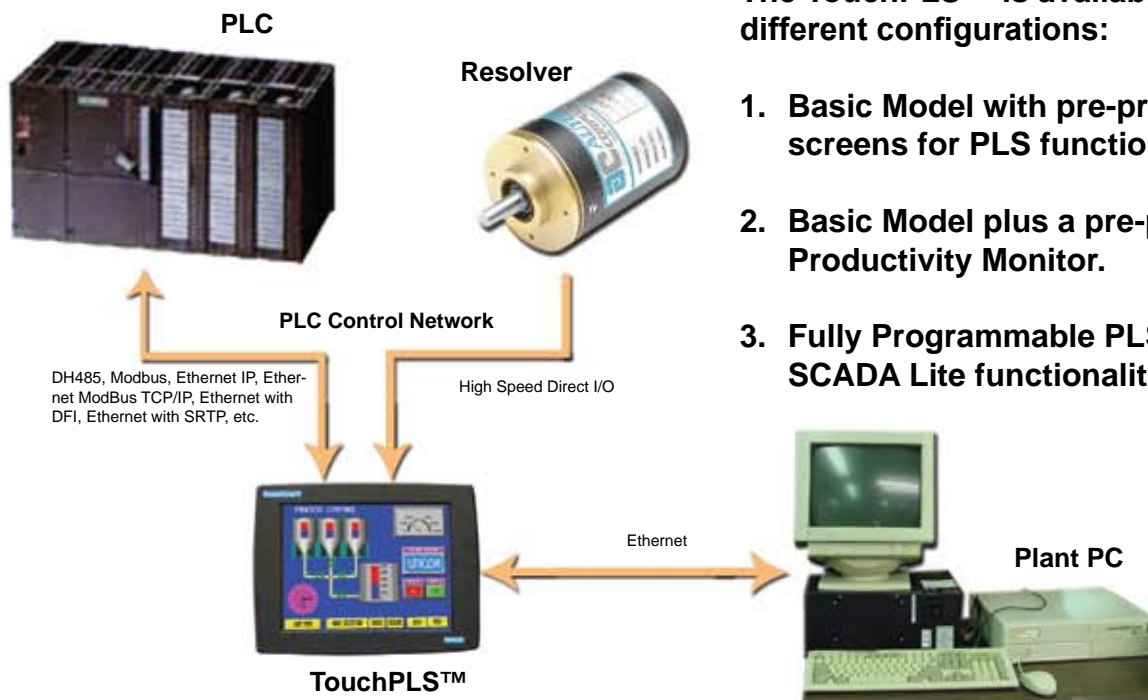
The M1000 achieved these goals. Since that time a number of different PLSs have been introduced including over 20 different models from Autotech itself, but none have been as innovative as the TouchPLS™.

The Touch PLS™ not only has all the features found in Autotech's most advanced PLS products (Dual edge speed compensation, pulse programming, angle ON/TIME OFF, ModZ, broken wire detection, etc.) but the Touch PLS™ has gone far beyond.

You now have the PLS of your dreams. You no longer have to enter multiple codes and numbers to change the PLS settings. Simply read machine position and speed and change values by the touch of your fingers! Watch the cam settings change before your eyes in the form of graphs. And that's just the beginning! The Touch PLS™ is connectable to more than 40 PLC control networks as well as most of the Ethernet protocols.

The TouchPLS™ is available in these different configurations:

1. **Basic Model with pre-programmed screens for PLS functionality.**
2. **Basic Model plus a pre-programmed Productivity Monitor.**
3. **Fully Programmable PLS and HMI with SCADA Lite functionality.**



with Touch Screen Settings TouchPLS™

PLS, with blazing speed and Total integration with PLC Control Networks, and optional Productivity Monitor.

Maximum RPM of 3600
3/8" - 5/8" Shaft Resolvers
-67 to +248 °F, NEMA4/4X Submersible,
Explosion proof options.

Broken wire detection
and Short-Circuit-Proof
Resolver wiring.

Touchscreen Graphical
PLS settings.

Graphical display
to show machine
position, RPM, and
output status.

Ratiometric converter
for highest noise
immunity even up to
2500 feet away.

Fine tune PLS settings
while in motion.

Less than 30 Micro second
response time along with
4096 per rev. resolution,
better than 0.1° accuracy.

Unlimited number of programs, on
board as well as downloadable from
PLC, stored on field replaceable
Flash Modules.

The TouchPLS™ also has
the ability to connect to most
major PLCs.

TouchPLS™ Programmable Screens with SCADA Lite HMI Built-in

**Offering a new horizon in PLS functionality
For the first time you can select, configure, or even
create a PLS system to meet your specific needs.**

This is just one possibility:

Create your own productivity
monitor like other Uticor
customers have done.

Display Uptime, Downtime, Good
Parts, Bad Parts, and send them
over the Ethernet.

Select cam to be set,
choose ON/OFF as many
times as you need, and
increase or decrease
settings while in motion.



Output, input, and
Cam Status lights.

Make multiple screens to
fit the process or task you
want to display.

Display cam position
and output status on
the screen.

Look at Shift Count compared
to Actual Count and send that
information to a marquee.

6" Monochrome to 15" TFT Models:



Specifications

TouchPLS	6" Mono 6" Color STN	8" Color STN	10" Color TFT	15" Color TFT
Display	Mono: 4.72" x 3.5" 16 Gray Shades Color: 4.65" x 3.5" 128 Colors	6.65" x 5.024" 128 Colors	8.31" x 6.22" 128 Colors	12.02" x 9.02" 128 Colors
Screen Pixels	320 x 240	640 x 480		
Operating Temp	0 - 50 °C	0 - 45 °C	0 - 55 °C	0 - 55 °C
Ext. Dimensions	8.576" x 6.800" x 2.800"	10.516" x 8.212" x 2.800"	13.168" x 10.124" x 3.035"	16.100" x 12.336" x 4.208"
Panel Cutout	7.54" x 5.64"	9.25" x 7.10"	11.93" x 8.94"	14.96" x 11.68"
Display Brightness	Mono: 140 nits Color: 180 nits	140 nits	200 nits	250 nits
Touch Screen	48 resistive cells (8 x 6 matrix)	192 resistive touch cells (16 x 12 matrix)		
Weight	Mono: 2.2 lbs. Color: 2.3 lbs.	2.9 lbs.	4.75 lbs.	8.9 lbs.
Power Input	20 - 30VDC 15 Watts @ 24VDC	20 - 30VDC 16 Watts @ 24 VDC	20 - 30VDC 18 Watts @ 24VDC	20 - 30VDC 33 Watts @ 24VDC
User Memory	512Kb System RAM			1Mb System RAM
RAM Modules	512Kb RAM Module, 1Mb RAM Module			
Flash Modules	512Kb Flash Module, 1Mb Flash Module, 2Mb Flash Module			
Applications	Single-Turn Rotary			
Position Input Devices	Autotech "E Series" Resolvers, 1/8" - 5/8" Shaft, Size 11 - Size 40, Up to 100lb Shaft Loading NEMA 1 - NEMA 4X, Class1, Div.1			
Number of Outputs	32 Total (16 Hard CAMs, 8 with Timer, 16 Soft CAMs to PLC)			
Expansion Capability	256 with 7 Slave Units			
Number of Programs	More than 500, Limited Only by User Memory			
Multiple Setpoints / Channel	Yes, Up to 256 per PLS Program			
Scan Time	26 Microseconds Total for all 256 Setpoints Including Speed Compensation and All Other Overhead			
Resolution Counts / Turn	1 - 4096			
Programming	Graphical Touch Panel Interface, and/or through Ethernet / PLC Port			
Communications	Serial RS232/422/485, or Ethernet for Programming, All PLC Protocols for Control Integration such as DH485, Modbus, Ethernet IP, SNP, FX, and numerous others			
Optical Isolation	Yes, Both input and output			
Types of Outputs	0.5 Amp 24VDC P or N			
Fine Tuning in Motion	Yes			
Operator Interface for PLC and PLS	PLS and PLC Operator Interface can be Programmed if Ordered with this option			
Productivity Monitor	Optional			
Speed Compensation	Leading or Trailing Edge for each channel, Programmed in Msec			
Dynamic Zeroing / ModZ	3 ModZ Inputs, Edge Triggered			
Brake Monitor	Optional, Check for Availability			
Motion Detector	Yes, Speed Detection Programmable from 0 - 2800 RPM			
Short-Circuit-Proof Resolver Connection	Yes			
NEMA / Agency Approval	NEMA 4X, Stainless Steel Option, UL, cUL, CE			
Environmental	Shock: 10G for under 12 msec, Vibration: 5-55Hz 2G for 2 hours, Humidity: 10-95% RH Non Condensing, Electrical Noise: NEMA ICS 2-230, Showering Arc, Ansi C37, 90a-1974 SWC, Level C Chattering Relay Test			

Features - Programmable Limit Switches

FEATURES	M1020	M1050 Series, M1050-A10, -M10, M1051-010, -R10, M1052-010, M1053-010, -020, M1056-P10	M1151	M1250, M1450-300, M1450-400, M1450-MROF	M1450-D64, M1450-D128, M1450-LTO	M1950	NPRLS, Touch-PLS, 5", 6", 8", 10", and 15" Models (NPRLS Also available without display)
Application:	Single-Turn Rotary	Single-Turn Rotary	Single-Turn Rotary	Single-Turn Rotary	Multi-Turn, Linear	Single-Turn Rotary	Single-Turn Rotary
Position Input Devices:	ML-Grade Resolver	ML-Grade Resolver	ML-Grade Resolver	ML-Grade Resolver	ML-Grade Resolver	ML-Grade Resolver	ML-Grade Resolver
Number of Outputs:	8	8 or 16	8 or 16	8-40 in multiples of 8	8-40 in multiples of 8	16 to 80 in multiples of 16	32 for Touch PLS 8 for NPRLS
Expansion Capability:	None	128 with 7 slave units	128 with 7 slave units	320 with 7 slave units	320 with 7 slave units	640 with 7 slave units	640 with 7 slave units
Number of Programs:	1	Varies, see product details	4; Keyboard or remote selectable	Unlimited, plug-in program modules	Unlimited, plug-in program modules	100	more than 500 Limited only by user memory
Multiple Setpoints per Channel:	NO	YES	YES	YES	YES	YES	Yes, up to 256 per PLS program for Touch PLS Yes, up to 16 per output for NPRLS
Scan Time:	Setpoint Dep. 430 µs max	120 µs to 2.7 ms	120 - 200 µs	57 µs to 85 µs for M1250 180 µs to 2.7 ms for others	1.3 to 2.7 ms 3.5 ms for LTO	120 to 280 µs	26 µs
Resolution Counts/Turn:	Fixed, 359 scale	17 - 1000	17 - 1000	~300' 17-1000' 400' 10-4096' M1250, MROF: 17-1000	10 - 4096	17 - 1000	10 - 4096
Programming:	Keyboard 5 keys only	Keyboard; 5 keys only (serial, selected models only)	Keyboard; 5 keys only	Keyboard	Keyboard	2 Line - 20 character LCD, 4-digit LED and keypad	PC and/or Touchscreen input
Zero Offset:	YES, to 359	YES	YES	YES	YES	YES	YES
Optical Isolation Output: Inputs:	NO NO	YES YES	YES YES	YES YES	YES YES	YES YES	YES YES
Types of Outputs:	Relay or solid-state	Built-in Power Outputs	Logic Outputs; Power Outputs with Remote Chassis	Built-in Power or Logic Outputs	Built-in Power or Logic Outputs	Built-in Power or Logic Outputs	Built-in Power or Logic Outputs
Fine-Tuning in Motion:	NO	YES	YES	YES	YES	YES	YES
Plug-in Outputs:	None	YES	YES	YES	YES	YES	NO
Self-Diagnose:	NO	YES	YES	NO	NO	YES	YES
Speed Compensation:	NO	YES	YES	YES	YES	YES	YES
Dynamic Zeroing / ModZ:	NO	Varies, see product details	Optional	YES, except M1450-MROF	YES	YES	YES
Serial Link:	NO	Certain Models supported	NO	NO	NO	NO	YES, RS-485A or Ethernet
Shift Register:	NO	NO	Optional	NO	NO	NO	NO
Brake Monitor:	NO	YES	Optional	NO	NO	YES	YES
Tachometer:	YES	YES	Built-in	Built-in	Built-in	YES	YES
Motion Detector:	NO	YES	YES	YES	YES	YES	YES
Short-Circuit-Proof Resolver Connection:	YES	YES	YES	YES	YES	YES	YES
Output for Remote Devices Position: Tachometer:	NO NO	NO Varies, see product details	Optional, Analog Optional, Analog	Analog or Digital Analog or Digital	Analog or Digital Analog or Digital	Analog or Digital Analog or Digital	YES, through network YES, through network
Size Width: Height: Depth:	7.25" (184.15mm) 5.5" (139.7mm) 5.3" (134.62mm)	7.25" (184.15mm) 5.25" (133.35mm) 5.12" (130.05mm)	4.11" (104.39mm) 2.19" (55.63mm) 6.12" (155.45mm)	5.25" (133.35mm) 4.5" (114.3mm) 7.25" (184.15mm)	5.25" (133.35mm) 4.5" (114.3mm) 7.25" (184.15mm)	6.25" (158.75mm) 5.5" (139.7mm) 5.25" (133.35mm)	See page 37
NEMA Rating (Face Plate):	NEMA 1	NEMA 12	NEMA 12	NEMA 12	NEMA 12	NEMA 12	NEMA 4X
Page:	25	28, 29	26, 27	30, 31	30, 31	32	34-37

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