PROFIBUS-DP Slave
E7N and E5N DigiSolvers

Instruction & Operation Manual

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The PROFIBUS-DP Slave E7N and E5N DigiSolver

Introduction

The DigiSolver, a Digital Resolver

The PROFIBUS DigiSolver is a resolver-based encoder, in which the analog signal produced by a brushless resolver is transformed to a digital format by a built-in ratiometric tracking converter. This new concept and the advanced technology of the DigiSolver, with electronic circuitry, provides higher accuracy, increased reliability, higher operating speeds, more flexible counts per turn and a smaller size than optical encoders.

No Optics, Mil-Grade Resolver
There is no optical coded disc or similar component used in the DigiSolver. A miniature Mil-Grade resolver produces an analog position signal and high-grade electronics molded in epoxy transforms this signal to digital format. The resolver is a passive transducer, well known for its ruggedness and performance in hostile industrial environments. The DigiSolver combines the ruggedness of a resolver with the reliability of solid-state electronics and is designed to operate reliably under severe environmental conditions, such as mechanical shock, vibrations, temperature and humidity changes, oil mist, coolants and solvents. No broken discs! No disc misalignments! No LED aging!

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

Single-Turn Operation
The DigiSolver is an absolute encoder, that is, it keeps track of the exact shaft position even during power outage or switching off the machine. At power-up, the DigiSolver will pick up the exact shaft position even if the machine moved during the power outage. In a single-turn operation, the machine cycle is completed during one complete revolution of the transducer shaft.

Field Selectable CW or CCW Operation
The DigiSolver is factory wired for ascending counts with Counterclockwise shaft rotation. However, the direction of operation can be easily selected in the field by opening up the case and simply reversing the DigiSolver input plug. No wires need to be unsoldered or soldered.

Ratiometric Resolver-to-Digital Converter
The Autotech ratiometric tracking converter is practically immune to electrical noise, voltage, frequency and temperature variations, and can track speeds up to 5000 RPM.

PROFIBUS Connection
The PROFIBUS E7N DigiSolver model is enclosed in a size 25 (2.5-inch diameter), NEMA 13 housing and designed for medium duty applications. It is available as a flange mount or a servo mount model with a PROFIBUS connector at the end. The E5N model is encloseded in a size 40 (4-inch diameter), NEMA 13 housing and is designed for heavy duty applications. It is available as a facemount with a PROFIBUS connector at the end.

Variety of Outputs
The DigiSolver is available with Binary, Gray Code, or BCD absolute position output formats.

Power Supply
An existing power supply can be used to power the DigiSolver, that is, if a programmable controller operates at 24 VDC, a 16-32 VDC DigiSolver model can be connected to the same power supply, thus cutting down the system cost.

Flexible Programming of Counts Per Turn
The advanced R to D converter used in the DigiSolver has made it possible to program any number of scaled Binary, BCD, or Gray Code counts per revolution. The default encoding format is set to 10 bit Gray Code.

PROFIBUS (PROCESS FIELD BUS)

The DigiSolver was designed to operate within a PROFIBUS Communication System. Serial field buses are used today primarily as the communication system for exchange of information between automation systems and distributed field devices. Thousands of successful applications have provided impressive proof that use of field bus technology can save up to 40% in costs for cabling, commissioning and maintenance as opposed to conventional technology.

PROFIBUS specifies the technical and functional characteristics of a serial fieldbus system with which decentralized digital controllers can be networked together from the field level to the cell level. PROFIBUS distinguishes between master devices and slave devices.

Master devices determine the data communication on the bus. A master can send messages without an external request when it holds the bus access rights (the token).

Slave devices are peripheral devices. Typical slave devices include input/output devices, valves, drives and measuring

transmitters. They do not have bus access rights and they can only acknowledge received messages or send messages to the master when requested to do so.

PROFIBUS-DPSlave DigiSolver
PROFIBUS-DP is designed for high-speed data transfers at the sensor actuator level. At this level, controllers (e.g., PLCs, PCs, UTICOR's PowerPanel) exchange data with their field devices (I/O, drives, valves, resolvers, etc.) via a high-speed RS-485 serial link. Most of the data communication with these distributed devices is done in a cyclic manner.

RS-485 transmission is the transmission technology used by PROFIBUS, and it is very easy to handle. Installation of the twisted pair cable does not require expert knowledge. The bus structure permits addition and removal of stations or step-by-step commissioning of the system without influencing the other stations.

Transmission speeds between 9.6 kbit/sec and 12 Mbit/sec can be selected. One unique transmission speed is selected for all devices on the bus when the system is commissioned.

The unit is designed to be a single-turn DP Slave DigiSolver on a PROFIBUS-DP network. The unit is configured to look like one 16-bit output word and one 16-bit input word to the network. Four bits of the output word select the encoding format and scale factor of the resolver. The other 12 bits of the output word are unused. 10 or 12 bits of the input word are used for the encoded position data. The unused bits of the input word are always zero.

If no output word from the PROFIBUS Master is written to the output word after powerup, the output word is set to zero. The default zero encoding format is selected.

DigiSsolver position data can be encoded in three different data formats. For each data format there is a choice for maximum counts per revolution. The following are the possible data encoding format choices:

- Binary: 1024, 4096
- BCD: 360, 1000, 3600
- Gray Code: 256, 360, 512, 1024, 4096

As a slave on the PROFIBUS network, the DigiSolver does not initiate any communications, it responds to requests from the DP master. Data exchange commands must be initiated from DP masters. Output encoding data is sent from a DP master as a 2 byte output word (16 bits). Byte N is the most significant 8 bits of the data word. Byte N+1 is the least significant 8 bits of the data word. Input position data is returned to a DP master device from the DP DigiSolver slave as a 2 byte input word (16 bits). Byte N is the most significant 8 bits of the data word. Byte N+1 is the least significant 8 bits of the data word.

Note: The number of position data bits returned is a function of the data format and the maximum counts per revolution of the resolver.

Output/Input Word Selection Chart

Output Word		Input Word		Encoding	Scale Factor
MSD	LSD	MSD	LSD		
XXXXXXXX	XXXX0000	000000DD	DDDDDDDD	Gray Code	1024
XXXXXXXX	XXXX0001	00000000	DDDDDDDD	Gray Code	256
XXXXXXXX	XXXX0010	0000000D	DDDDDDDD	Gray Code	360
XXXXXXXX	XXXX0011	0000000D	DDDDDDDD	Gray Code	512
XXXXXXXX	XXXX0100	0000DDDD	DDDDDDDD	Gray Code	4096
XXXXXXXX	XXXX0101	000000DD	DDDDDDDD	Binary	1024
XXXXXXXX	XXXX0110	0000DDDD	DDDDDDDD	Binary	4096
XXXXXXXX	XXXX0111	000000DD	DDDDDDDD	BCD	360
XXXXXXXX	XXXX1000	0000DDDD	DDDDDDDD	BCD	1000
XXXXXXXX	XXXX1001	DDDDDDDD	DDDDDDDD	BCD	3600
XXXXXXXX	XXXX1X1X	FUTURE			
D = Data					

Electrical Specifications

Input Power

Voltage: 16-32 VDC **Current:** 0.70 Amp @ 24 VDC

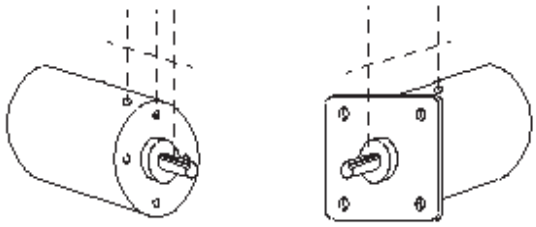
Installation

Mounting

1. Servo-Mount:
The DigiSolver can be either mounted with traditional servo-clamps or through the four 4-40 mounting holes on the face of the resolver.

Zero Reference (±5°) : When flat on shaft lines up with the screw in the case and the two mounting holes on the face plate.

Zero Reference



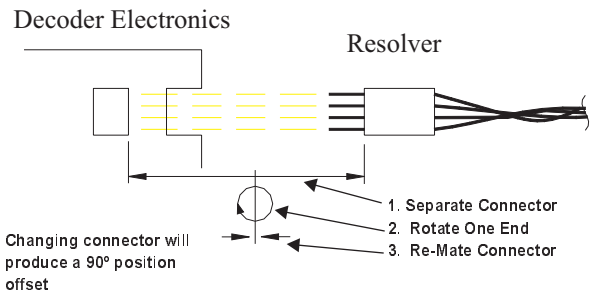
2. Flange-Mount:
The DigiSolver can be mounted using the four .218 diameter mounting holes on the square face plate.

Zero Reference (±5°): When flat of shaft lines up with the case screw that is in the middle of a flat side.

Direction of Rotation

The direction of rotation is normally set at the factory for increasing count with CCW rotation (viewed from the shaft end). This may be changed to increasing count with CW rotation by reversing the internal connector between the resolver and decoder electronics. When ordered with external CW/CCW selector switch, the selection switch is mounted at the back end. When reassembled, ensure connector mates securely and wiring is not pinched.

Direction of Rotation Vs Increasing Count Adjustment



CAUTION NOTES:

1. It is recommended that E7 series DigiSolver be coupled to an external shaft using a flexible coupling. Autotech recommends ACR series helical couplings. For further information contact helical products company directly at 805/928-3851.
2. NEMA 13 rating - to maintain the NEMA 13 rating of the DigiSolver, the bearing seals must be checked once every six months and replaced if necessary. Lubricating the bearing seal periodically prolongs its life.
3. If the DigiSolver is to be axially driven, be sure that the shafts are aligned. if misaligned, it can destroy the DigiSolver bearing.
4. The DigiSolvers must be returned to the factory for repair. DO NOT ATTEMPT TO REPAIR the Electronic Module in the field; THIS WILL VOID ALL WARRANTIES.

Wiring

1. The shielded interconnecting cable should be routed in its own conduit and kept separate from other high voltages/high inductance wiring. The shield drain wire should be connected to earth ground at both ends of cable.

2. This equipment uses isolated Sig Ref (Com). Failure to assure at least 100 K Ohm resistance between sig ref and earth ground may cause erratic output data.

CAUTION: Check the cable wiring before applying power to the DigiSolver

Grounding & Shielding

Failure to observe any of these requirements may cause unpredictable operation and will void any warranty.

1. All logic level wiring (including external power supply) must be done using overall foil shielded cables, with shields and equipment grounded as per above drawings. It is recommended that the DigiSolver shielded cable be run in its own separate conduit.

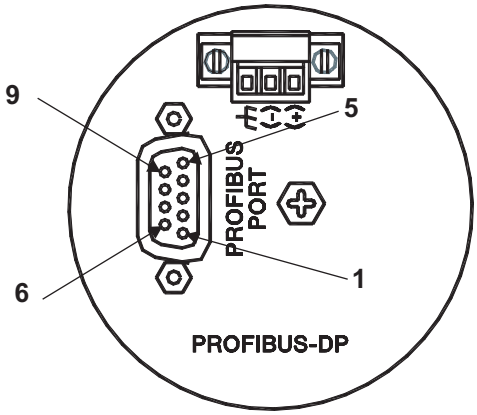
2. All ground planes on which the DigiSolver and all external equipment are mounted must be held to the same RF potential, by good metallic connections to building frames, conduit or wiring trays.

3. All shielded cable must be kept at a minimum distance of 2 inches from all high voltage or inductive wiring.

4. All shielded resolver cable must be kept at a minimum distance of 12 inches from all motor wiring controlled by AC or DC drives.

5. CAUTION: This equipment has an isolated Sig Ref (common). Failure to maintain this isolation between chassis ground (earth ground) and Sig Ref in external equipment (power supply or I/O cards) may cause electrical noise interference resulting in unpredictable operation of this equipment.

PROFIBUS-DP DigiSolver Connector



The PROFIBUS-DP Slave DigiSolver's Communication port is a female 9-pin D-sub connector. The pinout table is provided below.

Pin Number	Function
1	Not used
2	Not used
3	RXD/TXD+
4	Not used
5	COM ground
6	Not used
7	Not used
8	RXD/TXD-
9	Not used
Shield	Chassis ground

Power is brought to the PROFIBUS-DP Slave DigiSolver by a 3-pin Phoenix quick disconnect. The three power connections are: 1) +16–32 VDC; 2) DC GND; 3) Chassis GND.

The hardware connection for the PROFIBUS-DP interface is an optically isolated RS-485 connection. The DP Slave DigiSolver can handle Baud Rates from 9.6 Kbits/sec. to 12 Mbits/sec. The DP Slave DigiSolver handles detecting the baud rate automatically (Auto-Baud Detectable). The DP Slave DigiSolver's communication port is a female 9-pin D-sub connector.

Installation Hints for RS-485 Transmission

Up to 32 stations (master or slaves) can be connected in one segment. The bus is terminated by an active bus terminator at the beginning and end of each segment. To ensure error-free operation, both bus terminations must always be powered. When more than 32 stations are used, repeaters (line amplifiers) must be used to connect the individual bus segments.

The maximum cable length depends on the transmission speed. (See table below.) The specified cable length can be increased by the use of repeaters. The use of more than 3 repeaters in series is not recommended.

Distances based on transmission speed for type A cable							
Baud Rate (kbit/sec)	9.6	19.2	93.75	187.5	500	1500	12000
Distance/Segment	1200m	1200m	1200m	1000m	400m	200m	100m

Device ID Numbers

Each PROFIBUS-DP device on the network has an ID number. **The PROFIBUS-DP Slave DigiSolver ID number is 0887.** This number can be read by DP masters as a way to identify what slave device it is communicating with on the network. This number is factory set and cannot be changed. Also, each PROFIBUS-DP device on the network has a station number (TS Address). The PROFIBUS-DP DigiSolver TS address is programmable. Valid addresses are 1-126 decimal. Units shipped from the factory have the TS address preset at 126 decimal.

The TS address number can be field configured using a Class-2 DP Master (DPM2) programming/configuration/diagnostic device.

NOTE: All configuration commands must be initiated from Class-2 DP masters.

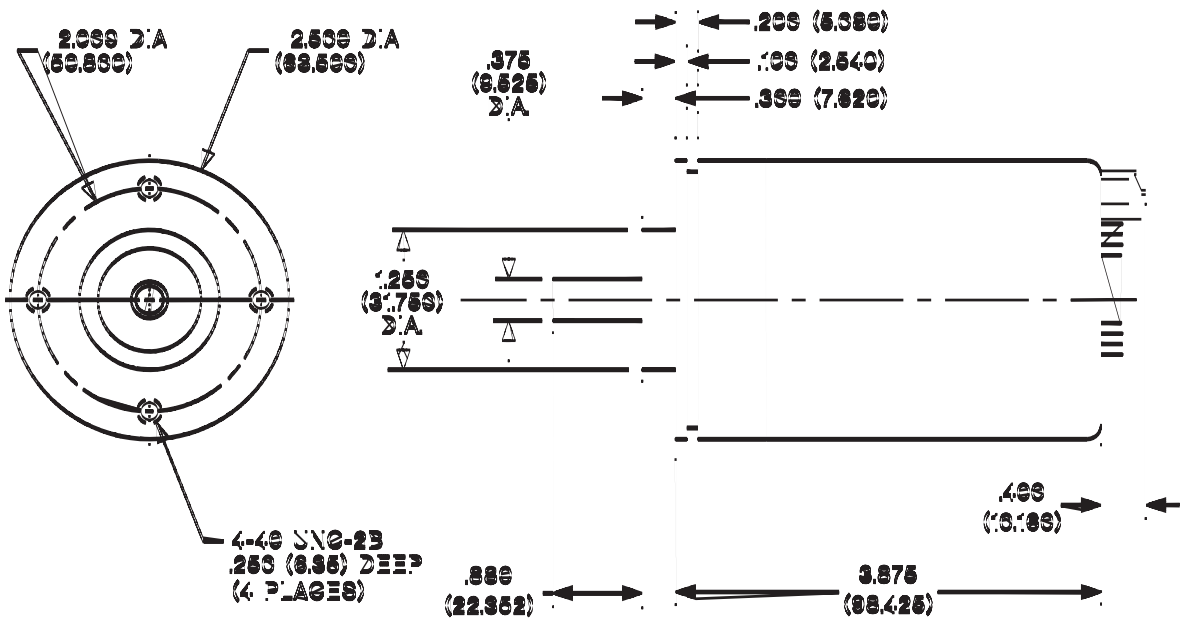
Class-2 DP masters are programmers, configuration devices or operator panels. They are used during commissioning for configuration of the DP Slave DigiSolver and for operation and monitoring purposes.

A Class-1 DP master (DPM1) is a central controller that exchanges information with the DP Slave DigiSolver within a specified message cycle. Typical master devices include programmable controllers (PLCs), and PC or VME systems.

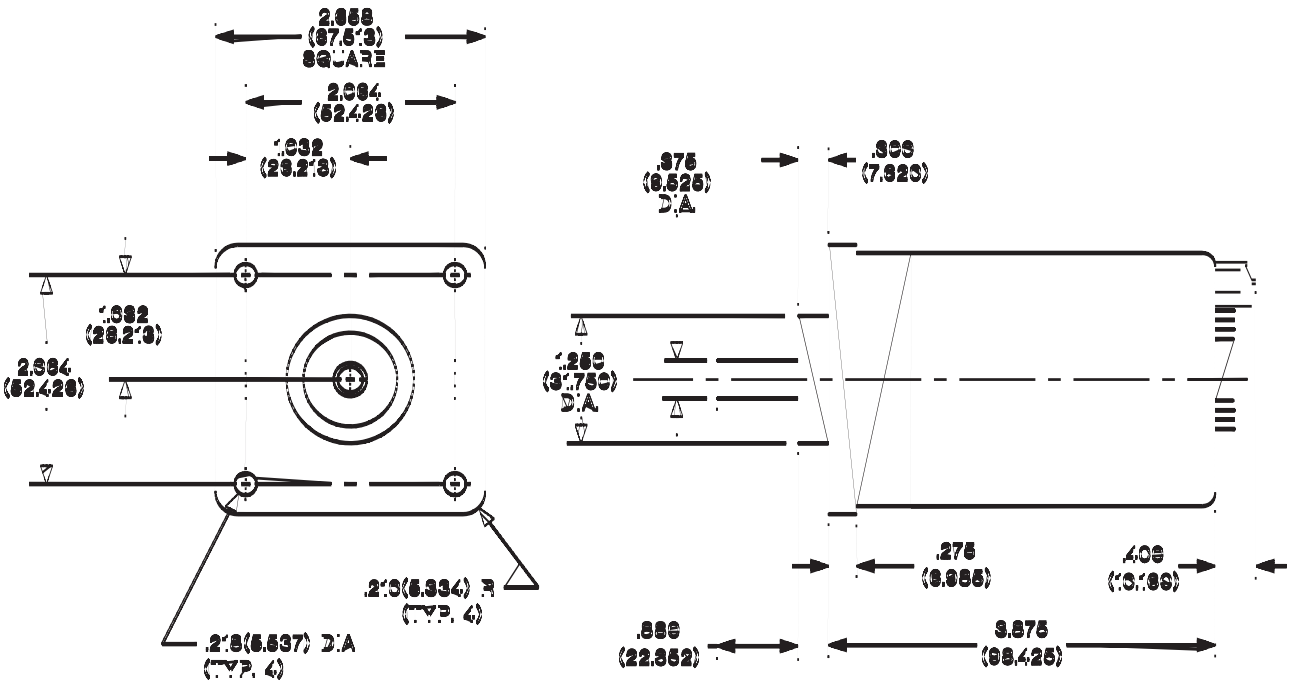
Outline Dimensions

The outline dimensions of the DigiSolvers are shown in the following diagrams.

Servo Mount



Flange Mount



How to Order

Network DigiSolvers: Single-Turn

E X N – X XXXX – 9F X X
1 2 3 4 5

Field selectable or factory set output format and resolution. Input Power Supply: 16 to 32 VDC

1. Housing Type:

7:	NEMA 13, size 25 (2.5" dia.), medium duty bearings
5:	NEMA 13, size 40 (4" dia) heavy duty bearing *(Consult factory)*

2. Option:

S:	Output format and counts per turn field selectable, Factory default set for 1024
G:	Output format and counts per turn factory set (Gray Code)
B:	Output format and counts per turn factory set (Natural Binary)
D:	Output format and counts per turn factory set (BCD)

3. Output Format and Counts Per Turn: Field selectable or factory set
(Note: Custom counts available, consult factory)

Field Bus Selectable:	**0000**
Gray Code:	**0256, 0360, 0512, 1024, 4096**
Natural Binary:	**1024, 4096**
BCD:	**0360, 1000, 3600**

4. Type of Field Bus:

R:	PROFIBUS
I:	InterBus-S
D:	DeviceNet

5. Mounting Style:

F:	Flange (E7)
S:	Servo (E7)
M:	Facemount (E5)

WARRANTY

Autotech Controls warrant their products to be free from defects in materials or workmanship for a period of one year from the date of shipment, provided the products have been installed and used under proper conditions. The defective products must be returned to the factory freight prepaid and must be accompanied by a Return Material Authorization (RMA) number. The Company's liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company's option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

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Autotech Controls' products are carefully engineered and rigorously tested to provide many years of reliable operation. However any solid-state device may fail or malfunction sometime.The user must ensure that his system design has built-in redundancies if Autotech Controls' product is being used in applications where a failure or malfunction of the unit may directly threaten life or cause human injury. The system should be so designed that a single failure or malfunction does not create an unsafe condition. Regularly scheduled inspections, at least once a week, should be made to verify that the redundant circuits are fully functional. All faults should be immediately corrected by repair or replacement of the faulty unit. In addition, the user may have to comply with OSHA, ANSI, state or local standards of safety. The user of Autotech Controls' products assumes all risks of such use and indemnifies Autotech Controls against any damages.

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