1. Introduction

Principle of Operation

The M8350 series resolver to digital decoder module provides a flexible, cost-effective, modularly constructed, space saving decoder that is used in conjunction with any one of Autotech's single turn resolvers and a specific programmable controller I/O rack. The M8350 is installed into one or two physical slots of an I/O rack. The modular plug-in system consists of three components:

- **Cradle (specific to the programmable controller)**
- **Function Module (for example: PLS or Resolver Decoder)**
- **Filler Module**

The M8350-010 Resolver Decoder Function Module is an intelligent, 12-bit, single-turn resolver decoder module. It is a member of Autotech Controls' LBus family of products and can be used in any of the LBusModules to interface to PLCs.

The M8350 Modules communicate with the programmable logic controller (PLC) through input and output registers. The Module's input registers allow you to read the resolver's shaft position, velocity (speed) and I/O status. The output registers allow you to program scale factor, offset, and high and low motion limit parameters from the PLC.

The Module offers Motion Detection, Broken Wire Detection, Diagnostic Fault Bit, and Direction Bit Detection through an I/O status word.

The functional block diagram of Autotech's Programmable LBus resolver decoder model M8350-010 is shown in figure 1. The M8350-010 accepts an input from a single turn resolver (such as Autotech's RL100, E6R, E7R and E8R series of resolvers) and decodes it to give a scaled 12-bit digital position signal. The decoded resolver position information is displayed on the front panel of the unit.

Simple User Interface

The M8350 Module is user-friendly. The five self-explanatory keys make programming the M8350 extremely simple. There are no long complex key sequences to remember. All functions are programmable with the five front panel keys and a smart front panel display. Figure 2 illustrates the M8350-010 Front Panel and Keyboard. Most commands are also programmable through the LBusModule to a specific PLC.

Programmable Resolution: 20–4096 Counts per Turn:

The programmable scale factor feature provides the flexibility of selecting the resolution. Resolution does not have to be defined at the time of ordering the unit. This feature allows for scaling the position to desired engineering units (inches, mm, etc.) as required. The scale factor value can be programmed from the front or from the programmable controller via the backplane.

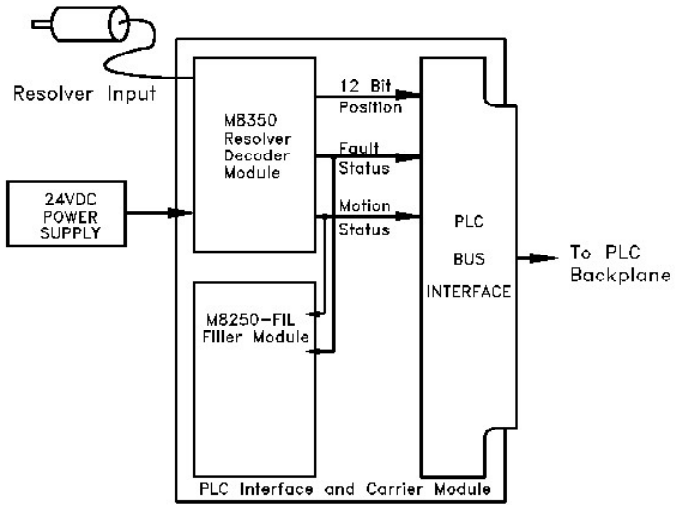


Figure 1. M8350-010 System Diagram

1. Introduction

The scale factor (desired counts per turn minus one) is programmable for 19–4095 to match the display and position to any output desired units in this range. For example, a scale factor of 359 may be selected to display resolver position in degrees, and a scale factor of 3599 will display the position in tenths of a degree.

Alignment to Machine Zero Made Easy

The resolver may be aligned to machine zero from the front panel keypad, or from the programmable controller and backplane. 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. 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.

Self Diagnostics with Fault Output

The M8350-010 is provided with an internal self check circuit that continuously monitors the microprocessor, DC power supplies, and resolver cable. 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.

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 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 and Motion Detector

The built-in tachometer and motion detector are updated over 68 times per second to provide fast, accurate indication and detection of rotary motion. The motion detector is programmed to energize the motion I/O status bit when the machine's RPM is between the low and high motion limits.

Broken Wire Detector

The Broken Wire I/O Status Bit is normally energized when the M8350 Module is operating normally and the resolver wiring is intact. If one or more of the resolver wires are broken or disconnected, the I/O status bit will de-energize.

Programmable Scale Factor/ Programmable Offset

The scale factor is programmable 19–4095 counts/ revolution. Offset is programmable from 0 to Scale Factor Value.

Program Security

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

Rugged and Reliable Resolver as Position Transducer

The M8350-010 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 environments 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.

1. Introduction

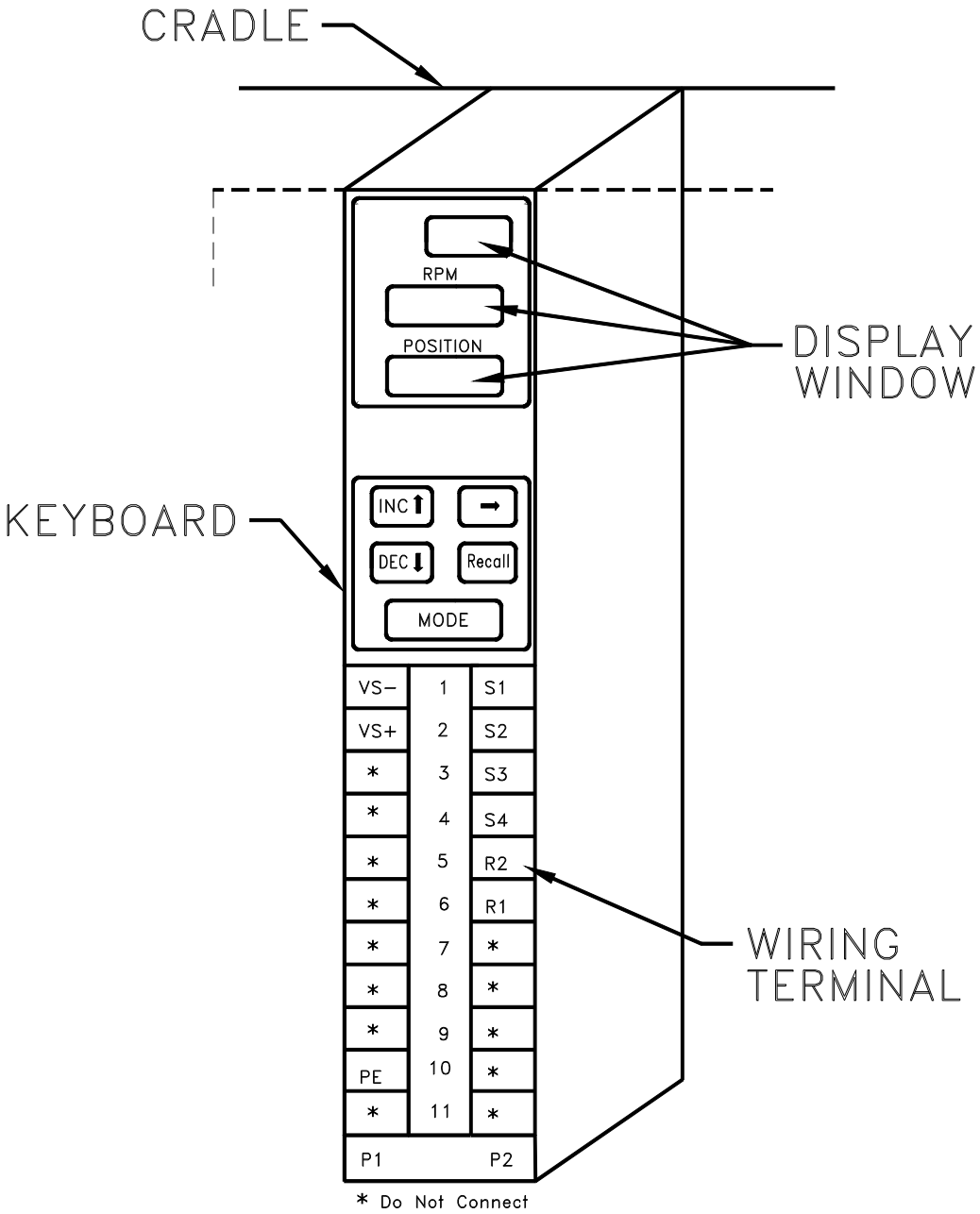


Figure 2. M8350-010 Front Panel and Keyboard

1. Introduction

Decimal Address: 132

Single-Turn Resolver Decoder
I/O Status (16 Bit)

MSD															LSD
X	X	X	X	X	X	MB	BW	X	X	X	X	DF	X	DB	PE

X = Not Used

PE = Program Enable
0 = Not energized
1 = Energized

DB = Direction Bit
0 = Clockwise (CW)
1 = Counterclockwise (CCW)

DF = Diagnostic Fault Bit
0 = Fault, 1 = No Fault

BW = Broken Wire Detection
0 = Fault, 1 = No Fault

MB = Motion Bit
0 = Motion Fault, 1 = No Fault
Bit = 1 or On whenever resolver RPM is between programmed motion limits

MSD = Most significant digit
LSD = Least significant digit

2. 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-NOUT) 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 @ 650 mA
Customer (Input Power): 24VDC @ 100 mA

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 RL100, 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.

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

Response Times:

Tach Update Time: 15 ms
Position, Tach, and Output Status available to Backplane: Every 700 µs 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

3. Wiring

Refer to figure 3, below, and tables 1 through 3, following, for connections to the module.

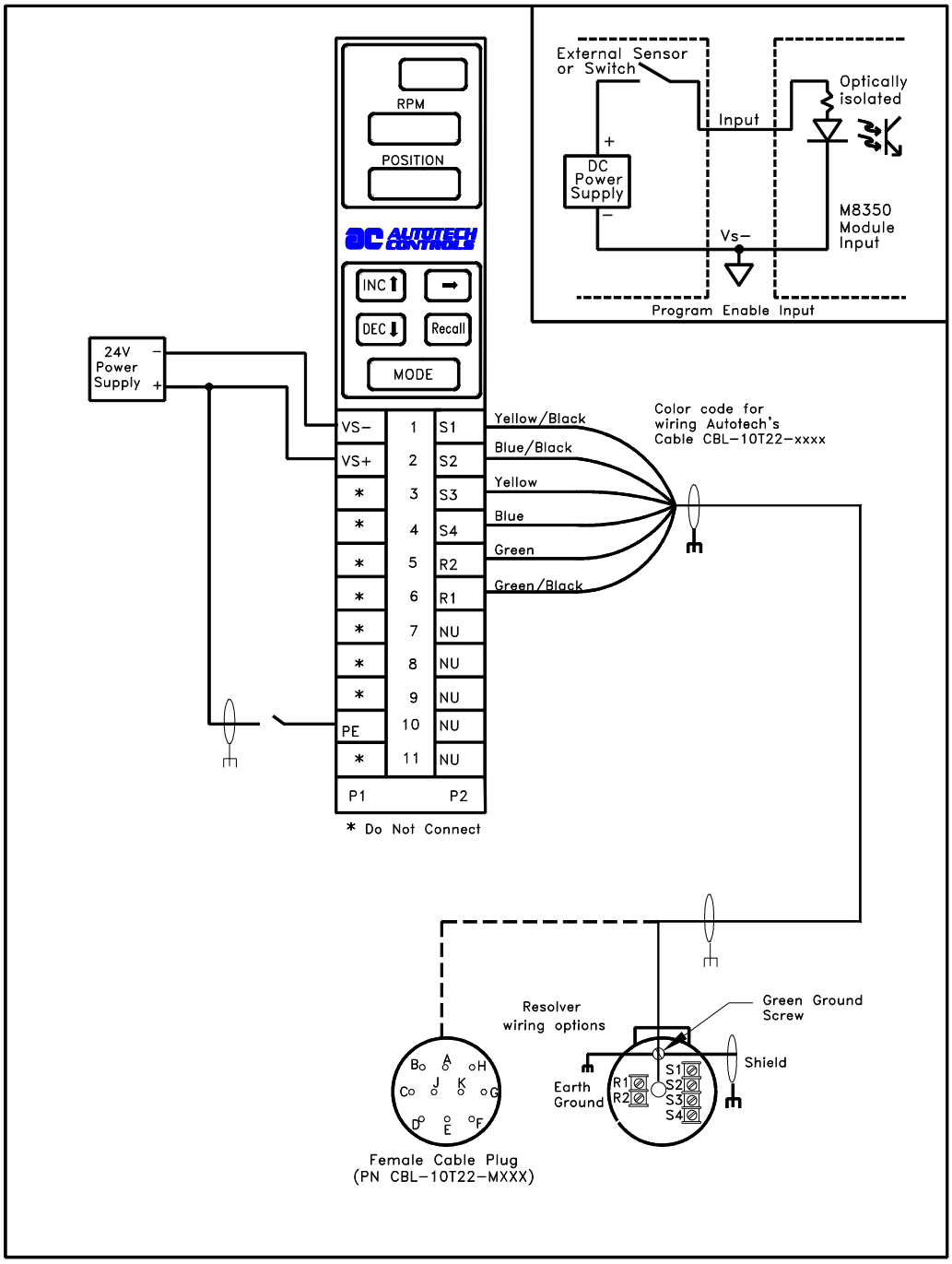


Figure 3. M8350-010 Wiring Diagram

3. Wiring

Table 1.
P1 Terminal Block

Terminal #	Designator	Function/Description
1	VS-	24 VDC external power source
2	VS+	
3	*	Do not connect
4	*	
5	*	
6	*	
7	*	
8	*	
9	*	
10	PE	Program Inable Input
11	*	Do not connect

Table2.
P2 Terminal Block

Terminal #	Designator	Function/Description
1	S1	Resolver (Stator)
2	S2	
3	S3	
4	S4	
5	R2	Resolver (Rotor)
6	R1	
7	NU	Not used
8	NU	
9	NU	
10	NU	
11	NU	

Table 3.
CBL-10T22-xxx Cable Resolver Wiring

Wire Color (twisted pair)	Terminal #	Resolver Terminal #	Connector Pin on MS Connector
Yellow-Black Yellow	P2-1 P2-3	S1 S3	D C
Blue-Black Blue	P2-2 P2-4	S2 S4	B A
Green-Black Green	P2-6 P2-5	R1 R2	F E
Shield		Grn Gnd	G
To change the resolver ascending count direction, reverse the S1 and S3 connections.			

4. Module Functions

Table 1. Single-Turn Decoder Functions

Parameter	Definition	Range
Scale Factor	Maximum number of counts per revolution, minus 1 (i.e., 999 Scale Factor gives 1000 counts/revolutions).	19 to 4095 Default: 359 to work in degrees
Base Offset	Counts to be added to resolver position. It is used to align resolver zero to machine zero.	0 to Scale Factor Default: 0
Motion Limits, High & Low	Motion output energizes if resolver RPM is within these limits.	0 to 1999

5. Memory Map

Decm	Hex	Type	Description
128	0080	Read Only	**RPM**
130	0082	Read Only	**Position**
132	0084	Read Only	**I/O Status (16Bits)**
258	0102	Read/Write	**Scale Factor**
260	0104	Read/Write	**Offset**
262	0106	Read/Write	**High Motion Limit**
264	0108	Read/Write	**Low Motion Limit**

6. Processor Programming

Programming the module from the processor involves sending the module a set of commands. Each command tells the module to perform a single action. As an example, a single action may be storing a new value for a parameter.

The module is fully programmable from the processor. The processor programs the module by sending commands through the output Registers assigned to the modules' slot. The module replies to the program command by sending status information back to the processor through the input Registers. These commands along with the published Memory Map give a PLC programmer complete access to the module.

7. Keypad Programming

Programming the M8350 from the keypad requires entering the following values/options for the unit:

Scale Factor (Mode 1): desired counts per revolution minus one.
Offset (Mode 2): constant to be added to the true resolver position, used to align machine zero with resolver zero.
Motion Hi and Lo Limits (Mode 3): the motion output is energized when resolver turns at a speed between the low and high motion limits. When the speed is outside these limits, the motion output is de-energized.

The five keys on the front panel are used in the following manner:

MODE KEY is used to step through different programming screens. Mode descriptions are explained further in this section.

INC/DEC KEYS are used to increase/decrease numerical entries, such as scale factor, offset, etc.

RIGHT ARROW KEY moves cursor on displays or scrolls through menu choices.

The **RECALL KEY** is not used with this particular function module (the M8350 Single-Turn Resolver Decoder).

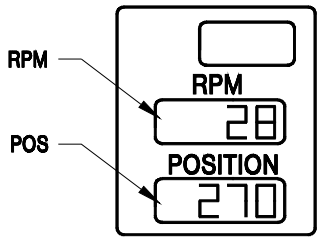
The following Mode descriptions provide key sequences for the M8350-010 displays.

Mode: Default Display

The module has one default display mode: Position/RPM. On power up, or time out, the display returns to the default display.

The following table shows action in response to different key presses:

Key Pressed	*Response*
MODE	Mode 1, Scale Factor *(Note: Programming Modes may only be accessed if the Program Enable input is TRUE)*
Others	No response
None	Display times out and returns to default display

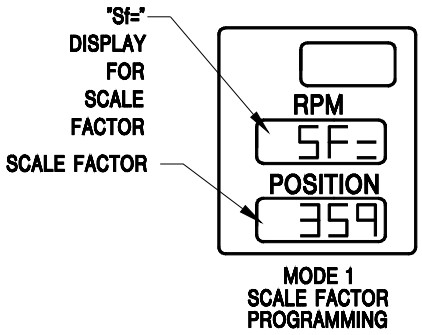


POSITION/RPM
DEFAULT DISPLAY

7. Keypad Programming

Mode 1: Scale Factor

Control Inputs: PE must be TRUE for programming
Previous Mode: Default Mode
The Scale Factor is the desired counts per turn minus one. For example, to work in degrees, program the Scale Factor to 359. The allowed range of values is 19 to 4095 resulting in a resolution of 20–4096. The following table shows action in response to different key presses:

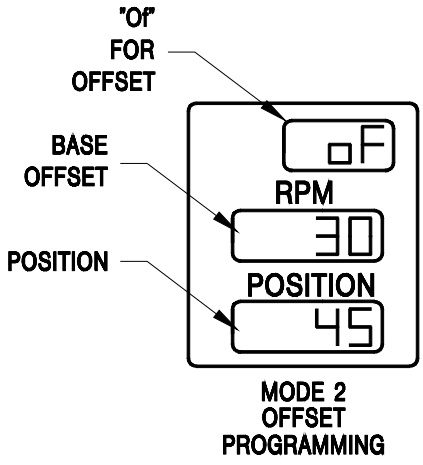


Key Pressed	*Response*
MODE	Switch to Mode 2 if SE TRUE
INC/DEC	If PE is TRUE, Increment/Decrement blinking scale factor.
Others	No response
None	Display times out and returns to default display

Mode 2: Offset

Control Inputs: PE must be TRUE for programming
Previous Mode: Mode 1 (Scale Factor)
The Offset value is used to electronically align the resolver zero to machine zero. This feature allows mounting of resolver without regard to realignment. The allowed range for the offset is 0 to Scale Factor.

The current Offset is displayed in RPM window, while the POSITION window shows position (which includes offset, i.e., Displayed Position = Resolver Position + Offset).



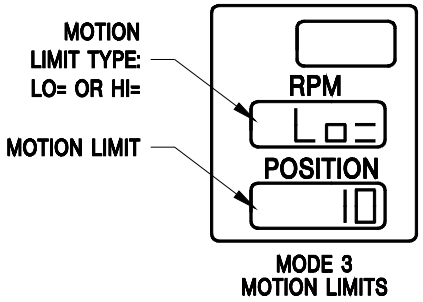
Key Pressed	*Response*
MODE	Switch to Mode 3, Motion Limits
INC/DEC	Increment/Decrement blinking Offset (in RPM window)
Others	No response
None	Display times out and returns to default display

7. Keypad Programming

Mode 3: Motion Limits

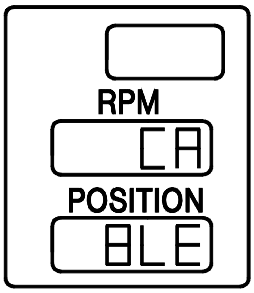
Control Inputs: PE must be TRUE for programming
Previous Mode: Mode 2 (Offset)
The Motion Output is controlled by the Low and High Motion Limits. If the resolver RPM is between the Motion Limits inclusively, the Motion Output will be energized.

Key Pressed	*Response*
MODE	Switch to Default Display
INC/DEC	If cursor on motion limit type (in RPM window), toggle between "Hi=" (High Motion Limit) and "Lo=" (Low Motion Limit) If cursor in POSITION window, increment/decrement displayed limit
Right Arrow	Moves cursor between motion limit type and the limit
Recall	No response
None	Display times out and returns to default display



Mode: Cable Fault Display

Control Inputs: Don't care
Previous Mode: Default
The M8350-010 self-check circuit continuously monitors the microprocessor, DC power, and resolver cable. If any fault is detected by the M8350-010, the "cable" fault detection display will appear. During this mode, the fail-safe fault output will turn OFF and all outputs are disabled automatically. When corrected, the display will return to the Default Display or Interrupted Display.



8. Troubleshooting

Table 2. Troubleshooting Table

Symptoms	Possible Causes
Unable to program unit parameters (Scale Factor, Offset, etc.)	1. Is the voltage level at the customer VS+/VS- input correct? 2. Is the machine moving? Programming of several parameters (i.e.,Scale Factor) is disabled if the resolver is turning faster than 3 RPM.
Program memory is changing by itself.	Have proper grounding and shielding practices been applied?
Position and RPM readings are incorrect.	1. Is the resolver correctly wired? Follow the steps below for a quick check. a. turn power off to M8350 unit b. measure with following with an ohm meter: -- (R1 to R2) = 15 to 50 ohms -- (S1 to S3) = 50 to 150 ohms -- (S4 to S2) = 50 to 150 ohms
Broken wire bit in I/O status word.	1. Is the resolver cable properly grounded and shielded? Supply (VS+, VS-) less than 20 VDC? 2. Is resolver wiring correct? Follow instructions for ohming out resolver wiring above.
Mechanical Zero drifts.	1. Is the mechanical resolver linkage loose? 2. Has the offset value been changed?
If all fails.	Call the local distributor or (630)668-3900 for service.

9. How to Order

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

1. M8350-010 LBus Resolver Decoder

ASY-M8350-010 ..... Programmable LBus single-turn resolver decoder function module

2. Cradle

Select a Cradle specific to the PLC:

SAC-M0800-010 ..... Cradle for Modicon Our Bus Series I/O Rack
SAC-VME6U-CRDL ..... Cradle for VME (GE 9070) Bus
SAC-T0505-010 ..... Cradle for Texas Instruments 505 I/O Rack

3. Output Module

Select the Filler or Output Module. If fault and/or motion outputs need to be directly wired to field devices, the Output Module (such as ASY-M8250-NOUT) must be used instead of the filler module. Consult autotech for specifications on output module.

ASY-M8250-FIL ..... Filler Module
ASY-M8250-NOUT ..... Output Module N-Channel (sinking)
ASY-M8250-POUT ..... Output Module P-Channel (sourcing)

4. Resolvers

The M8350-010 Resolver Decoder requires a single-turn resolver as an input device, such as Autotech's RL100, RL101, RL500, E1R, E7R, E8R or E9R series of resolvers. Please see appropriate Position Transducer Manual for complete ordering information on position transducers, cables, and appropriate accessories.

5. Cable

(See appropriate Position Transducer Manual for ordering cable)

CBL-10T22-Mxxx ..... 22 AWG, 10 conductor (5 twisted pairs) overall foil shielded cable without connector. "xxx" length must be ordered as 010, 020, 050 feet and increments of 50 feet.

CBL-10T22-Cxxx ..... 22 AWG, 10 conductor (5 twisted pairs) overall foil shielded cable, with 10-pin MS connector (ECM-10REC-ITT). "xxx" length must be ordered as 010, 020, 050 feet and increments of 50 feet (i.e. 100, 150, etc.) (2500 ft. max.)

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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