Autotech Controls

M1150-M10 Programmable Resolver Decoder

Instruction & Operation Manual

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MAN-M1150-M10
REV 03 06/30/99

Programmable Resolver Decoder

Multi-Turn with Limits

Model M1150-M10

Instruction Manual

Introduction

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

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

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

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

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

No Batteries, Nonvolatile Memory
Nonvolatile EEROM memory retains information indefinitely after power loss or machine shutdown, eliminating batteries and related hazards.

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

PC-Handshake for PLC Synchronization
On an external command, such as data transfer command from a programmable controller, the digital shaft angle position can be "frozen" at the input of the PC in order to ensure that the data is not sampled during transition from one angle to the next and that the PLC always reads a valid data. Unit may be setup in transparent mode using keyboard commands.

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

Built-in Tachometer and Motion Detector
The shaft RPM is displayed continuously on the front panel. Motion detector output is energized when the shaft is rotating within programmed motion limits.

Specifications

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

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

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

Signal Resolution: 4096 counts/turn

Scale Factor: 0.300 – 4095.999, programmable

Output Update Rate: 1.4 ms

Preset: 6 digits

Decimal Point: Fully Programmable

Resolver Cable length: 2500 ft. (max) shielded

Outputs: (*All outputs have to be same type*)

Type of Outputs:
T, P, N or **C**
T: LS TTL (74HC574)
Logic True: 2 VDC @15 mA,
20 µA 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 or No Connection
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;

Output Format : BCD

Motion Outputs:
Logic True when shaft within programmed limits

Output Isolation: All outputs optically isolated up to 2500 Volts

Inputs:

Program Enable Input, Preset Input, Output Enable Input
P, N,C,T: *Enable*: 0.8 V max @ 5 mA;
Disable: 4V – 28 VDC or No Connection

Data Transfer Input:
0 to 28 VDC logic; Edge triggered (i.e., data transfer on both rising and falling edges)
***Low Level*:** 0 to 0.8 V @ 3.2 mA;
High Level: 2.4 V @ 0.4 mA; *Minimum pulse width:* ***30*** **µs**
Timing: Depends upon the PC sync option selected from keyboard :
PC Synchronization Mode: Updates position output within 150 ms of a transition edge (low to high, or high to low) at data transfer input.
Transparent Mode /Microfreeze: Output data is continuously updated at full speed. The data is latched for 100 ± 10% µs within30 µs of a transition (high to low or low to high) at data transfer input

How to Order

1. Multi-Turn Decoder

SAC*–M1150–M10 x 0 Basic unit resolver-to-digital decoder
1

1. *Type of Output:*
- **T:** TTL, 5 V logic with multiplexing
- **P:** PNP source transistor, 100mA max @50V max, high true logic
- **N:** NPN sink transistor, 100mA max @50V max, low true logic
- **C:** NPN sink transistor, 100mA max @50V max, high true logic

* Standard unit is offered for 120VAC, 60 Hz power input. For a different AC power input replace C (in "SAC-") as follows:

- **2:** For 220V AC, 50Hz power input
- **4:** For 240V AC, 50Hz power input

2. NEMA 4 Cover & Back Panel Mounting Bracket

MBZ-M1150-NEMA4	NEMA4 cover for M1150-M10
MBK-M2250-PNLMT	Mounting bracket for M1150-M10

3. Cable

CBL-M1150-DCxxx	29 conductor cable for digital output wiring with overall foil shield and 37 pin sub "D" connector on one end **xxx** = Standard Length in feet (10, 25, 50 and in increments of 50 feet)
ECM-37PIN-M11	37 pin sub "D" male connector (mates with the connector on M1150-M10).

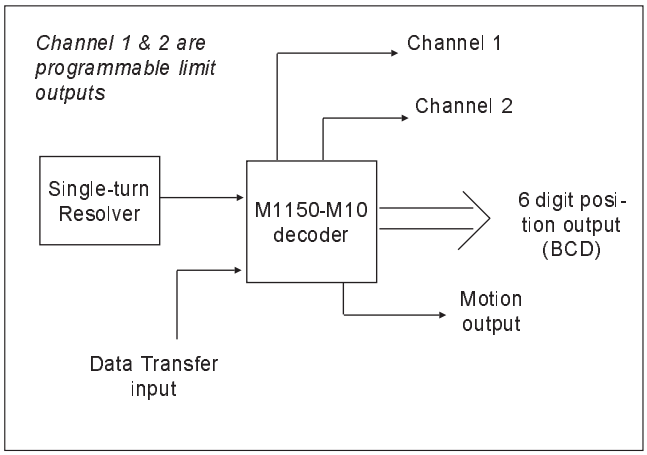
4. Position Transducer

M1150-M10 requires an Autotech single-turn resolver (such as, RL100, E6R, E7R and E8R Series of resolvers) as a position transducer. Consult section on Position transducer for ordering information on transducers, cables, couplings, and mounting brackets, etc.

Installation and Operation

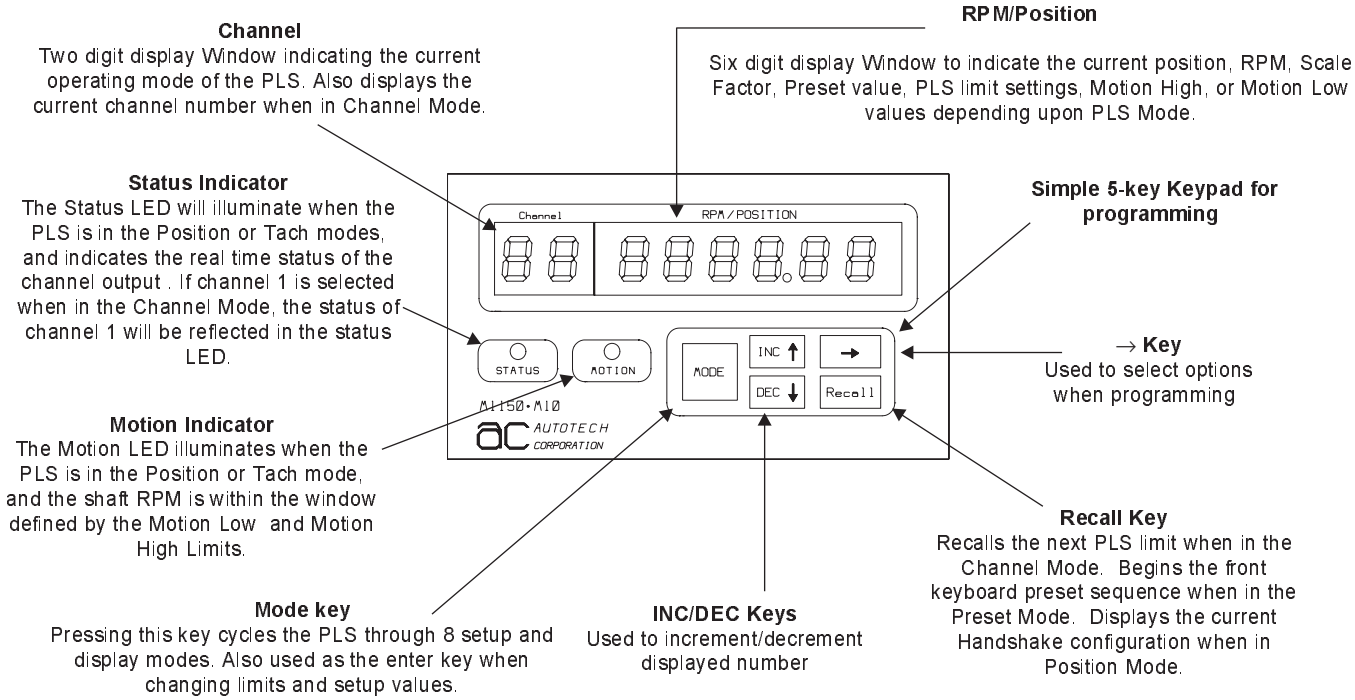
1. Introduction

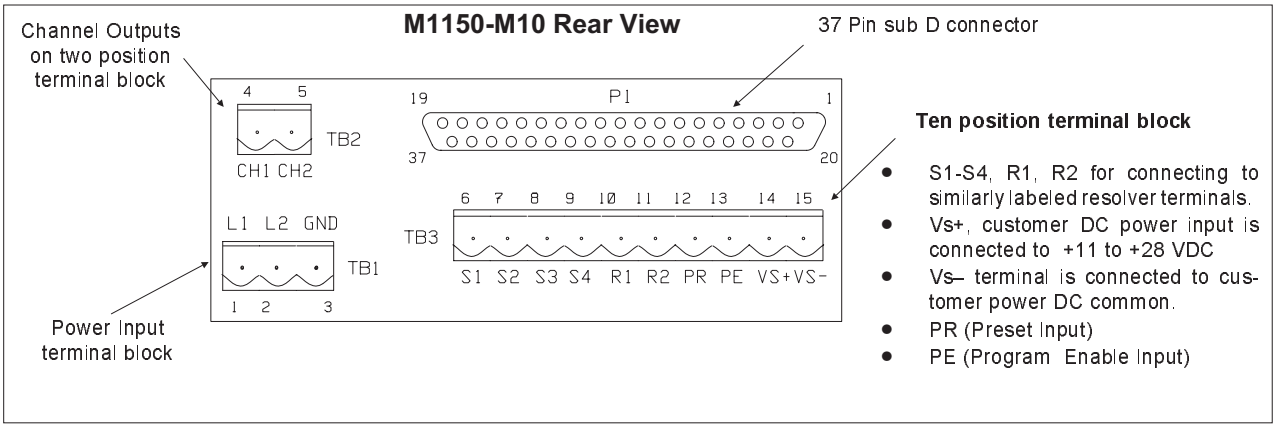
A functional block diagram of Autotech's multi-turn programmable resolver decoder model M1150-M10 is shown below:



The M1150-M10 is a multi-turn programmable resolver decoder. As shown above, it uses a single turn resolver as position transducer.The resolver is mounted on the shaft of the rotating machinery and the M1150-M10 is located near the operator. The M1150-M10 decodes the resolver signals and keeps track of the turns. This feature is useful to keep track of linear travel of a motor driven machine. The decoded resolver signals and the turns are scaled using the programmed scale factor. The scaled value is displayed on the front panel (see front panel diagram below)as well is made available on the 37 pin connector on the back of the unit for use in other control equipment. The data transfer mode (handshake or transparent) is key board selectable. A data transfer input is provided for reliable data transfer using handshake.

The M1150-M10 also provides two programmable limit outputs, called channel 1 and 2, on a two position terminal block (See rear view diagram on next page). For each channel a multiple of setpoints may be programmed. (For example on at 10, off at 20, on at 45, off at 90, etc.) The channel outputs are then turned on and off according to the programmed setpoints, as resolver rotates.





The unit also provides RPM display, motion detector output (energized when resolver is rotating within programmed motion limits).

All outputs of the M1150-M10 are optically isolated and the resolver inputs are differential, insuring stable operation of the unit even in the harshest of industrial conditions.

A preset value can be programmed in the unit for easy machine setup. In response to an external signal at PR input, the programmed preset value is made current position. The machine position is then tracked from this position.

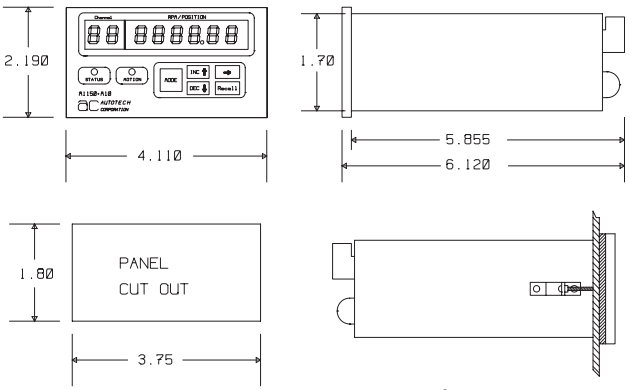
All limits and settings programmed by the operator are stored in nonvolatile memory. The unit will maintain the correct shaft angle with system power off, provided the shaft does not turn more than 180 degrees after loss of power. The ease of programming and stability of operation makes the M1150-M10 a powerful tool for industrial machine monitoring and control.

The diagrams below indicate the output configurations available with M1150-M10.

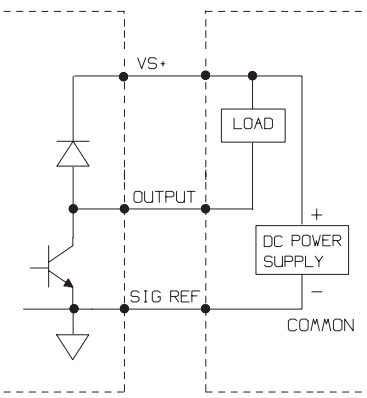
2. Mounting

The M1150-M10 is housed in an 1/8 DIN panel mount case, it will fit inside a 6" deep enclosure, and requires a rectangular panel cutout only (mounting holes not required). Slide the unit in through the panel opening with gasket, insert the two right-angle mounting brackets into the openings on either side of the M1150-M10 housing and slide brackets 1/4" towards the back of the unit to secure the brackets to the housing. Tighten the pair of screws on the right-angle brackets to hold the unit into the panel. **DO NOT OVERTIGHTEN!** Attach the pre-wired rear terminal blocks to the M1151 unit to complete the installation.

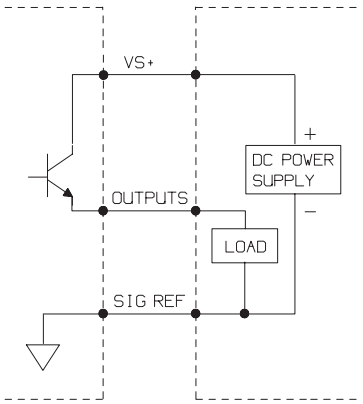
Mounting Dimensions
(Inches)



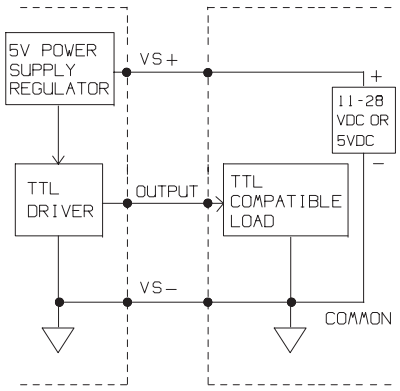
N & C type of output



P type of output



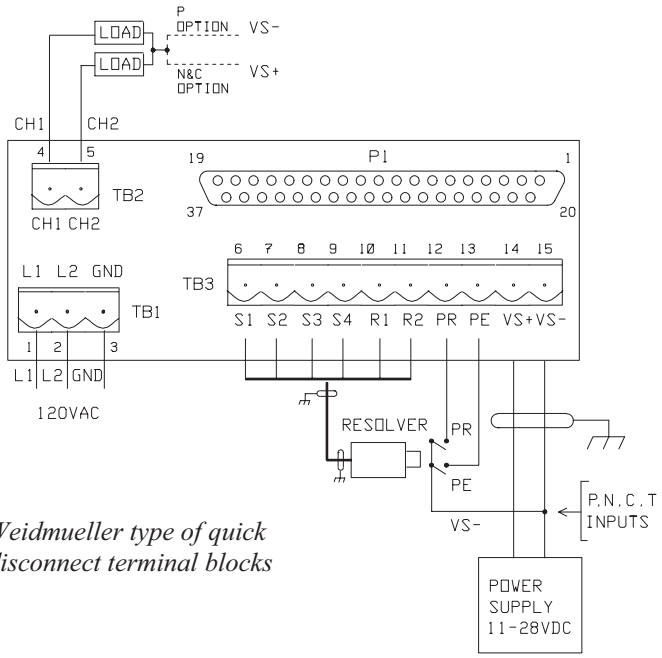
T type of output



3. Wiring

1. Output wiring to other electronic devices (programmable controls) must use shielded cable, with shield connected to a good earth ground at both ends.
2. No special tools are required for wiring input/output devices to the M1150-M10.
3. Pre-wire terminal blocks before attaching them to the M1150-M10 for easier installation.

Terminal Block Wiring			
Term.#	**TB#**	**Description**	**Function**
1	1	L1	AC Power Input
2	1	L2	AC Power Input
3	1	GND	Earth Ground
4	2	CH 1 Out	Dwell Output
5	2	CH 2 Out	Dwell Output
6	3	S1	Resolver Input
7	3	S2	Resolver Input
8	3	S3	Resolver Input
9		S4	Resolver Input
10	3	R1	Resolver Excitation Output
11	3	R2	Resolver Excitation Output
12	3	Preset	Preset Input
13	3	PE	Program Enable Input
14	3	VS+	+10 to 28 VDC Pwr In
15	3	VS-	Common



Weidmueller type of quick disconnect terminal blocks

The following table describes the functions of pins of 37 pin connector.

DB-37 connector pin descriptions (P1)		
Pin #	*Cable Color* CBL-M1150-DCxxx*	*Signal description*
1	White 12ga.	Vs- Same as term #15 on Terminal Block
2	Brown	OE Output Enable
3		NC
4		NC
5		NC
6	Red	BCD 400000
7	Orange	BCD 100000
8	Yellow	BCD 40000
9	Green	BCD 10000
10	Blue	BCD 4000
11	Violet	BCD 1000
12	Grey	BCD 400
13	White	BCD 100
14	Black	BCD 40
15	White Brown	BCD 10
16	White Red	BCD 4
17	White Orange	BCD 1
18		NC
19	White Yellow	Data Transfer Input
20	Black 12ga.	VCC+ Same as term #14 on terminal block
21		NC
22		NC
23		NC
24	White Green	BCD 800000
25	White Blue	BCD 200000
26	White Violet	BCD 80000
27	White Grey	BCD 20000
28	White Black	BCD 8000
29	White Black Brown	BCD 2000
30	White Black Red	BCD 800
31	White Black Orange	BCD 200
32	White Black Yellow	BCD 80
33	White Black Green	BCD 20
34	White Black Blue	BCD 8
35	White Black Violet	BCD 2
36		NC
37	White Black Grey	Motion Output

4. Programming

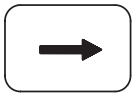
Programming the M1150-M10 requires entry of the following:

- **Scale Factor:** desired counts per revolution.
- **Decimal Location:** desired placement depends on engineering units displayed.
- **Preset : Reference or "home" position stored in nonvolatile memory. Can be loaded into the position by front-panel programming or by an external signal.**
- **Motion Hi Limit:** the Motion output energizes when the resolver rotates at a rate less than this limit, but greater than the Motion Lo Limit.:
- **Motion Lo Limit.**
- **PC synchronization option:** Position outputs may be programmed as PC handshake or transparent

Sections 4.1 through 4.10 describe the programming procedure normally used during initial setup of the **M1150-M10**. Parts of the following section may be used when changing or fine tuning specific values.

The MODE key cycles the M1150-M10 through 8 setups and display modes

The INC/DEC keys are used to increase/decrease numerical entries



Used to display and select options in different modes.

Recalls the next PLS limit when in the Channel Mode. Begins the front keyboard preset sequence when in the Preset Mode. Displays the current Handshake configuration when in Position Mode.

The **Mode Key** is used to cycle the PLS through the 8 display and programming modes of the PLS. When a specific PLS setting has been programmed, pressing the **Mode Key** will terminate the operation. Pressing the **Mode Key** a second time will cycle the PLS to the next mode. Pressing the **Mode Key will not** change any setup values and may be used to safely inspect all PLS settings. Programmed values are changed only when the **INC** or **DEC keys** are pressed provided that the Program Enable input is true. A state diagram of the key sequences used by the M1150-M10 is located in Sections 4.2 through 4.10 .

4.1 Initial Scaling Of The M1150-M10:

When first setting up the PLS, the engineer must know how the position information is to be displayed on the M1150-M10 front panel. Two parameters must be determined: **The amount of linear travel per resolver shaft revolution** (i.e., 360.0 degrees, 11.988 inches, 4.45 meters, etc.) and the **maximum travel** of the machine (i.e., 99999.9 degrees, 500.000 inches, 300.00 meters, etc.). These two values are used to set the scale factor and decimal point location.

Use the **Maximum travel** value to set the location of the decimal point. For example, if the maximum travel of the machine is 150 inches, set the decimal point to three decimal places. This allows readings to 1/1000 inch.

Use the **amount of linear travel per shaft revolution** value to determine the Scale Factor and to determine whether the decimal point should be a **Real** or **Arbitrary.** The scale factor will be entered as a whole number and a fractional number. (360.0 degrees would have 360 whole part and 000 fractional part). Scale Factor entry is described in Section 4.4.

If the total scale factor is less than 1.000, use the Arbitrary decimal point mode and enter the fractional part of the scale factor in the whole scale factor location and leave the fraction scale factor location blank. For example, if the scale factor is 0.355 counts per shaft revolution (less than 1.000), enter 355 in the **Scale Factor Whole** location and 000 for the Scale factor fractional location. Set the decimal point for three decimal places of **Arbitrary** type. One revolution of the shaft will then cause a display of 0.355.

4.2 Decimal Point Programming:

While in the **Position Mode** (default mode on power-up), press the key enable the decimal point change mode. The decimal point will begin blinking. Use the INC and DEC keys to move the decimal point to the required position. Repeatedly pressing the INC key will cycle the decimal point through four locations allowed in the Real decimal point mode, and then will cycle through five locations allowed in the Arbitrary decimal point mode (see table below). In the Arbitrary decimal point locations, the leading zeroes are not blanked. The current position shown in the display will adjust right or left according to the location and type of decimal point.

When the decimal point is located in the correct position in either **Real** or **Arbitrary** mode, press the **Mode** key to store the value to nonvolatile memory. **Both the current position and the outputs are affected accordingly, so be sure that all affected machinery is in a safe condition!**

Note: the maximum amount of resolution of the unit is 4096 counts per revolution regardless of decimal point location (i.e., 4.096 or 409.6). Additional decimal places may be added for clarity, but will not increase accuracy.

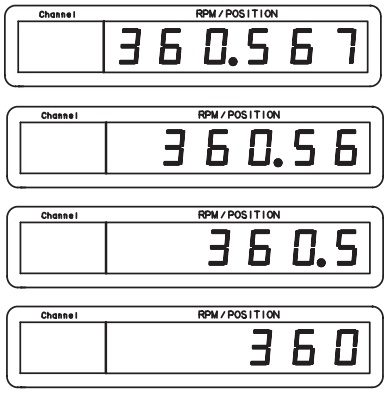
Press 

to display Position mode

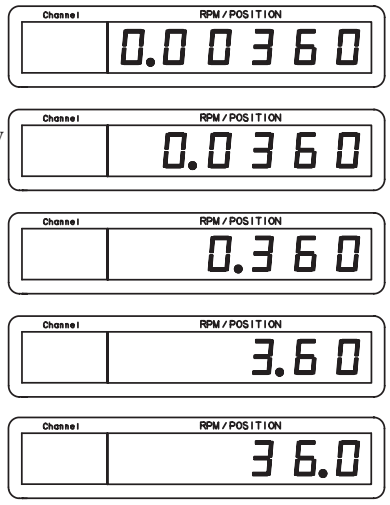
4.2.1 Relationship Of Scale Factor and Real/Arbitrary Decimal Points

The table assumes the following:

- The scale factor = 360.567 counts per revolution.
- The shaft has turned exactly one revolution.
- The decimal point has been set to this type and number of decimal places.
- The current position is shown.



Arbitrary D.P.

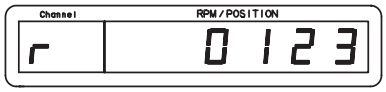


4.3 RPM Display:

This mode may be used to display the shaft rotation speed of the resolver in Revolutions per Minute. The **INC, DEC, ➡ and Recall** keys are ignored.

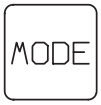
Press 

to display RPM mode



4.4 Scale Factor Programming

The Scale Factor is used to scale the shaft position into Engineering Units. Because the maximum scale factor of 4095.999 exceeds the number of display digits, the Whole part and the Fractional part must be programmed separately.

Press 

to proceed to scale factor whole part programming

4.4.1 Whole Part Mode:

The Whole part of the scale factor is displayed on the front panel with the decimal point at the right of the least significant digit. Use the **INC** and **DEC keys** to change this value to the desired number. The minimum scale factor value allowed is 0.300 counts/rev. If the total scale factor is less than 1.000, the **Arbitrary** decimal point mode and associated scale factor setup described in Section 4.4.2 should be used.

NOTE:

Changing the scale factor will Zero the current position and affect the corresponding outputs.

4.4.2 Scale Factor - Fractional Part Mode:

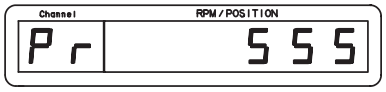
Press [MODE] to change to scale factor-fractional part

The Scale Factor fractional part is displayed with a decimal point to the left of the most significant digit. The operator may now reprogram this value if desired. Use the **INC** and **DEC keys** to alter this value.

4.5 Preset Mode:

Altering the preset value does not affect the position or the outputs until the preset is triggered either by external or by keyboard triggering. (See the procedure below.) Programming is enabled by the Program Enable input.

Press [MODE]

to display 

Use [INC ↑] o r [DEC ↓] to display or to increase or decrease the preset value

Use [→] to select specifically desired digits

To preset the PLS from the keyboard:

Keyboard triggering of the preset will change the current position (and associated outputs' state) to the preset value.

press [Recall]

to display 

Press [MODE] to load preset value

This will also put PLS back into Position Mode and affect the outputs.

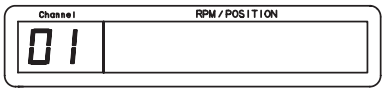
To abort the keyboard trigger,

press [Recall]

Press [MODE] to change to channel mode

4.6 Channel Mode:

In the channel mode the display will show:



Use [INC ↑] or [DEC ↓] to change the channel number.

4.6.1 Viewing Limit Settings:

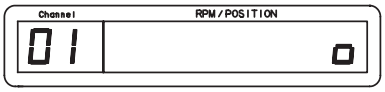
Press [Recall] to view the 1st limit of this selected channel

The status LED indicates whether the channel turns on or off at this position (illuminated=ON).

Repeated pressing of [Recall] will display each ON/OFF edge of the current programmed limits

If the channel has 0 limits programmed,

each press of [Recall] will display a "null" setpoint as

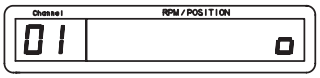


This "null" setpoint is used as the starting point for adding any ON/OFF setpoint pairs.

4.6.2 Clearing out an Entire Channel:

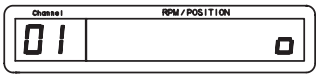
If the operator wishes to remove all setpoints from the currently selected channel, use the following key stroke sequence:

Press Recall to display a "null" setpoint as



Press DEC once to display:

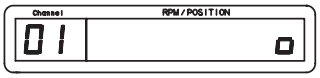
Press MODE the display will indicate the "null" setpoint



4.6.3 Adding a Set-Point Limit Pair:

Use the RECALL KEY to ensure that the new setpoint pair (ON/OFF) will not overlap any existing setpoint pairs:

Press Recall to get a "null" setpoint as



Press → to program specific digits to obtain the ON value for this limit pair

The selected digit will blink. Also, the channel digits will blink and remain blinking until the sequence is terminated by the operator. If the desired pair was to be ON = 3.40 and OFF = 15.00, the digits would be incremented to the value of:

Press MODE to enter this limit

Note that the channel units are still blinking - the unit is waiting for entry of the corresponding **off** limit.

Press → again to program each digit to the desired OFF value

The status LED will be dark, indicating selection of the OFF setpoint

Press MODE again to store this pair into nonvolatile memory

Use Recall to check that the new pair of limits has been added to this channel

4.6.4 Adding an Existing Set-Point Edge:

To change the ON or OFF edge of an existing setpoint pair on the fly,

Use Recall to display the specific limit edge to be adjusted

Use INC or DEC to fine tune this value

The limit will change in real time, and will immediately affect the corresponding output

Use → to change a single edge, but this feature will be disabled if the machine is in motion

4.6.5 Exiting the Channel Mode:

After completing set point programming the channel mode may be exited

by pressing [MODE] until Motion High mode is displayed

4.7 Motion Limit Programming

4.7.1 Motion High Limit:

In the Motion High limit mode, the display will show:

This value is the current upper window of the RPM limit setting. If shaft RPM is below this value and above the Motion Lo limit, the MOTION OUTPUT will turn on

Use [INC ↑] or [DEC ↓] to adjust this value

Press [MODE] to exit to motion low limit setting mode

4.7.2 Motion Low Limit:

As above, this mode displays the lower limit of the RPM setting, and may be adjusted,

using [INC ↑] or [DEC ↓]

Note: The PLS will not allow the motion low limit to exceed the motion high limit value.

Press [MODE] to exit to Position Mode

4.8 PC Sync Handshake Programming

The M1150-M10 unit may be configured for the BCD OUTPUTS to be either synchronized with the **PC SYNC** input, or to update normally (as when driving an external display).

Press [Recall] while in the Position Mode to view the handshake configuration. The display will either show a “tr” (transparent) or “HS” (PC handshake).

To configure for PC handshake,

press and hold [Recall] and simultaneously

press [INC ↑] key

To configure for the transparent (continuous update) mode,

press and hold [Recall] and simultaneously

press [DEC ↓] key

The change is stored automatically in nonvolatile memory

When in the PC sync (**HS** mode), the BCD outputs will be updated 5 to 150 microseconds max. after either edge of the PC sync input.

Special Instructions for Installation of M1150-NEMA4 Bezel (P/N MBZ-M1150-NEMA4)

These instructions should accompany the optional P/N MBZ-M1150-NEMA4 Bezel Assembly. These installation instructions are also provided here for your convenience.

1. Remove the M1150-M10 from the mounting panel.

2. Remove the mounting brackets from the unit.

3. Insert the metal bracket from the back of the M1150-M10 (recessed gasket end first) securely against the back of the front panel of the unit.

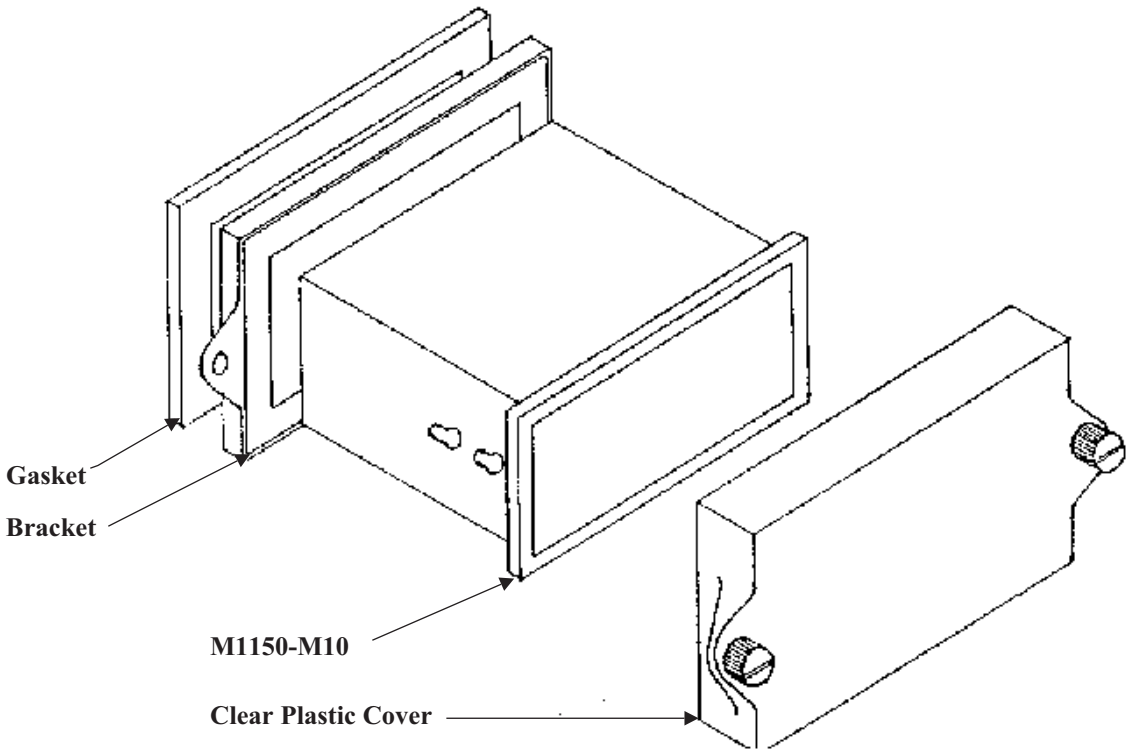
4. Remove the adhesive cover from the second gasket; slide it from the back of the unit and apply it to the other side of the metal bracket.

5. Secure the clear plastic face plate (cover)to the metal bracket with the captive thumb screws. Use a screw driver to tighten securely.

Parts required for each M1150-NEMA4 Assembly:

- Metal bracket (black) with factory installed gasket in the recessed area.
- Plastic face plate cover with factory installed thumb screws.
- Gasket for the other side of the metal bracket.

NOTE: When mounting the M1150-M10 to the panel, use the mounting brackets included with the bezel.



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