
Autotech Controls
M1151-M10A
Programmable, Multi-Turn (Dual)
Resolver Decoder for Shut Height Indication
Instruction & Operation Manual



AVG Automation
Autotech Controls
343 St. Paul Boulevard
Carol Stream, IL 60188

Telephone: 630-668-3900
800-TEC-ENGR

Fax: 630-668-4676

Programmable Resolver Decoder

Multi-Turn with Limits — Model M1151-M10A

- Fully absolute position; no loss of position under power loss
- Multi-turn (dual) resolver as position sensor
- Programmable gear ratio L (4, 8, 16, 32, 64, 128, or 256:1 gear ratio)
- Fail-safe broken resolver cable fault output
- Motion output
- Ideal for shut-height indication on process
- Very easy to calibrate — no calculations required
- Fail-safe upper and lower safety limits switch outputs
- Three general programmable limit switch outputs may be used as in-position output.

The M1151 M10A is a multi-turn programmable decoder. It takes the input from a multi-turn resolver like Autotech's series RL210 which is mounted on the shaft of the rotating machinery. The M1151-M10A decodes the resolver signals using a 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. In each of the three PLS channels, the position information is continuously compared to two programmable on and off limits called "set-points." The outputs are activated when limit conditions are satisfied. All outputs of the M1151-M10A are optically isolated and the resolver inputs are differential, ensuring extremely reliable operation of the unit even in the harshest of industrial conditions.

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

Simple Front Panel Programming

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

No Batteries, Nonvolatile Memory

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

Replacing Electromechanical Selsyn Systems

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

PC Handshake for PLC Synchronization

On an external data transfer command from a 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 valid data.

Reliable Under Extreme Environments

The M1151-M10A combines the ruggedness of a brushless resolver and reliability of a solid-state control. The resolver can be mounted on a machine shaft in hostile environments such as mechanical shock, vibrations, extreme humidity and temperature changes, oil mists, coolants, solvents, etc., and the programmable unit M1151-M10A can be mounted up to 250 feet away in a control panel. The ratiometric converter assures high tracking speed and high noise immunity.

Self Diagnostics with Healthy Output

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

Built in Motion Detector

Motion detector output and indicator LED is energized when the shaft is rotating in excess of 5 RPM. While the shaft is turning at less than 5 RPM or is stopped, the motion output and indicator LED may occasionally pulse on for a moment and then return to the off state.

Ideal Solution for Shut Height Indication

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

Specifications

Input Power:

AC: 120VAC \pm 10%, 7 VA; Optional 220, 240 VAC

DC: 11–28 VDC, 100mA (typical) exclusive of load, for outputs and control input

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

Position Transducer: Autotech's dual resolver series such as RL210.

Max. Resolution: 4096 counts/turn

Scale Factor: automatic

Output Update Rate: 1.4 ms

Display Range: 6 digits (000.000 to 999.999)

Decimal Point: Fixed

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

Resolver Cable Length: 2500 Ft. (max) shielded

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

Type of Outputs: T, P & N

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

T:LS TTL (74HC574);

Logic True: 2VDC @ 15 mA, 2 mA leakage when tristated

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

Mux Input: Low active TTL Level;

Logic True: 0–0.8V;

Logic False: 2–5V or no connection.

Position Output Format: BCD

PLS Outputs: 3 channels, 1 setpoint pair per channel

Motion Outputs: Logic True when shaft exceeds 5 RPM

Output Isolation: All outputs optically isolated up to 2500 Volts

Upper and Lower Safety Limits Output: TRUE when

Press Ram is positioned within the safe range

(between the programmed upper and lower safety limits). FALSE when the Press Ram is positioned above or below the programmed upper or lower safety limits. (See figure on page 4)

Control Inputs — Program Enable, Data Transfer, Output Enable Inputs

Electrical Specifications:

For Units with P Type Output:

TRUE: 11 to 28 VDC max @ 13.5 mA max;

FALSE: 2V or open circuit

For Units with N Type Output:

TRUE: 2v @ 13.5 max; or contact closure to DC common

FALSE: 11 to 28 VDC or open circuit

Data Transfer Input: Edge triggered (i.e., data transfer on both rising and falling edges)

Minimum 500 msec pulse width output updates within 5 msec of transition (less than 1 msec typical)

How to Order

1. Multi-Turn Decoder

SAC*-M1151-M10A x Basic unit resolver to digital
1 decoder

1. *Type of Output:*

P: PNP source transistor, 100mA max @50V max,
high true logic

N: NPN sink transistor, 100mA max @50V max,
low true logic

T: TTL, 5V logic with multiplexing

* 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. Cable

CBL-37S22-DCxxx 37 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
M1151-M10A).

3. Position Transducer

M1151-M10A requires Autotech's multi-turn resolvers
(such as RL210, etc., series of resolvers) as a position
transducer. Consult section on Position Transducer in
Autotech's master catalog for ordering information on
transducers, cables, couplings, and mounting brackets,
etc.

Overview

INSTALLATION *(see pages 5–9)*

1. Install resolver (Autotech's RL210 with gear ratio 4, 8, 16, 32, 64, 128 or 256:1). Make sure of direction of count. To change the resolver ascending count direction, reverse S1 and S3 connections.

2. Install and wire the M1151-M10A unit on the panel.

SETUP *(see page 10)*

Enable programming (PE input = TRUE)

3. Program Gear Ratio first.

4. Program Lower and Upper Safety Limit. *(These limits MUST be programmed even if the safety limit outputs are not being used.)*

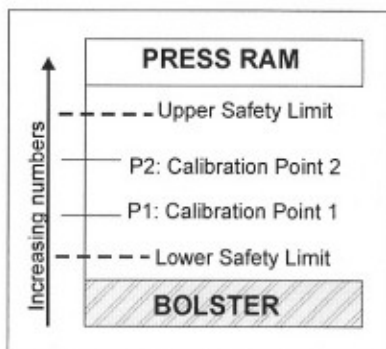
CALIBRATION *(see page 10)*

CAUTION

To calibrate the unit, the gear ratio, upper limit, lower limit, P1 and P2 must be entered. IF recalibration is required, P1 and P2 must be reentered (assuming the gear ratio, upper and lower safety limits are correct.) The new P1 and P2 should be different than the old P1 and P2 values, or the unit will not enter recalibration.

5. Move press/die to Point 1. Measure and enter the measured height.

6. Move press/die to Point 2. Enter this height. Point 2 must be higher than Point 1. See figure below.



PROGRAM *(see page 10)*

7. Program PLS setpoints for Channel 1, 2 and 3, if required.

8. Program PC to YES or NO, as required.

The unit is all read for use. Move ram to a different point and check the display against the actual ram position.

Disable programming.

TROUBLESHOOTING

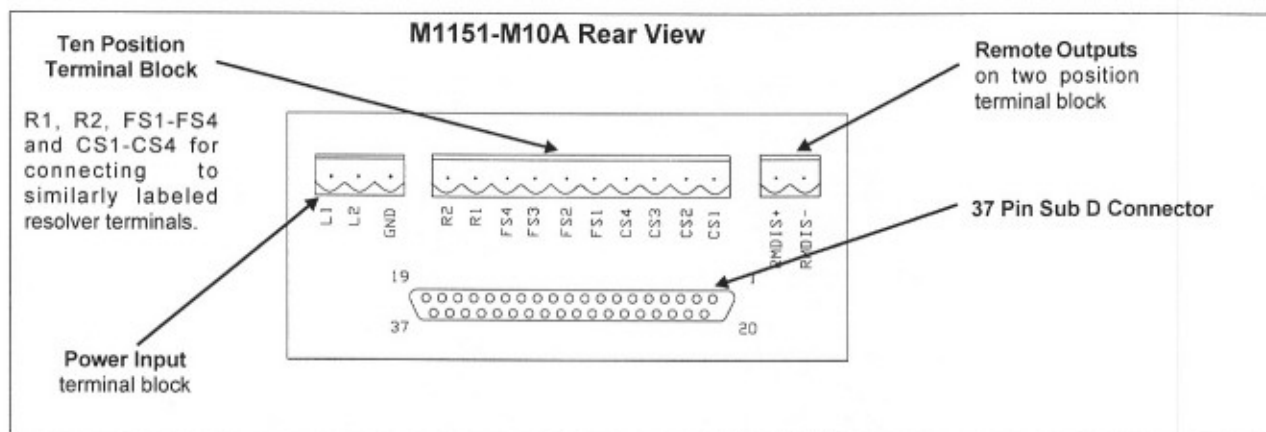
If the unit does not work as expected:

1. Ensure that the resolver is counting in the right direction. The numbers on the display should go up when the press is moving upward.

2. Ensure that the right gear ratio is programmed.

3. Ensure that the right values are entered for LL and UL.

4. If steps 1 through 3 above check out O.K., recalibrate by moving to and entering new P1 and P2 values. Both values must be entered and must be different than the values already stored in the unit.



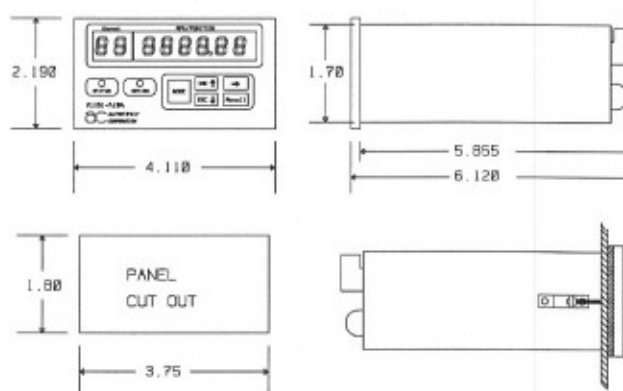
All outputs of the M1151-M10A are optically isolated and the resolver inputs are differential, ensuring stable operation of the unit even in the harshest of industrial conditions.

All limits and settings programmed by the operator are stored in nonvolatile memory. The ease of programming and stability of operation makes the M1151-M10A a powerful tool for industrial machine monitoring and control.

The diagrams below indicate the output configurations available with M1151-M10A.

DO NOT OVER-TIGHTEN! Attach the pre-wired rear terminal blocks to the M1151-M10A unit to complete the installation.

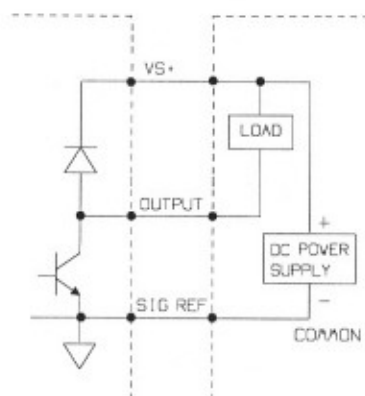
Mounting Dimensions (Inches)



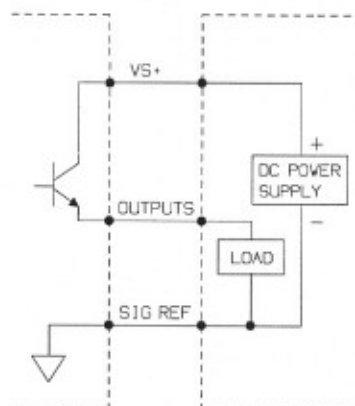
2. Mounting

(Refer to figure at right.) The M1151-M10A 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 M1151-M10A 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.

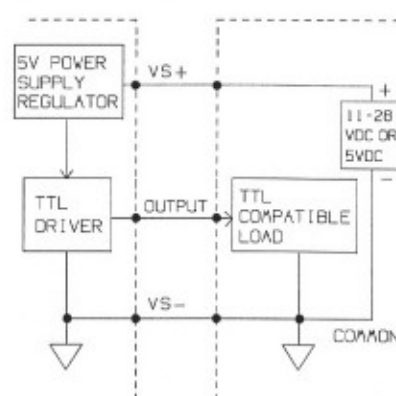
N type output



P type output



T type output

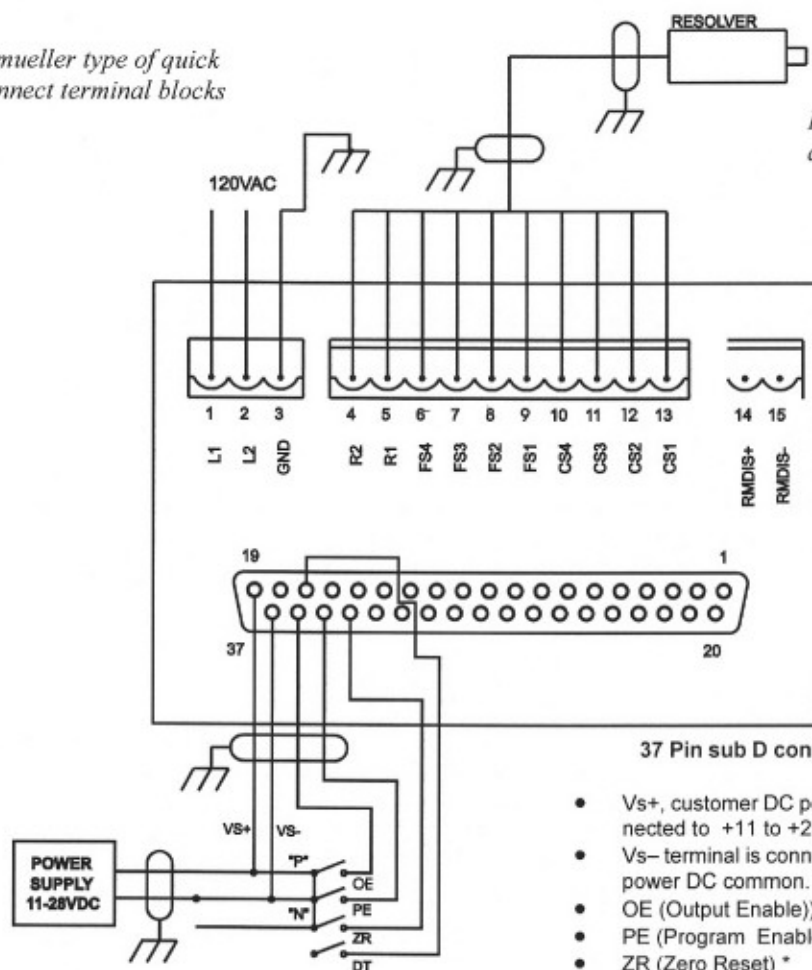


3. Wiring

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 M1151-M10A.
3. Pre-wire terminal blocks before attaching them to the M1151-M10A for easier installation.
4. The Output Disable input, when active, will cause the Healthy output to go into the fault condition (off).

Terminal Block Wiring		
Term.#	Description	Function
1	L1	120V 50/60 Hz
2	L2	AC Power return
3	GND	Earth Ground
4	R2	Rotors+
5	R1	Rotors—
6	FS4	Fine stator cos—
7	FS3	Fine stator sine+
8	FS2	Fine stator cos+
9	FS1	Fine stator sine—
10	CS4	Coarse stator cos—
11	CS3	Coarse stator sine+
12	CS2	Coarse stator cos+
13	CS1	Coarse stator sine—
14	RMDIS+	Remote display link*
15	RMDIS-	Remote display link*
* Not available with this unit		

Weidmueller type of quick disconnect terminal blocks



Resolver wiring is described on page 9.

37 Pin sub D connector

- Vs+, customer DC power input is connected to +11 to +28 VDC
- Vs- terminal is connected to customer power DC common.
- OE (Output Enable))
- PE (Program Enable Input)
- ZR (Zero Reset) *
- DT (Data Transfer)
- *not available with this unit

"T" Type
PE — Low to Enable
OE — Open to Enable

3. Wiring — *continued*

The following table describes the pin functions for the 37 pin connector.

DC-37 Connector Pin Descriptions		
Pin #	Cable Color CBL-37S22-DCxxx	Signal description
1	Green Black	BCD .001
2	Red	BCD .004
3	Orange	BCD .01
4	Orange Black	BCD .04
5	Green	BCD .1
6	Blue	BCD .4
7	Blue Black	BCD 1
8	Black White	BCD 4
9	White	BCD 10
10	Black	BCD 40
11	Red White	BCD 100
12	Green White	BCD 400
13	Red Green	Channel1
14	Blue White	Healthy
15	Red Black	Channel 3
16	White Black	Upper Limit
17	White Red	Data Transfer
18	Black Red	Zero Position Reset Input*
19	Orange Red	VS+
20	Blue Red	BCD .002
21	Orange Green	BCD .008
22	Black White Red	BCD .02
23	Red Black White	BCD .08
24	Green Black White	BCD .2
25	White Black Red	BCD .8
26	Orange Black White	BCD 2
27	Blue Black White	BCD 8
28	Black Red Green	BCD 20
29	White Red Green	BCD 80
30	Red Black Green	BCD 200
31	Green Black Orange	BCD 800
32	Orange Black Green	Channel 2
33	Orange White Blue	Motion
34	Blue White Orange	Reserved Output
35	Black White Orange	Program Enable
36	White Red Orange	Output Disable
37	White Red Blue	VS—
* Not available with this unit		

3. Wiring — continued

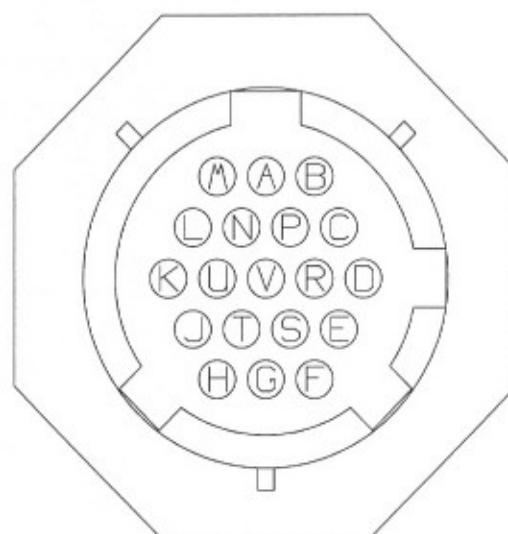
Wiring Table for Dual (Multi-turn) Resolvers SAC-RL210, E8R-RL210			
<i>CBL-10T22-Mxxx</i> Wire Color (Twisted Pairs)	Function	Resolver Terminal	MS Connector Pin #
Black/Green Green	Rotor R1 Rotor R2	1 2	A B
Black/Yellow Yellow	(Count Direction) Coarse Stator CS1 Coarse Stator CS3	3 5	C E
Black/White White	Coarse Stator CS2 Coarse Stator CS4	4 6	D F
Black/Red Red	Fine Stator FS1 Fine Stator FS3	7 9	H L
Black/Blue Blue	Fine Stator FS2 Fine Stator FS4	8 10	K M
Green	Shield	GND	G

NOTES:
 1. Black/Green indicates a black wire with green stripes.
 2. MS Connector: MS3112E-14-19P; mating connector: MS3116F-14-19S (Autotech P/N ECM-19REC-ITT).
 3. MS Connector is not available with E8R series.

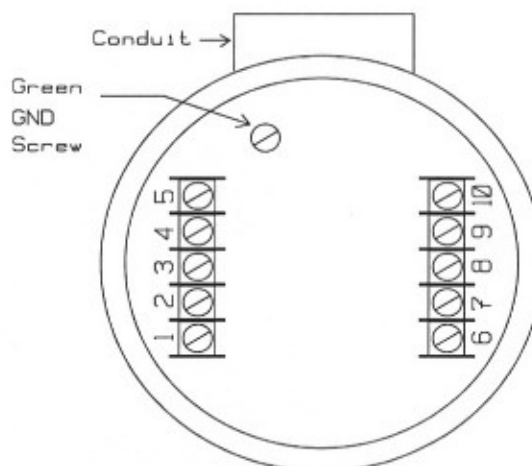
Grounding and Shielding

1. Resolver wiring must be done using twisted pairs in cable with an overall foil shield. The twisted pairs must be wired as per wiring instructions. See *How to Order* Section for suitable cable offered by Autotech.
2. It is recommended that the shielded resolver cable be routed in its own conduit or cable tray.
3. All shielded resolver 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. All ground planes (chassis grounds) in the total system must be held to the same RF potential, by good metallic connections to building frames, conduit or wiring trays.

MS Connector on a dual
(multi-turn) resolver



Terminal Block on a dual
(multi-turn) resolver



6. The shield drain wires may be terminated in one of two ways:
 - a. Connect to chassis ground at each end and not connected to signal reference at any point in the system.
 - b. Connect to signal reference at the decoder only. The shield drain should remain unconnected at the resolver end and the shield should not touch earth ground at any point in its run.

Note: Resolvers with MS connectors have shield drain wire pre-terminated for method 6.a., above. Method 6.a. is recommended for all Autotech products. In certain circumstances, in unusual EMI conditions, method 6.b. may be necessary after consulting the factory.

4. Programming

Programming the M1151-M10A requires entry of the following:

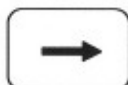
Sections 4.1 through 4.10 describe the programming procedure normally used during initial setup of the M1151-M10A. Parts of the following section may be used when changing or fine tuning specific values.



The MODE key cycles the M1151-M10A through 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 previously programmed value for the currently selected programmable feature.

The Mode Key is used to cycle the PLS through the display and programming modes of the PLS. When a specific PLS setting has been programmed, pressing the Mode Key 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 M1151-M10A is located in Sections 4.2 through 4.10

4.1 Initial Scaling Of The M1151-M10A

When first setting up the PLS, the engineer must know how the position information is to be displayed on the M1151-M10A front panel. Two programming points near the extremes of travel must have calibrated values. These two values are used to set the scale factor and offset

4.2 Default Position Display



The default display shows the current scaled position of the resolver. This is the first display shown at power up. The digits shown in this display are the same as the BCD code presented at the output connector. All of the position displays in this product are scaled fixed point numbers in the form "###.###". If a resolver wiring fault is detected, this display will be replaced with the word "CABLE." The Mode key may be used to advance to the next display. INC, DEC, →, and Recall have no effect in this mode.

4.3 Channel Status Display



The Channel Status display allows the user to view the status of the two PLS outputs. The left window shows the selected channel number "C#," and the right window shows the word "on" or "off". The "STATUS" LED lights if the PLS output is on. The Recall Key switches back to the position display screen. The Mode Key takes the user to the On Set point display.

4.4 On Set Point Display Off Set Point Display



The On and Off Set Point displays are used for displaying and changing the PLS Set Points. The left window indicates the selected PLS channel # and "n" for On or "F" for Off Set Point. The STATUS LED indicates the current status of the selected channel output. If programming is enabled, a digit in the right window blinks indicating the INC and DEC Keys can be used to change the Set Point. The → Key selects a digit to edit. The Recall Key restores the previously programmed value to the current Set Point.

The Mode Key cycles from channel 1 on point through channel 1 off, channel 2 on and channel 2 off to PC handshake display.

4.5 PC Handshake Display



The PC Handshake display shows the current handling method for the data transfer input. If PC = YES is displayed, outputs are updated only after a transition on data transfer input (Actual position information is captured within 200 μ s. Outputs are typically updated within 3 ms.

If PC = no is displayed, transparent update or microfreeze handshaking is in effect. Outputs are updated continuously. When a transition on the data transfer input is detected, the output states will be frozen for a minimum of 50 μ sec. If programming is enabled, the INC or DEC Keys can be used to change modes. The Mode Key advances to Gear Ratio Display.

4.6 Gear Ratio Display



The resolver used as a position transducer actually contains two resolvers with an internal gear train. Typically the fine resolver will make one turn per revolution of the external shaft and the coarse resolver will make one turn after many revolutions of the external shaft.

The right window of this display shows the number of turns of the fine resolver per turn of the coarse resolver. The left window displays "gr" to indicate gear ratio. If programming is enabled, the right window blinks and the INC and DEC Keys can be used to change the gear ratio.

Pressing the Recall Key will restore the previously stored gear ratio. The → Key has no effect in this display. The Mode Key advances to the Upper and Lower Safety Limit Displays.

4.7 Upper and Lower Safety Limits

Both the Upper and Lower Safety Limits (pins 16 and 34 of the 37-pin connector) are fail-safe outputs. The upper limit, UL, must be a value more than the lower safety limit, LL.

The Mode Key advances to the Calibration Display.

4.8 Calibration Display

The scaling of the position displays is based on two calibration points. The left window displays "P1" or "P2" indicating which calibration point is displayed. The right window displays the scaled position of the selected calibration point.

If recalibration is performed, both P1 and P2 must be re-entered. The new P1 and P2 should be different than the



old P1 and P2 values, or the unit will not enter recalibration.

The Mode Key advances from point one through point two to the Gear Ratio display. If programming is enabled, the → Key selects a digit (indicated by blinking) and the INC and DEC Keys change the digit's value.

The Recall Key will restore the current point's previously programmed value.

Once the Mode Key is pressed, the previous values will be over written with the new values, however the scale factor will not be altered until both points have been recalibrated and validated.

To recalibrate scaling, select two points near the opposite ends of the useful travel. These points must be separated by at least one tenth of one revolution of the fine resolver and less than one turn of the coarse resolver. Displayed values for these points must differ by at least 0.100. Before recalibration verify that the position display increases with the correct direction of machine travel.

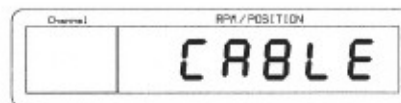
Direction can be reversed by switching S1 and S3 of each resolver. Jog the machine to the point with the desired lower value position, then edit the displayed value with the → and INC and DEC Keys. Even if the display is correct for this point, the INC and DEC Keys must be used to switch from display mode to calibrate mode.

The Recall Key can be used to abort calibration and return to display mode.

Once the new display value is selected, press MODE to advance to point 2. Jog the machine to the other point, select the display value and press MODE. In both cases when mode key is pressed, the resolver position and veloc-

ity are sampled. If the velocity is nonzero or if the resolver position or display values fail to meet minimum differences an "Error" message will be displayed. If a wiring fault is detected during calibration, the "CABLE" fault message will be displayed and the calibration procedure will be aborted.

4.9 Broken Wire Indication



Should one or more of the resolver wires break or become shorted, the healthy output will de-energize, and the display will indicate: CABLE.

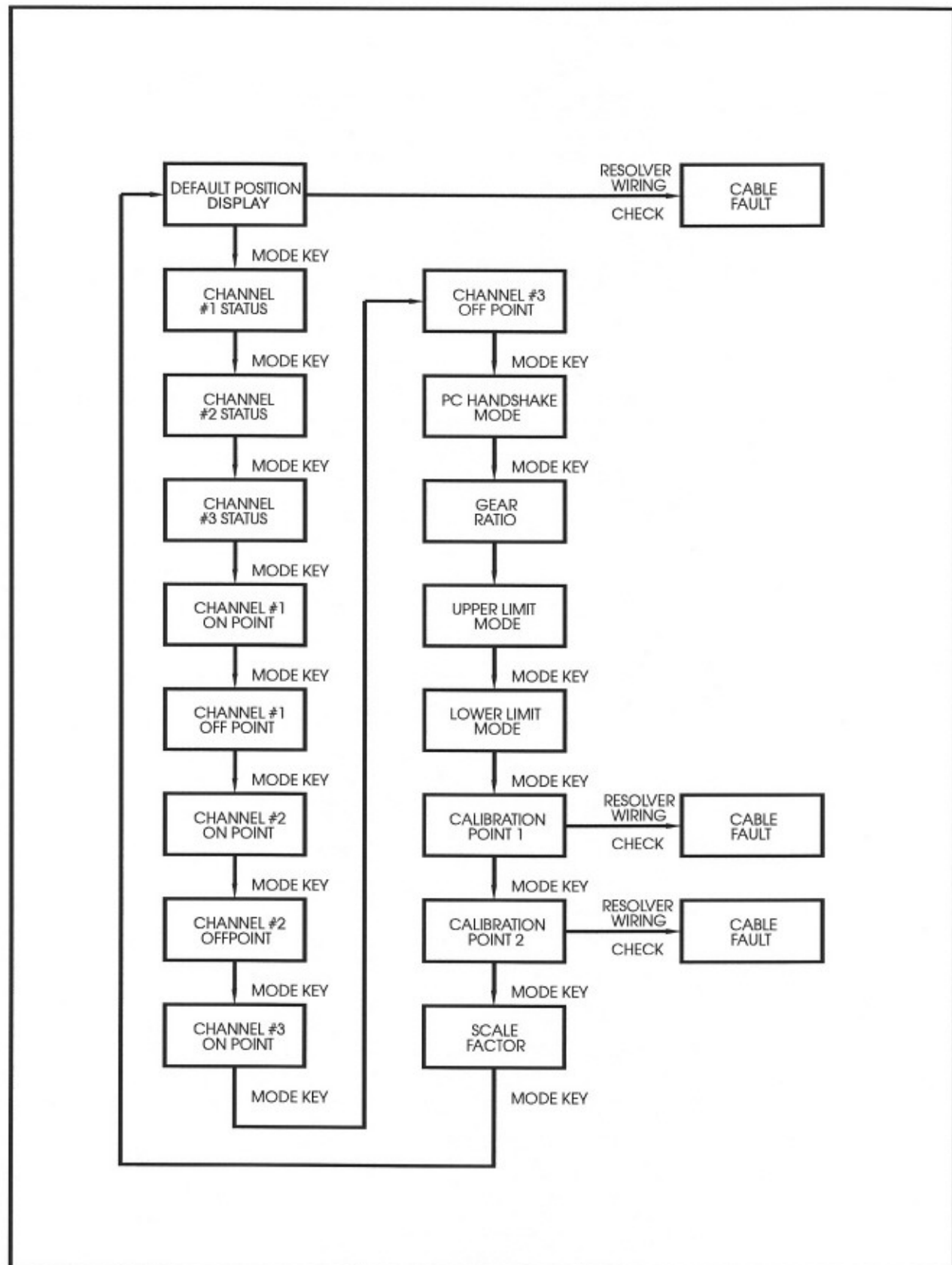
4.10 Scale Factor Display



This display shows the current scaling number in the user's units per resolver shaft revolution. The Mode Key advances to calibration, the Recall Key returns to position display and the INC, DEC and → Keys are ignored.

The Mode Key returns to the default position display.

Programming Flow Chart



WARRANTY

Autotech Corporation and MC Technologies 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.

The customer agrees to hold Autotech Controls harmless from, defend, and indemnify Autotech Controls against damages, claims, and expenses arising out of subsequent sales of Autotech Controls' products or products containing components manufactured by Autotech Controls and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or subcontractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (p.l. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company's products except those expressly contained herein. The customer acknowledges the disclaimers and limitations contained and relies on no other warranties or affirmations.

CAUTION

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.

The information in this book has been carefully checked and is believed to be accurate; however, no responsibility is assumed for inaccuracies. Autotech Controls reserves the right to make changes without further notice to any products herein to improve reliability, function or design. Autotech Controls does not assume any liability arising out of application or use of any product described herein.

Autotech Controls does not recommend the use of its products in applications wherein a failure or malfunction of the unit may directly threaten life or cause human injury. The user of Autotech Controls' products assumes all risks of such use and indemnifies Autotech Controls against all damages.

© Copyright 1997 by Autotech Controls, Limited Partnership. All rights reserved.

ADDENDUM

TO MANUAL MAN-M1151-M10A REV 02, 07/18/97 FOR THE SAC-M1151-M1NAN

The conversion of SAC-M1151-M10AN to SAC-M1151-M1NAN effects the display board only. The decimal point moves from "thousands" to "hundreds" with this unit (i.e., xxx.xxx to xxxx.xx). The rest of the information in the manual is relevant to both units.