M1151 MINI•PLS™

Instruction Manual

Introduction

The Mini•PLS family, since its introduction to the market, has set new standards for speed, precision and reliability. While retaining the key features of the Mini•PLS family, the M1151 features an incredibly small size and a simple man-machine interface. Now, Autotech has expanded the functions of the M1151 to serve the specialized needs of the industrial control marketplace.

Smallest PLS

The state-of-the-art design of the M1151, utilizing surface mount technology, makes it possible to package a full function PLS in 1.8" x 3.6" x 5.7" (HxWxD). With 16 outputs in this compact size, the M1151 is the smallest PLS available on the market. The space saving housing (6.5 sq. in. panel space) allows a M1151 retrofit to crowded control panels.

Simple Creative Keyboard

Creative engineering from Autotech has made it possible to program all the PLS functions utilizing only five programming keys. With these five self-explanatory programming keys, the M1151 is extremely simple to program — no complex key sequence needs to be remembered, nor do you need to carry any note cards.

Simultaneous Display of Channel Number, "ON" and "OFF" Setpoints

The large (.4") very bright LED display provides good visibility up to 30 feet in plant environments. The user-friendly front panel simultaneously displays the correlated parameters such as channel number, "ON" and "OFF" setpoints or program number, angle, and RPM allowing a simple and easy-to-understand man-machine interface.

Patented "↑" and "↓" Keys to Adjust Offset and Speed Compensations as well as Setpoints, even in Full Motion

Resolver alignment to machine "zero", as well as fine tuning the machine in motion, is accomplished through our patented "↑" and "↓" keys that increment or decrement the machine offset or the setpoints.

Individual Channel Speed Compensation

Relays and solenoids, because of their mechanical nature, have inherent fixed delays when activating, varying from 10 ms. to as much as 30 ms. A relay with a 10 ms turn on delay will cause as much as a 55 degree shift in operation at 600 RPM. Each channel may be programmed with individual speed-dependent advances to compensate for fixed delays attributed to relays and solenoids. Speed compensation is fully adjustable from 0 to 35.9 degrees advance per 10 RPM.

High Speed Operation, 120 µs Scan Time

The M1151 Mini•PLS can operate up to 1800 RPM. The 8 channel unit maintains a repeat accuracy of 120 µs while the 16 channel unit has 200 µs scan time.

Multiple Program Storage Reduces Down-Time at Job Changeovers

The M1151 Mini•PLS can internally store four independent programs for different jobs. With a preprogrammed M1151 for different product runs, the product changeover is as simple as pressing the MODE and INC/DEC Keys to select the program corresponding to the job. Remote selection of PLS programs may be accomplished by a PLC (Programmable Logic Controller) or an external selector switch.

Built-in Tachometer and Motion Detector

The built-in tachometer displays the shaft speed in RPM simultaneously with the position display. Additionally, the built-in motion detector continuously monitors shaft speed and allows the programming of high and low RPM limits for the motion output. The motion detector status is indicated on the front panel by an indicator LED.

Optically Isolated Inputs and Outputs

Optically isolated inputs and outputs are standard to provide enhanced noise immunity and ensure operational integrity of the M1151 Mini•PLS in harsh industrial environments.

Internal Diagnostics

The M1151 Mini•PLS has built in circuitry that continually monitors the operation of the unit. If any of the 6 resolver wires break or short together, the Broken Wire Detect circuitry will cause a fault condition. A fail-safe fault output is provided that is energized ONLY if the resolver cable is intact, the customer power supply is present, the line voltage is within specifications, and the processor is not in reset. The fault output will de-energize if the M1151 detects any of these faults.

Dynamic Zeroing MODZ

The M1151 Mini•PLS features optional dynamic zeroing or ModZ (MODification Zero) to modify the zero reference point for selected channels independent of actual resolver position. Upon receiving an external signal, the resolver position for the selected ModZ channels is reset to zero. Thereafter the position is incremented as the resolver rotates and outputs are turned "ON" or "OFF" at the programmed limit settings. The ModZ feature is ideal for gluing applications, where the glue gun must be activated at certain positions after detection of an upcoming product. Four ModZ channels, any of which can be used as a normal channel, are included in the M1151 Z option.

Brake Wear Monitor

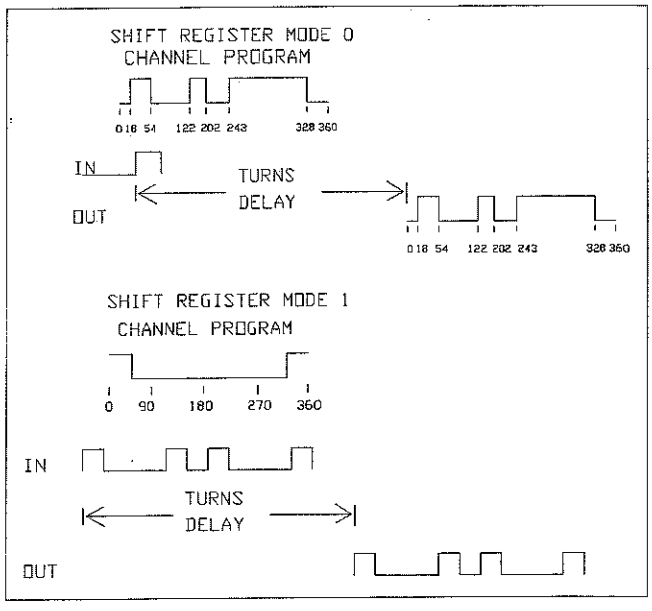
The optional M1151 Brake Monitor automatically measures the time in milliseconds from an input brake signal until the resolver shaft stops rotating. This stopping time is then compared to the programmed Warning Time and Danger Time and the appropriate Safe, Caution, or Danger output is energized as a result. The M1151 Brake Monitor is normally applied as an indication control on metal stamping presses. The brake wear monitor uses three PLS channels.

Shift Register

With the Shift Register option, the four shift register channels can be thought of as programmable position delays. The Shift Register length (Turns Delay) can be programmed from 1.00 to 50.00 revolutions of the input shaft. There are two shift register modes. The Mode 1 Shift Register emulates a normal electronic shift register circuit with a programmable length. To program a shift register channel for Mode 1 operation, program a single dwell whose **"From" setpoint is greater than the "To" setpoint.** The Mode 1 dwell never actually executes; it is a signal for Mode 1 operation. In Mode 1, the **input pattern** appears at the **output after the input shaft has rotated the programmed Turns Delay revolutions.**

The Mode 0 Shift Register **acts as a multi-turn MODZ.** Mode 0 can also be programmed with a Turns Delay from 1.00 revolutions to 50.00 revolutions. After a **false-to-true input transition, the entire pattern programmed into the Shift Register channel** appears at the **channel output after the input shaft has rotated the Turns Delay number of revolutions.** The M1151 Shift Register model features battery back-up of the shift register memory to retain shift register position during power down.

The shift register memory may be cleared either from the keyboard or from an external input. The additional output channels are programmed as normal PLS outputs.



Shift Register Modes and Operation

Specifications

POWER REQUIREMENTS
AC Power: 105–135 VAC, 50/60 Hz, 8 W exclusive of load (optional 220 VAC)
DC Interface Power: 11–28 VDC, 100 mA (exclusive of load)
Operating Temperature: –10 to +130 °F (–23 to +55 °C)
System Resolution: 12 Bits
Scale Factor: Programmable, 16 to 999
Offset: Programmable, "0" to full revolution.
Scan Time for Complete System Execution:
Standard M1151 (All speed compensations 0):
8 Output units: 120 microseconds
16 Output units: 200 microseconds
M1151 Brake Wear Monitor Option:
8 Output units: 135 microseconds
16 Output units: 215 microseconds
If Brake Time measurement is active, add 42 microseconds to normal scan time.
M1151 ModZ Option:
8 Output units: 185 microseconds
16 Output units: 265 microseconds
For each inactive ModZ channel, add 7 microseconds to above scan time. For each active ModZ channel, add 17 microseconds to above scan time.
M1151 Shift Register Option:
8 Output units: 210 microseconds
16 Output units: 290 microseconds
For each Mode 0 Shift Register channel, add 78 microseconds to above scan time. For each Mode 1 Shift Register channel, add 162 microseconds to above scan time.
Position Signal:
Autotech's Series RL100, E6R, E7R, or E8R Resolvers
Cable Length between Resolver and M1151:
2500 feet shielded
Resolver Cable: Autotech's CBL-10T22-xxxx
Maximum Resolver Shaft Speed: 3600 RPM
Resolver -to-Digital Decoder Tracking Speed: 1800 RPM

Outputs:

Types Of Outputs:
P: PNP Source Transistor;
Logic True: Transistor On, 1.7 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
Number of PLS Outputs:
7 or 15 plus one motion detector output
Number of ON/OFF Setpoints per channel:
Channel #1: 1 dual setpoint; *All other channels:* Counts per rev ÷ 2
Motion Detector:
Low Setpoint: up to 998 RPM max.
High setpoint: up to 999 RPM max.
Output: P or N type, (same as PLS outputs)
Note: Motion, fault and direction outputs will be the same as the PLS outputs ordered.
Optical Isolation:
1500 Vrms standard on all I/O
(except resolver and analog velocity signals)
Remote Power Relay Outputs
For Cam and Motion outputs requiring higher current ratings, a separate Remote Power Relay chassis Autotech's part number, ASY-RLYCH-xxxx, can be used. The relay chassis is connected to a unit having N type outputs using a pre-wired cable.
Relay Chassis Input Power: 120 VAC 50/60 Hz.
Number of outputs : 8 or 16 cam outputs plus one motion output.
Unit required : N type
Cable: Prewired with DB15 connector on both ends.
Relays: Relay chassis is available for EM or Solid state relays.
Electromagnetic Relays (Part# KSD-012D-C10A):
120 VAC @ 10 Amp, SPST
Solid-State AC Relay (Part# **KSS-120AC-3AMP**):
24–280 VAC @ 0.2–3 Amp, zero cross-over switching triac output relay,optically isolated
Solid-State DC Relays:
Part# **KSS-60VDC-3AMP**:
9–60 VDC @ 3 Amp, optically isolated
Part# **KSS-200VDC-1Amp:**
0–200 VDC @ 1Amp, optically isolated

Inputs:

Program Enable, Output enable, External Program Select, ModZ, Shift Register & Brake Wear Inputs:
For "P" Type units:
Enable or True = 11 to 28 VDC @ 13.5 mA max
or tied to terminal #9 on the terminal block.
(terminal 9 is internally wired to Vs+ for P type of units)
Disable or False = 2.0 VDC @ 0.2 mA max or open circuit

For "N" Type units:
Enable or True = 1.0 VDC @ –3.0 mA max
or tie to terminal #9 on the terminal Block
(terminal 9 is internally wired to Vs– for N type of units)
Disable or False = 3.8 V DC to 28 VDC Max @ -0.2 mA max
or open circuit.

How to Order

1. Mini PLS

SAC*–M1151–x x x x Mini•PLS with built-in rate offset
1 2 3 4

1. *Number of Output Channels:*
   8: 8 Channels
   6: 16 Channels

2. *Type of Output*
   P: PNP Source Transistor
   N: NPN Sink Transistor

3. Special Options
   Z: ModZ
   S: Shift Register
   B: Brake Wear Monitor
   0: None

4. Analog Tach Output
   0: None
   A: 0–10 V @ 600 RPM
   B: 0–10 V @ 500 RPM
   C: 0–10 V @ 400 RPM
   D: 0–10 V @ 300 RPM
   E: 0–10 V @ 200 RPM
   T: Outputs are on terminal block instead of the DP connector *(use pin description shown on page 8 of this manual, P/N SAC M1151-8xxT Wiring)*

* *For Slave MiniPLS, change the "A" in SAC to "S"*
For 240 VAC, 50/60 Hz power, change the "C" in SAC to "4"

2. Position Transducers:

The M1151 is designed to use the following Autotech Resolvers: RL100, E6R, E7R, or E8R. Please see position transducer manual section for *How to Order* information on these transducers and appropriate accessories.

3. Remote Power Relay Output Chassis

3.1 Select type and number of output chassis: (must use M1150 Series PLS with NPN type of outputs: Relays not included, see 3.2 to order)

ASY-RLYCH-08RL	Relay chassis for 8 EM SPDT outputs (Note: Use only KSD-012DC-10A, SPDT Relay)
ASY-RLYCH-16RL	Relay chassis for 16 EM SPDT outputs (Note: Use only KSD-012DC-10A, SPDT Relay)
ASY-RLYCH-08SS	Chassis for 8 solid-state relay outputs or EM SPDT outputs using KSD-A12DC-10AMP relays
ASY-RLYCH-16SS	Chassis for 16 solid-state relay outputs or EM SPDT outputs using KSD-A12DC-10 AMP relays
220/240 VAC Units	**2:** For 220/240/VAC, 50/60 Hz AC power input on above chassis, change the "Y" in ASY to "2"

3.2 Select type and number of output relays: (required in relay chassis)

KSD-A12DC-10A	EM relay, SPST, Form A, 120 VAC @ 10 Amps resistive
KSD-012DC-10A	EM relay, SPDT, 120 VAC @ 10 Amps resistive (Note: For use with ASY-RLYCH-08RL and ASY-RLYCH-16RL relay chassis only)
KSS-120AC-3AMP	AC Solid-state relay, 120 VAC @ 3 Amps
KSS-60VDC-3AMP	DC Solid-state relay, 10–60 VDC @ 3 Amps
KSS-200DC-1AMP	DC Solid-state relay, 200 VDC @ 1 Amp

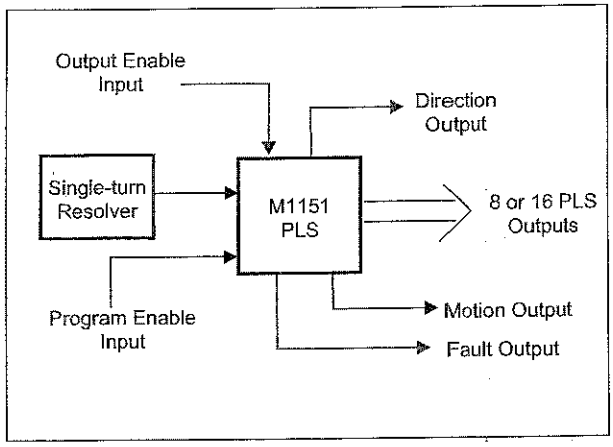
3.3 Cable connecting all M1151 models to relay chassis (8 outputs per cable):

CBL-RLYCH-DA4	15 conductor cable,with overall foil shield, 4 ft length and Dsub connector on both ends for interconnection of relay chassis to the PLS
CBL-RLYCH-DAxxx	Above with extended length, xxx = length in feet (10, 25, 50, and in 50 feet increments)
CBL-RLYCH-D04	15 conductor cable, with overall foil shield, 4 ft. length, Dsub connector on one end and open on other, for interconnection of relay chassis to PLS
CBL-15S22-DAxxx	Above with extended length xxx = length in feet (10, 25, 50 and in 50 feet increments)

Installation and Operation

1. Functional Description:

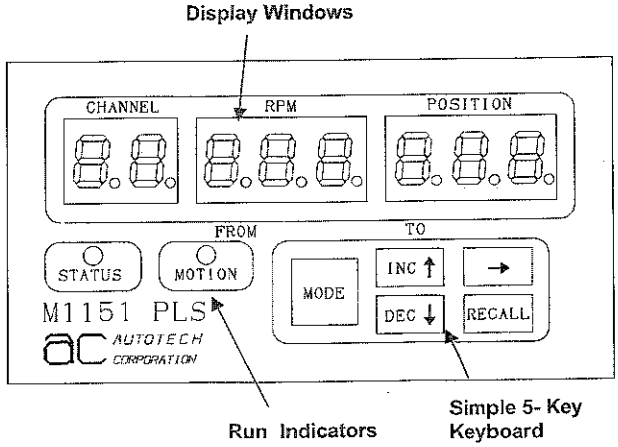
A simplified functional block diagram of M1151•PLS is shown below:



The M1151•PLS uses a resolver, such as Autotech's RL100, E6R, E7R or E8R series of resolvers, as a position transducer. The M1151•PLS controls 7 or 15 PLS outputs (turns ON/ OFF), according to the programmed position limits for each output. The M1151 also offers a motion output, that energizes when the resolver is rotating at a speed within the programmed motion limits.

The direction output from M1151 is energized whenever the position value is increasing. The M1151 continuously monitors its operation and resolver connections, and keeps the Fault output energized during safe operating conditions. The Fault output is de-energized if a fault develops in any monitored parameter.

1.1 Front Panel Indicators and Control



1.2 Display Windows

The 8 digit display is divided into three windows: Channel, RPM (or From) and Position (or To). The display in the windows depends upon the programming or display mode of the unit. For details, see programming in section 4.

1.3 Run Indicator Lights

Status LED — Indicates the current "ON/OFF" output status of the selected channel. The Status indicator is active in all 7 modes and shows status of the last selected channel.
Motion LED — Illuminates when the current shaft RPM is within the motion high and motion low limits. The Motion LED displays the status of the 8th (8 chan. units) or the 16th (16 chan. units) output designated as the "Motion output" of the M1151 PLS. The Motion indicator is always active.

1.4 Keyboard

Mode Key — Each key press steps the operator through each of the seven programming modes:

- **Program Number, Shift Register Clear (S option), Stop Time (B option)** and **Default Position/Tach Mode**
- **Scale Factor** Programming Mode
- **Offset** Programming Mode
- **Speed Compensation** Programming Mode
- **Turns Delay** (Shift Register option) or ModZ on/off (ModZ option) Programming Mode
- **Dwell Set Point** and **Warning, Danger** for Brake Wear Monitor Programming Mode
- **Motion High Limit** Programming Mode
- **Motion Low Limit** Programming Mode

In any of the programming modes, pressing the **Mode** Key will terminate the mode currently being programmed, store any changes that have been made, and switch to the next mode.

INC Key (↑) — Used in all programming modes to increment the value of the setting or limit of the current programming mode.

DEC Key (↓) — Used to decrement the value of the setting or limit of the current programming mode.

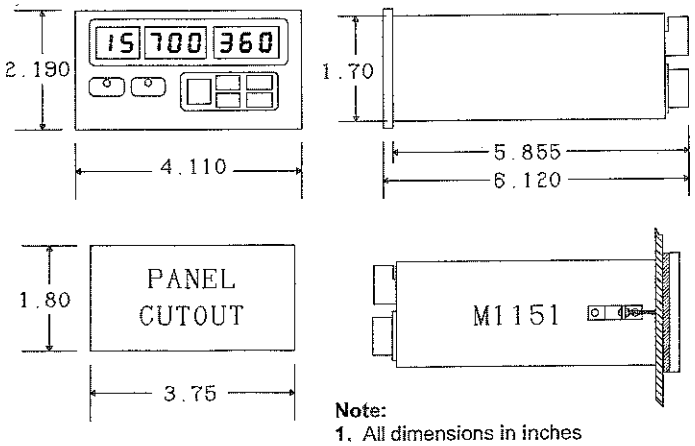
Arrow Key (→) — While in the **dwell set point limit** programming mode, this key changes the current operating window. When in the **dwell set point** programming mode, all 3 display windows are programmable, but the **INC** and **DEC** Keys will correspond to only one window at a time. The **Arrow** Key selects which of the 3 display windows may be acted upon by the **INC** and **DEC** Keys. In the Speed Compensation Mode, the **Arrow** Key allows the **INC** and

DEC Keys to select the channel number or change each channel's speed compensation value. In the Shift Register option Turns Delay mode, the **Arrow Key allows the** INC **and** DEC Keys to select the channel number or change each Channel's Turns Delay value. In the Brake Wear Monitor option, the (→) Key allows programming seconds or milliseconds depending on the window selected. The (→) Key is **ignored** during all other programming modes.

Recall Key— During **dwell set point** programming mode, the Recall Key will step the display through each of the dwell set points that have been programmed for the selected channel. Recall is **ignored** for all other programming modes.

2. Mounting

The M1151•PLS is housed in an 1/8 DIN panel mount case. The M1151 requires a rectangular panel cutout and mounting holes are not required. Slide the M1151 in through the panel opening with the furnished gasket, insert the two right-angle mounting brackets into the openings on either side of the M1151 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 and DB connector to the M1151 unit to complete the installation.



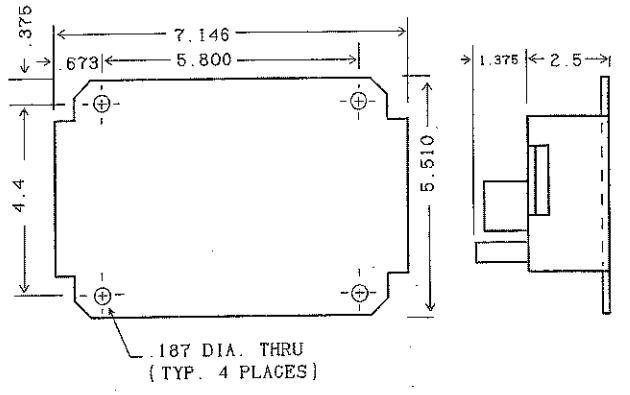
Note:
1. All dimensions in inches
2. Allow a minimum of 2.75 inches for DB connector

Resolver Cable (CBL-10T22-xxx) Wiring

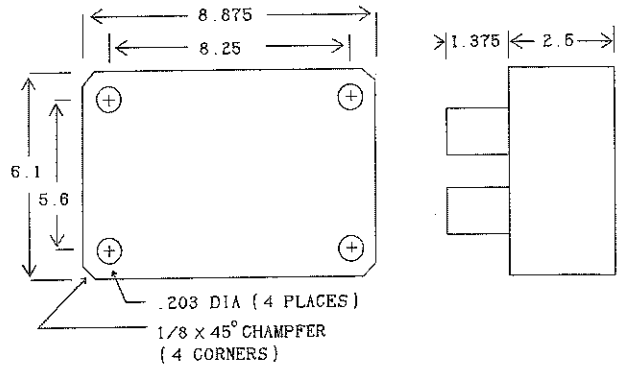
S4 ..	Blue	Pair
S2 ..	Black/Blue	
S3 ..	Yellow	Pair
S1 ..	Black/Yellow	
R2 ..	Green	Pair
R1 ..	Black/Green.	

3. Relay Chassis Mounting

Power Relay Output Chassis, 8 Channel



Power Relay Output Chassis, 16 Channel



Note: Resolver wiring must be twisted pair with overall foil shield

4. Wiring

Notes:

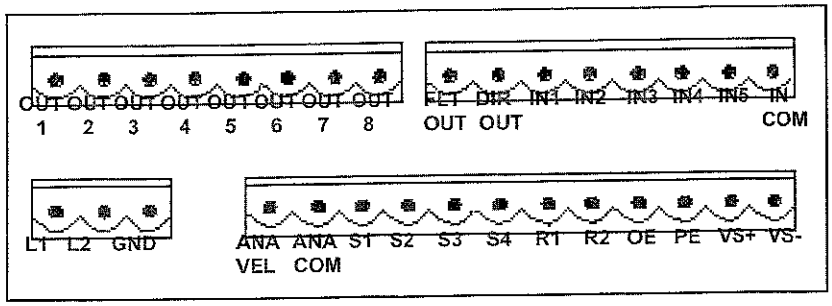
1. The M1151 must be supplied with 12–28 VDC (VS+, VS–) in addition to the normal 120 VAC. Relay chassis ASY-RLYCH-xxxx internally supplies this voltage through DB connectors.
2. Output (Channel) #8 in the eight output unit and output #16 in the sixteen output unit is a motion output.
3. Output wiring to other electronic devices (programmable controls) must use shielded cable, with shield connected to a good earth ground at both ends.
4. No special tools are required for wiring input/output devices to the Mini•PLS.
5. Pre-wire terminal blocks before attaching them to the M1151, for easier installation.
6. Wiring for the Analog Velocity Option, not available for the Shift Register or ModZ options, is connected to terminals 7 and 15. The load on the Analog outputs should be greater than 1K Ohm.
7. External Program Select is not available for the ModZ or Shift Register options. When wiring the External Program select, shift register, or ModZ inputs for "P" type units, the inputs may be directly wired to a PLC DC output sourcing card. The Common of the card must be wired to VS- (DB15-2).
8. The Output Enable input, when FALSE, de-energizes all outputs including the FAULT and Direction outputs.
9. **All** logic level wiring (including resolver and external power supply) must be done using **overall foil shielded** cables, with shields and equipment grounded. See *How to Order* section for suitable cables offered by Autotech.
10. Resolver shielded cable must consist of **twisted pairs,** and the twisted pairs must be wired as per wiring instructions. See *How to Order* section for a suitable resolver cable offered by Autotech. It is recommended that the resolver shielded cable be run in its own **separate** conduit.
11. All ground planes on which the M1151 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.
12. All shielded cable must be kept at a minimum distance of 2 inches from all high voltage or inductive wiring.
13. All shielded cable must be kept at a minimum distance of from all motor wiring controlled by AC or DC drives.
14. The table provided belowdescribes the resolver and DB-15 connector cable.

DB15 Connector Pin Functions *Cable:* **CBL-15S22-DAxxx**			
Pin #	**Cable Color**	**Connector A**	**Connector B**
1	Black	NC	NC
2	White	VS(–) (DC supply common)	VS(–)
3	Red	VS+ (Customer DC supply)	VS+
4	Green	Fault Output	Direction Output
5	Orange	Channel 7	Channel 15
6	Blue	Channel 5	Channel 13
7	White/Black	Channel 3	Channel 11
8	Red/Black	Channel 1	Channel 9
9	Green/Black	VS–	VS–
10	Orange/Black	VS+	VS+
11	Blue/Black	Output Enable	NC
12	Black/White (on 8 channel unit) (on 16 channel unit)	Motion Output Channel 8	Not applicable Motion Output
13	Red/white	Channel 6	Channel 14
14	Green/White	Channel 4	Channel 12
15	Blue/White	Channel 2	Channel 10

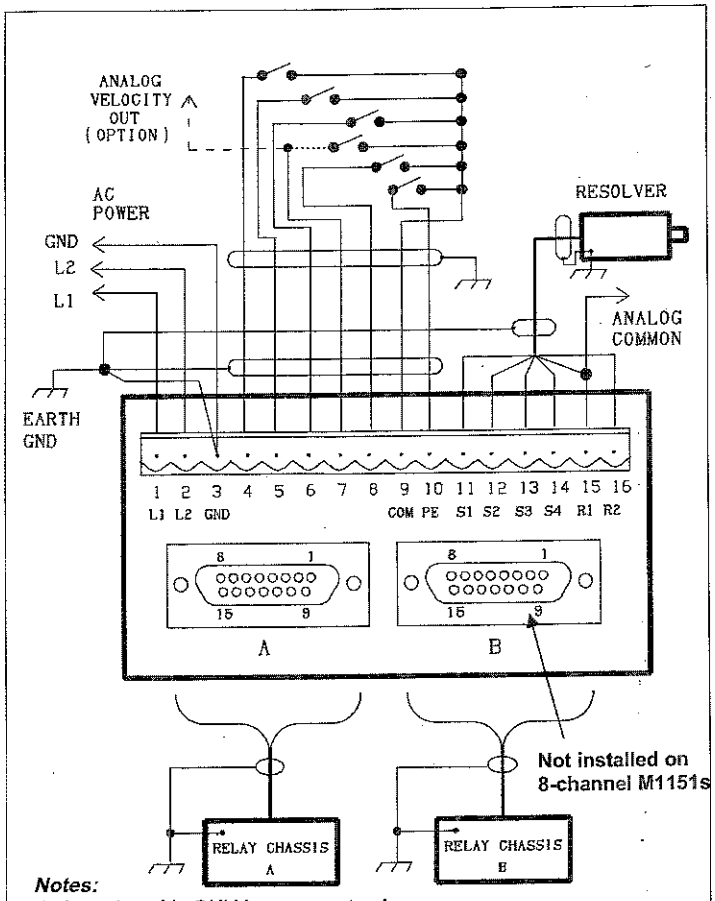
Note:
To enable output, connect output enable pin 11 of connector A to pin 9 (VS–) for "N" type outputs or

P/N SAC-M1151-8xxT Wiring

The unit functions are the same as the M1151, however, the outputs are on the terminal block instead of the DB connector. Please use the pin description shown in the figure below.

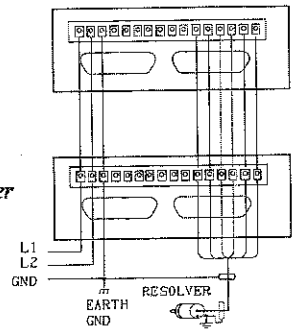


Standard and B Option M1151 External Program Select Wiring		
Program #	**Terminal 5**	**Terminal 4**
Prog 1	Open	Open
Prog 2	Open	Closed
Prog 3	Closed	Open

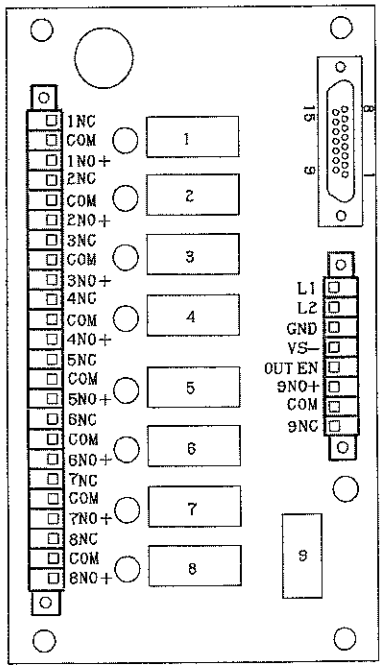


Notes:
1. Output enable ONLY on connector A
2. DB connector internally tied to Earth GND at connector end through mounting hardware.

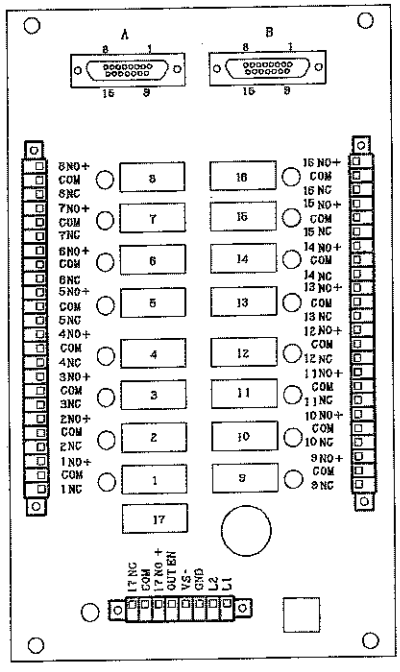
M1151 Input Function Table				
Term. #	**Standard**	**ModZ**	**Shift Reg.**	**Brake**
4	Ext. Sel. 1	MZ 1 In	S.R. 1 In	Ext. Sel. 1
5	Ext. Sel. 2	MZ 2 In	S.R. 2 In	Ext. Sel. 2
6	NC	MZ 3 In	S.R. 3 In	Ext. Enable
7	Analog Out	MZ 4 In	S.R. 4 In	Analog Out
8	Ext.Prog. Enable	MZ Enable	S.R. Clear	Brake Input



Master Slave Wiring (up to 7 Slaves possible)
Slave 1151 is different than Master 1151



8 Output Relay Chassis
(Part# : ASY-RLYCH-08xx)



16 Output Relay Chassis
(Part# : ASY-RLYCH-16xx)

- Use cable CBL-10T22-xxx for wiring resolver (see previous page for wire colors)
- Use cable CBL-RLYCH-DA4 to wire relay chassis to the M1151.
- When an 8 output M1151 unit is connected to 8 output relay chassis, the motion output is available on output relay 8 of the relay chassis, and Fault output is available on output relay 9.
- When a 16 output M1151 unit is connected to 16 output relay chassis, the motion output is available on output relay 16 of the relay chassis, and Fault output is available on output relay 17.

4. Programming the M1151 PLS

The front panel keys and indicators have been described earlier. Different modes, and corresponding displays in the display windows are listed in the table given below:

Mode	Display Window		
	Channel #	RPM (From)	Position (To)
Position/Tach (Default)	P1–P4 (Prog #)	Resolver RPM	Resolver Postion
Scale Factor	SF	Blank	Current Scale Factor
Offset	OF	Current Offset	Resolver Position
Speed Compensation (Rate Offset)	Channel #	SC	Current Rate Offset
Brake	CA (caution) dA (danger)	Limit (sec)	Limit (msec)
ModZ	Channel #	Blank	Act or PLS
Turns Delay (S Option)	Channel #	From (Start)	To (End)
Dwell Setpoint	Channel #	Low Limit	Blank

Following are the guidelines for programming a standard M1151: *(Please see section 4.8 for Shift Register Programming, section 4.9 for Brake Wear Monitor Programming, and section 4.10 for ModZ Programming.)*

1. Before programming the unit, make sure that:
   - AC Power is applied and the unit is operational.
   - External DC power must be +11 to 28 VDC.
   - The program enable input must be enabled (PE input (terminal #9 connected to terminal #10). Terminal #10 is internally tied to Vs– for N type units, and to Vs+ for P type units.

> **NOTE**
> The Program Enable input is an important safeguard against data pollution by strong industrial noise sources. Programming should only be enabled while actually programming the M1151.

2. **All decimal points** (illuminated on Power Up) is an alert to check the M1151 program. In the **unlikely** event of a power loss while in the **process** of programming, the program entered at power loss may be lost.
3. While programming, a flashing status indicator indicates that the M1151 is storing the item programmed into nonvolatile memory. Changing modes may be inhibited for this short period.
4. Because of safety concerns, scale factor, program number change, ModZ / Normal, and Shift Register clear will be locked out if the shaft is moving.

Because of the menu-driven style of key sequences, the M1151 does not have error modes. Illegal key sequences are simply ignored; Incrementing or Decrementing past specific boundaries (as in motion limit programming being limited to 999 RPM) is automatically inhibited by the M1151 PLS.

Pressing the **MODE** Key will step the operator through the following programming modes:

- **Scale Factor** (SF)
- **Offset** (OF)
- **Speed compensation mode** (SC)
- **Turns Delay** (td) (S option only)
- **ModZ (act) / normal (PLS) channel mode select** (td) (Z option only)
- **Channel/Dwell Setpoint** (1–7 or 1–15)
- **Caution (CA) and Danger (dA) Limits**
- **Motion High Limit** setting (HI)
- **Motion Low Limit** setting (LO)
- **Change** current operating program (P1–P4); Pressing the arrow key while the Program Number is displayed in S option units will allow the shift register memory to be cleared: Press INC, DEC, and Mode to complete the process.

The **MODE** key will terminate any programming operation and switch to the next programming mode in the loop. Note: There is not any "get-back" or "erase" key for programming errors; any program change occurs immediately as the operator INC's or DEC's a value. Always use caution when changing any setting.

When in any programming mode, if the keyboard is not pressed during a **1 to 2 minute** timeout period, the M1151•PLS will switch back to the default **position/tach** display mode. This is to prevent the M1151 from being accidently left in any programming mode for an extended time. If the timeout occurs while programming, simply use the **MODE** key to return to the desired mode.

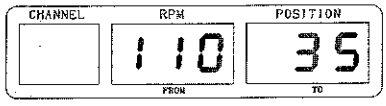
All values, limits, program numbers, and setpoints will retain their information in EEPROM memory indefinitely with or without power applied to the unit. The only item changed on loss of power is the current channel number that defaults to channel one.

IMPORTANT: If the M1151 unit is operating on a program— for example, number P3 — and power is removed from the unit, when power returns to the unit, it will remain operating in program number P3.

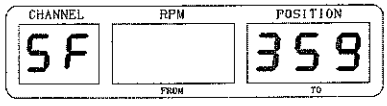
The following section is organized in the progression most often used when installing the M1151 PLS. Please note that Position, Tach, and limit values in the following examples are simply typical values, and do not mean to show any specific default or standard limits or values.

4.1 Scale Factor Mode

Upon power up, the M1151 will be in the default **position/tach** display mode. The display will appear as follows:



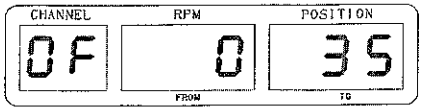
The channel number (and **status** LED) will be set for channel 1. The channel display will briefly identify the current operating program number (P1–P4) and then go blank. The RPM window will display the current shaft speed, and the position window will show the current shaft angle plus offset. The M1151 Brake Wear Monitor unit can also power up in the Stop Time (St) mode, indicating a stop time of 0.000. Press the **MODE** Key to switch to **Scale Factor** Mode. The display will indicate:



If programming is enabled, press the **INC** Key to increase the Scale Factor and press the **DEC** Key to decrease the scale factor. Please note that scale factor is desired counts per turn minus 1. The range of scale factor supported by M1151 is 16 to 999.

4.2 Offset Mode

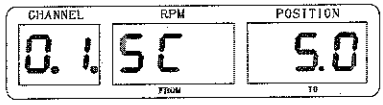
From the Scale factor mode, press the **MODE** Key to switch to **Offset** Mode. The offset is the value added to the current shaft angle to align the machine zero with the resolver zero (avoiding the old practice of mechanically zeroing the shaft encoder/ cam switches). The display shows "OF" (offset) in the **CHANNEL** window, the current offset value in the **RPM** window, and the current shaft angle position in the **POSITION** window.



If programming is enabled, pressing the **INC** or **DEC** Keys will increase or decrease the current value. Holding the **INC** or **DEC** Keys down will rapidly change the offset until the desired value is reached. Note that as the offset value changes, the current position and corresponding outputs also change accordingly.

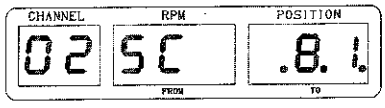
4.3 Speed Compensation Mode

Use the **MODE** Key to change from Scale Factor Mode to Speed Compensation Mode. Speed Compensation is defined in scale factor units per 10 RPM. The examples below assume a scale factor setting of 359. The **CHANNEL** window will display the current selected Channel Number (1–15), and the **POSITION** window displays the current programmed speed compensation for this channel.



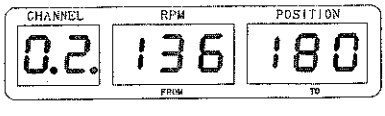
Here, Channel 1 has 5.0 degrees of offset at 10 RPM (and 0 degrees of offset at 0 RPM). Use the **INC** and **DEC** Keys to view each Channel's Speed Compensation Value. If the Speed Compensation of Channel 2 needs to be decreased, use the **ARROW** Key to move to the value display window, i.e., the decimal points change to the rightmost display window.

Channel 2 has 8.5 degrees of advance at 10 RPM. Using the **DEC** Key, that value might be reduced to 8.1 degrees, even when the machine is in motion. The Program Enable input must be active to change speed compensation values. Settings may be viewed at any time.

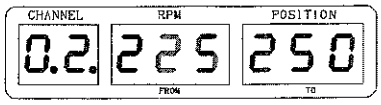


4.4 Channel/Dwell Set Point Mode

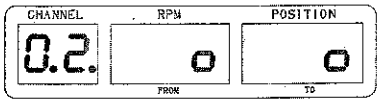
Pressing the **Mode** Key will step the operator into the **dwell set point** programming mode. The current channel number is in the **CHANNEL** display, the "FROM" set point value is in the **RPM** display, and the "TO" set point value is shown in the **POSITION** display:



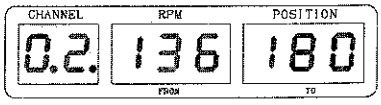
Here, the first Set Point Dwell for Channel 2 will turn on at 136 degrees, and turn off at 180 degrees. If another dwell set point exists for this channel, pressing the **RECALL** Key will display the next Set Point Dwell:



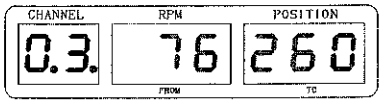
This dwell turns on at 225 degrees and turns off at 250 degrees. Assume that there are only 2 Set Point Dwells on Channel 2. Pressing **RECALL** a third time will display a NULL set point:



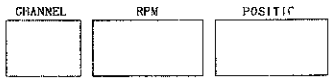
This pair is not an actual Set Point Swell, but is used to create more Set Point Dwells, as described later. Pressing the **RECALL** Key a fourth time will again display the first Set Point Dwell:



At this point, some clarification is needed about the decimal points that are illuminated in the **CHANNEL** window. Consider these as a cursor, or pointer, to indicate the particular window the **INC** and **DEC** Keys will act upon when pressed. When in the **CHANNEL** window, the decimal points indicate that pressing the **INC** Key will switch us to Channel 3:



Notice that the M1151 has automatically recalled the first Set Point Dwell for Channel 3 as it is selected. Pressing the **DEC** Key will bring the display back to Channel 2:

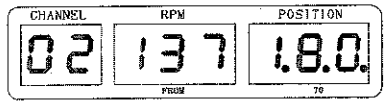


Note: the following key sequences for section 4.3 will be ignored by the M1151 if programming is not enabled.

Now press the → Key. This will move the cursor (pointer) to the "FROM" window:

If the **INC** Key is pressed, the "from" part of this dwell will be incremented.

Press the → Key again. The cursor (pointer) is now in the "TO" window:



If the **INC** or **DEC** Keys are pressed, the "to" value of this set point dwell will be incremented or decremented accordingly:

Repeated pressing of the → Key will continue to cycle the cursor through all three windows.

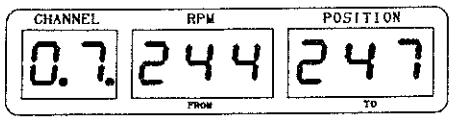
4.4.1 Removing a Set Point Dwell

Using the **RECALL** Key, display the Set Point Dwell that is to be deleted or erased. For example, to remove the channel 2 setpoint pair of 137 – 182: Press the →Key to activate the "FROM" window. Press and hold the **INC** Key until the "from" value is the same as the "to" value:

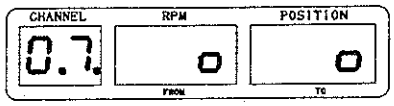
This Set Point Dwell is now deleted. Pressing the **RECALL** Key will prove that this set point dwell has been deleted.

4.4.2 Adding a New Set Point Dwell

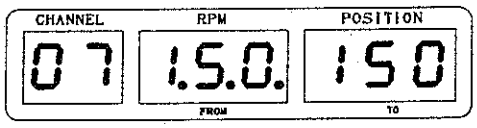
Using the → and the **inc** and **dec** keys, select the channel number that is to receive the new set point dwell, i.e. channel 7:



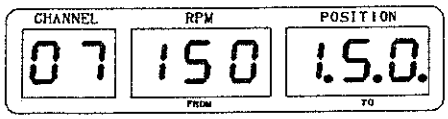
Press the **RECALL** key until the display shows the NULL set point pair:



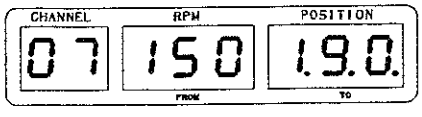
Use the → key to activate the "from" window. Press the **inc** or **dec** key to set the "from" window to the desired set point beginning "from" value. Notice that the "to" window will always equal the "from" window. Assuming that this set point should start at 150 degrees:



So far, this set point turns on at 150 degrees and turns off at 150 degrees, which means that it doesn't turn on at all, and that we have not created a set point dwell yet. If the **MODE** key is pressed, these two values will be lost. Press the → key to activate the "to" window:



Use the **inc** key to begin increasing the dwell of this set point. Assume that this dwell was to turn off at 190 degrees:



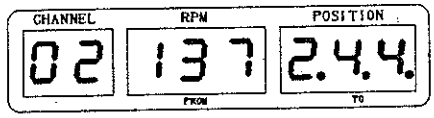
Now we **have** created another set point which turns on at 150 degrees and switches off at 190 degrees. If the **MODE** key is pressed, the set point will still exist as it has now been stored in EEPROM memory.

4.4.3 Merging Two Existing Set Point Dwells

Assume that the M1151 is set on channel 2 and there are two set point dwells: 137-182 and 244-247. Use the **RECALL** key to recall the 1st set point dwell and set the cursor on the "to" window:

Press and hold the **inc** key to expand the dwell of the 1st set point. If you stop just short of overlapping the 2nd set point, the display will show:

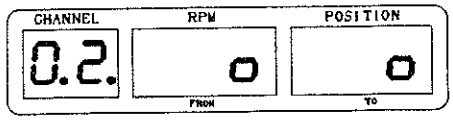
Now pressing the **inc** key once will change the display to:



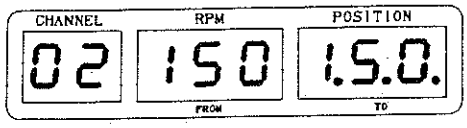
The set points are now merged. Pressing the **RECALL** key will now show only 1 set point dwell (137-247).

4.4.4 Separating One Set Point Dwell Into Two Separate Dwells

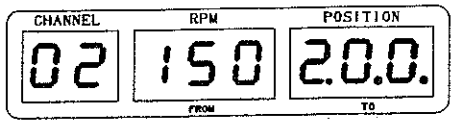
The best way to separate one large dwell into two smaller dwells is to press the **RECALL** key until the null setpoint appears on the display.



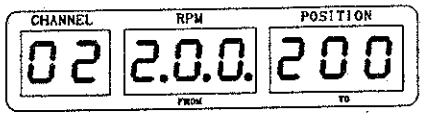
For example, suppose there is a setpoint on from 137 to 247 degrees and we would like to separate this dwell into two dwells: 137 to 150 degrees and 200 to 247 degrees. Advance the pointer to the "From" window and inc to 150.



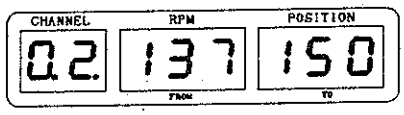
Now advance to the "To" window and **inc** to 200.

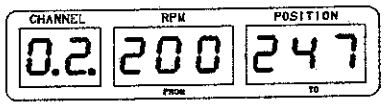


Then go back to the "From" window and **inc** to 200.



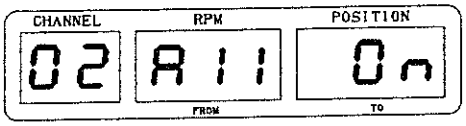
Pressing **RECALL** will now show two dwells: 137 to 150 and 200 to 247.





4.4.5 Turning a Channel Fully On

Press the **RECALL** key until the null setpoint appears on the display. Advance to the "From" window and **inc** a few counts. Advance to the "To" window and **inc** one full revolution of counts. Press **RECALL**. 'All On' will appear on the display.

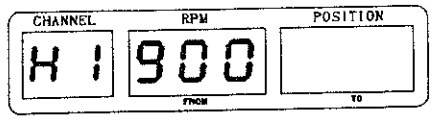


4.4.6 Opening a Dwell in a fully On Channel

Advance to the "From" window and **inc** or **dec** to the On ("From") value in the new dwell. Now advance to the "To" window and **dec** to the Off ("To") of the new dwell. Pressing **RECALL** will indicate the new dwell value.

4.5 Motion High Limit Setting Mode

From any of the programming steps in section 4.4, pressing the **MODE** key will step the M1151 unit into the tach motion high limit setting mode. "Hi" will appear in the channel window, and the current tachometer high limit will be displayed in the RPM window.



The position display is blank. Pressing the **inc** or **dec** keys will change this setting if programming is enabled. The M1151 will not inc up past 999 RPM, nor will it dec lower than the Motion Low limit setting. The motion output and corresponding motion LED will turn OFF if the shaft RPM exceeds this limit.

4.6 Motion Low Limit Setting Mode

Pressing the **MODE** key will step the M1151 unit into the Motion low limit setting mode. Use the **inc** or **dec** keys to adjust this lower motion limit. The M1151 will not allow a lower limit of less than zero, nor will it allow the limit to be inc'd higher than the current motion high limit setting. The Motion output and corresponding motion LED will be ON if the current shaft RPM is greater than this limit setting, otherwise the output and LED will be OFF.

4.7 Program Number Change and Default Position/RPM Display.

Important: ***Disable all outputs before switching program numbers to avoid activating outputs accidentally.***

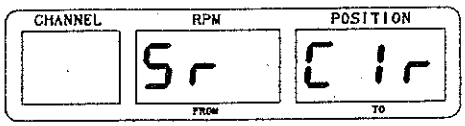
- Changing programs is not allowed if:
- programming is not enabled, or
- if the machine is in motion (>3 RPM)

Pressing the **MODE** switch will set the unit temporarily into a mode that will allow the operator to change the current operating program or set up (1-4). The channel display will indicate the current program number and the position and RPM displays will show position and RPM respectively. Once in this mode, the operator has just 15 seconds to use the **inc** or **dec** key to switch to the next operational setup. This changes all rate offsets and dwell set points to those values programmed in by the operator for this program number. In this manner four completely different setups may be stored in the M1151 and selected by the press of a button. The **inc** or **dec** key will step through each of the 4 setups stored in the unit (P1-P4).

After the 15 second timeout, the program number in the channel display will blank out and changing of the program number will be inhibited. To reactivate program selection, simply cycle the MODE switch 7 times to reactive program number change mode.

4.8 Keyboard and rear panel Clear of Shift Register Memory

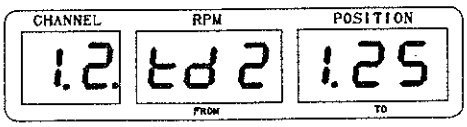
Except for the Shift Register Mode 1, in the default position/RPM display mode, all keys except for the MODE key are disabled. In the Shift Register Mode 1, if programming is enabled and the resolver shaft is stopped, pressing the → key will cause the display to indicate 'Sr Clr'.



To clear shift register memory, press the **inc** key, then the **dec** key, followed by the **MODE** key. When the Shift Register Memory has cleared, the M1151 will return to the default **POS/RPM** display. Also, if the rear-panel Shift Register Clear input (terminal 8) goes true for approximately two seconds and then goes false, the shift register memory will be cleared.

4.8.1 Shift Register Turns Delay Programming

The Shift Register Turns Delay is the number of revolutions and hundredths of revolutions of positional delay before a change in a Shift Register channel input will appear at that channel's output. In eight-channel models, channels 4 through 7 may be programmed as shift register channels. In 16-channel models, channels 12 through 15 may be programmed as shift register channels. If a shift register channel has a Turns Delay of 1.0 or more, that channel is a shift register, otherwise that channel may be used as a normal cam. To program the turns delay, press the mode key until 'td' appears in the center window.



Press the **inc** or **dec** key to select the desired channel. Press the → key to select the Turns Delay value window and use the **inc** and **dec** keys to change the Turns Delay between 1.00 and 50.00.

4.8.2 Shift Register Channel Mode and Dwell Programming

There are two Shift Register Modes: The Mode 1 Shift Register emulates a normal electronic shift register circuit with a programmable delay. In Mode 1, the input pattern will appear at the output after the input shaft has rotated the programmed Turns Delay revolutions.

4.8.3 Shift Register Mode Selection

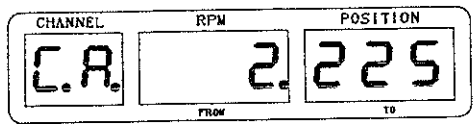
Mode 1 is selected by programming **one** dwell in a shift register channel that has a "From" setpoint that is numerically larger than the "To" setpoint. The M1151 Mode 0 Shift Register acts as a multi-turn ModZ. After a false-to-true input transition, the entire pattern programmed into the Shift Register channel will appear at the M1151 output at the position programmed by the Turns Delay.

4.9 Brake Monitor Option

The M1151 Brake Monitor automatically measures the time in milliseconds from an input 'Brake' signal until the resolver input shaft stops rotating. Because of the high resolution of the M1151's resolver decoding circuitry, determining that the shaft has actually stopped can be determined within just 0.014648 seconds. This stopping time is then compared to the programmed Caution Time and Danger Time and either the Safe, Caution, or Danger output is energized as a result. The additional output channels are programmed as normal PLS outputs. The M1151 Brake Monitor is normally applied as an indication control on metal stamping presses.

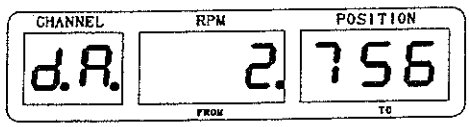
4.9.1 Brake Monitor Programming

In eight-channel models, channels 5 (Safe), 6 (Caution), and 7 (Danger) are Brake Monitor channels. In 16-channel models, channels 13 (Safe), 14 (Caution), and 15 (Danger) are Brake Monitor channels. The Safe channel cannot be programmed. To program the Caution limit, press the Mode key repeatedly to enter the Channel / Dwell programming mode. Press the **inc** key to increment the channel number until CA appears in the left window.



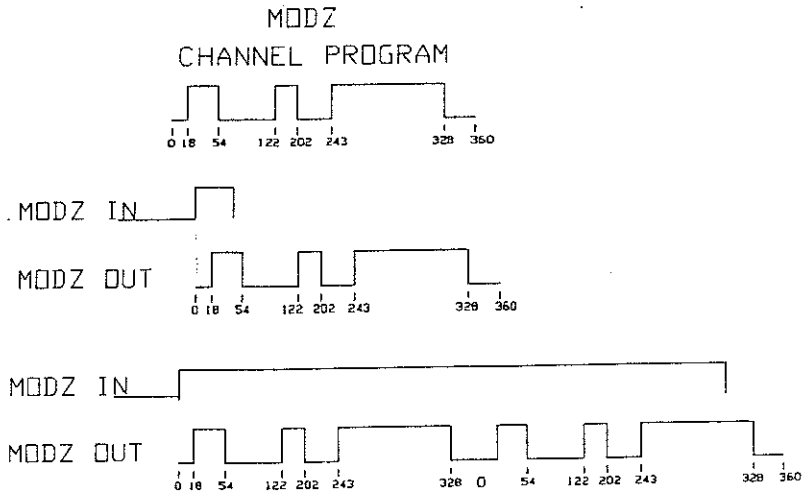
In this example, the 2 in the center window indicates seconds, and the 225 in the right-hand window indicates milliseconds. If the actual stopping time is shorter than 2.225 seconds, the Safe output will energize. If the machine stopping time exceeds 2.225 seconds but is less than the value programmed into the Danger limit, the Caution output will energize.

To program the Caution limit, press the → key to place the cursor key in the center window, then press the **inc** or **dec** key to change the Caution seconds value. Next, press the → key to place the cursor in the right-hand window and press the **inc** or **dec** key to change the Caution milliseconds value. Press the → key again to return to the left-hand window. Press the **inc** key to advance to the Danger limit programming field. In this example, the Danger Limit has been programmed to 2.756 seconds. Use the →, **inc**, and **dec** keys to program the Danger limit.



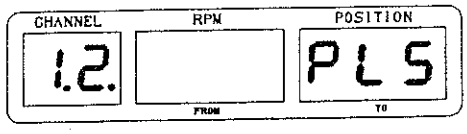
4.10 ModZ Description

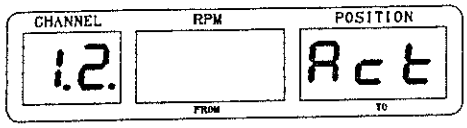
In the M1151 ModZ option, an eight-channel model will allow channels 4 through 7 to be used as ModZ channels, and a 16-channel model will allow channels 12 through 15 to be used as ModZ channels. ModZ allows a dynamic re-zeroing of any one of 4 ModZ PLS outputs to a false-to-true input transition. When the input transition occurs, the ModZ PLS channel will execute its stored program from angle 0, regardless of resolver position. Referring to the ModZ timing diagram below, note that if the input switches from false to true and goes false again before the resolver shaft has completed one rotation, the ModZ output will execute the entire setpoint dwell program stored for that channel and remain off until retriggered. If the ModZ Channel input goes true and remains true, the ModZ output will function continuously until the input switches false. If a ModZ sequence is in progress and that channel's input switches from false to true, the ModZ output will retrigger and execute the channel dwell program from the beginning.



4.10.1 ModZ / PLS Function Selection

To select either the ModZ function or normal PLS operation for a given channel, press the Mode key repeatedly until either of the following displays appears.

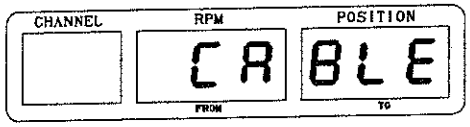




Press the inc key to change the channel number, if desired. Press the → key, then the **inc** or **dec** key to choose between the ModZ AcTive and normal PLS operation.

5.0 Broken Wire Indication

Should one or more of the resolver wires break or become shorted, all outputs including Fault will deenergize and the display will indicate: **CABLE.**



AUTOTECH CONTROLS

M1151 Tach Update Display for SAC-M1151-XX00

This addendum should be added to page 14 (before Section 4.5) of the Autotech Controls M1151 MiniPLS Instruction and Operation Manual (Man-M1151-Rev.00)

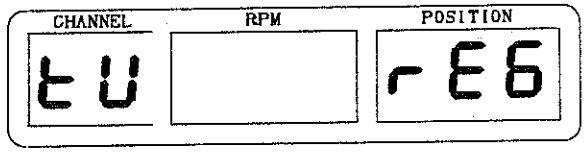
Overview

The M1151 offers two user-selectable display update algorithms for tach computation — regular (reg) or alternative (alt). The two choices differ in sampling time and averaging of tach readings. In most applications either of the two choices will be satisfactory to the user. While both displays are accurate, the user will observe the tach values may change more or less frequently depending on the algorithm chosen.

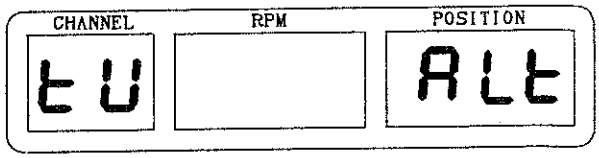
In applications where RPM is not constant, the user may perceive one type of algorithm to be better than the other for display purposes. The user can simply experiment to determine which tach display algorithm is more pleasing to him.

How to Program the Tach Update (tU) Display

After completing the Channel/Dwell Setpoint Programming as described in **Section 4.4 through 4.4.6**, press the **MODE** key. One of the following displays will appear:



OR



Press the **"DEC↓"** or **"INC↑"** keys on the front panel to toggle between regular (reg) and alternative (alt) display algorithms.

M1151 Troubleshooting Guide

Symptoms	Possible causes
Unable to program unit parameters (Scale Factor, Offset, etc.)	• Program Enable Input (PE) is false. • Machine is moving – programming of several parameters (Scale Factor, Program Number) is disabled if the resolver is turning faster than 3 RPM. • Customer VS+ is below +8 volts.
Program memory is changing by itself.	• The unit program number has been changed to a different number (P1-P4). • Proper grounding and shielding has not been applied. Sig Ref (R1) and Earth Ground must NOT be tied to-gether. To make sure follow these steps: –Turn power off to unit –Using Ohm meter, measure resistance from terminal R1 to Earth Ground. The reading should be more than 500 K • Inductive loads on outputs must have voltage suppresssion • Program Enable input is TRUE (while this will not cause the program to change itself – keeping it FALSE when not actually programming the unit – ensures that the memory cannot be programmed.)
Position and Tach reading are incorrect.	• Resolver is incorrectly wired. See below steps for a quick check: 1. Turn power off to M1151 unit 2. With main terminal block removed from unit, measure with ohm meter the following: A) Term. R1 to R2 = about 30 ohms B) Term. S1 to S3 = about 55 ohms C) Term. S2 to S4 = about 55 ohms • Resolver cable is not properly grounded and shielded.
Mechanical Zero drifts.	• Mechanical Resolver linkage is loose. • Offset value has been changed.

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