



M1050-A10 Programmable Limit Switch (PLS)

Instruction & Operation Manual

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M1050-A10 PLS

Instruction Manual

1. Introduction

Autotech's PLS and Mini•PLS families have continually set the standard for speed, precision, reliability, and product features in the Programmable Limit Switch marketplace. While retaining the key features and high standards of other Autotech products, the M1050-A10 combines 10 power outputs, fault detection and indication, eight user-defined PLS programs, and simple, easy-to-learn programming in one compact unit with a NEMA 12 front panel. In addition, each of the eight PLS programs supports up to 80 ON/OFF set point pairs. Included also are: a fault output with a display that indicates the source of the fault for fast, easy troubleshooting; and a motion detector that energizes when the resolver is rotating between motion limits.

Powerful, Easy to Learn, Man–Machine Interface

Autotech's human factors engineering has made it possible to program all PLS functions with only five front-panel keys and a smart front-panel display

With these five self-explanatory programming keys, programming the M1050-A10 is extremely simple — no long complex key sequences to remember.

Simultaneous Display of Related Parameters for Easy Understanding

In the normal operating mode, the large, .56" numerical display indicates the selected PLS program number, and the current resolver RPM and shaft position. When programming PLS set points, the display shows the selected channel number and the selected ON and OFF set points.

In all modes, bright, easy-to-read bar graph displays show the true output status of all eight PLS outputs, as well as the fault relay status, the motion output status, and the external program select enable input status.

Two User Configurable Modes of Operation

Brake Wear Monitor

When channels 7 and 8 are configured as brake wear, channel 8 output warns that the brake stopping time is dangerous. Channel 7 output warns that the brake is wearing out. Channels 1–6 are PLS.

Modified Zero

Each channel 1–8 can be configured with a ModZ input or can be normal PLS.

Individual Speed Compensation for All 8 PLS Outputs

The M1050-A10 PLS features a rate offset to compensate for speed variations. This rate offset represents a positive number that varies linearly with RPM. The rate offset is added to the resolver position and is used to advance the PLS settings as a function of the machine speed. In M1050-A10, the rate offset can be programmed in scale factor units per 100 RPM up to full scale factor value.

Patented “↑” and “↓” Keys for Fine Tuning in Motion

Most programmed values can be adjusted with the machine running, making fine tuning of job parameters easy. A fully isolated supervisory inputs prevent accidental or unauthorized program changes.

Multiple Program Storage Makes Job Changeover Easy

The M1050-A10 PLS can store up to eight independent, user-defined PLS programs for different machine setups. The M1050-A10 is easily configured to accept either front-panel or external programmable controller compatible input to select a program.

Fully Isolated Inputs and Outputs

All M1050-A10 inputs and outputs are fully isolated from user power sources to provide outstanding electrical noise immunity in harsh industrial environments.

Built-in Fault Detector

The Fault Output is normally energized when the M1050-A10 PLS is operating normally and the resolver wiring is intact. If an internal M1050-A10 fault is detected, or the power fails, or one or more of the resolver wires is broken or disconnected, the Fault output will de-energize. Under fault conditions all PLS outputs and the motion output will de-energize.

Built-in Tachometer and Motion Detector

The built-in tachometer and motion detector are accurate to 1 RPM and are calculated over 68 times per second to provide fast, accurate indication and detection of rotary motion. The motion detector is programmed to energize a power relay output when the machine's RPM is between the motion low and high limits. The motion detector output status is indicated on the front panel.

2. Specifications

Power Requirements:

105–135 VAC, 50/60 Hz, 20 W or
220–260 VAC, 50/60 Hz, 20 W (option)

Operating Temperature:

–10 to +130 °F (–23 to +55 °C)

PROGRAMMING

Number of PLS Programs:

8 selectable from keyboard or externally via 3 program selected inputs (PS0 – PS2)

PLS Set points:

80 per PLS Program, 640 total

Scale Factor:

Programmable from 16 to 999, common to all PLS programs (resolution 17 to 1000 counts/turn)

Offset: Programmable from 0 to Scale Factor Value, common to all PLS programs

Speed Compensation:

Programmable in scale factor units per 100 RPM, up to full scale factor value. Each PLS channel has its own speed compensation.

Motion Detector:

Low and High Motion Limits, common to all PLS programs. Programmable from 0 to 999 RPM

Brake Monitor Caution/Danger Limits:

Programmable from 0.00 to 9.99 seconds. Each PLS program has its own set of limits

ModZ Group Assignments:

PLS or ModZ (ZER). Common to all PLS programs

ModZ Inhibit Zone:

Programmable from 0 to scale factor. Common to all PLS programs

RESOLVER INTERFACE

Position Transducer:

Resolver, Autotech Series RL100, E6R, E7R, E8R, RL101 or equivalent

Cable Length between Resolver and M1056:

2500 feet max, shielded

Resolver Cable:

Autotech CBL-10T22=-XXXX

Maximum Resolver Shaft Speed: 3600 RPM

Resolver Decoder: Ratiometric

CONTROL INPUTS

Electrical Specifications: (All Inputs)

Optical Isolation: 1500 V
Input impedance: 1800 Ohms

Logic Levels

TRUE: 1 to 28 VDC sourcing; FALSE: 0 to 0.8 VDC

Program Enable (PE):

When TRUE, enables programming of parameters, and (if EP input is also TRUE) External Program Number Select

Output Enable (OE):

When TRUE, PLS channel outputs enabled (both Fault and Motion always enabled)

Brake/Modified Zero Input (BI/ModZ):

On channels where ModZ is used, on False to True transition the offset is captured and used for that cycle.

When Brake wear is used, False to True transition initiates timing.

True — Brake engaged **False** — Clutch engaged

Brake Monitor Clear (BC):

If TRUE — Resets brake monitor channels 7 & 8

External Program Number Select (EP) and Program Select Inputs (PS0 – PS2):

When External Program Number Select input (EP) and Program Enable (PE) are both TRUE, the PLS program is instantaneously selected by Program Select inputs PS0, PS1, and PS2, according to table given below:

Table 1. Program Select Inputs

Program Select Inputs			PLS Program Selected
PS0	PS1	PS2	
F	F	F	1
T	F	F	2
F	T	F	3
T	T	F	4
F	F	T	5
T	F	T	6
F	T	T	7
T	T	T	8

OUTPUTS

Unregulated Voltage Out (VO):

Current Limited, unregulated 12 VDC for use with M1050-A10 inputs ONLY. **Not** for external sensor power.

Fault Output:

Detects resolver broken wire and M1050-A10 internal faults) EM relay (Form C) output; 10 Amp resistive max @ 120 VAC;
Without Fault: Relay remains energized
With Fault: Relay de-energized

Motion Output:

EM relay (Form C) output; 10 Amp resistive max @ 120 VAC; Relay energized whenever resolver RPM is between programmed motion limits.

PLS Outputs:

Number of PLS Outputs: 8

Types of Outputs:

A. Electromechanical SPDT Relay

10 Amp resistive continuous @ 120 VAC

B. Solid-State Relay

- AC output: 120 VAC @ 3 A; ON time: <3 ms after zero cross; OFF time: At zero cross; Leakage: 2.1 mA @ 120 VAC
- DC output: Up to 60 VDC @ 3 A; ON time: 5 μs; OFF time: 35 ms; Leakage: 0.29 mA @ 15 VDC
- DC output: Up to 200 VDC @ 1 A; ON time: 15 μs; OFF time: 100 μs; Leakage: < 0.01 mA @ 30 VDC

3. Installation and Operation

M1050-A10 Front Panel

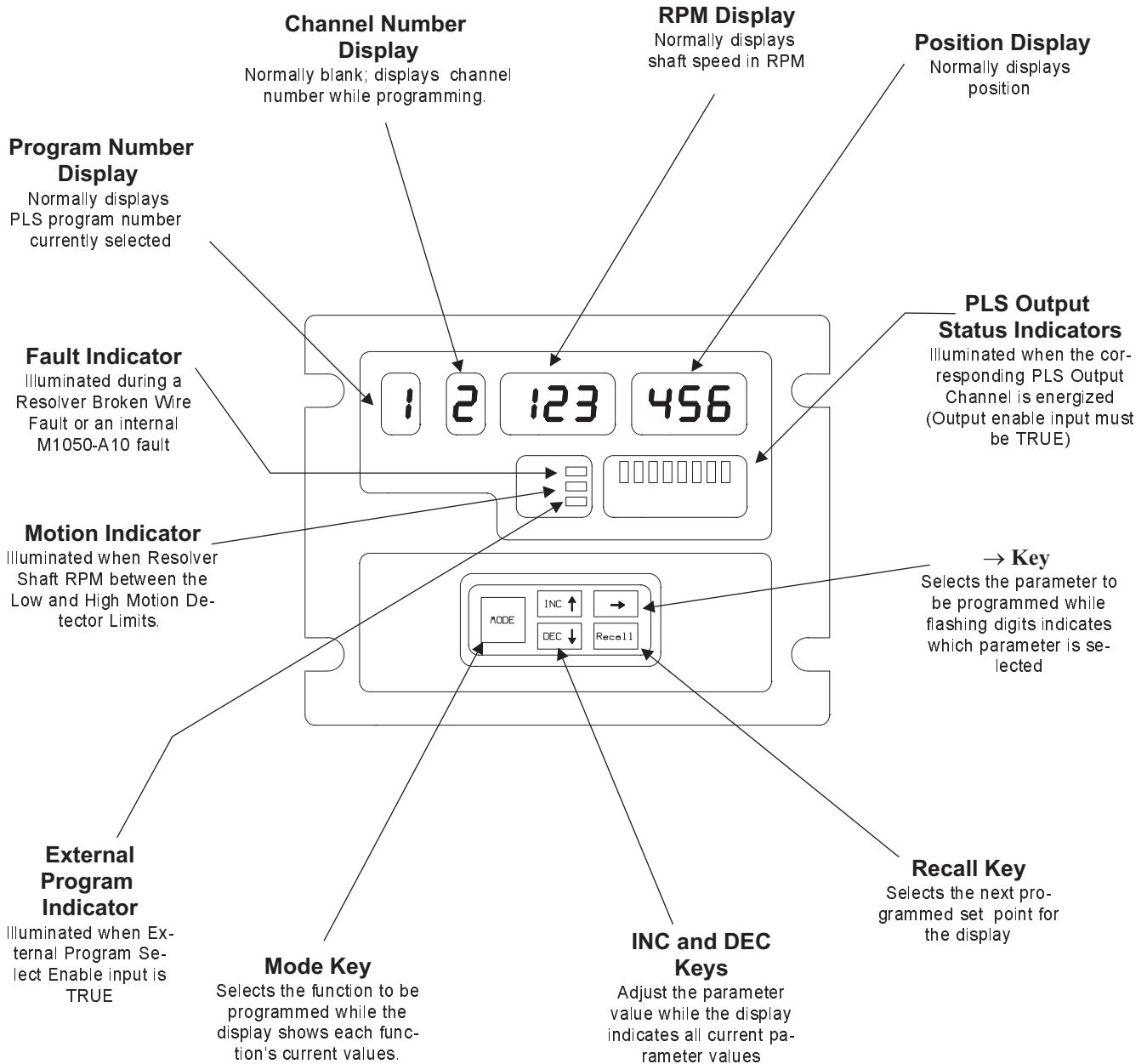


Illustration 1. M1050-A10 Front Panel

M1050-A10 Rear View, Terminals and Wiring

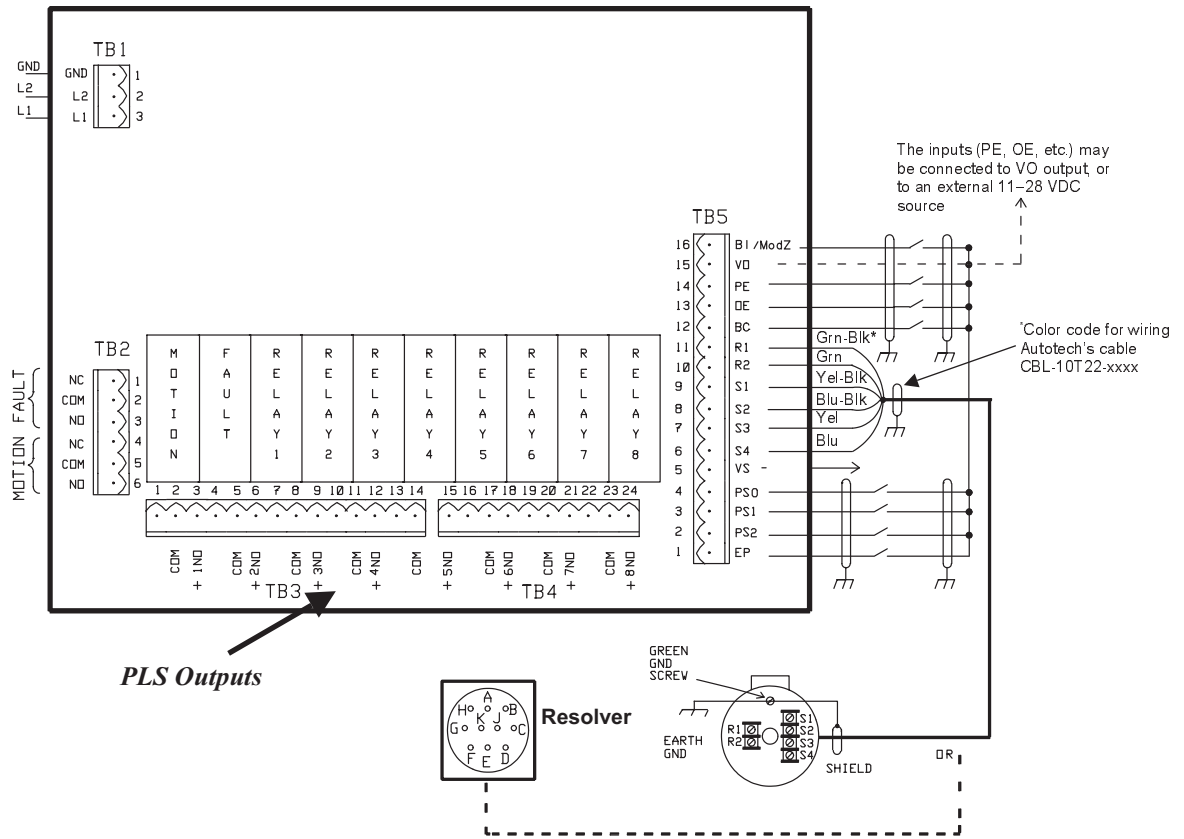


Illustration 2. Rear View Terminals and Wiring

Table 1. TB2, TB3, TB4, and TB5 Wiring Connections		
Term. #	Designation	Function/Description
TB5 1 2,3,4 5 6,7,8,9 10,11 12 13 14 15 16	EP	External PLS Program Select Enable Input. True enables external program number of changes.
	PS2, PS3, PS0	Program Select Inputs (respectively)
	Vs-	Common terminal for Customers 11–28 VDC source or common terminal for VO terminal.
	S4, S3, S2, S1	Resolver input (respectively)
	R2, R1	Resolver drive (respectively)
	BC	Break Monitor Clear Input. False to True transition resets brake wear monitor.
	OE	Output Enable Input. True enables channel outputs.
	PE	Program Enable Input. True enables programming.
	VO	Unregulated, Current Limited 12 VDC Output. For use with M1050-A10 inputs only.
	B1/ModZ	Break Wear Input. True—clutch engaged, False—brake engaged; Mod Z input. False to True transition captures Group Offset.
TB2-5	NO	Normally Open (positive side for all relays).
	COM	Switched output

Notes:

- to change the resolver ascending count direction, reverse the S1 and S3 connections.
- output wiring to other electronic devices (such as, programmable controllers) must use uninterrupted runs of shielded cable with the shield connected to earth ground at both ends.
- no special tools are required to wire the M1050-A10 PLS.
- only NO output is available with output relays. For solid-state relays, the NO terminal must be at a higher voltage than COM terminal.
- use Autotech’s overall foil shielded cables for wiring resolver. Table 2 provides wire colors of cable CBL-10T22-xxxx used to wire resolver.
- when Brake Wear is used, Relay #7 is a Caution Output and Relay #8 is a “fail safe” Danger Output.

Table 2. Resolver Wiring Cable CBL-10T22-xxxx		
Wire Color (Twisted Pair)	Resolver Terminal	Connector Pin
Green/Black	R1	F
Green	R2	E
Yellow/Black	S1	D
Yellow	S3	C
Blue/Black	S3	B
Blue	S4	A
Shield	Grn Gnd	G

To change the resolver ascending count direction, reverse the S1 and S3 connections.

Table 3. Brake Output Conditions		
Condition	Output 7 (Caution)	Output 8 (Danger)
Safe	OFF	ON
Caution	ON	ON
Danger	ON	OFF

Mounting

The M1050-A10 PLS mounts in a 6.3" x 5.1" panel cutout and requires four mounting holes as shown in the Panel Cutout drawing below. The M1050-A10 will fit in a 6 inches deep panel. Slide the M1050-A10 through the panel opening with gasket and tighten the four #8 mounting screws. Attach the pre-wired removable terminal blocks to complete the installation.

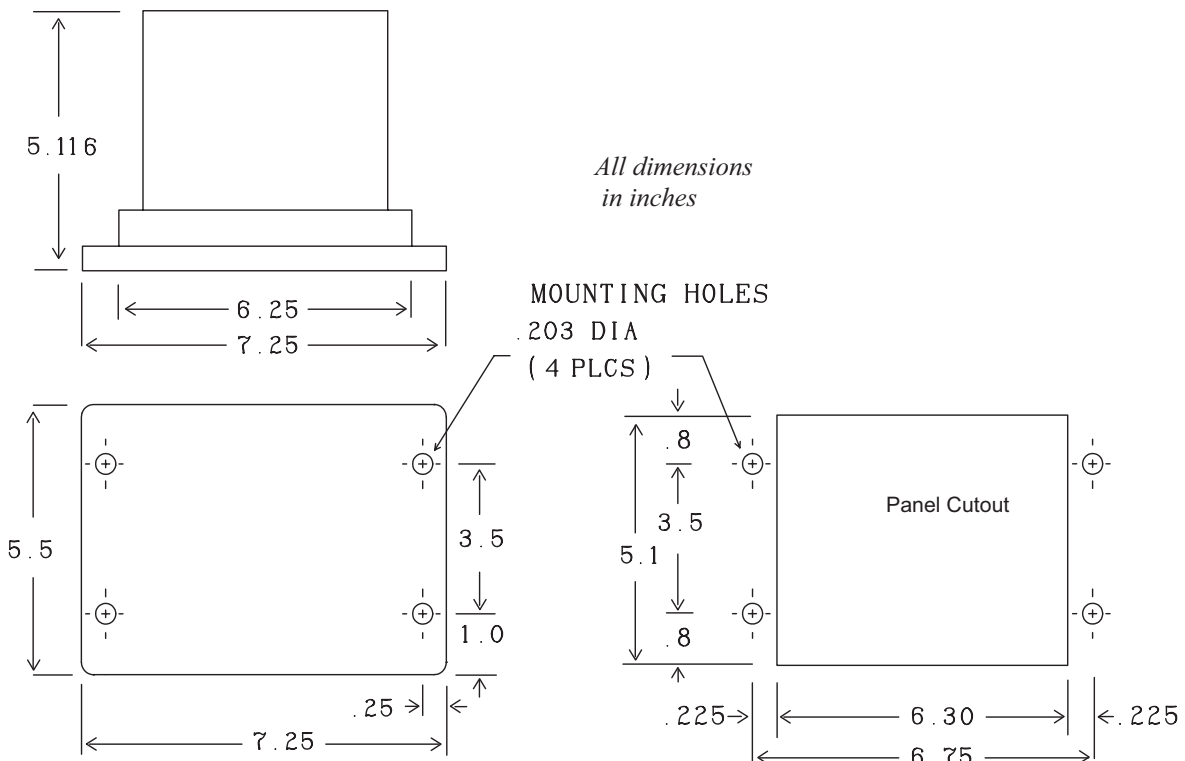


Illustration 3. Mounting Dimensions

4. Programming

Programming Modes

The following is an overview of the programming modes on the M1050-A10 PLS. The different modes are accessed by repeatedly pressing the MODE key until the desired mode is displayed. The M1050-A10 will automatically return to the Default Display mode if left in some other mode for more than one minute without any key presses.

- **Default Display:** Program Number, Tachometer, Position or Brake Stop Time (use right arrow)
- **Scale Factor** (16 to 999)
- **Offset** (0 to Scale Factor)
- If **ModZ** used:
ModZ Channel Association (ZER or PLS)
ModZ Inhibit Zone (0 to Scale Factor)
- If **Brake Wear** used:
Brake Limits:
Caution Limit (0 to Danger Limit)
Danger Limit (Caution Limit to 9.99 Sec)
- **Speed Compensation** (0 to Scale Factor)
- **Motion Limits:**
High RPM Limit (Low RPM Limit to 999)
Low RPM Limit (0 to High RPM Limit)
- **Program Number Selection From Keyboard:**
(1 to 8) (If EP and PE not selected)
- **Setpoint Programming** (direct access by pressing Recall from Default mode)

Program Enable (PE) when enabled (True), allows changing of all parameters and Program Enable (PE) when disabled (False), only allows viewing of all parameters.

Definitions

Program

There are eight distinct setups or programs that may be pre-programmed into the M1050-A10. These setups are identified by a Program Number from 1 to 8. The current Program Number may be selected in two ways:

1. External Program Select (EP) when enabled the program number is selected from inputs PS0, PS1 and PS2.
2. External Program Select (EP) when disabled the program number is selected from direct keypad entry.

The following parameters are independent of Program Number:

- Scale Factor
- Offset
- Motion Limits, High and Low
- ModZ Channel Association
- ModZ Inhibit Zone
- Brake Monitor Caution and Danger

The remainder may have different values from program to program.

Channel

There are 8 independent channels if ModZ group association is used and 6 independent channels if brake wear monitor is used. Each channel contains its own Setpoint Program to turn the output ON or OFF at different shaft angles. Each channel also contains its own speed compensation factor so that propagation delays from output to process may be compensated for.

Key Functions

The programming key sequences are fairly general for all modes. The keys function as follows:

MODE Key:

Press to sequence through the different programming modes. Pressing the MODE Key will save programming changes to the nonvolatile memory. The program flowchart is shown in Illustration 4.

INC/DEC Keys:

Blinking digits in a window indicate that that window's contents may be changed; numbers will be incremented or decremented, non-numerical selections will change to other selections. Channel Number in the second window can always be increased and decreased to display the information about those items. However, programming must be enabled (PE input TRUE) to edit the values in the other windows to the right.

Right Arrow Key:

If programming is enabled, use the Right Arrow Key to change the window that may be edited. Editing may occur in the window with the blinking digits. Also, from the Default mode, the Right Arrow Key will cause either the Tach and Position, or the Brake Stop Time to be displayed.

Recall Key:

The Recall Key is used to recall setpoints in Channel Setpoint mode. Also, from the Default mode, the Recall Key jumps directly to the Setpoint Programming Mode.

Programming Flow Chart

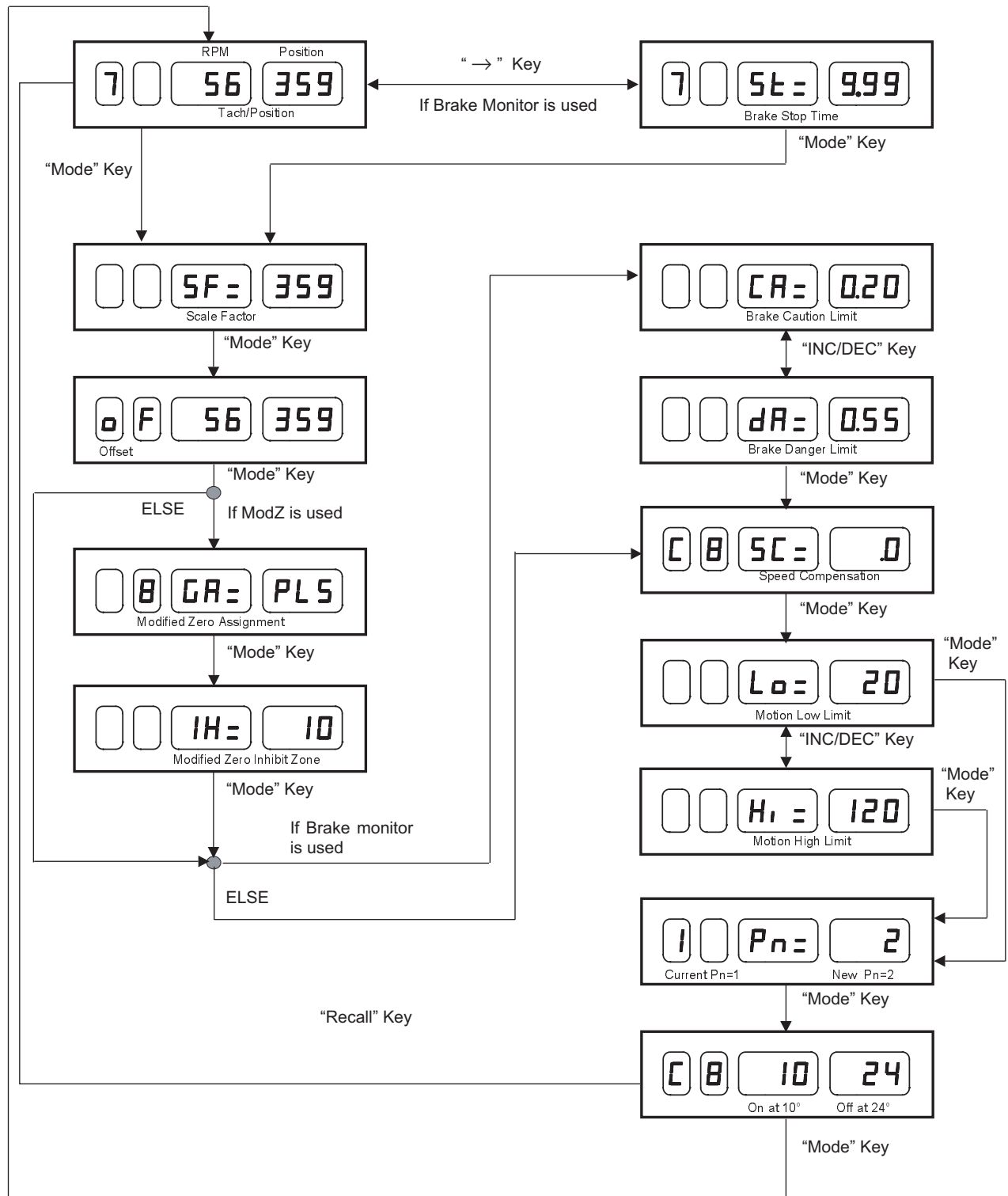
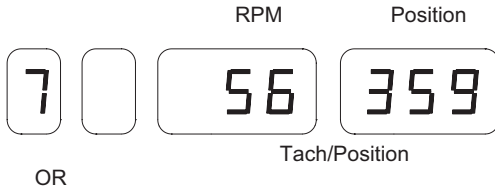


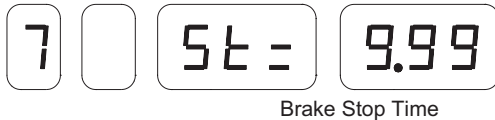
Illustration 4. Programming Flow Chart

1. Default Display

Program Number, Tachometer RPM, Base Position.

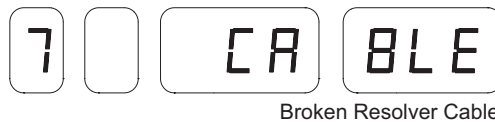


Program Number, Brake Stop Time in seconds (St=9.99)



Each mode can be viewed by pressing the **RIGHT ARROW** “→” Key.

In the event of a resolver cable fault: Program Number, and the message “CABLE” instead of Tach and Position.

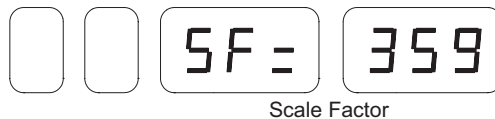


The Base Position for the M1050-A10 is composed of the absolute resolver position plus the machine offset value that is common to all eight programs.

2. Scale Factor

Scale Factor programming is only allowed if:

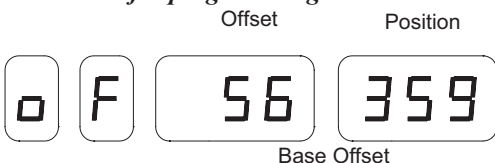
- The shaft is not turning (NO RPM)
- The Program Enable (PE) is True



The Scale Factor is the desired counts per turn minus one. For example, to work in degrees, program the Scale Factor to 359. The allowed range of values is 16 to 999. The Scale Factor is common to all Programs 1 to 8.

3. Offset

PE must be True for programming.



The Offset Value is the angle that when added to the absolute resolver position, yields the desired machine position. The allowed range for the Offset is 0 to Scale Factor. The Base Offset is common to all Programs 1 to 8.

4. Modified Zero Channel Assignments

Danger and Caution Brake Wear Limits must be zero to enter this mode.

Scale Factor programming is only allowed if:

- The shaft is not turning
- The Program Enable (PE) is True



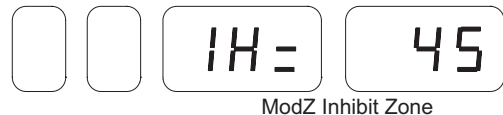
If the assignment is “PLS” the ModZ input is not associated with this channel and is unaffected by the ModZ input. If the assignment is “Zero”, the ModZ input is associated with this channel and is affected by the ModZ input in the following way:

ModZ, derived from MODification to Zero, is defined as an instantaneous reset to Zero. When the ModZ input makes a False to True transition, the current machine position will be treated as 000. All of the ModZ selected channels' setpoints will be referenced to this new Zero. The display will continue to show the True position.

The ModZ function is turned off by setting all group assignments to “zero”.

5. Modified Zero Inhibit Zone

PE must be True for programming.



The ModZ Inhibit Zone is an angular zone where the ModZ cycle may not be retriggered. The inhibit zone begins when the ModZ cycle is originally triggered (angle=0), and continues up to the preprogrammed angle. Once the ModZ cycle has progressed beyond this inhibit zone, the ModZ cycle may be restarted by retriggering the ModZ input.

6. Brake Wear Monitor Time Limits

All channel assignments must be “PLS” to enter this mode. PE must be True for programming.

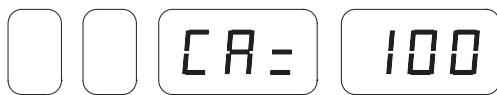
The amount of time it takes for a shaft to stop turning after the brakes are applied may be measured and compared to the Caution and Danger Time Limits. This measurement can warn of brakes that are wearing out and may need to be replaced for safety reasons.

If the shaft is turning and the brakes are applied, the “stop” signal may be wired into the “BI” brake input on the unit. Upon receiving this “stop” signal, the Brake Stop Timer begins counting, and if the shaft stops turning before the Caution Limit is exceeded, Outputs 7 and 8 will reflect a “Safe” condition.

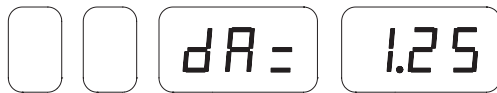
- If the Stopping Time is between the Caution and Danger Limits, the “Caution” condition will appear on the outputs.
- If the Shaft fails to stop before reaching the Danger Limit, the “Danger” output condition will appear.

When stopped, the brake timer may be cleared to the Caution condition by asserting the Brake Clear Input.

Brake Output Conditions on Outputs 7 and 8 (TB3)		
Condition	Output 7 CAUTION	Output 8 DANGER
Safe	OFF	ON
Caution	ON	ON
Danger	ON	OFF
OFF: De-energized		ON: Energized


Caution Limit = 1.00 Seconds

The Danger Limit will probably need to be entered first to allow room for the Caution Limit to be changed. The relationship between Caution and Danger Limits is as follows:
0.00 ≤ Caution ≤ Danger ≤ 9.99 seconds.

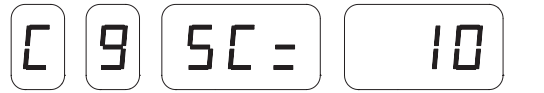

Danger Limit = 1.25 Seconds

PLS Set Points on channels 7 and 8 will not be executed so that the outputs can be used by the Brake Wear Monitor. This mode will be skipped if any ModZ groups are in use.

Turn off the Brake Wear function by setting both Danger and Caution limits to zero.

7. Speed Compensation

PE must be True for programming.


Channel 9 Speed Comp = 10° /100 RPM


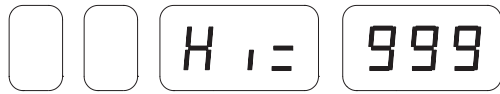
Channels 1–8 have their own programmable speed compensation. The value entered is the angle of offset to be added per each 100 RPM. To advance the setpoints the equation is:

$$\text{Speed Compensated Position} = \text{Position} + \left[\frac{\text{Speed Comp}}{100} \times \text{RPM} \right]$$

8. Motion Limits

PE must be True for programming.

Motion Output is controlled by the Low and High Motion Limits.

If the shaft RPM is between the Motion Limits inclusively, the Motion output will be energized. Motion Limits are common for all eight programs.

9. Program Number Selection

Program Number Selection is allowed only if the following conditions are met:

- The shaft is not turning (RPM < 4)
- The Program Enable (PE) is True.

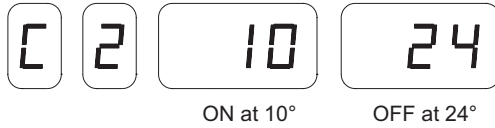

Current Pn = 1 New Pn = 7

The Program Number may be selected from the keyboard only if the External Program (EP) Select input is False. If the External Program Select input is True, then the logic states of the Program Select inputs (PS0–PS2) will determine which Program is selected.

10. Set Point Programming

PE must be True for programming.

Angle-on/Angle-off set points are programmed in this mode. Channels 7 and 8 do not function as PLS set points when Brake Wear Monitor is used (Danger and Caution non zero).



Angle-on/Angle-off

When the Shaft is moving in the forward direction (count incrementing), Angle-on/Angle-off set points are defined as:

Angle-on = Angle where the output will turn on.

Angle-off = Angle where the output will turn off.

These angles are programmed by using the Right Arrow Key to select the window to edit, then Incrementing or Decrementing the number. Pressing the Right Arrow key moves—

1. Channel Number window
2. On Set Point window
3. Off Set Point window
4. On and Off Set Point windows (Pulse)
5. Back to Channel Number

Pressing the Recall Key will reveal any additional Set Points in the selected channel and will provide the “Null Set Point” symbol [o][o] so that additional set points may be added to that channel. Each Channel 1 to 8 may contain any number of set points (on/off pairs) up to a total of 80 set points for all channels.

Symbols Used in Programming Displays

Symbol	English	Function/Description
C	C	Channel
CA	CA	Caution Limit
dA	dA	Danger Limit
CABLE	CABLE	Cable
GA	GA	Modified Zero Channel Assignments
IH	IH	Inhibit Zone
Hi	Hi	High Motion
Lo	Lo	Low Motion
oF	oF	Offset
Pn	Pn	Program Number
SC	SC	Speed Compensation Factor
SF	SF	Scale Factor
St	St	Stop Time

5. Troubleshooting Guide

Symptoms	Possible Causes
Unable to program unit parameters (Scale Factor, Offset, etc.)	<ul style="list-style-type: none"> • Is the Program Enable Input (PE) false? (i.e., the voltage level at the input is less than 11V). PE must be 1 volt or higher to enable programming • Is the machine moving? Programming of several parameters (Scale Factor, Program Number) is disabled if the resolver is turning faster than 3 RPM. • If unable to program set points, the PLS program may already have 80 set points.
Program memory is changing by itself.	<ul style="list-style-type: none"> • Has the program number been changed to a different number (P1 to P8)? • Have proper grounding and shielding practices been applied? • Is the Program Enable input 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 RPM readings are incorrect or Unit display reads "Cable"	<ul style="list-style-type: none"> • Is the resolver correctly wired? Follow the steps below for a quick check. <ol style="list-style-type: none"> 1. Turn power to M1050-A10 unit OFF. 2. With main terminal block removed from unit, measure the following with an ohm meter: <ol style="list-style-type: none"> a) Term 11 to Term 10 (R1 to R2) = about 20 to 50 ohms b) Term 9 to Term 7 (S1 to S3) = about 100 to 200 ohms c) Term 8 to Term 6 (S2 to S4) = about 200 to 200 ohms • Is the resolver cable properly grounded and shielded?
Mechanical Zero drifts.	<ul style="list-style-type: none"> • Is the mechanical resolver linkage loose? • Has the offset value been changed?
If all fails	Call AVG Technical Support at 1 (800) 832-3647

6. How to Order

1. M1050-A10 PLS

SAC-M1050-A10 Basic unit, 8 PLS outputs (*without* relays); 1 motion and 1 fault output (*with* electromechanical relays).

SSC-M1050-A10 Slave unit for M1050-A10 PLS

SA2-M1050-A10 220 VAC M1050-A10 PLS

SA4-M1050-A10 240 VAC M1050-A10 PLS

2. Power Output Relays

Select the number and type of relays required.

KSD-012DC-10A EM relay, SPDT, 120 VAC @ 10 Amps resistive

KSS-120AC-3AMP Solid-state relay, 120 VAC @ 3 Amps

KSS-60VDC-3AMP Solid-state relay, 60 VDC @ 3 Amps

KSS-200DC-1AMP Solid-state relay, 200 VDC @ 1 Amp

3. Position Transducers

The M1050-A10 requires a single turn resolver as an input device, such as Autotech's RL100, E6R, E7R or E8R series of resolvers. Please see rotary position transducer manual for How to Order information on these transducers and appropriate accessories.

4. Cables

CBL-10T22-Cxxx 10 conductor cable (5 twisted pairs), 22 AWG overall foil shielded cable, without connector

CBL-10T22-Mxxx 10 conductor cable (5 twisted pairs), 22 AWG overall foil shielded with MS connector on one end

WARRANTY

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

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.

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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.

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