Autotech Controls
M1451 Mini•PLS™
Instruction & Operation Manual

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M1451 /\/\INI•PLS™

Instruction Manual

The Mini•PLS, model M1451 is the most versatile PLS family in the market. We call it "Mini" because of the small compact size, but it is big in performance. In fact, Mini•PLS is *three-in-one:* Programmable Limit Switch, Tachometer and

Single or Multiturn Resolver

The Mini•PLS combines the ruggedness of a brushless resolver and the reliability of an advanced solid-state control. The rugged heavy duty NEMA 13 (IP54) single turn

Variety of Plug-In Output Modules

The plug-in "Cam Modules" are optically isolated and are available with TTL, PNP or NPN type of logic level outputs. The sub "D" connector style on these modules with preassembled cable assembly eliminates all field wiring and the related eventual wiring errors. Power Cam Modules are also available with AC (120 VAC @ 1 Amp) or DC (10-28 VDC @ 1 Amp) ratings. Optional electromechanical relays (10 Amp) and solid-state AC (3 Amp) or DC (3 Amp) relays are mounted on a separate chassis. All these relays are plug-in type for easy field replacement. The solid-state relays are optically isolated. Optional parallel BCD position and tach output modules with built-in PC-handshake as well as analog position/tach output modules are available for remote readouts or control devices.

Versatile Offset

An extremely versatile full scale programmable offset eliminates all calculations on the part of the operator, while matching "resolver zero" to "machine zero" or while compensating for machine wear and speed changes. After the resolver is mounted on the machine shaft, all you have to do is align the machine to a mechanical zero reference (e.g., Top Dead Center on a press, and "Auto-Zero" the Mini•PLS). The resolver offset will automatically be calculated and programmed, so that the position display reads zero. If required, a "machine offset" other than zero can be progammed by direct numerical entry. To obtain a precise machine operation, the offset can also be fine-tuned in motion by using "+" and "−" keys.

Multiple Setpoints (up to 500) On Each Channel

All the 40 channels of Mini•PLS can be programmed for multiple setpoints without any restrictions. Depending upon the scale factor and model selected, up to 500 dual setpoints can be programmed on each of the 40 channels. Just like an electromechanical Cam switch, the dwell setpoints on Mini•PLS can be programmed through zero (e.g. "ON" at 350 and "OFF" at 10).

Built-In Tachometer

In addition to the normal PLS function as described above, the Mini•PLS has a built-in tachometer. By pressing the TACH key, the unit goes in tachometer mode and the display shows shaft speed in RPM. When used with computer controls, optional analog or digital BCD Tach output Modules can be inserted in slots 4 or 5 to provide shaft speed information to variable speed drives.

Built-In Motion Detector

In tachometer mode, a motion detection "window" with low and high preset points can be programmed. Direct entry of low and high limits together with independent fine-tuning of each limit permits quick programming and in-motion adjustments. The motion detector status is indicated on front panel by an indication light and an NPN open collector output is available at the main terminal block, without occupying any of the "Cam" output circuits. In case a remote power relay chassis is used an independent motion detector relay is provided on the relay chassis.

Broken Wire Detector

The Mini•PLS features a broken wire detector to supervise the resolver input signal. The broken wire detector will signal the missing resolver input which can occur from a loose connection or defective cable.

Program Duplication at the Touch of a Button

When various modules need identical programming, use of program duplication key saves time and avoids errors by making fast copies of the original program. Just enter the ORIGIN slot number, select the COPY slot, press DUP key and the program is copied on the corresponding "Cam Module."

Write Protect

PNP and NPN type of Cam Modules are shipped with a factory wired jumper, which enables the Modules to receive any program. If "Write Protection" of the program is required after the machine is adequately set up, cutting the jumper will disable Module programming. This feature is especially useful when some of the Cam settings should not be accessible to the unauthorized personnel and, once adjusted, need not be changed frequently. Installing the jumper back into place will enable the Module for programming changes, if so required.

Multiple Program Selection

The multiple program selection capability of Mini•PLS makes set-up changes for different jobs just as simple as turning a rotary selector switch. Several "Cam Modules" can be preprogrammed and wired in parallel. Using an external selector switch, a program corresponding to the job to be performed can be selected simply by turning the knob. When TTL type of Cam Modules are used, multiple program selection is simply achieved by using a multiplexing input at terminal 4 of the Cam Module.

Operation At 1800 RPM, Adjustable in Motion

The high speed ratiometric resolver-to-digital converter and the micro-scan time of 450-905 microseconds guarantee perfect machine operation at speeds of up to 1800 RPM. In Mini•PLS, all the program variables are active in the memory immediately as they are entered by the user. This feature permits program changes and fine-tuning with machine in full motion at 1800 RPM. The "+" and "−" keys are especially useful to fine tune the machine control for maximum productivity.

Parallel or Serial Link

Parallel BCD output modules with built-in PC-handshake for easy interface to programmable controllers or remote displays are available and can be inserted into slots 4 or 5.

The TTL, PNP or NPN type of BCD outputs allow more flexibility for interface to external devices.

This Mini•PLS M1451 has been designed to accommodate special modules such as, serial link RS422 or RS232, etc. Consult factory for availability of special modules.

Programmable Rate Offset, ROF™, for Automatic Speed Compensation

The M1451 Mini•PLS features a rate offset to compensate for speed variations. This rate offset represents a positive number that varies linearly with RPM. This number is added to the resolver position and is used to advance the PLS settings as a function of the machine speed. You can program a single rate offset value for a group of 8 channels on three of the Cam Module and different rate offset values for up to 16 individual channels on the other two Cam Modules.

Dynamic Zeroing, ModZ™

The M1451 Mini•PLS features dynamic zeroing or ModZ (Modification Zero) to modify the zero reference point for selected channels independent of the actual resolver position. Upon receiving an external signal, the resolver position for the selected ModZ channel is reset to zero. Thereafter the position is incremented as the resolver rotates forward and outputs are turned "ON" and "OFF" at the programmed limit settings. This feature is ideal for gluing applications, where the glue-gun must be activated at a certain position after the detection of an upcoming product. You can operate up to 4 ModZ affecting outputs in groups of 4.

Choice of Front Panel, Back Panel or NEMA 12 (IP52) Enclosure Mounting

The basic Mini•PLS unit with its sealed front plate is designed for front panel mounting. It has T(5V, TTL), P or N type (50V DC @ 100 mA) outputs for light loads or PC interface. For higher voltages and currents, Power Cam Modules or remote power output chassis are available. The Mini•PLS can also be purchased in a back panel mount version with built-in power relay output chassis. This back panel model can be mounted either inside the user control panel or in a NEMA 12 (IP52) enclosure provided by Autotech.

Specifications

Input Power:
105-135 VAC, 50/60 Hz, 35 exclusive of load
(220 VAC or 240 VAC option)

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

Offset/Preset:
Programmable "0" to full scale

Rate Offset:
Programmable "0" to full revolution

Motion Detector Limits:
Programmable low and high limits

Number of Programmable Channels:
40 (5 outputs modules with 8 channels each)

Slave Systems:
Up to 7 M1451's may share same resolver

Resolution per turn: 17-1000

Scan Time (microseconds)
450 for 1 Cam, 800 for two Cams, 855 for 3 Cams, 870
for 4 Cams and 905 for 5 Cams

Number of Dual Setpoints Per Channel (On/Off):
Resolution divided by 2

Number of ModZ Channels:
Slots 1- 2; 16 channels in groups of 4

Channels Affected by Rate Offsets:
Slots 1- 2; 16 channels individually and slots 3 - 5 in
groups of 8

Die Protect Module:
Optically isolated I/O; Monitors up to 3 die protect sig-
nals (each as misfeed, shortfeed and part ejection, 11 - 28
VAC sourcing outputs) and provide a fail safe die protect
output, 3 PLS outputs and 2 brake outputs. All outputs
are NPN sinking transistor. The module should be used
in slot# 1.

Logic Cam:
8 Optically isolated outputs; provides ability to use con-
dition logic in series with PLS outputs. Accepts eight
11—28 VAC sourcing inputs.

Outputs: Electrical Characteristics:
PNP Transistor Sourcing Outputs:
Energized: Transistor On; 1.7V drop @ 100 mA
De-energized: Transistor Off.; 0.2 mA leakage
@ 50 VDC

NPN Transistor Sinking Outputs:
Energized: Transistor On; 1.1V drop @ 100 mA
De-energized: Transistor Off.; 0.1 mA leakage
@ 50 VDC

Remote Power Relay Outputs:
All modular with NPN sinking output can use remote
power relay chassis to provide higher power outputs. The
relay supported are electromechanical (10 A @ 120
VAC), AC solid state (3 A @ 24 - 280 VAC) and DC
solid state (3A @ 9 - 60 VDC or 1 A @ 0 - 200 VDC).

Input/Output

Inputs:
Position input: Resolver
Program Enable; ModZ; Brake-start inputs

Outputs:
Motion, Brake caution and danger outputs

Modules:
Cam Modules:
8 outputs each, TTL, PNP source transistor, NPN
sink transistor, power AC (0.5 Amp) or DC (0.5
Amp) type

Digital Position/Tach Output:
BCD Pos/Tach; TTL, PNP source or NPN sink out-
puts

Analog Position/Tach Output:
4 - 20 mA or 0 - 10 VAC position or tach

Serial Communication:
RS232C or RS422 serial communication

How to Order

1. Mini•PLS System Components

1.1 *Mini•PLS for front panel mount with* **logic level** *or* **power** *output Cam Modules:* **Follow steps 2 and 3.**

1.2 *Mini•PLS for front panel mounting with remote Power Relay Output Chassis:* **Follow steps 2, 3 and 4.**

1.3 *Mini•PLS with Remote or Built-in Power Relay Output Chassis: for Back Panel or NEMA 12 Enclosure mounting:* **Follow Steps 4 & 5.**

1.4 *Position transducers:*

M1451 PLS requires Autotech's position transducers (such as E6R, E7R, E8R, RL100 or RL101) as single turn resolver. Please see position transducer section for How to Order information on these transducers and appropriate accessories.

2. Mini•PLS

2.1 Select the following Single-Turn Rotary PLS's for front panel mounting . Cam Modules or power outputs are not included:

SAC-M1451-xxx   3-Digit, single turn, basic unit with ROF and ModZ

3. Output Modules

3.1 Select type and number of logic level output Cam Modules:

ASY-M1250-08TI   8 TTL output, Cam Module with terminal block (Replacement for ASY-M1250-08T)

ASY-M1250-08PI   8 PNP output, Cam Module with terminal block (Replacement for ASY-M1250-08P)

ASY-M1250-08NI   8 NPN output, Cam Module with terminal block (Replacement for ASY-M1250-08N)

ASY-M1451-04DP   Die Protect Module, Provides a fail-safe output if sensor inputs (up to 4) do not appear in respective programmed PLS windows, has a 9 pin and a 15 pin sub D connector for interconnection

ASY-M1451-LCAMP   Logic Cam output Module; Accepts 8 inputs (sourcing) and ANDs each of the 8 PLS outputs with respective inputs; has a 9 pin and a 15 pin sub D connector for interconnection, PNP sourcing outputs

ASY-M1451-LCAMN   Above with NPN sinking outputs

3.2 Select type and number of power output Cam Modules

ASY-M1250-08AC: 8 Output, 120 VAC @ 1 Amp each output, 4 Amp max. per module.

ASY-M1250-08DC: 8 Outputs, 10-28 VDC @ 1 Amp each output, 4 Amp max per module.

3.3 Select type and number of special (Position, Tach or communication) modules.
Notes: *Maximum two modules from this category may be used in a PLS.*

ASY-M1250-20MAP   Analog position/tach module; 4-20 mA current sourcing output.
ASY-M1250-20MAN   Above with current sinking output.
ASY-M1250-010V   Above with 0—10V analog output.
ASY-M1250-SER2   Bi-directional RS232C serial communication module.
ASY-M1250-SER4   Bi-directional RS422 serial communication module.

```
ASY-M1250-XXX X X      Digital position and Tach output modules

                ┌──────► Output Type
                │               T:   TTL with multiplexing
                │               P:   PNP source transistor
                │               N:   NPN sink transistor
                │
                └──────► PC Handshake
                │               1:   With PC sync circuit
                │               0:   Without PC sync circuit
                │
                └──────► Output Format
                                BCD:   BCD position
                                TAC:   Digital TACH; BCD output
```

3.4 Cable for wiring logic level Cam or special modules to external devices:

CBL-15S22-DAXXX   15 conductor, cable with overall foil shield, and sub "D" connector on one end XXX= length in feet (10, 25, 50, and in 50 feet increments)

CBL-18S22-Cxxx   18 conductor shielded cable for use with modules with terminal block

4. Remote Power Relay Output Chassis

4.1 Select type and number of output chassis:
(must use NPN type module as per step 3.1)

ASY*-RLYCH-16SS   Chassis for 16 solid-state relay outputs with motion detector output and built-in power supply

**For 220 /240 VAC, 50/60 Hz power input, change the "Y" to "2"*

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

KSD-A12DC-10A   10 Amp, SPST EM relay, Form A
KSS-120AC-3AMP   3 Amp, 120 VAC, solid-state AC module
KSS-60VDC-3AMP   3 Amp, 9 - 60 VDC, solid-state DC module
KSS-200DC-1AMP   1 Amp, 0 - 200 VDC, solid state DC module

4.3 Cable connecting Cam Modules to relay chassis:

CBL-RLYCH-D04   15 conductor cable, with overall foil shield, 4 ft length and sub "D" connector on one end and open on the other, for interconnection of relay chassis to the PLS
CBL-RLYCH-DA4   Above cable with sub "D" connector on both ends

5. Serial Communication Software

ASY-M1451-SOFT   Software package to program M1451 from an IBM compatible PC

6. Mini•PLS with Built-in Power Relay Output Chassis, Back Panel or NEMA 12 (IP52) Enclosure Mounting

5.1 *Select appropriate system:*

SAC-M<u>XXXX</u>-<u>XXXX</u>   Mini•PLS system for back panel mounting with Cam Modules, power output chassis and relays

→ *Type of power relay outputs*

16RL: 16 EM-relay outputs, 120 VAC @ 10 Amps
16AC: 16 solid-state AC relay outputs, 120 VAC @ 3 Amps
16DC: 16 solid-state DC relay outputs, 9-60 VDC @ 3 Amps
16AD: 8 solid-state AC relay outputs, 120 VAC @ 3 Amps
              8 solid-state DC relay outputs, 9-60 VDC @ 3 Amps
32RL: 32 EM-relay outputs, 120 VAC @ 10 Amps
32AC: 32 solid-state AC relay outputs, 120 VAC @ 3 Amps
32DC: 32 solid-state DC relay outputs, 9-60 VDC @ 3 Amps
40RL: 40 EM-relay outputs, 120 VAC @ 10 Amps
40AC: 40 solid-state AC relay outputs, 120 VAC @ 3 Amps
40DC: 40 solid-state DC relay outputs, 9-60 VDC @ 3 Amps

→ *Basic Model:*
    M1451: The M1451 Mini•PLS

For 200 VDC solid-state outputs consult factory.

5.2 *Select appropriate enclosure, if required:*

ENC-M1250-N16	NEMA 12 (IP52) enclosure for 16 channel PLS
ENC-M1250-W16	Above enclosure with see through window
ENC-M1250-N32	NEMA 12 (IP52) enclosure for 32 channel PLS
ENC-M1250-W32	Above enclosure with see through window
ENC-M1250-N40	NEMA 12 (IP52) enclosure for 40 channel PLS

5.3 *Spare Parts:*

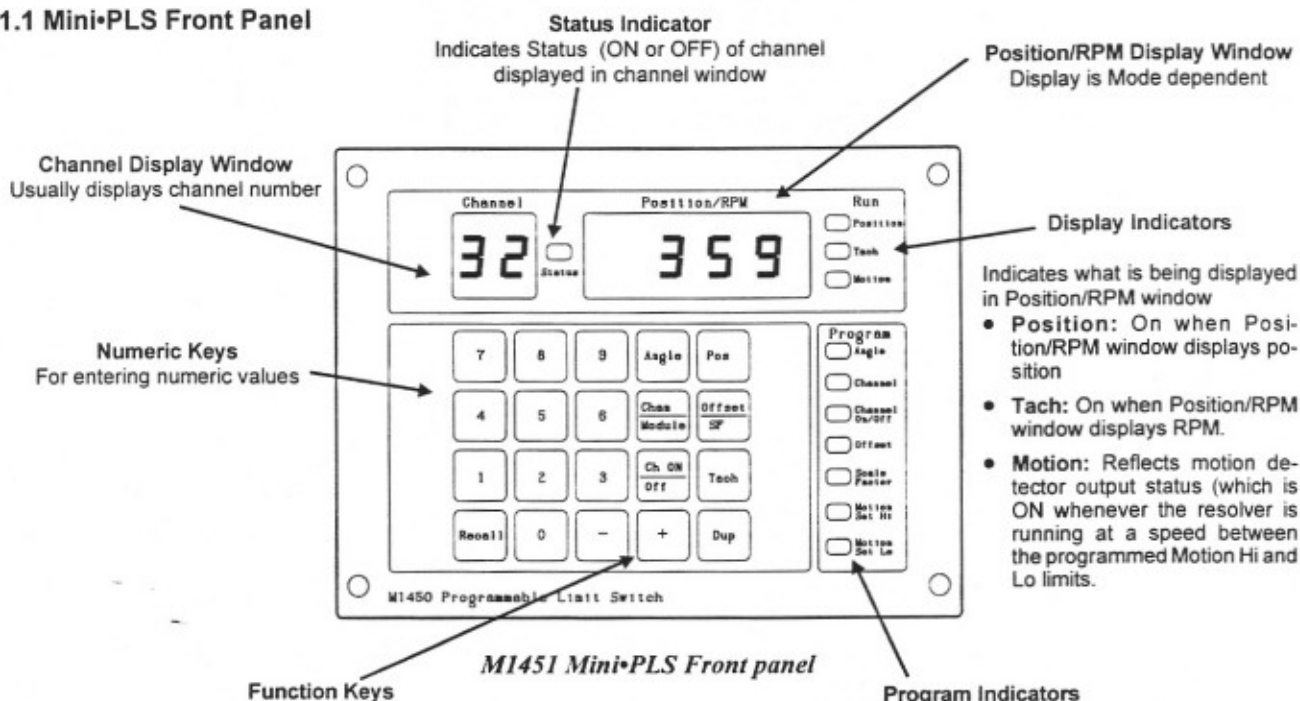|	
EEC-15PIN-0TB	15 position terminal block for Cam Modules.
EEC-18PIN-0TB	18 position Main terminal block for M1451
MCP-M1250-011	Cover plate for unoccupied Cam Module space
ECM-15PIN-M11	15 Pin sub "D" male connector

Installation & Operation

Status Indicator
Indicates Status (ON or OFF) of channel
displayed in channel window

Position/RPM Display Window
Display is Mode dependent

Channel Display Window
Usually displays channel number

Numeric Keys
For entering numeric values

Display Indicators

Indicates what is being displayed
in Position/RPM window
- **Position:** On when Position/RPM window displays position
- **Tach:** On when Position/RPM window displays RPM.
- **Motion:** Reflects motion detector output status (which is ON whenever the resolver is running at a speed between the programmed Motion Hi and Lo limits.

M1451 Mini•PLS Front panel

Function Keys
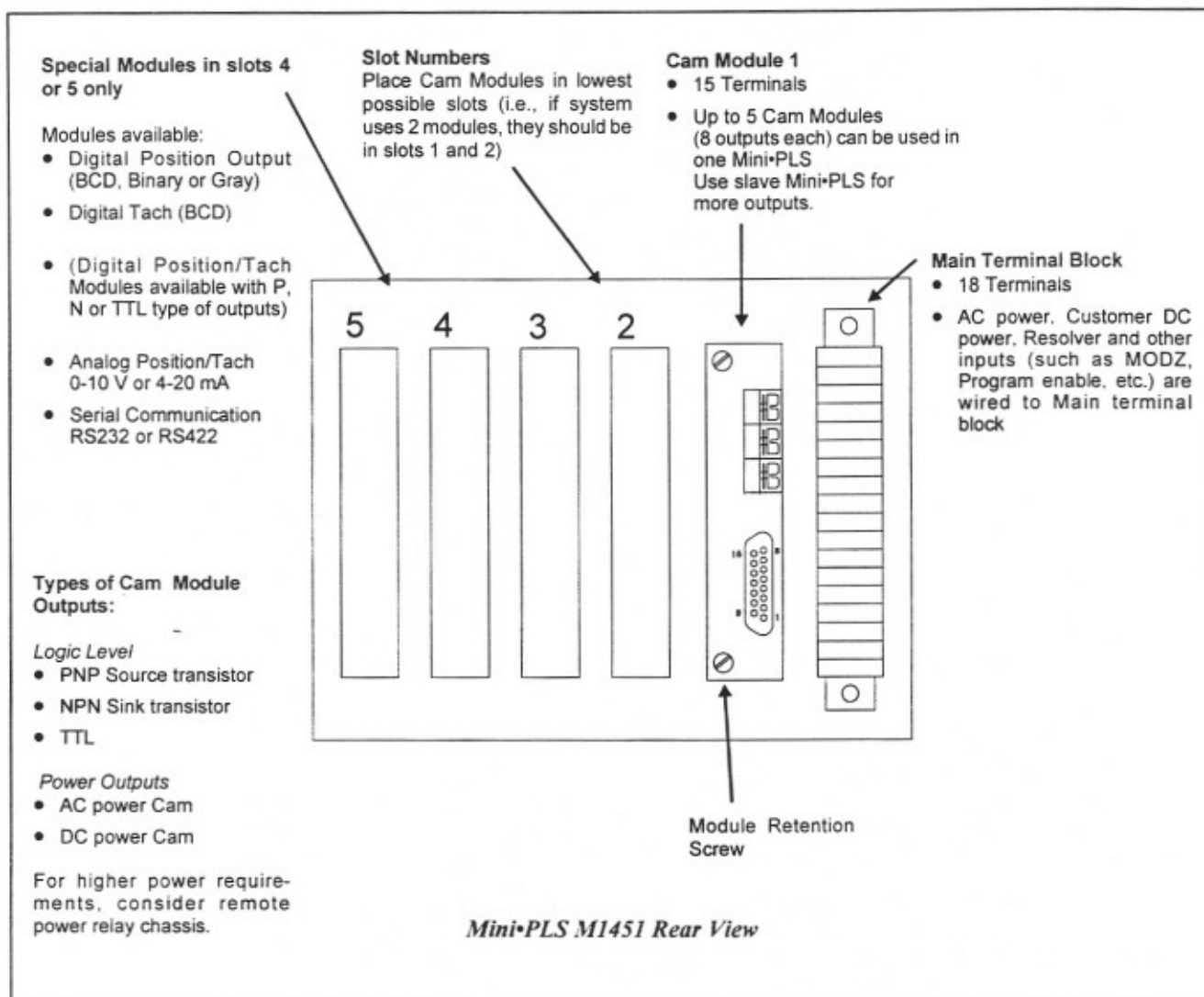
Program Indicators

For editing or viewing the program

- **Ang** : Press this key once for angle set point entry. Press this key twice for ModZ retrigger zone viewing (recall scrolls through 4 ModZ groups).
- **Chan:** Press this key for entry of new channel number
- **Chan On/Off:** When pressed, it toggles the Channel On/Off indicator.
- **Pos** : Pressing this key displays the current position (resolver position plus static offset) in Position/RPM window, and the last channel selected for programming in the Channel window. Pressing this key again displays stopping time for Brake Wear feature.
- **Offset/SF:** When this key is pressed, the current static offset is flashed in the Position/RPM window, and then the current position is displayed; and the unit is ready for offset reprogramming. When the key is pressed again without altering the offset, current scale factor is displayed, and the unit is ready for scale factor reprogramming.
- **Tach:** Press this key to display current RPM in the Position/RPM window.
- **+ and —** : These keys increment/decrement the displayed numerical values; used to fine tune programmed values.
- **Recall:** In *angle mode* (when angle indicator is on), pressing this key displays the Cam setpoints values and their programmed status (i.e., whether programmed on or off) in status indicator. In Tach mode (Tach indicator on), pressing this key displays Motion Lo and Hi setpoints. Pressing this key in position mode shows station number and baud rate for serial communication.
- **Dup:** Used to copy (duplicate) program from one Cam to another.
- **1, 2, 3, 4 Keys:** Pressed in position mode show ModZ angles of groups 1, 2, 3, or 4 respectively.

Indicates what is being programmed or edited

- **Angle:** ON in angle entry mode; angle displayed in Position/RPM window.
- **Channel:** ON in channel entry mode
- **Channel On/Off:** Used with channel programming; Turn it ON (by pressing Chan On/Off key) when a channel being programmed is intended to be ON; and turn it OFF when channel is intended to be OFF.
- **Offset:** ON when Offset is being displayed/programmed.
- **Scale Factor:** ON when SF is being displayed/ programmed.
- **Motion Set Hi:** ON when Motion Hi limit is being displayed/programmed.
- **Motion Set Lo:** ON when Motion Lo limit is being displayed/programmed.

1.2 Rear View of Mini•PLS

Special Modules in slots 4 or 5 only

Modules available:
- Digital Position Output (BCD, Binary or Gray)
- Digital Tach (BCD)
- (Digital Position/Tach Modules available with P, N or TTL type of outputs)
- Analog Position/Tach 0-10 V or 4-20 mA
- Serial Communication RS232 or RS422

Slot Numbers
Place Cam Modules in lowest possible slots (i.e., if system uses 2 modules, they should be in slots 1 and 2)

Cam Module 1
- 15 Terminals
- Up to 5 Cam Modules (8 outputs each) can be used in one Mini•PLS Use slave Mini•PLS for more outputs.

Main Terminal Block
- 18 Terminals
- AC power, Customer DC power, Resolver and other inputs (such as MODZ, Program enable, etc.) are wired to Main terminal block

Types of Cam Module Outputs:

Logic Level
- PNP Source transistor
- NPN Sink transistor
- TTL

Power Outputs
- AC power Cam
- DC power Cam

For higher power requirements, consider remote power relay chassis.

Module Retention Screw

Mini•PLS M1451 Rear View

1.3 Remote Power Relay Chassis

For applications requiring higher power than is available through Cam Modules, a remote power relay chassis may be used. The remote power relay chassis comes with 16 Cam outputs and one motion output relay (total 17 relays). Further the chassis may be ordered with Electromagnetic relays or solid state relays. The chassis has a DB15 connector for connection to an N-type of Cam Module. The chassis and Cam Module in Mini•PLS are connected using a prewired cable. Thus, the only wiring that needed is to the field devices.

1.4 Back Panel Mount Mini•PLS Chassis

This chassis is an integrated system, where the Mini•PLS, together with its input/output terminals and the remote power relay output chassis, has been mounted on a common base plate to be installed inside the user's control panel or a NEMA 12 enclosure provided by Autotech.

2. Installation and Wiring

2.1 Position Transducer Mounting and Wiring

See position transducer section for mounting and wiring of the transducer used in your application.

2.2 Mini•PLS Mounting (See figures below)

The Front Panel Mounting unit has a sealed front plate and is provided with four 0.188" dia holes (use 8-32 screws) for mounting. The remote power relay output chassis, if used, is mounted inside the customer's control panel. Six 0.196" dia. holes (use two 10-32 & four 6-32 screws) are provided for mounting.
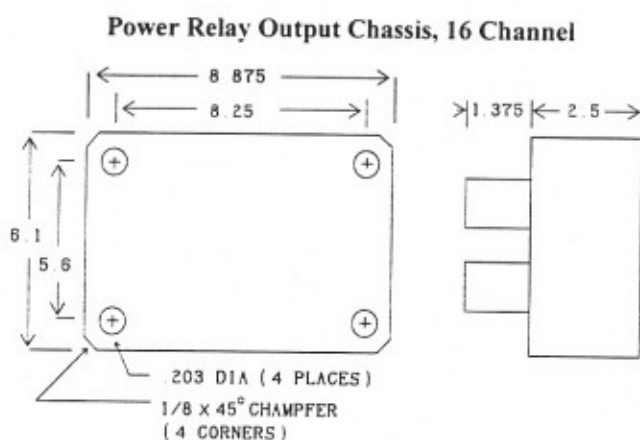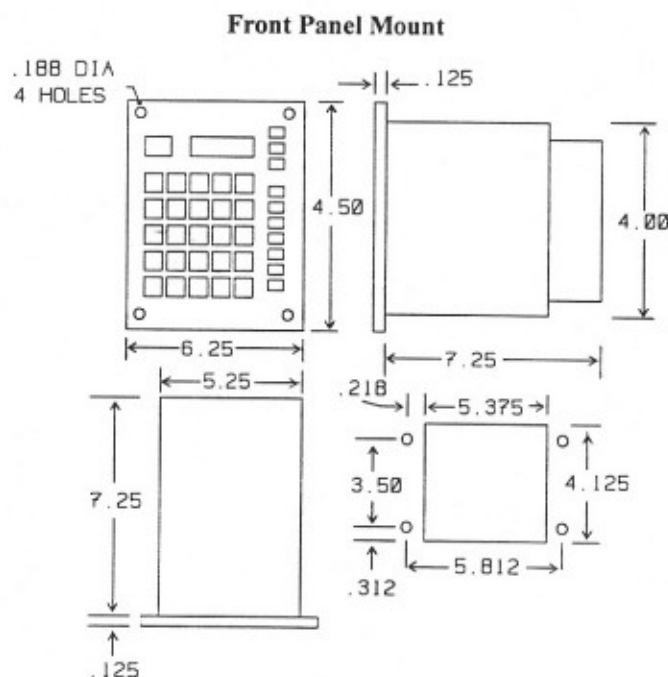
For Back Panel Mounting, the Mini•PLS, together with input terminal block and power relay outputs, is mounted on a back panel mount chassis. Four 0.25" diag. holes (use 10-32 screws) are provided for installation inside the customer's control panel close to the other existing controls. An optional NEMA12 (IP52) enclosure with or without see-through window is available. Two holes for 1.25" conduit fittings are provided for wiring harnesses. Four 5/16" dia. mounting holes (use 1/4" screws) are also provided.

Front Panel Mount

Power Relay Output Chassis, 16 Channel

NEMA 12 Enclosure

Back Panel Mount
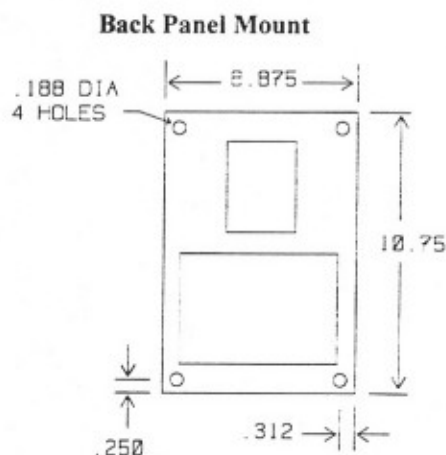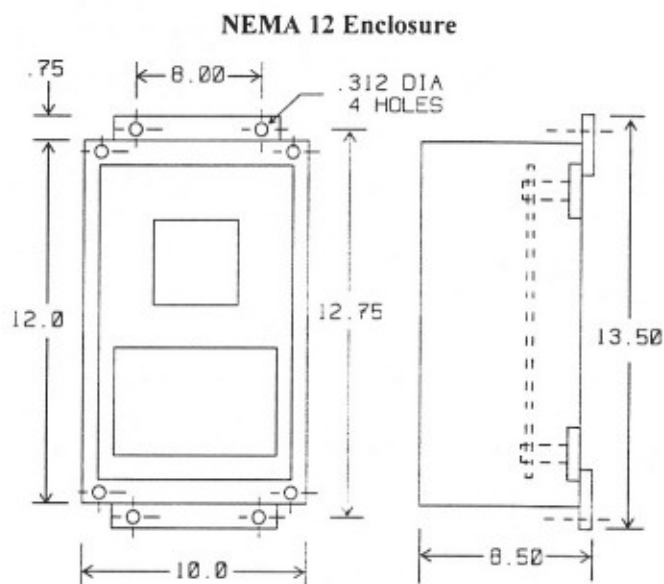
2.3 Mini·PLS Wiring

Notes:
- No special tools are required for wiring input or output devices to the Mini·PLS. Sems clamp screws on main terminal block eliminate need for wire lugs. Prewired cables may be used for modules with DB15 connectors.
- Follow shielding and grounding techniques as described in the grounding and shielding section.
- The 120 VAC input power neutral must be connected to terminal L2 and earth ground must be properly connected to the GND screw.
- When the Mini·PLS is mounted in an enclosure or a control panel, use separate conduit entrances for low voltage wiring and 120 VAC wiring.

CAUTION: This equipment has an isolated Sig. Ref. (common). Failure to maintain this isolation between chassis ground (earth ground) and Sig. Ref. in external equipment connected to the Mini·PLS may cause electrical noise interference resulting in unpredictable operation of this equipment.

2.3.1 M1451 Main Terminal Block Wiring

For the wiring of the M1451 Main terminal block, please refer to the table given below. The terminal functions are also discussed below:

- AC Power Connections: The 120 VAC input power is connected to L1 & L2 terminals (terminal # 1 & 2), where L2 is the neutral. Connect earth ground to GND screw on left rear of unit. Also connect input transducer shield to GND screw.
- Customer Power Connections: Customer DC power is necessary for some Cam Modules, ModZ inputs, or brake inputs. If ModZ inputs or brake wear monitor are used, customer supply negative reference must be connected to terminal 12 (cust Vs-).
- Motion Detector/Direction Output: Terminal #4 is an optically isolated, open collector NPN sinking type output that is referenced to customer VS- and is rated at 30 V @ 100 mA maximum.
- Program Enable/Disable: Located at terminal #5. To enable M1451 programming, switch terminal 5 to customer VS-. Connections can be made through an external key switch, if desired.
- Transducer and ModZ Input Wiring: ModZ inputs are true when connected or switched to customer VS+, false otherwise. Transducer is wired to the M1451 according to the Main terminal wiring table.

Important: If ModZ feature is not used, tie ModZ Enable input to VS-.

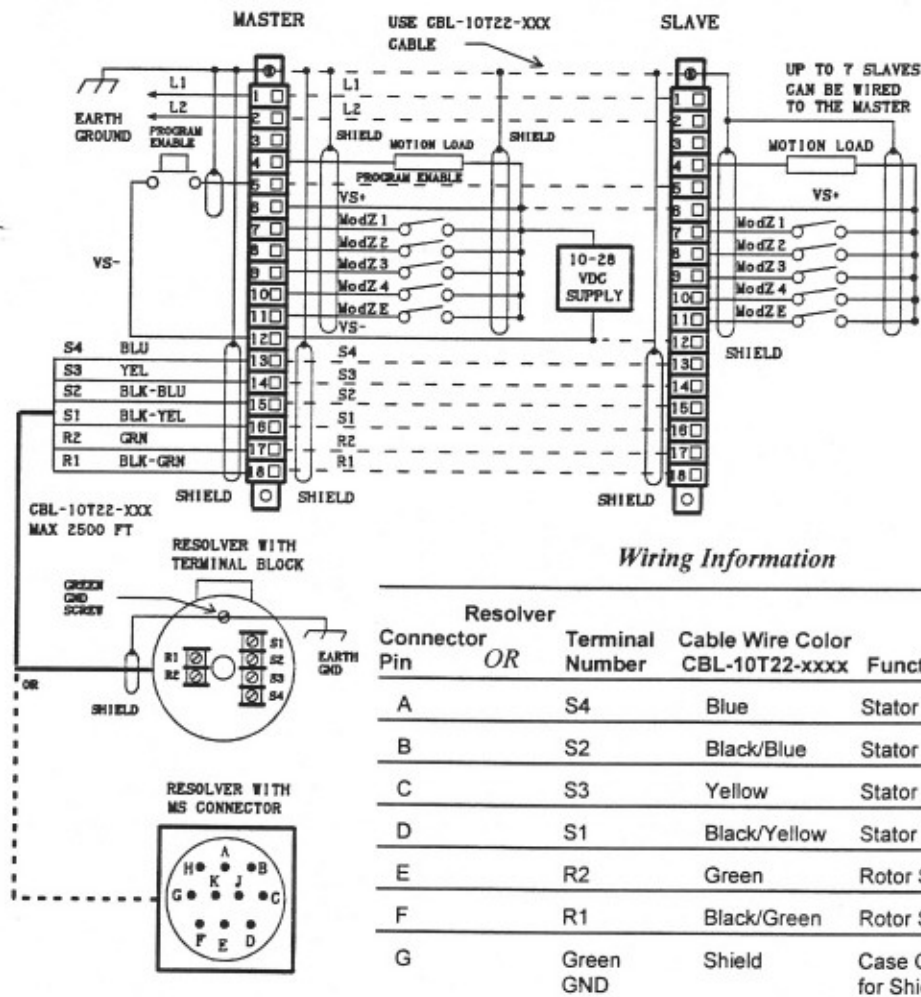| Table: M1451 Main Terminal Block (Input Terminal in Case of Back Panel Mount) Wiring					
Terminal Number	I/O	M1451	Terminal Number	I/O	M1451
Green Screw		GND			
1	I	L1	10	I	ModZ 4
2	I	L2	11	I	ModZ Enable
3		NC	12	I	Cust Vs-
4	O	Motion	13	I	Resolver S4
5	I	Program Enable	14	I	Resolver S3
6	I	Vs+	15	I	Resolver S2
7	I	ModZ 1 (or Brake Input)	16	I	Resolver S1
8	I	ModZ 2	17	O	Resolver R2
9	I	ModZ 3	18	O	Resolver R1
I: Input terminal; O: Output Terminal; NC: Not connected; CS: Coarse Resolver Stator; FS: Fine Resolver Stator					

2.3.2 M1451 Slave Units

Each Mini•PLS model has the capacity for up to 40 channels. If more than 40 channels are required, M1451 units may be used in a master-slave configuration sharing the same position transducer. This expands the capacity up to 320 channels by wiring one master and seven slave units in parallel. These 8 units may be any combination of M1451 units, provided they can use the same position transducer, as that used by the master.

The functional description, specifications, outputs and programming of slave units are the same as described for master Mini•PLS. All the program variables can be entered in each slave unit independent of the master or other slave units.

Main Terminal Block (Input terminal in case of Back Panel Mount) Wiring for the Master and the Slave units for the Models M1451

Wiring Information

Resolver Connector Pin	OR	Terminal Number	Cable Wire Color CBL-10T22-xxxx	Function
A		S4	Blue	Stator 1 Signal
B		S2	Black/Blue	Stator 1 Signal
C		S3	Yellow	Stator 2 Signal
D		S1	Black/Yellow	Stator 2 Signal
E		R2	Green	Rotor Signal
F		R1	Black/Green	Rotor Signal
G		Green GND	Shield	Case Ground for Shield

Notes :

1. Slave M1451 is different than the Master M1451 unit. Wiring to the slave unit is shown by dashed lines.
2. For a stand alone M1451 unit (i.e., without slave), follow the wiring of the master main terminal block.
3. Up to 7 units may be slaved to a master, and master and slave units may be any combination of the units mentioned above.

2.3.3 Cam Module Wiring

Cam Modules with 15 position terminal block ASY-M1250-08TI, -08PI, -08NI are offered with Mini•PLS M1451. These modules are replacement parts for ASY-M1250-08T, -08P, -08N parts.

Wiring Cam Module with Terminal Block (ASY-M1250-08xI)

These Cam Modules come with a quick disconnect terminal block. The functions of different terminals are given in the table below. Note that these modules are optically isolated, so power and Sig. Ref. should be connected on all modules.

Terminal designations for Cam Modules with terminal block (ASY-M1250-08xI)	
Pin #	**Function**
1	NC
2	NC
3	(P & N option only) Output Enable (See Multiple program selection)
4	(T option only) Tristate input
5	Channel 1
6	Channel 2
7	Channel 3
8	Channel 4
9	Channel 5
10	Channel 6
11	Channel 7
12	Channel 8
13	(T Option only) Vcc (5 VDC max.)
14	Sig Ref (Common) (Connect on all modules)
15	(P & N Option only) Vs+ (50 VDC max.)
NC : Not Connected	

Module in Slot #	Channels
1	1-8
2	9-16
3	17-24
4	25-32
5	33-40

Output Configurations and Load Wiring

N-type of output

PLS Output

P-type of output

PLS Output

T-type of output

PLS Output
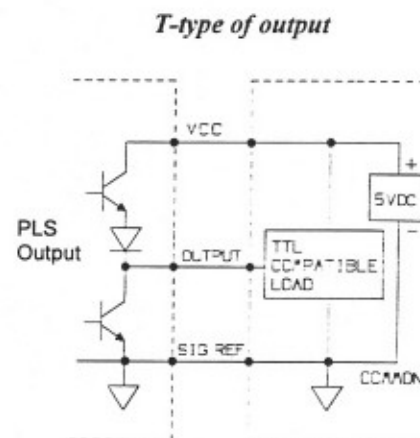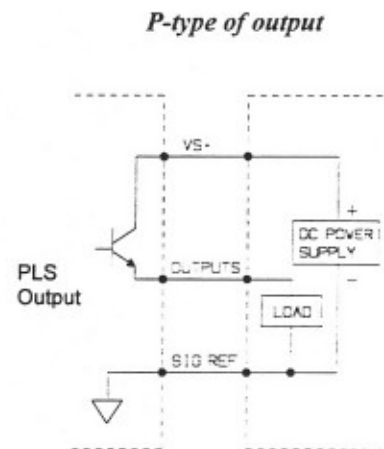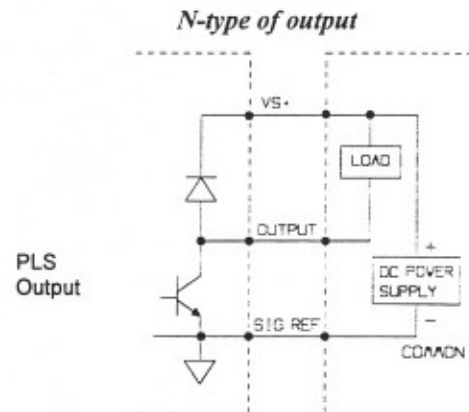
Multiple Program Selection/Output Enable

The storage of programmed set points in the individual Cam Modules in EEROM memory allows reprogramming of various Cam Modules for different jobs. Selection of the appropriate program Cam for the current job might be done with the use of an external selector switch, output enable input (Term #3). The output enable pin does not affect Cam outputs when jumper J1 is installed on the Cam Module (see figure below). When J1 is cut this pin may be used as follows:
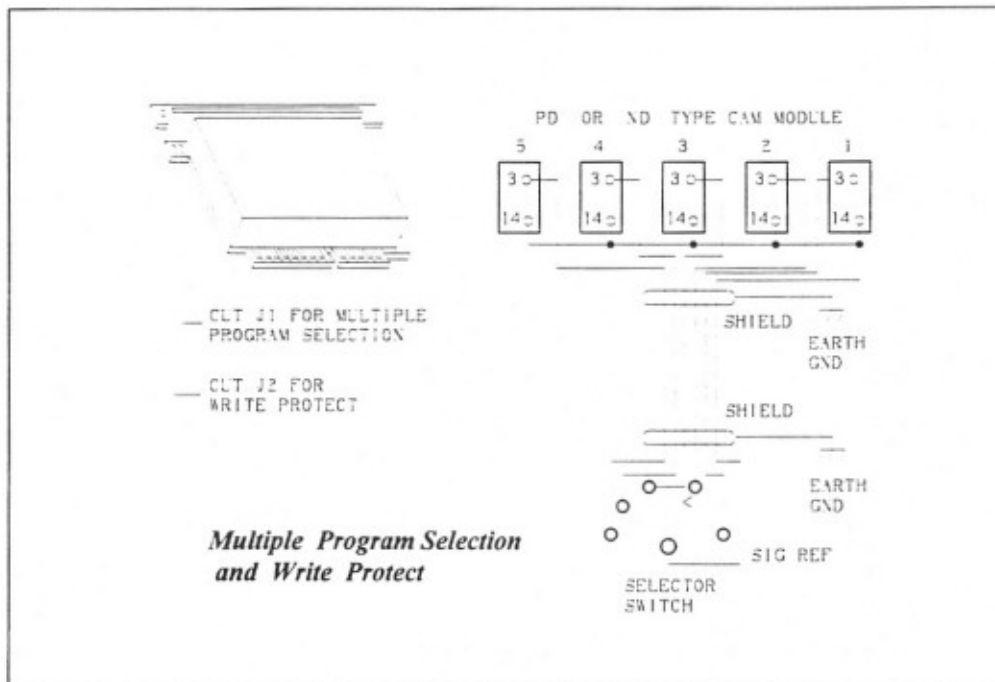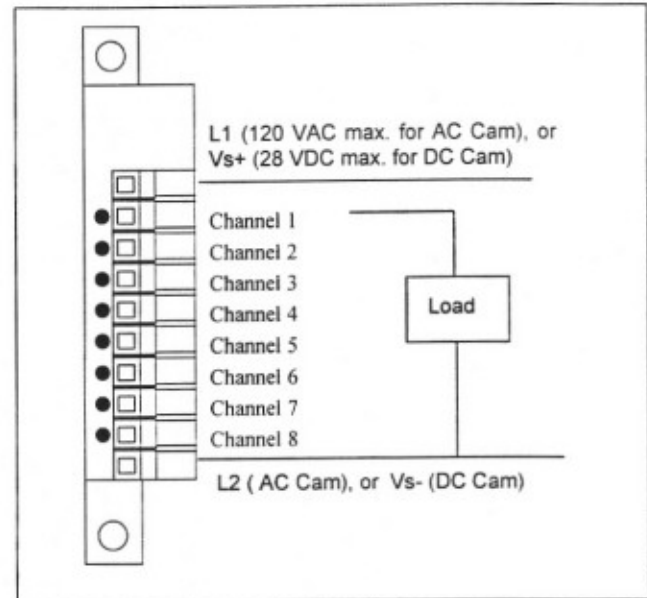
- TTL Cam Modules: For multiple program selection use a multiplexing/tristating input at Term #3 of the Cam Module. Multiplex input is low active TTL level input.
- PNP and NPN Cam Modules: For multiple program selection wire Term #3 to Vs- through selector switch as per diagram below.

Write Protect

As shown in the diagram below, the PNP and NPN type of Cam Modules are shipped with factory wired jumper J2, which enables the modules to receive any program. If "Write Protection" of the program is required after the machine is adequately set up, cut the jumper J2. This will disable module programming. This feature is especially useful when some of the Cam settings should not be accessible to the unauthorized personnel and, once adjusted, need not be changed frequently. Installing the jumper back into place will enable the module for programming changes, if so required.
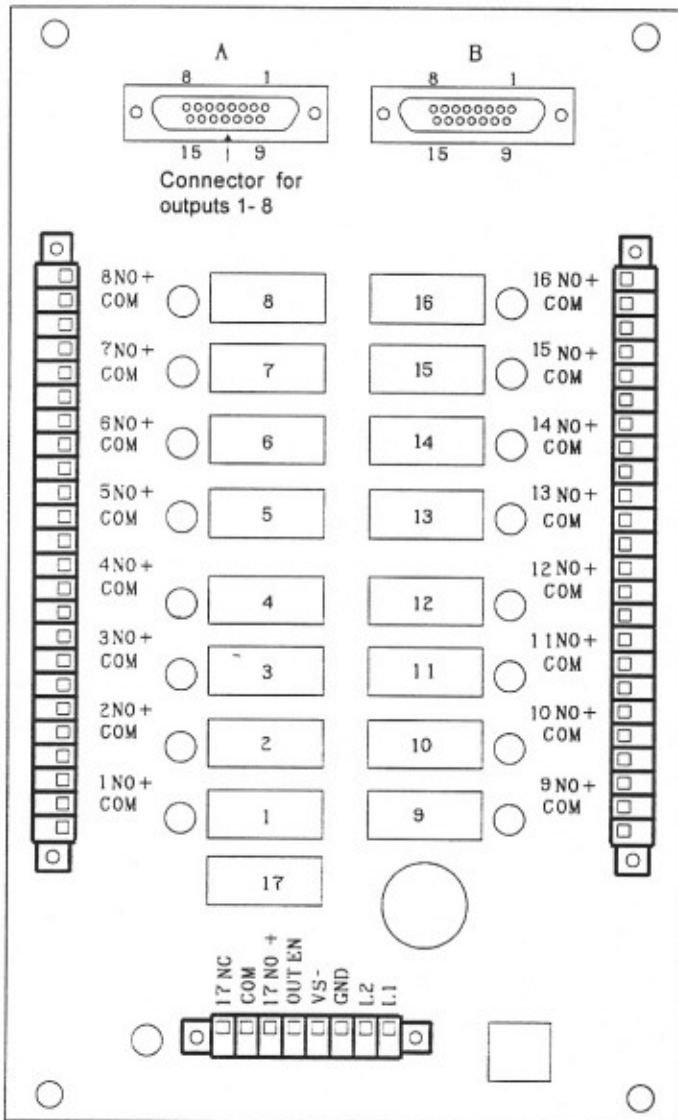
2.3.4 AC Power Cam Wiring

AC and DC power Cam use a quick disconnect terminal block for wiring to the module. The diagram below identifies the terminal on the AC and DC power Cams, and shows wiring a typical output.

L1 (120 VAC max. for AC Cam), or Vs+ (28 VDC max. for DC Cam)

Channel 1
Channel 2
Channel 3
Channel 4
Channel 5
Channel 6
Channel 7
Channel 8

Load

L2 (AC Cam), or Vs- (DC Cam)

PD OR ND TYPE CAM MODULE

CUT J1 FOR MULTIPLE PROGRAM SELECTION

CUT J2 FOR WRITE PROTECT

Multiple Program Selection and Write Protect

SHIELD

EARTH GND

SHIELD

EARTH GND

SIG REF

SELECTOR SWITCH

DB15 Connectors' Pin Functions
Cable: CBL-15S22-DAxxx

Pin#	Cable Color	ConnectorA	ConnectorB
1	Black	NC	NC
2	White	VS (−)	VS (−)
		(DC supply common)	
3	Red	VS+	VS+
		*Unregulated 12 VDC Output	
4	Green	Input 17	Direction Input
5	Orange	Input 7	Input 15
6	Blue	Input 5	Input 13
7	White/Black	Input 3	Input 11
8	Red/Black	Input 1	Input 9
9	Green/Black	VS −	VS −
10	Orange/Black	VS +	VS +
		*Unregulated 12 VDC Output	
11	Blue/Black	**Output Enable	NC
12	Black/White	Input 8	Input 16
			Motion Input
13	Red/White	Input 6	Input 14
14	Green/White	Input 4	Input 12
15	Blue/White	Input 2	Input 10

Notes:
*Unregulated DC output voltage with limited current capability
**This Pin is connected to OUT EN terminal and is used by Auto-tech's Products to enable/disable outputs.

Notes:

1. Relay chassis are available for EM relays or for solid-state relays, with 16 outputs. The EM relays provide NO, while solid state relays offer only NO (AC triac or DC transistor) output. The positive DC output is wired to the appropriate NO terminal block point.
2. The 16 output relay chassis requires one or two Cam Modules and two cables (CBL-RLYCH-D04).
3. **Motion Output:** The motion must be wired to the motion detect terminal output on the main terminal block of M1451 to activate the motion relay on the relay chassis. Also connect Sig Ref term#14 of Cam Module to term#12 of main terminal block. For 16-output relay chassis , only connector needs to be wired this way.
4. **DC power:** The relay chassis provides DC power to the connected Cam Module. This power may be used to power the main terminal block of M1451.
5. **Output Enable:** Output Enable input on the relay chassis will be effective only after the jumper J1 on the Cam Module is cut. On 16 channel relay chassis, the output enable input is common to the both connected Cam Modules.

2.3.6 SPECIAL MODULES

A. Digital Position/Tach Output Modules:

Digital Position/Tach Modules have a Terminal Block on them. See figure and table in the next column.

The Digital Position and Tach Modules are available with BCD output formats and following options:

- P, N or T type of outputs
- w/ or w/o PC synch circuit

These Modules can be used only in slot 4 and/or 5 on the Mini•PLS.

PC Synch Circuit

The PC synch option on BCD Modules is useful for programmable devices such as PC, which "read" the module. The reading device sends a data transfer signal to the module, and PC synch option then assures that data changes only between 30 μs to 100 μs after the receipt of a rising or falling edge on the data transfer input (pin #3). The Data Transfer signal is 0-24 volt logic input (*Logic Low:* -0.8V @ 3.2 mA and *Logic High:* 2.4V @ 0.4 mA) with 30 μs minimum pulse width. The data transfer takes place on both rising and falling edges of the signal.

Removing jumper J1 (the upper jumper pair) will disable Data Transfer and allow the module to continuously update the outputs. The modules without PC synch option update continuously. The update rate being dependent on the RPM and number of setpoints. *Module Update Rate:* 58ms.

Serial Communication Modules:

Consult manual on these modules for more details.
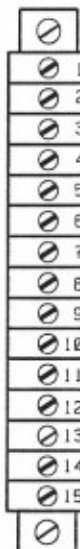
Modules available with P, N or T type of outputs. See specifications & How to Order. See below wiring for typical P and N output wiring.

Terminal Block Designations for Position/Tach Output Modules
Cable : CBL-18S22-Cxxx

Term #	Cable color	Function
1	Black/12	SigRef
2	White/12	Vs+
3	Black	Data
4	White	Bit 800(MSB)
5	Grey	Bit 400
6	Voilet	Bit 200
7	Blue	Bit 100
8	Green	Bit 80
9	Yellow	Bit 40
10	Orange	Bit 20
11	Red	Bit 10
12	Brown	Bit 8
13	White/Yellow	Bit 4
14	White/Orange	Bit 2
15	White/Red	Bit 1(LSB)
16	White/Brown	NC
17	White/Green	NC
18	White/Black	NC

NC : Not Connected; **MSB:** Most significant Bit;
LSB: Least Significant Bit;
Blue/White: Blue color with white stripes.

Analog Position/Tach Output Module Wiring

The Analog Position/Tach output Module provides an analog signal proportional to shaft position or speed. The module may be ordered with one of the following output configurations:

- 0 - 10 VDC out
- 4 - 20 mA sourcing output
- 4 - 20 mA sinking output

The module has 4 Dip switches to select between Position and Tach output, and to select ranges, as shown below. Two potentiometers are provided for adjusting zero and full-scale reading within the selected range. The Module update rate is background task RPM dependent.

Module Function Selection

Module Function Required	Switch #4 Position
Analog Position	ON
Analog Tach	OFF

Range Selection

- Position: Set switches so that the scale factor (SF) is within range (e.g., if SF=359, SW1=OFF, SW2=ON, SW3=OFF)
- Tach Function: Set switches so that ax RPM is within range (e.g., if ax RPM=200, SW1=OFF, SW2=ON, SW3=ON)
- For overlapping ranges, any range may be used.

Range	Switch#1	Switch#2	Switch #3
15 - 33	ON	ON	ON
27 - 47	OFF	ON	ON
36 - 75	ON	OFF	ON
60 - 26	OFF	OFF	ON
106 - 233	ON	ON	OFF
216 - 476	OFF	ON	OFF
415 - 900	ON	OFF	OFF
885 - 1999	OFF	OFF	OFF

Analog Position or Tach Module

Analog Out
(0 - 10 V or 4 - 20 mA)

Common

Zero Adjust Pot

Span Adjust Pot

Dip Switches for range selections

Calibration:
- Set switches as per function and range.
- Adjust Zero and Span adjust pots for zero and maximum readings.
- For tach function, it may be convenient to put module in position mode, turn resolver to read zero position, and set zero pot; then turn resolver so that the number in position display window equals the max. RPM, adjust span pot. After adjustment of pots, switch module back to tach.

B. Die Protect/Brake Wear Module

Die-Protect gives the ability to monitor four (4) different transition detectors for basic die protection items (for example short feed, misfeed, and part ejection). A fault output will occur if an input transition is not detected between the programmed set points. For example, a part is to be ejected out of the die between 180 and 230 degrees of the machine cycle. If the part is not sensed or detected within these parameters, a fault or stop signal is given to stop the machine.

Die Protect/Brake wear module must always be installed in slot 1.

To program machine cycle windows for transition detection, channels 5-8 must be used.

Channel 5 corresponds to input number 1
Channel 6 corresponds to input number 2
Channel 7 corresponds to input number 3
Channel 8 corresponds to input number 4

For example, if an ejection is to take place between 180 and 230, and eject signal is connected to input number 3, channel 7 should be programmed to contain 180 ON setpoint and 230 OFF setpoint. If any of the inputs are not used, the corresponding channels must be programmed not to have any setpoints.

All the transition inputs are provided at the DB connector. Inputs require voltage of 11-28V to be activated. For wiring details, see the table on the next page.

All the outputs are available at the DB9 connector. The module should be connected to the relay chassis with a standard DB15 male to male cable. If the relay chassis is not used, the power supply must be provided directly through the DB15 connector.

Channels 1 and 2 are used as Brake Wear monitor outputs, and any setpoints programmed in these channels will have no effect. Channels 3 and 4 may be used as normal PLS channels.

The Die Safe, Die Fault, Brake Safe and Brake Warning outputs are all active low. More details about channel and Brake Wear monitor programming can be found in the programming section.

Die Protect/Brake Wear Module Wiring Details

Pin Definitions for DB-15 Connectors on Cam Modules (Cable: CBL-15S22-DAxxx)

Pin #	Cable Color	Function
1	Black	NC
2	White	Vs- (SigRef or Com)
3	Red	Vs+ (50VDC max for P&N; 5VDC max for T)
4	Green	Motion
5	Orange	Die Safe
6	Blue	NC
7	White/Black	PLS
8	Red/Black	Brake Warning
9	Green/Black	Vs-
10	Orange/Black	Vs+
11	Blue/Black	NC
12	Black/White	Die Fault
13	Red/White	NC
14	Green/White	PLS
15	Blue/White	Brake Safe

NC:: Not Connected:
White/Black : White wire with Black stripes

Cam Module (ASY-M1451-04DP)

DB -9 Female Connector (Input)

DB -15 Female Connector (Output)
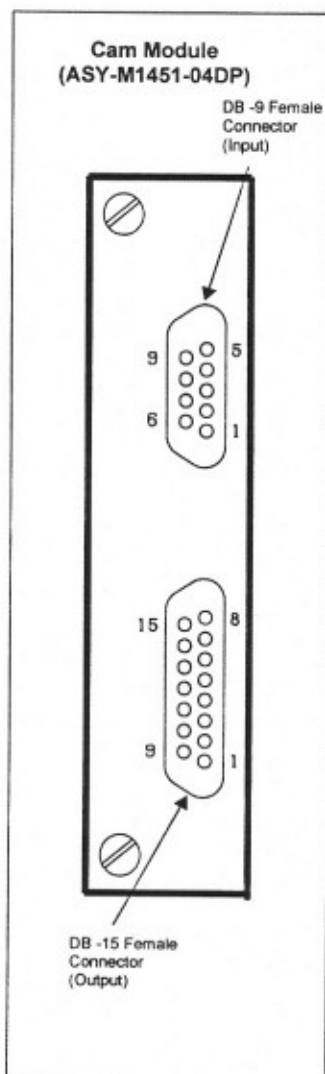
Pin Definitions for DB-9 Connectors on Cam Modules (Cable: CBL-09S22-DAxxx)

Pin #	Cable Color	Function
1	Green/Black	Vs-
2	Green	NC
3	Yellow/Black	NC
4	White/Black	Input # 4
5	Yellow	Input # 2
6	White	Reset
7	Red/Black	Motion
8	Blue/Black	Input # 1
9	Red	Input # 3

NC: Not Connected
White/Black : White wire with Black stripes

Note:
If Connector DB15 is wired to relay chassis, use CBL-RLYCH-DA4

C. Logic Cam

The Logic Cam has all the features of the ASY-M1250-08ND and ASY-M1250-08PD eight channel output module, except for the motion output. In addition, inputs have been provided for PLC control of each of the output channels. The driving source for these inputs should be positive logic current sourcing open source or totem pole outputs. The Logic Cam can be operated in either of two modes controlled by the placement of a jumper. In the transparent mode each output is active if the resolver shaft is between an ON setpoint and its corresponding OFF setpoint and the enable input is true. In the synchronous mode all eight enable inputs are latched on the falling edge of the eighth channel setpoint. The available output options are "N" type open drain current sinking and "P" open current sourcing. The "N" type outputs will directly drive the ASY-RLYCH-16SS power relay chassis through a CBL-RLYCH-DA4 cable. For other applications see the accompanying wiring diagram.

Pin Definitions for DA15S Enable Output Connectors on Cam Modules
(Cable: CBL-15S22-DAxxx)

Pin #	Cable Color	Function
1	Black	NC
2	White	Vs- (Sig Ref or Com)
3	Red	Vs+ (11 to 28 VDC)
4	Green	NC
5	Orange	Chan 7 Output
6	Blue	Chan 5 Output
7	White/Black	Chan 3 Output
8	Red/Black	Chan 1 Output
9	Green/Black	Vs- (Sig Ref)
10	Orange/Black	Vs+ (11 to 28 VDC)
11	Blue/Black	Output Enable (Async all Channels)
12	Black/White	Chan 8 Output
13	Red/White	Chan 6 Output
14	Green/White	Chan 4 Output
15	Blue/White	Chan 2 Output

NC: Not Connected
White/Black : White wire with Black stripes

Cam Module
(ASY-M1451-LCAMX)

DB -9 Female Connector (Input)

9   5
6   1

15   8
9   1

DB -15 Female Connector (Output)
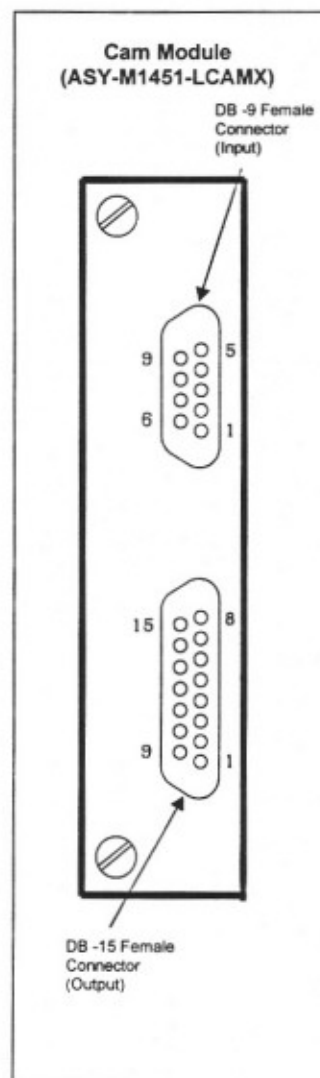
Pin Definitions for DE9S Enable Input Connectors on Cam Modules
(Cable: CBL-09S22-DAxxx)

Pin #	Cable Color	Function
1	Green/Black	Chan 1 Enable
2	Green	Chan 2 Enable
3	Yellow/Black	Chan 3 Enable
4	White/Black	Chan 4 Enable
5	Yellow	Chan 5 Enable
6	White	Chan 6 Enable
7	Red/Black	Chan 7 Enable
8	Blue/Black	Chan 8 Enable
9	Red	Vs- (Sig Ref)

NC: Not Connected
White/Black : White wire with Black stripes

Note:
If Connector DB15 is wired to relay chassis, use CBL-RLYCH-DA4

2.4 Grounding and Shielding


```
                                           GREEN GROUND
                                           SCREW
  P.L.C. OR
  RELAY CHASSIS
                                                      PROGRAM ENABLE
                                                      KEY SWITCH

                                                      ModZ/PRESET/
                                                      EXTERNAL POWER
                                                      SUPPLY

                                                RESOLVER
                                              SHIELD
  EXTERNAL
  SUPPLY IF                                            GREEN GROUND
  REQUIRED                                             SCREW ON
                      OUTPUT CAM    MAIN               TERMINAL UNITS
                      TERMINAL      TERMINAL
                      BLOCK         BLOCK

         INDICATES GOOD METALLIC CONNECTION TO GROUND PLANE ON WHICH EACH UNIT
         IS MOUNTED WITH SHORTEST POSSIBLE WIRE LENGTH OF 14 GUAGE OR BIGGER
```

Notes on grounding and shielding:

[Failure to observe any of these requirements may cause unpredictable operation and will void warranty]

1. **All** logic level wiring (including resolver and external power supply) must be done using **overall foil shielded** cables, with shields and equipment grounded as per above drawing. See How to Order section for suitable cables offered by Autotech.

2. Resolver shielded cable must consist of **twisted pairs,** and the twisted pairs must be wired as per wiring instructions.
   It is recommended that the resolver shielded cable be run in its own **separate** conduit.

3. All ground planes on which the M1451 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.

4. All shielded cable must be kept at a minimum distance of 2 inches from all high voltage or inductive wiring.

5. All shielded cable must be kept at a minimum distance of 12 inches from all motor wiring controlled by AC or DC drives.

6. **All electromechanical relays,** including Autotech's relay chassis, when driven from logic level outputs (Cams), must have metal oxide varistors (GMOV'S) across each set of relay contacts.

7. **Caution:** This equipment has an isolated Sig. Ref. (common). Failure to maintain this isolation between chassis ground (earth ground) and Sig. Ref. in external equipment (power supply or I/O cards) may cause electrical noise interference resulting in unpredictable operation of this equipment.

3. Programming Mini•PLS 1451

Programming of M1451 Mini•PLS requires entering appropriate values for the following:
- Scale Factor
- Offset
- Rate Offset
- ON/OFF Set Points
- BRAKE WEAR Monitor Limits
- PLS or ModZ Output Selection
- ModZ Retrigger Zones
- Motion Limits
- Station Number and Baud Rate for Serial Communication

Following are the general guidelines for programming M1451 models:
1. The Program Enable input must be at low (connected to Sig Ref). Connect on main terminal block, the terminal #5 to terminal #12 (VS-). This connection may be done through a switch.
2. Most of the programming functions have an error mode. If you do something illegal in programming, the display will flash ON and OFF to let you know about it. Just follow the appropriate escape sequence (i.e., press the function key you pressed last that caused error to clear the error).
3. A flashing function indicator is a reminder that a program change has been started but not concluded. Going from one function to another is possible without actually completing the reprogramming of the first function. You should make sure that the desired program change is complete before going to the next step.
4. The keyboard is segregated into two different types. White keys represent numerical entry and/or recall functions. The dark keys represent the Program entry functions. Therefore, think before pressing dark keys.

The following section is organized in the progression most often used when programming the M1451. The key sequences required will be described.

3.1 Scale Factor Programming

The Scale Factor (SF) determines the resolution of the M1451 and is defined as below:

The scale factor is defined to be equal to the desired resolution (counts per turn) *minus one*. Thus if you want to have one turn of resolver equal to 360 counts (so that position is indicated in degrees), the scale factor will be 359.

CAUTION: When changing the Scale Factor, the previously programmed "setpoints" will be automatically rescaled but may result in an erroneous output. The setpoint values should be rechecked and the limits retrimmed if necessary.

Follow the steps given below to program desired scale factor:
1. Press the Offset/SF key twice. Verify that the Scale Factor indicator is turned ON. (If not, press Pos key and repeat). The current scale factor is displayed in Position/RPM window.
2. Enter desired scale factor, ignoring decimal point if any. As soon as you start entering the numbers, the Scale Factor indicator will start flashing, reminding you that the Scale Factor change has been started, but not concluded. If you make a mistake, just keep entering numbers until the number displayed is the Scale Factor desired.
3. Press Offset/SF key to enter Scale Factor into the memory. The flashing Scale Factor indicator will become steady, if the number entered is acceptable.
4. If, after pressing Offset/SF key, the display starts flashing, this indicates an error mode. You might have entered a number beyond the Scale Factor range (16-999). To escape the error mode, press Offset/SF key again and repeat steps 1 through 3.
5. Go to the next step.

3.2 Offset Programming

Offset, or static offset, is the number that is added to the resolver position to determine the machine position. Thus offset may be used to electronically align machine to desired position. displayed position = resolver position + offset

There are three ways to program the offset: Auto-Zero, Numerical entry, and Fine-tune. For safety reasons, with machine in motion above 3 RPM, the Auto-Zero and Numerical entry modes are inhibited.

Offset: Auto-Zero Method
The function of the Auto-Zero mode is to calculate and program the resolver offset so that the M1450 automatically displays zero when the machine is aligned with mechanical zero.
1. With resolver shaft mechanically connected to the machine being controlled, adjust machine to its mechanical zero.
2. Press the Offset/SF key. The existing Offset will appear for a short interval and then the current Machine position will be displayed. The Offset Indicator will be illuminated.

3. Press the "0" key several times until the Position/RPM display reads 0. This is now the "Machine Position". The Offset Indicator will be flashing, which means that the Offset entry is not yet terminated.
4. To terminate this step, press Offset/SF key. The Offset Indicator will stop flashing, the M1451 will calculate the required Offset, display it for a short interval and go back to display new machine position (in this case 000).
5. Press the Pos key. The Position/RPM display will indicate "0".

Offset: Numerical Entry Method

1. Press the Offset/SF key. The Offset Indicator will be illuminated, the display will flash the existing offset, and then indicate the current Machine position.
2. The new Machine position can be entered in two ways:
   a) by entering a number corresponding to the new machine position,
   b) by adding or subtracting a number from the current machine position by pressing "+" or "–" key followed by a number that will be added to or subtracted from the current Machine position.
The offset indicator will be flashing, which means that this step is not yet terminated.
3. To terminate this step, press Offset/SF key. The Offset Indicator will stop flashing, the display will flash the new calculated Offset and then display the new Machine position.
4. Press Pos key. The Position/RPM display will indicate the required position.
5. If you entered an offset number higher than the scale factor, the unit will go in error mode in step 3. Press Offset/SF key to escape the error mode and repeat steps 1 through 3.

Offset: Fine Tune Method

1. Press the Offset/SF key. The Offset Indicator will be illuminated, the display will flash the existing Offset and indicate the current Machine position.
2. Press the "+" key to advance the Offset or "–" key to retard the Offset as desired. In this case, the changes are entered directly into the memory.
3. Go to the next step.

3.3 Rate Offset (Speed Compensation) Programming

Rate offset or Speed Compensation in M1451 allows the user to program a position advance that is linearly proportional to shaft RPM.

There is a total of 19 possible rate offsets. Channel 1-16 can have individual rate offsets. The Cam Modules in slots 3-5 can only have one rate offset per module (8 channels). Speed

Compensation is programmed in scale factor units and tenths of scale factor units per ten RPM. For example, if the Scale Factor is set to 359 and the Speed Compensation entered is 3.0, then at 600 RPM, the speed compensation offset will be 180 degrees. (3.0/10 x 600)

CAUTION: *Use care when entering Speed Compensation offset. Entering too much speed compensation for the highest shaft RPM encountered in a particular application can result in more than a full revolution of offset being added to the shaft position.*

NOTE: Maximum rate offset is internally limited to counts per turn divided by 20.

There are two ways to enter a speed compensation offset: Numerical entry, and Fine-tune. The number displayed in the Position mode is the actual machine position plus the machine offset. Offsets due to Speed Compensation are not displayed.

For safety reasons, with machine in motion above 3 RPM, the Numerical entry mode is inhibited. However, fine tuning the speed compensation is still possible with the "+" and "–" keys.

Speed Compensation: Numerical Entry Method

1. Press the Chan/Module key twice. The Channel display window will read "1" and the Position/RPM window will read "C" followed by the amount of speed compensation for channel 1.
2. Enter the amount of speed compensation desired with the number keys until the display reads the chosen number.
3. Press the Chan/Module key to enter the speed compensation into memory.
4. Press the Recall key to advance to another channel/module.
5. Repeat steps 2-4 until finished.

NOTE: The Recall key only steps through the speed compensation of the installed channels. In other words, if only one Cam Module is installed, the Recall allows viewing and modifying rate offsets for the first 8 channels only.

6. Go to next step.

Speed Compensation: Fine Tune Method

1. Press the Chan/Module key twice. The Channel display window will read "1" and the Position/RPM window will read "C" followed by the amount of speed compensation for channel 1.
2. If necessary, press Recall key until the channel or Cam Module number to be fine tuned appears in the Channel

window. (17 corresponds to Cam Module 3, 18 corresponds to Cam Module 4 and 19 to Cam Module 5.)
3. Press the "+" key or "–" key to increase or decrease the amount of speed compensation.
4. Repeat steps 2 and 3 until finished.
5. Go to next step.

3.4 The ON/OFF Setpoints Programming

The ON and OFF setpoints need to be programmed for each channel. Each channel may have more than one setpoint. Limit on the number of setpoints per each channel is equal to 512.

3.4.1 Viewing Existing Setpoints
1. Press Angle key followed by Chan key. Using numeric keypad enter the number of the channel whose setpoints are to be viewed.
2. Press Recall key to scroll through all setpoints of the selected channel. When the status LED is ON, the Position/RPM window displays an ON setpoint. When the status LED is OFF, OFF setpoint is displayed. Blinking display indicates that no setpoints are programmed for this particular channel. Pressing Recall key will stop display blinking.
3. Press Chan/Module key followed by the channel number to select any other channel. If an entered channel number is illegal or a Cam Module where this channel resides is not installed, the display starts blinking. Pressing Chan/Module key returns the unit to the previously selected channel.

3.4.2 Erasing Existing Setpoints
1. If not already in angle mode, press Angle key.
2. Press Chan/Module key followed by the number of the channel to be erased.
3. Press Recall key to display the OFF setpoint of the dwell to be erased.
4. Press Ch On/Off key to turn OFF Channel On/Off LED if necessary.
5. Press "–" key to decrement the OFF setpoint until it is less than the ON setpoint. This dwell is now erased as indicated by the Status LED turning OFF.
6. View channel setpoints as explained above. Blinking display indicates that no more setpoints exist in this channel. If more setpoints need to be erased, repeat steps 3-5. If all the setpoints in a channel need to be erased, select any OFF setpoint as described above and press "–" key until the displayed number is equal to the original OFF setpoint. The whole channel should be clear at this point.

3.4.3 Setting New Setpoint Values
1. If not already in angle mode, press Angle key.
2. Press Chan/Module key followed by channel number.
3. Make sure that Chan On/Off LED is ON. If not ON, press Chan On/Off key.

4. Use the numeric keypad to enter the ON setpoint value.
5. Press "+" key until the required OFF setpoint is reached.
6. Recall the setpoint to verify the program
7. Repeat for all channels and all setpoints.

3.4.4 Editing Existing Setpoints.

The dwells can be either shrunk or expanded. The Channel On/Off LED should be ON to expand the dwell. In order to shrink the dwell, the above mentioned LED should be OFF.

For example, the ON at 20°, OFF at 40° dwell residing in channel 2 needs to be modified to ON at 25° and OFF at 47°.

The following sequence should be followed:
1. Press Angle key if not already in the angle mode.
2. Press Chan key and enter 2.
3. Press Recall Key to find the ON setpoint.
4. Press Chan On/Off key to turn Chan On/Off LED Off if necessary.
5. Press "+" key until the Position/RPM display shows 25°.
6. Press Recall key to display the OFF setpoint.
7. Press Chan On/Off key to turn Channel On/Off LED on.
8. Press "+" key until the Position/RPM display shows 47°.

Now suppose that the new ON setpoint 25° and OFF setpoint 47° needs to be changed to 22° and 45° respectively.

1. Repeat steps 1-3 above if necessary.
2. Press Ch On/Off key to turn Channel On/Off LED ON if necessary.
3. Press "–" key until the Position/RPM display shows 22°.
4. Press Ch On/Off key to turn Channel On/Off LED OFF.
5. Press "–" key until the Position/RPM display shows 45°.

In summary, in order to shrink the dwell, the Channel On/Off LED must be OFF which makes incrementing of ON setpoints or decrementing of OFF sepoints possible. In order to expand the dwell, the Channel On/Off LED must be ON, which makes incrementing of OFF setpoints or decrementing of ON setpoints possible.

3.5 Brake Monitor Definition

The M1451 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 M1451's resolver decoding circuitry, determining that the shaft has actually stopped can be found within just 30 milliseconds. This stopping time is then compared to the programmed Caution Time and Danger Time and either the Caution output (output 1 in slot 1), or Danger output (output 2 in slot 1) is energized as a result. The M1451 Brake Monitor is normally applied as an indication control on metal stamping presses.

3.5.1 Brake Monitor Programming

For the Brake monitor to function properly, ModZ Enable (terminal 11 of the main terminal block) must be connected to Vs-. The Brake input is activated by applying Vs+ at the terminal 7 of the main terminal block. If Caution and Danger time are programmed to be zero, outputs 1 and 2 of slot 1 will function as normal PLS outputs. The following sequence should be used to program Caution time and Danger time:

1. Press the Tach key.
2. Press Ch On/Off key. "CA" will appear in the channel window, and the caution time in milliseconds will be displayed in the Position/RPM window.
3. Use numeric keypad to enter a new caution time value.
4. Press Tach key to save it.
5. Press Recall key. "dA" will appear in the channel window, and the danger time in the milliseconds will be displayed in the Position/RPM window.
6. Use numeric keypad to enter a new danger time value.
7. Press Tach key to save it. From this point on, Recall key will alternate caution and danger displays.

3.5.2 Viewing the Machine Stopping Time

The machine stopping time can be viewed by pressing Pos key from Position Mode. The following display will appear:
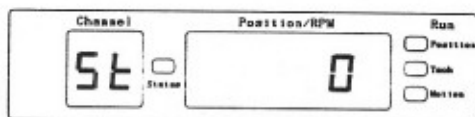
The value in the Position/RPM window is the time in milliseconds from the moment the brake input is applied to the moment the resolver comes to complete stop. If the actual stopping time exceeds 9999 milliseconds, the display will maximize at 9999.

The last stopping time reading is kept on the display until a new brake input is applied.

3.6 PLS or ModZ Output Selection

ModZ, derived from MODification to Zero, is defined as an instantaneous reset to zero. When the ModZ trigger signal is sensed, the appropriate group of channels, if enabled for ModZ, will treat the current machine position as 000 and all setpoint responses will be referenced to this new zero.

M1451 has up to 4 groups of 4 ModZ channels. Each group must be individually selected as ModZ or normal PLS. In addition, an external input, ModZ Enable, must be connected appropriately.

If M1451 is to be used as a normal PLS with or without Brake Monitor, ModZ Enable (terminal 11) of the main terminal block must be connected to Vs—. If ModZ feature is to be used, ModZ Enable must be connected to Vs+.

Please note the following with regard to ModZ functioning:
1. ModZ outputs can reside only in slots 1 and 2.

ModZ group 1 consists of channels 1-4; group2 consists of channels 5-8; group3 consists of channels 9-12; group4 consists of channels 13-16.

2. A group has to be enabled for ModZ before a trigger can start ModZ cycle for that group. The outputs from a ModZ enabled group are OFF except during a ModZ cycle.
3. The PLS outputs from ModZ channels are referenced to the modified zero, while outputs from normal channels are referenced to the normal zero.
4. There is an ability to program a ModZ retrigger setpoint for each ModZ groups. It means that if a particular group is already running a ModZ cycle, and ModZ trigger is reapplied before the retrigger setpoint is reached, the new ModZ trigger will be ignored. If a new trigger is applied after the retrigger setpoint is passed, the new ModZ trigger will take effect.
5. After the initiation of the ModZ cycle, the outputs will respond to the transducer position (referenced to modified zero) for one full resolution of the resolver regardless of the trigger input state.

3.6.1 Activating ModZ Groups

To select a group of channels as ModZ or normal PLS, the following steps should be taken:
1. Go to position mode by pressing Pos key.
2. Press Ch On/Off key, one of the following display will appear:
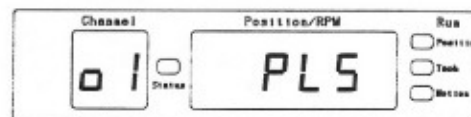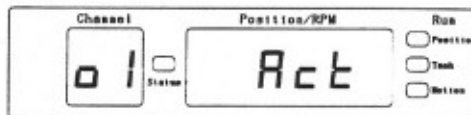
3. Press "–" key to select a group as normal PLS outputs (if not already selected). Press "+" key to make a group ModZ.
4. Press Recall key to select the next group.

Note: If ModZ Enable input is connected to Vs—, the group programming has no effect whatsoever. The outputs will behave as normal PLS outputs. Cam Modules in slots 3-5 will always have normal PLS outputs.

Note:
See next page for **Symbols** used in programming displays

3.6.2 Programming ModZ Retrigger Setpoints

ModZ retrigger is an angle before which all the ModZ retrigger inputs for a particular group are ignored. The group must already be in the ModZ cycle for this setpoint to make sense.

To program ModZ retrigger setpoints:
1. Press Angle key until the channel window shows:
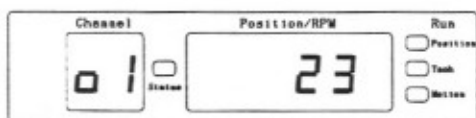
2. Using numeric keypad, enter a retrigger setpoint for this particular group. Angle LED will start flashing.
3. Press Angle key to save the retrigger setpoint value. The LED will stop flashing.
4. Press Recall key to go to the next group's retrigger setpoint.
5. Repeat steps 2 and 3 if necessary.
6. "+" and "–" keys may be used to fine tune retrigger setpoints.

3.6.3 ModZ Position Viewing

M1451 makes ModZ group position viewing possible. From the position mode, press 1, 2, 3, or 4 to view a respective ModZ group position. When there is no ModZ cycle, the Position/RPM window shows 360. When the ModZ input is applied, position goes to 0, and then tracks the ModZ position for one full revolution of resolver at which point 360 appears and stays on display.

3.7 Broken Wire Indication

Should one or more of the resolver wires break or get shorted, all outputs will de-energize. If M1451 is in the position mode, display will indicate a cable fault.

Symbols Used in Programming Displays		
Symbol	English	Function/Description
Act	Act	ModZ is active
$CAbL$	CAbL	Shorted/Broken wire
PLS	PLS	Programmable Limit Switch
St	St	Stop time

M1451 Trouble Shooting Guide

System Problem	Check
Unable to program unit. Parameters (Scale factor, Offset, etc.)	1. Common (VS-) on Term. 12. 2. Program Enable (Term. 5) is tied to VS- (Term. 12) 3. Machine must be at rest - several parameters (Scale Factor, Offset - numerical entry) are locked out if the resolver is turning faster than 3 RPM. 4. Memory damage due to severe electrical noise. Check grounding and shielding as per manual. (may need to send unit in, to replace memory)
Unit parameters program O.K., but unable to program Cams.	1. Cam Modules are installed **in order** (i.e., slots 1 & 2 for 2 Cams, slots 1, 2, 3, and 4 for 4 Cams) 2. Cam Module is **properly seated** in back of unit (not cocked at an angle) 3. Write Protect jumper on Cam Module is not cut (see section 4.3.5) 4. Ensure Cam Module wiring is done with shielded cable and is properly routed 5. May have to erase channel that is locked up. **Procedure:** Call up channel, turn channel On/Off light to be Off. Press "Angle" then enter "O". Use "+" button and plus to scale factor. Then enter dwell. 6. Damaged Cam Module - Replace
Cam Module Memory is changing by itself.	Program Enable input is not left enabled - while this will not cause the Cam Module program to change by itself - removing the Program Enable jumper when not actually programming the unit -ensures that the Cam Memory **cannot be programmed.** Sig. Ref. (R1) and Earth Ground **are not** tied together. 1) turn power off to the M1451 2) using and ohm meter, measure from Term. 18 (main terminal block) to Earth Ground. 3) The reading should be higher than 500k ohms. If Cams are driving electromechanical relays, then limit transients are below 1000V with suppressors. such as GE MOV V130L10, across electromechanical relay contacts.

System Problem	Check
Position and Tach readings are incorrect.	1. Proper grounding and shielding has been applied. 2. Resolver is correctly wired: a) Turn power off to M1451 unit b) with main terminal block connected to unit, measure with an ohm meter the following: — Term. 8 to Term. 10 = about 55 ohms — Term. 9 to Term. 11 = about 55 ohms — Term. 13 to Term. 15 = about 55 ohms — Term. 14 to Term. 16 = about 55 ohms — Term. 17 to Term. 18 = about 30 ohms
Mechanical Zero Drifts.	1. Resolver cable is properly grounded and shielded. 2. Mechanical Resolver linkage is not loose. 3. ModZ inputs are properly configured.

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