Autotech Controls
M1450-300/400/MROF Mini•PLS
Instruction & Operation Manual

Sales and Marketing ▼
343 St. Paul Blvd.
Carol Stream, IL 60188
Tel: (630)668-3900
FAX: (630)668-4676

Factory Customer Service/Order Entry ▼
4140 Utica Ridge Rd.
Bettendorf, IA 52722
Tel: (319)359-7501
(800)711-5109
FAX: (319)359-9094

Application Hotline
1 (800) TEC-ENGR (832-3647)

Vist our web site at: www.avg.net

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MINI•PLS™

M1450-300/400/MROF

Instruction Manual

The Mini•PLS

The Mini•PLS, Model M1450 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 **Motion Detector**. The powerful microprocessor and the revolutionary design make the Mini•PLS an extremely compact, fast and versatile solid--state replacement of electromechanical cam switches and older technology electronic programmable limit switches.

The high accuracy, reliability, operating speed and convenience of operation assure greater efficiencies in manufacturing, helping to increase production and reduce cost.

Principle of Operation

The Mini•PLS consists of two parts, one is a position transducer mounted on the machine and the other a programmable unit mounted in the machine control panel. The position transducer in this case is a resolver which produces a rotary position signal. This position signal is converted to digital format in the programmable unit, displayed on the front panel and compared to the dwell setpoints programmed into the PLS. When process cycle reaches these setpoints, outputs are enabled or disabled, starting or stopping desired functions during the cycle.

Absolute Encoder

Absolute Positioning With Programmable Scale Factor

The resolver provides absolute positioning, that is, the Mini•PLS always gives true position even upon machine movement after power outage. Further, a programmable scale factor up to 4095 (resolution of 4096 per turn) is provided to meet the required system resolution or for direct read-out in engineering units.

Simple to Program

Simple Front Panel Programming

The Mini•PLS is fully front panel programmable with convenient tactile keyboard yet secure against any unauthorized program changes. Opening of an external user provided key switch inhibits any program changes on the front panel. No special programming language needs to be learned. The programming functions are designed to duplicate the mental process used in setting up electromechanical cam switches.

Rugged and Reliable

Single-Turn 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 resolver can be mounted on a machine in any hostile environments, such as mechanical shock, vibrations, extreme humidity and temperature changes, oil mists, coolants, solvents etc. The programmable control unit can be mounted up to 2500 feet away in a control panel. The splash-proof, oil-tight front plate permits the unit to be installed directly on the machine itself, if so required. The ratiometric converter assures high tracking speed of 1800 RPM and high noise immunity.

Modular, Easy to Service

Modular 40 Channels in 6"x 4" x 6" Enclosure

The ultra-modern technology used by Autotech has made it possible to house 40 channels in such a small space saving enclosure. The system flexibility is further enhanced by the modular construction. The unit can be expanded up to 40 channels using 5 modules of 8 channels each. A "cam module" with desired logic level or power outputs or a separate chassis with plug-in power relay outputs can be selected to match the application. Parallel BCD position and tach output modules can be inserted in slots 4 or 5. This modular concept also permits an easy adoption in field to the future technological developments by simply adding new modules to the same basic unit.

EEROM Transportable Modules

No Batteries, Nonvolatile EEROM Memory

The scale factor, offset, dwell setpoints and motion detector setpoints are all stored in nonvolatile EEROM memory as they are entered by the user. The information is retained indefinitely after power loss or machine shutdown, eliminating need for backup batteries and related hazards.

Program Stored in Transportable Plug-in Modules

The program setpoints are stored directly in the "cam modules" in nonvolatile EEROM memory. The information is retained without power, even when the modules are taken away from the Mini•PLS. This unique feature of program storage in the "cam modules" permits programming of various modules for different jobs or spares, reducing downtime and eliminating eventual errors due to hurried reprogramming at job changes. Also, the "cam modules" can be programmed at a central place, such as corporate headquarters, and distributed to various plant locations.

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. **Power cam modules** are also available with AC (120 VAC @ 1 Amp) or DC (10–28VDC @ 1 Amp) ratings. **Optional electromechanical relays** (10Amp) 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 read-outs or control devices.

Versatile

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, then "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.

Program Duplication at the Touch of a Button

When various modules need to be programmed identical, 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, that 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.

High Speed Operation

Operation At 1800 RPM, Adjustable in Motion

The high speed ratiometric resolver-to-digital converter and the micro-scan time of 160 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.

Revolutionary New Design Yields High Speeds

The Mini •PLS converts the resolver signal to digital format, compares **all** the setpoints on **all** the 40 channels and activates **all** the outputs in a maximum of 160 microseconds. This is at least two orders of magnitude faster than programmable controllers and at least one order of magnitude faster than any PLS currently on the market. With one 8 channel module plugged-in, the scan time will be 57 microseconds.

Intelligent Communication

Parallel or Serial Link

Parallel BCD output modules with built-in PC-handshake for easy interface to programmable controllers or remote displays is available and can be inserted in slots 4 or 5. The TTL, PNP or NPN type of BCD outputs allow more flexibility for interface to external devices.

The Mini•PLS Model M1450-300 has been designed to accommodate special modules such as, serial link RS422 or RS232, etc. (Consult factory for availability of special modules.)

M1450 Mini•PLS Advanced Features

Programmable Rate Offset, ROF™, for Automatic Speed Compensation

The M1450 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. Depending upon the selected model, you can program a single rate offset value for a group of 8 channels on a cam module or different rate offset values for up to 16 individual channels.

Dynamic Zeroing, ModZ

The M1450 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 channels 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. Depending upon the selected model, you can operate up to four ModZ cam modules or 32 outputs.

Variety of Models to Meet Your Application Needs

Single-Turn Rotary PLS

Models SAC-M1450-300, SAC-M1450-MROF, SAC-M1450-400

All the above M1450 models are the advanced versions of the single-turn rotary PLS. The single-turn Mini•PLS is an absolute position programmable limit switch that uses a resolver as input and has a built-in tachometer and motion detector.

The M1450 Models offer rate offset (ROF) and dynamic zeroing (Mod Z) as standard features. Serial communication RS232 or RS422 is provided on the model M1450-300. The model M1450-MROF features programmable multiple rate offsets (up to 19), while the model M1450-400 is a high resolution PLS (up to 4096 counts per revolution).

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.

2. Specifications

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

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

Resolution and Scale Factor (See Table 1)
Resolution and scale factor are defined as follows:
The **Resolution** is defined to be equal to the counts per turn of the resolver. The **Scale Factor** is defined as the desired resolution (counts/rev) minus one.

Offset:
Programmable "0" to full revolution;

Rate Offset: (See Table 1)
Programmable, "0" to full revolution (CAUTION: entering too much rate offset may result in more than one revolution offset for higher speeds.) *Rate offset resolution:* Programmable in tenths of scale factor units per ten RPM.

Motion Detector Limits:
Low setpoint: up to 1899 RPM (max.)
High Setpoint: up to 1900 RPM (max.)

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

Slave Systems:
Up to 7 M1450s may be slaved to one master unit, giving additional 7 x 40 channels (total 320) using the same position transducer (The slave shares the position transducer with the master.)

Decimal Point on Display
In Model M1450-400, a decimal point may be placed arbitrarily after any digit. This decimal point is just for the convenience of display, and does not affect the data. Decimal point is not available in M1450-300 and M1450-MROF.

Input/Output

Program Enable :
Contact closure to customer power supply common (–Vs); or a solid-state switch 0.8 V @ 10 mA

ModZ Input:
Contact closure to customer power supply +VS; or 10 to 28 V logic input, *Logic false*: 4 VDC @ 1 mA and *Logic true:* 10 VDC @ 10 mA to 28 VDC @ 30 mA
Number of Mod Z channels: (**See Table 1)**

Motion Detector Output:
NPN sinking, 30 VDC max. @ 100 mA

Remote Power Relay Outputs:
For Cam and Motion outputs requiring higher current ratings, a separate Remote Power Relay chassis Autotech's part number, ASY-RLYCH-xxxx, can be used. The relay chassis is connected to an N type of cam module using a prewired cable.
Relay Chassis Input Power : 120 VAC 50/60 Hz.
Number of Outputs : 8 or 16 cam outputs plus one motion output.
Cam Module required : N or NI type
Cable: Prewired with DB15 connector on both ends.

Relays: Relay chassis is available for EM or Solid-state relays.
Electromagnetic relays (Part# KSD-A12DC-10A):
120 VAC @ 10 Amp, SPST
Solid-State AC Relay (KSS-120AC-3AMP):
24–280VAC @ 0.2–3 Amp, zero cross-over switching triac output relay,optically isolated

Solid-State DC Relays
KSS-60VDC-3AMP:
9–60 VDC @ 3 Amp, optically isolated
KSS-200VDC-1Amp:
0–200VDC @ 1 Amp, optically isolated

Special Output Modules

Digital Position/Tach Output Modules:
Digital Output Format:
BCD
Digital Output Interface:
TTL, PNP source transistor or NPN sink transistor, characteristics same as those of logic level cam output modules. **(See Table 2)**
Module Update Rate:
Background task, RPM dependent (consult factory).
PC Synch Circuit and Data Transfer Command:
(*Optional*)
0 to 24 Volt logic input (edge triggered i.e. data transfer on both rising and falling edges)
Logic Low: 0 to 0.8 V @ 3.2 mA
Logic High: >2.4 V @ 0.4 mA
Timings: Data latches between 30 µs – 100 µs after data transfer edge
Tach Full Scale Range: 0–1000 RPM

Analog Position/Tach Output Module:
Output: 4–20 mA (sourcing or sinking) or 0–10 VDC
Position or Tach: DIP switch selectable
Position/RPM range for max Output: DIP switch selectable

Serial Communication Modules:
(available for M1450-300 only) RS232C, and RS422

Table 1. Specifications Table

Model #	Resolution per turn	Scan Time (microseconds) Number of Cam Modules					Number of Dual Setpoints per Channel (ON/OFF)	Number of ModZ Channels	Channels affected by Rate Offsets
		1	2	3	4	5			
M1450-300	17–1000	160	200	240	280	301	Resolution ÷ 2	Slots 1–4; 32 Channels in Groups of 8	Slots 1–5; 40 Channels in Groups of 8
M1450-400	10–4096	1300	1700	2100	2400	2700	21	Slots 1–4; 32 Channels in Groups of 8	Slots 1–5; 40 Channels in Groups of 8
M1450-MROF	17–1000	200	400	430	460	490	Resolution ÷ 2	None	Slots 1–2; 16 Channels individually

Table 2. Cam Output Modules

Output Type	*Logic Level*			*Power*	
	TTL*	PNP Source Transistor	NPN Sink Transistor	AC	DC
Part Number	ASY-M1250-08Tx	ASY-M1250-08Px	ASY-M1250-08Nx	ASY-M1450-08AC	ASY-M1450-08DC
Number of Outputs per Module	8	8	8	8	8
Logic True	2 VDC @ 15 mA 2.4 V @ 3 mA (20 µA leakage when Tristated)	Transistor ON 1.7 V drop @ 100 mA	Transistor ON 1.1 V drop @ 100 mA	1 Amp Max per Channel Max 4 Amp per Module	1 Amp Max per Channel Max 4 Amp per Module
Logic False	0.35 VDC @ 24 mA (0.4 mA max leakage when Tristated)	Transistor OFF 0.2 mA leakage @ 50 VDC	Transistor OFF 0.1 mA leakage @ 50 VDC	3.0 mA max per output	0.1 mA max per output
Rated Voltage	5 VDC	50 VDC	50 VDC	105–135 VAC, 60 Hz	10–28 VDC
Response Time	Less than 1 µs	12 µs	12 µs	Turn “ON” 12 ms Turn “OFF” 25 ms	Turn “ON” 30-50 µs Turn “OFF” 15-40 µs
Electrical Isolation	2500 V between control circuit and output circuit				
* Note: Mux or Tristating Input = Low active, TTL level (i.e., Logic True: 0–0.8 V; Logic False: 2–5 VDC)					

Table 3. Position Transducers

PLS Model	Transducers	Cable
M1450-300 M1450-400 M1450-MROF	Single-turn Resolver, such as, Autotech’s RL100, E6R, E7R, E8R, RL101, or equivalent. Max tracking speed: 1800 RPM	Overall foil shielded Cable, such as, Autotech’s CBL-10T22-xxxxx or equivalent. Max: 2500 ft.

3. Installation & Operation

Mini•PLS Front Panel

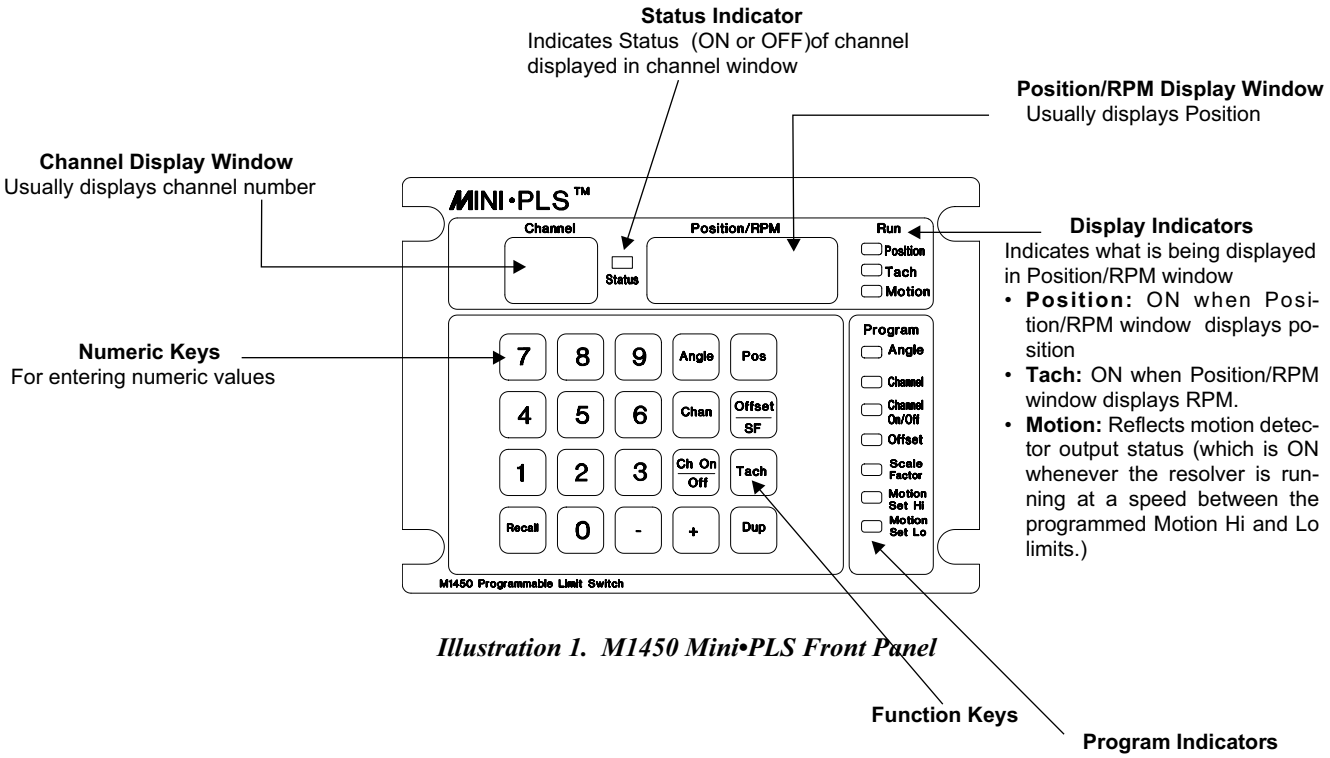


Illustration 1. M1450 Mini•PLS Front Panel

For editing the program:

- **Ang**: Press this key for angle set point entry.
- **Chan**: When pressed, the channel indicator turns on, and the unit is ready for the selection of channel to be programmed.
- **Chan On/Off**: When pressed, it toggles the Channel On/Off indicator.
- **Pos** : Pressing of 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.
- **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. The unit is ready for offset reprogramming. When the key is pressed again without altering the offset, the current scale factor is displayed. The unit is ready for scale factor programming.
- **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 of this key displays the cam setpoint values and their programmed status (i.e., whether programmed on or off) in the status indicator. In Tach mode (Tach indicator on), pressing this key displays Motion Lo and Hi setpoints.
- **Dup:** Used to copy (duplicate) program from one cam to another.

Indicates what is being programmed or edited:

- **Angle**: ON in angle entry mode; angle displayed in Position/RPM mode
- **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 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.

Rear View of Mini•PLS

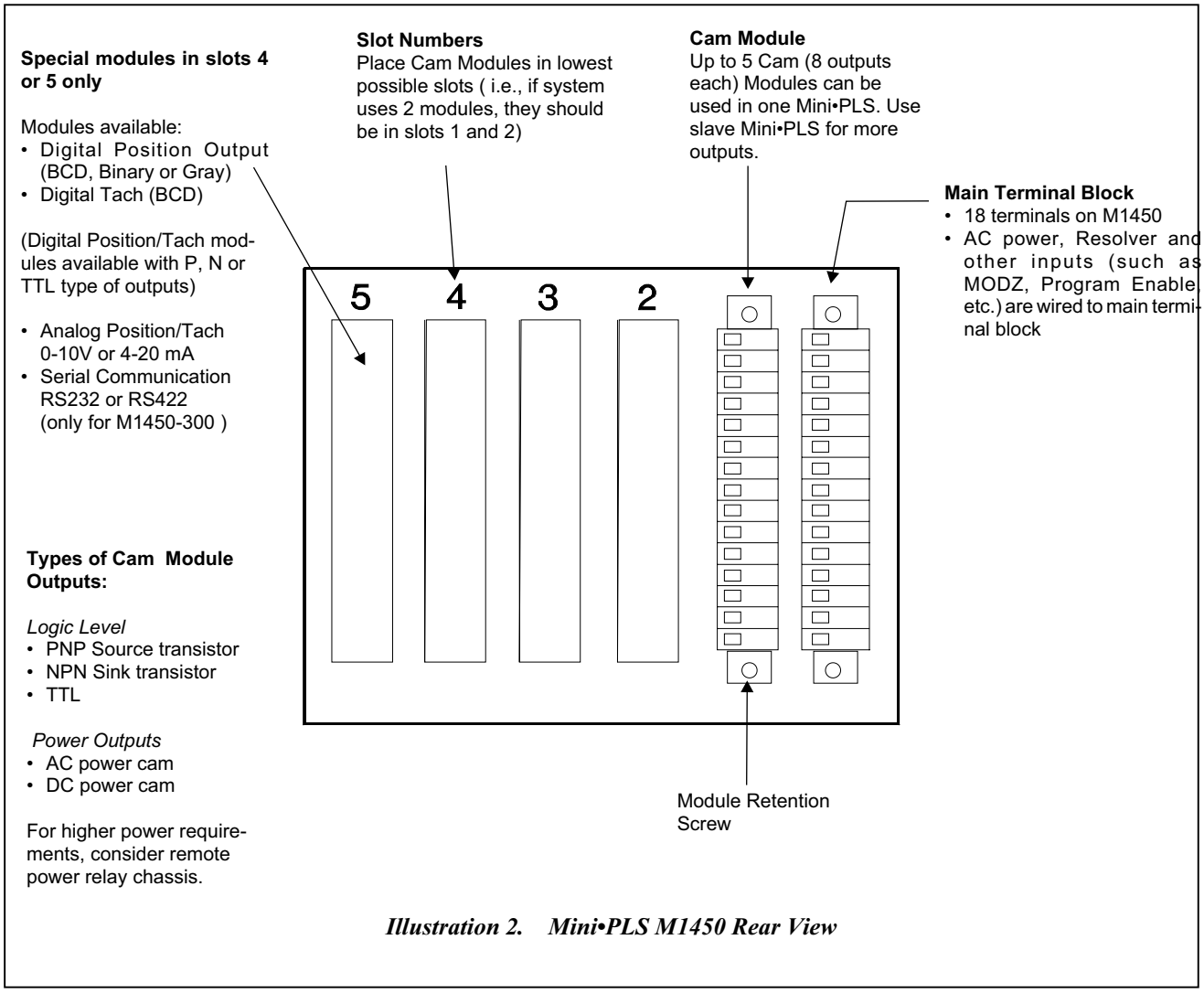


Illustration 2. Mini•PLS M1450 Rear View

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 8 or 16 cam outputs and one motion output relay (total 9 or 17 relays). Further the chassis may be ordered with Electromechanical relays or solid state relays. The chassis has a DB15 connector for connection to an N type of Cam module.

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.

Installation and Wiring

Position Transducer Mounting and Wiring

See the Position Transducer Section of the Autotech catalog for mounting and wiring of the transducer used in your application.

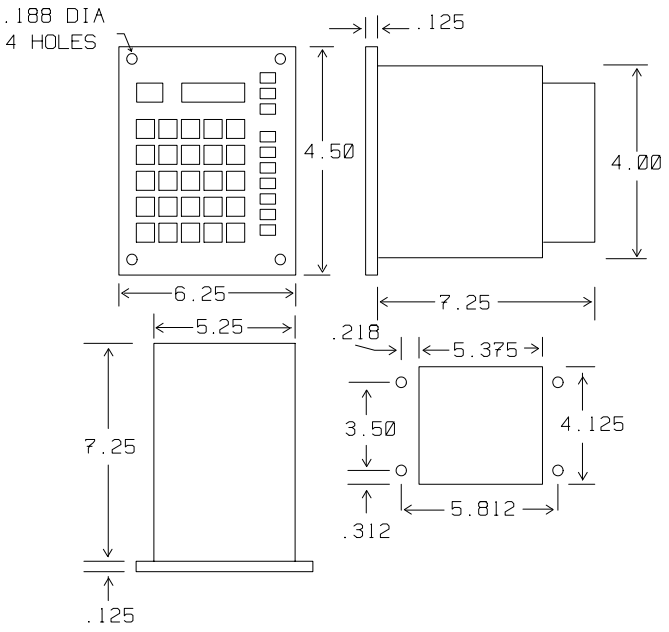
Mini•PLS Mounting

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.

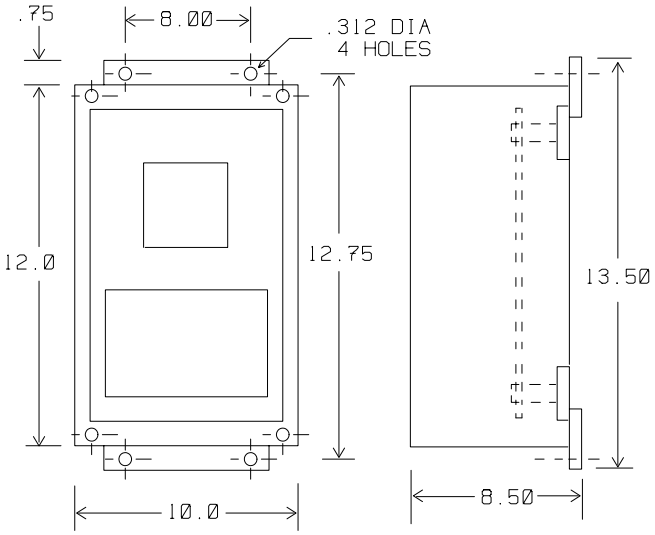
For Back Panel Mounting, the Mini•PLS, together with input terminal block and power relay outputs, is mounted on a back panel mount chassis. Four 0.25" diag. holes (use 10-32 screws) are provided for installation inside the customer's control panel close to the other existing controls.

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 l/4" screws) are also provided. See **Illustration 3** for all mounting dimensions.

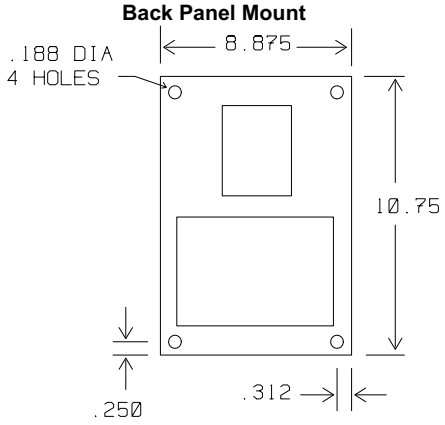
Front Panel Mount



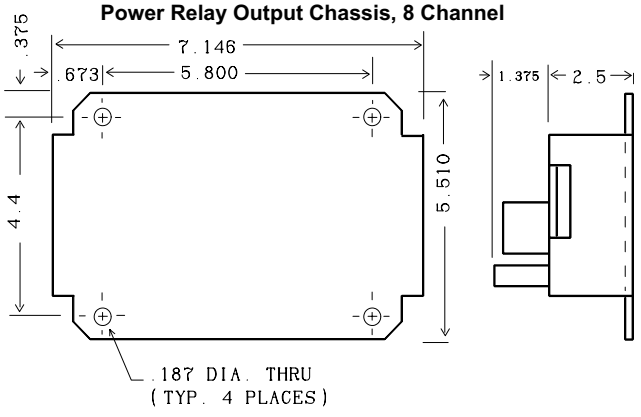
NEMA 12 Enclosure



Back Panel Mount



Power Relay Output Chassis, 8 Channel



Power Relay Output Chassis, 16 Channel

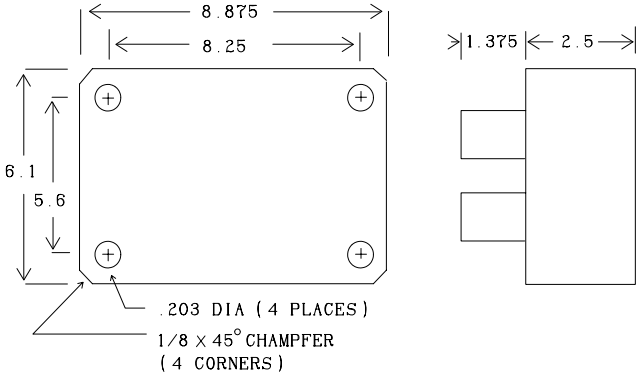


Illustration 3. Dimensions and Mounting Diagrams

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.
- 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.

M1450 Main Terminal Block Wiring

For the wiring of the M1450 Main terminal block, please refer to the following table (listing the terminal labels for different models of M1450 Mini•PLS) and the wiring diagram appropriate to the selected M1450 model. The terminal functions are also discussed below:

- **AC Power Connections**: The 120 VAC input power is connected to L1 & L2 terminals (terminal #1and #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 must be applied to the M1450 for correct operation. Connect +10 to 28 VDC (VS+) to Terminal 6 and the negative reference (VS–) to Terminal 12.
- **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 M1450 programming, switch terminal 5 to customer VS–. Connections can be made through an external key switch, if desired.
- **ModZ Input Wiring:** ModZ inputs are true when connected or switched to customer VS+, false otherwise. Transducer is wired to the M1450 according to the Main terminal wiring table.

☞ **IMPORTANT: If ModZ feature is not used, tie all ModZ inputs to VS+.**

Table 4. M1450 Main Terminal Block Wiring (Input Terminal in Case of Back Panel Mount)

Terminal Number	I/O	M1450-300 M1450-400	M1450-MROF
Green Screw		GND	GND
1	I	L1	L1
2	I	L2	L2
3		NC	NC
4	O	Motion	Motion
5	I	Program Enable	Program Enable
6	I	Cust Vs+	Cust Vs+
7	I	ModZ A	NC
8	I	ModZ B	NC
9	I	ModZ C	NC
10	I	ModZ D	NC
11	I	ModZ E/Preset	NC
12	I	Cust Vs-	Cust Vs-
13	I	Resolver S4	Resolver S4
14	I	Resolver S3	Resolver S3
15	I	Resolver S2	Resolver S2
16	I	Resolver S1	Resolver S1
17	O	Resolver R2	Resolver R2
18	O	Resolver R1	Resolver R1

I: Input Terminal; **O**: Output Terminal; **NC**: Not connected

M1450 Slave Units

Each Mini•PLS model has the capacity for up to 40 channels. If more than 40 channels are required, the M1450 units may be used in a master-slave configuration sharing the same position transducer. **By using a slave unit, the capacity expands up to 320 channels by wiring one master and seven slave units in parallel.** These 8 units may be any combination of M1450 units, provided they can use the same position transducer, as that is used by the Master.

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

Illustration 4. Main Terminal Block (Input Terminal in Case of Back Panel Mount)
Wiring for the Master and the Slave Units for the Models
M1450-300, M1450-400 and M1450-MROF

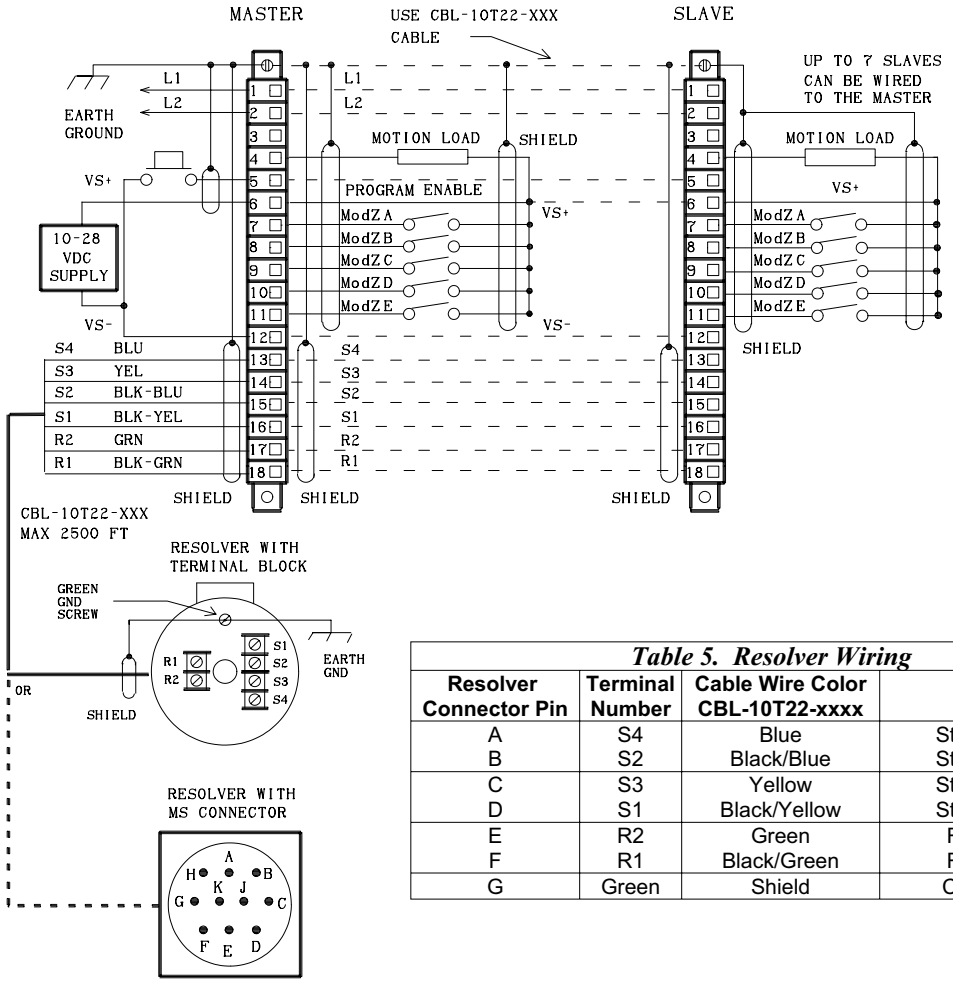


Table 5. Resolver Wiring

Resolver Connector Pin	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	Shield	Case Ground

Notes :

1. The Slave M1450 is different than the Master M1450 unit. Wiring to the slave unit is shown by dashed lines.
2. For a stand-alone M1450 unit (that is without slave), follow the wiring of the master main terminal block.
3. On M1450-MROF unit, the ModZ feature is not available, and the ModZ inputs are disabled.
4. Up to 7 units may be slaved to a master, and master and slave units may be any combination of the units mentioned above.

Cam Module Wiring

The Mini•PLS M1450 Cam Module has a 15-position main terminal block (ASY-M1250-8TI, -8PI, -8NI). This module is replacement for ASY-M1250-08TI, -08PI, and -08NI.

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 **Table 7**.

☞ **IMPORTANT NOTE.**
Note that these modules are optically isolated. Power & sig ref must be connected on all modules.

Multiple Program Selection/Output Enable
The storage of programmed setpoints 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 (pin 3). The output enable pin does not affect cam outputs when jumper J1 is installed on the cam module (see **Illustration 6**). When J1 is cut this pin may be used as follows:

- **TTL Cam Modules:** For multiple program selection use a multiplexing/tristating input at pin 4 of the Cam Module. Multiplex input is low active TTL level input.

- **PNP and NPN Cam Modules:** For multiple program selection wire pin #13 to Sig Ref through the selector switch as per **Illustration 6**.

Write Protect
As shown in **Illustration 6**, 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.

Table 6. Number of Channels per Module

Module in Slot #	Channels
1	1–8
2	9–16
3	17–24
4	14–32
5	32–40

Table 7. 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) (connect on all modules)

NC: Not connected

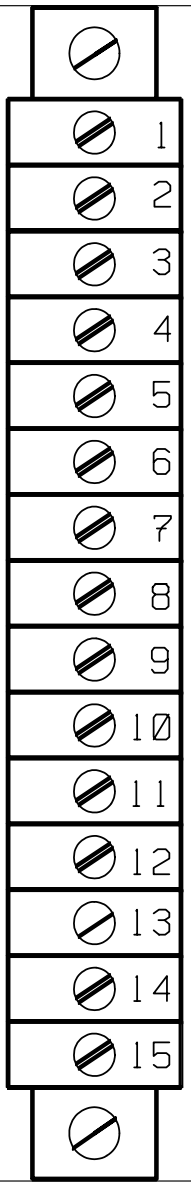
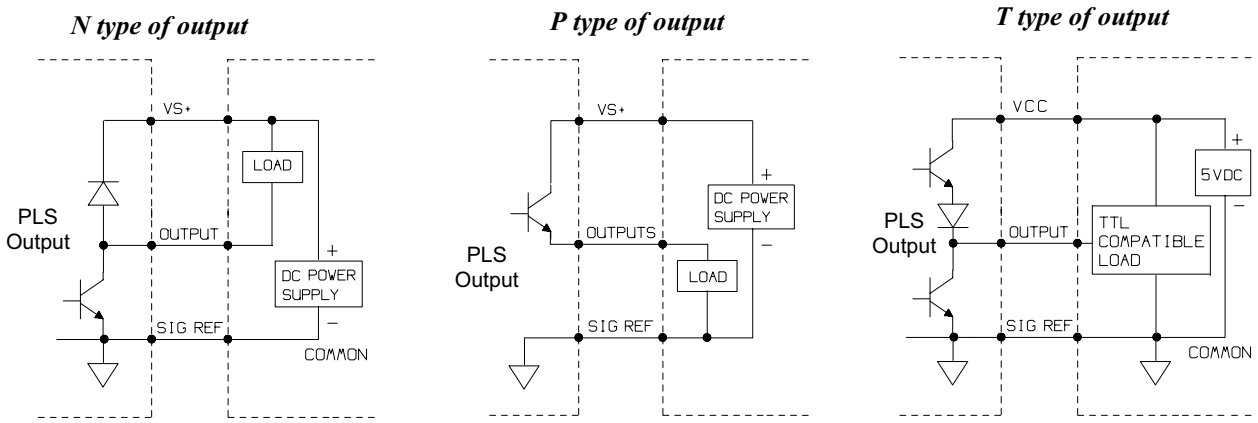


Illustration 5. Output Configurations and Load Wiring



AC Power Cam Wiring

AC and DC power cam use a quick disconnect terminal block for wiring to the module. **Illustration 7** identifies the terminal on the AC and DC power cams, and shows wiring a typical output.

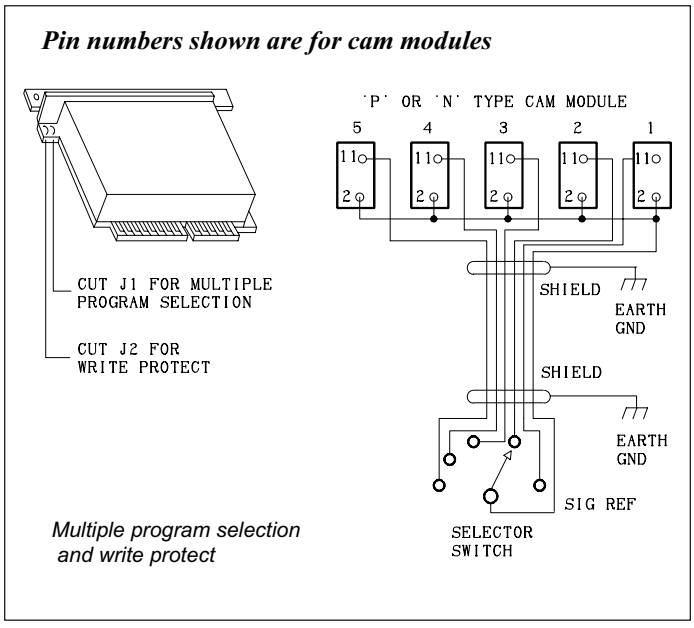


Illustration 6. Cam Module Wiring

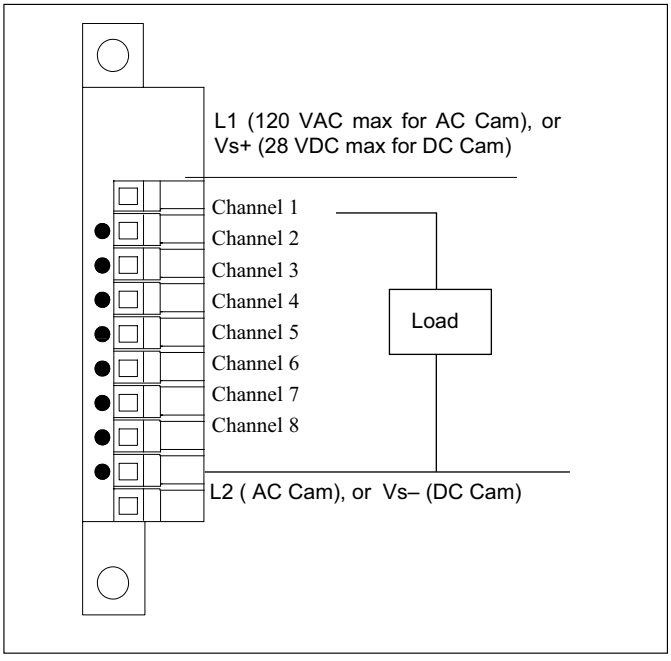
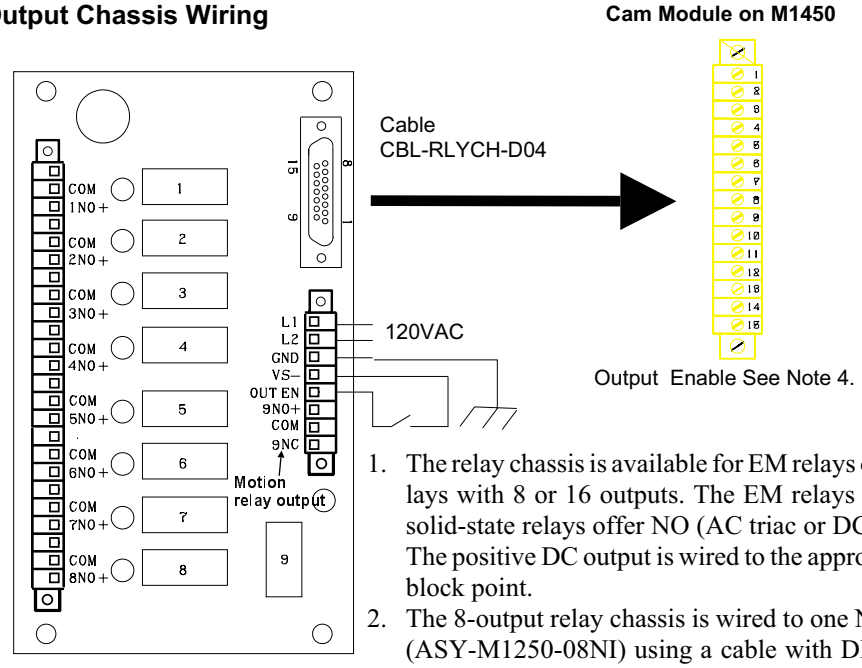


Illustration 7. AC and DC Cam Output Wiring

Remote Power Relay Output Chassis Wiring



Relay Outputs

NC: Normally Closed
NO: Normally Open
COM: Common

Illustration 8. Eight Outputs Relay Chassis

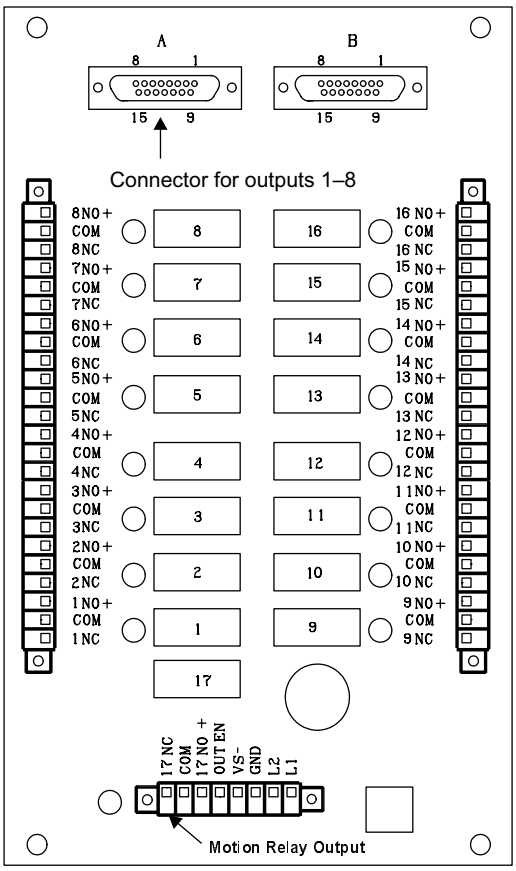


Illustration 9. Sixteen Output Relay Chassis

1. The relay chassis is available for EM relays or for solid-state relays with 8 or 16 outputs. The EM relays provide NO, while solid-state relays offer NO (AC triac or DC transistor) output. The positive DC output is wired to the appropriate NO terminal block point.
2. The 8-output relay chassis is wired to one N-type cam module (ASY-M1250-08NI) using a cable with DB-15 male connectors on one end, such as Autotech's CBL-RLYCH-D04. The 16-output relay chassis requires two cam modules and two cables.
3. **Motion Output**: Terminal #6 on the main terminal block of the M1450 must be connected to Pin #4 of Connector A, along with a jumper from Terminal #4 of the Main Terminal block to Terminal #14 of one cam module. The Motion relay on the eight channel chassis is relay #9; on the sixteen channel chassis the motion relay is #17.
4. **DC power**: The relay chassis provides DC power to the connected Cam module. The power is available on the terminal block of the cam module. This power may be used to power the main terminal block of M1450.
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 the 16 channel relay chassis, the output enable input is common to both connected cam modules.

Table 8. DB15 Connector Pins and Functions (CBL-15S22-DAxxx and CBL-RLCH-D04)

Pin#	Cable Color	Connector A	Connector B
1	Black	NC	NC
2	White	Vs- DC Supply Common	
3	Red	Vs+ [1] Unregulated 12 VDC Output	
4	Green	Motion Input	NC
5	Orange	Channel 7	Channel 15
6	Blue	Channel 5	Channel 13
7	White/Black	Channel 3	Channel 11
8	Red/Black	Channel 1	Channel 9
9	Green/Black	VS-	
10	Orange/Black	VS+ [1] Unregulated 12 VDC Output	
11	Blue/Black	[2]Output Enable	NC
12	Black/White	Channel 8	Channel 17
13	Red/White	Channel 6	Channel 14
14	Green/White	Channel 4	Channel 12
15	Blue/White	Channel 2	Channel 10

[1] Unregulated DC output voltage with limited current capability
[2] This Pin is connected to OUT EN terminal and is used by Autotech's Product to enable/disable outputs

Special Modules

Digital Position/Tach Output Modules:

The Digital Position/Tach Modules have a 15 terminal block connector on them. See **Illustration 10** and **Table 8**.
The digital position and Tach modules are available with BCD output formats and the following options:

- P, N or T type of outputs
- with or without a PC synch circuit.

These modules can only be used in slots 4 and/or 5 on the MiniPLS M1450. With more than 3-digit position information, two modules are required—one in slots 4&5 each. Slot 4 will automatically be assigned the lower three digits while slot 5 will have the higher 3 digits. Jumper J2 (the lower of the two jumpers) must be installed on both BCD modules of a **M1450-400** unit in order to keep both modules in synch with each other.

PC Synch Circuit

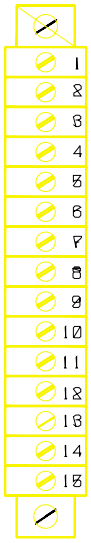
The PC synch option on the BCD modules is useful for programmable devices such as PC, which "read" the module. The reading device sends a data transfer signal to the module, and PC synch option then assures that data changes only between 30 µs to 100 µs after the receipt of a rising or falling edge on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

The communication modules are available for **M1450-300** only. Consult the Autotech Catalog for more module details.



Digital Position/Tach Module Terminal

Modules available with P, N or T type of outputs. See Specifications and How to Order. See Cam module wiring table for typical P, N and T outputs.

Table 9.
Suggested Pin Definitions for Position/Tach Output Modules
Cable : CBL-185S22-Cxxx

Term. #	Wire Color	Function
1	Black (12 gauge)	Sig Ref
2	White (12 gauge)	Vs+
3	Red	Data Transfer
4	Green	Bit 800 (MSB)
5	Orange	Bit 400
6	Blue	Bit 200
7	Yellow	Bit 100
8	Purple	Bit 80
9	Grey	Bit 40
10	White	Bit 20
11	Black	Bit 10
12	White/Brown	Bit 8
13	White/Black	Bit 4
14	White/Green	Bit 2
15	White/Red	Bit 1(LSB)

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

Table 10. Terminal Designation on Remote Power Relay Chassis for Back Panel Mounting					
TB1		**TB2**		**TB3**	
120 VAC	**Motion Detector Relay**	**Terminal Number**	**Function**	**Terminal Number**	**Function**
GND	NO	1	Motion Input	11	+12 VDC Unregulated
L1	COM	2	Signal Reference	12	Signal Reference
L2	NC	3	Channel 1	13	Channel 9
		4	Channel 2	14	Channel 10
		5	Channel 3	15	Channel 11
		6	Channel 4	16	Channel 12
		7	Channel 5	17	Channel 13
		8	Channel 6	18	Channel 14
		9	Channel 7	19	Channel 15
		10	Channel 8	20	Channel 16

Back Panel / Remote Relay Output Chassis:

The remote power relay output chassis is designed to accommodate 16 cam output relays and one motion detector relay. The chassis has a built-in power supply. Models are available for Electromechanical relays, Solid-State AC/DC modules, or 8 EM and 8 SS relays. See How to Order section.

The relay chassis wiring is shown in **Illustration 10**. Terminal Designations are listed in **Table 10**.

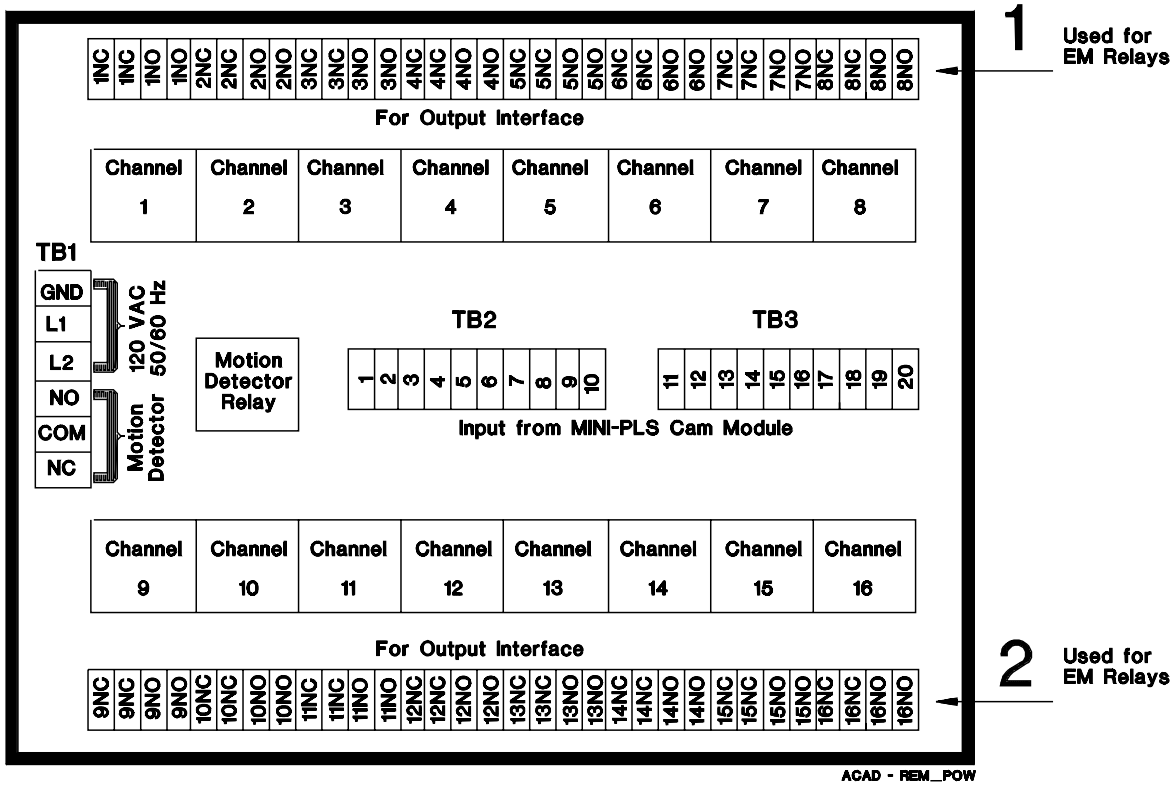


Illustration 10. - Remote Power Relay Output Chassis

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.

Table 11. Module Function Selection

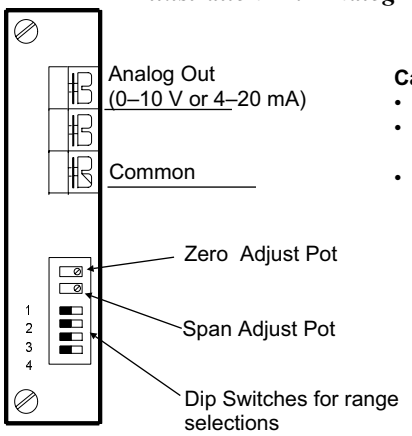
Module Function required	*Switch #4 Position*
Analog Position	ON
Analog Tach	OFF

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 max RPM is within range (e.g., if max RPM=200, SW1=OFF, SW2=ON, SW3=ON)
- For overlapping ranges, any range may be used.

Range	*Switch#1*	*#2*	*#3*
15–33	ON	ON	ON
27–47	OFF	ON	ON
36–75	ON	OFF	ON
60–126	OFF	OFF	ON
106–233	ON	ON	OFF
216–476	OFF	ON	OFF
415–900	ON	OFF	OFF
885–1999	OFF	OFF	OFF

Illustration 11. Analog Position or Tach Module



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.

Back Panel Mount Mini•PLS Wiring

The unit is factory wired and is delivered complete with all the necessary internal wiring. The user is required to wire only the input terminal block and the relay outputs. The diagrams below shows the location of the input terminal block and relay chassis. The input terminal block on units with M1450 is identical to the main terminal block wiring corresponding to the normal M1450 unit (see **Illustration 5** for the input terminal wiring table and wiring diagrams). For M1450 based units, an optional BCD position output module is also available.

NOTE: For BCD output option, please consult the factory.

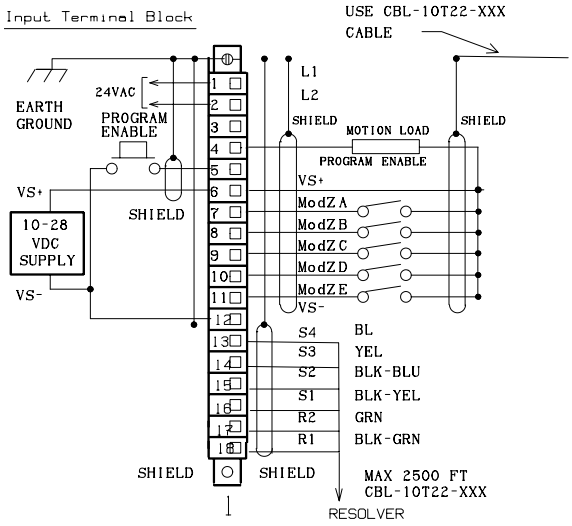


Illustration 12.
Back Panel Mount Wiring

Back Panel Mount M1450

For M1450 Back Panel Mount units, the Input Terminal wiring is same as that of the Main Terminal Block on M1450.

Grounding and Shielding

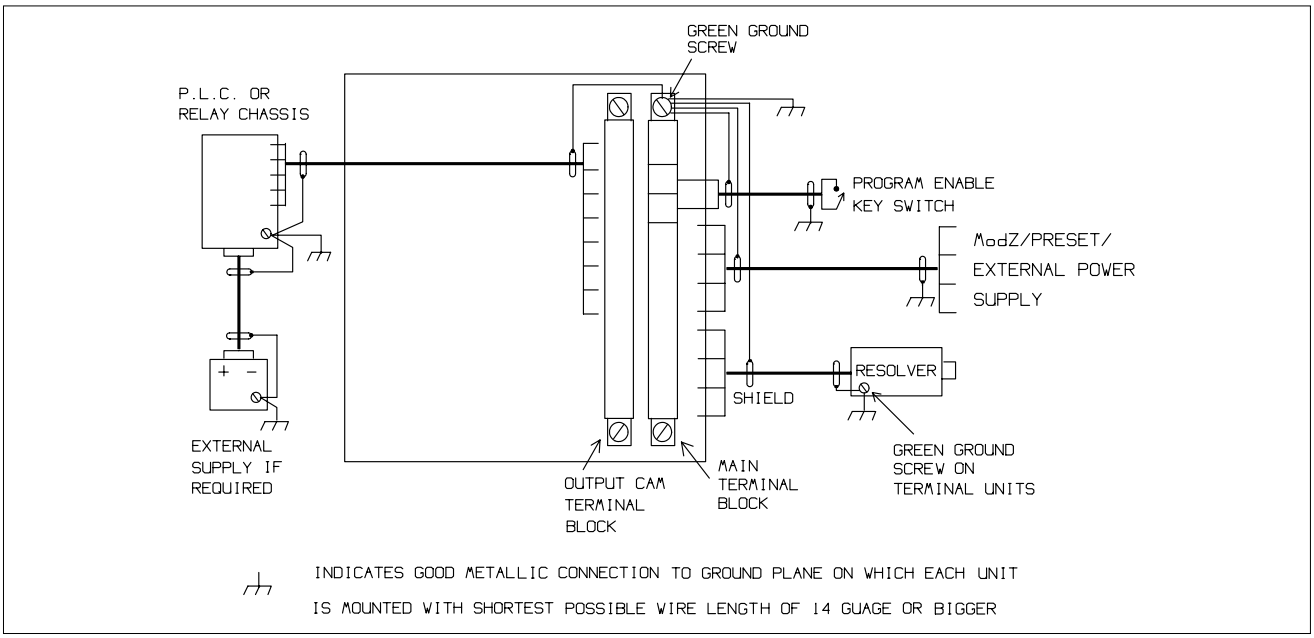


Illustration 13. Grounding and Shielding

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. See How to Order section for a suitable resolver cable offered by Autotech.

   It is recommended that the resolver shielded cable be run in its own **separate** conduit.

3. All ground planes on which 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.

4. Programming Mini•PLS 1450

Each of the Mini•PLS models share the same basic features and, therefore, the same programming methods and key sequences. However, there are a few variations in some cases. Those variations will be pointed out in the following programming steps.

Programming of M1450 Mini•PLS requires entering appropriate values for the following:

- **Scale factor**
- **Offset** or **Preset** (if required)
- **Rate Offset** (if applicable)
- **Motion Detector Limits** (if applicable), and
- **Limit ON/OFF Setpoints**
- **ModZ End Point** (If applicable)

The following are general guidelines for programming M1450 models:

1. **An external power supply** (+10 to 28 VDC) must be applied to terminal 6 (VS+) on the main terminal block.

2. **The Program Enable input must be at low** (connected to Sig Ref) i.e. connect terminal #5 to terminal #12 (VS–) on main terminal block. This connection may be done through a switch.

3. **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. Just follow the appropriate escape sequence (i.e., press the function key you pressed last that caused error to clear the error).

4. **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.

5. 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, use caution when pressing dark keys.

The following section is organized in the progression most often used when programming the M1450. The key sequences required will be described as well as shown pictorially. The graphic key sequence is for quick reference. We recommend that you read the description also.

4.1 Scale Factor Programming

The Scale Factor (SF) determines the resolution of the M1450 and is defined as below:

For all models using resolver as position transducer, **the scale factor is defined to be equal to the desired resolution (counts per turn) *minus one*.** Therefore 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.

In some models you may put a decimal point, just for the purpose of display, at an arbitrary place (that is after any digit) to match the displays with engineering units. The range of scale factors for different models has been given in the specification section and are repeated here for convenience:

Model	Scale Factor Range	Decimal Point Position
M1450-300	16–999	Not applicable
M1450-400	9–4095	Arbitrary
M1450-MROF	16–999	Not applicable

Note that the arbitrary decimal point is displayed only for the convenience, and does not affect any computation.

CAUTION: ***When changing the scale factor, the previously programmed "set points" 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 Channel 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, upon pressing Offset/SF key, the display starts flashing, this indicates an error mode. You might have entered a number beyond the Scale Factor range shown in the above table. To escape the error mode, press Offset/SF key again and repeat steps 1 through 3.

5. If applicable, move the decimal point to the desired position. Please note that the decimal point is only for display and does not affect any other parameters. To move the decimal point, press "+" key to shift it from one position to the other, while the display is in position mode.

6. Go to the next step.

4.2 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, indicating that the Offset entry is not yet terminated.
4. To terminate this step, press Offset/SF key. The Offset Indicator will stop flashing, the M1450 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, indicating 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 increments are entered directly into the memory.
3. Go to the next step.

4.3 Rate Offset (Speed Compensation) Programming

Rate Offset or Speed Compensation in M1450 allows the user to program a position advance that is linearly proportional to shaft RPM. The basic principle of rate offset or speed compensation is the same for all the models of Mini•PLS M1450; the only difference between different models is in the outputs that are affected by Speed Compensation programming. This difference has been pointed out before in the specification table, and is repeated on the next page for the convenience. 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.***

M1450 Model	*Channels affected by rate offset*
M1450-300 M1450-400	Rate offset defined for each cam module; the rate offset affects all 8 channels of the cam module. All 5 cam modules may have different rate offset; therefore, up to 5 different rate offsets are possible.
M1450-MROF	Rate offset defined individually for the 16 channels of cam modules 1 and 2. For cam modules 3, 4, and 5, the rate offset is defined for each cam, affecting all 8 channels of that cam; therefore, 19 different rate offsets are possible.

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 or ModZ 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 "C1" and the Position/RPM window will read "A" (advance) followed by the amount of speed compensation for cam module 1 (M1450-300) or for channel 1 (M1450-MROF).
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 enter the speed compensation into memory.
5. Repeat steps 2, 3, and 4 until finished.
6. Go to next step.

Speed Compensation: Fine-Tune Method

1. Press the CHAN/MODULE key twice. The Channel display window will read "C1" and the Position/RPM window will read "A" followed by the amount of speed compensation for cam module 1 (M1450-300) or for channel 1 (M1450-MROF).
2. If necessary, press Recall key until the channel or cam module number to be fine tuned appears in the Channel window.
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.

4.4 Cam Module Programming

Notes: The status indicator indicates what status (On/Off) now exiting in memory of chosen channel & angle

.

The channel On/Off indicator indicates what status (On/Off) is desired to be placed in memory at chosen channel & angle. The "+" and "–" keys do the actual programming.

The ON and OFF limits of the setpoints need to be programmed for each channel of all the installed cam modules. Each channel may have more than one set point. Different models have different limits on the number of set points per channel. These limits are mentioned in the specifications and are repeated here for convenience:

Models	*Dual Setpoints per Channel*
M1450-300 M1450-MROF	Resolution/2
M1450-400	21

Follow the key sequence described below:

1. Press the CHAN/MODULE key. Select the channel to be programmed by entering the desired channel number. If you try to enter a number for a nonexistent cam location, you will go into the error mode. To escape the error mode, press the CHAN/MODULE key again and enter a new number.
2. Press the Angle key and "0" will appear in the display window.
3. Before entering the new program, you must check what is existing in the memory. This can be done by pressing Recall key and observing the DISPLAY and the Status indicator.
4. **Entering The New Program:**
   The new program can be entered in two ways:
   - Programming from existing setpoints.
   - Erasing (i.e., programming OFF) the existing setpoints and entering the new ones.

   Programming From Existing Setpoints:
   a. Press Recall key, existing setpoint will appear in the display. The Status light indicates "ON" or "OFF" status of setpoints.
   b. Press the CH ON/OFF key to select the programming mode "ON" or "OFF." CHANNEL ON/OFF indicator will show the Status in which setpoints are being programmed.
   c. Press the "+" key to increment or "–" key to decrement the setpoint, until the required setpoint is achieved.
   d. Recall each setpoint to verify the program.
   e. Repeat for all channels and all setpoints.

Programming by Erasing the Existing and Entering the New Setpoints:

a. Erase all the setpoints on the channel to be programmed by pressing Angle key, adjusting Channel ON/OFF indicator to OFF and advancing from "0" through full revolution using "+" key. Now, if you press Recall key, the unit will go in flashing mode indicating that all locations are programmed OFF (status indicator dark). Escape flashing mode by pressing Recall key again.

b. Enter New Setpoints by following steps:

1) Set channel ON/OFF indicator to "ON" by pressing CH ON/OFF key, if necessary.

2) Use the numeric keyboard to enter the angle of the first set point.

3) Press "+" key to advance until you enter the required "dwell".

4) Recall each setpoint to verify the program.

5) Repeat for all channels and all setpoints.

Mini•PLS Model **M1450-400** has *an additional way* to program setpoints by *directly* entering the ON and OFF limits from the key board, as described below:

Add (delete) the new setpoint by performing the following steps:

1. Press Angle Key
2. Enter the "ON" setpoint angle
3. Press Ch On/Off Key until Chan On/Off Indicator **illuminates (darkens for deletion).**
4. Enter the "Off" setpoint angle — Angle Indicator will flash.
5. Press Ch On/Off Key

The unit has created a "dwell" that turns the output **ON (OFF in case of deletion)** when the "ON" set point is reached, and remains ON (OFF) until the "OFF" set point is reached.

If more than 21 dual setpoints are programmed into this channel, the position/RPM display will flash "Full," indicating that this channel has the maximum number of setpoints allowed. Some existing set points must be deleted or merged before any new setpoints may be added to this channel. Now, if you press Recall key, the Position display will indicate the "ON" set point with the Status indicator illuminated; pressing the Recall key again will display the "OFF" set point with the Status indicator dark.

Recall each set point to verify the program Repeat for all channels and all set points.

4.5 Cam Module Duplication Mode

The Mini•PLS provides a unique and easy method of duplication programs between Cam Modules. This duplication capability allows easy nonvolatile storage of several different Cam Modules for fast program changeovers for different production setups, repeating the same program for different Mini•PLSs.'

1. The Cam Module slots are numbered 1 through 5. The first slot is located next to the main terminal block.
2. The ORIGIN slot contains the Cam Module with the "master" program.
3. The COPY slot contains the Cam Module that will receive the "master" program.
4. Power should always be removed when removing or inserting Cam Modules.
5. You can copy the contents of Cam Modules from any slot to any other slot.

The key sequence for module duplication is as follows:

1. Press Dup. The Channel and Position windows will display "0."
2. Enter the ORIGIN slot number. The left hand 0 will be replaced by the origin slot number.
3. Enter the COPY slot number. The right hand 0 will be replaced by the copy slot number. If you make a mistake, just go back to step "2." If there is no cam module installed in ORIGIN or copy slot, the unit will go into error mode. To escape error mode, press Dup key and start over again.
4. Press Dup. The display will read 0 and then rapidly count up to 1023. If the copy is completely correct, the Mini•PLS will exit to the Position mode.
5. In extremely rare instances where the copy is not correct, the Mini•PLS will stop counting at the faulty memory location. An incorrect copy means that the COPY Cam Module is faulty. Replace the faulty Cam Module and start over.

4.6 Motion Detector Programming

1. Press the Tach key. The Position/RPM window will indicate the current shaft RPM and the Tach indicator will be illuminated.
2. To program motion detector setpoints, press Recall key. The display will indicate the current LOW preset. Enter a number between 0 and 1899 for the LOW preset and press Tach key to register it into the memory. If you enter a **LOW** preset higher than the **HIGH** preset, you will get an error mode, that can be cleared by pressing the TACH key.
3. Press Recall key. The display will indicate current HIGH preset. Enter a number between 1 and 1900 for the HIGH preset and press Tach key to register it into the memory. If you enter the HIGH preset lower than the LOW preset, you will get an error mode, which can be cleared by pressing Tach key.
4. While still in Tach mode, you can review the motion detector setpoints by pressing the Recall key. If desired, the HIGH and LOW presets can be adjusted and fine--tuned by using "+" or "–" keys.
5. If you try to enter numbers higher than 1900, they will not be accepted by the unit.

4.7 ModZ Programming

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

Various M1450 models offer different ModZ capabilities to suit needs of different applications. The specification table in the specification section has summarized the number of ModZ channels available in different models.

In general, on M1450 models, a cam has to be enabled before a ModZ trigger can start ModZ cycle. The cams which are **not enabled** for ModZ work as **normal cams**. A Cam is enabled by applying required voltage to appropriate inputs on the main terminal block (as described in the table below), and the trigger is a low to high transition (Customer Vs– to Customer Vs+) on appropriate input. The "H" in the tables to the right indicates customer Vs+ voltage level, and "L" indicates Customer Vs– level.

Please note the following with regard to ModZ functioning:

1. A cam has to be enabled for ModZ before a trigger can start a ModZ cycle for that cam. The outputs from a ModZ enabled cam are OFF except during a ModZ cycle.

2. If a cam is not enabled for ModZ, it will function as a normal cam.

3. The PLS outputs from a cam after the ModZ cycle, are referenced to the Modified Zero, while the outputs from normal cams are always referenced to the normal zero.

4. Every ModZ trigger, for a ModZ enabled cam, starts a new ModZ cycle for that cam.

5. After the initiation of the ModZ cycle, the outputs will keep responding to the transducer position (referenced to Modified Zero) until the ModZ trigger input goes low. See 6 below.

6. Once the ModZ trigger goes low, the ModZ cycle terminates, and the outputs will turn off after completing the rest of the revolution of resolver in case of single turn M1450 models (M1450-300, M1450-400 and M1450-MROF).

The tables given on this page describe the functions of different ModZ inputs, as well as the states of certain inputs to enable/disable cams for ModZ, on different M1450 models.

M1450-300, M1450-400 Models with 3 or less Cams Installed (see para. 4.7, ModZ Programming)

ModZ Terminals Function Description

Terminal Number	Designation on Wiring Diagram	Function
7	ModZ A	Trigger ModZ for CAM 1
8	ModZ B	Trigger ModZ for CAM 2
9	ModZ C	Trigger ModZ for CAM 3
10	ModZ D	Enable/Disable ModZ
11	ModZ E	Enable/Disable ModZ

ModZ Enable/Disable Table

ModZ D	ModZ E	Cams Enabled for ModZ
H	H	None
L	H	Cam Module 1
H	L	Cam Modules 1 and 2
L	L	Cam Modules 1, 2, and 3

M1450-300, M1450-400 Models with 4 or 5 Cams Installed (see para. 4.7, ModZ Programming)

ModZ Terminals Function Description

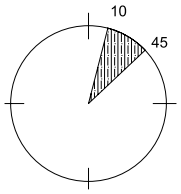
Terminal Number	Designation on Wiring Diagram	Function
7	ModZ A	Trigger ModZ for CAM 1
8	ModZ B	Trigger ModZ for CAM 2
9	ModZ C	Trigger ModZ for CAM 3
10	ModZ D	Trigger ModZ for CAM 4
11	ModZ E	Enable/Disable ModZ

ModZ Enable/Disable Table

ModZ E	Cams Enabled for ModZ
H	None
L	Cam Modules 1, 2, 3, and 4

M1450 Dwell Programming

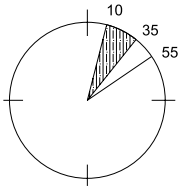
TO ADD ONE DWELL:



Program the PLS to turn ON at 10° and OFF at 45°.

KEYSTROKES:		RESPONSE:
Chan		
1		
Angle		
1	0	
Chan On OFF		Until Chan On/OFF LED is On
+		Repeat until angle = 45
Chan On OFF		Until Chan On/OFF LED is OFF
Recall		Status LED is ON at 10, OFF at 45

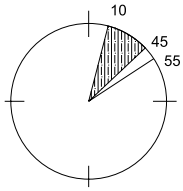
TO SUBTRACT DWELL FROM END OF EXISTING DWELL:



Subtracing dwell from the end of the existing dwell setpoint so that it will be ON at 10° and OFF at 35°.

Chan	
1	
Recall	Until 55 is seen
Chan On OFF	Until Chan On/OFF LED is OFF
-	Repeat until angle = 35
Recall	Status LED is ON at 10 and OFF at 35

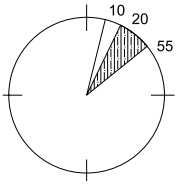
TO ADD DWELL TO END OF EXISTING DWELL:



Adding dwell to the end of the existing dwell setpoint so that it will be on at 10° and off at 55°.

Chan	
1	
Recall	Until 45 is seen
Chan On OFF	Chan On/OFF LED should turn ON
+	Repeat until angle = 55
Chan On OFF	Chan On/OFF LED should turn OFF
Recall	Status LED is ON at 10, OFF at 55

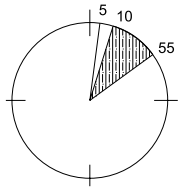
TO SUBTRACT A DWELL FROM FRONT OF EXISTING DWELL:



Subtracting dwell from the front of the existing dwell setpoint so that it will be ON at 20° and OFF at 55°.

Chan	
1	
Recall	Until 10 is seen
Chan On OFF	Chan On/OFF LED should turn ON
+	Repeat until angle = 20
Recall	Status LED is ON at 20 and OFF at 55

TO ADD DWELL TO FRONT OF EXISTING DWELL:



Adding dwell to the front of the exsiting dwell setpoint so that it will be ON at 5° and OFF at 55°.

Chan	
1	
Recall	Until 10 is seen
Chan On OFF	Chan On/Off LED should turn ON
+	Repeat until angle = 5
Chan On OFF	Chan On/OFF LED should turn OFF
Recall	Status LED is ON at 5, OFF at 55

M1450 Troubleshooting Guide

System Problem	Check
Unable to program unit. Parameters (Scale factor, Offset, etc.)	— Customer DC power is correctly wired. (+10 to +28 VDC (VS+) on Term. 6 — Common (VS–) on Term. 12. — Program Enable (Term. 5) is tied to VS– (Term. 12) — Machine must be at rest several parameters (Scale Factor, Offset - numerical entry) are locked out if the resolver is turning faster than 3 RPM. — 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.	— Cam Modules are installed **in order** (i.e., slots 1 & 2 for 2 cams, slots 1, 2, 3, and 4 for 4 cams — Cam Module is **properly seated** in back of unit (not cocked at an angle) — Write Protect jumper on Cam Module is not cut (see page 11) — Ensure cam module wiring is done with shielded cable and is properly routed. — 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 “0.” Use “+” button and plus to scale factor. Then enter dwell. — 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 M1450 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 1000 V with suppressors, such as GE MOV V130L10, across electromechanical relay contacts.

System Problem	Check
Position and Tach readings are incorrect.	— Proper grounding and shielding has been applied. — Resolver is correctly wired: 1) Turn power off to M1450 unit 2) with main terminal block connected to unit, measure with an ohm meter the following: a) Term. 13 to Term. 15 = about 55 ohms b) Term. 14 to Term. 16 = about 55 ohms c) Term. 17 to Term. 18 = about 30 ohms
Mechanical Zero Drifts.	— Resolver cable is properly grounded and shielded. — Mechanical Resolver linkage is not loose. — ModZ inputs are properly configured.

6. 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:*

Follow Autotech position transducer tables for the various Mini•PLS Models. Consult the Position Transducer Section of the Autotech Catalog for How to Order information on these transducers and appropriate accessories.

PLS Model	***Transducer***
SAC-M1450-300	RL100, E6R, E7R, E8R or RL101
SAC-M1450-MROF	Single-turn resolver
SAC-M1450-400	

2. Mini•PLS

2.1 *Select one of the following Single-Turn Rotary PLSs for front panel mounting . Cam modules or power outputs are not included:*

SAC-M1450-300	3-Digit, single-turn, basic unit with ROF and ModZ
SAC-M1450-MROF	Above unit with multiple rate offsets
SAC-M1450-400	4-Digit, single-turn, basic unit
SA2-M1450-xxx	For 220/240 VAC, 50/60 Hz AC power inputs (xxx refers to 300, MROF or 400, respectively)
SS2-M1450-xxx	Slave Unit for M1450 Master Unit (xxx refers to 300, MROF or 400)

3. Output Modules

3.1 Select type and number of logic level output cam modules:

Note: For ASY-M1250-08x<u>x</u>

i = optically isolated output
blank = non-optically isolated output

ASY-M1250-08TI	8 TTL output, cam module with terminal block (Replacement for ASY-M1250-08T)
ASY-M1250-08TD	8 TTL output, cam module with 15 pin sub “D” connector
ASY-M1250-08PI	8 PNP output, cam module with terminal block (Replacement for ASY-M1250-08P)
ASY-M1250-08PD	8 PNP output, cam module with 15 pin sub “D” connector
ASY-M1250-08NI	8 NPN output, cam module with terminal block (Replacement for ASY-M1250-08N)
ASY-M1250-08ND	8 NPN output, cam module with 15 pin sub “D” connector (*Required with remote output chassis*)

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 Output, 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: 1. Maximum two modules from this category may be used in a PLS.
2. The serial modules are supported by M1450-300 Mini•PLS only.

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 0–10 V analog output.
ASY-M1250-SER2	Bi-directional RS232C serial communication module.
ASY-M1250-SER2L	Above Module with long line serial communication.
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)*:

***ASY-RLYCH-08RL**	Chassis for 8 EM-relay outputs with motion detector output and built-in power supply
***ASY-RLYCH-16RL**	Above with 16 EM-relay output
***ASY-RLYCH-08SS**	Above chassis for 8 solid-state relay outputs
***ASY-RLYCH-16SS**	Above chassis for 16 solid-state relay outputs

**For 220 VAC unit, change the "Y" to "2" and for 240 VAC unit, change the "Y" to "4".*

4.2 *Select type and number of output relays:* (required in ASY-RLYCH-xxx relay chassis)

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

4.3 Cable connecting cam modules to relay chassis:

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

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

5.1 *Select appropriate system:*

SAC-MXXXX-XXXX X Mini•PLS system for back panel mounting with cam modules, power output chassis and relays

Type of Mini•PLS. Select the appropriate M1450 model as follows:
1: 3-digit, single-turn rotary PLS model M1450-300
2: 3-digit, single-turn rotary PLS with multiple rate offsets model M1450-MROF
3: 4-digit, single-turn rotary PLS model M1450-400

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
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:
M1450: The M1450 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 M1450
MCP-M1250-011 Cover plate for unoccupied cam module space
ECM-15PIN-M1115 Pin sub "D" male connector

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