AVG Automation

AUTOTECH CONTROLS

UTICOR

M1450-D64/D128
Dual Resolver Mini•PLS
Instruction & Operation Manual

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MAN-M1450-D64
REV 01 12/07/99

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1. Objective

The objective of this manual is to explain the operation, installation, wiring, programming and servicing of the MINI-PLS, Model M1450-D64, D128 Programmable Limit Switch. It is suggested that the user should read these instructions before applying power to the unit. If, after reading the manual, there are any unanswered questions, call the factory. An application engineer will be available to assist you. You may void your warranty if these instructions are not followed.

1.1. The M1450 MINI-PLS

The M1450 MINI-PLS is our second-generation MINI-PLS. The M1450 has all the features of its predecessor, the M1250: compact size, ultra-high speed, transportable EEROM Cam Modules, built-in tachometer and motion detector, and a user-friendly keyboard for programming and fine-tuning even while the controlled machine is in motion. Depending upon the specific model, the M1450 family has advanced features such as automatic, programmable speed compensation; instantaneous MODZ™ operation for synchronizing its cam outputs to the manufacturing process, and intelligent communication to programmable controllers including Allen-Bradley's Data Highway. The M1450 family can interface to single-turn resolver, dual geared resolver and also directly to linear, sonic transducers. Thus, high accuracy linear applications can now take advantage of the MINI-PLS's easy programming to minimize down time for new setups.

MOD Z (or MODification Zero) is a function that will allow the user to provide a control signal that re-zeroes the position "on-the-fly" at any time for a particular cam module's eight outputs.

Speed compensation is a function that will advance each cam module's control position by a user-defined amount proportional to resolver shaft rpm.

Note: Mod Z™, Auto-Zero™ and ROF™ are trademarks of Autotech Corporation.

1.2. Principle of Operation

The MINI-PLS consists of two parts; one being a geared rotary position transducer mounted on the machine; and the other a programmable unit, mounted in the machine control panel. The position transducer produces a position signal that is converted to a digital format by electronics in the programmable unit, displayed on the front panel and compared to the dwell set points programmed into the PLS. When the process cycle reaches these set points, outputs are turned on or off, starting or stopping desired operations during the cycle.

2. Functional Description

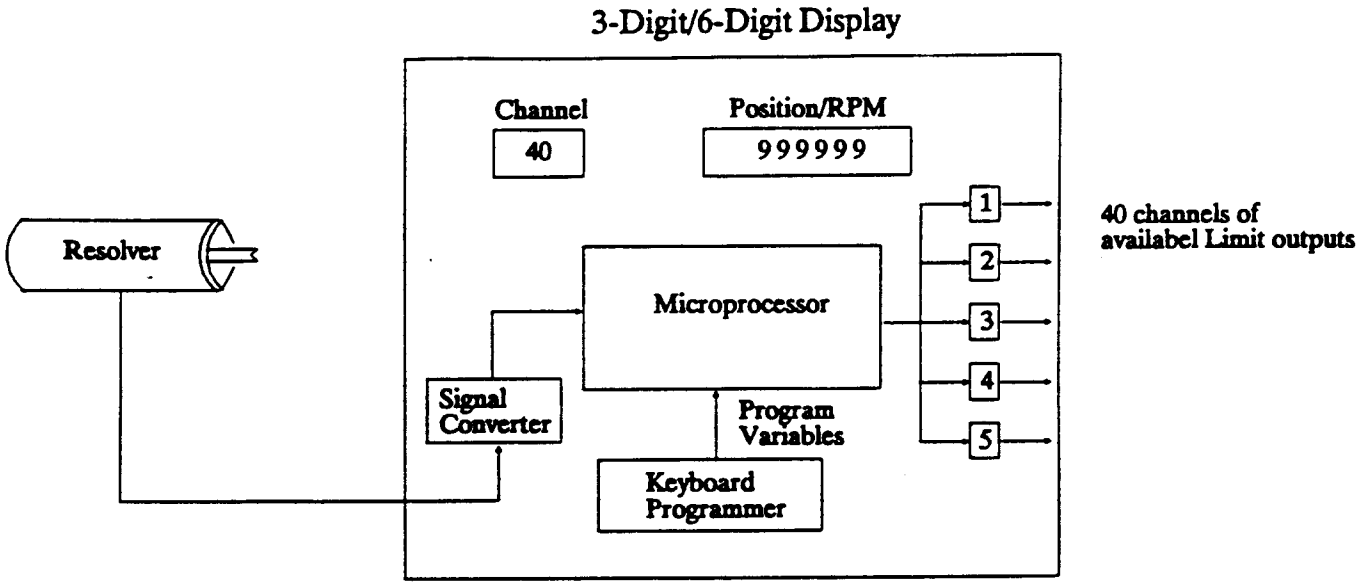
2.1. The M1450-D64

This is an absolute-position programmable limit switch that uses a dual geared resolver of 64:1 ratio as an input and has a maximum resolution of 4096 parts in a single revolution. Maximum achievable position is 262,143. One MODZ input is provided

that allows the MODZ function on cam module 1. Speed compensation programming is provided for all cam modules installed.

2.2. The M1450-D128

This is the same as the SAC-M1450-D64 except that it supports a dual geared resolver of 128:1 ratio as an input and has a maximum achievable position of 524,287.



5 output modules with 8 channels each. (open collector)

2.3. Front Panel Indicators and Controls

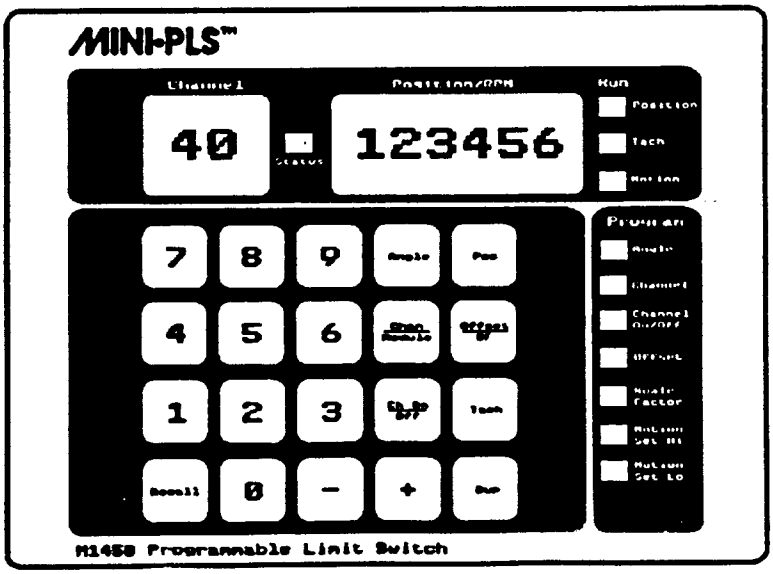


Diagram 1: Front Panel Layout

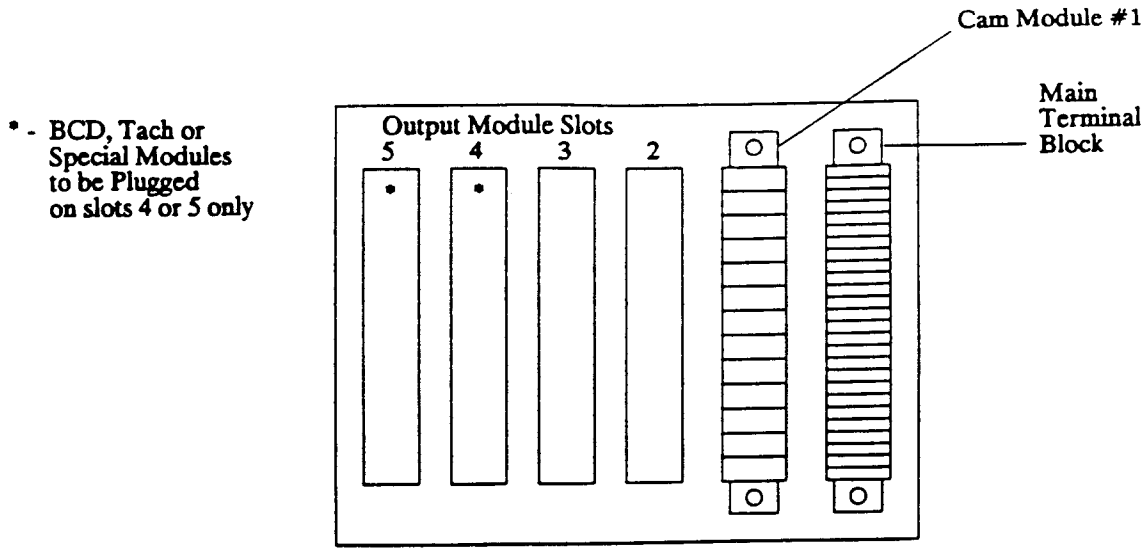


Diagram 2: MINI-PLS Rear View

2.3.1 Display Windows

Channel Display - Indicates channel number when in position, channel or angle modes. In Duplication mode, the left digit indicates the origin slot. Indication in other modes depends on model. Please see programming instructions.

Position/RPM Display - Upon pressing the appropriate keys, it indicates shaft position (counts), shaft rotation speed (RPM), scale factor, offset, dwell set points, amount of speed compensation and motion set points.

2.3.2 Run Mode Indicator Lights

Position Indicator Led - Illuminates in position mode. Position/RPM Display indicates shaft position in units defined by Scale Factor.

Tach Indicator Led - Illuminates in tachometer mode. Position/RPM Display indicates shaft rotation speed in RPM in tachometer mode or motion detector set points during motion detector programming mode.

Motion Indicator Led - Reflects Motion Detector output status. Illuminates when input shaft is rotating between the present minimum and maximum speeds.

Status Indicator - Illuminates when the numbers displayed in the Channel Display and Position/RPM display are programmed "ON". Used only in Position, Angle, Channel and Recall modes.

2.3.3 Program Mode Indicator Lights

Angle Indicator Led - Illuminates when in Angle entry mode. The angle to be programmed is displayed in the Position/RPM window.

Channel Indicator Led - Illuminates when in channel entry mode. The channel to be programmed is displayed in the **Channel** window.

Channel On/off Indicator Led - Illuminates when the Channel to be programmed is to be programmed "ON". This is active only when in **Angle** or **Channel** program mode.

Offset Indicator Led - Illuminates when in offset display or programming mode. Offset is displayed in the Position/RPM window.

Scale Factor Indicator Led - Illuminates when in scale factor display or programming mode. Scale factor is displayed in the Position/RPM window.

Motion Set Hi Indicator Led - Illuminates when in Motion Detector high preset limit display or programming mode. The set point is displayed in the Position/RPM window.

Motion Set Lo Indicator Led - Illuminates when in motion detector low preset limit display or programming mode. The set point is displayed in the Position/RPM window.

2.3.4 Keyboard

Angle Key - When the Angle key is pressed, the digit "O" appears in the display window and the unit is ready to accept other Angle entry.

Chan/Module Key - When the Chan/Module key is first pressed, the channel light goes "ON" and the unit is ready for selection of channel to be programmed. Successively pressing the **Chan/Module Key** can select other programming or display modes. See programming instructions for the particular model of interest.

Ch On/Off Key - Repeatedly pressing the Ch On/Off key alternates "ON" and "OFF" programming of the displayed channel-angle combination.

Pos Key - Pressing the Pos key displays the current transducer position including offset in the Position/RPM window and the most recent channel selected for programming in the **Channel** window.

Offset/SF Key - When the Offset/SF key is first pressed, the display flashes the "resolver offset" and then indicates the last programmed "machine offset". The unit is now ready for offset reprogramming. Pressing Offset/SF key a second time without altering the offset, the display indicates the current scale factor. The unit is now ready for scale factor reprogramming.

Tach Key - Pressing the Tach key displays current shaft speed (RPM) in the Position/RPM window. Pressing Recall while in tachometer mode allows the motion detector set points to be viewed or altered.

"+" and "-" Keys - Pressing these keys in various programming modes, increments or decrements the current numerical value. See programming instructions for the model of interest.

Recall Key - In the Angle mode, pressing Recall key displays the "cam" set points and their status. In other modes, pressing Recall can display the parameters desired. See programming instructions for the model of interest.

Dup Key - Used to copy the program from one Cam Module to another.

Number Keys (0-9) - Used in entering the parameters to be programmed.

2.3.5 Back Panel

Main Terminal Block - The main terminal block is the first one on the right hand side when looking at the back panel. The removable terminal block is plugged directly onto the PC-board connector and is shipped with the basic standard unit. The 120V AC input power, transducer input, program enable/disable input, MODZ inputs and motion detector/direction output are connected to the main terminal block as shown in Figures 4, 5 and 6. Care must be taken that the terminal block is correctly plugged onto the PC-board, i.e., 120V AC input power terminals must be at the top of the connector.

Note: AC line power and CUSTOMER power must both be turned OFF before field connectors are connected or disconnected from the M1450.

Cam Modules - The cam modules are the output modules inserted in the slots at the back of the unit. The programmed set points are stored in the Cam Modules in EEROM memory and retain information even when removed from the unit. Each Cam Module has 8 channels and a maximum of 5 Cam Modules can be installed, giving a total of 40 channels. The M1450 provides keyed connectors and chassis card guides to help prevent improper insertion. However, use care when inserting Cam Modules. Ensure that the Cam Module is straight, inserted in the card guides, and perpendicular to the chassis, otherwise internal components or modules may be damaged. The slot for Cam Module 1 is located next to the main terminal block. Cam Modules must be inserted IN ORDER (a system using only two cam modules must have the modules in slots l and 2, etc.) in up to five slots for normal operation. Touching the contact tips by hand should be avoided and power must be switched off while inserting/removing the Cam Modules.

Parallel BCD Position Output Module - The parallel BCD position output module can be inserted in slot 4 or 5 and is available with or without PC-handshake circuit to interface to programmable controllers or other remote devices, or displays.

Parallel Binary Position Output Module - The parallel binary position output module can be inserted in slot 4 or 5 and not available with the PC-handshake circuit.

Parallel Gray Code Position Output Module - The parallel gray code position output module can be inserted in slot 4 or 5 and is not available with the PC-handshake circuit.

Parallel Tach Output Modules-Analog or Digital - The analog or digital tach output modules can be inserted in slot 4 or 5. The digital tach module is available with or without PC-handshake circuit to interface to programmable controllers or other external devices, or displays.

2.3.6 Remote Power Relay Output Chassis

The remote power relay output chassis is designed to accommodate 16 cam output relays and 1 motion detector relay. The chassis has built-in power supply and is available in models for Electromechanical relays, or Solid state AC/DC modules for 8 EM and 8 SS relays.

2.3.7 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.

3. Specifications

Input Power: ..... 105-135V AC, 50/60 Hz,
35W exclusive of load
(optional 220V AC)

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

Position Inducer: ..... Autotech's series RL210 for both models

System Resolution: ..... 4096 counts per turn for both models

Scale Factor: ..... Programmable, 9 to 4095 for both models

Offset: ..... Programmable, "0" to full scale

Maximum Cable Length Between

Resolver And M1450: ..... 2500 Ft. shielded

Resolver Cable: CBL-RL210-MXXXX

Maximum Resolver Shaft Speed: ..... 3600 RPM

Resolver-to-digital Decoder Tracking Speed: ..... 1800 RPM

Maximum # Of Dual Set Points: ..... 21 per channel for both models

Cam Modules: ..... Compatible with M1250 Cam Modules

Microprocessor Scan Time For Complete System Execution:

"Cam Modules" Plugged-In	1	2	3	4	5
M1450-D64 Scan Time (M-Sec)	1.3	1.7	2.1	2.4	2.7
M1450-D128 Scan Time (M-Sec.)	1.3	1.7	2.1	2.4	2.7

Note: Above Scan Times Are Approximate

3.0.1 Outputs

Number Of Programmable Output Channels: 40 (5 modules with 8 channels each).

3.0.2 Types Of Outputs Available on Cam Modules

Logic Level Options:

T: TRI STATE TTL (74LS645)

Logic l: 2V @ 15mA 2.4V @3mA

Logic 0: 0.35V @ 24mA

Offstate 0: 0.4mA

Offstate l: 20 micro-amp

Multiplexing Input: TTL sinking

Logic 0: 0-0.8V DC

Logic l: 2-5V DC

P: Source Transistor, Vmax = 50V (Sprague UDN-2981A)

Logic l: (Cust. VCC -1.7V) @ 100mA

Logic 0: 0.2mA leakage @ 50V

N: Sink Transistor, Vmax = 50V (Sprague ULN-2803A)

Logic 0: l.lV max. @ 100mA

Logic l: 0.lmA leakage @ 50V

3.0.3 Power Outputs

Electromechanical or solid-state relay outputs are mounted on a separate chassis with built-in power supply.

Power Output Chassis Specifications:

Type Of "Cam Module" To Drive Power Outputs:

"N" (as described in 3.0.2 above)

Maximum Number Of Outputs Per Chassis: 16

Type Of Chassis:

RL: Chassis for 16 EM-relay outputs

SS: Chassis for 16 solid-state outputs

RS: Chassis for 8 EM and 8SS outputs

3.0.4 Type Of Output Relays

RL: Electromechanical relay with 1 NO and 1 NC contact rated at 10amp, resistive load at 125V AC

AC: Solid-state AC module, 20-135V AC, 3amp maximum load with 14 AWG wire connected

DC: Solid-state DC module, 3-40V DC, 2amp maximum load with 14 AWG wire connected

AC/DC: Low leakage AC/DC solid state module, 135V AC (r.m.s) @ 0.35 amp or 190V DC (max) @ 0.5 amp

3.0.5 Parallel BCD, Binary, and Gray Code Position Modules

Digital Output Interface: TTL, PNP or NPN as described in a. above

Data Transfer Command (Available for BCD Position Module only): 0 to 24 Volt logic input

Logic 0: 0 to 0.8V @ 3.2mA

Logic l: 2.4V @0.4mA

3.0.6 Parallel Tach Output Modules

Types of Modules: Analog or Digital BCD code

Module Update Rate: 58 mSec. typical

Full Scale Range: 0-1000 RPM

Analog Tach Outputs: 100 RPM/Volt for 0 to + 10V DC ("0" Volt = "0" RPM) and 100 RPM/1.6mA for 4 to 20mA (4mA = "0" RPM)

Digital Tach Output: TTL, PNP, or NPN as described in paragraph (3.0.2) above

Data Transfer Command: 0 to 24 Volt logic input

Logic 0: 0 to 0.8V @ 3.2mA

Logic 1: 2.4V @ 0.4mA

3.0.7 Motion Detector

Low Set point: up to 1899 RPM (max)

High Setpoint: up to 1900 RPM (max)

Output: NPN sinking, 30V DC maximum at 100mA

(referenced to Customer power supply)

3.0.8 Program Enable/Disable Input

Contact closure to Customer power supply reference enables programming. Solid-state switches should maintain 0.8V max. @ 10ma. to enable programming.

3.0.9 MODZ Inputs

Contact closure to Customer positive power supply is a 'true' input. Solid-state switches should maintain at least 10 but not more than 28V.

Logic 0: 4V DC @1mA

Logic 1: 10V DC @10mA to 28V DC @30mA

4. Installation and Wiring

4.1. Position Transducer Mounting and Wiring

See the Instruction Manual for the position transducer used in your particular applications.

4.2. MINI-PLS Mounting

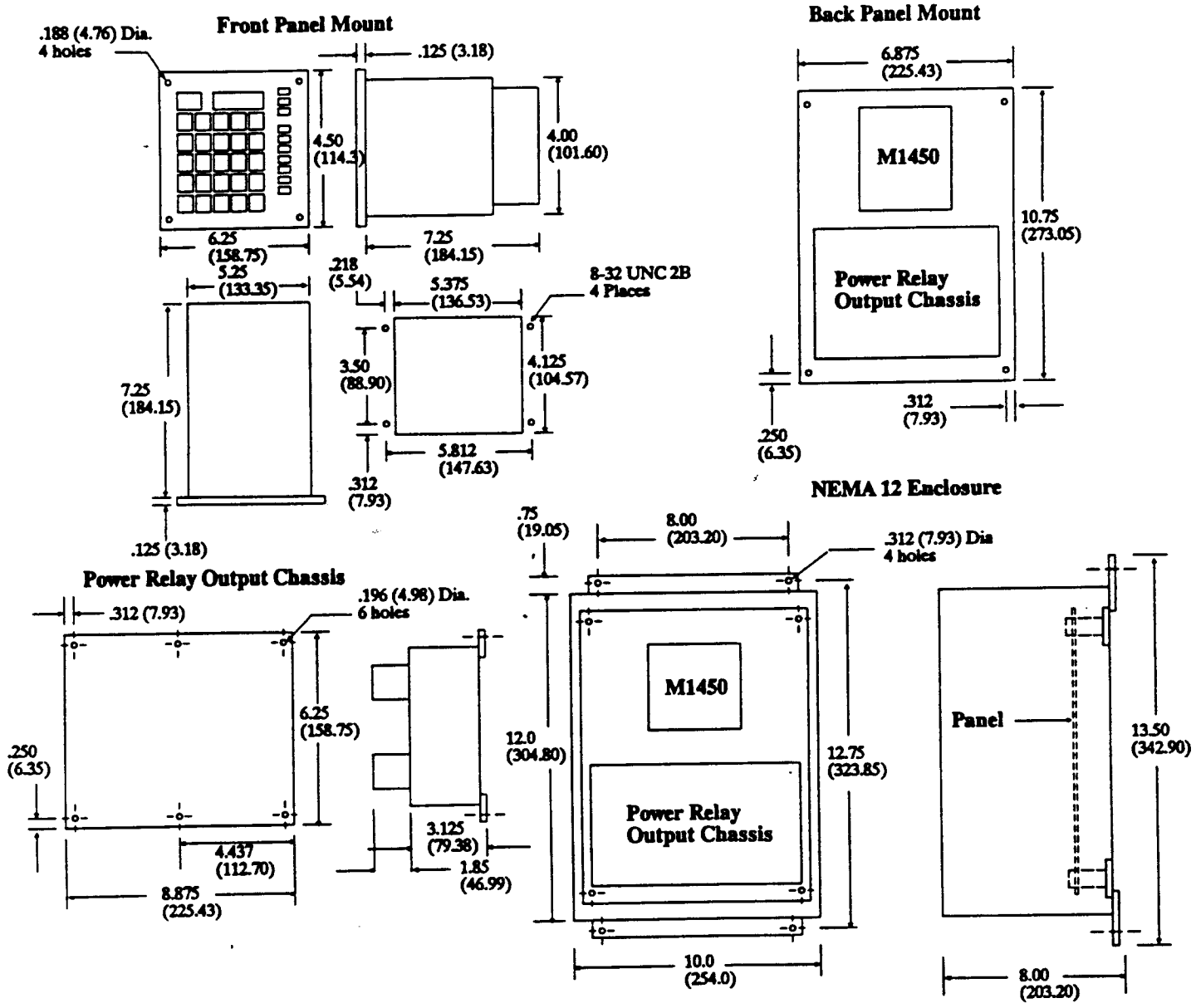


Diagram 3: Outline Dimension inches (mm)

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 mounts chassis. Four 0.25" dia. 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.

4.3. MINI-PLS Wiring

1) No special tools are required for wiring input or output devices to the MINI-PLS. Sems clamp screws eliminate need for wire lugs.
2) Follow shielding and grounding techniques as shown in diagram in the last section of this manual.
3) The 120V AC input power neutral must be connected to terminal L2 and earth ground must be properly connected to the GND screw.
4) When the MINI-PLS is mounted in an enclosure or a control panel, use separate conduit entrances for low voltage and 120V AC wiring.
5) **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.

4.3.1 Main Terminal Block Wiring

Reference Diagram 4.

AC Power Connections - The 120V AC input power is connected to L1 & L2 terminals, 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 28V DC (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 30V @ 100mA maximum. The output turns on when the shaft RPM is within the LOW and HIGH motion limit settings.

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.

Transducer and Modz Input Wiring - Modz inputs are true when connected or switched to customer VS+, false otherwise.

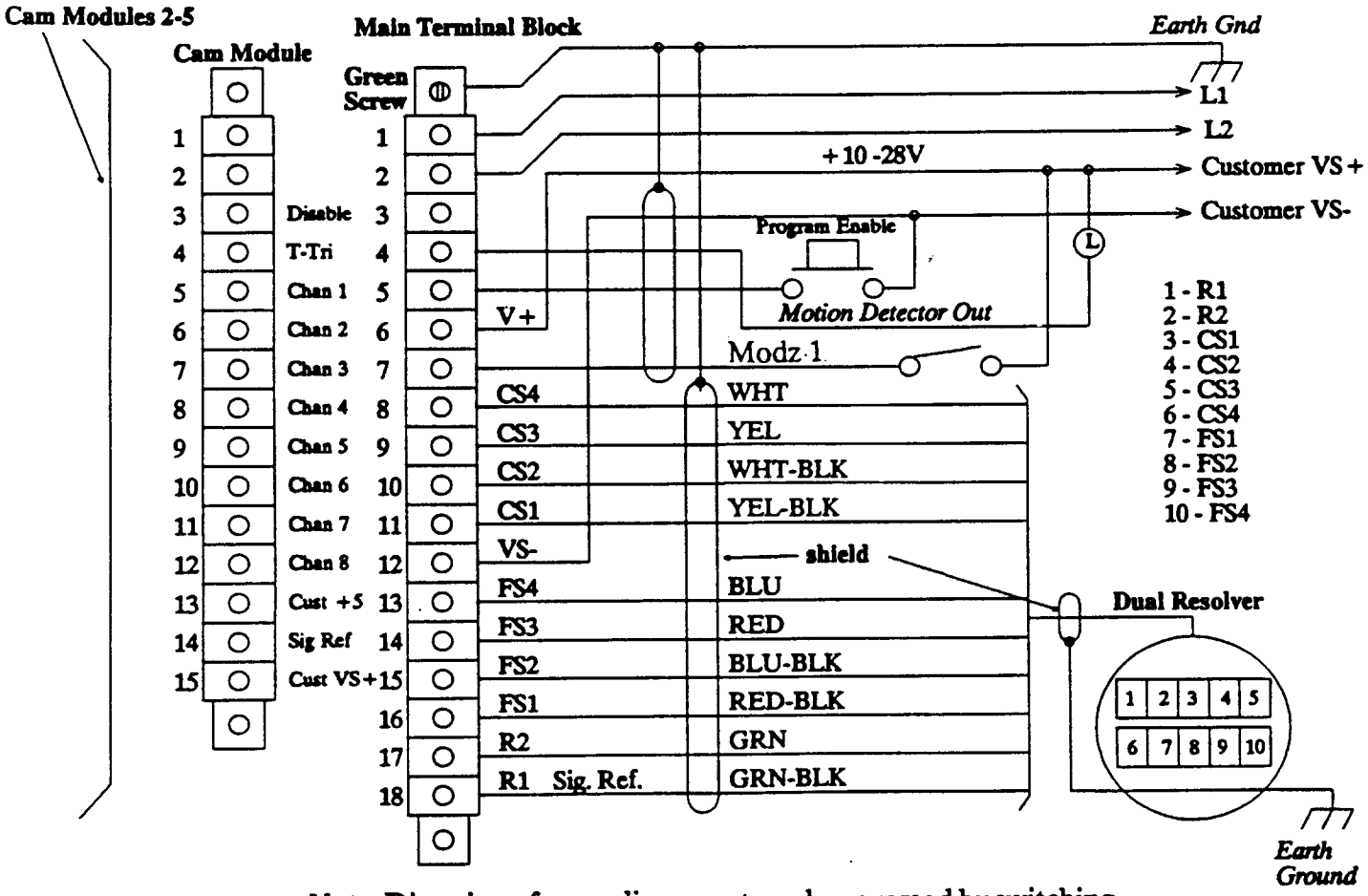
Note: If Mod Z feature is not used, tie all Mod Z inputs to VS+.

The M1450-D64 and D128 are connected as follows (Diagram 4):

Terminal 7 --- Modz 1 input
Terminal 8 --- Coarse Resolver S4 input
Terminal 9 --- Coarse Resolver S3 input
Terminal 10 -- Coarse Resolver S2 input
Terminal 11 -- Coarse Resolver S1 input
Terminal 13 -- Fine Resolver S4 input
Terminal 14 -- Fine Resolver S3 input
Terminal 15 -- Fine Resolver S2 input
Terminal 16 -- Fine Resolver S1 input
Terminal 17 -- Resolver R2 output (RH)
Terminal 18 -- Resolver R1 output (RL)

Note: See last page of this manual for grounding and shielding

1) Cams must be inserted in order 1 thru 5
2) BCD, Tach or other optional modules must be in slots 4 or 5
3) **Caution:** Turn power off while plugging or unplugging modules
4) Consult instruction manual for wiring other types of modules
5) Wire terminals marked (T) for TTL module only (P) for sourcing module and (N) for sinking module only



Note: Direction of ascending count can be reversed by switching S1 & S3 connections.

Diagram 4: Main Terminal Block Wiring

4.3.2 Slave MINI-PLS Multiturn Resolver Models

The master MINI PLS, Model 1450-D64 or -D128 has capacity for up to 40 channels. However, in case more than 40 channels may be required, the M1450-D64 or -D128 can be expanded up to 320 channels by wiring one (1) master and (7) slave units in parallel.

The functional description, specifications, outputs and programming 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.

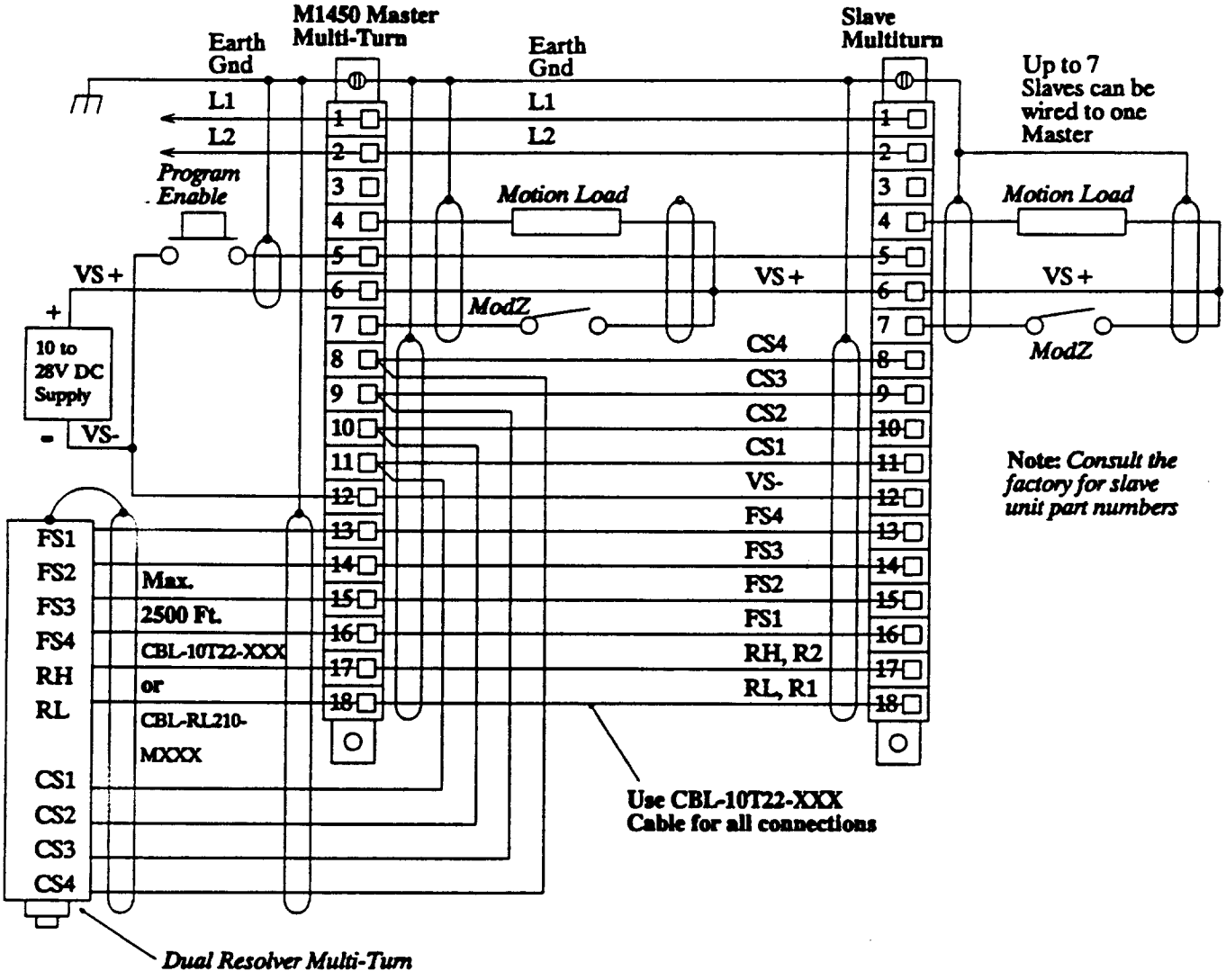


Diagram 5: Master-Slave Multi-Turn MINI-PLS Wiring

4.3.3 Cam Module Wiring

1) The User must provide a separate DC power supply for use with cam modules.

2) Cam Module 1 is located next to the main terminal block. A maximum of five cam modules with 8 channels each (40 channels total) can be installed. The output channel assignment and the corresponding terminals are as follows:

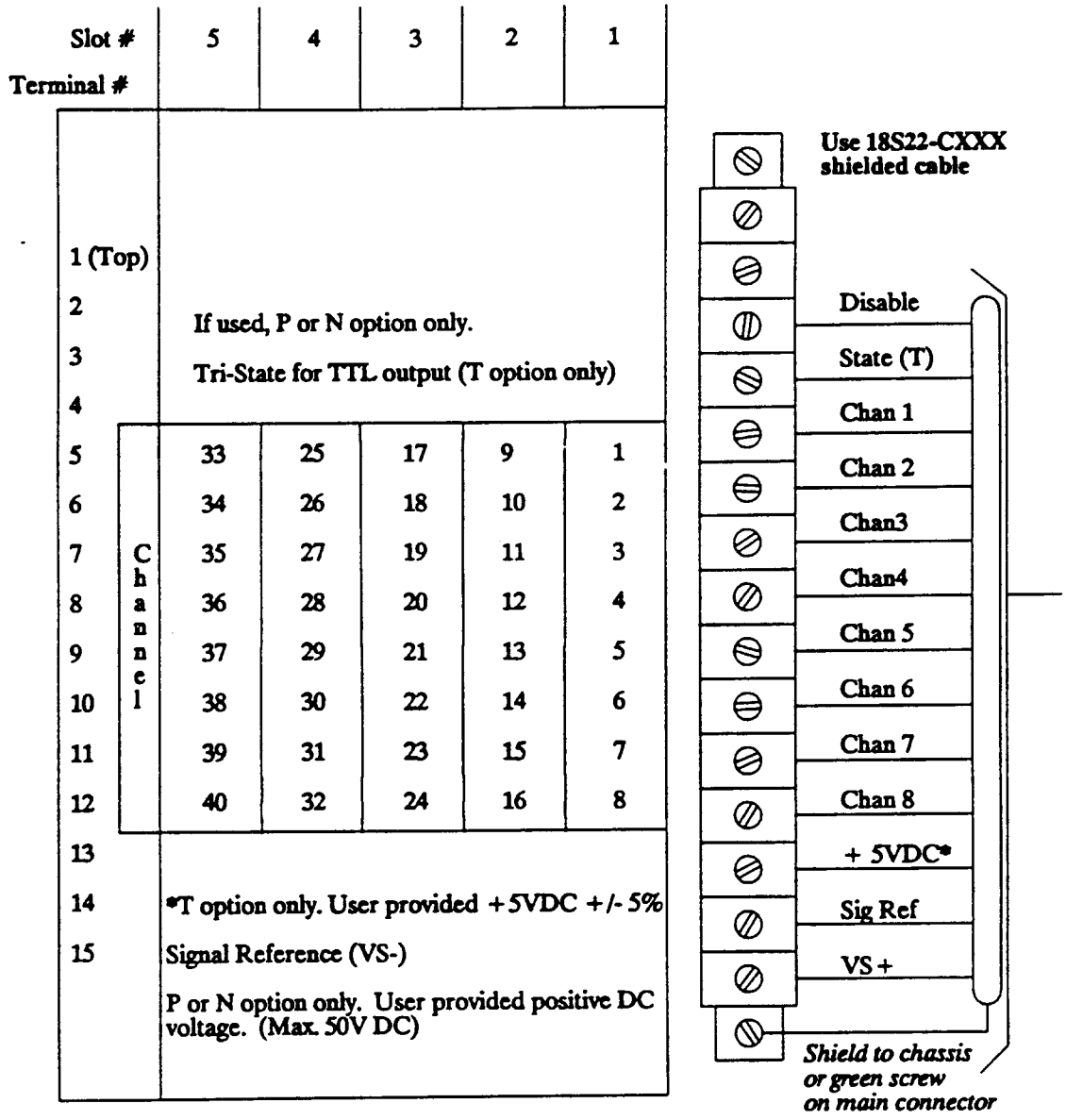


Diagram 6: Cam Module Channel Assignment and Wiring

4.3.4 Wiring for Multiple Program Selection

As previously explained, the storage of programmed set points in the individual cam modules in EEROM memory allows reprogramming of various cam modules for different jobs and selection of the appropriate program using an external selector switch.

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. See section 5.1 for multiplexing input.

To achieve multiple program selection with PNP and NPN Cam Modules, cut the factory wired jumper J1 and wire terminal #3 to VS- as per Diagram 7.

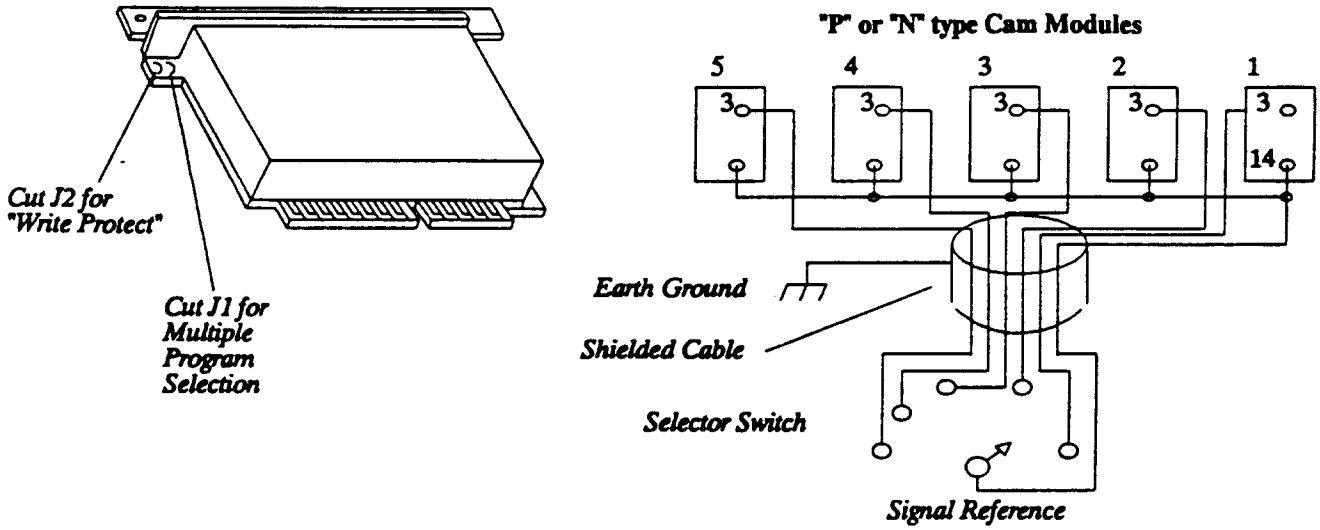


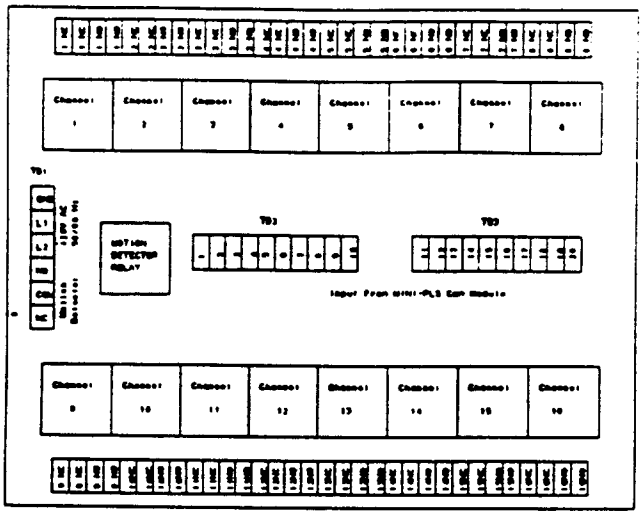
Diagram 7: Multiple Program Select with EXT. Switch

4.3.5 Write Protect

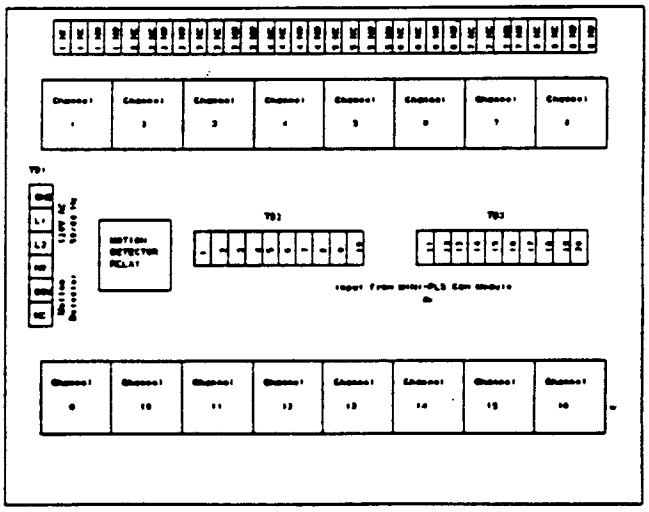
As shown in Diagram 7, the PNP and NPN type of Cam Module are shipped with factory wired jumper J2, which enables the modules to receive any program. If "Write Protection" of the program is required after the machine is adequately set up, cut the jumper J2. This will disable module programming. This 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.

4.3.6 Remote Power Relay Output Chassis Wiring

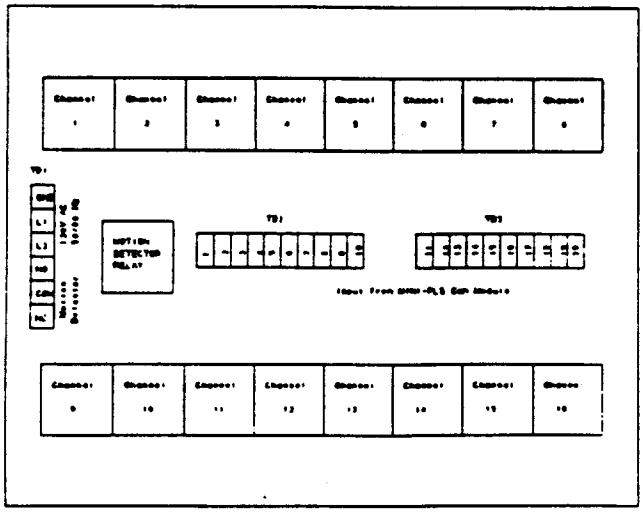
1) Must use NPN type of cam modules to drive the relay output chassis
2) Maximum permissible distance between MINI PLS and the relay output chassis is 50 ft.



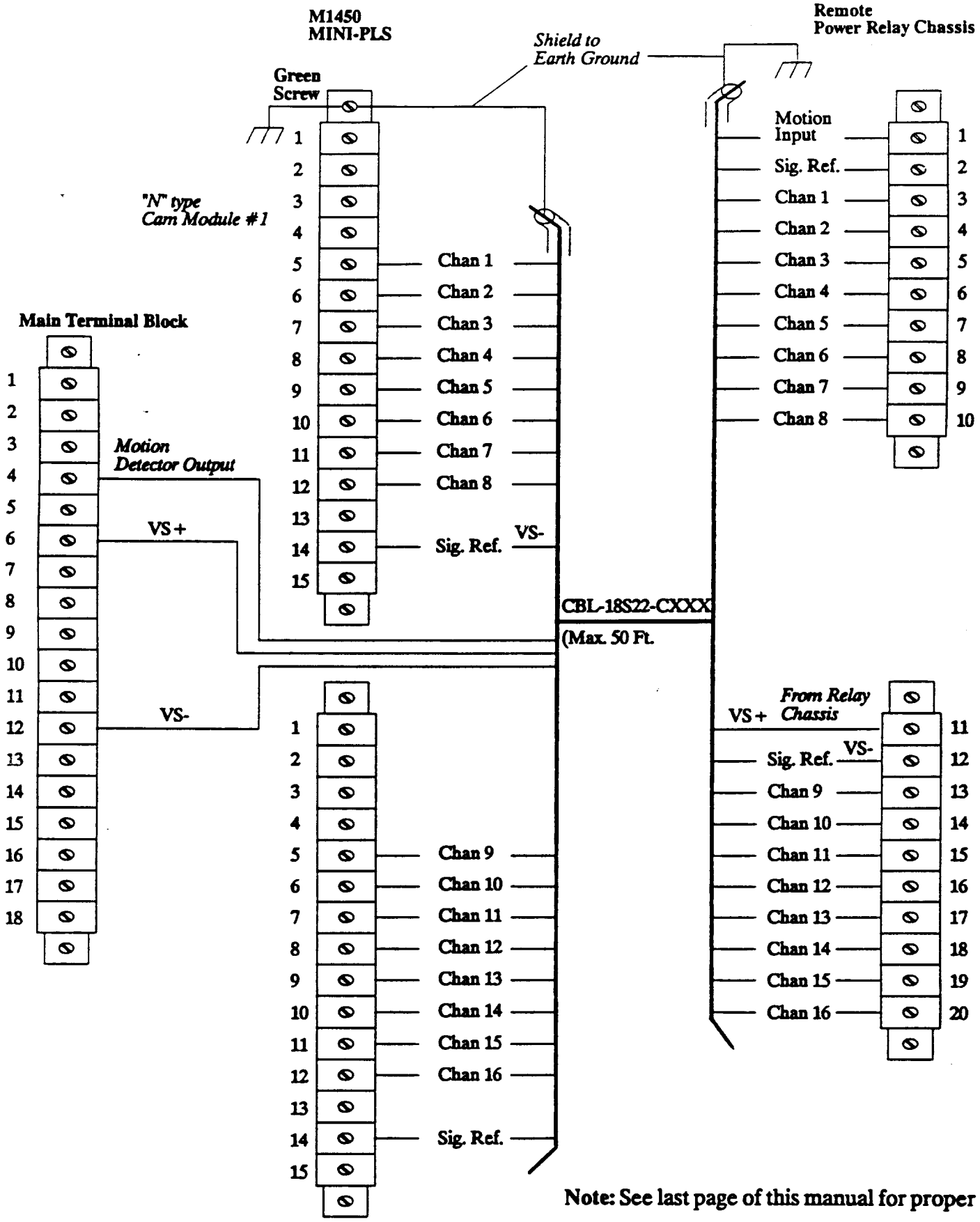
Remote Power Relay Output Chassis-EA Relays



Remote Power Relay Output Chassis-EA and SS Relays

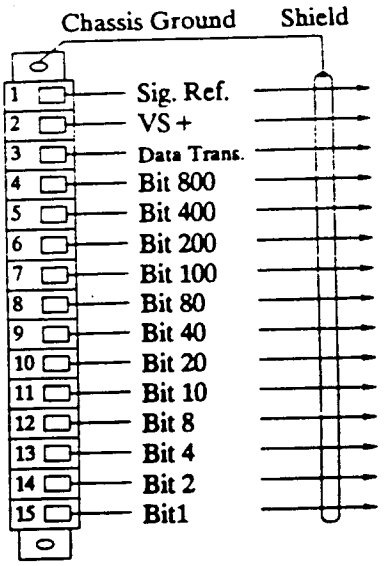


Remote Power Relay Output Chassis-Solid-State Relays



Note: See last page of this manual for proper grounding and shielding instructions.

4.3.7 Parallel BCD Position Output Module Wiring



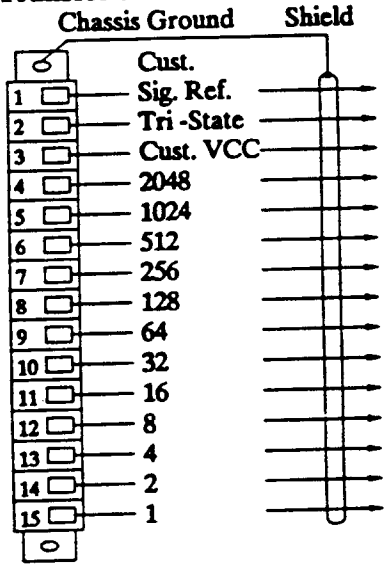
The parallel BCD position output module provides the digital position information to interface to PC's or remote readouts. This module is available with or without PC handshake circuit. PC handshake must be used while interfacing to PC's.

Use cable CBL-18S22-CXXX for wiring the BCD position output module. Two modules required on 6 digit M1450 systems. 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 sync with each other. (Slot 4 will automatically be assigned the lower 3 digits while slot 5 will have the higher 3 digits.)

For PNP or NPN interface, see section 5. The Data Transfer command is 0-24 volt logic input, i.e. Logic 0: 0-0.8V @ 3.2mA and Logic 1: 2.4V @ 0.4mA. Data is valid 120 uSec after either a rising or a falling edge of Data Transfer.

Removing jumper J1 (the upper jumper pair) will disable Data Transfer and allow the modules to continuously update.

4.3.8 Parallel Binary Position Output Module Wiring

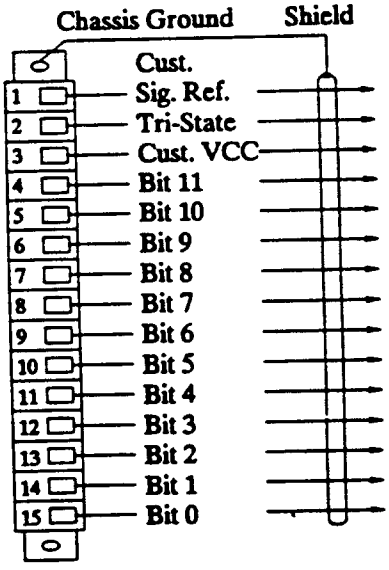


The parallel binary position output module provides the digital position information to interface to PC's or remote readouts. This module is available only without PC handshake circuit.

Use cable CBL-18S22-CXXX for wiring the binary position output module. For PNP or NPN interface, see section 7.

Note: This module does not offer PC handshake. For 6 digit applications, two modules would be required in slots 4 and 5. (Slot 4 will automatically be assigned the lower 3 digits while slot 5 will have the higher 3 digits.)

4.3.9 Parallel Gray Code Position Output Module Wiring



The parallel gray code position output module provides the digital position information to interface to PC's or remote readouts. This module is available only without PC handshake circuit.

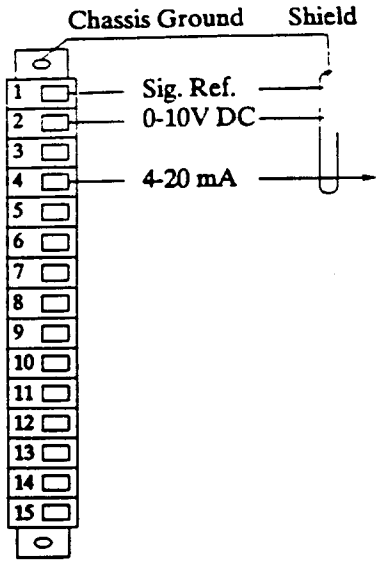
Use cable CBL-18S22-CXXX for wiring the position output module. For PNP or NPN interface, see section 5.

Note: This module does not offer PC handshake. For 6 digit applications, a matched pair of GRAY CODE modules must be inserted into slots 4 and 5 of the M1450. Consult the factory for more information. (Slot 4 will automatically be assigned the lower 3 digits while slot 5 will have the higher 3 digits).

4.3.10 Analog Tach Output Module Wiring

The Analog Tach output module provides an analog signal proportional to shaft speed between 0-1000 RPM. The voltage signal is 100 rpm per volt for 0-10V DC ("0" volt = 0 rpm) and the current signal is 100 rpm per 1.6mA for 4-20mA sinking (4mA = "0" rpm)

Use cable CBL-10T22-CXXX for wiring analog tach module.



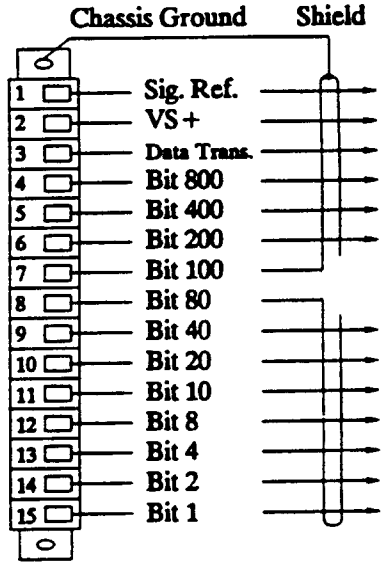
4.3.11 Digital Tach Output Module Wiring

PNP or NPN type BCD outputs are available. This module is available with or without PC handshake circuit to interface to PC's or remote readouts.

The Data transfer is a 0-2.4V logic output, i.e. Logic 0: 0-0.8V @ 3.2mA and Logic 1: 2.4V @ 0.4mA. Data is valid 120 uSec. after either a rising or falling edge of Data Transfer.

Data is valid 120 uSec after either a rising or a falling edge of Data Transfer.

For output interface, see Section 5. Use cable CBL-18S22-CXXX (max. 50 ft.) for wiring the digital tach output module.



Notes:

1) Connect shield to chassis ground.
2) Use CBL-18S22-CXXX cable to wire the Parallel BCD, Parallel Binary, and the Parallel Gray Code Position Output Modules.
3) Use CBL-10T22-CXXX cable to wire the Analog Tach and the Digital Tach Output Modules.

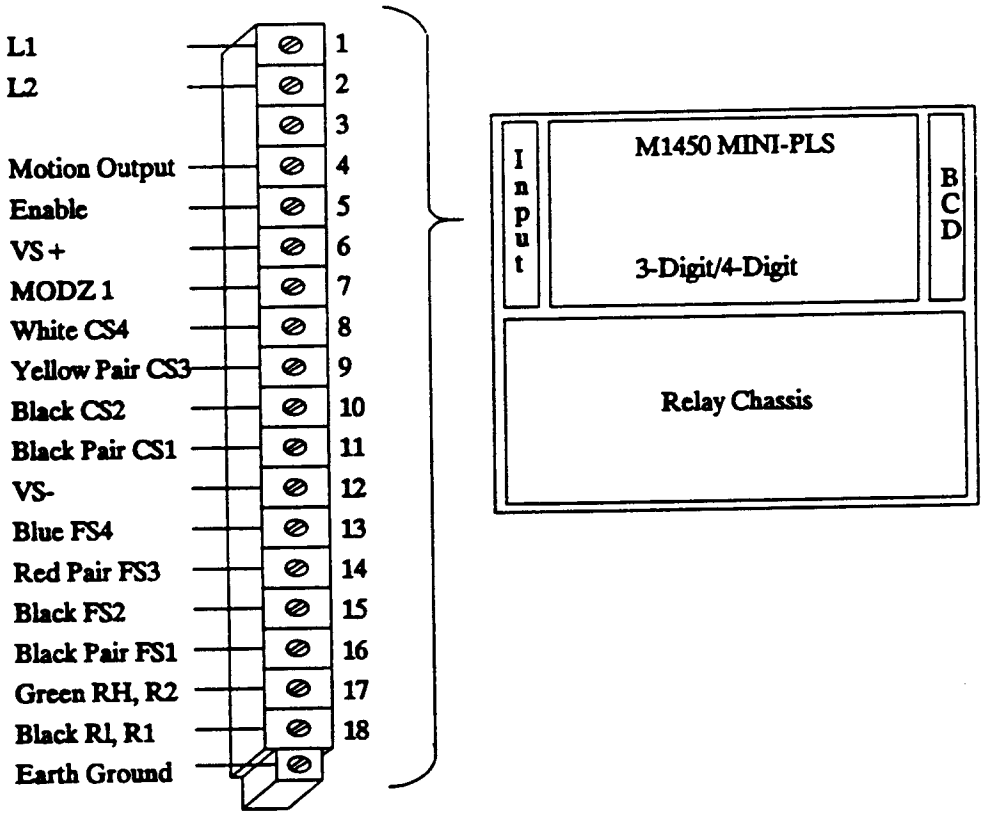
4.3.12 Back Panel Mount MINI PLS Wiring

This 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 relay outputs.

*For relay output wiring, see section 5.2

Note: For BCD output options, please consult the factory.

Wire the input terminals as follows:



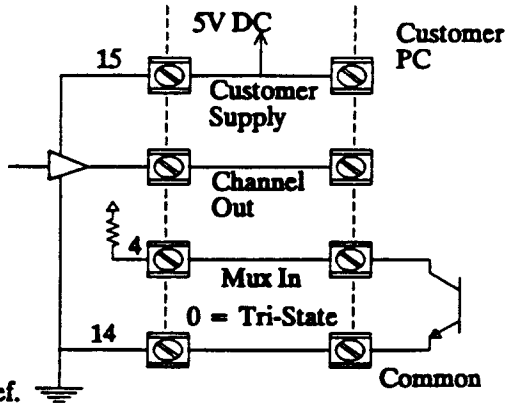
Note: See Transducer Instructions for Shield Connections

5. Output Interface

5.1. Logic Level Outputs

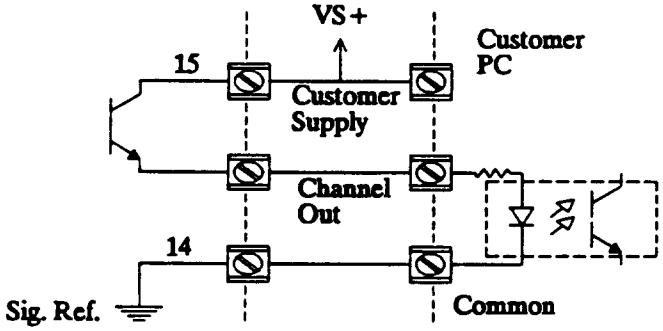
CAUTION: These outputs are not protected from excessive voltage or current. Be sure to check wiring thoroughly before applying power.

T: Tri-State TTL (74LS645)



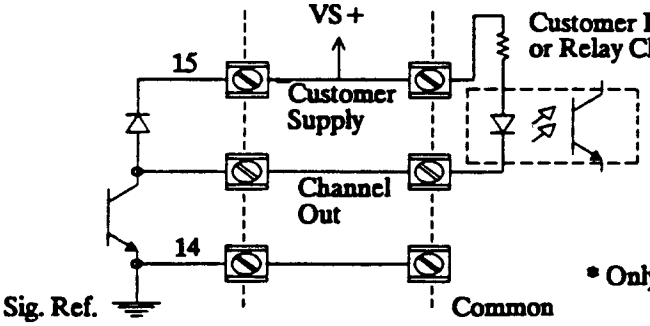
Positive True Logic
Logic 1: 2V @ 15 mA
2.4V @ 3 mA
Logic 0: 0.35V @ 24 mA
Multiplexing Input TTL Sinking
Logic 0: 0 to .8V DC (tri-state)
Logic 1: 2 to 5V DC (enable)

P: Source Transister (Sprague UDN-2981A)



Positive True Logic
VS = 50V max.
Logic 1: 1.7V drop @ 100 mA
Logic 0: 0.2 mA leakage @ 50V

N: Sink Transistor (Sprague ULN-2803A)



Negative True Logic
VS = 50V max.
Logic 0: 1.1V @ 100 mA
Logic 1: 0.1 mA leakage @ 50V

* Only necessary for Inductive Load

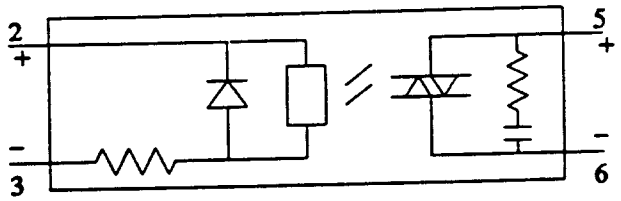
5.2. Power Outputs

5.2.1 Electromechanical Relay Output

Relay outputs are identified according to whether the contacts are normally open (NO) or normally closed (NC). The outputs are energized when the shaft position is within the dwell on-set points and de-energized when outside the on-set points. For example, if a closed contact is desired when the proper setting is detected, connect output wiring to the NO terminals.

5.2.2 Solid State AC Output Module

Connect the output wiring directly to the terminals on the red solid-state AC Output Module. The AC Output Module is a normally open 20-135V AC 3A switch. **Do not** connect this output module into DC circuits or into AC circuits above 135V AC. The indicator light on the AC output module illuminates when input to the AC module is present and does not indicate output status. When connecting the AC output module into logic circuits or into loads that are less than 3V AC connect a 5.6k-ohm, 3 w resistor in parallel with the load.

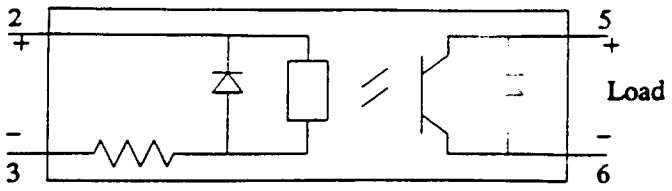


Specification @ 25 C Ambient

120V AC..... Output
3 Amps..... Max. Output (6" OF 14 ga wire on terminal)
1.5V..... Max. On Voltage
150 microSec..... Typical Turn On Time
8 mSec..... Max. Turn Off Time
10 mA..... Max. Leakage

5.2.3 Solid-State DC Output Module

Connect the output wiring directly to the terminals on the DC Output Module. Observe polarity. Connect the most positive voltage in the load to the + terminal. The DC Output Module is a normally open 3V DC-40V DC 2A switch. **Do not** connect this output module into AC circuits or into DC circuits above 40V DC. The indicator light on the DC output module illuminates when input to the DC module is present and does not indicate the output status.

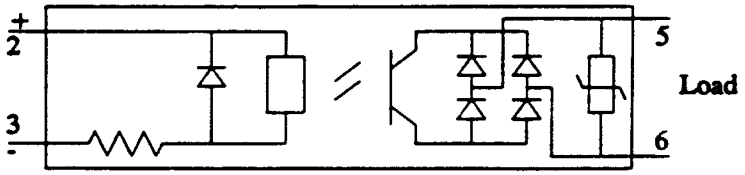


Specification @ 25 C Ambient

40V DC..... Max. Output
2 Amps..... Max. Output
1.5V..... Max. On Voltage
15 microSec..... Max. Turn On Time
100 microSec..... Turn Off Time

5.2.4 Solid-State AC/DC Output Module

Connect the output wiring directly to the terminals on the white solid state AC/DC output module. When connected to AC circuits, it operates as a 0-135V AC (r.m.s.) 0.35 Amp normally open switch, while in DC circuits, it is a normally open 190V DC (peak), 0.5ADC switch. With a very low leakage, it is specially suited for interface to PC's. The indicator light on the module illuminates when the input to the module is present, and does not indicate the output status.



Specification @ 25 C ambient	AC	DC
Max Voltage	135V RMS	190V Peak
Max Output	0.35A RMS	0.5A DC
Voltage Drop at Rated Current	3V	3V
Max Turn On Time 50V, 100 mA Load	10 micro Sec	10 micro Sec
Max Turn Off Time 50V, 100mA Load	100 micro Sec	100 micro Sec
Max Leakage at 120V	100 micro Amp	100 micro Amp

6. Applying Power To The MINI-PLS

1) Before applying power to the MINI-PLS, check:

2) That the transducer is properly wired

3) That all the modules are secure plugged in the slots and screwed down

4) That the BCD, Tach or other optional modules are inserted only in slots 4 or 5

5) That the input power is within 105-135V AC, 50/60 Hz or other option, if ordered.

7. Programming The MINI-PLS

Notes:

A) An external power supply (+ 10 to 28V DC) must be applied to terminal 6 (VS +) on the main terminal block. The Program Enable input, Terminal 5, and the power supply negative reference **must be** connected to terminal 12 (VS-).

B) 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 follows the appropriate escape sequence (i.e. press the function key you pressed last that caused error).

C) 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.

D) 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 installing the M1450. Once wiring has been completed and power applied, just follow the programming steps for your model in the order below.

7.1. Decimal Point Programming

The decimal point position can be changed by entering the Position mode and pressing the '+' key.

7.2. Scale Factor Programming

A) Press the Offset/SF key twice. 'SF' will appear in the Channel display window, the current scale factor will be displayed in the Position/RPM window and the SCALE FACTOR program indicator will be illuminated.

Note: The Scale Factor is one number less than the programming resolution for one rotation of the resolver shaft. Thus, if the desired resolution is 3600 for tenths of degrees, the number you should enter is 3599. If you want to program 2540 counts-/revolution, enter 2539 and so on.

CAUTION: When changing the scale factor, the previously programmed "set points" will retain their previously scaled values which will result in erroneous cam outputs. The set point values must be entered again after a scale factor change.

B) Enter a number between 10 and 4095. 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.

C) 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.

D) If, on pressing Offset/SF key, the display starts flashing, this indicates an error mode. You might have entered a number beyond the Scale Factor range, which is 10 to 4095. To escape the error mode, press Offset/SF key again and repeat steps A. through C.

E) Proceed to Offset Programming

7.3. Offset Programming

Resolver Offset - as defined by M1450-D64 and -D128 is the necessary offset number when the "Resolver Zero" is aligned to the real "Machine Zero".

Machine Offset is any additional offset number with "Machine Zero" as reference point.

There are three ways to use the offset: Auto-Zero, Numerical entry, and Fine-tune. The number displayed in the Position mode is the actual resolver position plus the machine offset. Offsets due to Speed Compensation or MODZ are not displayed.

For safety reasons, with machine in motion above 3RPM, the Auto-Zero and Numerical entry modes are inhibited.

7.3.1 Offset: Auto-Zero Method

The function of the Auto-Zero mode is tc automatically calculate the resolver offset so that the current resolver position is interpreted by the M1450 to be aligned with "Machine Zero".

A) With resolver shaft mechanically connected to the machine being controlled, adjust machine to its mechanical zero.

B) Press the Offset/SF key. The existing "Resolver Offset" will appear for a short interval and then the current "Machine Offset" will be displayed. The Offset Indicator will be illuminated.

C) Press the "0" key six times until the Position/RPM display reads 000000. This is now the "MACHINE OFFSET". The Offset Indicator will be flashing, which means that the Offset entry is not yet terminated.

D) To terminate this step, press Offset/SF key. The Offset Indicator will stop flashing, the M1450 will calculate the required "Resolver Offset", display it for a short interval and go back to display "machine offset" (in this case 000000).

E) Press the Pos key. The Position/RPM display will indicate "0".

7.3.2 Offset: Numerical Entry Method

A) Press the Offset/SF key. The Offset Indicator will be illuminated, the display will flash the existing "Resolver Offset" and then indicate the current "Machine Offset".

B) The new Machine Offset can be entered in two ways: either by entering a number corresponding to the required position, i.e. new Machine Offset or, by pressing "+" or "-" key and entering a number corresponding to the difference between the current and the new Machine Offset. The offset indicator will be flashing, which means that this step is not yet terminated.

C) To terminate this step, press Offset/SF key. The Offset Indicator will stop flashing, the display will flash the new calculated Resolver Offset and then display the new Machine Offset.

D) Press Pos key. The Position/RPM display will indicate the required position.

E) If you entered an offset number higher than 262143 for the -D64 or 524287 for the -D128 the unit will go in error mode in step C). Press Offset/SF key to escape the error mode and repeat steps A) through C).

7.3.3 Offset: Fine Tune Method - "On the Fly"

A) Press the Offset/SF key. The Offset Indicator will be illuminated, the display will flash the existing "Resolver Offset" and indicate the current "Machine Offset".

B) 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.

C) Go to next step.

7.4. Speed Compensation Programming

Speed Compensation in the M1450-D64 and -D128 allows the user to program a position advance that is linearly proportional to shaft RPM. The Speed Compensation offset is added to the resolver and machine offsets discussed above. 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) In the M1450-D64 and -D128, up to five speed compensation offsets are allowed depending on the number of the cam modules installed and the speed compensation affects all eight outputs for a particular cam module.

CAUTION: Use care when entering Speed Compensation offsets. 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.

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 resolver position plus the machine offset. Offsets due to Speed Compensation or MODZ are not displayed.

For safety reasons, with machine in motion above 3RPM, the Numerical entry mode is inhibited.

7.4.1 Speed Compensation: Numerical Entry Method

A) 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.

B) Enter the amount of speed compensation desired with the number keys until the display reads the chosen number.

C) Press the CHAN/MODULE key to enter the speed compensation into memory.

D) Press the Recall key to advance to the next cam module.

E) Repeat steps B, C, and D until finished.

F) Go to next step.

7.4.2 Speed Compensation: Fine Tuning Method

A) Press the CHAN/MODULE key twice. The Channel display window will "'C" and the Position/RPM window will read 'A' followed by the amount of speed compensation for cam module 1.

B) If necessary, press Recall key until the cam module number to be fine tuned appears in the Channel window.

C) Press the + or - key to increase or decrease the amount of speed compensation.

D) Repeat steps b and c until finished.

E) Go to next step.

7.5. Cam Module Programming

A) 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 non-existent 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.

B) Press the Angle key and "0" will appear in the display window.

C) 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.

D) **Entering The New Program:** The new program can be entered in two ways:

- Programming from existing set points
- Erasing (i.e. programming OFF) the existing set points and entering the new ones.

E) **Programming From Existing Set points:**

- Press Recall key, existing setpoint will appear in the display. The Status light indicates "ON" or "OFF" status of set points.
- Press the CH ON/OFF key to select the programming mode "ON" or "OFF". CHANNEL ON/OFF indicator will show the Status in which set points are being programmed.
- Press the "+" key to increment or "-" key to decrement the setpoint, until the required setpoint is achieved.
- Recall each setpoint to verify the program.
- Repeat for all channels and al set points.

F) **Programming By Erasing The Existing:**

- Erase all the set points on the channel to be programmed by performing the following steps:
  - Press Angle key
  - Enter "'1"
  - Press Ch On/Off key until Chan On/Off indicator is dark.

– Enter "0" -- Angle indicator will flash

– Press Ch On/Off key.

– Pres ' + ' key.

- Now, if you press Recall key, the unit will go into flashing mode indicating that all locations are programmed OFF (Status indicator dark). Escape flashing mode by pressing Recall key again.
- Enter the new setpoint by performing the following steps:

  – Press Angle key

  – Enter the 'ON' setpoint

  – Press Ch On/Off key until Chan On/Off indicator illuminates.

  – Enter the 'OFF' setpoint -- Angle indicator will flash

  – Press Ch On/Off key.

- If more than 21 set points are programmed into this channel, the Position/Rpm display will flash 'FULL', indicating that this channel has the maximum number of set points allowed. Some existing set points must be deleted or merged before any new set points may be added to this channel.
- Now, if you press Recall key, the Position display will indicate the 'ON' setpoint with the Status indicator illuminated; pressing the Recall key again will display the 'OFF' setpoint with the Status indicator dark.
- Recall each setpoint to verify the program.
- Repeat for all channels and all set points.

7.6. MODZ End Point Programming

The MODZ end point for Cam Module 1 is the final position where any channel in Cam Module 1 can be on during a MODZ cycle regardless of how the channel is programmed. MODZ end point has no effect when the channels in a particular Cam Module are being used in the 'normal' mode.

To program the MODZ end point in the M1450-D64 and -D128, perform the following steps:

A) Press and release the CHAN/MODULE key three times. "E1" will be displayed in the Channel display window. The MODZ end point for Cam Module 1 will be displayed in the Position/RPM window.

B) Enter the desired MODZ end point. If "0" is entered, there will be no end point for that Cam Module.

C) Press the CHAN/MODULE key again. The MODZ end point is now entered into memory.

D) Press the Recall key to advance to the next Cam Module's MODZ end point if more than Cam Module 1 is to be used as a MODZ cam and repeat steps B) and C).

7.7. Cam Module Duplication Mode

The M1450 provides a unique and easy method of duplication programs between Cam Modules. This duplication capability allows easy non-volatile storage of several different Cam Modules for fast program change-overs for different production set-ups, repeating the same program for different M1450's.

A) The Cam Module slots are numbered 1 through 5. The first slot is located next to the main terminal block.

B) The ORIGIN slot contains the Cam Module with the "master" program.

C) The COPY slot contains the Cam Module that will receive the "master" program.

D) Power should always be removed when removing or inserting Cam Modules.

E) 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 extreme left and right handed display positions will be 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 "1". 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 M1450 will exit to the Position mode.

5) In extremely rare instances where the copy is not correct, the M1450 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.

7.8. 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 set points, 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.

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 set points 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.

7.9. MODZ Definitions

7.9.1 Enabling/Disabling of Cam Modules

MODZ is defined as an instantaneous reset to zero. When the MODZ trigger signal is sensed, the appropriate cam module will treat the current machine position as 000 and all setpoint responses will be referenced to this new zero.

Applying positive customer VS+ to a MODZ input is defined as a true point. If enabled as a MODZ cam, a false-to-true transition initiates MODZ. If the MODZ input becomes false before one revolution of the resolver or before reaching the MODZ end point in linear and multi-turn models, the cycle will continue until either a full revolution or the end point is reached (see Figure 22).

These models are multiturn units and only have one MODZ input.

A MODZ end point is programmed from the keyboard to let the processor know when to terminate a MODZ cycle once it has been initiated. This feature prevents the need for the resolver to make 64 or 128 complete revolutions before the MODZ function can be rearmed.

If the M1450 is powered up with the MODZ input held low, Cam Module 1 outputs will be disabled. The system will wait for a low to high transition on the MODZ input to start its MODZ cycle.

If the MODZ End Point is non-zero, the MODZ cycle will terminate when the resolver position reaches the preprogrammed end point.

If the MODZ End Point is zero, and the logic remains high on the MODZ input, the M1450 will continue to respond indefinitely using the initial trigger point as position zero. When the MODZ input goes low, the MODZ cycle will terminate immediately.

If power is applied to the M1450 with the MODZ input held high, Cam Module's outputs will perform as normal Cams. If the MODZ input switches low all Cam Module 1 outputs will turn off and the paragraphs above regarding MODZ will apply.

M1450 MODZ Enable/Disable Definition Table

With 1 to 5 Output Cam Modules Installed

These models are multiturn units and will support only one MODZ input.

Output Cam Module behaving as ModZ Cam Module					Definition of each input is: ModZ
cam mod #1	cam mod #2	cam mod #3	cam mod #4	cam mod #5	#1 input pin 7
yes	norm	norm	norm	norm	L..... power ON..... then H
norm	norm	norm	norm	norm	H..... power ON..... always held logic H
yes	norm	norm	norm	norm	.....then logic L.....then.....
yes	norm	norm	norm	norm	H = ModZ start.....L = ModZ stop

Key: L = logic LOW H = logic HIGH

Notes:

A) If the M1450 is powered up with the MODZ input held low, Cam Module 1 outputs will be disabled. The system will wait for a low to high transition on the MODZ input (pin 7) to start its MODZ cycle. When the position reaches the preprogrammed end point, the outputs of Cam Module 1 will be disabled awaiting another MODZ input trigger.

B) If the M1450 is powered up with the MODZ input held high, Cam Module 1 outputs will perform as a normal cam module. If the MODZ input switches low, Cam Module 1 outputs will turn off and when the MODZ input goes high again, Cam Module 1 will revert back to a MODZ cam module.

C) A special feature is provided in these models where if a 000 000 was programmed in as the MODZ end point, a MODZ input low to high transition will start the MODZ cycle but the cycle will terminate as soon as the MODZ input line returns back to a logic low state.

8. Grounding and Shielding Requirements

8.1. General Considerations:

1) The M1450, position transducer, and input/output devices' ground planes must be held to the same RF potential by metallic connections (e.g. building frame, conduit, wire trays). These ground planes should be connected to a good earth ground.

2) Every shielded cable run must be grounded to a good earth ground at both ends.

3) All shielded cable run must be routed separate from 120/240/440V AC lines and other high current inductive wiring. All shielded cable must be continuous (no splices).

4) This equipment has isolated SIG ref (common). Failure to maintain this isolation between SIG ref and chassis ground (earth ground) in external equipment may cause electrical noise interference resulting in unpredictable operation.

5) Unshielded portion of the shielded cable must be kept to a minimum with at least 2" separation between the unshielded wires and any other wiring.

6) When using electro-mechanical relays driven directly from cam outputs, inductive transients at the relay contact(s) may lower contact life and pass transients onto the output lines which can result in periodic unpredictability in cam operation. Proper grounding and shielding along with limiting transients below 1000V DC with transient suppressors (such as GE MOV V130L10) is recommended in such cases.

7) The resolver transducer connections to the M1450 must be made with twisted pair shielded cable such as Autotech CBL-10T22-XXX. Substitution of another cable may result in degraded performance.

8) The MOD Z input cable is treated with same precautions as specified for resolver connections. MOD Z input wiring must be routed in shielded cable such as Autotech CBL-10T22-XXX. In some applications, the CBL-10T22-CXXX cable can also be used.

M1450-D64, -D128 Trouble Shooting Guide

System	Check
Unable to program unit. Parameters (Scale factor, Offset, etc.)	Customer DC power is correctly wired. (+10 to +28V DC (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.
Unit parameters program O.K. but unable to program Cams.	Cam Modules are installed in order i.e. slots 1 & 2 for 2 cams, slots1, 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 section 4.3.5) 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 - insures 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. Inductive loads on Cam Module outputs must have external voltage suppression. Proper grounding and shielding has been applied. (Sec. 8.1)
Position and Tach readings are incorrect.	Resolver is correctly wired: 1) Turn power off to M1450 unit 2) with main termminal block connected to unit, measure with an ohm meter the following: a) Term. 8 to Term. 10 = about 55 ohms b) Term. 9 to Term. 11 = about 55 ohms c) Term. 13 to Term. 15 = about 55 ohms d) Term. 14 to Term. 16 = about 55 ohms e) Term. 17 to Term. 18 = about 30 ohms Resolver cable is properly grounded and shielded.
Mechanical Zero Drifts.	Mechanical Resolver linkage is not loose. ModZ inputs are properly configured.

How to Order

Modular PLS with full numeric keypad, up to 40 outputs, up to 6 digits resolution, logic capability for Die-protect and other advanced features.

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:

The SAC-M1450-D128 and SAC-M1450-D64 use Autotech's RL210 Dual Resolver. Please see position transducer section of the Autotech Catalog for ordering information on this resolver and appropriate accessories.

2. Mini PLS

Select one of the following Multi-turn Linear PLS's for front panel mounting. Cam modules or power outputs not included:

SAC-M1450-D128	6-Digit, dual-resolver, 128:1 ratio, basic unit

Slave units	
S:	For Slave MiniPLS, change the "A" in SAC-M1x50-xxxx to "S"
220 /240 VAC units	
2:	For 220/240 VAC, 50/60 Hz AC power input, change the "C" in SAC-M1x50-xxxx to "2"

3. Output Modules

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

ASY-M1250-08TI	8 TTL output, cam module with terminal block
ASY-M1250-08PI	8 PNP output, cam module with terminal block
ASY-M1250-08NI	8 NPN output, cam module with terminal block

3.2 Select type and number of optically isolated power output cam modules (with terminal block connectors):

ASY-M1250-08AC	8 Output, 120 VAC @ 0.5 Amp each output, 4 Amp max per module
ASY-M1250-08DC	8 Output, 10-28 VDC @ 0.5 Amp each output, 4 Amp max per module

3.3. The following optically isolated power output cam modules with DB connectors are available for replacements only.

ASY-M1250-08PD	8 PNP Outputs with DB connector
ASY-M1250-08ND	8 NPN Outputs with DB connector

3.4 Select type and number of special (Position, Tach,and Logic modules:

- Maximum two modules from this category may be used in a PLS.

ASY-M1250-20MAP	Analog position/Tach module; 4-20mA current sourcing output
ASY-M1250-20MAN	Above with current sinking output
ASY-M1250-010V	Above with 0—10V analog output
ASY-M1250-xxx x x	Digital position and Tach output modules
1 2 3	

1. *Output Format*
   - **BCD:** BCD position
   - **TAC:** Digital TACH; BCD output
2. *PC Handshake*
   - **1:** With PC sync circuit
   - **0:** Without PC sync circuit
3. *Output Type*
   - **T:** TTL with multiplexing
   - **P:** PNP source transistor
   - **N:** NPN sink transistor

3.5 Cable for wiring logic level cam or special modules to external devices:

In following part numbers, xxx refers to the length of the cable in feet. The standard lengths offered are 10, 25, 50 and in increments of 50 feet (e.g. 100, 150, 200 ft., etc.)

CBL-15S22-DAxxx	Same as above but for cable length longer than 4 ft (xx is length in feet)
CBL-09S22-DAxxx	9 conductor, cable with overall foil shield, and sub "D" connector on one end
CBL-18S22-Cxxx	18 conductor shielded cable for use with modules with terminal block (per cam for ASY-OUTPT-xx)
ECM-15PIN-M11	15 pin male sub "D" connector
ECM-09PIN-M11	9 pin male sub "D" connector

4. Remote Power Relay Output Chassis

4.1 *Select part number of output chassis:*
(must use NPN type of output module. See step 3.1;
Relays not included, see 4.2 below to order)

ASY-RLYCH-8SS	Chassis for 8 solid-state relay outputs or electro- mechanical SPDT outputs using KSD-A12DC-10AMP relays
ASY*-RLYCH-16SS	Chassis for 16 solid-state relay outputs or electro- mechanical SPDT outputs using KSD-A12DC-10AMP relays
ASY-RLYCH-08RL	Relay chassis with 8 electro-mechanical SPDT outputs (Use only KSD-012DC-10A SPDT relay)
ASY-RLYCH-16RL	Relay chassis with 16 electro-mechanical SPDT outputs (Use only KSD-012DC-10A SPDT relay)

* 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 ASY-RLYCH-xxx relay chassis)

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

4.3 Cable connecting cam modules to relay chassis

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

4.4 Brake Input to the PLS Relay

ASY-BRAKE-RLY	Relay including socket required to wire brake input to the PLS, 120 VAC coil (changed from #KSD-120VAC-05A)

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 (1 2 3) — Mini PLS system for back panel mounting with cam modules, power output chassis and relays

1. *Basic Model*
   - **M1450:** The M1450 Mini PLS

2. *Type of power relay outputs*
   - **16RL:** 16 EM-relay outputs,120VAC @ 10 Amps
   - **16AC:** 16 solid-state AC relay outputs, 120VAC @ 3Amps
   - **16DC:** 16 solid-state DC relay outputs, 9-60VDC @ 3Amps
   - **16AD:** 8 solid -state AC relays (120VAC @ 3Amp) and 8 solid-state DC relays (9—60VDC @ 3Amp)
   - **32RL:** 32 EM-relay outputs, 120VAC @ 10Amps
   - **32AC:** 32 solid-state AC relay outputs, 120VAC @ 3Amps
   - **32DC:** 32 solid-state DC relay outputs, 9-60VDC @ 3Amps
   - **40RL:** 40 EM-relay outputs, 120VAC @ 10Amps
   - **40AC:** 40 solid-state AC relay outputs, 120VAC @ 3Amps
   - **40DC:** 40 solid-state DC relay outputs, 9-60VDC @ 3Amps

   For 200VDC solid state outputs consult factory

3. *Type of Mini PLS*
   - **6:** 6-digit, 128:1 ratio, multi-turn linear PLS model M1450-D128

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

5.3 Spare Parts:

EEC-15PIN-0TB	15 position terminal block for main terminal block on M1250 and 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-M11	15 Pin sub "D" male connector