Autotech Controls
M8251 PLS in the TI505 Series PLC System
(ASY-M8251-PAR)
Instruction & Operation Manual

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MAN-M8251-TI505
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1. Introduction

Autotech's PLS and Mini-PLS families have continually set the standard for speed, precision, reliability, and product features in the Program-

Simultaneous display of related parameters for easy understanding

In the normal operating mode, the display indicates the selected PLS setup number, the current

Optically Isolated Inputs and Outputs

All M8251 inputs and outputs are fully isolated to provide outstanding electrical noise immunity in harsh industrial environments.

Built-In Fault Detector

The Fault Output is normally energized when the M8251 LBus PLS is operating normally and the resolver wiring is intact. If an internal M8251 fault is detected, the power fails, one or more of the resolver wires is broken or disconnected, the Fault output, the PLS outputs, and the motion output will de-energize.

Built-In Tachometer and Motion Detector

The built-in tachometer and motion detector are updated over 68 times per second to provide fast, accurate indication and detection of rotary motion. The motion detector is programmed to energize an output when the machine's RPM is between the motion low and high limits.

Inputs and Outputs

The M8251 Module uses a separate output module for output functions that allow the user to select either sourcing or sinking drivers. Consult Autotech Controls' M8250 Sourcing or M8250 Sinking Output Module Manual (manual part numbers MAN-M8250-POUT and MAN-8250-NOUT, respectively).

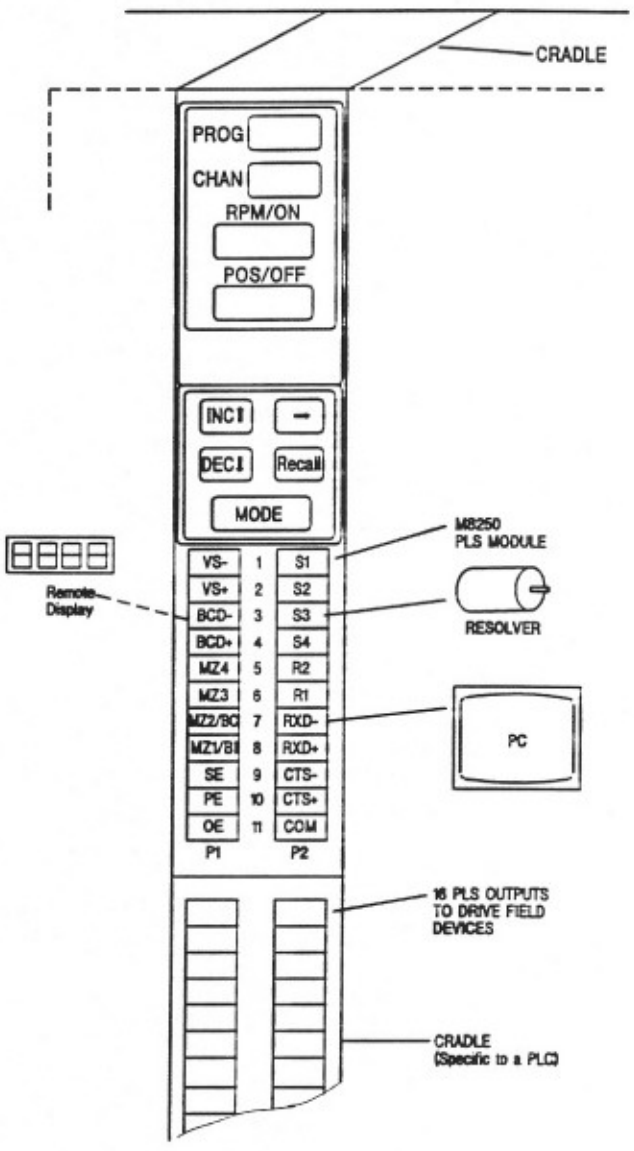


Figure 1. M8251 LBus PLS System Overview

Decimal Address: 132 **I/O Status (16 Bit)**

MSD[1]															LSD[1]
MZ4	MZ3	MZ2	MZ1	X	OE	SE	PW	X	X	X	X	DNGR	CTN	MOT	BW*

X = Not Used

DNGR= Danger Output; fail safe
- 0 = Stopping time exceeds the danger limit
- 1 = Stopping time is within the danger limit

CTN = Caution Output
- 0 = Stopping time is within the caution limit
- 1 = Stopping time exceeds the caution limit

MOT = Motion Output
- 0 = RPM exceeds the Motion Hi/Low Limit
- 1 = RPM within the Motion Hi/Low Limit

BW = Broken Wire
- 0 = Broken wire fault
- 1 = No broken wire fault

MZ1/BI = Mod Z Input 1 (Modification to zero) or Brake Input

Mod Z Input 1:
- 0 = No input
- 1 = Input present

Brake Input:
- 0 = Brake input present (Brake Mode)
- 1 = Brake input not present (Run Mode)

MZ2/BC = Mod Z Input 2 (Modification to zero) or Brake Clear
- 0 = No input
- 1 = Input present

MZ3 = Mod Z Input 3 (Modification to zero)
- 0 = No input
- 1 = Input present

MZ4 = Mod Z Input 4 (Modification to zero)
- 0 = No input
- 1 = Input present

FO = Fault Output (diagnostic); fail safe
- 0 = Fault
- 1 = No fault

OE = Output Enable
- 0 = No input
- 1 = Input present

SE = Supervisor Enable
- 0 = No input
- 1 = Input present

PE = Program Enable
- 0 = No input
- 1 = Input present

(Either hard wired input or MZ1 in ModZ and Brake inputs)

* Both must be in Run Mode (not present) for the BI input to function correctly.

Decimal Address: 160 **ModZ (Modification to Zero) & Brake Inputs (16 Bit)**

MSD															LSD
X	X	X	X	X	X	X	X	X	X	X	X	MZ4	MZ3	MZ2/BC	MZ1/BI*

X = Not Used

MZ1/BI = Mod Z/Brake Input

Brake: 0 = input present (Brake Mode), 1 = not present (Run Mode)

MZ2/BC = Mod Z/ Brake Clear

MZ3 = Mod Z

MZ4 = Mod Z

(ModZ and brake cannot be used together)

[1] **MSD = Most significant digit**
LSD = Least significant digit

* Both must be in Run Mode (not present) for the BI input to function correctly.

Decimal Address: 256 **Read/Write Error and Address (14 Bit)**

MSD													LSD
EADD	EADD	EADD	EADD	EADD	EADD	EADD	EADD	EADD	EADD	ENUM	ENUM	ENUM	ENUM

EADD = Error Address

ENUM = Error Number

- 00 No Error
- 01 No Program enable input
- 02 Programming a parameter during motion
- 03 Value out of range
- 04 Function module busy
- 05 Illegal command code.

Decimal Address: 272 **Group Types (14 Bit)**

MSD													LSD
X	X	X	X	X	X	X	X	X	X	GN4	GN3	GN2	GN1

X = Not used

GN1– GN4 = Group Number 1, 2, 3, or 4

- 0 = PLS
- 1 = MODZ

Decimal Address[2] **Group# + 256* Channel Type (14 Bit)**

MSD													LSD
X	X	X	X	X	ALCH	X	X	X	X	X	GRP	GRP	GRP

X = Not used

ALCH = All Channels

- 0 = ANGLE On/Off
- 1 = ANGLE On/Time Off

GRP = Group

- 000 = 0
- 001 = 1
- 010 = 2
- 011 = 3
- 100 = 4

[2] **Group # + 256* Chan Type's decimal address depends upon channel number (e.g., Decimal Address for Channel 1 is 324)**

2. Specifications

Power Requirements:
Rack : 5 VDC @ 650 mA
Customer: 24 VDC @ 100 mA

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

PROGRAMMING

Number of PLS Setups: 8

PLS Setpoints: 160 per PLS setup (80 per group of 8 outputs)—Front Panel. 112 per PLS Setup (56 per group of 8 outputs) — Backplane

Scale Factor:
Programmable from 16 to 999, common to all PLS setups (resolution 17 to 1000 counts/turn)

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

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

Motion Detector:
Low and High Motion Limits, common to all PLS setups. Programmable from 0 to 1999 RPM

Update Time:
1.6 msec. for ASY-M8251-010
Maximum Speed with 1^0 Resolution
100 RPM for ASY-M8251-010
0.8 msec. for ASY-M8251-F10
200 RPM for ASY-M8251-F10

RESOLVER INTERFACE

Position transducer: Resolver, Autotech Series RL100, RL101, RL500, E1R, E7R, E8R, E9R or equivalent

Cable Length between Resolver and M8251:
2500 feet max, shielded

Resolver Cable: Overall foil shielded, twisted pair, such as Autotech's cable CBL-10T22-XXXX

Maximum Resolver Shaft Speed: 2000 RPM

Resolver Decoder: Ratiometric

CONTROL INPUTS

Electrical specifications: (All Inputs)
Optical Isolation: 2500 V
Input impedance: 7500 Ohms

Logic Levels (See wiring section for typical schematic)
TRUE: 20 VDC to 30 VDC; 3 mA @ 24 VDC
FALSE: 0 to 2 VDC or open circuit

Program Enable (PE):
When TRUE, enables setpoint programming

Supervisor Enable (SE):
When TRUE, enables setpoint and setup (scale factor, offset, program # etc.)

— continued

2. Specifications — continued

Output Enable (OE):

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

ModZ and Brake Inputs (MZ1/BI = ModZ input 1 or Brake Input; MZ2/BC = ModZ input 1 or Brake Clear; MZ3 = ModZ Input 3; MZ4 = ModZ Input 4):

ModZ inputs when TRUE enables Modification to Zero
Brake Input when TRUE enables Run Mode, when FALSE enables Brake Mode
Brake Clear when TRUE clears Stopping Time and returns to Caution Condition

OUTPUTS

An output module is required for connection to field devices. Consult Autotech Controls' M8250 Sourcing or M8250 Sinking Output Module Manual (manual part numbers MAN-M8250-POUT and MAN-8250-NOUT, respectively).

Fault Output:

Normally energized; de-energizes if broken resolver wire or M8251 internal fault is detected.

Motion Output:

Output energized whenever resolver RPM is between programmed motion limits.

PLS Outputs:

Number of PLS Outputs: 16

3. Installation and Wiring

Refer to figure 2 and the following installation and wiring tables 1 through 4 for connections to Autotech's M8251 LBus PLS Module, Part Number ASY-M8251-010.

Table 1. P1 Terminal Block

Terminal #	Designator	Function/Description
1	VS-	24 VDC external power source
2	VS+	
3	BCD-	Do not connect
4	BCD+	
5	MZ4	ModZ trigger input for Group 4
6	MZ3	ModZ trigger input for Group 3
7	MZ2/BC	ModZ trigger input for Group 2/Brake Clear
8	MZ1/BI	ModZ trigger input for Group 1/Brake Wear Input (see wiring note below)
9	SE	Supervisor Enable Input
10	PE	Program Enable Input
11	OE	Output Enable Input

Input BI (Terminal 8) must be wired as follows:

- Input BI must be TRUE when brake is applied (clutch is disengaged)
- Input BI must be FALSE when brake is disengaged (clutch is applied)

Table 2. P2 Terminal Block

Terminal #	Designator	Function/Description
1	S1	Resolver (Stator)
2	S2	
3	S3	
4	S4	
5	R2	Resolver (Rotor)
6	R1	
7	RXD-	Receive/Transmit data line for RS485 Serial Port
8	RXD+	
9	CTS-	CTS/RTS Handshake line for RS485 Serial Port
10	CTS+	
11	COM	Serial Common

3. Installation and Wiring — continued

Table 3. CBL-09S22-DAxxxx Cable Serial Port Wiring			
Wire Color (twisted pairs)	M8251 Terminal		DB9 Connector Pin
	Term. #	Function	
Yellow-Black	P2-7	RXD-	3
White-Black	P2-8	RXD+	4
Red-Black Yellow	P2-9 P2-9	CTS-	7 5
Blue-Black White	P2-10 P2-10	CTS+	8 6
Red	P2-11	COM	9

Table 4. CBL-10T22-xxx Cable Resolver Wiring			
Wire Color (twisted pairs)	Terminal #	Resolver Terminal #	Connector Pin on MS Connector
Yellow-Black Yellow	P2-1 P2-3	S1 S3	D C
Blue-Black Blue	P2-2 P2-4	S2 S4	B A
Green-Black Green	P2-6 P2-5	R1 R2	F E
Shield		Grn Gnd	G
To change the resolver ascending count direction, reverse the S1 and S3 connections.			

3. Installation and Wiring — continued

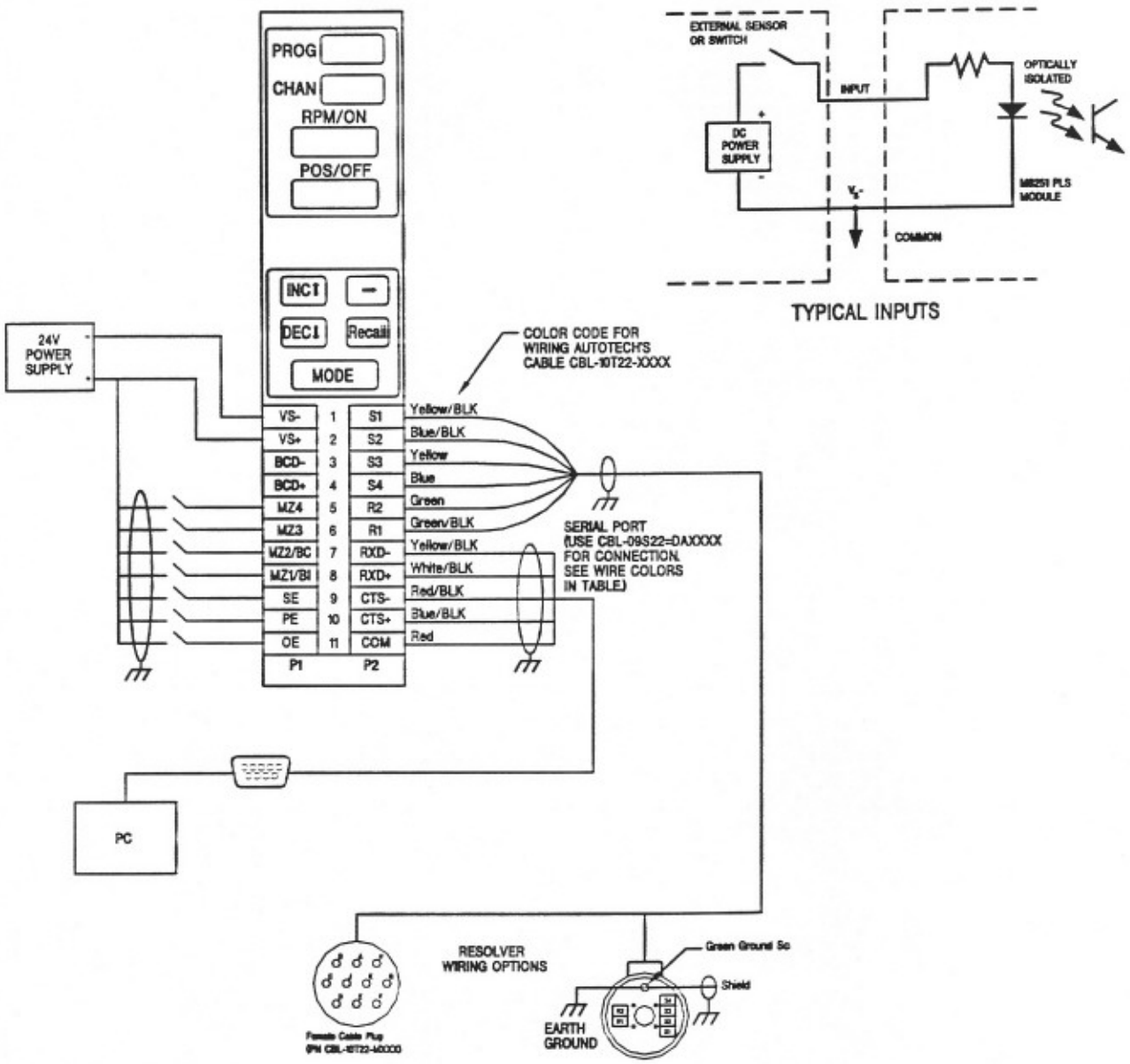


Figure 2. M8251 LBus PLS Module Wiring

4. Programming the M8251 LBus PLS Module

4.1 Overview

The M8251 LBus PLS Module can be programmed using one or more of the following:

- Keypad on the module
- IBM PC or a compatible computer
- PLC

Programming of the module using the Keypad is covered in this section. Programming through an IBM PC is covered in Autotech's Graphic PLS Interface Manual, Part Number PPC-M1051-00B. Programming through a PLC is described in the specific PLC manual.

On the M8251 LBus PLS, the different modes are accessed by repeatedly pressing the MODE key until the desired mode is displayed. The M8251 will automatically return to the Default Display Mode if left in some other mode for more than one minute without any key presses.

4.2 Definitions

This section defines nine commonly used terms associated with the M8251 LBus PLS Module programming instructions. These terms include:

- Program
- Keypad & Displays
  - — INC/DEC Keys
  - — Right Arrow Key
  - — Recall Key
  - — Default Display
  - — Cable Fault Display
- Groups
- ModZ Inhibit Zone
- Channel

Program

There are eight distinct setups that may be preprogrammed into the M8251 LBus PLS. The setups are identified by a Program Number from 1 to 8.

Keypad & Displays

Figure 3 shows the front view of the PLS module. The programming key sequences are fairly similar for all modes. Key Functions are described below.

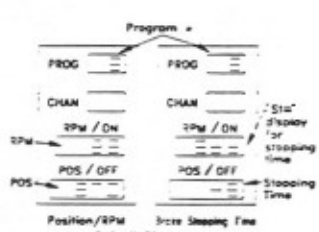
INC/DEC Keys — Blinking digits in a window indicate that the window's contents may be changed; numbers will be incremented or decremented, non-numerical selections will scroll to other selections. Channel and Group Numbers in the second window can always be increased and decreased to display the information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

Right Arrow Key — If programming is enabled, use the Right Arrow Key to move from one window to the other. Editing may occur in the window with the blinking digits. Also, from the Default Mode, the Right Arrow Key will cause either the RPM and Position, or the Brake Stop Time to be displayed.

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

Default Display — On power up, the PLS module displays one of the following two displays:

1) Program Number, Tachometer RPM, Base Position, or; 2) Program Number, Brake Stop Time in seconds (St=x.xx).



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4. Programming — continued

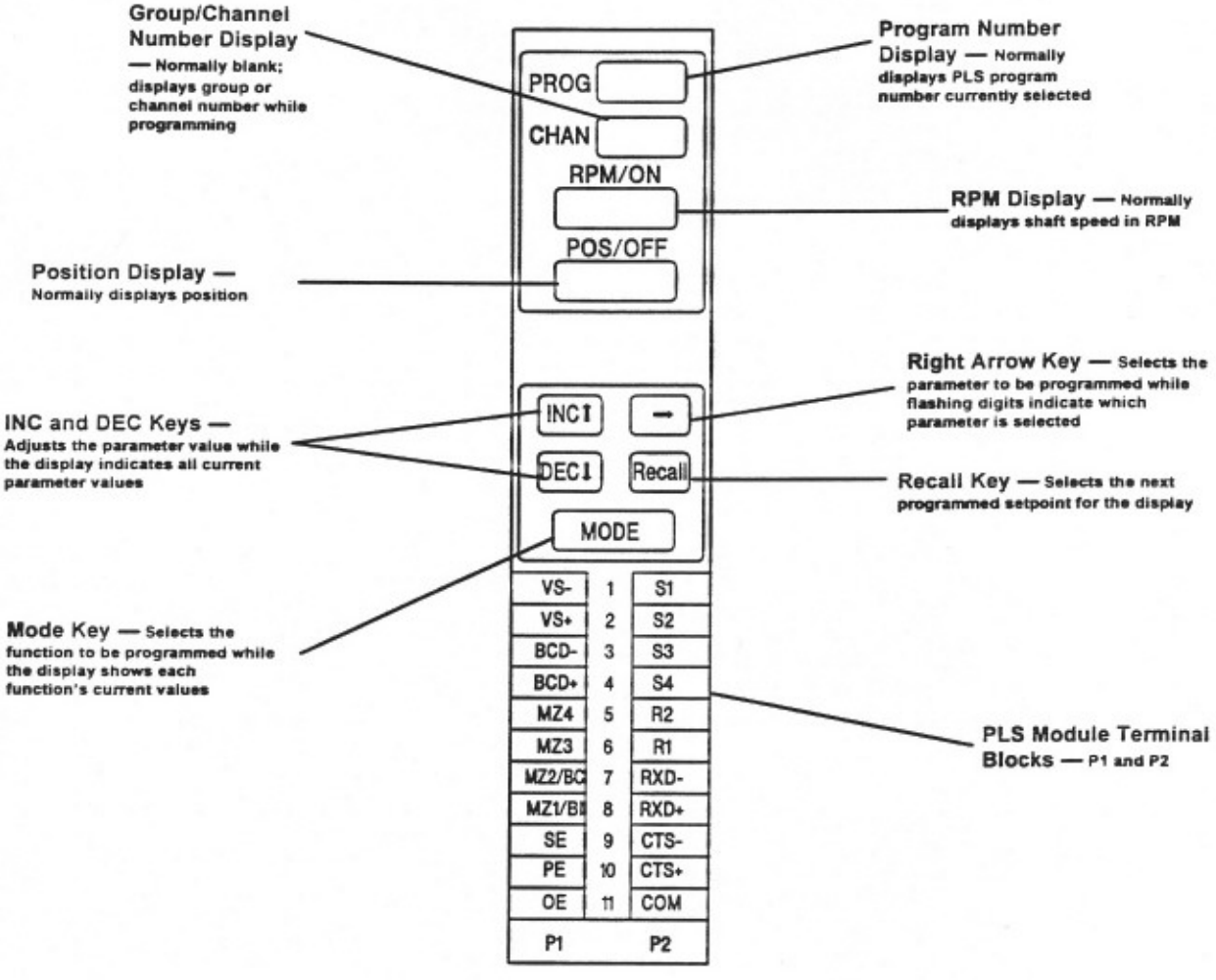
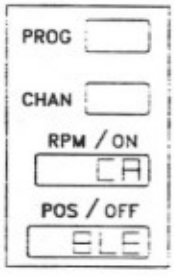


Figure 3. M8251 LBus PLS Module Keypad and PLS Terminal Blocks (P1 and P2)

4. Programming — continued

Cable Fault Display — In the event of a resolver cable fault, the message "CABLE" will be flashing in the RPM and Position windows:



Groups

Output channels may be "associated" or grouped together into one of four extra, independent groups. The base group is always PLS (Normal Programmable Limit Switch) type, while groups 1–4 may be defined as PLS or ModZ type. Each PLS group has its own group offset while each ModZ group has its own ModZ input and a ModZ inhibit zone. This creates the effect of having 5 independent M8251's running from the same resolver. This can be a very powerful and useful feature when it is desirable to control several different types of processes that are all driven by the same shaft.

ModZ Inhibit Zone

If the Group Type is ModZ, the Group Offset is not used. Instead, there is a parameter called the Inhibit Zone. The ModZ Inhibit Zone is an angular zone where the ModZ cycle may not be retriggered. The Inhibit Zone begins when the ModZ cycle is originally triggered (angle = 0), and continues up to the preprogrammed angle. Once the ModZ cycle has progressed beyond this Inhibit Zone, the ModZ cycle may be restarted by retriggering the ModZ input. A group may not be selected as a ModZ group if the Brake Wear Monitor is in use (i.e., the Brake Wear Limits are nonzero — see paragraph 4.4, *Programmable Options, ModZ*, this manual).

Channel

There are 16 independent output channels, each of which contains its own setpoint program to turn the output on or off at different shaft angles. Each channel also contains its own speed compensation factor so that propagation delays from output to process may be compensated for. Each channel is associated with one of the five groups; the default is the base group. Figure 4 shows the relationship between groups and channels.

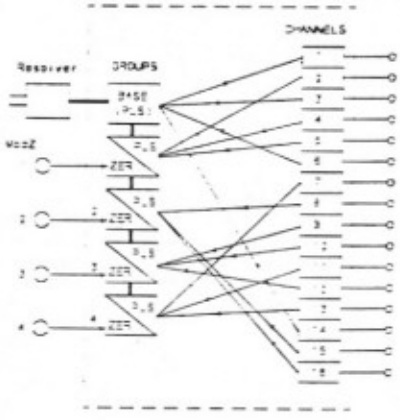


Figure 4. Groups and Channels Relationships

4.3 What needs to be programmed?

The module has many programmable parameters. Some of the parameters are program independent (i.e., they are common to all programs in the unit), while others are program specific. *Note that the M8251 LBus PLS can store 8 different setups (programs).* The current program is selected using the keypad, by a PLC command, or from the serial link.

Program Independent or Global Parameters

Table 5 summarizes program independent or global parameters. There are 16 independent output channels, each of which contains its own Setpoint program to turn the output on or off at different resolver angles. Each channel also contains its own speed compensation factor so that device response time may be compensated for. Inputs PE and SE control independent programming and viewing of the parameters. Both inputs must be TRUE to allow programming of all the parameters. *Programming Reference*, Section 5.0, provides complete key sequences for programming a parameter.

Program Dependent Parameters

Table 6 summarizes program dependent parameters.

Table 5. Program Independent Parameters

Parameters are common to all programs in the M8251 LBus PLS Module

Parameter	Definition	Range
Scale Factor (Prog. Mode 1)	Maximum number of counts per revolution: minus 1 (i.e., 999 Scale Factor gives 1000 counts/revolutions)	16-999 Default: 359 to work in degrees
Base Offset (Prog. Mode 2)	Counts to be added to resolver position. It is used to align resolver zero to machine zero.	0 to Scale Factor Default: 0
Motion Limits, High & Low (Prog. Mode 8)	Motion output energizes if resolver moves within these limits.	0 to 1999
Program Number (Prog. Mode 9)	Setup or Program number.	Range: 1-8 Default: 1
Station Number (Prog. Mode 10)	Unique node number for serial communication	0 to 255 Default: 16
Baud Rate (Prog. Mode 11)	Serial communication baud rate	110, 300, 600, 1200, 2400, 4800, 9600 Default: 9600

Table 6. Program Dependent Parameters

Parameters specific to a program

Parameter	Definition	Range
Speed Compensation (Prog. Mode 6)	A constant number in scale factor units to advance setpoints (dwells) based on resolver speed. Programmed in counts per 100 RPM.	0 to Scale Factor Default: 0 Programmed for each channel separately.
Brake Wear Monitor, Danger & Caution Limits (Prog. Mode 7)	Caution and danger limits for brake wear monitoring control outputs 7 and 8. If limits are 0, the outputs function as normal PLS outputs.	Range: 0 to 9.99 sec. Default: 0 Caution limit is less than Danger limit
Setpoints, ON & OFF for as many channels as required (Prog. Mode 12)	The associated output is energized at ON setpoint, and de-energized at OFF setpoint or Time-Off	Range: 0 to Scale Factor Multiple dwells possible in a channel. Maximum number of dwells = 80 per 8 channels Default: 0

4.4 Programmable Options

Speed Compensation

Speed compensation is used to advance/retard a programmed dwell dynamically based on resolver speed. This feature is useful to compensate for field device's response time. For example, consider an output driving a solenoid with a turn ON time of 10 ms. The application requires that the solenoid turns ON at 120 degrees, regardless of machine speed (i.e., turn ON the output 10 ms before machine reaches 120 degrees). That is, if the machine is running at 60 RPM, output needs to be turned ON at approx. 117 degrees. At 120 RPM, the same output needs to turned ON at 114 degrees. See *Mode 6, Programming Reference,* Section 5.0, for programming instructions on Speed Compensation.

Brake Wear Monitor

The M8251 LBus PLS has a programmable option to monitor wear on the machine brakes. To use this feature, the user needs to program two time limits, called Caution and Danger. A nonzero caution/danger limit indicates that the brake wear monitor feature is in use. With brake wear monitor, outputs 7 & 8 act as caution and danger outputs instead of normal PLS outputs. See *Mode 7, Programming Reference,* Section 5.0, for programming instructions for Brake Wear.

ModZ

Modification to zero (ModZ) is mutually exclusive with Brake Wear Monitor. ModZ works in the following way:

a. If a group is defined as ModZ, all the channels belonging to it are ModZ channels.

b. ModZ group is controlled by the corresponding ModZ input on the PLS terminal block P1.

c. When a false-to-true transition is detected on the ModZ input, the current angle becomes the new reference of "0" point. All the setpoints on the ModZ channels will be referenced to this point. ModZ channels will be referenced to this point. ModZ cycle terminates when one full resolver revolution is made.

CAUTION

Setpoints crossing "0" may give undesirable results when programmed into a ModZ output channel because the M8251 LBus PLS will react as if two setpoints were programmed: one beginning at zero, the other ending at zero.

Care should also be taken when programming ModZ setpoints and Speed Compensation into a PLS channel because too much Speed Compensation could cause a similar setpoint split or even cause a beginning of cycle setpoint to occur at the end of the cycle.

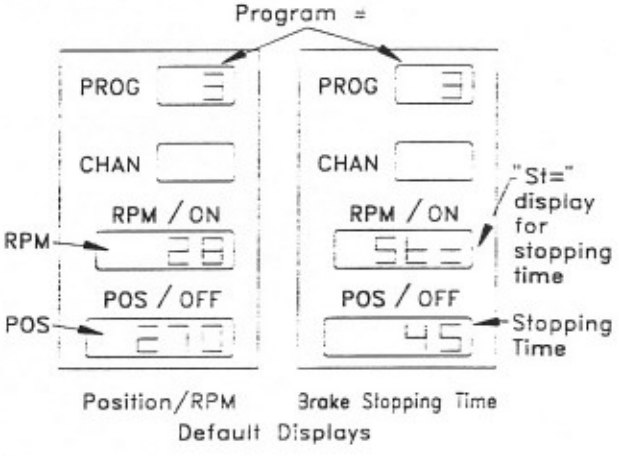
d. To start a new ModZ cycle, ModZ input must make a new false-to-true transition.

See *Mode 3, Group Type Definition, Programming Reference,* Section 5.0 for ModZ programming instructions.

5. Programming Reference

Mode: Default Displays

The module has two possible default display modes: (1) Position/RPM or (2) Brake Stopping time display. The right arrow key toggles the default display between these two display modes. On power up, or time out, the display returns to the current default display. The following table shows action in response to different key presses:



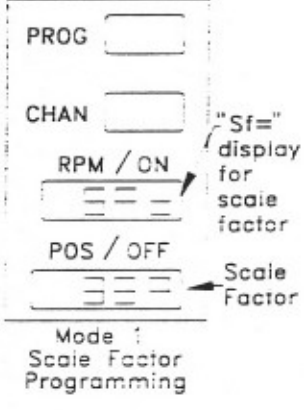
Key Pressed	Response
MODE	Switch to Mode 1 if SE TRUE or Mode 12 if SE FALSE
INC/DEC	Shows GR1-4 position + RPM If Group is undefined, POS=NULL
Right Arrow	Toggle between POS/RPM and Brake Stopping Time
Recall	Calls up setpoints

Mode 1: Scale Factor

Control Inputs: SE must be TRUE; PE must be TRUE for programming

Previous Mode: Default Mode

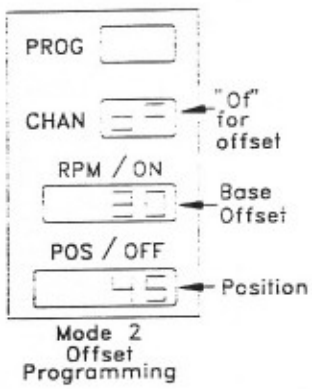
The Scale Factor is the desired counts per turn minus one. For example, to work in degrees, program the Scale Factor to 359. The allowed range of values is 16 to 999. The Scale Factor is common to all Setups. The following table shows action in response to different key presses:



Key Pressed	Response
MODE	Switch to Mode 2 if SE TRUE
INC/DEC	If PE is TRUE, Increment/Decrement blinking scale factor.
Others	No response
None	Display times out and returns to current default display

Mode 2: Base Offset

Control Inputs: SE must be TRUE; PE must be TRUE for programming
Previous Mode: Mode 1 (Scale Factor)
The Offset value is used to electronically align the resolver zero to machine zero. This feature allows mounting of resolver without regard to realignment. The allowed range for the offset is 0 to Scale Factor. The Offset is common to all setups. The current Offset is displayed in RPM/ON window, while the POS/OFF window shows position (which includes offset, i.e., Displayed Position = Resolver Position + Offset).

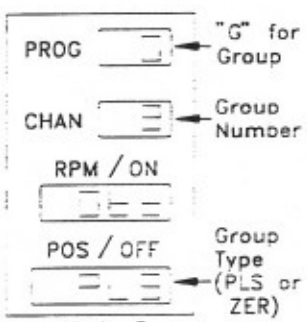


Mode 2 Offset Programming

Key Pressed	Response
MODE	Switch to Mode 3 if SE TRUE
INC/DEC	If PE is TRUE, Increment/Decrement blinking Offset (in RPM/ON window)
Others	No response to Recall & Right Arrow Keys
None	Display times out and returns to current default display

Mode 3: Group Type Definition

Control Inputs: SE must be TRUE; PE must be TRUE for programming
Previous Mode: Mode 2 (Offset)
The M8251 LBus PLS has a feature to associate outputs with up to 5 groups. These groups are called Groups 1 through 4 and Base. Base Group is the default group for all outputs (no ModZ feature associated with it). Groups 1 through 4 can individually be defined as PLS or ModZ ("Zer") groups. ModZ means Modified Zero.



Mode 3 Group Type Definition

A PLS Group can have an additional offset (in addition to base offset) called Group Offset — common to all associated outputs.

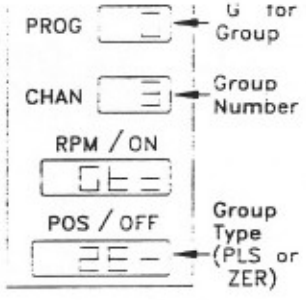
In a ModZ Group ("Zer"), all associated outputs share the same ModZ input (Group 1 will be controlled by ModZ1 input and so on). Any

— continued

output not associated with groups 1–4 is considered in Base Group, which is always a normal PLS type group (i.e., ModZ).

If the Group Type is ModZ, the Group Offset is not used. Instead, there is a parameter called the Inhibit Zone. The ModZ Inhibit Zone is an angular zone in which the ModZ cycle may not be retriggered. The Inhibit Zone begins when the ModZ cycle is originally triggered (angle = 0), and continues up to the preprogrammed angle. Once the ModZ cycle has progressed beyond this Inhibit Zone, the ModZ cycle may be restarted by retriggering the ModZ input.

Key Pressed	Response
MODE	Switch to Mode 4 if SE TRUE
INC/DEC	PE must be TRUE If cursor on group number (CHAN window), Increment/Decrement group number, decrementing below 1, displays "non" RPM/ON window. Leaving this mode with "Gr non" on display will mean no groups are defined. If cursor on group type window (POS/OFF window), toggle display between PLS (to define PLS type group) and ZER (to define ModZ type group).
Right arrow	If PE is TRUE, moves cursor between group number and group type windows. Pressing the Right Arrow Key again allows changing: - the Group Offset, if the group is a PLS, or - the MODZ Inhibit Zone, if the Group is ModZ ("Zer" on display)
None	Display times out and returns to current default display

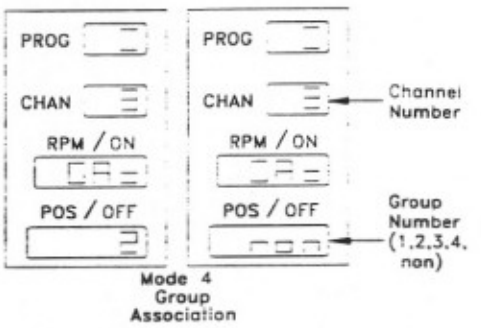


Mode 4: Group Association

Control Inputs: SE must be TRUE; PE must be TRUE for programming.

Previous Mode: Mode 3 (Group Type)

This mode is used to associate channels (outputs) selectively to groups defined in Mode 3. "non" in the group number display means that the channel is not associated with Groups 1–4, and that it is in the Base Group.



Key Pressed	Response
MODE	Switch to Mode 5 if SE TRUE
INC/DEC	If cursor on Channel Number, increment/decrement channel number. If cursor on Group Number, increment/decrement group number.
Right Arrow	If PE is TRUE, moves cursor between channel window having channel number and POS/OFF window displaying group number.
Recall	No response
None	Display times out and returns to default display

Mode 5: Channel Type Definition

Control Inputs: SE must be TRUE; PE must be TRUE for programming

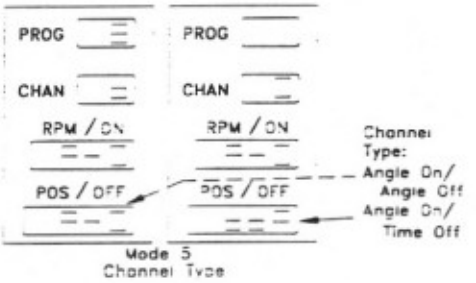
Previous Mode: Mode 4 (Group Association)

The outputs in M8251 LBus PLS are of two types:

Angle On – Angle Off: Outputs energized at an angle (on setpoint), and de-energized at another angle (off setpoint).

Angle On – Time Off: Outputs energized at an angle (on setpoint), and de-energized after programmed elapsed time.

This mode is used to program the type of output for each channel.



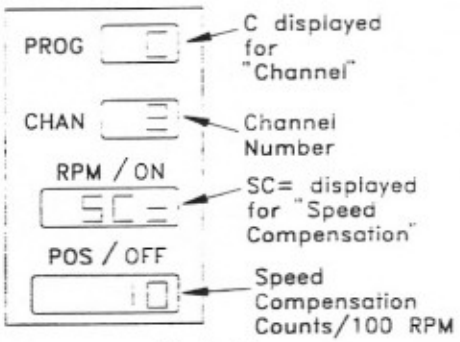
Key Pressed	Response
MODE	Switch to Mode 6 if SE TRUE
INC/DEC	If cursor on Channel Number, increment/decrement channel number. If cursor on Channel Type, increment/decrement Angle or Time Off.
Right Arrow	If PE is TRUE, moves cursor between channel window having channel number and POS/OFF window displaying channel type.
Recall	No response
None	Display times out and returns to default display

Mode 6: Speed Compensation

Control Inputs: SE must be TRUE; PE must be TRUE for programming

Previous Mode: Mode 5 (Channel Type Definition)

The M8251 LBus PLS requires speed compensation to be programmed in counts-to-be-advanced/retarded per 100 RPM. The speed compensation at other speeds is linearly calculated by the unit automatically. Most users program this value by trial and error. If you know the response time of the device to be compensated, a good starting value can be computed by the Speed Compensation formula as a function of response time: Delay (ms) (0.6 degrees/100 RPM). Each Channel 1 to 16 has its own programmable speed compensation, unless Channels 7 and 8 are used for Brake Wear Monitor (see Mode 7).



Mode 6
Speed Compensation

Key Pressed	Response
MODE	Switch to Mode 7 if SE TRUE
INC/DEC	If cursor on Channel Number, increment/decrement channel number. If cursor on Speed Compensation, increment/decrement speed compensation for the displayed channel number.
Right Arrow	If PE is TRUE, moves cursor between channel window having channel number and POS/OFF window shows speed compensation for displayed channel.
Recall	No response
None	Display times out and returns to default display

Mode 7: Brake Wear Monitor — Caution & Danger Time Limits

Control Inputs: SE must be TRUE; PE must be TRUE for programming
Previous Mode: Mode 6 (Speed Compensation)
Other Condition: ModZ groups not used
The Brake Wear Monitor is a programmable option. For brake wear monitoring, the user is required to program Caution and Danger Limits. If Danger Limit is OFF, the outputs function as normal PLS outputs. The Caution Limit is less than the Danger Limit. Maximum programmable limit is 9.99 sec. The Danger Limit will need to be entered first to allow room for the Caution Limit. *To turn off the Brake Wear function and use the output as a normal PLS output, set both limits to zero.*

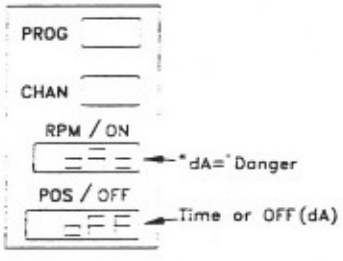
An input present on the BI (Terminal 8) starts a timer in the unit to measure machine stopping time — the internal brake input must be in brake mode before this statement is true. Likewise, the external brake input must be in brake mode when the internal brake input transitions from Run Mode to Brake Mode. The measured stopping time can be viewed by selecting it as default mode (see Default Displays). The stopping time is compared with programmed limits and outputs (Terminals 7 and 8) are controlled according to table 7 below.

A TRUE on BC input (Terminal P1-7) resets stopping time to zero, and also resets outputs to the Caution state. (Caution Output 7 ON, and Fail-safe Danger Output 8 ON).

Table 7. Brake Output Conditions on Terminals P1-7 and P1-8

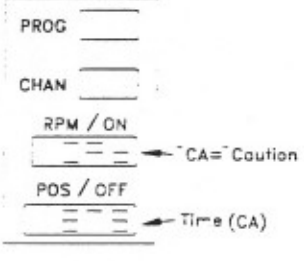
Condition	Output 7 (Caution)	Output 8 (Danger)
Safe (Stopping time less than caution limit)	Off	On
Caution (Stopping time between caution & danger Limits)	On	On
Danger (Stopping time more than danger limits)	On	Off

OFF: Denergized ON: Energized



Key Pressed	Response
MODE	Switch to Mode 8 if SE TRUE
INC/DEC	If RPM/ON window blinking - switch between Caution (CA=) & Danger (dA=) limits If POS/OFF window blinking (PE must be TRUE) - increment/decrement blinking number (limits)
Right Arrow	If PE is TRUE, moves cursor between Caution/Danger (RPM/ON) and Time Limit (POS/OFF) windows
Recall	No response
None	Display times out and returns to default display

or



Mode 7
Brake Wear Monitor
Caution & Danger Time Limits

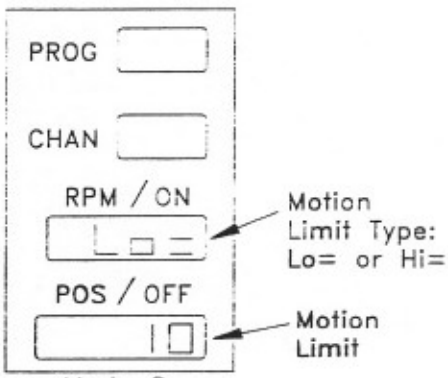
Mode 8: Motion Limits

Control Inputs: SE must be TRUE; PE must be TRUE for programming

Previous Mode: Mode 7 (Brake Wear Monitor)

The Motion Output is controlled by the Low and High Motion Limits. If the resolver RPM is between the Motion Limits inclusively, the Motion Output will be energized. Motion Limits are common for all eight programs.

Key Pressed	Response
MODE	Switch to Mode 9 if PE and SE are TRUE
INC/DEC	If cursor on motion limit type (in RPM/ON window), toggle between "Hi=" (High Motion Limit) and "Lo=" (Low Motion Limit) If cursor in POS/OFF window, increment/decrement displayed limit
Right Arrow	If PE is TRUE, moves cursor between motion limit type and the limit
Recall	No response
None	Display times out and returns to default display



Mode 8
Motion Limits

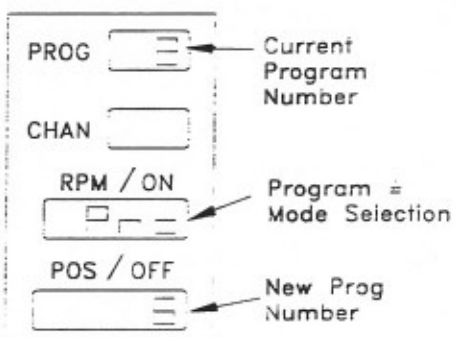
Mode 9: Program Number Selection

Control Inputs: SE must be TRUE; PE must be TRUE for programming.

Previous Mode: Mode 8 (Motion Limit)

Other Conditions: The resolver must not be moving (RPM<4)

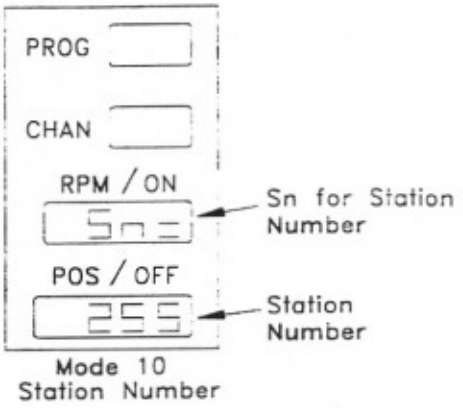
Key Pressed	Response
MODE	Switch to Mode 10 if PE and SE are TRUE
INC/DEC	If PE is TRUE, increments/decrements Program Number
Right Arrow	No response
Recall	No response
None	Display times out and returns to default display



Mode 9
Program Number Selection

Mode 10: Station Number Selection

Control Inputs: SE must be TRUE; PE must be TRUE for programming.
Previous Mode: Mode 9 (Program Number)
The Station Number for serial communications must be unique for each communicating device on the communications link. The number may be from Station #1 to #255. If serial communications should be disabled, select "off" (where #0 would be).



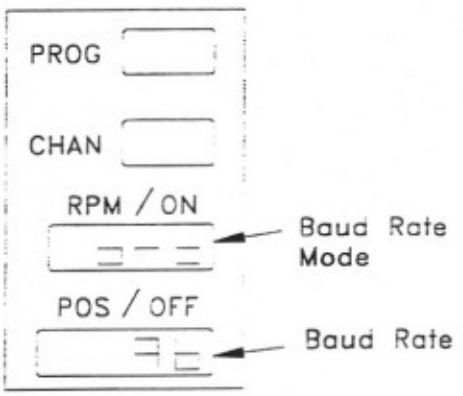
Mode 10
Station Number

Key Pressed	Response
MODE	Switch to Mode 11 if PE and SE are TRUE
INC/DEC	IIf PE is TRUE, increments/decrement displayed Station Number
Right Arrow	No response
Recall	No response
None	Display times out and returns to default display

Mode 11: Baud Rate Selection

Control Inputs: SE must be TRUE; PE must be TRUE for programming
Previous Mode: Mode 10 (Station Number Selection)

The M8251 LBus PLS supports the following baud rates for serial communication: 110, 300, 600, 1200, 2400, 4800, 9600.



Mode 11
Baud Rate

Key Pressed	Response
MODE	Switch to Mode 12 if PE and SE are TRUE
INC/DEC	If PE is TRUE, increments/decrement baud rate
Right Arrow	No response
Recall	No response
None	Display times out and returns to default display

Mode 12: Setpoint Programming

Control Inputs: PE must be TRUE for programming

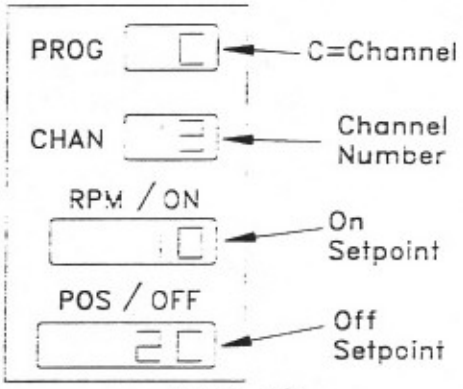
Previous Mode: Mode 11 (Baud Rate) if SE is TRUE (Default Mode) if SE is FALSE

When the shaft is moving in the forward direction, Angle-On/Angle-Off setpoints are defined as: On = Angle at which the output will turn on, Off = Angle at which the output will turn off. These angles are programmed by using the Right Arrow key to select the number to edit, then Incrementing or Decrementing the number. Pressing the Right Arrow Key moves you from Channel Number to:

1. On Setpoint
2. Off Setpoint or Time Off Value.
3. Set or Program both On and Off setpoints (INC or DEC) together (for retaining current dwell span), back to Channel Number.

Pressing the Recall Key will reveal any additional Setpoints in the selected channel and will provide the "Null Setpoint" symbol [o] [o] so that additional setpoints may be added to that channel. The blinking decimal point in the channel window serves as an acknowledgment that new setpoint pair is being stored. Each Channel 1 to 16 may contain any number of setpoints (on/off pairs) up to the following limits: the low 8 channels (1 to 8) are limited to a total of 80 setpoints; the high 8 channels (9 to 16) are limited to a total of 80 setpoints.

Key Pressed	Response
MODE	Switch to Default Mode
INC/DEC	Increment/Decrement
Right Arrow	Each press moves cursor from Channel Number to On to Off Setpoint Windows - First press: Channel Window to On Setpoint - Second press: On Setpoint Window to Off Setpoint -Third press: Off Setpoint Window to On and Off Setpoint (Channel Window) - Fourth press: On and Off Setpoint Windows to Channel Window (for retaining current dwell span)
Recall	Recall new setpoint pair if exists, or null setpoint
None	Display times out and returns to default display



Mode 12
Setpoint Programming

Mode: Cable Fault Display

Control Inputs: N/A

Previous Mode: Default

The M8251 LBus PLS internal self-check circuit continuously monitors the microprocessor, DC power, and resolver cable. If any fault is detected by the M8251 LBus PLS, the "cable" fault detection display will appear. During this mode, the fail-safe fault output will turn OFF and all outputs are disabled automatically. When corrected, the display will return to the Default Display.

How to Use the M8251 PLS in the TI 505 PLC System

The M8251 Programmable Limit Switch (PLS) is an intelligent I/O module used with TI 505 programmable controller family. All the parameters contained in the PLS can be accessed or programmed through a series of commands.

MODULE ACCESS

The PLC communicates with the M8251 Module through first 32 input and next 32 output registers. There are two ways to communicate with the M8251, read and write immediately or read and write issues commands. First 6 output registers are for request commands, next 28 registers are for immediately write data. First 6 input registers are for response commands and next 7 input registers are for immediately read parameters. The detailed commands and response formats are given in the Programming Commands. The general command and response formats are as follows:

Output Registers

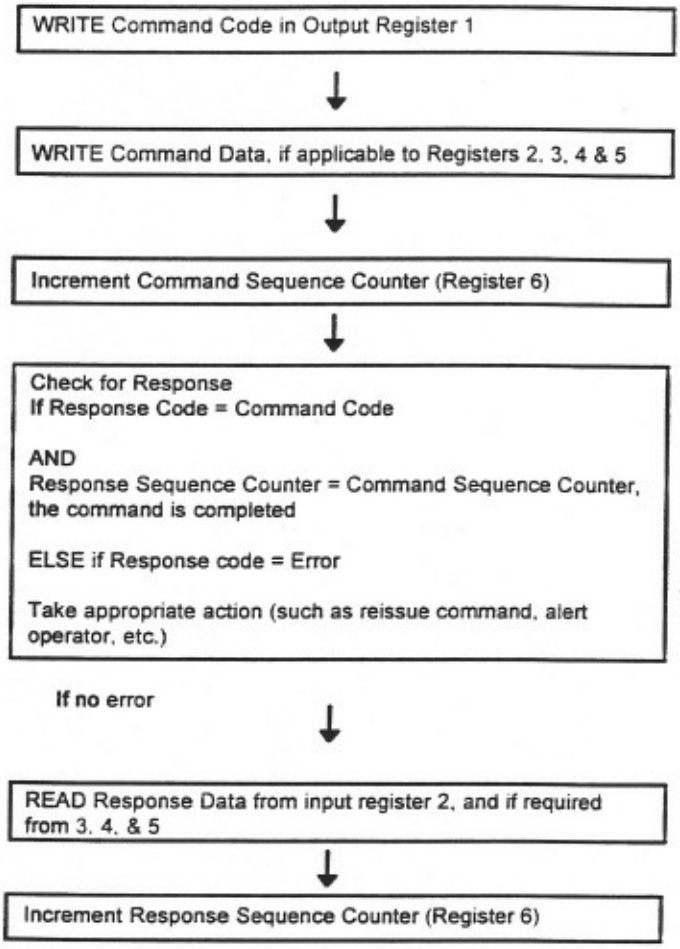
Output Register #	Information
1	Command Code
2	Command Data 1
3	Command Data 2
4	Command Data 3
5	Command Data 4
6	Command Sequence Counter

Input Registers

Input Register #	Information
1	Response Code
2	Response Data 1
3	Response Data 2
4	Response Data 3
5	Response Data 4
6	Response Sequence Counter

PROGRAMMING THE M8251

Follow the steps below to program the M8251:



Sequence Counter

The first 5 registers are general purpose I/O registers, while register 6 is a special register called SEQUENCE COUNTER. SEQUENCE COUNTER register is used to determine when response to the previous command register 6 must contain a non-zero value, preferably 0x5A5A to indicate the end of command.

This new value must be written to output register 6 after writing the rest of the request has been completed. When input register 6 comes back

with the same value, a valid response to the previous command is available in input registers 1-5. Getting the same response in the input register 1 as command in the output register 1 is not a guarantee that this is a response to the current command. After reading the command and receiving a valid response, the sequence counter should be reset back to zero, before the next command is written.

The following chart gives information regarding the TI505:

Status Words	Description
STW2	Base Controller Status
STW11	I/O Module Status
STW184	Mismatch Indicator

Input Words	Description
WX1	Response Command
WX2	Data
WX3	Data
WX4	Data
WX5	Data
WX6	Response Counter
WX7	Position
WX8	Position Valid
WX9	RPM
WX10	RPM Valid
WX11	Outputs
WX12	Outputs Valid
WX13	Status

Output Words	Description
WY33	Request Command
WY34	Data
WY35	Data
WY36	Data
WY37	Data
WY38	Command Counter
WY39	Frozen Immediately Inputs
WY56	Shift Setpoints Retard
WY57	Shift Setpoints Advance
WY58	Enable/Disable Outputs
WY59	Increment by # (1-50)

The following table provides information regarding communications between the TI505 Bus and Module 8251:

Communications for TI 505 Bus and Module

Base Offset for DP TI Bus 2000h		Base Offset for DP Module 4000h	
DP TI Bus	***Address***	***DP Module***	***Address***
Ident. Code (density = 30h)	00h	Request Buffer	000-03Fh
Ident. Code (x-y = 0)	01h		
Ident. Code (wx-wy = FFh)	02h		
Response Buffer	100-109h	Response Buffer	040-07Fh
Response Counter	10A-10Bh		
Position	10C-10Dh	Position	08E-08Fh
Position Valid	10E-10Fh	Position Valid	090h
RPM	110-111h	RPM	091-092h
RPM Valid	112-113h	RPM Valid	093h
Outputs	114-115h	Outputs	094-095h
Outputs Valid	116-117h	Outputs Valid	096h
Status	118-119h	Status	097-098h
Request Buffer	140-149h		
Command Counter	14A-14Bh		
Frozen Immediately Inputs	14C-14Dh		
Write Area Only	16E-17Fh	Write Area Only	0A0-0B1h
		Outputs Enable	3F1h
		Valid Write Data	3FCh
		Interrupt Module	3FEh
		Interrupt Bus	3FFh

- Request Buffer - Buffer for Read/Write Commands
- Command Counter - If counter not equal to zero, Request is TRUE
- Response Buffer - Buffer for response commands
- Response Counter - If Response Counter is equal to Request Counter, Response is TRUE
- Frozen Immediately Inputs - If register is not equal to zero, Position RPM, Outputs, Status are frozen
- Parameter Valid - If register equals 255, parameter is TRUE
- Shift Setpoints - Control of shifting setpoints Bit 0 - Control channel 1, Bit 15- Control Channel 16

Programming Commands - Read/Write Response

GENERAL GUIDELINES:

1. In the formats given below, Command and Response start in the lower numbered register.
2. Response Code is generally the same as the Command Code, except when error condition is encountered. For errors, the lower byte of the Response Code is the same as the Command Code, while the higher byte is an error code.
3. The following error codes apply:

Error Code	Error Description
0	No Error
1	No Program Enable Input
2	Resolver in Motion (programming is not allowed)
3	Illegal Parameter Value (usually, channel number is out of range or value being programmed is out of range. See the rules for valid ranges below)
4	Unit is busy processing previous command. Try again.
5	Illegal Command Code.

Parameter	READ FUNCTION		WRITE FUNCTION	
	Command Format	Response Format	Command Format	Response Format
Position	Command Code = 1	Response Code = 1 Position		
RPM	Command Code = 2	Response Code = 2 RPM		
Offset	Command Code = 3	Response Code = 3 Offset	Command Code=131 Offset	Response Code = 131 + 256 * Error Code
	Offset must be represented in Scale Factor units. Therefore, 0 <= Offset <= Scale Factor			
Scale Factor	Command Code = 4	Response Code = 4 Scale Factor	Command Code=132 Scale Factor	Response Code = 132 + 256 * Error Code
	*Note: Using Command Code 132 (Scale Factor) followed by Command Code 17 (Position); When changing the Scale Factor through Tisoft and then reading current position, please note that the position may be based on the previous Scale Factor for approximately 2-1/2 minutes or 2το 4° resolver movement.			
Low Motion Limit	Command Code =5	Response Code = 5 Low Motion Limit	Command Code=133 Low Motion Limit	Response Code = 133 + 256 * Error Code
	Low Motion Limit must be less than High Motion Limit			

Parameter	READ FUNCTION		WRITE FUNCTION	
	Command Format	Response Format	Command Format	Response Format
High Motion Limit	Command Code = 6	Response Code = 6 High Motion Limit	Command Code =134 High Motion Limit	Response Code = 134 + 256 * Error Code

High Motion limit must be greater than Low Motion Limit but less than 1000

Parameter	READ FUNCTION		WRITE FUNCTION	
	Command Format	Response Format	Command Format	Response Format
Program Number	Command Code = 8	Response Code = 8 Program Number	Command Code =136 Program Number	Response Code = 136 + 256 * Error Code

Valid Program Numbers are 1 - 8

Parameter	READ FUNCTION		WRITE FUNCTION	
	Command Format	Response Format	Command Format	Response Format
Inputs / Outputs	Command Code =11	Response Code =11 Inputs | Outputs		

Outputs / Inputs Register has the following format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MZ4	MZ3	MZ2	MZ1	NU	OE	SE	PE	NU	NU	NU	NU	Dngr	CTN	Mot	BW

NU = Not used (reserved, may be 1 or 0)

Bit 15 = ModZ4 input status
Bit 14 = ModZ3 input status
Bit 13 = ModZ2 input status
Bit 12 = ModZ1 input status
Bit 11 = Not used
Bit 10 = Output Enable (1 - Enabled)
Bit 9 = Supervisory Enable (1 = Enabled)
Bit 8 = Program Enable (1 - Enabled)
Bit 7 = Not Used
Bit 6 = Not Used
Bit 5 = Not Used
Bit 4 = Not Used
Bit 3 = Brakewear Danger Output Status
Bit 2 = Brakewear Caution Output Status
Bit 1 = Motion Output Status
Bit 0 = Resolver Broken Wire (1= - broken wire)

Parameter	READ FUNCTION		WRITE FUNCTION	
	Command Format	Response Format	Command Format	Response Format
Read Serial Commun-ication	Command Code = 12	Response Code = 12 Baud Rate Station Number	Command Code = 140 Baud Rate Station Number	Response Code = 140 +256* Error Code

Parameter	READ FUNCTION		WRITE FUNCTION	
	Command Format	Response Format	Command Format	Response Format
Caution Limit	Command Code = 13	Response Code = 13 Caution Limit	Command Code=141 Caution Limit	Response Code = 141 + 256 * Error Code

Caution Limit must be in milliseconds and less than Danger Limit

Parameter	READ FUNCTION		WRITE FUNCTION	
	Command Format	Response Format	Command Format	Response Format
Danger Limit	Command Code =14	Response Code = 14 Danger Limit	Command Code=142 Danger Limit	Response Code = 142 + 256 * Error Code
	Danger Limit must be in milliseconds, greater than Caution Limit, and less than 9990 msec			
Stopping Time	Command Code = 15	Response Code = 15 Stopping Time		
	Stopping time is given in milliseconds			
Group Positions	Command Code = 16	Response Code = 16 Group 1 Position Group 2 Position Group 3 Position Group 4 Position		
PLS Status	Command Code = 17	Response Code = 17 Position RPM Outputs* Inputs**		
	*Output information provided as Command 42 **Input information provided as shown for Command 11			
Number of Setpoints	Command Code = 18	Response Code = 18 Channel (1-16) Number of Setpoints		
Speed Compen-sation	Command Code = 32 Channel (1 - 16)	Response Code = 32 Channel Number Speed Compensation	Command Code=160 Channel (1 - 16) Speed Compensation	Response Code = 160 + 256 * Error Code
	Speed Compensation Value must not exceed Scale Factor			

Parameter	READ FUNCTION		WRITE FUNCTION	
	Command Format	Response Format	Command Format	Response Format
Setpoints	Command Code =36 Channel (1 - 16) Setpoint Number (1-80)	Response Code =36 Channel Number (1 - 16) Setpoint # On Setpoint Off Setpoint	Command Code=164 Channel Number (1 - 16) Additional Code (* See Below) On Setpoint Off Setpoint	Response Code = 164 + 256 * Error Code Channel Number (1-16) Setpoint #
Outputs	Command Code = 42	Response Code = 42 Outputs		
Group Association	Command Code = 43 Channel Number	Response Code = 43 Channel Number Group Number	Command Code = 171 Channel Number Group Number	Response Code = 171 +256* Error Code
Group Types	Command Code = 44	Response code = 44 Group Types	Command Code = 172 Group Number (1-4)	Response Code = 172 +256* Error Code

***Additional Code:**

0 = Erase existing setpoints before programming new

1 = Append new setpoints to the existing ones

2 = All ON setpoint

If All ON setpoint is being programmed, # of setpoint pairs and setpoint values following are not required.

To clear the Channel of all setpoints:

Additional Code = 0

On Setpoint 1 = 0

Off Setpoint 1 = 0

* Output information provided as Bit 0 = Output 1, Bit 1 = Output 2, Bit 2 = Output 3, etc.

There are 4 groups + base group, so valid values for Group Association are 1-4 for four groups and 255 for base group.

When reading with Tisoft using Command Code 43, valid values for Group Association are 0-3 for the four groups and 255 for base group. "0" will be Group 1, "1" will be Group 2, etc.

The Command Code 171 does not currently allow the user to write. The keypad or the serial input will be required for writing.

Group Types are indicated by the lowest 4 bits of the Group Types Register: Bit 0 = Group 1, Bit 1 = Group 2, Bit 2 = Group 3, Bit 3 = Group 4. If Bit = 0, the corresponding group is PLS; if Bit = 1, the corresponding group is MODZ.

Parameter	READ FUNCTION		WRITE FUNCTION	
	Command Format	Response Format	Command Format	Response Format
Channel Setup Data	Command Code =45 Channel (1 to 4)	Response Code = 45 Group Number Group Offset	Command Code = 173 Group Number (1-4) Group Offset	Response Code = 173 +256 * Error Code
	Offset must be represented in the scale factor units. Therefore, 0<= Offset <=Scale Factor.			
ModZ Inhibit Zone	Command Code = 46 Group Number (1-4)	Response Code = 46 Group Number ModZ Inhibit Zone	Command Code = 174 Group Number (1-4) ModZ Inhibit Zone	Response Code = 174 +256* Error Code
	ModZ Inhibit Zone must be represented in the Scale Factor units. Therefore, 0 <= Inhibit Zone <+ Scale Factor.			
Channel Types	Command Code = 47	Response Code = 47 Channel Types	Command Code = 175 Channel Types	Response Code = 175 +256* Error Code
	Channel type can be either Angle On/Angle Off or Angle On/Time Off. Each Channel Type is indicated by the corresponding bit in the Channel Type Register. Bit 0 corresponds to Channel 1, bit 15 corresponds to Channel 16. Bit = 0: Channel is Angle On/Angle Off Bit = 1: Channel is Angle On/Time Off			
Angle On/ Time Off	Command Code = 48 Channel (1-16)	Response Code = 48 Channel Number Angle On Time Off	Command Code = 176 Channel (1-16) Angle On Time Off	Response Code = 176 +256* Error Code
	Angle must be in scale factor units. Time must be in milliseconds <9990 msec. Angle On/Time Off Setpoints can be read from and written to a channel whose type is Angle On/Angle Off. They do not have any effect until channel type is changed to Angle On/Time Off. Similarly, Angle On/Angle Off Setpoint can be read from or written to Angle On/Time Off Channel.			

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