SERIES 7700

INTELLIGENT LDT INTERFACE MODULE

USER'S MANUAL

Catalog Number 7700-195M

This manual is written to explain the operation of the following AMCI Modules for the Allen-Bradley 1771 I/O:

7751
7752

Important User Information

The products and application data described in this manual are useful in a wide variety of different applications. Therefore, the user and others responsible for applying these products described herein are responsible for determining the acceptability for each application. While efforts have been made to provide accurate information within this manual, AMCI assumes no responsibility for the application or the completeness of the information contained herein.

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For technical support, call (860) 583-7271.

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Revision History

This revision, 7700-B94M, replaces 7700-293M. It adds information on the AMCI and Balluff transudcers. It was first released 11/17/94 and coincides with software Rev. 2.

The Series 7700 LDT Interface Modules

Today's manufacturing processes are becoming more and more complex. Achieving the goals of lower cost production, higher output, less wasted material, and fewer rejects is important if a company is to compete in today's global economy. To achieve these goals, programmable controller systems are being used in more and more applications because of the precise control and flexibility that such a system provides.

One device that can be use to accurately measure linear distances is the magnetostrictive Linear Displacement Transducer (LDT). Until the introduction of the Series 7700 Modules, interfacing a magnetostrictive LDT to a programmable controller system could be a difficult task. One possibility was to use an external decoder that interfaced to the programmable controller through an analog or digital input card. Another possibility was the Allen-Bradley Linear Positioning Module (1771-QB) that could be confusing to use in applications that require only position and velocity feedback instead of closed loop position control.

Utilizing licensed Allen-Bradley proprietary 1771 I/O interface technology and patents, and the latest in programmable chip technology, the Series 7700 Modules are direct interfaces between magnetostrictive LDT's and your A-B programmable controller. The many features of the 7700 Modules make them the most advanced products on the market today.

- Interfaces 1 or 2 AMCI, Balluff or Temposonics™ II LDT's to your programmable controller.
- Communicates with the processor via the Block Transfer Instructions. Block Transfer Read Instructions give access to position, velocity, and fault diagnostic data while Block Transfer Write Instructions make the module fully programmable from the backplane.
- Position and velocity resolution fully programmable down to one thousandth of an inch. Other features include: Position Offset, Count Direction, Auto Preset of position data and many more.
- Self-contained design eliminates the need for an external power supply.
- Extensive diagnostics continuously monitor the transducer and module for fault conditions.
- Sealed display and keyboard for quick program changes during setup or position and velocity data monitoring.

Series 7700 Family Members

The following make up the line of Series 7700 LDT Interface Modules. Potential future members may have higher resolution, compatibility with different manufacturers of LDT's, or more than two transducer inputs per module.

- 7751 One transducer interface, 0.001" resolution, ± 100,000 Counts
- 7752 Two transducer interface, 0.001" resolution, ± 100,000 Counts

Magnetostrictive LDT Description

Magnetostrictive LDT's rely on a phenomenon known as the Wiedemann Effect. All ferromagnetic metals such as iron and nickel display this phenomenon. A ferromagnetic metal forms a magnetic field around it whenever it conducts an electrical current. If this field interacts with a second magnetic field, the metal will physically twist. This twist then travels along the metal in the same fashion as a ripple in water.

Figure 1.1 shows a typical LDT. The waveguide is a hollow tube made from a ferromagnetic metal. Threaded through the waveguide is a wire that carries the current pulse from the head of the LDT. Using a second wire to carry the current pulse instead of the waveguide increases the accuracy and repeatability of the system. Also located in the head of the LDT, Pickup Coils sense when the twist in the waveguide, called the Strain Pulse, reaches the head of the LDT.

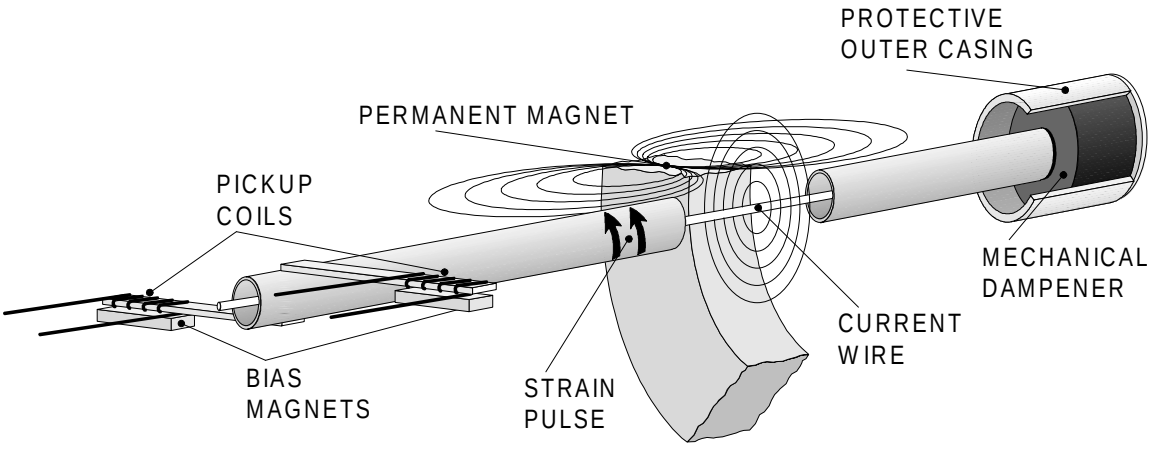


Fig 1.1 Typical Magnetostrictive LDT

To determine the position of a permanent magnet along the LDT's length, a current pulse is sent over the wire contained within the waveguide. This current pulse instantaneously forms a magnetic field around the waveguide. The waveguide twists where the fields formed by the current pulse and the magnet intersect. Like a ripple on water, this Strain Pulse travels towards the head and the end of the LDT at over 9000 feet per second (6000 miles per hour). The strain pulse that travels towards the head is detected by the pickup coils. The strain pulse that travels toward the end is absorbed by a mechanical dampener to prevent it from reflecting back to the head and causing a false signal. The mechanical dampener is the cause of the "dead zone" at the end of the LDT.

To determine the position of the magnet, it's important to know the speed that the strain pulse travels along the waveguide. MTS, the manufacturer of Temposonics™ II LDT's, calls this value the LDT's **Gradient** and specifies it in µSeconds per inch. Typically, the Gradient has a value of 9.03 but this varies slightly from transducer to transducer. The time it takes the strain pulse to reach the head of the LDT can be determined by starting a high speed counter when the current pulse is sent and stopping the counter when the pickup coils sense the strain pulse. The magnets absolute position from the pickup coil equals the counter time divided by the Gradient value.

7700 Functions and Parameters

FUNCTIONS

The 7700 Modules perform two operations. These two operations are called **Functions**. These Functions are:

Position Data Function - Gives you information on the position of the LDT's magnet relative to a zero point.

Velocity Data Function - Gives you information on the velocity of the magnet along the LDT's shaft.

> One or more inputs define each Function. One input is the magnets' absolute position on the LDT transducer. The other inputs are programmable from the keyboard or the PLC. These inputs are called **Parameters**.

SCALING PARAMETERS

Count Direction - Sets the direction, relative to the head of the LDT, that the magnet must travel to increment the Position Data.

Full Scale Length - Programmable in inches or millimeters, this parameter is the length that you expect the magnet to travel. Maximum value is 650 inches or 9999 millimeters.

Full Scale Count - This parameter sets the number of counts over the Full Scale Length. The position resolution is equal to the Full Scale Length ÷ Full Scale Count. Maximum resolution is 0.001 inches or 0.1 millimeters.

Position Offset - This parameter changes the value of the Position Function without moving the magnet on the LDT. Use it to set the zero or starting position of the magnet along the LDT's length.

SET-UP PARAMETERS

> These parameters are only available when the module is in Program Mode (See *Program Switch* Pg. 2-9 for more information.) These parameters contain information that usually not changed once the system is running.

LDT Type - This parameter tells the 7700 Module the type of LDT attached to the module. If you are using Temposonics™ II LDT's it also specifies the type of Personality Module installed in its head. Presently, AMCI, Balluff, and Temposonics II LDT's are supported. When using the 7752 Plug-in card, the two LDTs can be different.

DPM Recirculations - Shown only when a Temposonics II with a DPM module is selected as the LDT Type, this parameter tells the module how many Recirculations you have set on the DPM Module. Allowable values are 1, 2, and 4 recirculations.

Measurement Unit - Specifies the measurement unit for all parameters. Set it to the same measurement system used to specify the length of the LDT, inches or millimeters.

LDT Gradient - This is a LDT calibration parameter. It is the rate at which the return pulse propagates down the transducer's length. AMCI and Balluff specify it in meters per second while MTS specifies it in µSeconds per inch.

7700 Functions and Parameters (cont'd)

SET-UP PARAMETERS (cont'd)

Decimal Point Position - Used to fix a decimal point on the Position, Full Scale Count, Position Offset, and Preset Value displays, this parameter is for the convenience of someone looking at the display. It does not affect the data sent to the processor.

Preset Value - This parameter specifies the value that the Position Function will change to when the Auto Preset feature is used. Use the Auto Preset feature to set the Position Function to the correct value when the LDT is at its home or zero position.

Speed Average - Sets the update time of the 7700's Velocity Function. Update time is the amount of time that the Module totals the change in position of the magnet before calculating the velocity of the magnet in Counts per Second.

Data Format - Allows you to choose Binary or BCD format for the data being sent to the PLC.

Transfer Type - Allows you to choose between Block or Single Transfers. (7751 only.)

Application Notes

The Measurement Unit Parameter is in some ways the fundamental parameter of the 7700. This parameter effects the values that can be entered for the Full Scale Length, Full Scale Count and LDT Gradient Parameters. Changing the Measurement Parameter resets most other Parameters to their default values.

The example below shows how to use the Full Scale Length and Full Scale Count Parameters to scale the Position and Velocity data to a range of values meaningful to your application. In the example, you are measuring the amount of liquid on a cylindrical tank.

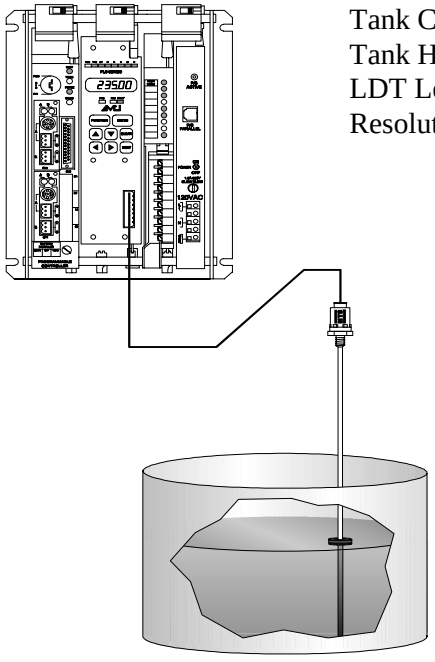


Figure 1.2 7700 Application

Tank Capacity = 250 Gallons
Tank Height = 40 Inches
LDT Length = 72 Inches
Resolution = 0.01 Gallons

7700 Programming

Count Direction: Negative.
F. S. Length: 40 Inches.
F. S. Count: 25000 (250 ÷ 0.01)
Position Offset: Approx. 20000. Exact Offset calculated with AUTO PRESET feature.
LDT Type: AMCI. (Default)
DPM Recycles: Not used with AMCI LDT.
Measurement Unit: Inches.
LDT Gradient: Transducer Dependent.
Decimal Point: 2.
Preset Value: 25000
Speed Average: 240 milliseconds.

Front Panel Description

The following is a description of the features found on the Series 7700 Modules. Separate sections of this chapter describes the parts in detail. Unless otherwise noted, all information presented in this chapter is applicable to all of the modules in the 7700 Series.

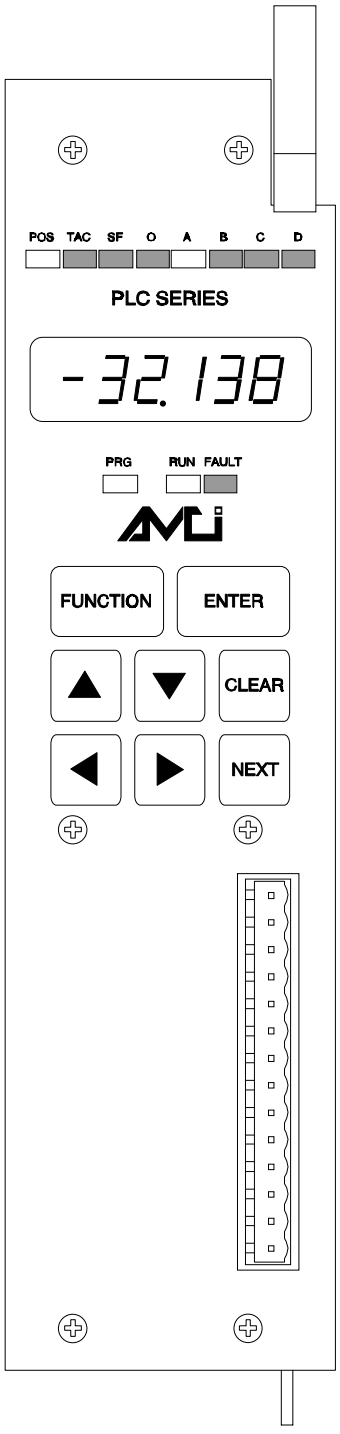


Fig 2.1 7700 Front Panel

Function Display - Used to show the Functions and Parameters of the 7700 Module. The eight LED indicators designate what is showing on the alpha-numeric display. When you are in Program Mode, a blinking digit on the alpha-numeric display shows the position of the Cursor.

Status Indicators - Indicates the operating condition of the module.

- PRG - Yellow light is on when the module is in Program Mode.
- RUN - Green light is blinking when the module is operating.
- FAULT - Red light is on when there is a fault condition. The nature of the fault is shown on the alpha-numeric display.

Program Switch - Located on the top panel, hidden from view. Used to enable or disable Program Mode. When enabled, the module is programmable from the keyboard.

Keyboard - Used to examine or change the Functions and Parameters of the module.

Transducer Input Connector - Connector for the AMCI, Balluff or MTS Temposonics II Transducers.

Function and Parameter Displays

The following displays are available on the 7700 Modules. A brief description of each Function or Parameter is given to the right of the display. Unless noted, each of the displays is available on all of the 7700 Modules. Please note that a shaded LED indicator is not lit in the display.

Fig 2.2 Position Display

Position Data Display - This display shows the current position of the magnet along the LDT's shaft. It's value is based on the displacement from a programmed zero point. Maximum/Minimum value is ±99,999. If the Position Data becomes greater than +99,999 the Position display will change to " End ". If the Position Data becomes less than -99,999 the Position Display will change to "-End ". If you are using a 7752 Module, the Position Data Display for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2. Position data is available to the Processor.

Fig 2.3 Velocity Display

Velocity Data Display - This display shows the velocity of the magnet along the LDT's Shaft in Counts/Second. The time between updates, which is the time it takes to determine the new velocity and show it on the display is set by the Speed Average Parameter. If you are using a 7752 Module, the Velocity Data Display for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2. Velocity data is available to the Processor.

Fig 2.4 Count Direction

Count Direction Parameter - Sets the direction, relative to the head of the LDT, that the magnet must travel to increment the Position Data. When the Count Direction is positive, ("P" on the display), the Position Function will increment when the magnet travels away from the LDT's head. When the Count Direction is negative, ("n" on the display), the Position Function will increment when the magnet travels towards the LDT's head. If you are using a 7752 Module, the Count Direction Parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2.

Function and Parameter Displays (cont'd)

Fig 2.5 Full Scale Length

Full Scale Length Parameter - Programmable in inches or millimeters, this parameter is the distance that you expect the magnet to travel. Maximum values of this parameter is 650 inches or 9999 mm. Minimum values are 2 inches or 50 mm. Before this parameter is programmed, the Measurement Unit Parameter (See Pg. 2-5) should be programmed appropriately. If you are using a 7752 Modules, the Full Scale Length Parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2. When this parameter is entered, the Full Scale Count parameter defaults to the maximum resolution allowed for the specified length. See *Specifications* Pg. 2-12.

Fig 2.6 Full Scale Count

Full Scale Count Parameter - This parameter sets the number of counts over the specified Full Scale Length. The position resolution is equal to the Full Scale Counts divided by the Full Scale Length. When the Full Scale Length parameter is entered, the Full Scale Count defaults to the maximum resolution allowed for the specified length. If you are using a 7752 Module, the Full Scale Count Parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2.

Fig 2.7 Position Offset

Position Offset Parameter - This parameter is used to set a reference point for the Position Function to start from. Max/Min values for the Position Offset are ±99,999. This parameter is most often used to set the zero position on the LDT probe. If you are using a 7752 Module, the Position Offset Parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2.

Function and Parameter Displays (cont'd)

Setup Parameters

These parameters are only available when the module is in Program Mode (See *Program Switch* Pg. 2-9 for more information.) These parameters contain information that would not be changed often once the system is running.

Fig 2.8 Setup Display

Setup Parameter Display - When this display is shown, press the [ENTER] Key to gain access to the Setup Parameters. Pressing the [FUNCTION] key will return you to the Position Function display.

Fig 2.9 LDT Type

LDT Type Parameter - This parameter specifies the type of LDT attached to the 7700. Presently, AMCI, Balluff and Temposonics II LDT's are supported.

- LDT Type 1: AMCI LHT Series Transducers.
- LDT Type 2: Balluff Transducers w/ 'K2' output option.
- LDT Type 3: Temposonics II w/ DPM Module.
- LDT Type 4: Temposonics II w/ RPM Module.

If you are using a 7752 Module, the LDT Type Parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2. A 7752 can support two different LDT's at the same time.

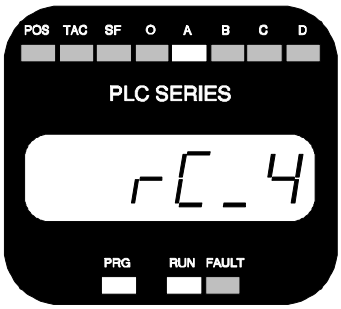


Fig 2.10 DPM Recirculations

DPM Recirculations Parameter - This parameter is available only when a Temposonics II with a DPM Module is selected as the LDT Type. This parameter tells the 7700 how many Recirculations the DPM Module is configured for. This parameter must equal the number of recirculations the DPM is set for or the Position data will not be valid. Allowable values for this parameter are 1, 2, or 4 recirculations. If you are using a 7752 Module, the DPM Recirculations parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2. Also, the DPM Recirculations parameter for the two LDT's can be different.

Function and Parameter Displays (cont'd)

Setup Parameters (cont'd)

Fig 2.11 Measurement Unit

Measurement Unit Parameter - Specifies the measurement unit as inches or millimeters. Changing this parameter will reset all parameters, except LDT Type and Speed Average, to their default values. If you are using a 7752 Module, the Measurement Unit parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2. The Measurement Unit parameter for the two LDT's can be different.

Fig 2.12 LDT Gradient

LDT Gradient Parameter - This is a calibration parameter supplied by the LDT manufacturer. The value of the LDT Gradient is printed on the head of the transducer. AMCI and Balluff specify the Gradient in meters/second. MTS specifies it in µSec/inch if the LDT's length is specified in inches or µSec/millimeter if the LDT's length is specified in millimeters. The Measurement Unit Parameter (see above) should be programmed appropriately before this parameter is entered. If this parameter is not programmed to be equal to the value printed on the transducers' head, the 7700 will not calculate accurate distances. AMCI and Balluff specify the Gradient Value to six figures while MTS specifies it to five places. If you use a Temposonics II LDT, set the last digit to zero. If you are using a 7752 Module, the LDT Gradient parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2.

Fig 2.13 Decimal Point

Decimal Point Parameter - This parameter sets the position of a decimal point on the Position, Full Scale Counts, Position Offset, and Preset Value displays. The value of the Decimal Point Parameter sets the number of digits to the right of the decimal point. Maximum value is 4 digits. If you are using a 7752 Module, the Decimal Point parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2.

Function and Parameter Displays (cont'd)

SETUP PARAMETERS (cont'd)

Fig 2.14 Preset Value

Preset Value Parameter - This parameter specifies the value that the Position Function will change to when the Auto Preset feature is used. (See *Auto Preset* Pg. 4-6) The values of this parameter range from ±99,999. If you are using the 7752 Module, the Preset Value parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2. The Auto Preset feature is most commonly used to set the Position Function to the correct value when the LDT is at its home or zero position.

Fig 2.15 Speed Average

Speed Average Parameter - This parameter sets the update time of the 7700's Velocity Function. Update time is the amount of time that the Module totals the change in position of the magnet before calculating its velocity in Counts per Second. Programmable values for this parameter are 32, 60, 120, and 240 mSec. If you are using the 7752 Module, the Speed Average Parameter for the additional transducer is sequentially available by pressing the [NEXT] Key. The "A" Indicator LED on the display indicates transducer 1 while the "B" Indicator LED indicates transducer 2.

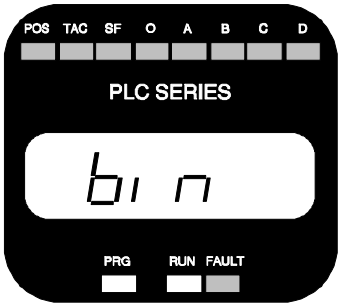


Fig 2.16 Data Format

Data Format Parameter - The Data Format Parameter allows you to choose the format of the Position and Velocity data that is sent to the PLC. The two choices are Binary and BCD.

Fig 2.17 Transfer Type

Transfer Type Parameter - Available with single channel modules only, the Transfer Type Parameter allows you to choose between Block or Single Transfers. When you choose Block Transfer, both the Position and Tachometer data is available to the PLC. When you choose Single Transfer, the module appears to be a 16 bit input module and Position Data only is available to the PLC. NOTE: When you change between the two modes, the module must have power cycled to it to re-initialize the A-B TIC chip.

Status Indicators

There are three single LED indicators below the alpha-numeric display that show the operating status of the module. Status information is also sent to the PLC.

- PRG: This yellow light is on when the module is in Program Mode. While in Program Mode, all of the parameters can be inspected and altered from the keyboard.
- RUN: A blinking green light indicates that the module is powered and operational.
- FAULT: This red light is on when the module recognizes a fault condition. The type of fault is shown on the alpha-numeric display. The Series 7700 Modules recognize three types of faults.

Fig 2.18 Transducer Fault

Error Class 1: Transducer Fault - This message is shown only when the module is displaying the Position or Velocity Data Functions. The Parameters will be displayed normally. This error is automatically cleared by the 7700 once the LDT responds to Interrogation pulses. There are four major causes of this fault:
- Magnet in Null or Dead Zone of LDT.
- Incorrect LDT Type
- Broken Transducer Cable.
- Improper wiring of the Transducer Cable.
- Faulty Transducer.

If you are using a multi-channel module, the transducer fault may not be on the channel that is being shown on the modules' display. In this case, the fault light will be on but the module will be displaying Position and Velocity information. Use the [NEXT] Key to cycle through the modules' channels until the fault is found.

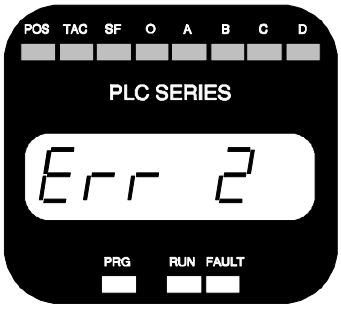


Fig 2.19 E^2PROM Fault

Error Class 2: E^2PROM Fault - This message is displayed at all times. The module recognizes that the program data (Scale Factor, Offsets, etc.) is incorrect. This error can be cleared by pressing the [CLEAR] Key. If the " Err 2" message remains after pressing the [CLEAR] Key, the E^2PROM memory is damaged and the module must be returned for repairs. See inside front cover *Returns Policy:* for additional information.

ERROR CLASS 3: RAM Fault - Not implemented on the Series 7700 Modules. Reserved for future expansion.

Status Indicators (cont'd)

Fig 2.20 P.S. Fault

Error Class 4: Power Supply Shut-down Fault - Shown only when the module is displaying the Position and Velocity Data Functions. The parameters will be displayed normally. This error occurs when the current draw from the power supply is to large and the Module turns the DC-DC converter off.
There are three major causes of this fault.
- Short across Transducer Cable.
- Mis-wired Transducer Cable.
- Faulty Transducer.

If you own a 7751 with a Serial # 10084 and above or a 7752 with a Serial # 9330 and above, the fault message will clear itself when the fault condition is removed. If you own a pre-10084 or 9330 Series 7700 Module, you must press the [CLEAR] Key to clear the error.
If you are using the 7752, a fault on one transducer will also shut down the other.

OVERFLOW/UNDERFLOW INDICATION

The value of the Position Function is limited to ±99,999. Under certain circumstances, it is possible to increment or decrement the Position value beyond these limits. When this occurs, the Position and Velocity Functions change to one of the following:

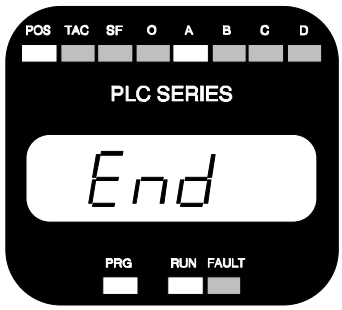


Fig 2.21 Position Overflow

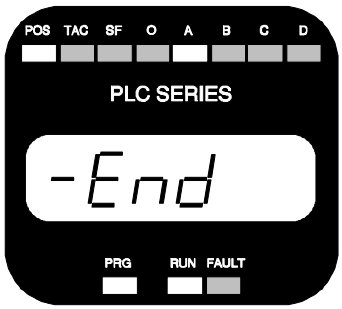


Fig 2.22 Position Underflow

The Position and Velocity displays will automatically show data once the magnet's position has moved or one or more of the Parameters has been changed. Overflow/Underflow indication is also sent to the Processor. See *Data Format* Pg. 5-1 for further information.

Program Switch

The Program Switch is used to enable or disable programming of the 7700 Module. The module is programmable (Program Mode, PRG light ON) when the switch is pushed towards the back of the module. When in Program Mode, all parameters can be modified. The module is not programmable (Display Mode, PRG light OFF) when the switch is pushed towards the front of the module. When in Display Mode, the Count Direction, FS Length, FS Count, and Position Offset can be examined but cannot be modified.

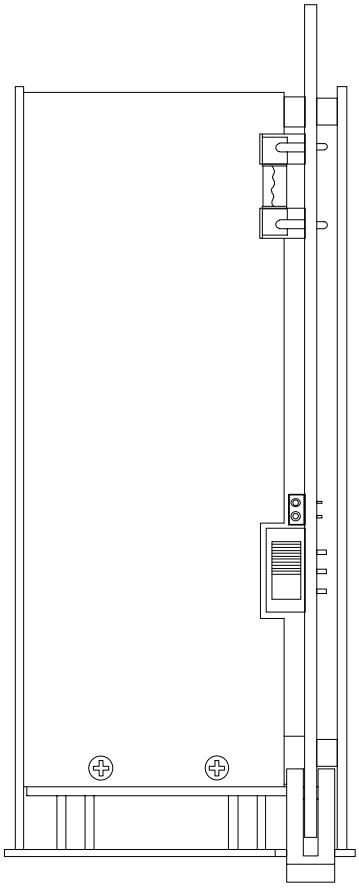


Fig 2.23 Program Switch

⚠WARNING Remove system power before removing or installing a module in the I/O Rack. Failure to observe this warning can result in damage to the module's circuitry and/or undesired operation with possible injury to personnel.

The Program Switch can be disabled by removing the jumper on the two pin header next to the switch. Removing this jumper locks the 7700 in Display Mode. It is usually good practice to remove this jumper once the system is operational. This will prevent someone from accidentally changing the 7700's parameters while the system is running. The only times that changes to the modules programming should be allowed are during set-up or trouble shooting procedures.

Two Pin Header shown with Jumper installed.

Program Switch shown in Program Mode position.

Keyboard Description

The following table describes what the keys do when you are in Display Mode, (PRG light OFF) or Program Mode (PRG light ON). When in Program Mode, a parameter that you show on the display can be changed if one of the digits on the display is blinking. The blinking digit shows the position of the Cursor.

Key	*Display Mode*	*Program Mode*
FUNCTION	Use this key to select the function or parameter you wish to show on the display.	Same as Display Mode.
ENTER	Not used in Display Mode.	If a parameter is shown with the Cursor, pressing this key will store the displayed value in E^2PROM Memory.
CLEAR	Use this key to recover from fault conditions. The exact nature of the fault is shown on the display. See *Status Indicators* Pg. 2-7.	Same as Display Mode. If the Position Function is on the display, press this key to use the AUTO PRESET feature
NEXT	Used to switch between the transducer inputs on a multi-channel module.	Same as Display Mode.
▲ ▼	Not used is Display Mode.	If the Cursor is shown, use these keys to increment [▲] or decrement [▼] the number under the cursor.
◄ ►	Not used in Display Mode.	If the Cursor is shown, these keys shift the Cursor to the left [◄] or the right [►] by one digit.

Fig 2.24 Keyboard Description

Transducer Input Connector

The Transducer Input Connector on the Series 7751 single channel Modules has eight contacts while the Transducer Input Connector on the Series 7752 dual channel Modules has fourteen contacts. The following table lists the AMCI and Phoenix Contact part numbers on the mating connectors:

	7751 Module	7752 Module
AMCI Part #	MS-8	MS-14
Phoenix Part #	MSTB2.5/8-ST-5.08	MSTB2.5/14-ST-5.08

Fig 2.25 Transducer Input Connector Part Numbers

The pin-out of the cables are given in Chapter 3, **Installation**.

Fuse Replacement

If the Power Fuse fails, it can be easily replaced. The factory installed fuse is a 3.5 Amp Fast Blow, Littelfuse Part Number 22503.5. Fuse kits are available from AMCI. The AMCI Part number is SKF-1. Each fuse kit contains five fuses.

CAUTION

To insure continued and adequate protection, any replacement fuse must have a rating of 3.5 Amp Fast Blow. Using a higher ampere rating or slow blow fuses may not protect the module from damage if the fault conditions are again applied to the module.

WARNING

Remove system power before removing or installing a module in the I/O Rack. Failure to observe this warning can result in damage to the module's circuitry and/or undesired operation with possible injury to personal.

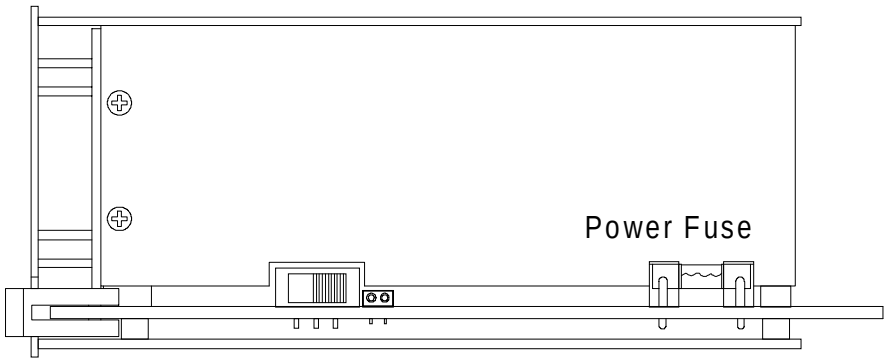


Fig. 2.26 Power Fuse

Specifications

Module Location

Any 1771 I/O chassis, occupies two slots

Position Transducer

AMCI LHT Series LDTs.
Balluff LDT with 'K2' output option.
MTS Temposonics™ II LDT with RPM or DPM Personality Modules.

Transducer Input

Optically Isolated (1500 Vac)

Number of Recirculations

1: Resolution ≤ 0.01"
2: Resolution > 0.01 and < 0.002"
4: Resolution ≥ 0.002 and ≤ 0.001"

Programmable Parameters

Count Direction
Full Scale Length
Full Scale Count
Position Offset
Connection Type
DPM Recirculations
Measurement Unit
LDT Gradient
Decimal Point Position
Preset Value
Speed Average
Data Format
Transfer Type

Measurement System

Programmable to inches or millimeters

Position Resolution

To 0.001 inches:	LDT Length	99 "
To 0.010 inches:	LDT Length	650 "

Position Offset

Programmable to any point on LDT's length.
Used to set the reference point on the LDT.

Velocity Data Response Time

Programmable to 32, 60, 120, or 240 mSec

Velocity Data Resolution

Determined by, and identical to, the Position Resolution.

Velocity Data Range

0 to 99999 Counts/sec

Data Transfer

Programmable for BTR or Single Transfers

Data Available to Processor

Magnet Position, Magnet Velocity, and Fault Diagnostics

Program Input

Modules' self-contained display and keyboard or BTW from Processor.

Program Storage

E^2PROM Memory

DC Supply Voltage from Backplane

+5 Volts @ 1.45A max. (7752 Module)

Module +5Vdc Supply Fuse

2A Fast Blow (Littelfuse 225002)

Environmental Conditions

Operating Temperature:	0 to 60° C
Relative Humidity w/o condensation:	5 to 95%
Storage Temperature:	-40 to 85°

Connector Keying

Between 28 and 30
Between 34 and 36

Power Requirements

A Series 7700 Module draws it's power from the I/O Chassis backplane +5 Vdc Supply. The maximum current draw by a 7700 Module is 1.45 Amps. Add this to the power requirements of all other cards in the chassis to avoid exceeding backplane or supply capacity.

Installing the Module

⚠WARNING Remove system power before removing or installing a module in the I/O Chassis. Failure to observe this warning can result in damage to the module's circuitry and/or undesired operation with possible injury to personal.

When the module is installed, it should be placed in a single slot pair within the chassis. Doing this will help you avoid addressing conflicts between the 7700 Module and a 16 bit I/O Card when using 2-Slot addressing or a 32 bit I/O Card when using 1-Slot addressing. A slot pair is made up of the two slots under each module locking latch. Figure 3.1 shows two 7700 Modules. The module on the left is correctly installed in a single slot pair while the module on the right is incorrectly installed in two slot pairs.

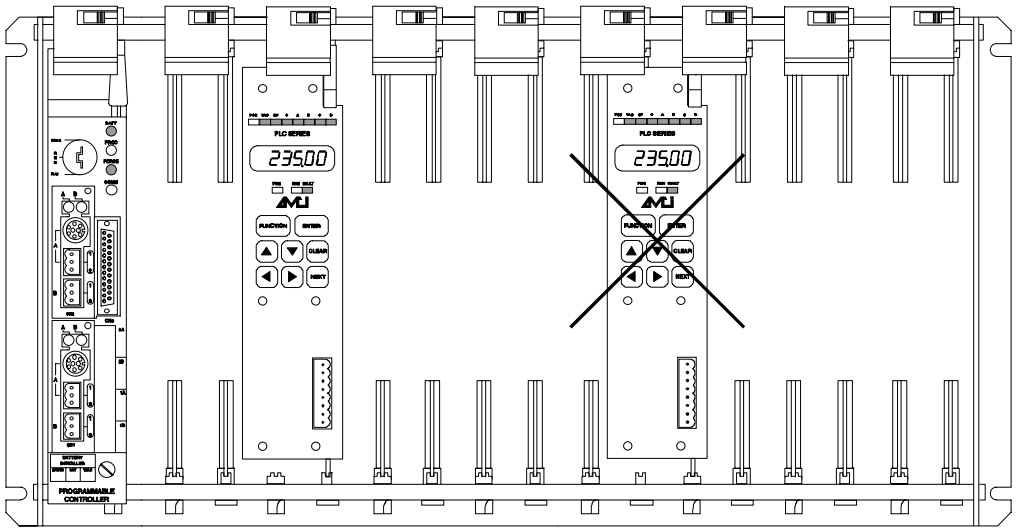


Fig 3.1 Module Installation

Keying Bands

Plastic keying bands can be inserted into the slot that the 7700 Module plugs into to insure that a different module cannot be inserted into the slot accidentally. The keying bands must be inserted in the top backplane connector to allow insertion of a 7700 Module:

- Between 28 and 30
- Between 34 and 36

Compatible Transducers

Presently, the Series 7700 Modules have been tested with AMCI's LHT Series LDTs, Balluff LDTs with a 'K2' Output/Power Supply Option, and MTS's Temposonics II LDTs. The modules will interface with a Temposonics II as long as it has an RPM or DPM Personality Module installed in its head.

Temposonics II DPM Setup

Located on the DPM Personality Module are switches that are used to configure it for various resolutions and internal or external interrogation. You should refer to MTS documentation for specifics on configuring the module. The 7700 Series require that the DPM be configured for External Interrogations and four recirculations. Switches 1 and 2 on the DPM are used to set the Intergation source and the number of recirculations. Switch 1 (SW1) must be set to position 4, Switch 2 (SW2) must be set to position 8.

Transducer Mounting

Refer to the documentation you recieved with your LDT to properly mount the transducer.

Grounding Clamp

The shield of the Transducer Cable must be attached to the chassis with a Grounding Clamp (AMCI part number GC-1) in order to provide a low impedance path to ground for any EMI radiation that may be induced into the cable. The drain wire from the Grounding Clamp must be connected to pin 4 of the MS-8 or MS-14 Transducer Input Connector. Pin 13 of the MS-14 connector is internally connected to pin 4 and does not need an additional wire.

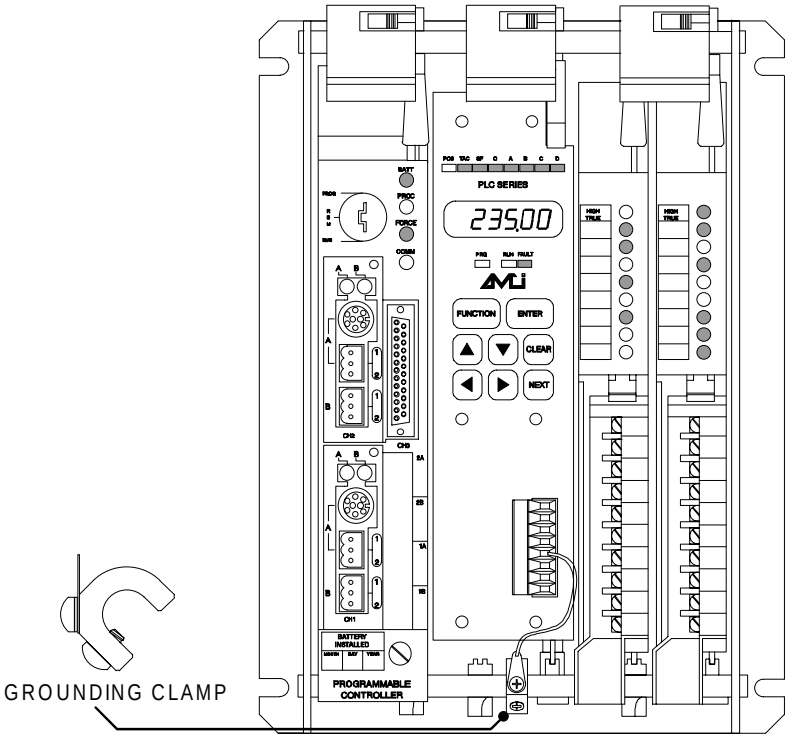


Fig 3.2 GC-1 Grounding Clamp Installation

Cable Installation

Cables can be ordered directly from the LDT manufacturer. Optionally, MTS specifies BELDEN #8105 for use as an extension cable.

Cable Prints are at the back of this manual. The following table lists print numbers and page numbers to refer to based on module and transducers types.

	7751	7752
AMCI/ Balluff	B1241 (P-3)	B1242 (P-4)
Temposonics II	B1178 (P-4)	B1177 (P-5)

Notes:

This chapter offers examples on how to program the Series 7700 modules. Unless noted, all programming examples are applicable to all Series 7700 Modules.

Before any of the Series 7700's parameters can be programmed, the module must be in Program Mode. (Program Switch set ON. See *Program Switch* Pg. 2-9 for more information.) When the module is in this mode, the yellow PRG light on the front panel is lit.

Conventions

The following conventions are used when describing the keystrokes needed to program the different parameters.

[KEY]: Used to show the key pressed on the module. The key's name will be inside the brackets.

If an asterisk appears before a key, (Example: *[FUNCTION]), the key must be pressed until the display matches what is shown in the instructions.

If a "X" and a number follow a key, (Example: [▲]X3), the key must be pressed the shown number of times. (In this example, the [▲] key would be pressed 3 times.)

IND. LEDS: Indicator LEDs that indicate the function or parameter being displayed or programmed.

"Display": Information shown on the 6 digit display. The blinking cursor is shown by a double underline.

The following keystroke examples use the least number of keystrokes. However, any series of keystrokes is valid as long as the data is correct before the [ENTER] key is pressed.

Scaling Parameters

Count Direction

You are using the Temposonics LDT to measure the liquid level in a 250 gallon cylindrical tank to 0.01 gallons. The transducer is mounted above the tank so you need the position values to decrease as the magnet moves away from the LDT head. You can accomplish this by changing the Count Direction Parameter to "negative".

If the Count Direction Parameter is Positive, the value of the Position Function is the Position Offset plus the True Position. If the Count Direction Parameter is Negative, the value of the Position Function is the Position Offset minus the True Position. The True Position is the actual distance from the magnet to the pickup coil in the head of the LDT.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	A	" dir _ P"	Present Value.
[▲]	A	" dir _ n"	Parameter changed to negative count direction.
[ENTER]	A	" dir _ n"	Value stored in E²PROM. Blinking cursor removed.

Scaling Parameters (cont'd)

Full Scale Length

The LDT length is 72 inches but only 40 inches of the probes' length will be used. Instead of entering the length of the LDT you can enter the distance that the LDTs' magnet will travel. In this case, it simplifies the calculations needed to determine the Full Scale Count.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	A	"L _ 0016"	Default Value.
[►]X2, [▲]X3, [►], [▲]X4, [ENTER]	A	"L _ 0040"	Value stored in E^2PROM. Blinking Cursor removed.

Full Scale Count

In most applications, the Full Scale Count is simply the Full Scale Length multiplied by a power of ten. This gives a position value that reads out directly in the desired unit of length. This is not the case for the example in *Application Notes* where the Position Function reads out in hundredths of gallons. 250 Gallons multiplied by 100 Counts per Gallon equals 25000 Counts.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	SF + A	" 40000"	Default for 40" Length.
[▼]X2, [►], [▲]X5, [ENTER]	SF + A	" 25000"	Value stored in E^2PROM. Blinking Cursor removed.

Position Offset

The Position Offset is used to change the value of the Position Function without moving the LDTs' magnet.

There is a True Position that the 7700 reads from the LDT. This position is the distance between the magnet and the pickup coils in the LDTs' head. Due to the manufacturing process, the True Position can vary from probe to probe by a small amount. The value of the Position Function is equal to the Position Offset added to the True Position. Note that the signs of the Position Offset and True Position are significant.

In most cases, you can use the Auto Preset feature to set the value of the Position Function instead of calculating the Position Offset. Using the Auto Preset, the Position Offset will be automatically calculated by the 7700. It is then simple, if necessary, to vary the Position Offset by small amounts from the Position Offset display.

Scaling Parameters (cont'd)

Position Offset (cont'd)

In this example, the Position Offset equals 32080 and must be changed to -32069.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	O + A	" 32080"	Present Value.
[◄], [▲], [►]X4, [▼]X2, [►], [▼], [ENTER]	O + A	"-32069"	Value stored in E^2PROM. Blinking Cursor removed.

Setup Parameters

The rest of the programmable parameters on the 7700 are Setup Parameters. They are available only when you are in Program Mode. The following keystrokes show you how to access these parameters.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	None	" SEtUP"	Setup Menu Display.
[ENTER]	A	"Con _ rP"	First Setup Parameter. Other values available by pressing the [FUNCTION] Key.

LDT Type

You are using a Temposonics II LDT that contains a DPM Personality Module. Presently, the 7700 is in its default configuration for AMCI LDT's.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	A	" Ldt _ 1"	Default Value, AMCI LDT's.
[▲] X2, [ENTER]	A	" Ldt _ 3"	Value stored in E^2PROM. Blinking Cursor removed.

Setup Parameters (cont'd)

DPM Recirculations

If a DPM Personality Module is used, the number of recirculations that it is set for must also be programmed into the 7700. Possible numbers are 1, 2, and 4 recycles. The LDT can be set for a higher number of recirculations without effecting the resolution, but the position update time will be longer. The minimum number of recirculations needed for a desired resolution is listed in *Specifications,* Pg 2-12.

> It is imperative that the number of recirculations set on the DPM module and DPM Recirculations Parameter be equal. If they are not, the 7700 will not calculate correct position or velocity data.

To decrease position update time and simplify your ladder logic program, you decide to limit your position values from 20 bits to 12 bits. Decreasing the resolution of the system allows you to change the number of recirculations from four to two. Note that the number of recirculations that the DPM Personality Module is set for must also be changed.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	A	" rC _ 4"	Present Value.
[▼], [ENTER]	A	" rC _ 2"	Value stored in E^2PROM. Blinking Cursor removed.

Measurement Unit

You are using a LDT that has its length and Gradient specified in millimeters. In order to simplify programming, you can change the Measurement Unit from the default of inches to millimeters.

> Changing this parameter will reset all other parameters to their default values except the Connection Type and Speed Average parameters.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	A	"Unit _ i"	Present Value.
[▼], [ENTER]	A	"Unit _ d"	Value stored in E^2PROM. Blinking Cursor removed.

Setup Parameters (cont'd)

LDT Gradient

The LDT Gradient is the velocity at which the return pulse propagates down the length of the transducer shaft. The value of the LDT Gradient varies from transducer to transducer. It's value is printed on the label of the LDT.

In this example, the LDT Gradient printed on the labelof a Temposonics II is 8.9986 µSec per Inch. Presently, the default value of 9.03000 is stored in memory.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	SF + A	" 9.03000"	Default Value.
[▼], [►], [▼], [►], [▼]X4, [►], [▼]X2, [►], [▼]X4, [ENTER]	SF + A	" 8.99860"	Value stored in E^{2}PROM. Blinking Cursor removed.

Decimal Point Position

You want to program a Decimal Point so that the last two digits on the position display are after it. The parameter presently has it's default setting of 0.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	A	" d.P. _ 0"	Default Value.
[▲]X2, [ENTER]	A	" d.P. _ 2"	Value stored in E^{2}PROM. Blinking Cursor removed.

Preset Value

You want to program a Preset Value of 25000 Counts. Presently, the default value of zero is in memory.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	SF + O + A	" 00000"	Default Value.
[▲]X2, [►], [▼]X5, [ENTER]	SF + O + A	" 25000"	Value stored in E^{2}PROM. Blinking Cursor removed.

Setup Parameters (cont'd)

Speed Average

You wish to change the Speed Average from it's default setting of 120 mSec to 240 mSec. The Speed Average parameter sets the amount of time that the 7700 Module totals the change in position of the magnet before calculating it's velocity in Counts per Second. Increasing the Speed Average will reduce the amount of "jitter" that may occur in the velocity data.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	A	"S.A. _ 120"	Default Value.
[▲], [ENTER]	A	"S.A. _ 240"	Value stored in E^{2}PROM. Blinking Cursor removed.

Data Format

You are using a PLC-2/16 processor in your application. Because all of the PLC-2's math instructions use BCD numbers, you want the Position and Velocity data in BCD format.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	NONE	" bin "	Default Value.
[▲], [ENTER]	NONE	" bcd "	Value stored in E^{2}PROM. Blinking Cursor removed.

Transfer Type

You are using a PLC-2/20 processor in your application. Because this processor does not have Block Transfer Instructions, you must configure the module to use Single Transfers.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	NONE	" blc "	Default Value.
[▲], [ENTER]	NONE	" Sin "	Value stored in E^{2}PROM. Blinking Cursor removed.

Auto Preset Feature

The Position Function can be forced to equal the Preset Value Parameter without the need to calculate the Position Offset. This allows you to quickly set a reference position on the LDT. In the example in *Applications Notes* this reference point is 250.00 and corresponds to the cylindrical tank being full.

In order to use the Auto Preset Feature, you must have the 7700 in Program Mode and the Position data must be showing on the display.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	POS + A	" xxx.xx"	Present Position Value.
[CLEAR]	POS + A	" 250.00"	Position = Preset Value.
*[FUNCTION]	O + A	"yyyy.yy"	Calculated Position Offset.

Notes

Module Addressing

This chapter explains how to address a Block Transfer module and is applicable to all AMCI products for the 1771 I/O structure. Also covered is addressing a Single Transfer module, which is applicable to the 1731, 1741 and 7751 Modules. When information in this chapter applies to an "AMCI Module", it applies to all Series 1700, 2700, and 7700 Modules. When information only applies to specific modules, product numbers of the effected modules are listed.

When you configure your Programmable Controller System, you specify a unique address for each slot of each chassis in the system. An I/O Rack number and an I/O Group Number make up each address. An I/O Slot number further specifies a Block Transfer address.

> Note that an I/O Chassis is not the same as an I/O Rack Number. An I/O Chassis is the physical enclosure that the cards and modules plug into. An I/O Rack Number is part of a modules' address in the system. Each I/O Chassis can have ¼ to 4 I/O Racks associated with it.

Definition of Terms

I/O Rack

The number of I/O Racks in the system, not the number of chassis, define the Programmable Controller System. In PLC-2 systems, the first I/O Rack is assigned the number 1. In PLC-3 or PLC-5 systems, the first I/O Rack is assigned the number 0. Each I/O Rack is further divided into 8 I/O Groups.

I/O Group

Eight I/O Groups make up 1 I/O Rack. The eight I/O Groups of each I/O Rack are assigned the numbers 0 through 7. Each slot in a chassis is assigned ½, 1, or 2 I/O Groups. You do this when you select which Slot Addressing to use in the chassis.

Slot Addressing

There are 3 different slot addressing schemes used by Allen-Bradley. They are 2 Slot, 1 Slot, and ½ Slot Addressing.

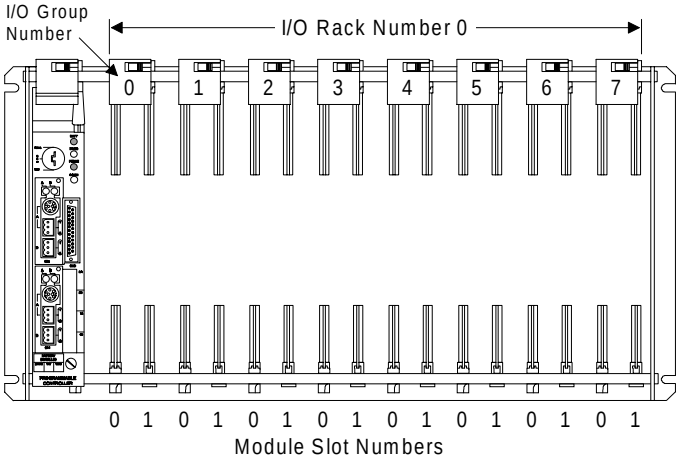


Fig 5.1 2-Slot Addressing

With **2-Slot Addressing**, 1 I/O Group is assigned to a slot pair in the chassis. A slot pair is made up of the two slots under a single module locking latch. The first slot of the pair is given the Module Slot Number 0. The second slot of the pair is given the Module Slot Number 1.

Module Addressing (cont'd)

Slot Addressing (cont'd)

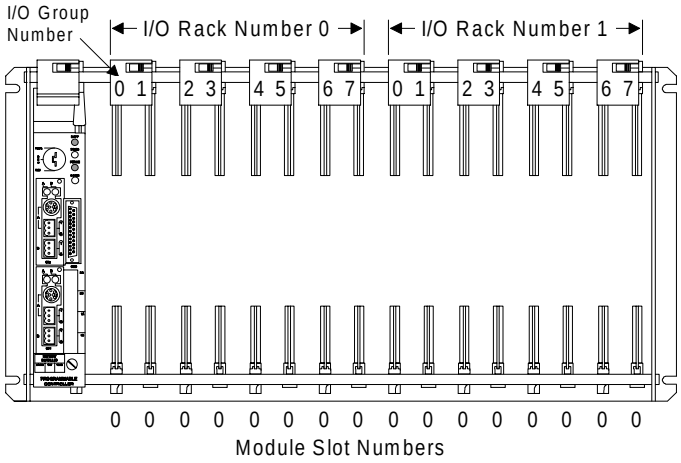


Fig 5.2 1-Slot Addressing

With **1 Slot Addressing**, 1 I/O Group is assigned to each slot in the chassis. Each slot is given the Module Slot Number 0.

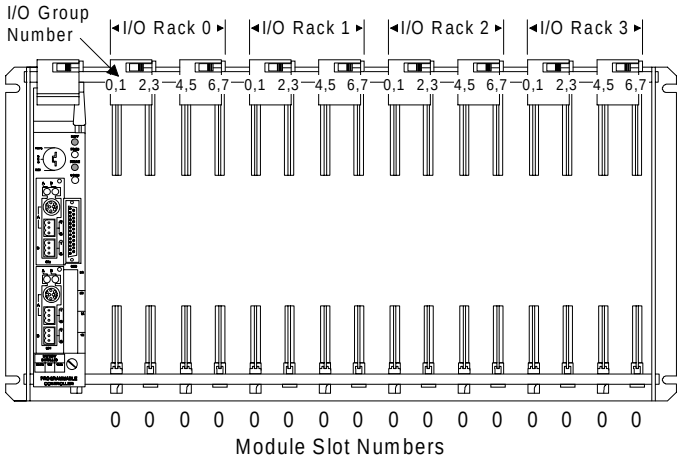


Fig 5.3 ½-Slot Addressing

With **½ Slot Addressing**, two I/O Groups are assigned to each slot. Each slot is given the Module Slot Number 0.

Addressing a Block Transfer Module

All AMCI Modules communicate with the PLC through Block Transfers. The PLC can read data from the AMCI Module with Block Transfer Read (BTR) Instructions and program the Modules' Programmable Parameters with Block Transfer Write (BTW) Instructions.

A BT module's address is made up of three numbers. They are the I/O Rack Number, the I/O Group Number, and the Module Slot Number.

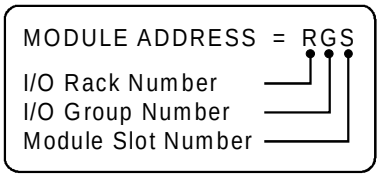


Fig 5.4 BT Module Address

Addressing a Single Transfer Module

The single channel Transducer Interface Modules, the 1731/41 and the 7751, can transfer position data to the PLC with Single Transfers. The transfer is done automatically at the beginning of every scan between the Input Image Table and the Interface Module. To access the Position data from a 1731/41 or 7751 Module that uses Single Transfers, you must know the memory location in the Input Image Table associated with the module.

- **PLC-2**: Three or four digit number. The first is a "1", followed by the I/O Rack and I/O Group Numbers.
- **PLC-3**: The letter "I" followed by a four digit number. The first three digits are I/O Rack Number, followed by I/O Group Number.
- **PLC-5**: The characters "I:" followed by a two or three digit number. The first one or two digits are the I/O Rack Number, followed by the I/O Group Number.

> When specifying an address in the Input Image Table, all I/O Rack numbers are expressed in octal. (i.e. 00, 01, 02, ... 06, 07, 10, 11, ...)

Addressing Examples

The following three figures show how to address an AMCI Module when using 2-Slot, 1-Slot, and ½-Slot Addressing. The addresses used when the module is configured for Block or Single Transfers are shown. Note the following:

- Only the 1731/41 or the 7751 Modules can use Single Transfers.
- You cannot use Single Transfers if your I/O Chassis is set-up for 2-Slot Addressing. This restriction is imposed by the Allen-Bradley TIC chip.
- When using ½-Slot addressing the I/O Group Number used in the address is the lower of the two I/O Group Numbers assigned to the slot.

In all of the following figures, the module is placed in a single slot pair. (Under a single locking latch, see Installing the Module Pg 3-1 for more information.) If the practice of installing an AMCI Module in a single slot pair is followed, the Addressing Shortcuts listed next to the figures can be used.

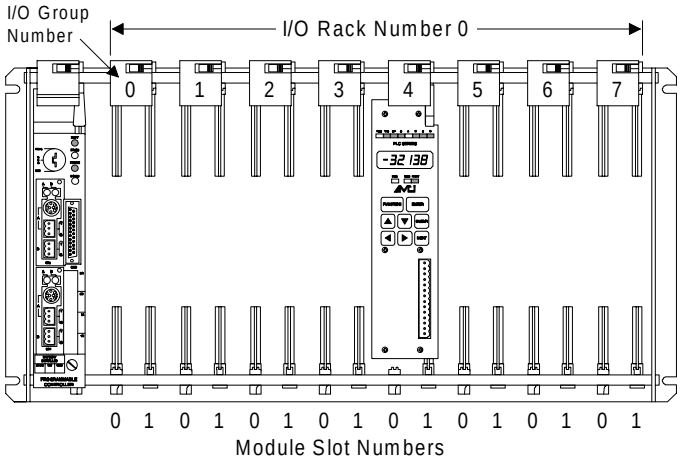


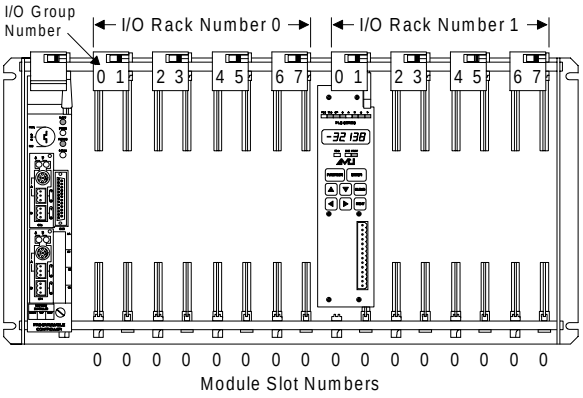
Fig 5.5 Modules' 2-Slot Address

Module BT Address = 041

Single Transfer cannot be used by the 1731/41 or 7751 Modules.

Addressing Shortcuts
1) Slot Number is always equal to 1.

Addressing Examples (cont'd)

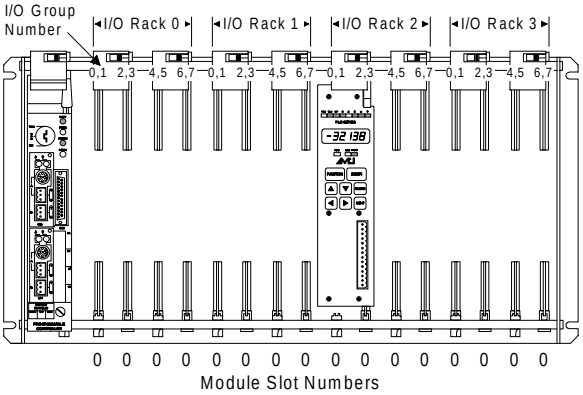


Module BT Address = 110

PLC-2 Single Addr = 111
PLC-3 Single Addr = I0011
PLC-5 Single Addr = I:011

Addressing Shortcuts
1) I/O Group Number is always odd
2) Slot Number is always equal to 0.

Fig 5.6 Modules' 1-Slot Address



Module BT Address = 220

PLC-2 Single Addr = 122
PLC-3 Single Addr = I0022
PLC-5 Single Addr = I:022

Addressing Shortcuts
1) I/O Group Number is always even.
2) Slot Number is always equal to 0.

Fig 5.7 Modules' ½-Slot Address

General Restrictions and Warnings

1. It is important to have the AMCI Module installed in a single slot pair. See *Installing the Module* Pg 3-1. Doing this will avoid any potential addressing conflicts when using a 1700 Module and 16 pt. modules with 2-Slot addressing or 32 pt. modules with 1-Slot addressing.
2. When using an AMCI Module as a Block Transfer Module in a chassis that uses a Remote I/O Adapter, the I/O Adapter must be a 1771 - ASB, Series B, Firmware Rev. F, or later. Using a Remote I/O Adapter that has an earlier Series or Firmware Revision may not work properly with a BT Module.

Single Transfer Restrictions and Warnings

1. When using a 1731/41 or 7751 as a Single Transfer Module, the chassis that contains the module CANNOT be set-up for 2-Slot addressing. This is because of restrictions imposed by the Allen-Bradley TIC chip.
2. If you change the Transfer Type Parameter on a 1731/41 or 7751, you MUST cycle power to the chassis that contains the module to re-initialize the A-B TIC chip.
3. If you have a system that presently uses a 1731/41 or 7751 as a BT Module and you are changing the system to use it as a Single Transfer Module, you must remove all BT Instructions from your program that address the Module. BT Instructions write information in the Input and Output Data Tables that may corrupt the data being transferred by the module.
4. The 1700 modules and A-B PLCs read data from the TIC chip one byte at a time. Therefore, it takes two memory read or write cycles to transfer one 16 bit word of data. In order to prevent data corruption*, the TIC chip is setup to interrupt the module when the PLC has read a complete word of data. The module accepts this interrupt immediately and write the latest position data to the TIC chip. The module then waits for the next interrupt before again writing to the TIC chip. Because of this, the position data available to the processor is 1 scan time behind the actual transducer position. In most applications this does not cause a significant error but if your application involves high transducer speeds or long scan times this delay can be avoided by placing two back to back Immediate Input Instructions in your ladder logic.

* Data Corruption occurs when:

1) The PLC reads one byte of "old" position data.
2) The module updates the position data
3) The PLC reads one byte of the "new" position data.

For example, if the old position data is 07FFh and the new position data is 0006h the PLC will read 0706h as the position data.

Notes

Overview

Most PLC-2 processors have Block Transfer Instructions in their instruction sets. There are four parts to PLC-2 BT Instructions. They are:

- **Data Address** - Address in the PLC-2's Timer/Counter Accumulated Registers where the Module Address is stored.
- **Module Address** - The I/O Rack, Group and Slot Numbers where the module is located.
- **Block Length** - Number of PLC-2 memory locations needed to store information read from or written to the AMCI Module.
- **File Address** - Starting and ending addresses in PLC-2 memory where the data is stored.

Data and Module Address

The value of the Data Address is the memory location that stores the Module Address. Each BT Instruction needs a different Data Address, even if you have multiple BT Instructions for one module (i.e., the Module Addresses are the same). The value of the Data Address must be the first available memory location in the Timer/Counter Accumulated Registers and all Data Addresses **MUST** come before **ANY** Timer or Counter Accumulated Registers.

The number of I/O Racks in your system determines the first memory location of the T/C Accumulated Registers section in PLC-2 Data Table. Figure 6.1 shows the first available memory location based on the number of I/O Racks that the processor is configured for.

Number of I/O Racks	1	2	3	4	5	6	7
First Available Address	020	030	040	050	060	070	200

Fig 6.1 First Memory Location of T/C Accumulated Register Memory

After all BT Data Addresses have been assigned, the next memory location should be loaded with the value 0000. This prevents the PLC-2 from using a timer or counter value as the address of a BT Module by forming a boundary that the PLC-2 will not cross when searching for a Module Address.

Block Length

The Block Length is the number of words needed to store the information read from or written to the AMCI Module. When programming a BTR Instruction, you can set the Block Length to 00. This will reserve 64 words in the PLC-2 memory, but the module will only transmit the number of words necessary. When programming a BTW Instruction, the number of words needed depends on the number of Program Instructions that you are writing to the AMCI Module.

The Block Length of a BTW Instruction **MUST** equal the number of words used by the Program Instructions. Using a Block Length of zero will cause an Invalid Command Error if the number of words used by the Program Instructions is not 64.

Block Length (cont'd)

The following tables list the number of words transmitted to the PLC when a BTR Instruction is executed. **Chapter 9 Data Format**, gives the format of the transmitted data.

> **1700 USERS:** To make the present 1700 modules compatible with older versions, you must set the Module to Read Only with the PLC Program Parameter. If you set the PLC Program Parameter to Read Only, the number of words transmitted by the 1700 Module is the second number listed in the following table.

1700 Module	1731/41	1732/42	1733/43	1734/44	1761	1762	1763
Block Length	3/2	5/4	7/6	9/8	4/3	7/6	5/4

Fig 6.2 1700 Module Block Length

2700 Module	2731/41	2732
Block Length	3	5

Fig 6.3 2700 Module Block Length

7700 Module	7751	7752
Block Length	5	9

Fig 6.4 7700 Module Block Length

File Address

The File Address is the first address in PLC-2 memory where you want to store data that is read from or written to the AMCI Module. The PLC programming software calculates the ending address based on the Block Length. The PLC-2 stores the value of the File Address at 100_8 memory locations above the value of the Data Address in the Timer/Counter Preset Value section of the Data Table. There are two areas in the PLC-2 memory that you can use to store the Block Transfer File.

The first, and preferred area, is in an expansion area. You can set this area aside when you set-up the system. Each expansion area is 128 words long and is the last section of the Data Table before the User Program. The expansion area has the advantage of being completely under your control because it is not used for any of the processor's functions.

The second area that you can use to store the Block Transfer File is in any unused memory in the T/C Accumulated or T/C Preset Values sections. These areas have the advantage of using memory that would otherwise be wasted, but have the disadvantage of potentially being overwritten by a Timer or Counter Instruction.

Enable (EN) and Done (DN) Bits

Used to signal the start and finish of a Block Transfer, the processor sets the EN bit to start the transfer and after successfully completing the transfer the module sets the DN bit. You should use the DN bit to buffer the data coming from the module. This prevents the program from using invalid Position and Velocity data from the AMCI Module.

The EN bit is located in the Output Image Table. The DN bit is located in the Input Image Table. Both BTR EN and DN bits are at bit number 07_8 if the module is in slot 0 or at 17_8 if the module is in slot 1. The BTW EN and DN bits are located at bit number 06_8 or 16_8.

Programming Example

The following example assumes 1-Slot addressing and an AMCI Module in the first slot group of the processor rack.

Rung 1: BTR Instruction to the AMCI Module. The Block Transfer Read executes every scan except when a Block Transfer Write is requested. The BTR must be disabled because the BTR and BTW files are of different lengths.

Rung 2: When the Block Transfer Read is completed, the BTR Done bit is set. This energizes the File to File Move that buffers data from the AMCI Module. The program uses the data at addresses 205 - 209 in the rest of the program.

Rung 3: The Block Transfer Write is requested whenever CR1 is latched on.

Rung 4: CR1 is latched on when a BTW Request is made.

Rung 5: CR1 is unlatched when the BTW Request is removed and the BTW Done bit is set.

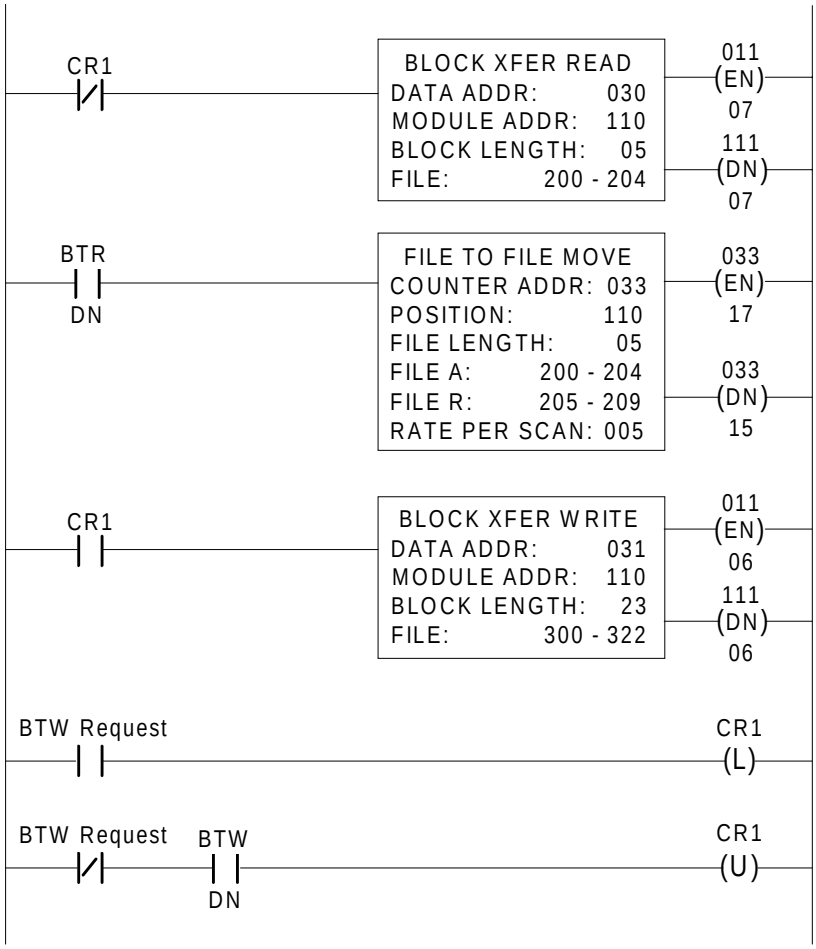


Fig 6.5 PLC-2 Programming Example

PLC-2 Restrictions and Warnings

⚠WARNING The following restrictions must be followed when using a BT Module in a PLC-2 System. If these restrictions are not followed, unpredictable operation may occur.

1. It is important to have an AMCI Module installed in a single slot pair. (See *Installing the Module* Chapter 3.) Doing this will avoid any potential addressing conflicts when using an AMCI Module and 16 pt. modules with 2-Slot addressing or 32 pt. modules with 1-Slot addressing.
2. When using an AMCI Module as a Block Transfer Module in a chassis that uses a Remote I/O Adapter, the I/O Adapter must be a 1771 - ASB, Series B, Firmware Rev. F, or later. Using a Remote I/O Adapter that has an earlier Series or Firmware Revision may not work properly with a BT Module.
3. When using a single channel Transducer Interface Module, (1731/41, 7751), as a Single Transfer Module, the chassis that contains the module MUST be set-up for 1-slot or ½-slot addressing. 2-Slot addressing will not function properly. This is because of the restrictions imposed by the Allen-Bradley TIC chip.
4. If remote racks are being used, words 125_8 and 126_8 are used to store remote I/O fault bits. BT and Input Modules must not be placed in the following slots: RACK 2, Groups 5 and 6.
5. Word 027 in the Output Image Table is reserved for processor use. DO NOT put a BT Module in I/O Rack 2, I/O Group 7.
6. The starting File address cannot exceed address 177778.
7. The maximum number of Block Transfers that can be handled by Rev J firmware of the PLC-2/30 processor module is fifty.
8. Each BT Module decreases the total number of available Timer or Counters by 1. The File to File Move Instruction used to buffer the data from an AMCI module also requires 1 Counter. If you need the counter, you can replace the File to File Move Instruction with a series of GET - PUT Instructions that are conditioned with the BTW Done bit.

Overview

All PLC-3 processors have Block Transfer Instructions in their instruction sets. There are four parts to PLC-3 BT Instructions. They are:

- **Module Address** - The I/O Rack, Group, and Slot Numbers where the module is located.
- **Data Address** - The starting file address that stores data written to or read from the module.
- **File Length** - The number of words needed to store data written to or read from the module.
- **Control File** - The starting address of the file used to control the Block Transfer.

Module Address

The Module address is the I/O Rack, Group, and Slot Numbers where the module is located in the system. The I/O Rack, Group, and Slot Numbers are entered separately in the Block Transfer Instruction.

Data Address

The Data File is the block of words that stores the information read from or written to the AMCI Module. The Data Address is the first address of the file. The Data File must have an Integer of Binary data type and can be a separate file or part of a larger file. Note that you must create the Data File before the program is executed. You create the file from your program loader. For details on creating files, refer to the users manual for your program loader.

File Length

The File Length is the number of words in your data file. When programming a BTR Instruction, you can set the Block Length to 00. This will reserve 64 words in the PLC-3 memory, but the module will only transmit the number of words necessary. When programming a BTW Instruction, the number of words needed depends on the number of Program Instructions that you are writing to the AMCI Module.

> The File Length of a BTW Instruction **MUST** equal the number of words used by the Program Instructions. Using a File Length of zero will cause an Invalid Command Error if the number of words used by the Program Instructions is not 64.

The table below lists the number of words transmitted by a 1700 Module when a BTR Instruction is executed. **Chapter 9 Data Format**, gives the format of the transmitted data.

> **1700 USERS:** To make the present 1700 modules compatible with older versions, you must set the Module to Read Only with the PLC Program Parameter. If you set the PLC Program Parameter to Read Only, the number of words transmitted by the 1700 Module is the second number listed in the following table.

1700 Module	1731/41	1732/42	1733/43	1734/44	1761	1762	1763
Block Length	3/2	5/4	7/6	9/8	4/3	7/6	5/4

Fig 7.1 1700 Module Block Length

File Length (cont'd)

The tables below list the number of words transmitted by a 2700 or 7700 module when a BTR Instruction is executed. **Chapter 9 Data Format** gives the format of the transmitted data.

2700 Module	2731/41	2732
Block Length	3	5

Fig 7.2 2700 Module Block Length

7700 Module	7751	7752
Block Length	5	9

Fig 7.3 7700 Module Block Length

Control File

The Control File is the 10 word long file that controls the actual transfer of data. The address that you enter into the BT Instruction if the first address of the file. The Control File **MUST** have a Binary data type. Each AMCI Module requires its own Control File. The Control File can be used to control both BT Reads and BT Writes to the module. Unlike Data Files, a Control File is automatically made by the program loader when you enter the address of the Control File. The Control File contains all of the information entered by the Instruction along with the Control Bits.

Latch Enable (LE), Error (ER), and Done (DN) Bits

Used to signal the start and finish of a Block Transfer, the processor sets the LE bit to start the transfer and after successfully completing the transfer the module sets the DN bit. If an error occurs in the transfer, the module will set the ER bit instead of the DN bit.

The LE, ER, and DN bits are located in the first word of the Control File. A Control File has one set of bits for a BTR and a second set for a BTW. For a BT Read, the LE Bit is bit 12_8, the ER Bit is bit 13_8 and the DN Bit is bit 15_8. For a BT Write, the LE Bit is bit 02_8, the ER Bit is bit 03_8 and the DN Bit is bit 05_8.

The LE, ER and DN bits should be used in the program to buffer the data from the module. This is done be enabling a file to file move when the DN bit is set. This will prevent the program from using position data from the module that may be incorrect.

There are other BT control bits in the Control File that may help you troubleshoot your system. Refer to your PLC-3 Programming Manual for further information.

Programming Example

The following example assumes 1-Slot addressing and an AMCI Module in I/O Rack 4, I/O Group 7 of the system.

Rung 1: BTR Instruction to the AMCI Module. The Block Transfer Read will automatically execute every other scan because it is enabled by the DN bit.

Rung 2: When the BTR is completed, the DN bit energizes the File to File Move that buffers data from the AMCI Module. The program uses data at addresses FN014:0005 - 9 in the rest of the program.

Rung 3: The BT Write is enabled whenever CR1 is latched on.

Rung 4: CR1 is latched on when a BTW Request is made.

Rung 5: CR1 in unlatched when the BTW Request is removed and the BTW Done bit is set.

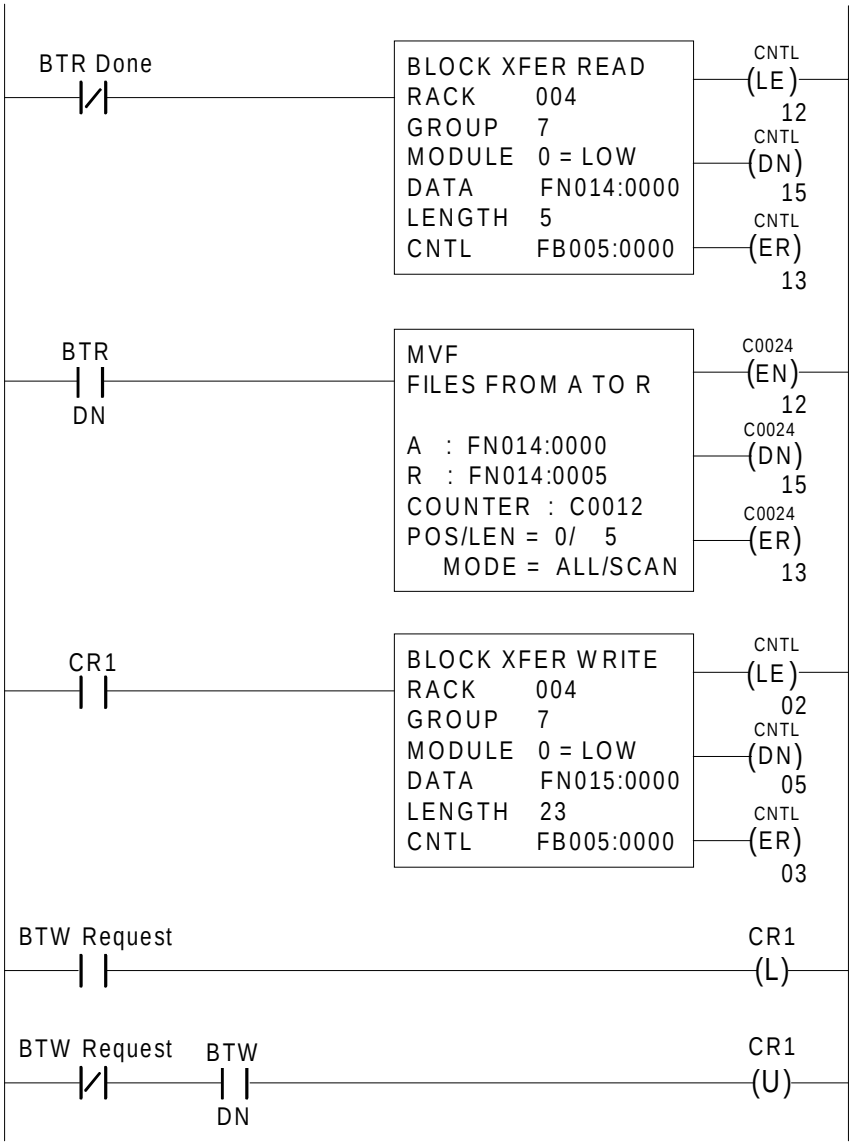


Fig 7.4 PLC-3 Programming Example

PLC-3 Restrictions and Warnings

The following restrictions and warnings must be followed when using a BT Module in a PLC-3 System. If these restrictions are not followed, unpredictable operation may occur.

1. It is important to have an AMCI Module installed in a single slot pair. (see *Installing the Module* Chapter 3.) Doing this will avoid any potential addressing conflicts when using an AMCI Module and 16 pt. modules with 2-Slot addressing or 32 pt. modules with 1-Slot addressing.
2. When using an AMCI Module as a Block Transfer Module the Remote I/O Adapter must be a 1771 - ASB Series B, Firmware Rev. F or later. Using a Remote I/O Adapter that has an earlier Series or Firmware may not work properly with a BT Module.
3. When using a single channel Transducer Interface Module, (1731/41, 7751), as a Single Transfer Module, the chassis that contains the module MUST be set-up for 1-slot or ½-slot addressing. 2-Slot addressing will not function properly. This is because of the restrictions imposed by the Allen-Bradley TIC chip.
4. Block Transfers can take place on all four I/O Scanners simultaneously. However, if you use the number one 1775-S4A or SR scanners, only 72 words can be transmitted on all four I/O Channels at one time.
5. When a BT Instruction is enabled but produces an error or does not complete, the most common problems are an incorrect Module Address or a missing Data File. You must create the Data File from your program loader before the program can be executed.
6. Because a Block Transfer is enabled only on False to True transitions, it can be requested at most every other scan. The programming example on page 7-3 shows how you can do this automatically by using the EXAMINE OFF Instruction to check the status of the DN bit.
7. When the PLC-3 is powered up, it may be necessary to write a value of 0000 to the first word of the Control Block before enabling the Block Transfer. This will clear all of the BT control bits. This should be necessary on power up only, not every time a Block Transfer is requested.

Overview

All PLC-5 processors have Block Transfer Instructions in their instruction sets. There are five parts to PLC-5 BT Instructions. They are:

- **Module Address** - The I/O Rack, Group, and Slot Numbers where the module is located.
- **Control Block** - The starting address of the five word block in memory that controls the Block Transfer.
- **Data File** - The starting file address that stores the data written to or read from the module.
- **File Length** - The number of words need edto store the data written to or read from the module.
- **Continuous Parameter** - Determines how often the Block Transfer is carried out.

Module Address

The Module address is the I/O Rack, Group, and Slot Numbers where the module is located in the system. The I/O Rack, Group, and Slot Numbers are entered separately in the Block Transfer Instruction.

Control Block

The Control Block is a block of five words that control the actual transfer of data. The address entered into the BT Instruction is the first address of the block. The Control Block must have an Integer data type and can be its own file or part of a larger file.

> Each BT Instruction requires a separate Control Block. This is true even if a BTW and BTR access the same module.

Data File

The Data File is the block of words that stores the information read from or written to the AMCI Module. The Data Address is the first address of the file. The Data File must have an Integer of Binary data type and can be a separate file or part of a larger file.

File Length

The File Length is the number of words in your data file. When programming a BTR Instruction, you can set the Block Length to 00. This will reserve 64 words in the PLC-5 memory, but the module will only transmit the number of words necessary. When programming a BTW Instruction, the number of words needed depends on the number of Program Instructions that you are writing to the AMCI Module.

> The File Length of a BTW Instruction **MUST** equal the number of words used by the Program Instructions. Using a File Length of zero will cause an Invalid Command Error if the number of words used by the Program Instructions is not 64.

File Length (cont'd)

The tables below lists the number of words transmitted by a AMCI Modules when a BTR Instruction is executed. **Chapter 9 Data Format**, gives the format of the transmitted data.

> **1700 USERS:** To make the present 1700 modules compatible with older versions, you must set the Module to Read Only with the PLC Program Parameter. If you set the PLC Program Parameter to Read Only, the number of words transmitted by the 1700 Module is the second number listed in the following table.

1700 Module	1731/41	1732/42	1733/43	1734/44	1761	1762	1763
Block Length	3/2	5/4	7/6	9/8	4/3	7/6	5/4

Fig 8.1 1700 Module Block Length

2700 Module	2731/41	2732
Block Length	3	5

Fig 8.2 2700 Module Block Length

7700 Module	7751	7752
Block Length	5	9

Fig 8.3 7700 Module Block Length

Continuous Parameter

The Continuous parameter controls how often the Block Transfer Instruction is executed. When the Continuous Parameter is set to "NO", the Block Transfer is executed only on a false to true transition on the rung. This means that a non-continuous Block Transfer can occur every other scan. When the Continuous Parameter is set to "YES", the Block Transfer will occur when the BT Instruction is first scanned and then every scan thereafter until an error in communication occurs.

> Block Transfer Writes to an AMCI Module **MUST** have the Continuous Parameter set to NO. Continuously writing Program Instructions to the module will shorten the life of the E^2PROM memory and the module will eventually give an E^2PROM ERROR message. See *Status Indicators*, Chapter 2 for more information.

Enable (EN), Error (ER), and Done (DN) Bits

Used to signal the start and finish of a Block Transfer, the processor sets the EN bit to start the transfer and after successfully completing the transfer the module sets the DN bit. If an error occurs in the transfer, the module will set the ER bit instead of the DN bit.

The EN, ER, and DN bits are located in the first word of the Control File. The EN Bit is bit 15, the ER Bit is bit 12 and the DN Bit is bit 13.

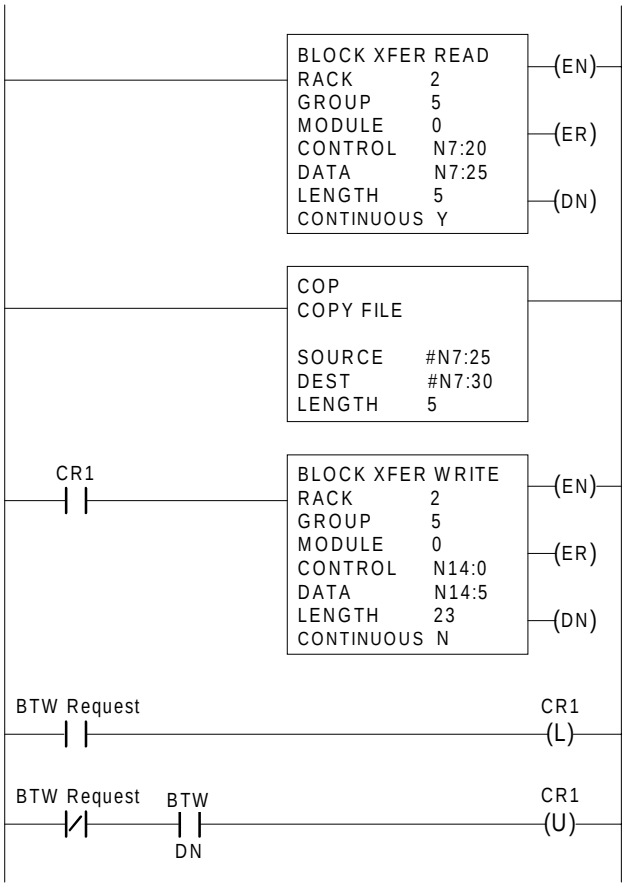
Enable (EN), Error (ER), and Done (DN) Bits (cont'd)

The following warning is taken verbatim from Allen-Bradley's PLC-5 Family Programmable Controllers Processor Manual, Publication 1785-6.8.2 - November, 1987 and refers to the Control Bits of the BT Instruction. These bits include the Enable, Error, and Done bits.

> "**IMPORTANT:** The processor executes block-transfer instructions asynchronous to the program scan. The status of these bits could change at any point in the program scan. When you test these bits (especially the done bit), test them only once every ladder program scan. If necessary, set temporary storage bits for the purpose of enabling subsequent rungs from them.
>
> Also, your ladder program should condition the use of block transfer data on the examination of the block-transfer error bit. An error may occur when the processor is switched from run mode, or when processor communications are interrupted."

Programming Example

The following example assumes 1-Slot addressing and the AMCI Module is I/O Rack 2, I/O Group 5 of the system.



Rung 1: BTR Instruction to the AMCI Module. Data will be transferred every scan with continuous transfer enabled.

Rung 2: Copy File Instruction buffers the data from the Module. This insures that the program will use the same data throughout each scan.

Rung 3: The BT Write is enabled when ever CR1 is latched on.

Rung 4: CR1 is latched on when a BTW Request is made.

Rung 5: CR1 is unlatched when the BTW Request is removed and the BTW Done bit is set.

Fig 8.4 PLC-5 Programming Example

PLC-5 Restrictions and Warnings

The following restrictions must be followed when using a BT Module in a PLC-5 System. If these restrictions are not followed, unpredictable operation may occur.

1. It is important to have an AMCI Module installed in a single slot pair. (See Installing the Module Chapter 3.) Doing this will avoid any potential addressing conflicts when using a 1700 Module and 16 pt. modules with 2-Slot addressing or 32 pt. modules with 1-Slot addressing.
2. When using an AMCI Module as a Block Transfer Module in a chassis that uses a Remote I/O Adapter, the I/O Adapter must be a 1771 - ASB, Series B, Firmware Rev. F, or later. Using a Remote I/O Adapter that has an earlier Series or Firmware Revision may not work properly with a BT Module.
3. When using a single channel Transducer Interface Module (1731/41, 7751) as a Single Transfer Module, the chassis that contains the module MUST be set-up for 1-slot or ½-slot addressing. 2-Slot addressing will not function properly. This is because of the restrictions imposed by the Allen-Bradley TIC chip.
4. When the processor enables a Block Transfer, it put all of the needed information into a queue. A queue is a data structure where the first piece of information put into the queue is the first piece of information taken out. Once the information is queued, a separate part of the processor performs the Block Transfer while the rest of the processor continues with the program scan. Each I/O Rack in the system has it's own queue. Each queue can hold 17 BT Requests. When the Block Transfer has its Continuous bit set to 1, Continuous Parameter is "YES", the Block Transfer is placed permanently in the queue.

   Each Queue has a "Queue Full" bit in word 7 of the processor's status file. Bit 8 is for Rack 0, Bit 9 is for Rack 1, and so on up to bit 15 for Rack 7. The appropriate bit is set when a Queue is full of BT Requests. Once set, your ladder logic program must clear these bits. We recommend that your program monitor these bits and take appropriate action if these bits are set.

   Note: If you have more than 17 Block Transfers associated with one rack and you set all of their continuous parameters to YES, only the first 17 Block Transfers scanned will be performed. All other transfers cannot be put into the queue and will never be performed.

Block Transfer Data Format

A 7700 Module normally transmits position and velocity data to the PLC when a Block Transfer Read Instruction accesses the module. The order and format of the position and velocity data is shown below. By using Read Status Instructions that you send to the module with a Block Transfer Write, you can force the module to transmit the present values of all the Programmable Parameters. *Read Status Data Format*, Pg 10-7 lists the format of the Block Transfer Read data when in Read Status Mode.

Hex Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
Word 1	T*	P*	0	0	0	0	U*	S*	Upper 2 digits Position Data							
Word 2	0	0	0	0	Lower 3 digits Position Data TRANS. 1											
Word 3	T*	P*	0	0	0	0	U*	S*	Upper 2 digits Velocity Data							
Word 4	0	0	0	0	Lower 3 digits Velocity Data TRANS. 1											
Word 5	T*	P*	0	0	0	0	U*	S*	Upper 2 digits Position Data							
Word 6	0	0	0	0	Lower 3 digits Position Data TRANS. 2											
Word 7	T*	P*	0	0	0	0	U*	S*	Upper 2 digits Velocity Data							
Word 8	0	0	0	0	Lower 3 digits Velocity Data TRANS. 2											
STATUS	Software Errors								Hardware Errors							

Fig 9.1 Data Format

Status Bits

T* - Transducer Fault Bit. It equals "1" when there is a Transducer Fault condition. Position and Velocity Data equal 0. See *Status Indicators* Pg 2-7 for more information.

P* - Power Supply Fault bit. It equals "1" when the internal power supply is shut down. Position and Velocity Data equal 0. See *Status Indicators* Pg 2-8 for more information.

U* - Underflow/Overflow Bit. It equals "1" when the Position Data is greater than 99,999 or less than -99,999. Position Data equals the amount of underflow/overflow. Use the Sign bit to determine if the condition is an Underflow or Overflow. See *Status Indicators* Pg 2-8 for more information.

S* - Sign Bit. It equals "1" when the Position Data is negative.

Notes

1: A 7751 transmits the first four words and the Status Word. A 7752 transmits all nine words.

2: Data can be transmitted in Binary or BCD format. See Data Format Parameter Pg. 2-6.

3: It may be necessary to convert the Position or Velocity data to a continuous 20 bit format. This is accomplished by: ((Word 1) * 1000 + (Word 2)). Note that you should mask the four status bits from Word 1 before you convert the Position data.

Block Transfer Data Format (cont'd)

Hardware Errors

The least significant byte (bit # 0-7), of the Status Word is used to transmit information on hardware faults. The format of the information is shown in Fig 5-2.

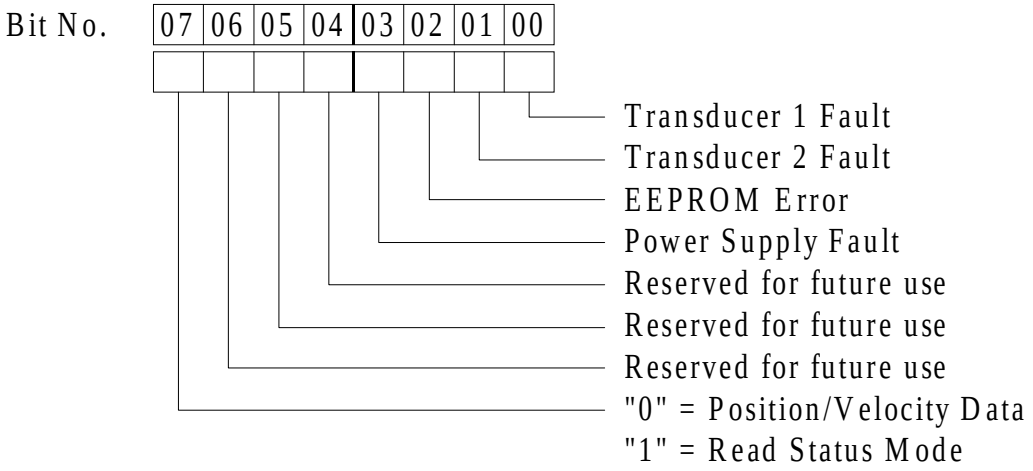


Fig 9.2 Hardware Error Format

Software Errors

Software Errors are errors that occur when programming a 7700 Module with Block Transfer Write Instructions. All software error codes are listed in *Error Codes*, Pg. 10-9.

Single Transfer Data Format

You can configure a 7751 to use Single Transfers instead of Block Transfers. See Transfer Type Parameter, Pg 2-6. When you do this, you lose the ability to program the 7751 from the PLC and you only have access to the Position Data.

Once configured to use Single Transfers, the 7751 acts like a 16 bit Input Card. It writes its data into the Input Image Table at the beginning of every scan. The following restrictions apply.

Notes and Restrictions

If you once used the 7751 as a Block Transfer module and you are converting your setup to use Single Transfers, you **Must Remove** all BTR and BTW Instructions that access the 7751 module. Block Transfer Instructions write control data into the Input and Output Image Table locations that may corrupt the data from the 7751.

Data is transmitted in Binary Format only.

Valid position data is in the range of 0 to 60,000 ($EA60_h$). An underflow/overflow message will be transmitted if the Position value is negative or greater than 60,000.

If the Position data is negative or greater than 60,000, the hexadecimal value $FFF0_h$ is transmitted to the PLC.

If there is a Transducer or Power Supply Fault , the hexadecimal value $FFFF_h$ is transmitted to the PLC.

Programming Structure

You can use your ladder logic to program the 7700 Module. This is done by transferring Program Instructions from the PLC to the module with the BTW Instruction. Each Program Instructions is made up of one or more 16 bit words.

The first word of every Program Instruction is the **Command Word**. The Command Word tells the module what action to take. This may be changing the value of the Scale Factor or Preset Value, or disabling the modules' Program Switch. The additional words of a Program Instruction are the **Data Words**. They contain the new values of the parameters: i.e. the new Scale Factor or Preset Value. The number of Program Instructions that can be sent to the Module at one time is limited only by the size of the block of words that you transmit. With the Block Transfer Write Instruction, you are limited to 64 Words.

Figure 10.1 shows the conceptual format of a group of Program Instructions.

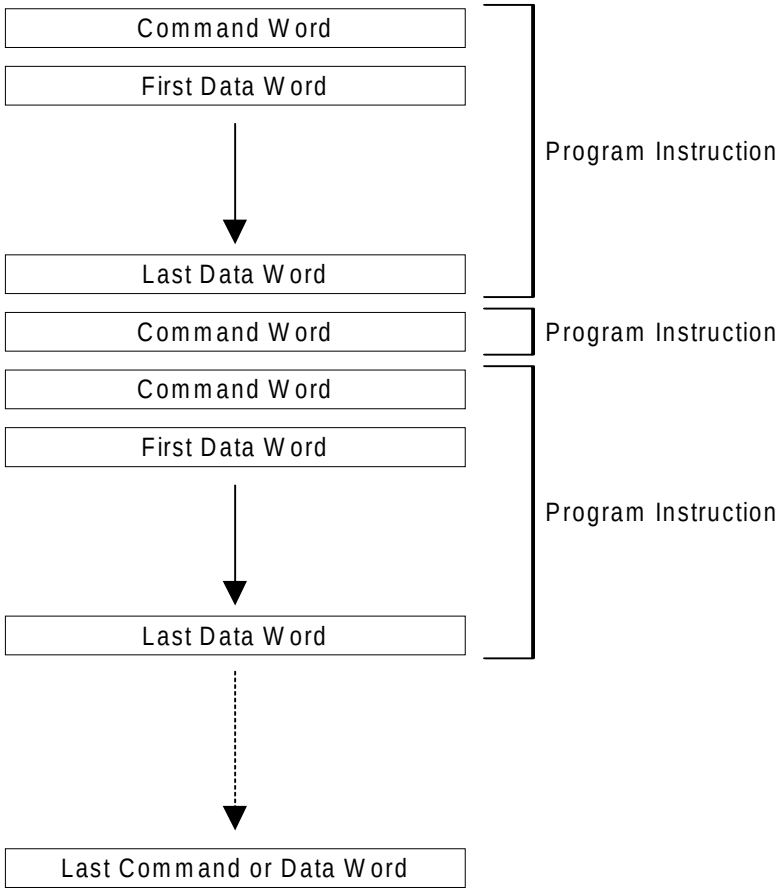


Fig 10.1 7700 Program Instruction Format

Program Instructions

Program Instructions can be broken down into three categories: Module Instructions, Transducer Instructions, and Read Status Instructions.

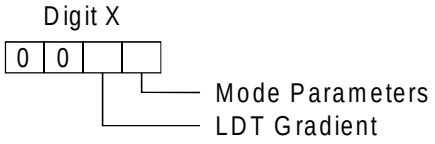
- **Module Instructions:** Instructions that affect the operation of the Module. These Instructions are: Disable Keyboard Programming, Enable Keyboard Programming, Clear Errors, Enter Read Status Mode, and Exit Read Status Mode. Note that Enter Read Status Mode and Exit Read Status Mode cannot be place in one BTW file.
- **Transducer Instructions:** Instructions that affect the Transducer Parameters. These Instructions are: Store Setup: Transducer 1, Store Parameters: Transducer 1, Store Setup: Transducer 2, Store Parameters: Transducer 2. You can program all of the module's parameters as well as preset the transducer's position value.
- **Read Status Instructions:** Instructions that tell the Module which programmable parameter values are to be sent to the PLC instead of Position and Tachometer data. These instructions can be issued only after Read Status Mode has been entered.

Module Instructions

COMMAND	COMMAND WORD	COMMENTS
Disable Keyboard Programming	8100h	Use this instruction to prevent programming the 7700 from the keyboard. See *Program Switch*, Pg 2-9 for more information.
Enable Keyboard Programming	8200h	Use this instruction to counteract a previous Disable Keyboard Programming Instruction. See *Program Switch*, Pg 2-9 for more information.
Clear Errors	8400h	Use this instruction to clear errors generated because of improper Program Instruction syntax. See *Error Codes*, Pg 10-9 for more information.
Enter Read Status Mode	8E00h	Enter this mode to read the values of the programmable parameters. Use this mode when debugging your system or to verify that program changes have not been made from the keyboard. When in this mode, the eighth bit of the Status Word (MSB of Hardware Errors Byte) is set to a one.
Exit Read Status Mode	8F00h	Use this instruction to leave Read Status Mode. When this command is issued, the module will transmit position and velocity data to the PLC.

Transducer Instructions

COMMAND	COMMAND WORD	COMMENTS
Store Setup Transducer 1	890Xh	(X={0...3}) Use this instruction to change LDT Type, DPM Recirculations, Measurement Unit, Decimal Point, Speed Average, Data Format and LDT Gradient parameters.

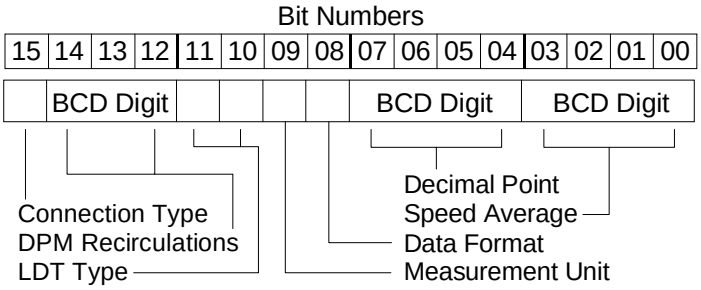


Bit Set to "1" = Store New Parameter.
Bit Set to "0" = Leave Parameter as is.
Example: 8901h = Store new Mode Parameters

The new values of the parameters are stored as Data Words immediately after the Command Word.

Mode Parameters

New Mode Parameters are stored in one word. The Data Word format is shown below.



Connection Type: Bit = 1: RPM Personality Module
Bit = 0: DPM Personality Module

DPM Recirculations: Valid Numbers are 1, 2, and 4.

LDT Type: 00 = AMCI LHT Series Transducers
01 = Balluff Transducers
10 = MTS Temposonics II Transducers

If LDT Type is not Temposonics, Bits 12-15 are not read.

Measurement Unit: Bit = 0: Inches
Bit = 1: Millimeters

Data Format: Bit = 0: Binary Format, 1: BCD Format

Decimal Point: Sets number of digits to right of decimal point. Valid Numbers are 1 through 4.

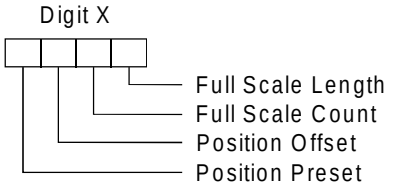
Speed Average: 0 = 32 mSec Response
1 = 60 mSec Response
2 = 120 mSec Response
3 = 240 mSec Response

Transducer Instructions (cont'd)

COMMAND	COMMAND WORD	COMMENTS
Store Setup Transducer 1 (cont'd)		**LDT Gradient Parameter** The LDT Gradient Parameter requires two Data Words and is stored in BCD format. The format of the words is shown below. 0 0 0 0 Upper 3 digits LDT Gradient 0 0 0 0 Lower 3 digits LDT Gradient **Programming Example** Set the module for a Temposonics II LDT with a RPM Personality Module, Speed Velocity Parameter to 60 mSec and set the LDT Gradient to 8.97290. All other parameters are set to their default values. Command Word: 8903h Data Words: 8801h Mode Parameters 0897h LDT Gradient 0290h

Transducer Instructions (cont'd)

COMMAND	COMMAND WORD	COMMENTS
Store Parameters Transducer 1	880Xh	(X={0...F}) Use this instruction to program the Full Scale Length, Count Direction, Full Scale Count, Position Offset, and Preset Value Parameters.



Bit Set to "1" = Store New Parameter.
Bit Set to "0" = Leave Parameter as is.
Example: 8801h = Store new Full Scale Length

The new values of the parameters are stored in BCD format as Data Words immediately after the Command Word.

4 BCD digit Full Scale Length								
D*	0	0	0	0	0	0	0	Upper 2 digits F.S. Count
0	0	0	0	Lower 3 digits F.S. Count				
S*	0	0	0	0	0	0	0	Upper 2 digits Position Offset
0	0	0	0	Lower 3 digits Position Offset				
S*	0	0	0	0	0	0	0	Upper 2 digits Position Preset
0	0	0	0	Lower 3 digits Position Preset				

D* Direction Parameter Bit. Set it equal to zero to increase the Position data as the magnet moves from the LDT head. Set it equal to 1 to increase the Position Data as the magnet moves toward the LDT head.

S* Sign Bit. Set it equal to 0 for positive Position Offset or Preset values. Set it equal to 1 for negative Position Offset or Preset values.

Programming Example

Set Count Direction to Negative, Full Scale Length to 40 inches, and Full Scale Count to 25000.

Command Word: 8803h
Data Words: 0040h Full Scale Length
8025h Count Direction &
0000h Full Scale Count

Transducer Instructions (cont'd)

COMMAND	COMMAND WORD	COMMENTS
Store Setup Transducer 2	990Xh	(X={0...3}) Not available with the 7751. Use this Program Instruction to program the Setup Parameters of the second transducer on the 7752 Module. Command Word and Data Word formats are the same as Store Setup: Transducer 1 Program Instruction.
Store Parameters Transducer 2	980Xh	(X={0...F}) Not available with the 7751. Use this Program Instruction to program the Parameters of the second transducer on the 7752 Module. Command Word and Data Word formats are the same as Store Parameters: Transducer 1 Program Instruction.
Preset Transducer 1	8500h	Use this command to set the Position Function of Transducer 1 equal to the programmed Preset Value.
Preset Transducer 2	9500h	Not available with the 7751. Use this command to set the Position Function of Transducer 2 equal to the programmed Preset Value.

Read Status Instructions

In order to read the programmed values of the modules' parameters, you must include the Enter Read Status Mode Instruction in the block of Programming Instructions transmitted to the module. Once this Instruction is accepted, use one of the four instructions listed below to tell the module which parameters to transmit.

These Instructions are valid only after the Enter Read Status Mode Instruction has been accepted and **MUST** be the last Instruction in the Block Transfer Write data. The format of the data transmitted back to the module while in Read Status Mode is given in the following section: *Read Status Data Format,* Pg 10-8.

COMMAND	COMMAND WORD	COMMENTS
Read Setup Transducer 1	870Xh	(X={0...3}) Use this Program Instruction to read the values of the parameters written to the module with the Store Setup: Transducer 1 Program Instruction. The format of the Command Word written to the module and the format of the Data Words read from the module are the same as the Store Setup: Transducer 1 Program Instruction.
Read Parameters Transducer 1	860Xh	(X={0...F}) Use this Program Instruction to read the values of the parameters written to the module with the Store Parameters: Transducer 1 Program Instruction. The format of the Command Word written to the module and the format of the Data Words read from the module are the same as the Store Parameter: Transducer 1 Program Instruction.

Read Status Instructions (cont'd)

COMMAND	COMMAND WORD	COMMENTS
Read Setup Transducer 2	970Xh	(X={0...3}) Not available with the 7751. Use this Program Instruction to read the values of the parameters written to the module with the Store Setup: Transducer 2 Program Instruction. The format of the Command Word written to the module and the format of the Data Words read from the module are the same as the Store Setup: Transducer 2 Program Instruction.
Read Parameters Transducer 2	960Xh	(X={0...F}) Not available with the 7751. Use this Program Instruction to read the values of the parameters written to the module with the Store Parameters: Transducer 2 Program Instruction. The format of the Command Word written to the module and the format of the Data Words read from the module are the same as the Store Parameter: Transducer 2 Program Instruction.

Read Status Data Format

The format of the data sent to the PLC when in Read Status Mode is given below.

Hex Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00

Word 1	ECHO OF LAST *READ PARAMETERS* COMMAND
Word 2	FIRST REQUESTED PARAMETER VALUE
Word 3	SECOND REQUESTED PARAMETER VALUE
Word 4	THIRD REQUESTED PARAMETER VALUE
Word 5	FOURTH REQUESTED PARAMETER VALUE
Word 6	FIFTH REQUESTED PARAMETER VALUE
Word 7	SIXTH REQUESTED PARAMETER VALUE
Word 8	SEVENTH REQUESTED PARAMETER VALUE
STATUS	Software Errors | Hardware Errors

Fig 10.2 Read Status Data Format

Notes:

1. If a Read Setup or Read Parameter Transducer (1/2) Instruction is used, it MUST be the last instruction in a BTW file. If any instruction follows one of these, a Programming Error will result. Therefore, Read Status Mode cannot be entered and exited with one BTW file of Instructions.
2. Only Read Setup or Read Parameter Transducer (1/2) Instructions are echoed back to the PLC. All other Instructions can still be executed. All requested parameters are echoed back in BCD format.
3. Note that a 7751 transmits only words 1 through 4, and Status.
4. The parameters can be read from the module one axis at a time. For example, you cannot read the Full Scale Length of Transducer 1 and the Position Offset of Transducer 2 with one Instruction. Therefore, reading all of the parameters from a 7751 Module would require 4 Block Transfer Read/Write cycles. The first places the module in Read Status Mode and transmits the Setup Parameter values for the first transducer. The second and third Block Transfer cycles transmit the other Parameters of the 7751 and the fourth Block Transfer cycle exits Read Status Mode. Likewise a 7752 requires 5 Block Transfer cycles.
5. If a word is not used to transmit a parameter value, it equals 0000h.
6. When in Read Status Mode, the eighth bit of the Status Word (the most significant bit of the Hardware Error byte) is set to a "1". This bit should be used to distinguish between Position/Velocity data and Parameter Value data in the BTR file.
7. If you are in Read Status Mode and change the value of a parameter that is being transmitted to the PLC, you must issue another Read Setup or Read Parameter Transducer (1/2) Instruction before the new parameter value is sent to the PLC.

Error Codes

There are two classes of errors that the module is programmed to detect.

- **Hardware Errors** - These errors occur when the module detects a problem with the transducer connections or its own internal hardware.
- **Software Errors** - These errors occur if the Program Instructions received from the PLC are incorrect.

Error diagnostic codes are placed in the Status Word of the BTR file that is sent to the PLC. In the case of Hardware Errors, fault messages are also displayed on the front panel. See *Status Indicators* Pg 2-7.

Hardware Errors

The least significant byte (bit # 0-7), of the Status Word is used to transmit information on hardware faults. The format of the information is shown below.

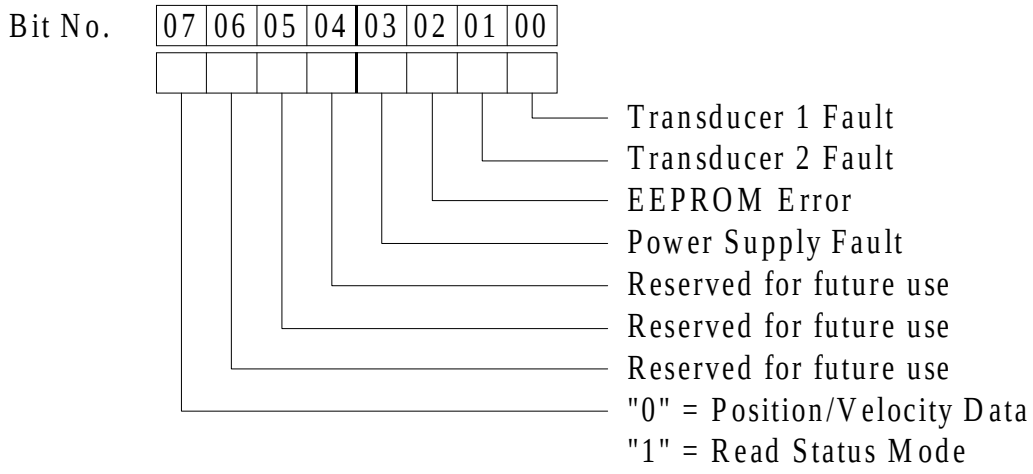


Fig 10.3 Hardware Error Format

When an error is detected, the 7700 Module sets the appropriate bit to "1".

Error Codes (cont'd)

Software Errors

When an error occurs in the Program Instructions, the 7700 responds by placing an error code in the Software Error byte of the Status Word and then stops accepting Program Instructions until the error is cleared with the Clear Errors Command. See Clear Errors Pg. 10-2.

For example, your BTW file contains 5 Program Instructions. The third Instruction tells the module to set the Full Scale Count to an invalid number. The 7700 will execute the first two Program Instructions normally but will set an error code when it tries to perform the third Instruction. Program Instructions 3, 4, and 5 will not execute.

ERROR CODE	ERROR WORD	COMMENTS
Invalid Command	21_{BCD}	Occurs when the Command Word is incorrect. This error most often occurs when a Data Word is interpreted as a Command Word.
Invalid Message Length	22_{BCD}	This error occurs when the final Instruction in the BTW file does not have enough Data Words. The problem may be an improper LENGTH value in the BTW Instruction. Placing **ANY** Instruction after a Read Parameter Instruction or attempting to read parameters from both transducer will also cause this error.
Message Ignored	23_{BCD}	You attempted to Write Program Instruction to the 7700 while it was reporting a Software Error.
Invalid Transducer Number	24_{BCD}	You attempted to write parameters for transducer 2 to a 7751 Module.
Invalid Mode	25_{BCD}	You sent a Read Parameters Instruction to the module when it is not in Read Status Mode.
Invalid Parameter Number	26_{BCD}	Occurs if a Read Parameter Instruction requests more parameter values then the BTR file can transmit. See Read Status Data Format, Note 4, Pg 10-8 for more information.

Error Codes (cont'd)

Software Errors (cont'd)

ERROR CODE	ERROR WORD	COMMENTS
Invalid Full Scale Length	31_{BCD}	Occurs when the specified value for the Full Scale Length Parameter is out of range.
Invalid Full Scale Count	32_{BCD}	Occurs when the specified value for the Full Scale Count Parameter is out of range.
Invalid Position Offset	33_{BCD}	Occurs when the specified value for the Position Offset Parameter is out of range.
Invalid Position Preset	34_{BCD}	Occurs when the specified value for the Position Preset Parameter is out of range.
Invalid LDT Gradient	41_{BCD}	Occurs when the specified value for the LDT Gradient Parameter is out of range.
Invalid Speed Average	42_{BCD}	Occurs when the specified value for the Speed Average Parameter is out of range.
Invalid DPM Recirculations	43_{BCD}	Occurs when the specified value for the DPM Recirculations Parameter is out of range.
Invalid Decimal Point	44_{BCD}	Occurs when the specified value for the Decimal Point Parameter is out of range.

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