User Manual

2762-17
Intelligent Position Control Module

AMCI

Allen-Bradley
1771 I/O
Module

ROCKWELL AUTOMATION ENCOMPASS™ AMERICAS PARTNER

Manual: 940-57080

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Introduction

This manual explains the operation, installation, programming, and servicing the 2762-17 Intelligent Position Control Module for the Allen-Bradley 1771 I/O programmable controller systems.

It is strongly recommended that you read the following instructions. If there are any unanswered questions after reading this manual, call the factory. An applications engineer will be available to assist you.

Manuals at AMCI are constantly evolving entities. Your questions and comments on this manual and the information it contains are both welcomed and necessary if this manual is to be improved. Please direct all comments to: Technical Documentation, AMCI, Gear Drive, Plymouth Industrial Park, Terryville CT 06786, or fax us at (860) 584-1973.

Revision Record

The following is the revision history for this manual. In addition to the information listed, revisions will fix any known typographic errors and clarification notes may be added.

This manual, 940-07080, superceeds LM2761756. It was first released January 13, 2000. No changes to the modules' hardware or firmware were made. This revision was done before creating the PDF version of this manual (940-57080). The engineering prints were eliminated and the page numbering scheme was changed so that the page numbers in the PDF file would be the same as the printed manual.

Past Revisions

The LM2761756 manual superseded LM2761746 and coresponded to software revision 2, checksum E033. The software change was customer driven. The Motion Status Bits change to "Stopped, In Position", whenever the position is within the specified Target Range. The Motion Status Bits are available in both block and single transfer data. See Pgs. 60 and 66.

This LM2761746 manual superseded LM2761736 and coresponded to software revision 1, checksum 5D1E. With this software, the 2762-17 first drove the position to the Overshoot Offset when the initial position is within the overshoot range. A programmable parameter, *Retry Value* was also added. This parameter specifies the number of attempts the 2762-17 makes to reach the target position before issuing a 'Stopped, Not in Position' error message. The *Retry Value* is only used if the move profile is initiated from the backplane. When initiated from the front panel, the 2762-17 will make a maximum of three attempts to reach the target position.

Revision LM2761736, was the first release of the manual. It was first released March 1996.

Notes

This chapter describes the uses and functionality of the 2762-17 module and compatible AMCI transducers.

The 2762-17 Intelligent Position Control Module

The 2762-17 Intelligent Position Control Module is a two channel, non-servo positioning controller for Allen-Bradley 1771 I/O systems. Each channel has four DC outputs for motor speed and direction control and utilizes a brushless resolver based transducer for absolute multiturn position feedback. Examples in this manual show the 2762-17 controlling only one channel. This is for clarity only. The 2762-17 is a true two channel controller that can drive both channels simultaneously.

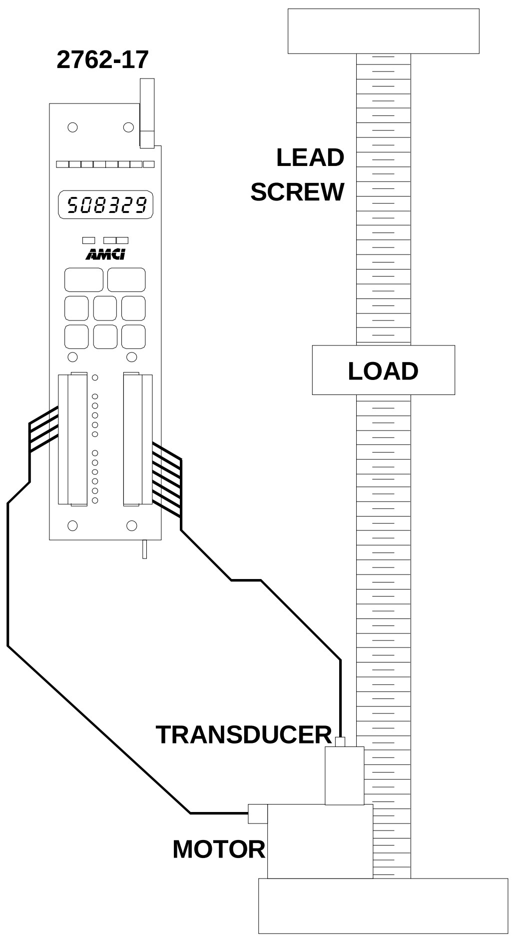


Figure 1.1 Typical 2762-17 Application

Module configuration is accomplished from the processor or integral keyboard and display. Module configuration includes *transducer setup*, which sets the relationship of transducer position to load position, and *positioning setup*, which sets the loads' target position and the motor control parameters needed to reach the target position once a *Move Profile* is initiated.

Once configured, the 2762-17 waits for a move profile command. Once the command is given from the processor or keyboard, the module uses the transducer position to fire its motor control outputs at the appropriate positions. The 2762-17 turns the motor off at a programmed *stop position* and the load coasts to the target position.

If the load does not stop at the target position, the 2762-17 adjusts the stop position and runs the move profile again. Because inertia and friction in most systems is repeatable, the module can accurately position the load without servo feedback.

The 2762-17 also gives you the ability to jog the position from the processor, keyboard or external input.

The 2762-17 uses block transfer writes to program the module from the processor. It uses block transfer reads to transmit position and tachometer information or programming data back to the processor. The module uses single transfer writes to initiate move profiles or jog the load position from data in the output data table. It uses single transfer reads to transmit positioning status to the input data table. The 2762-17 can perform concurrent block and single transfers.

Brushless Resolver Description

The brushless resolver is unsurpassed by any other type of rotary position transducer in its ability to withstand the harsh industrial environment. An analog sensor that is absolute over a single turn, the resolver was originally developed for military applications and has benefited from more than 50 years of continuous use and development.

The resolver is essentially a rotary transformer with one important distinction. The energy coupled through a rotary transformer is not affected by shaft position whereas the magnitude of energy coupled through a resolver varies sinusoidally as the shaft rotates. A resolver has one primary winding, the Reference Winding and two secondary windings, the SIN and COS Windings. (See Figure 1.2, Resolver Cut Away View). The Reference Winding is located in the rotor of the resolver, the SIN and COS Windings in the stator. The SIN and COS Windings are mechanically displaced 90 degrees from each other. In a brushless resolver, energy is supplied from the Reference Winding to the rotor by a rotary transformer. This eliminates brushes and slip rings in the resolver and the reliability problems associated with them.

In general, the Reference Winding is excited by an AC voltage called the Reference Voltage (V_R). (See Figure 1.3, Resolver Schematic). The induced voltages in the SIN and COS Windings are equal to the value of the Reference Voltage multiplied by the SIN or COS of the angle of the input shaft from a fixed zero point. Thus, the resolver provides two voltages whose ratio (SIN / COS = TAN θ, where θ = shaft angle) represents the absolute position of the input shaft. Because the ratio of the SIN and COS voltages is considered, any changes in the resolvers' characteristics, such as those caused by aging or a change in temperature, are ignored.

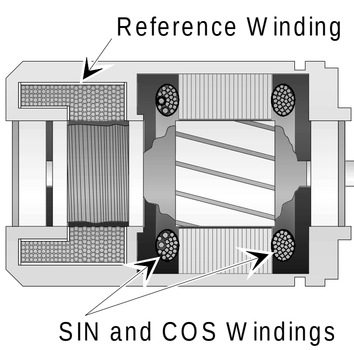


Fig 1.2 Resolver Cut away View

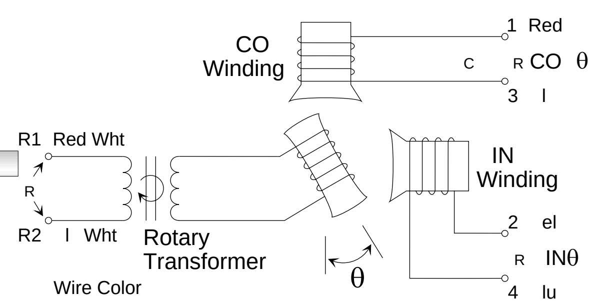


Fig 1.3 Resolver Schematic

AMCI Compatible Transducers

The 2762-17 is compatible with the following NEMA 4 transducers manufactured by AMCI.

- HTT-20-100: 100 turn absolute position transducer
- HTT-20-180: 180 turn absolute position transducer
- HTT-20-1000: 1,000 turn absolute position transducer
- HTT-20-1800: 1,800 turn absolute position transducer

Each transducer contains two resolvers. The first resolver, called the fine resolver, is attached with a flexible coupler directly to the shaft. The second resolver, called the coarse resolver, is geared to the fine. This gear ratio, either 99:100 or 179:180 determines the total number of turns the transducer can encode.

At the mechanical zero of the transducer the electrical zeros of the two resolvers are aligned. See Figure 1.4A. After one complete rotation, the zero of the coarse resolver lags behind the zero of the fine by one tooth, either 1/100 or 1/180 of a turn. After two rotations the lag is 2/100 or 2/180. See Figures 1.4B and 1.4C. After 100 or 180 turns, the electrical zeros of the resolvers are realigned and the multiturn cycle begins again.

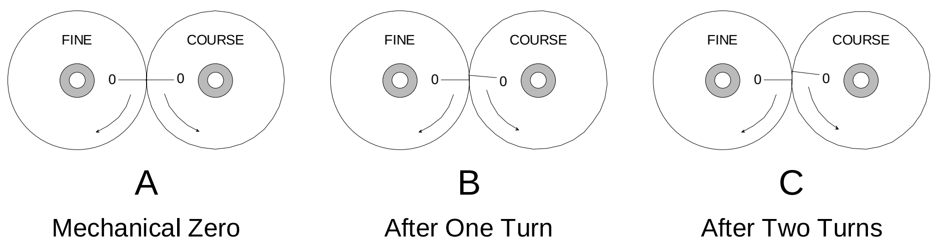


Figure 1.4 Resolver Alignment in Multiturn Transducers

The 2762-17 simultaneously reads the resolvers every 800 µSec. The fine resolver yields the absolute position within the turn directly. Using a proprietary algorithm, the 2762-17 determines the number of turns completed by the difference in positions of the two resolvers. The absolute multiturn position is then calculated as ((number of turns completed * counts per turn) + fine resolver position).

The 1,000 and 1,800 turn transducers have an additional 10:1 gear ratio between the input shaft and the fine resolver. Therefore they can encode ten times the number of turns but at a tenth of the resolution.

> To the 2762-17 module, the 1,000 and 1,800 turn transducers appear to be 100 or 180 turn transducers. Therefore only 100 and 180 turn transducers are discussed in this manual.

2762-17 DC Outputs

The 2762-17 has a total of eight DC motor control outputs, four per channel. Each channel has the following outputs.

- Motor Forward - Turns on to rotate the motor in one direction.
- Motor Reverse - Turns on to rotate the motor in the opposite direction of Motor Forward.
- High Speed - Turns on when motor can be driven at high speed.
- Low Speed - Turns on when the motor should be driven at low speed.

The outputs are sourcing type and are rated at 40 volts, 2 amps DC. Surge rating is 4 Adc for 10 mSec per output. Each channel (four outputs) has its own power supply connections and fuse. Fused with a 7 amp fast blow fuse, the suggested maximum output current per channel is 5 amps. Each output has a LED indicator. Two blown fuse indicators are also present.

The output names *Motor Forward* and *Motor Reverse* are completely arbitary and do not imply the direction of travel of the load. Depending on your setup, turning the Motor Forward output on will produce increasing position counts or decreasing position counts.

Transducer Setup Parameters

Transducer setup for each channel consists of nine parameters that define the transducer, the relationship between transducer position and load position, and the upper and lower position limits for the load. They can be programmed from the keyboard or processor. Programming from the processor is disabled when the keyboard is in use.

Transducer Type

This parameter must be set to the type of transducer attached to the channel, 100 turn or 180 turn. The 2762-17 needs this information to decode the multiturn position from the difference in positions of the two resolvers.

Count Direction

By default, the transducer position increases with CW rotation of the shaft, when looking at the shaft. Changing this parameter reverses the rotation for increasing position. In application terms, if the position of the load is increasing and the transducer position is decreasing, simply change this parameter.

Decimal Point

This parameter sets the position of a decimal point on many of the modules' displays and is for the user only. It does not affect the data sent over the backplane. For example, your travel is measured in inches and your resolution is one thousandth of an inch. Setting a decimal point at three forces many of the displays to show 'nnn.nnn' where nnnnnn is the present value.

Transducer Setup Parameters (continued)

Number of Turns

Use this parameter, along with the *Scale Factor* parameter, to set the correlation between the transducer position and the load position. This parameter is usually set to the number of rotations the transducer makes for the expected linear travel of the load. Its minimum value is 0.1 turns. Its maximum value is equal to the number of turns of the transducer, 100 or 180 turns, with 0.1 turn resolution. When using it with a 1000 or 1800 turn transducers consider it programmable from 1 turn to 1000 or 1800 turns with 1.0 turn resolution.

Scale Factor

Use this parameter, along with the *Number of Turns* parameter, to set the correlation between the transducer position and the load position. The Scale Factor sets the position resolution and must be set to the number of counts needed over the programmed Number of Turns parameter. The range of values that can be programmed for the Scale Factor is 2 to (4096 * Number of Turns).

Counts per Turn and Full Scale Count

The Scale Factor divided by the Number of Turns is the number of counts per turn. The 2762-17 uses this ratio when calculating the position values. Therefore the actual values for Number of Turns and Scale Factor can be any convenient numbers. For example, assume 150.7641 turns corresponds to 9.000 inches of travel. Therefore, the counts per turn ratio is 9000 / 150.7641 ≈ 59.6958. Setting the Number of Turns to 150.8 results in a significant error, 9000 / 150.8 ≈ 59.7213. Using successive approximation techniques to arrive at different values, setting the Number of Turns to 138.1 and the Scale Factor to 8244 results in a much better approximation. {8244 / 138.1 ≈ 59.6958. Its accuracy to the actual ratio is greater than five decimal places}.

The 2762-17 uses the counts per turn ratio to calculate the Full Scale Count (FSC). The Full Scale Count is the largest number the position value will attain before the transducer completes its multi-turn cycle. (100 or 180 turns.) See Figure 1.5.

The Full Scale Count sets limits on the values that can be programmed into the other transducer setup parameters as well as some of the positioning setup parameters.

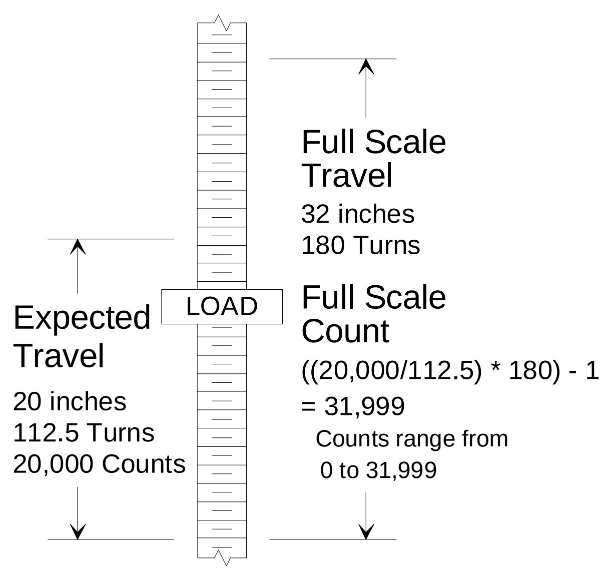


Figure 1.5 Full Scale Count Example

Transducer Setup Parameters (continued)

Linear Offset

The Linear Offset is a fixed number that is added to the transducer position data. It adjusts the range of position values the 2762-17 uses. For example, a twenty inch expected travel is over a range of 35.000 to 55.000 inches. Programming a linear offset of 35,000 will force the position data to read from 35,000 to 55,000. The module can output positions between -99,999 and 999,999. Therefore the range of values for the linear offset is -99,999 to (999,999 - Full Scale Count).

Preset Value

The Preset Value allows you to adjust the position data without rotating the transducer shaft. It's most commonly used to set the position data equal to the actual position of the load. Once programmed, the position can be set to the preset value from the keyboard or processor. The programmable range of the Preset Value is Linear Offset to (Linear Offset + FSC).

Upper and Lower Travel Limits

In many applications, the machine will be damaged if the load exceeds the boundaries of expected travel. The Upper and Lower Travel Limits are programmable boundaries that will disable the motor outputs if the position exceeds them during a move profile. Once the position exceeds these limits, the only way to move the load is by jogging the position. The upper travel limit sets the upper boundary and is programmable from (Lower Travel Limit + 1) to (Linear Offset + Full Scale Count). The lower travel limit sets the lower boundary and is programmable from Linear Offset to (Upper Travel Limit -1).

Positioning Setup Parameters

> Positioning setup for each channel consists of six parameters that define the positions at which the motor control outputs change state. They can be programmed from the keyboard or processor. Processor programming is disabled when the keyboard is in use.

Target Position

Target Position is the desired position of the load when a move profile is completed. It is programmed as an absolute position within the Lower and Upper Travel Limits. Except for Positioning Direction, the other parameters are programmed as absolute values relative to this position.

The direction of approach to the Target Position is programmable. Therefore, the definitions of the parameters refer to a *positive side of the Target Position* and a *negative side of the Target Position*. The *positive side* refers to all values greater than the Target Position and the *negative side* refer to all values less than the Target Position.

Positioning Direction

Positioning Direction defines the direction of the approach to the Target Position. A *Positive Approach* forces an approach from the positive side of the Target Position. A *Negative Approach* forces an approach from the negative side. If the starting position of the move profile is on the opposite side of the Target Position, the 2762-17 will drive the load to the correct side of the Target Position before completing the move profile.

Positioning Setup Parameters (continued)

Overshoot Offset

The 2762-17 uses the Overshoot Offset to determine how far away from the Target Position to drive the load before beginning the approach to the Target Position. If the starting position is between the Target Position and Overshoot Offset, or on the opposite side of the Target Position, the 2762-17 will drive the load to the Overshoot Offset before beginning the approach. The Overshoot Offset is also used when backing off from the Target Position if the previous attempt to reach it failed.

The Overshoot Offset can be programmed to any value between (Low Speed Offset +1) and Full Scale Count.

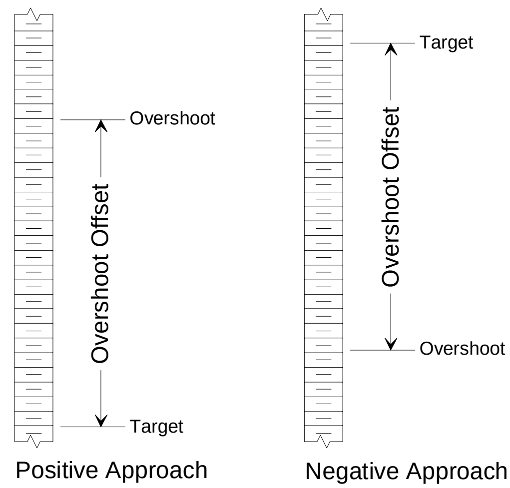


Figure 1.6 Overshoot Offset

If a positive approach is defined and (Target Position + Overshoot Offset) is greater than the Upper Travel Limit, the module will issue an 'Invalid Profile' error message when a move profile is initiated. The same error message will be issued if a negative approach is defined and (Target Position - Overshoot Offset) is less than the Lower Travel Limit.

Low Speed Offset

The Low Speed Offset defines the position that the motor switches from high to low speed. It is used in two ways.

- When approaching the Target Position from the correct direction, (Target Position ± Low Speed Offset) is the point at which the motor switches from high to low speed.
- When traveling towards the Overshoot, the motor will switch to low speed when the position is (Overshoot ± Low Speed Offset). It will then travel at low speed to the Overshoot position, turn off the motor, and reverse direction before completing the profile.

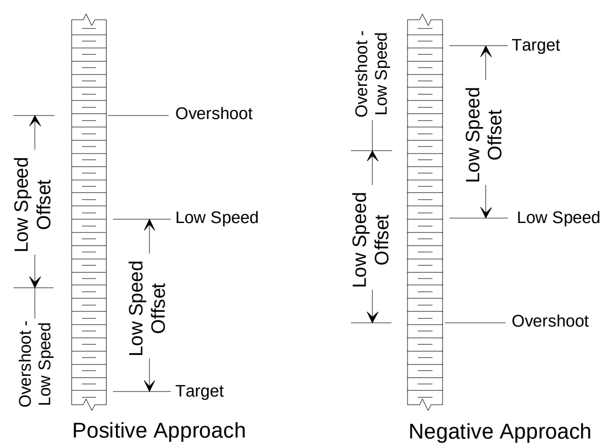


Figure 1.7 Low Speed Offset

The Low Speed Offset can be programmed to zero or from (Stop Offset + 1) to (Overshoot Offset - 1). Setting the Low Speed Offset to zero disables the high speed motor output. All movement will be at low speed if the Low Speed Offset equals zero.

Positioning Setup Parameters (continued)

Stop Offset

Once on the correct side of the Target Position, the Stop Offset defines the position at which the motor outputs are turned off at the end of the move profile. The load then coasts to the Target Position.

The Stop Offset can be programmed to any value between one and (Low Speed Offset - 1). If the Low Speed Offset equals zero, the Stop Offset can be programmed to any value between one and (Overshoot Offset -1).

If the load is not at Target Position at the end of the move profile the 2762-17 adjusts the Stop Offset by the difference between the actual position and the Target Position. The module will then back out to the overshoot position and run the profile again with the adjusted Stop Offset. The 2762-17 will not allow the adjusted value of the Stop Offset to be greater than the Overshoot Offset.

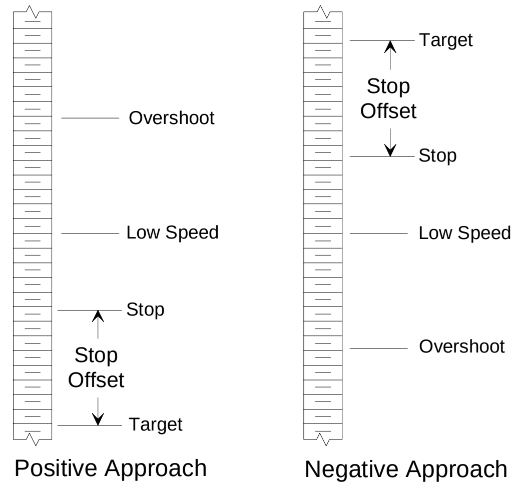


Figure 1.8 Stop Offset

When initiated from the keyboard, the 2762-17 will adjust and re-run the profile a maximum of three times before issuing an error message. When initiated from the backplane, the module will adjust and re-run the profile the number of times specified by the *Retry Value* parameter before issuing an error message. If the Target Position is reached, the 2762-17 stores the adjusted Stop Offset if it is within the range listed above.

Target Range

The Target Range defines a dead band around the Target Position. If the position at the end of a move profile is (Target Position ± Target Range) then the move profile is considered complete.

The Target Range can be programmed to any value between zero and Full Scale Count.

As shown in Figure 1.9, the Target Range is added to and subtracted from the Target Position when determining the dead band. For example, assume a Target Position of 10,000 and a Target Range of five. The acceptable positions at the end of the move profile are then 9,995 to 10,005.

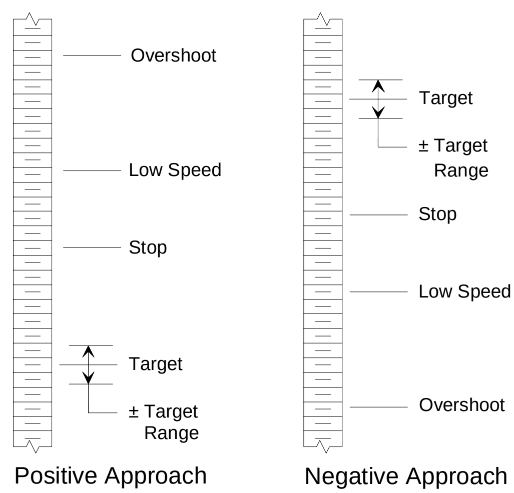


Figure 1.9 Target Range

Positioning Setup Parameters (continued)

Retry Value

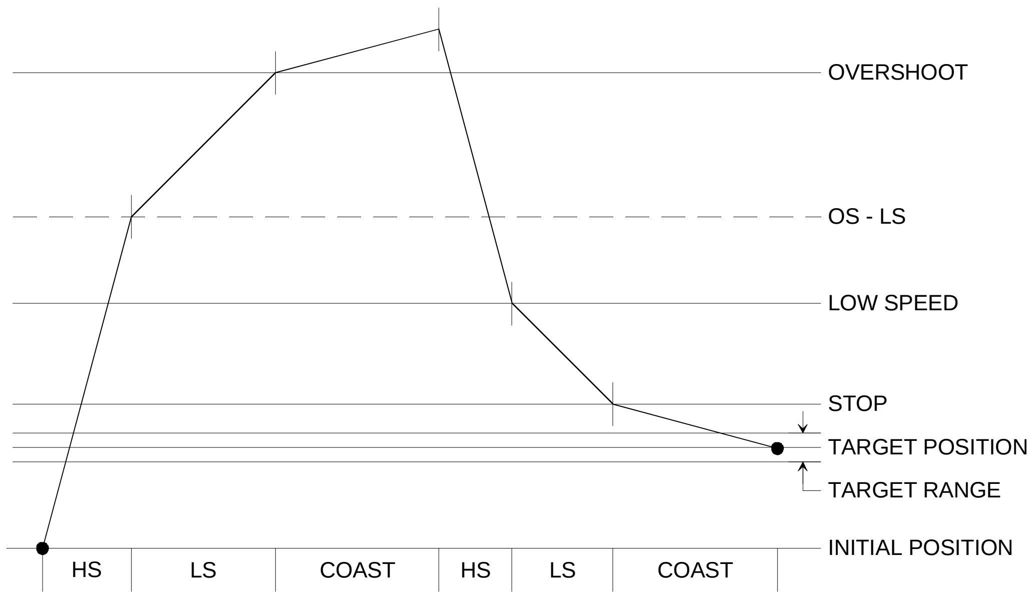
The Retry Value is only used when a move profile is initiated from the backplane and specifies the maximum number of attempts the 2762-17 will make to reach the target position if the first attempt failed.

The Retry Value can be programmed to any value between 1 and 255. The default value is three. If you program a value greater than 255 or a value of zero, the module responds with and error message. The Retry Value is programmable from the backplane only. There is no front panel display for this parameter. You must use a Read Positioning Setup Auxiliary Command (See Pg. 19) to check its value.

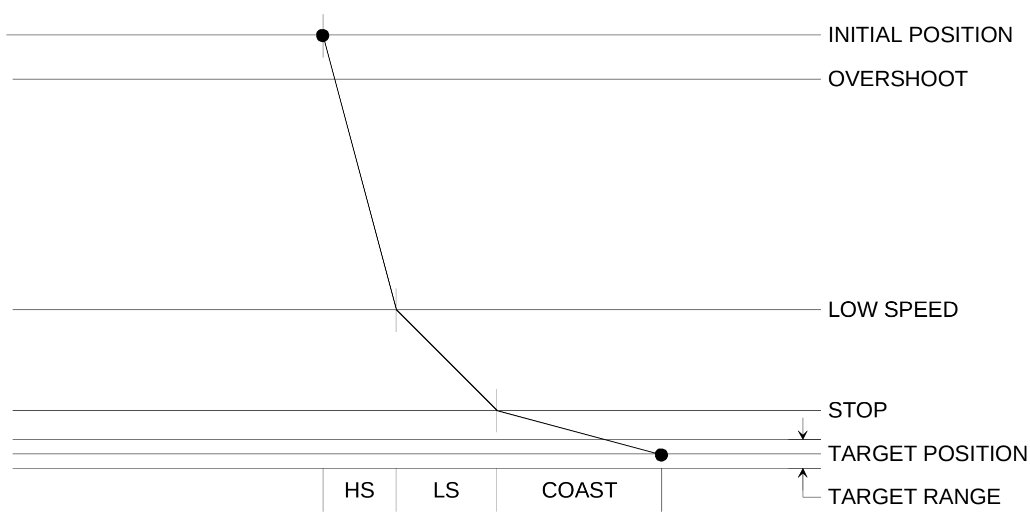
Sample Move Profiles

The following diagrams show the state of the motor control outputs based on initial position and programmed parameters. The diagrams show the most common positioning waveforms. All possible combinations are not shown.

Positioning Direction: Positive
Initial Position: Negative Side

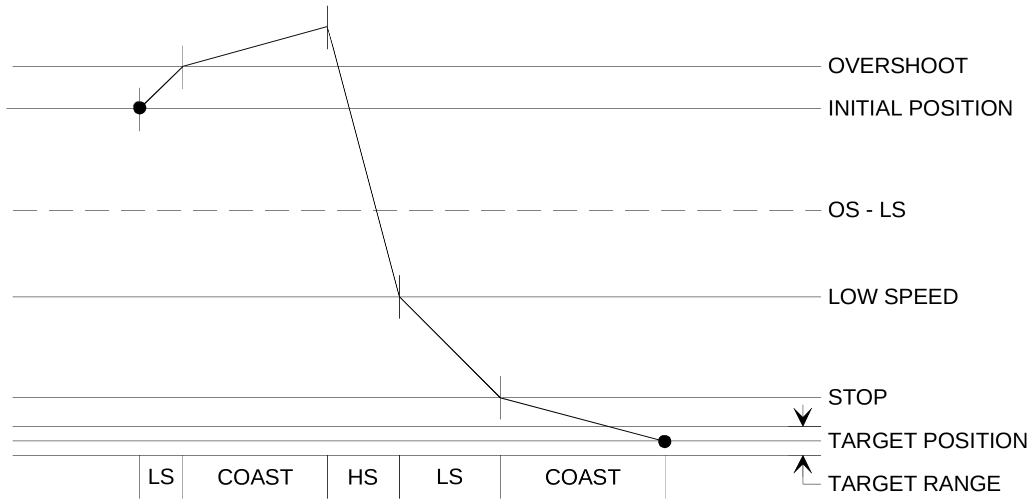


Positioning Direction: Positive
Initial Position: Positive Side, Outside overshoot position

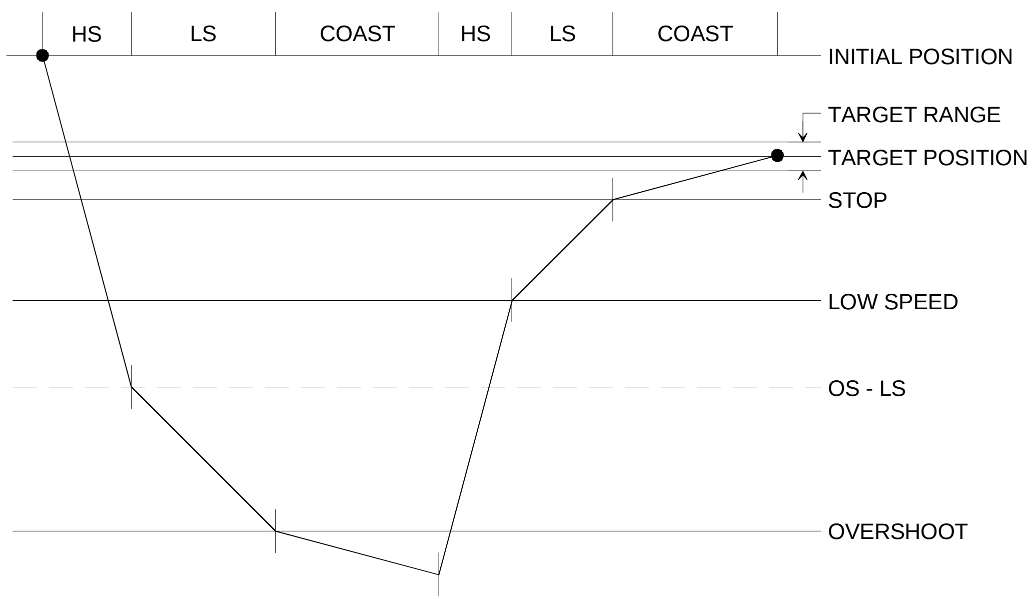


Sample Move Profiles (continued)

Positioning Direction: Positive
Initial Position: Positive Side, Inside overshoot position

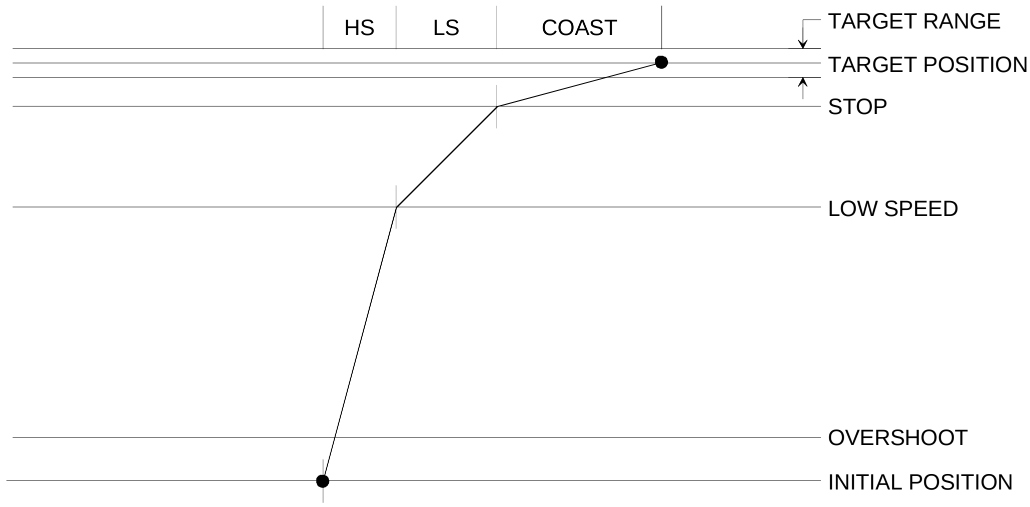


Positioning Direction: Negative
Initial Position: Positive Side

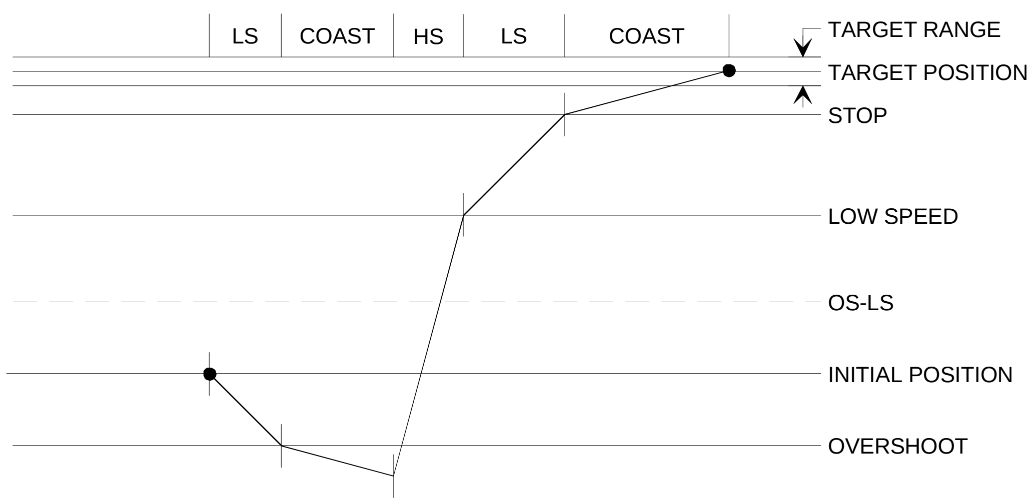


Sample Move Profiles (continued)

Positioning Direction: Negative
Initial Position: Negative Side, Outside overshoot position

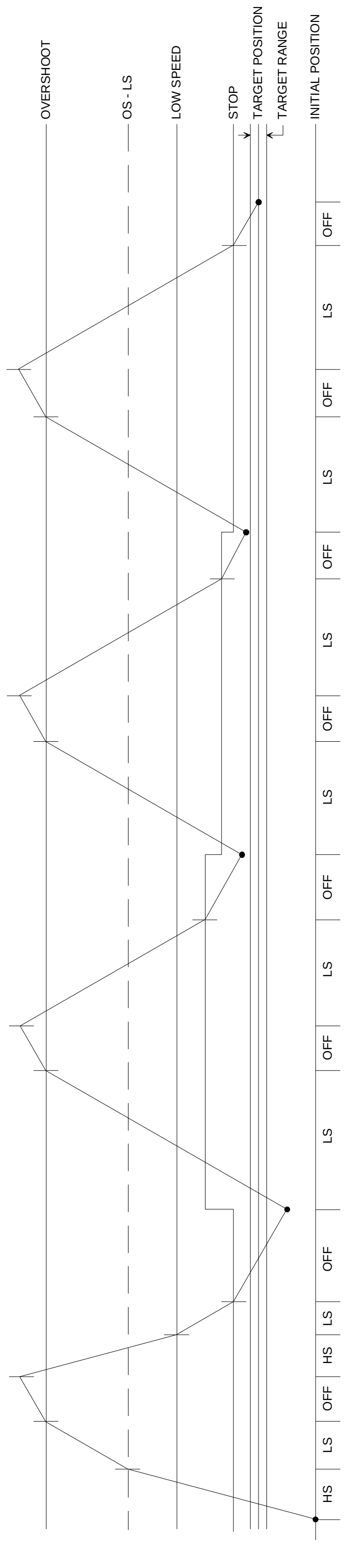


Positioning Direction: Negative
Initial Position: Negative Side, Inside overshoot position



Sample Move Profiles (continued)

Positioning Direction: Positive
Initial Position: Negative Side



This waveform shows the 2762-17 making four attempts to reach the Target Position by adjusting the Stop Offset.

Note that the 2762-17 will not adjust the Stop Offset to a value greater than the Overshoot Offset.

The 2762-17 will run the profile a maximum of four times before issuing an error message when the profile is initiated from the keyboard. When initiated from the backplane, the 2762-17 uses the *Retry Value* parameter to determine how many times to run the profile. The default Retry Value is three, which means the profile will run four times.

If the 2762-17 adjusts the Stop Offset to the Overshoot Offset and the Target Position is still overshot, the module will stop trying to reach the Target Position and issue an error message.

Jogging the Load Position

The 2762-17 allows you to manually jog the load position in one of three ways. From the processor, the modules' keypad, or an external input. The motor runs at low speed when jogging the position.

CAUTION It is possible to jog the load past the upper or lower travel limits.

Jogging from the Processor

You jog the position from the processor by setting a bit in the output image table. Jog Up and Jog Down bits are defined for each channel. The position will jog as long as the bit is set.

Jogging from the Keyboard

The 2762-17 has a separate menu for jogging the position. The module displays the current position when in this menu. Press the [▲] or [▼] key to jog the position in the corresponding direction. The position will jog as long as the key is pressed.

Jogging from the external input

The 2762-17 accepts a single input to jog the position. Bits in the output image table enable the input and set the jogs' direction. Each channel has its own enable and direction bits.

CAUTION It is possible to jog both channels simultaneously with the external input. It is also possible to simultaneously jog the channels in opposite directions.

The external input is opto-isolated and has the following electrical specifications.

- Input Voltage: 10 to 24 Volts AC or DC.
- Input Current: 10 mA required to turn input on.

Auxiliary Commands

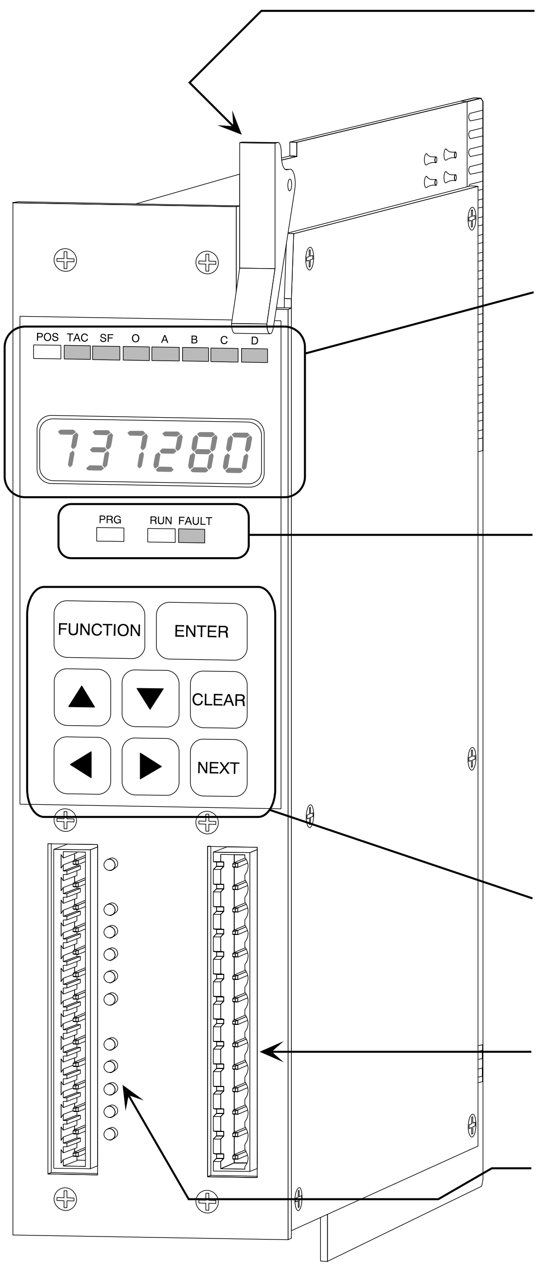
Auxiliary Commands are commands issued from the processor with a block transfer write. They affect the operation of the module. There are six commands:

- Clear Errors - Clears all transducer faults and programming errors.
- Disable Keyboard - Disables all programming from the keyboard. Move profiles cannot be initiated. Parameters can be monitored from the keyboard but they cannot be modified. Jogging from the keyboard is still enabled.
- Enable Keyboard - Counteracts a previous Disable Keyboard Command. The status of the keyboard is retained when power is removed. The only way to enable the keyboard after a Disable Keyboard command is with this command.
- Read Status and Position - After this command, the 2762-17 will transmit module status with position and tachometer data for both transducers when a block transfer read addresses the module.
- Read Transducer Setup - After this command, the 2762-17 will transmit Transducer Setup data for the specified channel when a block transfer read addresses the module.
- Read Positioning Setup - After this command, the 2762-17 transmits Positioning Setup data for the specified channel when a block transfer read accesses the module.

Notes

This chapter describes the physical layout of the 2762-17 module as well as keyboard programming.

Front Panel Description



Program Switch - (On other side of PC Board, hidden from view.) Used to enable programming the 2762-17 from the keyboard. A two pin header next to the switch can be removed to disable Program Mode. The switch can also be disabled from the processor.

Function Display - Used to display position data and parameter values. The eight LED indicators designate what is showing on the display. When programming a parameter, a blinking digit in the display shows the position of the *Cursor*.

Status Indicators - Indicates the operating status 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 module fault. The type of fault is shown on the display.

Keyboard - Used to examine or change the programming of the module. Also used to start a move profile or jog the position.

Transducer Input Connector - Connector for the two AMCI transducers.

Motor Control Output Connector - Connector for the eight DC motor control outputs and the external jog input.

Figure 2.1 2762-17 Front Panel

Program Mode vs. Display Mode

The 2762-17 front panel has two operating modes.

- Program Mode - (Yellow PRG light on) The parameters can be modified from the keyboard. Move profiles can be initiated and the position can be jogged from the module.
- Display Mode - (Yellow PRG light off) The parameters can be viewed, but not modified. Move profiles cannot be initiated but the position can still be jogged.

Program Mode and Display Mode refer to the modules' front panel only. It does not refer to the backplane interface. The 2762-17 is not programmable from the backplane only under two conditions. First is when a parameter is being modified from the keyboard. Second is when a move profile or jog is in process.

The 2762-17 can be locked in display mode in two ways. The first is by removing a jumper on the module. The second is with a processor instruction. It is usually good practice to lock the module in display mode once the system is operational. This will prevent someone from accidentally changing the 2762-17's parameters while the system is running. The only times that changes to the programming should be allowed are during set-up or trouble shooting procedures.

Program Switch

The Program Switch is used to quickly enable or disable program mode as long as the 2762-17 is not locked in display mode. The module is in program mode when the switch is pushed towards the back of the module. The module is in display mode when the switch is pushed towards the front of the module. The yellow PRG light is on when the 2762-17 is in program mode.

The Program Switch can be disabled by removing the jumper on the two pin header next to the switch. Removing this jumper locks the 2762-17 in display mode. You can also lock the module in display mode with the Auxiliary Command *Disable Keyboard*. See page 18.

⚠WARNING Remove system power before removing or installing any module in an 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 personnel.

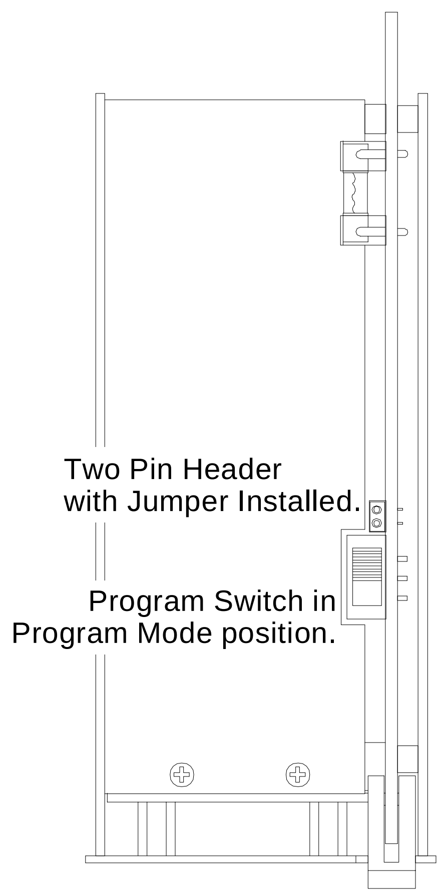


Figure 2.2 Program Switch

The Menu System

Programming the 2762-17 from the front panel involves navigating a menu system in which the parameters are broken down into sub-menus. The menu system layout is shown in Figure 2.3. The 2762-17 displays the current position on power up.

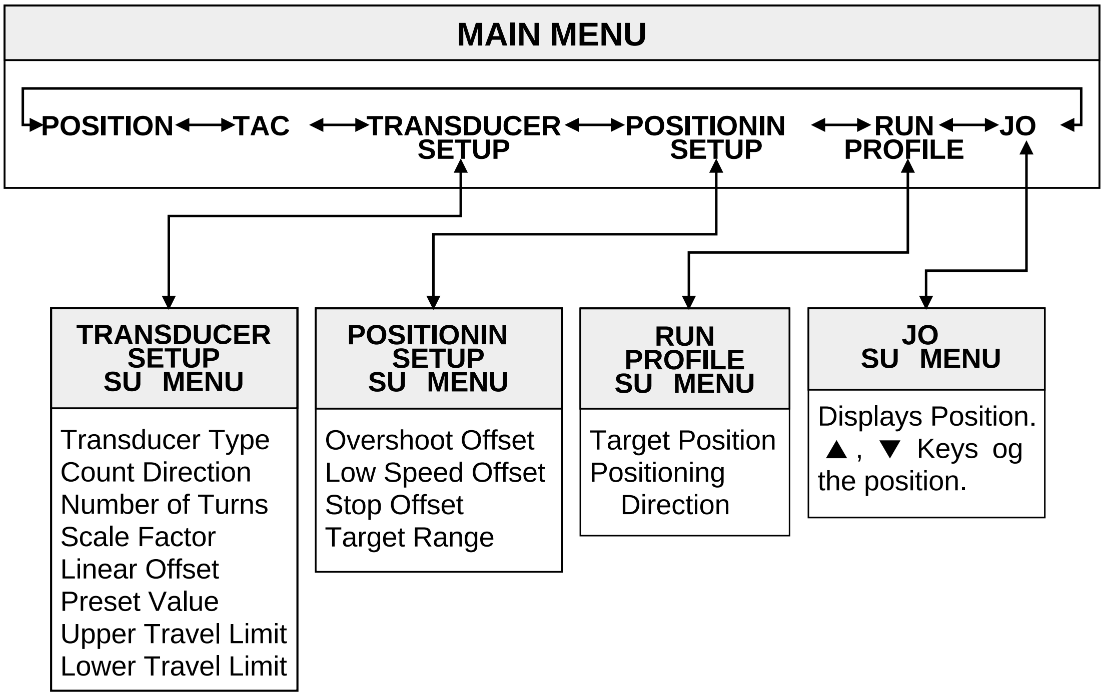


Figure 2.3 2762-17 Menu System Layout

Switching between Channels

Pressing the [**NEXT**] key will switch between the two channels at almost every point in the menu system. The only time you cannot switch between the two channels is when you are setting the Positioning Direction in the Run Profile submenu. The '**D**' indicator LED is on when displaying data for channel two.

Navigating the Main Menu

The main menu is navigated with three keys, [**FUNCTION**], [►] , and [◄]. The [**FUNCTION**] and [►] keys move you one item to the right in the menu. The [◄] key moves you one item to the left.

The menu is circular. When at the Jog menu, pressing the [**FUNCTION**] or [►] keys will move you to the position display. Pressing the [◄] key when you are at the Position display returns you to the Jog item.

To enter a submenu, display the appropriate menu item and press the [**ENTER**] key. Exiting the last submenu item will return you to the main menu at the point you left it.

The Menu System (continued)

Navigating the Submenus in Display Mode

Once in a submenu, use the [**FUNCTION**] key to scroll through the parameters. Pressing the [**FUNCTION**] key when at the last parameter returns you to the main menu. Press the [**ENTER**] key to re-enter the submenu.

You cannot program parameters or initiate a move profile while in display mode. You can jog the position. The jog submenu displays the current position. Press the [▲] or [▼] keys to increase or decrease the current position. The position will jog as long as a key is pressed. Use the [**FUNCTION**] key to exit the submenu.

Navigating the Submenus in Program Mode

You program most of the parameters in the Transducer Setup and Positioning Setup submenus. One of the digits will blink when you first enter a parameter display. This shows the position of the cursor. Use the [►] , and [◄] keys to move the cursor and the [▲] and [▼] keys to change the value of the digit. To quickly set most parameters to zero, press the [**CLEAR**] key. Once the parameter is modified, press the [**ENTER**] key to accept the value. If the 2762-17 accepts the value the cursor is removed from the display.

The module will only accept valid values for the parameters. If the 2762-17 does not accept a value it will return the display to the last valid number and move the cursor to the first digit. The valid range for many parameters is based on the values of other parameters. If the module does not accept a new value, check the other parameter settings.

Pressing the [**FUNCTION**] key at any time will remove the cursor if you do not want to modify the parameter that is on the display. The [**FUNCTION**] key is also used to scroll to the next parameter in the submenu.

The Run Profile submenu allows you to initiate a move profile from the module. Simply program the Target Position and the Positioning Direction. The move profile is initiated when you press [**ENTER**] at the Positioning Direction display. When the move profile is complete the 2762-17 will display the final position with all of the digits blinking if it completes successfully. If it does not complete, the module displays one of several error messages. Pressing the [**CLEAR**] key while a move profile is running will immediately stop the profile.

The Jog submenu behaves as it does in display mode. Press the [▲] or [▼] keys to increase or decrease the current position. Press the [**FUNCTION**] key to exit the submenu.

Indicator LED Patterns

The eight LEDs above the seven segment displays are the indicator LEDs. Figure 2.4 is a list of the menu and submenu items and the associated indicator LED pattern. Note that some of the parameters have the same indicator pattern. In these cases, the actual displays are different enough to distinguish between the parameters.

	POS	TAC	SF	O	A	B	C	D	
	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	POSITION
	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	TACHOMETER
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	TRANSDUCER SETUP
TRANSDUCER SETUP SUBMENU	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	Transducer Type
TRANSDUCER SETUP SUBMENU	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	Count Direction
TRANSDUCER SETUP SUBMENU	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	Decimal Point
TRANSDUCER SETUP SUBMENU	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	Number of Turns
TRANSDUCER SETUP SUBMENU	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	Scale Factor
TRANSDUCER SETUP SUBMENU	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	Linear Offset
TRANSDUCER SETUP SUBMENU	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF Ch 1 / ON Ch 2	Preset Value
TRANSDUCER SETUP SUBMENU	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF Ch 1 / ON Ch 2	Upper Travel Limit
TRANSDUCER SETUP SUBMENU	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF Ch 1 / ON Ch 2	Lower Travel Limit
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	POSITIONING SETUP
POSITIONING SETUP SUBMENU	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	OverShoot Offset
POSITIONING SETUP SUBMENU	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF Ch 1 / ON Ch 2	Low Speed Offset
POSITIONING SETUP SUBMENU	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF Ch 1 / ON Ch 2	Stop Offset
POSITIONING SETUP SUBMENU	OFF	ON	OFF	OFF	OFF	OFF	ON	OFF Ch 1 / ON Ch 2	Target Range
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	RUN PROFILE
RUN PROFILE SUBMENU	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF Ch 1 / ON Ch 2	Target Position
RUN PROFILE SUBMENU	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF Ch 1 / ON Ch 2	Positioning Direction
RUN PROFILE SUBMENU	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF Ch 1 / ON Ch 2	All other RP Displays
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	JOG
JOG SUBMENU	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF Ch 1 / ON Ch 2	Jog Position

LED OFF

LED ON

LED OFF For Channel 1
LED ON For Channel 2

Figure 2.4 Indicator LED Patterns

Position Display

As shown in figure 2.5a, the Position Display shows the current position when a transducer is properly attached to the channel. Figures 2.5b and 2.5c show the display when there is a transducer fault. Figure 2.5b is the channel 1 display. Figure 2.5c is the channel 2 display. There are four major causes of a transducer fault.

- Broken or intermittent transducer cable
- Non-compatible transducer
- Improper wiring of the transducer Cable
- Faulty Transducer.

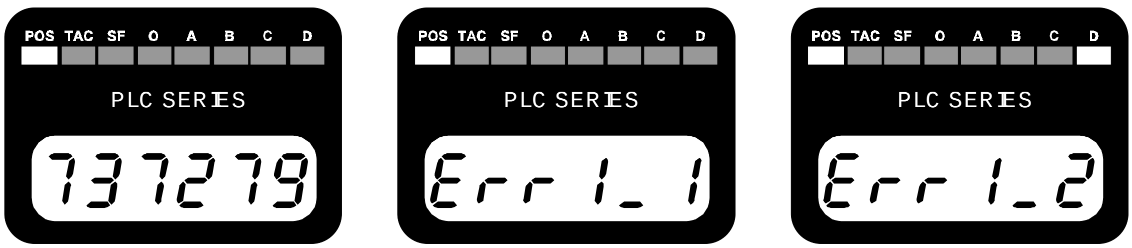


Fig A
CURRENT POSITION

Fig B
TRANSDUCER FAULT
CHANNEL 1

Fig C
TRANSDUCER FAULT
CHANNEL 2

Figure 2.5 Position Displays

The red FAULT LED is lit when there is a transducer fault. If this LED is on while the position is displayed, the fault is on the other channel. Use the [**NEXT**] key to switch to the other channel. The fault can be cleared by pressing the [**CLEAR**] key if the 'Err1' message is blinking.

Tachometer Display

The tachometer display shows the current speed of the transducer in counts per minute. See Figure 2.6. If there is a transducer fault, the display will show the 'Err1' messages instead of the current speed.

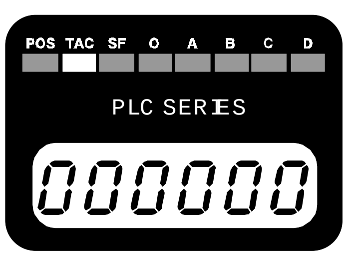
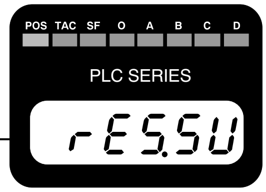


Figure 2.6 Tachometer Display

The relationship to load speed is application specific. For example, programming the Number of Turns and Scale Factor parameter such that the transducer rotates one count for every 0.001" of load travel means the tachometer will read out in thousandths of an inch per minute. This equals inches per minute with three decimal point accuracy.

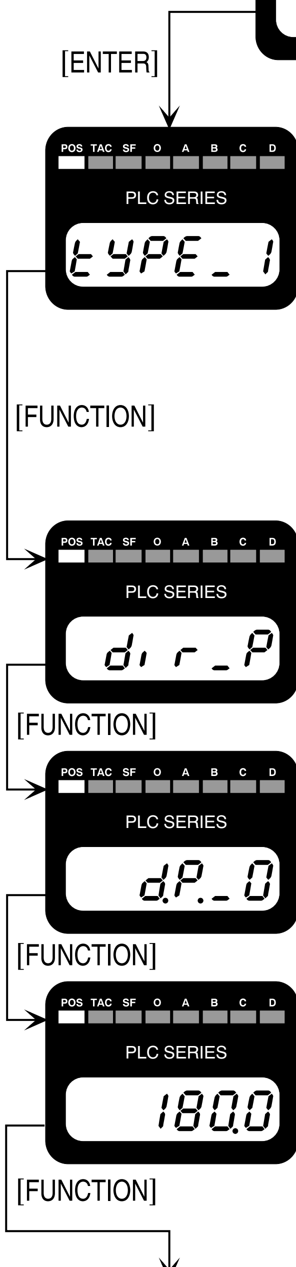
Transducer Setup Submenu

The Transducer Setup submenu contains all of the transducer setup parameters. The figure below and on the following page show all of the displays as they appear on the module. Default values, range of values and any special programming instructions are also listed.



Transducer Setup Menu

Press [**FUNCTION**] or [►] to advance to the Positioning Setup Menu. Press [◄] to return to the Tachometer Display.



Transducer Type Parameter

0 = HTT-20-100 or HTT-20-1000 Transducer
1 = HTT-20-180 or HTT-20-1800 Transducer

Press [▲] or [▼] to change transducer type. Press [**ENTER**] to accept the value. Press [**FUNCTION**] to accept the value without changes.

WARNIN : Pressing [**ENTER**] while displaying this parameter will reset all other Transducer Setup Parameters to their default values.

Count Direction Parameter

P = Clockwise increasing count
n = Counter-clockwise increasing count

Decimal Point Parameter

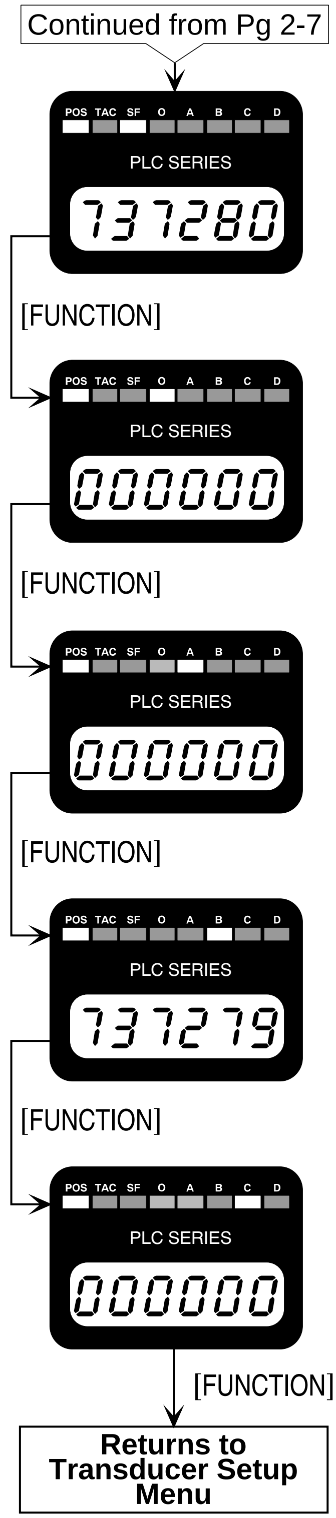
Default: 0
Range: 0 to 5 inclusive.

Number of Turns Parameter

Default: 180.0 turns
Range: HTT-20-180: 0.1 to 180.0, 0.1 turn resolution
HTT-20-100: 0.1 to 100.0, 0.1 turn resolution

Continued on Pg 2-8

Transducer Setup Submenu (continued)



Scale Factor Parameter

Default: 737,280
Range: 2 to (Number of Turns * 4096)

Linear Offset Parameter

Default: 0
Range: -99,999 to (999,999 - Full Scale Count†)

Preset Value Parameter

Default: 0 (Linear Offset)
Range: Linear Offset to (Linear Offset + FSC†)

Upper Travel Limit Parameter

Default: 737,279 (Linear Offset + FSC†)
Range: (Lower Travel Limit + 1) to (Linear Offset + FSC†)

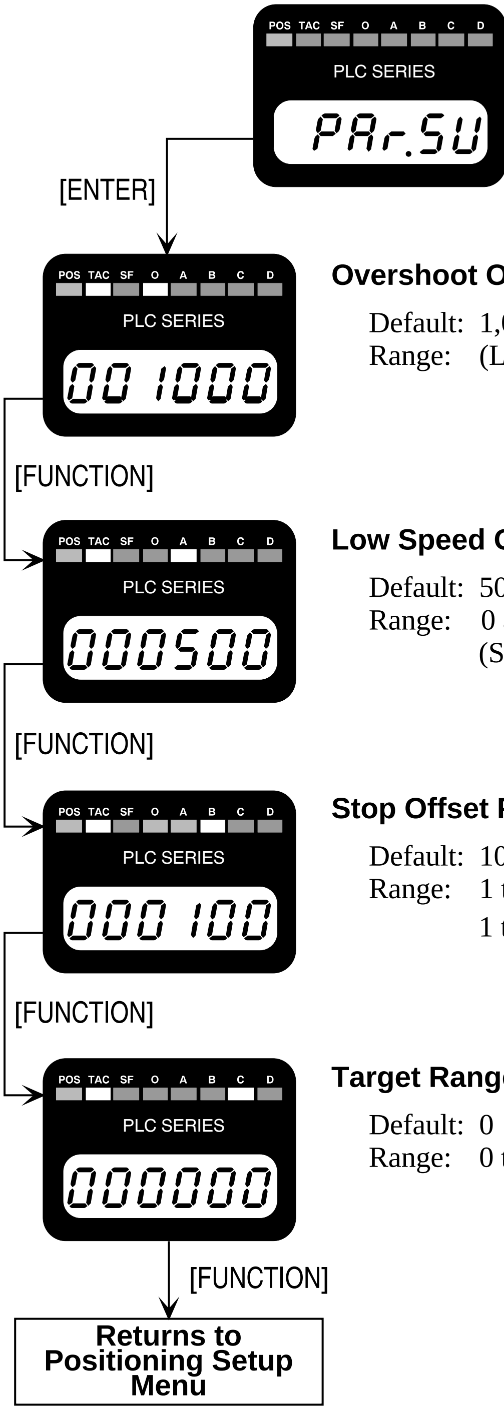
Lower Travel Limit Parameter

Default: 0 (Linear Offset)
Range: Linear Offset to (Upper Travel Limit -1)

† FSC: Full Scale Count = (Transducer Type {100 or 180} * (Scale Factor/Number of Turns)) - 1

Positioning Setup Submenu

The Positioning Setup submenu contains all of the positioning setup parameters except for Target Position and Positioning Direction. The figure below show all of the displays as they appear on the module. Default values and range of values are also listed.



Positioning Setup Menu
Press **[FUNCTION]** or [å] to advance to the Run Profile menu. Press [ä] to return to the Transducer Setup menu.

Overshoot Offset Parameter

Default: 1,000
Range: (Low Speed Offset + 1) to Full Scale Count†

Low Speed Offset Parameter

Default: 500
Range: 0 and
(Stop Offset + 1) to (Overshoot Offset - 1)

Stop Offset Parameter

Default: 100
Range: 1 to (Overshoot Offset - 1) if Low Speed = 0
1 to (Low Speed - 1) if Low Speed ≠ 0

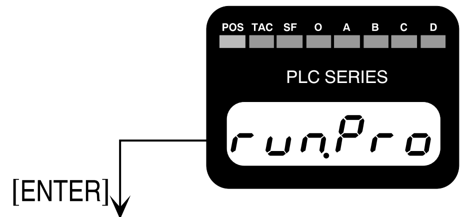
Target Range Parameter

Default: 0
Range: 0 to Full Scale Count†

† FSC: Full Scale Count = (Transducer Type {100 or 180} * (Scale Factor/Number of Turns)) - 1

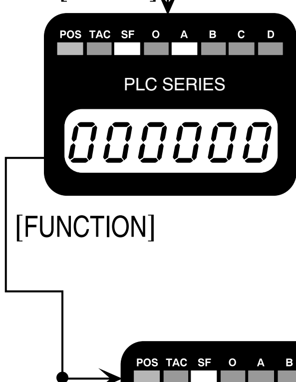
Run Profile Submenu, Running a Move Profile From the Keyboard

As the name implies, you initiate a move profile from this submenu. Move profiles cannot be initiated while in display mode. You must be in program mode to initiate a move profile.



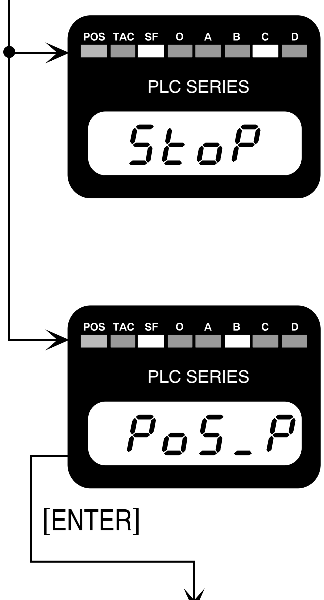
Run Profile Menu

Press [**FUNCTION**] or [►] to advance to the Jog menu. Press [◄] to return to the Positioning Setup menu.



Target Position Parameter

Default: 0
Range: Linear Offset to Linear Offset + FSC†



Continued on Pg 2-11

Not in Program Mode

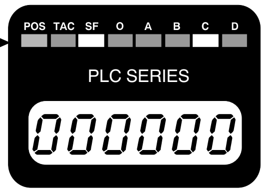
You cannot initiate a move profile when in display mode. If you try, the 2762-17 displays this error instead the Positioning Direction parameter.

Positioning Direction Parameter

Default: Positive Approach
Range: Positive Approach or Negative Approach
Press [**FUNCTION**] to return to the Run Profile Menu
After setting the approach, press [**ENTER**] to initiate a move profile. When the profile is complete, the display changes to one of the five listed on the next page.

Run Profile Submenu, Running a Move Profile From the Keyboard (continued)

Continued from Pg 2-10

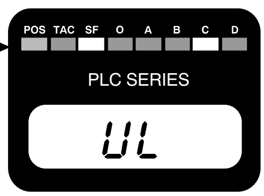


Target Position Reached

The current position flashes on the display if the move profile completes successfully.

Move Profile Stopped

The display changes to 'Stop' if the move profile is halted. Pressing the [CLEAR] key while the move profile is running will halt the profile.

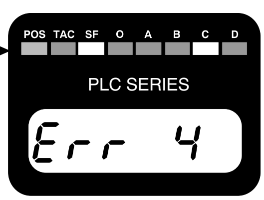


At Upper Travel Limit

During the move profile, the position exceeded the programmed upper travel limit. The move profile stops itself immediately when the position exceed the upper travel limit.

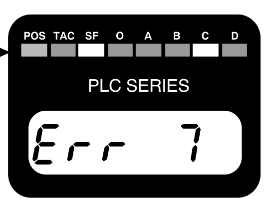
At Lower Travel Limit

During the move profile, the position became less than the programmed lower travel limit. The move profile stops itself immediately when the position becomes less than the lower travel limit.



Profile Error

If Positioning Direction = Positive:
(Target Position + Overshoot) > Upper Travel Limit
If Positioning Direction = Negative:
(Target Position - Overshoot) < Lower Travel Limit

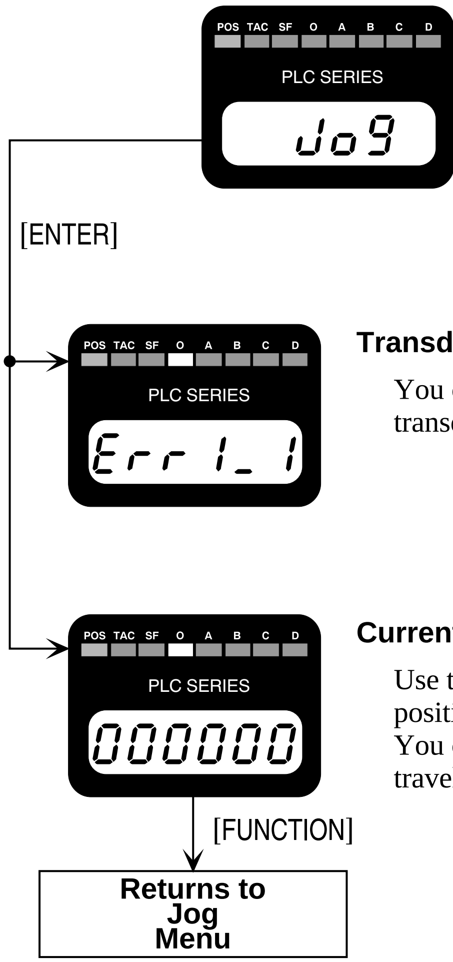


Target Position cannot be reached

The target position could not be reached within the programmed target range. A maximum of four attempts are made. The 2762-17 adjusts the Stop Offset after each attempt. If less than four attempts are made, the module adjusted the Stop Offset to the Overshoot Offset, which is its maximum value, and the Target Position was still overshot.

Jog Position Submenu

The Jog position submenu has only one display that shows the current position or the transducer fault message.



Run Profile Menu

Press [**FUNCTION**] or [►] to advance to the Position Display. Press [◄] to return to the Run Profile menu.

Transducer Fault

You cannot jog the position while the channel is in transducer fault.

Current Position

Use the [▲] and [▼] keys to increase or decrease the position. Use caution when jogging the position. You can jog the position past the upper or lower travel limits.

NvRAM Error (Err2)

All of the parameters are stored in a non-volatile static RAM memory when power is removed from the 2762-17. The NvRAM has an integral lithium battery that will maintain the parameter values in the absence of power for approximately ten years from the date of manufacture.

It is remotely possible that the values can become corrupted through electrical noise or an inopportune power outage. If this occurs, the 2762-17 display will change to figure 2.7.

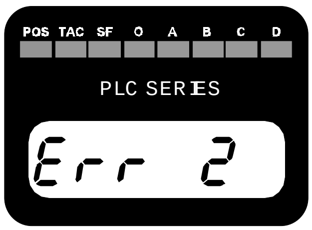


Figure 2.7 NvRAM Error

This message is displayed at all times. This error can only be cleared by pressing the [CLEAR] key. It cannot be cleared from the backplane. If the message remains after pressing the [CLEAR] key, the NvRAM is damaged. If the message appears on every power up but can be cleared then the battery is discharged. In either case, the module must be returned to AMCI for repairs. See the inside front cover, *Returns Policy*, for additional information.

Motor Control Output Connector

The motor control output connector has fourteen contacts and accepts the following connector

- AMCI Part #: MS-141
- Weidmüller Part #: 128291

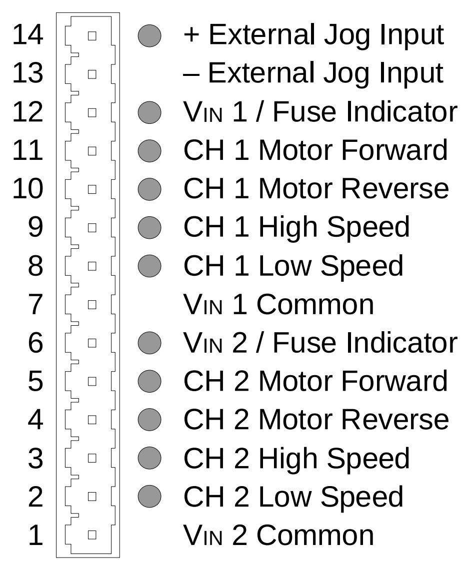


Figure 2.8 Motor Control Output Connector

When enabled from the processor, the position will jog as long as the external jog input is active.

Input Voltage Specs:

Logic 0: 0 to 3 Vac/dc @ 500 µA max.
Logic 1: 10 to 24 Vac/dc @ 10 mA min.

All motor control outputs are fuse protected. Fuse 1 protects channel 1 outputs. Fuse 2 protects channel 2 outputs. If a fuse blows, the appropriate Fuse Indicator will turn on.

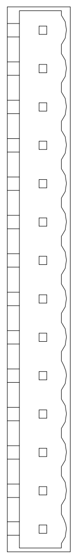
A wiring diagram for the motor control output connector and external jog input are given in Chapter 3, *Motor Control Output Connections*, page 42.

Transducer Input Connector

The transducer input connector has fourteen contacts and accepts the following connector

- AMCI Part #: MS-14
- Phoenix Part #: MSTB2.5/14-ST-5.08

Figure 2.9 shows the pinout to industry standard resolver wire designations. A cable diagram is given in chapter 3, *Transducer Cable Installation*, page 39. An engineering print is given at the back of the manual. Print # B1091.



14	S4, CH2 Fine
13	S1, CH2 Fine
12	S4, CH2 Course
11	S3, CH2 Course
10	S2, S3, CH2 Fine and S1, S2 CH 2 Course
9	CH 2 Shields
8	S4, CH1 Fine
7	S1, CH1 Fine
6	S4, CH1 Course
5	S3, CH1 Course
4	S2, S3, CH1 Fine and S1, S2 CH 1 Course
3	CH 1 Shields
2	R2, CH 1 and CH2
1	R1, CH1 and CH2

- R1/R2 - Reference Winding
- S1/S3 - COS winding
- S2/S4 - SIN Winding

Figure 2.9 Transducer Input Connector

Fuse Replacement

There are three fuses on the 2762-17. The Power Fuse is located at the top of the module. The two Output Fuses are located inside the module.

Power Fuse

If the Power Fuse fails, it can be easily replaced. The factory installed fuse is a 3.5 Amp fast blow, Littelfuse Inc. part number 22503.5. Fuse kits are available from AMCI. The AMCI part number is SKF-3. Each fuse kit contains five fuses.

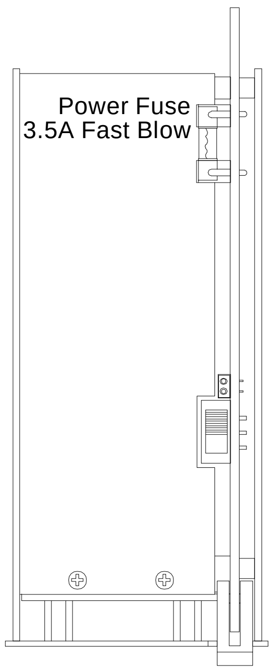


Figure 2.10 Power Fuse

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 if the fault conditions are again applied.

WARNING Remove system power before removing or installing any 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.

Fuse Replacement (continued)

Output Fuses

If an Output Fuse fails, the module must be opened before the fuse can be replaced. The factory installed fuses are 7A fast blow, Littelfuse Inc. part # 225007. A fuse kit of five fuses is available from AMCI. The AMCI part number for the kit is SKF-4.

CAUTION To insure continued and adequate protection, any replacement fuse must have a rating of 7 Amp Fast Blow. Using a higher ampere rating or slow blow fuses may not protect the module if the fault conditions are again applied.

CAUTION Output fuse replacement should be done in an ESD safe environment because the module must be opened to replace the output fuses.

WARNING Remove system power before removing or installing any 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.

Refer to figure 2.11 when replacing the fuses.

1) Remove the module from the I/O chassis and lay it on an ESD mat so that it is orientated as it is in the picture.
2) Remove the six screws that have boxes around them and arrows pointing to them.
3) Gently open the module like a book, with the bottom of the panel going to the left.
4) Replace the fuse. Channel 1 fuse is closest to pin 14 of the connector. Channel 2 fuse is closest to pin 6.
5) Reposition the side panel onto the unit making sure the ribbon cable is not pinched between the panel and the rest of the module. Replace the screws.

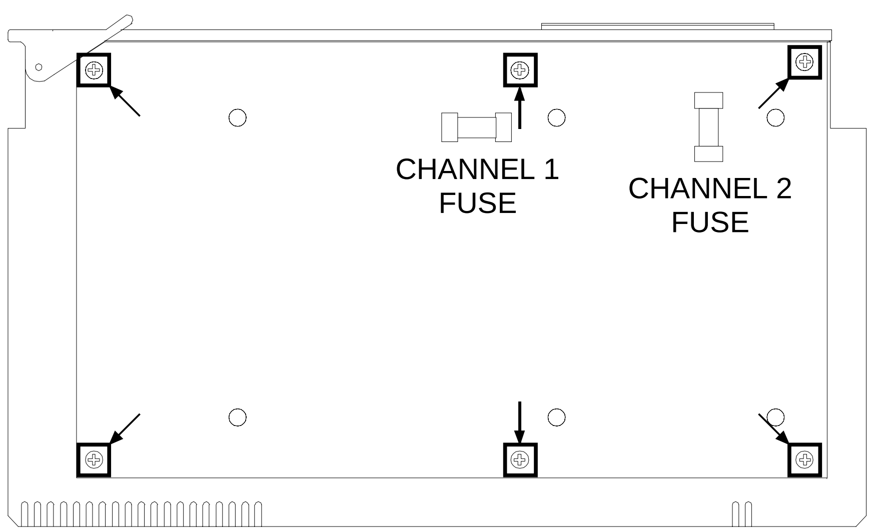


Figure 2.11 Output Fuse Placement

This chapter describes how to install the 2762-17 into the I/O chassis as well as the HTT-20 transducers and cable. Suggested wiring of the motor control outputs and external jog input is also included.

Power Requirements

The 2762-17 draws it power from the I/O chassis + 5Vdc supply. The maximum current draw is 800 mA. Add this to the power requirements of all other modules in the chassis when determining maximum system load to avoid exceeding backplane or power supply capacity.

Installing the Module

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

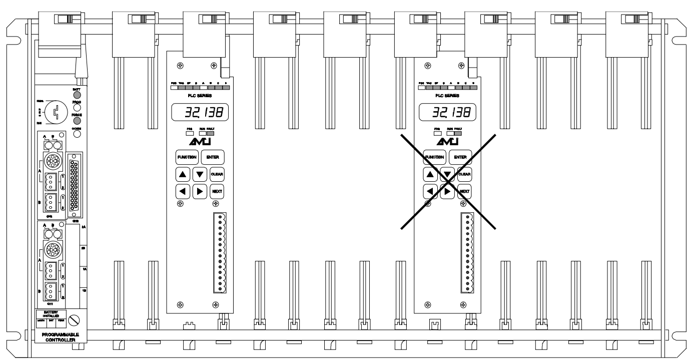


Fig 3.1 Module Installation

Install the module in a single slot pair within the chassis. A slot pair is two adjacent backplane slots, the left of which is even numbered. Most A-B chassis have the slots numbered on the backplane silkscreen. Figure 3.1 shows two modules. The module on the left is installed correctly in a single slot pair while the module on the right is incorrectly installed in two slot pairs.

The 2762-17 must be installed in a single slot pair to operate properly.

Keying Bands

Plastic keying bands can be inserted into the top backplane connector to prevent the insertion of other modules. Insert the bands between the following pins:

- Pins 28 and 30
- Pins 32 and 34.

Transducer Mounting

All AMCI HTT-20 resolver based transducers are designed to operate in the industrial environment and therefore require little attention. However, there are some general guidelines that should be observed to ensure long life.

- Limit transducer shaft loading to the following maximums:

Radial Loads	Axial Loads
100 lbs. (445 N)	50 lbs. (222.5 N)

- Minimize shaft misalignment when direct coupling shafts. Even small misalignments produce large loading effects on front bearings. It is recommended that you use a flexible coupler whenever possible.

HTT-20-(x) Transducer Outline Drawing

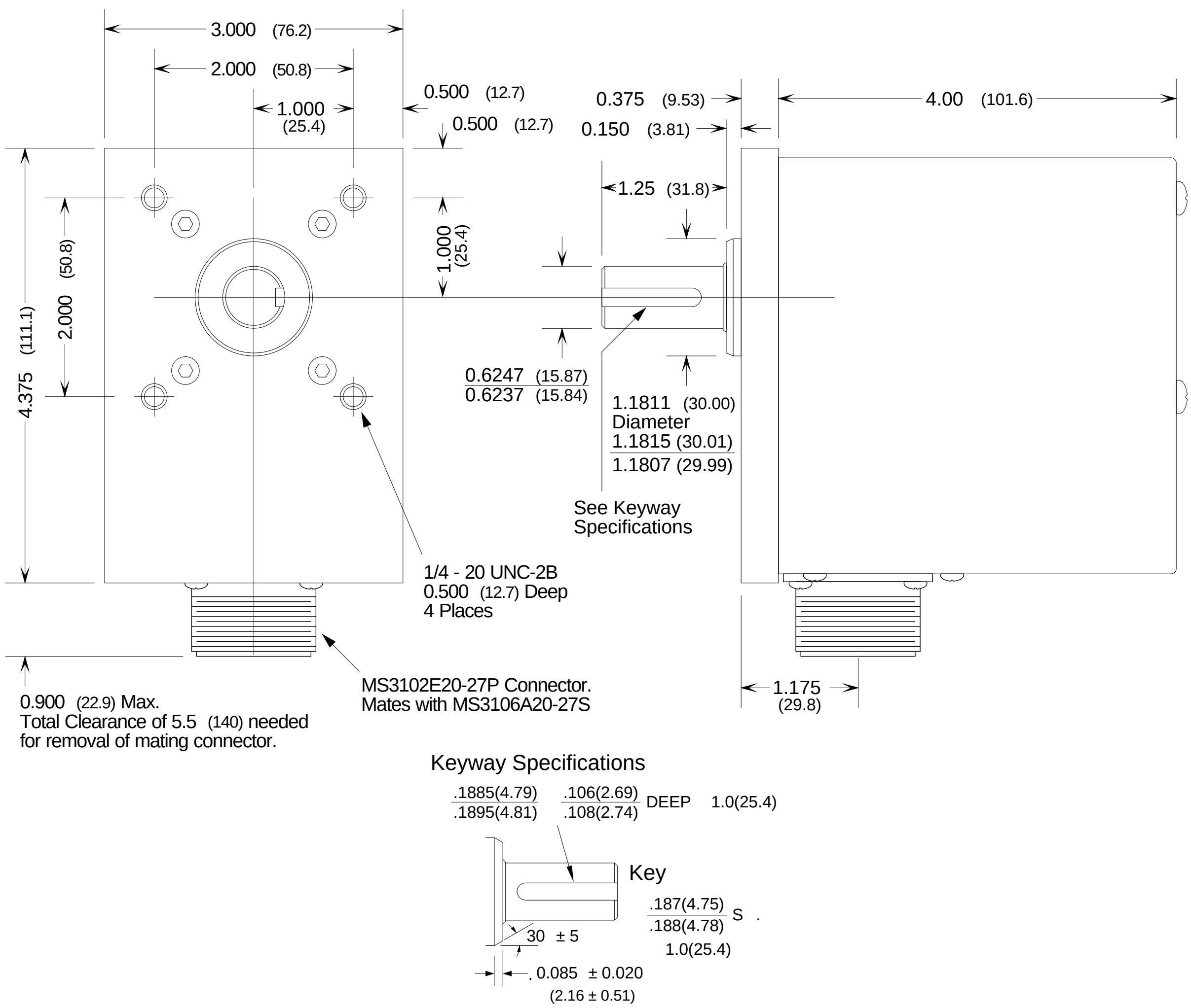


Fig 3.2 HTT-20-(x) Outline Drawing

Transducer Cable Installation

The transducer cable used with the 2762-17 module must be BELDEN 9731 or an exact equivalent. Complete cables can be ordered from AMCI with the part number C2TT-(x) where (x) is the length in feet. A wiring diagram of the C2TT-(x) cable is on the next page, figure 3.4.

If you plan to make your own cables, the required cable and connectors can be ordered from AMCI. The AMCI part numbers are:

- Belden 9731 - Transducer Cable
- MS-14 - 2762-17 Connector
- MS-20 - HTT Transducer Connector

CAUTION

The cable shields must be grounded at the 2762-17 Module ONLY! The shields must not be connected to the transducer and must be isolated from the raceway that the cable is installed in. Treat the shield of the cable as a signal conductor. This practice will eliminate ground loops that may induce EMI noise into the cable or damage the 2762-17 module.

Transducer Cable Installation (continued)

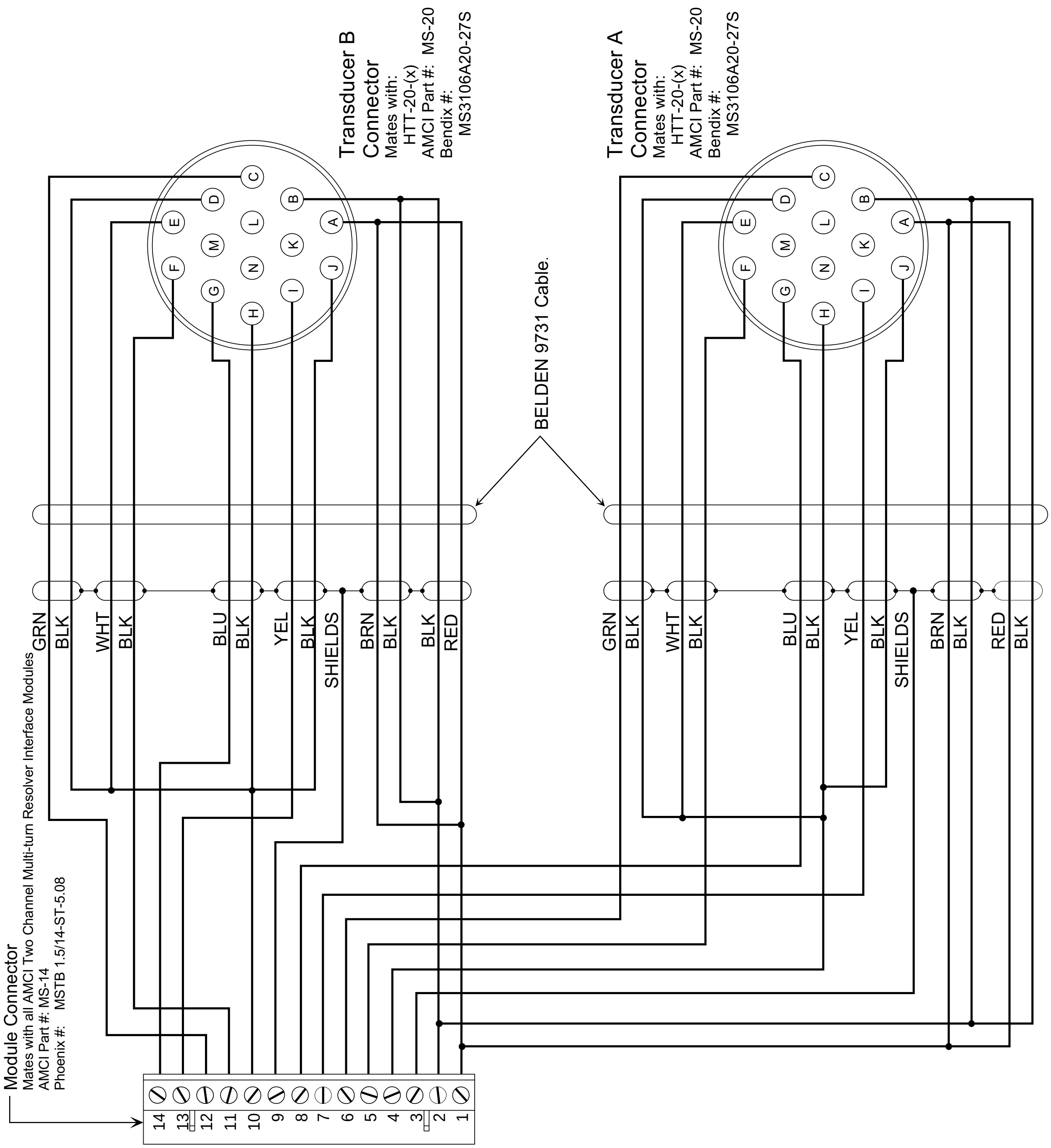


Figure 3.3 C2TT-(x) Wiring Diagram

Grounding Clamp

The shield of the transducer cable must be attached to the chassis with a Grounding Clamp (AMCI part number GC-1) to guarantee 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 3 of the MS-14 Transducer Input Connector. Pin 9 of the MS-14 connector is internally connected to pin 3 and does not need an additional wire.

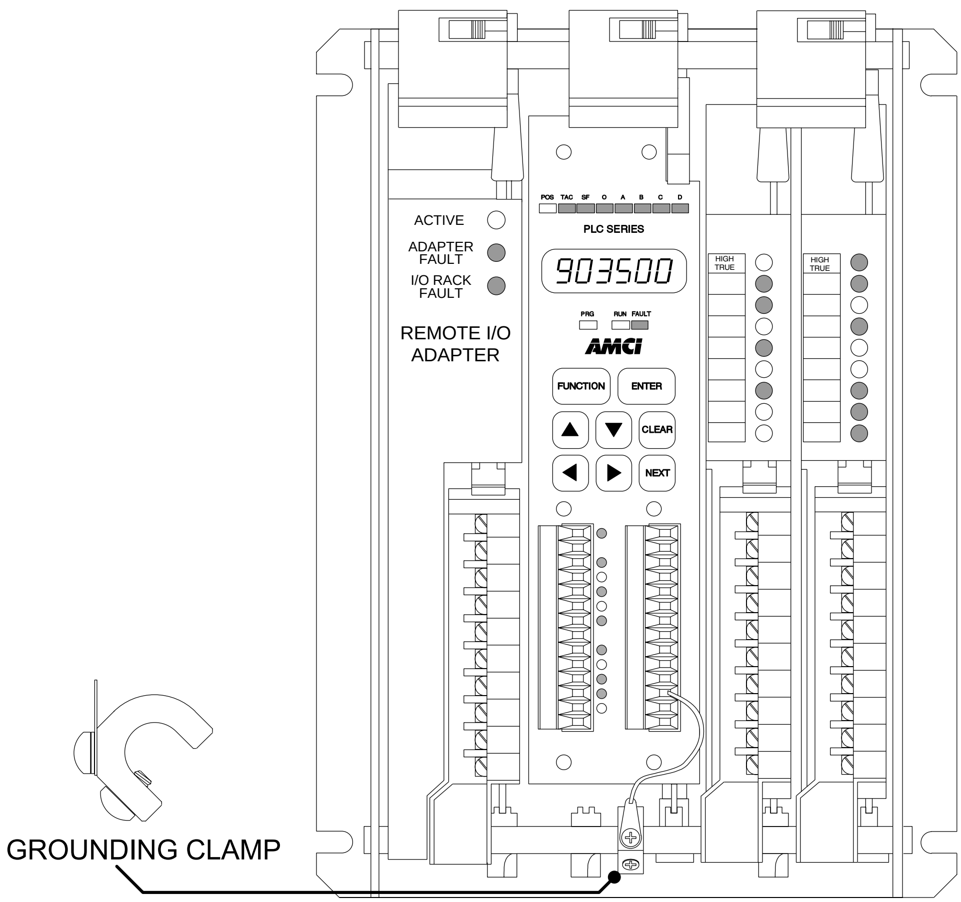


Fig 3.4 GC-1 Grounding Clamp Installation

Motor Control Output Connections

The figure below shows the wiring to the motor control output connector.

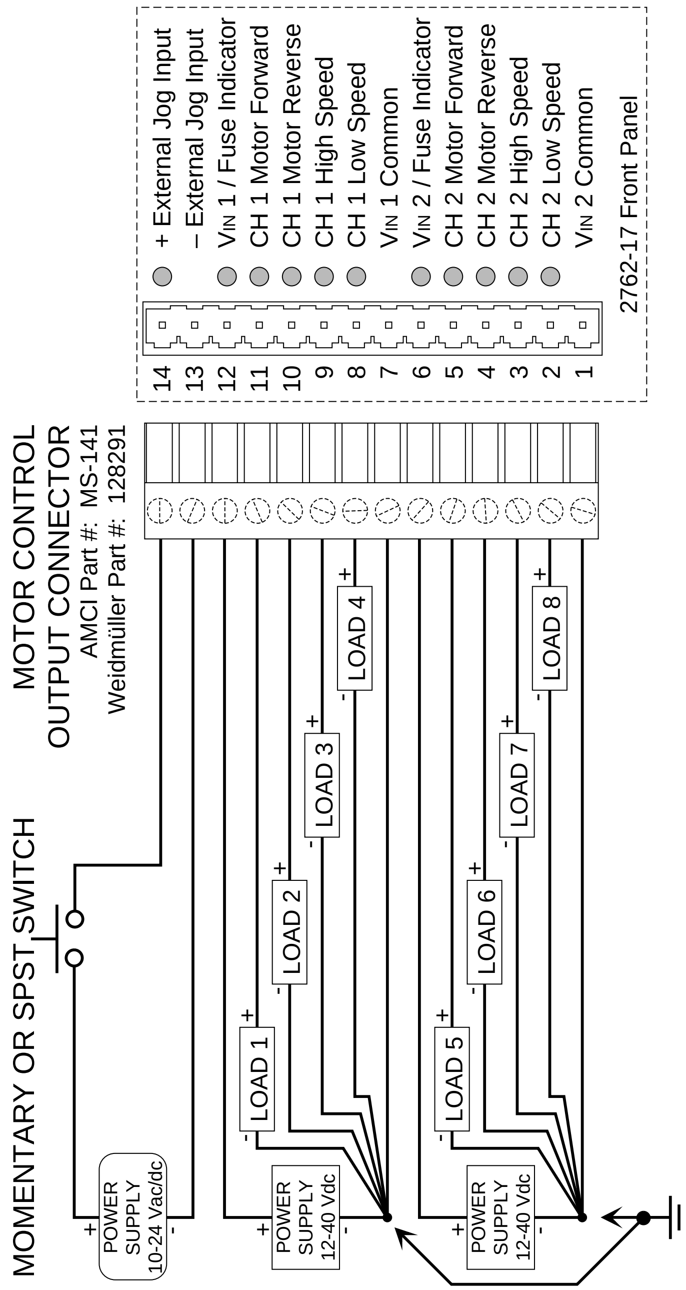


Figure 3.5 Motor Control Output Connector Wiring

Maximum Output Current

2 Adc per Output
5 Adc per Channel

Surge Rating (10 mSec)

4 Adc per Output

Input Specifications

10 to 24 Vdc/ac
10 mA max. turn on current

All cabling from the motor control outputs must be routed away from the transducer cable. This limits the effects of EMI that may be generated by the loads.

All inductive loads, (motors, relays, solenoids, etc.) connected to the control outputs must have surge suppressors installed on their power terminals.

All return connections from the loads must be terminated as close to the power supply as possible.

If the power supply is to be connected to earth ground, the connection must be made at the supply.

When configuring you system, first set the Count Direction parameter (page 8) so the transducer position increases when the load position increases. Then reverse the Motor Forward and Motor Reverse leads if the motor drives the load in wrong direction. (i.e. A Jog Up makes the load position decrease.)

This chapter explains how to address a 2762-17 in a programmable controller system. Remember that a 2762-17 performs concurrent block and single transfers.

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. A Module Slot number further specifies a block transfer address.

Note that an I/O Chassis is not the same as an I/O Rack. An I/O Chassis is the physical enclosure that the processor and I/O 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

Block Transfer

The transfer of a block of data over the backplane in one scan. A Block Transfer Read transmits data from an I/O module to the processor. A Block Transfer Write transmits data from the processor to an I/O module. Up to sixty-four words can be transmitted per block transfer. The 2762-17 requires block transfers of twelve words.

Single Transfer

The transfer of a single unit (8, 16, or 32 bits) of data over the backplane. The transfer occurs between I/O Modules and the processors' Input or Output Image Tables. Single transfers occur automatically every I/O scan and can occur during a program scan with the use of Immediate Input and Immediate Output Instructions. In addition to using block transfers, the 2762-17 accepts and transmits single transfer data 16 bits at a time.

I/O Rack

The number of I/O Racks in the system, not the number of chassis, define the programmable controller system. In 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.

When specifying a block transfer or single transfer address all I/O Rack and Group numbers are expressed in octal. (i.e. 00, 01, 02, ... 06, 07, 10, 11, ...)

I/O Group

An I/O Group consists of 16 input and 16 output bits. Eight I/O Groups, numbered 0 through 7, make up a single I/O Rack.

Slot Pair

Backplane slots of an I/O Chassis are numbered consecutively from zero starting at the leftmost I/O slot. A slot pair is two adjacent backplane slots, the left of which is even numbered. Most A-B chassis have the slots numbered on the backplane silk screen.

A 2762-17 module must be installed in a single slot pair to operate properly. See *Installing the Module*, Pg. 37. The figures in this chapter show the module in a Slot Pair.

Definition of Terms (cont'd)

2-Slot Addressing

Two slot addressing cannot be used with the 2762-17 module. Two slot addressing assigns one I/O group to a slot pair in the chassis. A minimum of two I/O groups (32 I/O bits) must be assigned to the slot pair so the 2762-17 can perform concurrent single and block transfers.

1-Slot Addressing

With 1-slot addressing, one I/O group (16 I/O bits) is assigned to each slot in the chassis. Therefore the 2762-17 has two I/O groups to use, one in each slot of its slot pair. The 2762-17 uses the first I/O group to control its block transfers and the second I/O group for its single transfers.

½-Slot Addressing

With ½-slot addressing, two I/O groups (32 I/O bits) are assigned to each slot in the chassis. Therefore the 2762-17 has four I/O groups to use, two in each slot of its slot pair. The 2762-17 uses the first I/O group to control its block transfers and the second I/O group for its single transfers. The third and fourth I/O groups are not used.

Addressing the Block Transfer Data

The PLC reads operating data from the 2762-17 module with block transfer read (BTR) instructions and programs the setup parameters with block transfer write (BTW) instructions.

The block transfer address is made up of four digits. They are the I/O Rack Number (two digits), the I/O Group Number (one digit), and the Module Slot Number (one digit, always 0).

> Note: The I/O Group number used for block transfers is always the lowest, even numbered I/O Group assigned to the ***Slot Pair*** the 2762-17 resides in.

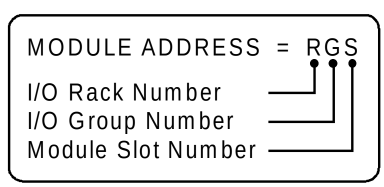


Fig 4.1 BT Module Address

Addressing the Single Transfer Data

The processor writes commands and reads status data from the 2762-17 with single transfers. To communicate using single transfers you must know the memory locations in the output and input image tables associated with the module.

- **PLC-5 Input Table:** The characters "I:" followed by a three digit number. The first two digits are the I/O rack number, followed by the I/O group number.
- **Output Table:** The characters "O:" followed by a three digit number. The first two digits are the I/O rack number, followed by the I/O group number.

> Note: The I/O group number used for single transfers is always the lowest, odd numbered I/O group assigned to the ***Slot Pair*** the 2762-17 resides in.

Addressing Examples

The following are examples of module addressing for 1-Slot and ½-Slot configurations. The PLC-5 addresses for block and single transfers are also shown.

In the following figures, the module is placed in a single slot pair. See *Installing the Module* Pg. 37 for more information.

> The 2762-17 must be installed in a single slot pair to operate properly.

1-Slot Addressing

Rack Number: 01
I/O Group Numbers: 0,1
Module Slot Number: 0

PLC-5 BT Address = 0100

PLC-5 Single Addr = I:011

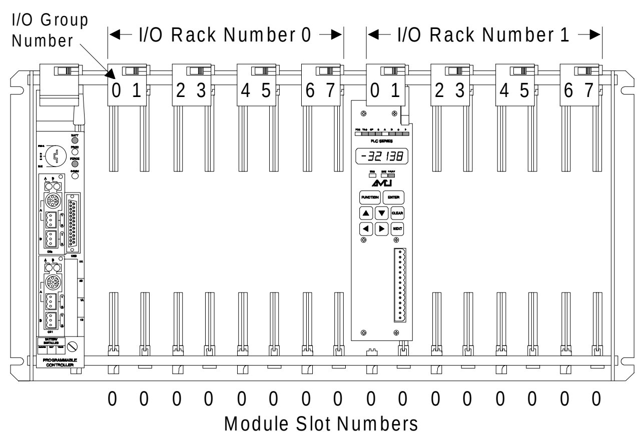


Fig 4.2 2762-17 1-Slot Address

Addressing Examples (cont'd)

½-Slot Addressing

Rack Number: 02
I/O Group Numbers: 0,1,2,3
Module Slot Number: 0

PLC-5 BT Address = 0200
PLC-5 Single Addr = I:021

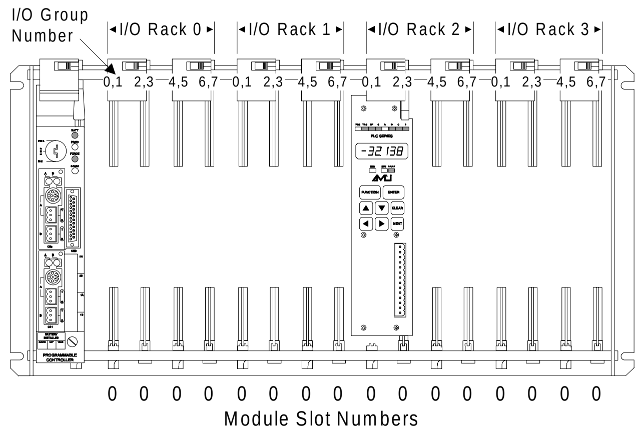


Fig 4.3 2762-17 ½-Slot Address

Restrictions and Warnings

1. The 2762-17 must be installed in a single slot pair in order to operate properly. See *Installing the Module* Pg. 37.
2. The 2762-17 module cannot be installed in a chassis set-up for 2-Slot addressing.
3. When using a 2762-17 in a Remote I/O chassis, 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 the 2762-17 module.

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 needed to 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 or BT 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 2762-17. The Data Address is the first address of the file. The data file must have an integer or 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 must equal twelve.

> The File Length of a BTW instruction **MUST** equal 12. Using a File Length of zero will cause a Program Command Error.

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 at most 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 the 2762-17 module **MUST** have the Continuous Parameter set to NO. Continuously writing Program Instructions to the module may intefere with normal module operation. **Block Transfer Reads** to the 2762-17 can have their Continuous Parameter set to "YES".

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.

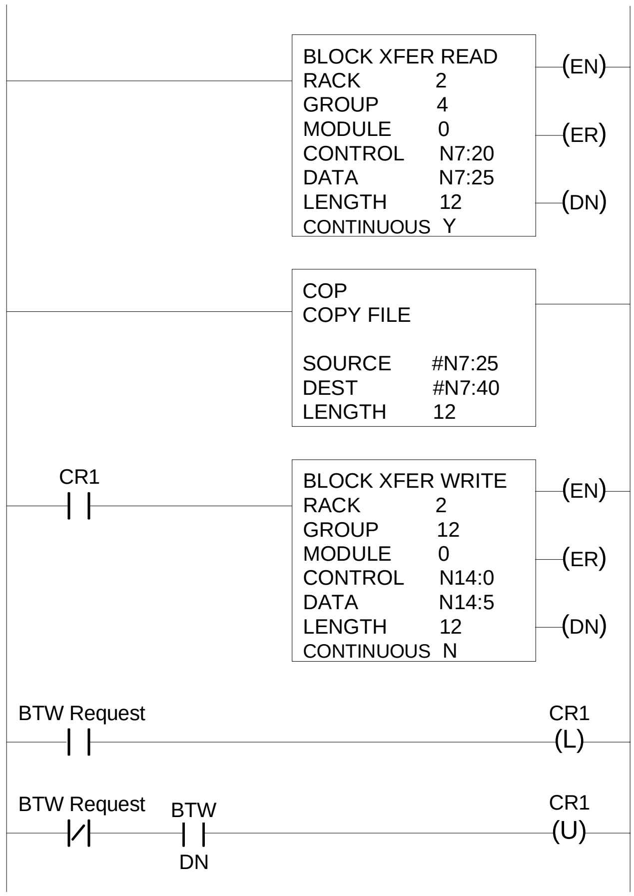
The EN, ER, and DN bits are located in the first word of the Control File. The EN Bit is bit 15, the ER Bit is bit 12 and the DN Bit is bit 13.

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 2762-17 module is I/O Rack 2, I/O Groups 4 & 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 whenever CR1 is latched on. Note that the continuous parameter is set to NO.

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 5.1 PLC-5 Programming Example

PLC-5 Restrictions and Warnings

WARNING The following restrictions must be followed when using the 2762-17 in a PLC-5 System. If these restrictions are not followed, unpredictable operation may occur.

1. The 2762-17 will not operate in a chassis configured for 2-Slot addressing. The chassis must be configured for 1-Slot or ½-Slot addressing.
2. The 2762-17 module must be installed in a single slot pair. (See chapter 3, *Installing the Module,* page 37.) If it is not installed correctly, the module will not be able to perform concurrent block and single transfers.
3. When using the 2762-17 in a remote chassis, 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 Revision may not work properly with the 2762-17.
4. When the processor enables a block transfer, it puts 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.

This chapter describes the format of the data written to and read from the 2762-17 using BTW and BTR instructions. It assumes familiarity with the setup and operation of the 2762-17. Descriptions of the modules' parameters given in chapter 1 are not repeated here. However, the default, minimum and maximum values that can be programmed are listed. If you are not familiar with the operation of the 2762-17, review chapters 1 and 2 before proceeding.

Block Transfer Writes

In addition to the keyboard, every 2762-17 parameter can be programmed with block transfer writes (BTW). Programming from the keyboard can also be disabled. Follow these guidelines when using block transfer writes.

- BTW length is always 12 words. Do not set the length to zero when programming the BTW. Any unused words in the block transfer should be considered reserved and set to zero.
- All parameter values, (Full Scale Count, Linear Offset, etc.) must be transferred in binary format. Before entering data in the data table set the radix to decimal.
- Most of the 2762-17 parameters can exceed ±32,768. Therefore they require two words to hold the data. The thousands digits must be transferred in the first word, the ones, tens, and hundreds digits must be transferred in the second word. For example, a Full Scale Count of 368,640 would be transferred as 368 in the first word and 640 in the second word.
- Negative values are transmitted in sign-magnitude format. The MSB of the first word of the parameter is the sign bit. To enter a negative value set the data table radix to decimal and enter the absolute value of the parameter. Next, switch the radix to binary and set the MSB of the first word.
- Once a block transfer write to the 2762-17 has completed, (i.e. The DONE Bit is set), perform a block transfer read to input the status, position and tach data of the module. Check the error bits and take appropriate action if an error has occurred.
- If there is an error in the data sent to the 2762-17, the module responds by setting the appropriate error bits and ignores all of the data sent to it with the block transfer write.

BTW Command Word

The first word of a BTW is the Command Word. As shown in figure 6.1, setting a bit in the upper byte of the Command Word tells the 2762-17 which parameters are transferred in the remaining eleven words. Note that only one bit can be set per block transfer. The meaning of the lower byte changes, and is explained in later sections.

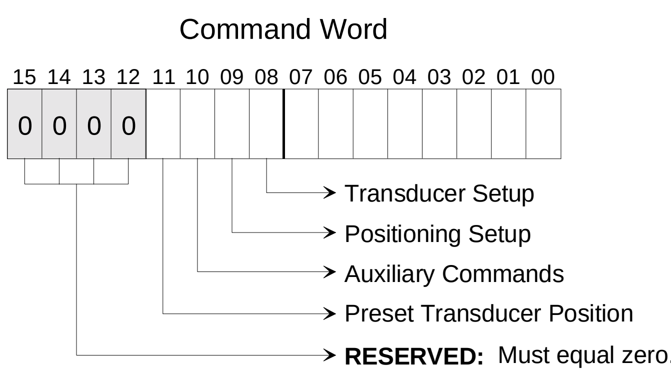


Fig. 6.1 Command Word Format

Transducer Setup Data

When the Transducer Setup bit, (bit 8) of the Command word is set, the 2762-17 uses the rest of the data to configure the transducer specified by the LSB of the Command Word. Configuring both transducers requires two block transfers. Transducer Setup programs the parameters shown below. The data format is shown in figure 6.2.

- Transducer Type
- Number of Turns
- Preset Value
- Count Direction
- Scale Factor
- Upper Travel Limit
- Decimal Point
- Linear Offset
- Lower Travel Limit

Transducer Setup Command

<table>
<tr><th></th><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>09</th><th>08</th><th>07</th><th>06</th><th>05</th><th>04</th><th>03</th><th>02</th><th>01</th><th>00</th></tr>
<tr><td>Word 0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td colspan="3">Decimal Point</td><td>DIR</td><td>TType</td><td>ChNm</td></tr>
<tr><td>Word 1</td><td colspan="16">Number of Turns</td></tr>
<tr><td>Word 2</td><td colspan="16">Upper 1, 2 or 3 digits: Scale Factor</td></tr>
<tr><td>Word 3</td><td colspan="16">Lower 3 digits: Scale Factor</td></tr>
<tr><td>Word 4</td><td>SGN</td><td colspan="15">Upper 1, 2 or 3 digits: Linear Offset</td></tr>
<tr><td>Word 5</td><td colspan="16">Lower 3 digits: Linear Offset</td></tr>
<tr><td>Word 6</td><td>SGN</td><td colspan="15">Upper 1, 2 or 3 digits: Preset Value</td></tr>
<tr><td>Word 7</td><td colspan="16">Lower 3 digits: Preset Value</td></tr>
<tr><td>Word 8</td><td>SGN</td><td colspan="15">Upper 1, 2 or 3 digits: Upper Travel Limit</td></tr>
<tr><td>Word 9</td><td colspan="16">Lower 3 digits: Upper Travel Limit</td></tr>
<tr><td>Word 10</td><td>SGN</td><td colspan="15">Upper 1, 2 or 3 digits: Lower Travel Limit</td></tr>
<tr><td>Word 11</td><td colspan="16">Lower 3 digits: Lower Travel Limit</td></tr>
</table>

Fig 6.2 Transducer Setup Command Data Format

Programming Bit Values

ChNum: Channel Number Bit. Set to 0 to program transducer channel one or set to 1 to program transducer channel two.

TType: Transducer Type Bit. Set to 0 if programming for an HTT-20-100 or set to 1 if programming for an HTT-20-180.

DIR: Direction Bit: Set to 0 if you want the count to increase with a clockwise rotation of the transducer shaft or set to 1 if you want an increase with a counter-clockwise rotation.

Transducer Setup Data (continued)

Programming Bit Values (continued)

Decimal Point: Bits five, four, and three define a binary number that sets the number of digits to the right of the decimal point on the 2762-17 display. This parameter has no affect on the data transmitted over the backplane.

Bit # 5	4	3	
0	0	0	= 0 (xxxxxx)
0	0	1	= 1 (xxxxx.x)
0	1	0	= 2 (xxxx.xx)
0	1	1	= 3 (xxx.xxx)
1	0	0	= 4 (xx.xxxx)
1	0	1	= 5 (x.xxxxx)
1	1	0	Undefined
1	1	1	Undefined

SGN: Sign Bit: Set to 0 if the corresponding value is positive or set to 1 if the value is negative.

Ranges and Factory Default Values

Parameter	*Range*	*Factory Default*
Transducer Type	HTT-20-180, HTT-20-100	HTT-20-180
Count Direction	CW increasing, CCW increasing.	CW increasing
Decimal Point	0 to 5 inclusive	0
Number of Turns	HTT-20-180: 0.1 to 180.0, 0.1 turn resolution HTT-20-100: 0.1 to 100.0, 0.1 turn resolution	180.0
Scale Factor	2 to (Number of Turns * 4,096)	737,280
Linear Offset	-99,999 to (999,999 - FSC†)	0
Preset Value	Linear Offset to (Linear Offset + FSC†)	0
Upper Travel Limit	(Lower Travel Limit + 1) to (Linear Offset + FSC†)	737,279
Lower Travel Limit	Linear Offset to (Upper Travel Limit - 1)	0

† FSC: Full Scale Count = (Transducer Type {100 or 180} * (Scale Factor/Number of Turns)) - 1

Positioning Setup Data

When the Positioning Setup bit, (bit 9) of the Command word is set, the 2762-17 uses the rest of the data to configure the positioning data of the transducer specified by the LSB of the Command Word. Configuring both transducers requires two block transfer writes. Positioning Setup programs the parameters shown below. The data format is shown in figure 6.3.

- Positioning Direction
- Target Position
- Overshoot Offset
- Low Speed Offset
- Stop Offset
- Target Range

Positioning Setup Command

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	PDir	ChNm
Word 1	SGN	Upper 1, 2 or 3 digits: Target Position														
Word 2	Lower 3 digits: Target Position															
Word 3	Upper 1, 2 or 3 digits: Overshoot Offset															
Word 4	Lower 3 digits: Overshoot Offset															
Word 5	Upper 1, 2 or 3 digits: Low Speed Offset															
Word 6	Lower 3 digits: Low Speed Offset															
Word 7	Upper 1, 2 or 3 digits: Stop Offset															
Word 8	Lower 3 digits: Stop Offset															
Word 9	Upper 1, 2 or 3 digits: Target Range															
Word 10	Lower 3 digits: Target Range															
Word 11	Retry Value															

Fig. 6.3 Positioning Setup Command Data Format

Programming Bit Values

ChNum: Channel Number Bit. Set to '0' to program channel one positioning data or set to '1' to program channel two positioning data.

PDir: Positioning Direction Bit. Set to '0' to approach the Target Position from a position greater than the Target Position, a "positive approach". Set to '1' to approach the Target Position from a position less than the Target Position, a "negative approach".

SGN: Sign Bit: Set to 0 if the Target Position is positive or set to 1 if the value is negative.

Positioning Setup Data (continued)

Ranges and Factory Default Values

Parameter	*Range*	*Factory Default*
Target Position	Linear Offset to (Linear Offset + FSC†)	0
Overshoot Offset	(Low Speed Offset + 1) to Full Scale Count†	1,000
Low Speed Offset	0 and (Stop Offset + 1) to (Overshoot Offset - 1)	500
Stop Offset	1 to (Overshoot Offset - 1) if Low Speed = 0 1 to (Low Speed -1) if Low Speed ≠ 0	100
Target Range	0 to Full Scale Count†	0
Retry Value	1 to 255	3

Notes on Positioning Data

- Overshoot Offset, Low Speed Offset, Stop Offset, and Target Range are defined as being relative to the Target Position and are programmed as absolute values. If the Positioning Direction Bit defines a positive approach, the values are added to the Target Position. If the Positioning Direction Bit defines a negative approach, the values are subtracted from the Target Position.
- The Positioning Direction Bit defines the direction of the approach to the Target Position, either a positive or neagtive approach. It is possible for the starting position of the move profile to be on the opposite side of the Target Position. (The starting position is less than the Target Position and a positive approach is programmed, or visa versa.) If this is the case, the 2762-17 will drive the motor to (Target Position ± Overshoot Offset) and remove power. Once the motor has coasted to a stop, the 2762-17 completes the profile with the defined approach.
- Setting the Low Speed Offset to zero disables high speed motion.
- The range checking listed in the above table is performed when the data is entered. However the data may not define a valid profile. As an example, (Target Position + Overshoot Offset) may exceed the Upper Travel Limit. Profile checking is not performed until a profile move is requested. If the profile cannot be performed, a Profile Error message is sent to the processor through the single transfer input data. For more information on the single transfer input data refer to *Single Transfer Input Data,* chapter 7, page 66.
- The Retry Value applies only to move profiles initiated from the backplane.

† FSC: Full Scale Count = (Transducer Type {100 or 180} * (Scale Factor/Number of Turns)) - 1

Auxiliary Commands Data

When the Auxiliary Commands bit, (bit 10) of the Command Word is set, the 2762-17 uses bits 0 through 6 of the Command Word as data. Auxiliary Commands include clearing errors, enabling or disabling keyboard programming and defining the data transmitted to the processor with block transfer reads. Format of the block transfer read data is defined starting on page 58.

Words 1 through 11 are not used but must be transmitted. These words should be considered reserved for future use and must be set to zero. The data format for Auxiliary Commands is show in figure 6.4

Additional Commands

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	0	0	0	0	0	1	0	0	0	RPS	RTS	RSP	EnKB	DisKB	ClrErr	RBC
	Words 1-11 RESERVED: Must equal zero.															

Fig 6.4 Auxiliary Commands Data Format

Programming Bit Values

RBC: Read Back Channel Bit. The 2762-17 has the ability to send its programmed values back to the PLC. Set this bit to 0 to read back the parameters of channel one or set to 1 to read back the parameters of channel two.

ClrErr: Clear Errors Bit. Set to 1 to clear module and programming errors. These include:
- Transducer Faults
- All Programming Errors

Note that the NvRAM error must be cleared from the keyboard.

DisKB: Disable Keyboard Bit. Set this bit to 1 to disable all programming from the 2762-17 keyboard. Parameters can be monitored from the keyboard but they cannot be changed. This bit does not have to be set continuously to disable keyboard programming. The status of the keyboard is retained by the 2762-17 when power is removed. Therefore, the only way to enable the keyboard once the Disable Keyboard Command is accepted is with an Enable Keyboard command.

EnKB: Enable Keyboard Bit. Set this bit to 1 to counteract a previous Disable Keyboard command.

RSP: Read Status and Position Bit. Set this bit to 1 to read back module status with position and tachometer data of both transducers.

RTS: Read Transducer Setup Bit. Set this bit to 1 to read back Transducer Setup data of the transducer specified by the RBC bit (bit 00).

RPS: Read Positioning Setup Bit. Set this bit to 1 to read back Positioning Setup data of the transducer specified by the RBC bit (bit 00).

Auxiliary Commands Data (continued)

Notes on Auxiliary Commands Data

- Setting both the DisKB and EnKB will cause a command error.
- One, and only one of the RSP, RTS, and RPS bits must be set when transmitting this command. Setting more than one, or none, will cause a command error.

Preset Position Data

When the Preset Position bit, (bit 11) of the Command Word is set, the 2762-17 presets the position of one or both of the transducers. This is accomplished by calculating the internal offset needed to change the transducer position to the preset value programmed with the transducer setup data.

Words 1 through 11 are not used, but must be transmitted. These words should be considered reserved for future use and must be set to zero. The data format for Preset Position is show in figure 6.5

Preset Position Command

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	PS2	PS1
	Words 1-11 RESERVED: Must equal zero.															

Fig 6.5 Preset Position Data Format

Programming Bit Values

PS1: Preset Transducer 1 Bit. Set this bit to 1 to alter the position data of channel one to its preset value.

PS2: Preset Transducer 2 Bit. Set this bit to 1 to alter the position data of channel two to its preset value.

Notes on Preset Position Data

- Both transducers can be preset with one command.

Block Transfer Reads

Use block transfer reads to transfer complete module status to the processor. The block transfer is always twelve words long. The block transfer data takes one of three forms.

- Status, Position and Tachometer data
- Transducer Setup data
- Positioning Setup data.

On power up, the 2762-17 transmits status, position and tachometer data. Use the *Auxiliary Commands* command with the RTS or RPS bit set to read the other types of data. (For a full description of the *Auxiliary Commands* command, see Pg. 56.)

Status, Position and Tachometer Data

The format of the status, position and tachometer data is shown in figure 6.6. Words 0 and 6 contain the status bits. Word 0 contains the status bits for channel 1 and word 6 contains the status bits for channel 2. The forma of the two words is identical. The tables on the following page lists the meanings of the status bits.

Status, Position and Tachometer Data

	15	14	13	12	11	10 09 08	07 06 05 04	03 02 01 00
Word 0	0	0	0	KBIN	0	Module Status	Motion Status	Output Status
Word 1	SGN	Upper 1, 2 or 3 digits: Position 1						
Word 2	Lower 3 digits: Position 1							
Word 3	Upper 1, 2 or 3 digits: Tachometer 1							
Word 4	Lower 3 digits: Tachometer 1							
Word 5	Transducer 2 Status Word							
Word 6	SGN	Upper 1, 2 or 3 digits: Position 2						
Word 7	Lower 3 digits: Position 2							
Word 8	Upper 1, 2 or 3 digits: Tachometer 2							
Word 9	Lower 3 digits: Tachometer 2							
Word 10	Not used. Set equal to 0000.							
Word 11	Not used. Set equal to 0000.							

Fig 6.6 Status, Position, and Tachometer Data Format

Status, Position and Tachometer Data (continued)

KBIN Status Bit: Bit 12, Keyboard In Use

This bit is set under the following conditions.

- The keyboard is being used to program *any* parameter.
- A move profile initiated from the keyboard is in progress.
- The position is being jogged from the keyboard.

Module Status Bits

Bit #			
10	09	08	
0	0	0	No Errors. Module operating without errors.
0	0	1	Transducer Fault. There is a transducer fault or wiring error.
0	1	0	NvRAM Error. Parameters have not been stored correctly.
0	1	1	Program Command Error. Indicates error in the programming bits of word 0 of the last BTW or BTW length ≠ 12. When there is an error that forces a Program Command Error response, this bit pattern is placed in both Word 0 and Word 6.
1	0	0	Program Parameter Error. Indicates that a parameter sent with the last BTW is outside its valid range.
1	0	1	Command Ignored. 1) Attempted to program while there is a NvRAM error. 2) Attempted to program while any parameter is being edited from the keyboard. 3) Attempted to program while a move profile is running. 4) Attempted to preset a position, jog the position, or run a move profile while the channel is in transducer fault.
1	1	0	Reserved
1	1	1	Reserved

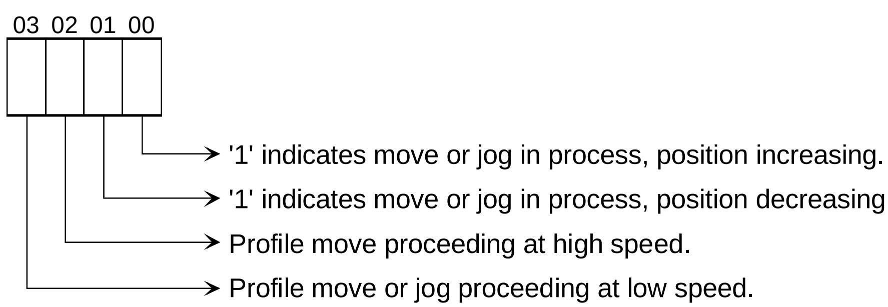
Note: Transducer Faults can be cleared with an *Auxiliary Commands* block transfer write with the Clear Errors Bit set to 1. See Pg 56 for more information on the *Auxiliary Commands* data format. NvRAM Errors can only be cleared from the modules' keyboard.

Status, Position and Tachometer Data (continued)

Motion Status Bits

Bit #				
07	06	05	04	
0	0	0	0	Stopped. Move profile terminated before it completed or a jog is stopped within the lower and upper travel limits.
0	0	0	1	Stopped, In Position. The present position is within the specified Target Range.
0	0	1	0	Jogging Up. Position is manually forced to increase
0	0	1	1	Jogging Down. Position is manually forced to decrease.
0	1	0	0	Positioning Up, Low Speed. Move profile active, position increasing at low speed.
0	1	0	1	Positioning Down, Low Speed. Move profile active, position decreasing at low speed.
0	1	1	0	Positioning Up, High Speed. Move profile active, position increasing at high speed.
0	1	1	1	Positioning Down, High Speed. Move profile active, position decreasing at high speed.
1	0	0	0	At Upper Travel Limit. Position ≥ Upper Travel Limit.
1	0	0	1	At Lower Travel Limit. Position ≤ Lower Travel Limit.
1010 - 1110				Reserved. Not implemented in this software revision.
1	1	1	1	Stopped, Not In Position. The present position is not within the specified Target Range.

Output Status Bits



Transducer Setup Read Back Data

When you send an *Auxiliary Commands* command with the RTS (Read Transducer Setup) bit set, the 2762-17 responds by echoing back the Transducer Setup data. The Channel Number bit (bit 00) of the *Auxiliary Commands* command determines which transducer data is set. Therefore it requires two BTW/BTR sequences to read all of the Transducer Setup data. The format of the data is shown below in figure 6.7. Note that read back data has bit 15 of word 0 set to '1'.

Transducer Setup Read Back

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	1	0	0	0	0	0	0	1	0	0	Decimal Point			DIR	TType	ChNm
Word 1	Number of Turns															
Word 2	Upper 1, 2 or 3 digits: Scale Factor															
Word 3	Lower 3 digits: Scale Factor															
Word 4	SGN	Upper 1, 2 or 3 digits: Linear Offset														
Word 5	Lower 3 digits: Linear Offset															
Word 6	SGN	Upper 1, 2 or 3 digits: Preset Value														
Word 7	Lower 3 digits: Preset Value															
Word 8	SGN	Upper 1, 2 or 3 digits: Upper Travel Limit														
Word 9	Lower 3 digits: Upper Travel Limit															
Word 10	SGN	Upper 1, 2 or 3 digits: Lower Travel Limit														
Word 11	Lower 3 digits: Lower Travel Limit															

Fig 6.7 Read Back Transducer Setup Data

Positioning Setup Read Back Data

When you send an *Auxiliary Commands* command with the RPS (Read Positioning Setup) bit set, the 2762-17 responds by echoing back the Positioning Setup data. The Channel Number bit (bit 00) of the *Auxiliary Commands* command determines which positioning data is set. Therefore it requires two BTW/BTR sequences to read all of the Positioning Setup data. The format of the data is shown below in figure 6.8. Note that read back data has bit 15 of word 0 set to '1'.

Positioning Setup Read Back

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	PDir	ChNm
Word 1	SGN	Upper 1, 2 or 3 digits: Target Position														
Word 2	Lower 3 digits: Target Position															
Word 3	Upper 1, 2 or 3 digits: Overshoot Offset															
Word 4	Lower 3 digits: Overshoot Offset															
Word 5	Upper 1, 2 or 3 digits: Low Speed Offset															
Word 6	Lower 3 digits: Low Speed Offset															
Word 7	Upper 1, 2 or 3 digits: Stop Offset															
Word 8	Lower 3 digits: Stop Offset															
Word 9	Upper 1, 2 or 3 digits: Target Range															
Word 10	Lower 3 digits: Target Range															
Word 11	Retry Value															

Fig 6.8 Read Back Positioning Setup Data

This chapter describes the format of the data written to and read from the 2762-17 using single transfers. This data is stored in the processors output and input data tables. This chapter assumes familiarity with the setup and operation of the module. If you are not familiar with the operation of the 2762-17, review chapters 1 and 2 before proceeding.

Single Transfer Data

You issue the following commands to the 2762-17 with single transfer output data.

- Start Move Profile
- Stop Move Profile
- Jog Up
- Jog Down
- Set jog direction for external jog input
- Enable / Disable external jog input

Single transfer output data is written to the 2762-17 via the processors' output image table. Simply move the data to the modules address in the table and the processor will transfer the data to the 2762-17 at the end of the program scan. You can also use immediate output instructions in your ladder logic to update the module before the end of the program scan.

Single transfer input data gives you status information on the module and positioning information for both channels. Single transfer input data is read by the processor before the beginning of the program scan. You can also use immediate input instructions in your ladder logic to update the status information during your program scan.

Single Transfer Output Data

The format of the output data is shown in figure 7.1. Bits 0 - 7 control channel one and bits 10-17 control channel two. Note that these bits are numbered in octal. Bit addresses in the I/O data tables are in octal.

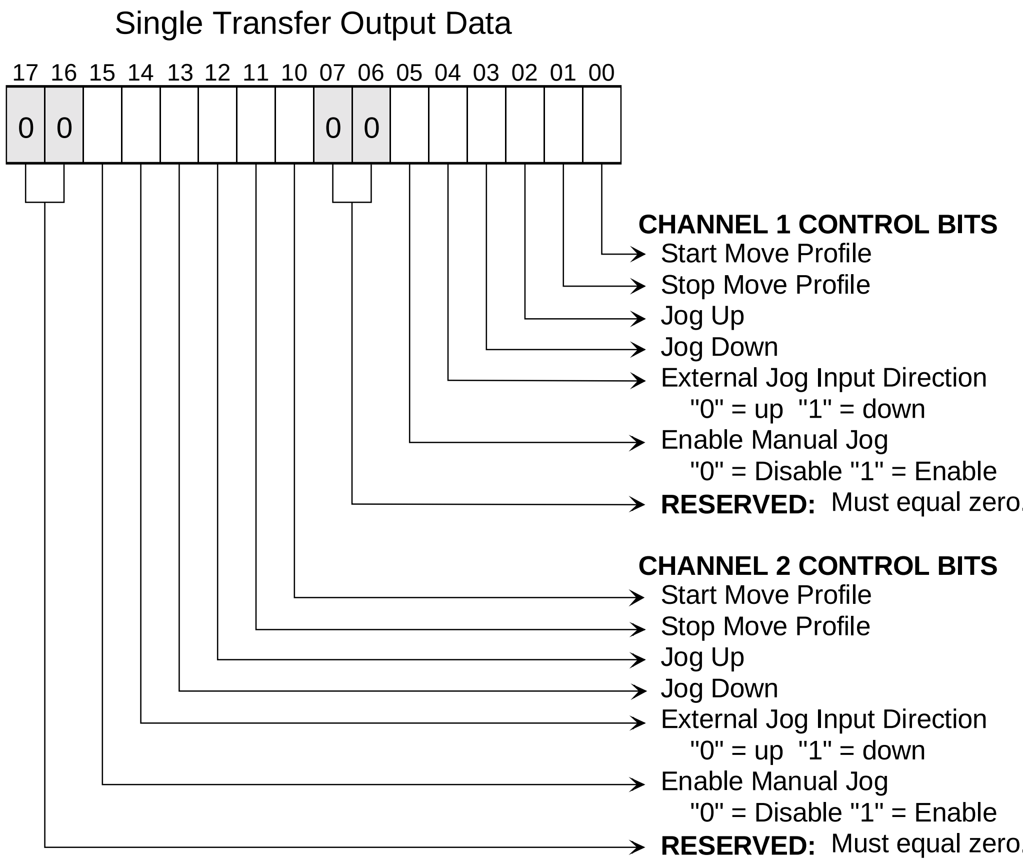


Figure 7.1 Single Transfer Output Data Format.

Single Transfer Output Data (continued)

Command Bits

Start Move Profile. CH1: Bit 0, CH2: Bit 10.

A 0 → 1 transition initiates a move profile.

Stop Move Profile. CH1: Bit 1, CH2: Bit 11.

A 0 → 1 transition immediately stops a move profile.

Jog Up. CH1: Bit 2, CH2: Bit 12.

Set this bit to travel at low speed towards the upper travel limit. Note that it is possible to jog up past the programmed upper travel limit.

Jog Down. CH1: Bit 3, CH2: Bit 13.

Set this bit to travel at low speed towards the lower travel limit. Note that it is possible to jog down below the programmed lower travel limit

External Jog Input Direction. CH1: Bit 4, CH2: Bit 14.

Reset this bit when the external jog input must initiate a jog up. Set this bit when the external jog input must initiate a jog down. This bit is used with the Jog Enable bit.

Jog Enable. CH1: Bit 5, CH2: Bit 15.

Set this bit to enable the external jog input to jog the channels' position. Reset this bit to disable the external jog input. If the external jog input is active when this bit is reset the jog will stop immediately.

Valid Command Bit Combinations

The following table lists the valid command bit combinations with a brief description. All other bit patterns cause a Program Command Error. Program Command Errors are reported to the processor through block transfer read instructions and single transfer input data.

Bit # 7-0 or 17-10	
"0 0 0 0 0 0 0 0"	Perform no change in action.
"0 0 0 0 0 0 0 1"	Start Move Profile.
"0 0 0 0 0 0 1 0"	Stop Move Profile.
"0 0 0 0 0 1 0 0"	Jog Up.
"0 0 0 0 1 0 0 0"	Jog Down.
"0 0 1 0 0 0 0 0"	Enable a manual jog up.
"0 0 1 1 0 0 0 0"	Enable a manual jog down.

The PLC-5 Bit Field Distribution (BTD) Instruction can be used to copy eight bits from a source word to a destination word. Defining the above seven patterns in an integer file and using the BTD instruction to copy them to the appropriate byte in the output image table is one way of avoiding Program Command Errors.

Single Transfer Input Data

The format of the input data is shown in figure 7.2. Bits 0 - 7 are status bits for channel one and bits 17 - 10 are for channel two. Note that these bits are numbered in octal. Bit addresses in the I/O data tables are in octal.

Single Transfer Input Data

17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
KBIN	Module Status Ch 2			Motion Status Ch 2				KBIN	Module Status Ch 1			Motion Status Ch 1			

Figure 7.2 Single Transfer Input Data Format

Motion Status Bits

Bit #				
13/3	12/2	11/1	10/0	
0	0	0	0	Stopped. Move profile terminated before it completed or a jog is stopped within the lower and upper travel limits.
0	0	0	1	Stopped, In Position. The present position is within the specified Target Range
0	0	1	0	Jogging Up. Position is manually forced to increase
0	0	1	1	Jogging Down. Position is manually forced to decrease.
0	1	0	0	Positioning Up, Low Speed. Move profile active, position increasing at low speed.
0	1	0	1	Positioning Down, Low Speed. Move profile active, position decreasing at low speed.
0	1	1	0	Positioning Up, High Speed. Move profile active, position increasing at high speed.
0	1	1	1	Positioning Down, High Speed. Move profile active, position decreasing at high speed.
1	0	0	0	At Upper Travel Limit. Position Upper Travel Limit.
1	0	0	1	At Lower Travel Limit. Position Lower Travel Limit.
1010 - 1110				Reserved. Not implemented in this software revision.
1	1	1	1	Stopped, Not In Position. The present position is not within the specified Target Range.

Single Transfer Input Data (continued)

Module Status Bits

Bit #			
16/6	15/5	14/4	
0	0	0	No Errors. Module operating without errors.
0	0	1	Transducer Fault. There is a transducer fault or wiring error.
0	1	0	NvRAM Error. Parameters have not been stored correctly.
0	1	1	Command Error. Indicates error in the single transfer output data.
1	0	0	Profile Error. Once a profile has been requested, this bit pattern is set if the programmed profile could not be executed. Most common cause is (Target Position ± Overshoot Position) exceeding Upper or Lower Travel Limit.
1	0	1	Command Ignored. 1) Attempted any action while there is a NvRAM error. 2) Attempted a move profile or jog while <u>any</u> parameter is being edited from the keyboard. 3) Issued *any* command while a move profile is active, even another *Start Move Profile* command. 4) Attempted a move profile or to jog while the channel is in fault. 5) Attempted to run a move profile while transducer position outside the range of upper and lower travel limits. When there is an error that forces a Command Ignored response, this bit pattern is placed in both bits 16-14 and 6-4
1	1	0	Reserved
1	1	1	Reserved

> Note: Transducer Faults can be cleared with an *Auxiliary Commands* block transfer write with the Clear Errors Bit set to 1. See Pg 56 for more information on the *Auxiliary Commands* data format. NvRAM Errors can only be cleared from the modules' keyboard.

KBIN Status Bit: Bits 17 and 7, Keyboard In Use

These bits are set under the following conditions.

- The keyboard is being used to program *any* parameter.
- A move profile initiated from the keyboard is in progress.
- The position is being jogged from the keyboard.

Notes

The following ladder logic program is an example of how block transfer instructions can be used to interface the 2762-17 module to a PLC-5. The block transfer functionality allows the PLC to read Status, Position, Velocity data as well as parameter values from the 2762-17. It also allows the PLC to program all setup information, as well as perform any error handling.

The program shows how to read and buffer the data from a 2762-17 module, and how a single block transfer write instruction can be used to send the various setup and control functions to the module. This program also shows how to restrict all block transfer write programming when the module's keyboard is in use. It also restricts all programming but auxiliary commands programming when there is a block transfer read module status error.

The 2762-17 module transmits the motor control output status, whether the outputs are on or off, to the PLC in the block transfer read data. However, this may not be fast enough for some applications. Rungs 2:9 through 2:12 can be used to determine the channel 1 output status from the Motion Status Bits located in the input image table. These rungs should only be used when the direction parameter is set to 'Positive' or CW increasing readings.

```
+-----------------------------------------------------+
|               Allen-Bradley Company                 |
|                6200 Series Software                 |
|       PLC-5 Programming Terminal Software           |
|                   Release 5.11                      |
|               Program Listing Report                |
|                                                     |
|                                                     |
|                                                     |
|             Processor File: 2762_17                 |
|          Thu Feb 22, 1996 -  9:10:56 am             |
|                                                     |
|                                                     |
| REPORT OPTIONS                                      |
|    Page Width:                                80    |
|    Page Length:                               66    |
|    Graphics Capabilities:                     NO    |
|    Right Power Rail:                         YES    |
|    Address Display:                       SYMBOL    |
|    Address Comments:                         YES    |
|    Rung Comments:                            YES    |
|    Output Cross Reference:                    NO    |
|    Ladder Cross Reference:                  NONE    |
|    Starting Rung:                            2:0    |
|    Ending Rung:                        999:32767    |
|    Formatting Commands:                   ACTIVE    |
+-----------------------------------------------------+
```

```
                                                  Thu Feb 22, 1996   Page 1
Program Listing Report            PLC-5/11    File 2762_17            Rung 2:0


Rung 2:0
The output image table of a PLC-5 is not cleared at power up.  To insure that
the 2762-17 module will not initiate any motion at power up, it is strongly
recommended that you clear the output image table on the first pass through
your ladder logic program.
| first                                                        2762-17        |
| pass bit                                                     module         |
|    S:1                                                  +MOV---------------+ |
+----] [--------------------------------------------------+MOVE             +-+
|      15                                                 |Source          0| |
|                                                         |                 | |
|                                                         |Destination  O:007| |
|                                                         |                0| |
|                                                         +-----------------+ |

Rung 2:1
| 2762-17                                                 2762-17             |
| BTR Enable                                              Block               |
| bit                                                     Transfer            |
|                                                         Read                |
|   BT9:0                                       +BTR--------------------+      |
+----]/[----------------------------------------+BLOCK TRANSFER READ    +-(EN)-+
|      EN                                       |Rack                 00|      |
|                                               |Group                 6+-(DN) |
|                                               |Module                0|      |
|                                               |Control block     BT9:0+-(ER) |
|                                               |Data file         N10:0|      |
|                                               |Length               12|      |
|                                               |Continuous            N|      |
|                                               +-----------------------+      |

Rung 2:2
| 2762-17                                                   2762-17           |
| BTR Done                                                  bufferred         |
| bit                                                       BTR data          |
|   BT9:0                                              +COP--------------------+ |
+----] [-----------------------------------------------+COP FILE              +-+
|      DN                                              |Source          #N10:0| |
|                                                      |Destination    #N10:20| |
|                                                      |Length              12| |
|                                                      +-----------------------+ |
```

```
                                                        Thu Feb 22, 1996   Page 2
Program Listing Report             PLC-5/11    File 2762_17             Rung 2:3


Rung 2:3
|  2762-17 BT                                                      2762-17 BT |
|  module                                                          module     |
|  status                                                          status     |
|  error bit                                                       error      |
|                                                                  exists     |
|    N10:20                                                            B3     |
+-+---] [----+---------------------------------------------------------( )-----+
| |      10  |                                                          0     |
| |2762-17 BT|                                                                |
| |module    |                                                                |
| |status    |                                                                |
| |error bit |                                                                |
| |  N10:20  |                                                                |
| +---] [----+                                                                |
| |       9  |                                                                |
| |2762-17 BT|                                                                |
| |module    |                                                                |
| |status    |                                                                |
| |error bit |                                                                |
| |  N10:20  |                                                                |
| +---] [----+                                                                |
|         8                                                                   |

Rung 2:4
| set to     |set to     |set to     |set to                 BTW data         |
| program    |program    |program    |preset                                  |
| resolver   |position   |auxiliary  |position                                |
| data       |data       |commands   |                                        |
|   I:011      I:011      I:011      I:011          +MOV--------------------+ |
+----] [--------]/[--------]/[--------]/[------------+MOVE                 +-+
|      00         01         02         03          |Source              40| |
|                                                   |                      | |
|                                                   |Destination  BT9:1.ELEM| |
|                                                   |                    80| |
|                                                   +----------------------+ |

Rung 2:5
| set to     |set to     |set to     |set to                 BTW data         |
| program    |program    |program    |preset                                  |
| resolver   |position   |auxiliary  |position                                |
| data       |data       |commands   |                                        |
|   I:011      I:011      I:011      I:011          +MOV--------------------+ |
+----]/[--------] [--------]/[--------]/[------------+MOVE                 +-+
|      00         01         02         03          |Source              60| |
|                                                   |                      | |
|                                                   |Destination  BT9:1.ELEM| |
|                                                   |                    80| |
|                                                   +----------------------+ |
```

```
                                                         Thu Feb 22, 1996   Page 3
Program Listing Report            PLC-5/11    File 2762_17              Rung 2:6

Rung 2:6
| set to    |set to    |set to    |set to                  BTW data           |
| program   |program   |program   |preset                                     |
| resolver  |position  |auxiliary |position                                   |
| data      |data      |commands  |                                           |
|   I:011      I:011      I:011      I:011          +MOV--------------------+ |
+----]/[--------]/[--------] [--------]/[------------+MOVE                  +-+
|      00         01         02         03          |Source              80| |
|                                                   |                      | |
|                                                   |Destination  BT9:1.ELEM| |
|                                                   |                    80| |
|                                                   +----------------------+ |

Rung 2:7
| set to    |set to    |set to    |set to                  BTW data           |
| program   |program   |program   |preset                                     |
| resolver  |position  |auxiliary |position                                   |
| data      |data      |commands  |                                           |
|   I:011      I:011      I:011      I:011          +MOV--------------------+ |
+----]/[--------]/[--------]/[--------] [------------+MOVE                  +-+
|      00         01         02         03          |Source             100| |
|                                                   |                      | |
|                                                   |Destination  BT9:1.ELEM| |
|                                                   |                    80| |
|                                                   +----------------------+ |
```

```
                                                        Thu Feb 22, 1996   Page 4
Program Listing Report            PLC-5/11    File 2762_17            Rung 2:8


Rung 2:8
| set when  |2762-17 BT|set to      one shot             2762-17           |
| 2762-17   |module    |program     control              Block             |
| keyboard  |status    |resolver                         Transfer          |
| in use    |error     |data                             Write             |
|           |exists    |                                                   |
|   N10:20      B3       I:011         B3      +BTW--------------------+   |
+----]/[----+---]/[----+---] [----++--[ONS]-----+BLOCK TRANSFER WRITE   +-(EN)-+
|      12   |      0   |      00   ||      1     |Rack                 00|      |
|           |          |set to     ||            |Group                 6+-(DN) |
|           |          |program    ||            |Module                0|      |
|           |          |position   ||            |Control block     BT9:1+-(ER) |
|           |          |data       ||            |Data file        N10:80|      |
|           |          |  I:011    ||            |Length               12|      |
|           |          +---] [----+|            |Continuous            N|      |
|           |          |      01   ||            +-----------------------+      |
|           |          |set to     ||                                           |
|           |          |preset     ||                                           |
|           |          |position   ||                                           |
|           |          |  I:011    ||                                           |
|           |          +---] [----+|                                           |
|           |               03     |                                           |
|           |set to                |                                           |
|           |program               |                                           |
|           |auxiliary             |                                           |
|           |commands              |                                           |
|           |  I:011               |                                           |
|           +---] [----------------+                                           |
|                02                                                            |
```

Rung 2:9
The following three rungs are used to determine the channel 1 output status of an AMCI 2762-17 module from the Input Image Table motion status bits. These three rungs should be used when the direction parameter is set to "P" or CW increasing readings.

```
|                                                                    comment    |
|                                                                    coil       |
|                                                                       N7:0    |
+-----------------------------------------------------------------------( )-----+
|                                                                          1    |
```

```
                                                       Thu Feb 22, 1996   Page 5
Program Listing Report             PLC-5/11    File 2762_17            Rung 2:10


Rung 2:10
| 2762-17   |2762-17   |2762-17                         2762-17   |indicates   |
| motion    |motion    |motion                          motion    |forward     |
| status bit|status bit|status bit                      status bit|motion      |
|                                                                 |output      |
|                                                                 |active      |
|   I:007      I:007      I:007                           I:007        B3      |
+----]/[----+---]/[--------] [-----+-------------------+---]/[--------( )----+-+
|      03   |     02         01    |                   |     00         16   | |
|           |2762-17   |2762-17    |                   |2762-17   |indicates | |
|           |motion    |motion     |                   |motion    |reverse   | |
|           |status bit|status bit |                   |status bit|motion    | |
|           |  I:007      I:007     |                   |          |output    | |
|           +---] [----+---]/[----++                   |          |active    | |
|                 02   |     01   |                    |  I:007       B3    | |
|                      |2762-17   |                    +---] [--------( )----+ |
|                      |motion    |                         00          17     |
|                      |status bit|                                            |
|                      |  I:007   |                                            |
|                      +---] [----+                                            |
|                            01                                                |

Rung 2:11
| 2762-17   |2762-17   |2762-17                                     indicates  |
| motion    |motion    |motion                                      2762-17    |
| status bit|status bit|status bit                                  high speed |
|                                                                   output     |
|                                                                   active     |
|   I:007      I:007      I:007                                         B3     |
+----]/[--------] [--------] [-----------------------------------------( )-----+
|      03         02         01                                          18    |

Rung 2:12
| 2762-17   |2762-17   |2762-17                                     indicates  |
| motion    |motion    |motion                                      2762-17    |
| status bit|status bit|status bit                                  low speed  |
|                                                                   output     |
|                                                                   active     |
|   I:007      I:007      I:007                                         B3     |
+----]/[----+---]/[--------] [----+------------------------------------( )-----+
|      03   |     02         01   |                                      19    |
|           |2762-17   |2762-17   |                                            |
|           |motion    |motion    |                                            |
|           |status bit|status bit|                                            |
|           |  I:007      I:007   |                                            |
|           +---] [--------]/[----+                                            |
|                 02         01                                                |
```

```
                                                          Thu Feb 22, 1996   Page 6
Program Listing Report             PLC-5/11    File 2762_17             Rung 2:13


Rung 2:13
The following three rungs are used to determine the channel 1 output status of
an AMCI 2762-17 module from the Input Image Table motion status bits.  These
three rungs should be used when the direction parameter is set to "n" or CCW
increasing readings.
|                                                                    comment    |
|                                                                    coil       |
|                                                                       N7:0    |
+----------------------------------------------------------------------( )-----+
|                                                                          0    |

Rung 2:14
| 2762-17    |2762-17    |2762-17                         2762-17    |indicates   |
| motion     |motion     |motion                          motion     |forward     |
| status bit|status bit|status bit                      status bit|motion      |
|                                                                    |output      |
|                                                                    |active      |
|   I:007      I:007      I:007                            I:007        B3      |
+----]/[----+---]/[--------] [-----+-------------------+---]/[--------( )----+-+
|      03   |      02         01   |                   |      00         33   | |
|           |2762-17    |2762-17   |                   |2762-17    |indicates | |
|           |motion     |motion    |                   |motion     |reverse   | |
|           |status bit|status bit |                   |status bit|motion    | |
|           |  I:007      I:007    |                   |           |output    | |
|           +---] [----+---]/[----++                   |           |active    | |
|                 02   |      01   |                   |  I:007        B3     | |
|                      |2762-17    |                   +---] [--------( )----+ |
|                      |motion     |                         00         32      |
|                      |status bit|                                             |
|                      |  I:007    |                                             |
|                      +---] [----+                                             |
|                            01                                                 |
                                                                                
Rung 2:15
| 2762-17    |2762-17    |2762-17                                  indicates   |
| motion     |motion     |motion                                   2762-17     |
| status bit|status bit|status bit                               high speed |
|                                                                   output      |
|                                                                   active      |
|   I:007      I:007      I:007                                        B3      |
+----]/[--------] [--------] [----------------------------------------( )-----+
|      03         02         01                                         34     |
```

```
                                                       Thu Feb 22, 1996   Page 7
Program Listing Report            PLC-5/11    File 2762_17            Rung 2:16


Rung 2:16
| 2762-17   |2762-17   |2762-17                                  indicates  |
| motion    |motion    |motion                                   2762-17    |
| status bit|status bit|status bit                               low speed  |
|                                                                output     |
|                                                                active     |
|   I:007      I:007      I:007                                    B3       |
+----]/[----+---]/[--------] [----+-----------------------------------( )-----+
|      03   |     02         01   |                                  35       |
|           |2762-17   |2762-17   |                                           |
|           |motion    |motion    |                                           |
|           |status bit|status bit|                                           |
|           |  I:007      I:007   |                                           |
|           +---] [--------]/[----+                                           |
|                 02         01                                               |

Rung 2:17
|                                                                             |
+--------------------------------[END OF FILE]--------------------------------+
|                                                                             |

NO MORE FILES
```

```
+-----------------------------------------------------+
|               Allen-Bradley Company                 |
|                6200 Series Software                 |
|        PLC-5 Programming Terminal Software          |
|                   Release 5.11                      |
|                 Data Table Report                   |
|                                                     |
|                                                     |
|                                                     |
|              Processor File: 2762_17E               |
|           Tue Apr 23, 1996 - 11:39:39 am            |
|                                                     |
|                                                     |
| REPORT OPTIONS                                      |
|    Page Width:                              80      |
|    Page Length:                             66      |
|    Graphics Capabilities:                   NO      |
|    Starting File:                           10      |
|    Ending File:                             10      |
+-----------------------------------------------------+
```

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Data Table Report PLC-5/11 File 2762_17E Data Table File N10:0

Address	0	1	2	3	4	5	6	7	8	9
N10:0	16	270	1	0	0	0	22	765	0	0
N10:10	0	0	0	0	0	0	0	0	0	0
N10:20	16	270	1	0	0	0	22	765	0	0
N10:30	0	0	0	0	0	0	0	0	0	0
N10:40	256	1000	409	600	10	0	10	0	350	0
N10:50	25	0	0	0	0	0	0	0	0	0
N10:60	513	20	123	5	100	2	700	1	230	0
N10:70	20	3	0	0	0	0	0	0	0	0
N10:80	1026	0	0	0	0	0	0	0	0	0
N10:90	0	0	0	0	0	0	0	0	0	0
N10:100	2049	0	0	0	0	0	0	0	0	0
N10:110	0	0								

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