

**2573-TCM2**  
**SERIAL DEVICE INTERFACE ADAPTER**  
**INSTALLATION AND OPERATION GUIDE**  
**Version 1.6**

CTI Part # 062-00181-016





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Version 1.0	1/26/95	Original Release
Version 1.1	5/19/95	Revised error code section Corrected error in PLC logic example for CAMP master Added note about alternate switchblock labeling (OPEN / CLOSED)
Version 1.2	6/2/95	Added and clarified examples of cable construction Corrected typographical errors in PLC logic example Performed other minor typographical corrections and revisions
Version 1.3	11/15/95	Added documentation of Modem Control feature Added CAMP Memory Exchange command documentation
Version 1.4	10/24/96	Corrected Error in Memory Exchange command and examples Added Appendix D - PLC Command Interface
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## ***PREFACE***

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This ***Installation and Operation Guide*** provides installation and operation instructions for the CTI 2573-TCM2. The information in this manual is directed to individuals who will be installing, maintaining, and troubleshooting the module.

This manual assumes that you are familiar with the installation and operation of SIMATIC TI505 programmable controllers. Please refer to the appropriate SIMATIC user documentation for specific information on SIMATIC TI505 programmable controllers and I/O modules.

This manual describes the use of NITP/ CAMP Slave, Task Code Master, and CAMP Master protocol managers. Instructions for using the General ASCII Support (GAS) Protocol Manager is contained in a separate manual, the *General ASCII Support Protocol Manager Reference Manual* (CTI Part # 62-182).



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## **USAGE CONVENTIONS**

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**NOTE:**

*Notes alert the user to special features or procedures.*

**CAUTION:**

*Cautions alert the user to procedures that could damage equipment.*

**WARNING:**

**Warnings alert the user to procedures that could damage equipment and endanger the user.**





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# CHAPTER 1. DESCRIPTION

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## 1.1. Introduction

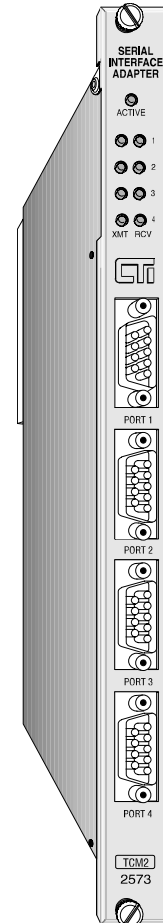
The CTI 2573-TCM2 Serial Interface Adapter is a microprocessor-based communications adapter for SIMATIC TI505 controllers. The 2573-TCM2 provides the capability to interface the PLC to devices which support serial data communications. Typical serial devices include bar code readers, scales, displays, motor drives, printers, and other PLCs.

The 2573-TCM2 provides four serial ports. Each port is independently configurable for electrical interface, communications parameters, and protocol. Each serial port supports RS-422, RS-485, and a subset of RS-232-C electrical interfaces. The operative electrical interface is determined by choosing which pins are connected to the serial communications cable.

The module Programmable Read-Only Memory (PROM) firmware includes a set of Protocol Managers which process messages sent to and from the 2573-TCM2 serial ports and transfer message data between the module and the PLC. Each serial port can be individually configured to use a particular protocol manager. Once configured, each serial port operates independently and concurrently.

The 2573-TCM2 protocol managers include both master and slave support for the Non-Intelligent Terminal Protocol (NITP) and the Common ASCII Message Protocol (CAMP). The 2573-TCM2 also features a General ASCII Support (GAS) protocol manager which can be tailored to support a wide variety of ASCII protocols.

The module provides an Active LED, which indicates module status, and four sets of transmit and receive LEDs which indicate when a signal is transmitted and received.



*Figure 1. 2573-TCM2 Front Panel*

## 1.2. Serial Ports

The 2573-TCM2 provides four serial ports. All four ports can operate concurrently. Each serial port can be independently configured. Thus, you could have up to four different types of devices communicating with the PLC at the same time.

The serial ports use a male DB9 connector which incorporates the most common serial electrical interfaces, RS-232-C, RS-422, and RS-485-A. You select the electrical interface by connecting the appropriate connector pins to the communications cable.

The most commonly used electrical interface for point-to-point serial communications is RS-232C. The module supports the standard PC/AT RS-232 pinout configuration for RECEIVE DATA (RxD - pin 2), TRANSMIT DATA (TxD - pin 3), SIGNAL GROUND (SG - pin 5), REQUEST TO SEND (RTS - pin 7), and CLEAR TO SEND (CTS - pin 8). ***Other pins normally used for other RS-232 handshake lines, including DATA SET READY (DSR), DATA TERMINAL READY (DTR), and CARRIER DETECT (CD), are dedicated to the other electrical interfaces.***

**NOTE:**

*Many cables used with the PC/AT interface will work with the 2573-TCM2. However, those cables that strap DSR and DTR will not work.*

The RS-422 interface is typically used to improve noise immunity and/or to extend the length of cable that can be reliably used. RS-422 uses two sets of twisted pair wires, one for transmit and one for receive. Within each set of twisted pair, one wire carries the signal in positive polarity and the other in negative polarity. This configuration, often called *balanced line*, tends to cancel interference. RS-422 is normally used for point to point communications. The 2573-TCM2 uses pin 1 for RECEIVE + (Rx+) and pin 6 for RECEIVE - (Rx-). Pin 4 is used for TRANSMIT + (Tx+) and Pin 9 is used for TRANSMIT - (Tx-).

The RS-485-A interface is similar to the RS-422 interface, except that only one twisted pair is used. The single twisted pair is used for both transmitting and receiving data. The 2573-TCM2 uses Pin 4 for TRANSMIT/RECEIVE + (Tx/Rx +) and Pin 9 for TRANSMIT/RECEIVE - (Tx/Rx-).

RS-422-A and RS-485 circuits may require the use of termination resistors at the 2573-TCM2 connection. The 2573-TCM2 provides jumpers which allow you to insert or remove termination resistance from the circuit.

**NOTE:**

*See Appendix A for details on port configuration, cabling, and jumper settings.*

The ports may be configured using PLC logic for various protocols and communications parameters. For some protocols, the module may be configured by module dipswitches. See Chapter 2, page 9.

## 1.3. LED Indicators

### Active LED

The *Active* LED will illuminate steady when the module hardware is performing properly. Should a hardware problem be detected by the diagnostic software, the LED will flash intermittently. The LED is off when no power is present. It may also cycle off for a few seconds when the module power is first applied.

### Transmit / Receive LEDs

The module provides a pair of Transmit and Receive LEDs for each serial port which flash when a signal is present. The Transmit LED will illuminate when an output signal is present; the Receive LED will illuminate when a signal is received. During normal data communications activity the LEDs will appear to flicker at a rate which corresponds to the baud rate. The LEDs are a positive indication that the serial ports are operating and serve as a valuable problem determination tool.

## 1.4. Functional Overview

The 2573-TCM2 serial ports may be used for a wide variety of applications. These uses include:

- Attaching an NITP compatible operator interface to the PLC,
- Transferring data to/from another PLC (SIMATIC Series TI500 or TI505),
- Communicating with other CTI products including another 2573-TCM2,
- Sending command to and/or obtaining data from serial ASCII devices (such as bar code readers, scales, etc.).

The CTI 2573-TCM2 uses software called *Protocol Managers* to accomplish these functions. Protocol Managers create outgoing messages and process incoming messages under control of the PLC. The 2573-TCM2 provides several different protocol managers whose functions are described below.

### NITP/CAMP Slave

When a 2573-TCM2 serial port is configured to use the *NITP/CAMP Slave* protocol manager, it will support both the *Non-Intelligent Terminal Protocol* (NITP) used by Simatic TI500 and TI505 Series PLCs and the *Common ASCII Message Protocol* (CAMP) used by most CTI communications modules. This protocol manager acts as a slave, responding to commands from the attached device. No PLC logic is required to implement this protocol manager. See the example in Chapter 5 on page 34.

The NITP support emulates the program port of a SIMATIC TI505 series PLC. A device which can communicate using NITP (Non-Intelligent Terminal Protocol), such as an operator interface panel, can access the PLC using this port. When an NITP message containing a task code is received by the module, it retrieves the task code from the message and routes it to the PLC processor via the backplane. When the PLC processor replies to the task code, the 2573-TCM2 sends an NITP message containing the response back to the device.

CAMP (Common ASCII Message Protocol) is used by most CTI communications modules to transfer data. As compared to NITP, CAMP allows much more data to be sent in a single message. Where NITP will allow only 16 words per message, CAMP allows 256 words per message. For applications requiring large amounts of data transfer, the increased message size results in improved performance. See the section on CAMP Master below for additional information.

### **Task Code (NITP) Master**

When a 2573-TCM2 serial port is configured to use the Task Code Master protocol manager, the PLC can *initiate* NITP messages containing task codes. Since NITP is used, the message can be processed directly by the program ports of both TI505 and TI500 series PLCs. You can attach a cable from the 2573-TCM2 port to the program port of the PLC. See the example application in Chapter 5 on page 35.

This function allows the PLC to read data from or write data to another PLC (called a *remote* PLC) under control of the local PLC logic. On command from the local PLC, the 2573-TCM2 will build the task code message and send it to the remote PLC attached to the serial port. The response from the remote PLC will be processed by the protocol manager and any data retrieved will be stored in local PLC memory.

### **CAMP Master**

When a 2573-TCM2 serial port is configured to use the CAMP Master protocol manager, the PLC can *initiate* messages using the Common ASCII Messaging Protocol format. Because CAMP allows up to 256 words of data to be sent in one message, it offers improved performance over NITP. CAMP is typically used to transfer data among CTI communications modules. For example, in an application where you need to transfer large amounts of data between two PLCs, you might configure both PLCs with a 2573-TCM2 in each rack, cable the 2573 ports together, and use CAMP to transfer the data. See the example in Chapter 5 on page 39.

### **General ASCII Support (GAS)**

When a 2573-TCM2 serial port is configured to use the General ASCII Support (GAS) protocol manager, it can be used to communicate with a wide variety of devices which use the ASCII data encoding standard. GAS allows the application developer to specify how output messages will be constructed and how input messages will be processed. PLC logic can be used to control sending and receiving device messages. The GAS protocol manager is described in a separate reference manual. See the *General ASCII Support Protocol Manager Reference Manual* for comprehensive information.



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## CHAPTER 2. INSTALLATION

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The installation of the Module consists of the following steps:

1. Planning the installation,
2. Unpacking and configuring the module,
3. Physical installation,
4. Connecting cables,
5. Checking the module operation.

### 2.1. Installation Planning

The 2573-TCM2 is a single wide module which draws 6.0 watts at 5 VDC from the backplane. You should ensure that you have adequate space and power available for the module.

The serial ports on the 2573-TCM2 provide electrical interfaces for RS-422-A, RS-485, and a subset of RS-232-C. The electrical interface used is determined by how the pins on the DB-9 connector are connected to the cable. You should determine which interface you wish to use (typically determined by the capability of the attached devices) and construct/obtain cables which implement the desired interface. See Appendix A for port configuration and cabling details.

The serial ports can be configured for a variety of different protocols. Before installation, you should review your requirements and determine which protocols you wish to use. If you are using the Task Code Master or CAMP Master protocols, you should review the material contained in Chapter 4 of this manual. If you are using the General ASCII Support (GAS) protocol manager, you should read the material in the *General ASCII Support Protocol Manager Reference Manual*.

### 2.2. Unpacking the Module

Open the shipping carton and remove the special anti-static bag that contains the module. After discharging any static build-up, remove the module from the static bag. Do not discard the static bag. Always use this bag for protection against static damage when the module is not inserted into the I/O base.

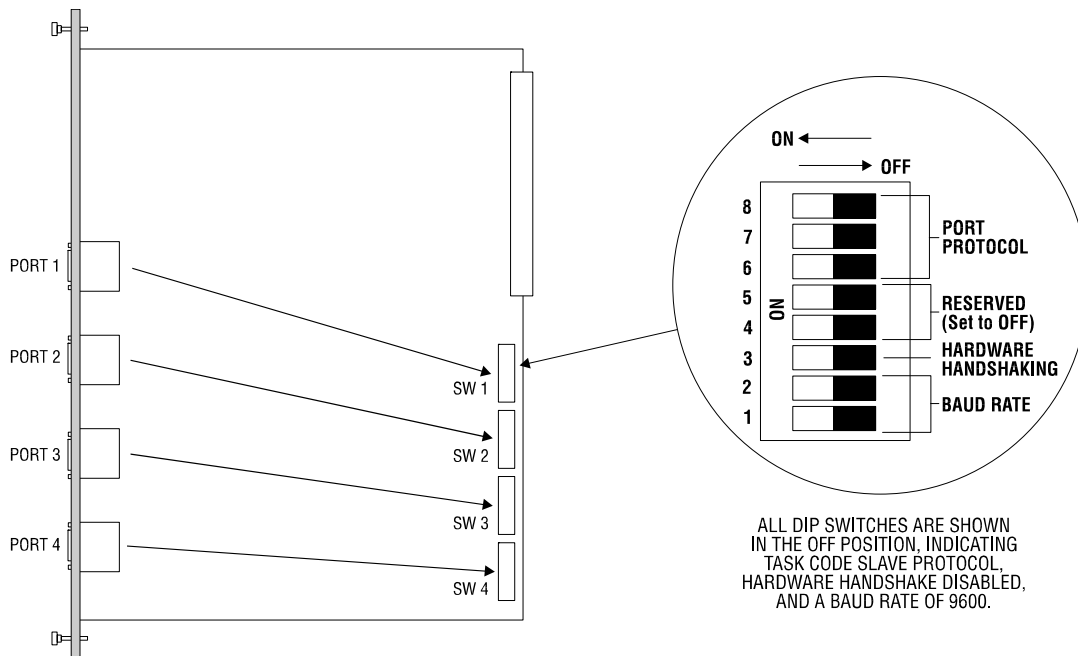
**CAUTION:**

*The components on the 2573-TCM2 module can be damaged by static electricity discharge. To prevent this damage, the module is shipped in a special anti-static bag. Static control precautions should be followed when removing the module from the bag and when handling the printed circuit card during configuration.*

## 2.3. Setting the 2573 Switches

There are four switchblocks on the 2573-TCM2, one for each serial port. Each switchblock contains a set of eight switches. You may use the switches on the 2573 to select the baud rate, handshaking, and protocol for each serial port. Alternately, you may set the switches so that PLC logic is used to select the above.

Figure 2 illustrates the location of the switches.



**Figure 2. 2573 Switch Locations**

**NOTE:**

*The switch settings are read by the module at startup only. If you change the switch settings, you must reset the module by removing and restoring power before the new settings will take effect.*

**NOTE:**

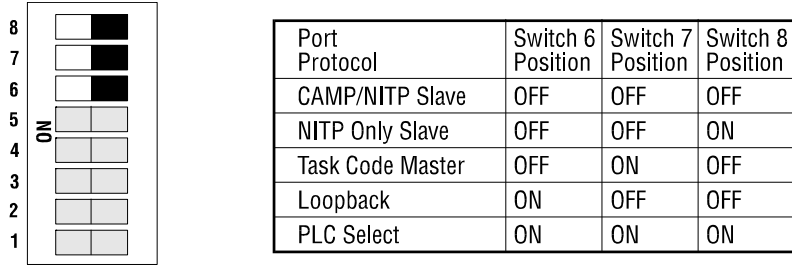
*Switches on some versions may be labeled OPEN and CLOSED rather than OFF and ON. OPEN is equivalent to OFF and CLOSED is equivalent to ON.*

## Serial Port Protocol

Switches 6, 7, and 8 on each switch block are used to set the protocol used by the port. You have the following options:

<b>Protocol</b>	<b>Description</b>	<b>Use</b>
NITP/CAMP Slave	Supports both NITP (Non-Intelligent Terminal Protocol) and CAMP (Common ASCII Message Protocol).  This protocol manager responds to commands sent from another device acting as a master.	Used to access PLC memory.  NITP slave emulates a PLC programming port. Typically used to connect operator interface devices, MMI software, or PCs running TISOFT.  CAMP supports higher density memory transfer and is used between CTI modules. It is also used for special module specific commands.
NITP Only Slave	Similar to the function above except that it supports only NITP (not CAMP).	Used when you need strict NITP compatibility with the TI505 Series program port. This is usually not required.
Task Code Master	Allows PLC logic to send task codes using NITP (Non-Intelligent Terminal Protocol).	Used to transfer data between PLCs. You can attach to the remote PLC via the program port.
Loopback	Loopback generates a series of ASCII characters which may be directed back to the serial port via a loopback connector.	Used to Test serial ports and cables.  See Appendix A for construction of loopback connectors.
PLC Select	Allows the PLC logic to select the port protocol.	Used to load other port protocol managers including the CAMP Master and the General ASCII Support (GAS) protocol managers.

See the figure below for switch settings used for protocol selection:



**Figure 3. Port Protocol Settings**

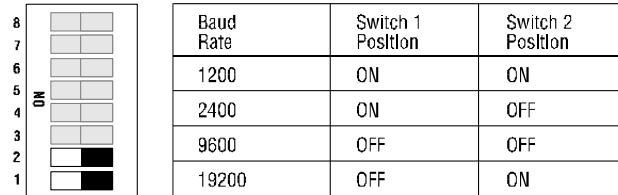
All unused positions will select the loopback protocol manager.

**NOTE:**  
*If you are not using the port for other purposes, you should set the switches to select the NITP/CAMP Slave protocol manager (Switch 6, 7, and 8 in OFF position). This is the factory setting.*

**NOTE:**  
*When you use the module switches to select the Task Code Slave protocol or Task Code Master protocol, the baud rate is determined by switch settings. Other communications parameters such as data bits, parity, and stop bits default to those used by the SIMATIC T1505 program port.*

## Serial Port Baud Rate

You can individually set the default baud rate settings for each serial port. The diagram below applies to all switchblocks (SW1-SW4).



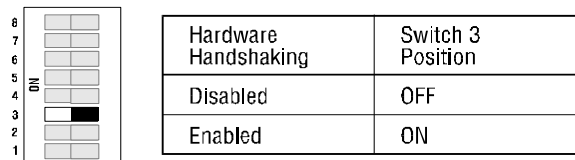
**Figure 4. Baud Rate Settings**

**NOTE:**

*If switches 6, 7, and 8 are set to PLC Select (see Figure 3), the baud rate parameter is obtained from the PLC command block. The switch settings for baud rate are ignored. Chapter 4 describes the command blocks.*

## Hardware Handshaking

The figure below shows the switch settings for hardware handshake.



**Figure 5. Handshake Settings**

**NOTE:**

*If switches 6, 7, and 8 are set to PLC Select, the handshake parameter is obtained from the PLC command block. The switch settings for hardware handshake are ignored.*

## 2.4. RS-422/485 Disconnect Switches (Board Revision D and above)

In order to use a standard 9-pin 'D' shell connector, the 2573 routes the lines used for RS-422 and RS-485 communications to pins normally used for the following RS-232 hardware handshaking lines:

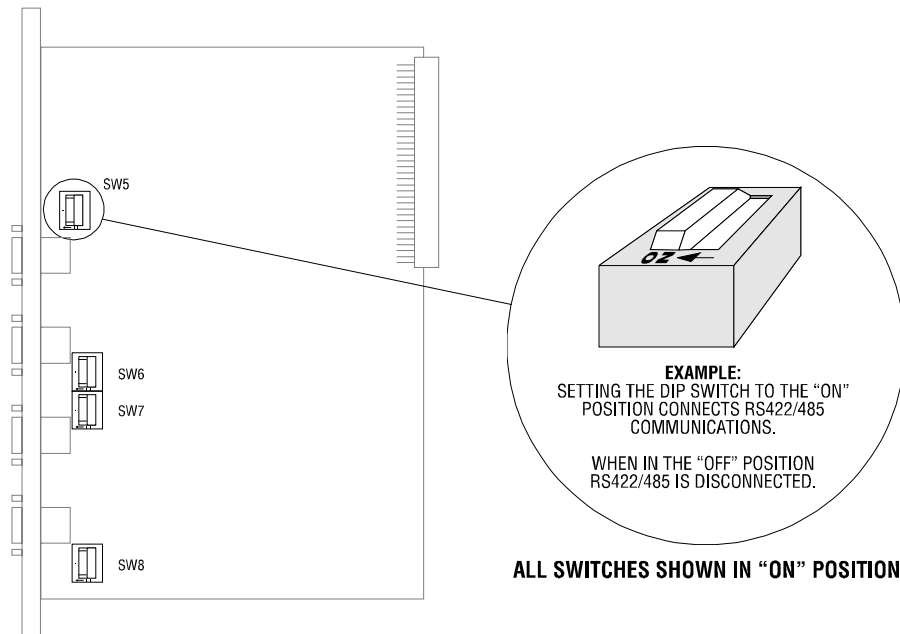
- Data Carrier Detect (DCD)
- Data Terminal Ready (DTR)
- Data Set Ready (DSR).

This arrangement can cause communications problems when you use a cable that straps these handshake lines together (such as a typical TISOFT cable). Revision D and above of the 2573 printed circuit board contains a switch for each port which allows you to disconnect the RS-422 and RS-485 lines from the 9 pin connector. Putting the switch in the 'OFF' (disconnected) position allows you to use unmodified TISOFT cables with the 2573 module.

For board revisions C and below, you will need to construct new cables or build an adapter cable to eliminate the problem. Appendix A describes how to construct these cables.

### Setting the RS-422/485 Disconnect Switches

The RS-422/485 Disconnect switches are located adjacent to the ports they serve, as seen in the following figure. When the interface for an individual port is RS-232, the associated Disconnect switch may be left in the 'ON' (connected) position, unless transition problems arise from that setting. For RS-422/485 operation, the Disconnect switch *must* be in the 'ON' (connected) position.



**Figure 6. 2573 RS-422/485 Disconnect Switch Locations**

## 2.5. Hardware Handshake Operation

If hardware handshaking is enabled, the Request to Send (RTS) and Clear to Send (CTS) hardware handshake line are controlled as follows:

- *Input Flow Control (RTS).* When hardware handshake is enabled, the 2573-TCM2 controls the RTS control line. RTS is normally high unless the input buffer is almost full. If the number of characters in the input buffer exceeds a preset value (about 2/3 of the buffer size), the 2573-TCM2 will pull the RTS line low. When the number of characters in the buffer goes below this value, the 2573-TCM2 will drive RTS high.
- *Output Flow Control (CTS).* When hardware handshake is enabled, the 2573-TCM2 senses the state of the CTS control line. When the state of the line is high, the 2573-TCM2 will transmit if there are characters to be transmitted. If the state of the line is low, no output occurs.

**NOTE:**

*Unless the device you are attaching explicitly requires hardware handshaking, you should leave hardware handshaking disabled.*

The 2573 is shipped from CTI with all DIP switches in the OFF position. This corresponds to:

Baud Rate	9600
Hardware Handshaking	DISABLED
Serial Port Protocol	CAMP/NITP SLAVE

## 2.6. Termination Resistor Jumpers

RS-422C and RS-485 electrical interfaces may use termination resistors to reduce circuit reflections and to improve signal quality. For RS-422A, the termination resistor is optional. It is usually not used at baud rates below 20kb. For RS-485, termination resistance is required on both ends of the line. See the documentation accompanying your device for particular installation information.

The 2573-TCM2 uses a set of jumpers to insert or remove the termination resistance from the circuit.

The 2573-TCM2 is shipped from the factory with the jumpers positioned so that the termination resistance is disabled (not installed in the circuit). If you need to change the factory setting, Appendix A, page 73 illustrates the jumper locations and configurations.

**NOTE:**

*Jumpers for RS-422 and RS-485 are shipped in the disabled position. If you are using an RS-485 circuit you will probably need to change the setting. See Appendix A.*

## 2.7. Physical Installation

### Inserting the Module into the I/O Base

Ensure that power to the base is off. Hold the top and bottom of the bezel and slide the module carefully into the slot, pushing it all the way into the base. If you have inserted the module correctly, you will feel a slight increase in resistance as the module mates with the base backplane connector. Once the module is fully seated in the slot, tighten the captive screws at the top and bottom to hold the module in place. To remove the module from the I/O base, remove power from the base, loosen the captive screws, then remove the module. Take care not to damage the connector at the back of the module when inserting or removing the module.

### Power Up

First turn on the base power supply. If the diagnostics on the Model 2573 detect no problems, the ACTIVE indicator will illuminate. If the indicator does not illuminate or exhibits a blinking pattern, the module has detected a component failure. For information on viewing failed module status, refer to your SIMATIC TI TISOFT Programming Manual. See Chapter 7 of this manual for troubleshooting information.

### Checking PLC Login

Next, check that the module is configured in the memory of the PLC. The 2573 logs in as a special function module with 2 WX and 6 WY words. To view the PLC I/O configuration chart refer to your SIMATIC TI TISOFT Programming Manual.

In this example, the Model 2573 module is installed into slot 1 on I/O base 0. For your particular installation, look in the chart at the slot address occupied by the module in your configuration. If the

I/O MODULE DEFINITION FOR CHANNEL . . . 1    BASE . . . . . 00

I/O SLOT	ADDRESS	X	NUMBER OF Y	BIT AND WX	WORD WY	I/O	SPECIAL FUNCTION
01	00001	00	00	02	06		YES
02	00000	00	00	00	00		NO
..	.....	..	..	..	..		...
15	00000	00	00	00	00		NO
16	00000	00	00	00	00		NO

**Figure 7. Sample I/O Configuration**

WX and WY values are the same as those shown in the example above and Special function = YES, then the module is logged into the PLC memory and is ready for operation. If the line is blank or erroneous, re-check the module to ensure that it is firmly seated in the I/O base slot. Generate the PLC I/O configuration chart again by reading the I/O base. If the problem persists, contact your distributor or contact CTI at 1-800-537-8398.



## 2.8. Connecting Cables

Connect the serial cabling from the 2573-TCM2 serial port(s) to the device(s) with which you wish to communicate. Your cables should have been wired to select the electrical interface you wish to use. See Appendix A for port pin-out and cable wiring examples.

## 2.9. Module Checkout

Apply power to the module. After a few seconds the ACTIVE LED should remain lit. If the ACTIVE LED cycles off and on slowly, the 2573-TCM2 diagnostics have detected a hardware error. If the ACTIVE LED is off either power is not applied or module hardware has failed. See Chapter 7 for more information.

If you wish to check out each serial port, you can set the module dipswitches for the loopback function. If you have selected the loopback setting for a port, you should see the XMT LED for the port flash, indicating data is being sent to the port. If you install a loopback connector (see Appendix A), you should see the XMT and RCV indicators flash.



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## **CHAPTER 3. OPERATION**

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### **3.1. General Module Operation**

Under normal conditions, the red ACTIVE LED should be lit. This indicates that the module is receiving power and that no hardware problems have been detected by the module diagnostic software. If the ACTIVE LED is not lit or if it is blinking, please refer to Chapter 7 for troubleshooting information.

Any port configured via module dip switches as a Task Code /CAMP slave does not require PLC logic in order to work. If you are using other protocols, including Task Code Master, Camp Master, or General ASCII Support, you will need to use PLC logic to control the operation.

### **3.2. PLC Command Interface**

The 2573-TCM2 provides a standard PLC logic interface for sending messages and processing responses. The interface consists of two structures:

#### **1. Module WX/WY Words**

The PLC logic can use certain WX/WY words to initiate and monitor the module commands. Then module monitors selected bits in these words to determine when to start a command and manipulates other bits to indicate that a command is in process or that an error has occurred.

#### **2. Command Blocks.**

Command Blocks are blocks of V memory which contain the command parameters. The module uses the data in the command block to determine what to do.

These structures are summarized below. For a more complete description of the interface, see *Appendix D*.

## 2573-TCM2 WX and WY Words

The 2573-TCM2 logs in as a Special Function module and is assigned two WX words and six WY words. PLC logic uses the WY words to select the Command Block and to trigger the command execution. The status of the module and of command execution can be monitored via the WX words. The words are used as follows:

<b>Word</b>	<b>Function</b>	<b>Description</b>
WX1	Module Status	The high 8 bits contain module status bits. The lower 8 bits are a counter that increments approximately once per second.
WX2	Command Status	The 2573-TCM2 will set these bits to indicate the status of command processing. There are 4 sets of 4 bits. The four sets correspond to the four command slots and to the four sets of Command Control bits in WY4.
WY3	Module Control	Contains bits which your PLC logic can use to control general module functions (e.g. reset the module).
WY4	Command Control	Your PLC logic will set these bits to control command processing by the 2573-TCM2. There are 4 sets of 4 bits. The 4 sets correspond to the four command slots and to the 4 sets of Command Status bits in WX2.
WY5	Command Slot 1	Contains the V memory address of the Command Block used with the first set of command and status bits.
WY6	Command Slot 2	Contains the V memory address of the Command Block used with the second set of command and status bits.
WY7	Command Slot 3	Contains the V memory address of the Command Block used with the third set of command and status bits.
WY8	Command Slot 4	Contains the V memory address of the Command Block used with the fourth set of command and status bits.

**NOTE:**

*The word numbers above assume that the module is logged in starting at WX1. If you log the module in at a different word number, the word numbers above will be offset accordingly.*

## Command Block

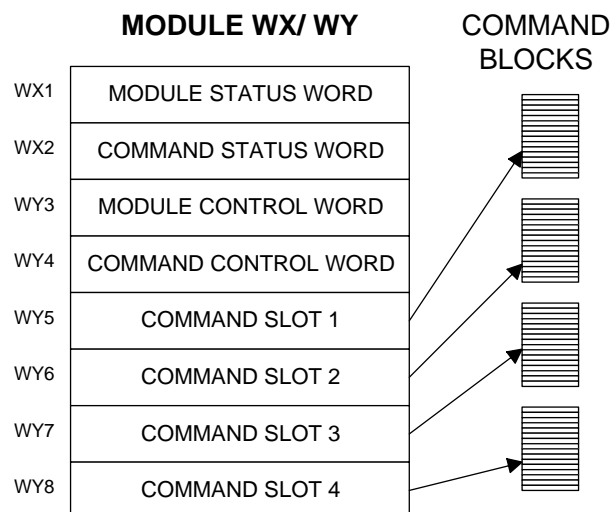
A Command Block is a contiguous group of V memory words used to store values which specify which module command that will be executed and how the command will be processed. For example, the Command Block for the *Word Transfer - Read Remote* command specifies:

- The command number,
- The connection number
- The beginning memory address in the remote PLC,
- The number of words to transfer,
- The beginning V memory address in the local PLC where the answer will be stored.

The exact content of the Command Block will vary with the command being issued. The Command Block is typically created in programming software such as TISOFT, and stored permanently in PLC V memory. Chapter 4 describes the Command Blocks used with the 2573-TCM2.

Figure 8 illustrates how the module WX/WY words and the command blocks are used together. The 2573-TCM2 controls the value in the WX words. WX1 contains bits which indicate module status. WX2 contains bits which indicate the status of command execution. For example, WX2 bits indicate the module is busy executing a command or that an error has occurred.

To use the module command interface, your PLC logic typically loads a Command Slot with the address of the desired command block. It then sets a corresponding trigger bit in WY4 to cause the



**Figure 8. 2573-TCM2 PLC Interface**

2573-TCM2 to execute the command. Your logic then monitors the condition of the command status bits to determine whether the command completed successfully. Please refer to *Appendix D* for additional information. Also, see Chapter 5 of this manual for examples that use the command interface.

*NOTE:*

*Although there is no direct correlation between the command slots and the module physical ports, most applications will usually use command slot 1 to control the protocol manager on Serial Port 1, command slot 2 to control the protocol manager on Serial Port 2, etc.*

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## CHAPTER 4. COMMAND BLOCKS

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### 4.1. Overview

This chapter describes the Command Blocks used to control 2573-TCM2 functions. These include Command Blocks to control the Task Code Master protocol manager and the CAMP Master Protocol Manager. The Command Blocks used with the General ASCII Support protocol manager are described in a separate publication, the *CTI General ASCII Support Protocol Manager Reference Manual*.

The command block illustrations show the contents in both Hexadecimal and Decimal (integer) format. You can enter and display values in either format using TISOFT or an equivalent program. The hexadecimal presentation format is usually used to display the error word.

*NOTE:*

*In the Command Block Description, a boldface entry in the value column designates a required value. Other entries are recommended values.*

Some of the Command Blocks allow you set a timeout value for executing the commands. The timeout represents the number of seconds that can elapse from starting the command until the command is completed. If the command has not been completed within the elapsed time, the 2573-TCM2 will suspend command processing and will set the CMD ERR bit. The protocol managers used with 2573-TCM2 have a default timeout of approximately 9 seconds. For most applications, you should use the default value.

All Command blocks must contain hex 4B in the high byte of offset 2. This signature byte is used to ensure that the reference V memory is actually a Command Block. This is why you will use Connection numbers such as 19221 decimal, which is 4B15 in hexadecimal notation.

## 4.2. Task Code Master Commands

### General Information

Using Task Code Master commands, you can transfer a block of V memory between a SIMATIC TI505 PLC with a 2573-TCM2 installed and another SIMATIC TI505 or TI500 PLC. When command block is triggered by the PLC, the 2573-TCM2 generates the applicable sequence of task codes required to read or write V memory in the remote PLC. The task codes are encoded in the Non-Intelligent Terminal Protocol (NITP) message format, which is supported by all SIMATIC TI505 and TI500 Series PLC program ports.

The Command Blocks allow you to transfer up to 256 words with a single command trigger; however, the NITP message format supports only 15 words per message. The 2573-TCM2 firmware accomplishes the transfer of more than 15 words by generating multiple NITP messages. Although this operation is transparent to the local PLC logic, transferring a large number of words may require a multiple scans. At baud rates of 9600 or above, the primary determination of the command completion time is the transfer performance of the attached PLCs. This performance is determined by the PLC scan time and other task code activity.

*NOTE:*

*When designing applications that transfer large amounts of V memory, you should carefully evaluate the response time to ensure that it meets your requirements. If you need to improve performance, you may wish to install a 2573-TCM2 in the remote PLC and use the Common ASCII Message Protocol (CAMP) protocol manager instead of the Task Code Master.*

### Create Connection Command

Normally, you will use the 2573-TCM2 DIP switches to configure a serial port for the Task Code Master protocol. However, you must use the CREATE CONNECTION command for the Task Code Master protocol if you wish to use the 2573 Modem Control Feature. To use this command, the serial port must have been configured as *PLC Select*.

This command starts a copy (instance) of the protocol manager and associates this copy with a physical port. After you have successfully completed this command, you then use the connection number to refer to this instance in all subsequent commands.

Assuming you have not created any previous connections or automatically started any protocol managers via dipswitch settings, you can create up to four connections (one for each physical port). Ensure that the physical port you select in offset 4 has been enabled for *PLC Select*. See the *2573-TCM2 Installation and Operation Guide*, Chapter 2, for information regarding switch settings.



Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command (Create Connection)	0001	1
2	Connection Number (19221 - 19299)		
3	Protocol Manager Number (Task Code Master)	0020	32
4	Physical Port Number (1,2,3,4)		
5	Port Baud Rate (300, 600, 1200, 2400, 4800, 9600, 19200)		
6	Bits Per Character (7 or 8)	0007	7
7	Parity (0=None, 1=Odd, 2= Even)	0001	1
8	Stop Bits (1 or 2)	0001	1
9	Handshake (0=None, 1=Software, 2=Hardware)	0000	0
10	Option Bits (0x0000 = None, 0x0001 = Modem)		
11	V memory address of Modem Configuration Table		
12-15	Unused - reserved for future use (Set to 0)	0000	0

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command for CREATE CONNECTION is 1.

Offset 2 *Connection Number* - Any valid number within the range 19221 to 19299 may be assigned as long as it has not been used previously. For clarity, you may wish to set the lower digit to match the physical port number (e.g. 19221 for port 1, 19222 for port 2).

Offset 3 *Protocol Manager Number* - Set to 32 (Hex 0020) to select the Task Code Master protocol manager.

Offset 4 *Physical Port Number* - Set to the physical port (1-4) you wish to use.

Offset 5-8 *Communications Parameters* - This must match the characteristics of your device. The values entered will override any switch settings on the module. NITP requires the following settings: Bits per Character =7, Parity = Odd, Stop Bits =1.

Offset 9 *Handshake*- Set to match your device requirements.

Offset 10 *Option Bits* - These are used to select special protocol manager options. Bit 16 is used to select the 2573 Modem Control Feature (see CHAPTER 6. 2573 MODEM CONTROL FEATURE). Other option bits are currently unused and should be set to 0.

Offset 11 *V Memory Address of Modem Configuration Table* - Used with the 2573 Modem Control Feature. See offset 10 above.

Offset 12-15 *Unused* - Reserved for future use. Set to 0.

*NOTE:*  
*If you have used the module dipswitches to start the Task Code Master protocol manager, you should not execute this command.*

### Close Connection Command

This command is used to close a connection that was previously created by a CREATE CONNECTION command. Once a connection has been closed, you can initiate another CREATE CONNECTION command which reuses the physical port and/or connection number.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command Code (Close Connection)	0002	02
2	Connection Number (19221 - 19299)		
3 - 15	Unused (Set to 0)	0000	0

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command for CLOSE CONNECTION is 2.

Offset 2 *Connection Number* - Enter the connection number you wish to close.

Offset 3-15 *Unused* - Set to 0.

## Write Remote PLC Memory

This function reads the contents of a block of V memory in the local PLC and writes the values in a block of V memory in the remote PLC. You can specify the starting V memory addresses on both the local and remote PLCs and the number of words to be transferred (up to 256 words). Based on the specification, the protocol manager reads the local V memory, generates NITP messages containing the applicable task code and data, and sends the message via the designated port. When the response is returned from the remote PLC, the protocol manager verifies that the task code was properly processed. If not, the protocol manager sets the applicable error bit and writes an error code to the Command Error Word.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command Code (Write Remote Memory)	0201	513
2	Connection Number (19201 - 19299)		
3	Source: Starting V Memory Address in this PLC		
4	Number of Words to Transfer (1-256)		
5	Destination: Starting V Memory Address in Remote PLC		
6	Command Timeout in seconds (0=Use Default)	0000	0
7-15	Unused (Set to 0)	0000	0

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command Code for WRITE REMOTE MEMORY is 513 decimal (0x0201).

Offset 2 *Connection Number* - If the Task Code Master protocol was initiated using a CREATE CONNECTION command, use the connection number that was established in that Command Block.

If the Task Code Master protocol was *automatically started* using the applicable module Dipswitch setting, the connection number entry in offset 2 should correspond to the 2573-TCM2 physical port number as follows:

Connection Number 19201 specifies the protocol manager started on serial port 1,  
 Connection Number 19202 specifies the protocol manager started on serial port 2,  
 Connection Number 19203 specifies the protocol manager started on serial port 3,  
 Connection Number 19204 specifies the protocol manager started on serial port 4.

Offset 3 *Source: Starting V Memory* - Enter the address of V memory in the local PLC which contains the first data value you want to transfer.

Offset 4 *Number of Words to Transfer* - Enter the number of words you want to transfer. For large transfers see the caution on performance on page 20.

Offset 5 *Destination: Starting V Memory* - Enter the beginning address of the V memory block in the remote PLC you want to update.

Offset 6 *Command Timeout in Seconds* - This is the time interval allowed to complete command processing. If the command has not completed within this interval, the protocol manager will return a timeout error. You should normally set this value to 0, indicating the default. The Task Code Master protocol manager default is approximately 9 seconds. A value greater than 999 specifies an infinite timeout.

## Read Remote PLC Memory

This function reads the contents of a block of V memory in the remote PLC and writes the values in a block of V memory in the local PLC. You can specify the starting V memory addresses on both the local and remote PLCs and the number of words to be transferred (up to 256 words). Based on the specification, the protocol manager generates NITP messages containing the applicable task code, verifies the response, and writes the data in local V memory. If an error is encountered, the protocol manager will set the applicable error bit and write an error code in the Command Error Word.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command Code (Read Remote Memory)	0202	514
2	Connection Number (19201 - 19299)		
3	Source: Starting V Memory Address in Remote PLC		
4	Number of Words to Transfer (1-256)		
5	Destination: Starting V Memory Address in this PLC		
6	Command Timeout in seconds (0=Use Default)	0000	0
7-15	Unused (Set to 0)	0000	0

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command Code for READ REMOTE MEMORY is 514 (hex 0202).

Offset 2 *Connection Number* - If the Task Code Master protocol was initiated using a CREATE CONNECTION command, use the connection number that was established in that Command Block.

If the task code master protocol was *automatically started* using the applicable module DIP switch setting, the connection number entry in offset 2 should correspond to the 2573-TCM2 physical port number as follows:

Connection Number 19201 specifies the protocol manager started on serial port 1,  
Connection Number 19202 specifies the protocol manager started on serial port 2,  
Connection Number 19203 specifies the protocol manager started on serial port 3,  
Connection Number 19204 specifies the protocol manager started on serial port 4.

Offset 3 *Source: Starting V Memory* - Enter the first V memory location in the remote PLC which contains the values which you want to transfer.

Offset 4 *Number of Words to Transfer* - Enter the number of words you want to transfer. For large transfers see note on performance on page 20.

Offset 5 *Destination: Starting V Memory* - Enter the beginning address of the V memory block in the local PLC you want to update.

Offset 6 *Command Timeout in Seconds* - This is the time interval allowed to complete command processing. If the command has not completed within this interval, the protocol manager will return a timeout error. You should normally set this value to 0, indicating the default. The Task Code Master protocol manager default is approximately 9 seconds. A value greater than 999 specifies an infinite timeout.

### 4.3. CAMP Commands

The CAMP protocol manager is used to transfer data between CTI communications modules. You may wish to use the CAMP Master rather than the Task Code Master protocol when:

- You are transferring data between SIMATIC Series 505 PLCs,
- Each PLC rack contains a 2573-TCM2 or compatible communications module,
- You are transferring larger amounts of data,
- Throughput is an important consideration.

Note that the memory transfer commands for CAMP are the same as the Task Code Master, except that a command which facilitates higher performance PLC memory exchange has been added.

#### Create Connection Command

This command starts a copy (instance) of the protocol manager and associates this copy with a physical port. After you have successfully completed this command, you then refer to this instance by the logical connection number in all subsequent commands.

Assuming you have not created any previous connections or automatically started any protocol managers via dipswitch settings, you can create up to four connections (one for each physical port).

Ensure that the physical port you select in offset 4 has been enabled for *PLC Select*. See Chapter 2 for information regarding switch settings.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command (Create Connection)	0001	1
2	Connection Number (19221 -- 19299)		
3	Protocol Manager Number (CAMP Master)	0024	36
4	Physical Port Number (1,2,3,4)		
5	Port Baud Rate (300, 600, 1200, 2400, 4800, 9600, 19200)		
6	Bits Per Character (7 or 8)	0007	7
7	Parity (0=None, 1=Odd, 2= Even)	0001	1
8	Stop Bits (1 or 2)	0001	1
9	Handshake (0=None, 1=Software, 2=Hardware)	0000	0
10	Option Bits (0x0000 = none, 0x0001 = Modem)		
11	V memory address of Modem Configuration Table		
12-15	Unused - reserved for future use (Set to 0)	0000	0

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command for CREATE CONNECTION is 1.

Offset 2 *Connection Number* - Any valid number within the range 19221 to 19299 may be assigned as long as it is has not been used previously. For clarity, you may wish to set the lower digit to match the physical port number (e.g. 19221 for port 1, 19222 for port 2).

Offset 3 *Protocol Manager Number* - Set to 36 (Hex 0024) to select the CAMP protocol manager.

Offset 4 *Physical Port Number* - Set to the physical port (1-4) you wish to use.

Offset 5-8 *Communications Parameters* - This must match the characteristics of your device. The values entered will override any switch settings on the module. CAMP requires the following settings: Bits per Character =7, Parity = Odd, Stop Bits =1.

Offset 9 *Handshake*- Set to match your device requirements.

Offset 10 *Option Bits* - These are used to select special protocol manager options. Bit 16 is used to select the 2573 Modem Control Feature (see CHAPTER 6. 2573 MODEM CONTROL FEATURE). Other option bits are currently unused and should be set to 0.

Offset 11 *V Memory Address of Modem Configuration Table* - Used with the 2573 Modem Control Feature. See offset 10 above.

Offset 12-15 *Unused* - Reserved for future use. Set to 0.

### Close Connection Command

This command is used to close a connection that was previously created by a CREATE CONNECTION command. Once a connection has been closed, you can initiate another CREATE CONNECTION command which reuses the physical port and/or connection number.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command Code (Close Connection)	0002	2
2	Connection Number (19221 - 19299)		
3 - 15	Unused (Set to 0)	0000	0

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command for CLOSE CONNECTION is 2.

Offset 2 *Connection Number* - Enter the connection number you wish to close.

Offset 3-15 *Unused* - Set to 0.

## Word Transfer - Write Remote

This function reads the contents of a block of V memory in the local PLC and writes the values in a block of memory in the PLC connected to the serial port (*remote PLC*). You can specify the starting memory addresses on both the local and remote PLC and the number of words to be transferred (up to 256 words). Based on the specification, the CAMP protocol manager reads the local V memory and sends a message containing the data to the 2573-TCM2 in the remote PLC rack. When the response message is returned, the CAMP protocol manager verifies the response. If there is an error, it places an error code in the Command Error Word and raises the applicable error bit.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command Code (Write Remote Memory)	0201	513
2	Connection Number (19221 - 19299)		
3	Source: Starting V Memory Address in this PLC		
4	Number of Words to Transfer (1-256)		
5	Destination: Starting V Memory Address in Remote PLC		
6	Command Timeout in seconds (0=Use Default)	0000	0
7-15	Unused (Set to 0)	0000	0

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command Code for WRITE REMOTE MEMORY is 513 decimal (hex 0201).

Offset 2 *Connection Number* - Use the connection number that was established in the CREATE CONNECTION command block.

Offset 3 *Source: Starting V Memory* - Enter the address of V memory in the local PLC which contains the first data value you want to transfer.

Offset 4 *Number of Words to Transfer* - Enter the number of words you want to transfer.

Offset 5 *Destination: Starting V Memory* - Enter the beginning address of the V memory block in the remote PLC you want to update.

Offset 6 *Command Timeout in seconds* - You should normally set this value to 0, indicating the default. The CAMP protocol manager default is approximately 9 seconds. A value of 999 specifies an infinite timeout.



## Word Transfer - Read Remote

This function reads the contents of a block of V memory in a PLC attached to the serial port (remote PLC) and writes the values in a block of V memory in the local PLC. You can specify the starting V memory addresses on both the local and remote PLCs and the number of words to be transferred (up to 256 words). Based on the specification, the CAMP protocol manager sends a message requesting the data to the remote PLC connected to the serial port. When the response message is returned, the CAMP protocol manager verifies the response and, if there is no error, writes the data in local V memory. If an error is encountered, it will set the applicable error bit and write the error code into the Command Error Word.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command Code (Read Remote Memory)	0202	514
2	Connection Number (19221 - 19299)		
3	Source: Starting V Memory Address in Remote PLC		
4	Number of Words to Transfer (1-256)		
5	Destination: Starting V Memory Address in this PLC		
6	Command Timeout in seconds (0=Use Default)	0000	0
7-15	Unused (Set to 0)	0000	0

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command Code for READ REMOTE MEMORY is 514 (hex 0202).

Offset 2 *Connection Number* - Use the connection number that was established in the CREATE CONNECTION command block.

Offset 3 *Source: Starting V Memory* - Enter the first V memory location in the *remote* PLC which contains the values you wish to read.

Offset 4 *Number of Words to Transfer* - Enter the number of words you want to read.

Offset 5 *Destination: Starting V Memory* - Enter the beginning address of the V memory block in the *local* PLC you want to update.

Offset 6 *Command Timeout in seconds* - You should normally set this value to 0, indicating the default. The CAMP protocol manager default is approximately 9 seconds. A value of 999 specifies an infinite timeout.

## Word Transfer - Memory Exchange (Firmware V4.8 and above)

This function is a combination of the Write Remote and Read Remote commands. As the name implies, it is intended to be used in applications that exchange values between two PLCs. The command writes the contents of a block of local PLC V memory to a block of memory in the remote PLC, then reads a block of V memory in the remote PLC and writes the values to a block of V memory in the local PLC. Since this is accomplished in one transaction, it is much faster than executing separate read and write commands.

You can specify the locations of the V memory blocks in both PLCs, the number of words to be written to the remote PLC, and the number of words to be read from the remote PLC. When the command is triggered, the CAMP protocol manager sends a message containing the data to be written to the remote PLC. When the response message is returned, the CAMP protocol manager verifies the response and, if there is no error, writes the data in local V memory. If an error is encountered, it will set the applicable error bit and write the error code into the Command Error Word.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command Code (Memory Exchange)	0203	515
2	Connection Number (19221 - 19299)		
3	Write Source: Starting V Memory Address in Remote PLC		
4	Number of Words to Write (1-254)		
5	Write Destination: Starting V Memory Address in Local PLC		
6	Command Timeout in seconds (0=Use Default)	0000	0
7	Read Source: Starting V Memory Address in Remote PLC		
8	Number of Words to Read (1-256)		
9	Read Destination: Starting V Memory Address in Local PLC.		
10 - 15	Unused (Set to 0)	0000	0

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command Code for READ REMOTE MEMORY is 515 (hex 0202).

Offset 2 *Connection Number* - Use the connection number that was established in the CREATE CONNECTION command block.

Offset 3 *Write Source: Starting V Memory* - Enter the beginning address of the V memory block in the remote PLC which contains the values which you wish to write to the local PLC.

Offset 4 *Number of Words to Transfer* - Enter the number of words you want to write.

Offset 5 *Write Destination: Starting V Memory* - Enter the first V memory location in the *local* PLC to which you want to write this data.

Offset 6 *Command Timeout in seconds* - You should normally set this value to 0, indicating the default. The CAMP protocol manager default is approximately 9 seconds. A value of 999 specifies an infinite timeout.

Offset 7 *Read Source: Starting V Memory* - Enter the first V memory location in the *remote* PLC from which you wish to read data.

Offset 8 *Number of Words to Transfer* - Enter the number of words you want to read.

Offset 9 *Write Destination: Starting V Memory* - Enter the beginning address of the V memory block in the *local* PLC to which you want to write this data.



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## CHAPTER 5. APPLICATION EXAMPLES

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### 5.1. General Comments

The following examples illustrate how you can use the 2573-TCM2 in a variety of typical applications. The first example, NITP/CAMP Slave, does not require PLC logic. The second example, Task Code Master, illustrates how to use a protocol manager that is automatically started but requires PLC logic to initiate messages. The third example, CAMP Master, shows how to use a protocol manager that must be initialized using PLC logic and requires PLC logic to initiate messages.

These examples assume that you have the 2573 logged in starting at WX1. Therefore, the module will use words 1 - 8 as follows:

WX1	Module Status Word	WY5	Command Slot 1
WX2	Command Status Word	WY6	Command Slot 2
WX3	Module Control Word	WY7	Command Slot 3
WX4	Command Control Word	WY8	Command Slot 4.

See the *WX/WY Quick Reference* in Appendix C on page 98 of this manual for an illustration of word use. Note that the four groups of Command Status bits and Command Control bits correspond to the four command slots. In these examples:

- WX2.1 - WX2.4 and WY4.1 - WY4.4 are used with Command Slot 1 (WY5),
- WX2.5 - WX2.8 and WY4.5 - WY4.8 are used with Command Slot 2 (WY6),
- WX2.9 - WX2.12 and WY4.9 - WY4.12 are used with Command Slot 3 (WY7),
- WX2.13- WX2.16 and WY4.13 - WY4.16 are used with Command Slot 4 (WY8).

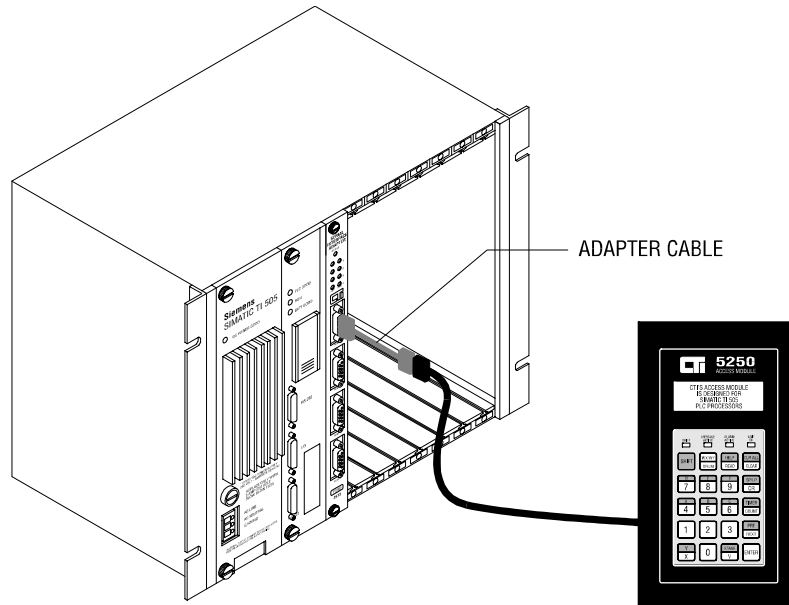
For complete details, refer to *Appendix D*.

These examples use the command slots so that the slot number corresponds to the physical port number. For example, Command Slot 2 is used for commands to the protocol manager running on physical port 2 and Command Slot 3 is used for commands to the protocol manager running on physical port 3. Although any command slot can be used for any port, this is a useful convention that helps you keep track of your application logic.

Although these examples show ladder logic, you can trigger the command block execution manually. See Chapter 7 for manual triggering techniques. To observe the action of the commands, you will probably want to create a TISOFT (or equivalent) chart. See the example in Chapter 7 as a guide.

## 5.2. NITP/CAMP Slave

This application configures a 2573-TCM2 port as a slave port for devices that use either the NITP (task code) or CAMP protocol. This allows you to connect operator interfaces such as the CTI 5250-TI5.



**Figure 9. TCAM to 2573-TCM2**

In slave mode, the protocol manager for the serial port will accept and validate incoming NITP or CAMP messages. For NITP, the module will then transfer the task code commands and data directly from the message to the PLC via the backplane. For CAMP, the module will construct the applicable PLC command(s) and transfer the command and data to the PLC via the backplane. When the PLC responds, the 2573-TCM2 will build the applicable response message and send it via the serial port.

To configure port 1 for a NITP/CAMP Slave with a baud rate of 9600 and no hardware shaking, you would set all dipswitches for port 1 (on switchblock SW1) to the *off* position. See information in Chapter 2, beginning on page 6 for details. With this switch setting, when the 2573-TCM2 is powered on, Serial Port 1 will function as a NITP/CAMP slave. No PLC logic is required.

If you use the standard TCAM cable, you will need to construct an adapter cable. See Appendix A for further information on building cables.

### 5.3. Task Code Master

In this example, you will use a 2573-TCM2 port to communicate with a remote SIMATIC TI505 Series PLC via the serial port. Although the example illustrates use of the PLC RS-232 serial port, you could use RS-422 communications instead. See Appendix A for information on construction of the appropriate cable. Your local PLC logic will cause the 2573-TCM2 to generate task codes which will read data from the remote PLC V memory and place the results in local PLC V memory.

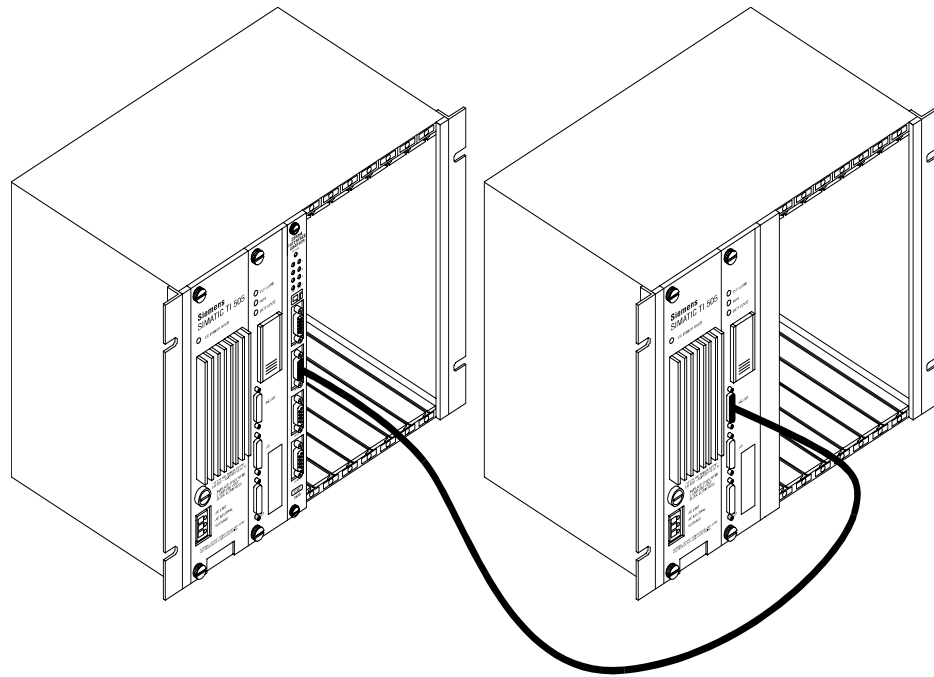


FIG. 10. 2573-TCM2 PORT RS-232 CONNECTION

**NOTE:**

*You can simulate the remote PLC by cabling to the programming port of the local PLC or to a serial port of the 2573-TCM2 configured as a NITP/CAMP slave.*

This example will use the same baud rate and hardware handshake settings as the previous one. However, it will use a different port (port 2) and select a different protocol manager (the Task Code Master) using the module dipswitches.

First, ensure that all dipswitches for port 2 (Switchblock SW2) are set to the off position (see Chapter 2, page 6). Then refer to Figure 3 on page 8 to set the protocol to Task Code Master. With this switch setting, when the 2573-TCM2 is powered on, serial port 2 will act as a Task Code Master.

### Command Block- Task Code Master Example

To use the Task Code Master, you will need to create some PLC logic. First, use a program such as TISOFT to store the command block in V memory. This example assumes that you will store the command block in V memory, starting at V100.

Location	Description	Decimal Value
V100	Command Error Word	0
V101	Command Code (Read Remote Memory)	514
V102	Connection Number (19202)	19202
V103	Source: Starting V Memory Address in Remote PLC	400
V104	Number of Words to Transfer (1-256)	25
V105	Destination: Starting V Memory Address in this PLC	500
V106	Command Timeout in seconds (0=Use Default)	0
V107-V115	Unused (Set to 0)	0

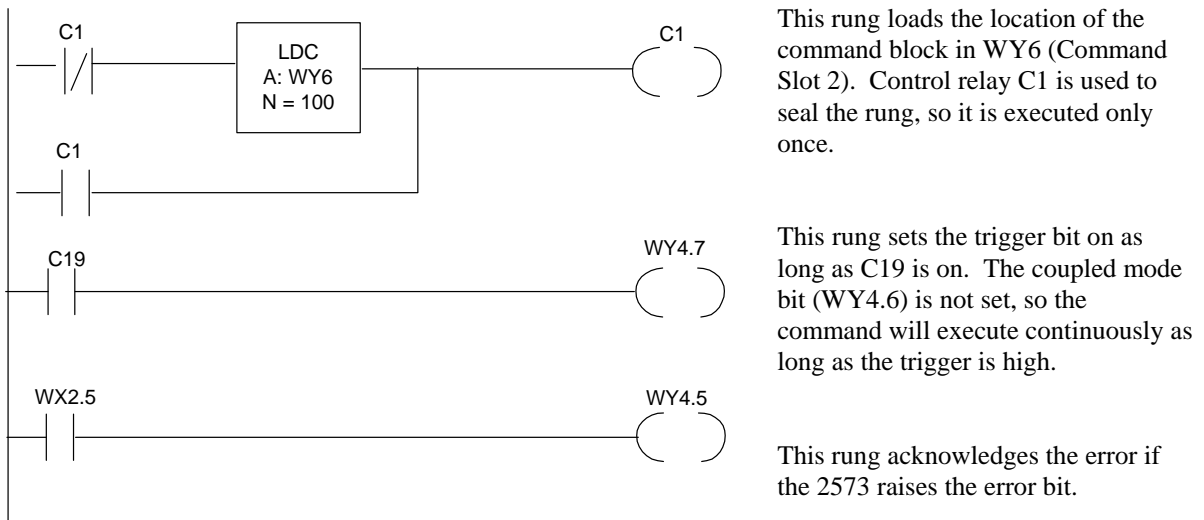
The command block above, when triggered by the PLC, will cause the 2573-TCM2 to read a block of 25 words from the remote PLC V memory (V400-V424) and to place the results in V500-V524 in the local PLC. Since you used the dip switch to start the protocol manager on port 2, the Connection Number is 19202. See Chapter 4, page 24, for details on the command block.



## PLC Logic - Task Code Master Example

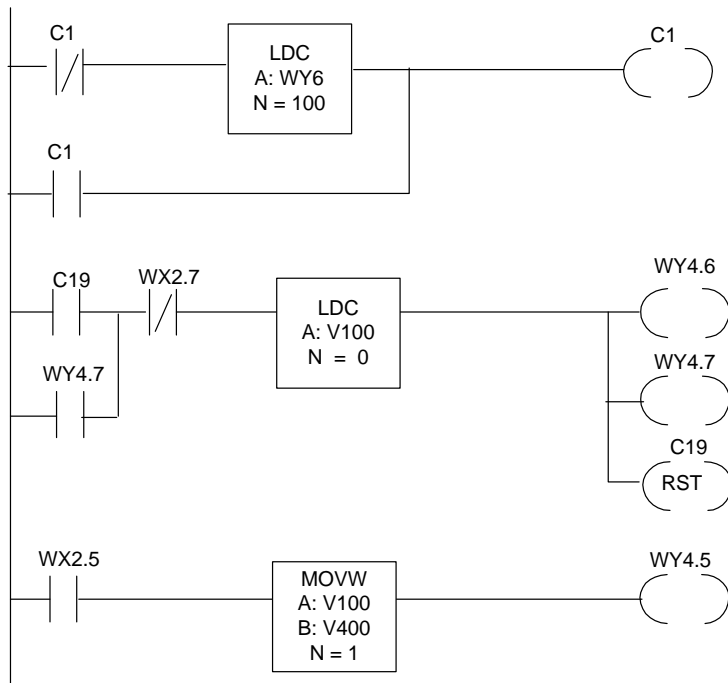
Once you have stored the command block in V memory, you will need to add some PLC logic to cause the 2573-TCM2 to actually execute the command. The following ladder logic example will load the address of the command block in WY6 (Command Slot 2) and then trigger the command. It is typical of how you might use an uncoupled mode trigger.

In this example, the 2573-TCM2 will execute the command as fast as possible as long as the enabling control relay (C19) is on. You might use this mode when you want to continuously update the PLC. The example logic simply acknowledges any errors, without implementing any other error processing logic. Acknowledging the error, by raising WY4.5 when the module raises WX2.5, will cause the 2573-TCM2 to lower the Command Error bit (WX2.5) and the Command Busy bit (WX2.7). If the trigger bit (WY4.7) is set, the module will attempt to re-execute the command.



The example above will cause the module to execute the command continuously. However, there are many applications where you want the command to execute only once per trigger. This requires the use of coupled mode. In coupled mode, the module will execute the command once when you raise the trigger. After you raise the trigger, you must lower it and then raise it before the command will execute again. See the *Appendix D* for additional information.

The following ladder example uses coupled mode. The second rung is typical of how you should structure all coupled mode trigger rungs. The example also shows how you could keep the last command error word encountered in a special V memory location.



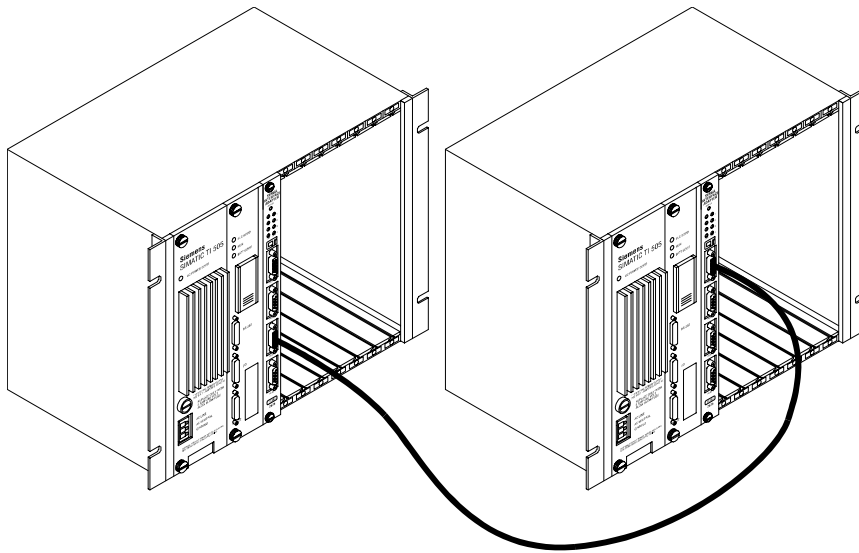
This rung loads the address of the command block in WY6.

This rung illustrates a coupled mode trigger. Note that the mode bit (WY4.6) is set as well as the trigger bit (WY4.7). These bits will be set when C19 is on and Command Busy (WX2.7) is off. After the trigger is set, WY4.7 will hold the bits high on subsequent scans until the Command Busy bit comes on. When the trigger is turned on, C19 is reset, preventing re-triggering for the same event. This rung also clears the error word.

When the command error bit is set, this rung stores the command error word and acknowledges the error.

## 5.4. CAMP Master

This example illustrates how you could use the CAMP Master protocol manager to exchange data between two PLCs. Both PLCs are assumed to have a 2573 installed. A serial cable is connected between port 3 of the local 2573-TCM2 to port 1 of the remote 2573. See Appendix A for instructions on building cables.



*Figure 11. 2573-TCM2 to 2573-TCM2*

The 2573-TCM2 in the *remote* PLC should have serial port 1 configured for the NITP/CAMP slave protocol manager (See example 1). Port 3 of the *local* 2573-TCM2 should be configured for PLC SELECT. See Figure 3. Port Protocol Settings, on page 8. Since you are using the PLC SELECT setting, the switch settings for baud rate and handshake are ignored.

**NOTE:**

*You can simulate the remote PLC by connecting a cable from port 3 to another port on the same 2573-TCM2 which has been configured for the NITP/CAMP Slave protocol.*

## Command Blocks- CAMP Master Example

Since the port is configured for PLC SELECT, you must use a CREATE CONNECTION command block to start the protocol manager. This command block is assumed begin at V200.

Location	Description	Decimal Value
V200	Command Error Word	0
V201	Command (Create Connection)	1
V202	Connection Number (19223)	19223
V203	Protocol Manager Number (CAMP Master)	36
V204	Physical Port Number (1,2,3,4)	3
V205	Port Baud Rate (9600)	9600
V206	Bits Per Character (7)	7
V207	Parity (1=Odd)	1
V208	Stop Bits (1)	1
V209	Handshake (0=None)	0
V210 - 211	Option Bits (0=None)	0
V211	Modem Configuration Table Address (not used)	0
V212 -V215	Reserved for future use (Set to 0)	0

Although the connection number 19223 was chosen, you can pick any number in the allowable range of 19221-19299 that has not been used previously by another CREATE CONNECTION command.

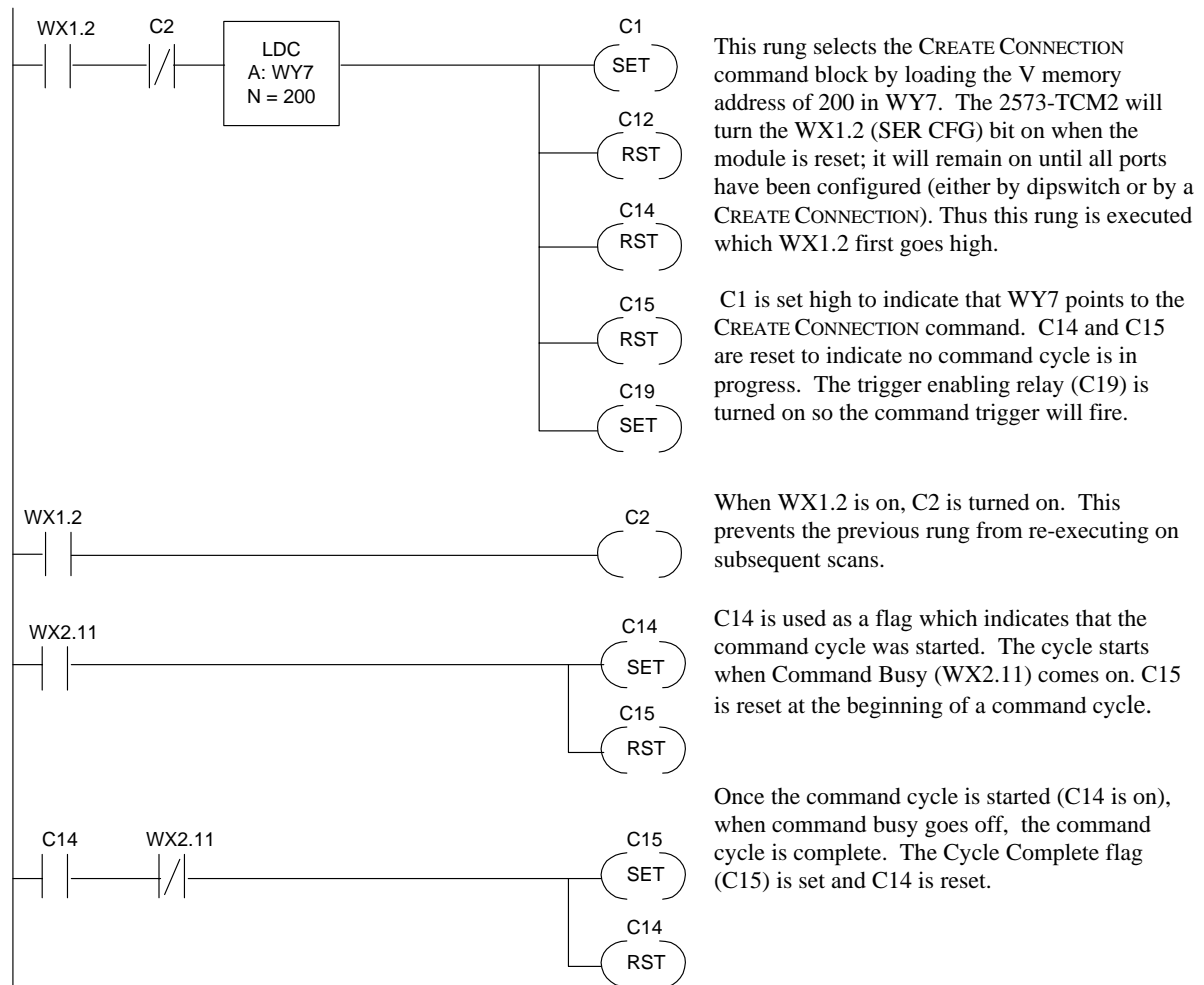
The following command block is used to write a block of 100 words stored in V500-599 to V600-699 in the remote PLC, then reads a block of 150 words stored at V700-849 in the remote PLC and writes these values to V700-849 in the local PLC.

Location	Description	Decimal Value
V220	Command Error Word	0
V221	Command Code (Memory Exchange)	515
V222	Connection Number (19221 - 19299)	19223
V223	Write Source: Starting V Memory Address in Remote PLC	500
V224	Number of Words to Write (1-254)	100
V225	Write Destination: Starting V Memory Address in Local PLC	600
V226	Command Timeout in seconds (0=Use Default)	0
V227	Read Source: Starting V Memory Address in Remote PLC	700
V228	Number of Words to Read (1-256)	150
V229	Read Destination: Starting V Memory Address in Local PLC.	700
V230- V235	Unused (Set to 0)	0

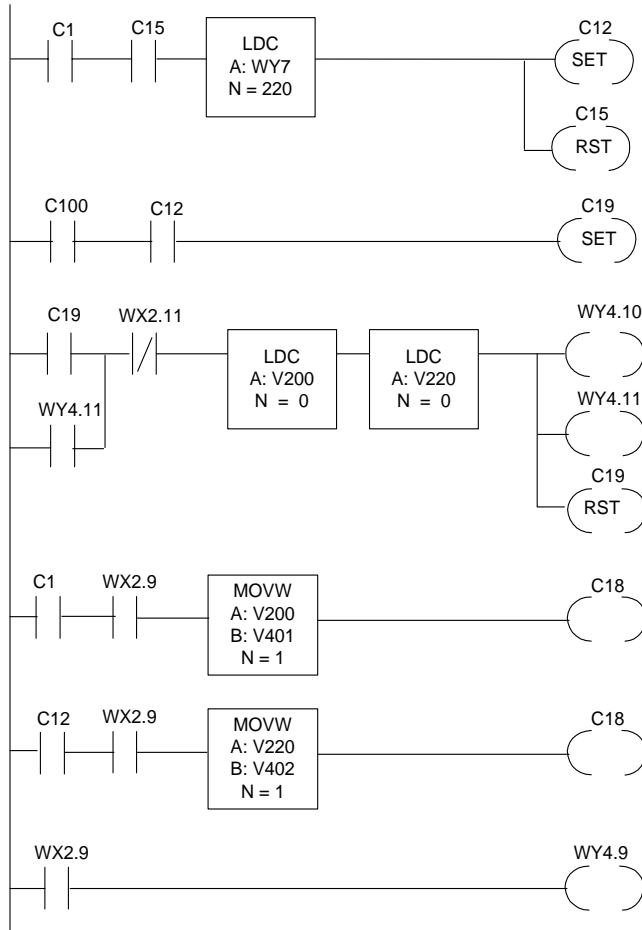
## PLC Logic - CAMP Master Example

This example shows typical PLC logic used when the PLC SELECT dipswitch option is selected. You must execute a CREATE CONNECTION command to start the protocol manager as well as a MEMORY TRANSFER command to communicate the data. Command Slot 3 (WY7) is used for both commands. The particular command to be executed is determined by the value loaded into WY7. If 200 is loaded, then the CREATE CONNECTION command block at V200 will be selected; if 220 is loaded, then the MEMORY EXCHANGE command block at V220 will be selected.

The logic must first execute the CREATE CONNECTION command before it can execute any MEMORY EXCHANGE commands. To determine when to load the address of the MEMORY EXCHANGE command, you must recognize that a command cycle completed while WY7 contained the address of the CREATE CONNECTION command. A command cycle is completed when Command Busy (WX2.11) goes high and *then* goes low. C14 and C15 track this event. C1 is set when WY7 points to V200, C12 is set when WY7 points to V220. See the *Appendix D* for related timing diagrams.



## PLC Logic Example (Continued)



If C1 is on, then WY7 contains the address of the CREATE CONNECTION command block. When C15 is on, the module has completed a command cycle. When both events are true, you are ready for the MEMORY EXCHANGE command. This rung load WY7 with the address of this command block (V220), sets C12 to indicate this, and reset the Cycle Complete flag (C15).

This rung is used to enable the trigger for the memory read command, assuming that other logic sets C100 when a particular event happens.

This rung is the command trigger for coupled mode. It works exactly like the one in the previous example except that the Command Error words in both Command Blocks are cleared.

If an error occurs (WX2.9 is on) and the CREATE CONNECTION command is executing (C1 is on), this copies the Command Error Word to another V memory location.

This rung performs a function similar to the rung above for errors that occur when executing the MEMORY EXCHANGE Memory command (C12 is on).

This rung raises ERR ACK (WY4.9) when the command error (WY2.9) is raised. When the error is acknowledged, the 2573 will lower command busy and command error. You can then trigger a new command.

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## CHAPTER 6. 2573 MODEM CONTROL FEATURE

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### 6.1. Overview

Modems provide a means for transmitting data across voice grade telephone lines. They operate by modulating digital signals into a series of tones at the transmitting end and de-modulating the tones back into digital signals at the receiving end. When a modem is in *data mode*, characters sent to the modem serial port are transmitted via the telephone line.

Most modern modems can also operate in *command mode*. In this mode, characters sent to the serial port are interpreted as commands to the modem rather than data to be sent out the wire. Some commands may configure the modem while others may cause the modem to dial a number or to hang up a connection.

When your application requires a modem and the PLC is the answering location, you can simply use an auto-answer modem attached to the serial port of CTI communications module or to the program port of the PLC; no unique PLC support is required. However, when the PLC must *initiate* the dial-up connection, special support is required to enable the PLC to control the modem. The CTI 2573-TCM2 provides this support via a facility known as the 2573 Modem Control Feature. This feature is available in firmware versions 4.3 and above.

Using the 2573 Modem Control Feature you may:

1. Use PLC logic to establish a dial-up modem connection for sending and receiving data;
2. Use PLC logic to establish a dial-up modem connection and send DTMF\* signals;
3. Use PLC logic to hang up the modem connection;
4. Configure the 2573 to automatically establish a modem connection before sending data;
5. Configure the 2573 to automatically hang up a modem connection after a specified period with no data traffic.

**NOTE:**

*\* DTMF stands for Dial Tone Multi-Frequency. DTMF is commonly referred to as tone dialing. Button phones use tone dialing. Rotary phones typically use pulse dialing.*

The 2573 Modem Control Feature may be used with the NITP (Task Code) Master, CAMP Master, and GAS (General ASCII Support) protocol managers. The 2573 Modem Control Feature is selected by entries in offset 10 and 11 of the CREATE CONNECTION command block.

Once the modem connection is established, the protocol managers use their standard commands to send and receive messages using the protocol manager message format. For example, the CAMP Master protocol manager would send messages using the CAMP protocol. The GAS protocol manager may send messages as configured by the user.

The 2573 Modem Control Feature uses the “AT” modem commands to control the modem. Originally used on modems manufactured by the Hayes corporation, the “AT” command set has become the de-facto standard for modem control. These commands allow you to control the modem operation, including establishing and terminating switched line connections. For example, when dialing a number you may specify a fully qualified number, including access code, area code, and local number as well as characters which cause the modem to wait for dial tones or pause for switching equipment delays.

**NOTE:**

*The following two modems have been fully tested and are supported by CTI: Hayes Accura 144 and Hayes Optima 288. Other models and brands, even ones termed “Hayes compatible”, may not function correctly with the Modem Control Feature. Contact CTI concerning the use of any other modems.*

## **Manual Mode**

The 2573 Modem Control Feature allows PLC logic to initiate the following functions:

1. Cause the modem to go off hook and to dial a sequence based on a string of ASCII characters stored in PLC V memory. If the modem cannot make the connection because there is no local dial tone, the line is busy, or there is no answer after a specified time, the user logic will be notified via the standard 257x error reporting structure with unique error codes. Switching between Pulse Dial and DTMF can be done via a character in the dial string.
2. Hang up the modem and place the modem in the default state as defined by the Modem Configuration Table and the 2573 Modem Control Feature defaults.

The modem connection is established by using a DIAL command. A HANG-UP command is used to terminate the modem connection. Should the connection be lost, the protocol manager will return an error to the PLC logic when an attempt is made to send a message. The PLC logic is responsible for re-establishing the connection.

## **Auto-Dial Mode**

In the autodial mode, the PLC logic is not required to trigger a DIAL command. The 2573 Modem Control Feature will determine whether to initiate a dial connection when the PLC logic attempts to send a message.

If the modem carrier is present, the message will be sent immediately. If there is no modem connection, the 2573 Modem Control Feature will attempt to make the connection based on a default dial string stored in V memory. If the connection is successful, the message will be sent, else an error code will be returned to the PLC logic in the command block.



If no data has been sent or received via the modem link after a user specified time period, the protocol manager will hang up the connection (Auto Hang-Up). Alternately, PLC logic may explicitly issue a hang up command.

## 6.2. Modem Setup

When the 2573 Modem Control Feature is initiated, it will attempt to set the modem to the following:

Result Codes in Verbose Mode  
Ignore DTR  
Always Assert DSR.  
Suppress Echo

If possible, you should use the modem's configuration program to set the modem defaults to this configuration. In addition, you should set the modem default configuration to force a fixed baud rate between the modem and the 2573.

**NOTE:**

*Some modems change the baud rate "on the fly" when data line communications rates change. The 2573 firmware does not support variable baud rates. Therefore, you must set the modem default to fixed baud rate or you may experience intermittent failures and data errors.*

The cable between the modem and the 2573 serial port should not connect DTR and DSR signal lines. See Figure 13 in the module Installation and Operation Guide for an example of a cable that connects only transmit, receive, and ground.

### Modem Configuration Table

The 2573 Modem Control Feature uses a block of V memory for a Modem Configuration Table. This table contains certain default parameters which will be used by the 2573 Modem Control Feature. It must be stored in V memory before the 2573 Modem Control Feature can be initiated. The Modem Configuration Table is read when the CREATE CONNECTION command is executed.

The Modem Configuration Table has the following structure:

Offset	Description
0	Signature Value
1	Reserved for Future Use. Set this value to 0.
2	Auto Answer Rings (0 - 9) (0 = No Auto Answer)
3	Auto-Dial Selection (0 = Manual Dial, 1 = Auto Dial)
4	Modem Option Flag Bits 1 - 13 (Unused) Bit 14: Busy Detection (0 = Enabled, 1 = Disabled) Bit 15: Dial Tone Detection (0 = Enabled, 1 = Disabled) Bit 16 - Default Dial Method (0 = DTMF, 1 = Pulse Dial).
5	Auto Hang-Up Timeout in Seconds (0 = No auto hang-up)
6	V Memory Address of Default Dial String
7	Autodial Timeout in Seconds
8 - 15	Reserved for Future Use (Set these values to 0)

Offset 0 *Signature Word*. The signature word is a unique number which identifies the start of a Modem Configuration Table. It is used to help ensure that the correct memory block is referenced. It is the ASCII equivalent of the letters AT (0x4154)

Offset 1 *Reserved*. You should set this value to 0.

Offset 2 *Auto Answer Rings*. This word specifies the number of rings before the modem will auto answer. If this value is non-zero, the modem will be placed in auto answer mode after a Hang-Up command has been executed. ***This value should be set to 0 unless you explicitly need to support both dial-up and auto answer on this line.***

**NOTE:**

*Auto-answer is not supported by the Task Code Master or the CAMP Master protocol managers. When using the auto-answer mode on the same line as dial-out, it is possible to place some modems in a state from which the 2573 cannot command a recovery. To minimize the chance of this occurrence, you must set the attention guard band value (S register 12) to a value of 0. See the documentation for your modem.*

Offset 3 *Auto-Dial Option*. Selects the automatic dial option. If the value is set to 0, PLC logic must explicitly establish the dial-up connection. If the value is set to 1, then the 2573 will automatically attempt to make the connection using information stored in the Modem Configuration Table.

Offset 4 *Modem Option Bits*. This word contains bits that specify certain modem defaults. The lower bit (bit 16) determines the default dial mode (tone or pulse). In manual dial mode, you may override the defaults in the Dial command block.

Offset 5 *Auto Hang-Up Timeout*. This word used to specify that the 2573 should issue a HANG-UP command if no messages have been sent or received within the timeout interval. A value of 0 specifies the default value of no Auto Hang-Up. The maximum value is 3600 seconds; the minimum non-zero value is 60 seconds. Auto Hang-Up timeout applies to both Auto-Dial and Manual Dial modes.

Offset 6 *Dial string V Memory Address*. This value is the address of the V memory word that contains the first character of the dial string. It must be greater than 0 if AUTO-DIAL is selected in offset 3 of the Modem Configuration Table. The dial string must contain only valid digits and the special characters listed in the following section of this manual. Since the dial string is variable length, the dial string must be enclosed in ASCII double quote marks.

**NOTE**

*Other required modem control characters, including the AT header, progress monitoring modifier, and command state modifier, will be inserted by the 2573 Modem Control Feature.*

**NOTE:**

*If you use the standard ASCII entry format of TISOFT, the characters will be stored in this sequence.*

The maximum length of the dial string is 64 characters. Some older modems allow only 40 characters. You must ensure that you avoid exceeding the modem limit.

Offset 7 *Autodial Timeout*. This sets the timeout for the AUTODIAL function in seconds. Minimum value is 30 seconds. 0 = 2573 default of 30 seconds.

**NOTE:**

*In Auto-Dial mode, this timeout value is added to the timeout value specified for the protocol manager command.*

Offset 8 - 15 *Reserved*. Reserved for future use (ignored by this release). You should set these words to 0.

## Dial Strings

Dial strings are a sequence of characters which are sent to the modem. The dial strings indicate the sequence of numbers to be dialed and control how the numbers are dialed. The dial string may consist of the ASCII characters 0 - 9 (0x30 - 0x39), \* (0x2A), # (0x23), and other characters as described below. Dial strings are stored in PLC V memory and must be enclosed in double quote marks (0x22).

## Dial Modifier Characters

Dial modifier characters control the transmission of the dial characters. The following dial modifier characters are supported.

ASCII Char	Hex Value	Description	Use
,	(0x2C)	Calibrated Pause	Pauses two seconds before continuing with the dial string. For longer pauses you may use multiple consecutive commas.
R	(0x52)	Reverse Mode of Operation	This allows you to originate a call, then go into answer mode. Used when communicating with an "originate only" modem, a vanishing breed. This modifier should be used with caution.
!	(0x21)	Switch Hook Flash	Simulates a quick cycling of the switchhook. Some switchboard systems react to the flash to transfer to a specific extension.
@	(0x40)	Wait for Silence	This waits for one or more ringbacks followed by a 5 second period of silence. It is used for accessing systems that do not provide a dial tone.
P	(0x50)	Pulse Dialing	Sets pulse dialing mode. Pulse dialing is a method used by rotary-dial telephones. Dial characters following the P will be sent using pulse dial.
T	(0x54)	Tone Dialing	Sets the tone dialing mode. Tone dialing is a method used by push-button (touch tone) phones. This is also called DTMF (dual tone multi frequency). Dial characters following the D will be sent using tone dial.
W	(0x57)	Wait for Additional Dial Tone	The modem will automatically wait for the first dial tone before proceeding. This modifier will cause the modem to wait for a second dial tone before proceeding. This is commonly used when you must route through a local switchboard. This modifier will not work if dial tone detection is disabled.
\$	(0x24)	Wait for Credit Card Tone  (Supported by some modems).	This will cause the modem to wait for the AT&T "calling card" tone before proceeding. Check your modem documentation to determine support.

## Miscellaneous Control Characters

The following characters may be embedded into the dial string to control modem functions.

ASCII Char	Hex Value	Description	Use
L	(0x4C)	Speaker Volume Control L0 = off or very low L1 = Low L2 = Medium L3 = High	Sets the volume of the modem speaker.  You may wish to set this parameter default manually (using the modem setup software) rather than controlling it in the dial string.
M	(0x4D)	Speaker Control M0 = Always Off M1 = On until carrier link is established. M2 = Always On M3 = On except during dialing, then on until carrier is established.	Controls when the speaker is enabled.  The audio signal from the speaker can be used to monitor call progress.  The 2573 Modem Control Feature will default to M1 if no value is included in the dial string.
&J	(0x264A)	Auxiliary Relay Control	This is used to turn on/off an auxiliary relay. Some radio modems may require this relay to turn on the transmitter before sending.

Alphabetic characters may be entered in upper or lower case. You may insert the following characters in the dial string for readability.

Character	Description	Hex Equivalent
(	Left Parenthesis	0x28
)	Right Parentheses	0x29
-	Dash	0x2D
.	Period	0X2E
	Space	0x20

If a character other than those indicated in the sections above appears in the dial string, the protocol manager will return an error code (invalid dial string).

## Example Dial Strings

To dial the area code 423 and the number 584-0440, you could use one of the following:

"4235840440" or "423-584-0440" or "(423)-584-0440".

"9,,1-800-537-8398" will dial a 9 (access to the switchboard), wait 4 seconds, then continue the dial. You could also use the following dial string: "9W1-800-537-8398" to accomplish the same thing, where the W waits for a second dial tone.

## 6.3. Command Blocks

### Create Connection

The CREATE CONNECTION command block is used to start a protocol manager on a specific serial port. For the protocol managers which implement the 2573 Modem Control Feature, the standard command block has been extended to make use of offsets 10 and 11. If the low bit (bit 16) of Offset 10 is 1, the Modem Configuration Table pointed to by Offset 11 is read. See CHAPTER 4. COMMAND BLOCKS for additional information on using the CREATE CONNECTION command with a specific protocol manager.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command (Create Connection)	0001	
2	Connection Number (19221 -- 19299)		
3	Protocol Manager Number		
4	Physical Port Number (1,2,3, or 4)		
5	Port Baud Rate (300, 600, 1200, 2400, 4800, 9600, 19200)		
6	Bits Per Character (7 or 8)		
7	Parity (0 = none, 1 = Odd, 2 = Even)		
8	Stop Bits (1 or 2)		
9	Handshake (0=none, 1= Software, 2 = Hardware). <i>If you choose handshaking, you must manually configure the modem to use it.</i>		
10	Special Option Bits (0x0000 = None, 0x0001 = Modem) Bit 16 must be set to indicate modem use. Table referenced in offset 11 will be read if bit is set.		
11	V Memory Address of Modem Configuration Table		
12 - 15	Reserved		

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command for CREATE CONNECTION is 1.

Offset 2 *Connection Number* - Any valid number within the range 19221 to 19299 may be assigned as long as it has not been used previously. For clarity, you may wish to set the lower digit to match the physical port number (e.g. 19221 for port 1, 19222 for port 2).

Offset 3 *Protocol Manager Number* - Set to 36 (Hex 0024) to select the CAMP Master protocol manager. Set to 38 (Hex 0026) to select the GAS protocol manager. Set to 32 (Hex 0020) to select the NITP (Task Code) Master protocol manager.

Offset 4 *Physical Port Number* - Set to the physical port (1-4) you wish to use.

Offset 5-8 *Communications Parameters* - This must match the characteristics of the remote device. CAMP and Task Code Master protocols require the following settings: Bits per Character = 7, Parity = Odd, Stop Bits = 1. GAS may be set to any value which matches the attached device.

Offset 9 *Handshake*- This allows you to select the method of flow control. Unless you have a special requirement, you should set this value to 0, no handshake.

**NOTE:**

*The use of handshaking with a modem can be complex, since several implementations of handshaking may be available, including "passing through" software handshake to the remote device. For this reason, if you choose to use handshaking, you must manually configure the modem to default to the handshake option you wish to use.*

Offset 10 *Option Bits* - Set low order bit (bit 16) to 1 to select the 2573 Modem Control Feature. When this bit is set, offset 11 must contain a valid address for the Modem Configuration Table.

Offset 11 *V Memory Address of the Modem Configuration Table* - This value must contain the V memory address of the first word (signature word) of the Modem Configuration Table.

## Dial Command

The following command block will be used to initiate a series of modem commands which will take the modem off hook and dial up the remote user. *If you have selected Auto-Dial, you are not required to initiate this command.*

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	<b>0000</b>	<b>0</b>
1	Command (Dial Up))	<b>0401</b>	
2	Connection Number (19221 -- 19299)		
3	Command Flag - (see below)		
4	V Memory address of the dial string (0 is invalid)		
5	Busy Signal Detection ( 0 = Enable, 1 = Disable)		
6	Dial Tone Detection (0 = Enable, 1 = Disable)		
7	Command Complete Mode (0= Data Mode, 1 = Command Mode)		
8	Command Timeout in Seconds		
9 - 15	Reserved - Set to 0	0000	0

Offset 0 *Command Error Word* - Your PLC logic should set this to 0 so that any previous error code is cleared. If a processing error is encountered, the protocol manager will write an error code into this word.

Offset 1 *Command Code* - The Command for Dial is 0x0401

Offset 2 *Connection Number* - The connection number must match the one used in the CREATE CONNECTION command.

Offset 3 *Command Flag*

Bits 1 - 15	Bit 16
Unused by this release and should be set to 0.	0 = Reset Modem before dial command and load CTI defaults. 1 = Do not reset modem or load CTI defaults before dial command.

**NOTE:**

*Except for special cases, you should set offset 3 to a value of 0. Disabling automatic reset could result in the modem being placed in a state unknown to the protocol manager.*



Offset 4 *Dial String Location*. V memory Address which contains the dial string. See additional information regarding the dial string in the following section.

Offset 5 *Busy Signal Detection*. Determines whether the modem detects a busy signal. This should be set to 0 (Enable) unless there is a specific reason to do otherwise.

Offset 6 *Dial Tone Detection*. Determines whether the modem will detect a dial tone signal. This should be set to 0 (Enable) unless there is a specific reason to do otherwise. You might set this to 1 (disable) if you are using the dial command to send additional tone commands to a DTMF device. If this function is disabled, dial modifiers which specify waiting on a dial tone (such as the W modifier) will not work; you must use a timed delay instead.

Offset 7 *Command Complete Mode*. 0 = Place in data mode after completing command. This is the normal mode to send data to a modem.

1 = Leave in command mode after completing command. *This bit is used when sending DTMF commands to devices which do not present a modem “carrier” (for example, pagers).*

**NOTE:**

*When you leave the modem in command mode, some modems do not return an error message if the dialed number was busy or did not answer. If you use this option, you should test this condition using your modems.*

The command will be considered complete when the modem signals that the dial command is completed. An error code will be returned if the connection could not be made (See Error Code listing).

## Hang-Up Command

This command will terminate the connection and place the modem on hook. If specified in the Modem Configuration Table, the modem will be placed in auto answer mode.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command (Hang Up)	0402	1026
2	Connection Number (19221 -- 19299)		
3-15	Reserved - set to 0	0000	0

In the event a hang-up command is issued and the modem is already on-hook, no error will be returned to the PLC logic.

*NOTE:*

*In manual mode, if a dial sequence is aborted for any reason (including modem errors), you should issue the hang-up command to reset the modem to a known state.*

## 6.4. Application Example

The following illustrates how the 2573 Modem Control Feature can be used. The example assumes the following:

1. You have acquired compatible modems configured as described in the previous section.
2. You have a “local” PLC configuration which includes a 2573 with the modem connected to port 3.
3. You have a “remote” location which also has a 2573/PLC combination.
4. On a certain event, you wish to connect to the remote site and transfer 150 words to the remote PLC.
5. You want to use the auto-dial mode of 2573 Modem Control Feature, to avoid having to provide additional PLC logic.
6. You want to automatically hang up the connection if no data has been sent or received within 60 seconds.

Since both sites have a 2573 installed, we will use the CAMP protocol to transfer the data. CAMP will be the fastest and most reliable choice when both sites have a CTI 2573 Serial Interface Adapter module installed.

In your particular application, you might substitute a remote computer for the remote PLC and use the GAS protocol manager rather than CAMP, since GAS allows you to design your own protocol.

## Modem Configuration Table

This table is entered in to V memory starting at V1000

Location	Value	Description
V1000	0x4154	Signature Value = ASCII characters AT
V1001	0	Reserved for Future Use. Set this value to 0.
V1002	0	Auto Answer Rings (0 - 9) <b>(0 = No Auto Answer)</b>
V1003	1	Auto-Dial Selection (0 = Manual Dial, <b>1 = Auto Dial</b> )
V1004	0x0000	Modem Option Flag Bits 1 - 13 (Unused) Bit 14: Busy Detection ( <b>0 = Enabled</b> , 1 = Disabled) Bit 15: Dial Tone Detection ( <b>0 = Enabled</b> , 1 = Disabled) Bit 16 - Default Dial Method ( <b>0 = DTMF</b> , 1 = Pulse Dial).
V 1005	120	Auto Hang-Up Timeout in Seconds (0 = No auto hang-up)
V1006	1016	V Memory Address of Default Dial String
V1007	0	Autodial Timeout in Seconds ( <b>0= default of 30 seconds</b> )
V1008- V1015		Reserved for Future Use (Set these values to 0)

## Dial String

The following dial string is entered into V memory, starting a V1016 (referenced in V1006 above).

**"1,4235551216"**

This will dial the long distance access code, pause for two seconds, then dial the rest of the number. The string is stored in V memory as shown below.

Location	V1016		V1017		V1018		V1019		V1020		V1021		V1022	
Hex Value	22	31	2C	34	32	33	35	35	35	31	32	31	36	22
ASCII	"	1	,	4	2	3	5	5	5	1	2	1	6	"

### Create Connection Command Block

The following Command Block can be used to start up the CAMP Master protocol manager on the 2573 port 3 using a baud rate of 9600.

Offset	Description	Decimal Value
V200	Command Error Word	0
V201	Command (Create Connection)	1
V202	Connection Number 19223	19223
V203	CAMP Master Protocol Manager Number	36
V204	Physical Port Number 3	3
V205	Port Baud Rate = 9600	9600
V206	Bits Per Character = 7 (required setting for CAMP)	7
V207	Parity = 1 (required setting for CAMP)	1
V208	Stop Bits = 1 (required setting for CAMP)	1
V209	Handshake = 0 = none,	0
V210	Special Option Bits 0x0001 = Modem	1
V211	V Memory Address of Modem Configuration Table	1000
V212-215	Reserved	0

### Memory Transfer Command Block

The following command block will read 150 words of data from V 2000 in the local PLC and write them to V3000 in the remote PLC.

Offset	Description	Decimal Value
V220	Command Error Word	0
V221	Command (Write Remote Memory)	513
V222	Connection Number (19223)	19223
V223	Source: Starting V Memory in this PLC	2000
V224	Number of Words	150
V225	Destination: Starting V Memory in Remote PLC	3000
V226	Command Timeout (0 = default = 9 seconds)	0
V227-235	Reserved, Set to 0	0

Since the 2573 Modem Control Feature has been configured for auto-dial and auto-hang-up, the PLC logic to use the dial up modem is *exactly the same* as the logic to initiate data transfer using dedicated lines. See the PLC logic examples in the previous chapter. However, you may wish to add special error identification and recovery logic.

No PLC logic is required to initiate the dial-up connection or to hang up after the data has been sent. If the modem connection is not established when you trigger the command block, the 2573 will automatically initiate the dial sequence using the values stored in the Modem Configuration Table. When the 2573 Modem Control Feature must dial the connection, it calculates the timeout by adding the Auto-Dial timeout of 60 seconds (see offset 7 of the Modem Configuration Table) to the Command Timeout of 9 seconds specified in V226 above. If the connection cannot be made, the 2573 will return an error code and set the error bit. After your logic acknowledges the error, the 2573 will retry the dial sequence when you trigger the command block again.

### Hang-Up

After a period of no activity specified in offset 5 of the Modem Configuration Table, the 2573 will automatically hang up the modem. If you wish, you can use PLC logic to explicitly hang up the connection even though the 2573 is configured for auto-hang up. To explicitly hang up the modem, you would use the following command block. You would also need to add the applicable PLC logic to trigger the hang-up command.

Offset	Description	Decimal Value
0	Command Error Word	0
1	Command (Hang Up)	1026
2	Connection Number = 19223	19223
3-15	Reserved - set to 0	0

## 6.5. Implementation Tips

If you are developing a complex application using the 2573 Modem Control Feature, you may wish to isolate the implementation and testing modem part of the application from the implementation and testing of the serial data transfer portion. A typical method for accomplishing this is as follows:

1. Develop and test the PLC data transfer using direct connected serial lines. If you are using the auto-dial and auto-hang-up features, you need only to set the modem Option Bit in the CREATE CONNECTION command to 0. If you are using the manual dial feature, you will need to disable that portion of your PLC logic.
2. Check out the modems using a standard PC application (such as Microsoft Terminal) to establish the dial connection and to transfer data.
3. Once both portions of the application are operating successfully, then integrate the two by connecting the modem to the PLC and enabling the 2573 Modem Control Feature.

Please ensure that you have set up the modems as explained in Section 6.2. Modem Setup on page 45.

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## CHAPTER 7. TROUBLESHOOTING

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### 7.1. General Module Problems

When the module is first powered up, the red ACTIVE LED at the top of the module should light after a few seconds. If the ACTIVE indicator remains on, the module hardware is operational. If the indicator blinks, the module diagnostic software has detected a hardware problem. If the indicator fails to illuminate and power has been applied to the module, there is a problem with the hardware; the module should be replaced.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Active Indicator not Lit	No Power to Module.	Ensure that power is supplied to the rack and that the module is securely inserted.
	Defective Module.	Cycle the power. If the ACTIVE light does not remain on, replace the module.
Active Indicator cycles off and on.	The 2573 diagnostic program has detected a defective module component.	Cycle the power. If the problem persists, replace the module.

### 7.2. Serial Communications Problems

Common sources of communications problems are bad or improperly wired cables and improperly set communications parameters. The receive (RCV) and transmit (XMT) indicators can be a valuable aid in troubleshooting these errors. The RCV LED illuminates when a signal is received at the serial port receive line. The XMT LED illuminates when the 2573 sends a signal to the serial port.

In addition, you can use the Loopback setting for a port in conjunction with a loopback connector to verify the serial port operation and cable wiring. See Chapter 2 for the dipswitch settings and Appendix A for instructions on making a loopback connector.

A valuable tool in locating and correcting communications problems is a serial line analyzer. A serial line analyzer displays the actual messages transmitted via the serial line. Several vendors offer software products which work with a PC to perform serial line analyzer functions. Typically, these products may be purchased for about \$300.00. Contact CTI for further information.

See the following table for a list of symptoms and possible solutions.

<b>SYMPTOM</b>	<b>PROBABLE CAUSE</b>	<b>CORRECTIVE ACTION</b>
RCV indicator glows steadily when you attach the communications cable.	You are using an RS-232 communications cable which straps pin 6 high. Many cables designed to work with the 545 PLC program port strap pins 1 & 6. In the standard PC/AT 9 pins serial port, pin 6 is Data Set Ready. On the 2573, pin 6 is RS-422a Rx-.	Replace the cable with one properly configured or construct an adapter cable which does not connect pins used for RS-422.  See appendix A for cabling instructions.
RCV Indicator does not flash when you attempt to send data to the 2573 from a device attached to the serial port.	No signal is being received by the 2573. This is probably due to a defective cable. It may be due to a faulty device or, if you are using a PC, a faulty communications card.	Check the communications cable wiring. Replace with a known good cable and retry. If failure still occurs, try another device or communications card.
	If you are communicating using RS-422/485 on Rev. D boards and above, the port's Disconnect 422/485 switch may be inadvertently set to the 'OFF' (disconnected) position.	Set the port's RS-422/485 Disconnect switch to 'ON' (connected) position.  See page 10 for settings switches.
When using the NITP/CAMP Slave protocol: a signal is received from the attached device but the 2573 does not respond (XMT LED does not flash).	The 2573 is receiving a message which it cannot interpret. Check the following:	
	Communications Parameter Mismatch.	Ensure that the communications parameters for the device and the module match.
	Incorrect Protocol. The attached device is not using NITP or CAMP message protocols.	Refer to the device documentation. Try a device known to use NITP or CAMP such as a CTI 5250-TI5.
	Hardware Handshaking Mismatch. The 2573 is waiting on the attached device to raise the handshake line before sending.	Enable hardware handshaking on the attached device or DISABLE hardware handshaking on the 2573.
	Cable is not wired for hardware handshaking and hardware handshake is enabled in the 2573	Check cable for proper wiring. Temporarily DISABLE hardware handshake on the 2573 to test results.



<b>SYMPTOM</b>	<b>PROBABLE CAUSE</b>	<b>CORRECTIVE ACTION</b>
When using the NITP/CAMP Slave protocol manager: No signal is received by the attached device AND the 2573 XMT light flashes.	This is probably due to a defective cable. It may be a defective device.	Replace cable with one known to be good.  Try an alternate device.
When you attempt to send a message, no signal is received by the remote device <b>and</b> the XMT LED <b>does not</b> flash.	You are not sending a message.	Check the PLC logic used to Create Connection and to send the message. Inspect the Command Error Word for an error code. If one is present see Appendix B for an explanation.  Ensure that hardware handshake is not erroneously enabled.
When you attempt to send a message, the XMT LED <b>does flash</b> but no signal is received by the remote device.	The cable is defective or improperly wired.	Check the communications cable wiring. Replace with a known good cable and retry. If failure still occurs, try another device or communications card.
When you attempt to send a message, the XMT LED <b>does flash</b> and a signal is received by the remote device but the device does not respond.	Protocol Problem The message you are sending is not understood by the device.	Ensure that the remote device supports NITP or CAMP.
	Communications Parameter Mismatch.	Ensure that the settings for data bits, stop bits, parity and baud rate match.
Intermittent Communications Problem.	Communications "noise."	Reduce the baud rate on the 2573 and the attached device and retry. Re-route or replace cabling.
	Ground Loop This may occur when more than one device is connected via separate cables to the module and the devices have different grounds.	Remove cables to other ports. If the problem subsides, install isolation. The 2573-TCM2 does not provide channel to channel isolation.
RS-485 does not function but other electrical interfaces work properly.	The Create Connection command for the protocol manager did not select the RS-485 handshake option in offset 9.	Correct the entry in the Command Block. Note that only the GAS protocol manager supports RS-485.

## **Communications Cables**

Ensure that the cables are properly wired. Refer to the documentation for the plant floor device and the wiring diagrams shown in Appendix A.

## **Communications Parameters Mismatch**

First, check to ensure that the baud rate settings on both the 2573-TCM2 and the plant floor device are set to the same data rate. If you note a problem, set both to the same baud rates and retry. Also check the data bits, parity, and stop bit settings. If you are using the GAS protocol manager, you may find that the error code indicates a framing error.

## **Hardware Handshaking Error - RS-232**

If your device is NOT configured for hardware handshaking, ensure that hardware handshaking is DISABLED. If your device IS configured for hardware handshaking, ensure that the handshaking wires are properly connected (see the documentation for the connected device). In some cases you can check out a handshake wiring problem by temporarily disabling hardware handshaking on the module and the plant floor device. If the 2573 responds to the attached device (XMT LED flashes), then you probably have a wiring problem.

Hardware handshaking is not used with RS-422-A or RS-485 electrical interfaces.

## **Protocol Problems**

When the port is set for NITP mode, the attached device must issue and respond to task code packets as defined in the Non-Intelligent Terminal Protocol (NITP). If you are unsure of this fact, you can attach the device directly to the programming port to determine if it works properly. If it does not work and cabling/configuration items discussed in other sections above have been checked, then you probably have a protocol problem.

If it does work, there is still a chance that the device is using Transparent Byte Protocol (TBP), which is not supported in the 2573-TCM2. For example, TISOFT will attempt to use TBP before switching to NITP. Most application programs and operator interface devices that can use TBP allow you to force the use of Non-Intelligent Terminal Protocol (NITP), which is supported.

## **Intermittent Communications Problems**

If you experience intermittent communications failures, you may be experiencing noise on the communications cable which interferes with data transmission. If you are communicating at rates higher than 1200 baud, you can reduce the baud rate to check for improvement. If reducing the baud rate does correct the problem, you most likely have a noise problem. You should first ensure that you have not exceeded the maximum distances for cabling lengths (50 feet for RS-232 and 4000 feet for RS-422). Also check for proper grounding of the cable shields; we recommend connecting the shield at one end only. Longer cable runs may be subject to ground loops; you may require the addition of an electrical isolation device.

## 7.3. Development and Debugging Tips

### Manual Triggering

You can test your command blocks and format specifications separately from the PLC logic that actually executes them by manipulating the command control bits manually. First, place the PLC in program mode so that the PLC logic will not be executing. Then you can manipulate the bits as shown below. If you are not familiar with the 2573 PLC Command Interface, you should read Appendix D. Also see the WX/WY Quick Reference in Appendix C.

The command control bits are located in the 4th module word. For example, if you logged the module in starting at Word 1, then the command control bits will be located in WY4. See the WX/WY Quick Reference at the end of this manual. There are 4 sets of control bits, one set for each command slot.

WY4	Bits 1 -4	Bits 5 - 7	Bits 8 - 11	Bits 12 -16
	Command Control Bits - Slot 1	Command Control Bits - Slot 2	Command Control Bits - Slot 3	Command Control Bits - Slot 4
	Hex 0-F	Hex 0 - F	Hex 0 - F	Hex 0 - F

Within each set of four Command Control bits:

- The first bit is the Error Acknowledge,
- The second bit is the Command Mode bit
- The third bit is the Command Trigger
- The fourth bit the Abort Trigger.

So a bit pattern of 0110 will set the command mode bit and the command trigger. Similarly, the bit pattern 1000 will set the Error Acknowledge bit. Using hexadecimal notation is a convenient way to observe and manipulate these bits, because each hexadecimal digit represents 4 bits. Thus, bit pattern 0110 is represented by hexadecimal 6 (0+4+2+0). When the error acknowledge bit on is represented by hexadecimal 8 (1000).

Similarly, the command status bits written by the module are located at the second module word (WX2 in this example) in a bit grouping that matches the command control word.

WX2	Bits 1 -4	Bits 5 - 7	Bits 8 - 11	Bits 12 -16
	Command Status Bits - Slot 1	Command Status Bits - Slot 2	Command Status Bits - Slot 3	Command Status Bits - Slot 4
	Hex 0-F	Hex 0 - F	Hex 0 - F	Hex 0 - F

Within each set of four Command Status bits:

- The first bit is the Command Error bit,
- The second bit is the PLC Error bit,
- The third bit is the Command Busy bit,
- The fourth bit is the Abort Busy bit,

Therefore, to set a command trigger only (uncoupled mode) for the first command slot, set WY4 to hex 2000. To set the command trigger for the second slot, set the WY4 to hex 0200. To set the error acknowledge for the third Command Slot, set WY4 to hex 0080.

When you are using PLC logic to control the PLC, it is often useful to display the module WX/WY words, parts of the command blocks, and sections of the format specifications as a TISOFT chart. Following is an example chart.

LOCATION	STATUS	LOCATION	STATUS	LOCATION	STATUS
WX1 =	HEX	V200 =	HEX	V500 =	INTEGER
WX2 =	HEX	V201 =	INTEGER	V501 =	INTEGER
WY3 =	HEX	V202 =	INTEGER	V502 =	INTEGER
WY4 =	HEX	V203 =	INTEGER	V503 =	INTEGER
WY5 =	INTEGER	V204 =	INTEGER	V504 =	INTEGER
WY6 =	INTEGER			V505 =	INTEGER
WY7 =	INTEGER	V220 =	HEX	V600 =	INTEGER
WY8 =	INTEGER	V221 =	INTEGER	V601 =	INTEGER
		V222 =	INTEGER	V602 =	INTEGER
		V223 =	INTEGER	V603 =	INTEGER
		V224 =	INTEGER	V604 =	INTEGER
				V605 =	INTEGER

The above chart allows you to examine at the value of the module status word (WX1), the command status word (WX2), the module control word (WY3), and the command control word (WY4) in hexadecimal format. The command slots (WY5-WY8) are displayed as integers. V200-V215 and V220-V235 are assumed to contain command blocks you are using. This display shows the first 4 words of each the command block with the error words in hex. V500-V505 and V600-V605 are assumed to contain data you want to observe. You will want to change the display to match your setup.

To trigger a coupled mode command for command slot 1 (Assuming the module is logged at Word WX1):

1. Put the address of the Command Block you want to use in WY5.
2. Change the value of WY4 to hex 6000. WX2 should change to hex 2000, indicating that the module is executing the command.
3. After WX2 changes to hex 2000, set the value of WY4 to hex 0000 to clear the trigger. If WX2 transitions from hex 2000 to hex 0000, the command was executed successfully.
4. If WX2 changes to hex A000, a command error was encountered. Inspect the Command Error Word (in the command block - offset 0) and clear the error by changing WY4 to hex 8000. Then lower error acknowledge bit by setting WY4 to hex 0000. Perform the necessary error recovery action based on the error code in the Command Error Word.

### **Slowing the PLC Scan**

Because of the communications latency between TISOFT and the PLC, you may not be able to observe all bit transitions at the highest PLC scan rate. One way to improve this situation is to change the PLC to the slowest fixed scan rate available. Generally, this value is 255 milliseconds.

*NOTE:*

*If you use these techniques for debugging, be sure to set the parameters back before running the actual application.*



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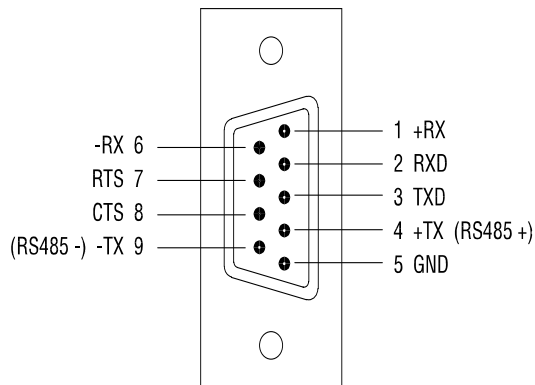
## APPENDIX A. CONNECTORS AND CABLING

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### 2573 Serial Port Cabling

#### 2573-TCM2 Serial Port Pinout

The serial ports on the 2573-TCM2 use a DB9 male connector to provide multiple electrical



*Figure 12. 2573-TCM2 Serial Port Pinout*

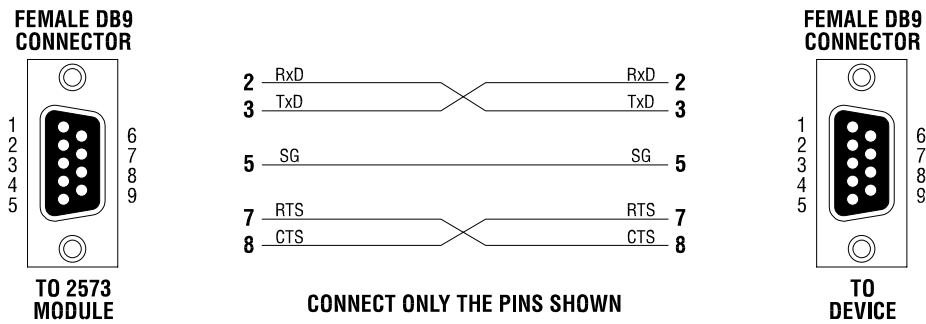
interfaces. The electrical interface in use is determined by which pins are connected to the serial communications cable. The illustration above shows the pinouts for one of the ports; all ports are identical.

#### RS232 Cabling

To use the RS232 electrical interface, connect to the pins as shown below. Do not connect pins 1,4,6, or 9.

Pin #	RS-232 Signal
2	RxD: Received Data (input)
3	TxD: Transmitted Data (output)
5	SG: Signal Ground
7	RTS: Request to Send (output)
8	CTS: Clear to Send (input)

The following figure illustrates how to construct an RS-232 cable typically used for connecting plant floor equipment to the 2573-TCM2. This “rolls” the transmit/receive and RTS/CTS lines so that the output line on one connector is tied to the input line on the other connector. This cable can be used to connect a typical PC to the 2573 serial port. This cable is similar to a null modem cable, except only RTS and CTS handshake lines are connected.



**Figure 13. RS-232 2573-TCM2 to Device Cable (PC/AT Style)**

**NOTE:**

*The 2573-TCM2 supports only the RTS and CTS hardware handshake lines. Other pins typically used for other handshake lines are dedicated to RS-422-A and RS-485. The cable shield should be connected to the chassis ground at one end only to minimize the potential for ground loops. To connect to chassis ground, attach the shield to the female DB9 connector base.*

At typical baud rates and electrical environments, you should limit the length of RS-232 cables to 50 feet or less.





## RS-422-A Cabling

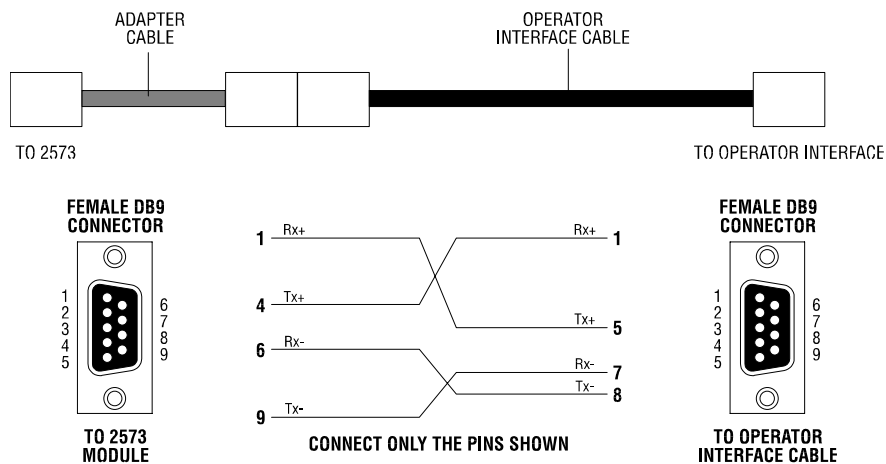
The RS-422-A electrical interface is typically used for point to point serial connections where extended distance or improved noise immunity is required. An RS-422-A cable consists of two pairs of twisted pair wires enclosed by a shield. One pair of wires is used for transmitting data, the other pair for receiving data. The pair employs a balanced voltage circuit which tends to cancel out externally generated interference. To use the RS-422-A electrical interface, connect the pins as follows:

Pin #	RS-422-A Signal
1	RX+: Received Data - Positive polarity (input)
6	RX-: Received Data - Negative Polarity (input)
4	TX+: Transmitted Data - Positive Polarity (output)
9	TX-: Transmitted Data - Negative Polarity (output)

**NOTE:**

*The cable shield should be connected to the chassis ground at one end only to minimize the potential for ground loops. To connect to chassis ground at the 2573 and the PLC, attach the shield to the female DB9 connector base.*

Although there are no standards for pinout configuration for RS-422, you may already have cables used with CTI operator interface products which connect to the TI545 programming port. If you want to use these cables with both the 2573-TCM2 and the PLC serial port, you can construct this simple adapter cable for the 2573-TCM2.

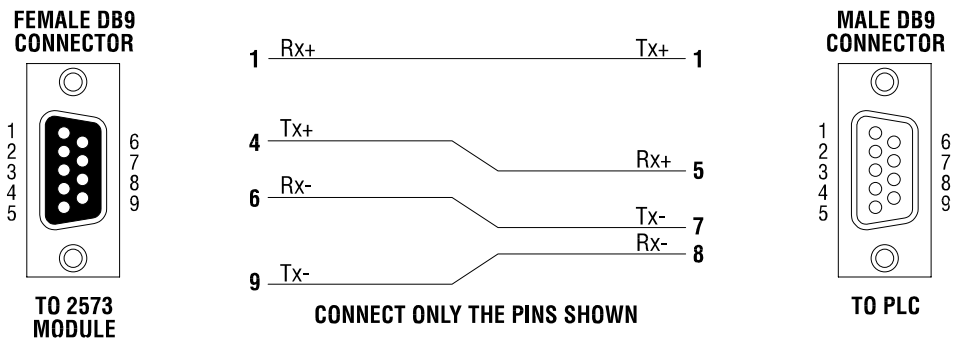


**Figure 16. TCAM to RS-422A Adapter Cable**

If you wish to build an RS-422 cable that will connect between a 2573-TCM2 serial port and a SIMATIC TI545 or TI555 PLC serial port, see the following examples.

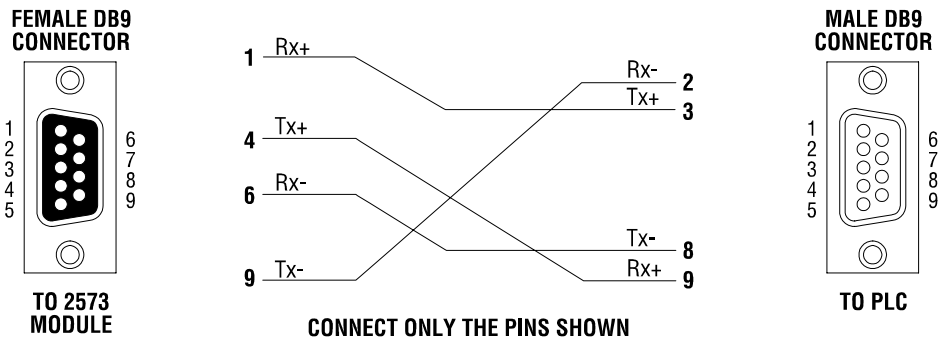
**NOTE:**  
*The RS-422 serial port pin out varies between SIMATIC PLC models.*

The pin out for the 545-1101 PLC is:



**Figure 17. 2573-TCM2 to PLC Cable (RS-422) Old Configuration**

For the 545-1102 and above, and for the 555-1101 and above, use the pin out below:



**Figure 18. 2573-TCM2 to PLC Cable (RS-422) New Configuration**

## RS-485 Cabling

The RS-485 electrical interface is typically used for multipoint serial connections. This electrical interface uses one pair of wires for both transmit and receive. Like RS-422-A, RS-485 uses a balanced circuit, with one wire positive polarity and the other negative polarity. To use the RS-485 electrical interface, connect the pins as shown below. Do not connect to any other pins at the 2573-TCM2 serial port.

Pin #	RS-485 Signal
4	Tx+/Rx+: Transmitted and Received Data Positive Polarity
9	Tx-/Rx-: Transmitted and Received Data Negative Polarity

**NOTE:**

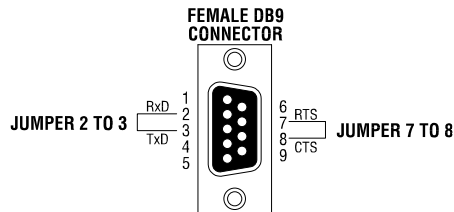
*The cable shield should be connected to the chassis ground at one end only to minimize the potential for ground loops. To connect to chassis ground, attach the shield to the female DB9 connector base.*

**NOTE:**

*Ensure that that offset 9 ( Handshake) in the CREATE CONNECTION command block is set to the value of 4 to select RS-485 port communications. Only the GAS protocol manager supports RS-485.*

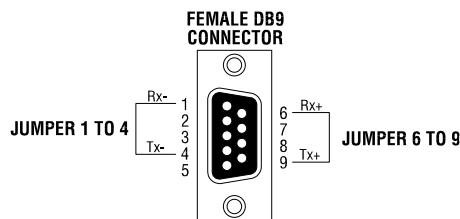
## Loopback Connector Construction

The following shows how to construct an RS-232 loopback connector. You can attach this directly to the 2573-TCM2 serial port to verify operation for RS-232. The 2573-TCM2 has a switch setting to support loopback testing. You may also be able to use this connector to check out certain cable configurations (such as the 2573-TCM2 to PC/AT RS-232 cable shown earlier in this chapter).



*Figure 19. RS-232 Loopback Connector*

The following figure illustrates the construction of an RS422-A loopback connector. You can attach this directly to the 2573-TCM2 serial port to verify operation for RS-422.



*Figure 20. RS-422 Loopback Connector*

**NOTE:**

*There is no RS-485 loopback connector, since RS-485 uses a single pair for both transmit and receive.*

## Termination Resistance Jumpers

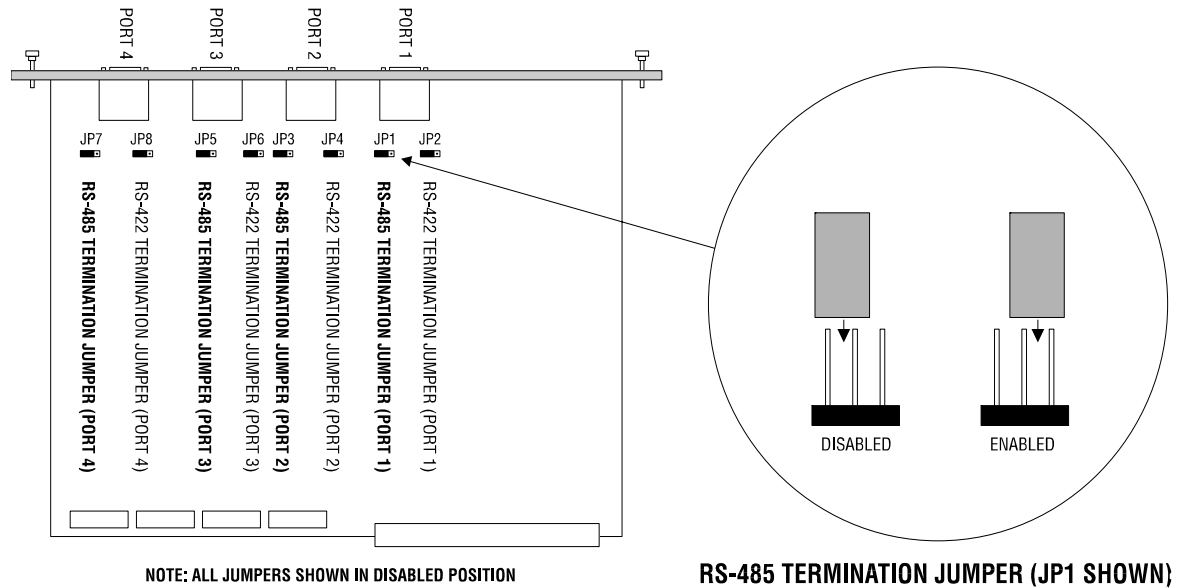


Figure 21. Termination Resistor Jumper Locations

### RS-485 Termination Resistance

RS-485 circuits require that 120 ohm termination resistors be installed at *each end* of the transmission line to suppress signal reflection. In a typical installation, the 2573-TCM2 will be at one end and will require a terminating resistance. You should refer to the documentation for the plant floor device you are connecting for specific instructions about your installation.

The 2573-TCM2 circuit board contains a 120 ohm termination resistor which can be placed in the circuit (enabled) by repositioning a jumper on the board. See the illustration above for the location of the RS-485 termination jumpers (JMP1, JMP3, JMP5, JMP7). If your particular installation requires the resistor at the 2573-TCM2 connection, you can enable it by moving the appropriate jumper.

### RS-422-A Termination Resistance

Most RS-422 installations **do not** require a termination resistance; however, a few RS-422 installations may specify a termination resistance. If your particular installation is one of these, you can reposition the jumpers labeled *RS-422 Termination Jumper* to insert the resistance into the 2573-TCM2 RS-422 receive circuit. Do not enable termination resistance unless specified by your device vendor.

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## APPENDIX B. ERROR CODES

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### Error Processing Overview

This Appendix provides a description of the error codes that may be returned to the PLC by the 2573-TCM2 except for errors returned by the GAS Protocol Manager. The GAS Protocol Manager Errors are documented in the General ASCII Support Protocol Manager Reference Manual.

Potential solutions to the error conditions are also presented. When an error is detected by the 2573-TCM2, it sets the PLC ERR bit in the command status word, places a command error code in offset 0 of the command block, and suspends processing on the particular port. See the Appendix D for a complete description of error processing.

The error codes are shown in both Hexadecimal and Integer format. When viewed in hexadecimal format, the high byte indicates the software/protocol manager that is responding to the error; it will usually contain the number of the protocol manager who generated to error code. If the 2573 operating environment generated the error code, the high byte will be 00. For memory transfer commands, the high byte of the error code will be the 0x02, regardless of the underlying protocol. The lower byte will contain the specific error code. The integer format is useful when you are using PLC logic to respond to certain error codes.

**NOTE:**

*When you are viewing the error codes using a software package such as TISOFIT, you should set the display to view the error codes in hexadecimal format. This will improve troubleshooting by allowing you to determine the protocol manager that generated the error.*

**NOTE:**

*The 2573-TCM2 protocol managers do not reset the Command Error Word to 0 after the error is cleared. You must do this in your PLC logic.*

Error codes are listed in the following sections in numerical order.

## System Errors

System errors are detected by the module operating environment. System error codes have hex 00 in the high byte of the command error word.

HEX	DEC	DESCRIPTION	SOLUTION
0097	151	<p><b>INVALID COMMAND</b></p> <p>While attempting to execute a system command, you specified an invalid command number.</p>	<p>Correct the Command Number in the Command Block.</p>
009E	158	<p><b>ALREADY BUSY</b></p> <p>You attempted to send a command to a function that was already busy executing a previous command.</p>	<p>You can cause this error by using two command slots to send commands to the same connection number.</p> <p>Don't do this.</p>
009F	159	<p><b>INVALID CONNECTION NUMBER</b></p> <p>The command block contains an invalid connection number. Valid connection numbers range from 19221-19229 when using a Create Connection command.</p>	<p>Correct the parameter in the connection number in the command block.</p>
00A5	165	<p><b>INVALID SYSTEM COMMAND</b></p> <p>Connection number 19200 (system) was specified in the command block but the command is not a valid system command.</p>	<p>Change the command block parameter to a valid connection number or the command number to a valid system command.</p>
00A6	166	<p><b>CONNECTION NOT ACTIVE</b></p> <p>An attempt was made to send a command to a connection number that has not been created.</p> <p>Note: You can receive this error if you incorrectly enter the connection number.</p>	<p>Check the following for the Create Connection Command:</p> <ol style="list-style-type: none"> <li>1) Make sure that the command block contains the correct data,</li> <li>2) Ensure that the Command Slot points to the proper command block,</li> <li>3) Ensure that the Command Trigger has been set.</li> <li>4) Check for reported errors for the Create Connection Command</li> </ol> <p>Ensure that you have entered the correct connection number in the command block.</p>



HEX	DEC	DESCRIPTION	SOLUTION
00A7	167	<p><b>DUPLICATE CONNECTION NUMBER</b></p> <p>An attempt was made to start two protocol managers with the same connection number and the same physical port.</p>	<p>Check the Command Blocks for the respective Create Connection commands. Ensure that the Create Connection commands use different connection numbers and different ports.</p> <p>Make sure that another protocol manager was not started via dipswitch with the same connection number. See the product IOG.</p>
00A8	168	<p><b>DUPLICATE CONNECTION NUMBER</b></p> <p>An attempt was made to start two protocol managers with the same connection number.</p>	See error 00A7 above.
00A9	169	<p><b>INVALID PROTOCOL MGR NUMBER</b></p> <p>An attempt was made to start a protocol manager which does not exist in the list of valid protocol manager numbers.</p>	This error will occur if you are using PLC logic to create a connection to a port and you specify an invalid protocol manager number in the command block. Review the documentation and correct the command block.
00AA	170	<p><b>INVALID PHYSICAL PORT NUMBER</b></p> <p>An attempt was made to start a protocol manager with an invalid physical port number. Valid physical port numbers for the 2573 are 1,2,3, or 4.</p>	This error will occur if you enter an invalid physical port number in the command block for the Create Connection command. Correct the command block and retry the command.
00AB	171	<p><b>PORT ALREADY CONNECTED</b></p> <p>An attempt was made to connect two protocol managers to the same physical serial port. Only one protocol manager can be connected to one physical serial port.</p>	<p>This error is typically caused by one of three circumstances.</p> <ol style="list-style-type: none"> <li>1) The PLC logic triggers the same Create Connection command more than once. Examine and correct the PLC logic.</li> <li>2) You have inadvertently used the same physical port number more than once in separate Create Connection commands. Change the physical port number to eliminate the conflict.</li> <li>3) You have automatically started the protocol manager on this port using the module dip switch settings (See page 7). You should either set the port dipswitch to PLC Select mode or you should not execute a Create Connection command for this port.</li> </ol>

<b>HEX</b>	<b>DEC</b>	<b>DESCRIPTION</b>	<b>SOLUTION</b>
00B2	178	INVALID V MEMORY ADDRESS The Command Block V memory address of 0.	Correct the Command Block data.
00B3	179	INSUFFICIENT V MEMORY RESERVED You failed to reserve enough V memory to hold the data returned by the command.	Correct the Command Block data.

## General Memory Transfer Error Codes (NITP)

The following error codes (0201-0261) are generated by the Siemens PLC, only when using the Task Code Master. The 2573-MOD Task Code Master protocol manager will simply pass on these errors.

HEX	DEC	DESCRIPTION
0201	513	Reset Current Transaction
0202	514	Address out of Range (Other than Ladder Logic)
0203	515	Requested Data not Found
0204	516	Illegal Task Code Request (e.g. Task Code not Supported)
0205	517	Request Exceeds Program Memory Size (Ladder Logic)
0206	518	Diagnostic Fail upon Power Up
0207	519	Fatal Error Detected
0208	520	Keylock Protect Error
0209	521	Incorrect amount of Data sent with Request
020A	522	Illegal Request in Current Operational Mode
020B	523	Network was not Deleted
020C	524	Attempted Write Operation Did Not Verify
020D	525	Illegal Number of ASCII Characters Received
020E	526	Illegal Write to Program Memory (Non Volatile)
020F	527	Data not Inserted
0210	528	Data not Written
0211	529	Invalid Data sent with the Command
0212	530	Invalid Operation with NIM (Obsolete)
0213	531	The store and forward buffer is busy
0214	532	No response from the Special Function Module
0215	533	Illegal Instruction found in program memory on a Program to Run transition
0216	534	Attempted Write to a Protected Variable (e.g. TCC, TCP)
0217	535	No response from PLC (e.g. Single Scan not performed)
0218	536	Requested memory size exceeds total available memory
0219	537	Requested Memory size is not a multiple of block allocation size
021A	538	Requested memory size is less than minimum defined value.
021B	539	Requested memory size is larger than maximum defined value
021C	540	PLC Busy - Cannot complete the requested operation
021D	541	Comm error in HOLD mode - Transition to Run not allowed
021E	542	Port Lockout is Active (ref task Code 48)
0221	545	I/O Configuration Error - too many points
0222	546	I/O Configuration Conflict
023F	575	Bus Error Detected

HEX	DEC	DESCRIPTION
0240	576	Operating System Error Detected
0241	577	Invalid Control Block Type
0242	578	Control Block Number out of range
0243	579	Control Block does not exist
0244	580	Control Block already exists
0246	582	Offset out of range.
0247	583	Arithmetic error detected while writing loop or analog alarm parameters
0248	584	Invalid SF Program type
0249	585	Instruction number or RAMP/SOAK Step number out of range
024A	586	Attempt to access an integer only variable as a real.
024B	587	Attempt to access a real -only value as an integer.
024C	588	Task Code buffer overflow -- too much data requested
024D	589	Control Block size error. (Maximum = 32767 bytes)
024E	590	Attempt to write a read only variable.
024F	591	Invalid variable type for this operation
0250	592	Task code request buffer too large (PLC internal error)
0251	593	Invalid SF Statement size specified
0252	594	Invalid return value
0253	595	Attempt to execute a Cyclic statement in a non-cyclic SF program
0254	596	Control Block is disabled
0255	597	Control Block is not disabled
0256	598	Attempt to perform a FTSR-OUT Statement on an empty FIFO
0257	599	Attempt to perform a FTSR-IN Statement on a full FIFO
0258	600	Stack overflow while evaluating a MAATH, IF-THEN, or IMATH expression
0259	601	Maximum SF Subroutine nesting level exceeded (Max depth = 4)
025A	602	Arithmetic Overflow
025B	603	Invalid Operator in an IF, MATH, or IMATH expression
025C	604	S Memory Overflow
025D	605	Attempt to divide by 0 (IMATH Statement)
025E	606	FIFO is incompatible with FTSR-IN or FTSR-OUT statement
025F	607	FIFO is invalid
0260	608	Invalid Data Type code (Usually MATH, IMATH, or IF-THEN statement)
0261	609	RAMP/SOAK step type mismatch. Error is logged by Task Code 6 (Write RAMP/SOAK step) if the fields are being updated and the step type indicated but the task code does not match the step type of the step being modified.

## General Memory Transfer Errors (NITP and CAMP)

The following error codes are generated by protocol managers which support memory transfer commands. For the 2573-TCM2, either the Task Code Master protocol manager or the CAMP Master protocol manager may generate these errors.

HEX	DEC	DESCRIPTION	SOLUTION
026E	622	<p>NITP PROTOCOL ERROR</p> <p>The 2573 received an invalid NITP message. NITP protocol errors include:</p> <ul style="list-style-type: none"> <li>- Odd number of characters received,</li> <li>- Invalid characters received,</li> <li>- Checksum error,</li> <li>- Incorrect character count field.</li> </ul>	<p>This usually results from “noise” on the communications line. Retry the command.</p> <p>This may occur if you are using a computer system to emulate a task code slave and the system has been improperly programmed. Try using communicating with another 257x module (2571, 2572, 2573). If the problem goes away, then the computer system program is in error.</p>
026F	623	<p>REMOTE MEMORY READ: WORD COUNT ERROR</p> <p>The remote PLC responded with fewer words than requested by the Remote Memory Read command block.</p>	<p>This error usually occurs when the number of words requested in the command block causes the read request to exceed the V memory boundary in the remote PLC. In other words, you are trying to read V memory that isn't there.</p> <p>You should reduce the number of words requested, change starting V memory address to a smaller value, or change the memory configuration for the remote PLC.</p>
0271	625	<p>MEMORY TRANSFER WORDS OUT OF RANGE - LOW</p> <p>Offset 4 in the command block for a Remote Memory Read, Remote Memory Write, or Memory Exchange contained 0 or a negative value</p> <p>Offset 8 in the command block for a Memory Exchange contained 0 or a negative number.</p>	<p>Change the value to set the number of words to transfer within the valid range of values.</p> <p>Check that the value in the Command Slot points to the Command Block</p>
0272	626	<p>MEMORY TRANSFER WORDS OUT OF RANGE - HIGH</p> <p>Offset 4 in the command block for a Remote Memory Read, Remote Memory Write, or Memory Exchange contained a value greater than maximum allowed.</p> <p>Offset 8 in the command block for a Memory Exchange contained a value greater than the maximum allowed.</p>	<p>Change the value to set the number of words to transfer within the valid range of values.</p> <p>Check that the value in the Command Slot points to the Command Block</p>

HEX	DEC	DESCRIPTION	SOLUTION
0273	627	<b>BAD OR MISSING DELIMITER</b> The receiving device detected a bad or missing delimiter in the command message	This error usually indicates a transient error in the data link. You should retry the command.  If the receiving node is a computer simulating a 2573-TCM2 PLC slave, ensure that the software is correctly processing the message.  If the error persists contact CTI.
0274	628	<b>BAD BLOCK CHECK CHARACTER</b> The receiving device found the block check character to be bad.	See error code 0273 above.
0275	629	<b>INVALID TYPE</b> The receiving device detected an invalid TYPE character in the message.	See error code 0273 above.
0276	630	<b>INVALID DATA CHARACTER</b> The receiving device detected an invalid data character. Only characters 0-9 and A-F are allowed.	See error code 0273 above.
0277	631	<b>ODD NUMBER OF CHARACTERS</b> The receiving device detected an odd number of characters in the message. All CAMP messages have an even number of characters.	See error code 0273 above.
0278	632	<b>INVALID DEVICE CODE</b> The <i>receiving</i> device reported an invalid device code in the message.	See error code 0273.
027A	634	<b>INVALID DEVICE CODE</b> The 2573 detected an invalid device code in the response from the remote device	This error may result from a transient error in the data link. You should retry the command. If the problem persists, check the quality of the data link.  If the remote node is a computer simulating a 2573 PLC server, ensure that the software is correctly creating the response the response message
027B	635	<b>BAD OR MISSING DELIMITER</b> The 2573 detected a missing delimiter in the response message	See error code 027A.
027C	636	<b>BAD BLOCK CHECK CHARACTER</b> The 2573 found a bad block check character in the response message.	See error code 027A.

HEX	DEC	DESCRIPTION	SOLUTION
027D	637	<p><b>INVALID TYPE</b></p> <p>The 2573 detected an invalid TYPE character in the message sent from the remote device.</p>	See error code 027A.
027E	638	<p><b>INVALID DATA CHARACTER</b></p> <p>The 2573 detected an invalid data character in the message sent from the remote device. Only characters 0-9 and A-F are allowed.</p>	See error code 027A.
027F	639	<p><b>ODD NUMBER OF CHARACTERS</b></p> <p>The 2573 detected an odd number of characters in the message sent from the remote device. All CAMP messages have an even number of characters.</p>	See error code 027A.
0280	640	<p><b>UNKNOWN ERROR CHARACTER</b></p> <p>The response contained an unknown error character.</p>	This error is probably caused by an improperly programmed slave node. If the slave is a PLC emulating a 2573-TCM2 slave, review the code and correct as required. If the slave is another 2573-TCM2 and the error persists, contact CTI.
0284	644	<p><b>INCOMPLETE WRITE</b></p> <p>The actual number of words written does not match the requested number of words.</p> <p>The actual number of words written is contained in the response message from the remote device.</p>	<p>This error is probably caused by an improperly programmed slave. If the slave is a computer system emulating a 2573-TCM2 slave, review the code and correct as required.</p> <p>If the slave is another 2573-TCM2, contact CTI.</p>
0290	656	<p><b>INVALID ADDRESS CLASS</b></p> <p>The address class is not supported by the server</p>	See error 0284 above.
0292	658	<p><b>MESSAGE ID MISMATCH</b></p> <p>The response message contained an ID field which did not match the ID field in the command.</p>	<p>This error could be caused by a timeout value which is too short followed by an attempt to resend. Therefore, by the time the response to the first command arrives, you have already sent a second command. You may correct this condition by increasing the timeout value.</p> <p>This may also be caused by an improperly programmed server. If the server is a PLC emulating a 2573 server, review the code and correct as required.</p>

HEX	DEC	DESCRIPTION	SOLUTION
029A	666	<p><b>ERROR WRITING SERIAL PORT</b></p> <p>The protocol manager encountered an error while writing to a serial port.</p>	<p>Retry the command. If the error persists, this condition may indicate a module hardware problem. Contact CTI.</p>
029D	669	<p><b>CMD TIMEOUT ERROR</b></p> <p>The time to process the requested command exceeded the Command Timeout value. Command processing has been suspended.</p>	<p>The device may be slow in responding, increase the timeout value to determine if the problem will go away.</p> <p>This error may indicate a bad connection (faulty cable, loose connector, etc.). Check all cabling carefully.</p>
029E	670	<p><b>ALREADY BUSY ERROR</b></p> <p>The protocol manager received a new command prior to the completing the previous command.</p>	<p>This error can also be produced by simultaneously triggering two command slots which reference the same command block. If more than one command slot is used, make sure that they reference different command blocks and that the command blocks that they reference have different connection numbers.</p>
02AC	684	<p><b>MEMORY READ ERROR</b></p> <p>The protocol manager was unable to read the requested V memory.</p> <p>If this occurs on a WRITE REMOTE command block, it indicates that the 2573 could not obtain the data from the local PLC V memory.</p> <p>If this occurs on a READ REMOTE command block, it indicates that the memory in the remote device could not be read.</p>	<p>When this error occurs, it is usually due to an invalid memory address specification in the command block. Check the value for Source in Offset 3 and make corrections if necessary.</p> <p>When this error is returned in response to a READ REMOTE command block, it is also possible that there is a problem in the remote PLC which prevents the 2573 from reading V memory. Retry the command. If the problem persists, check the remote device.</p>
02AD	685	<p><b>MEMORY WRITE ERROR</b></p> <p>The was unable to write the requested memory.</p> <p>If this occurs on a WRITE REMOTE command block, it indicates that the remote device could not write the data into remote memory.</p> <p>If this occurs on a READ REMOTE command block, it indicates that the local PLC could not write the result from the remote device into local V memory</p>	<p>When this error occurs, it is usually due to an invalid memory address specification in the command block. Check the value for Destination in Offset 5 and make corrections if necessary.</p> <p>When this error is returned in response to a WRITE REMOTE command block, it is possible that there is a problem in the remote PLC which prevents the 2573 from writing V memory. Retry the command, if the problem persists, check the remote device</p>



## Modem Control Feature Error Codes

The following error codes are unique to the modem control feature.

HEX	DEC	DESCRIPTION	SOLUTION
04BA	1210	MODEM HARDWARE ERROR The modem reported a general error.	Check the modem, modem setup, and cabling. Correct as required.
04BB	1211	NO OR LOST CARRIER This indicates that there is no connection to the remote modem. This error may be encountered during dial up or when attempting to send data. Some modems may return a "No Carrier" message when the remote connection does not answer.	Manual Mode: Acknowledge the error, issue a Hang-Up Command, then re-trigger the Dial Command.  Auto-Dial Mode: Re-trigger the command to transmit a data message.  If the condition persists you should check the remote modem, the signal quality of the phone line, and ensure that the modem is configured for a fixed baud rate.
04BC	1212	NO DIAL TONE No dial tone was detected by the modem This probably results from the modem not connected to the phone line.	Check the phone cable and connections and make necessary corrections.
04BD	1213	BUSY TONE DETECTED The number you are dialing is busy.	Manual Mode: Issue a hang-up command and retry at a later time.  Auto-Dial Mode: Retry the command to which sends a data message.
04BE	1214	NO ANSWER The number you are dialing does not answer.	See error 04BD above.
04BF	1215	INVALID V MEMORY ADDRESS FOR MODEM CONFIGURATION TABLE You have specified a V memory location in the Create Connection command block, offset 11, which is not valid for this PLC memory configuration.	Check the value in the Command block. If the modem flag bit in Offset 10 is set to 1, then offset 11 must contain a valid V memory address. <i>Note that 0 is not a valid V memory address.</i>
04C0	1216	INVALID SIGNATURE IN CONFIG TABLE The first word in the V memory block referenced in offset 11 does not contain the String "AT" (0x4154). This word is used to help ensure that the referenced V memory is really a Modem Configuration Table.	Ensure that the first word in the Modem Configuration Table contains the valid signature value and correct if required.  Check that the value in offset 11 points to the first word in the Modem Configuration Table. Correct if required.

HEX	DEC	DESCRIPTION	SOLUTION
04C1	1217	<p>INVALID V MEMORY ADDRESS FOR DIAL STRING</p> <p>In the dial command block, you have specified a value in offset 4 which is not a valid memory address for this PLC memory configuration.</p>	Correct the entry in offset 4
04C2	1218	<p>INVALID DIAL STRING</p> <p>The high byte of the first word in the dial string does not contain a double quote mark ("), 0x22.</p> <p>OR</p> <p>The ending double quote mark delimiter for the string could not be found.</p>	<p>For manual dial, ensure that the value in Offset 4 of the dial command block points to the first word of the dial string.</p> <p>For auto dial, ensure that the value in offset 6 of the Modem Configuration Table points to the first word of the dial string.</p> <p>Make sure the high byte of the first word contains the double quote mark and that you have entered a double quote mark after the last character in the dial string.</p>
04C3	1219	<p>MODEM SUPPORT IS NOT ACTIVE</p> <p>You have attempted to issue a modem command (dial or hang-up) to a protocol manager which has not been configured for modem support in the Create Connection command block.</p>	Make sure that the modem flag bit has been set for the Create Connection command.
04C4	1220	<p>MODEM STATE MISMATCH</p> <p>You attempted to dial a number while you are already connected and in data mode.</p>	Issue a Hang-Up command before dialing.
04C5	1221	<p>UNKNOWN RESPONSE</p> <p>The modem responded with an unsupported, non-standard reply.</p>	Ensure that you have configured the modem to use the Hayes compatible AT command/reply set (verbose mode).
04C6	1222	<p>INVALID CHARACTER in DIAL STRING</p> <p>An unsupported character has been detected in the dial string</p>	<p>Examine the character string and correct erroneous character entries.</p> <p>Ensure that a double quote delimiter immediately follows the last character in the dial string.</p>
04EA	1258	<p>MODEM BAD CONTROL STATE</p> <p>A modem DIAL command terminated before the call was established</p>	<p>Ensure that the command time-out is not too short and is timing out while the command is actually in progress.</p> <p>Make sure the modem is configured to make responses to our commands.</p> <p>Depending upon why the command failed, a subsequent HANGUP command may free the port from this state.</p>

<b>HEX</b>	<b>DEC</b>	<b>DESCRIPTION</b>	<b>SOLUTION</b>
04EB	1259	MODEM PORT READ FAILURE The module detected an error during a read on a 2573 serial port.	Ensure that the modem is using the same fixed baud rate that the port has been configure to.
04EC	1260	MODEM PORT WRITE FAILURE The module detected an error during a write on a 2573 serial port.	Ensure that the modem is using the same fixed baud rate that the port has been configure to.

## Task Code Master Error Codes

The following error codes may be returned by the Task Code Master protocol manager.

HEX	DEC	DESCRIPTION	SOLUTION
206E	8302	<p>NITP PROTOCOL ERROR</p> <p>The 2573 received an invalid NITP message. NITP protocol errors include:</p> <ul style="list-style-type: none"> <li>- Odd number of characters received,</li> <li>- Invalid characters received,</li> <li>- Checksum error,</li> <li>- Incorrect character count field.</li> </ul>	<p>This usually results from “noise” on the communications line. Retry the command.</p> <p>This may occur if you are using a computer system to emulate a task code slave and the system has been improperly programmed. Try using communicating with another 257x module (2571, 2572, 2573). If the problem goes away, then the computer system program is in error.</p>
2097	9343	<p>UNKNOWN COMMAND</p> <p>The protocol manager received a command number which is not valid.</p>	<p>Ensure that Offset 1 in the Command block contains a valid Command Code.</p> <p>Check to be sure that the Command Slot points to the correct V memory Address for the Command Block.</p> <p>Make sure that you have started the correct protocol manager and that you are using the correct connection number.</p>
2099	8345	<p>ERROR READING PORT</p> <p>The protocol manager detected an error during a read on a 2573 serial port.</p>	<p>Retry the command. If the error persists, this may indicate a module hardware problem. Contact CTI.</p>
209A	8346	<p>ERROR WRITING PORT</p> <p>The protocol manager detected an error during a write on a 2573 serial port.</p>	<p>See error code 0299 above.</p>
209D	8349	<p>CMD TIMEOUT ERROR</p> <p>The time to process the requested command exceeded the Command Timeout value. Command processing has been suspended.</p>	<p>The device may be slow in responding, increase the timeout value to determine if the problem will go away.</p> <p>This error may indicate a bad connection (faulty cable, loose connector, etc.). Check all cabling carefully.</p>

HEX	DEC	DESCRIPTION	SOLUTION
209E	8350	<p><b>ALREADY BUSY ERROR</b></p> <p>The protocol manager received a new command prior to the completing the previous command.</p>	<p>This error can also be produced by simultaneously triggering two command slots which reference the same command block.</p> <p>If more than one command slot is used, make sure that they reference different command blocks and that the command blocks that they reference have different connection numbers.</p>
20AD		<p><b>MEMORY WRITE ERROR</b></p> <p>The 2573 was unable to write the requested memory.</p> <p>If this occurs on a WRITE REMOTE command block, it indicates that the remote device could not write the data into remote memory.</p> <p>If this occurs on a READ REMOTE command block, it indicates that the local PLC could not write the result from the remote device into local V memory</p>	<p>When this error occurs, it is usually due to an invalid memory address specification in the command block. Check the value for Destination in Offset 5 and make corrections if necessary.</p> <p>When this error is returned in response to a WRITE REMOTE command block, it is possible that there is a problem in the remote PLC which prevents the 2573 from writing V memory. Retry the command, if the problem persists, check the remote device</p>

## CAMP Master Error Codes

The following error codes may be returned by the CAMP Master protocol manager.

HEX	DEC	DESCRIPTION	SOLUTION
2465	9317	NITP - CHARACTER PARITY ERROR The receiving device detected a parity error in the NITP message.	This error may occur because of "noise" on the communications line. Retry the command.  You may also observe this error if you have set the communications parameters incorrectly.
2466	9318	NITP - INVALID CHARACTER The receiving device detected an invalid character in the NITP message.	See Error Code 2465.
2467	9319	NITP - INVALID CHARACTER COUNT FIELD The number of characters detected by the receiving device did not match the character count in the NITP message.	See Error Code 2465.
2468	9320	NITP - ODD NUMBER OF CHARACTERS The receiving device detected an odd number of characters in the received NITP message.	See Error Code 2465.
2369	9321	NITP - CHECKSUM ERROR The receiving device detected a checksum error. device detected a parity error in the message.	See Error Code 2465.
246E	9326	NITP - PROTOCOL ERROR When the 2573 sent an NITP message, the receiving device replied with an invalid NITP message. NITP protocol errors include:  - Odd number of characters received, - Invalid characters received, - Checksum error, - Incorrect character count field.	This error may occur due to communications error (line noise, etc.) on serial lines. It may also result from an improperly programmed remote device or a bad cable.  Retry the operation. If the error persists, check out the remote device.
2473	9331	BAD OR MISSING DELIMITER The <i>receiving</i> device detected a bad or missing delimiter in the command message	This error usually indicates a transient error in the data link. You should retry the command.  If the receiving node is a computer simulating a 2573 PLC server, ensure that the software is correctly processing the message.  If the error persists contact CTI.

HEX	DEC	DESCRIPTION	SOLUTION
2474	9332	<b>BAD BLOCK CHECK CHARACTER</b> The <i>receiving</i> device detected an block check character error in the command message.	See error code 2473
2475	9333	<b>INVALID TYPE CODE</b> The <i>receiving</i> device detected a bad command type in the message.	See error code 2473
2476	9334	<b>INVALID DATA CHARACTER</b> The <i>receiving</i> device reported an invalid data character. Only characters 0-9 and A-F are allowed.	See error code 2473.
2477	9335	<b>ODD NUMBER OF CHARACTERS</b> The <i>receiving</i> device reported an odd number of characters in the message. All CAMP messages have an even number of characters.	See error code 2473.
2478	9336	<b>INVALID DEVICE CODE</b> The <i>receiving</i> device reported an invalid device code in the message.	See error code 2473.
247A	9338	<b>INVALID DEVICE CODE</b> The 2573 detected an invalid device code in the response from the remote device	This error may result from a transient error in the data link. You should retry the command. If the problem persists, check the quality of the data link.  If the remote node is a computer simulating a 2573 PLC server, ensure that the software is correctly creating the response the response message
247B	9339	<b>BAD OR MISSING DELIMITER</b> The 2573 detected a missing delimiter in the response message	See error code 247A.
247C	9340	<b>BAD BLOCK CHECK CHARACTER</b> The 2573 found a bad block check character in the response message.	See error code 247A.
247D	9341	<b>INVALID TYPE</b> The 2573 detected an invalid TYPE character in the message sent from the remote device.	See error code 247A.

HEX	DEC	DESCRIPTION	SOLUTION
247E	9342	<p><b>INVALID DATA CHARACTER</b></p> <p>The 2573 detected an invalid data character in the message sent from the remote device. Only characters 0-9 and A-F are allowed.</p>	See error code 247A.
247F	9343	<p><b>ODD NUMBER OF CHARACTERS</b></p> <p>The 2573 detected an odd number of characters in the message sent from the remote device. All CAMP messages have an even number of characters.</p>	See error code 247A.
2480	9344	<p><b>UNKNOWN ERROR CHARACTER</b></p> <p>The response contained an unknown error character.</p>	This error is probably caused by an improperly programmed server node. If the server is a PLC emulating a 2573 server, review the code and correct as required. If the server is another 2573, contact CTI.
2482	9346	<p><b>INVALID WORD COUNT</b></p> <p>The number of words in the response message does not match the actual number of words in the message.</p>	This error is probably caused by an improperly programmed remote device. If the device is a PC emulating a 2573 server, review the code and correct as required. If the device is another 2573, contact CTI.
2490	9360	<p><b>INVALID ADDRESS CLASS</b></p> <p>The address class is not supported by the server</p>	See Error Code 2482
2492	9362	<p><b>CAMP ID MISMATCH</b></p> <p>The response did not contain a message ID which matched the command.</p> <p>This can be caused by an improperly programmed remote device. It can also be caused by a response delays which exceed the command timeout value. Thus it may be a response to a previous command.</p>	<p>Check the remote device for problems and correct as required.</p> <p>Determine whether you have response delays that exceed the command timeout. You may be able to increase the timeout value so that the command waits longer for a response.</p>
2497	9367	<p><b>UNKNOWN COMMAND</b></p> <p>The protocol manager received a command number which is not valid.</p>	<p>Ensure that Offset 1 in the Command block contains a valid Command Code.</p> <p>Check to be sure that the Command Slot points to the correct V memory Address for the Command Block.</p> <p>Make sure that you have specified the correct protocol manager number in the Create Connection command and that you are using the right connection number.</p>



HEX	DEC	DESCRIPTION	SOLUTION
2498	9368	<p><b>COULD NOT OPEN PORT</b></p> <p>The protocol manager could not open the 2573 serial port. This may occur during a Create Connection command.</p>	<p>This could result from a hardware error, which may be transient. Retry the command. If the error persists, reset the module. If the error re-occurs after reset, replace the module.</p>
2499	9369	<p><b>ERROR READING PORT</b></p> <p>The protocol manager detected an error during a read on a 2573 serial port.</p>	<p>See error code 2498 above.</p>
249A	9370	<p><b>ERROR WRITING PORT</b></p> <p>The protocol manager detected an error during a write on a 2573 serial port.</p>	<p>See error code 2498 above.</p>
249D	9373	<p><b>CMD TIMEOUT ERROR</b></p> <p>The time to process the requested command exceeded the Command Timeout value. Command processing has been halted.</p> <p>Note that the timeout value may have been explicitly set in the Command Block or the default may have been used (timeout = 0).</p>	<p>In some circumstances, you may occasionally get a timeout error, especially with heavy network traffic or remote modem data links. In these circumstances, your logic should retry the command.</p> <p>This error may indicate a bad connection (faulty cable, loose connector, etc.). Check all cabling carefully.</p> <p>If the error persists and you have explicitly set the timeout value, it is possible that you have set the timeout value too small. Try increasing the value or using the default value.</p>
249E	9374	<p><b>PROTOCOL MANAGER BUSY</b></p> <p>The protocol manager received a new command prior to completing the previous command.</p>	<p>You can cause this error by using two command slots to send concurrent commands to the same connection number. Don't do this.</p>
249F	9375	<p><b>INVALID CONNECTION NO.</b></p> <p>The connection number used during Create Connection was out of the valid range. The valid range of connection numbers is 19221 - 19299.</p>	<p>Correct the command block data.</p>
24A0	9376	<p><b>BAUD RATE SELECTION ERROR</b></p> <p>The protocol manager was passed an invalid baud rate. Valid baud rates are 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600, and 19200.</p>	<p>This error usually results from an incorrect value in the command block for the Create Connection command. Check the value and correct any entry errors. Ensure that the Command Slot points to the correct command block.</p>

HEX	DEC	DESCRIPTION	SOLUTION
24A1	9377	DATA BITS SELECTION ERROR The protocol manager was passed an invalid value for data bits. Valid data bit values are 5, 6, 7, 8.	See error code 24A0 above.
24A2	9378	PARITY SELECTION ERROR The protocol manager was passed an invalid parity value. Valid parity values are 0-None, 1-Odd, 2-Even.	See error code 24A0 above.
24A3	9379	STOP BIT SELECTION ERROR The protocol manager was passed an invalid number of stop bits. Valid stop bit values are 1 and 2.	See error code 24A0 above.
24A4	9380	HANDSHAKE SELECTION ERROR The protocol manager was passed an invalid handshake value. Valid handshake values are:  0-No Handshake, 1-Software Handshake, 2-Hardware Handshake.	See error code 24A0 above.
24AC	9388	MEMORY READ ERROR The 2573 was unable to read the requested V memory.	When this error occurs, it is usually due to an invalid memory address specification in the command block. Check the value for Source in Offset 3 and make corrections if necessary.  Check to ensure that the PLC you are addressing is configured for the address you are trying to access.
24AD	9389	MEMORY WRITE ERROR The 2573 was unable to write the requested V memory.	See Error Code 24AC above

## General ASCII Support (GAS) Protocol Manager Error Codes

The error codes generated by the GAS protocol manager can be found in the *CTI General ASCII Protocol Manager Reference Manual*.

### 2573 Internal Errors

Error codes which have a value greater than hex C8 in the *low* byte are internal code errors. If you should experience one of these errors, contact CTI for assistance.

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## APPENDIX C. REFERENCE MATERIAL

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00	NUL
01	SOH
02	STX
03	ETX
04	EOT
05	ENQ
06	ACK
07	BEL
08	BS
09	HT
0A	LF
0B	VT
0C	FF
0D	CR
0E	SO
0F	SI
10	DLE
11	DC1
12	DC2
13	DC3
14	DC4
15	NAK
16	SYN
17	ETB
18	CAN
19	EM
1A	SUB
1B	ESC
1C	FS
1D	GS
1E	RS
1F	US

20	space
21	!
22	"
23	#
24	\$
25	%
26	&
27	'
28	(
29	)
2A	*
2B	+
2C	,
2D	-
2E	.
2F	/
30	0
31	1
32	2
33	3
34	4
35	5
36	6
37	7
38	8
39	9
3A	:
3B	;
3C	<
3D	=
3E	>
3F	?

40	@
41	A
42	B
43	C
44	D
45	E
46	F
47	G
48	H
49	I
4A	J
4B	K
4C	L
4D	M
4E	N
4F	O
50	P
51	Q
52	R
53	S
54	T
55	U
56	V
57	W
58	X
59	Y
5A	Z
5B	[
5C	\
5D	]
5E	^
5F	_

60	`
61	a
62	b
63	c
64	d
65	e
66	f
67	g
68	h
69	i
6A	j
6B	k
6C	l
6D	m
6E	n
6F	o
70	p
71	q
72	r
73	s
74	t
75	u
76	v
77	w
78	x
79	y
7A	z
7B	{
7C	
7D	}
7E	~
7F	DEL

### Hexadecimal to ASCII Conversion Table

## Command Block Summary

The following information is provided as a quick reference. See Chapter 2 for more information on the command blocks.

### Create Connection

The CREATE CONNECTION command associates a protocol manager with a physical port. Unless you have set the module dip switches to automatically start a protocol manager on a port, you must complete the CREATE CONNECTION command before you can use the port.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command (Create Connection)	0001	1
2	Connection Number (19221 - 19299)		
3	Protocol Manager Number		
4	Physical Port Number (1,2,3,4)		
5	Port Baud Rate (300, 600, 1200, 2400, 4800, 9600, 19200)		
6	Bits Per Character (7 or 8)		
7	Parity (0=None, 1=Odd, 2= Even)		
8	Stop Bits (1 or 2)		
9	Handshake (0=None, 1=Software, 2=Hardware)		
10	Option Bits (0x0000 = None, 0x0001 = Modem)		
11	V Memory Address of Modem Configuration Table		
10-15	Unused - reserved for future use (Set to 0)	0000	0

### Close Connection

The Close Connection command unloads the protocol manager associated with a given connection number and frees the resources used by the particular instance of the protocol manager.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command Code (Close Connection)	0002	02
2	Connection Number (19221 - 19299)		
3 - 15	Unused (Set to 0)	0000	0

## Word Transfer - Write Remote Memory

The Write Remote Memory command is used to copy values from local V memory to memory in the remote device. It can be used with the Task Code Master and the CAMP Master protocol managers.

If the protocol manager was started using the CREATE CONNECTION command, the Connection Number should match the one used in the CREATE CONNECTION Command block. If the protocol manager was automatically started (based on dip switch settings) the last two digits of the Connection Numbers should match the port number (for example, 19201 for port 1).

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command Code (Write Remote Memory)	0201	513
2	Connection Number (19201 - 19299)		
3	Source: Starting V Memory Address in this PLC		
4	Number of Words to Transfer (1-256)		
5	Destination: Starting V Memory Address in Remote PLC		
6	Command Timeout in seconds (0=Use Default)	0000	0
7-15	Unused (Set to 0)	0000	0

## Word Transfer - Read Remote Memory

The READ REMOTE MEMORY command is used to copy values from memory in the remote device to local V memory. It can be used with the Task Code Master and the CAMP Master protocol managers. See the section above regarding the use of Connection Number.

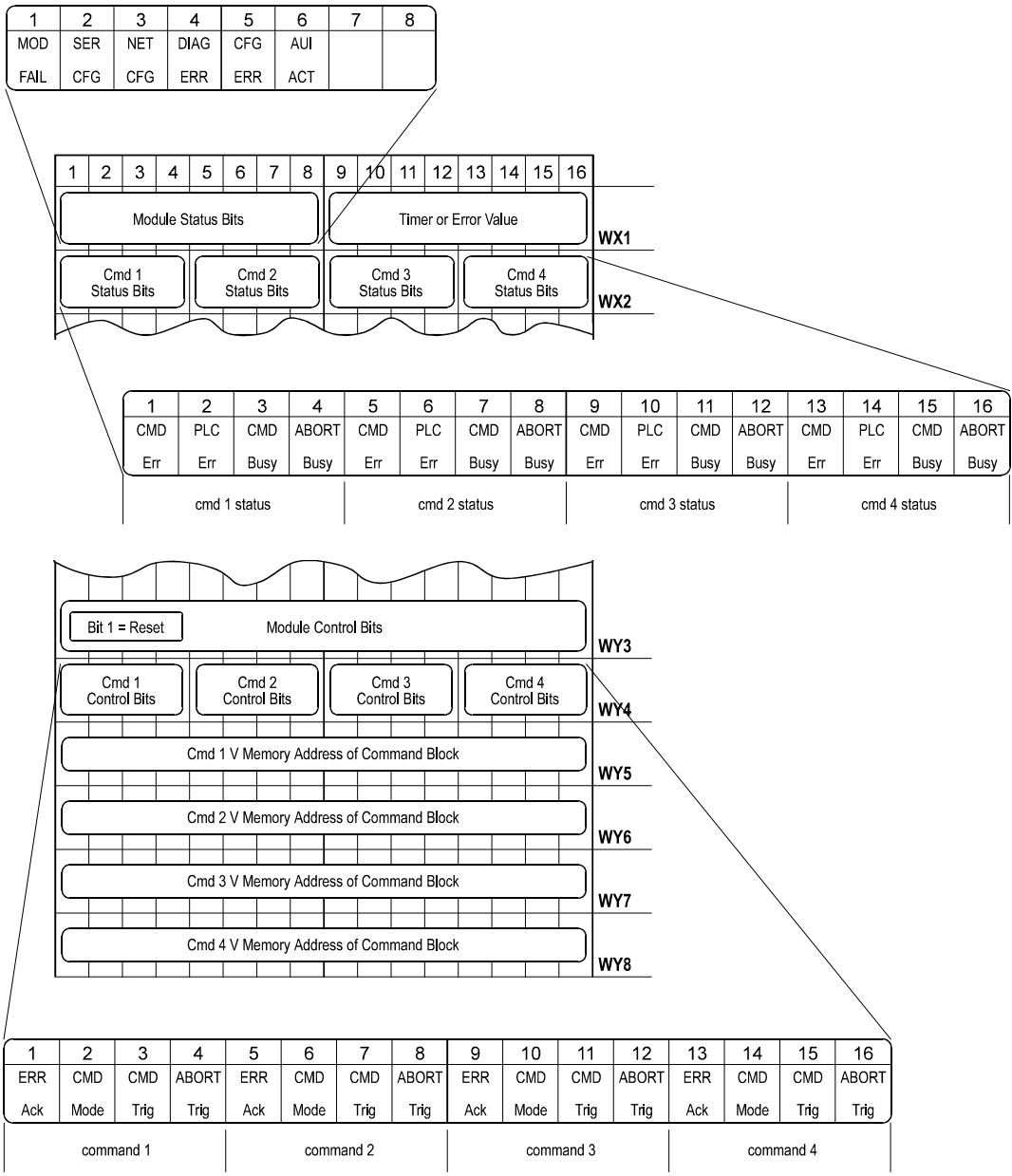
Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0	0
1	Command Code (Read Remote Memory)	0202	514
2	Connection Number (19201 - 19299)		
3	Source: Starting V Memory Address in Remote PLC		
4	Number of Words to Transfer (1-256)		
5	Destination: Starting V Memory Address in this PLC		
6	Command Timeout in seconds (0=Use Default)	0	0
7-15	Unused (Set to 0)	0	0

## Word Transfer - Memory Exchange

The MEMORY EXCHANGE command is used to exchange V memory data blocks between two PLCs, each containing a 2573 module. It can be used with the CAMP Master protocol manager only.

Offset	Description	Hex Value	Decimal Value
0	Command Error Word	0000	0
1	Command Code (Memory Exchange)	0203	515
2	Connection Number (19221 - 19299)		
3	Write Source: Starting V Memory Address in Local PLC		
4	Number of Words to Write (1-254)		
5	Write Destination: Starting V Memory Address in Remote PLC		
6	Command Timeout in seconds (0=Use Default)	0000	0
7	Read Source: Starting V Memory Address in Remote PLC		
8	Number of Words to Read (1-256)		
9	Read Destination: Starting V Memory Address in Local PLC.		
10 - 15	Unused (Set to 0)	0000	0

# WX / WY Quick Reference







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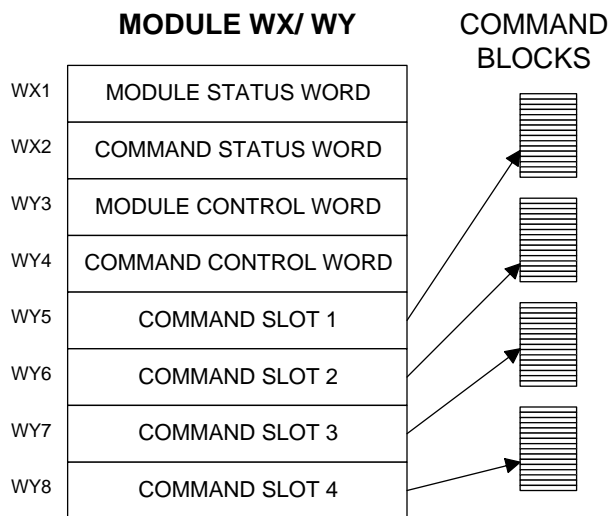
## APPENDIX D. PLC COMMAND INTERFACE

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### General Description

The module logs into the PLC as 2 WX inputs and 6 WY outputs. The PLC controls the module by placing values in specific WY words. The PLC obtains status information from the module via the WX words. Areas of V memory called *Command Blocks* are used to store command information.

Figure 22 illustrates the 2573 PLC Command Interface. The control structures consist of the module



**Figure 22. PLC Command Interface**

WX/WY words and the Command Blocks. Words WY5-WY8 contain the V memory addresses of the command blocks. Using this command interface, the PLC can initiate up to four commands at one time. The status and control bits for the four commands are located in WX2 and WY4, respectively.

## Command Processing Modes

You can specify how the module command execution is synchronized with the PLC logic by setting the Command Mode bit in WY4. The Command Mode bit is described in detail later in this appendix. You can select either *coupled* mode or *uncoupled* mode.

### Coupled Mode Processing

Coupled Mode provides for tight "handshaking" between the module and the PLC. When the PLC triggers the command, the module will execute the command *only once*. The module will then wait for acknowledgment from the PLC before allowing the command to be triggered again. Coupled mode is useful for initiating transfers that must be done exactly one time per PLC event (such as Starting the Network Server).

### Uncoupled Mode Processing

Uncoupled Mode does not require a handshaking sequence from the PLC. When Uncoupled Mode is selected, the module will execute the command continuously as long as the command trigger is set. Uncoupled mode is useful for providing continuous updates of PLC data.

## Command Processing Procedure

Following is the typical procedure used to initiate a module command:

- Set up the Command Block(s) in V memory using TISOFT
- Load the command slot(s) with the address of the Command Block(s).
- Set the applicable command trigger and mode bits in WY4.
- Monitor the status of the command processing using WX2.

## WX/WY Description

Figure 23 shows the layout of the WX and WY words assigned to the module. WX1 and WY3 are used for global module control and status. The remaining words are used for command processing. Note there are four command slots, which allows the PLC to trigger up to four module commands in one scan. The four sets of bits in WX2 and WY4 correspond to the four command slots.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Module Status Word																WX1
Command Status Word																WX2
CMD 1 Status Bits				CMD 2 Status Bits				CMD 3 Status Bits				CMD 4 Status Bits				
Module Control Word																WY3
Command Control Word																WY4
CMD 1 Control Bits				CMD 2 Control Bits				CMD 3 Control Bits				CMD 4 Control Bits				
Command Slot 1: V Memory Address of Command Block for CMD1																WY5
Command Slot 2: V Memory Address of Command Block for CMD2																WY6
Command Slot 3: V Memory Address of Command Block for CMD3																WY7
Command Slot 4: V Memory Address of Command Block for CMD4																WY8

**Figure 23. WX/WY Map**

## Module Status Word

The module Status Word is located in the module WY1. This word is used to communicate the overall status of the module. The module uses the following bit structure:

1	2	3	4	5	6	7	8	9 - 15
MOD FAIL	SER CFG	NET CFG	DIAG ERR	CFG ERR	AUI ACT	RSVD	RSVD	Timer E Code

### **MOD FAIL** - *Severe Module Failure*

If the diagnostics discovers a severe fault, the module sets the MOD FAIL bit and (usually) one of the of the error bits to indicate the problem source. After a delay of about 1 second, the module will perform an internal reset and attempt to perform normal processing. If the fault recurs, the wait and reset cycle will be repeated indefinitely. If the fault is cleared, the module will resume normal operations.

### **SER CFG** - *Serial Configuration Required*

This bit will remain set until *all* serial ports have been configured. When all ports have been configured, this bit will be cleared.

### **NET CFG** - *Network Configuration Required*

Not used by the 2573 module.

### **DIAG ERR** - *Diagnostic Detected Error*

If the module diagnostics detect a faulty RAM or ROM, the DIAG ERR bit will be set. When this type of error occurs, the problem is severe. The module will also set the module fail bit and perform a reset after a short delay.

### **CFG ERR** - *Configuration Error*

This bit will be set if the module detects invalid hardware switch settings or invalid EEPROM data at startup / reset time.

### **AUI ACT** - *AUI Active*

Not used by the 2573 module.

### **RSVD** - *Reserved*

These bit positions are reserved for future use.

### **TIMER/ ECODE** - *Timer or Error Code*

When the module processor is operating and there are no significant errors, the lower 8 bits of WX1 will display the value of a module timer. If a hardware error occurs, an error code will be written to this field, if possible.

**NOTE:**

*The changing timer bits are an indication that the module processor is operating.*

## Module Control Word

Module Control Word (WY3)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mod Rst	Reserved Bits (Set to 0)														

Module Control Bits are contained in WY3. Bit 1 is a module reset bit. **When the bit is set and all four abort triggers are set, the module will perform a hardware reset.** This operation resets the processor and starts all hardware diagnostics and startup functions. It is available for extreme error cases where simply acknowledging an error or aborting a command does not clear the error.

*NOTE:*  
*Once the module has reset, your PLC logic must re-execute any commands used to configure the module or to start the network server.*

Bits other than bit 1 are reserved for future use and should be set to 0.

## Command Control and Command Status Words

The command status word and the command control word contains bits that are used to synchronize and control the execution of module commands. The Command Control Word is located in module word WY4 and contains bits that are set by the PLC logic. The Command Status Word is located in WX2 and contains bits that are set by the module.

Since the PLC can send up to four commands to the module per scan, both the Command Control Word and the Command Status Word contain four sets of bits, one set for each possible concurrent command. For example, the first four bits (bits 1-4) in both words relate to command Slot 1, the next four bits (bits 5-8) relate to command Slot 2, etc.

The four command slots execute commands independently. Thus, an error on one command does not affect processing on the other commands than happen to be executing at the same time. The command slots can be triggered at different times or some (or all) may be triggered concurrently.

### Command Status Word

The Command Status Word contains bits that are set by the module. The following illustration indicates how the bits within the word are used.

COMMAND STATUS WORD (WX2)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CMD Err	PLC Err	CMD Busy	Abt Busy	CMD Err	PLC Err	CMD Busy	Abt Busy	CMD Err	PLC Err	CMD Busy	Abt Busy	CMD Err	PLC Err	CMD Busy	Abt Busy
COMMAND 1				COMMAND 2				COMMAND 3				COMMAND 4			

**CMD Err**      *Command Error.* The 2573 sets this bit when it encounters an error while attempting to execute the command. The 2573 will write an error code into Offset 0 of the command block unless PLC ERR is also set (see below).

**PLC Err**      *PLC Read/Write Error.* The 2573 sets this bit to indicate that it could not read a valid command block from V memory. Therefore, there is no place to write an error word. This may be caused by loading a value in the Command Slot which is not a valid V memory location (such as 0) or which points to V memory that does not contain a Command Block.

**CMD Busy**      Indicates the module is in the process of executing a command.

**ABORT Busy**      Indicates the module is attempting to abort a command.

### Command Control Word

The Command Control Word contains bits that are set by the PLC logic. The following illustration indicates how the bits within the word are used.

COMMAND CONTROL WORD (WY4)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
ERR Ack	CMD Mode	CMD Trig	Abort Trig	ERR Ack	CMD Mode	CMD Trig	Abort Trig	ERR Ack	CMD Mode	CMD Trig	Abort Trig	ERR Ack	CMD Mode	CMD Trig	Abort Trig
COMMAND 1				COMMAND 2				COMMAND 3				COMMAND 4			

- ERROR Ack**     *Error Acknowledge.* The PLC sets this bit to acknowledge the error bit which was set by the 2573.
- CMD Mode**     *Command Mode.* The PLC sets this bit to control how the module command execution is synchronized with the PLC logic:  
                          0 = Uncoupled mode - The 2573 command processing is not synchronized with the PLC logic.  
                          1 = Coupled mode - The 2573 command processing is synchronized with the PLC logic.
- CMD Trig**     *Command Trigger.* The PLC sets this bit to initiate a command.
- ABORT Trig**    *Abort Trigger.* The PLC sets this bit to abort a command in progress.

## WX2 and WY4 Relationships

The following illustrates the relationship between the first four bits in WX2 and WY4. This relationship applies to the other three sets of bits.

Word	Bit 1	Bit 2	Bit 3	Bit 4
WX2	CMD Err	PLC Err	CMD Busy	Abort Busy
WY4	ERR Ack	CMD Mode	CMD Trigger	Abort Trigger

### *Error Processing Bits*

The module will set CMD ERR any time an error occurs in processing a command. The module will also set PLC ERR if a valid Command Block cannot be read from V memory. After setting the error bits, the module will halt processing on this command. The PLC acknowledges the error by setting ERR ACK. When the module sees ERR ACK go high, it aborts the command, clears the error bits, and is ready to accept another command trigger for this slot.

### *Command Processing bits*

The PLC sets the CMD MODE bit to select whether Coupled Mode or Uncoupled Mode is used. The PLC sets the CMD TRIGGER to initiate the command. When the module begins command processing, it sets the CMD BUSY bit. The CMD BUSY bit will remain on until the module has completed processing the command.

### *Abort Processing Bits*

The PLC can set the ABORT TRIGGER to request the module to abort a command that is in process. When the module starts the process of aborting a command, it raises the ABORT BUSY bit. When the process is complete, it lowers ABORT BUSY (and also CMD BUSY).

The timing diagrams in this appendix describe the interaction of the various Command Control and Command Status bits.

### **Command Slots (WY5-WY8)**

Module words WY5, WY6, WY7, and WY8 are called Command Slots. There are four command slots, one for each possible concurrent command. The value in the command slot points to the V memory address of a command block as illustrated below. Addresses of 0 or less are invalid. Addresses greater than 64k cannot be referenced.

COMMAND SLOTS

WY5	Command Slot 1: V Memory Address of Command Block for CMD1
WY6	Command Slot 2: V Memory Address of Command Block for CMD2
WY7	Command Slot 3: V Memory Address of Command Block for CMD3
WY8	Command Slot 4: V Memory Address of Command Block for CMD4

Note that the command slots match up with the command control and command status bits in WY4 and WX2. For example, the command block whose address in Command Slot 1 will be triggered by setting bit 3 in WY4 (Bit 3 is the Command Trigger for Command 1).



## Command Blocks

Command Blocks contain information which specifies how the command is to be executed. The standard Command Block consists of 16 contiguous words located in the first 64k of PLC V memory and has the following general structure.

Offset	Contents
0	Error Word
1	Command Code
2	Connection Number
3	Command Parameter 1
4 - 15	Additional parameters

**Error Word** Assuming the Command Block is valid, the module will write an error code into this location when it encounters an error in executing the command. The error code can be used during development as an aid to de-bugging logic. It may also be used by the PLC logic as an indication to execute specific error processing logic.

**Command Code** The Command Code is a number which uniquely defines the command you wish to execute.

**Connection Number** The connection number identifies the instance of the protocol manager with which you are communicating. A connection number is similar to a file handle used in other operating environments. The connection number is established when a CREATE CONNECTION or CREATE SOCKET command is executed. During this process, a specific protocol manager is loaded and associated with a particular physical port or a network socket. If the connection is created using PLC logic, the programmer can assign a connection number. If the connection is automatically created by the module, the module will assign a connection number.

The high byte of the Connection number should always contains hex 4B. The module uses this byte as a Command Block "signature". The use of the signature byte provides a way for the module to verify that the address you loaded in the command slot indeed points to a valid command block and not some arbitrary area of V memory. When the module detects that you have referenced an area of V memory where the high byte of offset 3 does not contain hex 4B, it asserts the CMD Err and PLC Err. Since the module assumes that a block without a signature byte is not a command block but a reference error, it does not attempt to process the block of V memory and does not write any error information back into offset 0 of the block .

**Command Parameters** The command parameters provide command execution information. For example, for a Read Command they may specify where to obtain the data, how many words to read, and where to store the results. The number of command parameters required will vary with different commands.

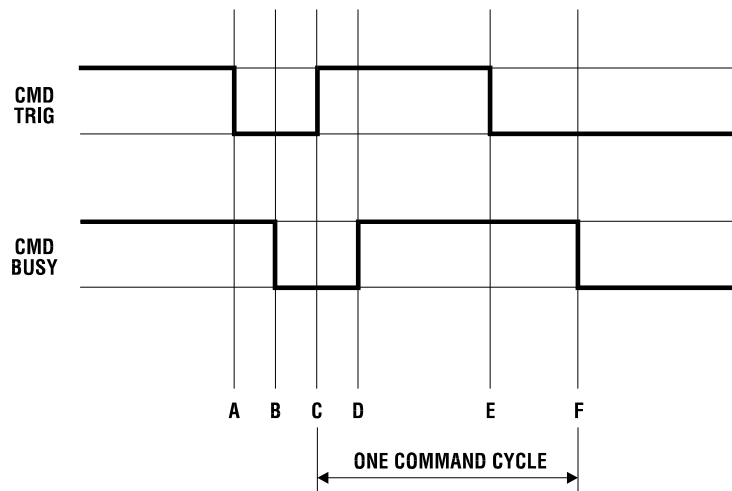
## Command Timing Diagrams

### Coupled Mode Timing (CMD Mode = 1)

Coupled Mode should be selected when you want to ensure that the module will execute a command only once per trigger. In Coupled Mode the PLC and the module use the CMD TRIG (Command Trigger) and the CMD BUSY (Command Busy) bits in a "handshaking" sequence. The following figure illustrates the timing relationships between CMD TRIG and CMD BUSY for a Coupled Mode command.

The PLC has cleared CMD TRIG (Time A) and the module has cleared CMD BUSY (Time B) indicating that the processing of the previous command is complete.

At Time C, the PLC asserts CMD TRIG to initiate a command. When the module recognizes that CMD TRIG is high, it asserts CMD BUSY (Time D) and samples the CMD MODE bit to determine the command mode. It then retrieves the command block and starts processing the command. Any time after the PLC sees CMD BUSY go high, it may lower CMD TRIG (Time E).



*Figure 24. Coupled Mode Timing*

Once the module completes processing the command, it samples CMD TRIG. If CMD TRIG is off, the Module will lower CMD BUSY (Time F) and wait for the next trigger. If CMD TRIG is on, the module will hold busy high and wait until CMD TRIG is turned off. Time F will be delayed as required until CMD TRIG is off. At time F (equivalent to time B), both CMD TRIG and CMD BUSY are low and a new cycle can begin whenever the PLC asserts CMD TRIG.

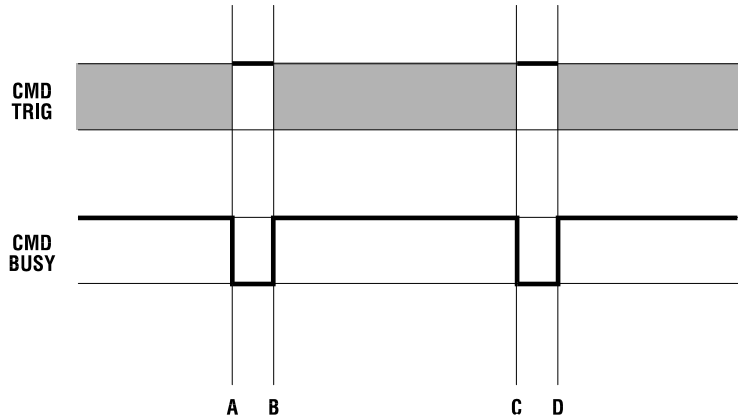
**NOTE:**

*The Command Block is subject to access and change by the module anytime after CMD TRIG is asserted (time C) until CMD BUSY is cleared (time F), Thus, the Command Block should not be changed by the PLC at any time between time C and F.*

### Uncoupled Mode Timing (CMD Mode =0)

Uncoupled Mode may be selected when close synchronization between the PLC and the module is not required. In this mode, a single trigger can cause the module to execute a command many times. Uncoupled mode is useful in applications where you want to continuously update the remote PLC. Uncoupled Mode usually takes less PLC logic to implement than Coupled Mode. The following figure illustrates the timing relationships between CMD TRIG and CMD BUSY for an Uncoupled Mode command. The shaded area in the diagram indicates that it does not matter what the status of the bit happens to be (*don't care* condition).

At time A, the module has cleared CMD BUSY, indicating that Command processing is complete. When CMD BUSY is low and CMD TRIG is high the module will assert CMD BUSY (Time B) and begin command processing. CMD BUSY will remain on during the processing of the Command Block. When the processing is complete, the module will lower CMD BUSY (Time C). *Note that in Coupled Mode, the module would wait for the PLC to lower the trigger before clearing CMD BUSY.*



**Figure 25. Uncoupled Mode Timing**

At the next end of the PLC I/O scan, the module will again sample CMD TRIG. If CMD TRIG is high, the module will raise CMD BUSY and processing of the Command Block will start again.

Note that the PLC logic is not required to cycle CMD TRIG and that the PLC may change the state of CMD TRIG at any time. As soon as the module completes a command and lowers CMD BUSY, it will sample CMD TRIG. If CMD TRIG is set, it will execute the command.

If constant operation is desired, the PLC can simply leave the CMD TRIG on. The Module will then repeat the command as fast as possible.

**NOTE:**

*The contents of the Command Block are subject to access and change by the module at any time from the assertion of CMD TRIG (Time A) until CMD BUSY is cleared (Time C). If CMD TRIG is held high, the CMD BUSY transition may never be detected by the PLC. Therefore, if you wish to change the command to the module, the PLC logic should clear CMD TRIG and ensure CMD BUSY is cleared before changing the contents of the Command Block or the associated Command Slot.*

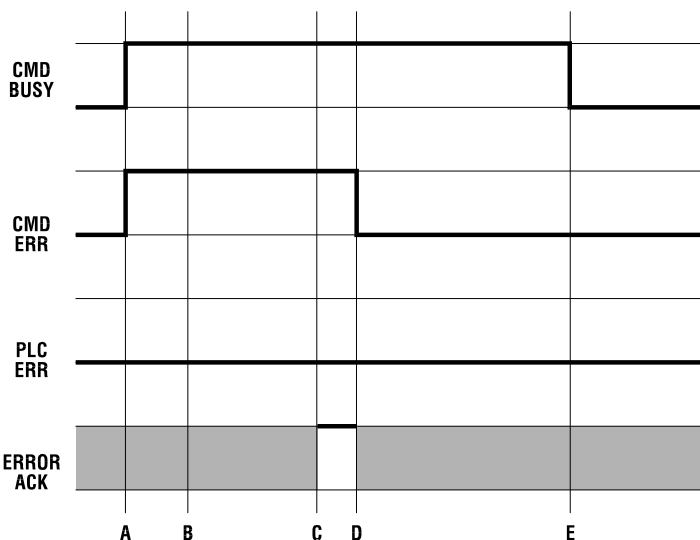
## Command Error Timing

The module provides a mechanism for command execution communicating errors to the PLC. This is accomplished via the CMD ERR bit and the ERROR WORD in the Command Block. The following figure illustrates Command Error timing. Note that the shaded area indicates a "don't care" condition for the particular bit.

At time A, the module has set CMD BUSY and is attempting to retrieve the command block and to process the command.

Some time later, a command processing error occurs. The module writes error information into the error word of the Command Block and asserts CMD ERR at time B. Processing of this command is halted.

If the module cannot write the error word to the Command Block, it also asserts the PLC ERR bit (see the following section). *The error word is valid only when CMD error is asserted and PLC ERR is clear.*



**Figure 26. Command Error Timing**

At the end of each PLC I/O scan, the module samples the state of ERROR ACK (Error Acknowledge). As soon as the module detects that ERROR ACK is set (Time C), it will turn off CMD ERR (and PLC ERR if on) at Time D and proceed with the error recovery.

After error recovery is completed, the module will clear CMD BUSY (Time E). This may or may not be in the same PLC I/O scan. CMD ERR will never be asserted unless CMD BUSY is asserted. CMD ERR is always cleared prior to or at the same time as the release of the CMD BUSY signal (Time D is always before or the same as time E).

**NOTE:**

*The contents of the error word in the Command Block is valid only when CMD ERR is asserted and PLC ERR is clear.*

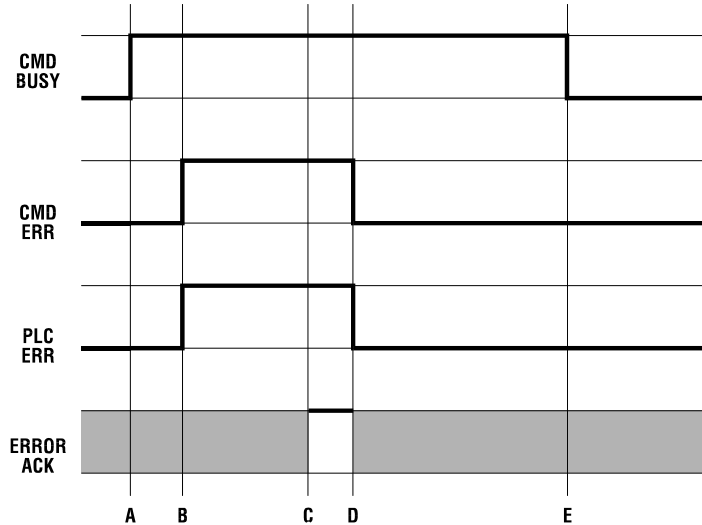
The ERROR ACK signal is sampled only when CMD ERR or PLC ERR is asserted; transitions are not part of the timing cycle. Thus, if you wish to ignore all errors in your PLC logic, the PLC can set the ERROR ACK bit to 1 and leave it on.

## PLC Error Timing

A PLC error occurs when the module cannot read a valid Command Block from the PLC V memory or it cannot write back to this location. The following diagram illustrates timing for the PLC ERR bit. Note that the shaded area indicates a "don't care" condition for the particular bit.

At time A, the module has set CMD BUSY and attempts to retrieve the command block from V memory. At time B, the module determines it cannot retrieve a valid command block and asserts the CMD ERR and the PLC ERR bit. Since a valid command cannot be retrieved, the module halts processing of this command.

At time C the module samples the ERROR ACK bit and determines that it is asserted, indicating that the PLC has acknowledged the error. Some time later the module clears the CMD ERR and PLC ERR bits (Time D) and the CMD BUSY bit (Time E). The error bits will always be cleared prior to or at the same time as CMD BUSY.



**Figure 27. PLC Error Timing**

Note that, in this example, no error code is written to the command block. Since a Command Block could not be read, the module does not attempt to write an error code into the V memory location indicated in the command slot.

**NOTE:**

- When the PLC ERR bit is set, it is almost always the result of:*
- 1) an invalid address in the Command Slot (WY5, WY6, WY7, or WY8) or*
  - 2) a command block connection number that does not have hex 4B in the high byte*
- If the PLC ERR bit is on, you should check your PLC logic carefully!*

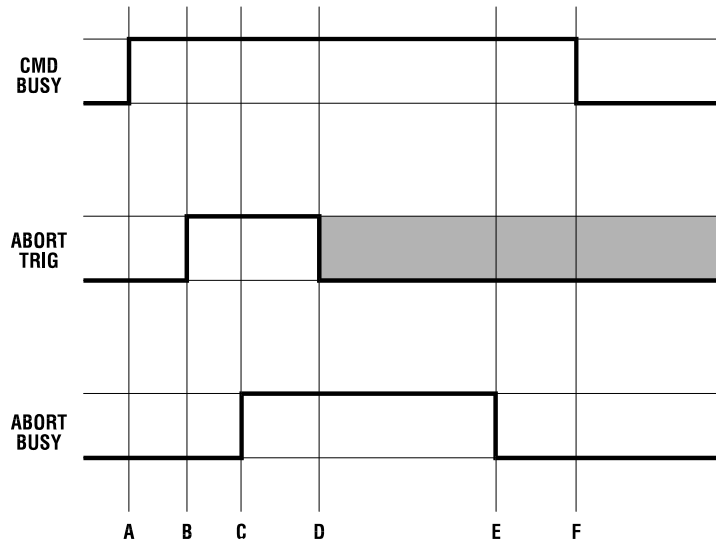
## Command Abort Timing

There may be rare occasions when you need to abort a command that is in progress. For example, if you triggered a READ REMOTE command with an infinite timeout and the data was never returned, the protocol manager would wait forever, blocking further execution in the command slot. Figure 28 illustrates abort timing.

Assume the module is busy processing a command (Time A). At time B, the PLC asserts ABORT TRIG to stop the ongoing command processing. When the module recognizes that ABORT TRIG is high, the module will assert ABORT BUSY (Time C).

After detecting ABORT BUSY, the PLC should clear ABORT TRIG (Time D). When the Module has completed abort processing, it clears ABORT BUSY (Time E).

After ABORT BUSY is cleared, the module will clear CMD BUSY (Time F). Time F may be on the same scan or on a later scan than time D. ABORT BUSY will never be asserted unless CMD BUSY is also asserted.



**Figure 28. Command Abort Timing**

**NOTE:**

*ABORT BUSY will be cleared even if the ABORT TRIG is still active. If the PLC does not clear ABORT TRIG, no further commands will be processed for the Command slot.*

Depending upon the nature of the command and circumstances of execution, some commands cannot be aborted.

**NOTE:**

*Setting all four abort triggers and asserting the module reset bit in WY3 will cause the module to perform a complete reset.*

## General Command Considerations

When designing your PLC logic you should be aware of the following:

- The Command Trigger is ignored for a command if the associated Abort Trigger is set.
- In Uncoupled Mode, the PLC may not see CMD BUSY go low in between command cycles. After you lower the trigger, the module may execute the command additional times.
- If ERR ACK is set and left high, the associated CMD ERR bit may be set and cleared without the PLC detecting it.
- With the notable exception of Module Reset (all four abort triggers are set along with the module reset bit) the command slots are totally independent. Unless the commands are directed to a common resource, the command slots should have no effect on each other.





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## **HARDWARE SPECIFICATIONS**

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### **Serial Communications Ports:**

4ea. - combined RS-232, RS422, and RS-485  
Hardware Handshake lines - RTS, CTS  
1500 VDC Isolation - channel to PLC

### **Switch Configurable Serial Port Communications Parameters:**

Data Rate: 1200,2400,**9600**,19200 Baud  
Data Bits: 7  
Parity: Odd  
Stop Bits: 1  
Hardware Handshaking: **Disabled**, Enabled (switch selectable, RS-232 port)  
*Values in bold represent the factory switch settings.*

### **Software Configurable Serial Port Communications Parameters**

Data Rate: 300, 600, 1200, 2400, 4800, 9600, 19200 Baud  
Data Bits: 7 or 8  
Parity: Even, Odd, None  
Stop Bits: 1,2  
Handshaking: Hardware, Software, None

### **Diagnostic LEDs:**

1 ea. - Module Status (ACTIVE)  
4 ea. - Transmit Data (Serial Port 1-4)  
4 ea. - Receive Data (Serial Port 1-4)

### **Module Size:**

Single Wide TI505 I/O

### **Backplane Power Consumption:**

6.0 watts @ 5 VDC

### **Operating Temperature:**

0° to 60° C (32° to 185° F)

### **Storage Temperature:**

-40° to 85° C (-40° to 185° F)

### **Humidity:**

0% to 95%, non-condensing

### **Shipping Weight:**

2 Lb.



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## **LIMITED PRODUCT WARRANTY**

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CTI warrants that this CTI Industrial Product shall be free from defects in material and workmanship for a period of one (1) year after purchase from CTI or from an authorized CTI Industrial Distributor. This CTI Industrial Product will be newly manufactured from new and/or serviceable used parts which are equal to new in the Product.

Should this CTI Industrial Product fail to be free from defects in material and workmanship at any time during this (1) year warranty period, CTI will repair or replace (at its option) parts or Products found to be defective and shipped prepaid by the customer to a designated CTI service location along with proof of purchase date and associated serial number. Repair parts and replacement Product furnished under this warranty will be on an exchange basis and will be either reconditioned or new. All exchanged parts or Products become the property of CTI. Should any Product or part returned to CTI hereunder be found by CTI to be without defect, CTI will return such Product or part to the customer.

This warranty does not include repair of damage to a part or Product resulting from: failure to provide a suitable environment as specified in applicable Product specifications, or damage caused by an accident, disaster, acts of God, neglect, abuse, misuse, transportation, alterations, attachments, accessories, supplies, non-CTI parts, non-CTI repairs or activities, or to any damage whose proximate cause was utilities or utility like services, or faulty installation or maintenance done by someone other than CTI.

Control Technology Inc. reserves the right to make changes to the Product in order to improve reliability, function, or design in the pursuit of providing the best possible Product. CTI assumes no responsibility for indirect or consequential damages resulting from the use or application of this equipment.

THE WARRANTY SET FORTH ABOVE IN THIS ARTICLE IS THE ONLY WARRANTY CTI GRANTS AND IT IS IN LIEU OF ANY OTHER IMPLIED OR EXPRESSED GUARANTY OR WARRANTY ON CTI PRODUCTS, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE AND IS IN LIEU OF ALL OBLIGATIONS OR LIABILITY OF CTI FOR DAMAGES IN CONNECTION WITH LOSS, DELIVERY, USE OR PERFORMANCE OF CTI PRODUCTS OR INTERRUPTION OF BUSINESS, LOSS OF USE, REVENUE OR PROFIT. IN NO EVENT WILL CTI BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.



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## ***REPAIR POLICY***

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In the event that the Product should fail during or after the warranty period, a Return Material Authorization (RMA) number can be requested orally or in writing from CTI main offices. Whether this equipment is in or out of warranty, a Purchase Order number provided to CTI when requesting the RMA number will aid in expediting the repair process. The RMA number that is issued and your Purchase Order number should be referenced on the returning equipment's shipping documentation. Additionally, if the product is under warranty, proof of purchase date and serial number must accompany the returned equipment. The current repair and/or exchange rates can be obtained by contacting CTI's main office at 1-800-537-8398.

When returning any module to CTI, follow proper static control precautions. Keep the module away from polyethylene products, polystyrene products and all other static producing materials. Packing the module in its original conductive bag is the preferred way to control static problems during shipment. Failure to observe static control precautions may void the warranty. For additional information on static control precautions, contact CTI's main office at 1-800-537-8398.

# WX/WY QUICK REFERENCE

