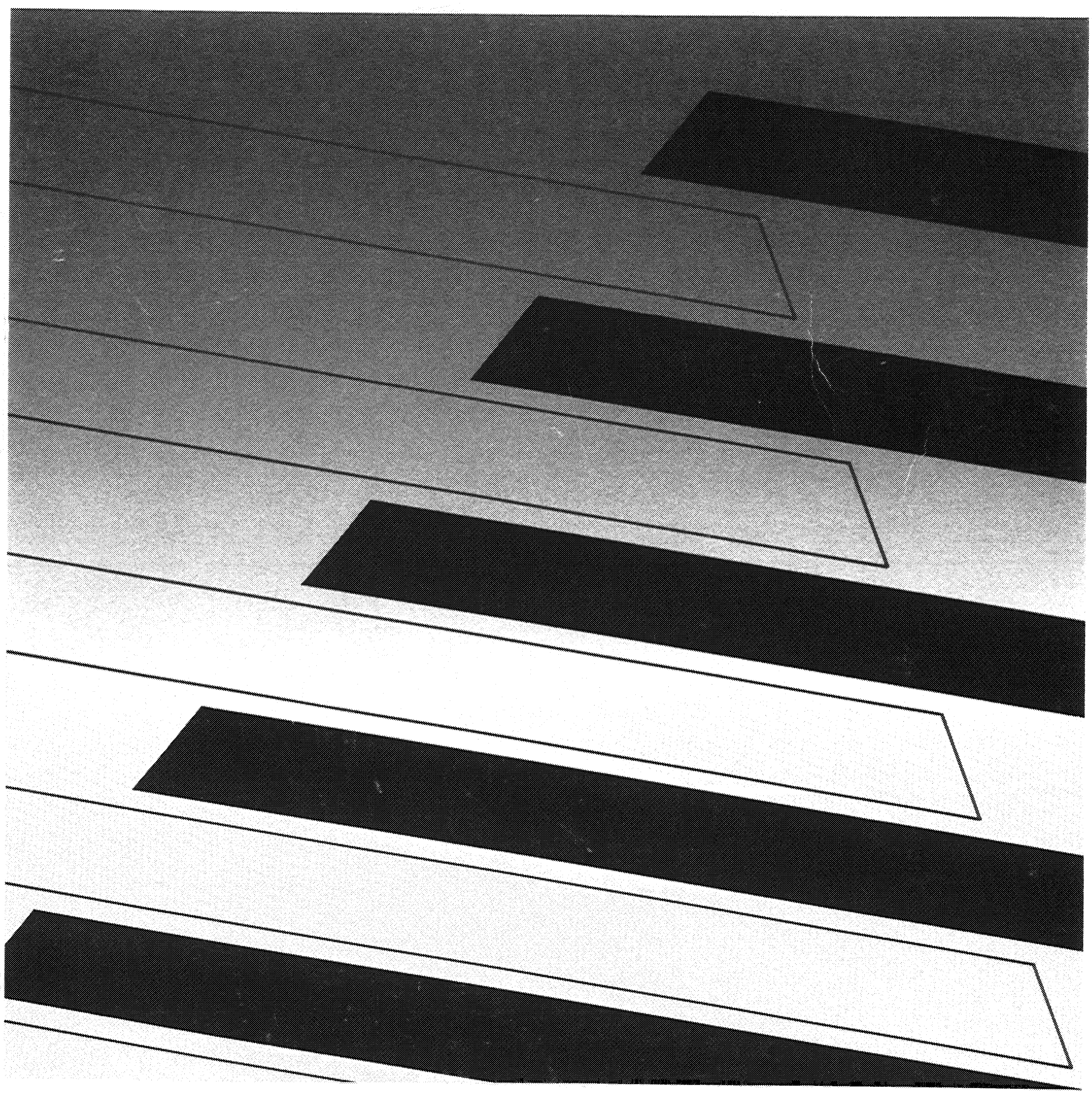
Allen-Bradley
1771-KA2 Communication Adapter Module

User's Manual



Important User Information

Because of the variety of uses for the solid state equipment described herein, and because of the differences between it and electromechanical equipment, you must satisfy yourself as to its acceptability for each of your applications. In no event will Allen-Bradley Company be responsible or liable for indirect or consequential damages that may result from installation or use of this equipment.

The illustrations, charts, and layout examples shown in this manual are intended solely to help you understand the text, not to guarantee operation. Because of the many variables and requirements associated with any particular installation, Allen-Bradley Company will not assume responsibility for actual use based upon illustrations of applications.

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Table of Contents

Chapter 1

Introduction

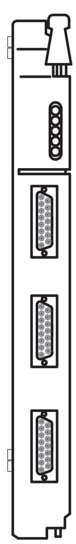
Description

An Allen-Bradley Data Highway extends the capabilities of programmable controllers by letting them exchange data with each other and with other intelligent RS-232-C devices. Data Highway integrates individual controllers into a larger automated manufacturing network. On a single Data Highway cable, as many as 64 separate programmable controllers and computers can be connected over a distance of 10,000 feet (3,048m).

The unit that interfaces PLC-2 family programmable controllers to this network, and makes communication possible, is an A-B Communication Adapter Module (cat. no. 1771-KA2). (See Figure 1.1) It is a Data Highway station interface module and is used with Bulletin 1772 programmable controller processors. These processors are:

- PLC-2 Processor (cat. no. 1772-LR)
- PLC-2/20 Processor (cat. no. 1772-LP1, -LP2)
- PLC-2/30 Processor (cat. no. 1772-LP3)

Figure 1.1
Communication Adapter Module (cat. no. 1771-KA2)



10862-I

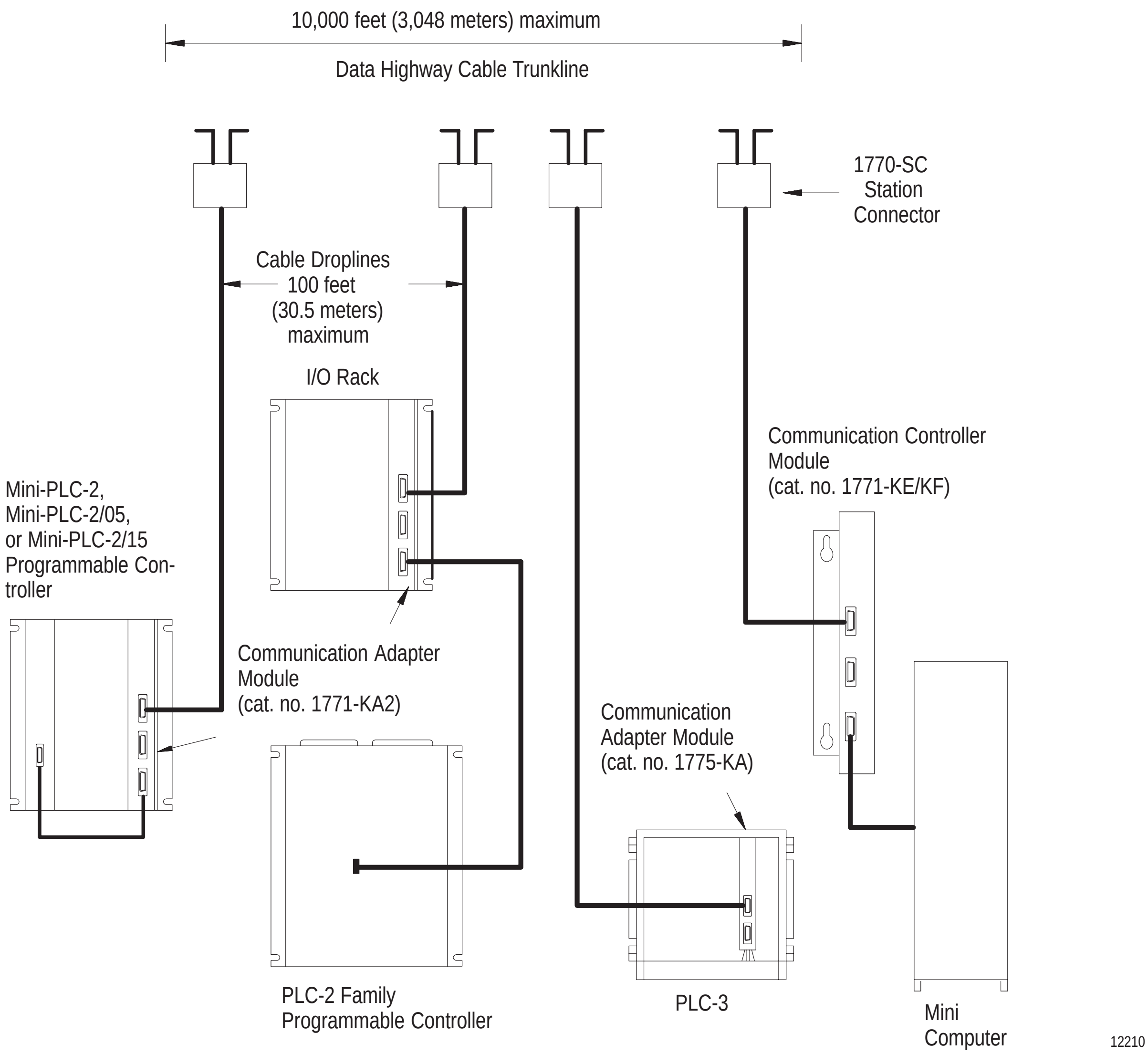
- Mini-PLC-2 Processor (cat. no. 1772-LN1, -LN2, -LN3)
- Mini-PLC-2/05 (cat. no. 1772-LS, LSP)

- Mini-PLC-2/15 (cat. no. 1772-LV)

This module enables communication of memory data between these processors, and from any of these processors to other processors on the Data Highway via communication adapter modules.

A typical Data Highway configuration is shown in Figure 1.2.

Figure 1.2
Representative Data Highway Configuration



About This Manual

The terms “communication adapter module” and “1771-KA2” and “KA2” are interchanged throughout the manual.

This manual describes installation, operation, and programming necessary to use the KA2 communication adapter module. Use this manual with the other manuals and publications pertinent to your system. Table 1.A lists other available Data Highway manuals and Table 1.B lists PC manuals.

Table 1.A
Data Highway Documentation

Old Publication Number	New Publication Number	Title
1774-819	1774-6.5.8	User's Manual, Communication Adapter Module (cat. no. 1771-KA)
1771-822	1771-6.5.15	User's Manual, Communication Controller Module (cat. no. 1771-KE/KF)
1771-823	1771-6.5.16	User's Manual, PROVOX system Interface Module (cat. no. 1771-KX1)
1773-801	1773-6.5.2	User's Manual, PLC-4 Microtrol Communication Interface Module (cat. no. 1773-KA)
1775-802	1775-6.5.1	User's Manual, Communication Adapter Module (cat. no. 1775-KA)
1771--811	1771-6.5.8	User's Manual, PLC-2 Family/RS-232-C Interface Module (cat. no. 1771-KG)
1770-810	1770-6.2.1	Data Highway Cable Installation Manual

Table 1.B
Manuals for Allen-Bradley Programmable Controllers

Controller	Old Number	New Number	Manual TItle
Mini-PLC-2 Program. Cont.	1772-820 1772-821	1772-6.6.3 1772-6.8.4	Assembly and Installation Programming and Operation
Mini-PLC-2/05	1772-830 1772-831	1772--6.6.6 1772-6.8.6	Assembly and Installation Programming and Operations
Mini-PLC-2/15 Program. Cont.	1772-803 1772-804	1772-6.6.1 1774-6.8.2	Assembly and Installation Programming and Operations
PLC-2/20 Program. Cont.	1772-807 1772-802	1772-6.6.2 1772-6.8.1	Assembly and Installation Programming and Operations
PLC-2/30 Program. Cont.	1772-807 1772-806	1772-6.6.2 1772-6.8.3	Assembly and Installation Programming and Operations
PLC Program. Cont.	1774-812 1774-800	1774-6.6.2 1774-6.8.1	Assembly and Installation Programming and Operations
PLC-3 Program. Cont.	1775-800 1775-801	1775-6.7.1 1775-6.4.1	Installation and Operations Programming
PLC-4 Microtrol	1773-800	1773-6.5.1	Product Guide

To use this manual, 1772-6.5.1, knowledge of the particular progammable controller being used in your application is essential. Because you connect the communication adapter module to an operating programmable controller, you must have a good understanding of programmable controller operation, installation, memory structure, and programming.

Publications are available for each Allen-Bradley programmable controller. All publications in Table 1.A and Table 1.B are available from an A-B sales office, or from Allen-Bradley Publications, 6100 Industrial Court, Greendale, WI 53129.

Features of a 1772-KA2

- Here are some of the KA2’s features:
- New commands have been added to the 1771-KA2 that simplify upload and download procedures.
- A KA2 lets you to change (remotely) the size of the PC data table. (New with 1772-KA2 module.)
- It has second module or “daisy chain” capability. (New with 1772-KA 2 module.)
- Uses ladder diagram instructions for ease of programming.
- Offers memory write protection through programming and switch selection.

- Controls communication without need for a host computer.
- Has automatic error checking of data it receives.
- Has self-checking diagnostics.
- Shows status and diagnostics with LED indicators and error codes.
- Controls DONE and REMOTE/LOCAL FAULT memory bits as status and diagnostic indicators.
- Automatically re-tries messages.
- Automatically recovers from master station fault condition.
- Has selectable priority levels for commands.
- Is compatible with industrial terminal system.
- Installs easily.

Organization

The chapters in this manual are organized as follows and each chapter closes with a summary:

- Chapter 2 describes the hardware components that make up a Data Highway station.
- Chapter 3 outlines procedures for module installation.
- Chapter 4 describes programmed commands and memory access.
- Chapter 5 describes programming of the communication zone of program.
- Chapter 6 describes status words that are controlled by the module at its station processor.
- Chapter 7 outlines programming that is necessary to initiate and monitor command execution.
- Chapter 8 describes station interface module interaction along the Data Highway.
- Chapter 9 describes start-up and troubleshooting tools and procedures.
- Chapter 10 provides aids to design and documentation of a Data Highway that uses a communication adapter module.

Chapter Summary

This chapter discussed:

- Features of a 1771-KA2 Communication Adapter Module
- How the module fits into an A-B Data Highway system
- What a 1771-KA2 does, and the A-B PLC data processor it works with
- Publications available for Data Highway and PLC-2 family PCs

In chapter 2 you will learn about a Data Highway station and the KA2's role in station function.

Chapter 2

Station Hardware

General

The following components make up a Data Highway station with a PLC-2 family PC:

- Communication Adapter Module
- Processor
- PLC-2 I/O adapter module for PLC-2/20 and PLC-2/30 processors
- Bulletin 1771 I/O chassis
- Power supply
- Data Highway/Processor cable
- Data Highway cable dropline

Figure 2.1 shows the configuration of a typical Data Highway station for PLC-2/20 and PLC-2/30 processors. Figure 2.2 shows a typical configuration for the mini-processor module.

Figure 2.1
Typical Station Configuration--PLC-2/20 and PLC-2/30 Processors

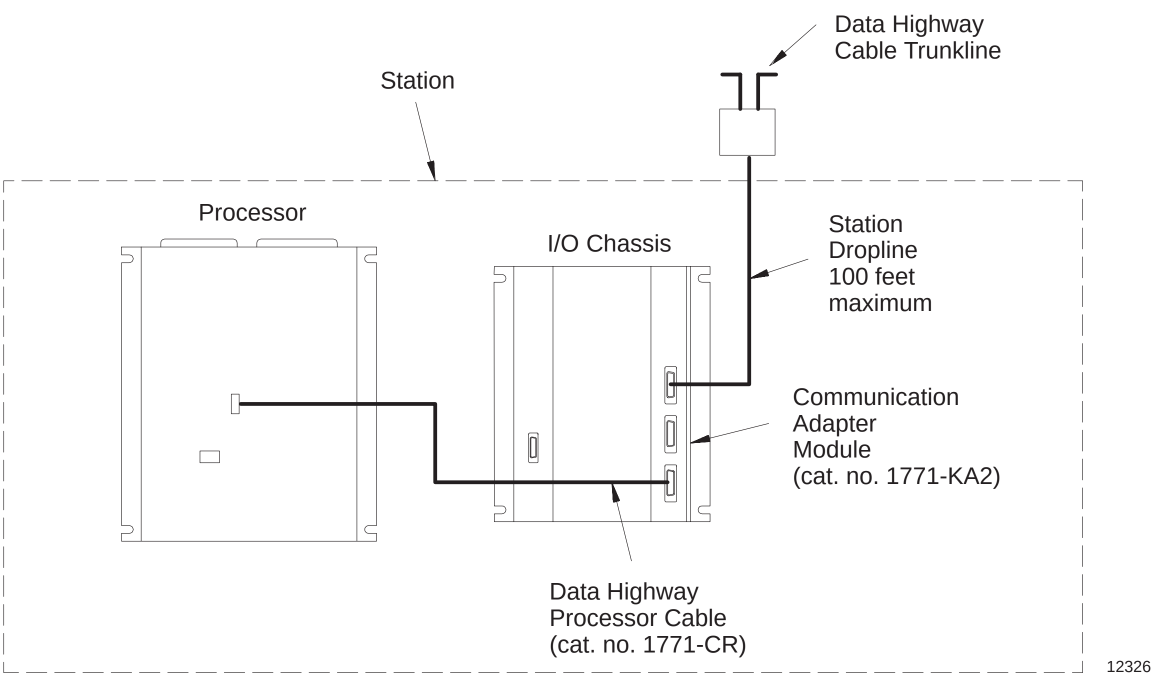
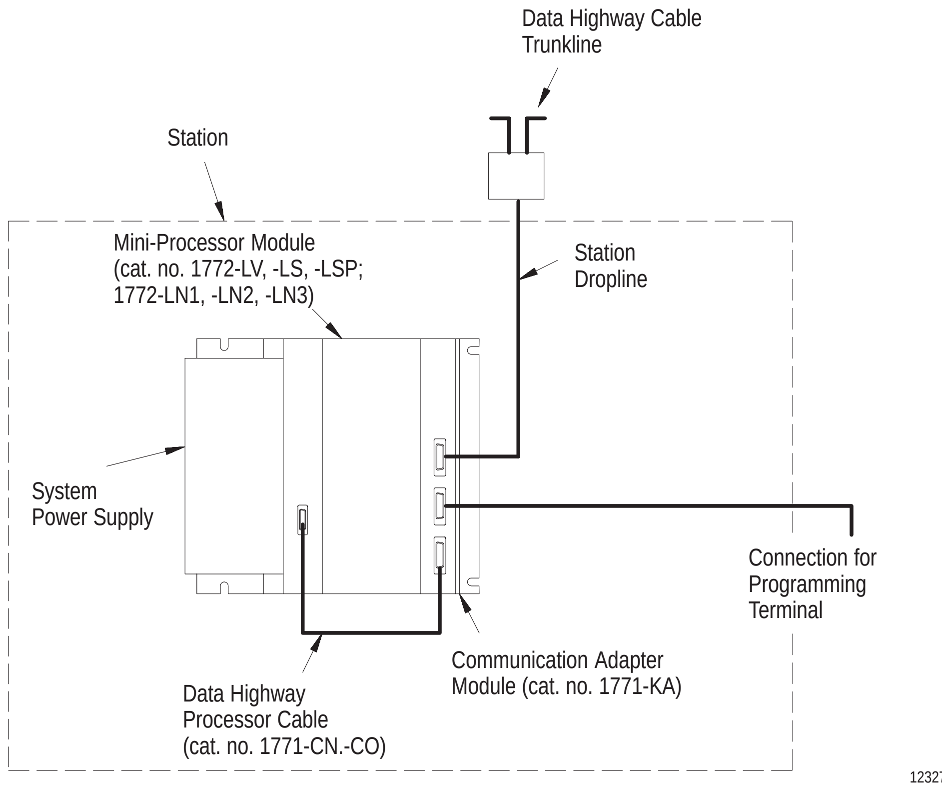


Figure 2.2
Typical Station Configuration--Mini-PLC-2, Mini-PLC-2/05, and Mini-PLC-2/15 Controllers



As these figures illustrate, the term “station” combines both the communication adapter module and its connected programmable controller processor. (When specifying only the individual processor or communication adapter module at a station, the terms “station processor” or “station communication adapter module” are used.)

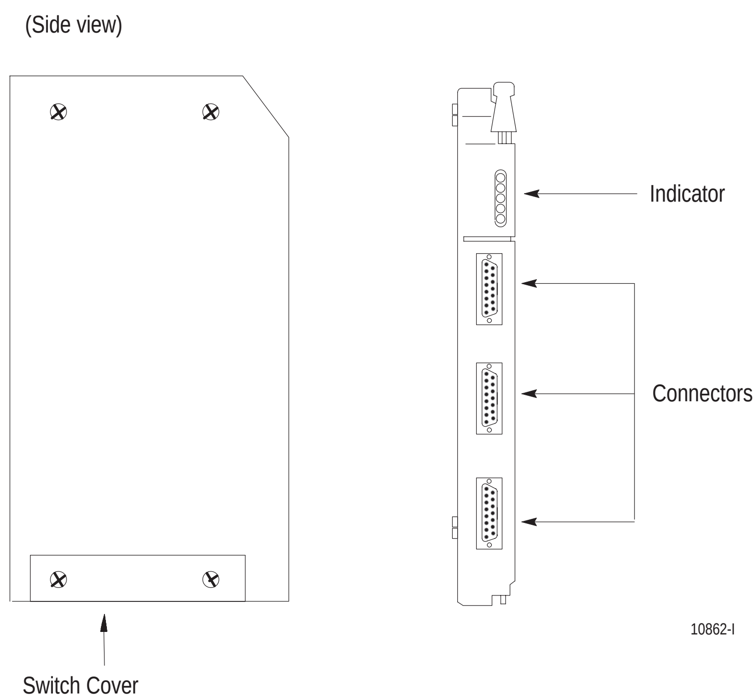
The following sections describe the functions and compatibility of each station hardware component.

Communication Adapter Module

A communication adapter module (cat. no. 1772-KA2) provides the interface between all PLC-2 family PCs and other stations on the Data Highway. (Refer to Figure 2.3). The module has sockets for cable connection, switches for enabling or disabling specific module operations, and indicators to aid in monitoring module behavior and in troubleshooting. Subsequent sections describe each of these parts of the module and other aspects of module hardware that are significant in its set-up and installation.

Each communication adapter module in a Data Highway installation must have a unique station number. This station number is used to address commands to the module from other stations.

Figure 2.3
Communication Adapter Module (cat. no. 1771-KA2)



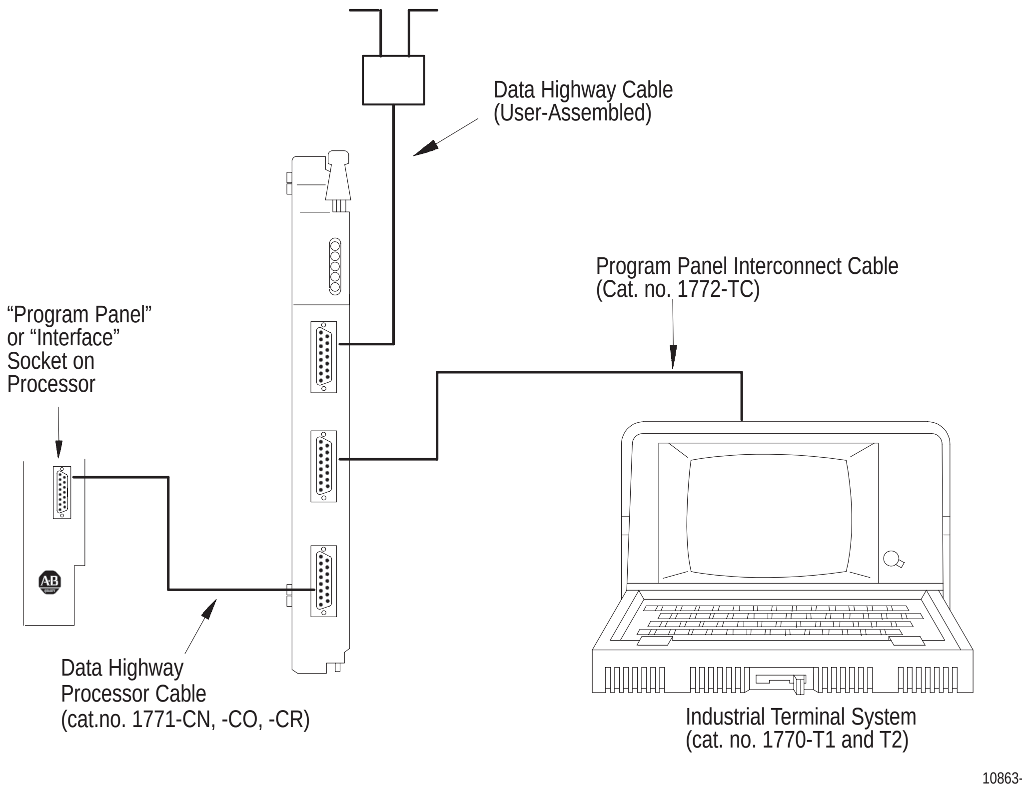
Connectors

The front of a 1772-KA2 module has 3 cable connectors labeled:

- DATA HIGHWAY
- PROGRAM INTERFACE
- PROCESSOR

See Figure 2.4.

Figure 2.4
Module Connection Summary



Data Highway Connector

The upper connector of the module accepts the 15-pin Data Highway dropline cable. Through this connection, a single KA2 module can communicate with as many as 63 other Data Highway stations.

Module transmitting and receiving circuitry on this channel are transformer-coupled to the Data Highway link. This design permits differential transmission of data with high common-mode noise immunity. Electrically, transformer coupling provides isolation between module logic circuitry and the Data Highway cable.

Program Interface Connector

The middle outlet on the module connects to an industrial terminal system (cat. no. 1770-T1, -T3), or to a second KA2, or to a 1771-KG series B module.

To connect any programming terminal to the PROGRAM INTERFACE connector, use a program panel interconnect cable (cat. no. 1772-TC).

With a 1772-KA2 module installed, the PROGRAM INTERFACE connector substitutes for the PROGRAM PANEL connector on PLC-2/20 or PLC-2/30 processors or the INTERFACE socket on the Mini-PLC-2, Mini-PLC-2/05, or Mini-PLC-2/15. This means that all interaction between the processor and the programming terminal is controlled through the communication adapter module. This interaction includes program entry and any functions that involve peripheral devices except cassette loads--including report generation, contact histograms, and generation of program copies on paper or on punched tape.

The communication rate over this channel is 9600 baud. Optical-electrical isolation is provided between receiving circuitry on this channel and module logic circuitry.

NOTE: The PROGRAM INTERFACE connector need not connect to a programming terminal for the module to operate. This connector serves as a programming terminal connection whenever such a device is needed for program entry, editing or monitoring.

Processor Connector

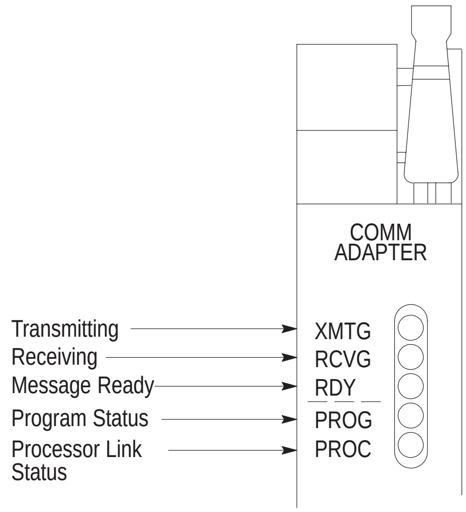
The lower connector of the module connects to the station PLC-2/20 or PLC-2/30 processor, or Mini-processor module. (Refer to Figure 2.1 and Figure 2.2) A Data Highway/Processor cable, described in section titled “Cables,” is used for this connection.

Indicators

There are 5 LED indicators on the front of the module, as seen in Figure 2.5.

These indicators are useful for monitoring module activity and for troubleshooting. Three green indicators show module status during normal receiving and transmitting of messages. Two red indicators show the status of module diagnostics.

Figure 2.5
Module Indicators



XMTG

The green transmitting indicator turns on when the module is current master of the Data Highway. When this indicator is on, therefore, the communication adapter module is transmitting messages on the Data Highway communication link, or it is polling.

RCVG

The receiving indicator turns on when the module is receiving a message addressed to it. Otherwise, RCVG is off.

When both the RCVG and XMTG indicators are on, the module is current master of the Data Highway and is polling. (The section titled "Polling," in chapter 8, describes polling procedure.)

RDY

The green message ready indicator turns on when the module has messages ready to transmit. With this indicator on, the module is ready to assume mastership when it is polled.

PROG

The red program status indicator tells you the status of module checks on the communication zone rungs of the user program. (The section titled "Overall Format," chapter 5, describes these rungs.) The module first checks these rungs at power-up. When it locates the header rung of this zone, the module turns the PROG indicator on. After it checks the rungs, provided no errors are found, the module turns the PROG indicator OFF. However, if the module detects any programming error in the communication zone of the program, this indicator remains ON. In this event, the module cannot function. You must check the communication zone of the program and correct any errors. (Start-up procedures are described in chapter 9.)

PROC

The red processor link status indicator gives the status of error-checking diagnostics for communication adapter/processor communication. The PROC indicator is normally off.

Should the 1771-KA2 module detect an error in data transmission with the processor, it turns the PROC indicator on. This may mean one of the following:

- Disconnection of the Data Highway/Processor cable between the communication adapter and the processor
- Fault in processor operation
- Incorrect selection of processor link communication rate on the module (Refer to section titled "Write Option Switch Assembly," chapter 3).

The section titled "Module Indicators," in chapter 9, describes the use of indicators in troubleshooting.

Switches

There are 3 sets of switches on the 1771-KA2 module circuit board. These switches are beneath the small switch cover plate on the component-side cover of the module. (Refer to Figure 2.3).

The programmer selects the settings of these switches for each communication adapter module, based upon such variables as station number, command capabilities, and type of station processor. Switch settings are a part of module installation, described in chapter 3.

Module Specification Summary

Table 2.A lists operating specifications for a 1771-KA2 module.

Table 2.A
Operating Specifications

Function
- Interface entire PLC-2 family programmable controller to the Data Highway

Location
- Bulletin 1771 I/O Chassis (any slot except furthest left)

Communication Channels
- To Data Highway
- To programming terminal or second module in daisy chain
- To processor or first module in daisy chain

Communication Rates
- To Data Highway: 57.6k baud (Recommended)
- To programming terminal or second module: 9.6k buad
- To processor: 91.2k baud for processor (except PLC-2, cat. no. 1772-LR); 9.6k baud for first communication module or PLC-2-family processor.

Compatible Power Supplies
- System power supply (cat. no. 1771-P1)
- Auxiliary power supply (cat. no. 1772-P2)
- System power supply module (cat. no. 1772-P1, series B or later)
- Auxiliary power supply (cat. no. 1772-P2 series B or later)
- Power supply module 1771-P3
- Power supply module 1771-P4
- Power supply module 1771-P5

Ambient Temperature Rating
- 32^{o} to 140^{o}F (0^{o} to 60^{o}C) (operational)
- -40^{o} to 185^{o}F (-40^{o} - 85^{o}C) (storage)

Humidity Rating
- 5% to 95% (without condensation)

Keying
- Module slotted for I/O chassis keying band positioning.
- Positions 4-6, 22-24

Power Supply Requirement
- +5V DC at 1.2A (max.)

Processor

This manual uses the term “processor” as a general term for any of the PLC-2 family processors. Individual processors are specified only when some distinction must be made.

The normal operating sequence of the station processor is not changed by a communication adapter module, that is, the processor carries out its scan of input and output modules and execution of the user program as though the communication adapter module weren’t there.

The interaction between a KA2 module and its station processor occurs in memory control. The station KA2 can read data from and write data into processor memory, based on various user-programmed commands. Commands that originate at a station communication adapter module can control only data table areas of processor memory. Commands generated by a computer that is connected to the Data Highway through a communication **controller module** (cat. no. 1771-KE/KF) can control both data table and user program memory areas.

Note that the processor continues to execute the user program and to control output devices, whether or not the station communication adapter module is in operation. Thus, disconnection of the Data Highway cable or faulted operation of the communication adapter module does not cause shutdown of the station processor.

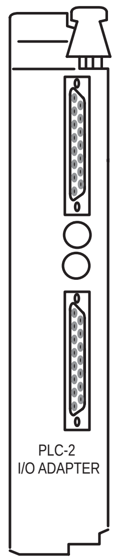
I/O Chassis

A-B designed the 1771-KA2 module to fit in a Bulletin 1771 I/O chassis assembly (cat. no. 1771-A1,-A2,-A4). This chassis houses Mini-PLC-2, Mini-PLC-2/05 and Mini-PLC-2/15 programmable controllers. With one of these controllers, you can use any unoccupied I/O slot for communication adapter modules.

With PLC-2/20 and PLC-2/30 programmable controllers, use a Bulletin 1771 I/O chassis as an I/O rack. In this case, the 1771-KA2 module can be installed in any chassis slot except the one furthest left. This left-most slot must be occupied by a PLC-2 I/O adapter module (cat. no. 1771-AL or 1771-AS), shown in Figure 2.6, or a backplane jumper board assembly (cat. no. 1771-EY).

A Bulletin 1771 I/O chassis is usually mounted within an enclosure. We recommend proper grounding of this enclosure because it minimizes the effect of noise from the surrounding industrial environment. (Grounding procedures for the Bulletin 1771 I/O chassis are described in publication 1772-6.6.3).

Figure 2.6
1771-AL Adapter Module



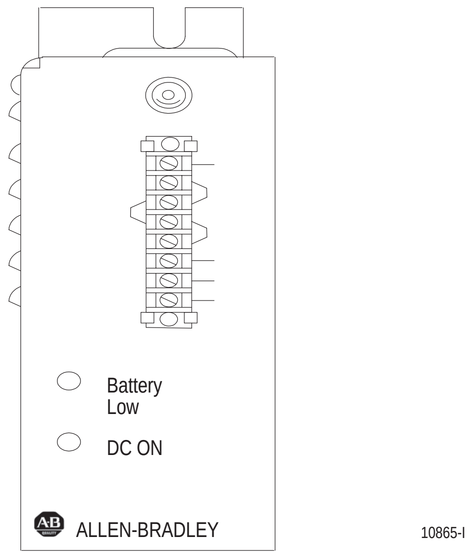
Power Supply

A 1771-KA2 module gets its power from the backplane. It requires +5V DC at 1.2 amperes (max.). The following power supplies are compatible:

- System power supply (cat. no. 1771-P1)
- Auxiliary power supply (cat. no. 1771-P2)
- PLC-2 system power supply module (cat. no. 1772-P1, series B or later)
- PLC-2 auxiliary power supply (cat. no. 1777-P2, and 1777-P4 series B or later)
- Modular power supplies (cat. no. 1771-P3, -P4, -P5)

You must connect one of these supplies to the I/O chassis that contains the KA2 communication adapter module. In a Mini-PLC-2, or a Mini-PLC-2/15 this is the system power supply, shown in Figure 2.7. In a Mini-PLC-2/05, you must use a 1771-P3, -P4, or P5 power supply.

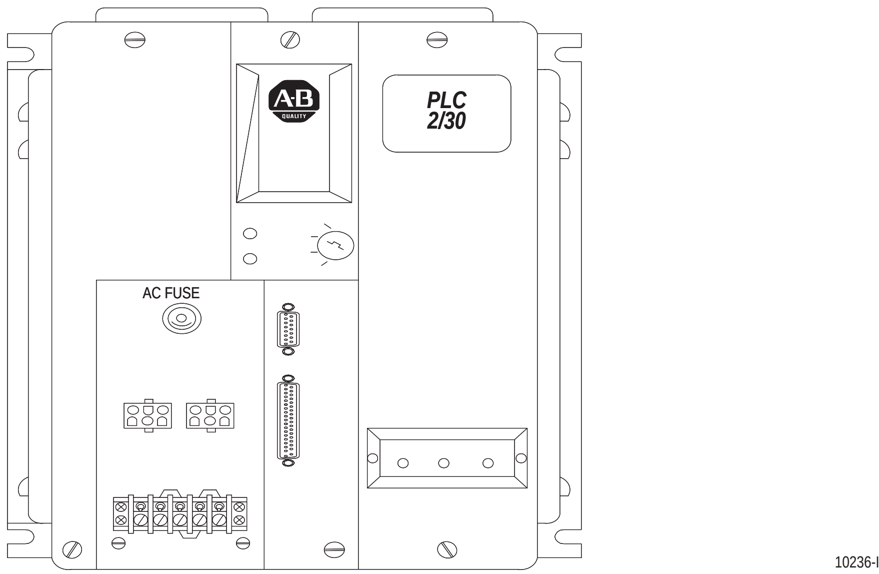
Figure 2.7
1771-P1 System Power Supply



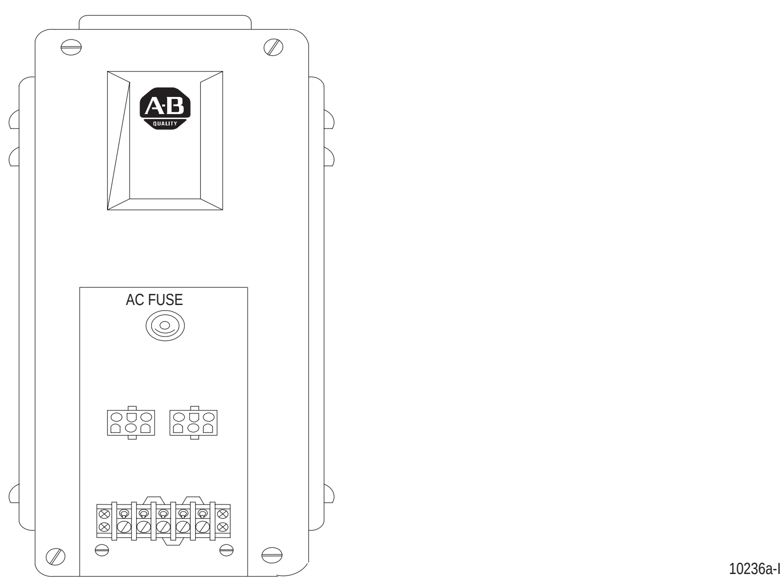
When using the PLC-2/20 or PLC-2/30 processor, any of these supplies can power the I/O chassis so long as core memory is not being used. (Refer to processor manuals.) An auxiliary power supply (cat. no. 1771-P2) closely resembles the system power supply shown in Figure 2.7. PLC-2 power supply module (cat. no. 1772-P1) is not a separate unit, but is enclosed within the metal chassis of the PLC-2/20 or PLC-2/30 processor.

PLC-2 power supplies must be series B or later for communication adapter module compatibility. On both of these supplies, a label on the front edge of the circuit board identifies the series level. To locate this label, remove AC power from the supply and remove the metal front plate that covers the module. If the label shows the catalog number but not the series level, the module is series A. Otherwise, series B or later is indicated.

Figure 2.8
PLC-2 Power Supplies



a. PLC-2 System Power Supply Module



b. PLC-2 Auxiliary Power Supply

Cables

A 1771-KA2 module requires the following cables for installation:

- Data Highway/Processor cable (cat. no. 1771-CN,-CO,-CR)
- User-assembled Data Highway cable

Figure 2.1 and Figure 2.2 show the connections made with these cables.

You can order Data Highway/Processor cables in 3 lengths:

- 1.5 ft. (cat. no. 1771-CN)
- 3.5 ft. (cat. no. 1771-CO)
- 10.5 ft. (cat. no. 1771-CR)

The 2 shorter cables are intended for connection to a Mini-PLC-2, Mini-PLC-2/05, or Mini-PLC-2/15 module. A 10.5 ft. cable is used with PLC-2, PLC-2/20 or PLC-2/30 processors.

You must assemble and install your own Data Highway cable, dropline and trunkline segments. A separate publication, Data Highway Cable, Assembly and Installation Manual, publication 1770-6.2.1, gives information on layout, make-up, and installation of the cable.

Other Optional Equipment

In addition to the components shown in Figure 2.1 and Figure 2.2, you can install your own equipment at or near the Data Highway station. The chief purpose of additional components is to provide diagnostic or monitoring information. Such devices as alarms, displays and indicators can be controlled from output modules of the programmable controller to provide operating or fault information to plant personnel.

Minimally, a single indicator should be installed to alert your personnel to a REMOTE or LOCAL FAULT condition that prevents normal message transfer. The significance of REMOTE/LOCAL FAULT bits, and the recommended programming to monitor these bits, is described in chapter 7.

Chapter Summary

This chapter told you the:

- Components of an A-B Data Highway system
- Role of a 1771-KA2, its connectors, switches, and indicators
- Specs of a 1771-KA2
- Where a KA2 resides and how it is connected to its station
- Optional equipment possibilities at a Data Highway station

In chapter 3 you will read about KA2 switches and installation.

Chapter 3

Module Installation

General

This chapter outlines procedures for preparation, installation, and connection of a 1771–KA2 module. Before performing these procedures, you should check component compatibility and the station set–up recommendations in chapter 2.

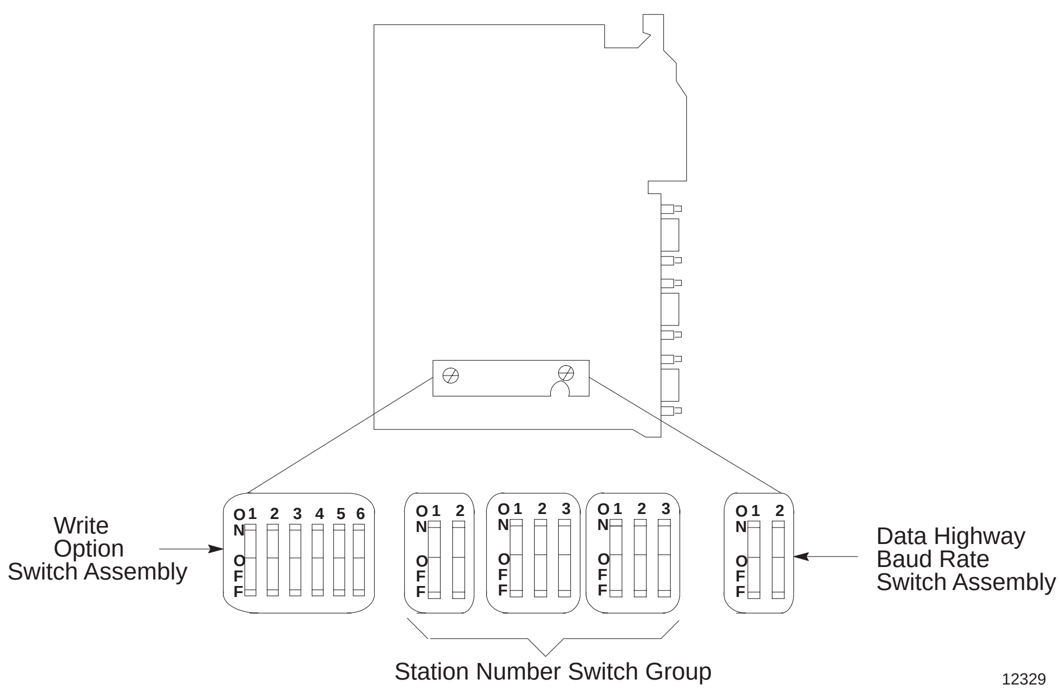
Switch Settings

There are 3 sets of switches on a 1771–KA2 circuit board:

- Write option switch assembly
- Station no. switch group
- Data Highway baud rate switch assembly

Refer to Figure 3.1. The switches at each station communication adapter module must be set as the programmer specifies. To access these switches, loosen the two screws that hold the small cover plate to the side of the module. Then, rotate this cover plate to expose the switches.

Figure 3.1
Module Switches



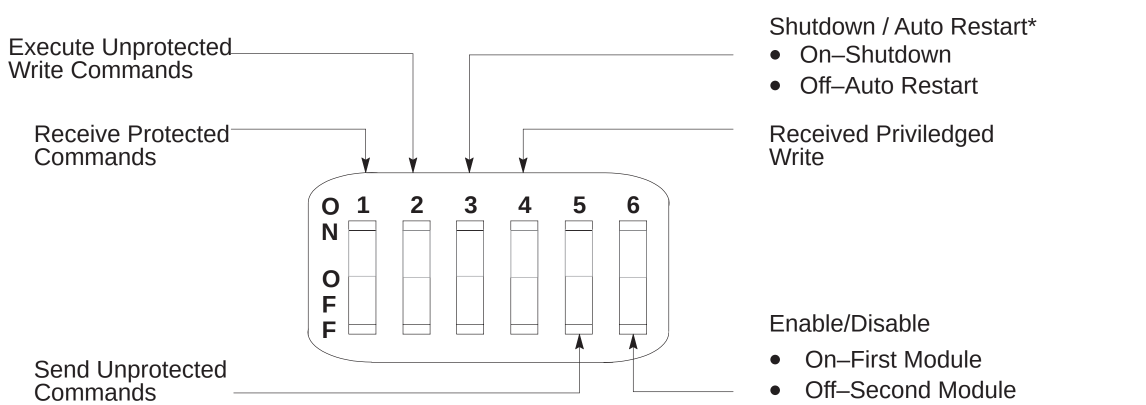
Use the tip of a ball–point or other pointed instrument to set these switches. Do not use a pencil, as lead could jam the switch.

For troubleshooting purposes, we recommend that the programmer document the required switch settings for each 1771–KA2. Use form 5030, in chapter 10, to record switch settings for the module at each station. That way, should replacement of the module be required, switches on the replacements can be set quickly.

Write Option Switch Assembly

The first rocker switch assembly from the left is the write option switch assembly. (Refer to Figure 3.2). In this assembly, switches numbered 1 through 5 enable or disable different types of write and bit write commands from being received by, or sent from, the communication adapter module. (Note that the unprotected read command is not affected by any of these switch settings.) Switch no. 6 enables and disables daisy chain operation. See FIRST/SECOND MODULE at end of this section.

Figure 3.2
Write Option Switch Assembly



* After revision D, the name and function of switch 3 changed to "Execute download in RUN program."

The following paragraphs describe settings for these switches.

RECEIVE PROTECTED COMMAND SWITCH

Switch no. 1 of the write options switch assembly determines whether the module is enabled to receive and execute protected write and bit write commands from other stations. Set this switch as follows:

- ON – Enables execution of received protected commands.
- OFF – Disables received protected commands.

Note that both an ON setting of this switch and a memory access rung are required to allow execution of received protected commands. (Memory Access rungs are described in chapter 5.)

This switch does not prevent the module from receiving and executing unprotected commands from another station. (A separate switch, described subsequently, enables or disables execution of received unprotected commands.)

EXECUTE UNPROTECTED WRITE COMMANDS SWITCH

Switch 2 determines whether the module can receive and execute unprotected write and bit write commands from other stations. Set this switch as follows:

- ON – Enables received unprotected write and bit write commands to be executed.
- OFF – Disables the module from executing received unprotected write and bit write commands

Note that this switch does not disable unprotected read commands from being received and executed by the module.

SHUTDOWN/AUTOMATIC RESTART SWITCH

On modules before revision D, switch 3 presents the option, after a hard error, of restarting the 1771–KA2, or shutting it down.

- ON – Shuts down the module
- OFF – Automatically restarts itself

When a hard error occurs it normally indicates fairly severe communication problems that should be corrected before starting. Such errors usually involve bad cabling or noise.

REVISION D

The third switch in the Write Option Switch assembly on the 1771–KA2 module (formerly the Shutdown/Automatic Restart Switch) will change function for revision D and become the Execute Download in Run Program switch.

RECEIVE PRIVILEGED WRITE SWITCH

Switch 4 determines whether the module can execute received privileged write commands. These commands can be issued only from a computer connected through a communication controller module (cat. no. 1771–KE/KF).

These commands give the computer the capability to alter the user program memory of the station processor. Set this switch as follows:

- ON – Enables a 1771–KA2 to execute received privileged write commands
- OFF – Disables the 1771–KA2 from executing received privileged write commands.

SEND UNPROTECTED COMMANDS SWITCH

Switch 5 determines whether the module can send unprotected write or bit write commands to another station. Set this switch as follows:

- ON – Enables the module to send unprotected write and bit write commands
- OFF – Disables the module from sending unprotected write and bit write commands

This switch does not prevent unprotected read commands from being sent by a communication adapter module.

FIRST/SECOND MODULE

Use switch 6 for first/second module selection. Set switch:

- ON – Use this setting when connected directly to any compatible processor except PLC–2 (1772–LR).
- OFF – Use this setting when the KA2 module is connected to a PLC–2 (1772–LR), a 1771–KG series B module, or another KA2 module.

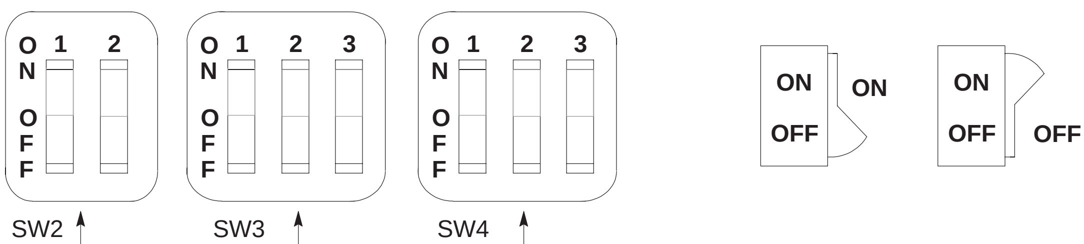
Station No. Switch Group

You must designate a unique station number for each communication adapter module on a Data Highway. This designation is made by the programmer and switch–selected on the station number switch group of the module.

The station number switch group comprises 3 switch assemblies (SW2, SW3, SW4) on the module circuit board, as Figure 3.3 indicates. These switches determine the station number of each communication adapter module.

The station number is a 3–digit octal number from 010_8–077_8 or 110_8–376_8. Each of the 3 switch assemblies in this group is set to represent an individual digit of this station number. Figure 3.3 shows the combination of switch settings for each digit.

Figure 3.3
Station Number Switch Settings



SWITCH SETTING		DIGIT
No. 1	No. 2	
OFF	OFF	0
OFF	ON	1
ON	OFF	2
ON	ON	3

a. First Digit

SWITCH SETTING			DIGIT
No. 1	No. 2	No. 3	
OFF	OFF	OFF	0
OFF	OFF	ON	1
OFF	ON	OFF	2
OFF	ON	ON	3
ON	OFF	OFF	4
ON	OFF	ON	5
ON	ON	OFF	6
ON	ON	ON	7

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b. Second and Third Digits

In this binary–coded octal numbering arrangement, each switch has an associated binary value: 1, 2, or 4 if set ON, 0 if set OFF. The value of each individual digit of the station number is the sum of the binary values in its corresponding switch assembly. Table 3.A gives an example for the settings of this switch group.

Table 3.A
Switch Setting Example: Station No. 037

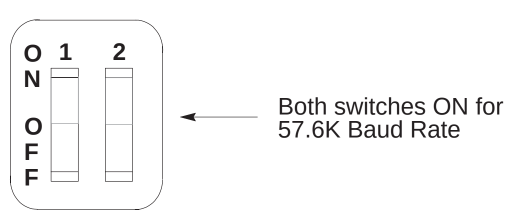
STATION NO. DIGITS	**0**		**3**			**7**		
SWITCH NO.	1	2	1	2	3	1	2	3
SWITCH SETTING	OFF	OFF	OFF	ON	ON	ON	ON	ON

Note that the switches allow a range of station numbers from 000_8 to 377_8 (256 possible numbers). However, there are practical reasons for using the the range 010_8 –077_8 and 110_8 –376_8. These station numbers are addressable from any station using an industrial terminal. PLC–2 family programmable controllers cannot address 000_8 to 007_8 or 100_8 to 107_8. Also, station 377_8 is an illegal address on the Data Highway. To optimize response times, use consecutive station numbers beginning with 010_8.

Data Highway Baud Rate Switch Assembly

The switch assembly labeled SW5 on the module circuit board is the data highway baud rate switch assembly. (Refer to Figure 3.4). The switches in this assembly must be set for the baud rate being used on the Data Highway communication link.

Figure 3.4
Data Highway Baud Rate Switch Assembly



The module is shipped with these switches set for 57.6K baud. Both switches are set ON for this communication rate. This baud rate is the intended Data Highway communication rate.

CAUTION: Do not set these switches for any other baud rate. Incorrect setting of these switches may cause faulted data transmission on the Data Highway communication link. This may disable Data Highway operation until the switch setting is corrected.

After rechecking all switch settings, replace the cover plate on the module.

Keying

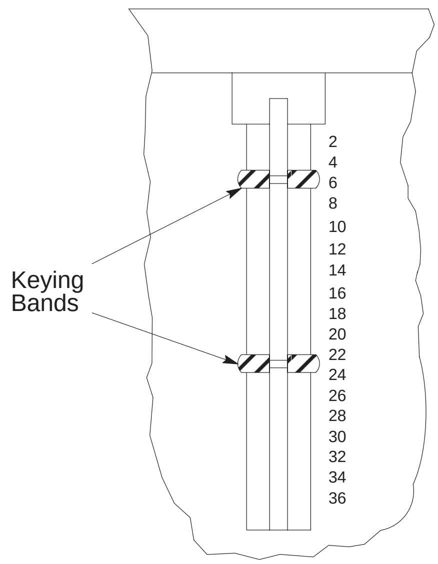
The I/O slot designated for the 1771–KA2 communication adapter module should be keyed to admit only that module. Plastic keying bands, shipped with the I/O chassis, accomplish this purpose. These keying bands provide for only one type of module in a slot.

On the rear edge of the communication adapter module are 2 slots. Position the keying bands on the backplane connector to align with these slots. For the communication adapter module, position keying bands on the upper backplane connector between these numbers printed on the backplane:

- 4 and 6
- 22 and 24

Refer to Figure 3.5. Use needle–nose pliers to insert or remove keying bands.

Figure 3.5
Keying Band Position



Installation In The I/O Slot

Follow these procedures to install the module:

1. Turn I/O chassis power off. (This refers to the power supply that connects to the I/O chassis at its backplane.

CAUTION: To avoid module damage, always be certain that power to the I/O chassis is off before insertion or removal of the KA2.

---

2. Insert the keying bands, as described in section titled "Keying."

3. Insert the module into its designated slot. Plastic tracks on the top and bottom of the slot guide the module into position. Do not force the module into its backplane connectors. Rather, apply a firm, even pressure to seat the module in its slot.

4. Snap the plastic chassis latch over the module. This secures the module firmly in the I/O chassis.

Cable Connections

The following cable connections are made to a communication adapter module:

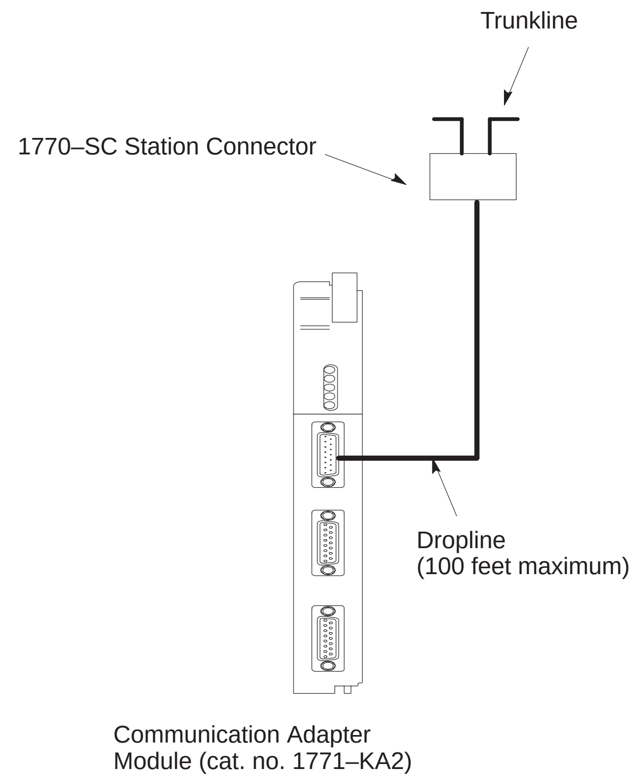
- Data Highway cable
- Program panel interconnect cable (cat. no. 1772–TC)
- Data Highway/Processor cable (cat. no. 1771–CR, –CO,–CN)

At set up, all cable connections to the module can be made with power on. After the program is up and running, however, it is safer to make connections with power off because of the possibility of noise that connecting will make. Also, again after the program is running, a module should only be connected to a Data Highway with power off. A powered–up module that is disconnected from the Data Highway will be in the polling state and cause a highway fault if it is re–connected. This is the same as connecting two active highway segments (which also should not be done).

Data Highway Connection

The module connects to the Data Highway communication link by means of a user–assembled dropline. This dropline connects to the trunkline of the Data Highway at a 1770–SC station connector (Figure 3.6), or a 1770–XG tee connector.

Figure 3.6
Data Highway Cable Connection



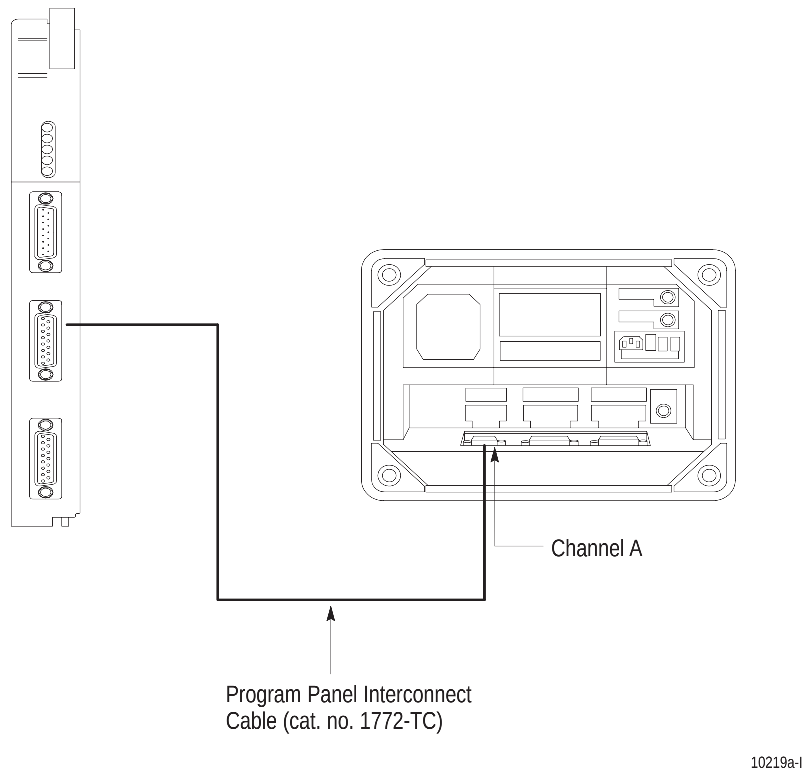
Program Panel Interconnect Cable Connection

The center connector of the communication adapter module is labeled PROGRAM INTERFACE. When the module is installed and connected to the processor, this socket connects an industrial terminal system (cat. no. 1770–T1, –T3).

To connect with any of these terminals, use the program panel interconnect cable (cat. no. 1772–TC). Figure 3.7 shows the programming terminal connections to the communication adapter module.

When an industrial terminal is connected this way, you can perform all terminal functions except cassette loads, or dumps. You must disconnect the KA2 perform these functions.

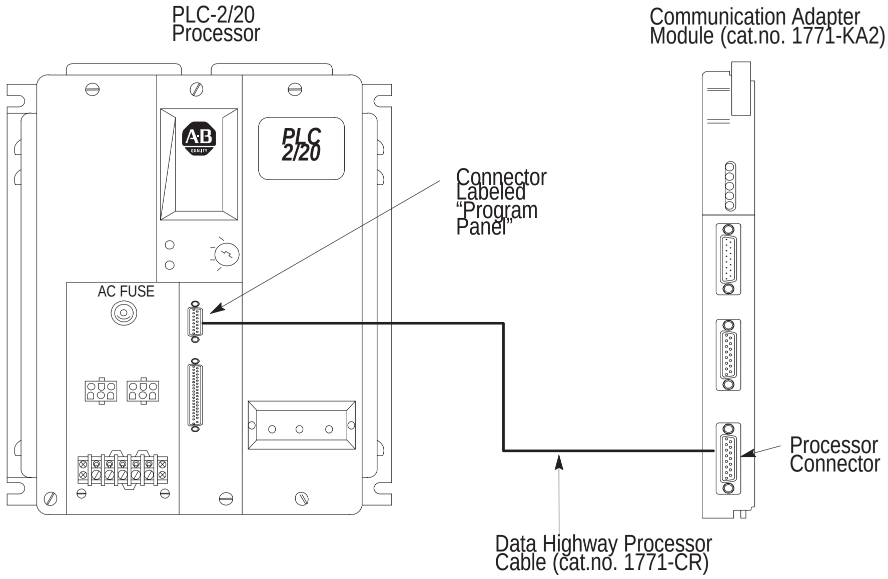
Figure 3.7
Industrial Terminal Connection



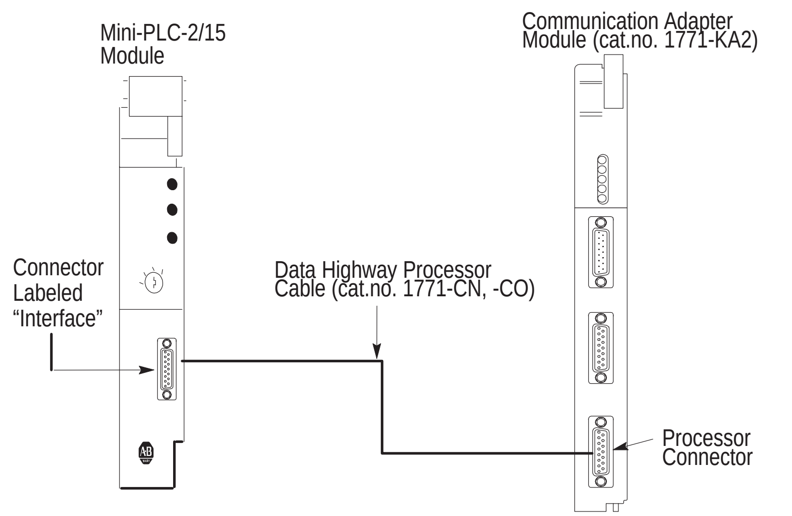
Data Highway/Processor Cable Connector

The bottom connector of a 1771–KA2 module is labeled PROCESSOR. The communication module communicates with the station processor through this connector. The Data Highway/Processor cable (cat. no. 1771–CN, –CO, –CR) connects from this socket to a socket on the fact of the station processor. On a PLC–2/20 or PLC–2/30 this is the connector labeled PROGRAM PANEL; on a Mini–PLC–2 or Mini–PLC–2/15, the connector is labeled INTERFACE. (Refer to Figure 3.8) and on a Mini–PLC–2/05 the socket is labeled INTFC.

Figure 3.8
Data Highway/Processor Cable Connection



a. Connection to PLC-2/20 or PLC-2/30 Processor



b. Connection to Mini-PLC-2, Mini-PLC-2/05, and Mini-PLC-2/15

A Second Link

To provide a second communication link at a data highway station, you can connect a KA2 module to another KA2 or to an A–B 1771–KG (series B) interface module to provide an RS–232–C link and a Data Highway link. These links enable communication with, say, a PLC–2 family processor on the highway, and a stand–alone computer.

In such a scheme, the 1771–KG module can be connected directly to the PLC–2 family processor, and the KA2 connected to the PROGRAM INTERFACE connector of the 1771–KG, or vice versa.

Chapter 4

Commands

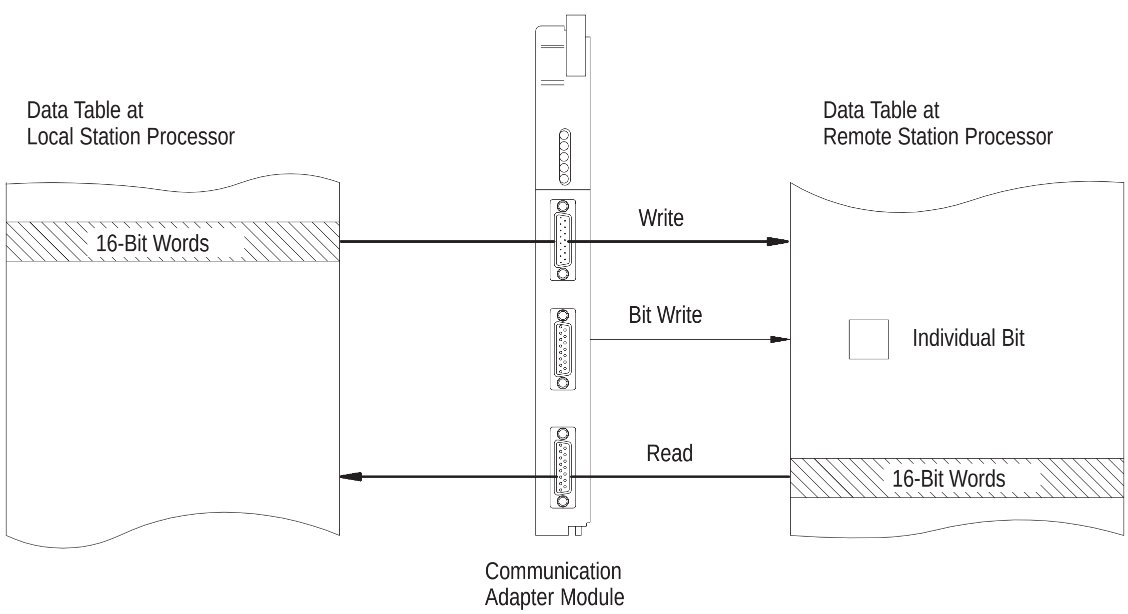
General

The primary function of a KA2 module is to transfer data to and from its station processor. The module is instructed to transfer specific units of data by user-programmed commands. The communication adapter module transmits and receives the following set of non-privileged commands:

- Protected write
- Protected bit write
- Unprotected write
- Unprotected bit write
- Read

These commands are of three general types: write, bit write, and read. (Refer to Figure 4.1). The write and read commands transfer word data between the data table of the local station processor and the data table of a remote station processor. The bit write command controls ON/OFF status of one or more memory bits at a remote station processor.

Figure 4.1
Module Command Summary



Privileged Commands

This chapter describes functions of these commands and their access to data table locations at station processors. A KA2 module can also receive privileged commands from a computer or another intelligent RS-232-C device through a 1771-KE/KF communication controller module. These privileged commands and their functions (briefly) include:

- Diagnostic counters reset - resets to zero all diagnostic timers & counters in the station interface module.
- Diagnostic loop - use to check integrity of transmission over communication link.
- Diagnostic read - reads up to 244 bytes of data from PROM or RAM of station interface module.
- Diagnostic status - reads a block of station information from station interface module; reply includes station information in module's data field.
- Enter download mode - puts PLC-2 family processor into download mode. Use before sending physical write commands to station.
- Enter upload mode (new on KA2 module) - puts PLC-2 family processor into upload mode. Use before sending physical reads to station.
- Exit download/upload mode - takes PLC-2 family processor out of upload/download mode. Use to restart processor after uploading or downloading.
- Physical read - reads bytes of data from PC data table or program memory. Use the upload contents of PLC-2 family processor memory to computer.
- Physical write - writes bytes of data into PC data table or program memory. Use to download computer contents to PLC-2 family processor memory.
- Set data table size* - sets data table size for PLC-2 family processor. Use before physical writes on PLC-2 family processor. All PLC-2 family data tables are configurable, but some have wider ranges than others. Check the appropriate manual for the processor in your application.

Later chapters cover the following:

- Command programming (chapter 5)
- Command status bits (chapter 6)
- Command initiation and execution monitoring (chapter 7)

Terminology: Remote/Local Station

In this and later chapters, we use the terms "remote station" or "local station." The local station is the point of reference. When describing the commands, for instance, the local station is the one sending the command. A remote station is any station that receives a command from the local station.

Figure 4.1 illustrates this terminology.

Protected/Unprotected

Each 1771-KA2 module command has a prefix, either "protected" or "unprotected." This prefix denotes memory access of the command. The distinction between these command types is:

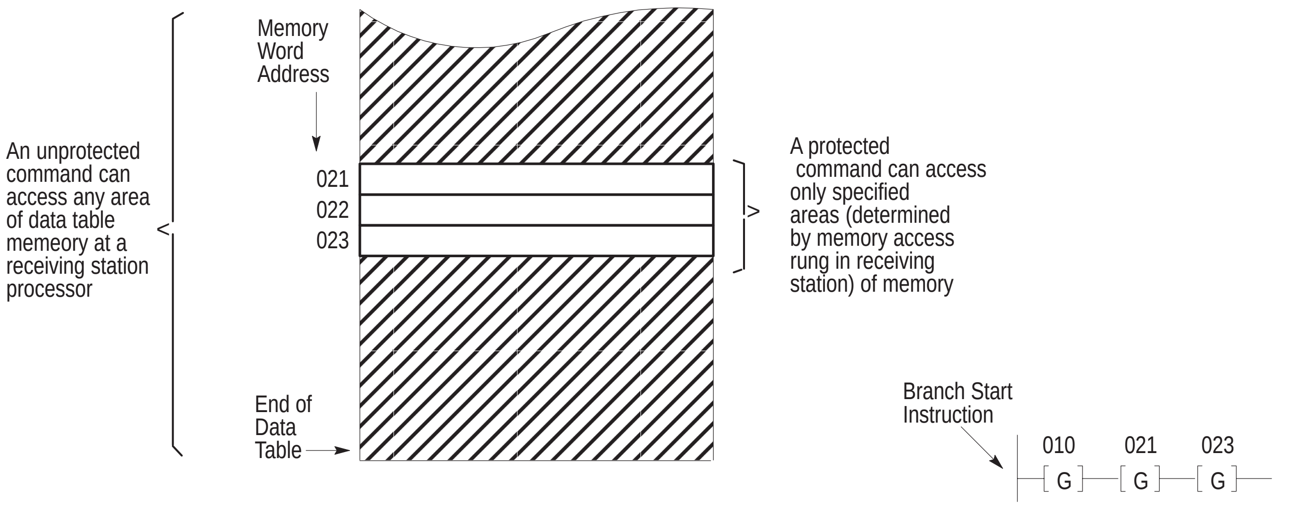
Protected commands can access (write into) only specified data table areas. The program in the receiving station processor controls these areas. In that program, a memory access rung determines which data table areas will accept protected write or protected bit write commands. (Rungs are described in chapter 5.) The receiving station ignores protected commands that are not defined by the memory access rung.

Unprotected commands require no memory access rung, and they can read or write into any addressable data table word in the receiving station processor.

The primary distinction between these commands is program restriction of memory access. Switch selections can also be made on the module for write protection, to enable/disable execution of many of these commands. (Chapter 3 gives switch selections.)

Figure 4.2 summarizes the distinction between protected and unprotected commands.

Figure 4.2
Protected/Unprotected Command Distinction



a. Access Definition **b. Memory Access Branch (typical)**

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NOTE: For most write and bit write operations between station processors, protected commands should be used. Because memory access must be allowed by the program at the receiving station processor, protected commands allow programmed write protection, which gives the programmer an added degree of control over command execution. Unprotected commands provide the same functions in transferring data, but without this write protection at the receiving station.

Write Commands

A write command transfers word data from the local station processor to a remote station. A single write command can send from 1 to 121 consecutive data table words.

There are 2 types of write commands that can be sent from a station communication adapter module:

- Protected write
- Unprotected write

The distinction between these types of commands is their memory access. Protected write commands are not executed by the receiving station unless a memory access rung is programmed at that station and switch 1 on write options is set. Because this allows added control over data transfer, use of protected commands is recommended.

A write command can control data table words at any station processor. However, certain data table areas at each type of processor have a special function and should not be controlled by write commands. (Sections titled “Accessible Data Table Locations-PLC-2 Processors” and “Accessible Data Table Locations-PLC Processors” cover data table control.)

Bit Write Commands

Bit write commands control the ON/OFF status of bits in a remote station data table. Unlike read or write commands, bit write commands do not transfer data table memory data. Instead, the programmed command rung itself specifies which bits are to be set on or off when the command is executed. (Refer to chapter 5.)

There are 2 types of bit write commands that can be sent from a communication adapter module:

- Protected bit write
- Unprotected bit write

The distinction between these commands is their memory access. Protected bit write commands are not executed by the receiving station unless a memory access rung defining the appropriate memory area is programmed at that station and switch 1 is set. Because this write protection feature allows added control over command execution, use of protected commands is recommended.

A bit write command can control data table areas at any station processor. However, certain data table words at each type of processor have a special function and should not be controlled by bit write commands. (Data table control is the subject of sections titled “Accessible Data Table Locations-PLC-2 Processors” and “Accessible Data Table Locations-PLC Processors”).

On each 1771-KA2 communication adapter module, the sending and receiving of write messages can be enabled or disabled by switch settings. (Refer to chapter 3.)

Bit Write Access

The bit write command can be used to control any accessible data table bit. However, this command must not be used to control the following:

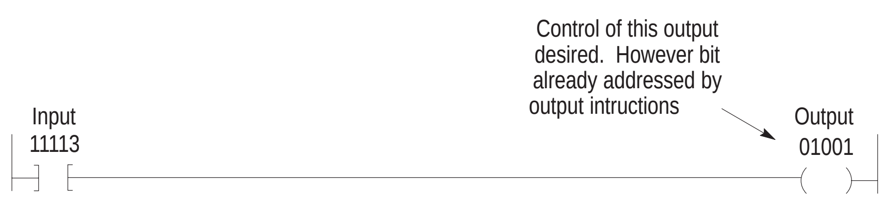
- Any bit whose status is controlled by a programmed output instruction.
- Any bit in a byte that also contains program-controlled bits.

This first restriction simply states that no bit should be directly controlled, that is, addressed, by both an output instruction at its local station processor and a bit write command from some remote station processor.

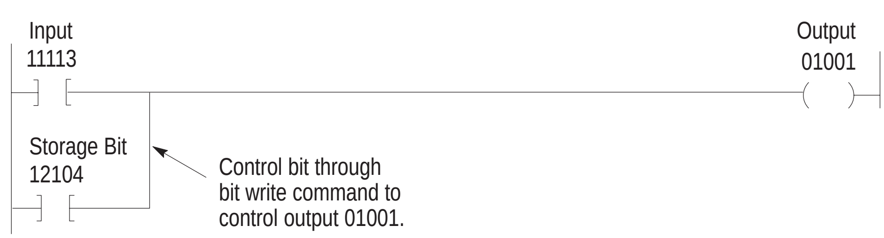
Bit write commands are generally used to set storage bits in a station processor data table. These storage bits may then be examined in the user program as conditions to energize an output bit. This indirect programming technique allows control using bit write commands, but helps to prevent the confusion that can result if an individual bit is controlled from both an OUTPUT ENERGIZE instruction and a bit write command.

Figure 4.3 gives an example of an indirect programming technique used to control bit 01001, which is addressed by an output instruction, with a bit write command. Here storage bit 12104 is controlled by the bit write command. This bit is then examined by the program to control the status of bit 01001. The output bit, 01001, cannot be directly addressed by the bit write command. However, by controlling the storage bit and examining it in the program, the same effect is achieved.

Figure 4.3
Bit Control Use (example)



a. Original Rung



b. Recommended Technique

The second restriction listed above applies when the destination station is a PLC-2 family PC. For these processors, when the station communication adapter module receives a bit write command it manipulates the 8-bit **byte** of the 16-bit memory word in which the addressed bit is located. (This may be the low byte, containing bits 00-07, or the high byte, containing bits 10-17.) Should program instructions control other bits within the same byte, there is a slight possibility that the communication adapter module may write over programmed status for these program-controlled bits. This would occur only if the program caused a bit to be altered during the time the communication adapter module was executing a received bit write command.

Therefore, when using the bit write command, address only bits within a byte that is set aside exclusively for control by these commands.

Read Command

The unprotected read command transfers word data from a remote station processor to the local station data table. A single unprotected read command can access from 1 to 122 consecutive data table words.

The unprotected read command is not restricted by user programming. This command can read data table words from any remote station processor, regardless of either memory access rung programming or module switch settings.

Because this command controls data table words at its local station processor, the rules for data table control apply when using this command. (Data table control is the subject of sections titled “Accessible Data Table Locations-PLC-2 Processors” and “Accessible Data Table Locations-PLC Processor”).

Accessible Data Table Locations - PLC-2 Processors

When it executes a read, write, or bit write command, the communication adapter module controls data table locations at a station processor. This section outlines the recommendations for control of data table locations in PLC-2 family processors.

A KA2 module executes read, write, or bit write commands to control any accessible data table words in any of these processors. It also controls user-selected status words in the data table of these processors. (Status words are described in chapter 6.) A KA2 can access most data table words. However, certain memory areas in these processors have special functions that prevent control of these areas by the module. The following are data table areas with a special function in these processors:

- Processor work areas
- Input image table
- Word 027

Later paragraphs describe the limitations in controlling each of these areas. Access to all other data table areas is subject to the requirements of the programmer.

Processor Work Areas

The processor work areas for PLC-2 family processors are addresses 000-007 and 100-107. These areas are used for specific processor functions and are not accessible to commands from a station communication adapter module. The processor prevents an attempt to write data into this area from a remote station KA2. Note also that an attempt to read data from this area causes all 0's to be read.

Only privileged commands from a computer can write into or read from this area of the data table.

Input Image Table

The input image table areas for these processors are addressed as follows:

- PLC-2 processor: 110-127
- PLC-2/30 processor: 110-177
- PLC-2/20 processor: 110-177
- Mini-PLC-2 processor module: 110-117
- Mini-PLC-2/05 processor: 110-117
- Mini-PLC-2/15 processor: 110-117

Please see appropriate processor manuals (Table 1.B) for details.

This area of memory is updated each input scan. Any data written into it will be cleared on the next input scan. This limits use of the input image table as a storage area for values or bits. Note, however, that the input image table may be read from or written to another station. This control restriction applies only when attempting to write data into the input image table using a command from a communication adapter module.

Word 027

Word 027 has a special function with PLC-2 family processors. For example, bits 02710-02717 are used for report generation; bit 02700 indicates a low-battery condition. Because of these special functions, care must be exercised in controlling word 027 with a write or bit write command.

The processor does not prevent data from being written to this data table word.

Accessible Data Table Locations - PLC Processors

When it executes a read, write, or bit write command, the communication adapter module controls data table locations at a station processor. When addressing a command to a Bulletin 1774 PLC processor, note that there are certain data table areas with a special function. These data table areas are not to be used for control by communication adapter module commands:

- Any input image table word that has a corresponding input module in a Bulletin 1778 or 1771 I/O rack
- Word 377
- Word 000

Input Image Table

When an input image table word in the PLC processor data table is unused, that is, has no corresponding input module in an I/O rack, that word can be used for storage. However, should an input module correspond to that word, the data in the word is updated from the input module each I/O scan.

Note that this restriction does not prevent any word of the input image table from being written to another station. This control restriction applies only when attempting to write data into input image table locations.

Word 377

Word 377 has special status functions within the PLC processor. For this reason, the communication adapter module must not execute write or bit write commands into this word.

A read command from a local station can address word 377 at a remote station PLC processor.

Word 000

Reserve word 000 of the PLC processor output image table when using a KA2. This means that commands from another station must not be programmed to control word 000 or any of its bits.

Accessible Data Table Locations - PLC-3 Processors

Each PLC/PLC-2 station on a Data Highway can read from or write to only one specific buffer file at a PLC-3 station. That is the PLC-3 input file with a number that corresponds to the station number of the PLC/PLC-2 station. For example, the read/write files assigned to PLC/PLC-2 stations 1 to 100 (octal) would be as follows:

PLC/PLC-2 Station Number (octal)	Assigned PLC-3 Input File for Read/Write Access	
000		
001	I001	
002	I002	
003	I003	
004	I004	
005	I005	
006	I006	
007	I007	
		I008
		I009 (Not assigned)
010	I010	
011	I011	
012	I012	
.	.	
.	.	
.	.	
0770	I077	
100	I100	

PLC/PLC-2 station numbers are octal, while PLC-3 input files have decimal addresses. This means that PLC-3 input files with an 8 or 9 in their addresses are not used for read/write access by a PLC/PLC-2 station. The only exception to these rules is that station number 000 is assigned input file I008.

The PLC/PLC-2 station can use either protected or unprotected commands to access its assigned PLC-3 file. Note, however, that the PLC/PLC-2 station cannot access its assigned file until you create and allocate that file. To create a PLC-3 file, use the CREATE command described in the PLC-3 Programming Manual (publication 1775-6.4.1).

Accessible Data Table Locations - PLC-4 Microtrol Processors

Programmable controllers can send the following non-privileged commands to a 1773-KA interface module:

- unprotected read
- unprotected write
- unprotected bit write
- protected write
- protected bit write

A 1773-KA module accepts non-privileged commands like other Data Highway interface modules with one exception: the 1773-KA module does not have memory protection rungs. Instead, you set switches that allow or disallow the module to receive protected and unprotected commands.

The PLC-4 Microtrol controller uses a four-digit address for its input, output, flags, store, timer and counter bits. (Timer and Counter status bits require an additional two digits.) When you issue a command from another programmable controller or computer, do not enter these addresses; instead, enter an address code. It is important that you understand these addresses, however, to see how they relate to address codes.

The addressing scheme is summarized in this chart:

Table 4.A
Internal Addressing of a PLC-4 Microtrol Controller

Type of Address	**Controller I.D.**	**Bit Address Range**	
I=Input	1-8	01-20	
O=Output	1-8	01-12	
X=Flags	1-8	01-32 **(1)**	
S=Stores	1-8	01-99	
Type of Address	**Controller I.D.**	**Timer/Counter Number**	**Bit Description**
T = Timer	1-8	01-32	15 - Timer Clock
			16 - Enable
			31 - Timer Timing
			32 - Done
C = Counter	1-8	01-32	15 - Count -Down Enable
			16 - Count-Up Enable
			31 - Overflow Underflow
			32 - Done

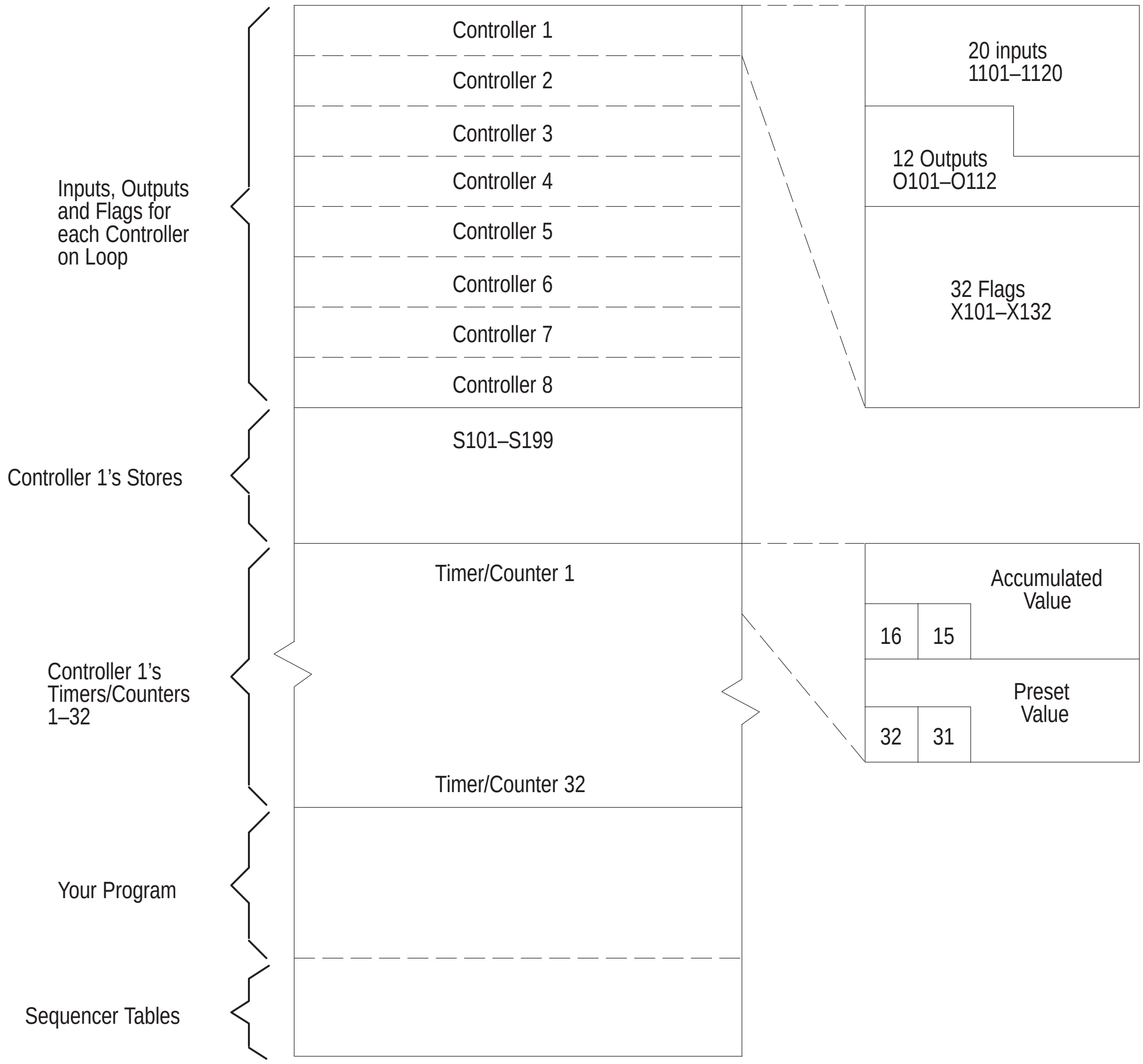
(1) Flag bits 31 and 32 have a special significance. See the PLC-4 Microtrol Product Guide (publication 1773-800).

The memory map for a PLC-4 Microtrol controller, ID #1, shown in Figure 4.4, includes data on inputs, outputs and flags of each active controller on the loop.

Each member of the PLC-4 Microtrol loop, including the interface module, shares the status of the input, output, and flag bits for each controller on the loop. This becomes significant when you want to determine response time.

Each time you enter a non-privileged command, you must enter an address code. This becomes significant when you want to determine response time.

Figure 4.4
Memory Map for Controller 1



Each time you enter a non-privileged command, you must enter an address code. This code designates what part of the controller's memory the command will affect. Note that this is a code, and not a true memory address. A memory address code is a 3-4 digit code that represents a word (16 bits) in the data table of a PLC-4 Microtrol controller. The right-most digit of an address code represents the controller ID number in **octal**. For example, address code 01**0**

addresses the first controller - controller 1 - while

address code 01**1**

addresses the second controller - controller 2.

A PLC-4 Microtrol uses a decimal addressing scheme (Table 4.A). The PLC-2 family of programmable controllers use an octal addressing scheme. Thus, you must convert the PLC-4 Microtrol's decimal addresses to octal.

Address codes are divided into four sets:

1. store words

2. input, output, and flag words

3. input, output and flag area

4. timer/counter words

When using these address codes, observe these restrictions:

1. Do not address more than one set at a time. For example, if you want to read both the store and the input words of controller 1, send one command to read the store area, and a second command to read the input words.

2. Do not address more than one controller at a time. For example, if you want to read the store area of both controller 1 and controller 2, send two separate read commands.

3. Do not send a command to a controller that is in program mode. A controller in program mode is not an active member of the loop, because its data table is not being updated.

Chapter Summary

This chapter told you about the 1771-KA2's:

- Station terminology
- Commands, protected and unprotected, reads & writes
- Processors' input image table addresses, locations

In chapter 5 you will learn about rungs, codes, and more commands.

Chapter 5

Communication Zone Rungs

General

At the beginning of the ladder-diagram program, you enter a special set of rungs that dictate communication adapter module activity. The KA2 scans this set of rungs at power-up for operating information.

WARNING: Do not make on-line edits of the communication zone. Since the module scans the communication zone only when it powers up or when the processor changes state (from program to run), the changes will not affect module operation until you cycle power to the 1771-KA2 module or change the operating mode of the processor. Attempting such edits may cause unexpected communication on the Data Highway.

Communication zone rungs use the standard controller instruction set. However, the meaning of these instructions and addresses differs **significantly** from their meaning in standard ladder-diagram programming. For this reason, each programmed element in a communication zone rung must be understood as it is described in this chapter, not as it would normally be understood in a ladder- diagram logic context.

In several instances, the 3- or 5-digit number entered above the communication zone rung element has no relation to an actual data table address. This chapter specifically identifies this type of number as either a **station number** or **code**. Where one of these designations is given, the actual data table bit or word at that address is not affected by KA2 module operation and may be used in the balance of the user program.

For the purpose of this description, the reference point is termed the local station. All other stations are then considered remote stations. These rungs are entered at the local station so that it can send commands to, or receive commands from a remote station.

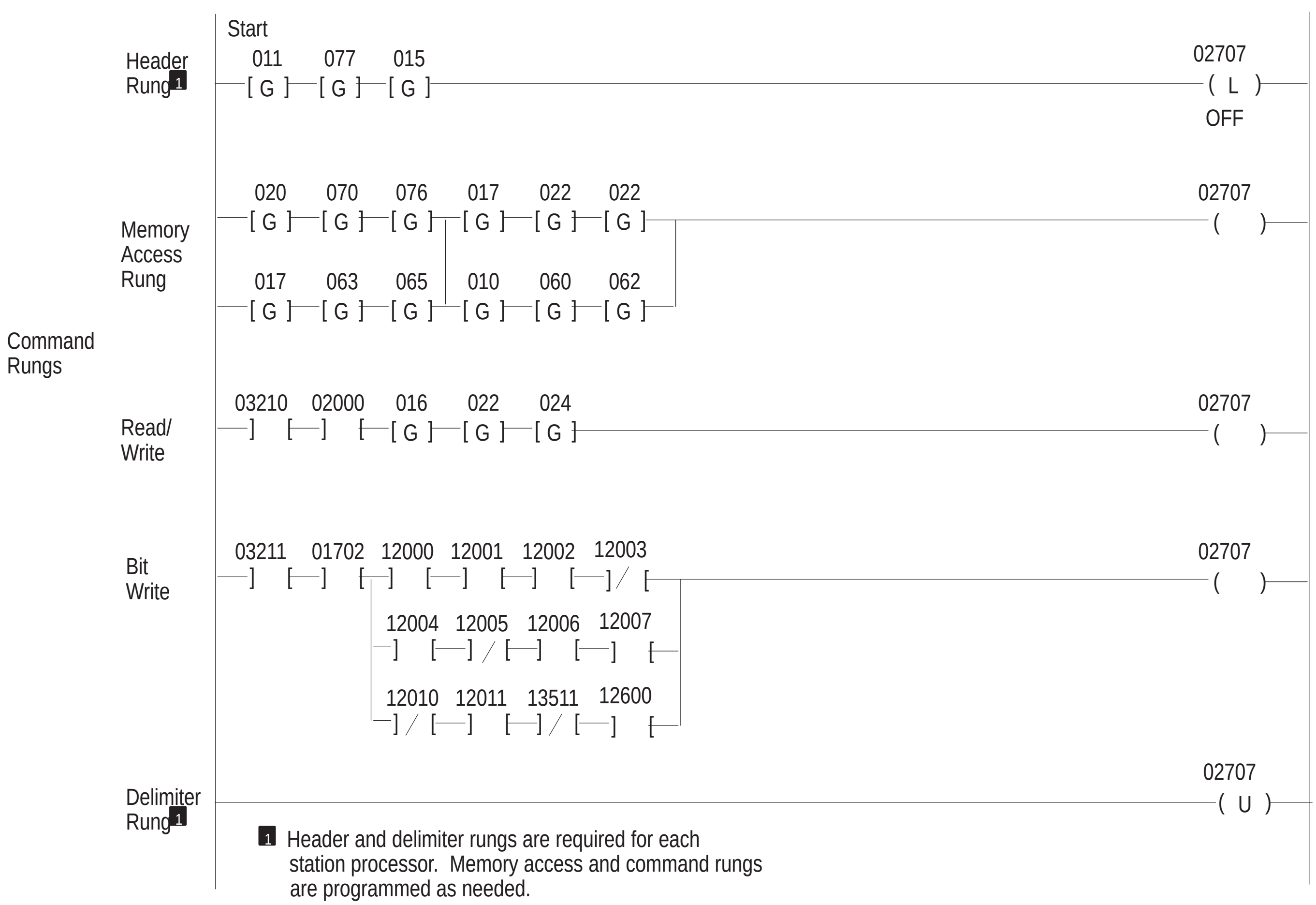
Obviously, this reference point is not fixed. Each station - as it is being programmed - is considered the local station at that time.

Overall Format

The overall format for the communication zone of program is shown in Figure 5.1. This figure shows each type of rung that can be entered in this zone.

The actual communication zone rungs for any station processor may vary significantly from those shown in Figure 5.1. The length of this program area is a function of the number of remote stations processors with which the local station processor communicates and the number of transmissions of data with these remote stations.

Figure 5.1
Communication Zone Format (general)



The order of these communication zone rungs is as follows:

1. Header rung

2. Memory access rung(s) (as needed)

3. Command rung(s) (as needed)

4. Delimiter rung

These rungs must always appear in this order at the beginning of the ladder diagram program. If you are using two KA2 modules, or a combination of KA2 and -KG modules with the same processor, enter one immediately after the other.

As a minimum requirement, each station processor must have a header rung and a delimiter rung. This provides the advantage of an ERROR CODE storage word, controlled by the module as a diagnostic indicator.

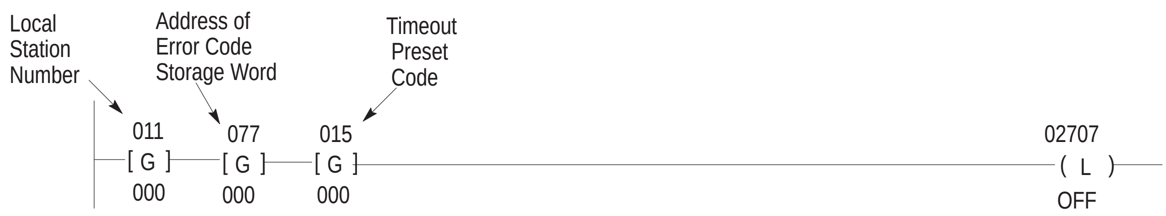
If you are using two communication modules with the same processor, (possible with 1771-KA2 and 1771-KG series B modules only) you must program a separate and complete communication zone for each module. Modules must have different station numbers.

The figures in this chapter show 3-digit addresses above most GET instructions, but not the 3-digit data value displayed below the GET symbol. This convention is used for clarity, since, for the most part, only the 3-digit GET address is significant when entering a program. In entering communication zone rungs, you needn't program any data into GET instructions.

Header Rungs

A header rung, as shown in Figure 5.2, indicates the beginning of the communication zone. For the communication adapter module (cat. no. 1771-KA2), the output position of this rung is always the LATCH 02707 instruction.

Figure 5.2
Header Rung



The 3 GET instructions in the header rung list the following:

- Local station number
- Address of ERROR CODE storage word
- Timeout preset code

The local station number is a 3-digit number switch-selected on the 1771-KA2 module. This is an octal number from 010_8 to 077_8 or from 110_8 to 376_8.

The ERROR CODE storage word is a status word in the data table of the local station processor, controlled by the communication adapter. (Section titled "Error Code Storage Word," chapter 6, describes the significance of the ERROR CODE storage word.)

The timeout preset code gives a programmed timeout interval for command completion. Based on the 3-digit value entered in the address field of this GET instruction, the communication adapter module monitors command execution for all commands sent from a station. In the examples in this publication, the number 015 is entered as the timeout preset code. This value, which designates a 5-second timeout preset, is suitable for most applications. The significance of this preset code, its computation, and timeout considerations are described in section titled "Timeout Preset Value," chapter7.

Memory Access Rungs

The memory access rung defines data table words that you can access with the following commands:

- Protect write
- Protect bit write

Protected commands, received from a remote station, may control only those local station processor memory areas listed in memory access rungs.

(Note that memory access rungs are not needed to allow unprotected commands; only protected commands require a memory access rung.)

A memory access rung is composed of one or more memory access branches, as shown in Figure 5.3.A. In this format, a BRANCH START precedes a group of 3 GET instructions. The first GET instruction address is the station number of a remote station. The next 2 GET addresses define the word boundaries of the accessible data table area in the local station processor. The specified remote station may control any bit or word within three boundaries through protected commands.

Figure 5.3.B. illustrates the memory area that is now accessible to protected commands from remote station 010, due to the memory access branch of Figure 5.3.A.

Multiple memory access branches can be listed in a single memory access rung. Each group of 3 GET instructions must be preceded by a BRANCH START instruction. (This is true in all cases, even when only one memory access branch is defined.) BRANCH END instructions can be used to fit the memory access rung into the ladder diagram-display format.

Use output instruction, OUTPUT ENERGIZE 02707, to fit the memory access rung into the proper display format. (This output instruction has no significance in memory access rung logic.)

Figure 5.3
Memory Access Example

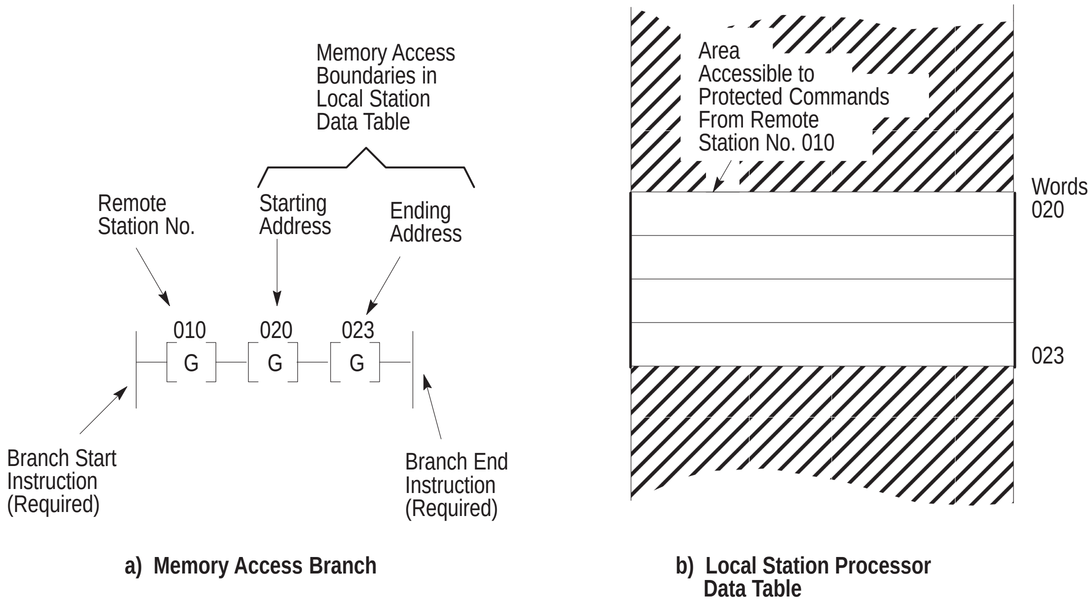
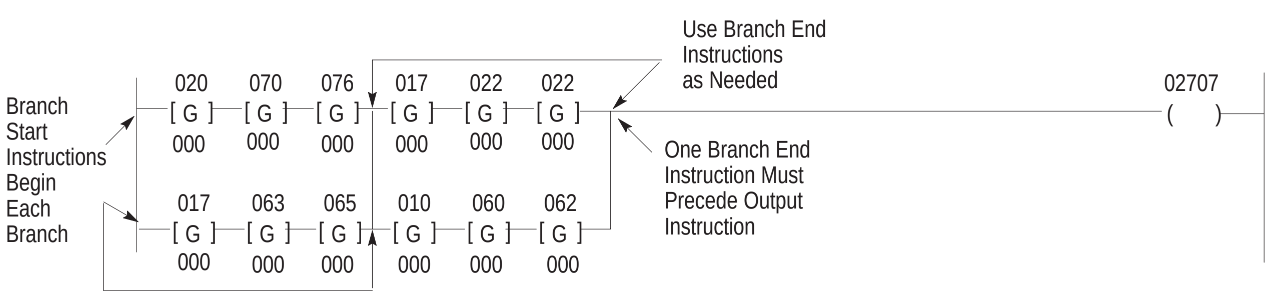


Figure 5.4 shows a memory access rung with multiple branches. This rung lists the remote station that may control specific data table words with protected commands, as follows:

- Station no. 020 can control words 070-076
- Station no. 017 can control words 063-065 and word 022
- Station no. 010 can control words 060-062

As shown in Figure 5.4, a single remote station processor may be identified in more than one memory access rung branch.

Figure 5.4
Memory Access Rung (typical)



For practical reasons, do not exceed the display area of the programming terminal when entering these rungs. You can program more than one memory access rung if needed. Note, however, that should multiple memory access rungs be required, you must enter them in succession in the communication zone, immediately following the header rung and before any command rung.

Command Rungs

The command rungs direct the data transfer operations of the communication adapter module. The command rung lists the type of command and the memory areas affected and allows command execution to be initiated in the user program.

There are 2 basic command rung formats that differ only in terms of the unit of memory which they control. The basic command rung formats are:

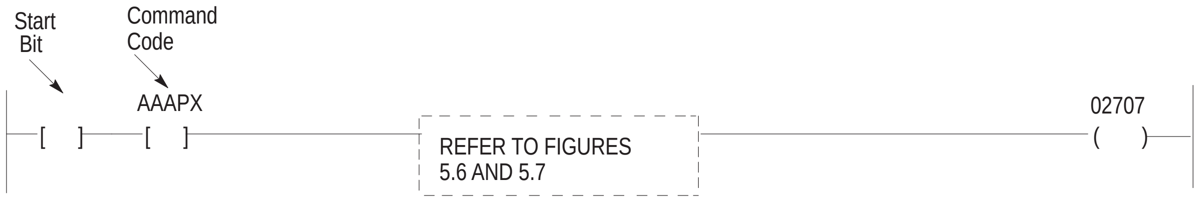
- Word command format
- Bit command format

Use the word command format for commands that transfer one or more data table words between stations. These are unprotected write, read, and protected write commands.

Use the bit command format for commands that control, from one station, one or more data table bits at another station processor. These are unprotected bit write and protected bit write commands.

In both formats the command rung begins in a similar manner. (Refer to Figure 5.5). The first rung element is an EXAMINE ON instruction, addressing the START bit. The second rung element, termed the command code, tells the remote station number, type, and priority of the command. (Section titled “Message Priority,” chapter 8, describes command priority.) For most commands, normal priority is preferred.

Figure 5.5
Command Rung Format



AAA – REMOTE STATION NO.

P – PRIORITY INDICATOR
1 = PRIORITY MESSAGE
0 = NORMAL MESSAGE

X – COMMAND TYPE
0 = PROTECTED WRITE
1 = UNPROTECTED READ
2 = PROTECTED BIT WRITE
3 = UNPROTECTED WRITE
4 = UNPROTECTED BIT WRITE

After the command code, the command rung then lists the memory areas affected by the command. The format of this area varies, based upon the type of memory area controlled by the command.

The length of the communication zone in PLC-2 family PCs is limited by the memory available inside the communication module. Very few applications approach this limit, but if you program too many command rungs, the value 26 will appear in the error code word when you place the processor in RUN or RUN/PROGRAM mode.

Each command rung ends with an OUTPUT ENERGIZE 02707 element. This instruction is used solely for the purpose of fitting the command rung into the proper display format. The output instruction of the command rung has no significance in program logic.

Examine START Bit

Each command rung has a unique START bit in a memory word selected by the programmer. (Refer to section titled “START/DONE Word,” chapter 6). The START bits are examined by the communication adapter module. When a START bit is on, the communication adapter module carries out the programmed command.

The START bit is controlled by the program. This allows a command to be initiated only when necessary. (Programming methods for START bit control are given in chapter 7.)

Command Code

The second element in a command rung, the command code, identifies the following:

- Remote station number
- Priority status of the command (priority or normal)
- Type of command

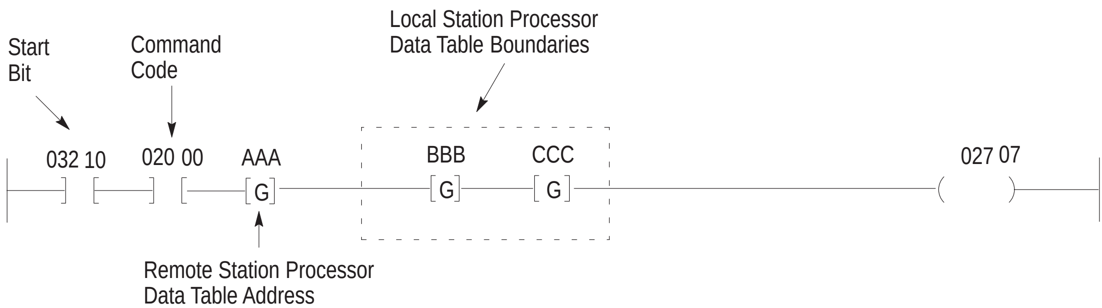
NOTE: The command code uses the address of an EXAMINE ON instruction, but does not examine or control any bit in the data table of the local station processor.

Figure 5.5 shows the coding for this rung element.

Word Command Format

When the command code specifies a protected write, read, or unprotected write command, use the format shown in Figure 5.6.

Figure 5.6
Word Command Format



Legend

AAA Beginning word address of remote station processor for write/read operation

BBB Beginning Word Address of local station processor for write/read operation

CCC Ending Word Address at local station processor for write/read operation

This format uses 3 GET statements. The address position of the first GET statement lists a remote station data table word. The specified command operation begins at this memory location. The second and third GET statements define the starting and ending boundaries of the data table words in the local station processor. These words are the beginning and ending data table locations for the words to be transferred in the write or read operation.

In write operations, data words are written to a remote station from the local station data table. For a write command, the first GET element in the command rung lists a beginning address at the remote station. Data is to be written into this word, and succeeding words from the local station data table. The second and third GET elements in this type of rung list starting and ending boundaries for the word or words to be written from the local station data table.

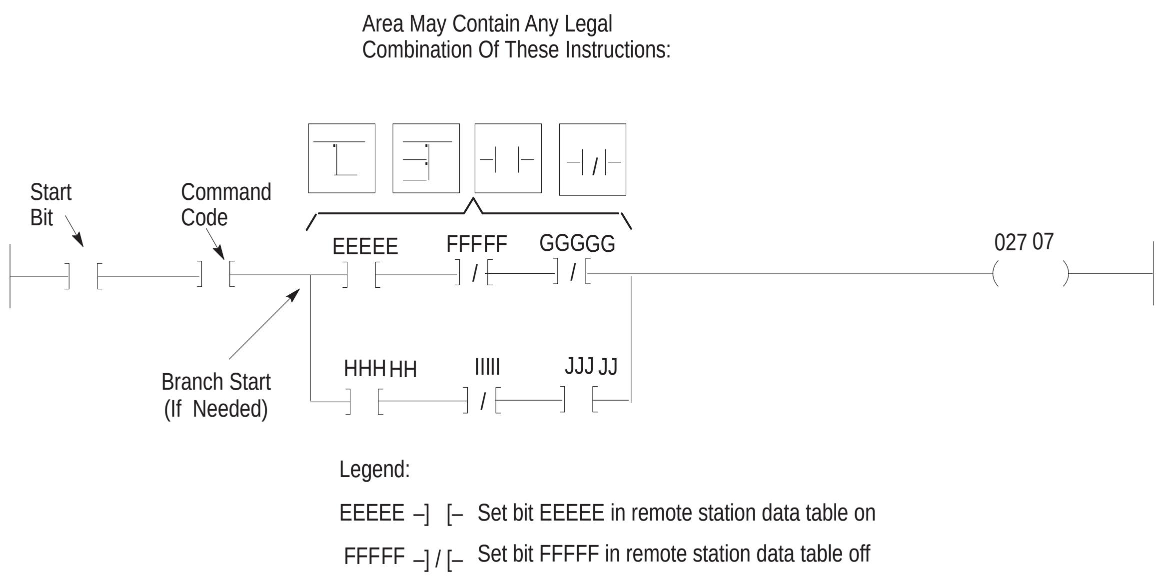
In a read operation, data words are read from a remote station processor into the local station data table. The first GET element in the unprotected read command rung lists the beginning address from which data is to be read. Remote data table words are read in succession, beginning with this address. Words are read only into the area of the local data table bounded by the second and third GET elements in the rung.

Only one set of GET instructions, as shown in Figure 5.6, can be programmed in a single command rung.

Bit Command Format

When the command code specifies a protected bit write or unprotected bit write command, use the format shown in Figure 5.7.

Figure 5.7
Bit Command Format



This format uses EXAMINE elements that address bits in the remote station processor. These elements control remote station data table bits as follows:

- -] [- EXAMINE ON - This rung element instructs the remote station communication adapter module to turn the addressed bit on.
- -]/[- EXAMINE OFF - This rung element instructs the remote station communication adapter module to turn the addressed bit off.

Program these elements immediately after the command code. Any combination of these elements may make up this type of command rung. Where necessary, BRANCH START instructions and a BRANCH END instruction can be used to fit these elements into the display area of the programming terminal. For practical reasons, do not exceed this display area. Multiple rungs of this type can be used as necessary.

Delimiter Rung

The delimiter rung ends the communication zone of program. With PLC-2 family processors, this rung always has the format shown in Figure 5.8.

Figure 5.8
Delimiter Rung

Chapter Summary

Chapter 5 was the RUNG chapter; it discussed:

- Communication zone rungs
- Communication zone of program
- Header rungs
- Memory access rungs
- Command rungs
- Start bit, command code and word command format
- Bit command format with EXAMINE ON, EXAMINE OFF elements

In chapter 6 you will read about bit storage, fault words, and error codes.

Chapter 6

Status Words

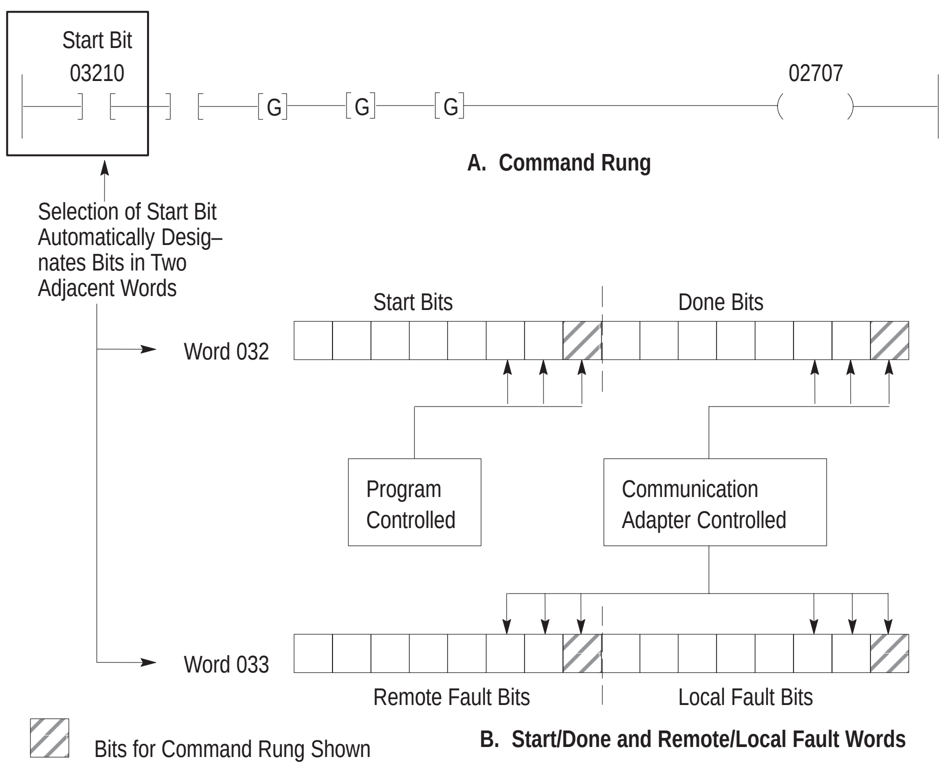
General

A 1771-KA2 communication adapter module controls certain data table words specified in the local station processor by the programmer. These data table words indicate the status of command execution and provide various types of diagnostic information for start-up and troubleshooting. These locations are:

- One or more pairs of adjacent words for START/DONE and REMOTE/LOCAL FAULT bit storage
- An ERROR CODE storage word

Refer to Figure 6.1. The programmer specifies the locations of these status words when entering the communication zone rungs, as described in chapter 5. Two START/DONE and REMOTE/LOCAL FAULT bit storage words are defined by selection of the START bit in a command rung. You specify the ERROR CODE storage word in the header rung.

Figure 6.1
Adjacent Status Word



Any accessible data table words can be used as status words in the station processor. Note that the same recommendations for data table control given in section titled “Accessible Data Table Locations - PLC-2 Processors,” chapter 4, should be followed when selecting status words. That is, processor work areas, input image table words and word 027 should not be used as status words.

START/DONE Word

The START/DONE word is the first of a pair of adjacent status words for communication adapter module use. This word stores a START bit and corresponding DONE bit for each of up to 8 commands. (NOTE: should more than 8 command rungs be programmed at a station, additional pairs of START/DONE and REMOTE/LOCAL FAULT words can be used.)

The START bit for any command is always in the upper byte (bits 10-17) of the START/DONE word. The DONE bit for this command is then the corresponding bit in the lower byte (bits 00-07) of the same word.

In Figure 6.1.A the sample command rung examines bit 03210 as its START bit. As Figure 6.1.B shows, the corresponding DONE bit is bit 03200. Note that the 5-digit address of START/DONE bits for each command differs only in the fourth digit: the START bit always has a “1” in the fourth digit, the DONE bit always has a “0.”

As its name implies, the START bit initiates command execution. This bit, controlled by the user program, is set ON to initiate the sending of a command. The communication adapter module monitors the status of START bits and executes the corresponding command when its START bit is set ON.

The DONE bit as its name implies, indicates command completion. This bit, controlled by the KA2, is set ON when a command is executed.

Each command rung examines a unique START bit. Thus, one pair of START/DONE and REMOTE/LOCAL FAULT words has enough bits for up to 8 command rungs. Should more command rungs be programmed, select additional word pairs as necessary.

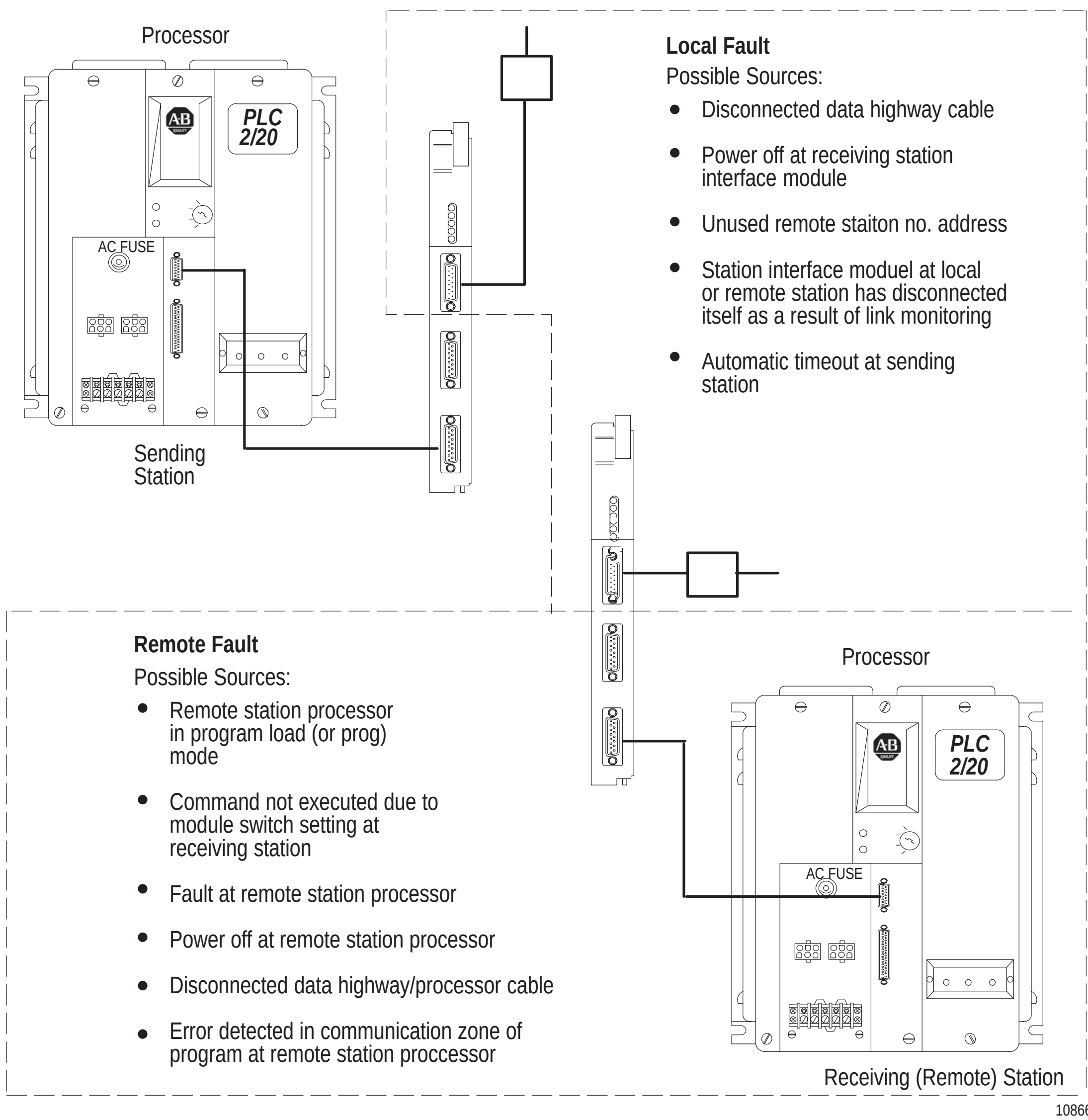
To optimize memory use and minimize the time required by the communication adapter module to scan START bits, use all 8 START bits in one word pair before using another START/DONE word. For the same reason, when programming communication zone rungs, group in sequential fashion command rungs that use the same START/DONE word.

REMOTE/LOCAL FAULT Word

As Figure 6.1 shows, the selection of a START bit in the program not only causes a corresponding DONE bit to be controlled in the same word, but also causes REMOTE and LOCAL FAULT bits to be controlled in the next data table word. A REMOTE FAULT and LOCAL FAULT bit are controlled for each command. For a command, the position of each of these FAULT bits within their respective bytes corresponds directly to the position of START and DONE bits for that command.

The KA2 controls REMOTE and LOCAL FAULT bits. The module sets a FAULT bit ON when a command cannot be executed due to a hardware-related fault either between stations or between the remote station communication adapter module and its station processor. Figure 6.2 summarizes the significance of these bits.

Figure 6.2
REMOTE/LOCAL FAULT Bit Significance



REMOTE FAULT bits are in the upper byte of this word. A REMOTE FAULT bit is set ON when a command is received at a remote station but cannot be executed by the remote station. This may mean one of the following:

- Remote station processor has detected a fault in its own operation or has shut down.
- Remote station processor has power OFF.
- Remote station processor has mode select switch in PROGRAM LOAD (or PROG) mode.
- Cable between remote station adapter and processor is disconnected or faulty.
- Module switch setting prevents execution of the received command.
- Error has been detected in communication zone of program at remote station processor (PROG indicator may be ON).

A REMOTE FAULT bit indicates that the remote station communication adapter or controller module received a message, but could not communicate with its station processor to execute that command.

LOCAL FAULT bits are in the lower byte of this word, bits 00-07. A LOCAL FAULT bit is set when the local station cannot confirm delivery of the message to the remote station. This may mean one of the following:

- Automatic timeout of command completion by communication adapter module.
- Disconnection of the local or remote station interface module from the Data Highway cable
- Loss of power to the remote station communication adapter module
- Unused station number addressed by the command.
- Excessive noise along the Data Highway cable caused by other equipment in the industrial environment.

At the same time it sets a REMOTE or LOCAL FAULT bit ON, the KA2 enters a 2-digit ERROR CODE into the ERROR CODE storage word. (The ERROR CODE storage word is described in the following section.)

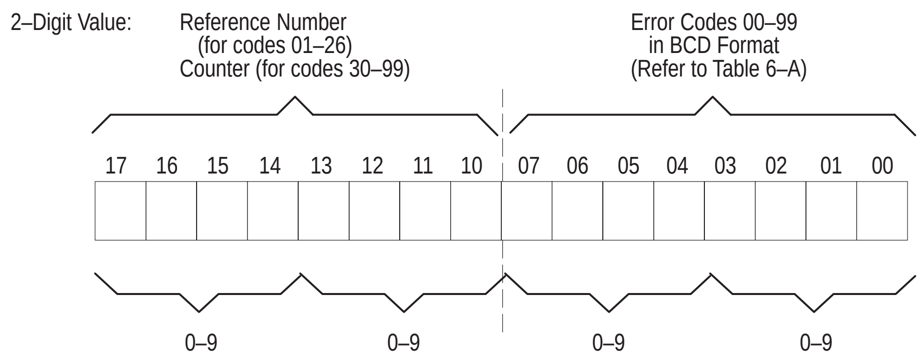
By monitoring these bits in the program, operators can be alerted to hardware conditions that prevent normal transmission and execution of commands. (Programming techniques for monitoring FAULT bits are described in chapter 7.)

Error Code Storage Word

When a command cannot be carried out due to a user programming error or a discrepancy in data handled by the communication adapter module, an ERROR CODE may be written into a data table memory word. The programmer selects the error code storage word and lists it in the header rung of the communication zone of program. This word stores the most recent error code written by the KA2.

Figure 6.3 shows the structure of the ERROR CODE storage word. The lower byte of this word (bits 00-07) stores any ERROR CODE entered by the module. In this byte the ERROR CODE is represented as a 2-digit binary coded decimal (BCD) number from 00-99. Table A.1 (Appendix A) lists and describes these ERROR CODES.

Figure 6.3
ERROR CODE Word Format



ERROR CODES can be grouped as follows:

- Codes 01-29 generally indicate that some programming error has been detected in the communication zone of program. These codes are intended to indicate errors or processor communication faults detected at power-up. The program status indicator (PROG) may be on if one of these codes is displayed.
- Codes 30-99 generally indicate that some programming or hardware related fault has been detected during attempts at communication between stations. Codes 30-99 serve as diagnostic indicators after the initial power-up checks of program have been completed.

A code in this 30-99 group is displayed whenever a REMOTE or LOCAL FAULT bit is set ON.

The upper byte of the ERROR CODE storage word (bits 10-17) stores a 2-digit BCD value. This value gives supplemental error or fault information, depending on the type of ERROR CODE displayed. It may have one of two meanings:

- Reference number
- Counter

For ERROR CODES 01-29, the upper byte stores a 2-digit reference number. This number points to the location of a programming error within the communication zone of program. This error may be an incorrect instruction or an improper address entered within a rung of the communication zone. In this numbering scheme, the header rung of the communication zone of program is designated as “00.” Subsequent communication zone rungs are numbered sequentially.

Note that ERROR CODES 01-29 are intended as aids in start-up debugging of the communication zone of program. Thus, the reference number stored in this word can be a valuable tool for debugging purposes.

For ERROR CODES 30-99, the upper byte stores a 2-digit counter. This counter shows the number of ERROR CODES 30-99 written into the storage word by the communication adapter module. The counter increments each time a different ERROR CODE storage word.

These codes are generally to be displayed on a programming terminal rather than used in application programming. They have special value in station start-up, when programming errors are detected in the communication zone of program.

By viewing the header rung of the communication zone, the programmer can examine a displayed ERROR CODE and the least significant digit of the counter in this word. (Section titled “Header Rung,” chapter 5, describes a header rung.)

In some instances, however, it may be preferable to display the 2-digit error code using a 7-segment BCD numerical display controlled from output modules of the controller. This 7-segment display, mounted at an operator’s station, can provide a useful troubleshooting aid for quickly locating fault conditions.

Chapter Summary

This was the WORD and CODE chapter and it discussed:

- START/DONE, REMOTE/LOCAL FAULT bit storage
- REMOTE/LOCAL fault word
- Error code storage word (Error code list is in Appendix A.)

Chapter 7 continues discussion about command initiation, control bits, fault words, and monitoring.

Chapter 7

Command Initiation, Execution, and Monitoring

General

This chapter describes the **support programming** for commands at each station processor. This programming uses the START/DONE and REMOTE/LOCAL FAULT bits, described in chapter 6, to initiate and monitor command execution. Using these recommended techniques, the programmer coordinates communication zone programming with his application program.

START/DONE Bit Timing

The START bit that initiates a command is program-controlled; the DONE bit, which indicates command completion, is communication adapter module-controlled. The timing relationship of START and DONE bits is used by the programmer to initiate and terminate commands. The following sections describe this relationship in normal operation and describe the automatic responses that result from faulted operation.

Normal Operation

Command execution begins when the user program turns a START bit ON, normally with a LATCH instruction. The 1771-KA2 communication adapter module detects the ON state of this bit and then begins the operations necessary to format and transmit a command message.

When the remote station communication adapter module receives the command message, it acknowledges it. Then, while normal Data Highway operation continues, the remote station communication adapter module executes the command and prepares a reply message. (A reply message is sent for each type of command.) The remote station communication adapter module responds to a poll for mastership, then transmits its reply message to the local (sending) station. (Refer to chapter 8 for a description of mastership and polling.)

When the local station communication adapter module receives the reply, it sets the done bit on at the local station processor. The DONE bit, in turn, is examined in the user program to turn OFF the START bit.

After the START bit has been turned OFF (unlatched), the communication adapter module resets the DONE bit.

Figure 7.1 shows the timing of START and DONE bits for a command. The significance of START/DONE bit status is summarized in Table 7.A.

Figure 7.1
START/DONE Bit Timing - Normal Operation

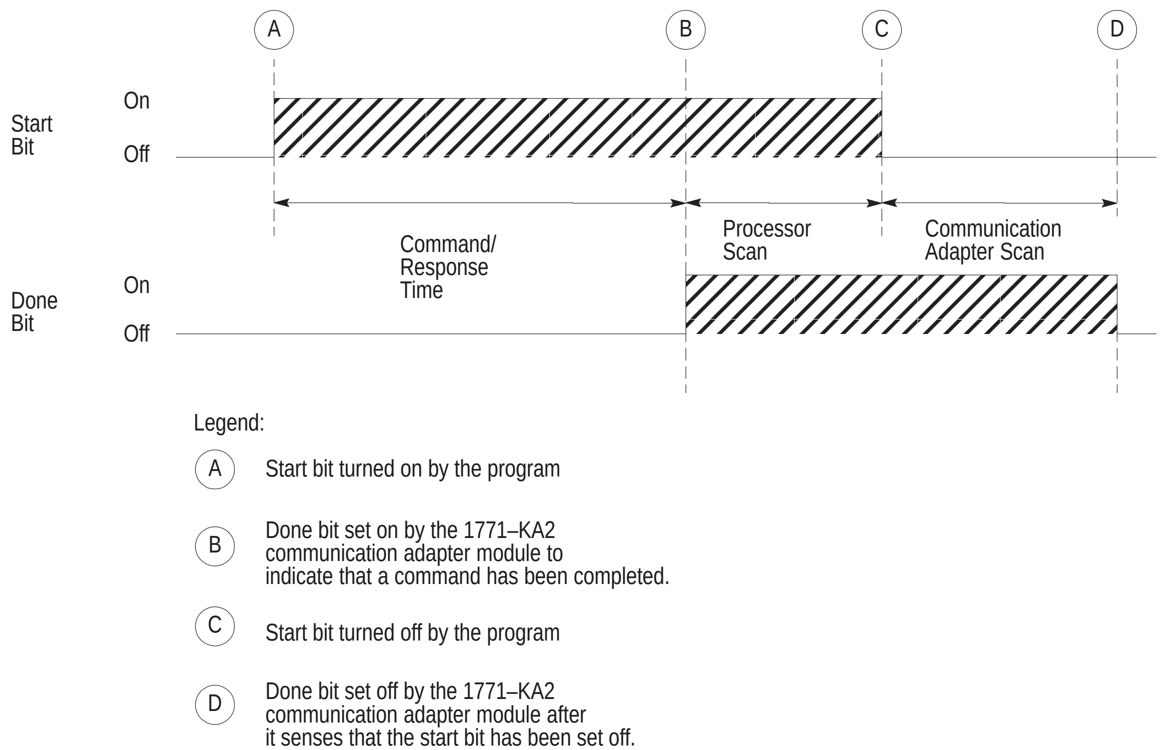


Table 7.A
START/DONE Bit Status

Status		Significance
Start Bit	**Done Bit**	
0	0	Idle
1	0	Command initiated or in progress
1	1	Command/reply operation complete
0	1	The processor, based on the program, acknowledges completion of the command/reply operation (transient condition, since the communication adapter turns the DONE bit OFF in its next scan.)

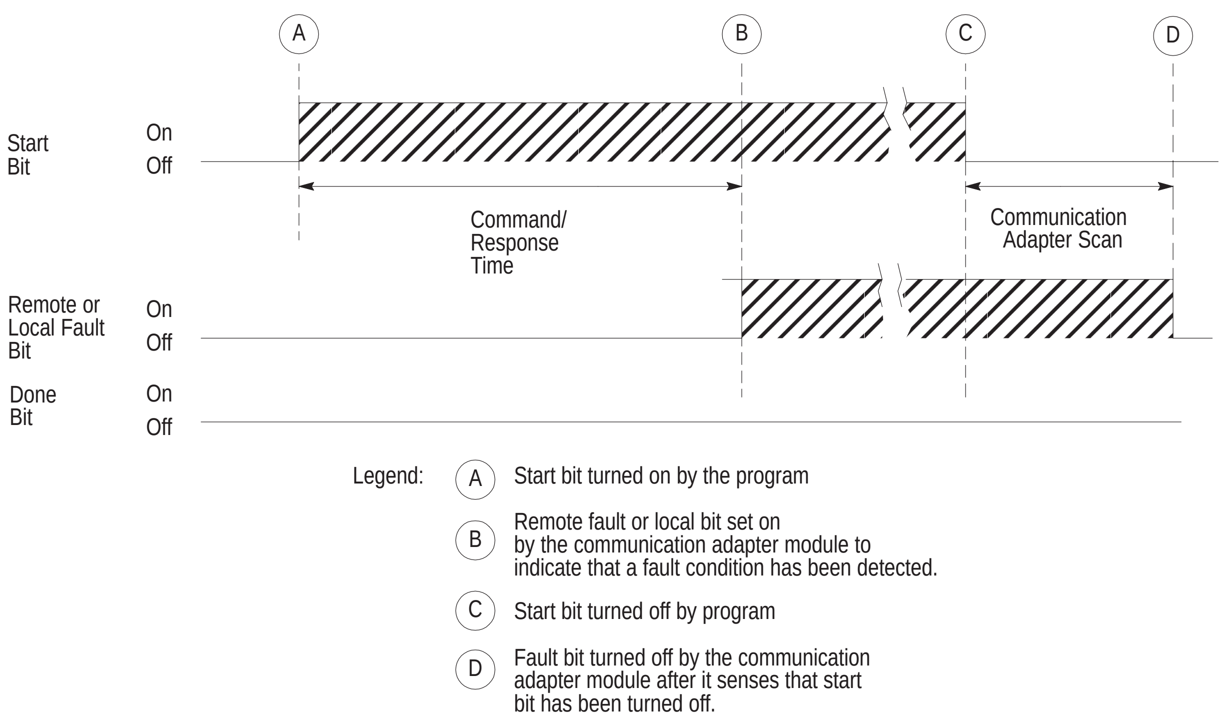
Faulty Operation

Certain fault conditions can prevent normal reception and execution of commands by the receiving station. To indicate the source of such fault conditions, the KA2 controls REMOTE and LOCAL FAULT bits at the station processor.

In general, the LOCAL FAULT bit indicates that the local station cannot confirm delivery of a command to the remote station. The REMOTE FAULT bit, on the other hand, indicates that the intended receiving station communication adapter module has received the command message, but is unable to execute the command at its station processor. (For a quick summary of the distinction between these FAULT types, refer to Figure 6.3.)

The timing relationship of these FAULT bits in command execution is shown in Figure 7.2. In this example, the command initiated at the setting of the START bit executed due to some fault condition. The communication adapter module, detecting this fault condition, sets either a LOCAL or REMOTE FAULT bit.

Figure 7.2
START/FAULT Bit Timing - Faulted Operation



Recall that the START bit is program-controlled. The REMOTE/LOCAL FAULT bits, meanwhile, are controlled by the 1771-KA2 module. The programmer must keep this relationship in mind when planning START bit control and FAULT bit monitoring in the ladder-diagram program.

Note from Figure 7.2 that the FAULT bit, once ON, remains ON until the START bit is reset (turned OFF). Only after it has detected that the program-controlled START bit is OFF does the communication adapter module then turn the FAULT bit OFF. Note also that the DONE bit is not set ON in the event of a fault condition.

NOTE: In the special case where the START bit is turned OFF by the program before the KA2 sets a DONE or FAULT bit, attempts to send that command are terminated. The LOCAL FAULT bit is pulsed ON for approximately 60 msec in this instance. This type of situation may occur, for example, if some event is programmed to UNLATCH the START bit before command completion.

Controlling The Start Bit

The user program controls the START bit: setting it ON to initiate command execution, turning it OFF after command completion or after a fault is detected. Normally, the START bit is turned ON by a LATCH instruction, OFF by an UNLATCH instruction. The use of retentive LATCH/UNLATCH instructions is best suited for the timing relationship of START, DONE, and FAULT bits and helps to keep programming simple and straightforward.

To LATCH the START bit, the program examines application conditions. These may include input/output device data, values, or other information from the controlled process. For the most part, an application condition used to initiate a command is one of these general types:

- The ON or OFF status of some I/O device
- Transition of some I/O device
- Timed condition

To UNLATCH the START bit, the program examines the response from the communication adapter module. This response may be one of the following:

- DONE bit
- REMOTE FAULT bit
- LOCAL FAULT bit

Thus, the rung used to UNLATCH the START bit examines these three possible responses in parallel branches of the ladder diagram program.

Section titled “ON/OFF Input Status,” “Transition,” and “Timed” describe the most commonly used forms of START bit control. Each section describes a different method for initiating command execution; all examples show how the program uses both DONE and FAULT bits to UNLATCH the START bit.

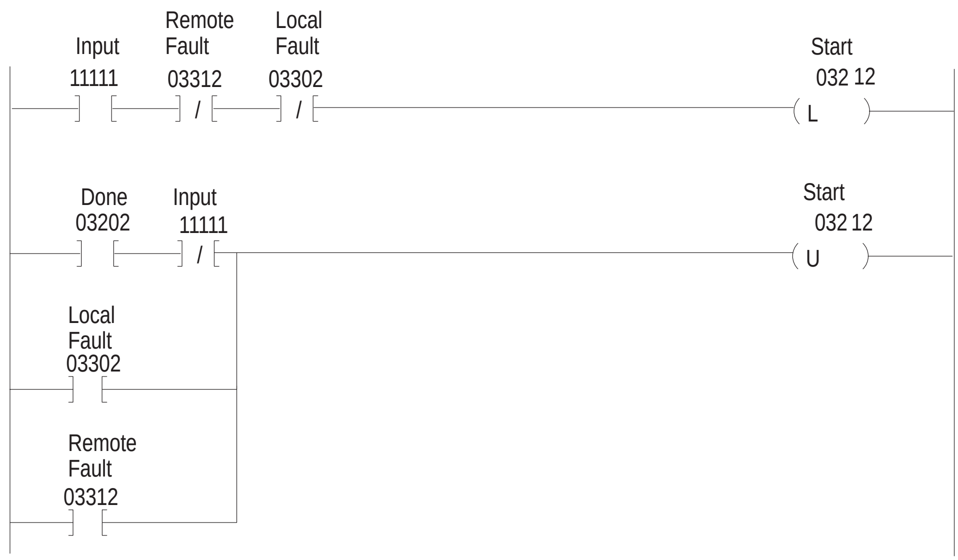
An important assumption underlies the examples outlined in sections titled “ON/OFF Input Status,” “Transition,” and “Timed” and shown in Figures 7.3 through 7.5. Here, the program automatically re-tries transmission of a command in the event of a fault. Only the DONE bit terminates attempts at command execution; a LOCAL or REMOTE FAULT bit response causes the program to re-initiate command execution. (This type of programmed re-try is not to be confused with the re-try procedure of the 1771-KA2 module itself; transparent to user programming, the module automatically attempts several re-tries of a message before it sets a FAULT bit. Section titled “Floating Master,” in chapter 8, describes these automatic re-tries of the module.)

Programmed re-try has distinct advantages. As the communication adapter module continuously tries to send the command message, any data content of the message (for a write command) is continuously updated. As soon as the fault condition is corrected, the message is sent, with the latest data. In addition, once the command is completed, the program automatically UNLATCHES the START bit. This eliminates the need for a manual reset of the START bit when a fault condition is corrected.

ON/OFF Input Status

The ON or OFF status of an input device can be used to LATCH the START bit. Figure 7.3 shows rungs for this type of command initiation.

Figure 7.3
Status-Initiated Command



In this example, the first rung is programmed to LATCH the START bit when the input, bit 11111, is ON, provided that both FAULT bits are OFF. The second rung is programmed to UNLATCH the START bit based on the response of the communication adapter module.

In normal operation, the START bit is LATCHED by the input 11111; the FAULT bits, initially, are OFF. This causes the command message to be formatted and sent. Then, when the command is completed, the DONE bit is set ON by the communication adapter module. Note that the input bit, 11111, must also be OFF to UNLATCH the START bit in this example. With this arrangement, the command message is sent only once; input 11111 must be turned OFF, then ON again, to execute this command a second time. In normal operation, the START bit, after successful command completion, remains ON until input 11111 goes OFF. (Recall from Figure 7.1 that the communication adapter module holds the DONE bit ON until after the START bit is turned OFF.)

Should a fault condition prevent normal execution, these rungs provide a programmed re-try of the command. A REMOTE or LOCAL FAULT bit resets the START bit in the second rung. In the first rung, the START bit is LATCHED again after the communication adapter module resets the FAULT bit. (As Figure 7.2 shows, the 1771-KA2 module resets a FAULT bit only after the START bit has been turned OFF.)

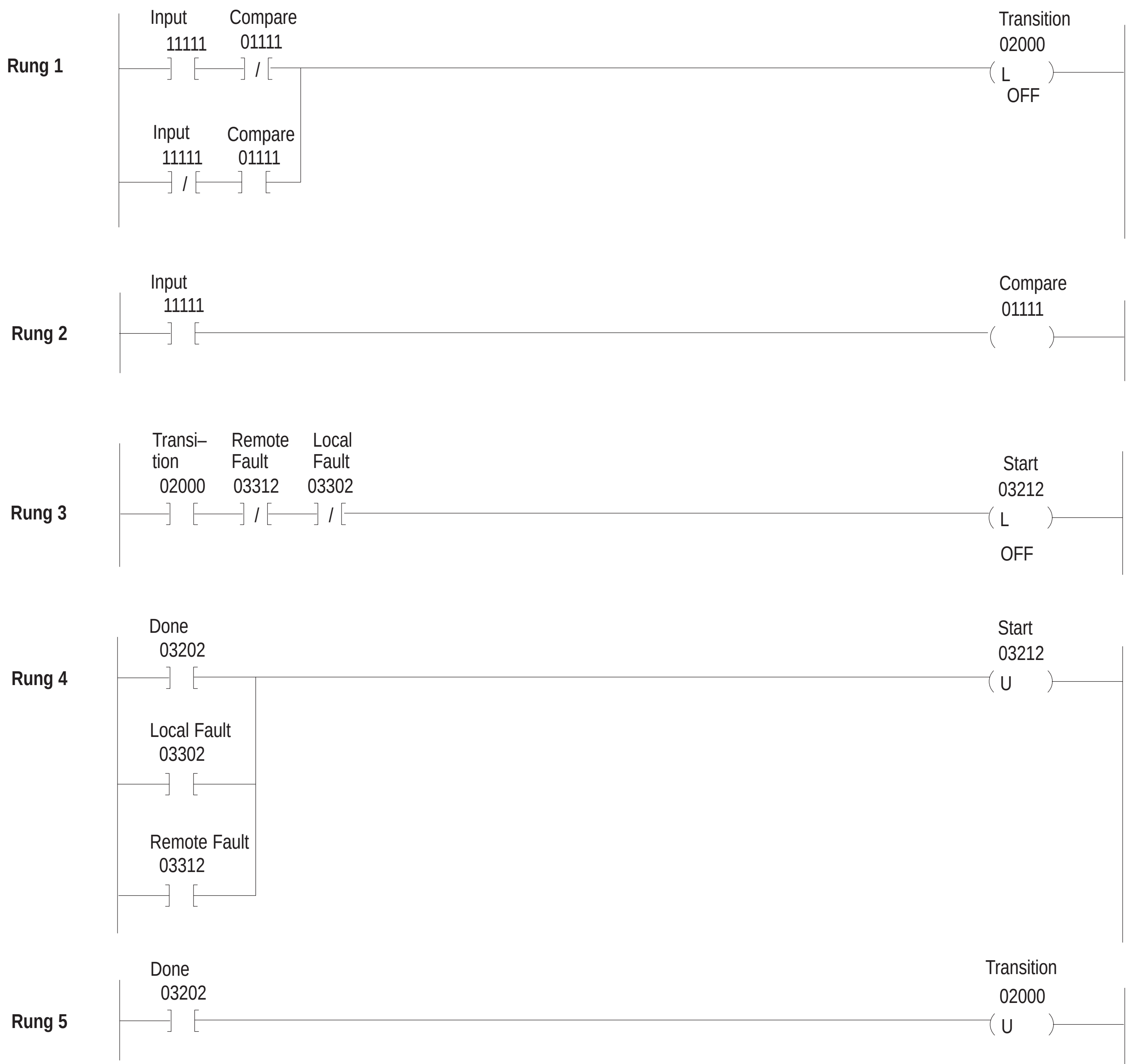
Even though the FAULT bits are continually reset with this method, their usefulness must not be overlooked. The section titled “REMOTE/FAULT Bit Monitoring” outlines a useful method to monitor FAULT bits and control an output indicator based on FAULT bit status.

In some applications, it may be useful to send a command continuously between stations. With the example of Figure 7.3, this can be accomplished by eliminating the EXAMINE OFF instruction for input 11111 in the second rung. This would cause the command to be sent continuously as long as input 11111 remains ON.

Transition

The transition of an input device from ON to OFF and from OFF to ON can be used to LATCH the START bit. This allows a command to be sent each time a condition changes state. Figure 7.4 shows example rungs for this type of command initiation.

Figure 7.4
Transition-Initiated Command



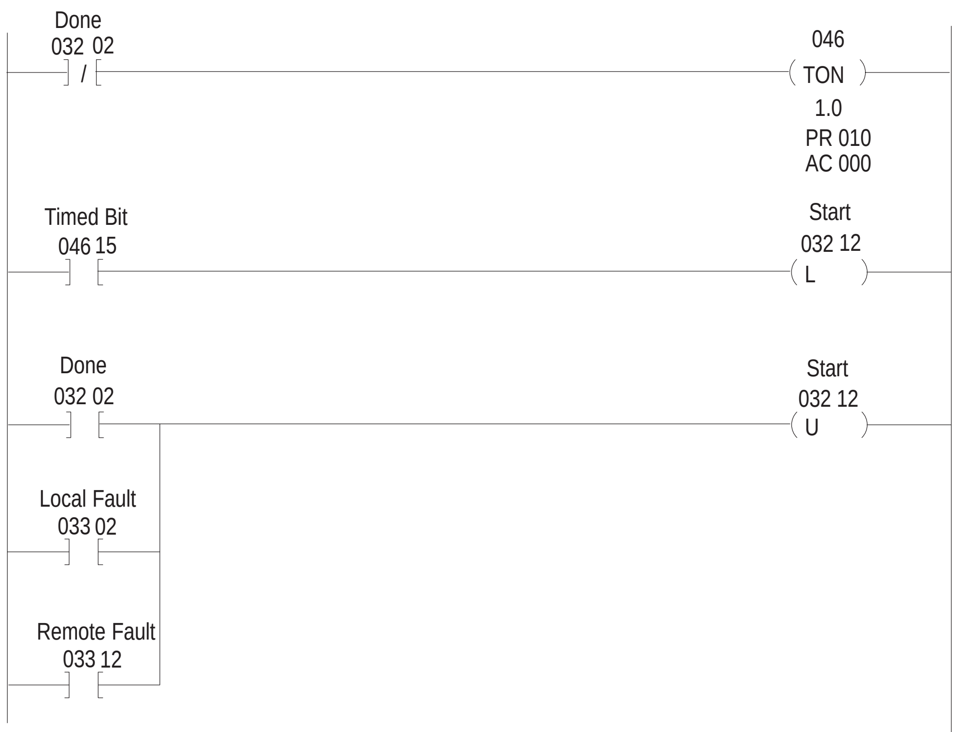
In this example, a storage bit, called the "transition" bit, is manipulated to control the sending of the command. This bit is LATCHED whenever a transition of input 11111 is detected, UNLATCHED only when the DONE bit is set ON. A "compare" bit, 01111 in this example, is used to manipulate the transition bit. In rung 2, the compare bit is controlled to match the ON/OFF status of the input. Because the input and the compare bit are programmed to have matching states, both ON or both OFF, the conditions of RUNG 1 can be TRUE only when the input has just changed from ON to OFF or from OFF to ON. Thus rung 1 conditions set up a "one-shot," TRUE only long enough to LATCH the transition bit. Note that these rung conditions are FALSE as soon as the processor scans rung 2. The order of these rungs is important for this reason.

With the transition bit LATCHED, the START bit, in turn, is LATCHED in rung 3. This initiates the command. In normal operation, the DONE bit UNLATCHES the START bit in rung 4 and then UNLATCHES the transition bit in rung 5. In faulted operation, however, rungs 3 and 4 repeatedly re-try the command in much the same manner as in the example of Figure 7.3.

Timed

The START bit may be LATCHED periodically to send a command at a user-determined time interval. Figure 7.5 shows example rungs for this type of command initiation.

Figure 7.5
Timer-Initiated Command



In this example, timed bit 04615 is used to initiate the command at every preset interval, 10 seconds. This bit is examined to LATCH the START bit. The DONE, LOCAL FAULT, and REMOTE FAULT bit are examined in parallel branches to UNLATCH the START bit.

In normal operation, after the command is executed, the DONE bit is set ON by the communication adapter module. This causes the program to UNLATCH the START bit. The timer then begins timing again once the DONE bit is set OFF. (As Figure 7.1 shows, the DONE bit is reset only after the START bit is reset.)

Note that this programming causes continuous re-try of a command in the event of faulted operation.

REMOTE/LOCAL FAULT Bit Monitoring

When it cannot execute a command, the Communication adapter module sets a REMOTE or LOCAL FAULT bit ON. These bits, in the data table of the station processor, are located in the word immediately following the START/DONE bit word. They indicate not only that a command was not executed, but also point to the general type of fault condition that prevented command completion.

The user program must monitor the REMOTE and LOCAL FAULT bits for each command. The recommendations of this section describe two methods for monitoring FAULT bits and using these bits to signal a fault condition.

Diagnostic FAULT Rungs

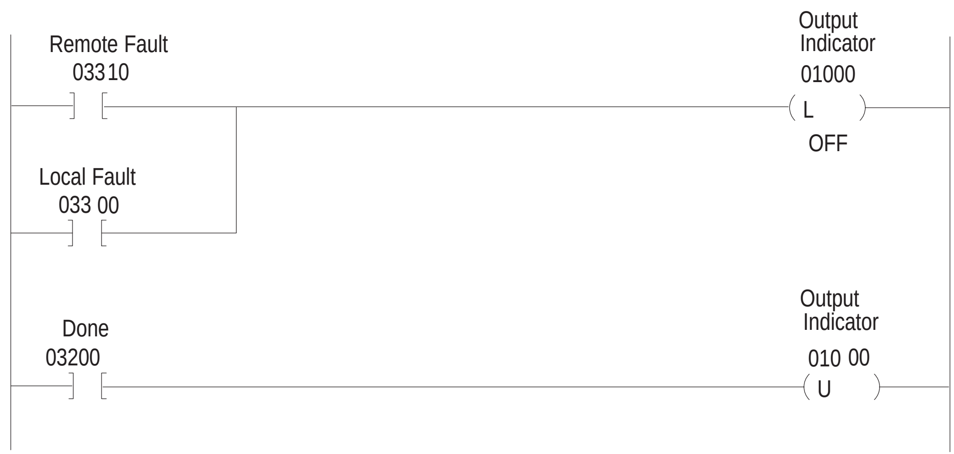
The purpose of monitoring REMOTE/LOCAL FAULT bits is to control one or more output indicators to signal a fault condition. Fault indicators controlled for this purpose may be as simple as a warning light or an annunciator, or as complex as a line printer or CRT terminal used to display a fault message. By controlling the fault indicator device, the user program can alert user personnel to the nature and location of a fault condition.

To monitor the REMOTE and LOCAL FAULT bits, a programmer must understand their timing relationship to the corresponding START bit. Figure 7.2 summarizes this relationship.

The section titled “Controlling the Start Bit” showed how the FAULT bit can be programmed to UNLATCH the START bit in a fault situation and thus provide automatic re-tries through the program. When used in this manner, however, a FAULT bit will be rapidly cycled ON and OFF if a fault is detected. Because the fault bit can be constantly changing state at a rapid rate, the program must use some method of detecting this transient state of any FAULT bit and of controlling the output device based on this state.

Figure 7.6 shows a simple method for the control of a fault indicator. Here, either the REMOTE or LOCAL FAULT bit can LATCH the output indicator ON. The indicator remains ON until the DONE bit is energized. This then UNLATCHES the output indicator in the second rung of Figure 7.6. This example allows for the transience of the FAULT bits, since the first rung need only be TRUE once for the output indicator to be latched.

Figure 7.6
FAULT Bit Diagnostic Rungs (Single Command Example)



The method of Figure 7.6 can be extended to monitor multiple commands from a station, controlling multiple output indicators as necessary. However, where more than one command is being sent from a station, the use of multiple output indicators may not be practical. In this instance, a single output indicator can be used to signal all REMOTE or LOCAL FAULT conditions for commands from that station. Figure 7.7 shows a method for fault indicator control assuming multiple commands.

Figure 7.7
FAULT Bit Diagnostic Rungs (Multiple Commands Example)

This example shows the FAULT bit monitoring for 8 commands. The 8 LOCAL FAULT bits are monitored in rung 1. As long as all 8 bits are OFF, status bit 05500 remains ON. However, should any LOCAL FAULT bit be ON, status bit 05500 is de-energized. In rung 2, the 8 REMOTE FAULT bits are monitored in the same manner, to control status bit 05501.

The status bits controlled by rungs 1 and 2 are, in turn, used to control an OFF-DELAY timer in rung 3. The OFF-DELAY timer begins to time when either of the status bits goes from OFF to ON, that is, when rung conditions go from TRUE to FALSE. Bit 03015, the timed bit of the timer, controls the output indicator. As soon as the conditions of the timer in rung 3 are TRUE, this bit is set ON causing the indicator to be energized. Once ON, this bit remains on as long as the timer is timing, that is, for at least as long as the preset interval. In the example of Figure 7.7, this preset is set at 2 seconds. This value is not critical but should exceed 0.5 seconds for practical purposes.

The OFF-DELAY timer is useful in this application because it is continually reset when its rung conditions go TRUE. This means that the timed bit, 03015, remains on for as long as any FAULT bit is changing state during programmed re-tries. This keeps the output indicator on until after the DONE bit indicates command completion.

NOTE: Using the rungs of Figure 7.7, the indicator goes ON automatically at power-up, or whenever the mode select switch on the processor is changed from the PROGRAM LOAD (or PROG) mode to any other mode. However, the indicator only remains on initially for the preset interval; after this time, the indicator is valid for fault conditions.

Rungs 1 and 2 examine all 8 FAULT bits of each type. Should fewer than 8 command rungs be programmed at a station processor, fewer bits need be examined. Then, should command rungs be added subsequently, the appropriate bits could be addressed in rungs 1 and 2. Conversely, if more than 8 command rungs were programmed at a station, additional rungs would be needed to examine both REMOTE and LOCAL FAULT bits for the additional commands. Status bits controlled by these additional rungs could then be examined in branches of rung 3, parallel to those shown.

Of course, other methods can be used to monitor REMOTE and LOCAL FAULT bits. Such factors as availability of output terminals, memory space, and type of application dictate the specifics of FAULT bit monitoring and program response.

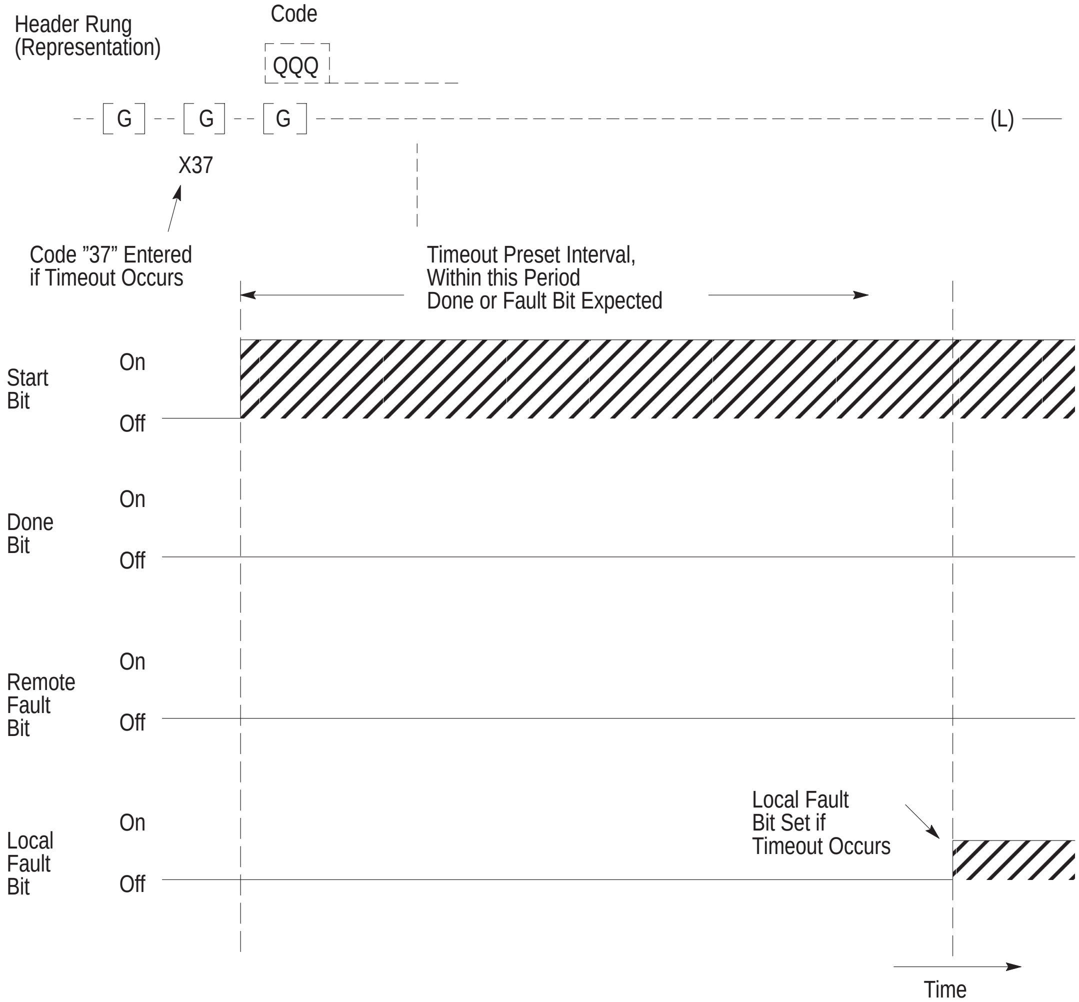
Use of FAULT bits in start-up and troubleshooting procedures is described in chapter 9.

Timeout Preset Value

In addition to its REMOTE/LOCAL FAULT bit control, a 1771-KA2 module also provides an automatic timer for monitoring command completion. While it functions automatically during module operation, the timer uses a preset value entered in the user program. This feature enables the module to monitor command execution time without using timer (TON) instructions in the user program.

Figure 7.8 shows the significance of the timeout preset interval. From the time the START bit is set ON, the module must set either a DONE bit or a REMOTE or LOCAL FAULT bit within the timeout preset interval. Should the module detect no DONE or FAULT bit response within the preset interval, some type of fault is assumed. As a response to this type of timeout situation, the module sets the LOCAL FAULT bit ON and enters the value 37 in the lower byte of the ERROR CODE storage word of the header rung.

Figure 7.8
Timeout Preset Significance



Timeout preset monitoring is intended as a **backup** for the other communication monitoring functions of the module. It is designed to signal any condition where the module has not completed its communication with another station or detected some fault condition within a short time. Because this timer is primarily intended as a backup for some LOCAL FAULT type of situation, its preset value is not critical. In the examples in this manual, a nominal value of 5 seconds, coded 015, is programmed as the timeout preset value. This value is appropriate for most applications.

Programming the Preset Code

The timeout preset code for Data Highway communication is entered in the header rung of the communication zone of program. The address field of the third GET instructions in this rung is used for the timeout preset code. Figure 7.8 shows the position of this rung element.

The 3-digit address of a GET instruction is an octal (base 8) number. Because only octal values can be entered in this address field the timeout preset value is a code, computed as outlined in this section.

As section titled "Timeout Preset Value" points out, the timeout preset is not a critical value. For most applications, a 5-second present is acceptable. The code for this timeout preset is 015. However, there may be instance where another timeout preset interval is desired. Table 7.B lists the 3-digit codes for intervals from 1 to 10 seconds. Note that values listed provide nominal values that will vary with activity level in the KA2.

Table 7.B
Timeout Preset Codes

Timeout Interval (Sec,)	Code
1	011
2	012
3	013
4	014
5	015
6	016
7	017
8	020
9	021
10	022

If it is necessary to use a value other than those provided in Table 7.B, compute the 3-digit timeout preset code as follows:

1. Select a timeout preset interval. This interval must be at least one second.

For the purpose of computing the code, label this number “S.”

EXAMPLE: desired interval = 7 seconds = S

2. Compute a decimal (base 10) number using the desired interval of step 1 in the following formula:

S + 8

EXAMPLE: S + 8 = 15

3. Convert this value to a 3-digit octal (base 8) value.

EXAMPLE: $15_{10} = 17_8$

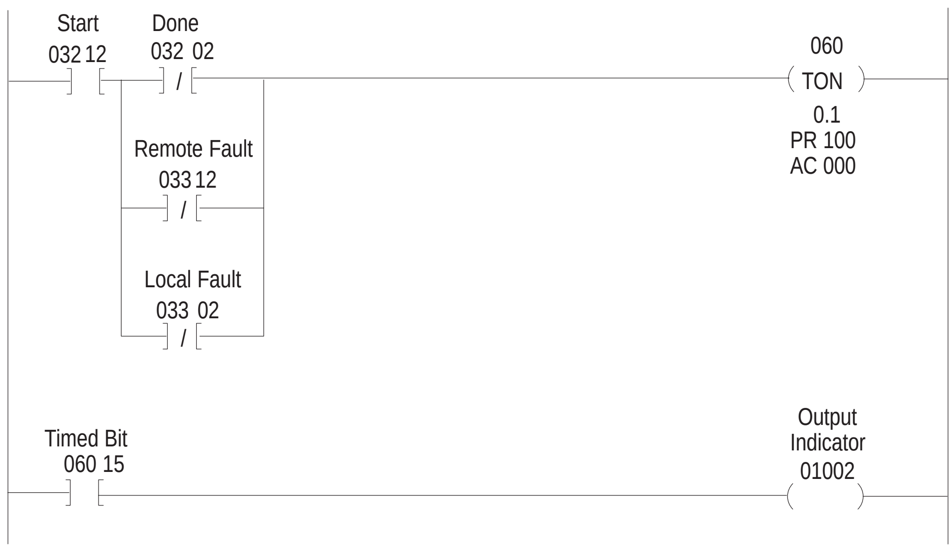
For a brief description of decimal-to octal conversion, refer to chapter 13 of publication 1772-821, Programming and Operations Manual, Mini-PLC-2 Programmable Controller. You can disable the timeout by using the value 010.

User-Programmed Timeout (Optional)

The automatic timeout of a 1771-KA2 communication adapter module has a backup function. This automatic monitoring routine continuously checks module interaction with other Data Highway stations, timing the execution of commands. This automatic timeout does not check module communication with its **own** station processor. For a backup check on module/processor communication, an optional programmed ON-DELAY timer instruction (TON) can be used.

With proper module/processor communication, the module sets either a DONE bit or a REMOTE or LOCAL FAULT bit as a response to a command. However, in the event of faulted module/processor communication or faulted module operation, a response bit might not be set. Instead, the START bit would remain on in this instance until the fault situation was corrected. Several programming methods can be used to detect such a condition; the simplest of these methods uses an ON-DELAY timer. Figure 7.9 shows typical rungs that can be programmed for this purpose.

Figure 7.9
Typical User-Programmed Timeout



In the first rung of this figure, timer 060 times the interval between the setting of the START bit for a command and the DONE, LOCAL FAULT, or REMOTE FAULT response of the module. If no response is received within the preset interval of this timer, here 10 seconds, a fault may be indicated and bit 06015 set ON. The second rung examines this bit to turn on a warning indicator. Depending on the individual application, this bit could also be used to enable or disable various parts of the program.

The preset value of this programmed TON instruction is not critical. For this type of backup monitoring, the programmed preset must exceed the timeout preset interval entered as a code in the header rung. (Remember that the automatic timeout of the module gives a LOCAL FAULT response to a command, which would indicate normal module/processor communication, but faulted communication with some other station.)

As with automatic timeout preset monitoring, a user-programmed timeout is useful as a **backup** to the other monitoring functions of the communication adapter module. (REMOTE and LOCAL FAULT bits at other stations indicate the same types of faults that can be detected using a user-programmed timeout.) A programmed timeout would not be necessary for each command from a station. Instead, a single command at each station can be monitored in this manner. Select a command that is sent regularly for this type of monitoring.

There may be other instances where program monitoring of commands is useful. In some cases, a user-programmed timeout may be used to monitor the execution time of critical commands. An application may require that a critical message, such as a priority command, be sent within a certain limited amount of time. A programmed TON instruction can be used for this purpose; here, however, its preset interval will generally be shorter than the interval entered as the timeout preset for the module.

Chapter Summary

This chapter dovetailed with chapter 6. It discussed command initiation, execution, and monitoring and their association with:

- START/DONE bit timing
- Normal operation
- START/DONE bit status
- Faulty operation
- Control of START bit
- ON/OFF input status
- Transition of an input device from ON to OFF and OFF to ON
- Timed start bits
- Diagnostic FAULT rungs
- Timeout preset values
- Programming a preset code
- Optional user-programmed timeouts

Chapter 8 discusses interfacing a KA2 with other modules on a Data Highway, mastership of the highway and Data Highway computer commands.

Chapter 8

Station Interfacing

General

To execute commands, a 1771-KA2 communication adapter module at one station interacts with all other stations interface modules on the Data Highway. This chapter describes this interaction of station interface modules.

Because much of this interaction is transparent to user programming, the information given here is largely for background. However, an understanding of station interaction is useful in optimizing use of each individual communication adapter module and of the Data Highway as a whole. Specifically, the information aids in an understanding of the following:

- Floating master operation and polling
- Message types
- Sequence of messages for command execution
- Acknowledgements
- Re-tries of transmitted messages
- Priority command designation
- Automatic disconnection of faulted master
- Commands that can be sent by computer

Floating Master

Central to the interaction of station interface modules is the concept of shared mastership--the floating master. With this arrangement, no single station controls the Data Highway communication link at all times. Instead, each station vies for mastership based on its need to send messages.

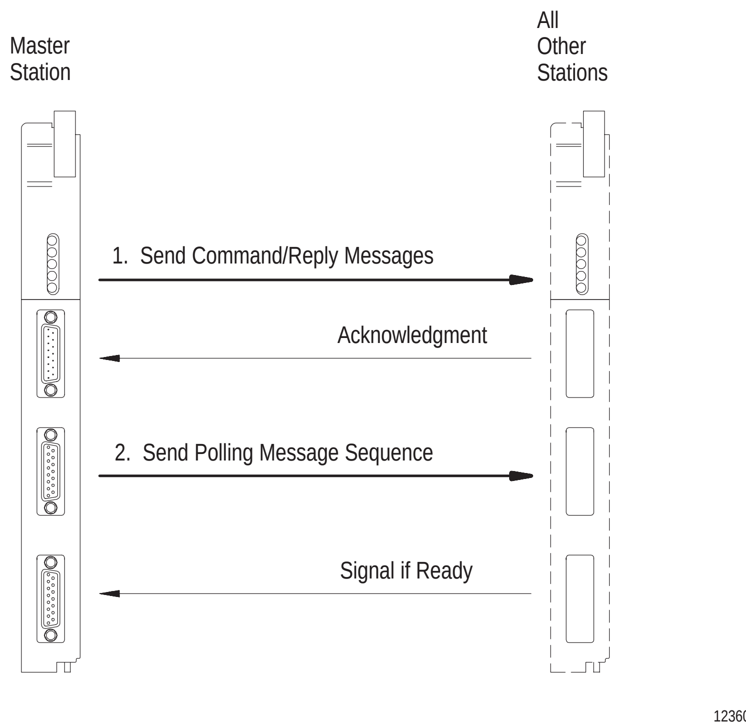
The advantage of this arrangement is that Data Highway operation can continue even if one or more stations are unable to maintain communication. Thus, disconnection of a station or a fault at a station processor or communication adapter module does not disable communication between other operating stations. This minimizes the need for redundancy in many applications.

Mastership

A Data Highway cable links as many as 64 stations. Because this cable has a single pair of wires, only one station can transmit at a time. When a station interface module gains control of this data link to transmit messages, that station has mastership.

When one station interface module is master, all other station interface modules assume a "slave" or receive mode. This enables these stations to receive and acknowledge messages sent to them. The relationship between the master station interface module and all other stations is shown in Figure 8.1.

Figure 8.1
Master Station Functions



As master, a communication adapter module can send the following types of messages:

- Command
- Reply
- Polling

The function of both command and reply messages is the transfer of data between stations. As soon as the communication module attains mastership, it sends its command and reply messages (up to a maximum number--16 for the 1771-KA2).

After the module sends its command and reply messages, it transmits a sequence of polling messages. By this sequence, it selects the next station to be master of the Data Highway communication link.

Command Messages

A command message from the master communication adapter module instructs another station interface module to execute a command. In general, a command from a communication adapter module can do one of the following:

- Write data table data to another station
- Write bit status to another station
- Request data table data from another station through a read command

The command rung, entered in the communication zone of user program, instructs the communication adapter module to format a command message. Once this message is sent, execution of the command begins. (Command types, execution, and programming are described in chapters 4 through 7.)

Each command message causes a reply message to be generated by the receiving station.

Reply Messages

Reply messages are generated by a station in response to command messages that it receives. The reply message indicates whether the command message was received and whether the station interface module has completed the sequence of events required of it for command execution. For commands that write data, the reply message indicates whether the write operation has been completed at the receiving station. For commands that read data the reply message contains the data specified by the command. If the command was not executed successfully, the reply message contains an indication of the error in the STS byte.

The reply message is an automatic function of communication adapter module operation, transparent to the user program. To send a reply message, a station must have mastership.

Acknowledgement

When a station receives a message addressed to it, whether it is a command or reply message, the receiving station sends an acknowledgement. The acknowledgement is merely a signal that confirms that a message has been received. Transparent to the user program, the acknowledgement is an automatic function of communication adapter module operation.

The acknowledgement serves 2 basic functions: it indicates that the receiving station is operating and has received the message, and it indicates that the received command or reply message is in intelligible format. Should the proper acknowledgment not be received, a fault in the receiving module may be indicated. In this event, the master station communication adapter module re-tries transmission of the message. The communication adapter module attempts several re-tries for a command or reply message. Re-tries are automatic, transparent to the user program.

If re-tries are unsuccessful, a LOCAL FAULT bit may be set ON at the local (sending) station processor. (LOCAL FAULT bits are described in chapter 6.)

Acknowledgements are sent only by a station that is in the receive mode, not the current master station.

Message Priority

Each message transmitted over the Data Highway communication link has one of these priority levels: normal and priority.

These priority levels determine the order in which stations obtain mastership and the order in which messages are transmitted. Priority messages of a given type (either command, reply, or polling) will always be transmitted before normal messages of the same type.

The programmer designates a priority level for each command message. The command code, an element in each command rung, specifies the priority level of the command message. The station that receives a command message automatically establishes the same priority level for its corresponding reply message. (The command code is described in chapter 5.)

Priority commands are executed ahead of normal commands throughout the command/reply message cycle. For this reason, a command should be given priority designation **only** when special handling of specific data is required. Using an excessive number of priority commands defeats the purpose of this feature and could delay or inhibit the transmission of normal messages.

When a station communication adapter module has a priority command or reply message ready for transmission, the module responds to the next priority poll to gain mastership.

Polling

No single station is permanent master of the Data Highway communication link. Each station bids for mastership when it needs to send a message. The station interface module at the current master station conducts a poll to select the next master station. A poll is an orderly, systematic method to determine which stations have messages to send, and to select one of these stations as master.

The mechanics of the polling algorithm are essentially transparent to you. This is because the communication modules handle this automatically. However, the polling algorithm does lead to the following basic rules that you should follow to optimize Data Highway performance:

- Number your stations sequentially whenever possible, and
- Keep the number of high priority messages as low as possible.

Large numbers of high priority messages slow all traffic on the network. In general, you should limit the number of high priority messages to less than 1% of the total traffic on the Data Highway.

Commands From A Computer

A communication adapter module can execute commands from a computer connected through a communication controller module (cat. no. 1771-KE or -KF). The command set of the computer includes the command set of the 1771-KA2 module:

- Protected write
- Protected bit write
- Unprotected read
- Unprotected write

- Unprotected bit write

These commands have the same execution sequence and memory access as the same commands from a communication adapter module.

In addition to these commands, the command set from the computer includes the following, which can be executed by a PLC-2 family processor:

- Privileged read
- Privileged write
- Diagnostic loop
- Enter download mode
- Enter upload mode (New for 1771-KA2)
- Exit upload/download mode
- Diagnostic read
- Diagnostic counters reset
- Set data table size (New for 1771-KA2)
- Diagnostic Status

Privileged commands give the computer the capability to read from or write into the entire processor memory. This includes both data commands and user program areas. Privileged commands are used chiefly to load programs from a computer to a station processor on the Data Highway.

During program downloading, outputs are held in their last state by the processor. However, at the computer programmer’s option, privileged write commands can also be used to change data table values during a download of program. (Refer to publications 1771-6.5.8 and 1771-6.5.15.)

Diagnostic commands affect only the communication adapter module at a station, not the station processor. These commands access the read/write memory of the communication adapter module. They provide a check of module activity and permit computer control of specific aspects of communication adapter module behavior. A summary of diagnostic commands and their functions is given in Table 8.A.

Table 8.A
Diagnostic Command Summary

Command	Function
Diagnostic loop	Echoes transmitted data back in reply message
Diagnostic read	Copies up to 245 bytes of data from module memory
Diagnostic counters reset	Resets all diagnostic error counters n the module
Diagnostic status	Allows access to 28 bytes of processor and module status information

Other commands are available for communication with other processors, but will return an error code if sent to a PLC-2 family processor.

Indications of Upload, Download (Earlier revisions)

If you are using a revision of the 1771-KA2 module before revision D, or a revision of the 1770-T3 terminal before revision G, and are uploading or downloading, the 1770-T3 terminal will:

- display a mode select menu and a communication fault message
- clear all force instructions

(Later Revisions)

When you connect a 1770-T3 terminal (revision G or later) to a 1771-KA2 module (series A, revision D or later) and perform program uploads with the 1770-T3 terminal in the PLC-2 mode, the terminal does the following:

Uploads

1. Displays the prompt:
UPLOAD IN PROGRESS - PLEASE WAIT FOR COMPLETION

2. disables the PLC-2 mode

3. displays the prompt:
UPLOAD COMPLETED - PRESS ANY KEY TO CONTINUE

4. re-enables the PLC-2 mode and forces are maintained after you press any key

Downloads

For program downloads with the 1770-T3 terminal in the PLC-2 mode, the terminal:

1. displays the prompt:

DOWNLOAD IN PROGRESS - ALL FORCES CLEARED

2. displays a mode select menu

3. displays the prompt:

DOWNLOAD COMPLETED - ALL FORCES CLEARED

4. displays a mode select menu

When you connect a 1770-T3 terminal (revision G) to a 1771-KA2 module (series A, revision D) and perform program uploads when the 1770-T3 terminal is not in PLC-2 mode, the terminal displays a mode select menu and the following prompts:

1. UPLOAD IN PROGRESS - PLEASE WAIT FOR COMPLETION

2. UPLOAD COMPLETED

If you perform program downloads when the terminal is not in PLC-2 mode, the terminal displays a mode select menu and the following prompts:

1. DOWNLOAD IN PROGRESS - PLEASE WAIT FOR COMPLETION

2. DOWNLOAD COMPLETED

Using Two Communication Modules

When you connect two communication modules to your PLC-2 family processor, forces may or may not be cleared during uploading. Use the following cross-reference to determine whether forces will be cleared.

	Does uploading take place through a later revision 1771–KA2 module (series A, revision D or later)? yes	no
Does uploading take place through a module directly connected to a 1770–T3 terminal? yes	forces are **not** cleared	forces are cleared and terminal shows mode select menu
no	forces are cleared and terminal shows mode select menu	forces are cleared and terminal shows mode select menu

Chapter Summary

This chapter dealt with interfacing and interaction of a 1771-KA2 with its station and other stations on a Data Highway. This chapter covered:

- Floating master format
- Mastership of a Data Highway
- Command and reply messages, acknowledgements
- Message priority
- Data Highway link disconnects
- Commands from a computer on a Data Highway through a communication controller module (1771-KE/KF)
- Diagnostic command summary

Chapter 9 discusses start-up and troubleshooting, monitoring, and module replacement.

Chapter 9

Start-up and Troubleshooting

General

This chapter outlines an approach to start-up and troubleshooting procedures. Necessarily, exact procedures that would be followed vary from one application to the next. However, these guidelines provide a useful starting point when initiating a Data Highway installation or when trying to locate a fault condition.

The methods described in this chapter can be used to test any station that contains a Bulletin 1772 programmable controller and a 1771-KA2 communication adapter module. Methods for start-up and troubleshooting of other processors are described in other manuals.

When using a computer connected through a 1771-KE, -KF communication controller module, additional procedures are available for start-up and troubleshooting. Among these added capabilities, a set of diagnostic commands is available. Use of these commands to test module interaction is described in the User's Manual, Communication Controller Module, publication 1771-6.5.15. Even where a computer is connected to the Data Highway, however, it is recommended that the procedures in this chapter to follow the **initial** testing of the station. Once each station with a programmable controller has been tested, operation of computer interfacing can then be checked.

Start-up and Troubleshooting Aids

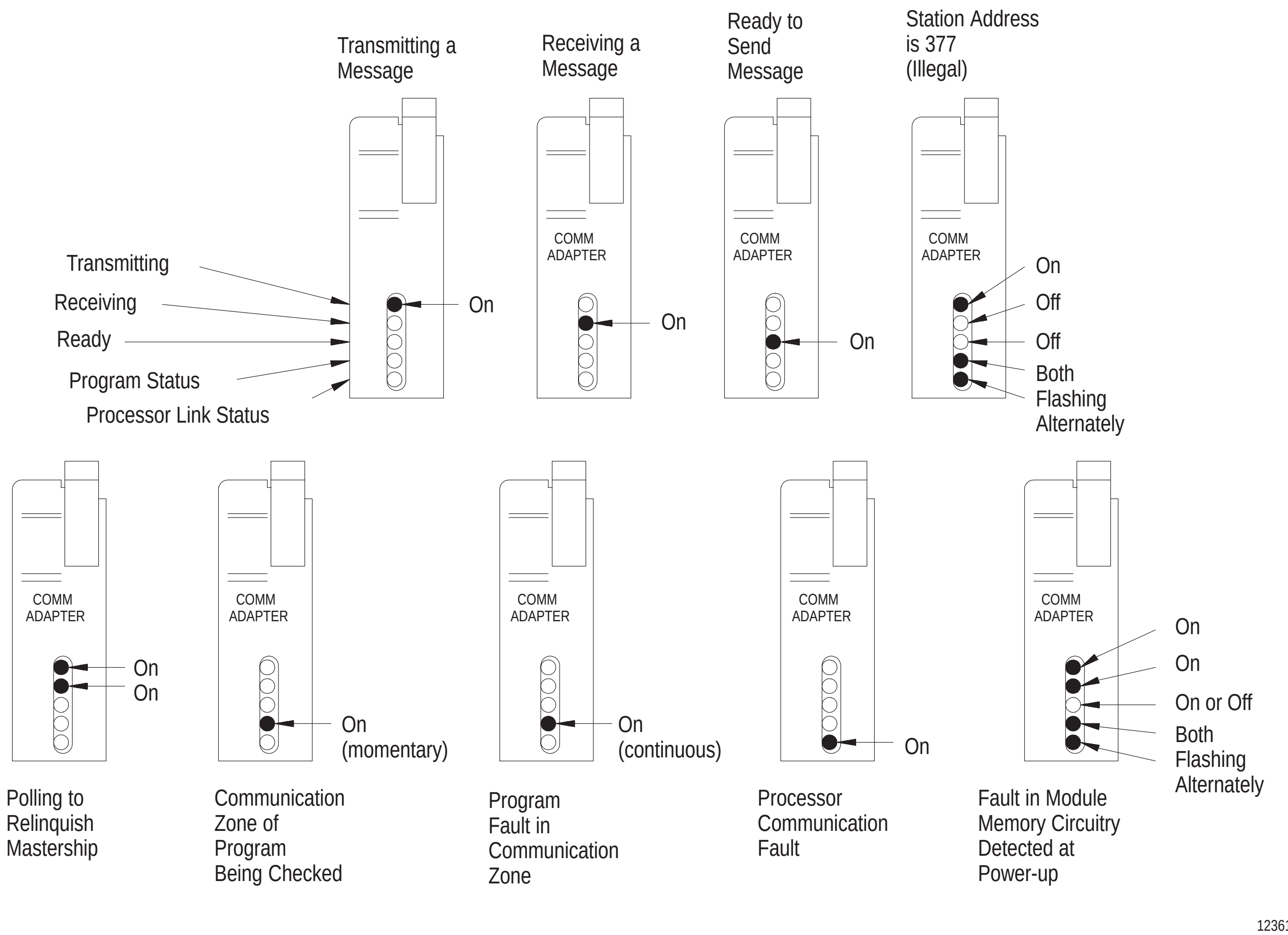
This section describes the tools available to start-up and troubleshoot the system. These aids are provided by the module itself, by programming terminals, and by careful documentation provided by the programmer of the station processor.

Module Indicators

Module diagnostic indicators show the status of module operation with its station processor and with the Data Highway. This section describes these indicators and their significance in start-up and troubleshooting.

Figure 9.1 shows the significance of various combinations of energized indicators. Three green indicators show module status in normal message transfer. Two red indicators show the status of module tests of the program and module communication with its station processor.

Figure 9.1
Module Indicator Combinations



The following paragraphs describe each indicator and its significance to the troubleshooter.

XMTG

The green transmitting indicator, labeled XMTG, turns ON when the module is current master of the Data Highway. As described in chapter 8, mastership means that the module is sending messages on the Data Highway communication link. This may be a command, reply, or polling message.

RCVG

The green receiving indicator, labeled RCVG, turns ON when the module is receiving a message addressed to it. When both this indicator and the XMTG indicator are ON, the module is polling.

RDY

The green message ready indicator, labeled RDY, turns ON when the module has messages that it is ready to transmit. With this indicator on, the module is ready to assume mastership when it is polled.

PROG

The red program status indicator, labeled PROG, indicates the status of module checks on the communication zone rungs of program. (These rungs are described in chapter 5.)

A 1771-KA2 module checks the communication zone rungs of program at power-up and whenever the mode select switch on the processor is turned from PROG to TEST or RUN. It also checks these rungs after any received privileged write command is executed or whenever the Data Highway/Processor cable is reconnected between the module and its station processor. During this initializing procedure, the PROG indicator turns on. After the module has checked these communication zone rungs, and if it has found no errors in programming format for these rungs, the module turns the PROG indicator off. However, should any programming error be detected in the communication zone of program this indicator remains on and module activity on the Data Highway is disabled. In this event, the ERROR CODE storage word can be checked for an indication of the problem. (Refer to section titled “Start-up Procedures” for start-up procedures.)

Should the PROG indicator fail to run on momentarily at power-up, or when the mode select switch is turned from PROGRAM LOAD (PROG) mode, the switch-selected station number may not match the station number in the header rung of the communication zone of program.

PROC

The red processor link status indicator, labeled PROC, tells you the status of the module’s communication with the station processor. This indicator must be off for normal communication.

Should the PROC indicator go on, one of the following problems may have occurred:

- Disconnection of the Data Highway/Processor cable, which connects the communication adapter module and the processor
- Power OFF at the processor
- Fault in processor operation
- Incorrect processor link communication rate switch-selected on the module (Refer to section titled “Write Option Switch Assembly.”)

Processor troubleshooting is described in the appropriate Assembly and Installation or User's Manual for each controller.

After the processor fault is corrected, the module automatically rechecks its communication with the processor and checks the communication zone rungs. Should proper communication and programming be detected, module-to-processor interaction is resumed and the PROC indicator turns OFF. Should both the PROC and PROG indicators be on at the same time, turn the mode select switch on the processor to PROGRAM LOAD (PROG) then back to RUN position to reset module operation.

Programming Terminals

Industrial terminals and program panels are invaluable aids for start-up and troubleshooting. These devices make available such aids as status indicators, value display, bit ON/OFF status control, FAULT bit monitoring, and ERROR CODE display.

For the initial start-up procedures described in this chapter, it is best to have a least 2 programming terminals available. This allows a sending and receiving station to be monitored at the same time.

Operation and use of the various programming terminals are described in other publications. (Please refer to the Programming & Operations manuals in Table 1.B.) This section briefly reviews the following functions of the programming terminals that have a special importance in troubleshooting testing:

- SEARCH functions
- Status indication
- FORCE functions

Each of these tools is used in the procedures of sections titled “Start-up Procedures” and “Troubleshooting.”

SEARCH Functions

SEARCH functions enable various parts of a program to be quickly located and displayed. Table 9.A lists these functions on an industrial terminal.

Table 9.A
SEARCH Functions - Industrial Terminal

Key Sequence	Response
[→]	Positions cursor on the following program instruction.
[←]	Positions cursor on preceding program instruction.
[↑]	Displays previous rung.
[↓]	Displays following rung.
[Search] [↑]	Displays first rung of program.
[Search] [↓]	Displays END statement of program.
[Search] [Display]	Single rung display. (Press same key sequence to restore multiple rung display.)
[Search] [A] XXXXXX [Search] [B] XXX	The specified instruction is displayed as it appears in one location in the program. Press [SEARCH] to display other locations where this instruction is used.
[Search] [-[B]-] XXXX [Search] [8] XXX	Displays output instructions which control the word xxx or any of its 16 bits. After initially pressing this key sequence, simply press [SEARCH] to display each other program location in which word xxx or its individual bits are addressed. (EXAMINE instructions not displayed by this SEARCH function.)
Legend:	
[A]	A relay-type instruction which addresses a single bit. This includes EXAMINE ON, EXAMINE OFF, OUTPUT ENERGIZE, LATCH, and UNLATCH instructions.
[B]	An instruction which addresses a three-digit word. This includes all Timer/Counter, GET/PUT, LES, EQU, IMMEDIATE I/O, and Arithmetic Instructions.
X	Numeric key.

Status Indication

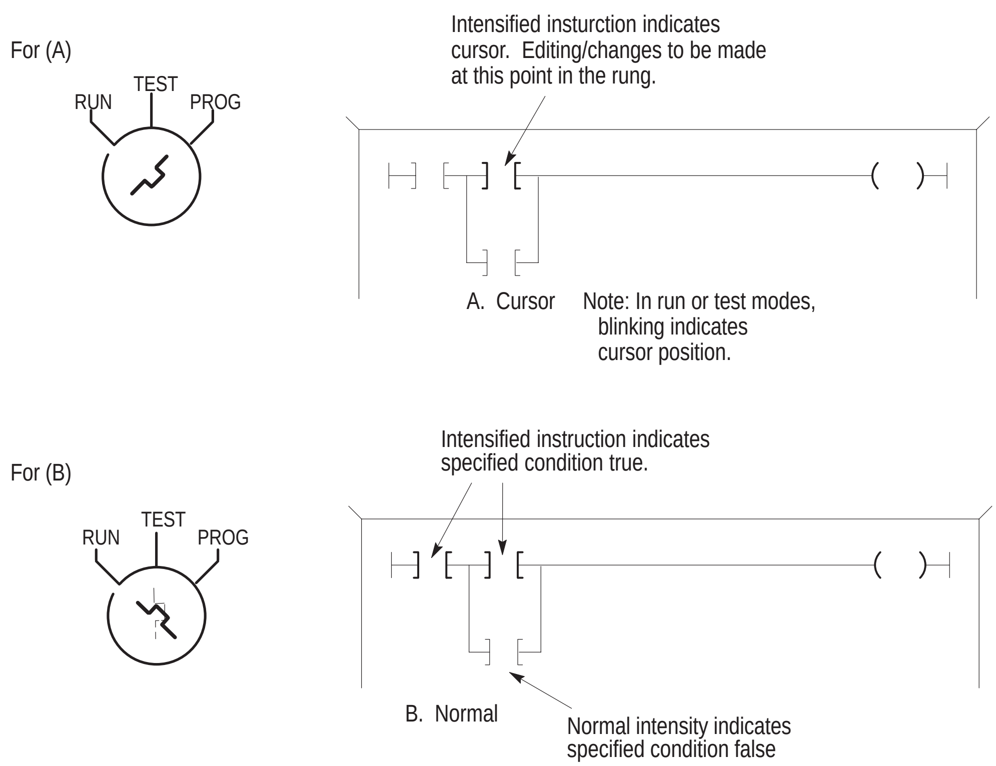
The programming terminals provide a status indication for most program instructions. For both the industrial terminal and the PLC program panel (CRT), this status indication is similar. With these terminals, an instruction symbol is intensified when the instruction is logically TRUE. For an input instruction, this means that the condition specified by the instruction has been met. For an output instruction, this means that the instruction is being carried out.

An EXAMINE ON instruction, for example, is intensified when the corresponding input device is ON. This means that the memory bit addressed by the instruction is ON. Conversely, an EXAMINE OFF instruction is intensified when the memory bit it addresses is OFF.

Note that this status indication is provided in both RUN and TEST modes. In the PROGRAM LOAD (or PROG) mode, however, intensity of a displayed instruction indicates cursor position.

Figure 9.2 illustrates the significance of an intensified instruction for both the industrial terminal and the PLC program panel.

Figure 9.2
Meaning of Intensified CRT Display



The PLC-2 program panel, meanwhile, has a different type of status indicator. On this terminal, an LED indicator is labeled STATUS. When the displayed instruction is logically TRUE, this STATUS indicator illuminates.

Again, this STATUS indicator is provided in both RUN and TEST modes.

The status indication is useful in monitoring the ON/OFF status of START/DONE and REMOTE/LOCAL FAULT bits.

FORCE ON Function

The FORCE ON function, available with each of the 3 programming terminals, can be a useful troubleshooting tool. When used in conjunction with the optional test rungs of section titled “Test Rungs (Optional),” this function controls the initiation of each command programmed at a station. An advantage of this programming terminal function is that it can be used only when the programming terminal is connected to the processor, or, in this case, to the PROGRAM INTERFACE socket of the communication adapter module. When the programming terminal is disconnected, the FORCE function is removed.

A FORCE function can be entered in either the TEST or RUN mode. On the industrial terminal and the PLC program panel, the cursor must point to the instruction for a FORCE function to be entered. On the PLC-2 program panel, an instruction must be displayed for a FORCE function to be entered.

On the industrial terminal, use the following key sequence for the FORCE ON function:

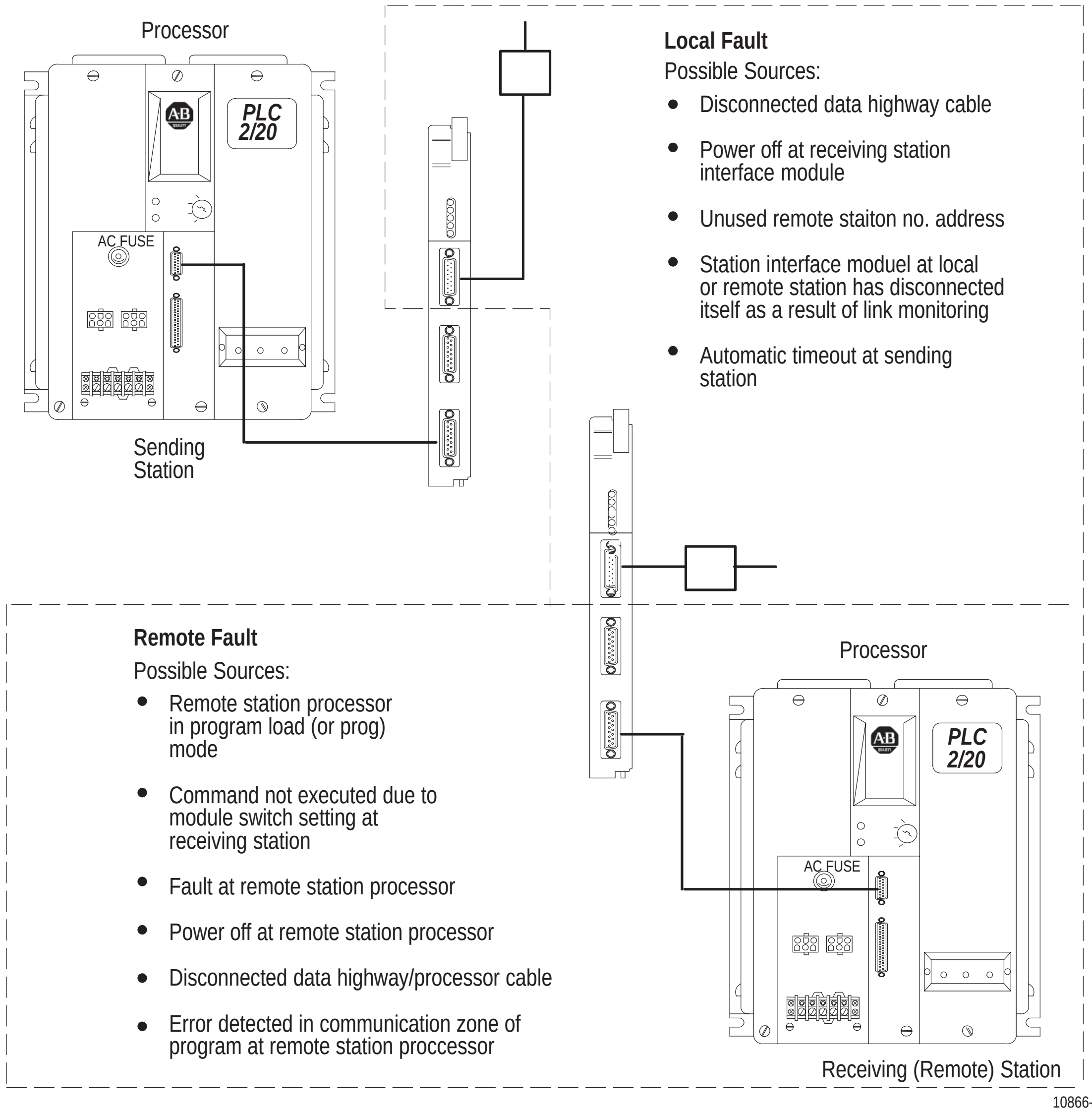
- To initiate [FORCE ON][INSERT]
- To remove [FORCE ON][REMOVE]

REMOTE/LOCAL FAULT Bits

The REMOTE and LOCAL FAULT bits provide the chief indicator of a hardware- related fault that prevents normal communication. As recommended in chapter 7, these bits must be programmed to control some output device to alert plant personnel of a fault condition. When this output device signals a fault condition, a programming terminal can then be used to display the ON/OFF status of any REMOTE or LOCAL FAULT bit station processor.

Figure 9.3 summarizes the significance of both REMOTE FAULT bits.

Figure 9.3
REMOTE/LOCAL FAULT Bit Significance



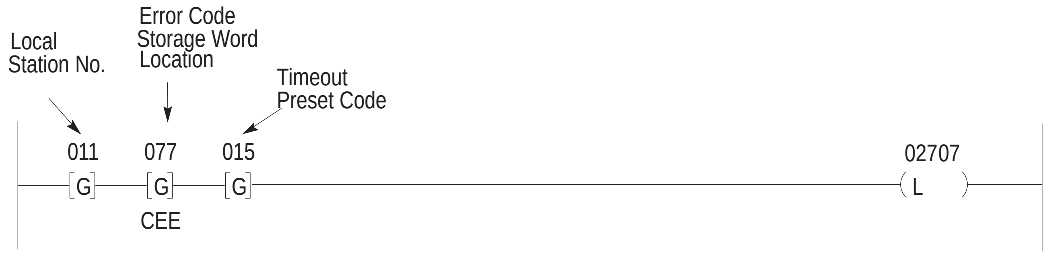
ERROR CODE Storage Word

The ERROR CODE storage word is especially useful for station start-up. The codes displayed in the lower 2 digits of the ERROR CODE word may indicate an error in programming, switch-setting, or certain other conditions that prevent normal communication adapter module operation.

The ERROR CODE storage word is addressed by the second GET instruction in the header rung (Refer to Figure 9.4.) This is the first rung of the communication zone of program.

Appendix A lists each ERROR CODE and its meaning.

Figure 9.4
Header Rung



Test Rungs (Optional)

For start-up and troubleshooting testing, you must have some means for control of each START bit. To execute a command during testing, you can energize the START bit for each command. Here's the way it happens:

The START bit is controlled by a rung of the user application program. The most direct way to control this bit in troubleshooting, therefore, is to manipulate the conditions of the rung to energize the START bit. If this can be done easily for each START bit at a station processor, no special procedure for command initiation is necessary.

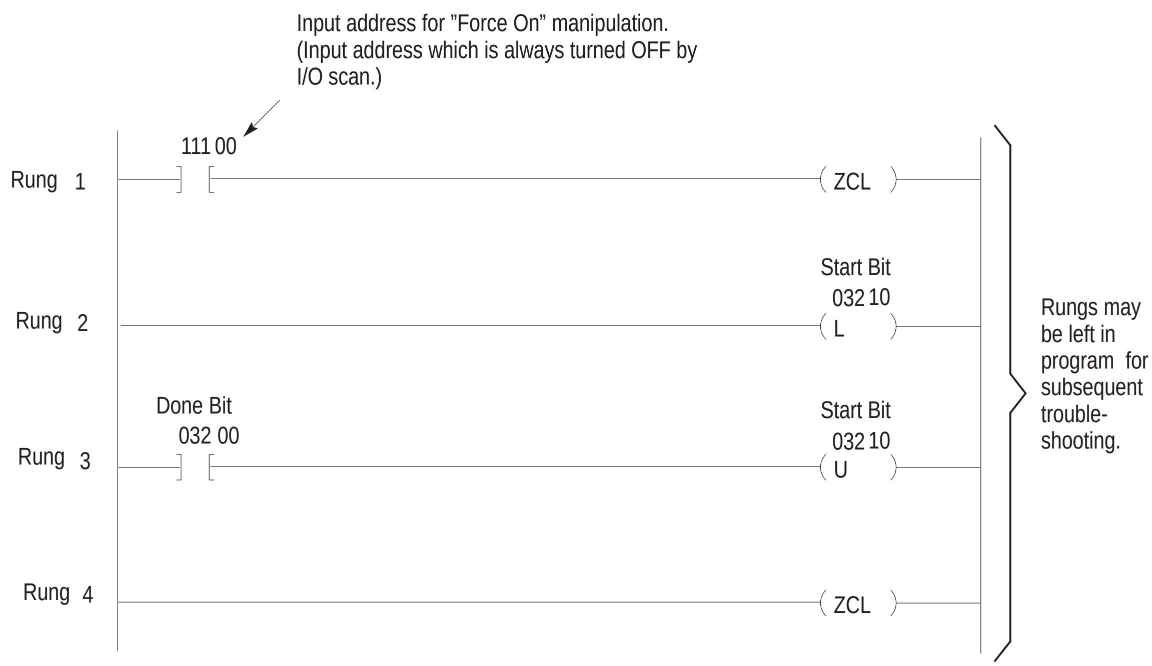
However, it may not always be practical to simulate application conditions for the purpose of command testing. In this case, a special set of test rungs can be added at the end of the user program. Using these rungs, the programmer control command initiation directly from the programming terminal.

CAUTION: Do not alter the application program for troubleshooting purposes. This can cause undesired machine operation, since the program may no longer operate as had been intended.

The optional test rungs described here are recommended with this caution in mind. The specific format of these rungs allows control of commands without altering the main body of the application program. Because these tests rungs are within a ZCL area, the output instructions of these rungs are executed only under strict programmer-controlled conditions and only when the programming terminal is connected. Except where intentionally activated by the proper key sequence, these rungs are ignored by program logic in normal operation.

Optional test rungs are shown in Figure 9.5. Within this ZCL area, the START bit is unconditionally LATCHED ON (rung 2) and UNLATCHED when the DONE bit is ON (rung 3). In rung 1, a single input image table bit is the condition for the ZCL area.

Figure 9.5
Optional Test Rungs



The input image table bit examined in rung 1 must always be turned OFF by the processor I/O scan. This bit can be any unused input image table bit. For this purpose, choose a bit that is not usable because its corresponding I/O chassis slot contains an output module.

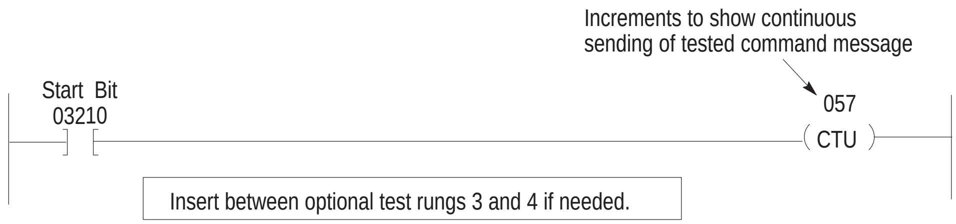
Because the processor turns this bit OFF on each I/O scan, the ZCL area is disabled unless both of these conditions are met:

- The programming terminal is connected to the processor, that is, to the communication adapter module PROGRAM INTERFACE socket
- The addressed input image table bit is FORCED ON

When both of these conditions are met, the commands programmed at a station processor can be initiated and monitored. To test individual commands, the addresses of the corresponding START and DONE bit are entered into rungs 2 and 3. In this manner, each command can be tested individually.

These rungs send the command continuously, as long as the ZCL area is enabled. As a quick check of this continuous command execution and completion, another rung can be added to the test rungs within the ZCL area. This rung examines the START bit as the input condition to a counter, as shown in Figure 9.6. Using this optional counter, you can verify that the command is being executed continuously. To use this optional counter, insert this additional rung within the ZCL area, between rungs 3 and 4.

Figure 9.6
Optional Test Counter



Note that the counter value shown on the programming terminal may not display the actual number of times a command has been sent, due to CRT delay time. However, the purpose of the counter is to provide an indication to the troubleshooter that the command is being continuously executed, rather than to give an actual count of the number of times it is executed.

Again, the use of these test rungs is optional, subject to the discretion of the programmer. An advantage of these rungs is that they may be kept at the end of the user program after start-up is completed. This enables use of these rungs in subsequent troubleshooting or later testing, as when a command rung is subsequently added to the communication zone of program. Of course, these rungs can be removed after start-up is completed, at the programmer's option.

Recommended Documentation

For testing and troubleshooting command execution, the following documentation should be available at each station processor:

- Copy of the ladder-diagram program in the station processor
- Completed forms giving the following information:
  - Communication adapter module switch settings
  - Listing of commands sent by the station
  - Listing of commands received by the station

A ladder-diagram printout can be generated on a compatible data terminal, such as a teletype or other line printer.

Forms for programmer documentation are described in chapter 10.

Start-up Procedures

A careful start-up procedure is essential to proper Data Highway operation. With a methodical start-up procedure, cabling connections, module set-up and support programming for module communication can be tested at each station.

Start-up of a newly-installed Data Highway requires the combined efforts of maintenance personnel, the programmable controller programmer, and in many cases, the computer programmer. Because applications may vary widely, the recommendations in this section are general. Specific start-up procedures will depend on the exact nature of the individual application.

For the procedures in this chapter, the following preparation is assumed:

- Station assembled using compatible components, as described in chapter 2.
- Communication adapter module properly installed, as described in chapter 3.
- Programming at the station processor includes the communication zone and the necessary support programming for initiating and monitoring user commands, as described in chapters 5 and 7.
- That your application program is fully tested.

The last point is **very** important. Testing your application program at each station is essential for proper operation. This means that the application program must be tested before the Data Highway is tested. You must test the program that controls output devices, including those parts of the program that use data transferred from other stations.

In a new installation, you must complete all start-up procedures of the controller before attempting to test Data Highway operation. This includes complete testing of I/O devices, I/O wiring and program sequencing. Procedures for start-up of a new controller are covered in other publications. A lists of these publications appears in chapter 1.

In many cases, Data Highway capability is added to an existing controller installation. Here, the application program may be only slightly modified to use data from other stations. However, any editing or change of the program must be tested at the controller so that errors can be corrected before the program is put into full operation.

Overall Approach

In start-up testing, it is best to limit the number of things happening at one time. By carefully limiting the scope of start-up testing to a small number of variables, the source of a problem is more readily detected.

Paired Testing

In the early stages of Data Highway testing, limit the size of the group of stations being tested. Initially, start-up testing is done with only 2 stations communicating at a time; all other stations are OFF. Then, after each station has been tested in this manner the testing of more than 2 stations at a time can begin. Finally, after comprehensive testing of all stations, station processors can begin normal operation.

To begin, one station is selected as a starting point. For the purpose of this description, this station is labeled A. Any station to which station A sends a command can then be selected as station B. The first testing is then carried out between stations A and B, with all other station interface modules disconnected. Each command from A to B is tested and monitored to verify proper operation. Then station B is checked for any commands that it received from station A and for any commands that it sends to station A.

Once testing between these two stations has been completed, station B is disconnected and another station, C, is selected, again based on its being addressed by a command from station A. Since station A has already been tested for several functions, problems with station C can be more readily located and corrected.

Paired testing continues in this manner until all commands programmed at station A have been tested. Then, commands from station B are tested with other stations. This procedure continues, with pairs of stations being tested each time until all commands sent on the Data Highway have been checked in this manner.

By following this procedure, you test each command for proper execution by the station interface modules at each station. This testing also checks the support programming done at each station to initiate and monitor commands, including REMOTE/LOCAL FAULT monitoring.

The procedures of sections titled “Testing the Sending Station” and “Testing the Receiving Station” are used for paired testing of stations. For a station sending a command, carry out the procedures of section titled “Testing the Sending Station.” At the receiving station, carry out the procedures of section titled “Start-up Procedures.”

Increasing the Group Size

Once paired testing has been completed, execution of each command has been verified. At this point, the size of the tested group of stations is increased and station interaction of this larger group can be monitored. For this phase of testing, the same checks outlined in sections titled “Testing the Sending Station” and “Testing the Receiving Station” can be made, but without the need to test each individual command. At this time, all station processors remain in the TEST mode.

In this procedure, gradually increase the size of the tested group until all stations are communicating.

Operation

Once the interaction of all station interface modules has been checked, the station processors can be put into operation, one at a time. You must determine which controller you intent to put in the RUN mode initially, and in what order other stations are to be added in the RUN mode. Monitoring of station interaction can continue during these procedures.

By adding stations one at a time, you can exercise maximum control over the application and monitor controller behavior.

Power-Up

Only the 2 stations being examined in the first phase of start-up should be ON. Follow these steps in powering up each of these stations:

1. Turn the processor mode select switch to PROG position.

2. Turn power ON at the station processor and communication adapter module. Observe power supply and processor indicators for proper status.

3. While observing the indicators of the communication adapter module, turn the mode select switch to TEST position.

Within a short time, the PROG indicator on the module should turn ON briefly, then OFF. This indicates that the module has checked the communication zone rungs of program. If this indicator remains on, an error may have been detected in these rungs. Should this be the case, check the ERROR CODE storage word, as described in step 4.

If this indicator does not turn on, the communication zone of program may be incorrectly entered. Check this zone if necessary.

The indicator labeled PROC should be OFF. If this indicator is ON, check for a processor fault indication or poor Data Highway/Processor cable connection.

4. If the PROG indicator does not turn off after a few seconds, observe the ERROR CODE storage word.

The ERROR CODE storage word is listed in the header rung of the communication zone of program.

The significance of the ERROR CODE storage word is described in section titled “Testing the Receiving Station.” Correct the communication zone rungs as indicated by the ERROR CODE. Then repeat step 3, checking the status of the PROG indicator.

When the indicators on the station communication adapter module and its station processor show normal operation for both stations being tested, perform the procedures of sections titled “Testing the Sending Station” and “Testing the Receiving Station.”

Testing the Sending Station

Use the following procedures to test commands from each station. After completing these steps for a command, verify data transfer at the receiving station, as outlined in section titled “Testing the Receiving Station.”

The procedures outlined here can be used for any phase of start-up and troubleshooting testing, and any time a command rung is added at a station processor. During initial testing, only 2 stations have power on and are connected to the Data Highway cable for these procedures. In addition, both station processors must be in TEST mode for initial start-up testing. During later phases of start-up testing, more than 2 stations may have power on for these procedures.

There are 2 steps for testing of each command from a sending station:

1. Set the START bit.

2. Monitor the DONE and REMOTE/LOCAL FAULT bits.

Each of these steps is described later.

Setting the START Bit

The most direct way to control the START bit for test purposes is to duplicate the input conditions of the user program rung that latches this bit on. If it is possible to do this easily during testing, duplicate these conditions and proceed to step 2. However, because this may not always be practical, the set of optional test rungs, as described in section titled “Test Rungs (Optional),” can be used. These rungs, entered at the end of the application program, can be controlled to test each command individually.

Sample test rungs are shown in Figure 9.5. The following steps outline the procedures for programming these rungs for testing. With the programming terminal connected, follow these procedures:

1. Display the END (of program) statement. The key sequence that displays this part of the program is as follows:

[SEARCH] [↓]

2. Turn the processor mode select switch to the PROGRAM or PROG position.

3. Enter the test rungs in the format of Figure 9.5 with the following addresses:

- Rung 1 - Enter the address of an unused input image table bit for the EXAMINE ON instruction. (Section titled “Test Rungs (Optional)” describes the reason for selection of this bit.)
- Rung 2 - In the LATCH instruction, enter the START bit address for the command being monitored.
- Rung 3 - Enter the address of the DONE bit for the EXAMINE ON instruction. Enter the address of the START bit for the LATCH instruction.

Check that the format of these test rungs resembles the one shown in Figure 9.5.

With these rungs entered, a command can now be initiated. To do this, use the FORCE ON function of the programming terminal. Perform the following steps:

4. Turn the processor mode select switch to the TEST position.

5. Position the cursor on the EXAMINE ON instruction of Rung 1. (On the PLC-2 program panel, display this instruction.)

6. On the programming terminal, press the key sequence for the FORCE ON function.

With an industrial terminal, press these keys:

[FORCE ON][INSERT]

With program panels, press these keys:

[SELECT][FORCE ON][INSERT]

The START bit is now LATCHED ON. Under normal operation this bit is being LATCHED and UNLATCHED as the processor executes its scan, and the command is sent continuously.

With the START bit energized, proceed to the monitoring checks of the paragraph entitled “Monitoring DONE and REMOTE/LOCAL FAULT Bits.” Once these checks have been completed, the next START/DONE bit addresses can be entered in the test rung for testing of the next command.

The FORCE ON function can be removed using the programming terminal. On the industrial terminal, position the cursor on the FORCED instruction and press the following keys:

[FORCE ON][REMOVE]

On the **program panels**, press the following keys to remove a FORCE ON function:

[SELECT][FORCE ON][REMOVE]

The FORCE ON function is also removed when the programming terminal is disconnected from the station.

Monitoring REMOTE/LOCAL FAULT Bits

This second step in command checking requires that the status indicator of the programming terminals be monitored for FAULT bits. Use the following steps to observe the instructions that examine the FAULT bits.

1. Turn the processor mode select switch to TEST position.

2. Use the SEARCH functions of the programming terminal to locate instructions that examine FAULT bits. (SEARCH functions are described in section titled “Programming Terminals.”)

3. Observe the ON/OFF status indicator of the programming terminal for each DONE and FAULT bit corresponding to the command. (These ON/OFF status indicators are described in section titled “Programming Terminals.”) Either a DONE bit or FAULT bit will turn on for each command.

If the REMOTE or LOCAL FAULT bit turns ON for the command sent, some hardware-related fault or programming error can be suspected. Check the connections and equipment indicated in Figure 9.3.

If the DONE bit turns on the command has been executed properly by the sending station.

After checking a command in this manner, check the receiving station, as described in section titled “Testing the Receiving Station.” Then, check any other commands as necessary, using the applicable procedures of sections titled “Power-up,” “Testing the Sending Station,” and “Testing the Receiving Station.”

Testing the Receiving Station

The receiving station is checked with the sending station for one purpose--verification of data transfer. Although this procedure may be time-consuming, it is essential in initial start-up testing and for testing whenever a command is added at a station.

The station communication adapter module, upon receiving a command message, executes the command at its station processor, and formats and transmits a reply message back to the sending station. START/DONE and REMOTE/LOCAL FAULT bits indicate proper execution of this procedure.

The checks performed in testing the sending station, therefore, can indicate and help to isolate the source of a problem that prevents the command from being executed. The checks at the receiving station help to verify that program addressing and station number switch selection is correct and that data are being sent to the intended station.

When a command has been initiated and tested at its sending station, perform the following procedures at the receiving station.

1. On the programming terminal at that station, display the instructions for the application program that are affected by data transferred from the sending station.

To identify areas of the program that are affected by transferred data, refer to Form 5033, which is recommended programmer documentation for each station.

2. Observe that the data at these locations matches the data in the proper locations at the sending station processor. For write or read commands, observe instructions that address transferred words in the program at the receiving station processor. (These instructions include GET, PUT, TON, TOF, RTO, CTU, and CTD.)

For bit write commands, observe the ON/OFF status indicator for instructions that examine those bits in the program.

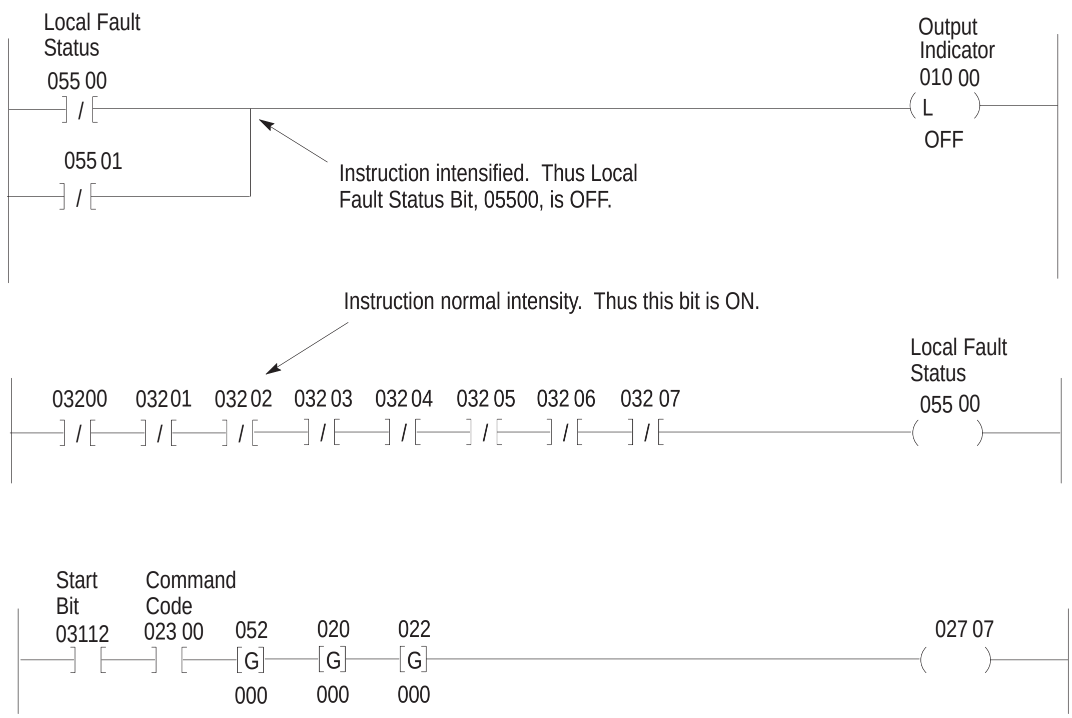
Troubleshooting

The same tools and procedures used in start-up of a station containing a communication adapter module can be used for troubleshooting. This section outlines procedures that can be used in addition to the start-up procedures of section titled “Start-up Procedures.”

REMOTE/LOCAL FAULT Indicator ON

As recommended in chapter 7, some indicator must be controlled by the status of the REMOTE and LOCAL FAULT bits at each station processor. Should this indicator go ON, connect and initialize a programming terminal and follow these procedures to isolate the source of the fault condition. (The steps of this procedure are outlined in the example of Figure 9.7.)

Figure 9.7
REMOTE/LOCAL FAULT Troubleshooting Example



1. Using the SEARCH functions, display the rung of program that controls the external FAULT indicator device. Determine whether a status bit indicates that either a REMOTE or LOCAL FAULT bit is set ON.
2. Using the SEARCH functions, display the rung of program that examines either the REMOTE or the LOCAL FAULT bits, and controls a status bit or bits based on FAULT bit states.
3. Observe the individual instructions of this rung to detect any change in FAULT bit status.

When you use the rungs recommended in Figure 7.6, EXAMINE OFF instructions address each fault bit. When these instructions are displayed on the program panel or industrial terminal, observe the status indicators of the terminal carefully. Due to CRT delay time, the intensity of an EXAMINE OFF instruction, which shows its status, may not change as rapidly as does the actual ON/OFF status of the FAULT bit. (Recall that programming re-tries caused the FAULT bit to be continuously turned ON and OFF.) Thus, it may take a few seconds for the programming terminal to show a change in FAULT bit status.

Should it be difficult to detect the changing ON/OFF bit status for an individual FAULT bit, the contact histogram feature can be used to display changes in status.

4. From the results of step 3, determine the START bit address for the corresponding command.

The START bit has a strictly defined correspondence to a REMOTE or LOCAL FAULT bit. Figure 6.2 shows this relationship.

5. Use the SEARCH functions to locate the command rung that begins with the START bit, as determined in the previous step.

6. Examine the command code of this rung to determine the remote station number to which the command was sent.

7. Determine the nature of the faulted condition and correct this condition.

Use Figure 9.3 as a guide to tracing possible sources of a faulted condition.

8. Verify that the FAULT condition was corrected. Observe the fault indicator at the sending station.

Module Replacement

After other troubleshooting checks have been made, it may be necessary to replace the communication adapter module.

Removing the Module

1. Turn off power to the module.

This power is provided by the power supply that connects to the backplane of the Bulletin 1771 I/O chassis.

2. Disconnect all cables connected to module sockets.

3. A plastic latch on the top of the chassis holds the module in place. Pivot this latch upward, out of the way of the module.

4. Lift the plastic lever on the module to break its backplane connection.
5. Firmly grasp the sides of the module and pull it gently from the I/O chassis slot.

Installing the Replacement Module

1. Set module switches to proper positions, then replace the switch cover.
2. Insert the replacement module in the I/O chassis. Snap down the latch on the top of the chassis and re-connect the cables to module sockets.

Module power-up is described in section titled “Power-up.”

Station Disconnection

For most troubleshooting and startup purposes, a station can be disconnected from the Data Highway communication link simply by disconnecting the station dropline from the DATA HIGHWAY socket of the module. However, should a station be disconnected for an extended period, or should a dropline no longer be needed at any point along the Data Highway cable, the station should be disconnected at the 1770-XG tee connector, or the 1770-SC station connector, whichever one was used.

To disconnect a station joined by a tee connector, remove the station dropline from the connector. Then remove the male and female truckline cables from the tee and connect them to each other.

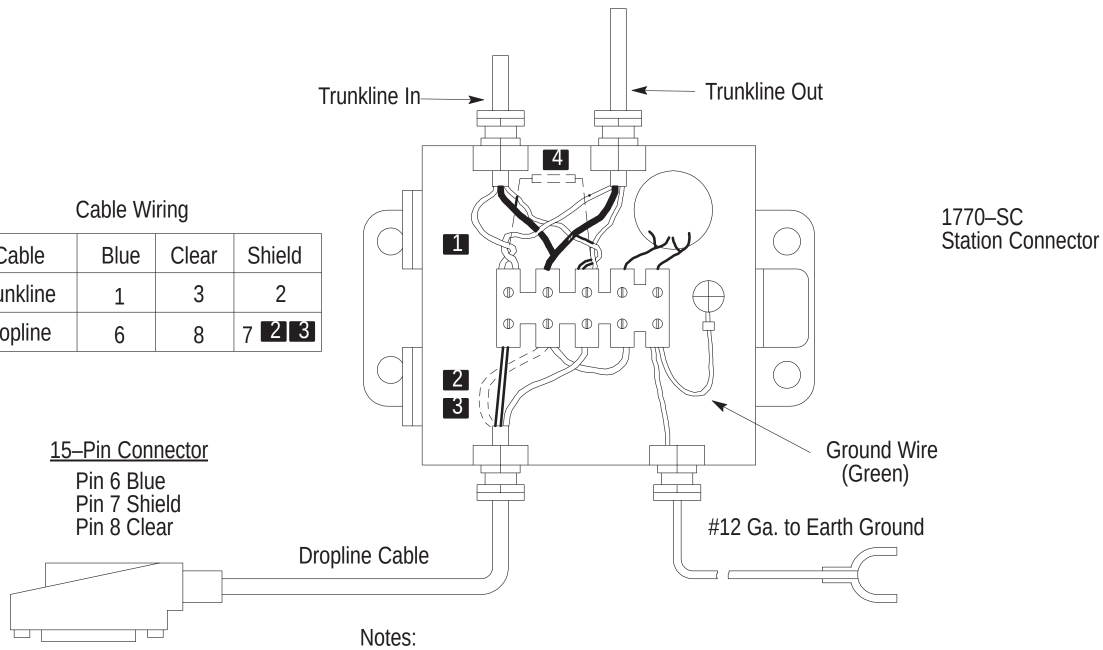
To disconnect a station joined by a 1770-SC connector, remove the SC’s cover, then disconnect the wires from terminals 6 and 8. If the dropline cable was longer than 10 ft. and the drain wire was connected to terminal 7, disconnect that one also. (See A-B PD sheet 1770-953.) Replace the SC cover.

Figure 9.8 illustrates station connections with a 1770-SC connector and a tee connector.

Figure 9.8
Disconnecting a Station

Cable Wiring

Cable	Blue	Clear	Shield
Trunkline	1	3	2
Dropline	6	8	7 2 3



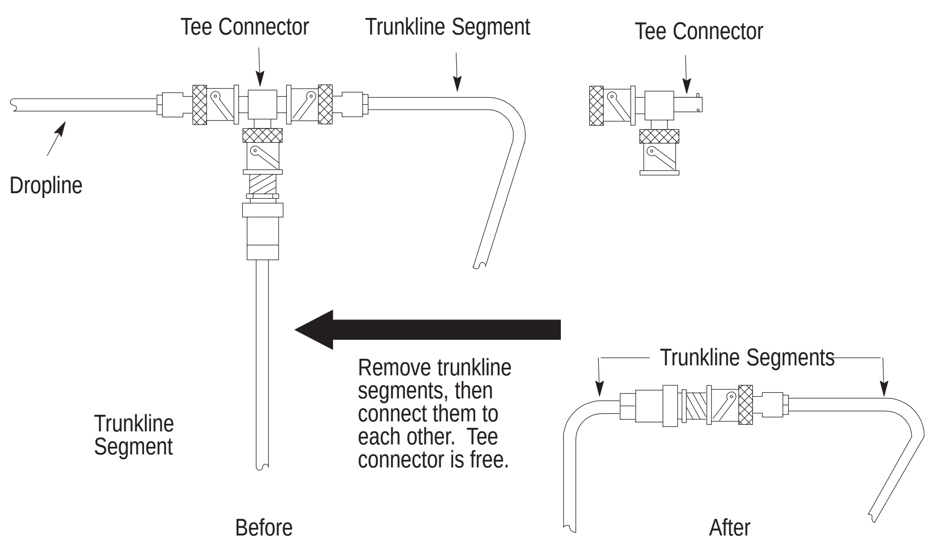
Notes:

1 Twist trunkline wires of same color before securing to screw–clamp terminals 1, 2 and 3.

2 For dropline cable ten feet or less, isolate the dropline shield from the enclosure.

3 For dropline cables greater than ten feet, attach the dropline drain wire to terminal 7.

4 When the station is first or last on a trunkline, attach a 150W resistor to terminals 1 and 3.



Chapter Summary

Procedures for start-up and troubleshooting were discussed in this chapter. It detailed:

- General procedures
- Aids to start-up and troubleshooting
- Significant indicators (on the 1771-KA2) in troubleshooting
- Use of industrial terminals and panels in troubleshooting
- Search functions
- Status indication for program instructions
- FORCE ON function
- REMOTE/LOCAL FAULT bits, ERROR CODE storage words
- The START bit's role in start-up and troubleshooting
- Start-up procedures
- Paired testing of Data Highway stations
- Steps for testing sending station and setting START bit
- Monitoring FAULT bits
- Module replacement
- Station disconnection

In chapter 10 you will read about organizing and writing a program for a KA 2 module; program summarization, forms, and memory maps for PLC-2 family PCs.

Chapter 10

Design Aids and Documentation

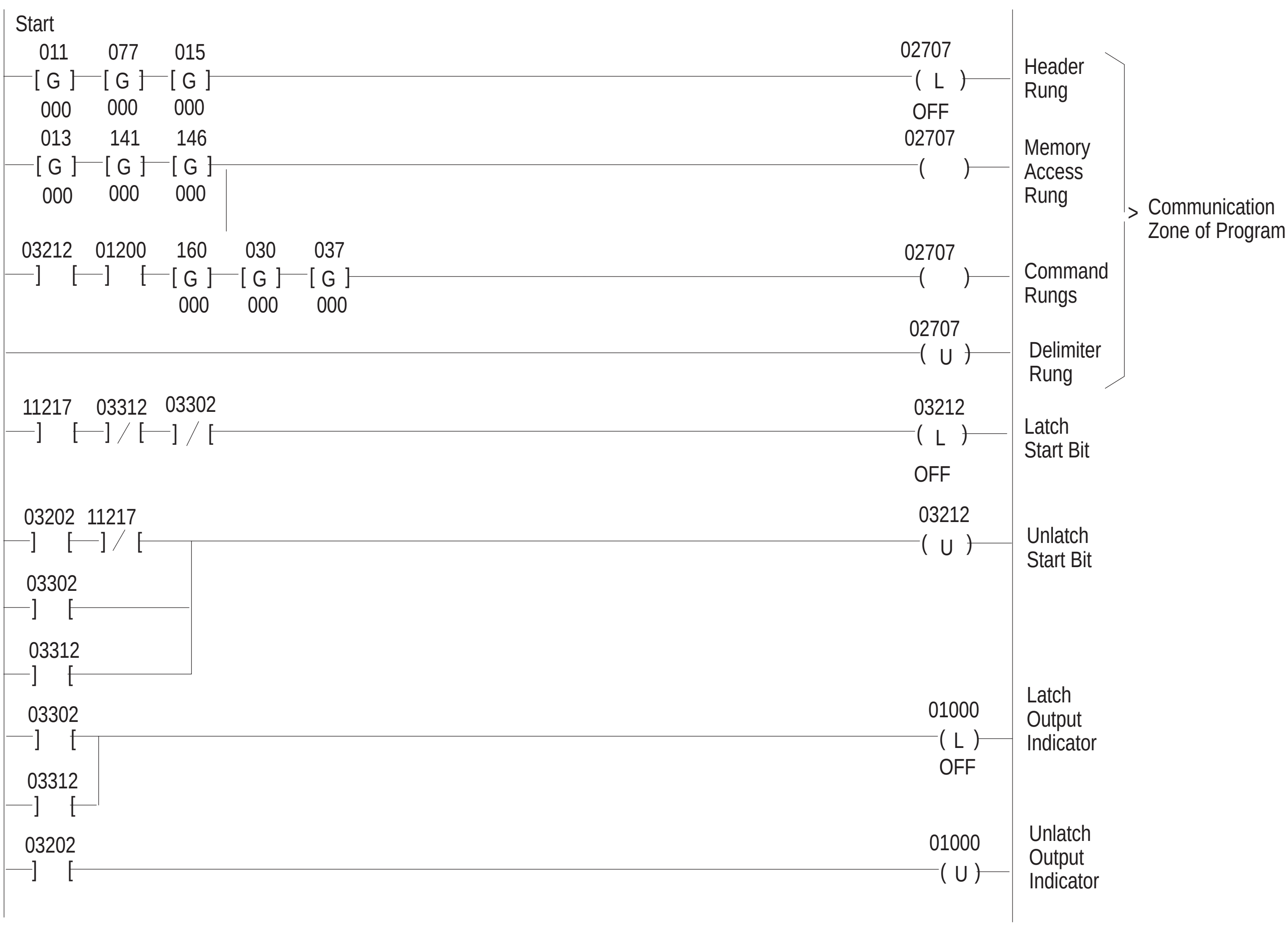
General

This chapter provides programmer aids to help in writing, organizing, and documenting a program for a communication adapter module.

Program Summary

Figure 10.1 is a sample program that incorporates both a communication zone and the support programming recommended for the single command programmed in this zone.

Figure 10.1
Sample Program



The rungs used in this example illustrate the programming principles of chapters 5 through 7 of this manual. Of course, user application programming may vary widely from this example. In any case, certain types of support programming should be used in any program for a command at a station. Support programming for each command includes:

- START bit LATCH and UNLATCH control
- REMOTE/LOCAL FAULT bit monitoring

Each of these parts of the program is shown in Figure 10.1.

Forms

Forms shown in Figure 10.7 to Figure 10.9 are available for programmer documentation:

- Switch settings - Communication Adapter Module (cat. no. 1771-KA2), form 5030
- Command Listing - From station, form 5032
- Command Listing - To station, form 5033

These forms should be a part of the standard documentation at each station that uses a programmable controller.

Forms are available in quantity through Catalog Services, Allen-Bradley Co., Milwaukee, Wisconsin 53129

Memory Maps

For quick reference, a map of the memory organization for each Bulletin 1772 Mini-PLC-2/15, PLC-2/30, and Mini-PLC-2/05 Programmable Controller is included here. These maps should be used in conjunction with the recommendations of chapter 4, concerning communication adapter module access to memory areas.

Figures 10.2 through 10.6 show the memory organization for each Controller.

This chapter was provided to help you write, organize, and document a program for a 1772-KA2 module. It reviewed:

- Program summary
- Forms
- Memory maps for PLC-2 family processors

Figure 10.2
PLC-2/20 Processor Memory Organization

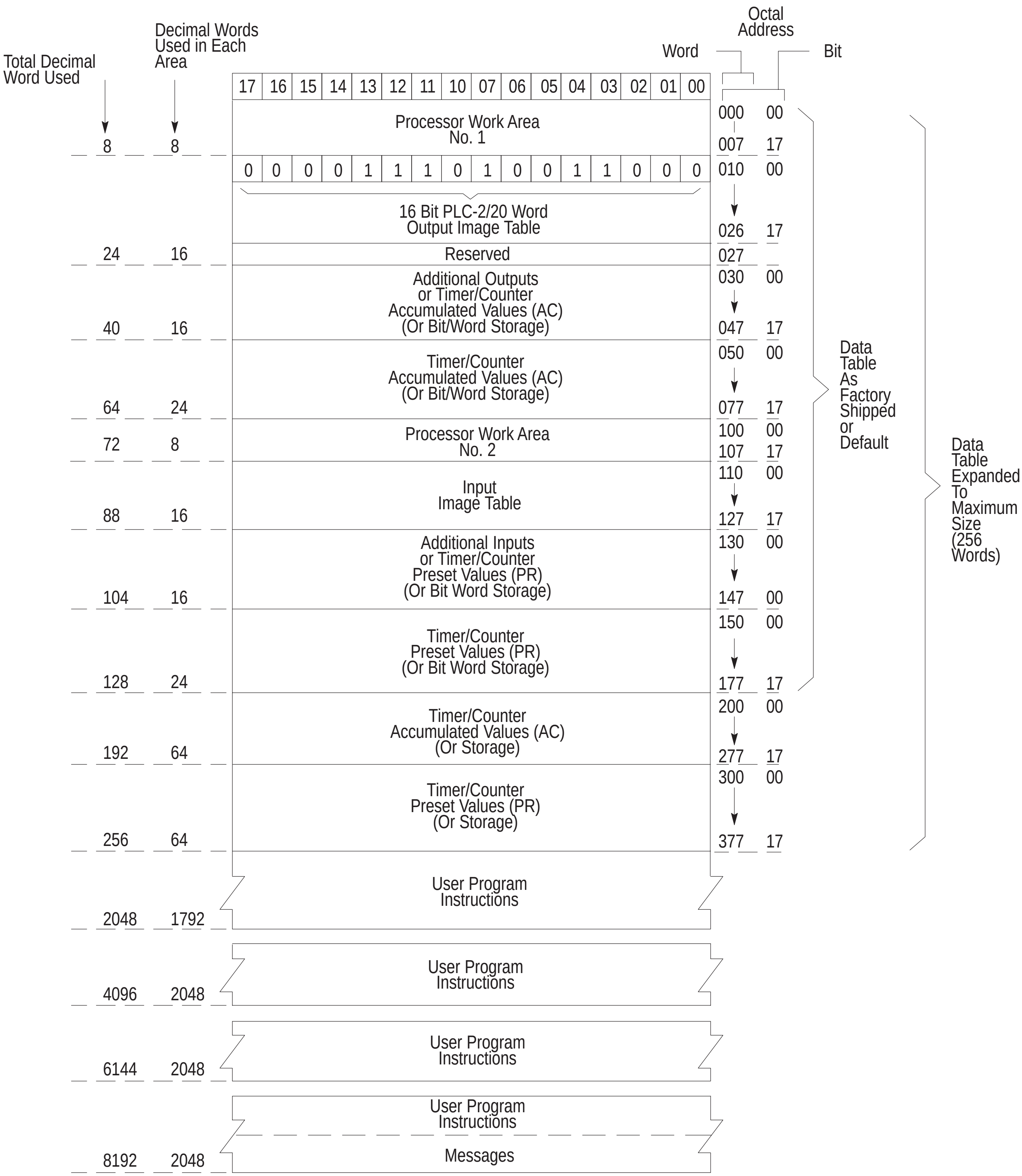
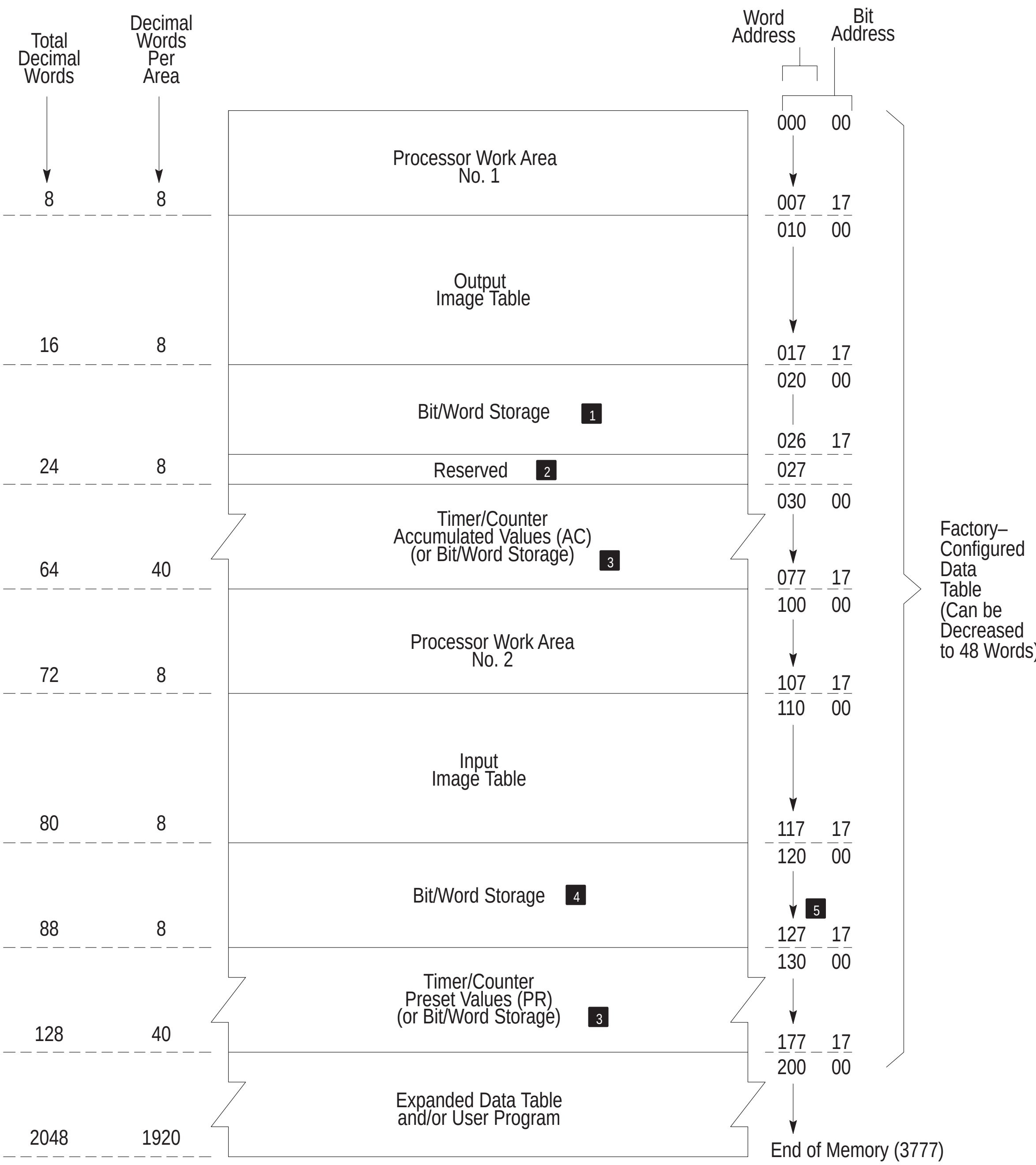


Figure 10.3
Mini-PLC-2/15 Memory Organization



1 May not be used for accumulated values.

2 Not available for bit/word storage. Bits in this word are used by the processor for battery low condition, message generation, EPROM transfer and data highway.

3 Unused timer/counter memory words can reduce data table size and increase user program area.

4 May not be used for preset values.

5 Do not use word 127 for block transfer data storage.

Figure 10.4
PLC-2/30 Memory Organization

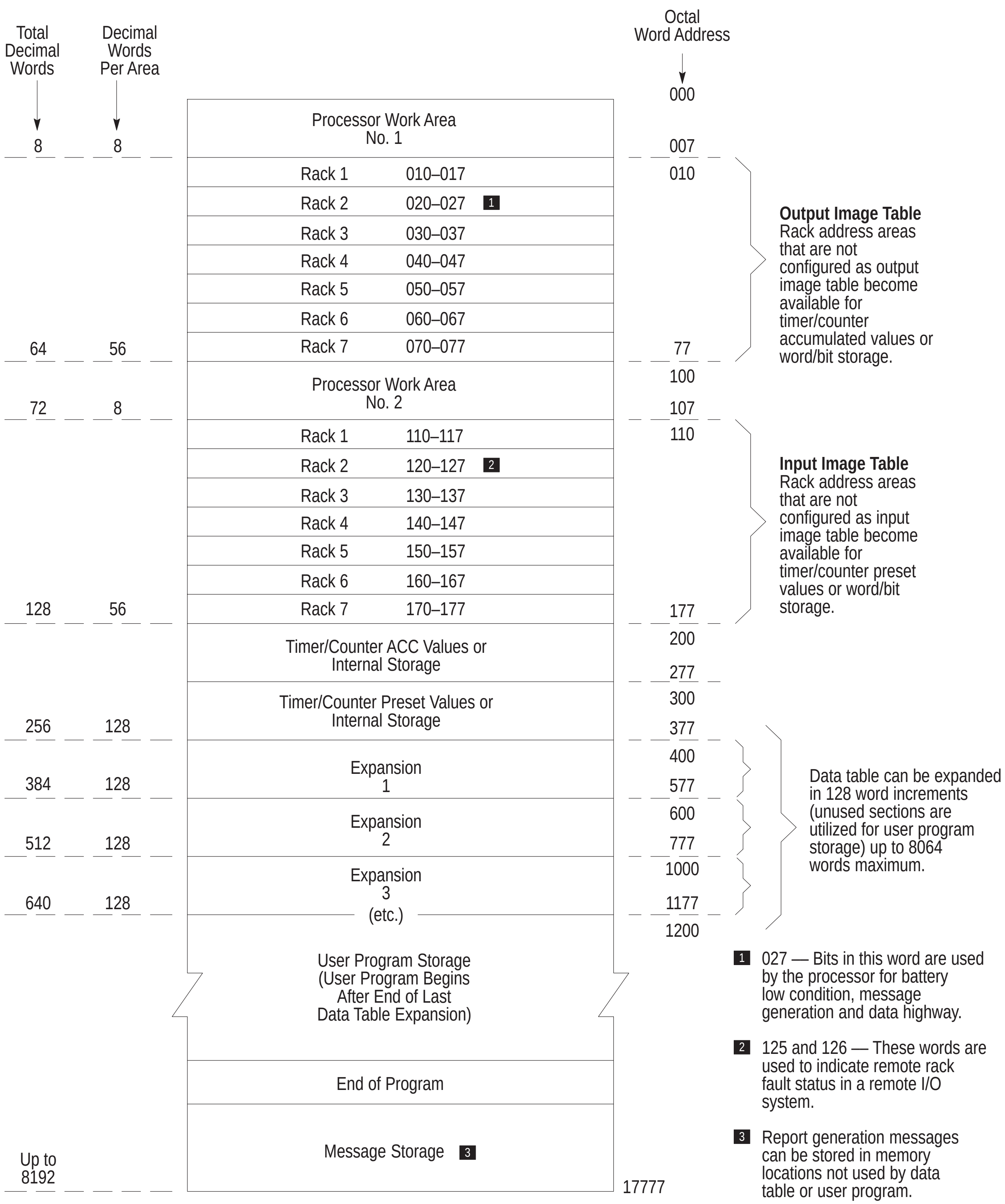


Figure 10.5
Mini-PLC-2 Memory Organization

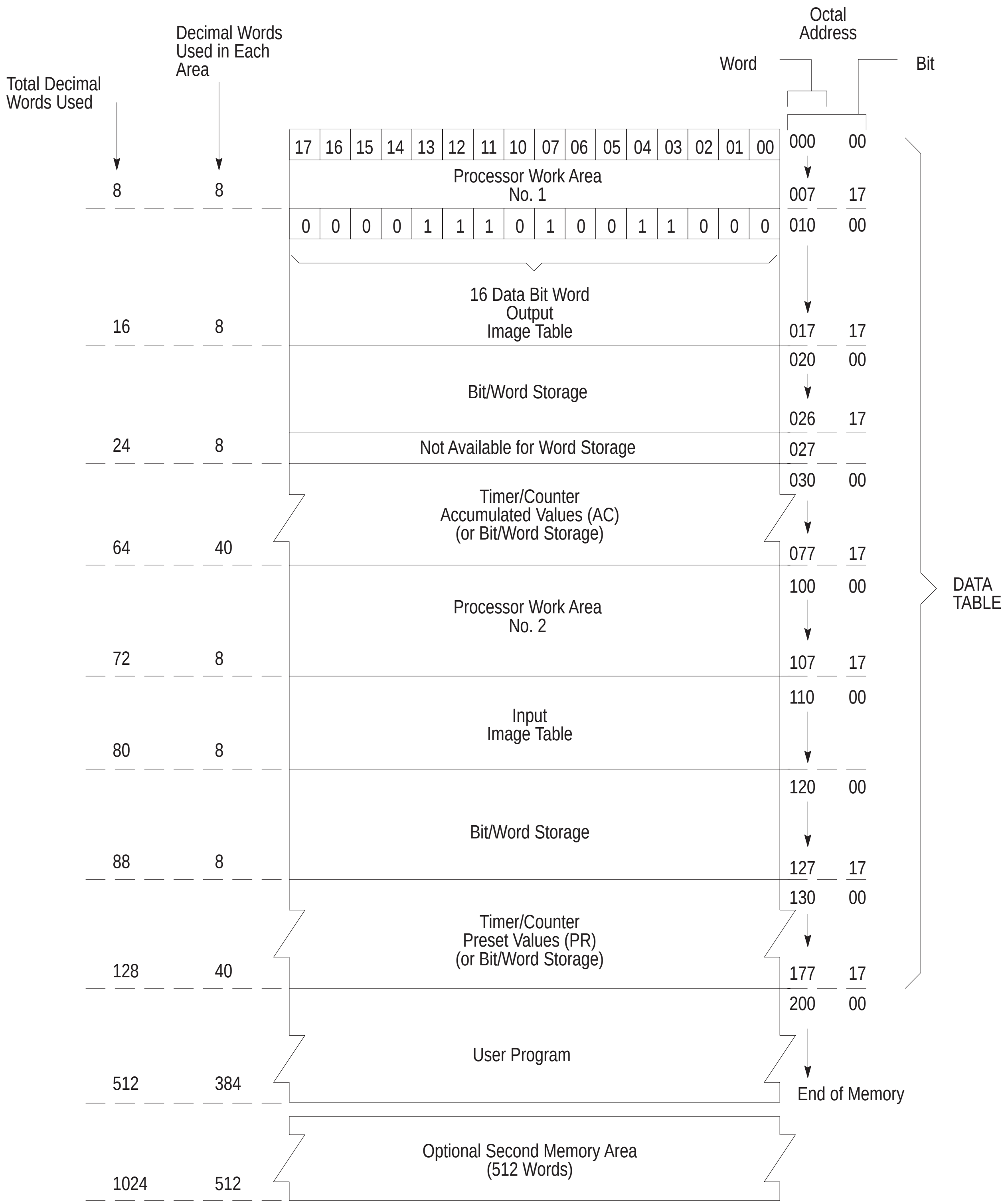
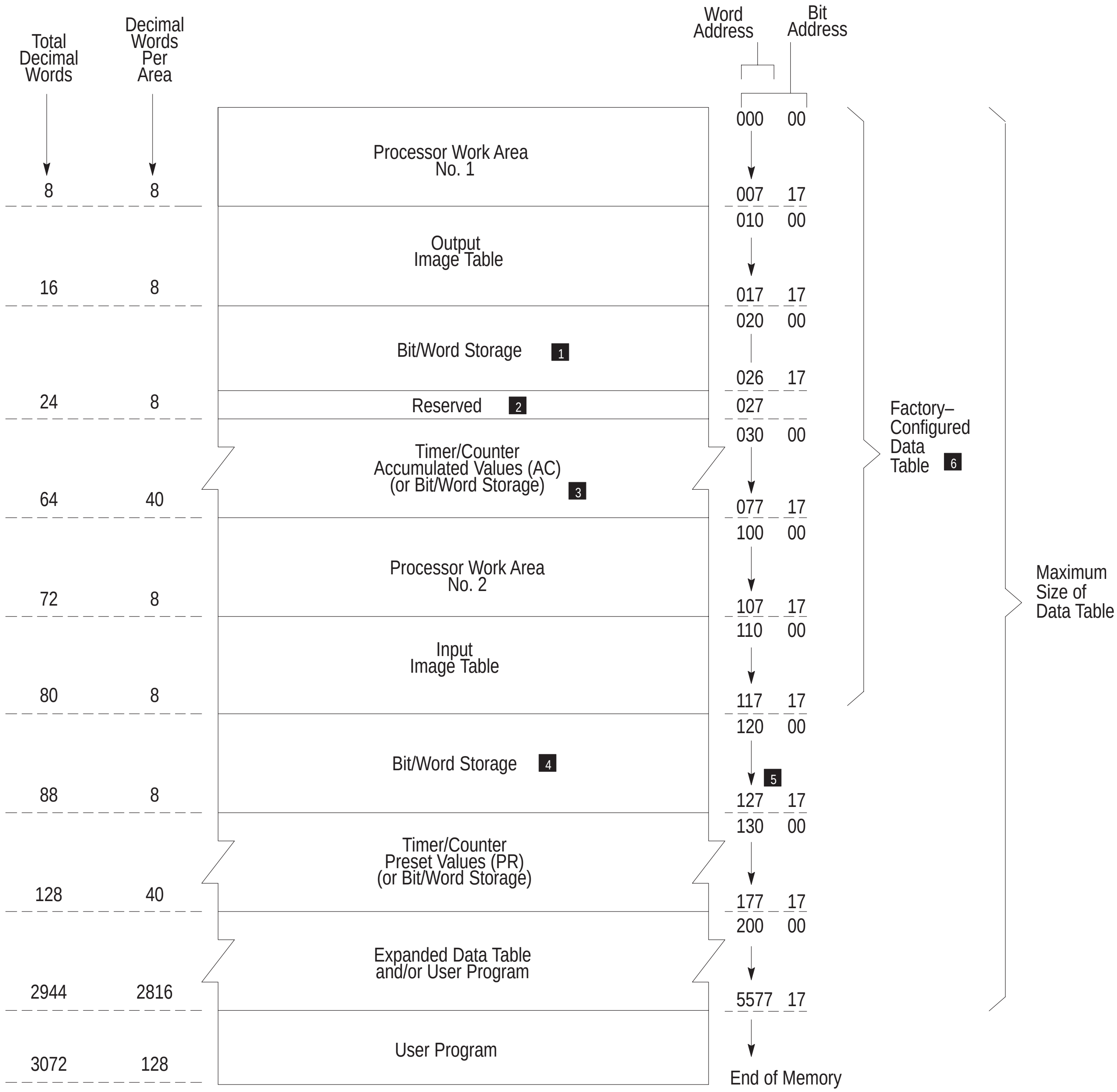


Figure 10.6
Mini-PLC-2/05 Memory Organization



1. May not be used for accumulated values.
2. Not available for bit/word storage. Bits in this word are used by the processor.
3. Unused timer/counter memory words can reduce data table size and increase user program area.
4. May not be used for preset values.
5. Do not use word 127 for block transfer data storage.
6. Can be decreased to 48 words.

Figure 10.7
Sample Form (publication 5030) for Switch Settings on Communication Adapter Module (cat. no. 1771-KA2)

ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL COMPANY

DATE: ______________

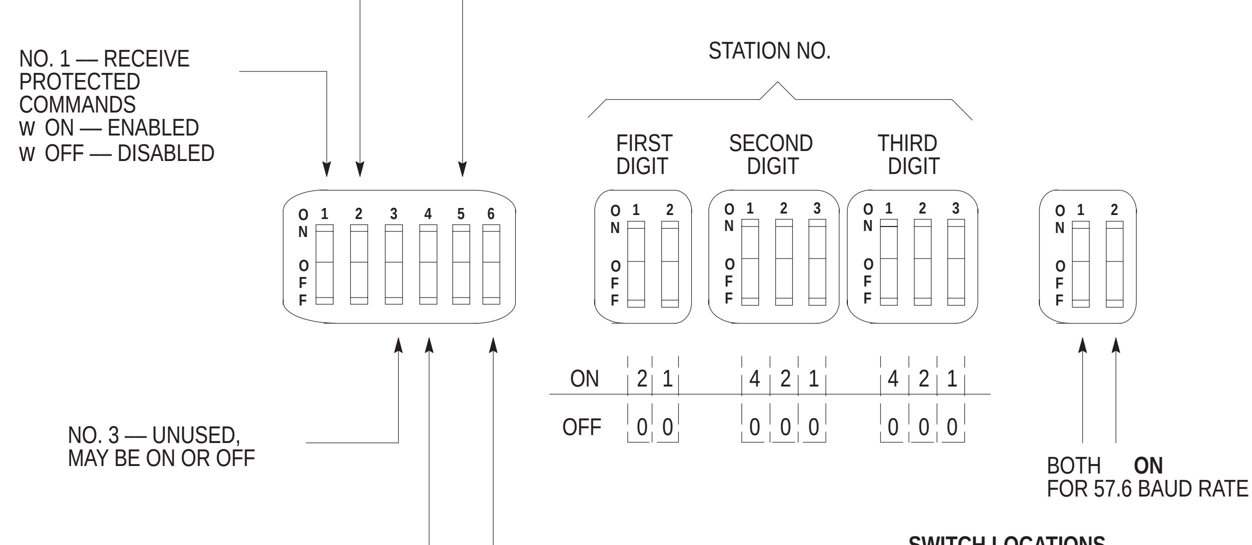
BY: ______________

ALLEN–BRADLEY DATA HIGHWAY
SWITCH SETTINGS
COMMUNICATIONS ADAPTER MODULE
CAT. NO. 1771–KA
(Publication 5030 — October, 1980)

STATION NO. ______________

INSTRUCTIONS: USE A PENCIL TO DARKEN SWITCHES TO SHOW PROPER SETTINGS, AS SHOWN. KEEP THIS FORM WHERE IT CAN BE EASILY REFERENCED.

EXAMPLE: ON OFF



SWITCH LOCATIONS

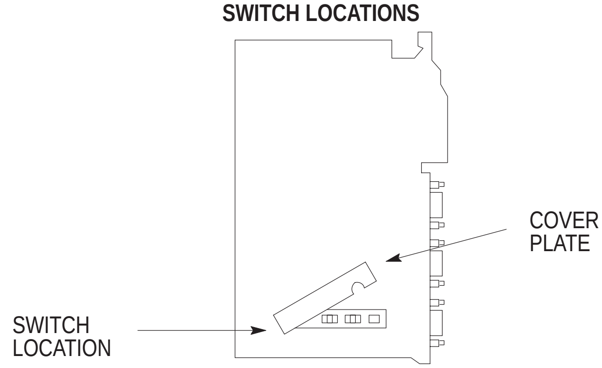


Figure 10.8
Sample Form (publication 5032) for Command Listing--From Station

ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL COMPANY

DATE: ____________
BY: ____________

ALLEN–BRADLEY DATA HIGHWAY
COMMAND LISTING – FROM STATION
(Publication 5032 – October, 1980)

STATION NO. ____________

EXAMPLE:

START BITS	COMMAND TYPE	PRIORITY/ NORMAL	REMOTE STATION NO. ADDRESSED	AREAS CONTROLLED AT LOCAL STATION	AREAS CONTROLLED AT REMOTE STATION	COMMENTS
04010	WRITE	N	022	060 – 062	051 – 053	PARTS COUNT

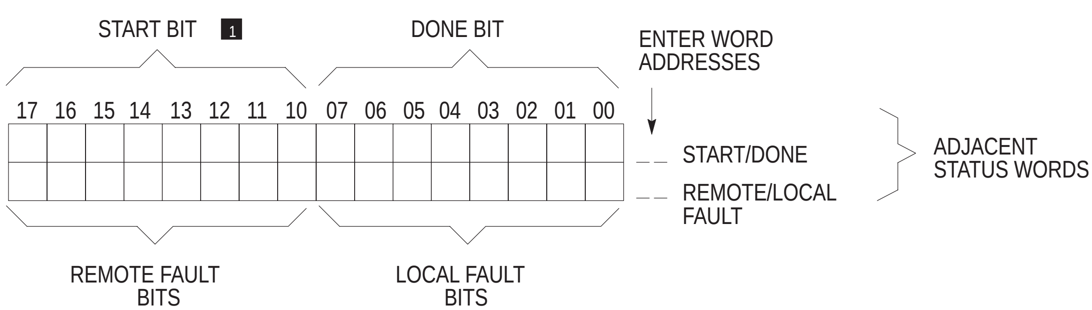
COMMANDS AT THIS STATION

(ENTER INFORMATION AS SHOWN)

START BITS	COMMAND TYPE	PRIORITY/ NORMAL	REMOTE STATION NO. ADDRESSED	AREAS CONTROLLED AT LOCAL STATION	AREAS CONTROLLED AT REMOTE STATION	COMMENTS

STATUS WORDS

(DARKEN USED BITS FOR QUICK REFERENCE.)



1 NOTE: WHEN A START BIT IS SELECTED, A DONE BIT, A REMOTE FAULT BIT, AND A LOCAL FAULT BIT ARE AUTOMATICALLY ASSIGNED. REFER TO USER'S MANUAL, COMMUNICATION ADAPTER MODULE.

Figure 10.9
Sample Form (publication 5033) for Command Listing--To Station

ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL COMPANY

DATE: ____________
BY: ____________

ALLEN–BRADLEY DATA HIGHWAY
COMMAND LISTING – TO STATION
(Publication 5033 – October, 1980)

STATION NO. ____________

DIRECTIONS: USE THIS FORM TO DOCUMENT COMMANDS RECEIVED AT THIS STATION FROM OTHER STATIONS.

EXAMPLE:

REMOTE STATION SENDING COMMAND STATION NO.	COMMAND TYPE	DATA WRITTEN TO ADDRESS(ES)	COMMENTS
010	WRITE	023–025	TEMP. VALUES

REMOTE STATION SENDING COMMAND STATION NO.	COMMAND TYPE	DATA WRITTEN TO ADDRESS(ES)	COMMENTS

We have tried to present information on the KA2 module in a way that will be most helpful to you. Obviously we don't try to make errors and omissions, but they crop up. If you feel there's a way we could be of greater assistance, please contact us at Allen-Bradley Industrial Computer Group, Publication Department, 747 Alpha Drive, Highland Heights, Ohio 44143. Many thanks.

Appendix A

Error Code Listing

Code	STS Byte of Reply Message (in Hex)	Meaning
00	00	No Error
01, 02		Processor communications problem. May be processor fault.
03		No memory in communication adapter module for START bit file
		MEMORY ACCESS RUNG FORMAT
04		First GET instruction incorrectly entered
05		Invalid station number
06		Second GET instruction incorrectly entered
07		Third GET instruction incorrectly entered
08		Third GET address less than second GET address (improper access boundary definition)
09		Invalid end of access branch (BRANCH END instruction must be inserted.
10		Invalid end of access rung
11		Beginning of next rung invalid. (Refers to any rung after a memory access rung.) Or, BRANCH START instruction missing.
		COMMAND RUNG FORMAT
12		START bit in lower byte. (START bit must be selected from upper byte, bits 10-17)
13		Second EXAMINE element incorrectly entered
14		Invalid command code
15		Invalid remote station number in command code
16		Invalid element in bit write rung
17		First GET incorrectly entered (word command format)
18		Second GET incorrectly entered (word command format)
19		Third GET incorrectly entered (word command format)
20		End of rung incorrectly entered (word command format)
21		Beginning of new command rung invalid or memory access rung programmed following command rung.
22		REMOTE/LOCAL FAULT word not in data table. (START/DONE word incorrectly chosen.)
23		Unprotected command not allowed by switch setting at local station.
24		Same start bit used in more than one command rung.
26		Excessive number of command rungs (more than 256).
27		Timeout setting too large. Valid timeout settings are 011 to 407. A setting of 010 disables the timeout.
28		Bad address in command rung.
29		Bad size in read/write command.

Code	STS Byte of Reply Message (in Hex)	Meaning
		COMMUNICATIONS ERRORS (MAY BE DISPLAYED IN CONJUNCTION WITH REMOTE/LOCAL FAULT BITS)
30		Processor memory discrepancy
31		Controller communications problem. May be processor fault.
32		Improper command message size
33		Invalid command code
34		Invalid station number
35		Attempt to send unprotected command invalid
36		Command execution aborted by sending station processor
37		Command execution aborted. Execution time exceeds timeout preset value.
38		Local processor entered the program mode
50		Processor communications problem. May be processor fault.
51		Invalid transparent word in reply message
52		No communication zone rungs in program
53		Reply not expected. (Reply received, but START bit is OFF)
54		Processor memory not in format for communication
55		Invalid reply. (Reply received, but communication zone rungs are incorrectly entered. Or, reply received when processor mode select keylock switch is in the PROGRAM LOAD POSITION.) Program status indicator (PROG) may be ON to indicate this type of error condition. May mean memory access rung missing for received protected command
56		Incorrect sequence number in reply. (Refers to transparent word in message format.)
57		Reply message is of incorrect size
81	10	Illegal command
82		Station processor communication problem
83	30	Remote station processor faulted or OFF
84	40	I/O fault at remote station processor
85	50	Transmitted command disallowed by switch setting or memory access rung programming at remote station
86	60	Transmitted command disallowed by switch setting at remote station
87	70	Remote station processor in PROG or PROGRAM LOAD mode
88	80	Communication zone invalid at remote station processor. Program status indicator (PROG) may be ON at that station.
89	90	Remote station communication adapter module unable to buffer received command in memory
8B	B0	Remote station is in download mode; or error in download command; or operation not allowed in upload or download mode; or operation not allowed when not in download mode.
92	02	Destination station fails to respond
93	03	Contention between master stations prevents message transmission

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