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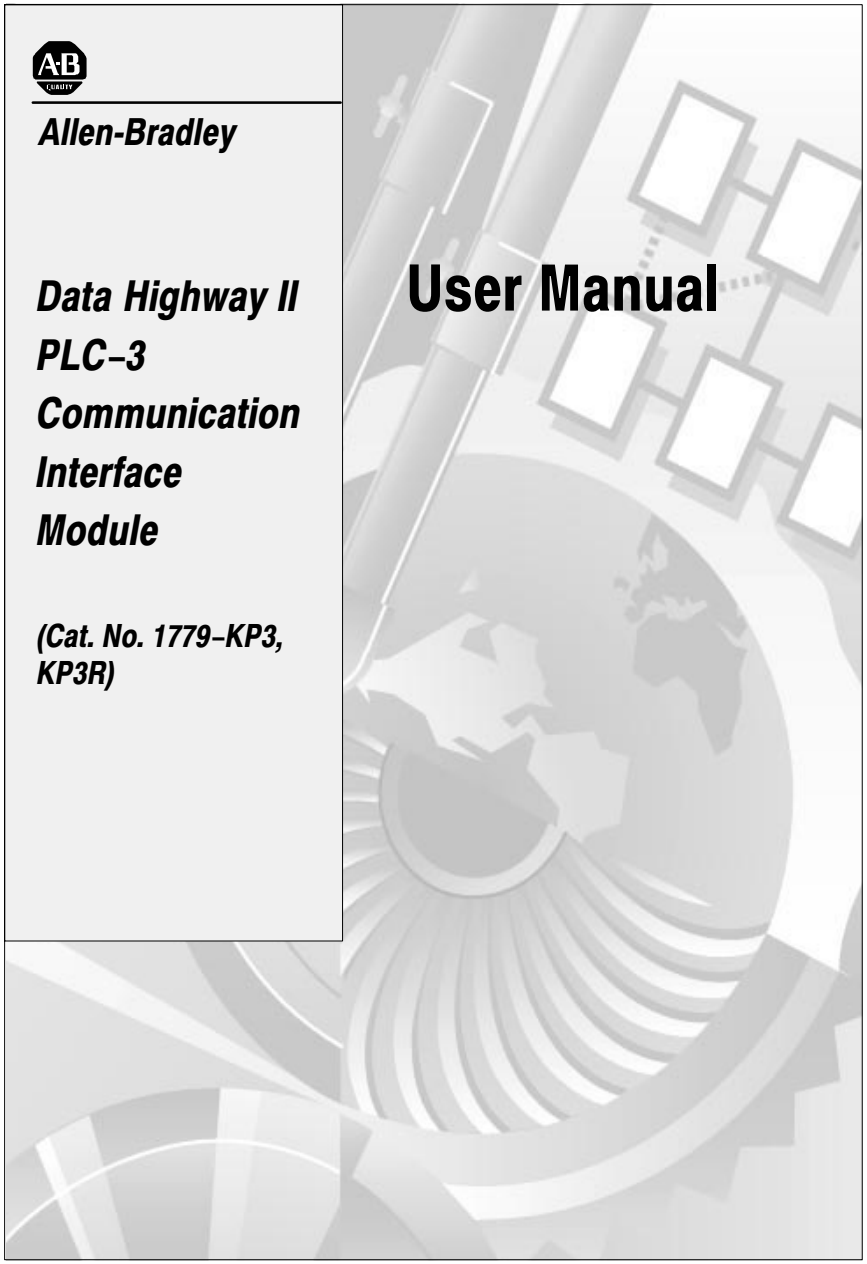
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Allen-Bradley

User Manual

Data Highway II PLC–3 Communication Interface Module

(Cat. No. 1779–KP3, KP3R)

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Preface

Purpose of This Manual

This manual describes the Allen–Bradley 1779–KP3, –KP3R Communication Interface Module and provides information on:

- the Data Highway II™ Network
- other Allen–Bradley communication interface modules
- the 1779–KP3, –KP3R hardware and firmware components
- installing and configuring the 1779–KP3, –KP3R Module
- connecting the 1779–KP3, –KP3R Module to the Data Highway II network
- installing a backup cable system
- programming the 1779–KP3, –KP3R Module

Who Should Read This Manual

You should read this manual before using the 1779–KP3, –KP3R Communication Interface Module. We assume you have basic knowledge of:

- the Data Highway II network
- the Data Highway Plus™ network
- Allen–Bradley PLC® Programmable Controllers
- programming through Allen–Bradley 6200 software

Precautionary Notes

In this manual, you may see:

- **Important** notes that stress information critical to your understanding and use of the product.
- **WARNING**s that describe where you may be injured if you do not follow procedures properly.
- **CAUTION**s that describe where equipment may be damaged if you do not follow procedures properly.

What This Package Contains

If you have ordered the 1779–KP3 or –KP3R communication interface module, you should have received:

- the module itself
- this user manual

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Frequently Used Terms

To make this manual easier to read, we occasionally use abbreviated versions of some terms. You may see:

Term/symbol:	Meaning:
DH	the Allen–Bradley Data Highway network
DHII™	the Allen–Bradley Data Highway II network
DH+™	The Allen–Bradley Data Highway Plus network.
KP3 module or KP3	the 1779–KP3 communication interface module. Generally, we use ‘‘KP3” to refer to both types of modules; we specifically use KP3R when only referring to it.
KP3R module or KP3R	the 1779–KP3R communication interface module (the redundant–cabling version of the KP3 module).
< >	(angle brackets) used in text describing programming. It symbolizes where you need to add information specific to your application.

Important: In this manual, we use the term ‘‘KP3” to refer to both the 1779–KP3 and 1779–KP3R Modules. When it is necessary to specify the 1779–KP3R Module alone, we do so.

Related Products

The 1779–KP3 is part of a complete line of Allen–Bradley Data Highway II product family. The following table lists others:

Product:	Catalog Number:
Data Highway II Asynchronous–device Interface	1779–KFL, –KFLR
Data Highway II Synchronous–device Interface	1779–KFM, –KFMR
Data Highway II PLC–2 Communication Interface Module	1779–KP2, –KP2R
Data Highway II/ Data Highway Plus Interface Module	1779–KP5, –KP5R

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Related Publications

The following table shows you where to read more about related Allen–Bradley products:

Title:	Publication Number:
Data Highway II Local Area Network Overview	1779–2.10
Data Highway/Data Highway Plus/Data Highway II/Data Highway 485 Cable Planning and Installation Manual	1770–6.2.2
Data Highway II Asynchronous–device Interface	1779–6.5.1
Data Highway II Synchronous–device Interface	1779–6.5.2
Data Highway II PLC–2 Communication Interface Module	1779–6.5.3
Data Highway II/ Data Highway Plus Interface Module	1779–6.5.6

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Chapter 1

Overview

Chapter Objectives

This chapter serves as an introduction to the Allen–Bradley Data Highway II PLC–3 Communication Interface Module and contains the following sections:

- Introducing the 1779–KP3
- Data Highway II Overview
- Data Highway II Communication
- Allen–Bradley Communication Interface Modules

This information is meant to provide you with a general overview of these topics. For further detailed discussions of any of the subjects listed above, refer to the Preface section titled *Related Publications.* If you are already familiar with these subjects, you can proceed to Chapter 2.

Introducing the 1779–KP3

The 1779–KP3 is a Data Highway II communication interface module that allows you to connect your PLC–3® Programmable Controller to the Data Highway II network, providing you with the ability to communicate to:

- other nodes on your Data Highway II link
- nodes on another Data Highway II link
- Data Highway Plus nodes on a Data Highway Plus sub–network

The 1779–KP3 operates in a single slot of an Allen–Bradley PLC–3 chassis. The front of the module (figure 1.1) contains:

- LEDs that indicate the state of the module and the state of its connection to the network
- two ports for use in a backed–up system
- a single thumbwheel switch that identifies the KP3 interface module from other KP3 interface modules in the PLC–3 chassis
- three thumbwheel switches that determine the node address
- a single Data Highway II auxiliary access port that is reserved for future use

The front panel of the 1779–KP3R Module is shown in Appendix A (figure A.1) of this manual.

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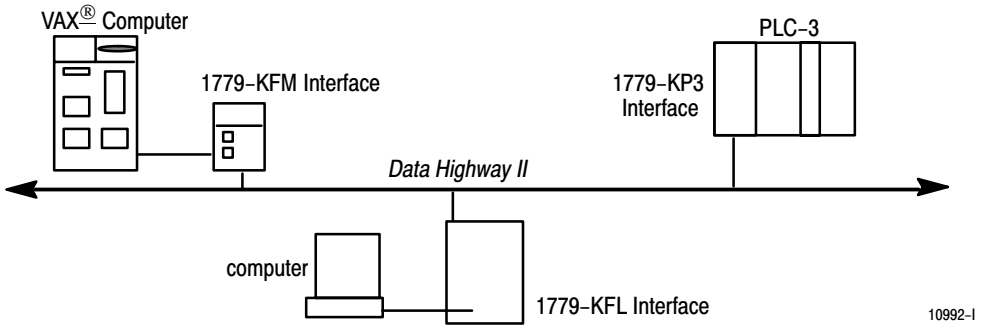
Figure 1.1
Front Panel of the KP3

The following sections provide a brief overview of the Data Highway II environment and related concepts you should be familiar with before using the 1779–KP3 module.

A Brief Look at Data Highway II

Allen–Bradley Data Highway II is local area network designed for the plant environment that allows your intelligent devices to communicate with each other (figure 1.2).

Figure 1.2
Sample Data Highway II Network



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The Data Highway II network offers:

- a transmission rate of one megabit per second
- high immunity to noise
- easy connection to control devices

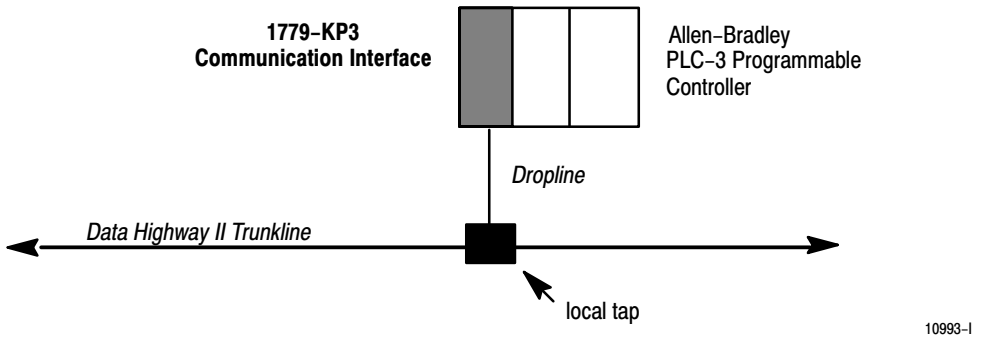
This network is meant for time–critical operations where the status or position of one **device** (e.g., PLC Programmable Controller, personal computer, etc.) may affect another device, or an entire production line.

Data Highway II Cabling

All communication on Data Highway II travels from one device to another through the **trunkline** (figure 1.3). The trunkline varies in length depending on the number of nodes and their location. Data Highway II cabling is compatible with IEEE Specification 802.4 for single channel phase–continuous FSK (frequency shift keying) systems.

You connect Allen–Bradley PLC Programmable Controllers to the Data Highway II trunkline via an Allen–Bradley **communications interface.** Data Highway II **droplines** connect the communication interfaces to the trunkline. The mechanical connection between the dropline and the trunkline is a **local tap** (figure 1.3).

Figure 1.3
The KP3 Communications Interface on Data Highway II



For information on planning and installing Data Highway II refer to the Allen–Bradley *Data Highway/Data Highway Plus/Data Highway II/Data Highway 485 Cable Planning and Installation Manual*, publication 1770–6.2.2.

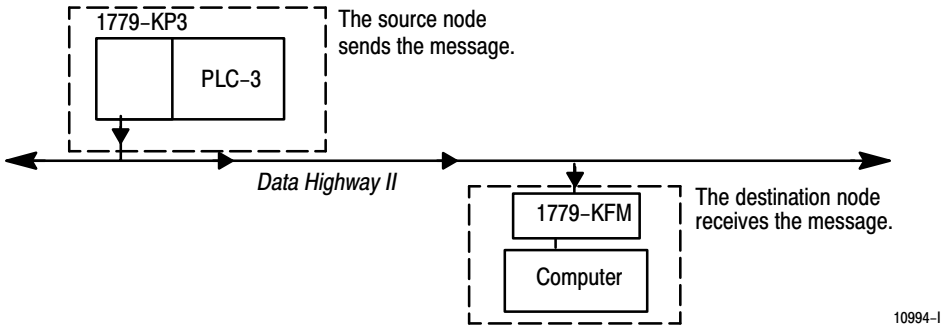
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You also have the option of running **redundant cabling.** You can order Allen–Bradley Data Highway II interface modules with dual ports, which allows you to install a back–up cable system. Thus providing more security for your system if a failure occurs. See Chapter 2 for information on redundant cabling.

Data Highway II Communication

A device and its communication interface make up a **node** on the Data Highway II network (figure 1.4). The node *sending* a message is the **source node**; the node *receiving* a message is the **destination node.**

Figure 1.4
Sample Data Highway II Nodes

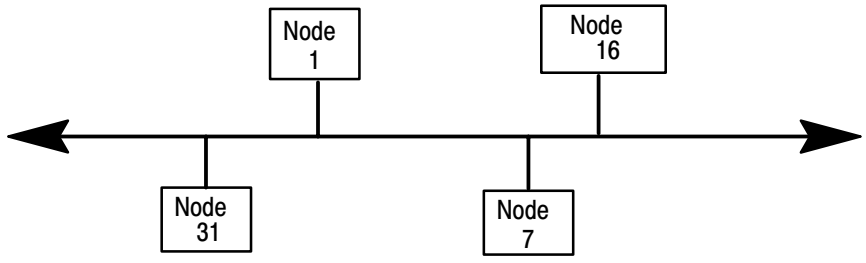


Allen–Bradley Data Highway II has its own *Data Highway II proprietary communication protocol* between the network communication interfaces. All communication interface modules connected to this network ‘‘talk” to each other using this protocol. For more information on Data Highway II protocol, refer to Data Highway II Asynchronous–device Interface User’s Manual (Publication 1779–6.5.1) or the Data Highway II Synchronous–device Interface User’s Manual (Publication 1779–6.5.2).

In a Data Highway II configuration, the nodes are situated along a **physical bus** (figure 1.5)**.** Communication is sent across the entire length of the cable to the end nodes. Each node waits and ‘‘listens” for any message addressed to it, accepts the message, and signals the original sender that it has received the message.

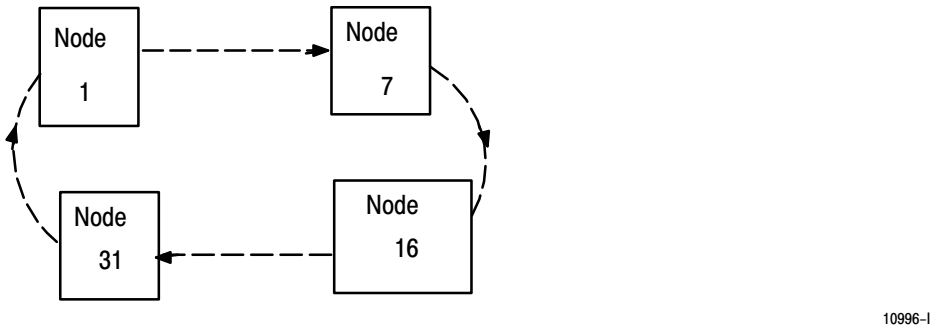
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Figure 1.5
Data Highway II is a Physical Bus Network



While the physical layout of the Data Highway II network is a bus, the method of access to the network is a **logical ring**. Nodes are allowed to communicate on the network while they posses the **token.** This token is passed around the ring according to the nodes' addresses on the Data Highway II link. While a node possesses the token it is the **master,** and it is the only node that can send commands out to the network. When it is finished, the token passes to the node with the next highest address, regardless of the node's physical proximity to the previous node (figure 1.6).

Figure 1.6
A Conceptual View of Data Highway II Logical Ring Communication



When a node leaves the ring unexpectedly, the ring performs a recovery procedure. The node with the next lowest node number attempts to pass the token to the exiting node, but because it cannot, the ring must undergo a recovery procedure to rebuild itself. When the message returns to the inquiring node, the node can then pass the token to the node that has the next highest number.

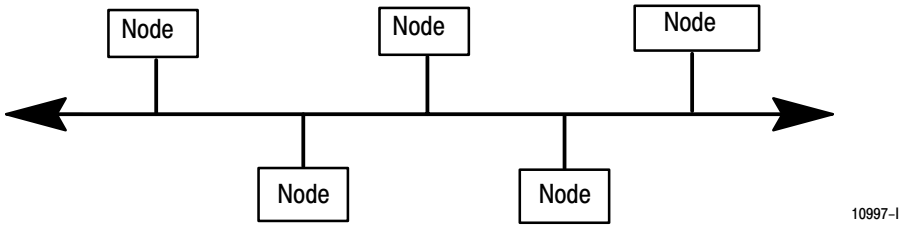
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Data Highway II communication interfaces operate at different modes that vary according the their relationship with the logical ring. The modes are:

- **In–ring mode**, which is when the interface is a fully operational member of the ring. It accepts messages, replies to them, and is ready to send them.
- **Seeking–membership mode**, which is when the interface is trying to become a member of the ring so that it can send messages.

When we talk of communication on a Data Highway II network, it is important to keep in mind the concept of a **link**. A Data Highway II link is one section of trunkline, including nodes, that makes up a Data Highway II network (figure 1.7); links are limited by length of the trunkline. Nodes on different links are ‘‘off–link” with respect to each other; nodes on the some link are ‘‘on–link” with respect to each other.

Figure 1.7
A Data Highway II Link



You can expand your Data Highway II network with the help of two Allen–Bradley 1779–KP5 communication interface modules configured as bridges. In this case, you would have *two* Data Highway II links (figure 1.8).

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Figure 1.8
Two Data Highway II Links

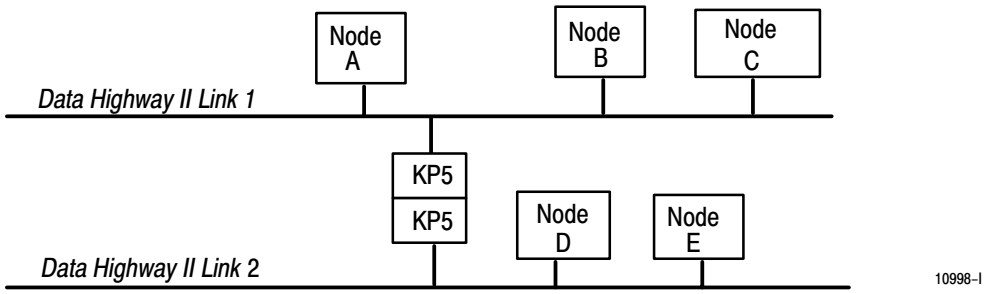
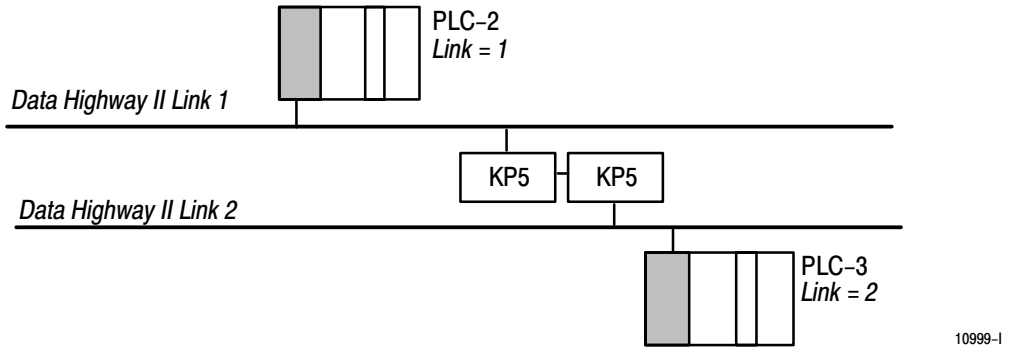


Figure 1.8 shows two Data Highway II links. Notice that to ‘‘Node A”, ‘‘Node B” is on–link, and ‘‘Node D” is off–link. Data Highway II nodes consider other nodes ‘‘off–link” if, to communicate with them, the Data Highway II nodes have to cross a bridge.

The link numbers become an important factor when you are addressing messages. For example, if you have two Data Highway II networks bridged together via two Allen–Bradley KP5 modules, the two links have different link numbers (Figure 1.9). You use this link information inside your message instruction (see Chapter 3 on *Programming* for more information).

Figure 1.9
Example of Two Data Highway II Links



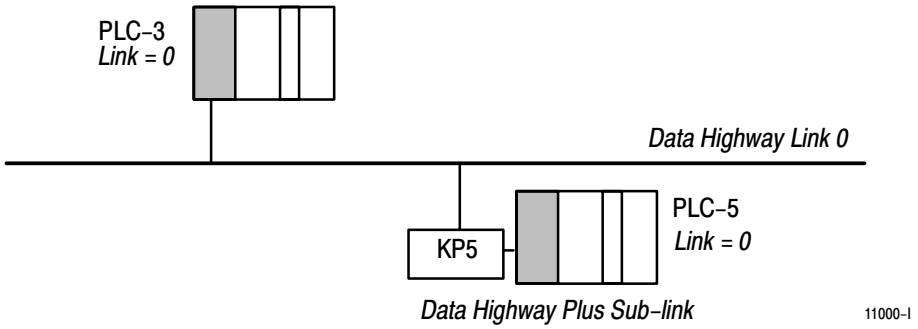
Nodes on the same link (**on–link)**, have the same link number; nodes on different link (**off–link)**, have different link numbers. Note that your local link may always be specified as link zero; by default, the link you are connected to is considered zero with respect to other local nodes you may be communicating with.

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You can also connect a Data Highway Plus subnetwork to your Data Highway II network via one Allen–Bradley KP5 module. When you have a Data Highway Plus sub–network attached to your Data Highway II network, the nodes on Data Highway Plus are considered **on–link** to the nodes on Data Highway II.

If you are sending a message instruction from a PLC–3 controller on Data Highway II to a PLC–5® controller on Data Highway Plus, you would use the same link number for both (figure 1.10).

Figure 1.10
Example of Using Link Numbers When Addressing



Note that in the this example, the PLC–5 controller considers the KP3 module a remote station and may refer to the KP3 as *offlink*. The PLC–5 controller **cannot** communicate to stations on another Data Highway II link.

Note also that when we speak of KP3 *communication* on the Data Highway II network, there are different types: communication initiated by the KP3 and communication initiated via a computer. Refer to the following table.

The KP3 has the ability to initiate simple data transfers to:	**You can initiate via a computer (through a KFM or KFL module):**
another KP3	uploading and downloading of processor memory
a KP2	diagnostics
a PLC–5 controller (via a KP5)	station management

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Allen–Bradley Communication Interface Modules

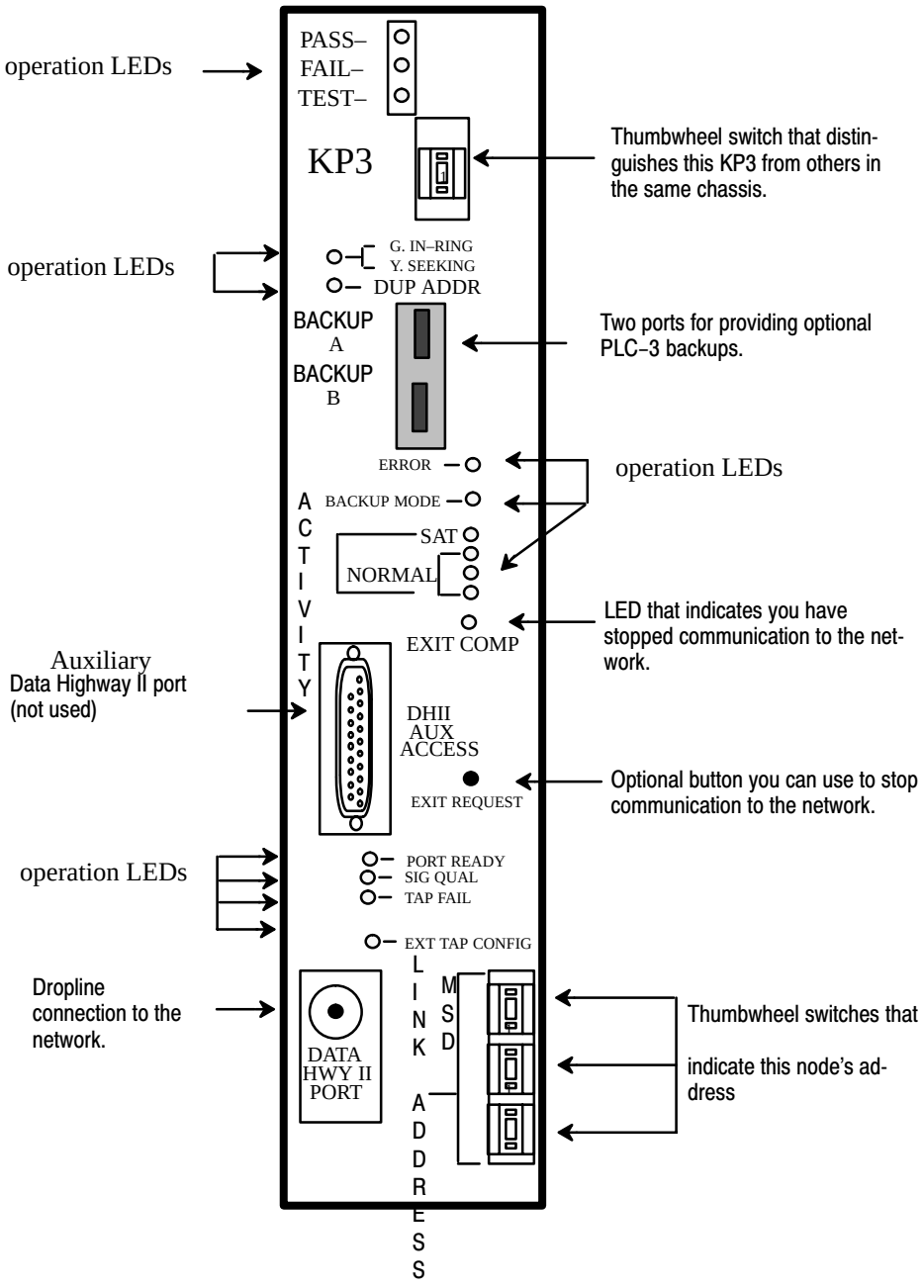
The following tables show the types of on–link and off–link connections that are possible and the type of Allen–Bradley Communication Interface Modules you need.

To connect this to a Data Highway II Link:	You must use this Allen–Bradley communication interface:
an Allen–Bradley PLC–3 Controller	1779–KP3, –KP3R
an Allen–Bradley PLC–2 Controller	1779–KP2, –KP2R[1]
a synchronous interface device (RS–449 compatible)	1779–KFM, –KFMR
an asynchronous interface device (RS–232, –422 compatible)	1779–KFL, –KFLR
another Data Highway II link	two 1779–KP5 modules configured as bridges
a Data Highway Plus sub–network link	one 1779–KP5 Module (see table below)

[1] The 1779–KP2 module does not allow communication to or from other Data Highway II links.

To connect this to a Data Highway Plus Sub–network Link:	You must use this Allen–Bradley communication interface:
an Allen–Bradley PLC–3 Controller	1775–S5, –SR5
an Allen–Bradley PLC–2 Controller	1785–KA3
an Allen–Bradley PLC–5 Controller	(built–in interface)
personal computer	1784–KT and 6001–F1E Standard Driver Software or 1785–KE for RS–232 communication

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Chapter 2

Installing the 1779–KP3 Communication Interface

Chapter Objectives

This chapter contains the information you need to install your 1779–KP3 Communication Interface module. It covers the following topics:

- printed circuit boards
- setting the switches on the host board
- setting thumbwheel switches
- installing the KP3 into the PLC–3 chassis
- using the LIST option to select additional KP3 parameters
- connecting the KP3 to Data Highway II
- connecting a PLC–3 to multiple Data Highway II links
- how a PLC–3 backup system works on Data Highway II
- installing a backup PLC–3 on Data Highway II

Printed Circuit Boards

The 1779–KP3 interface is a single module that consists of two printed circuit boards:

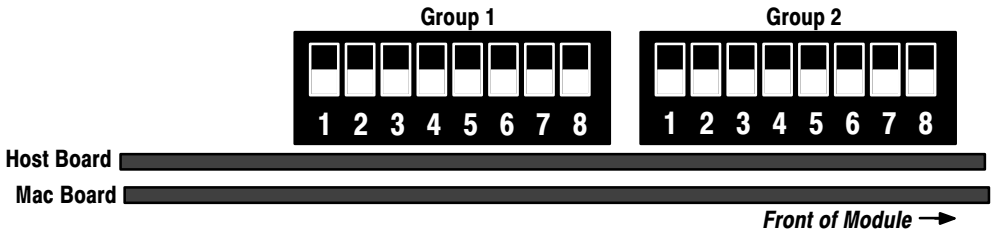
- the host board
- the media access controller (MAC) board

There are switches associated with each of these boards. Read the following section before installing your module.

Set the Switches on the Host Board

Before you install your KP3 interface, you must set the switches located inside the module on the host board. There are two groups of switches: Group 1 and 2. You can view them from the top of the module, looking inside at the board (figure 2.1).

Figure 2.1
Top View of Switches on the KP3 Module's Host Board

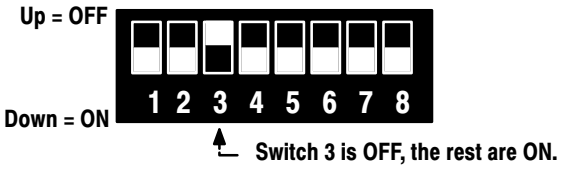


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You set these switches to select module options and protection/privilege options. Keep in mind that when the switch is **down**, it is **on** (closed); when it is **up**, it is **off** (open). Figure 2.2 shows an example setting; the white areas correspond to the movable part within each switch.

Figure 2.2
Clarifying the Switch Positions



Setting Switches in Group 1

In Group 1, switches 1 and 2 determine the actions of the KP3 and PLC–3 controller if either should fault for some reason. Switches 3 and 4 are used if you are using your KP3 in a backup system (see *Installing Backup PLC–3s on Data Highway II* later in this chapter for more information). Switches 5 through 8 are reserved for future Allen–Bradley applications and you should not set them. Table 2.A lists the Group 1 switches and the setting indications.

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Table 2.A
Group1 Switch Settings

If:	Set switch number:	To:
you want the KP3 to fault and disable its Data HIghway II port if the PLC–3 faults	1	OFF
you want the KP3 Data Highway II port to remain enabled if the PLC–3 faults		ON
you want the PLC–3 to fault if the KP3 faults	2	OFF
you want the PLC–3 to remain enabled if the KP3 faults		ON
the KP3 is part of a backup system **Important:** If you select OFF, set the thumbwheels of your primary and backup KP3s to the same link address. When the backup is in effect, Data Highway II sees the link address of the backup KP3 as one number greater than the node thumbwheel. If switch 3 is OFF, then switch 1 **must** be OFF also.	3	OFF
the PLC–3, not the KP3, is in a backup system **Important:** The KP3 will keep the node address when it is in a backup PLC–3. It will not react to a switch over.		ON
you want the backup connector on the KP3 enabled	4	OFF
you want the backup connector on the KP3 disabled		ON
Important: Do not touch switches 5,6,7, and 8; they are reserved for future use.		

Setting Switches in Group 2

The Group 2 switches deal with programming options. Table 2.B lists the Group 2 switches and the setting indications. Switches 1, 2, 3, 7 and 8 are reserved for future Allen–Bradley applications and you should not set them.

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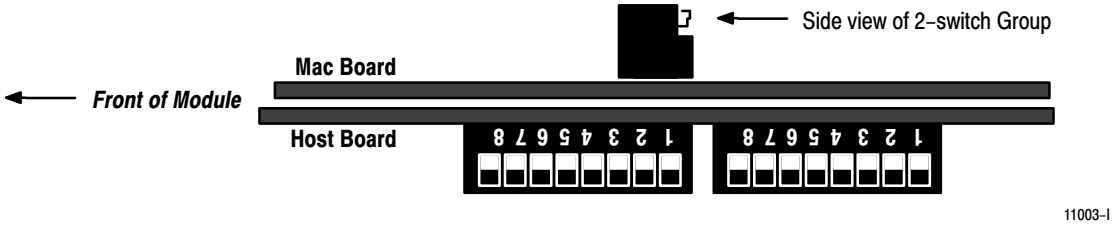
Table 2.B
Group 2 Switch Settings

If:	Set switch number:	To:
you want the KP3 to accept write commands to the program areas of the PLC–3 memory, regardless of the PLC–3 keyswitch position	4	ON
you want the PLC–3 keyswitch position checked to determine if write commands are allowed to the program areas of PLC–3 memory		OFF
you want the KP3 to accept write commands to the data table areas of the PLC–3 memory, regardless of the PLC–3 keyswitch position	5	ON
the PLC–3 keyswitch position checked to determine if write commands are allowed to the data table areas of PLC–3 memory		OFF
you want the KP3 to accept write commands to the status areas of memory, regardless of the PLC–3 keyswitch position	6	ON
you want the PLC–3 keyswitch position checked to determine if write commands are allowed to the status areas of PLC–3 memory		OFF
Important: Do not touch switches 1, 2, and 3; they are reserved for future use.		

The MAC Board Switch Your Module May Have

If your 1779–KP3 Interface has a *series A* MAC board, you will also have a 2–switch group on the MAC board. You can view it from the top of the module looking down at the MAC board. Figure 2.3 shows the location of this switch in relation to the host board switches; this is a side view of this group. Note that this switch **does not** exist on redundant modules (1779–KP3R) or 1779–KP3 modules with series B MAC boards.

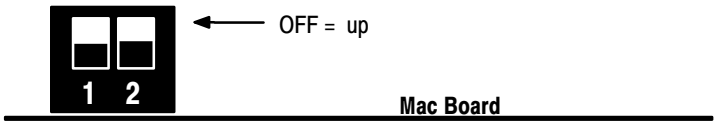
Figure 2.3
The MAC Board Switch Group



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Verify that both of the switches in this group are set to OFF (open). Figure 2.4 shows the position they should remain in.

Figure 2.4
Correct Position of the MAC Switches (Front View)



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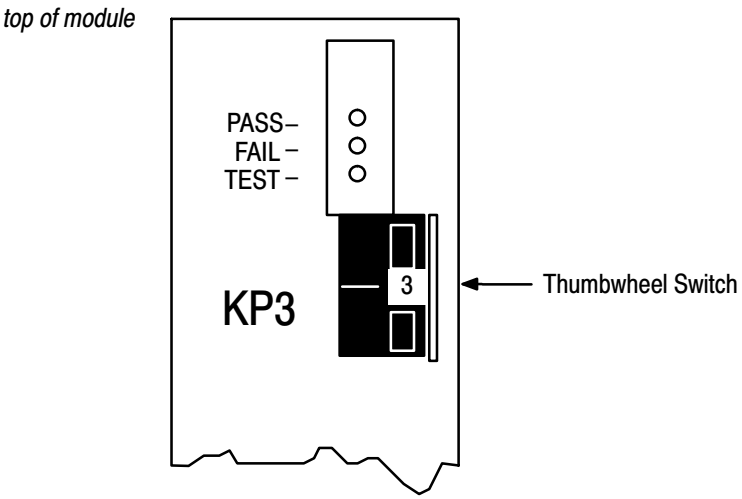
Important: Do not to change these switch settings if you have them. In the later (series B) versions of the KP3 MAC board, changes were made to the hardware, making the need for this MAC switch unnecessary.

Set the Thumbwheel Switches

There are four thumbwheel switches on the KP3's front panel. Use the one at the top of the module (figure 2.5) to set the KP3's module number. This number distinguishes it from other KP3 modules in the chassis. You should start with the number 1 and as you add KP3 modules to the chassis, go to the next highest consecutive number.

Important: If you are using the KP3 in a backup system make sure the module numbers in the primary and backup KP3s are the same.

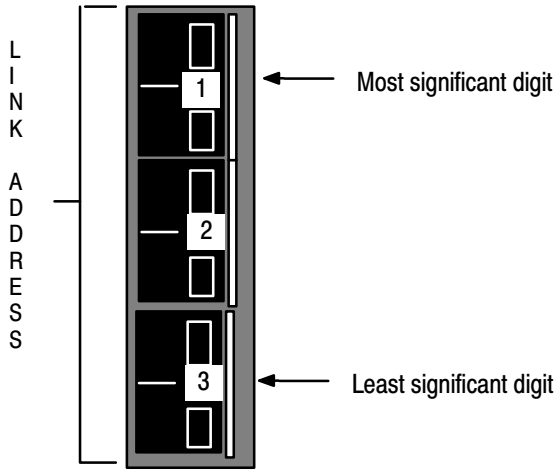
Figure 2.5
The Thumbwheel Switch to Set the KP3 Module Number



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Use the three thumbwheel switches at the bottom of the front panel to set the Data Highway II node address for the KP3. You can use from 1 to 376 octal. For example, to select node address 123, set the thumbwheels as shown in figure 2.6.

Figure 2.6
Example Thumbwheel Switch Setting for the Node Address



Install the KP3 Module

Once you have set the switches on the host board and the thumbwheels on the front panel, you are ready to install the KP3 module into the PLC–3 chassis. The KP3 is a single–slot module that you can place next to any other PLC–3 module in the chassis.

Important: We assume you have a Data Highway II network up and running, and a drop line cable ready to attach to the module. If you need cabling information, refer to the Allen–Bradley *Data Highway/Data Highway Plus/Data Highway II/DH–485 Cable Installation Manual (publicatio*n 1770–6.2.2).

Follow the procedure below to install your KP3 module into your Allen–Bradley PLC–3 chassis.

1. Remove power from the PLC–3 chassis.

2. Lift the interlock bar that is inside the chassis and secure it to the brackets that are mounted at the top of the chassis (your chassis may have a hinged interlock bar attached to the top that flips up away from the front).

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3. Slide the module into the chassis slot, making sure it slides along the grove at the bottom of the slot. Press firmly until you feel it snap into the backplane.

4. Pull the interlock bar back into place.

5. Restore power to the chassis.

6. Use LIST to select additional KP3 options (see following section).

Use the LIST Option to Select Additional KP3 Parameters

After you install the KP3 into the chassis, use the LIST option to select additional operational KP3 parameters. You access the LIST option through an Allen–Bradley PLC–3 Industrial Terminal (1770–T4) which has the ability to communicate directly with your Allen–Bradley PLC–3. Refer to the PLC–3 Controller Installation and Operations manual, publication 1775–6.7.1, for instructions on accessing the LIST function.

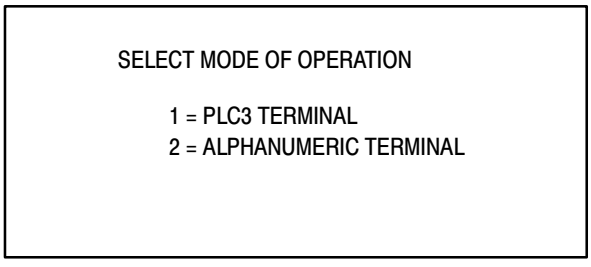
You can also access LIST through Allen–Bradley 6200 Programming Software (see the PLC–3 Programming Software User Manual for information, publication 6200–6.5.3).

The following procedure shows you how to use LIST.

1. Connect a T4 Industrial Terminal (1770–T4) to the PLC–3 controller.

2. Turn the T4 terminal ON.

3. Press the *shift* key and then the *mode* key. You receive a *mode of operation* menu:



11005–I

4. Press 1. You receive a blank screen with a $ sign prompt at the bottom.

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5. Enter the LIST function at the $ prompt by pressing the *shift* key and then the *list* key. You receive the *SYSTEM–MODE* menu:

```
SYSTEM–MODE SCREEN
  1. TEST MONITOR
  2. RUN MONITOR
  3. *PROGRAM LOAD
  4. REMOTE ENABLE
  5. SYSTEM STATUS
  6.  MODULE STATUS
  ENTER NEXT>
```

11006–I

6. Select the *MODULE STATUS* option by typing *6 <enter>*.

The *MODULES* menu appears, which lists all of the modules in the PLC–3 system by catalog number, including the KP3.

7. Select 1779–KP3 from the *MODULES* menu by typing the number next to it and pressing *<enter>*. You will receive a *DATA HWY II INTERFACE* menu:

```
Data Hwy II Interface
KP3 1, Node 111
Chassis 0, Slot 6

1  Message Timeouts
2   Token Hold Factor
3   Set Node Mode
4   Input File List
Enter Next>
```

The menu above shows the 4 different options you have to choose from within the first menu. When you choose any of these options, you will receive another menu. The following sections describes each of these options and the sub–menu options associated with them.

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The Message Time–outs Menu

When you choose option 1, you receive the *Message Time-outs* menu:

```
KP3 1, MESSAGE TIMEOUTS

1  TIME CRITICAL TIMEOUT
2  SUPERVISORY TIMEOUT
3  THIRD–PARTY TIMEOUT
ENTER NEXT >
```

This option:	allows you to:	Minimum value:	Maximum Value:	Default Value[1]:
1	set the time–out for time–critical messages.	0.01 seconds	10.00 seconds	.50 seconds
2	set the time–out for supervisory messages. Use to send information that in not time critical, such as reports.	0.01 seconds	650.00 seconds	1.00 seconds
3	(Not available with this release.)			

[1] The default value appears the first time you use this menu.

Important: You must enter the time–out value for time–critical and supervisory messages with a decimal point and two digits to the right of it.

The Token Hold Factor Menu

When you select option 2 from the *Data Highway Interface* menu, you receive the *Token Hold Factor* menu:

```
KP3 1, TOKEN HOLD FACTOR
FACTOR = 1
ENTER FACTOR >
```

This menu allows you to set and display the amount of time a node is allowed to possess the token before passing it to the next node. The menu allows you to change the link–layer token hold factor.

You can enter a number from 1 to 256, the default factor is 1. With a factor of 1, the node will hold the token for the standard hold time. The

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token hold time is multiplied by the number you enter. For example, if you enter 2, the token hold time will double. You may want to increase the token hold time at the node if, for example, that node typically has more messages to send than other nodes.

The Set Node Mode Menu

When you select option 3 from the *Data Highway II Interface* menu, you receive the *Set Node Mode* menu. This menu allows you to change the mode of the KP3:

```
KP3 1, SET NODE MODE
1  INRING
2  ONLINE
3  OFFLINE
```

The following table shows what each value means.

If you set the mode to:	Then:
INRING	the KP3 is fully operational.
ONLINE	the KP3 allows requests for immediate data and "time–critical writes with no reply". The KP3 will not initiate any messages, nor reply to any.
OFFLINE	the KP3 will not initiate or respond to any messages.

The Input File List Menu

When you select option 4 from the *Data Highway II Interface* menu, you receive the *Input File List* menu:

```
KP3 1, INPUT FILE LIST
ENTER STATION AND INPUT FILE >
```

Use this to tell the KP3 which input file to read data from or write data to when it receives a message from a device using PLC–2–style addressing (e.g., a 1779–KP2, –KFL, or, –KFM interface module or another KP3 module).

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When the KP3 receives a message containing PLC–2–style addressing, it searches the input file list and reads to or writes from the input file specified for the node that sent the message. If the sending node is not in the list, the KP3 uses the octal address of the source node as the decimal input–file number.

You can enter any given node only once into the input file list, for example:

```
KP3 1, INPUT FILE LIST
ENTER STATION AND INPUT FILE >          :5 2
```

The example above sets up node ‘‘5” to read from or write to input file ‘‘2”.

If the station is on another Data Highway II link, specify the link number **before** the : sign. If the station is **not** *user 1* (e.g., channel 2 of a 1779–KFL module), put a period (.) and after the node number, and followed by the user number.

To delete an input file entry, enter the node, followed by ‘‘/D”, for example:

```
KP3 1, INPUT FILE LIST
ENTER STATION AND INPUT FILE >          :5 /D
```

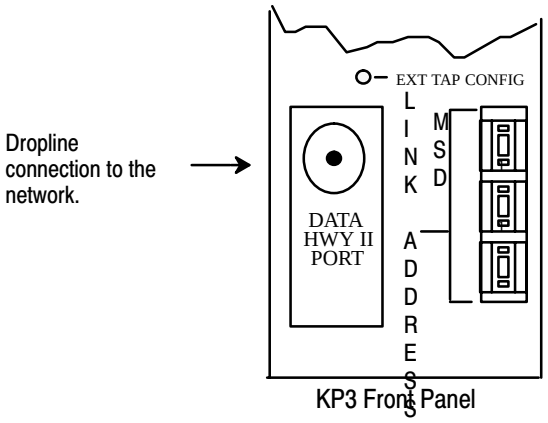

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Connecting the KP3 to Data Highway II

Once you have installed and configured the KP3 module, follow the procedure below to connect it to the highway.

Important: If you are connecting a backup PLC–3 system to Data Highway II, remember that you must run at least 30 feet of trunkline cable between droplines to the primary and backup KP3 modules.

1. Locate the *Data Highway II Port* on the KP3 front panel.



2. Connect a Data Highway II dropline to the connector by sliding the dropline connector over the port and twisting the collar clockwise.

If you have a KP3R module, repeat steps 1 and 2 for the port labeled *Data Highway II PORT 2*.

Connecting a PLC–3 to Multiple Data Highway II Links

You can connect a PLC–3 to multiple Data Highway II links. The PLC–3 requires one KP3 for each Data Highway II link it communicates over.

Follow the procedure below to connect a PLC–3 to multiple Data Highway II links.

1. Install one KP3 in the PLC–3 chassis for each link the PLC–3 will communicate over.

2. Select a unique module number on the thumbwheel of each KP3 in the same chassis.

3. Connect each KP3 module to separate links via separate droplines.

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You can assign the same node address to more than one KP3 in the same PLC–3 chassis as long as the KP3s are communicating over different links.

Important: You are not required to connect these separate links by Data Highway II bridges.

How a PLC–3 Backup System Works on Data Highway II

When we talk about a ‘‘backup” system, we a talking about having a *primary* PLC–3 on the network and a *backup* PLC–3. The pairs need to be connected in such a way that one ‘‘takes over” if something should happen to the other (switchover).

When you configure a backup system on Data Highway II, the primary and backup KP3s must have their thumbwheels set to the same link address. As far as the Data Highway II is concerned, however, the backup KP3 will assume a link address that is one number higher than the primary KP3.

For example, if you have set the link address on both KP3s to 176 octal, Data Highway II will list the backup KP3 as having a link address of 177 octal. This enables you to send messages to the backup KP3 from other nodes on the link. When a switchover occurs, the backup KP3 will become node 176 as far as the link is concerned. Node 177, the link address of the backup KP3, will then disappear from the link.

What You Should to Monitor Possible Switchover

At the time a switchover happens and the backup KP3 becomes the primary KP3, the new primary KP3 has no way of knowing which messages were initiated by the former primary KP3. For this reason, you should monitor the **run/backup bit** (data table status section, file 0, word 3, bit 7) in your PLC–3 ladder diagram program. In the event of a switchover, set the **done bit** of each message instruction. This allows any message being initiated during a switchover to be sent again.

Important: Alert the proper personnel when a switchover occurs. One way you can provide this indication is by having your program monitor the run/backup bit, and turn on alarms or lights when the status changes from backup to run. This bit is set in the primary processor and reset in the backup processor.

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Installing a Back–up PLC–3 System on Data Highway II

You can set up a PLC–3 backup system in three ways, using an:

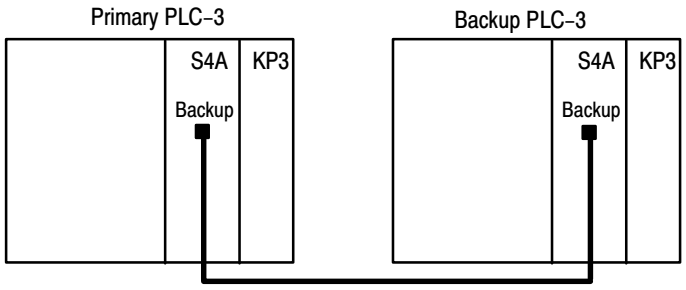
- I/O Scanner–programmer Interface Module (1775–S4A), a PLC–3 I/O Scanner Communication Adapter Module (1775–S5) or a Memory Communication Module (1775–MX) **without** the KP3
- S4A, S5, **or** MX **with** the KP3
- S4A or S5 **with** an MX, **and** the KP3

The following sections discuss each of these possibilities.

Using an S4A, S5 or MX Without the KP3

You can connect the primary and backup PLC–3s by connecting the 1775–S4A (1775–S5, or 1775–MX) in each PLC–3 processor (figure 2.7).

Figure 2.7
Backup Cabling Without the KP3



This method is recommended when the application process requires that the Data Highway II switchover of communication happens *after* the backup PLC–3 has taken control of the live I/O. Use this method when the KP3 is involved in primarily supervisory transactions. This method is fully explained in the PLC–3 Backup Concepts Manual (publication 1775–6.3.1).

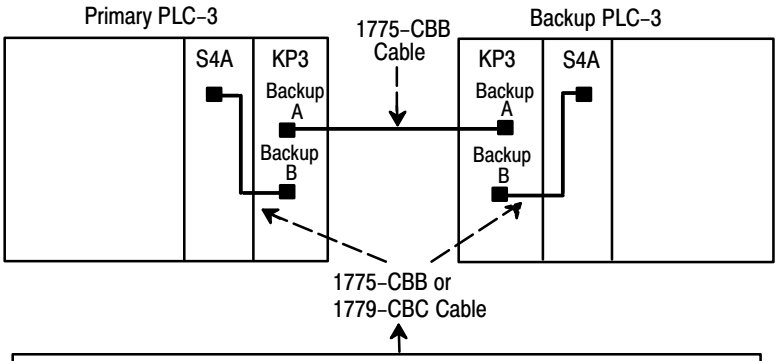
You can also directly connect the S5 or MX modules in the primary and backup PLC–3s.

Using the S4A, S5, or MX With the KP3

You can connect the S4A (S5 or MX) module to the KP3 module in **both** the primary and backup PLC–3s. Then connect the KP3 in the primary PLC–3 to the KP3 in the backup PLC–3 (figure 2.8).

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Figure 2.8
Backup Cabling With the KP3



This method provides faster switchover of communications between primary and backup PLC–3s. Use this method when:

- the application process requires that switchover occur as fast as possible and that the backup KP3 switches to primary operation without waiting for the backup PLC–3 to take control of the I/O.
- the KP3 module is involved in many time–critical transactions.
- you plan to send time–critical messages to the PLC–3 processor.

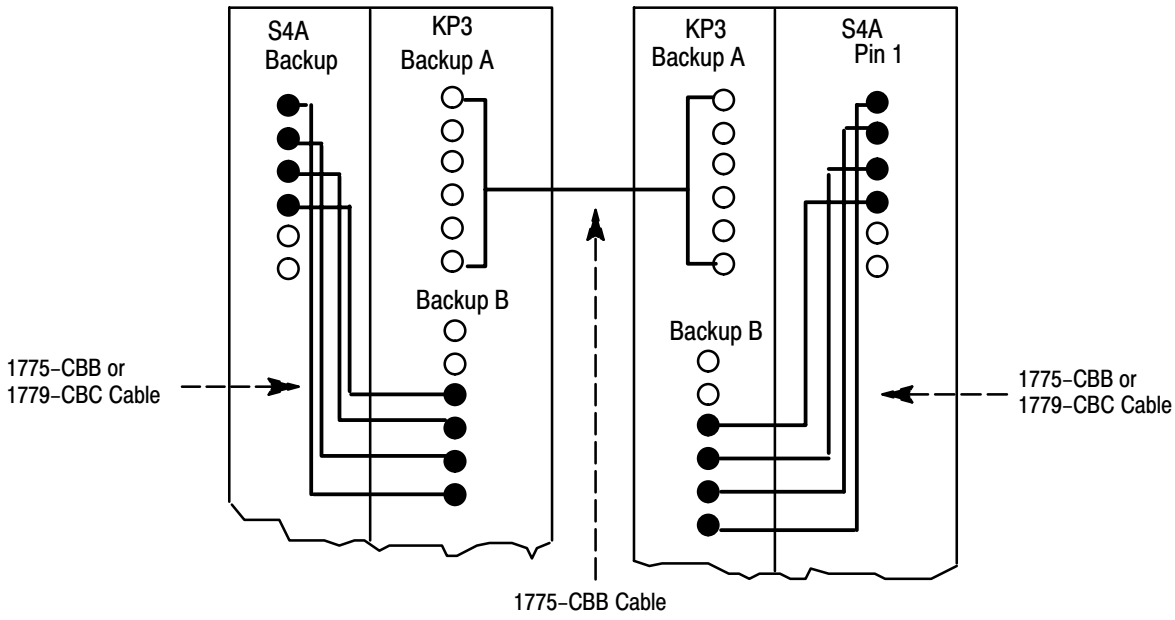
Because of the various options for this cable, refer to the backup cable configuration information in the PLC–3 Backup Concepts Manual (publication 1775–6.3.1).

Important: The 1775–CBB cable assembly has one end that you can configure. When making cables, note the location of the locking connector tab on the module to be certain of the correct connector position. The S4A and MX modules both have the locking tab on the opposite side in comparison to the KP3. The connection between the S4A and the KP3 module is a straight through cable in relation to pin 1 of the connectors (figure 2.9).

The 1779–CBC cable is shipped assembled at both ends.

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Figure 2.9
Backup Cabling Using the SA4 and KP3 Modules in Detail

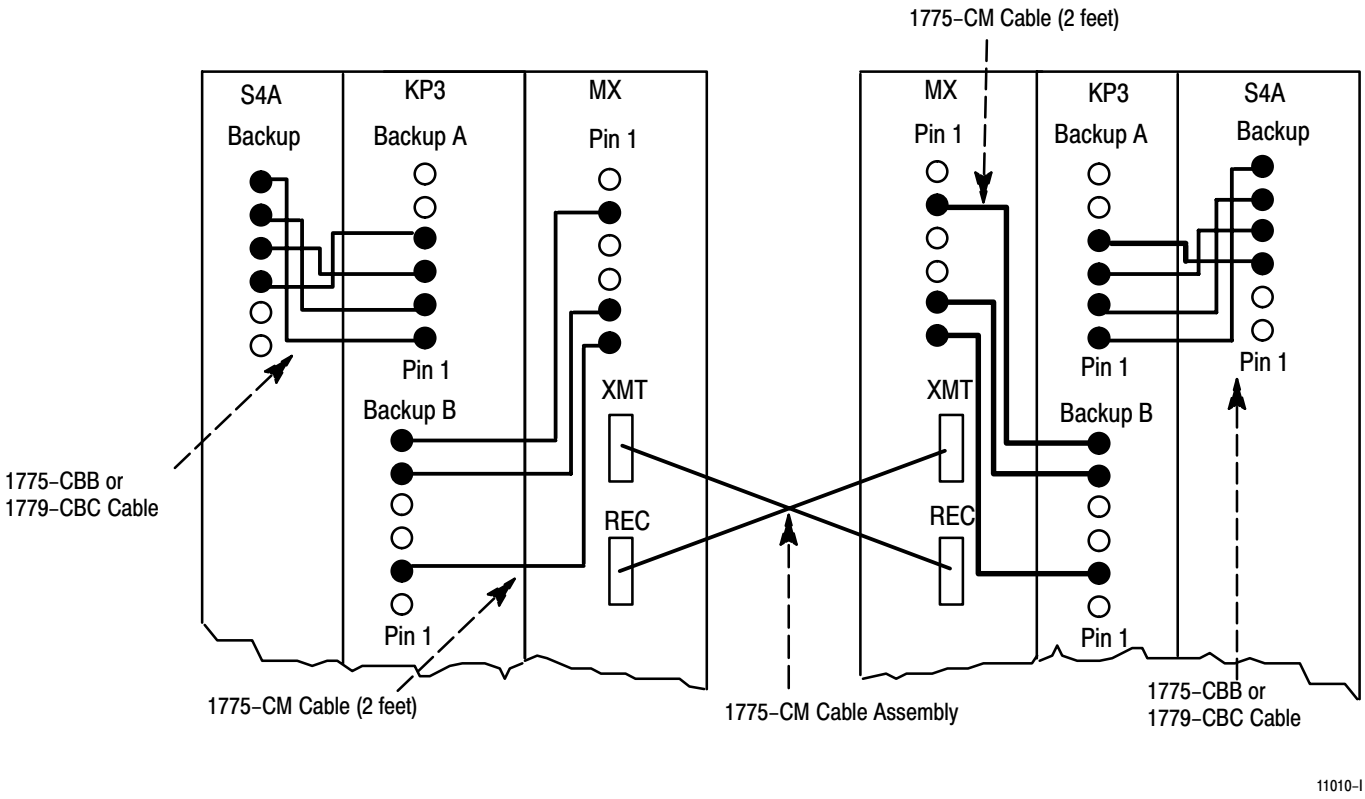


Using an S4A or S5, an MX, and a KP3

You can provide backup PLC–3s by connecting the S4A (or S5) module to the KP3 module in both the primary and backup PLC–3s. Then connect each KP3 to the MX modules. Then connect the primary MX module to the MX in the backup (figure 2.10). This method provides faster switchover of communications between the primary and backup PLC–3 processors.

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Figure 2.10
Using an S4A, MX, and a KP3 for Running Backup Cabling



Important: The 1775–CBB cable assembly has one end that you can configure. When making cables, note the location of the locking connector tab on the module to be certain of the correct connector position. The S4A and MX modules both have the locking tab on the opposite side in comparison to the KP3. The connection between the S4A and the KP3 module is a straight through cable in relation to pin 1 of the connectors.

The 1779–CBC cable is shipped assembled at both ends.

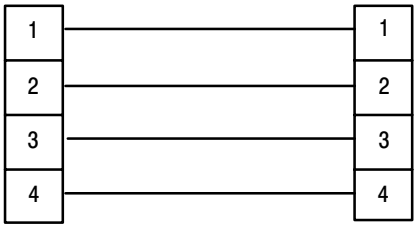
The 1775–CM cable assembly includes four cables: two for transmit/receive connections for the MX modules, and two interconnect cables that you can use to connect the KP3 modules to the MX modules.

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Backup Cable Wiring for Linking a KP3 to an S4A, S5, or MX

The following diagram shows the recommended wiring for a backup cable linking a KP3 module to an S4A or MX module.

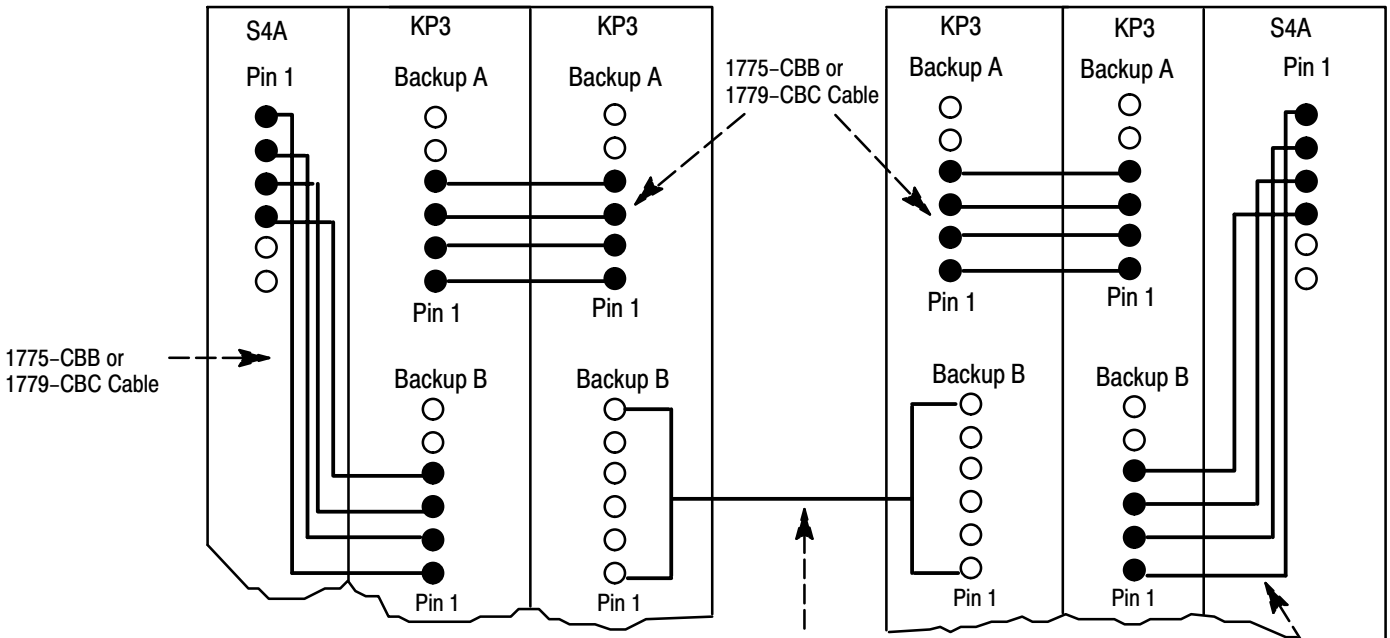
Figure 2.11
Recommended Wiring for Backup Cable Linking a KP3 to an S4A, S5, or MX Module



Creating a Backup System for a PLC–3 Communicating on Multiple Links

If the PLC–3 processor is communicating on more than one link, connect the KP3s in each chassis by routing a 1775–CBB cable from backup port A on the first KP3 to backup port B on the next KP3 (figure 2.12).

Figure 2.12
Backup Cable With More Than One Data Highway II Link



Important: Because of the various options for this cable, refer to the backup cable configuration information in the PLC–3 Backup Concepts Manual (publication 1775–6.3.1).

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Important: The 1775–CBB cable assembly has one end that you can configure. When making cables, note the location of the locking connector tab on the module to be certain of the correct connector position. The S4A and MX modules both have the locking tab on the opposite side in comparison to the KP3. The connection between the S4A and the KP3 module is a straight through cable in relation to pin 1 of the connectors.

The 1779–CBC cable is shipped assembled at both ends.

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Chapter 3

Programming

Chapter Objectives

This chapter contains information on programming your PLC–3 to communicate on the Data Highway II network. We will discuss the information you place in a PLC–3 *message send* instruction. The PLC–3 Message Send instruction itself is covered in greater detail in the PLC–3 Programmable Controller Programming Manual (publication 1775–6.4.1).

This chapter covers the following topics:

- transferring data
- the TO and FROM qualifiers
- the format for addressing Data Highway II nodes
- the format for addressing the memory in Allen–Bradley PLC Programmable Controllers

The terms *onlink* and *offlink* are used extensively throughout this chapter and we assume that you are familiar with them. For an overview of these concepts, refer to Chapter 1.

Transferring Data

This section covers the commands and qualifiers you can use to transfer data using the KP3 module.

The commands you can use are listed in the table below:

Command:	Use to:
MOVE	tell the KP3 to move a bit, a word, or a contiguous block of words. This is usually used to move data to or from a remote node on Data Highway II, but you can also use it to move data to and from a node on Data Highway Plus or within the PLC–3.
TMOVE	tell the KP3 to move a bit, a word, or a contiguous block of words. This can be used to transfer data to and from an onlink Data Highway II node. It is usually used to transfer small amounts of time–critical data in a small amount of time.

A **qualifier** is a word used to specify the details of the data transfer. The qualifiers you can use with the commands above are listed in the following table.

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Qualifier:	Use:
TO	to specify the destination of the data transfer. You must use TO when using either command and it must be followed an address (which must include a data table address and can include a remote node address). You can abbreviate as T.
FROM	to specify where you want to transfer data from. You can use FROM with either command, but if omitted, you must replace it with an integer constant. FROM is always followed by an address (which must include a data table address and can include a remote node address). You can abbreviate as F.
NOSTATUS	only with a TMOVE command designed to transfer data to some remote node. Use when error reporting is not necessary and you want to eliminate the time spent receiving information about the success or failure of the command (see the TMOVE Command section for usage). You can abbreviate as N.

You can specify an **integer constant** in a MOVE or TMOVE command in place of the FROM qualifier and its associated address. The correct format for an integer constant is:

#digit

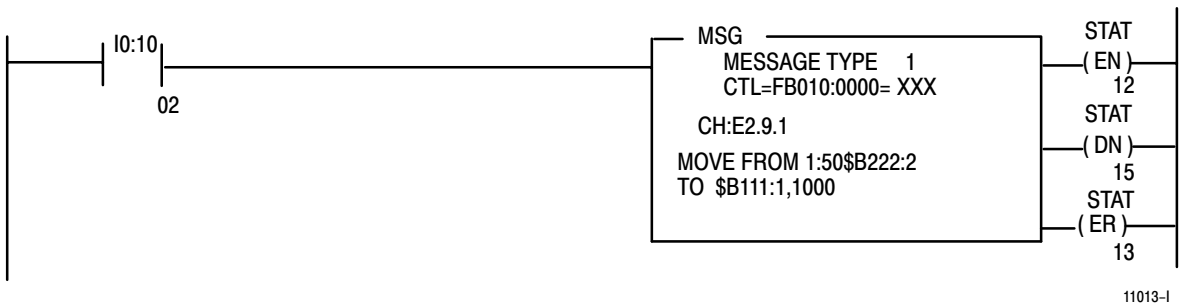
Where **digit** is either the integer 0 or 1. You can use integer constants only when moving bits.

You enter the commands and qualifiers in a command line to create a **PLC–3 message instruction.** The following is an example of a typical command line containing a command and qualifiers:

MOVE FROM 1:50$B222:2 TO $B111:1, 1000

Figure 3.1 shows an example message instruction display of the data from the command above.

Figure 3.1
Example of a Message Instruction Display



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Refer to the PLC–3 Programming manual (publication 1775–6.4.1) for more information on the PLC–3 Message Send Instruction. The following sections cover each command in more detail and give examples for usage. In the syntax examples that follow, we use angle brackets < > to indicate information that you will enter that is specific to your application. For example <address> in a command line indicates where you would add an address specific to your application.

Using the MOVE Command to Transfer Data

Use the MOVE command to instruct the KP3 to transfer a:

- bit
- word
- contiguous block of information

Usually this data is transferred to or from a remote node on Data Highway II. You can, however, use the MOVE command to transfer data within the *local* PLC–3 simply by omitting the ‘‘remote” node address (the node you are transferring the data to).

You **must** specify the TO qualifier when using the MOVE command; you can specify the FROM qualifier (optional). If you do not use FROM, you must replace it with an integer constant (see preceding section for description).

Syntax for the MOVE Command With the FROM Qualifier

The syntax for this command when using the **FROM** qualifier is:

MOVE FROM <address> TO <address> or
MOVE TO <address> FROM <address>

Where:	is:
MOVE	the command that tells the KP3 to transfer data.
FROM	the qualifier that specifies where you want to transfer data from; you can abbreviate as F. FROM is always followed by an address (which must include a data table address and can include a remote node address). The FROM qualifier is optional, but if you omit it, you must replace if with an *integer constant (*see page 3–2).
<address>	the address where the data that you are moving resides. This is either a Data Highway II node address or programmable controller memory address (see section titled *Addressing Techniques* for addressing style information).

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Where:	is:
TO	the qualifier that specifies the destination of the data transfer; you can abbreviate as T. You must specify the TO qualifier and it must be followed by an address (which must include a data table address and can include a remote node address).
<address>	the destination address for the data you are moving. This is either a Data Highway II node address or programmable controller memory address (see section titled *Addressing Techniques* for addressing style information).

These are examples of using the MOVE command with the FROM qualifier:

```
MOVE FROM $B2:3/4 TO :76$B40:50/2
M F :66$010/1 T $B2:3/4
```

Syntax for the MOVE Command With an Integer Constant

The syntax for this command when using an **integer constant** is:

MOVE <integer constant> TO <address> or
MOVE TO <address> <integer constant>

Where:	is:
MOVE	the command that tells the KP3 to transfer data.
<integer constant>	what you use in place of the FROM qualifier. The correct format is #digit, where digit is either 0 or 1.
TO	the qualifier that specifies the destination of the data transfer; you can abbreviate as T. You must specify the TO qualifier and it must be followed by an address (which must include a data table address and can include a remote node address.
<address>	the address where the data resides that you are moving. This is either a Data Highway II node address or programmable controller memory address (see section titled *Addressing Techniques* for addressing style information).

These are examples of using the MOVE command with an integer constant:

```
MOVE #1 TO :76$222/3
M #0 T :76$B2:3/4
```

See the section titled *Programming Examples*, at the end of this chapter, for more command examples.

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Using the TMOVE Command to Transfer Data

Like the MOVE command, you use the TMOVE command to tell the KP3 to transfer a:

- bit
- word
- contiguous block of information

Unlike the MOVE command, the TMOVE command can only be used to transfer data to and from a remote node. This data bypasses some message processing for faster communication between nodes, therefore you should use TMOVE for transferring small amounts of time–critical data. The maximum amount of data that you can transfer with TMOVE depends on the memory address involved (see section titled *Addressing Techniques* for information on addressing a block of words.)

The following sections show examples and syntax of the TMOVE command line that include:

- the FROM qualifier
- an integer constant
- the FROM and NOSTATUS qualifiers
- NOSTATUS qualifier and an integer constant

Remember, the TO qualifier is **always** specified.

Syntax for the TMOVE Command With the FROM Qualifier

The syntax for the TMOVE command when using the **FROM** qualifier is:

TMOVE FROM <address> TO <address> or
TMOVE TO <address> FROM <address>

Where:	is:
TMOVE	the command that tells the KP3 to transfer data to or from a remote node.
FROM	the qualifier that specifies where you want to transfer data from; you can abbreviate as F. FROM is always followed by an address (which must include a data table address and can include a remote node address).
<address>	the address where the data that you are moving resides. This is either a Data Highway II node address or programmable controller memory address (see section titled *Addressing Techniques* for addressing style information).

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Where:	is:
TO	the qualifier that specifies the destination of the data transfer; you can abbreviate as T. You must specify the TO qualifier and it must be followed an address (which must include a data table address and can include a remote node address).
<address>	the destination address for the data you are moving. This is either a Data Highway II node address or programmable controller memory address (see section titled *Addressing Techniques* for addressing style information).

These are examples of using the TMOVE command with the FROM qualifier:

TMOVE FROM :66$010 TO $B2:3
TM F $B2:3 T :66$010

Syntax for the TMOVE Command With an Integer Constant

The syntax for the TMOVE command when using an **integer constant** is:

TMOVE <integer constant> TO <address> or
TMOVE TO <address> <integer constant>

Where:	is:
TMOVE	the command that tells the KP3 to transfer data to or from a remote node.
<integer constant>	what you use in place of the FROM qualifier. The correct format is #digit, where digit is either 0 or 1.
TO	the qualifier that specifies the destination of the data transfer; you can abbreviate as T. You must specify the TO qualifier and it must be followed an address (which must include a data table address and can include a remote node address).
<address>	the destination address for the data you are moving. This is either a Data Highway II node address or programmable controller memory address (see section titled *Addressing Techniques* for addressing style information).

These are examples of using the TMOVE command with an integer constant:

TMOVE #1 TO :76$222/3
TM #0 T :76$B2:3/4

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See the section titled *Programming Examples*, at the end of this chapter, for more command examples.

Syntax for the TMOVE Command With the FROM and NOSTATUS Qualifiers

The syntax for the TMOVE command when using the **FROM and NOSTATUS** qualifiers is:

TMOVE FROM <address> TO <address> NOSTATUS or
TMOVE TO <address> FROM <address> NOSTATUS

Where:	**is:**
TMOVE	the command that tells the KP3 to transfer data to or from a remote node.
FROM	the qualifier that specifies where you want to transfer data from; you can abbreviate as F. FROM is always followed by an address (which must include a data table address and can include a remote node address).
<address>	the address where the data that you are moving resides. This is either a Data Highway II node address or programmable controller memory address (see section titled *Addressing Techniques* for addressing style information).
TO	the qualifier that specifies the destination of the data transfer; you can abbreviate as T. You must specify the TO qualifier and it must be followed an address (which must include a data table address and can include a remote node address).
<address>	the destination address for the data you are moving. This is either a Data Highway II node address or programmable controller memory address (see section titled *Addressing Techniques* for addressing style information).
NOSTATUS	the qualifier used only with a TMOVE command designed to transfer data to some remote node. Use when error reporting is not necessary and you want to eliminate the time spent receiving information about the success or failure of the command. You can abbreviate as N.

These are examples of using the TMOVE command with the FROM and NOSTATUS qualifiers:

```
TMOVE FROM :66$010 TO $B2:3 NOSTATUS
TM T  $B2:3 F :66$010 N
```


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Syntax for the TMOVE Command With an Integer Constant and the NOSTATUS Qualifier

The syntax for the TMOVE command when using an **integer constant and the NOSTATUS** qualifier is:

TMOVE <integer constant> TO <address> NOSTATUS or
TMOVE TO <address> <integer constant> NOSTATUS

Where:	is:
TMOVE	the command that tells the KP3 to transfer data to or from a remote node.
<integer constant>	what you use in place of the FROM qualifier. The correct format is #digit, where digit is either 0 or 1.
TO	the qualifier that specifies the destination of the data transfer; you can abbreviate as T. You must specify the TO qualifier and it must be followed an address (which must include a data table address and can include a remote node address).
<address>	the destination address for the data you are moving. This is either a Data Highway II node address or programmable controller memory address (see section titled *Addressing Techniques* for addressing style information).
NOSTATUS	the qualifier used only with a TMOVE command designed to transfer data to some remote node. Use when error reporting is not necessary and you want to eliminate the time spent receiving information about the success or failure of the command. You can abbreviate as N.

These are examples of using the TMOVE command with an integer constant:

TMOVE #1 TO :76$222/3
TM #0 T :76$B2:3/4

See the section titled *Programming Examples*, at the end of this chapter, for more command examples.

Addressing Techniques

In the previous sections, we used many examples with **<address>** as part of the PLC–3 command line. This describes what type of information you place into your command line to designate an address. There are two types of addressing we cover:

- Data Highway II node addresses
- programmable controller memory addresses

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You need to specify both of these to create a complete address. The general format is:

<link> : <node> . <user> <&> <addr> <, or **/ > <size>**

Information on specifying link, node and user numbers is covered in the following section. Information on specifying addr (addresses) is covered in the section titled *Addressing Memory.*

Addressing Data Highway II Nodes

The order of the addressing Data Highway II nodes is:

<link number> :<node number> .<user number>

This is an example of a node address:

1 :50.1

Where:	is:
1	the link number
:	a delimiter; must precede the node number
50	the node number; must be preceded by a colon delimiter
.	a delimiter; must precede the user number
1	the user number; must be preceded by a decimal point delimiter

You must assign Data Highway II nodes addresses that include each of the following:

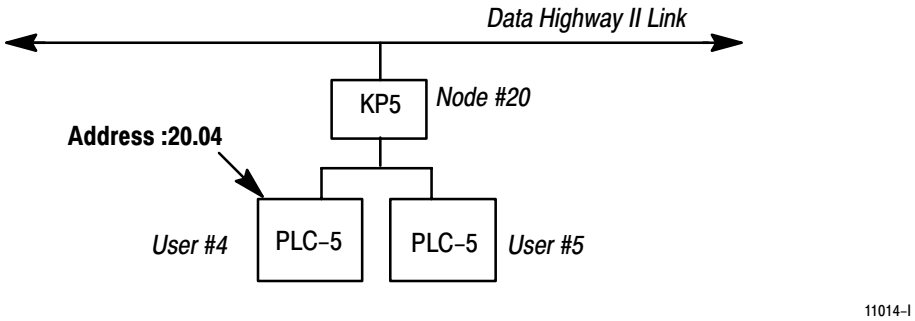
- **link number,** which is the number of the link you are communicating from. Note that you can omit this parameter, or use zero in its place, if the remote node is on the local link.
- **node number,** which is the address for the communication interface on the link. Enter a number from 1 to 376 (octal). Node addresses 0 and 377 are reserved on Data Highway II and cannot be used.
- **user number**, which identifies the particular device attached to the communications interface. It is optional; the default is user 1. You do not need to specify the user number when you are transferring data to or from a KP2, KFM, or another KP3 (you do not need to specify a user number if you are transferring an immediate read command to a KP2 or KP3). The KFL can have more than one device connected to it. Use device number 1 to address KFL channel 1, and 2 to address KFL channel 2.

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The KP5 can also have more than one user. When using the KP5 as a Data Highway II/Data Highway Plus interface, you can use user numbers from 2 to 20 to identify Data Highway Plus devices.

For example, the address of a PLC–5 (that has its node address switches set to 4) connected to a KP5 (with a node #20) that is connected to a Data Highway Link might look like: **:20.04** (figure 3.2).

Figure 3.2
Addressing a Node When the Interface Has More Than One Device Attached



Addressing Memory

In addition to addressing a node, you need to address the PLC controller memory at your node or the memory of the device connected to another node. Data is referenced by its address in memory. In a command line, you must precede a memory address with a dollar sign ($), which acts as a delimiter to tell the KP3 module that it has encountered a data address.

A memory address is made up of one or more of the following parts:

This:	is:
wordaddr	the numerical address of a word.
fileaddr	the alphanumeric address of a PLC–2, PLC–3 or PLC–5 controller file.
size	the number of words of data you are transferring; this is always preceded by a comma (,).
bit	the number of a particular bit within the addressed word; this is always preceded by a back–slash mark (/).
extraddr	PLC–3 extended address format. You can use this to address any memory section, not just a data table section. Refer to the PLC–3 Programmable Controller Programming Manual (publication 1775–6.4.1) for more information on extended addressing.
imblock	immediate block number at some remote KP3.

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The following list shows the possible ways you form memory addresses:

- $ wordaddr
- $ wordaddr/bit
- $ wordaddr,size
- $ fileaddr:wordaddr
- $ fileaddr:wordaddr/bit
- $ fileaddr:wordaddr,size
- $ extaddr
- & imblock

Important: The numbers you enter into the fields when addressing memory are interrupted as decimal (base 10) unless you indicate that they are octal (base 8). You can specify an octal number by starting it with a zero. For example, 17 is interpreted as decimal 17, but 017 is interpreted as octal 17 (or decimal 15). In all of the examples that follow, we will use a leading zero to indicate octal addresses. Some addresses, however, are always interrupted as octal.

Addressing a Word

This section provides examples of addressing a word in each PLC–2, PLC–3, and PLC–5 memory.

To address a single word in:	Use this format:	Examples:
PLC–2 memory	$wordaddr	$010 (specifies the word at address 010)
PLC–3 memory	$fileaddr:wordaddr **or** $extaddr	$B111:1 (specifies word 1 of binary file 111) $E3.1.8.111.0.1 (extended addressing)
PLC–5 memory	$extaddr	$E0.10.2.0 (specifies word 2 or integer file 10)

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Addressing a Block of Words

This section provides examples of addressing a block of words in each PLC–2, PLC–3, and PLC–5 memory.

<table>
<tr><th>To address a block of words in:</th><th>Use this format:</th><th>Examples:</th></tr>
<tr><td>PLC–2 memory</td><td>$wordaddr,size</td><td>$010,22 (specifies 22 words beginning with the address 010).
The maximum number of words you can specify with the size parameter is 65,535 for MOVE command.
For TMOVE, the maximum is 18 (if wordaddr is less than 127) and 17 (if wordaddr is greater than 127).</td></tr>
<tr><td>PLC–3 memory</td><td>$fileaddr:wordaddr,size
or
$extaddr,size</td><td>$A1:0,1024 (specifies 1024 words starting at word 0 of ASCII file 1)
$E3.1.9.1.0.0, 1024 (specifies 1024 words starting at word 0 to ASCII file 1).
The maximum number of words you can specify with the size parameter is 65,535 for MOVE command.
For TMOVE, the maximum is based on the following chart (all values in decimal).
<table>
<tr><th>File:</th><th>Word:</th><th>Maximum:</th></tr>
<tr><td>0</td><td>0</td><td>18</td></tr>
<tr><td>0</td><td>0 < word ≤254</td><td>17</td></tr>
<tr><td>0</td><td>0 < word≤254</td><td>16</td></tr>
<tr><td>0 < file ≤254</td><td>word ≤ 254</td><td>17</td></tr>
<tr><td>file > 254</td><td>word ≤ 254</td><td>16</td></tr>
<tr><td>0 < file ≤ 254</td><td>word > 254</td><td>16</td></tr>
<tr><td>file > 254</td><td>word > 254</td><td>15</td></tr>
</table></td></tr>
<tr><td>PLC–5 memory</td><td>$extraddr,size</td><td>$E0.10.1.0,10 specifies 10 words beginning with word 1 of file 10.</td></tr>
</table>

Addressing Immediate–access Block Numbers

There are 16 immediate–access blocks of 42 bytes in length in every KP3 or KP2 module. To address them you “specify & digit”, where digit can be from 0 to 15. When you define an immediate–access block, you are setting aside an area in the KP3 that will be updated (via the TMOVE command) with data from a specified area in the PLC–3 memory.

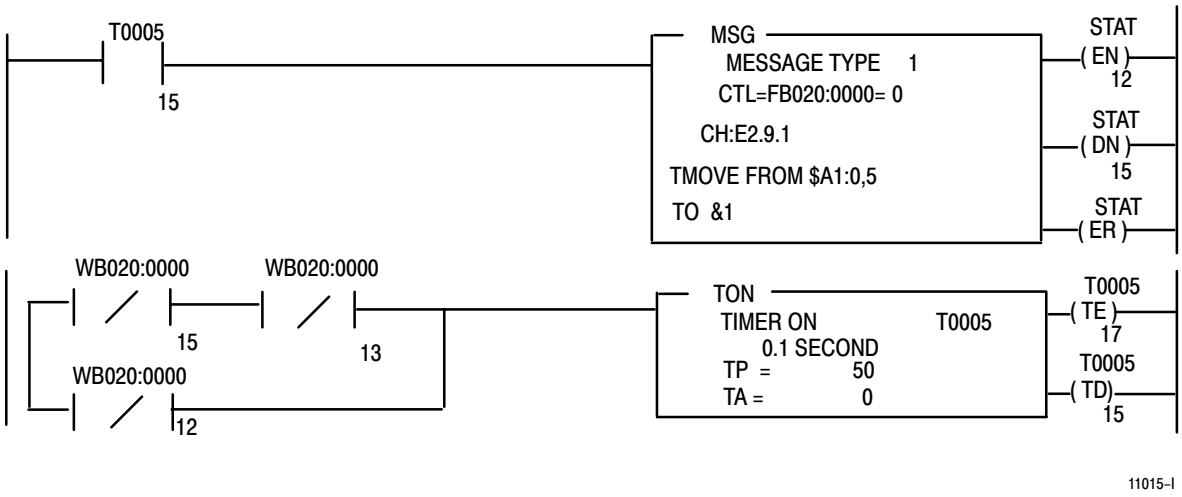
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When another node reads the immediate–access block, it does not have to wait as long to receive a reply. Usually, the node that receives a command must wait to receive the token before it can reply to a command. With the immediate–access block, the node that receives the command can transmit a reply without having to wait to receive the token first. Thus the node that sent the command, receives a reply sooner.

To transfer data using the immediate blocks, use the TMOVE command to update the data in the local node's immediate blocks and/or to read data from some remote node's immediate blocks.

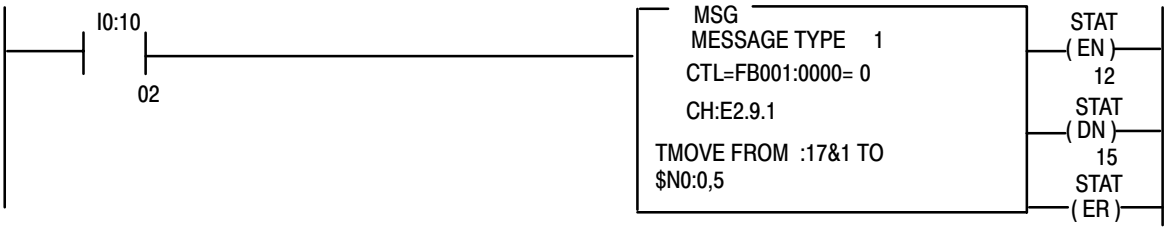
Based on the nature of data, the user program must update the local node's immediate blocks at the selected time interval. In the following example, we show a user program that updates the immediate block in the local KP3 at 5–second intervals (figure 3.3), then one that reads it (figure 3.4).

Figure 3.3
User Program to Initiate and Update Immediate Blocks at Five–Second Intervals



11015–I

Figure 3.4
User Program to Read Immediate Blocks



11016–I

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Addressing a Bit Within a Word

This section provides examples of addressing a bit within a word in each PLC–2, PLC–3, and PLC–5 memory.

To address a bit within a word in:	use this format:	Examples:
PLC–2 memory	$wordaddr/bit	$010/5 (specifies bit 5 of address 010)
PLC–3 memory	$fileaddr:wordaddr/bit **or** $extaddr/bit	$B111:2/3 (specifies bit 3 of word 2 of binary file 111) $E3.1.8.111.0.2/3 (extended addressing)
PLC–5 memory	$extaddr/bit	$E0.10.2.0/011 (specifies bit 11 of word 2 of file 10)

Programming Examples

This section contains examples of programming PLC–2, PLC–3, and PLC–5 programmable controllers using the MOVE and TMOVE commands.

The following table contains examples of using the MOVE command to move a word:

To move data from:	Command line example:	Explanation:
PLC–3 to PLC–2	MOVE FROM :66$010 TO $B2:3 or M F :66$010 T $B2:3	Transfers word 010 from node 66 to word 3 of binary file 2.
PLC–3 to PLC–2	MOVE FROM $B2:3 TO :66$010 or M F $B2:3 T :66$010	Transfers word 3 of binary file 2 to word address 010 at node 66.
PLC–3 to PLC–3	MOVE FROM :76$I4:50 TO $B2:3 or M F :76$I4:50 T $B2:3	Transfers word 50 of input file 4 from node 76 to word 3 of binary file 2.
PLC–3 to PLC–3	MOVE FROM $B2:3 TO :76$I4:50 or M F $B2:3 T :76$I4:50	Transfers word 3 of binary file 2 to word address 010 at node 76.
PLC–3 to PLC–5	MOVE FROM $B2:3 TO :40.2$E0.10.2.0 or M F $B2:3 T :40.2$E.0.10.2.0	Transfers word 3 of binary file 2 to word 2 of file 10 in the PLC–5 address 2 connected to KP5 node 40.
PLC–3 to PLC–5	MOVE FROM :40.2$E0.10.2.0 TO $B2:3 or M F :40.2$E.0.10.2.0 T $B2:3	Transfers from word 2 of file 10 in the PLC–5 address 2 connected to KP5 node 40 to word 3 of binary file 2.

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The following table contains examples of using the MOVE command to move a block of words:

To move data from:	Command line example:	Explanation:
PLC–3 to PLC–2	MOVE FROM :66$010,1024 TO $B2:3 or M F :66$010,1024 T $B2:3	Transfers 1024 words beginning at word 010 at node 66 to word 3 of binary file 2.
PLC–3 to PLC–2	MOVE FROM $B2:3,1024 TO :66$010 or M F $B2:3,1024 T :66$010	Transfers 1024 words beginning at word 3 of binary file 2 to word address 010 at node 66.
PLC–3 to PLC–3	MOVE FROM :76$I4:50 TO $B2:3,444 or M F :76$I4:50 T $B2:3,444	Transfers 444 words beginning at word 50 of input file 4 at node 76 to word 3 of binary file 2.
PLC–3 to PLC–2	MOVE FROM $B2:3 TO :76$010,444 or M F $B2:3 T :76$010,444	Transfers 444 words beginning at word 3 of binary file 2 to word address 010 at node 76.
PLC–3 to PLC–5	MOVE FROM $B2:3,1024 TO :40.2$E0.10.2.0 or M F $B2:3,1024 T :40.2$E0.10.2.0	Transfers 1024 words beginning at word 3 in binary file 2 to file 10 beginning at word 2 in the PLC–5 address 2 connected to KP5 node 40.

The following table contains examples of using the MOVE command to move a bit:

To move data from:	Command line example:	Explanation:
PLC–3 to PLC–2	MOVE FROM :66$010/1 TO $B2:3/4 or M F :66$010/1 T $B2:3/4	Transfers bit 1 of word 010 from node 66 to bit 4 of word 3 of binary file 2.
PLC–3 to PLC–2	MOVE FROM $B2:3/011 TO :66$010/015 or M F $B2:3/011 T :66$010/015	Transfers bit 11 of word 3 of binary file 2 to bit 15 of word address 010 at node 66.
PLC–3 to PLC–3	MOVE FROM :76$I4:50/2 TO $B2:3/4 or M F :76$I4:50/2 T $B2:3/4	Transfers bit 2 of word 50 of input file 4 from node 76 to bit 4 of word 3 of binary file 2.
PLC–3 to PLC–3	MOVE FROM $B2:3/4 TO :76$B40:50/2 or M F $B2:3/4 T :76$B40:50/2	Transfers bit 4 of word 3 of binary file 2 to bit 2 of word 50 on binary file 40 at node 76.
PLC–3 to PLC–2	MOVE #1 TO :76$0222/3 or M #1 T :76$0222/3	Transfers the integer constant 1 to bit 3 of word address 222 at node 76.
PLC–3 to PLC–3	MOVE #0 TO :76$B2:3/4 or M #0 T :76$B2:3/4	Transfers the integer constant 0 to bit 4 of word 3 of binary file 2 at node 76.

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The following table contains examples of using the TMOVE command to move a word:

To move data from:	Command line example:	Explanation:
PLC–3 to PLC–2	TMOVE FROM :66$010 TO $B2:3 or TM F :66$010 T $B2:3	Transfers word 010 from node 66 to word 3 of binary file 2.
PLC–3 to PLC–2	TMOVE FROM $B2:3 TO :66$010 or TM F $B2:3 T :66$010	Transfers word 3 of binary file 2 to word address 010 at node 66.
PLC–3 to PLC–3	TMOVE FROM $B2:3 TO :76$I4:50 or TM F $B2:3 T :76$I4:50	Transfers word 3 of binary file 2 to word address 50 of input file 4.

The following table contains examples of using the TMOVE command to move a block of words:

To move data from:	Command line example:	Explanation:
PLC–3 to PLC–2	TMOVE FROM :66$010,18 TO $B2:3 or TM F :66$010,18 T $B2:3	Transfers 18 words beginning at word 010 at node 66 to word 3 of binary file 2.
PLC–3 to PLC–2	TMOVE FROM $B2:3 TO :66$010,1024 or TM F $B2:3 T :66$010,1024	Transfers 1024 words beginning at word 3 binary file 2 to word address 010 at node 66.
PLC–3 to PLC–3	TMOVE FROM :76$I4:50 TO $B2:3,5 or TM F :76$I4:50 T $B2:3,5	Transfers 5 words from word 50 of input file 4 at node 76 to word 3 of binary file 2.
PLC–3 to PLC–2	TMOVE FROM $B2:3 TO :76$010,5 or TM F $B2:3 T :76$010,5	Transfers 5 words beginning at word 3 of binary file 2 to word 010 at node 76.

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The following table contains examples of using the TMOVE command to move bit:

To move data from:	Command line example:	Explanation:
PLC–3 to PLC–2	TMOVE FROM :66$010/1 TO $B2:3/4 or TM F :66$010/1 T $B2:3/4	Transfers bit 1 of word 010 from node 66 to bit 4 of word 3 of binary file 2.
PLC–3 to PLC–2	TMOVE FROM $B2:3/011 TO :66$010/015 or TM F $B2:3/011 T :66$010/015	Transfers bit 11 of word 3 from binary file 2 to bit 15 of word address 010 at node 66.
PLC–3 to PLC–3	TMOVE FROM :76$I4:50/2 TO $B2:3/4 or TM F :76$I4:50/2 T $B2:3/4	Transfers bit 2 of word 50 of input file 4 from node 76 to bit 4 of word 3 of binary file 2.
PLC–3 to PLC–3	TMOVE FROM $B2:3/4 TO :76$B40:50/2 or TM F $B2:3/4 T :76$B40:50/2	Transfers bit 4 of word 3 of binary file 2 to bit 2 of word 50 on binary file 40 at node 76.
PLC–3 to PLC–2	TMOVE #1 TO :76$222/3 or TM #1 T :76$222/3	Transfers the integer constant 1 to bit 3 of word address 222 at node 76.
PLC–3 to PLC–3	TMOVE #0 TO :76$B2:3/4 or TM #0 T :76$B2:3/4 or	Transfers the integer constant 0 to bit 4 of word 3 of binary file 2 at node 76.

More Examples

Example 1

The following is an example of **s**pecifying a variable word range length**.**

```
M F $N1:0 T :024$N1:0,($N0:0)
```

$N0:0 provides the variable length

Example 2

The following is an example of **performing a file read.**

```
M F $N0 T :024$N0
```

Note, there is no colon after $N0

Important: When you perform a *file read* as shown in Example 2, the source and destination files must be the same length.

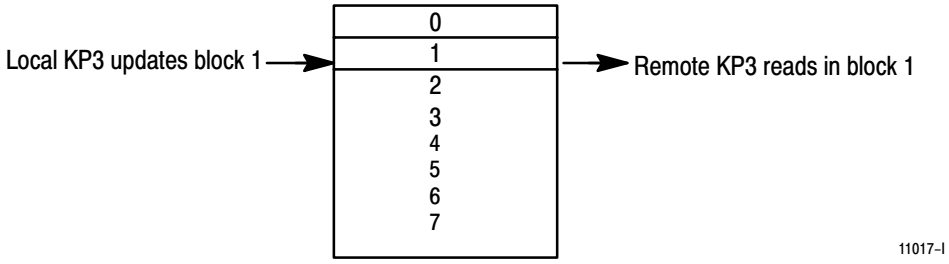
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Examples 3 and 4 show how to use the TMOVE command to move immediate blocks. For both examples, assume there are two nodes, both KP3s. The local node is 010, and the remote node is 020.

Example 3

Local: TMOVE FROM $B5:0,21TO &1
Remote: TMOVE FROM :010&1 TO $I5:0,21

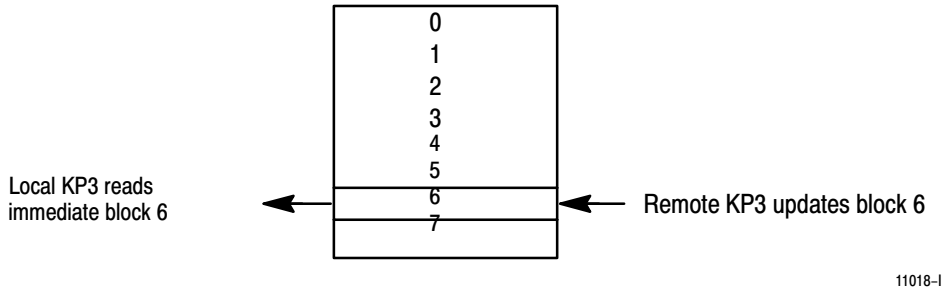
Explanation:



Example 4

Local: TMOVE FROM :020&6 to $B5:0,21
Remote: TMOVE FROM $I5:0,21 TO &6

Explanation:



A single immediate access block is up to 42 bytes in length.

Important: The KP3 will return error code 19 (decimal) if a node attempts to read the immediate access block while it is being updated (or before it has been updated). Error code 19 is *NAK – inactive lsap.* See Appendix B, *Error Codes*, for more information

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Appendix A

Operation and Troubleshooting

Appendix Objectives

This appendix contains information to aid in operating and troubleshooting your 1779–KP3 module. It covers the following topics:

- an overview of the KP3 module during operation
- LED indicators
- using the Exit Request switch
- troubleshooting the KP3 module

KP3 Operation

The following sections provide information on the way in which the KP3 operates.

Power–up

After the KP3 module is powered–up, it goes through self–diagnostic tests. If no faults are detected, the PASS indicator turns green, and the module is **running**. Initially, the PORT–READY indicator turns green and the IN–RING/SEEKING–MEM indicator turns yellow to indicate that this node is seeking membership.

During Normal Operation

If another communication interface is connected in the Data Highway II link and is operational, the SIG QUAL indicator turns green and then the IN–RING/SEEKING–MEM indicator turns from yellow to green to indicate that this node is now logically in a ring and receiving the token periodically.

If there is a cabling problem or no other communication interface is operational, then every ten seconds the MAC board goes through a one–second self–diagnostic test. This is indicated by the MAC–TEST indicator turning yellow and the IN–RING/SEEKING–MEM and REDUN WARN indicators flashing rapidly.

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Turning–off the Module's Power

Whenever you want to turn off the module's power, press the EXIT REQ switch first. This exit request notifies other nodes you are leaving the ring, thus saving the other nodes time that they would otherwise lose by trying to pass the token to a node that they cannot find.

LED Indicators

The KP3 module has 16 LED indicators on its front panel; the KP3R has 20 (figure A.1).

Figure A.1
The Front Panel of the KP3 and KP3R Modules

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The following tables shows the diagnostic information each of the LEDs provide. We have spilt them into two categories: the host board and the MAC board.

Table A.A
LEDs Associated with the Host Board

When this LED(s):	does this:	then:
PASS	goes ON green	the host and MAC boards performed and passed self–diagnostic tests.
FAIL	goes ON red	the host board has either: – failed the self–diagnostic test or – faulted while in operation
TEST	goes ON yellow	the host and MAC boards are performing self–diagnostic tests.
ERROR	blinks ON red once	after the message is complete, one of the following has occurred: – there is an error in the ladder diagram program – the message instruction is incorrect or received an error status from the MAC board or remote station. –there is a module or cable problem
BACKUP MODE	goes ON yellow	the KP3 is functioning as a module in a backed–up system. Link addresses should be the same on the primary and backup modules. When it is the backup module, Data Highway II assumes its link address is one number higher than the primary KP3.
ACTIVITY SAT	goes ON yellow	the node has reached the peak of its ability to process messages.
ACTIVITY NORMAL	all three ON green	the amount of message activity is high. If just one is ON, the amount of message activity is low. The three ACTIVITY NORMAL LEDs work like a bar graph.
EXIT COMP	goes ON yellow	this node has gracefully exited the ring on the Data Highway II link.

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Table A.B
LEDs Associated with the MAC Board

When this LED(s):	is:	then:
IN–RING	ON green	this node is a member of the logical ring on the Data Highway II link.
SEEKING	ON yellow	this node is trying to become a member of the logical ring, or trying to build a logical ring in the case that a ring does not already exist.
	OFF	this node is not a member of a logical ring and is not seeking membership
DUP ADDR	ON red	another node has the same address on the Data Highway II link. This condition also places this node into the disconnect state.
REDUN WARN[1]	ON yellow	a valid signal is being received at only one of the two Data Highway II ports.
PORT READY	ON green	the on–board relay connecting the MAC board to the dropline is closed.
SIG QUAL	ON green	a valid signal is being received at this Data Highway II port.
TAP FAIL	This LED is **not** used at this time, and will remain OFF.	
EXT TAP CONFIG	This LED is **not** used at this time, and will remain OFF.	
PORT READY	ON green	the on–board relay connecting the MAC board to the dropline is closed.
SIG QUAL	ON green	valid data is being received on Data Highway II.
	ON red	a difference in data was noted between this port and the other port, and this port was found to be in error. Each detected error causes this LED to be turned ON for one–half second.
	OFF	no data is being received.
TAP FAIL	ON red	the extended tap has failed or its dropline connection to the port has opened. **Important:** this LED can only go ON if the switch on the MAC board is set for extended tap[2]

[1] This LED is only on the redundant module 1779–KP3R.

[2] Extended taps are not available with this product release. Although these indicators are present, they do not perform the functions at this time.

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Using the Exit Request Switch

The interface has an EXIT REQ pushbutton switch on its front panel. When you press this switch, the interface sends out a signal to the other nodes of the Data Highway II link that it no longer wants to be included in the logical ring After exiting, the interface turns on the EXIT COMP LED. The other nodes will not attempt to pass the token to this node unit it is reset

Use the EXIT REQ switch **before** turning off interface power. If you do not, the other nodes will waste time trying to reconstruct the ring after being unable to pass the token to this node.

Troubleshooting the KP3

When you suspect that the KP3 module is not functioning properly, follow the steps in the table below.

Step:	If:	Then:
1. Check the FAIL LED indicator.	ON	replace the KP3 module.
	OFF	go to step 2.
2. Check the DUP ADDR indicator	ON	follow these steps:
		a. Turn the PLC–3 power OFF. b. Set a unique node address for the node using the thumbwheels switches. c. Turn the PLC–3 power ON.
	OFF	go to step 3.
3. Check the IN–RING.SEEKING–MEM LED indicator.	yellow	check the cabling on the Data Highway II link.
	green	go to step 4.
4. Check the ERROR LED indicator.	flashing	check the message instruction in the ladder diagram program for an error code beside the control file address. You can look up the error code in Appendix B.
	OFF	check the ladder diagram program for proper use of the message instruction, and check the PLC–3 mode (no messages can be sent in **program mode).**

If you are still experiencing problems after troubleshooting attempts fail, contact your local Allen–Bradley Integrator or Sales office.

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Appendix B

Error Codes

Appendix Objectives

This appendix contains the error codes associated with using the KP3 module. The error codes listed in the following tables are broken into these categories:

- KP3 error codes
- link–layer error codes
- MAC task error codes
- local errors
- remote errors
- extended status error codes
- time–critical error codes
- KP2 error codes

Error Codes

We use the following abbreviations within this appendix:

This abbreviation:	means:
ACK	acknowledgement
ADDR	address
I/O	input/output
lsap	link service access point
NAK	negative acknowledgement
max	maximum
PDU	packet data unit
PLC	programmable Logic Controller
RDR	read data request
RMWS	read modify write
SAP	source access point
SSAP	source SAP
TNS	transaction identifier
XIC	examine if closed
XIO	examine if open

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Table B.A
KP3 Error Codes

Error Code (decimal):	Error Code (Hex):	Description:
100	64	A carriage return on a blank line.
101	65	A constant preceded by a # is bad.
103	68	A local node in message with a non–local link.
105	69	A number entered for link or node is bad.
108	6C	Duplicate wild card operator used in a perform message.
109	6D	User symbol or number is bad.
110	6E	An illegal memory address preceded by a $.
111	6F	Illegal character in a message cannot be parsed.
112	70	The command word is illegal.
113	71	The qualifier is illegal.
114	72	Unknown identifier character in parser detected.
115	73	A command qualifier not first in message.
160	A0	A bit error.
161	A1	A length error.
162	A2	An address type error.
163	A3	An immediate block error.
164	A4	A symbol exists.
165	A5	A balance error.
166	A6	A node error.
167	A7	A qualifier error.
168	A8	The TMOVE PDU size is too big.
180	B4	A mailbox read error.

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Table B.B
Link–layer Error Codes

Error Code (decimal):	Error Code (Hex):	Description:
16	10	ACK – 0 to 255 bytes of data.
17	11	NAK – no memory.
18	12	NAK – offline.
19	13	NAK – inactive lsap.
20	14	NAK – illegal PDU format. (Internal checking for proper data format.)
21	15	NAK – high water mark hit.
24	18	Illegal ACK from remote node.
25	19	Illegal RDR reply size.
26	1A	Attempted to transmit when not in ring.
27	1B	Underrun transmitting packet.
28	1C	Message delivery not confirmed due to duplicate node address.
29	1D	Message delivery not confirmed due to duplicate token.
30	1E	Sequential delivery could not be achieved.
31	1F	ACK timeout.

Table B.C
MAC Task Error Codes

Error Code (decimal):	Error Code (Hex):	Description:
32	20	Data field is too large.
33	21	The source SAP has not been activated.
34	22	Illegal destination address (O or FF).
35	23	Illegal class (low priority RDR is illegal).
36	24	The implementation does not support SSAP number.
37	25	Unused.
38	26	SAP unavailable until recovery time expired.
46	2E	The local node is out of memory.

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Error Code (decimal):	Error Code (Hex):	Description:
47	2F	No more tasks for outgoing messages.
251	OFB	Illegal destination link value.
252	OFC	The message timed–out by application timer.
253	OFD	Response from wrong source node.
254	OFE	Response TNS did not match.
255	OFF	Application layer has been reset.

Table B.D
Local Errors

Error Code (decimal):	Error Code (Hex):	Description:
49	31	Unused.
50	32	Cannot guarantee delivery, link layer timed–out or received a NAK.
51	33	Duplicate token holder detected by link layer.
52	34	Local port is disconnected.
53	35	Attempt to send invalid command.
54	36	Bad source link address in response.
55	37	Message time–out: execution time exceeds time–out preset value.

Table B.E
Remote Errors

Error Code (decimal):	Error Code (Hex):	Description:
129	81	Illegal command.
130	82	Station processor communication problem.
131	83	Remote node's processor has faulted or is OFF.
132	84	I/O fault at remote station processor.
133	85	Transmitted command not allowed by switch setting or memory access rung at the remote node.
134	86	Transmitted command disallowed by switch setting at remote node.

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Error Code (decimal):	Error Code (Hex):	Description:
135	87	Remote node's processor in program or program load mode.
136	88	Communication zone invalid at remote node's processor.
137	89	Remote node's interface device unable to buffer received command in memory.
139	8B	Either remote node is in download mode, error in download command, or operation not allowed in upload or download mode.
146	92	Destination node fails to respond.

Table B.F
Extended Status Error Codes

Error Code (decimal):	Error Code (Hex):	Description:
64	40	Unused.
65	41	Error in converting block address.
66	42	Specified address is less than minimum level.
67	43	Specified address is more that maximum level.
68	44	Symbol not found.
69	45	Symbol of improper format.
70	46	Address does not point to something usable.
71	47	File is the wrong size.
72	48	Cannot complete request; situation has changed since the start of the request.
73	49	File is too big.
74	4A	Transaction size plus word address is too large.
75	4B	Access denied; improper privilege.
76	4C	Condition cannot be generated.
77	4D	Condition already exists.
78	4E	Shutdown could not be executed.
79	4F	Requestor does not have upload or download access.
80	50	Histogram overflow.

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Error Code (decimal):	Error Code (Hex):	Description:
81	51	Illegal data type.
82	52	Bad parameter.

Table B.G
Time–critical Error Codes

Error Code (decimal):	Error Code (Hex):	Description:
176	0B0	Base.
177	0B1	Host faulted.
178	0B2	No such address.
179	0B3	Over boundary.
180	0B4	Data table closed.
181	0B5	Area protected.
182	0B6	Bad or no address field.
183	0B7	Missing field.
184	0B8	Timed out.
185	0B9	In wrong mode.
186	0BA	Exceeds max read.
187	0BB	Exceeds max number of words in a time–critical read.
188	0BC	Read immediate block mismatch.

Table B.H
KP2 Error Codes

Error Code (decimal):	Error Code (Hex):	Description:
00	0	Function completed successfully.
01	01	PLC not responding.
210	D2	Switched back to program mode.
211	D3	No communication zone – not an error.
212	D4	Starts different than expected.

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Error Code (decimal):	Error Code (Hex):	Description:
213	D5	Program end before delimiter rung.
214	D6	~XIC in update mode.
215	D7	No memory access yet.
216	D8	Own link ADDR expected in update cmd.
217	D9	No symbolic addressing yet.
218	DA	Fault bits in non–dt regions.
219	DB	Startbit not 10 to 17.
220	DC	~(XIC) in command rung.
221	DD	~GET (for remote address).
222	DE	~GET (for start address).
223	DF	~GET (for end address).
224	E0	Start ADDR is greater than end ADDR.
225	E1	No (XIC or XIO) in bitwrite command.
226	E2	Number of addresses is greater than MAXSCATTERED.
227	E3	Node is less that 1 or greater than 254
228	E4	Errata after a valid command.
229	E5	Same start bit used twice.
230	E6	Too much time–critical data to send.
240	E7	Too big for low priority.
250	E8	User dropped SB before we were done.
251	E9	Tried to use reserve code.
252	EA	Link specified in a time–critical command.
253	EB	User ID must be 0 to 15 (010 – 027)
254	EC	Invalid node number.

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Appendix C

Specifications

Appendix Objectives

This appendix contains the specifications related to the use of the 1779–KP3, –KP3R module.

Specifications

Refer to the following table for the KP3, KP3R module specifications.

Description:	Specification:
Module function	Interface the PLC–3 processor with Allen–Bradley Data Highway II.
Location	Single slot of chassis of multi–chassis PLC–3 or PLC–3/10 system.
Data Highway II communication port	one on the KP3 two on the KP3R
Communication rate	To Data Highway II: 1Mb per second.
Backplane power requirements	5.0 A maximum @ +5v dc 100 mA maximum @ +15v dc
Ambient temperature rating	32º to 139ºF (0º to 60º C) operational –40º to 184ºF (–40º to 85º C) storage
Humidity Rating	5% to 95% non–condensing

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