1

Getting Started

In This Chapter. . . .

- Introduction
- What is Remote I/O
- Remote Master (D4-RM) Features
- Remote Slave (D4-RS or D4-RSDC) Features
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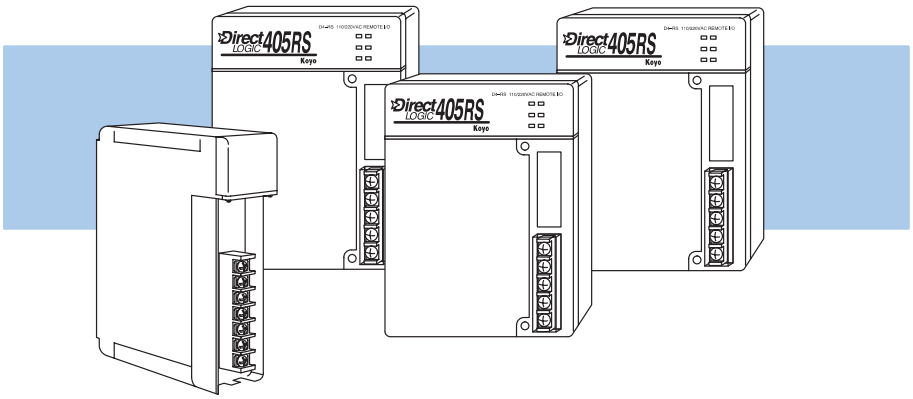
- How the CPU Updates Remote I/O Points
- 3 Easy Steps for Setting Up Remote I/O

Manual Introduction

The Purpose of this Manual

This manual shows you how to install, program, and maintain the equipment. It also helps you understand the system operation characteristics.



Who Should Read this Manual

If you understand PLC systems, our manuals will provide all the information you need to get and keep your remote I/O system up and running. We will use examples and explanations to clarify our meaning and perhaps help you brush up on specific features used in the DL405 system. This manual is not intended to be a generic PLC training manual, but rather a user reference manual for the DL405 remote I/O system.

Supplemental Manuals

Depending on the products you have purchased, there may be other manuals necessary for your application. You will want to supplement this manual with any other manuals written for other products. We suggest:

- D4-USER-M (the D4-405 User Manual)
- DA-DSOFT-M (the ***Direct***SOFT User Manual)

Technical Support

We realize that even though we strive to be the best, the information may be arranged in such a way you cannot find what you are looking for. First, check these resources for help in locating the information:

- **Table of Contents** – chapter and section listing of contents, in the front of this manual
- **Quick Guide to Contents** – chapter summary listing on the next page
- **Appendix** – reference material for commonly used networking terms
- **Index** – alphabetical listing of key words, at the end of this manual

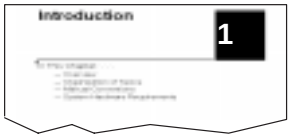
You can also check our online resources for the latest product support information:

- **Internet** – the address of our Web site is http://www.plcdirect.com
- **Bulletin Board Service(BBS)** – call (770)–844–4209

If you still need assistance, please call us at 800–633–0405. Our technical support group is glad to work with you in answering your questions. They are available Monday through Friday from 9:00 A.M. to 6:00 P.M. Eastern Standard Time. If you have a comment or question about any of our products, services, or manuals, please fill out and return the ‘Suggestions’ card that was shipped with this manual.

Key Topics for Each Chapter

The beginning of each chapter will list the key topics that can be found in that chapter.



Chapters

Below is a table showing a summary of contents provided within each section of this manual. The manual is organized into the following four chapters:

1	**Getting Started**	contains information you need to know to get started. It includes a brief description of a remote I/O system, the basic components of the system, and an overview of the steps necessary to develop a working system.
2	**Designing Your Remote I/O System**	shows you how to design your system. It includes a tutorial on how to use worksheets to keep track of all the remote I/O and the address assignments for remote I/O. It provides the framework for developing the necessary information you will need for programming and hardware setup.
3	**Installation and Communication Wiring Guidelines**	shows you how to install your modules. This chapter includes wiring information, shows you how to set the rotary dial and dip switch on each module, how to daisy chain the remote units, how to size and use termination resistors, and how to connect the Run Output circuit.
4	**Writing the Setup Program**	shows you how to use ***Direct***SOFT to write the remote I/O setup program. This chapter takes the information developed from your worksheets and helps you develop a working program.

Appendices

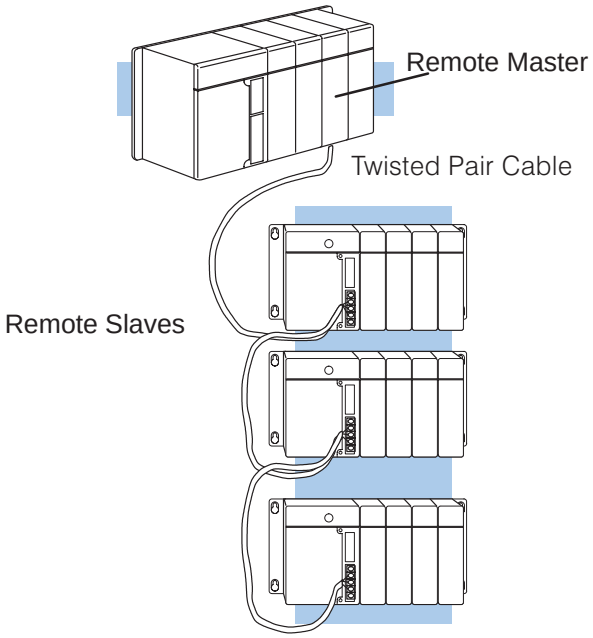
Additional information is available in the following appendices.

A	**Remote I/O Worksheet**	included is a blank worksheet that can be copied and used for designing your system.
B	**Reserved Memory Tables**	shows the reserved memory locations for the transfer of remote I/O data. It is cross-referenced by data type.
C	**Determining I/O Update Time**	shows you how to calculate the amount of delay inherent with the transfer of data back and forth between the master and its remote slaves. Provides tables for both 19.2 kB and 38.4 kB, based on number of I/O points used.

What is Remote I/O?

A remote I/O system allows you to locate I/O modules in bases at some remote distance from the CPU base, but still under its control. These remote bases have no CPU of their own, and are completely controlled by the CPU in the main base via a special module called a **remote master**. Each remote base unit has a **remote slave** (consisting of an internal power supply and I/O adapter circuitry) that allows the exchange of data with the CPU in the main base via the master module. The communications link between the master and its slaves is provided by twisted-pair cable. Up to 512 remote I/O points can be supported by either the DL430 or DL440 CPU's, with baud rates of 19.2 and 38.4 kBaud.

One Master in CPU Base (1–Channel)



When Do You Need Remote I/O?

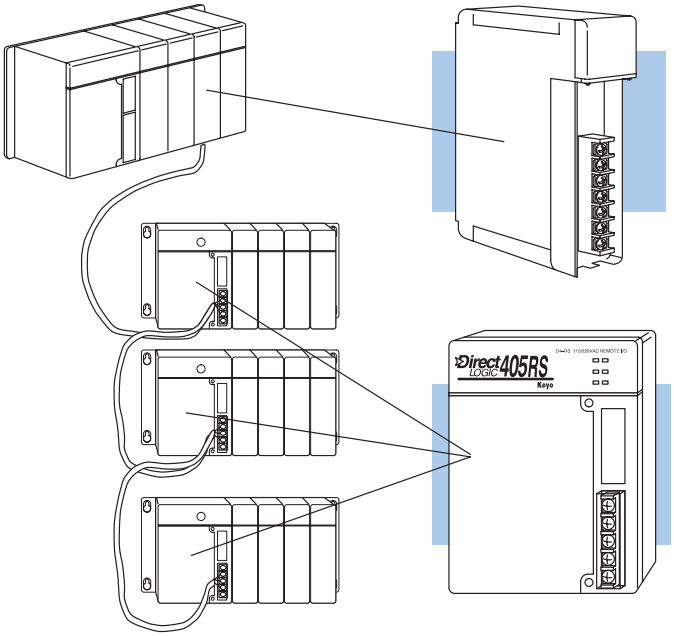
Remote I/O offers tremendous savings on wiring materials and labor costs for larger systems in which the field devices are in clusters at various spread-out locations. With the CPU in a main control room or some other central area, only the remote I/O cable is brought back to the CPU base. This avoids the use of a large number of field wires over greatly separated distances to all the various field devices. By locating the remote bases and their respective I/O modules close to the field devices, wiring costs are reduced significantly.

Another inherent advantage of remote I/O is the ability to add or remove slave bases, or temporarily take a base off line without disrupting the operation of the remaining system.

How Does the DL405 Support Remote I/O?

With the DL405 system, up to 512 remote I/O points can be supported by the DL440 CPU or the DL430 CPU.

The *remote master* is placed in the CPU base. This master (D4–RM) controls up to 7 *remote slaves* (D4–RS or D4–RSDC).



Remote Master -The D4-RM can link up to 7 remote slaves. It is mounted in the CPU base. Up to 2 masters can be used.

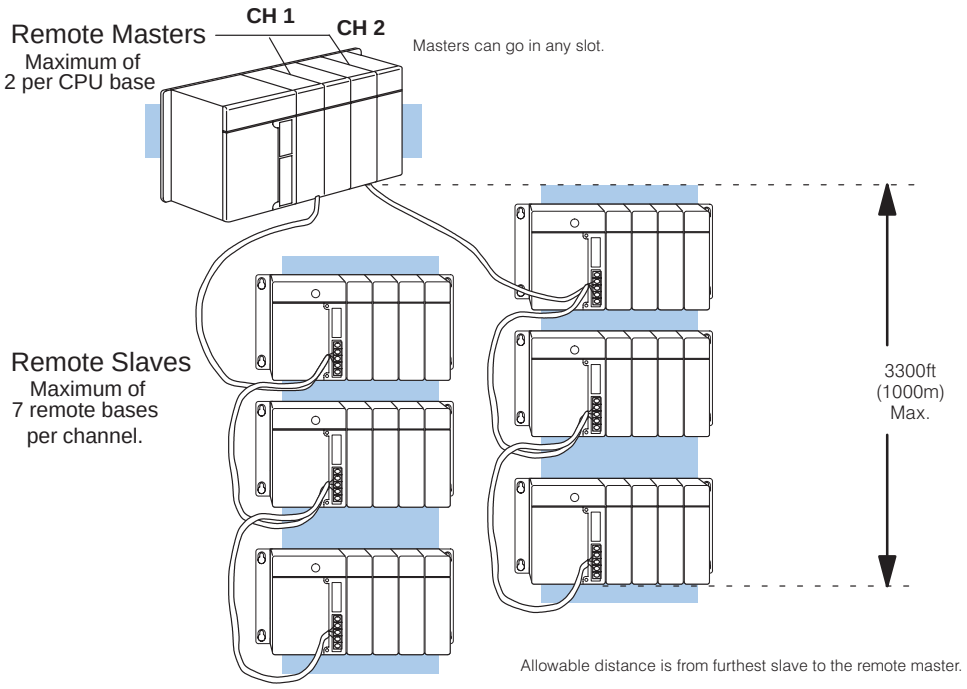
Remote Slave -The D4-RS and D4-RSDC are placed in remote base units. Each slave has a built-in power supply and and the I/O circuitry required to be linked to the master module via twisted pair cable. Only one D4-RS or D4-RSDC is required for each remote base.

D4-RS: Accepts AC power.
D4-RSDC: Accepts DC power.

Number of Masters and Slaves Allowed

In its simplist form, you may want to use only one master in your CPU base and then attach from one to seven remote I/O bases. However, in addition to the simple configuration, more than one master can be placed in the CPU base. You may use a maximum of two masters per CPU base. Here is an example where we have placed two masters in the CPU base and then attached a total of six remote I/O racks.

Two Masters in the Same Base (2–Channel)

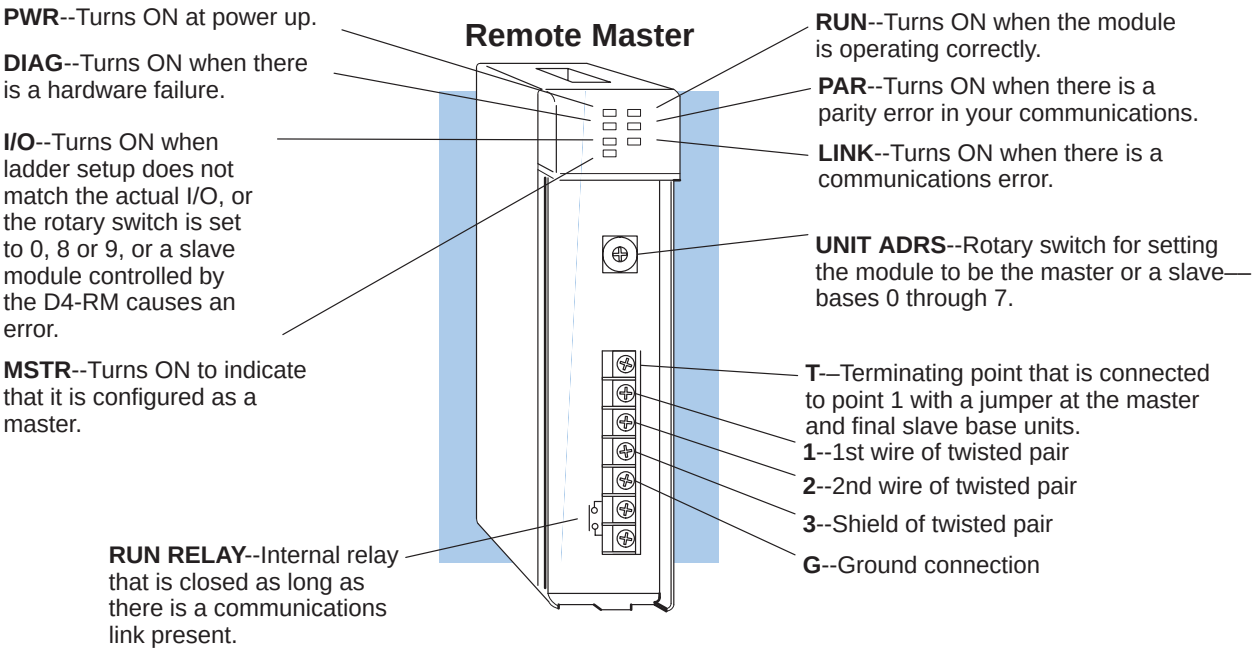


Distance Between Slaves and Master, Baud Rates

Each slave belonging to the same master is hooked together in a daisy chain using a shielded twisted pair cable. The last slave unit in the daisy chain cannot be further than 3300 feet from the CPU base. You set switches that designate the slaves as No. 1, No. 2, etc. There is an additional switch on each unit to set the baud rate for communication. You have your choice of either 19.2 kB or 38.4 kB. Slaves and Master must be set to the same baud rate.

Let’s now take a closer look at each of the remote I/O modules.

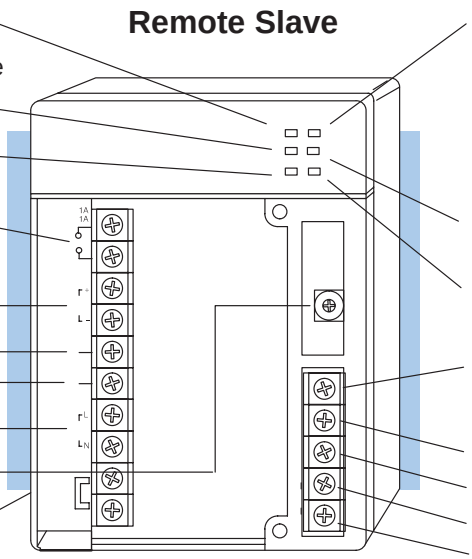
Remote Master (D4-RM) Features



Specifications

Number of Masters per CPU	2 max. for DL430 or DL440
Maximum No. Slaves Supported	7
Number of Remote I/O Points per CPU	512
Module Type	Intelligent
Installation Requirements	Any slot, CPU base only
Internal Power Consumption	300 mA maximum
Digital I/O Consumed	None
Run Output Relay Rating	250 VAC at 1A 30 VDC at 1A
Communication Baud Rates	19.2 kB or 38.4 kB (Switch Selectable)
Communication Method	Asynchronous (half-duplex)
Communication Cabling	RS-485 twisted pair Belden 9271 or equivalent
Maximum Transimission Distance	3300 ft. (1000 meters)
Operating Temperature	32 to 140° F (0 to 60° C)
Storage Temperature	–4 to 158° F (–20 to 70° C)
Relative Humidity	5 to 95% (non-condensing)
Environmental air	No corrosive gases permitted
Vibration	MIL STD 810C 514.2
Shock	MIL STD 810C 516.2
Noise Immunity	NEMA ICS3–304

Remote Slave (D4-RS or D4-RSDC) Features



PWR--Turns ON at power up.

RUN--Turns ON when the module is operating correctly.

DIAG--Turns ON when there is a hardware failure.

RUN RELAY

24-VOLT AUXILLARY POWER

LOGIC GROUND

CHASSIS GROUND

POWER[1]

UNIT ADRS--Rotary switch for setting the module to be a slave—bases 1 through 7.

DIP SWITCH--On rear of module for setting baud rate.

I/O--Turns ON when the communications link is set up wrong, or the rotary switch is set to 0, 8 or 9, or a slave module controlled by the D4-RM causes an error. BLINKS when module user power supply fails (e.g. analog module with no 24VDC connected).

PAR--Turns ON when there is a parity error in your setup.

LINK--Turns ON when there is a communications error.

T—Terminating point that is connected to point 1 with a jumper at the final slave base unit.

1--1st wire of twisted pair

2--2nd wire of twisted pair

3--Shield of twisted pair

G--Ground connection

[1]Depends on model-- D4-RS=AC, D4-RSDC=DC

Specifications

Slaves per channel	7
Module Type	Non–intelligent slave
Installation Requirements	CPU slot in any 4, 6 or 8-slot base
Power Required	110 VAC/220 VAC (D4-RS) 24 VDC (D4-RSDC)
Digital I/O Consumed	None Note: Consumes remote I/O points at a rate equal to the number of I/O points in each base.
Run Output Relay Rating	250 VAC at 1A 30 VDC at 1A
Communication Baud Rates	19.2 kB or 38.4 kB (Switch Selectable)
Communication Cabling	RS-485 twisted pair Belden 9271 or equivalent
Operating Temperature	32 to 140° F (0 to 60° C)
Storage Temperature	–4 to 158° F (–20 to 70° C)
Relative Humidity	5 to 95% (non-condensing)
Environmental air	No corrosive gases permitted
Vibration	MIL STD 810C 514.2
Shock	MIL STD 810C 516.2
Noise Immunity	NEMA ICS3–304

Assigning the Remote Input and Output Addresses

You Assign the Addresses

If you've used a DL405 CPU and local (or expansion) I/O before, then you probably know that the CPU will automatically assign the input and output addresses. That is, input points are automatically assigned starting at X0, and output points are automatically assigned starting at Y0. In a Remote I/O system, the input and output points in the remote bases *are not* automatically assigned in this manner. Instead, you have to add some setup logic to your control program that tells the CPU how to assign the addresses to the remote input and output points.

Remote I/O Data Types

In a local/expansion system, inputs are assigned starting at X0 and outputs are assigned starting at Y0. In a Remote I/O system, you can choose this conventional method, or you can choose to assign the inputs and outputs to other data types. For example, you could assign the remote inputs and outputs as GX (global) data type, or as the C (control relay) data type. This provides flexibility and becomes especially useful if you have already used all of the available X input and Y output addresses in your local and expansion bases.

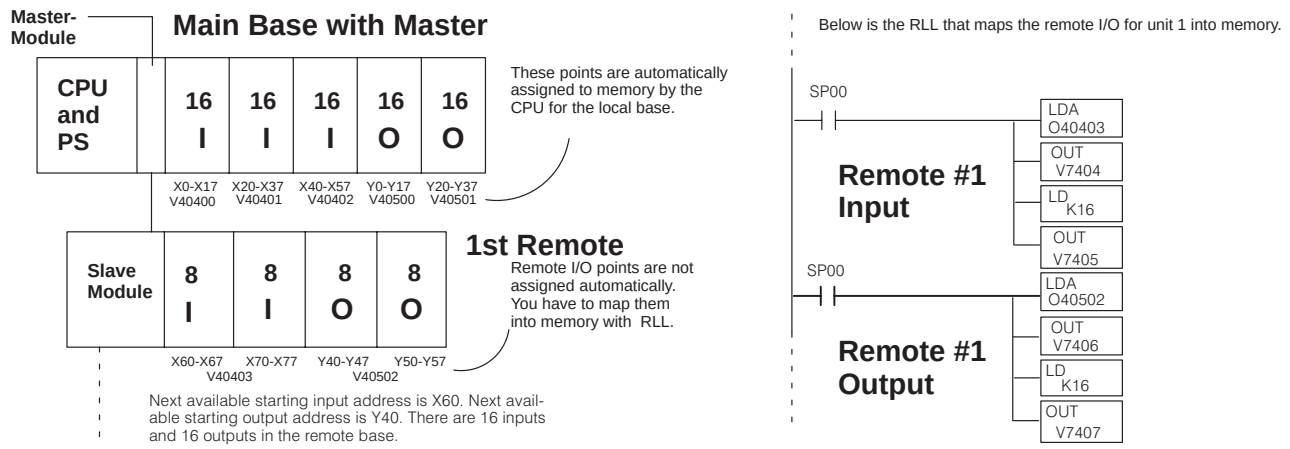
For example, if you had a local/expansion system that used several 32-point input and output modules, you could easily use the entire limit of 320 X input or 320 Y output points (640 total max. I/O points). Now if you added modules in a Remote I/O system, there may not be any additional X input or Y output addresses available for the remote inputs and outputs. (In the vast majority of remote I/O systems, you *will* be able to use the X input and Y output addresses, but you can see that there may be occasions when you need a different data type for the remote points.

Specify Addresses with Setup Logic

The DL405 CPUs have specific memory locations (called pointers) that tell the CPU how to assign the remote I/O addresses. First, you use the tables (in Appendix B) to look up the next available starting address for the data type you want to use. Next, you use a combination of LDA, LD, and OUT store this information in the pointers.

Consider the following example. Although it hasn't been discussed yet, we know that V7404 is the pointer for the 1st Remote base belonging to the 1st Remote Master. If your starting address for the I/O points belonging to the 1st Remote are going to be X60, then you would look in Appendix B to find that the starting memory location for X60 is V40403. Then you would use LDA and OUT commands to map the address into that pointer (V7404). Next you would tell the CPU how many input points are in the Remote base. Then, you repeat the steps for the output points. Later in this manual you will be shown all the pointer addresses in a convenient table and we'll go into greater detail with additional examples.

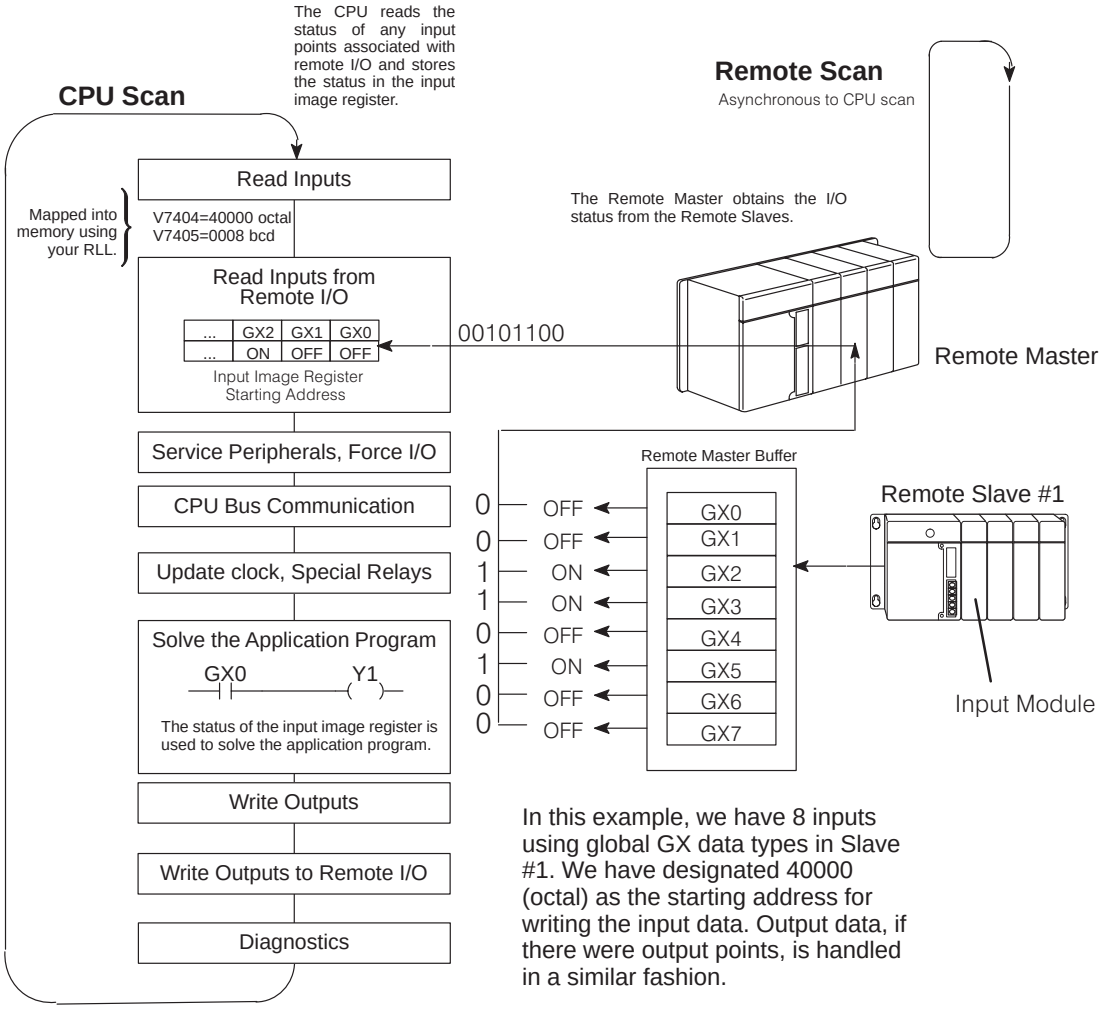
Remote I/O Address Assignement



How the CPU Updates Remote I/O Points

The CPU and remote master work together to update the remote I/O points. Below is an example showing how scanning and updating takes place. Notice that there are two independent scan cycles going on at the same time, but asynchronously. The CPU module is doing its scan which includes looking at the information that the remote master is writing to its internal buffers.

During every CPU scan, the CPU examines the internal buffers of the remote master, and updates input and output data from the remote I/O. It is very possible for the CPU to be scanning faster than the remote master can do its scan. It is largely dependent on the size of the application program, the baud rate you have selected for the data transfer between the slaves and master, as well as the number of I/O points being monitored. Therefore, if you have I/O ppoints that must be monitored on every CPU scan, you should place these critical I/O points in the local or expansion bases.



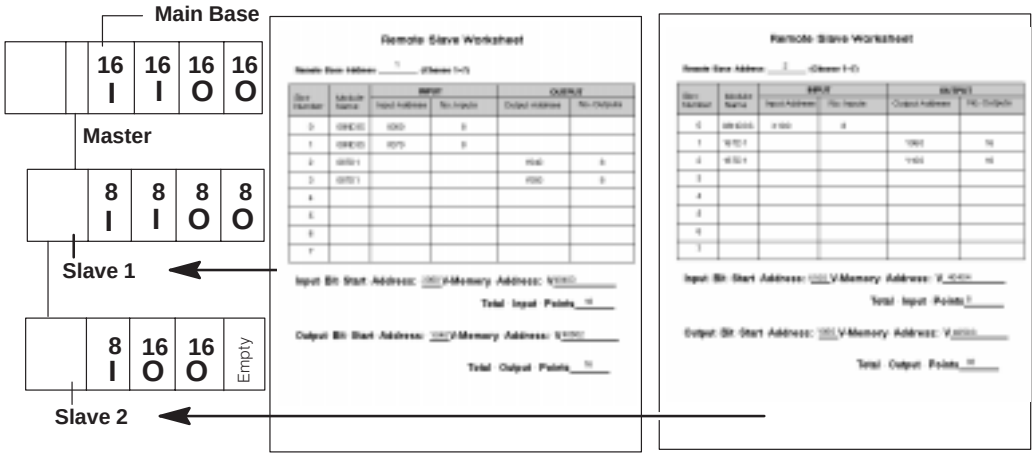
In this example, we have 8 inputs using global GX data types in Slave #1. We have designated 40000 (octal) as the starting address for writing the input data. Output data, if there were output points, is handled in a similar fashion.

NOTE: In some cases it may be helpful to understand the update time required for a Remote I/O system. Appendix C shows example calculations.

3 Easy Steps for Setting Up Remote I/O

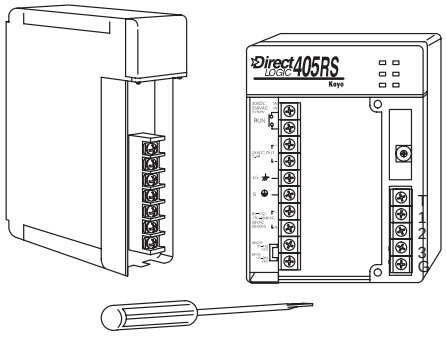
Step One: Design the System

Figure out how much remote I/O you will need. This will, in turn, tell you how many remote masters and remote slaves you will need. **In Chapter 2**, we will show you how to use worksheets to plan and keep track of your data type assignments. We'll also show you how to determine the correct addresses for reading and writing remote I/O data.



Step Two: Install the Components

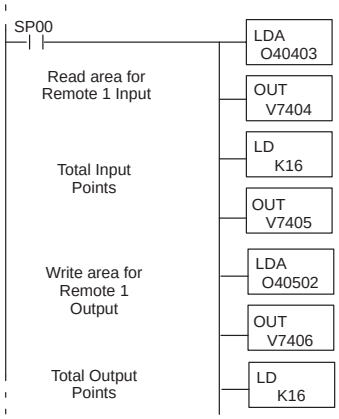
Install the bases and insert the master(s) and the remote slaves. Wire all of your I/O to match your information in Step 1. Set the hardware switches so that the CPU can identify the master and slave units. This also will set the baud rate for data transfer and designate how the slave units are numbered, i.e. No. 1, No. 2, and so on. **Covered in Chapter 3.**



Step Three: Write the Setup Program

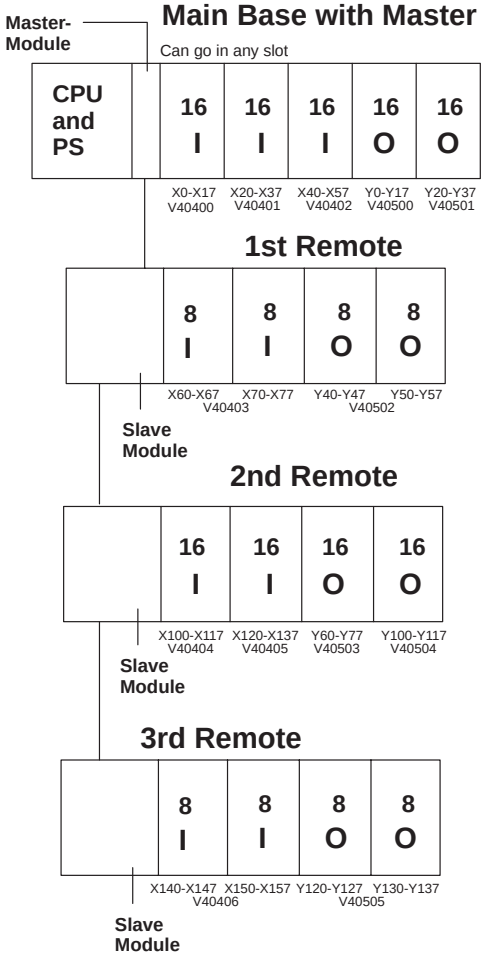
Write the RLL setup program that will tell the CPU which address you want to use for the remote input and output points. **Covered in Chapter 4**.

The next two pages provide a complete overview of the entire process for an example remote I/O system. Of course, to learn all of the details, you should read each chapter carefully.



EXAMPLE:
38.4 kBaud, D4-440

Step 1: Design the Remote I/O System



Remote Slave Worksheet

Remote Base Address 1 **(Choose 1–7)**

Slot Number	Module Name	INPUT		OUTPUT	
		Input Address	**No. Inputs**	Output Address	**No.Outputs**
0	08ND3S	X060	8		
1	08ND3S	X070	8		
2	08TD1			Y040	8
3	08TD1			Y050	8
4					
5					
6					
7					

Input Bit Start Address: X060 **V-Memory Address:V** 40403

Total Input Points 16

Output Bit Start Address: Y040 **V-Memory Address:V** 40502

Total Output Points 16

Remote Slave Worksheet

Remote Base Address 2 **(Choose 1–7)**

Slot Number	Module Name	INPUT		OUTPUT	
		Input Address	**No. Inputs**	Output Address	**No.Outputs**
0	16ND2	X100	16		
1	16ND2	X120	16		
2	16TD1			Y060	16
3	16TD1			Y100	16
4					
5					
6					
7					

ut Bit Start Address: X100 **V-Memory Address:V** 40404

Total Input Points 32

tput Bit Start Address: Y060 **V-Memory Address:V** 40503

Total Output Points 32

Remote Slave Worksheet

Remote Base Address 3 **(Choose 1–7)**

Slot Number	Module Name	INPUT		OUTPUT	
		Input Address	**No. Inputs**	Output Address	**No.Outputs**
0	08ND3S	X140	8		
1	08ND3S	X150	8		
2	08TD1			Y120	8
3	08TD1			Y130	8
4					
5					
6					
7					

Input Bit Start Address: X140 **V-Memory Address:V** 40406

Total Input Points 16

Output Bit Start Address: Y120 **V-Memory Address:V** 40505

Total Output Points 16

Note:

The Remote Slave Worksheet is found in Appendix A.

Step 2: Set the Hardware

Table for setting DIP switch

Position	1	2	3	4
Master	Always ON	ON=38.4kB OFF=19.2kB	Always OFF	Always OFF
Remote	Always OFF	ON=38.4kB OFF=19.2kB	Always OFF	Always OFF

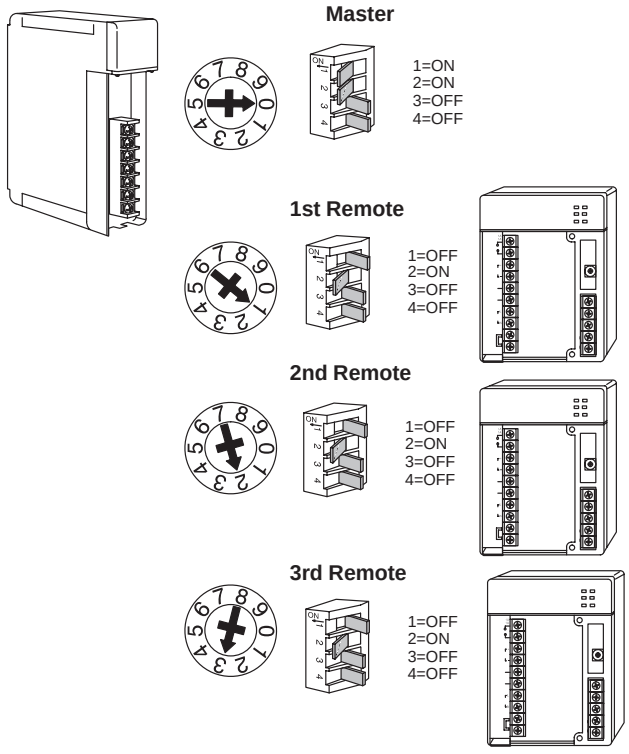


Table of Reserved Memory for Remote I/O Setup

	First Master Module				Second Master Module			
Slave	Input Address	Number of Input Pts	Output Address	Number of Output Pts	Input Address	Number of Input Pts	Output Address	Number of Output Pts
1	V7404	V7405	V7406	V7407	V7444	V7445	V7446	V7447
2	V7410	V7411	V7412	V7413	V7450	V7451	V7452	V7453
3	V7414	V7415	V7416	V7417	V7454	V7455	V7456	V7457
4	V7420	V7421	V7422	V7423	V7460	V7461	V7462	V7463
5	V7424	V7425	V7426	V7427	V7464	V7465	V7466	V7467
6	V7430	V7431	V7432	V7433	V7470	V7471	V7472	V7473
7	V7434	V7435	V7436	V7437	V7474	V7475	V7476	V7477

= unused memory for this example

Step 3: Write the Setup Program

RLL Program