1

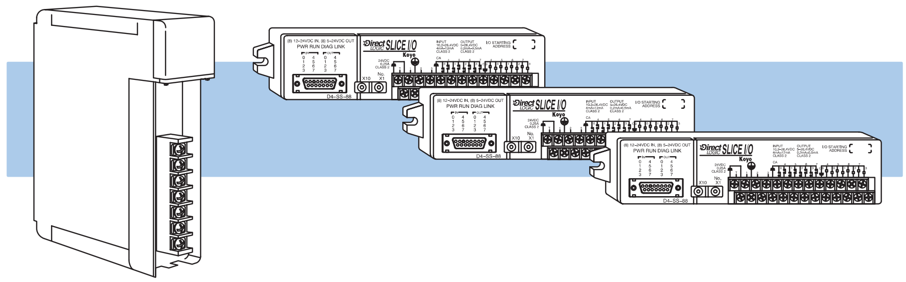
Getting Started

In This Chapter. . . .

Introduction

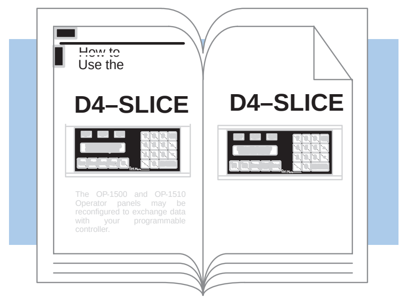
The Purpose of this Manual

This manual shows you how to install, program, and maintain the DL405 Slice I/O system. It also helps you understand the system operation characteristics. .



Contents of the Manual

If you understand PLC systems, this manuals will provide all the information you need to get and keep your Slice 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 Slice 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 DL405 User Manual)
- DA-DSOFT-M (the ***Direct***SOFT User Manual, which is included with the ***Direct***SOFT Programming software)

Where to Begin

If you are in a hurry and already understand the basics of remote I/O systems,you may only want to skim this chapter, and move on to Chapter 2, Installation and Wiring. Be sure to keep this manual handy for reference when you run into questions. If you are a new DL405 customer, we suggest you read this manual completely so you can fully understand the Slice modules, configurations, and procedures used. We believe you will be pleasantly surprised with how much you can accomplish with PLC***Direct***™ products.

If you're really in a hurry, check the diagram shown on Pages 1–14 and 1–15. It shows how the system design, hardware settings, programming, and memory map tables are used to develop a working system.

Technical Assistance

After completely reading this manual, if you are not successful with implementing the OP-1500 or OP-1510, you may call PLC***Direct*** at (800) 633-0405, Monday through Friday from 9:00 A.M. to 6:00 P.M. Eastern Standard Time. Our technical support group will work with you in answering your application questions. If you have a comment or question about our products, services, or manuals which we provide, please fill out and return the suggestions card included with this manual.

Chapters The main contents of this manual are organized into the following four chapters.

1	**Getting Started**	contains basic information you need to know in order to get started. It includes a brief description of a Slice I/O system, an explanation of who needs such a system, and an overview of the basic system components and the steps necessary to develop a working system.
2	**Designing the Slice I/O System**	shows the steps required to design your system. It includes a tutorial on how to use worksheets to keep track of all the I/O address assignments. 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 the Slice Master and Slice Slave units. 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 Slice I/O setup program. This chapter takes the information developed from your worksheets and helps you develop a working program. This includes showing you how to map certain addresses together in order for the I/O status of each Slice I/O unit to be read and written to the CPU's memory image area. You will also be shown how to use certain internal relays to monitor communications status, build error traps, and perform other useful functions.

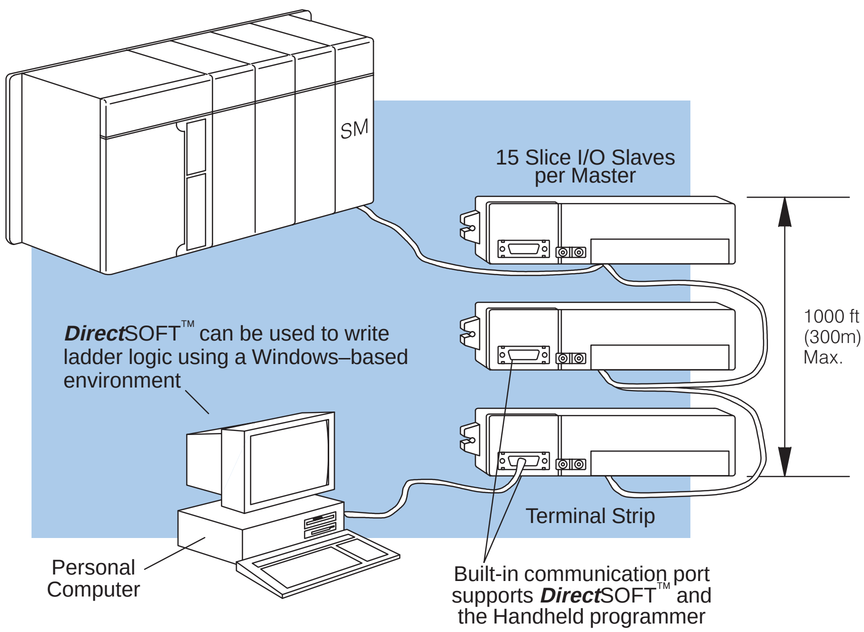
Appendices Additional examples and reference information are in the following three appendices:

A	**Writing the Setup Program**	includes a blank worksheet that can be copied and used for designing your system.
B	**Memory Tables for Remote I/O Addresses**	shows the reserved memory locations for the transfer of Slice 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 Slice slaves. Provides tables for all four baud rates available, based on number of I/O points used.

What is Slice I/O?

A Slice I/O system is simply another cost-effective form of remote I/O which allows you to locate I/O modules at remote distances from the CPU base, without using separate I/O bases. These remote units have no CPU of their own, and are completely controlled by the CPU in the main base via a special module called a **Slice Master**. Each **Slice Slave** (consisting of an internal power supply and I/O adapter circuitry) exchanges 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 19.2K, 38.4K, 153.6K and 614.4K.

Example Slice I/O with one master and three slaves



When Do You Need Slice I/O?

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

Each slave has a built-in communications port which supports connection to a computer or handheld programmer. This permits system programming from a remote location.

Another inherent advantage of Slice I/O is the ability to add Slice slave units, or temporarily take a unit off line, without disrupting the operation of the remaining system.

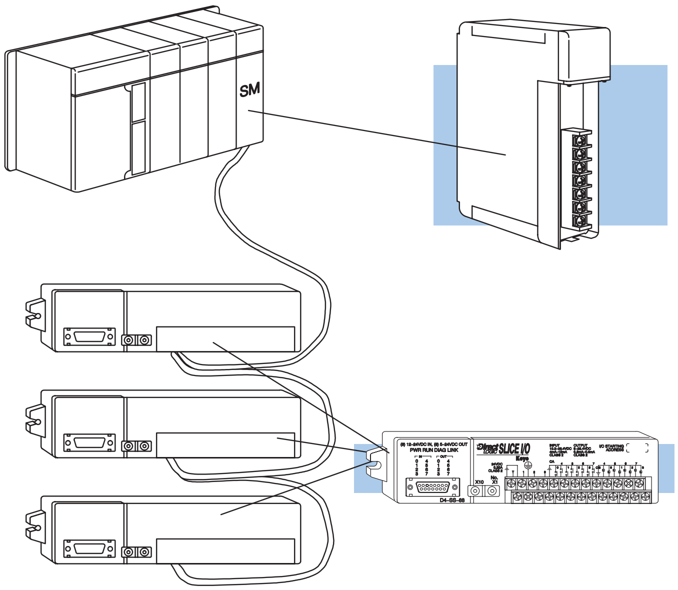
How Does Slice I/O Compare to Standard Remote?

Compared to standard remote I/O systems (e.g. D4-RM and D4-RS combinations), the Slice I/O system is more economical and can support more slaves per channel. It cannot, however, have as much distance between the master and slaves as the conventional remote I/O system. The furthest distance from the master that a slave can be located for the Slice system is 1000 feet. For the conventional remote system, the furthest distance that a slave can be located from its master is 3300 feet. You must examine the needs of your application to determine which type of remote I/O system is best for you.

How Does the DL405 Support Slice 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 Slice Master is placed in the CPU base. The Master (D4–SM) controls up to 15 Slice Slaves (D4–SS–88, D4–SS–16T, D4–SS–16N, and D4–SS–106).



Slice Master -The D4-SM can link up to 15 Slice slaves (using discrete addressing) per master module. It is mounted in the CPU base. Up to 2 masters can be used.

Note: *There are three different addressing modes available for assigning I/O points to the system. The number of slaves that can be used will vary depending on the method used. This is discussed in detail later.*

Slice Slave - The Slaves are linked together in a daisy chain fashion and are connected to the Master with a twisted pair cable. Each slave must be powered externally by 24 VDC. If you plan to connect a handheld programmer or some other operater interface requiring power from the RS232 port on the front of the unit, then you will have to make sure your power supply has the proper current rating. Slaves require 60mA (max) at 24 VDC without a handheld programmer, but require 250mA (max) with a handheld programmer. At time of publication, Slice Slaves are available as follows:

D4-SS-88 (8 inputs, 8 outputs)
D4-SS-106 (10 inputs, 6 outputs)
D4-SS-16N (16 inputs)
D4-SS-16T (16 outputs)

Number of Masters and Slaves Allowed

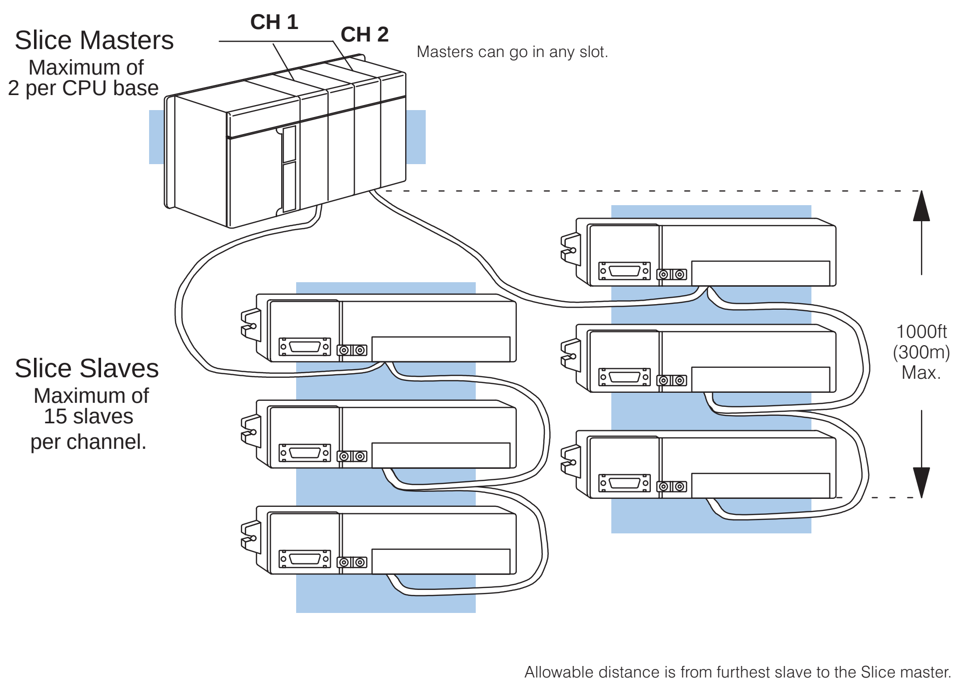
In a simple application, you may want to use only one master in your CPU base and then attach from 1 to 15 Slice I/O units. However, in addition to this basic configuration, more than one master can be placed in the CPU base. You may use a maximum of two masters per CPU base.

The actual number of Slice I/O units that can be connected depends on the addressing mode selected. The various modes are discussed in more detail later.

- **Automatic Addressing** — 12 slaves. In a system with two masters, you can only have one master using automatic addressing. The other master is subject to the following limits.
- **Manual Addressing** — 15 slaves per master
- **Discrete Addressing** — 7 slaves per master

Here is an example where we have placed two masters in the CPU base and then attached a total of six Slice I/O units.

Two Masters in the Same Base (2–Channel)

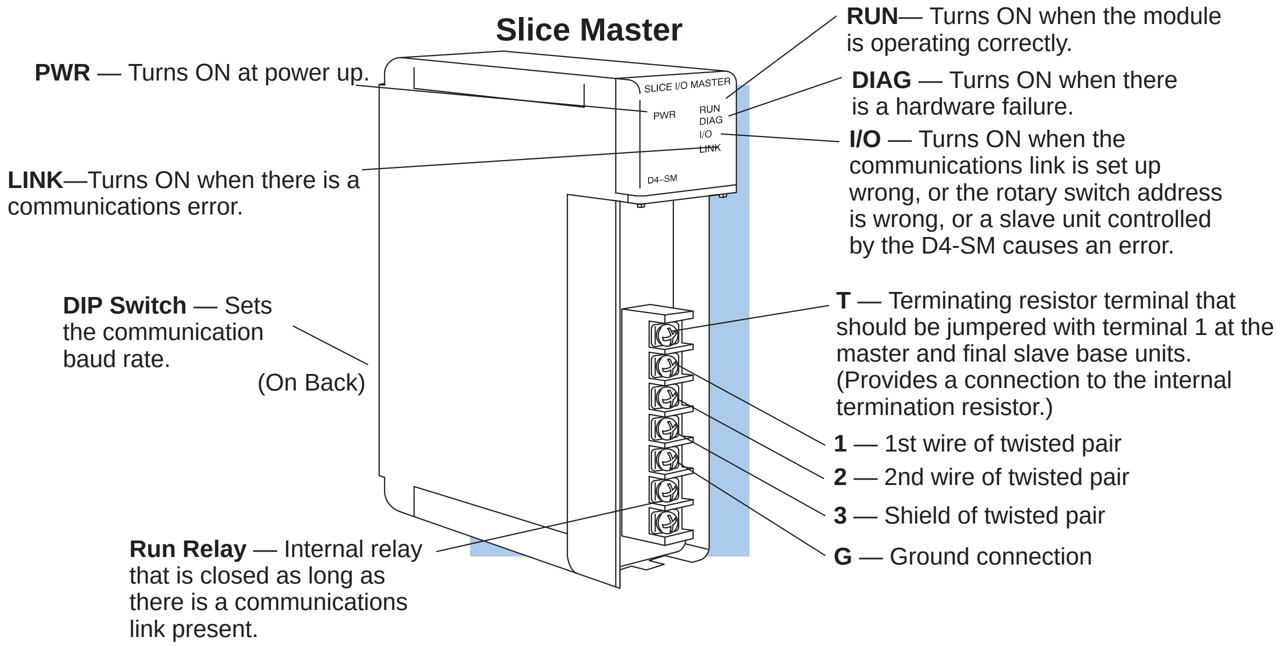


Distance Between Slaves and Master, Baud Rates

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 1000 feet from the CPU base. Each has an address and should be numbered sequentially from 1 through 15 (decimal). You assign this address by setting rotary switches on the front of each slave unit. There are additional switches on the back of each unit to set the communication baud rate. You have your choice of 19.2, 38.4, 153.6, and 614.4 Kb/s. All Slaves and the Master must be set to the same baud rate.

Let’s now take a closer look at the Master module and the Slaves.

Slice Master Features (D4-SM)



Specifications

Number of Masters per CPU	2 max. for DL430 or DL440
Maximum No. Slaves Supported	15 per master (total 30 per 2-master system)
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, 38.4, 153.6, 614.4 kB (Switch Selectable)
Communication Method	Asynchronous (half-duplex)
Communication Cabling	RS-485 twisted pair Belden 9271 or equivalent
Maximum Transmission Distance	1000 ft. (approx. 300 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 (1500 V 1 minute)

Slice Slave Features (D4-SS-xx)

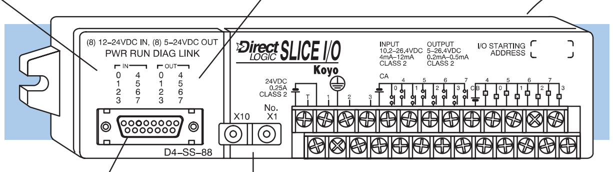
The following Slice slave units are available:

- D4-SS-88 — 8, 12-24VDC Inputs; 8, 5–24VDC Outputs
- D4-SS-106 — 10, 12-24VDC Inputs; 6, 5–24VDC Outputs
- D4-SS-16T — 16, 5–24VDC Outputs
- D4-SS-16N — 16, 12-24VDC Inputs

Input LED's—These correspond to the numeral indicated plus the starting base address, i.e. (X200+1), (X200+2), etc.

Output LED's—These correspond to the numeral indicated plus the starting base address, i.e. (Y200+1),(Y200+2), etc.

DIP Switch—Used to set the baud rate for communication with the master module. Located on the back of the unit.



Com Port—15 pin female D-shell communications port. This port is identical to the top port on the DL405 CPUs. You can program or monitor the CPU with a handheld programmer or ***Direct***SOFT through this port. You can also connect a DV–1000 Operator Interface to this port.

Connection Screws—For attaching power supply, twisted pair communication cable, and input and output points. Varies by model number.

Rotary Switches—Used to set unit address.

General Specifications

Slaves per channel (See text for details)	15, 12 or 7 depending on addressing mode
Module Type	Non–intelligent slave
Installation Requirements	No base required
Power Required	24 VDC (external) +/– 15% 60mA max. at 24 VDC with no handheld programmer 250mA. max at 24 VDC with a handheld programmer
Run Output Relay Rating	250 VAC at 1A 30 VDC at 1A
Communication Baud Rates	19.2, 38.4, 153.6, 614.4 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

Slice Slave Input Specifications

Rated Input Voltage	12-24 VDC
Operating Voltage	10.2-26.4 VDC
Input Current	3.8 mA @ 12 VDC 8.3 mA @ 24 VDC
Maximum Voltage	26.4 VDC
ON Current/Voltage	>3.5 mA @ 10.2 VDC
OFF Current/Voltage	<1.5 mA @ 4.0 VDC
OFF to ON Response	<7 ms
ON to OFF Response	<12 ms
Number of input points	D4-SS-88: 8 (Consumes 16 inputs, however) D4-SS-16N: 16 D4-SS-16T: None D4-SS-106: 10 (Consumes 16 inputs, however)
Commons	D4-SS-88: 8 points per common D4-SS-16N: 16 points per common D4-SS-16T: N/A (no input available) D4-SS-106: 10 points per common
Wire Gauge	AWG22–AWG18

Slice Slave Output Specifications

Output Circuitry	NPN Open Collector
Operating Voltage	4.5-26.4 VDC
Output Current	0.5A / point (subject to derating, see Chapter 3) 3.0A / common
Maximum Voltage	40 VDC
Maximum Leakage Current	0.1mA @ 40 VDC
ON Voltage Drop	1.0V @ 0.5A
Smallest Recommended Load	0.2mA
Maximum Inrush Current	1.0A for 100ms 2.0A for 10ms
OFF to ON Response	0.5ms
ON to OFF Response	0.5ms
Fuses	1, 5.0A fuse per output common
Number of output points	D4-SS-88: 8 (Consumes 16 outputs, however) D4-SS-16N: None D4-SS-16T: 16 D4-SS-106: 6 (Consumes 16 outputs, however)
Commons	D4-SS-88: 1, 8 points per common D4-SS-16N: N/A (no outputs available) D4-SS-16T: 2, 8 points per common D4-SS-106: 1, 6 points per common
Wire Gauge	AWG22–AWG18

Addressing Modes

What is Addressing?

In order for the CPU to recognize the I/O points in a Slice I/O system, the I/O must first be configured by writing setup information to special V-memory locations. This configuration process is called "addressing". The addressing process links (also referred to as "maps") the I/O data stored in the Slice master module with the memory of the PLC. We'll show you more about this addressing process in a moment.

3 Modes of Addressing Available

Later in this manual, you will learn how to use any of three possible modes to assign slice I/O addresses:

- **Automatic:** With this mode, your CPU will automatically assign your Slice *inputs* and Slice *outputs* starting with X200 and Y200 respectively. This means the X200/Y200 I/O points cannot already be assigned to some other module; otherwise, there would be an address conflict. This mode also consumes at least 16 input points and 16 output points per slave, even if the slave does not have 16 points. This means the addresses associated with the Slice I/O inputs start at X200 and extend to *at least X220*, and for the outputs, start at Y200 extending to *at least Y220*. Even if you don't use all of these I/O points, they are consumed by the system and you cannot have unused I/O assigned to local I/O.

NOTE: There is a limit to how many slaves you can use with a master that has been configured automatically. You can only attach a maximum of 12 slaves to a master that has been configured automatically. Additionally, if you use a second master, only one of the masters can be addressed automatically.

- **Manual:** With this mode, you must select data types. You have your choice of using X Y, C or GX data types. These data types will be explained in more detail a little later. Manual addressing can be used with one or two masters. *Manual addressing allows a maximum of 15 slaves per master.*

  Unlike automatic addressing, you choose the starting addresses for the manual mode. There are tables in Appendix B to help you do this. Everything is assigned in blocks of 16 bits; so you can't just use 8 consecutive bits for your Slice I/O assignment and assign the other 8 bits for local I/O. You are committed to 32 points for each slave (16 inputs, 16 outputs).
- **Discrete:** This is very similar to manual addressing with two exceptions:
  (1) You are not committed to 16 inputs and 16 outputs in some cases. For example, if you discretely addressed a D4-SS-106 slave, the 32-point comsumption rule says that even you will consume 16 input points and 16 output points, even though you are only actually using 10 inputs and 6 outputs. But take another example where you are discretely addressing either the D4-SS-16N or the D4-SS-16T. Each of these would only consume 16 points per slave. (This is discussed in more detail in Chapter 2.)
  (2) *Discrete addressing allows a maximum of 7 slaves per master.* Discrete addressing, like manual addressing, requires that you choose data types among the X, Y, C and GX options. Again, this will be discussed in detail later.

Assigning the Remote Input and Output Addresses

Automatic Addressing for Local and Expansion I/O

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 for local or expansion I/O. That is, input points are automatically assigned starting at X0, and output points are automatically assigned starting at Y0.

The Affect of Automatic Addressing on Slice I/O

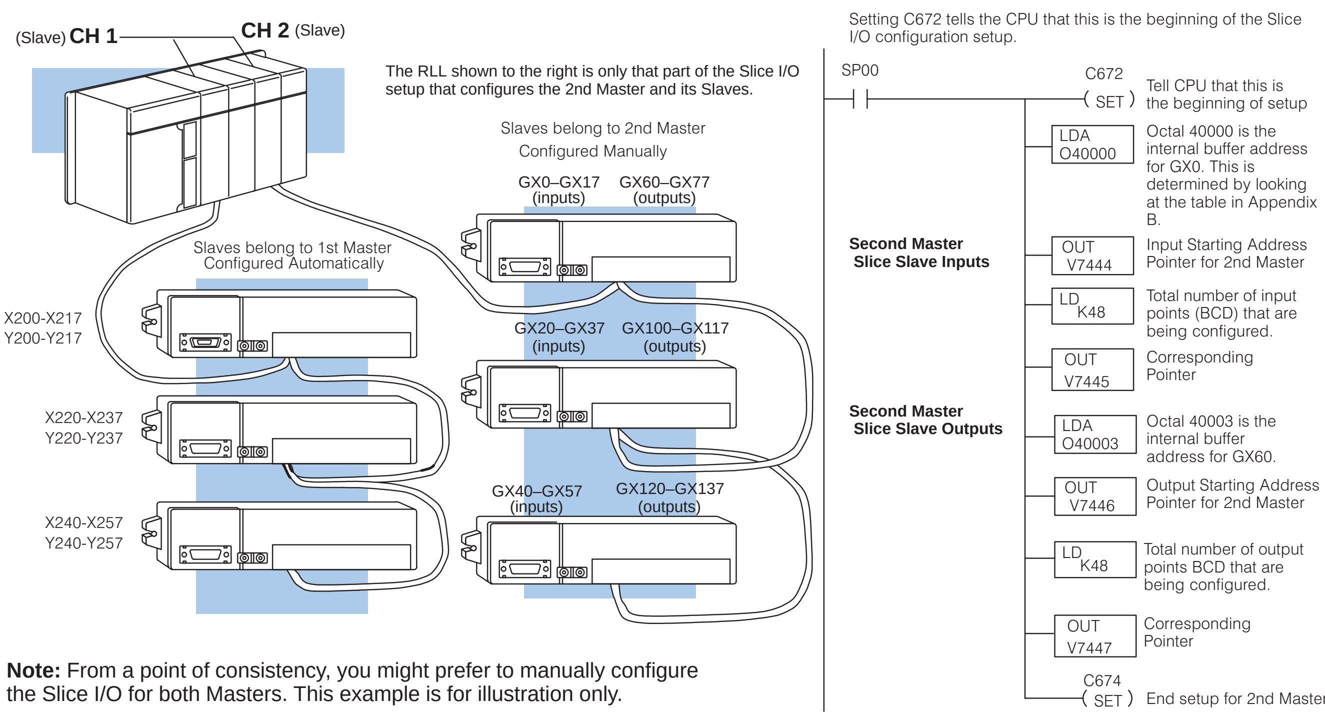
A Slice I/O system uses the automatic addressing concept, but it *is not* related to the automatic configuration that is done by the CPU for the local and expansion I/O. The local and expansion addressing will start at X0 and Y0 for inputs and outputs. The Slice I/O automatic addressing starts at X200 and Y200 for input and output points. There are three key things to remember with the Slice I/O and automatic addressing.

- If your local and/or expansion I/O uses input and/or output points above X200 or Y200, then you can't use automatic addressing for the Slice I/O.
- You can only use automatic addressing for one master in a Slice I/O system. With two masters, one must use discrete or manual addressing.
- The CPU will assign X's starting at X200 and assign Y's starting at Y200, at the rate of 16 input and 16 output points per slave unit.

Manual or Discrete Addressing for those Points Not Automatically Configured

For manual or discrete addressing, the DL405 CPUs have specific memory locations (called pointers) that tell the CPU how to assign the Slice I/O addresses . The starting address for the pointers of the 1st Slice Master starts with V7404 and the starting address for the pointers of the 2nd Slice Master is V7444. Your RLL must store addresses in these pointer locations to tell the CPU where the Slice I/O will appear in the I/O image area. In the example below, the CPU will automatically configure the I/O of the 1st Slice Master and use global (GX) I/O points to manually configure the 2nd Slice Master. Don't worry about understanding everything shown below. Chapter 4 will provide the missing details.

Example Slice I/O Address Assignment



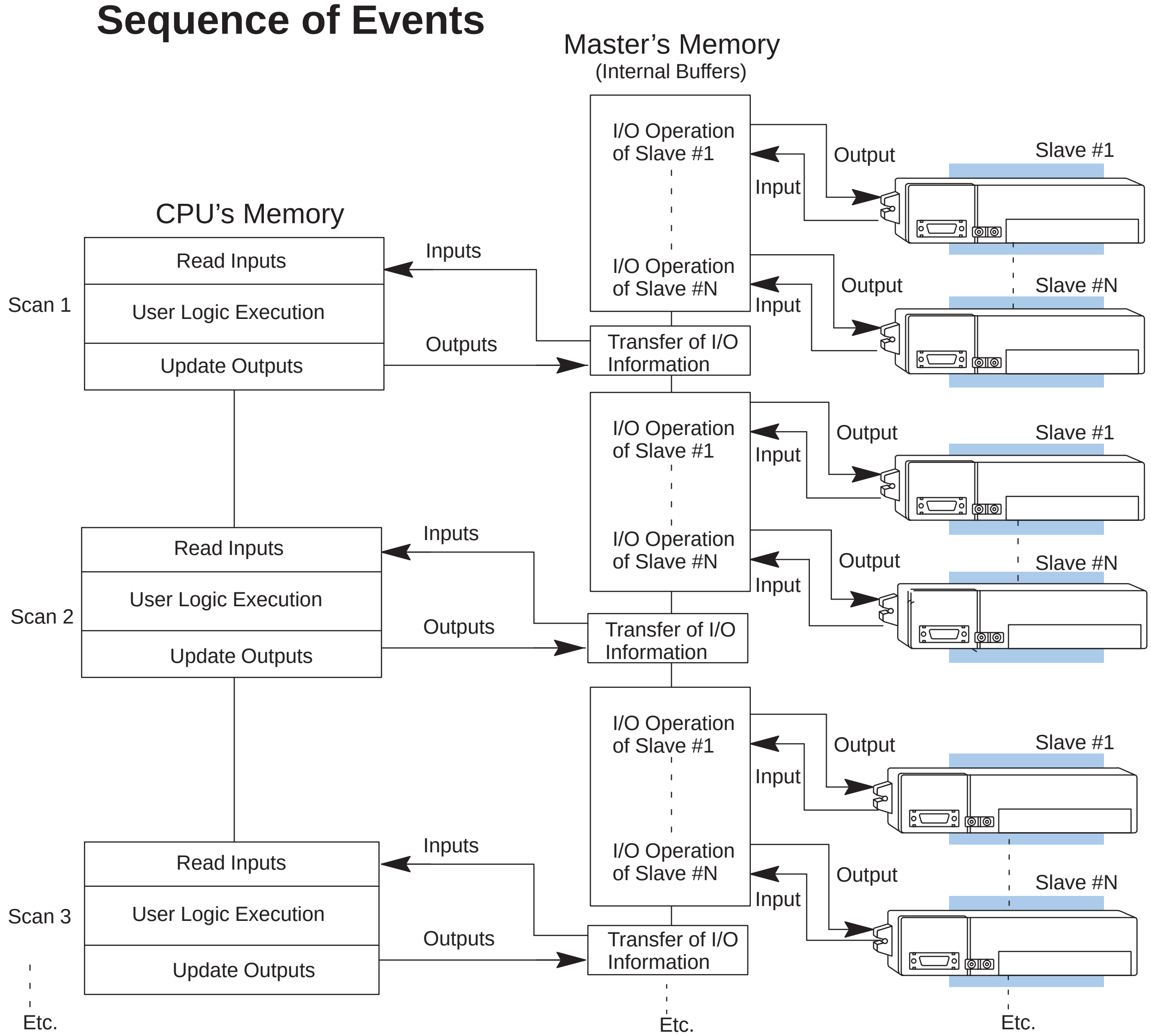
Note: From a point of consistency, you might prefer to manually configure the Slice I/O for both Masters. This example is for illustration only.

How the CPU Updates Slice I/O Points

The CPU and Slice Master work together to update the remote Slice 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 master is writing to its internal buffers.

During every CPU scan, the CPU examines the internal buffers of the Slice Master, and updates input and output data from the Slice I/O. It is very possible for the CPU to be scanning faster than the Slice 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.

Sequence of Events

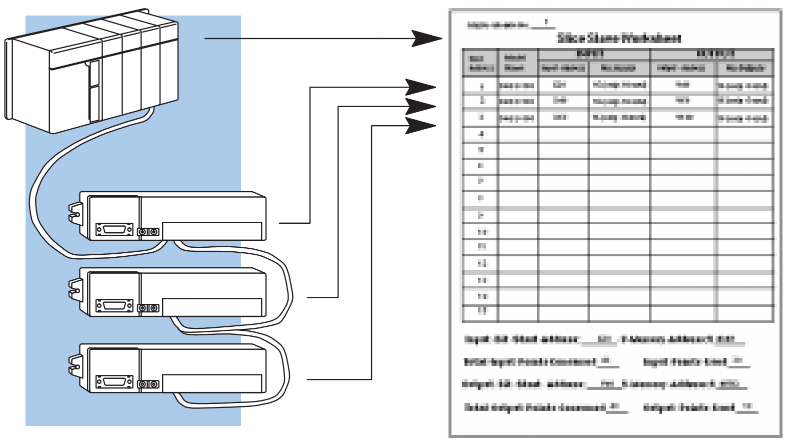


NOTE: In some cases it may be helpful to understand the update time required for a Slice I/O system. Appendix C shows example calculations.

3 Steps for Setting Up Slice I/O

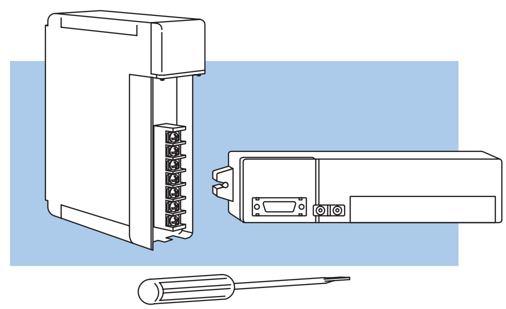
Step One: Design the System

First figure out how many I/O points you will need at each remote drop. This will tell you how many Slice masters and Slice 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 the Slice I/O data.



Step Two: Install the Components

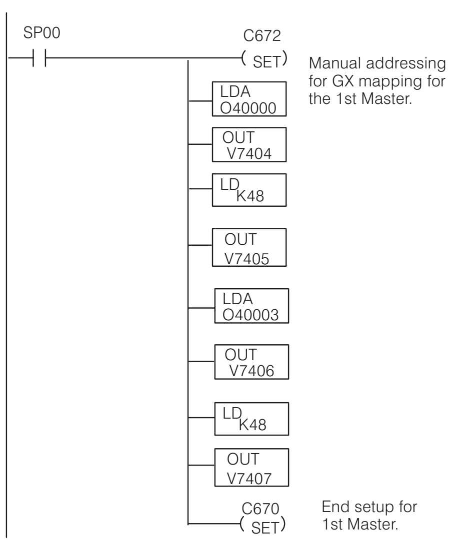
Set the hardware switches so that the CPU can identify the master and slave units. This also will set the baud rate for data transfer and designate how the slave units are numbered, i.e. No. 1, No. 2, and so on. Then, insert the master(s) into the base, and mount the slaves. Wire all of your I/O to match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



Step Three: Write the Setup Program

Write the RLL setup program. **Covered in Chapter 4**.

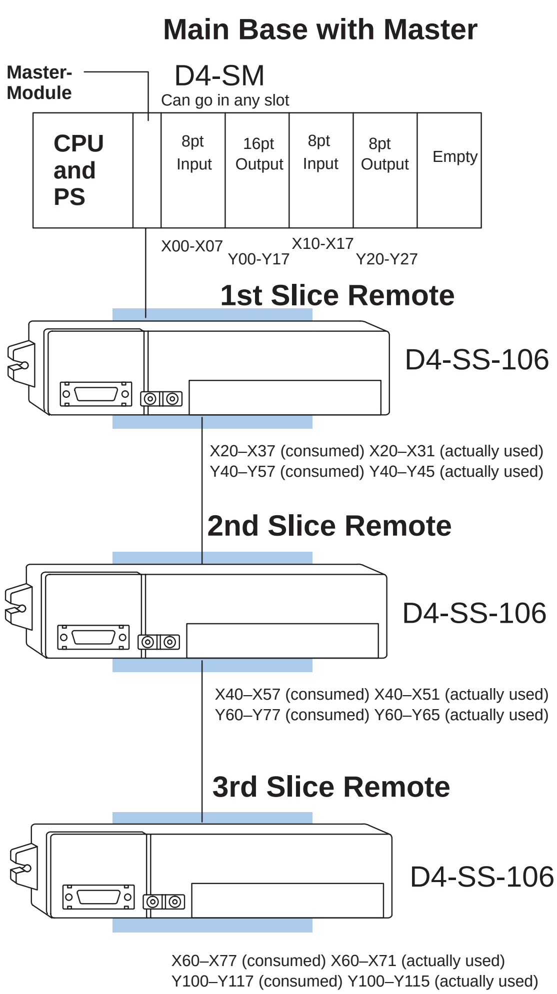
The next two pages provide a complete overview of the entire process for an example Slice I/O system. Of course, to learn all of the details, you should read each chapter carefully.



EXAMPLE:
In this example, we are using only one master and three Slice slaves. We are setting the baud rate to 153.6 kB and we are using manual addressing. The address assignments shown for the modules in the local base consume X0–X17 and Y0–Y27. Therefore we are starting our manual addressing for the slaves at X20 and Y40. (We could not start at Y30 because the addresses must start on a 16pt. boundary.)

Step 1: Design the Slice I/O System

The worksheet is included in Appendix A. You don't have to use a worksheet, but it may help organize your planning and even make the task of writing your ladder logic a little easier. You can have up to two masters per system. If you use a second master, you will have to fill out two of these sheets. Even though we could have up to 30 slaves (15 per master) with manual addressing, we have only used three in this simple example. See note below for other types of addressing and the respective limitations on number of slaves supported.



Master Module No. 1

Slice Slave Worksheet

Unit Address	Model Name	INPUT		OUTPUT	
		Input Address	**No. Inputs**	Output Address	**No . Outputs**
1	D4-SS-106	X20	16 (only 10 used)	Y40	16 (only 6 used)
2	D4-SS-106	X40	16 (only 10 used)	Y60	16 (only 6 used)
3	D4-SS-106	X60	16 (only 10 used)	Y100	16 (only 6 used)
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Input Bit Start Address: X20 **V-Memory Address:V** 40401

Total Input Points Consumed 48 **Input Points Used** 30

Output Bit Start Address: Y40 **V-Memory Address:V** 40502

Total Output Points Consumed 48 **Output Points Used** 18

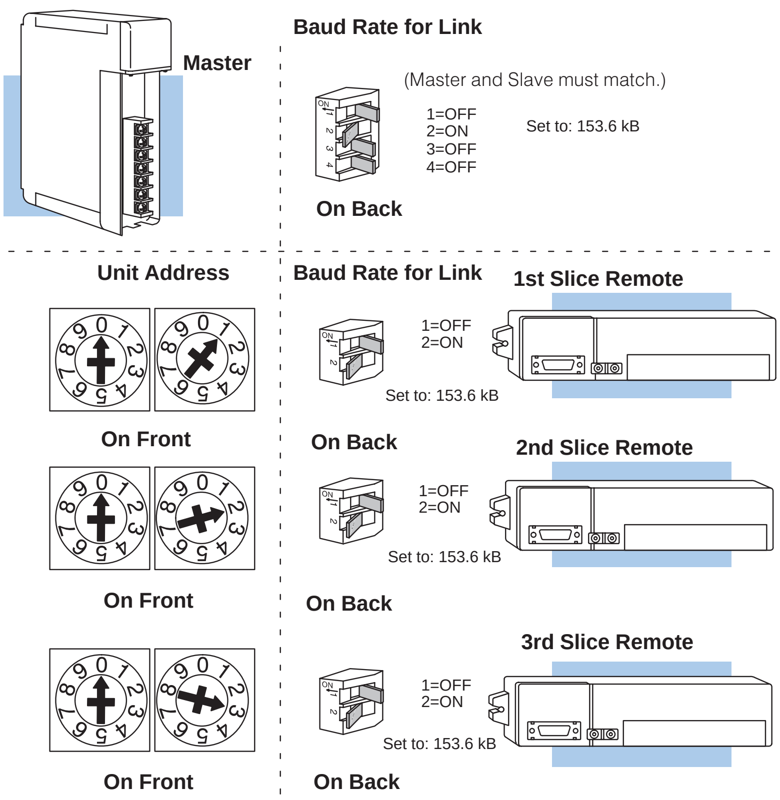
Note: Manual addressing will support 15 slaves per master. Automatic addressing will support 12 slaves per master. Discrete addressing will support 7 slaves per Slice master. Automatic addressing can only be used by one of two masters mounted in the CPU base. Manual and discrete addressing can be used with both masters.

Step 2: Set the Hardware

Table for setting DIP switch

Baud Rate		19.2kB	38.4kB	153.6kB	614.4kB
Master	1	OFF	ON	OFF	ON
	2	OFF	OFF	ON	ON
	3	Not used, should be set to OFF			
	4	See Chapter 3*	See Chapter 3*	See Chapter 3*	See Chapter 3*
Remote	1	OFF	ON	OFF	ON
	2	OFF	OFF	ON	ON

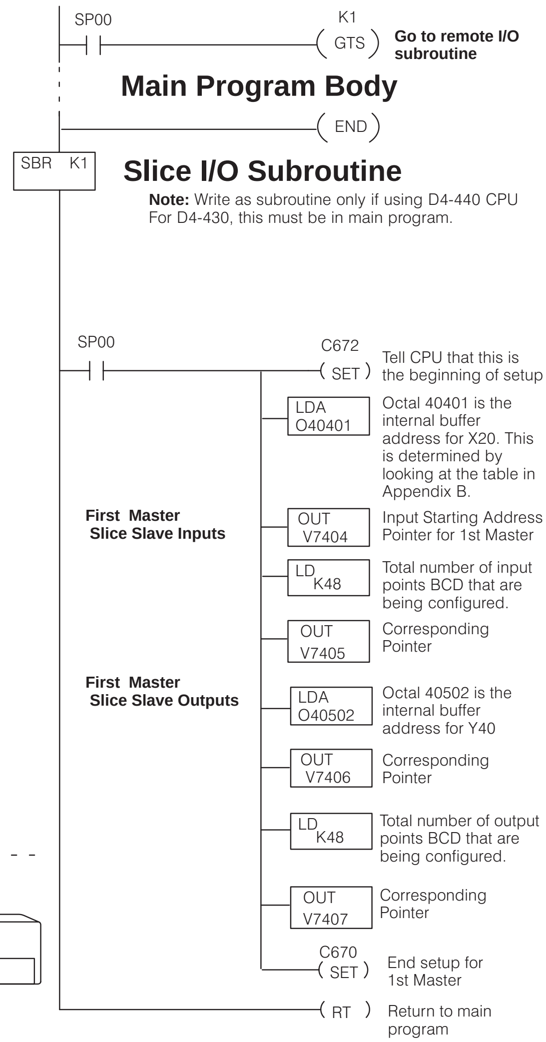
Settings for this Example



*In Chapter 3, you will learn how the setting of the binary switch on the master module affects the system's ability to make use of discrete addressing and the system's slave removal process.

Step 3: Write the Setup Program

RLL Program



Note: V-memory pointer for 1st Master inputs start at V7404 with number of points being transferred in V7405. The output pointer starts at V7406 with number of points being transferred in V7407.

If you were to use two channels, the second master pointers would be as follows: V-memory pointer for inputs would start at V7444 with number of points being transferred in V7445. Output pointer starts at V7446 with number of points being transferred in V7447.

A table showing all of the pointers is included in Chapter 4.

C670 ends the setup for 1st Master, but C674 must end the setup for 2nd Master.