Designing a Remote I/O System

2

In This Chapter. . . .

Designing Your System

Determine I/O Needed and How Many Masters & Slaves

The first step in putting any system together is to at least establish a mental picture of the system components. You may even want to draw a diagram. Below is a drawing of a typical system with:

- one master module in the main base.
- main base has three input modules and two output modules, each with 16-points.
- first remote base has two input and two output modules--each with 8-points.
- second remote base has four 16-point modules--two input and two output.
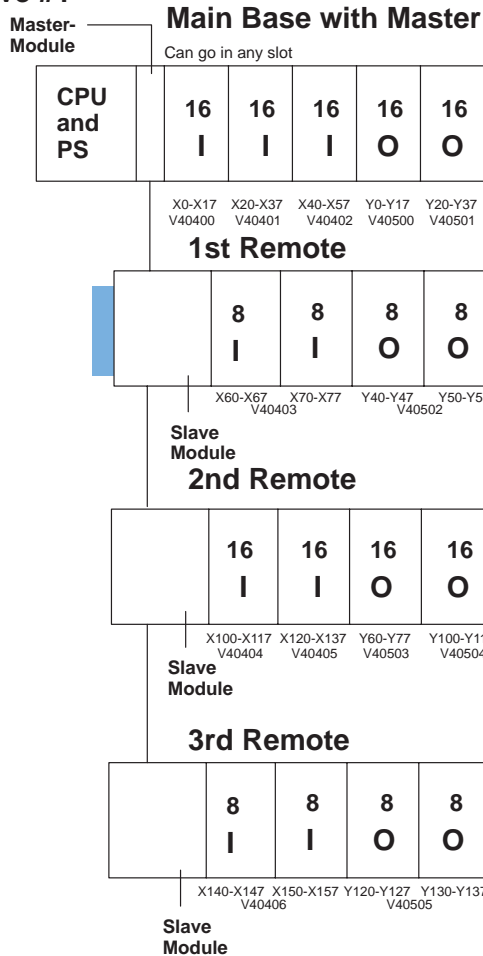- third remote base is identical to the first.
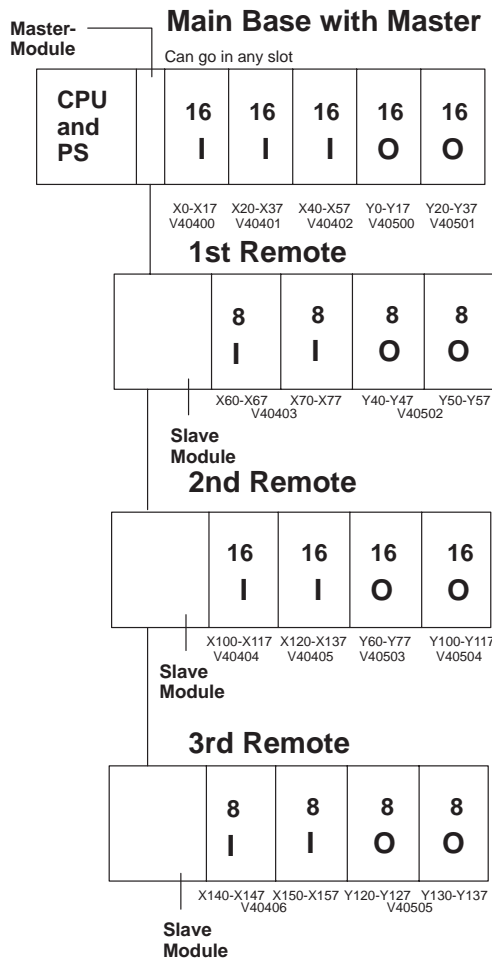
Better Define Your Idea By Using Worksheets

In Appendix A of this manual you will find a worksheet for planning the design of each of your remote I/O bases. We suggest that you photocopy this sheet and use it to map out the details of your system. Assuming this will be your procedure, this chapter will walk you through the process using the example visualized above. You will need the details from these worksheets when you set the switches on your hardware and you write the configuration code inside your ladder logic program.

Filling Out the Remote Slave Worksheet for Slave #1

The following remote slave worksheet has been filled in to match the first remote I/O base of the example system.

Main Base with Master

Master-Module

Can go in any slot

| CPU and PS | 16 I | 16 I | 16 I | 16 O | 16 O |

X0-X17 V40400 | X20-X37 V40401 | X40-X57 V40402 | Y0-Y17 V40500 | Y20-Y37 V40501

1st Remote

| | 8 I | 8 I | 8 O | 8 O |

X60-X67 V40403 | X70-X77 | Y40-Y47 V40502 | Y50-Y57

Slave Module

2nd Remote

| | 16 I | 16 I | 16 O | 16 O |

X100-X117 V40404 | X120-X137 V40405 | Y60-Y77 V40503 | Y100-Y117 V40504

Slave Module

3rd Remote

| | 8 I | 8 I | 8 O | 8 O |

X140-X147 V40406 | X150-X157 | Y120-Y127 V40505 | Y130-Y137

Slave Module

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 Committed ___16___

Output Bit Start Address: ___Y040__ **V-Memory Address: V** __40502__

Total Output Points Committed ___16___

X60 - X67 | X70 - X77 | Y40 - X47 | Y50 - Y57
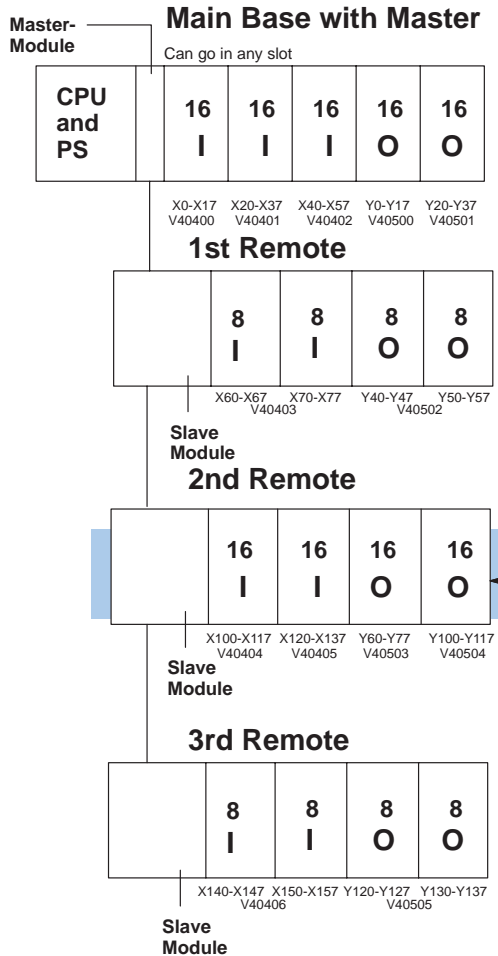
Starting Addresses From Appendix B = V40403   V40502
                                            Input   Output

In this example, the CPU base has 80 points allocated to its input and output modules, which are automatically configured as points X0 thru X57 and Y0 thru Y37. Thus, the starting address for the *first remote base* inputs can start at X060 (or higher) and the starting address for outputs can be Y040 (or higher). Turning to Appendix B, you look up the V-memory addresses for these points in their respective input and output memory address charts. The far right-hand column of each of these charts shows the "bit start" address. For example, for the bit start address for input X060 you look for 060 on the far left-hand portion of the chart. There you find the cross-referenced register address: 40403. On the output chart, you find cross-reference Y040 with 40502. These numbers are filled in at the bottom of the worksheet. They will be used later in your ladder logic.

Now let's do the same thing for your *second* remote I/O base.

Remote I/O
Designing the System

Filling Out the Remote Slave Worksheet for Slave #2

The following remote slave worksheet has been filled in to match the second remote I/O base of the example system.

Main Base with Master

Master-Module

Can go in any slot

CPU and PS	16 I	16 I	16 I	16 O	16 O

X0-X17 V40400 X20-X37 V40401 X40-X57 V40402 Y0-Y17 V40500 Y20-Y37 V40501

1st Remote

	8 I	8 I	8 O	8 O

X60-X67 V40403 X70-X77 Y40-Y47 V40502 Y50-Y57

Slave Module

2nd Remote

	16 I	16 I	16 O	16 O

X100-X117 V40404 X120-X137 V40405 Y60-Y77 V40503 Y100-Y117 V40504

Slave Module

3rd Remote

	8 I	8 I	8 O	8 O

X140-X147 V40406 X150-X157 Y120-Y127 V40505 Y130-Y137

Slave Module

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			Y60	16
3	16TD1			Y100	16
4					
5					
6					
7					

Input Bit Start Address: ___X100__ V-Memory Address: V __40404__

Total Input Points Committed___32____

Output Bit Start Address: ___Y60___ V-Memory Address: V__40503__

Total Output Points Committed___32____

X100 - X117 X120 - X137 Y60 - Y77 Y100 - Y117
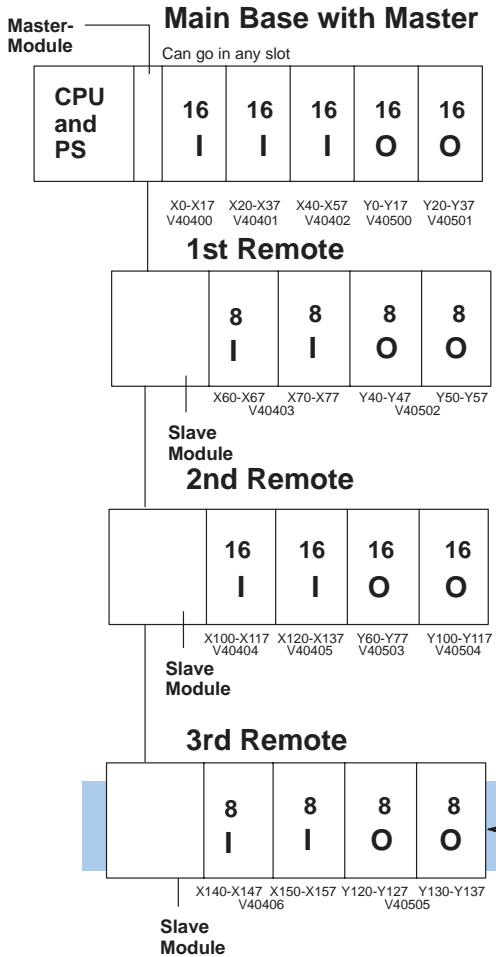
Starting Addresses From Appendix B = V40404   V40503
                                     Input   Output

Remote Slave #1 has points X060 to X077 allocated to its inputs and points Y040 to Y057 allocated to its outputs. This means the starting address for the *second remote base inputs* is X100 (or higher) and the starting address for *outputs* is Y060 (or higher). Turning to Appendix B, you look up the V-memory addresses for these points in their respective input and output memory address charts, you find the starting address for the inputs to be V40404. On the output chart, you find cross-reference 060 with V40502. These numbers are filled in at the bottom of the worksheet.

Now let's do the same thing for *third* remote I/O base.

Filling Out the Remote Slave Worksheet for Slave #3

The following remote slave worksheet has been filled in to match the third remote I/O base of the example system.

Master-Module

Main Base with Master

Can go in any slot

| CPU and PS | 16 I | 16 I | 16 I | 16 O | 16 O |

X0-X17 V40400 X20-X37 V40401 X40-X57 V40402 Y0-Y17 V40500 Y20-Y37 V40501

1st Remote

| | 8 I | 8 I | 8 O | 8 O |

X60-X67 V40403 X70-X77 Y40-Y47 V40502 Y50-Y57

Slave Module

2nd Remote

| | 16 I | 16 I | 16 O | 16 O |

X100-X117 V40404 X120-X137 V40405 Y60-Y77 V40503 Y100-Y117 V40504

Slave Module

3rd Remote

| | 8 I | 8 I | 8 O | 8 O |

X140-X147 V40406 X150-X157 Y120-Y127 V40505 Y130-Y137

Slave Module

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 Committed ___16___

Output Bit Start Address: ___Y120___ **V-Memory Address: V** __40505__

Total Output Points Committed ___16___

X140 - X147 X150 - X157 Y120 - Y127 Y130 - Y137

Starting Addresses From Appendix B = V40406   V40505
                                      Input   Output

Remote Slave #2 has points X100 to X137 allocated to its inputs and points Y100 to Y117 allocated to its outputs. This means the starting address for the *third base inputs* is X140 (or higher) and the starting address for *outputs* is Y120 (or higher). Turning to Appendix B, you look up the V-memory addresses for these points in their respective input and output memory address charts, you find the starting address for the inputs to be V40406. On the output chart, you find cross-reference 120 with V40505. These numbers are filled in at the bottom of the worksheet.

Calculating the Power Budget

Managing your Power Resource

When determining the types and quantity of I/O modules you will be using in the DL405 system, it is important to remember there is a limited amount of power available from the power supply to the system. We have provided a chart to help you easily see the amount of power you will have with your CPU, Expansion Unit or Remote Slave selection. At the end of this section you will also find an example of power budgeting and a worksheet showing sample calculations.

If the I/O you chose exceeds the maximum power available from the power supply you can resolve the problem by adding another base--either remote or expansion.

WARNING: It is *extremely* important to calculate the power budget correctly. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

CPU Power Specifications

The following chart shows the amount of current **supplied** by the the DL405 CPU, Expansion unit or Remote Slave unit. Use this to calculate the power budget for your system. The Auxiliary 24V Power Source mentioned in the table can be used to power field devices or DL405 modules that require an external 24VDC. (Check the terminal strip wiring diagrams shown in Chapter 3 for the location of these terminals.)

CPUs	5V Current Supplied in mA.	Auxiliary 24V Power Source Current Supplied in mA.	Remote and Expansion Units	5V Current Supplied in mA.	Auxiliary 24V Power Source Current Supplied in mA.
D4–430	3700	400	D4–EX	4000	400
D4–440	3700	400	D4–EXDC	4000	None
D4–440DC–1	3700	None	D4–RS	3700	400
D4–440DC–2	3700	None	D4–RSDC	3700	None

Module Power Requirements

The chart on the next page shows the amount of maximum current **required** for each of the DL405 modules. Use this information to calculate the power budget for your system. If an external 24VDC power source is required, you can use the built-in 24VDC auxiliary supply from the CPU or the Remote Slave as long as the power budget is not exceeded.

NOTE: Not all of the modules shown in the following table can be used in a Remote base. Check page 2–9 for module placement restrictions.

Device	5V Current Required in mA.	External 24V Current Required in mA.
I/O Bases		
D4–04B	80	None
D4–04BNX	80	None
D4–06B	80	None
D4–06BNX	80	None
D4–08B	80	None
D4–08BNX	80	None
DC Input Modules		
D4–08ND3S	100	None
D4–16ND2	150	None
D4–16ND2F	150	None
D4–32ND3–1	150	None
D4–32ND3–2	150	None
D4–64ND2	300 (max)	None
AC Input Modules		
D4–08NA	100	None
D4–16NA	150	None
AC/DC Input Modules		
D4–16NE3	150	None
F4–08NE3S	90	None
DC Output Modules		
D4–08TD1	150	35
D4–16TD1	200	125
D4–16TD2	400	None
D4–32TD1	250	140
D4–32TD1–1	250	140 (15V)
D4–32TD2	350	120 / (4A max including loads)
D4–64TD1	800 (max)	None
AC Output Modules		
D4–08TA	250	None
D4–16TA	450	None
Relay Output Modules		
D4–08TR	550	None
F4–08TRS–1	575	None
F4–08TRS–2	575	None
D4–16TR	1000	None

Device	5V Current Required in mA.	External 24V Current Required in mA.
Analog Modules		
D4–04AD	200	200
F4–04ADS	270	120
F4–08AD	75	90
D4–02DA	250	300
F4–04DA	120	180
F4–08THM–N	75	40
Remote I/O		
D4–RM	300	None
D4–SM	300	None
D4–SS–88	None	100 (250 with HPP)
D4–SS–106	None	100 (250 with HPP)
D4–SS–16T	None	100 (250 with HPP)
D4–SS–16N	None	100 (250 with HPP)
F4–SDS	110	None
Communications and Networking		
D4–DCM	500	None
F4–MAS–MB	235	None
F4–SLV–MB	235	None
F4–SLV–MBR	350	None
F4–SLV–TW	250	None
F4–SDN	235	None
FA–UNICON	None	65
CoProcessors™		
F4–CP128	305	None
F4–CP512	235	None
F4–CP128–T	350	None
F4–CP128–R	350	None
Specialty Modules		
D4–INT	100	None
D4–HSC	300	None
F4–16PID	160	None
F4–08MPI	225	170
D4–16SIM	150	None
F4–4LTC	160	None
Programming		
D4–HPP	320	None
Operator Interface		
DV–1000	150	None

**Power Budget
Calculation
Example**

The following example shows how to calculate the power budget for the first slave unit of a remote I/O system.

Slave # 1	Module Type	5 VDC (mA)	Auxiliary Power Source 24 VDC Output (mA)
Remote Slave Used	D4–RS	**3700**	**400**
Slot 0	D4–08ND3S	100	0
Slot 1	D4–08ND3S	100	0
Slot 2	D4–08TD1	150	0
Slot 3	D4–08TD1	150	0
Slot 4			
Slot 5			
Slot 6			
Slot 7			
Other			
Base	D4–08B	80	0
Maximum power required		**580**	**0**
Remaining Power Available		3700–580 =**3120**	400 – 0 = **400**

1. Using the tables at the beginning of the Power Budgeting section of this chapter fill in the information for the CPU/Remote Slave, I/O modules, and any other devices that will use system power including devices that use the 24 VDC output. Pay special attention to the current supplied by either the CPU, Expansion Unit, and Remote Slave since they do differ. Devices which fall into the "**Other**" category are devices such as the Base and the Handheld programmer which also have power requirements but do not directly plug into the base.

2. Add the current columns starting with Slot 0 and put the total in the row labeled "**Maximum power required**"**.**

3. Subtract the row labeled "**Maximum power required**" from the row labeled "**CPU/Expansion Unit/Remote Slave Used**". Place the difference in the row labeled **"Remaining Power Available**".

4. If **"Maximum Power Required"** is greater than "**CPU/Expansion Unit/Remote Slave Used**" in any of the three columns, the power budget will be exceeded. It will be unsafe to used this configuration and you will need to restructure your I/O configuration.

Which Modules Can Go In the Remote Bases

The most commonly used I/O modules for the DL405 system (AC, DC, AC/DC, Relay and Analog) can be used in the remote I/O bases. The table below lists by category those modules that can be used in the remote I/O base.

Module/Unit	Remote Base
CPUs	No
Expansion Units	No
DC Input Modules	Yes
AC Input Modules	Yes
AC/DC Input Modules	Yes
DC Output Modules	Yes
AC Output Modules	Yes
Relay Output Modules	Yes
Analog Modules	Yes
Remote I/O	
Remote Master	No
Remote Slave Unit	CPU Slot Only
Slice Master	No
Communications and Networking Modules	No
CoProcessor Modules	No
Specialty Modules	
Interrupt	No
High Speed Counter	No
PID	No
I/O Simulator	Yes
Filler	Yes

NOTE: The User Manual for Analog I/O Modules discusses scan times for updating analog I/O data for modules that have been installed in *local or expansion bases.* Please be aware that the **scan times for updating are different for remote I/O modules installed in remote bases**. The CPU scan is asynchronous with the remote scan by the master module. Thus, an analog input module installed in a remote base, for example, may not have its data updated by the CPU "once every scan per channel" as stated in the user manual. The CPU scan may, in fact, cycle several times while the remote scan is taking place. You should take this into account in applications where the timing is critical.