D2–RMSM/D2–RSSS

Remote Master/Remote Slave

Manual Number D2–REMIO-M

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Manual Revisions

If you contact us in reference to this manual, be sure to include the revision number.

Title: DL205 Remote Master/Remote Slave D2–RMSM and D2–RSSS
Manual Number: D2–REMIO–M

Issue	Date	Effective Pages	Description of Changes
Original	9/97	Cover/Copyright Contents 1-1 – 1-19 2–1 – 2-14 3-1 – 3-12 4-1 – 4-21 5-1 – 5-18 6-1 – 6-14 A-1 – A-5 B-1 – B-5 C-1 – C–6	Original Issue
Rev. A	5/98	5–9, 5–12, and 5–15 6–4	Setup programs Added possible causes to “Link is on”.

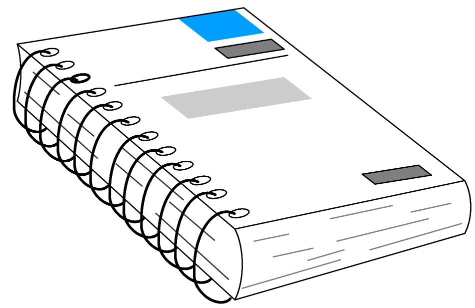
1

Getting Started

Introduction

The Purpose of this Manual

Thank you for purchasing the remote I/O system for the DL205. This manual shows you how to install, program, and maintain the equipment. It also helps you understand the system operation characteristics.



This manual contains important information for personnel who will install remote I/O, and for the PLC programmer. If you understand PLC systems our manuals will provide all the information you need to get and keep your system up and running.

Since we constantly try to improve our product line, we occasionally issue addenda that document new features and changes to the products. If an addendum is included with this manual, please read it to see which areas of the manual or product have changed.

Where to Begin

If you already understand the basics of remote I/O systems, you may only want to skim this chapter, and move on to Chapter 2, “Designing the System”. Be sure to keep this manual handy for reference when you run into questions. If you are a new DL205 customer, we suggest you read this manual completely so you can understand the remote modules, configurations, and procedures used. We believe you will be pleasantly surprised with how much you can accomplish with PLC***Direct***™ products.

Supplemental Manuals

Depending on the products you have purchased, there may be other manuals necessary for you application. You will need to supplement this manual with the manuals that are written for those products.

Technical Support

We realize that even though we strive to be the best, we may have arranged our information 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
- **Appendices** – reference material for key topics, near the end of this manual

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.

Chapters The main contents of this manual are organized into the following six chapters:

1	**Getting Started**	introduces the basic components of the remote I/O system, an explanation of who needs such a 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 by using worksheets to keep track of system parameters and the address and range assignments for remote I/O, needed for programming and hardware setup. It also gives you guidelines for calculating a “power budget” to make sure your system does not draw more than the allowable base current.
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 dials and DIP switch on each module, how to daisy chain the remote units, and how to size and use termination resistors.
4	**D2-RMSM Setup Programming**	shows you how to use DirectSoft to write the remote I/O setup program when using the D2-RMSM. This chapter takes the information developed from your worksheets and helps you write a working setup program.
5	**DL250/DL350 Setup Programming**	shows you how to use DirectSoft to write the setup program when using the DL250 or DL350 CPU bottom port as a remote master. The examples take the information from your worksheets and help you write a working setup program.
6	**Diagnostics and Troubleshooting**	shows you how to interpret the status lights on the modules, use certain internal relays to monitor communications status, and monitor diagnostics information.

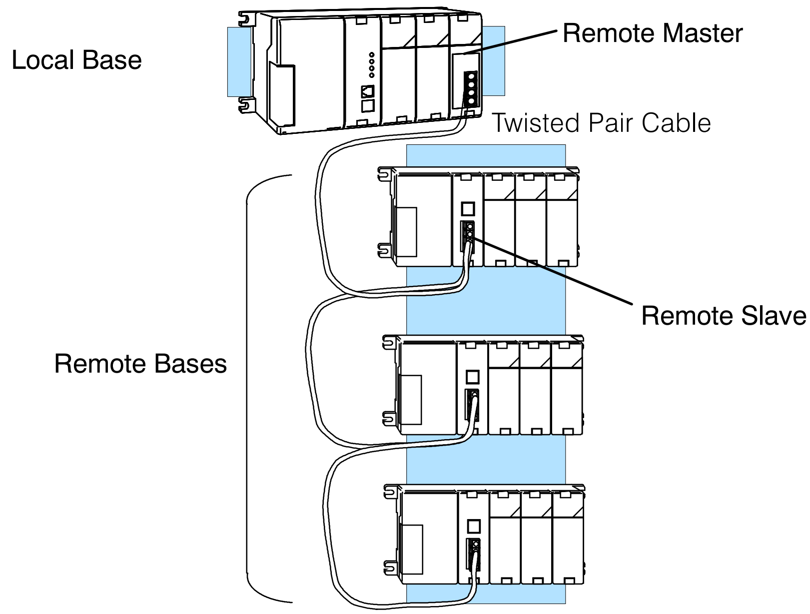
Appendices Additional reference information on remote I/O is in the following three appendices:

A	**Remote I/O Worksheets**	included are blank worksheets that you can copy and use to design 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 all baud rates, based on the protocol selected and 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** 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, with baud rates ranging between 19.2 to 614.4 kBaud, depending on the configuration. Up to 2048 remote I/O points can be supported by the DL250 (896 points for the DL240). The DL230 does not support remote I/O.

One Master in CPU Base (one channel)



When Do You Need Remote I/O?

For the DL205 series, the main advantage of remote I/O is that it expands the I/O capability beyond the local CPU base. Remote I/O can also offer tremendous savings on wiring materials and labor costs for larger systems in which the field devices are in clusters at various 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.

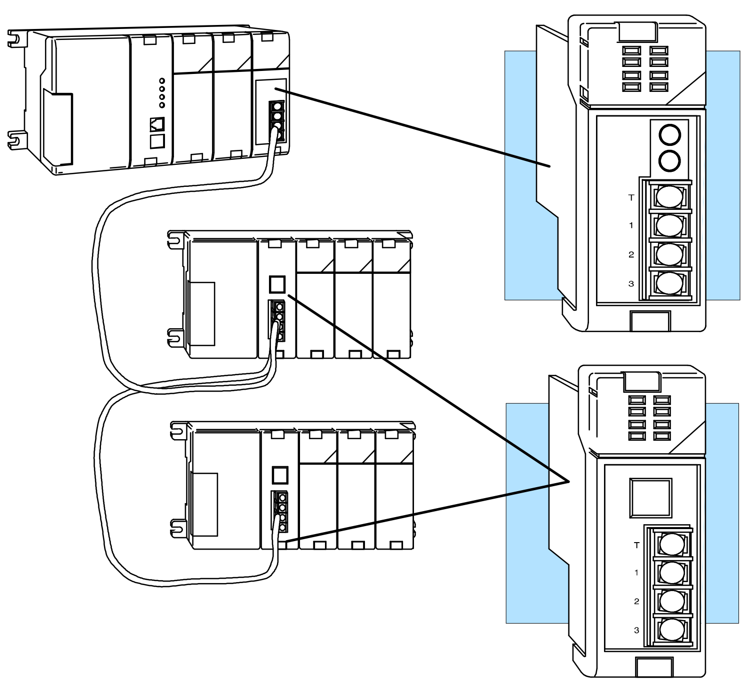
How Does the DL205 Support Remote I/O?

With the DL205 system, up to 896 (DL240) or 2048 (DL250) remote I/O points can be supported, depending on the configuration. This is accomplished with the D2-RMSM Remote Master module and D2-RSSS Remote Slave modules. The DL230 does not support remote I/O.

The D2-RMSM *remote master* supports two different remote I/O communications protocols:

- The Remote Master protocol (RM-NET) is the same protocol used by the D4-RM and D4-RS (DL405 Remote Master and Slave) and the built in ports on the DL250, DL350 and DL450 CPUs. This means that the remote I/O bases connected to a D2-RMSM in a DL205 CPU base can be a combination of D2-RSSS and D4-RS (DL405 Remote Slave) modules. Also, the DL405 series CPUs can use DL205 remote bases as remote I/O, for cost and space savings. RM-NET does not support the use of the built in communications port on the slave unit.
- The Slice Master protocol (SM-NET) is the same protocol used by the D4-SM and D4-SS (DL405 Slice Master and Slave) units. This means that the DL205 series can take advantage of the Slice I/O features by using a D2-RMSM Master connected to D2-RSSS and/or Slice Slave units, up to the maximum allowed number of remote units and I/O points, as well as operate at a higher baud rate. Also, the DL405 Slice Master can use DL205 remote bases as slaves. This protocol supports the built in RS-232 communications port on the D2-RSSS.

A *remote master* resides in the CPU base. Depending on the protocol selected, this master (D2-RMSM) controls up to 7 *remote slaves* (RM-NET), or up to 31 *remote slaves* (SM-NET).



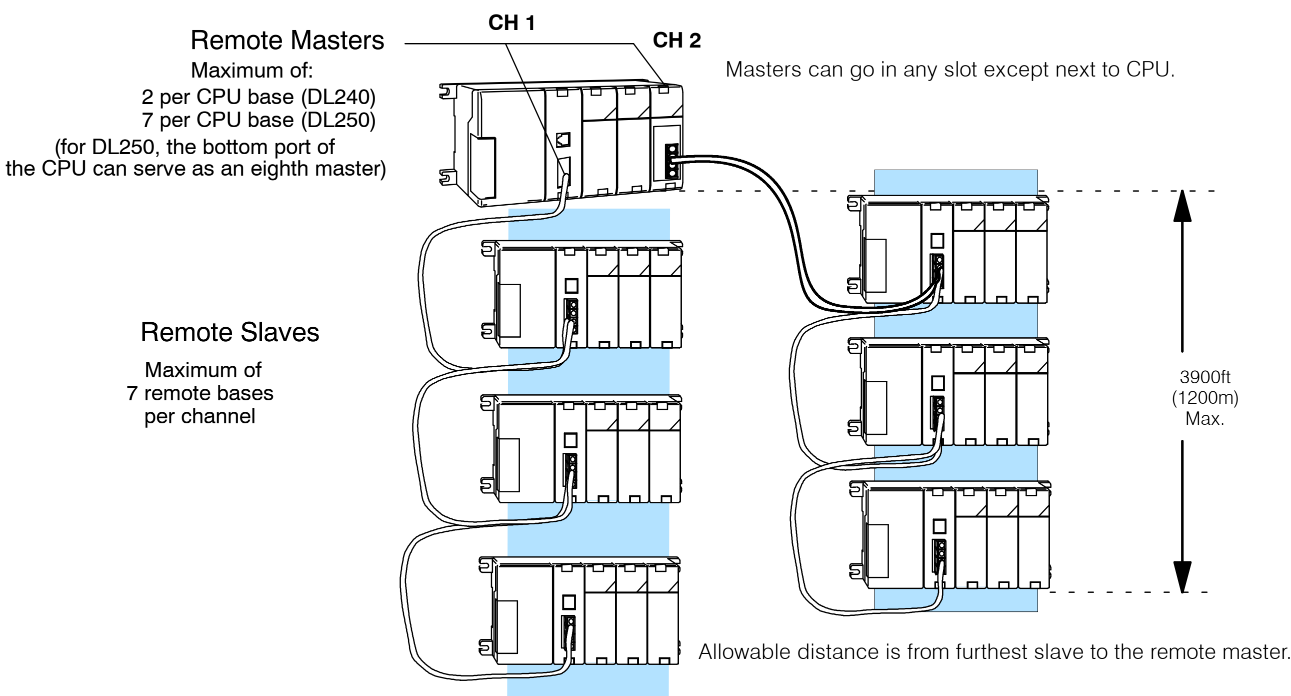
Remote Master – The D2-RMSM is mounted in the CPU base. Up to two master modules can be used with the DL240; up to seven master modules can be used with the DL250

Remote Slave – The D2-RSSS modules are placed in remote base units. Each slave has the I/O circuitry required to be linked to the master module via twisted pair cable. One D2-RSSS is required for each remote base.

Number of Masters and Slaves Allowed (RM-NET)

In its simplest 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 used in the CPU base. The DL240 CPU can handle two masters maximum. The DL250 CPU can operate seven D2-RMSM masters (using a 9-slot rack), and the bottom port of the DL250 can serve as an eighth master. Here is an example where we have used two masters in the CPU base (one of which is the bottom port on the DL250 CPU) and then attached a total of six remote I/O racks.

Two Masters in the Same Base (two channels, RM-NET)



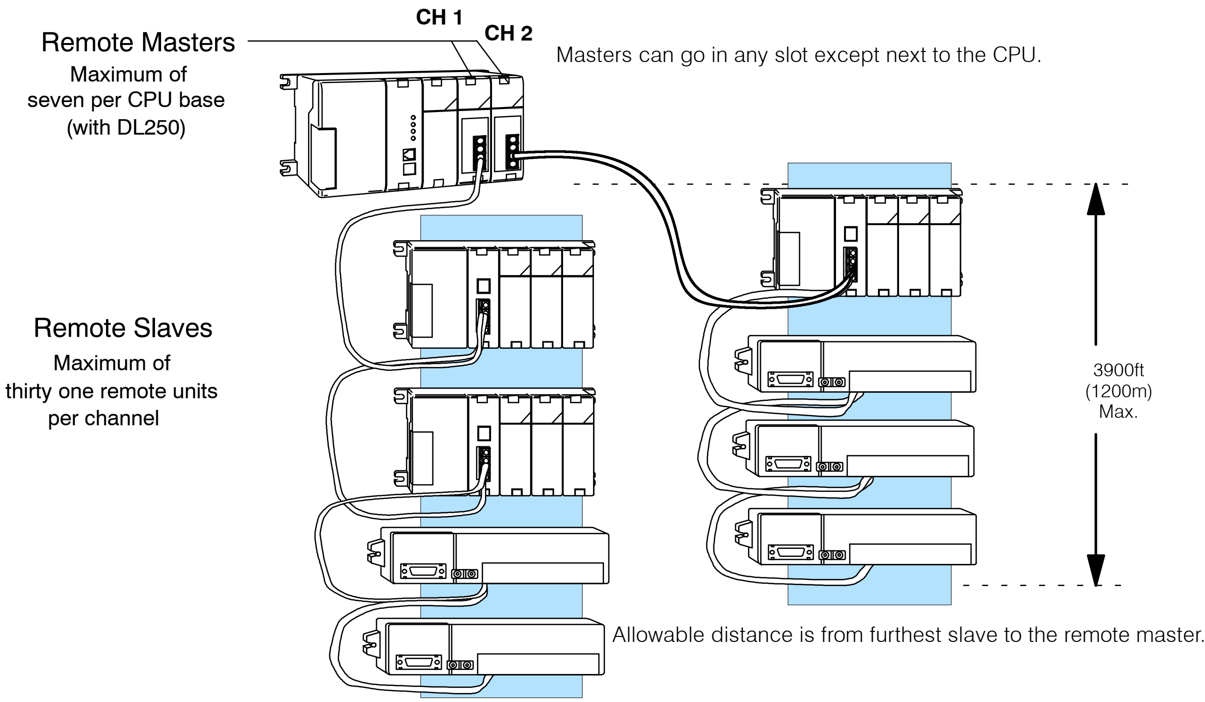
Distance Between Slaves and Master, Baud Rates (RM-NET)

Each slave belonging to the same master is connected in a daisy chain using a shielded twisted pair cable. The last slave unit in the daisy chain cannot be further than 3900 feet from the CPU base. You must set rotary switches that designate the slaves as No. 1, No. 2, etc. There is a DIP switch on each unit to set the baud rate for communication. You have a choice of either 19.2 kB or 38.4 kB. The slaves and master must be set to the same baud rate.

Number of Masters and Slaves Allowed (SM-NET)

In the *SM-NET* mode, one master in your CPU base will allow you to attach from one to 31 remote I/O units. You may use a maximum of two (with DL240) or seven (with DL250) masters per CPU base, all of which have to be the D2-RMSM module. Here is an example where we have placed two masters in the CPU base and then attached a total of eight remote I/O units, which can be a combination of rack and Slice I/O. Slice I/O units can have unit addresses of 1 to 15 only.

Two Masters in the Same Base (two channels, SM-NET)



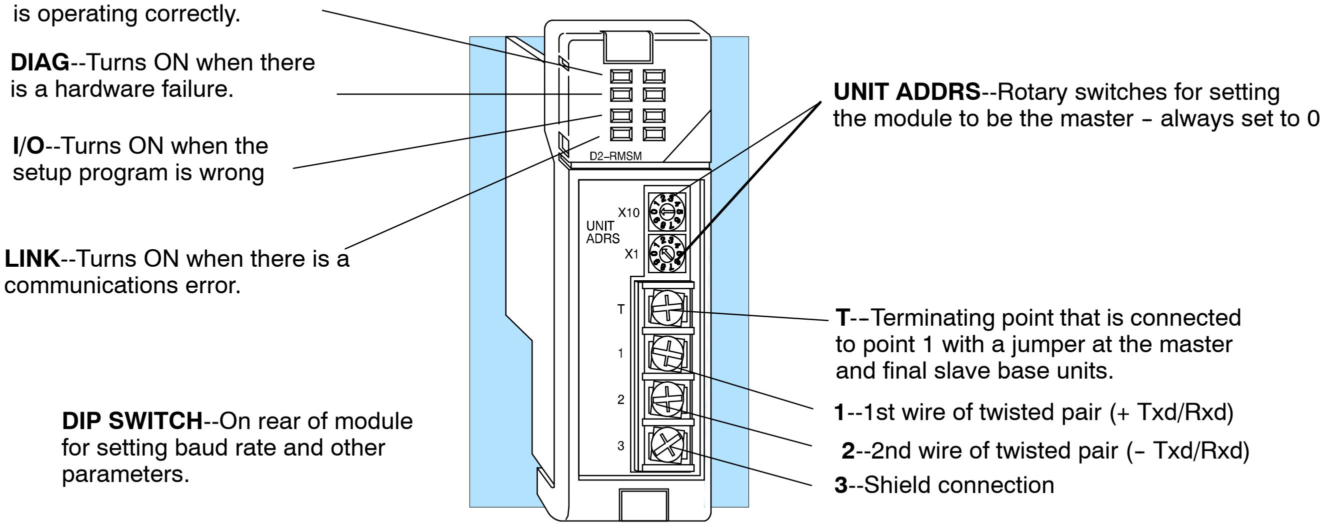
Distance Between Slaves and Master, Baud Rates (SM-NET)

Each slave belonging to the same master is hooked together in a daisy chain using a shielded twisted pair cable. At the lowest baud rate, the last slave unit in the daisy chain cannot be further than 3900 feet from the CPU base. You set rotary switches that designate the slaves as No. 1, No. 2, etc. There is a DIP switch on each unit to set the baud rate for communication. You have a choice of 19.2 kB, 38.4 kB,153.6 kB, 307.2kB, or 614.4 kB. The 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 (D2-RMSM) Features

Remote Master



Functional Specifications

# of Masters (channels) per CPU	2 max. for DL240, 7 + 1 max. for DL250 (built-in RM-NET master feature in DL250 bottom port can be the eighth master)	
Channel Specifications:	RM–NET	SM–NET
Maximum # of Slaves	7	31
Baud Rates	Selectable 19.2K or 38.4K baud	Selectable 19.2K, 38.4K, 153.6K, 307.2K, or 614.4Kbaud
Transmission Distance	3900 feet (1.2Km)	3900 feet (1.2Km) @ 19.2K or 38.4Kbaud 1968 feet (600m) @ 153.6Kbaud 984 feet (300m) @ 307.2Kbaud 328 feet (100m) @ 614.4Kbaud
Remote I/O Capacity (see note):	DL240	DL250
Total Remote I/O	896	2048
Max. points per channel	512	512
Module Type	Intelligent	
Digital I/O Consumed	None	
Communication Method	Asynchronous (half-duplex)	

NOTE: **Remote I/O Capacity** – Total remote I/O available is actually limited by the total references available.The DL240 CPU supports 320 X inputs and 320 Y outputs, so 640 points is the limit for I/O references. It is possible to map remote I/O into other types of memory, such as control relay points, to achieve 896 points. The DL250 has more X, Y, and C points and thus could use 2048 points, without local I/O.

The following specifications define the operating characteristics of the D2–RMSM module.

Physical Specifications

Installation Requirements	CPU base only, any slot except adjacent to CPU
Internal Power Consumption	200 mA maximum
Communication Cabling	RS-485 twisted pair, Belden 9841 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

Remote Slave (D2-RSSS) Features

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

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

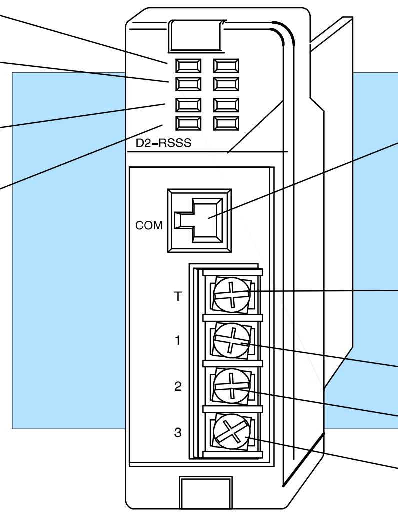
I/O--Turns ON when there is an I/O failure at the slave

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

UNIT ADDRS--Rotary switches on rear of module for setting the module to be a slave – maximium base address dependent on protocol selected

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

Remote Slave



COM –– Communication Port (in SM–NET mode, can be used for programmer or operator interface)

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

1--1st wire of twisted pair (+ Txd/Rxd)

2--2nd wire of twisted pair (–Txd/Rxd)

3--Shield connection

Functional Specifications

Slaves per channel	RM–NET: 7 SM–NET: 31
Maximum Slave Points per CPU	No remote I/O for DL230 DL240, DL250, and DL350 support a maximum of 512 points per channel. The actual I/O available is limited by total available references. The DL240 has a total of 320 X inputs and 320 Y outputs available to share between local and remote I/O, and the DL250 has a total of 512 X inputs and 512 Y outputs. Mapping remote I/O into other types of memory could allow 896 points for the DL240, or 2048 points for the DL250. The DL350 CPU has a maximum configuration of 368 local/expansion I/O and 512 remote I/O.
Module Type	Non–intelligent slave
Digital I/O Consumed	Consumes remote I/O points at a rate equal to the number of I/O points configured in each base.
Communication Baud Rates	RM–NET: Selectable 19.2K or 38.4K baud SM–NET: Selectable 19.2K, 38.4K, 153.6K, 307.2K, or 614.4K baud
Communication Failure Response	Selectable to clear or hold last state of outputs

The following specifications define the operating characteristics of the D2–RSSS module.

Physical Specifications

Installation Requirements	CPU slot in any 3, 4, 6, or 9 slot base
Base Power Requirement	200 mA maximum
Communication Cabling	for remote I/O, RS-485 twisted pair, Belden 9841 or equivalent
Communications Port (active in SM–NET mode only)	RS232C, 9600 Baud, Odd Parity, 8 Data Bits, 1 stop bit (same as top port on DL205 CPUs), K–sequence
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

Assign the Addresses

If you've used a DL205 CPU and I/O before, then you probably know that the CPU will automatically assign the local input and output addresses. That is, the CPU automatically assigns input points starting at X0, and output points starting at Y0. In a remote I/O system, your program must assign the starting addresses and ranges to the remote input and output points.

To make the address and range assignments requires setup logic in your control program. The D2-RMSM has specific memory locations (called shared memory) that tell it how to assign the remote I/O addresses. First, you must use the tables in Appendix B to look up the next available starting address for the data type you want to use. Then you must calculate the number (range) of input and output points used *per slave*. You use a combination of LDA, LD, OUT and WT instructions to store this information in the shared memory. There are additional setup parameters which the setup program must write to the shared memory of the D2-RMSM; these are discussed in detail in Chapter 4.

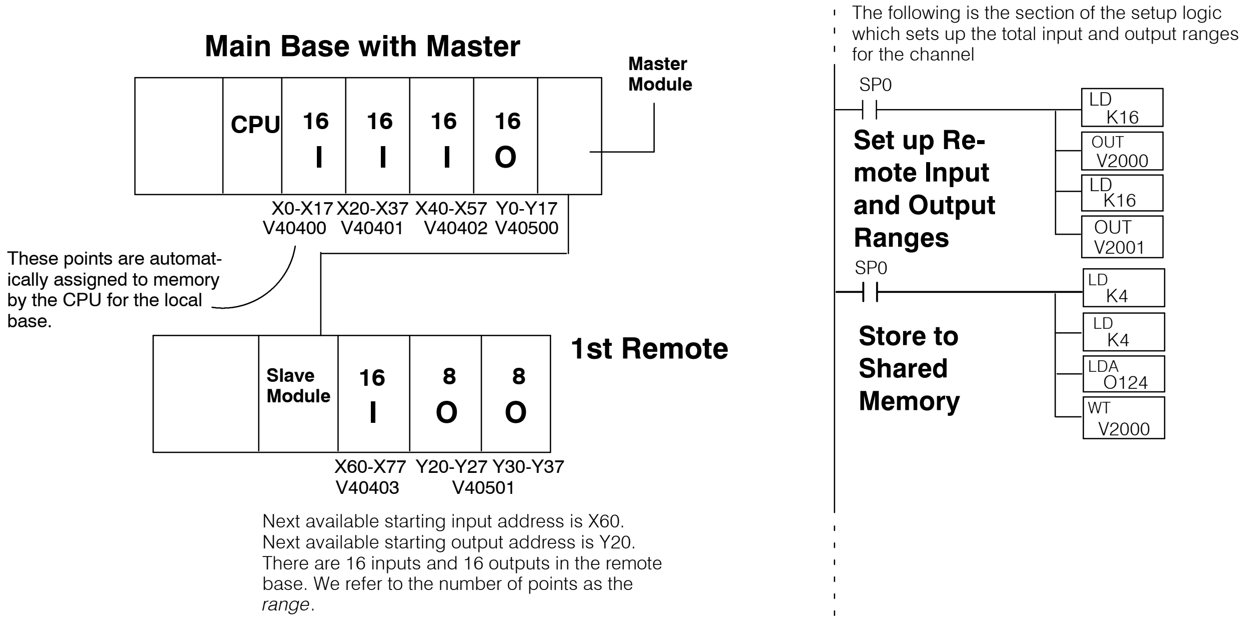
Remote I/O Data Types

In a local system, the CPU assigns input addresses starting at X0 and output addresses 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 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 existing remote bases.

For example, if you had a D2-240 local/remote system that required a large amount of input and output modules, you could use the entire limit of 320 X input or 320 Y output points (640 total I/O points). Now if you added a channel in the remote I/O system, there may not be any additional X input or Y output addresses available for these 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 some remote points.)

Please consider the following example. Although it hasn't been discussed yet, address 124 (in the RMSM shared memory) is the memory location for the input range, and 126 is the memory location for the output range for the channel. You must load temporary V memory with the totals, then store the data to the shared memory. Later in this manual we will show all the shared memory addresses in a convenient table and we'll go into greater detail with complete examples.

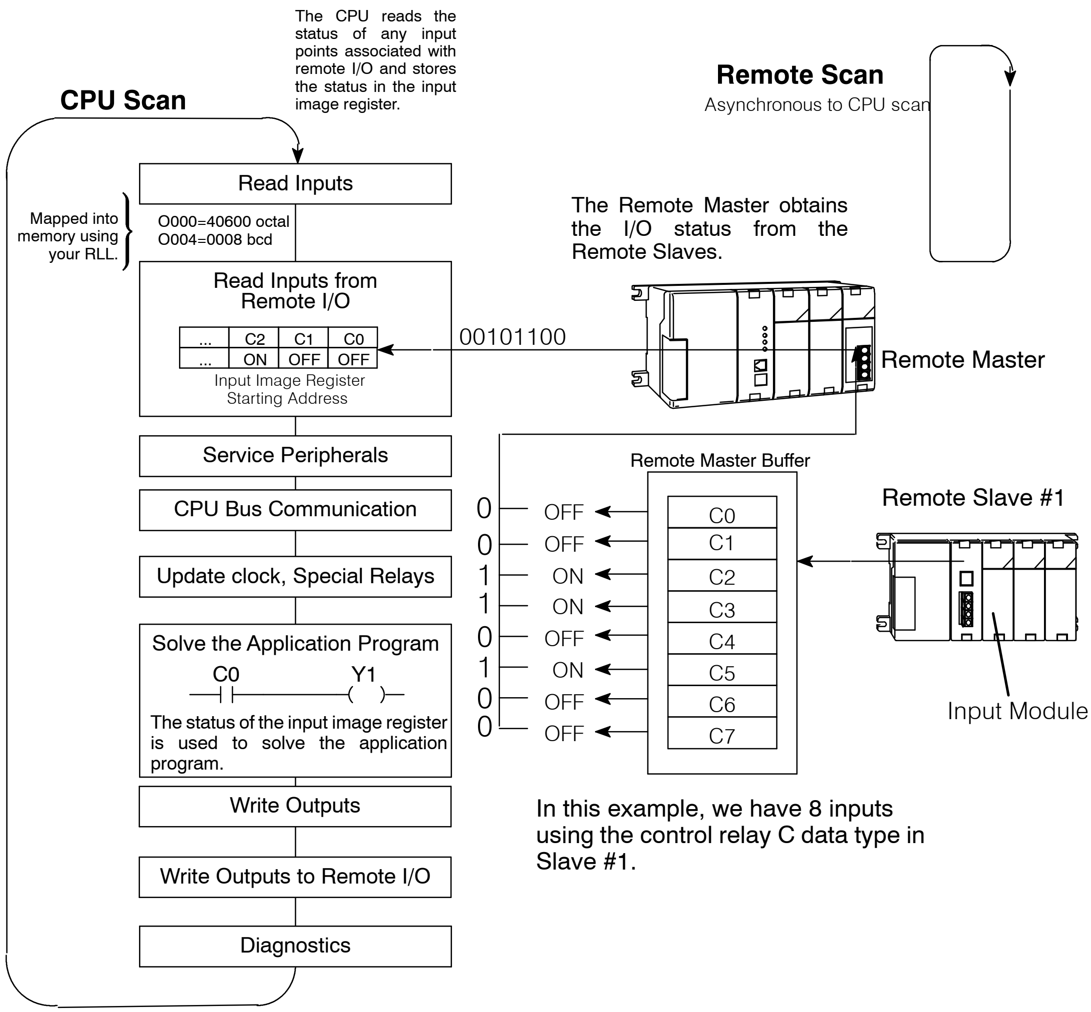
Remote I/O Address and Range Assignment



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 occuring 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 points that must be monitored on every CPU scan, it's a good idea to place these critical I/O points in the local base.



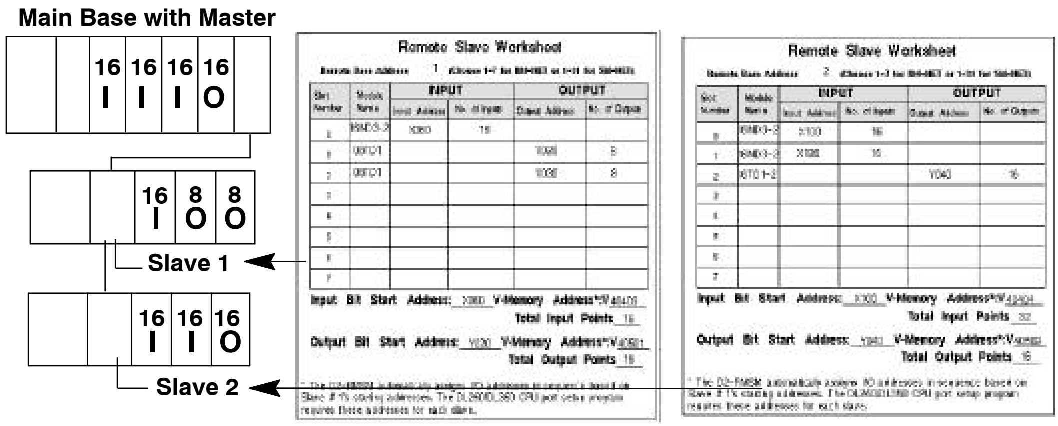
NOTE: In some cases it may be helpful to understand the update time required for a Remote I/O system. Appendix C shows example calculations.

3 Easy Steps for Setting Up Remote I/O

1

Design the Remote I/O System

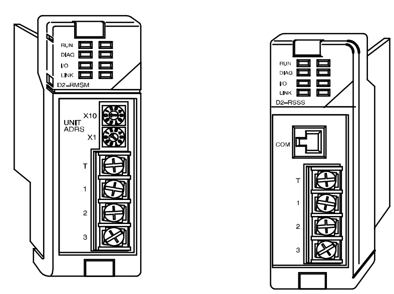
Figure out how much remote I/O you will need. This will, in turn, tell you which CPU and the number of remote masters and slaves you will need. **In Chapter 2**, we will show you how to use worksheets to plan and keep track of your data type assignments. We'll also show you how to determine the correct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



2

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, protocol selection, and other parameters. Installation is **covered in Chapter 3.**

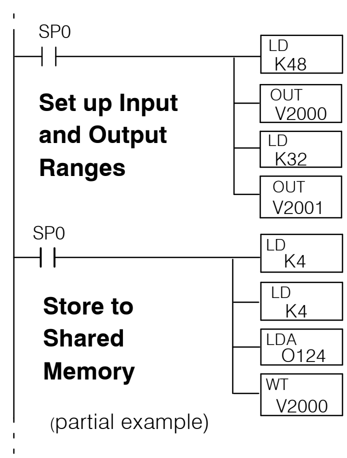


3

Write the Setup Program

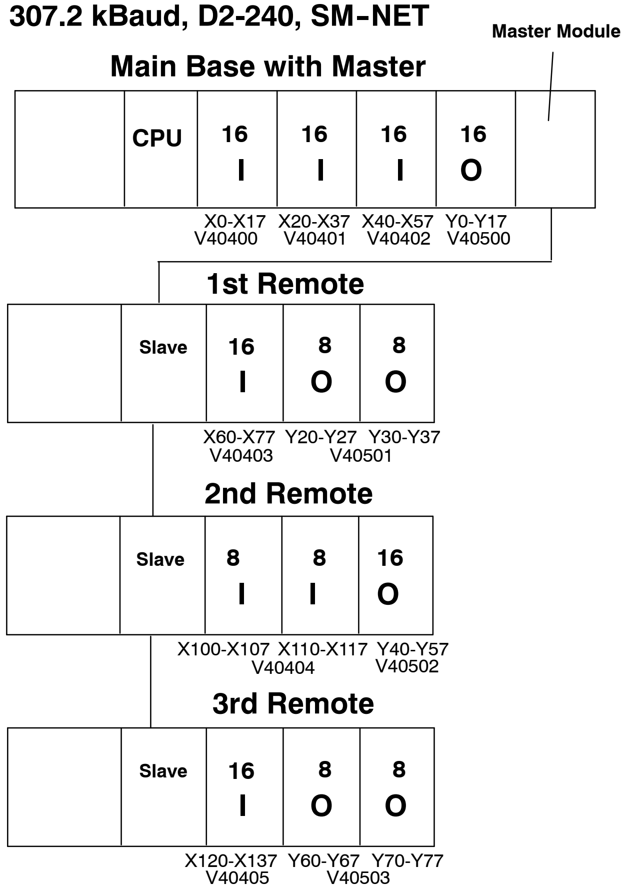
Write the RLL setup program. Complete examples are **covered in Chapter 4**.

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.



Step 1: Design the Remote I/O System

EXAMPLE:
307.2 kBaud, D2-240, SM-NET



Remote Slave Worksheet

Remote Base Address 1 **(Choose 1-7 for RM-NET or 1-31 for SM-NET)**

Slot Number	Module Name	INPUT		OUTPUT	
		Input Address	No. of Inputs	Output Address	No. of Outputs
0	16ND3-2	X060	16		
1	08TD1			Y020	8
2	08TD1			Y030	8
3					
4					
5					
6					
7					

Input Bit Start Address: X060 **V-Memory Address*:V** 40403
Total Input Points 16

Output Bit Start Address: Y020 **V-Memory Address*:V** 40501
Total Output Points 16

* The D2-RMSM automatically assigns I/O addresses in sequence based on Slave # 1's starting addresses. The DL250/DL350 CPU port setup program requires these addresses for each slave.

Remote Slave Worksheet

Remote Base Address 2 **(Choose 1-7 for RM-net or 1-31 for SM-NET)**

Slot Number	Module Name	INPUT		OUTPUT	
		Input Address	No. of Inputs	Output Address	No. of Outputs
0	08ND3	X100	8		
1	08ND3	X110	8		
2	16TD1-2			Y040	16
3					
4					
5					
6					
7					

put Bit Start Address: X100 **V-Memory Address*:V** 40404
Total Input Points 16

put Bit Start Address: Y040 **V-Memory Address*:V** 40502
Total Output Points 16

he D2-RMSM automatically assigns I/O addresses in sequence based on ve # 1's starting addresses. The DL250/DL350 CPU port setup program uires these addresses for each slave.

Remote Slave Worksheet

Remote Base Address 3 **(Choose 1-7 for RM-NET or 1-31 for SM-NET)**

Slot Number	Module Name	INPUT		OUTPUT	
		Input Address	No. of Inputs	Output Address	No. of Outputs
0	16NA	X120	16		
1	08TA			Y060	8
2	08TA			Y070	8
3					
4					
5					
6					
7					

Input Bit Start Address: X120 **V-Memory Address*:V** 40405
Total Input Points 16

Output Bit Start Address: Y060 **V-Memory Address*:V** 40503
Total Output Points 16

* The D2-RMSM automatically assigns I/O addresses in sequence based on Slave # 1's starting addresses. The DL250/DL350 CPU port setup program requires these addresses for each slave.

Note:
The Remote Slave Worksheet is located in Appendix A.

Step 2: Set the Hardware

Dip Switches Set for:
SM-NET mode
307.2 KBaud
Outputs clear on fault

Channel Configuration Worksheet

D2-RMSM Remote Master Module
Master Slot Address 4 (1-7)
Protocol Selected SM-NET (RM-NET or SM-NET)

Circle one selection for each parameter (selections for each protocol are shown)

Configuration Parameter	RM-NET	SM-NET
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4	19.2 38.4 153.6 307.2 614.4
Operator Interface	N/A	YES NO
Auto Return to Network (either protocol)	YES NO	YES NO

Starting Input V Memory Address: V40403 **Starting Output V Memory Address:** V40501
Total Inputs 48 **Total Outputs** 48

Slave Station	No. of Inputs	No. of Outputs	Slave Station	No. of Inputs	No. of Outputs
0	N/A	N/A	16		
1	16	16	17		
2	16	16	18		
3	16	16	19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		

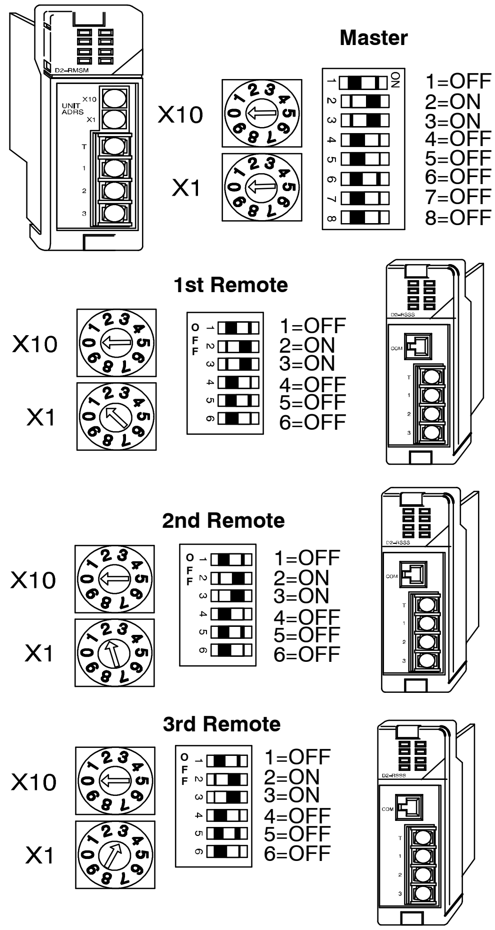
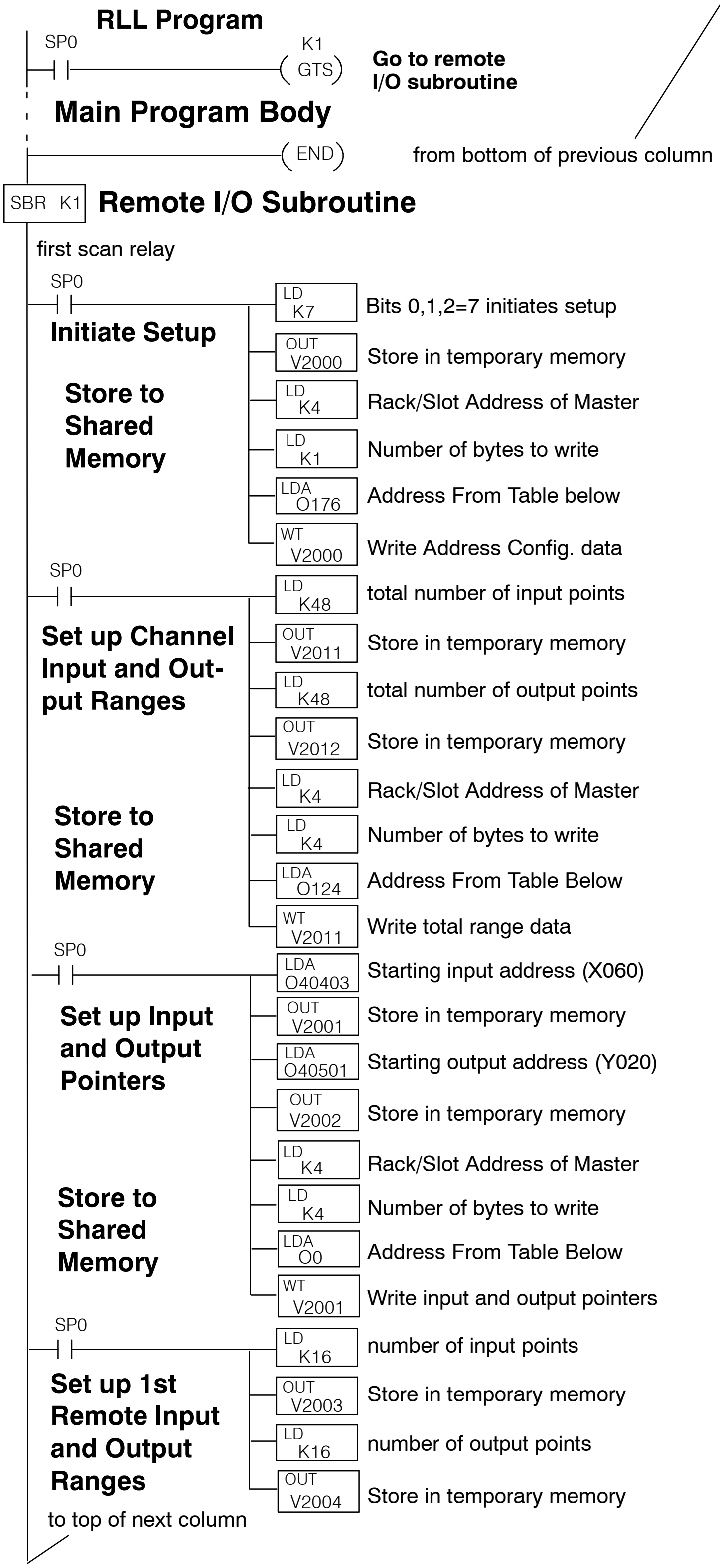
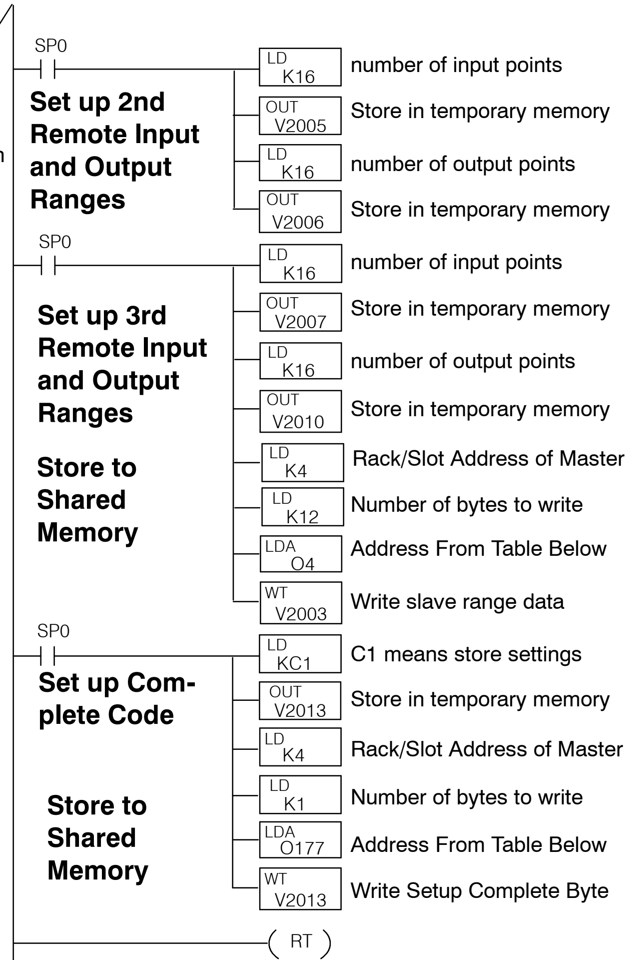


Chart for DIP Switch Settings

Module	DIP Position 1	2,3,4	5	6	7	8
Master (RMSM)	**Mode** OFF=SM-NET ON=RM-NET	**Baud Rate** Switch Position Baud Rate 2 3 4 19.2K O O O 38.4K X O O 153.6K O X O 307.2K X X O 614.4K O O X where X=ON, O=OFF Note: Baud rates above 38.4K for SM-NET only	Always OFF	Always OFF	Always OFF	**Diagnostics** OFF=Normal ON=Diagnostic
Slave (RSSS)	**Mode** Same as Master	**Baud Rate** Same as Master	**Output Default** OFF=Clear ON=Hold	**Diagnostics** OFF=Normal ON=Diagnostic	N/A	N/A

Step 3: Write the Setup Program





Quick Reference Table of Shared Memory Addresses

D2-RMSM				
Setup Initiation Byte				176
Setup Complete Byte				177
Slave	Input Address	Output Address	Number of Input Pts	Number of Output Pts
ALL	000	002	124	126
1	N/A	N/A	004	006
2	N/A	N/A	010	012
3	N/A	N/A	014	016
4	N/A	N/A	020	022
5	N/A	N/A	024	026
6	N/A	N/A	030	032
7	N/A	N/A	034	036

Frequently Asked Questions

Q. How much remote I/O can I have?

A. The physical limitation depends on the CPU and the protocol you select (i.e. number of channels and number of slaves per channel). In terms of addressing the remote I/O, you can use up to the maximum input and output addresses allowed for the CPU chosen (640 for the DL240, 1024 for the DL250) if you have no local I/O. If you need more, you can define inputs and/or outputs to use the C (control relay) memory type, up to the maximum address available. In theory, this could give you 896 I/O for the DL240, and 2048 I/O for the D250. For the DL350 CPU, the bottom port can have the maximum of 512 remote points. Combined with the maximum local/expansion configuration of 368 points, this could give you 880 total I/O for a DL350 system.

Q. What if I want to add remote I/O after I have programmed the system?

A. Your setup program can allot unused slots to I/O in a remote slave base, or a block of I/O at the end of a channel, which you can install at a later date. If the local base has blank slots, you can install a D2-RMSM to add a new channel.

Q. Can I use this remote I/O with other DL series products?

A. Yes, the D2-RSSS slave units can be attached to the DL350 and DL450 CPU bottom ports, as well as the D4-RM Remote Master or D4-SM Slice Master. The D2-RMSM remote master can communicate to D4-RS remote slaves or D4-SS slice slaves. This manual covers DL350 setup programming in Chapter 5; refer to the DL405 User Manual, D4-RM Remote Master manual, or DL405 Slice I/O manual to configure and program a DL405 system that includes D2-RSSS slave units.

Q. Can I use a programmer or operator interface on the remote I/O link?

A. Yes, in the SM-NET protocol mode, the communications port on the D2-RSSS remote slave supports a handheld programmer, ***Direct***Soft, or an operator interface such as the DV-1000. Note that since the bottom port of the DL250 or DL350 CPU supports the RM-NET mode only, you *cannot* use the remote communications port on slaves which are attached to the CPU.

Q. What if my cable routing causes the channel communication cable to exceed the maximum allowed distance?

A. You may need to reconsider the physical layout of your system. For example, you could split one large channel into two channels whose individual cable lengths would be acceptable. Or you could locate the local rack that contains the master modules in the “center” of the system, and radiate multiple channel communications cables in many directions.

2

Designing a Remote I/O System

In This Chapter. . . .

— Determining the System Layout
— Calculating the Power Budget

Determining the System Layout

Determine the Hardware Configuration

The first step in putting any system together is to establish a picture of the system components. The DL205 remote I/O gives you the flexibility to build a system which takes advantage of the features you need. The possibilities are endless, but the table below shows some combinations that will fit the majority of applications. And if you need a combination of features, remember that you can configure each remote master in a system differently.

Products	Configuration	Advantages
D2-240 D2-250 D2-RMSM D2-RSSS D4-RS	DL205 CPU with Remote Master(s) to rack-based DL205 Remote I/O and/or DL405 remote I/O	Uses RM-NET mode; efficient way to expand I/O for DL205 (the remote I/O racks may be located with the CPU base). You can use the bottom port of the DL250 CPU as the first master for a cost savings.
D4-440 D4-450 D4-RM D4-RS D2-RSSS	DL405 CPU with Remote Master(s) to rack-based DL205 and rack-based DL405 Remote I/O	Uses RM-NET mode; this gives you remote I/O which is smaller and less expensive than the DL405 I/O, as long as the DL205 I/O selection meets your needs
D2-240 D2-250 D2-RMSM D2-RSSS D4-SS-X	DL205 CPU with Remote Master(s) to rack-based DL205 Remote I/O and/or DL405 Slice I/O units	Uses SM-NET mode; this gives you a way to distribute small amounts of I/O to many locations, as well as locating operator interfaces at any of those locations. Also allows higher baud rates.Slice I/O unit addresses are limited to 1 to 15 only.
D4-440 D4-450 D4-SM D4-SS-X D2-RSSS	DL405 CPU with Slice I/O Master(s) to rack-based DL205 Remote I/O and/or DL405 Slice I/O units	Uses SM-NET mode; this can distribute small amounts of less expensive I/O to many locations, as well as locating operator interfaces at any of those locations. The DL405 CPU gives you the most advanced programming instruction set for more complex applications, as long as the DL205 I/O selection for remote I/O meets your needs.
D3-350 D4-RS D2-RSSS	DL350 CPU with built in bottom port as remote master to rack-based DL205 and/or rack-based DL405 Remote I/O	Uses RM-NET mode; this gives you remote I/O expansion for a DL350 system to extend the amount and distance of I/O

Which Modules can go in the Remote Bases

The remote I/O bases accept the most commonly used I/O modules for the DL205 system (AC, DC, AC/DC, Relay and Analog). The table below lists by category those modules that you may use in a remote I/O base.

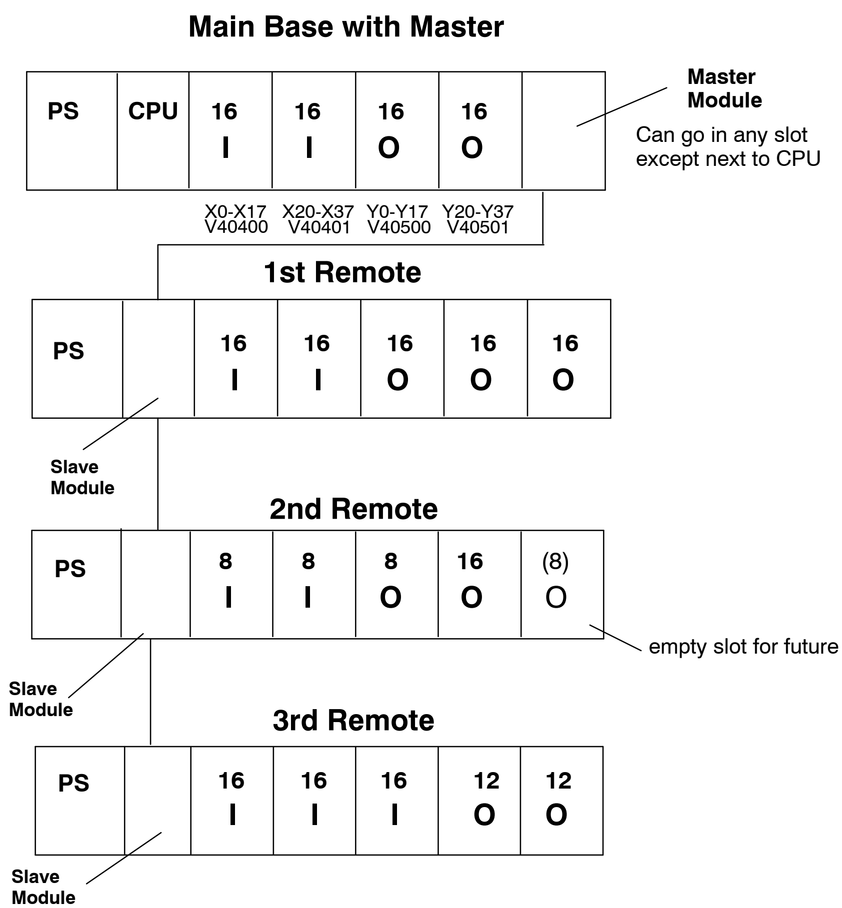
Module/Unit	Remote Base
CPUs	No
DC Input Modules	Yes
AC Input Modules	Yes
AC/DC Input Modules	Yes
DC Output Modules	Yes
AC Output Modules	Yes
Relay Output Modules	Yes
Analog Modules	Yes
Thermocouple Module	Yes
RTD Module	Yes
Remote I/O	
Remote Master	No
Remote Slave Unit	CPU Slot Only
Communications and Networking Modules	No
Specialty Modules	
High Speed Counter	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 installed in *local 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. Take this into account in applications where the timing is critical.

Determine I/O Needed and How Many Masters & Slaves

Once you choose the hardware configuration you need, create a diagram of the system I/O to help determine the amount and locations of remote bases . Below is a drawing of a typical system with:

- one master module in the main base.
- main base has two input modules and two output modules, each with 16 points.
- first remote base has two input and three output modules--each with 16 points.
- second remote base has two 8-point input modules, one 8-point output module, and one 16-point output module. It also contains space for a future output module.
- third remote base has three 16-point input modules, and two 12-point output modules.



This layout might be typical of a system which requires additional I/O at the CPU location (beyond the local rack capacity), as well as a remote location or two.

Define the System Details By Using Worksheets

In Appendix A of this manual you will find worksheets for designing the remote I/O system and defining its parameters. We suggest that you photocopy these sheets and use them 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 system. The Channel Configuration Sheet defines the operating parameters for a channel. The Remote Slave Worksheet records the amount and addresses of the I/O for each slave. First, select the Channel Configuration Worksheet to determine the characteristics for each channel (master) in the system.

Choosing the Protocol Mode – RM-NET vs. SM-NET

The most important decision you must make is to choose the protocol mode for each master in the system. The two protocols, RM-NET and SM-NET, each have features which may be of importance to your configuration. The system layout affects this choice, since there is a difference in the number of slaves allowed, the possible baud rates, and the total I/O link distance. First, let's review the specifications for the two protocol modes:

Specification	RM-NET	SM-NET
Maximum # of Slaves (per channel)	7	31
Maximum # of I/O per channel	512	512
Baud Rates	19.2K or 38.4K baud	19.2K, 38.4K, 153.6K, 307.2K, or 614.4K baud
Transmission Distance	3900 ft (1.2Km)	3900 ft (1.2Km) @ 19.2K or 38.4K baud 1968 ft (600m) @ 153.6K baud 984 ft (300m) @ 307.2K baud 328 ft (100m) @ 614.4K baud

Based on system layout, there may be advantages in choosing one protocol over the other. The comparison chart below lists these advantages in practical terms.

Reasons to Choose RM-NET vs SM-NET

RM-NET Advantages	SM-NET Advantages
Cost savings for D2-250 system if first/ only channel is attached to CPU Port 2 Can use D2-RSSS Remote Slave units with DL405 Remote Master for cost & space savings over DL405 Remote I/O	Supplies high speed I/O expansion When Remote I/O must be highly distributed – need more slaves per channel, can use Slice I/O if needed Desire programming port or operator interface port at remote base location(s)

Choosing the Output Default Mode – Hold Last State vs. Clear

The hardware selection for the output default mode determines the outputs' response to a communications failure. A DIP switch setting on the slave modules defines the default mode for each slave. "Hold Last State" causes the outputs in that slave unit to remain in their last state upon a communication error. "Clear Outputs" sets the outputs in that slave unit to OFF (0).

NOTE: The Output Default mode does not have to be the same for all slaves on a channel.

The selection of the output default mode will depend on your application. You must consider the consequences of turning off all the devices in one or all slaves at the same time vs. letting the system run "steady state" while unresponsive to input changes. For example, a conveyor system would typically suffer no harm if the system were shut down all at once. In a way, it is the equivalent of an "E-STOP". On the other hand, for a continuous process such as waste water treatment, holding the last state would allow the current state of the process to continue until the operator can intervene manually .

WARNING: Selecting "HOLD LAST STATE" as the default mode means that outputs in the remote bases will not be under program control in the event of a communications failure. Consider the consequences to process operation carefully before selecting this mode.

Auto Return to Network Option

The remote master queries the channel to detect which slaves are present in three instances:

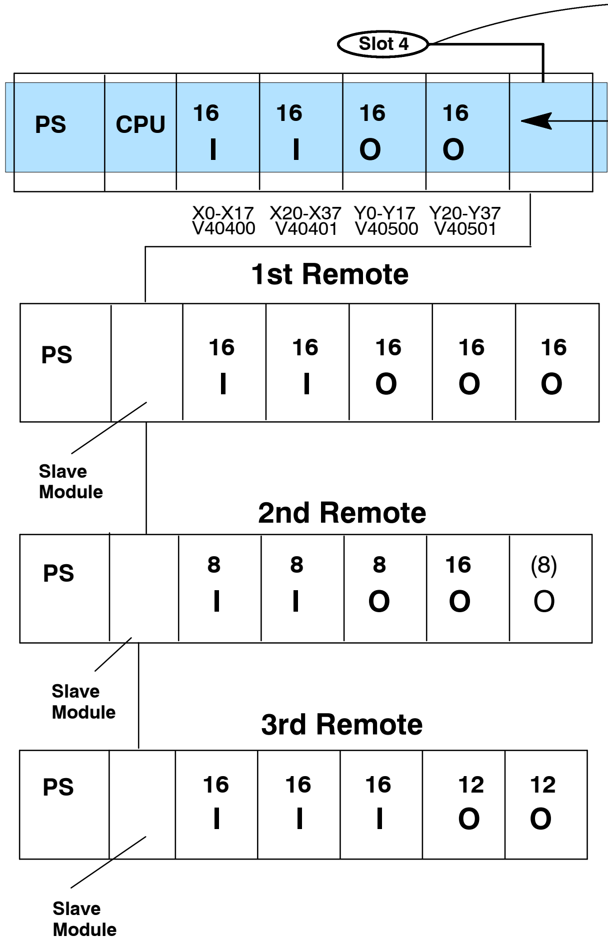
- on power up
- on transition from CPU Program Mode to Run Mode
- when user logic commands the remote master to log its parameters to EEPROM

If an offline slave comes on after the master powers up, the master may never know that a slave has returned to the network. If you select the Auto Return to Network mode, the master can detect reinstated slaves at any time.

Completing the Channel Configuration Worksheet (top half)

The top half of the following Channel Configuration Worksheet shows the parameter choices for the single master in our example system. This helps determine the hardware settings and the setup program data. We chose RM–NET for illustration purposes.

Main Base with Master



Channel Configuration Worksheet

D2–RMSM Remote Master Module
Master Slot Address 4 (1–7)
Protocol Selected RM–NET (RM–NET or SM–NET)

Circle one selection for each parameter (selections for each protocol are shown)

Configuration Parameter	RM–NET	SM–NET
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4	19.2 38.4 153.6 307.2 614.4
Operator Interface	N/A	YES NO
Auto Return to Network (either protocol)	YES NO	YES NO

Starting Input V Memory Address: V______ **Starting Output V Memory Address: V_____**
Total Inputs ________ **Total Outputs ________**

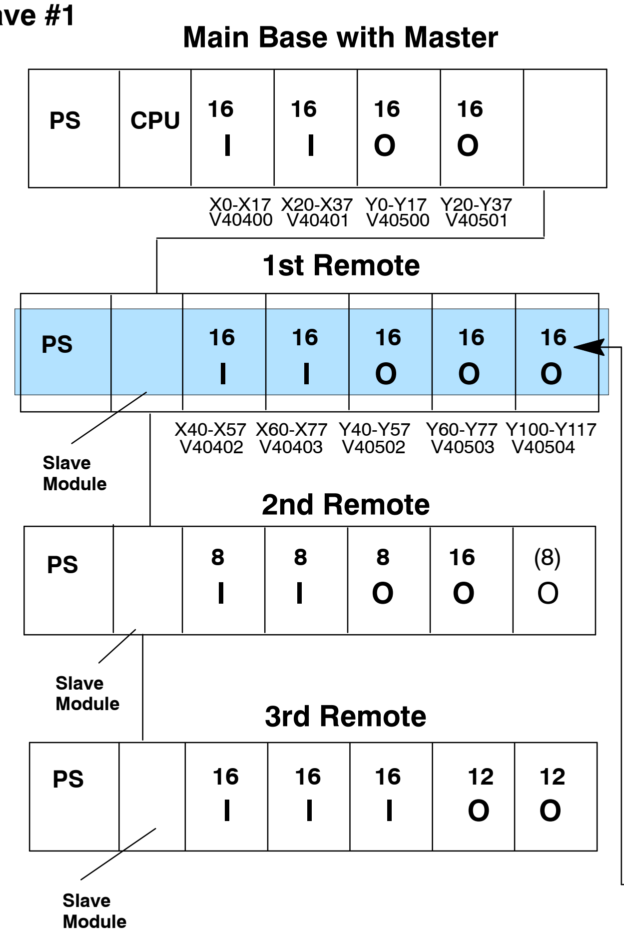
Slave Station	No. of Inputs	No. of Outputs	Slave Station	No. of Inputs	No. of Outputs
0	N/A	N/A	16		
1			17		
2			18		
3			19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		

NOTE: The slot number of the master is important because the setup program uses it to address the master module.

Now that we have determined the hardware layout and the channel parameters, we can fill in the details for the three remote bases.

Completing the Remote Slave Worksheet for Slave #1

We have filled in the following remote slave worksheet to match the first remote I/O base of the example system.



Remote Slave Worksheet

Remote Base Address 1 **(Choose 1-7 for RM-NET or 1-31 for SM-NET)**

Slot Number	Module Name	INPUT		OUTPUT	
		Input Address	No. of Inputs	Output Address	No. of Outputs
0	16ND3-2	X040	16		
1	16ND3-2	X060	16		
2	16TD1-2			Y040	16
3	16TD1-2			Y060	16
4	16TD1-2			Y100	16
5					
6					
7					

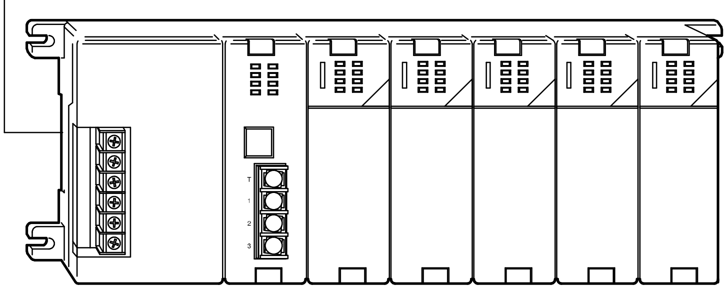
Input Bit Start Address: X040 **V-Memory Address*:V** 40402

Total Input Points 32

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

Total Output Points 48

* The D2–RMSM automatically assigns I/O addresses in sequence based on Slave # 1's starting addresses. The DL250/DL350 port setup program requires these addresses for each slave.



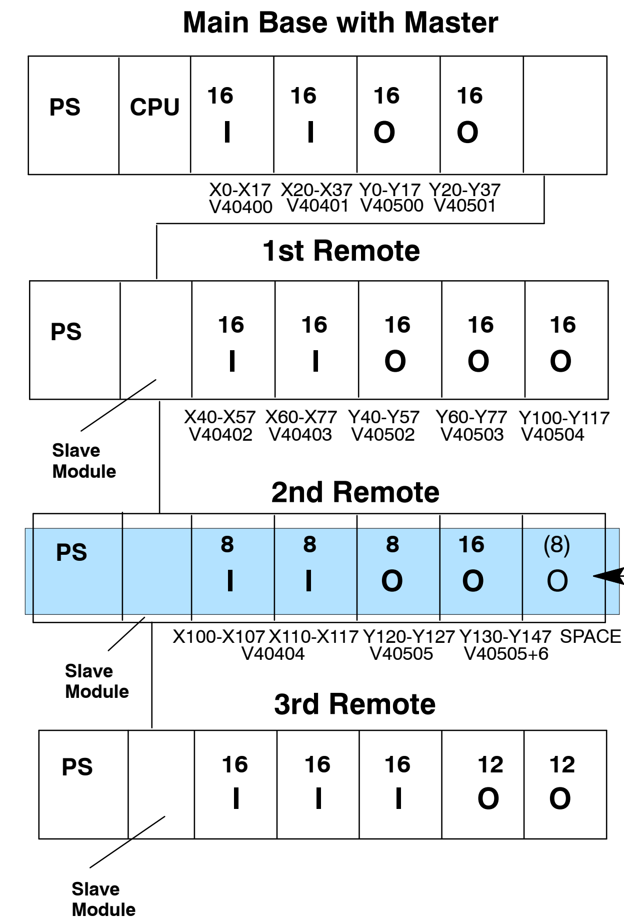
Starting Addresses From Appendix B = V40402 Input V40502 Output

In this example, the CPU base has 64 points allocated to its input and output modules, which the CPU automatically configures as points X0 thru X37 and Y0 thru Y37. Thus, the starting address for the *first remote base* inputs can start at X040 (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 X040, you look for 040 on the chart. There you find the cross-referenced register address: 40402. On the output chart, you cross-reference Y040 with 40502. Enter enter these numbers on the worksheet, as you will use them later in your setup logic.

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

Completing the Remote Slave Worksheet for Slave #2

We have filled in the following remote slave worksheet to match the second remote I/O base of the example system.



Remote Slave Worksheet

Remote Base Address 2 **(Choose 1-7 for RM-NET or 1-31 for SM-NET)**

Slot Number	Module Name	INPUT		OUTPUT	
		Input Address	No. of Inputs	Output Address	No. of Outputs
0	08ND3	X100	8		
1	08ND3	X110	8		
2	08TD1			Y120	8
3	16TD1-2			Y130	16
4	SPACE			Y150	8
5					
6					
7					

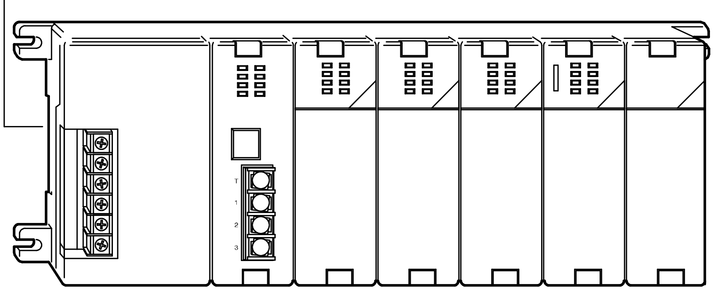
Input Bit Start Address: X100 **V-Memory Address*:V** 40404

Total Input Points 16

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

Total Output Points 32

* The D2-RMSM automatically assigns I/O addresses in sequence based on Slave # 1's starting addresses. The DL250/DL350 CPU port setup program requires these addresses for each slave.

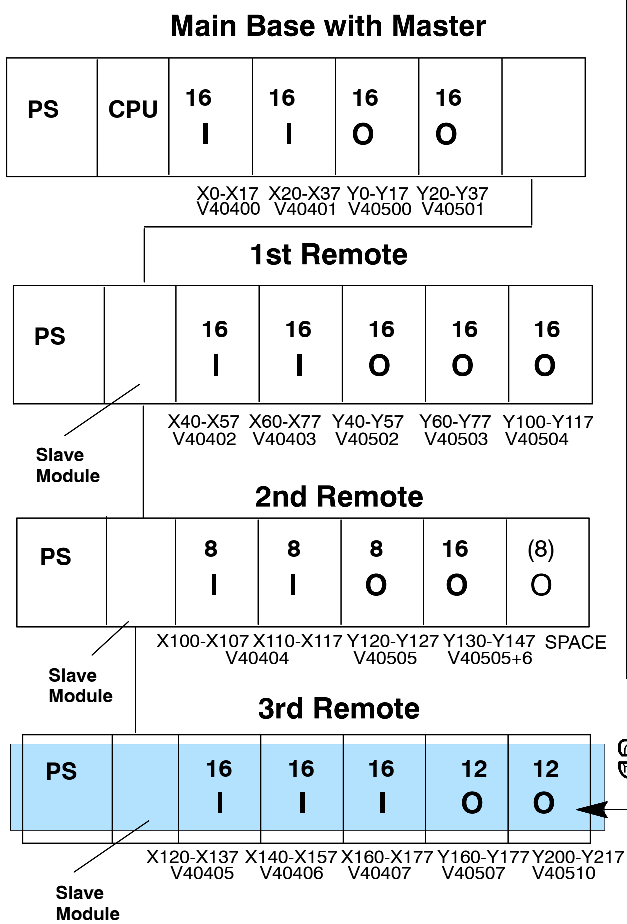


Based on the V-memory addresses we chose, the D2-RMSM allocated points X040 to X077 to Remote Slave #1's inputs, and Y040 to Y117 to its outputs. This means the starting address for the *second remote base inputs* is X100 (assigned automatically by the remote master) and the starting address for *outputs* is Y120 (assigned automatically). This remote slave has an empty slot to which we have allotted 8 future output points. The output points total on the worksheet includes the empty slot.

Completing the Remote Slave Worksheet for Slave #3

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

We have filled in the following remote slave worksheet to match the third remote I/O base of the example system.



Remote Slave Worksheet

Remote Base Address 3 **(Choose 1–7 for RM–NET or 1–31 for SM–NET)**

Slot Number	Module Name	INPUT		OUTPUT	
		Input Address	No. of Inputs	Output Address	No. of Outputs
0	16NA	X120	16		
1	16NA	X140	16		
2	16NA	X160	16		
3	12TA			Y160	16
4	12TA			Y200	16
5					
6					
7					

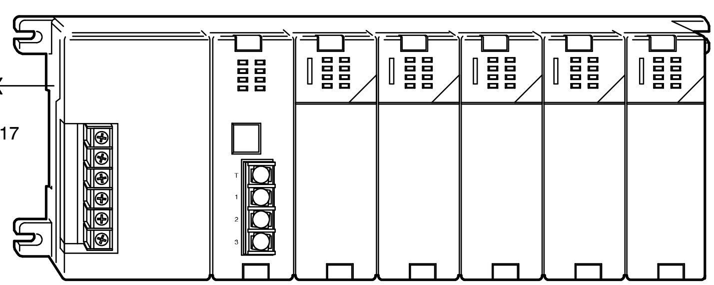
Input Bit Start Address: X120 **V-Memory Address*:V** 40405

Total Input Points 48

Output Bit Start Address: Y160 **V-Memory Address*:V** 40507

Total Output Points 32

* The D2–RMSM automatically assigns I/O addresses in sequence based on Slave # 1's starting addresses. The DL250/DL350 CPU port setup program requires these addresses for each slave.

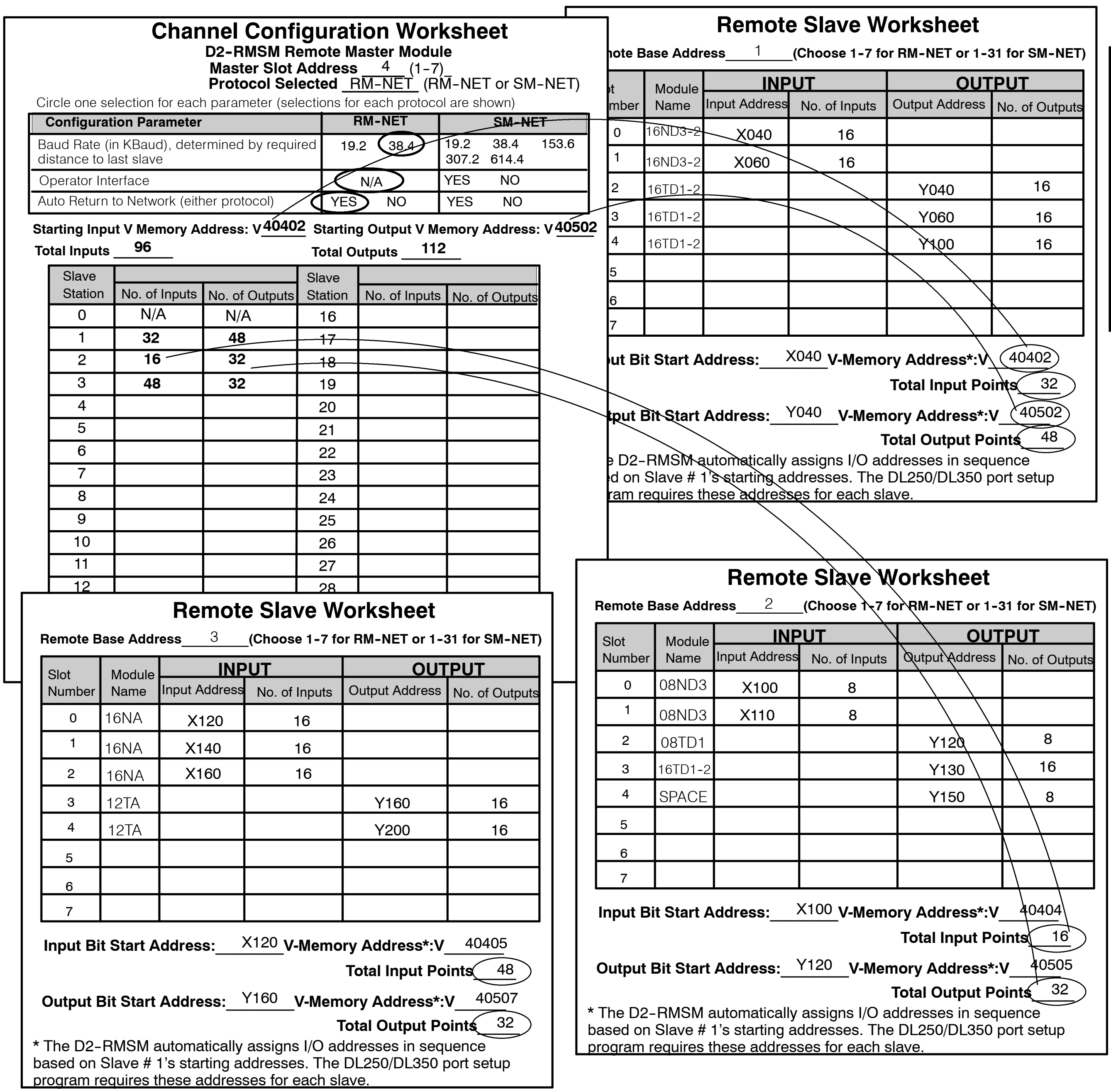


The D2–RMSM allocated X100 to X117 to Remote Slave #2's inputs, and Y120 to Y157 to its outputs. This means the starting address for the *third base inputs* is X120 (assigned automatically) and the starting address for *outputs* is Y160 (assigned automatically).

NOTE: The 12-point modules actually consume 16 points each since the memory allottment for a module must be on an 8-bit boundary.

Completing the Channel Configuration Worksheet (bottom half)

To complete the Channel Configuration Worksheet, we retrieve information from the Remote Slave Worksheets. Transfer the V-memory addresses for the inputs and outputs of Remote Slave # 1, and the input and output range for each slave to the Channel Worksheet to prepare to write the setup program. If using the DL250/DL350 CPU version of the configuration worksheet, transfer both the starting addresses and quantities from each slave sheet onto the chart.



Add the input and output ranges for the slaves to find the total input and output ranges for the channel. Enter the totals as shown on the Configuration 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 DL205 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 base selection. At the end of this section you will also find an example of power budgeting and a worksheet showing sample calculations. Appendix A contains a blank worksheet.

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

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.

Base Power Specifications

The following chart shows the amount of current **supplied** by the DL205 base units. 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 DL205 modules that require an external 24VDC. (Check the DL205 User Manual for the location of these terminals.)

Base Units	5V Current Supplied in mA (internal)	Auxiliary 24V Power Source Current Supplied in mA.	Base Units	5V Current Supplied in mA. (internal)	Auxiliary 24V Power Source Current Supplied in mA.
D2-03B	1550	200	D2-06B	1550	200
D2-03BDC-1	1550	None	D2-06BDC-1	1550	None
D2-03BDC-2	1550	200	D2-06BDC-2	1550	200
D2-04B	1550	200	D2-09B	2600	300
D2-04BDC-1	1550	None	D2-09BDC-1	2600	None
D2-04BDC-2	1550	200	D2-09BDC-2	2600	300

Module Power Requirements

This chart shows the amount of maximum current **required** for each of the DL205 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 base (if available) as long as you do not exceed the power budget.

Device	5V Current Required in mA. (internal)	External 24V Current Required in mA.
CPUs		
D2-230	120	None
D2-240	120	None
D2-250	330	None
DC Input Modules		
D2-08ND3	50	None
D2-16ND3-2	100	None
AC Input Modules		
D2-08NA-1	50	None
D2-16NA	100	None
D2-02NA-2	100	None
DC Output Modules		
D2-04TD1	60	20
D2-08TD1	100	None
D2-16TD1-2	200	80
D2-16TD2-2	200	None
AC Output Modules		
D2-08TA	250	None
D2-12TA	350	None
Relay Output Modules		
D2-04TRS	250	None
D2-08TR	250	None
D2-08TRS	670	None
D2-12TR	450	None
Combination In/Out Modules		
D2-08CDR	200	None

Device	5V Current Required in mA. (internal)	External 24V Current Required in mA.
Analog Modules		
F2-04AD-1	50	80
F2-04AD-1L	60	90 (12VDC)
F2-04AD-2	60	80
F2-04AD-2L	60	90 (12 VDC)
F2-08AD-1	50	80
F2-02DA-1	40	100
F2-02DA-2	40	60
F2-04AD2DA	60	100
F2-04THM	110	None
F2-04RTD	90	None
Remote I/O		
D2-RMSM	200	None
D2-RSSS	150	None
Communications		
FA-UNICON	External 24V or 5V @ 100mA	
F2-UNICON	Internal 5V @ 100mA (bottom port of CPU)	
FA-ISONET	Internal 5V (bottom port of CPU) or external 24V @ 100mA	
Specialty Modules		
F2-08SIM	50	None
D2-CTRINT	50*	None
D2-DCM	300	None
Programming		
D2-HPP	200	None
Operator Interface		
DV-1000	150	None

* requires external 5VDC for outputs

NOTE: Not all of the modules shown in the above table can be used in a remote base. Check page 2-3 for module placement restrictions.

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	Part Number	5 VDC (mA) (supplied or used)	Auxiliary Power Source 24 VDC Output (mA) (supplied or used)
Base Used	D2-06B	**1550**	**200**
CPU Slot	D2-RSSS	150	0
Slot 0	D2-08ND3	50	0
Slot 1	D2-08ND3	50	0
Slot 2	D2-08TD1	100	0
Slot 3			
Slot 4			
Slot 5			
Slot 6			
Slot 7			
Other			
		0	0
Maximum power required		**350**	**0**
Remaining Power Available		1550–350 =**1200**	200 – 0 = **200**

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. Devices which fall into the "**Other**" category are devices such as the handheld programmer which also have power requirements but do not directly plug into a slot in the base.
2. Add the current columns starting with the CPU SLot and put the total in the row labeled "**Maximum power required**"**.**
3. Subtract the row labeled "**Maximum power required**" from the row labeled "**Base Used**". Place the difference in the row labeled **"Remaining Power Available**".
4. If **"Maximum Power Required"** is greater than "**Base Used**" in either of the two columns, the power budget will be exceeded. It will be unsafe to use this configuration and you will need to restructure your I/O configuration.

Installation & Field Wiring Guidelines

3

In This Chapter. . . .

Introduction

4 Easy Steps: There are four easy steps to install either a D2-RMSM or D2-RSSS module:

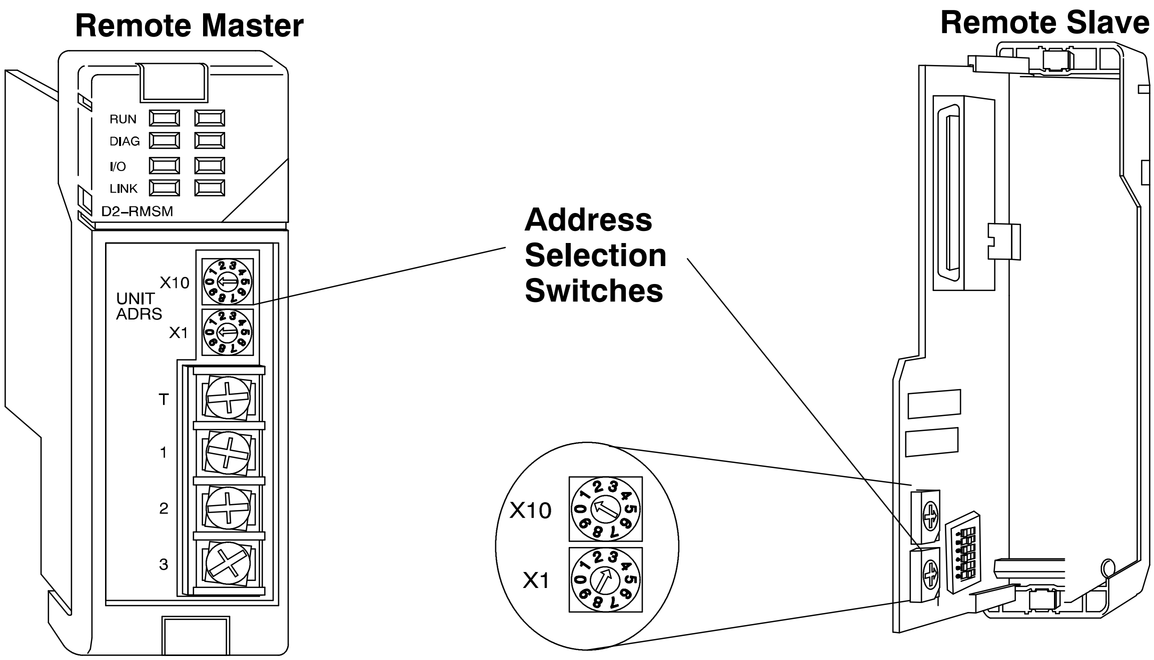
1. Set the address on the front or rear rotary switches.
2. Set the protocol mode, baud rate, and output default on the rear DIP switch.
3. With no power applied, insert the module into the base.
4. With no power applied, connect the wiring.

The text that follows will cover each of these steps in detail.

NOTE: We advise you to read the previous chapter on "Defining Your I/O System" before you install your remote master and slave units. The decision-making process explained in that chapter will help you understand the rotary switches and dip switches covered in this chapter. It will also help you with writing your ladder logic in the next chapter.

Step One: Setting the Rotary Switches

Both the remote master and slave have two small rotary switches to set the unit address. On the remote master (D2-RMSM), they are on the face of the module, with the label “UNIT ADRS” beside it. On the remote slave (D2-RSSS), they are on the printed circuit board of the module, and are labeled “SW2” and “SW3”. Adjust the switches by rotating them with a small flathead screwdriver.



One switch is marked X1 and the other X10. Don’t confuse these with the conventional data type labeling - *these do not refer to inputs* X1 and X10. Instead, these set the address in decimal for each unit. X1 is the “one’s” position and X10 is the “ten’s” position. For example, set address 13 by turning the X10 switch to 1 and the X1 switch to 3 (10+3=13).

Align the arrows on the switches to 0 to use the module as a **master** (D2-RMSM only). Set them to any number (1-7 for RM-NET mode or 1-31 for SM-NET mode) if it will be a **slave** (D2-RSSS). Two slaves cannot have the same number if they are linked to the same master. **Always use consecutive numbers for slaves, starting with Address 1—don’t skip numbers**.

Step Two: Setting the Rear DIP Switches

Toward the rear of each module you will find a DIP switch mounted on the circuit board. The remote master (D2–RMSM) has an 8-position switch labeled “SW3”, while the remote slave (D2–RSSS) has a 6-position switch labeled “SW1”. Set these switches to configure the protocol mode, the baud rate, and the output response on communication failure.

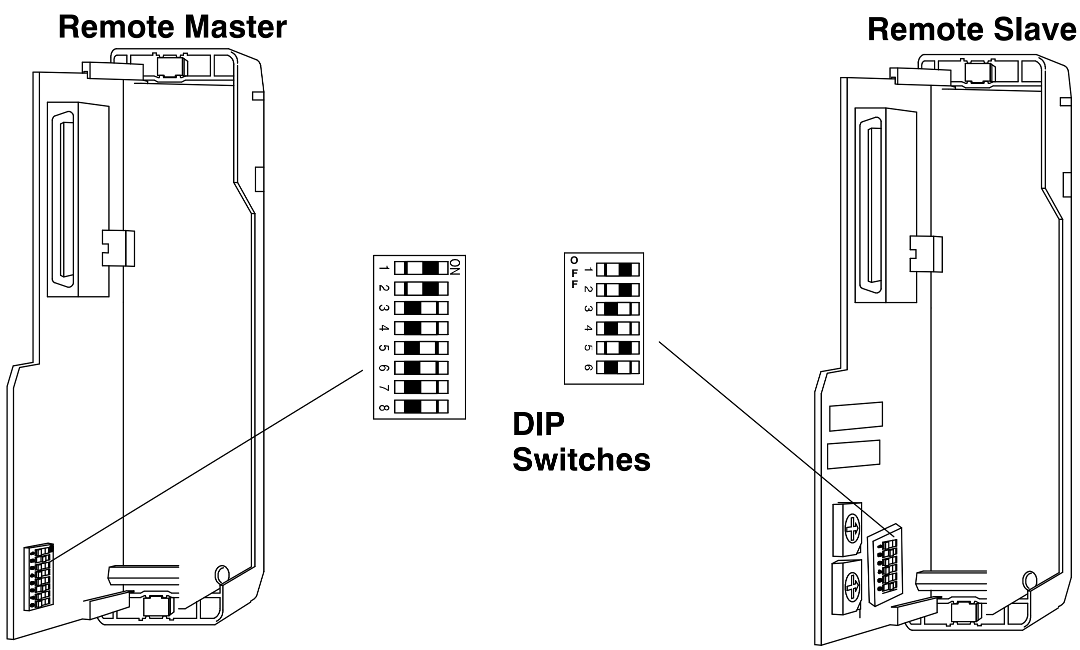


Chart for DIP Switch Settings

Module	DIP Position					
	1	**2,3,4**	**5**	**6**	**7**	**8**
Master (RMSM)	**Mode** OFF=SM–NET ON=RM–NET	**Baud Rate** Switch Position Baud Rate 2 3 4 19.2K O O O 38.4K X O O 153.6K O X O 307.2K X X O 614.4K O O X where X=ON, O=OFF- Note: Baud rates above 38.4K for SM–NET only	Always OFF	Always OFF	Always OFF	**Diagnostics** OFF=Normal ON=Diagnostic
Slave (RSSS)	**Mode** Same as Master	**Baud Rate** Same as Master	**Output Default** OFF=Clear ON=Hold	**Diagnostics** OFF=Normal ON=Diagnostic	N/A	N/A

For the D2-RMSM, the word “ON” is visible on the switch beside Position 1 to indicate which side is the ON position. For the D2-RSSS, the word “OFF” is visible on the switch beside Position 1 to indicate which side is the “OFF” position.

Mode: DIP switch Position 1 on both the master and slave unit selects the protocol mode for the remote I/O link. The DL205 remote I/O can use one of two protocols, **RM-NET** or **SM-NET.** Chapters 1 and 2 discussed the features of these protocols and the considerations for using each. Position 1 of the master and all slaves linked to it must be set to the same setting in order to communicate. If there are multiple masters in the system, each can use a different protocol if necessary.

Baud Rate: DIP switch Positions 2,3, and 4 on both the master and slave unit select the baud rate for the remote I/O link. If you have selected the **RM-NET** protocol mode, only Switch 2 selects the baud rate,either 19.2K or 38.4K baud. In this mode, be sure to set switches 3 and 4 OFF. If you have selected the **SM-NET** protocol mode, you set switches 2,3, and 4 to select among five baud rates ranging from 19.2K to 614.4K baud. The higher the baud rate, the less distance is allowed between the master and the end slave. See the Functional Specifications in Chapter 1 for the allowable distance at each baud rate. All stations on a remote I/O link must have the same baud rate before the communications will operate properly. If there are multiple masters in the system, each can use a different baud rate if necessary.

Output Default: DIP switch Position 5 on the slave determines the outputs' response to a communications failure. If DIP switch 5 is ON, the outputs in that slave unit will hold their last state upon a communication error. If OFF, the outputs in that slave unit will turn off in response to an error.

Diagnostics: DIP switch Position 8 on the master and Position 6 on the slave select the factory diagnostic mode, and should always be OFF. If the diagnostic mode is active, the module will not operate correctly.

Example Showing Proper Setting of Switches

Here's the way Steps 1 and 2 would be carried out for the system shown below, if we decided to operate **RM-NET** at 38.4 kBaud, and holding outputs upon a communication error:

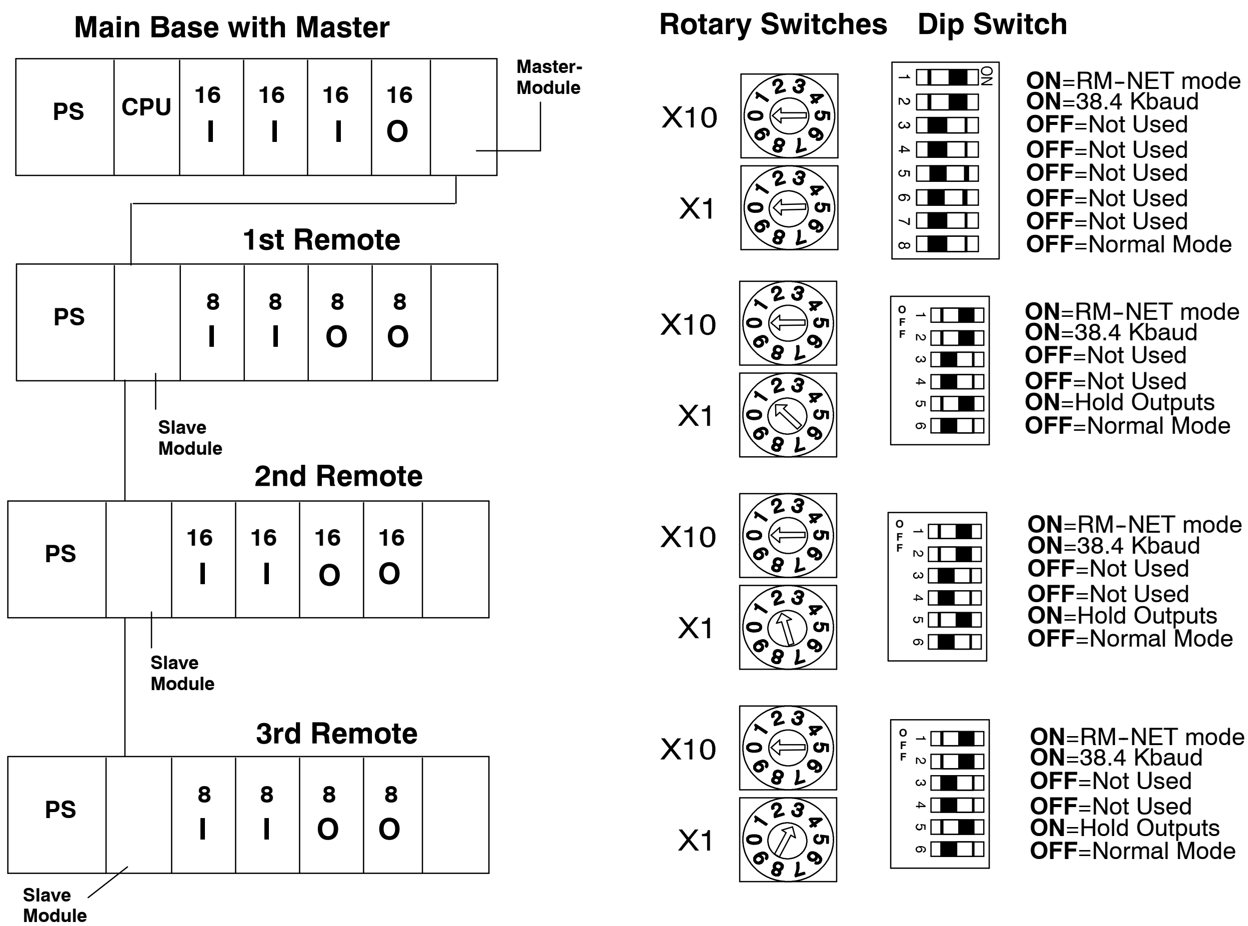


Chart for DIP Switch Settings

Module	DIP Position					
	1	2,3,4	5	6	7	8
Master (RMSM)	**Mode** OFF=SM-NET ON=RM-NET	**Baud Rate** Switch Position Baud Rate 2 3 4 19.2K O O O 38.4K X O O 153.6K O X O 307.2K X X O 614.4K O O X where X=ON, O=OFF Note: Baud rates above 38.4 K for SM-NET only	Always OFF	Always OFF	Always OFF	**Diagnostics** OFF=Normal ON=Diagnostic
Slave (RSSS)	**Mode** Same as Master	**Baud Rate** Same as Master	**Output Default** OFF=Clear ON=Hold	**Diagnostics** OFF=Normal ON=Diagnostic	N/A	N/A

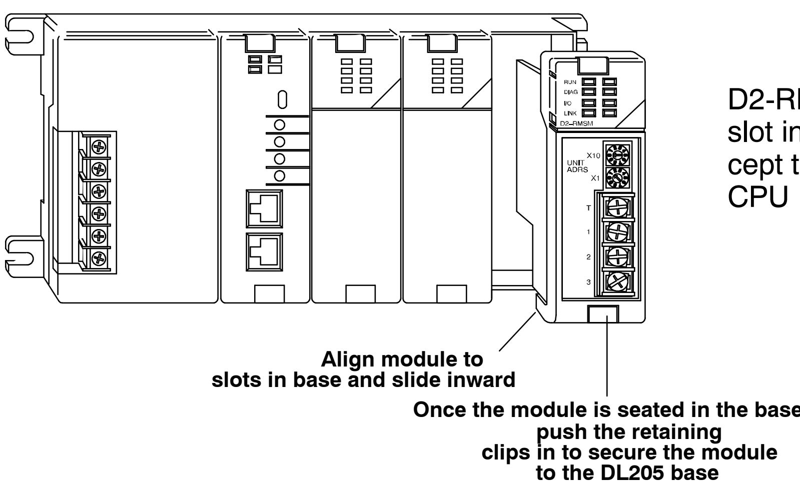
Step Three: Inserting the Module in the Base

The D2-RMSM can occupy any slot in the CPU base, except the slot adjacent to the CPU (that slot accomodates the counter interface module and its memory). The D2-RSSS must reside in the CPU slot of the remote base(s).

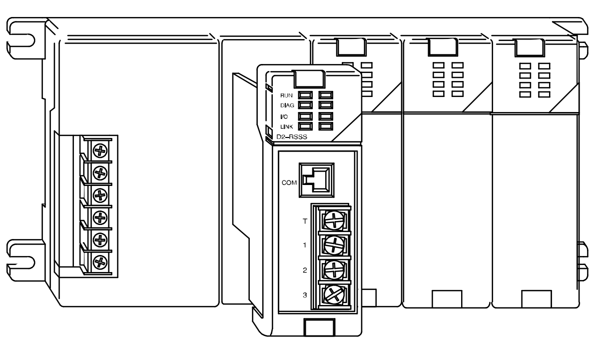
NOTE: Don't forget to check your total **power budget** and make sure the total current drawn by the remote modules and other I/O modules does not exceed the total amount allowable for the CPU you are using. See Chapter 2 of this manual or your DL205 User Manual for instructions on how to compute the power budget.

WARNING: To minimize the risk of electrical shock, personal injury, or equipment damage, always disconnect the system power before installing or removing any system component.

To insert the module into the base, align the circuit board with the grooves on the top and bottom of the base. Push the module straight into the base until it is firmly seated in the backplane connector. Once the module is inserted into the base, push in the retaining clips (located at the top and bottom of the module) to firmly secure the module to the base.



D2-RMSM can go into any slot in the local base except the slot adjacent to the CPU



D2-RSSS must be in the CPU slot of the remote base.

Step Four: Connecting the Wiring

General Wiring Guidelines

Consider the following wiring guidelines when wiring the communication cabling in your system:

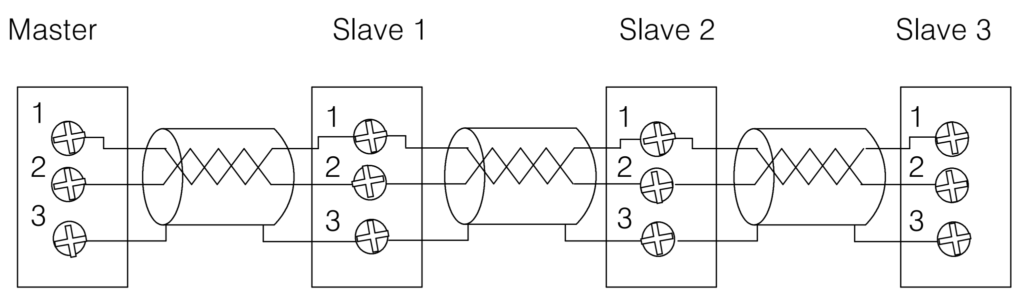
1. Always use a continuous length of cable. Do not combine cables to attain a needed length.
2. Use the shortest possible cable length.
3. Where possible, use conduit for cable routing.
4. Avoid running cable near high energy wiring.
5. Where possible, avoid running communications cabling in close proximity to AC wiring.
6. Avoid creating sharp bends in the cables.
7. Label all wires.

Cable Recommendation

The recommended cable for connecting the master and slaves is a single twisted pair cable, Belden 9841 or equivalent. This cable meets the RS-485 standard for communications. Its impedance specification is 120 ohms per thousand feet.

Cabling Between the D2–RMSM Master and Slaves

The diagram shown below depicts the cabling between the D2-RMSM master and its slaves. The two inner wires are connected to terminals 1 and 2 of each module. The shield wire is connected to terminal 3. *Make sure the the connections between master and all slaves are always 1 to 1, 2 to 2 and 3 to 3*.

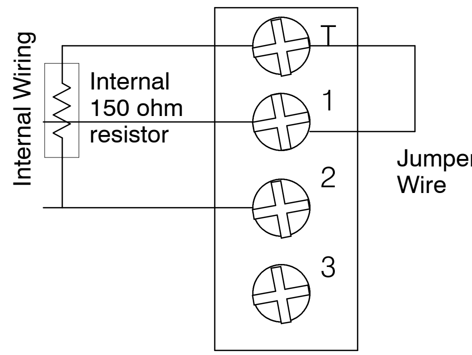


Termination Resistors

At each end of a master/slave system, it is necessary to have a *termination resistor* to prevent signal reflections from interfering with the communications. Although the modules have a 150 ohm resistor built in for this purpose, there are three options to consider:

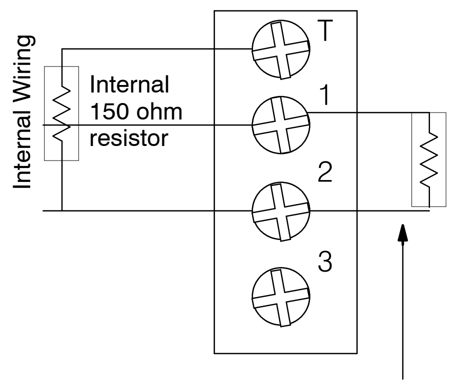
Option 1:
Use Internal Resistor Only

With this configuration, you use the internal resistor of the module to provide all the terminating resistance necessary. Place a jumper wire between the terminating terminal and terminal 1.



Option 2:
Use Internal Resistor and Balance Resistor

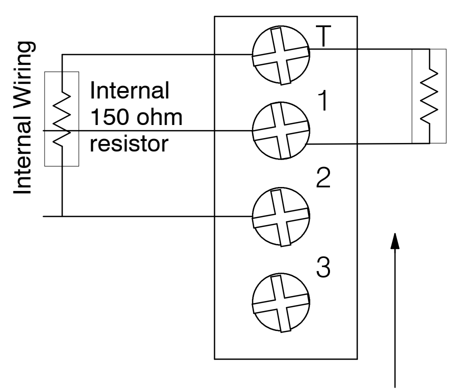
To better match the impedance of the cabling, you can elect not use the internal resistor; and instead, use a resistor of your choice externally. Connect this resistor between terminals 1 and 2. You do not use the jumper wire in this case.



You add your own resistor, using a resistor between 100 and 500 ohms.

Option 3:
External Resistor in Series

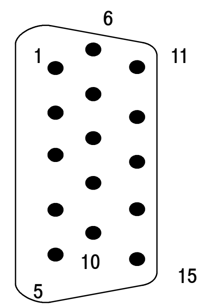
With this option, you use an external resisor in series with the internal resistor. The sum resistance should match the cabling impedance.



You use an external resistor in series with the internal resistor.

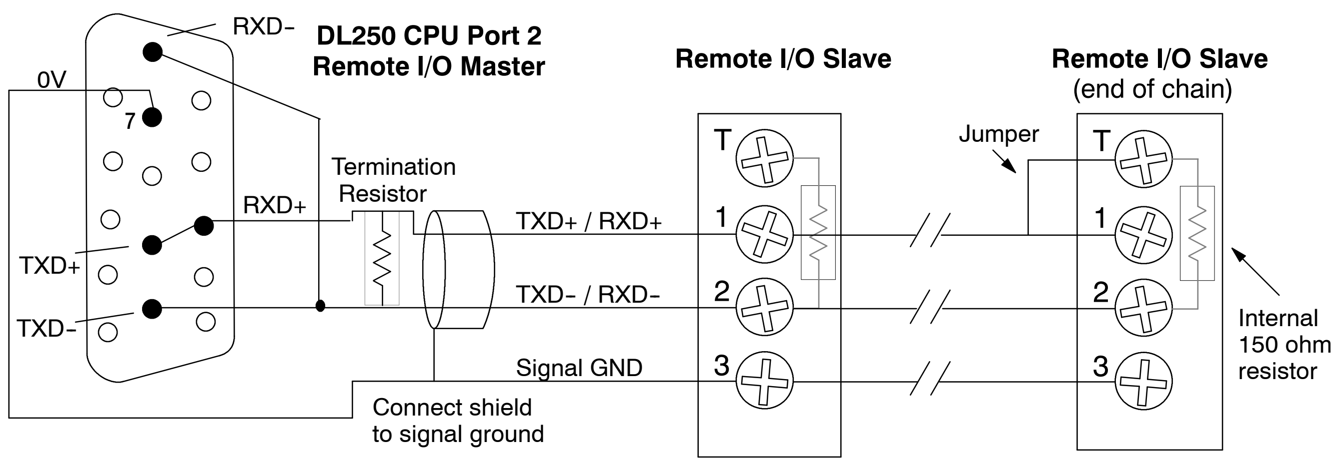
Cabling Between the D2–250 CPU bottom port and slaves

The standard remote I/O link is a 3-wire, half-duplex type. Since Port 2 of the DL250 CPU is a 5-wire full duplex-capable port, we must jumper its transmit and receive lines together as shown below (converts it to 3-wire, half-duplex). The diagram also depicts the port pinout for the D2–250 CPU bottom port.



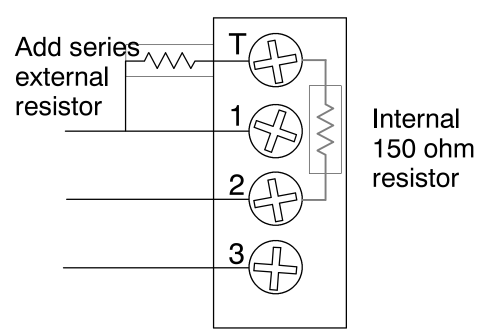
15-pin Female
D Connector

Port 2 Pin Descriptions (DL250 CPU)		
1	5V	5 VDC
2	TXD	Transmit Data (RS232C)
3	RXD	Receive Data (RS232C)
4	RTS	Ready to Send (RS–232C)
5	CTS	Clear to Send (RS–232C)
6	RXD2–	Receive Data – (RS–422)
7	0V	Logic Ground
8	0V	Logic Ground
9	TXD2+	Transmit Data + (RS–422)
10	TXD2 –	Transmit Data – (RS–422)
11	RTS2 +	Request to Send + (RS–422)
12	RTS2 –	Request to Send – (RS–422)
13	RXD2 +	Receive Data + (RS–422)
14	CTS2 +	Clear to Send + (RS422)
15	CTS2 –	Clear to Send – (RS–422)



The twisted/shielded pair connects to the DL250's Port 2 as shown. Be sure to connect the cable shield wire to the signal ground connection. A termination resistor must be added externally to the CPU, as close as possible to the connector pins. Its purpose is to minimize electrical reflections that occur over long cables. Be sure to add the jumper at the last slave to connect the required internal termination resistor.

Ideally, the two termination resistors at the cable's opposite ends and the cable's rated impedance will all three match. For cable impedances greater than 150 ohms, add a series resistor at the last slave as shown to the right. If less than 150 ohms, parallel a matching resistance across the slave's pins 1 and 2 instead.



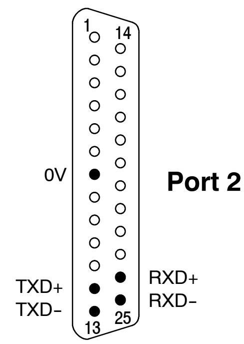
Remember to size the termination resistor at Port 2 to match the cable's rated impedance. *The resistance values should be between 100 and 500 ohms.*

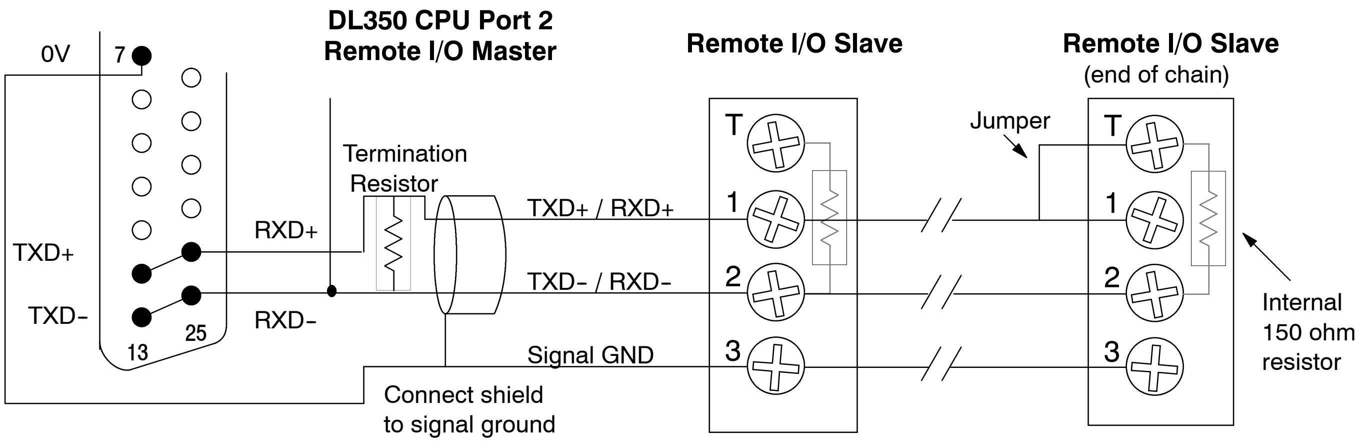
Cabling Between the D3-350 CPU bottom port and Slaves

The remote I/O link is a 3-wire, half-duplex type. Since Port 2 of the DL350 CPU is a 5-wire full duplex-capable port, we must jumper its transmit and receive lines together as shown below (converts it to 3-wire, half-duplex). The diagram depicts the port pinout for the D3-350 CPU bottom port.

The location of Port 2 on the DL350 is on the 25-pin connector , as pictured to the right.

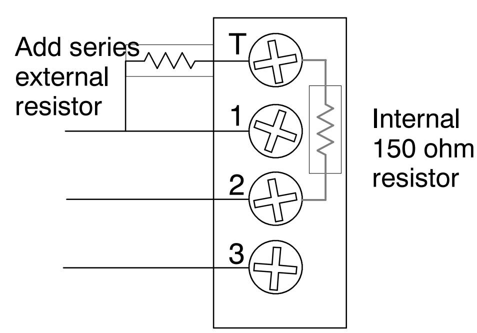
- Pin 7 Signal GND
- Pin 12 TXD+
- Pin 13 TXD-
- Pin 24 RXD+
- Pin 25 RXD-





The twisted/shielded pair connects to the DL350's Port 2 as shown. Be sure to connect the cable shield wire to the signal ground connection. A termination resistor must be added externally to the CPU, as close as possible to the connector pins. Its purpose is to minimize electrical reflections that occur over long cables. Be sure to add the jumper at the last slave to connect the required internal termination resistor.

Ideally, the two termination resistors at the cable's opposite ends and the cable's rated impedance will all three match. For cable impedances greater than 150 ohms, add a series resistor at the last slave as shown to the right. If less than 150 ohms, parallel a matching resistance across the slave's pins 1 and 2 instead.



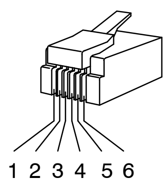
Remember to size the termination resistor at Port 2 to match the cable's rated impedance. *The resistance values should be between 100 and 500 ohms.*

Using the Slave Unit Communications Port

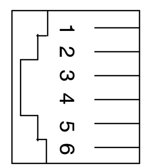
Port Specifications Each D2-RSSS slave module has an RJ-12 phone plug type communications port. It operates at 9600 baud, 8 data bits, one stop bit, and odd parity. It is active only when the channel is configured for SM-NET protocol. You can program or monitor the CPU through this port with ***Direct***SOFT or the handheld programmer. You can also connect the DV-1000 Operator Interface to this port. (Note, if you are using the handheld programmer or the DV-1000, remember to add the power requirement for the device when you calculate your power budget.) You may use multiple slave communication ports simultaneously on one channel.

Port Pinout The port pinout is shown below:

RJ12 plug on cable



RJ12 socket on D2-RSSS



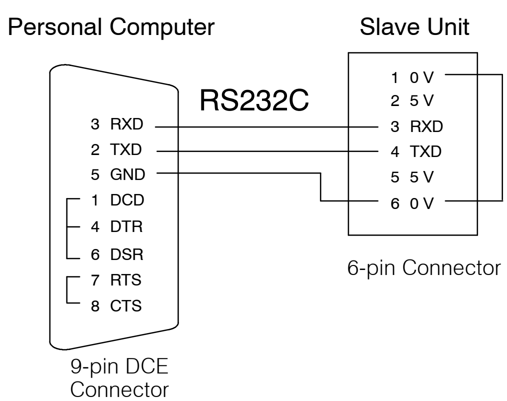
Port Pinout

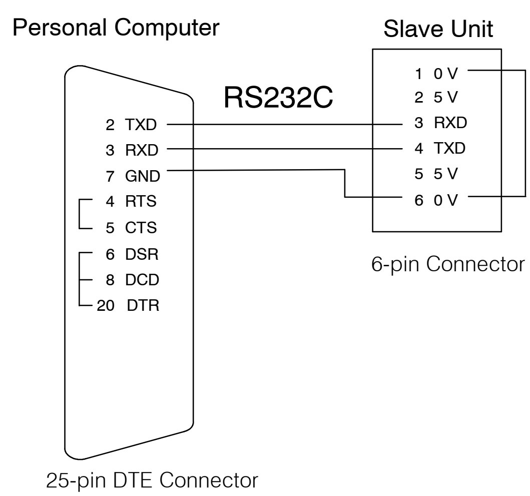
Pin	Signal Definition
1	0 V
2	5 V
3	RS232C Data In
4	RS232C Data Out
5	5 V
6	0 V

Port Cabling Since the handheld programmer and the DV-1000 obtain their operating power from the Slave unit, we strongly suggest you use the standard cables for these devices. You can order the necessary cables with the following part numbers:

- D2-DSCBL - ***Direct***SOFT Programming cable for the DL205 CPUs
- DV-1000CBL - 2m cable to connect DV-1000 Operator Interface

However, there may be an occasion where you need to quickly make your own programming cable for use with your laptop or personal computer. In this case, use the following cable pinout diagrams:





Pin labeling conforms to the IBM DTE and DCE standards.

4

D2–RMSM Setup Programming

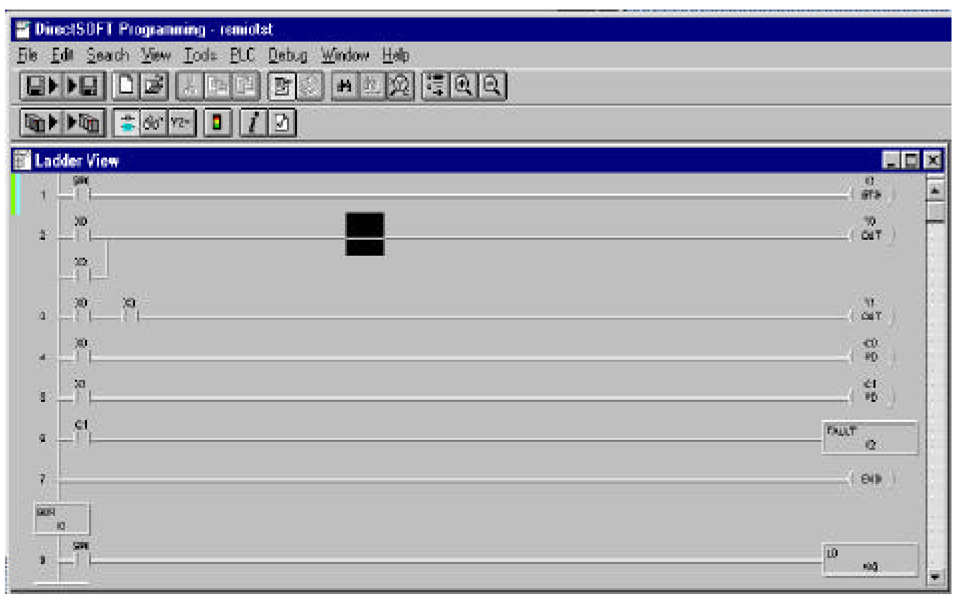
In This Chapter. . . .

Getting Started with Your Programming

You can write your program using either a handheld programmer or a PC loaded with software such as ***Direct***SOFT. The examples that follow will show you how to do it using ***Direct***SOFT.

To get started, enter ***Direct***SOFT and carry out the normal ***Direct***SOFT setup procedures for communicating with your DL205 CPU. If you do not know how to do this, refer to your ***Direct***SOFT Manual. Your DL205 User's Manual has a very good coverage of the basic commands available and examples of using the commands to write general ladder logic. We will be showing you in this chapter only those commands that pertain to setting up your remote I/O initialization and its successful utilization.

First open ***Direct***SOFT from Windows and establish a link with your CPU. Then enter the Edit Mode for programming. You should now be looking at a screen similar to the one shown below:



The ***Direct***SOFT window shown above depicts a program that has already been written. Your window, of course, will be empty when you first enter it. The pages that follow will show you how to write each part of your initialization program.

Writing Your Remote I/O Setup

Step 1: Decide How You Are Going to Call Your Program

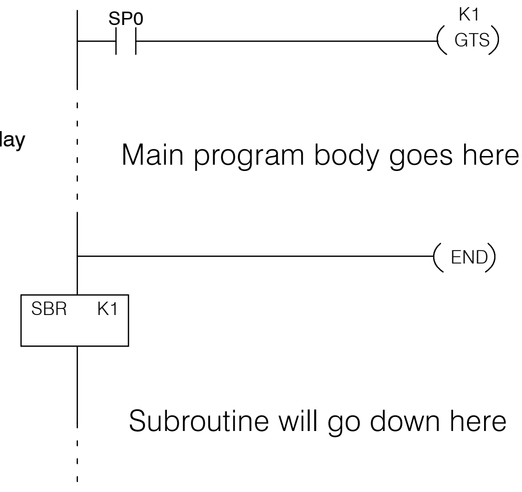
Is your setup logic going to be in the main program body or is it going to be in a subroutine?

A subroutine for your remote I/O setup has an advantage over writing the code into the program's main body. Some remote I/O setup logic becomes quite lengthy. By putting the setup in a subroutine, you don't have to scroll through extra logic during routine troubleshooting procedures. We advise you to use a subroutine for your remote I/O initialization. Here's how:

Using the GTS Command for the Setup Logic

Note: SP0 is a special relay contact which energizes only on the first scan of the program

*Direct*SOFT Display



Step 2: Write the Setup Logic for Each Channel

Whether you choose to write the remote I/O setup program as a subroutine or as a part of the main program, the procedure is still the same. You have several things you must do for each channel of remote I/O:

- Tell the remote master to initiate setup, and define the auto return to network option.
- Tell the remote master the starting V-memory address for inputs and outputs, and the total number of each for the channel. You do this with address *pointers* and constant data.
- Tell the remote master how many input and output points are located in each base.
- Tell the remote master to save the parameters in EEPROM (setup is complete).

To write the setup logic, we use the CPU instructions described below. If you are not familiar with these instructions, you may want to refer to the DL205 User Manual for more details and examples.

The Load instruction is a 16-bit instruction that loads the value (Aaaa), which is either a V-memory location or a 4-digit constant, into the lower 16 bits of the accumulator. The upper 16 bits of the accumulator are set to 0.

LD
A aaa

The Load Address instruction is a 16 bit instruction. It converts any octal value or address to the HEX equivalent value and loads the HEX value into the accumulator.

LDA
O aaa

The OUT instruction is a 16 bit instruction that copies the values in the lower 16 bits of the accumulator to a specified V-memory location (Aaaa).

OUT
A aaa

The WT instruction writes a block of data (1–128 bytes max.) to an intelligent I/O module from a block of V-memory in the CPU. The function parameters (module base/slot address, number of bytes, and the intelligent I/O module memory address) are loaded into the first and second level of the accumulator stack, and the accumulator by three additional instructions. In the WT instruction, Aaaa specifies the starting V-memory address where the data will be written from in the CPU.

WT
A aaa

You use these instructions to set up the configuration data in a block of V-memory which serves as a buffer. Use WT instructions to store the data to various shared memory locations in the Remote Master module. Use your worksheets to assist you in creating the setup logic.

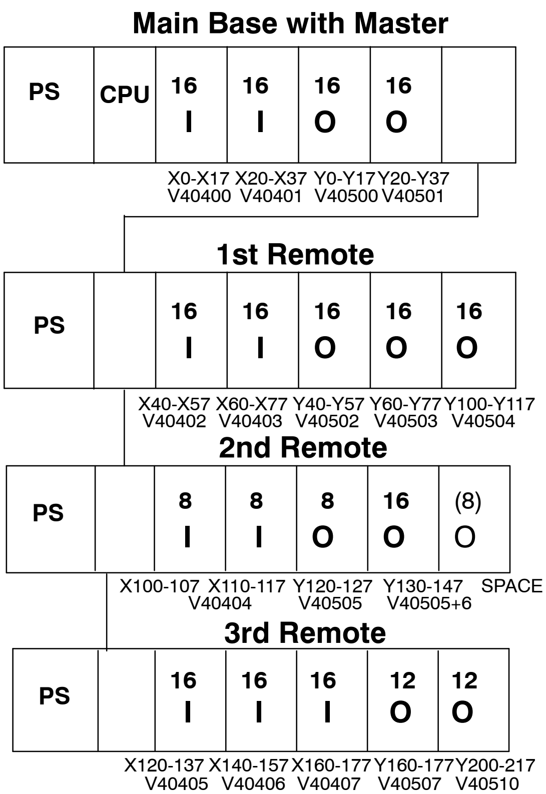
Examples for Typical Configurations

Example 1: Addressing using X and Y memory

To illustrate the setup program for a system using X's as remote inputs and Y's as remote outputs, we will use the example system from Chapter 2, shown here with a completed Channel Configuration Worksheet.

The first block of logic tells the remote master to initiate the setup, and to enable the Auto Return to Network option. To find the D2–RMSM shared memory addresses used in the setup program, refer to the Shared Memory Table at the end of this chapter.

Write Configuration Byte



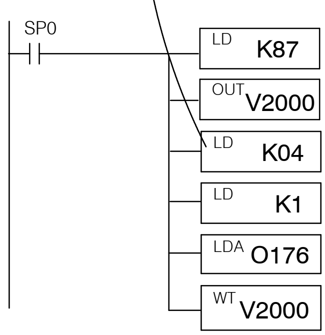
Channel Configuration Sheet
D2–RMSM Remote Master Module
Master Slot Address 4 (1–7)
Protocol Selected RM–NET (RM–NET or SM–NET)

Circle one selection for each parameter (selections for each protocol are shown)

Configuration Parameter	RM–NET	SM–NET
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4	19.2 38.4 153.6 307.2 614.4
Operator Interface	N/A	YES NO
Auto Return to Network (either protocol)	YES	NO

Starting Input V Memory Address: V 40402 **Starting Output V Memory Address:** V 40502
Total No. Inputs 96 **Total No. Outputs** 112

Slave Station	No. Inputs	No. Outputs	Slave Station	No. Inputs	No. Outputs
0	N/A	N/A	16		
1	32	48	17		
2	16	32	18		
3	48	32	19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		

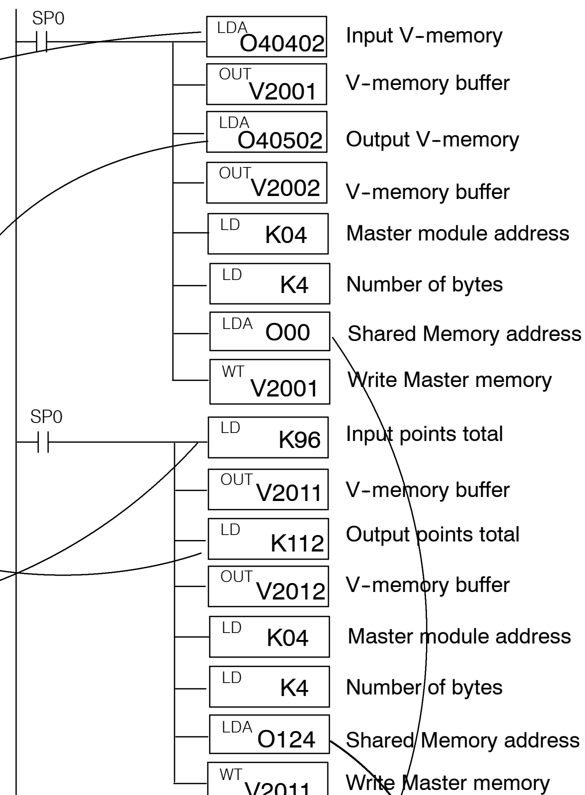


Bits 0,1,2 ON initiates the setup
Bit 7 defines Auto Return to Network (ON=Yes)
Choose a word of available V memory to use as a buffer
Master address: High byte is rack (0), low byte is slot (4)
Number of bytes to write to shared memory (1 byte)
Shared memory address of configuration byte
Write value in lower byte of V2000 to Master memory

This block of logic tells the remote master the starting V-memory addresses for the inputs and outputs, and the total number of each for the channel. Use the LD, LDA, and OUT commands to load the starting addresses and point totals into temporary memory, then write the values to the master's shared memory. The Quick Reference Table shows the correct shared memory addresses in octal.

Write Input and Output Pointers, and Input and Output Ranges for Channel

The LDA instruction uses octal numbers, designated by the capital O in front of the number.



Channel Configuration Worksheet

D2–RMSM Remote Master Module
Master Slot Address 4 (1–7)
Protocol Selected RM–NET (RM–NET or SM–NET)

Circle one selection for each parameter (selections for each protocol are shown)

Configuration Parameter	RM–NET	SM–NET
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4	19.2 38.4 153.6 307.2 614.4
Operator Interface	N/A	YES NO
Auto Return to Network (either protocol)	YES NO	YES NO

Starting Input V Memory Address: V40402 **Starting Output V Memory Address:** V40502
Total Inputs 96 **Total Outputs** 112

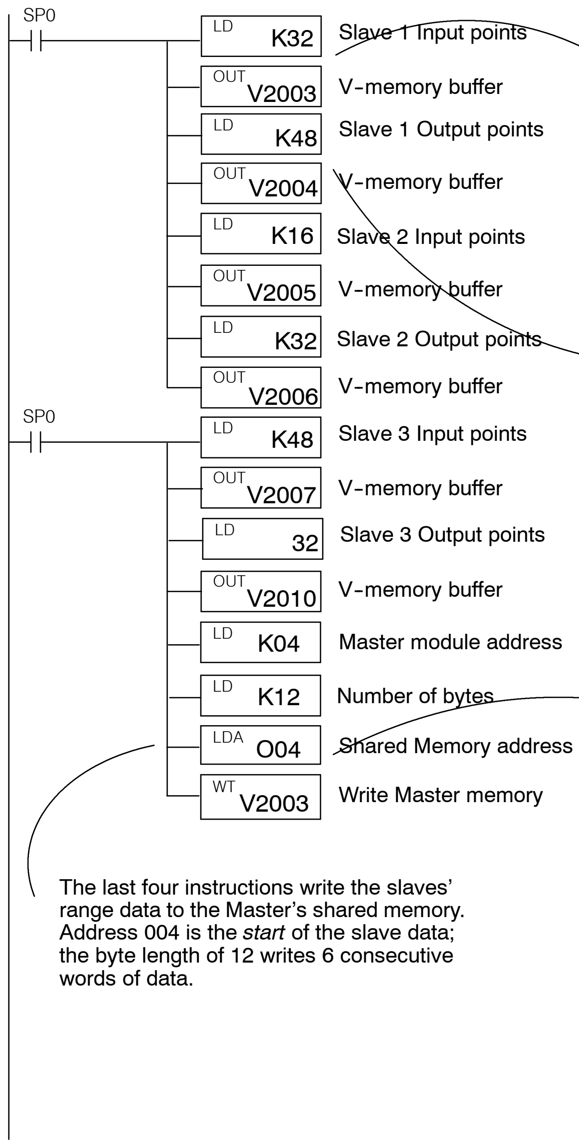
Slave Station	No. of Inputs	No. of Outputs	Slave Station	No. of Inputs	No. of Outputs
0	N/A	N/A	16		
1	**32**	**48**	17		
2	**16**	**32**	18		
3	**48**	**32**	19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		

Quick Reference Table of Shared Memory Addresses

D2–RMSM				
Setup Initiation Byte				176
Setup Complete Byte				177
Slave	Input Address	Output Address	Number of Input Pts	Number of Output Pts
ALL	000	002	124	126
1	N/A	N/A	004	006
2	N/A	N/A	010	012
3	N/A	N/A	014	016
4	N/A	N/A	020	022
5	N/A	N/A	024	026
6	N/A	N/A	030	032
7	N/A	N/A	034	036

This block of logic tells the remote master how many input and output points are located in each base. Each group of four instructions loads the I/O ranges for a slave into temporary memory, the values for which are retrieved from the Remote Slave Worksheets. The WT instruction stores the entire buffer area to the master's shared memory. The Quick Reference Table shows the correct shared memory addresses in octal.

Write Input and Output Ranges for each Slave



The last four instructions write the slaves' range data to the Master's shared memory. Address 004 is the *start* of the slave data; the byte length of 12 writes 6 consecutive words of data.

Channel Configuration Worksheet

D2–RMSM Remote Master Module
Master Slot Address 4 (1–7)
Protocol Selected RM–NET (RM–NET or SM–NET)

Circle one selection for each parameter (selections for each protocol are shown)

Configuration Parameter	RM–NET	SM–NET
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4	19.2 38.4 153.6 307.2 614.4
Operator Interface	N/A	YES NO
Auto Return to Network (either protocol)	YES NO	YES NO

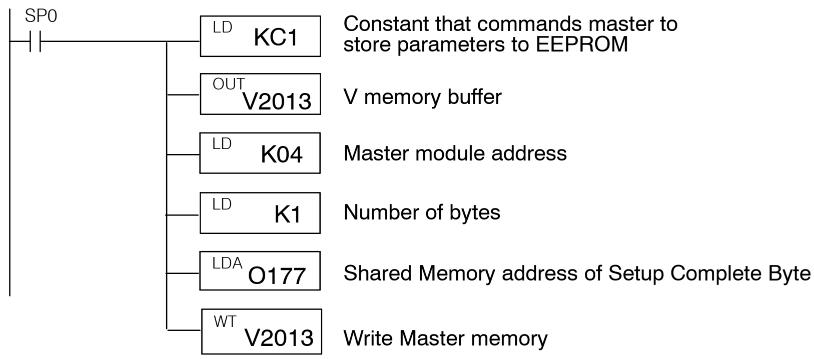
Starting Input V Memory Address: V40402 **Starting Output V Memory Address:** V40502
Total Inputs 96 **Total Outputs** 112

Slave Station	No. of Inputs	No. of Outputs	Slave Station	No. of Inputs	No. of Outputs
0	N/A	N/A	16		
1	32	48	17		
2	16	32	18		
3	48	32	19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		

Quick Reference Table of Shared Memory Addresses

D2–RMSM				
Configuration Byte				176
Setup Complete Byte				177
Slave	Input Address	Output Address	Number of Input Pts	Number of Output Pts
ALL	000	002	124	126
1	N/A	N/A	004	006
2	N/A	N/A	010	012
3	N/A	N/A	014	016
4	N/A	N/A	020	022
5	N/A	N/A	024	026
6	N/A	N/A	030	032
7	N/A	N/A	034	036

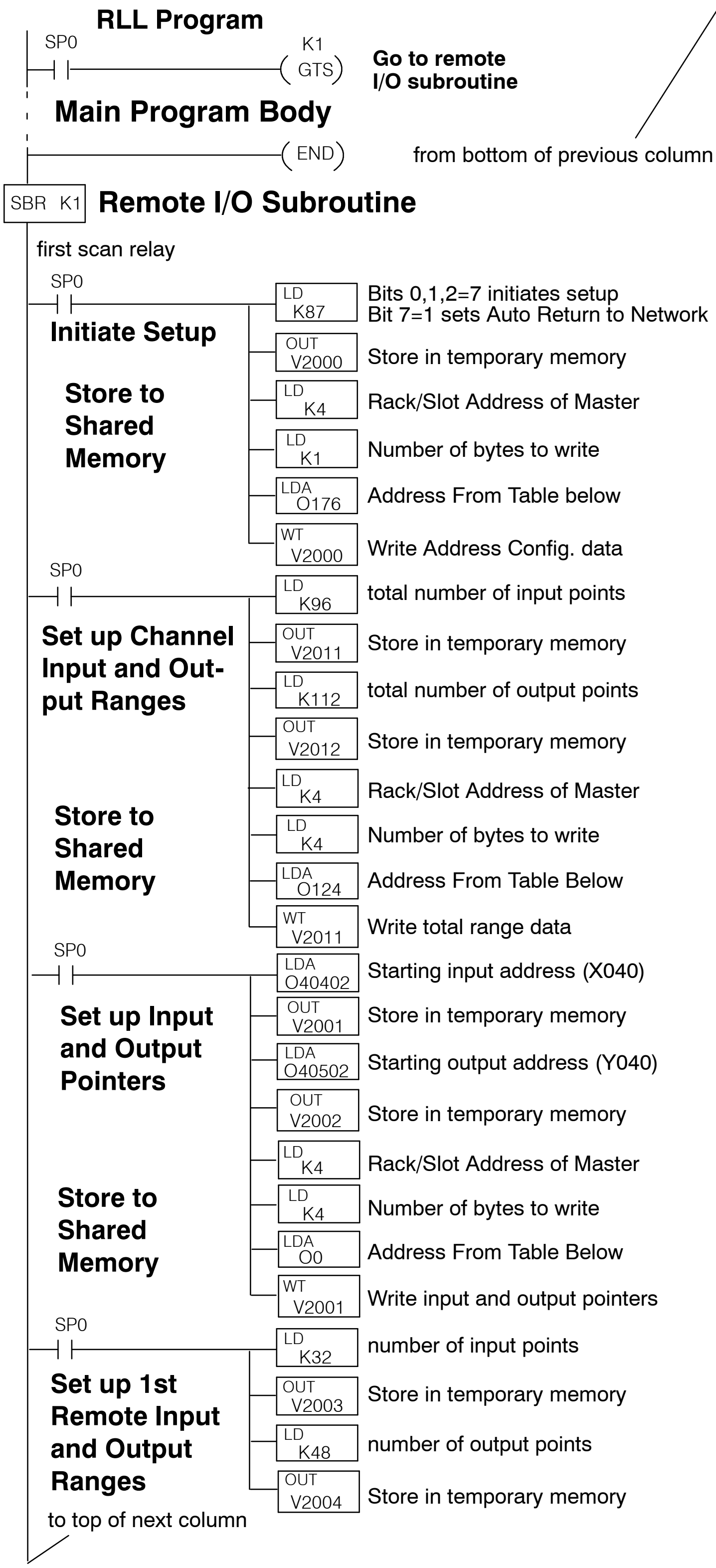
Write Setup Complete (store channel parameters to EEPROM)

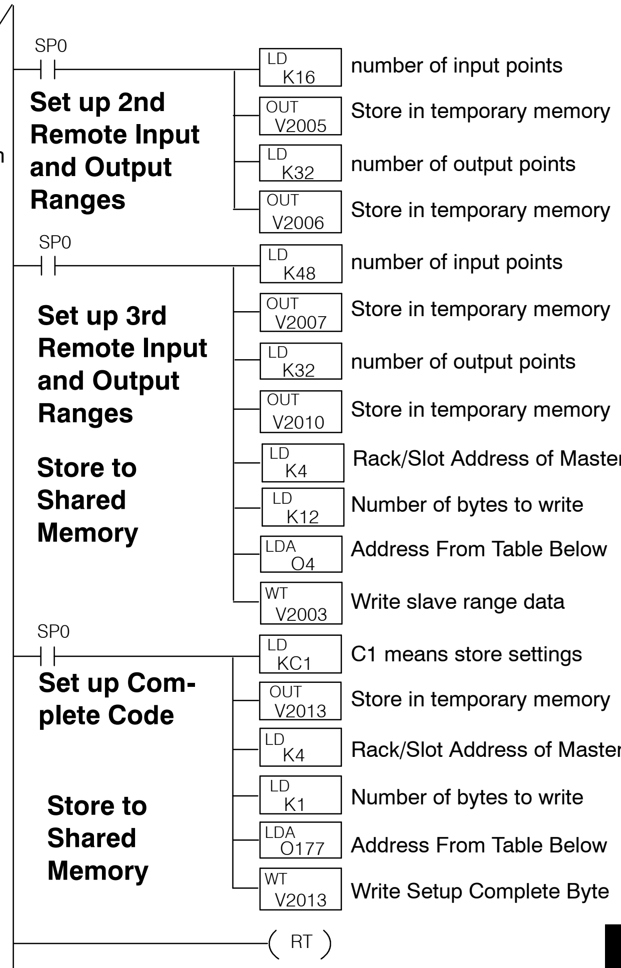


We can now complete the setup program.This last block of logic tells the remote master to save the parameters in EEPROM (setup is complete). The setup complete logic structure is the same for any channel using a D2-RMSM as a master.

The completed setup program for this example is shown on the next page.

Completed Setup Program for X and Y Addressing





Quick Reference Table of Shared Memory Addresses

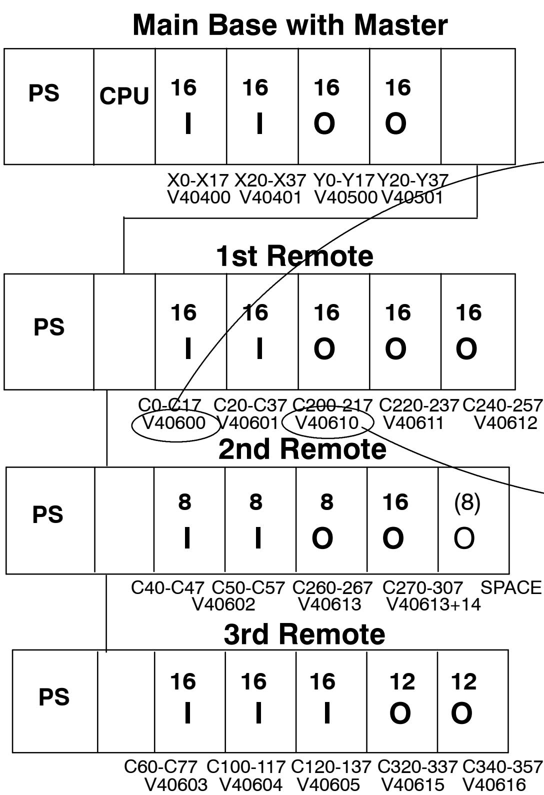
D2-RMSM				
Setup Initiation Byte				176
Setup Complete Byte				177
Slave	Input Address	Output Address	Number of Input Pts	Number of Output Pts
ALL	000	002	124	126
1	N/A	N/A	004	006
2	N/A	N/A	010	012
3	N/A	N/A	014	016
4	N/A	N/A	020	022
5	N/A	N/A	024	026
6	N/A	N/A	030	032
7	N/A	N/A	034	036

Example 2: Addressing using Control Relay Memory

In certain applications, you may need to address remote I/O as a memory type other than real inputs (X type) and/or real outputs (Y type). If you have used all available I/O references in the system, and need to add remote I/O, you can use the control relay (C type) memory as the I/O references. You may allocate C memory for inputs, outputs, or both.

To write a setup program with this option, we will use the system from Example 1. This example illustrates the difference in defining the pointer addresses; we have assigned both inputs and outputs to control relay references. Retrieve the V–memory addresses for the input and output control relays from the Reserved Memory Table in Appendix B. The rest of the setup logic is identical to Example 1.

Write Configuration Byte



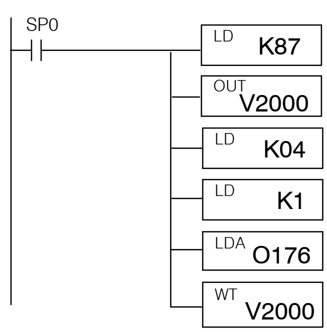
Channel Configuration Worksheet
D2–RMSM Remote Master Module
Master Slot Address 4 (1–7)
Protocol Selected RM–NET (RM–NET or SM–NET)

Circle one selection for each parameter (selections for each protocol are shown)

Configuration Parameter	RM–NET	SM–NET
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4	19.2 38.4 153.6 307.2 614.4
Operator Interface	N/A	YES NO
Auto Return to Network (either protocol)	YES NO	YES NO

Starting Input V Memory Address: V40600 **Starting Output V Memory Address:** V40610
Total Inputs 96 **Total Outputs** 112

Slave Station	No. of Inputs	No. of Outputs	Slave Station	No. of Inputs	No. of Outputs
0	N/A	N/A	16		
1	32	48	17		
2	16	32	18		
3	48	32	19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		



Bits 0,1,2 = ON initiates setup
Bit 7 defines Auto Return to Network (ON=Yes)
Choose a word of available V–memory to use as a buffer
Master address: High byte is rack (0), low byte is slot (4)
Number of bytes to write to shared memory (1 byte)
Shared memory address of configuration byte
Write value in lower byte of V2000 to Master memory

This block of logic tells the remote master the starting V-memory addresses for the inputs and outputs, and the total number of each for the channel. The V-memory addresses correspond to C0 (for inputs) and C200 (for outputs). Load the starting addresses and point totals into temporary memory, then write the values to the master's shared memory. The Quick Reference Table shows the correct shared memory addresses in octal.

Write Input and Output Pointers, and Input and Output Ranges for Channel

SP0	LDA	O40600	Input V–memory
	OUT	V2001	V–memory buffer
	LDA	O40610	Output V–memory
	OUT	V2002	V–memory buffer
	LD	K04	Master module address
	LD	K4	Number of bytes
	LDA	O00	Shared Memory address
	WT	V2001	Write Master memory
SP0	LD	K96	Input points total
	OUT	V2011	V–memory buffer
	LD	K112	Output points total
	OUT	V2012	V–memory buffer
	LD	K04	Master module address
	LD	K4	Number of bytes
	LDA	O124	Shared Memory address
	WT	V2011	Write Master memory

Channel Configuration Worksheet

D2–RMSM Remote Master Module
Master Slot Address 4 (1–7)
Protocol Selected RM–NET (RM–NET or SM–NET)

Circle one selection for each parameter (selections for each protocol are shown)

Configuration Parameter	RM–NET	SM–NET
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4	19.2 38.4 153.6 307.2 614.4
Operator Interface	N/A	YES NO
Auto Return to Network (either protocol)	YES NO	YES NO

Starting Input V Memory Address: V40600 **Starting Output V Memory Address:** V40610
Total Inputs 96 **Total Outputs** 112

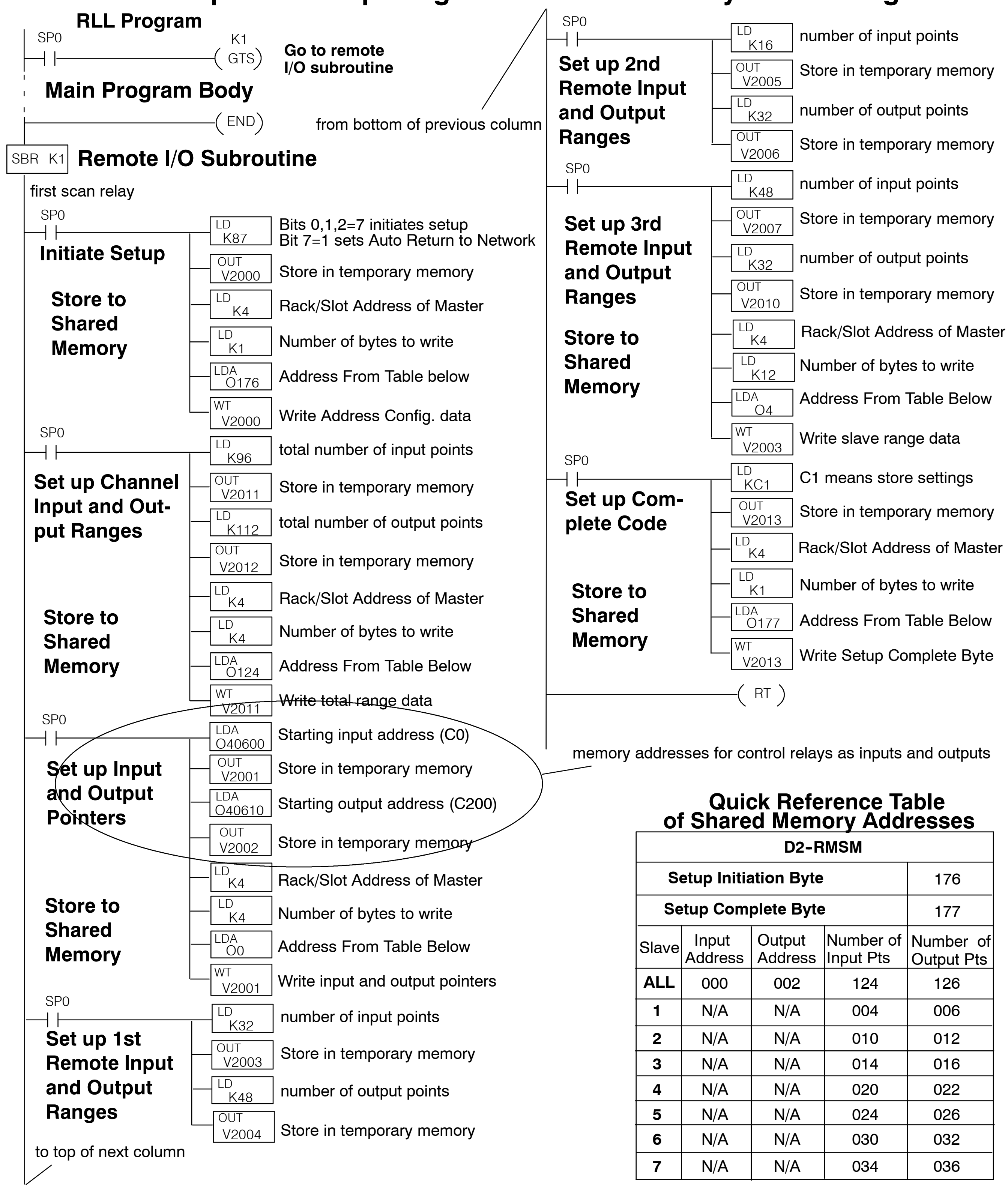
Slave Station	No. of Inputs	No. of Outputs	Slave Station	No. of Inputs	No. of Outputs
0	N/A	N/A	16		
1	32	48	17		
2	16	32	18		
3	48	32	19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		

Quick Reference Table of Shared Memory Addresses

D2–RMSM				
Setup Initiation Byte				176
Setup Complete Byte				177
Slave	Input Address	Output Address	Number of Input Pts	Number of Output Pts
ALL	000	002	124	126
1	N/A	N/A	004	006
2	N/A	N/A	010	012
3	N/A	N/A	014	016
4	N/A	N/A	020	022
5	N/A	N/A	024	026
6	N/A	N/A	030	032
7	N/A	N/A	034	036

Since the logic for the slave range data and setup complete is identical to Example 1, we will now show the completed setup program on the next page.

Completed Setup Program for Control Relay Addressing



Quick Reference Table of Shared Memory Addresses

D2-RMSM				
Setup Initiation Byte				176
Setup Complete Byte				177
Slave	Input Address	Output Address	Number of Input Pts	Number of Output Pts
ALL	000	002	124	126
1	N/A	N/A	004	006
2	N/A	N/A	010	012
3	N/A	N/A	014	016
4	N/A	N/A	020	022
5	N/A	N/A	024	026
6	N/A	N/A	030	032
7	N/A	N/A	034	036

Changing Configurations

If you have stored a configuration to the D2–RMSM via the setup program and need to change it, follow these guidelines to ensure the module accepts the new configuration:

1. Change the constants in the setup program that are affected by the new system configuration. For example, if you add an I/O module to a remote slave unit, you must change the input or output range for that slave, as well as the range total for the channel. If the new range totals do not match the sum of the individual slave ranges, the D2–RMSM *will not* accept the new configuration. It will retain the old configuration, and give you an I/O error.
2. If you are removing a slave from the channel, you must change the logic of the setup program to clear that slave's range data in the D2–RMSM shared memory. Otherwise it will still see the old data from the previous configuration. For example, if you remove the third slave from our example system, you would load a constant of zero into the slave's input and output range data, located at buffer memory addresses V2007 and V2010. If removing I/O, remember to reduce the total I/O range values also.
3. After you have modified the setup program, cycle CPU power, or transition from the STOP to RUN mode to execute the new setup logic. This is necessary if the setup logic executes on the first CPU scan.

Shared Memory Table for D2–RMSM Remote Master

OCTAL ADDRESS	FUNCTION (Slaves 1–15)	FUNCTION (Slaves 16–31)	# Bytes
For memory addresses 000 to 077, the user's setup program must store the correct values into these locations.			
000	Starting V–memory address for inputs on the channel (in octal)	Number of input points for Slave 16	2
002	Starting V–memory address for outputs on the channel (in octal)	Number of output points for Slave 16	2
004	Number of input points for Slave 1	Number of input points for Slave 17	2
006	Number of output points for Slave 1	Number of output points for Slave 17	2
010	Number of input points for Slave 2	Number of input points for Slave 18	2
012	Number of output points for Slave 2	Number of output points for Slave 18	2
014	Number of input points for Slave 3	Number of input points for Slave 19	2
016	Number of output points for Slave 3	Number of output points for Slave 19	2
020	Number of input points for Slave 4	Number of input points for Slave 20	2
022	Number of output points for Slave 4	Number of output points for Slave 20	2
024	Number of input points for Slave 5	Number of input points for Slave 21	2
026	Number of output points for Slave 5	Number of output points for Slave 21	2
030	Number of input points for Slave 6	Number of input points for Slave 22	2
032	Number of output points for Slave 6	Number of output points for Slave 22	2
034	Number of input points for Slave 7	Number of input points for Slave 23	2
036	Number of output points for Slave 7	Number of output points for Slave 23	2
040	Number of input points for Slave 8	Number of input points for Slave 24	2
042	Number of output points for Slave 8	Number of output points for Slave 24	2
044	Number of input points for Slave 9	Number of input points for Slave 25	2
046	Number of output points for Slave 9	Number of output points for Slave 25	2
050	Number of input points for Slave 10	Number of input points for Slave 26	2
052	Number of output points for Slave 10	Number of output points for Slave 26	2
054	Number of input points for Slave 11	Number of input points for Slave 27	2
056	Number of output points for Slave 11	Number of output points for Slave 27	2
060	Number of input points for Slave 12	Number of input points for Slave 28	2
062	Number of output points for Slave 12	Number of output points for Slave 28	2
064	Number of input points for Slave 13	Number of input points for Slave 29	2
066	Number of output points for Slave 13	Number of output points for Slave 29	2
070	Number of input points for Slave 14	Number of input points for Slave 30	2
072	Number of output points for Slave 14	Number of output points for Slave 30	2
074	Number of input points for Slave 15	Number of input points for Slave 31	2
076	Number of output points for Slave 15	Number of output points for Slave 31	2

OCTAL ADDRESS	FUNCTION	DETAIL	# Bytes
100 – 121	Reserved		18
122	Status of Rotary Switches on module – **Read Only**	Data is 00 to 1F hex, representing the address of the module set by the rotary switches.	1
123	Status of DIP Switches on module – **Read Only**	Bit status represents the setting of each switch on the module's DIP Switch , which sets configuration parameters. 0=OFF, 1=ON. Bit 0 SW1 status Bit 1 SW2 status Bit 2 SW3 status Bit 3 SW4 status Bit 4 SW5 status Bit 5 SW6 status Bit 6 SW7 status Bit 7 SW8 status	1
124	Number of input points committed to the entire channel	User's setup program stores the correct BCD value to this memory location.	2
126	Number of output points committed to the entire channel	User's setup program stores the correct BCD value to this memory location.	2

OCTAL ADDRESS	FUNCTION	DETAIL	# Bytes
130 – 131	Communication stop mode selection (communication stops when any specified slave fails)	In communication stop mode, the master stops updating the entire channel when a communication error occurs with any specified slave station. To select this mode for each slave, turn ON the corresponding bit of the shared memory shown below. Address 130 / Address 131 Bit 0: Entire channel stops when any slave fails / Slave 16 Bit 1: Slave 1 / Slave 17 Bit 2: Slave 2 / Slave 18 Bit 3: Slave 3 / Slave 19 Bit 4: Slave 4 / Slave 20 Bit 5: Slave 5 / Slave 21 Bit 6: Slave 6 / Slave 22 Bit 7: Slave 7 / Slave 23 Bit 8: Slave 8 / Slave 24 Bit 9: Slave 9 / Slave 25 Bit 10: Slave 10 / Slave 26 Bit 11: Slave 11 / Slave 27 Bit 12: Slave 12 / Slave 28 Bit 13: Slave 13 / Slave 29 Bit 14: Slave 14 / Slave 30 Bit 15: Slave 15 / Slave 31	2

OCTAL ADDRESS	FUNCTION	DETAIL	# Bytes
132 - 133	Slave removal mode selection (communication stops to only the slave(s) with a communication error)	In slave removal mode, the master stops updating only the slave(s) with a communication error. It continues updating the I/O for the other slaves on the channel. To select this mode for each slave, turn ON the corresponding bit of the shared memory shown below. Address 132 / Address 133 Bit 0: Not used / Slave 16 Bit 1: Slave 1 / Slave 17 Bit 2: Slave 2 / Slave 18 Bit 3: Slave 3 / Slave 19 Bit 4: Slave 4 / Slave 20 Bit 5: Slave 5 / Slave 21 Bit 6: Slave 6 / Slave 22 Bit 7: Slave 7 / Slave 23 Bit 8: Slave 8 / Slave 24 Bit 9: Slave 9 / Slave 25 Bit 10: Slave 10 / Slave 26 Bit 11: Slave 11 / Slave 27 Bit 12: Slave 12 / Slave 28 Bit 13: Slave 13 / Slave 29 Bit 14: Slave 14 / Slave 30 Bit 15: Slave 15 / Slave 31	2
134	Communication hold or resume mode	The program can cause the communications on a channel to stop by setting the first bit in this byte ON. After communication stops, only a mode transition of the CPU (from STOP to RUN) will restart the communications. The bit is not cleared automatically, so if using this mode, the user program should clear this byte on the first scan.	1
135 - 137	Reserved		3
140	Network Error Flags - **Read Only**	Bit status represents network errors detected by the D2-RMSM. 0=OK, 1=ERROR Bit 0 Configuration Error (see Address 142 for details) Bit 1 Communication Error (see Address 144 for details) Bit 2 Diagnostics Error (see Address 150 for details)	2

OCTAL ADDRESS	FUNCTION	DETAIL	# Bytes
142	Configuration Error Code - **Read Only**	Error code in BCD 20 Total inputs exceeds 512 21 Total outputs exceeds 512 24 I/O address out of I/O range 25 I/O address allocated to bad range 29 A slave has more than 512 points 70 Discrepancy between current configuration and old one 71 A module is in the wrong slot 72 Slave configuration is different from old one 73 Different slave is there	1
143	Station Number of Configuration Error - **Read Only**	Station number in BCD	1
144	Communication Error Code - **Read Only**	Error code in BCD 01 slave does not respond 02 wrong I/O information 03 I/O update error : CRC check error	1
145	Station Number of Communication Error Code - **Read Only**	Station number in BCD	1
146	Communication Error Counter - **Read Only**	Number of communication errors detected since CPU went into RUN mode, in BCD	2
150	Diagnostics Error Code	Error code in BCD 0201 Terminal block removed 0202 module not present 0203 Blown fuse 0206 Low battery voltage 0226 Power capacity exceeded	2
152	Reserved		1
153	Station number of Diagnostics error - **Read Only**	Station number in BCD	1

OCTAL ADDRESS	FUNCTION	DETAIL	# Bytes
154 - 157	Reserved		4
160	Current bus scan time - **Read Only**	BCD value of current bus scan, in msec	2
162	Bus scan time upper limit	User can store BCD value of bus scan upper limit, in msec. Default is 100 msec.	2
164	Shortest bus scan time - **Read Only**	BCD value of shortest bus scan detected since CPU went into RUN mode, in msec	2
166	Longest bus scan time - **Read Only**	BCD value of longest bus scan detected since CPU went into RUN mode, in msec	2
170	Bus scan counter - **Read Only**	BCD value of number of bus scans detected since CPU went into RUN mode	2
172	Overlimit Bus scan counter - **Read Only**	BCD value of number of bus scans which have exceeded the scan time upper limit	2
174 - 175	Reserved		2
176	Setup Initiation Byte (includes Auto Return to Network)	User's setup program stores the correct bit pattern to this memory location to configure the following modes: Bits 0,1, and 2 must be ON to initiate setup of remote slave addressing Bit 7 ON=Specifies that offline slaves can return to the network without cycling CPU	1
177	Copy Configuration to EEPROM (Setup Complete)	User's setup program stores a BCD value to this location to log the parameters stored by the setup program to the Master's EEPROM. C1 - Signifies that setup is complete. Hint: This should be the last function of your setup program.	1
200 - 374	Reserved		125

OCTAL ADDRESS	FUNCTION	DETAIL	# Bytes
375	Slave Page Selection	User's setup program stores a BCD value to this location to select the page of slave parameters for setup programming: 81 Slaves 1-15 82 Slaves 16-31	1
376 - 377	Reserved		2

Quick Reference Table of Shared Memory Addresses

D2-RMSM				
Setup Initiation Byte				176
Setup Complete Byte				177
Slave	Input Address	Output Address	Number of Input Points	Number of Output Points
ALL	000	002	124	126
1	N/A	N/A	004	006
2	N/A	N/A	010	012
3	N/A	N/A	014	016
4	N/A	N/A	020	022
5	N/A	N/A	024	026
6	N/A	N/A	030	032
7	N/A	N/A	034	036
8	N/A	N/A	040	042
9	N/A	N/A	044	046
10	N/A	N/A	050	052
11	N/A	N/A	054	056
12	N/A	N/A	060	062
13	N/A	N/A	064	066
14	N/A	N/A	070	072
15	N/A	N/A	074	076
2nd page of slave range data				
16	N/A	N/A	000	002
17	N/A	N/A	004	006
18	N/A	N/A	010	012
19	N/A	N/A	014	016
20	N/A	N/A	020	022
21	N/A	N/A	024	026
22	N/A	N/A	030	032
23	N/A	N/A	034	036
24	N/A	N/A	040	042
25	N/A	N/A	044	046
26	N/A	N/A	050	052
27	N/A	N/A	054	056
28	N/A	N/A	060	062
29	N/A	N/A	064	066
30	N/A	N/A	070	072
31	N/A	N/A	074	076

5

DL250/DL350 CPU Setup & Programming

In This Chapter. . . .

- — DL250/D350 CPU Bottom Port as Remote Master
- — Writing Your Remote I/O Setup for a DL250/DL350 CPU
- — Examples for Typical Configurations
- — Configuring the bottom port of the DL250/DL350 CPU
- — DL250/DL350 Reserved Memory for 2nd port as Remote Master

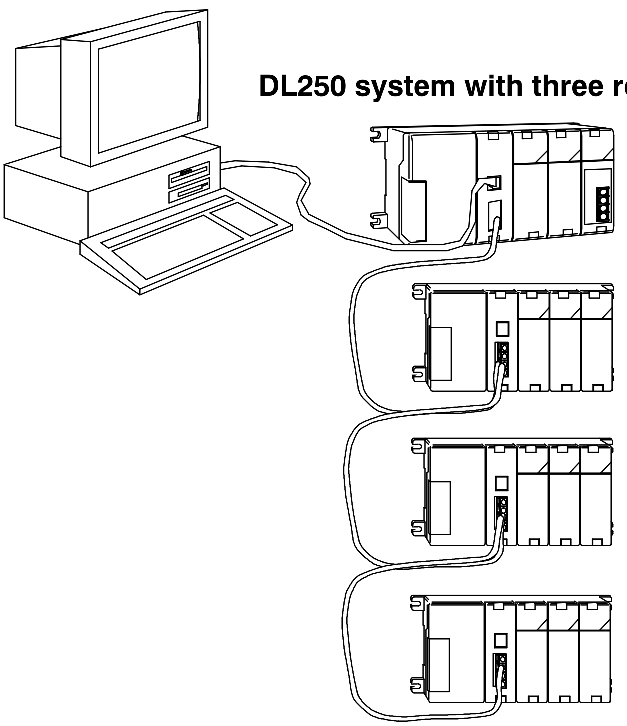
DL250/DL350 CPU Bottom Port as Remote Master

For the D2-250 or D3-350 CPU, the most cost-effective way to add remote I/O is to use the bottom port of the CPU as a remote master. The restriction is that it operates in the RM-NET addressing mode only, which means a maximum of seven slaves at a baud rate of 38.4 kBaud.

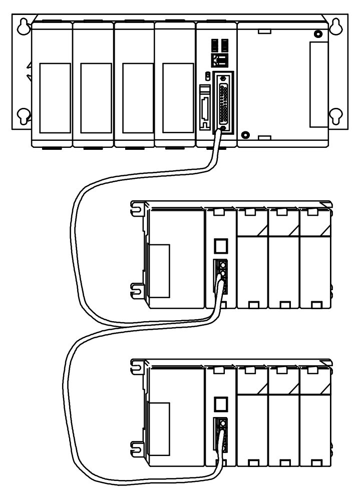
This configuration requires some setup programming for the CPU. You can write your program using either a handheld programmer or PC loaded with software such as ***Direct***SOFT. The examples that follow will show you how to do this using ***Direct***SOFT.

To get started, enter ***Direct***SOFT and carry out the normal ***Direct***SOFT setup procedures for communicating with your DL250 or DL350 CPU. If you do not know how to do this, refer to your ***Direct***SOFT Manual. Your DL205 or DL305 User Manual have very good coverage of the basic commands available and examples of using the commands to write general ladder logic. We will be showing you in this chapter only those commands that pertain to setting up your remote I/O initialization and its successful utilization.

DL250 system with three remote bases



DL350 system with two remote bases

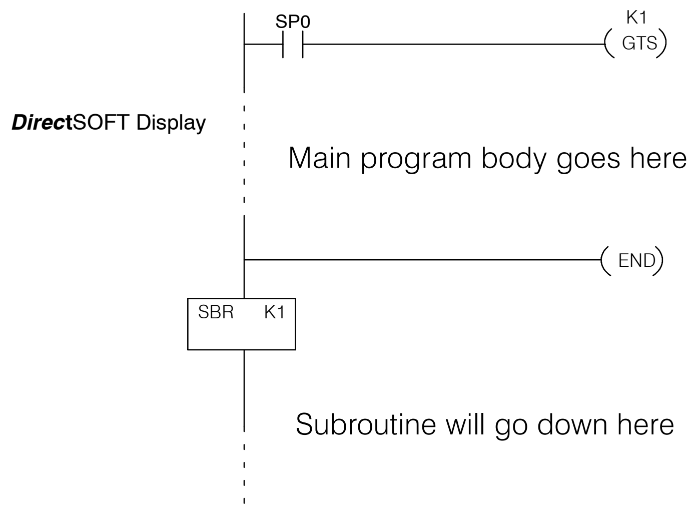


Writing Your Remote I/O Setup for a DL250/DL350 CPU

Step 1: Decide How You Are Going to Call the Program

Your setup logic can be in the main program body or in a subroutine. A subroutine for remote I/O setup has an advantage over writing the code into the program's main body. Some remote I/O setup logic becomes quite lengthy. By putting the setup in a subroutine, you don't have to scroll through extra logic during routine troubleshooting procedures. We advise you to use a subroutine for your remote I/O initialization, by following the example below:

Using the GTS Command for the Setup Logic



Step 2: Write the Setup Logic for the Channel

The setup program to use the D2-250 or D3-350 bottom port as master is different from the program for the D2-RMSM as master. These are the things you must do for this channel of remote I/O:

- Tell the CPU the station number of the port ("0" for master), communication V-memory address (start of pointer table), and the baud rate setting.
- Tell the CPU, *for each slave*, the starting V-memory addresses for the inputs and outputs, and the total number of each. You do this with address "pointers" and constant data.
- Tell the CPU that setup is complete.

To write the setup logic, we use the CPU instructions described below. If you are not familiar with these instructions, you may want to refer to the DL205 or DL305 User Manual for more details and examples.

The Load instruction is a 16-bit instruction that loads the value (Aaaa), which is either a V-memory location or a 4-digit constant, into the lower 16 bits of the accumulator. The upper 16 bits of the accumulator are set to 0.	LD A aaa
The Load Address instruction is a 16-bit instruction. It converts any octal value or address to the HEX equivalent value and loads the HEX value into the accumulator.	LDA O aaa
The OUT instruction is a 16-bit instruction that copies the values in the lower 16 bits of the accumulator to a specified V-memory location (Aaaa).	OUT A aaa

Use your worksheets to assist you in creating the setup logic.

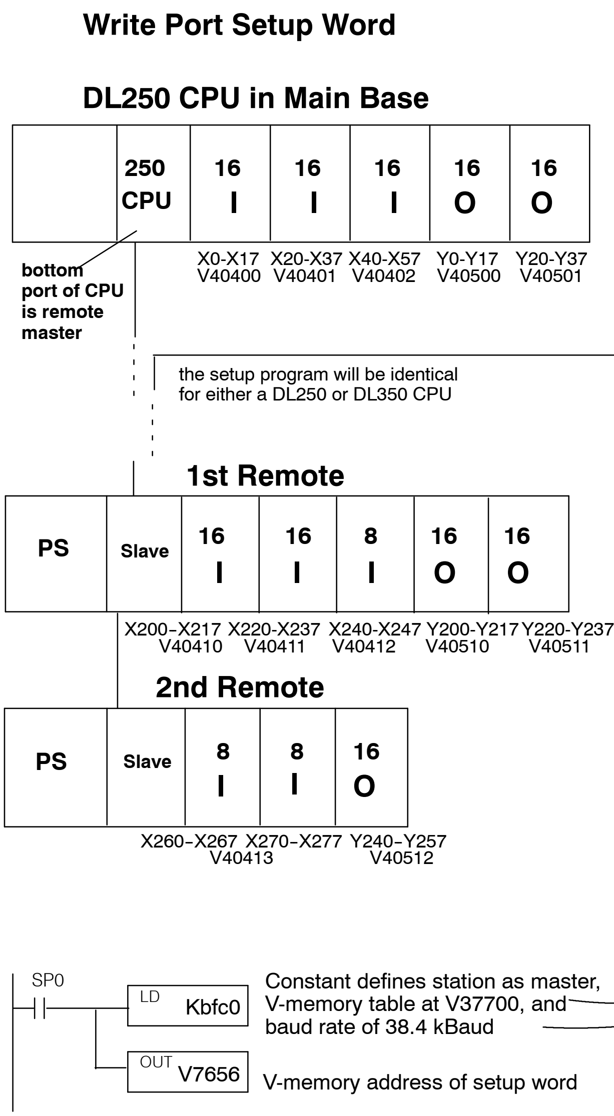
Examples for Typical Configurations

Example 1: Using X and Y addresses as the remote I/O memory types

A typical system uses X and Y memory types for the inputs and outputs on the remote I/O channel.

To illustrate the setup program for this configuration, we will use the remote I/O system below, shown with the completed Channel Configuration Worksheet.

The first block of logic tells the CPU the station number of the port, communication V-memory address, and the baud rate setting. Define the constant value based on these selections (see DL250/DL350 Reserved Memory Table at the end of this chapter), and then write the value to the reserved V-memory address in the CPU. You can also perform this function interactively with ***Direct***SOFT (see “Configuring the Bottom Port of the CPU“, later in this chapter).



Channel Configuration Worksheet
DL250/DL350 CPU Bottom Port

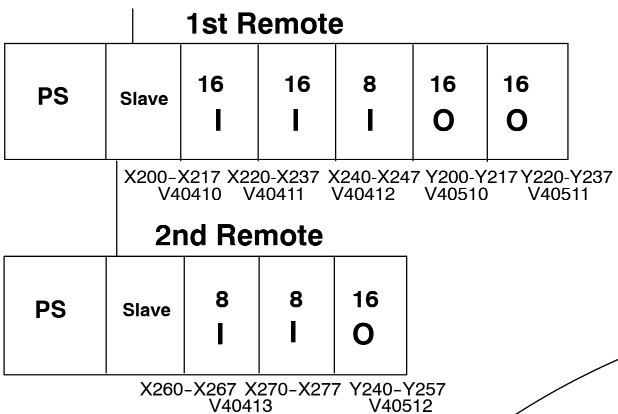
Circle one selection or fill in blank for each parameter

Configuration Parameter	SELECTION
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4
Remote I/O Configuration table Starting address	V 37700 (V37700 is default)

Slave Station	INPUT		OUTPUT	
	Input Address	No. of Inputs	Output Address	No. of Outputs
1	V40410	48	V40510	32
2	V40413	16	V40512	16
3				
4				
5				
6				
7				

To calculate the input and output addresses and ranges, complete the Remote Slave Worksheets and fill in the V-memory addresses *for each slave*, not just the first one. You can transfer this data to the Channel Configuration Worksheet to condense it, or fill in the Channel Worksheet directly if you choose not to use the Remote Slave Worksheets.

Calculate input and output addresses and ranges for each remote base



Remote Slave Worksheet

Remote Base Address 1 **(Choose 1-7 for RM-NET or 1-31 for SM-NET)**

Slot Number	Module Name	INPUT: Input Address	INPUT: No. of Inputs	OUTPUT: Output Address	OUTPUT: No. of Outputs
0	16ND3-2	X200	16		
1	16ND3-2	X220	16		
2	08ND3	X240	16 (8 used)		
3	16TD1-2			Y200	16
4	16TD1-2			Y220	16
5					
6					
7					

Input Bit Start Address: X200 **V-Memory Address*:V** 40410

Total Input Points 48

Output Bit Start Address: Y200 **V-Memory Address*:V** 40510

Total Output Points 32

D2-RMSM automatically assigns I/O addresses in sequence based on # 1's starting addresses. The DL250/DL350 CPU port setup program es these addresses for each slave.

Channel Configuration Worksheet
DL250/DL350 CPU Bottom Port

Circle one selection or fill in blank for each parameter

Configuration Parameter	SELECTION
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4
Remote I/O Configuration table Starting address	V **37700** (V37700 is def

Slave Station	INPUT: Input Address	INPUT: No. of Inputs	OUTPUT: Output Address	OUTPUT: No. of Outputs
1	**V40410**	**48**	**V40510**	**32**
2	**V40413**	**16**	**V40512**	**16**
3				
4				
5				
6				
7				

Remote Slave Worksheet

Remote Base Address 2 **(Choose 1-7 for RM-net or 1-31 for SM-NET)**

Slot Number	Module Name	INPUT: Input Address	INPUT: No. of Inputs	OUTPUT: Output Address	OUTPUT: No. of Outputs
0	08ND3	X260	8		
1	08ND3	X270	8		
2	16TD1-2			Y240	16
3					
4					
5					
6					
7					

Input Bit Start Address: X260 **V-Memory Address*:V** 40413

Total Input Points 16

Output Bit Start Address: Y240 **V-Memory Address*:V** 40512

Total Output Points 16

* The D2-RMSM automatically assigns I/O addresses in sequence based on Slave # 1's starting addresses. The DL250/DL350 CPU port setup program requires these addresses for each slave.

NOTE: Configuring remote I/O for the DL250 or DL350 CPU port requires *both* the starting addresses and the number of input and output points for each slave. The starting addresses for each slave must be on a 16-point boundary. In this example, this means that X250-X257 in Slave # 1 are unused.

The second block of logic tells the CPU, *for each slave*, the starting V-memory addresses for the inputs and outputs, and the total number of each. The CPU has reserved memory locations, called pointers, that accomplish this task. Use the values from the Remote Slave Worksheets or the Channel Configuration Sheet and the pointer addresses from the DL250/DL350 Reserved Memory Table to complete this logic.

Write Input and Output Pointers and Ranges for each remote base

Channel Configuration Worksheet

DL250/DL350 CPU Bottom Port

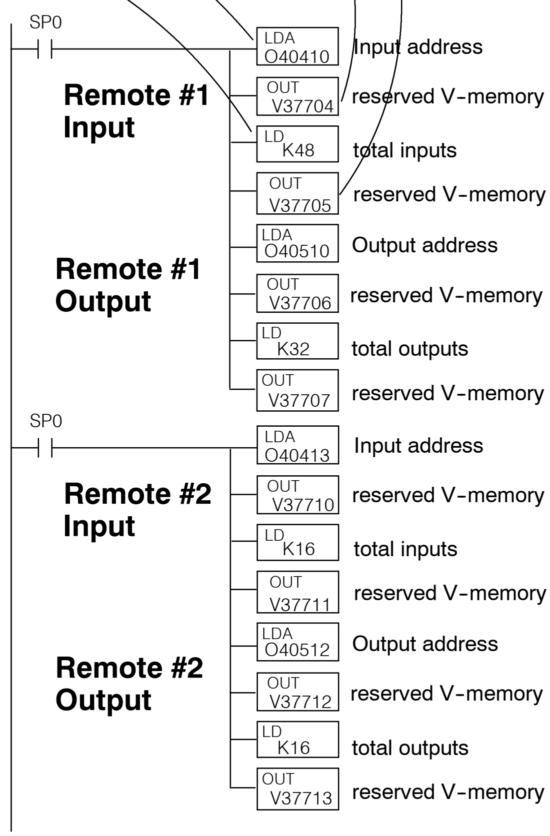
Circle one selection or fill in blank for each parameter

Configuration Parameter	SELECTION
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4
Remote I/O Configuration table Starting address	V 37700 (V37700 is default)

Slave Station	INPUT		OUTPUT	
	Input Address	No. of Inputs	Output Address	No. of Outputs
1	V40410	48	V40510	32
2	V40413	16	V40512	16
3				
4				
5				
6				
7				

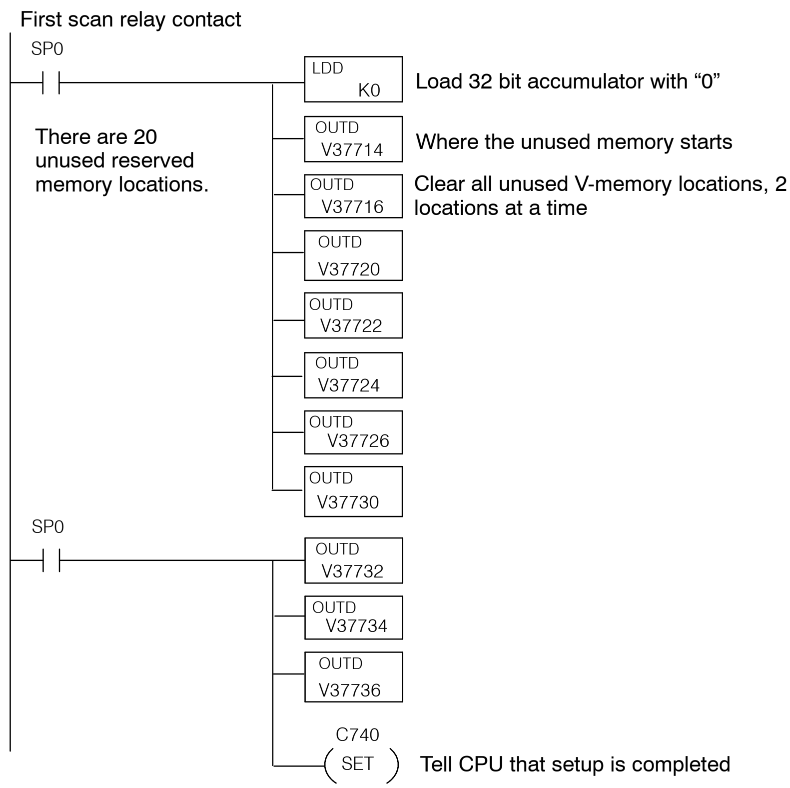
DL250/DL350 Reserved Memory Table

Port Setup Word				V7656
Setup Complete Flag				C740
Slave	Input Address	Number of Input Pts	Output Address	Number of Output Pts
1	V37704	V37705	V37706	V37707
2	V37710	V37711	V37712	V37713
3	V37714	V37715	V37716	V37717
4	V37720	V37721	V37722	V37723
5	V37724	V37725	V37726	V37727
6	V37730	V37731	V37732	V37733
7	V37734	V37735	V37736	V37737

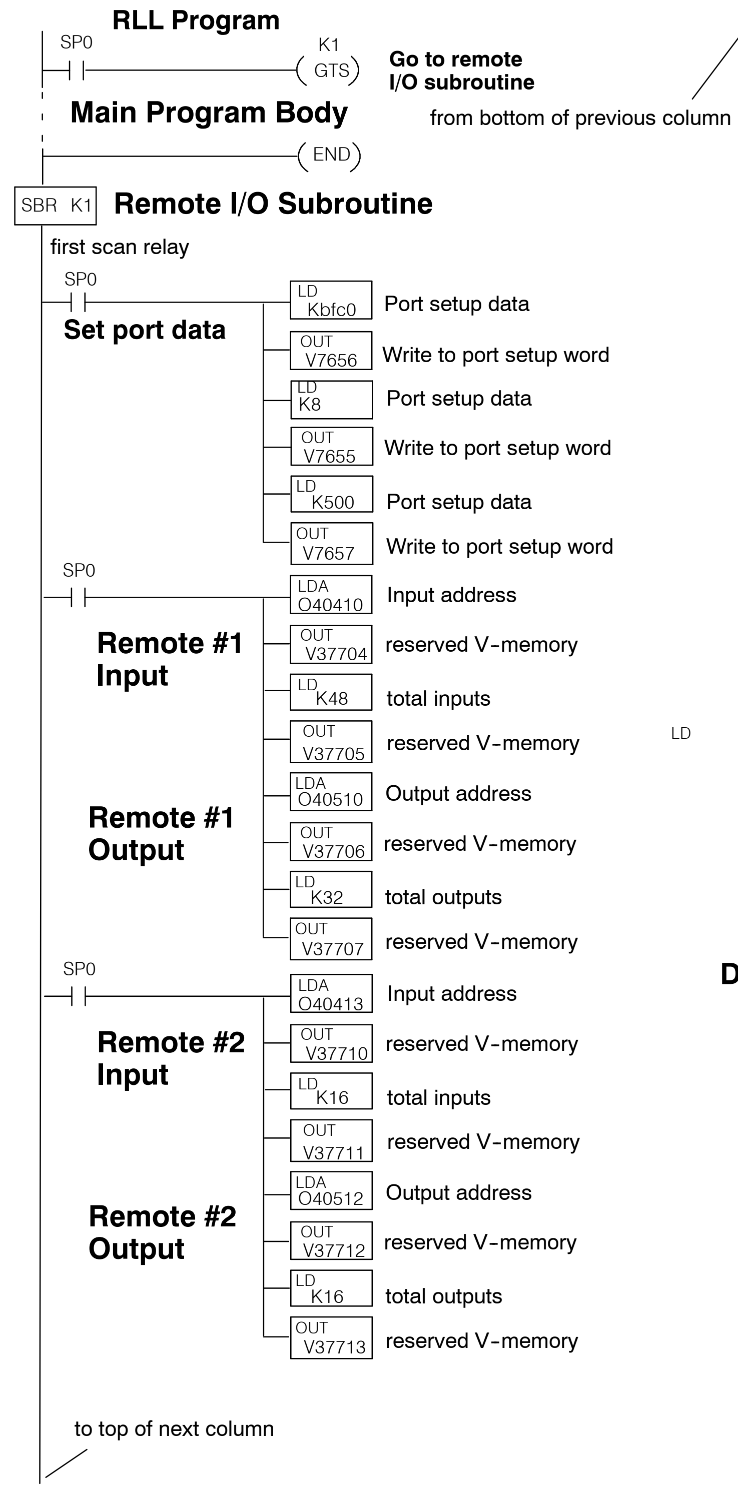


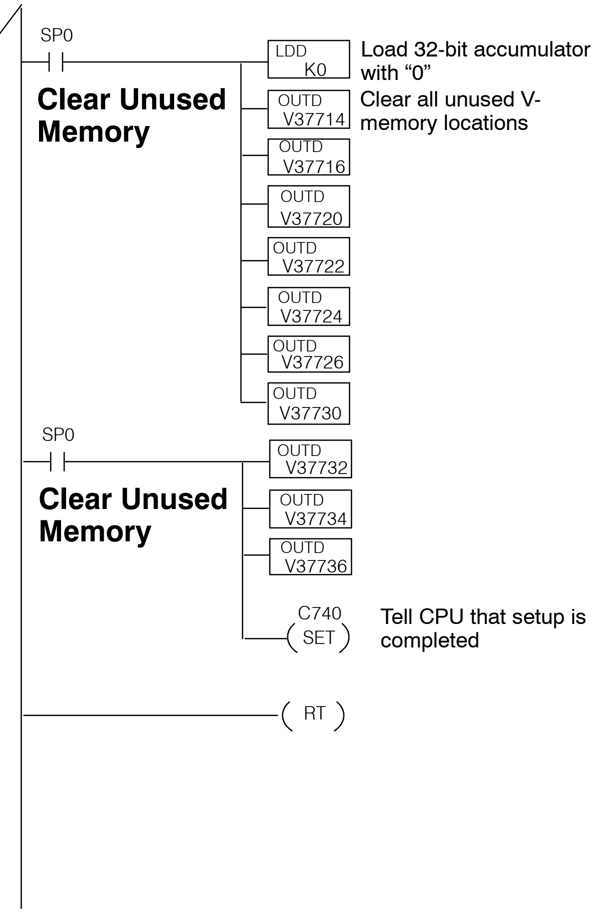
Once you have written all of the logic to map the starting addresses and point totals for each remote base, you have to zero out all of the reserved memory locations you are not going to use and then tell the CPU that you are finished with the setup. If you don't insert zeros in the unused areas, the CPU will assume that every pointer address V37714 through V37736 is pointing to a read or write start address. This could cause problems; you may have garbage in these locations. At the very least, it will take up unnecessary scan time.

The most efficient method for zeroing out the unused memory is to use LDD and OUTD instructions (load and store double) to clear two consecutive memory locations at a time. The following logic shows how to finish the setup program for this example.



Completed Setup Program for DL250/DL350 as Remote Master





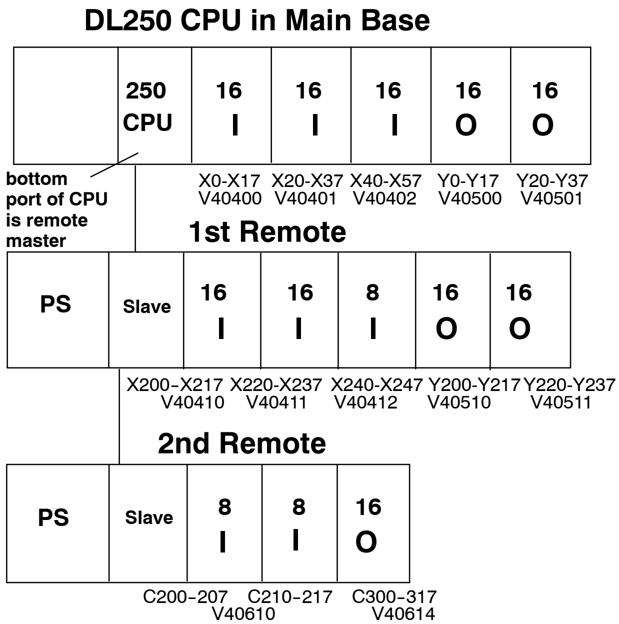
DL250/DL350 Reserved Memory Table

Port Setup Word				V7656
Setup Complete Flag				C740
Slave	Input Address	Number of Input Pts	Output Address	Number of Output Pts
1	V37704	V37705	V37706	V37707
2	V37710	V37711	V37712	V37713
3	V37714	V37715	V37716	V37717
4	V37720	V37721	V37722	V37723
5	V37724	V37725	V37726	V37727
6	V37730	V37731	V37732	V37733
7	V37734	V37735	V37736	V37737

Example 2: Using Control Relays as a Remote I/O Memory Type

In certain applications, you may need to address remote I/O as a memory type other than real inputs (X type) and/or real outputs (Y type). To conserve X/Y addresses, use the control relay (C type) memory as the references for inputs, outputs, or both, on a per slave basis.

To illustrate the setup program with this option, we will use the DL250 system from Example 1, except that we have assigned the C memory type to Slave #2's inputs and outputs. To define the input and outputs as control relays, choose the correct V-memory addresses from the Control Relay (C) Addresses table in Appendix B.



Remote Slave Worksheet

Remote Base Address 1 (Choose 1-7 for RM-NET or 1-31 for SM-NET)

Slot Number	Module Name	INPUT Input Address	INPUT No. Inputs	OUTPUT Output Address	OUTPUT No.Outputs
0	16ND3-2	X200	16		
1	16ND3-2	X220	16		
2	08ND3	X240	16 (8 used)		
3	16TD1-2			Y200	16
4	16TD1-2			Y220	16
5					
6					
7					

Input Bit Start Address: X200 V-Memory Address*:V 40410
Total Input Points 48

Output Bit Start Address: Y200 V-Memory Address*:V 40510
Total Output Points 32

* The D2–RMSM automatically assigns I/O addresses in sequence based on Slave # 1's starting addresses. The DL250/DL350 CPU port setup program requires these addresses for each slave.

Channel Configuration Worksheet
DL250/DL350 CPU Bottom Port

Circle one selection or fill in blank for each parameter

Configuration Parameter	SELECTION
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4
Remote I/O Configuration table Starting address	V 37700 (V37700 is default)

Slave Station	INPUT Input Address	INPUT No. of Inputs	OUTPUT Output Address	OUTPUT No. of Outputs
1	V40410	48	V40510	32
2	V40610	16	V40614	16
3				
4				
5				
6				
7				

Remote Slave Worksheet

...te Base Address 2 (Choose 1-7 for RM-net or 1-31 for SM-NET)

...r	Module Name	INPUT Input Address	INPUT No. Inputs	OUTPUT Output Address	OUTPUT No.Outputs
	08ND3	C200	8		
	08ND3	C210	8		
	16TD1-2			C300	16

...Bit Start Address: C200 V-Memory Address*:V 40610
Total Input Points 16

...Bit Start Address: C300 V-Memory Address*:V 40614
Total Output Points 16

...2–RMSM automatically assigns I/O addresses in sequence based on ... 1's starting addresses. The DL250/DL350 CPU port setup program ...s these addresses for each slave.

The logic to write the port setup word is identical to Example 1, so we will proceed to the second block of logic.

This block of logic tells the CPU, *for each slave*, the starting V-memory addresses for the inputs and outputs, and the total number of each. Use the values from the Remote Slave Worksheets or Channel Configuration Worksheet and the pointer addresses from the DL250/DL350 Reserved Memory Table to complete the logic.

Write Input and Output Pointers and Ranges for each remote base

Channel Configuration Worksheet
DL250/DL350 CPU Bottom Port

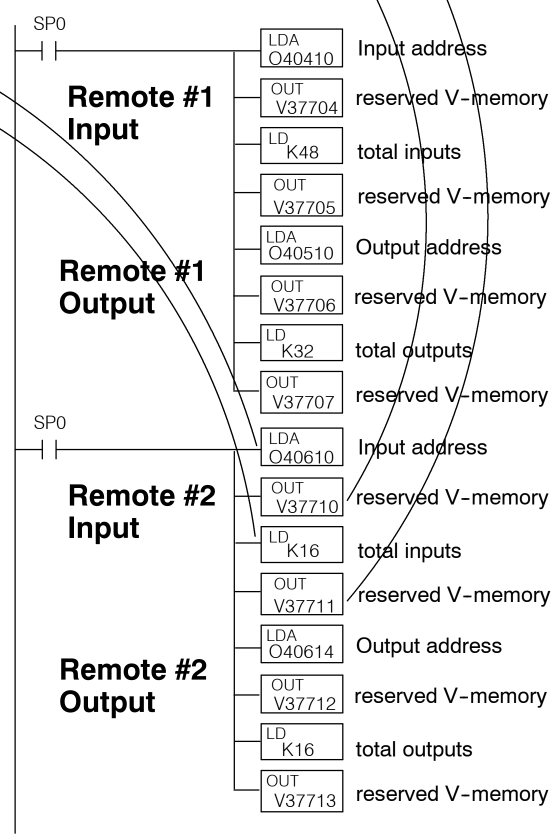
Circle one selection or fill in blank for each parameter

Configuration Parameter	SELECTION
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4
Remote I/O Configuration table Starting address	V 37700 (V37700 is default)

Slave Station	INPUT		OUTPUT	
	Input Address	No. of Inputs	Output Address	No. of Outputs
1	V40410	48	V40510	32
2	V40610	16	V40614	16
3				
4				
5				
6				
7				

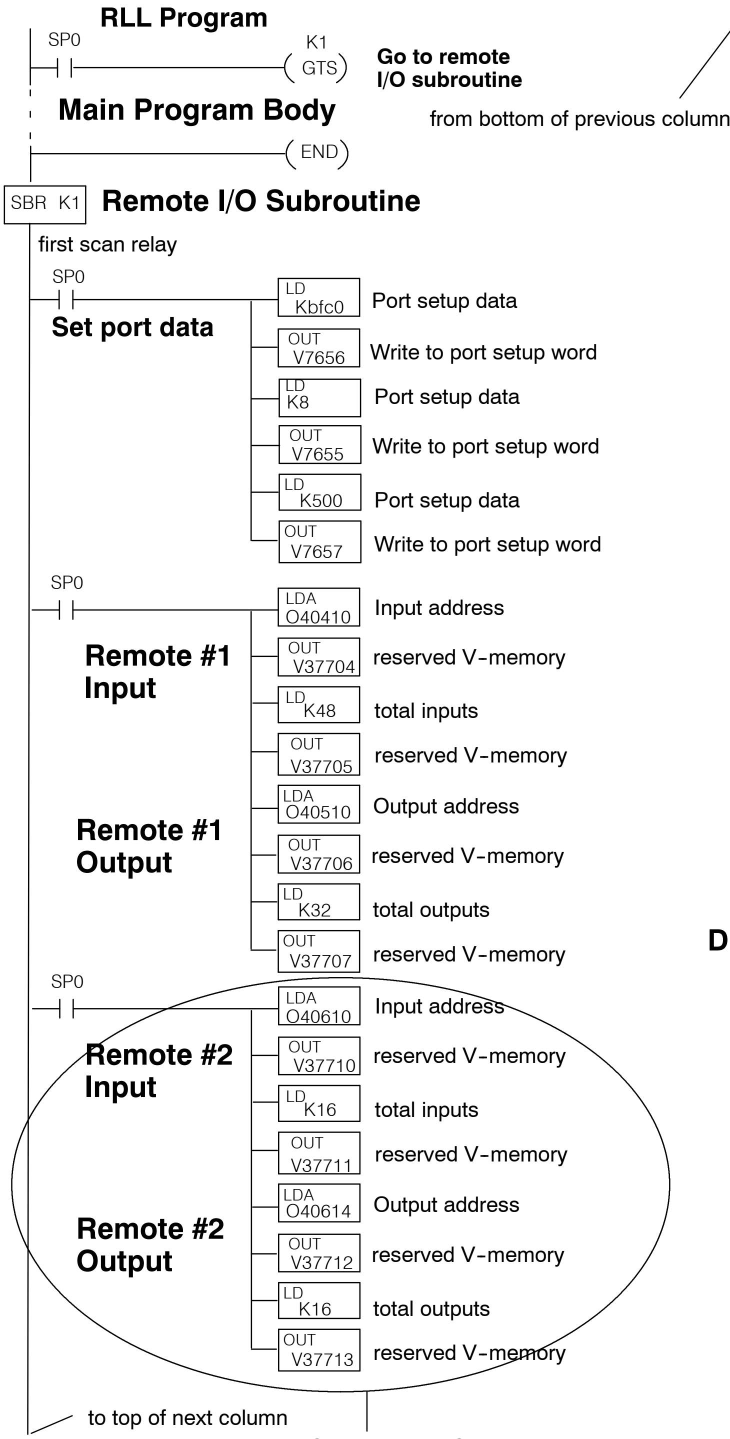
DL250/DL350 Reserved Memory Table

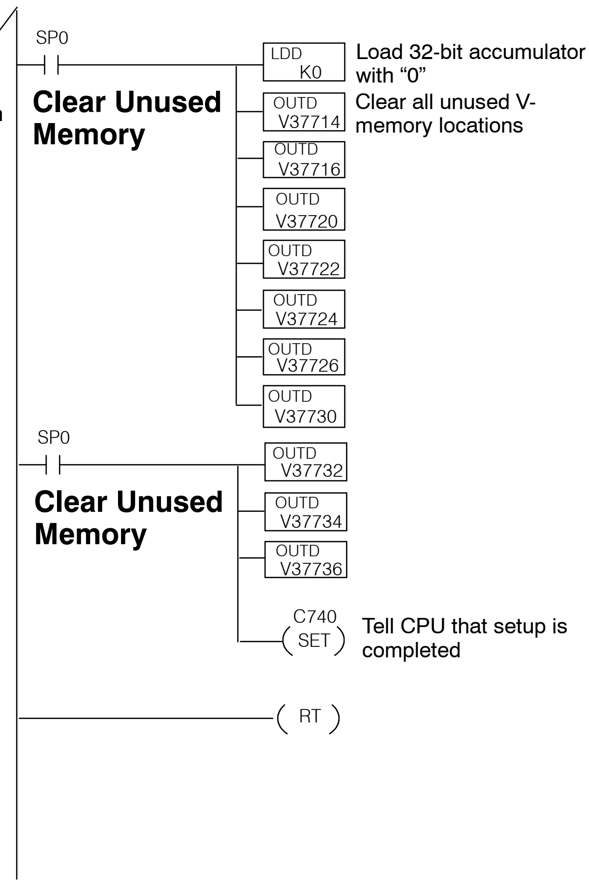
Port Setup Word				V7656
Setup Complete Flag				C740
Slave	Input Address	Number of Input Pts	Output Address	Number of Output Pts
1	V37704	V37705	V37706	V37707
2	V37710	V37711	V37712	V37713
3	V37714	V37715	V37716	V37717
4	V37720	V37721	V37722	V37723
5	V37724	V37725	V37726	V37727
6	V37730	V37731	V37732	V37733
7	V37734	V37735	V37736	V37737



Since the rest of the logic is identical to Example 1, we will now show the completed setup program.

Completed Setup Program for DL250/DL350 as Remote Master using C memory type





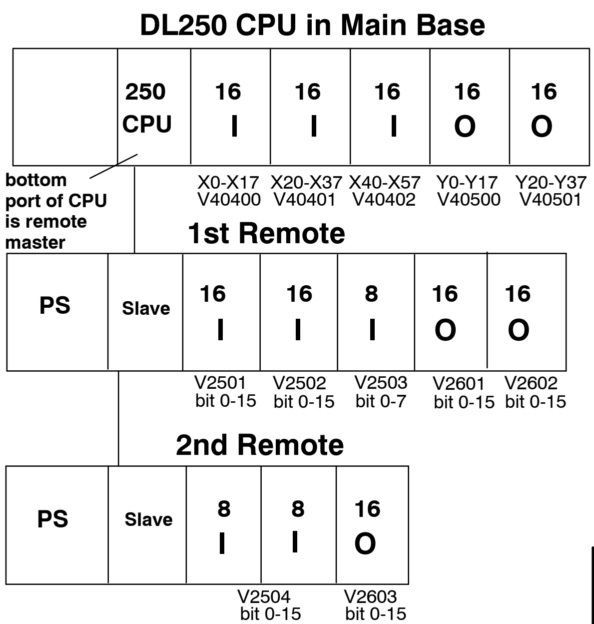
DL250/DL350 Reserved Memory Table

Port Setup Word				V7656
Setup Complete Flag				C740
Slave	Input Address	Number of Input Pts	Output Address	Number of Output Pts
1	V37704	V37705	V37706	V37707
2	V37710	V37711	V37712	V37713
3	V37714	V37715	V37716	V37717
4	V37720	V37721	V37722	V37723
5	V37724	V37725	V37726	V37727
6	V37730	V37731	V37732	V37733
7	V37734	V37735	V37736	V37737

Example 3: Using V memory as Remote I/O type

To assign I/O references to other than the X/Y and C addresses, you can use the V-memory as the references for inputs, outputs, or both, on a per slave basis. Note that this option is not available for the D2–RMSM channels.

To illustrate the setup program with this option, we will use our DL250 sample system, except that we have assigned the V-memory type to all slave inputs and outputs. To reference the individual input and output status in the application program, use the “Bit of Word” instructions, detailed in the DL205 or DL305 User Manual.



Remote Slave Worksheet

Remote Base Address 1 (Choose 1-7 for RM-NET or 1-31 for SM-NET)

Slot Number	Module Name	INPUT Input Address	INPUT No. of Inputs	OUTPUT Output Address	OUTPUT No. of Outputs
0	16ND3-2	V2501	16		
1	16ND3-2	V2502	16		
2	08ND3	V2503	16 (8 used)		
3	16TD1-2			V2601	16
4	16TD1-2			V2602	16
5					
6					
7					

Input Bit Start Address:________V-Memory Address*:V 2501
Total Input Points 48
Output Bit Start Address:________V-Memory Address*:V 2601

Channel Configuration Worksheet
DL250/DL350 CPU Bottom Port

ne selection or fill in blank for each parameter

guration Parameter	SELECTION
ate (in KBaud), determined by required e to last slave	19.2 38.4
I/O Configuration table Starting address	V 37700 (V37700 is default)

Slave Station	INPUT Input Address	INPUT No. of Inputs	OUTPUT Output Address	OUTPUT No. of Outputs
1	V2501	48	V2601	32
2	V2504	16	V2603	16
3				
4				
5				
6				
7				

Remote Slave Worksheet

Remote Base Address 2 (Choose 1-7 for RM-net or 1-31 for SM-NET)

Slot Number	Module Name	INPUT Input Address	INPUT No. of Inputs	OUTPUT Output Address	OUTPUT No. of Outputs
0	08ND3	V2504	8		
1	08ND3	V2504	8		
2	16TD1-2			V2603	16
3					
4					
5					
6					
7					

Input Bit Start Address:________V-Memory Address*:V 2504
Total Input Points 16
Output Bit Start Address:________V-Memory Address*:V 2603
Total Output Points 16

* The D2–RMSM automatically assigns I/O addresses in sequence based on Slave # 1’s starting addresses. The DL250/DL350 CPU port setup program requires these addresses for each slave.

NOTE: Do not use V-memory words reserved for other functions.

The logic to write the port setup word is identical to Example 1, so we will proceed to the second block of logic.

This block of logic tells the CPU, *for each slave*, the starting V-memory addresses for the inputs and outputs, and the total number of each. Use the values from the Remote Slave Worksheets or Channel Configuration Worksheet and the pointer addresses from the DL250/DL350 Reserved Memory Table to complete the logic.

Write Input and Output Pointers and Ranges for each remote base

DL250/DL350 Reserved Memory Table

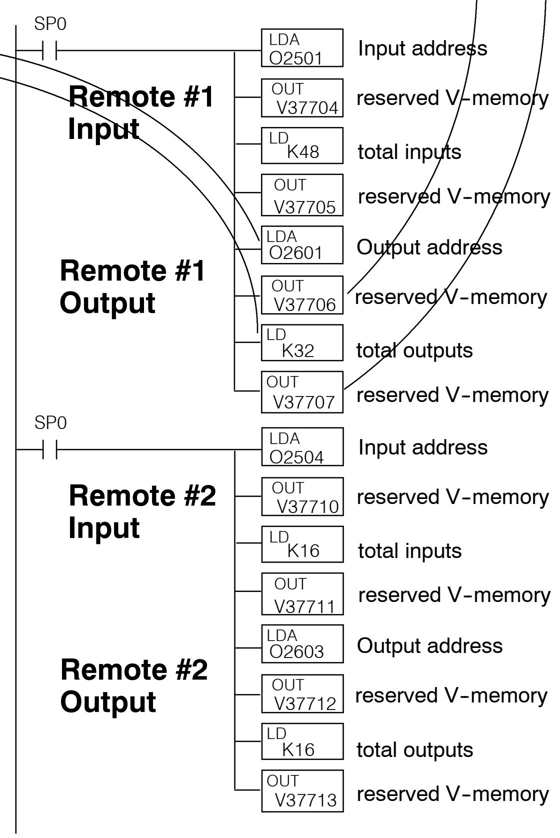
Port Setup Word				V7656
Setup Complete Flag				C740
Slave	Input Address	Number of Input Pts	Output Address	Number of Output Pts
1	V37704	V37705	V37706	V37707
2	V37710	V37711	V37712	V37713
3	V37714	V37715	V37716	V37717
4	V37720	V37721	V37722	V37723
5	V37724	V37725	V37726	V37727
6	V37730	V37731	V37732	V37733
7	V37734	V37735	V37736	V37737

Channel Configuration Worksheet
DL250/DL350 CPU Bottom Port

Circle one selection or fill in blank for each parameter

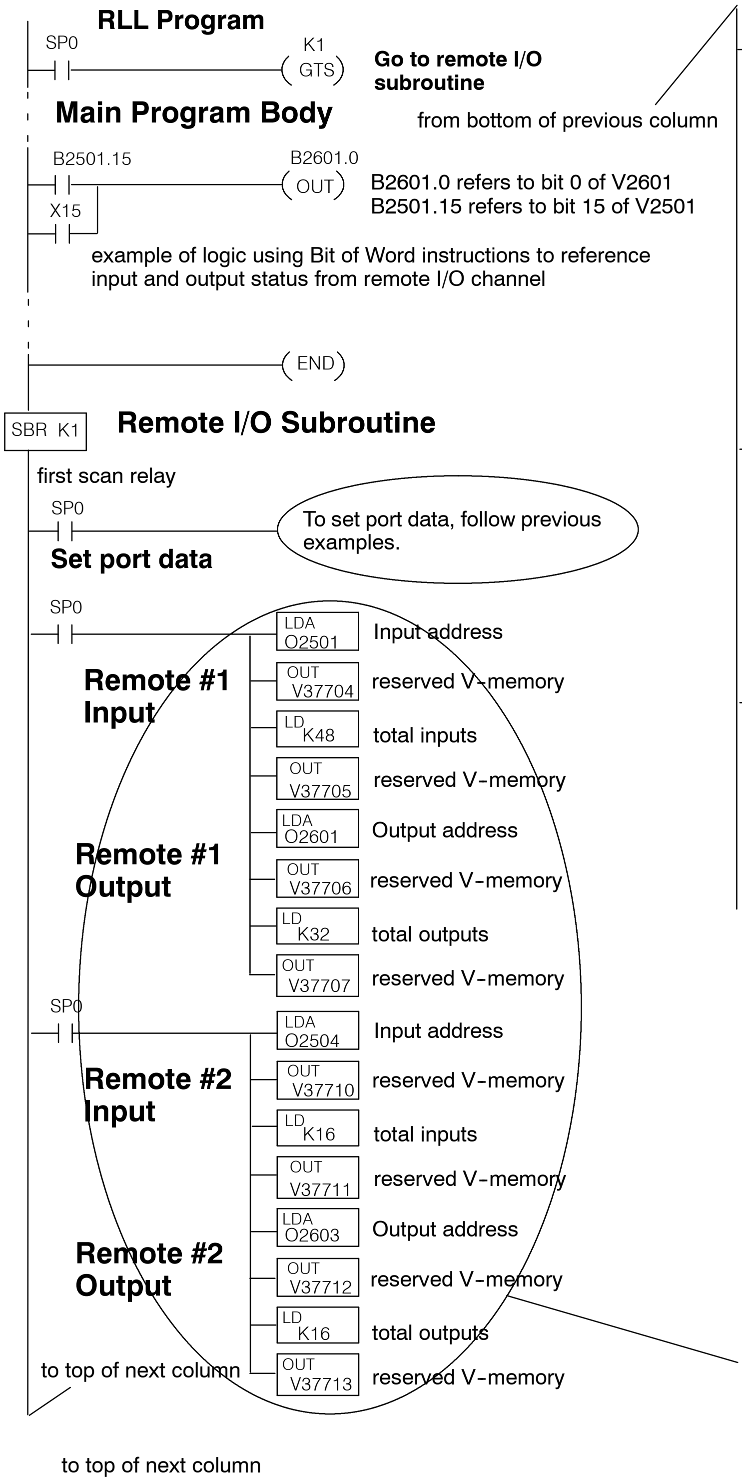
Configuration Parameter	SELECTION
Baud Rate (in KBaud), determined by required distance to last slave	19.2 38.4
Remote I/O Configuration table Starting address	V 37700 (V37700 is default)

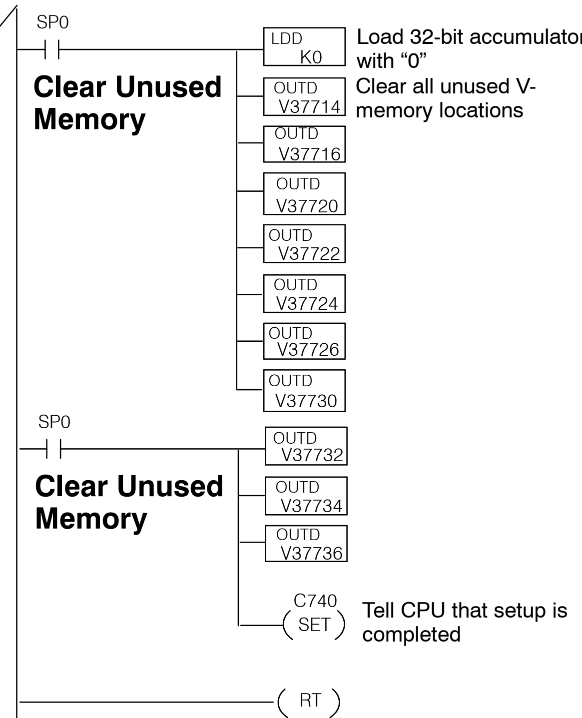
Slave Station	INPUT		OUTPUT	
	Input Address	No. of Inputs	Output Address	No. of Outputs
1	V2501	48	V2601	32
2	V2504	16	V2603	16
3				
4				
5				
6				
7				



Since the rest of the logic is identical to Example 1, we will now show the completed setup program.

Completed Setup Program for DL250/DL350 as Remote Master using V memory type





Slaves use V–memory type as inputs and outputs

to top of next column

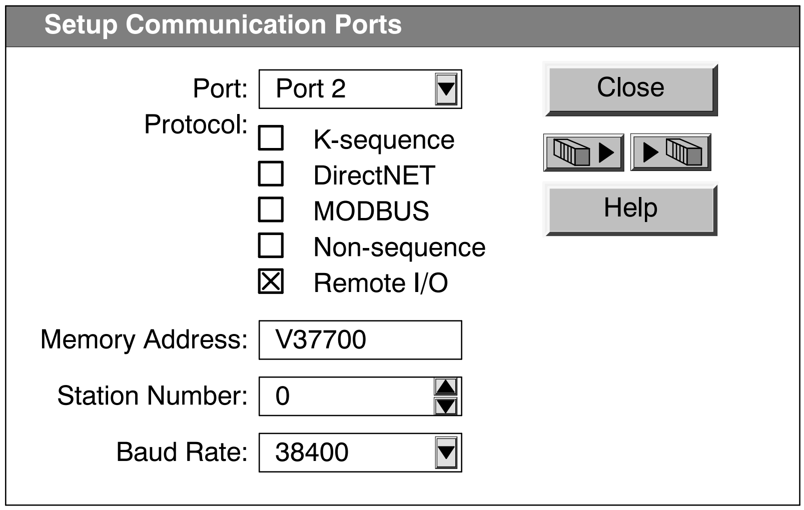
DL250/DL350 Reserved Memory Table

Port Setup Word				V7656
Setup Complete Flag				C740
Slave	Input Address	Number of Input Pts	Output Address	Number of Output Pts
1	V37704	V37705	V37706	V37707
2	V37710	V37711	V37712	V37713
3	V37714	V37715	V37716	V37717
4	V37720	V37721	V37722	V37723
5	V37724	V37725	V37726	V37727
6	V37730	V37731	V37732	V37733
7	V37734	V37735	V37736	V37737

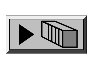
Configuring the bottom port of the DL250 or DL350 CPU

To configure the port using the Handheld Programmer, use AUX 56 and follow the prompts, making the same choices as indicated below on this page. To configure the port in ***Direct***SOFT, choose the PLC menu, then Setup, then Setup Secondary Comm Port...

- **Port:** From the port number list box at the top, choose “Port 2”.
- **Protocol:** Click the check box to the left of “Remote I/O” (called “M–NET” on the HPP), and then you’ll see the dialog box shown below.



- **Memory Address:** Choose a V-memory address to use as the starting location of a Remote I/O configuration table (V37700 is the default). This table is separate and independent from the table for any Remote Master(s) in the system.
- **Station Number:** Choose “0” as the station number, which makes the DL250 or DL350 the master. Station numbers 1–7 are reserved for remote slaves.
- **Baud Rate:** The baud rates 19200 and 38400 baud are available. Choose 38400 initially as the remote I/O baud rate, and revert to 19200 baud if you experience data errors or noise problems on the link. Important: You must configure the baud rate on the Remote Slaves (via DIP switches) to match the baud rate selection for the CPU’s Port 2.

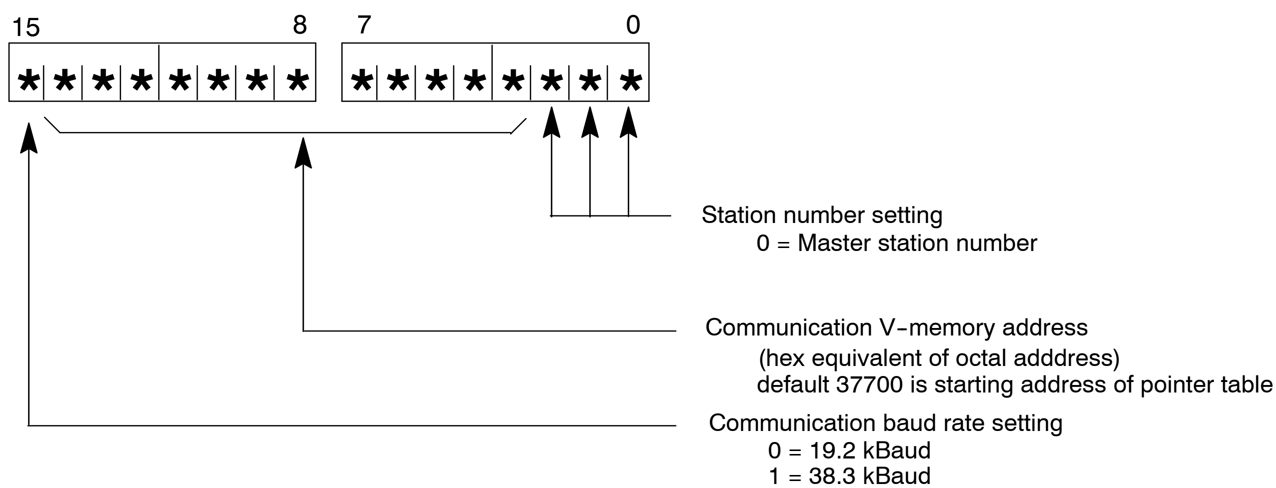


Then click the button indicated to send the Port 2 configuration to the CPU, and click Close.

DL250/DL350 Reserved Memory for 2nd Port as Remote Master

When you configure the bottom port of the DL250 or DL350 CPU via ***Direct***Soft or the Handheld Programmer, you are actually loading a reserved V-memory adddress (V7656) with configuration data. The following chart defines the meaning of the bits in this register. The examples include logic in the setup program to set these parameters so they are not lost or accidentally changed.

Remote I/O Communication (V7656)



This table provides a listing of the reserved memory addresses in the DL250 or DL350 CPU to program the pointer addresses and ranges for slaves attached to the bottom port of the CPU.

DL250/DL350 Reserved Memory Table

Port Setup Word				V7656
Setup Complete Flag				C740
Slave	Input Address	Number of Input Points	Output Address	Number of Output Points
Reserved	V37700	V37701	V37702	V37703
1	V37704	V37705	V37706	V37707
2	V37710	V37711	V37712	V37713
3	V37714	V37715	V37716	V37717
4	V37720	V37721	V37722	V37723
5	V37724	V37725	V37726	V37727
6	V37730	V37731	V37732	V37733
7	V37734	V37735	V37736	V37737

This table provides a listing of the control relay flags available for the setup and monitoring of remote I/O attached to the bottom port of the DL250 or DL350 CPU.

FLAG ADDRESS	FUNCTION	DETAIL
C740	Setup Complete Flag	Set ON to command CPU to read and check parameters loaded into setup memory
C741	Communications Error Response Flag	This flag determines the CPU's response if there is a communications error. Set ON to hold last state of received inputs; set OFF to clear the status of the received inputs.

6

Diagnostics and Troubleshooting

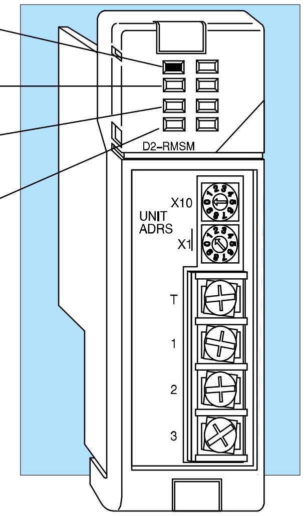
In This Chapter. . . .

Troubleshooting Remote I/O

Module Indicators

Check the indicators on the Remote Master and Slave units to verify that the network is operating correctly. The following diagram shows the proper indicator conditions.

Remote Master



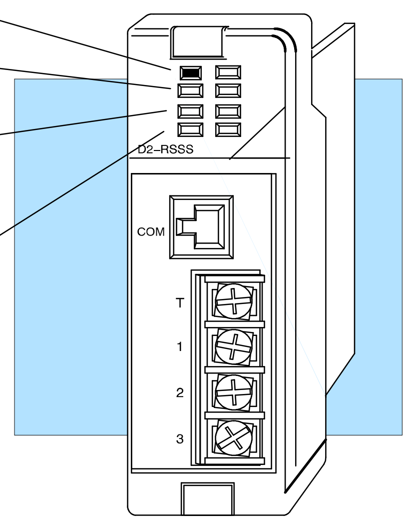
RUN--Turns ON when the module is operating correctly.

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

I/O--Turns ON when the setup program is wrong

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

Remote Slave



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

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

I/O--Turns ON when there is an I/O failure at the slave, or rotary switch setting exceeds valid number

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

Troubleshooting Quick Steps

If the remote I/O channel does not seem to be working correctly, check the following items. These items represent the problems found most often.

1. Cable and connections. Incorrectly wired cables and loose terminations cause the majority of problems. Verify you've selected the proper cable configuration and check the cable, making sure it is wired correctly. Also check the cable routing to ensure that the installation guidelines in Chapter 3 were followed.
2. Incorrect Baud Rate. Make sure you've set all D2–RSSS units to match the communication parameters set on the master station (D2–RMSM, D2–250 or D3–350 bottom port, D4–RM, D4–SM).
3. Incorrect protocol. Make sure you've set all D2–RSSS units to match the protocol setting on the master station (D2–RMSM, D2–250 or D3–350 bottom port, D4–RM, D4–SM).
4. Setup program. Check the setup program for errors such as incorrect pointers or constants, or writing to the wrong module address. Be sure that the total inputs and outputs values match the sum of the individual slave input and output ranges; otherwise, the D2–RMSM *will not* accept the setup data.

NOTE: If you need more in-depth troubleshooting, see the chart on the next page. It provides several different indicator patterns that may help identify your exact problem.

Troubleshooting Chart

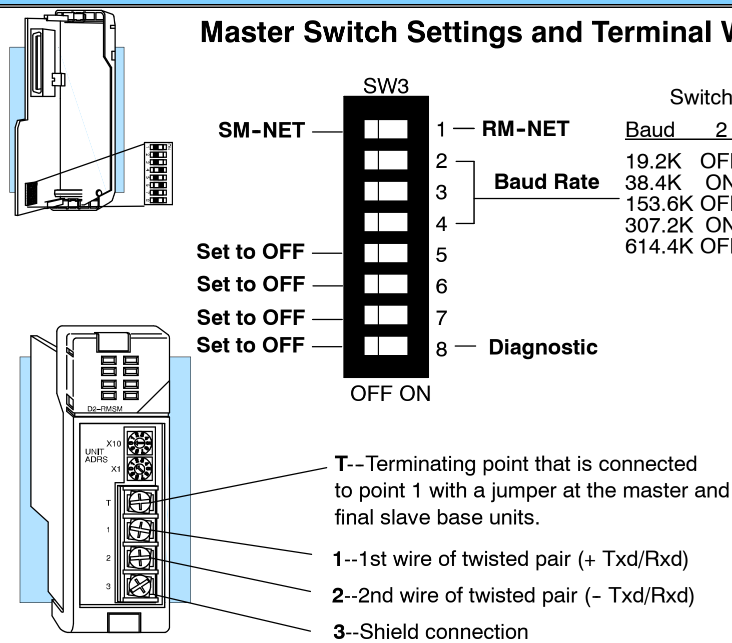
off on flash

The following chart identifies the indicator status, possible cause, and corrective action for a variety of commonly found problems.

Master Station Indicators	Slave Station Indicators	Possible Cause	Corrective Action
RUN DIAG I/O LINK — RUN is off.	RUN DIAG I/O LINK	1. Master PLC power is disconnected. 2. Remote Master is defective.	1. Check the PLC power source. 2. Replace the Remote Master.
RUN DIAG I/O LINK — RUN is on.	RUN DIAG I/O LINK — LINK is on.	1. Switch setting on master or slave station is incorrect. 2. Communications wiring is incorrect.	1. Check the DIP switches on Remote Master and slaves to ensure their baud rate and protocol settings match. 2. Check the communications wiring and termination resistors.
RUN DIAG I/O LINK — RUN is flashing, I/O is on.	RUN DIAG I/O LINK	1. Setup program is not correct. 2. I/O totals do not match values in D2–RMSM shared memory 124 and 126.	1. Check the setup program to ensure pointer values and configuration constants are correct. 2. Check the I/O totals against the sum of the individual slave ranges in the setup program.
RUN DIAG I/O LINK — LINK is on.	RUN DIAG I/O LINK — I/O is flashing	1. I/O module failure at slave. 2. Slave module is missing 24VDC power. 3. Slave base pwer budget overloaded.	1. Check the I/O modules in the slave unit for failures.
RUN DIAG I/O LINK — Lights blink in sequence, then all lights turn on.	RUN DIAG I/O LINK — Lights blink in sequence, then all lights turn on	1. Module's Diagnostic DIP switch is ON.	1. Check the Diagnostic DIP switch on Master or slave to ensure that it is off.
RUN DIAG I/O LINK — RUN is on.	RUN DIAG I/O LINK — I/O is on.	1. Rotary switches' setting for slave ID exceeds valid address for chosen protocol.	1. Check rotary switches on slave for valid unit number: must be 31 or less for SM–NET, must be 7 or less for RM–NET

Switch Settings & Port Pinouts

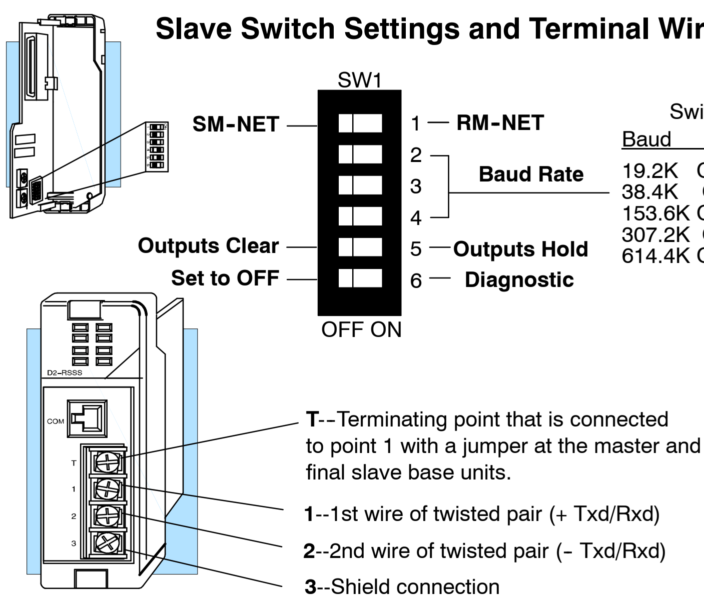
Master Switch Settings and Terminal Wiring



Switch Positions

Baud	2	3	4
19.2K	OFF	OFF	OFF
38.4K	ON	OFF	OFF
153.6K	OFF	ON	OFF
307.2K	ON	ON	OFF
614.4K	OFF	OFF	ON

Slave Switch Settings and Terminal Wiring



Switch Positions

Baud	2	3	4
19.2K	OFF	OFF	OFF
38.4K	ON	OFF	OFF
153.6K	OFF	ON	OFF
307.2K	ON	ON	OFF
614.4K	OFF	OFF	ON

Special CPU Memory for Diagnostics

Communication Status Flags in V-memory

This table provides a listing of the individual flags in V-memory for communication status. The corresponding bit of V-memory turns ON when the slave is communicating. Station 0 represents the master; its bit turns on when communication begins with its slaves. You may use ***Direct***SOFT or the application program to monitor these flags. If there is a communications error, this memory may not show the correct data.

	Master in Slot No.:							
	0	1	2	3	4	5	6	7
Station	N/A	V7661	V7662	V7663	V7664	V7665	V7666	V7667
0	Bit 0							
1	Bit 1							
2	Bit 2							
3	Bit 3							
4	Bit 4							
5	Bit 5							
6	Bit 6							
7	Bit 7							
8	Bit 8							
9	Bit 9							
10	Bit 10							
11	Bit 11							
12	Bit 12							
13	Bit 13							
14	Bit 14							
15	Bit 15							

Error Flags in V-memory

This table provides a listing of the individual flags in V-memory for slave errors. The corresponding bit of V-memory turns ON when the slave has an error. Station 0 represents the master; its bit turns on when an error occurs with any slave. You may use ***Direct***SOFT or the application program to monitor these flags. If there is a communications error, this memory may not show the correct data.

	Masster in Slot No.:							
	0	1	2	3	4	5	6	7
Station	N/A	V7671	V7672	V7673	V7674	V7675	V7676	V7677
0	Bit 0							
1	Bit 1							
2	Bit 2							
3	Bit 3							
4	Bit 4							
5	Bit 5							
6	Bit 6							
7	Bit 7							
8	Bit 8							
9	Bit 9							
10	Bit 10							
11	Bit 11							
12	Bit 12							
13	Bit 13							
14	Bit 14							
15	Bit 15							

D2-RMSM Memory for Diagnostics

The following tables describe the shared memory locations in the D2-RMSM Remote Master which provide status and error information about the module and its attached remote I/O network.

Hardware Status

This table lists the status bytes available in the D2-RMSM shared memory which report the hardware settings. You can implement logic to read these bytes to check your configuration without having to remove the module.

OCTAL ADDRESS	FUNCTION	DETAIL	# Bytes
122	Status of Rotary Switches on module – **Read Only**	Data is 00 to 1F hex, representing the address of the module set by the Rotary Switches	1
123	Status of DIP Switches on module – **Read Only**	Bit status represents the setting of each switch on the module's DIP Switch , which sets configuration parameters. 0=OFF, 1=ON. Bit 0 SW1 status Bit 1 SW2 status Bit 2 SW3 status Bit 3 SW4 status Bit 4 SW5 status Bit 5 SW6 status Bit 6 SW7 status Bit 7 SW8 status	1

Bus Scan Status

This table lists the status words that provide information on bus performance. The user can implement logic to read the status, as well as set the bus scan upper limit parameter.

OCTAL ADDRESS	FUNCTION	DETAIL	# Bytes
160	Current bus scan time – **Read Only**	BCD value of current bus scan, in msec	2
162	Bus scan time upper limit	User can store BCD value of bus scan upper limit, in msec. Default is 100 msec.	2
164	Shortest bus scan time – **Read Only**	BCD value of shortest bus scan detected since CPU went into RUN mode, in msec	2
166	Longest bus scan time – **Read Only**	BCD value of longest bus scan detected since CPU went into RUN mode, in msec	2
170	Bus scan counter – **Read Only**	BCD value of number of bus scans detected since CPU went into RUN mode	2
172	Overlimit Bus scan counter – **Read Only**	BCD value of number of bus scans which have exceeded the scan time upper limit	2

Network Errors

This table lists the shared memory addresses that report network errors and their locations. The user can read these errors to assist in troubleshooting.

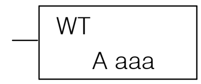
OCTAL ADDRESS	FUNCTION	DETAIL	# Bytes
140	Network Error Flags – **Read Only**	Bit status represents network errors detected by the D2–RMSM. 0=OK, 1=ERROR Bit 0 Configuration Error (see Address 142 for details) Bit 1 Communication Error (see Address 144 for details) Bit 2 Diagnostics Error (see Address 150 for details)	2
142	Configuration Error Code – **Read Only**	Error code in BCD 20 Total inputs exceeds 512 21 Total outputs exceeds 512 24 I/O address out of I/O range 25 I/O address allocated to bad range 29 A slave has more than 512 points 70 Discrepancy between current configuration and old one 71 A module is in the wrong slot. 72 Slave configuration is different from old one 73 Different slave is there	1
143	Station Number of Configuration Error – **Read Only**	Station number in BCD	1
144	Communication Error Code – **Read Only**	Error code in BCD 01 slave does not respond 02 wrong I/O information 03 I/O update error : CRC check error	1
145	Station Number of Communication Error Code – **Read Only**	Station number in BCD	1
146	Communication Error Counter – **Read Only**	Number of communication errors detected since CPU went into RUN mode, in BCD	2

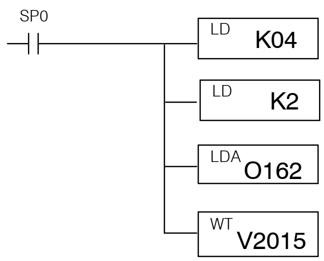
OCTAL ADDRESS	FUNCTION	DETAIL	# Bytes
150	Diagnostics Error Code	Error code in BCD 0201 Terminal block removed 0202 Module not present 0203 Blown fuse 0206 Low battery voltage 0226 Power capacity exceeded	2
153	Station number of Diagnostics error – **Read Only**	station number in BCD	1

How to Access Diagnostics Information

To access diagnostics information, we exchange data with the D2–RMSM module. The remote master unit is an intelligent module, which means it operates asyncronously from the CPU, and it has its own memory. We use the CPU instructions described below to communicate with an intelligent module.

The WT instruction writes a block of data (1–128 bytes max.) to an intelligent I/O module from a block of V-memory in the CPU. The function parameters (module base/slot address, number of bytes, and the intelligent I/O module memory address) are loaded into the first and second level of the accumulator stack, and the accumulator by three additional instructions. In the WT instruction, Aaaa specifies the starting V-memory address where the data will be written from in the CPU. Listed below are the steps to program the WT instruction:





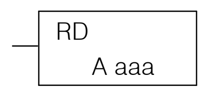
Load the base number (0) into the first byte and the slot number (1–7) into the second byte of the second level of the accumulator stack.

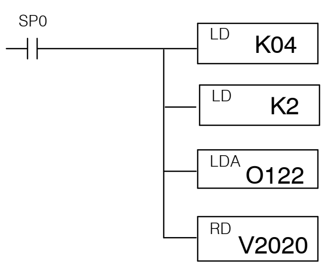
Load the number of bytes to be transferred into the first level of the accumulator stack.

Load the intelligent module address which will receive the data into the accumulator. We use the LDA to convert the octal address into its HEX equivalent.

Insert the WT instruction, which specifies the starting V–memory location where the data will be written from in the CPU.

The RD instruction reads a block of data (1–128 bytes max.) from an intelligent I/O module into the CPU's V–memory. The function parameters (module base/slot address, number of bytes, and the intelligent I/O module memory address) are loaded into the first and second level of the accumulator stack, and the accumulator by three additional instructions. In the RD instruction, Aaaa specifies the starting V–memory address where the intelligent module stores the data in the CPU. Listed below are the steps to program the RD instruction:





Load the base number (0) into the first byte and the slot number (1–7) into the second byte of the second level of the accumulator stack.

Load the number of bytes to be transferred into the first level of the accumulator stack.

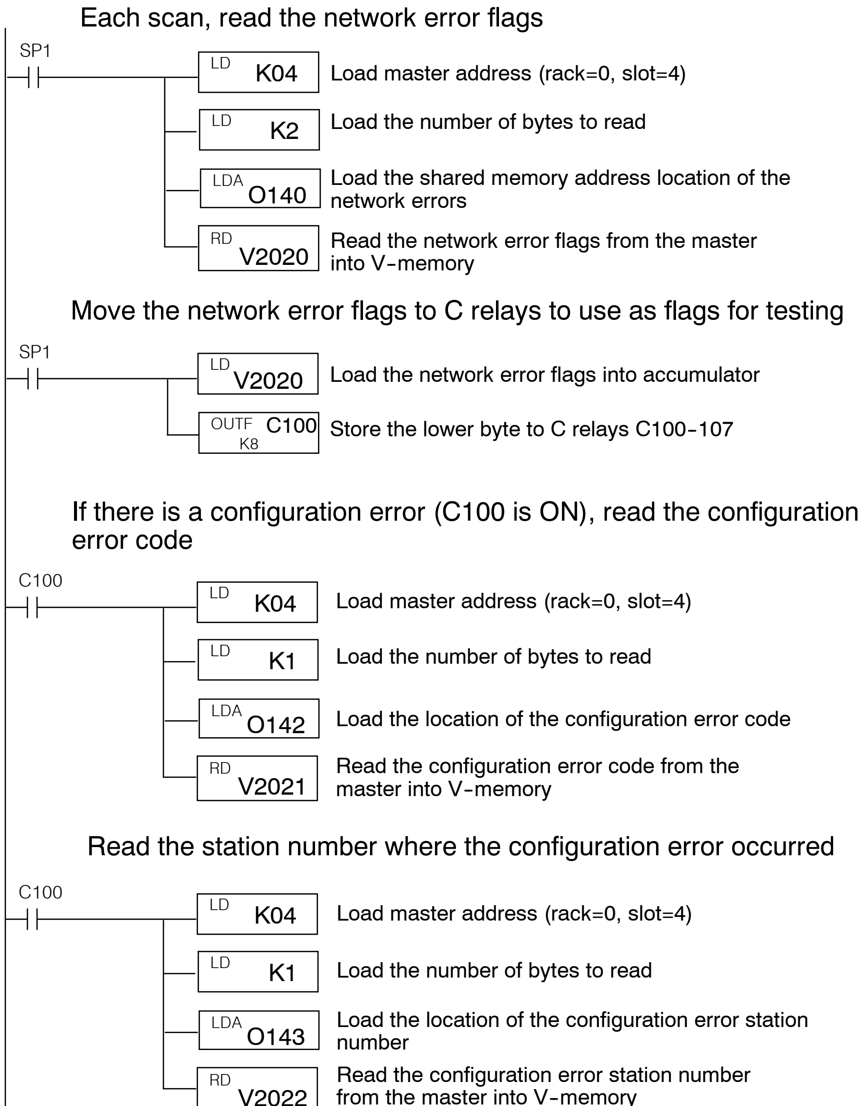
Load the intelligent module address from which the data will be read into the accumulator. The parameter must be a HEX value.

Insert the RD instruction, which specifies the starting V–memory location where the data will be stored.

Example 1: Reading Diagnostic Errors

The diagnostic error information can assist you in locating errors on a remote I/O network, either during installation or for a previously operating system. During installation, we might expect configuration errors caused by incorrect switch settings or an invalid setup program. For a previously operating system, the diagnostics can help locate such faults as a slave not responding, an I/O module not present, or a loose terminal block.

In this example, we read the network error flags each scan, and if there is a configuration error present, we read the error details.



To read communication errors (C101 ON) and diagnostic errors (C102 ON), implement similar logic to check the flag and read the error details.

You can then use the retrieved data in logic or display it in a Dataview in ***Direct***SOFT to determine the nature and location of the error. The Network Error Table describes the error codes.

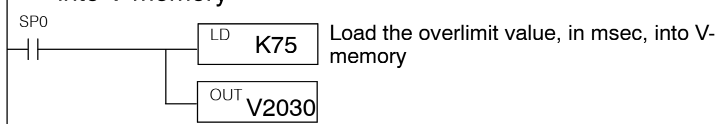
Example 2: Writing Bus Scan Overlimit and Reading Bus Scan Status

In certain applications, the scan time of the remote I/O bus can be an important factor in the response time of the system. Factors which affect the scan time include number of slaves on the bus and the baud rate. Required bus performance may dictate your system layout. For example, you may want to increase the number of remote channels in the system to decrease the number of slaves on each channel. Or you may need to choose SM–NET as the protocol to operate at a higher baud rate.

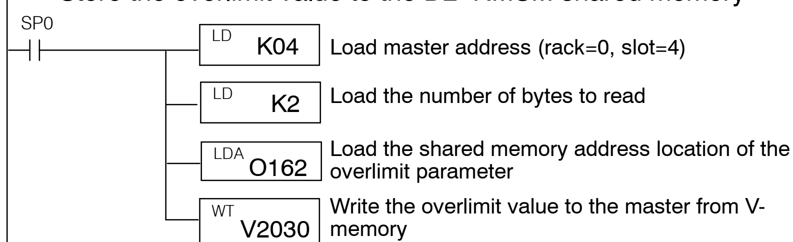
Bus scan performance data includes current bus scan time, the longest and shortest scans detected, a scan counter, and a scan overlimit counter. The overlimit counter records the number of times the scan has exceeded the overlimit value. The overlimit value, in msec, can be set by the user's logic; the default is 100 msec.

In this example, we demonstrate how to set the bus scan overlimit parameter, and then read the bus scan data to check performance.

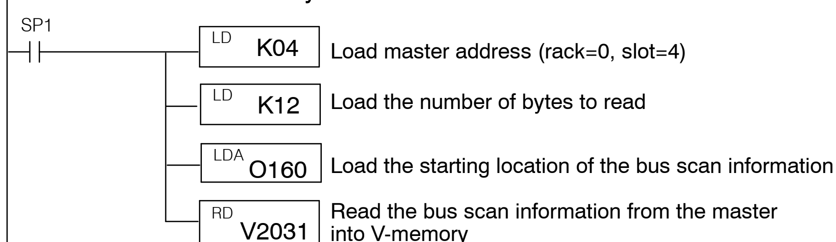
On the first scan, load the desired bus scan overlimit parameter value into V memory



Store the overlimit value to the D2–RMSM shared memory

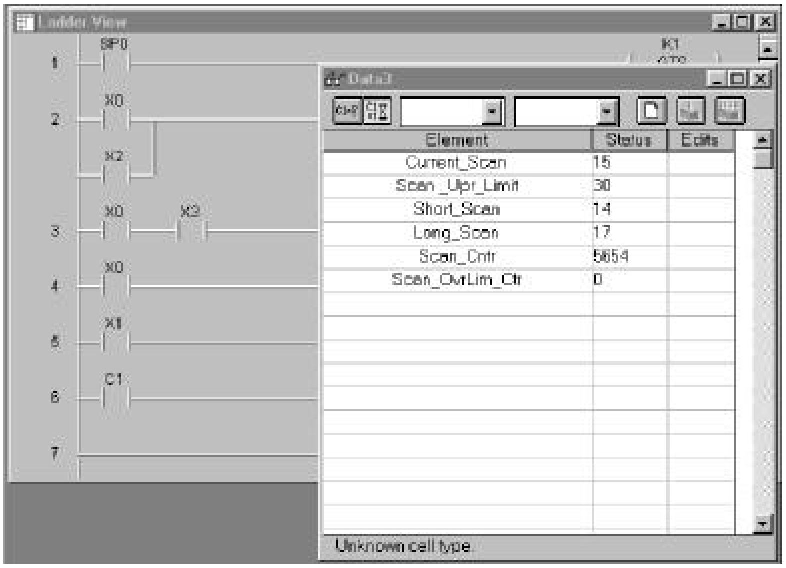


On every scan, read all bus scan diagnostic information from the master into V-memory



You can then use the retrieved data in logic or display it in a Dataview in ***Direct***SOFT (shown on the next page) to monitor bus performance. The Bus Scan Status Table describes the definitions of the status values.

Bus scan performance data displayed in a Dataview



Appendix A Remote I/O Worksheets

A

Remote Slave Worksheet

Remote Base Address __________ (Choose 1-7 for RM-NET or 1-31 for SM-NET)

Slot Number	Module Name	INPUT		OUTPUT	
		Input Address	No. of Inputs	Output Address	No. of Outputs
0					
1					
2					
3					
4					
5					
6					
7					

Input Bit Start Address: _____V-Memory Address*: V___________

Total Input Points________

Output Bit Start Address: _____V-Memory Address*: V___________

Total Output Points________

* The D2-RMSM automatically assigns I/O addresses in sequence based on Slave #1's starting addresses. The DL250/DL350 CPU port setup program requires these addresses for each slave.

Channel Configuration Worksheet

D2-RMSM Remote Master Module

Master Slot Address _______ (1 – 7)

Protocol Selected __________ (RM-NET or SM-NET)

Circle one selection for each parameter (selections for each protocol are shown)

Configuration Parameter	RM-NET	SM-NET
Baud Rate (in KBaud, determined by required distance to last slave)	19.2 38.4	19.2 38.4 153.6 307.2 614.4
Operator Interface	N/A	YES NO
Auto Return to Network	YES NO	YES NO

Starting Input V-Memory Address: V__________ **Starting Output V-Memory Address: V** __________

Total Inputs __________ **Total Outputs** __________

Slave Station	No. of Inputs	No. of Outputs	Slave Station	No. of Inputs	No. of Outputs
0			16		
1			17		
2			18		
3			19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		

Channel Configuration Worksheet

DL250/DL350 CPU Bottom Port

Circle one selection or fill in blank for each parameter

Configuration Parameter	SELECTION
Baud Rate (in KBaud, determined by required distance to last slave)	19.2 38.4
Remote I/O configuration table starting address	V __________ (V37700 is default)

Slave Station	INPUT		OUTPUT	
	Input Address	No. of Inputs	Output Address	No. of Outputs
1				
2				
3				
4				
5				
6				
7				

Power Budget Worksheet

Slave # ________	Part Number	5 VDC (mA) (supplied or used)	Auxiliary Power Source 24 VDC Output (mA) (supplied or used)
Base Used			
CPU Slot			
Slot 0			
Slot 1			
Slot 2			
Slot 3			
Slot 4			
Slot 5			
Slot 6			
Slot 7			
Other			
Maximum power required			
Remaining Power Available			

Appendix B
Reserved Memory Tables

B

Standard Input (X) Addresses

This table provides a listing of the individual input points associated with each V-memory address bit for the DL240 and DL250 CPUs. The DL240 CPU input addresses end at 477; additional DL250 addresses extend to 777.

MSB															LSB	Address
17	16	15	14	13	12	11	10	7	6	5	4	3	2	1	0	
017	016	015	014	013	012	011	010	007	006	005	004	003	002	001	000	V40400
037	036	035	034	033	032	031	030	027	026	025	024	023	022	021	020	V40401
057	056	055	054	053	052	051	050	047	046	045	044	043	042	041	040	V40402
077	076	075	074	073	072	071	070	067	066	065	064	063	062	061	060	V40403
117	116	115	114	113	112	111	110	107	106	105	104	103	102	101	100	V40404
137	136	135	134	133	132	131	130	127	126	125	124	123	122	121	120	V40405
157	156	155	154	153	152	151	150	147	146	145	144	143	142	141	140	V40406
177	176	175	174	173	172	171	170	167	166	165	164	163	162	161	160	V40407
217	216	215	214	213	212	211	210	207	206	205	204	203	202	201	200	V40410
237	236	235	234	233	232	231	230	227	226	225	224	223	222	221	220	V40411
257	256	255	254	253	252	251	250	247	246	245	244	243	242	241	240	V40412
277	276	275	274	273	272	271	270	267	266	265	264	263	262	261	260	V40413
317	316	315	314	313	312	311	310	307	306	305	304	303	302	301	300	V40414
337	336	335	334	333	332	331	330	327	326	325	324	323	322	321	320	V40415
357	356	355	354	353	352	351	350	347	346	345	344	343	342	341	340	V40416
377	376	375	374	373	372	371	370	367	366	365	364	363	362	361	360	V40417
417	416	415	414	413	412	411	410	407	406	405	404	403	402	401	400	V40420
437	436	435	434	433	432	431	430	427	426	425	424	423	422	421	420	V40421
457	456	455	454	453	452	451	450	447	446	445	444	443	442	441	440	V40422
477	476	475	474	473	472	471	470	467	466	465	464	463	462	461	460	V40423

517	516	515	514	513	512	511	510	507	506	505	504	503	502	501	500	V40424
537	536	535	534	533	532	531	530	527	526	525	524	523	522	521	520	V40425
557	556	555	554	553	552	551	550	547	546	545	544	543	542	541	540	V40426
577	576	575	574	573	572	571	570	567	566	565	564	563	562	561	560	V40427
617	616	615	614	613	612	611	610	607	606	605	604	603	602	601	600	V40430
637	636	635	634	633	632	631	630	627	626	625	624	623	622	621	620	V40431
657	656	655	654	653	652	651	650	647	646	645	644	643	642	641	640	V40432
677	676	675	674	673	672	671	670	667	666	665	664	663	662	661	660	V40433
717	716	715	714	713	712	711	710	707	706	705	704	703	702	701	700	V40434
737	736	735	734	733	732	731	730	727	726	725	724	723	722	721	720	V40435
757	756	755	754	753	752	751	750	747	746	745	744	743	742	741	740	V40436
777	776	775	774	773	772	771	770	767	766	765	764	763	762	761	760	V40437

Standard Output (Y) Addresses

This table provides a listing of the individual output points associated with each V-memory address bit for the DL240 and DL250 CPUs. The DL240 CPU output addresses end at 477; additional DL250 addresses extend to 777.

MSB															LSB	Address
17	16	15	14	13	12	11	10	7	6	5	4	3	2	1	0	
017	016	015	014	013	012	011	010	007	006	005	004	003	002	001	000	V40500
037	036	035	034	033	032	031	030	027	026	025	024	023	022	021	020	V40501
057	056	055	054	053	052	051	050	047	046	045	044	043	042	041	040	V40502
077	076	075	074	073	072	071	070	067	066	065	064	063	062	061	060	V40503
117	116	115	114	113	112	111	110	107	106	105	104	103	102	101	100	V40504
137	136	135	134	133	132	131	130	127	126	125	124	123	122	121	120	V40505
157	156	155	154	153	152	151	150	147	146	145	144	143	142	141	140	V40506
177	176	175	174	173	172	171	170	167	166	165	164	163	162	161	160	V40507
217	216	215	214	213	212	211	210	207	206	205	204	203	202	201	200	V40510
237	236	235	234	233	232	231	230	227	226	225	224	223	222	221	220	V40511
257	256	255	254	253	252	251	250	247	246	245	244	243	242	241	240	V40512
277	276	275	274	273	272	271	270	267	266	265	264	263	262	261	260	V40513
317	316	315	314	313	312	311	310	307	306	305	304	303	302	301	300	V40514
337	336	335	334	333	332	331	330	327	326	325	324	323	322	321	320	V40515
357	356	355	354	353	352	351	350	347	346	345	344	343	342	341	340	V40516
377	376	375	374	373	372	371	370	367	366	365	364	363	362	361	360	V40517
417	416	415	414	413	412	411	410	407	406	405	404	403	402	401	400	V40520
437	436	435	434	433	432	431	430	427	426	425	424	423	422	421	420	V40521
457	456	455	454	453	452	451	450	447	446	445	444	443	442	441	440	V40522
477	476	475	474	473	472	471	470	467	466	465	464	463	462	461	460	V40523
517	516	515	514	513	512	511	510	507	506	505	504	503	502	501	500	V40524
537	536	535	534	533	532	531	530	527	526	525	524	523	522	521	520	V40525
557	556	555	554	553	552	551	550	547	546	545	544	543	542	541	540	V40526
577	576	575	574	573	572	571	570	567	566	565	564	563	562	561	560	V40527
617	616	615	614	613	612	611	610	607	606	605	604	603	602	601	600	V40530
637	636	635	634	633	632	631	630	627	626	625	624	623	622	621	620	V40531
657	656	655	654	653	652	651	650	647	646	645	644	643	642	641	640	V40532
677	676	675	674	673	672	671	670	667	666	665	664	663	662	661	660	V40533
717	716	715	714	713	712	711	710	707	706	705	704	703	702	701	700	V40534
737	736	735	734	733	732	731	730	727	726	725	724	723	722	721	720	V40535
757	756	755	754	753	752	751	750	747	746	745	744	743	742	741	740	V40536
777	776	775	774	773	772	771	770	767	766	765	764	763	762	761	760	V40537

Control Relay (C) Addresses

This table provides a listing of the individual control relays associated with each V-memory address bit for the DL240 and DL250 CPUs. The DL240 CPU control relay addresses end at 377; additional DL250 addresses extend to 1777.

MSB															LSB	Address
17	16	15	14	13	12	11	10	7	6	5	4	3	2	1	0	
017	016	015	014	013	012	011	010	007	006	005	004	003	002	001	000	V40600
037	036	035	034	033	032	031	030	027	026	025	024	023	022	021	020	V40601
057	056	055	054	053	052	051	050	047	046	045	044	043	042	041	040	V40602
077	076	075	074	073	072	071	070	067	066	065	064	063	062	061	060	V40603
117	116	115	114	113	112	111	110	107	106	105	104	103	102	101	100	V40604
137	136	135	134	133	132	131	130	127	126	125	124	123	122	121	120	V40605
157	156	155	154	153	152	151	150	147	146	145	144	143	142	141	140	V40606
177	176	175	174	173	172	171	170	167	166	165	164	163	162	161	160	V40607
217	216	215	214	213	212	211	210	207	206	205	204	203	202	201	200	V40610
237	236	235	234	233	232	231	230	227	226	225	224	223	222	221	220	V40611
257	256	255	254	253	252	251	250	247	246	245	244	243	242	241	240	V40612
277	276	275	274	273	272	271	270	267	266	265	264	263	262	261	260	V40613
317	316	315	314	313	312	311	310	307	306	305	304	303	302	301	300	V40614
337	336	335	334	333	332	331	330	327	326	325	324	323	322	321	320	V40615
357	356	355	354	353	352	351	350	347	346	345	344	343	342	341	340	V40616
377	376	375	374	373	372	371	370	367	366	365	364	363	362	361	360	V40617
417	416	415	414	413	412	411	410	407	406	405	404	403	402	401	400	V40620
437	436	435	434	433	432	431	430	427	426	425	424	423	422	421	420	V40621
457	456	455	454	453	452	451	450	447	446	445	444	443	442	441	440	V40622
477	476	475	474	473	472	471	470	467	466	465	464	463	462	461	460	V40623
517	516	515	514	513	512	511	510	507	506	505	504	503	502	501	500	V40624
537	536	535	534	533	532	531	530	527	526	525	524	523	522	521	520	V40625
557	556	555	554	553	552	551	550	547	546	545	544	543	542	541	540	V40626
577	576	575	574	573	572	571	570	567	566	565	564	563	562	561	560	V40627
617	616	615	614	613	612	611	610	607	606	605	604	603	602	601	600	V40630
637	636	635	634	633	632	631	630	627	626	625	624	623	622	621	620	V40631
657	656	655	654	653	652	651	650	647	646	645	644	643	642	641	640	V40632
677	676	675	674	673	672	671	670	667	666	665	664	663	662	661	660	V40633
717	716	715	714	713	712	711	710	707	706	705	704	703	702	701	700	V40634
737	736	735	734	733	732	731	730	727	726	725	724	723	722	721	720	V40635
757	756	755	754	753	752	751	750	747	746	745	744	743	742	741	740	V40636
777	776	775	774	773	772	771	770	767	766	765	764	763	762	761	760	V40637

MSB															LSB	Address
17	16	15	14	13	12	11	10	7	6	5	4	3	2	1	0	Address
1017	1016	1015	1014	1013	1012	1011	1010	1007	1006	1005	1004	1003	1002	1001	1000	V40640
1037	1036	1035	1034	1033	1032	1031	1030	1027	1026	1025	1024	1023	1022	1021	1020	V40641
1057	1056	1055	1054	1053	1052	1051	1050	1047	1046	1045	1044	1043	1042	1041	1040	V40642
1077	1076	1075	1074	1073	1072	1071	1070	1067	1066	1065	1064	1063	1062	1061	1060	V40643
1117	1116	1115	1114	1113	1112	1111	1110	1107	1106	1105	1104	1103	1102	1101	1100	V40644
1137	1136	1135	1134	1133	1132	1131	1130	1127	1126	1125	1124	1123	1122	1121	1120	V40645
1157	1156	1155	1154	1153	1152	1151	1150	1147	1146	1145	1144	1143	1142	1141	1140	V40646
1177	1176	1175	1174	1173	1172	1171	1170	1167	1166	1165	1164	1163	1162	1161	1160	V40647
1217	1216	1215	1214	1213	1212	1211	1210	1207	1206	1205	1204	1203	1202	1201	1200	V40650
1237	1236	1235	1234	1233	1232	1231	1230	1227	1226	1225	1224	1223	1222	1221	1220	V40651
1257	1256	1255	1254	1253	1252	1251	1250	1247	1246	1245	1244	1243	1242	1241	1240	V40652
1277	1276	1275	1274	1273	1272	1271	1270	1267	1266	1265	1264	1263	1262	1261	1260	V40653
1317	1316	1315	1314	1313	1312	1311	1310	1307	1306	1305	1304	1303	1302	1301	1300	V40654
1337	1336	1335	1334	1333	1332	1331	1330	1327	1326	1325	1324	1323	1322	1321	1320	V40665
1357	1356	1355	1354	1353	1352	1351	1350	1347	1346	1345	1344	1343	1342	1341	1340	V40656
1377	1376	1375	1374	1373	1372	1371	1370	1367	1366	1365	1364	1363	1362	1361	1360	V40657
1417	1416	1415	1414	1413	1412	1411	1410	1407	1406	1405	1404	1403	1402	1401	1400	V40660
1437	1436	1435	1434	1433	1432	1431	1430	1427	1426	1425	1424	1423	1422	1421	1420	V40661
1457	1456	1455	1454	1453	1452	1451	1450	1447	1446	1445	1444	1443	1442	1441	1440	V40662
1477	1476	1475	1474	1473	1472	1471	1470	1467	1466	1465	1464	1463	1462	1461	1460	V40663
1517	1516	1515	1514	1513	1512	1511	1510	1507	1506	1505	1504	1503	1502	1501	1500	V40664
1537	1536	1535	1534	1533	1532	1531	1530	1527	1526	1525	1524	1523	1522	1521	1520	V40665
1557	1556	1555	1554	1553	1552	1551	1550	1547	1546	1545	1544	1543	1542	1541	1540	V40666
1577	1576	1575	1574	1573	1572	1571	1570	1567	1566	1565	1564	1563	1562	1561	1560	V40667
1617	1616	1615	1614	1613	1612	1611	1610	1607	1606	1605	1604	1603	1602	1601	1600	V40670
1637	1636	1635	1634	1633	1632	1631	1630	1627	1626	1625	1624	1623	1622	1621	1620	V40671
1657	1656	1655	1654	1653	1652	1651	1650	1647	1646	1645	1644	1643	1642	1641	1640	V40672
1677	1676	1675	1674	1673	1672	1671	1670	1667	1666	1665	1664	1663	1662	1661	1660	V40673
1717	1716	1715	1714	1713	1712	1711	1710	1707	1706	1705	1704	1703	1702	1701	1700	V40674
1737	1736	1735	1734	1733	1732	1731	1730	1727	1726	1725	1724	1723	1722	1721	1720	V40675
1757	1756	1755	1754	1753	1752	1751	1750	1747	1746	1745	1744	1743	1742	1741	1740	V40676
1777	1776	1775	1774	1773	1772	1771	1770	1767	1766	1765	1764	1763	1762	1761	1760	V40677

C

Appendix C Determining I/O Update Time

- — Overview
- — Remote I/O Update Table
- — Calculating Total Delay for the System

Overview

Since the Remote Master and the CPU operate asynchronously from one another, it is possible that the remote I/O points may not be updated on every CPU scan. Therefore, in some applications it may helpful to understand the amount of time required to update the remote I/O points. Depending on the number of I/O points used in your remote configuration and the baud rate you have selected for communication, your update time requirements will vary. This appendix will show you how to estimate the total delay time for your system.

NOTE: In most situations, this delay will be so small that either it makes no difference to the particular application, or the mechanical speeds of the field devices are slower than the delay itself.

If you have an application that requires a thorough understanding of the time delay, you can use the following information in order to calculate the delay:

- **Baud Rate —** this is the communication baud rate that you selected with the DIP switch settings on the remote master and remote slaves.
- **CPU Scan Time —** this is the total CPU scan time. The easiest way is to use AUX53 from a DL205 Handheld Programmer, or use the Diagnostics option under the PLC menu in our ***Direct***SOFT Programming Software. You can also use the DL205 User Manual to calculate the scan time, but this is often very time consuming. If you use the User Manual, you will have to estimate this time, because it is dependent on the main program length, and the number of I/O points in the local base as well.
- **Remote Master Scan —** this is the time required for the Remote Master to scan the individual Slave stations to update the status of the I/O modules. Use the formula and table shown on the following page.
- **Module ON to OFF, OFF to ON Response Time —** this is the amount of time that the module requires to see a transition in status. For example, when a switch connected to an input module closes, it can take a few milliseconds (1-12 typical) before the module actually makes the transition from OFF to ON. The easiest way to find this information is from the module specifications in the respective User Manuals. This basic information is also available in the specifications of the Sales Catalog.
- **Total Delay Time —** this is the total delay time that takes all of the above factors into consideration. There are several formulas that you can use to calculate this delay time. See the formulas on Page C5 of this appendix. Once you have selected the formula applicable to your system, you will use the information you have gathered for the above items to calculate the total system delay time.

Since each application is different, we cannot possibly show all of the options for the CPU scan time or the possible module response delays. You can easily find this information in other publications. However, the next few pages *will* show you how to calculate the delay time for the Remote Master Scan. Also, we show the total delay time for our example system that was used earlier in this manual.

Remote I/O Update Table

The table shown below shows you how much time is required for the Remote Master Module to update its I/O data to its internal buffers. Remember from earlier reading in this appendix that the remote I/O scan and CPU scan are asynchronous. The CPU may be looking at the master module's internal buffers several times before the master actually has enough time to store new data. This chart shows the maximum amount of delay based on the number of I/O points on the channel.

# of Remote I/O Points	Update Time Required (in ms)				
	19.2 kB	38.4 kB	153.6 kB	307.2 kB	614.4 kB
16	3.64	1.82	.45	.23	.12
32	5.72	2.86	.72	.36	.18
64	9.88	4.94	1.24	.62	.31
128	18.20	9.10	2.28	1.14	.57
160	22.36	11.18	2.80	1.40	.70
192	26.52	13.26	3.32	1.66	.83
224	30.68	15.34	3.84	1.92	.96
256	34.84	17.42	4.36	2.18	1.09
288	39.00	19.50	4.88	2.44	1.22
320	43.16	21.58	5.40	2.70	1.35
352	47.32	23.66	5.92	2.96	1.48
384	51.48	25.74	6.44	3.22	1.61
416	55.64	27.82	6.96	3.48	1.74
448	59.80	29.90	7.48	3.74	1.87
480	63.96	31.98	8.00	4.00	2.00
512	68.12	34.06	8.52	4.26	2.13

Remote Scan Time Formula

Use the following formula to calculate the amount of time required for the remote I/O scan update:

$$T_{RS} = \text{Time from Above Table} + (2\text{ ms} \times \text{No. of Slaves})$$

Example: Given a 38.4 kB system with a total of 128 remote points and 3 slaves:

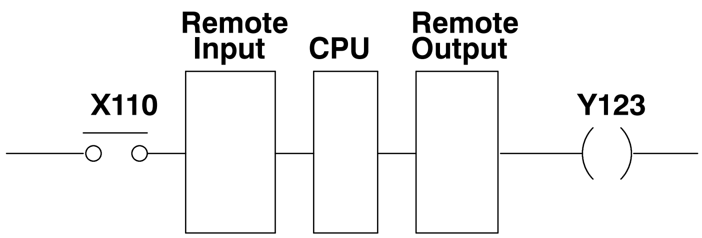
$$T_{RS} = 9.10\text{ ms} + (2\text{ ms} \times 3) = 15.10\text{ ms}$$

Calculating Total Delay for the System

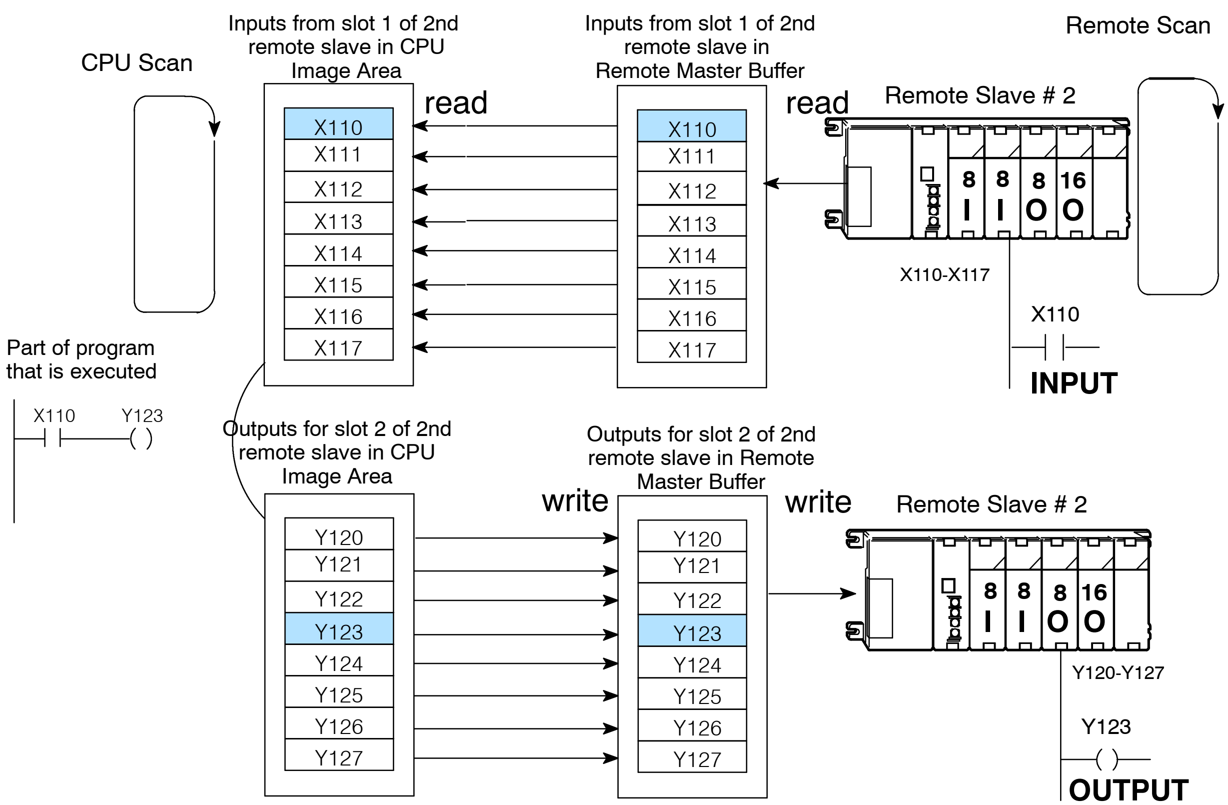
Now that you have calculated the time required for the Remote Master to go through its scan cycle and update its internal buffer area, we need to add this time to other delay times inherent in the overall system. Below is an example of a remote input changing a remote output.

Example of a Remote Input Changing a Remote Output

This example can be simplified schematically to look like this:



The drawing below shows the details of the CPU and Remote Master interaction .

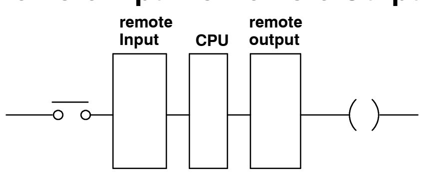
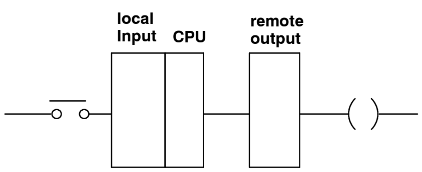
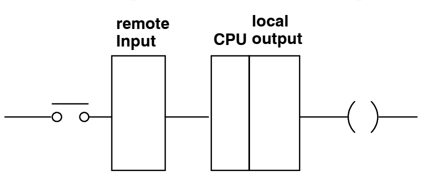


The table on the adjacent page shows the formula for calculating the overall system delay for this scenario. It also shows you formulae for two other possible scenarios.

Total Delay Time Formulas

The following table provides delay formulas for three different configuration scenarios. Notice the two sets of formulas for each scenario. The formula chosen depends on whether the CPU scan time is greater than or less than the Remote Master scan time. There are several variables used in the formulas. The following descriptions will help you understand them.

- T_{CS} — CPU scan time. You can use ***Direct***SOFT or a Handheld Programmer to determine this time, or you can estimate the time required by using the DL205 User Manual.
- T_{RS} — Remote Master scan time. Use the table and formula shown previously to determine this time.
- T_{IN} and T_{OUT} — Module response delay time. You can find this information from the module specifications tables which you will find in the DL205 User Manual.

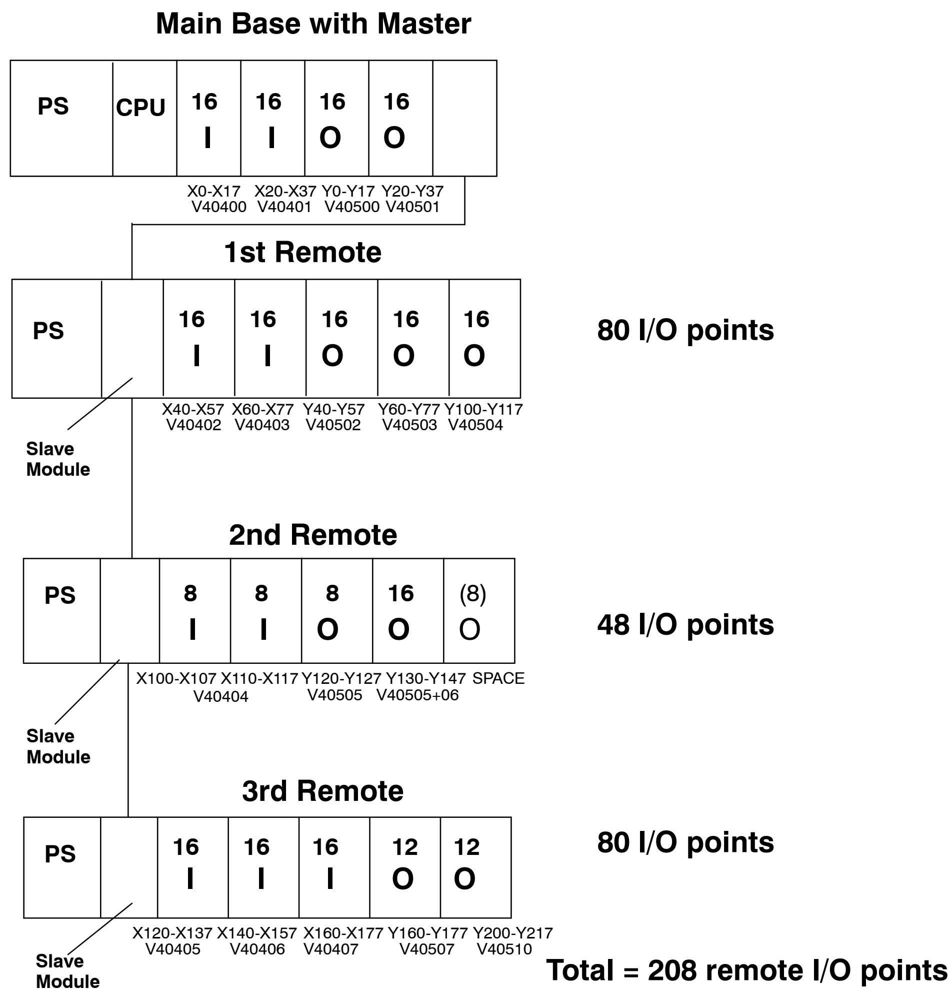
	T_{RS} T_{CS}	T_{RS} T_{CS}
Remote Input to Remote Output 	$T_{IN} + 6(T_{CS}) + T_{OUT}$	$T_{IN} + 4(T_{RS}) + 6(T_{CS}) + T_{OUT}$
Local Input to Remote Output  **Remote Input to Local Output** 	$T_{IN} + 4(T_{CS}) + T_{OUT}$	$T_{IN} + 2(T_{RS}) + 4(T_{CS}) + T_{OUT}$

The following page will show you how to use one of the formulas to calculate the delay time for our example system.

Delay Time Example

The following example shows you how to calculate the total time required for reading a remote input,solving the CPU logic, then changing an output at the remote base. We have used the following configuration, which features 3 remote slaves, 1 master and 208 remote I/O points, communicating at 38.4 kBaud.

EXAMPLE:
38.4 kBaud, D2-240, X110 causing a change in Y123.



Given that the CPU scan (T_{CS}) is estimated to be 25 ms, the results of the calculations are:

T_{IN} = Maximum response input module time (16ND3–2) = 9 ms
T_{OUT} = Maximum response output module time (16TD1–2) = .5 ms
T_{RS} = 15.34 ms + (2ms x3) = 21.34 ms T_{CS}

Total Delay for Configuration = $T_{IN} + 6(T_{CS}) + T_{OUT}$

= 9 ms + 6(25 ms) + .5 ms

= 159.5 ms