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Getting Started

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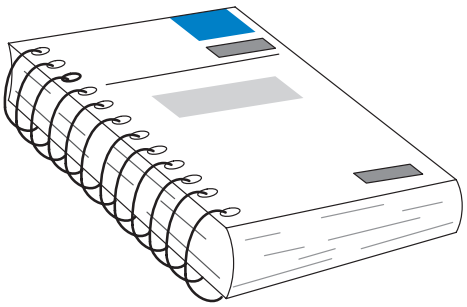
— What is Remote I/O?
— Remote Master (D2-RMSM) Features
— Remote Slave (D2-RSSS) Features
— Assigning the Remote Input and Output Addresses
— How the CPU Updates Remote I/O Points
— 3 Easy Steps for Setting Up Remote I/O
— Frequently Asked Questions

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.

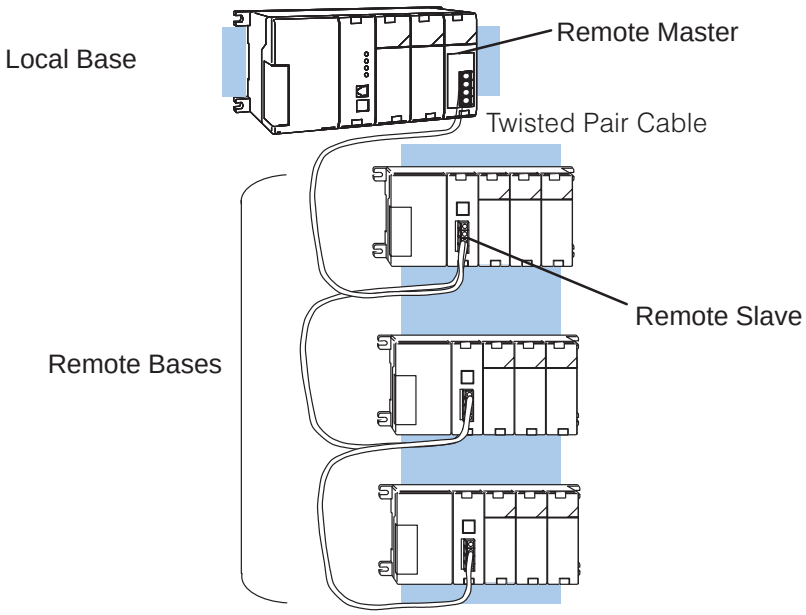
Appendices Additional reference information on remote I/O is in the following three appendices:

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.

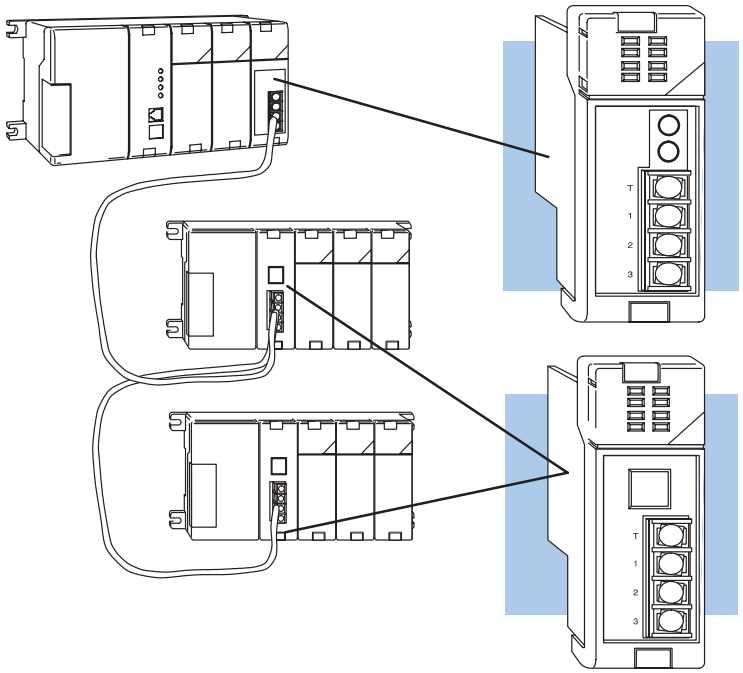
How Does the DL205 Support Remote I/O?

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).



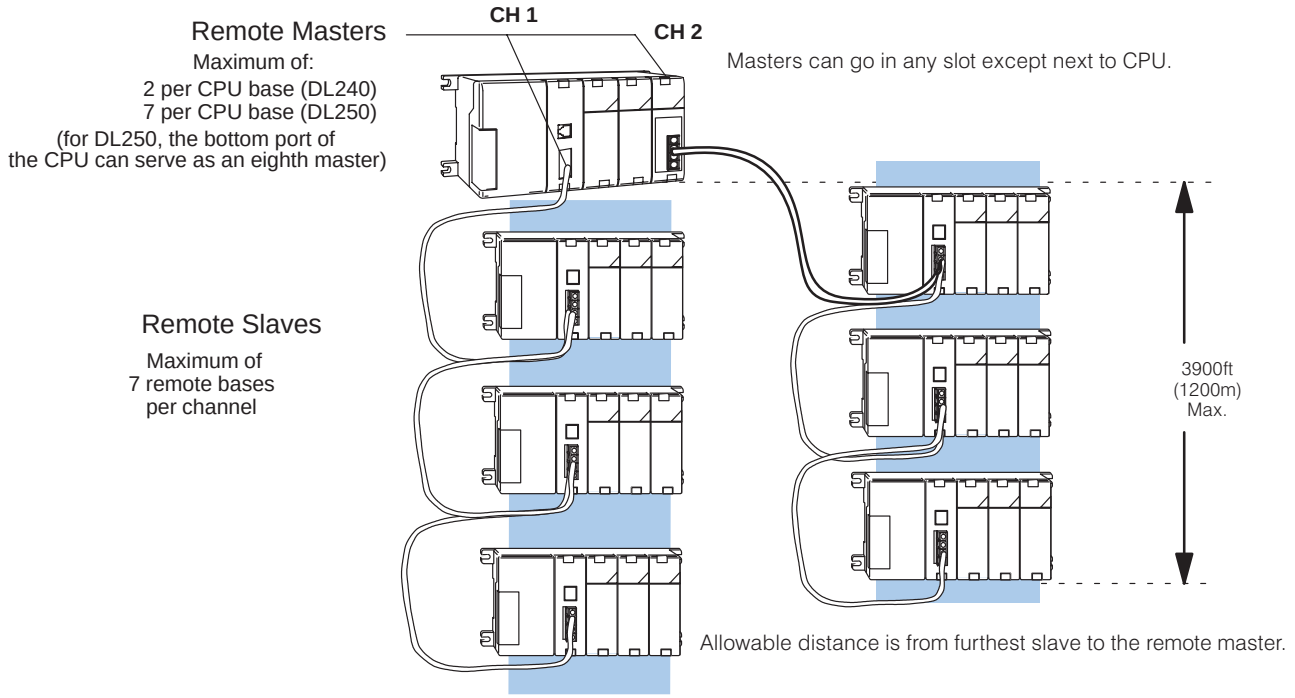
Remote Master – The D2–RMSM is mounted in the CPU base. Up to two master modules can be used with the DL240; up to seven master modules can be used with the DL250

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)



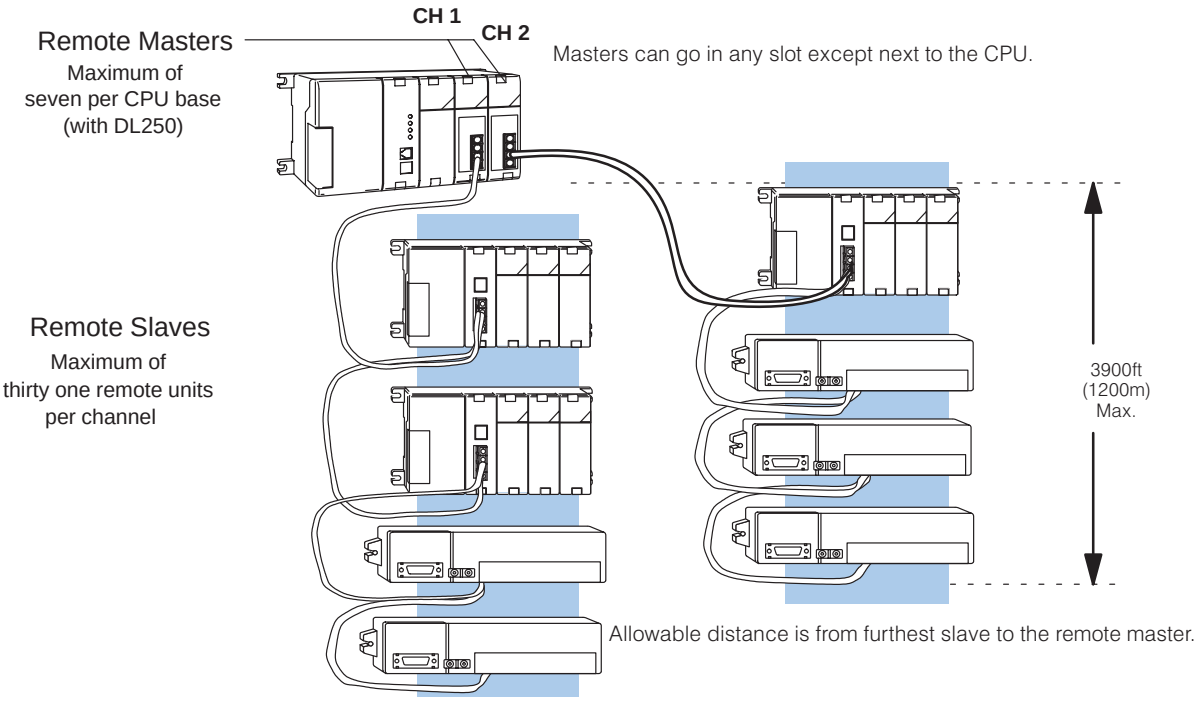
Distance Between Slaves and Master, Baud Rates (RM–NET)

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)

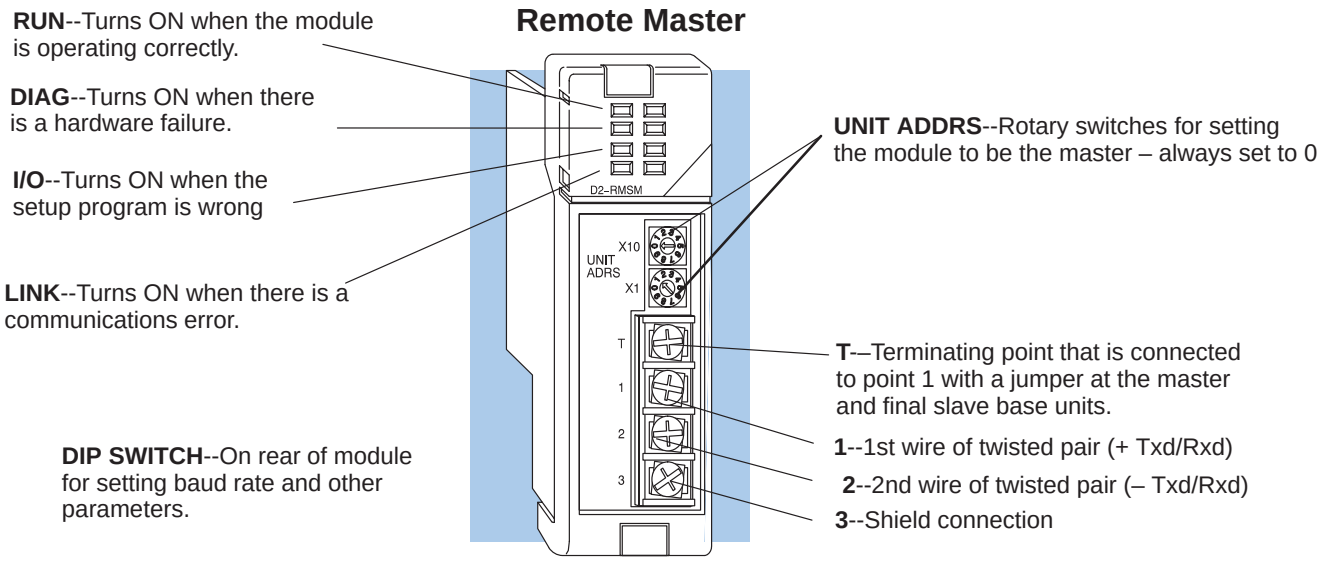


Distance Between Slaves and Master, Baud Rates (SM–NET)

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



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	Selectable
	19.2K or 38.4K baud	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)	

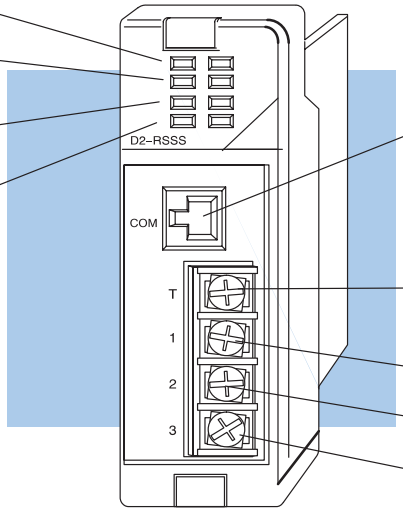
NOTE: **Remote I/O Capacity** – Total remote I/O available is actually limited by the total references available.The DL240 CPU supports 320 X inputs and 320 Y outputs, so 640 points is the limit for I/O references. It is possible to map remote I/O into other types of memory, such as control relay points, 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.

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.

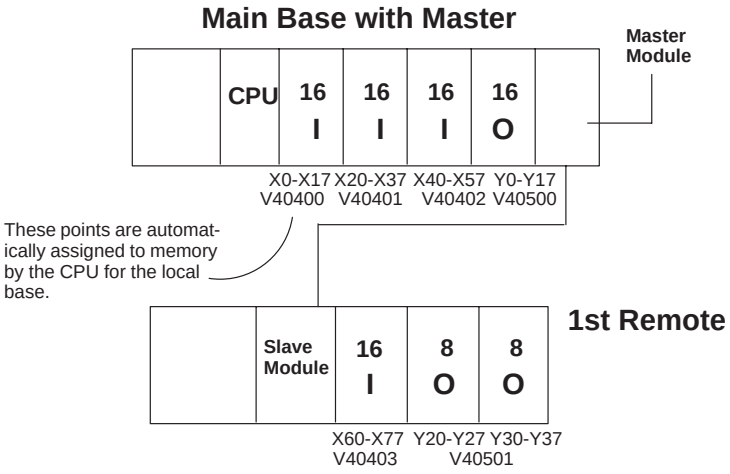
Remote I/O Data Types

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.)

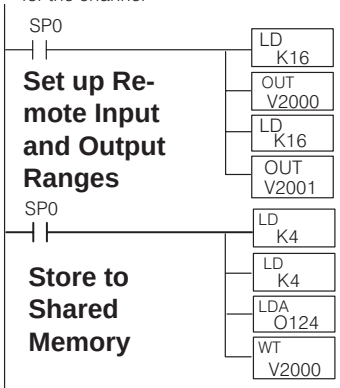
Please consider the following example. Although it hasn't been discussed yet, address 124 (in the RMSM shared memory) is the memory location for the input range, and 126 is the memory location for the output range for the channel.You must load temporary V memory with the totals, then store the data to 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



Next available starting input address is X60.
Next available starting output address is Y20.
There are 16 inputs and 16 outputs in the remote base. We refer to the number of points as the *range*.

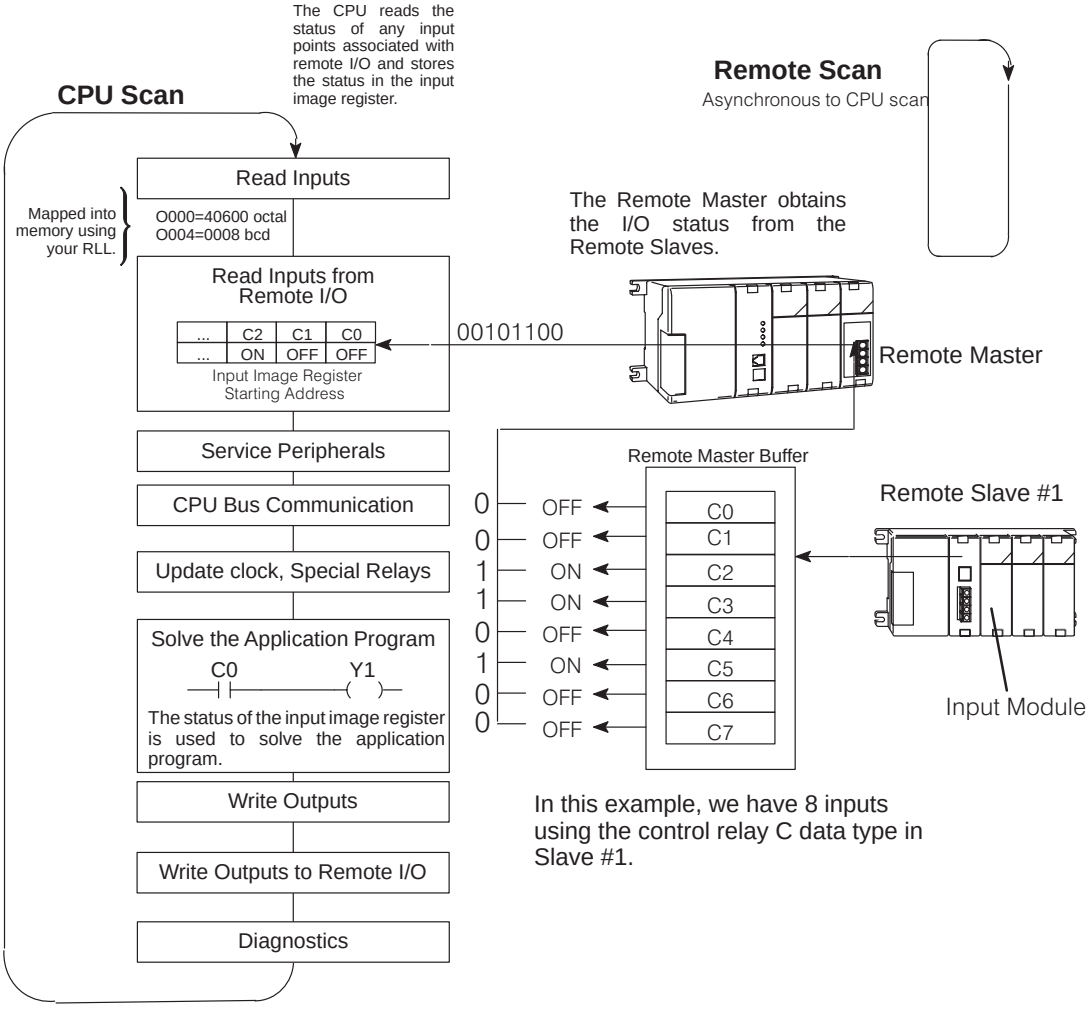
The following is the section of the setup logic which sets up the total input and output ranges for the channel



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.

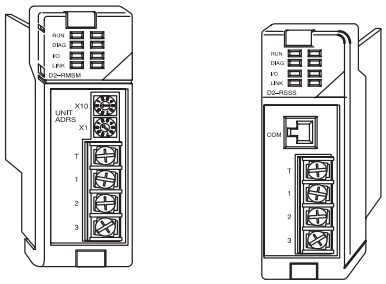
3 Easy Steps for Setting Up Remote I/O

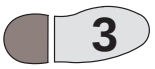
Design the Remote I/O System

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.

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.**

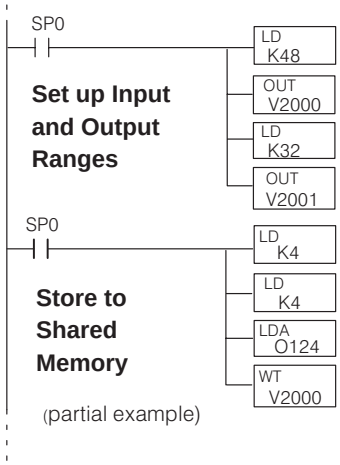




Write the Setup Program

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

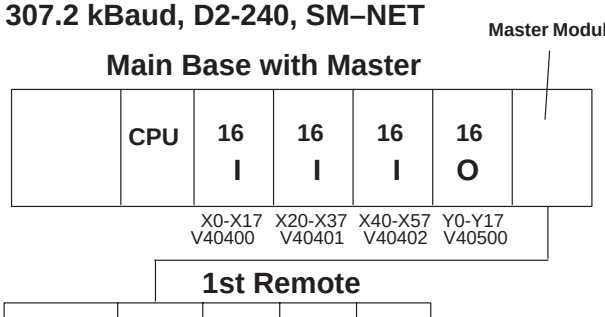
The next two pages provide a complete overview of the entire process for an example remote I/O system. Of course, to learn all of the details, you should read each chapter carefully.



Step 1: Design the Remote I/O System

EXAMPLE:
307.2 kBaud, D2-240, SM–NET

Main Base with Master



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: V **40403** **Starting Output V Memory Address:** V **40501**

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		

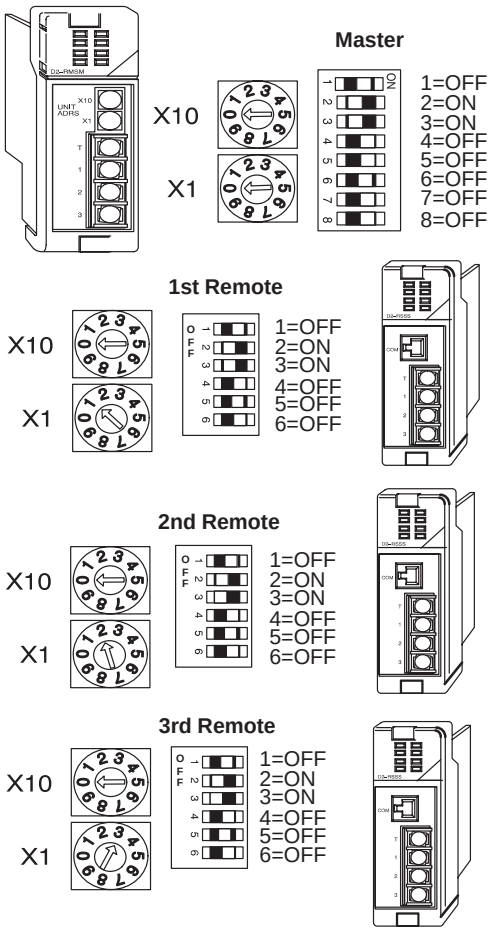
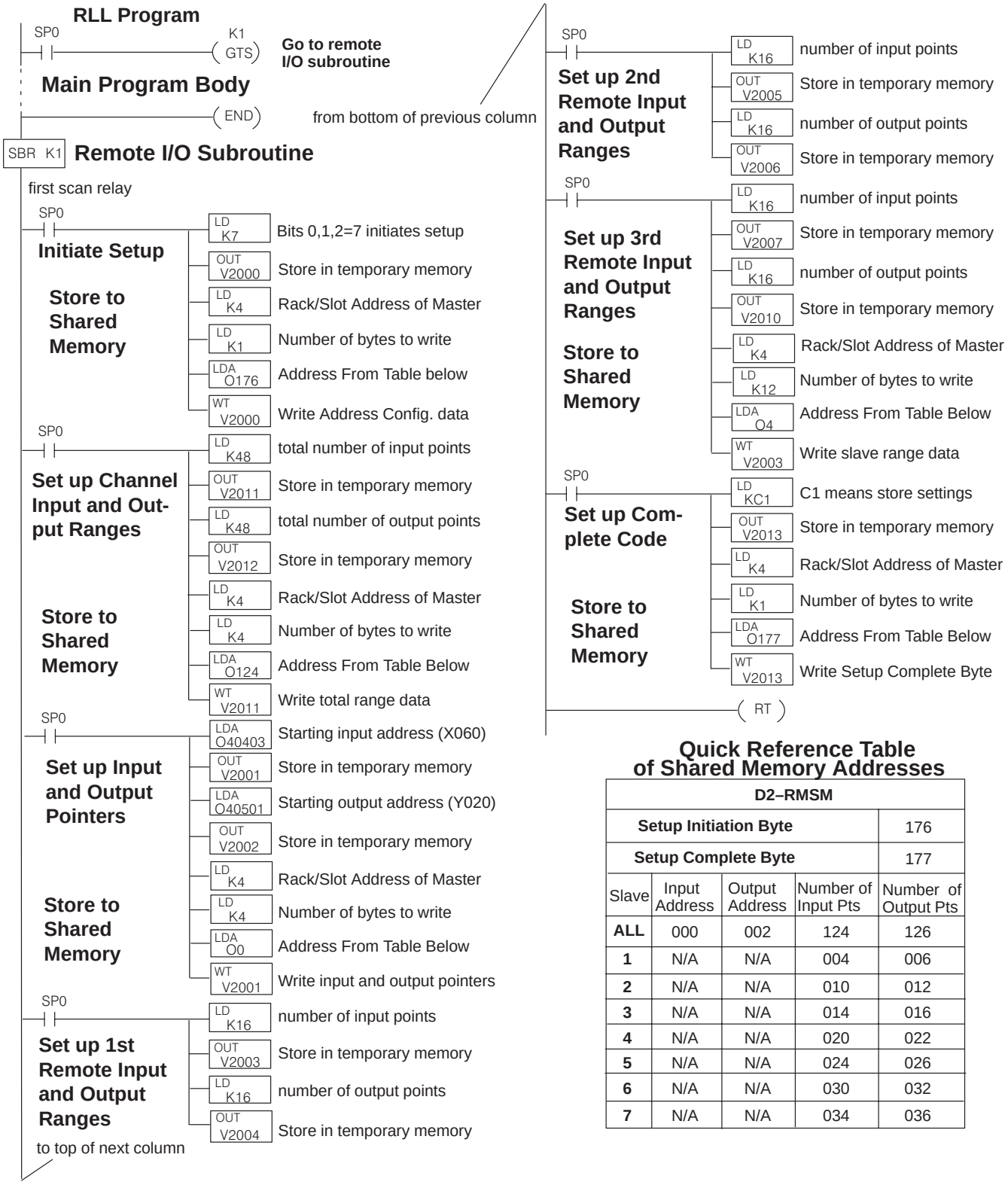


Chart for DIP Switch Settings

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.