Getting Started

1

Introduction

The Purpose of this Manual

Thank you for purchasing the Terminator Remote I/O system. 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.
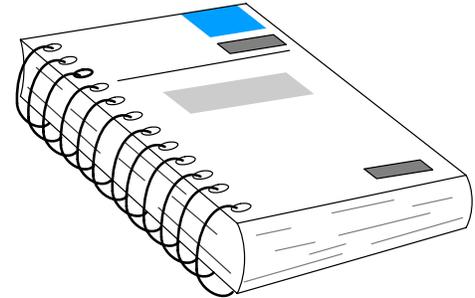
Where to Begin

If you already understand the basics of remote I/O systems, you may only want to skim this chapter. Be sure to keep this manual handy for reference when you run into questions. If you are a new 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 *Automationdirect*™ products.

Supplemental Manuals

Depending on the products you have purchased, there may be other manuals necessary for your application. You will need to supplement this manual with the manuals that are written for those products. You will need the User Manual for the PLC sytem that you have chosen to use with the Terminator I/O.

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 770–844–4200 or visit our web site at **www.automationdirect.com**. 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.

Getting Started

Chapters   The main contents of this manual are organized into the following four 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   **D2–RMSM / T1K–RSSS 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. Includes switch settings and wiring information.

3   **D2–RMSM Setup Programming and Troubleshooting**   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.

4   **DL250 / DL350 / DL450 Remote I/O System, Setup Programming and Troubleshooting**   shows you how to use DirectSoft to write the setup program when using the DL250, DL350 or DL450 CPU bottom port as a remote master. The examples take the information from your worksheets and help you write a working setup program. Includes switch settings and wiring information.
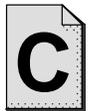
Appendices   Additional reference information on remote I/O is in the following three appendices:

A   **Remote I/O Worksheets**   included are blank worksheets that you can copy and use to design your system.

B   **Terminator Analog I/O**   provides specific information on analog I/O module resolution and includes scaling examples.

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.

D   **I/O Module Hot Swap**   explains the T1K–RSSS I/O module Hot Swap feature.

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. For example, up to 2048 remote I/O points can be supported by the DL205 Remote I/O Masters.

One Master in CPU Base (one channel)

Local Base

205 Remote Master

Twisted Pair Cable

Terminator Remote Slaves

Remote Bases
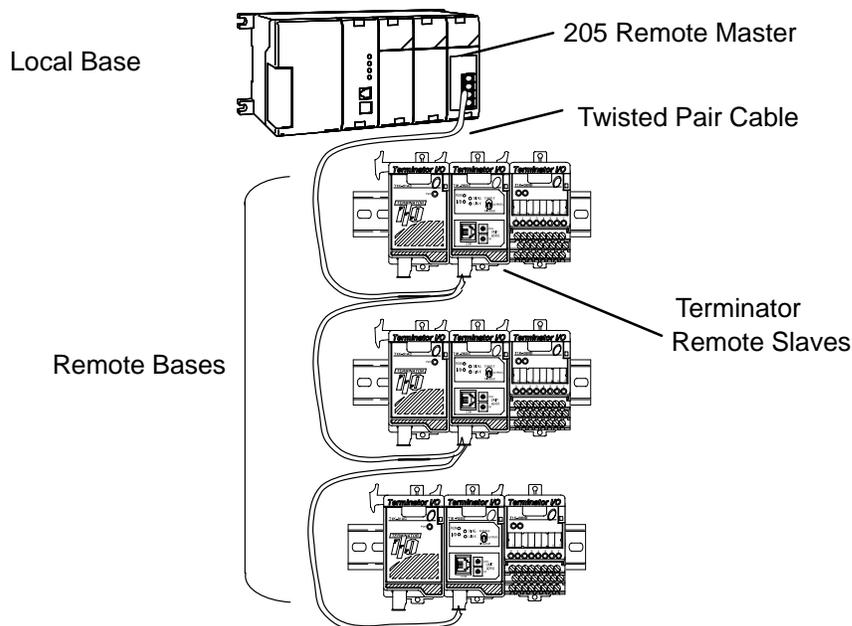
When Do You Need Remote I/O? The main advantage of Terminator Remote I/O is that it expands the I/O capability beyond the local CPU base. Remote I/O can also offer tremendous savings on wiring materials and labor costs for larger systems in which the field devices are in clusters at various locations. 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.

Remote I/O Communication Protocols

The Remote I/O system supports two different remote I/O communications protocols:

- The Remote Master protocol **(RM–NET)** is supported by the DL205 system as well as the bottom ports on the DL250, DL350 and DL450 CPUs. This means that the remote I/O slaves (set for RM–NET mode) connected to a RM–NET master can be a combination of T1K–RSSS and D2–RSSS slave modules up to the maximum allowed number of remote units and I/O points. Remote communications baud rates of 19.2K and 38.4K are supported.

- The Slice Master protocol **(SM–NET)** is also supported by the DL205 system (the CPU bottom ports do not support SM–NET). This means that the remote I/O slaves (set for SM–NET mode) connected to a SM–NET master can be a combination of T1K–RSSS and D2–RSSS and up to the maximum allowed number of remote units and I/O points. Up to 614.4K baud rate is supported by SM–NET. This protocol supports the built in RS–232 communications port on the remote slave units.
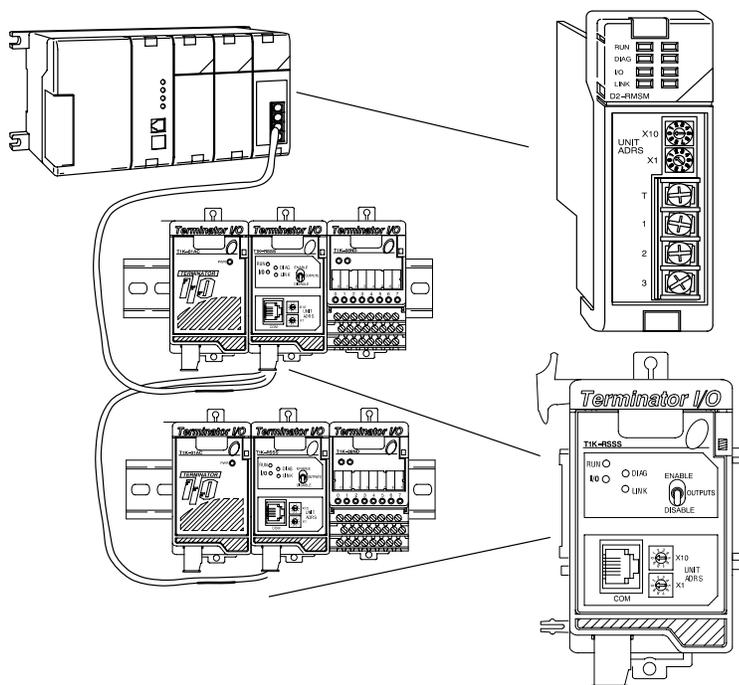
Remote Master : The master module(s) are mounted in the CPU base.
The bottom port of the DL250, DL350 and DL450 can serve as a RM–NET master.

Remote Slave – The T1K–RSSS controllers are placed in each remote slave location. Each slave has the I/O circuitry required to be linked to the master module via twisted pair cable.

NOTE: The Remote I/O Masters that support the T1K–RSSS are the D2–250, D3–350, D4–450, D2–RMSM, D4–RM and D4–SM. The D4–RM and D4–SM will be included in the next revision of this manual. The manuals for the D4–RM and D4–SM accompanied by this manual will provide enough information to setup and program the remote I/O system. The D4–RM and D4–SM are limited to 512 I/O points per channel.

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 slaves. However, in addition to the simple configuration, more than one master can be used in the CPU. You may use a maximum of two (with DL240) and seven (with DL250) masters per CPU base, all of which have to be the D2–RMSM module. 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)

Remote Masters
Maximum of:

205:
2 D2–RMSM per CPU base (DL240)
7 D2–RMSM per CPU base (DL250)
DL250 bottom port

305:
DL350 bottom port only

405:
DL450 bottom port only

Remote Slaves

Maximum of
7 remote slaves
per channel

CH 1   CH 2

Note: RM–NET. does **not** support the serial communications port on the slaves.

3900ft
(1200m)
Max.

Allowable distance is from farthest slave to the remote master.
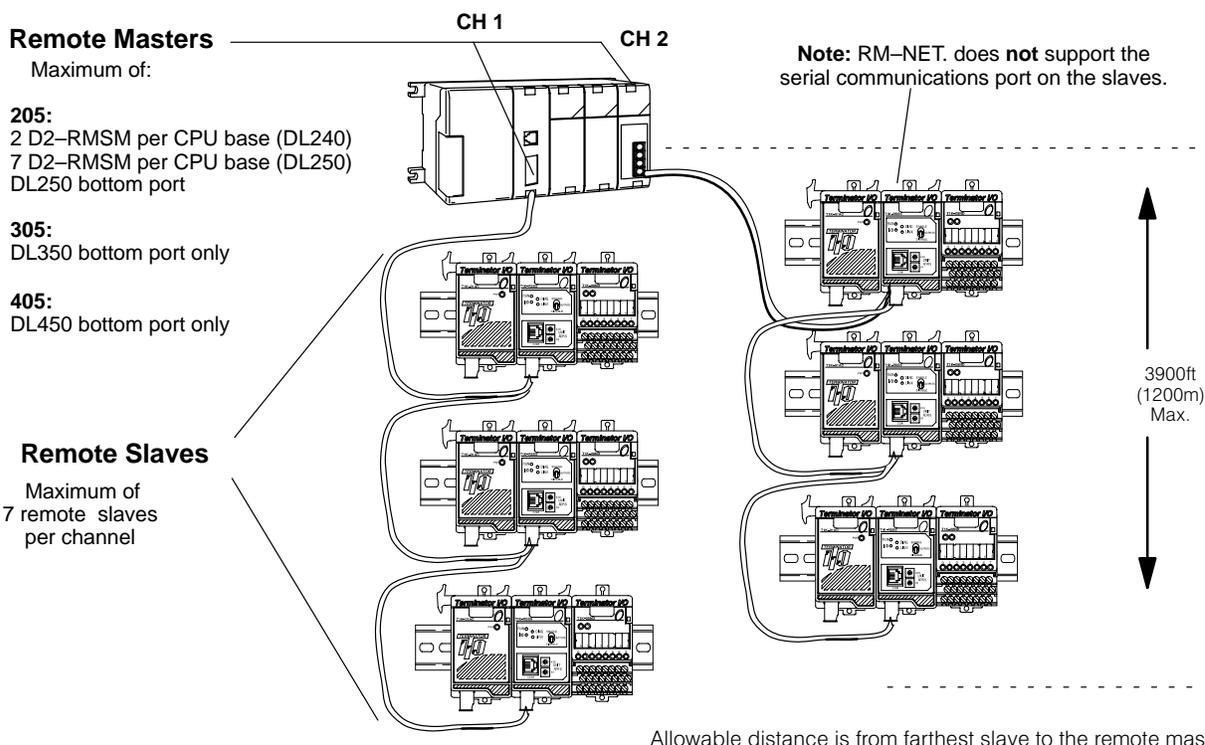
Distance Between Slaves and Master, Baud Rates (RM–NET)

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 1 to 31 remote I/O units. You may use a maximum of two (with DL240) and seven (with DL250) masters per CPU base, all of which have to be the D2–RMSM module. Below is a SM–NET example where we have placed two masters in the CPU base and then attached a total of six remote I/O units.

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

Remote Masters
    Maximum of:

205:
2 D2–RMSM per CPU base (DL240)
7 D2–RMSM per CPU base (DL250)

Note: PLC bottom ports do **not** support SM–NET.

CH 1 **CH 2**

Note: SM–NET. supports the serial communications port on the slaves.

Remote Slaves
    Maximum of:
    31 remote units
    per channel

3900ft (1200m) Max.

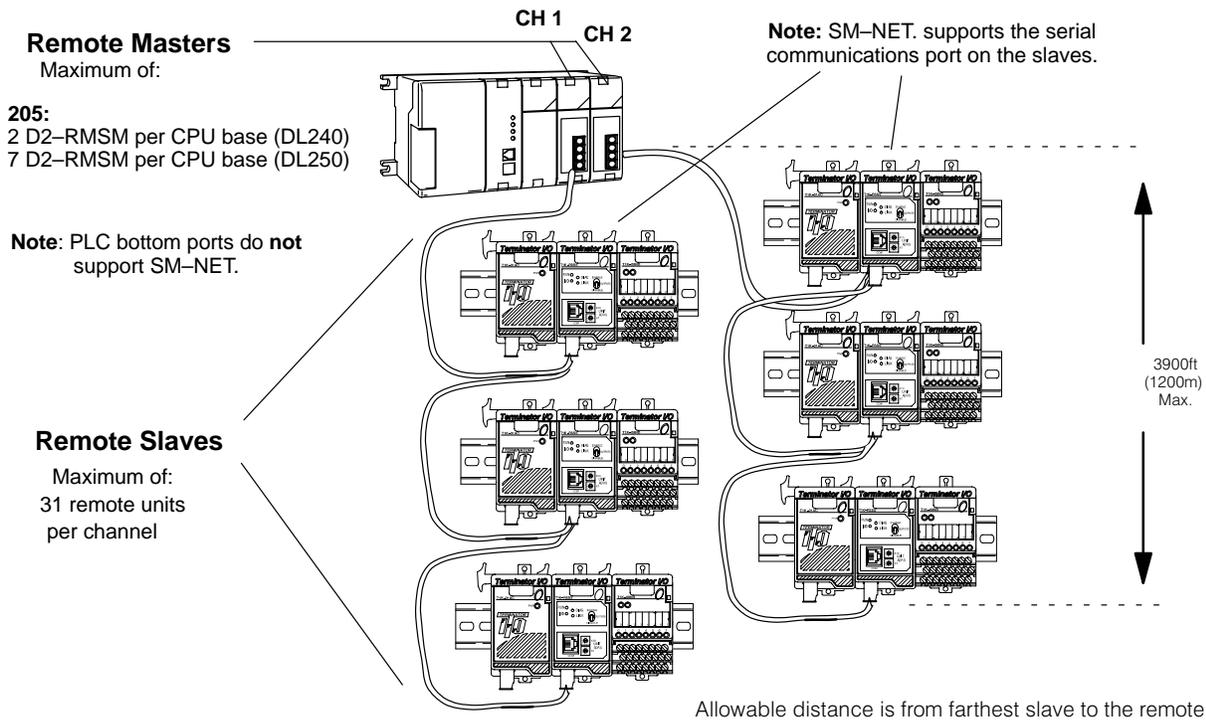Allowable distance is from farthest slave to the remote master.

Distance Between Slaves and Master, Baud Rates (SM–NET) Each slave belonging to the same master is connected 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 farther 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. The T1K–RSSS serial communications port is active in SM–NET mode.

Getting Started

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

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 pts. per channel (see note below)	2048* D2–RMSM 2048* DL250 CPU port 2048* DL350 CPU port 2048* DL450 CPU port	2048* D2–RMSM Note: CPU ports do not support SM–NET
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

*Requires CPU firmware version: D2–250 version 1.51 or later, D3–350 version 1.30 or later, D4–450 version (SH)1.460 or (SH)2.460 or later and D2–RMSM version 1.55 or later. Earlier firmware version supports 512 I/O points per channel.

NOTE: Remote I/O Capacity – Total remote I/O available is actually limited by the total references available.The DL250 CPU supports 512 X inputs and 512 Y outputs, so 1024 points is the limit for X and Y I/O references for local and remote I/O. It is possible to map remote I/O into V memory to achieve more I/O points.

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 system if first/only channel is attached to CPU Port Can use T1K–RSSS Remote Slave units with DL450 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 **Desire programming port or operator interface port at remote slave location(s)**

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.

The CPU reads the status of any input points associated with remote I/O and stores the status in the input image register.

CPU Scan

Remote Scan

Asynchronous to CPU scan

Read Inputs

The Remote Master obtains the I/O status from the Remote Slaves.

Mapped into memory using your RLL.

O000=40600 octal
O004=0008 bcd

Read Inputs from Remote I/O

...	C2	C1	C0
...	ON	OFF	OFF

00101100

Input Image Register Starting Address

Remote Master

Service Peripherals

CPU Bus Communication

Remote Master Buffer

0	OFF ←	C0
0	OFF ←	C1
1	ON ←	C2
1	ON ←	C3
0	OFF ←	C4
1	ON ←	C5
0	OFF ←	C6
0	OFF ←	C7

Remote Slave #1

Update clock, Special Relays

Solve the Application Program

```
C0          Y1
—| |—      —( )—
```

The status of the input image register is used to solve the application program.

Write Outputs

In this example, we have 8 inputs using the control relay C data type in Slave #1.

Input Module

Write Outputs to Remote I/O

Diagnostics

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 the following chapters, 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. **If analog remote I/O modules are used in the application, it is recommended to use a DL250 CPU and V memory addressing for the remote I/O. The analog modules consume either 256 and 512 discrete I/O points each. The DL250 CPU supports "Bit–of–Word" instructions to access the bits in the V memory data words.**

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	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	16ND3	X100	16		
1	16ND3	X120	16		
2	16TD1			Y040	16
3					
4					
5					
6					
7					

Input Bit Start Address: X100 V-Memory Address*:V 40404
Total Input Points 32

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

2

Install the Components

Install 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.
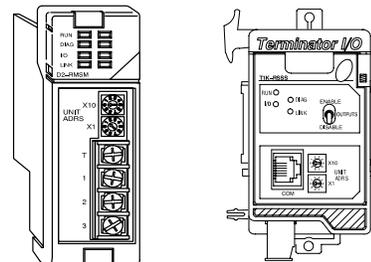
3

Write the Setup Program

Write the RLL setup program. Complete programming examples are provided in the following chapters.
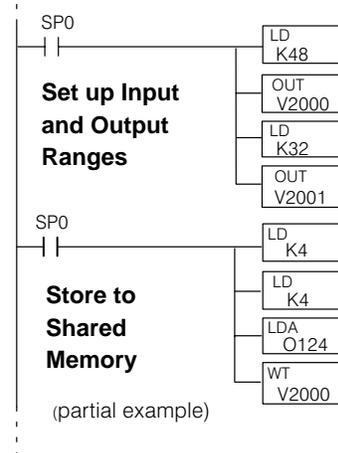
Frequently Asked Questions

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 X input and Y 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 I/O points, you can define remote I/O to use the C (control relay) memory type or V memory type, up to the maximum address available.

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

> **A.** Your D2–RMSM setup program can allot unused I/O at the end of a slave, 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 a programmer or operator interface on the remote I/O link?

> **A.** Yes, in the SM–NET protocol mode, the communications port on the T1K–RSSS remote slave supports a handheld programmer, *Direct*Soft, or an operator interface. Note that since the bottom port of the DL250, DL350 and DL450 CPUs support the RM–NET mode only, you *cannot* use the serial 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.