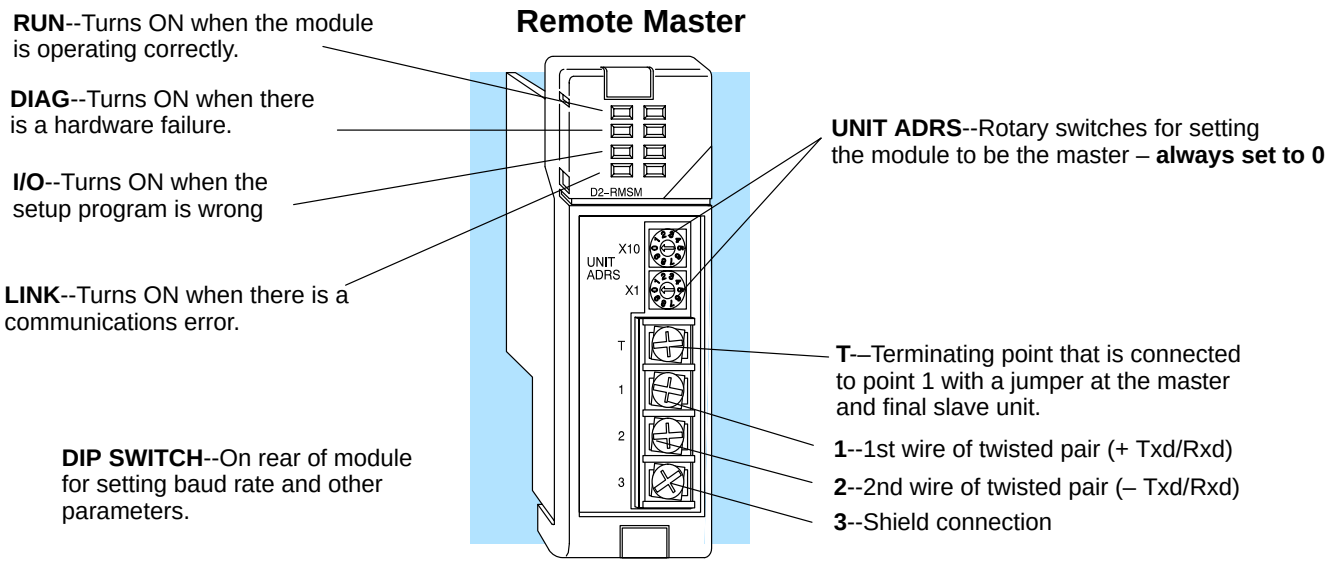
2

D2–RMSM/ T1K– RSSS Remote I/O System

In This Chapter. . . .

- D2–RMSM Features
- T1K–RSSS Features
- Setting the Rotary Switches
- Setting the DIP Switches
- Determine the System Layout
- Connect the Wiring

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). The DL230 does not support Remote I/O.
Channel Specifications:	RM–NET / SM–NET
I/O Points per Master (channel)	2048 (requires firmware version 1.55 or later. Earlier firmware versions support 512 I/O points per channel. (see “Remote I/O Capacity” Note on following page)
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
CPU Memory Type available for Remote I/O **Note: 8 channel analog modules consume 256 discrete I/O pts. and 16 channel analog modules consume 512 I/O pts. The DL250 CPU and V memory addressing is recommended when using analog I/O modules.**	DL240 / DL250 X Inputs 320 / 512 Y Outputs 320 / 512 Control Relays 256 / 1024 V Memory (words) 1024 / 7186
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 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/remote I/O. It is possible to map remote I/O into other types of memory, such as control relays or V memory to achieve more I/O points.

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

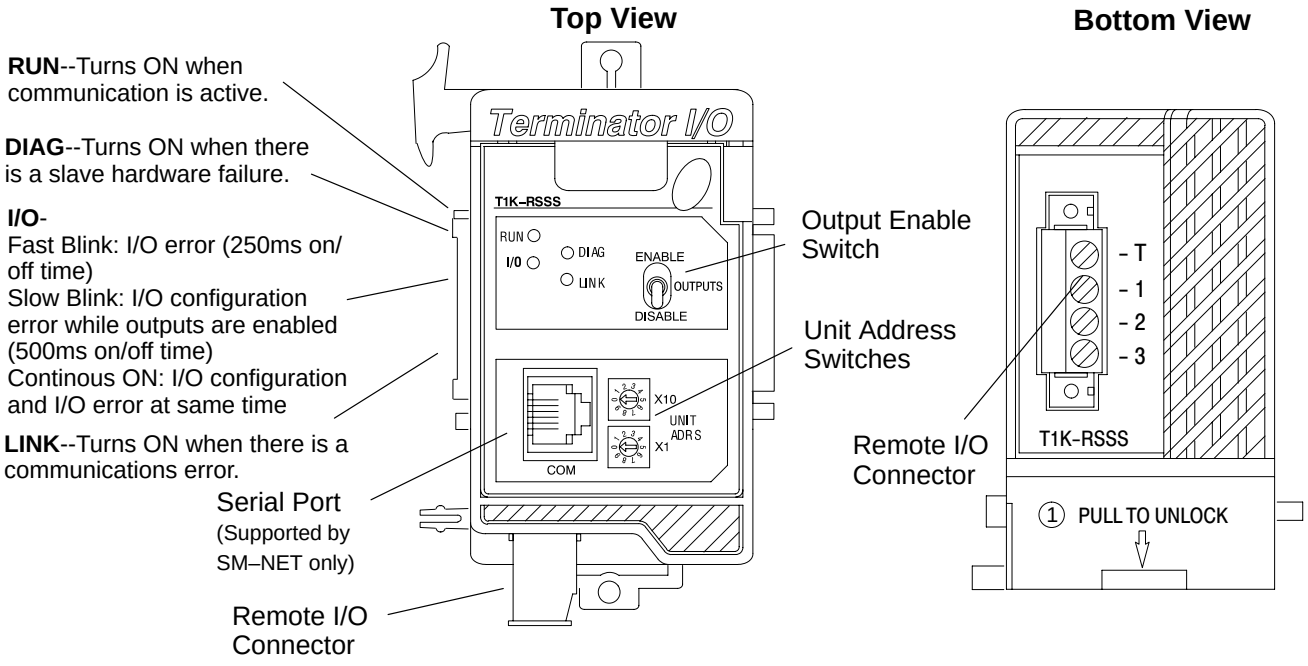
Auto Return to Network Option

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.

Remote Slave (T1K-RSSS) Features



Functional Specifications

Max. # of Slaves per channel	RM–NET 7	SM–NET 31
Maximum I/O Modules per Slave	16 (be sure to check power budget)	
Maximum Remote I/O Points per CPU **Note: 8 channel analog modules consume 256 discrete I/O pts. and 16 channel analog modules consume 512 I/O pts. The DL250 CPU and V memory addressing is recommended when using analog I/O modules.**	No remote I/O for DL230 DL240, DL250, support a maximum of 2048 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. The DL250 has a total of 512 X inputs and 512 Y outputs. Mapping remote I/O into control relays or V memory of could allow more I/O points for the DL240 or DL250.	
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 unit.	
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 T1K–RSSS module.

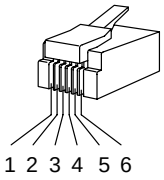
Physical Specifications

Installation Requirements	mount to right of first power supply
Base Power Requirement	250 mA maximum
Communication Cabling	for remote I/O, RS-485 twisted pair, Belden 9841 or equivalent
Slave Serial Communications Port (active in SM–NET mode only)	RS232C (K–Sequence) Dip switch selectable: Baud rate: 4800–38400bps Parity: odd (default), none Fixed settings: 8 data bits, 1 start bit, 1 stop bit
Operating Temperature	32 to 131° F (0 to 55° C)
Storage Temperature	–4 to 158° F (–20 to 70° C)
Relative Humidity	5 to 95% (non-condensing)
Environmental air	No corrosive gases, pollution level = 2 (UL 840)
Vibration	MIL STD 810C 514.2
Shock	MIL STD 810C 516.2
Noise Immunity	NEMA ICS3–304 Impulse noise 1us, 1000V FCC class A RFI (144MHz, 430MHz, 10W, 10cm)

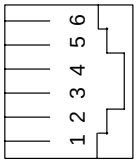
Serial Port Pinout

The port pinout is shown below: (The port is active in SM–NET only).

RJ12 plug on cable



RJ12 socket on T1K–RSSS

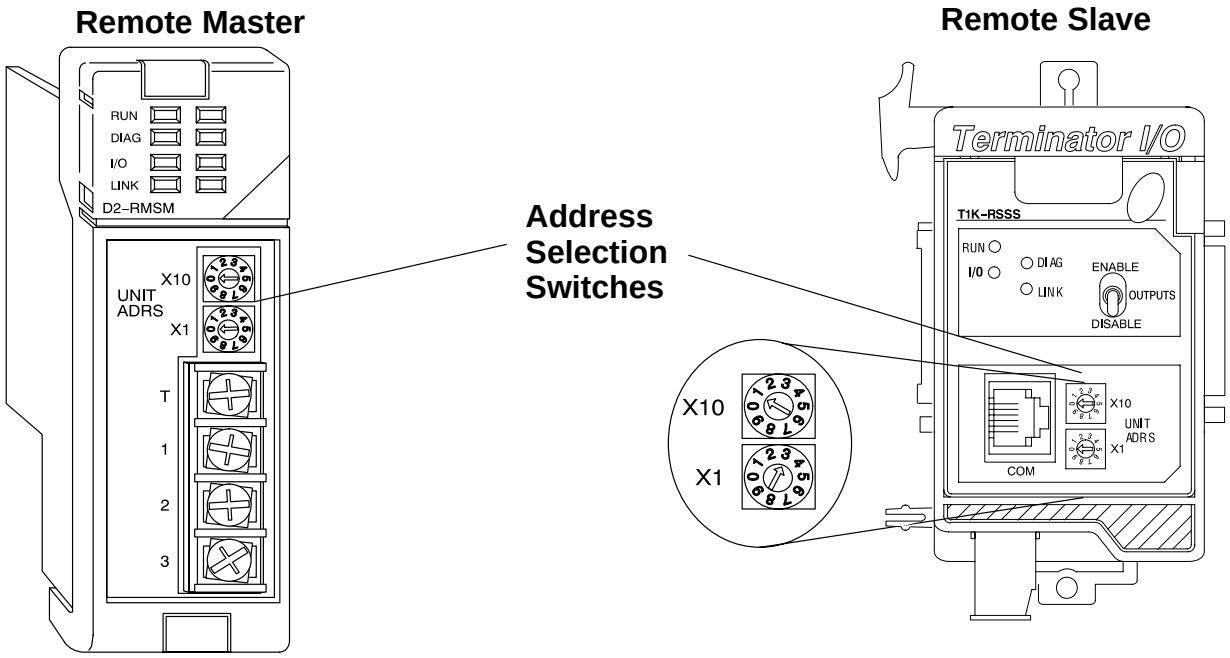


Port Pinout

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

Setting the Rotary Switches

Both the remote master and slave have two small rotary switches to set the unit address. They are on the face of the module, with the label “UNIT ADRS” beside it. Adjust the switches by rotating them with a small flathead screwdriver.

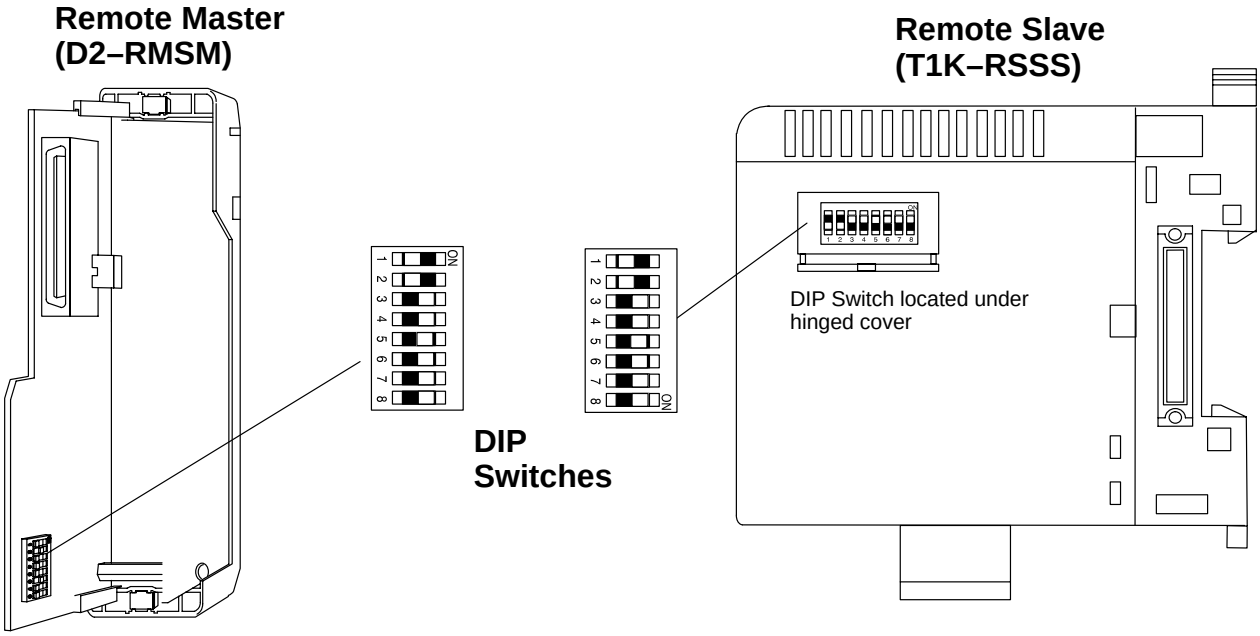


One switch is marked X1 and the other X10. Don’t confuse these with the conventional data type labeling – *these do not refer to inputs* X1 and X10. Instead, these set the address in decimal for each unit. X1 is the “one’s” position and X10 is the “ten’s” position. For example, set address 13 by turning 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** (T1K-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**.

Setting the DIP Switches

The remote master (D2–RMSM) has an 8-position DIP switch labeled “SW3” that is mounted toward the rear of the module on the PC board. The remote slave (T1K–RSSS) also has an 8–position DIP switch labeled “SW1” that is located on the side of the module under a hinged cover. Set these switches to configure the protocol mode, the baud rate, the output response on communication failure and the slave serial port settings. The word “ON” appears beside the switch to indicate the ON position.



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 (T1K–RSSS)	**Mode** Same as Master	**Baud Rate** Same as Master	**Output Default** OFF=Clear ON=Hold	**Serial Port Parity** OFF = Odd ON = None (Active in SM–NET only)	**Serial Port Baud Rate** (Active in SM–NET Only) Baud Rate DIP position-7 8 4.8K X O 9.6K O O 19.2K O X 38.4K X X where X=ON, O=OFF	

Mode: DIP switch Position 1 on both the master and slave unit selects the protocol mode for the remote I/O link. The Terminator 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 D2–RMSM Functional Specifications earlier in this chapter 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 when a communication error occurs. If OFF, the outputs in that slave unit will turn off in response to an error. The setting does not have to be the same for all the slaves on an output 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.

Diagnostics: DIP switch Position 8 on the master selects the factory diagnostic mode, and should always be OFF. If the diagnostic mode is active, the module will not operate correctly. Turning the diagnostic switch to the ON position and applying power to the CPU base will clear the shared memory in the remote master module. Be sure to remove the master module from the base and return the switch to the OFF position for normal operation.

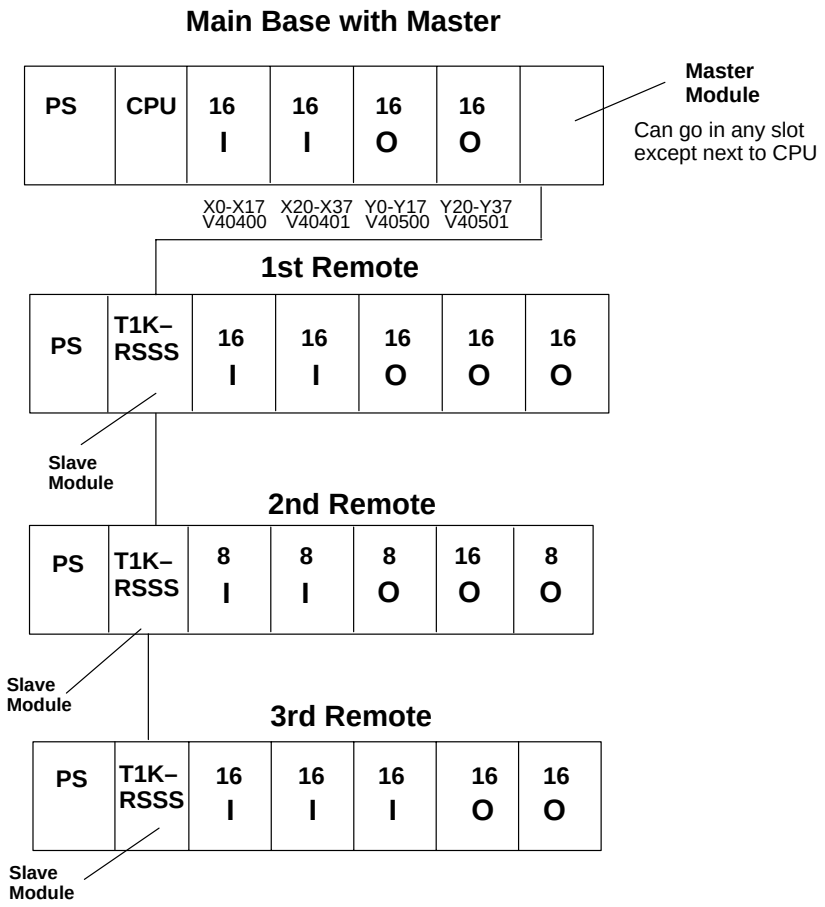
Slave Serial Port: DIP switch Positions 6, 7 and 8 on the slave select the parity and baud rate for the slave's serial communications port. *The port is active only if the remote I/O link is set for **SM–NET** protocol*. Switch 6 selects the parity and switches 7 and 8 select the baud rate.

Determine the System Layout

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, two 8-point output modules and one 16-point output module.
- third remote base has three 16-point input modules, and two 16-point output modules.



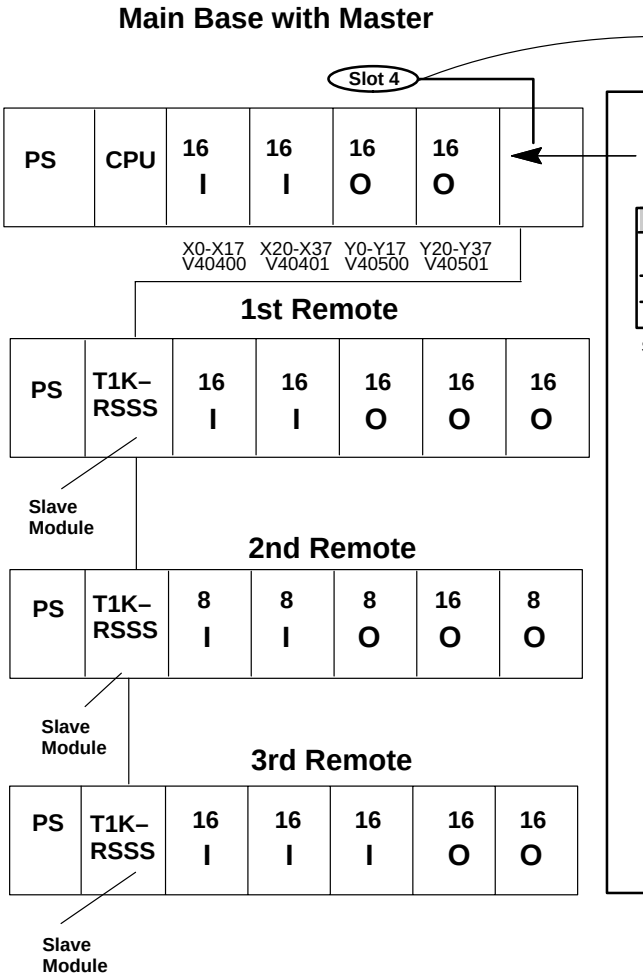
This layout might be typical of a system which requires additional I/O at the CPU location (beyond the local rack capacity), as well as a remote location or two.

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.

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.



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** _____

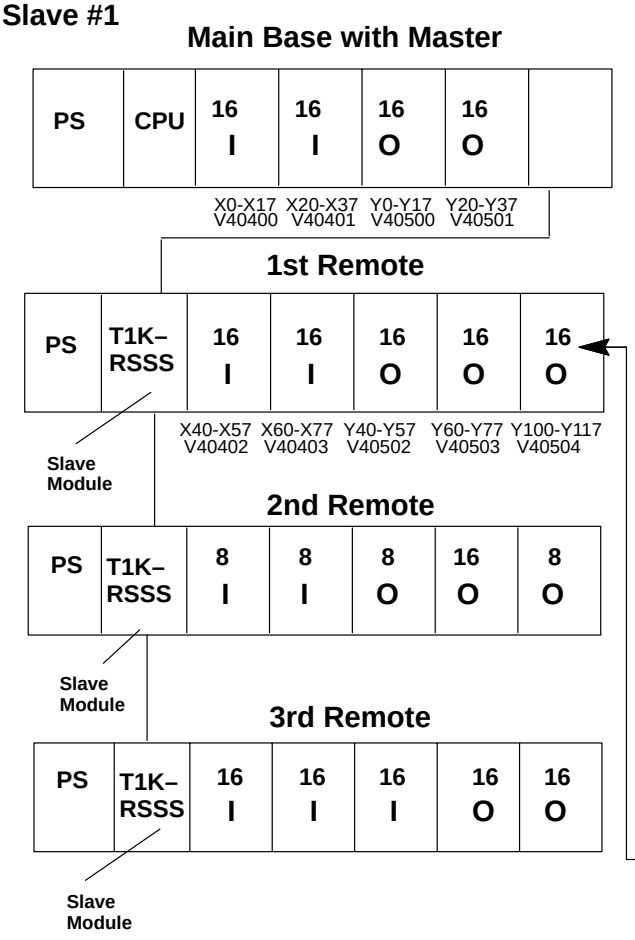
Slave Station	No. of Inputs	No. of Outputs	Slave Station	No. of Inputs	No. of Outputs
0	N/A	N/A	16		
1			17		
2			18		
3			19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		

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 units

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 Unit 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	X40	16		
1	16ND3	X60	16		
2	16TD1			Y40	16
3	16TD1			Y60	16
4	16TD1			Y100	16
5					
6					
7					

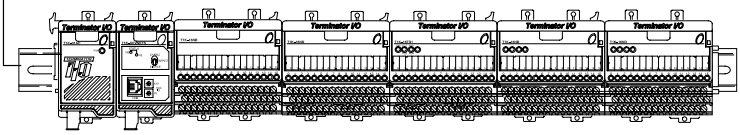
Input Bit Start Address: X040 **V-Memory Address*:V** 40402

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/DL450 port setup program requires these addresses for each slave.



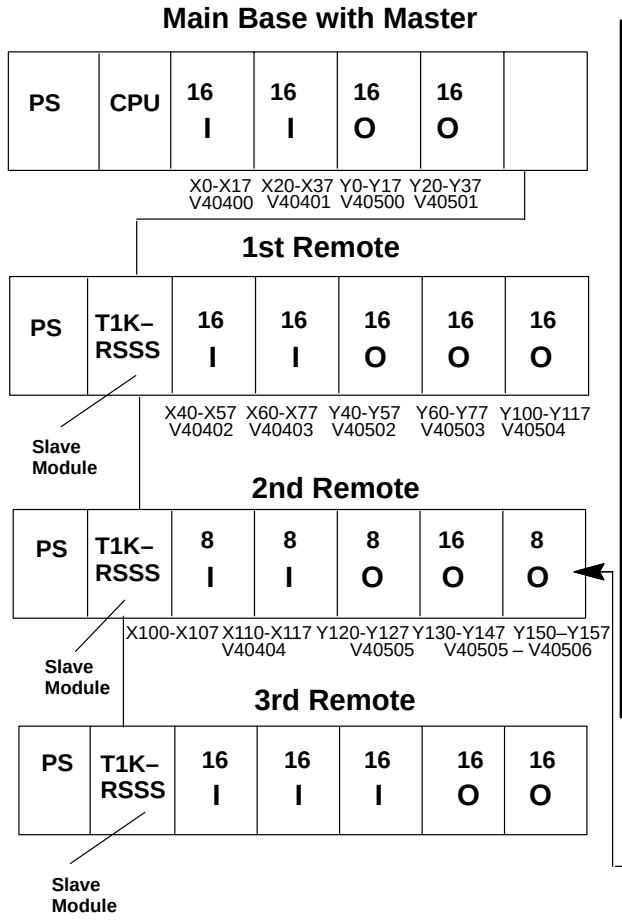
Starting Addresses From Appendix B = V40402 Input V40502 Output

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 X40 (or higher) and the starting address for outputs can be Y40 (or higher). The far right-hand column of each of these charts shows the "bit start" address. For example, for the bit start address for input X40, you look for X40 on the chart. There you find the cross-referenced register address: 40402. On the output chart, you cross-reference Y40 with 40502. 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 Unit 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			Y130	16
4	08TD1			Y150	8
5					
6					
7					

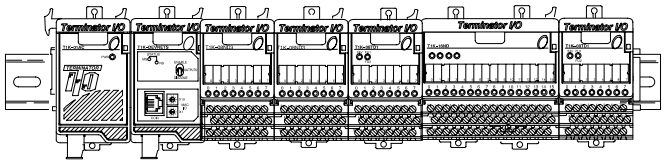
Input Bit Start Address: X100 **V-Memory Address*:V** 40404

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/DL450 CPU port setup program requires these addresses for each slave.

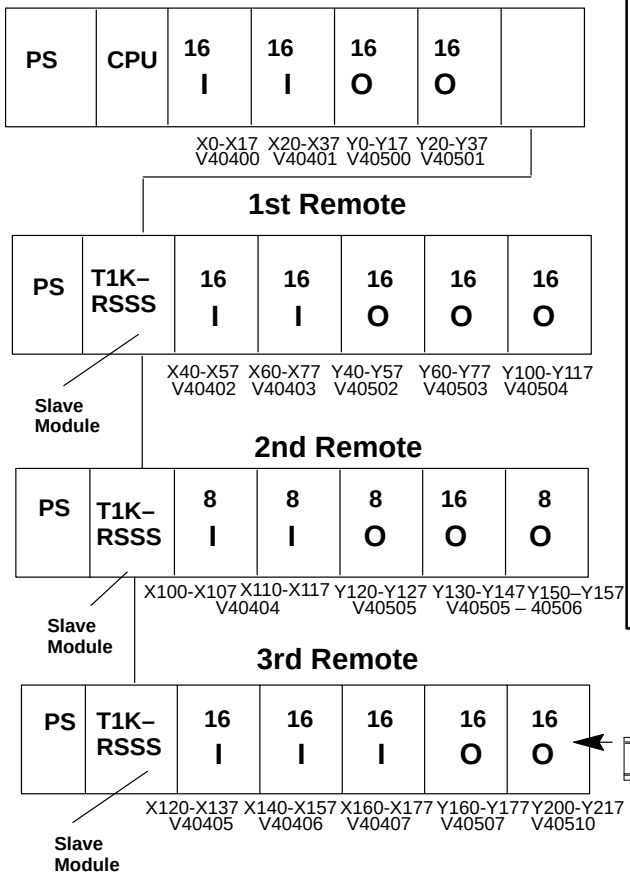


Based on the V-memory addresses we chose, the D2–RMSM allocated points X40 to X77 to Remote Slave #1's inputs, and Y40 to Y117 to its outputs. This means the starting address for the *second remote base inputs* is X100 (assigned automatically by the remote master) and the starting address for *outputs* is Y120 (assigned automatically).

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

Completing the Remote Slave Worksheet for Slave #3

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 Unit 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	16TA			Y160	16
4	16TA			Y200	16
5					
6					
7					

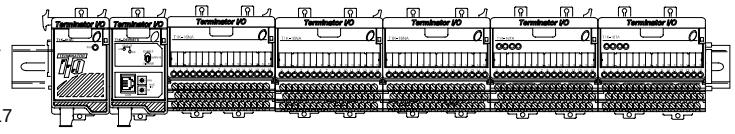
Input Bit Start Address: X120 **V-Memory Address*:V** 40405

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/DL450 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).

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.

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 40402 **Starting Output V Memory Address: V** 40502

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		

Remote Slave Worksheet

Remote Unit 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	X40	16		
1	16ND3	X60	16		
2	16TD1			Y040	16
3	16TD1			Y060	16
4	16TD1			Y100	16
5					
6					
7					

Input Bit Start Address: X40 **V-Memory Address*:V** 40402
Total Input Points 32
Output Bit Start Address: Y40 **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/DL450 port setup program requires these addresses for each slave.

Remote Slave Worksheet

Remote Unit Address 3 **(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	16NA	X120	16		
1	16NA	X140	16		
2	16NA	X160	16		
3	16TA			Y160	16
4	16TA			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/DL450 port setup program requires these addresses for each slave.

Remote Slave Worksheet

Remote Unit 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	X100	8		
1	08ND3	X110	8		
2	08TD1			Y120	8
3	16TD1			Y130	16
4	08TD1			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/DL450 port setup program requires these addresses for each slave.

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.

Connecting the Wiring

General Wiring Guidelines

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

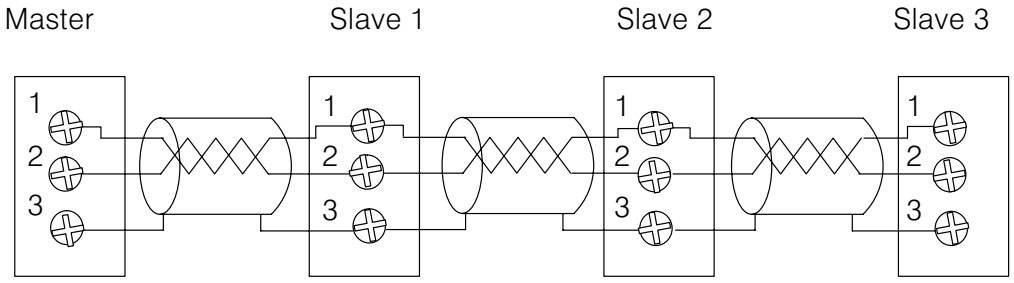
1. Always use a continuous length of cable. Do not combine cables to attain a needed length.
2. Use the shortest possible cable length.
3. Where possible, use conduit for cable routing.
4. Avoid running cable near high energy wiring.
5. Where possible, avoid running communications cabling in close proximity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

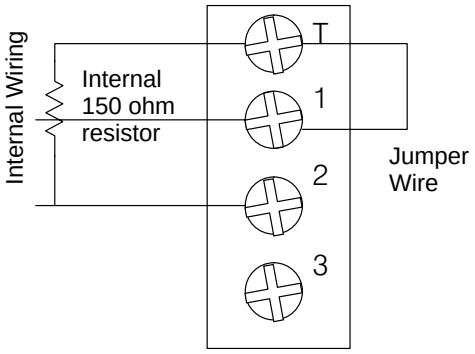


Termination Resistors

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:

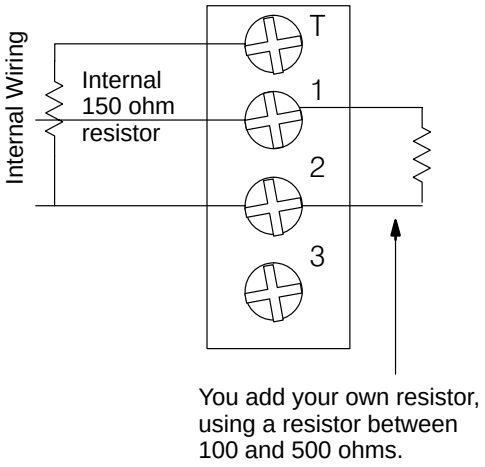
Option 1:
Use Internal Resistor Only

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.



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.