

Hardware Installation and Configuration



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Hardware Installation

The DeviceMaster RTS enables communications with serial devices over an Ethernet network. The RTS provides for remote management, configuration, and connectivity through its 10/100BASE-T Ethernet connection. The RTS also has a built-in downstream port for daisy-chaining DeviceMaster systems or other network-ready devices. This document discusses the following models:

- DeviceMaster RTS 4-port (DB9 and RJ45)
- DeviceMaster RTS 8-port (DB9 and RJ45)
- DeviceMaster RTS 16-port (RJ45)

Note: *The DeviceMaster Primo is not supported in this document.*

Connecting to the Network

Use the following procedure to install the DeviceMaster RTS and connect it to your ethernet hub, ethernet switch, or a server's NIC.

1. Record the MAC address, model number, and serial number of the DeviceMaster RTS unit on the customer service label provided.

Note: *You need the MAC address during NS-Link device driver configuration.*

Serial Number*	MAC*
	00 C0 4E _ _ _ _

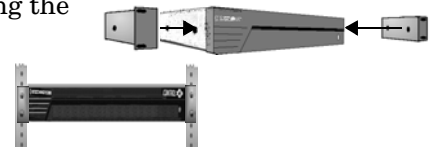
* *The serial number and MAC address are located on a label on the unit.*

Note: *Do not connect multiple units until you have changed the default IP address. All RTS units have 192.168.250.250 as the default address (Host Name).*

2. Place the DeviceMaster RTS on a stable surface, or *optionally* mount the DeviceMaster RTS 16 in a rack.

Rack Installation:

- a. Attach the L brackets to the device using the screws supplied with the unit.
- b. You can mount the unit facing in either direction.
- c. Attach the L bracket into your rack



3. Connect the RTS to the ethernet network using one of the following methods:
 - **Ethernet hub or switch (10/100Base-T):** Connect to the port labeled **UP** on the RTS using a standard ethernet cable.
 - **Server NIC (10/100Base-T):** Connect to the port labeled **DOWN** on the RTS using a standard ethernet cable.
 - **Daisy-chaining DeviceMaster RTS units:** Connect the port labeled **DOWN** on the first RTS to the port labeled **UP** on the second RTS or other device using a standard ethernet cable.

Note: See [Daisy-Chaining DeviceMaster RTS Units](#) on Page 17 for more information about daisy-chaining devices.



The NS-Link device driver's default port setting is RS-232. Make sure that you do not connect RS-422/485 devices until the appropriate port interface type has been configured in NS-Link.

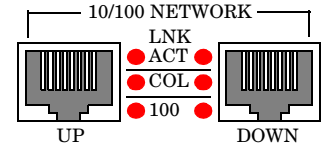
4. Connect the AC power adapter to the DeviceMaster RTS.
5. Connect the power cord to the power adapter and plug the power cord into a power source.

Note: You may need to select the appropriate AC power cable for your location.

6. Verify that the network connection for the RTS is functioning properly:
 - The yellow or red **PWR** LED on the front panel of the RTS is lit, indicating you have power and it has completed the boot cycle.

Note: The **PWR LED** flashes while booting and it takes approximately 10 seconds for the bootloader to complete the cycle.

- The red **LNK ACT** LED is lit, indicating that you have a working Ethernet connection.
- The red **100** LED is lit, indicating a working 100 MB Ethernet connection (100 MB network, only).



If the red **COL LED** is lit, there is a network collision.

Note: If necessary, see *Adding a Unit to an Existing Installation* (below).

Note: The DeviceMaster RTS default IP address: **192.168.250.250**.

7. Go to [Configuring the Network Setup](#) on Page 6 to configure the RTS for use.

Adding a Unit to an Existing Installation

Use this procedure to add another DeviceMaster RTS to an existing configuration.

1. Install the DeviceMaster RTS to an Ethernet hub or server NIC using [Connecting to the Network](#).
2. Power-up the new DeviceMaster RTS and verify that the **PWR LED** lights.
3. Program an IP address into the new DeviceMaster RTS.
4. Configure serial ports to support the serial devices.

Replacing Hardware

Follow this procedure, to replace an RTS with another RTS in an existing configuration.

1. Configure the IP address in the new RTS.
2. Remove the old unit and attach a new or spare DeviceMaster RTS.
3. Connect the new DeviceMaster RTS to the network hub or server NIC.
4. Connect the power source to the new RTS and verify that it passes the power on self-test.
5. Change the NS-Link driver to reflect the MAC or IP address of the new RTS.
6. Configure any RS-422 or RS-485 ports to match the previous unit.
7. Transfer *all* cabling from the old RTS to the new DeviceMaster RTS.
8. *It is not necessary* to shut down and restart the server.

Configuring the Network Setup

This section provides an overview of the DeviceMaster RTS configuration.

Depending upon how you plan on communicating to the DeviceMaster RTS will determine what procedures you need to perform to configure the RTS. Refer to the installation document for your operating system for an overview of the advantages of MAC or IP addressing. See [Locating the NS-Link Drivers and Installation Documentation](#) to locate the appropriate document.

Programming the IP Address

If you are planning on using an IP address to control the RTS, you should take into consideration how you plan on using the serial ports. The ports can be configured with COM or TTY characteristics and as sockets.

- To configure the ports for COM or TTY characteristics, you must install an NS-Link driver. After configuring the IP address and the port characteristics, you can also configure the socket characteristics using the NS-Link SocketServer. See *Locating the NS-Link Drivers and Installation Documentation* (below) for details.
- To configure the ports for only socket characteristics, you will use Redboot to program the IP address and then configure the socket characteristics using SocketServer. See the *Installation Overview* in the *Getting Started* section of the [DeviceMaster RTS Installation and Configuration Guide](#). You can download the latest copy of the guide at, ftp://ftp.comtrol.com/Dev_Mstr/RTS/RTS_Library.pdf.

Programming the MAC Address

If you are planning on using a MAC address to communicate with the DeviceMaster RTS, the RTS must be on the same network segment as the host server. To use MAC addressing, install one of the NS-Link device drivers below.

Locating the NS-Link Drivers and Installation Documentation

You can use the drivers on the CD, but you may want to download the latest driver and installation document using these hyperlinks to the ftp site.

Operating System	ftp://ftp.comtrol.com/Dev_Mstr/RTS/Drivers/ Driver	Installation Document
Linux	/linux/	/Linux/SW_Doc/
Windows 2000	/Win2000	/Win2000/SW_Doc/
Windows 98/ME	/Win98	/Win98/SW_Doc/
Windows NT	/WinNT	/WinNT/SW_Doc/

If you want to use the files on the CD that shipped with your product, insert the CD and follow the menu system to install the driver. If the menu system does not launch after you insert the CD, use the **readme.pdf** file at the root of the CD to locate the NS-Link driver and associated installation documentation.

Connecting Serial Devices

This section contains the following topics:

- How to connect your serial devices.
- Pinouts of the DB9 and RJ45 connectors.
- How to build loopback connectors for testing the ports.

Connecting Devices



Caution

Use the following discussion to connect asynchronous serial devices to the DeviceMaster RTS ports.

If necessary, make sure that you have configured the ports using the NS-Link driver or SocketServer for the correct communications mode before connecting any devices. The default mode in the NS-Link drivers is RS-232. There is a remote possibility that connecting a peripheral for the wrong mode could damage the peripheral.

1. Connect your serial devices to the appropriate port on the DeviceMaster RTS using the appropriate cable. You can build your own cables using the [Building Null-Modem Cables](#) (Page 8) or [Building Straight-Through Cables](#) (Page 9) discussions.

Note: Use the hardware manufacturer's installation documentation if you need help with connector pinouts or cabling for the peripheral device.

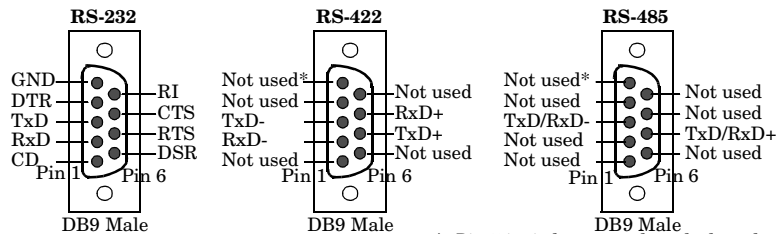
2. Verify that the devices are communicating properly:

- The yellow Rx LED shows that the data receiver is connected to another RS-232 device or receiving data in RS-422/485 mode.
- The green Tx LED shows that the data is transmitting.

Rx1*
Tx1* 1* represents the port number

DB9 Connector Pinouts

Use the following pinout information for the DB9 serial port connectors on the DeviceMaster RTS.



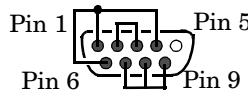
Building Additional DB9 Loopback Plugs

Loopback connectors are DB9 female serial port plugs, with pins wired together as shown, that are used in conjunction with application software to test serial ports. The DeviceMaster RTS is shipped with a single loopback plug (RS-232/422).

Note: Drivers for Microsoft operating systems are bundled with the Test Terminal (WCOM32) program. Linux users can use MiniCom. See the driver documentation for about using these applications.

Wire the following pins together to build additional plugs or replace a missing RS-232 loopback plug:

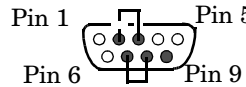
- Pins 1 to 4 to 6
- Pins 2 to 3
- Pins 7 to 8 to 9



RS-232 Only (Back View) *The RS-232 loopback plug also works for RS-422.*

Wire the following pins together for an RS-422 loopback plug:

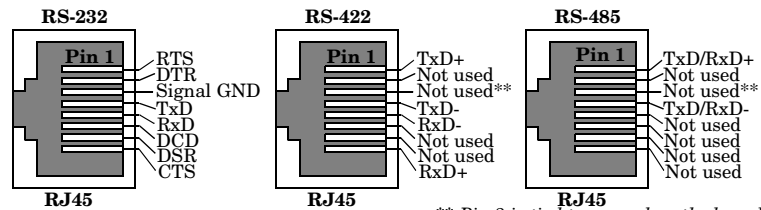
- Pins 2 to 3
- Pins 7 to 8



RS-422 Only (Back View)

RJ45 Connector Pinouts

Use the following pinout information for the RJ45 serial port connectors on the DeviceMaster RTS.

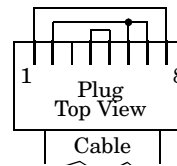


** Pin 3 is tied to ground on the board, but is not used in the cable.

Building Additional RJ45 Loopback Plugs

Loopback connectors are RJ45 serial port plugs, with pins wired together as shown, that are used in conjunction with application software to test serial ports. The DeviceMaster RTS is shipped with a single loopback plug (RS-232/422).

- Pins 4 to 5
- Pins 1 to 8
- Pins 2 to 6 to 7



The RS-232 loopback plug also works for RS-422.

Note: Drivers for Windows 98 and Windows NT are bundled with the Test

Terminal (WCOM32) program. Linux users can use MiniCom. See the NS-Link driver documentation for your system for information about using these applications.

Building Null-Modem Cables

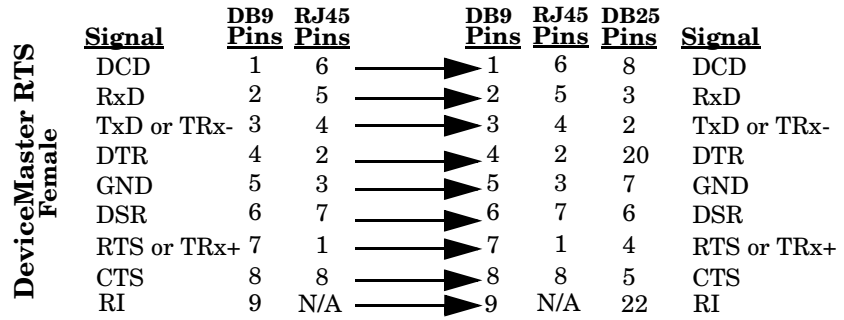
Use the following figure if you need to build a null-modem cable. A null-modem cable is required for connecting DTE devices.

DeviceMaster RTS Female	Signal	DB9 Pins	RJ45 Pins	DB9 Pins	DB25 Pins	RJ45 Pins	Signal
	TxD	3	4	2	3	5	RxD
	RxD	2	5	3	2	4	TxD
	RTS	7	1	8	5	8	CTS
	CTS	8	8	7	4	1	RTS
	DSR	6	7	4	20	2	DTR
	DCD	1	6	1	8	6	DCD
	DTR	4	2	6	6	7	DSR
	GND	5	3	5	7	3	GND
	RI	9	N/A	9	22	N/A	RI

Note: You may want to purchase or build a straight-through cable and purchase a null-modem adapter.

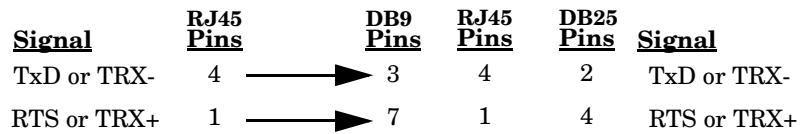
Building Straight-Through Cables

Use the following figure if you need to build a straight-through cable. Straight-through cables are used to connect DCE devices.



Building an RS-485 Test Cable

You can use a straight-through cable as illustrated previously, or build your own cable.



RTS Specifications

The following subsections contain specifications and safety notices for the DeviceMaster RTS.

Electromagnetic Compliances

The following table lists electromagnetic compliances for the RTS.

Electromagnetic Compliances	Status
Emission: Canadian EMC requirements CISPR-22/EN55022 Class A FCC Part 15 Class A	Yes Yes Yes
Immunity: EN55024: 1998 IEC 1000-4-2: 1995 ESD IEC 1000-4-3: 1996 RF IEC 1000-4-4: 1994 Fast Transient IEC 1000-4-5: 1995 Surge IEC 1000-4-6: 1996 Conducted disturbance IEC 1000-4-8: 1994 Magnetic field IEC 1000-4-11: 1994 Dips and Voltage Variations	Yes Yes Yes Yes Yes Yes Yes
Safety: EN60950 UL Listed	Yes Yes

Hardware Specifications

The following table lists hardware specifications for the RTS.

Topic	Specification
Current consumption @ 24VDC: 4-Port 8-Port 16-Port	200 mA 290 mA 490 mA
Power consumption: 4-Port 8-Port 16-Port	4.8 W 6.96 W 11.76 W
External power supply: Line frequency Line voltage	50 - 60 Hz 100 - 240VAC
Processor type	ARM7
Memory	8MB SDRAM/4MB flash
Real time clock	Battery backup, 256B RAM, watchdog time/power off monitor

Topic	Specification
Baud rate/port (maximum)	230.4 Kbps
Ethernet host interface (upstream and downstream)	10/100Base-T (10/100 Mbps - RJ45)
Serial interface	RS-232, RS-422, and RS-485
Serial connector types: 4/8-Port 16-Port	DB9 or RJ45 RJ45
Network default values IP address Subnet mask Gateway	192.168.250.250 255.255.0.0 192.168.250.1
Network protocols	TCP, UDP, BOOTP, TFTP, ICMP, ARP, SNMP (MIB-II), Telnet, HTTP
NS-Link control: Data bits Parity Stop bits	7 or 8 Odd, Even, None 1 or 2
SNMP support	Monitoring only.
Dimensions: 4-Port 8-Port 16-Port	10.8" x 6.3" x 1.5" 10.8" x 6.3" x 1.8" 17.25" x 8.0" x 1.74"
Weight (hub, only): 4-Port DB9 4-Port RJ45 8-Port DB9 8-Port RJ45 16-Port RJ45	54.6 oz 54.1 oz 59.6 oz 58.6 oz 36.3 oz

Environmental Specifications

This table list environmental conditions.

Environmental Conditions	Value
Air temperature: System on (operational) System off (storage)	0 to 45°C -20 to 85°C
Altitude	0 to 10,000 feet
Heat output: 4-Port 8-Port 16-Port	16.4 BTU/Hr 23.8 BTU/Hr 40.1 BTU/Hr
Humidity (non-condensing): System on (operational) System off (storage)	8% to 80% 20% to 80%

Environmental Conditions	Value
Mean time between failures (MTBF):	
4-Port	25.0 years
8-Port	21.5 years
16-Port	13.2 years

Notices

Radio Frequency Interference (RFI) (FCC 15.105)

This equipment has been tested and found to comply with the limits for Class A digital devices pursuant to Part 15 of the FCC Rules.

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Labeling Requirements (FCC 15.19)

This equipment complies with part 15 of FCC rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Modifications (FCC 15.21)

Changes or modifications to this equipment not expressly approved by Control Corporation may void the user's authority to operate this equipment.

Serial Cables (FCC 15.27)

This equipment is certified for Class A operation when used with unshielded cables.

Underwriters Laboratory

This equipment is Underwriters Laboratory "UL" listed.

Important Safety Information

To avoid contact with electrical current:

- Never install electrical wiring during an electrical storm.
- Never install the power plug in wet locations.
- Use a screwdriver and other tools with insulated handles.



Troubleshooting and Technical Support

This section contains troubleshooting information for your Comtrol device. You should review the following subsections before calling Technical Support because they will request that you perform many of the procedures or verifications before they will be able to help you diagnose the problem.

- Troubleshooting checklist
- [General Troubleshooting](#) on Page 14
- [NS-Link Driver Troubleshooting](#) on Page 15
- [Daisy-Chaining DeviceMaster RTS Units](#) on Page 17

If you cannot diagnose the problem, you can contact Technical Support using [Technical Support](#) on Page 18.

Troubleshooting Checklist

The following checklist may help you diagnose your problem:

- Verify that you are using the correct types of cables on the correct connectors and that all cables are connected securely using the hardware documentation.
Note: Most customer problems reported to Comtrol Technical Support are eventually traced to cabling or network problems. Use a standard Ethernet cable to connect from the UP port to an Ethernet hub or from the DOWN port to a NIC in a server.
- Verify that the ethernet hub and any other network devices between the server and the Comtrol device are powered up and operating.
- Reset the power on the Comtrol device by disconnecting and reconnecting the power cord.
- Verify that the port polarity is correct, especially if using RS-422 or RS-485 mode.
- Verify that the network (MAC) address in NS-Link matches the address on the Comtrol device.
- Verify that the network IP address is correct. If IP addressing is being used, the server should be able to ping the Comtrol device.
- Verify that the IP address programmed into the Comtrol device matches the unique reserved IP configured address assigned by the system administrator.
- If using a driver for Microsoft systems, verify that you are addressing the port correctly. In many applications, device names above COM9 require the prefix \\.\ in order to be recognized. For example, to reference COM20, use \\.\COM20 as the file or port name.
- If using NS-Link for a Microsoft system, you can use one of the tools bundled with the drivers:
 - Test Terminal program (**wcom32.exe**), which can be used to troubleshoot communications on a port-by-port basis.
 - Port Monitor program (**portmon.exe**), which checks for errors, modem control, and status signals. In addition, it provides you with raw byte input and output counts.
 - Device Advisor, which helps identify problems is a tab in the **Device** window of the driver.

- If Windows NT, Peer Tracer program (**peer.exe**), which traces driver events.
- If using Windows NT, enable the **Verbose Event Log** feature under the **Setup Options** tab and then reboot the server.
- Reboot the server and the Comtrol device.
 - Isolate the unit from the network. Connect the device directly to the NIC in the server. Use a standard Ethernet cable and connect to the port labeled: **DOWN**.
- Remove and reinstall NS-Link.
- If you have a spare Comtrol device, try replacing the device.

General Troubleshooting

This table illustrates some general troubleshooting tips.

Note: Make sure that you have reviewed the [Troubleshooting Checklist](#) on Page 13.

General Condition	Explanation/Action
PWR LED not lit	Indicates that power has not been applied or there is a hardware failure. Contact Technical Support.
Can ping the Comtrol device, but cannot open the ports from a remote location. (You must have previously programmed the IP address, subnet mask, and IP gateway.)	<p>The NS-Link driver uses Port 4606 (11FE h) to communicate with the Comtrol device.</p> <p>When using a “sniffer” to track NS-Link packets, filtering for Port 4606 will easily track the packet. The packet should also contain the MAC address of the device and the originating PC so that it can be determined if the packet is able to travel the full distance one way or not.</p> <p>If the 4606 packet is found on one side of a firewall or router, using sniffer, and not on the other side, then that port needs to be opened up to allow the 4606 to pass.</p> <p>This will most often be seen with firewalls, but is not uncommon in some routers.</p>
Cannot ping the device through Ethernet hub	Isolate the unit from the network. Connect the device directly to the NIC in the server to the port labeled: DOWN .
Cannot ping or connect to the DeviceMaster RTS.	<p>The default IP address is often not accessible due to the subnet masking from another network unless 192.168 is used in the network.</p> <p>In most cases, it will be necessary to program in an address that conforms to your network.</p> <p>If you do not use the NS-Link driver to program the IP address, you only have 10 seconds to disable the bootloader with Redboot to get into the setup utility.</p> <p>See ftp://ftp.comtrol.com/Dev_Mstr/RTS/RTS_Library.pdf for the Redboot method of programming an IP address.</p>

NS-Link Driver Troubleshooting

This table includes some tips related to NS-Link drivers.

NS-Link Condition	Explanation/Action
<p>Need to program IP address into the device.</p>	<p>Before programming an IP address it is critical that the unit be operational and passes the power on tests when configured for the MAC address.</p> <p><i>Note: If the unit is NOT operational, do NOT attempt to program or use an IP address with the unit.</i></p> <p>This is a general procedure for drivers for Microsoft operating systems.</p> <ol style="list-style-type: none"> 1. In the Control Setup, highlight the Control device. 2. Select Properties. 3. Select IP Programming. 4. Select Retrieve and confirm or modify addresses as necessary. <p><i>Note: Enter in all 3 categories. The unit must have Address, Mask and Gateway IP values entered.</i></p> <ol style="list-style-type: none"> 5. Select Program. 6. Select Reset - power LED should begin blinking. 7. Select Device Setup. 8. Uncheck MAC. 9. Check IP and enter IP number that you configured earlier. 10. Select Ok (several times) and reboot the system. <p>IP addressing will now be in effect.</p>
<p>Cannot open port</p>	<ol style="list-style-type: none"> 1. Verify that MAC address in the NS-Link driver matches the address on the Control device. 2. Verify that you are using the correct NS-Link driver. If necessary, remove and reinstall a new driver. 3. Isolate the unit from the network. Connect the device directly to the NIC in the server to the port labeled: DOWN. 4. Check to see if another program or computer is active on this port.

NS-Link Condition	Explanation/Action										
<p>The Comtrol device has a lower limitation of network bandwidth requirement of 64 Kbps.</p>	<p>At this speed the entire available bandwidth is required for the purpose of uploading the firmware from the driver to the Comtrol device. At lower speeds, timing issues will prevent the firmware from being successfully installed to the Comtrol device, thus preventing the device from normal operation.</p> <p>When using the Comtrol device over a WAN link that is less than the recommended 64Kbps, a timing modification may be made that will allow uploading of the firmware.</p> <p>There are two possible solutions.</p> <ol style="list-style-type: none"> 1. Load the driver locally to the device for the purpose of getting the firmware installed. The PC on the other side of the slow link can then “share” the port. The sharing may be exclusive as the firmware loader PC may not need to access the ports. 2. Modify the <i>Scan Rate</i> setting to an unusually high value. The default value for the Scan Rate is 10 ms. Changing this rate may cause decreased performance as it may be necessary to increase this value to several seconds as opposed to milliseconds. This may also require some experimentation to determine the lowest value that will provide successful uploading of the firmware. With experimentation, Scan Rate values of less than 5000 ms may be attempted. <p>A value of 5000 ms has been successfully used to upload the firmware across connection lines as slow as 14.4 Kbps. This is the only value that the following Kbps/duration values will be demonstrated.</p> <p>Bandwidth of less than 14.4K has not been tested and is not recommended under any circumstance but is a decision to be made by the end user with considerations of device port speed requirements, duration of transmissions, frequency of transmissions, etc.</p> <p>With the Scan Rate set to 5000ms.</p> <table border="0" data-bbox="818 1272 1409 1486"> <thead> <tr> <th data-bbox="818 1272 1036 1329"><u>Connection speed (bandwidth):</u></th> <th data-bbox="1162 1272 1409 1329"><u>Time required to upload firmware:</u></th> </tr> </thead> <tbody> <tr> <td data-bbox="883 1339 938 1367">32K</td> <td data-bbox="1195 1339 1317 1367">3 minutes</td> </tr> <tr> <td data-bbox="883 1377 959 1404">28.8K</td> <td data-bbox="1195 1377 1341 1404">3.5 minutes</td> </tr> <tr> <td data-bbox="883 1415 959 1442">19.2K</td> <td data-bbox="1195 1415 1317 1442">4 minutes</td> </tr> <tr> <td data-bbox="883 1453 959 1480">14.4K</td> <td data-bbox="1195 1453 1341 1480">4.5 minutes</td> </tr> </tbody> </table> <p>If you need help changing the Scan Rate value in the Options field. See the NS-Link installation document for your operating system or use the help system in the driver.</p>	<u>Connection speed (bandwidth):</u>	<u>Time required to upload firmware:</u>	32K	3 minutes	28.8K	3.5 minutes	19.2K	4 minutes	14.4K	4.5 minutes
<u>Connection speed (bandwidth):</u>	<u>Time required to upload firmware:</u>										
32K	3 minutes										
28.8K	3.5 minutes										
19.2K	4 minutes										
14.4K	4.5 minutes										

Daisy-Chaining DeviceMaster RTS Units

DeviceMaster RTS products follows the IEEE specifications for standard Ethernet topologies.

When using the **UP** and **DOWN** ports, the DeviceMaster RTS is classified as a switch. When using the **UP** port only, it is a simple end node device.

The maximum number of DeviceMaster RTS units, and the maximum distance between units is based on the Ethernet standards and will be determined by your own environment and the conformity of your network to these standards.

Control has tested with seven DeviceMaster RTS units daisy-chained together using 10 foot CAT5 cables, but this is not the theoretical limit. You may experience a performance hit on the devices at the end of the chain, so it is recommended that you overload and test for performance in your environment. The OS and the application may also limit the total number of ports that may be installed.

Following are some quick guidelines and URLs of additional information. Please note that standards and URLs do change.

- Ethernet 10BASE-T Rules
 - The maximum number of repeater hops is four.
 - You can use Category 3 or 5 twisted-pair 10BASE-T cables.
 - The maximum length of each cable is 100m (328ft).

***Note:** Category 3 or 5 twisted pair cables look the same as telephone cables but they are not the same. The network will not work if telephone cables are used to connect the equipment.*
- Fast Ethernet 100BASE-TX rules
 - The maximum number of repeater hops is two (for a Class II hub). A Class II hub can be connected directly to one other Class II Fast Ethernet hub. A Class I hub cannot be connected directly to another Fast Ethernet hub.
 - You must use Category 5 twisted-pair 100BASE-TX cables.
 - The maximum length of each twisted-pair cable is 100m (328ft).
 - The total length of twisted-pair cabling (across directly connected hubs) must not exceed 205m (672ft).

***Note:** Category 5 twisted pair cables look the same as telephone cables but they are not the same. The network will not work if telephone cables are used to connect the equipment.*
- IEEE 802.3 specification: A network using repeaters between communicating stations (PCs) is subject to the "5-4-3" rule of repeater placement on the network:
 - Five segments connected on the network.
 - Four repeaters.
 - Three segments of the 5 segments can have stations connected. The other two segments must be inter-repeater link segments with no stations connected.

See <http://www.optronics.gr/Tutorials/ethernet.htm> for more specific information.

Additional information may be found at <http://compnetworking.about.com/cs/ethernet1/> or by searching the web.

Technical Support

If you need technical support, contact Comtrol using one of the following methods.

Contact Method	Corporate Headquarters	Comtrol Europe
FAQ/Online	http://support.comtrol.com/support.asp	
Downloads	http://support.comtrol.com/download.asp	
Email	support@comtrol.com	support@comtrol.co.uk
Web site	http://www.comtrol.com	http://www.comtrol.co.uk
Fax	(763) 494-4199	+44 (0) 1 869-323-211
Phone	(763) 494-4100	+44 (0) 1 869-323-220

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