# EOTec 2104 User Manual

## *Industrial Ethernet Ring Switch*

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First Edition

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## Copyright

## Standards and Safety

The EOTec 2104 Ethernet Ring Switch from Weed Instrument has been designed to meet the following standards.

| | |
|---|---|
| | Electrical safety – CSA C22.2/14; IEC61010-1 |
| CE | EMI emissions – FCC part 15, ICES 003, EN55022<br>EMC immunity – IEC61326-1 |
| FM APPROVED | FM/cFM Class I, Division 2, Groups A, B, C, and D, T4<br>(-40°C To +85°C) |
| ⚠ | **WARNING** – EXPOSURE TO SOME CHEMICALS MAY DEGRADE THE SEALING PROPERTIES OF MATERIALS USED IN THE FOLLOWING DEVICES:<br><br>RELAYS K1, K2 & K3 – LCP resin housing with epoxy resin seal<br><br>If the above devices are exposed to degrading chemicals, it is recommended that periodic inspection be performed and replacement of the unit occur if degradation is found. |
| ⚠ | Install the Weed Ring Switch in accordance with local and national electrical codes. |
| ⚡ | Lightning Danger: Do not work on equipment during periods of lightning activity. Do not connect a telephone line into the Ethernet RJ45 connectors. |

Refer to the Technical Specifications section, at the end of this manual, for complete specifications on agency approvals.

## FCC Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, 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 to correct the interference by one or more of the following measures: Reorient or relocate the receiving antenna; Increase the separation between the equipment and 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.

# Table of Contents

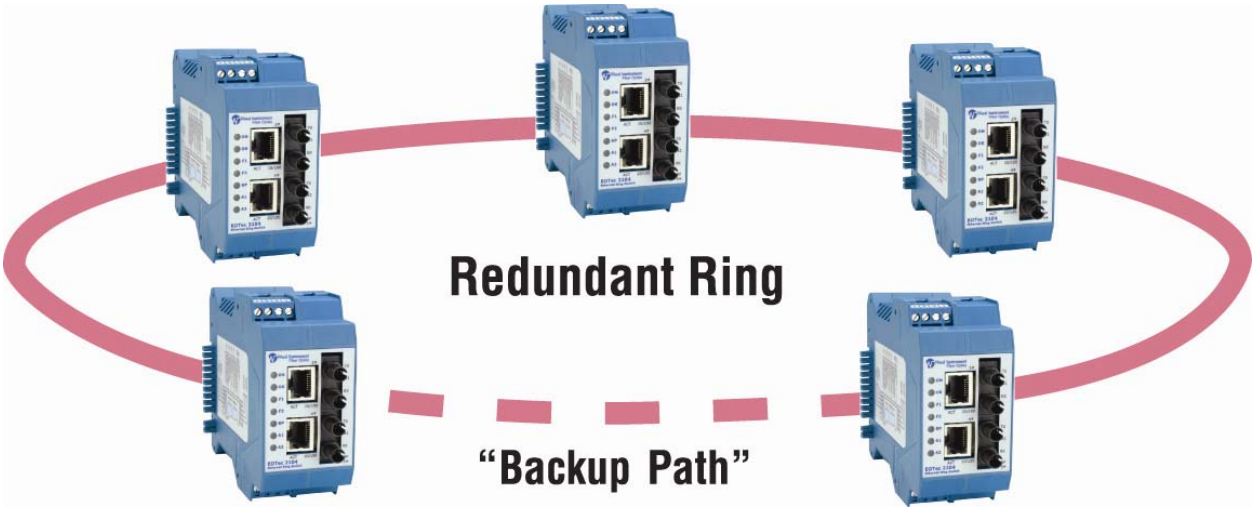
# 1 Introduction

This manual describes how to use the EOTec 2104 Ethernet Ring Switch, an intelligent Ethernet device switch specially designed for connecting Ethernet-enabled devices in industrial field applications.

Ethernet is swiftly being adopted by the industrial automation and control industry. Industrial applications often demand rugged, robust equipment that can provide high reliability in settings far removed from a comfortable, climate-controlled office environment. In addition, Ethernet gives the advantage of widespread usage and lower costs due to high volumes.

Industrial Ethernet devices attached to a network usually cannot tell what is happening elsewhere on the system. As a result, the responsibility for monitoring the network must fall on the Ethernet communication equipment that connects these devices. Real-time alarm messages are a vital feature to inform system administrators and operators when a problem exists on the network.

## Introducing the EOTec 2104 Ethernet Ring Switch

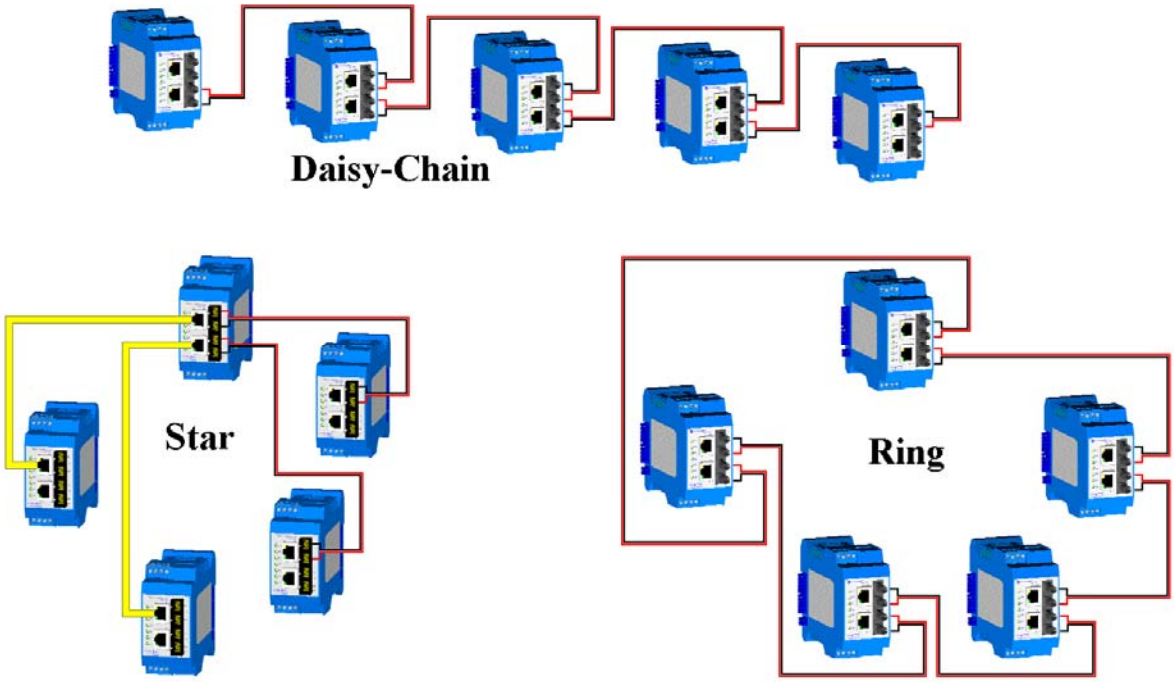



Fiber optic technology provides many advantages for industrial control applications. These include EMI/RFI immunity, the ability to run fiber optic cable through hazardous areas, and the ability to connect long distance communication links. Another benefit is the ability to achieve media redundancy without incurring the cost of duplicate hardware systems. By using the Weed Instrument Self-Healing Ring solution, a critical system can achieve uninterrupted communications, even in the event of a failure in the fiber optic communication lines.

The EOTec 2104 Ethernet Ring Switch is designed to give reliable operation in harsh industrial environments. The product includes software to control maintenance and monitoring of sophisticated networks. The ring switch can be used right out of the box without configuration; or through some simple configuration steps, you can enable some powerful managed switch features such as priority queuing for prioritizing your traffic, message rate filtering for broadcast storm protection, and port mirroring for diagnostics.

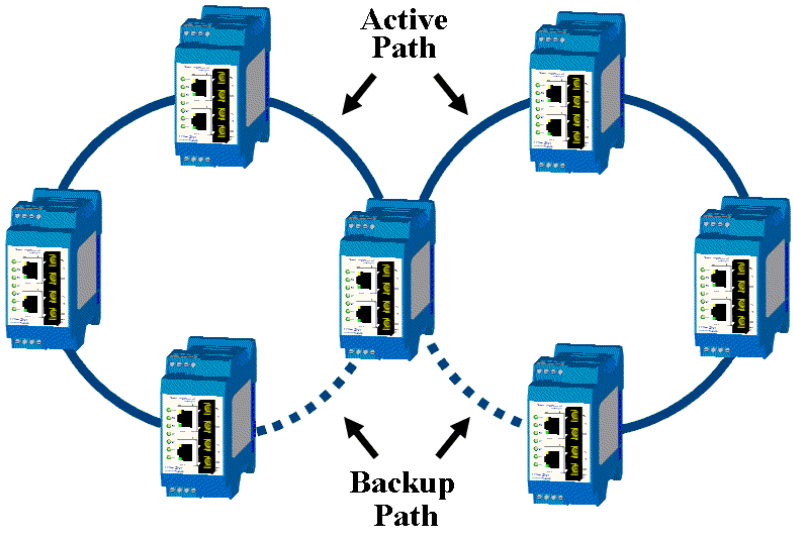
In the Weed Ring Switch, messages are intelligently routed for the sake of increasing the efficiency and reliability of your network. Unlike an Ethernet hub, the ring switch forwards packets to specific ports to reduce unnecessary traffic on network paths, thus optimizing network efficiency.

You can use the Weed Ring Switch in traditional star or daisy-chain topologies, or you can use a ring topology that can take advantage of network path redundancy.




Ring topology is important in path redundancy because no matter where in the ring that a path gets cut, all devices connected to a node in the ring can still communicate with each other. In the following diagram, if the active path between two switches is disabled, the backup path immediately takes over to maintain the integrity of your network.

**Important:** To ensure the highest rate of communication for your switch connection and minimize lost data due to collisions or bottlenecks always match port settings with the connected link partner. See Configuring the 2104 Ring Switch Ports section for more information.




**Do not use conventional switches and hubs in a ring topology.**

Conventional switches and hubs *cannot* be used in ring topologies because of broadcast storms. Broadcast storms can bring a network to a stop if conventional switches or hubs are being used in a ring topology because of broadcast message reproduction. Using Weed Ring Switches in the loop will prevent broadcast storms because they have the intelligence to detect loops and to assign the necessary ports to be in the backup (disabled) state. These backup ports are instantly enabled if the primary path in their respective ring fails.

# Feature Overview

The EOTec 2104 Ethernet Ring Switch supports both 10BaseT (10 Mbps) and 100BaseTX (100 Mbps) on its RJ45 ports. Each of these ports independently auto-senses the speed, allowing you to interface to either regular or fast Ethernet devices. All models also have 100BaseFX (100 Mbps) fiber optic ports. For more information, see Configuring the 2104 Ring Switch Ports.

Various EOTec 2104 models support maximum fiber optic cable lengths from 2 km to 60 km. Appendix B, *EOTec 2104 Product Series*, includes more information on the different models.

An EOTec 2104 Ethernet Ring Switch has all the networking capability of a typical unmanaged switch plus some advanced capability that you would find only in a managed switch, including ring functionality. Like an unmanaged switch, the Weed Ring Switch is *plug and play*, meaning that it can be used right out of the box without any user configuration. This includes the ring functionality, which is already pre-configured in the switch. This is suitable for most applications.

For advanced applications, you can use the EOTec 2104 Switch Tools (a Windows software utility) to enable some advanced capabilities such as priority queuing for prioritizing your traffic, message rate filtering for broadcast storm protection, and port mirroring for diagnostics.

**Important:** Only use Weed Ring Switches when connecting switches in a ring. Weed Ring Switches use a specialized high-speed ring algorithm that only they can recognize. Otherwise, these ring switches are fully IEEE 802.3 compatible.

# Optional Accessories

Contact your Weed sales representative to order any of these accessories.

- Port expansion modules

  Appendix B, *EOTec 2104 Product Series*, includes information on the port expansion modules and expansion modules, including their part numbers.

- Redundant power supplies

| Model | Input Power Requirements |
|---|---|
| 2A06 | 85 to 240 VAC, 50/60 Hz<br>85 to 140 VDC, 250 mA |
| 2A08 | 15 to 30 VDC @ 400 mA |
| 2A16 | 85 to 240 VAC, 50/60 Hz<br>85 to 140 VDC, 250 mA<br>Alarm relay output indicates loss of supply output. |

# Advanced Industrial Ethernet Capability

- **Message Rate Filtering (Broadcast Storm Protection)**

  Poorly configured applications and devices or malicious users can flood your network with broadcast packets that are forwarded to all ports and can quickly consume most of a network's bandwidth. The EOTec 2104 Ethernet Ring Switch protects against broadcast storms by limiting the quantity of broadcast and multicast messages. This protection is enabled by default.

- **Priority Queuing (Traffic Prioritization using QoS, CoS, ToS/DiffServ)**

  With priority queuing configured in the EOTec 2104 Ethernet Ring Switch, low-priority data will not interfere with your time-critical data again. Network traffic can be prioritized to achieve the performance that time-sensitive data demands. Refer to the EOTec 2104 Switch Tools on-line help for more information and details on configuring priority queuing.

- **Port Mirroring**

  This advanced diagnostic capability allows messages from one or more ports to be copied to another port. Then a port analyzer or *sniffer* program can be used to monitor the traffic without affecting the operation of the switch. Configure the Weed Ring Switch for port mirroring through the EOTec 2104 Switch Tools. See the on-line help for details.

**Important:** To ensure the highest rate of communication for your switch connection and minimize lost data due to collisions or bottlenecks always match port settings with the connected link partner. See Configuring the 2104 Ring Switch Ports section for more information.

# User-Friendly Configuration Tools

- **EOTec 2104 Switch Tools utility**

  For advanced applications, you can use the EOTec 2104 Switch Tools (Windows software utility) to enable some advanced capabilities such as priority queuing for prioritizing your traffic, message rate filtering for broadcast storm protection, and port mirroring for diagnostics. The utility features extensive online help, and is described in Chapter 3, *Introducing Switch Tools*.

- **Switch Status utility**

  The EOTec 2104 Switch Tools Status utility provides a view-only display of the current operating status of EOTec 2104 Ring Switches connected to the computer and running this software. Identification information of the ring switch, status of each Ethernet port, and the operating status of any rings that are in use are displayed. The operation of this utility is fully automatic, with the addressable Weed Ring Switches found automatically by a network search. All EOTec 2104 Ring Switches detected on your Ethernet network are displayed in this status window. For more information, refer to the EOTec 2104 Switch Status Utility section in Chapter 3, *Introducing Switch Tools*.

# 2

# EOTec 2104 Ring Switch Hardware

This chapter describes the EOTec 2104 Ethernet Ring Switch, which is designed to give reliable operation in harsh industrial environments.

## Designed for Industrial Applications

- -40 to +85 °C operating temperature range
- Redundant, dual DC power inputs
- IP 30, rugged high-strength case
- DIN-rail mounting ability
- Rate limiting to prevent unpredictable network status
- Port mirroring for online debugging
- Automatic recovery of connected device IP address
- Line-swap fast recovery

## EOTec 2104 Ring Switch Performance

These general specifications apply to the EOTec 2104 Ethernet Ring Switch. For complete details, refer to Appendix A, *Technical Specifications*.

| Specifications Summary | |
|---|---|
| Ports | 4 |
| Port types | 10/100BaseT(X) shielded RJ45;<br>100BaseFX (ST or SC connectors) |
| Ethernet switch type | Intelligent store and forward, plus some management capabilities |
| Ethernet protocols supported | All IEEE 802.3 |
| RJ45 operation | Auto-negotiation, Auto-crossover and Auto-polarity |
| Fiber operation | Multimode with distances up to 2 km, or single-mode with distances up to 15 km, 40 km, or 60 km, depending on the model. |

# EOTec 2104 Ring Switch Power and Alarm Connections

Weed Ring Switches can be powered from the same DC source that is used to power other Weed I/O devices. Weed Ring Switches are powered by +15 to +40 VDC. Power is applied to the bottom connector as shown in the illustration on page 8.

Alternatively, you can connect an EOTec Power Supply Module to the backplane of the EOTec 2104 Ethernet Ring Switch Module. The power supply module prevents possible down time resulting from power loss, and is available in several models from Weed Instrument.

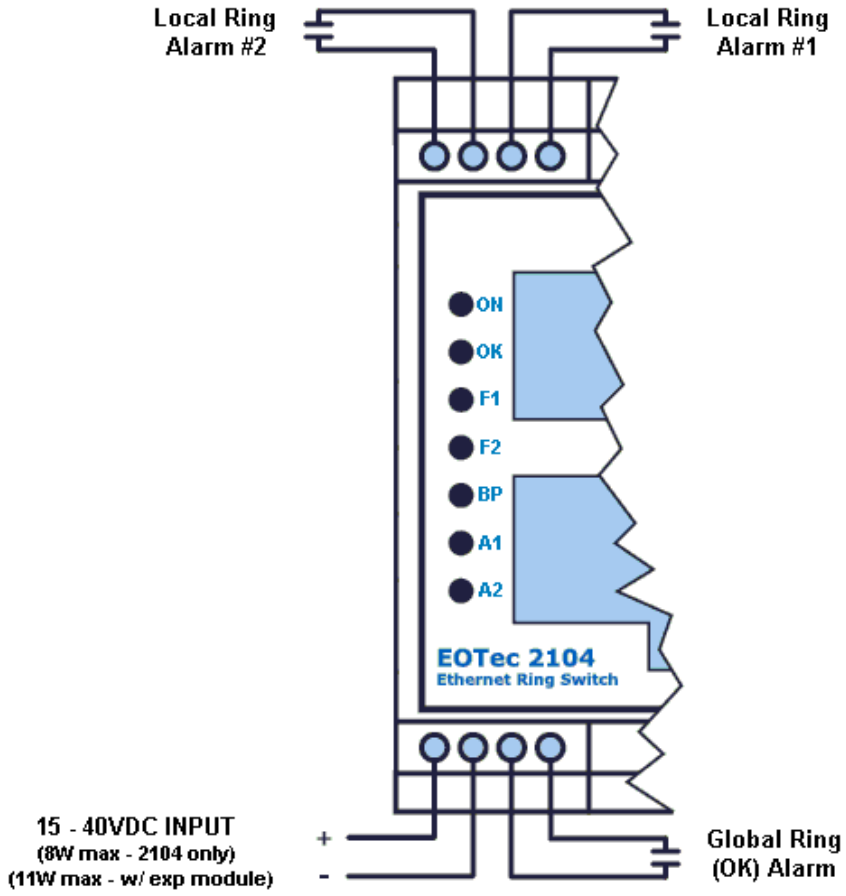
| Model | Input Power Requirements |
|---|---|
| 2A06 | 85 to 240 VAC, 50/60 Hz<br>85 to 140 VDC, 250 mA |
| 2A08 | 15 to 30 VDC @ 400 mA |
| 2A16 | 85 to 240 VAC, 50/60 Hz<br>85 to 140 VDC, 250 mA<br>Alarm relay output indicates loss of supply output. |

Weed Ring Switches have three relay outputs that can be used to signal an error to a PLC, PC or other supervisory devices. By default, these outputs are normally closed when power input is present and there are no ring errors. All outputs will open if power input fails. The Global Ring relay opens if a ring break is detected. The two Local Ring relays open when their respective ring ports lose a link.

# OK Output Alarm (Global Alarm Relay)

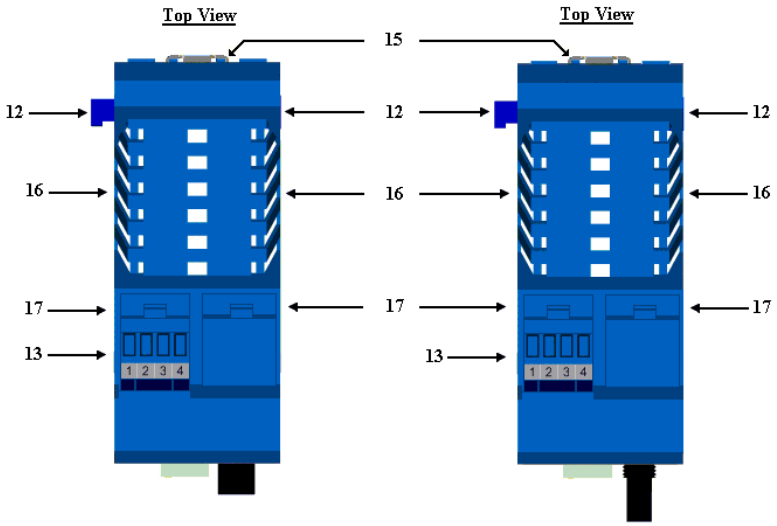
All EOTec 2104 Ethernet Ring Switch models have an **OK** output alarm.

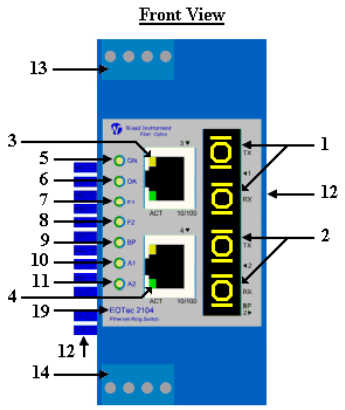
The **OK** output alarm normally is activated if any of the user-configurable alarm conditions occurs, such as a loss of primary DC power or a communication failure in the ring port(s). You can configure the functionality of this alarm using the EOTec 2104 Switch Tools utility.

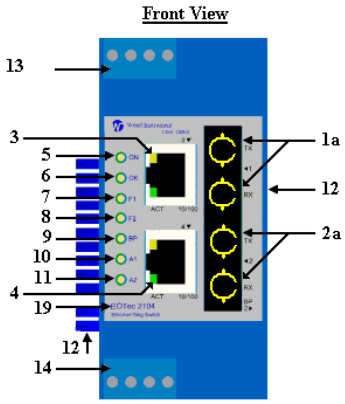


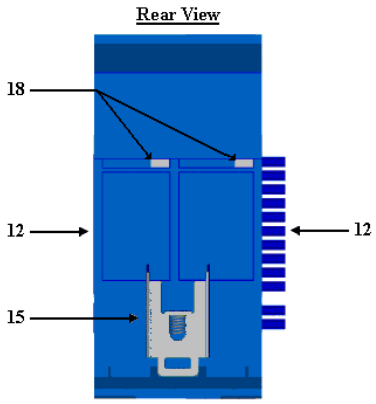
# Switch Layout

The Weed Ring Switch has communication LEDs for each port and a power LED. In addition, three LEDs (OK, A1 and A2) provide switch and network status.




1 Port 1 (Fiber) SC Connector
1a Port 1 (Fiber) ST Connector
2 Port 2 (Fiber) SC Connector
2a Port 2 (Fiber) ST Connector
3 Port 3 (Copper) RJ45 Connector
4 Port 4 (Copper) RJ45 Connector
5 ON LED
6 OK LED
7 F1 (Fiber 1) LED
8 F2 (Fiber 2)LED
9 BP (Backplane) LED
10 A1 (Alarm 1) LED
11 A2 (Alarm 2) LED
12 Backplane Connector
13 Connector for Local Relays (A1, A2)
14 Connector for Power & OK (Global) Relay
15 DIN Rail Clip
16 Ventilation Louvers
17 Cover Release Tabs
18 Chassis Ground Tabs
19 EOTec Model Number

# EOTec 2104 Ring Switch LEDs

This section describes the functionality of the LEDs on the EOTec 2104 Ethernet Ring Switch.

| LED | Function | Description |
|---|---|---|
| **ON** | **Power** | Power ON – On solid **green** when power is applied.<br>LED will turn off if the power supply fails. |
| **OK** | **Switch Status** | Global Ring Status – Indicates the operational status. |
| | **Solid Green** | **GRN**-ring OK – The ring has continuous ring integrity. No errors. |
| | **Solid Red** | Error – This switch has encountered a segment failure on any active rings where this switch is a member (Global Ring Alarm). |
| | **Blinking Red** | Long OFF, short **red** ON – If the **OK** LED is OFF for about 1.9 seconds and ON for 0.1 second, an internal error has occurred in the unit. Cycle power or reset the switch from the configuration utility to clear this error. |
| | **Blinking Green** | The **OK** LED can blink **green** at different rates. |
| | | Continuous rapid **green** blinking – To verify communication and target switch selection, you can request the switch to "wink" its **OK** LED to visually identify the unit. |
| | | Rapid **green** blinking, with a single short pause – Blinks rapidly for about 5 seconds and then pauses for about 1 second.<br>• On power-up<br>• When loading firmware<br>• When resetting the switch |
| **F1, F2** | **Fiber Ports** | Indicates status of the fiber optic port connections. |
| | **Solid Green** | ON-connected – A proper Ethernet connection (Link) exists between the port and another Ethernet device, but no communications activity is detected. |
| | **Blinking Green** | BLINK-activity – A proper Ethernet connection (Link) exists between the port and another Ethernet device, and there is communications activity. |
| | OFF Completely | A proper Ethernet connection (Link) does not exist between the port and another Ethernet device. |

| LED | Function | Description |
|---|---|---|
| **BP** | **Backplane** | Indicates status of the Ethernet backplane port connections. |
| | **Solid Green** | ON-connected – A proper Ethernet connection (Link) exists between the port and another Ethernet device, but no communications activity is detected. |
| | **Blinking Green** | BLINK-activity – A proper Ethernet connection (Link) exists between the port and another Ethernet device, and there is communications activity. |
| | OFF Completely | A proper Ethernet connection (Link) does not exist between the port and another Ethernet device. |
| **A1, A2** | **Ring Status** | Indicates the status of your local ring connections. |
| | **Solid Green** | **GRN**-normal – Its associated ring port is active and has a good link status. |
| | **Solid Red** | When both A1 and A2 are solid **red**, both ring ports have lost communication and the ring switch will not be able to communicate with other switches in the ring. |
| | **Blinking Red** | BLINK **RED**-ring port failure – A break has been discovered for its associated ring port. The break is at this location. Diagnostically speaking; in simple rings, the segment with the problem will be between the two switches with their ring port LEDs in the blink state. Also, you can ascertain the general location of where the segment error has occurred with a HMI, a master controller, or some other MODBUS Master through MODBUS/UDP polling. |
| | OFF Completely | The switch has not been configured for any rings. |
| **ACT/LNK** | **Copper Ports** | Each RJ45 copper port has Activity and Link LEDs. |
| | **Green LED** | Off: No link detected.<br>On: Link detected but no activity.<br>Flash: Activity at either 10 Mbps or 100 Mbps. |
| | **Yellow LED** | Off: Only 10 Mbps (10BaseT) connection is detected or no link detected.<br>On: 100 Mbps (100BaseTX) connection is detected. |

# Ethernet and Fiber Optic Wiring

Weed Ring Switches provide Ethernet and fiber connections to devices on the factory floor through star, daisy-chain, or ring topology. When wiring Weed Ring Switches in a ring topology, it is important to use only Weed Ring Switches for each node in the ring. With proper ring wiring, all nodes in the ring can maintain the same data connectivity should a path in the ring be cut.

## *RJ45 Wiring Guidelines*

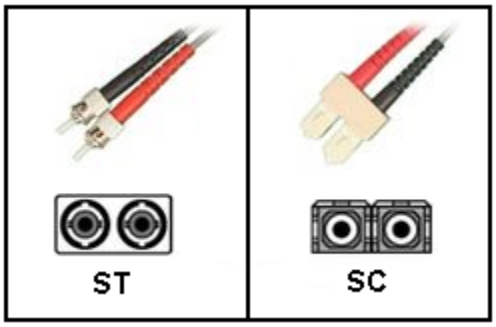
Use data-quality (not voice-quality) twisted-pair cable rated category 5 or higher with standard RJ45 connectors. For best performance, use shielded cable. Straight-through or crossover category 5 cable can be used regardless of the type of device connected to the EOTec 2104 Ethernet Ring Switch. This is because the Weed Ring Switch supports auto-MDI/MDIX-crossover.

## *Ethernet Fiber Wiring Guidelines*

The EOTec 2104 Ethernet Ring Switch also has a pair of multimode or single-mode fiber ports.

- For multimode, the maximum segment length is 2 km.
- Single-mode models can support maximum segment lengths of 15 km, 40 km, or 60 km.

Each fiber optic port on the switch is comprised of a pair of ST or SC connectors. For each fiber port there is a Transmit (TX) and Receive (RX) signal. When making your fiber optic connections, ensure that the Transmit (TX) port of the first switch connects to the Receive (RX) port of the second device, and the RX port of the first switch connects to the TX port of the second device. Fiber optic cables with color-coded ST or SC connectors are recommended because it is easier to ensure you connect one end to TX and the other end to RX.




The **ACT/LNK** LED is ON solid when you have made a proper connection.

# 3

# Introducing Switch Tools

Because the Weed Ring Switch is ready to use right out of the box, many users will not need to use the EOTec 2104 Switch Tools configuration software. By default, ports 1 and 2 are preconfigured as ring ports. If the default settings are suitable for your system, you can skip this chapter entirely.

For those of you who are ready to become power users of this ring switch through custom port settings, ring configurations, message filtering, port mirroring, and priority queuing, read on!

By using the EOTec 2104 Switch Tools utility, you can customize each Weed Ring Switch to fit your application and take advantage of the built-in capabilities listed below.

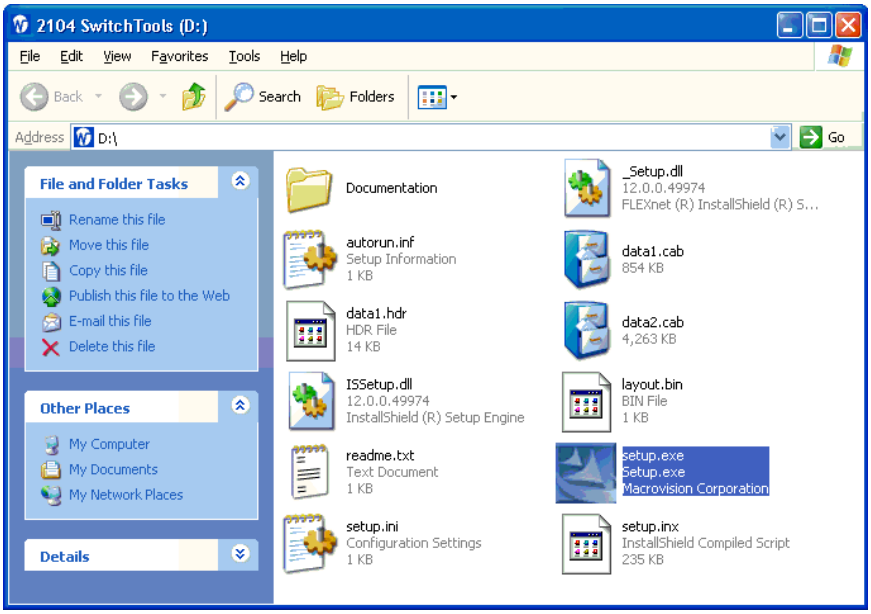
| | |
|---|---|
| **Administration** | You can enable or disable individual ports. Each port can be set to auto-negotiate Ethernet speed or the port can be assigned a fixed configuration that is compatible with the device(s) that will be connected to the port. |
| **Ring Configuration** | You have the ability to configure zero, one or two rings on a Weed Ring Switch. |
| **Priorities** | You can configure how the Weed Ring Switch assigns, removes, and handles message priority for each port. |
| **Port Mirroring** | You can configure port mirroring, where diagnostic messages from one or more ports can be copied to a single port for monitoring purposes. |
| **Modbus Monitoring** | Use Modbus Ethernet commands to monitor communication and DC power status within each Weed Ring Switch. |

# Loading the EOTec 2104 Software

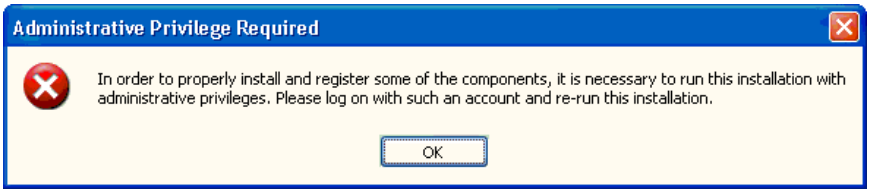
This section describes the process of installing the contents of your EOTec 2104 CD. The CD contains the following items:

- EOTec 2104 Switch Tools utility
- EOTec 2104 Switch Status utility
- *EOTec 2104 User Manual* (PDF)
- *EOTec 2104 Installation Guide* (PDF)

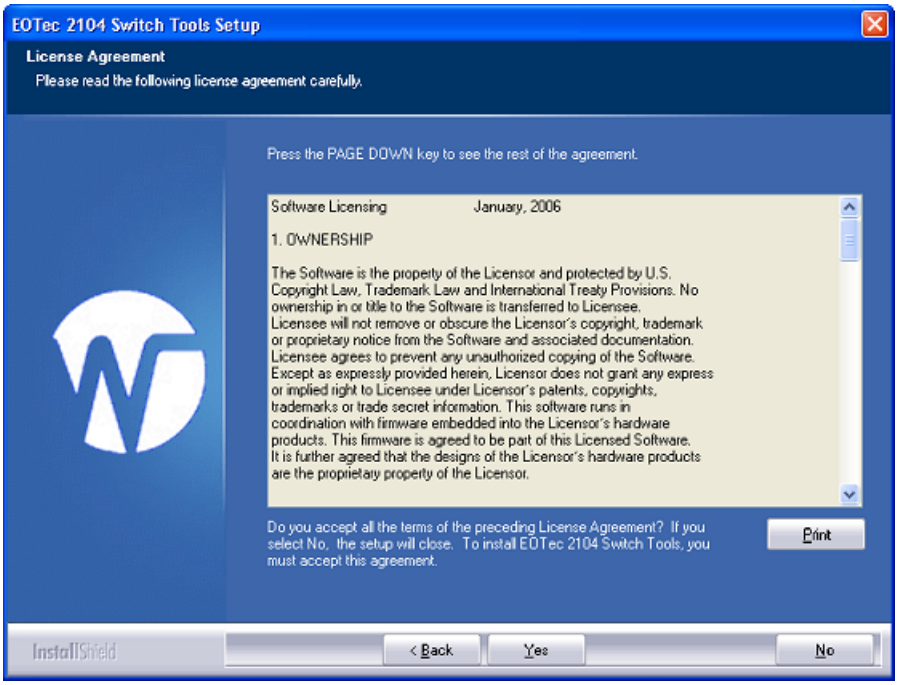
1. Launch the **Setup.exe** file on the CD to begin the installation, as shown below.



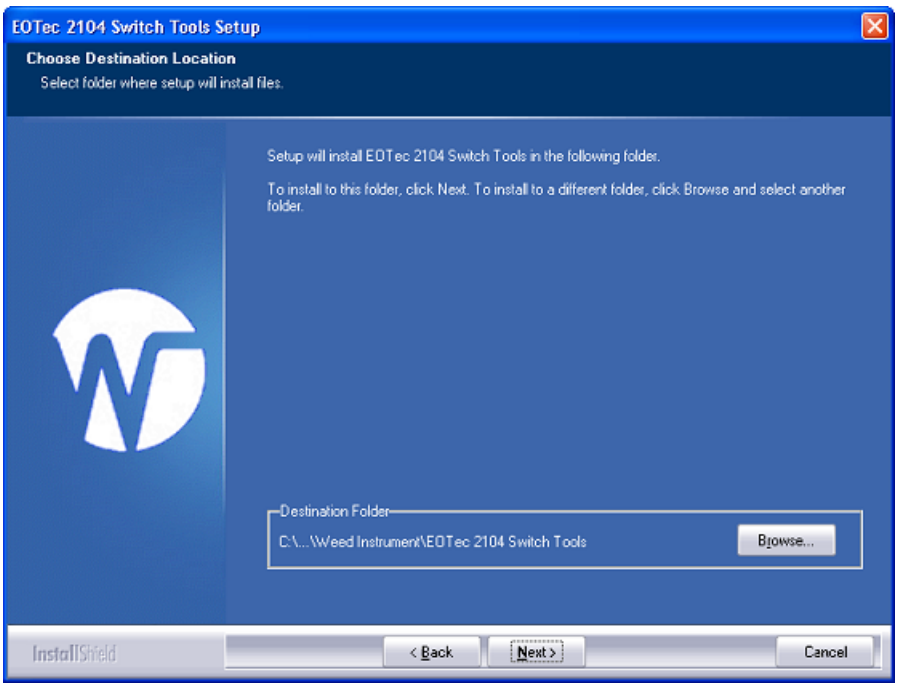

2. Administrative privileges are required for proper installation.



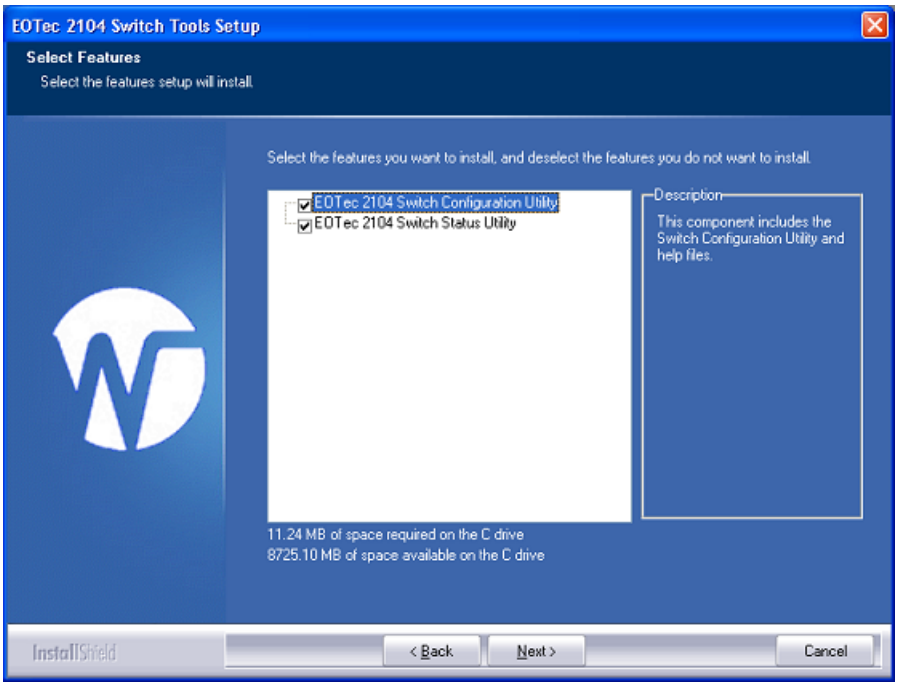
3. Setup will close if you do not accept the license agreement. Click **Yes** to continue. Notice you can print the agreement from this window as well.




4. Browse to select a destination where Setup should install the files, or accept the default directory. Click **Next >**.



5. The user can choose whether to install all the software utilities. You can install both, one, or neither of the utilities.



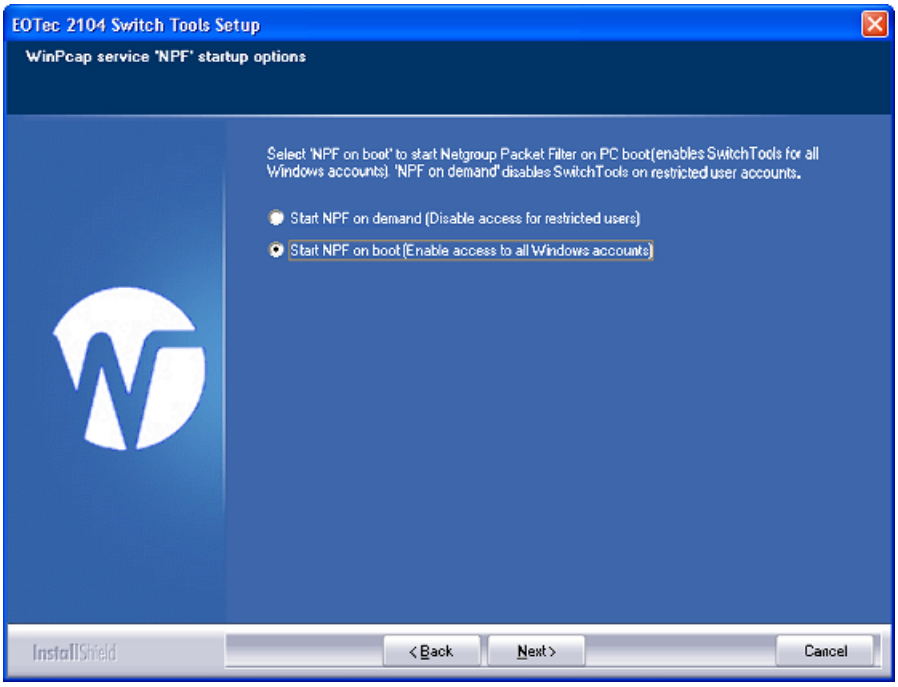

**EOTec 2104 Switch Configuration Utility** is the tool for configuring the 2104 Ring Switches. It includes online help to guide you through the configuration process. Install this utility if you want to give users at this station the ability to modify the default settings and unlock the advanced capabilities of the EOTec 2104 Ring Switch.

**EOTec 2104 Switch Status Utility** displays the status of all 2104 Switches detected on your network. This is a view-only utility that allows a user on this station to evaluate the network.

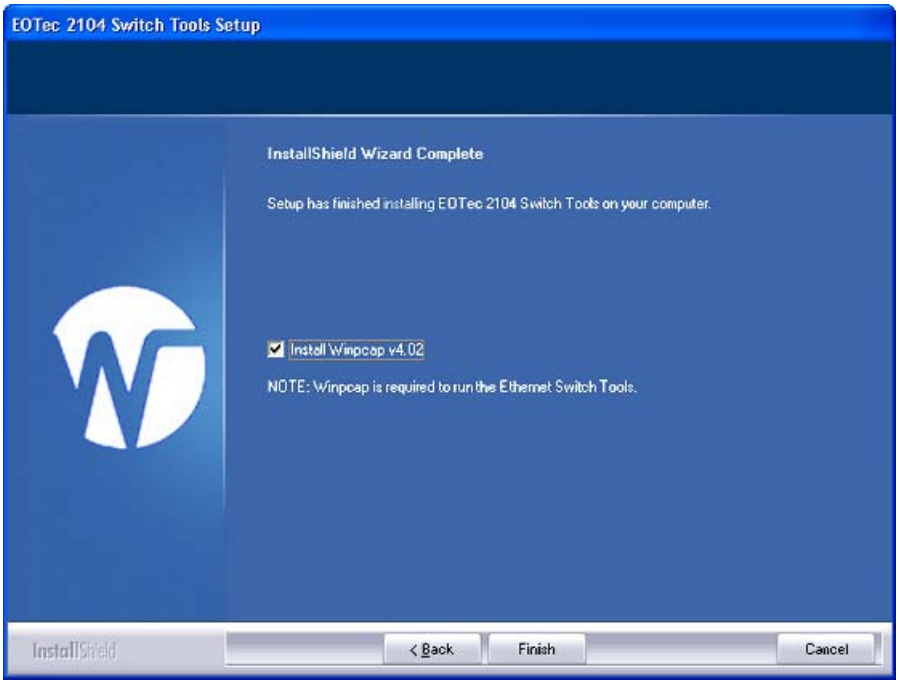
You can install the EOTec 2104 Switch Status utility (ringstat.exe) with or independently of the EOTec 2104 Switch Tools program. Installing only the EOTec 2104 Switch Status utility prevents a user from making changes to the configuration in any 2104 Switches. This is the option you should use to set up a computer as a monitoring-only station.

Refer to the EOTec 2104 Switch Status Utility section, later in this chapter, for more information about using this utility.

6. An added feature of SwitchTools v1.7 is to support users with Windows Limited Use or Restricted accounts. When using a PC with more than one account a user may want to restrict SwitchTools access by installing a configuration to start NPF on demand. This will prevent any guest or limited use account from searching for and editing network configurations. Otherwise, choose start NPF on boot. See NPF for more information.



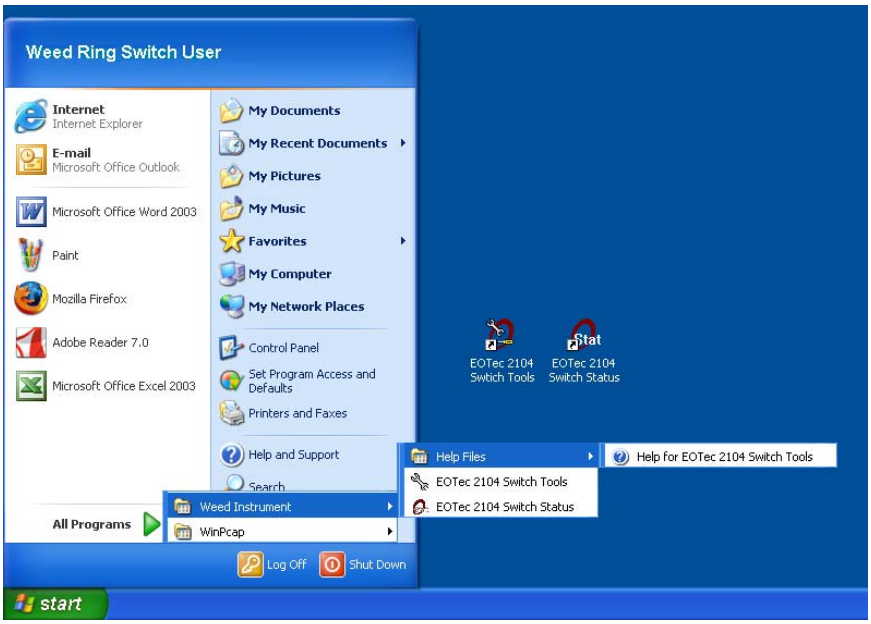

7. The Switch Tools utilities use raw Ethernet sockets. If your Windows system does not support raw sockets, Switch Tools can accommodate for this by installing WinPcap on your computer. If this is the case, ensure the box is checked to **Install WinPcap v4.0.2** when installing EOTec 2104 Switch Tools. Click **Finish** to complete the installation.



8. When software is installed on your computer you will be able to launch the software utilities in any of the following ways:

   Icons for EOTec 2104 Switch Tools and EOTec 2104 Switch Status appear on your desktop.

   If you accepted the default location for the installation, you also can find these tools by selecting **Weed Instrument** from your **Start → All Programs** directory. Notice you can also select the online help separately from this location.

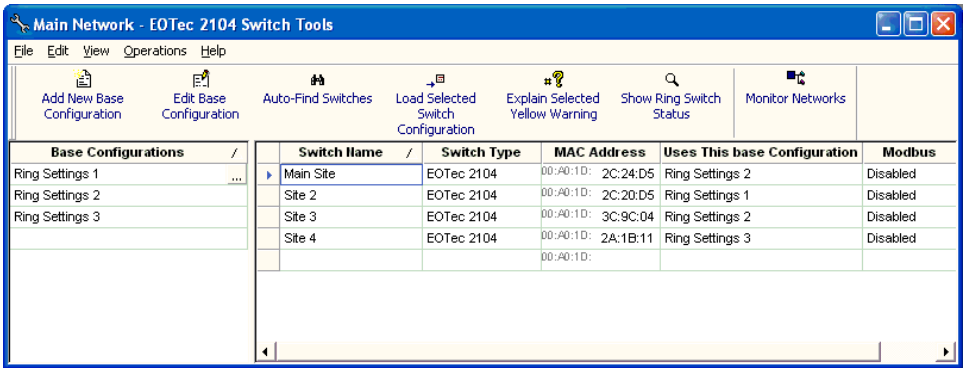


# Getting Started with EOTec 2104 Switch Tools

Begin by creating and saving one or more base configurations within a single project file. A base configuration contains settings that control the advanced capabilities in each EOTec 2104 Ethernet Ring Switch.

Each base configuration you create and save in the project folder can be assigned to any number of ring switches. You should create a new base configuration each time you have a ring switch or group of ring switches that needs to have different base configuration settings than other ring switches in the same project file.

For help creating base configurations for your project, refer to Using the Base Configuration Windows, later in this chapter.




## *Switch Configuration Using the Auto-Find Feature*

After you create your base configuration(s), connect your EOTec 2104 Ring Switches to your Ethernet network. The EOTec 2104 Switch Tools utility can automatically detect all Weed Ring Switches on the network when you click the **Auto-Find Switches** button. Run the **Auto-Find Switches** feature to auto-detect these ring switches and then add them to your project, as described in the Find All Switches Window section, later in this chapter.

## *Switch Configuration Using the Manual Method*

As an alternative to the Auto-Find method above, you can also manually enter EOTec 2104 Ethernet Ring Switches into the project:

1. In the EOTec 2104 Switch Tools main window, click in a blank line and enter a **Switch Name** (up to 32 characters).
2. In the **Switch Type** field, click to access the drop-down list of switch types and select the appropriate model.
3. In the **MAC Address** field, enter the last six digits of the MAC address, which you can find on the label of your Weed Ring Switch. There should be a colon character after the second and fourth characters. For example, 2E:4D:3C.

To complete each EOTec 2104 Ethernet Ring Switch configuration, click in the **Uses this Base Configuration** drop-down list for each ring switch and select a base configuration to use for that switch. If you want to enable Modbus monitoring, click in the **Modbus** field. The Modbus Options window appears. Enter a Modbus station number, IP address, subnet mask, and default gateway as appropriate.

Refer to the Monitoring the Status of EOTec 2104 Ethernet Ring Switches section in Chapter 5, *Advanced Features of Switch Tools* for more information about Modbus monitoring.

The final step is to load each Weed Ring Switch with its configuration. Highlight the ring switch to be loaded and then select the **Load Selected Switch Configuration** command.

**Note**: A direct Ethernet connection is all that is required to load a configuration into your Weed Ring Switch—no serial port or IP address is needed.

## *Toolbar Buttons*

| Toolbar Button | Description |
|---|---|
| **Add New Base Configuration**<br><br>**Edit Base Configuration** | These buttons launch a Wizard to lead you through the base configuration process. When editing an existing base configuration, first select the configuration to edit listed under **Base Configurations**. To find out more details about the base configuration process, refer to Using the Base Configuration Windows, later in this chapter. |
| **Auto-Find Switches** | This button activates a self-seeking feature that finds all EOTec 2104 Ring Switches on the network and displays them in the Find All Switches window, where you can selectively add them to your project. |
| **Load Selected Switch Configuration** | Click this button to load a switch configuration into the selected Weed Ring Switch. For more details, refer to Loading a Configuration into the Ring Switch, later in this chapter. |
| **Explain Selected Yellow Warning** | Should there be any errors made during configuration, the cell highlighted yellow indicates the location of the error. Select that cell and then click this button to find out how to resolve the problem. |
| **Show Ring Switch Status** | Click this button to open the Switch Status window, which displays ring, port, DC power and OK output status for the selected Weed Ring Switch. |
| **Monitor Networks** | Click this button to open the Network Monitor window, which displays switch name, type, MAC address, firmware version, and **OK** LED status of all ring switches found on your network. |

## *Menu Commands*

| File Menu | |
|---|---|
| **Command** | **Description** |
| **New** | Starts a new project (no predefined switch configurations and loading schemes). |
| **Open…** | Opens a saved EOTec 2104 Switch Tools project (project file ending with .6sw). |
| **Save** | Saves or resaves the current project. |
| **Save As…** | Saves the current project under a different project file name. |
| **Output to File** | Copies your project file details to a comma-separated variable (.csv) file. |
| **Auto-Open Last File** | When the EOTec 2104 Switch Tools utility starts, it automatically loads the last project file that was opened with this utility. |
| **Exit** | Closes the EOTec 2104 Switch Tools utility. |
| **Note**: For your convenience, the EOTec 2104 Switch Tools utility maintains a list of the most recent project files that were opened. Click on any of the files listed at the bottom of the **File** menu to easily jump between projects. | |

| Edit Menu | |
|---|---|
| **Command** | **Description** |
| **Add New Base Configuration…** | Launches a Wizard to lead you through the process of creating a base configuration. |
| **Edit Base Configuration…** | Opens the selected base configuration so you can make adjustments to it. |
| **Delete Switch Configuration** | Removes the selected base configuration from the current project. |
| **Copy Switch Configuration…** | Copies the selected base configuration to another project file. For more details, refer to the Copying a Base Configuration section, in Chapter 5, *Advanced Features of Switch Tools*. |
| **Delete Switch** | Removes the selected ring switch from the current project. |

| View Menu | |
|---|---|
| **Command** | **Description** |
| **Toolbar** | Shows or hides the toolbar. The toolbar contains shortcuts for creating and editing configurations, auto-finding ring switches, and loading a configuration into a ring switch. |

| Operations Menu | |
|---|---|
| **Command** | **Description** |
| **Auto-Find Switches** | Activates a search for all EOTec 2104 Ring Switches on the Ethernet network and displays the results in the Find All Switches window. |
| **Load Selected Switch Configuration** | Loads the currently selected ring switch. |
| **Wink** | Flashes the **OK** LED of the currently selected ring switch for identification purposes. |
| **Show Switch Status** | Displays the switch name, switch type, MAC address and firmware revision as read from the selected ring switch. Refer to the EOTec 2104 Switch Status Utility section. |
| **Advanced** | |
| **Update Ring Switch Firmware** | Loads firmware into the currently selected ring switch. See the Updating Weed Ring Switch Firmware section. |
| **Recover Ring Switch** | Allows you to re-establish communication with an EOTec 2104 Ring Switch whose settings are unknown or incorrect. |

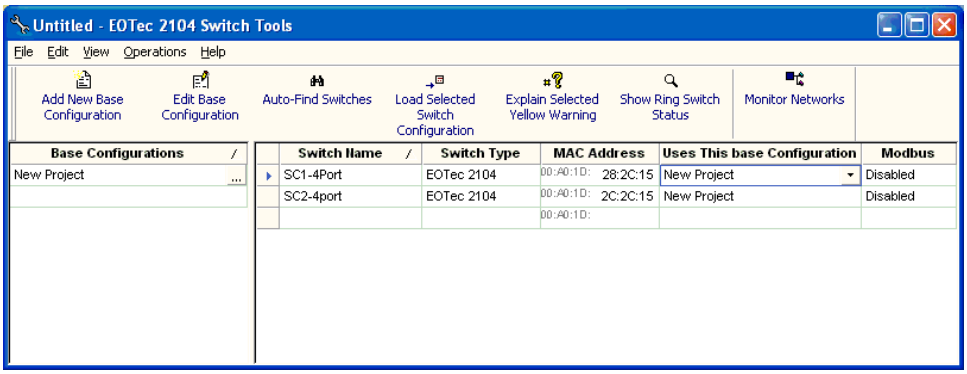
| Help Menu | |
|---|---|
| **Command** | **Description** |
| **Index** | Displays the EOTec 2104 Switch Tools Help. |
| **Product Support** | Displays information about where to find product support resources. |
| **Getting Started** | Displays the Getting Started with EOTec 2104 Switch Tools topic. |
| **Software License** | Displays the software license agreement for this program. |
| **About setswitch** | Displays the version of EOTec 2104 Switch Tools you are using. |
| **Application Tips** | Displays information on connecting and using EOTec 2104 Ring Switches in your system. |

# Creating and Saving a New Base Configuration

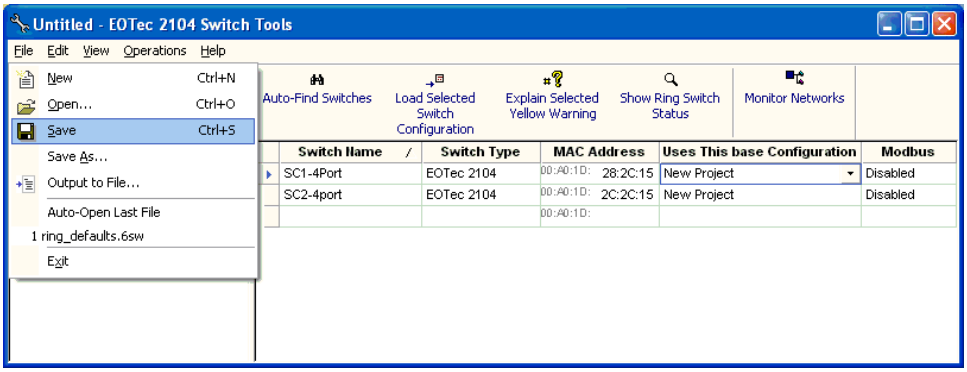
You can save a switch configuration as a project file and use it to configure multiple switches. You also can easily edit a saved configuration and save it as a separate project file. Weed provides a default project file in your projects folder (created during install) that offers several ring configurations to help you get started. Or you can create your own configurations by simply following the directions below.

When creating a new base configuration, use the **Save** command to keep this project file for future use. To use this time-saving feature:

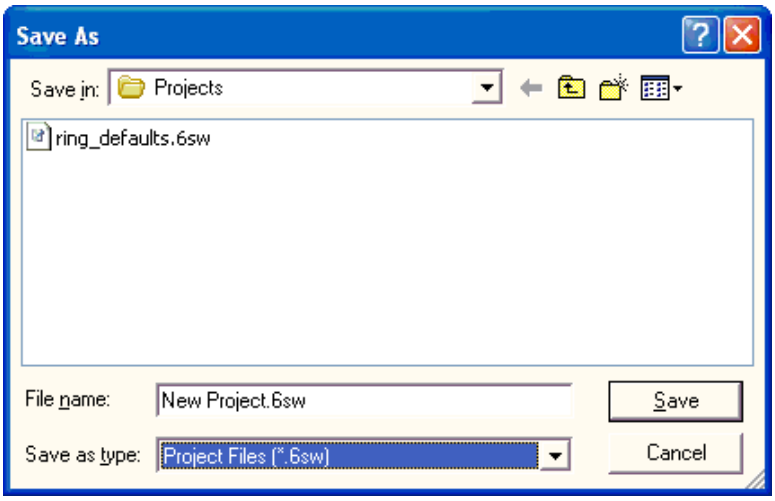
1. Create a base configuration that you wish to save by using the base configuration windows, as described later in this chapter.
2. Use **Auto-Find Switches** to easily find and add switches to your project.



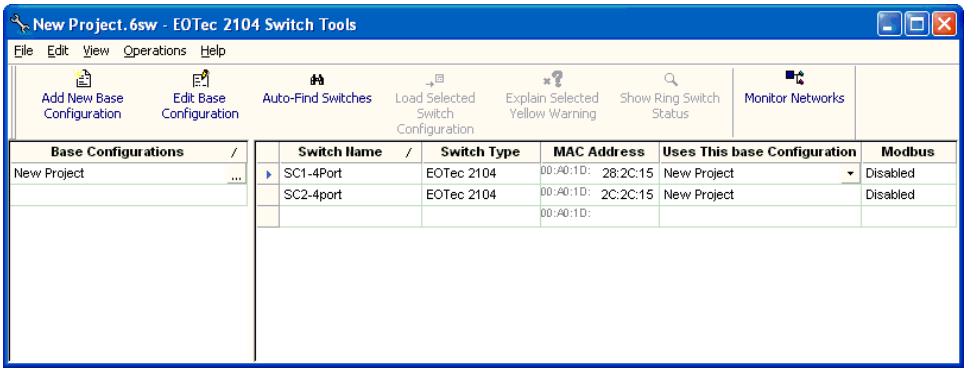

3. Select **Save** from the drop-down **File** menu.




4. Give this new base configuration a name.
5. Click **Save** to add this new configuration to the Projects Folder.

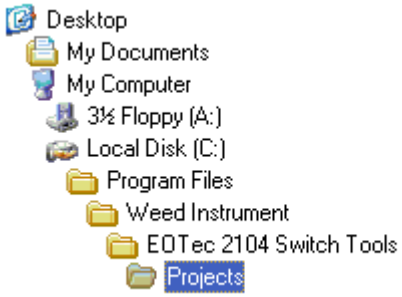



6. The project name will now appear in the title bar of the Switch Tools window.



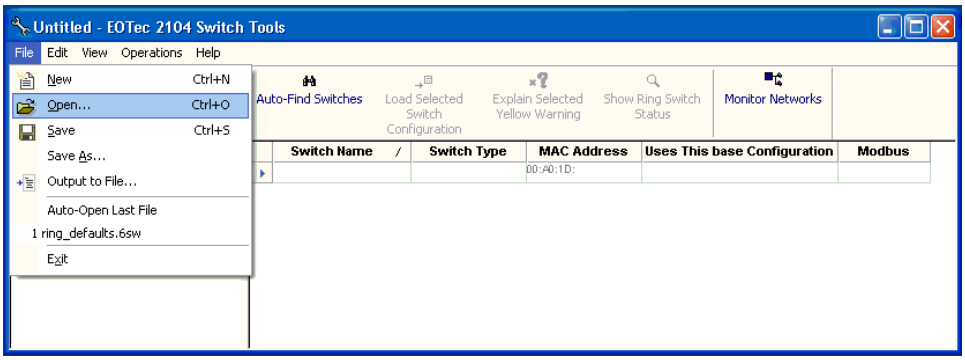

# Default Project File

During the installation on the EOTec 2104 Switch Tools, Weed created a projects folder for you and provided a default project file. If you did not change the default path during installation, the following path shows where you can find your default project file.

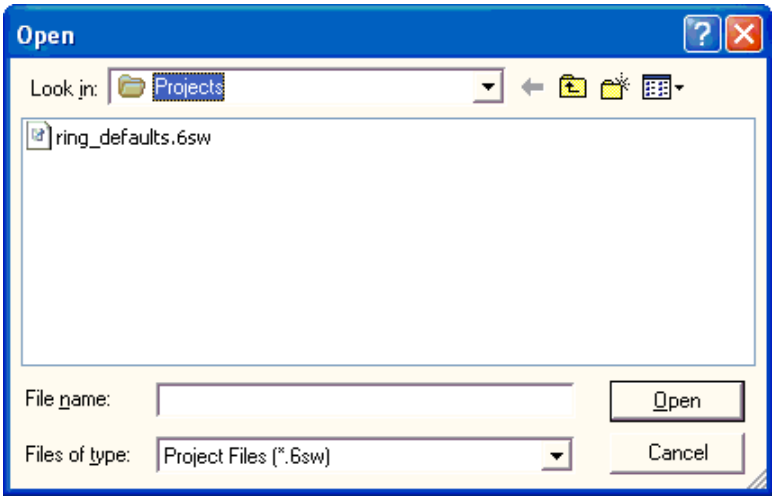



The Default Project File (ring_defaults.6sw) offers several ring configurations to help you get started. To quickly begin follow these steps:

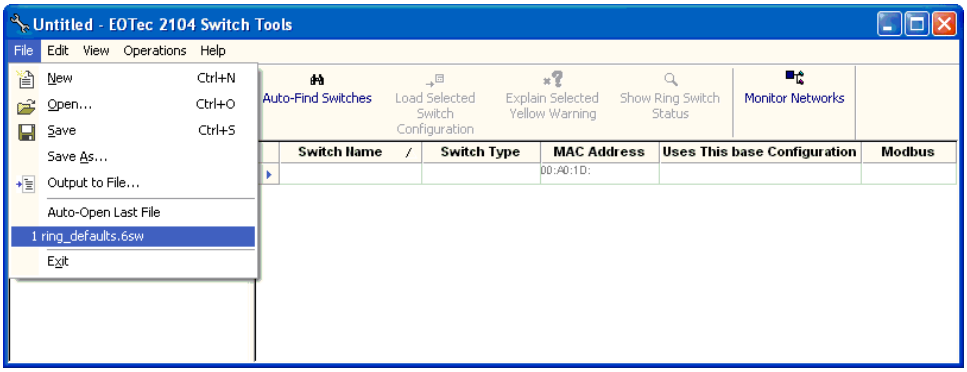
1. From the **File** menu, select **Open**. This opens your project folder, where you can select the default project file.



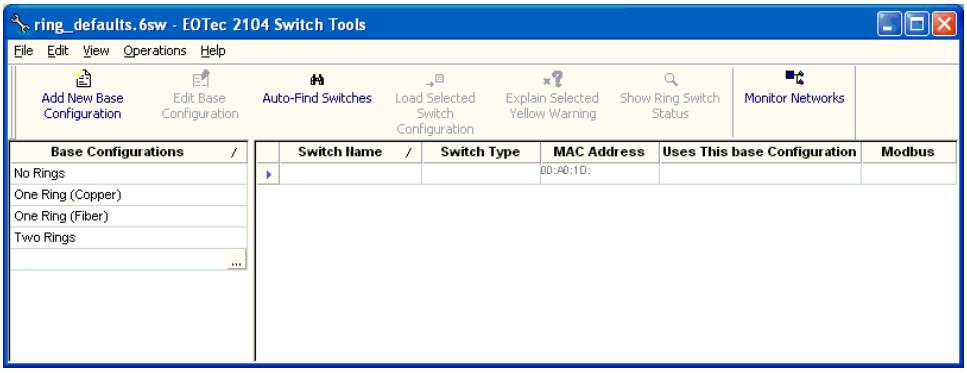

2. Select the file **ring_defaults.6sw** to highlight it and click **Open**. The default project is loaded into Switch Tools.



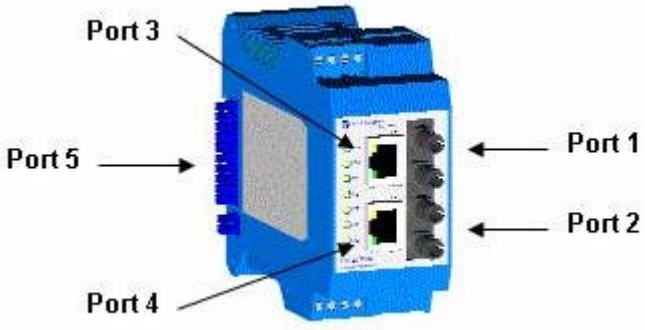

Alternatively, you can select ring_defaults.6sw from the list of recently opened files. This automatically loads the default file.




3. Once the default file is loaded, select the appropriate Base Configuration from the left-side menu that best matches your desired configuration. Clicking on this selection opens the base configuration windows, where you can make any other necessary configuration changes.



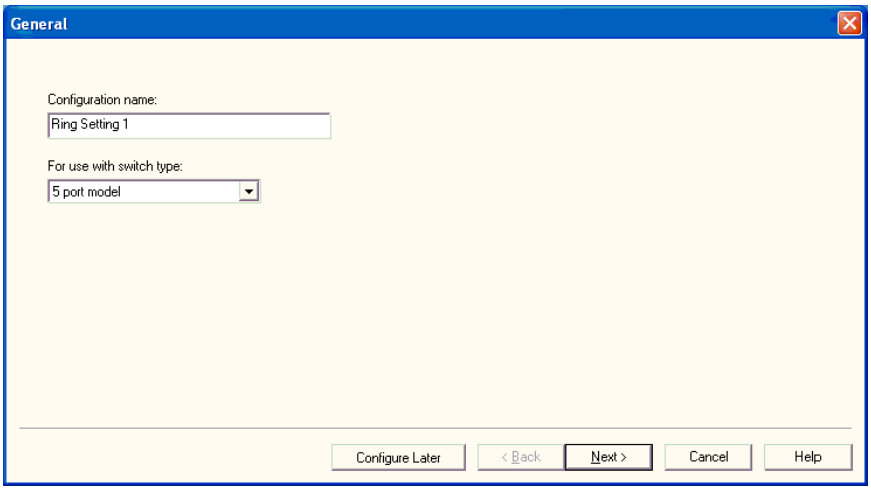

4. Remember that this switch has five ports, but Port 5 can only be used to plug into an expansion module (as shown below).



# Using the Base Configuration Windows

Use the Switch Configuration window to create base configurations for EOTec Ring Switches. A project file can contain one or more base configurations. Any given base configuration may be loaded into any number of Weed Ring Switches.

Click **Add New Base Configuration** from the toolbar to get started.

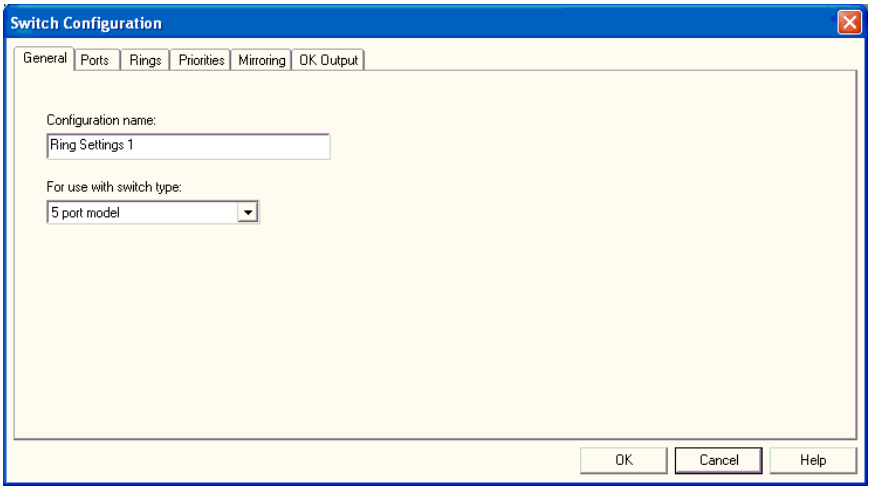



**Tip**: If you want to start out by naming all of your base configurations before doing anything else, just click **Configure Later** after entering each name in the Configuration name box. The names will appear in the Base Configurations column on the main window. Then, when you are ready to edit an existing configuration, select its name from the Base Configurations column and click **Edit Base Configuration**.

The Switch Configuration window has a series of pages (tabs) to help you create unique base configurations. The following table lists what you can do on each page.

| | |
|---|---|
| **General** | Enter a name for the configuration, and define which model of EOTec 2104 Ring Switches may accept the configuration. |
| **Ports** | Enable / disable individual ports, select automatic or fixed negotiation, and define the negotiation type (if fixed) to use for each port. |
| **Rings** | Enable / disable rings, and define which ports constitute each ring. |
| **Priorities** | Configure how the EOTec 2104 Ring Switch assigns, removes, and handles message priority. |
| **Mirroring** | Configure port mirroring, where diagnostic messages from one or more ports can be copied to a single monitoring port. |
| **OK Output** | Configure the functionality of the **OK** LED on the face of the switch. |

## *Switch Configuration Window – General Page*

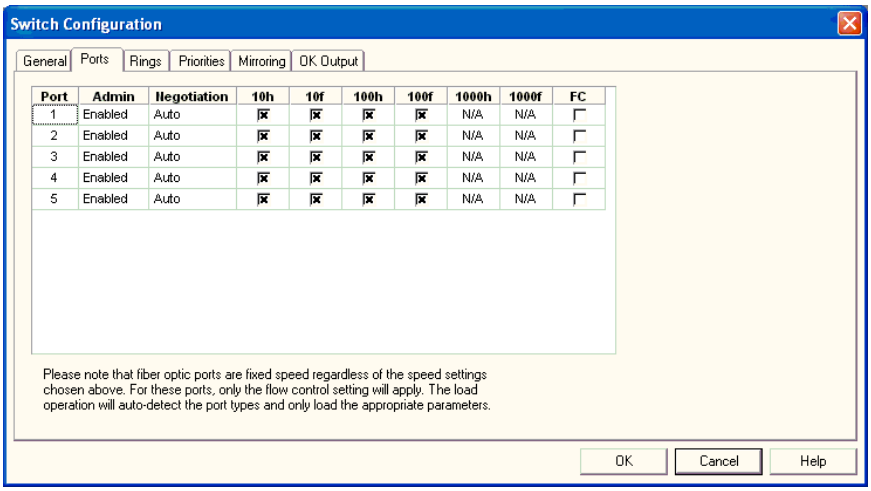



Enter a name for the new base configuration. The name can have a maximum of 32 characters, including spaces.

The base configuration is restricted for use with exclusively 5-port Weed Ring Switches.

**Note**: All EOTec 2104 ring switches have four ports (two copper and two fiber) and an additional Ethernet backplane port that attaches on the side to other Weed modules near the back of each unit.

## *Switch Configuration Window – Ports Page*




## Configuring the 2104 Ring Switch Ports

EOTec 2104 Ethernet Ring Switches support both 10BaseT and 100BaseTX technology. The EOTec 2104 also supports fiber optics 100BaseFX. The Weed Ring Switch comes with a default configuration that should allow you to connect other Ethernet devices to its Ethernet ports. The Weed Ring Switch will auto-negotiate the settings for you. If necessary, you can manually configure the settings for a port to a fixed, predetermined state (or a restricted set of the possible modes).

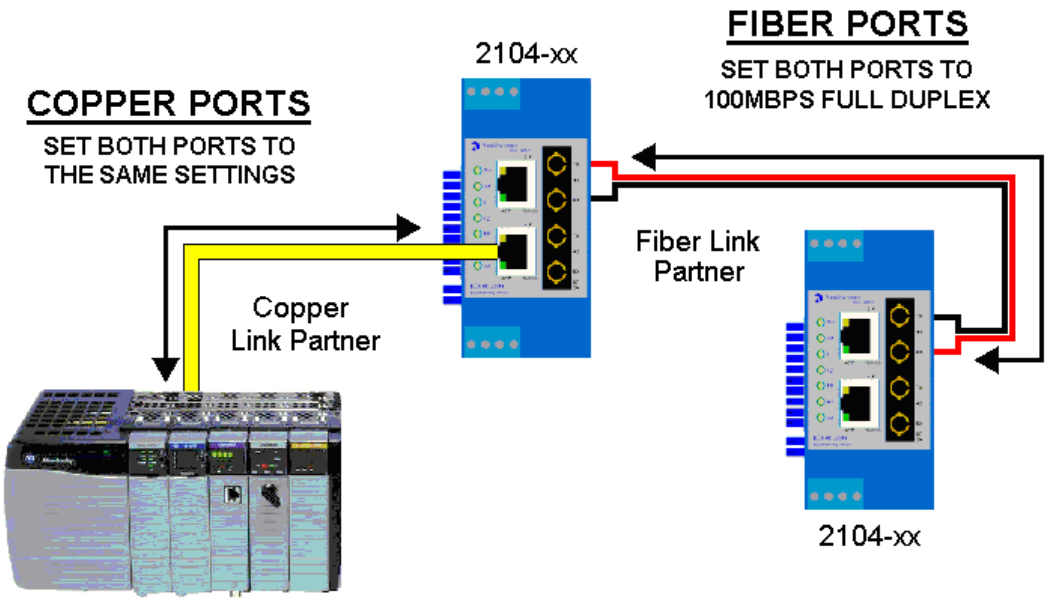
### Matching Link Partner Port Settings

When configuring the ports on an EOTec 2104 Ring Switch it is essential to take into consideration the port settings of the link partner connected to each port. It is important that the baud and duplex modes for each 2104 Ring Switch be set accordingly otherwise data loss may occur. Each of the 2104's RJ45 port settings are dependant on the link partner's capabilities and should be considered when setting up your 2014 Ring Switch. Identical port settings should always be used for both the 2104 and its link partner to prevent data loss and ensure highest bandwidth.

When an Ethernet port is set to auto-negotiate, it will send its communications capabilities to its link partner by advertising it's highest baud rate and duplex mode settings. However, when a port is fixed to a specific baud rate, it only advertises its baud rate and not its duplex mode. Therefore, its auto-negotiating link partner must assume the lowest mode to ensure good communications and sets communication for half duplex; even if the link partner is set to full duplex.

When a 2104 Ring Switch and its link partner have different settings, data loss may occur. For example, if the 2104 is forced to 100Mbps Full Duplex and its link partner is set to auto-negotiate, then the link partner will auto-negotiate to 100Mbps Half Duplex. This results in collisions and dropped packets since the auto-negotiate link partner must assume half duplex mode and causes a communication bottleneck.

In situations where link partners cannot use the auto-negotiate feature, a specific baud and duplex mode must be user selected for each port on the 2104. To avoid a mismatch in link partner communication, be sure to match both baud rate and duplex modes ports settings of the port connected. A reliable communication link will occur when port settings are matched.



### Fiber Ports

One of the main reasons for selecting a fiber solution is its high bandwidth capabilities. For best fiber performance, always set the fiber ports of the EOTec 2104 and its link partner to the highest setting; 100Mbps full-duplex. This will ensure the highest rate of communication for your switch connection and minimize lost data due to collisions or bottlenecks.

### Copper Ports

Matching the baud and duplex modes on copper ports (3 and 4) with the link partner is also required, otherwise data loss may occur. Each of the 2104's RJ45 port settings is dependant on the link partner's capabilities and should be set accordingly. Identical port settings should be used for both the 2104 and its link partner. An auto-negotiation setting will allow any 2104 and its link partner to negotiate the best possible link speed and duplex setting.

| Copper Link Partner Port Settings | | |
|---|---|---|
| **Level** | **Link Partner** | **2104-xx** |
| 1 | Auto-Negotiate | Auto-Negotiate |
| 2 | 100Mbps Full Duplex | 100Mbps Full Duplex |
| 3 | 100Mbps Half Duplex | 100Mbps Half Duplex |
| 4 | 10Mbps Full Duplex | 10Mbps Full Duplex |
| 5 | 10Mbps Half Duplex | 10Mbps Half Duplex |

In situations where link partners cannot use the auto-negotiate feature, a specific baud and duplex can be user selected for a particular port on the 2104 Ring Switch. A reliable communications link will occur when port settings are matched. The following order of preference for copper port settings is provided to ensure the user the highest level of bandwidth with error free communication:

**Note:** The 2104's backplane (port 5) can only be connected and used with other EOTec 2104 devices so this port should always be set to "Auto-Negotiate".

## The Port Configuration Interface

### Admin

Ports can be enabled or disabled in the Weed Ring Switch. Ports that are disabled are virtually nonexistent (not visible in terms of switch operation). Choose to enable or disable a port by selecting **Enabled** or **Disabled**, respectively.

### Negotiation

All copper ports in the 2104 Ring Switch are capable of auto-negotiation such that the fastest bandwidth is selected. By default, all ports in the Switch are set to auto-negotiate. To reduce setup time, new 2104 switches can be easily connected together using the **Auto** setting. However, when adding a new switch into an existing network be sure to maintain matched link partner settings. For more information, see Configuring the 2104 Ring Switch Ports.

All fiber ports in the Weed Ring Switch support 100 Mbps with full duplex only, and therefore need no configuration.

### Speed/Duplex/Flow Control

The Weed Ring Switch accepts several local area network Ethernet standards. The first standard, 10BaseT, runs 10 Mbps with twisted-pair Ethernet cable between network interfaces. The second local area network standard is 100BaseTX, which runs at 100 Mbps over the same twisted-pair Ethernet cable. (Note that Category 5 or better cable is required for 100BaseTX.) The standard for fiber is 100BaseFX, which runs at 100 Mbps.

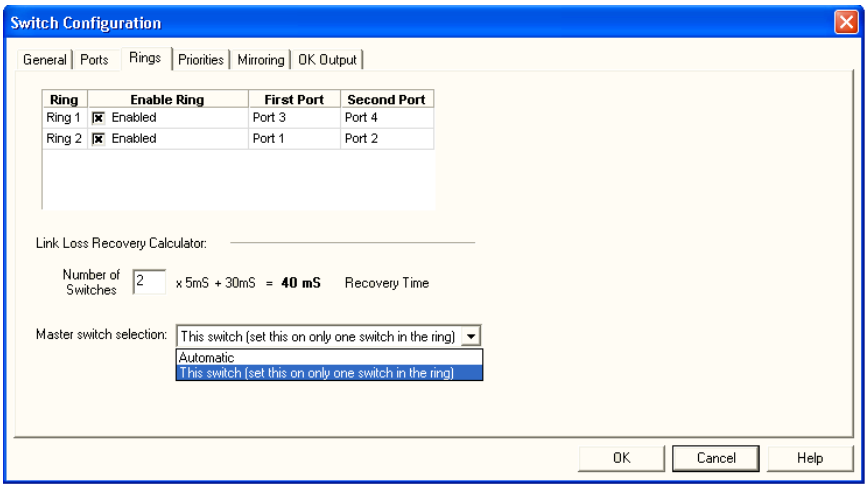
The following options are available:

**10h** 10 Mbps, Half Duplex
**10f** 10 Mbps, Full Duplex
**100h** 100 Mbps, Half Duplex
**100f** 100 Mbps, Full Duplex

**FC** Flow control can also be enabled or disabled. Devices use flow control to ensure that the receiving device takes in all the data without error. If the transmitting device sends data at a faster rate than the receiving device can accept, the receiving device's buffer will eventually fill up with pending data. No further data can be accepted when the buffer is full, so a flow control signal is sent to the transmitting device to temporarily stop the flow of incoming data.

**Important:** To ensure the highest rate of communication for your switch connection and minimize lost data due to collisions or bottlenecks always match port settings with the connected link partner. See Configuring the 2104 Ring Switch Ports section for more information.

## *Switch Configuration Window – Rings Page*



## Activating and Configuring a Ring

Activate a ring by selecting the appropriate **Enable Ring** checkbox. You can configure up to two rings.

When a ring is enabled, be sure to choose the two ports being used to connect the Weed Ring Switch into that particular ring. To do so, simply pick the available ports from the **First Port** and **Second Port** drop-down lists. Each port should be assigned to only one ring. If you inadvertently have two rings sharing the same port, those cells would be indicated in yellow to alert you to the error.

**Note**: The Rings page includes a Link Loss Recovery Calculator. You can use this calculator to estimate how long it would take for a ring to recover if a network segment along the ring is broken.

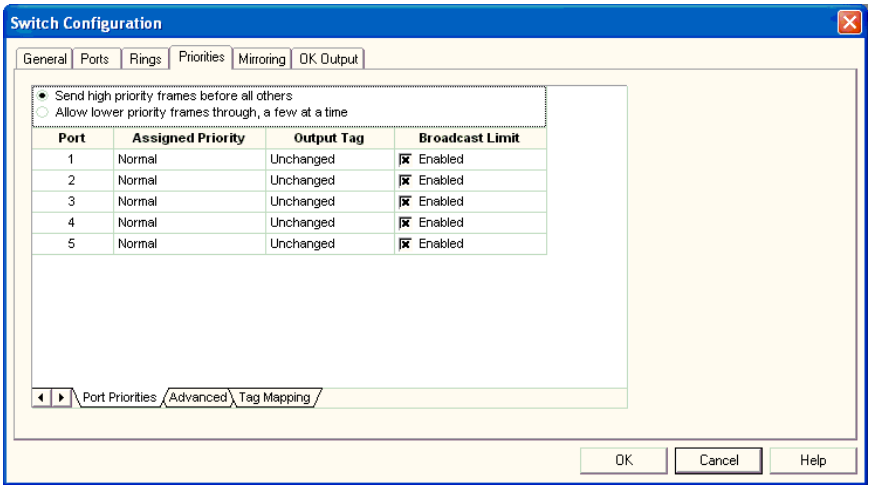
In firmware version 1.03 and newer, the ring switch with the lowest-numbered MAC address in a ring will be the master switch. The master switch blocks communication in the ring from one of its two ring ports, which establishes the active path of ring communication. Only the master ring switch in a ring does this. You can specify a different Weed Ring Switch in the ring to be the master switch by choosing **this switch** from the **Master switch selection** drop-down list for the desired switch. All other ring switches in the ring should be set to the default **Automatic** setting.

**Note**: This feature is supported in EOTec 2104 Ring Switch firmware version 1.03 and newer only.

## What does waiting for a link loss to *recover* mean?

All Weed Ring Switches in the ring must have a way to keep track of each other in case a failure in communication occurs along the ring. To keep track of the health of the ring, the EOTec 2104 Ring Switches periodically send test messages to each other. As a result, the EOTec 2104 Ring Switches will recognize when a ring gets cut at a certain location and they will take the appropriate action to bring the network back online. The time that it takes for the last ring switch to realize there is a communication problem and take appropriate action to rectify it will be when the link loss recovers.

## *Switch Configuration Window – Port Priorities Page*



## Choosing a Forwarding Policy

Choose the forwarding policy that is more appropriate for your application:

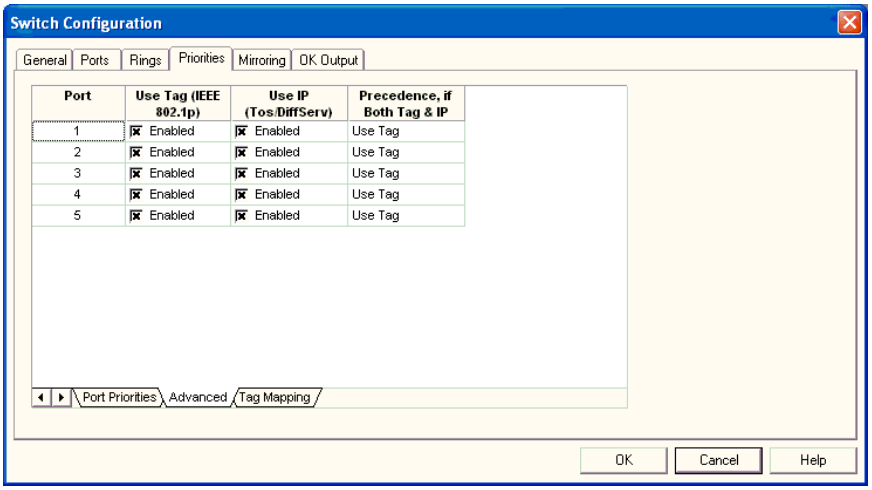
- The first policy states that the Weed Ring Switch will **send high-priority frames before all others.** Under this policy, all data in the highest port priority queue is sent before sending data from the second-highest port priority queue. All data from the second-highest port priority queue is sent before sending data from the third highest, and so on. This assures that high-priority data always gets through as quickly as possible.
- The second policy states that the Weed Ring Switch will **allow lower priority frames through, a few at a time**. Under this policy, a round-robin algorithm is used, weighted so that more high-priority than low-priority data gets through. Specifically, the switch sends eight frames from the urgent port priority queue, followed by four from the expedited port priority queue, two from the normal port priority queue, and one from the background port priority queue, and then starts over with the urgent queue. This assures that the lower-priority queues will not be starved.

## Adding Priority to Messages

If any devices connected to the EOTec 2104 Ring Switch do not natively put priority-handling information into their messages, you still can prioritize their messages by adding 802.1 CoS (Class of Service) priority tags.

**Note**: When adding priority data to non-prioritized messages, the switch can only add CoS tags—it will not modify the IP ToS (Type of Service) header. All messages with a certain priority in the IP ToS header will always enter and leave the Weed Ring Switch with the same value. The IP ToS header priority is usually set at the source device (device from which the IP packet originated).Using the EOTec 2104 Switch Tools utility, you can configure each port to add priority tags to messages for placement in a specific priority queue. By using standard IEEE 802.1p CoS tags, tagged messages from the Weed Ring Switch will achieve the same level of treatment from other 802.1p compatible switches.

## *Switch Configuration Window – Advanced Priorities Page*



The Advanced Priorities page provides further options for how each port handles IP headers/ToS or 802.1p tags.

By default, each port on the EOTec 2104 Ring Switch honors both IP ToS and 802.1p tags. You can change this so that the port honors only one or neither by selecting or clearing the **Use Tag (IEEE 802.1p)** and **Use IP (ToS/DiffServ)** checkboxes.

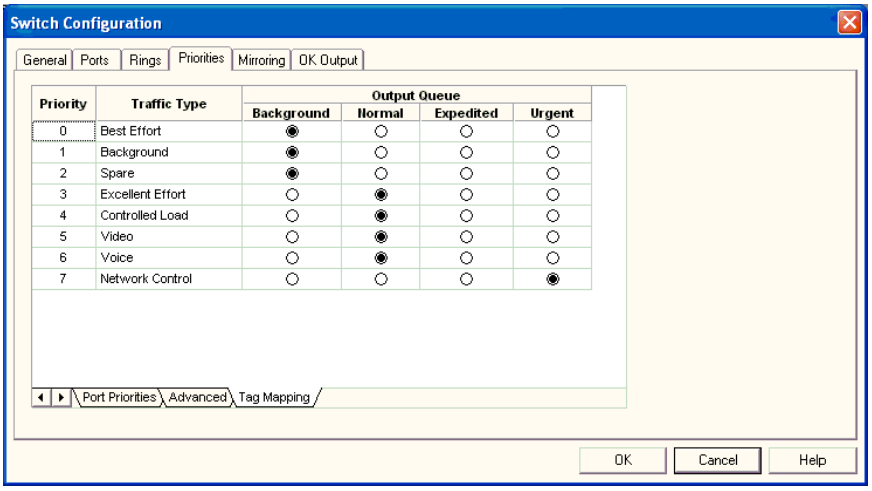
In case a port receives a message that has both IP ToS and 802.1p tags, choose to have the switch take precedence of one over the other by selecting **Use Tag** or **Use IP** in the **Precedence, if Both Tag & IP** drop-down list.

## Customizing Tag Priority and Output Queue Assignment

Each of the eight IEEE tag priority values can be assigned to one of the four output priority queues:

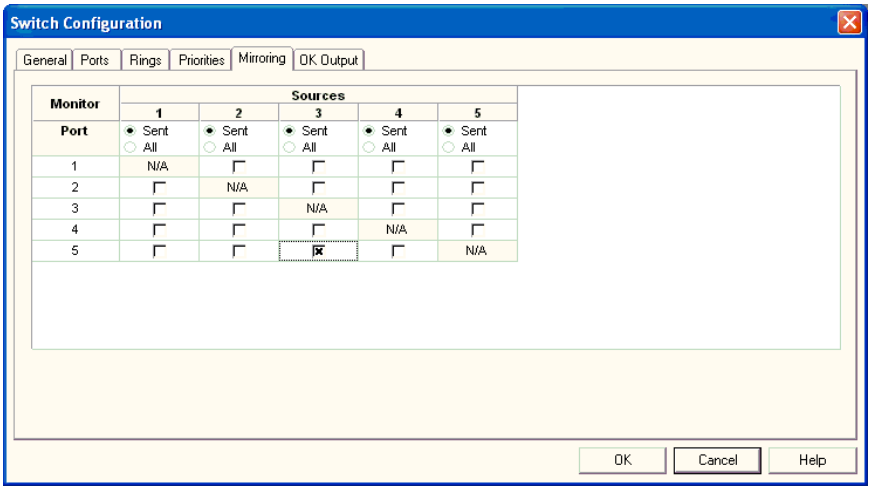
- Background
- Normal
- Expedited
- Urgent

## *Switch Configuration Window – Tag Mapping Page*




Use the Tag Mapping page to customize how to map each IEEE 802.1p tag to one of the four priority queues. Pick the radio button that corresponds to the priority and output queue you want to specify.

## *Switch Configuration Window – Mirroring Page*

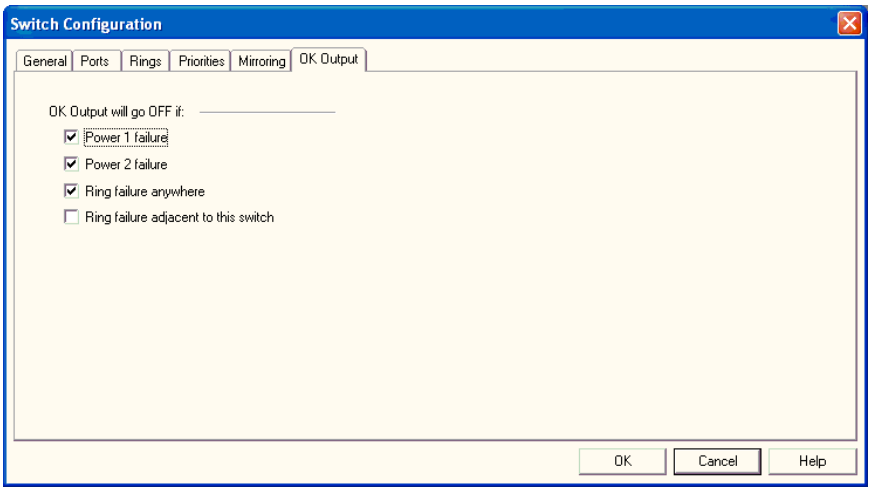



## Performing Network Diagnostics

The EOTec 2104 Ring Switch has a built-in network diagnostic feature called *port mirroring*. This diagnostic capability allows messages from one or more ports to be copied to a single monitoring port, which presumably is connected to a diagnostic device. The port mirroring configuration window is used for this purpose.

When enabling the port-mirroring feature, choose the source ports to be mirrored (monitored) and the one port to monitor their traffic. For each source port, choose to monitor only messages that are being sent from the port (select **Sent**) or both sent and received messages (select **All**). For the monitor/target port, you can enable or disable mirroring for each source port. In the sample image above, port 5 is monitoring only the messages sent from port 3.

## *Switch Configuration Window – OK Output Page*



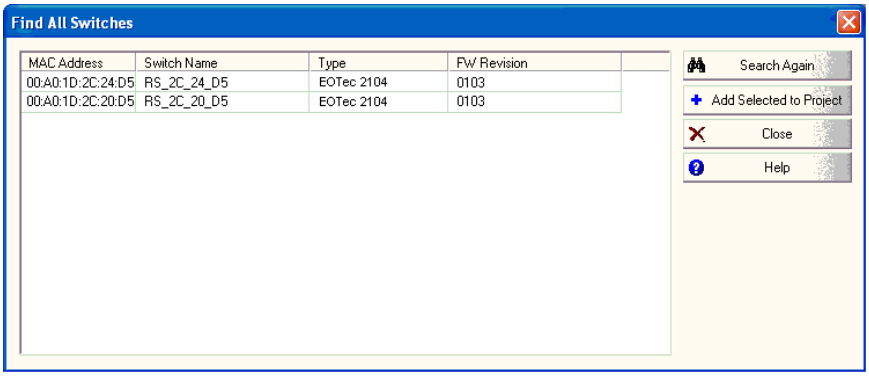

Use this page to configure the functionality for the OK Output Alarm. The **OK** LED is normally **Green** when conditions are good.

Select the conditions that should trigger a fault.

| Function | Description |
|---|---|
| Power 1 failure | DC inputs to the switch. |
| Power 2 failure | For the EOTec 2104, Power 1 and Power 2 are electrically tied together, so either check signifies the same power failure. |
| Ring failure anywhere | A break in the ring at any location is considered a fault condition. |
| Ring failure adjacent to this switch | Only a break between this Weed Ring Switch and an adjacent Weed Ring Switch is considered a fault condition. |

# Find All Switches Window

This window displays a list of all EOTec 2104 Ethernet Ring Switches detected after you click the **Auto-Find Switches** button.




When you locate and add switches to your project, the Auto-find feature creates a row for each ring switch currently connected to your Ethernet network and automatically fills in its **MAC Address**, **Switch Name**, **Type**, and **FW Revision** fields. To copy the detected Weed Ring Switches to the project file, highlight the ring switches in the list and click **Add Selected to Project**.

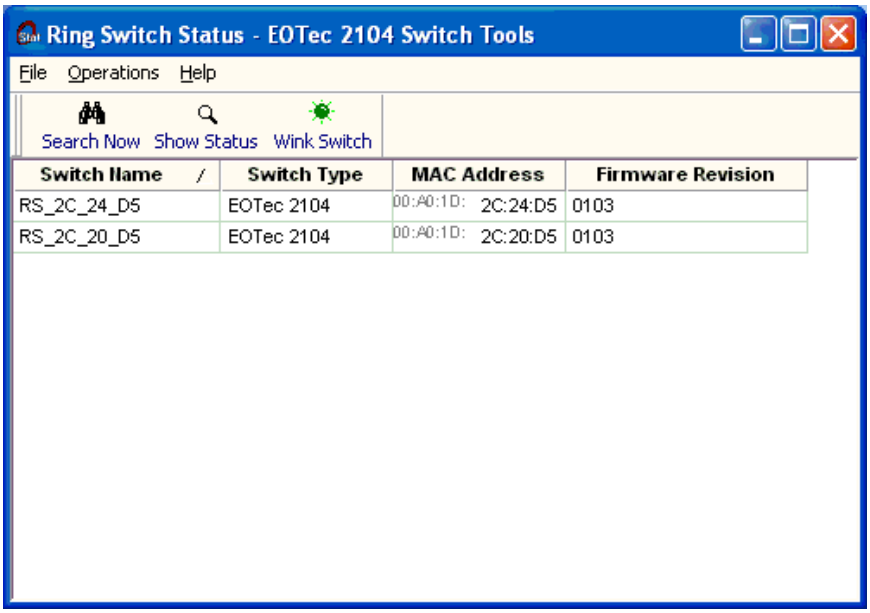
# Loading a Configuration into the Ring Switch

To load a configuration into a Weed Ring Switch:

1. Select the ring switch you want to load by clicking in any field of the definition line for the switch.
2. Click the **Load Selected Switch Configuration** button.
3. Repeat steps 1 and 2 for each Weed Ring Switch in your system.

# EOTec 2104 Switch Status Utility

The EOTec 2104 Switch Status utility provides a view-only display of the current operating status of EOTec 2104 Ethernet Ring Switches connected to the computer and running this software. The utility displays identification information of the ring switch, status of each Ethernet port, and the operating status of any rings that are in use. The operation of this utility is fully automatic, with the addressable Weed Ring Switches found automatically by a network search. All EOTec 2104 Ethernet Ring Switches detected on your Ethernet network are displayed in this status window.




The following information is displayed for each switch:

- Switch Name
- Switch Type
- MAC Address
- Firmware Revision

There are several ways to get more information on any particular switch:

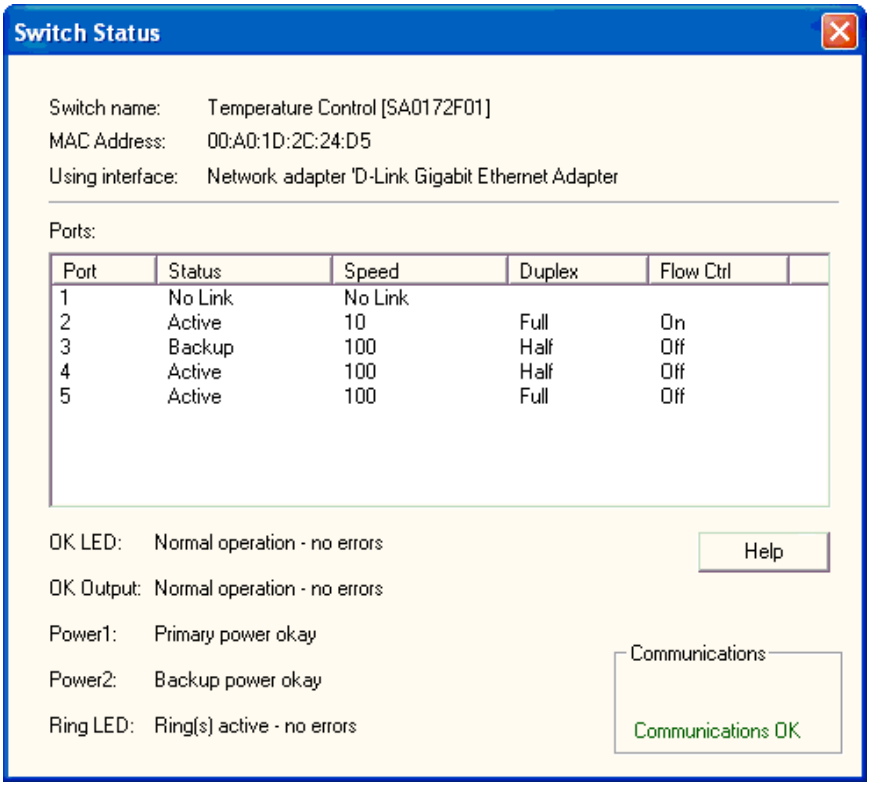
- Highlight a ring switch in the Ring Switch Status window and click the **Show Status** button.
- Double-click the switch name.
- Select **Operations → Show Status**. This option opens the Switch Status window, where you can remotely diagnose the status of each Weed Ring Switch on the network.

## *Wink Switch Button*

You can use the **Wink Switch** button in the toolbar to wink the **OK** LED of the currently selected EOTec 2104 Ethernet Ring Switch. This is a helpful tool you can use while you try out different configurations.

# Switch Status Window

If communication to the EOTec 2104 Ethernet Ring Switch is good, a **Communications OK** indicator appears in the lower-right corner of the window, and a **Polling** indication flashes approximately every three seconds. If communication is broken between this switch and the computer, the **Communications OK** message changes to **Communications**.




The top of the Switch Status window has three indicators:

**Switch name** This is the name of the switch.

**MAC Address** This is the MAC address of the switch, as indicated on the switch's label.

**Using interface** This is the name of your computer's Ethernet interface card.

The middle part of the window displays the status of all the ports on this ring switch. Each port has four status categories:

- Status
- Speed
- Duplex
- Flow Control (Flow Ctrl).

The **Status** category has four states:

| | |
|---|---|
| **Active** | The port is currently configured to receive and transmit packets (Active part of ring). |
| **Backup** | The port is connected to the backup segment of the ring (blocking packets). |
| **No Link** | There is a faulty connection or no connection has been made to another Ethernet device. |
| **Disabled** | The port has been configured to act as if it does not exist on the switch. |

**Note**: Although a copper port does not virtually exist, the **Activity** and **Link** LEDs of the RJ45 connector will still blink if an Ethernet device is sending traffic into the port.

The **Speed** category has three states:

| | |
|---|---|
| **100** | The port is set at 100 Mbps. |
| **10** | The port is set at 10 Mbps. |
| **No Link** | There is a faulty connection, or no connection has been made to another Ethernet device. |

The **Duplex** category has two states:

| | |
|---|---|
| **Full** | Full Duplex |
| **Half** | Half Duplex |

The **Flow Control** category has two states:

| | |
|---|---|
| **ON** | Enabled |
| **OFF** | Disabled |

The bottom section of the window shows the status of other indicators:

| Indicator | Possible Messages |
|---|---|
| OK LED | **ERROR with ring(s) or power** |
| | **ERROR – check configuration** |
| | **Normal operation – no errors** |
| OK Output | **ERROR with ring(s) or power** |
| | **Normal operation – no errors** |
| Power 1, Power 2 (tied together) | **WARNING – no primary power** |
| | **Primary power okay** |
| Ring Port LED | **No rings configured** |
| | **ERROR with associated ring port** |
| | **Ring(s) active – no errors** |

## *OK LED, OK Output*

The Weed Ring Switch is in the "OK" state when the unit is powered and all configured rings are healthy (complete). Under these conditions, the **OK** LED and **OK** Output report **Normal operation – no errors** in the Switch Status window. If the switch is not in the "OK" state, the **OK** LED and **OK** Output report **ERROR with ring(s) or power**.

## *Power 1, Power 2*

Determine how the EOTec 2104 Ethernet Ring Switch is currently powered by checking if Power 1 and Power 2 are reporting back as OK. A warning message is displayed if the unit power terminal loses power.

**Note**: For the EOTec 2104, Power 1 and Power 2 are electrically tied together, so both will indicate the same power status.

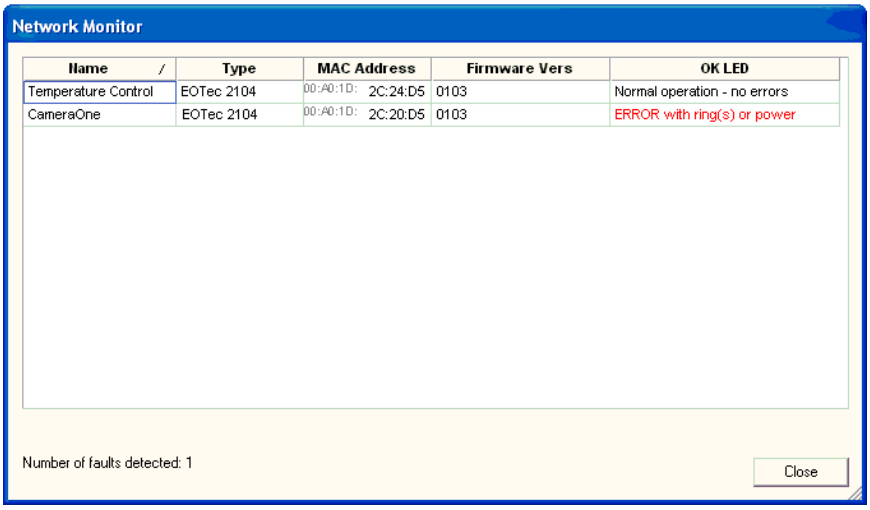
## *Ring Port LED*

When all configured rings are healthy, the Ring Port LED reports **Ring(s) active – no errors.** Otherwise, if one or more configured rings are broken, the Ring Port LED will report **ERROR with associated ring port**. When debugging a ring network, look for configured ring ports that are reporting **ERROR with associated ring port** to determine breaks local to the switch.

# Network Monitor Window

After creating a project and the ring switches are displayed in the EOTec 2104 Switch Tools window, you will have the ability to monitor your ring network. A menu feature called the Network Monitor reports current status of all ring switches in the network.

From EOTec 2104 Switch Tools, click the **Monitor Networks** button from the toolbar. The Network Monitor window appears.




| Field | Description |
|---|---|
| **Name** | Name designated for the ring switch during base configuration load |
| **Type** | Indicates the ring switch model |
| **MAC Address** | Static assignment |
| **Firmware Version** | Current firmware version loaded |
| **OK LED** | Indicates ring status |

You can launch the Switch Status window within this window by double-clicking in a field of any ring switch. While the Network Monitor gives you a few basic details about all the EOTec 2104 Ethernet Ring Switches of the network, Switch Status provides more details on the selected switch.

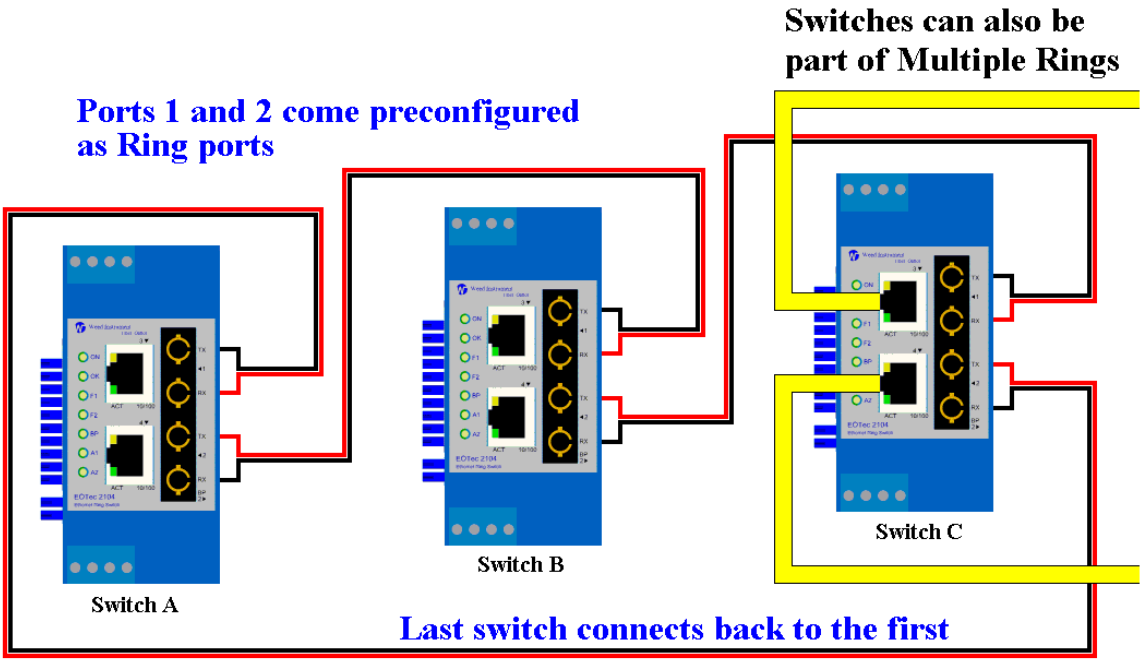
# 4

# Ring Configurations

This chapter describes various topologies you can configure with EOTec 2104 Ethernet Ring Switches, discusses how to avoid invalid or unintended rings, and describes two ring setup examples in detail.

## Ring Setup and Operation

For ring operation in most applications, no user configuration is necessary. Just connect the ring-configured ports of your EOTec 2104 Ethernet Ring Switches in a ring by connecting the last switch back to the first. Make sure you use only the ring-configured ports for your ring connections. Use the non-ring ports to connect to your Ethernet devices such as PLCs, computers, and so on.




Switches can be part of multiple rings. Refer to the Valid Ring Configurations section for some examples.

# Ring Application Tips

A Weed Ring Switch increases network reliability by providing an alternative path for message flow in the event of a network segment failure. When a Weed Ring Switch detects a communications break, it quickly notifies the other switches in the ring. Messages are automatically rerouted through the alternative ring path within milliseconds. Here are some helpful tips for using Weed Ring Switches:

- Plan the ring wiring to minimize the number of connections and the length of the network cables. Simple and short is always better.
- While it is possible to include 50 or more switches in a ring, it is more reliable to divide your network into multiple, smaller rings. This increases reliability and recovery time by reducing the number of elements that can potentially cause a failure in any one ring.
- The EOTec 2104 Ring Switches can be configured to support up to two independent rings simultaneously. For more information, refer to Implementing Two Rings with the EOTec 2104 Ring Switch, later in this chapter.
- The local alarm LEDs (A1 and A2) will blink if the ring is not complete.

**Important Note**: Use only Weed Ring Switches when connecting switches in a ring. Weed Ring Switches use a specialized high-speed ring algorithm that only they can recognize.

## *Why Use a Weed Ring Switch?*

The fault tolerance provided by Weed Ring Switches is not possible with conventional Ethernet hubs or unmanaged switches for two main reasons:

- Certain network packets will endlessly flow around the ring, creating broadcast storms that will very quickly overload the network.
- Conventional switches read the source address in network messages to intelligently route network packets. The arrival of messages from the same source on two different ports will confuse the switch. Even when a change of routing occurs, a traditional unmanaged switch can take several minutes to notice and respond to the change of port assignment.

The *Rapid Spanning Tree* algorithm in Managed Switches can be used to create rings. However, Spanning Trees were designed for the office environment and do not guarantee deterministic performance. Weed Ring Switches, on the other hand, are deterministic by design and use their knowledge of the well-known alternative paths to ensure real-time recovery of network failures. Weed Ring Switches are also simpler to install, with no configuration necessary in most situations. Weed Ring Switches do not need an IP address assigned to each switch for the Ring capability to function.

### *Weed Ring Advantages over Spanning Trees and Other Schemes*

- Deterministic performance – 5 mS per hop
- No IP address or complex set up required
- Expandable to 50+ nodes (RSTP limited to 6 hops max.)
- Can increase reliability by establishing multiple rings
- No ring master is required – no one switch is critical
- Weed Rings are ultra stable:
  - Will not be confused by multiple simultaneous failures
  - Always recover to the same, known configuration
- Weed Ring Switches cost less than Managed Switches

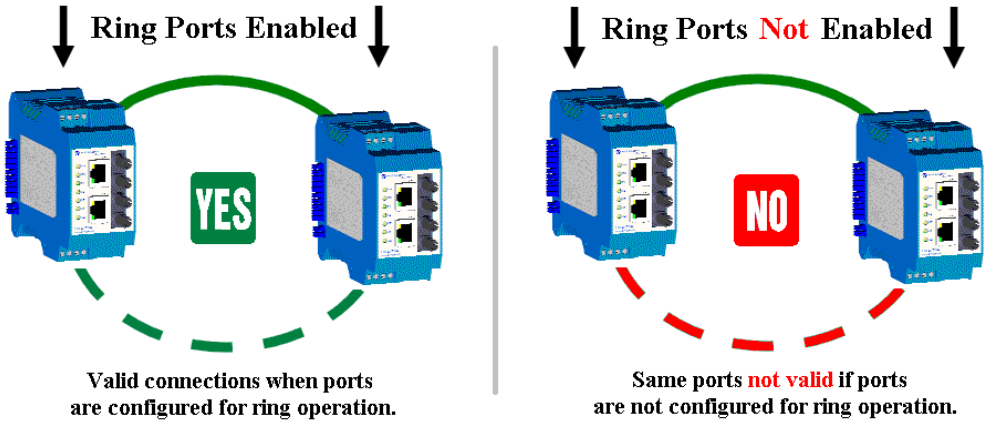
### *How a Weed Ring Operates without IP Addresses*

Weed Ring Switches are addressed through their MAC addresses using low overhead primary Ethernet packets. Every Ethernet device has a unique MAC address, which is used by all Ethernet devices to route network packets. By eliminating the IP layer from the ring management messages, message size is reduced, processing (coding and decode) steps are eliminated, and response speed is therefore maximized.

By not requiring the assignment of an IP address, Weed Ring Switches offer the great benefit of being able to be installed straight away without ever being connected to a laptop computer. If a configuration change is required (perhaps to fix a port or a specific speed, or to enable a second independent ring), the EOTec 2104 Switch Tools utility can identify the switches in the ring for you by using an Auto-Find feature. This feature finds the EOTec 2104 Ethernet Ring Switches and lists their MAC addresses automatically. A *wink* feature, included in the configuration tools, identifies a switch for you by flashing the switch's OK LED.

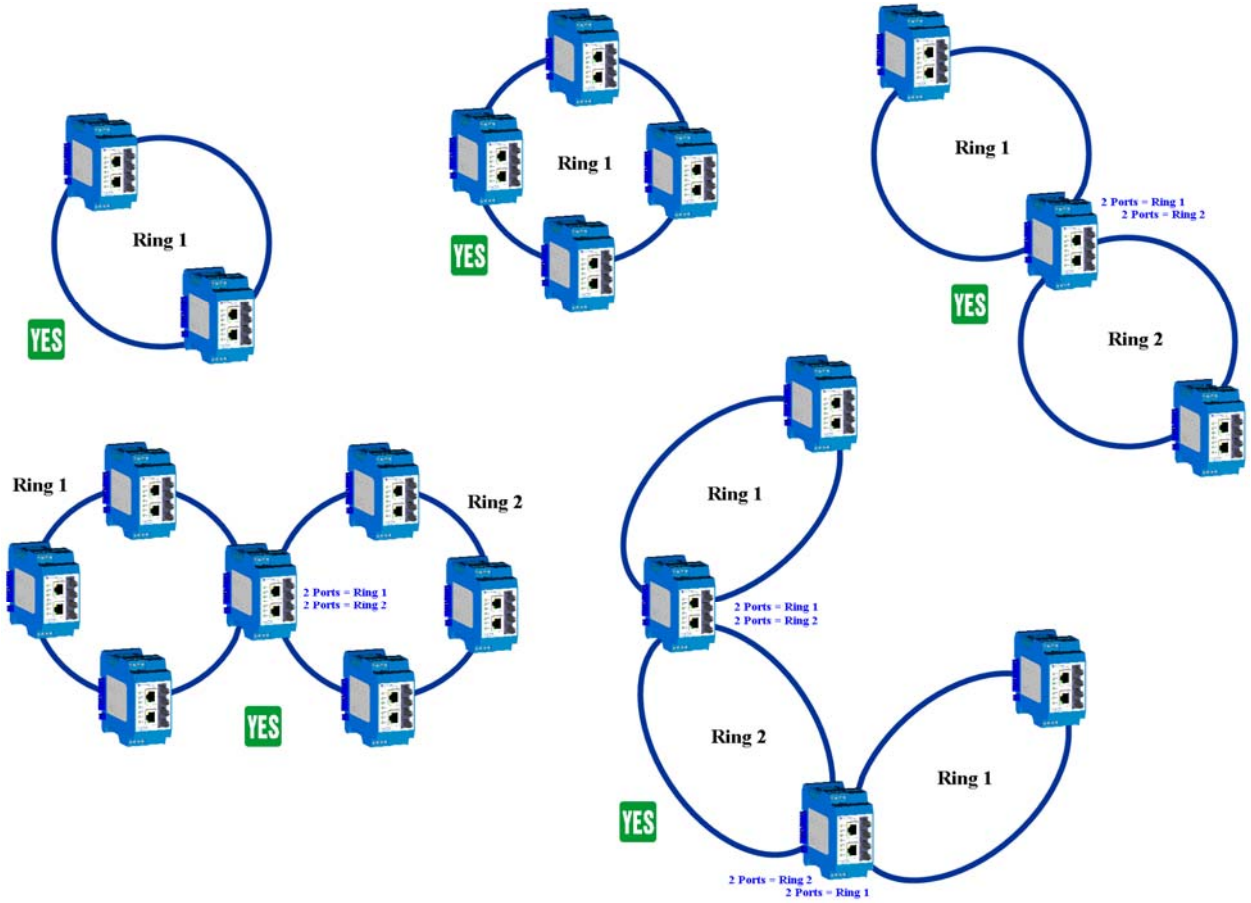
## Configuring Rings in Your Ring Switch

It is essential to ensure that ring operation is enabled for the appropriate ports. In other words, you must specify which ports the EOTec 2104 Ethernet Ring Switch is going to use as ring ports (all fiber ports are delivered pre-configured as ring ports). Never wire a ring switch in a ring topology without first configuring the switches ports as ring ports.



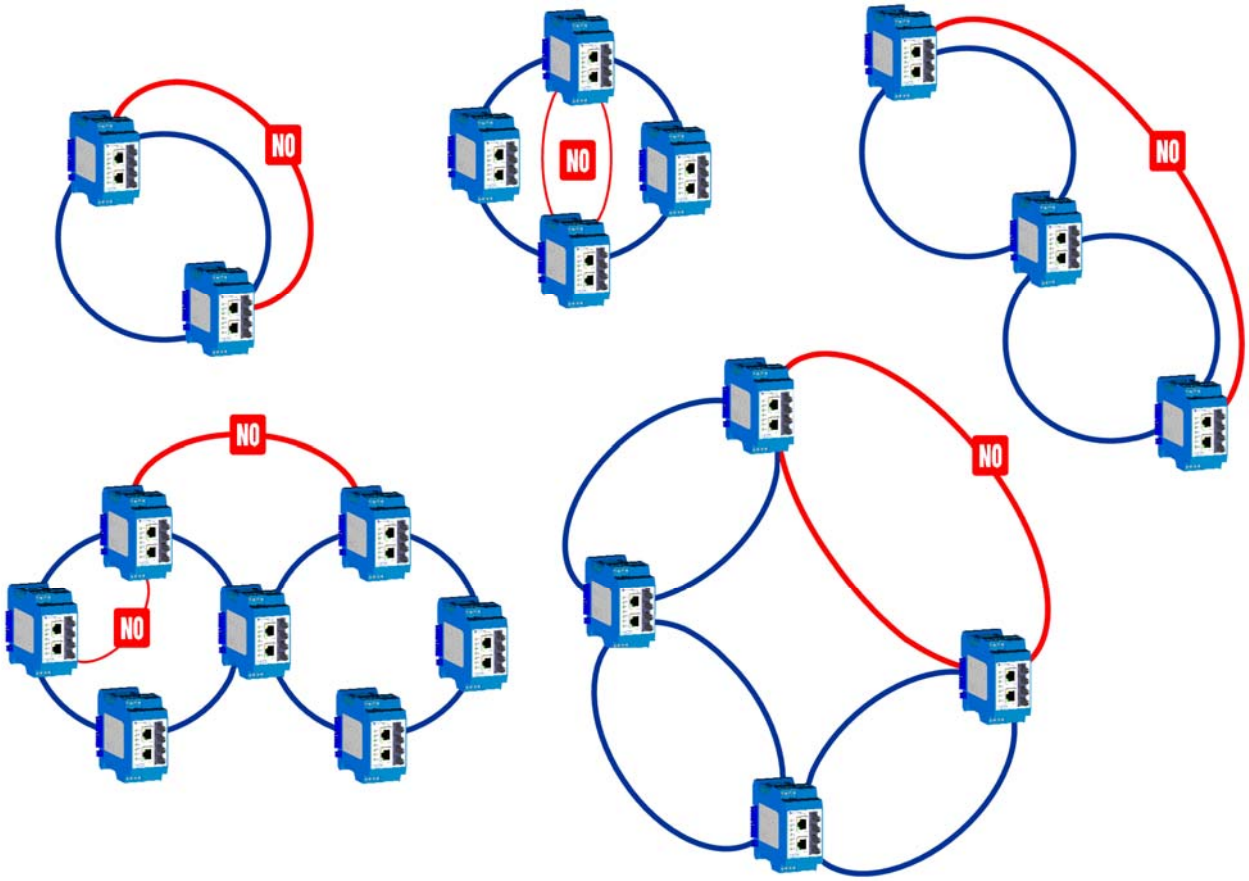
# Valid Ring Topologies

Valid ring connections require that the appropriate ports are software-configured for ring operation. The following diagrams are examples of how you could wire your EOTec 2104 Ethernet Ring Switches together. In general, you should keep your topology simple.



# Invalid Ring Topologies

The examples below are invalid ring topologies. Do ***not*** connect EOTec 2104 Ethernet Ring Switches in the ways shown below, as they will lead to unpredictable network performance. Paths indicated by the color **red** create unintended rings, as described in the next section.

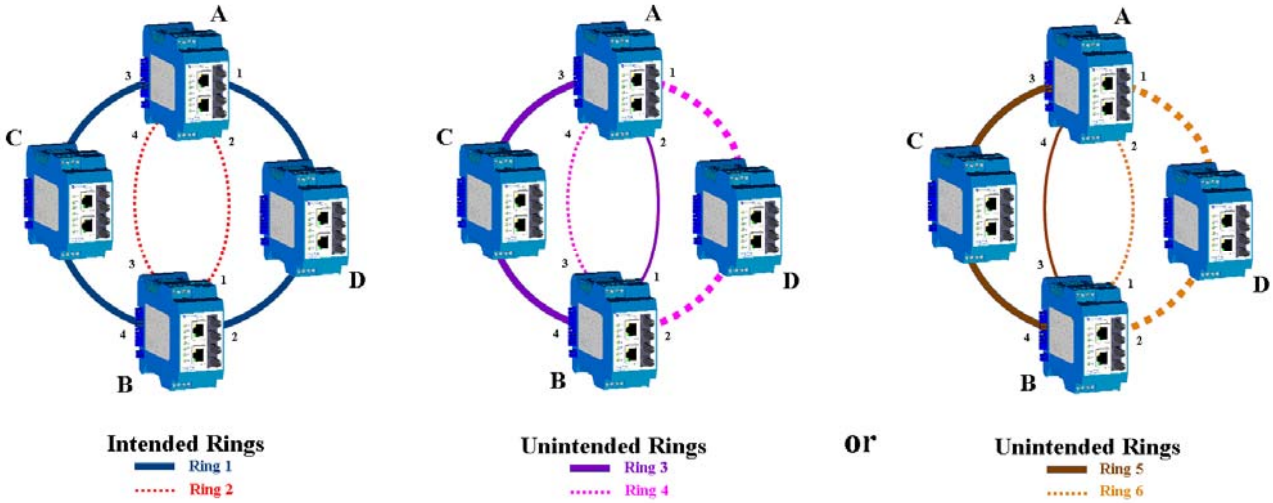



In addition, the EOTec2104 Ring Switches are not designed to be stacked side-by-side as shown below. Electrically, port 5 (backplane port) will function properly with all other ports/switches, but the ring diagnostic relays will no longer function properly.


You can, however, attach the EOTec 2104 Ring Switch to a port expansion module or power supply module in this manner.

## *Unintended Rings Example*

Refer to the diagram below. In this example, Ring Switches A and B have been software configured for two rings each. Ring Switches C and D have been software configured for one ring each. The physical connections for the two rings are shown in blue solid and red dotted lines.




Because of the configuration rule for Ring Switches that each switch knows about all rings that are attached to it, it would appear that the example above is legal. However, this is not the case. There are actually more than two ring paths that are created. There are multiple paths that message traffic can use to move from Switch A and back to Switch A. The same applies to Switch B. These unintended Ring paths that Switch A and Switch B don't know about are labeled as Unintended Rings 3, 4, 5 and 6.

Since Ring Switch A and Ring Switch B don't know about these extra ring paths, they are not included in the ring algorithm for these switches. Paths that are not included in the ring algorithm will result in harmful broadcast storms, which also would happen when conventional switches are connected in a ring topology.

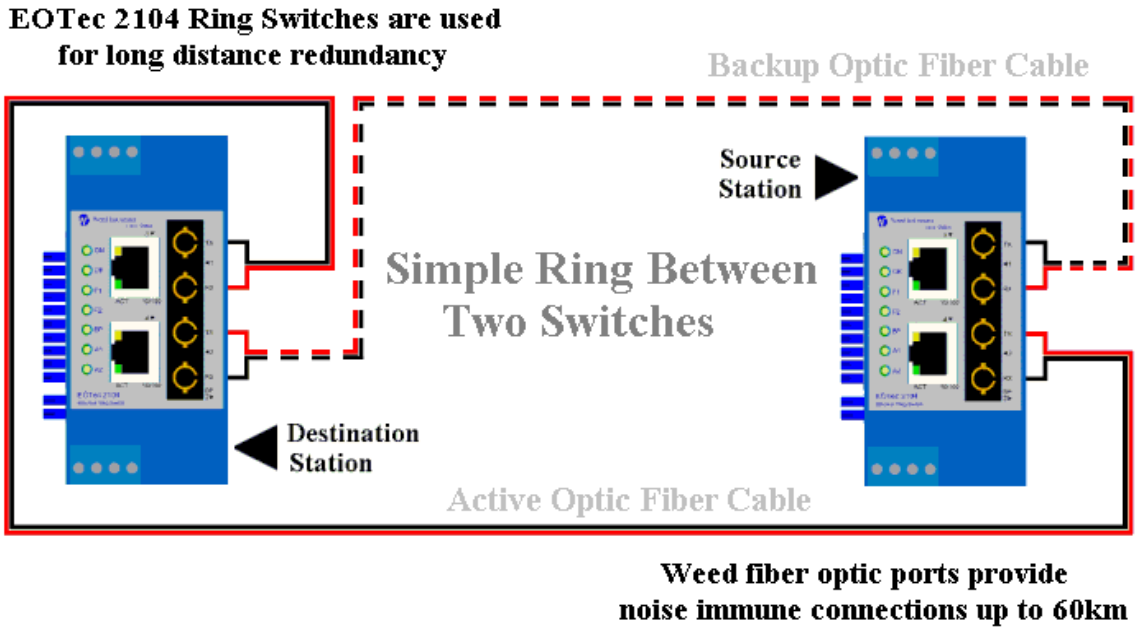
# Detailed Ring Examples

The following examples may help you plan your own ring configuration. The first example describes a single ring in a long-distance connection. The second example describes an effective way to build two rings with the EOTec 2104 Ring Switch.

## *Implementing a Single Ring in a Long Distance Connection*

Suppose that a telecommunications company needs to transfer video data between a source and destination station. An integrator helps the telecommunications company out by making a few suggestions:

1. The distance between source and destination station is three kilometers; so fiber would be the communications medium of choice.
2. Since the telecommunications company loses a lot of money when a broadcast is interrupted, the integrator decides that two fiber optic runs between source and destination station should dramatically reduce the chance of a broadcast failure due to an accidental disconnection between the source and destination stations. The fiber cables are to be run parallel, but not very close to each other. The reason for this is that if one of the cables were to be accidentally cut, the other would still be physically intact to maintain an active data connection.
3. The network can have only one of the fiber runs active at a time (Refer to the Ring Applications Tips section, earlier in this chapter, for an explanation). Therefore, to implement this fiber ring implementation, the integrator uses EOTec 2104 Ethernet Ring Switches. These Weed Ring Switches have the intelligence to ensure only one data path is active at a time. Should the primary data path fail, the Weed Ring Switches will quickly act to enable the backup data path.




The telecommunications company likes the integrator's proposal, and decides to go with the recommended solution. A few weeks later, after the two fiber cables have been run between stations, the integrator can now act to implement the Weed Ring Switches.

In this scenario, the integrator takes two EOTec 2104 Ethernet Ring Switches from stock and configures them to have one ring enabled on the fiber ports. Here are the steps undertaken.

1. In the EOTec 2104 Switch Tools utility, the integrator starts a new configuration by selecting **Add New Base Configuration**. A name is assigned, and a switch type for this particular configuration is selected. In this case the switch type is a **5 port model**, as shown in Figure 4.1 below.

**Note**: All EOTec 2104 switches have four ports (two copper and two fiber) and an additional Ethernet backplane port that attaches on the side to other Weed modules near the back of each unit.

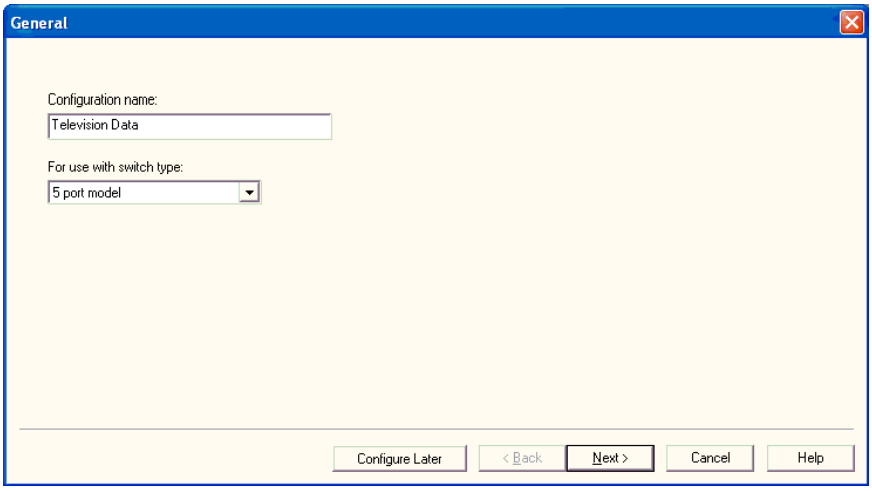



**Figure 4.1**

2. No ports, priorities, or mirroring settings need to be made at this time, so the integrator keeps the default port settings and continues to the next screen by selecting **Next >**.

3. The source and destination stations are connected to each other via a fiber ring such that fiber runs from port 1 of the first switch to port 1 of the second switch. Another fiber runs from port 2 of the first switch to port 2 of the second switch. Since each dual-fiber switch uses ports 1 and 2 in the ring, the integrator configures the rings screen as shown in Figure 4.2.

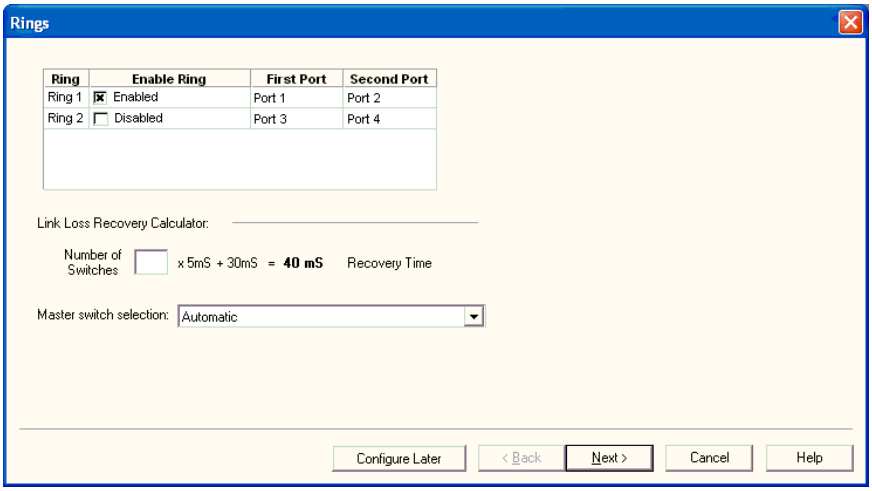



**Figure 4.2**

4. At this time, the integrator doesn't wish to prioritize data traffic, use mirroring features to debug the network, or change output alarms. He/she therefore skips through the Priorities, Mirroring, and OK Output windows and concludes the new customized switch configuration by selecting **Finish** at the end of the sequence.

5. For the last few steps, the integrator clicks **Auto-Find Switches**, which displays a list of all EOTec 2104 Ring Switches on his network, and then selects the **Television Data** configuration to be the configuration of choice for both switches (shown in Figure 4.3).

6. After assigning each switch a name, the integrator saves the project and then clicks **Load Selected Switch Configuration** for each switch shown in Figure 4.3. (Make sure to highlight the row of the switch that is to be loaded).

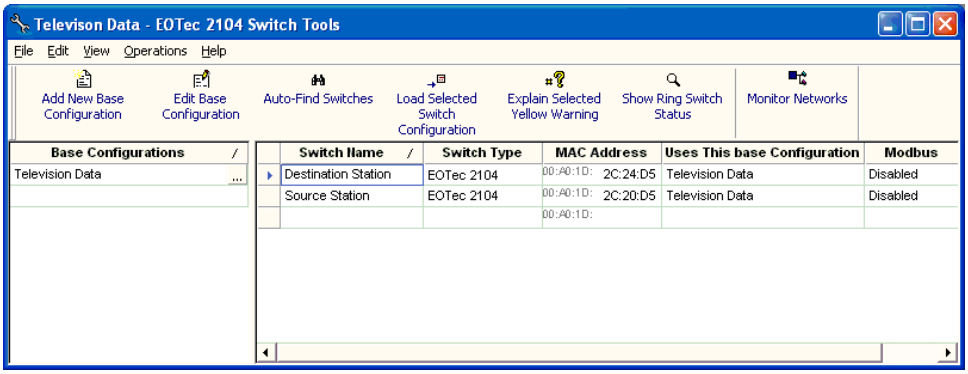
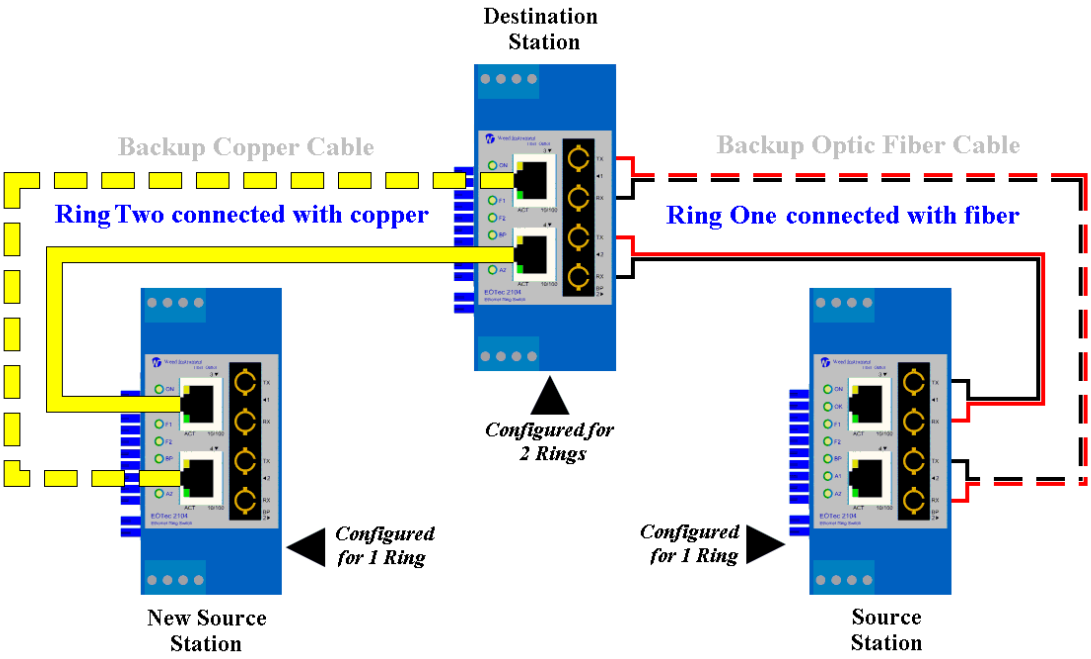



**Figure 4.3**

## *Implementing Two Rings with the EOTec 2104 Ring Switch*

Joining two rings at a switch is simple. In the Single Ring example in the previous section, we had a source and destination station connected to each other via a single ring using EOTec 2104 Ethernet Ring Switches (via fiber). The customer now wishes to expand upon the existing system such that the destination system receives data from two source stations instead of one. The new source station is actually in the same building as the destination station—shorter copper technology will satisfy—and reliability is still important.




The integrator prepares to implement an Ethernet ring between the new source station and the destination station. Here are the steps undertaken:

1. The integrator knows that the original source station configuration doesn't need to be changed because the switch is still connected to one ring on ports 1 and 2.
2. The integrator realizes that the current configuration in the destination station will have to be modified, however, because, as shown previously in Figure 4.2, only one ring is enabled on the switch.

3. Since the original configuration in the destination switch no longer applies, the integrator creates a new configuration for the destination station by clicking **Add New Base Configuration**. The integrator then fills out the configuration name and selects the switch type, as shown in Figure 4.4.

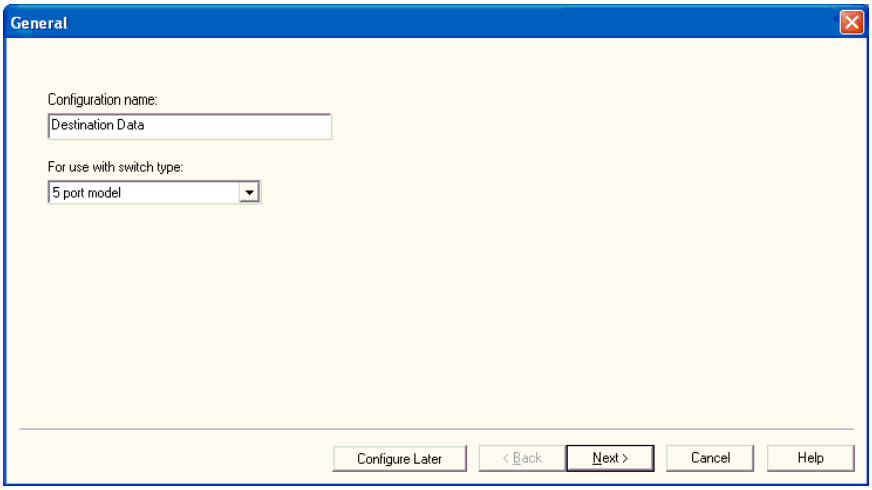



**Figure 4.4**

4. The new configuration keeps the fiber ring enabled on ports 1 and 2, and also enables an Ethernet ring on ports 3 and 4, as shown in Figure 4.5.

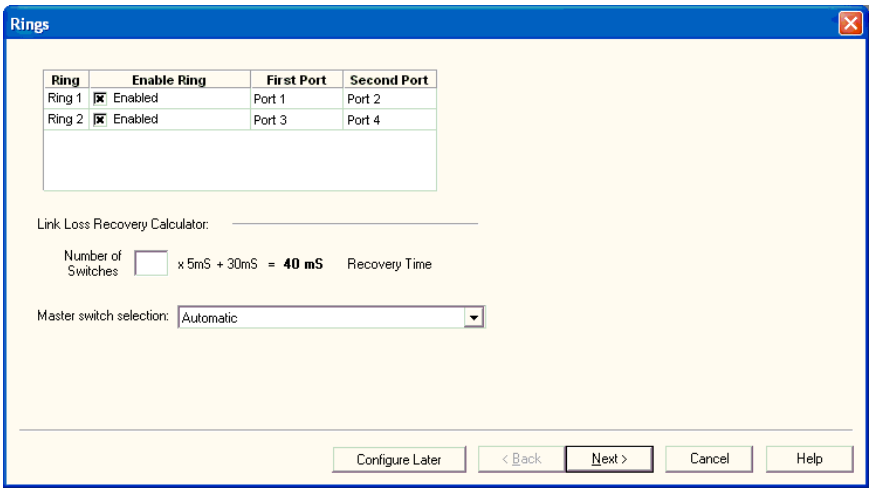



**Figure 4.5**

5. No special ports, priorities, or mirroring settings need to be added to the ring switch at this time, so the integrator selects **Next >** to skip through those screens and concludes the new customized switch configuration by selecting **Finish** at the end of the sequence.

6. The new source station will need a new configuration to enable a ring using ports 3 and 4. The integrator clicks **Add New Base Configuration** and fills out the configuration name and then selects the switch type, as shown in Figure 4.6.

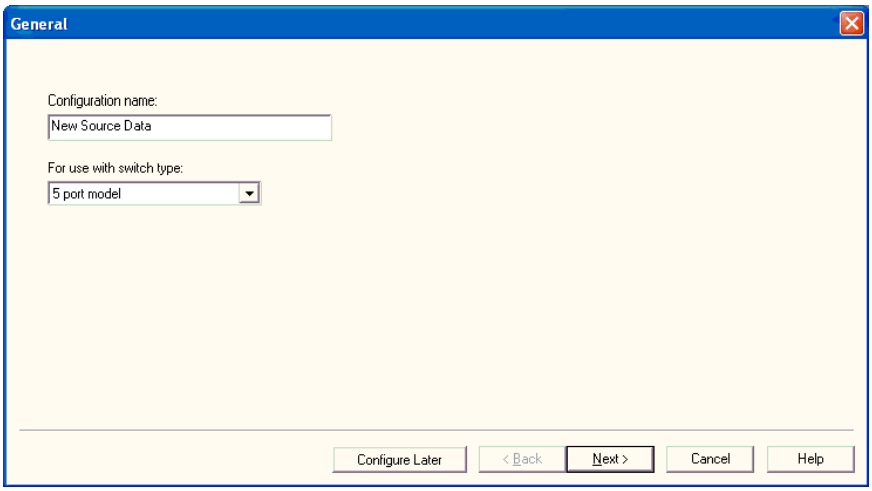



**Figure 4.6**

7. For the ring settings, the integrator enables a ring on ports 3 and 4 as shown in Figure 4.7.

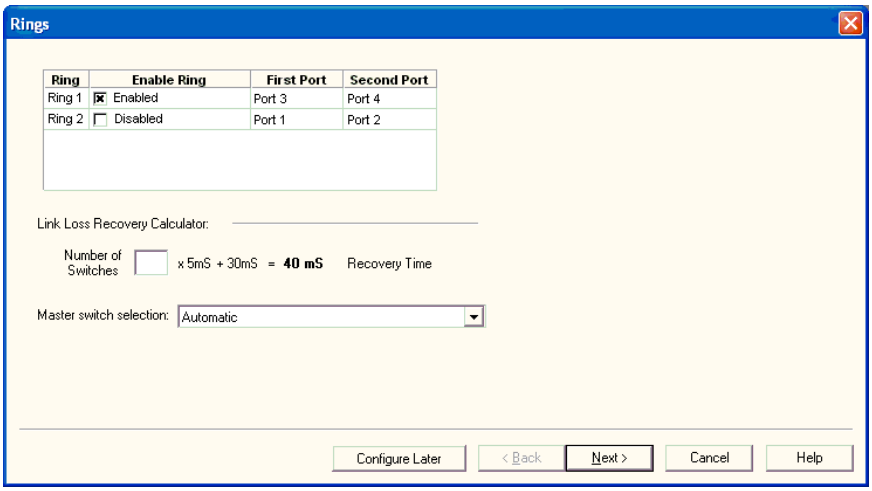



**Figure 4.7**

8. No special ports, priority, or mirroring settings need to be added to the switch at this time, so the integrator again skips through those screens by selecting **Next >** and concludes the new customized switch configuration by selecting **Finish** at the end of the sequence.

9. The integrator clicks **Auto-Find Switches** to refresh the list of EOTec 2104 Ring Switches found and assigns the appropriate configurations and names to the list of switches.

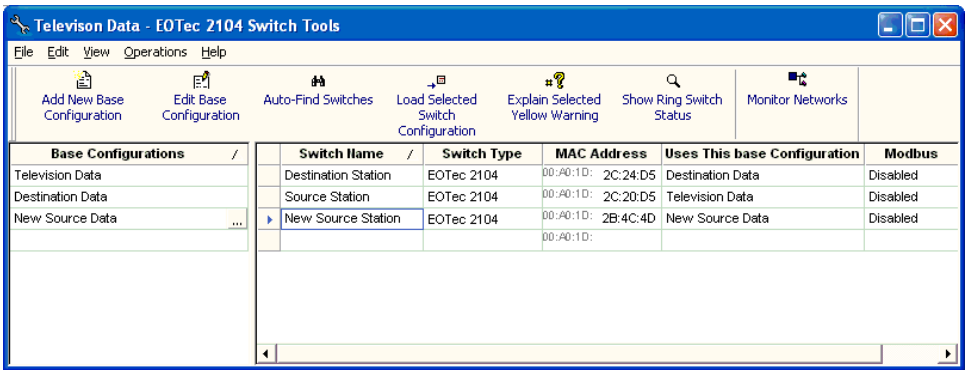



**Figure 4.8**

10. The integrator saves the Project File and then loads each switch by clicking **Load Selected Switch Configuration** for each switch shown in Figure 4.8. (Make sure to highlight the row of the switch that is to be loaded).

# 5

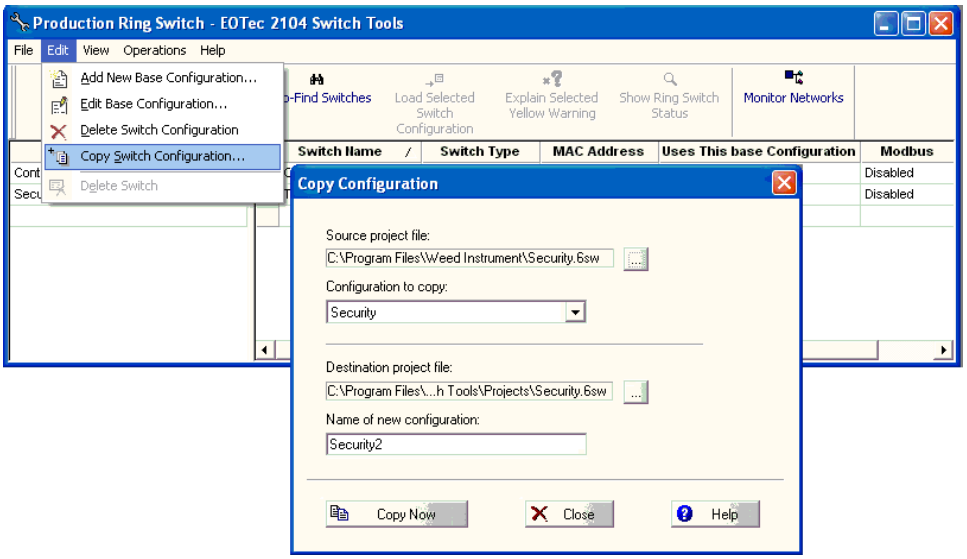
# Advanced Features of Switch Tools

This section explains how to use more advanced features of the EOTec 2104 Switch Tools utility.

## Copying a Base Configuration

Use the **Copy Switch Configuration** command to copy a base configuration from one project file to another, or to a new base configuration within the same project file. To use this time-saving feature:

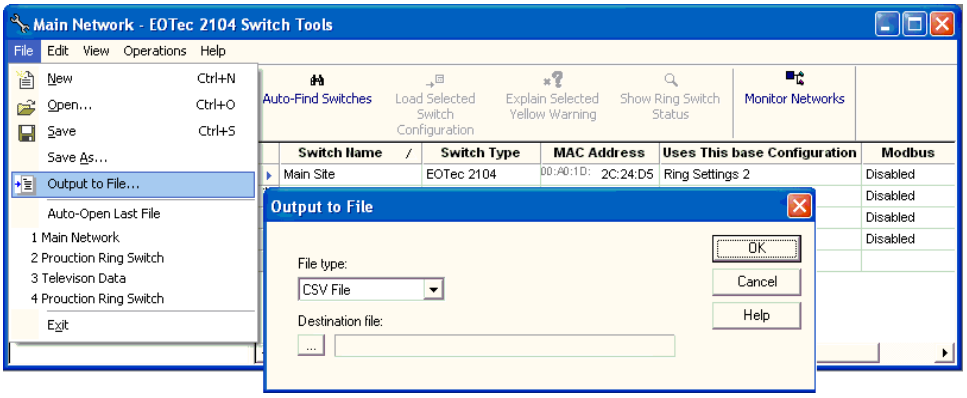
1. Find the base configuration that you want to copy by browsing for the source project file and selecting the base configuration name from the **Configuration to copy** drop-down box.
2. Find the destination project file where you want to copy the base configuration. In addition, type a name for the copied base configuration.
3. Click **Copy Now** to perform the copy process.



# Output to File Window

Use this window to create a file that will contain the following information for each Weed Ring Switch in the project file:

- Switch Name
- Switch Type
- MAC Address
- Base Configuration
- IP Address
- Modbus Address




In the Output to File window, choose the type of file you want to create. You can create three types of files:

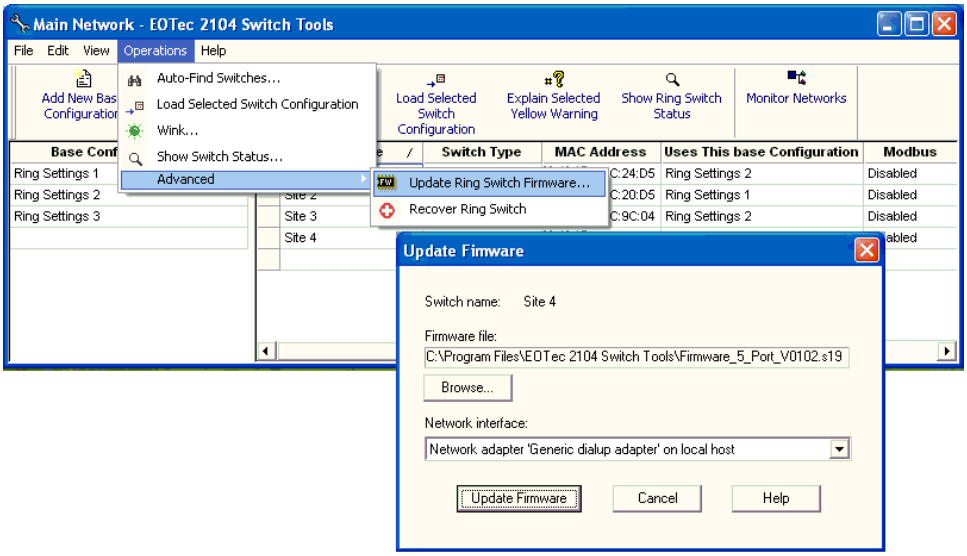
- Comma-separated (.csv) text file
- Tab-delimited file
- Text (.txt) file

A text file can be opened using a variety of programs. A .csv file can be opened and viewed using a spreadsheet program such as Microsoft Excel.

In the lower portion of this window, select the destination file where you want to create the output file. Use the browse button, if necessary, to point to the destination file.

# Updating Weed Ring Switch Firmware

To read the current firmware version in an EOTec 2104 Ethernet Ring Switch, you can either run the **Auto-Find Switches** command from the **Operations** menu or click the **Auto-Find Switches** button in the toolbar. The firmware version in each detected ring switch is displayed in the Find All Switches window.




Follow these steps to update the firmware in an EOTec 2104 Ethernet Ring Switch:

1. The computer running the EOTec 2104 Switch Tools program must have a direct Ethernet connection to one of the Ethernet ports of the ring switch receiving the firmware.

**Note**: The Ethernet port you connect to **must not be** configured as a **ring port**.

2. The ring switch that will be receiving the new firmware **must not** be connected within a ring of other Weed Ring Switches. If it is, temporarily remove the Ethernet connections to the ports configured for ring operation.
3. In the EOTec 2104 Switch Tools utility, open the project file that contains the appropriate configuration for the ring switch that will receive the firmware. Highlight the ring switch that will receive the firmware.
4. Select **Update Ring Switch Firmware** from the **Operations** pull-down menu. In the Update Firmware window, select the appropriate Ethernet adapter in your computer and select the location of the firmware (.s19) file.

A progress bar appears once the firmware transfer begins.

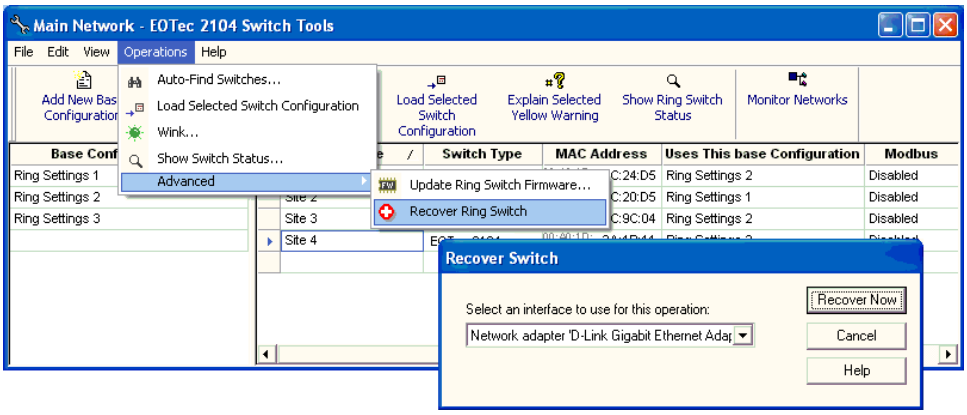
### *If You Have Trouble Upgrading Firmware*

1. Verify that you have a direct Ethernet connection (not through any other switches or hubs) from your computer to your EOTec 2104 Ethernet Ring Switch. You will need to plug into an Ethernet port that is **not** configured for ring operation. Check the Rings Page of the EOTec 2104 Switch Tools Switch Configuration Window to be sure.
2. The EOTec 2104 Ethernet Ring Switch that will be receiving the new firmware must not be connected within a ring of other ring switches. If it is, temporarily remove the Ethernet connections to the ports configured for ring operation.

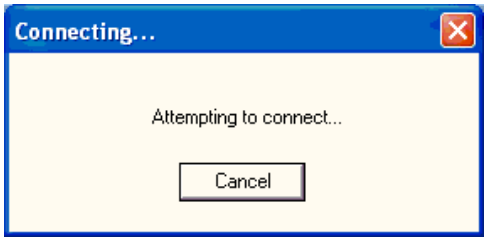
## Recovering an EOTec 2104 Ring Switch

To restore the factory settings, select the advanced command **Recover Ring Switch** from the **Operations** menu. Use this command to recover an EOTec 2104 Ring Switch that has been put into a non-communicating state, such as disabling all ports in the switch.

First ensure that a switch has been selected in the EOTec 2104 Switch Tools main window. When you select this command, the Recover Switch window appears.




In the window, select the correct computer network device that is attached to the ring and click **Recover Now**. The below **Connecting…** message appears when the recovery begins and will close when recovery is complete.



# Prioritizing Your Network Traffic

With priority queuing, critical applications can get the network performance that they deserve through priority tagging. Once priority queuing is configured, low-priority data will not interfere with your time-critical data. You can prioritize network traffic to achieve the performance that time-sensitive data demands.

A conventional switch, by default, forwards all messages such that no message will get special treatment over others. To optimize the network throughput of time-sensitive data, there must be a way to prioritize messages.

The Weed Ring Switch supports two common means of prioritizing messages:

- **IP header/ToS (Type of Service)** – The header is present in all message frames and contains a priority field, which defaults to 0 and can be set as high as 255.
- **802.1p tags** – 802.1p tags contain a priority field, which you can set from 0 to 7.

## *Selecting a Priority Level*

| | |
|---|---|
| **Urgent** | This priority is used for ring management messages. Assign this priority sparingly. Overuse of this priority will impede the ring recovery time. |
| **Expedited** | Assign this priority to network traffic with specific real-time requirements. |
| **Normal** | This is the default priority for general network traffic. |
| **Background** | Assign this priority to messages that do not need to be delivered in real-time. |

## *Assigning Priority Tags*

For the port you are configuring, select the priority you want to assign to incoming messages from the **Assigned Priority** drop-down box.

Also for that port, select the CoS (Class of Service) **Add Tag** from the **Output Tag** drop-down box.

**Note**: Messages assigned as **Urgent** are tagged with a CoS priority of 6.
Messages assigned as **Expedited** are tagged with a CoS priority of 4.
Messages assigned as **Normal** are tagged with a CoS priority of 2.
Messages assigned as **Background** are tagged with a CoS priority of 0.

## *Removing Priority Tags*

For the port you are configuring, select **Remove Tag** from the **Output Tag** drop-down box.

**Note**: You should configure **Remove Tag** for all tagged messages at each exit port, just in case the destination station cannot interpret standard CoS tags.

A broadcast limiting feature is enabled by default for each port. Basically, the EOTec 2104 Ethernet Ring Switch provides some form of protection against broadcast storms by limiting the quantity of broadcast and multicast packets. In special applications, it may be necessary to disable this feature. If so, clear the **Enabled** checkbox in the **Broadcast Limit** field.

## *Port Priority Queues*

When the switch receives a message, the message is *switched* to an appropriate outbound port. At the outbound port, the message is placed in one of four lines, depending on its message priority. These lines are called port priority queues, which are labeled as Urgent, Expedited, Normal, and Background.

To clarify the concept of port priority queues, we will use an analogy of customers attending a theatre:

- The outbound port represents the entrance to a popular theater event.
- Each customer is an Ethernet message.
- The cost of each ticket is the level of message priority.

This particular event decides to sell tickets at four different prices. The cost of each ticket is directly related to how long a customer has to wait in line before getting into the theater. Since there are four prices, there are four lines: A, B, C, and D, where A is the highest paying line and D is the lowest paying line. Basically, an usher lets some people in from line A, then B, then C, and then finally D. The general concept is that the usher will let more people in from a line with customers holding more expensive tickets than a line with customers holding less expensive tickets.

The concept from this analogy applies directly to the Weed Ring Switch, where the incoming message (a customer) is switched to the appropriate outbound port (a theater entrance). Each message has a message priority (a ticket) and gets placed in the appropriate line based on its message priority number (the cost of a ticket). There are a total of four port priority queues that these messages could wait in. These port priority queues are called Urgent (line A), Expedited (line B), Normal (line C), and Background (line D). More messages will be forwarded from a queue of higher priority than a queue with lower priority.

## *IP ToS Priority Example*

Using IP ToS, it is the switch's job to interpolate how a message with a certain message priority level gets sent to the appropriate outbound port priority queue. Because the IP ToS method has a message priority range from 0 to 255, and there are four possible outbound port priority queues, the switch simply divides the total number of priorities (256) by four (number of priority queues).

For example: A message is received and the switch assigns the incoming packet to the appropriate outbound port (example: the outbound port that the packet is supposed to go to is port number 2). There are four possible queues at each outbound port, the switch looks at the message's priority number (example: message priority is 70). The switch will have an internal translation table such as the one below:

| Outbound Priorities | Assigned IP ToS Priority Range |
|---|---|
| Urgent | 0-63 |
| Expedited | 64-127 |
| Normal | 128-191 |
| Background | 192-255 |

Based on the value of the message's priority (70), the switch places it in Port 2's Expedited outbound queue.

### *802.1p Priority*

As with IP ToS, the value of a message's priority determines which outbound port priority queue it gets placed in. The only difference is that the user can now pick how each individual priority value gets assigned to each outbound priority queue. Click to see the default table the switch uses for assigning priorities to output port priority queues and to learn how to customize the table.

The wizard breaks down priority configuration into three parts:

- Port Priorities
- Advanced
- Tag Mapping

## Remote Status Monitoring

There are two ways to remotely monitor the status of your Ring Switch network.

The first method is to use the EOTec 2104 Switch Tools status display. This display will show the status of the selected Ring Switch by providing details such as port, power, and ring states. Find more details about how to use this display by referring to the EOTec 2104 Switch Tools on-line help.

The second method that can be used for determining the state of your Ring Switch network is via Modbus UDP. Through Modbus UDP (**Note: TCP is *not* supported**), you can remotely monitor the status of the EOTec 2104 Ethernet Ring Switch. Using the EOTec 2104 Switch Tools, you can configure the ring switch as a Modbus slave station with its own Modbus station number and IP address.

## Monitoring the Status of EOTec 2104 Ethernet Ring Switches

Each EOTec 2104 Ring Switch has 32 discrete input registers that are regularly updated with status information on port link and ring status (both copper and fiber), and status of the OK and ON LEDs. These 32 registers can be polled using Modbus Protocol.

These switches respond as Modbus slaves using standard Modbus over Ethernet messaging. The EOTec 2104 Ethernet Ring Switch supports standard Modbus IP packets. In order to maintain their real-time characteristics, these switches support UDP messaging. These switches will not establish TCP/IP sessions because the TCP layer adds overhead to the communications and cannot ensure real-time performance. (Please note that both TCP and UDP use the identical IP message packets.)

Most Modbus over Ethernet masters give you a choice of using UDP or TCP. Sometimes the UDP is identified as a real-time option. For computer applications, the use of the **KepServerEx OPC Server** is recommended.

**Note**: You also will need to purchase the Modbus Ethernet driver for the KepServerEx.)

Modbus support must be enabled in the EOTec 2104 Switch Tools utility. When Modbus status reporting is enabled, it is necessary to assign a unique IP address to each Weed Ring Switch. It is also recommended to assign a unique Modbus station address (1 to 247) to each switch.

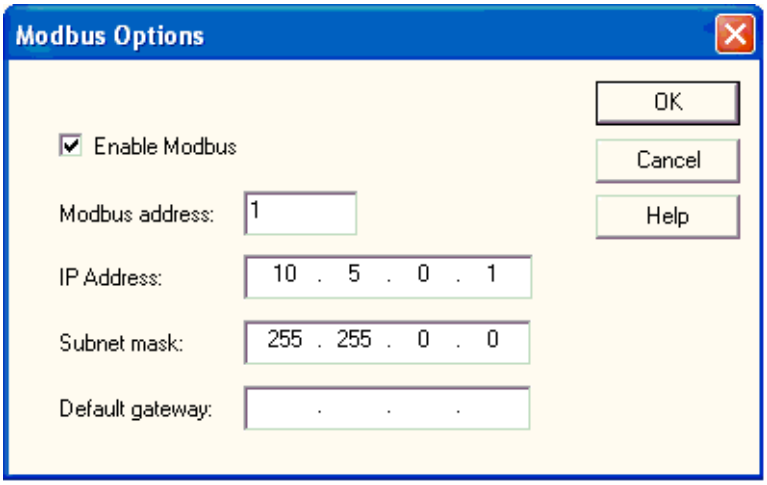
| Modbus Address | Status | Modbus Address | Status |
|---|---|---|---|
| 10001 | Link on port 1 | 10019 | Ring 1: Second port is passing data (not blocked) |
| 10002 | Link on port 2 | 10020 | Ring 2 complete |
| 10003 | Link on port 3 | 10021 | Ring 2: First port is passing data (not blocked) |
| 10004 | Link on port 4 | | |
| 10005 | Link on port 5 | 10022 | Ring 2 second port is passing data (not blocked) |
| 10006 | Link on port 6 | | |
| 10007 | Link on port 7 | 10030 | OK output ON (no alarms) Output will be ON if both power and all enabled rings are complete. |
| 10008 | Link on port 8 | | |
| 10009 | Link on port 9 | | |
| 10017 | Ring 1 complete | 10031 | First power input valid ** |
| 10018 | Ring 1: First port is passing data (not blocked) | 10032 | Second power input valid ** |

** For the EOTec 2104, Power 1 and Power 2 are electrically tied together so both will indicate the same power status.

**Note**: When EOTec 2104 Ring Switches are connected in a complete (not broken) ring, one of the ring port registers (1:0018, 1:0019, 1:0021 or 1:0022) on the ring switch with the lowest-numbered MAC address will show as OFF. This is to be expected, because one of the ring ports must block communication in one direction on the ring. By design, the ring switch with the lowest-numbered MAC address does this, unless you designate an alternate ring switch from within the rings configuration window of the EOTec 2104 Switch Tools utility. Refer to the description of the Switch Configuration window, Rings Page in Chapter 3, *Introducing Switch Tools*, for more information.

# Modbus Options Window

If you want to enable Modbus monitoring, click in the **Modbus** field on the main window. The Modbus Options window appears.




In this window, assign a unique Modbus address (station number), a unique IP address and an appropriate subnet mask for the IP address. The Modbus address must be in the range of 1 to 247.

## *IP Address*

Enter a unique IP address for the Weed Ring Switch. An Ethernet IP address is a 4-byte value that is displayed in dotted decimal notation:

**Example**: 10. 5. 0. 1

This address contains two pieces of information: the network ID and the host ID.

### Network ID

Typically, the first one-to-three bytes of the IP address are the network ID. This ID identifies a group of computers and other devices (such as Weed Ring Switches) that are all located on the same logical network. In *internetworks* (networks formed by a collection of local area networks), there is a unique network ID for each network.

### Host ID

The last one-to-three bytes of the IP address are the host ID. This ID identifies your computer or Weed Ring Switch within a particular network ID. (A host is any device that is attached to the network and uses TCP/IP protocol.)

## *Subnet Mask*

Enter a subnet mask that is appropriate for your Ethernet network.

A sizable Ethernet network can be divided into a number of sub-networks (subnets). These user-defined sub-networks allow unique clusters of Ethernet devices to perform their own communications simultaneously over the same Ethernet wires, independent of the other sub-networks.

Every device on such a subdivided network is assigned a subnet mask. The subnet mask you assign effectively attaches that device to a given sub-network. Devices with comparable subnet masks will be able to communicate with one another. Devices with dissimilar subnet masks can communicate only through a gateway or routing device.

If the *masked* bits of two IP addresses are the same, the two addresses belong to the same subnet.

When you apply a subnet mask to an IP address, you perform a BITWISE AND operation. The AND operation is performed when you apply Boolean algebra to the binary format of both the IP address and the mask. The rules of an AND state that, if both digits are 1, the result is 1. If either digit is 0, the result is 0.

In our first example, we perform an AND operation on the local stations and the destination station #1 using the same subnet mask (255.255.255.240). Notice that in Figure 5.1 and Figure 5.2 this operation results in an address of **208.222.150.0**. In the fourth byte of the subnet mask, the four right-most bits (1111**0000**) are not significant because they are all zeros. Therefore, address 208.222.150.0 is the result of *ANDing* Figure 5.1 and Figure 5.2 and will be the result when we apply the mask to every address between 208.222.150.0 and 208.222.150.15. From this, we can establish that 208.222.150.0 to 208.222.150.15 is the range of IP addresses for one subnet. Notice that both IP addresses from Figure 5.1 and Figure 5.2 fall within this range. We can now conclude that **yes**, these two IP addresses reside on the same subnet and, therefore, can communicate with each other without any assistance from a gateway or routing device.

| | IP Address | First Byte | Second Byte | Third Byte | Fourth Byte |
|---|---|---|---|---|---|
| **Subnet Mask** | 255.255.255.240 | 11111111 | 11111111 | 11111111 | 1111**0000** |
| **Destination IP Address #2** | 208.222.150.7 | 11010000 | 11011110 | 10010110 | 00000111 |
| **Result of AND** | **208.222.150.0** | 11010000 | 11011110 | 10010110 | 00000000 |

**Figure 5.1**

| | IP Address | First Byte | Second Byte | Third Byte | Fourth Byte |
|---|---|---|---|---|---|
| **Subnet Mask** | 255.255.255.240 | 11111111 | 11111111 | 11111111 | 1111**0000** |
| **Destination IP Address #2** | 208.222.150.11 | 11010000 | 11011110 | 10010110 | 00001011 |
| **Result of AND** | **208.222.150.0** | 11010000 | 11011110 | 10010110 | 00000000 |

**Figure 5.2**

In the second example we apply our mask to destination address 208.222.150.18. Notice in Figure 5.3, the fourth byte for this destination IP address (**0001**0010) is different than Figure 5.1 and Figure 5.2. Because of this difference, a different result will be derived. Note that 208.222.150.18 is out of our previous subnet range of 208.222.150.0 to 208.222.150.15. We can conclude that **no**, this IP address does not reside on the same subnet as Figure 5.1 and Figure 5.2. This IP address must reside on a different subnet because it is not compatible with our subnet mask. Because it does not reside on this subnet, messages for this IP address must be sent to a gateway or routing device to be forwarded until a compatible subnet mask accepts them.

| | IP Address | First Byte | Second Byte | Third Byte | Fourth Byte |
|---|---|---|---|---|---|
| **Subnet Mask** | 255.255.255.240 | 11111111 | 11111111 | 11111111 | 11110000 |
| **Destination IP Address #2** | 208.222.150.18 | 11010000 | 11011110 | 10010110 | **0001**0010 |
| **Result of AND** | **208.222.150.16** | 11010000 | 11011110 | 10010110 | 00010000 |

**Figure 5.3**

## *Default Gateway*

If necessary, enter an appropriate default gateway in this field.

This feature lets your Weed Ring Switch communicate with devices on other networks. If you specify a default gateway address, then the default gateway, if configured properly, will be able to route messages to the other networks.

The subnet mask setting in the Modbus Options window is what determines whether a message should be routed to another network.

## *Modbus Monitor Poll Time*

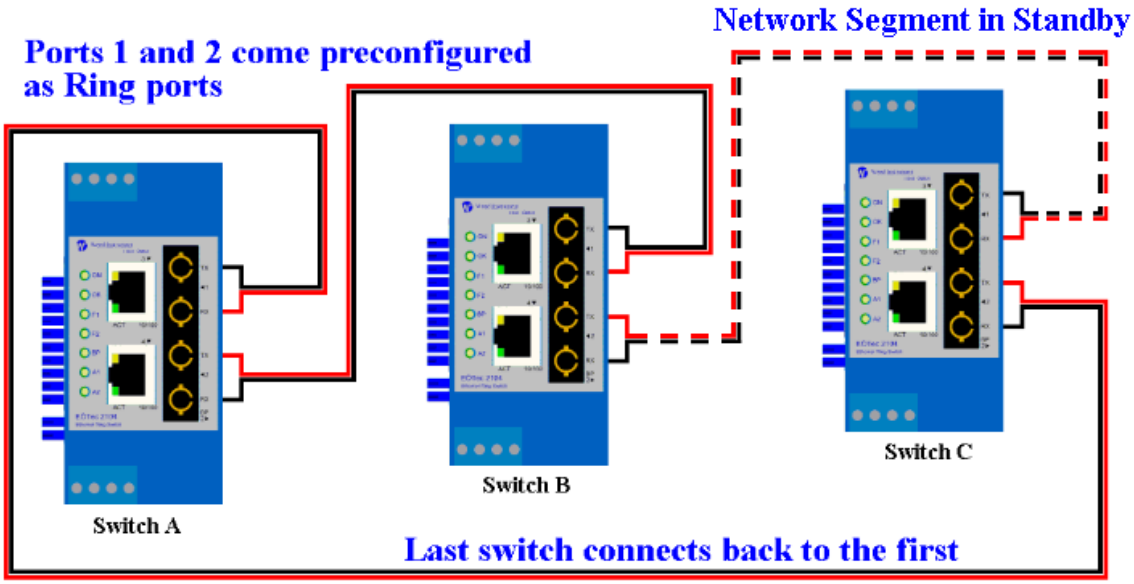
If you are using the Modbus Monitor feature, it is best to keep the poll time of your Modbus master driver or hardware device to a reasonable rate. Polling the EOTec 2104 Ring Switch too rapidly may degrade its performance. The fastest poll time you should use will depend on the application. As a guideline, a poll time of 500 mS should not adversely affect the performance of your ring switch.

# Modbus Diagnostics Example

As an example of how to debug a network using the Modbus registers, we will examine a simple ring topology.

## *Scenario 1: No Breaks*

The diagram below depicts three EOTec 2104 Ethernet Ring Switches configured for one ring. The ring network is currently in good health (no breaks in the ring) with the solid line indicating the active part of the ring, and the dashed line indicating the standby (blocked) part of the ring.



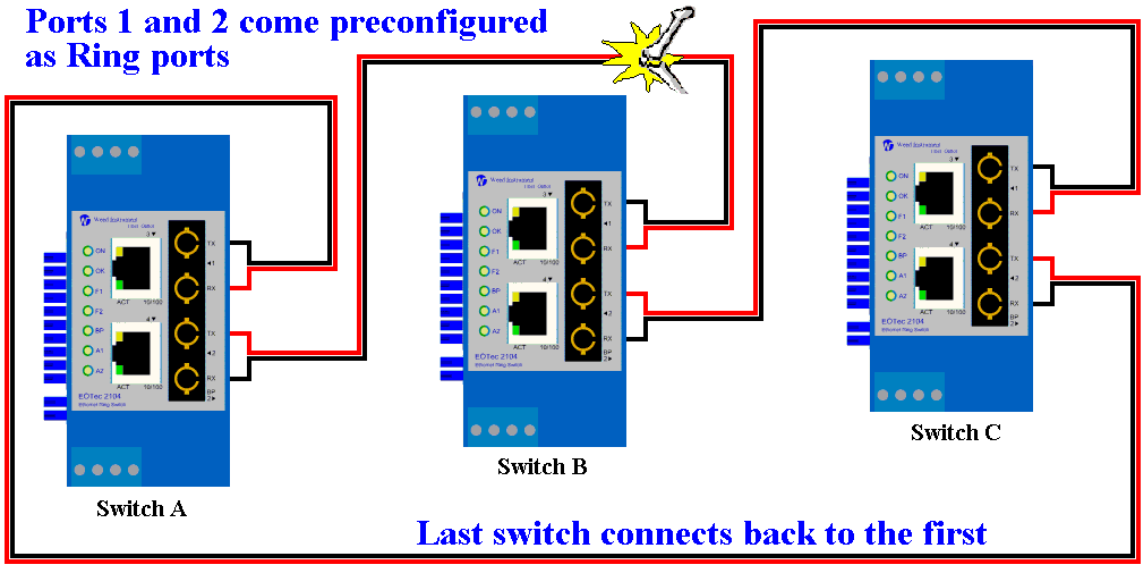

Because the ring network is in good health, we can expect these values from the Modbus registers of each switch:

| Switch A | Switch B | Switch C |
|---|---|---|
| Ring 1 Complete: **1** | Ring 1 Complete: **1** | Ring 1 Complete: **1** |
| First Port of Ring 1: **1** | First Port of Ring 1: **1** | First Port of Ring 1: **0** |
| Second Port of Ring 1: **1** | Second Port of Ring 1: **1** | Second Port of Ring 1: **1** |

A ring network in good health would have the Ring Complete bit set to one in all ring switches. Also, all ports in the ring should be forwarding except for one port that should be blocking. The blocking port indicates the standby/backup path of the existing ring.

## *Scenario 2: A Network Break*

If the ring experiences a break as depicted below, we immediately see that the Ring 1 Complete bits for each switch have gone to 0. The port that was in the blocking state automatically changes to the forwarding state to activate the standby Ethernet path.




With the break indicated above, we would expect these values from the Modbus registers of each switch:

| Switch A | Switch B | Switch C |
|---|---|---|
| Ring 1 Complete : **0** | Ring 1 Complete : **0** | Ring 1 Complete : **0** |
| First Port of Ring 1 : **1** | First Port of Ring 1 : **0** | First Port of Ring 1 : **1** |
| Second Port of Ring 1 : **0** | Second Port of Ring 1 : **1** | Second Port of Ring 1 : **1** |

With the ring broken, each ring port reports whether its ring partner is available. In the example above, we see that for switch A, the *First Port of Ring 1* has a value of 1. This means that switch A can talk to its ring partner (Ring Switch C). For the same switch, we see that the *Second Port of Ring 1* has a value of 0. This means that switch A is **not** able to talk to its ring partner for that port (Ring Switch B).

Based on this information, you can localize where a break in a ring has occurred by checking which ports report back with 0 when a ring is broken. When a port reports back with 0, it means the break is local to that particular port.

# 6

# Default Settings

This chapter lists the factory default settings when the EOTec 2104 Ethernet Ring Switch comes out of the box. Use this information to find out what changes may be necessary for tailoring the switch to your exact needs.

## Default Settings

### *Pre-configured Port Settings*

Fiber ports [1; 2] configured as ring ports.

Copper ports [3; 4; 5] configured as standard Ethernet ports

Master switch selection: Automatic

### *Port Configuration (all ports)*

| Port | Name | Admin | Negotiation | Speed and Duplex | Flow Control |
|---|---|---|---|---|---|
| # | Port_1 | Enabled | Auto | 10h 10f 100h 100f | Disabled |

### *Broadcast Limit*

Enabled on all ports

### *Port Mirroring*

Mirroring: Disabled

### *Priority Queuing*

Use 802.1p Tag Priority: Enabled

Use IP ToS/DiffServ: Enabled

Priority Precedence: Tag

Default Priority: Normal

Output Tag: Unchanged

## *IEEE Tagging*

| Priority | Traffic Type | Output Queue |
|---|---|---|
| 0 | Best Effort | 0 |
| 1 | Background | 0 |
| 2 | Spare | 0 |
| 3 | Excellent Effort | 1 |
| 4 | Controlled Load | 1 |
| 5 | Video | 1 |
| 6 | Voice | 1 |
| 7 | Network Control | 3 |

# 7

# General Features and Capabilities

This section explains the primary Ethernet and fiber capabilities of the EOTec 2104 Ethernet Ring Switch.

## Ring Algorithm and Performance

The Ring feature utilizes a special algorithm that assures very fast recovery times. Each EOTec 2104 Ethernet Ring Switch utilizes the special high-speed algorithm to keep track of the health of the ring. In a healthy ring (a complete ring), one ring switch is automatically picked to act as a master (switch with lowest MAC address) for the ring network. Alternatively, you can designate one of your ring switches to be the master using the EOTec 2104 Switch Tools. It is the master switch's job to determine which one of its local ring ports are to be in the forwarding or backup state. The ring port chosen to be in the backup state is where the backup segment of the ring will be. By default, the ring port with the higher port number will become the backup port.

All ring switches in the ring must have a way to keep track of each other in case a failure in communication occurs along the ring. To keep track of the health of the ring, the EOTec 2104 Ethernet Ring Switches periodically send test messages to each other. Therefore, the ring switches can sense if a ring gets cut at a certain location and will take the appropriate action to bring the network back online. The ring will recover after the last switch knows about the situation and takes appropriate action to rectify the communication problem.

To estimate recovery time, multiply 5 mS times the number of switches, and then add 30 mS (for loss of link errors) or 60 mS (for message loss errors). For example, a ring of 10 switches would have a recovery time of 80 mS for the typical loss of link type errors.

## Master Switch Selection

As mentioned above, the ring switch with the lowest MAC address automatically becomes the master and blocks one of its ports (highest number port). Alternatively, you can designate one of your ring switches to be the master using the EOTec 2104 Switch Tools. There is a simple check box where you can select **Automatic** or **This Switch** for the master ring switch selection. This advanced capability allows you to control where the backup port will be in your network. It is recommended that only one ring switch be designated as the master. If more than one is designated as the master, the one with the lowest MAC address will prevail.

# EOTec 2104 Switch Tools

In some applications it may be desirable or required to adjust the Weed Ring Switch parameters for proper or best operation. The EOTec 2104 Switch Tools software utility is provided to make these adjustments. Using the **Auto-Find Switches** feature in the utility, you can pick from a list of detected ring switches and load custom configurations via Ethernet. The auto-find feature eliminates the hassle of loading via a serial connection and the overhead time spent assigning IP addresses. Refer to the on-line help or Chapter 3 of this manual for details on using the EOTec 2104 Switch Tools.

# Port Configuration

EOTec 2104 Ring Switches auto-negotiate port settings. When connecting ports of 2104 switches together, port settings are best left in the default **Auto** connection mode. For situations where you must link a port of a 2104 switch to a port of a non-2104 switch that has a **Fixed** setting, ensure that you match port settings of the link partners that connect these two switches. See Configuring the 2104 Ring Switch Ports section for more information. Adjust port configuration settings using the EOTec 2104 Switch Tools.

# NPF – Netgroup Packet Filter

Netgroup Packet Filter is the kernel portion of WinPcap. Normal users are probably interested in how to use WinPcap and not in its internal structure, but a brief summary is provided here for the more curious users.

NPF is the WinPcap component that does the hard work, processing the packets that transit on the network and exporting capture, injection and analysis capabilities to user-level. NPF is implemented as a protocol driver. This is not the best possible choice from the performance point of view, but allows reasonable independence from the MAC layer and as well as complete access to the raw traffic. Interaction with the OS is normally asynchronous. This means that the driver provides a set of callback functions that are invoked by the system when some operation is required to NPF. NPF exports callback functions for all the I/O operations of the applications: open, close, read, write, etc.

EOTec 2104 Switch Tools v1.7 provides a new feature that will allow a Windows OS administrator to enable or disable the NFP driver on restricted user accounts. For PCs with more than one user account such as a guest or limited use account, the NFP driver can be disabled for the restricted account only while remaining active at the admin level. See Loading the EOTec 2104 Software on how to install this function.

More information on NFP can be found at www.winpcap.org

# Fault Tolerant Rings

A network backbone wired in a ring-type topology is one of the best choices for a fault-tolerant network. By default, Weed Ring Switches are factory preset to have one ring enabled. Factory presetting a ring configuration lets you skip the step of using the EOTec 2104 Switch Tools to enable your rings so you can have the convenience of plug and play operation. To change the ring configuration in the switch, simply launch the EOTec 2104 Switch Tools and specify a pair of ports for your new enabled ring. The OK LED will be green if all enabled rings (one or two) for this switch have continuous ring integrity.

For a ring to function, all switches in the path of the ring must have Ring support. Do not connect rings within rings. Only simple non-overlapped rings are allowed. Two active rings cannot share a network segment. It is possible to join two rings together by configuring two rings in a single switch. The ports used for each ring must be distinct, so that no network segment is shared by both rings.

Refer to Chapter 4, *Ring Configurations*, for information and illustrations on valid ring topologies.

# General Features and Capabilities

This section summarizes the features and capabilities of the EOTec 2104 Ring Switch, in alphabetical order.

## *10BaseT and 100BaseTX Auto-detection*

Standard Ethernet (10BaseT) has a maximum speed of 10 Mbps (half duplex mode) or 20 Mbps (full duplex mode). Fast Ethernet (100BaseTX) has a maximum speed of 100 Mbps (half duplex mode) or 200 Mbps (full duplex mode).

## *100BaseFX (Multimode and Single-mode) Fiber Optic Port*

The fiber optic ports found on some models are classified as 100BaseFX and support 100 Mbps operation. Both multimode and single-mode models are available. Multimode accommodates multiple wavelengths over a cable with a typical core diameter of 50 or 62.5 microns. The maximum distance for multimode is up to 2 km. Single-mode uses a single wavelength and cable core diameter of around 9 microns, which allows for a maximum distance of 40 km (long haul models) or more (contact your switch vendor for longer distances).

## *2K MAC Addresses with Automatic Learning, Aging, and Migration*

Each Ethernet device inserts its unique Media Access Control (MAC) address into each message it sends out. The port on the switch used for a given MAC address is automatically learned when a frame is received from that address. Once an address is learned, the switch will route messages to only the appropriate port, instead of broadcasting messages out all ports like a hub. A time stamp is also placed in memory when a new address is learned. This time stamp is used with the aging feature, which removes unused MAC addresses from the table after 300 seconds. If a device moves, the associated port on the switch is changed (migrated) as needed.

## *3.2 Gbps Bandwidth*

The fast Ethernet switches have 3.2 Gbps. This means they can support full duplex communications on all ports at the same time.

## *Auto-crossover (Auto-MDI/MDIX)*

The RJ45 ports of the EOTec 2104 Ethernet Ring Switch automatically detect the cable type (straight-through vs. cross-wired) and re-configure themselves accordingly.

## *Auto-polarity*

The auto-polarity feature corrects reversed polarity on transmit and receive twisted pair.

## *Automatic Power Saving*

If there is no cable on a port, most of the circuitry for that port is disabled to save power.

## *Auto-sensing Speed and Flow Control*

The RJ45 ports of the EOTec 2104 Ethernet Ring Switch will auto-negotiate with the connected device to determine the optimal speed and flow control for each port. Be aware that the Ethernet protocol does not provide for auto-sensing of a switches duplex mode. When an auto-sensing port is linked to a fixed port, the auto-sensing port must assume the lowest duplex mode (half duplex) to ensure a proper connection. See Configuring the 2104 Ring Switch Ports section for more information.

## *Backplane*

Each EOTec 2104 module has a backplane that can plug directly into other Weed Instrument modules. This BUS interconnection is located on the side of each unit and provides an additional Ethernet connection without the need of a cabled interface.

## *Broadcast Storm Protection*

Each port can be configured to filter out undesirable broadcast and multicast messages.

## *Buffering*

SRAM is used for buffering the messages. The EOTec 2104 Ethernet Ring Switches have 1 Mbits (128 Kbytes). The buffer size is automatically allocated for each port as necessary.

## *Flow Control*

Weed Ring Switches automatically support flow control frames on both transmit and receive sides. Back-pressure flow control is used for half-duplex ports. Pause-frame flow control is used for full-duplex ports.

## *Forwarding*

Weed Ring Switches support store and forward mode. They will forward messages with known addresses out only the appropriate port. Messages with unknown addresses, broadcast messages, and multicast messages will get forwarded out all ports except the source port.

## *Full / Half Duplex Operation*

The RJ45 ports of these switches support both full and half duplex operation. The fiber optic port(s) are full duplex. Weed does not recommended connecting link partners with different duplex modes. See Configuring the 2104 Ring Switch Ports section for more information.

## *Illegal Frames*

Illegal frames as defined by IEEE 802.3 will be dropped. This includes short frames, long frames, CRC error frames, and alignment error frames.

## *IEEE 802.3 Compliant*

EOTec 2104 Ethernet Ring Switches strictly abide to the IEEE 802.3 standard for 10BaseT, 100BaseTX, and 100BaseFX Ethernet communications.

## *Latency*

The typical latency of a message is 5 microseconds (@ 100 Mbps) plus the frame time. The latency is the time it takes a message to be routed internal to a switch from one port to another. This time is highly dependent on the amount of network activity, the speed, and the features enabled in the ring switch.

## *Non-blocking*

This means that the ring switches offer the best in performance and are capable of full-wire speed transmissions.

## *Port Mirroring*

Port mirroring is a powerful diagnostic mode that lets you map messages between ports.

## *Plug and Play*

This means that most functions or features of these ring switches are automatic and that there are minimal or no optional parameters that need to be set. Just plug in your Ethernet cables, apply power, and the unit will immediately begin to operate. The EOTec 2104 Ethernet Ring Switches can even be factory pre-configured to your exact needs.

## *Priority Queuing or Traffic Prioritization*

The Weed Ring Switches support QoS (Quality of Service), CoS (Class of Service), ToS (Type of Service), and DS (Differentiated Services) mechanism for ensuring the priority traffic is handled properly. These advanced parameters can be set via the configuration utility.

## *Protocol Independent*

The Weed Ring Switches will work with all popular Ethernet protocols and networks such as TCP/IP, the Internet (IP), UDP, NetBEUI, and many more. They are compatible with all protocols that run over standard Ethernet (IEEE 802.3). In fact, they will support packets of different protocols simultaneously.

# A

# Technical Specifications

| Copper RJ45 Ports: (10/100BaseTX) | |
|---|---|
| Connectors | Shielded RJ45 |
| Protocols supported | All standard IEEE 802.3 |
| Ethernet compliancy | IEEE 802.3, 802.3u, 802.3x, 802.3z, 802.1p, and more |
| Auto-crossover | RJ45 MDI/MDIX (allows you to use straight or cross wired cables) |
| Auto-negotiating | 10BaseT and 100BaseTX |
| Auto-sensing | Full or half duplex |
| Auto-polarity | Yes, on the TD and RD pairs |
| Flow control | Yes, for full or half duplex |
| Full or half duplex | Yes, automatic or configurable |
| Ethernet isolation | 1500 VRMS 1 minute |
| Plug and play | Yes, with factory pre-configuration available for special parameters |
| Cable requirements | Twisted pair (Cat. 5 or better) (shielded recommended) |
| Max. cable distance | 100 meters |

| Backplane Port: (10/100BaseTX) | |
|---|---|
| Connectors | Standard EOTec 2000 backplane connector |
| Protocols supported | All standard IEEE 802.3 |
| Ethernet compliancy | IEEE 802.3, 802.3u, 802.3x, 802.3z, 802.1p, and more |
| Auto-crossover | Not applicable (no cable) |
| Auto-negotiating | 10BaseT and 100BaseTX |
| Auto-sensing | Full or half duplex |
| Auto-polarity | Not applicable (no cable) |
| Flow control | Yes, for full or half duplex |
| Full or half duplex | Yes, automatic or configurable |
| Ethernet isolation | 1500 VRMS 1 minute |

| Backplane Port: (10/100BaseTX) | |
|---|---|
| Plug and play | Yes, with factory pre-configuration available for special parameters |
| Cable requirements | Not applicable (no cable) |
| Max. cable distance | Not applicable (no cable) |

| SC or ST Fiber Ports: (100BaseF multimode or single-mode) | |
|---|---|
| 100BaseFX ports | 2 |
| Fiber port mode | Multimode (MM) or single-mode (SM) |
| Fiber port connector | Duplex SC or ST |
| Optimal fiber cable | 62.5/125 µm for MM; 9/125 µm for SM |
| Center wavelength | 1300 nm |
| TX output power | Contact your switch vendor |
| RX input sensitivity | Contact your switch vendor |
| Max. distance (full duplex) | 2 km with MM; 15 km with SM,<br>40 or 60 km with long haul SM |
| Full and half duplex | Software configurable |
| Ethernet compliance | 100BaseFX |
| Eye safety | IEC 60825-1, Class 1; FDA 21 CFR 1040.10 and 1040.11 |

| General: | | |
|---|---|---|
| **Operation** | Intelligent store and forward, non-blocking | |
| Ethernet protocols supported | All IEEE 802.3 | |
| Typical latency for 10 Mbps | 16 µs + frame time | Varies on load and settings |
| Typical latency for 100 Mbps | 5 µs + frame time | |
| MAC addresses supported | 2 K | |
| Buffer memory | 1 Mbits (128 Kbytes) | |
| Buffer allocation per port | Automatic and dynamic | |
| Memory bandwidth | 3.2 Gbps for full-wire speed on all ports | |
| Address learning | Automatic | |
| Address aging | Remove old address after 300s | |

| General: | |
|---|---|
| Address migration | Automatic |
| Back pressure | Automatic for half-duplex |
| Illegal frames | Dropped per 802.3 |
| Flow control | Yes, for half and full duplex |
| Traffic prioritization | 802.1p, QoS, CoS, ToS/DS |
| **Status Reporting** | Power and operational status |
| Modbus over Ethernet (UDP) | Modbus status registers |
| OK, A1 and A2 relay contacts | 30VDC, 0.5A |

| | |
|---|---|
| **Ring Features** | Fault-tolerant loop support |
| Maximum switches in ring | 50+ |
| Dual ring support | Yes |
| Link loss recovery time | Less than 30 mS plus 5 mS per hop |
| **Environmental** | DIN rail mounting |
| Power input | Backplane and screw terminals |
| Input power (typical with all ports active) | 8.0 W |
| Input voltage | 15-40 VDC |
| Transient protection | 1500 Watts peak |
| Spike protection | 5,000 Watts (10x for 1000 µs) or 250 volts (50x for 100 µs) |
| Ethernet isolation | 1500 VRMS 1 minute |
| Operating temperature range | -40 to +85 °C |
| Storage temperature range | -40 to +85 °C |
| Humidity (non-condensing) | 5 to 95% RH |
| EMI emissions<br>EMC immunity | CFR 47 FCC part 15, IEC61326-1 |
| Hazardous locations | FM/cFM Class I, Division 2, Groups A, B, C and D, T4 |
| Packaging (polyamide) | UL 94V-0 |
| Dimensions (L x W x H) | See mechanical diagram in installation guide |

# B

# EOTec 2104 Product Series

| EOTec 2104 Product Series | | | | Power | | Optical Fiber | |
|---|---|---|---|---|---|---|---|
| Part Number | Description | Connector (Qty) | Connector Type | 24VDC To Module | 9VDC Thru-Backplane | Mode | Distance | Fiber (Glass) |
| 2104-55 | Ethernet Ring Switch, 4 Port, 1300nm | 2 | RJ45 | X | X | MM | 2km | 62.5/125µm |
| | | 2 | ST | | | | | |
| 2104-57 | Ethernet Ring Switch, 4 Port, 1300nm | 2 | RJ45 | X | X | MM | 2km | 62.5/125µm |
| | | 2 | SC | | | | | |
| 2104-59 | Ethernet Ring Switch, 4 Port, 1300nm | 2 | RJ45 | X | X | SM | 15km | 9/125µm |
| | | 2 | SC | | | | | |
| 2104-61 | Ethernet Ring Switch, 4 Port, 1300nm | 2 | RJ45 | X | X | SM | 40km | 9/125µm |
| | | 2 | SC | | | | | |
| 2104-63 | Ethernet Ring Switch, 4 Port, 1300nm | 2 | RJ45 | X | X | SM | 60km | 9/125µm |
| | | 2 | SC | | | | | |
| 2104-E | Ethernet Switch Expansion Module | 4 | RJ45 | | X | n/a | n/a | n/a |
| 2E54 | Ethernet Converter Module, 2 Port, 1300nm | 1 | RJ45 | | X | MM | 2km | 62.5/125µm |
| | | 1 | ST | | | | | |
| 2E56 | Ethernet Converter Module, 2 Port, 1300nm | 1 | RJ45 | | X | MM | 2km | 62.5/125µm |
| | | 1 | SC | | | | | |
| 2E58 | Ethernet Converter Module, 2 Port, 1300nm | 1 | RJ45 | | X | SM | 15km | 9/125µm |
| | | 1 | SC | | | | | |
| 2E60 | Ethernet Converter Module, 2 Port, 1300nm | 1 | RJ45 | | X | SM | 40km | 9/125µm |
| | | 1 | SC | | | | | |
| 2E62 | Ethernet Converter Module, 2 Port, 1300nm | 1 | RJ45 | | X | SM | 60km | 9/125µm |
| | | 1 | SC | | | | | |

# C

# Service Information

## Technical Support and Service

For technical support, please go to our website at:
**www.weedinstrument.com/contact_us/technical.html**

### *Installation and Operation*

Our professionals guide you through the installation and operation of your new product so that it is efficiently operational in the minimum amount of time. Weed Instrument also helps you install options and upgrades to ensure that your product is successfully enhanced with more performance and new capabilities.

### *Troubleshooting*

Should you have a question regarding the operation of your instrument or its perceived malfunction, the technical support experts will help you determine the issue and offer you the best possible solution. Before contacting us, please go to our website at **www.weedinstrument.com/contact_us/tech_support/troubleshooting.html** and determine if any of the troubleshooting tips solve your problem.

### *Service and Repair*

If you need service or repair, please go to our website at:
**www.weedinstrument.com/contact_us/tech_support/service.html**

1. Click the link for the RETURN MATERIAL AUTHORIZATION FORM. This must be filled out completely in order to obtain a Return Material Authorization Number (RMA#) from Weed Instrument.
2. The RMA# must be marked on the outside of the box prior to shipping the unit to us for repair or calibration.
3. You are responsible for fully decontaminating your unit prior to shipment. If we receive a contaminated product we reserve the right to have it removed and destroyed by a HAZ MAT team at the owner's expense.
4. Once the form is complete, please send to Weed Instrument by clicking on the **Submit** button. You will be given an RMA number within 24 hours. If you need the RMA# immediately, please call after sending it and a Service Administrator will give you the number verbally.

**Part Number:** **RM0900187**
**Revision:** **08/08**