TECHNICAL MANUAL

quadbox

FIBER/COPPER, COPPER/FIBER TRANSPORT MEDIA CONVERSION MODULES

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1.1 DOCUMENTATION AND SAFETY OVERVIEW

This manual provides instructions for the installation, operation, and maintenance of the Quadbox series transport media conversion modules built by PESA.

It is the responsibility of all personnel involved in the installation, operation, and maintenance of the equipment to know all the applicable safety regulations for the areas they will be working in. ***Under no circumstances should any person perform any procedure or sequence in this manual if the procedural sequence will directly conflict with local Safe Practices. Local Safe Practices shall remain as the sole determining factor for performing any procedure or sequence outlined in this document.***

1.2 WARNINGS, CAUTIONS, AND NOTES

Throughout this document, you should notice various Warnings, Cautions, and Notes. These addendum statements supply necessary information pertaining to the text or topic they address. It is imperative that audiences read and understand the statements to avoid possible loss of life, personal injury, and/or destruction/damage to the equipment. These additional statements may also provide added information that could enhance the operating characteristics of the equipment (i.e., Notes). Examples of the graphic symbol used to identify each type of statement and the nature of the statement content are shown in the following paragraphs:

1.2.1 WARNING

	**Warning statements identify conditions or practices that can result in loss of life or permanent personal injury if the instructions contained in the statement are not complied with.**

1.2.2 CAUTION

	**Caution statements identify conditions or practices that can result in personal injury and/or damage to equipment if the instructions contained in the statement are not complied with.**

1.2.3 NOTE

	**Notes are for information purposes only. However, they may contain invaluable information important to the correct installation, operation, and/or maintenance of the equipment.**

Chapter 2 Introduction

2.1 DESCRIPTION

PESA's Quadbox Series transport media converter modules provide a full line of versatile, low cost copper (coax) to fiber/fiber to copper converters for SDI signals; some models include signal routing capability in addition to media conversion. Quadbox offers easy solutions for transport media conversion applications or signal extension over fiber, up to 10kM. Modules are available with up to four independent conversion channels for SD, HD or 3G-SDI signals, compliant with SMPTE 259M, 292M, 372M and 424M, utilizing a dedicated 2.97 Gbps optical transport per fiber port.

Quadbox converters/extenders are available as Transmit Modules that accept input signals through BNC connectors over copper coax cable and provide these as fiber output signals; or Receive Modules that accept fiber inputs and provide outputs to BNC signal connectors. Transmit and Receive modules may be paired for signal extension over fiber, or may be used individually for transport media conversion applications. Modules may be used as standalone "bricks" or mounted in an optional 1 Rack Unit (RU) frame that holds up to 4 modules, and includes a power supply that powers all modules in the rack from a single input power source. Figure 2-1 shows a typical transmit module (top) and receive module.

Figure 2-1 Quadbox Transport Media Converter - Typical Transmit and Receive Module

Several variations of transmit and receive modules are available to accommodate a wide range of applications in the most cost effective manner. In their standard configuration, modules offer up to four paired channels, meaning that each input connector and its corresponding output connector function as a dedicated set and operate totally independent of other paired I/O channels. Models of transmit and receive modules are also available with internal switching/routing capability, meaning that any input can be routed to any, or all, outputs. Switching and routing functions and channel assignments are configured through the GUI application and may be changed as needed for a particular application. Each module type is discussed in the following paragraphs:

- **Dual-30 Transmit or Receive Module** – Dual transmit modules provide two active BNC input connectors for coax and a single installed dual SFP module that provides two independent fiber output signals. Input 1/Output 1 and input 2/Output 2 are dedicated pairs and function fully independent of one another. Dual receive modules provide two fiber signal inputs (one dual SFP device) and two active BNC output connectors. Dual transmit or receive modules are available only as modules capable of SD-SDI to 3G-SDI operation, up to 3Gbps, in accordance with SMPTE standards 259M, 292M, 372M and 424M.

- **Quad-15 Transmit or Receive Module** – With Quad-15 transmit modules all four BNC input connectors are active and two dual SFP modules are installed, providing four independent fiber output signals. Input 1/Output 1 through Input 4/Output 4 are dedicated pairs and function fully independent of one another. Quad-15 receive modules provide four fiber signal inputs (two dual SFP devices) and four active BNC output connectors. Quad-15 transmit or receive modules process SD-SDI or HD-SDI signals, up to 1.5Gbps, in accordance with SMPTE standards 259M, 292M and 372M.

- **Quad-30 Transmit or Receive Module** – Quad-30 transmit modules provide all four BNC connectors as active inputs and two dual SFP modules, providing four independent fiber output signals. Input 1/Output 1 through Input 4/Output 4 are dedicated pairs and function fully independent of one another. Quad-30 receive modules provide four fiber signal inputs (two dual SFP devices) and four active BNC output connectors. Quad-30 transmit or receive modules are capable of SD-SDI to 3G-SDI operation, up to 3Gbps, in accordance with SMPTE standards 259M, 292M, 372M and 424M.

- **Dual-30 4X2 Transmit Module** – Dual 4X2 transmit modules provide four active BNC input connectors for coax and a single installed dual SFP module that provides two fiber output signals. Through the GUI application, and the internal routing function, any of the four coax inputs may be selected as the output signal for the fiber optic outputs. Dual transmit modules with internal routing are capable of SD-SDI to 3G-SDI operation, up to 3Gbps, in accordance with SMPTE standards 259M, 292M, 372M and 424M.

- **Dual-30 2X4 Receive Module** – Dual 2X4 receive modules provide two fiber signal inputs (one dual SFP device) and four active BNC output connectors. Through the GUI application, and the internal routing function, either of the two input signals may be selected as the output signal for any of the four BNC coax output connectors. Dual receive modules with internal routing are capable of SD-SDI to 3G-SDI operation, up to 3Gbps, in accordance with SMPTE standards 259M, 292M, 372M and 424M.

- **Quad-30 4X4 Transmit Module** – Quad 4X4 transmit modules provide four active BNC input connectors for coax and two installed dual SFP module that provide four fiber output signals. Through the GUI application, and the internal routing function, any of the four coax inputs may be selected as the output signal for any of the four fiber optic outputs. Quad transmit modules with internal routing are capable of SD-SDI to 3G-SDI operation, up to 3Gbps, in accordance with SMPTE standards 259M, 292M, 372M and 424M.

- **Quad-30 4X4 Receive Module** – Quad 4X4 receive modules provide four fiber signal inputs (two dual SFP devices) and four active BNC output connectors. Through the GUI application, and the internal routing function, any of the four input signals may be selected as the output signal for any of the four BNC coax output connectors. Quad receive modules with internal routing are capable of SD-SDI to 3G-SDI operation, up to 3Gbps, in accordance with SMPTE standards 259M, 292M, 372M and 424M.

Each Quadbox variant listed above is available as a standalone module with a power supply or for use in the 1RU rack frame where power for each module is derived from the rack chassis power supply. All variations of Quadbox have the same chassis connections and I/O ports. The difference between dual and quad versions is that dual versions are equipped with only one SFP fiber module, and two of the four BNC connectors (channels 3 and 4) are inactive.

Status monitoring and module configuration for Quadbox is done through graphical user interface (GUI) menu screens of PESA's Cattrax controller application installed on a host Windows based PC, as discussed in Chapter 5 of this manual.

Every Quadbox module is equipped with both Ethernet and USB connectivity ports. Single modules may be connected individually to the host PC through the USB port. Status monitoring, set-up configuration and internal signal routing, with modules so equipped, may be performed on a single module over the direct USB connection using the supplied Cattrax controller application.

When Quadbox modules are installed on an Ethernet network, Cattrax can be used as a real-time status monitor or to issue commands to any desired module. If modules are equipped for internal signal routing, switch commands may be sent in real-time to any Quadbox module so equipped over the Ethernet connection. Each module may be assigned a unique identifier name, called its alias, for easy identification on a network installation, or any installation where multiple Quadbox modules are used.

2.2 QUADBOX FEATURES

- Up to 4 copper/fiber conversion ports per module
- 1310 nm optical laser transport signals
- Supports singlemode and multimode fiber cable
- Supports both 62.5m and 50m multimode
- Software setting for output reclocking or by-pass mode
- Can be packaged up to 16 I/O channels in a 1RU space
- Supports redundant power in the 1 RU frame
- Ethernet port for network capabilities
- USB for local setup and diagnostics
- Supports SMPTE 259M-C, 292M, 372M, and 424M
- Up to 2.97Gb/s per port
- 12VDC, 90-240VAC 60/50Hz power brick for standalone modules

2.3 TRANSMIT MODULE

A Quadbox Transmit Module accepts up to four inputs of SDI video over coaxial cable through the chassis mounted BNC connectors. Each input is processed to a fiber media compatible format and is available at the SFP module outputs. Modules with no internal routing capability deliver each input signal to the fiber output corresponding to the input channel number: the signal at BNC input 1 is available at the output of SFP connector 1, etc. Figure 2-2 illustrates a typical Quadbox transmit module.

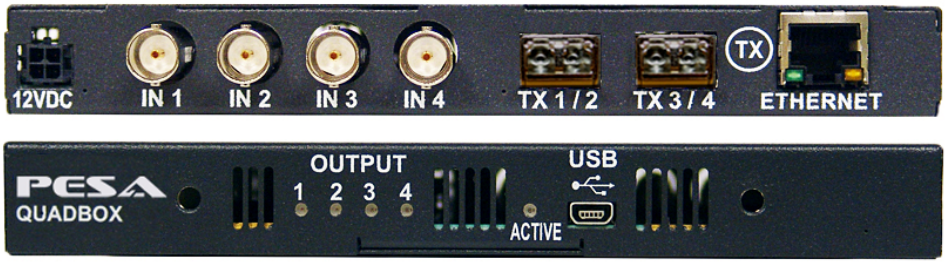


Figure 2-2 Quadbox Transmit Module - Typical

Connectors and status LEDs are identified in Figure 2-2. The function of each is discussed below:

Power Operating power (12 VDC) from an external supply is attached to this connector. When the module is used standalone, power is derived from a furnished "wall-wart" type power supply. If the module is mounted in a rack frame, power for all modules in the frame, plus the frame cooling fans, is derived from a single power brick connected to the frame power distribution panel. A connecting cable connects between the frame power distribution panel and the module power input connector.

Fiber There are two fiber module ports on each transmit module, labeled TX 1/2 and TX 3/4; these are fiber optic outputs 1, 2 and 3, 4, respectively. In quad versions, both ports contain an active LC type, SFP dual fiber transmitter module installed in the carrier slot. In dual versions only port TX 1/2 is equipped with a fiber transmit module, since only outputs 1 and 2 are active. Either singlemode or multimode fiber cable can be used when connecting the output to a receive module or fiber input of a video matrix switcher. Optical cable runs up to 10 kilometers are possible using singlemode fiber; runs up to 400 meters are possible when using multimode fiber cable.

BNC Connectors The four BNC connectors, labeled IN 1 thru IN 4 are the input point for each SDI signal source. In quad versions, all four BNCs are active input connectors. In dual versions, only connectors IN 1 and IN 2 are active.

Ethernet This is a standard 10/100, base-T Ethernet network connector for CAT5E cable. When the transmit module is installed on the facility network, status and configuration operations may be performed at any time using the Cattrax control application through the host PC.

Status LEDs There are four LEDs mounted on the front side of the module, labeled OUTPUT 1 thru 4 and correspond to fiber output channels 1 thru 4. When an LED is lit, it indicates the corresponding fiber output channel is locked to the incoming signal.

USB The USB connector allows the transmit module to communicate with a host PC over a standard USB bus. This connector is used when initially entering operational and set-up parameters to the module via the GUI application. It is not necessary to keep the module attached to the host PC during normal operation.

ACTIVE There is a single LED, labeled ACTIVE, located on the module front panel. When lit, it indicates the Quadbox module is connected to a source of power and is in an operational state.

2.4 RECEIVE MODULE

A Quadbox Receive Module accepts up to four inputs of SDI video over fiber optic cable through the chassis mounted SFP receiver modules. Each input is processed to a coax cable compatible format and is available at the four BNC output connectors. Modules with no internal routing capability deliver each input signal to the BNC output corresponding to the input channel number: the signal at fiber input 1 is available at output BNC connector 1, etc. Figure 2-3 illustrates a typical Quadbox receive module.

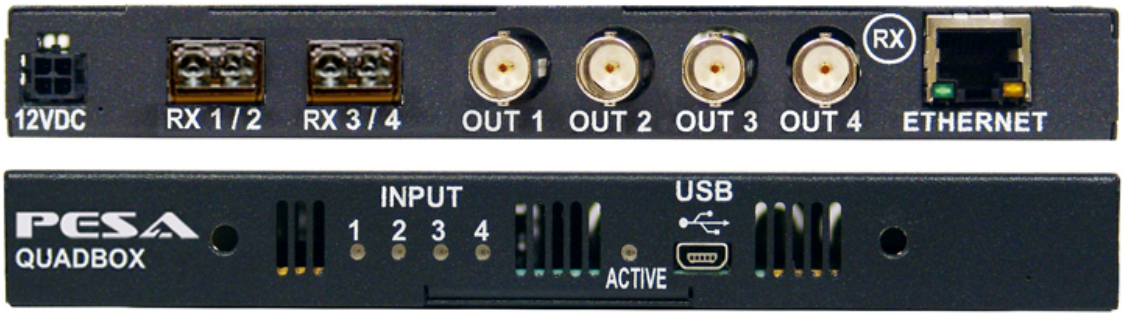


Figure 2-3 Quadbox Receive Module - Typical

Connectors and status LEDs are identified in Figure 2-3. The function of each is discussed below:

Power Operating power (12 VDC) from an external supply is attached to this connector. When the module is used standalone, power is derived from a furnished “wall-wart” type power supply. If the module is mounted in a rack frame, power for all modules in the frame, plus the frame cooling fans, is derived from a single power brick connected to the frame power distribution panel. A connecting cable connects between the frame power distribution panel and the module power input connector.

Fiber There are two fiber module ports on each receive module, labeled RX 1/2 and RX 3/4; these are fiber optic inputs 1, 2 and 3, 4, respectively. In quad versions, both ports contain an active LC type, SFP dual fiber receiver module installed in the carrier slot. In dual versions only port RX 1/2 is equipped with a fiber receiver module, since only inputs 1 and 2 are active. Either singlemode or multimode fiber cable can be used when connecting the output to a transmit module or fiber output of a video matrix switcher. Optical cable runs up to 10 kilometers are possible using singlemode fiber; runs up to 400 meters are possible when using multimode fiber cable.

BNC Connectors The four BNC connectors, labeled OUT 1 thru OUT 4 are the output point for each SDI signal source. In quad versions, all four BNCs are active output connectors. In dual versions, only connectors OUT 1 and OUT 2 are active.

Ethernet This is a standard 10/100, base-T Ethernet network connector for CAT5E cable. When the receive module is installed on the facility network, status and configuration operations may be performed at any time using the Cattrax control application through the host PC.

Status LEDs There are four LEDs mounted on the front side of the module, labeled INPUT 1 thru 4 and correspond to fiber input channels 1 thru 4. When an LED is lit, it indicates the corresponding fiber input channel is locked to the incoming signal.

USB The USB connector allows the receive module to communicate with a host PC over a standard USB bus. This connector is used when initially entering operational and set-up parameters to the module via the GUI application. It is not necessary to keep the module attached to the host PC during normal operation.

ACTIVE There is a single LED, labeled ACTIVE, located on the module front panel. When lit, it indicates the Quadbox module is connected to a source of power and is in an operational state.

2.5 TYPICAL QUADBOX SYSTEM APPLICATION

The most basic Quadbox configuration uses one transmit and one receive module as shown by Figure 2-4. SDI video sources are connected through BNC connectors on the transmit module and routed through channel-dedicated, independent fiber cables, up to a distance of 10 kM, to the receive module. The receive module converts fiber signals for each input channel and provides SDI video outputs on BNC connectors.

Figure 2-4 illustrates Quadbox modules connected to a host PC running the Cattrax controller application over an Ethernet network. Once the modules are initially configured, it is not necessary for operation that they remain connected to the network; however, the network connection allows real-time monitoring of operational status for multiple modules. If any Quadbox modules in the system are equipped with internal routing capability, the network connection allows real-time selection of any active input to any active output from the controller application.

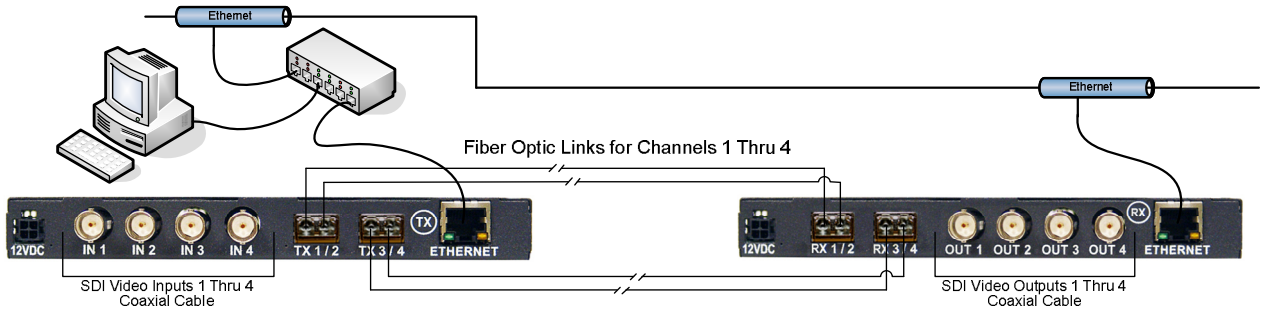


Figure 2-4 Typical TX Direct to RX Installation

2.6 SPECIFICATIONS

Media Extender Specifications

Electrical

Input Type	BNC - 75 Ohm
Number of Inputs	4 BNC
Output Type	SFP 1310nm (Fiber Transport) Dual Transmitter
Number of Outputs	Up to 4 (One or Two Dual SFP Fiber Modules)
Signal Formats	SMPTE 259M, 292M, 372M, 424M

SMPTE 424M Specifications for transport

Return Loss	>15dB 5MHz to 1.485MHz; >10dB 1.485 to 2.97MHz
Signal Amplitude	800mV (p-p)
DC offset	0.0V, +/- 0.5V
Rise/Fall Time	<135ps (20% - 80%)
Overshoot	< 10%
Jitter	<0.2UI (SMPTE 292M), <0.3UI (SMPTE 424M), compliant with SMPTE RP-184
Cable EQ	3G-SDI: Auto to 80m; HD-SDI: Auto to 100m, SDI (270Mbs): Auto to 300m

Signal Operations

Polarity	All Paths Non-Inverted

Optical

Connector Type	SFP Module, LC Connector
Wavelength	1310nm
Mode	Singlemode
Module	Small Form Factor, Hot Pluggable
Compliance	ITU-T G.957
Data rates	270Mbs up to 2.97Gbs

The fiber module used with Quadbox is a class 1 laser product compliant with FDA Radiation Performance Standards, 21 CFR Subchapter J. This component is also class 1 laser compliant according to International Safety Standard IEC-825-1.

Optical Fiber Interconnect (TX to RX) Specifications

Number	Up to Four Fiber Optic Cable
Connector type	LC simplex
Operating distance	9/125u - 10km (6.25 miles); 50/125u - 400m (1200ft), 62.5/125u - 200m (600ft)

Operating distances are approximate, cable loss and other interconnects can affect total light loss between TX and RX extenders.

Transmitter Power	Singlemode -9dBm min, -3dBm max.
Receiver Sensitivity	Singlemode -20dBm min, -1dBm max.

Dimensions

Receiver/Transmitter	6.75 (171.45)W x 6.25 (158.75)D x .825 (20.96)H
Rack Mount Kit	19.00 (482.6)W x 6.25 (158.75)D x 1.75 (44.45)H
Weight	0.5 lbs/unit (Transmitter or Receiver)
Weight	1.6 lbs (Rack Mount with PS)
Weight	(four units in rack mount) 3.65 lbs

Environmental & Miscellaneous Specifications

Operating Temp	-20C to 60C
Storage Temp	-40C to 75C
Relative Humidity	9% to 95% non-condensing
MTBF	> 57,000 Hours
Power Source	90-240VAC, 50/60Hz source
Power to unit	12VDC
Power Consumption	4.5W Max per module
Cooling	Convection / Fans in 1RU frame
Rack Mount	yes, with optional 1RU rack frame

Diagnostic Specifications

LED	Power and Optical Links

Control Specifications

Input connection	USB mini-connector / Ethernet RJ-45
Program	Windows based GUI with diagnostics, supports Windows NT, 2000, XP

Chapter 3 Basic Fiber Optic Tutorial

3.1 INTRODUCTION

Fiber optic technology is widely used in video and audio communication applications, and offers many advantages in speed, efficiency and reliability over conventional copper cable such as:

- Exceptional Bandwidth
- Immune to Electromagnetic Interference
- No Electromagnetic Emissions
- Light Weight

There are, however, many considerations that must be included when planning, installing or maintaining fiber optic devices in a facility. Many PESA users are familiar with optic devices, but for those who would like more information we have prepared this very basic tutorial section to help make your installation easier, and acquaint you with the type of fiber devices used in PESA's Quadbox.

Fiber-optic systems use light pulses to transmit information over fiber optic cables rather than electrical signals to transmit information over copper wires. The fiber communication link for Quadbox is unidirectional, with the signal originating at the transmitter device, travelling over the fiber cable path to a receiver device. Just as with any transmission system, data integrity at the receiving end depends a great deal on the path the signal takes from transmitter to receiver.

3.2 FIBER OPTIC CABLE

Perhaps more than with any other link in the chain, signal losses and other degradations that often occur in the cable path can have a profound effect on the overall functionality of the system. The type of cable used, signal propagation, connectors, patch fields and any other elements in the path are all factors that can cause signal strength loss within the cable path.

Think of a fiber cable as a very long tube with a mirror coating on the inside. If we shine a light in one end we can see light come out at the far end - even if there is a bend in the tube. Light pulses travel through fiber optic cable because of a principle called total internal reflection. This principle states that when the angle of incidence exceeds a critical value, light cannot get out of the tube; instead, the light bounces back in. Since the angle of incidence is always equal to the angle of reflection the reflected light will again be reflected. The light continues this bouncing path down the length of the fiber optic cable. If light strikes the cable core at an angle less than the critical angle then it is attenuated very rapidly with propagation distance. Every type of fiber optic cable is subject to losses, primarily through dispersion and scattering of light within the cable itself. The faster the source light fluctuates, the greater the risk of dispersion.

A fiber optic cable is composed of two concentric layers - the core and the cladding; light is piped through the core. In addition to the two inner layers, there is an exterior coating called the jacket, as shown by Figure 3-1. The jacket protects the core and cladding from shocks that might affect their optical or physical properties, and also provides protection from abrasions, solvents and other contaminants. The jacket has no optical properties and does not affect propagation of light within the core. Fiber optic cables have extremely small diameters – typically ranging from 8 microns to approximately 100 microns. To get some appreciation of how small these sizes actually are, a typical human hair has a diameter of 100 microns. Fiber cable sizes are usually expressed by first giving the core size followed by the cladding size. For example, 8/125 indicates a core diameter of 8 microns and a cladding diameter of 125 microns, 100/140 indicates a core diameter of 100 microns and a cladding diameter of 140 microns, etc.

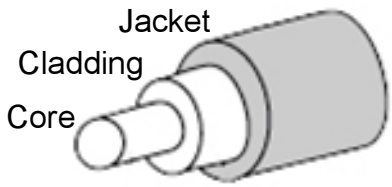


Figure 3-1 Fiber Optic Cable, Basic Cross Section

There are a variety of fiber cable types, but the two most common types you will encounter are called **multimode** and **singlemode**. Regardless of cable type, the construction of fiber cable is the same. Typical core sizes used with devices such as Quadbox are 8 -9 microns for singlemode and 50 - 62.5 microns for multimode.

Before we discuss the differences between these cable types – let's briefly introduce the term ***mode*** as it relates to fiber optic cables. In a previous paragraph we said that light travels through fiber by reflections off the coating. We know that when light enters the cable it can propagate in many different paths down the fiber - the larger the diameter of the fiber, the more potential paths for light to disperse. Wavelength of the light source also plays a factor in dispersion characteristics. Each path the light follows is called a **mode**, and different cable diameters and other characteristics determine the amount of potential modes that can occur within the fiber.

3.2.1 SINGLEMODE CABLE

Singlemode fiber optic cable is a single strand of glass fiber with a very narrow diameter of 8.3 to 10 microns through which only one mode will propagate. It offers higher bandwidth capacity than multimode fiber but requires a narrow light source; typically a light source with wavelength 1310 or 1550nm is used. Singlemode fiber has a much smaller core than multimode. The small core and single light-wave virtually eliminate any distortion that could result from overlapping light pulses, providing the least signal attenuation and the highest transmission lengths of any fiber cable type.

3.2.2 MULTIMODE CABLE

Multimode fiber optic cable is larger in diameter than singlemode, with typical core diameters of 50 or 62.5 microns. Multimode fiber provides high bandwidth at high speeds over medium distances. Light entering the core is dispersed into numerous paths, or modes, as they travel through the core. Typically a light source with a wavelength of 850 or 1300nm is used with multimode cable. In long cable run installations, multiple paths of light can cause signal distortion at the receiving end, resulting in data errors.

3.3 FIBER TRANSMITTER AND RECEIVER DEVICES

At the signal origination point, the transmitter device accepts a signal input and converts the electrical variations of the signal to variations of a light source. Usually the light source is either a LASER device or a LED, operating at extremely short wavelengths, typically in the 850 nanometer (nm) to 1,500 nm range; and over a specified output power level range, depending on the transmitter device used. Transmitter devices used with Quadbox modules contain a LASER light source. Light pulses from the transmitter are focused through a lens into the fiber-optic cable. At the signal destination point, the receiver device accepts an input of modulated light from the transmitter and converts it back to an electrical signal.

Both transmitter and receiver devices are typically specified for use with either singlemode or multimode cable, depending on the operating wavelength among other factors. Devices used in PESA Quadbox Modules are designed for use with singlemode cable; however, under most circumstances it is permissible to use multimode cable with Quadbox, refer to Paragraph 3.6.

Fiber transmit and receive modules are available in a number of different sizes and styles. Quadbox modules all use Small Form-Factor Pluggable (SFP) devices that install into metal sleeve carriers mounted to the module circuit card. Each module uses a type LC connector to interface with fiber cable.

3.4 OPTICAL POWER AND LOSS BUDGET

Every fiber receiver device is specified with a minimum and maximum input power level range that the device can receive in order to properly decode incoming data. With fiber devices proper power level is even more important than with some other systems in that not only can too little power cause serious degradation of the signal, but too MUCH power at the input causes receiver saturation, resulting in data degradation. Receiver devices used in PESA Quadbox modules typically specify a usable power range from a minimum input of -20dBm to a maximum of -1dBm.

On the transmitter side, devices are also specified with minimum and maximum output power levels. Power output levels can vary within the specified range between devices for a number of reasons; plus transmitter output levels degrade over time. Transmitter power range and degradation must be carefully considered during all phases of planning and installation. Transmitter devices used in Quadbox modules typically specify a power range from a minimum output of -9dBm to a maximum of -3dBm; and PESA recommends that you should expect 2-3dB degradation in power output over time.

Careful planning and loss calculations must be conducted in order to ensure the most reliable signal transfer. When planning a fiber installation, the ***optical loss budget*** is critical – thankfully, in most installations, it's not a complicated parameter to calculate.

Many factors must be considered for potential signal loss. All fiber optic cable presents a certain amount of signal loss, dependent on length, cable type and other factors. Loss specifications for a particular cable are always available from the manufacturer. In addition to cable losses, typical cable paths have connectors on each end of each piece of cable, the path may be routed through connector panels, or the cable may be spliced in one or more locations along the path – each of these elements also introduce a certain amount of signal loss. By adding the loss value introduced by each element in the path, plus the loss introduced by the cable itself, we can arrive at the total loss value for the entire cable path.

Previously we said that the receiver device required a light input power level within a specified range in order to operate properly. In order to ensure the receiver gets the proper input power, we need to consider the specified output power of the transmitter device, time degradation of transmit output power, cable path losses, and the input power requirement for the receiver. If we take the input power requirement of the receiver and subtract that value from the output power of the transmitter, we have calculated the maximum loss that can exist in the path between the devices. This value is termed the **optical loss budget**, since it is the maximum amount of power loss that can be distributed over every element in the fiber cable path. Once we perform the loss calculations, it is possible that the input power to the receiver is too strong in which case we would need to consider inserting power attenuators in the cable path. Let's consider an example:

- A good rule of thumb is to use the *minimum* specified receiver input power and the *minimum* specified transmitter output power when performing your worst-case loss calculations. It is also good practice to add an additional 2-3dB ***safety margin*** to the calculated maximum loss value to compensate for degradation of transmitter output power and other possible losses over time.
- Using typical values specified for Quadbox devices, we can calculate the **worst-case** optical loss between transmitter and receiver
- Where Minimum XMTR output power is -9dBm (specified)

  Minimum RCVR input power is -20dBm (specified)

  [(-20dBm) – (-9dBm)] = -11dB, or stated another way, 11dB would be the maximum permitted power loss between XMTR and RCVR at worst-case device performance
- Adding in a Safety Margin of an additional potential 3dB loss

  [(-11dB) + (3dB)] = -8dB
- -11dB being the maximum amount of acceptable power loss, plus our 3dB added safety margin yields an **Optical Loss Budget** of -8dB, or stated another way, 8dB would be the maximum permitted TOTAL loss between XMTR and RCVR assuming both transmit and receive devices are operating at the very minimum levels specified by the manufacturer.

Now, we must calculate the total loss introduced by the cable path. In order to do this we must obtain the loss factor for the cable we are using from the manufacturers specifications. This value is typically given as the amount of loss in dB for a given length of cable. We must also count the number of connectors, splices, jacks, and all other potential loss elements in the cable path since each of these elements has a specific loss value.

For best accuracy, it is a good idea to obtain loss value from data supplied by the manufacturer of each of the loss elements in the path; however, for quick reference Table 3-1 provides typical values often encountered in fiber installations:

Source Wavelength and Cable Type	Cable Size (Microns)	Cable Attenuation (Per kilometer)	Connector Attenuation (Per Connection)	Splice Attenuation (Per Splice)
850 nm/Multimode	62.5/125	3 dB	0.5 dB	0.1 dB
1300 nm/Multimode	62.5/125	1 dB	0.5 dB	0.1 dB
850 nm/Multimode	50/125	3 dB	0.5 dB	0.1 dB
1300 nm/Multimode	50/125	1 dB	0.5 dB	0.1 dB
1310 nm/Singlemode	9/125	0.3 dB	0.5 dB	0.1 dB
1550 nm/Singlemode	9/125	0.2 dB	0.5 dB	0.1 dB

Table 3-1 Average Fiber Optic Loss Values

Assume we are installing a fiber run of 9/125 singlemode cable over a total distance of 2.5 kilometers through a patch panel using two cables with a connector on each end of each cable. We are connecting this cable path to a transmitter device operating at a wavelength of 1310nm.

- Referring to Table 3-1 we see that 9/125 cable at 1310nm presents a loss of 0.3dB per km, so we can easily calculate cable loss for our run

  2.5km X 0.3dB/km = 0.75dB cable loss

- Calculate loss for the connectors

  4 connectors X 0.5dB/connector = 2dB connector loss

- We can now calculate total cable path loss

  0.75dB cable loss + 2dB connector loss = 2.75dB total cable path loss

Since our loss budget, with safety margin added, was 8dB, this path falls easily within that range and would offer a reliable fiber link between Quadbox modules even if the optical devices were operating at worst-case performance.

Calculating optical losses is really not complicated, but is vitally important when planning any fiber installation.

3.5 QUADBOX DEVICE POWER METERS

In Paragraph 5.7.5, we introduce a Quadbox monitor screen that provides direct readout of optical device operating power levels. The monitor screen for transmit modules provides a readout of actual output power from the transmitter device; and the screen for receive modules indicates power level of the light source present at the input of the device. In our example power loss calculation, we used the worst-case specified values for both XMTR and RCVR devices; typically, each device is going to perform well above specified minimum levels. You can use these meter displays to verify proper functionality of fiber links. If you are using these readings for calculating loss budget for a specific installation, remember to allow a safety margin for transmitter output fluctuations and degradation over time.

3.6 SINGLEMODE AND MULTIMODE CABLE CONSIDERATIONS

When using singlemode cable, there should be no problems with receiver saturation using Quadbox supplied transmit and receive modules. Even if the transmitter is operating at its upper specified output level of -3dBm, and the cable path presents a loss factor of no more 1dB, the power level reaching the receiver input would be -4bBm which is below the specified maximum input level.

In most circumstances it is permissible to use multimode cable with Quadbox optical devices. However, due to using a singlemode driver with multimode cable, there is a potential that the optical signal might arrive at the receiver input at a level that is too high, or too distorted to provide proper data decoding. Due to the nature of multimode cable, light can arrive at the receiver from multiple paths causing overload, or it can suffer from dispersion distortion. Overload problems usually manifest from short runs of multimode cable between XMTR and RCVR; and dispersion distortion typically occurs with long cable runs. If you are experiencing signal reliability issues with multimode cable due to overload, these can often be eliminated by using a signal attenuator between the end of the cable run and the input of the receiver module.

3.7 FIBER INSTALLATION AND MAINTENANCE CONSIDERATIONS

Fiber optic cable, like any other cable, is available in bulk spools of varying lengths without connectors attached. Be aware that some degree of specialized training, skill and equipment is required when installing connectors on the ends of fiber optic cable or splicing two cable ends together. In some installations it may be necessary, due to routing requirements or other constraints, to run bulk cable and attach connectors once the cable is in place. For easier and quicker installation, pre-assembled fiber optic cables, in various lengths, with connectors attached are readily available from a number of sources. PESA highly recommends that, unless you have training in working with optical cable and the necessary equipment, you purchase pre-assembled cables if at all possible for your installation. If using pre-assembled cabling is not feasible for your installation, consider procuring the services of a trained fiber technician, certified for fiber terminations, to install connectors and verify cable continuity before proceeding with Quadbox installation.

Another point you must consider when installing fiber cable is the minimum bend radius. This specification is provided by the manufacturer's data sheet for a particular cable and indicates the maximum amount the cable can be bent towards a 180 degree fold without damaging the cable or seriously degrading performance. Use extra care when pulling cable around corners, over-bending can cause breaks in the glass fiber.

One final point on dealing with optical cable - be sure that the optical connectors are clean and dust free. Each end of a fiber cable connection is normally fitted with a small lens to direct the light source. Remember that the core of even multimode cable is smaller in diameter than a human hair, and the core of a singlemode cable is considerably smaller than multimode. So you can see that dust and dirt, even small amounts, can greatly degrade performance of an optical data transmission system. Always keep dust caps on cable connector ends and optical receptacle connectors when cables are not attached. NEVER touch the end of the optical connector or receptacle with your bare skin. Any source of grease and dirt, even in minute amounts, can seriously degrade performance of the optics.

The core conductor of fiber optic cable is normally attached to a connector equipped with a fiber-end lens. This assembly mates to the optical transmit or receive device by inserting the connector end into its mating receptacle with very slight pressure. A snap latch secures the end into the receptacle. To remove cable-end connector from an optical device, gently press the latch tab and pull cable from receptacle. Immediately replace dust caps on the end of each fiber cable conductor and the optical module connector receptacle.

	**Dust, even small amounts, can greatly degrade performance of an optical data transmission system. Always keep the dust caps on the cable connector ends and the optical receptacle connectors when the cables are not attached. NEVER touch the end of the optical connector or receptacle with your bare skin. Grease and dirt, even minute amounts, can seriously degrade performance of the optics.**

Chapter 4 Installation

4.1 GENERAL INSTALLATION CONSIDERATIONS

Quadbox modules are shipped from the factory pre-configured for the specified module type. In most installations, no further configuration should be required. There are very few restrictions on placement of modules. Locate each module for convenient access to video source signals or destination points. Ensure that a source of primary power is available and that each module has clearance for cooling air. If the installation has modules installed on a network, ensure that an Ethernet drop is convenient. It is not necessary that Quadbox modules be continuously connected to a network or host PC for operation. Network connection allows monitoring of modules and executing on-the-fly changes to internal routing or operational parameters. Monitoring and configuration functions may be performed on a single module over a USB connection to a host PC running the Cattrax control application if the modules are not installed on a network.

4.2 INSTALLING QUADBOX TRANSMIT MODULES

Transmit modules accept up to four video inputs over coaxial cable through the panel mounted BNC connectors. Remember that every channel of a Quadbox is independent, unless the module is equipped with internal routing. The signal present at BNC input 1 is routed over fiber output 1, BNC input 2 over fiber output 2, etc. Fiber outputs may be directly connected to a Quadbox receive module or to the fiber input of any compatible fiber optic router, such as the PESA Cheetah routers, or other fiber interface device. Install each transmit module as follows:

- Connect video input signals to the BNC coaxial cable connectors
- Connect singlemode or multimode fiber optic cable to the fiber output connectors
- Connect the module to a facility network using CAT5E cable fitted with an RJ45 connector attached to the Ethernet port on the module
- Connect the power plug from the external power supply to the module power connector and connect the power supply to a source of primary power.

When power is first applied to a transmit module, the four LED indicators labeled OUTPUT will light, along with the LED labeled ACTIVE. As the processor executes its start-up procedure, the OUTPUT lights will extinguish one-by-one. When start-up is completed, the OUTPUT LEDs indicate activity on the module fiber channels. The ACTIVE LED remains lit indicating the module is powered and operating.

4.3 INSTALLING QUADBOX RECEIVE MODULES

Receive modules accept up to four video inputs over fiber optic cable through the panel mounted SFP modules. Remember that every channel of a Quadbox is independent, unless the module is equipped with internal routing. The signal present at fiber input 1 is routed over coaxial output 1, fiber input 2 over coaxial output 2, etc. Fiber inputs may be directly connected to a Quadbox transmit module or to the fiber output of any compatible fiber optic router, such as the PESA Cheetah routers, or other fiber interface device. Install each receive module as follows:

- Connect coaxial cable from output destinations to the BNC connectors
- Connect singlemode or multimode fiber optic cable to the fiber input connectors
- Connect the module to a facility network using CAT5E cable fitted with an RJ45 connector attached to the Ethernet port on the module
- Connect the power plug from the external power supply to the module power connector and connect the power supply to a source of primary power.

When power is first applied to a receive module, the four LED indicators labeled INPUT will light, along with the LED labeled ACTIVE. As the processor executes its start-up procedure, the INPUT lights will extinguish one-by-one. When start-up is completed, the INPUT LEDs indicate activity on the SFP module fiber channels. The ACTIVE LED remains lit indicating the module is powered and operating.

Chapter 5 System Set-Up and Configuration

5.1 INTRODUCTION TO THE CATTRAX CONTROL APPLICATION

Set-up, configuration and monitoring functions for Quadbox modules are performed through graphical user interface (GUI) menu screens of PESA's Cattrax controller application installed on a host PC running the Microsoft Windows® 2000, XP, Vista or Windows 7 operating system. Cattrax is a multi-system application that can communicate and control many different types of PESA equipment; it incorporates data files for specific equipment into the software structure that contain equipment-specific interface screens, configuration parameters and control functions. In order for Cattrax to "discover" and communicate with a Quadbox module, or any other piece of PESA equipment, the proper data file must be present in the Cattrax program. In addition, the QFX USB driver file must be installed on the host PC in order for Cattrax to communicate with PESA equipment over the USB port.

Cattrax automatically searches for PESA equipment through a process called "discovery." When a piece of equipment is detected on the USB port of the host PC or connected to the facility network, the application establishes communication with the equipment and lists it as an active device in the Devices View window. Using a USB interface, only one module may be connected to the host PC at a time; Ethernet interface allows simultaneous control of multiple devices.

Procedures in the following paragraphs discuss operator screens and functions of Cattrax to control Quadbox modules. If you need more user information on specific functions or features of the control application, refer to the Cattrax User Guide.

Quadbox modules are shipped from the factory with an auto-run CD that loads Cattrax and the QFX USB driver onto a host PC. Procedures for loading these on the host PC are presented in Paragraph 5.3.

5.2 INITIAL SET-UP STEPS

In most installations Quadbox modules are programmed at the factory and should not require additional configuration prior to installation. In some installations it may be necessary to change the factory default I/O mapping of units equipped with internal signal routing, or it may be necessary to modify factory set network communication parameters.

Using Cattrax, the user can monitor and modify many functional attributes of a module, review module identification data, set data rates manually for video sources or select automatic rate selection, and map input signals to output channels on modules equipped with internal signal routing capability. Procedures for connecting a Quadbox to a network and modifying network communication parameters with Cattrax are contained in Paragraph 5.8.

	**DO NOT connect a transmit or receive module to the host PC until the QFX USB driver is installed on the computer.**

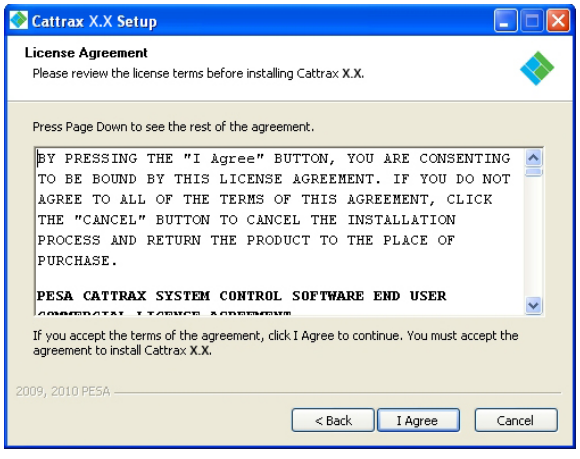
5.3 INSTALL CATTRAX AND QFX USB DRIVER ONTO THE HOST PC

Your Cattrax installation disk contains an auto-run file that guides you through the installation process. Examples of the pop-up screens you will see are shown below with the appropriate step. Notice the "X" used in place of actual values on each example screen presented here. During installation the release number of Cattrax software you are installing is displayed.

Install the Cattrax software application as follows:

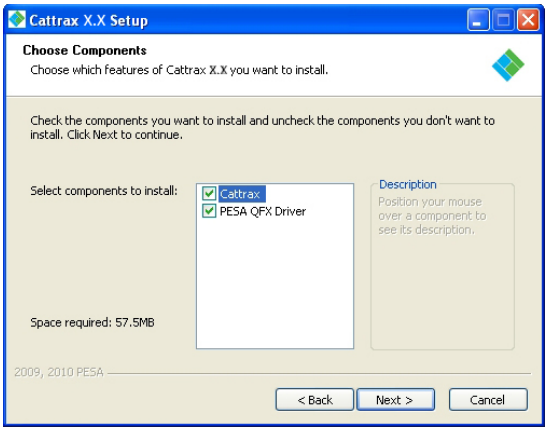
1. Insert Cattrax CD into CD Drive of host PC.
2. Allow the disk to initiate the auto-run function. When initialization is complete, the banner, as shown at right, is displayed on the desktop. Click **Next** to begin installation of the Cattrax application.
3. If the auto-run function does not automatically launch, navigate to the directory of the disk drive containing the installation CD and double click the **Cattrax.exe** file. The banner shown at right should be displayed on the desktop. Click **Next** to begin installation.

I

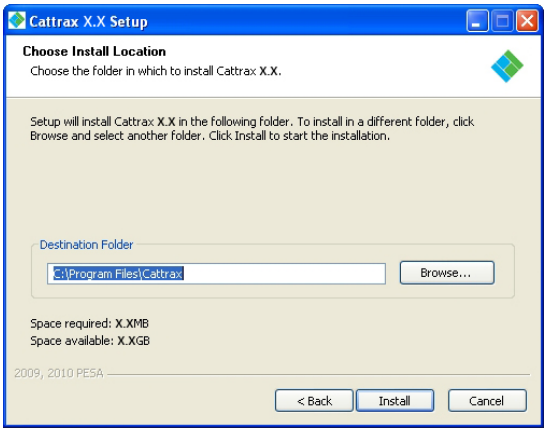


4. Read the license agreement and click **Agree** to continue, as shown at left.

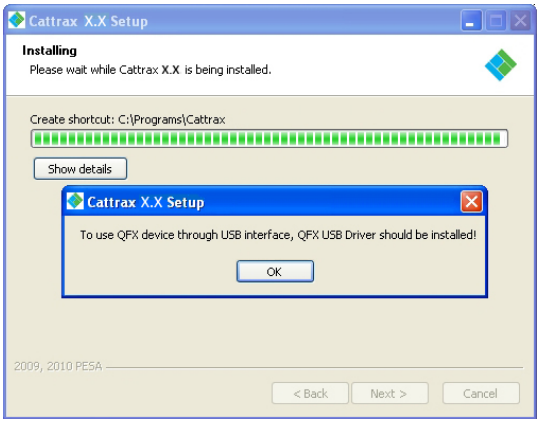
5. The Choose Components window allows you to select the software components you wish to install. During initial installation, the only option is to install the entire program. Ensure that the box next to "Cattrax" in the list box is checked.



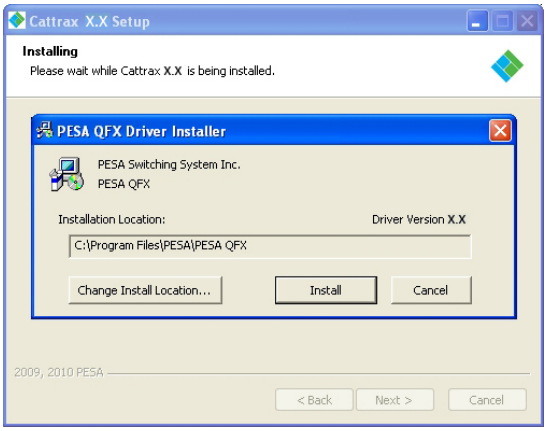
6. If you want to install the USB port driver, also check the "PESA QFX Driver" box
7. Click **Next** to continue installation.



8. By default auto-install creates the folder shown at left for the Cattrax application. If you wish to install the software in a directory or folder other than the default, click **Browse** and navigate to the destination. Click **Install** to continue installation.

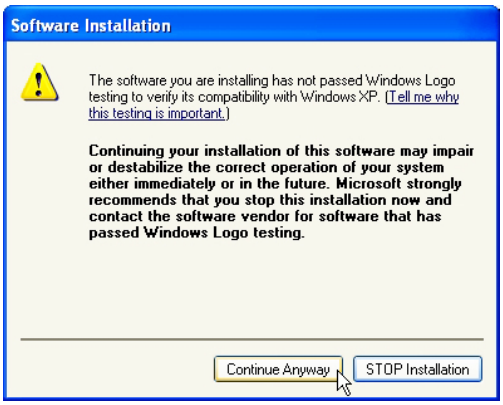


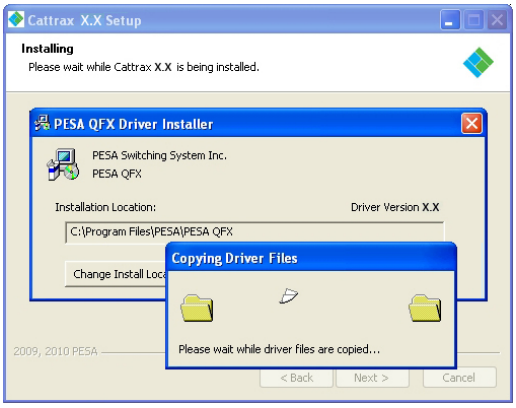
9. Once Cattrax is installed, you will receive the prompt to install the QFX USB driver. Click "OK" to install the driver. If the QFX USB driver is not present on the host PC, Cattrax will not be able to communicate with a connected device through the USB port.



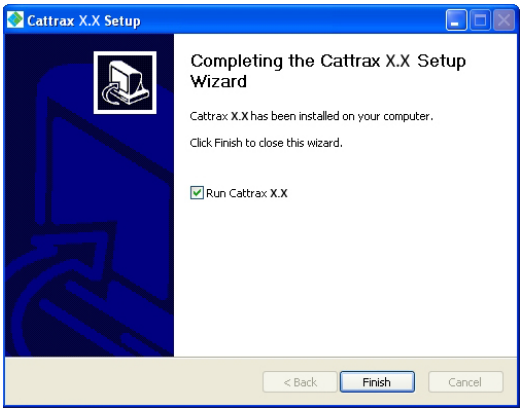
10. You may accept the default installation location, as shown at left, or browse to another folder in which you wish to install the QFX USB driver. When the destination folder is correct, click the Install button to proceed with driver installation.

11. You may receive a message indicating that the software has not passed Windows Logo testing, as shown at right. The USB driver files have been thoroughly validated. Click "Continue Anyway" to continue.

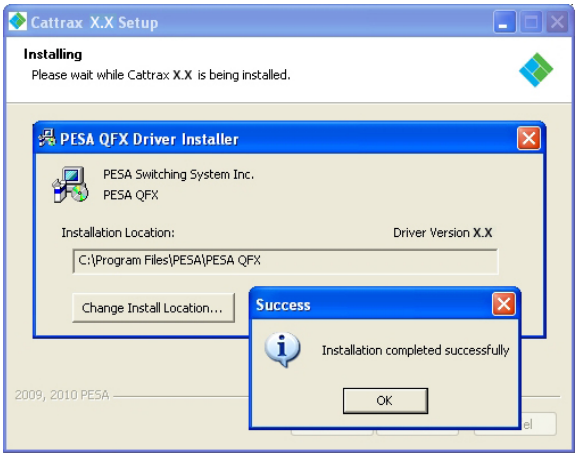




13. When driver installation is complete, you will receive a prompt indicating that the installation was successful, as shown at right. Click "OK" to continue to the "Installation Complete" prompt.



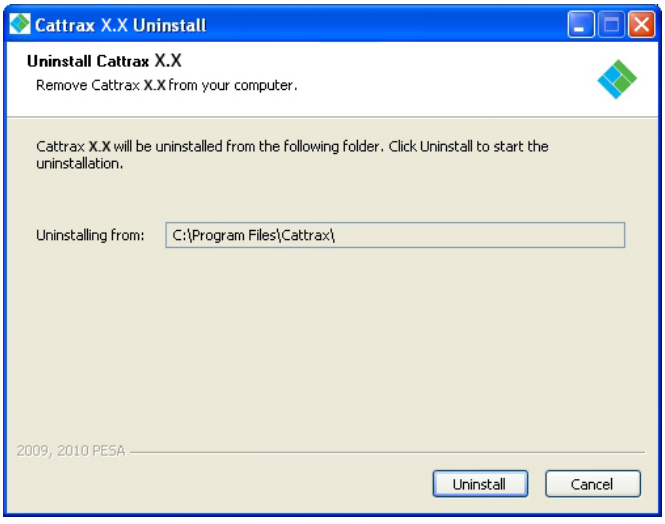
12. You will see the screen at left as installation continues.



14. Click **Finish** to exit the installation process. During installation a shortcut icon to launch Cattrax is automatically placed on the desktop. If the box next to "Run Cattrax Release X.X" is checked, the application will start immediately.

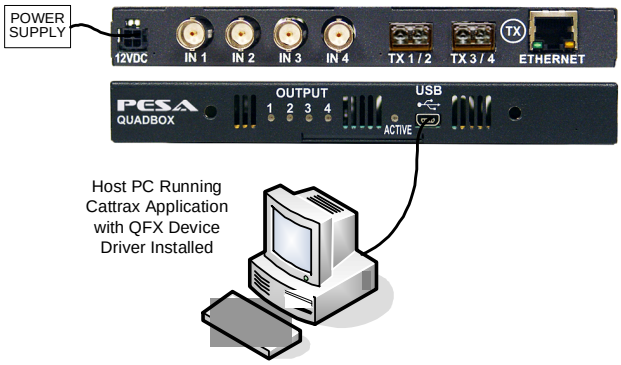
5.4 REMOVING CATTRAX INSTALLATION

Should it ever be necessary to remove Cattrax from the PC, the uninstall command is available through the Start menu of the Windows® operating system. A prompt window as shown at right is displayed on the desktop. Click **Uninstall** to complete the command.



5.5 CONNECT A QUADBOX MODULE TO THE HOST PC THROUGH A USB PORT

If you wish to control a Quadbox module over a USB connection using Cattrax, perform the following steps to allow "Plug and Play" capability of the Windows® operating system to interface Quadbox hardware to host PC.

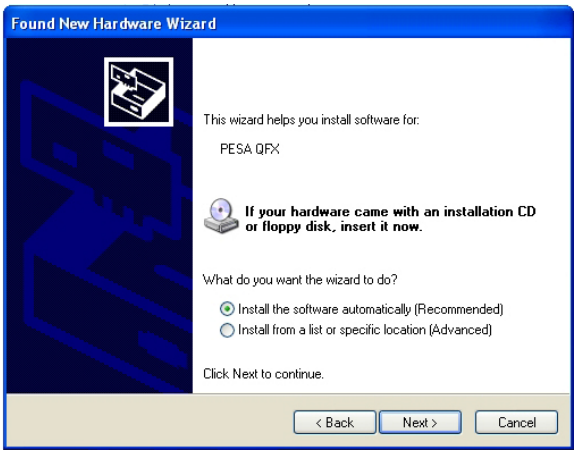


1. Apply power to the Quadbox module by connecting the external power supply to the module and to a source of primary power.
2. Connect the supplied USB cable first to the module and then into an open USB port on the host PC, as shown by the illustration to the left.
3. After a brief pop-up from the taskbar, the "Found New Hardware" window, as shown below, **may** appear on the monitor.

NOTE

This window only appears if this is the first power-up after USB driver installation

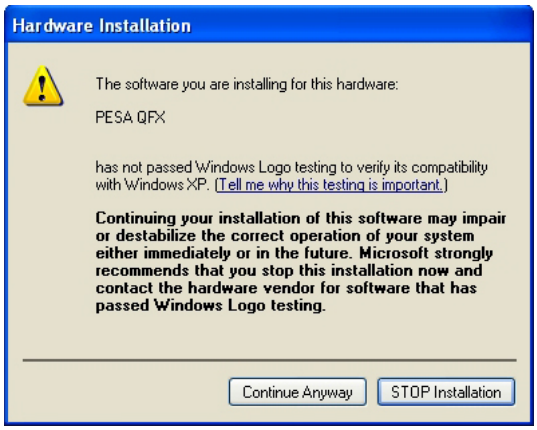
4. Select the "No, not this time" option button and then click Next to continue.

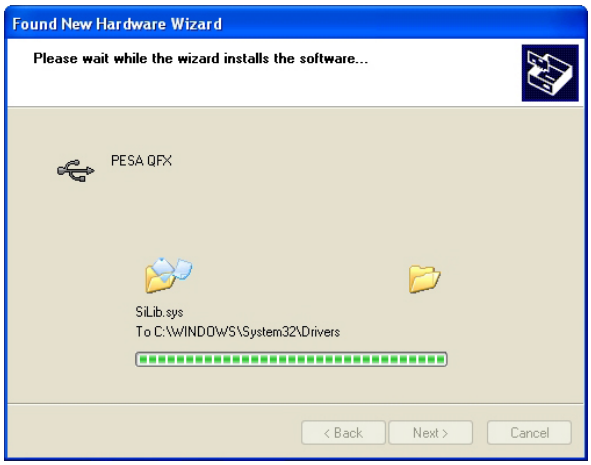


5. The Driver Installation screen, as shown to the left, prompts you for your choice of how to locate and install the hardware driver.

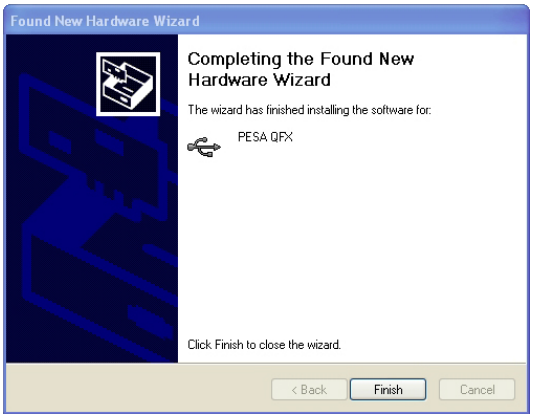
6. Select the first option, "Install the software automatically (recommended)," and click on the "next" button to continue.

7. You will receive a message indicating that the software has not passed Windows Logo testing, as shown to the right. The USB driver files have been thoroughly validated. Click "Continue Anyway" to continue.





8. During driver software installation, the prompt screen shown to the left is displayed. The progress bar monitors the installation procedure.



9. When hardware installation is complete, the completion screen, as shown to the left is displayed. Click the "Finish" button to exit the hardware installation wizard.
10. The Quadbox module should now be communicating with the host PC.

5.6 START CATTRAX APPLICATION

During installation, a Cattrax icon is placed on the PC desktop. You may start the application by clicking on the desktop icon, or by navigating to the folder containing the Cattrax program files and clicking on the ***Cattrax.exe*** file.

When Cattrax is first started, an application interface similar to the one shown in Figure 5-1- is displayed on the PC monitor. If this is the first time Cattarx has been launched, the display windows will all be empty until a PESA device is connected to the USB port and "discovered" for control. If the application has been previously used, the Devices View window displays a list of inactive devices that have been discovered in previous sessions as shown in the example screen. Detailed operating instructions for the software application are contained in the Cattrax User Guide, but for purposes of this discussion there are two screen display areas we need to introduce.

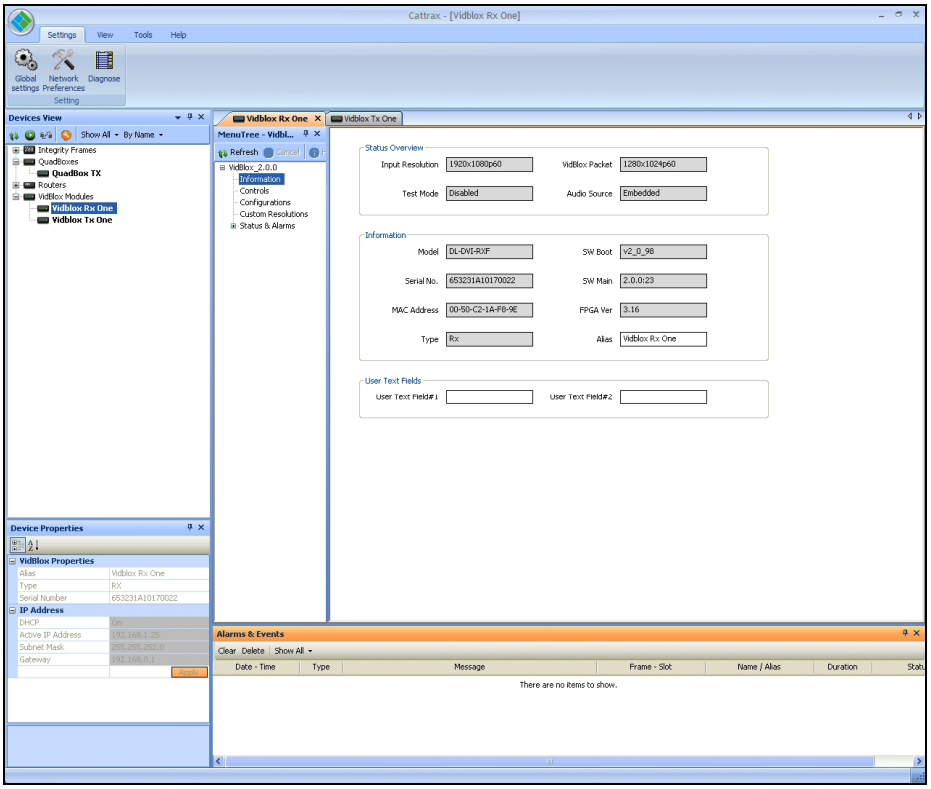


Figure 5-1 Cattrax Main Display Screen

5.6.1 DEVICES VIEW WINDOW

The Devices View window, Figure 5-2, identifies the device currently under active control of Cattrax and lists devices that have been previously connected to the application. Whenever a Quadbox module is connected to the host PC, and communication is established, the module identity is displayed as a branch of the menu tree in the Devices View in bold letters. Remember that Cattrax can only control one device at a time over a USB port, therefore only one menu entry will be highlighted. If the device has been "discovered" previously but is not currently connected to the host PC, the device name appears in the menu tree in gray letters. Depending on the view mode selected, devices may be displayed by group as shown in Figure 5-2. Notice that the heading *Quadboxes* appears in the menu tree with branches to individual modules, identified by type and serial number that have been previously discovered or controlled by Cattrax. The purpose of this introduction is to differentiate between a bold and grayed entry in the tree, and to stress that previously accessed modules will still appear in the tree, until they are manually removed, even though the module may not be connected to the host PC. You may obtain more information on viewing modes and other operational features and functions of Cattrax by referring to the User Guide for the software application.

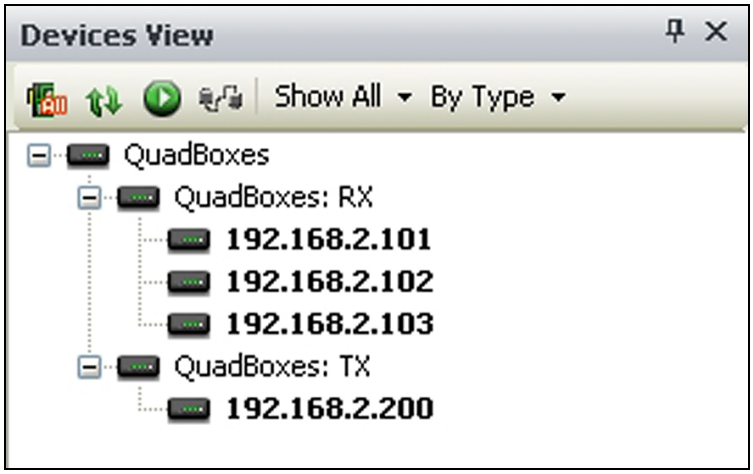


Figure 5-2 Example Devices View Screen

5.6.2 ALARMS AND EVENTS WINDOW

The Alarms and Events Window, Figure 5-3, displays flags when a defined alarm condition occurs or when a defined event occurs within the system. Notice from the example screen that when Cattrax establishes connection with a Quadbox module, it is flagged as an event; as is disconnecting a module from the host PC USB port or the network. When a module is discovered and flagged as connected, its identity appears in the Devices View window in bold letters, and the information screen is displayed in the main display window.

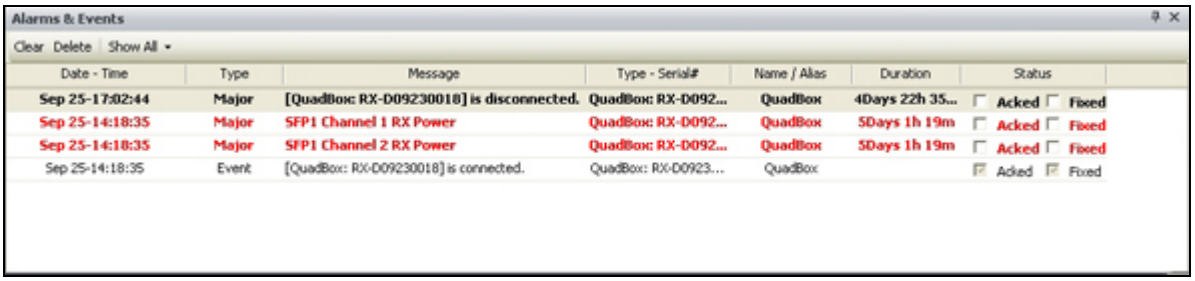


Figure 5-3 Example Alarms and Events Screen

5.7 MODULE CONFIGURATION SCREENS

When a Quadbox module of any model variant is under control of Cattrax, operator screens and functions presented in the following paragraphs are available. Most screens for transmit and receive modules are identical in appearance, even though the data displayed may have different interpretation. In the paragraphs below, example screens for a 4 input/4 output receive module with internal routing capability are used. If your Quadbox modules do not have internal routing capability, the matrix discussed in Paragraph 5.7.3 will not be present on the configuration screen. Also, if your modules are equipped with only 2 inputs or 2 outputs, displays for input or output channels 3 and 4 will either not be present or will be inactive. Paragraph text discusses any differences between data inputs and displays for transmit and receive modules.

With Cattrax communicating with Quadbox over a network, numerous modules may be identified as active in the Devices View Window. Click on any active device in the listing to access configuration screens for that module. Status and monitor information is updated for the selected module in real-time.

If a Quadbox module is attached to the USB port of the host PC when Cattrax is started, the application will automatically discover the module. When a module is discovered the identity of the connected module is displayed in bold letters in the Devices View window, and the information screen for that module opens in the main display window as shown in Figure 5-4.

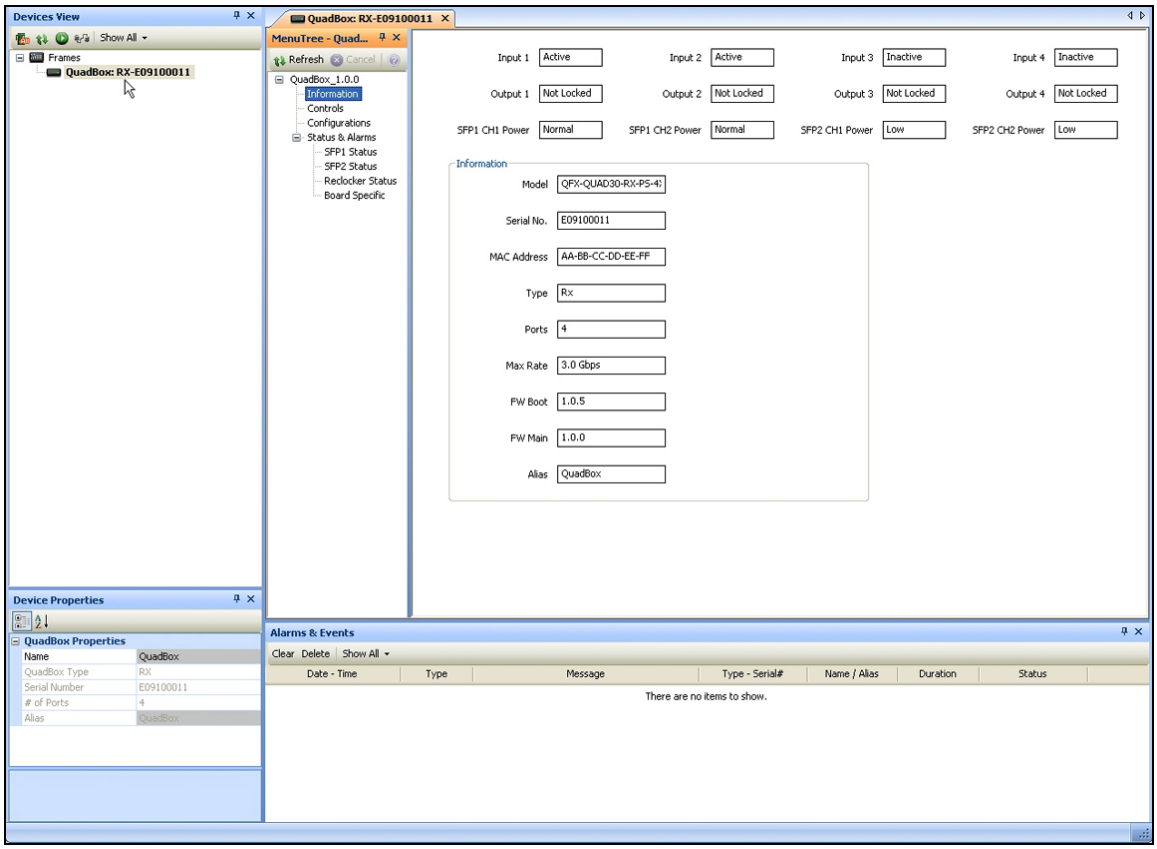


Figure 5-4 Example Quadbox Initial Display Screen

5.7.1 STATUS DISPLAY TEXT BOXES

Regardless of which menu selection you choose from the menu tree, the top portion of the main display window always displays the status monitor text boxes as shown in Figure 5-5. Display information is updated in real-time for the selected module. The following status data is provided by these text boxes:

Input – There are four text boxes for input channel status labeled Input 1 thru Input 4; each box indicates if the corresponding input channel is currently active or inactive. With receive modules, monitor data indicates input signal presence for fiber optic channels, and with transmit modules data is for signal presence at BNC input channels.

Output – The four text boxes for output channel status, labeled Output 1 thru Output 4, indicate if the associated output channel is currently locked to a standard data rate (Locked) or running in bypass mode (Not Locked). With receive modules, monitor data indicates signal lock status of BNC output channels, and with transmit modules data is for signal lock status at fiber optic channels.

SFP Power – These text boxes display status of the optical signal power level at each channel of the SFP modules. The possible readouts are Low, Normal and High, and indicate the current real-time status of each fiber optic channel. With receive modules, status data indicates strength of the optical signal being received by the indicated SFP module channel. For transmit modules, status data indicates strength of the optical signal leaving the indicated SFP module channel.

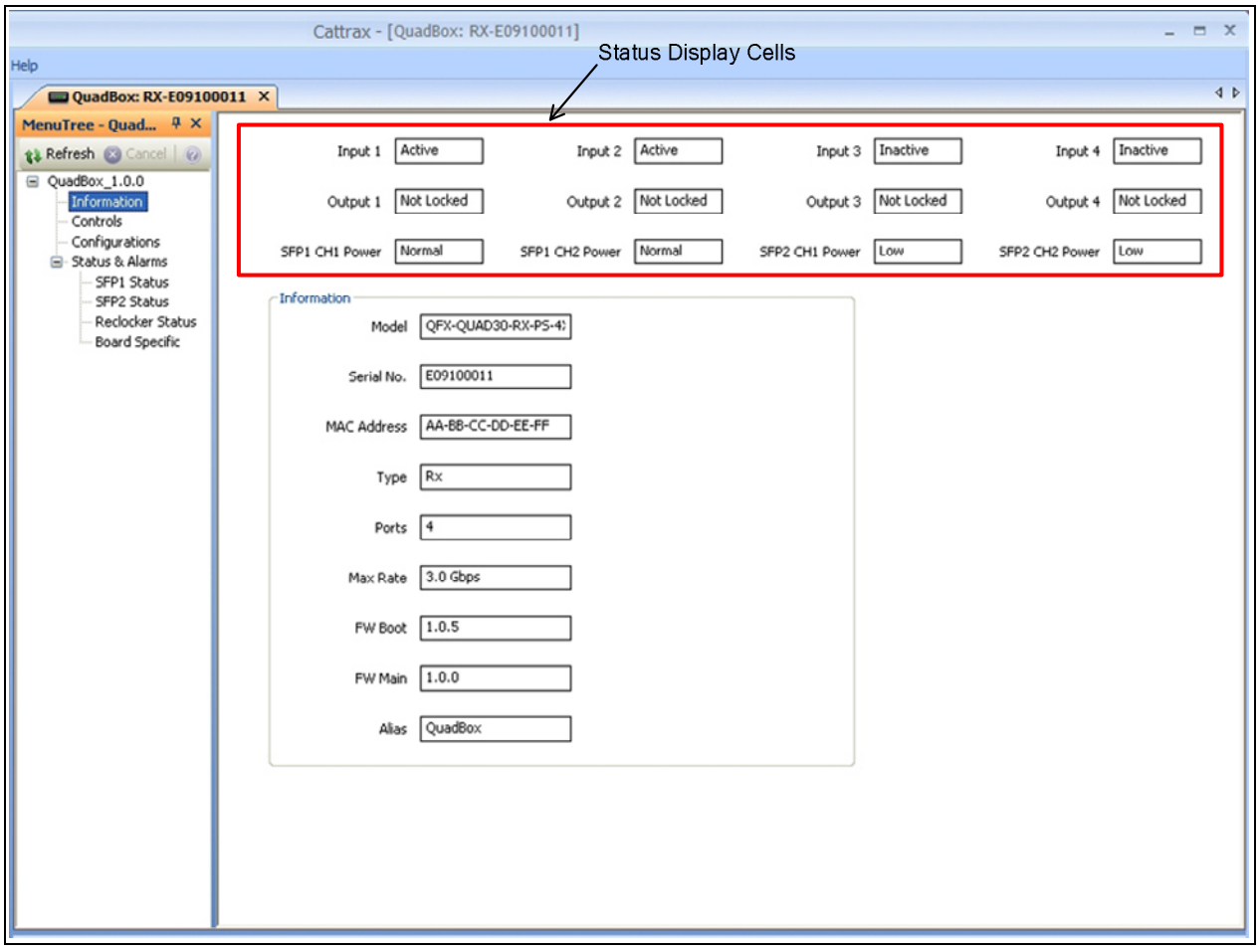


Figure 5-5 Status Display Text Boxes

5.7.2 INFORMATION MENU

When the Information menu entry is selected from the menu tree, the screen shown by Figure 5-6 is displayed. This screen provides the following configuration data for the selected Quadbox module:

- **Model Number and Serial Number** – Model and serial numbers of the selected module
- **MAC Address** – Identifies the assigned MAC address for the module
- **Type** – Indentifies whether the module is a receiver (Rx) or transmitter (Tx)
- **Ports** – Indicates the number of active fiber channels (2 or 4)
- **Max Rate** – This display indicates the maximum data rate capability of the module
- **FW Boot and FW Main** – Indicate the revision levels of the boot code and main program firmware
- **Alias** – Alias is a name assigned to the selected module for identification on the network or within the system of Quadbox modules; and it will become the identifier for the module in the Devices View window. You may enter any name you wish to assign the module in the Alias text box. Press the Enter key to initiate the name change.

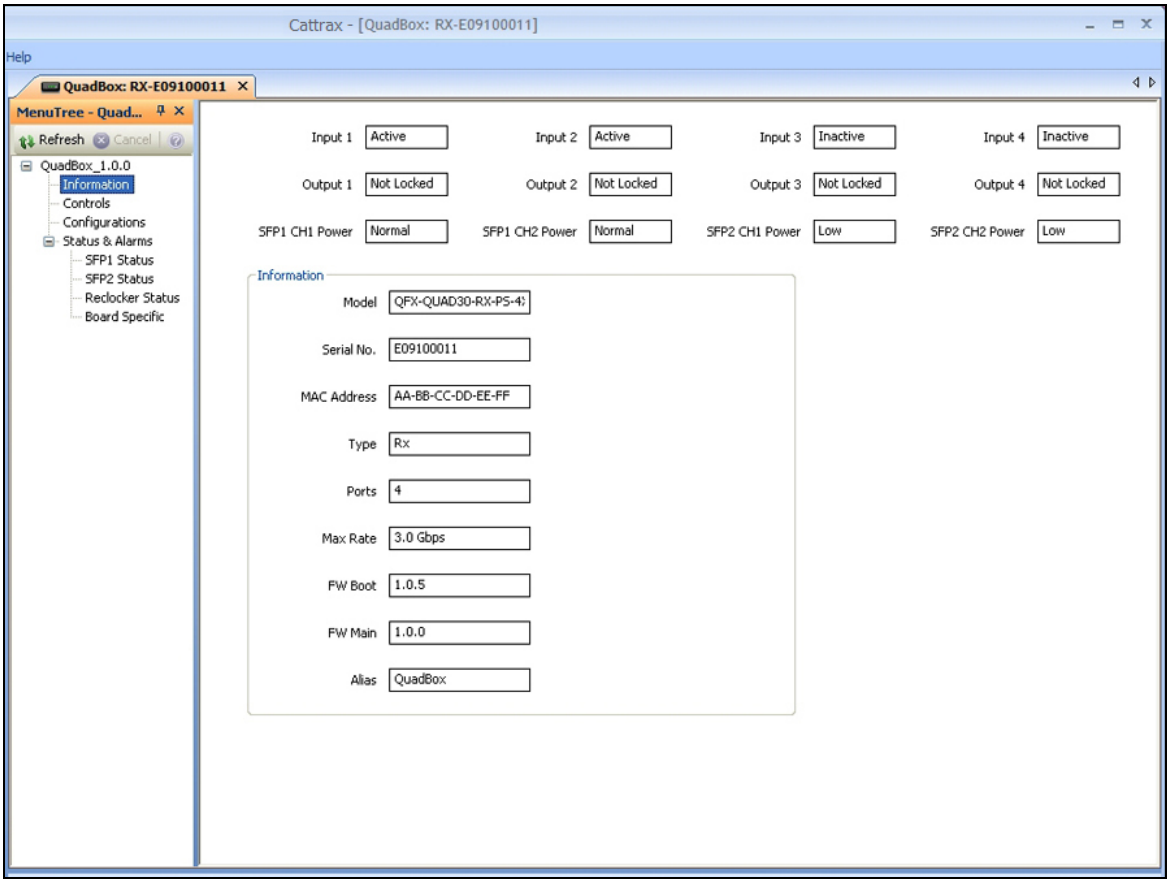


Figure 5-6 Example Information Screen

5.7.3 CONTROLS MENU

Selecting the Controls menu entry from the menu tree displays the screen shown by Figure 5-7. This screen allows you to configure internal routing, if the module is so equipped, and set data rates for the output signals on the selected Quadbox module.

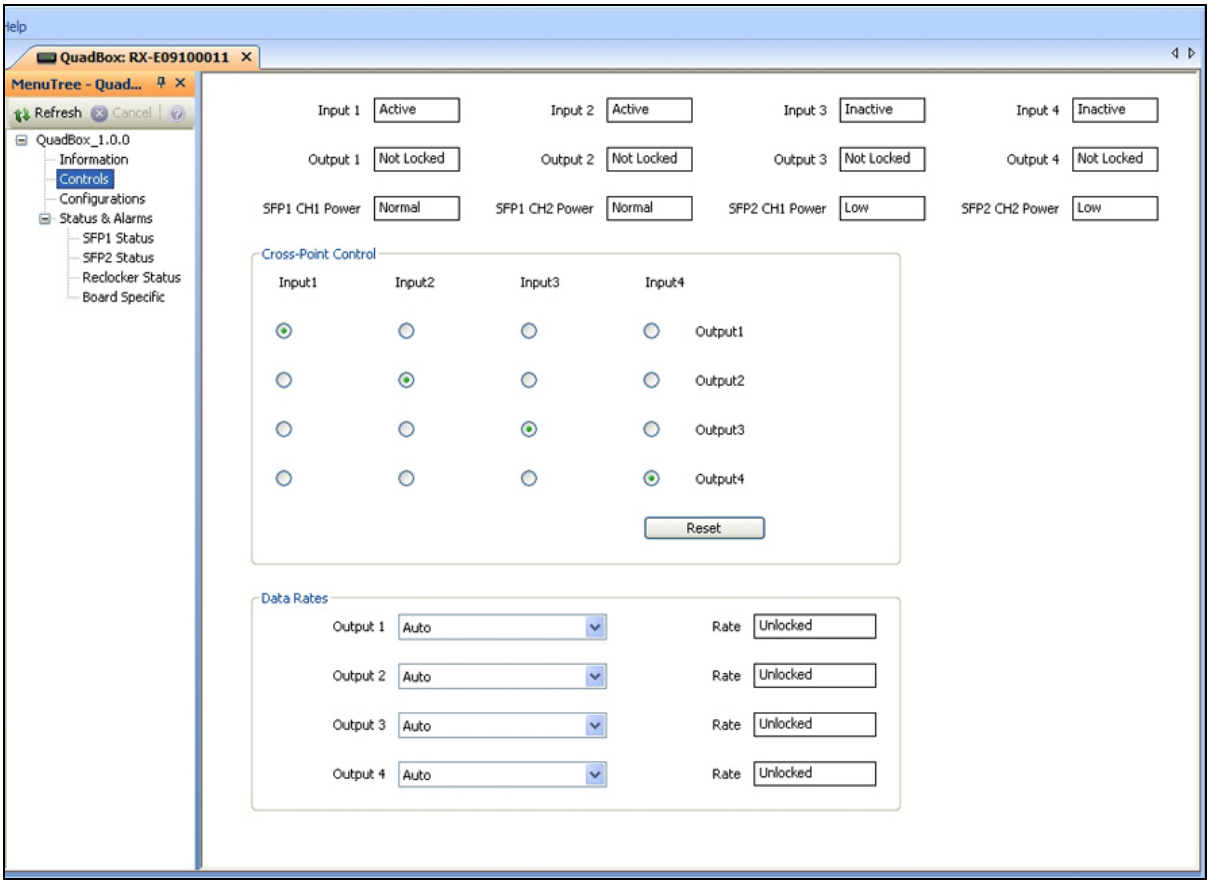


Figure 5-7 Example Controls Screen

Crosspoint Control

The control matrix displayed in the center of the screen allows you to select signal routing if the module is equipped with an internal router. Notice that each Output, 1 thru 4, is listed on a separate row and each Input, 1 thru 4, is listed in a dedicated column. To change signal routing, click the radio button corresponding to the desired input source for each output signal. The default routing scheme is shown in the figure where Input 1 is routed to Output 1, Input 2 to Output 2, etc. Clicking the Reset button returns the router to factory default.

If the selected Quadbox module is not equipped with an internal routing function, the matrix shown in Figure 5-7 is not displayed. If the selected module is equipped with only two input or two output channels, the matrix contains only valid inputs and outputs.

Data Rates

A Data Rate pull-down box that selects the reclocking rate is listed for each valid module channel. Depending on module type, the listing is for Output 1 and Output 2, or Output 1 thru Output 4. The pull-down menu lists all valid data reclocking rates supported by Quadbox, plus the automatic (Auto) option. When Auto is selected, the output data rate is set the same as the input signal assigned to the output channel. If you wish to select a different data rate for the output, open the pull-down menu and select the desired value. When the Bypass option is selected, output video is not reclocked.

When configuring Receive modules the data rate selection sets output rate for the indicated BNC (copper coaxial) channel, and on transmit modules sets the output rate for the indicated fiber optic output channel. The following chart lists valid output data rate choices:

- Auto
- HD-SDI (1485/1483.5 MHz)
- SD-SDI / DVB-ASI (270 MHz)
- 2 x HD-SDI (2967/2970 MHz)
- 2 x SD-SDI (540 MHz)
- SD 16:9 (360 MHz)
- Composite NTSC (143 MHz)
- Composite PAL (177 MHz)
- Bypass

A text box labeled Rate is displayed to the right of each pull-down menu box. If the output signal is locked to a valid data rate, the actual data rate is displayed as a numeric value in the Rate box. If the reclocker stage is bypassed for the indicated output signal, the message Unlocked appears in the box.

5.7.4 CONFIGURATIONS MENU

Selecting the Configurations menu entry from the menu tree accesses the input Equalizer Controls when a Quadbox ***transmit*** module is connected to the host PC, as shown by Figure 5-8. When this menu entry is selected with a ***receive*** module connected, the screen shown in Figure 5-9 is displayed to indicate there is no active controls for the module . The window contains a listing of equalizer controls for each valid copper (BNC) input channel with two radio buttons in each row. These controls allow you to select, by input channel, whether the input equalizer function is On or Bypassed. Click the button for the desired equalizer setting on each input channel entry. The input equalizer function applies only to BNC connector inputs fed by copper coaxial cable. Therefore, the Equalizer Controls window does not appear on the Configurations screen for receive modules

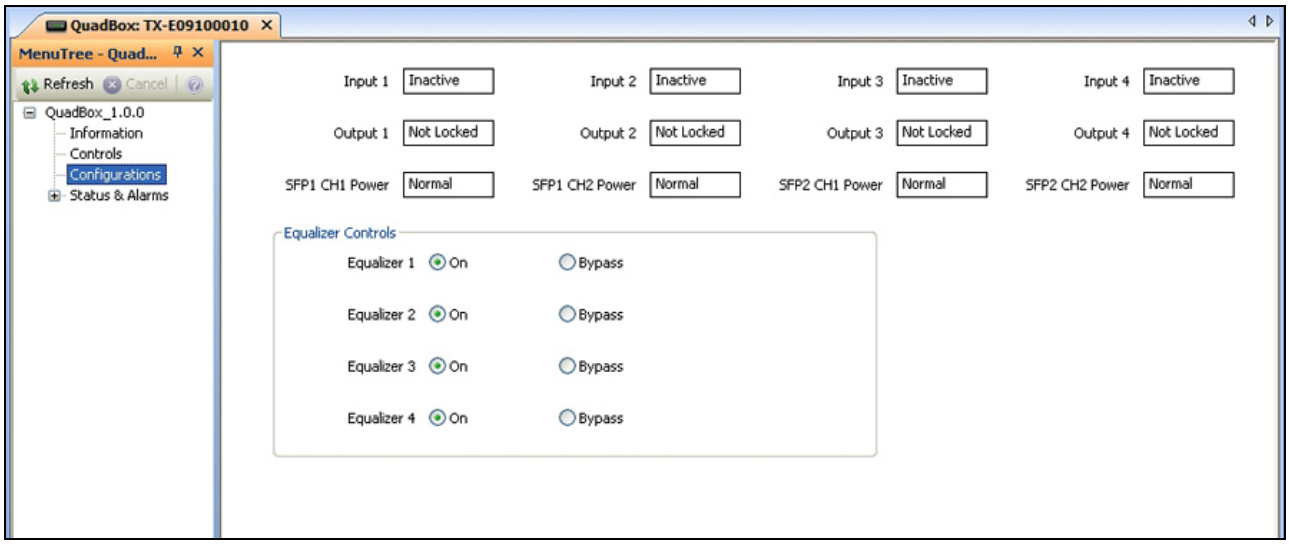


Figure 5-8 Example *Transmit* Module Configurations Screen

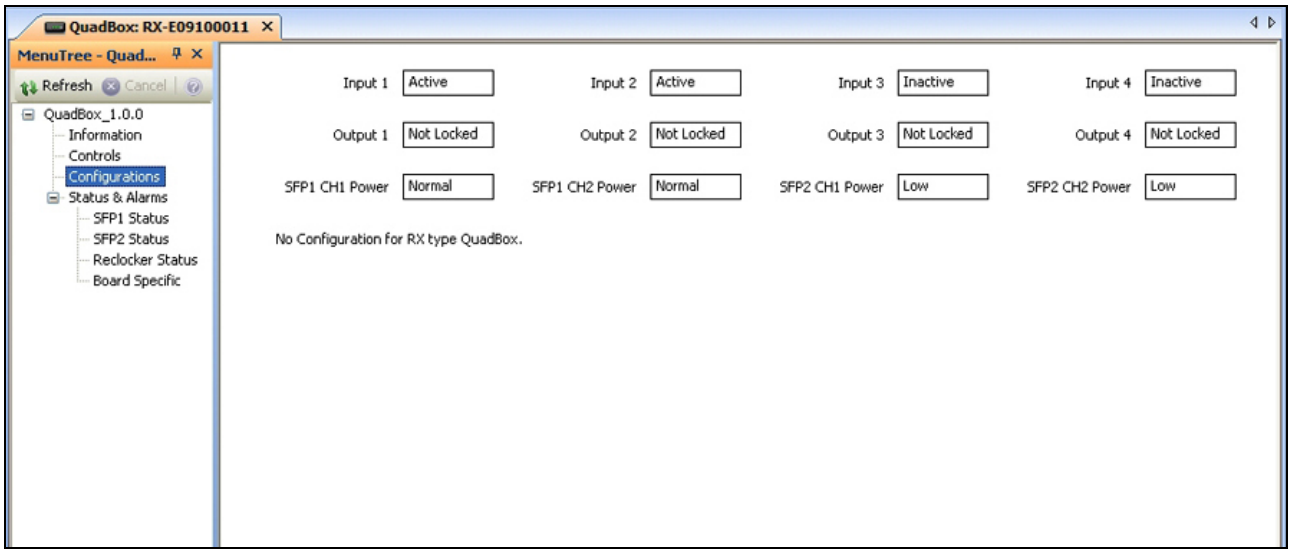


FIGURE 5-9 Example *Receive* Module Configurations Screen

5.7.5 SFP1 AND SFP2 STATUS MENUS

Menu entries SFP1 Status and SFP2 Status access status screens for SFP Module 1 and SFP Module 2, respectively. Each menu provides status monitoring data for each channel of the indicated SFP module. Both are identical in layout and function, with the exception that the information and channel status windows are labeled SFP1 or SFP2, depending on the selected menu. An example screen for SFP1 is shown by Figure 5-10.

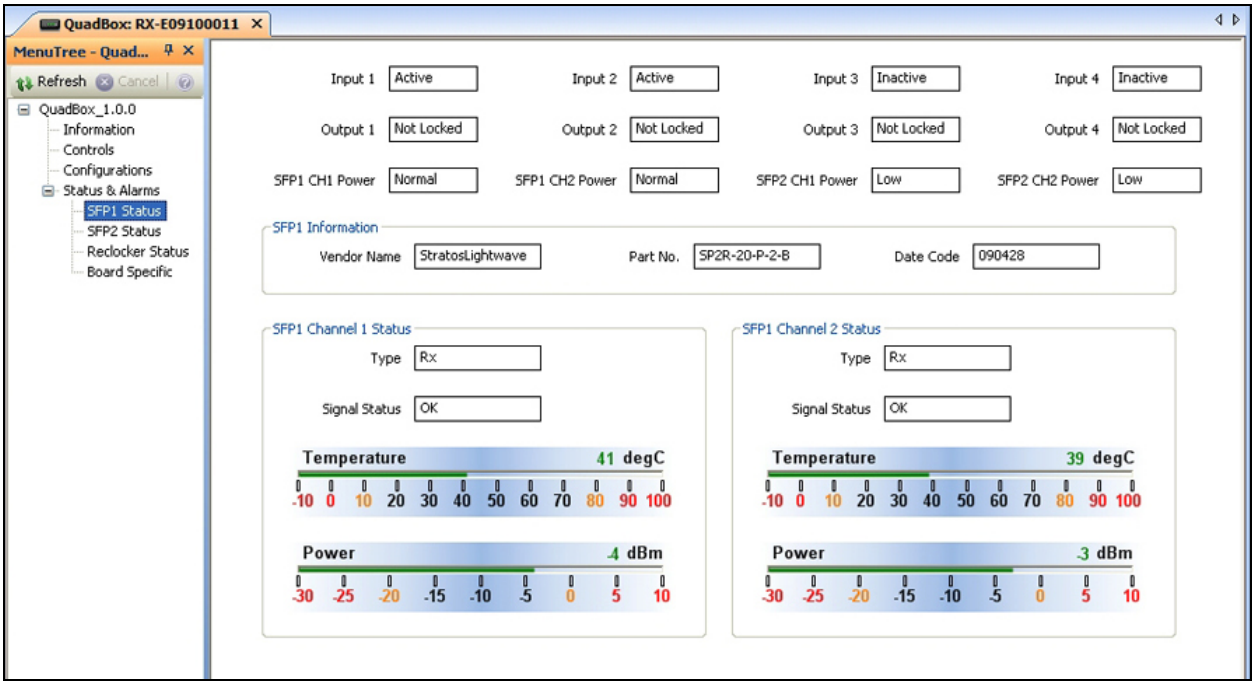


Figure 5-10 Example SFP Status Screen

SFP1 Information or SFP2 Information

There are three text boxes in the SFP information window that display the following characteristics of the indicated SFP module:

- **Vendor Name** – Identifies the manufacturer of the SFP module by name
- **Part No.** – Identifies the manufacturer's part number for the module
- **Date Code** – Displays the date of manufacture for the SFP module

SFP1 Channel 1 Status or SFP2 Channel 1 Status

There are two text boxes and two analog-type meter displays contained in the channel status window used to provide the following real-time status monitoring data for channel 1 on the indicated SFP module:

- **Type** – Identifies the SFP module as a transmit (Tx) or receive (Rx) module
- **TXFault (Transmit Modules Only)** – Indicates if the optical transmit signal is present (OK) or absent (Error) at the output of Channel 1 on the indicated SFP module
- **Signal Status (Receive Modules Only)** – Indicates if an optical input signal is present (OK) or absent (Error) at the input of Channel 1 on the indicated SFP module
- **Temperature** – Provides a direct analog readout of the current operating temperature of the signal path device associated with channel 1 of the indicated SFP module
- **Power** – Provides a direct analog power readout in dBm of the optical output signal leaving channel 1 of the indicated SFP transmit module; or the optical input signal entering channel 1 of the indicated SFP receive module

SFP1 Channel 2 Status or SFP2 Channel 2 Status

Displays for SFP module channel 2 are the same as module channel 1, above, and provide the following real-time status monitoring data for channel 2 on the indicated SFP module:

- **Type** – Identifies the SFP module as a transmit (Tx) or receive (Rx) module
- **TXFault (Transmit Modules Only)** – Indicates if the optical transmit signal is present (OK) or absent (Error) at the output of Channel 2 on the indicated SFP module
- **Signal Status (Receive Modules Only)** – Indicates if an optical input signal is present (OK) or absent (Error) at the input of Channel 2 on the indicated SFP module
- **Temperature** – Provides a direct analog readout of the current operating temperature of the signal path device associated with channel 2 of the indicated SFP module
- **Power** – Provides a direct analog power readout in dBm of the optical output signal leaving channel 1 of the indicated SFP transmit module; or the optical input signal entering channel 2 of the indicated SFP receive module

5.7.6 RECLOCKER STATUS

Selecting the Reclocker Status menu entry from the menu tree displays the screen shown by Figure 5-11. This screen provides real-time status monitoring data for the output reclocker device on the selected Quadbox module.

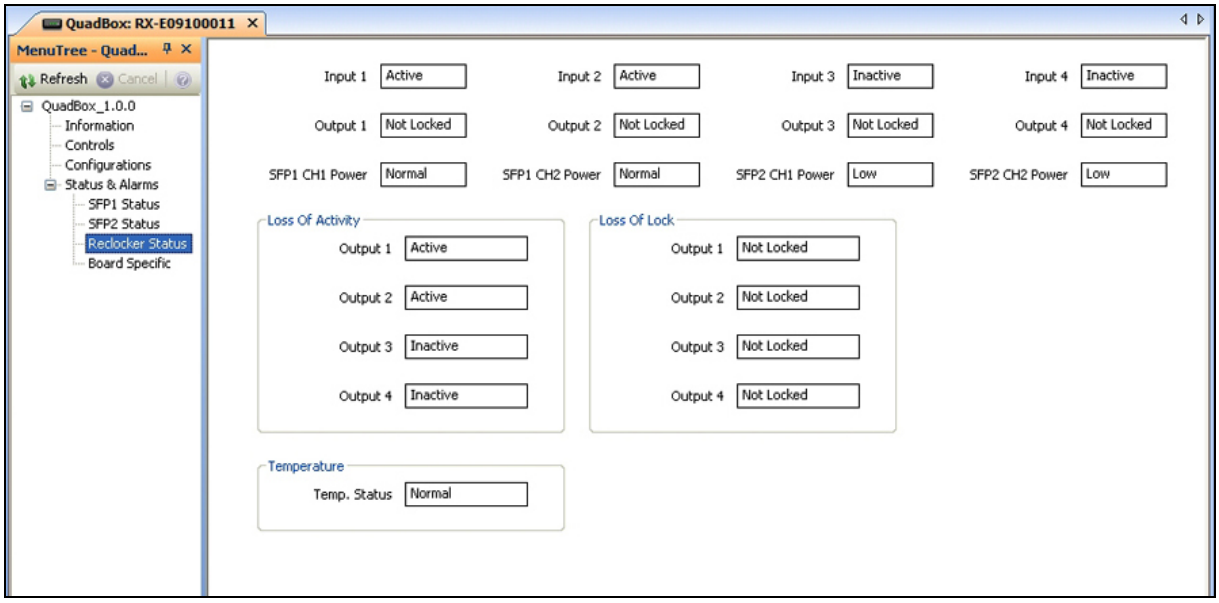


Figure 5-11 Example Reclocker Status Screen

Loss of Activity

Within the Loss of Activity window a status box is listed for each valid module output, by channel number, which displays whether or not there is an Active **input** signal present for the indicated output channel. If the box displays the message Inactive, there is no active input for the channel. Depending on module type, the listing is for Output 1 and Output 2, or Output 1 thru Output 4. When monitoring Receive modules each display box indicates an active signal on the fiber optic input channel, and on transmit modules indicates an active signal on the BNC (copper coaxial) input channel.

Loss of Lock

The Loss of Lock window contains a list of each valid module output by channel number that displays whether the reclocked output is locked to a standard data rate (Locked) or bypassing the reclocker (Not Locked.) Depending on module type, the listing is for Output 1 and Output 2, or Output 1 thru Output 4. When monitoring Receive modules the display indicates reclocker lock status for the BNC (copper coaxial) channels, and on transmit modules indicates reclocker lock status for the indicated fiber optic output channel.

Temperature

The Temp. Status box indicates status of the reclocker device operating temperature.

5.7.7 BOARD SPECIFIC MENU

Selecting the Board Specific Menu entry opens a display screen with monitoring data pertaining to the circuit board of the selected Quadbox module. An example screen is shown by Figure 5-12.

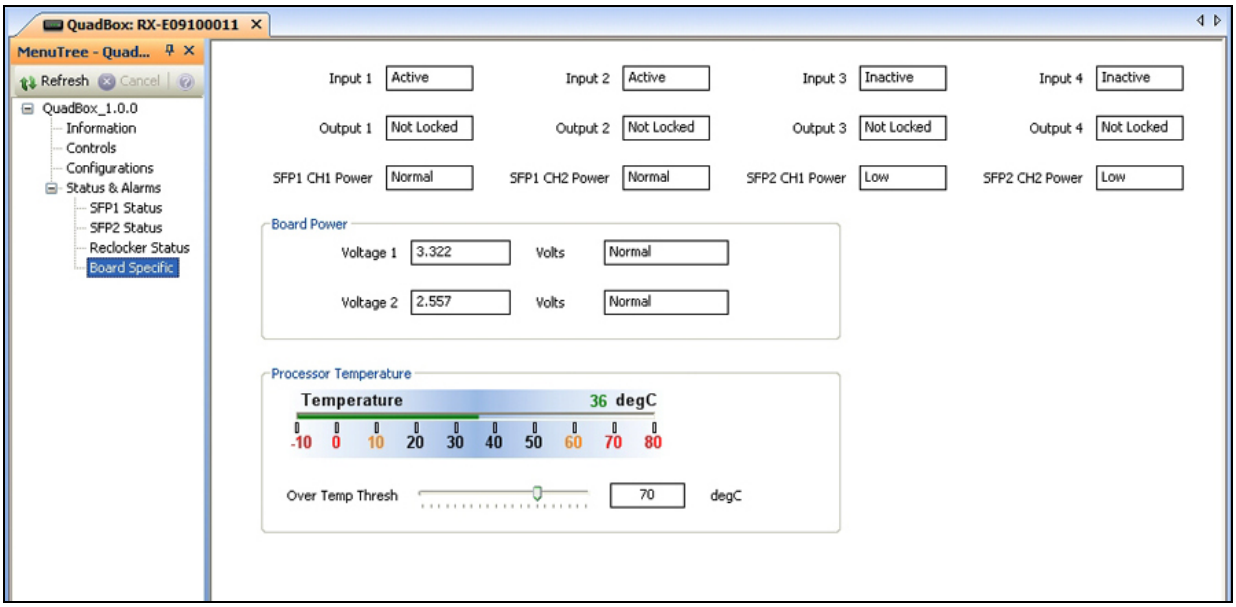


Figure 5-12 Example Board Specific Screen

Board Power

There are four text boxes in the Board Power information window arranged in two rows, each row indicates the voltage level and status for the main power supply rails on the circuit board. The left-hand box in each row provides a digital readout of the actual measured operating voltage for the indicated power rail. The right-hand box indicates the status of the power supply voltage as low, normal or high.

Processor Temperature

The analog-type meter display contained in the Processor Temperature window provides a direct analog readout of the current operating temperature of the processor device contained on the Quadbox circuit board.

Over Temperature Threshold

Moving the Over Temp Thresh slider beneath the temperature readout display determines the temperature (in degrees Celsius) at which the Over Temp alarm triggers an alert in the Alarms and Events panel of the Cattrax control application. The selected threshold temperature is displayed in the box beside the slider.

5.8 NETWORK CONFIGURATION WITH CATTRAX

In order to communicate with Quadbox modules on the facility network, Cattrax must have the same IP subnet address and be physically connected to the same subnet as the devices it needs to manage. As the diagram in Figure 5-13 shows, the PC running Cattrax may be connected to an existing switch that connects Quadbox modules and other PESA equipment.

The IP Address of the PC must be set such that it has the same subnet address as modules, frames and panels. For example, if the Quadbox module has an IP address of 192.168.0.35 and the Subnet Mask is 255.255.255.0; then the IP address of the PC running Cattrax must be set to 192.168.0.XX, where XX is any number that is not already in use by other devices on the network. In this example, the IP address of the PC may be set to a value such as 192.168.0.70.

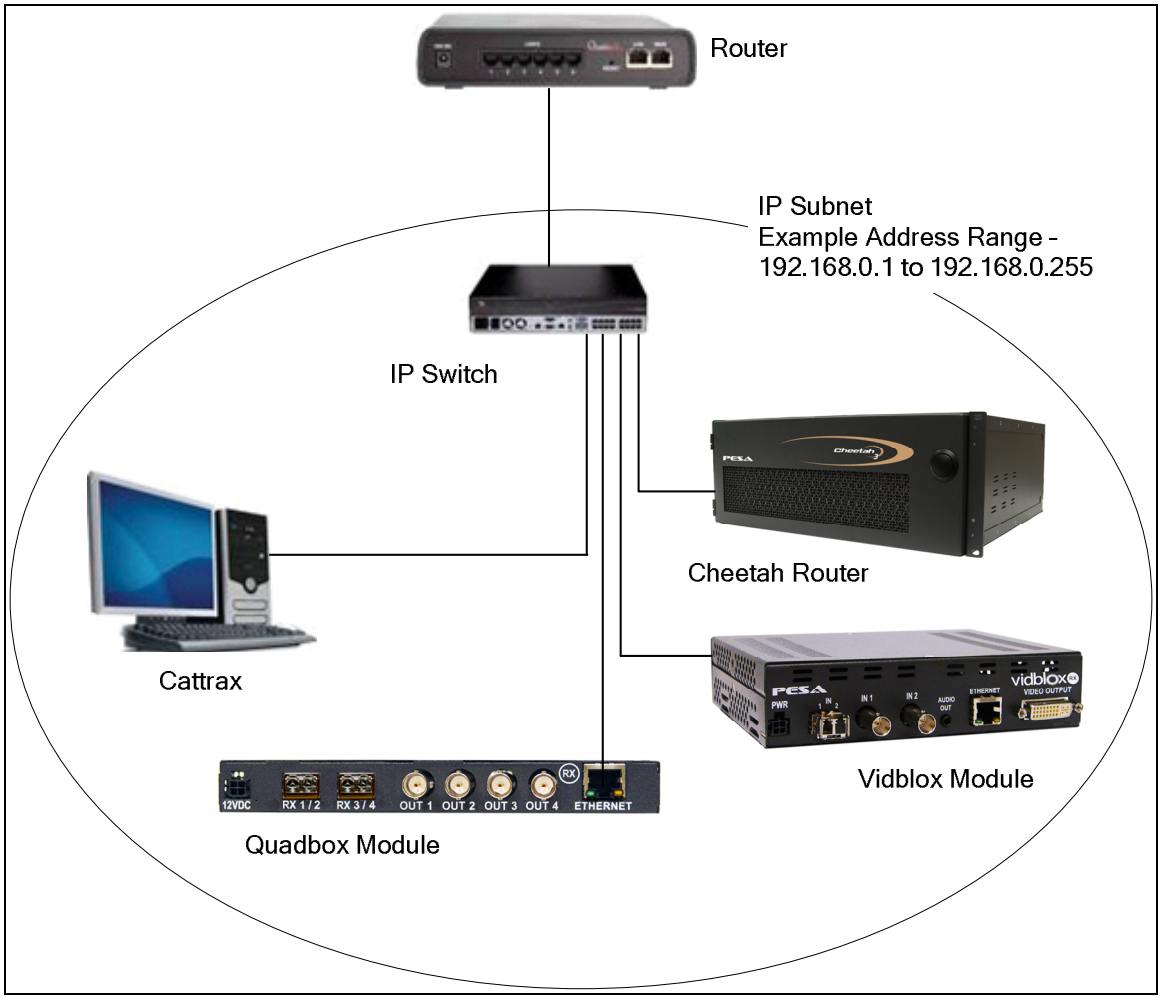


Figure 5-13 Cattrax Installation Using an IP Switch to Connect Managed Devices

5.9 CHANGING DEVICE NETWORK ADDRESSING PARAMETERS

Cattrax allows users to change the IP address and other network addressing parameters of both active and inactive Quadbox modules from the Device Properties panel shown below in Figure 5-14. This feature is particularly useful for devices that are inactive due to an IP address conflict with other devices, or having a different network address. Cattrax allows the user to correctly set the IP address of such devices directly without having to isolate the device from the network.

To change networking parameters for the selected device, simply enter the desired IP address, Subnet Mask or Gateway address in the boxes contained under the **IP Address** panel on the Devices Properties panel and click **Apply**. If the new IP entered is the same as an existing IP address of another device, Cattrax reports an error.

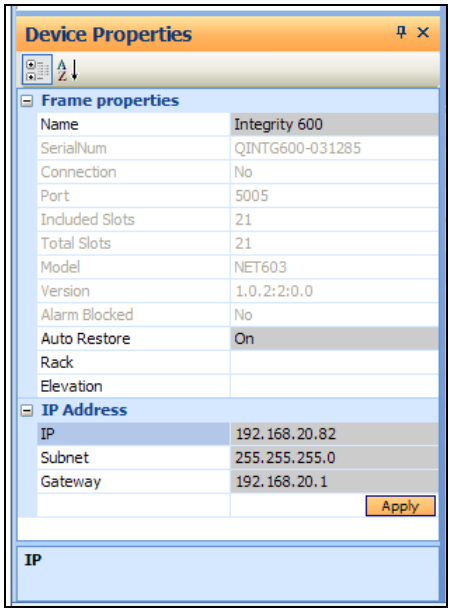


Figure 5-14 Changing IP Address from Device Properties Panel

Chapter 6 Maintenance and Repair

6.1 PERIODIC MAINTENANCE

No periodic maintenance is required.

6.2 PESA CUSTOMER SERVICE

If you are experiencing any difficulty with a Quadbox module, please contact the PESA Customer Service Department. Skilled technicians are available to assist you 24 hours a day, seven days a week.

6.3 REPAIR

Before attempting to repair this equipment, please consult your warranty documents and the PESA Customer Service Department. Unauthorized repairs may void your warranty.

	**PC boards in this equipment contain Surface Mount Technology (SMT) components. Special tools are required to replace these components without causing damage to adjacent areas.** **Failure to consult with Customer Service before attempting to repair these boards may void your warranty.**

6.4 REPLACEMENT PARTS

Only parts of the highest quality have been used in the design and manufacture of this equipment. If the inherent stability and reliability are to be maintained, replacement parts must be of the same high quality. Please consult our Customer Service Department before installing any parts not purchased from PESA.

6.5 FACTORY SERVICE

Before returning any equipment to our factory for service or repair, please contact our Customer Service Department for an RMA number.


PESA