QVidium® TECHNOLOGIES, INC.

QVENC4K™ 4K/UHD HEVC/AVC Streaming Internet Video Encoder

For Live Internet Streaming and Professional Video

Applications

Model: #**QVENC4K**

User Manual v.2

September 19, 2023

Application Firmware Version 34.59.14

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QVidium provides the capability to inter-operate with most Content Delivery Networks (CDNs). As a result, the QVENC4K can send to a CDN in one of four common protocols, SRT, RIST, RTMP/RTMPS and HLS. These capabilities are described in Chapter 2. This feature allows the QVENC4K to interoperate with large content gathering points such as Facebook and YouTube.

1 Introduction

Congratulations on purchasing your new QVidium® Live Internet Streaming video encoder.

QVidium® QVENC4K UHD/4K video encoder – Front View (top), Rear View (bottom)

1.1 Overview

QVidium's QVENC4K™ streaming video encoder is a high performance, high resolution video over IP networking device capable of encoding broadcast quality video at resolutions up to 3840x2160 and at frame rates up to 60 frames per second. Utilizing a high-end, state-of-the-art multi-core CPU with a specialized on-chip hardware video encoding core, the QVENC4K can process video in real-time using HEVC/H.265 or MPEG4-AVC/H.264 compression. The QVENC4K can transmit 4:2:0, 8-bit, UHD/4K video. Along with the video, the QVENC4K can process up to 8 channels of audio (4 stereo pairs) with a selection of common audio encoding formats, including surround sound 7.1..

QVidium was the first company to invent a negative-acknowledgement feedback-based video transport and error correction mechanism, called QVidium ARQ (Automatic Retransmission request), for which it holds 2 U.S. patents and an Emmy© Award. QVidium ARQ enables the transport of broadcast quality video over nearly any Internet and wireless network, provided that it has sufficient bandwidth to carry the stream.

Like all other QVidium video encoder, decoder, gateway and server products, the QVENC4K employs QVidium's patented ARQ. In addition, the QVENC4K also offers other video transport and error correction with protocols such as Zixi, SRT, RIST for live video error correction and transport, and RTMP/RTMPS,and HLS for compatibility with Content Delivery Networks (CDNs) such as Facebook, YouTube, and Ustream.

The following sections and chapters explain how to configure and operate the QVENC4K using screen snapshots and explanations of the various settings, and provide examples of the output you should expect.

1.2 Accessing the Network Interface

To gain access to the control and status interface for the QVENC4K, you must first log in from a web browser by entering the IP address assigned to your QVENC4K. By default, the IP address is automatically configured via DHCP. If you do not know what IP address was assigned to your unit, you can use our CodecManager application, described in Section 1.4, Network Setup.

Log in using the username, "admin" and the password also "admin".. For more detail on logging in, please see Section 1.6, Password and Security. If you have trouble logging in, please try clicking on the browser's refresh control, usually shown as a counterclockwise circular arrow.

1.3 Dashboard and System Menu

The first menu item after logging in is the Dashboard, which shows relevant parameters for the current state of the system, such as the current encoding network statistics, system uptime, memory usage, and send and receive stats for the two network interfaces. This is shown below, in Figure 1.

Figure 1. Dashboard and System Menu.

In Figure 1, we have expanded he **System** menu to show the available system settings: **Name, Password, Time, Upgrade, Processes, Shutdown, and Reboot**. You can set the system name, to help distinguish one QVENC4K from another, and change the password from the default (Serial Number) to one of your own choosing,

You can update the firmware to the latest version, provided that your QVENC4K is connected to the Internet, by clicking **System/Upgrade**. This will compare the various firmware modules on your

QVENC4K with the latest version on our server and download and install the modules that are not up to date. For more details about updating your firmware, please see Section 1.8, Updating.

Reboot will restart the entire system and **Shutdown** will turn off the power to the system. After shutting down the system, you will need to push the power button on the front of the unit or power-cycle the power to the system to regain access to the system.

1.4 Network Setup

The QVENC4K™ includes two built-in gigabit Ethernet ports, labeled **GigE 1** and **GigE 2**. The default factory setting enables DHCP on both built-in **GigE 1** and **GigE 2** ports to automatically set its IP address and network configuration. In addition, you can add additional Ethernet ports by inserting an Ethernet to USB dongle into the USB3-Type A port that is next to the two built-in Ethernet ports.

QVidium provides software called **CodecManager** that you can download from the **Support** page at http://www.qvidium.com to configure and determine the IP address of the Ethernet port of your QVENC4K. Alternatively, you can use the QVENC4K's built-in Web interface to change the network settings – assuming that you know the address assigned to your QVENC4K by the DHCP server.

To configure the network settings of your QVENC4K using CodecManager, follow these steps:

1) Download and install the QVidium CodecManager application from the Support page at http://www.qvidium.com. Before running CodecManager, please have your QVENC4K connected to an Ethernet switch via a Cat5 or equivalent cable. Then have your PC or other network device connected to another port on that same switch and disable any wireless or other wireline network ports on your PC.
2) Make certain that your QVENC4K is powered on and operational. It takes about 20 seconds for it to completely boot up into its operational state.
3) Run the CodecManager application. You should see the IP address of the QVENC4K and any other QVidium devices connected to that switch. To avoid confusion, we recommend disconnecting or powering off any other QVidium devices or products that may be connected to that Ethernet switch.
4) Click once on the entry for the QVENC4K that you want to configure and click on Edit to configure the IP address. For setting a static IP address, please be certain to disable DHCP mode. After clicking OK, you should see the IP address for the QVENC4K entry change to the new address.
5) If a static IP address is desired, you can enter any valid IP address, Gateway, and Netmask. However, please be aware that if you want to connect to, and interact with the web interface of the QVENC4K, your PC must be on the same IP subnet that you had assigned to the QVENC4K.
6) Assuming that you set up a valid IP address in Step 5, then you can then Double-click on the entry for the QVENC4K to pull up a browser and enter the Graphical User Interface (GUI) to interact with the QVENC4K.

TROUBLESHOOTING: If your QVENC4K™ does not show up in CodecManager or if you have a Linux or MAC or other non-Windows PC, you can install Java and try running the Java version of CodecManager. This version will try all your PC's network interfaces to find the QVENC4K. You can also log into your DHCP server to see what IP address was assigned to your QVENC4K.

NOTE: The QVENC4K™ requires user authentication to enter the web interface. The factory preset **username** is "**admin**" and the **password** is also preset to "**admin**". We strongly recommend that you change this to keep your device secure.

To reconfigure the network interface using a Web browser, follow these steps:

1) Determine the IP address of the QVENC4K™ from your DHCP server
2) Make certain that the IP address of your PC is on the same subnet as the QVENC4K
3) Enter the IP address of the QVENC4K into a web browser on your PC
4) Click on "`Configure`" under the "`Network`" menu on the left.

You should see a web page similar to the following network configuration web page, Figure 2:
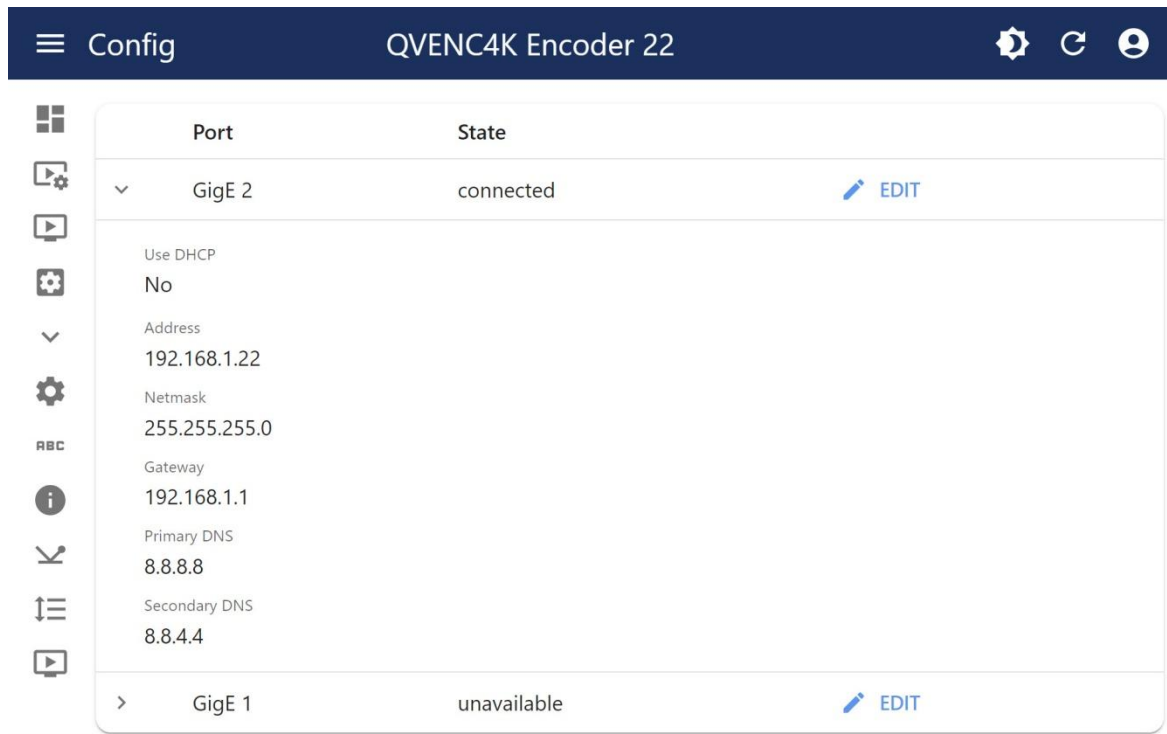
Figure 2. Network configuration example for GigE 2

3) Change settings as desired and click "`Save`".

4) If you change the IP address, you will need to change the URL in the web browser to point to the new address after clicking on "`Save`".

The Network/Configure page allows you to modify the static IP address parameters and DNS server settings, or to have these settings automatically configured through DHCP. A Hostname page allows you to specify the host name for use in conjunction with a DNS server to assign a predetermined IP address.

1.5 Reconfiguring and Resetting Network Settings

In case you are not able to connect to the QVENC4K™ through the network port(s), we have provided 2 different mechanisms for resetting the IP addresses and network settings: through **CodecManager** and through the **USB console serial port**. Any one of these 2 methods we describe in this section will allow you to recover in case the IP address was changed or set to DHCP and you do not know its current value.

CodecManager: As previously described in the last section, if you have a Windows PC or a Mac running a PC emulator, you can download and run the QVidium application, CodecManager™, to change or set the IP address for the built-in Ethernet port. You can download CodecManager from the Support page at http://www.qvidium.com. If you have more than one network adapter on your PC, you may need to select the proper Network Interface from the pull-down control in the lower left corner of the CodecManager application. Also, because CodecManager relies on low-level Ethernet-level multicasts, we recommend having both the QVENC4K and your PC connected through a switch, and not via a direct Ethernet cable. If you do not see the QVENC4K on CodecManager, even after clicking on the Discover button, then you should try connecting to the other LAN port on the QVENC4K. If you still do not see the QVENC4K, then we suggest either resetting the network interface using the **USB Console Port** method, below, or via the USB serial port.

USB Console Port: Alternatively, you can connect a USB cable to the Console USB port to log into the Linux shell and change the IP address or other settings. To reset the IP settings to their factory defaults, connect a PC running a terminal emulator, such we Hyperterm or TeraTerm. You should then see a new COM port on your PC. Set the Baud rate to 1500000 and try connecting the terminal emulator to the new USB port. The other serial port settings should be set to 8-N-1, no flow control. Upon power-on, you should see a stream of characters as the system is booting, ending with the login prompt. Login as user "qvidium" with the barcode serial number as the password,then hit **Enter**. From this prompt, type **resetnetwork** followed by hitting the Enter key (<CR>, carriage return) to reset the network settings to use DHCP. You can also type **ifconfig eth0** (and <CR>) to see the current IP address.

If you have experience with network monitoring software, such as Wireshark (www.wireshark.org), please note that upon power-up, the Encoder will emit a gratuitous ARP packet from which you can determine its IP address by looking for the ARP packets that the QVENC4K generates and analyzing its contents.

1.6 Ping and Traceroute

Selecting Ping allows you to test network connectivity by sending ping packets to an address or hostname you specify. However, to use a hostname in place of an IP address, you must have configured at least one DNS server.

The following figure, Figure 3, shows the Network Ping configuration and output.
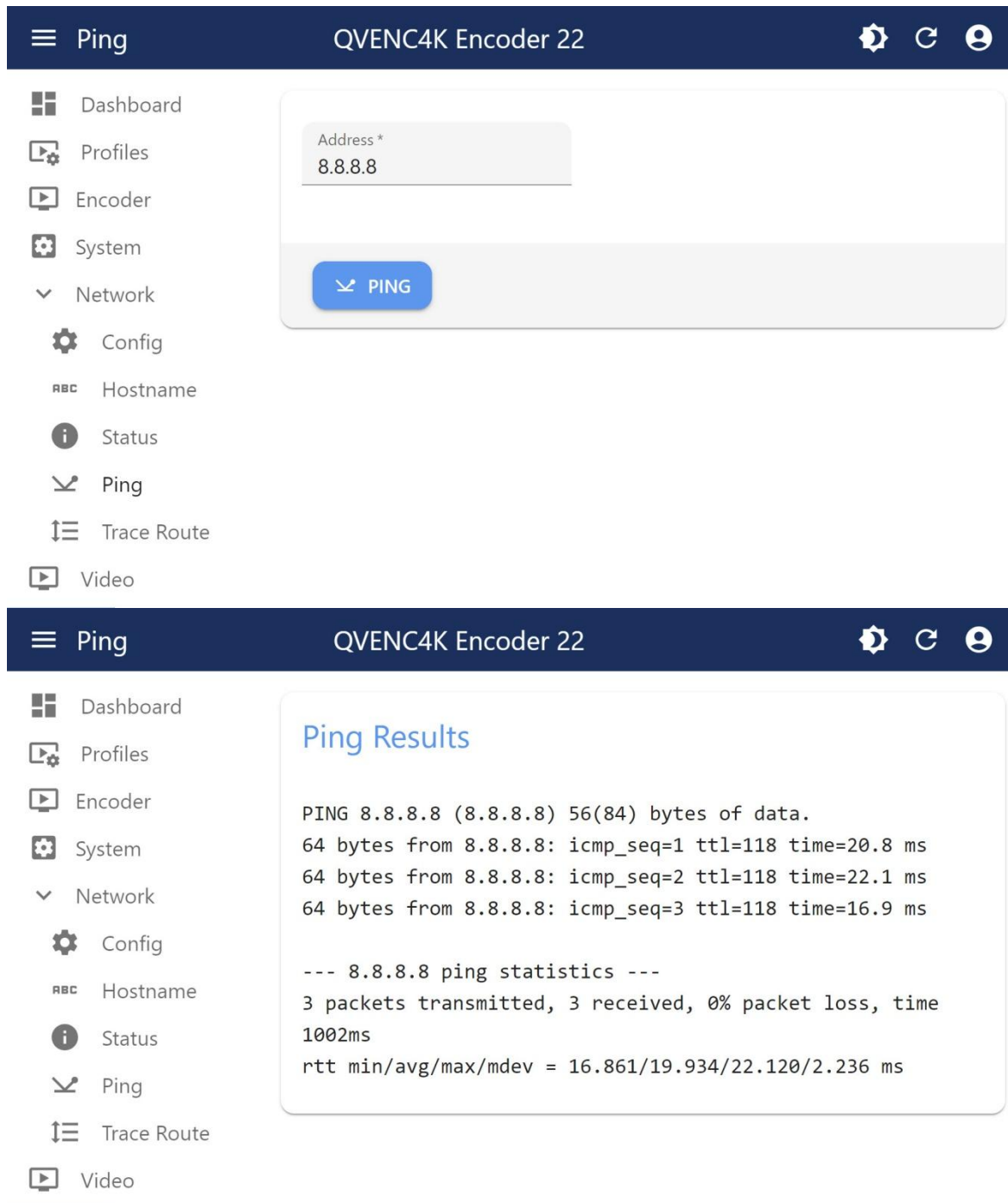
Figure 3. Network Ping example for GigE 2. Top: Configuration; Bottom: Output
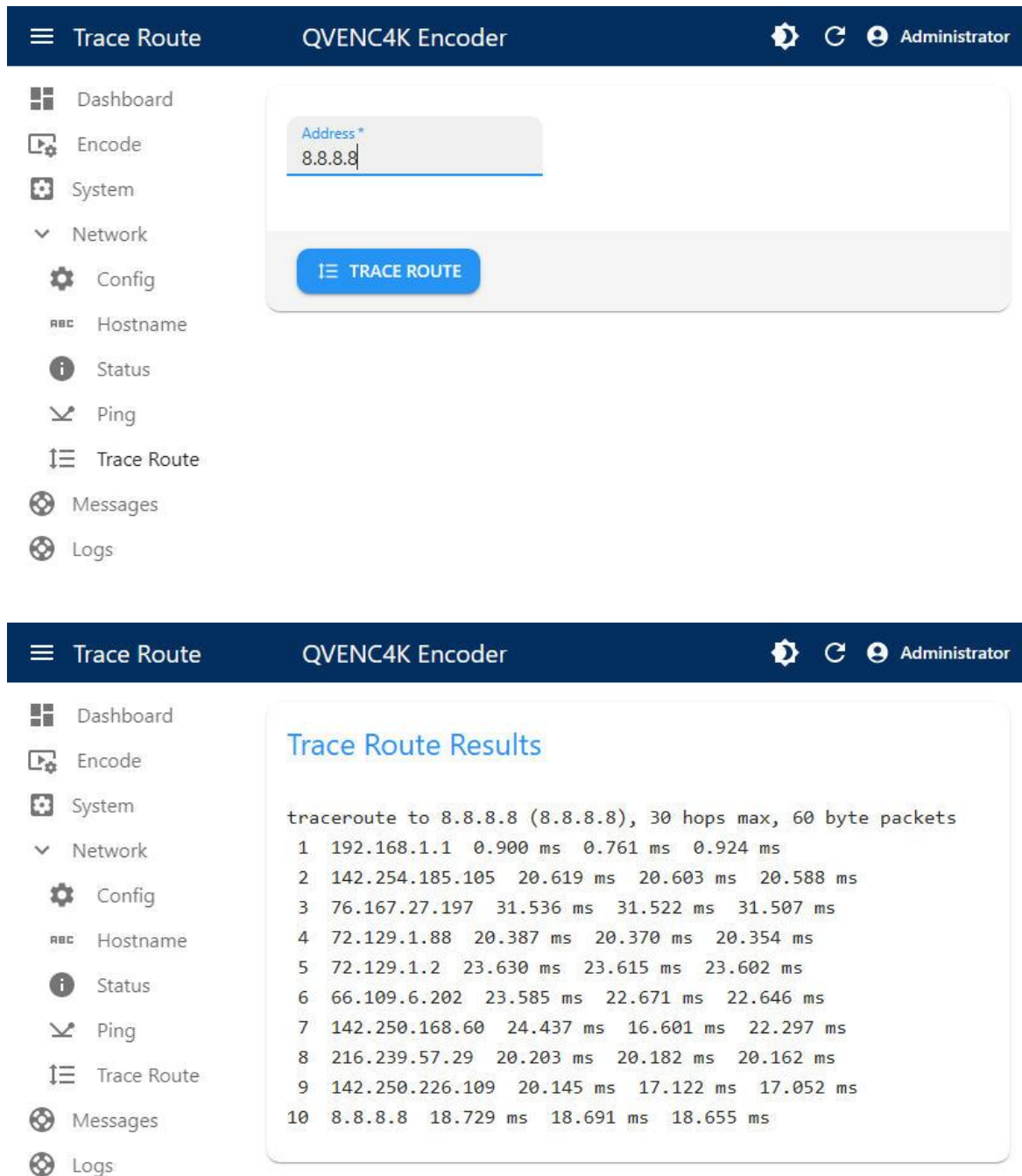
Figure 4. Network Traceroute example for GigE 2. Top: Configuration; Bottom: Output

Likewise, you can use Traceroute (shown above in Figure 4) to ping every router along the route from the QVENC4K to the IP or DNS address you specify. Traceroute is very helpful in locating instances where an ISP might employ dynamic load balancing and other routing problems that can affect the quality of the video transport. Dynamic Load Balancing occurs where an ISP might specify an alternate route to send packets to balance the load across its network. This is fine for web pages that use TCP and can tolerate random delays. However, this can cause video streams

to become mis-ordered, jumbling the video content. Using the Jitter Buffer in the QVidium decoder or ARQ software can often restore correct packet order and stream integrity, at the cost of additional delay. You can also avoid Dynamic Load Balancing by requesting MPLS (Multi-Protocol Labeled Switching) service from your ISP.

1.7 Passwords and Security

The QVENC4K™ requires a username and password to protect access to its configuration settings. This includes both Web access and SSH access. The default user name for the web interface is "**admin**" and the **default password** is also initially set to "admin". Logging in as the user **root** is not allowed. We strongly suggest that you change the password to keep your QVENC4K secure, especially if it has direct access from the Internet.

Note on Resetting Password: If you lose the password and need to reset it, you can go to http://www.qvidium.com/reset, click on **Reset Password**, copy the "autorun" file onto a USB flash, and plug flash into QVENC4K. (File must be saved as "autorun" and not "autorun.txt".). This will reset the admin password back to the serial number of the unit You must have physical access to the USB ports on the QVENC4K to use this procedure.

As shipped from the factory, the QVENC4K comes with SSH and root access disabled. The RPM update system used, as discussed in the next section on Updating, prevents any unauthorized firmware from entering the unit. Should the user require shell or SSH access to the unit, a public-private certificate-based system can be enabled that disallows shell login via username/password as a further security enhancement.

1.8 Updating

QVidium provides firmware updates from time to time to add new features, overcome limitations, or to fix bugs. The QVENC4K firmware builds upon the RPM Package Manager to catalog, manage, automate, secure, and simplify the update process. With a click to System/Update from the web interface, the QVENC4K will connect with the QVidium update server via the Internet to take inventory of which packages need to be updated and seamlessly keep the QVENC4K running with the latest features and more robust firmware available. This secure mechanism forms a part of the overall protections that help to prevent malware and all non-authorized firmware from infecting the QVENC4K.

To update to the latest firmware, make certain that your unit has access to the Internet and click on **System/Update**, then confirm that you wish to proceed. The system will connect to the QVidium server, take inventory of the packages loaded on your QVENC4K, and then proceed to determine which packages need to be updated and download and install only those packages that need to be updated. After this completes, you must reboot your system for the update to take effect by clicking on System/Reboot from the web browser interface. You should also clear your web browser's cache or at least refresh the web pages after updating the firmware in case the new firmware had changed some of the web pages.

1.9 System View – QVENC4K

Front View – Power Indicator

Indicator	Description
Power	Glows **amber** when power is first applied. Glows **green** when powered on and operational. Glows **red** upon encountering an error condition.

Note: A USB2-MicroB Console port and USB3-TypeC USB port are primarily for system maintenance purposes and should rarely, if ever, be needed by the customer.

Rear View – Power, SDI Video/Audio I/O, USB and Ethernet Ports
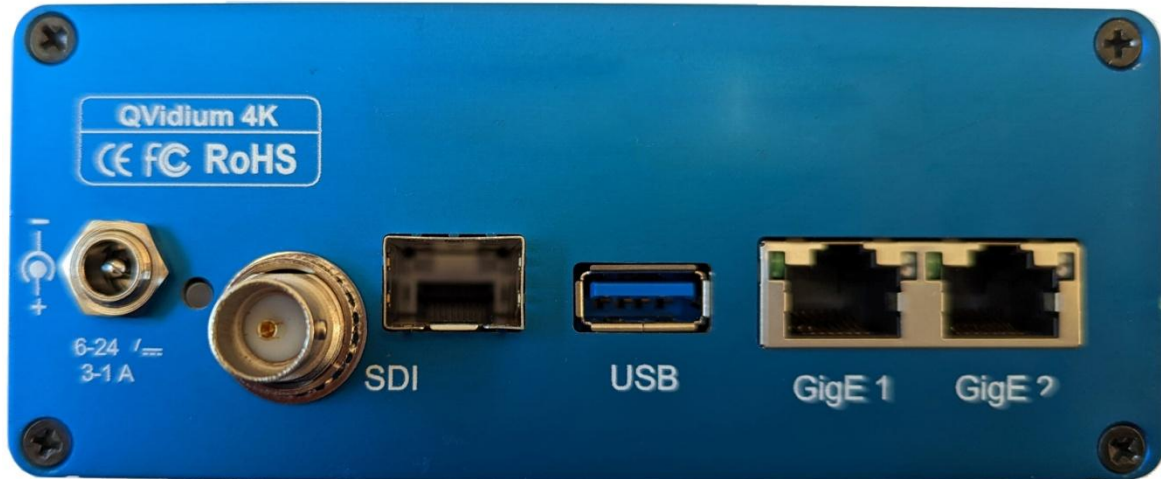
Ref	Component	Description
1	**DC Power**	$=$ 6VDC @ 3A to 24VDC @ 1A
2	**SDI Lock**	SDI lock indicator
3	**SDI**	12G-SDI Input/Output port, all SDI rates up to 12Gbps.
4	**SDI**	SFP port for 2nd SDI I/O port (optical or copper), 12G-SDI max.
5	**USB**	USB-3.0 type A connector for additional memory or Ethernet port
6	**GigE 1**	First 10/100/1000 Ethernet port
7	**GigE 2**	Second 10/100/1000 Ethernet port

Note: Serial number barcode label (not shown) would be located on this back plate.

1.10 IMPORTANT SAFETY INFORMATION – PLEASE READ

- ⚠ **Use this product only as specified in the manual. If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired, resulting in personal injury or damage to the product.**

- ⚠ **Only product safety-approved DC power supply units based on all applicable local, state/provincial, and/or national regulations shall be used with this product.**

- **For PLUGGABLE EQUIPMENT, the socket-outlet shall be installed near the equipment and shall be easily accessible.**

- **This equipment is not suitable for use in locations where children are likely to be present.**

- **NO USER SERVICABLE COMPONENTS.**

2 Encoder Configuration

To configure and operate the encoder from a web browser first select **Profiles**. From this Profiles menu, you can create, start, edit, and delete a multitude of profiles that contain all the parameters to configure the encoder. Accing a profile will allow you to quickly redeploy the QVENC4K for a broad range of applications. An example showing various profiles is shown in the following screen shot of Figure 5.

Figure 5. Sample Encoder Profiles Page

All settings are stored in non-volatile flash memory, allowing the encoder to automatically recover after a power failure, and to restart the profile that was running at that time. The next section explains how to configure the QVENC4K encoding parameters with a description of each of the encoder settings.

Each encoder profile allows you to output up to 4 copies of the encoded video into a unique IP stream, each to its own destination address and each stream copy individually configured with any of the available IP transport protocols that you select.

2.1 Quickstart Encoder Configuration

Below is a simple procedure to quickly start streaming from one QVENC4K for encoding to a compatible video decoder.

1. Enter `http://<IPAddress>` where `<IPAddress>` is the IP address of the QVidium QVENC4K™ HEVC UHD-HDR Video Encoder unit that you want to configure as an encoder. (See section *1.2 Network Settings1.2* to get or set the IP address.)

2. Click **Profiles** from the menu on the left. Then, either click to highlight an existing encoder profile you wish to edit and click **Edit**, or click **Create** or "**+**" to create a new encoder profile. The "`Encoder Profile`" interface should then display in the main area to the right of the menu.

3. At this point, the web interface displays a list of all the configurable video and audio encoding parameters, We recommend that you initially use all of the defaut settings for these parameters, unless there is an obvious change required for your application.

4. Next, configure one or more of the four **Output** fields, which are listed after the audio settings in at the end of the parameter list. Click to select the desired video transport protocol, and enter the destination IP address and UDP port or URL and any other parameters associated with the protocol that you selected for this output. For "Listener Mode", you can leave the Destination IP address blank.

5. When sending a video stream over a LAN or other private hardwired network, you can select UDP for the IP transport. The UDP protocol is the simplest to configure and incurs the least amount of added delay. However, to send a video stream over the public Internet or a wireless network with the potential for packet loss, we strongly recommend that you choose a video transport protocol designed to recover from potential packet loss, such as our patented QVidium ARQ protocol. If you also require interoperability with a third-party decoder, you may wish to select from among SRT, RIST, or Zixi. To stream to a content delivery network, such as Facebook or Youtube, we recommend selecting RTMP or HLS.

6. When selecting a particular IP transport protocol, the web interface will change to show the available parameters that are specific to that protocol. At a minimum, you will need to select a UDP port or URL. Most protocols will require a destination IP address or DNS name for the receiver, but several of the protocols, such as QVidium ARQ, RIST, and SRT, allow you to leave the destination blank and have the receiver initiate the stream. We refer to this operation as Listener Mode or Pull Mode.

7. After configuring an **Output** field, you must click on **Update URL** to save the changes for that output. Next, click the **Save** button to save the profile. None of your changes will be saved nor have any effect unless you first save them. These changes are stored in permanent memory and will persist even after a power failure.

8. To then start a stream, click the Start button associate with that profile.

Figure 6, below, provides an example of a profile with its settings configured to send to four unique destinations, each with a different IP transport protocol.

If you have connected a valid video source to the selected SDI input and click on **Dashboard** (on the upper left), the stats should now display the video input resolution, and the **Send** bit rate should be appropriate for the stream that you are outputting. Figure 7 shows an example of what you should see when the encoder is connected to a valid source and outputting an IP stream on GigE Port2.

NOTE: The QVENC4K is designed to only accommodate HD-SDI, 3G-SDI, 6G-SDI, and 12G-SDI input speeds for video resolutions from 720p through 2160p. The QVENC4K cannot process standard definition video input. However, you can downscale (or upscale) the video output to lower (or higher) resolutions, as explained in the next section.

NOTE: The QVENC4K will automatically upscale 1080i video input to 1080p. It cannot directly encode interlaced video, so a 1080i interlaced video input is automatically upscaled to 1080p progressive video before encoding.
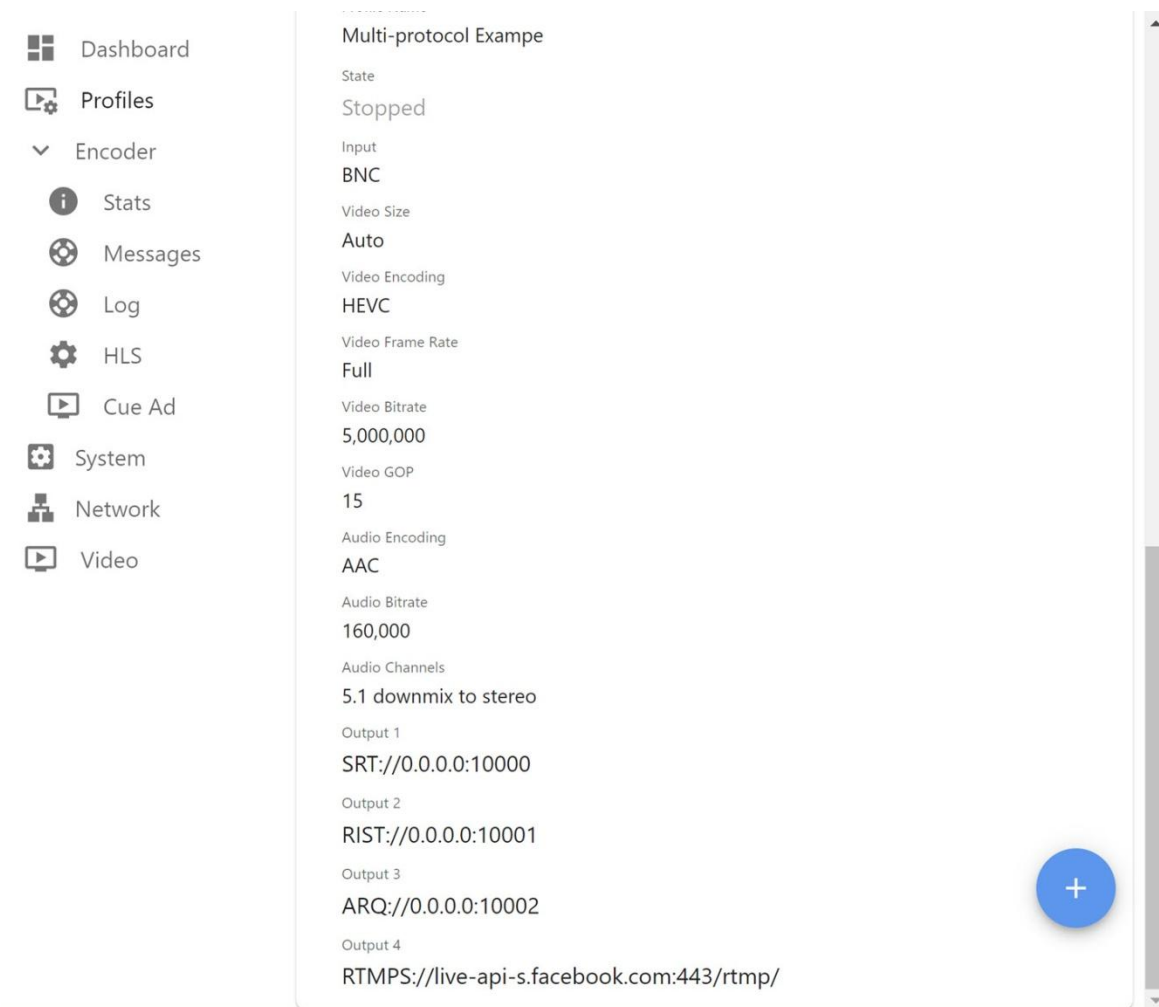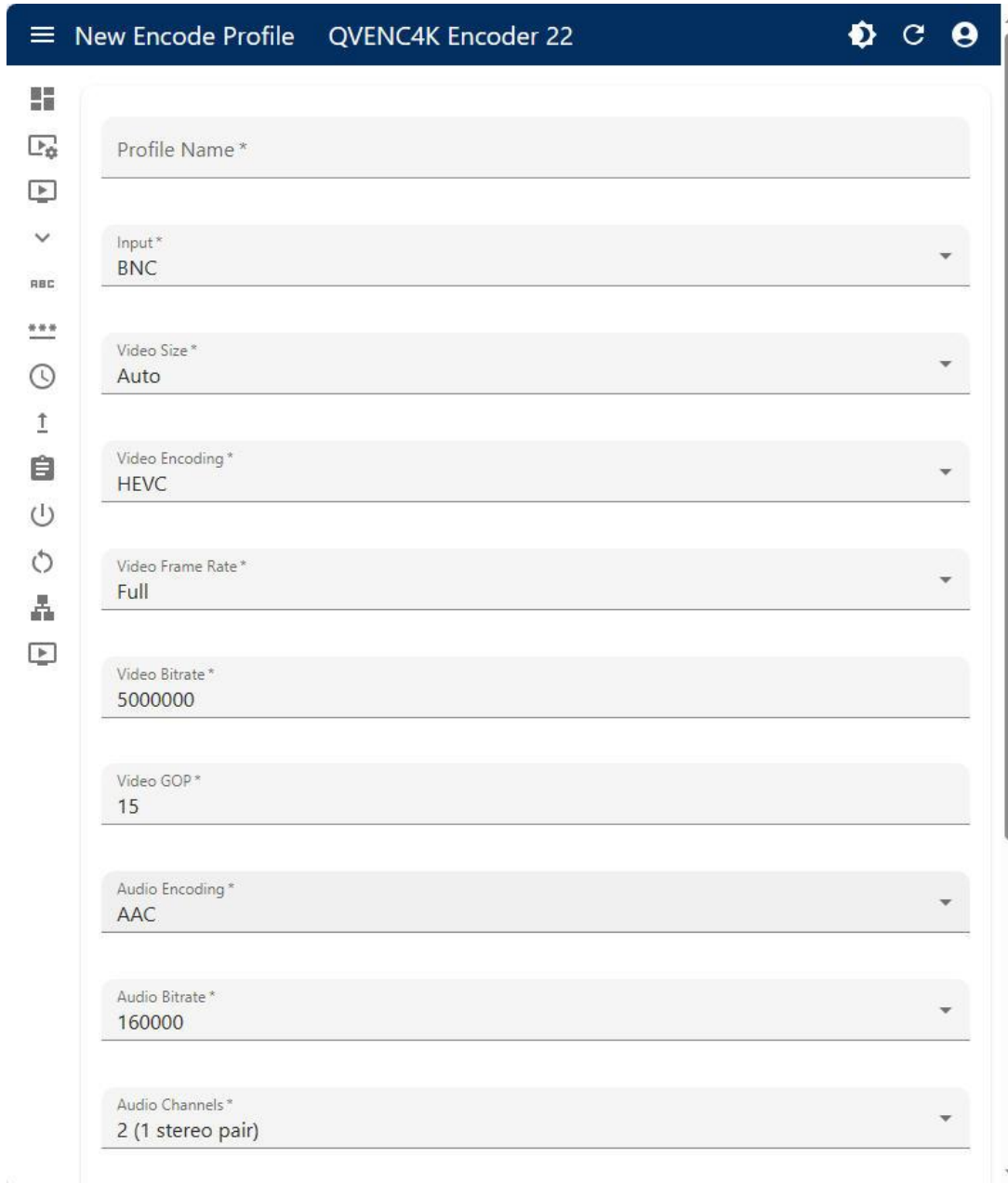
Figure 6. Encoder Profile Example showing

2.2 Detailed Encoder Configuration

Shown below in Figure 7 is the encoder profile configuration form, which lets you set the video and audio encoding format and bitrates. The QVENC4K encoder will automatically detect and adjust for the SDI input video resolution and format. The encoder contains a built-in video scalar that provides the QVENC4K the ability to change the video resolution before it is encoded and output as a stream.

Figure 7. Encoder Profile Example

The QVENC4K outputs the encoded video stream as a capped Variable Bit Rate (VBR) IP stream. VBR video encoding is more efficient than Constant Bit Rate (CBR) encoding because it only uses the amount of bandwidth needed to encode the video content. There is no wasted bandwidth to carry Null-packets for filler. However, a VBR stream may have large variations in bit rate.

Note: Be aware that the user interface will not warn you if you try to enter a bit rate beyond the operating limits of the encoder. For more details on the range of **encoding bit rates**, please **see Appendix C** (Section 7.2). For more information on the various **video parameters** (Frame Rate, Encoding, Format, Resolution, etc.) please **see Appendix A** (Section 7.1). For UHD or HD video, you can select either HEVC (H.265) or MPEG4-AVC (H.264) **Video Encoding**.

2.2.1 Basic Encoding Parameters

All the basic parameters you normally would need to set when creating a new encoding profile are grouped together under the **Profiles** menu when editing or creating a profile, as shown in Figure 7, above. Below is a description of these basic video and audio encoding settings:

Input: BNC or SFP. Default is **BNC**. The QVENC4K has 2 video inputs capable of SDI rates from HD-SDI and 3G-SDI through 12G-SDI. You can select between SFP input or BNC input from a 75 Ohm coaxial cable. SFP allow you to insert one of any standard SFP form-factor modules. Usually this is to allow for a fiber-optic SDI feed, which is very useful for accommodating long cable spans.

Video Size: Auto, **1920x1080**, **1280x720**, **960x540**, **854x480**, **640x360**, and **480x270**. Default is **Auto**. The QVENC4K has in internal video scalar. Setting resolution to "**Auto**" retains the resolution of the SDI signal. Otherwise, the scalar downscales or upscales the resolution to the selected value. **Note:** The QVENC4K cannot de-interlace an interlaced signal, nor can it create interlaced video from progressive. When presented with interlaced video, it will automatically upscale the video before encoding it.

Video Encoding: HEVC (H.265) or **H264** (H.264/MPEG4-AVC). Default is **HEVC**. You can select between HEVC/H.265 encoding and MPEG4-AVC/H.264 (Main profile). HEVC requires about one-half 1/2) to one-third (1/3) of the bit rate for comparable video quality versus H.264 for UHD/4K video because it uses a much larger block size. The video encoding format of the output IP stream is 8-bit, 4:2:0.

Vide Frame Rate: Full or **Half**. Default is **Full**. This setting allows you to reduce the frame rate to one-half of the original Standard video frame rates are normally 59.94 fps. or 50 fps. Halving the frame rate allows for half the stream bit rate.

Video Bit Rate: Defaut is **7,500**Kbps (7.5 Mbps). This sets the total output stream bit rate in kilobits per second (Kbps). The QVENC4K sets an internal video bit rate by subtracting the audio bit rate from the Stream Bit Rate and setting an additional margin for IP packetization. For all stream modes, the output bit rate should not exceed this value. However, there may be a variation in output bit rate of up to about 5% over the value you set. If the bit rate is too low for the video content you have, then you can expect to see pixelization and blurring of the image for scenes with high motion. The minimum bit rate is set to 500Kbps (500). The maximum bit rate is 60Mbps (60000) per stream.

Vide GOP: Default is **15**. This sets the Group-of-Pictures (GOP) value. Each GOP begins with an I-Frame (aka. Key-Frame) which is essentially a JPEG snapshot, followed by P (Predictive) Frames and B (Bidirectional) Frames to create a full GOP. A larger GOP can decrease the overall required bit rate, at the expense of a longer delay and video that would take longer to recover from a lost or corrupted frame.

Audio Encoding: Opus, **MPEG1**, or **AAC**. Default is **AAC**. This setting specifies what format to use for audio encoding. MPEG1 is perhaps the most widely interoperable. AAC is best for music and maintaining the highest fidelity. For speech and verbal content, we recommend Opus, which is used by Google in Android phones. (See Figure 9, below.)

Audio Bit Rate (bps): Various selections from **16Kbps** to **384Kbps.** Default is **160000**. This sets the total bit rate for the combination of the 2 audio channels (left and right channels of each audio pair). (The default of 160Kbps actually produces the same TS Stream Bit Rate as setting the audio bit rate to 128Kbps because of size constraints for audio packet sizes that must fit within a fixed TS packet size.) The minimum audio bitrate is 16Kbps and the maximum is 384Kbps per channel. When encoding 5.1 surround-sound, the bit rate you specify is for the entire set of 6 audio channels. (See Figure 9, below.)

   NOTE: The audio sampling rate is fixed at 48 KHz as this is standard for SDI.

Audio Channels: 0 (no audio), 2 (1 stereo pair), 4 (2 stereo pairs), 6 (3 stereo pairs), 8 (4 stereo pairs), 4 channels (independent), 5.1 multi-channel*, 5.1 downmix to stereo, AC-3 pass through, AC-3 transcode, or AC-3 transcode to stereo, . Default is **2 (1 stereo pair)**. This setting allows you to select how to handle the embedded audio and which audio channels to encode. For many streaming applications, video players cannot handle multi-channel surround-sound. For multichannel input in a streaming applications, we recommend downmixing or transcoding to stereo. (See Figure 9, below.)

   ***NOTE:** Encoding to 5.1 Surround-Sound only applies to AAC and Opus. MPEG1 is only applicable to stereo pairs.

Output 1, Output 2, Output 3, Output 4: Video output URLs (Universal Resource Locator). This is described in detail in the next section

Note: Please remember to always hit the **SAVE** button after making any changes or your changes will be lost. You must also restart the encoder with the updated profile for these changes to take effect. You can do this by simply clicking **Start.**
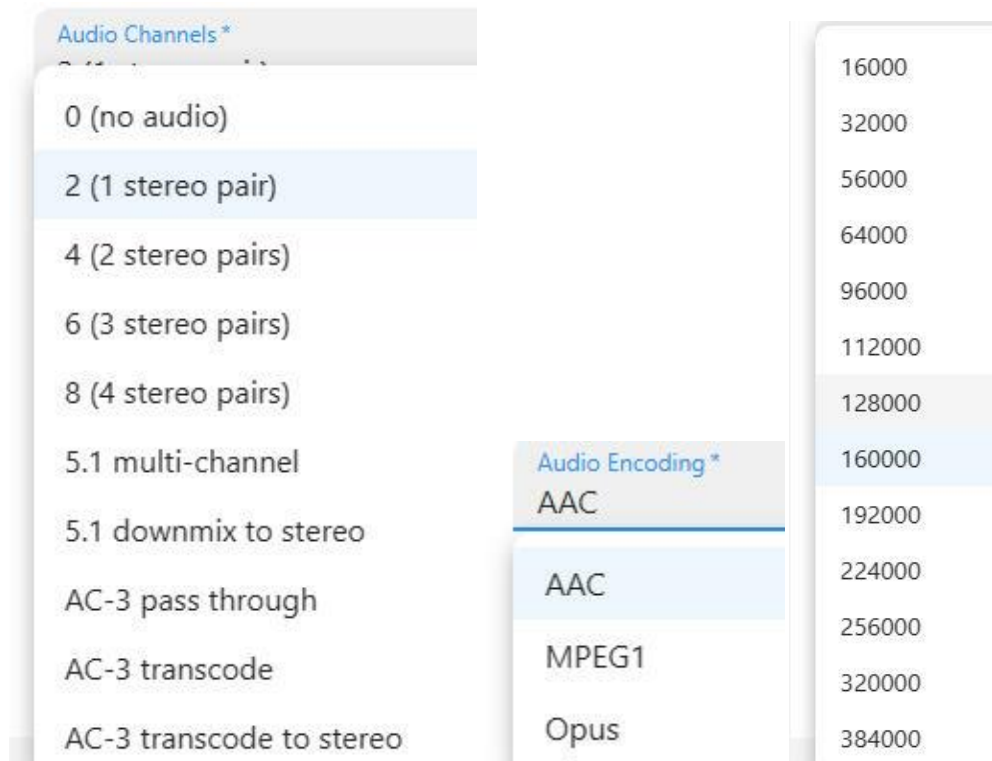
Figure 9. List of audio channel options, audio encoding formats and audio bit rates.

2.2.2 Output (1 through 4): Network Output Settings

The QVENC4K is capable of outputting multiple copies of the same encoded stream to multiple destinations with any combination of IP transport protocols. Specifically, you can specify up to 4 sets of output settings, as shown below in Figure 10. Each output field will contain the destination IP address and the transport protocol, along with the specific parameters associated with the specified protocol. We will refer to the combination of transport protocol, destination address, and associated parameters a Universal Resource Locator, or URL,
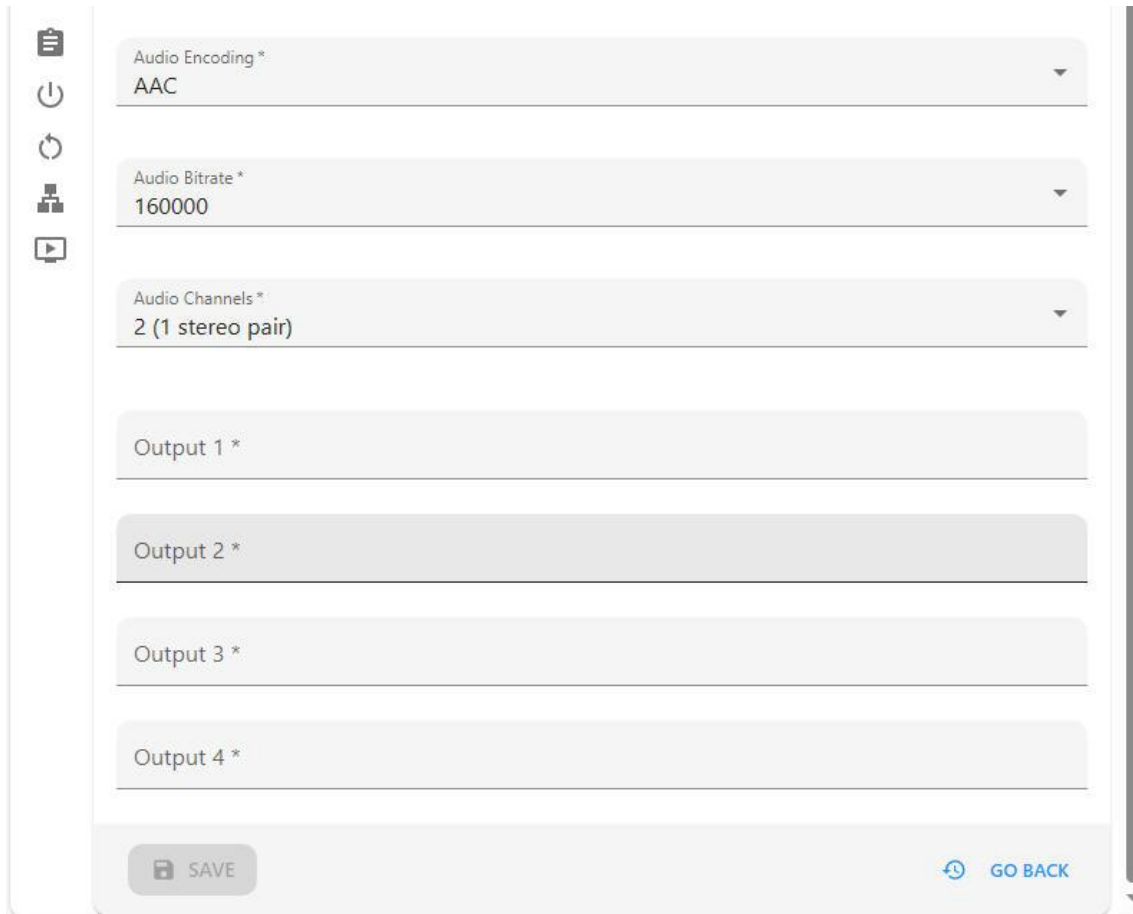
Figure 10. Lower portion of encoder profile showing the 4 fields for specifying output protocols and destinations, termed Univerasl Resource Locators or URLs.

There is no default for these output URL fields, you construct each desired URL by first clicking on an output field. Clicking on an output field will expand the settings as shown below in Figure 11.
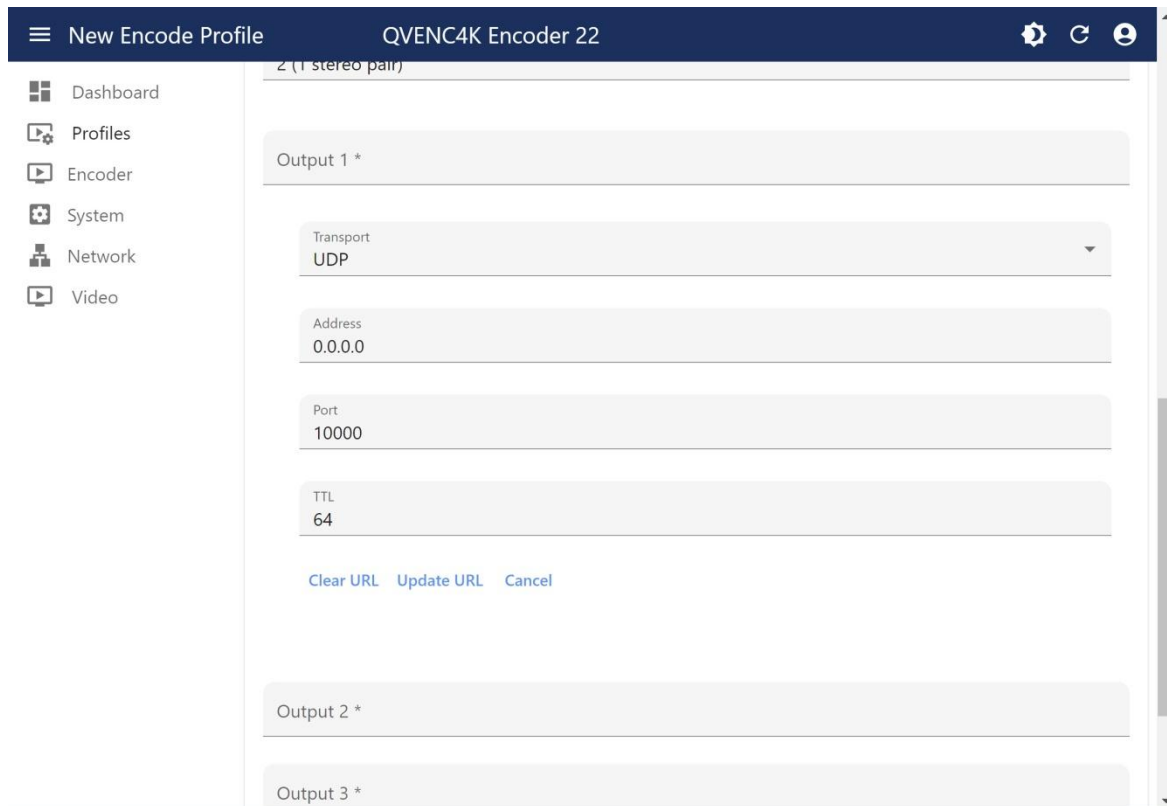
Figure 11. Initial expansion of Output 1 showing the default settings for UDP transport..

The basic settings for configuring each network output are: IP **Transport**, Destination IP **Address**, and UDP **Port**. Changing the IP **Transport** setting will automatically display the optional settings associated with each unique mode of operation, including any applicable encryption settings. The default **Transport** setting, **UDP**, is also the simplest, which is shown above in Figure 11.

Clicking on the **Transport** pull-down field reveals the available IP Transport options: **SRT**, **RIST** (Main and Simple profiles), QVidium **ARQ**, **RTMP** (both RTMP and RTMPS), **Zixi**, **UDP**, and **RTP**.

Here are the parameters required for the following video transport protocol:
- UDP, RTP: Destination IP address, UDP port, Time-to-Live(TTL) for Multicast
- QVidium ARQ: Destination IP address*, UDP port, ARQ port
- SRT: Destination IP address*, UDP port, peer latency, bandwidth overhead percentage, encryption strength and passphrase
- Zixi: Dest. IP address, UDP port, Stream ID, password, encryption strength & key
- RIST: Profile (Main/Simple), Dest. IP addr., UDP port, encrypt. strength & passphrase
- RTMP: URL, Stream key, username, password

In addition the following protocols also allow you to optionally send a UDP stream at the same time to a specified IP address and UDP port: ARQ, SRT, RIST, Zixi

IP Addr or Hostname: By default and when requested, this field can be left blank. The most common mode of operation is "Push Mode" or sender-initiated operation, wherein you provide the IP address or hostname for the destination that is to receive the IP video stream. In this mode the

receiver, usually a decoder, passively listens for the stream that you plan to send. However some IP Transport Options, currently QVidium ARQ and SRT, RIST(Main), and Zixi, can operate in a "Pull" or "Caller" mode, i.e. a receiver-initiated mode of operation, In Pull Mode, you can leave the IP Address/Hostname field blank and the receiver tells the encoder to start or stop the stream.

For UDP and RIST Simple Profile, this can either be a unicast or a multicast IP address. For all other modes, this must be a Unicast address (first octet is less than 224). When providing a multicast IP address, you can also specify the Time-To-Live (TTL). (The TTL is set to 64 for unicast IP addresses.)

For QVidium ARQ IP Transport, you can also supply up to 4 IP addresses, separated only by commas (','), no spaces.

Note: For QVidium ARQ in Pull-Mode of operation, you must specify a different ARQ port than the UDP port. Under QVidium ARQ, you can both Push and Pull streams at the same time by entering an IP address/hostname to push streams while other receivers pull streams from your QVidium ARQ server. For ARQ push mode, we recommend setting the ARQ and UDP ports to the same value.

UDP Port: Default is 10000. Live, real-time video streaming protocols such as ARQ, SRT, Zixi, and RIST use UDP protocol at the IP transport level. For the IP transport modes that require the specification of a UDP port, the value should be greater than 1023, so as not to potentially interfere with internally used ports, and less than 65536.

Note: CDN protocols, RTMP/RTMPS and HLS, use TCP instead of UDP. TCP provides a form of error correction to replace missing packets, but can cause long pauses or freezing of the video when packets are not recovered, adds large delays into the stream, and limits the maximum stream bitrate as the packet round-trip delay increases. TCP-based protocols usually use a fixed and well-known port, so a port is usually not specified. (Should you need to change the TCP port for RTMP, you would affix a colon (':') and the port number after the IP address.)

2.2.3 Stream Encryption

Stream encryption is available for **Zixi**, **SRT**, and **RIST Main Profile** IP transport modes. **Zixi** and **SRT** both use a pre-shared key that you must choose beforehand and provide to both the QVENC4K encoder and decoder profiles. Please be aware that the encryption is only as good as the ability to keep this key private.

2.2.4 Optional UDP Output

For those protocols that allow you to optionally output an additional UDP stream, this additional IP stream is a plain, unencrypted UDP stream. This second copy of the encoded video stream does not include any error correction, but can be a multicast stream, so it is best suited for monitoring the encoded stream over a local area network (LAN).

WARNING: DO NOT ENTER THE SAME IP ADDRESS HERE AS IN THE DESTINATION "IP ADDRESS OR HOSTNAME" FIELD, ABOVE. Doing so will send two conflicting streams to the decoder. PLEASE LEAVE THIS IP ADDRESS FIELD BLANK UNLESS YOU INTEND TO USE THIS FEATURE.

2.3 QVidium ARQ Video Transport & Error Correction

The QVidium QVENC4K Video Encoder™ features some of the most powerful and advanced error correction capabilities found in any video over IP product. The QVENC4K implements QVidium's patented ARQ error correction and clock synchronization (US Patents #7,551,647 and #7,522,528) for robust video transmission with the lowest delay. QVidium's ARQ (Automatic Retransmission Request) is a dynamically responsive feedback error correction mechanism designed specifically to enable the highest quality video transport over wireless networks and the Internet. ARQ senses packet loss at the receiver and requests replacement packets from the server. ARQ can provide nearly flawless reproduction of a video stream even through extremely lossy or congested networks.

The QVENC4K HEVC UHD Video encoder minimizes network bandwidth and loading due to the high efficiency of HEVC encoding and ARQ video transport. The QVENC4K™ implements HEVC (H.265) Main Profile video encoding, providing advanced coding techniques in hardware.

The QVENC4K supports QVidium's patented ARQ error correction as well as new industry standard RIST and SRT protocols for interoperability with third-party encoders and decoders. ARQ is a robust feedback-based error correction that can successfully recover nearly all packet loss, even in harsh network environments.

In contrast with Forward Error Correction (FEC), ARQ employs a feedback mechanism that detects packet loss at the receiver and requests the retransmission of only those lost packets from a video source. A user-configurable buffer at the receiver (decoder) delays the video stream just long enough to allow the system to replace any missing packets and re-insert them in their proper order without disturbing play out of the video stream. Because ARQ senses actual packet loss, rather than attempt to predict packet loss, it can precisely and completely restore all lost packets without disturbing timing of the video play out. In contrast to FEC, ARQ can successfully recover lost packets regardless of the magnitude or pattern of the packet losses, provided that the network connection has enough capacity to send both the original video stream and the replacement packets.

ARQ shares similarities with robust packet transport protocols, such as TCP/IP in that both use feedback to create robust network packet transport. However TCP/IP uses a sliding window that limits the number of packets that a source can have in transit and requires a positive acknowledgement for each window of packets. This limits TCP's throughput, especially over links with long latencies. Furthermore, under heavy loss conditions, TCP/IP scales back the data transmission rates and provides no concise deadlines or constraints on packet delivery times. For real-time video, this limits the usefulness of TCP/IP, making it unacceptable for low-latency uses.

In contrast with TCP/IP, QVidium designed its patented ARQ error correction specifically for live, interactive, real-time video and audio signals to automatically recover nearly all lost packets with minimal latency and over nearly any link loss conditions. It adds a small configurable amount of delay to the network transport in exchange for significantly improving the robustness and reliability of video transport.

2.3.1 Configuring Video over IP Network Parameters

To configure the IP network parameters, within the Network Parameters section of the encoder profile, first select an IP Transport mode. Depending upon the IP Transport more that you select, tables of additional optional parameters relevant to that IP Transport will then appear. For more protocols, you will also be required to specify the destination IP address and UDP port number. The destination IP address is usually a unicast IP address, but for UDP and RIST Simple Profile, it can also be a multicast address.

For QVidium ARQ, you may specify up to 4 comma-separated destination IP addresses for

sending copies of the output to multiple destinations. For sending more than 4 output copies of a stream, either use an IP Transport that allows multicasting (and UDP, RTP, or RIST Simple Profile) or send the stream to a server or PC running the QVidium QVARQ-TxRep QoS Proxy server (see http://www.qvidium.com/proxy).

The encoder internally encapsulates the video and audio signals as UDP packets in all cases, regardless of the type of packet transport you select. Specifying UDP eliminates the RTP header and encapsulates the encoder's multiplexed MPEG-2 transport stream directly as the payload of the UDP packet. All the other transport selections (except SRT, RTMP and HLS) add an RTP header to the UDP packet stream. In the case of RTMP and HLS, the QVENC4K converts the stream to TCP protocol. SRT uses a proprietary protocol called UDT that was originally designed for reliable file transfer.

The RTP header adds a timestamp and packet sequence number to the UDP packet and then adds the 188-byte MPEG-2 Transport Stream sections into the IP packet payload. A typical Ethernet/IP packet contains 7 of these MPEG Transport Stream sections. RTP protocol is a commonly used and widely interoperable protocol for sending video. The IP encapsulation adheres to the IETF/RFC3550 standard for video over IP that specifies that the packet payload must comprise an integral number of whole 188-byte MPEG-2 transport stream sections within an RTP header.

2.3.2 Error Correction - ARQ: Automatic Retransmission Request

To enable **A**utomatic **R**etransmission Re**q**uest (ARQ), you must first select ARQ transport from the `Profile` dialog. ARQ transport must also be enabled at the decoder. With ARQ selected and the encoder started, the encoder will begin to save outgoing packets for later retransmission, when necessary. Normally, the ARQ port should be set to the same value as the outgoing UDP port for the video stream, with a default value of 10000. This will allow the upstream ARQ retransmission-request packets to travel back through most encoder-side firewalls without requiring any special configuration at the encoder-side firewall. If you use a different ARQ port than video UDP port, then you must also be certain to configure any encoder-side firewalls to allow the upstream ARQ retransmission request packets through to the encoder. You may change the value of the ARQ port, but the ARQ and UDP port settings must match on both the encoder and decoder.

At the receiver, the ARQ error correction mechanism first buffers incoming packets in a synchronized network de-jitter buffer that maintains a constant, configurable delay for incoming packets. The de-jitter buffer processes RTP sequence numbers and reorders packets as necessary to restore proper packet sequence and to buffer against erratic network delays. Its goal is to output a smooth, consistent flow of packets with increasing sequence numbers. This output feeds the ARQ error correction mechanism.

The ARQ unit at the receiver watches for gaps in RTP sequence number from the de-jitter buffer output, and immediately sends out retransmission requests when necessary. Incoming retransmitted ARQ packets bypass the de-jitter queue and find their correct place in the ARQ buffer, so that by the time packet are output by the ARQ buffer, the ARQ error correction mechanism should no longer contain any missing packets.

When the encoder and decoder are both started, the decoder automatically measures the round-trip delay and packet jitter to the encoder and automatically configures ARQ for optimal operation according to a few basic user-specified parameters, as described in Section 2.3.2.

Note: For testing ARQ error correction, select ARQ transport at both the encoder and decoder and use the default ARQ parameters at the decoder (receiver).

2.4 Additional Protocol-Specific Parameters

Certain protocols, specifically RIST Main Profile, RTMP, and Zixi have additional features with their associated additional parameters that will appear in the configuration settings when selected.

RIST Main Profile created a virtual private network tunnel when started. It therefore has additional parameters to configure related to this feature. RTMP adds a Key and URL. Zixi has username/password authentication for connecting to their server and a bonding feature that allows you to use both of the QVENC4K Ethernet network ports for bonding and failover features. Please contact QVidium for further details, should you require any assistance in these additional configurations.

3 Encoder Operation

This section explains how to start and stop the QVENC4K for video encoding. This section assumes that you have already created one or more encoding profiles as per Section 2, above.

3.1 Starting and Stopping the Encoder

Enter `http://IPAddress` where `IPAddress` is the IP address of the encoder.

1. Select the **Profile** menu on the left side of the web page.

2. Click the **Start** button associated with the profile you wish to run.

3. To confirm that the encoder has started, click on the **Dashboard** to confirm that the `Bit Rate` is non-zero. If you have trouble starting the encoder, please check that the SDI Lock indicator light on at the back right side of the encoder is lit. If not, then check your source. The **Encoder/Messages** page should also provide details about the encoder operation, and may help pinpoint why the encoder did not start. Figure 12 provides an example of the Dashboard when outputting an ARQ stream on GigE 2. Note that the **Send** bit rate is as expected for outputting a video stream, in this case, 14.1Mbps.

4. Clicking `Stop` will stop the encoder. You can edit any encoder parameters while the encoder is running, both for the current profile and other profiles. However, to change settings or profiles, you must first click Stop and then click on `Start` to restart the encoder with a new or updated profile.

Note: If you wish to reconfigure the encoder, remember to first **Save** any configuration changes **before** restarting the encoder. A message will appear at the top of the page to confirm that your changes have been saved.
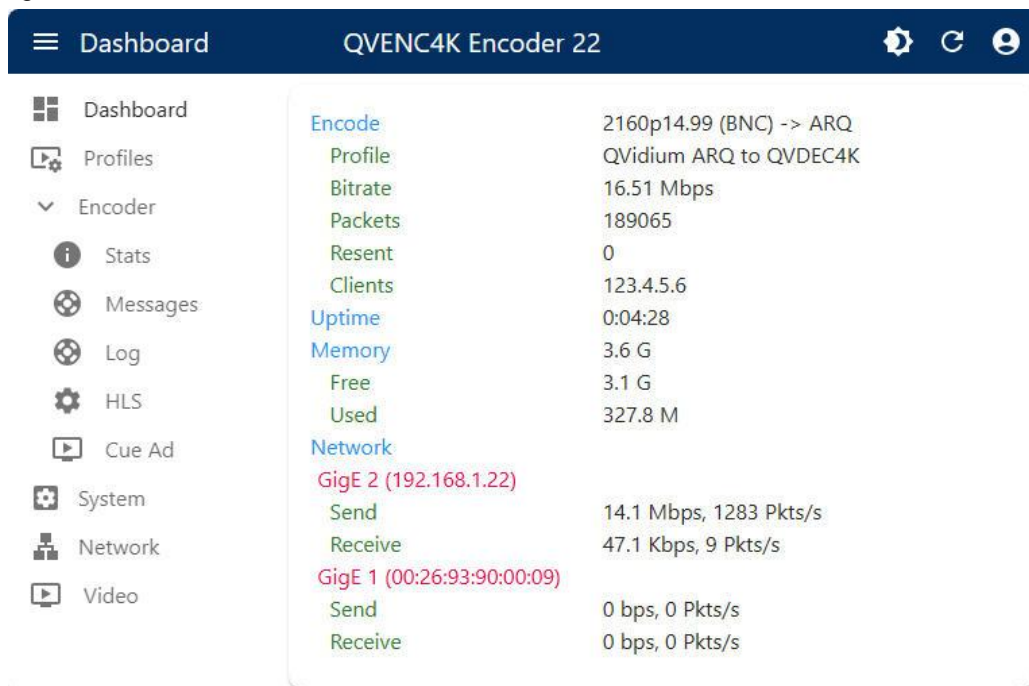

Figure 12. Dashboard showing status when outputting an ARQ stream.

4 CodecManager & System Reset

4.1 CodecManager

QVidium supplies an application we call **CodecManager™** as a free download for its customers under the **Downloads** section of the QVidium web site at http://www.qvidium.com. **CodecManager** will detect any QVidium® Video Encoders, Encoders, and Decoders connected through Layer-2 switches over the local-area network. At launch, **CodecManager** sends a Layer-2 MAC broadcast to which the QVidium products respond with their MAC address, IP Address, and name. From this application, you can double-click on a Encoder to launch a browser window to that Encoder. In addition, CodecManager makes it simple to change the IP Address, launch a Telnet window, or edit other settings of any Encoder it detects directly from the **CodecManager** application, even if several encoders are mis-configured with the same IP address. You can also instantly stop all encoders by the simple click of a button.

We encourage you to download and use the **CodecManager** application to manage your QVidium products, since it is easier, more convenient, and less intrusive than resetting the Encoder through the console.

Note: CodesManager may not work when the Ethernet cable is connected directly between the PC and the QVidium product, as it requires connection through a switch to multicast the identification packets. Also, you may need to disable network adapters other than the Ethernet network adapter, such as any WiFi adapters.

4.2 Resetting the Network Parameters

If you cannot determine the IP address using **CodecManager**, you can connect to the internal Linux command console through the USB Console port with a USB cable having a Micro-B USB2 connector on one end for the Console Port on the QVENC4K, and a USB2 Type-A connector for connecting to a PC.

After connecting the QVENC4K to a PC and starting the Terminal emulator program, you should see that two new serial ports have become available to select. We recommend using **TeraTerm** for the terminal emulator, but other software such as **Putty** or **Hyperterm** also work. Set the serial configuration to 1500000 Baud (1.5MegaBaud), 8 data bits, 1 stop bit, and no flow control, then click "<enter>". If you do not see a prompt or any legible text, then try selecting the second of the two serial ports. You can also try power cycling the QVENC4K with the USB console port connected to the PC runnign the terminal emulator to see that there is the startup text when the unit boots.

If you do not see any text on either of the two virtual USB serial ports immediately after power-cycling the QVENC4K, then please e-mail QVidium at **support@qvidium.com** to troubleshoot.

Once you see a prompt, type "**ifconfig eth0**<enter>" to find the IP address. It will be listed as "**inet addr**". To find the serial number, type "**qvc4k_read_sn.py**<enter>".

4.3 Resetting the System Configuration

To reset all of the system settings and configuration to the Factory Defaults, First log into the USB Console as per **Section 1.3**. They log in as user "root" using password, "qvidium". Then type, "**/opt/qvidium/backend/db-init**<enter>". Lastly, reboot the system by typing: "**sync;reboot**<enter>". Your system will reboot as it was when first shipped from QVidium.

4.4 Resetting the Password

If you lose the root password and cannot gain access to your encoder, you can log into the QVENC4K via the USB console port with a terminal emulator program, as described in **Section 1.3** under the paragraph heading, "**USB Console Port**". At the login prompt, you can log in as "root" with the password, "qvidium". SSH and Telnet are disabled by default, so you must have physical access to the unit to log in as root. Once you have logged in, type "**resetpasswd**" (note the spelling). This will reset the password for the web interface (with username admin) to the serial number found on the bar code label on the bottom of the unit.

4.5 Command-Line Interface

4.5.1 Mounting and Un-mounting an External Storage Device

When you connect a NTFS or FAT formatted external storage device to the USB interface, the embedded Linux 2.6 Operating System will automatically mount the file system. (If you wish to connect a Linux formatted Filesystem, such as ext2 or ext3, you will have to manually mount the file system.) The initial mount point is /media/sda1. From the command-line interface, first type "cd /media/sda1" then use "ls" for a listing of the files on the storage device.

However, if you wish to remove a mounted storage device, you must first unmount it. To unmount the disk or storage device, you must first stop any programs that are accessing the device, then you must cd away from the mounted directory, such as "cd /". You can then issue the unmount command: "umount /media/sda1". After this command successfully completes, you can safely remove the external storage device and, if desired, insert another storage device. As long as you first unmount the old storage device, the next storage device will be mounted as /media/sda1. If you do not unmount the storage device, or mount a second storage device, the second device will mount at location /media/sdb1. Currently, there us a limit of only 2 different mount points, sda1 and sdb1. Additional partitions on a given storage device will auto-mount as /media/sdaX or /media/sdbY, where X and Y are partition numbers starting with 2, and incrementing up to the number of partitions on that storage device.

5 Built-in Firewall

QVidium offers firewall software for the QVENC4K encoder product. This firewall is based on a "white list" of allowed IP addresses and IP address ranges that you specify and add to a list. You can individually enable and/or disable any particular entry in the list by clicking on the checkbox before the entry in the list and then clicking on the **Change Firewall Configuration** button at the bottom of the page. By default, QVidium has included its own addresses to allow remote QVidium access from the **Technical Support Access** setting. You can disable this access if you wish by changing the setting to **No**. When enabled, this internal firewall will block all access from any from any device with an IP address not on this list.

To enable the firewall, simply click **Yes** on the first setting called "**Firewall**" and then clicking on the **Change Firewall Configuration** button at the bottom of the page.

WARNING: Before enabling the firewall, please make certain that your IP address is in the list so that you will continue to have access to the device. If your device is remotely accessing your QVidium encoder, you can determine its external IP address to add to the **white list** by going to the URL: http://www.ipchicken.com, Also, you must specifically allow access to the IP address(es) of any other QVidium device(s) you are sending to or receiving data from. If, for example, you fail to add the IP address for your decoder from your encoder, then ARQ will be blocked from functioning.

To specify a range of addresses, you can use the notation: XXX.XXX.XXX.XXX/YY, where XXX.XXX.XXX.XXX is the IPv4 IP address of the device to which you want to grant access, and YY is a number from 1 to 32 that tells the firewall software how many of the most-significant-bits (MSBs) in the IP address you specify to pay attention to. In other words, The value 32-YY is the number of least0significant-bits in the IP address that can be set to any value and still gain access. For example, to set a range of addresses in a small subnet of addresses from 202.91.33.32 to 202.91.33.47, you would add 202.91.33.32/28 to this list. Since 32-28 = 4, this tells the firewall that any combination of 1's and 0's in the last 4 bits of the IP address you specified will be granted access. In this case, it would be a total of 2^4 = **16** addresses.

For further information, please see the instructions on the Firewall page mentioned above.

6   Troubleshooting & Support

The QVENC4K ™ includes a number of features to aid in system security and logging.

6.1   Troubleshooting – Common Problems

In general, if you are having trouble getting video from the encoder to the decoder, follow the following procedure:

1. Check the **Encoder/Status** page for a valid bit rate to make certain that the encoder is running - if not please check the video input, or for SDI input check the Diagnostics page, or click on Show Log and e-mail the log output to us at info@qvidium.com along with your phone number or Skype ID so that we can contact you.
2. Delete your current profiles and start with the Default settings on the encoder and decoder and avoid changing any Advanced Settings.
3. Restart the encoder using the default settings (only changing the bit rate, video input, and destination IP address. If still no input, then please check the **Encoder/Show Msg** page for errors. Remember, if using SDI without embedded audio, you must change the **Audio Channels** setting to "0".
4. Try sending a copy of the encoder stream to a local PC running VLC (on a local area network, not over the Internet). NOTE: If GDR is enabled, you must start VLC before starting the encoder for VLC to work with GDR.
5. If you can receive the stream over your LAN using VLC, but the **Decoder/Status** page shows **No Data**, then you likely have a firewall before the decoder blocking the traffic. You must add a Port Forwarding rule on the decoder-side firewall to allow UDP traffic on port 10000 (or whatever UDP port you had set on the encoder).

If this does not help, or for other problems, please see below:

No response from web browser or cannot ping system

1. Make certain that device is powered on and connected to your network.

2. Check that green LAN light in front is lit and link light at RJ-45 port is on.

3. Make certain that device is on the same subnet as the computer you plan to connect to. (Either use a cross-over Ethernet cable to connect directly to the computer or connect through the same switch as your computer.)

4. Use QVidium's **CodecManager** application to find IP address of system and to confirm that Encoder is online. You can download **CodecManager** from QVidium's Download page (http://www.qvidium.com/), click on **Downloads**, and scroll down to the **QVidium Encoder Management Software** section. Download and install the file: QVidiumCodecManager-X.msi (X is the current version number). If that fails to locate your Encoder, then try the other LAN port. If still not seeing the code, then continue to step 5.

   NOTE: CodecManager requires that any intermediate switches or other network equipment between your PC and the QVENC4K Encoder must pass Ethernet Broadcast packets. (If not, then you can try using a cross-over Ethernet cable and connecting the QVENC4K encoder directly to the PC. If **CodecManager** still does not appear to find the QVENC4K-Encoder, even after selecting the correct Network Interface (if not grayed out)

and clicking on the Discover button, and you are certain that the switch passes Ethernet broadcast packets, then try the other LAN port. By default, the QVENC4K encoder will output broadcast Ethernet packets back to CodecManager on LAN1. However, these multicast discover packets may go out on LAN2 if selected as the multicast interface.

5. Open a shell window (On Windows™ select "Start/Run…" and type "cmd").

6. Clear the ARP cache by typing "arp –d" and hit Enter.

7. Try pinging the system by typing "ping 192.168.1.23".

8. If all else fails, you can reset the network settings by going to: http://www.qvidium.com/reset. Then copy the file "autorun" to a USB flash stick, and plugging it into your encoder. The **autorun** file must be saved directly, not first converted to a text file. It should not be saved as "autorun.txt". On Internet Explorer, use the **Save Target As…** command and select **All Files** for the File Type. Then, plug the flash stick into the QVENC4K. It will then reset all the network settings back to the defaults (192.168.1.23).

Cannot Receive Encoded IP Packet Stream at Decoder

1. On the encoder, check that is is powered-on, and check the **Encoder/Status** page to make certain that the encoder bitrate is non-zero. It the bitrate is zero, then go to the next step to get a valid output packet stream.

2. Make certain that decoder is powered on and connected to your network.

3. Check that the LAN link-light and activity lights for the RJ-45 Ethernet port on both encoder, decoder, and switch(s) are lit.

4. Make certain that you have entered the correct IP address for the destination (under Encoder/Profile) and the correct gateway (under Network/Configure) if the receiver is on another subnet.

5. Try pinging the destination IP address for the decoder from the encoder clicking on Network/Ping and entering the IP address for the decoder device.

6. If you cannot ping the decoder from the encoder, then your stream may be blocked by a firewall at the decoder side. If necessary, add a Network Address Translation (NAT) rule to the decoder-side firewall to port-forward incoming packets from the UDP port you set on the encoder to be forwarded to the decoder.

Encoder does not start or is not outputting any packets

1. Check that a valid video signal is connected to the video **Input** you have configured. Use the Encoder/Profile page to select the video input that you have connected and wish to use. The SDI input will auto-sense and select among SD-SDI, HD-SDI, and 3G-SDI signals. Make certain that you **Saved** the profile and **afterwards** hit the **Start** menu item.

2. If the bitrate is zero, then check for a valid video input.

3. If you have a valid video input, then check **Encoder/Show Log** to see whether there are any errors.

4. If the log says "**Video not LOCKED: waiting for valid input"**, then check whether there is embedded audio on the SDI or HDMI feed. At present, the encoder requires an embedded audio signal to lock onto before it can start encoding.

5. If you are trying to encode interlaced video, such as 1080i, make certain that the **Video Encoding** is set to **HEVC**. (The QVENC4K does not support H.264 encoding for interlaced video.)

6. If you are getting error messages in the log such as `Command Timed Out`, then check whether you have a valid embedded audio signal on the SDI input. If not, then set the

number of **Advanced Channels** to "0".

Audio pauses, clicks, or gaps or video freezes during decoding

- Excessive network jitter, such as on satellite, long-distance Internet, or 3G wireless links, can result in pauses or short gaps or clicks in the audio output. To fix this, increase the size of the decoder's **Video Input Buffer Size** to buffer out any excessive jitter on the video input stream.

Audio distortion

- A *tinny* or metallic quality to the audio or a distortion that seems to appear only during periods of relatively louder audio passages can be the result of clipping of the input audio signal. This occurs when the input audio signal level exceeds the voltage level limits of the audio input circuitry. To fix this problem, increase the audio attenuation in the Volume control on the Encoder when the encoder is running, until the distortion is gone.

Other problems with encoding and decoding video

1. First eliminate any network problems by connecting the encoder and decoder to the same Ethernet switch. Use CodecManager, running on a PC also connected to that switch, to verify that the IP and MAC addresses are all different.

2. Click on Defaults on the Encode and Decode sides to reset all your profile settings to their factory default values.

3. Verify that the Destination IP address and port specified on the encoder match their configured values on the decoder. For unicast, leave the "multicast address" blank on the decoder. For Multicast, make certain that you have specified the same multicast address on the decoder as well as on the encoder. If multicasting through a router, make certain that the router supports IGMP v3 and that it is enabled.

6.2 Support

For specific technical help, we kindly ask that you first contact the reseller or distributor from whom you purchased your QVidium product. If you still require further assistance, or you purchased your product directly from QVidium, please contact QVidium Technologies, Inc. by either phone or e-mail at:

Phone: (858) 792-6407
Phone Support Hours: Monday - Friday 9:00 am to 5:00 pm PST

E-mail: support@qvidium.com
E-mail response time: within 24-hours

Technical support is limited to the basic functionality found in the Web user interface and to standard network applications. For example, we cannot provide detailed command-line support unless the user has sufficient experience and knowledge of Unix or the Linux operating system. For Broadband Wireless networking applications, because of the inherent low bitrate constraints, bit rate and link variability, and complexities of found in Broadband Wireless networks, we cannot directly provide support for applications over Broadband Wireless Networks. In these cases, we would be glad to refer you to one of our vertical marketing and system integration partners for help with your specific application.

7 Appendices

7.1 Appendix A: Encoder Configuration Parameters

This section explains the parameters related to the analog input signals and encoding settings and how they relate to the operation of the encoder and error correction and network transport setup.

Video Encoding Bit Rate: Total peak stream bit rate for Variable Bit Rate (VBR) video encoding. The resulting transport stream bit rate is the sum of the bit rates of the video program, audio program and program stream information. The video bit rate is specified in bits per second and can range from 128 Kbps for CIF resolution to 19 Mbps for 720x480 (NTSC) or 720x576 (PAL) standard definition resolutions, or can range from 4 Mbps to 19 Mbps for high definition video resolutions. The higher the bit rate, the better the video quality.

Audio Bit Rate (compressed): The audio bit rate determines encoding audio quality and allows you to trade off audio throughput for quality. The audio bit rate can be set to one of 64,000, 128,000, 192,000, 256,000 or 384,000 bits per second. Increasing the audio bitrate, up to a maximum value of 384 Kbps increases the audio fidelity. Regardless of the audio signal level on either channel, selecting an audio bitrate of 64 Kbps or higher will always force the encoder to send 2 channels of audio (stereo audio). Each audio channel uses one-half of the selected audio bitrate. The H.264 HD Video Encoder™ encodes audio using either MPEG-1 Layer II encoding, MPEG2 AAC, or MPEG4 AAC audio encoding.

For minimizing the audio bitrate, we provide the option of setting the number of audio channels to 1 and the audio bitrate to 16 Kbps or 32 Kbps. Do not use an audio bitrate less than 64 Kbps unless you set the number of audio channels to 1. Even then, setting the number of audio channels to 1 has the potential to cause unexpected halting of the encoder. So, please be aware that this option may impact the reliability of the encoder.

Audio Sampling Rate (Hz): The audio sampling rate specifies the clock rate for capturing and digitizing the incoming analog audio signal. Because of anti-aliasing filtering, the maximum audio frequency that can be digitized is limited to a frequency of about 1/3 to 1/2 of the audio sampling rate. Internal anti-aliasing filters severely attenuate audio signals above a frequency of about 1/3 of the sampling rate. Thus, for a standard music CD rate of 44.1 KHz, the maximum audio frequency that the encoder can pass is about 14.7 KHz.

SDI formatting requires that the audio sampling rate be fixed at 48 KHz, so the current user interface disables setting this value.

Network Parameters

The fields below relate to Ethernet/IP video transport settings.

IP Transport: This selects the type of video IP packet encapsulation and error correction used by the encoder in generating a Video/IP stream. All packetized video transport mechanisms encapsulate a multiplexed variable bit rate MPEG-2 transport stream.

- *ARQ uses QVidium's patented error correction mechanism based on a time-constrained selective packet retransmission algorithm, in place of FEC. It also encapsulates the video*

as per COP3.2 (without the FEC) and RFC 2733. However it relies upon an upstream channel on UDP port 7020.

- *RTP disables all error correction mechanisms, but still encapsulates the MPEG-2 multiplexed data according to RFC2733.*
- *UDP is similar to the RTP transport above, but does not add the RTP header to the UDP packets. Instead it simply encapsulates the MPEG-2 transport stream data directly into the UDP/IP packet payload.*

Destination IP Address or Hostname: *This specifies the IP address or Hostname for the Video/IP stream.*

UDP Port: *This specifies the UDP port number (P), base 10, for the Video/IP stream.*

TS packets per IP packet: *This field allows specification of the number of 188-byte MPEG-2 Transport Stream packets per IP packet. The standard MTU for Ethernet packets permits a maximum of 7 TS packets per IP packets, which is the default.*

ARQ

The parameters below ONLY pertain to ARQ error correction. They will be ignored when ARQ IP Transport is not selected.

ARQ Port: *By default, ARQ normally sends upstream retransmission request packets on UDP port 7020. You can change this ARQ Port setting to any valid and non-conflicting UDP port. However, you must make certain that you specify the same port number at both the encoder and the decoder.*

7.2 Appendix B: Video Encoder™ Bitrate Limits

Encode Bit Rate Limits:

The video encoding bit rate limits specified below are subjective suggestions based on limited empirical testing. The QVENC4K encoder will allow you to enter any video stream bit rate from 500Kbps to 60Mbps, and will attempt to produce the best video quality it can, based on the video bit rate you set. The encoder outputs the stream as a Capped Variable Bit Rate (VBR) stream, meaning that it uses the value you specify as an upper limit on the peak bit rate. Unless noted otherwise, all bitrates below assume full NTSC (59.94 fps) or PAL frame rates (50 fps). Therefore, we have provided the values here are only as a general guideline to help with estimating the expected network loading:

Maximum Video Encoding Stream Bit Rates: 60 Mbps

Minimum Suggested Stream Bit Rates for general content, such as movies:
(assumes audio bitrate of 160 Kbps)

> *H.264 (MPEG4-AVC High Profile, CBR mode):*
> - 12 Mbps for 2160p video resolution
> - 6 Mbps for 1080p video resolution
> - 4 Mbps for 1080i video resolution
> - 2 Mbps for 720p video resolution

Note: Video quality is subjective and content dependent. The minimum bitrates suggested above may not produce acceptable video for any given application. As a general rule we suggest that you use HEVC (H.265) encoding for best video quality, and adjust the bitrate based on your own observations to suit your needs.

Decode Bitrate Limits

Bitrate limits related to receiving MPEG Transport Stream video from the network:

> *Maximum MPEG TS bitrates:* 60 Mbps

> *Minimum MPEG TS bitrates:* 500 Kbps

7.3   Appendix C: Hints for Minimizing Bitrates

Audio Notes

To minimize wasted audio overhead and minimize audio bitrates, you should set one of the following:

1. Set the Audio Bitrate to 56 Kbps and the Sample Rate to 48 KHz. Encoding MUST be AAC (results in 63 Kbps); or
2. Set the Audio Bitrate to 64 Kbps and the Sample Rate to 32 KHz. Any audio encoding (results in 84 Kbps)

At low bitrates, we have found that MPEG1/Layer2 Audio Encoding sounds best.
(Note: setting MPEG1/Layer2 to 56 Kbps results in a total of 126 Kbps audio overhead.)

Low-Bitrate Encoder Settings

On the Encoder menu:

1. Click on "Default" to reset the Encoder Profile.
2. Then set the following:

On basic tab:	On Advanced Encoding tab:
Video Bit Rate: 200000	Stream Mode: Capped VBR
Video Encoding: H264	Video Filtering: On
Audio Bit Rate: 64000	Video Frame Rate: Half
Audio Encoding: MPEG1/Layer2	Video Resolution: CIF
Audio Sampling Rate: 48000	

7.4   Appendix D: Technical Specifications

Below is a summary of the specifications common to the QVENC, QVDEC, and QVENC4K, meant as a general guide only. For the must up-to-date and more complete specs, please see the datasheet for the relevant model QVidium product at http://www.qvidium.com.

For video input and encoding, the specs are only relevant to the QVENC4K and QVENC.
For video output and decoding, the specs are only relevant to the QVENC4K and QVDEC.

Specifications

Network Interface:
- IEEE 802.3 1000/100/10 Base-TX Gigabit Ethernet (RJ-45) (1 port QVENC/QVDEC, 2 ports QVENC4K)

IP Network Stream Conditioning & Error Correction (EC):
- QVidium patented ARQ error correction
- SMPTE 2022 ProMPEG Forward Error Correction, Release 3.2, Annex B
- QVidium packet pacing

Network Protocols:
- IP Encapsulation: RTP/UDP/IP and UDP/IP
- IETF DiffServ and IEEE TOS compliance
- IGMP v.3 Multicast, SNMP v.2 traps
- RTSP, RTMP, and HLS with EVOstream option on QVENC, QVENC4K, and QVSD
- DHCP client

Audio/Video Interfaces:
- 1 SD-SDI / HD-SDI / 3G-SDI (SMPTE 259M/292M/425M) video input (BNC connector)
- 1 SD-SDI / HD-SDI / 3G-SDI (SMPTE 259M/292M/425M) video output (BNC connector)
- SMPTE 272M-ABC SDI including 2 channels of embedded audio (1 AES stereo pair), (4-channel support is expected in a future release)
- 1 HDMI Input (QVENC4K only)
- 1 HDMI Output (QVENC4K and QVDEC)
- 2 3.5mm mini-phono inputs on QVENC,
- 2 3.5mm mini-phono outputs on QVDEC
- S/PDIF (input on QVENC, output on QVDEC)
- 1 Composite (CVBS) on QVENC and QVDEC
- 1 S-Video input (Y/C) on QVENC

Transport Stream Bitrate (Audio & Video):
- 160 Kbps to 30.0 Mbps (encoding UDP/IP output for IP Transport mode)

Audio:
- MPEG-1 Layer-II audio encoding, ISO/IEC-11172-3 Layer 2 standards compliant
- MPEG2 and MPEG4 AAC audio encoding
- Stereo bit rates: 56, 64, 128, 192, 256 & 384 Kbps
- Sampling rates (non SDI input): 32 KHz, 44.1 KHz, and 48 KHz
- SDI and HDMI (HD or SD) embedded audio at 48 KHz, 20-bit
- Up to 4 mono-audio channels for encoding or decoding
- AC3 Pass-through on QVENC and QVDEC.

Video:
- 4:2:0 MPEG-2 MP@ML encoding: ISO/IEC-13818-2 standards compliant
- 4:2:0 H.264/MPEG-4 AVC High Profile (Advanced Video Coding, Part 10)
- Configurable between High Profile, Main Profile and Baseline Profile, encoding up to Level 4.1
- HD Input: 1920x1080 @ 60 or 50 fps progressive (1080p), 1920x1080 @ 30 or 25 fps interlaced (1080i), 1280x720 @ 60 or 50 fps (720p)
- HD encoding: 1920x1080 @ 50 or 60 fps progressive, 1920x1080 @ 25 or 30 fps interlaced, 1280x720 @ 25 or 30 fps progressive
- NTSC: 720x480, 352x240 (SIF resolution)
- PAL: 720x576, 352x288 (CIF resolution)
- Multiplexing Format: MPEG-2 Transport Stream, (RTMP and MP4 available with Evostream add-on.)
- Encode and Decode Line 21 Closed Captioning (EIA 608 only)
- Encode and Decode VANC Closed Captioning (CEA-608 and CEA-708)
- Video Up/Down Scaling and Frame-rate conversion for decoding
- Video Down Scaling for encoding and transcoding
- Minimum End-to-end latency (QVENC4K/QVENC to QVENC4K/QVDEC): < 300 ms,

Closed Captioning:
- EIA-608 on Line 21 for QVENC and QVDEC (Composite and SDI), and QVENC4K (SDI only)
- CEA-608 and CEA-708 Vertical Ancillary Data (VANC) on SDI input for QVENC encoding
- CEA-608 and CEA-708 VANC on SDI output for QVDEC decoding

Serial Interfaces:
- 1 DB-9 RS-232 Console Interface
- 1 DB-9 RS-232 with VISCA PTZ support and for future expansion (QVENC4K only)
- 2 USB 2.0 Ports for video storage

Configuration and Monitoring:
- Web setup & monitoring interface over IP network
- SNMP v1 & v2c traps (optional)

Electrical:
- AC Power Input: 100-240VAC, 150 mA, 50/60Hz
- DC Power Input: 7 VDC @ 3 A max, to 20 VDC @ 1 A max
- Auto sensing AC power adapter included

Mechanical: (see relevant datasheet)
- Unit Weight: 4 lbs
- Rack mount bracket, up to 2 units in 1 RU

Environmental:
- Operating temperature: 0 to 55° C
- Operating humidity: 0 to 90% R.H., non-condensing
- Non-operating temperature: -20 to 70° C
- Non-operating humidity: 0 to 95% R.H., non-condensing

Regulatory:
- RoHS, CE, and FCC compliant

Warranty:
- Parts and labor: 1-year

7.5   Appendix E: Product Warranty Terms and Conditions

1)   Warranty Statement
Thank you for purchasing a QVidium product. All QVidium products come with a one-year limited warranty against defects in material and workmanship during the warranty period. If a product proves to be defective in material or workmanship during the warranty period, QVidium will, at its sole option, repair or replace the product with a similar product. Replacement Product or parts may include remanufactured or refurbished parts or components. The replacement unit will be covered by the balance of the time remaining on the customer's original limited warranty. QVidium provides no warranty for the third-party software included with the product or installed by the customer. QVidium does not warrant that the operation of any product will be interrupted or error free and QVidium is not responsible for damage arising from failure to following instructions relating to the product's use.

2)   Warranty Conditions
The warranty is valid only for the first consumer purchaser and is not transferable. Proof of purchase will be required for any limited warranty. The warranty does not cover: 1) any product on which the serial number has been defaced, modified or removed or 2) Damage, deterioration or malfunction resulting from: a) Accident, misuse, neglect, fire, water, lightning, or other acts of nature, unauthorized product modification, or failure to follow instructions supplied with the product; b) Repair or attempted repair by anyone not authorized by QVidium; c) Damage to or loss of any programs, data or removable storage media; d) Software or data loss occurring during repair or replacement; e) Any damage of the product due to shipment; f) Removal or installation of the product; g) Causes external to the product, such as electric power fluctuations or failure; h) Use of supplies or parts not meeting QVidium's specifications; i) Normal wear and tear; j) Failure of owner to perform periodic product maintenance; k) which has been subjected to unusual physical or electrical stress, misuse, abuse, power shortage, or negligence or; l) Any other cause which does not relate to a product defect.

3)   Warranty Procedure
For the duration of the warranty period, QVidium will replace or repair defective products. If a product is suspected of being defective, the owner should contact the reseller or distributor that sold the product. A representative will authorize the exchange or repair of the defective item. Products must be shipped in the original or comparable packaging with shipping and insurance charges prepaid in U.S. currency.

4)   Limitation of Warranty
Neither QVidium nor its third party suppliers make any other warranty or condition of any kind whether expressed or implied, with respect to the QVidium products, and specifically disclaim the implied warranties or conditions of merchantability, satisfactory quality, and fitness for a particular purpose.

5)   Limitation of Liability
Except for the limited obligations specifically set forth in this warranty statement, in no event shall QVidium or its third party suppliers be liable for direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory and whether advised of the possibilities of such damages.

Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above limitations and/or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

7.6   Appendix F: **FCC Notice**

NOTE: This equipment has been tested and found to comply with the limits
for a Class A digital device, pursuant to part 15 of the FCC Rules.
These limits are designed to provide reasonable protection against
harmful interference when the equipment is operated in a commercial
environment. This equipment generates, uses, and can radiate radio
frequency energy and, if not installed and used in accordance with the
instruction manual, may cause harmful interference to radio
communications. Operation of this equipment in a residential area may
cause harmful interference in which case the user will be required to
correct the interference at his own expense.