QVidium® TECHNOLOGIES, INC.

QVSD H.264 SD Video Codec™

For Broadcast and Professional Video Applications

Model: #**QVSD**

User's Manual v.3

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Application Firmware Version 28

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1 Introduction

Congratulations on purchasing the QVidium® QVSD H.264 SD Video Codec™.

QVidium® QVSD H.264 SD Video Codec™ – Front View

1.1 Overview

The QVidium QVSD H.264 SD Video Codec™ can encode, decode, or transcode standard or high definition video using either MPEG2 (main profile) or MPEG4-AVC (Part 10, H.264 High Profile, Level 4.1) compression, and to interface a video feed from a wide range of video standards and connections for transport over nearly any IP network. The H.264 SD Video Codec™ includes QVidium's patented, advanced ARQ Error Correction and clock synchronization. With these advanced Quality of Service (QoS) features, the H.264 SD Video Codec™ can send video over nearly any network and across the world, including wireless connections and the public Internet, with unsurpassed video transport quality and state-of-the-art video compression for minimizing bandwidth.

1.2 Network Setup

The H.264 SD Video Codec™ comes with a factory preset IP address of 192.168.1.23 and Netmask of 255.255.255.0. You can download and run our **CodecManager** application to determine or change the IP settings, even when the IP address has been reset to an unknown address. Please refer to Section 8 of this manual for configuration using the CodecManager application.

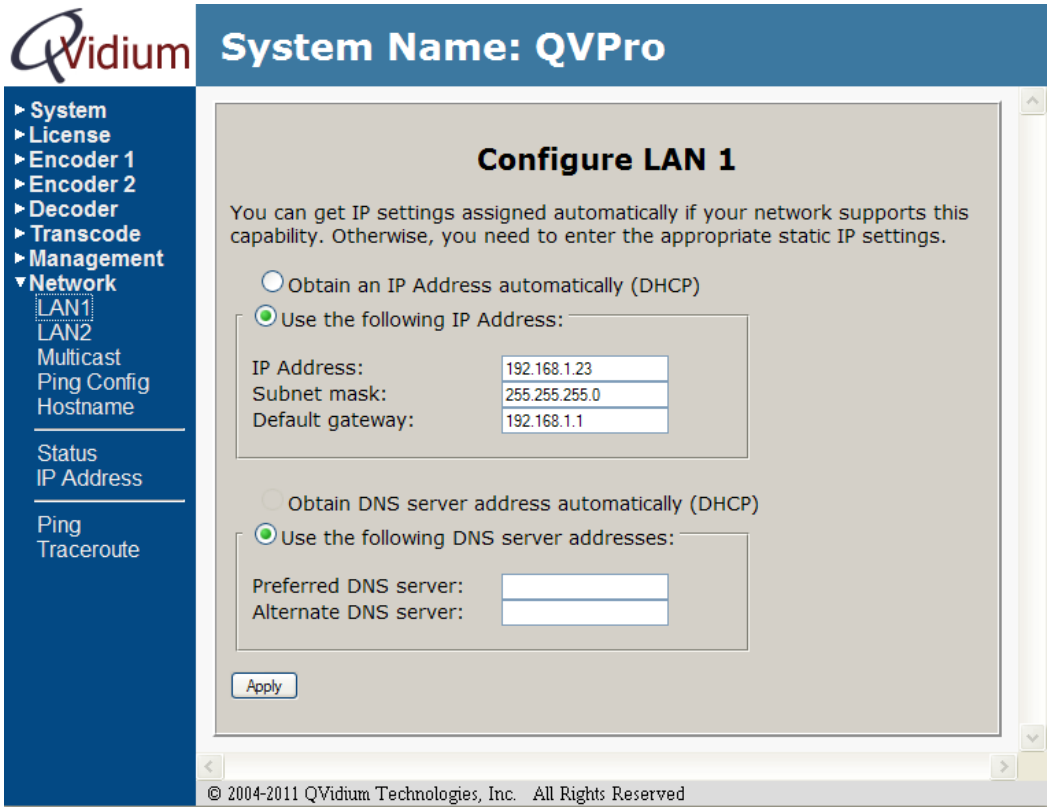
The H.264 SD Video Codec™ can also be reconfigured through a web browser when you know the IP address. Follow the steps below to reconfigure the network settings through a web browser on a computer connected to the same subnet as the Codec.

1) Point your web browser to http://192.168.1.23

NOTE: The H.264 SD Video Codec™ requires user authentication to enter the web browser or to log in using Telnet. The factory preset **username** is "**root**" and the **password** is also "**root**." Please enter these settings when prompted to access the system.

2) Click on "`Configure`" under the "`Network`" menu on the left.

You should see a web page similar to the following network configuration web page:



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

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 "`Apply`".

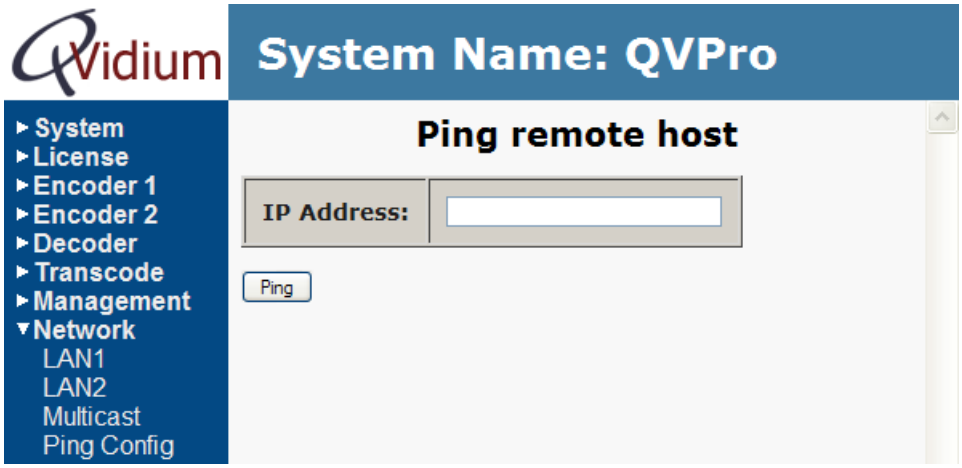
The Network Configure panel allows you to modify the static IP address parameters and DNS server settings, or to have these settings automatically configured through DHCP. A Hostname panel allows you to specify the host name for use in conjunction with a DNS server to assign a predetermined IP address.

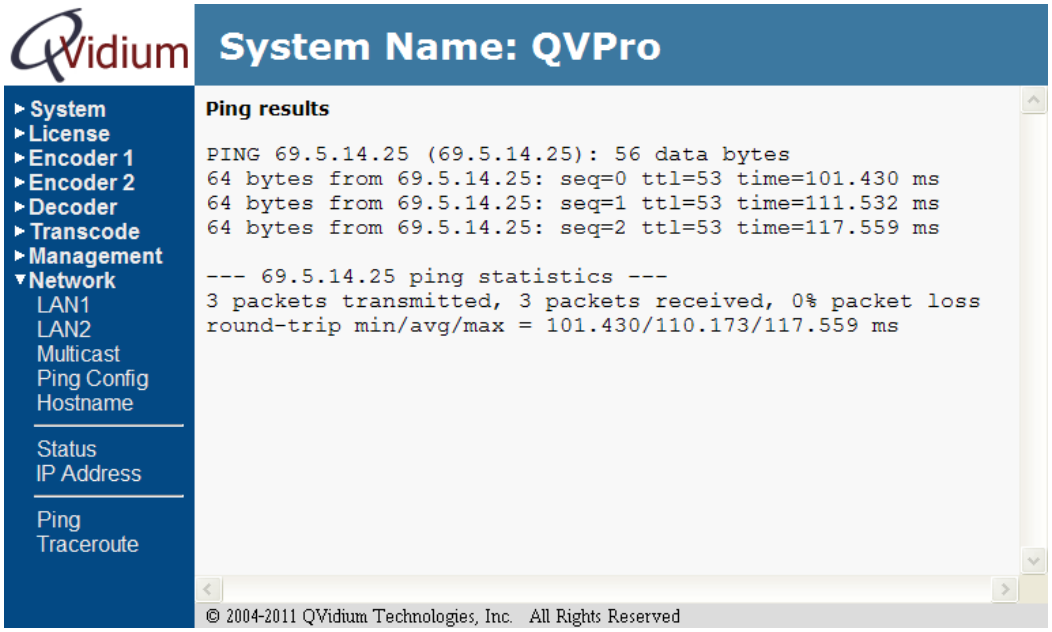
Note on Resetting IP Address: In case you change the IP address or select DHCP and cannot determine the IP address, you use the QVidium application, CodecManager that you can download from the Downloads page of www.qvidium.com. Alternatively, you can connect the Console serial port to log into the Linux shell and change the IP address or other settings. To reset the IP settings, connect a PC running a terminal emulator, such we Hyperterm or TeraTerm at 57,600 Baud (8-N-1, no flow control) and type "ifconfig eth0 <IP address>," where <IP address> is replaced by the desired IP address, for example, "ifconfig eth0 192.168.1.23". Alternatively, upon power-up the Codec will emit a gratuitous ARP packet from which you can determine its IP address by using a packet snifter or network monitor such as Wireshark (from www.wireshark.org).

Or, go to http://www.qvidium.com/reset, copy the "autorun" file on a USB flash, and plug flash into QVSD. This will reset all IP network settings. (File must be "autorun" and not "autorun.txt".)

1.3 Ping

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.





1.4 Passwords and Security

The QVidium H.264 SD Video Codec™ requires a username and password to protect access to its configuration settings. This includes both Web access and Telnet access. The default user name is "**root**" and the default password is also initially set to "**root**." You can change the password by selecting the Password menu item under the System Menu at the upper left of the Web page.

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 QVSD. This will reset the root password back to "root". (File must be saved as "autorun" and not "autorun.txt".) You must have physical access to the USB ports on the QVSD to use this procedure.

1.5 Updating

QVidium provides firmware updates from time to time to add new features, overcome limitations, or to fix bugs. You can find these new update packages on the QVidium Web Site under **Support** or by going to: http://www.qvidium.com/QVSD. QVidium provides these update as a .pkg file that you can upload into the Codec via the web browser interface. To perform an upgrade, you must perform the following steps:

1) Stop the Encoder, Decoder, and Transcoder if any of these functions are running.
2) Power cycle the system to clear memory.
3) Copy the upgrade .pkg file into a convenient location on your PC.
4) Point your web browser to the Codec and click on "`Upgrade`" in the "`System`" menu.
5) Click on the "`Browse`" button and locate the upgrade file.
6) Click on "`Upgrade`" and wait for the upgrade to finish. DO NOT DISCONNECT FROM POWER OR INTERRUPT THIS OPERATION UNTIL IT COMPLETES.
7) Click on "`Reboot`" from the system menu to reboot the Codec.

As part of this update, the update will be stopping and restarting the HTTP Daemon in the codec.

Note: Sometimes, a web browser will not be able to continue to reconnect to the new HTTP Daemon after it restarts, causing you to no longer see the update progress. **If this happens, please wait 2 minutes, after which it would be safe to power-cycle the codec so that it can boot from the new update.** You can then check under **System/Version** to confirm that you have the new firmware.

1.6 System View

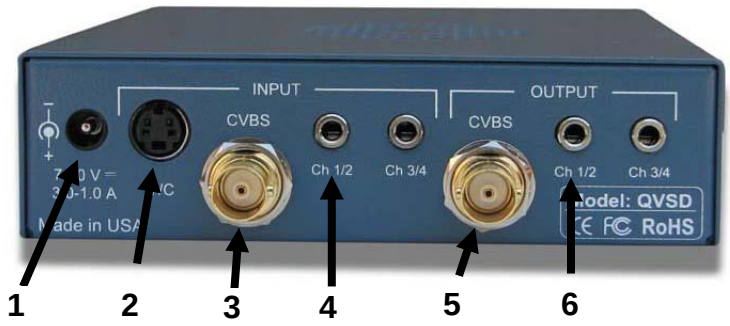
Front View – Computer Interface ports and Indicators

(All indicator lights either glow green or are off.)

Ref	Indicator/Switch	Description
1	**Video**	Glows green with active Composite or S-Video input.
2	**Power**	Glows green when the power is connected and unit is on.
3	**Reset**	Various reset functions. See description in manual.

Ref	Port	Description
5	**USB**	2 USB 2.0 Ports (external storage or LCD console).
6	**Console**	RS-232 Console Interface via DB-9 Connector.
7	**LAN**	LAN1 & LAN2, 10/100/1000-Base-TX Gigabit Ethernet Ports.

Rear View – Power, Video/Audio I/O Connectors, & RS-232 Port



Ref	Component	Description
1	**DC Power**	7 VDC to 20 VDC (1 to 3 Amps) alternative DC power input.
2	**S-Video Input**	NTSC/PAL/SECAM composite analog video input.
3	**Composite Input**	NTSC/PAL/SECAM composite analog video input.
4	**Audio Inputs**	Mini-phono stereo analog audio inputs.
5	**Composite Output**	NTSC/PAL/SECAM analog video output.
6	**Audio Outputs**	Mini-phono stereo analog audio output connectors.

Note: Serial number (not shown) is located above DC power connector.

Important Safety Information:

- **For PLUGGABLE EQUIPMENT, the socket-outlet shall be installed near the equipment and shall be easily accessible.**
- **CAUTION: The QVSD Codec contains an internal 3V. Lithium battery. RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. USE ONLY PANASONIC CR2032 20MM COIN-TYPE BATTERY OR EQUIVALENT. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.**

2 Encoder Configuration

The encoder is configured and operated from a web browser. This section explains how to configure the Codec's encoding parameters.

2.1 Configuring the Encoder - Overview

1. Enter `http://<IPAddress>` where <`IPAddress`> is the IP address of the QVidium QVSD H.264 SD Video Codec™ that you want to configure. (The default address is http://192.168.1.23.)

2. Click on "`Profile`" under "`Encoder`" from the menu on the left. "`The Encoder Profile`" interface should display in the main area to the right of the menu system, as shown in Figure 1.

3. Enter the destination IP address and UDP port number for the decoder, media server, or network equipment that will be receiving the stream. Enter the desired Video Bit Rate (in bps), and modify the other audio and video parameters, such as Video Input, and Audio Bitrate (in Kbps), to suit your needs, as shown in Figure 1a, and explained below.

4. Press the "`Save`" button to save your changes. None of your changes will be saved nor have any effect unless you first save them. If you have any doubt about the parameters selected when running the encoder, you should click on Profile after saving the parameters or starting the coder to see the current operational encoder settings.

2.2 Basic Encoding Configuration

As shown in Figure 1a, you can select the video input source, and set the video and audio encoding format and bitrates. For the QVSD codec, the **Video Input** can be either Composite or S-Video. The QVSD codec will automatically detect and adjust for the input video resolution and format (PAL vs. NTSC vs. SECAM). You can also use the advanced encoding parameters (Section 2.4) to scale the video resolution and frame-rate.

The QVSD can output the encoded video stream either as a Variable Bit Rate (VBR) IP stream, or (in a forthcoming firmware release) a Constant Bit Rate (CBR) IP stream. When CBR mode is supported, enter the total desired output bitrate, including audio and video feeds, as the **Stream Bit Rate**. In this mode, it will ignore the Video Bit Rate parameter. At present, this mode is not functional.

For VBR mode, enter the desired peak video encoding bit rate in bits per second as the **Video Bit Rate** parameter. A VBR stream optimizes IP network efficiency by eliminating unnecessary null packets from the media stream. The encoder will use the Video Bit Rate number as an upper limit on video data bursts. In general, the video rate may be less than this rate, depending upon video content. To calculate the maximum peak IP data rate, you must add to this video bit rate the audio bitrate plus any transport-stream multiplexing and network packetization overhead (usually between 5 and 10%).

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 codec. For more details on the range of **MPEG encoding bit rates**, please **see Appendix C** (Section 12.3). For more information on the various **video parameters** (Frame

Rate, Encoding, Format, Resolution, etc.) please **see Appendix A** (Section 12.1). For SD video, you can select either MPEG2 or MPEG4-AVC (H.264) **Video Encoding**.

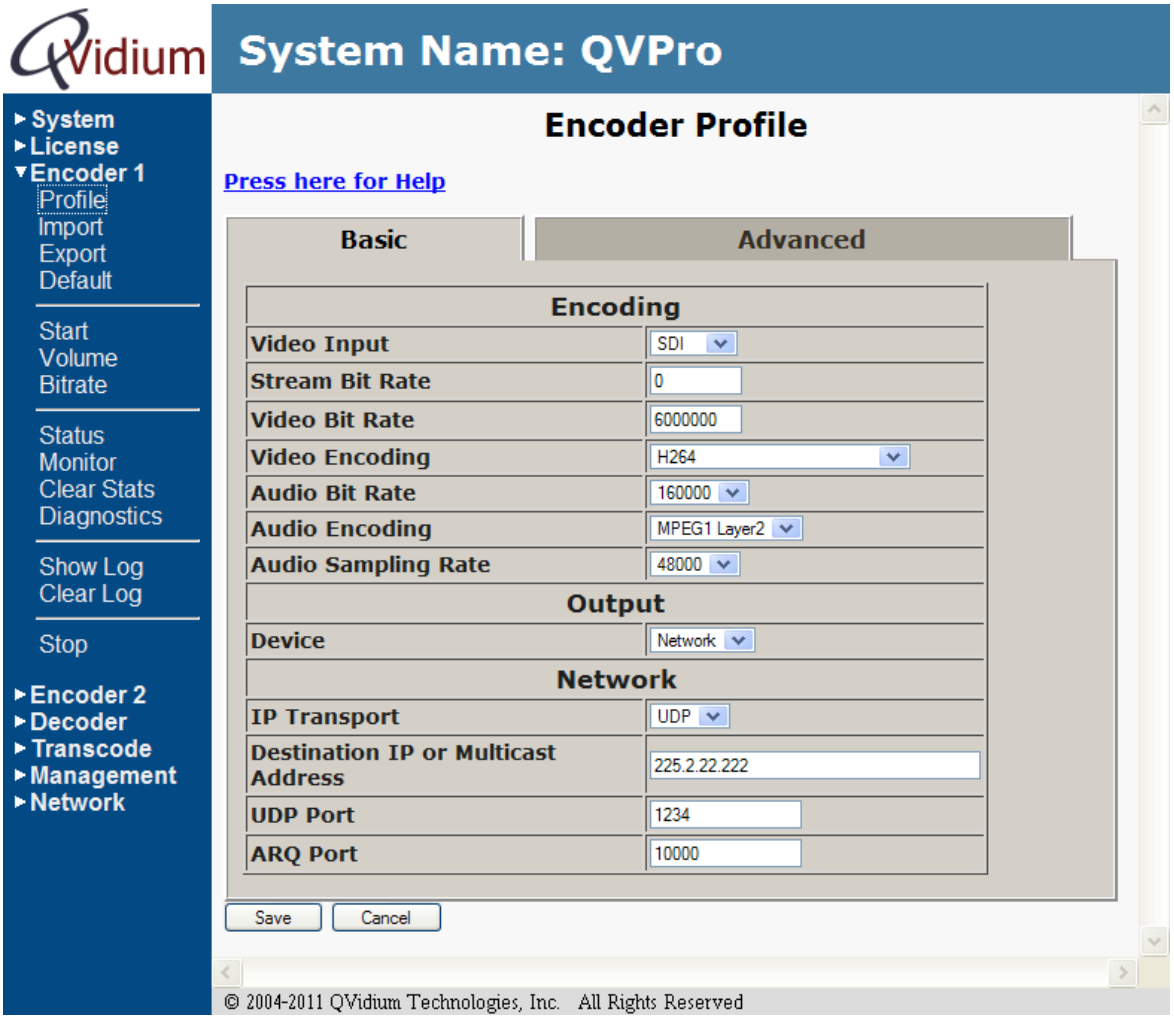


Figure 1a: Basic Encoder Configuration.

2.3 Configuring Packet Transport & Error Correction

The QVidium H.264 SD Video Codec™ features some of the most powerful and advanced error correction capabilities found in any video over IP product. The QVidium H.264 SD Video Codec™ implements QVidium's patented ARQ error correction and clock synchronization (US Patents #7,551,647 and #7,522,528) for the more robust video transmission with the lowest delay. QVidium's ARQ (Automatic Retransmission Request) is a dynamically adjusting 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 QVSD H.264 SD Video Codec™ minimizes network bandwidth and loading due to its extremely efficient encoding and video transport. The SD Video Codec™ implements MPEG4-AVC (H.264) High Profile (Levels 4 and 4.1) video encoding, providing advanced coding techniques in hardware, such as CABAC processing, not normally found in other MPEG4 codecs. Our codec

also features variable bit rate (VBR) transport, which strips out unnecessary null packets from the video transport stream to minimize network loading.

The QVSD supports QVidium's patented ARQ error correction. ARQ is a robust feedback-based error correction that can successfully recover nearly all packet loss, even in harsh network environments. However, because of support for CBR, the QVSD also will be supporting SMPTE-2022 (ProMPEG) Forward Error Correction (FEC). Because the ProMPEG FEC specification does not support VBR streams, you must use CBR mode when using ProMPEG FEC. However, as FEC cannot anticipate varying network conditions nor correct many common forms of packet loss, we suggest using ARQ wherever possible.

In contrast with FEC, QVidium's ARQ is 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 and makes it unacceptable for live, low-latency video transport.

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.

This section explains how to configure the video transport capabilities of the QVSD H.264 SD Video Codec™ and how to enable ARQ error correction.

2.3.1 Configuring Video over IP Network Parameters

To configure the IP network parameters, within the Network Parameters section of the encoder profile, select among RTSP, ARQ, RTP, or UDP packet transport. Also, specify the destination IP address and UDP port number. The destination IP address may be a multicast or a unicast IP address. The encoder 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 add an RTP header to the UDP packet stream. The RTP header adds a timestamp and packet sequence number before inserting the MPEG-2 transport stream packets into the RTP/UDP/IP packet payload.

All of these transport types insert an integral number of 188-byte MPEG-2 transport stream packets into the packet payload as specified by the TS packets per IP packet parameter. The IP encapsulation adheres to the IETF/RFC 2733 standard for video over IP that specifies that the packet payload must comprise an integral number of whole MPEG-2 transport stream packets within an RTP header, so all transport types, aside from UDP-only, are compatible with the

ProMPEG Forum's standard and the IETF/RFC 2733 standard.

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. You must also be certain to configure any firewalls to allow the ARQ retransmission request packets through. The default port for these upstream ARQ request packets is UDP port 7020, although you can configure this to any other valid, non-conflicting UDP port. However, if you choose to change the ARQ request port, you must make certain the settings at the encoder and decoder match.

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 Advanced Video Encoding Configuration

The encoder has a set of advanced configuration settings that you can configure from the Advanced Encoder Profile tab as shown in Figure 1b below. These parameters are divided into 3 sections: Advanced Encoding parameters, Output parameters, and Network parameters.

Warning: Some combinations of parameters can cause the encoder to malfunction. QVidium does not test nor can it support all possible combinations of parameters. However, our philosophy is to allow the user to have the flexibility of setting these parameters to suit his needs and make the decision for himself as to whether the resulting operation meets the needs of his application. To get the system into a known reliable configuration, simply click Default. This will reset all the advanced parameters to known good values.

Advanced Encoding Parameters:

Capture Closed Caption (CC): (Currently implemented for MPEG2 SD video only, but soon to support H.264 and SD video in a forthcoming firmware release.) Setting this to Yes will allow the encoder to pass certain data on Line 21 into the video stream. In the current firmware release, the QVSD may not produce compatible Closed Captioned video, even for SD MPEG2 video. It has only been tested to work with VLC. We expect these constraints to be lifted with the upcoming firmware release when closed captioning and teletext becomes fully supported.

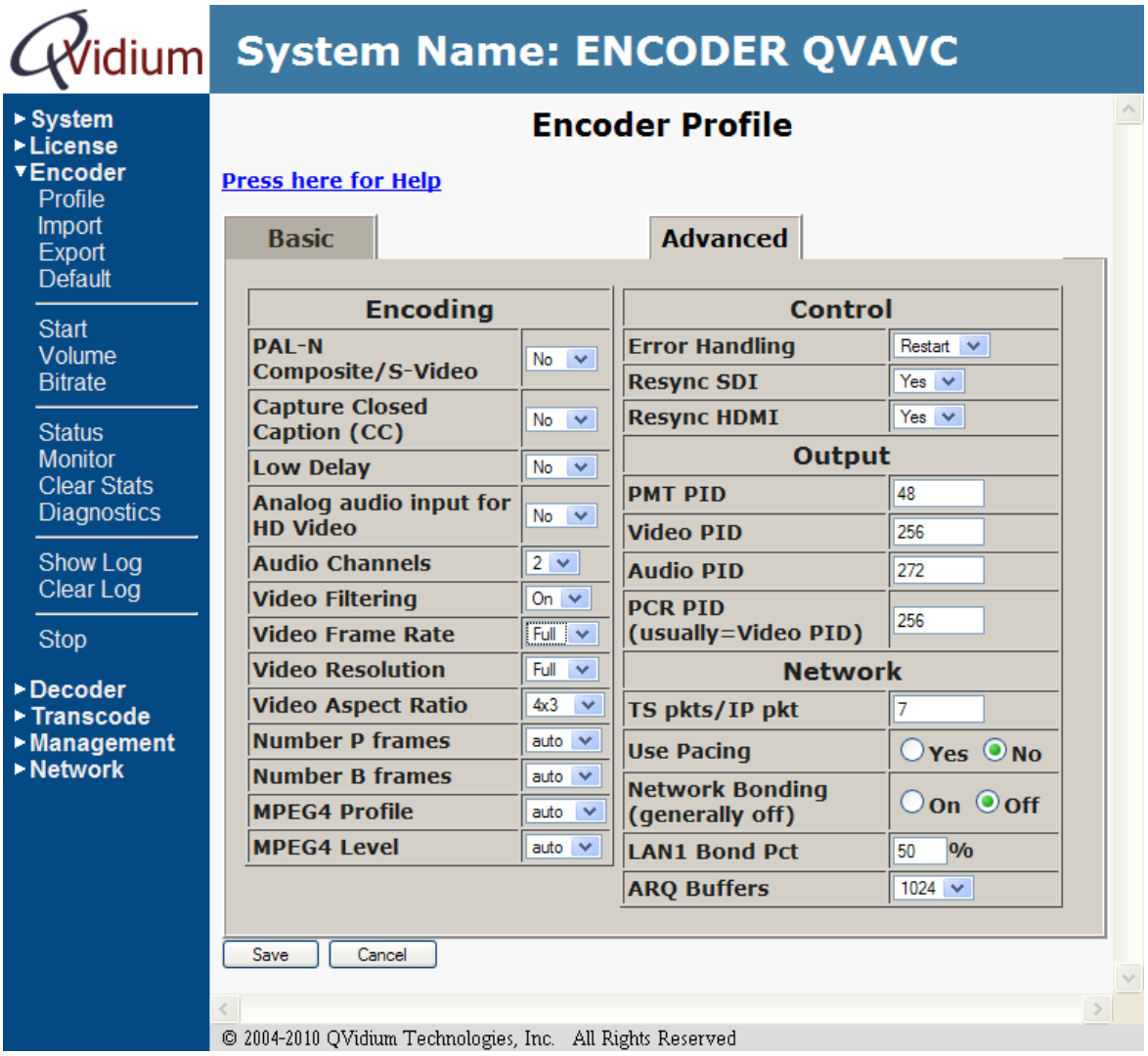


Figure 1b: Advanced Encoder Configuration.

Low Delay: This parameter enables a low latency mode that will generally reduce the total end-to-end latency to between ½ second and one second.

Audio Channels: Normally this is set to two for stereo audio encoding. You can set this to one for monaural audio to reduce audio bitrate. **WARNING:** *Setting this to 1 channel can cause the encoder to unexpectedly halt under certain circumstances.*

Video Filtering: Enabling Video Filtering applies a special pre-filter to the video input, allowing more efficient video encoding.

Video Frame Rate and **Resolution (for SD):** Normally, the encoder automatically detects the frame rate and resolution of the video input signal. Setting these values allows you to override the original input signal to reduce the frame rate and/or resolution, enabling very low output encoding bitrates, such as for broadband wireless connections.

Video Aspect Ratio: This sets a bit in the video stream to tell the display device what output aspect ratio to display.

Number P Frames: This sets the number or Predictive frames in the Group-of-Pictures (GOP). Unless you need a specific GOP, you should set this to `Auto`.

Number B Frames: This sets the number of Bi-Directional frames in the GOP. Unless you need a specific GOP, you should set this to Auto. The GOP can be calculated by the formula:

GOP = (P+1)*(B+1).

Thus, for all I-Frames (GOP=1), you would set P=0 and B=0. For Baseline Profile, the B parameter is ignored (internally set to 0).

MPEG4 Profile and Level: This sets the H.264 profile and level. Auto uses the best possible encoding for the given parameters. Use this for backward compatibility with decoders that cannot handle the more advanced encoding features. If you see jerky video on a decoder and there is no packet loss and the CPU is not overloaded, then you may want to try lower values for these settings.

Control Parameters:

Error Handling: Enable this feature when high reliability is required. When set to Reboot or Restart, this feature starts a supervisory monitoring process that will reboot or restart the encoder when the encoder halts for any reason. Restarting the encoder is very fast (less than a second), but may not recover from all types of errors. Restarting can take up to 23 seconds, but will recover from nearly any error.

Output Parameters:

PMT, Video, Audio, and **PCR PID:** Changing these values changes the values for the respective PIDs.

Network Parameters:

TS packets per IP packet: This sets the number of 188-byte MPEG-2 transport stream packets per UDP/IP output packet payload. The default of 7 sets the payload to 1316 bytes, which minimizes the IP packetization overhead. A lower value results in a higher output packet rate.

Use Pacing: Because the video stream is VBR (variable bit rate), an I-Frame (Key Frame) may generate a large burst of IP packets. Pacing adds output buffering and regulates the output packet rate to attempt to equalize the output packet rate and reduce burstiness.

Network Bonding and LAN1 Bonding Percent: Network bonding is a special feature designed for broadband wireless and other network links where a single network link has insufficient bandwidth for the video and instead you wish to take advantage of both Ethernet ports on the codec. Setting this parameter to **true** distributes the video load across both When the two network links are asymmetric, LAN1 Bonding Percent specifies the relative distribution of Ethernet packets among the two Ethernet ports. The default, 50 splits the load to 50% on each Ethernet port.

ARQ Buffers: This controls the amount of memory allocated for storing outgoing packets for possible later retransmission by the ARQ error correction. The default is 1024, which is generally enough for normal operation for bitrates under 5 Mbps. This setting allows enough memory to also run the decoder at the same time for SD video. However, you should increase this to 4096 when encoding SD video, or when using encoding at bitrates higher than 5 Mbps. However, you must not start the decoder when running the encoder with this parameter set to 4096.

3 Encoder Operation

This section explains how to operate the Codec as a video encoder. Once the encoder has started, you can also change the audio attenuation and gain settings and dynamically change the video encoding bitrate.

3.1 Starting and Stopping the Encoder

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

1. Select the `Encoder` menu on the left side of the web page.

2. Select the `Start` menu option underneath the `Encoder` menu to start the encoder. Likewise, click on `Stop` to stop the encoder. If the encoder is running, you can edit the parameters and click on `Start` to restart the encoder with the new parameters. There is no need to first stop the encoder since the `Start` command first performs a `Stop` operation.

Note: If you wish to reconfigure the encoder, remember to first **Save** any configuration changes **before** restarting the encoder.

3.2 Adjusting Encoder Audio Levels

The analog audio conditioning and digitizing circuitry includes both an audio preamplifier followed by a audio attenuation block. Once the encoder has started, you can dynamically vary the gain and attenuation of the audio signal that is being fed to the digitizer with the controls in Figure 2, below.

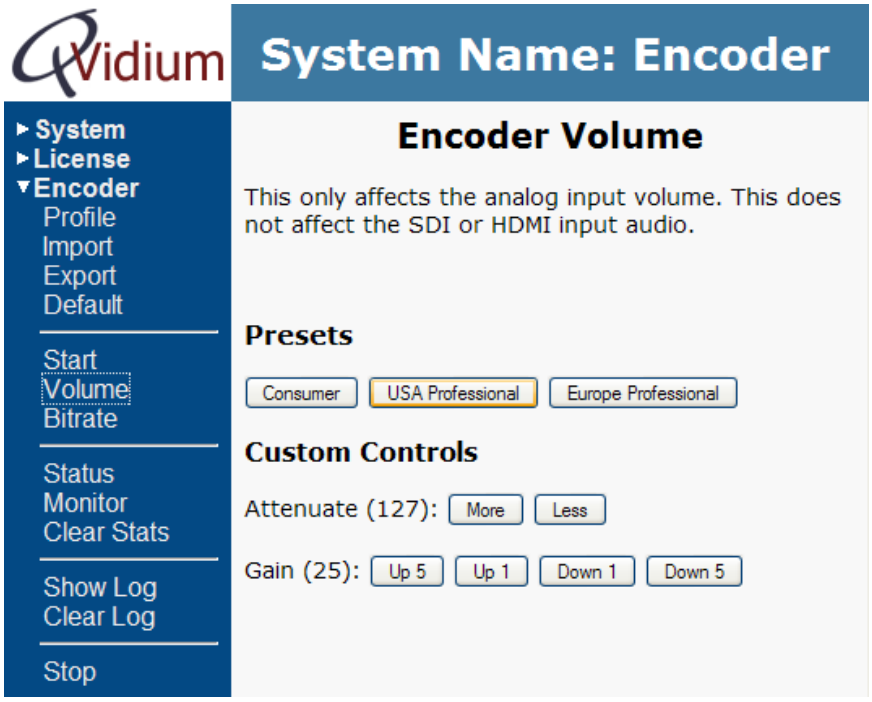


Figure 2: Encoder audio gain and attenuation controls.

The analog audio input, by default, accepts a maximum input voltage of about ±400 mV_{peak}. Above this level, the input circuitry limits any additional signal levels by clipping the digitized signal to this peak value. This level is close to the standard consumer analog level of ±447 mV_{peak}, and significantly less than professional peak audio voltage levels (1.737 V_{peak} US and 2.192 V_{peak} German). In order to accommodate various consumer and professional analog audio input sources, you can select from among 3 preset standard audio signal levels, Consumer, Professional US, Professional Europe. You can also manually adjust the attenuation of the audio input.

3.3 Dynamically Changing the Video Encoding Bitrate

Once encoding has begun, you can instantaneously vary the video encoding bitrate. This can be useful when connecting to wireless modems and other network connections with limited, but unpredictable, time-varying throughput characteristics. As described in this section, we provide several mechanisms for dynamically adjusting the video encoding bitrate. In particular, this can allow a modem to feed back link throughput constraints directly to the encoder to dynamically optimize video quality over such bandwidth-constrained networking links.

3.3.1 URL Control

There are 2 URLs, one to get the current video bitrate and a second url to set the video bitrate. These URLs return plain text (no HTML) to simplify parsing. The "`Encoder->Bitrate`" link in the web UI allows you to set the video bitrate with a browser.

/cgi-bin/encoder_bitrate2.cgi: Gets the current video bitrate. Returns VIDEO_BITRATE=xxxxxxx, where xxxxxxx is the current bitrate.

/cgi-bin/encoder_bitrate2.cgi?VIDEO_BITRATE=xxxxxxx: Sets the video bitrate where xxxxxxx is the desired bitrate. Returns VIDEO_BITRATE=xxxxxxx where xxxxxxx is the bitrate that was set. The maximum video bitrate is 25000000.

Examples of using the wget command. The initial bitrate was 23Mbps.

$ wget -q -O - http://root:root@192.168.1.23/cgi-bin/encoder_bitrate2.cgi
VIDEO_BITRATE=23000000
$ wget -q -O - http://root:root@192.168.1.23/cgi-bin/encoder_bitrate2.cgi?VIDEO_BITRATE=9000000
VIDEO_BITRATE=9000000
$ wget -q -O - http://root:root@192.168.1.23/cgi-bin/encoder_bitrate2.cgi
VIDEO_BITRATE=9000000
$ wget -q -O - http://root:root@192.168.1.23/cgi-bin/encoder_bitrate2.cgi?VIDEO_BITRATE=500000000
VIDEO_BITRATE=25000000

3.3.2 Command-line Control

The program, /qvidium/qvctrl, allows you to communicate with the encoder via a command-line interface, such as **telnet**, **ssh**, or the RS-232 Console port. The first argument is always /dev/qvencode, The second argument is "get_videobitrate" or "set_videobitrate xxxxxx" where xxxxxx is the bitrate would want to set (max bitrate is 25000000). The command always returns VIDEO_BITRATE=xxxxxxx where xxxxxx is the current bitrate. Here are examples:

[QVSD.qvidium.com]$ /qvidium/qvctrl /dev/qvencode "get_videobitrate"
VIDEO_BITRATE=4000000
[QVSD.qvidium.com]$ /qvidium/qvctrl /dev/qvencode "set_videobitrate 2000000"
VIDEO_BITRATE=2000000
[QVSD.qvidium.com]$ /qvidium/qvctrl /dev/qvencode "set_videobitrate 8000000"
VIDEO_BITRATE=8000000

3.4 Configuring the Encoder for RTSP and Server Mode

After clicking on **Start** under the **Encoder** menu, the configuration we had described in section 2.1 will immediately begin to send out a continuous video stream of UDP/IP packets, optionally encapsulated with RTP headers, to the destination address. However, the QVSD also has two alternate modes of operation that allows a remote Decoder, such as another QVSD code, an Amino Set-top box configured with QVidium software, or the QVidium StreamViewer application, to initiate the video stream. These modes are: **RTSP** and **Server Mode**.

3.4.1 RTSP Mode

Real-Time Streaming Protocol, or RTSP, is a common and widely used protocol for controlling a video stream. To set up the QVSD codec for RTSP operation to a computer running VLC, for example, you can use the following procedure:

1. On **Encoder Profile** select **RTSP** IP Transport on the **Basic** tab.
2. Click **Save** and then click **Start**.
3. From **VLC** (www.videolan.org) :
   a) Select **'Open Network Stream...'** from the **'Media'** menu.
      An **'Open Media'** dialog should display.
   b) On the dialog, select **'RTSP'** from the **'Protocol'** drop down list.
   c) Enter **"192.168.1.23/vox.mpg&xcode=0&input=0"** in the **'Address'** field. (Substitute 192.168.1.23 for the actual IP address of your codec.)
   d) Click on the **'Play'** button in **VLC**.

A green screen from VLC usually means the decoder is not receiving IP packets. On the decoder menu you can click '**Status**'. That will tell you if you are receiving bits. Also on the Encoder you can click on '**Status**' from the Encoder menu to see if the encoder is sending bits. On both systems there is a '**Show Log**' menu option that may help debug the setup if it is not working.

3.4.2 Server Mode

QVidium also has its own Server Mode that allows a QVidium decoder device or application to remotely start a QVidium encoder and initiate a video stream. On the QVSD, simply leave the **Destination IP Address** blank and **Start** the encoder. This will cause the encoder to listen for a start packet from the decoder. On a QVSD Decoder, click '**Enable**' under the Decoder's **Server** tab and enter the IP address of the QVidium encoder. When you click **Start** on the Decoder, the decoder will send an IP packet to the encoder to initiate a video session.

4 Decoder Configuration and Operation

As with the encoder, the decoder can be configured and operated from a web browser. This section describes how to configure and operate the decoder.

4.1 Decoding Profile and Web Interface

You must use the web interface to edit the decoding profile.

Enter `http://IPAddress` where `IPAddress` is the IP address of the decoder. For example, http://192.168.1.23.

1. Make certain that the encoder is stopped as explained in Section 3.1.
2. Select the `Decoder` menu on the left side of the web page.
3. Select the `Profile` menu option underneath the `Decoder` menu.

   A `Decoder Profile` interface should display in the main area to the right of the menu system as shown in Figure 3a through 3c, below and in Appendix B.

4. Edit the decoder profile. Three tabbed forms together comprise the complete decoder profile. These 3 forms, shown in Figures 3a through 3d, allow configuration of: video parameters, network configuration, ARQ error correction setup, and configuration of a remote QVidium video server, respectively. Please refer to Appendix B for a detailed description of each of these parameters.

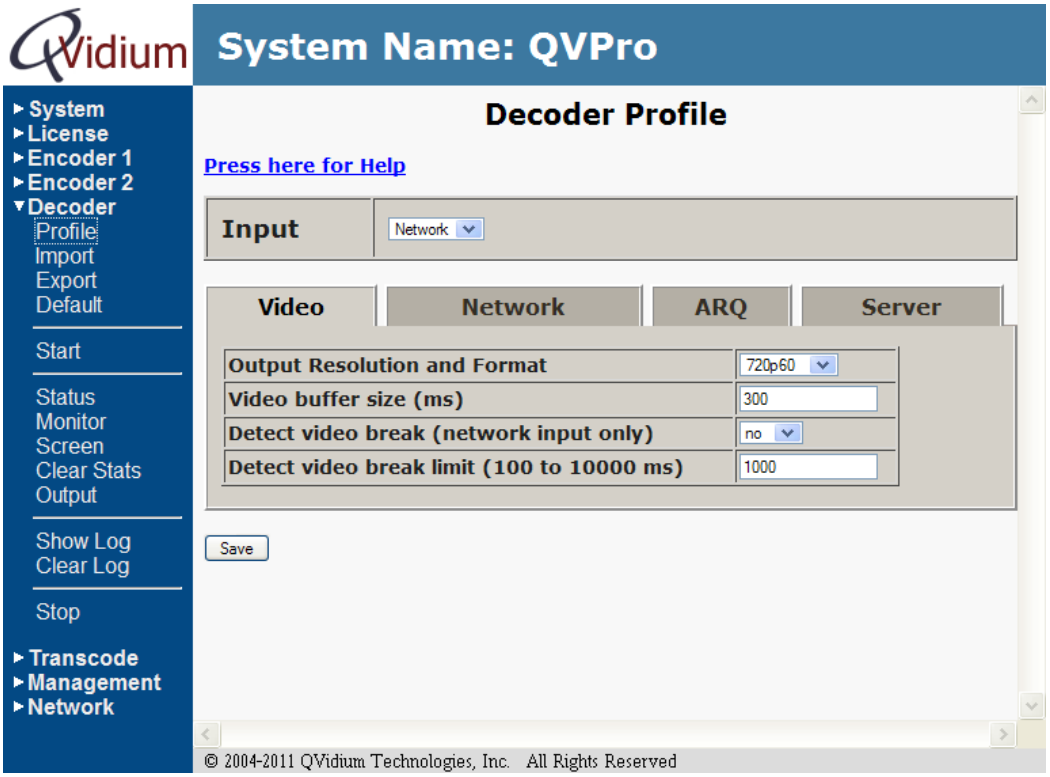


Figure 3a: Decoder profile: "Video Tab"

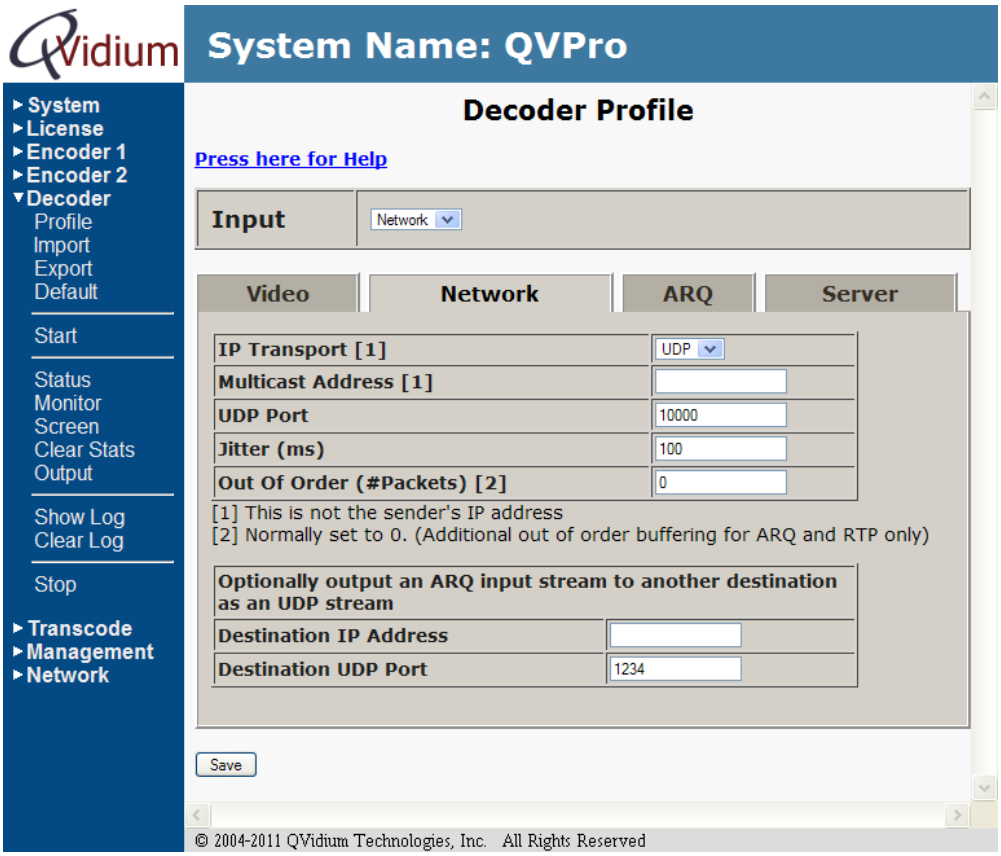


Figure 3b: Decoder profile: "Network Tab"

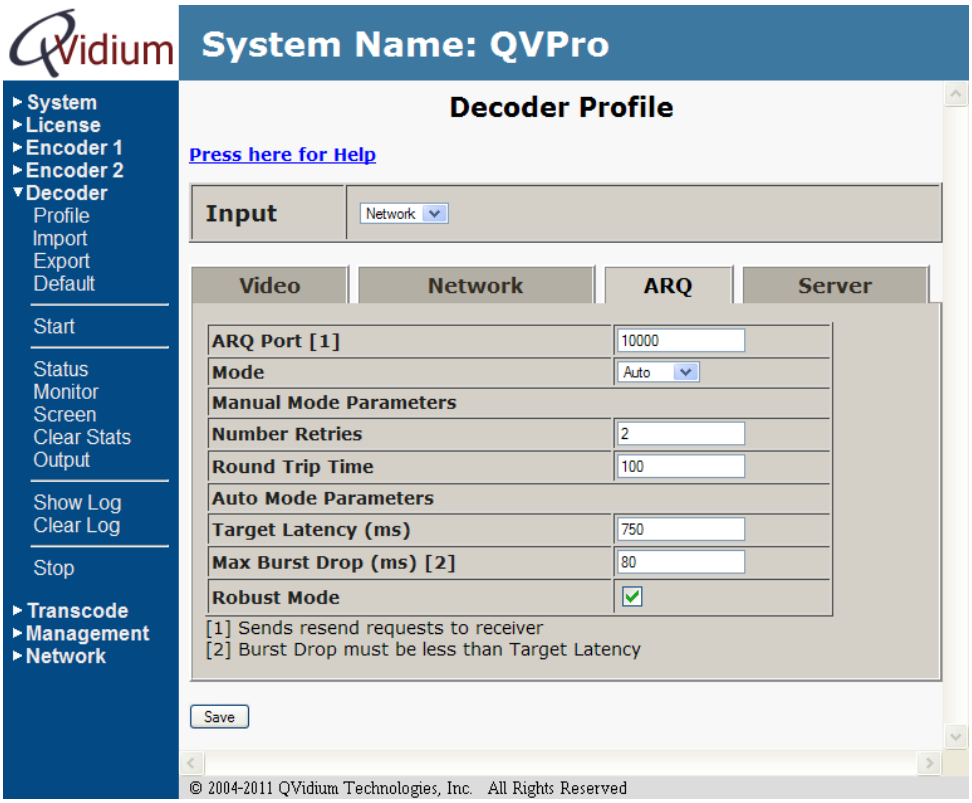


Figure 3c: Decoder profile: "ARQ Tab"

On the Network tab, shown in Figure 3b, enter the desired **IP Transport** type (ARQ, RTP, or UDP). Select ARQ to enable error correction. ARQ uses RTP over UDP transport. RTP adds statistics to the UDP header to help keep track of packet loss in the Status display. UDP is most compatible with third-party video encoders. Enter the **UDP port** on which to receive IP video packets. Enter a **multicast address** if receiving multicast packets, **otherwise, leave this field blank**. You can also add an input **Jitter Buffer**, specified in milliseconds, to smooth variations in packet delay and fix packet ordering problems.

Figure 3d: Decoder profile: "Server Tab"

Two other parameters, **Video buffer size**, specified in milliseconds, and **Detect video break**, can help with the robustness of the decoder in handling packet loss and network interruptions. We generally recommend setting the **Video buffer size** to between 300 and 500 ms. For low-latency applications, you can try setting it as low as 150 ms. For maximum robustness, you can increase this parameter to 1000 ms. We also recommend enabling **Detect video break** and setting the **Detect video break limit** to 150 ms. When the decoder detects a pause or interruption in the flow of incoming packets of this value or higher, the **Detect video break** feature will automatically restart the decoder to help prevent it from getting into a bad state. This can help if you are experiencing color loss or other decoder problems.

The **ARQ** tab, shown in Figure 3c above, configures the parameters for Automatic Retransmission Request (ARQ) Error Correction. These parameters are explained in Appendix B. The last panel, the **Server** tab, enables you to pull in a stream from a QVidium video server. For more details on these features, please consult Appendix B. You should set the **Use Server** to **No** (the default) when not using a QVidium server and in general when receiving a stream from an encoder.

5. Press the `Save` button to save your changes. If you don't click `Save`, then your changes will be ignored.

4.2 Starting the Decoder

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

1. Select the `Decoder` menu on the left side of the web page.
2. Click on the `Start` button.
3. When a valid video over IP stream is being received and decoded, the Video Status page will show bitrate and other statistics related to the incoming video stream.

4.3 Stopping and Reconfiguring the Decoder

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

1. If the `Decoder` menu is not shown, select `Decoder` on the left side of the web page.
2. Select the `Stop` menu option underneath the `Decoder` menu. You should see the following message at the top of the web page main area.

   `Decoder is Stopped.`

4.4 Configuring Packet Transport & Error Correction

This section explains how to configure the video transport and error correction capabilities of the QVidium H.264 SD Video Codec™ and how to configure its decoder for proper operation of these error correction mechanisms. Section 4.4.1 describes the configuration of the decoder's network transport and Section 4.4.2 describes the ARQ error correction mechanisms of the QVidium H.264 SD Video Codec™.

4.4.1 Configuring the Decoder's Network Transport

Within the `Network Parameters` section of the decoder profile, select among ARQ, RTP, or UDP packet transport. Also, specify the UDP port number. The `Multicast Address` specifies the IP multicast address, if any, to listen to for the Video/IP stream. If expecting a unicast video/IP stream, leave this field blank. The decoder interprets the video and audio signals as UDP/IP packets in all cases, regardless of the type of packet transport you select. Specifying UDP treats the packet payload as raw MPEG-2 Transport Stream data. All the other transport types will assume that the incoming packets have an RTP header at the start of the payload, as per IETF/RFC 2733 and related standards.

The network interface to the decoder includes QVidium's patented synchronized network de-jitter buffering mechanism. In the decode interface, you may specify a delay for this de-jitter buffer in milliseconds. When using ARQ or RTP network transport mode, the de-jitter buffer holds the specified number of milliseconds of packets to give the decoder ample time to account for random delays and to allow the decoder to correct packet ordering. The decoder uses RTP sequence numbers of incoming packets to insert incoming packets into their proper place in the de-jitter buffer before releasing those packets into the MPEG decoder. The de-jitter buffer also uses the RTP timestamp to synchronize the decoder's network clock with the video source to adjust the de-jitter buffer hold time.

In addition to the de-jitter packet buffer, you can specify the size (in milliseconds) of the decoder's low-level video data buffer. In contrast to the de-jitter buffer, this video input buffer always exists, even when error correction is disabled. It buffers out variations due to both network-induced jitter and operating-system jitter, to insure that the decoder never runs out of video or audio data, despite variations in CPU processing and packet arrival times.

4.4.2 ARQ: Automatic Retransmission Request

Automatic **R**etransmission Re**q**uest (ARQ) tries to recover any packets lost during transport to the decoder by adding a small amount of delay at the decoder during which time the decoder would have time to detect and request any missing packets. The size of this delay should also include adequate time for the missing packet to be received and inserted into the play out queue so that the video stream can continue to flow smoothly and unimpeded to the MPEG decoder.

To enable ARQ, you must first select ARQ transport from the `Profile` dialog. Also, ARQ transport must be enabled at the encoder. With ARQ selected and the decoder started, the

decoder will watch for gaps in the RTP sequence numbers from the output of the jitter buffer. When it detects missing packets, it sends retransmission requests to the encoder so that the encoder can quickly resend any missing packets. Incoming retransmitted ARQ packets bypass the network 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 output of the ARQ buffer should no longer contain any missing packets.

ARQ has three parameters that can be configured in `manual` mode: `Round Trip Time`, `Number Retries`, `Burst Drop`, and `Robust Mode`. In `automatic` mode, the system automatically measures and calculates the `Round Trip Time` and `Number Retries`. Automatic mode only uses two parameters: `Target Latency` and `Burst Drop`. In most cases automatic mode and the default parameters should be adequate.

Of the required parameters, the first parameter, `Target Latency`, specifies the total delay, in milliseconds, allotted for the request, retransmission, and recovery process. The ARQ mechanism will attempt as many retries as possible within this target latency time. Thus, larger target latency times increase the delay before video is output, but allows for more chances of requesting and recovering any missing packets. However, automatic mode also sets an internal maximum limit based on its measurements that may be less than the target latency time.

A `Burst Drop` delay can also be specified to delay any retransmission requests for a time equal to the maximum expected packet loss time, such as from dynamic router changes of other sources of burst loss.

A `Robust Mode` can also be selected. When selected (checked), a minimum of two tries will be attempted for recovering any missing packets. When not selected (unchecked), ARQ will always try at least once to recover any missing packets.

To help with firewall configuration and to handle potential port conflicts, the user can change the default port that ARQ uses to send upstream retransmission requests, `ARQ Port`. However, you must make certain that the same ARQ port number is set in both the encoder as in the decoder.

Although the automatic measurement of the round-trip time uses multiple measurements to take into account random network delays, for some networks you might wish to specify a larger round-trip value, or to specify a larger number of retries in case the upstream link loses some of the retransmission request messages. In automatic robust-mode of ARQ operation, the system automatically measures the round-trip time and divides that number into your specified Target Latency to determine the number of retries to use. However in `Manual Mode`, you can force ARQ to always use a specified number or retransmission requests.

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). Please also be certain that ARQ has also been selected at the encoder.*

5 Transcoding

The QVidium QVSD Video Codec™ can operate as a transcoder and convert, in real-time, a live video stream from one video encoding format to another, change the video stream bit rate, scale down the video resolution, and change the audio encoding format and audio bitrate. In order to enable transcoding, you must obtain a Transcoding License Key from QVidium Technologies, Inc., or one of its authorized resellers, and enter that License Key in the **License/Transcode** page.

As a transcoder, the QVSD can input either a video stream from either the IP/Ethernet interface or the DVB-ASI input interface, and output the transcoded stream to either the IP/Ethernet network port or output to the DVB-ASI interface. The configuration profile includes 5 configuration panels for setting up the transcoder: **Transcode**, **Network In**, **ARQ In**, **Server**, and **Network Out**.

The **Transcode** configuration panel, shown below, allows you to set the input and output interfaces, output video bitrate, format, and resolution, and the audio encoding format. The QVSD automatically detects the characteristics of the incoming video stream. You can then select the new characteristics for the converted output video stream. You can choose either DVB-ASI or Ethernet/IP as the input or output interface. You can select among MPEG2 and H.264 output formats. If selecting H.264 (MPEG4-AVC), you can also select the MPEG4 Profile and Level. The transcoder also allows you to scale down the output resolution, or select "**auto**" to preserve the input resolution. Lastly, you can also either pass-through the audio, untouched (including Dolby® AC3), or transcode among Mpeg1/Layer 2, MPEG2 AAC, and MPEG4 AAC audio formats.

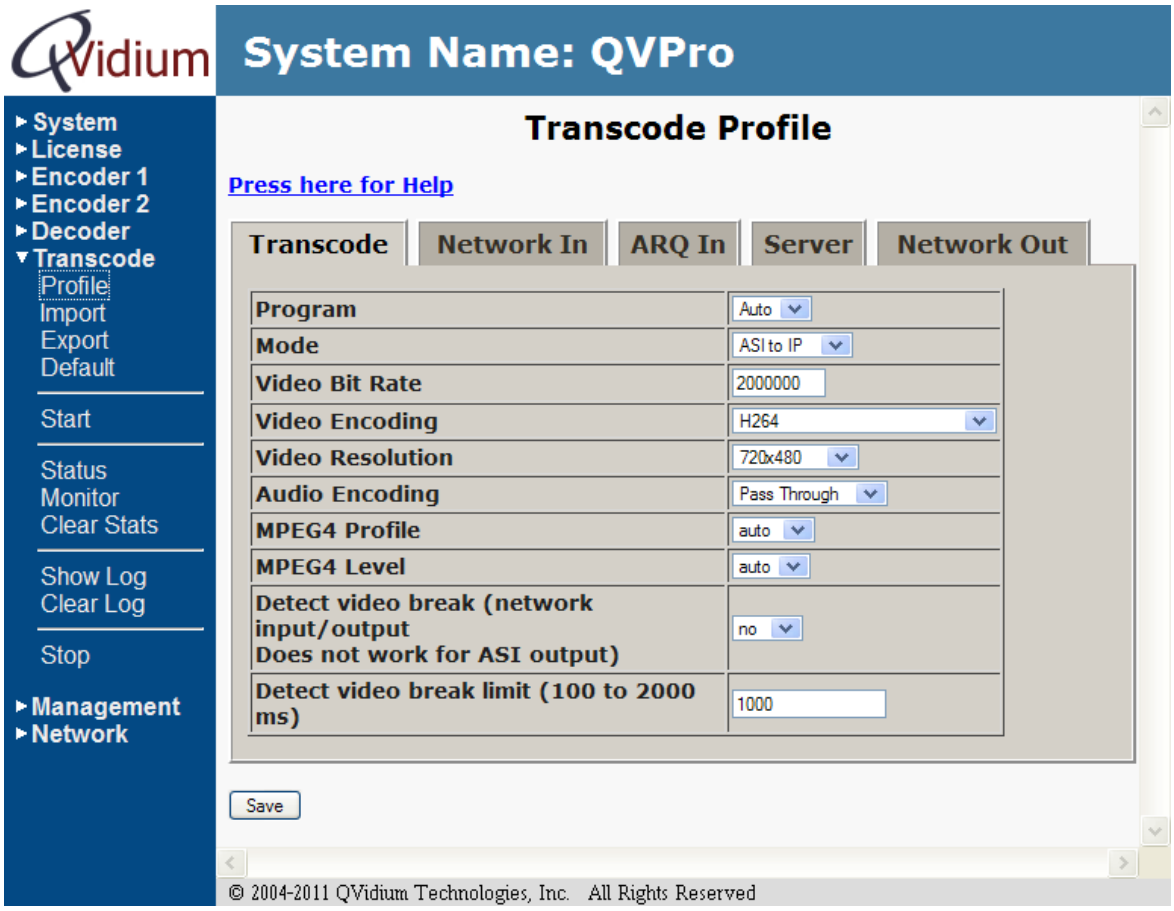


Figure 4a: Transcoder Profile: "Transcode Tab"

Since the transcoder mode acts as a combination of a decoder coupled directly into an encoder, you can configure most of the same parameters as with the decoder: network input parameters, ARQ parameters, and optionally start the transcoder in Server Mode – allowing the transcoder to initiate a stream from a remote source when you start the transcoder. All these three configuration panels, Network In, ARQ In, and Server, are nearly identical to their corresponding configuration panels in the Decoder configuration profile. Please refer to the Decode Section, above, and the Appendices, below, for more information regarding these settings. Similarly the Network Out configuration panel, shown below, is nearly identical to the Network configuration of the Encoder, so please consult the Encoder Section and Appendices for and explanation of these settings as well.

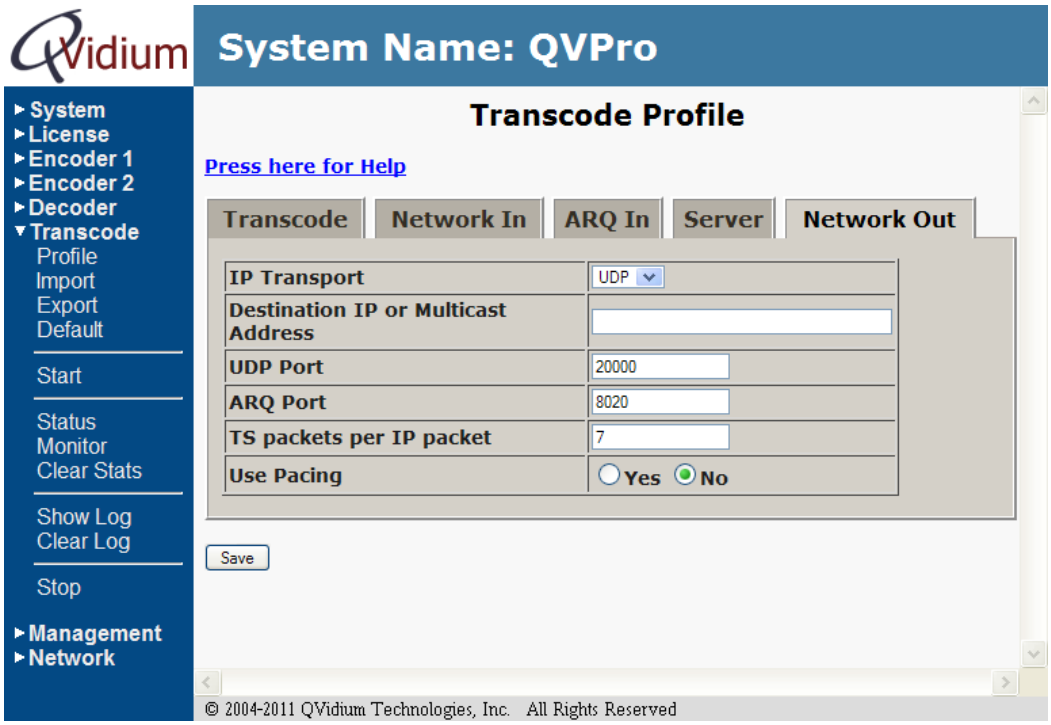


Figure 4b: Transcoder Profile: "Network Out Tab"

6 Importing, Exporting, & Resetting Profiles

Under the both the **Encoder**, **Decoder**, and **Transcoder** menus, you will find an **Import** menu item, an **Export** menu item, and a **Default** menu item. These operations provide a quick and easy means for transferring the configuration of one QVidium H.264 SD Video Codec™ to another H.264 SD Video Codec™ or for resetting the configuration settings to a known state. From the Web browser interface, clicking on **Export** opens a panel that allows you to specify the name of a file to store configuration information. To configure another codec with the same parameters, just point the browser to the second Codec that you want to configure. You can then click on **Import** to automatically configure that second codec, specifying the file you had just used to save the configuration of the first codec.

Default will reset the configuration settings for the **Encoder**, **Decoder**, or **Transcoder**, depending upon which **Default** menu you select, to their factory default settings. This will allow you to reset the configuration settings to a known good state. Clicking on **Default** will bring up a confirmation dialog box to prevent accidental resetting of the configuration. **Default** can be helpful if you have trouble getting the encoder to work properly or cannot remember the correct settings, you can click on **Default** to restore the encoder configuration with the factory default profile.

You may find it useful to use a USB flash memory stick to store these configuration profiles. All configurations a stored as Unix text files. If you have a text editor such as Notepad++, which has a Unix editing mode, you have the option of editing an encoder configuration profile manually. All parameters are stored in the form of multiple lines of Paramer=Value<LF>.

7 System Management

7.1 Access Configuration

The H.264 SD Video Codec™ includes a number of features to aid in system security and logging. A **Management Configuration** page, shown below, allows you to specify the HTTP port for web access and whether to enable or disable Telnet or SSH access. By default, Telnet and SSH access is enabled and allows you to log in as **root** using the password **root**.

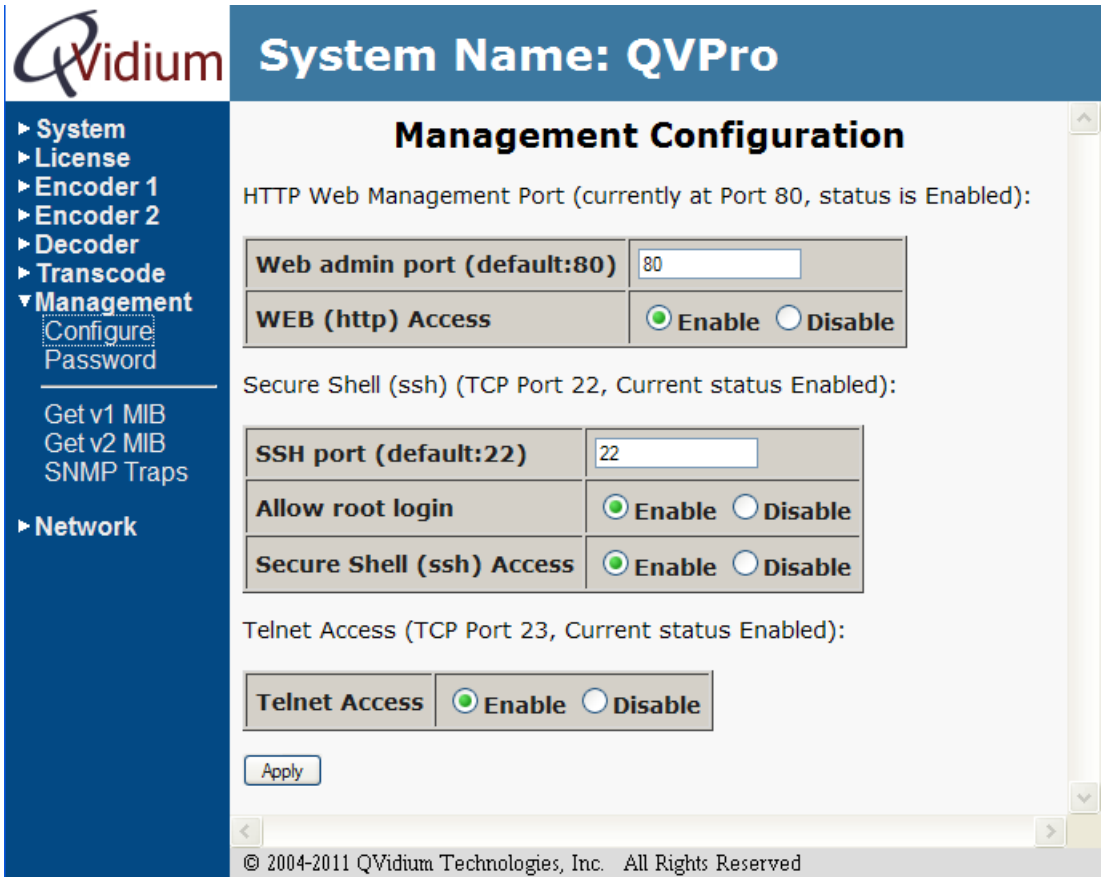


Figure 5: Management Configuration web page.

7.2 SNMP Trap Configuration

The H.264 SD Video Codec™ implements SNMP v1 and SNMP v2c traps to alert a network management system (NMS) of certain problems that might arise. To enable SNMP traps, you must enter the IP address of the NMS server where the SNMP trap messages should be sent and check **Yes** under **Send Traps**. Below is the SNMP Trap Configuration page that shows all the current trap configuration settings.

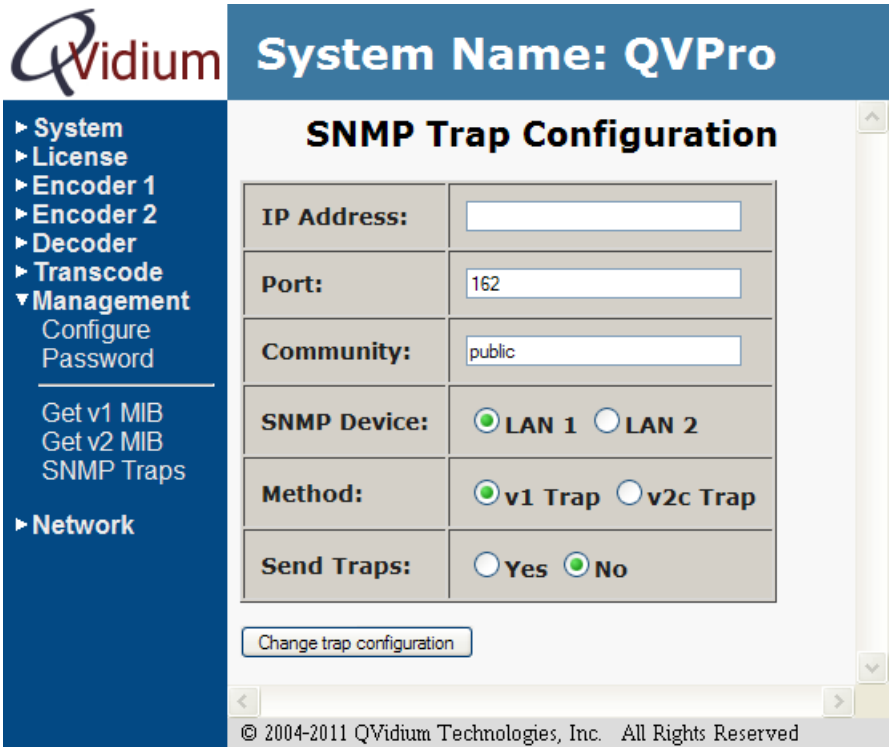


Figure 6: SNMP Trap Configuration.

For the encoder with traps enabled, an SNMP trap notification will be sent when the video input loses or has no signal. It will also send a trap when the video input has been restored.

For the decoder with traps enabled, an SNMP trap notification will be send under any of the following events:

- The decoder detects that the incoming video packet stream has lost a packet
- The network input has been disconnected or has no signal
- The network input connection has been restored
- A packet has not been recovered by the ARQ error correction (when ARQ is enabled)

For mode details, please see the MIB files.

8 Codec Manager & System Resets

8.1 Codec Manager

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 H.264 SD Video Codec™s and other QVidium equipment 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 Codec to launch a browser window to that Codec. In addition, CodecManager makes it simple to change the IP Address, launch a Telnet window, or edit other settings of any Codec it detects directly from the **CodecManager** application, even if several codecs are mis-configured with the same IP address. You can also instantly stop all codecs 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 Codec through the console.

8.2 Resetting the Network Parameters

If you cannot determine the IP address using **CodecManager**, you have two other alternative methods of resetting the IP address: either through the Console RS-232 port or with a USB flash memory stick.

Console Port Method: You can connect the Console serial port to log into the Linux shell and change the IP address or other settings. To reset the IP settings, connect a PC running a terminal emulator, such we Hyperterm or TeraTerm at 57,600 Baud (8-N-1, no flow control) and type "ifconfig eth0 <IP address>," where <IP address> is replaced by the desired IP address, for example, "ifconfig eth0 192.168.1.23".

USB Flash Stick Method: Go to http://www.qvidium.com/reset, copy the "autorun" file on a USB flash, and plug flash into QVSD. This will reset all IP network settings. (File must be "autorun" and not "autorun.txt".)

8.3 Resetting the Password

If you lose the root password and cannot gain access to your codec, there are two procedures for resetting the password. The simplest is to go to the QVidium web site at http://www.qvidium.com/reset, click on **Reset Password**, same the resulting "autorun" file to a USB flash stick, and simply insert that USB flash stick into the QVSD codec. The autorun program will automatically run, resetting the password to the default: **root**.

Alternatively, and to change the password for web access, you must first connect via the Console RS-232 serial port to a serial terminal or a PC running a serial terminal emulator, such as TeraTerm or Hyperterm. Use 115,200 Baud, and 8-bit data, No Parity, 1 Stop-bit (8-N-1) and no flow control. You may need to use a Null modem cable since the QVSD codec, like a PC, is a DCE (Data Communications Equipment). There is no login prompt. Once connected, you connect directly to a Borne shell.

Now that you have access the console, type "passwd" and follow the prompts to temporarily change the password. Next, please type "rm /flash/qvidium/httpd.conf" to remove the password from the web server configuration. You can then type "/etc/init.d/rc.httpd restart" to restart the web server with this new password.

8.4 Re-installing the Application Software

If for some reason the QVSD codec becomes completely unresponsive, or you suspect that as a result of a failed update procedure the application memory had somehow become corrupted, you can completely reinstall the application software with the following procedure. The Linux Kernel is loaded into a separate area of memory and is unlikely to become corrupted, so if the system does not respond to this procedure, you may have a hardware problem and you should consult a QVidium technical expert.

Application Memory Reload Procedure:

1) Go to http://www.qvidium.com/QVSD and download and save the **QVSD-XX.pkg** file to a USB flash stick. This file is about 9 Mbytes. (XX is the version number of the application software.)
2) Go to http://www.qvidium.com/reset, click on **Reset Software**, and download and save the resulting "**autorun**" file to the same USB flash stick.
3) Insert the flash stick and wait about one minute. Then power cycle the codec.

9 Encoding & Decoding to/from Files

The QVSD codec has both USB and eSATA (external SATA) interfaces that allow you to connect a USB Flash stick or an external disk drive or other external memory device to the codec. You can encode a video stream directly to a file on this storage device, and you can also play back a saved file from this external storage device. To access external storage, you must connect to a command-line interface in one of 3 ways: 1) through the RS-232 Console port (57.6 KBaud, 8-N-1, No Flow Control, Null Modem cable), 2) Telnet (port 23), or 3) SSH (port 22). For `telnet` or `ssh`, log in using username `root`. The initial password is `root`, but you can change this from the web GUI using the System/Password menu.

9.1 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. (Note: the eSATA does not currently automount when you attach an external storage device. So unless you are familiar with mounting filesystems in Linux, we suggest that you use an external storage device with a USB interface instead.)

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.

9.2 Encoding to a File

You will be using the application "`qvplayer`" located in the `/qvidium` directory to operate the codec from the command-line interface. To get the full set of options to `qvplayer`, run it as follows:

```
/qvidium/qvplayer –h
```

We suggest that you first `cd` to the mount external storage directory and then run `qvplayer`. To encode to a file, run the following command:

```
/qvidium/qvplayer –I <input source> –O file –o <output file name>
```

The input source can be "composite" or "svideo". The encoder automatically detects the input video resolution, whether it is PAL, SDECAM, or NTSC video. For example, to encode a `composite` input to an MPEG2-TS output file called "test.ts" type:

```
/qvidium/qvplayer -I composite -O file -o test.ts
```

The output video can be saved either as an MPEG-2 Transport Stream (TS), which is the default, or as an MP4 (Apple Quicktime®) output format. For MP4 format, add an '–m mp4' option to the example above. Simply leaving off the –m parameter will use the default MPEG-2 TS format. This command example uses the default parameters of 8Mb/s for the H264 video bitrate and 128Mb/sec for the audio bitrate, encoding the audio using MPEG4 AAC with a 48KHz audio sampling rate. To encode using a different video bitrate or to set other encoding parameters, use the –h option as described above to first find the options you are interested in, and then add them to the command line using the above command line as an example to start with.

By default, starting `qvplayer` from the command line runs it in the foreground. From this foreground mode, you can interactively set certain parameters, such as changing the video encoding bitrate. Typing `help` gives you a list of the interactive commands. Type `quit` to stop the encoding.

9.3 Playing Video From a File

To decode and play out a stored file, `cd` to the external media directory (such as `cd /media/sda1`) and type:

```
/qvidium/qvplayer –I file –O video –f <filename>
```

Where <filename> is the file name referenced to the current directory. For example, if the file on a USB Flash stick is called test.mp4, then use `test.mp4` as the filename:

```
/qvidium/qvplayer –I file –O video –f test.ts
```

The decoder knows to automatically set the format type, the resolution, the bitrate, and all other relevant encoding parameters.

10 Known Problems

The following problems are currently known to exist:

Encoder:

1. Only outputs VBR (variable bit rate). CBR (constant bit rate is not yet implemented).
2. Closed Captioning (CC) is only partially implemented for SD MPEG2 video.
3. Setting the number of Audio Channels to 1 may cause the encoder to unexpectedly halt.
4. DVB-ASI output is not yet implemented.
5. Dolby AC3 encoding only available upon special request.
6. Encoding an SD video input may unexpectedly stop (and be restarted if error handling is set).
7. The output bitrate may exceed the selected VBR peak bitrate.

Decoder:

1. Dolby AC3 decoding only available upon special request.
2. Closed Captioning is not yet supported.
3. ASI input is not yet implemented.
4. Interlaced output resolutions are not currently working properly.

Transcoding:

1. ASI interfaces are not currently implemented.
2. Transcoding is limited to the first 2 audio channels, others are discarded.
3. Closed Captioning and Tele-text are not currently supported. (However, subtitle pass-through is supported for IP output.)

Note: You can simultaneously run the encoder and decoder for full-duplex operation when encoding and decoding SD video and when the encoder ARQ buffers are set to 1024. However, you may have to restart the decoder if you restart the encoder.

Warning: Running more than two of any of these operations at the same time may not work or may require restarting of one of the previously started functions. QVidium does NOT warrant operation when starting more than two of the 3 modes of operation - encoding, decoding, and transcoding at the same time, or running multiple operations when there could be a conflict in resources.

11 Troubleshooting & Support

The H.264 SD Video Codec™ includes a number of features to aid in system security and logging.

11.1 Troubleshooting – Common Problems

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 Codec is online. You can download **CodecManager** from QVidium's Download page (http://www.qvidium.com/), click on **Downloads**, and scroll down to the **QVidium Codec Management Software** section. Download and install the file: QVidiumCodecManager-X.msi (X is the current version number). If that fails to locate your Codec, 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 QVSD Codec must pass Ethernet Broadcast packets. (If not, then you can try using a cross-over Ethernet cable and connecting the QVSD codec directly to the PC. If **CodecManager** still does not appear to find the QVSD-Codec, 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 QVSD codec 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 codec. 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 QVSD. It will then reset all the network settings back to the defaults (192.168.1.23).

Cannot get encoder to send IP packets

1. Check that a valid video signal is connected to the video **Input** you have configured. Use the Encoder/Profile page to select among Composite or S-Video inputs. The video input

will auto-sense and select among NTSC, PAL, and SECAM signals. Make certain that you **Saved** the profile and **afterwards** hit the **Start** menu item.

2. Make certain that device is powered on and connected to your network.
3. Check that green LAN light in front is lit and link light at RJ-45 port is on.
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 system clicking on Network/Ping and entering the IP address for the decoder device.

Encoder does not start or is not outputting any packets

1. Check the **Encoder/Status** page to see whether the bitrate is non-zero
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 that you have a valid video signal on the selected input (Composite or S-Video). The Video Lock indicator on the front should glow green when it detects a valid video input.

Cannot get decoder to display video

1. Use network monitor software on look for blinking link lights to be certain that the encoder is sending packets to your decoder. If not, follow the steps for "Cannot get encoder to send IP packets". .
2. Make certain that device is powered on and connected to your network.
3. Check that green LAN light in front is lit and link light at RJ-45 port is on.
4. Try pinging the encoder by entering the IP address for the source device. For a H.264 SD Video Codec™, try clicking on "Network/Ping".
5. Make certain that both encoder and decoder are set to the same transport type (ARQ, RTP, or UDP). For a Set-Top Box, such as an Amino, make certain that the encoder is set to Transport & UDP.

Color loss on decoded video

a. Network losses or other interruptions that can cause breaks in the input video stream may cause the decoder to lose sync and get into a state where it cannot decode color, resulting in a complete loss of color on the decoded video output.

b. To help increase the tolerance of the decoder to these issues, try increasing the Video Buffer Size to a minimum of 500 ms, or increasing it up to 1000 ms.

c. Enable "Detect Video Break" so that the decoder will restart when it detects a break in the packet stream to help prevent the decoder from getting into a bad state.

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 v2 and that it is enabled.

11.2 Support

We have set up a special support page for our QVSD line of products at: http://www.qvidium.com/QVSD. Please take advantage of this web page for the latest firmware and application software updates, the latest Changes document that describes any changes and new features, and for other tips and pointers for optimal use of your new codec.

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 3G networking applications, because of the inherent low bitrate constraints, bit rate and link variability, and complexities of found in Broadband Wireless 3G networks, we cannot directly provide support for applications over Broadband Wireless 3G 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.

12 Appendices

12.1 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 SD Video Codec™ 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. The valid selectable audio sampling clock rates are 32 KHz, 44.1 KHz, and 48 KHz.*

SDI formatting requires that the audio sampling rate be fixed at 48 KHz, so if sending to another codec with SDI output, please use 48 KHz sample rate.

Video Frame Rate (Full Frame Rate and fractions thereof): *Select Full Frame Rate for normal video. This will encode the video signal at 29.97 frames per second for NTSC and*

25 fps for PAL video format. If you need to produce lower video bitrates, and reducing the resolution is not sufficient or undesired, you can use this feature to sacrifice frame rate for lower bitrates.

Video Encoding: *The H.264 SD Video Codec™ digitizes and converts an analog video input signal according to the ITU-R.BT-656 standard, performs a 4:2:2 to 4:2:0 conversion and compresses the digitized video using either the MPEG-2 video encoding standard (MP@ML, ISO/IEC-13818-2) or MPEG4-AVC (H.264) high profile compression, depending upon your selection.*

We suggest that you select H.264 compression. The QVSD codec incorporates High Profile, Level 4.0 to 4.1 MPEG4-AVC (part 10) video encoding. This nearly always produces better video than MPEG-2 video encoding. However, we provide the option to select MPEG-2 video encoding for backward compatibility with other devices.

Video Format: *The QVSD Codec automatically senses and selects the correct video input format (NTSC or PAL along with the correct resolution). NTSC captures interlaced video at 29.97 frames per second, while PAL captures interlaced video at 25 frames per second. Thus, Video Format is not listed in the user interface.*

(SD Only) Video Resolution (NTSC and PAL): *The video resolution for Standard Definition video (D-1 resolution) is 720x480 pixels for NTSC resolution (480i) and 720x576 pixels for PAL video format (576i). This is the resolution commonly used for DVDs and Standard Definition broadcasting. When you need to encode the video at lower bitrates, the H.264 SD Video Codec™ allows you to select lower CIF resolution (352x240 for NTSC and 352x288 for PAL).*

Video Aspect Ratio (4:3 or 16:9): *Standard Definition NTSC video has a 4:3 aspect ratio. This is the default setting. However, many new HD Camcorders and video mixing equipment can output a 16:9 SD video feed by squeezing the image to a 4:3 aspect ratio before outputting. Setting the Aspect Ratio to 16:9 in the encoder sets bits in the MPEG elementary stream that tell an MPEG decoder to stretch the incoming video stream back to a 16:9 aspect ratio. This option does not actually change the encoding resolution. Rather, it only tells the decoder to stretch the output video to match the original 16:9 aspect ratio.*

Video Input: *This allows you to select between Composite and S-Video video inputs.*

Closed Captioning / TeleText: *This switch enables the encoder to capture and pass through VBI Close Captioning or TeleText (depending upon whether it senses NTSC or PAL video input, respectively). This feature is not yet supported, but planned for a future firmware release.*

Low Delay: *This mode minimizes internal buffering to reduce the end-to-end delay (encoder to decoder) to less than 300 ms. (To be supported in a future firmware release.)*

Video Filtering: *You can select this feature to add a special filter to the input video that helps reduce noise and thereby improve compression efficiency as well as clean up the picture.*

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 codec 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.*

12.2 Appendix B: Decoder Configuration Parameters

This section explains the parameters related to the setup and operation of the MPEG Decoder, the error correction algorithms, and network transport configuration.

Network Parameters

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

IP Transport: *This selects the type of video IP packet decapsulation and error correction expected by the codec in receiving a Video/IP stream. All packetized video transport mechanisms expect to receive a multiplexed constant or variable bit rate MPEG-2 transport stream to decapsulate and decode.*

- *ARQ uses QVidium's patented error correction mechanism for lost packet recovery. ARQ encapsulates the video stream as a standard MPEG-2 Transport Stream as the payload of UDP packets with an RTP packet header as per RFC2733. It relies upon an upstream channel on UDP port 7020.*
- *RTP mode decapsulates the MPEG-2 multiplexed data according to RFC2733. It will process the data through the de-jitter buffer (if set to a non-zero value) and the reorder buffer (also if set to a non-zero value), but will not send out ARQ retransmission requests. Because RTP headers include a timestamp and sequence numbing, RTP protocol has the advantage of providing lost packet and other network statistics.*
- *UDP mode disables all error correction. It expects raw UDP packets without an RTP header, and expects to receive an MPEG-2 transport stream directly from the UDP payload. Use this setting for interoperability with some Set-Top Boxes.*

Multicast Address: *This specifies the IP multicast address, if any, to listen to for the Video/IP stream.* ***For receiving a unicast video/IP stream, leave this field blank.***

UDP Port: *This specifies which UDP port number (P), base 10, to listen on for the Video/IP stream. Be certain to open also your firewall to port P+2 and P+4 for ProMPEG FEC. (P+2 for column parity and P+4 for row parity packets.)*

Jitter Buffer: *The IP packets of incoming video streams may lose their ordering or suffer variable delays during transport through an IP network. If the value of the Jitter Buffer is non-zero, the QVidium QVSD H.264IP Codec will process all incoming video/IP packets through a time-based buffer that removes variations in packet arrival times, also known as packet jitter, and reorders RTP encapsulated packets by their RTP sequence number. The Jitter Buffer parameter specifies the size of this incoming packet buffer in milliseconds of delay, and holds incoming packets for this amount of time before releasing them. You can specify zero (0) here to disable this additional buffering when latency needs to be minimized. This buffer can only exist in ARQ and RTP modes.*

Video Buffer Size: *This value, specified in milliseconds, adjusts a buffer in the video decoder that helps prevent the decoder from running out of data and losing sync due to*

jitter or variability in the delivery of data to the decoder. If you notice audio clicks or pauses, or if the decoded video occasionally freezes or loses lip-sync, especially over long network distances, increasing this value may help. The default value should be 300ms, but for operation over a WAN, we would suggest increasing this value to 500ms or larger. Increasing this value will increase overall latency, so you should minimize this value to minimize latency.

Out-of-Order buffer: *When in ARQ mode, the decoder includes an optional additional buffer, in addition to the Jitter Buffer, that reorders incoming packets in case the network is causing some of the packets in the incoming video stream to arrive out of order. This buffer will re-order any packets within it to be output in the order of the RTP sequence number. To enable this feature, you must specify a buffer size in terms of the number of packets this buffer must hold until any packets are output to the decoder. This feature is most useful if you choose to use Network Bonding on the decoder which causes the outgoing video stream to be interleaved between the two Ethernet ports. In this case, varying network delays may cause packets to arrive out of sequence, which this feature helps to fix.*

Detect video break: *This feature only works for Network input. It monitors the PCR timestamps in the incoming MPEG2 Transport Stream for discontinuities and unexpected values and then automatically restarts the decoder when it detects a problem.*

Detect video break limit: *This parameter lets you set the minimum discontinuity time-out of between 100ms and 2000ms (2 seconds). If the decoder detects a break in the incoming IP stream larger than this value, then it will restart the decoder to prevent the decoder from getting into a bad state.*

ARQ Parameters

The parameters below ONLY pertain to QVidium ARQ error correction. They will be ignored unless ARQ is selected for IP Transport.

Mode: `Auto` *or* `Manual`. *In "*`Auto`*" mode, immediately after clicking on* `Start`*, the decoder sends out a series of packets upstream to the encoder to measure the round-trip time and automatically set the number of retries and round-trip time parameters based on the* `Target Latency` *parameter. The results of these measurements can be seen in the decoder's log file by clicking on* `Show Log` *and scrolling towards the bottom of the log file. Clicking on Status will show the resulting value of these parameter based on the measurements seen in the log file.*

In "`Manual`*" mode, the codec uses the* `Number Retries` *and* `Round Trip Time` *parameters to create an ARQ buffer with the ARQ delay =* `Number Retries * Round Trip Time`*. In Manual mode, the decoder's ARQ mechanism ignores the Target Latency parameter and does not take any upstream link measurements.*

Target Latency: *QVidium's ARQ error correction operates through the addition of a small additional buffering delay to provide enough time to request and receive replacement for each lost packet. Target Latency gives the ARQ mechanism a target value*

for determining the necessary ARQ delay. The ARQ divides the Target Latency, specified in milliseconds, by the round-trip time to the video encoding source to determine the number of request attempts. Unless Robust Mode is enabled, it sets a minimum ARQ latency of one round-trip time. A larger Target Latency allows the system to increase the number or repeat requests, although the system will limit the maximum number of retries to a maximum of 5, even if the Target Latency value would have otherwise allowed more retries. Thus depending upon the Round-Trip time, the maximum delay may end up being less than the specified Target Latency value.

Max Burst Drop: *Burst packet losses are common occurrences in many IP networks and the Internet. IP networks may dynamically change paths in response to load balancing, link failure avoidance, and for other reasons. During a re-route, a sequence of queued packets on a discontinued path may be dropped. A burst of packets may be dropped when higher priority packets stall a lower priority buffer. ARQ will notice a burst packet loss when the first packet after the loss arrives at the codec. Setting the Max Burst Drop Delay (in milliseconds) will delay the ARQ repeat request by this amount to handle packet burst losses.*

Robust Mode: *Normally, the ARQ will only require that a minimum of one repeat request is sent to the video encoding source device, regardless of the Target Latency. However, enabling Robust Mode will increase the minimum number of repeat requests to a minimum of two retries.*

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.*

Server

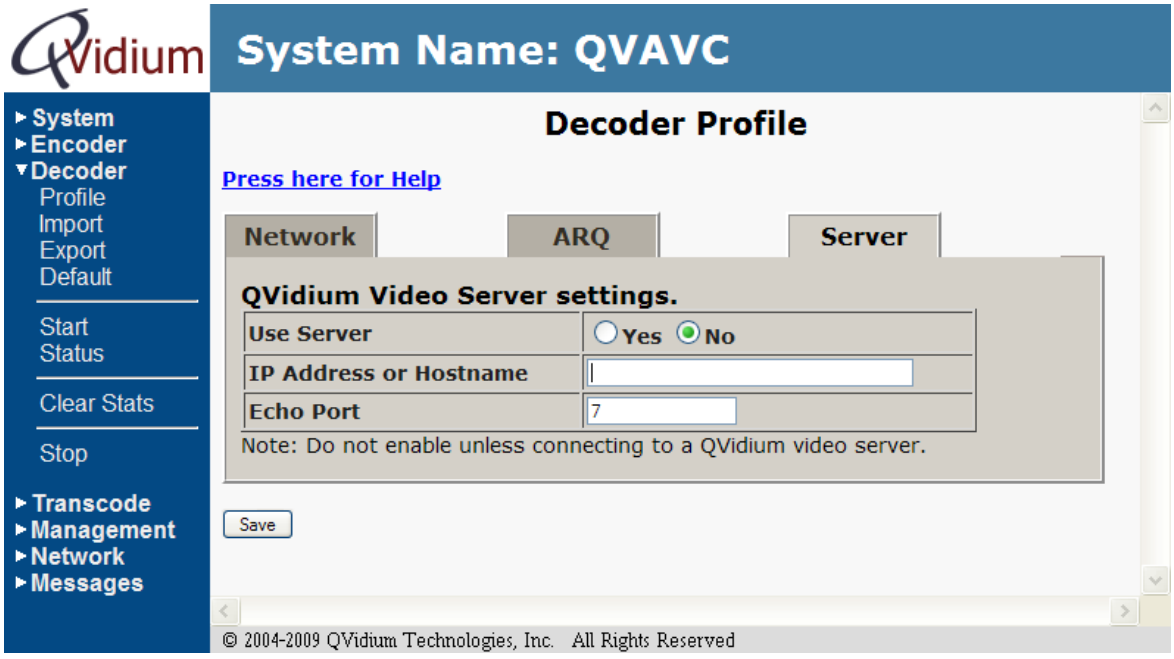
The parameters below ONLY pertain to the operation of the QVidium H.264 SD Video Codec™ with a QVidium QoS Proxy Server. Leave this disabled when not connecting to a QoS Proxy Server.

This feature allows the decoder to initiate and receive a unicast stream from a QoS Proxy Server. You must provide the IP address and control port for the QoS Proxy Server. The decoder then sends a control packet upstream to the server when you start the decoder.

Use Server: *Select No to disable this feature. Select Yes to enable operation with a QoS Proxy Server.*

IP Address or Hostname: *Enter the IP address of the QoS Proxy Server to which the decoder will send a start-stream message.*

Echo Port: *Normally, this should be left to the default UDP port 7. This port number must match the value at the QoS Proxy Server. In addition, you may need to configure a firewall at the server to allow ingress for packets on this port.*



12.3 Appendix C: H.264 SD Video Codec™ Bitrate Limits

Encode Bitrate Limits

The video encoding bit rate limits specified below are subjective suggestions based on limited empirical testing. The QVSD codec will allow you to enter any video encoding bitrate and will attempt to produce the best video quality it can, based on the video bit rate you set as an upper limit on the average peak bitrate. (Unless noted otherwise, all bitrates below assume full NTSC (29.97 fps) or PAL frame rates (25 fps).)

Therefore, the values here are only provided as a general guideline to help with estimating the expected network loading:

Maximum Video Encoding Bit Rates:

- 25 Mbps for UDP or RTP transport (error correction disabled)
- 15 Mbps with ARQ error correction enabled

Minimum Suggested Bit Rates for general content, such as movies:

MPEG-2 (Main Profile):

- 2.0 Mbps for Full video resolution (720x480)
- 500 Kbps for CIF video resolution (352x240)
- 250 Kbps for CIF video resolution at Half Frame Rate

H.264 (MPEG4-AVC High Profile):

- 4.8 Mbps for 1080i video resolution
- 2.4 Mbps for 720p video resolution
- 1.0 Mbps for Full SD video resolution (720x480)
- 250 Kbps for CIF video resolution (352x240)
- 125 Kbps for CIF video resolution at Half Frame Rate

Note: Video quality is content dependent and the minimum bitrates suggested above may not produce acceptable video for any given application. As a general rule we suggest that you use H.264 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-2 Transport Stream video from the network:

Maximum MPEG-2 TS bitrates (MPEG-2 or H.264):

15 Mbps for UDP and RTP input transport
4.5 Mbps for ARQ

Minimum MPEG-2 TS bitrates (MPEG-2 or H.264):

1 Mbps *(Lower input bitrates can produce decoder instability.)*

12.4 Appendix D: 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 tab:**
Video Bit Rate: 200000	Low Delay: Yes
Video Encoding: H264	Video Filtering: On
Audio Bit Rate: 64000	Video Frame Rate: Half
Audio Encoding: MPEG1/Layer2	Video Resolution: CIF
Audio Sampling Rate: 32000	

12.5 Appendix E: Technical Specifications

Specifications

Network Interface:
- 2 IEEE 802.3 1000/100/10 Base-TX Gigabit Ethernet (RJ-45)

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

Network Protocols:
- IP Encapsulation: RTP/UDP/IP and UDP/IP
- IETF DiffServ and IEEE TOS compliance
- IGMP v.2 Multicast, SNMP v.2 traps
- RTSP
- DHCP

Audio/Video Interfaces:
- 1 Composite video input (BNC connector)
- 1 S-Video video input (BNC connector)
- 1 Composite video output (BNC connector)
- 2 Mini-phono stereo audio connectors for 4 channels of audio input
- 2 Mini-phono stereo audio connectors for 4 channels of audio output

Transport Stream Bitrate (Audio & Video):
- 160 Kbps to 19.0 Mbps (encode or transcode)

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: 32 KHz, 44.1 KHz, and 48 KHz

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
- SD Input: 720x480 @ 60 fps interlaced (NTSC) and 720x576 @ 50 fps interlaced (PAL and SECAM)
- NTSC: 720x480, 352x240 (SIF resolution)
- PAL: 720x576, 352x288 (CIF resolution)
- Multiplexing Format: MPEG-2 Transport Stream & MP4. (MP4 for files only – not for live streaming)
- Encode & Decode Line 21 Closed Captioning (EIA 608 and EIA 708) – Planned future option
- Video Up/Down Scaling for encoding, decoding, and transcoding

Serial Interfaces:
- 1 DB-9 RS-232 Console Interface
- 1 DB-9 RS-232 with VISCA PTZ support and for future expansion
- 2 USB 2.0 Ports for video storage (and plans for LCD Keypoard/console)

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

Electrical:
- DC Power Input: 7 VDC @ 3 A max, to 20 VDC @ 1 A max
- Input Power: 18W
- DC Connector: 2.5mm I.D. x 5.5mm O.D. x 9.5mm Female

Mechanical:
- Dimensions: 4.84"(W) x 7.20" (D) x 1.30" (H)
- Dimensions (mm): 123 (W) x 183 (D) x 33 (H)
- Unit Weight: 1.65 lbs (750g)

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

12.6 Appendix F: 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.

12.7 Appendix G: **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 is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.