User Instructions
Ultra-Compact H.264 Media Encoder and Streamer
Model Name: Z3Stream-01

Software Version 2.44a

DOC-USR-0090-05

Before attempting to connect or operate this product, please read these instructions carefully and save this manual for future use.

REVISION HISTORY

Version	Date	Change Note	Author
01	04/11/2016	Original Z3Stream-01 Document	TA
02	06/16/2016	Updated Hardware Warranty Information. Minor grammar and formatting updates.	TA
03	08/10/2016	Added additional information regarding RTP streaming. Updated Troubleshooting section. Updated website in page footer. Minor formatting updates.	TA
04	03/02/2017	Updated per software v2.40b. Updated Section 2.0 Features. Updated Section 7.3 to include YouTube Live. Added Section 8.6 Upgrade Firmware. Formatting updates.	TA
05	03/13/2017	Updated per software v2.45. Updated Section 2.0 Features. Updated Section 7.3 to include Facebook Live.	TA

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1.0 GENERAL DESCRIPTION

The **Z3**Stream encoder is a compact 98 x 81 x 21 mm (3.88 x 3.19 x 0.81 in) system that allows encode of video at SD and HD resolutions up to 1080p60 through an HDMI input and encode of SD video through a composite input. It also allows users to quickly stream video from either of those sources to the web or internal clients/PCs via UDP, RTP, TSRTP, or RTMP.

The compactness, ease-of-use, and performance of this system makes it ideal for live event streaming, corporate meetings and conferences, houses of worship, and remote location encoding.

Figure 1 Z3Stream-01 Encoder Dimensions

2.0 FEATURES

- HD resolutions up to 1920x1080 including 1080i, 1080p60 and 720p
- Standard Definition encoding for ISDB-T, DVB-H, and other standards
- Video Inputs: HDMI, Composite
- Outputs RTP, RTMP or MPEG-2 Transport Stream (UDP)
- On-board video scaler provides full screen resizing with all resolutions
- DHCP (Dynamic Host Configuration Protocol) and DNS support
- Limited RTSP support
- HTTP-based configuration software for user-friendly configuration and control
- Operating Temp: 0 to 50 degrees C at 20-80% relative humidity (non-condensing)
- Storage Temp: -40 to 70 degrees C at 20-80% relative humidity (non-condensing)
- Measurements: 98 x 81 x 21 mm (3.88 x 3.19 x 0.81 in)
- Weight: 221 g (0.49 lb)

2.1 Compatibility

Compatible with CDN's and social media streaming including:

- Facebook Live
- Wowza Streaming Engine™
- YouTube Live

2.2 Supported Input Resolutions

1080p60, 1080p50, 1080i30, 1080i29.97, 1080i25, 720p60, 720p59.94, 720p50, 576p50, 576i25, 480p60, 480i30, 480i29.97, and CIF (352x240)

3.0 PACKAGE CONTENTS

Z3Stream Encoder

HDMI Cable

Ethernet Cable

5V Power Supply

Composite Adapter Cable

Figure 2 Z3Stream Package Contents

4.0 OPERATING CONTROLS

1: USB 2.0[1]
2: RS-232 Serial Port[2]
3: Status Lights[3]
4: Power Switch
5: 5V Power
6: Composite Input
7: HDMI Output[4]
8: GigE
9: HDMI Input[5]

Figure 3 Rear and Front Views

1 Not currently supported by Z3Stream.

[2] For advanced debugging purposes only. Not needed by typical users.

[3] The status lights will blink depending upon the source that is being encoded: HDMI or Composite (CVBS).

[4] Pass through output only.

[5] Non-HDCP HDMI content only. For example, a Blu-Ray player cannot be used as a video source.

5.0 GETTING STARTED WITH Z3STREAM

This section gives step-by-step instructions on using your PC to access the **Z3Stream** user interface. Here you'll be able to change the settings to fit your encoding needs. In addition to the **Z3Stream** encoder, a Windows PC, a 5V power supply and an Ethernet cable are required.

5.1 Connect and Power Up the Encoder

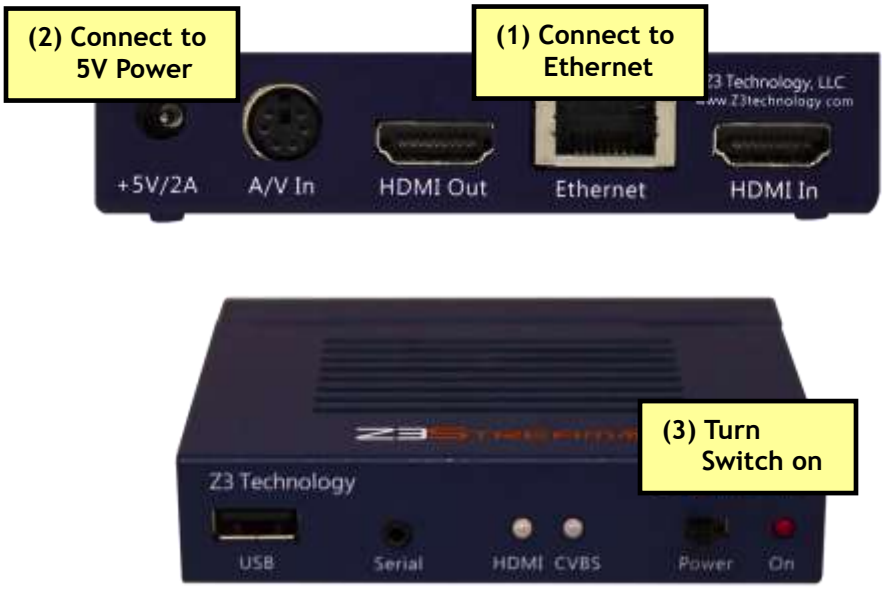


Figure 4 Power up Connections for the Encoder

(1) Connect an Ethernet cable directly from your PC to **Ethernet** on the back of the encoder. Your encoder may also be connected through a hub or router on the same network as a PC. For your initial set up, we recommend a direct Ethernet connection to a DHCP[6] enabled PC.

(2) Connect the 5V power supply to **+5V/2A** on the encoder and plug into a power outlet.

(3) Turn on the **Power** switch. It will take 45-60 seconds to boot.

[6] Dynamic Host Configuration Protocol. This enables the PC to dynamically receive an IP address at startup and allows your PC to correctly communicate with a Z3Stream-01 with default manufacturing settings.

5.2 Find the Encoder on the Network Using ZFinder

ZFinder is a PC utility that allows you to find any Z3 Technology product on your network. If you have not yet downloaded this to your computer, you can find it at Z3Stream.com.

(4) Verify your PC is set to DHCP. If it is set to a static IP address and is directly connected, ZFinder will be unable to discover your encoder.

(5) Run the ZFinder PC utility on your PC. You may need to allow it past any firewalls or security programs on your PC. The ZFinder window appears and completes a scan of the network. ZFinder then lists all Z3 systems connected to the network. The **Z3Stream** encoder appears.

(6) Click on the **Z3Stream** entry in the window to select it. This will cause the **Edit Device** and **Open Device** buttons to activate.

Figure 5 ZFinder with Z3Stream Selected

Note: *Selecting* **Edit Device** *allows for manual changes to network settings. Selecting* **Flash LEDs** *in ZFinder is not applicable to the Z3Stream encoder. See Section 9.6, ZFinder, for more information.*

(7) Click on **Open Device**. An internet browser window is opened in your default web browser and the user interface appears with the Encoder tab open.

Figure 6 Z3Stream User Interface – Encoder Tab

(8) By default, the system will have automatically started encoding. If the encoder status message in the bottom right corner of the screen shows **RUNNING**, you will need to click the red **Stop** button in order to change any settings.

6.0 CONFIGURING ENCODE

This section gives step-by-step instructions on setting up the **Z3Stream** encoder to encode video from an HDMI or composite video source. In addition to the **Z3Stream**, a TV or other monitor and a non-HDCP video source with HDMI output or a video source with a composite output are required as well as the appropriate cables. Your encoder should already be connected to your PC with the user interface open per Section 5.0, GETTING STARTED WITH Z3STREAM.

6.1 HDMI Encoder Setup

(1) Select a video source with non-HDCP[7] HDMI output.

(2) Verify your source works as expected:

a. Power on the video source.

b. Connect an HDMI cable from the source output to your TV or monitor.

c. Change your source settings so that its output is at your desired resolution. In the following example, we are using 1080p60 resolution.

d. If you are using a video player, select the content you would like to stream.

e. If you see playback on the monitor, you've confirmed the source works.

(3) Connect the HDMI cable from the video source to **HDMI In** on the encoder.

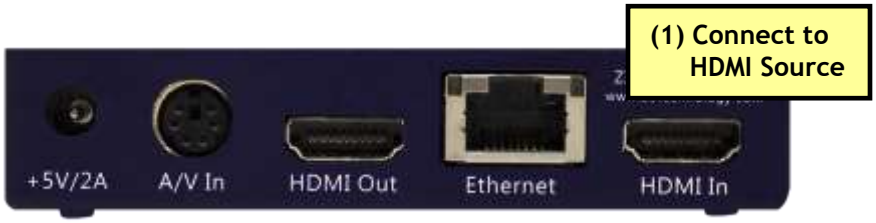


Figure 7 HDMI Connection for Encoding

(4) In the user interface Encoder tab, verify the **Video Source** is set to **HDMI**.

Note: *Settings in the user interface cannot be changed if the unit is currently encoding. When the unit is encoding the status light that corresponds to the source video should be blinking green. If it is blinking red when encoding HDMI, verify that your cable is connected to* **HDMI In** *and not* **HDMI Out**.

[7] HDCP stands for High-Bandwidth Digital Content Protection. Only non-HDCP HDMI video is supported. For example, using a DVD player as a video source is not supported.

(5) Change **Encode Quality** to match your video source output resolution. In this example, select **Full HD**[8]. See **Table 1** for a more information about each available option in the Encode Quality dropdown menu.

(6) Verify **Frame Rate** is set to **Full**.

(7) Verify **Audio Enable** is set to **True**.

(8) Next you will need to set your encoding output to your desired settings. See Section 7.0 for more information.

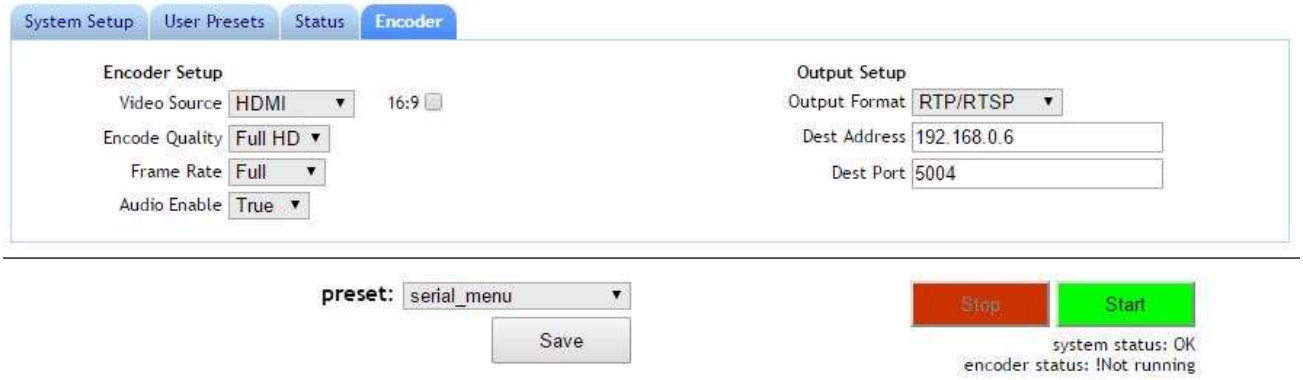


Figure 8 Encoder Tab Configuration - HDMI

	Resolution	H.264 Profile	Bframes	Bitrate		
				SD	HD	Full-HD
FullHD	Follow Input	Main	2	2.5 Mbps	5.1 Mbps	5.1 Mbps
HD	Follow Input	Main	2	2.0 Mbps	2.5 Mbps	3 Mbps
High	1280x720	Main	2	1.7 Mbps	-	-
Medium	720x480	Main	2	900 Kbps	-	-
Low	352x240 (CIF)	Main	2	500 Kbps	-	-
Mobile	352x240 (CIF)	Baseline	0	450 Kbps	-	-

Table 1 Encode Quality Options with Resolutions

Note: *For all options other than* **FullHD** *and* **HD**, *if the source resolution differs from the resolution listed in Table 1 above, resizing will occur.*

[8] When **Full HD** or **HD** are selected, the encoder will output the resolution of the detected video source resolution.

6.2 Composite Encoder Setup

(1) Select a video source with composite output.

(2) Verify your source works as expected:

a. Power on the video source.

b. Connect composite from the source output to a TV or monitor.

c. Change your source settings so that its output is at your desired resolution. In the following example, we are using 720x480 resolution.

d. If you are using a video player, select the content you would like to stream.

e. If you see playback on the monitor, you've confirmed the source works.

(3) Using the special composite adapter cable that came with your encoder (pictured below), connect the yellow/red/white cables to your composite source.

a. The yellow connector connects to the composite output.

b. The red and white connectors connect to the analog audio outputs.

Figure 9 Composite Adapter Cable

(4) Connect the special adapter end of the cable to **A/V In** on the encoder.

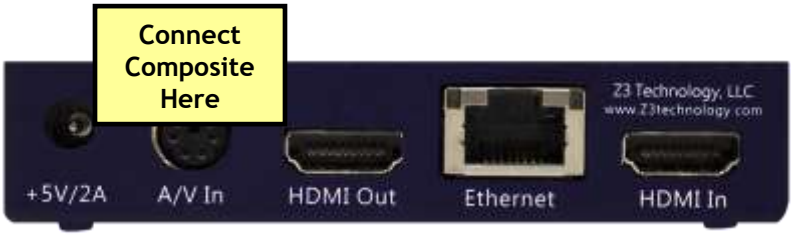


Figure 10 Composite Connection for Encoding

(5) In the user interface Encoder tab, change the **Video Source** to **Composite**.

Note: *Settings in the user interface cannot be changed if the unit is currently encoding.*

(6) Change **Encode Quality** to match your video source output resolution. In this example, we are using a 720x480 source and would select **Medium**. See **Table 1** for a more information about each available option in the Encode Quality dropdown menu.

(7) Verify **Frame Rate** is set to **Full**.

(8) Verify **Audio Enable** is set to **True**.

(9) Next you will need to set your encoding output to your desired settings. See Section 7.0 for more information.

Figure 11 Encoder Tab Configuration - Composite

7.0 SET ENCODING OUTPUT

This section gives step-by-step instructions on setting the **Z3Stream** encoder to output and stream video using each of the output format options: UDP, RTP/RTSP and RTMP. In addition to the **Z3Stream**, a Windows PC with the VLC media player[9] downloaded is required. Your encoder should be connected to a video source and configured accordingly per Section 6.0, CONFIGURING ENCODE.

7.1 Stream UDP

UDP (User Datagram Protocol) is a common Internet protocol used for low bandwidth and latency. UDP streams send an MPEG-2 TS stream over UDP.

7.1.1 UDP Encoder Setup

(1) Under Output Setup, Set **Output Format** to **UDP**.

(2) Set **Dest Address** to:

a. the IP address of your PC that will be running the VLC media player. To determine the correct IP address of your PC, see APPENDIX B: Finding the IP Address of Your Computer. In the example pictured, 169.254.208.180 is used.

b. or to a multicast address. An example multicast address would be 225.1.2.3. If you are on a shared network, check with your Network Administrator.

(3) Make note of the value listed for **Dest Port**. This will be **5004** by default when your system is first received.

(4) Click on the green **Start** button. After a moment, the encoder status will change to **RUNNING** and the fields above will appear in dark grey.

Note: *Settings in the user interface cannot be changed if the unit is currently encoding. When the unit is encoding the status light that corresponds to the source video should be blinking green. If it is blinking red when encoding HDMI, verify that your cable is connected to* **HDMI In** *and not* **HDMI Out**.

[9] VLC is an open source media player from the VideoLAN organization that can be downloaded for free online.

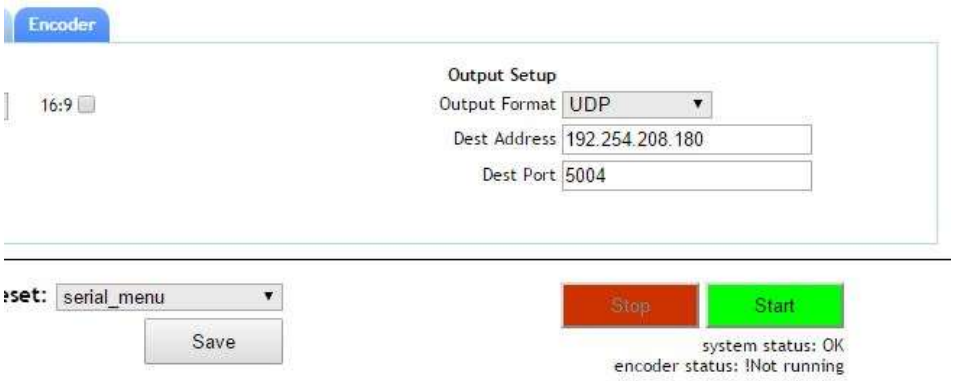


Figure 12 Encoder Tab Configuration - UDP

7.1.2 Run VLC to View UDP Stream

(5) Open the VLC media player on your PC (Version used by Z3: 2.1.5).

(6) Select the **Media** menu.

(7) Select **Open Network Stream**.

(8) Under the Network tab, enter "**udp://@Dest_Address:Dest_Port**" for the network URL.

a. **Dest_Address** will be values of the IP address or multicast address entered in the **Dest Address** field in the user interface Encoder tab. The IP address used in this example is 169.254.208.180.

b. **Dest_Port** will match the value found in the **Dest Port** field in the Encoder tab. The default value is 5004.

c. In this example, the full network URL would be "udp://@169.254.208.180:5004".

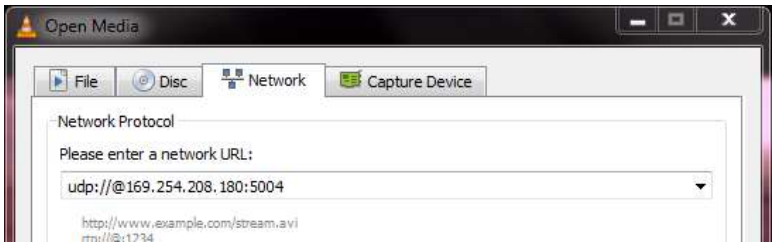


Figure 13 VLC Open Network Stream Screen - UDP

(10) Press **Enter** or click **Play**. You will see your source video streaming to VLC:

Figure 14 Example of Video Streaming to VLC - UDP

7.2 Stream RTP/RTSP

RTP (Real-Time Transport Protocol) is a common Internet protocol for streaming media. RTP has less IP overhead than UDP.

7.2.1 RTP/RTSP Encoder Setup

(1) Under Output Setup, select **RTP/RTSP** in the **Output Format** dropdown menu.

When RTP/RTSP is selected, the encoder will send an RTP stream using the Dest Address and Dest Port listed in the user interface. If RTSP will be used exclusively, the Dest Address field can be set to **127.0.0.1** to prevent the RTP stream from being sent.

Note: *As RTSP operates through port 554, it is advised never to set the* **Dest Port** *field to* **554** *when RTP/RTSP is selected.*

(2) Click on the **Start** button. After a moment, the encoder status will change to **RUNNING** and the fields above will appear in dark grey.

Figure 15 Encoder Tab Configuration – RTP/RTSP

Note: *Settings in the user interface cannot be changed if the unit is currently encoding. When the unit is encoding the status light that corresponds to the source video should be blinking green. If it is blinking red when encoding HDMI, verify that your cable is connected to* **HDMI In** *and not* **HDMI Out**.

7.2.2 Run VLC to View RTP/RTSP Stream

(3) Open the VLC media player on your PC (Version used by Z3: 2.1.5).

(4) Select the **Media** menu.

(5) Select **Open Network Stream**.

(6) Enter "**rtsp:// IP_Address/z3-1{m}.mp4**" for the network URL.

a. **IP_Address** will be the IP address of your **Z3Stream** encoder. If your encoder is set to DHCP (This is the default setting when you first receive your encoder.), you can find this in ZFinder or the web browser with your user interface open. If you have set your encoder to a static IP address, this should match the **Local IP Address** field in the System Setup tab. In the example pictured, the encoder was assigned 169.254.154.1 at start up.

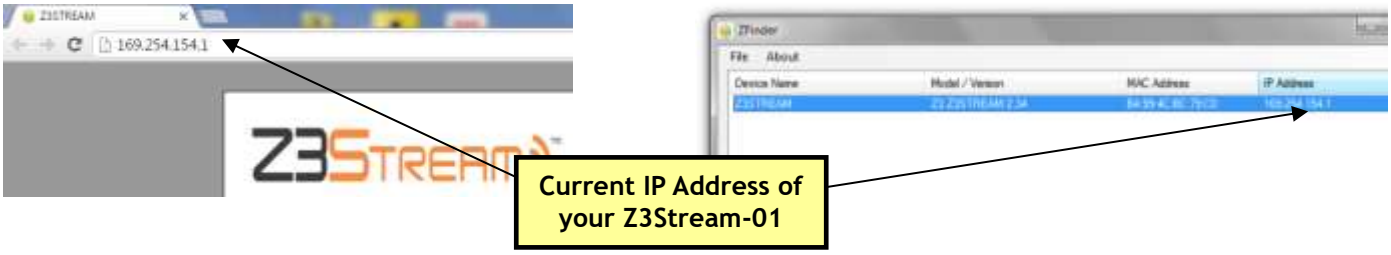


Figure 16 Finding Your Encoder's IP Address

b. **{m}** is added if a multicast address is being used. (For example, rtsp://IP_Address/z3-1m.mp4) If you are using a unicast address, as we are in the example pictured, omit the letter **m** after z3-1 in the address.

c. In this example, the full network URL would be "rtsp://169.254.154.1 /z3-1.mp4".

Figure 17 VLC Open Network Stream Screen - RTSP

(7) Press **Enter** or click **Play**. You will see your source video streaming to VLC.

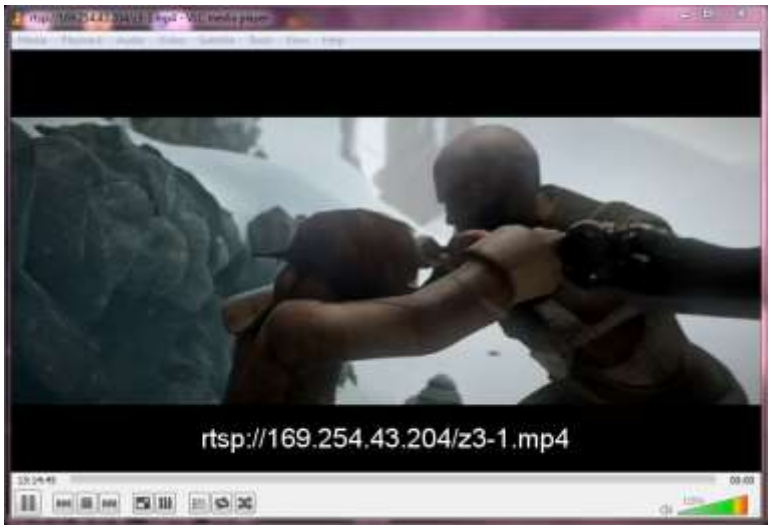
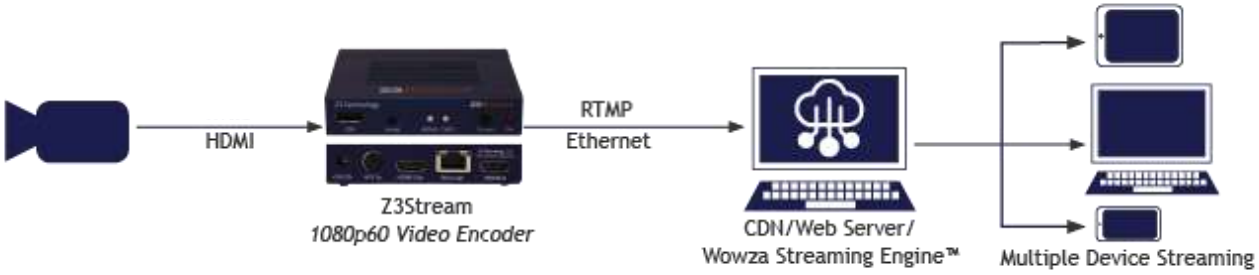


Figure 18 Example of Video Streaming to VLC - RTSP

Note: *RTSP is only supported with VLC version 2.1.5 or later. When encoding via RTP/RTSP, any time the encoding session is stopped and restarted, you will need to reopen VLC in order to view the stream.*

7.3 Stream RTMP

RTMP (Real Time Messaging Protocol) is a network protocol designed for playing Flash video. The **Z3Stream** supports RTMP streaming accepted by a variety of CDN's (Content Delivery Networks) and social media platforms for wide content distribution and live streaming.



7.3.1 RTMP Encoder Setup – Wowza Streaming Engine™

Z3 Technology is a member of the Wowza Media Systems™ Technology Alliance partner program, and the Wowza Streaming Engine™ is used as an example CDN.

(1) Under Output Setup, select **RTMP** in the **Output Format** dropdown menu.

(2) Set **Dest Address** to "**IP_Address: port#/application/Stream_Name**".

a. **IP_Address** will be the IP address of the PC with the Wowza server. In this example, 192.168.0.4 is used.

b. **port#** will be the port number of the PC with the Wowza server. In this example, 1935 is used.

c. **application** will need to match the application selected in Wowza. In this example the live application is used.

d. **Stream_Name** will need to match the stream information you provide to the Wowza server. In this example, 720 is used.

e. In this example, the full destination address would be "192.168.0.4:1935/live/720".

(3) If necessary, set **Authentication** to **Enable** and enter your valid Wowza log in credentials.

Figure 19 Encoder Tap Configuration – RTMP – Wowza Streaming Engine™

(4) Click on the **Start** button. After a moment, the encoder status will change to **RUNNING** and the fields above will appear in dark grey.

Note: *Settings in the user interface cannot be changed if the unit is currently encoding. When the unit is encoding the status light that corresponds to the source video should be blinking green. If it is blinking red when encoding HDMI, verify that your cable is connected to* **HDMI In** *and not* **HDMI Out**.

(5) If you have not already done so, install the Wowza Streaming Engine™ server on a PC on your network (for details on configuring Wowza, please see "APPENDIX A: Configuring the Wowza Server for RTMP").

Note: *VLC does not support RTMP. The test player within Wowza Streaming Engine™ is recommended.*

(6) Go to any PC that is on the same network as the Wowza server and open a web browser. Type in the IP address of the Wowza server with the port 8088 (in this example, "192.168.0.4:8088"). This will bring up the Wowza Streaming Engine™ home page.

(7) Log in with your valid user name and password.

(8) At the top of the screen, click on **Applications**.

(9) Select **live** on the left side of the screen.

(10) Click **Test Players** in the top right hand corner.

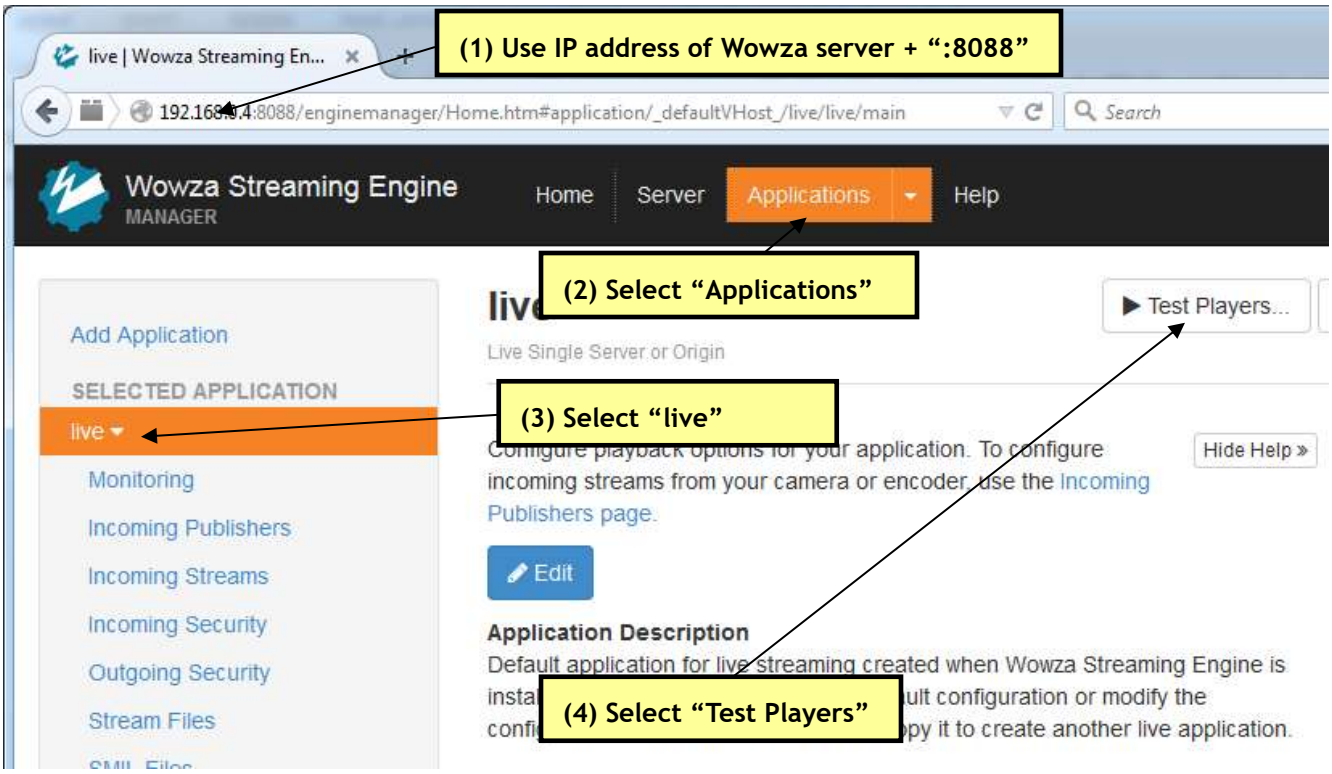


Figure 20 Navigating to the Wowza Test Player

(11) The Test Players popup screen will appear. Select the **Adobe RTMP** tab.

(12) Enter the **Stream** name you listed in your Dest Address in **Section 7.3.1**. For this example, enter 720.

(13) Click **Start**. You will see your source video streaming to the Wowza server.

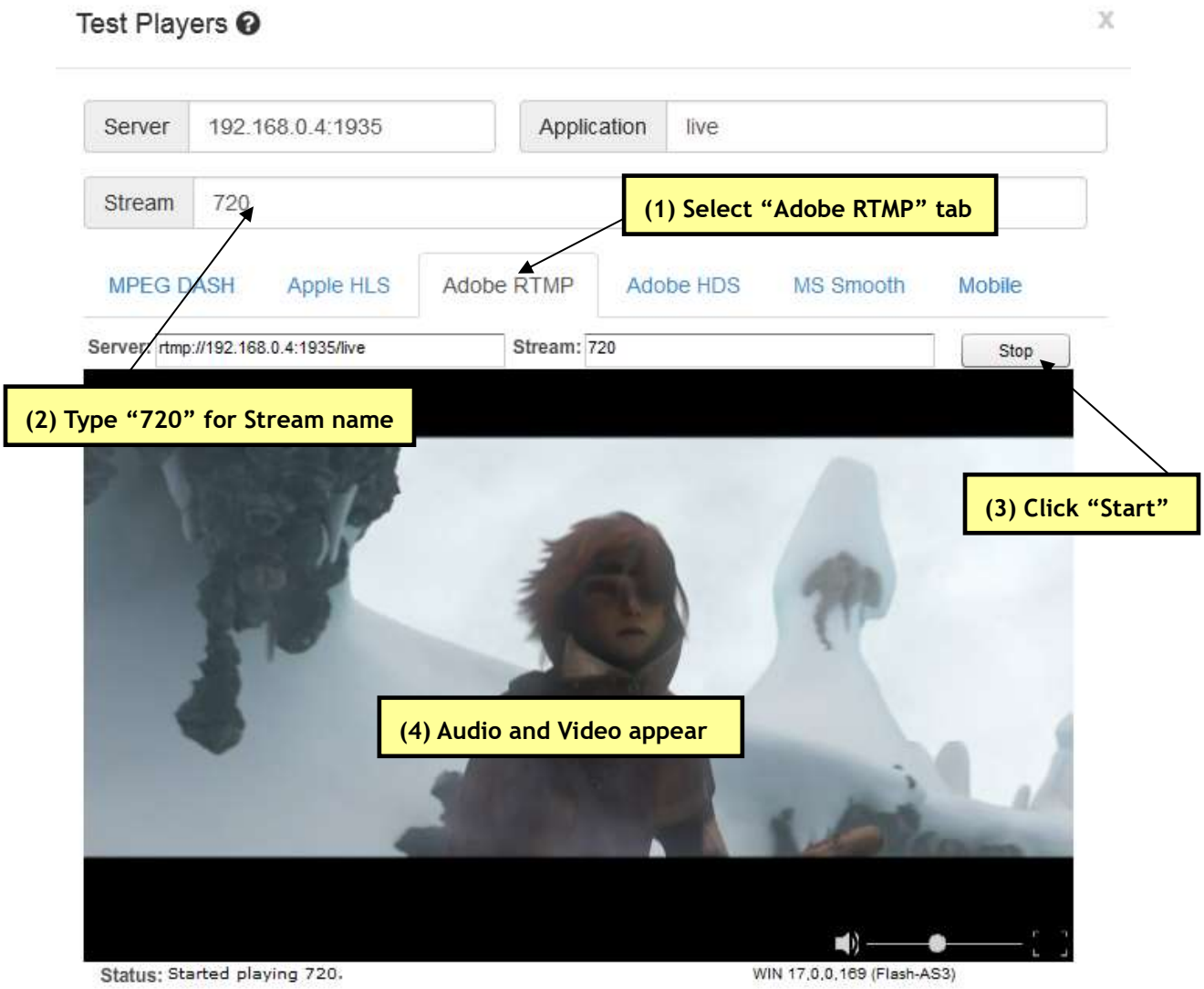


Figure 21 Viewing Encoded Content on the Wowza Test Player

7.3.2 RTMP Encoder Setup – YouTube Live

(1) If you have not already done so, verify you have set up a YouTube live account and access your YouTube live dashboard. (As of the date of this document, the dashboard URL is: https://www.youtube.com/live_dashboard)

(2) Under Encoder Setup, locate your **Server URL** and **Stream name/key**.

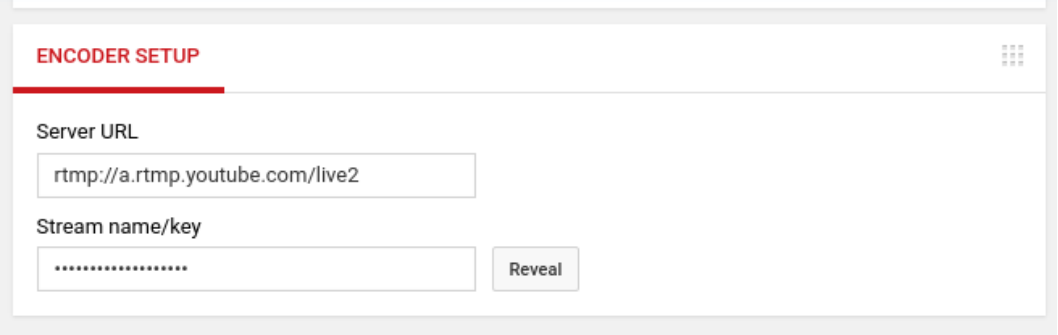


Figure 22 YouTube Live Dashboard – Encoder Setup

(3) Return to the encoder user interface Encoder tab, and under Output Setup, select **RTMP** in the **Output Format** dropdown menu.

(4) Set **Dest Address** to "**Server_URL/Stream_Key**".

a. **Server_URL** will be the value specified in your YouTube Live dashboard. Omit the RTMP protocol "rtmp://" and enter "a.rtmp.youtube.com/live2".

b. **Stream_Key** will be the value specified in your YouTube Live dashboard.

(5) It is recommended to set **Encode Quality** to **CBR**. . In addition to setting the rate control to a constant bitrate, this allows fields to appear for quick access to adjust your video resolution and video bitrate.

(6) Consult the YouTube live stream setup documentation available in YouTube's online Live streaming guide for recommended bitrates for your resolution. (As of the date of this document, YouTube's online streaming instructions are found at: https://support.google.com/youtube/answer/2474026?hl=en)

(7) It is also recommended to set **GOP Size** to:

a. 120 Frames – 240 Frames for 60 fps content.

b. 60 Frames – 120 Frames for 30 fps content.

c. By default, the encoder is set to 120 Frames.

Note: *By default a limited selection of video encoding settings are available in the user interface. To access additional settings, including* **GOP Size**, *set* **Encode Quality** *to* **Custom**. *See Section 9.4, The Encoder Tab, for more information on available custom settings.*

(8) Set **Authentication** to **Disable** as this field is not applicable to YouTube.

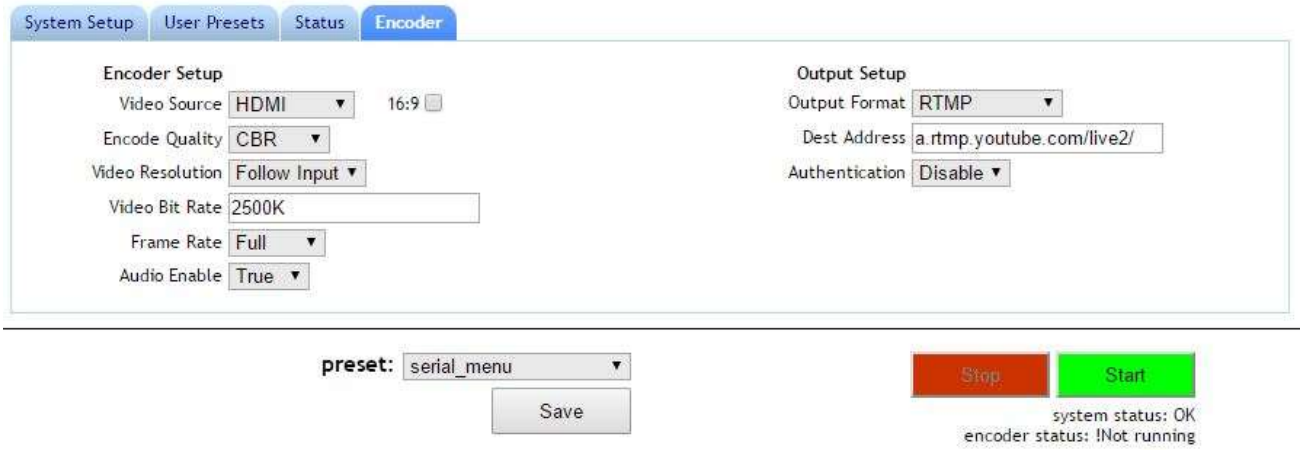


Figure 23 Encoder Tap Configuration – RTMP – YouTube Live

(1) Click on the **Start** button. After a moment, the encoder status will change to **RUNNING** and the fields above will appear in dark grey.

Note: *Settings in the user interface cannot be changed if the unit is currently encoding. When the unit is encoding the status light that corresponds to the source video should be blinking green. If it is blinking red when encoding HDMI, verify that your cable is connected to* **HDMI In** *and not* **HDMI Out**.

(9) Allow a few seconds for your video to appear in your YouTube live dashboard.

7.3.3 RTMP Encoder Setup – Facebook Live

Note: *Verify SSL is disabled on your network before setting up your live stream to Facebook Live.*

(1) If you have not already done so, verify you have set up a Facebook account and access:

a. Publishing Tools if you have a business page. (As of the date of this document, Facebook's online streaming instructions for business pages are found at: https://www.facebook.com/facebookmedia/get-started/live)

b. Your profile or the live stream setup page if you have a personal account. (As of the date of this document, Facebook's online streaming instructions are found at: https://www.facebook.com/help/587160588142067)

(2) Following Facebook's instructions, navigate to the appropriate page to lick on the **+ Live** button or **Create Live Stream** button to begin configuring your live stream.

(3) From Facebook, obtain a **Single Field Server or Stream URL** or both the **Server URL** and **Stream Key**.

(4) Return to the encoder user interface Encoder tab, and under Output Setup, select **RTMP** in the **Output Format** dropdown menu.

(5) Set **Dest Address** to:

a. The **Single Field Server or Stream URL** as provided by Facebook. Omit the RTMP protocol "rtmp://" and enter the text beginning with "rtmp-api.facebook.com:80/rtmp/…".

b. Or to the **Server URL** followed by the **Stream Key** as provided by Facebook. Omit the RTMP protocol "rtmp://" and enter the text beginning with "rtmp-api.facebook.com:80/rtmp/…".

(6) It is recommended to set **Encode Quality** to **CBR**. In addition to setting the rate control to a constant bitrate, this allows fields to appear for quick access to adjust your video resolution and video bitrate.

(7) Set **Video Resolution** to **1280x720** or lower. This is the maximum resolution supported by Facebook Live.

(8) Set **Video Bitrate** to **4000K** or lower depending upon your resolution.

(9) Set **Frame Rate** to:

a. **Full** if your video source is outputting 30 fps.

b. **Half** if your video source is outputting 60 fps.

(10) It is also recommended to set **GOP Size** between **30 Frames** and **60 Frames.**

(11) In the Audio settings, set **Sample Rate** to **44100 Hz**.

Note: *By default a limited selection of video encoding settings are available in the user interface. To access additional settings, including* **GOP Size** *and audio* **Sample Rate**, *set* **Encode Quality** *to* **Custom**. *See Section 9.4, The Encoder Tab, for more information on available custom settings.*

(12) Set **Authentication** to **Disable** as this field is not applicable to Facebook.

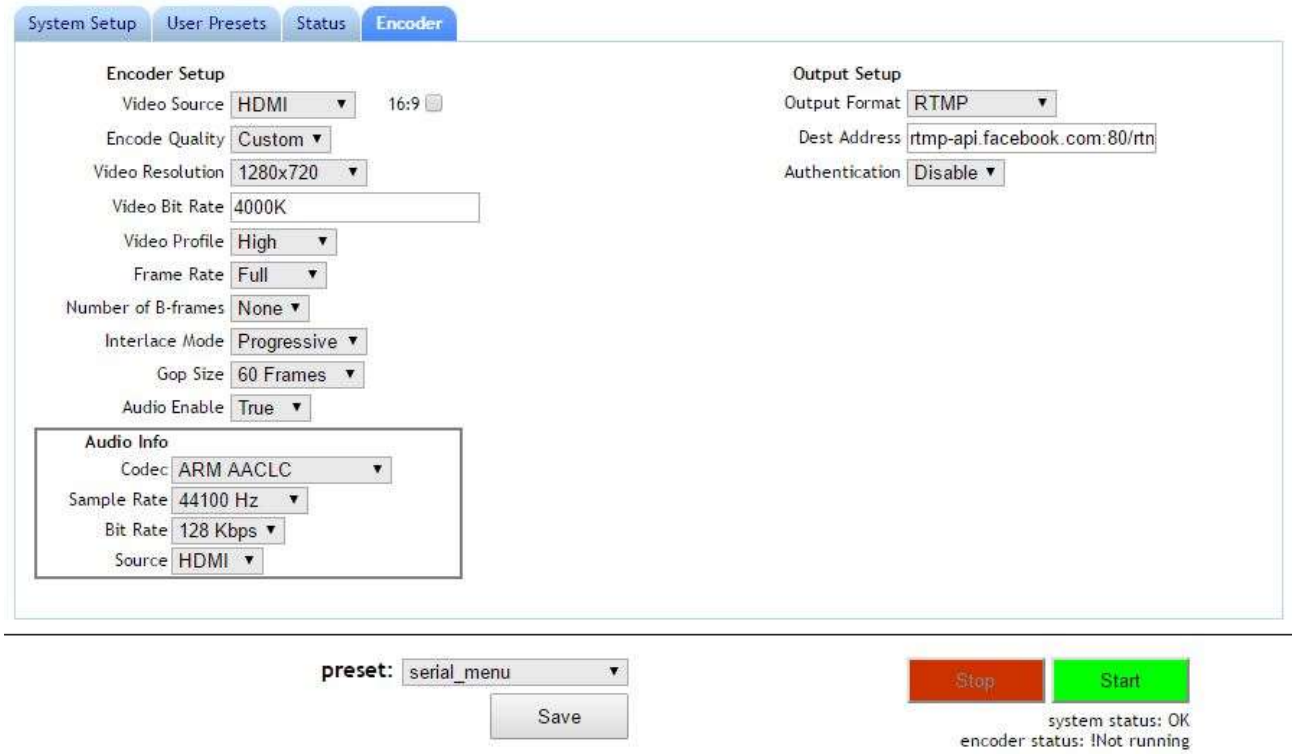


Figure 24 Encoder Tab Configuration – RTMP – Facebook Live

(13) Click on the **Start** button. After a moment, the encoder status will change to **RUNNING** and the fields above will appear in dark grey.

Note: *Settings in the user interface cannot be changed if the unit is currently encoding. When the unit is encoding the status light that corresponds to the source video should be blinking green. If it is blinking red when encoding HDMI, verify that your cable is connected to* **HDMI In** *and not* **HDMI Out**.

(14) Allow a few seconds for your video to appear in Facebook Live.

8.0 PERFORMING OTHER OPERATIONS WITH Z3STREAM

8.1 Change Frame Rate

The **Z3Stream** encoder supports several frame rate options based upon the frame rate of your source video. These include:

- **Full**: the full frame rate of your source video
- **Half**: the frame rate of your source video reduced by half
- **Quarter**: the frame rate of your source video reduced to one quarter
- **Sixth**: the frame rate of your source video reduced to one sixth

(1) To change the frame rate of your encoded stream, stop the encoder if it is currently running.

(2) In the Encoder tab, select your desired rate from the **Frame Rate** dropdown menu.

(3) Click the **Start** button.

(4) In the Status tab, verify the FPS (Frames Per Second) listed is the appropriate amount based on your source.

   a. For example, if your source content outputting 1080p at 60 frames per second, by selecting **Half**, you will see 30.0 FPS on the Status tab.

Note: *You will see a visible reduction in the smoothness of video playback when reducing the frame rate.*

8.2 Adjust Aspect Ratio

The **Z3**Stream encoder supports changing the aspect ratio of standard resolution video to that of HD resolution video.

(1) Connect a video source outputting 720x480 or another resolution with an aspect ratio of 4:3.

(2) Follow the steps in sections 6.0 to 7.0 to verify video playing in VLC is at a 4:3 aspect ratio.

(3) Click on the **Stop** button in the user interface.

(4) On the Encoder tab, check the **16:9** box.

(5) Click on the **Start** button.

(6) Return to your VLC window to see the video playing at a 16:9 aspect ratio.

4:3 Aspect Ratio

16:9 Aspect Ratio

Figure 25 Comparing 4:3 to 16:9 Aspect Ratio

8.3 HDMI Pass-Through

The **Z3Stream** encoder allows for the currently encoded content from either HDMI or Composite to be passed through to the HDMI output while the unit is encoding.

(1) To view this pass-through content, verify the unit is currently encoding. The encoder status will show **RUNNING** in the bottom right corner of the GUI.

(2) Connect an HDMI cable from **HDMI Out** on the encoder to a display monitor.

Figure 26 Pass-Through Connection

(3) Return to the user interface System Setup tab. Under **Display Setup**, select your desired output resolution and click **Set Display**.

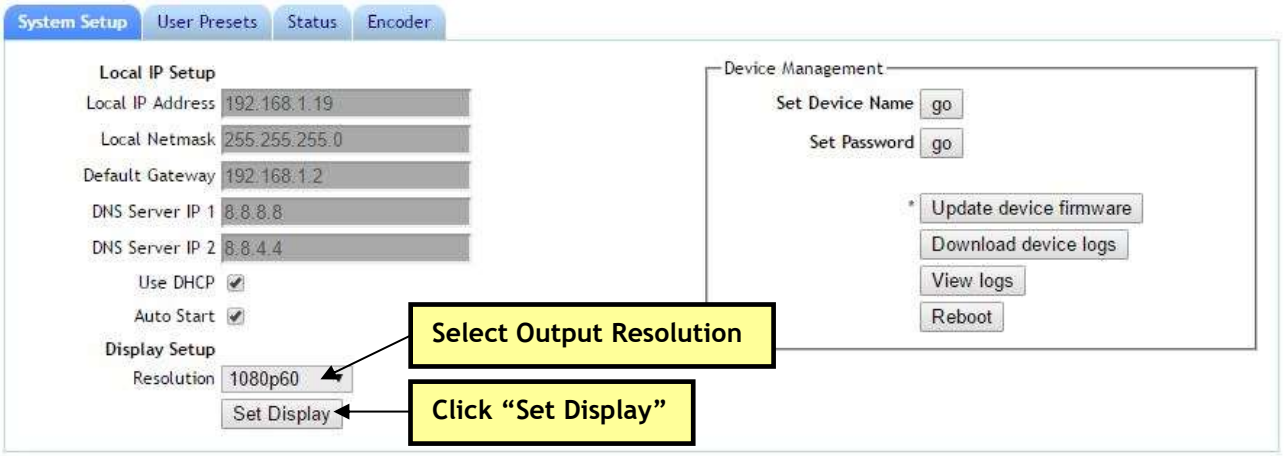


Figure 27 Set Pass-Through Output Resolution

8.4 Save Current Settings

If you have a specific configuration you'd like to preserve, you can save it so that when the **Z3Stream** encoder is powered off and back on, it automatically uses those settings.

(1) Click on the **User Presets** tab.

(2) Click on the **new** button.

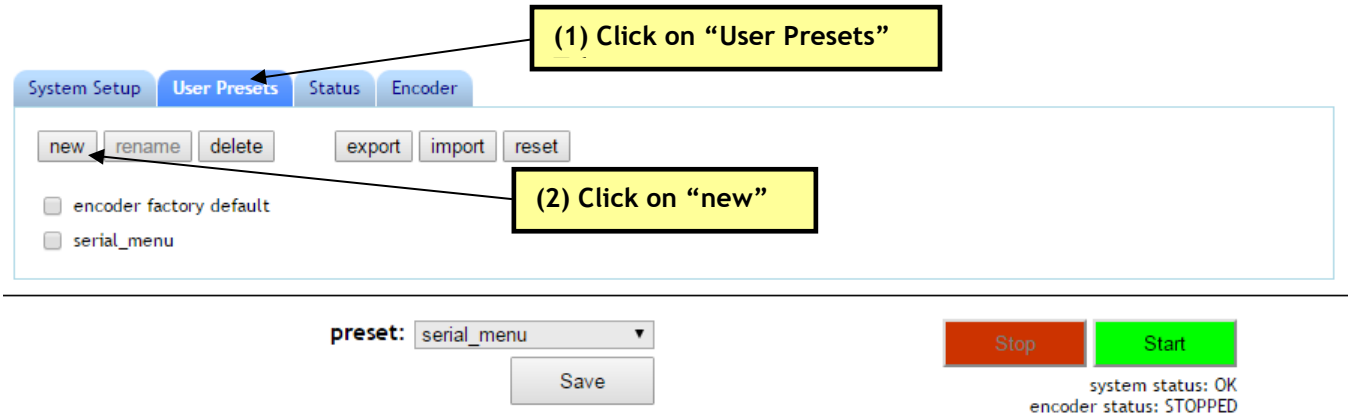


Figure 28 The User Presets Tab

(3) This brings up a text box to enter the new user preset name. For this example, type "**z3_config1**".

(4) Click **ok**.

Figure 29 Entering a User Preset Name

(5) Return to the System Setup tab.

(6) Select your newly created configuration from the preset dropdown menu at the bottom of the screen.

(7) As soon as you select **z3_config1**, the screen will reload.

(8) Change your desired settings.

(9) Once your changes have been set in this configuration, click on the **Save** button.

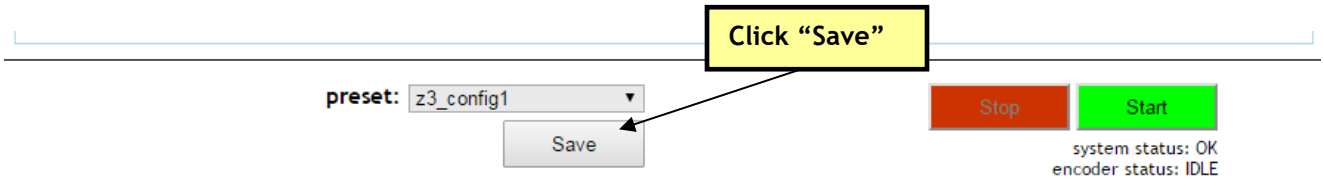


Figure 30 Saving a User Preset

(10) A pop-up window appears to confirm the saving of these settings is complete. Click **OK**.

Note: *The very first time settings are saved may take up to 30 seconds. This is due to some flash initialization which occurs on the very first configuration save.*

(11) In order for these changes to take effect, the unit must be re-started. Power the unit off then back on and wait 45-60 seconds for the unit to boot up.

8.5 Set a Static IP Address

The **Z3Stream** supports DHCP (Dynamic Host Configuration Protocol). This is enabled by default, allowing the encoder to dynamically receive an IP address at startup. The IP address that is assigned can be seen through using ZFinder. If you prefer, you can set your encoder to a static IP address. If you would like to have your PC set to a static IP address, you will need to set your encoder to a static IP address as well in order for it to be discoverable by ZFinder.

To set your unit to a static IP address, complete the following steps:

8.5.1 Setup a Custom Configuration

(1) The first step is to set up a custom configuration so that the manual networking settings will be used the next time the system boots up. To do this, see Section 8.4: Save Current Settings.

(2) Return to the System Setup tab.

(3) Select your newly created configuration from the preset dropdown menu at the bottom of the screen.

(4) As soon as you select your preset, the screen will reload.

(5) Un-check the **Use DHCP** box.

(6) Enter in your desired network settings including **Local IP Address**, **Local Netmask**, **Default Gateway**, **DNS Server IP 1**, and **DNS Server IP 2**.

(7) Now that DHCP is no longer set in this configuration and your network settings have been entered, click on the **Save** button.

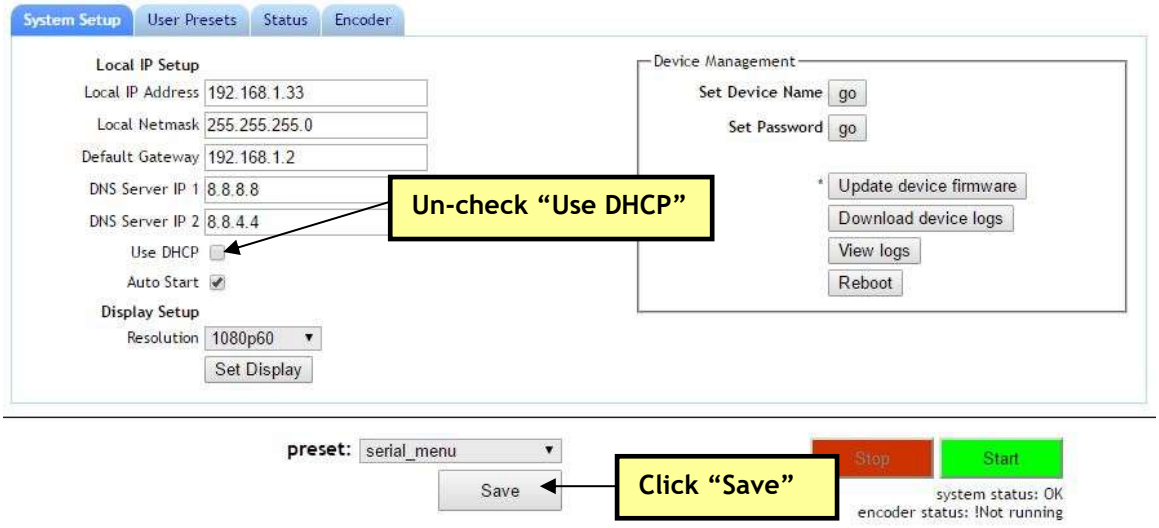


Figure 31 Saving IP Address Settings

(8) A pop-up window appears to confirm the saving of these settings is complete. Click **OK**.

Note: *The very first time settings are saved may take up to 30 seconds. This is due to some flash initialization which occurs on the very first configuration save.*

(9) In order for these changes to take effect, the unit must be re-started. Power the unit off then back on and wait 45-60 seconds for the unit to boot up.

(10) You can return to the use of DHCP by checking **Use DHCP** in the System Setup tab and saving that to the preset.

8.5.2 Open the User Interface Using ZFinder

(11) Run the ZFinder PC Utility on your Windows PC. The ZFinder window appears. ZFinder does a scan of the network and lists the location of all Z3 systems connected to the network. The **Z3Stream** appears with your manually entered IP address.

(12) Select the **Z3 Stream**.

(13) Click **Open Device** to reach the user interface.

8.5.3 Open the User Interface Manually

(14) You can also access the user interface by manually typing your unit's static IP address into a web browser on any computer connected to the same network as the unit.

8.6 Upgrade Firmware

Firmware upgrades for the **Z3Stream** encoder are available for download at www.Z3Stream.com.

(1) In the System Setup Tab, click the **Update device firmware** button.

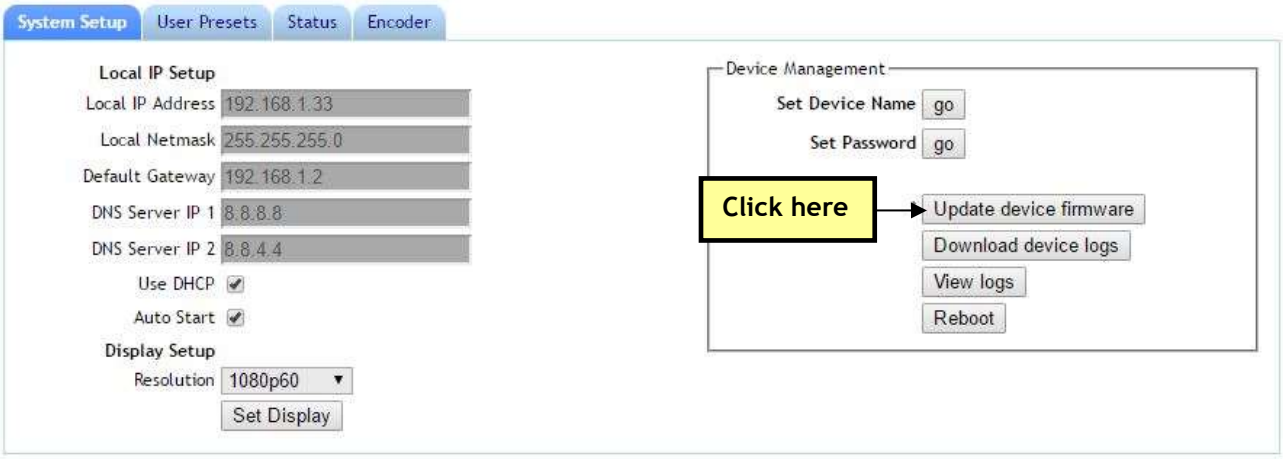


Figure 32 Updating Device Firmware

Note: *If this button is not selectable, it is because the encoder is running. If you click* **Stop** *at the bottom of the screen, the* **Update device firmware** *button will become active.*

(2) A Software Updater screen will appear. Click **Choose File** and navigate to the software image file on your PC that you wish to update with.

Figure 33 Software Updater Screen

(3) Once your desired image file is selected, click **Open**.

(4) Click **Upload and Update**. A progress message will appear. Once update of firmware is completed it will return to the main menu.

8.7 Use the Password Feature

Note: *Once a password has been set, it can be changed, but the requirement of a password cannot be undone.*

(1) In the System Setup tab, click **go** next to **Set Password**.

(2) The change password options appear. Enter your desired password twice and click **change**.

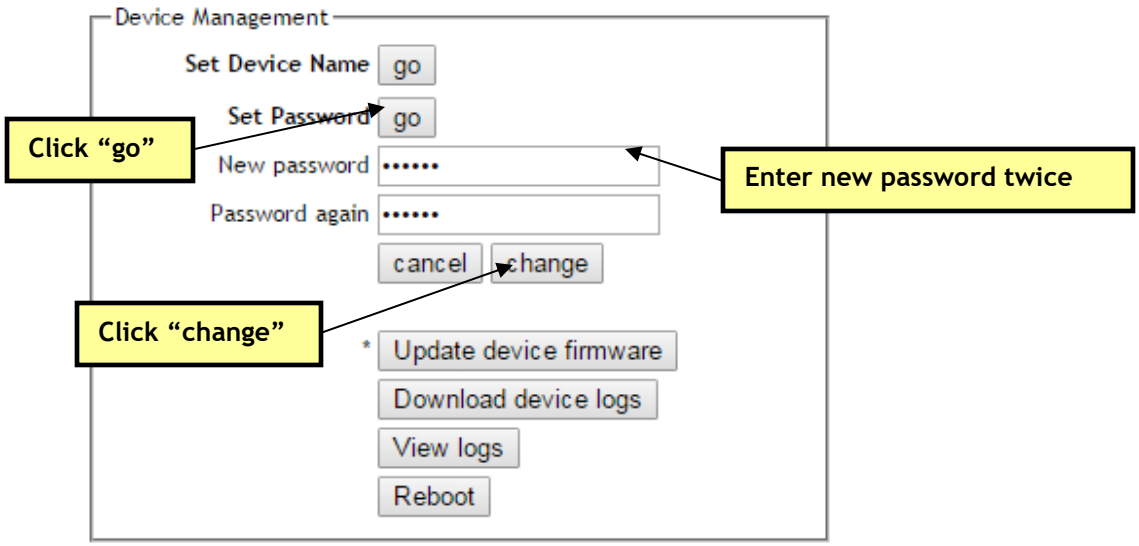


Figure 34 Changing the Password

(3) Wait for the password options to disappear. This indicates that the password has changed.

(4) Retype the IP address or refresh the web browser. You will now see a log in prompt. The default **User Name** is "**admin**". Enter your newly selected **Password**.

Figure 35 Password Entry Screen

(5) You will now be able to access the user interface only through logging in with this password.

(6) At any point, you can also click the **logout** button to return to the login prompt.

9.0 SUMMARY OF OPTIONS

This section lists the different options that are available in the various menus and tabs for configuration of your encoder.

9.1 The System Setup Tab

Parameter	Options (default in bold)	Description
Local IP Setup		
Local IP Address	192.168.x.y **(192.168.81.7)**	Sets the static IP address of the Z3Stream encoder. Note that a "save" of these settings and a reboot is needed for changes to this value to take effect. When in DHCP mode, this field is not applicable.
Local Netmask	255.255.z.w (**255.255.0.0**)	Sets the netmask of the Z3Stream encoder. Note that a "save" of these settings and a reboot is needed for changes to this value to take effect. When in DHCP mode, this field is not applicable.
Default Gateway	192.168.a.b (**192.168.0.1**)	Sets the network gateway to use for the Z3Stream encoder. Note that a "save" of these settings and a reboot is needed for changes to this value to take effect. When in DHCP mode, this field is not applicable.
DNS Server IP 1	a.b.c.d (**8.8.8.8**)	Specifies the primary DNS server to be used for hostname lookup when in static IP mode. When in DHCP mode, DNS information is acquired from the DHCP server, and this field is not applicable.
DNS Server IP 2	e.f.g.h (**8.8.4.4**)	Specifies the secondary DNS server to be used for hostname lookup when in static IP mode. When in DHCP mode, DNS information is acquired from the DHCP server, and this field is not applicable.
Use DHCP	**Checked** Unchecked	Check this box to use DHCP to obtain an IP address for the system upon powering on.
Auto Start	**Checked** Unchecked	Check this box to set the system to automatically start encoding upon powering on.
Display Setup		

Resolution	(See Note 1) 1080i30 1080p50 1080i29.97 720p60 1080i25 720p59.94 **1080p60** 720p50 1080p59.94 480p60 1080p30 576p50	Selects the desired resolution for HDMI pass-through output.
Set Display Button		Click once the desired selection is made in the Resolution dropdown menu to make real time changes.
Device Management		
Set Device Name		Sets the name for the Z3Stream encoder. This will appear in ZFinder and can be helpful in identifying multiple Z3 encoders on the same network.
Set Password		Sets the system password for access restriction. See Section 8.7 for more details.
Update device firmware Button		Allows for an update of the Z3Stream firmware. See Section 8.6 for more details.
Download device logs Button		Causes the system to extract a set of diagnostic logs for analysis in the event of an issue. The resulting file is saved on the PC with the user interface open.
View logs Button		Allows the user to view diagnostic logs previously created.
Reboot Button		Restarts the unit.
Note 1: Resolutions supported: 1080p60, 1080p59.94, 1080p50, 1080i30, 1080i29.97, 1080i25, 720p60, 720p59.94, 720p50, 480p60, 576p50		

9.2 The User Presets Tab

Parameter	Options (default in bold)	Description
new		Define a new configuration file. Up to 9 configurations can be created.
rename		Rename an existing configuration file.
delete		Delete an existing configuration file.
export		Not supported in this release.
import		Not supported in this release.
Reset		Reset the user presets.
a list of presets	Checked **Unchecked**	Check the box next to a preset to select it for editing.

9.3 The Status Tab

Note: *This tab may take a few seconds to load.*	
Output Value	**Description**
Video Status	
CH	The Z3Stream is a single channel encoder. This will always be 1.
Bitrate (Kbps)	Current target bitrate of encoder
Actual Bitrate	Actual bitrate being output by encoder
FPS	Current target frames per second of encoder
Actual FPS	Actual frames per second being encoded
Key-frame FPS	Number of key-frames per second (for example, a value of 0.5 means a key frame is inserted every two seconds)
Width	Width of encoded picture
Height	Height of encoded picture. The letter "I" will appear if interlaced is being encoded.
Audio Status	
Channel	The Z3Stream is a single channel encoder. This will always be **1**.
Subchannel	The Z3Stream is a single channel encoder. This will always be **1**.
Codec	The codec being used to encode audio
Stream Status	
Channel	The Z3Stream is a single channel encoder. This will always be **1**.

URL	The URL the channel is being streamed to	
Frames	Number of frames sent from encoder to channel since the beginning of encoding. This can serve as a quick sanity check (for example, you can click “Refresh”, count to 10, click “Refresh” again, and you should see an increase of around 600 for 60 frames per second content).	
Input Status		
Input	Input type	
Resolution	Capture resolution for that input	
FPS	Capture frames per second for that input	
Refresh Button	Refresh the current status values.	
Auto Refresh	Checked **Unchecked**	If checked, the values in the status tab will be refreshed automatically once every five seconds.

9.4 The Encoder Tab

Parameter	Options (default in bold)	Description
Encoder Setup		
Video Source	**HDMI** Composite	The video source selected for encode.
16:9	Checked **Unchecked**	For any SD resolutions (NTSC, PAL), the default output aspect ratio is 4:3. Checking this box forces the output aspect ratio to be 16:9. This checkbox is not applicable for HD resolutions.
Encode Quality	Full HD **HD** High Medium Low Mobile CBR Custom	The quality and resolution of your output stream. See Table 1 Encode Quality Options with Resolutions for details on each option. If this resolution is different from the source resolution, resizing will occur. **CBR** (Constant Bitrate) means that a stable encoding bitrate is ensured within the bitrate statistical time. This option is included under **Encode Quality** as quick access to recommended settings for RTMP streaming. When selected, **Video Resolution** and **Video Bitrate** will appear. Please

		see the descriptions of these options below. If **Custom** is selected, additional configuration options will appear. Please see the descriptions of these options below.
Video Resolution (CBR Only)	352x240 – 1920x1080 **Follow Input**	The encode resolution. If this resolution is different from the capture resolution, resizing will occur. "Follow Input" generates the resolution based on the capture resolution. [**Note 1**]
Video Bitrate (CBR Only)	100 – 12000K (**2500K**)	Textbox for entering video bitrate. For example: 1M = 1,000,000 bits per second 1000K = 1,000,000 bits per second 2.5M = Not a Valid Format
Frame Rate	**Full** Half Quarter Sixth	Used to encode at less than the input frame rate (for example, an input frame rate of 30fps with **Half** selected would cause an output stream of 15fps). If interlaced input is used then this is used to reduce the number of fields being encoded.
Audio Enable	**True** False	**True** enables the encode of audio from the video source.
Output Setup		
Output Format	**RTP/RTSP** UDP RTMP TS Over RTP	Output format of the encoded stream. RTP requires the use of the RTSP URL (see Section 7.2, " Stream RTP" for more details). If UDP is selected, don't forget to check the value of TS Rate to make sure it is in line with expectation. *(Custom option only)* TSRTP streams TS over RTP. See Section 7.3, "Stream RTMP" for more on using the RTMP format.
Dest Address	192.168.x.y **(192.168.0.6)**	The IP address of the destination of the encoded stream.

Dest Port (UDP, RTP/RTSP or TS Over RTP Only)	0 – 9999 (**5004**)	The destination port that the encoder is streaming to.
Authentication (RTMP only)	**Disable** Enable	When in RTMP mode, the encoder supports entering an authentication User Name and Password. If this is desired, set to **Enable**. User and Password text boxes then become active.
User (RTMP Only)		User name to enter when **Authentication** is enabled.
Password (RTMP Only)		Password to enter when **Authentication** is enabled.
Custom Encode Options (To access these options, **Custom** must be selected in the **Encode Quality** dropdown menu.)		
Video Resolution	352x240 – 1920x1080 **Follow Input**	The encode resolution. If this resolution is different from the capture resolution, resizing will occur. "Follow Input" generates the resolution based on the capture resolution. [**Note 1**]
Video Bitrate	100 – 12000K (**2500K**)	Textbox for entering video bitrate. For example: 1M = 1,000,000 bits per second 1000K = 1,000,000 bits per second 2.5M = Not a Valid Format
Video Profile	**High** Main Baseline	The H.264 profile of the bitstream. Generally High is used for 1080p, Main for D1, and Baseline for <D1.
Frame Rate	**Full** Half Quarter Sixth	Used to encode at less than the input frame rate (for example, an input frame rate of 30fps with **Half** selected would cause an output stream of 15fps). If interlaced input is used then this is used to reduce the number of fields being encoded. **[Note 2]**
Number of B-frames	**None** 1 2	The number of B-frames. Selecting **None** disables B-frames.

Interlace Mode	Follow Input **Progressive** Interlace	This allows the user to specially handle interlaced input. **Follow Input** will leave interlaced input as is. **Progressive** will convert the interlaced input to a progressive picture. This can be used to improve quality if playing back on a PC player. **Interlace** can be used to make progressive input interlaced.
GOP Size	10 – 240 Frames (**120 Frames**)	I-frame frequency. The number of frames in each Group of Pictures (GOP)
Audio Enable	**True** False	**True** enables the encode of audio from the video source.
TS Rate (UDP or TS Over RTP Only)	125K – 20000K (**0**)	The rate of the transport stream. Normally, this value should be set to 1.25 * (video bitrate + audio bitrate). This can be set to higher values to allow leeway for times when many bits are needed to encode. This can be especially useful for ensuring smooth playback at lower bitrates.
Audio Info (To access these options, **Custom** must be selected in the **Encode Quality** dropdown menu.)		
Codec	**ARM AACLC** ARM AACLC MPEG2 ARM AACHE ARM AACHE V2 ARM MPEG1L2	The codec for audio encode.
Sample Rate	Follow Input **44100 Hz**	Sample rate of audio.
Bit Rate	12Kbps – 384Kbps (**128Kbps**)	The bitrate of the audio. The bitrate range for **AACLC** is 32Kbps –384Kbps (though staying above 64Kbps is recommended for best results). The bitrate range for **AACHE** is 32Kbps – 64Kbps.

Source	**HDMI** Analog None	The source of the audio signal.
RTP Port (RTP Only)	0 – 9999 (**8892**)	If the **Output Format** is set to **RTP/RTSP**, the port number associated with that audio channel.

Note 1: Encode Resolutions Supported:

WQVGA (320x180), QVGA (320x240), SIF (352x240), CIF (352x288), 2-CIF (352x576), 640x360, VGA (640x480), 4-CIF (704x576), 16:9 PAL (1024x576), D1 PAL (720x576), D1 NTSC (720x480), 720p (1280x720), XGA (1280x1024), 1080p (1920x1080), Follow input

"Follow input" = Generate encoder resolution based on capture resolution detected

Note 2:

If input is interlaced, then Frame Rate will divide the number of fields used. This means, a conversion to progressive is done. This method allows for a reduction in bits needed / processing power without introducing extra jerkiness when there is motion in the video. For example, if the input is 1080i at 60 fields per second (30 frames per second), Frame Rate Divider has the following effect:

Frame Rate Divider	Output	# fields used	frame rate
Full	1080i	60	30
Half	1080p	30	30
Quarter	1080p	15	15
Sixth	1080p	10	10

Note 3: GOP Sizes Supported:

10, 12, 15, 25, 30, 50, 60, 100, 120, 200, 240 frames

9.5 Values Appearing at the Bottom of All Tabs

Parameter	Options (default in bold italics)	Description
preset	encoder factory default **serial_menu** (any user-defined profiles) --- new preset ---	The configuration file selected for use. **encoder factory default:** Factory default settings **serial_menu:** Last values saved in user interface

		Can also add more profiles by selecting **--- new preset ---**.
Save Button		Click to save preset value to the selected configuration.
Stop Button		Stop current encode session.
Start Button		Start encode session.
System Status	OK	
encoder status	!Not running, IDLE, STOPPED, RUNNING, POLLING	Current status of the encode process. **STOPPED** indicates that the unit is not currently encoding. Must be in this mode to make any configuration changes. **POLLING** indicates "start" was pressed and the encoder is waiting for valid input data to be detected. **RUNNING** indicates the unit is currently encoding.

9.6 ZFinder

Buttons	**Description**
Refresh	Rescans the network for Z3 Technology products
Edit Device	Allows for manual edits to encoder settings: **Name**: Name visible in ZFinder and top right corner of GUI (useful when multiple encoders are on the same network) **IP Address** **Subnet Mask** **Gateway**
Open Device	Opens the HTTP-based graphical user interface (GUI)
Flash LEDs	Not supported by Z3Stream hardware

APPENDIX A: Configuring the Wowza Server for RTMP

In this section, configuring Wowza Streaming Engine™ version 4.1.0 is described.

To configure Wowza to work with the **Z3Stream** RTMP streaming, the following steps are needed:

(1) Log in to the Wowza Streaming Engine Manager Home page by typing **http://localhost:8088**.
   (a) **localhost** is the IP address of the PC with the server
   (b) In this example, the full URL is "http://192.168.0.4:8088".

(2) Click on **Server** in the top band of options.
(3) On the left column, click on **Performance Tuning** and then **Java Settings**.
(4) Click **Edit** and then change **Java Heap Size** to **Production Level** and **Java Garbage Collection Settings** to **Concurrent collector**.
(5) Click on **Save**.

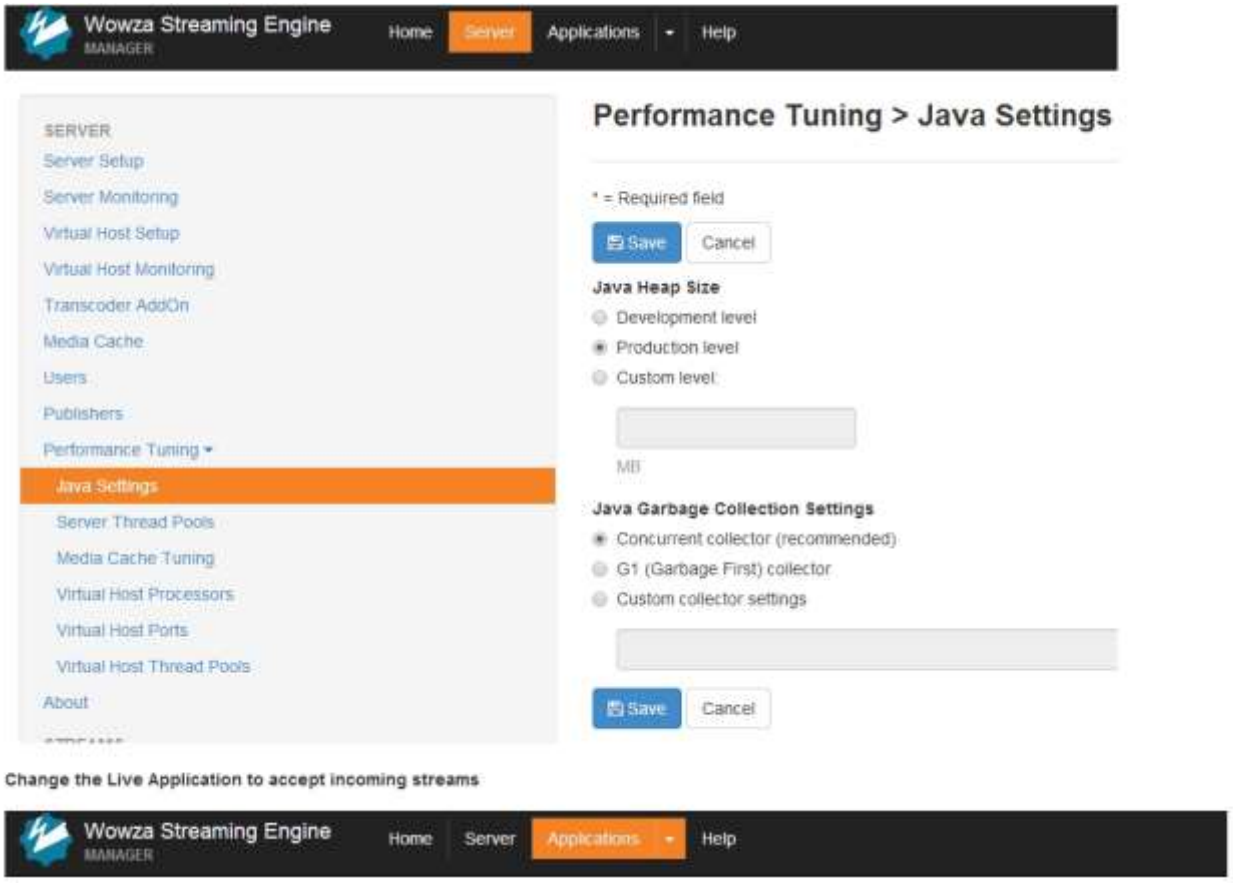


Figure 36 Wowza Performance Settings

(6) Click on **Applications** in the top band of options.

(7) On the left column, click on **live** and then **Incoming Security**.

(8) Click **Edit** and then verify **RTMP Publishing** and **RTSP Publishing** are both set to **Open**.

(9) Verify **Client Restrictions** is set to **No client restrictions**.

(10) Click on **Save**.

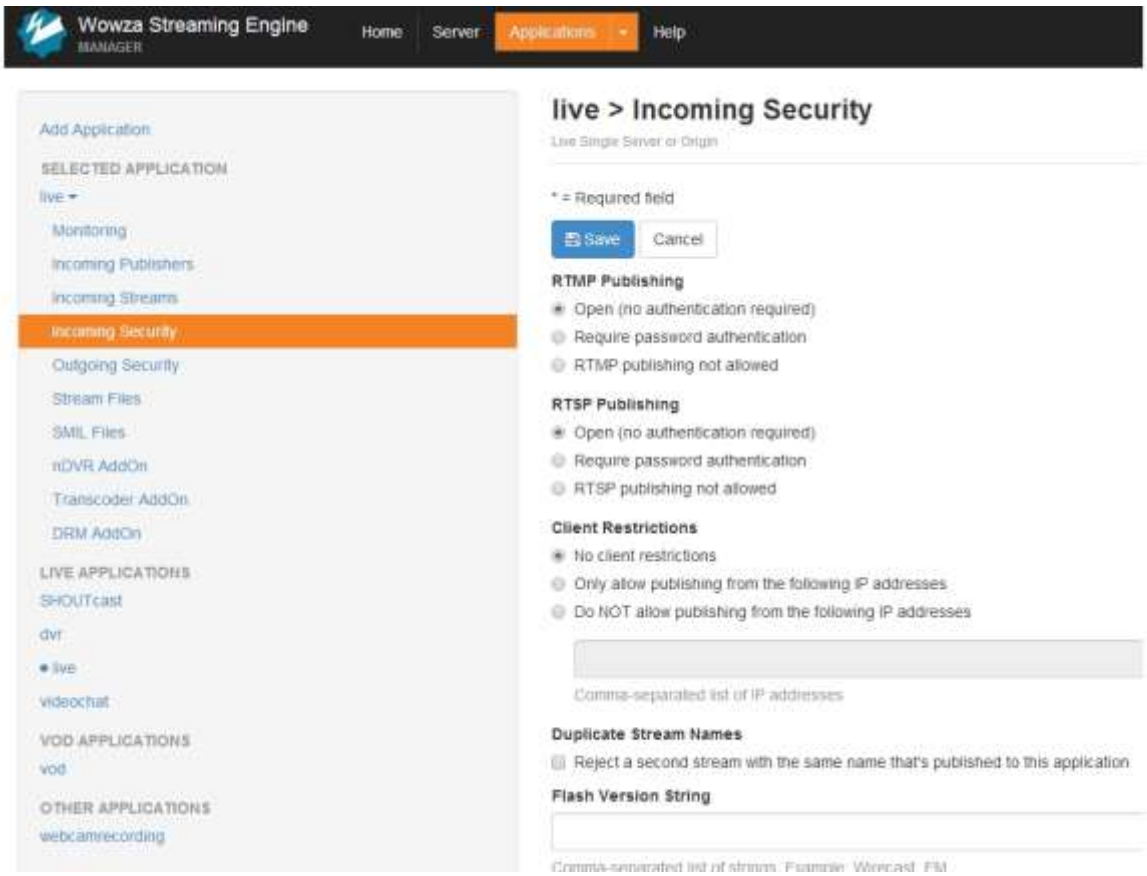


Figure 37 Wowza Security Settings

The Wowza server is now configured to work with your **Z3Stream** encoder.

Note: *You can also select* **Require password authentication** *under* **RTMP Publishing**. *In this case,* **Authentication** *on the Encoder tab needs to be enabled and a valid Wowza user name and password need to be entered to successfully access Wowza.*

If you are unable to see RTMP streaming to Wowza working correctly, please verify the Firewall on your PC with the Wowza server is turned off.

APPENDIX B: Finding the IP Address of Your Computer

To find the IP address of your computer when it is set to DHCP:

(1) Open the Windows Start Menu/Start Screen and type **cmd** or **Command Prompt**.

(2) Open the command prompt.

(3) Type **ipconfig** and press the **Enter** key.

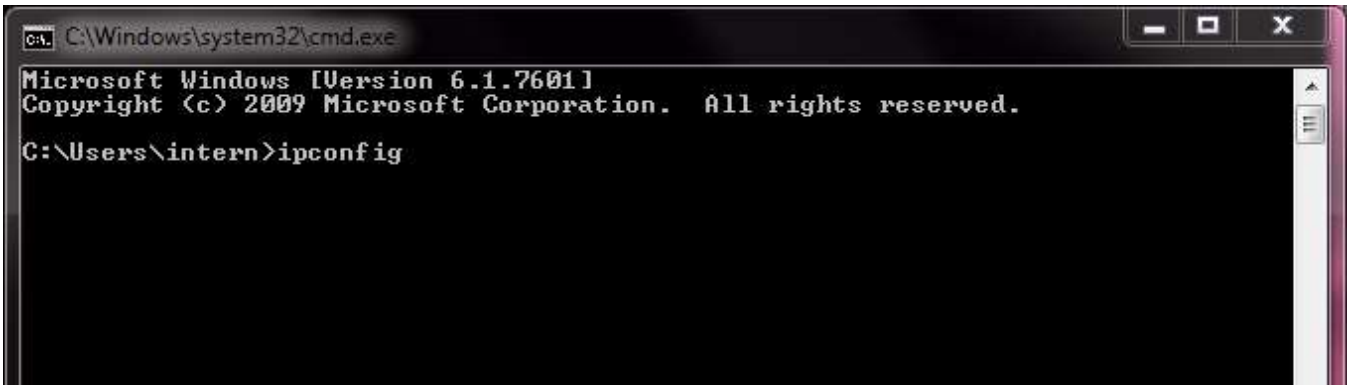


Figure 38 Using the Command Prompt to Determine Your PC's IP Address

(4) The IP address of your computer can be found in the section labeled either **Ethernet** or **Ethernet adapter Local Area Connection**. The IP address will display as 169.254.x.x where x is any one to three digit number.

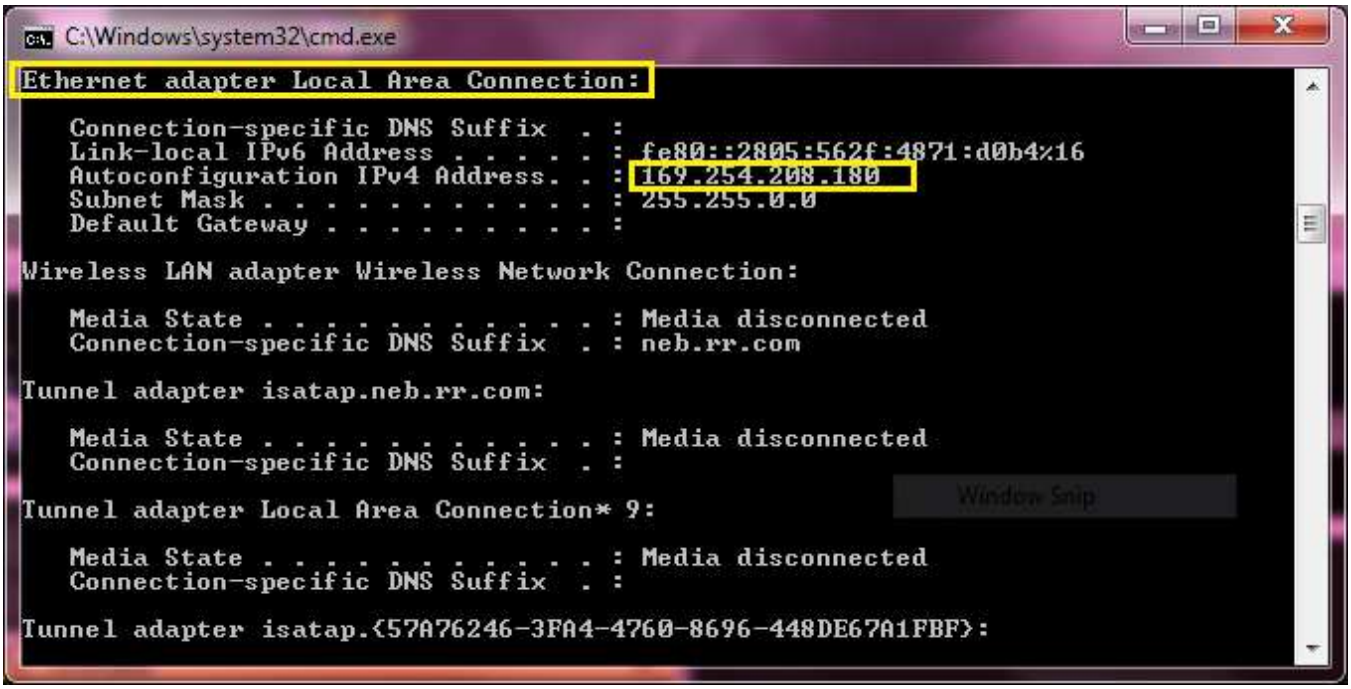


Figure 39 Locating Your Computer's IP Address

APPENDIX C: Troubleshooting

- **Problem:** ***ZFinder is not opening on my computer.***

  -If the user profile on your computer does not have administrator rights, you will need to right-click on the ZFinder icon and select "Run as administrator" in order for it to open.

- **Problem:** ***My Z3Stream does not appear in ZFinder.***

  -Is the Ethernet cable plugged in to the encoder solidly? Do you see the link light?

  -Try connecting the PC directly to the encoder without any routers, switches, etc.

  -Verify your computer is set to DHCP.

  -Try turning off your computer's wifi.

- **Problem: The *HTTP-based user interface does not appear.***

  -Is the Ethernet cable plugged in to the encoder solidly? Do you see the link light?

  -Are all firewalls on the network turned off?

  -Try connecting the PC directly to the encoder without any routers, switches, etc.

  -Can the PC and target board see each other on the network?

  -Try pinging the encoder IP address from the PC.

  -Try pinging the PC from the encoder.

  -If using static IP's, do the encoder Local IP Address and the PC IP address have the same first two values (or, if netmask is set to 255.255.255.0, the same first three values)?

  -Do the encoder and the PC have the same netmask? (Default value is 255.255.0.0)

- **Problem:** ***I'm receiving a "Bad Destination" error in the user interface. (UDP)***

  -Does the IP address set in Dest Address equal the IP address of the PC running VLC?

  -Verify the IP address set in Dest Address equals the IP address found in the Ethernet adapter Local Area Connection settings of the PC running VLC.

- **Problem:** ***I'm receiving a "Bad Destination" error in the user interface. (RTMP to YouTube)***

  -Do the values entered for the Dest Address match those provided by your YouTube dashboard?

  -Is your YouTube stream key newly created?

  -Try generating a new stream key.

  -Is **Authentication** set to **Disable**?

- **Problem: I do not see video from an HDMI source.**

  -Verify the HDMI cable is plugged into the HDMI In jack and not the HDMI Out jack.

- **Problem: I do not see video in VLC. (*UDP*)**

  -Does the IP address set in Dest Address equal the IP address of the PC running VLC?

  -Does the port number in Dest Port equal the value entered in the URL for VLC?

  -Is the PC fast enough for 1080p decode on VLC?

  -Does the PC have enough DDR to handle 1080p decode on VLC?

  -Is VLC version 1.1x or later?

  -Are all firewalls on the network turned off?

  -Try connecting the PC directly to the encoder without any routers, switches, etc.

- **Problem: I do not see video in VLC. (*RTP*)**

  -If using an SDP file, is the correct SDP file (z3-dm8107.sdp) being used and "Dest Port" set to 5004?

  Contact Z3 Technology to obtain an SDP file for default streaming settings.

- **Problem: I do not see video in VLC. (*RTSP*)**

  -If using the RTSP URL, is the version of VLC version 2.1.5 or newer?

  -Are all firewalls on the network turned off?

  -Try connecting the PC directly to the encoder without any routers, switches, etc.

  -Is the Dest Port field in the user interface set to 554? This field denotes the port used by a simultaneous RTP stream. Try using a port that is not 554. 5004 is the default.

  -Are you using a cellular service network? Some RTSP streaming limitations have been observed with cellular networks. Non-cellular internet networks are recommended.

- **Problem: My multicast stream is not reaching multiple networks. (*UDP*)**

  -By default, the TTL value of a multicast stream sent from the Z3Stream is set to 1. To reach multiple networks, the TTL value may need to be increased. The TTL value for multicast addresses can be changed by adding **/#** to the end of your multicast address. For example, to set the TTL to 5, you can enter **225.1.2.3/5** as the Dest Address.

When contacting Z3 Technology for additional support, please click the **Download device logs** *button in the System Setup tab of the user interface at the time the problem occurs and send the resulting .tgz file, along with screenshots of all applicable tabs in the user interface to Z3.*

APPENDIX D: Warranty

EXPRESS LIMITED WARRANTY FOR Z3Stream™ VIDEO HARDWARE

1. **Terms of Express Limited Warranty for Z3Stream Video Products.** Z3 Technology, LLC ("Z3") warrants that it will repair or replace, at its election and expense, any hardware which proves to have a defect in material or workmanship. Z3 further warrants that the hardware will perform substantially in accordance with Z3's specifications and related documentation for the hardware. This warranty does not cover software. The hardware is otherwise provided "as is." Z3 makes no other warranties, express or implied or statutory, including warranties of merchantability, fitness for a particular purpose, accuracy or completeness. This Express Limited Warranty will be void if: the label on the hardware bearing the Serial Number is removed, tampered with or defaced; if the enclosure is opened; or the electronics are tampered with or subject to unauthorized repair.

2. **Term Limitations of Express Limited Warranty.** This warranty commences upon shipment of the hardware to the Purchaser and terminates [360] days thereafter.

3. **Z3's Responsibilities Under the Express Limited Warranty.** Z3 shall be responsible for the repair or replacement, at its election, of covered defective hardware and all reasonable labor required to effect such a repair or replacement regarding a warranted failure during the express limited warranty term. All such labor shall be provided by Z3 or at Z3's direction.

4. **Purchaser's Responsibilities Under the Express Limited Warranty.** The purchaser of the hardware shall be responsible for:
    a. The installation, use, maintenance and operation of the hardware as set forth in the specifications and related documentation established by Z3 for the hardware;
    b. Notifying Z3 of any covered claim under this limited warranty in writing within the warranty term set forth above.
    c. Providing proof of purchase with a purchase date within the warranty term set forth above.
    d. Making the hardware available to Z3 or at Z3's direction for any covered warranty repair;
    e. All direct and indirect costs incurred as the result of removal, repair or reinstallation of hardware as may be required to effect any warranted repair;
    f. All administrative costs and expenses resulting from a warranted failure;
    g. Shipping costs to return the hardware to Z3 with regard to a warranty claim;
    h. Loss of revenue, loss of or damage to real and or personal property, and liability to third parties.

5. **Limitation of Z3's Obligations.** Z3's obligations under this express limited warranty shall be waived and voided in cases of:
    a. Abuse, misuse, accident or neglect, including but not limited to any operation, installation, storage, application or maintenance practice not in accordance with guidelines or specifications established by Z3; or
    b. Modifications or repairs of the hardware not authorized by Z3; or
    c. Failure to provide prompt notice to Z3 of a claimed defect; or
    d. Failure to make the hardware available to Z3 or its authorized representatives; or
    e. Normal wear and tear;
    f. Damage that may occur in shipment through no fault of Z3.

(Ref. DOC-ADM-0029-02)

To submit a warranty claim, complete a Return Material Authorization (RMA) request form online at http://z3technology.com/Support/Report-RMA.html. Your receipt with the original purchase and ship date is required for warranty coverage.