Resource Identifier: 100326

Revision 1.0

BROADCAST SYSTEMS

For the moments that matter

Onyx HEVC Encoder Setup Guide

Commercial in Confidence

0. Preface

0.1 About this Document

This document contains relevant information required to identify, install, and control the equipment or system.

Since the available functions can be licensed and depend on the specific implementation, not all the functions and or applications contained in this document may be relevant or applicable to the system you will be working with.

The actual presentation may differ from those in this document due to hardware or software changes.

0.2 Notice about this Publication

While every attempt is made to maintain the accuracy of the information in this product manual, it is subject to change without notice.

Performance specifications are included for guidance. All particulars are given in good faith, actual performance may vary.

0.3 Copyright

0.4 Related Documents

All DTC documents can be downloaded from WatchDox, see *Section 7.1*.

Document	Source
Onyx HEVC Decoder Setup Guide	DBS – 100327

0.5 Document History

This is a controlled document, written and produced by the DTC Technical Publications team. Changes are recorded in the table below.

Revision	Date	Author	Summary of Changes
1.0	06/02/2023	IR	First release

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1. Product Overview

1.1 Description

Onyx HEVC is a broadcast quality H.265 encoder, offering exceptional compression ratios on video resolutions up to 4K UHD. The Onyx Encoder is ideal for remote production applications over leased lines or satellite, handling 4x HD or 1x UHD/4K feed with ultra-low latency.

Onyx is a feature-rich family of professional broadcast encoders and decoders. Onyx encoders can stream across dual networks using a variety of IP formats including SRT, at bitrates of up to 120Mb/s. The use of ST2022-7 technology at the decoder ensures glitch free recovery from network errors or path fail over. For legacy systems and satellite modem connection the Onyx encoder is equipped with ASI inputs and outputs. Built in encryption mechanisms such a BISS and DES can be employed to protect valuable content.

The unique quad mode allows four non-synchronous HD inputs to be encoded with end-to-end latencies as low as 40ms, this high density and low latency of encoding is ideal for the coverage of live sporting events.

Each video output can support 2 stereo pairs of embedded audio or a single video can support 8x stereo pairs. Onyx can also be equipped with an optional analogue audio interface allowing two stereo analogue audio outputs as well as return ‘talk back’ audio interfaces.

SFP cages are provided for ST2110 interfacing (OPTION)

The separate control port offers web browser control and a front panel is supplied for local control and monitoring.

A dual input power supply is provided for use where redundant power systems are available.

1.2 Basic Specifications

Power Input	90-255VAC 9-36VDC (option)
Dimensions	482mm x 352mm x 1RU
Weight	2.9kg

Note: Detailed technical specifications are given in the product datasheet. Please contact DBS for latest specifications.

1.3 Approval Notices

1.3.1 EMC/Safety and CE Marking

The equipment has been designed to meet and has been tested against harmonized EMC and safety standards. The CE Declaration of Conformity as well as the technical file are available on request.

2. Product Package

2.1 Overview

Carefully open the packaging and verify that all the parts have been included, as ordered. Retain the packing materials for storage.

The part numbers are useful for identification and if you need to order a new part.

Note: If you do not have all the parts or are not happy with the condition of your delivered product, please contact DTC. See *Section 7.2*.

2.2 Variants

This part number will identify the product; it is also on the label.

Part Number	Description
ONYX-E-RACK	Onyx HEVC ultra-low delay encoder high feature set IP output

2.3 Hardware Options

If you have purchased any of these items, they will be included in the assembly.

Part Number	Description
*HWOPT-25G	Dual ST2110-25G I/O
HWOPT-AUD	Analogue audio I/O
HWOPT-DCIN	Convert one AC input to DC 9-36V
*ONYX-ST2110-25-E	Quad ST2110-25G input

* Future development

2.4 Licensing Options

Some product functions are enabled by licenses. The license for your product can be viewed in the control software.

Part Number	Description
LIC-4K-TX	Enable 4K/UHD encoding
LIC-BISS1-ENC	Enable BISS 1 encryption
LIC BISS2-ENC	Enable BISS 2 encryption
*LIC-JPEG2K-XS-ENC	Enable JPEG-XS encoding

* Future development

3. Connections, Controls, and Indicators

3.1 Introduction

This chapter will help identify all the connections and interfaces of the product needed to install, control, and monitor the device.

CAUTION: There are air vents on the front and side panels to aid cooling of internal components. Please take care not to obstruct these vents to avoid overheating of the device.

3.2 Front Panel

No.	Item	Connection
1	On/off switch	Power control switch.
2	Touchscreen display	When fully booted (approx. 90s), the touchscreen display can be used for limited IP configuration and video/audio monitoring. **Note**: The web user interface should be used for detailed configuration of the Onyx IP Encoder.

3.3 Rear Panel

No.	Item	Connection
1	IEC inlet	90-255VAC IEC mains input.
2	IEC inlet	90-255VAC IEC mains input. **Note**: HWOPT-DCIN allows for a 9-36VDC input option via a Hirose 6-way (male) connector.
3	RJ45 jack	Gigabit Ethernet connection. **Note**: The label is notional and is used to differentiate the connection.
4	SFP+ cage	10G SFP auxiliary port. Modules may be fitted for SDI video output.
5	High density BNC (female) x 4	SDI 1 video output supports 12G/6G/3G-SDI video formats. SDI 2 video output supports 6G/3G-SDI video formats. SDI 3 video output supports 3G-SDI video formats. SDI 4 video output supports 3G-SDI video formats.
6/7	RJ45 jack	Gigabit Ethernet connection. **Note**: The label is notional and is used to differentiate the connection.
8	D-Sub 9-way (male)	Serial data interface. See *Section 3.4.1* for pinout.
9	High density BNC (female)	ASI video output.
10	High density BNC (female)	Genlock input for studio synchronisation.

3.4 Pinout

3.4.1 Serial Data

Pin	Function
1	N/C
2	RS232 TX2
3	RS232 RX2
4	N/C
5	0V
6	RS232 TX1
7	RS232 RX1
8	N/C
9	0V

Note: RS232 2 settings are configurable in the web interface **Serial** page. RS232 1 can be used as a console interface for controlling the unit using MASH-CLI, the settings are fixed but can be viewed in the web interface.

4. Web Browser Control

4.1 Introduction

The Onyx IP Encoder has a comprehensive web user interface (WUI) for detailed monitoring and control. The WUI is accessed via a web browser using the IP address of the Onyx, so an Ethernet connection from the **Control**, **STREAM A** or **STREAM B** port to a PC device is required.

Our devices are shipped to you with the IP DHCP setting enabled. This means that if the Onyx is connected to a network which is administered by a DHCP server, the IP address will be automatically assigned. If the device is connected to a network which does **not** have a DHCP server, contact your Network Administrator for an IP address you can use.

The IP address can be discovered via the web interface, Device Finder application, or via the front panel, see *Section 4.3*.

Note: If you are using a standalone PC or laptop, you will need to set the IP address of the PC to match the IP address range of the device. Refer to *Section 6.1* to find out how to do this.

4.2 Power

The Onyx IP Encoder is powered directly from a mains supply via an IEC lead. Two connections are provided for supply redundancy. There is a switch on the front panel which can be used to power the unit On or Off.

When the unit has been switched on, it will take approximately 90s to boot-up, indicated when the front panel display becomes active.

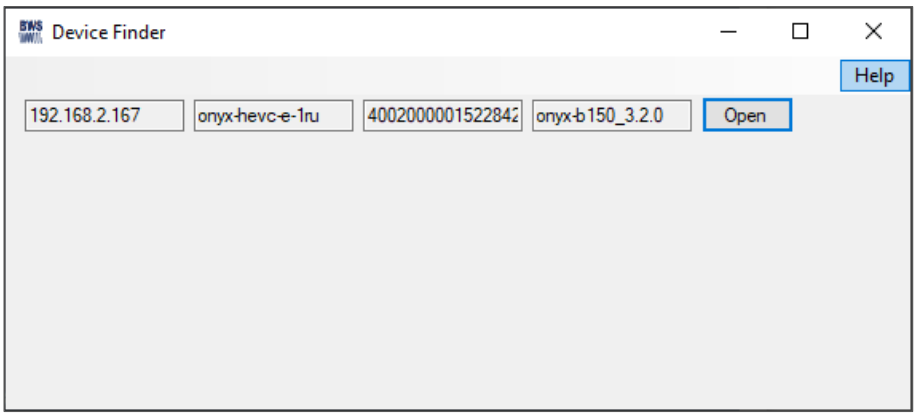
4.3 IP Address Identification

4.3.1 Device Finder

Device Finder application can be used to identify DBS product IP addresses on a network.

Device Finder comes as a simple executable file which can be downloaded from DTC's WatchDox facility, see *Section 7.1*. This can be saved to the PC desktop.

Double-click the Device Finder executable to open the application. All DBS devices attached to the network will be detected. Click **Open** to initialise communications with your PC's default web browser.

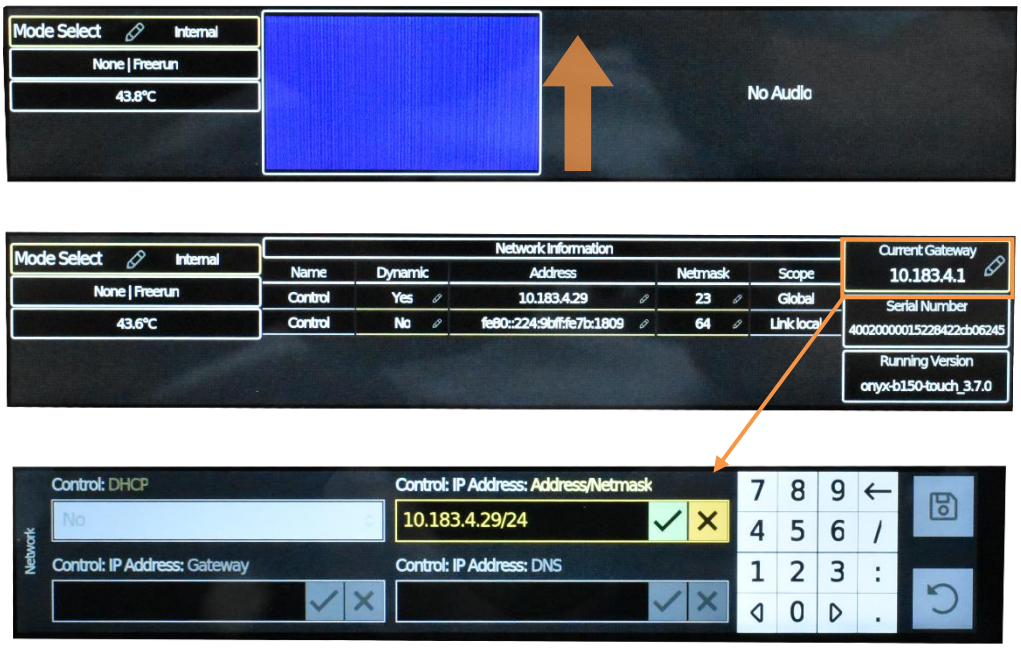


4.3.2 Front Panel Touchscreen

The IP address of the Onyx can be found and edited, if required from the front panel touchscreen. This can be useful if the device is not connected via a DHCP server, or the IP address does not match the subnet of the PC and the IP address settings need to be changed.

The IP address can be discovered by swiping up on the touchscreen to find the **Network Information** page.

The IP settings can be edited by pressing the **Current Gateway** parameter. IP addresses must be entered in CIDR notation, see description in *Section 4.4.2*.



4.3.3 IPv6 Address

DBS products support link-local IPv6 addressing. This will allow web browser control if the device is not connected via a DHCP server, or the IP address does not match the subnet of the PC.

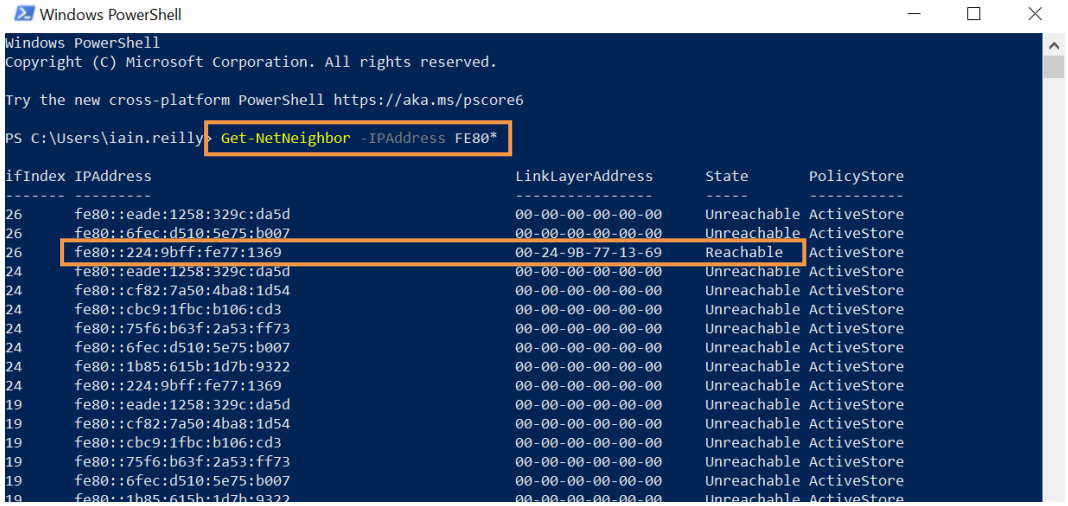
Enter the IPv6 IP address into your web browser using square brackets around the address, e.g., https://[fe80::224:9bff:fe77:1369].

The IPv6 address of the Onyx can be discovered from the front panel touchscreen, see *Section 4.3.2* above.

Alternatively, the IPv6 address can be discovered from Windows Powershell by entering the command:

*Get-NetNeighbor -IPAddress FE80**

The IP address for the Onyx must have a **Reachable** state.



4.4 Open the Web Interface

4.4.1 Initial Communications

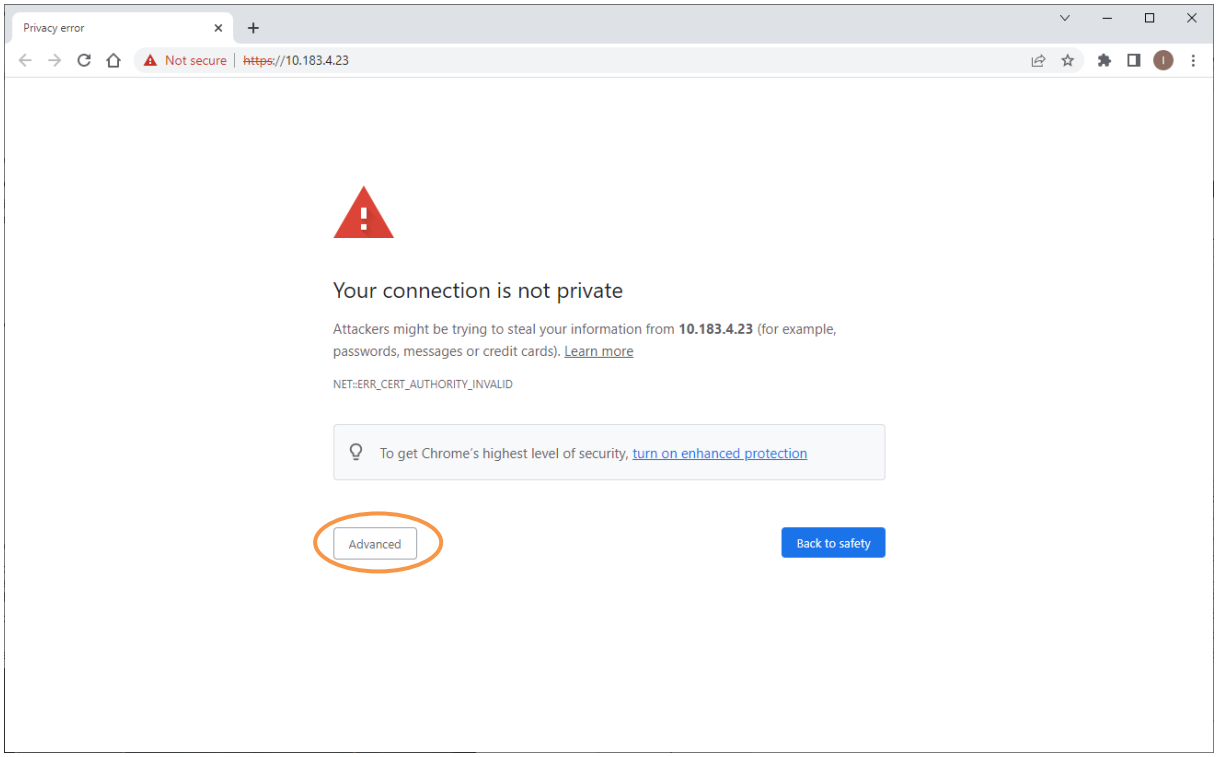
Once the IP address has been confirmed, open a web browser on a PC device and enter the IP address of the Onyx in the address bar.

Note: If using the IPv6 address, enter the IP address into your web browser using square brackets around the address, e.g., https://[fe80::224:9bff:fe77:1369].

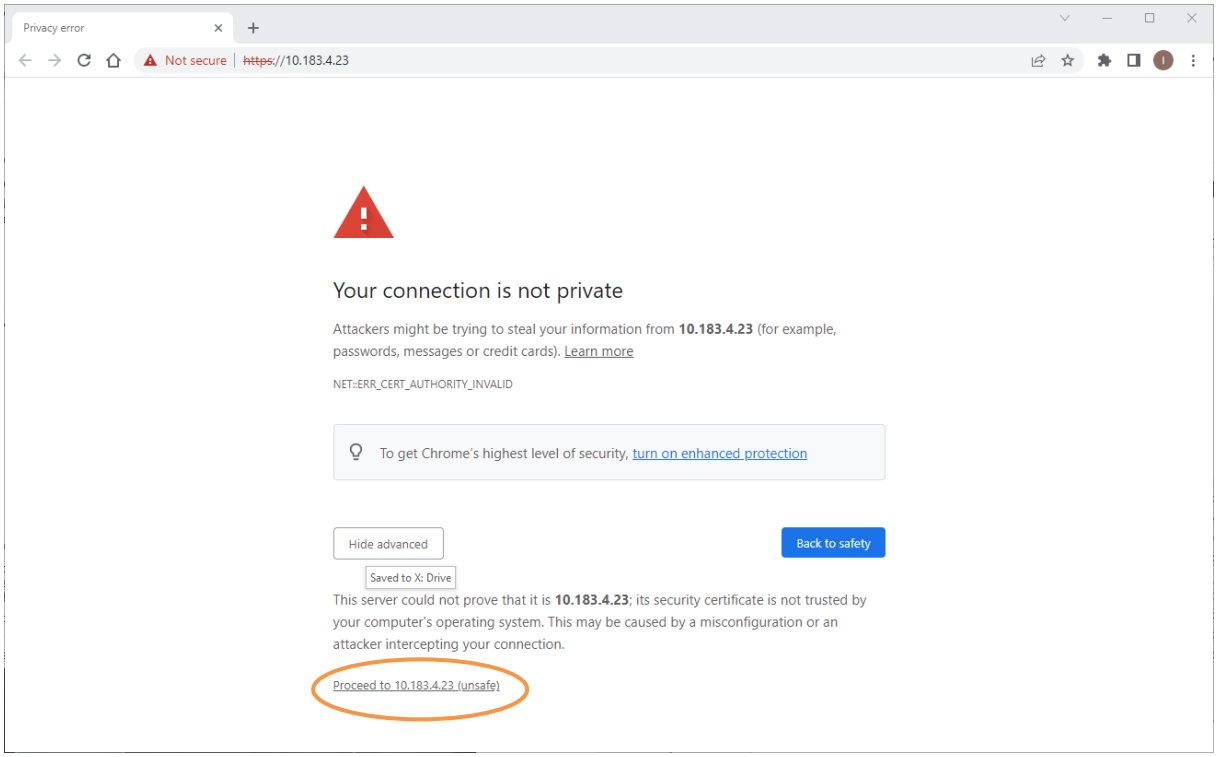
Alternatively, if running Device Finder, click **Open** on the line of the device address.

Onyx devices have a pre-installed self-signed HTTPS certificate, the first time web communications are established, it will be necessary to trust the address.

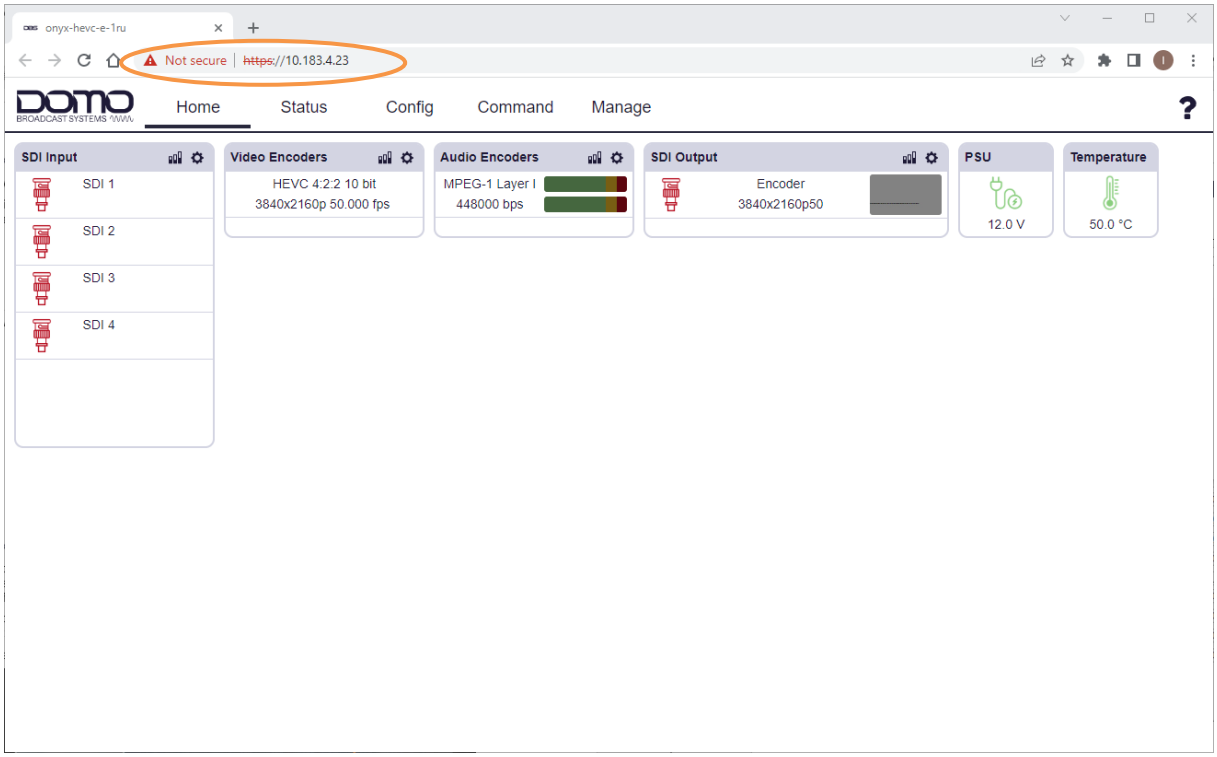
The presentation of the web page will differ depending on the browser application; the following example is Google Chrome. Click on **Advanced** to proceed.



Click **Proceed to <*ip_address*> (unsafe)** to open the web user interface.



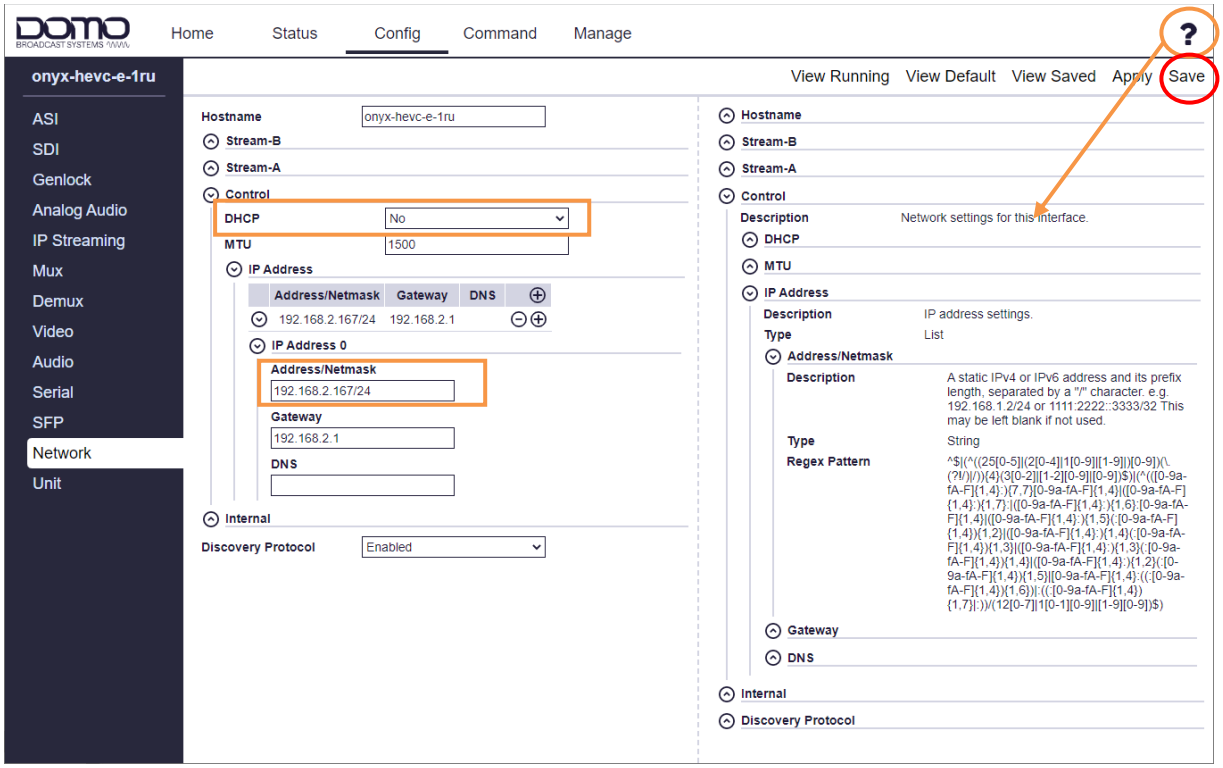
The browser will indicate that the site is connected by HTTPS but is not secure.



4.4.2 IP Address Configuration via Web User Interface

To re-configure the IP address via the web interface, go to the **Config>Network** page.

Note: It may be useful to open the **Help** (?) menu for descriptions of settings.



Change the **DHCP** setting to **No** if you do not want the unit to set the IP settings from a DHCP server.

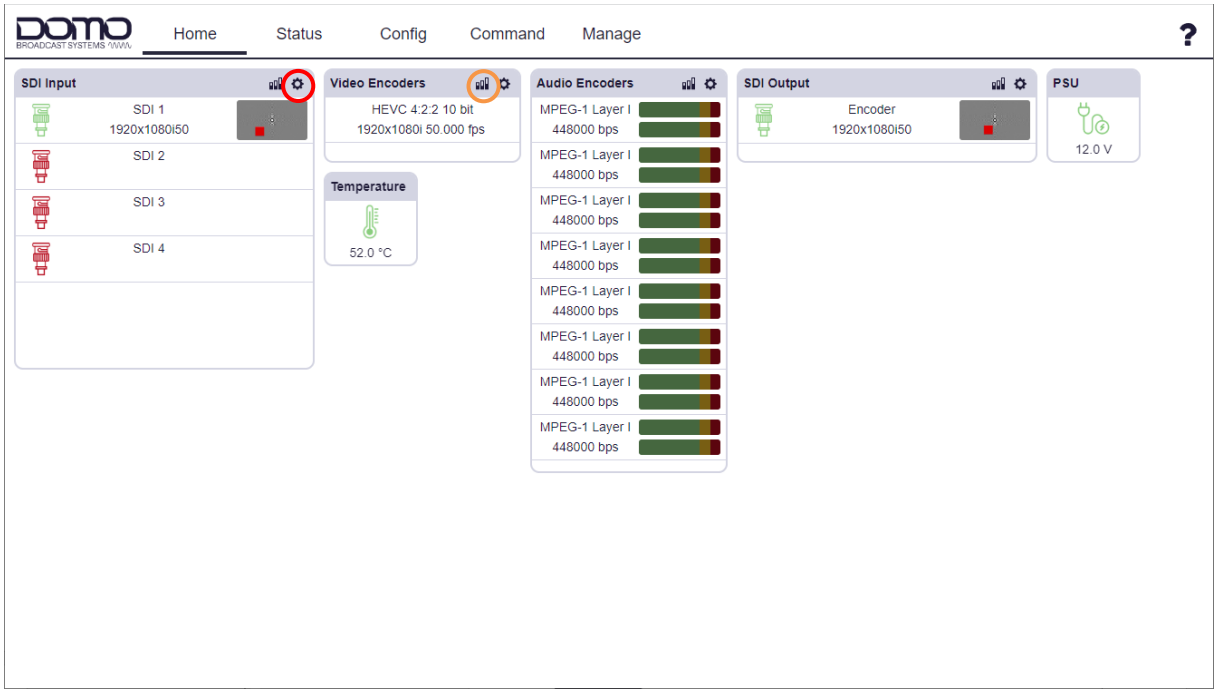
The **IP Address/Netmask** parameter is written in CIDR notation. This is a compact representation where the IP address is followed by a slash (/) and then a decimal number which indicates the count of leading 1-bits in the network mask.

For example, an IP address 192.168.0.15 with a netmask of 255.255.255.0 would be written in CIDR notation as 192.168.0.15/24, where the first 24-bits of the IP address are masked. See *Section 6.2* for a table of subnets mapped to CIDR values.

Click **Apply** to activate a running config and **Save** to retain.

4.5 Home Page Overview

The Home page provides a dashboard of information relating to currently active configurations. There are shortcuts to Config pages (red circle) or Status pages (orange circle).

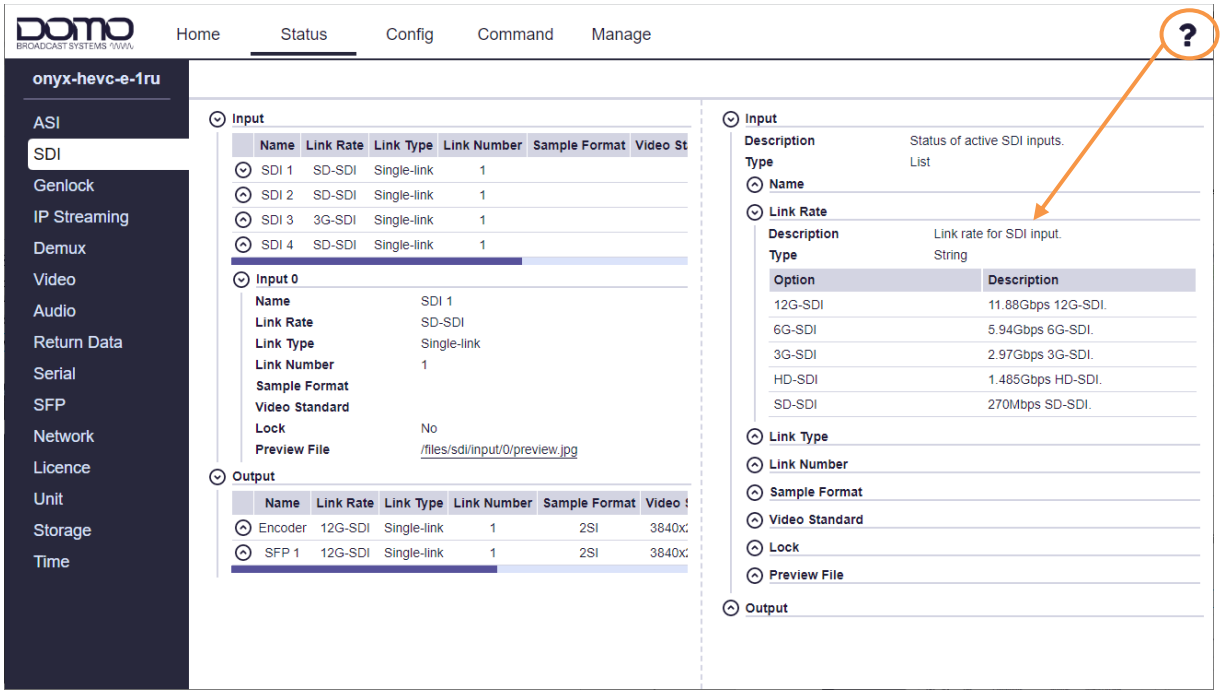


4.6 Status Pages Overview

The Status pages are provided giving detailed information for the Onyx IP Encoder. Select the category you want to view from the list on the left panel.

Menus can be expanded or collapsed using the arrows adjacent to the header of each parameter.

Note: It may be useful to open the **Help** (?) menu for descriptions of settings.

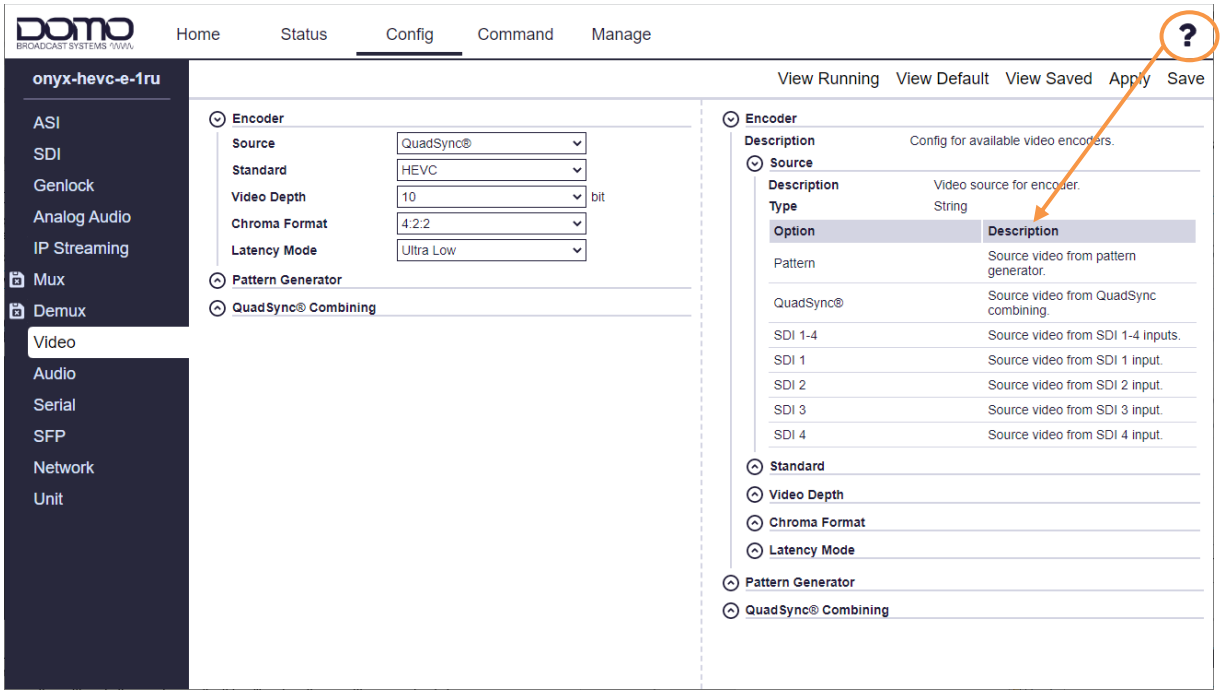


4.7 Config Pages Overview

The Config pages are used to make changes to configuration settings. Select the category you want to edit from the list on the left panel.

Menus can be expanded or collapsed using the arrows adjacent to the header of each parameter.

Note: It may be useful to open the **Help** (?) menu for descriptions of settings.



Changes to settings can be applied or saved. It is important to understand the differences:

- **Apply** – applies the setting to the running config, this does not save the setting. On reboot the unit will return to the saved settings.
- **Save** – saves the settings in the running config, this will restore these settings on reboot. To save a change, it must be applied first.

Note: Categories on the left panel marked with a save icon , indicate that they have been applied but not saved. To carry out a global save, go to the **Manage>Config** page.

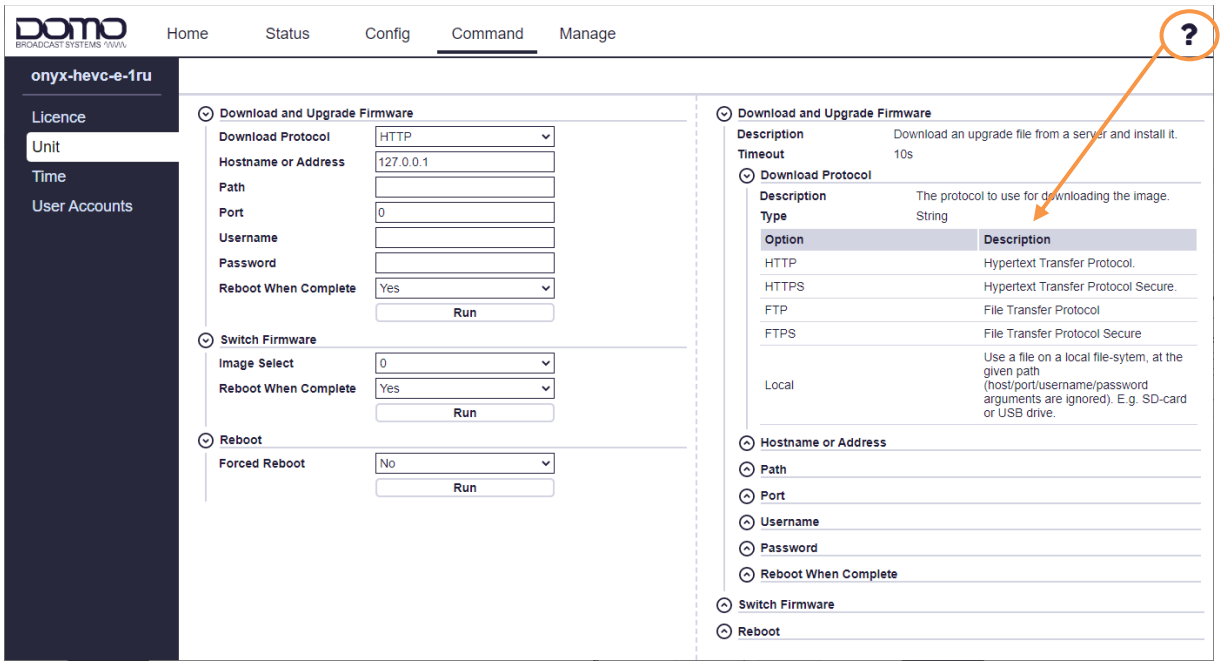
4.8 Command Pages Overview

The Command pages are used to send commands to the device, or upgrades via external servers.

Select the category you want to send commands to from the list on the left panel.

Menus can be expanded or collapsed using the arrows adjacent to the header of each parameter.

Note: It may be useful to open the **Help** (?) menu for descriptions of settings.



4.9 Manage Pages Overview

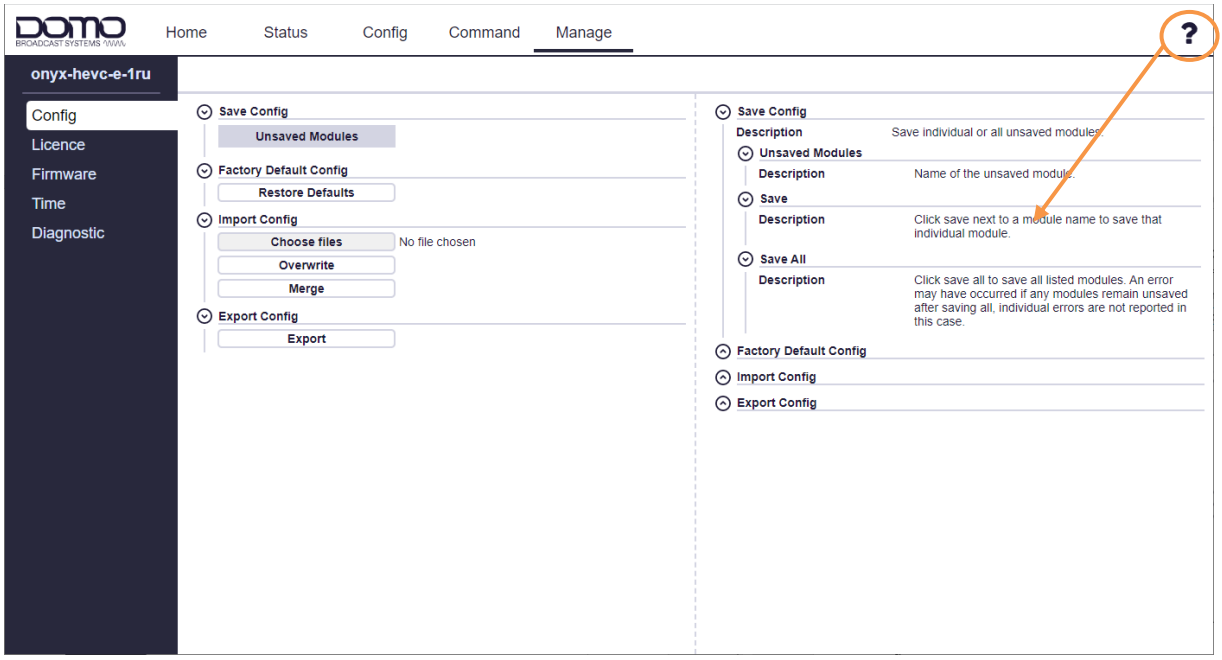
The Manage pages are used for maintenance of the Onyx IP Encoder internal software and settings.

Select the category you want to manage from the list on the left panel.

Menus can be expanded or collapsed using the arrows adjacent to the header of each parameter.

Note: It may be useful to open the **Help** (?) menu for descriptions of settings.

CAUTION: If performing a firmware upgrade, please ensure the correct upgrade files are being applied according to the hardware, i.e., touchscreen encoders have touchscreen firmware.



5. Basic Setup Guide

5.1 Introduction

The sections in this chapter can be used in conjunction as a workflow to complete a system configuration.

Currently only limited setup can be achieved via the front panel touchscreen, therefore, only web interface configuration is covered.

Only settings for the Onyx IP Encoder are explained, it is assumed that the inputs to the system are provided.

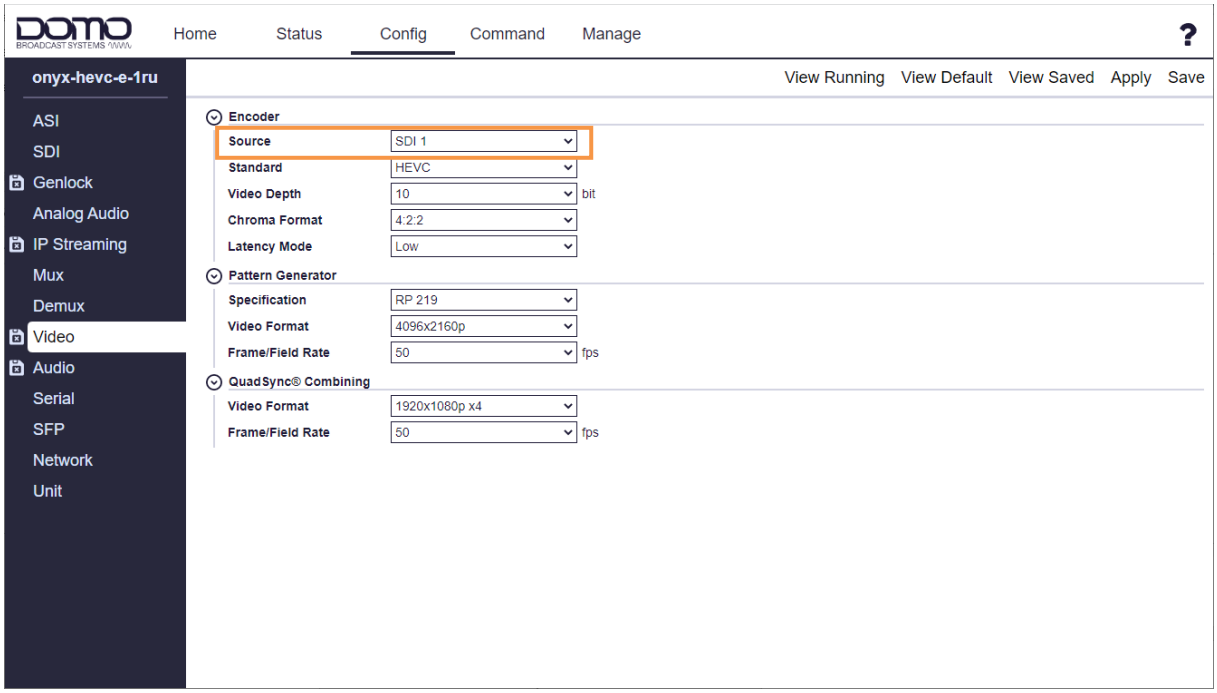
5.2 Video Input

The Onyx IP Encoder can be configured to receive a video input which can be used as a source for an IP streaming output or the Demux service.

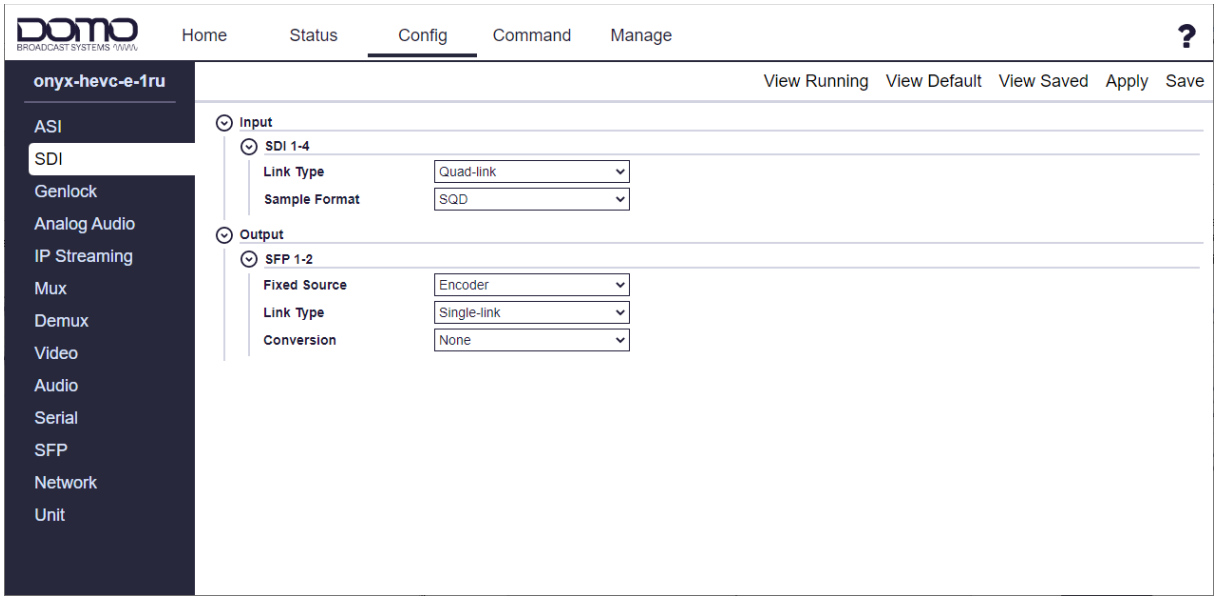
DBS' **QuadSync®** mode allows four non-synchronous HD-SDI inputs to be encoded into one output which can be decoded at the DBS receive device.

Note: The **Pattern Generator** can be used to test video through the system prior to a live transmission.

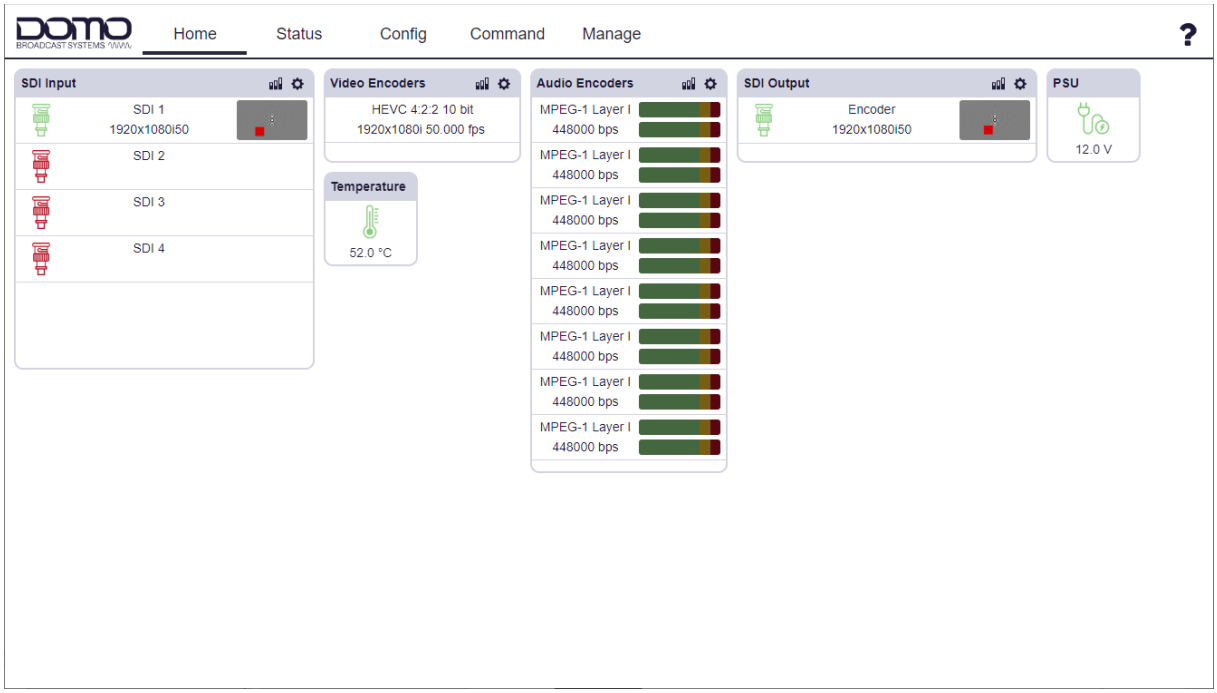
Go to the **Config>Video** page and set the **Encoder Source** for the physical video input port. This example shows a single source SDI video input.



Depending on the video input, it may be necessary to configure **SDI** settings. For a single video input this should not necessary.



Video input lock can be verified on the front panel touchscreen and on the WUI **Status** and **Home** pages.



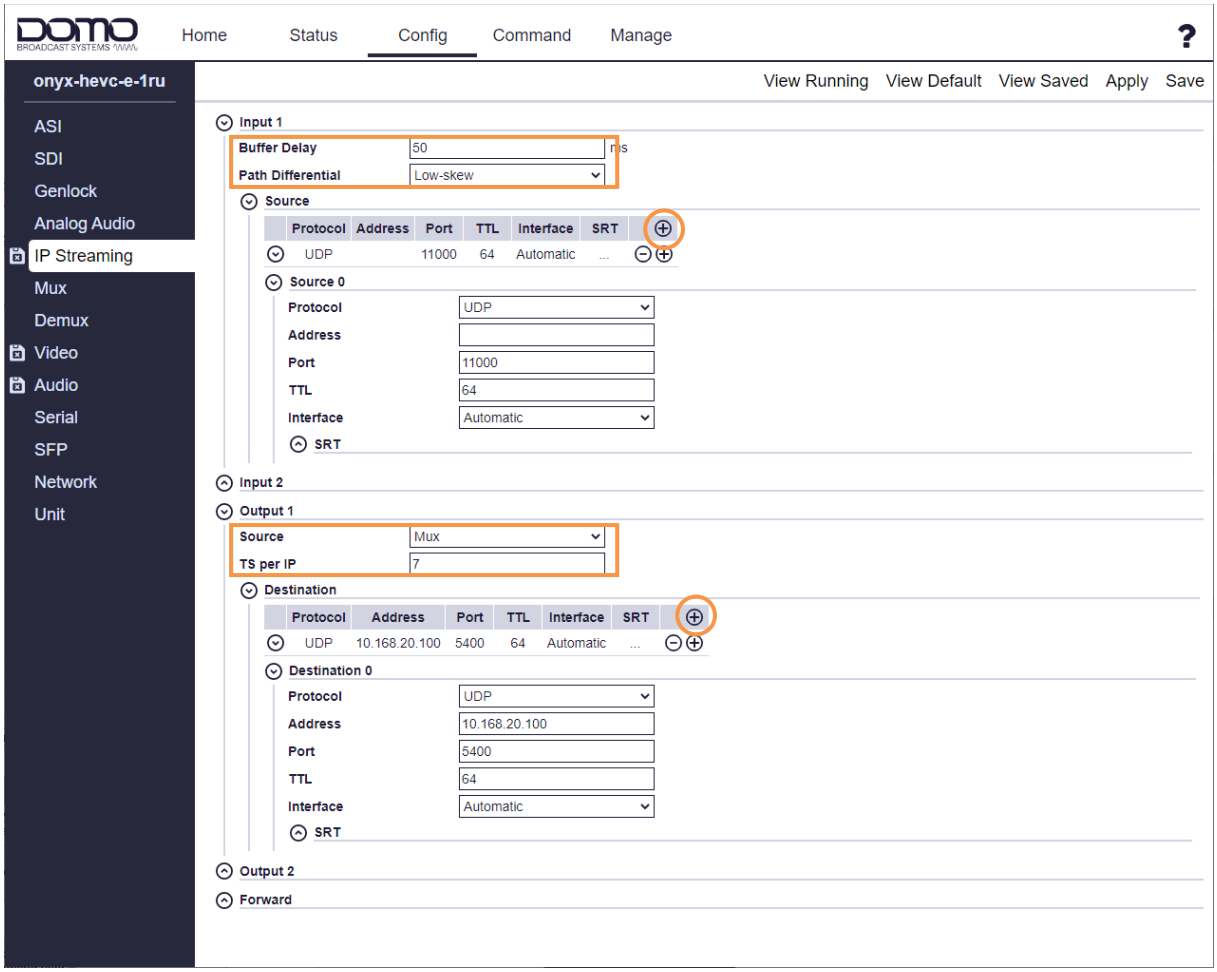
5.3 IP Streaming

5.3.1 IP Streaming Overview

The Onyx IP Encoder can be configured as an IP streaming input (IP1/IP2) which can be used as a source for the ASI output, the IP streaming output or the Demux service. Setting the Demux to IP1/IP2 will allow you to encode from the IP input.

Go to the **Config>IP Streaming** page, click the **+** button (orange circle) to create new input/output settings. Up to two streams per input/output can be applied for redundancy or in SMPTE 2022-7 networks, see *Section 5.3.4*.

Once settings have been entered, click **Apply** to activate a running config and **Save** to retain.



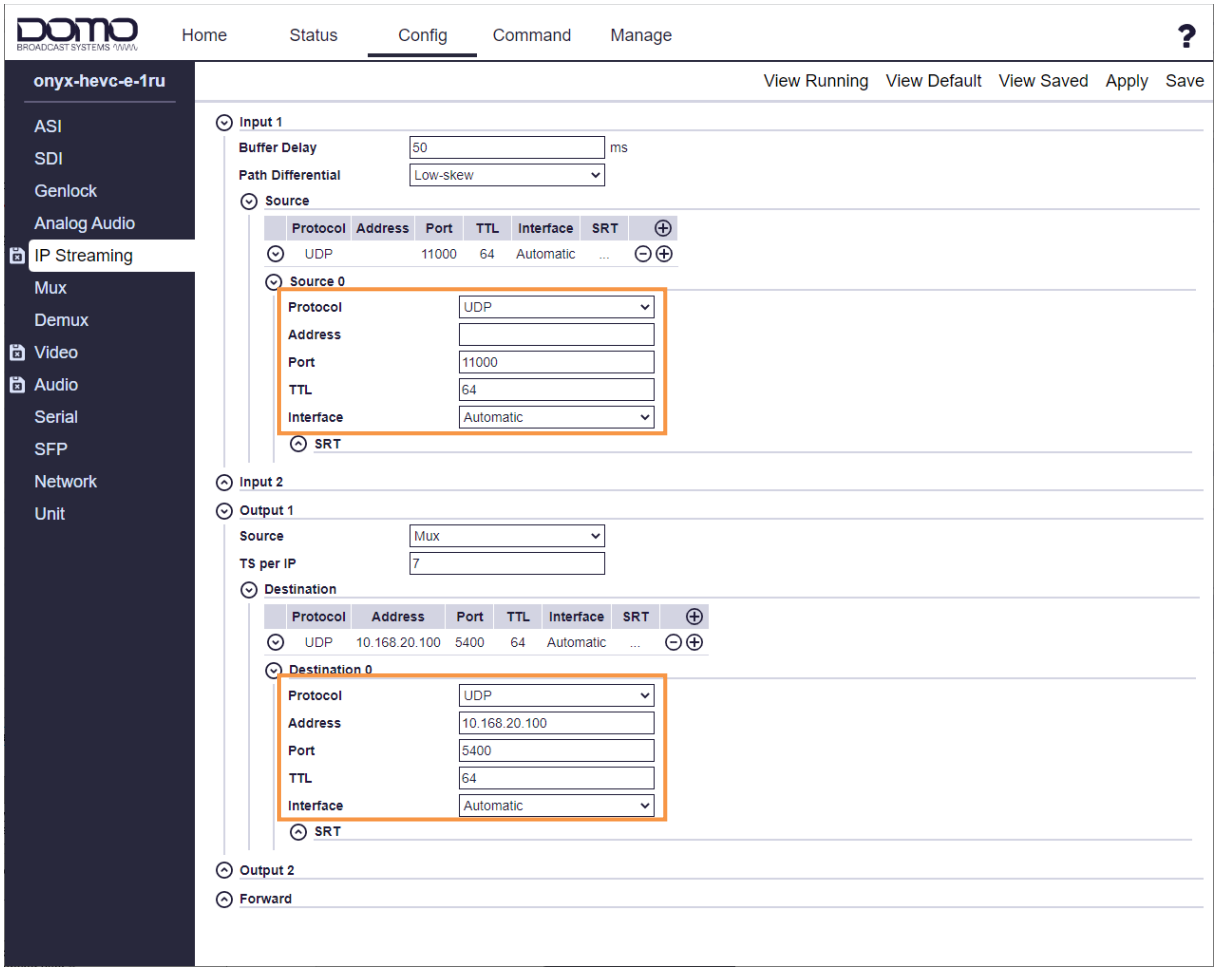
Note: Streaming status can be monitored in the **Status>IP Streaming** page, see *Section 5.3.5*.

Item	Notes
Buffer Delay	IP packets can be received unevenly which causes jitter. This setting will make the flow of data smoother by adding a delay to the input stream.
Path Differential	The path differential is a delay difference between sources when there are different routes to the destination, for example in SMPTE 2022-7 systems, see *Section 5.3.4*.
Source	Set the source of the output stream. If using IP1 or IP2, ensure the input settings are configured.
TS per IP	The number of transport stream packets in each IP packet. Leave this at the default value of 7 unless an advanced user.

5.3.2 UDP/RTP IP Streaming

Unicast Streaming

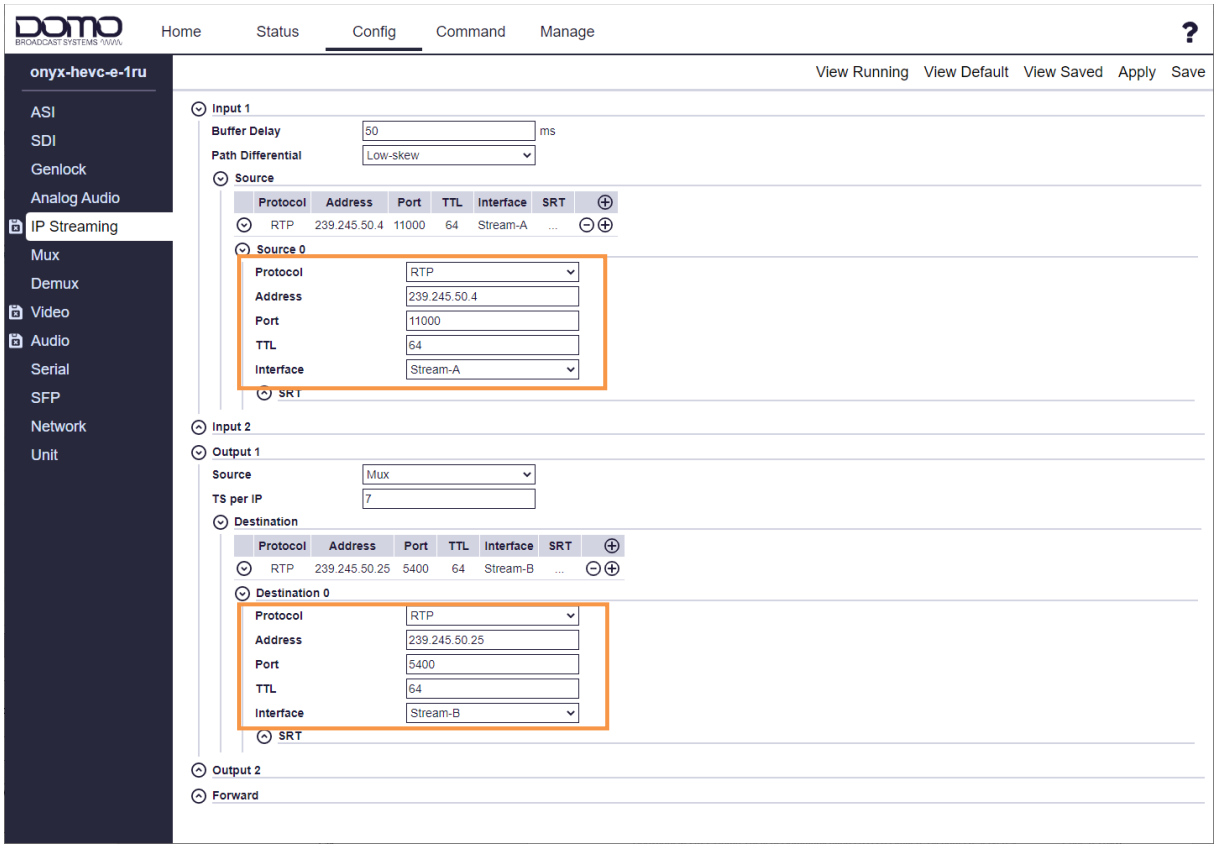
Unicasting is one-to-one streaming between a sender and receiver. The Onyx can be configured as an input, output or both.



Item	Notes
Protocol	UDP, RTP or SRT. **Note**: See *Section 5.3.3* for SRT details.
Address	When configuring an **Input**, it is not necessary to enter an address. When configuring an **Output**, enter the IP address of the destination device.
Port	Port numbers are used to identify IP address connections.
TTL	The time to live value limits how long data circulates in a system.
Interface	This will set the physical interface that the unicast is received on.

Multicast Streaming

Multicasting is one-to-many streaming between a sender and multiple receivers. The Onyx can be configured as an input, output or both.



Item	Notes
Protocol	UDP or RTP.
Address	Enter the multicast stream address that is being received or sent. The multicast address range is 224.0.0.0 to 239.255.255.255. For more guidance on multicast addressing, see *Table 5-1*.
Port	Port numbers are used to identify IP address connections.
TTL	The time to live value limits how long data circulates in a system.
Interface	This will set the physical interface that the multicast is expected on. When multicast streaming, it is particularly important to select the actual interface being used.

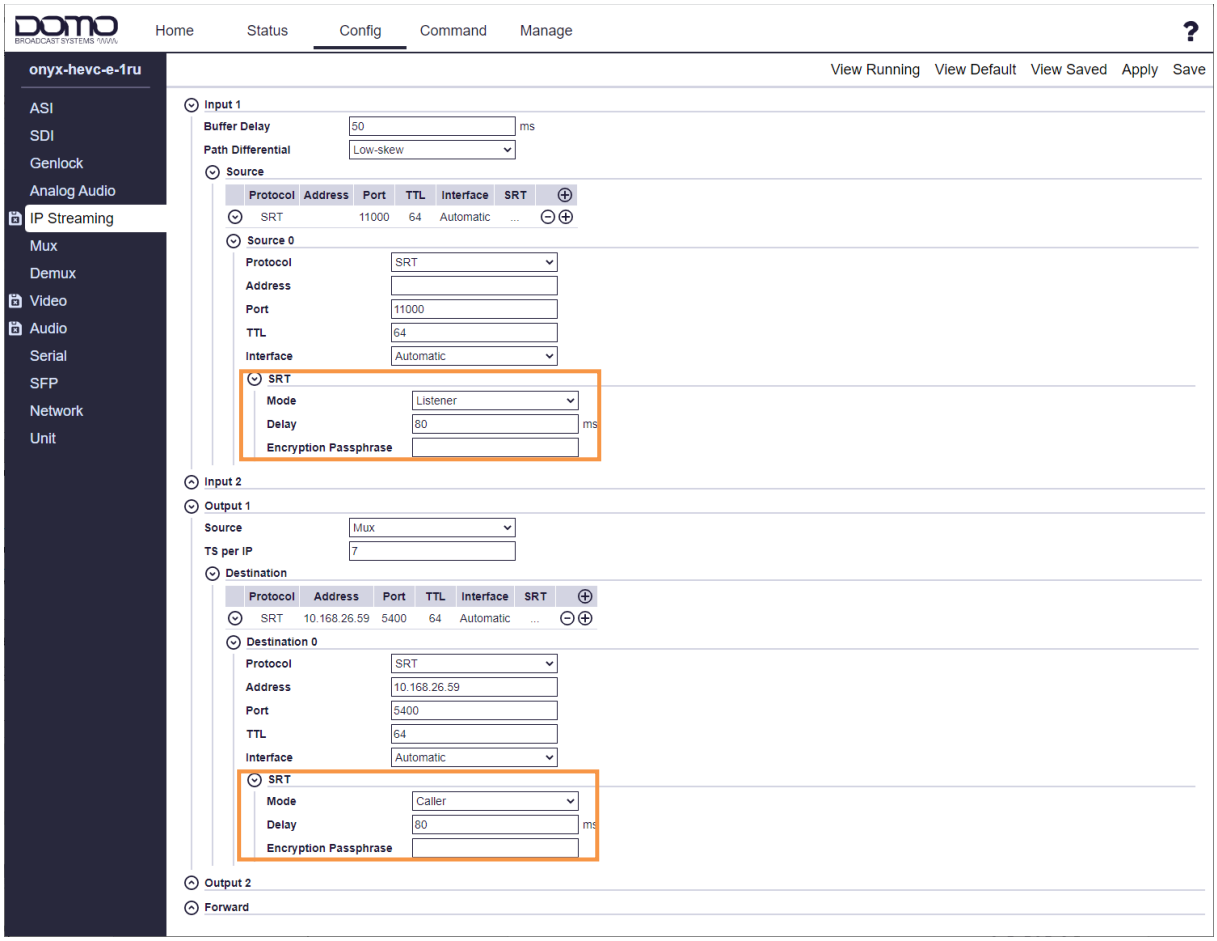
Start Address	End Address	Description
224.0.0.0	224.0.0.255	Reserved for special well-known multicast addresses
224.0.1.0	238.255.255.255	Globally scoped (Internet-wide) multicast addresses
239.0.0.0	239.255.255.255	Administratively scoped (local) multicast addresses

Table 5-1: Multicast Address Uses

5.3.3 SRT (Secure Reliable Transport) Protocol

SRT is a video streaming transport protocol that delivers secure low latency streaming over noisy or unpredictable (lossy) networks such as the public internet. SRT utilises the UDP transport protocol but adds error checking for reliability.

If SRT streaming is required, the settings for unicast streaming will also need to be configured, see *Section 5.3.2*.

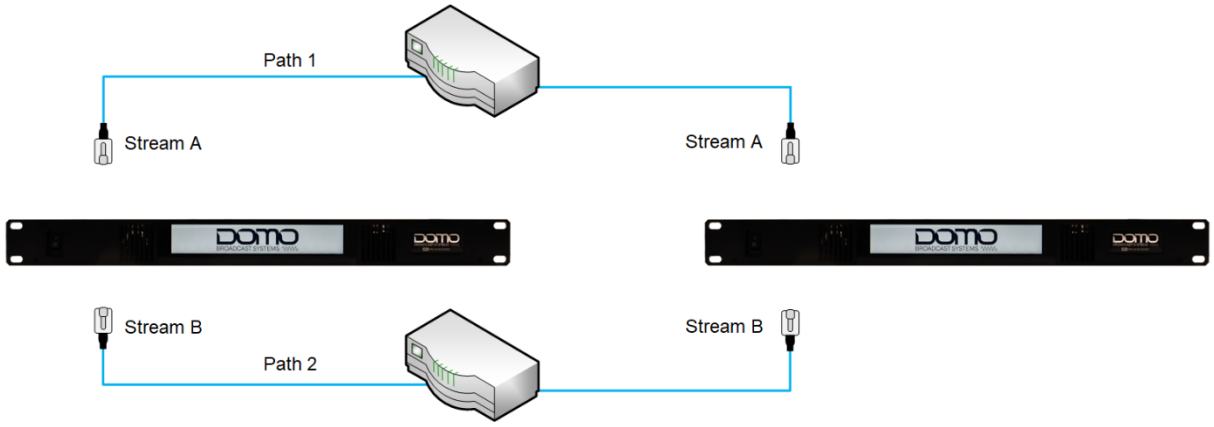


Item	Notes
Mode	The **Caller** initiates the outbound call to the Listener. The Caller can be an input (receiver) or output (sender). The **Listener** waits for an inbound connection from the Caller. The Listener can be an input (receiver) or output (sender). **Note**: In a one-to-one setup, it is arbitrary whether the Caller and Listener device is the input or output. However, the input or output must be set to Listener if it is ingesting multiple Callers. A **Rendezvous** server will allow the delivery of messages from one source to another. This can be used to avoid port forwarding via a router.
Delay	The delay ca be adjusted to account for dropped packets. The delay will depend on the round-trip time (RTT) and the packet loss. This is advised in the web page help guide.

Item	Notes
Encryption Passphrase	SRT includes an AES128 encrypted passphrase. This must be matched in the input and output device. If this is left blank, no encryption will be applied.

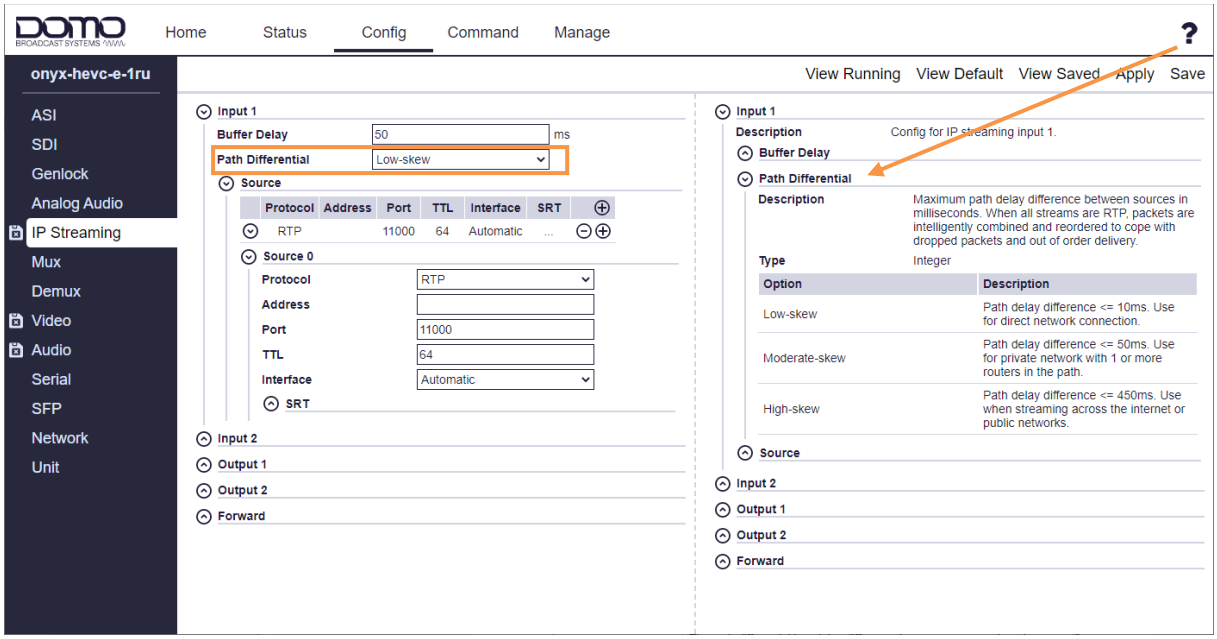
5.3.4 SMPTE-2022-7 Networks

The Onyx IP Encoder is SMPTE-2022-7 compliant. SMPTE 2022-7 IP networks allow for the recovery of lost packets by generating two streams with the same data using different routes to the destination. If a packet was lost at the receiver on path 1, the packet is taken from path 2 and vice versa. To be able to switch between path 1 and path 2 packets seamlessly, some buffering is needed to deal with the delay difference or jitter (can be observed in the **Status>IP Streaming** page).



Adjust the **Path Differential** setting depending on the distance between the sources, the options are explained in the Onyx web page help guide.

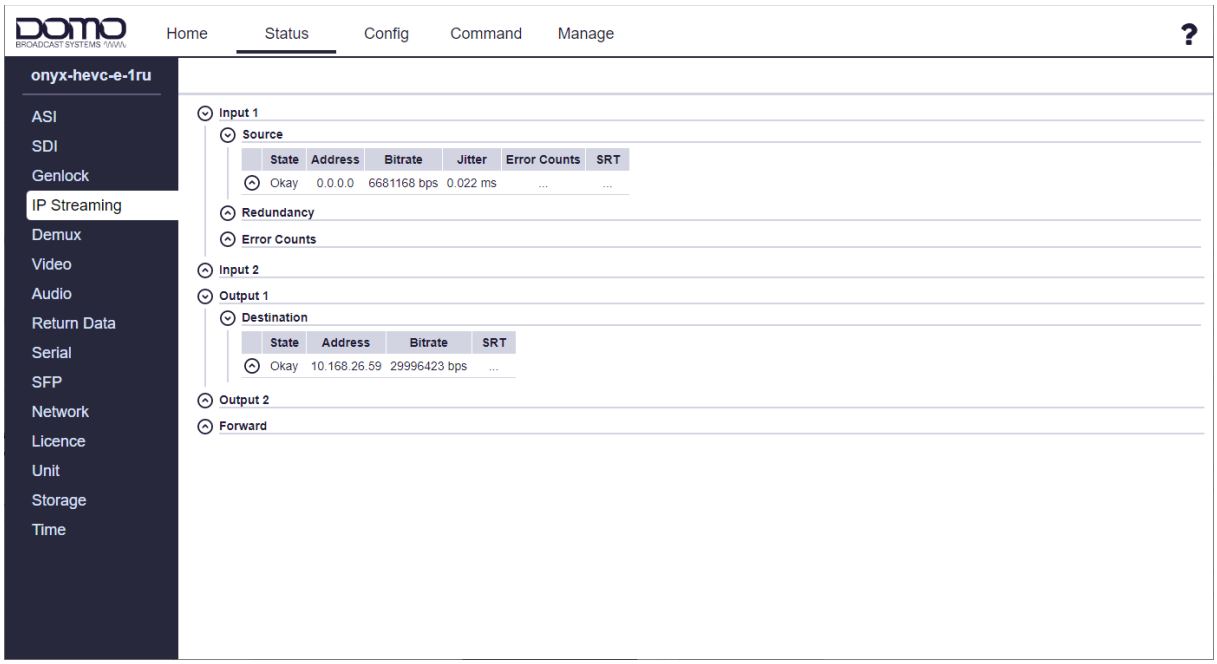
UDP/RTP settings for unicast or multicast will also need to be configured, see *Section 5.3.2*.



5.3.5 IP Streaming Status

The streaming input and output status can be monitored in the **Status>IP Streaming** page.

Jitter and error count measurements are key performance indicators which can be corrected by adjusting buffer delay parameters in the setup.



6. Appendix A – Reference Material

6.1 How to Configure a PC IP Address

The following guide will tell you how to configure a PC or laptop IP address so that it matches the IP address range of the unit you are connected to. This is important because if they don't match, you will not be able to communicate with your device.

The IP address range given in this example is a good one to use if you are unsure.

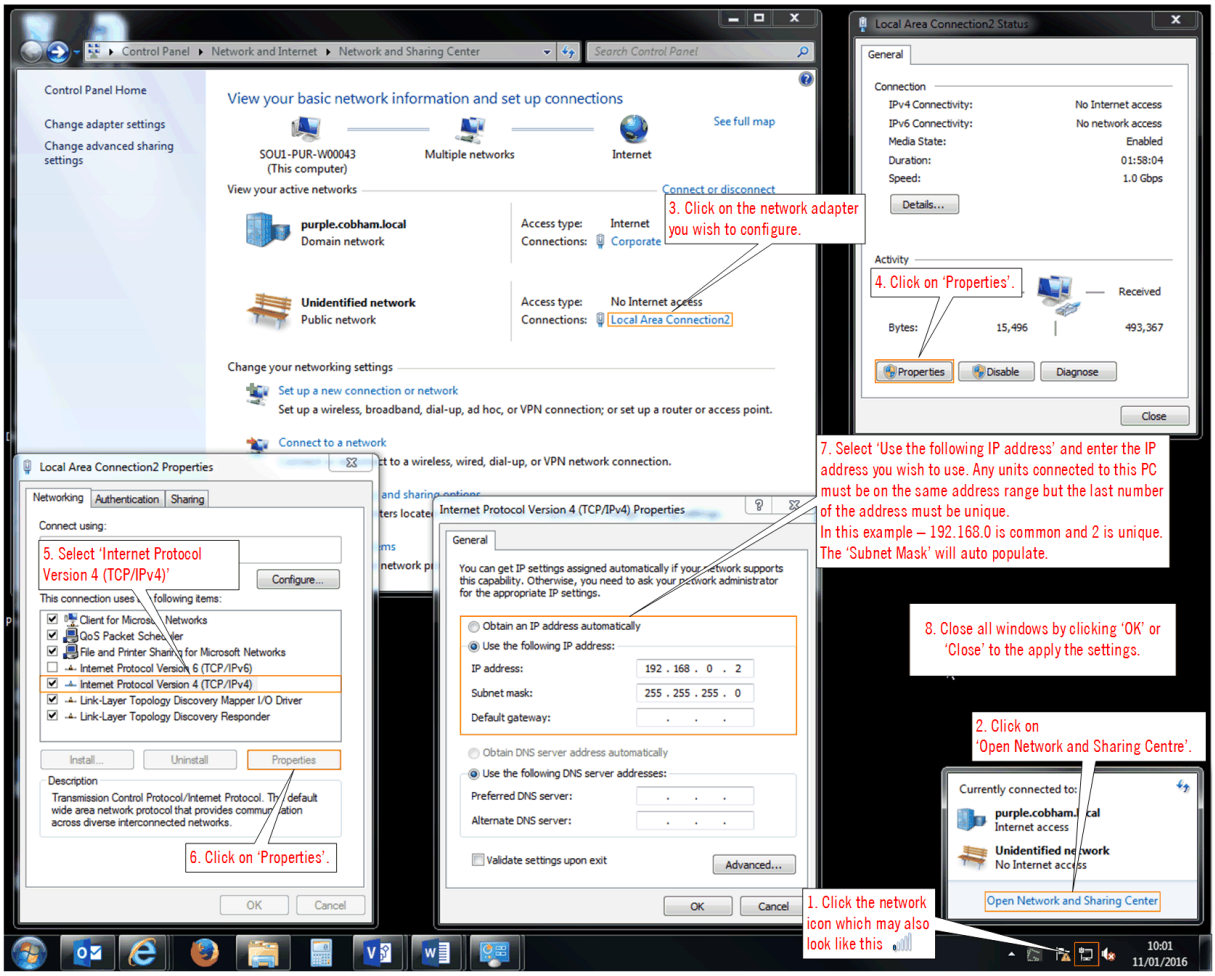


Figure 6-1 How to configure a PC IP address

6.2 Subnet with CIDR Values

CIDR	Subnet Mask
/32	255.255.255.255
/31	255.255.255.254
/30	255.255.255.252
/29	255.255.255.248
/28	255.255.255.240
/27	255.255.255.224
/26	255.255.255.192
/25	255.255.255.128
/24	255.255.255.0
/23	255.255.254.0
/22	255.255.252.0
/21	255.255.248.0
/20	255.255.240.0
/19	255.255.224.0
/18	255.255.192.0
/17	255.255.128.0
/16	255.255.0.0

CIDR	Subnet Mask
/15	255.254.0.0
/14	255.252.0.0
/13	255.248.0.0
/12	255.240.0.0
/11	255.224.0.0
/10	255.192.0.0
/9	255.128.0.0
/8	255.0.0.0
/7	254.0.0.0
/6	252.0.0.0
/5	248.0.0.0
/4	240.0.0.0
/3	224.0.0.0
/2	192.0.0.0
/1	128.0.0.0
/0	0.0.0.0

6.3 Video Resolutions

The following table defines video resolution to the SDI interface.

SDI	Resolution
12G-SDI	2160p60, 2160p59.94, 2160p50
6G-SDI	2160p30, 2160p29.97, 2160p25, 2160p24, 2160p23.98
3G-SDI	1080p60, 1080p59.94, 1080p50
1.5G-SDI	1080p30, 1080p29.97, 1080p25, 1080p24, 1080p23.98 1080i60, 1080i59.94, 1080i50

7. Appendix B – After Sales Support

7.1 Documentation and Software

It is DTC's practise to make the majority of our latest user guides and software available to customers online, by using our WatchDox facility. To access this site, please contact your Account Manager or send a request to uk.technical.support@domotactical.com.

You will be sent a link where you can log in and create your own password followed by a confirmation email. Once you have done this, you can then log in to your account.

7.2 Contact Technical Support

The Technical Support team can be accessed by one of the following:

- **Phone US**: 1 800 665 4648. Monday to Friday 08:30-17:30 (ET)
- **Phone UK**: +44 1489 884 550. Monday to Friday 0900-1730 (UK time)
- **Email US**: dtc.support@domotactical.com (no restricted content)
- **Email ROW**: uk.technical.support@domotactical.com (no restricted content)

7.3 Using the DTC RMA Service

7.3.1 Contact DTC

If there is a problem and our technical support team have been unable to resolve the issue, email dtc.rma@domotactical.com (US) or solent.customerhub@domotactical.com (UK/ROW) to request a Return Material Authorisation (RMA) form.

Note: Alternatively, use the online form at https://www.domotactical.com/support/.

7.3.2 Complete and Return the RMA Form

Complete the RMA form with the following information and return to the customer hub:

- Name
- Address
- Unit serial number
- Date of purchase or the original invoice number
- Date of failure
- A detailed description of the problems you have encountered
- A list of the hardware/software configuration if applicable

When the hub receives the completed form, an RMA number and shipping instructions will be sent.

7.3.3 Pack the Device

Note: Before packing, remove all personal non-DTC kit or media from the device.

Use the original shipping container and packing materials, if possible.

If the original packing materials are not available, wrap the equipment with soft material (e.g., PU/PE form) then put the wrapped equipment into a hard cardboard shipping box.

7.3.4 Put the RMA Number on the Box

Clearly mark the outside of the shipping box with the RMA number. If an RMA number is not present on the shipping box, receiving will be unable to identify it and it might be returned.

7.3.5 Send the Box to DTC

Send the box using your normal shipping process.

8. Appendix C – Safety and Maintenance

Note: The following guidelines may or may not be applicable to your product. However, we would ask that you read them to assess their relevance.

8.1 Cautions and Warnings

Area	Note
Aircraft safety	Use of this equipment on board aircraft is strictly forbidden without the required testing and qualification for aircraft type. Use of radio transmitter equipment in an aircraft can endanger navigation and other systems without appropriate testing, or carry-on certification by a competent certified body.
Cables	Connecting cables should not be positioned where they are likely to become damaged or where they may present a trip hazard.
Electrostatic discharge	ESD guidelines must be followed for this electrostatic sensitive device.
Enclosures	Do not remove any factory installed screws or fastenings as this may void any warranties. There are no functions that require the user to gain access to the interior of the product. There are no user serviceable parts inside.
Environment	The equipment should not be used in hazardous or corrosive atmospheres. Users are reminded of the necessity of complying with restrictions regarding the use of radio devices in fuel depots, chemical plants and locations where explosives are stored and/or used.
Lightning strike	There is a risk of lightning strike to antennas. The equipment should not be assembled in an area at the time of lightning activity. Antennas should be adequately protected from lightning strikes.
Power supply	Ensure that the power supply arrangements are adequate to meet the stated requirements of each product. Observe all electrical safety precautions.
Risk of eye injury	Care should be taken to avoid eye contact with the antennas.
RF emissions	When using this device please ensure 20cm is maintained between your device and your body while the device is transmitting.
Thermal control system	If you operate this device in an enclosed space, you must ensure it has adequate airflow to keep it cool. If worn close to the body, care must be taken to protect the operator from excessive temperatures.
Working at height	Observe caution when locating the device at height, for example on a mast. Ensure the unit is well secured to prevent it falling and injuring personnel.

8.2 Repairs and Alterations

Attempted repairs, alterations, improper installations or connections may invalidate the warranty.

Please contact Technical Support if you suspect a faulty or defective component. See *Section 7.2*.

8.3 Caring for your Equipment

- Do not subject the unit to physical abuse, excessive shock or vibration
- Do not drop, jar or throw the unit
- Do not carry the unit by the antenna
- Avoid exposure to excessive moisture or liquids
- Do not submerse the unit unless it is designed to be submersible
- Do not expose the unit to corrosives, solvents, cleaners or mineral spirits
- Avoid exposure to excessive cold and heat
- Avoid prolonged exposure to direct sunlight
- Do not place or leave units on surfaces that are unstable
- Only use accessories intended for the specific make and model of your unit, especially batteries, chargers and power adapters.

8.4 Charging

- Use approved batteries, chargers and adapters designed specifically for your make and model unit
- Do not attempt to charge a wet unit or battery pack
- Do not charge the unit or battery pack near anything flammable
- Stabilize the battery pack to room temperature (22°C) before charging
- Do not charge units and/or battery packs on wet or unstable surfaces
- Do not leave units and/or batteries in chargers for excessive periods

8.5 Working with Lithium Batteries

- Charge only with the approved charging cable
- Batteries are to be used only for the specified purpose. Incorrect use will invalidate the warranty and may make the battery become dangerous.
- Charge in a clean, dry environment ideally at 10°C (0 to 45°C is permissible).
- Do not store or operate in direct sunlight for extended periods. Battery can be damaged by over-heating, for example if placed on the rear parcel shelf of a motor vehicle.
- Store in a cool dry environment. Storage at elevated temperatures can cause permanent loss of capacity.
- For short term storage (less than six months), store in a fully charged state.
- For extended periods of storage (more than one year), charge before storage and recharge every six to nine months.
- Always fully recharge the battery after any storage period greater than one month before use.
- Do not store the battery with the charge depleted as this can cause failure of the battery and invalidate warranty.
- Do not short circuit
- Do not immerse in water
- Do not incinerate. Cells are likely to explode if placed in a fire.

- Dispose of batteries in accordance with the regulations in place for the country of use. Batteries are normally considered separate waste and should not be allowed to enter the normal waste stream. Either return to the seller or deliver to an approved re-cycling facility.

8.6 Cleaning

- Turn off the unit and remove batteries (if applicable) before maintenance
- Use a clean, soft, damp cloth to clean the unit. A microfiber cloth is recommended.
- Do not use alcohol or cleaning solutions to clean the unit
- Do not immerse the unit in water to clean it
- If the unit becomes wet, immediately dry it with a microfiber or other lint-free cloth

8.7 Storage

- Turn off the unit and remove batteries before storage
- Store units and battery packs in a cool, dry area at room temperature (22°C)
- Do not store units and/or batteries in active chargers