# 3G-IP-MUX-8-SFP

8 channel bi-directional 3G/HD/SD Video over IP multiplexer/De-multiplexer

# User manual

Rev. A

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## Revision history

Current revision of this document is the uppermost in the table below.

| Rev. | Repl. | Date | Sign | Change description |
|---|---|---|---|---|
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| A | - | 2016-06-10 | JD | Initial revision |

# Contents

# 1 Product overview

**The Flashlink 3G-IP-MUX-8-SFP is an 8 channel VSF-TR04/ SMPTE2022-6 compliant video over IP converter and multiplexer product.**

Its main application is to provide conversion between baseband and IP for 3G, HD and SD-SDI signals for in-studio usage. The product supports Precision Time Protocol (PTP), allowing downstream equipment to adjust the latency according to the timing information tagged in each stream. The outputs also uses this timing information to compensate for network latency and lock the output phase to the PTP reference. A PTP server on the network is required.

The product has 8x 3G, HD and SDI-SDI capable video ports, where 2 are inputs, 2 are outputs and 4 can be individually configured as inputs or outputs. This flexibility makes the product well suited for many applications. The output channels can also be setup as an SDI reference output timed from the PTP source removing the need for separate sync distribution to cameras, routers or switchers.

The product is built with a small output buffer that corrects switching errors of aligned streams in the network. However, full frame alignment of streams is expected done either at the ingest point, or as a central resource in the network.

Flashlink also provides extensive change-over portfolio enabling full 1+1 redundancy connectivity towards mission critical components. And the Flashlink SP&D offering provides useful and extensive functionality towards the baseband connectivity making Flashlink the go to solution for IP to baseband edge conversion.

***A PTP server on the network is required for the product to work. PTP sync packets must be available on the 10G Ethernet connection.***

# 2 Connections

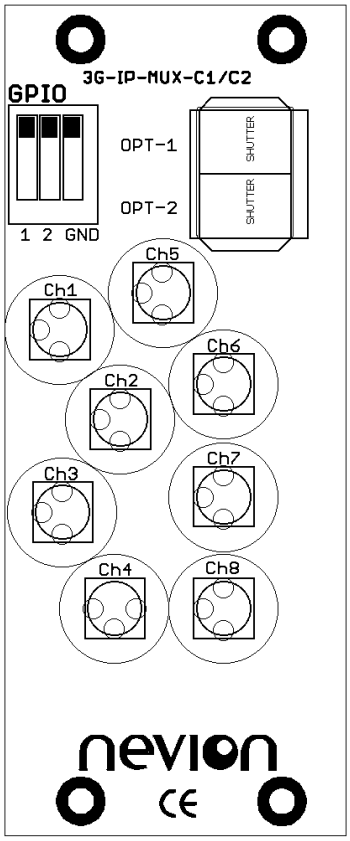



**Figure 1 3G-IP-MUX-C1 and 3G-IP-MUX-C2**

The backplane 3G-IP-MUX-C1 and 3G-IP-MUX-C2 is used for the 3G-IP-MUX-8-SFP module. All external connections are made via the backplane. –C1 is with DIN 1.0/2.3 and –C2 is for HD-BNC connector.

| Function | Label | Connector type |
|---|---|---|
| HD/SD-SDI channel 1 | Ch1 | HD-BNC or DIN 1.0/2.3 input |
| HD/SD-SDI channel 2 | Ch2 | HD-BNC or DIN 1.0/2.3 input |
| HD/SD-SDI channel 3 | Ch3 | HD-BNC or DIN 1.0/2.3 output |
| HD/SD-SDI channel 4 | Ch4 | HD-BNC or DIN 1.0/2.3 output |
| HD/SD-SDI channel 5 | Ch5 | HD-BNC or DIN 1.0/2.3 bidirectional |
| HD/SD-SDI channel 6 | Ch6 | HD-BNC or DIN 1.0/2.3 bidirectional |
| HD/SD-SDI channel 7 | Ch7 | HD-BNC or DIN 1.0/2.3 bidirectional |
| HD/SD-SDI channel 8 | Ch8 | HD-BNC or DIN 1.0/2.3 bidirectional |
| TX optical port w/cover | OPT1 | LC/UPC |
| RX optical port w/cover | OPT2 | LC/UPC |
| GPI status and control | GPIO | Pin 1: Laser disable, Active low<br>Pin 2: Card status<br>Pin 3 GND |

**Table 1: Connector functions**

# 3 Monitoring

## 3.1 In Multicon

The Multicon information page shows the status of the modules. In the illustration below the 3G-IP-MUX-8 is transmitting two 1080/25i signals on IP. And receiving one 1080/25i and one 486/29i from IP.

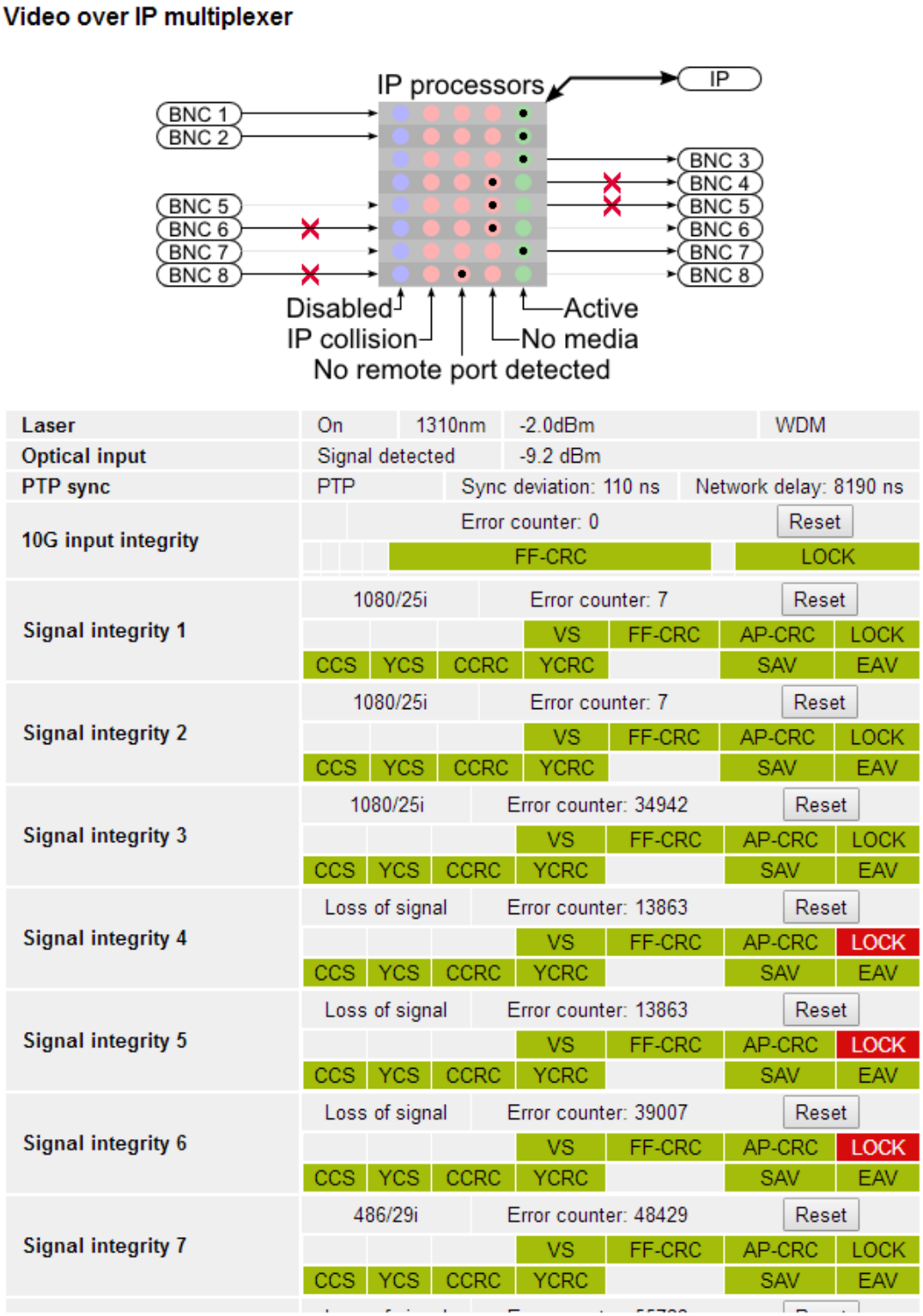



**Figure 2 The info page in Multicon**

The temperature of the SFP and the FPGA and the voltage of several power rails on each board are monitored, and can trigger alarms if they fall outside their respective limits. These limits can be seen in the alarm section of the Configuration page. The alarms themselves are a feature of Multicon, please refer to the Multicon user manual.

In the graphical representation of the board there are two red crosses representing the SDI inputs and the two red crosses representing the SDI outputs that have no signal. This information is also available in the table representation of the board, where input BNC numbers 6 and 8, and output BNC numbers 4, and 5 indicate "*Loss of signal".* The channels that do have a recognizable video format will indicate the video format present, as shown for input BNC 1 and 2 and output BNC 3 and 7.

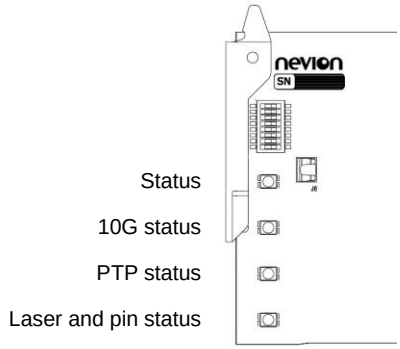
Each channel also has its own error bit indicators. The boxes that have a red background color indicate an error that is currently detected and counted. A green background will indicate that the particular error is set to be counted, but that the error is currently not detected. Errors that are not to be counted (i.e. set to "*Ignore'"* will be presented as the error bit name on a gray background color (no example shown here), regardless if the error is currently detected or not. Error types that are not supported for that particular channel will be shown as blank boxes with gray backgrounds. Most web browser will expand the boxes that contain text at the expense of these blank ones, as the example above shows.

## 3.2 On front mounted LEDs

| | Red LED | Orange LED | Green LED | No light |
|---|---|---|---|---|
| **Card status**<br><br>(uppermost LED) | FPGA not loaded, or at least one voltage outside legal levels | Module has not been programmed or RESET and OVR DIPS are on or module is loading new firmware | Module is OK | Module has no power |
| **10G status** | Loss of lock | CRC error | OK | Module has no power |
| **PTP status** | No PTP packets | The module has received PTP sync and is locking | Module is locked to PTP and delay response messages are received. | Module has no power |
| **Laser and Pin status** | Laser missing or failed<br>or<br>input missing or signal below -28 dBm | Laser present but turned off<br>or<br>input signal below -25 dBm | Laser present and turned on and detected optical input signal stronger than<br>-25 dBm | Module has no power |

**Table 2: LED states and what they mean**

The LEDs on the board are not labeled in silk screen. Users familiar with the Flashlink range will know that the upper LED (closest to the red handle) is the Card status LED. The order of the rest of the LEDs corresponds to the order in the table above.




### 3.2.1 Exceptions/special conditions for the LEDS

The "*locate"* command will make all four LEDs blink on and off synchronously to quickly identify the module in a larger installation. The condition of the card is not otherwise affected by the command, only the appearance of the LEDs will change. The LEDs return to their normal states and functions after the special locate condition has timed out.

## 3.3 On GPIO pins

There are two GPIO status lines, see **Table *1*: Connector functions** on page 5. One is a general card status alarm; the connection to ground is open when the card has either detected a critical fault or is powered off, the connection to ground is closed when the module is in normal operation. This GPIO pin effectively follows the status LED described in Table 2: LED states and what they mean in the previous chapter.

There is also one GPIO status line for the optical input/ output alarm; a green LED gives a closed connection to the ground pin, while a red or orange LED gives an open connection to the ground pin.

# 4 Configuration and control

## 4.1 In Multicon

The 3G-IP-MUX8 is made to be as transparent as possible, and therefore there are only a few functions that are configurable. The modules will do as little as possible to the signals themselves, but they will provide error detection and a few nifty options to raise alarms on unexpected video formats, or to diagnose errors that occur very infrequently.

There are four bidirectional I/O BNCs whose direction can be controlled; these are BNC 5 to 8. Using the configuration settings, the user can choose to set each channel individually to be either an output or an input.

Furthermore, the number of error types that can be detected is more for the input signals than the output signals, also there is an extra signal integrity block for the 10G input.

The following illustration shows the user configuration settings.

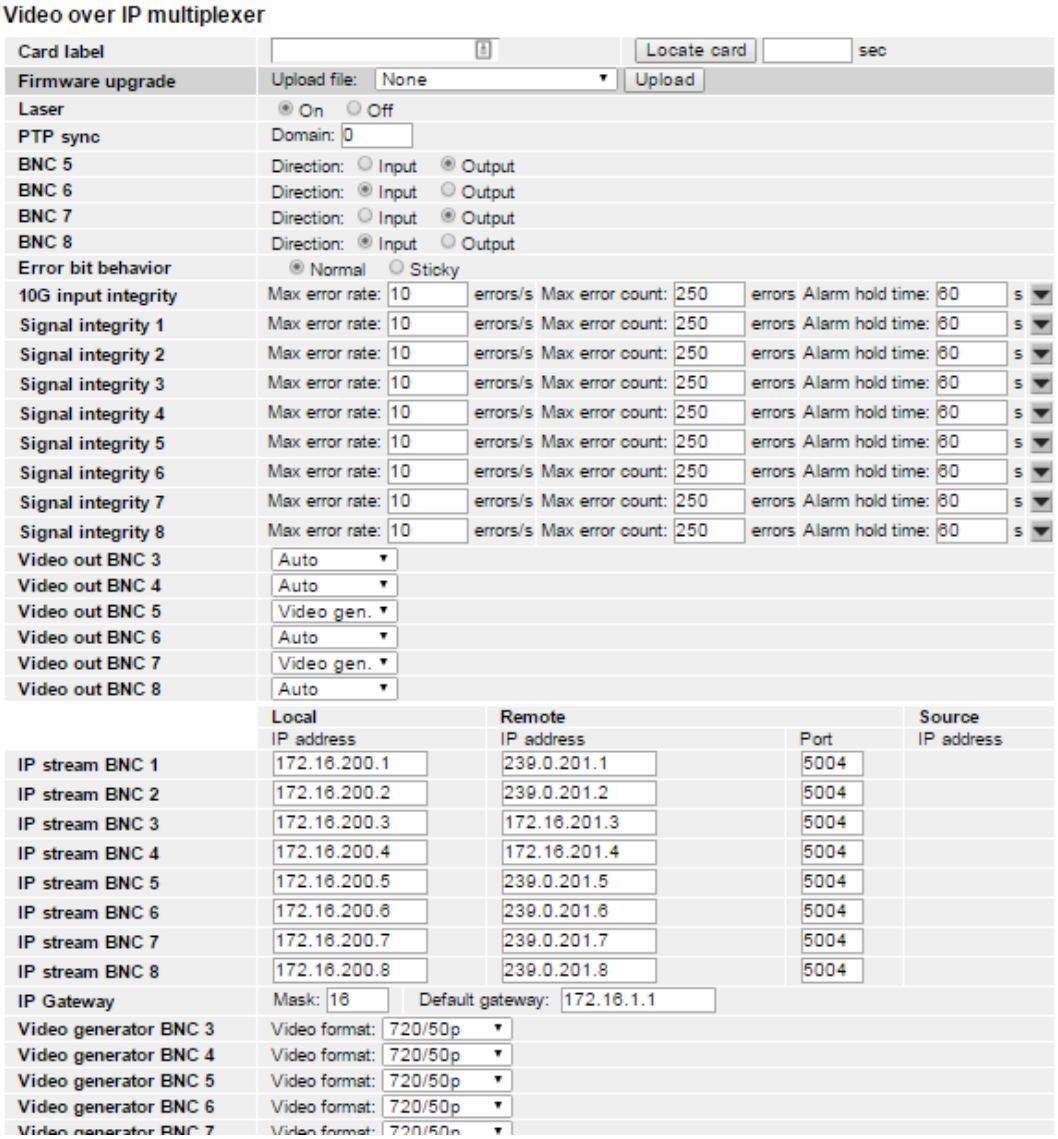



**Figure 3 An overview of the configuration page**

### 4.1.1 Laser on/off

The video transport from over IP will not work when the laser is switched off, and this setting is primarily intended as a safety feature when work is being done on the rear of a live Flashlink rack or the connected fiber. A GPIO input line is also available to disable the laser, see ch. 4.3.

### 4.1.2 Sticky vs. Normal error indication

In the Sticky error indication mode, the error bits will only be cleared when the operator resets the error counter from the Multicon Info page. The error counters will still only count the number of fields or frames that actually contains errors. This way it is possible to diagnose the error even a long time after the error situation has been rectified. Note however, that if several errors have occurred since the last counter reset it will not be possible to tell when or for how long each was present, or if they occurred at the same time or not.

When errors are detected and counted they are indicated on the Multicon Info page by red background in the corresponding error box. Default behavior (Normal error indication mode) is to accumulate the number of errors occurred between each time Multicon asks for status.

Due to the internal architecture of Multicon, it is possible that errors will occur and the error counter increase without any error bits being shown as red on the information page. The processes that retrieve information from the cards are not synced up to the processes that display the results to multiple users/clients. What this means is that short-lived errors may turn up and disappear again *between* two web browser updates for a certain client. The error will be counted, but the operator may never see any indication of what kind of error that occurred.

The sticky error indication mode is also useful to capture errors that occur very infrequently, in order to find out what type of error it was.

### 4.1.3 Signal integrity

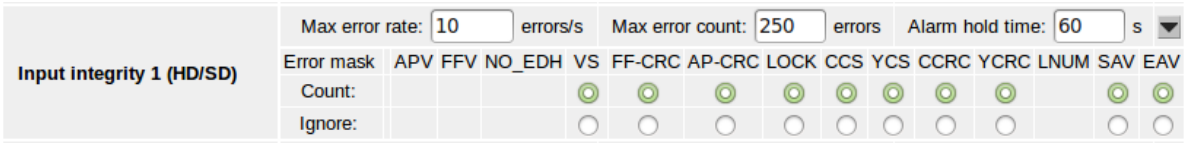



**Figure 4: Selection of error bits to be counted or ignored**

Eight built-in analyzers – one for each input or output – will report errors seen in the previous video frame. There is also an analyzer for the 10G fiber input. The errors that can be detected in one or more of the detectors are:

***NO_EDH***: No EDH flags

***VS***: Unexpected video format (see ch 4.1.4)

***FF-CRC***: Full-frame checksum error

***AP-CRC***: Active picture checksum error

***LOCK***: Can't lock to incoming video standard

***CCS / YCS***: Checksum error in ancillary data packets, Y or C data space.

***CCRC / YCRC***: Line checksum error, Y or C (HD only)

***LNUM***: Unexpected line number sequence (HD only)

***SAV***: Unexpected Start-of-active-video sequence

***EAV***: Unexpected End-of-active-video sequence

The operator can select which of the errors are to be counted and which are to be ignored (masked out). This is done individually for each input or output channel. The error counters count fields with un-masked errors (for interlaced formats) or frames with un-masked errors (for progressive formats), not individual errors, of which there can be many in a single field. The maximum error rate generated in a single channel is thus equal to the field rate or frame rate. Setting the error rate alarm limit in Multicon below the lowest field/frame rate (20 errors/s, for instance) will thus guarantee that any *permanent* error condition will trigger the alarm.

If the input to a channel should disappear altogether, an internal counter with a frequency slightly above 60 Hz will take over. This guarantees that the error rate from the LOCK error and VS error bits are always at least as high as the error rate generated by the other types of errors.

The YCS, CCRC and YCRC error bits have no meaning in SD.

***Note that when an input is missing, only the LOCK error bit is set, not the other error bits. It is therefore advisable to count the LOCK error bit, as the other error bits will indicate that everything is OK when the input signal has indeed been lost. Individual reclocker alarms also exist, and while a single observation of loss of lock is enough to trigger these alarms, the lock status is only sampled when Multicon asks the card for its current status. The update frequency will thus depend on how many other cards are in the system, and glitches in lock status will not necessarily be reported to Multicon to trigger an alarm there.***

### 4.1.4 Video Generator

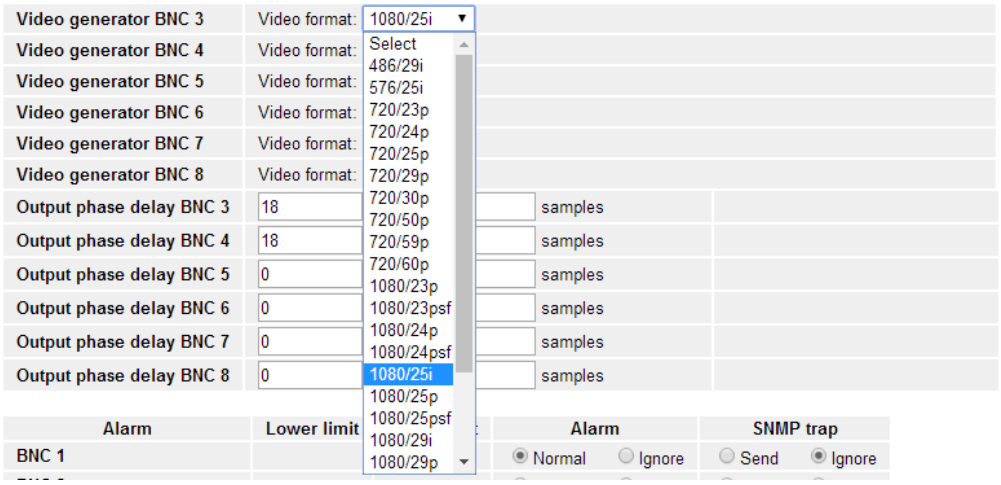



**Figure 5: Selection of video generator format**

The operator can select which video format that is on the output when the video change-over is set to video generator. If the “Video out BNC #” is set to “auto” the video format is the same as the signal received from the IP stream. Video generator makes a black picture.

Note that the video formats are quoted in frames per second, instead of fields per second.

The generators are not available on streams that convert from SDI to IP.

### 4.1.5 Video output change-over

For each output BNC the user can select the behavior of fallback to a Video generator.

“Auto” will generate black picture if there are no IP-stream detected. This will be of the same format as the last detected input video from that IP channel.

“IP stream” will disable the video on BNC output if no IP stream is present.

“Video gen.” Will ignore the IP stream and the video on the BNC output will be black picture with video format taken from the Video Generator selection.


**Figure 6 Video output change-over selection**

### 4.1.6 BNC direction

The operator can select the direction for BNC connectors five to eight. In the example in Figure 3, 6 and 8 are set to input, while 5 and 7 are set to output.

### 4.1.7 PTP domain

It is possible to select which PTP domain the card will listen to. This is normally domain 0. Some video PTP servers also use domain 127. Valid range is 0 to 127.


**Figure 7 PTP domain selection**

### 4.1.8 IP stream

**Local IP address.**
The local IP address is the local host IP of the stream. This will be the source IP address in the IP-packet when the stream is set to SDI input with output over IP. It is also the destination address when IP stream is set to SDI output and unicast is used.

**Remote IP address**
The remote IP address is the IP address for the card in the other end. For SDI input streams this will be the destination address. For SDI output streams, this will be the source address if the stream is unicast and destination address if multicast is used.

**Port**
This is the User Datagram Protocol (UDP) port number. This should be set to a non-zero value when transmitting IP. When receiving IP a zero in the port number will disable the UDP port filtering. When receiving IP, a non-zero value much match the destination port number of the video received. Default UDP port value is 5004 – “Real-time Transport Protocol media data”.

**Source IP address**
Source IP address will only show up when the IP stream is set to SDI output and the “Remote IP address” is set to 232.x.x.x. This enables destination and source filtering for Multicast packets.

| | Local | Remote | | Source |
|---|---|---|---|---|
| | IP address | IP address | Port | IP address |
| IP stream BNC 1 | 172.16.200.1 | 239.16.201.1 | 5004 | |
| IP stream BNC 2 | 172.16.200.2 | 239.16.201.2 | 5004 | |
| IP stream BNC 3 | 172.16.200.3 | 232.16.201.3 | 5004 | 172.16.202.1 |
| IP stream BNC 4 | 172.16.200.4 | 239.16.201.4 | 5004 | |
| IP stream BNC 5 | 172.16.200.5 | 232.16.201.5 | 5004 | 172.16.202.2 |
| IP stream BNC 6 | 172.16.200.6 | 239.16.201.6 | 5004 | |
| IP stream BNC 7 | 172.16.200.7 | 172.16.202.6 | 5004 | |
| IP stream BNC 8 | 172.16.200.8 | 172.16.202.5 | 5004 | |
| IP Gateway | Mask: 16 | Default gateway: 172.16.0.254 | | |

**Figure 8 IP settings**

### 4.1.9 IP Gateway

For unicast streams the gateway IP and mask must match up so that a source channel discovers the endpoints. Mask of 16 means 255.255.0.0. A mask of 23 would mean 255.255.254.0. For the example given in Figure 8 all the local IP addresses must be 172.16.x.x because the gateway is 172.16.0.254 and the mask is the 16 most significant bits.

### 4.1.10 Output phase delay.

It is possible set the output phase relative to the PTP start of frame. The card has only space for 90 IP-packets in the buffer for each stream, so the output phase will only adjust to upper and lower limit of the buffer. 90 packets equals 16 lines in 1080/25i and 57 lines in 576/25i. If an output phase of 0 lines and 0 samples is desirable, the IP stream must be pre-compensated at the ingress point.

| | | | | | |
|---|---|---|---|---|---|
| Output phase delay BNC 3 | 18 | lines | 0 | samples | |
| Output phase delay BNC 4 | 18 | lines | 0 | samples | |
| Output phase delay BNC 5 | 0 | lines | 0 | samples | |
| Output phase delay BNC 6 | 0 | lines | 0 | samples | |
| Output phase delay BNC 7 | 0 | lines | 0 | samples | |
| Output phase delay BNC 8 | 0 | lines | 0 | samples | |

**Figure 9 Output phase delay**

## 4.2 In manual mode (DIP switch control)

The lower switch is used to put the module in the DIP switch controlled mode itself. This will then only serve as a protection mechanism, in the sense that commands from Multicon will be ignored in manual mode. The module will still answer status requests from Multicon, and Multicon can thus still be used to monitor the module and trigger alarms in the event of errors.

Note that the switch that selects operating mode is only read at start-up, i.e. to go from DIP switch control to Multicon control (or vice versa) the switch position must be changed *and* the module restarted. The inward position (i.e. to right in the illustration below) is manual mode and the outward position is Multicon controlled mode.

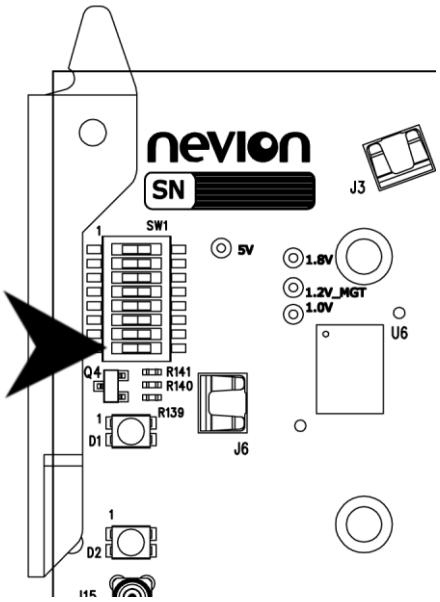



**Illustration 1: Location of the manual/Multicon control switch**

The top DIP switch on the board is used to disable the laser when this is switched to the inward position. It is important for the module to be set to 'manual' mode in order for any of the other DIP switches to work. The four DIP switches bellow this one are used to set the direction of the four bidirectional ports. The default setting is for these is to be set to outputs, and so switching these to the inward position will set the channels to be inputs.

The table below shows the DIP switches and their functions. The numbering starts from the top of the card. The inward position on the card refers to the DIP switch being set to ‘on’.

| Switch # | Function name | Function DIPs |
|---|---|---|
| **1** | Laser | On: Laser is disabled<br>Off: Laser is enabled |
| **2** | Channel 5 | Off: Channel 5 is output<br>On: Channel 5 is input |
| **3** | Channel 6 | Off: Channel 6 is output<br>On: Channel 6 is input |
| **4** | Channel 7 | Off: Channel 7 is output<br>On: Channel 7 is input |
| **5** | Channel 8 | Off: Channel 8 is output<br>On: Channel 8 is input |
| **6** | Factory reset state | See Table 4: Factory reset state |
| **7** | Factory reset state | See Table 4: Factory reset state |
| **8** | OVR | Off: GYDA mode<br>On: Manual mode |

**Table 3: DIP switches and their functions**

| SW-7 | SW-6 | Factory reset state |
|---|---|---|
| OFF | OFF | Use values present by MULTICON GYDA |
| OFF | ON | Unicast module #1 |
| ON | OFF | Unicast module #2 |
| ON | ON | Multicast remote |

**Table 4: Factory reset state**

To activate factory reset following the below steps:

1. Eject the card.
2. Turn dip 8 on and set dip 6 and 7 according to Table 4: Factory reset state.
3. Insert the card into the frame. Wait 10 second, before ejecting the card again.
4. Turn dip 6 and 7 off and leave dip 8 on.
5. Insert the card into the frame. Wait 1 minutes, before ejecting the card again.
6. Turn dip 8 off.
7. The card and the connected Multicon have been updated with factory reset values.

## 4.3 With GPIO pins

There is only one GPIO pin that is an input to the module. This provides another way to shut down the laser. This is intended as a safety feature when work is being done on the rear of a live Flashlink rack.

When the GPIO pin is pulled to ground, the laser is disabled. See Table 1: Connector functions in ch. 2 for GPIO pin-out.

# 5 Technical data

## 5.1 Engineering drawings

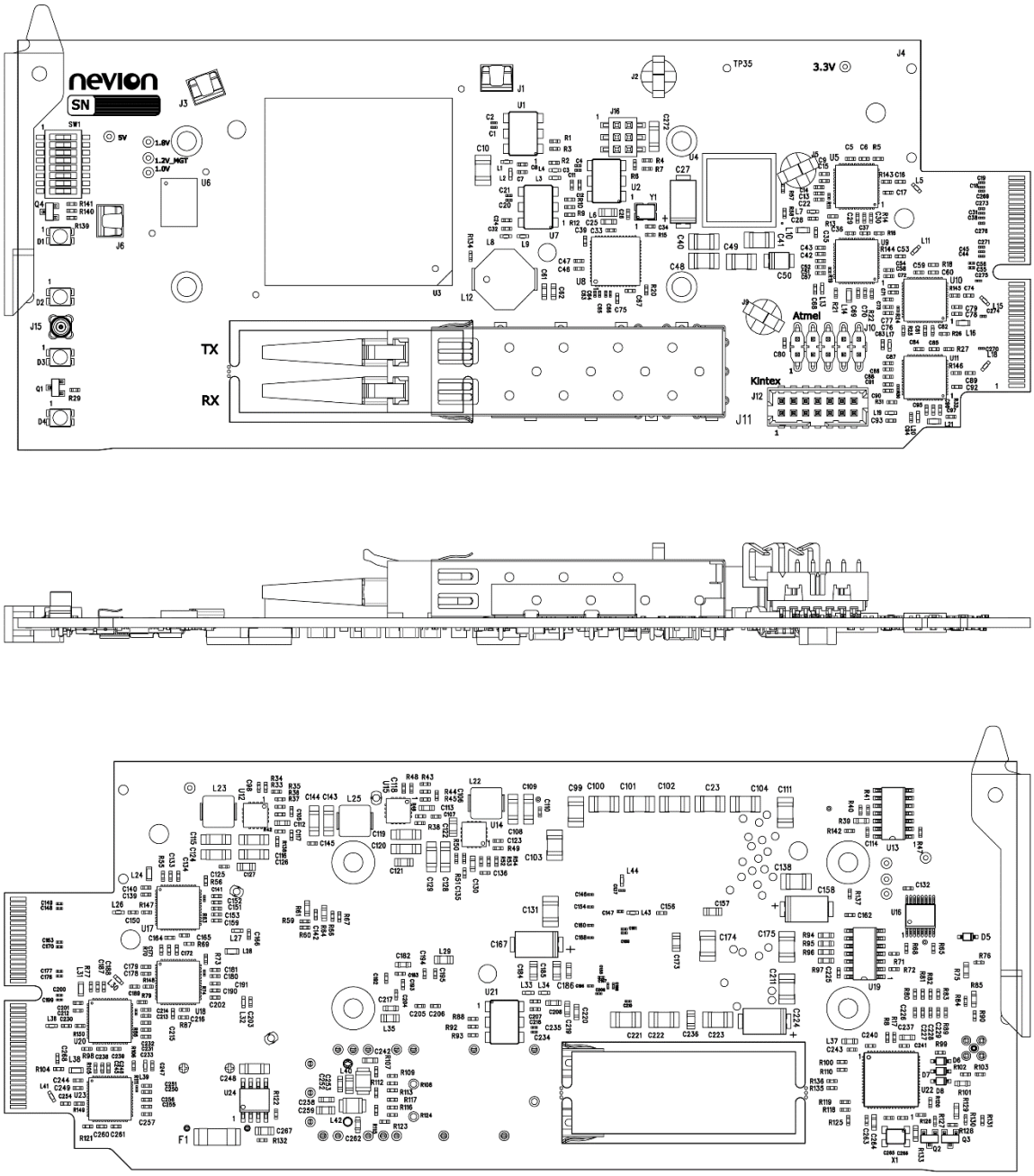



**Illustration 2: Front, bottom and rear views of the hardware.**

**See ch. 2 for backplane drawings.**

## 5.2 Specifications

### Optical 10G input/output

| | |
|---|---|
| Signal type | 10GbE |
| Connector | Backplane dependent LC/UPC or SC/UPC |
| See relevant SFP+ datasheet | |

### Electrical SDI inputs

| | |
|---|---|
| Number of inputs | 2 fixed inputs, 4 configurable I/O |
| Connectors | 75 Ohm HD-BNC or DIN 1.0/2.3 |
| Equalization | Automatic;<br>>275 m @270 Mbps w/Belden 8281, with BER < 10E-12<br>>100 m @1485 Mbps w/Belden 1694A, with BER < 10E-12<br>>70 m @2970 ;Mpbs w/Belden 1694A, with BER < 10E-12 |
| Input Return loss | >15 dB, 5 MHz -1.5 GHz<br>>10dB 1.5 GHz – 3 GHz |
| Jitter tolerance | SD limit:<br>10 Hz-1 kHz: >1 UI<br>10 kHz – 5 MHz: >0.2 UI<br>HD limit:<br>10 Hz-100 kHz: >1 UI<br>100 kHz–10 MHz: >0.2 UI<br>3G limit:<br>10 Hz-100 kHz: >1 UI<br>100 kHz–10 MHz: >0.3 UI |

### Electrical SDI outputs

| | |
|---|---|
| Number of outputs | 2 fixed outputs, 4 configurable I/O |
| Connectors | 75 Ohm HD-BNC or DIN 1.0/2.3 |
| Output Return loss | >15 dB, 5 MHz -1.5 GHz<br>>10dB 1.5 GHz – 3 GHz |
| Output signal level | 800 mV +/- 10% |
| Output signal rise / fall time 20% - 80% | SD limit: [0.4 ns – 1.5 ns]; <0.5 ns rise/fall var.<br>HD limit: <270 ps, <100 ps rise/fall var. |
| Amplitude overshoot | <10% |
| Output timing jitter | SD: <0.2 UI<br>HD: <1 UI<br>3G: <1 UI |
| Output alignment jitter | SD: <0.15 UI<br>HD: <0.15 UI<br>3G: <0.3 UI |

### Supported standards

| | |
|---|---|
| SD, 270 Mbps | SMPTE 259M, SMPTE 272M-AC |
| HD, 1485 Mbps, 1483 Mbps | SMPTE 292M, SMPTE 274M, SMPTE 291M, SMPTE 296M, SMPTE 299M |
| 3G, 2970 Mbps, 2967 Mpbs | SMPTE 424M, SMPTE 425 level A |
| 10GbE | SMPTE 2022-6, SMPTE 2059, IEEE 1588-2008 |

**Power consumption (+5 VDC)**

| | |
|---|---|
| Maximum power, at 50°C | 12.2 W |

***Subtract 0.5 W from the power figure above if the boards are used without the piggy-back fan modules. This requires the use FR202 Flashlink frame or of a rack with built-in fans for cooling!***

## General environmental requirements for Nevion equipment

1. The equipment will meet the guaranteed performance specification under the following environmental conditions:
   - Operating room temperature range: 0°C to 45°C
   - Operating relative humidity range: <90% (non-condensing)

2. The equipment will operate without damage under the following environmental conditions:
   - Temperature range: -10°C to 55°C
   - Relative humidity range: <95% (non-condensing)

## Product Warranty

The warranty terms and conditions for the product(s) covered by this manual follow the General Sales Conditions by Nevion, which are available on the company web site:

www.nevion.com

# Appendix A Materials declaration and recycling information

## A.1 Materials declaration

For product sold into China after 1st March 2007, we comply with the “Administrative Measure on the Control of Pollution by Electronic Information Products”. In the first stage of this legislation, content of six hazardous materials has to be declared. The table below shows the required information.

| 組成名稱<br>Part Name | Toxic or hazardous substances and elements | | | | | |
|---|---|---|---|---|---|---|
| | 鉛<br>Lead (Pb) | 汞<br>Mercury (Hg) | 镉<br>Cadmium (Cd) | 六价铬<br>Hexavalent Chromium (Cr(VI)) | 多溴联苯<br>Polybrominated biphenyls (PBB) | 多溴二苯醚<br>Polybrominated diphenyl ethers (PBDE) |
| 3G-IP-MUX-8-SFP | O | O | O | O | O | O |

O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006.

This is indicated by the product marking:

## A.2 Recycling information

Nevion provides assistance to customers and recyclers through our web site http://www.nevion.com/. Please contact Nevion's Customer Support for assistance with recycling if this site does not show the information you require.

Where it is not possible to return the product to Nevion or its agents for recycling, the following general information may be of assistance:

- Before attempting disassembly, ensure the product is completely disconnected from power and signal connections.
- All major parts are marked or labeled to show their material content.
- Depending on the date of manufacture, this product may contain lead in solder.
- Some circuit boards may contain battery-backed memory devices.