HD-TD-10GX-8-SFP

8 channel bi-directional HD/SD/ASI multiplexer/De-multiplexer
over optical 10Gbps interface

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
A	-	2015-04-24	CC	Initial revision

Contents

1 Product overview

The Flashlink HD-TD-10GX-8-SFP is an eight-port bidirectional multi-format video multiplexer. The module features eight video ports, comprising of two fixed inputs, two fixed outputs and four channels whose directions are individually configured to adopt to changing requirements.

The eight video ports in this module support all common HD-SDI, SD-SDI and ASI formats. Optical standards compliance allows for easy interoperability with third party fiber optical systems.

It is possible to transport up to six video streams in any one direction simultaneously. In combination with other Nevion Flashlink products (SD-TD-MUX-4 and SD-TD-DMUX-4), which can pack in four SD-SDI streams into each of the HD-SDI streams, there is a possibility to transport up to 24 SD-SDI streams over a single 10 Gb/s link. Physically this solution will fit in a single Flashlink frame at each end of the 10 Gb/s link.

The inputs have built-in error detection and video format detection. For each of the input or output channels there is also the option to trigger a Multicon Gyda alarm if the current video format does not match what the operator has indicated as normal.

The SFP+ optical transmitter and receiver module can easily be replaced. If new SFP+ modules bring significant improvements over the current ones, a quick and simple upgrade path exists. See Nevions 10GbE SFP+ range for applicable optical interfaces.

1 Connections

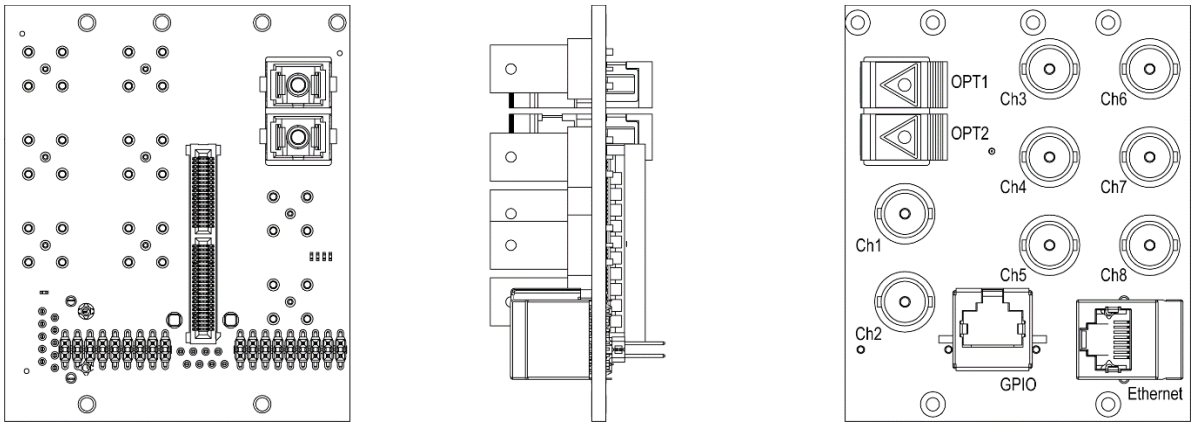


Illustration 1: The backplane, HD-TD-10G-C1

The backplane HD-TD-10G-C1 is used for the HD-TD-10GX-8-SFP module. All external connections are made via the backplane.

The backplane occupies two slots in the Flashlink frame, and the module will then go in the rightmost of the two slots.

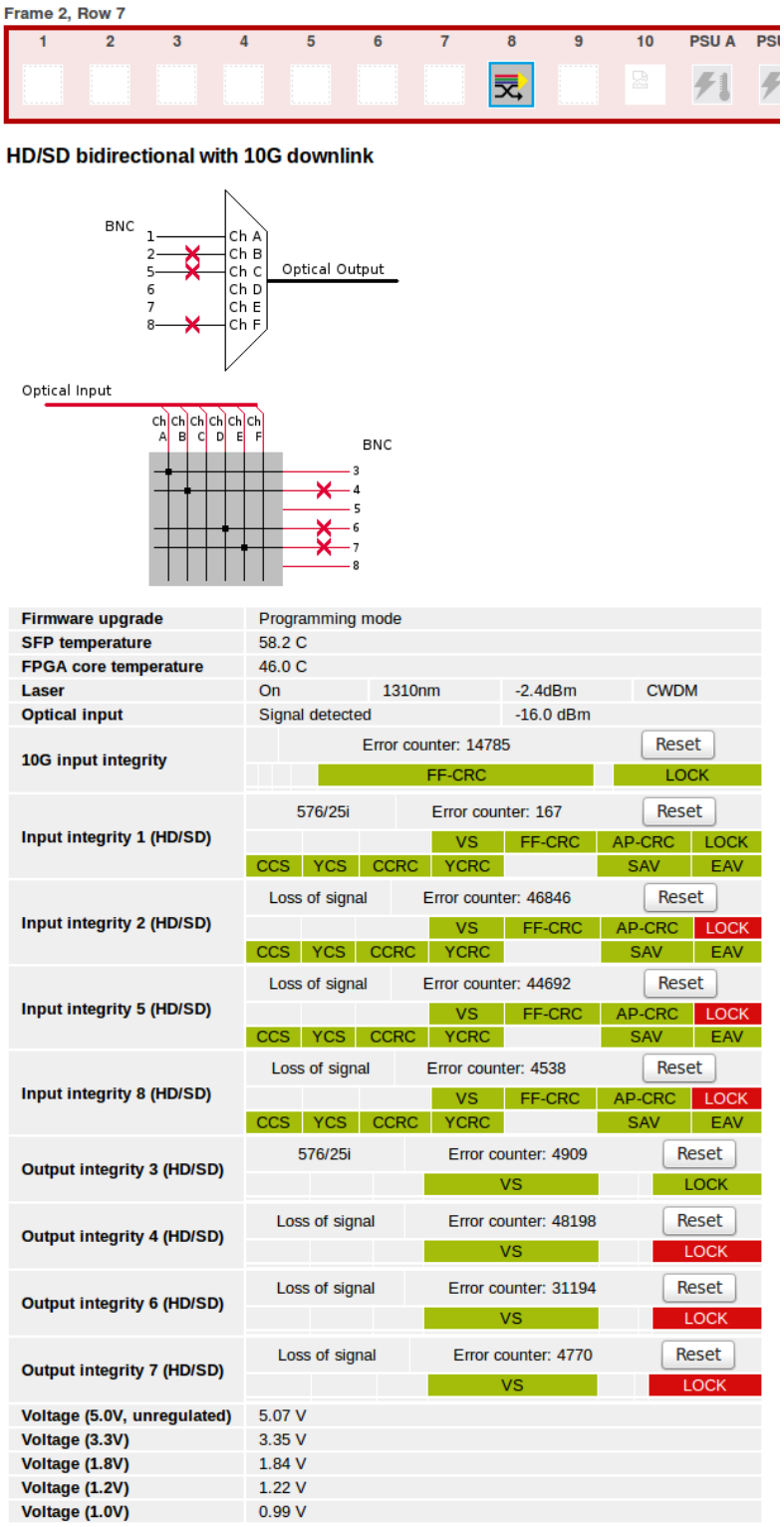
Function	Label	Connector type
HD/SD-SDI channel 1	Ch1	BNC input
HD/SD-SDI channel 2	Ch2	BNC input
HD/SD-SDI channel 3	Ch3	BNC output
HD/SD-SDI channel 4	Ch4	BNC output
HD/SD-SDI channel 5	Ch5	BNC bidirectional
HD/SD-SDI channel 6	Ch6	BNC bidirectional
HD/SD-SDI channel 7	Ch7	BNC bidirectional
HD/SD-SDI channel 8	Ch8	BNC bidirectional
TX optical port w/cover	OPT1	SC/UPC
RX optical port w/cover	OPT2	SC/UPC
GPI outputs	GPIO	TP45, pin 2 (card status, open when alarm) TP45, pin 3 (optical alarm), TP45, pin 6 (channel 1-8 status, closed when alarm)
GPI inputs	GPIO	TP45, pin 1 (laser disable, active low)
GPI GND	GPIO	TP45, pin 8
---	Ethernet	TP45

Table 1: Connector functions

2 Monitoring

2.1 In Multicon

The Multicon information page shows the status of the modules. In the illustration below, the mux is transporting one 576/25i channel and the de-mux is receiving one 576/25i channel, while three input and three output channels are not utilized.



Firmware upgrade	Programming mode			
SFP temperature	58.2 C			
FPGA core temperature	46.0 C			
Laser	On	1310nm	-2.4dBm	CWDM
Optical input	Signal detected		-16.0 dBm	
10G input integrity	Error counter: 14785	Reset		
	FF-CRC	LOCK		
Input integrity 1 (HD/SD)	576/25i	Error counter: 167	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS YCS CCRC YCRC		SAV	EAV
Input integrity 2 (HD/SD)	Loss of signal	Error counter: 46846	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS YCS CCRC YCRC		SAV	EAV
Input integrity 5 (HD/SD)	Loss of signal	Error counter: 44692	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS YCS CCRC YCRC		SAV	EAV
Input integrity 8 (HD/SD)	Loss of signal	Error counter: 4538	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS YCS CCRC YCRC		SAV	EAV
Output integrity 3 (HD/SD)	576/25i	Error counter: 4909	Reset	
	VS		LOCK	
Output integrity 4 (HD/SD)	Loss of signal	Error counter: 48198	Reset	
	VS		LOCK	
Output integrity 6 (HD/SD)	Loss of signal	Error counter: 31194	Reset	
	VS		LOCK	
Output integrity 7 (HD/SD)	Loss of signal	Error counter: 4770	Reset	
	VS		LOCK	
Voltage (5.0V, unregulated)	5.07 V			
Voltage (3.3V)	3.35 V			
Voltage (1.8V)	1.84 V			
Voltage (1.2V)	1.22 V			
Voltage (1.0V)	0.99 V			

Illustration 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 three red crosses representing the mux inputs and the three red crosses representing the de-mux outputs that have no signal. This information is also available in the table representation of the board, where input BNC numbers 2, 5 and 8, and output BNC numbers 4, 6 and 7 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 output BNC 3. This is also shown in the table part of this illustration, where the lock bit error is removed and the video format "576/25i" is stated for these channels. In the event that an unknown format is present, this is indicated as "*Unknown"* but still be transported if possible.

The matrix below the graphical representation of the board shows which output signals have been connected to each of the input signals. This can be set in the configuration settings, and any combination is possible, meaning one input signal can be routed to many output channels.

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.

2.2 On front mounted LEDs

	Red LED	Orange LED	Green LED	No light
Card status	FPGA not loaded, or at least one voltage outside legal levels	---	Module is OK	Module has no power
Laser **Pin**	Laser missing or failed Or Input missing or signal below -28 dBm	Laser present but turned off Or Input signal below -25 dBm	Laser present and turned on And Input signal stronger than -25 dBm	Module has no power
Inputs 1-4	At least one of the channels 1-4 that are not set to *Don't care* is missing lock	At least one of the channels 1-4 that are not set to *Don't care* is locked to the wrong video format	Channels 1-4 are all either set to *Don't care* or are present and have the right video format	Module has no power
Inputs 5-8	At least one of the channels 5-8 that are not set to *Don't care* is missing lock	At least one of the channels 5-8 that are not set to *Don't care* is locked to the wrong video format	Channels 5-8 are all either set to *Don't care* or are present and have the right video format	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 status LED. The order of the rest of the LEDs corresponds to the order in the table above.

Note that the configuration of the Expected video format will influence the way the LEDs behave. The "Don't care" condition mentioned in the table above refers to the "Expected video format" settings, and only those channels assigned a specific video format will affect the LEDs. Conversely, setting all channels to "Don't care" will result in LED 3 and LED 4 always being green, even if all video signals are missing.

2.2.1 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.

2.3 On GPIO pins

There are three GPIO status lines, see Table 1: Connector functions on page 6. 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. Then there is one alarm, which reflects LEDs 3 and 4 as described in Table 2; 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.

3 Configuration and control

3.1 In Multicon

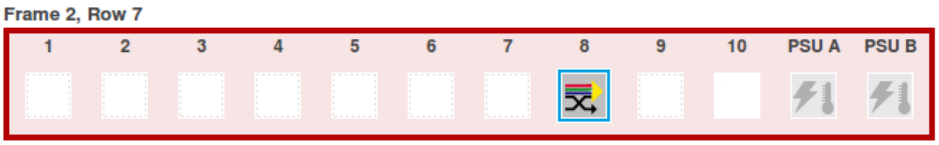
The HD-TD-10GX-8-SFP is made to be as transparent as possible, and therefore there are only a few functions that are configurable. The modules will do as little as possible to the signals themselves, but they will provide error detection and a few nifty options to raise alarms on unexpected video formats, or to diagnose errors that occur very infrequently.

As far as the user interface goes, the mux part of the module uses a laser and laser on/off setting, whereas the de-mux part has a pin-diode receiver which does not have any settings.

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, and there is a switch matrix in order to set the desired output channel to any of the inputs.

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.



HD/SD bidirectional with 10G downlink

Card label		Locate card sec
Firmware upgrade	Programming mode	Finalize
Firmware upgrade	Upload file: None	Upload
Laser	On Off	
Error bit behavior	Normal Sticky	
10G input integrity	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60	
Input integrity 1 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60	
Input integrity 2 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60	
Input integrity 5 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60	
Input integrity 6 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60	
Input integrity 7 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60	
Input integrity 8 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60	
Output integrity 3 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60	
Output integrity 4 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60	
Expected video format ch 1	Don't care	
Expected video format ch 2	Don't care	
Expected video format ch 3	Don't care	
Expected video format ch 4	Don't care	
Expected video format ch 5	Don't care	
Expected video format ch 6	Don't care	
Expected video format ch 7	Don't care	
Expected video format ch 8	Don't care	

Matrix

Input:	Ch A	Ch B	Ch C	Ch D	Ch E	Ch F
BNC output 3:	◉	○	○	○	○	○
BNC output 4:	○	◉	○	○	○	○
BNC output 5:	○	○	○	○	○	○
BNC output 6:	○	○	○	◉	○	○
BNC output 7:	○	○	○	○	◉	○
BNC output 8:	○	○	○	○	○	○

BNC 5	Direction: ◉ Input ○ Output
BNC 6	Direction: ○ Input ◉ Output
BNC 7	Direction: ○ Input ◉ Output
BNC 8	Direction: ◉ Input ○ Output

Illustration 3: An overview of the configuration page

3.1.1 Laser on/off

The video transport from mux to de-mux will obviously 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. A GPIO input line is also available to disable the laser, see ch. 3.3.

3.1.2 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.

3.1.3 Signal integrity

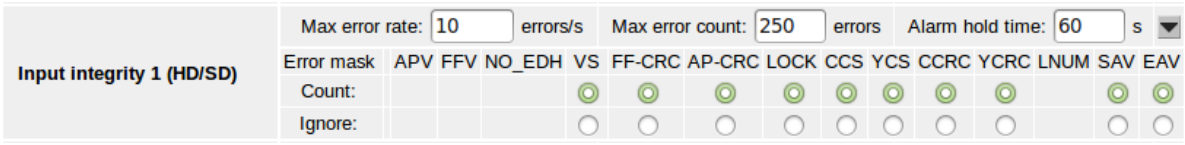


Illustration 4: Selection of error bits to be counted or ignored

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 3.1.4)

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.

For the output signals, there are only VS and LOCK error bits available. These error indicators are actually transported from the mux side; to save power there are no actual error detectors on the de-mux side, except on the 10G fiber transport stream. If errors are indicated on the 10G stream, chances are that one or more of the outputs have also been affected. The error bits for the fiber transport stream are limited to LOCK error and FF-CRC error. This FF-CRC bit is not the same as FF-CRC for normal SDI video, but rather a mapping of several internal checksums into one error bit. This error counter behaves as the others in the sense that the error count per second is limited to slightly more than 60.

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.

3.1.4 Expected video format

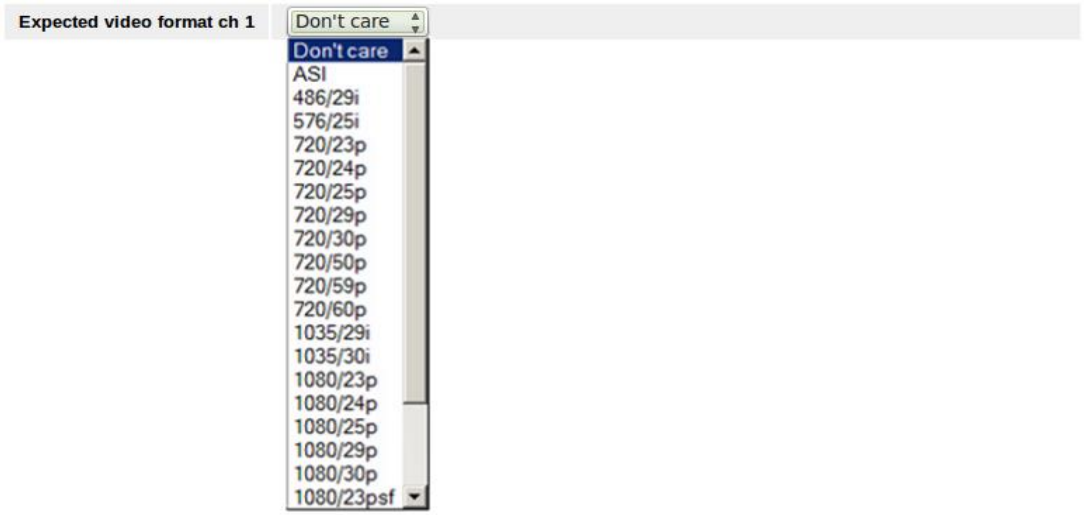


Illustration 5: Selection of expected video format

In transport products like these it is not always enough to know that video is present and error-free. It can be equally important to know that the video format is correct. The operator can select an "*Expected video format"* for each channel. An input or output signal that does

not match its expected video format will be indicated as a VS error in Signal integrity (see ch. 3.1.3). In addition to the formats shown in the illustration above, “1080/24psf”, “1080/25i”, “1080/29i” and “1080/30i” are available in the drop-down menu if scrolled down. Additionally, there is also a “*Don’t care”* setting.

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

> ***Note that in order to trigger a Signal integrity alarm, the VS error bit must be set to Counted and the error rate set below the video frame rate. Note also that missing video will not trigger the VS error bit. The operator should instead rely on the LOCK error bit or the reclocker alarms to detect loss of lock. See note at the end of ch. 3.1.3.***

3.1.5 Video Cross Point Matrix

The video cross point matrix is a six by six cross point with inputs and outputs as shown in the Gyda configuration settings in Illustration 3.

The video cross point matrix is used to set the configuration of the output BNC connectors, to control how they are connected to the channels coming from the 10G multiplex. All channels are free to be routed in any manner desired dynamically without affecting the signals running on the other ports.

The mapping of inputs is fixed regarding the channels in the 10G stream. Any routing must be done on the output BNC.

Input	10G Stream
BNC 1	Channel A
BNC 2	Channel B
BNC 5	Channel C
BNC 6	Channel D
BNC 7	Channel E
BNC 8	Channel F

3.1.6 BNC direction

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

When changing direction on a channel, the card will disappear from Multicon for a while so that the Multicon can show the correct information for this setting. The 10G link will not be interrupted and other video streams will not be affected.

The bidirectional BNCs will, when set to output, also send the selected output to the corresponding multiplex in the output 10G stream. E.g. if BNC 5 is set up as output, the signal selected for BNC output 5 will also be inserted on channel C.

3.2 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 postion (i.e. to right in the illustration below) is manual mode and the outward position is Multicon controlled mode.

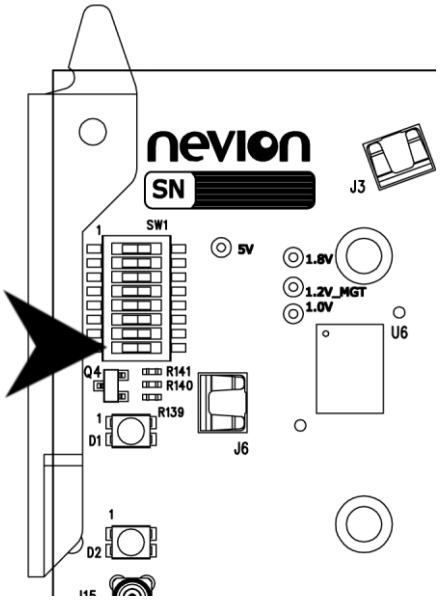


Illustration 6: Location of the manual/Multicon control switch

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 switch below this is be used to change the output matrix from the default setting to an alternative setting of the four bidirectional channels' output, in order to test the signals using a confidence loop. These two settings are shown in the illustration below.

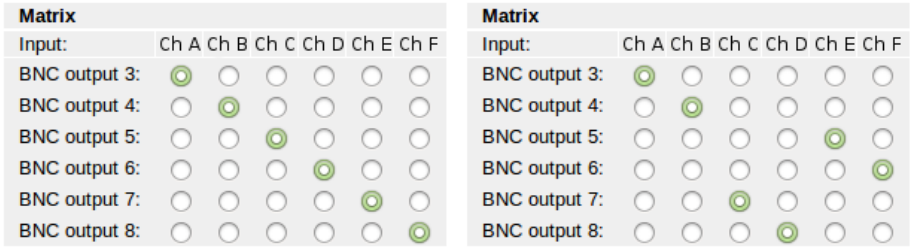


Illustration 7: Diagonal matrix (left) and alternative matrix (right)

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 Off: Laser is enabled

2	Channel 5	Off: Channel 5 is output On: Channel 5 is input
3	Channel 6	Off: Channel 6 is output On: Channel 6 is input
4	Channel 7	Off: Channel 7 is output On: Channel 7 is input
5	Channel 8	Off: Channel 8 is output On: Channel 8 is input
6	Switch matrix	Off: Switch matrix is in diagonal formation On: Switch matrix is in alternate diagonal formation
7	-	No function
8	OVR	Off: GYDA mode On: Manual mode

Table 3: DIP switches and their functions

3.3 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. 1 for GPIO pin-out.

4 Technical data

4.1 Engineering drawings

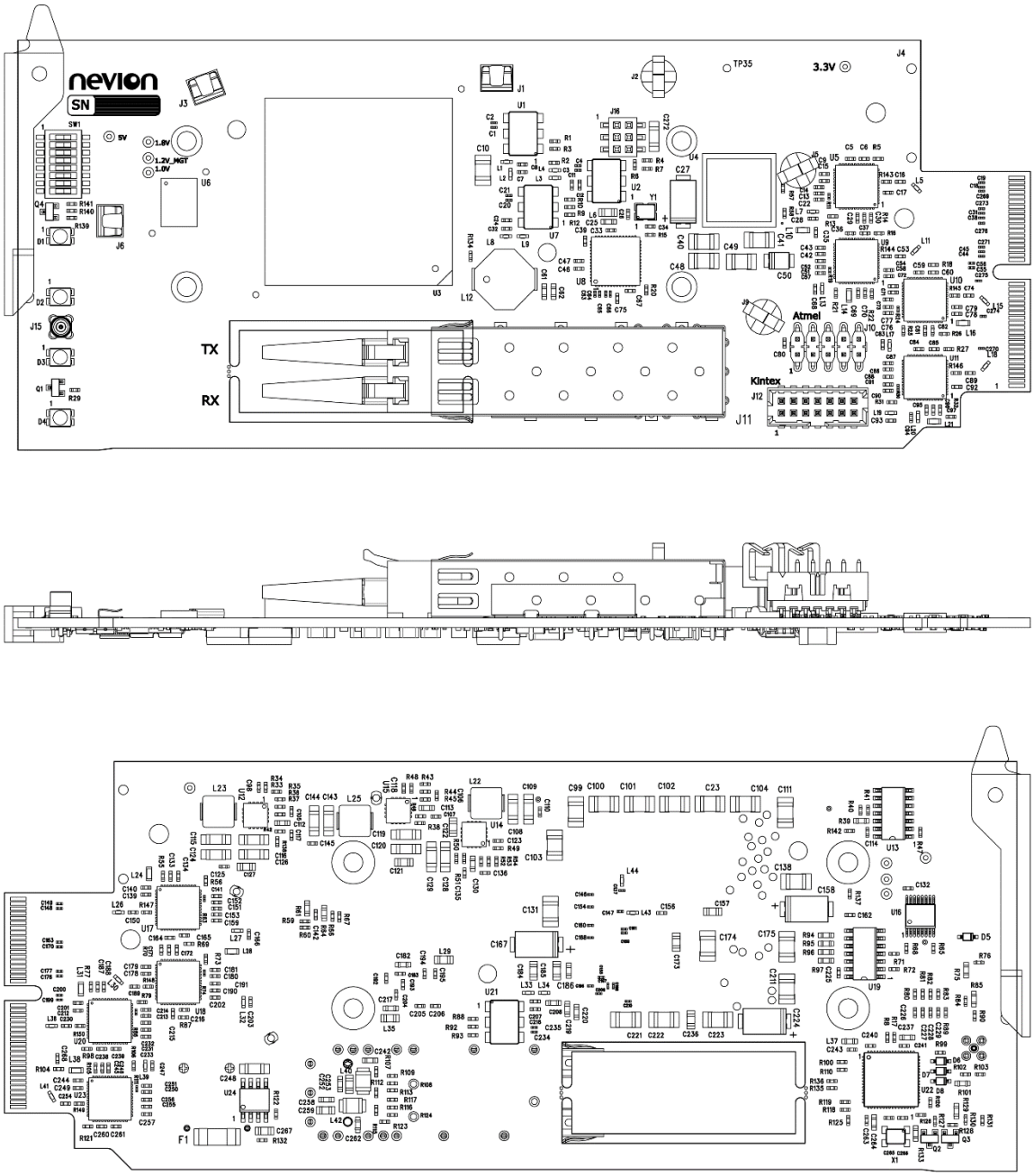


Illustration 8: Front, bottom and rear views of the hardware.

See ch. 1 for backplane drawings.

4.2 Specifications

Optical 10G input/output

See relevant SFP+ datasheet

Electrical SDI inputs

Number of inputs	6
Connectors	75 Ohm BNC
Equalization	Automatic; >275 m @270 Mbps w/Belden 8281, with BER < 10E-12 >100 m @1485 Mbps w/Belden 1694A, with BER < 10E-12
Input Return loss	>15 dB, 5 MHz -1.5 GHz
Jitter tolerance	SD limit: 10 Hz-1 kHz: >1 UI 10 kHz – 5 MHz: >0.2 UI HD limit: 10 Hz-100 kHz: >1 UI 100 kHz–10 MHz: >0.2 UII

Electrical SDI outputs

Number of outputs	6
Connectors	75 Ohm BNC
Output Return loss	>15 dB, 5 MHz -1.5 GHz
Output signal level	800 mV +/- 10%
Output signal rise / fall time	SD limit: [0.4 ns – 1.5 ns]; <0.5 ns rise/fall var.
20% - 80%	HD limit: <270 ps, <100 ps rise/fall var.
Amplitude overshoot	<10%
Output timing jitter	SD: <0.2 UI HD: <1 UI
Output alignment jitter	SD: <0.15 UI HD: <0.15 UI

Supported standards

SD, 270 Mbps	SMPTE 259M, SMPTE 272M-AC
HD, 1485 Mbps	SMPTE 292M, SMPTE 274M, SMPTE 291M, SMPTE 296M, SMPTE 299M
ASI	EN50083-9

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 Part Name	Toxic or hazardous substances and elements					
	鉛 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr(VI))	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
HD-TD-10GMX-6 HD-TD-10GDX-6	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.