FTX-L 3G

Dual channel 3Gb/s, HD or SD to fibre optic transmitter

Crystal Vision

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Contents

Revision 1	Added Visionweb, updated front panel menu pictures and updated I/O connection info	05/04/17
Revision 2	Corrected card edge slew rate configuration information	10/05/17

Warning

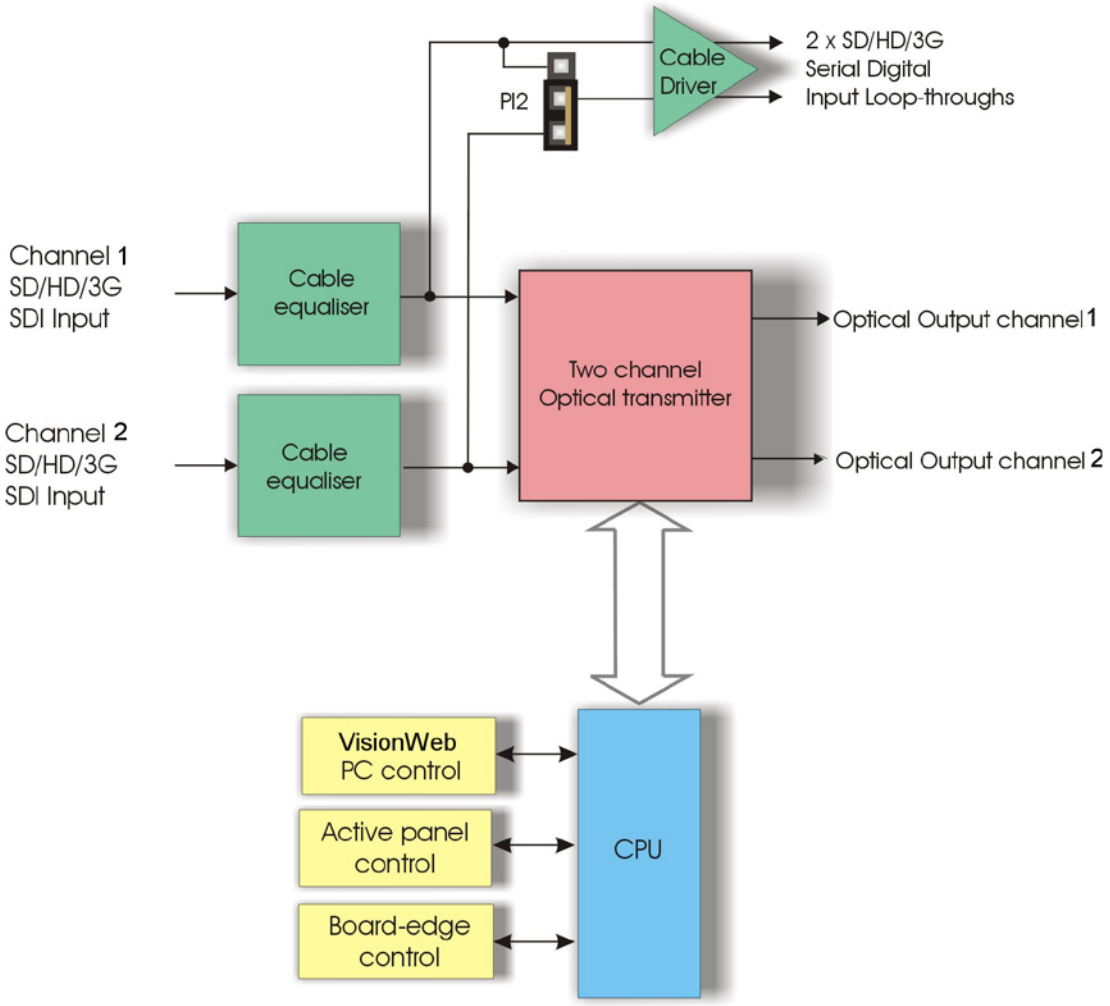
Note: Caution must be taken when removing optical cabling from the rear of the frame when an optical signal is present due to the possible damaging nature of high intensity light to the naked eye.

Although Crystal Vision optical products contain class 1 devices that have been designed to be safe under all circumstances, you are advised not to look directly into any vacant optical outlet.

1 Introduction

The FTX-L 3G is a two-channel serial digital video optical transmitter that will accept both 1.5G and 3G High Definition video as well as Standard Definition video.

The universal connection system allows a mixture of Crystal Vision modules in the frame. The modules plug in the front and the rear connectors plug in the back. A removable front panel reveals LED indication of input and PSU status when opened.



FTX-L 3G two channel SDI optical transmitter

The FTX-L 3G is from the range of Crystal Vision optical boards which have been designed to fit in the Crystal Vision range of 2U and 1U frames issue 2 and above, as well as the issue 2 desk top box. The board may be plugged into any of the PCB slots, the only exception being where it needs to be placed below a Standard Definition board. The rules governing frame configuration are explained in the Installation chapter.

The RM55 single slot rear connector provides two serial digital inputs, two input loop-throughs and two optical outputs with up to 12 modules in 2U of rack space.

The Indigo frames have been designed to accept any selection of boards from Crystal Vision's range of Standard Definition, High Definition, 3G audio, video and optical products. The high packing density allows up to six modules in 1U, up to 12 modules in 2U, and up to two modules in the desk top box.

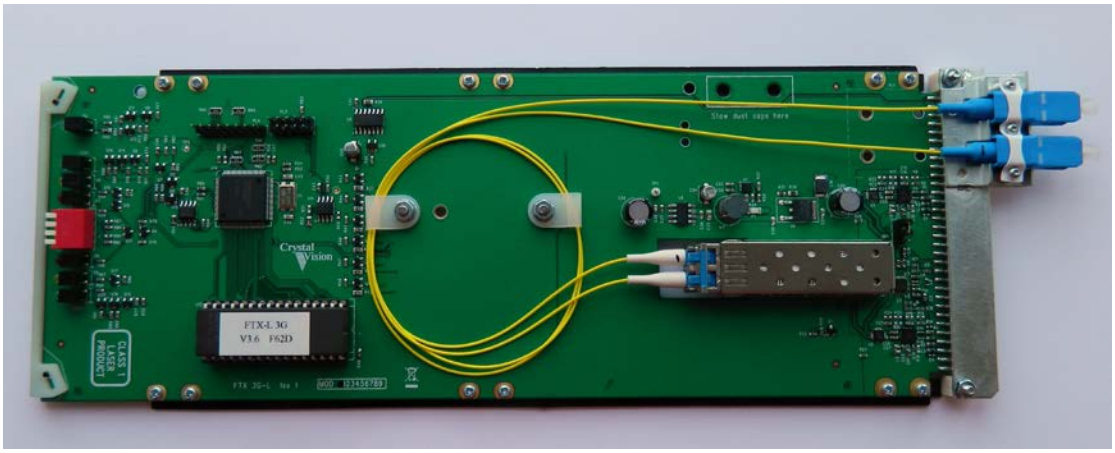
The main features of the FTX-L 3G are as follows:

- 2 channel 3G/HD/SD serial digital optical transmitter
- Handles pathological test pattern
- 1310nm class 1 compliant two channel laser module
- LED SDI input present indication
- Indication of laser near end of life and shutdown
- Automatic and manual laser shutdown
- Single-mode fibre system
- Assignable input loop-throughs

FTX-L 3G

The two identical channels of the FTX-L 3G optical transmitter are completely independent of each other. Each channel consists of a serial digital input section, which equalises the input signal for cable length, a driver module and laser diode. Both channels are under the control of a CPU, which monitors and reports their status. An added feature of the FTX-L 3G are its assignable input loop-throughs. These can be assigned as Input 1 and Input 2 input loop-throughs or both loop-throughs can be assigned to input 1.

At the heart of the FTX-L 3G is a two-channel state-of-the-art laser driver module incorporating automatic power control, which gives the laser diode emitters a stable performance throughout their lifetime. Safety circuitry within the laser module monitors the operation of the laser driver and forces a shutdown should any critical parameters be exceeded. Warning is also given once the laser is considered to have reached near to the end of its expected lifetime. This warning is triggered after approximately 85% of its expected lifetime has expired.



FTX-L 3G dual channel 3G/HD/SD optical transmitter

The FTX-L 3G is primarily designed to work with single-mode optical cable and can achieve distances in excess of 10km depending on cable quality and number of connectors and splices (see *Fibre distance calculations guide*). The FTX-L 3G may also work with multi-mode optical cable in some circumstances and distances of approximately 1km have been achieved with a Standard Definition video input. Distances of 200-300m may also be achievable with a High Definition video input, but performance with multi-mode fibre is not guaranteed.

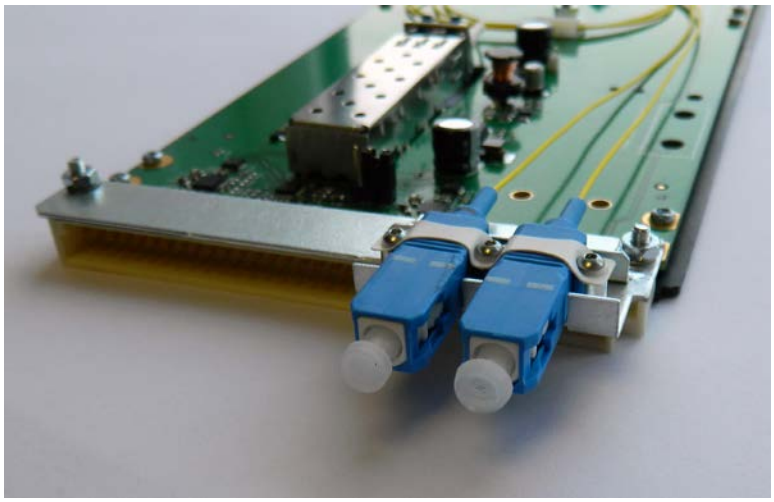
2 Hardware installation

The Crystal Vision optical boards have been designed to work in conjunction with the 2U CoolFlow frames, or Indigo 1 and 2 frames of issue 2 or higher, and the issue 2 desk top box. All modules can be plugged in and removed while the frame is powered without damage.

Note: *You can find the issue number of a frame on the inside of the front of the frame.*

Handling

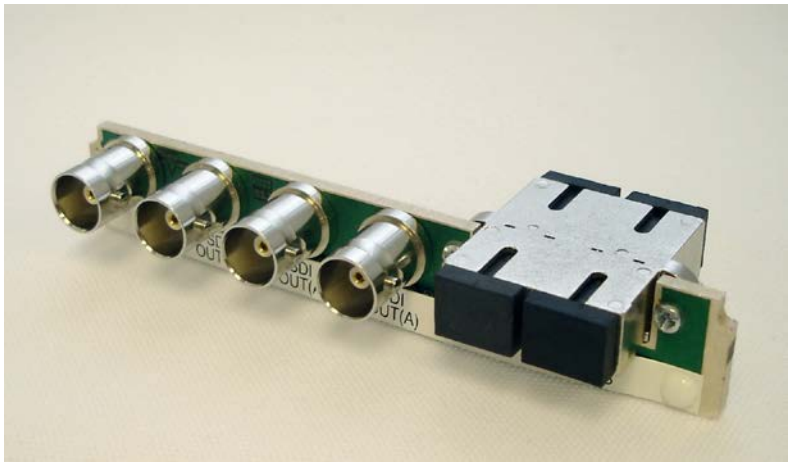
Due to its fragile nature, fibre optic equipment must be handled with care. Sharp blows or snagging the fibre pigtails will fracture the internal glass filament and destroy its light carrying ability. A degraded performance will also result if a build-up of dust and dirt film on the connector ferrules is allowed to occur. It is strongly recommended that the supplied dust caps are replaced whenever the transmitter card or rear modules are de-mounted for any reason.



FTX-L 3G connectors with the dust caps fitted

When the FTX-L 3G is fitted in a frame, the dust caps can be stored on the board by pushing into the holes provided.

The RM55 rear module is fitted with dust caps on both sides of the optical connector. The pair of dust caps that will be internal to the frame must be removed before the rear module is fitted. The external pair can then be removed when the fibre tails are connected. It is also recommended that dust caps should be re-fitted if the fibre tails are to be removed for any length of time. Should the FTX-L 3G be removed for any length of time it is recommended that the rear module should also be removed and stored with the dust caps fitted.



RM55 rear module with dust caps fitted to both sides of the optical connector

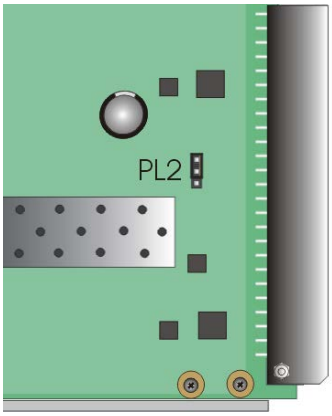
Assigning Input loop-throughs

A useful feature of the FTX-L 3G is that the loop-through outputs are configurable using the link PL2.

The choices are:

- Both Input 1 and Input 2 loop outputs
- Input 1 with two loop outputs and no loop 2 output.

PL2	Up
Up	Input 1 and Input 2 loop-throughs
Down	Input 1 with two loop-throughs



2.1 Universal rear connectors

When using the RM55 single height rear connector, the 2U frame will house up to 12 modules and dual power supplies, while the 1U Indigo 1 frame will house six modules and a single or dual power supply. The Indigo DT desk top box will house up to two modules.

All frames have hinged front panels giving access to the PSU and all modules. The universal frame wiring system allows any interface range modules to be fitted in any position [(1)] with the use of pluggable rear modules.

[(1)] Due to height restraints, there are restrictions when mixing optical modules with other Crystal Vision modules.

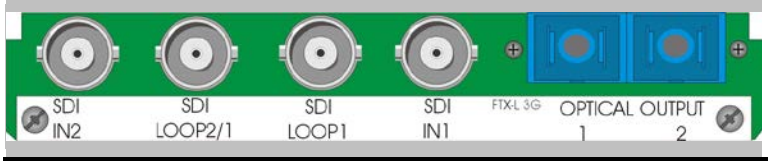
Loading restrictions

The FTX-L 3G can be loaded into any compatible frame's slot but due to the extra height of the FTX-L 3G module it is not possible to place cards from the Crystal Vision Standard Definition or audio range directly above in certain positions. High Definition boards do not share this restriction and can be placed in any slot position.

Frame type				
Indigo 4		xxxxxxxx	xxxxxxxx	xxxxxxxx
		Optical module	Optical module	Optical module
		xxxxxxxx	xxxxxxxx	xxxxxxxx
		Optical module	Optical module	Optical module
	Indigo 2	xxxxxxxx	xxxxxxxx	xxxxxxxx
		Optical module	Optical module	Optical module
	Indigo 1	xxxxxxxx	xxxxxxxx	xxxxxxxx
		Optical module	Optical module	Optical module

Optical cards loaded in these slots will not allow Standard Definition or audio cards to be fitted in the slots immediately above.

Rear module connections with RM55

RM55 fits in all frames	Description
	**RM55** • 12 modules in 2U and six in 1U • All frame slots can be used

BNC	I/O assignment
OPTICAL OUTPUT 2	Optical serial digital video output 2
OPTICAL OUTPUT 1	Optical serial digital video output 1
SDI IN1	Channel 1 3G/HD/SD serial digital input
SDI LOOP1	Channel 1 loop-though output
SDI LOOP2/1	Either Channel 2 or Channel 1 loop-though output depending on PL2 setting.
SDI IN2	Channel 2 HD/SD serial digital input

2.2 General purpose interface

The external GPI control lines 'a' to 'f' at the frame remote connectors are provided to allow remote control and/or remote status indication. The FTX-L 3G has six GPI output lines assigned for status reporting.

GPI Connections

	High (+5V)	Low (less than 1V)
'a'	Serial digital input present on Input 1	No serial digital input present on Input 1
'b'	Serial digital input present on Input 2	No serial digital input present on Input 2
'c'	Channel 1 laser functioning within normal tolerances	Channel 1 laser has reached its near end of life point
'd'	Channel 2 laser functioning within normal tolerances	Channel 2 laser has reached its near end of life point
'e'	Channel 1 laser operating	Channel 1 laser shut down
'f'	Channel 2 laser operating	Channel 2 laser shut down

Each GPI output line is pulled up to the frame +5V with a 6k8 ohm resistor; they are also protected by a 270 ohm current limiting series resistor.

2U frame GPI Connections

GPI lines ‘a’ to ‘f’ of each card connect to two of four rear remote connectors as follows:

Slot no.	‘a’ pin	‘b’ pin	‘c’ pin	‘d’ pin	‘e’ pin	‘f’ pin
1	8 (1)	9 (1)	18 (1)	26 (1)	19 (2)	20 (2)
2	7 (1)	16 (1)	17 (1)	25 (1)	10 (2)	11 (2)
3	8 (3)	9 (3)	18 (3)	26 (3)	19 (4)	20 (4)
4	7 (3)	16 (3)	17 (3)	25 (3)	10 (4)	11 (4)
5	5 (1)	6 (1)	15 (1)	24 (1)	1 (2)	2 (2)
6	4 (1)	14 (1)	13 (1)	23 (1)	3 (2)	4 (2)
7	5 (3)	6 (3)	15 (3)	24 (3)	1 (4)	2 (4)
8	4 (3)	14 (3)	13 (3)	23 (3)	3 (4)	4 (4)
9	3 (1)	12 (1)	22 (1)	21 (1)	12 (2)	13 (2)
10	10 (1)	11 (1)	19 (1)	20 (1)	21 (2)	22 (2)
11	3 (3)	12 (3)	22 (3)	21 (3)	12 (4)	13 (4)
12	10 (3)	11 (3)	19 (3)	20 (3)	21 (4)	22 (4)

Table shows pin number (Remote number)

Note: *Remote 1 and Remote 3 are 26 way high-density D-Type female sockets. Frame ground is pin 2 and +5V @500mA is pin 1 in each case.*

Remote 2 and Remote 4 are 26 way high-density D-Type male plugs and frame ground is pin 6 in each case and +5V @500mA is pin 15 on Remote 2.

The +5V output is protected by self-resetting thermal fuses, which limit the total output current available from Remotes 1-4 to approximately 1A.

1U frame GPI connections

GPI lines ‘a’ to ‘f’ of each card connect to the two rear remote connectors as follows:

Slot no.	‘a’ pin	‘b’ pin	‘c’ pin	‘d’ pin	‘e’ pin	‘f’ pin
1	8 (1)	9 (1)	18 (1)	26 (1)	19 (2)	20 (2)
2	7 (1)	16 (1)	17 (1)	25 (1)	10 (2)	11 (2)
3	5 (1)	6 (1)	15 (1)	24 (1)	1 (2)	2 (2)
4	4 (1)	14 (1)	13 (1)	23 (1)	3 (2)	4 (2)
5	3 (1)	12 (1)	22 (1)	21 (1)	12 (2)	13 (2)
6	10 (1)	11 (1)	19 (1)	20 (1)	21 (2)	22 (2)

Table shows pin number (Remote number)

Note: *Remote 1: 26 way high-density D-Type female socket. Frame ground is pin 2 and +5V @500mA is pin 1.*

Remote 2: 26 way high-density D-Type male plugs and frame ground is pin 6 and +5V @500mA is pin 15.

The +5V output is protected by self-resetting thermal fuses, which limit the total output current available from Remotes 1-2 to approximately 1A.

Indigo DT desk top box GPI connections

GPI lines ‘a’ to ‘f’ of each card connect to the rear remote connector as follows:

Slot no.	‘a’ pin	‘b’ pin	‘c’ pin	‘d’ pin	‘e’ pin	‘f’ pin
1	8 (1)	9 (1)	18 (1)	26 (1)	19 (2)	20 (2)
2	7 (1)	16 (1)	17 (1)	25 (1)	10 (2)	11 (2)

Table shows pin number (remote number)

Note: *Remote 1: 26 way high-density D-Type female socket. Frame ground is pin 2 and +5V @500mA is pin 1.*

Remote 2: 26 way high-density D-Type male plugs and frame ground is pin 6 and +5V @500mA is pin 15.

The +5V output is protected by self-resetting thermal fuses, which limit the total output current available from Remotes 1-2 to approximately 1A.

3 Card edge operation

Card edge controls and indicators

The front edge of the FTX-L 3G card provides power rail monitoring and status.

LED	colour	Meaning when lit
PSU Ok	Green	All PSU voltages are within range.
I/P1 Pres	Green	There is a serial digital video input on Channel 1.
Warn	Amber	Channel 1 laser has reached its near end of life.
Shut	Red	Channel 1 laser is not emitting light or has been disabled.
Shut	Red	Channel 2 laser is not emitting light or has been disabled.
Warn	Amber	Channel 2 laser has reached its near end of life.
I/P2 Pres	Green	There is a serial digital video input on Channel 2.

LED indications (viewed left to right)

Note: *A laser module is near end of life when its bias current has reached approximately 85% of its maximum.*

Switch	Label	Up	Down
1	**HD SD**	Set Channel 1 rise/fall time to HD (SMPTE 259M)	Set Channel 1 rise/fall time to SD (SMPTE 424M)
2	**Dis 1**	Set Channel 1 laser shutdown mode to auto	Manually shutdown the Channel 1 laser to prevent light emission
3	**Dis 2**	Set Channel 2 laser shutdown mode to auto	Manually shutdown the Channel 2 laser to prevent light emission
4	**HD SD**	Set Channel 2 rise/fall time to HD (SMPTE 259M)	Set Channel 2 rise/fall time to SD (SMPTE 424M)

Card edge switch functions

4 Control and status monitoring

4.1 Using the front control panel

On power up, the LEDs of all eight control panel keys will illuminate briefly. Once the panel has completed its power up and configuration sequence the panel will enter its status mode and display the current software version and frame IP address.

'Status' menu showing current software version and IP address

Selecting a FTX-L 3G

To continue with control panel operation or configuration, press the 'Device' key once. The control panel will display the name of the card that first responds to the polling request together with its location number. The location number consists of the frame number plus the card position in the frame. Rotate the Shaft control to poll through the available cards. Use the F2 soft key to toggle between the card's serial number and issue number with modification level.

'Device' menu showing FTX 3G / FTX-L 3G in slot 1.01

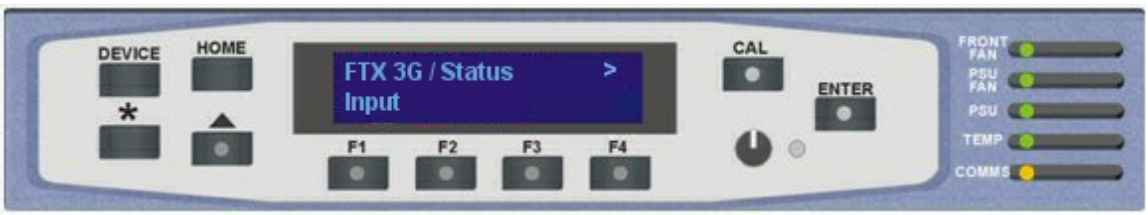
In the example above, the card displayed is located in the first frame in slot number 1.

Note: *The active front panel cannot differentiate between an FTX-L 3G and an FTX 3G. The active front panel will report an FTX-L 3G as an FTX 3G.*

When the desired card is selected press the ENTER key to access that card's HOME menu.

The FTX-L 3G home menu

Rotate the shaft control to scroll through the menu structure and press ENTER to select the sub-menus. Press HOME at any time to return to the home menu.



FTX-L 3G Status sub-menu

Press ENTER to select the Video Status menu or SCROLL to display other sub-menus. See description of menu structure below for list of sub-menus.

Control Panel keys overview

The functions assigned to the control panel keys are:

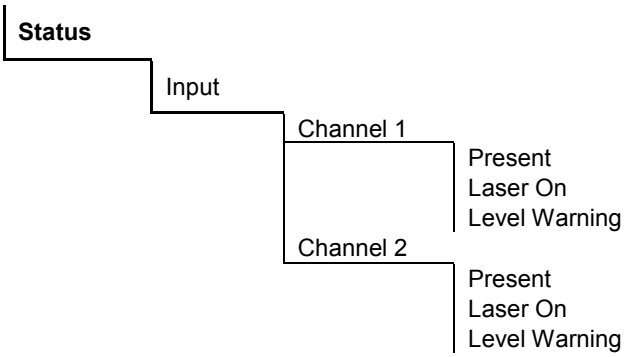
- **DEVICE** – enters 'device' menu to select a card or show available cards.
- **ASTERISK** (*) – selects 'network configuration' menu.
- **F1 to F4** – soft keys not currently used by FTX-L 3G.
- **HOME** – returns to top of the menu structure.
- **ENTER** – accept current selection.
- **Up arrow** – used to move up through the menu structure.
- **Rotary control** – shaft encoder used to select sub-menus or variable data.

Updating the display

The values displayed on an active front panel are only updated when an adjustment is made and when changing menu level. If changes occur using card edge controls or other remote control, the text displayed on the active front panel will not be updated immediately. If necessary, use the upward arrow to leave and then re-enter a menu to update the display.

Menu Structure

The basic menu tree for front panel access and VisionWeb is identical and consists of the following menus and sub-menus:



4.2 Controlling cards via VisionWeb

Crystal Vision cards use an XML file to create a control database that is used by the the Indigo frame front panel controller, VisionPanel and VisionWeb software. VisionWeb PC software offers a full range of controls with slider controls etc.

Accessing the Indigo Home page with a PC browser via the Ethernet connector of an Ethernet-enabled frame will display a list of the cards fitted (see Frame Manual for more details).

Typical Indigo home page

The example above shows a FTX 3G/FTX-L 3G card fitted in slot 1 and the frame's power supply and status monitor in slots 13 and 14. Clicking on the FTX-L 3G card will bring up the card's home page:

FTX-L 3G Status Page

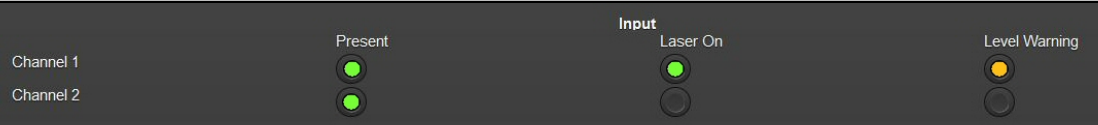
5 Control Descriptions

The controls of FTX-L 3G are accessible from the front panel, VisionWeb software, VisionPanel remote panels or SNMP. The description of controls used in this manual is based on VisionWeb GUI screen grabs but the path to locate controls via the front panel follows the same logic. VisionWeb GUI controls are accessed by menus at the bottom of the page which, when selected, may offer sub-menus containing a number of controls. Some controls are simulated LEDs that are used to show status, others are check boxes, buttons or sliders which change various settings.

FTX-L 3G only has a single menu **STATUS** for input and laser status monitoring.

The menu is shown with a screen grab and description of each control's function.

5.1 Status Menu

Status	
Display presence of incoming video signal and laser status.	
	
Present	**On when Channel 1 or Channel 2 input video is present. With no input present the laser will automatically shut down.**
Laser On	**On when Channel 1 or Channel 2 laser is active. Note that there can be several reasons for the laser to shut down, apart from it being manually disabled for maintenance purposes or through a lack of video input, an automatic shutdown will result if the laser's working parameters become out of specification. For example, reaching the end of its working life or for a transitory transgression of design limits. Once the laser has been shut down, as a safety feature it will latch in this condition. If it is suspected that the shutdown has been the result of a transitory condition this latched shutdown condition may be reversed by moving the channel 'Dis' switch down then up again.**
Level Warning	**On if Channel 1 or 2 laser is producing low output power. This indicates that the laser has reached 85% of expected life and should be replaced as soon as possible.**

6 Troubleshooting

Simple troubleshooting can be performed by using either the card edge or a remote status panel display.

6.1 Card edge status LEDs

Board edge LEDs provide status reporting and may be useful when fault finding.

The following table summarises the card edge switches, LED functions and colours (from left to right):

LED	Location/colour	Meaning when lit
PSU Ok	Green	All PSU voltages are within range.
I/P 1 Pres	Green	There is a serial digital video input on Channel 1.
Warn	Amber	Channel 1 laser has reached its near end of life.
Shut	Red	Channel 1 laser is not emitting light or has been disabled.
Shut	Red	Channel 2 laser is not emitting light or has been disabled.
Warn	Amber	Channel 2 laser has reached its near end of life.
I/P 2 Pres	Green	There is a serial digital video input on Channel 2.

Switch	Label	Up	Down
1	HD SD	HD slew rate	SD slew rate
2	Dis 1	Laser shutdown is under auto control	The Channel 1 laser is manually shutdown preventing light emission.
3	Dis 2	Laser shutdown is under auto control	The Channel 2 laser is manually shutdown preventing light emission.
4	HD SD	HD slew rate	SD slew rate

Basic fault finding guide

The Power OK LEDs are not illuminated

Check that the frame PSU is functioning – refer to the appropriate frame manual for detailed information.

Check that the card is seated correctly in the frame.

There is no video input present

Check that valid video input is present and that any cabling is intact.

There is no optical output

Check that the laser disabled/error LED is not illuminated.

Laser disable/error LED illuminated

Check that SDI input is present.

Check that the card edge shutdown switch is not in the down position.

Toggle the shutdown switch to reset the laser driver. If reset is not successful there is likely to have been a catastrophic fault.

Laser level warning LED illuminated

Near end of life. The laser emitter is reaching its life expectancy and will require replacement.

The video output is low quality

Check that the maximum cable length has not been exceeded for both the video input or optical output (see *Fibre distance calculations guide*).

Check that the optical connectors have not become contaminated.

Re-setting the card

If required the card may be reset by simply removing the card from the frame and then re-inserting it or, if practical, briefly remove the power to the frame.

It is safe to re-insert the card whilst the rack is powered.

7 Specification

General

Dimensions	100mm x 266mm module with DIN 41612 connector
Weight	200g
Power consumption	3 W

Inputs

Video	HD or SD SDI 270Mb/s to 2.97Gb/s serial compliant to SMPTE 259 or ASI data, SMPTE 292-1 and SMPTE 424/425-A
Cable equalisation	3G up to 80m and HD up to 140m with Belden 1694 or equivalent (Belden 8281 or equivalent up to 60 and 100m)
	SD (270Mb/s) >250 metres

Outputs

Video	
Number and type:	Two input loop-throughs. HD or SD SDI 270Mb/s to 2.97Gb/s serial compliant to SMPTE 259 or ASI data, SMPTE 292-1 and SMPTE 424/425-A
Optical	
Number and type:	One optical output per channel as standard or one dual CWDM laser per card as an option:
	Class 1 FDA and IEC60825-1 Laser Safety compliant: meets the SMPTE 297-2006 short-haul specification for single-mode or multi-mode fibre.
Average Optical power	Max -0.0dBm, min -5.0dBm
Fibre pigtail	Single mode 9/125uM
Optical wavelength	1290-1330nm, 1310 typical
Extinction Ratio	7.5dB
Connector type	SC/PC

Laser CWDM option

Number and type:	Two DFB lasers with 20nm wavelength spacing between channels configured for CWDM:
	Class 1 FDA and IEC60825-1 Laser Safety compliant: meets the SMPTE 297-2006 short-haul specification.
Optical wavelength:	Ch1 1271 Ch2 1291nm. Ch1 1311 Ch2 1331nm. Ch1 1351 Ch2 1371nm. Ch1 1391 Ch2 1411nm.

Ch1 1431 Ch2 1451nm.
Ch1 1471 Ch2 1491nm.
Ch1 1511 Ch2 1531nm.
Ch1 1551 Ch2 1571nm.
Ch1 1591 Ch2 1611nm.
Ch1 1310 Ch2 1550nm.

Output power: Minimum 0dBm.
Maximum +5dBm.
Typically, +2.5dBm (1.78mW).

GPI Outputs

Number and type: 6 off indicating for both channels: input present, laser ageing and laser shutdown

Status monitoring

LED display: Front of card edge visual monitoring with LED indicators to indicate:

PSU rail present, SDI input present, laser near end of life, laser error/disabled

4-way piano level switch: Manual laser shutdown and loop-though slew rate

8 Appendix

8.1 Fibre distance calculations guide

The maximum distance for a reliable fibre optic link will depend on several factors. The power of the lasers, the sensitivity of the receiver, the type of fibre optic cable used, the quality and cleanliness of the connectors, the data rate of the digital signal, the amount of jitter on the digital signal applied to the system, even possibly the number and sharpness of bends in the cable. Therefore, working an exact limit is very difficult and the number will vary from one installation to another.

The calculations shown below provide a simple basis to know if you are going exceed the maximum length which is defined by the power lasers and sensitivity of the receiver. This is often referred to as the link budget.

Link budget = Laser Power output - cable loss - connector loss

The Link budget must be greater than the receiver sensitivity.

This will tell you if the length you wish to achieve is possible, assuming the other factors mentioned are not significant. By this we mean normal or average conditions.

The Crystal Vision FTX-L 3G SDI to fibre converter is quoted as having an output power of typically -2dbm but there's a worst case figure of -5dbm and so you should use that.

The FRX 3G sensitivity is defined as the minimum input level being -20dBm.

Typical cable loss could be 0.4db per km, for 1310nm light. Connector loss could be 0.5dB each.

So, if we wanted to send the signal down 25km of cable then we would then do the following calculation…

(-5 for FTX) – (25Kmx0.4 for cable) – 1 (for the 2 connectors) = -16

which is more than -20 by a long way.

It is recommended that to be very safe you do not get within -3dBm of the limit of receiver sensitivity. This would mean that you have a link budget maximum of -17. This then works back to a maximum cable length of 32.5km.

However, these calculations are based purely on power loses. As the data rate rises from 270Mbs to 1.5Gbs or higher there are other effects which start to reduce the performance. These optical effects introduce jitter on the signal and then reduce the maximum cable length which can be achieved. Therefore, what we would recommend is working to these guidelines.

With the FTX-L 3G and using a SMPTE 297-2006 compatible receiver (e.g. FRX 3G) over **single-mode** fibre, the typical distance which can be achieved is 21km for HD-SDI, and 30km for SD-SDI.

Note - If you are using multi-mode fibre then the cable lengths are always lower, probably by at least a factor of 10 or more.