USER MANUAL

Vision SYSTEM

FTX-VF

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

Crystal Vision

Crystal Vision Ltd., Lion Technology Park, Station Road East, Whittlesford, Cambridge, CB22 4WL, England.
Tel: +44(0) 1223 497049 Fax: +44(0) 1223 497059 sales@crystalvision.tv www.crystalvision.tv

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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.

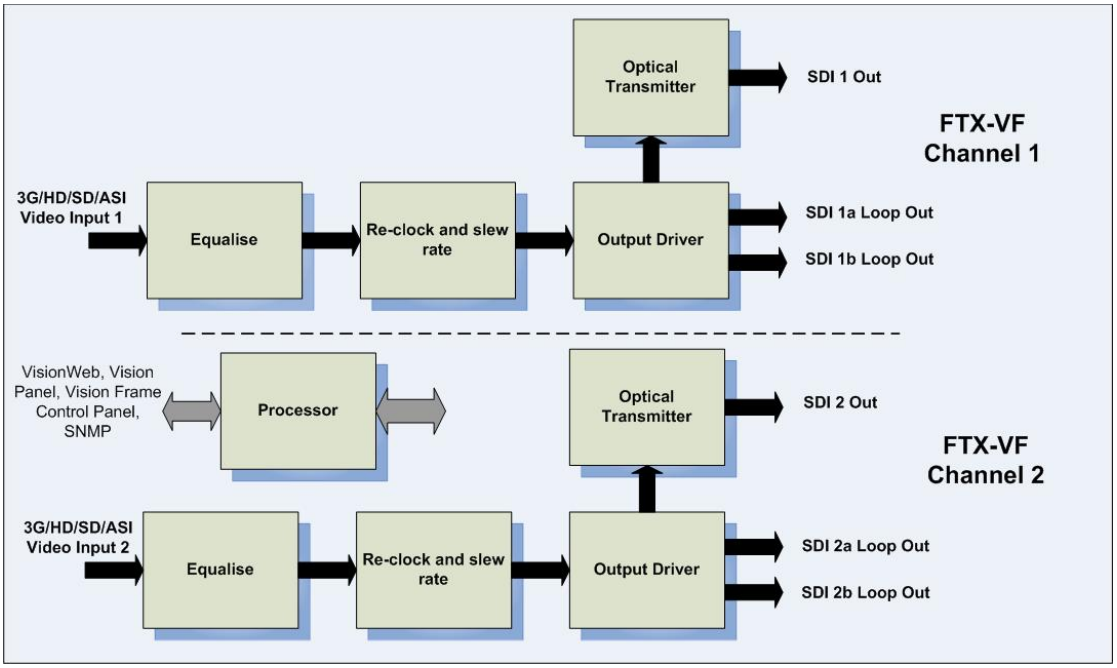
1 Introduction

The FTX-VF is a dual channel, reclocking, 3G/HD/SD video to fibre transmitter that can be used with single-mode or multi-mode fibres and meets the SMPTE 297-2006 short-haul specification. Distances in excess of 10km are possible with single-mode fibre depending on cable quality and number of connectors and splices (see *Fibre distance calculations guide*). Optional CWDM lasers are available which, with an external combiner, enables the transmission of two video signals down a single fibre for up to 50km.

FTX-VF is a space-saving 96mm x 325mm module which fits in the standard Vision frames from Crystal Vision, with the inputs and outputs accessed by using the VR14 rear module. Status monitoring and control is by the Vision frame active front panel, remote VisionPanel control panel, SNMP or VisionWeb PC software.

In addition to the fibre output, FTX-VF provides two reclocked loop-through video outputs per channel.

FTX-VF provides remote monitoring of video input presence and warnings of low laser output (failure) and high bias current (imminent failure). The laser output automatically turns off if the input video is removed and can be remotely turned on and off as required.



FTX-VF block diagram showing two independent optical outputs

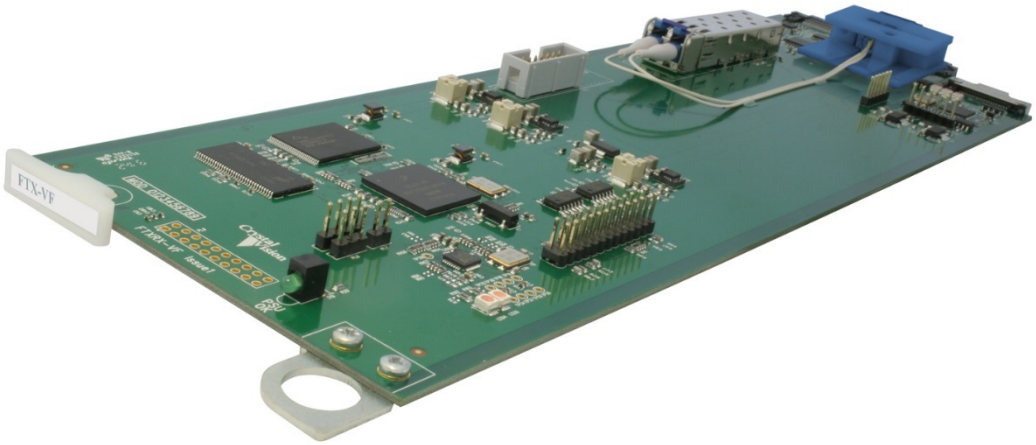
The rear connector details may be found in the section *Rear modules and signal I/O*.

The main features are as follows:

- Dual channel, video input to optical fibre output operation
- Class 1 FDA and IEC60825-1 Laser Safety compliant
- Single or multi-mode fibre operation – meets SMPTE 297-2006 short-haul specification
- Optional coarse wavelength division multiplexing (CWDM) lasers available with a choice of ten different wavelength pairs
- 270Mb/s to 2.97Gb/s serial digital compliant to SMPTE 259M, SMPTE 292M and SMPTE 424M
- Following video standards supported: 720p 50/59.94/60Hz, 1080p 50/59.94Hz, 1080i 50/59.94/60Hz, 1080p 23.98/24/25/29.97/30/50/59.94/60Hz, 1080PsF 23.98/24/25/29.97/30Hz, 2048x1080p 23.98/24/25/29.97/30Hz*, 2048x1080PsF 23.98/24/25/29.97/30Hz* *(*= YUV 4:2:2 10 bit)*
- Two equalised and reclocked input loop-through outputs per channel
- Capable of achieving distances in excess of 10km with single-mode fibre, depending on cable quality and number of connectors and splices
- Remote warning indications of laser level fault (actual failure) and laser bias fault (imminent failure)
- DVB-ASI compatible, all outputs positive polarity
- Up to 20 FTX-VF cards in a Vision 3 3U frame
- Less than 100ns delay
- Remote monitoring and control via VisionPanel, VisionWeb control system, SNMP and the frame active panel

2 Hardware installation

2.1 Board Configuration



FTX-VF card

Link Configuration

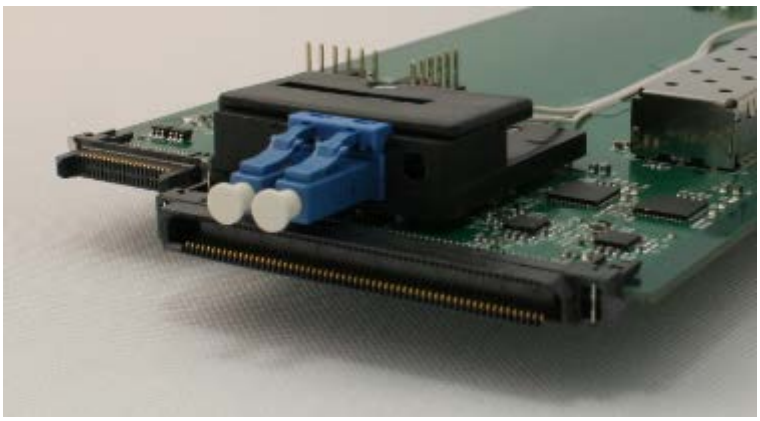
The FTX-VF has no user-selectable links. Any links or controls should remain in their factory set positions.

Inserting cards

Cards can be plugged in and out of powered Vision frames without damage. Although no electrical damage should occur if an FTX-VF is plugged into the incorrect frame slot, the optical connectors may be damaged.

See Vision frame User Manual for the correct procedure for installing cards and rear modules.

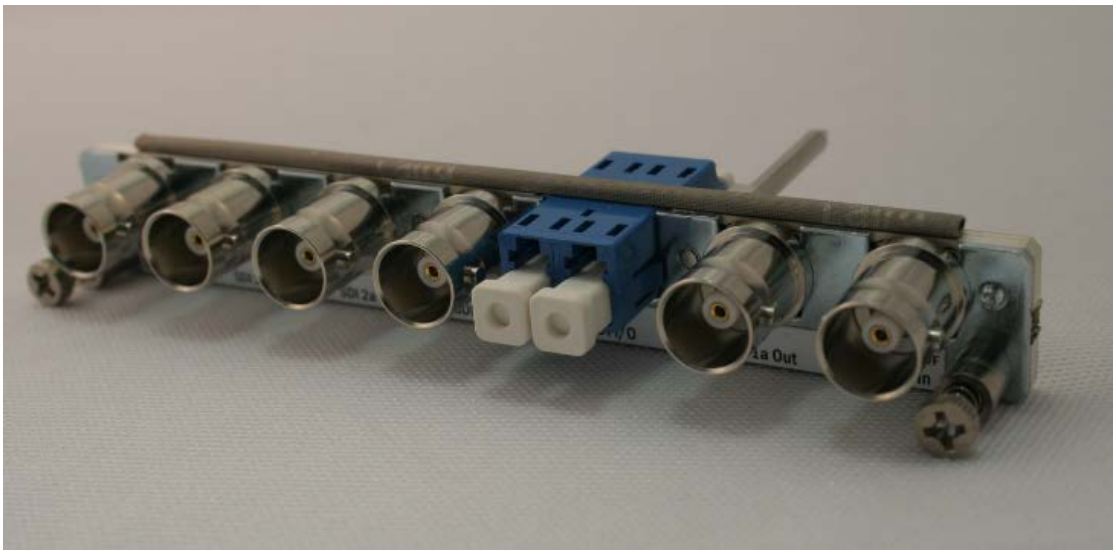
Due to its fragile nature fibre optic equipment must be handled with care. Sharp blows or snagging the fibre pigtails will fracture the internal glass filament and destroy its light carrying ability. A degraded performance will also result if dust caps are not replaced whenever the transmitter card or rear modules are de-mounted for any reason and 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-VF connectors with the dust caps fitted

The dust caps must be removed before fitting the FTX-VF into a frame.

The VR14 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-VF 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.



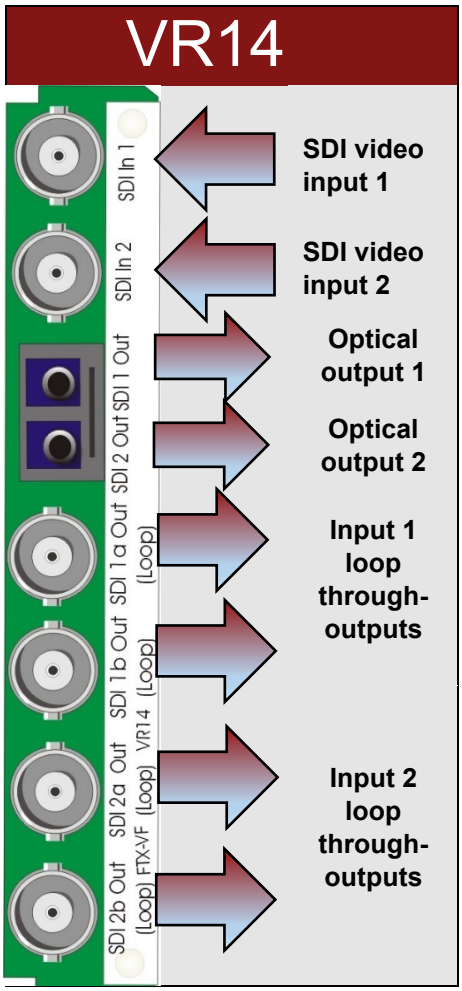
VR14 rear module

3 Rear modules and signal I/O

The FTX-VF fibre transmitter fits into all Vision rack frames from Crystal Vision and can be plugged in and removed while the frame is powered without damage.

Vision frames all have a hinged front panel that gives access to the PSUs and all cards. The universal frame wiring system allows any of the interface range of cards to be fitted in any position with the use of removable rear modules.

3.1 Rear module connections with VR14



The VR14 single-slot rear module allows up to 20 FTX-VF cards to fit into a Vision 3 frame.

BNC connectors provide two 3G/HD/SD video inputs both with two reclocked loop-through outputs. A dual LC/SFP fibre connector provides the optical output for both channels.

4 Status monitoring

FTX-VF status can be accessed most easily by VisionWeb remote control PC software but also by VisionPanel, the Vision frame's front panel and SNMP. The following screen grabs are from the VisionWeb GUI and are used to identify the various available status indications. The menu tree for VisionWeb, front panel and VisionPanel operation is identical although the appearance and labelling of some controls may vary according to the available space. See the Vision frame and VisionPanel's User Manuals for more details.

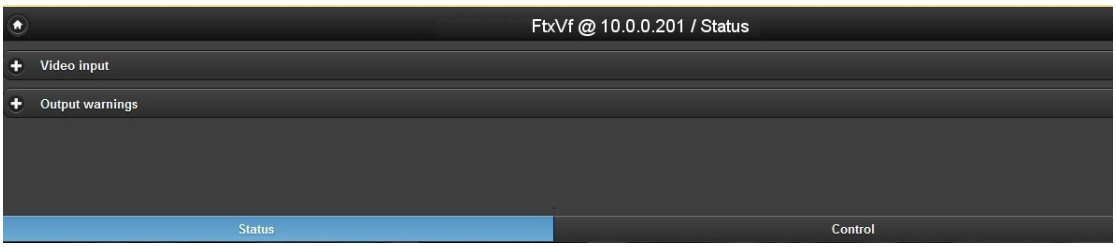
4.1 Controlling cards via VisionWeb

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

Accessing the Vision frame homepage with a PC browser via the Ethernet connector of a frame will display a list of the cards fitted. (See 'Vision' frame User Manual for more details.)

Typical Vision 3 frame homepage

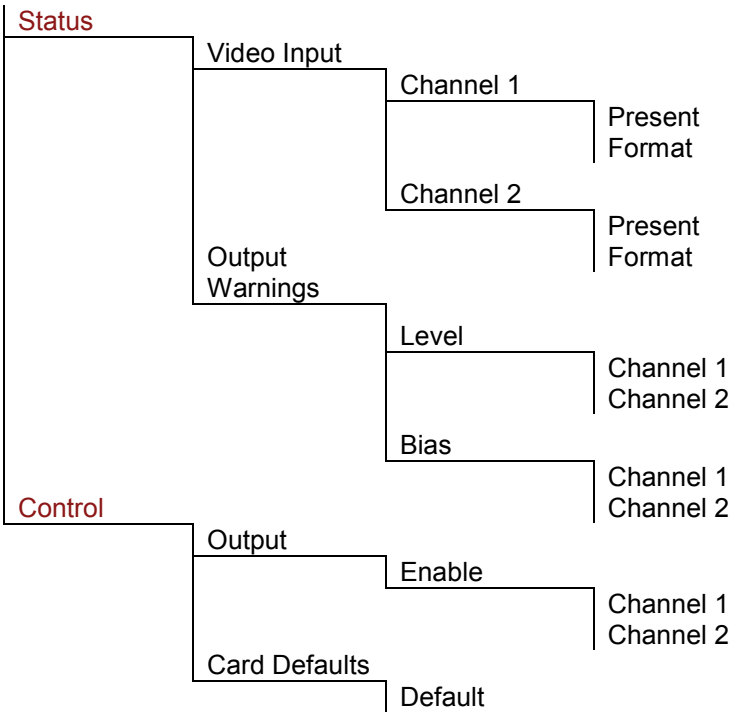
The example above shows a FTX-VF card fitted in slot 1 and other Vision cards in slots 2, 3, 5 and 7. Clicking on the FTX-VF card will bring up the card's Status page, for example:



FTX-VF Status Page

4.2 Menu Structure

Operators of a Vision frame active front panel or VisionPanel should use the following tree to access the FTX-VF controls:



Users of VisionWeb need only select the tabs shown above in red to access the pages containing the set of controls.

4.3 Control Descriptions

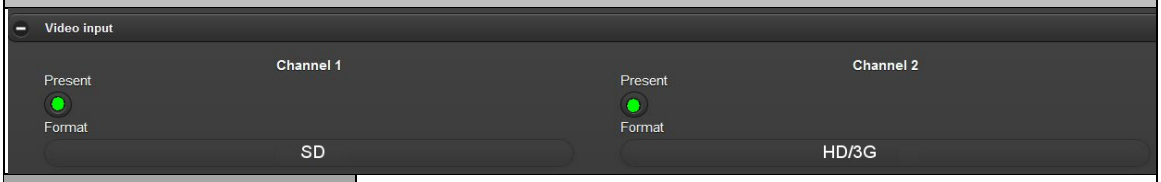
The description of controls used in this manual is based on VisionWeb GUI screen grabs. VisionWeb monitoring and control pages are accessed by tabs at the bottom of the page which, when selected, offer controls such as LEDs, check boxes, buttons, sliders and labels.

The description of the monitoring and control pages is in the order shown in the menu tree i.e.

VIDEO INPUT, OUTPUT WARNINGS, CONTROL:

Video Input

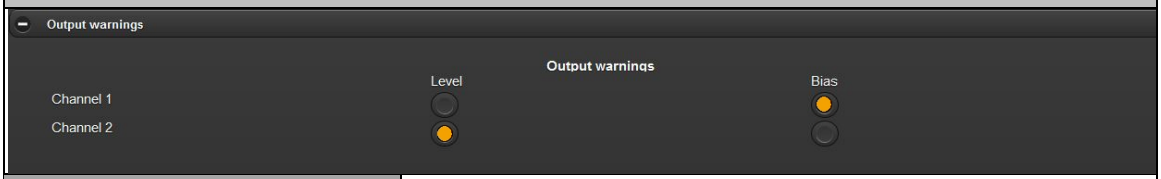
Display presence and status of input signal.



Present	**On if an input signal is detected.**
Format	**Displays current format of input video signal as SD, HD/3G or unknown.** **525i/59.94Hz and 625i/50Hz SDI video formats are reported as 'SD'.** **The following formats are reported as 'HD/3G':** **720p 50/59.94/60 1080p 50/59.94, 1080i 50/59.94/60, 1080p 23.98/24/25/29.97/30/50/59.94/ 60, 1080PsF 23.98/24/25/29.97/30, 2048x1080p 23.98/24/25/29.97/30*, 2048x1080PsF 23.98/24/25/29.97/30*** *(*= YUV 4:2:2 10 bit)* **All other formats are reported as 'unknown'.**

Output Warnings

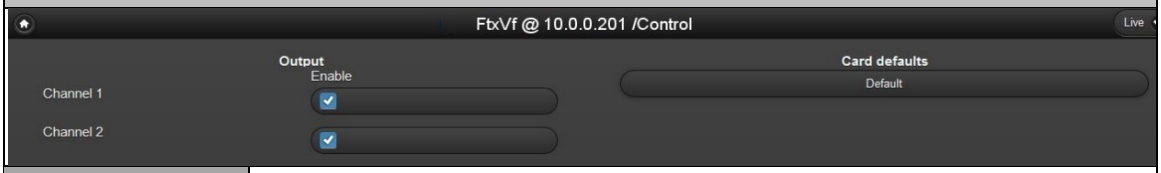
Display laser fail warnings.



Level	**On if the laser is producing low output power. This indicates that the laser has failed and should be replaced immediately.**
Bias	**On if the laser bias current has risen above a threshold which indicates imminent failure of the device. The laser should be replaced as soon as possible.**

Control

Manually turn laser on/off and reset card to default values.



Output Enable	**Manually turn the laser on or off.**
Card default	**Click on this button to return the card to its default values: Channel 1 & 2 Output = Enabled.**

5 Troubleshooting

5.1 Card edge monitoring

The green LED on the front edge of the card provides power rail monitoring. The red LED, if fitted, currently has no function.

FTX-VF front edge

5.2 Basic fault finding guide

WARNING: *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. As the visible spectrum is well below the wavelengths used by the FTX-VF there is no point looking into the end of a cable to see if there is a signal.*

- **Power OK LED not illuminated:** Check that the frame PSU is functioning – refer to the 'Vision' frame manual for detailed information.
- **There is no optical output:** With VisionWeb or a remote panel, check that the Output 'Enable' check-box is ticked on the 'Control' page. Check that there is no 'level' warning on the 'Output Warnings' page. Check that a valid input is present and that any cabling is intact and that there is an input present indication and of the expected format.
- **Poor video signal at receiving end:** Check that the optical connectors have not become contaminated with dust etc. The maximum distance that can be achieved depends on fibre quality and the number of splices/connectors. Distances in excess of 10km are possible with single-mode fibre at 3Gb/s but the maximum achievable

distance with multi-mode fibre is considerably less, possibly only a few hundred metres. Single-mode fibre, or any single-mode components should never be used downstream of multi-mode fibre. See *Fibre distance calculations guide* for more information.

- **The video output is low quality:** Check that the maximum length of input cable has not been exceeded.

- **Receiver input power 'High' or 'Overload':** Consider using an optical attenuator or a longer fibre cable run (single-mode fibre, typically attenuates the signal by about 0.5 dB per km for 1310nm sources). The receiver could be saturated (poor video output) or, in extreme cases, damaged if the received optical power is too high. Check that the combination of maximum output power of the transmitting device and fibre attenuation is not greater than the maximum permissible receiving level. **Note**: *Users should be aware that the maximum output power of the FTX-VF SFP laser module is 0dBm, and +5dBm for the CWDM module. These levels may necessitate additional attenuation when used in conjunction with the FRX-VF which has an overload level of -3dBm.*

- **The card no longer responds to front panel control:** Check that the card is seated correctly and that the Power OK LED is lit. Check if the control panel can control another card in the same rack. If necessary reset the card.

- **Resetting the card:** If required, the card may be reset by removing the card from the frame and then re-inserting it. It is safe to re-insert the card whilst the frame is powered. Any previous configuration will be retained.

6 Specification

General

Dimensions	96mm x 325mm module with connector.
Weight	200g.
Power consumption	FTX-VF 4 Watts.

Inputs

Video	Two 3G/HD/SD video inputs, one per channel, compliant to SMPTE 259, SMPTE 292-1 and SMPTE 424/425-A. **Supported formats**: SDI 525i/59.94Hz, 625i/50Hz. 720p 50/59.94/60Hz, 1080p 50/59.94Hz, 1080i 50/59.94/60Hz, 1080p 23.98/24/25/29.97/30/50/59.94/60Hz, 1080PsF 23.98/24/25/29.97/30Hz, 2048x1080p 23.98/24/25/29.97/30Hz*, 2048x1080PsF 23.98/24/25/29.97/30Hz* *(*= YUV 4:2:2 10 bit)*
Cable Length	3G (2.970Gb/s) – 100 metres, Belden 1694A or equivalent. HD (1.485Gb/s) – 140 metres, Belden 1694A or equivalent. SD (270Mb/s) >250 metres, Belden 8281 or equivalent.

Outputs

Number and type:	**Optical** - One output per channel as standard or one dual CWDM laser per card as an option: **Video** – Two input loop-through outputs per channel: 3G, HD or SD SDI 270Mb/s to 2.97Gb/s serial digital compliant to SMPTE 259, SMPTE 292-1 and SMPTE 424/425-A.

Laser SFP option

Number and type:	One FP laser per channel: Class 1 FDA and IEC60825-1 Laser Safety compliant: meets the SMPTE 297-2006 short-haul specification for single-mode or multi-mode fibre.
Output power:	Minimum -5dBm. Maximum 0dBm. (when output is coupled into a 9/125um single mode fibre).
Fibre pigtail:	Single mode 9/125um.
Connector type:	Dual LC/SFP.
Transmission distance:	Worst case 10km, single-mode fibre @ 3Gb/s. (See *Fibre distance calculations guide*.)

Laser emission data:

Optical wavelength:	Nominal 1310nm.

Total laser output power:	<0.195mW (as defined by FDA:7mm aperture @ 20cms). <15.6mW (as defined by IEC:7mm aperture @ 10cms).
Beam divergence:	12.5 deg.

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).
Transmission distance:	Up to 50km, CWDM installation @ 3Gb/s. (See *Fibre distance calculations guide*.)

Rear Module I/O

VR14	Per channel: one BNC video input with two loop-through outputs and one optical output.

Delays

Delay through board	Less than 100nS.

Monitoring and Control

Remote:	Monitor and control from Vision frame front panel, VisionPanel remote panel and VisionWeb Control which is available via the web server on the frame and allows operation using a standard web browser on a computer, tablet or phone. Complimentary SNMP control and monitoring via frame CPU and Ethernet connection.

7 Appendix

7.1 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 out 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-VF SDI to fibre converters are quoted as having an output power of typically -2dBm but there's a worst case figure of -5dBm and so you should use that.

Our FRX-VF sensitivity is defined as the minimum input level being -20dBm.

Typical cable loss could be 0.4dB per kilometre, 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) - (25km x 0.4 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-VF and using a SMPTE 297-2006 compatible receiver (e.g. FRX-VF) 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 ten or more.