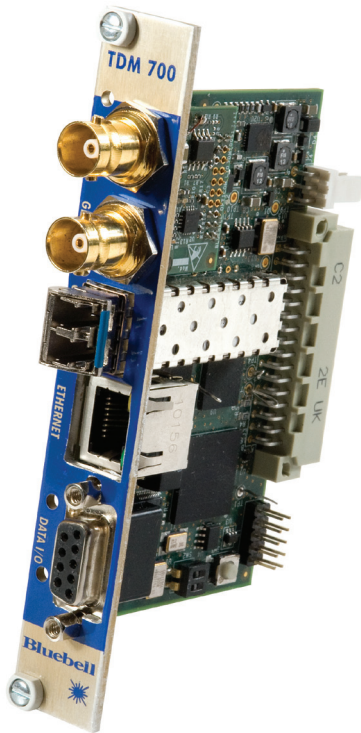


TDM-700 Series Fibre video interfaces



Operation Guide

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Declaration of Conformities

The components of the Bluebell Opticom TDM-700 Fibre-optic Transmission System complies with the essential requirements of the following EU directives, where appropriate:

89/336/EEC, EN61000-6-3, EN61000-6-4, EN55022B, EN61000-6-1, EN61000-6-2, EN61000-4-11, EN61000-4-4 (Level 2), EN61000-4-4FTB, EN61000-4-2 and EN61000-4-5.

RoSH and WEEE declaration



Bluebell Opticom Ltd. complies with EU RoSH Directive 2002/95/EC, which restricts the use of substances hazardous to humans and their environment in the manufacture of electrical and electronic equipment.

The “crossed out wheelie bin” symbol on the enclosures and represented above is there to remind users of the obligation of selective collection of waste. This label is applied to various products to indicate that the product is not to be thrown away as unsorted municipal waste. At the end of life, dispose of this product by returning it to the point of sale or to your local municipal collection point for recycling of electric and electronic devices.

Customer participation is important to minimize the potential effects on the environment and human health that can result from hazardous substances that may be contained in this product.

Please dispose of this product and its packaging in accordance with local and national disposal regulations, including those governing the recovery and recycling of waste electrical and electronic equipment. Contact your local waste administration, waste collection company or dealer.

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Overview

Thank you for purchasing this Bluebell Opticom professional broadcast video product. If you are new to Bluebell products, or to the subject of transmitting video and/or other data over fibre links, please take the time to read through this document before putting the TDM-700 to use.

Introduction

The TDM-700 Series is a range of compact and rugged fibre interfaces designed specifically for Outside Broadcast (OB) applications. They allow the implementation of a dual-fibre optical link between a remote POV (Point of View) Camera and an OB van (or Control Room).

With all TDM-700 Series models, the optical link carries an HD/SD-SDI feed from the camera. Certain TDM-700 variants can additionally:

- Add a return composite video feed for genlock or monitoring.
- Add bi-directional RS-232/RS-422 data and a GPI tally to the multiplex, allowing full remote control of the POV.
- Add a 10/100 BaseT Ethernet link to the multiplex, allowing control of IP-based devices.

A single TDM-700 link requires two interfaces; one is installed at the POV Camera location, the other in the OB van/Control Room. All interfaces are fitted with a dual optical port, separate fibres being used for data in each direction.

Variants

Multiplex options

Four versions of the TDM-700 range are available; these differ in the types of additional information which can be encoded along with an HD-SDI video signal (common to all versions).

- TDM-700: HD-SDI video plus Ethernet, RS-232/422 serial/GPI and genlock
- TDM-710: HD-SDI video plus genlock and RS-232/422 serial/GPI
- TDM-720: HD-SDI video plus RS-232/422 serial/GPI only
- TDM-730: HD-SDI video plus Ethernet only

Physical formats

TDM-700 Series interfaces are available in two formats: plug-in cards or stand-alone units. Some versions can be supplied in either format.

Plug-in cards:

These are designed to fit the Bluebell BC-100 or BC-160 19" modular rack enclosures. The racks can house six (BC-160) or fifteen (BC-100) interface cards, and are fitted with dual internal AC power supplies. (The racks are also compatible with Bluebell BC Series interface cards.)

Alternatively, cards may be fitted into smaller aluminium chassis; the BC101 and BC102 hold one and two cards respectively and require an external DC power source, while the BC120 holds three cards and has an integral mains PSU.

All plug-in cards are fitted with cartridge-style SFP dual fibre transceiver modules. The transmitter wavelength is specified at the time of order, but cartridges may be changed in the field at a later date if necessary. The receivers are wideband. See page 14 for more details of optical wavelengths.

Extended stand-alone units:

The TDM-700 and TDM-710 are available as ‘stand-alone’ units; these versions have type numbers ending with the suffix ‘E’.

The stand-alone units consist of one interface card in a fully-enclosed robust aluminium casing, and are intended for remote location in a (possibly) hostile OB environment. They require an external DC power source; a suitable AC mains adaptor is supplied with each unit.

Stand-alone units utilise a heavy-duty fibre connector suitable for outdoor use and field deployment. Two types of connector are available – Lemo L3K or Neutrik OpticalCON – the type is specified at the time of order. The transmitter wavelength is generally fixed at 1310 nm (alternatives may be supplied to special order) and the receivers are wideband.

Base and Camera ends

All TDM-700 versions are available for installation either at the “base station” end of the fibre connection (type numbers with suffix ‘B’) or at the “camera” end (type numbers with suffix ‘C’). Base interfaces encode genlock, serial/GPI control data and Ethernet data for transmission to the remote location and extract HD-SDI video from the received fibre bitstream. Camera interfaces perform the opposite functions, receiving and decoding control data while encoding the camera video signal for transmission back to base.

The various options are summarised in the following table. This User Guide is applicable to all models listed below.

	Location		Multiplex of:			
	Base	Camera	HD-SDI	Genlock	Serial/GPI	Ethernet
Plug-in cards:						
TDM-700B	✓		✓	✓	✓	✓
TDM-700C		✓	✓	✓	✓	✓
TDM-710B	✓		✓	✓	✓	
TDM-710C		✓	✓	✓	✓	
TDM-720B	✓		✓		✓	
TDM-720C		✓	✓		✓	
TDM-730B	✓		✓			✓
TDM-730C		✓	✓			✓
Stand-alone units:						
TDM-700BE	✓		✓	✓	✓	✓
TDM-700CE		✓	✓	✓	✓	✓
TDM-710BE	✓		✓	✓	✓	
TDM-710CE		✓	✓	✓	✓	



TDM-700C

TDM-700CE
(with LEMO connector)

Power requirements

For all versions, power supply requirements are dictated by the enclosure type used.

BC-100 modular rack units:

These may be fitted with either one or two AC mains PSU modules (number specified at time of order). Each module has sufficient capacity to power a fully-loaded rack. The AC connection is via standard IEC cables, DC power distribution inside the rack is via the motherboard. See the User Guide supplied with the rack units for more details.

BC-160 modular rack units:

These are fitted as standard with dual internal AC mains power supplies of sufficient capacity to power a fully-loaded rack. The AC connection is via standard IEC cables, DC power distribution inside the rack is via the motherboard. See the User Guide supplied with the rack units for more details.

BC101 and BC102 single- and dual-slot chassis:

These are supplied with an external Universal AC adaptor which connects to the chassis via a flying lead terminated in a 4-pin locking XLR connector. Mains is via an IEC connector.

BC120 triple-slot chassis:

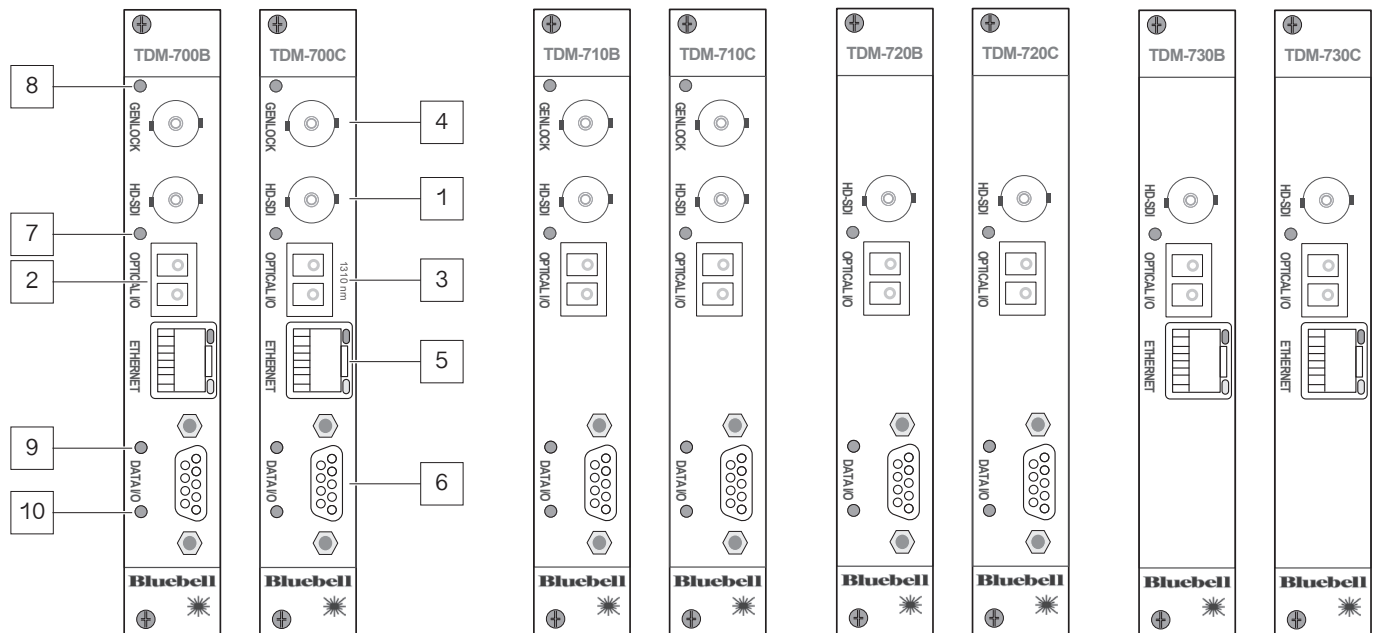
This housing for three plug-in cards is fitted with an internal AC mains supply; mains connection is via a rear IEC connector.

TDM-7xxBE/CE Stand-alone versions:

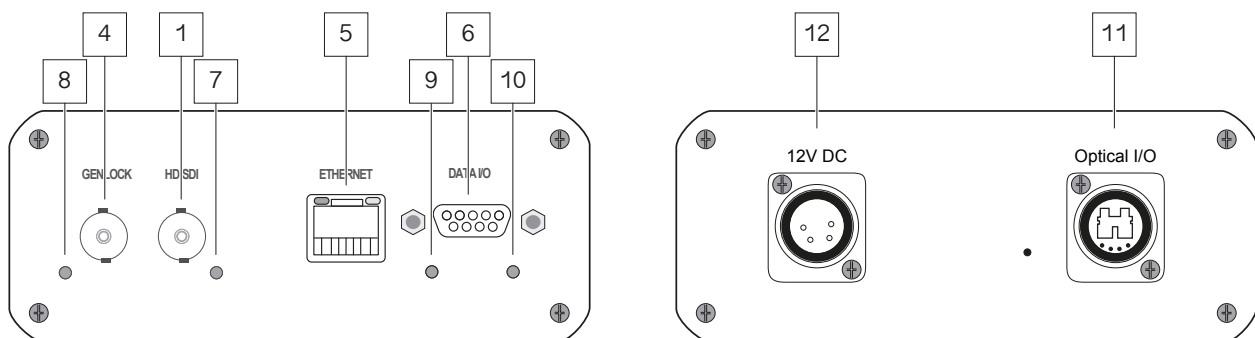
The Stand-alone enclosures are fitted with a 4-pin XLR male connector. They are supplied with an external Universal AC adaptor with a flying lead terminated in a mating XLR. AC mains to the adaptor is via a standard IEC connector.

TDM-700 Series connections

Plug-in cards:



Stand-alone units:



1. **HD-SDI** – 75 ohm BNC connector for input (camera end) or output (base end) of HD SDI video. See page 13 for standards supported.
2. **OPTICAL I/O** – SFP dual fibre connector. The connector is mounted on a removable cartridge.
3. **Transmission wavelength** – a sticker will be fitted to the faceplate to indicate the wavelength (in nm) of the optical transmitter, If no sticker is fitted, the wavelength can be taken as 1310 nm.
4. **GENLOCK** – 75 ohm BNC connector for input (base end) or output (camera end) of standard 1 V pk-pk genlock signal. Compatible with Black Burst and Tri-level sync standards. This connection can be used to distribute genlock to the POV locations, or to send a return video feed to the POV for monitoring purposes.
5. **ETHERNET** – standard RJ45 network connector. 10/100 MB/s half-/full-duplex, with auto-negotiation. Use this connection to interface with POV cameras equipped with Ethernet control, or if an Ethernet link to the POV location is required for any other purpose. The connector has integral LEDs to confirm a valid link (green) and data activity (yellow).

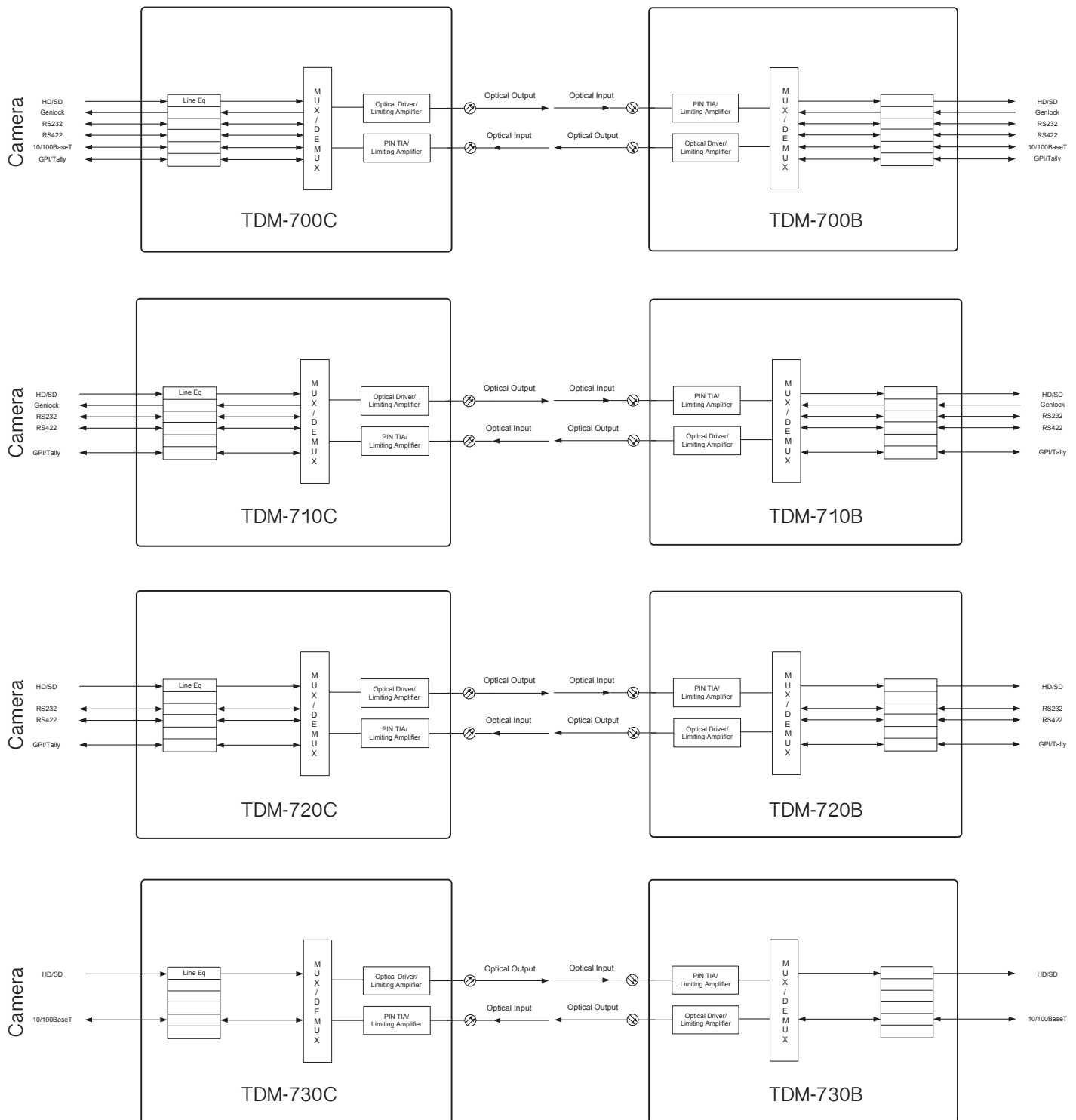
6. **DATA I/O** – 9-pin female Dsub connector for RS-232/422 bi-directional data transmission. Two GPI control/tally lines are included. Note that as this connector is multi-functional, the pinout is non-standard:

PIN	FUNCTION
1	GND
2	RS-232 O/P
3	RS-422 I/P +
4	GPI OUT
5	RS-422 O/P -
6	RS-232 I/P
7	GPI IN
8	RS-422 I/P -
9	RS-422 O/P +

7. Video valid LED – illuminates when a valid SDI video signal is present at the HD-SDI BNC connector. On camera end cards ('C' suffix) this confirms a good video feed from the camera itself. On base end cards ('B' suffix), it confirms that a good video signal has been recovered from the optical data.
8. Optical activity LED – illuminates when valid optical data is received at the fibre port.
9. Serial data activity (input) LED – illuminates when RS-232/422 data is present at the serial inputs of the Dsub connector.
10. Serial data activity (output) LED – illuminates when RS-232/422 data is present at the serial outputs of the Dsub connector.
11. **OPTICAL I/O** – The TDM-700 Series BE and CE versions are fitted with either a Lemo L3K or a Neutrik OpticalCON dual fibre connector.
12. **DC INPUT** – 4-pin latching male XLR connector for DC power input from the external AC adaptor. The pinout is as follows:

PIN	FUNCTION
1	0 V
2	n/c
3	n/c
4	DC IN (4.5 – 17 V)

System block diagrams



The TDM-700 system uses two 3G optical signals on twin fibres to provide a robust long-distance interconnection between camera and base station. The interconnection can carry a multiplex of HD-SD/SDI video, genlock, RS-232/422 serial and/or Ethernet control signals, plus a bi-directional GPI command/tally.

To allow a remote camera to be synchronised to the station genlock reference, the genlock must be transported across the TDM-700 link. The TDM-700B base unit combines the genlock with any GPI and control data onto a 3G optical carrier, which is sent through the fibre to the TDM-700C camera end unit. The genlock and control data are extracted from the optical bitstream and fed to the camera.

The camera's synchronised HD/SD-SDI video output is fed into the TDM-700C interface, together with any return control data. The TDM-700C encodes them onto another 3G optical carrier for transmission back to the base station using the second fibre. The TDM-700C card normally synchronises to the SDI signal; if there is no camera output for any reason, it free-runs. The returned optical signal is received at the base station, which synchronises to the incoming 3G data, thus ensuring that the extracted SDI feed remains in sync with the original genlock.

All common SDI standards and line/frame rates are supported and auto-detected (see page 13), and the system will assume the standard of the video signal applied at the camera end. If no SDI signal is present on initial power-up, the TDM-700 defaults to 1080i/50. The video recovered at the base station will always be of the same standard as that encoded at the camera end. In the event of loss of video, the last-used standard will be stored as long as power is applied.

Connections for Installation

The TDM-700 system has been designed for rapid deployment; no set-up procedure is necessary.

Base end:

TDM-700B, TDM-710B, TDM-720B and TDM-730B: plug the card into a spare slot in a Bluebell BC100, BC160 modular rack unit or a BC120 triple-slot enclosure. Power is provided by the rack in these cases. If using a BC101 or BC102 enclosure, fit the card and connect an external source of DC power via the XLR4 socket. TDM-700BE stand-alone units are self-contained and merely require external DC power to be connected,

Input Connections:

- **Genlock** (TDM-700B, TDM-710B and TDM-710BE): this can be a standard Bi-level (Black Burst) or Tri-level sync. The peak-to-peak input level must not exceed 1.8 V. Alternatively, the input can be used as a monitoring feed back to the POV.

Output connections:

- **Video** (all versions): HD/SD-SDI output from the camera.

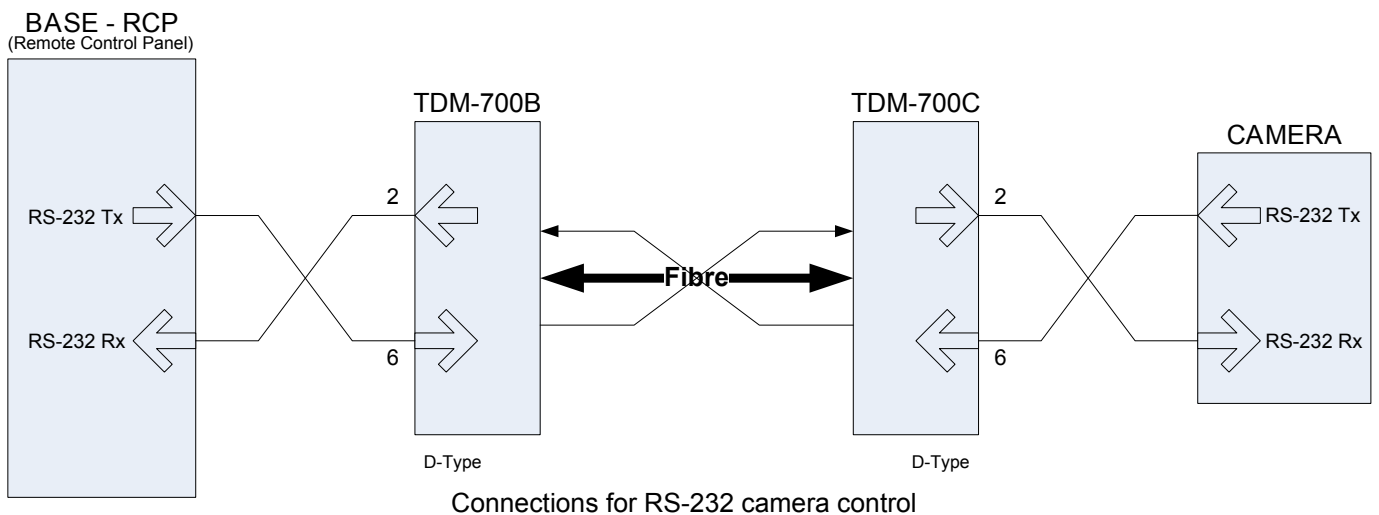
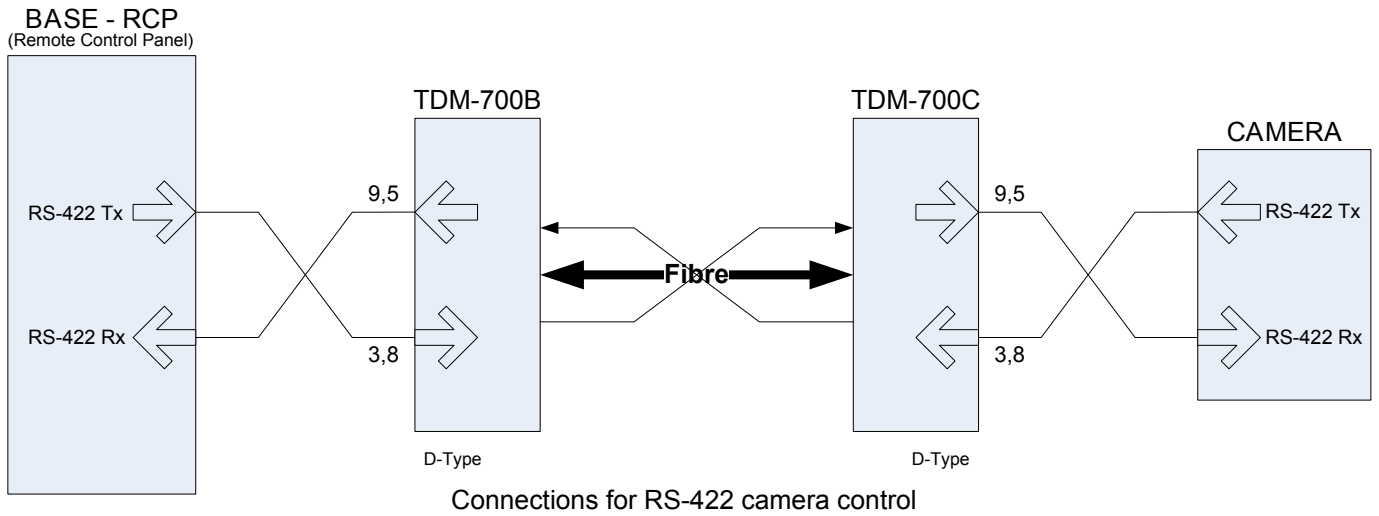
Bi-directional connections:

- **Optical** – on all plug-in card versions the optical port is a dual SFP port on a removable transceiver cartridge. Use single-mode fibres to connect either directly to the POV location, or to a break-out panel to convert to ruggedised fibre for outside deployment. The transmission wavelength is 1310 nm, unless the faceplate is marked to the contrary.

On stand-alone (BE) versions, the optical connector will be either a Lemo L3K or a Neutrik OpticalCOM (specified at time of ordering).

- **Ethernet** (TDM-700B, TDM-720B and TDM-700BE): This passes Ethernet data transparently to/from the POV device. The TDM-700 system does not appear to a network as a client. Use this connection with a POV camera (or other device) which can be controlled via Ethernet. The port auto-negotiates full or half duplex 10/100 BaseT working.
- **Serial/GPI** (TDM-700B, TDM-710B, TDM-730B and TDM-700BE): see the pinout table at page 8 for wiring details. Use this connection with cameras requiring RS-232/422 serial control. Connect pins 1, 2 and 6 if using RS-232, or pins 1, 3, 5, 8 and 9 if using RS-422; maximum data rates are approximately 120 kbaud for RS-232 and 1 Mbaud for RS-422.

Note that when using the TDM-700 system with camera control systems using RS-232 and RS-422, “crossed” cables are needed at both the base and camera ends. The diagram below shows the required interconnections:



Pins 7 and 4 are reserved for a general purpose DC control command and a corresponding tally output respectively. Both are active LOW; the input has an internal pull-up resistor to 3.3 V. The output is diode-protected, and should be used with an external pull-up resistor; the pull-up voltage should be less than 5.5 V and the current drawn not more than 24 mA.

The command and tally lines can be used for any general signalisation purpose.

Camera end:

TDM-700C, TDM-710C, TDM-720C and TDM-730C: plug the card into a spare slot in a Bluebell BC100, BC160 modular rack unit or a BC120 triple-slot enclosure. Power is provided by the rack in these cases. If using a BC101 or BC102 enclosure, fit the card and connect an external source of DC power via the XLR4 socket. TDM-700CE stand-alone units are self-contained and merely require external DC power to be connected,

Input Connections:

- **Video** (all versions): connect the camera's HD/SD-SDI output to this BNC socket.

Output connections:

- **Genlock** (TDM-700C, TDM-710C and TDM-710CE): this carries the genlock (or monitoring video) signal connected at the GENLOCK input at the base end.

Bi-directional connections:

- **Optical** – on all plug-in card versions the optical port is a dual SFP port on a removable transceiver cartridge. Use single-mode fibres to connect either directly to the base end, or to a break-out panel to convert to ruggedised fibre. As at the base end, the transmission wavelength is 1310 nm, unless the faceplate is marked to the contrary.

On stand-alone (CE) versions, the optical connector will be either a Lemo L3K or a Neutrik OpticalCON (specified at time of ordering).

- **Ethernet** (TDM-700C, TDM-720C and TDM-700CE): This passes Ethernet data transparently to/from the base location. Use Cat 5 cable to connect to an Ethernet-controllable camera (or other device).
- **Serial/GPI** (TDM-700C, TDM-710C, TDM-730C and TDM-700CE): see the pinout table at page 8 for wiring details. Use this connection with cameras requiring RS-232/422 serial control.

Pins 7 and 4 should be connected if the GPI command and/or tally lines are to be used.

Appendix

Specifications - TDM-700 System

HD/SD video input from camera	
Connector	75 ohm BNC per IEC 60169-8 Amendment 2
Standards supported	SMPTE 292M, SMPTE 259M, SMPTE 297M
Line/frame rates	(625/50, 525/59.94, 1080i/50, 1080i/59.94, 720p/50, 720p/59.94 – auto detecting)
Equalisation	Automatic to 200 m @ 1.485 Gb/s Automatic to 300 m @ 270 Mb/s
Return Loss	>15 dB @ 1.485 Gb/s
HD/SD video output from base unit	
Connector	75 ohm BNC per IEC 60169-8 Amendment 2
Return Loss	>15 dB @ 1.485 Gb/s
Polarity	Non-inverting
Signal Level	800 mV +/- 10%
Jitter	0 ±0.5 V
Genlock Video Input and Output	
Standards	Composite 1 V pk-pk; PAL, NTSC, SECAM; Bi-Level, Tri-Level syncs
Connector	75 ohm BNC
Diff Phase	< 1°
Diff Gain	< 1% (at sub-carrier 3.58/4.43 MHz)
Ethernet Input/Output	
Connector	RJ45
Format	Full duplex 100Base-FX Data Transmission with 1/100 MB/s half/full duplex auto-negotiation
Data Input/Output	
Connector	9-pin female Dsub
Format	1 x RS-232, 1 x RS-422 , 1 x GPI, all bi-directional
RS-232 I/P Level	$V_{IL} < 0.6 V, V_{IH} > 2.4 V$
RS-232 O/P Level	± 5.4 V typical
General plug-in card specifications	
Depth	60 mm
Width	20 mm 4 TE
Height	100 mm (3RU)
Weight	100 g
Operating Temp	-30 to +70 °C
Power	6 W
General stand-alone unit specifications (Exact size is connector-dependant)	
Depth	160 mm
Width	120 mm
Height	45 mm
Weight	200 g

Conformities	
EMI/RFI	Complies with 89/336/EEC
Electrical	Complies with EN 61000-6-1, EN61000-6-2
Laser Safety	Complies with Class 1 laser product 24 CFR 1040.10 & 1040.11
RoHS	Complies with Directive 2002/95/EC
Optical Input/Output	
Physical	SFP Transceiver Module
Connector	Plug-in cards: SFP; Stand-alone units: Lemo L3K or Neutrik OptiCOM
Wavelength	Plug-in cards: CWDM wavelengths (see table below) Stand-alone units: 1310 nm single mode or 850 nm multi mode (or user-specified)
Optical Power	-2 dBm @ 1310/1510 nm (typical)

Optical wavelengths

TDM-700 Series plug-in cards are fitted with a removable SFP transceiver cartridge. These have a standard transmission wavelength of 1310 nm, however the wavelength may be specified at the time of ordering to be any of the standard CWDM wavelengths. Cartridges are field-interchangeable. All receivers are wideband.

Part Ref.	Transmitter	Receiver
Standard wavelengths:		
VTR/S/SFP	Single mode, dual channel SFP transceiver, 1310 nm	Wideband
VTR/M/SFP	Multi mode, dual channel SFP transceiver, 850 nm	
CWDM wavelengths:		
VTR/S/SFP/CWDM/27	Single mode, single channel CWDM SFP transmitter, 1270nm	Wideband
VTR/S/SFP/CWDM/29	Single mode, single channel CWDM SFP transmitter, 1290nm	
VTR/S/SFP/CWDM/31	Single mode, single channel CWDM SFP transmitter, 1310nm	
VTR/S/SFP/CWDM/33	Single mode, single channel CWDM SFP transmitter, 1330nm	
VTR/S/SFP/CWDM/35	Single mode, single channel CWDM SFP transmitter, 1350nm	
VTR/S/SFP/CWDM/37	Single mode, single channel CWDM SFP transmitter, 1370nm	
VTR/S/SFP/CWDM/39	Single mode, single channel CWDM SFP transmitter, 1390nm	
VTR/S/SFP/CWDM/41	Single mode, single channel CWDM SFP transmitter, 1410nm	
VTR/S/SFP/CWDM/47	Single mode, single channel CWDM SFP transmitter, 1470nm	
VTR/S/SFP/CWDM/49	Single mode, single channel CWDM SFP transmitter, 1490nm	
VTR/S/SFP/CWDM/51	Single mode, single channel CWDM SFP transmitter, 1510nm	
VTR/S/SFP/CWDM/53	Single mode, single channel CWDM SFP transmitter, 1530nm	
VTR/S/SFP/CWDM/55	Single mode, single channel CWDM SFP transmitter, 1550nm	
VTR/S/SFP/CWDM/57	Single mode, single channel CWDM SFP transmitter, 1570nm	
VTR/S/SFP/CWDM/59	Single mode, single channel CWDM SFP transmitter, 1590nm	
VTR/S/SFP/CWDM/61	Single mode, single channel CWDM SFP transmitter, 1610nm	

