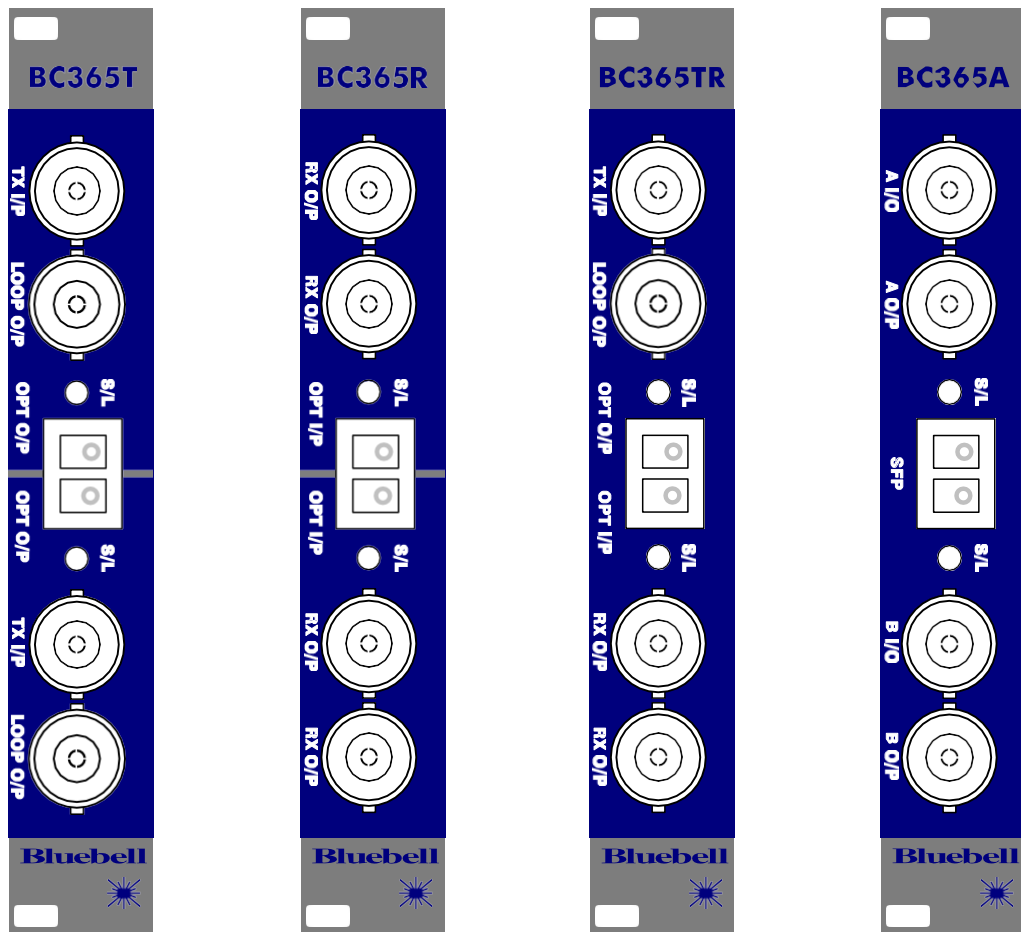


BC365 Series 12G dual channel Electrical to Optical interfaces



Operation Guide

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Optical transmitter elements are Class 1 Laser Safety compliant with 24 CFR 1040.10 and 1040.11.

RoHS and WEEE declaration

Bluebell Opticom Limited manages its business and collaborates with its suppliers to comply with the European Union restriction of the use of certain hazardous substances in electrical and electronic equipment, RoHS Directive (2011/65/EU), and similar restrictions in other jurisdictions.



The "crossed out wheellie bin" symbol on the product 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.

Safety Warning – Important Precautions

To reduce the risk of fire or electric shock, do not expose this equipment to rain, moisture, or wet conditions.

General Safety Guidelines

- Always **disconnect the entire system from the AC mains** before cleaning or servicing.
- The following product frames – **BC100, BC100i, BC101, BC102, BC120, BC160i** – must be connected using a **three-conductor AC mains power cord with an earth ground**. All three conductors must be used at all times to prevent electric shock.
- Do **not** bypass or disable any fuse.
- Only replace fuses with those of the **specified type and rating**.
- Do **not** use flammable or combustible chemicals for cleaning.
- Do **not** pour or spill liquids directly onto the unit.
- Do **not** allow any liquid to enter the unit or wet the internal components.
- Do **not** operate the unit with any cover or panel removed.
- Do **not** obstruct the ventilation slots—**adequate airflow must be maintained**.
- Do **not** operate the unit in environments with **extreme temperatures**.
- Do **not** use or store the unit in **explosive atmospheres**.
- Do **not** attempt to repair the unit yourself. If servicing is required, please contact your local **Bluebell Opticom** distributor.

Product Warranty

Bluebell Opticom Ltd provides warranty coverage as detailed in our general terms and conditions.

Please note that warranty support is only valid **if product serial numbers remain intact and legible**. Tampering with or removing serial numbers may void your warranty.

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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 types of signal over fibre links, please take the time to read through this document before putting the module to use.

Introduction

The BC365T, BC365R, BC365TR and BC365A plug-in cards belong to the range of the Bluebell Opticom BC Series modular fibre interfaces, designed primarily for TV Outside Broadcast (OB) or studio applications. The cards have been designed for the transport of 4K SDI video over a fibre-optic link: typically they will be used to connect video cameras installed at remote locations, as may be the case at large-scale sporting events, music festivals and similar OB situations. They are compatible with SD, HD, 3G, 6G and 12G SDI video standards: alternatively they can be used for the transport of MADI data.

The BC365 range comprises four variants:

- BC365T transmitter – two independent channels, dual SDI inputs to dual fibre outputs
- BC365R receiver – two independent channels, dual fibre inputs to dual SDI outputs
- BC365TR transceiver – two independent channels: channel A is configured as a transmitter, and channel B as a receiver
- BC365A “adaptive” variant – may be configured as a dual channel transmitter, a dual channel receiver, or a transceiver, emulating the functionality of a BC365T, BC365R or BC365TR respectively.

The four variants are of similar construction, and in outward appearance differ only in the silk-screened labelling on the faceplate.

Cards will normally be used in pairs, typically with a BC365T installed at the remote end (camera station) and a BC365R at the control centre end (base station). If bidirectional operation is needed, a BC365TR may be installed at both locations.

On all variants, the “copper” connections for SDI video use 12G-compliant 75 ohm BNC sockets, while the fibre optic connectivity is a dual LC optical connector in a standard SFP carrier.

Singlemode fibre operation will normally be at 1310 nm; alternative CWDM grid wavelengths are also possible. The optical option is generally specified at the time of order. The optical receiver will be wideband.

Physical formats

All BC365 Series cards fit the Bluebell BC100i and BC160i 19" modular frames. These frames can house fifteen (BC100i) or six (BC160i) interface cards, and are fitted with dual internal AC power supplies. The cards are also compatible with earlier Bluebell 19" modular frame types BC100 and BC160.

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.

Power requirements

Power supply requirements are dictated by the enclosure type used.

BC100i modular frames:

This is normally fitted with two identical AC mains PSU modules. Each module has sufficient capacity to power a fully-loaded frame. The AC connection is via standard IEC cables, DC power distribution inside the frame is via the motherboard. See the Operation Guide supplied with the frame for more details.

BC160i modular frames:

This is fitted as standard with dual internal AC mains power supplies, each of sufficient capacity to power a fully-loaded frame. The AC connection is via standard IEC cables, DC power distribution inside the frame is via the motherboard. See the Operation Guide supplied with the frame 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 connection is via an IEC connector.

BC120 triple-slot chassis:

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

Inputs and outputs

SDI Video:

BC365 interfaces can be used with serial digital video signals having data rates up to 12 Gb/s. Standards supported are:

SD-SDI : SMPTE ST 259 compliant
HD-SDI : SMPTE ST 292 compliant
3G-SDI : SMPTE ST 424 compliant
6G-SDI : SMPTE ST 2081 compliant
12G-SDI : SMPTE ST 2082 compliant

ASI baseband streams are also compatible.

Video inputs and outputs are on 75 ohm BNC sockets. All variants have four connectors:

- BC365T: each channel has an input and a loopthrough output
- BC365R: each channel has two (buffered) outputs
- BC365TR: Channel 1 has an input and a loopthrough output; Channel 2 has two (buffered) outputs

The signal direction at the BNCs on the BC365A will depend on the SFP module fitted.

MADI:

BC365 interfaces can also be used to transmit and/or receive MADI data streams via the BNC connectors. The interfaces are agnostic to MADI format – 56/64 channels, 48/96 kHz frame rate, and all standard sample rates from 44.1 kHz to 192 kHz. The optical data rate is fixed at 125 Mb/s.

Optical (BC365T, BC365R, BC365TR):

An SFP cage fitted with a dual LC optical module is standard on the BC365T, BC365R and BC365TR; the module type will depend on the variant. Each SDI stream uses one of the two optical fibre ports.

Optical operation is single-mode. The standard transmission wavelength is 1310 nm. Transmitters fitted with lasers tuned to specific CWDM wavelengths are also available: any alternative option will have been specified at the time of order.

Note that the optical receivers in the BC365R and BC365TR are wideband, and can be used with all wavelengths in the range 1270 – 1610 nm.

Optical (BC365A):

The BC365A will be supplied with an empty SFP cage for users to fit their own SFP modules, and change them as operational needs require. The type of module fitted – dual transmitter, dual receiver or single channel transceiver – is automatically detected and the interface configured to suit.

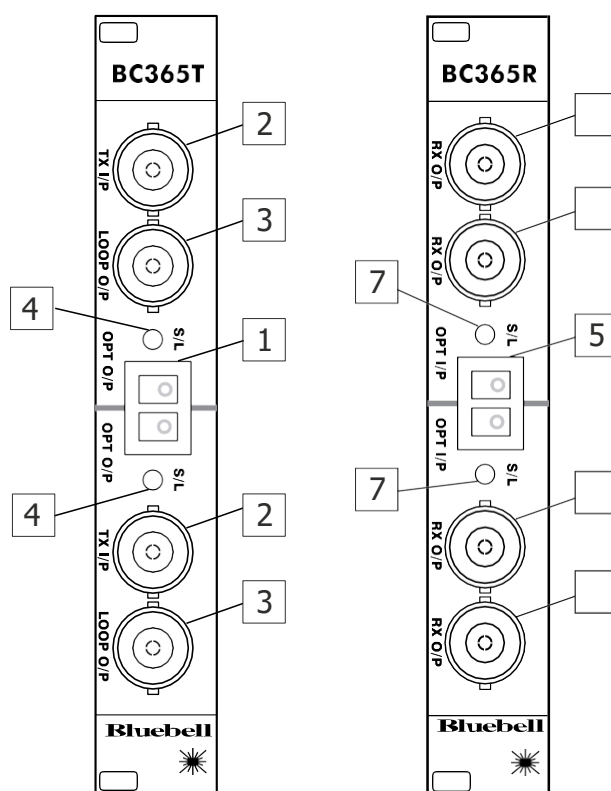
IMPORTANT: BC365 interfaces will only operate correctly when fitted with non-MSA SFP modules: note that this restriction applies to all variants.

Apart from Bluebell Opticom's own SFP modules, modules from the following manufacturers were tested and approved for use with the BC365A in April 2022:

- Embrionix
- Eoptolink
- Optoway

Please contact Bluebell Opticom if you wish to use SFPs from other manufacturers.

BC365 Series connections and indicators

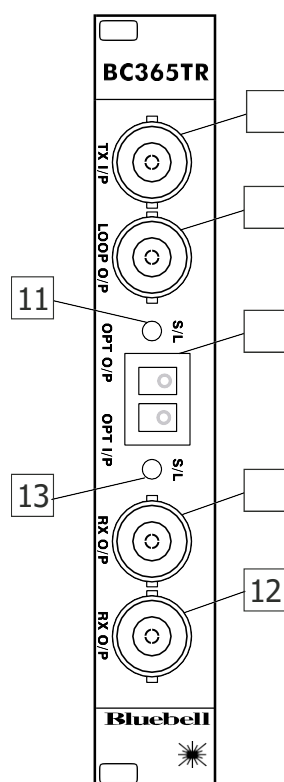


BC365T – two independent transmission channels

1. **OPT O/P** - SFP carrier factory-fitted with dual LC optical connector. This port is a dual transmitter, one LC connector per channel. The standard operating wavelength is 1310 nm; alternative wavelengths may have been specified at time of order.
2. **TX I/P** – 75 ohm BNC socket for connection to an SDI video (or MADI) source: one per channel.
3. **LOOP O/P** – 75 ohm BNC socket providing a reclocked and equalised loop-through output of the signal applied at the adjacent **TX I/P** socket.
4. **S/L** – a bi-colour LED for each channel indicating SDI status. The LED illuminates green to confirm that valid data is detected at the channel's SDI input, and red if no valid signal is detected.

BC365R – two independent receive channels

5. **OPT I/P** - SFP carrier factory-fitted with dual LC optical connector. This port is a dual receiver, one LC connector per channel. The optical receiver is wideband in the range 1270 to 1610 nm.
6. **RX O/P** – two 75 ohm BNC sockets per channel, carrying the SDI video (or MADI) signal recovered from the optical input. The two outputs of each channel are identical, but fully buffered from each other.
7. **S/L** – a bi-colour LED for each channel indicating SDI status. The LED illuminates green to confirm that valid data is available at the channel's RX O/P socket, and red if not.



BC365TR – two independent channels: one transmission, one receive

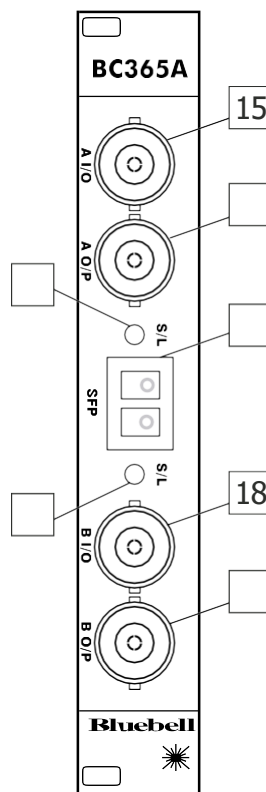
8. **OPT O/P & OPT I/P** – SFP carrier factory-fitted with dual LC optical connector. This port is a transceiver, the upper LC connector transmits, the lower receives. The standard operating wavelength for the transmit channel is 1310 nm; alternative wavelengths may have been specified at time of order. The optical receiver is wideband in the range 1270 to 1610 nm.

Channel A:

9. **TX I/P** – 75 ohm BNC socket for connection to an SDI (or MADI) source.
10. **LOOP O/P** – 75 ohm BNC socket providing a reclocked and equalised loop-through output of the signal applied at the **TX I/P** socket.
11. **S/L** – a bi-colour LED indicating SDI status. The LED illuminates green to confirm that valid data is detected at the SDI input, and red if no valid signal is detected.

Channel B:

12. **RX O/P** – two 75 ohm BNC sockets, carrying the SDI (or MADI) signal recovered from the optical input. The two outputs are identical, but fully buffered from each other.
13. **S/L** – a bi-colour LED indicating SDI status. The LED illuminates green to confirm that valid data is available at the **RX O/P** socket, and red if not.



BC365A – adaptive version

14. **OPT I/O** – empty SFP carrier which may be fitted with a dual transmitter, dual receiver or transceiver module, according to the user's requirements. The BC365A card self-configures its inputs and outputs according to the SFP type (internal DIP switches allow the self-configuration to be overridden in case of a non-standard or faulty SFP).

Channel A:

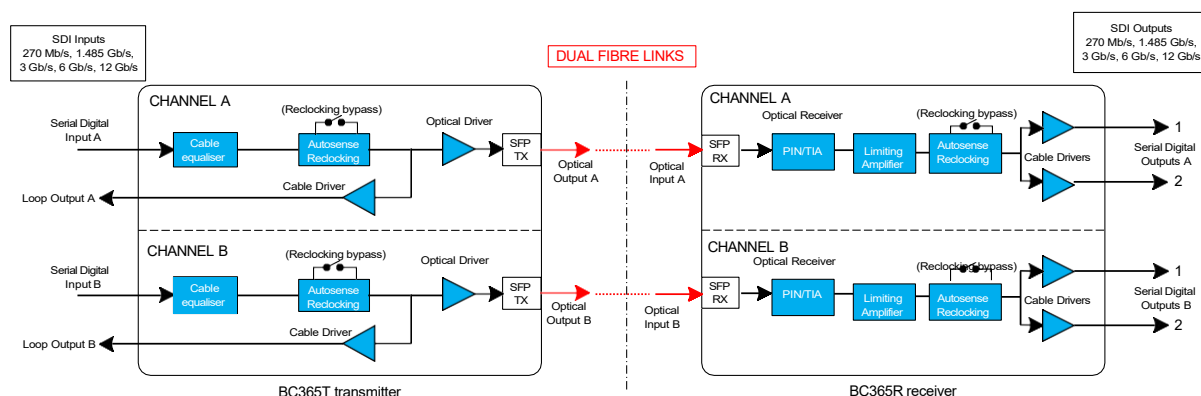
15. **I/O A** – 75 ohm BNC socket: this will be either an input or output for Channel A, depending on how the card is configured.
16. **O/P A** – 75 ohm BNC socket: this will be a loop output of **I/O A** if the card is configured as a BC365T or BC365TR, or Channel A's SDI output if it is configured as a BC365R.
17. **S/L** – a bi-colour LED indicating Channel A SDI status. The LED illuminates green to confirm a valid SDI signal, and red otherwise; its point of signal detection will be either the SDI input or output, depending on the card's configuration.

Channel B:

18. **I/O B** – 75 ohm BNC socket: this will be either an input or output for Channel B, depending on how the card is configured.
19. **O/P B** – 75 ohm BNC socket: this will be a loop output of **I/O B** if the card is configured as a BC365T, or Channel B's SDI output if it is configured as a BC365R or BC365TR.
20. **S/L** – a bi-colour LED indicating Channel B SDI status. The LED illuminates green to confirm a valid SDI signal, and red otherwise; its point of signal detection will be either the SDI input or output, depending on the card's configuration.

Signal routing

BC365T/BC365R pair:



In this application, a BC365T will typically be installed at a remote camera location and a BC365R at the base location. Two independent SDI signals applied at Channel A and Channel B inputs of the BC365T will be transported over separate optical links, and can be recovered at the Channel A and Channel B outputs of the BC365R. The video signal in each channel may be of any of the supported SDI standards.

BC365TR/BC365TR pair

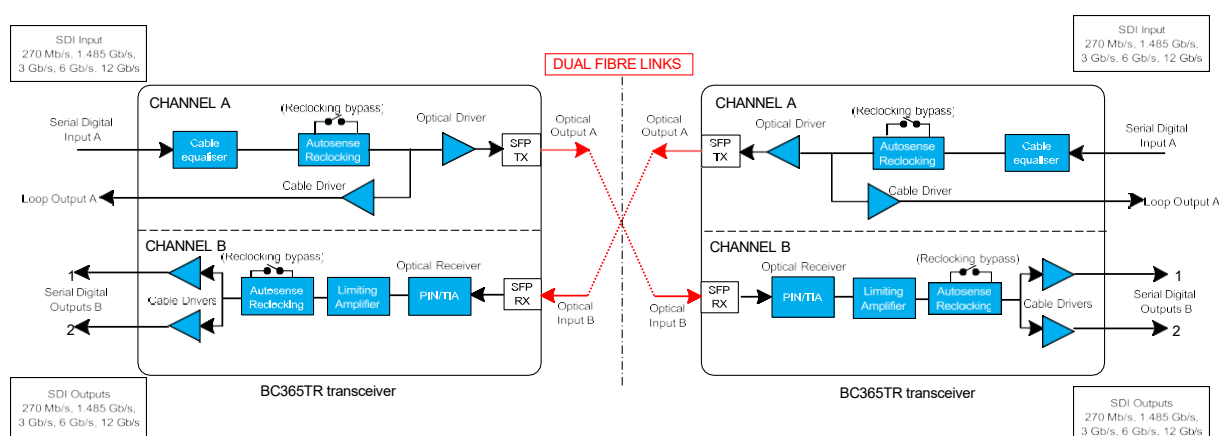


Diagram assumes each BC365TR card is mounted in a BC100/100i rack frame

For bidirectional operation, two BC365TR cards may be used, one at each location. In this application, one fibre transports signal data in each direction. Channel A of a BC365TR is the "transmit" channel, with an electrical SDI input (and loop-through output) and an optical output. Channel B is the "receive" channel, with an optical input and dual SDI outputs. Hence, an SDI signal applied to Channel A at one end of the link, will be recovered from Channel B at the other end, as the two fibre links need to be "crossed", as shown in the diagram above. The video signal in each channel may be of any of the supported SDI standards.

NOTE: the concept of a physical fibre “crossover” only applies when both BC365TR cards are vertically mounted in BC100/100i frames. This is because, in these frames, the “transmit” channel of each card (Ch. A) occupies the upper half of the card faceplate, above the “receive” channel (Ch. B). If the cards are horizontally mounted in smaller Bluebell frames (BC160/160i/120/101/102), a slightly different situation arises, because Channel A will always be on the left of the card (looking at the front of the frames), with Channel B on right: therefore the fibres do not need to be crossed.

Whichever frame type(s) are in use, Channel A of the BC365TR card in each location must always be connected to Channel B of the card in the other location, via one of the two fibre links.

BC365A

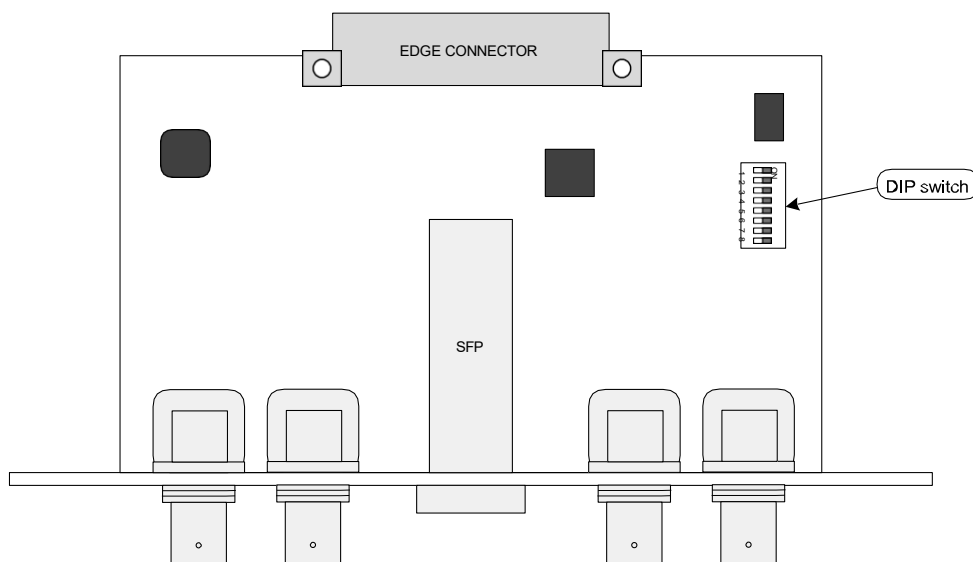
The BC365A card may be configured as a BC365T, BC365R or BC365TR, depending on the SFP module fitted. All four BNC connectors on the BC365A are labelled “I/O”, reflecting that they may be either an input or an output, according to the auto-configuration.

IMPORTANT: Please read the Guide section “Setup options” if non-standard SFPs are to be used.

In use, the BC365A can replace any of these three card variants in the application scenarios described above.

Setup options

The PCBs for all card variants have an 8-pole DIP switch and a single jumper. Note that the BC365R has a slightly different PCB from the BC365T, BC365TR and BC365A. The locations of the DIP switch and the jumper are the same on the two PCB types; the diagram below indicates these:



NOT TO SCALE – FOR LOCATION PURPOSES ONLY.
ONLY PRIMARY COMPONENTS SHOWN.

DIP switch – summary

Switch	Function	OFF*	ON	Remarks
SW1	Ch A Reclock bypass	Auto	Bypass	
SW2	Ch B Reclock bypass	Auto	Bypass	
SW3	Ch A SFP Laser	Auto	Always enabled	Only applicable to Tx channels
SW4	Ch B SFP Laser	Auto	Always enabled	
SW5	Ch A signal direction	Tx	Rx	Applies to BC365A only: non-functional if SW7/8 are set to Auto
SW6	Ch B signal direction	Tx	Rx	
SW7	Ch A signal direction mode	Auto	Manual	Applies to BC365A only: set to manual to enable SW5/6.
SW8	Ch B signal direction mode	Auto	Manual	

***OFF** is the default switch position for all card variants

Reclock bypass – SW1 & 2

Each channel of all BC365 card variants feature autosense reclocking of SDI signals. The Auto reclocking mode is enabled by default: signals will be reclocked unless they are of a non-standard data rate, in which case reclocking is automatically bypassed. If necessary, reclocking may be manually bypassed, independently on each channel, by moving DIP switches SW1 (Channel A) and SW2 (channel B) to ON.

SFP Laser auto-override – SW3 & 4

With SW3/4 set to **Auto** (switches set to OFF), the laser in a Tx channel will only be enabled when valid signal lock is detected: this prevents the SFP from sending erroneous data. However, if the Reclock bypass switch SW1/2 for the corresponding channel is set to Bypass, this lock detection is overridden and the laser will be enabled.

With SW3/4 set to Always Enabled (switches set to ON), the laser will be enabled at all times.

The above description assumes that the channel's SFP is a Tx type: if an Rx SFP is fitted to the channel, its Laser auto-override switch will have no effect.

Signal direction – SW5 & 6

NOTE: These switches are only functional on card variant BC365A. They have no purpose on the other variants. They will also only be functional if the corresponding switch SW7 (Channel A) or SW8 (Channel B) is set to 'ON'.

Normally, a compliant SFP module will configure the signal flow direction in the two channels to correctly match the SFP type. In case a non-compliant or faulty SFP does not force the correct configuration, SW5 (Channel A) and SW6 (Channel B) will define the channel's signal direction: OFF will force the channel to Tx mode, ON will force the channel to Rx mode.

Signal direction mode – SW7 and 8

NOTE: These switches are only functional on card variant BC365A. They have no purpose on the other variants.

The default setting for these switches is **Auto** (switches set to OFF), when the SFP type auto-configures the signal direction in each channel. Setting SW1/7 (Channel A) or SW1/8 (Channel B) to Manual (switches set to ON) enables SW1/5 or SW1/6 respectively, allowing them to be used to define the signal direction.

If SW5-8 are used to force the signal direction in a channel, it is the BC365A user's responsibility to ensure that the correct type of SFP is fitted. For example, a channel set manually to Tx by SW5/6 will be configured as a 'transmit' channel even if an Rx SFP is fitted; this will result in non-operation.

External monitoring

When installed in a BC100i, BC100, BC160i or BC160 frame, all cards in the Bluebell modular range can report their status to the frame's monitoring system. The BC100i and BC160i frames provide visual indication of correct card operation (or otherwise) on the Home page of the frames' LCD touchscreens: extended card data is available on other pages. Earlier BC100 and BC160 frames provide card status information using two LEDs per card slot.

On all the above frame types, remote monitoring is also available if the optional network interface card is fitted. Contact Bluebell for the relevant .mib file.

Frame monitoring

BC100i/160i Home page or BC100/160 Frame LEDs

		BC365/365T/365TR
LED Ch A	Green	Ch A data locked
	Red	Ch A data not locked (invalid signal)
LED Ch B	Green	Ch B data locked
	Red	Ch B data not locked (invalid signal)

BC100i Card Info page

When operating correctly, the BC100i Card info page for a BC365T card will appear as below (items specific to individual cards excepted). The Card Info pages for BC365R and BC365TR are very similar.



Slot 2

Card Information

Card type	BC365T	S/N eeprom detected	yes
Card function summary	2ch BNC -> fibre	Card serial number	23465-001
Card hardware revision	1	Card firmware revision	1
Card chA signal status	good	Card chB signal status	good

Card Specific Parameters

chA Input	12G	chB Input	12G
chA Reclocker Bypass	Auto	chB Reclocker Bypass	Auto
chA SFP Tx Laser	Auto	chB SFP Tx Laser	Auto

SFP 1

Home

BC160i Card Info page

When operating correctly, the BC160i Card Info page for a BC365T card will display a subset of the data shown below (items specific to individual cards excepted). Use the Up and Down scroll buttons to show data not currently displayed. The Card Info pages for BC365R and BC365TR are very similar.

Card Information in Slot 2

Card type	BC365T
S/N eeprom detected	yes
Card function summary	2ch BNC -> fibre
Card serial number	23465-001
Card hardware revision	1
Card firmware revision	1
Card chA signal status	good
Card chB signal status	good

Up

SFP1

Down

Home

Card Specific Parameters

chA Input	12G
chB Input	12G
chA Reclocker Bypass	Auto
chB Reclocker Bypass	Auto
chA SFP Tx Laser	Auto
chB SFP Tx Laser	Auto

Monitoring via webpages:

“Overview” webpage:

		BC365/365T/365TR
LED Ch A	Green	Ch A data locked
	Red	Ch A data not locked (invalid signal)
LED Ch B	Green	Ch B data locked
	Red	Ch B data not locked (invalid signal)

“Frame Information” webpage:

Signal status		BC365T/365R/365TR
LED Ch A	“good”	Ch A data locked
	“fail”	Ch A data not locked (invalid signal)
	“unknown”	Card not recognised
LED Ch B	“good”	Ch B data locked
	“fail”	Ch B data not locked (invalid signal)
	“unknown”	Card not recognised

Remote monitoring via SNMP

		BC365T/365R/365TR
cardsigChA	“good”	Ch A data locked
	“fail”	Ch A data not locked (invalid signal)
	“unknown”	Card not recognised
cardsigChB	“good”	Ch B data locked
	“fail”	Ch B data not locked (invalid signal)
	“unknown”	Card not recognised

Appendix

Specifications – BC365 Series

	BC365 – Tx channels	BC365 – Rx channels
Electrical Inputs and Outputs		
SDI standards – conformities	Compliant with: SD-SDI : SMPTE ST 259 compliant HD-SDI : SMPTE ST 292 compliant 3G-SDI : SMPTE ST 424 compliant 6G-SDI : SMPTE ST 2081 compliant 12G-SDI : SMPTE ST 2082 compliant	
Signal standards:	SD-SDI, HD-SDI, 3G-SDI, 6G-SDI, 12G-SDI, DVB-ASI, MADI at 125 Mb/s	
Equalisation (T only)	Automatic to: SD-SDI : 400 m @ 270 Mb/s HD-SDI : 240 m @ 1.485 Gb/s 3G-SDI : 170 m @ 2.97 Gb/s 6G-SDI : 90 m @ 5.94 Gb/s 12G-SDI : 70 m @ 11.88 Gb/s	
Return Loss	<15 dB, 5 Mb/s – 1.485 Gb/s <12 dB, 1.485 Gb/s – 2.97 Gb/s <8 dB, 2.974 Gb/s – 5.94 Gb/s <5 dB, 5.94 Gb/s – 11.88 Gb/s	<17 dB, 5 Mb/s – 1.485 Gb/s <12 dB, 1.485 Gb/s – 2.97 Gb/s <8 dB, 2.974 Gb/s – 5.94 Gb/s <5 dB, 5.94 Gb/s – 11.88 Gb/s
Connectors	4 x 75 ohm BNC per IEC 60169-8, Amendment 2	
Format	Re-clocked (may be bypassed)	
Polarity (R only)		Non-inverting
Signal Level (R only)		800 mV +/-10%
Timing Jitter (R only)		0.2 UI line equalised @ 270 Mb/s 1 UI line equalised @ 1.485 Gb/s 2 UI line equalised @ 2.97 Gb/s 4 UI line equalised @ 5.94 Gb/s 8 UI line equalised @ 11.88 Gb/s
Alignment Jitter (R only)		0.2 UI line equalised @ 270 Mb/s 0.2 UI line equalised @ 1.485 Gb/s 0.3 UI line equalised @ 2.97 Gb/s 0.3 UI line equalised @ 5.94 Gb/s 0.3 UI line equalised @ 11.88 Gb/s
Optical Inputs and Outputs		
Most specs determined by SFP fitted. Typical values given below.		
Optical conformity	SMPTE ST 297 compliant	
Connector	2 x female LC	
Wavelength	1270 – 1610 nm	
Optical power (T only)	-15 dBm @1310 nm multimode -6 dBm @ 1310 nm singlemode -6 dBm @1310 nm (4K emSFP)	
Sensitivity (R only)		>-25 dBm @ 1.485 Gb/s >-22 dBm @ 2.97 Gb/s >-20 dBm @ 5.94 Gb/s >-18 dBm @ 11.88 Gb/s

Monitoring		
Front panel	S/L: bi-colour LED per channel indicating a valid and locked signal	
External via BC100/BC160 rack frame	Bi-colour LED per channel indicating lock status of electrical inputs	Bi-colour LED per channel indicating lock status of optical inputs
External via BC100i/BC160i rack frame screen or BM102i monitoring web page	Bi-colour virtual LED per channel indicating lock status of electrical inputs	Bi-colour virtual LED per channel indicating lock status of optical inputs
SNMP monitoring (via BC100i/BC160i rack frame with BM102i card fitted)	Lock status of electrical inputs	Lock status of each optical input
Conformities		
Laser Safety	Complies with Class 1 laser product	
RoHS & WEEE	Complies with RoHS Directive 2011/65/EU, WEEE Directive 2012/19/EU	
General		
Input Voltage	6 – 18 V	
Power consumption	4 W Typical	
Depth	85 mm (60 mm excluding connectors)	
Width	20 mm (4HP)	
Height	129 mm (3RU)	
Weight	100 g (excluding SFP)	
Operating Temperature	-30 to +70 °C	