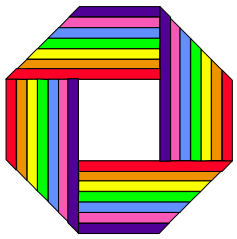

DATA / VOICE MULTIPLEXER

USER'S MANUAL

OPT 100 SERIES

This system is year 2000 compatible

May 1999

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USER MANUAL

OPT 100 Series Configurable Multiplexer

This document contains information and warnings which must be followed by the user to ensure safe operation and to retain the equipment in safe condition.

Whilst all possible care is taken in the preparation of this document BMW CONSULTANTS cannot be held responsible for any inaccuracies that may be found.

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REVISION RECORD

OPT 100 Series Configurable Multiplexer

Date	Rev	Description

CONTENTS LIST

1. INTRODUCTION

1.1 Function of a Multiplexer

The function of a multiplexer is to combine a number of signals onto a single communications channel. There are several possible motivations for this:

Economy of cables	-	in both cost and physical space.
Economy of connectors	-	in some systems there is limited external space available.
Economy of equipment	-	only a single box, power supply and transmission interface are required.

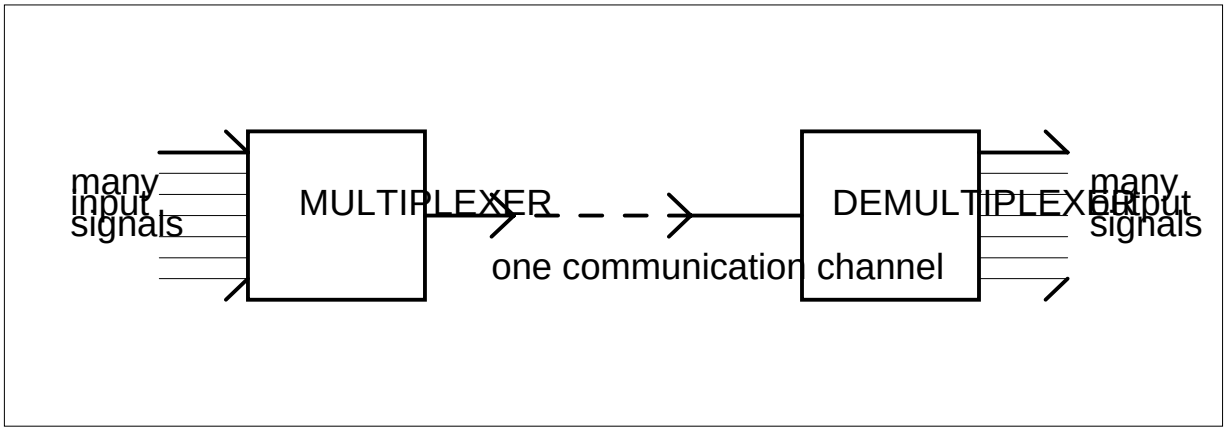

Figure 1 A multiplexed system

1.2 Basic Concepts of a Multiplexer

The operation of a multiplexer can be split into several sub-functions. (The word multiplexer will be used to describe both the multiplexing and demultiplexing apparatus)

Input signals are received and converted if necessary.

The input data channels are combined together.

Control information is added to the signal information to facilitate demultiplexing later.

The data is encoded for transmission.

The encoded data is transmitted into the communication medium.

The data is picked up by a receiver.

The transmission coding is decoded.

Control information is extracted.

Data channels are separated.

Signals are output.

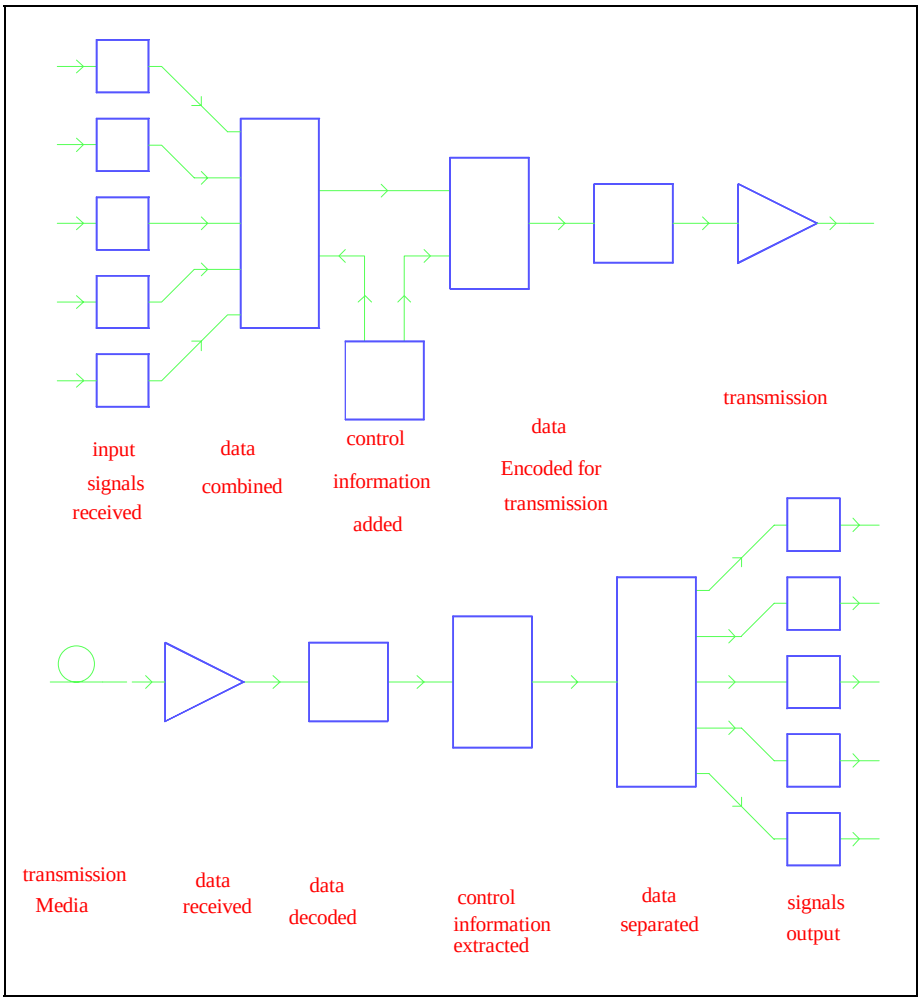

Figure 2 Block diagram of a typical multiplexer

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1.3 Methods of Multiplexing

There are several techniques available for multiplexing a number of signals into one transmission medium.

1.4 Time Division Multiplexing

A time slot is allocated to each channel. During that slot the signal from that channel is transmitted. Each channel is totally isolated from what happens in any other channel's time slot. Benefits of TDM are that it does not require to know what protocol is being used on the channel (for example number of stop bits or parity).

1.5 Frequency Division Multiplexing

Frequency division multiplexing uses one 'carrier signal' per channel. Each carrier signal is 'modulated' by its channel data and all the carriers are mixed together in the transmission medium.

1.6 Statistical Multiplexing

The statistical multiplexer can accept data characters from all input channels but typically not all channels are fully active at the same time. Only data from active channels is transmitted; in this way communication channel bandwidth is not wasted on sending unused signals. A disadvantage of statistical multiplexers is that they need to know the data transmission protocol for each channel.

1.7 Hierarchical Multiplexing

Multiplexing techniques can be layered in a hierarchy. For instance the signal used to modulate a carrier frequency may be made up of several sub-carriers which are themselves modulated by data channels. Similarly in a time division multiplexed system one time slot may actually be split into a number of sub-slots for lower bandwidth channels etc.

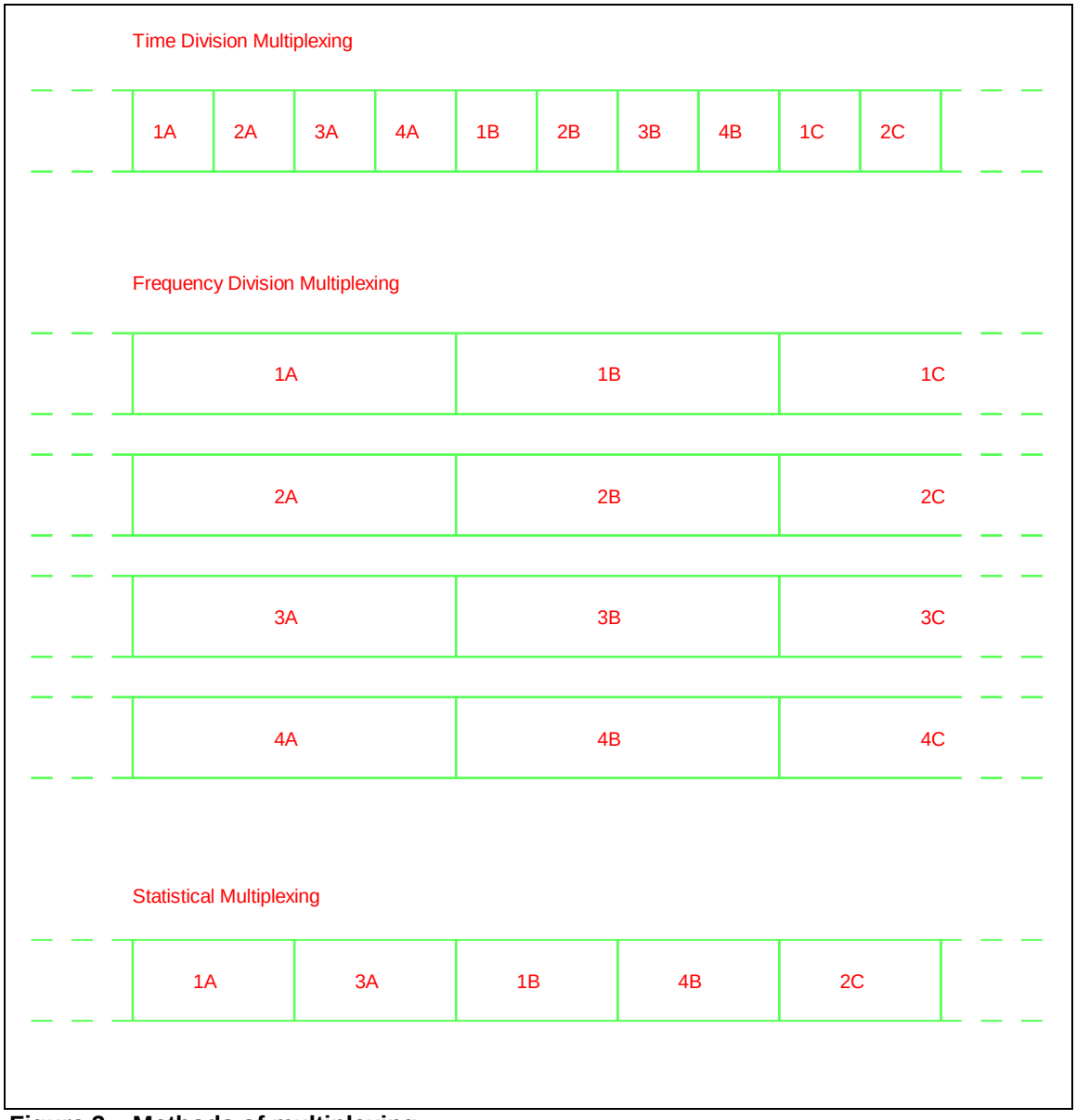


Figure 3 Methods of multiplexing

2. 0 TECHNICAL DESCRIPTION

2.1 Introduction

The OPT 100 series configurable Multiplexer (hereafter referred to as the OCM) is a time division multiplexer which is configurable to particular applications. It combines up to four different types of signals into a single communications channel.

2.2 Minimum Configuration

The OCM is a duplex multiplexer/demultiplexer so one optic fibre in each direction is used between a pair of OCMs. A number of OCMs may be connected together in a chain with one pair of fibres in each link of the chain.

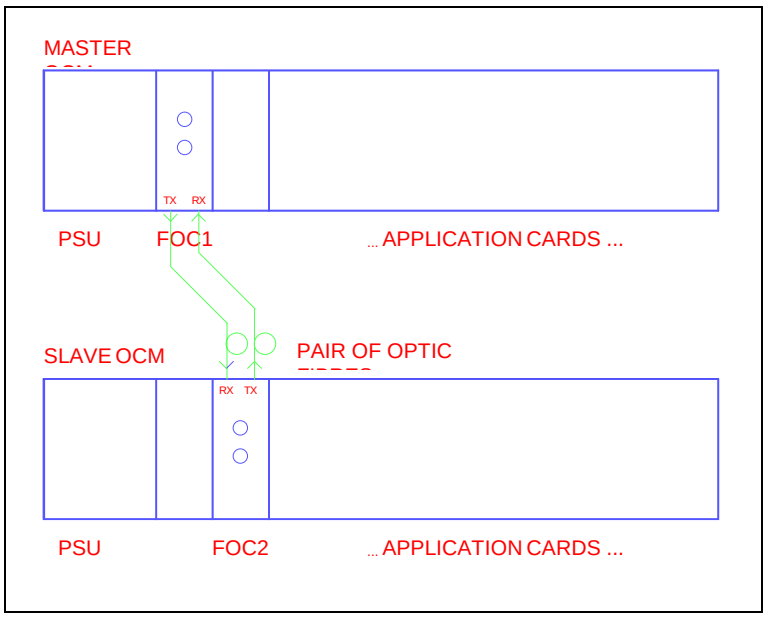


Figure 4 Minimum configuration

2.3 Physical Description

The multiplexer consists of a 3U high 19 inch subrack. It comprises a legended front panel, a rear plate for mounting backplanes (see below) and several types of functional modules described below.

2.4 Mains Power Supply

This takes 220-240 VAC 50Hz and produces the dc voltages required by the electronics
The power supply has selection switch which may be set to mains input of 110-120 VAC 60 Hz.

2.5 Motherboard

This is the printed circuit board containing the connectors which mate to the plug in cards. It also holds power feed wires and power good indication LEDs.

2.6 Fibre-Optic Driver Cards

These contain the circuits which interface to the optic fibres. Each card can transmit to one fibre and receive from one fibre. Individual multiplexers have either one or two fibre-optic cards.

This card also contains circuitry which adds in the control information when multiplexing and interprets the control information when demultiplexing. It sequences the data to and from each of the application cards in turn.

2.7 Application Cards

These contain the input and output circuits for the individual data channels. There are up to eight application cards per multiplexer; each of four pairs can be of differing types. A ribbon cable connects all the application to the backplanes.

2.8 Backplanes

These carry the connectors for the individual channels. Different types of interfaces use different connectors.
Some system installations have bespoke backplanes.

3. 0 DESCRIPTION OF OPERATION

3.1 Introduction

The OCM uses a hierarchical system of time division multiplexing. The single communication channel is split into four time slots which are allocated to what are termed 'pages'. Each page can have any one of the available interface types, for example voice, RS422, RS232.

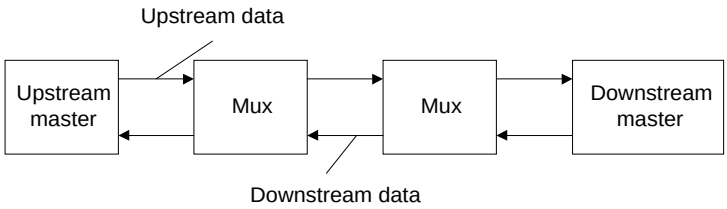
3.2 Definitions

- **Receive** data comes from the outside world through the connectors to the mux., and is then transmitted to other muxes optically.
- **Transmit** data comes from the optical fibre and is transmitted to the outside world by the mux..
- Data **passing through** a node is from optical fibre to optical fibre.
- Data **output to** or **input from** a connector refers to the external connectors the user plugs into.
- Up and down data, like winds, are labelled after the direction from which they come. Thus up data is received from upstream, but actually travels downstream.

3.3 Topology; up and down data streams

The OPT100 series multiplexers must be configured to form a linear chain - no branching is possible with this design. The chain comprises a series of multiplexers joined together with full duplex links. The two data directions run simultaneously and independently and are somewhat arbitrarily named up and down stream.
A multiplexer comprises a number of **application cards** which interface to the user, and usually two **optics cards**. An optics card communicates bidirectionally with one other multiplexer. It contains receive and transmit sections which work asynchronously since they are on different datastreams.
There are two special types of multiplexer:

- A **master multiplexer** is one which is not receiving valid optical data from multiplexers either side of it.
- An **end multiplexer** is one which is on the end of a string of multiplexers, which has only one optics card installed (all others have two). End multiplexers are of course necessarily masters; the upstream master originates the up data and *vice versa*.



If a link should break for some reason, the multiplexers either side of the broken link become master (but not end) multiplexers. It is important to distinguish between end and master multiplexers in this case because of redundant mode broadcasts which broadcast the same message simultaneously from both end multiplexers. Any unit in between them must receive from the direction which still connects to the end multiplexer.
A multiplexer in the middle of a string receives data from the previous unit and transmits it on to the next; this happens with both data streams simultaneously and independently. It transmits the data at the same speed it receives it, with a single byte's delay (about 100ns). If it is a master multiplexer it will not be receiving data from one direction and must therefore originate the data transfer speed from an internal clock.
Note that the data transfer speed referred to here is the average number of bytes of data transferred, not including the sync bytes that the TAXI chip transmits. It is necessary, of course, for the data transfer speed to be below the full speed that the TAXI chip can transmit. It will be noticed that the data rates for the two directions will not be identical, thus a normal (non-master) mux must receive data from the two directions simultaneously without any assumptions on the phase (this is different from the OPT 100 series of muxes).

A diagram below shows diagrammatically a method of connecting several multiplexers in a chain.

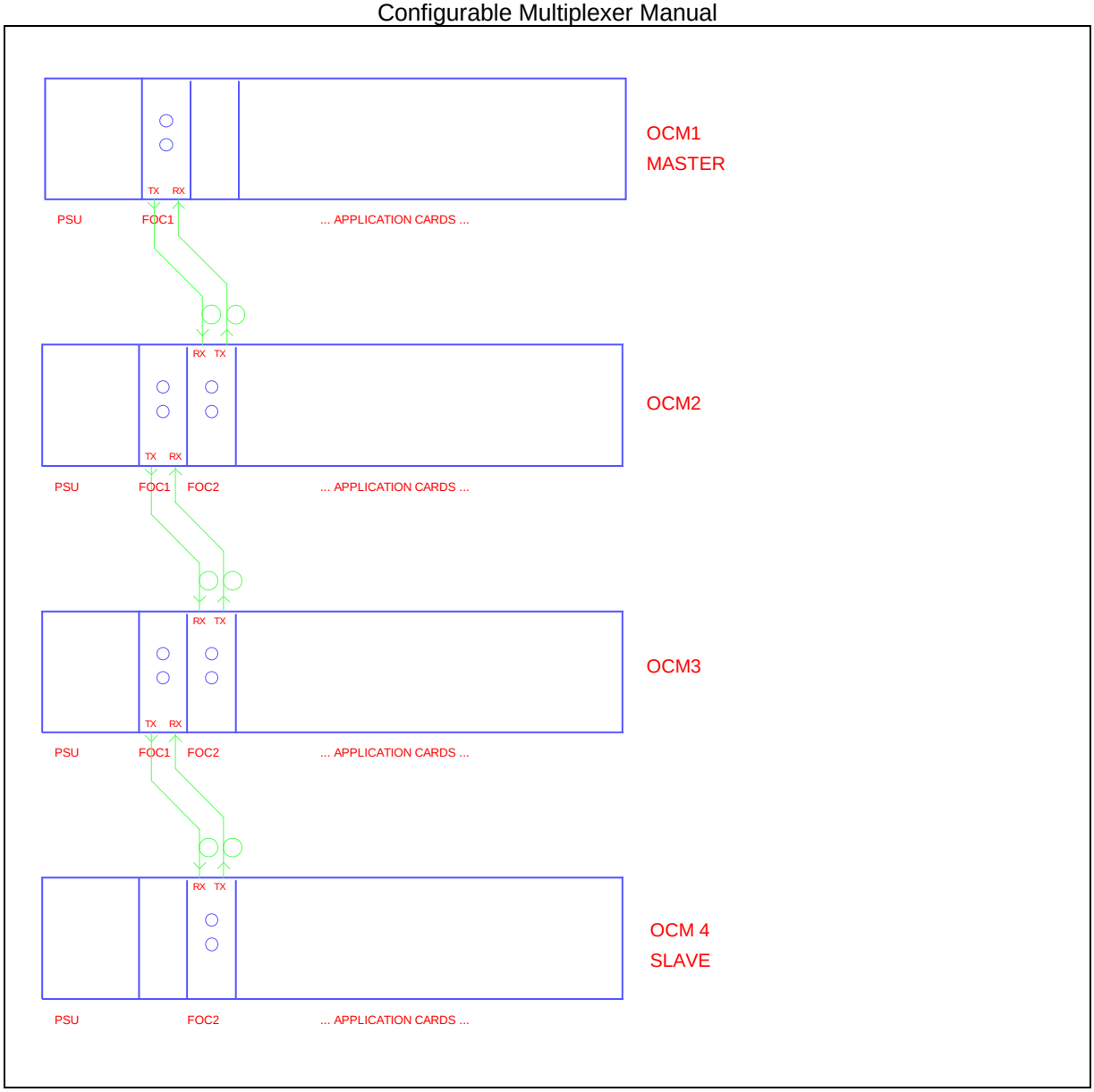


Figure 5 Typical configuration

3.4 Communication Channel

The data is communicated between OCMs on an optic fibre. A fibre optic driver card (FOC) includes one transmitter and one receiver to provide a duplex link to one other OCM. An OCM in the middle of a chain structure has two FOCs because it is linked to two other OCMs. Each OCM at the end of a chain has one FOC.

Several options are available for the fibre optic interface on the FOC. The fibre may be single mode or multi-mode, the transmitting device a semiconductor laser or a light emitting diode and the infra red wavelength used may be 850 or 1300nm with either multimode or single mode fibre.

The data transmitted over the link is encoded using the 4B/5B encoding technique. This technique is used because it facilitates clock recovery which could be difficult if not impossible from the baseband signal. This encoding is transparent to the data channels connected through the multiplexer. When the FOC is ready to transmit a signal the **TX indicator** on the FOC front panel lights up.

The FOC receives the light from the fibre and converts it to an electrical signal. The clock and data and control information are extracted from this digital signal and passed to the Application cards. When the FOC is receiving a signal the **RX indicator** on its front panel lights up.

3.5 Optics cards (FOC)

An optics card transmits one data stream and receive another - it is named after the data stream it receives.

- An **up** card, receives up data and transmits down data
- A **down** card, receives down data and transmits up data.

The modes are controlled by SW4 switch. When it is open the card is in UP mode, when closed the card is in DOWN mode.

The data originates with the receiver and ends up at the transmitter, for example, the up optics card receives up data, derives the up address and passes these down to the down optics card which then transmits the up data.

Page numbers

The bandwidth of the optics cards must be shared between all 8 possible applications cards. This is done by assigning each applications card a page number (0…7), and giving it access to the CData and T busses with the least three significant bits of the address match

Control Information

The **Control section** of the FOC performs several functions. This card selects between an onboard crystal clock and an incoming signal clock. It carries out the top level of multiplexing; interfacing between the transmitted data stream and the four time slots plus control information. It also sequences the control signals to application cards so that each can interpret its incoming data stream in its own way.

In a system of OCMs, whether a simple system containing just two or a long chain, the two end units is designated UP and DOWN master. The master OCM uses a crystal controlled oscillator on its control card to provide a clock signal for the UP and DOWN signals. The UP and DOWN clocks are not synchronised. All OCMs further down the chain will recognise that they have an incoming clock signal and slave to that, ignoring their own crystal oscillators. A link used to set an FOC to be a master.

The fibre going from the master unit FOC1 output to the next unit's FOC2 input is referred to as the *down* fibre and that in the opposite direction as the *up* fibre. The continuations of these fibre from the second unit on to any others are referred to in the same way. *Down* data flows away from the master, *up* data towards it. The above paragraph regarding clocks can also be stated as 'any unit receiving no down signal assumes it is a master'. This means that if the down fibre link between a pair of OCMs is damaged then the next one down in the chain will take over the job of master for the remaining portion of the chain.

Part of the flexibility of the OCM is its ability to mix up to four different types of interface within one unit. Optics and application cards may be plugged into any slot in the mother board. However, due to mechanical restrain only two end slots are used for Optics Cards. The multiplexed data is divided into pages and therefore for application cards to communicate with each other must be set to the same page by a hex switch.

3.6 Application Cards

The interface standards to be used by an OCM are chosen by fitting appropriate application cards into the slots. The application cards interface the signals from the outside to the multiplexer and from the multiplexer to the outside.

All application cards must convert optics data to the correct format (e.g. RS232) and output it on an external connector, and convert incoming data to connector data ready for transmission to another multiplexer. They also provide the links for the user to set the mode information, and must act on it in a suitable way. Specifically, the card must read the address and if selected

1. Determine the mode (which varies with the address)
2. Output the correct value to the T bus

3. Output the correct data converted from the user's connector to the CData bus
4. Capture the optics data, if relevant, convert it and present it to the user.

It must do this to the two directions simultaneously which leads to complications since these two data flows are asynchronous. (The OPT100 series had synchronous data flows, as a result in this design the optics card is simplified and the applications cards made rather more complex; overall I prefer the present method).

Application card modes

There are four modes that each channel of an application card can take. Each sends data to some combination of up and down stream, and received data from one direction. In two of the modes, the data received can change dynamically – the direction is "rDir" – if only one link is working, it uses that. If both are working, it uses the link selectable preferred direction.

When there are only two multiplexer in a point to point configuration only two modes: UP and DOWN are relevant. All channels one multiplexer must be set in a DOWN mode and in the other to UP mode. When multiplexers are linked in a chain each channel on each multiplexer must be set in an appropriate mode.

Mode	Rx	Comments
Pass through	rDir	Cannot receive data from connector
Broadcast	rDir	Connector data writes both ways
Down	Down	CData is fed to the down optics card which transmits the down data
Up	Up	CData is fed to the up optics card which transmits the up data

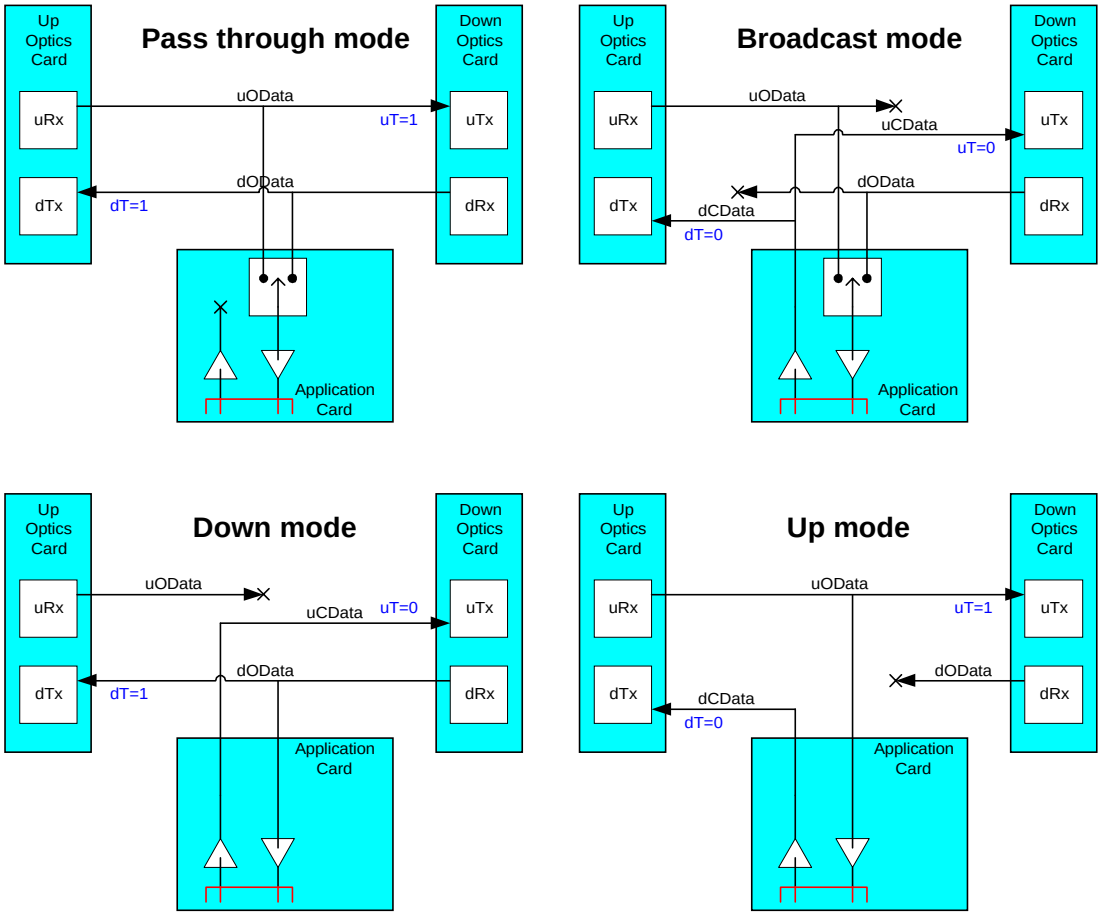


Figure 6. System Modes

3.6.1 RS232 Application Card

The RS232 application card implements eight channels of asynchronous RS232 standard interface. Each channel has one data line and two handshake/control lines in each direction. The handshake/control signals are sampled in the same way as data signals (except less frequently) and not interpreted specially by the OCM. Thus these signals can be used for lower baudrate data rather than for handshake/control information.

The Control card only sees the RS232 card as an *asynchronous* card, it is not aware that the signals being multiplexed were originally RS232 levels. Other asynchronous cards, for instance RS422 and TTL, multiplex their channels and channel components in the same sequence. This means that it is possible to have, for example, an RS232 card in one OCM communicating with an RS422 card in another with the interface standard conversion occurring transparently.

The *RX indicator light* for a given channel on the RS232 card lights when there is activity on the external data input line for that channel i.e. when data is being received by the OCM. Similarly the *TX indicator light* for a given channel on the card lights when there is activity on the external data output line for that channel i.e. when data is being transmitted by the OCM.

Mode pins for the eight external connectors

Connector	1	2	3	4	5	6	7	8
Mode 0	JP1	JP13	JP5	JP9	JP7	JP11	JP3	JP15
Mode 1	JP2	JP14	JP6	JP10	JP8	JP12	JP4	JP16

Link position: ON=link connected, OFF=link disconnected

Mode	Mode 1	Mode 0
Pass through	OFF	OFF
Broadcast	OFF	ON
Down	ON	OFF
Up	ON	OFF

3.6.2 RS422 Application Card

The RS422 application card implements eight channels of asynchronous RS422 standard interface. Each channel has one pair of lines for data and one pair for handshake/control in each direction. The handshake/control signals are sampled in the same way as data signals (except less frequently) and not interpreted specially by the OCM. Thus these signals can be used for lower baudrate data rather than for handshake/control information.

The Control card only sees the RS422 card as an *asynchronous* card, it is not aware that the signals being multiplexed were originally RS422 levels. Other asynchronous cards, for instance RS232 and TTL, multiplex their channels and channel components in the same sequence. This means that it is possible to have, for example, an RS422 card in one OCM communicating with an RS232 card in another with the interface standard conversion occurring transparently.

The *RX indicator light* for a given channel on the RS422 card lights when there is activity on the external data input line for that channel i.e. when data is being received by the OCM. Similarly the *TX indicator light* for a given channel on the card lights when there is activity on the external data output line for that channel i.e. when data is being transmitted by the OCM.

3.6.3 Audio Application Card

The card operates with standard audio interface impedances, it presents 600 ohm impedance and expects a 600 ohm load. The signal level is 1 volt rms.

The *RX indicator light* for a given channel on the voice card lights when there is a sufficiently loud signal being received by the OCM. Similarly the *TX indicator light* for a given channel on the card lights when there is a sufficiently loud signal being output (i.e. transmitted) by the OCM.

The Audio Stereo Card has been built which has the following specification:

Signal to Noise Ratio	63dB
Third Harmonic Distortion	-88dB
Dynamic Range	95dB
Frequency Response (-3dB)	10Hz to 20KHz
Pass Band Ripple	±0.5dB
Stop band Attenuation	-65dB

Audio Card Modes

The mode settings for this card are exactly the same as for RS232 card described above.

Mode pins for the eight external connectors

Connector	1	2	3	4	5	6	7	8
Mode 0	JP1	JP3	JP5	JP7	JP9	JP11	JP13	JP15
Mode 1	JP2	JP4	JP6	JP8	JP10	JP12	JP14	JP16

Link position: ON=link connected, OFF=link disconnected

Mode	Mode 1	Mode 0
Pass through	OFF	OFF
Broadcast	OFF	ON
Down	ON	OFF
Up	ON	OFF

3.7 Backplanes

Each application card has a corresponding backplane which connects from the rear of the application card.

It is also possible to have bespoke backplanes for special interface applications such as different connectors, voltage levels,impedances etc,or for special function applications such as engineer order wire telephones, alarm routing etc.

The engineer order wire telephone backplane allows a standard telephone to be connected to each OCM for a system communication network.

4.0 CONFIGURATION DESCRIPTION

4.1 Introduction

The OCM is very flexible in that it can be configured to suit a system's requirements. This flexibility extends down to the level of individual channels within a card. There follows an overview of the operation followed by a more detailed look at aspects of configuration.

4.2 Operating Principle

The data stream travelling away from the head of the chain (the master OCM) is referred to as the *down* data stream, that in the opposite direction is termed the *up* data stream. Normally duplex links are implemented, with the two halves of a link being on the two data streams.

4.3 Independence of Card Position

The system is designed to operate on a common bus thus any card may be plugged into any slot. However, the position of Optical Cards is restricted by the mechanical design of the housing.

4.4 Independence of Channels

All of the OCMs in a chain have the same types of application card in corresponding pages. A particular type of application card will split its total available bandwidth into a number of channels. These channels can be thought of as totally separate lines as if they were separate communication links.

Each application card has a set of links, two links per channel, which are used to control the operation of the channels. The channels are configured entirely independently of one another. The link settings for a particular system installation are normally planned out and set up on the cards before a system is installed.

4.5 Communication Capability

There are two basic modes of communication available in an OCM system, *point to point* and *broadcast*. In addition there is a *drop and insert* capability.

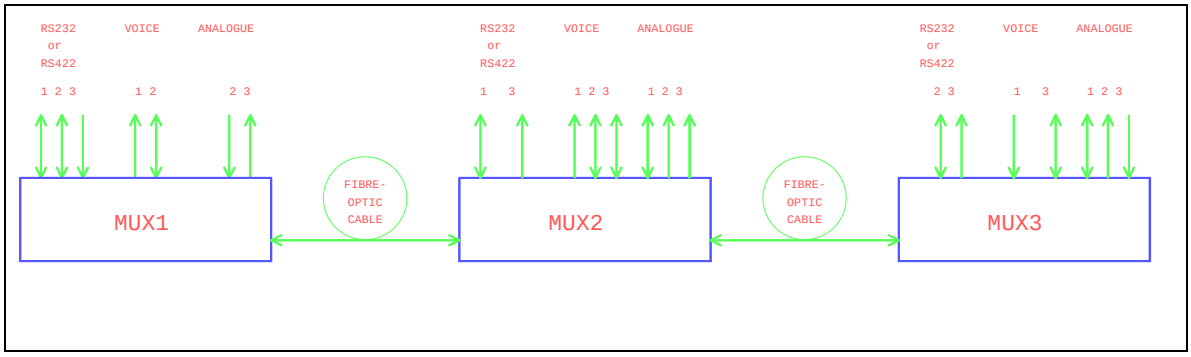


Figure 7 Typical modes of communication.

4.6 Point to point

Point to point communication is used to provide a simple link between two places. This link will typically be duplex (i.e. a symmetric link in each direction) but obviously does not have to be. The two OCMs at the ends of such a link do not need to be adjacent in a chain. They must both have the same type of application card in the same card position.

4.7 Drop and Insert

If a particular channel is used to provide a link between two points on a chain then this link has no effect on that channel in other parts of the chain. The same channel may be used for a second totally separate point to point link further down the chain. A channel can be reused as many times as is required within a chain of muxes the only limitations being

(1) The links must not overlap.
(2) A particular channel in a particular OCM has only one external connector. Thus there cannot be links in both directions starting from one OCM *unless* they use separate channels.

Intervening OCMs between two involved in a point to point link do not need to have an application card fitted in the card position being used by the link. However, if such OCMs do have application cards in those positions, these cards must be of the appropriate type and they must be configured for that channel such that they do not intercept the link (and so do not become one end of a point to point link themselves).

4.8 Broadcast

The OCM also supports a broadcast mode in which data sent from a single source can be received at many destinations. The signals may also be received from one (usually) default direction.

Broadcast links and point to point links can be freely combined within a system. Thus it is possible for one card in an OCM to be participating in point to point links, transmitting broadcasts and receiving broadcasts in both directions all simultaneously provided that card has enough channels. Similarly the channels of an application card may be configured to be routed to any destinations even all different ones.

4.9 Channel Configuration

The configuration for every channel on every application card in a system should be mapped out. Each channel is set to one of four *modes* described below which determine which data goes where. For a specific channel there is data coming from the external world and the up and down receive fibres and data is required to be sent to the external world and the up and down transmit fibres.

5.0 INSTALLATION

Safety Warning

(a) Extreme care must be exercised when installing, adjusting, servicing or repairing the equipment when equipment is connected to the mains supply.

(b) Any interruption of the protective conductor inside or outside the equipment, or disconnection of the protective earth (safety ground) terminal, is likely to make the equipment dangerous.

Before any other connections are made, the equipment must be connected to a protective earth (safety ground) conductor via a three core mains cable. The mains plug must be inserted only into a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

The signal ground connections provided for interface of the data signals must not be used to connect the protective earth conductor.

(c) Testing or operation of an optical transmitter may present potential hazards to test personnel from high levels of optical radiation. Care should be taken to avoid possible eye damage resulting from looking either directly into a laser light source or into the end of an optic fibre which is energised from such a source. No type of magnifying device should ever be used to look at such a source or fibre.

(d) It is generally accepted that LEDs do not pose a health hazard. As a precautionnever view the LED aperture directly (or with optical viewing aids), when the LED is energised, for more than 17 minutes from a distance of less than 35mm. Similarly, if the equipment is connected to an optical fibre, then this may not diminish the output power significantly and the same caution should be taken with the free end of the fibre. This may expose the eye beyond the maximum permissible level recommended in BS4803.

(e) If there is any suspicion about the equipment not being safe, do not put it into operation.

(f) BMW CONSULTANTS assume no responsibility should the equipment be used in any way other than specified.

5.1 Introduction

This section provides installation instructions for the OPT 100 Series Configurable Multiplexer and also includes information regarding the initial inspections, damage claims, preparation for use, cabling, interfacing, packaging shortage and shipping.

5.2 Delivery and Initial Inspection

Within seven days of delivery of goods the buyer should inspect and test the goods and should give notice to BMW CONSULTANTS in writing of any damage, defect, discrepancy or shortage. If goods arrive damaged, the container and all original packing material should be retained to comply with such conditions as to notice in respect of damage, defect, discrepancy or shortage as may be required by the carrier.

Any failure to give such notice within the specified period shall bar any claim in respect of goods by the buyer, and the goods shall be deemed to have been accepted by the buyer.

5.3 Preparation for Use

The following check should be carried out before the equipment is connected to the mains supply.

The 19 inch 3U sub-rack should be mounted to ensure a free flow of air around the equipment. All cards should be checked for correct seating in the sub-rack (front panel should all be flush).

5.4 Optical Cables

The cable must be installed in such a way as to minimise stress and to ensure that the specified minimum bend radius is not exceeded.

5.5 Signal Input/Output Cables

The signal cables connected will be specific to the interface cards used. Connectors fitted with screw locks (such as some D type connectors) should be correctly attached to the corresponding fittings on the backplanes. A good quality screened cables should be used with the system.

5.6 Fibre Optic Connectors

The fibre optic input/output connectors should always be protected by a dust cap when not connected to the optical fibre, to guard against contamination by dust or mechanical damage. Dust contaminated optical connectors can be cleaned by compressed air or gas.

5.7 Mains Voltage Selection

Units for operation in Europe are factory set to accept a mains supply of 220VAC to 250VAC.

Units for operation in USA are factory set to accept a mains supply of 120VAC.

Other operating voltages are available on request.

6.0 CHANNEL CONFIGURATION

6.1 Introduction

This section describes the application cards switch positions and settings to configure each channel as described in the configuration description.

6.2 Access

To access an application card, switch off power supply, remove top cover (4 screws) and pull out an application card. To remove Optical Cards it may be necessary to undo the back plate of the housing Refer to the following application card diagrams for configuration details.

6.3 Optics Card

As explained before the FOC must be also set to either UP or DOWN mode and also link LK4 must set to indicate whether the card is at the end of a chain or in the middle.

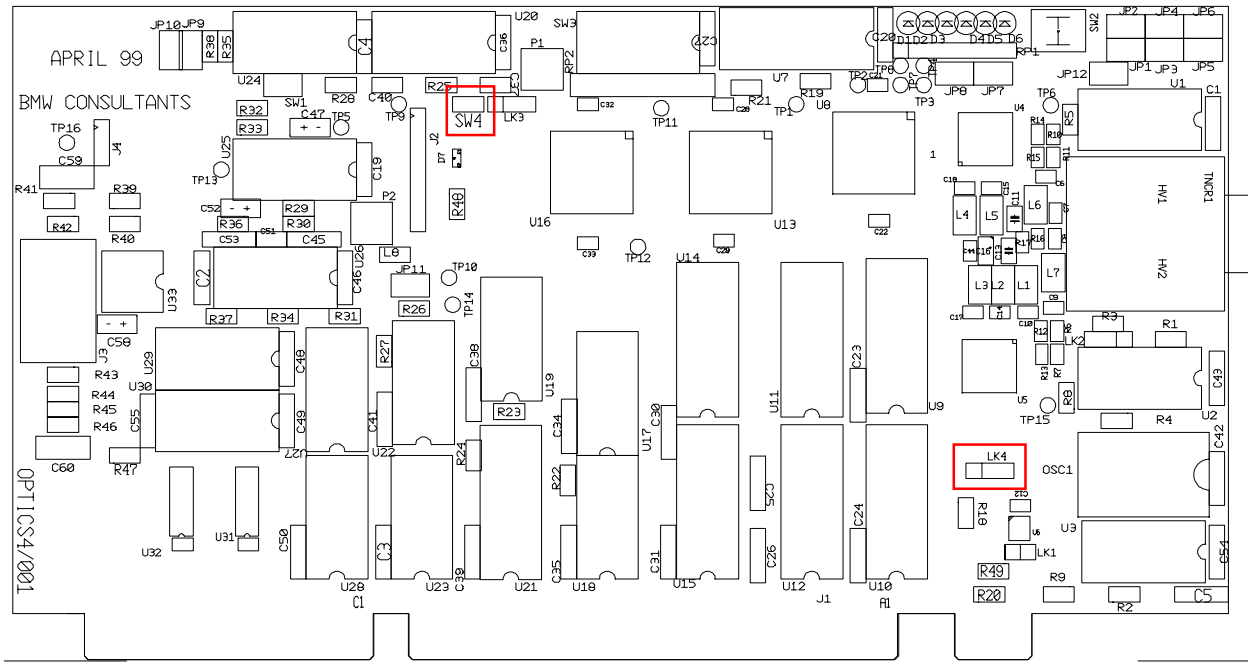


Figure 9. **Optics Card**

Description	UP	DOWN
SW4	OPEN	CLOSED

Description	END CARD	INTERMEDIATE
LK4	link 2-3 (right)	link (left)1-2

6.4 RS232 Application Card

The that need to be set are marked in red. See the tables and diagram below.

Mode pins for the eight external connectors

Connector	1	2	3	4	5	6	7	8
Mode 0	JP1	JP13	JP5	JP9	JP7	JP11	JP3	JP15
Mode 1	JP2	JP14	JP6	JP10	JP8	JP12	JP4	JP16

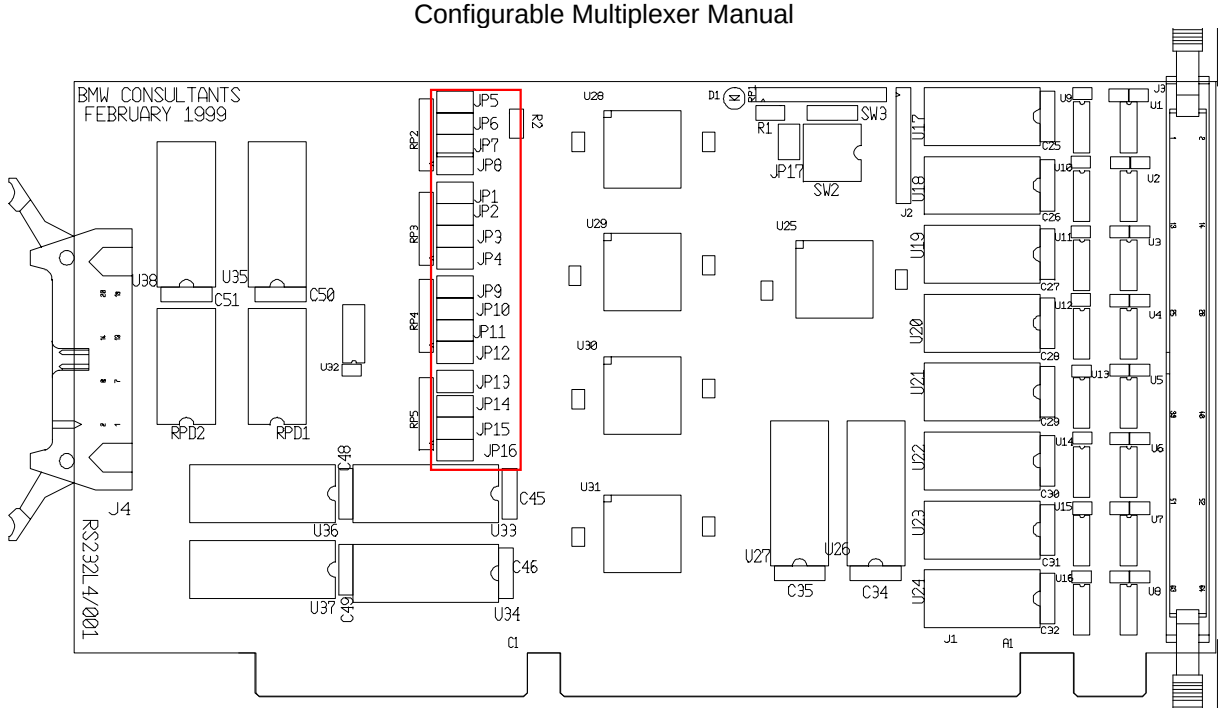


Figure 10 Configuration links on RS232 application card

Link position: ON=link connected, OFF=link disconnected

Mode	Mode 1	Mode 0
Pass through	OFF	OFF
Broadcast	OFF	ON
Down	ON	OFF
Up	ON	OFF

The pin out connections on the RS232 backplane are:

RS232 Card	D25 connector (socket)
1	May be connected to system Ground by a link (factory default: no connections)
2	Rx1 (Signal ***into*** the multiplexer from an outside source)
3	Tx1 (Signal output ***from*** the multiplexer)
4	Rx2 (Signal ***into*** the multiplexer from an outside source)
5	Tx2 (Signal output ***from*** the multiplexer)
6	Tx3 (Signal output ***from*** the multiplexer)
7	GND Signal ground
20	Rx2 (Signal ***into*** the multiplexer from an outside source)
8-19, 21-25	No connection

6.5 Stereo Audio Application Card

The that need to be set are marked in red. See the table below.

Mode pins for the eight external connectors

Connector	1	2	3	4	5	6	7	8
Mode 0	JP1	JP3	JP5	JP7	JP9	JP11	JP13	JP15
Mode 1	JP2	JP4	JP6	JP8	JP10	JP12	JP14	JP16

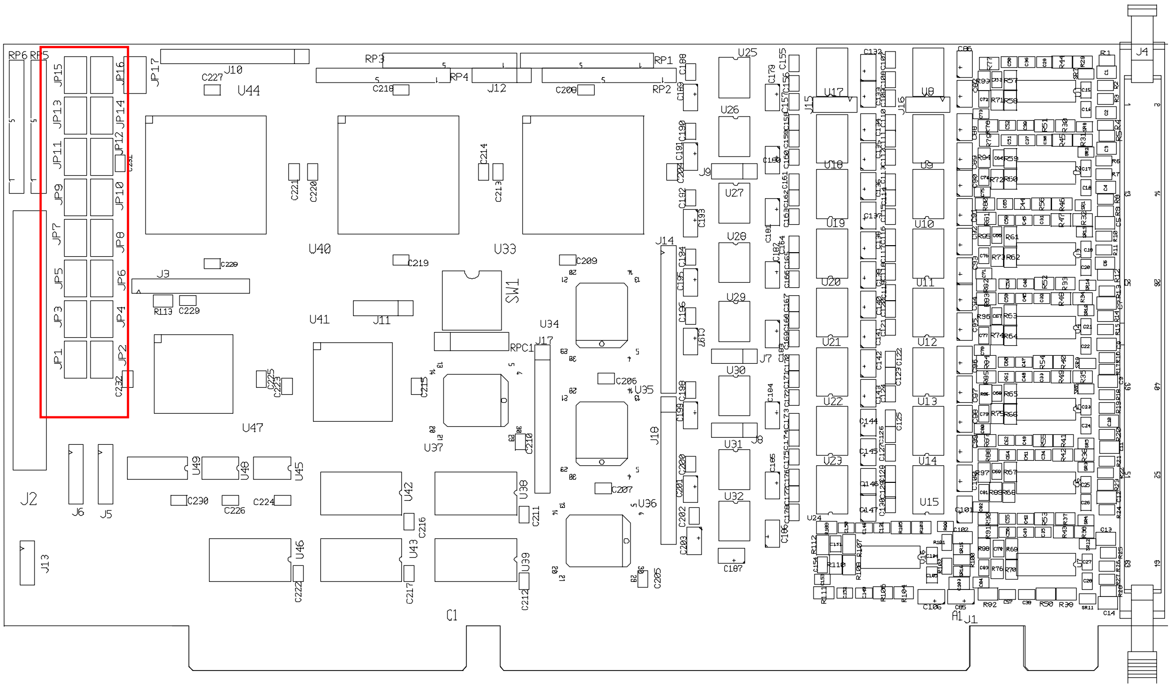


Figure 11 Configuration links for analogue application card

Link position: ON=link connected, OFF=link disconnected

Mode	Mode 1	Mode 0
Pass through	OFF	OFF
Broadcast	OFF	ON
Down	ON	OFF
Up	ON	OFF

The pin out connections on the Audio Card backplane are:

Audio Card (stereo)	D15 connector (socket)
1	May be connected to system Ground by a link (factory default: no connections)
2-4	No connections
5	Positive **input** (to the multiplexer) of the right hand channel
6	Positive **input** (to the multiplexer) of the left hand channel
7	Positive **output** (from the multiplexer) of the left hand channel
8	Positive **output** (from the multiplexer) of the right hand channel
9-13	No connection
14	Common connection for input signals
15	Common connection for output signals

7.0 MAINTENANCE

Introduction

The units were designed for exceptional reliability and do not require regular maintenance. The following points should be observed and checked to prevent unnecessary failures.

Optical Connectors

When an optical fibre is disconnected from an optical input/output connector, both connectors should be protected with dust caps to prevent mechanical damage or contamination.

Fibre Optic Connections

The optical fibre terminations should be checked periodically for tightness to ensure the correct fitting to input/output connectors. All fibre optic connections should be 'finger tight' only. Extreme force, for instance by using a fixed spanner, can cause damage to the PIN/LED device inside the input/output optical connector.

Electrical Connections

Interface connectors should normally be held in place by securing screws (D-type connectors) or bayonet fitting (BNC connectors) so should not work loose.

Dust and Airflow

Prevent dust from collecting on the equipment and maintain a sufficient airflow around the equipment to ensure long trouble free operation.

8.0 WARRANTY

Introduction

BMW CONSULTANTS assumes responsibility for the equipment sold hereunder to be free from defects in materials and workmanship for a period of 6 (six) months from the date of delivery. BMW CONSULTANTS will replace or repair, at its option, any equipment which in its judgement is defective, provided:

1. The equipment has been subjected to normal use and service.

2. The defect is not due to damage occurring after the original acceptance of the goods by the Buyer.

3. The equipment has not been altered or modified by persons unauthorised by BMW CONSULTANTS or not in accordance with instructions furnished by BMW CONSULTANTS.

4. All transportation and insurance charges for the return of the equipment to BMW CONSULTANTS service and repair facility have been prepaid by the Buyer.

BMW CONSULTANTS will pay return shipping expenses for the repaired equipment, including the cost of insurance, provided the equipment proves to be defective and is within the limits of the warranty. Otherwise, the Buyer is liable for all handling, shipping and insurance costs.

Defective equipment may be returned to BMW CONSULTANTS during the 6 month warranty period, subject to a Return Material Authorisation (RMA). The RMA number must be obtained from BMW CONSULTANTS Fibre Systems Sales Department.

Liability

BMW CONSULTANTS shall not have liability or responsibility to the customer or any other person or entity with respect to any liability, injury or loss caused or alleged to be caused directly or indirectly by products and equipment sold by BMW CONSULTANTS, including but not limited to any interruption of service, loss of business or anticipatory profits or consequential damages resulting from the use or operation of such. It is the responsibility of the Buyer to determine the suitability of the products for their intended use.

BMW CONSULTANTS liability for breach of warranty under any contract or otherwise, shall not exceed the purchase prices of the specific product shipped and against which a claim is made.

This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorised to represent or assume for BMW CONSULTANTS any liability in connection with the sale of our products other than set for herein.

Assistance

For repairs outside of warranty service or after the warranty period, charges will be the prevailing authorised repair prices. Product maintenance agreements and other customer assistance agreements are available for BMW CONSULTANTS AND OPTRONICS products.

Warning

This is class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

9.0 TECHNICAL SPECIFICATION

PERFORMANCE

GENERAL

Type of multiplexing	Time division
Data rate	125 Mb/s
Signal coding	NRZ 4B/5B or 5B/6B
Bit error rate	$<10^{-9}$
Configuration	Point to Point Drop and Insert, Broadcast Mode

INTERFACES

RS 232	19.2 Kb/s
RS 422	38 Kb/s
Audio (-3dB)	10Hz-20KHz

OPTICAL

Optical budget at 850nm	11 dB (50/125)
Optical budget at 1300nm	13 dB (50/125)

CHANNELS

Standalone/Rackmount	192

MECHANICAL AND ELECTRICAL

DIMENSIONS

Standalone	485 x 220 mm x 3U
Rackmount	19" x 220mm x 3U

POWER CONSUPTIONS

Standalone/Rackmount	240 VAC (55W)

ENVIRONMENTAL

Storage temperature	-20°C to +65°C
Operating temperature	0°C to +50°C
Relative Humidity	92% non condensing

ELECTRICAL CONNECTORS

RS232	D25
RS422	D15
Audio/Voice	D15
Power connector for subrack and standalone modules	IEC

OPTICAL CONNECTORS

850 nm LED	ST
1300 nm LED	ST
1300 nm LASER	PC

ORDERING INFORMATION

Part No. 1 -

Chassis
1 = Rackmount
2 = Standalone

Package/Power
A = 240 VAC
B = 110 VAC
C = 48 VDC

Optics Cards
1 = 1 Optics Card
2 = 2 Optics Cards

Optics
1 = 850nm LED ST
2 = 1300nm LED ST
3 = 850nm LED SC
4 = 1300nm LED SC
5 = 1300nm Laser single mode fibre SC connectors

Interface Cards
101 = RS232 with 2 hand shaking channels
102 = RS422
103 = TTL
104 = RS485
105 = 20mA Current Loop
106 = A/D Manchester
107 = Voice
108 = Analogue