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**OPTICAL**

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**SYSTEMS**

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**DESIGN**

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**OPERATOR MANUAL**

**OSD1240A SSI INTERFACE**

**INDUSTRIAL MODEM**

**MOLEX CONNECTOR VERSION**



# OPTICAL SYSTEMS DESIGN

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## 1 TECHNICAL SUMMARY

### 1.1 DESCRIPTION

The OSD1240A is a small, self-contained modem designed to connect Data Link Modules used in the SSI railway signaling system. It is intended to operate in a bus topology analogous to the standard copper datalink using either multimode or singlemode fibers, over spans of up to 100km when using singlemode fiber.

While it normally interfaces with SSI bi-phase encoded data streams operating at 10kbps it is capable of handling data up to 500kbps so is compatible with almost any upgrade to this system.

This system operates by sampling the incoming data from the DLM interface at a high rate, encoding it and transmitting over the fiber in both directions. Each subsequent modem simply regenerates this encoded signal so that pulse distortion does not depend on the number of units in series.

Consequently, an OSD1240A based system can have as many as 40 systems in series, enough to cover all likely situations.

The OSD1240A is designed to mount either on a flat surface or in a TS32 DIN rail system.

It operates from an unregulated DC supply of 12 to 24V @ 6VA.

### 1.2 THEORY OF OPERATION

A simplified block diagram of the OSD1240A is shown in Figure 1. The unit is designed to operate in a bus topology (see Figure 8) with the control centre OSD1240A located anywhere along the bus. Note that at each site there will be two OSD1240As, one for each copper datalink. The unit located at the control centre is designated the Master and acts as both the start and end of the Bus, ie signals do not pass through from Channel 1 to Channel 2 (and vice versa) as they do at the slaves.

As Figure 1 shows, the 2-wire transformer coupled data signal is converted to 4-wire format at the OSD1240A Data Interface and transmitted in each direction. Naturally this can only occur when there is no incoming optical data signals otherwise there would be interference between the signals.

Likewise any incoming optical signal is decoded and output via the Data Interface to the external 2-wire system. Again, circuitry must be included to ensure that there is no interference between any of the signal sources.

Such circuitry is shown in Figure 3. Arbitration ensures “first come first served” in terms of access to or from the copper bus.

A key issue in the design is the format of the optical signal. It is quite possible to transmit the data signal over the fiber pretty much in the same format as received from the 2-wire copper system. However, this has several disadvantages:

- Each time the signal is received and repeated at an intermediate location there is a bit more pulse width distortion added: this limits the number of units that can be included in a network.
- There is no easy way of transmitting system status information or control signals as can be very useful when installing or fault finding networks.
- Assessment of optical losses and power is only practical when the units are taken out of service.

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For these reasons the OSD1240A transmits optical signals in the form of a bi-phase encoded 2-bit word which is constantly being transmitted.

A further consideration is the need to ensure that faults don't cause the bus to be monopolised. This could be due to a software fault in a remote unit causing transmission or it may be a fault within the optical modem forcing a logical "1" to be continuously transmitted. The unit therefore has three anti-streaming (or anti-jabber) circuits, which inhibit transmission if some preset time limit is exceeded and then enable transmission after a fixed time of inactivity. The OSD1240A has 30ms for the first limit and 1 second for the second limit. This ensures that a faulty unit cannot monopolise the bus for more than 3% of the time.

Figure 3 is much the same as Figure 2 but with anti-streaming added.

A concern with systems like this, which continuously regenerates the signals, is that system timing can be lost or degraded if an intermediate unit fails. The receiver after this failed unit has no data or its recovered clock to lock onto so the clock used for its transmit side may swing to an extreme part of its operating range or may wander around over its range. Such a situation would lead to faulty system behavior. The OSD1240A overcomes this by having a fixed crystal oscillator at each node. When the incoming data exhibits either a very high bit error rate (this rate is around  $1 \times 10^{-2}$ ) or the incoming optical signal is lost the associated transmitter's timing is switched over to the fixed oscillator.

## 1.3 FRAME STRUCTURE

The simplest way of transmitting the data over the fiber is to encode it using methods like Bi-phase or Manchester coding. This enables simple and effective timing recovery and bit error monitoring over the link. OSD has elected in this case to transmit the data in 2-bit words that are then Manchester encoded for transmission. The key advantage of this is that it allows for the transmission of other data (e.g. controls or supervisory signals) in addition to the primary SSI data stream.

This increase in functionality comes at very little increase in complexity.

The frame is very simple: Bit 0 is the SSI data as sampled at 4.5MHz and Bit 1 consists of an 8-bit word: Bits 0 to 5 are unassigned as yet, Bits 6 and 7 are for synchronization and bit error detection.

Thus the frame is composed of eight 2-bit words. The serial data rate over the fiber is 9Mbps so 4.5Mbps is allocated to SSI data and 4.5Mbps to supervision and control.

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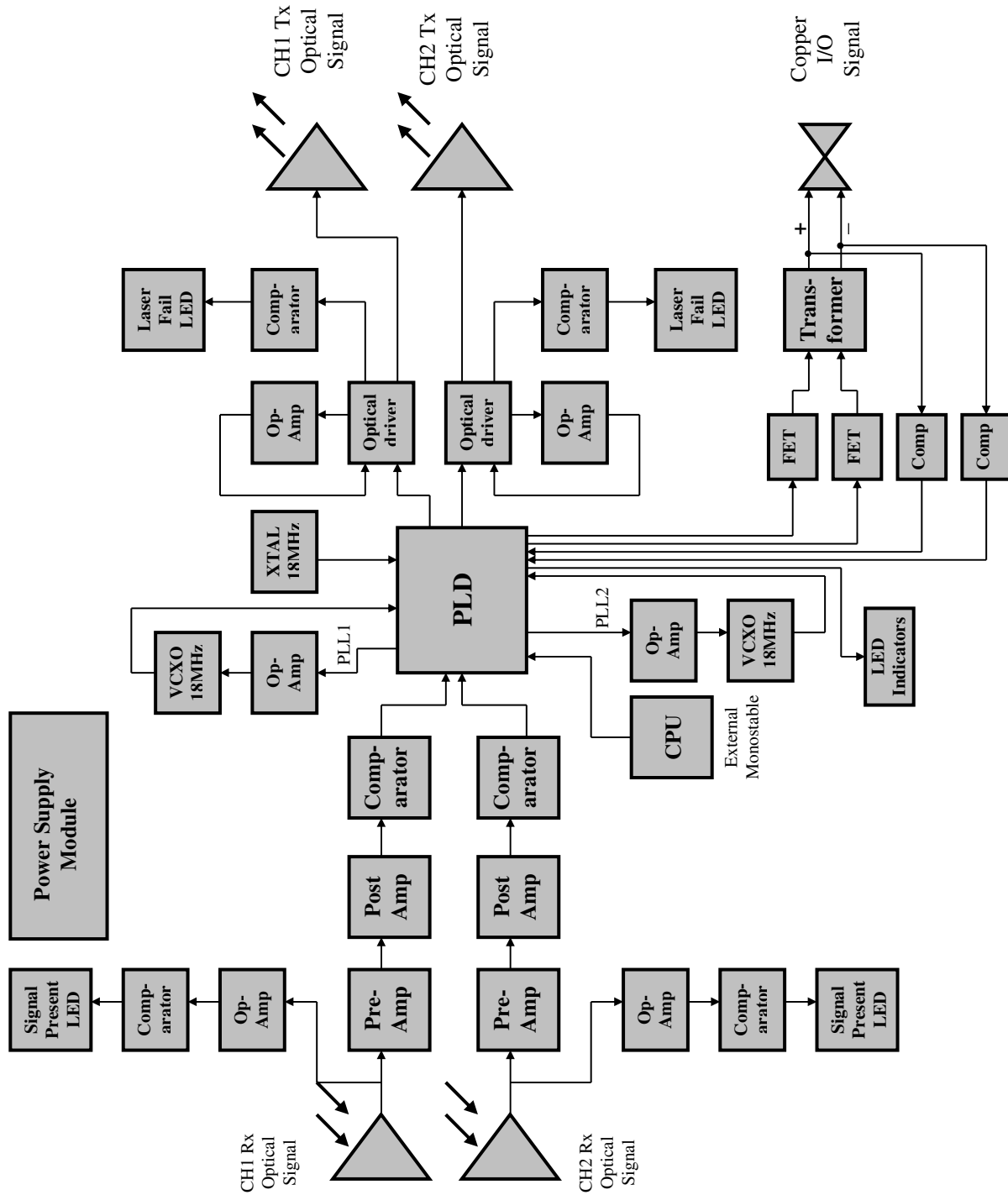


FIGURE 1: BASIC BLOCK DIAGRAM

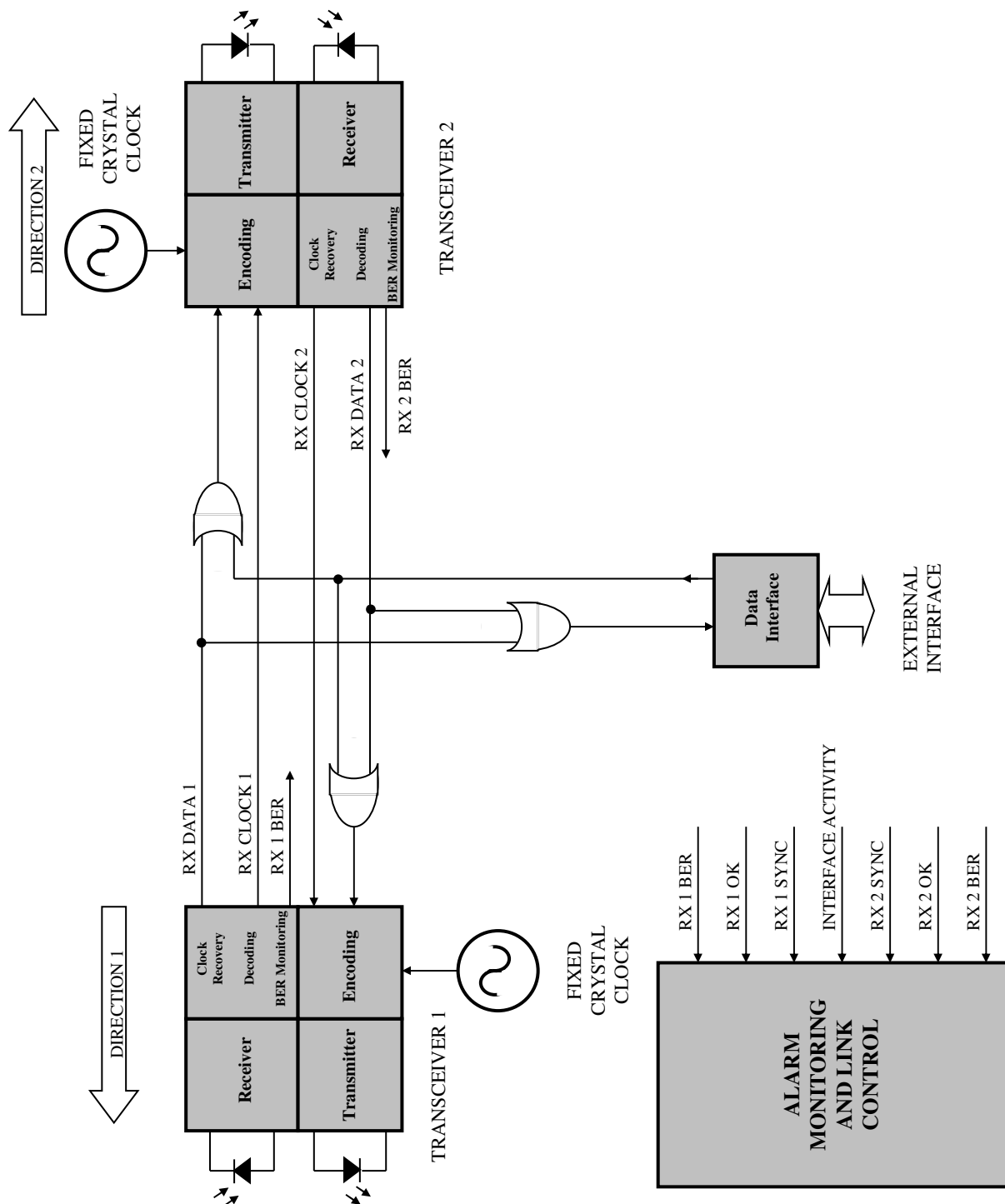


FIGURE 2: DETAILED BLOCK DIAGRAM

# OPTICAL SYSTEMS DESIGN

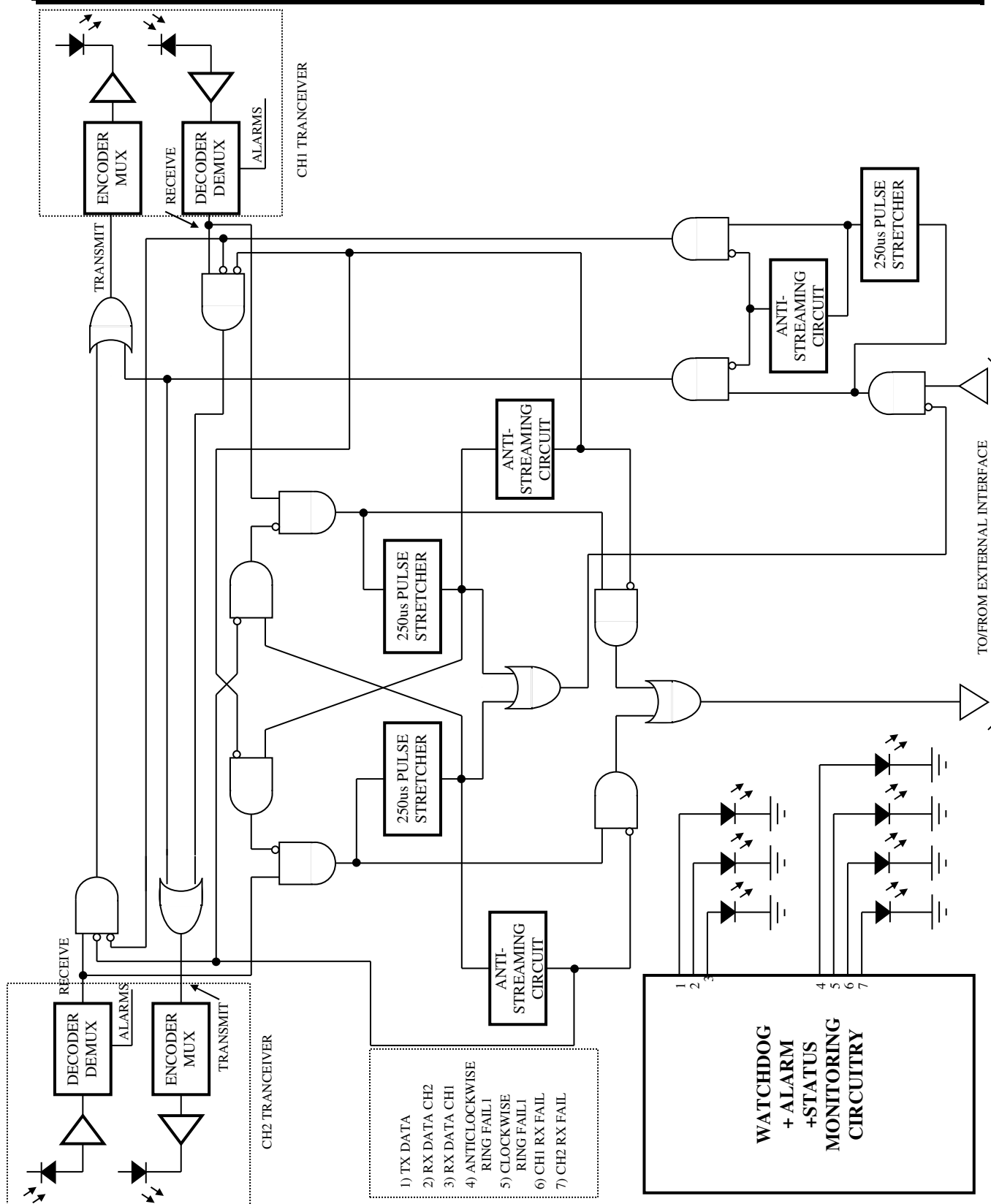


FIGURE 3: DETAILED BLOCK DIAGRAM WITH ANTI-STREAMING



# OPTICAL SYSTEMS DESIGN

## 1.4 SPECIFICATIONS

No.	SPECIFICATION	PERFORMANCE
<b>Electrical</b>		
1	Data Interface	SSI 2-wire balanced copper pair
2	Electrical Connector	6-pin Molex Mini-Fit JR 39-01-2060 socket
3	Data Rate	5 to 500kbps bi-phase encoded
4	Bit Error Rate	$< 1 \times 10^{-9}$
<b>Optical</b>		
5	Optical Wavelength	1300nm (1550nm is optional)
6	Optical Connectors	FC
7	Transmit Power	-12 to -6dBm (higher powers available)
8	Receive Sensitivity	$< -35\text{dBm}$
9	Receive Saturation	$> -5\text{dBm}$
10	Receiver Fail Indication	$< -39\text{dBm}$ to $-41\text{dBm}$
<b>Indicators</b>		
11	Copper Transmit Data Present	Amber (1 Only)
12	Receiver Optical Signal Ok	Green/Red (2, 1 per port)
13	Receiver Sync Ok	Green/Red (2, 1 per port)
14	Laser Ok	Green/Red (2, 1 per port)
15	Receiver Data Present	Amber (2, 1 per port)
16	Receiver Bit Error	Red (2, 1 per port)
17	Transmitter Switched to Local Crystal	Red (2, 1 per port)
<b>Packaging and Environmental</b>		
18	Dimensions (mm) excluding flanges and connectors	104W x 144D x 40H
19	Weight	500g
20	Operating Temperature	$-20^{\circ}\text{C}$ to $70^{\circ}\text{C}$
21	Relative Humidity	0 to 95% non-condensing
22	Power Requirements	12 to 24 V <sub>DC</sub> @ 6VA
23	Power Connector	4-pin Molex Mini-Fit JR 39-01-2040 socket

102124005

TABLE 1: OSD1240A SPECIFICATIONS

## 2 INSTALLATION AND OPERATING INSTRUCTIONS

This section briefly outlines the steps required to install and operate the OSD1240A successfully. It should be studied carefully to avoid undue damage to the equipment and poor operation.

This equipment has been fully tested before dispatch and is ready for immediate operation. However, it is advisable to check for external transportation damage before operation. If damage is present, return the unit and packing to the supplier immediately.

### 2.1 DRAWINGS AND MOUNTING DIMENSIONS

The unit is designed to rest on a flat surface such as a modem tray or bench top or, via the optional mounting bracket onto a TS32 DIN rail.

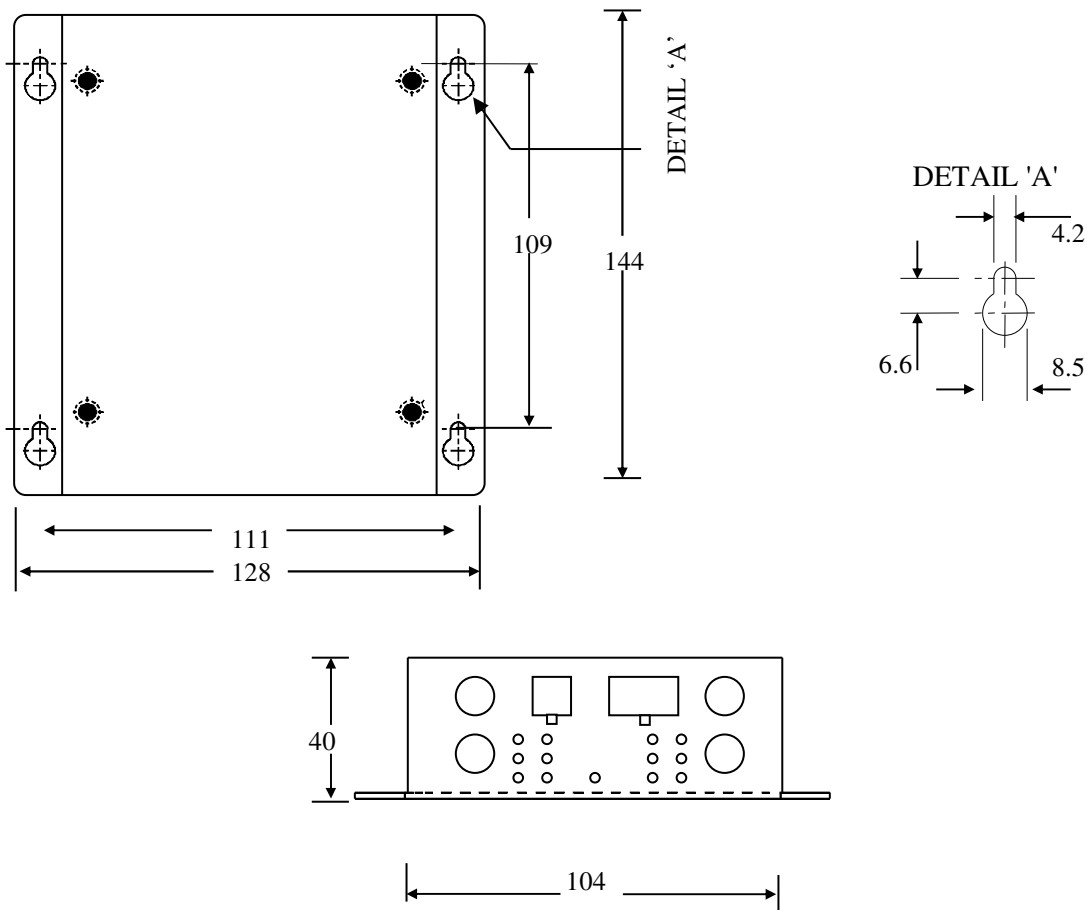


FIGURE 4: MOUNTING DIMENSIONS

# OPTICAL SYSTEMS DESIGN

## 2.2 POWER CONNECTION

Units are powered by +12V to 24V<sub>DC</sub> via a 4-pin Molex Mini-Fit JR 39-01-2040 socket on the unit's front panel. Connect power as shown in Figure 5 and Table 2.

PIN No.	FUNCTION	WIRE COLOUR
1	Ground	Black
4	+12 to 24 V <sub>DC</sub>	Red
2 & 3	Not Connected	-

TABLE 2: POWER PIN CONNECTION

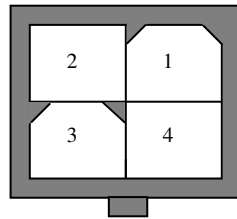


FIGURE 5: POWER PIN CONNECTION DIAGRAM

**WARNING** - Ensure that you are using the correct voltage!

The unit employs an internal resettable solid state fuse to protect both it and the power source in the event of a fault in the modem's internal power supply.

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## 2.3 SIGNAL CONNECTION

Connect data signals as shown in Figure 6. Data + and Data - and Cable Shield are supported via a female 6-pin Molex Mini-Fit JR 39-01-2060 socket. This also has two terminals that determine whether the unit is a Master or a Slave. In order to set the unit to Master mode, use a plug connector with a link between pins 1 and 3. To set the unit to Slave mode, use a plug connector with no connection between pins 1 and 3. A connection between pins 2 & 5 provides a 47Ω/1W termination across the line if required.

PIN No.	FUNCTION
4	Data +
6	Data -
2 & 5	47Ω/1W Line Termination
1 & 3	Master: Connect pins together Slave: No connection

\* Note: Pins 4 and 5 internally connected

TABLE 3: SIGNAL PIN-OUT CONNECTION

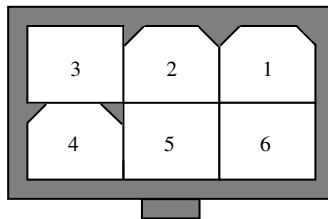


FIGURE 6: DATA AND MASTER/SLAVE CONNECTION DIAGRAM

## 2.4 USER CONTROLS

The only controls a user has is to set the unit in either Master or Slave mode. See section 2.3 SIGNAL CONNECTION for setting unit mode.

## 2.5 FIBER OPTIC CABLE CONNECTION

The OSD1240A supports all commonly available multimode and singlemode optical fibers with FC connectors. Remove the protective caps from the optical output and optical input ports.

Before inserting the optical connectors ensure they are free from any contamination. If they need cleaning use alcohol and lint free tissues. Connect the already terminated cables to the output/input ports. Ensure that the optical output port of one OSD1240A connects to the optical input port of an OSD1240A at the other end.

Remember that the optical transmit channel of one modem connects to the optical receive channel of the next unit of the system and vice versa.

Figure 8 shows the set up for a bus configured system.

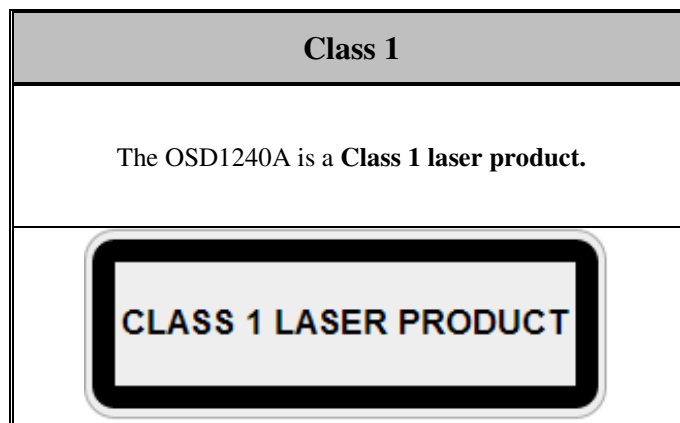
## 2.6 OPTICAL POWER LEVELS

### ▲ ELECTROMAGNETIC COMPATIBILITY

**WARNING:** This is a 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.

### ▲ OPTICAL OUTPUT OPERATION

**WARNING: Laser Safety:** Class 1 Laser Product per IEC/EN 60825-1:20011 standard.



## PRECAUTIONS

- ▲ All service personnel should be provided training as to the hazards of direct viewing of laser radiation and of the precautionary measures during servicing of equipment
- ▲ Areas where laser products are installed should be restricted in access to trained service personnel only and appropriate warning signs posted in the work area.
- ▲ All laser apertures should be covered by protective covers when not connected to optical fibers. Never leave outputs uncovered.
- ▲ Laser equipment should be positioned above or below eye level where possible. Apertures should be positioned away from personnel.
- ▲ Protective eyewear should be worn in the vicinity of laser equipment.

The standard OSD1240A is designed to operate with no adjustment to transmit power levels over distances from zero to the maximum link distance.

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## 2.7 INDICATORS

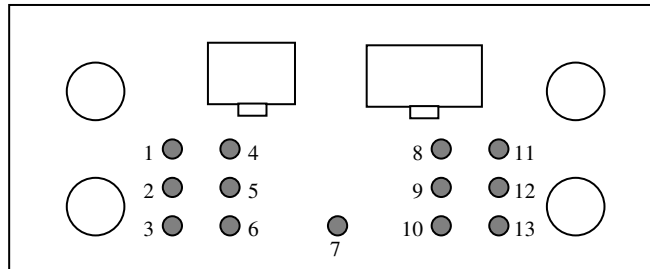


FIGURE 7: LED FRONT PANEL INDICATORS.

LED No		LABEL	LED COLOUR	FUNCTION
CH 1	CH 2			
1	11	Rx LOS	Green	Optical signal is received
			Red	Loss of optical signal
2	12	Link OK	Green	Receiver locking onto data frame
			Red	Data frame not locked
3	13	Laser OK	Green	Laser is functioning
			Red	Laser is not working properly and/or adjusted incorrectly
4	8	DLM RxD	Orange	Receiving from channel and transmitting to copper output
			Off	Not receiving
5	9	Bit Error	Red	Receiver is producing bit errors
			Off	No bit errors are present.
6	10	Slave TxC	Red	Receiver loses lock or loss of optical signal
			Off	When set in Master Mode or as slave and repeating signal
7		DLM TxD	Orange	Optical data is transmitted to copper output
			Off	Optical data is not transmitted to copper output

TABLE 4: LED INDICATOR FUNCTIONS

# OPTICAL SYSTEMS DESIGN

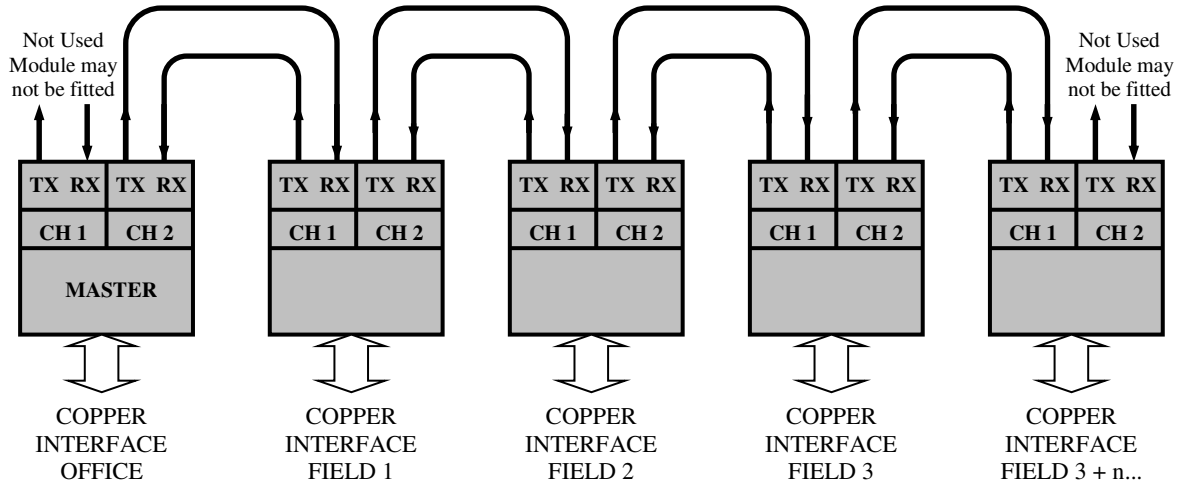


FIGURE 8: BUS CONFIGURED SYSTEM

### 3 MAINTENANCE

The following section briefly outlines the fault-finding procedures for the OSD1240A modem. Please take note of the following:

Personnel without considerable technical training should not attempt any maintenance other than that outlined below.

If further maintenance is attempted than which is outlined below, you are warned that every care should be taken to ensure that internal measurements made while the equipment is running are taken carefully. Some components are extremely expensive and can be damaged by failure of any part of their support circuitry.

#### 3.1 EXTERNAL INSPECTION

Visually check the following:

Check that the power leads are correctly terminated and that the correct power source has been selected.

Check that the SSI DLM has been correctly terminated.

Check that the status LEDs illuminate properly.

Check that the correct optical power levels are present at both receiver and transmitter ports.

Inspect the optical connectors and give them a clean before reinsertion.

#### 3.2 ROUTINE MAINTENANCE

No routine maintenance is required for this equipment.



## 4 WARRANTY

Thank you for purchasing equipment designed, manufactured and serviced by Optical Systems Design (OSD). OSD warrants that at the time of shipment, its products are free from defects in material and workmanship and conforms to specifications. Our Warranty conditions are outlined below:

### 4.1 WARRANTY PERIOD

For warranty period, please call your local OSD distributor.

### 4.2 REPAIRS

Optical Systems Design reserves the right to repair or replace faulty modules/units. Please obtain a "Return Material Authorisation" (RMA) form and number before returning goods.

Goods must be returned in adequate packing material to Optical Systems Design, Warriewood or its nominated authorised representative, for all repairs.

#### 4.2.2 WARRANTY REPAIRS

Return shipments to OSD shall be at customer's expense and freight back to the customer will be at OSD expense.

#### 4.2.2 OUT-OF-WARRANTY REPAIRS

OSD reserves the right to repair or replace any faulty goods. Freight costs and insurance for both journeys are met by the user. All equipment repaired by OSD will have a 3-month warranty from the date of dispatch.

#### 4.2.3 SITE REPAIRS

By agreement site repairs may be undertaken for which out of pocket, hotel and travel expenses will be charged.

#### 4.2.4 EXCLUSIONS

This warranty does not apply to defects caused by unauthorized modifications, misuse, abuse or transport damage to the equipment. All modifications to OSD's standard product will need written authorization and will be charged at normal repair rates. All modifications are to be carried out by OSD Technicians. Warranty is void if unauthorized removal and/or tampering with serial number and/or repair labels is evident.

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Optical Systems Design Pty. Ltd.

7/1 Vuko Pl. Warriewood 2102

P.O. Box 891 Mona Vale

N.S.W. Australia 2103

Telephone: +61 2 9913 8540


Facsimile: +61 2 9913 8735

Email: [sales@osd.com.au](mailto:sales@osd.com.au)

Web Site: [www.osd.com.au](http://www.osd.com.au)

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