OPTICAL
SYSTEMS
DESIGN

OPERATOR MANUAL

OSD9003/OSD9004

WIDEBAND FIBEROPTIC RF LINK

INDEX 1

1 TECHNICAL SUMMARY

1.1 BRIEF DESCRIPTION

1.1.1 OVERVIEW

The OSD9003 transmitter provides an extremely wideband transmission capability which allows its use in a variety of RF over fiber applications. It has an excellent frequency response characteristic which enables its employment in paging systems as well as its primary applications of cellular RF trunking at 800-1000MHz and 1700-1900MHz. It employs extremely linear circuitry to ensure very wide dynamic range performance as required in uplink applications. It is completely format independent so can support any current or proposed cellular system.

The unit employs a very wideband laser driver and DFB laser to ensure outstanding linearity, noise performance and dynamic range.

A very convenient feature is the user selectable automatic or manual input RF level adjustment.

The OSD9004 is designed to receive intensity modulated optical signals in the wavelength range 1200 to 1600nm. It also employs extremely linear circuitry to ensure very wide dynamic range performance as required in uplink applications and is completely format independent so can support any current or proposed cellular system.

The receiver is a wideband balanced PIN photodiode design which has outstanding linearity, noise performance and dynamic range.

The OSD9004 is supplied with a built in automatic gain control (AGC) controlled by the received optical level, a feature which greatly simplifies installation and ongoing operation. However the user can elect to use manual gain control which can be useful in some specialized applications.

Both the OSD9003 and OSD9004 are packaged in a very small, rugged standalone enclosure operating from a wide range of input power supply voltages, allowing totally non-critical powering.

Furthermore the enclosure has excellent RF shielding so that the unit can be installed in almost any RF environment which, combined with its wide operating range of -20 to +65ºC, allows it to be installed almost anywhere on the planet.

1.1.2 APPLICATIONS

- Any linear RF transmission over fiber from 10 to 2500MHz such as remoting and EMI/EMC measurements
- Mobile RF systems between 800 and 1900MHz
- UHF/VHF radio links

1.1.3 FEATURES AND BENEFITS

- Standard optical and RF connectors simplify system integration
- Operates over from at least 40km of singlemode cable and optionally available with high power laser to operate over at least 80km
- OSD9003 has high linearity and low noise DFB laser enables very wide dynamic range links
- OSD9003 has user selectable manual or automatic input level control enables flexible system integration
- Operates with non-critical power
- OSD9003 has a bargraph display of input RF level while the OSD9004 displays the input optical signal level
- OSD9004 is available with user selectable manual gain control or automatic gain control for convenient system integration.
- Operates from -20°C to +65°C so can be installed in almost any environment
- Extremely rugged metal case
- Optional remote monitoring/alarming capability

1.2 TECHNICAL SPECIFICATIONS

TABLE 1: OSD9003 TECHNICAL SPECIFICATIONS

SPECIFICATION	PERFORMANCE
Operating Wavelength	1310 ±5nm nominal. Also available in all 18 CWDM wavelengths (1270-1610)nm
Optical Output Power	+3.0 ±1.0dBm
Optical Connector	SC/APC (FC/APC is optional)
Optical Return Loss	>45dB
RF Input Impedance	50Ω nominal, unbalanced
RF Input Return Loss	>10dB
RF Input Connector	SMA
Transmitter Bandwidth	10 – 2500MHz ±2.0dB
Input Level Control	Automatic over a 31dB range or user adjustable User adjustable over 31dB range in 1dB increments using DIP switch
Input 1dB Compression Point	>+15dBm (Input attenuation set to 0dB)
Input 3rd Order Intercept Point	>+32dBm (Input attenuation set to 0dB)
Dimensions (mm)	60W x 94D x 26H
Weight	0.3kg
Power Requirements	+9V to +28V_{DC} @ 3VA
Operating Temperature	-20°C to +65°C
Relative Humidity	0 to 95% non-condensing

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TABLE 2: OSD9004 TECHNICAL SPECIFICATIONS

SPECIFICATION	PERFORMANCE
Operating Wavelength	1260 – 1620nm
Receiver Bandwidth	30 – 2500MHz ±2.0dB
Optical Connector	SC/APC (FC/APC is optional)
Optical Return Loss	>45dB
Receiver Saturation	>2dBm
Maximum Optical Input Power	3dBm continuous, 6dBm transient (60 seconds maximum)
RF Input Impedance	50Ω nominal, unbalanced
RF Input Return Loss	>10dB
RF Input Connector	SMA
Output Level Control (Manual)	User adjustable over 31dB RF range (15.5dB optical) in 1dB increments
Output Level Control (Auto)	Self adjusts from -15 to +1dBm optical input power
Output 1dB Compression Point	>+18dBm
Output Third Order Intercept Point	>+35dBm (Input attenuation set to 0dB)
Dimensions (mm)	60W x 94D x 26H
Weight	0.3kg
Power Requirements	+9V to +28V_{DC} @ 3VA
Operating Temperature	-20°C to +65°C
Relative Humidity	0 to 95% non-condensing

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2 INSTALLATION AND OPERATION

2.1 INTRODUCTION

This section outlines the methods required to install and operate the OSD9003/OSD9004 successfully. It should be studied carefully if damage to the equipment or poor results are to be avoided.

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

2.2 INSTALLATION

2.2.1 WARNING AND PRECAUTIONS

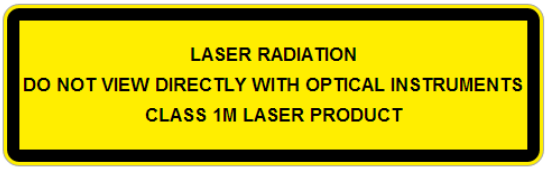
ELECTROMAGNETIC COMPATIBILITY

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.

Precautions have to be taken not to overdrive the OSD9003 RF input with excessive signal level. **Laser damage may occur** as a result of excessive signal power being applied to the input. The total maximum RF power applied to OSD9003 RF input port is < +20dBm.

OSD9004 uses a sensitive photodiode that can be damaged when optical power is too high. **It is necessary to ensure that optical power going into OSD9004 input is less than +3dBm or damage to the unit may occur**. The OSD9003 can launch optical power as high as +7dBm. In situations where optical path attenuation is not high enough, a fixed optical attenuator must be used to reduce optical power at the OSD9004 receiver input to less than +3dBm.

OPTICAL OUTPUT OPERATION

Class 1M	
The OSD9003 is a **Class 1M laser product.** Class 1M 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.

2.3 OSD9003/OSD9004 DRAWINGS AND DIMENSIONS

The OSD9003/OSD9004 standalone module is designed to be mounted on an even surface and to be secured by means of M4 or smaller screws.

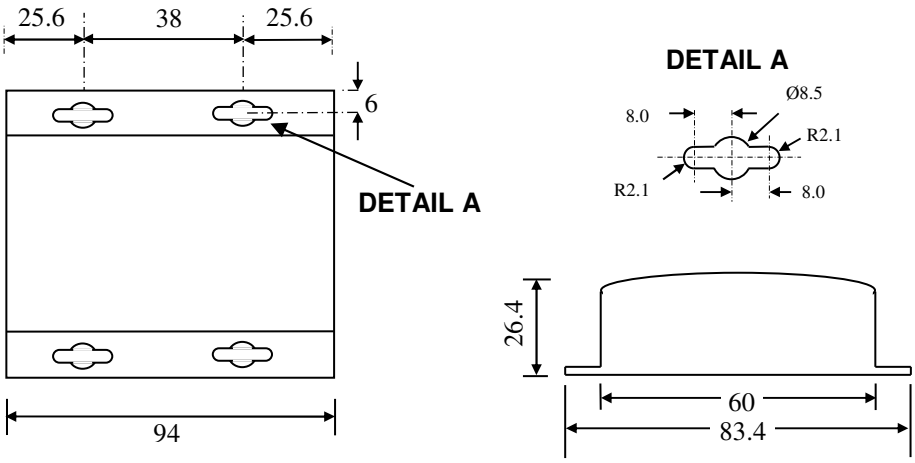


FIGURE 1: OSD9003/OSD9004 MOUNTING DIMENSIONS

2.4 OSD9003/OSD9004 FRONT AND REAR PANELS

The front panel consists of an optical output (OSD9003) optical input (OSD9004), 6-way DIP switch and LED indicators. The rear panel consists of a 3-way terminal block power/alarm connector, an RF Input (OSD9003) and an RF Output (OSD9004) . Each section will be described further throughout this manual.

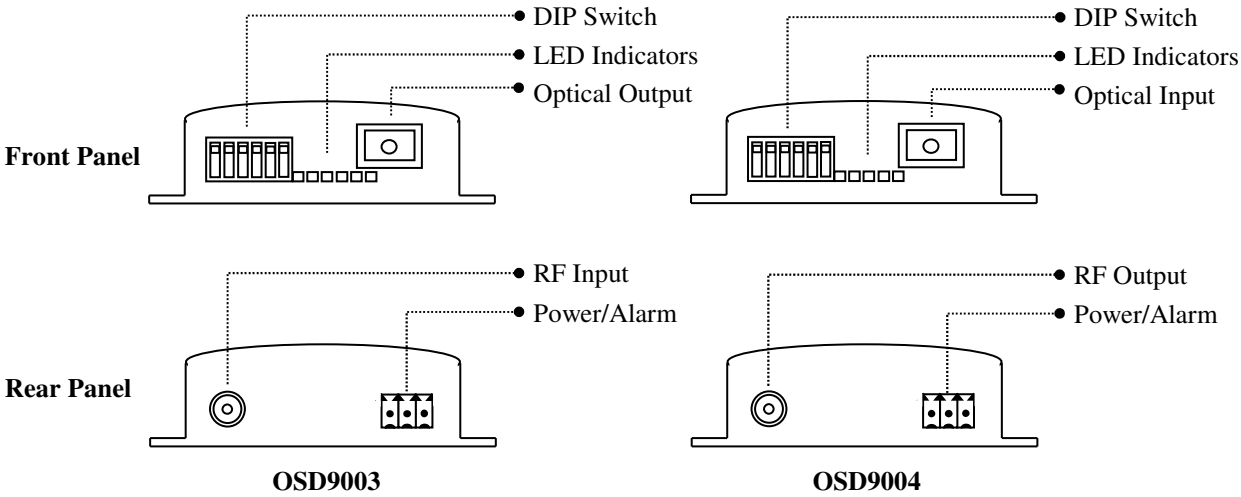


FIGURE 2: OSD9003/OSD9004 FRONT/REAR PANELS

2.5 OPERATION AND CONNECTIONS

2.5.1 POWER SUPPLY CONNECTIONS

The OSD9003/OSD9004 module requires external 9 to 28V_{DC} @ 3VA. Power should be connected to the power socket located at the back of the case as indicated in Table 3.

TABLE 3: DC OR AC POWER CONNECTION

External Power Pin	Specification
Pin 1	9 to 28V_{DC} @ 3VA
Pin 2	Ground – 0V
Pin 3	Remote Alarm

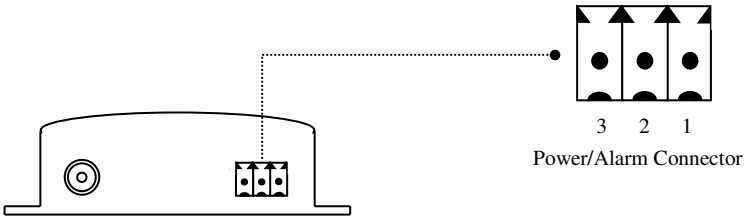


FIGURE 3: OSD9003/9004 POWER SUPPLY CONNECTIONS

2.5.2 REMOTE ALARM CONNECTIONS

The OSD9003/OSD9004 provides a remote alarm connection located on pin 3 of the 3-way power/alarm connector (see Figure 3). Open drain alarm output sinks current in the absence of an alarm condition. When an alarm occurs, the output goes into a high impedance state.

When power to the OSD9003 unit is switched off or the laser current monitor indicates laser fail mode Pin 3 becomes open circuit. The unit's monitoring circuit connects Pin3 to Pin2 (circuit ground) when there is no fault.

When power to the OSD9004 unit is switched off or there is a optical loss condition Pin 3 becomes open circuit. The unit's monitoring circuit connects Pin 3 to Pin 2 (circuit ground) when there is no fault.

2.5.3 OSD9003/OSD9004 SWITCH SETTINGS

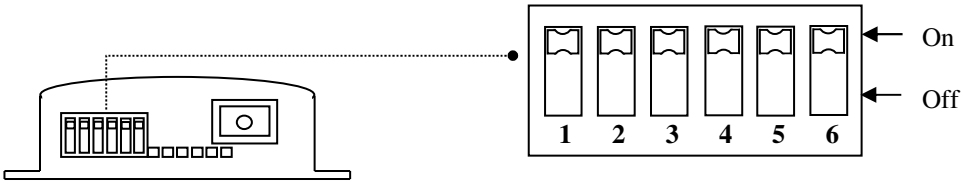


FIGURE 4: OSD9003 SWITCH SETTINGS

OSD9003 Settings

In Manual Mode the RF attenuation is controlled by dip switches (SW1-SW5). Each toggle switch changes the Input RF attenuation level by 1,2,4,8 and 16dB respectively. Toggling the position on any switch is the sum of the attenuated amount *ie switch 1 (16dB) and 3 (4dB) enabled will provide an attenuation of 20dB.* See Table 4 for switch control Note: On is up position, down is off.

TABLE 4: OSD9003 SWITCH FUNCTION

Switch No	**1**	**2**	**3**	**4**	**5**	**6***
Attenuation	16dB	8dB	4dB	2dB	1dB	-

*Switch 6 has no function and can be either On or Off.

The RF input level to the transmitter is adjusted for optimum Optical Modulation Index (OMI). The input RF attenuator has a range of 31dB. It is important to set the attenuator so that the laser is working with optimum modulation that will provide the best signal to noise ratio for the received signal. Table 5 provides a matrix of attenuator settings (RF Attn in dB) for the number of carrier channels whilst showing the RF input range in dBm per carrier.

TABLE 5: ATTENUATOR SETTING MATRIX

RF Att. (dB)	Number of Carriers								RF Input Range (dBm/carrier)
	1	**2**	**4**	**6**	**10**	**15**	**30**	**60**	
0	-10	–13	–16	–18	–20	–22	–25	–28	
1	-9	-12	-15	-17	-19	-21	-24	-27	
2	-8	-11	-14	-16	-18	-20	-23	-26	
3	-7	-10	-13	-15	-17	-19	-22	-25	
4	-6	-9	-12	-14	-16	-18	-21	-24	
5	-5	-8	-11	-13	-15	-17	-20	-23	
6	-4	-7	-10	-12	-14	-16	-19	-22	
7	-3	-6	-9	-11	-13	-15	-18	-21	
8	-2	-5	-8	-10	-12	-14	-17	-20	
9	-1	-4	-7	-9	-11	-13	-16	-19	
10	0	-3	-6	-8	-10	-12	-15	-18	
11	+1	-2	-5	-7	-9	-11	-14	-17	
12	+2	-1	-4	-6	-8	-10	-13	-16	
13	+3	0	-3	-5	-7	-9	-12	-15	
14	+4	+1	-2	-4	-6	-8	-11	-14	
15	+5	+2	-1	-3	-5	-7	-10	-13	
16	+6	+3	0	-2	-4	-6	-9	-12	
17	+7	+4	+1	-1	-3	-5	-8	-11	
18	+8	+5	+2	0	-2	-4	-7	-10	
19	+9	+6	+3	+1	-1	-3	-6	-9	
20	+10	+7	+4	+2	0	-2	-5	-8	
21	+11	+8	+5	+3	+1	-1	-4	-7	
22	+12	+9	+6	+4	+2	0	-3	-6	
23	+13	+10	+7	+5	+3	+1	-2	-5	
24	+14	+11	+8	+6	+4	+2	-1	-4	
25	+15	+12	+9	+7	+5	+3	0	-3	
26	+16	+13	+10	+8	+6	+4	+1	-2	
27	+17	+14	+11	+9	+7	+5	+2	-1	
28	+18	+15	+12	+10	+8	+6	+3	0	
29	+19	+16	+13	+11	+9	+7	+4	+1	
30	+20	+17	+14	+12	+10	+8	+5	+2	
31	+21	+18	+15	+13	+11	+9	+6	+3	

OSD9004 Settings

The OSD9004 receiver has one user adjustment available. The receiver attenuator can be set to the required RF output power manually or alternatively can be set to automatic gain control by setting switch 6 to the on position (up). In automatic gain control mode the unit maintains constant output level over the optical range of 15dB.

2.5.4 SYSTEM SETTING RECOMMENDATIONS

The RF output power can be set to provide system unity gain if there is sufficient received optical power. Table 6 shows what levels to expect in OSD9003/9004 system

TABLE 6: TYPICAL LEVELS FOR SINGLE CARRIER

Input RF [dBm]	**OSD9003 RF Attenuator [dB]**	**Tx Optical Power [dBm]**	**Optical Attenuation [dB]**	**Rx Optical Power [dBm]**	**OSD9004 RF Attenuator [dB]**	**Output RF [dBm]**
-10	0	+5.0	5.0	0	Auto	–26... –28
-10	0	+5.0	11	–6	Auto	–26... –28
-10	0	+5.0	17	–12	Auto	–26... –28
-10	0	+5.0	23	–18	Auto	–32... –34
-10	0	+5.0	26	–21	Auto	–38
-10	0	+5.0	26	–21	0	–38
-10	0	+5.0	23	–18	0	–32
-10	0	+5.0	20	–15	0	–26
-10	0	+5.0	17	–12	6	–26
-10	0	+5.0	14	–9	12	–26
-10	0	+5.0	11	–6	18	–27
-10	0	+5.0	8	–3	24	–27
-10	0	+5.0	5	0	30	–27

For best results, please note the following:

ALL RF Fiber Optic Transmission Systems operate best if:

a. Input carriers are as close as possible within each other, as this maximises the effective optical power available to each carrier.

b. The combined RF input spectrum is adjusted just below the onset of inter-modulation distortion where the laser is still reasonably linear.

c. It is important to have minimal optical reflections back to the laser diode. This is best ensured by using only high quality, angle polished physical contact (SC/APC) optical connectors which have a high optical return loss. Connectors must be clean and scratch free. Similarly high quality splices (typically these are fusion splices) must be used to minimise such reflections.

d. The receiver's optical input is not overloaded with too much optical power, ie more than +3dBm optical power, as this will cause saturation and subsequent intermodulation distortion.

RF level figures in Table 6 are given for a single carrier. Suggested power levels per carrier for multichannel operation are in Table 5.

2.5.5 OSD9003 LED INDICATORS

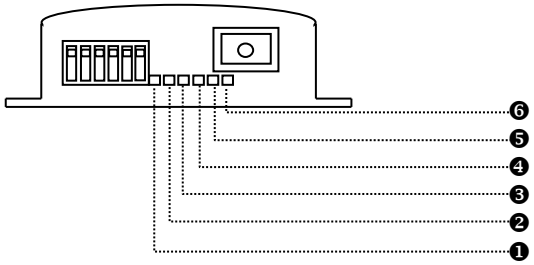


FIGURE 5: OSD9003 LED INDICATORS

TABLE 7: OSD9003 LED INDICATOR FUNCTION

LED Indicator	LED Colour	Input RF Power (dBm)
❶	Red (blinking)	> +20
	Green LED ON	> +10
❷	Green LED ON	> 0
❸	Green LED ON	> -10
❹	Green LED ON	> -20
❺	Red LED ON	< -30 (out of range)
❻	Red LED ON	Laser Fail*

***** Laser Fail Red LED is laser over-current alarm indicator. It is normally off.

2.5.6 OSD9004 LED INDICATORS

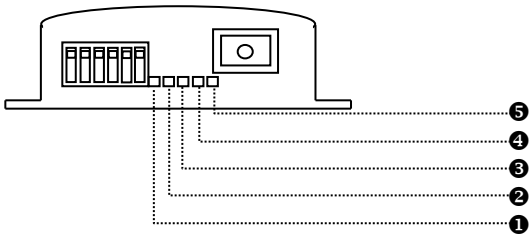


FIGURE 6: OSD9004 LED INDICATOR

TABLE 8: OSD9004 LED INDICATOR FUNCTION

LED Indicator	LED Colour	Input Optical Power (dBm)
❶	Red (blinking)	> +3
	Green LED ON	> 0
❷	Green LED ON	> -5
❸	Green LED ON	> -10
❹	Green LED ON	> -15
❺	Red LED ON	< -17 (out of range)

2.5.7 OSD9003 CONNECTIONS

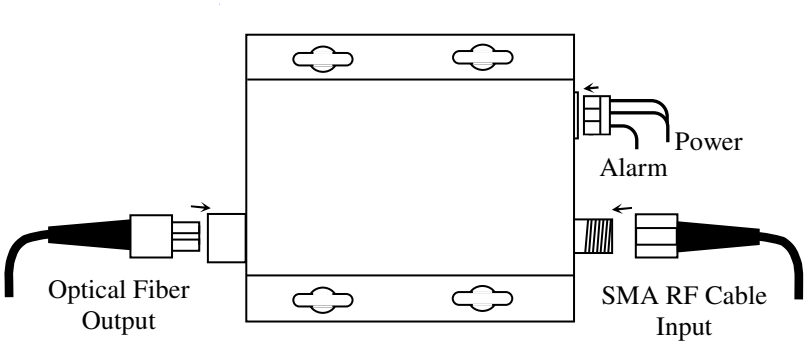


FIGURE 7: OSD9003 CONNECTIONS

2.5.8 OSD9004 CONNECTIONS

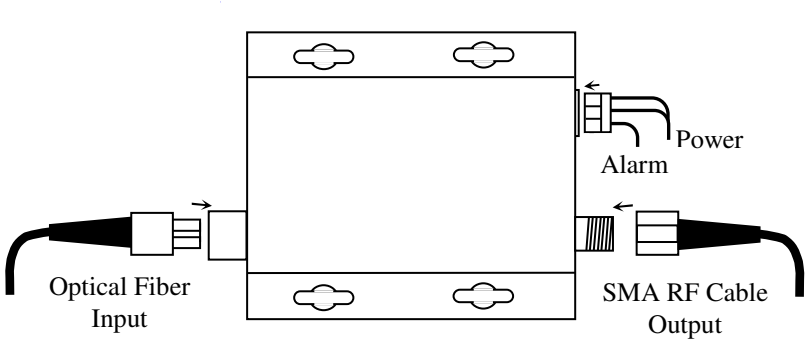


FIGURE 8: OSD9004 CONNECTIONS

3 MAINTENANCE

3.1 INTRODUCTION

The following section outlines the fault-finding procedure for the OSD9003/OSD9004 modems. Please take note of the following:

- Personnel without appropriate training should not attempt any maintenance except that outlined below.
- If further maintenance is attempted you are warned that every care should be taken to ensure that internal measurements made while the equipment is operational are taken carefully as some components within the unit are expensive and may be damaged by failure of any portion of their support circuitry.
- Some components within the unit are Electrostatic (ES) sensitive and Electrostatic Discharge (ESD) precautions should be taken when performing maintenance upon the unit.

3.2 EXTERNAL INSPECTION

Visually check for the following:

- Check that the correct power source is connected to the power socket.
- Check that the RF cables are connected to the modem correctly and that the distant modem has been connected correctly to any external equipment.
- Inspect the optical connectors (for fiber SFP option) for any contamination and clean using isopropyl alcohol and a lint free tissue if any contamination is detected.

3.3 ROUTINE MAINTENANCE

- There is no routine maintenance required with the OSD9003/OSD9004.

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 contact 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.

4.2.1 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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