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HIGH ISOLATION MICRO-OPTIC WDM

QUALIFICATION/RELIABILITY TEST REPORT

Prepared by

Approval and Revision List:

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Title	Name	Signature	Date
Product Manager			
Manager of Reliability / FA Eng			
Chief Quality Officer			
VP of Engineering			

Revision History Details

Rev	Description	Prepared By	Date
01	Initial Release		

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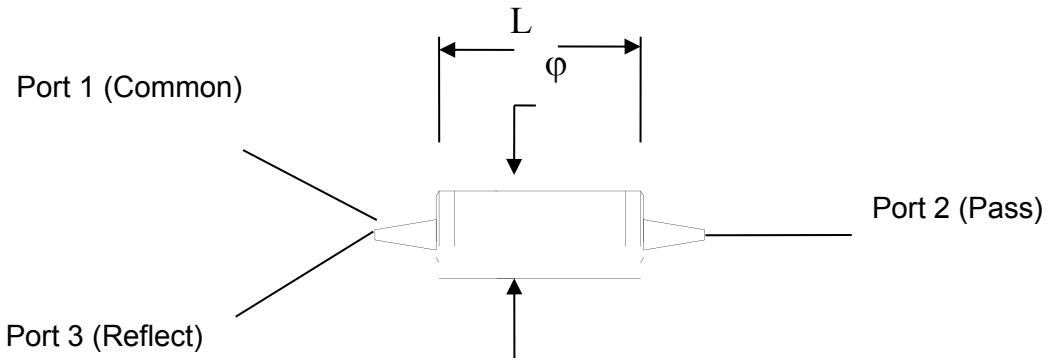
1.0 INTRODUCTION

This report lists reliability tests to be performed High Isolation Micro-Optic WDM based on athermal platform manufactured at Oplink, Zhu Hai still to meet the respective industrial standards.

Fig. 1 Schematic diagram of the 100G OADM



2.0 RELIABILITY TESTS AND SAMPLE PREPARATION

The reliability tests, conditions, durations, sample sizes and qualification results are summarized in Table 1. The test equipment and locations are summarized in Table 2. The sample group description and manufacture dates are summarized in Table 3.

Table 1 Reliability Test Result Summaries

Test	Reference	Condition (CO, LTPD 20%) / Duration	Sample Size	Pass / Fail
High Temperature Storage (Damp Heat)	Telcordia GR-1221-CORE, 6.2.5	• Temp: 85 °C (±2 °C) • Humidity: 85%RH (±5%) • Duration Time: 500 hrs for pass/fail criteria, 2000 hrs for information	11	11
Temperature Cycling	Telcordia GR-1221-CORE, 6.2.7	• Temp : -40 °C to 85 °C • Rate: 3 °C/min. • Duration Time: 100 cycles for pass/fail criteria, 500 cycles for info.	11	11
Vibration	Telcordia GR-1221-CORE, 6.2.2	• Type: Sinusoidal • Acceleration Level: 20G • Frequency Range: 20 to 2000 Hz • Duration : 4 min./cycles • 4 cycles/axis	11	11
Impact	Telcordia GR-1221-CORE, 6.2.1	• No. of Shock: 5 times per direction for 6 directions (on 3 axes) • Shock Level: 500G • Duration: 1 ms	11	11
Fiber Retention	Telcordia GR-1209-CORE 5.4.3.4	0.45kg, 5 seconds, 3 X	11	11
Side Pull	Telcordia GR-1209-CORE 5.4.3.3	0.23kg, 5 seconds, 2 dir.	11	11

Low Temperature Storage	Telcordia GR-1221-CORE, 6.2.6	• Temp : -40 °C (±2 °C) • RH uncontrolled • Duration Time: 2000 hrs	11	11
High Temperature Storage (Dry Heat)	Telcordia GR-1221-CORE, 6.2.4	• Temp: 85 °C (±2 °C), • Humidity < 40% RH • Duration Time: 2000 hrs	11	11
High Power	TIA-455-229	• Temperature: 75 ℃ • Humidity: N/A • Power: 2.0W • Test Time: 500hr	8	8

Table 2 Reliability Test Equipment and Locations

Test	Equipment	MFGR	Equipment Model	Test Place
Impact	Shock Tester Test Partner Software VER. 2	AVCO Lansmont Corporation	Vs-400.1.5	
Vibration	Electric Magnetic Vibration Machine	IMV	SM-105-MP	
High Temp. (Dry Heat) Storage	Oven	Chuanhua Percision Corp.	RHD-45	
High Temp. (Damp Heat) Storage	Temperature Humidity Chamber	Thermotron	SE-600-3-3	
Low Temp. Storage	Freezer Chamber	Ultra-Low Technology of GS laboratory Equipment	Legaci™	
Temperature Cycling	Temperature Cycling Chamber	Thermotron	S-16	
High Power	1480nm high power laser source. Hot plate	Telecom	RL5-1480	
Fiber Integrity Cable Retention & Side Pull	Tailor Made Mixture & Capstan	Oplink	N/A	

Table 3 Sample Group Description and Manufacture Date

Group	Reliability Test	Manufacturing Date
Z495	• High Temperature Storage (Damp Heat)	Jan.2007
Z496	• Temperature Cycling	Jan.2007
Z491	• High Temp. (Dry Heat) Storage • High Power	Jan.2007
Z490	• Low Temp. Storage • Fiber Retention • Side Pull • Vibration • Impact	Jan.2007

3.0 PRODUCT SPEC AND PASS/FAIL CRITERIA

An insertion loss change of ≤ ±0.5 dB is used according to the recommendation in Telcordia GR-1221-CORE. Other criteria used are that PDL and so on should meet Oplink's product specification. Table 4 is the product spec. Table 5 summarizes the pass/fail criteria.

Table 4 Product Spec

Item	Parameters	Note	Min	Typical	Max	Unit
1.	Pass Channel Wavelength	1591+/-6.5				nm
2.	Reflection Channel Wavelength	1310+/-50 1490+/-10				nm
3	IL C-P				1.0	
4	IL C-R				0.6	
5.	Polarization Dependent Loss (PDL)				0.15	dB
6	Isolation C-T		40			
7.	Isolation C-R@1550nm		15			dB
8	Return Loss		50			dB
9	Directivity		50			dB
10	Operating Temperature		0		75	
11.	Storage Temperature		-40		85	℃

Table 5 Pass/Fail Criteria

Wavelength: 1550nm(Pass channel),1310nm&1490nm(Reflect channel), 23℃

Parameters	Maximum/Minimum Allowable Value

Central Wavelength Insertion Loss Change (dB) (Pass Channel& Reflect Channel)		|ΔIL| ≤ 0.50
Polarization Dependent Loss (dB) (Pass Channel& Reflect Channel)		≤ 0.15
Isolation (dB)	Pass Channel @ 1310nm&1490nm)	≥ 40
	Reflect Channel @ 1550nm	≥ 15
Return Loss (dB) (Common Port) @1550nm ,1310nm&1490nm		≥ 50

4.0 TEST RESULT AND CONCLUSION

All results shown that APOD HWDM passed Telcordia tests (GR-1221-CORE, GR-1209-CORE and TIA-455-229) and met the criteria defined in Table 5. Detailed test results are provided in Fig. 2 through Fib. 10.

High Temp. (Damp Heat) Storage Test Result

Figure 2a Insertion Loss Change 1-2 (1591nm) ≤ ±0.50 dB

Figure 2b Insertion Loss Change1-3 (1490nm) ≤ ±0.50 dB

Figure 2c Insertion Loss Change1-3 (1310nm) ≤ ±0.50 dB

Figure 2d Polarization Dependent Loss 1-2 (1591nm) ≤ ± 0.15 dB

Figure 2e	Polarization Dependent Loss 1-3 (1490nm) ≤ ± 0.15 dB
Figure 2f	Polarization Dependent Loss 1-3 (1310nm) ≤ ± 0.15 dB
Figure 2g	Return Loss 1-1 (1490nm) ≥ 50 dB
Figure 2h	Return Loss 1-1 (1310nm) ≥ 50 dB
Figure 2i	Return Loss 1-1 (1591nm) ≥ 50 dB
Figure 2j	Isolation 1-2 (1490nm) ≥ 40 dB
Figure 2k	Isolation 1-2 (1310nm) ≥ 40 dB
Figure 2l	Isolation 1-3 (1550nm) ≥ 15 dB

Temperature Cycle Storage Test Result

Figure 3a	Insertion Loss Change 1-2 (1591nm) ≤ ±0.50 dB
Figure 3b	Insertion Loss Change1-3 (1490nm) ≤ ±0.50 dB
Figure 3c	Insertion Loss Change1-3 (1310nm) ≤ ±0.50 dB
Figure 3d	Polarization Dependent Loss 1-2 (1591nm) ≤ ± 0.15 dB

Figure 3e	Polarization Dependent Loss 1-3 (1490nm) ≤ ± 0.15 dB
Figure 3f	Polarization Dependent Loss 1-3 (1310nm) ≤ ± 0.15 dB
Figure 3g	Return Loss 1-1 (1490nm) ≥ 50 dB
Figure 3h	Return Loss 1-1 (1310nm) ≥ 50 dB
Figure 3i	Return Loss 1-1 (1591nm) ≥ 50 dB
Figure 3j	Isolation 1-2 (1490nm) ≥ 40 dB
Figure 3k	Isolation 1-2 (1310nm) ≥ 40 dB
Figure 3l	Isolation 1-3 (1550nm) ≥ 15 dB

Vibration Storage Test Result

Figure 4a	Insertion Loss Change 1-2 (1591nm) ≤ ±0.50 dB
Figure 4b	Insertion Loss Change1-3 (1490nm) ≤ ±0.50 dB
Figure 4c	Insertion Loss Change1-3 (1310nm) ≤ ±0.50 dB
Figure 4d	Polarization Dependent Loss 1-2 (1591nm) ≤ ± 0.15 dB

Figure 4e	Polarization Dependent Loss 1-3 (1490nm) ≤ ± 0.15 dB
Figure 4f	Polarization Dependent Loss 1-3 (1310nm) ≤ ± 0.15 dB
Figure 4g	Return Loss 1-1 (1490nm) ≥ 50 dB
Figure 4h	Return Loss 1-1 (1310nm) ≥ 50 dB
Figure 4i	Return Loss 1-1 (1591nm) ≥ 50 dB
Figure 4j	Isolation 1-2 (1490nm) ≥ 40 dB
Figure 4k	Isolation 1-2 (1310nm) ≥ 40 dB
Figure 4l	Isolation 1-3 (1550nm) ≥ 15 dB

Impact Storage Test Result

Figure 5a	Insertion Loss Change 1-2 (1591nm) ≤ ±0.50 dB
Figure 5b	Insertion Loss Change1-3 (1490nm) ≤ ±0.50 dB
Figure 5c	Insertion Loss Change1-3 (1310nm) ≤ ±0.50 dB
Figure 5d	Polarization Dependent Loss 1-2 (1591nm) ≤ ± 0.15 dB

Figure 5e	Polarization Dependent Loss 1-3 (1490nm) ≤ ± 0.15 dB
Figure 5f	Polarization Dependent Loss 1-3 (1310nm) ≤ ± 0.15 dB
Figure 5g	Return Loss 1-1 (1490nm) ≥ 50 dB
Figure 5h	Return Loss 1-1 (1310nm) ≥ 50 dB
Figure 5i	Return Loss 1-1 (1591nm) ≥ 50 dB
Figure 5j	Isolation 1-2 (1490nm) ≥ 40 dB
Figure 5k	Isolation 1-2 (1310nm) ≥ 40 dB
Figure 5l	Isolation 1-3 (1550nm) ≥ 15 dB

Fiber Pull Test Result

Figure 6a	Insertion Loss Change 1-2 (1591nm) ≤ ±0.50 dB
Figure 6b	Insertion Loss Change1-3 (1490nm) ≤ ±0.50 dB
Figure 6c	Insertion Loss Change1-3 (1310nm) ≤ ±0.50 dB
Figure 6d	Polarization Dependent Loss 1-2 (1591nm) ≤ ± 0.15 dB

Figure 6e	Polarization Dependent Loss 1-3 (1490nm) ≤ ± 0.15 dB
Figure 6f	Polarization Dependent Loss 1-3 (1310nm) ≤ ± 0.15 dB
Figure 6g	Return Loss 1-1 (1490nm) ≥ 50 dB
Figure 6h	Return Loss 1-1 (1310nm) ≥ 50 dB
Figure 6i	Return Loss 1-1 (1591nm) ≥ 50 dB
Figure 6j	Isolation 1-2 (1490nm) ≥ 40 dB
Figure 6k	Isolation 1-2 (1310nm) ≥ 40 dB
Figure 6l	Isolation 1-3 (1550nm) ≥ 15 dB

Side Pull Test Result

Figure 7a	Insertion Loss Change 1-2 (1591nm) ≤ ±0.50 dB
Figure 7b	Insertion Loss Change1-3 (1490nm) ≤ ±0.50 dB
Figure 7c	Insertion Loss Change1-3 (1310nm) ≤ ±0.50 dB
Figure 7d	Polarization Dependent Loss 1-2 (1591nm) ≤ ± 0.15 dB

Figure 7e	Polarization Dependent Loss 1-3 (1490nm) ≤ ± 0.15 dB
Figure 7f	Polarization Dependent Loss 1-3 (1310nm) ≤ ± 0.15 dB
Figure 7g	Return Loss 1-1 (1490nm) ≥ 50 dB
Figure 7h	Return Loss 1-1 (1310nm) ≥ 50 dB
Figure 7i	Return Loss 1-1 (1591nm) ≥ 50 dB
Figure 7j	Isolation 1-2 (1490nm) ≥ 40 dB
Figure 7k	Isolation 1-2 (1310nm) ≥ 40 dB
Figure 7l	Isolation 1-3 (1550nm) ≥ 15 dB

Low Temperature Test Result

Figure 8a	Insertion Loss Change 1-2 (1591nm) ≤ ±0.50 dB
Figure 8b	Insertion Loss Change1-3 (1490nm) ≤ ±0.50 dB
Figure 8c	Insertion Loss Change1-3 (1310nm) ≤ ±0.50 dB
Figure 8d	Polarization Dependent Loss 1-2 (1591nm) ≤ ± 0.15 dB

Figure 8e	Polarization Dependent Loss 1-3 (1490nm) ≤ ± 0.15 dB
Figure 8f	Polarization Dependent Loss 1-3 (1310nm) ≤ ± 0.15 dB
Figure 8g	Return Loss 1-1 (1490nm) ≥ 50 dB
Figure 8h	Return Loss 1-1 (1310nm) ≥ 50 dB
Figure 8i	Return Loss 1-1 (1591nm) ≥ 50 dB
Figure 8j	Isolation 1-2 (1490nm) ≥ 40 dB
Figure 8k	Isolation 1-2 (1310nm) ≥ 40 dB
Figure 8l	Isolation 1-3 (1550nm) ≥ 15 dB

Dry Heat Test Result

Figure 9a Insertion Loss Change 1-2 (1591nm) ≤ ±0.50 dB

Figure 9b Insertion Loss Change1-3 (1490nm) ≤ ±0.50 dB

Figure 9c Insertion Loss Change1-3 (1310nm) ≤ ±0.50 dB

Figure 9d Polarization Dependent Loss 1-2 (1591nm) ≤ ± 0.15 dB

Figure 9e	Polarization Dependent Loss 1-3 (1490nm) ≤ ± 0.15 dB
Figure 9f	Polarization Dependent Loss 1-3 (1310nm) ≤ ± 0.15 dB
Figure 9g	Return Loss 1-1 (1490nm) ≥ 50 dB
Figure 9h	Return Loss 1-1 (1310nm) ≥ 50 dB
Figure 9i	Return Loss 1-1 (1591nm) ≥ 50 dB
Figure 9j	Isolation 1-2 (1490nm) ≥ 40 dB
Figure 9k	Isolation 1-2 (1310nm) ≥ 40 dB
Figure 9l	Isolation 1-3 (1550nm) ≥ 15 dB

High Power Test Result

Figure 10a	Insertion Loss Change 1-2 (1591nm) ≤ ±0.50 dB
Figure 10b	Insertion Loss Change1-3 (1490nm) ≤ ±0.50 dB
Figure 10c	Insertion Loss Change1-3 (1310nm) ≤ ±0.50 dB
Figure 10d	Polarization Dependent Loss 1-2 (1591nm) ≤ ± 0.15 dB

Figure 10e Polarization Dependent Loss 1-3 (1490nm) ≤ ± 0.15 dB

Figure 10f Polarization Dependent Loss 1-3 (1310nm) ≤ ± 0.15 dB

Figure 10g Return Loss 1-1 (1490nm) ≥ 50 dB

Figure 10h Return Loss 1-1 (1310nm) ≥ 50 dB

Figure 10i Return Loss 1-1 (1591nm) ≥ 50 dB

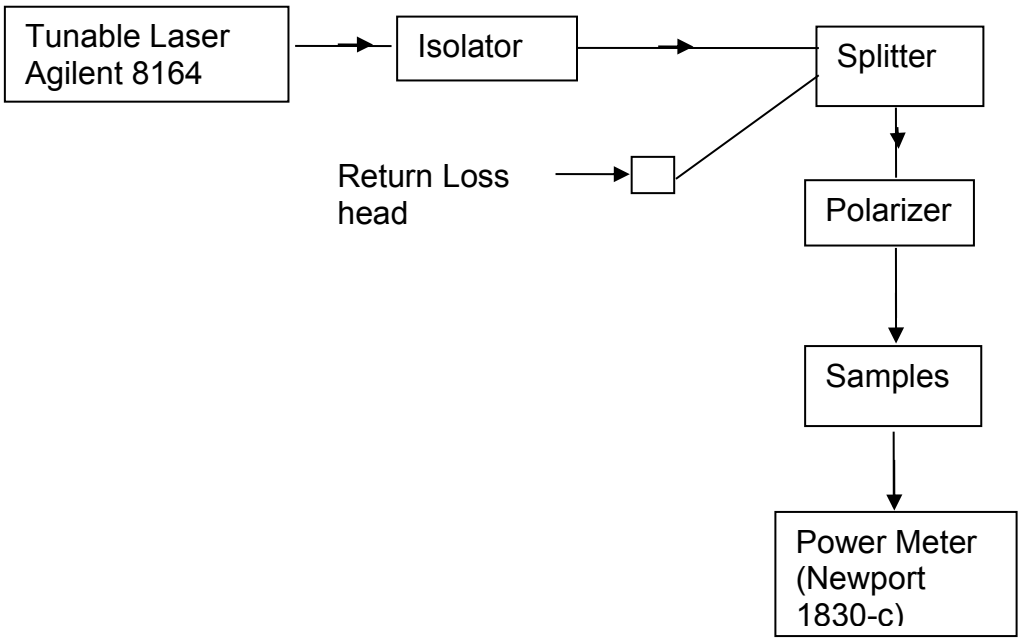
Figure 10j Isolation 1-2 (1490nm) ≥ 40 dB

Figure 10k Isolation 1-2 (1310nm) ≥ 40 dB

Figure 10l Isolation 1-3 (1550nm) ≥ 15 dB

Appendix: Test Setup

The test setup for measuring the performance values is shown below (test at 23 °C)



The test setup for high power is shown below:

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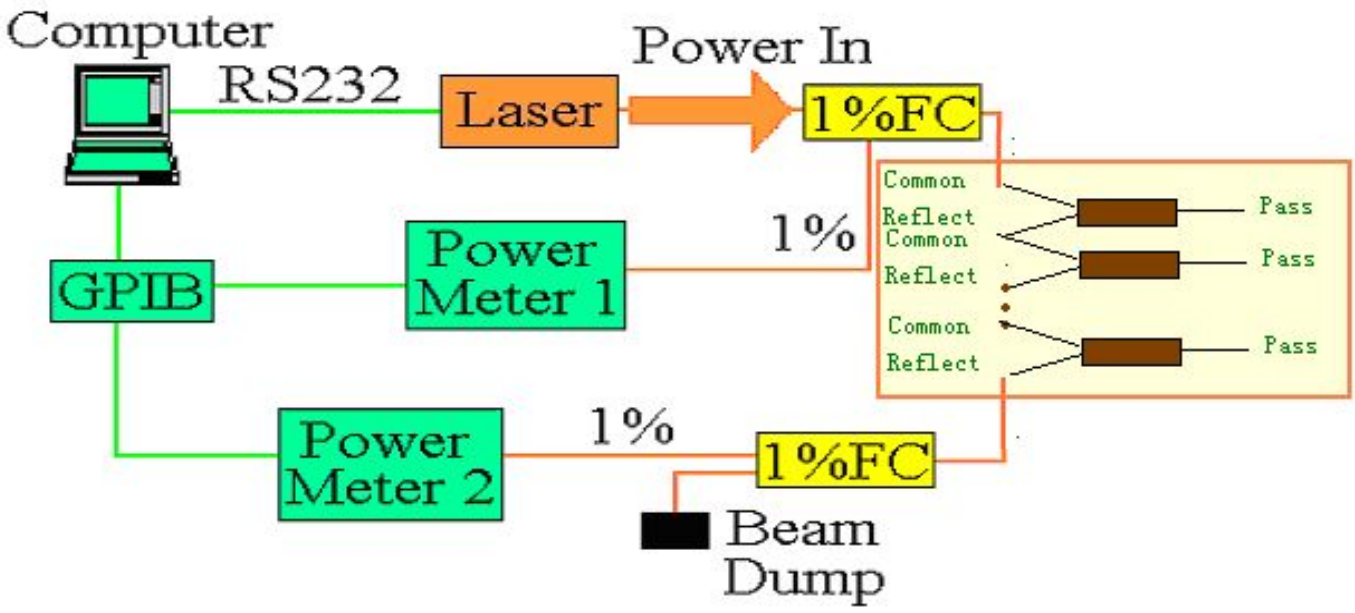

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