Optoplex™ CORPORATION

Product Specification and User Manual

--- Optical Spectral Analyzer ---

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1. Introduction

1.1 Introduction

Optoplex's near-infrared optical spectrum analyzer module (NIR OSA) is a high performance optical spectral engine for Process Analytical Technology (PAT) and Fiber Optic Test Equipment (FOTE) applications. Based on proprietary MEMS and micro-optic technologies, Optoplex's OSA module offers higher spectral resolution than those available in the market, which is demanding in today's increasing spectroscopy applications. Moreover, the MEMS tunable filter provides high-speed tuning that is highly demanded in many applications. Full range scanning is less than 1 sec for our standard C, L, C+L and O-band OSA and less than 2 sec for our full-band OSA.

Other features include: compact, light-weight, low power consumption and wide wavelength coverage. With a dimension of 112 x 68 x12 mm, Optoplex's compact OSA modules are suitable for a variety of handheld, portable, bench-top and inline OSA/spectrometer applications.
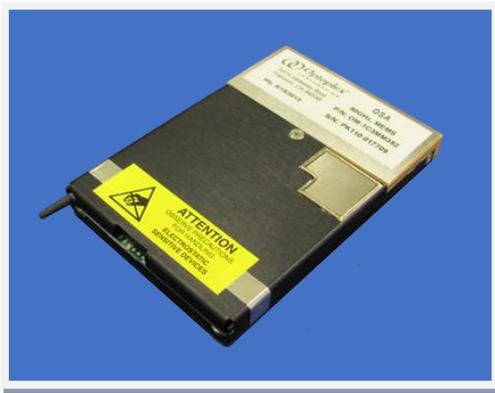
Applications

- Optical spectral analyzing
- Analytical spectroscopic instrumentation
- Optical testing in optical communications
- Optical channel/performance monitoring (OPM)
- Portable OSA in T&M and field test
- Biomedical optics, i.e., OCT imaging
- Fiber sensing
- Portable OSA in defense /military applications

Key Features and Benefits

- Super spectral measurement performance
  - Extraordinary spectral resolution, and
  - High wavelength accuracy
- High power sensitivity
- High power accuracy
- Compact size, light weight
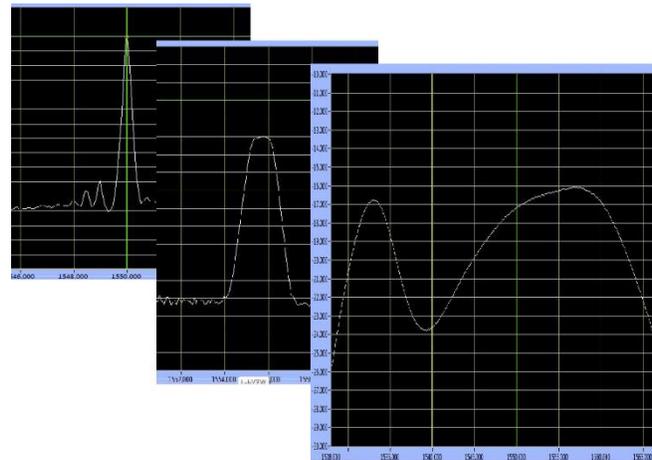
1.2. Models

Table 1.1, List of Optoplex MEMS-based OSA OEM Modules

#	Product	Part Number	Wavelength Range	Remarks
1	C-Band OSA, Std.	OM-1C2MM353	1527 ~ 1567nm	
2	C+L Band OSA, Std.	OM-2T2MM301	1521 ~ 1611nm	
3	C+L Band OSA, Extended Range	OM-2T2MM301E	1500 ~ 1610nm	
4	O-Band OSA, Std.	OM-2O2MM302	1260 ~ 1360nm	
5	O-Band OSA, Extended Range	OM-2O2MM302E	1260 ~ 1380nm	
6	O-Band OSA, High SMSR	OM-2O2MM312	1260 ~ 1360nm	SMSR > 50dB, Typ. >55dB
7	E-U Band OSA, Std.	OM-2EUFM306	1400 ~ 1700nm	
8	1064nm OSA, Std.	OM-2A2MM307	1000 ~ 1100nm	
9	Full-Band OSA, Std.	OM-2AFOE304	1250 ~ 1650nm	

Notes:

1. For all above OSAs, the module size, electrical interface, the communication protocol are same. Refer to Sections 5 and 6 in this document.

2. The difference of each pat number is the Optical Performance. Refer to Section 2.

3. Customer has the choice to select the type of the optical connector. By default it is FC/APC. Others available: FC/UPC, LC/APC, and LC/UPC. Just indicate the type of the connector when ordering. Contact Optoplex if you need special connector.

4. There is an evaluation kit as an Optional offer (at additional cost) which includes a UART/USB cable and a Labview-based Software for Window-PC. The evaluation kit is same for all above models (part numbers) of the OSAs. Refer to Section-8 "Ordering Information".

2. Optical Performance Specifications

2.1 C-Band OSA, Standard, P/N: OM-1C2MM353

Table 2.1, Standard C-Band OSA Performance Specification

Parameter	Unit	Spec	Note
Wavelength Range	nm	1527 – 1567	C band
Maximum Input Power	dBm	10	From all spectrum
Input Power Range[1]	dBm	-50 ~10	Single channel
Absolute Channel Power Accuracy[1]	dB	± 0.5	Do not include PDL
Relative Power Accuracy[1]	dB	± 0.4	Do not include PDL
Power Measurement Repeatability	dB	± 0.1	For fixed polarization
PDL	dB	< 0.3	
Absolute Wavelength Accuracy[1]	pm	± 50	
Wavelength Repeatability	pm	± 10	
Wavelength Resolution	nm	0.2 (0.16 typical)	FWHM[2]
Wavelength Readout	pm	1	
Optical Power Rejection Ratio	dB	> 25	Offset 50 GHz, away from signal bandwidth
		> 40	Offset 200 GHz, away from the signal bandwidth
Noise Floor	dBm	−55	Electronics
Response Time	s	2~3	Power, wavelength, and raw data at 1 GHz step size
Power Consumption	W	< 2.5	See Section 4.2

Notes:
1. Specs guarantee only from −40 ~ −10 dBm.
2. Wavelength Resolution (nm) describes the minimum resolvable wavelength separation between any two nearby spectral features. It is characterized by Full Width at Half Maximum (FWHM). In OSA, due to the dependence of FWHM on wavelength, the worst case value (i.e., maximum FWHM across all channels) is used to specify the wavelength resolution.

2.2 C+L Band OSA, Standard, P/N: OM-2T2MM301

Table 2.2, Standard C+L Band OSA Performance Specification

Parameter	Unit	Spec	Note
Wavelength Range	nm	1521 – 1611	C+L-band
Maximum Input Power	dBm	10	From all spectrum
Input Power Range[1]	dBm	-50 ~10	Single channel
Absolute Channel Power Accuracy[1]	dB	± 0.5	Do not include PDL
Relative Power Accuracy[1]	dB	± 0.4	Do not include PDL
Power Measurement Repeatability	dB	± 0.1	For fixed polarization
PDL	dB	< 0.3	
Absolute Wavelength Accuracy[1]	pm	± 50	
Wavelength Repeatability	pm	± 10	
Wavelength Resolution	nm	0.4 (0.32 typical)	FWHM[2]
Wavelength Readout	pm	1	
Optical Power Rejection Ratio	dB	> 25	Offset 100 GHz, away from signal bandwidth
		> 40	Offset 400 GHz, away from the signal bandwidth
Noise Floor	dBm	−55	Electronics
Response Time	s	2~3	Power, wavelength, and raw data at 2 GHz step size
Power Consumption	W	< 2.5	See Section 4.2

Notes:
3. Specs guarantee only from −40 ~ −10 dBm.
4. Wavelength Resolution (nm) describes the minimum resolvable wavelength separation between any two nearby spectral features. It is characterized by Full Width at Half Maximum (FWHM). In OSA, due to the dependence of FWHM on wavelength, the worst case value (i.e., maximum FWHM across all channels) is used to specify the wavelength resolution.

2.3 Extended C+L Band OSA, P/N: OM-2T2MM301E

Table 2.3, Extended C+L Band OSA Performance Specification

Parameter	Unit	Spec	Note
Wavelength Range	nm	1500 – 1610	Extended C+L-band
Maximum Input Power	dBm	10	From all spectrum
Input Power Range[1]	dBm	-50 ~10	Single channel
Absolute Channel Power Accuracy[1]	dB	± 0.5	Do not include PDL
Relative Power Accuracy[1]	dB	± 0.4	Do not include PDL
Power Measurement Repeatability	dB	± 0.1	For fixed polarization
PDL	dB	< 0.3	
Absolute Wavelength Accuracy[1]	pm	± 50	
Wavelength Repeatability	pm	± 10	
Wavelength Resolution	nm	~ 0.4	FWHM[2], typical
Wavelength Readout	pm	1	
Optical Power Rejection Ratio	dB	> 25	Offset 100 GHz, away from signal bandwidth
		> 40	Offset 400 GHz, away from the signal bandwidth
Noise Floor	dBm	−55	Electronics
Response Time	s	2~3	Power, wavelength, and raw data at 2 GHz step size
Power Consumption	W	< 2.5	See Section 4.2

2.4 Standard O- Band OSA, P/N: OM-2O2MM302

Table 2.4, Standard O-Band OSA Performance Specification

Parameter	Unit	Min	Typ.	Max	Note
Wavelength Range	nm		1260 – 1360		O-band
Bandwidth	nm		0.18		@1dB
	nm		0.31		@3dB
	nm		0.79		@20dB
Maximum Input Power	dBm			10	From all spectrum
Input Power Range[1]	dBm	-50		15	Single channel
Absolute Channel Power Accuracy[1]	dB		± 0.5		Do not include PDL
Relative Power Accuracy[1]	dB		± 0.4		Do not include PDL
Power Measurement Repeatability	dB		± 0.1		For fixed polarization
PDL	dB			0.3	
Absolute Wavelength Accuracy[1]	pm		± 50		
Wavelength Repeatability	pm		± 10		
Wavelength Resolution	nm		0.36	0.4	FWHM[2]
Wavelength Readout	pm		1		
Optical Power Rejection Ratio	dB		6		@±25GHz (±0.2nm)
			24		@±50GHz (±0.4nm)
			45		@±75GHz (±0.6nm)
Noise Floor	dBm		−55		Electronics
Response Time	sec	2		3	Power, wavelength, and raw data at 2 GHz step size
Power Consumption	W			2.5	See Section 4.2

2.5 Extended O- Band OSA, P/N: OM-2O2MM302E

Table 2.5, Extended O-Band OSA Performance Specification

Parameter	Unit	Min	Typ.	Max	Note
Wavelength Range	nm		1260 – 1380		Extended O-band
Bandwidth	nm		0.22		@1dB
	nm		0.39		@3dB
	nm		0.99		@20dB
Maximum Input Power	dBm			10	From all spectrum
Input Power Range[1]	dBm	-50		15	Single channel
Absolute Channel Power Accuracy[1]	dB		± 0.5		Do not include PDL
Relative Power Accuracy[1]	dB		± 0.4		Do not include PDL
Power Measurement Repeatability	dB		± 0.1		For fixed polarization
PDL	dB			0.3	
Absolute Wavelength Accuracy[1]	pm		± 50		
Wavelength Repeatability	pm		± 10		
Wavelength Resolution	nm		0.36	0.4	FWHM[2]
Wavelength Readout	pm		1		
Optical Power Rejection Ratio	dB				
			20		@±50GHz (±0.4nm)
			40		@±75GHz (±0.6nm)
Noise Floor	dBm		−55		Electronics
Response Time	sec	2		3	Power, wavelength, and raw data at 2 GHz step size
Power Consumption	W			2.5	See Section 4.2

2.6 High SMSR O-Band OSA, P/N: OM-2Q2MM312

Table 2.6, High SMSR O-Band OSA Performance Specification

Parameter	Unit	Min	Typ.	Max	Note
Wavelength Range	nm		1260 – 1360		O-Band
FWHM (-3dB BW)	nm		0.45		@3dB
Maximum Input Power	dBm			10	From all spectrum
Input Power Range[1]	dBm	-50		10	Single channel
Absolute Channel Power Accuracy[1]	dB		± 0.5		Do not include PDL
Relative Power Accuracy[1]	dB		± 0.4		Do not include PDL
Power Measurement Repeatability	dB		± 0.1		For fixed polarization
PDL	dB			0.3	
Absolute Wavelength Accuracy[1]	pm		± 50		
Wavelength Repeatability	pm		± 10		
Wavelength Resolution	nm		0.36	0.4	FWHM[2]
Wavelength Readout	pm		1		
Side-Mode-Suppression Ratio	dB		> 50		Typical, >55
Noise Floor	dBm		~ −65		Electronics
Response Time	sec	2		3	Power, wavelength, and raw data at 2 GHz step size
Power Consumption	W			2.5	See Section 4.2

2.7 1400~1700nm OSA, P/N: OM-2EUFM306

Table 2.7, 1400~1700nm OSA Performance Specification

Parameter	Unit	Spec	Note
Wavelength Range	nm	1400 ~ 1700	E ~ U Band
Maximum Input Power	dBm	10	All channels
Input Power Range[1]	dBm	-50 ~10	Single channel
Absolute Channel Power Accuracy[1]	dB	± 0.5	Excluding PDL
Relative Power Accuracy[1]	dB	± 0.4	Excluding PDL
Power Measurement Repeatability	dB	± 0.1	For fixed polarization
PDL	dB	< 0.3	
Absolute Wavelength Accuracy[1]	pm	± 50	
Wavelength Repeatability	pm	± 10	
Wavelength Resolution	nm	0.5	OSA's FWHM[2]
Wavelength Readout	pm	1	
Optical Power Rejection Ratio	dB	> 25	0.5nm from signal's center frequency
		> 40	1.0nm from signal's center frequency
Noise Floor	dBm	−55	Electronics noise baseline
Response Time	s	2 ~ 3	Power, wavelength, and raw data at 1 GHz step size
Power Consumption	W	< 2.5	

2.8 1064nm OSA, P/N: OM-2A2MM307

Table 2.8, 1064nm OSA Performance Specification

Parameter	Unit	Spec	Note
Wavelength Range	*nm*	1000 – 1100	
Maximum Input Power	*dBm*	10	From all spectrum
Input Power Range[1]	*dBm*	-50 ~10	Single channel
Absolute Channel Power Accuracy[1]	*dB*	± 0.5	Do not include PDL
Relative Power Accuracy[1]	*dB*	± 0.4	Do not include PDL
Power Measurement Repeatability	*dB*	± 0.1	For fixed polarization
PDL	*dB*	< 0.3	
Absolute Wavelength Accuracy[1]	*pm*	± 50	
Wavelength Repeatability	*pm*	± 10	
Wavelength Resolution	*nm*	0.2	FWHM[2]
Wavelength Readout	*pm*	1	
Optical Power Rejection Ratio	*dB*	> 25	Offset 100 GHz, away from signal bandwidth
		> 40	Offset 400 GHz, away from the signal bandwidth
Noise Floor	*dBm*	−55	Electronics
Response Time	*s*	2~3	Power, wavelength, and raw data at 2 GHz step size
Power Consumption	*W*	< 2.5	See Section 5.2

2.9 Full-Band (1250~1650nm) OSA, P/N: OM-2AFOE304

Table 2.8, 1064nm OSA Performance Specification

Parameter	Unit	Spec	Note
Wavelength Range	nm	1250 – 1650	Full-band
Maximum Input Power	dBm	10	Total power
Input Power Range	dBm	-50 ~ 10	Single channel
Absolute Channel Power Accuracy[1]	dB	± 1.0	Do not include PDL
Relative Power Accuracy[1]	dB	± 0.75	Do not include PDL
Power Measurement Repeatability	dB	± 0.1	For fixed polarization
PDL	dB	< 0.5	
Absolute Wavelength Accuracy[1]	nm	± 0.5	
Wavelength Repeatability	nm	± 0.1	
Wavelength Resolution	nm	4 (3.5 typical)	FWHM[2]
Wavelength Readout	pm	10	
Optical Power Rejection Ratio	dB	> 25	Bandwidth TBD
		> 40	Bandwidth TBD
Noise Floor	dBm	−55	Electronics
Response Time	s	2~3	Power, wavelength, and raw data at 20 GHz step size
Power Consumption	W	< 2.5	See Section 5.2

3. Environmental Conditions
3.1 Absolute Maximum Ratings

Table 3.1 Absolute Maximum Ratings

No	Parameter	Symbol	Unit	Conditions	Ratings		Notes
					Min	Max	
3.1.1	Input Optical Power	P_{in_Max}	mW		-	300	
3.1.2	Operating Temperature	T_c	^oC		-5	+70	
3.1.3	Operating Humidity	-	%RH	T_c = +65°C, Non-condensing	5	85	
3.1.4	Storage Temperature	T_{stg}	^oC		-40	+85	
3.1.5	Storage Humidity	-	%RH	T_c = +85°C, Non-condensing	5	85	

3.2 Operating Conditions

Table 3.2 Operating Conditions

No	Parameter	Symbol	Unit	Conditions	Ratings			Notes
					Min	Typ.	Max	
3.2.1	Input Optical Power	P_{in_Max}	mW		-		300	
3.2.2	Operating Temperature	T_c	^oC		-5		+65	
3.2.3	Operating Humidity, Relative, 40°C non-condensing	-	%RH		5		85	
3.2.4	Storage Temperature	T_{stg}	^oC		-40		+85	
3.2.5	Storage Humidity	-	%RH		5		85	

4. Mechanical Specification

4.1 Module Size

Table 4.1 Module Dimension

	Unit	Specification	Note
Module Dimension (L x W x H)	*mm*	112 x 68 x 12.0	

4.2 Mechanical Drawings

In this section, the mechanical drawings show the dimensions, positions of mounting holes, locations of electrical connector and input fiber port.
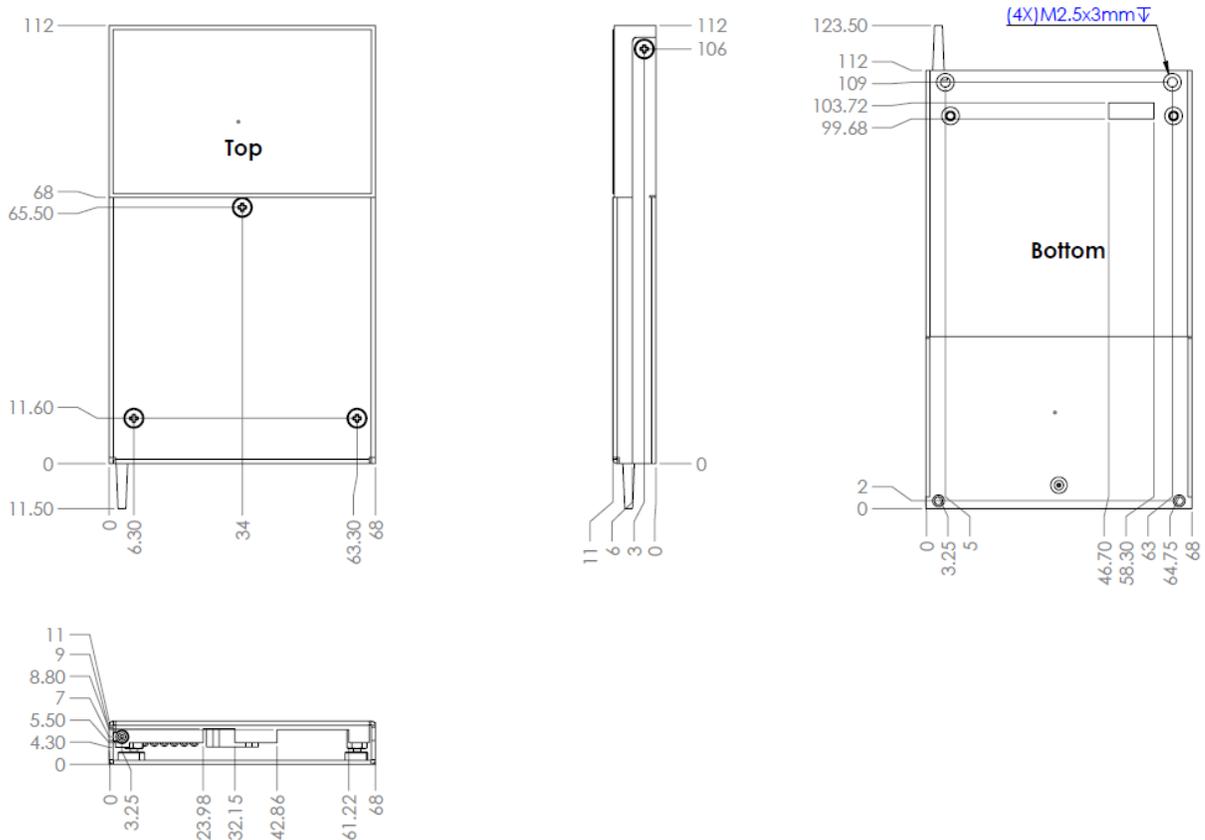
Figure 4.1: Mechanical drawings of OSA
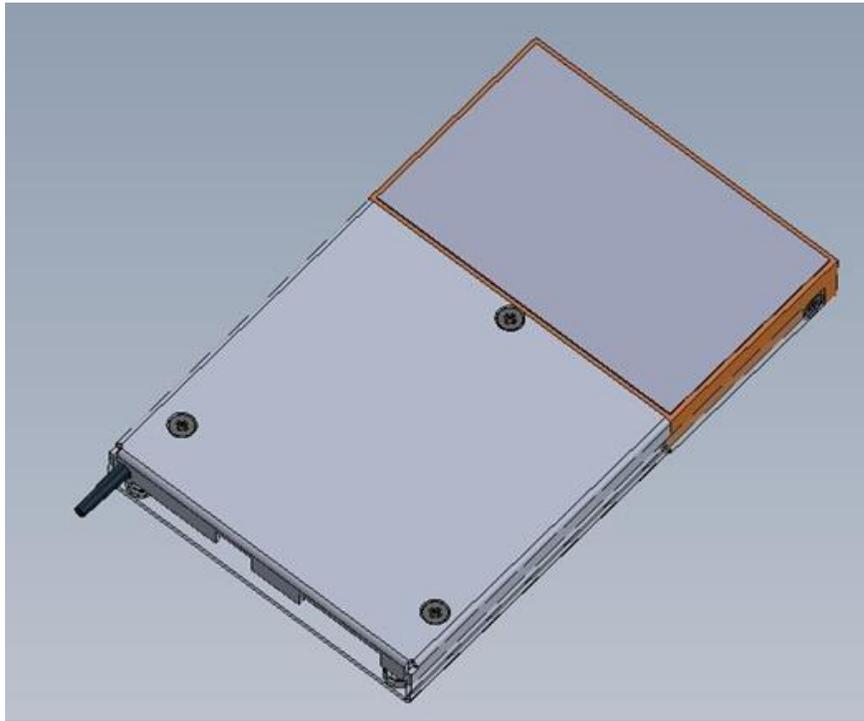
Figure 4.2: 3D drawing of the OSA

4.3 Fiber and Optical Connector

Table 4.2, Fiber and Connector

Item	Unit	Specification	Note
Type of Fiber	*mm*	SMF-28e+ or equivalent	With 900um tight buffer
Length of Fiber	*m*	1.0 +/- 0.1	
Type of Connector	/	FC/APC	default

Note:
Other types of connectors available: FC/UPC, LC/APC, LC/UPC, SC/UPC.

5. OSA Electrical Specifications

5.1 Electrical Configuration

The PC sends UART commands to the OSA, and receives data from it. The data are formatted according to the two UART interface protocols as detailed in Section 6.

5.2 Power Supply

OSA will accept 5V DC Power supply. Table 5.1 lists their specifications.

Table 5.1: Voltage and maximum current specifications for power supplies

Voltage Supply	+5.0 VDC
Typical Current	0.24 A
Maximum Current	0.4 A
Tolerance	± 10%

5.3 Electrical Connectors and Pin Assignment

UART connectors are:
    Pin header on OSA: HRS DF3A-8P-2DS
    Crimping socket for cable: HRS DF3-8S-2C plus DF3-2428SCC

8-pin UART pin header on OSA:
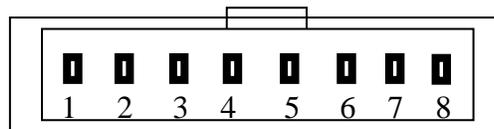
Figure 5.1: UART Connector Pin Assignment

Table 5.2: Connector Pin Assignment

Pin Number	Pin Definition
1	/Reset
2	+5V VCC
3	Device Rx (LVTTL)
4	Device Tx (LVTTL)
5	Ground
6	Trigger out
7	Trigger in
8	Ground

6. UART Communication Protocol

6.1 Requirements

Communication Signal Level: **LVTTL**

Table 6.1-1: Logic Voltage Level

Symbol	Parameter	Condition	Minimum	Maximum
V(IH)	High-level input voltage		1.7 V	4.1 V
V(IL)	Low-level input voltage		-0.5 V	0.7 V
V(OH)	High-level output voltage	I(OH) = -4 to –24mA	2.4 V	
V(OL)	Low-level output voltage	I(OL) = 4 to 24mA		0.45 V

(RS232 Line Driver Level PCB is Optional)

RS232 Port Setting:
      Baud Rate: 115200
      Data Bits: 8
      Parity: None
      Stop Bits: 1
      Flow Control: None

6.1.1 Message from Host to Device Format

The generic data stream from host to device should follow the format given in Table 6.1-2 to be a valid command.

Table 6.1-2: Host to device Message Format

	Field	Length
Header	Message ID	32 Bit
	Message Length	32 Bit
	Reserved	32 Bit
	Reserved	32 Bit
Payload	Data / Sub Command	32 Bit x N
Footer	Data Checksum	32 Bit
	Error Code	32 Bit
	Message Checksum	32 Bit

Message bit order should send MSB the first and LSB the last:

MSB			LSB

31   …
    24
	23 … 16	15 … 8	7 …
			            0

6.1.2 Message from Device to Host Format

After Device received the valid command, device will return the data stream as the format given in Table 6.1-3.

Table 6.1-3: Device to Host Message Format

	Field	**Length**
Header	Message ID	32 Bit
	Message Length	32 Bit
	Device Status	32 Bit
	Device Temperature	32 Bit
Payload	Data	32 Bit x N
Footer	Data Checksum	32 Bit
	Error Code	32 Bit
	Message Checksum	32 Bit

Table 6.1-4: Message bit order should send MSB the first and LSB the last:

MSB			LSB

31   …
    24
	23 …
	    16
		15 … 8	7 … 0

6.2 UART Command Sets

6.2.1 Command Sets
The available command set is listed in Table 6.2-1.

Table 6.2-1: Command set

	Command Definition	Message ID	Sub Command	Remark
1.a	Scan Spectrum: Report Detected Peak Powers and Peak Frequencies	0x00000003h	0x00000001h	
1.b	Scan Spectrum: Report Detected Peak Powers, Peak Frequencies, and Data Spectrum	0x00000003h	0x00000008h	
1.c	Scan Spectrum: Report Detected Peak Powers, Peak Frequencies, OSNR, and Data Spectrum.	0x00000003h	0x00000009h	Only valid for OSNR mode OPM
1.d	Report custom spectrum from frequency1 to frequency2	0x00000003h	x0000000Fh	
2	Firmware Download	0x00000010h		
3	Version Request	0x00000030h		
4	Device Reset	0x00000040h		

6.2.2 Scan Spectrum Commands

- Table 6.2-2 shows the valid data stream for commands 1.a, 1.b, and 1.c.

Parameter	Scan Optical Signal Command			
	Report Detected Peak Powers and Peak Frequencies	Report Detected Peak Powers, Peak Frequencies, and Data Spectrum	Report Detected Peak Powers, Peak Frequencies, OSNR, and Data Spectrum.	Report custom spectrum from frequency1 to frequency2
Message ID	0x00000003h	0x00000003h	0x00000003h	0x00000003h
Message Length	0x0000002Ch	0x0000002Ch	0x0000002Ch	0x0000002Ch

Reserved (always zero)	0x00000000h	0x00000000h	0x00000000h	0x00000000h
Reserved (always zero)	0x00000000h	0x00000000h	0x00000000h	0x00000000h
Sub-Command	0x00000001h	0x00000008h	0x00000009h	0x0000000Fh
Custom Freq Range	0x00000000h	0x00000000h	0x00000000h	0xaaaabbbbh
Data Spectrum Decimation Factor (N)	0x00000001h	0x00000001h	0x00000001h	0x00000001h
Reserved (always zero)	0x00000000h	0x00000000h	0x00000000h	0x00000000h
Data Checksum	0xFFFFFFFDh	0xFFFFFFF6h	0xFFFFFFF5h	0xFFFFFE41h
Reserved (always zero)	0x00000000h	0x00000000h	0x00000000h	0x00000000h
Message Checksum	0xFFFFFBD4h	0xFFFFFBD4h	0xFFFFFBD4h	0xFFFFFAD5h

Table 6.2-2: Scan Optical Spectrum Command

Message ID:
   0x00000003h: Initiate an OSA scan optical signal command. The Sub-Command will determine how the results are reported.

Message Length:
   Total number of command bytes from Message ID to Message Checksum.

Sub-Command:
   0x00000001h: Report Detected Peak Powers and Peak Frequencies
   0x00000008h: Report Detected Peak Powers, Peak Frequencies, and Data Spectrum
            0x00000009h: Report Detected Peak Powers, Peak Frequencies, OSNR, and Data Spectrum.
   0x0000000Fh: Report custom spectrum from frequency1 to frequency2
            For instance, from 186.80THz to 192.5THz:
            Frequency1 = (186.80 – 180.00) * 1000 = 6800 => 0x1A90h
            Frequency2 = (192.50 – 180.00) * 1000 = 12500 => 0x30D4h
            So that 0xaaaabbbbh => 0x1A9030D4h.

Data Spectrum Decimation Factor (N):
   The OSA will return every Nth spectral data point. When N =zero, OSA will transmit NO Data Spectrum. Peak Data are not affected by the value of N.
   When N = 1, OSA will transmit M data points at 2 GHz step size
   When N = 2, OSA will transmit M data points at 4 GHz step size

For example, original data points at 2 GHz step size are 5000. For N = 1, M = 5000. For N = 2, M = 2501 = 5000/2+1. For details of M, see Table 6.2-2.

Data Checksum:
1's complement of the 32bits unsigned integer cumulate of all bytes from Sub-Command to bytes before Data Checksum, NOT including Data Checksum itself.

Message Checksum:
1's complement of the 32bits unsigned integer cumulate of all bytes from Message ID to bytes before Message Checksum, NOT including Message Checksum itself.

- The device will respond the following data stream after the device received the valid command.

Table 6.2-3: OSA Response Format

Parameter	OSA Response Format			
	Report Detected Peak Powers and Peak Frequencies	Report Detected Peak Powers, Peak Frequencies, and Data Spectrum	Report Detected Peak Powers, Peak Frequencies, OSNR, and Data Spectrum.	Report custom spectrum from frequency1 to frequency2
Message ID	0x00000003h	0x00000003h	0x00000003h	0x00000003h
Message Length	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer
Reserved (always zero)	0x00000000h	0x00000000h	0x00000000h	0x00000000h
Temperature	32bits signed integer	32bits signed integer	32bits signed integer	32bits signed integer
Reserved (always zero)	0x00000000h	0x00000000h	0x00000000h	0x00000000h
Max Power of raw detected power data	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer	N/A
Frequency where Max Power is located	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer	N/A
Total number of channels found	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer	N/A

*Found peak optical power (Power and Freq in one 32bits for sub-command 0x00000001h and 0x00000008h)	High-16bits for power as signed integer Low-16bits for Freq as unsigned integer	High-16bits for power as signed integer Low-16bits for Freq as unsigned integer	32bits floating point	N/A
Found peak frequency	N/A	N/A	32bits floating point	N/A
Found peak OSNR	N/A	N/A	32bits floating point	N/A
Found peak optical power, same as above	N/A	N/A	32bits floating point	N/A
Reserved	N/A	N/A	0x00000000h (32bits)	0x00000000h (32bits)
Repeat to * in 5 numbers each group until all found channels have been reported				N/A
Total number of Data Spectrum Points = M (affected by Data Spectrum Decimation Factor)	N/A	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer (reserved)
Reserved	N/A	N/A	N/A	0x00000000h (32bits)
Total number of Data Spectrum Points = M (affected by subcommand 0x0000000F)	N/A	N/A	N/A	32bits unsigned integer
M points of power data of the spectrum.	N/A	M-32bits floating point	32bits floating point	32bits floating point

M points of frequency data of the spectrum.	N/A	M-32bits floating point	32bits floating point	32bits floating point (Wavelength data, nm)
Total Power in the Spectrum.	N/A	N/A	32bits floating point	N/A
Data Checksum	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer
Error Code	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer
Message Checksum	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer	32bits unsigned integer

Message ID:
  0x00000003h: Response to an "OSA scan optical signal command".

Message Length:
  Total number of command bytes from Message ID to Message Checksum in 32bits unsigned integer format.

Temperature:
  Current OSA temperature in degrees Celsius in 32bits signed integer format.

Max Power of raw detected power data:
  Maximum of all acquired raw data powers in 32bits unsigned integer format. Unit is A/D counts.

Frequency where Max Power is located (F):
  Frequency of the maximum acquired raw data point in 32bits unsigned integer. Unit is GHz, offset by 180000 GHz. That is, Frequency (GHz) = F + 180000

Total number of found channels:
  The total number of channels found within OSA band.

Found peak optical power:
  Power of detected channel, unit is dBm.
  For sub-commands 0x00000001h and 0x00000008h, in one 32bits number, the high-16bits is the power data which is in 16bits signed integer format with resolution of 0.1dBm. (i.e., –215 = -21.5 Bm).
  For sub-command 0x00000009h, the power is given in 32bits IEEE floating point. This value is NOT returned when the Total Number of Channels Found is zero.

Found peak frequency (F):

Frequency of detected channel, unit is GHz, offset by 180000 GHz.
Frequency (GHz) = F + 180000.
For sub-commands 0x00000001h and 0x00000008h, in one 32bits number, the low-16bits is the frequency data which is in 16bits unsigned integer format.
For sub-command 0x00000009h, the frequency is given in 32bits IEEE floating point.
This value is NOT returned when the Total Number of Channels Found is zero.

Found peak OSNR:
  OSNR of detected channel, unit is dBm. The power is given in 32bits IEEE floating point.
  This value is NOT returned when the Total Number of Channels Found is zero.

Total number of Data Spectrum Points (M):
  The total number of data points in the raw spectrum returned. The total number of acquired raw data points and the Data Spectrum Decimation Factor will determine how many data points are returned here.

M points of power data of the spectrum:
  A series of 32bits floating point for power values in dBm of raw spectrum data.

M points of frequency data of the spectrum:
  A series of 32bits floating point for frequency values in THz of raw spectrum data.

Total Power of Spectrum:
  Sum of all power values in the spectrum band covered by OSA. Unit is dBm.

Data Checksum:
  1's complement of the 32bits unsigned integer cumulate of all bytes from Sub-Command to bytes before Data Checksum, NOT including Data Checksum itself.

Error Code:
  0x00000000h: No Error
  0x000027A2h: Data Checksum Error
  0x000027A3h: Message Checksum Error
  0x000027A4h: Message Length Error
  0x00002783h: Unknown Command
  0xFFFFFFF0h: Data Acquisition Time-out
  0xFFFFFFF1h: Error Detected During Data Acquisition

Message Checksum:
  1's complement of the 32bits unsigned integer cumulate of all bytes from Message ID to Error Code.

6.2.3 Firmware Download Command (TBD)

Table 6.2-4: Firmware Download Command

Parameter	Firmware Download Command
Message ID	0x00000010h
Message Length	32bit unsigned integer
Reserved (always zero)	0x00000000h
Reserved (always zero)	0x00000000h
*All firmware bytes	All bytes from firmware binary file
Repeat * until all firmware bytes have been sent	
Data Checksum	32bit unsigned integer
Reserved (always zero)	0x00000000h
Message Checksum	32bit unsigned integer

Message ID:
   0x00000010h: Firmware Download to OSA.

Message Length:
   Total number of command bytes from Message ID to Message Checksum.

All Firmware Bytes:
   All bytes from the supplied firmware download binary file compatible with current OSA.

Data Checksum:
   1's complement of the 32bits unsigned integer cumulate of all bytes from the supplied firmware download binary file sent.

Message Checksum:
   1's complement of the 32bits unsigned integer cumulate of all bytes from Message ID to Reserved (always Zero). Do not include Message checksum.

Table 6.2-5: OSA Response Format

Parameter	OSA Response Format
Message ID	0x00000010h
Message Length	0x00000020h
Reserved (always zero)	0x00000000h
Temperature	32bit signed integer
Reserved (always zero)	0x00000000h

Data Checksum	0xFFFFFFFFh
Error Code	32bit unsigned integer
Message Checksum	32bit unsigned integer

Message ID:
   0x00000010h: Firmware Download to OSA.

Message Length:
   Total number of command bytes from Message ID to Message Checksum.

Temperature:
   Current OSA temperature is in degrees Celsius.

Data Checksum:
   Default to 0xFFFFFFFFh

Error Code:
   0x00000000h: No Error
   0x000027A2h: Data Checksum Error
   0x000027A3h: Message Checksum Error
   0x000027A4h: Message Length Error
   0x0000277Dh: Sector Flash Erase Did Not Complete Within 1.5 sec
   0x00002783h: Unknown Command
   0xFFFFFFF2h: Newly Downloaded Firmware Failed to Start, Revert Back to Old
   Firmware
   0xFFFFFFF3h: Flash Selection Switch Did Not Complete Within 100ms
   0xFFFFFFF5h: Read Flash Did Not Complete Within 4.5 sec
   0xFFFFFFF6h: Downloaded Firmware Checksum Does Not Match Firmware Header
   0xFFFFFFF7h: Firmware Failed to Install, Flash Switch Did Not Complete

Message Checksum:
   1's complement of the 32bits unsigned integer cumulate of all bytes from Message ID
   to Error Code. Do not include Message checksum.

6.2.4 Version Request Command

Table 6.2-6: Device Version Request Command

Parameter	Device Version Request Command
Message ID	0x00000030h
Message Length	0x00000020h
Reserved (always zero)	0x00000000h
Reserved (always zero)	0x00000000h

Reserved (always zero)	0x00000000h
Data Checksum	0xFFFFFFFFh
Reserved (always zero)	0x00000000h
Message Checksum	0xFFFFFBB3h

Message ID:
   0x00000030h: Device Version Request Command

Message Length:
   Total number of command bytes from Message ID to Message Checksum. In this case, it is always 0x00000020h.

Data Checksum:
   Default to 0xFFFFFFFFh

Message Checksum:
   Default to 0xFFFFFBB3h

Table 6.2-7: OSA Response Format

Parameter	OSA Response Format
Message ID	0x00000030h
Message Length	0x00000090h
Reserved (always zero)	0x00000000h
Temperature	32bit signed integer
Reserved Bytes (always zero)	36 consecutive bytes of 0x00h
Firmware Version	37 bytes of string characters
Assembly Serial Number	20 bytes of string characters
Filter Serial Number	23 bytes of string characters
Data Checksum	32bit unsigned integer
Error Code	32bit unsigned integer
Message Checksum	32bit unsigned integer

Message ID:
   0x00000030h: Device Version Request

Message Length:
   Total number of command bytes from Message ID to Message Checksum. In this case, it is always 0x00000090h.

Temperature:
   Current OSA temperature in degrees Celsius

Firmware Version:
    37 bytes of ASCII string characters indicate OSA firmware revision number

Assembly Serial Number:
    20 bytes of ASCII string characters indicate OSA assembly serial number
    The first 12 bytes of string characters are used for Serial Number Pxxxx-xxxxxx.

Filter Serial Number:
    23 bytes of ASCII string characters indicate OSA internal optical passband filter serial
    number

Data Checksum:
    1's complement of the 32bits unsigned integer cumulate of all bytes from Firmware
    Version to Filter Serial Number, NOT including Data Checksum itself.

Error Code:
    0x00000000h: No Error
    0x000027A2h: Data Checksum Error
    0x000027A3h: Message Checksum Error
    0x000027A4h: Message Length Error
    0x00002783h: Unknown Command

Message Checksum:
    1's complement of the 32bits unsigned integer cumulate of all bytes from Message ID
    to Error Code.

6.2.5 Device Reset Command

Table 6.2-8: Device Reset Command

Parameter	Device Reset Command
Message ID	0x00000040h
Message Length	0x00000020h
Reserved (always zero)	0x00000000h
Reserved (always zero)	0x00000000h
Reserved (always zero)	0x00000000h
Data Checksum	0xFFFFFFFFh
Reserved (always zero)	0x00000000h
Message Checksum	0xFFFFFBA3h

Message ID:
    0x00000040h: Device Reset

Message Length:
   Total number of command bytes from Message ID to Message Checksum. In this case,
   it is always 0x00000020h.

Data Checksum:
   Default to 0xFFFFFFFFh

Message Checksum:
   Default to 0xFFFFFBA3h

Table 6.2-9: OSA Response Format

Parameter	OSA Response Format
Message ID	0x00000040h
Message Length	0x00000090h
Reserved (always zero)	0x00000000h
Temperature	32bit signed integer
Reserved Bytes (always zero)	36 consecutive bytes of 0x00h
Firmware Version	37 bytes of string characters
Assembly Serial Number	20 bytes of string characters
Filter Serial Number	23 bytes of string characters
Data Checksum	32bit unsigned integer
Error Code	32bit unsigned integer
Message Checksum	32bit unsigned integer

Message ID:
   0x00000040h: Device Reset

Message Length:
   Total number of command bytes from Message ID to Message Checksum. In this
   case, it is always 0x00000090h.

Temperature:
   Current OSA temperature in degree Celsius

Firmware Version:
   37 bytes of ASCII string characters indicate OSA firmware revision number

Assembly Serial Number:
   20 bytes of ASCII string characters indicate OSA assembly serial number
   The first 12 bytes of string characters are used for Serial Number Pxxxx-xxxxxx.

Filter Serial Number:

23 bytes of ASCII string characters indicate OSA internal optical passband filter serial number

Data Checksum:

1's complement of the 32bits unsigned integer cumulate of all bytes from Firmware Version to Filter Serial Number, NOT including Data Checksum itself.

Error Code:

0x00000000h: No Error
0x000027A2h: Data Checksum Error
0x000027A3h: Message Checksum Error
0x000027A4h: Message Length Error
0x00002783h: Unknown Command

Message Checksum:

1's complement of the 32bits unsigned integer cumulate of all bytes from Message ID to Error Code.

7. Labeling

Each OSA device should have a label including the following information

A. Supplier name: Optoplex Corporation

B. Device name: Optical Spectrum Analyzer, C+L Band

C. Supplier part number: (MPN)

D. Supplier serial number: YYOPMABV1234

For the Supplier serial number: YYOPMABV1234, YY- manufacturing year, OP-Optoplex, M- manufacturing month (1~9, O, N, D), A- hardware version, B- firmware version, V- Customer code, 1234 sequential number.

E. Production date: mm/dd/yyyy

8. Ordering Information

8.1 Models and Part Numbers

#	Product	Part Number	Wavelength Range	Remarks
1	C-Band OSA, Std.	OM-1C2MM353	1527 ~ 1567nm	
2	C+L Band OSA, Std.	OM-2T2MM301	1521 ~ 1611nm	
3	C+L Band OSA, Extended Range	OM-2T2MM301E	1500 ~ 1610nm	
4	O-Band OSA, Std.	OM-2O2MM302	1260 ~ 1360nm	
5	O-Band OSA, Extended Range	OM-2O2MM302E	1260 ~ 1380nm	
6	O-Band OSA, High SMSR	OM-2O2MM312	1260 ~ 1360nm	SMSR > 50dB, Typ. >55dB
7	E-U Band OSA, Std.	OM-2EUFM306	1400 ~ 1700nm	
8	1064nm OSA, Std.	OM-2A2MM307	1000 ~ 1100nm	
9	Full-Band OSA, Std.	OM-2AFOE304	1250 ~ 1650nm	

8.2 Evaluation Kit (applicable to all models), Optional at additional cost

Evaluation Kit for MEMS TF/OSA, including an UART/USB cable and a Software Program for Window-PC

MPN: CP-MTS8C005

User Manual of the Evaluation Kit:
Free-download from Optoplex website for existing customers.

9. Revision History

Rev.	Date	Revision History	Originated by	Signed by
1.0	1/27/2014	New release.	Tao Yu	Danny Yu
1.1	3/18/2014	Updated mechanical drawing.	Jindong Li	Danny Yu
1.2	3/21/2014	Updated command set and response format.	Jindong Li	Danny Yu
1.3	4/8/2014	Updated wavelength range from 1527-1605 nm to 1521-1611 nm. Changed fiber length from 0.88 m to 0.95 m. Add customer command. Update table 5-5 item1.d.	Jindong Li	Danny Yu
1.4	5/8/2014	Changed optical connector to FC/UPC Changed Stop Bits from 2 to 1 Changed fiber length to 1.0 m Re-defined serial number by reducing sequential number from 12346 to 1234	Jindong Li	Danny Yu
1.5	3/19/2015	Changed the mechanical drawing of Fig. 3-1 and 3-2	Jindong Li	James Pang
1.6	4/2/2015	Change connector from FC/UPC to FC/APC	Jindong Li	James Pang
2.0	5/18/2016	Remove "Engine" from Product Description (front page), title of Table 1.1, and captions of Figures 3.1 and 3.2	Stephanie Hung	James Pang
2.1	7/20/2016	Revised Maximum Input Power and Input Power Range specs (Table 1.1) Revised Corporate address to 48500 Kato Road	Stephanie Hung	James Pang
2.2	7/13/2017	Removed Mounting Base (Figures 3-1 & 3-2), the Dimension is now 112 x 68 x 11 mm (Table 1-1) Revised maximum and typical current specifications for power supplies (Table 4.1)	Stephanie Hung	James Pang
2.3	4/23/2019	Updated the Module Box and UART/USB port locations at the same side as the fiber input port	Gary Wang	Songtao Du
3.0	3/1/2022	Consolidate the specs of all models into one document.	Gary Wang	James Pang