Product Specification

Spec#: **5013**
Part Number: **OPMCB50GMT01**
Description: **50/100 GHz C-Band OPM/OCM**
Category: **GouMax Standard**

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1. Product Description

Optical channel monitor (OCM) or Optical performance monitor (OPM) has played an important role in optical networks to measure signal quality at optical layer. It is used for managing high-capacity dense wavelength division multiplexing (DWDM) optical network and ROADM (reconfigurable optical Add/Drop) systems. OPM involves assessing the quality of data channel by measuring its optical characteristics without directly looking at the individual bit of data. OPM measures channel power, channel wavelength, and optical signal-to-noise ratio (OSNR) for each channel. These fiber-optic components/modules are typically configured at 50 GHz and 100 GHz ITU grids.

GouMax's OPM consists of a narrow bandpass tunable optical filter, a photodetector and low noise, high-dynamic range electronics, as schematically shown in Figure 1-1. When a multiple-channel optical signal is incident to the tunable filter, it allows a narrow band of input light centered at a given wavelength to pass through the filter. By altering the central wavelength of pass band of the tunable filter through control electronics, the whole input signal can be scanned and spectrum information of incident signal is detected sequentially. The photodetector converts the light passing through the filter into electrical current that is then amplified and digitized. The data processing unit analyzes the data, calculates channel wavelength, power and OSNR, and then outputs to the customers.

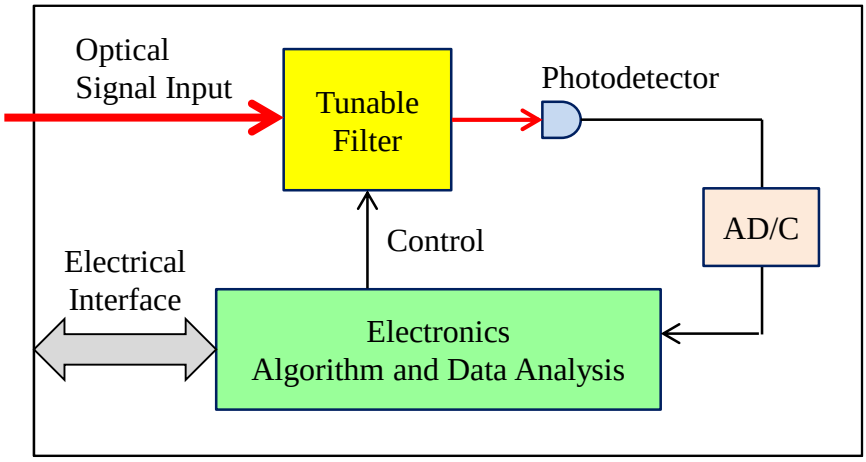

Figure 1-1: Schematic diagram of working process of OPM.

2. Specifications

The following specifications define GouMax's 50 GHz C-band OPM.

2.1 Specifications

Table 2-1: Specifications for C-band OPM

Parameters	Unit	Min.	Typ.	Max.	Notes
Signal Conditions					
Operation Wavelength Range	nm	1527.216 ~ 1567.133			Upto 96 Channels
Channel Spacing	GHz	50 & 100			
Channel Power Range	dBm	-40		-10	Per channel
Maximum Input Power	dBm	25			Total power
Input Channel Frequency Accuracy	GHz	-8		8	
Minimum Channel Spacing	GHz	42			
Adjacent Channel Power Divergence	dB			10 7	2.5/5/10Gb/s 40/100Gb/s
Maximum Channel Power Difference	dB			10	
OSNR Range	dB	10		25	100GHz, 2.5/5/10Gb/s
OPM Performance					
Absolute Wavelength Accuracy	pm	-50		+50	
Wavelength Readout Resolution	pm	10			
Absolute Power Accuracy	dB	-0.7		0.7	Do not include PDL
Relative Power Accuracy	dB			± 0.5	Do not include PDL
Power Measurement Repeatability	dB			± 0.3	Do not include PDL At the same test condition
OSNR Accuracy (100GHz spacing, 2.5/5/10 Gb/s)	dB	-1.5 -2.0		+1.5 +2.0	10 dB≤ OSNR ≤ 20 dB 20 dB≤ OSNR ≤ 25 dB
Return Loss	dB	35			
PDL	dB			0.3	
Noise Floor	dBm	-60			Electronics noise
Scan Time	s			1.0	

Note:

1) OPM can be used at 50 GHz or 100 GHz mode.
2) OSNR is measured at 100 GHz mode only for 2.5/5/10Gb/s signals. At 50 GHz mode, no OSNR is measured.

2.2 Environmental Conditions

Table 2-2: Environmental specifications

Parameters	Units	Specifications
Operating Temperature	°C	-5 ~ +65
Storage Temperature	°C	-40 ~ +85
Operating Relative Humidity	%	5 ~ 85 (non-condensing)
Storage Relative Humidity	%	5 ~ 95

2.3 Fiber Specifications

Table 2-3: Fiber specifications

Parameters	Units	Specifications
Fiber Type	-	SMF-28 900 μm
Fiber Length	m	1.0 ± 0.1
Optical Connector Type	-	LC/UPC or LC/APC

3. Mechanics

GouMax provides standalone C-band OPM module. The mounting holes, locations of electrical connector and optical connector are shown in Figure 3-1.

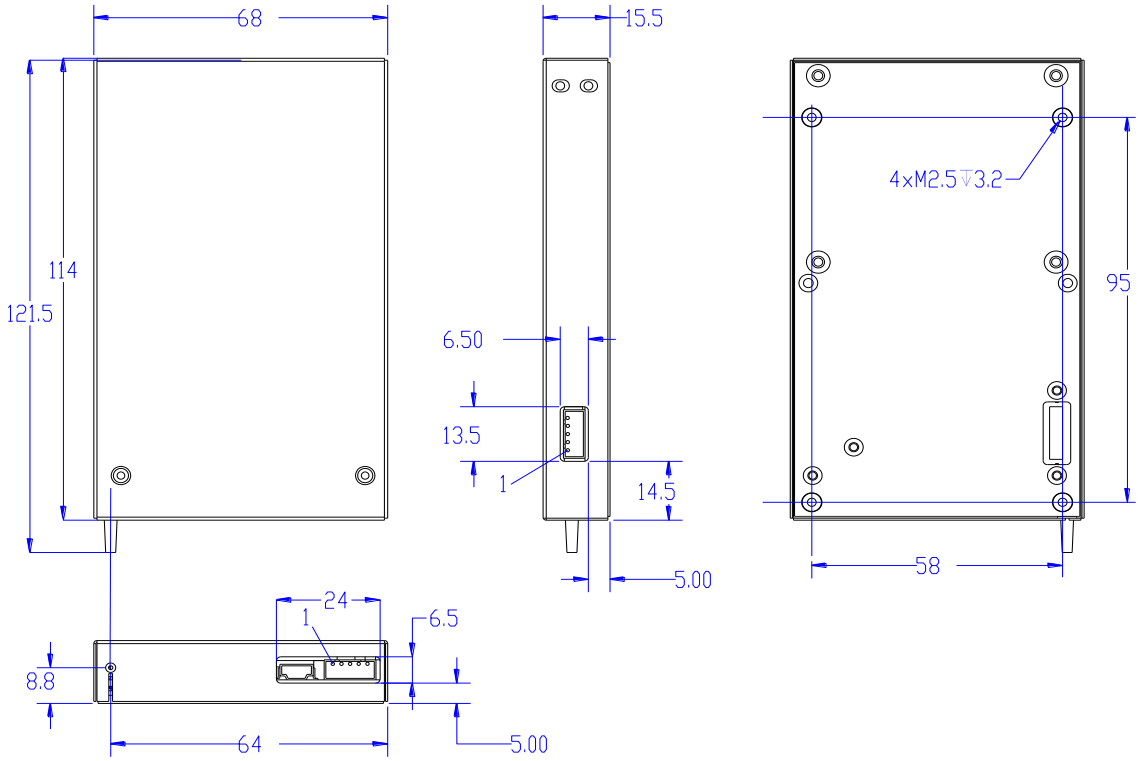

Figure 3-1: OPM mechanical drawing.

Figure 3-2: C-Band OPM photo.

4. Electrical Specifications

4.1 Power Supply

Table 4-1 lists the specification of power supply.

Table 4-1: Voltage and current specifications

Electrical Parameters	Specification
Voltage Supply	+5.0 V DC
Voltage Tolerance	± 10%
Typical Current	0.3 A
Maximum Current	0.4 A

4.2 Electrical Connector and Pin Assignment

5-Pin UART connector on OPM module is: HRS DF3-5P-2DS(01)
Mating connector: HRS DF3-5S-2C

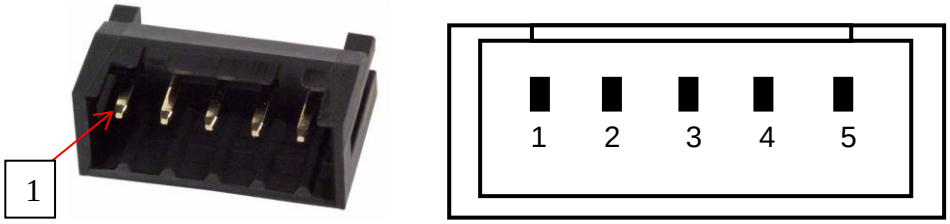

Figure 4-1: UART connector HRS DF3-5P-2DS(01) and Pin locations

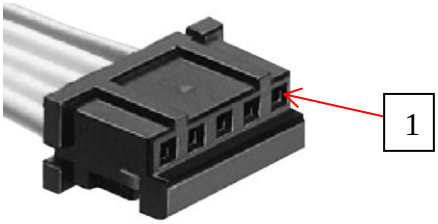

Figure 4-2: Mating connector HRS DF3-5S-2C

Table 4-2: Pin assignment of UART

Pin Number	Pin Definition
1	/Reset
2	+5V DC
3	Rx (OPM)
4	Tx (OPM)
5	Ground

Table 4-3: LVTTL Logic Voltage Level

Symbol	Parameter	Condition	Minimum	Maximum
V(IH)	High-level input voltage		2.0 V	3.6 V
V(IL)	Low-level input voltage		-0.3 V	0.8 V
V(OH)	High-level output voltage	Max I(OH) = 8 mA	2.4 V	
V(OL)	Low-level output voltage	Max I(OL) = -8 mA[1)]		0.4 V

Note: 1) Absolute value is 8 mA and the "-" sign stands for current direction.

5. Communication Protocol

GouMax's OPM provides UART Serial port communication. Customer can program and control OPM through UART serial port communication. Communication commands are compatible to RS232.

5.1 UART Serial Port Setting

UART serial port setting for OPM is shown in Table 5-1.

Table 5-1: UART serial port setting

Item	Setting
Baud Rate	115200
Data Bits	8
Parity	None
Stop Bits	1
Flow Control	None

In the following, Checksum is a 16-bits unsigned integer. It is the sum of all bytes from the first bye of "Command Word-1" to the last byte before "checksum" word. It does not include the "Head byte 0xAA" and "Checksum" itself.

5.2 Host start OPM Scan for channel data commands

Table 5-2: Scan for OPM channel data command for 50GHz spacing

Field	Parameter	Scan Channel Data Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x4348
2	Command Word_2	0x3035
3	Data Length Word	0x0001 (Number of Words in Field 4)
4	Sub-command Word	0x0007 or 0x000B, See Note 1), 2), 3)
5	Checksum Word	Unsigned 16-bit integer

Notes:

1) Sub-command = 0x0007 to get detected signal channel data.
2) Sub-command = 0x000B to get detected signal channel and OSNR data.
3) No OSNR data for 50 GHz spacing OPM.

Table 5-3: OPM response to scan channel data command for 50 GHz spacing

Field	Parameter	OPM response
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x4348
2	Command Word_2	0x3035
3	Data Length Word	(Number of Words in Field 4 ~9)
4	Error Word	16-bit Error Code (0x0000 for No error)
5	Sub-command Word	0x0007 or 0x000B, See Note 1), 2), 3)
6	Detected Channel number	16-bits (Number N of detected channels)
7	Channel frequency data	N × 32-bit integer numbers. See Note 4)
8	Channel power data	N × 16-bit signed integer of Q-8 data
9	Channel OSNR data	N × 16-bit signed integer of Q-8 data, See Note 5)
10	Checksum Word	Unsigned 16-bit integer

Notes:

1) Each has High 16-bit and Low 16-bit of one 32-bit integer data.
   The frequency is expressed by a 9-digit integer in 1/1000 GHz. For example, the integer 192500125 stands for 192500.125 GHz.
2) No Field 9 if Sub-command = 0x0007.

Table 5-4: Scan for OPM channel data command for 100 GHz spacing

Field	Parameter	Scan Channel Data Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x4348
2	Command Word_2	0x3130
3	Data Length Word	0x0001 (Number of Words in Field 4)
4	Sub-command Word	0x0007 or 0x000B, See Note 1), 2)
5	Checksum Word	Unsigned 16-bit integer

Notes:

1) Sub-command = 0x0007 to get detected signal channel data.
2) Sub-command = 0x000B to get detected signal channel and OSNR data.

Table 5-5: OPM response to scan channel data command for 100 GHz spacing

Field	Parameter	OPM response
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x4348
2	Command Word_2	0x3130
3	Data Length Word	(Number of Words in Field 4 ~9)
4	Error Word	16-bit Error Code (0x0000 for No error)
5	Sub-command Word	0x0007 or 0x000B, See Note 1), 2)
6	Detected Channel number	16-bits (Number N of detected channels)
7	Channel frequency data	N×32-bit integer numbers. See Note 3)
8	Channel power data	N×16-bit signed integer of Q-8 data
9	Channel OSNR data	N×16-bit signed integer of Q-8 data, See Note 4)
10	Checksum Word	Unsigned 16-bit integer

Notes:

1) Each has High 16-bit and Low 16-bit of one 32-bit integer data.
   The frequency is expressed by a 9-digit integer in 1/1000 GHz. For example, the integer 192500125 stands for 192500.125 GHz.
2) No Field 9 if Sub-command = 0x0007.

5.3 Host scan OPM channel and spectrum data commands

Table 5-6: Scan channel and spectrum data command for 50 GHz spacing

Field	Parameter	Scan Channel and Spectrum Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x5350
2	Command Word_2	0x3035
3	Data Length Word	0x0002 (Number of Words in Field 4, 5)
4	Sub-command Word	16-bit integer, See Note 1), 2), 3) and 4).
5	Decimation Factor	16-bit integer (Minimum = 1)
6	Checksum Word	Unsigned 16-bit integer

Notes:

1) Sub-command=0x0000, to get spectrum data only, no channel data.
2) Sub-command=0x0003, to get detected signal channel data and spectrum data.
3) Sub-command=0x0009, to get detected signal channel data, channel OSNR data and spectrum data.
4) No OSNR data for 50 GHz spacing OPM.

Table 5-7: OPM response to scan channel and spectrum command for 50GHz spacing

Field	Parameter	OPM response
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x5350
2	Command Word_2	0x3035
3	Data Length Word	(Number of Words in Field 4 ~16)
4	Error Word	16-bit Error Code (0x0000 for No error)
5	Sub-command Word	16-bit integer, See Note 1), 2), 3) and 4).
6	Channel number (N) Word	16-bit integer, See Note 5).
7	Channel frequency data	N × 32-bit integer numbers. See Note 6)
8	Channel power data	N × 16-bit signed integer of Q-8 data
9	Channel OSNR data	N × 16-bit signed integer of Q-8 data, See Note 7).
10	Start Frequency high-16 bits	High 16-bits of 32-bits integer, See Note 8)
11	Start Frequency low-16 bits	Low 16-bits of 32-bits integer
12	End Frequency high-16 bits	High 16-bits of 32-bits integer
13	End Frequency low-16 bits	Low 16-bits of 32-bits integer
14	Decimation Factor	16-bit integer (Minimum = 1)
15	Spectrum data length Word	16-bits (Number of words in Field 16)
16	Spectrum data Words	16-bit signed integer of Q-8 data See Note 9)
17	Checksum Word	Unsigned 16-bit integer

Notes:

1) Channel number N = 0, if no detected OPM signal, or if sub-command 0x0000.
2) Each has High 16-bit and Low 16-bit of one 32-bit integer data.

   The frequency is expressed by a 9-digit integer in 1/1000 GHz. For example, the integer 192500125 stands for 192500.125 GHz.
3) No Field 9 if Sub-command ≠ 0x0009.
4) Spectrum data start and end frequencies are 32-bit integers in 1/1000 GHz.
5) Spectrum power data points in equal frequency spacing.

Table 5-8: Scan channel and spectrum data command for 100 GHz spacing

Field	Parameter	Scan Channel and Spectrum Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x5350
2	Command Word_2	0x3130
3	Data Length Word	0x0002 (Number of Words in Field 4, 5)
4	Sub-command Word	16-bit integer, See Note 1), 2), 3) and 4).
5	Decimation Factor	16-bit integer (Minimum = 1)
6	Checksum Word	Unsigned 16-bit integer

Notes:

1) Sub-command=0x0000, to get spectrum data only, no channel data.
2) Sub-command=0x0003 to get detected signal channel data and Spectrum data.
3) Sub-command=0x0009 to get detected signal, OSNR channel data and Spectrum data.

Table 5-9: OPM response to scan channel and spectrum command for 100 GHz spacing

Field	Parameter	OPM response
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x5350
2	Command Word_2	0x3130
3	Data Length Word	(Number of Words in Field 4 ~16)
4	Error Word	16-bit Error Code (0x0000 for No error)
5	Sub-command Word	16-bit integer, See Note 1), 2), 3) and 4)
6	Channel number (N) Word	16-bit integer, See Note 4).
7	Channel frequency data	N×32-bit integer numbers. See Note 5)
8	Channel power data	N×16-bit signed integer of Q-8 data
9	Channel OSNR data	N×16-bit signed integer of Q-8 data, See Note 6)
10	Start Frequency high-16 bits	High 16-bits of 32-bits integer, See Note 7)
11	Start Frequency low-16 bits	Low 16-bits of 32-bits integer
12	End Frequency high-16 bits	High 16-bits of 32-bits integer
13	End Frequency low-16 bits	Low 16-bits of 32-bits integer
14	Decimation Factor	16-bit integer (Minimum = 1)
15	Spectrum data length Word	16-bits (Number of words in Field 16)
16	Spectrum data Words	16-bit signed integer of Q-8 data, See Note 8)
17	Checksum Word	Unsigned 16-bit integer

Notes:

4) Channel number N = 0, if no detected OPM signal, or if sub-command 0x0000,
5) Each has High 16-bit and Low 16-bit of one 32-bit integer data.
   The frequency is expressed by a 9-digit integer in 1/1000 GHz. For example, the integer 192500125 stands for 192500.125 GHz.
6) No Field 9 if Sub-command ≠ 0x0009.
7) Spectrum data start and end frequencies are 32-bit integers in 1/1000 GHz.
8) Spectrum power data points in equal frequency spacing.

5.4 Host Read OPM Information

Table 5-10: Read OPM Information

Field	Parameter	Read OPM Information
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x534E
2	Command Word_2	0x4656
3	Data Length Word	0x0001 (Number of Words in Field 4)
4	Reserved Word	0x0000
5	Checksum Word	Unsigned 16-bit integer

Table 5-11: OPM module response to read OPM Information command

Field	Parameter	OPM response
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x534E
2	Command Word_2	0x4656
3	Data Length Word	16-bit integer (Number of Words in Field 4~10)
4	Error Word	16-bit Error Code (0x0000 for No error)
5	OPM PN Words	PN max. length 20 bytes ASCII codes
6	OPM SN Words	SN max. length 20 bytes ASCII codes
7	Calibration Date Words	10 bytes ASCII codes (MM-DD-YYYY)
8	OPM FW version Words	8 bytes ASCII codes
9	OPM HW version Words	12 bytes ASCII codes
10	OPM temperature Word	16 bits signed integer as 10xT degree.
11	Checksum Word	Unsigned 16-bit integer

Notes:

(1) PN, SN and version numbers are in ASCII format.
(2) PN/SN fields have maximum length 20 bytes. If PN/SN length is less than 20 bytes, 0 is appended.
(3) Manufacturing date has 10 bytes ASCII codes as MM-DD-YYYY.
(4) OPM temperature is a signed 16 bits integer for 10xT. For example, number 342 = 34.2°C, and number -21 = -2.1°C.

5.5 Firmware Download

Table 5-12: OPM firmware download command

Field	Parameter	OPM FW download command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x444C
2	Command Word_2	0x4657
3	Data Length Word	(Number of words Word in Field 4 to 7)
4	Reserved Word	0x0000
5	Reserved Word	0x0000
6	FW code page ID Words	16-bit integer
7	FW code Words	1024 words in each FW page, See Note 1)
8	Checksum Word	Unsigned 16-bit integer

Notes:

1) OPM firmware may contain many pages. Each page consists of 1024 words.

Table 5-13: Response to OPM firmware download command

Field	Parameter	OPM response
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x444C
2	Command Word_2	0x4657
3	Data Length Word	0x0003 (Number of Words in Field 4 ~ 6)
4	Error Word	16-bit Error Code (0x0000 for No error)
5	Reserved Word	0x0000
6	FW page ID Word	16-bit integer
7	Checksum Word	Unsigned 16-bit integer

5.6 Firmware installation after finishing downloading

Table 5-14: OPM firmware installation command

Field	Parameter	OPM FW installation command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x494E
2	Command Word_2	0x4657
3	Data Length Word	0x0001 (Number of Words in Field 4)
4	Reserved Word	0x0000
5	Checksum Word	Unsigned 16-bit integer

Table 5-15: Response to OPM firmware installation command

Field	Parameter	OPM response
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x494E
2	Command Word_2	0x4657
3	Data Length Word	0x0001 (Number of Words in Field 4)
4	Error Word	16-bit Error Code (0x0000 for No error)
5	Checksum Word	Unsigned 16-bit integer

5.7 Error Codes

OPM will return one of the following error codes in its response.

Table 5-16: OPM Error Codes

Error Code	Description
0x0000	No error
0x0001	OPM received an unknown command.
0x0002	OPM received data is “Out-of-Range”.
0x0003	OPM data is “Not available”.
0x0009	OPM received data has “Checksum error”.
0x000A	OPM FW download has “Checksum error”.
0x000B	OPM FW download has “block number error”
0x000C	OPM FW Installation failed.

6. RoHS Compliance

The product is RoHS 6 compliant.