



Product Specification

Spec#: 5032
Product: TLS-1000 Tunable Lasers

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Revision History

Rev.	Date	Revision History	Originated by	Signed by
1.0	9/22/2017	Initial release	Mark Geng	Jay Hsieh

1. Product Description

GouMax tunable lasers are a new-generation high performance continuous wave (CW) tunable laser source for use in various single band or combined band windows, ranging from 1050 nm to 1660 nm. The innovative design employs the state-of-the-art tunable technology and gain continuation in wide wavelength range. With no moving parts, the voltage-controlled wavelength tuning enables rapid wavelength switching over the whole operating wavelength window. Figure 1-1 shows an example of laser spectrum of C-band tunable laser at 1550 nm.

This specification describes and defines GouMax's CW tunable lasers with applications to test and measurement. It provides fast wavelength tuning, high power output, and high power stability. GouMax tunable laser products support C-band, L-band, S-band, E-band, O-band, and other single-band operation. A full-band tunable laser is also available, covering 1250~1650 nm wavelength range, with seamless wavelength tuning.

System control and communication is provided through the RS232 interface, which allows users to dynamically set operating wavelength with ease.

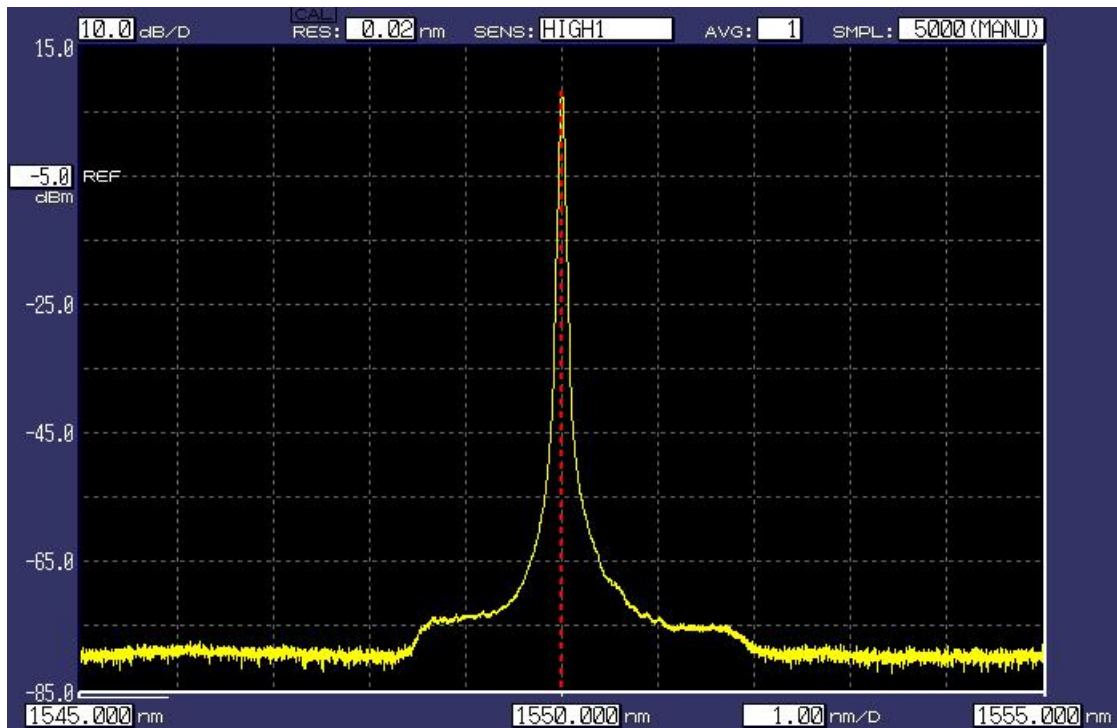


Figure 1-1: Laser spectrum of C-band tunable laser at 1550 nm.

2. Specifications

2.1 Specifications

Table 2-1: Specifications for C-band, Extended C-band, C+L-band and S+C+L-band tunable lasers

Parameters		Unit	C-Band	E C-Band	CL-Band	SCL-Band
Wavelength Range		nm	1527~1567	1520~1605	1525~1625	1450~1650
Wavelength Tuning Resolution		pm	≤ 5	≤ 5	≤ 5	≤ 10
Maximum Sweep Speed		nm/s	400	400	400	400
Wavelength Stability ¹⁾		pm	≤ 5	≤ 5	≤ 5	≤ 5
Linewidth FWHM		nm	≤ 0.04	≤ 0.04	≤ 0.04	≤ 0.1
Minimum Power Output ¹⁾		mW	≥ 15	≥ 10	≥ 10	≥ 3
Signal to Total ASE Suppression Ratio ²⁾		dB	≥ 50	≥ 50	≥ 50	≥ 40
Signal to Source ASE ³⁾		dB	≥ 60	≥ 60	≥ 50	≥ 50
Absolute Wavelength Accuracy ¹⁾		pm	≤ 10	≤ 20	≤ 20	≤ 50
Relative Wavelength Accuracy ¹⁾		pm	± 8	± 16	± 16	± 30
Wavelength Repeatability ⁴⁾	Stepped Mode	pm	± 5	± 10	± 10	± 20
	Sweep Mode		± 5	± 10	± 10	± 20
Power Repeatability ^{4),5)}	Stepped Mode	pm	± 0.01	± 0.01	± 0.01	± 0.01
	Sweep Mode		N/A	N/A	N/A	N/A
Power Stability ^{4),5)}	Stepped Mode	dB	± 0.01	± 0.015	± 0.02	± 0.02
	Sweep Mode		N/A	N/A	N/A	N/A
Step Tuning Time		ms	50	50	50	50

Notes:

- 1) Stepped Mode only: When measured after warm-up time, measurements over 1 hour at $25 \pm 1^\circ\text{C}$.
- 2) ASE is measured within 30 nm wavelength range.
- 3) ASE is measured within 0.1 nm wavelength range.
- 4) When measured after warm-up time, measurements over 1 hour at $25 \pm 1^\circ\text{C}$.
- 5) For output power at > 0 dBm.

Table 2-2: Specifications for O-band, Extended O-band, E-band, and S-band tunable lasers

Parameters		Unit	O-Band	E O-Band	E-Band	S-Band
Wavelength Range		nm	1250~1340	1250~1380	1350~1450	1450~1530
Wavelength Tuning Resolution		pm	≤ 5	≤ 5	≤ 5	≤ 5
Maximum Sweep Speed		nm/s	400	400	400	400
Wavelength Stability ¹⁾		pm	≤ 5	≤ 5	≤ 5	≤ 5
Linewidth FWHM		nm	≤ 0.04	≤ 0.04	≤ 0.04	≤ 0.04
Minimum Power Output ¹⁾		mW	≥ 6	≥ 5	≥ 5	≥ 5
Signal to Total ASE Suppression Ratio ²⁾		dB	≥ 50	≥ 50	≥ 50	≥ 50
Signal to Source ASE ³⁾		dB	≥ 60	≥ 60	≥ 60	≥ 60
Absolute Wavelength Accuracy ¹⁾		pm	≤ 10	≤ 15	≤ 10	≤ 10
Relative Wavelength Accuracy ¹⁾		pm	± 10	± 10	± 10	± 10
Wavelength Repeatability ⁴⁾	Stepped Mode	pm	± 10	± 10	± 10	± 10
	Sweep Mode		± 10	± 10	± 10	± 10
Power Repeatability ^{4),5)}	Stepped Mode	pm	± 0.01	± 0.01	± 0.01	± 0.01
	Sweep Mode		N/A	N/A	N/A	N/A
Power Stability ^{4),5)}	Stepped Mode	dB	± 0.02	± 0.02	± 0.02	± 0.02
	Sweep Mode		N/A	N/A	N/A	N/A
Step Tuning Time		ms	50	50	50	50

Notes:

- 1) Stepped Mode only: When measured after warm-up time, measurements over 1 hour at $25\pm 1^\circ\text{C}$.
- 2) ASE is measured within 30 nm wavelength range.
- 3) ASE is measured within 0.1 nm wavelength range.
- 4) When measured after warm-up time, measurements over 1 hour at $25\pm 1^\circ\text{C}$.
- 5) For output power at > 0 dBm.

Table 2-3: Specifications for Full-band tunable lasers

Parameters		Unit	Full-Band
Wavelength Range		nm	1250~1650
Wavelength Tuning Resolution		pm	≤ 20
Maximum Sweep Speed		nm/s	400
Wavelength Stability ¹⁾		pm	≤ 5
Linewidth FWHM		nm	≤ 0.2
Minimum Power Output ¹⁾		mW	≥ 2
Signal to Total ASE Suppression Ratio ²⁾		dB	≥ 35
Signal to Source ASE ³⁾		dB	≥ 45
Absolute Wavelength Accuracy ¹⁾		pm	≤ 100
Relative Wavelength Accuracy ¹⁾		pm	± 80
Wavelength Repeatability ⁴⁾	Stepped Mode	pm	± 50
	Sweep Mode		± 50
Power Repeatability ^{4),5)}	Stepped Mode	pm	± 0.01
	Sweep Mode		N/A
Power Stability ^{4),5)}	Stepped Mode	dB	± 0.02
	Sweep Mode		N/A
Step Tuning Time		ms	50

Notes:

- 1) Stepped Mode only: When measured after warm-up time, measurements over 1 hour at $25 \pm 1^\circ\text{C}$.
- 2) ASE is measured within 30 nm wavelength range.
- 3) ASE is measured within 1.0 nm wavelength range.
- 4) When measured after warm-up time, measurements over 1 hour at $25 \pm 1^\circ\text{C}$.
- 5) For output power at > 0 dBm.

2.2 Environmental Conditions

Table 2-4: Environmental specifications

Parameters	Units	Specifications
Operating Temperature	°C	15 ~ 35
Storage Temperature	°C	-40 ~ +85
Operating Relative Humidity	%	5 ~ 85 (non-condensing)
Storage Relative Humidity	%	5 ~ 95

3. Mechanics

GouMax tunable laser is packaged in a 2RU rack mount chassis. The photo of the tunable laser is shown in Figure 3-1. Dimension is 406 (16")×432 (17")×89 (2RU) mm without mounting eras and 406 (16")×482 (19")×89 (2RU).



Figure 3-1: Front panel of tunable laser

4. Electrical Specifications

Table 4-1: Power supply

Electrical Parameters	Specification
Supply Voltage	110/220 V (AC)
Voltage Tolerance	± 10%
Supply Frequency	50/60 Hz

Note: The power supply uses the 3 AMP slow blow fuse.

5. Communication Protocol

In manual wavelength tuning mode, user can set the target operation wavelength of TLS-1000 manually by “Set TLS Wavelength” command. For convenient use, two additional commands “Step TLS Wavelength-UP” and “Step TLS Wavelength-Down” are provided to quickly increase or decrease wavelength by a small step. In this mode, user can check the operation wavelength by the command “Read TLS Wavelength” at any time.

GouMax provides TLS operation software for TLS-1000 tunable laser. Customer can also program and control TLS-1000 tunable laser through UART Serial port communication. Communication commands are compatible to RS232.

5.1 UART Serial Port Setting

UART serial port setting for TLS-1000 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

5.2 General Commands

5.2.1 Host Send “Set TLS ON” Command

Table 5-2: Set TLS ON command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x4C53
2	Command Word_2	0x4F4E
3	Length word	0x0000
4	Checksum word	0x013C

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

Table 5-3: TLS response to Set TLS ON command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x4C53
2	Command Word_2	0x4F4E
3	Length word	0x0001
4	Error word	16-bit Error Code (0x0000 for No error)
5	Checksum word	0x013D for No error Unsigned 16-bits integer

5.2.2 Host Send “Set TLS OFF” Command

Table 5-4: Set TLS OFF command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x4C53
2	Command Word_2	0x4F46
3	Length word	0x0000
4	Checksum word	0x0134

Table 5-5: TLS response to Set TLS OFF command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x4C53
2	Command Word_2	0x4F46
3	Length word	0x0001
4	Error word	16-bit Error Code (0x0000 for No error)
5	Checksum word	0x0135 for No error Unsigned 16-bit integer

5.2.3 Host Read TLS Information

Table 5-6: Read TLS Info

Field	Parameter	Read OSA Info Data
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x534E
2	Command Word_2	0x4656
3	Length word	0x0001 (Word in Field 4)
4	Reserved word	0x0000
5	Checksum word	013E for No error Unsigned 16-bit integer

Table 5-7: TLS response to read TLS Info command

Field	Parameter	Response to TLS Info Data
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x534E
2	Command Word_2	0x4656
3	Length word	16-bit integer (Words in Field 4~10)
4	Error word	16-bit Error Code (0x0000 for No error)
5	TLS PN words (10 word)	20 bytes ASCII codes
6	TLS SN words (10 word)	20 bytes ASCII codes
7	Manufacturing date words (5 words)	10 bytes ASCII codes
8	TLS FW version (4 words)	8 bytes ASCII codes
9	TLS HW version (6 words)	12 bytes ASCII codes
10	TLS temperature (1 word)	16 bits signed integer as $10 \times T$ degrees.
11	Laser status (1 word)	Off: 0x0000, On: 0x0001
12	User start WL word_1	High 16-bit of User-Start WL (pm)
13	User start WL word_2	Low 16-bit of User-Start WL (pm)
14	User stop WL word_1	High 16-bit of User-Stop WL (pm)
15	User stop WL word_2	Low 16-bit of User-Stop WL (pm)
16	Checksum word	Unsigned 16-bit integer

Notes:

- (1) TLS information includes Part number (PN), Serial number (SN), Manufacturing date, Firmware version, Hardware version and TLS temperature.
- (2) PN, SN and version numbers are in ASCII format.
- (3) PN and SN fields have maximum length 20 bytes. If PN/SN length is less than 20 bytes, 0 is appended.
- (4) Manufacturing date has 10 bytes ASCII codes as MM-DD-YYYY.
- (5) TLS temperature is a signed 16 bits integer for $10 \times T$. For example, number 342 = $342/10 = 34.2^{\circ}\text{C}$, and number -21 = $-21/10 = -2.1^{\circ}\text{C}$.
- (6) Laser status: 0 for Off and 1 for On
- (7) User start wavelength and stop wavelength

5.3 Manual Tuning Mode

5.3.1 Host Send “Set TLS Wavelength” Command

Table 5-8: Set TLS wavelength command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x474F
2	Command Word_2	0x574C
3	Length word	0x0002
4	Wavelength: High 16 bits	High 16 bits of 32 bits integer
5	Wavelength: Low 16 bits	Low 16 bits of 32 bits integer
6	Checksum word	Unsigned 16 bits integer

Return wavelength number is the set TLS wavelength, if no error. Its unit is pm.

Table 5-9: TLS response to Set TLS wavelength command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x474F
2	Command Word_2	0x574C
3	Length word	0x0003 if Error code is 0x0000 0x0001 if Error code is not 0x0000
4	Error word	16-bit Error Code (0x0000 for No error)
5	Wavelength: High 16 bits	High 16 bits of 32 bits integer (if No error)
6	Wavelength: Low 16 bits	Low 16 bits of 32 bits integer (if No error)
7	Checksum word	Unsigned 16-bit integer

Note: Wavelength number is a 32-bits integer with unit pm.

5.3.2 Host Send “Step TLS Wavelength-UP” Command

Table 5-10: Step TLS wavelength UP command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x5550
2	Command Word_2	0x574C
3	Length word	0x0001
4	Wavelength step data	16 bits integer for wavelength step (pm)
5	Checksum word	Unsigned 16 bits integer

Table 5-11: TLS response to Step TLS wavelength-UP command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x5550
2	Command Word_2	0x574C
3	Length word	0x0003 if Error code is 0x0000 0x0001 if Error code is not 0x0000
4	Error word	16-bit Error Code (0x0000 for No error)
5	Wavelength: High 16 bits	High 16 bits of 32 bits integer (if No error)
6	Wavelength: Low 16 bits	Low 16 bits of 32 bits integer (if No error)
7	Checksum word	Unsigned 16-bit integer

Note: Returned wavelength number is TLS wavelength after “Step UP”, if no error. Its unit is pm.

5.3.3 Host Send “Step TLS Wavelength-Down” Command

Table 5-12: Step TLS wavelength-Down command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x444E
2	Command Word_2	0x574C
3	Length word	0x0001
4	Wavelength step data	16 bits integer for wavelength step (pm)
5	Checksum word	Unsigned 16 bits integer

Table 5-13: TLS response to Step TLS wavelength-Down command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x444E
2	Command Word_2	0x574C
3	Length word	0x0003 if Error code is 0x0000 0x0001 if Error code is not 0x0000
4	Error word	16-bit Error Code (0x0000 for No error)
5	Wavelength: High 16 bits	High 16 bits of 32 bits integer (if No error)
6	Wavelength: Low 16 bits	Low 16 bits of 32 bits integer (if No error)
7	Checksum word	Unsigned 16-bit integer

Note: Returned wavelength number is TLS wavelength after “Step down”, if no error. Its unit is pm.

5.3.4 Host Send “Read TLS Wavelength” Command

Table 5-14: Read TLS wavelength command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x4754
2	Command Word_2	0x574C
3	Length word	0x0000
6	Checksum word	0x013E

Table 5-15: Response to Read TLS wavelength command

Field	Parameter	TLS Command
0	Head byte	0xAA (One byte head)
1	Command Word_1	0x4754
2	Command Word_2	0x574C
3	Length word	0x0003 if Error code is 0x0000 0x0001 if Error code is not 0x0000
4	Error word	16-bit Error Code (0x0000 for No error)
5	Wavelength: High 16 bits	High 16 bits of 32 bits integer (if No error)
6	Wavelength: Low 16 bits	Low 16 bits of 32 bits integer (if No error)
7	Checksum word	Unsigned 16-bit integer

5.4 Error Codes

TLS will return one of the following error codes in its response

- 1) 0x0000: No error
- 2) 0x0001: TLS received an unknown command.
- 3) 0x0002: TLS received data is “Out-of-Range”.
- 4) 0x0009: TLS received data has “Checksum error”.