Bookham TECHNOLOGY

2.5 Gb/s Tunable Transmitter Module - DWDM, 100 GHz

The MT25T transmitter module is a completely self-contained optical source for Dense Wavelength Division Multi-plexed (DWDM) applications up to 2.7 Gb/s data rates. The MT25T allows non-DWDM optical links to be upgraded very easily. A key feature is that the module can operate at one of four wavelengths on adjacent 100 GHz ITU channels and is fully configurable through a two-wire communication interface. The MT25T conforms to Telcordia OC-48 Long Reach specifications for data links to 160 Km (3000ps/nm) and beyond. Over 40 wavelengths are available as specified by the ITU grid at 100 GHz channel spacing covering the C-band EDFA window.

Features

- Four wavelengths from single module
- Advanced interface for complete configuration
- Up to 2.7 Gb/s
- ITU 100 GHz grid compliant
- 0 to +70°C operation
- High reliability optical components
- Optical Link lengths to 3000 ps/nm & beyond
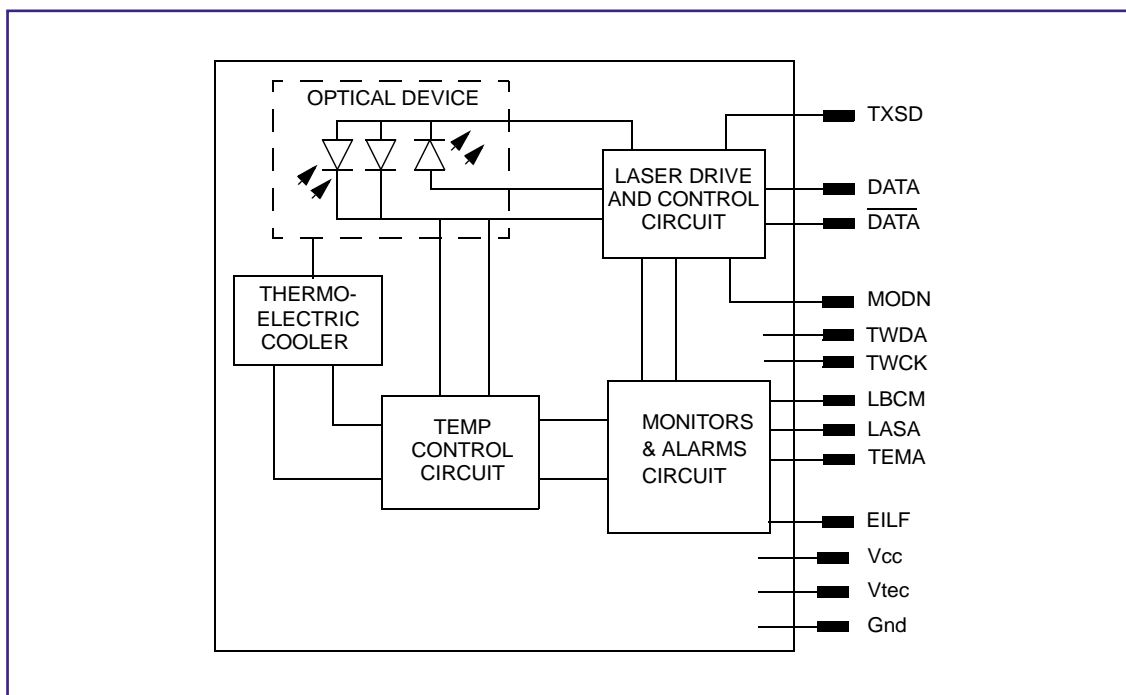- Source Wavelengths available covering the C-band EDFA window

Figure 1: Transmitter block diagram

Functional description

Power supply requirements are +5 V Vcc, +5 V Vtec and 0 V. The module has high speed complementary data inputs (PECL/ECL) which are AC coupled and have internal 50 Ω termination, transmitter disable input, modulation input for wavelength tagging, alarm and monitor supervisory outputs, **Etalon** in lock output flag. The optical output is via a single mode pigtail which can be fitted with a variety of single mode optical connectors.

The module comprises of a hermetically packaged 1550 nm BH Laser device with optical isolation and **Etalon** wavelength feedback. This ensures that the optical source remains within optical power and wavelength limits over variations in temperature and over life. Internal circuitry and a microprocessor control the operation of the module and by using a Thermo-Electric Cooler (TEC) ensures the correct laser temperature to achieve constant wavelength based on true wavelength feedback from the **Etalon** filter. The microprocessor provides a two-wire communication interface allowing customer configuration of the desired channel as well as monitoring of operating conditions and alarms.

Transmitter operation

Optical power control

The on board microprocessor provides fully automatic integrated power and wavelength control using the **Etalon** output signals as feedback. This approach enables a controlled start and inter-channel protection, as well as normal constant power control.

Transmitter disable (TXSD)

Transmitter operation can be disabled by applying a CMOS Logic 1 level to the TXSD pin. The laser can be disabled by the modules microprocessor in the event of gross failure. When disabled, output power is guaranteed < -40 dBm. The transmitter disable can be activated by the module microprocessor for gross failure of the temperature or laser circuits. In this case the microprocessor sets the Laser Alarm, Temperature Alarm and **Etalon**-in-lock flag and maintains the transmitter disable until a power on reset or toggle of TXSD.

Transmitter operation (continued)

Data input (DATA, $\overline{DATA}$)

The inputs are internally AC coupled and terminated with 50 Ω. This provides 100 Ω differential impedance. The recommended input signal must meet the required voltage swing for PECL/ECL. Due to the high speed nature of this product it is vital that high speed design rules are followed in the design of the system board. Follow the recommended user interfaces. This transmitter is not suitable for burst mode operation and unbalanced data patterns may affect the automatic constant power circuit.

Modulation input (MODN)

The modulation input allows for the use of a low frequency tone (10-500 kHz) for modulation of the "1"s level. This input is AC coupled and must be driven from a 50 Ω source. Over driving this input can cause waveform distortion. If unused, connect this input to 0 V to prevent noise pickup.

Two-wire interface (TWCK, TWDA)

The module can be configured using a two-wire communication interface with 7-bit address capability. TWCK carries the clock signal generated by the external master. TWDA carries the serial data stream.

Laser Bias Current Monitor (LBCM)

The LBCM provides an analog voltage output corresponding to the laser bias current. The LBCM output is referenced to ground and indicates the change of laser threshold as the laser ages. The LBCM output is buffered; but use with high impedance loads to reduce errors and dissipation.

Laser alarm (LASA)

The Laser Alarm is an Active High CMOS level output. The Laser Alarm is active when the optical output power is outside of operation limits.

Temperature alarm (TEMA)

The temperature alarm is an active high CMOS level output. The temperature alarm is activated when the laser temperature is approximately 1°C above or below normal laser operating temperature for **Etalon** lock. This is a high current output and can drive alarms directly.

Etalon in lock flag (EILF)

This output provides a CMOS level indication of when the wavelength is locked to the reference wavelength under **Etalon** control.

Power supplies

The module operates from a single rail power supply of +5.0 V nominal. The Thermo-Electric Cooler is supplied from a separate pin (Pin 20 Vtec). Ensure the supply to the module is well filtered and as noise free as possible to prevent any possible interference with the module (see the recommended system interface). The supply feeds to the module and TEC must be of low DC impedance with minimal voltage drop at the maximum module and TEC currents. For maximum EMI screening, the case is electrically connected to the 0 V (Gnd) pins.

Pinout

Table 1: Module pinout

Pin #	Name	Pin #	Name
1	Gnd	24	Two-wire Data
2	$\overline{\text{Data}}$	23	Two-wire Clock
3	Data	22	Gnd
4	Gnd	21	Vcc
5	Laser Disable	20	Vtec
6	Vcc	19	Temperature Alarm
7	Vcc	18	No internal connection
8	Vcc	17	Laser Alarm
9	Modulation Input	16	Laser Bias Current Monitor
10	Gnd	15	Etalon in Lock Flag
11	A4	14	A1
12	A3	13	A2

Gnd pins are connected to the module case.

Specification

Stresses beyond those in Table 2: "Absolute maximum ratings" may cause permanent damage to the module. These are stress ratings only and functional operation of the module at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied.
Exposure to absolute maximum rating conditions for extended periods may affect the module's reliability.

Table 2: Absolute maximum ratings

Parameter	Min	Max	Unit
Operating Case Temp	0	+70	°C
Shipping/storage Temp	-40	+85	°C
Relative Humidity		95	%RH
Applied Voltage(Any Pin)	-0.5	6.0	V
Lead Soldering Temp		250	C
Lead Soldering Time		10	S
Fibre Bend Radius	30		mm

Physical dimensions

Table 3: Fibre pigtail

Parameter	Min	Max	Unit
Bend Radius	30		mm
Mode Field Diameter	8.8	9.8	µm
Cladding Diameter	122	128	µm
Concentricity Error		0.5	µm
Pigtail Length (Typical) [1]	950	1050	mm

Note 1: Other pigtail fibre lengths available on request

Mechanical outline

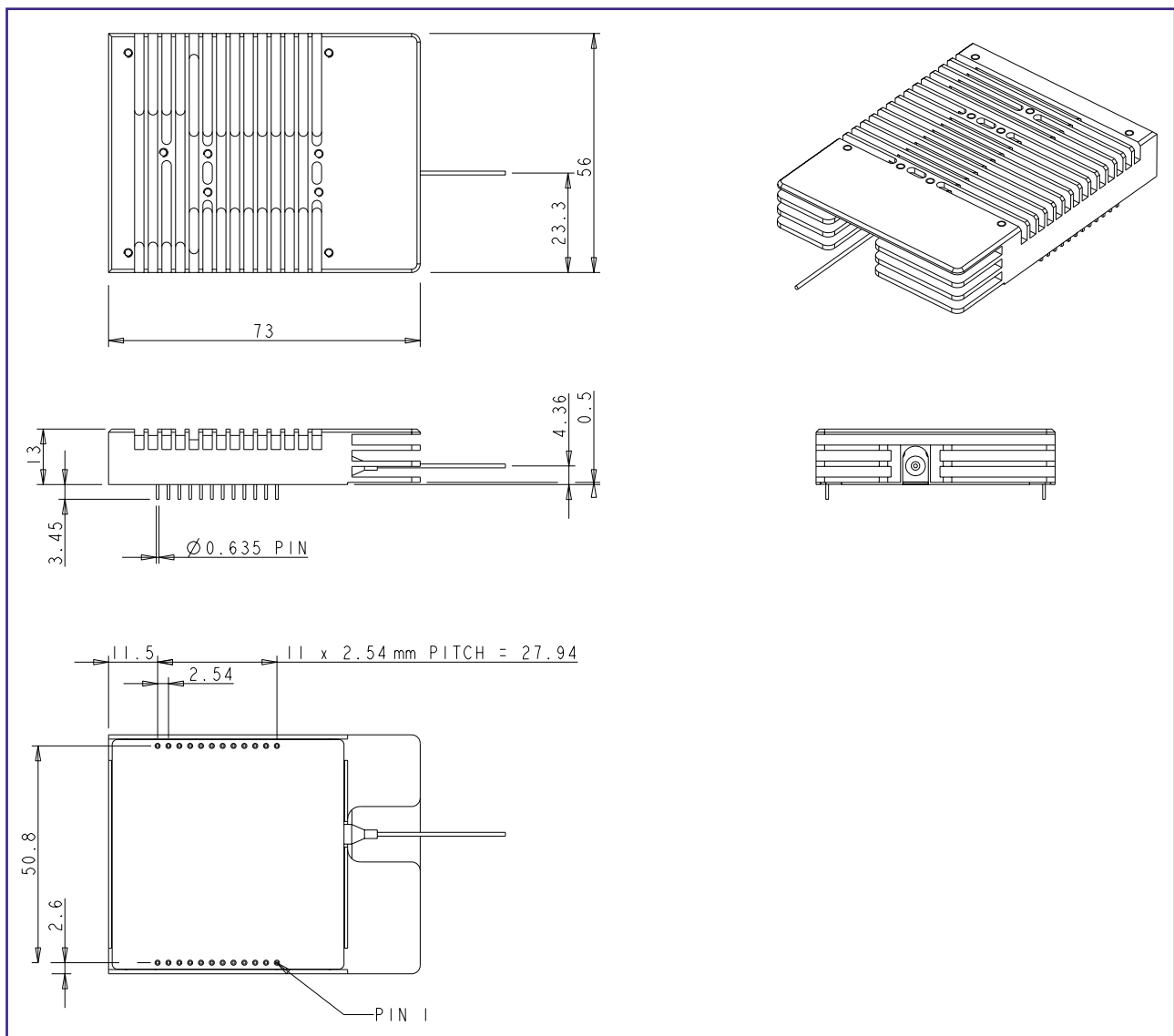All dimensions in mm unless otherwise stated, general tolerance = 0.25 mm

Figure 2: Mechanical outline

Electrical characteristics

The product is intended for use in STM16 Long-haul optical links. These are defined by ITU-T G.957, G.958, and G.692. It is also intended for use in OC48 Long/Intermediate reach optical links as defined by Telcodia TA-NWT-000253. Table 4 shows the power supply requirements and digital data levels which must be met over temperature and life.

Typical parameters are RT/SOL, MIN and MAX values are over the operating temperature and power supply range.

Data input is 2.488 Gb/s 2^{23}-1 PRBS NRZ. PECL 10 K.

Table 4: Electrical characteristics

Parameter	Min	Typ	Max	Unit	Notes
Supply Voltage Vcc	4.7	5.0	5.3	V	
Supply Voltage Vtec	4.7	5.0	5.3	V	
Supply Current Icc		190	250	mA	
Supply Current Itec			1.2	A	
Transmitter Enable voltage	0		0.8	V	
Transmitter Disable voltage	3.6		Vcc	V	
Output Disable time			0.2	us	
Output Enable time			90	s	controlled start
Laser Bias Current Monitor	0		3.6	V	
LBC Monitor - Slope	35	40	45	mV/mA	
LBC Monitor -o/p current			1	mA	
Temperature Alarm Window	-1.0		+1.0	°C	
Temperature Alarm High	Vcc-0.7			V	
Temperature Alarm Low			0.6	V	
Etalon in Lock Flag High	Vcc-0.7		Vcc	V	Note 3
Etalon in Lock Flag Low	0		0.6	V	Note 3
Laser Alarm - High	Vcc-1		Vcc	V	
Laser Alarm - Low	0		1	V	
Laser Alarm o/p current			10	mA	
Data Input Voltage	500	800	1000	mV	Pk-Pk
Data Input bit rate	0.1	2.488	2.7	Gb/s	Note 1
Modulation Voltage(RMS)	0		0.4	Vrms	Note 2
Modulation Input Frequency	10		500	kHz	

Note 1: SONET/ITU compliance is at 2.488 Gb/s.

Note 2: Actual modulation depth obtained for a given input voltage varies between modules.

Note 3: In normal operation (Etalon in lock) the flag is high. Out of lock is indicated by a low level.

Optical characteristics

Typical parameters are RT/SOL, MIN and MAX values are over the operating temperature and power supply range.

Table 5: Optical characteristics

Parameter	Min	Typ	Max	Unit	Notes
Mean Output Power, SOL	+1.5	+1.7	+2.5	dBm	Note 1
Mean Output Power, EOL	-0.5		+4.5	dBm	
Power Variation with Temp	-0.5		0.5	dB	
Wavelength	1527.22	-	1563.05	nm	Note 2
Wavelength Stability	-30		30	pm	
Spectral Width (-20 dB)			1.0	nm	
Side Mode Suppression	30			dB	
Extinction Ratio	8.2			dB	
Optical rise/fall times		150		ps	Note 4
Dispersion Penalty			2.0	dB	Note 3

Note 1: Other mean output powers available on request.

Note 2: Compliant to ITU-T G692 100 GHz grid.

Note 3: Measured with 2^23 10e-10 over 3000 ps/nm fibre

Note 4: Measured between 20% and 80% of rising/falling edge

Optical Eye/Jitter characteristics

The filtered optical eye obtained from the transmitter when driven with PRBS NRZ data must remain within the unshaded area of the SONET/SDH mask shown in Figure 3. A 4th Order Bessel Thompson with a 3 dB point at 1.49 GHz is used to filter the incoming signal before applying the mask. "0.0" and "1.0" on the mask are normalised to "0" and "1" data levels of the optical output. See Table 5 for Optical Power Outputs.
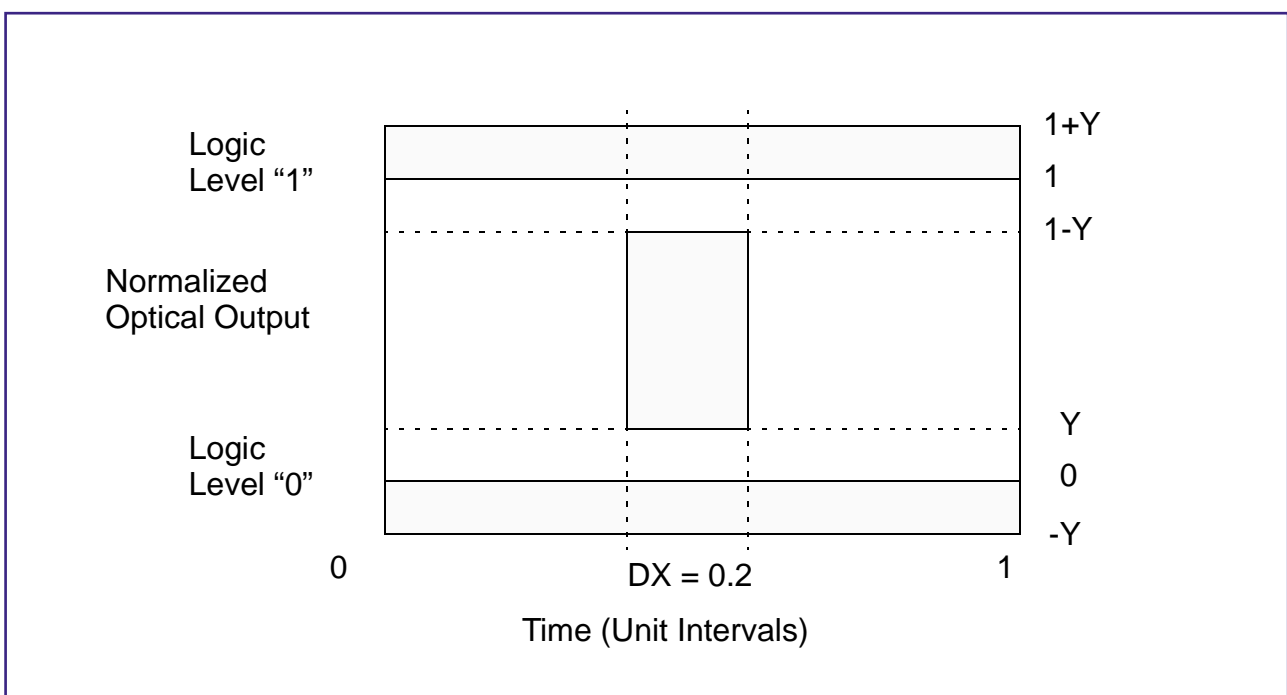

Figure 3: Optical eye/jitter characteristics

Wavelength

The tuneable module operates in groups of four wavelengths defined in Table 6: System installation.

Table 6: Wavelength selection grid

Wavelength	Part	Wavelength	Part
1528.77	MT25TAB**-**	1547.72	MT25TAH**-**
1529.55		1548.51	
1530.33		1549.32	
1531.12		1550.12	
1531.90	MT25TAC**-**	1550.92	MT25TAJ**-**
1532.68		1551.72	
1533.47		1552.52	
1534.25		1553.33	
1535.04	MT25TAD**-**	1554.13	MT25TAK**-**
1535.82		1554.94	
1536.61		1555.75	
1537.40		1556.55	
1538.19	MT25TAE**-**	1557.36	MT25TAL**-**
1538.98		1558.17	
1539.77		1558.98	
1540.56		1559.79	
1541.35	MT25TAF**-**	1560.61	MT25TAM**-**
1542.14		1561.42	
1542.94		1562.23	
1543.73		1563.05	
1544.53	MT25TAG**-**		
1545.32			
1546.12			
1546.92			

For example: MT25TAD$#-**

MT25T : Module, Transmitter, 2.488 Gb/s, Tunable DWDM

AD : Source wavelengths, 1535.04 nm, 1535.82 nm, 1536.61 nm and 1537.40 nm

$ Power C=3 mW (+1.7 dBm mean)

: Reach C=160 km

** : Connector type and fibre length

Two Wire Interface

Communication with the module is via an industry standard synchronous two-wire interface. Detailed information describing the modules implementation of this bus can be found in the references section.

Addressing

The module uses standard 7 bit addressing and has a base address of 60 h. The lower 4 bits of the address (A3 to A0) are set via the four address pins on the module. This allows up to 16 module to share one bus. These pins should be connected to Vcc to set a binary '1' and to ground to set a binary '0'. The address pins should not be left floating.

TWCK and TWDA

The two bus connections are implemented internally as an open collector interface. Pullups are not provided on board the module, these must be provided externally if the two wire bus is to be used. The value of the pullups will depend on the bus speed to be used but should be in the range 4.7 k to 10 k. The module supports two wire bus operation up to a maximum speed of 100 kHz.

Clock Stretching

After being addressed and after every byte transfer from the host to the module, the module will hold the TWCK line low whilst the onboard processor readies data for either reception or transmission. The master device must be able to comply with this clock stretching technique. The time for which the clock is held low will typically be less than 0.1 ms.

Command Structure

All commands are one byte (eight bits) long. Extra data may be sent or received depending on the command. Some parameters are readable and writable (e.g. optical channel). In this case the same command is used to read or write, but the method of addressing the module determines if a read or a write operation occurs. See the table entitled "Two Wire Commands" for a complete list for the module command set.

Sending Data

To send a command to the module, first a start condition is asserted, followed by the address of the module, with the least significant bit (the $R/\overline{W}$ bit) clear. If the address matches that of a module on the bus, the module will acknowledge (ACK) on the next clock. The command is then sent to the module, which will also be acknowledged by the module. If no further data is to be sent, a stop condition can be asserted. If more data is to be sent, the module will ACK each byte until the stop condition is asserted. In the following diagrams, Slv ACK refers to the slave device (i.e. the module) acknowledging the master device. Mst ACK refers to the master device acknowledging the slave.

Sending command only

START	ADDRESS ($R/\overline{W}$ = 0)	Slv ACK	COMMAND	Slv ACK	STOP

Sending command with extra data

START	ADDRESS (R/W = 0)	Slv ACK	COMMAND	Slv ACK	DATA1	Slv ACK	DATA2	Slv ACK	STOP

Receiving Data

To receive data from the module e.g. submount temperature, first the module is addressed for write (R/$\overline{W}$ bit clear) and the appropriate command is sent. After the module has returned an ACK, a re-start condition is asserted, and the module is readdressed for read (R/$\overline{W}$ bit set). The master can clock out the appropriate number of bytes from the module. The master must ACK the module for every byte received, apart from the last byte which the master must NACK. It is very important that the master sends NACK for the last byte, failure to do so can result in being unable to assert the stop condition if a low value has been set on the SDA line by the module.

Receiving one byte

START	ADDRESS (R/$\overline{W}$ = 0)	Slv ACK	COMMAND	Slv ACK	START	ADDRESS (R/$\overline{W}$= 1)	Slv ACK	DATA	Mst NACK	STOP

Receiving multiple bytes

START	ADDRESS (R/$\overline{W}$ = 0)	Slv ACK	COMMAND	Slv ACK	START	ADDRESS (R/$\overline{W}$= 1)	Mst ACK	DATA	Mst ACK	DATA	Mst NACK	STOP

Command Set Details

CHN (00h)

Sets or return the current operating optical channel or disables optical output. The command either accepts an unsigned one byte operand to set the channel or returns one byte on a read operation. Valid channels are:

> 00 h - Module disabled
> 01 h - Channel 1
> 02 h - Channel 2
> 03 h - Channel 3
> 04 h - Channel 4

DEF (01h)

Set or return the default power-on channel of the module. The command either accepts an unsigned one byte operand to set the channel or returns one byte on a read operation. Valid channels are:

> 00 h - Module disabled
> 01 h - Channel 1
> 02 h - Channel 2
> 03 h - Channel 3
> 04 h - Channel 4

TUN (02h)

Set or return the optical wavelength fine tune value. This command accepts an operand in the range -127 to +128 in two's complement form. This will give an adjustment range of approximately 30 pm either side of the ITU grid wavelength. This value is volatile and is defaulted to zero on power up.

TWL (03h)

Return the ITU grid wavelength in pm. Result is returned as an unsigned 32-bit value, the MSB is returned first followed by the three lower bytes. The number returned is only a guide to the nominal wavelength of the currently selected channel and does not change if e.g. the TUN command is used to shift the frequency.
Command is read-only.

LAS (04 h)

Return the laser bias current in mA. Result is returned as an unsigned 16 bit value, MSB first followed by the LSB. Command is read-only.

SBT (05 h)

Return the laser submount temperature in units of 1/10ths of a degree C, e.g. 345 = 34.5C. Result is returned as an unsigned 16 bit value, MSB first followed by the LSB. Command is read-only.

SBF (06 h)

Return the current in uA of the short wavelength back-facet monitor (BFM). Result is returned as an unsigned 16 bit value, MSB first followed by the LSB. Command is read-only.

LBF (07 h)

Return the current in uA of the long wavelength BFM. Result is returned as an unsigned 16 bit value, MSB first followed by the LSB. Command is read-only. The sum of the short and long BFM currents can be used to monitor relative optical power. The difference between the two gives an relative indication of wavelength.

STA (08 h)

Return the module status. Module returns one byte that is divided into several bit fields as shown. Command is read-only.

Status bits							
7	6	5	4	3	2	1	0
Etalon In Lock If set, all parameters are within tolerance	Temperature Alarm. If set, submount temperature is outside tolerance	Laser Alarm If set, optical power and/or ER are outside tolerance	Control loop state, see Control State table below for details				Laser Type bit Clear : one BFM Set : two BFM/Etalon

The following table describes the Control loop state bits

Status bit Description				
4	3	2	1	
0	0	0	0	THERMISTOR_STATE. (All laser types) Submount temperature is being stabilised under thermistor control
0	0	0	1	DUAL_BFM_ACQ_STATE. (Etalon laser only) Submount temperature stabilised. Laser drive increased until a valid response is obtained from BFM's
0	0	1	0	DUAL_BFM_RAMP_STATE (Etalon laser only) Submount temperature now under Etalon control. Optical power and extinction are ramping to their final values.
0	0	1	1	DUAL_BFM_LOCK_LASER (Etalon laser only) Wavelength, optical power and extinction ratio have stabilised at their pre-set values. Module is ready for use.
0	1	0	0	DISABLE (All lasers types) A fault has caused the module to disable the laser.
0	1	0	1	POWER_UP (All laser types) First state after power up. Laser is disabled while the microcontroler initialises peripherals.
0	1	1	0	EXTERNAL_LASER_DISABLE (All laser types) User has disabled the laser via the module disable input.
0	1	1	1	SYSTEM_CONFIG (All laser types) Module is initialising all calibration parameters after a power on.
1	0	0	0	SINGLE_BFM_ACQ_STATE (Single BFM laser only) Submount temperature stabilised. Laser drive increased until a valid response is obtained from BFM's
1	0	0	1	SINGLE_BFM_RAMP_STATE (Single BFM laser only) Optical power and extinction ratio ramped up to final values.
1	0	1	0	SINGLE_BFM_LOCK_LASER (Single BFM laser only) Wavelength, optical power and extinction ratio have stabilised at their pre-set values. Module is ready for use.
1	0	1	1	OPEN_LOOP (All Laser types) For factory set-up and calibration purposes. The state can only be initialised via a command that is unavailable after calibration.

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SER (09 h)

Return the module serial number. The serial number is 9 characters long and will typically include upper-case letters A-Z, digits 0-9, a period "." separator and may contain spaces to pad the serial number to nine characters if needed.
All characters are returned in ASCII format. The serial number is sent in logical order i.e. first digit of the number is sent first. Command is read-only

THR (0A h)

Returns the laser threshold calibration. Calibration value is returned as an unsigned 16 bit value, MSB first. This value is a factory set calibration value for internal control loop operation. The value is specific to each optical channel that the module supports and the value will not change under normal operation. Command is read-only.

MOD (0B h)

Returns the laser modulation calibration. Calibration value is returned as an unsigned 16 bit value, MSB first. This value is a factory set calibration value for internal control loop operation. The value is specific to each optical channel that the module supports and the value will not change under normal operation. Command is read-only.

BIS (OC h)

Returns the laser bias calibration. Calibration value is returned as an unsigned 16 bit value, MSB first. This value is a factory set calibration value for internal control loop operation. The value is specific to each optical channel that the module supports and the value will not change under normal operation. Command is read-only.

WAV (0D h)

Returns the laser wavelength calibration. Calibration value is returned as an unsigned 16 bit value, MSB first. This value is a factory set calibration value for internal control loop operation. The value is specific to each optical channel that the module supports and the value will not change under normal operation. Command is read-only.

THM (10 h)

Returns the submount temperature calibration. Calibration value is returned as an unsigned 16 bit value, MSB first. This value is a factory set calibration value for internal control loop operation. The value is specific to each optical channel that the module supports and the value will not change under normal operation. Command is read-only.

MCH (12 h)

Returns the number of optical channels that the module supports. Value is returned as an 8 bit unsigned value with a value from 1 to 4. Command is read-only.

FWR (13 h)

Returns the firmware revision. Result is returned as two unsigned bytes. The first value returned is the major revision number, the second is the minor revision. Command is read-only.

POW (16h)

Returns transmitted optical power in uW. The reported power will only be accurate whilst the module is wavelength locked (EIL flag active). During start-up and under certain fault conditions this monitor may not return an accurate representation of the transmitted power. Command is read-only.

Two Wire Command Summary

Command-Mnemonic	Command byte	Write Values	Read Values	Function
CHN	00 h	(1 byte) 00 h Disable 01 h Channel 1 02 h Channel 2 03 h Channel 3 04 h Channel 4	(1 byte) 00 h Disabled 01 h Channel 1 02 h Channel 2 03 h Channel 3 04 h Channel 4	Set or read current optical channel or disable device
DEF	01 h	(1 byte) 00 h Wait 01 h Channel 1 02 h Channel 2 03 h Channel 3 04 h Channel 4	(1 byte) 00h Wait 01 h Channel 1 02 h Channel 2 03 h Channel 3 04 h Channel 4	Set or read optical channel to use at power up. 0x00 causes the module to power up in a disabled state.
TUN	02 h	(1 signed byte -80 to +80	(1 signed byte -80 to +80	Fine tune the current wavelength
TWL	03 h	-	(4 bytes) 32 bit value sent MSB first.	Returns the wavelength of the current channel in pm.
LAS	04 h	-	(2 bytes) 16 bit value sent MSB first	Returns the laser bias current in mA.
SBT	05 h	-	(2 bytes) 16 bit value sent MSB first	Returns the current submount temperature in C*10 (e.g. 125 would be 12.5 C)
SBF	06 h	-	(2 bytes) 16 bit value sent MSB first	Returns the BFM current on the short wavelength side of the Etalon. Result is in uA.
LBF	07 h	-	(2 bytes) 16 bit value sent MSB first	Returns the BFM current on the long wavelength side of the Etalon. Result is in uA.
STA	08 h	-	(1 byte)	Return status byte.
SER	09 h	-	(9 bytes)	Returns the serial number of the module.
THR	0A h	-	(2 bytes) 16 bit value sent MSB first	Returns laser threshold calibration for the current channel
MOD	0B h	-	(2 bytes) 16 bit value sent MSB first	Returns laser modulation calibration for the current channel
BIS	0C h	-	(2 bytes) 16 bit value sent MSB first	Returns laser bias calibration for the current channel
WAV	0D h	-	(2 bytes) 16 bit value sent MSB first	Returns laser wavelength calibration for the current channel
THM	10 h	-	(2 bytes) 16 bit value sent MSB first	Return submount temperature calibration for the current channel
MCH	12 h	-	(1 byte)	Returns the number of optical channels the module supports (1 to 4)
FWR	13 h	-	(2 bytes)	Return firmware revision in the form Major/Minor e.g. first byte = 1, second byte = 2 would be revision 1.2
POW	16h	-	(2 bytes) 16 bit value, MSB first	Returns transmitted optical power in uW

Thinking optical solutions

System installation

Electrostatic precautions

The module has built in protection and is qualified to ±500 V, however the following procedures for handling ESD sensitive devices are recommended:

- reduce body charge by using non metallic carbon wrist stations
- ground the measuring and inspecting equipment and the work stations
- conduct assembly and testing at static protected work areas
- open shipment cartons in a static protected area
- make carrier jigs and packing cases conductive

Fibre handling

The secondary coated fibre pigtail has a nominal length of 1000 mm. Do not subject the fibre to excessive force and observe the minimum bend radius of 30 mm. The standard connector is a SC, C28 type. During soldering operations the fibre must be protected from excessive heat, maximum 85°C, and flux/cleaner contamination.

Soldering

It is recommended that the module is hand soldered. If wave soldering is used observe the maximum temperature and soldering times. In addition the case, which is not sealed, must not be immersed in or sprayed with any liquids.

General PCB layout guidelines

This module is a high speed electronic device. If the following advice is not adhered to, the module may fail to operate as required:

- follow high speed ECL design rules
- all high speed output lines must be controlled impedance lines with the termination impedance matching the line impedance. Ensure that paired lines such as DATA and DATA are of equal length. Avoid impedance interruptions such as 90 o bends
- ensure that data and clock lines are as short and as straight as possible, and are isolated from noise sources and from each other
- ensure that the +5 V supply rail is decoupled and filtered
- use a multilayer PCB so that the ground plane surrounds the area underneath and around the receiver. Attach all ground pins directly to the ground plane with no additional lead length
- all unused outputs must be terminated. Recommended components are surface mount resistors and ceramic capacitors, X7R or equivalent

Recommended system interface
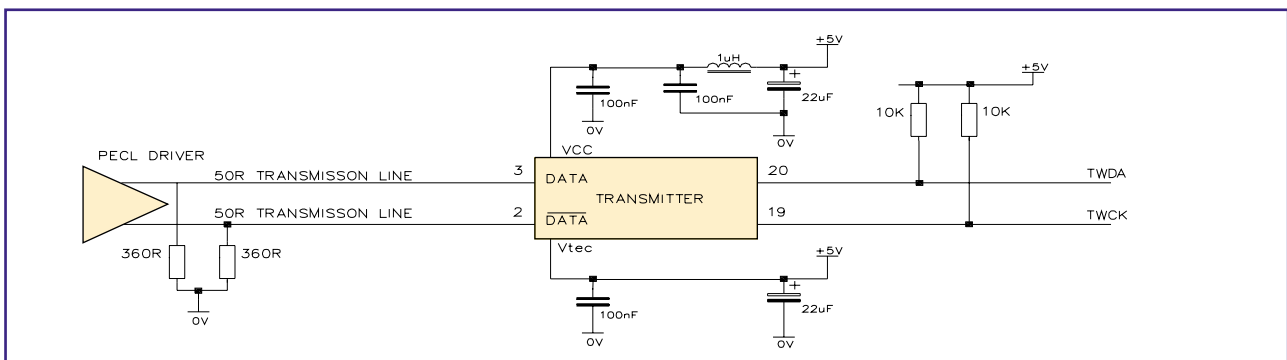
Transmitter safety

Materials used meet fire safety specification UL94V1 with an oxygen index of greater than 28% except for the following:

Single mode Hytrel secondary coated fibre. The oxygen index of this material is of the order of 21%. The material has been subjected to the needle flame test and sustains a flame

Santoprene 251/80 silicon free Protective boot. UL94 flame rating 1.39 mm V-0, LOI 25%

The volume of this material is very small compared to the volume content of the expected system into which the device is mounted. As this material is not concentrated in one area, (since the fibre should not be coiled tighter than a radius of 30 mm) it is considered suitable for use.

Ordering Information

For information on ordering this product please refer to table 6 on page 8 of this document.

INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY
WITH OPTICAL
INSTRUMENTS
CLASS 1M LASER

REFERENCE IEC 60825-1: Edition 1.2

DANGER

INVISIBLE LASER RADIATION
AVOID DIRECT
EXPOSURE TO BEAM

OUTPUT POWER 3 mW
WAVELENGTH >1527 nm

CLASS I for non-viewed sources

This product complies with 21CFR 1040.10 and has been assessed as Class I for non-viewed sources

CAUTION
STATIC SENSITIVE DEVICE
OBSERVE PRECAUTIONS

Certificate No. FM 15040

Certificate No. EMS 35100

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