Logic Interface Laser Transmitter

Application Note 1130

XMT5170, XMT5370

Introduction

This application note details the recommended circuit connections for the XMT5x70 laser transmitter. The XMT5x70 is a multisourced SONET/SDH laser transmitter. The device will operate from a single supply rail with the XMT5x70A version specified for -40°C to +85°C operation and the XMT5x70B version operated from 0°C to +70°C.

Evaluation Board (Part No. 101017.000)

Hewlett-Packard supplies an evaluation board , as shown in Figure 1, to provide power and interface connections to the device. Figure 2 shows the evaluation circuit diagram.

The evaluation board operates from between - 8 V and -15 V bias. This voltage is regulated for the device supply rail. Adjustment of potentiometer VR1 will adjust the module supply rail to enable testing over the specified range (-4.75 V to -5.5 V). The bias monitor (IB MON) and rear facet monitor (IM MON) are accessible via a connector mounted on the pcb.

Product Code Information

XMT5x70x-xxx-xx

- Connector Options
- 155 = 155 Mb/s, 622 = 622 Mb/s
- A = -40°C to +85°C, B = 0°C to +70°C
- 1 = Long Reach, 3 = Intermediate Reach

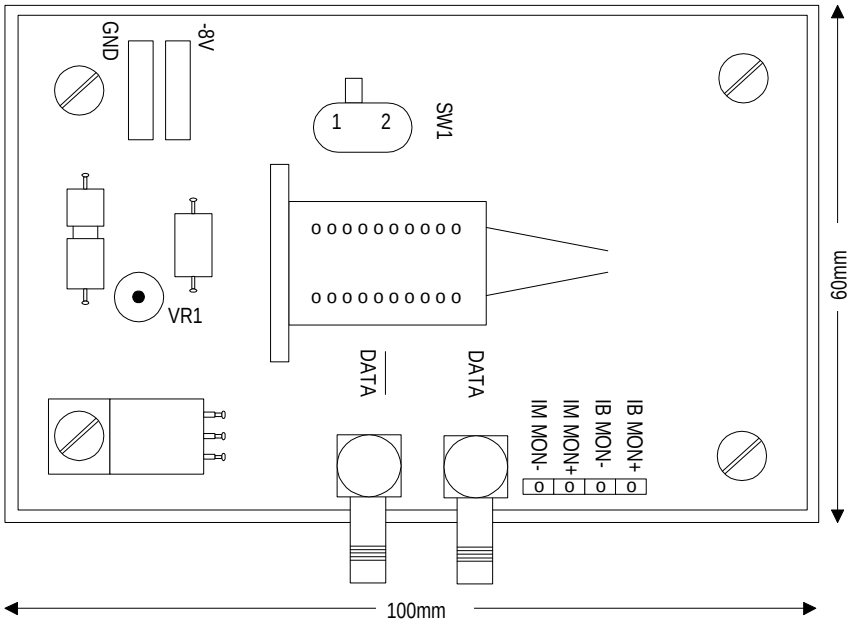
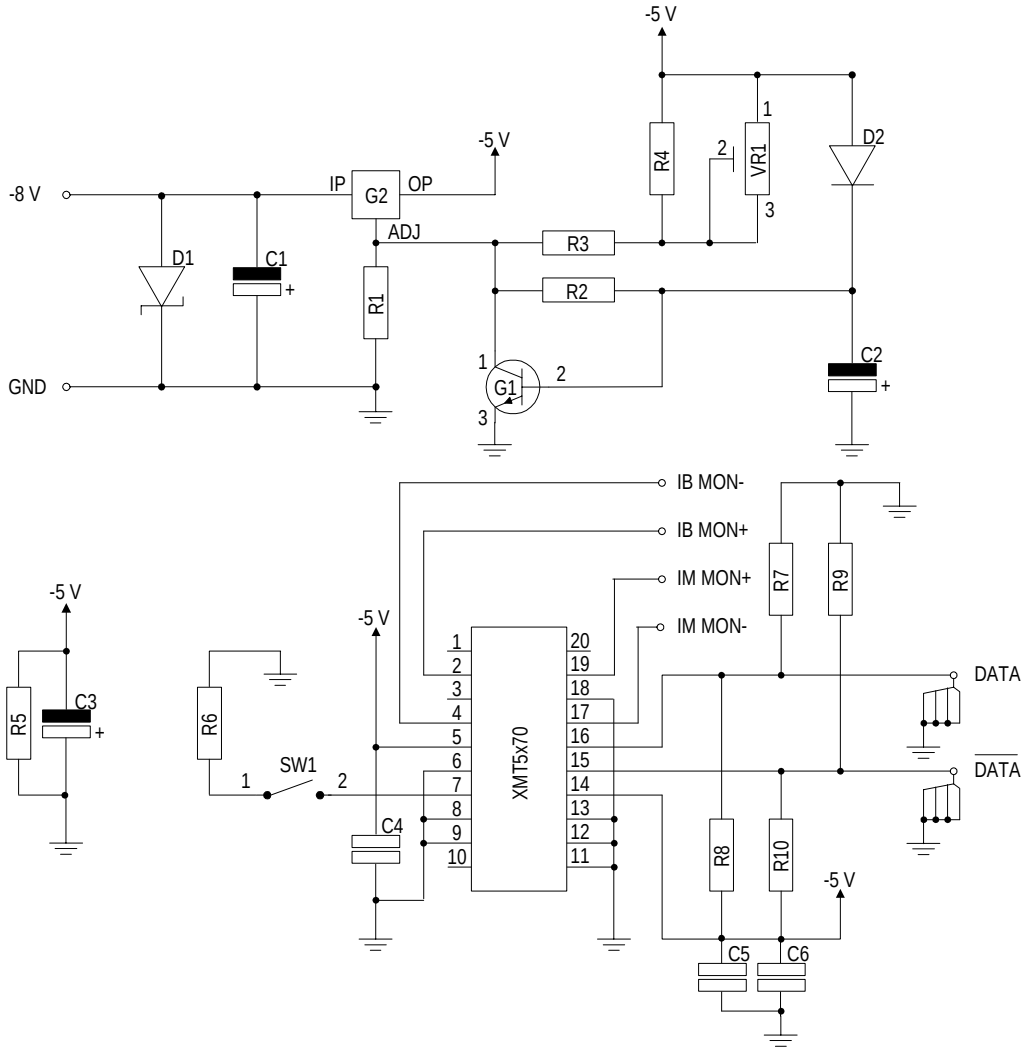


Figure 1. Evaluation Board



Ref.	Description	Qty.	Ref.	Description	Qty.
R1	360R 1% - 0805 Chip Resistor	1	C1	2.2 µF 10% 10 V - 1206 Chip Tantalum Capacitor	1
R2	51K 5% - 0805 Chip Resistor	1	C2	22 µF 10 V Axial Electrolytic Capacitor	1
R3	100R 1% - 0805 Chip Resistor	1	C3	3.3 µF Tantalum Capacitor	1
R4	91R 1% - 0805 Chip Resistor	1	C4	0.1 µF 10% - 1206 Chip Capacitor	1
R5	4.7K 5% - 0805 Chip Resistor	1	C5	0.1 µF 10% - 1206 Chip Capacitor	1
R6	510R 5% - 0805 Chip Resistor	1	C6	0.1 µF 10% - 1206 Chip Capacitor	1
R7	82R 5% - 0805 Chip Resistor	1	D1	1N6276 - 9.5 mm x 5.2 mm Diode	1
R8	130R 5% - 0805 Chip Resistor	1	D2	BAV99 - SOT23 Packaged Diode	1
R9	82R 5% - 0805 Chip Resistor	1	G1	BFS17 - SOT23 Packaged Transistor	1
R10	130R 5% - 0805 Chip Resistor	1	G2	LM337T - TO220 Packaged Voltage Regulator	1
VR1	50R - Ø6.35 mm Plastic Body Variable Resistor	1	SW1	S.P.D.T. - RS332-818 Right Angled Slide Switch	1

Figure 2. Evaluation Circuit Diagram

On the evaluation board SMA connections are provided for differential ECL interfacing. The termination resistors are provided. If single-ended input is required the termination resistors on the unused input should be removed and then ac coupled to ground.

SW1 is the disable switch. The module is normally enabled if no connection is made to the disable pin 7. With no connection the disable input is internally pulled to V_{EE} with a 100 kΩ resistor. SW1 will connect pin 7 to V_{CC} to disable the module when in position (2).

The evaluation board contains a variable voltage regulator serving two functions. The first is to enable voltage characterization. The second is to provide a slow turn-on of the device power supply. This will prevent damage from p.s.u. turn-on transients. A zener diode across the evaluation board p.s.u. input limits the voltage input to -18 V.

Functional Description

The ECL input allows operation from many logic families and both single-ended or differential signals.

The disable function disables the laser bias and modulator. The switching threshold is V_{CC} -3.2 V. If this input is not connected the module is enabled. This input may be connected to a CMOS HI or tied to V_{CC} to disable.

The module provides the necessary bias and modulation control to maintain the extinction ratio according to specification and the waveform is compliant with SONET/SDH Eyemask standard G.957.

The laser bias control loop compensates for temperature induced variations in laser performance. The bias current monitor indicates the amount of dc current supplied to the laser. (This is approximately the laser threshold current).

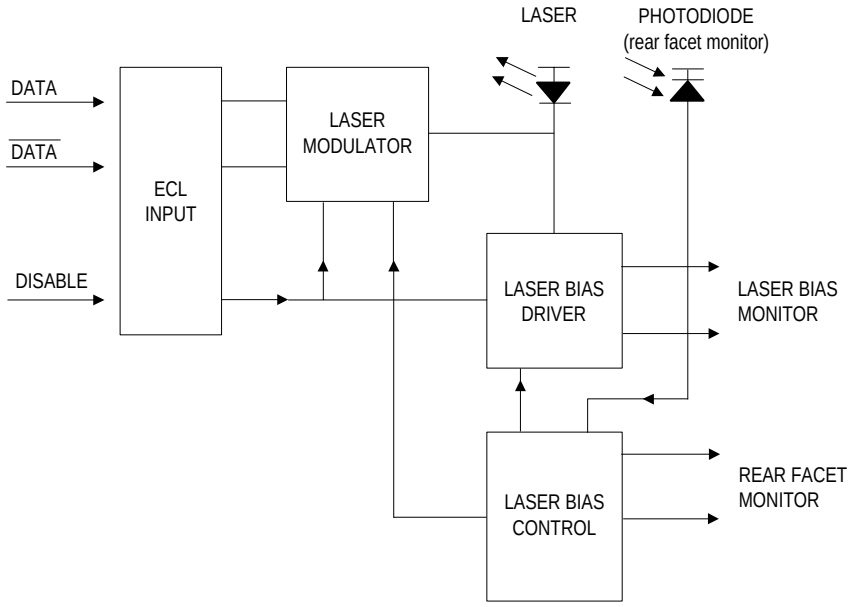


Figure 3. Simplified Transmitter Schematic

The rear facet monitor is a signal proportional to the laser output power. This can be used as part of a HI/LO light alarm.

In the absence of data the laser will emit a mean optical power within the specified limits. The extinction ratio and duty cycle distortion are specified assuring a 50% duty cycle at the correct data rate.

Electrical Characteristics

Table 3 provides a description of the function and use of each pin of the XMT5X70.

Supply voltage

The XMT5x70 module will operate with either a positive or negative supply in the range ±4.75 V to ±5.5 V. V_{CC} must always be positive with respect to V_{EE}. All pins labeled V_{CC} or V_{EE} must be connected. Pins labeled N/C must, under no circumstances, be connected. Connections are accessible via pins 11 and 13 and should be connected to the system ground.

Care should be taken to avoid supply transients. The filter network shown in Figure 4 should be placed as close as possible to the device supply pins.

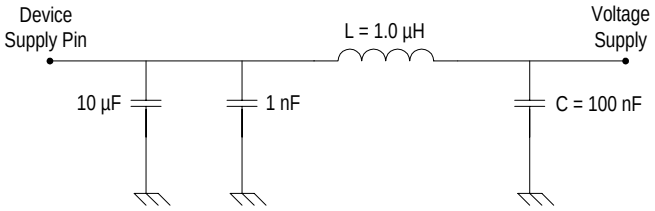


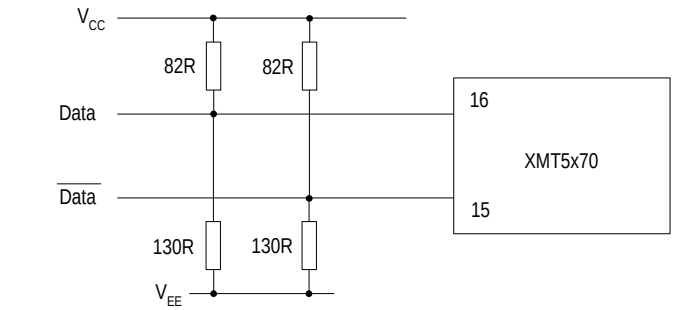
Figure 4. Protection Circuit

Data inputs
The DATA and $\overline{DATA}$ inputs will accept standard ECL levels (10 kH ECL, PECL). The use of standard logic levels is recommended although the inputs will toggle with logic swings as low as 250 mV peak to peak when driven differently.

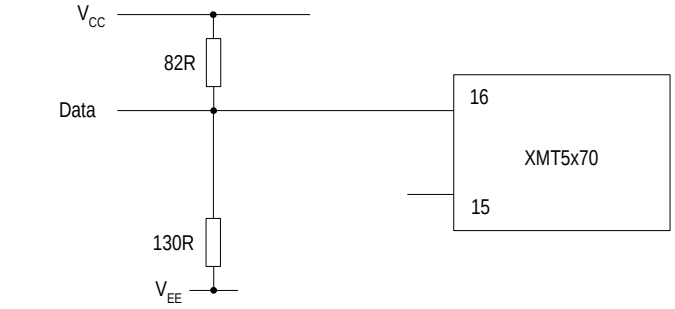
The inputs may be ac coupled in all cases. This will be required for operation from a positive rail. Care must be taken to choose a large enough capacitor to give the required low frequency cutoff. The frequency is defined as $1/2\ \pi$ RC (Hz) where R is the termination resistor. The low frequency cutoff should be set to be at least a factor of 10 below the lowest frequency content of the transmitted signal.

Both DATA inputs are internally tied to V_{BB}. For single ended operation no connection or biasing is required at the unused input. With single-ended data - some additional duty cycle distortion (DCD) may be experienced due to input current imbalance. Decoupling the unused input will improve this and reduce signal noise.

Signal input
The module input will require a 50% duty cycle signal for normal operation. Failure to provide this may cause the optical parameters to move out of specification. Extinction ratio and duty cycle distortion may be compromised. The low frequency cutoff of the transmitter mean power control loop is <20 Hz.



a) Differential drive



b) Single-ended drive

Figure 5. Recommended Interfaces

In the absence of data the module will emit a mean optical power within the specified limit.

The module will function with up to 72 consecutive 1's or 0's within the PRBS as specified by CCITT for STM-1.

Enable/disable
The module is normally enabled. The disable input pin 7 is internally pulled to V_{EE} with a 100 kΩ resistor. To ensure switching to disable, Pin 7 must be pulled to V_{CC} -3.2 V min. Ideally, tied to V_{CC}. The switching threshold will vary with supply voltage but V_{CC} -3.2 V will ensure switching.

When the module is disabled all current to the laser is removed resulting in zero optical output power.

Analogue monitor points

Bias monitor
The laser bias monitor is implemented as in Figure 6.

During normal (modulated) operation the bias current will be approximately the laser threshold. In the absence of data the bias current will be equal to the laser forward current required to give the correct optical output power. i.e.
Threshold + $\frac{\text{Modulation current}}{2}$
current
The differential voltage generated between Pin 2 and Pin 4 is 10 mV/mA with a common mode voltage of approximately V_{CC} -1.6 V (to Pin 2).

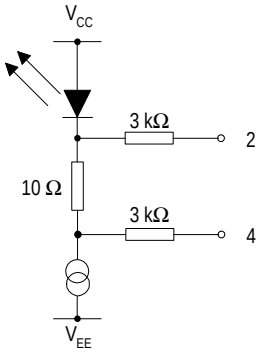


Figure 6. Bias Monitor

This monitor may be used to detect an end-of-life bias current. A typical example is to have an end-of-life current of 40 mA. This will give a differential voltage of 0.7 V at end-of-life and T_{MAX}.

It is important to note that if such an alarm is used the absence of data may cause a false alarm.

Users should note that bias current is temperature dependent. The laser used in this product exhibits extremely small threshold currents such that operational temperatures below +25°C may provide a differential voltage too low for use by an end-of-life alarm circuit. For more accurate alarms it is recommended that a temperature compensated alarm operation point will need to be provided by the user. For most applications a 40 mA end-of-life alarm will be sufficient.

Laser rear facet monitor
The laser diode has a monitor photodiode to measure rear facet power. This is used in the output power control loop.

Under normal operation, modulated or not, this voltage will remain constant ±10% (over life, over temperature). The absolute value will vary with each module. The range is typically 5 mV to 50 mV. The monitor is implemented as shown in Figure 7.

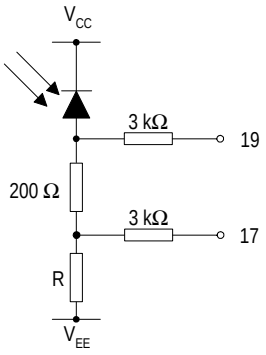


Figure 7. Laser rear facet monitor

The differential voltage is measured between Pin 19 and Pin 17 with the common mode voltage typically V_{CC} -4 V (to Pin 19).

This monitor may be used to detect a high or low power failure. Any such failure would be catastrophic and so the alarm should be set to ±50% of the initial value.

Pigtail

The fiber used is step index single Mode floppy fiber. Typical parameters are as shown in Table 1.

Table 1.

Cladding diameter	125 µm
Core diameter	9 µm
Cutoff wavelength	1150 nm - 1200 nm
Concentricity	<1.0 µm
Attenuation (@ 1300 nm)	<0.5 dB/km
Cladding non-circularity	<2%

Regulatory Compliance

The transmitter is intended to enable commercial system designers to develop equipment that complies with the various regulations governing Certification of Information Technology Equipment (See Table 2). Additional information is available from your Hewlett-Packard sales representative.

Electrostatic Discharge (ESD)

There are two design cases in which immunity to ESD damage is important.

The first case is during handling of the transmitter prior to mounting it on the circuit board. It is important to use normal ESD handling precautions for ESD sensitive devices. These precautions include using grounded wrist straps, work benches, and floor mats in ESD controlled areas.

The second case to consider is static discharges to the exterior of the equipment chassis containing the transmitter parts.

Electromagnetic Interference (EMI)

Most equipment designs utilizing these high-speed transmitters from Hewlett-Packard will be required to meet the requirements of FCC in the United States, CENELEC EN55022 (CISPR 22) in Europe and VCCI in Japan.

The XMT5x70 has been characterized without a chassis enclosure. Performance of a system containing these transmitters within a well designed chassis is expected to be better than the results of these tests with no chassis enclosure.

Table 2. Regulatory Compliance - Typical Performance

Feature	Test Method	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883C Method 3015.4	>500 V Based on Human Body Model.
Eye Safety	IEC 825/CDRH Class 1	CDRH Accession Number: XMT5x7x-xxx 9111445-06 TUV Bauart License: XMT5x70x-155 933/510703/02 XMT5x70x-622 933/510703/04

Table 3. Pin Out Table

Pin	Symbol	Functional Description
1	NC	This pin should not be connected and should be left open circuit on the application board.
2	Laser Bias Monitor(+)	This analogue current is monitored by measuring the voltage drop across a 10 ohm resistor placed between high impedance resistors connected to pins 2 and 4, internal to the transmitter.
3	NC	This pin should not be connected and should be left open circuit on the application board.
4	Laser Bias Monitor(-)	This analogue current is monitored by measuring the voltage drop across a 10 ohm resistor placed between high impedance resistors connected to pins 2 and 4, internal to the transmitter.
5	V_{EE}	This pin is connected to ground in +5 V systems and -5 V in negative supply systems. If connected to -5 V supply, the filter network shown in Figure 4 should be placed as close as possible to this pin.
6	V_{CC}	This pin is connected to +5 V in positive supply systems and ground in -5 V systems. If connected to +5 V supply, the filter network shown in Figure 4 should be placed as close as possible to this pin.
7	Transmit Disable	This input pin floats to V_{EE} when left open circuit, enabling the transmitter. It must be biased to within 3 V of V_{CC} to disable.
8	V_{CC}	This pin is connected to +5 V in positive supply systems and ground in -5 V systems. If connected to +5 V supply, the filter network shown in Figure 4 should be placed as close as possible to this pin.
9	V_{CC}	This pin is connected to +5 V in positive supply systems and ground in -5 V systems. If connected to +5 V supply, the filter network shown in Figure 4 should be placed as close as possible to this pin.
10	NC	This pin should not be connected and should be left open circuit on the application board.
11	Case Ground	The XMT5x70's case is plastic, therefore this pin is not connected.
12	V_{CC}	This pin is connected to +5 V in positive supply systems and ground in -5.2 V systems. If connected to +5 V supply, the filter network shown in Figure 4 should be placed as close as possible to this pin.
13	Case Ground	The XMT5x70's case is plastic, therefore this pin is not connected.
14	V_{EE}	This pin is connected to ground in +5 V systems and -5 V in negative supply systems. If connected to -5 V supply, the filter network shown in Figure 4 should be placed as close as possible to this pin.
15	$\overline{\text{DATA}}$	This is a differential ECL input. If open circuit this pin will float to V_{BB} (V_{CC} -1.3 V). If this is an unused input then this pin requires no connection or biasing.
16	DATA	This is a differential ECL input. If open circuit this pin will float to V_{BB} (V_{CC} -1.3 V). If this is an unused input then this pin requires no connection or biasing.

Table 3. Pin Out Table (continued)

Pin	Symbol	Functional Description
17	Laser Back Facet Monitor(-)	This pin provides a voltage proportional to the laser output power with respect to pin19. This analogue current is monitored by measuring the voltage drop across a 200ohm resistor placed between high impedance resistors connected to pins 17 and 19 internal to the transmitter.
18	V_{CC}	This pin is connected to +5 V in positive supply systems and ground in -5 V systems. If connected to +5 V supply, the filter network shown in Figure 4 should be placed as close as possible to this pin.
19	Laser Back Facet Monitor(+)	This pin provides a voltage proportional to the laser output power with respect to pin19. This analogue current is monitored by measuring the voltage drop across a 200ohm resistor placed between high impedance resistors connected to pins 17 and 19 internal to the transmitter.
20	NC	This pin should not be connected and should be left open circuit on the application board.

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