

## Product Features

- Compliant with ITU-T G.695
- Compliant with SFF-8074i and SFF-8472, revision 9.5
- Compliant with SFP MSA Specification
- Digital Diagnostic Monitoring available
- CWDM wavelengths, Uncooled DFB laser
- Full to O-band wavelength
- Up to 1.25Gb/s bi-directional data links
- Duplex LC connector compliant
- Single +3.3V DC power supply
- Hot-pluggable SFP footprint
- Digital Diagnostic Monitoring available
- Class 1 laser safety certified
- Commercial operating temperature:  
0°C to +70°C
- RoHS6 Compliant



## Applications

- Gigabit Ethernet 1000Base-EZX
- 1.0625Gb/s Fiber Channel
- Enterprise Router
- Switch to Switch Interface
- Other Optical Links

## Descriptions

LX151xCDL SFP transceivers, according to Small Form Factor Pluggable Multi-Sourcing Agreement (MSA) SFF-8074i and SFF-8472, revision 9.5, are designed for Gigabit Ethernet and Fibre Channel CWDM networking systems. They are available in eighteen different CWDM wavelengths over full O-band wavelength.

LX151xCDL are compliant with RoHS.

## Ordering Information

**Table 1. Ordering Information**

Part Number	Transmitter	Output Power	Receiver	Sensitivity	Reach	Temp	DDM	RoHS
LX1511CDL	1271nm DFB	0 ~ +5dBm	APD	< -32dBm	100km	0 ~ 70 °C	Available	Compliant
LX1512CDL	1291nm DFB	0 ~ +5dBm	APD	< -32dBm	100km	0 ~ 70 °C	Available	Compliant
LX1513CDL	1311nm DFB	0 ~ +5dBm	APD	< -32dBm	100km	0 ~ 70 °C	Available	Compliant
LX1514CDL	1331nm DFB	0 ~ +5dBm	APD	< -32dBm	100km	0 ~ 70 °C	Available	Compliant
LX1515CDL	1351nm DFB	0 ~ +5dBm	APD	< -32dBm	100km	0 ~ 70 °C	Available	Compliant
LX1516CDL	1371nm DFB	0 ~ +5dBm	APD	< -32dBm	100km	0 ~ 70 °C	Available	Compliant
LX1517CDL	1391nm DFB	0 ~ +5dBm	APD	< -32dBm	100km	0 ~ 70 °C	Available	Compliant
LX1518CDL	1411nm DFB	0 ~ +5dBm	APD	< -32dBm	100km	0 ~ 70 °C	Available	Compliant

LX1519CDL	1431nm DFB	0 ~ +5dBm	APD	< -32dBm	100km	0 ~ 70 °C	Available	Compliant
LX1520CDL	1451nm DFB	0 ~ +5dBm	APD	< -32dBm	100km	0 ~ 70 °C	Available	Compliant

## Pin Description

**Table 2. Pin Description**

Pin	Name	Function/Description	Engagement order (Insertion)	Notes
1	VeeT	Transmitter Ground	1	-
2	TX Fault	Transmitter Fault Indication	3	1
3	TX Disable	Transmitter Disable-Module disables on high or open	3	2
4	MOD-DEF2	Module Definition 2-Two wire serial ID interface	3	3
5	MOD-DEF1	Module Definition 1-Two wire serial ID interface	3	3
6	MOD-DEF0	Module Definition 0-Grounded in module	3	3
7	Rate Select	Not Connected	3	-
8	LOS	Loss of Signal	3	4
9	VeeR	Receiver Ground	1	-
10	VeeR	Receiver Ground	1	-
11	VeeR	Receiver Ground	1	-
12	RD-	Inverse Received Data out	3	5
13	RD+	Received Data out	3	5
14	VeeR	Receiver Ground	1	-
15	VccR	Receiver Power - +3.3V±5%	2	6
16	VccT	Transmitter Power - +3.3 V±5%	2	6
17	VeeT	Transmitter Ground	1	-
18	TD+	Transmitter Data In	3	7
19	TD-	Inverse Transmitter Data In	3	7
20	VeeT	Transmitter Ground	1	-

**Notes:**

- TX Fault is open collector/drain output which should be pulled up externally with a 4.7KΩ-10KΩ resistor on the host board to supply <math>V\_{ccT} + 0.3V</math> or <math>V\_{ccR} + 0.3V</math>. When high, this output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to <math>< 0.8V</math>.
- TX Disable input is used to shut down the laser output per the state table below. It is pulled up within the module with a 4.7KΩ-10KΩ resistor.
 

Low (0 – 0.8V):	Transmitter on
Between (0.8V and 2V):	Undefined
High (2.0 – VccT):	Transmitter Disabled
Open :	Transmitter Disabled
- Mod-Def 0, 1, 2. These are the module definition pins. They should be pulled up with a 4.7KΩ-10KΩ resistor on the host board to supply less than <math>V\_{ccT} + 0.3V</math> or <math>V\_{ccR} + 0.3V</math>.

Mod-Def 0 is grounded by the module to indicate that the module is present.

Mod-Def 1 is clock line of two wire serial interface for optional serial ID.

Mod-Def 2 is data line of two wire serial interface for optional serial ID.

4. LOS (Loss of signal) is an open collector/drain output which should be pulled up externally with a 4.7KΩ-10KΩ resistor on the host board to supply  $<V_{ccT}+0.3V$  or  $V_{ccR}+0.3V$ . When high, this output indicates the received optical power is below the worst case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to  $<0.8V$ .
5. RD-/+ : These are the differential receiver outputs. They are AC coupled 100Ω differential lines which should be terminated with 100Ω differential at the user SERDES. The AC coupling is done inside the module and thus not required on the host board.
6. VccR and VccT are the receiver and transmitter power supplies. They are defined as  $3.3V\pm 5\%$  at the SFP connector pin. The in-rush current will typically be no more than 30mA above steady state supply current after 500ns.
7. TD-/+ : These are the differential transmitter inputs. They are AC coupled differential lines with 100Ω differential termination inside the module. The AC coupling is done inside the module and is thus not required on host board.

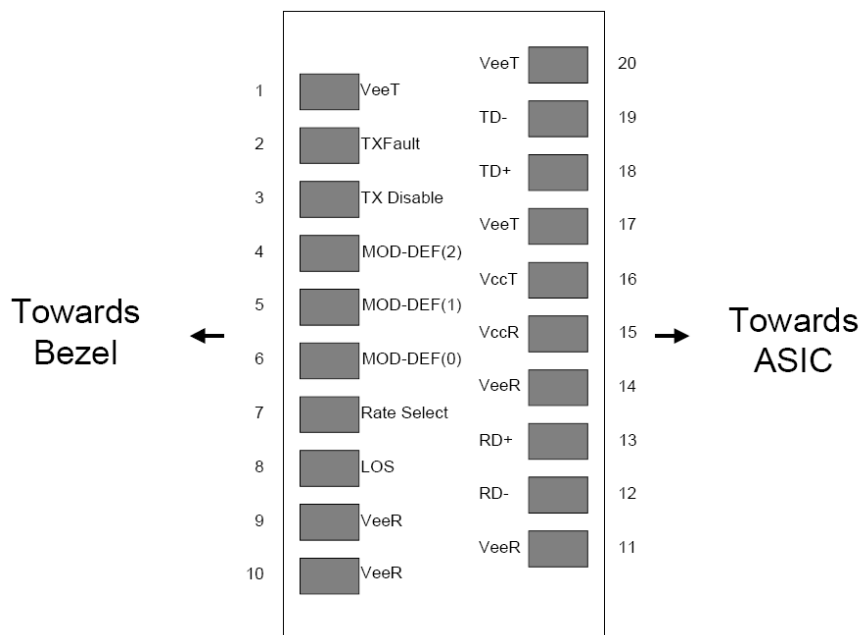


Figure 1. Diagram of Host Board Connector Block Pin Numbers and Names

## Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

### Table 3. Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Unit
Storage Temperature	T <sub>S</sub>	-40	85	°C
Relative Humidity	RH	5	95	%
Supply Voltage	V <sub>CC</sub>	-0.5	4.0	V

## Recommended Operating Conditions

**Table 4. Recommended Operating Conditions**

Parameter	Symbol	Min	Typ	Max	Unit
Operating Case Temperature	T <sub>C</sub>	0	25	70	°C
Supply Voltage	V <sub>CC</sub>	3.135	3.3	3.465	V
Data Rate	-	-	1.25 1.0625	-	Gb/s

## Transceiver Electrical Characteristics

**Table 5. Transceiver Electrical Characteristics**

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Module Supply Current	I <sub>CC</sub>	-	-	300	mA	-
Power dissipation	P <sub>D</sub>	-	-	1000	mW	-
Transmitter Differential Input Voltage (TD +/-)	-	300	-	2200	mV <sub>P-P</sub>	1
Receiver Differential Output Voltage (RD +/-)	-	600	-	1200	mV <sub>P-P</sub>	2
Low speed output: Transmitter Fault(TX_FAULT) / Loss of Signal (LOS)	VOH	2.0	-	V <sub>CC</sub>	V	3
	VOL	0	-	0.8	V	-
Low speed input: Transmitter Disable (TX_DISABLE), MOD_DEF 1, MOD_DEF 2	VIH	2.0	-	V <sub>CC</sub>	V	4
	VIL	0	-	0.8	V	-

**Notes:**

1. Internally AC coupled and terminated to 100Ω differential load.
2. Internally AC coupled, but requires a 100Ω differential termination or internal to Serializer/Deserializer.
3. Pulled up externally with a 4.7KΩ-10KΩ resistor on the host board to V<sub>CCT,R</sub>.
4. Mod\_Def1 and Mod\_Def2 must be pulled up externally with a 4.7KΩ-10KΩ resistor on the host board to V<sub>CCT,R</sub>.

## Transmitter Optical Characteristics

**Table 6. Transmitter Optical Characteristics**

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Launch Optical Power	P <sub>o</sub>	0	-	+5	dBm	-
Center Wavelength Range	λ <sub>c</sub>	λ-6.5	λ	λ+6.5	nm	1
Extinction Ratio	EX	9	-	-	dB	-

Spectral Width (-20dB)	$\Delta\lambda$	-	-	1	nm	-
Side Mode Supression Ratio	SMSR	30	-	-	dB	-
Total Jitter	TJ	-	-	266	ps	-
Dispersion Penalty	-	-	-	2	dB	-
Optical Rise/Fall Time	$T_{rise}/T_{fall}$	-	-	260	ps	-
Pout @TX-Disable Asserted	$P_{off}$	-	-	-45	dBm	-
Eye Diagram	IEEE Std 802.3-2005 Gigabit Ethernet 1000Base-LX compatible					

**Notes:**

- The CWDM Transmitter Center Wavelengths “ $\lambda$ ” are: 1270, 1290, 1310, 1330, 1350, 1370, 1390, 1410, 1430, 1450, 1470, 1490, 1510, 1530, 1510, 1570, 1590 and 1610nm. 1270 to 1450nm are named herein as O-band wavelength and 1470 to 1610nm as L-band wavelength generally.

## Receiver Optical Characteristics

**Table 7. Receiver Optical Characteristics**

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Receiver Sensitivity	S	-	-	-32	dBm	1
Receiver Overload	$P_{OL}$	-9	-	-	dBm	-
Optical Return Loss	ORL	27	-	-	dB	-
LOS De-Assert	$LOS_D$	-	-	-33	dBm	-
LOS Assert	$LOS_A$	-45	-	-	dBm	-
LOS Hysteresis	-	0.5	3	5	dB	-

**Notes:**

- Measured with PRBS 2<sup>7</sup>-1 test pattern, 1.25Gb/s, EX=9dB, BER<10<sup>-12</sup>.

## Timing characteristic

**Table 8. Receiver Optical Characteristics**

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Tx_disable assert time	T_off	-	-	10	us	-
Tx_disable negate time	T_on	-	-	1	ms	-
Time to initialize,include reset of TX_FAULT	T_init	-	-	300	ms	-
TX_FAULT from fault to assertion	T_fault	-	-	100	us	-
Tx_disable time to start reset	T_reset	10	-	-	us	-
Receiver LOS Assert Time(on to off)	T_D,RX_LOS	-	-	80	us	-
Receiver LOS Assert Time(off to on)	T_A,RX_LOS	-	-	80	us	-
Serial I2C Clock Rate	I2C_Clock	-	-	100	kHz	-

## Digital Diagnostic Memory Map

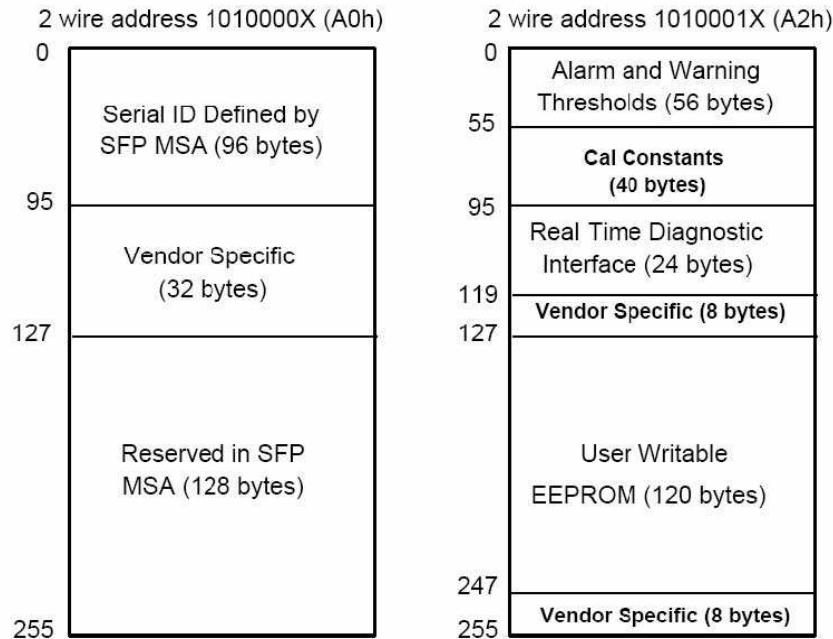


Figure 2. Digital Diagnostic Memory Map Specific Data Field Descriptions

## EEPROM Serial ID Memory Contents

The SFP MSA defines a 256-byte memory map in EEPROM describing the transceiver’s capabilities, standard interfaces, manufacturer, and other information, which is accessible over a 2 wire serial interface at the 8-bit address 1010000X (A0h), and the clock frequency up to 100KHz. The memory contents are shown in Table 9.

**Table 9. Serial ID Memory Contents**

Data Address	Name of Field	Contents(Hex)	Description
0	Identifier	03	SFP
1	Ext. Identifier	04	SFP function is defined by serial ID
2	Connector	07	LC
3-10	Transceiver	00 00 00 02 12 00 01 01	Transmitter Code
11	Encoding	01	8B10B
12	BR, Nominal	0D	1.25Gb/s
13	Reserved	00	
14	Length (9µm) km	64	100km
15	Length (9µm) 100m	FF	
16	Length (50µm) 10m	00	
17	Length(62.5µm)10m	00	

18	Length (Copper)	00	
19	Reserved	00	
20-35	Vendor name	4C 49 4E 4B 54 45 4C 20 20 20 20 2020 20 20 20	"LINKTEL"(ASCII)
36	Reserved	00	
37—39	Vendor OUI	00 00 00	
40—55	Vendor PN	4C 58 31 35 31 xx 43 44 4C 20 20 20 20 20 20 20	"LX151xCDL " (ASCII)
56—59	Vendor rev	31 2E 30 20	Rev 1.0 ( ASCII)
60-61	Wavelength	xx xx	
62	Reserved	00	
63	CC BASE	xx	Check sum of bytes 0 - 62
64—65	Options	00 1A	LOS, TX_FAULT and TX_DISABLE
66	BR, max	00	
67	BR, min	00	
68—83	Vendor SN	xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx	ASCII
84—91	Vendor date code	xx xx xx xx xx xx 20 20	Year (2 bytes), Month (2 bytes), Day (2 bytes)
92	Diagnostic type	68	Diagnostics (Internal. Cal)
93	Enhanced option	B0	Diagnostics(Optional Alarm/warning flags, Soft TX_FAULT and Soft TX_LOS monitoring)
94	SFF-8472	02	Diagnostics(SFF-8472 Rev 9.5)
95	CC_EXT	xx	Check sum for bytes 64-94
96—255		00	

**Note:** The "xx" byte should be filled in according to practical case. For more information, please refer to the related document of SFF-8472 Rev 9.5.

## Diagnostic Monitor Specifications

The digital diagnostic monitoring interface also defines another 256-byte memory map in EEPROM, which makes use of the 8 bit address 1010001X (A2h). Please see Figure 2. For detail EEPROM information, please refer to the related document of SFF-8472 Rev 9.5. The monitoring specification of this product is described in Table 9.

**Table 9. Diagnostic Monitor Specifications**

Parameter	Range	Accuracy	Calibration	Note
Temperature	-5 to +80 C	±3 C	Internal	-
Voltage	3.0 to 3.6V	±3%	Internal	-
Bias Current	0 to 80mA	±10%	Internal	-

TX Power	-1 to +6dBm	±3dB	Internal	-
RX Power	-33 to -8 dBm	±3dB	Internal	-

## Required Host Board Components

The MSA power supply noise rejection filter is required on the host PCB to meet data sheet performance. The MSA filter incorporates an inductor which should be rated 400mA DC and 1 serial resistance or better. It should not be replaced with a ferrite. The required filter is illustrated in Figure 3.

The MSA also specifies that 4.7KΩ to 10KΩ pull-up resistors for TX\_FAULT, LOS, and MOD\_DEF0,1,2 are required on the host PCB. Figure is the suggested transceiver/host interface.

Figure 3 shows the recommended host board power supply circuit.

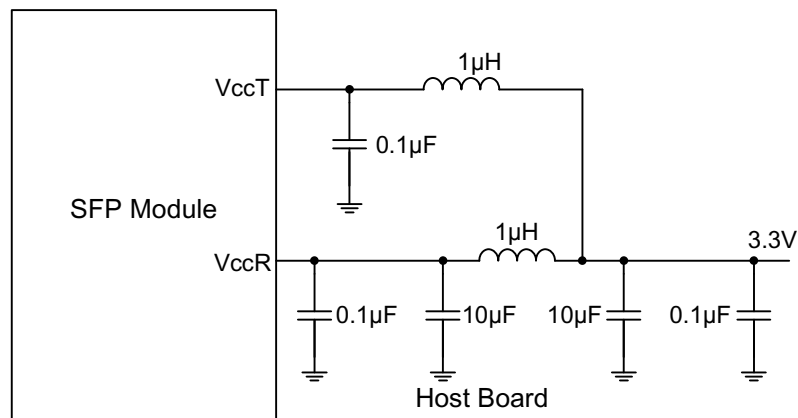


Figure 3. Recommended Host Board Power Supply Circuit



## Recommended Application Interface Circuit

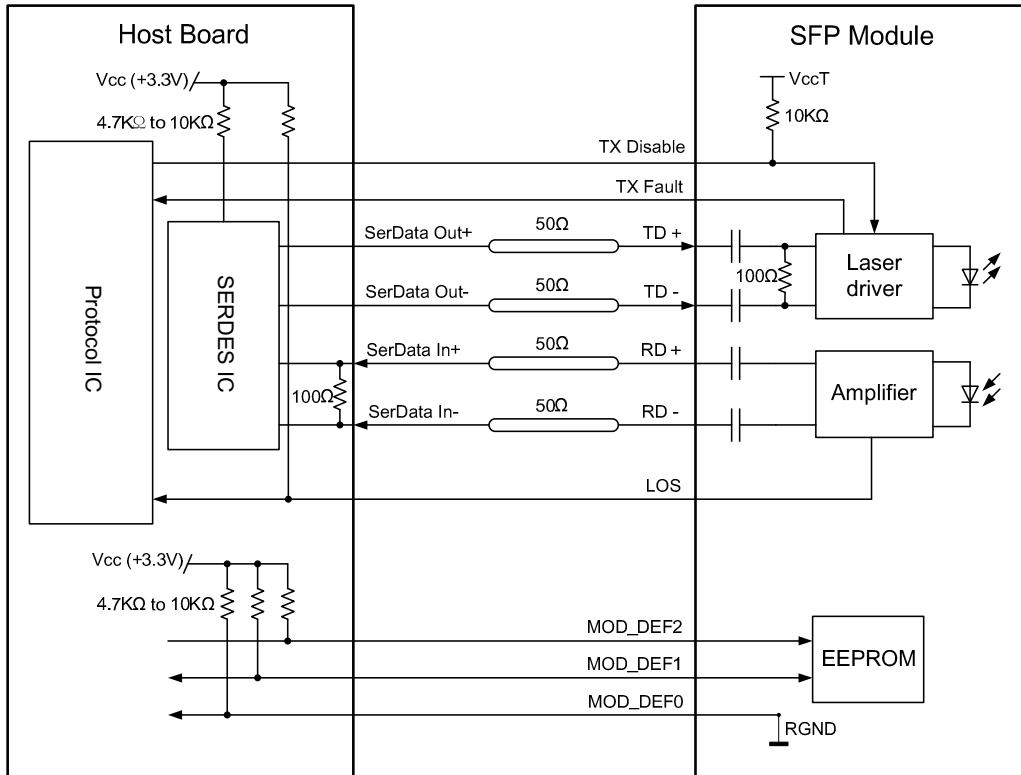


Figure 4. Recommended Application Interface Circuit

## Mechanical specifications

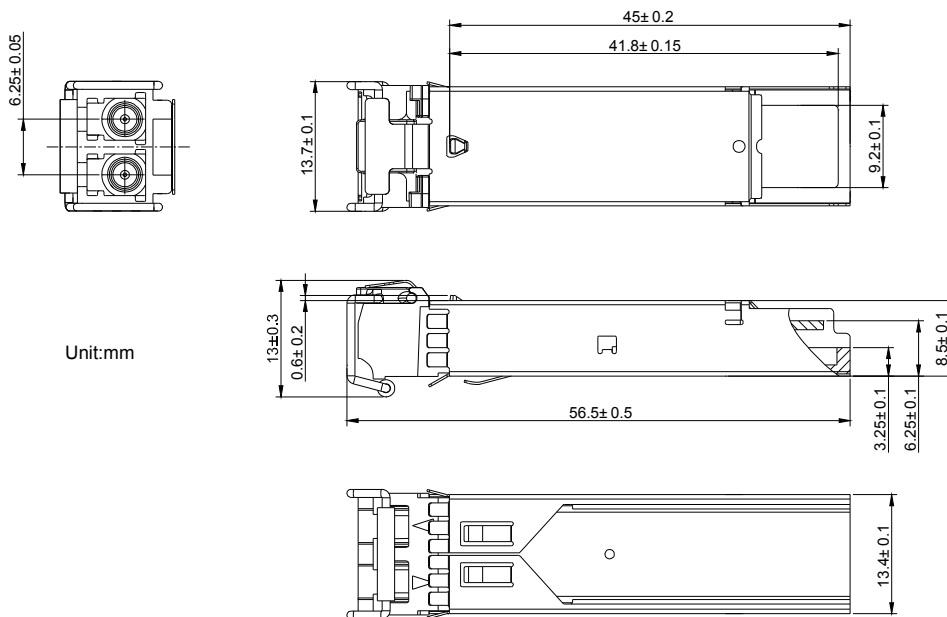


Figure 5. Outline Drawing

## PCB layout recommendation

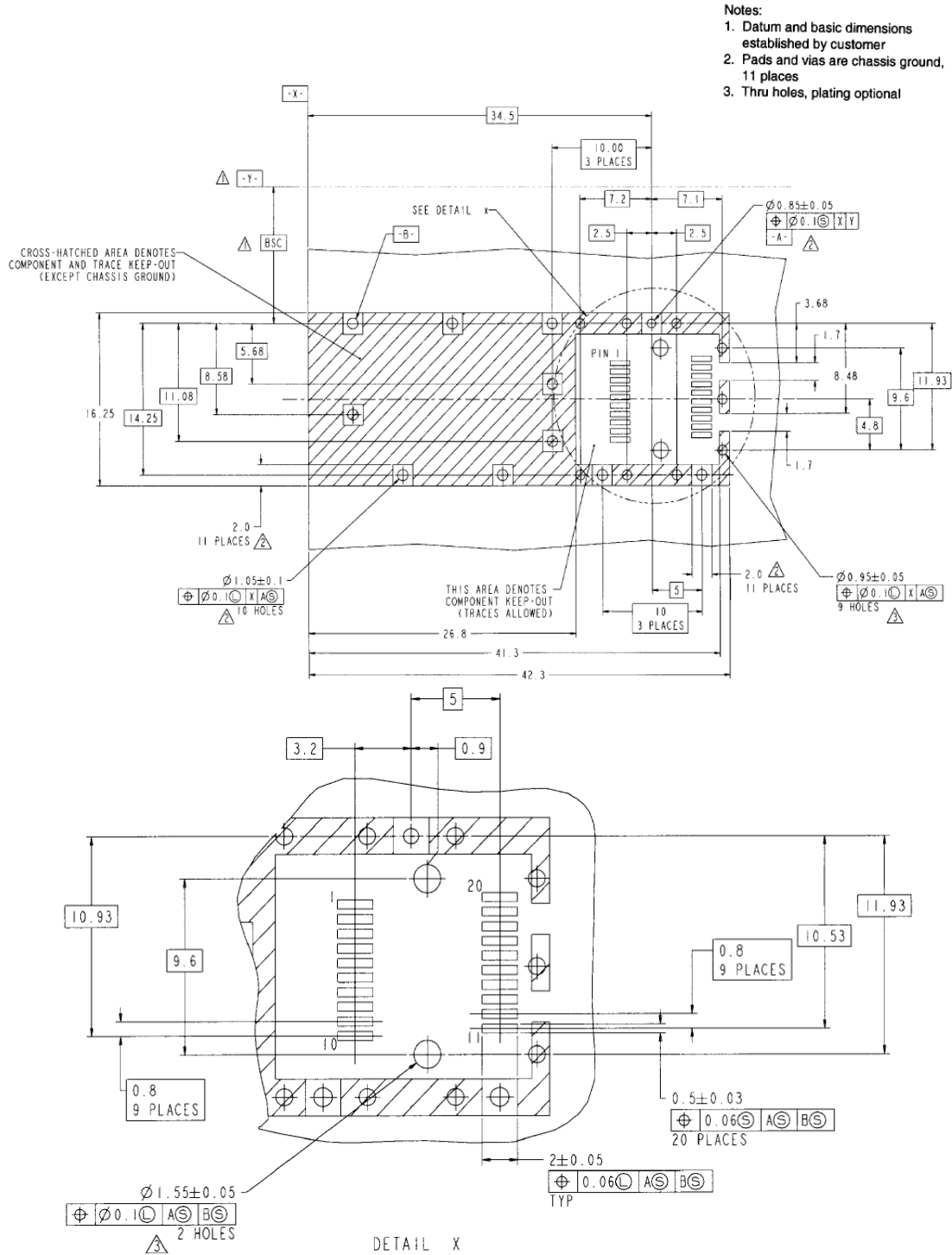


Figure 6. PCB layout recommendation

## **For More Information**

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