

## Product Features

- Electrical interface specifications per SFF-8431
- Management interface specifications per SFF-8431 and SFF-8472
- SFP+ MSA package with Single LC receptacle
- 1270nm DFB Laser, PIN photo-detector
- Up to 11.3G bi-directional data links
- Single +3.3V power supply
- Class 1 laser safety certified
- Operating temperature Options
  - (Commercial) 0°C to +70°C
  - (Industrial) -40°C to +85°C
- Up to 40km on 9/125µm SMF
- RoHS Compliant



## Applications

- 10GBASE-BX Ethernet
- 10GBASE-LR at 10.3125Gbps
- 10GBASE-LW at 9.953Gbps
- CPRI 2/3/4/5/6/7/8 and OBSAI 2X/4X/8X

## Descriptions

LX4421C(I)DR are designed for Single Fiber Bidirectional serial optical data communications up to 11.3 Gb/s. The electrical interface is compliant with SFI specifications of SFF-8431. The transceiver consists of 10Gbit/s 1270nm DFB optical transmitter and PIN receiver, and transmission distance up to 40Km on single mode fiber.

LX4421C(I)DR offer commercial and industrial operating temperature options.

## Ordering Information

**Table 1. Ordering Information**

| Part Number | Transmitter | Output Power | Receiver   | Sensitivity | Reach | Temp        | DDM       | RoHS      |
|-------------|-------------|--------------|------------|-------------|-------|-------------|-----------|-----------|
| LX4421CDR   | 1270nm DFB  | +0.5 ~ +6dBm | 1330nm PIN | < -14.5dBm  | 40km  | 0 ~ 70 °C   | Available | Compliant |
| LX4421IDR   | 1270nm DFB  | +0.5 ~ +6dBm | 1330nm PIN | < -14.5dBm  | 40km  | -40 ~ 85 °C | Available | Compliant |

## Pin Description

**Table 2. Pin Description**

| Pin | Name | Function/Description | Notes |
|-----|------|----------------------|-------|
| 1   | VeeT | Transmitter Ground   | 1     |

|    |            |                                                                        |   |
|----|------------|------------------------------------------------------------------------|---|
| 2  | TX_Fault   | Transmitter Fault (LVTTTL-O) - High indicates a fault condition        | 2 |
| 3  | TX_Disable | Transmitter Disable (LVTTTL-I) – High or open disables the transmitter | 3 |
| 4  | SDA        | Two wire serial interface Data Line (LVCMOS-I/O) (MOD-DEF2)            | 4 |
| 5  | SCL        | Two wire serial interface Clock Line (LVCMOS-I/O) (MOD-DEF1)           | 4 |
| 6  | MOD_ABS    | Module Absent (Output), connected to VeeT or VeeR in the module        | 5 |
| 7  | RS0        | Internal 33KΩ pull-down to ground                                      | - |
| 8  | RX_LOS     | Receiver Loss of Signal (LVTTTL-O)                                     | 2 |
| 9  | RS1        | Internal 33KΩ pull-down to ground                                      | - |
| 10 | VeeR       | Receiver Ground                                                        | 1 |
| 11 | VeeR       | Receiver Ground                                                        | 1 |
| 12 | RD-        | Inverse Received Data out (CML-O)                                      | - |
| 13 | RD+        | Received Data out (CML-O)                                              | - |
| 14 | VeeR       | Receiver Ground                                                        | - |
| 15 | VccR       | Receiver Power - +3.3V                                                 | - |
| 16 | VccT       | Transmitter Power - +3.3 V                                             | - |
| 17 | VeeT       | Transmitter Ground                                                     | 1 |
| 18 | TD+        | Transmitter Data In (CML-I)                                            | - |
| 19 | TD-        | Inverse Transmitter Data In (CML-I)                                    | - |
| 20 | VeeT       | Transmitter Ground                                                     | 1 |

**Notes:**

1. The module signal grounds are isolated from the module case.
2. This is an open collector/drain output that on the host board requires a 4.7KΩ to 10KΩ pull-up resistor to VccHost.
3. This input is internally biased high with a 4.7KΩ to 10KΩ pull-up resistor to VccT.
4. Two-Wire Serial interface clock and data lines require an external pull-up resistor dependent on the capacitance load.
5. This is a ground return that on the host board requires a 4.7KΩ to 10KΩ pull-up resistor to VccHost.

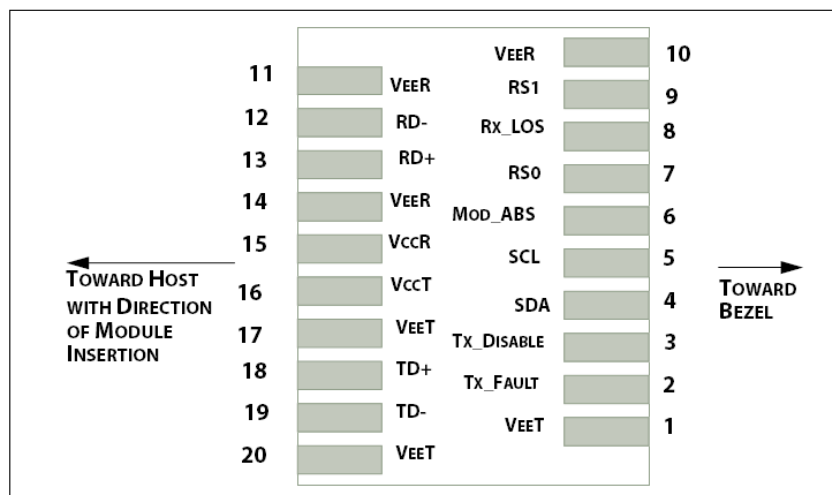


Figure 1. Host PCB SFP+ pad assignment top view

## 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> | -0.3    | 4.0     | V    |

## Recommended Operating Conditions

**Table 4. Recommended Operating Conditions**

| Parameter                  | Symbol          | Min            | Typ          | Max   | Unit |    |
|----------------------------|-----------------|----------------|--------------|-------|------|----|
| Operating Case Temperature | LX4421CDR       | T <sub>c</sub> | 0            | 25    | 70   | °C |
|                            | LX4421IDR       | T <sub>c</sub> | -40          | 25    | 85   | °C |
| Supply Voltage             | V <sub>CC</sub> | 3.135          | 3.3          | 3.465 | V    |    |
| Data Rate                  | -               | 1              | 9.95<br>10.3 | 11.3  | Gb/s |    |

## Transceiver Electrical Characteristics

**Table 5. Transceiver Electrical Characteristics**

| Parameter                      | Symbol                | Minimum         | Typical | Maximum | Unit                | Notes |   |
|--------------------------------|-----------------------|-----------------|---------|---------|---------------------|-------|---|
| Module Supply Current          | I <sub>CC</sub>       | -               | -       | 350     | mA                  | -     |   |
| Power Dissipation              | P <sub>D</sub>        | -               | -       | 1200    | mW                  | -     |   |
| <b>Transmitter</b>             |                       |                 |         |         |                     |       |   |
| Input Differential Impedance   | Z <sub>IN</sub>       | -               | 100     | -       | Ω                   | -     |   |
| Differential Data Input Swing  | V <sub>IN, P-P</sub>  | 180             | -       | 700     | mV <sub>P-P</sub>   | -     |   |
| TX_FAULT                       | Transmitter Fault     | V <sub>OH</sub> | 2.0     | -       | V <sub>CCHOST</sub> | V     | - |
|                                | Normal Operation      | V <sub>OL</sub> | 0       | -       | 0.8                 | V     | - |
| TX_DISABLE                     | Transmitter Disable   | V <sub>IH</sub> | 2.0     | -       | V <sub>CCHOST</sub> | V     | - |
|                                | Transmitter Enable    | V <sub>IL</sub> | 0       | -       | 0.8                 | V     | - |
| <b>Receiver</b>                |                       |                 |         |         |                     |       |   |
| Output Differential Impedance  | Z <sub>O</sub>        | -               | 100     | -       | Ω                   | -     |   |
| Differential Data Output Swing | V <sub>OUT, P-P</sub> | 400             | -       | 850     | mV <sub>P-P</sub>   | 1     |   |

|                                  |                      |          |     |    |              |   |   |
|----------------------------------|----------------------|----------|-----|----|--------------|---|---|
| Data Output Rise Time, Fall Time | $t_r, t_f$           | -        | 60  | ps | 2            |   |   |
| RX_LOS                           | Loss of signal (LOS) | $V_{OH}$ | 2.0 | -  | $V_{CCHOST}$ | V | 3 |
|                                  | Normal Operation     | $V_{OL}$ | 0   | -  | 0.8          | V | 3 |

**Notes:**

1. Internally AC coupled, but requires a external 100Ω differential load termination.
2. 20–80%.
3. LOS is an open collector output. Should be pulled up with 4.7kΩ on the host board.

## Transmitter Optical Characteristics

**Table 6. Transmitter Optical Characteristics**

| Parameter                    | Symbol          | Minimum | Typical | Maximum | Unit  | Notes |
|------------------------------|-----------------|---------|---------|---------|-------|-------|
| Launch Optical Power         | $P_o$           | 0.5     | -       | +6      | dBm   | 1     |
| Center Wavelength Range      | $\lambda_c$     | 1260    | 1270    | 1280    | nm    | -     |
| Extinction Ratio             | EX              | 3.5     | -       | -       | dB    | 2     |
| Optical Modulation Amplitude | OMA             | -5.2    | -       | -       | dBm   |       |
| Spectral Width (-20dB)       | $\Delta\lambda$ | -       | -       | 1       | nm    | -     |
| Side Mode Suppression Ratio  | SMSR            | 30      | -       | -       | dB    | -     |
| Relative Intensity Noise     | RIN             |         |         | -128    | dB/Hz |       |
| Pout @TX-Disable Asserted    | $P_{off}$       | -       | -       | -35     | dBm   | 1     |

**Notes:**

1. The optical power is launched into 9/125μm SMF.
2. Measured with a PRBS 2<sup>31</sup>-1 test pattern @10.3125Gbps.

## Receiver Optical Characteristics

**Table 7. Receiver Optical Characteristics**

| Parameter                          | Symbol      | Minimum | Typical | Maximum | Unit | Notes |
|------------------------------------|-------------|---------|---------|---------|------|-------|
| Center Wavelength                  | $\lambda_c$ | 1320    | 1330    | 1340    | nm   | -     |
| Receiver Sensitivity ( $P_{avg}$ ) | S           | -       | -       | -14.5   | dBm  | 1     |
| Receiver Overload ( $P_{avg}$ )    | $P_{OL}$    | 0.5     | -       | -       | dBm  | 1     |
| Optical Return Loss                | ORL         | 12      | -       | -       | dB   | -     |
| LOS De-Assert                      | $LOS_D$     | -       | -       | -17     | dBm  | -     |
| LOS Assert                         | $LOS_A$     | -30     | -       | -       | dBm  | -     |
| LOS Hysteresis                     | -           | 0.5     | -       | -       | dB   | -     |

**Notes:**

1. Measured with PRBS 2<sup>31</sup>-1 test pattern, 10.3125Gb/s, BER<10<sup>-12</sup>.

## Digital Diagnostic Memory Map

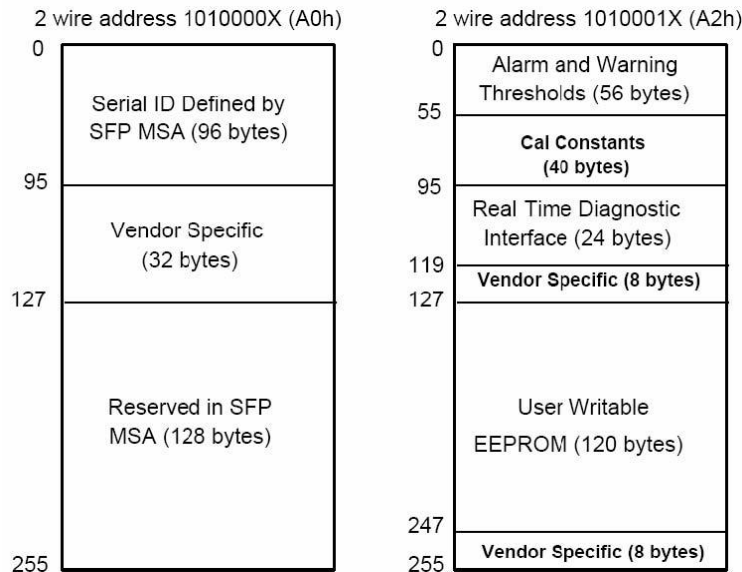


Figure 2. Digital Diagnostic Memory Map Specific Data Field Descriptions

## 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 8.

**Table 8. 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       | 80 00 00 00 00 10<br>01 80 | 10G Base-ER                          |
| 11           | Encoding          | 06                         | 64B/66B                              |
| 12           | BR, Nominal       | 67                         | 10.3Gb/s                             |
| 13           | Reserved          | 00                         | -                                    |
| 14           | Length (9µm) km   | 28                         | 40km                                 |
| 15           | Length (9µm) 100m | FF                         | 40000m                               |
| 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<br>45 4C 20 20 20<br>20 20 20 20 20 20 | LINKTEL (ASCII)                                                                                  |
| 36     | Reserved         | 00                                                    |                                                                                                  |
| 37-39  | Vendor OUI       | 00 00 00                                              |                                                                                                  |
| 40-55  | Vendor PN        | 4C 58 34 34 32 31<br>xx 44 52 20 20 20<br>20 20 20 20 | LX4421xDR                                                                                        |
| 56-59  | Vendor rev       | 31 2E 30 20                                           | Rev 1.0 ( ASCII)                                                                                 |
| 60-62  | Wavelength       | 04 F6 00                                              | 1270nm                                                                                           |
| 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        | 33 31 34 30 34 30<br>37 30 31 35 20 20<br>20 20 20 20 | Serial Number of transceiver (ASCII). For example "3140407015".                                  |
| 84-91  | Vendor date code | xx xx xx xx xx xx<br>20 20                            | Year (2 bytes), Month (2 bytes), Day (2 bytes)                                                   |
| 92     | Diagnostic type  | 68                                                    | Diagnostics (Internally Cal)                                                                     |
| 93     | Enhanced option  | F0                                                    | Diagnostics(Optional Alarm/warning flags, Soft TX_DIS, Soft TX_FAULT and Soft TX_LOS monitoring) |
| 94     | SFF-8472         | 03                                                    | Diagnostics(SFF-8472 Rev 10.2)                                                                   |
| 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 10.2.

## 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 10.2. The monitoring specification of this product is described in Table 9.

**Table 9. Diagnostic Monitor Specifications**

| Parameter    | Range          | Accuracy     | Calibration |
|--------------|----------------|--------------|-------------|
| Temperature  | LX4421CDR      | -10 to +75°C | ±3°C        |
|              | LX4421IDR      | -43 to +88°C | ±3°C        |
| Voltage      | 2.9 to 3.6V    | ±3%          | Internal    |
| Bias Current | 0.5 to 90mA    | ±10%         | Internal    |
| TX Power     | -0.5 to +7dBm  | ±2dB         | Internal    |
| RX Power     | -18 to +2.5dBm | ±2dB         | Internal    |

## Recommended Host Board Power Supply Filter Network

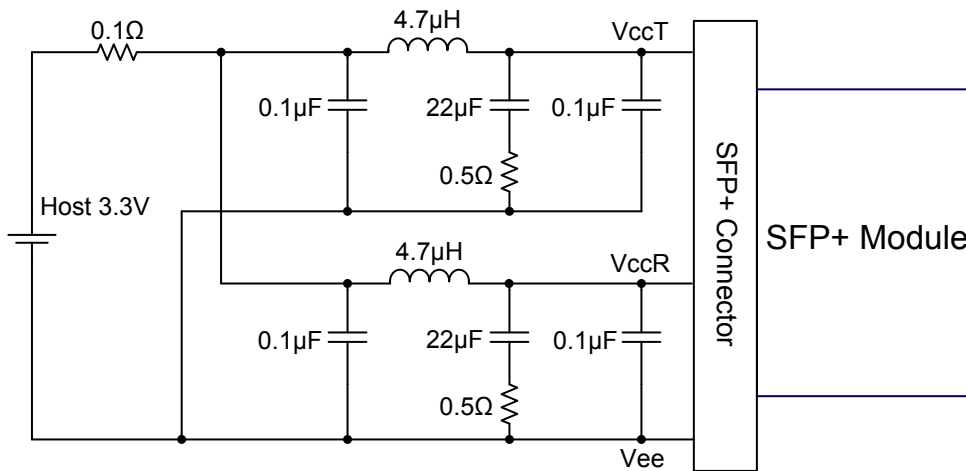


Figure 2. Recommended Host Board Power Supply Filter Network

## Recommended Application Interface Block Diagram

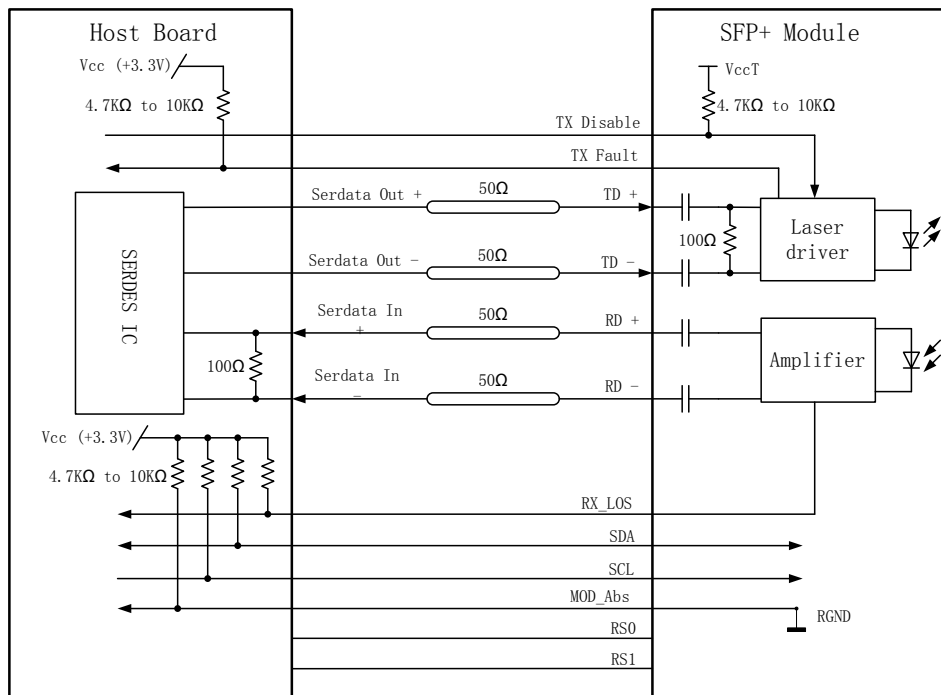


Figure 4. Recommended Application Interface Block Diagram

## Mechanical specifications

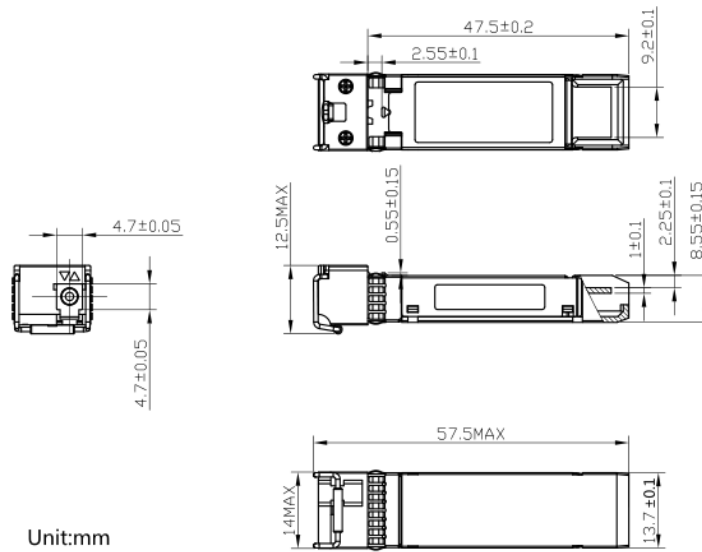
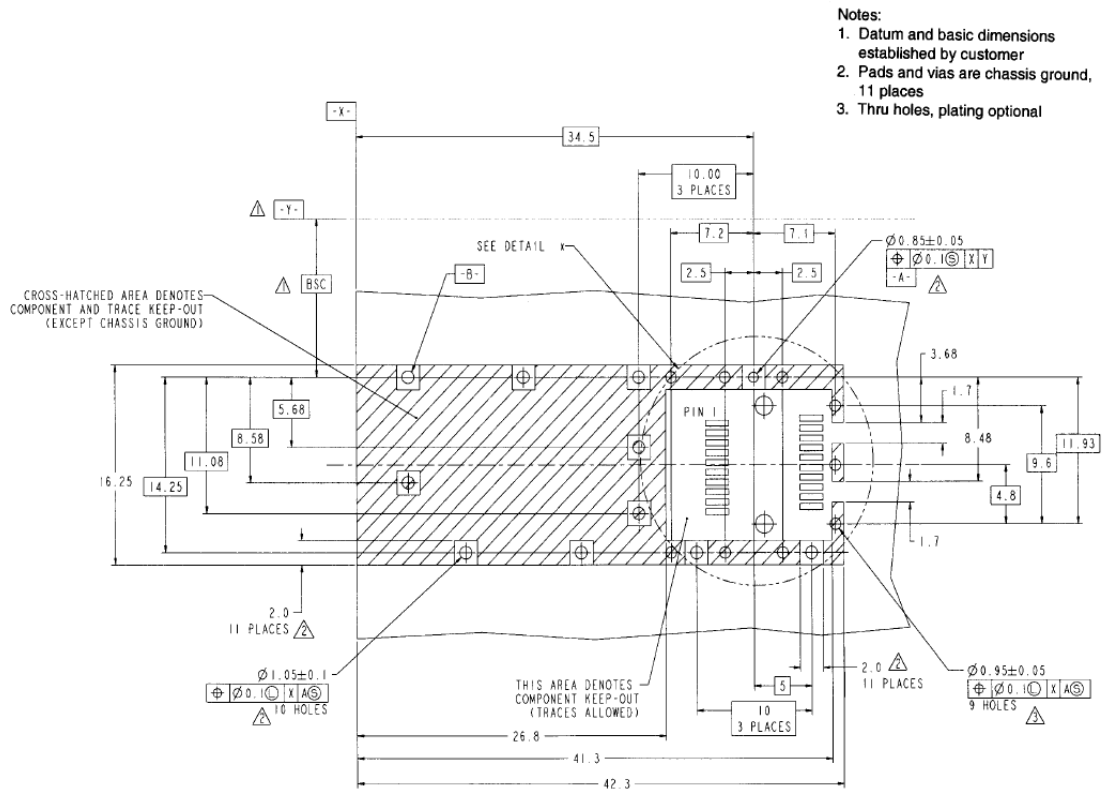


Figure 5. Outline Drawing

## PCB layout recommendation





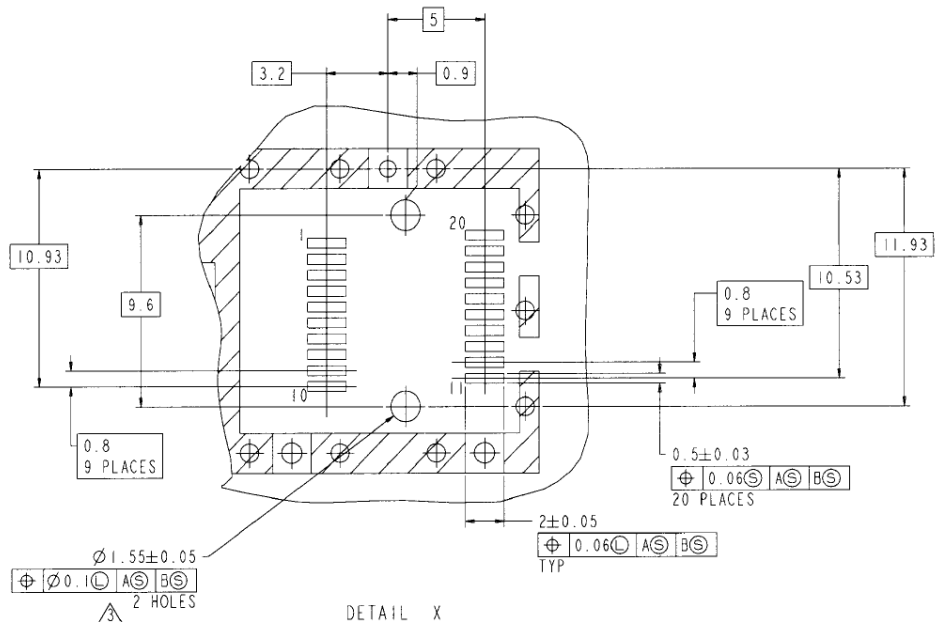


Figure 6. PCB layout recommendation

## Revision History

| Date       | Rev  | Description             | Modified By     |
|------------|------|-------------------------|-----------------|
| 08/20/2020 | V2.3 | Add contact information | Jianxiong Jiang |
|            |      |                         |                 |

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