XEK66700

XFP Reference Design Kit

Preliminary Datasheet

Product Features

- XFP Reference Design Kit in compliance with the XFP specification - Appendix A consisting of:
  - —Host System Compliance Test Board
  - —Module Compliance Test Board
- Fully characterised compliance test kit for modules and host systems
- High-speed characterization data available in test report
- Access to all XFP specified signals
- Low loss high-speed connections for data signals
- Rogers 3003 board laminate
- Power supply monitoring and control
- Mechanically stable construction
- Ready to go kit with getting started notes

Application

The XFP Reference Design Kit has been developed as a tool to assist in compliance testing of XFP host systems and modules in accordance with the Compliance Reference Model in Appendix A of the XFP specification. The two boards are meant to be used each for host system testing and module testing respectively. In normal operation this means that the boards will be operated separately, the Host System Compliance Test Board for testing Host Systems and the Module Compliance Board for testing modules.

Order Number: 252328-001
December, 2002

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Revision History

Date	Revision	Description
December, 2002	001	Initial revision

1.0 Introduction

In the development of the XFP specification during 2002 it became clear that the compliance points of the specification would need special tools to be accessed while preserving the high speed signal integrity. In order to overcome this issue it was considered to make a set of commonly agreed high quality test boards to be used for compliance testing and this way ensure uniform test results that could lead to true compliance and inter operability. The XFP Reference Design Kit (XEK66700) is a result of these considerations and it is believed that these boards will help the industry to achieve a higher degree of inter operability.

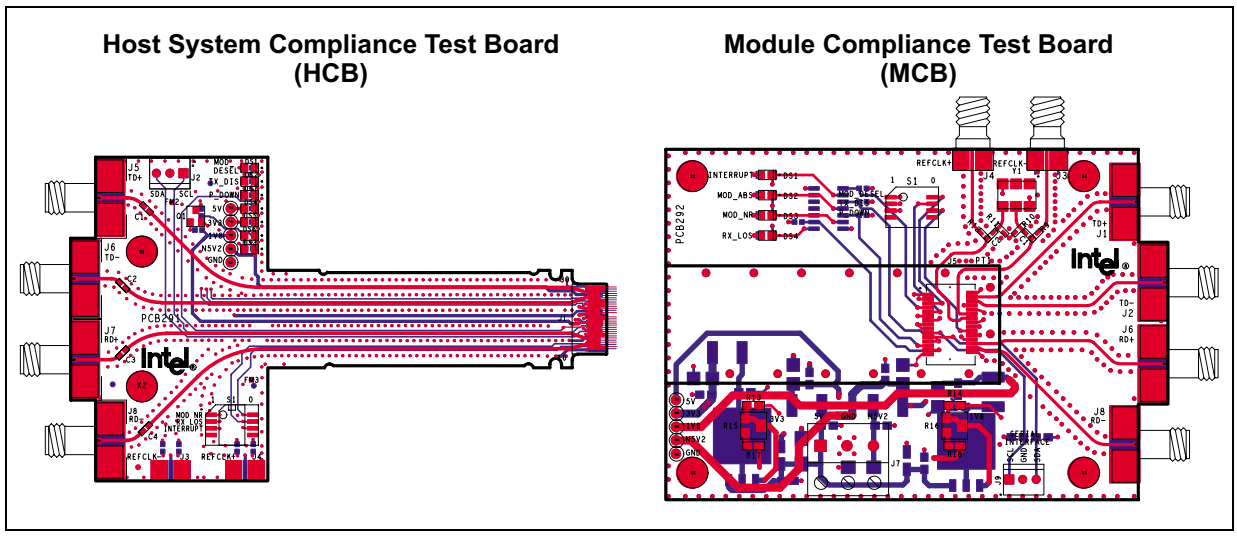
The two boards of the reference kit:

- the Module Compliance Test Board (MCB) - XEB60009
- the Host System Compliance Test Board (HCB) - XEB72353

are meant to be used each for host system testing and module testing respectively. In normal operation this means that the boards will be operated separately, the Host System Compliance Test Board for testing Host Systems and the Module Compliance Board for testing modules. Only for a quick evaluation of the boards and connector performance they could be joined together as a pass trough test set-up.

To assess the quality of the high-speed signals (TD and RD) the boards have been thoroughly characterized. The work compromise Eye diagrams, TDR measurements, and S-parameter analysis. The results show good performance and sufficient margin, allowing the boards to be used for compliance testing. A detailed test report is available.

Figure 1. The XFP Reference Design Kit (XEK66700)



2.0 Module Compliance Test Board (MCB) - XEB60009

2.1 General Description

The Module Compliance Test Board (MCB) - XEB60009 is designed for XFP module vendors to evaluate and test modules, based on a four layer Rogers 3003 / FR4 laminate.

The board is a general-purpose design for evaluating XFP modules. The high-speed transmission lines on the board are designed for minimal loss and optimal high frequency performance.

Only single power supply voltage (+5 V) is needed to power the module. Voltage regulators for +3.3 V and +1.8 V are mounted on board. A connector is available for optional external -5.2 V supply.

2.1.1 Product Features

- Accurate evaluation of high-speed performance of XFP modules.
- PCB Laminate in Rogers 3003 quality.
- 50 Ω matching transmission lines.
- High quality SMA connectors for differential TD and RD interfaces.
- SMA differential reference clock input.
- Optional on board XO land pads for individual reference clock frequency.
- On board XFP host 30-position right angle connector (Tyco 788862C).
- On board Cage for positioning the DUT (XFP module).
- Cage assembly includes heat Sink and Clip.
- Single power supply input +5 V (–5.2 V if needed)
- On board adjustable voltage regulators for VCC3 (+3.3 V) and VCC2 (+1.8 V)
- On board monitor connector for all power supply voltages.
- Board dimensions 66 x 95 mm (exclusive connectors and Cage).
- LED indicators for XFP module status signals.
- DIL-switch for XFP module control signal settings.
- Connector for XFP two wire serial interface lines (SCL/SDA).
- Mounting holes for fixing the host board in test jig.

Figure 2. PCB - Top View

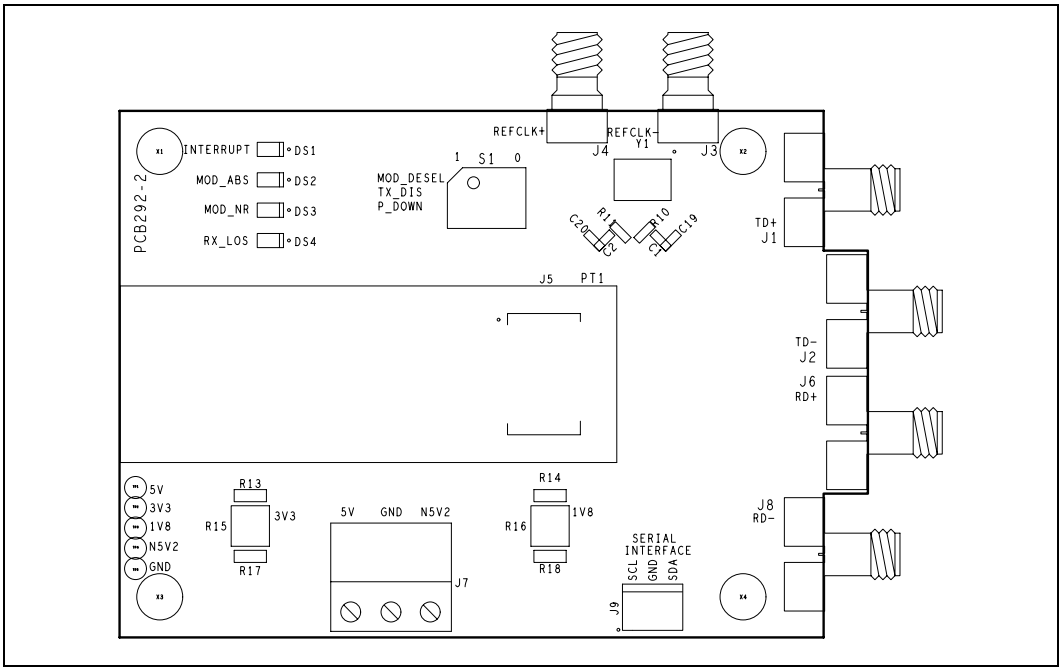
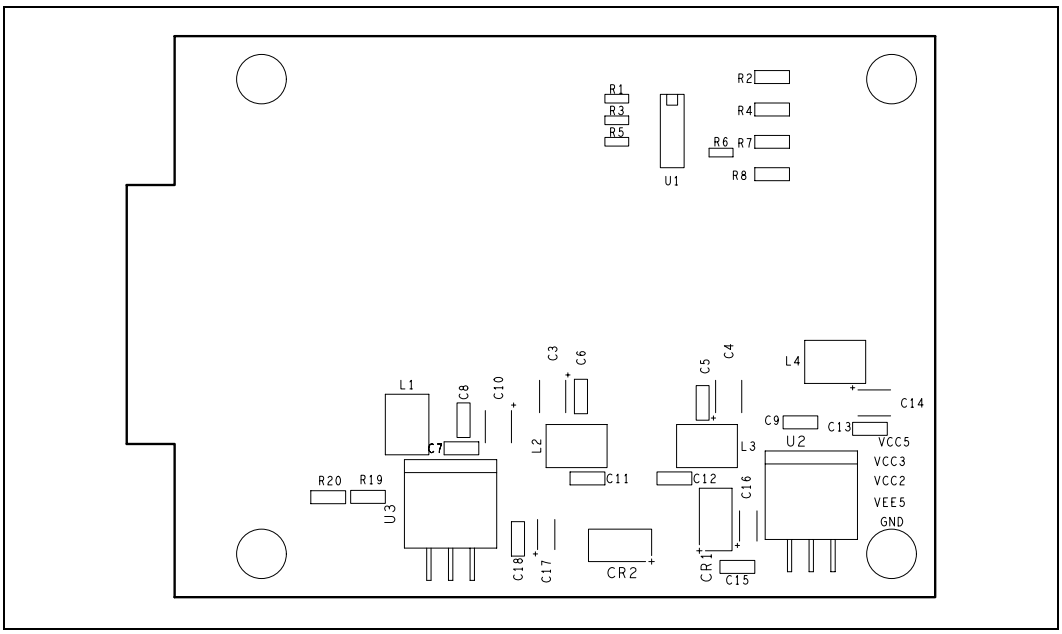


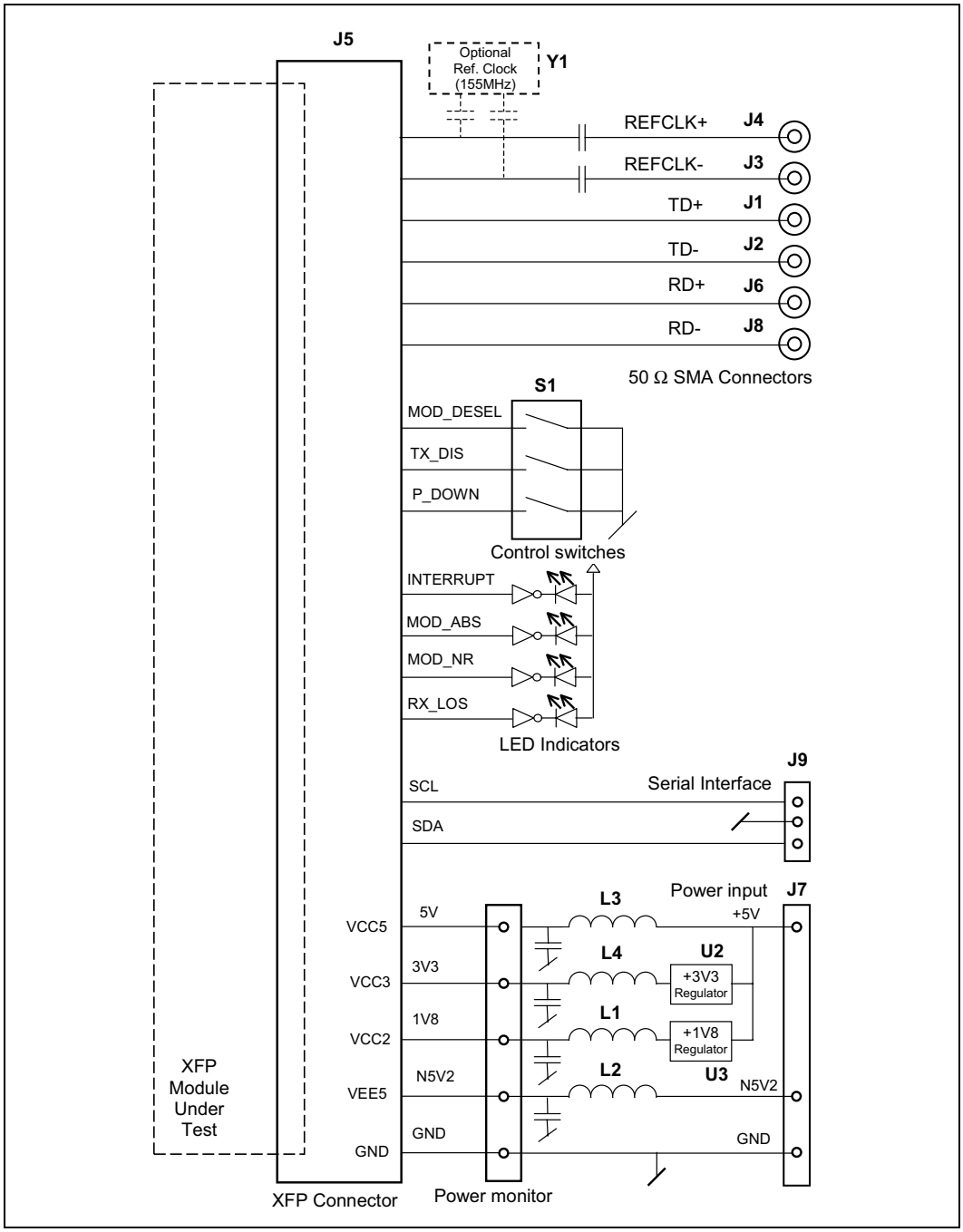
Figure 3. PCB - Bottom View



2.2 Functional Details

An overall functionality of the MCB is shown on the block diagram in Figure 4 as a supplement to the more detailed schematics on page 14.

Figure 4. Block Diagram



2.3 Connectors

- Power supply connector
- SMA connectors for:
  - TD+/-
  - RD+/-
  - REFCLK+/-.
- XFP host 30-position right angle connector
- Two wire serial interface (SCL/SDA) connector
- Power Monitor test connector.

2.4 DATA / RefCLK I/Os

- The Transmitter Non-Inverted Data (TD+) is DC coupled to SMA connector (J1)
- The Transmitter Inverted Data (TD-) is DC coupled to SMA connector (J2)

- The Receiver Non-Inverted Data (RD+) is DC coupled to SMA connector (J6)
- The Receiver Inverted Data (RD-) is DC coupled to SMA connector (J8)

- The Reference Clock Non-Inverted (RefCLK+) is AC coupled on the host board to SMA connector (J4)
- Reference Clock Inverted (RefCLK-) is AC coupled on the host board to SMA connector (J3)

Alternatively an on board crystal oscillator can be mounted on the land pattern as Y1. In this case, the following resistors and capacitors have to be mounted on the board with reference to the schematics on page 14: C19, C20, R10, and R11. C1 and C2 should be removed.

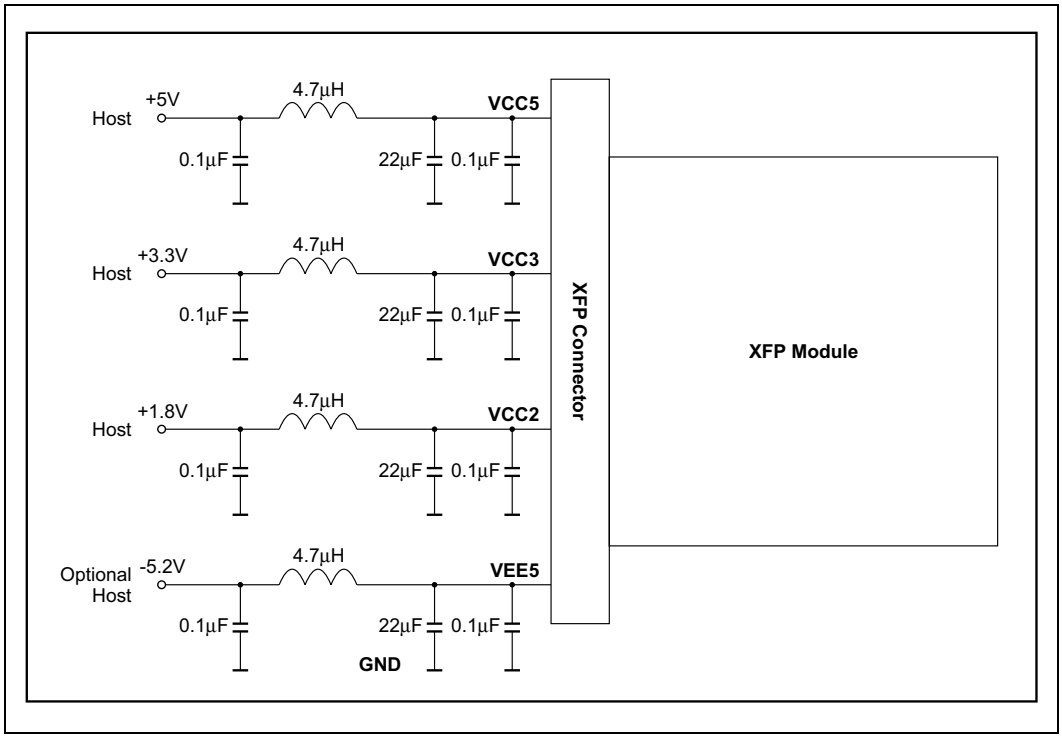
2.5 Power Supply

The XFP host has three power supplies (+1.8 V, +3.3 V, and +5.0 V) and an optional (-5.2 V) supply. The +1.8 V and +3.3 V supplies have two designated power pins in the connector for each power supply rail. The +5 V and -5.2 supplies have one designated power pin each. The maximum continuous or peak current carrying capacity for each connector pin is 500 mA.

+5 V has to be supplied to J7 pin 1.

On the MCB two separate on board voltage regulators (U2 and U3) supplies +3.3 V and +1.8 V from the +5 V main supply. Additionally -5.2 V can be supplied by N5V2 at J7 pin 3 if needed. All four supply voltages are filtered in accordance with the XFP specification.

Figure 5. MCB Supply Filtering Network



Alternatively the board (and the Module under test) can be supplied from an external power source directly to the power monitor connector. In this case the individual inductors (L1, L2, L3, and L4) should be removed from the board, to not conflict with the on board voltage regulators (U2 and U3).

2.6 2-Wire Serial Interface

The low speed serial interface can be connected to J9 on the host board.

- SCL 2-Wire Serial Interface Clock: J9 pin 1
- SDA 2-Wire Serial Interface Data Line: J9 pin 3
- GND connection: J9 pin 2.

Serial Clock (SCL): The host supplied SCL input to XFP transceivers is used to positively edge clock data into each XFP device and negative clock data out of each device.

Serial Data (SDA): The SDA pin is bi-directional for serial data transfer.

On the 2-wire interface SCL (Clock), SDA (Data), the Host board uses pull-up resistors (10 kΩ) connected to V_{CC} of +3.3 V.

2.7 Indicators

Four green LED indicators available and described below.

2.7.1 Interrupt

DS1 lights when the incoming status level at XFP connector pin 4 is “high”.

Interrupt is an output pin seen from the module. When “Low”, indicates possible module operational fault or a status critical to the host system. The Interrupt pin is on the module an open collector output and is pulled up to VCC3 on the host board.

2.7.2 MOD_ABS (Module ABSence)

DS2 lights when the incoming status level at XFP connector pin 12 is “high”. Indicates Module is not present.

MOD_ABS is pulled up to VCC3 on the host board and should be grounded in the XFP module. Mod_ABS is then asserted “high” when the XFP module is physically absent from the host slot.

2.7.3 MOD_NR (Module Not Ready)

DS3 lights when the incoming status level at XFP connector pin 13 is “high”. Module Not Ready Indicating Module Operational Fault.

The Mod_NR is an output pin from the module that when High, indicates that the module has detected a condition that renders transmitter and or receiver data invalid. The Mod_NR output pin is on the module an open collector and is pulled to VCC3 on the host board.

2.7.4 RX_LOS

DS4 lights when the incoming status level at XFP connector pin 14 is “high”. RX_LOS Receiver Loss Of Signal Indicator. The RX_LOS when High indicates insufficient optical power for reliable signal reception. The RX_LOS pin is on the module an open collector output and is pulled to VCC3 on the host board.

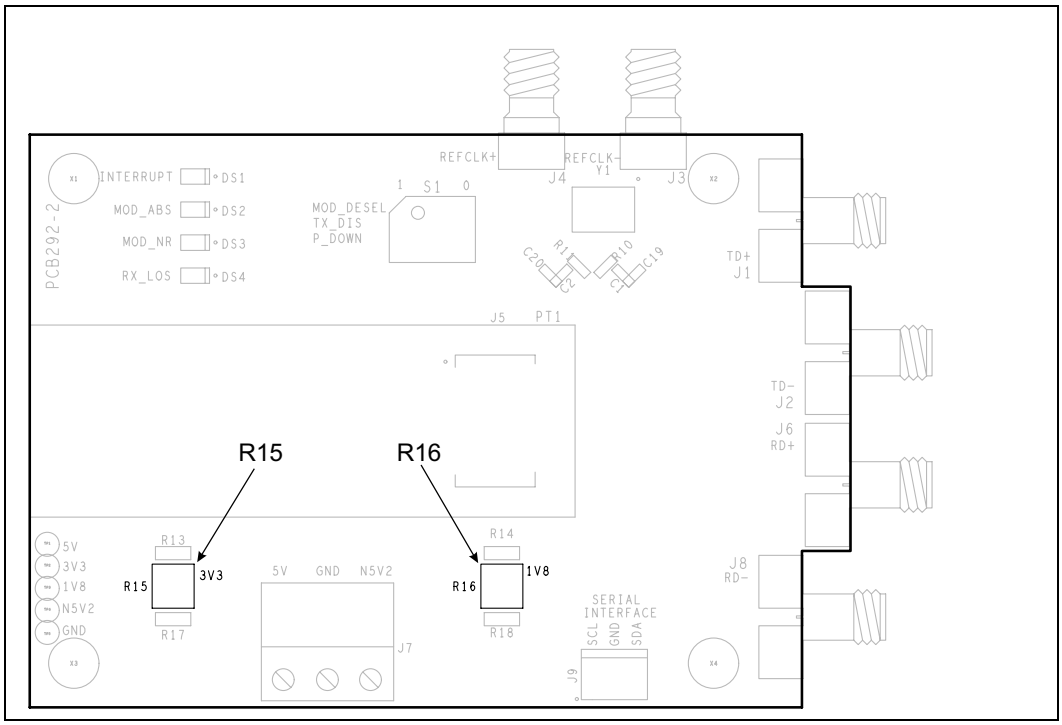
2.8 Adjustments

2.8.1 Power Supply

The voltage regulator (U2) is pre-adjusted to VCC3 = +3.3 V by potentiometer R15. The voltage can be adjusted within the range of +3.0 and +3.5 V

The voltage regulator (U3) is pre-adjusted to VCC2 = +1.8 V by potentiometer R16. The voltage can be adjusted within the range of +1.75 and +1.95 V

Figure 6. Adjustment Potentiometers



2.9 MCB Switch Settings

Multi DIL Switch (S1) has four separate switches. The settings are control inputs to the XFP module under test.

The XFP module has the following low speed pins for control:

- Mod_DeSel
- TX_DIS
- P_Down/RST

Table 1 shows the actual S1 (1 to 4) control switch settings.

Table 1. MCB Switch S1 Settings

Name	S1	Settings		Input	Function
MOD_DESEL	1	1	0	LVTTL_I	Module De-select
TX_DIS	2	1	0	LVTTL_I	Transmitter Disable
P_Down/RST	3	1	0	LVTTL_I	Power down
No function	4				N/A
NOTE: Switch setting “1”= open corresponds to “high” and “0”= closed to “low” signal levels.					

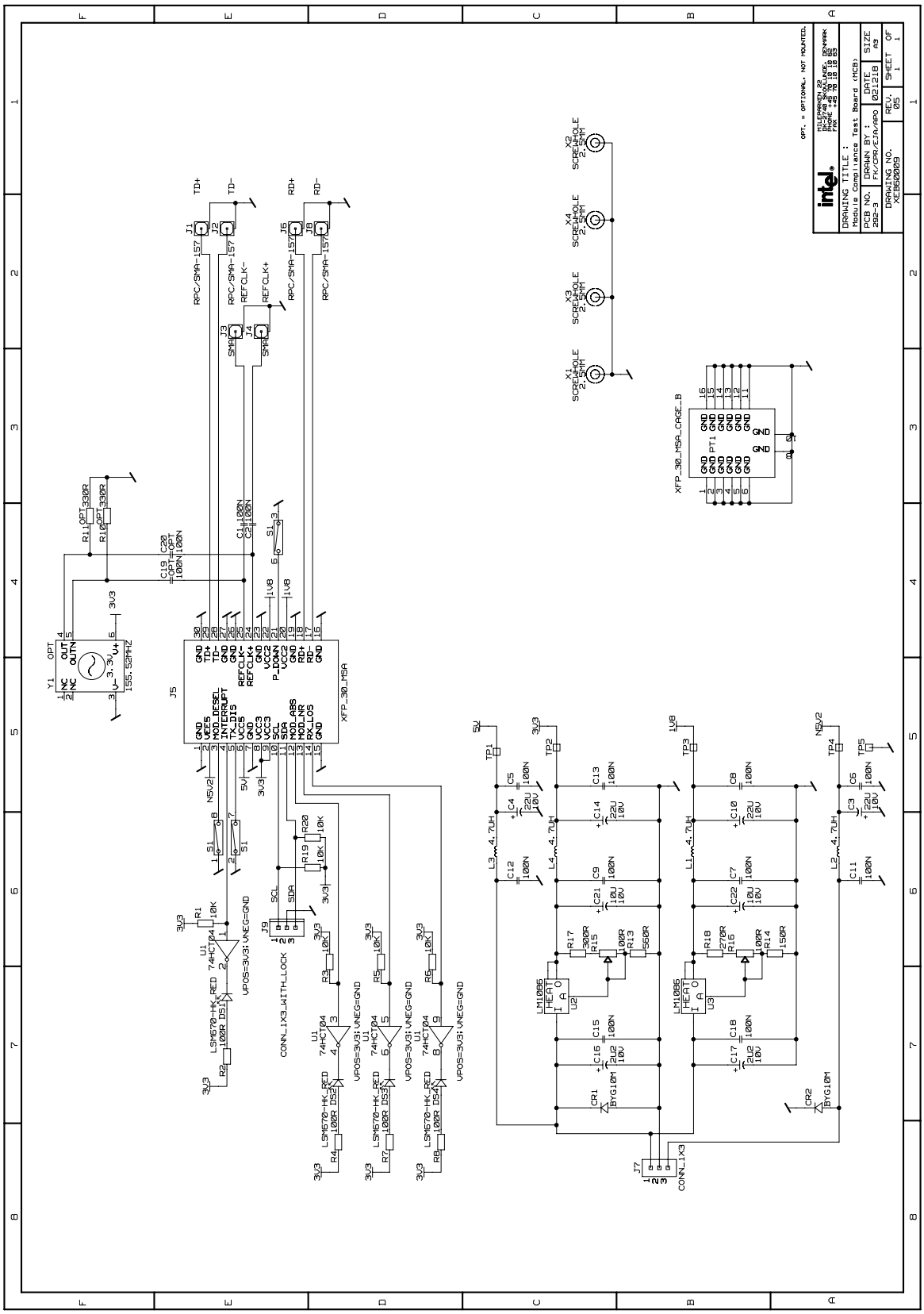
More detailed description on S1 DIL-switch control settings:

- Mod_DeSel: (XFP connector pin 3)
  When held Low by the host, the module responds to 2-wire serial communication commands. When the Mod_DeSel pin is “High”, the module shall not respond to or acknowledge any 2-wire interface communication from the host. Mod_DeSel pin must be pulled to VCC3 in the module.
- TX_DIS: (XFP connector pin 5)
  When asserted “High” the XFP module transmitter output is turned off. The TX_DIS pin must be pulled up to VCC3 on the XFP module board.
- P_Down: (XFP connector pin 21)
  When held High by the host, places the module in the standby (Low Power) mode.

2.10 Stack-up

1. Layer	Primary Side
0.010" Rogers 3003	
2. Layer	Ground
0.040" FR4 Prepreg	
3. Layer	Power
0.010" Rogers 3003	
4. Layer	Secondary side

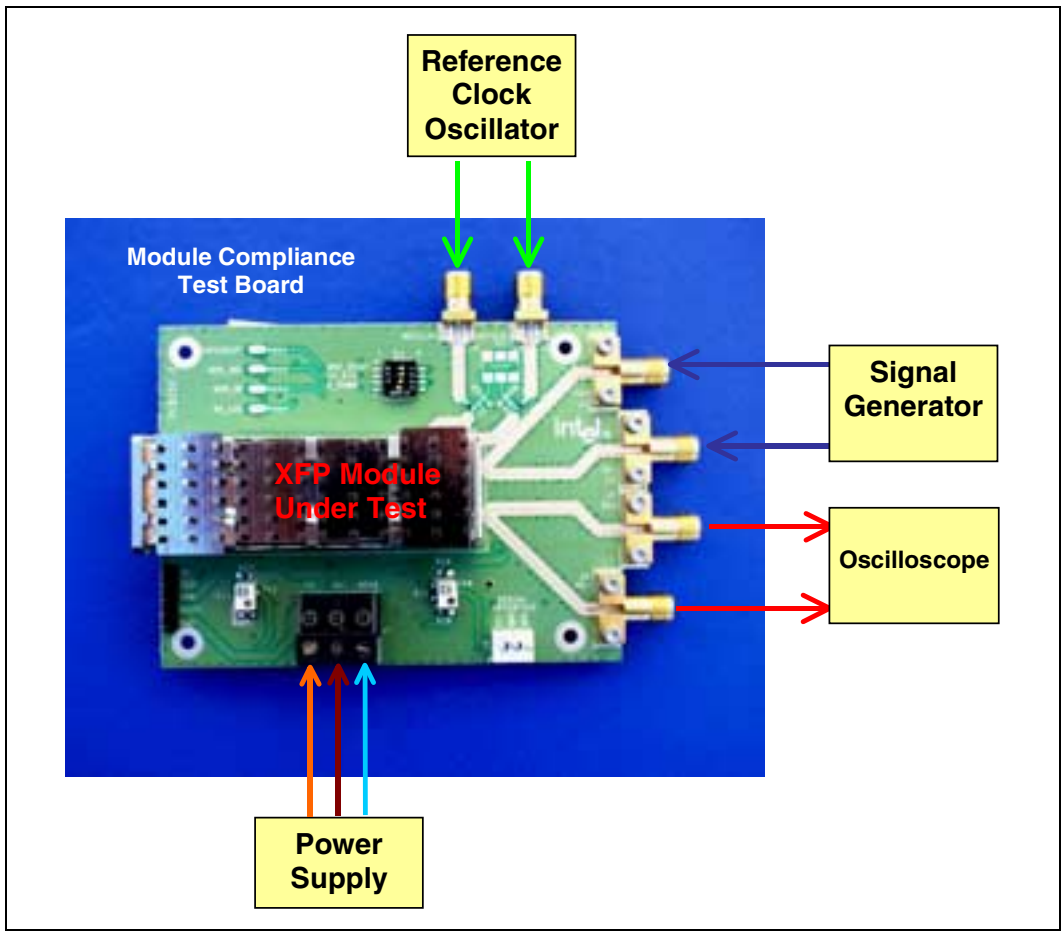
2.11 Schematic - XEB60009



2.12 How to Get Started

In order to get a quick and smooth start, we recommend the set-up outlined in Figure 7.

Figure 7. Test Set-up



This set-up is equivalent to the Module Compliance Test diagram in the XFP standard (Appendix-A) is shown on page 16.

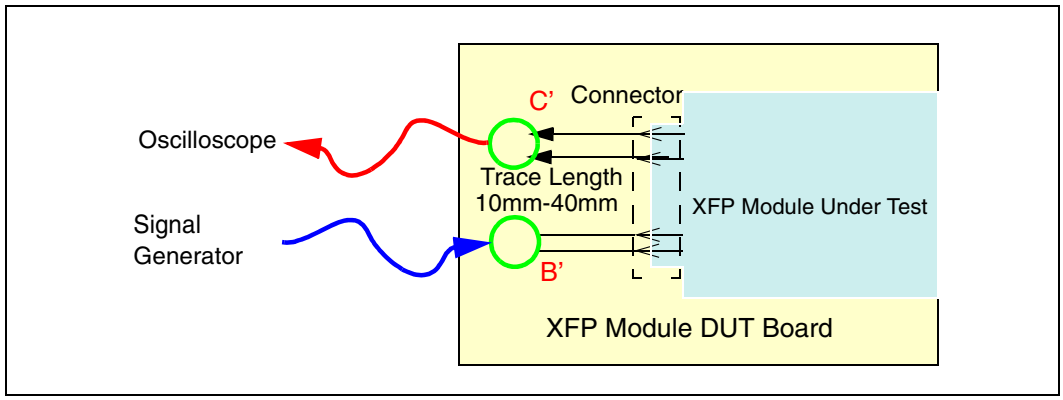
Please note that valid observations at 10 Gbit/s data rates require instruments, test cables, and connectors suitable for microwave operation. In particular, observation of rise/fall times, waveform, and jitter characteristics is not trivial at this transmission rate.

- A single ended data source can be applied. In this case the unused input should be terminated.
- Remember to terminate the unused output of a differential signal when you connect a single ended instrument.

2.12.1 XFP Module Compliance Testing

From the XFP specification - Appendix A: “XFP modules are validated by testing them with Module Compliance Test Board with 30 position XFP connector and 10 mm-40 mm of traces on low loss dielectric material.”

Figure 8. XFP Module Compliance Testing



The compliance points are as the following:

- **B’**: Host system Output. The applicable measurements are:
  Input sensitivity
  Jitter tolerance
  Return Loss S11.
- **C**’: XFP module output. The applicable measurements are:
  Output amplitude
  Jitter output
  Return Loss S22.

2.13 Insertion of XFP Module into Cage on the Host Board.

The Host board is now ready for insertion of a XFP module in the slot (Cage).

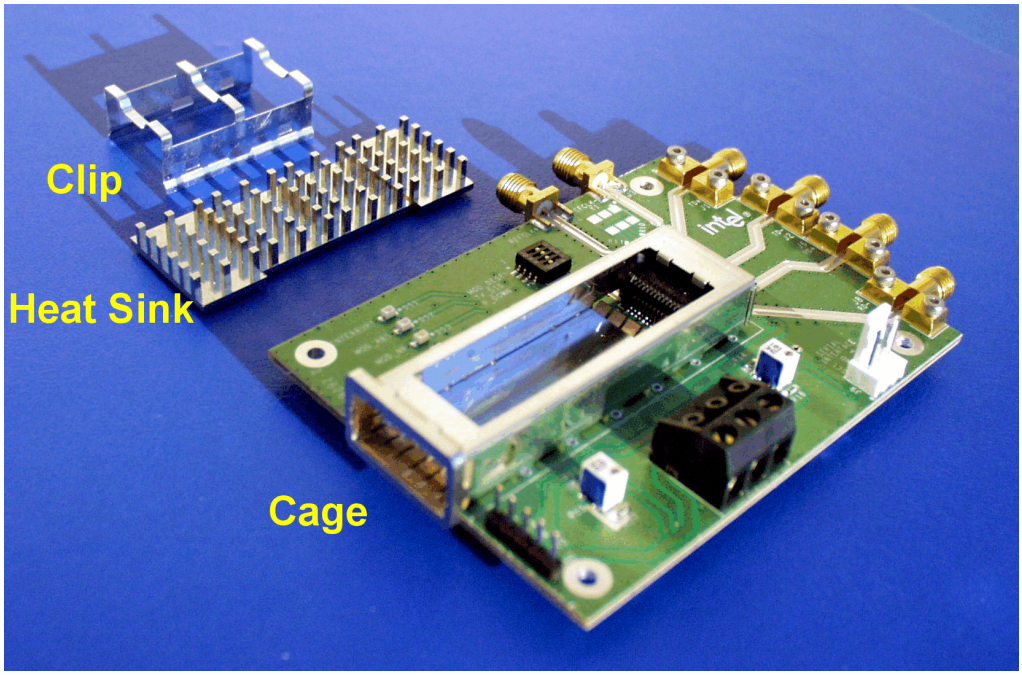
Please observe that the Heat sink on top of the Cage can be removed by lifting the clip from its seats.

The heat sink is “floating” when fastened to the Cage by the clip. This allows individual mechanical adjustment and good thermal contact between the module top and the bottom side of the heat sink.

The mechanical components defined in this section are illustrated in Figure 9.

The module can be inserted and removed from the cage with the heat sink and clip attached.

Figure 9. The Mechanical Components



3.0 Host System Compliance Test Board (HCB) - XEB72353

3.1 General Description

The Host System Compliance Test Board (HCB) - XEB72353 is designed for System vendors to evaluate and test host systems, based on a six layer Rogers 3003 / FR4 laminate.

The board is a high quality design for evaluating host Systems. The high-speed transmission lines are designed for minimal losses and optimal high frequency performance.

3.1.1 Product Features

- Accurate evaluation of high-speed performance of host systems.
- PCB Laminate in Rogers 3003 quality.
- 50 Ω matching transmission lines.
- High quality SMA connectors for differential TD and RD interfaces.
- SMA differential Reference clock output
- Monitor connector for all power supply voltages.
- Board dimensions: XFP module like + extension part for SMA connectors.
- LED indicators for System (Host) status signals.
- DIL-switch for System (Host) control signal settings.
- Connector for XFP two wire serial interface lines (SCL/SDA).
- Printed circuit board that mates with the XFP electrical connector.
- XFP module look-alike enclosure of the test board.
- Mounting holes for fixing the board in a test jig.

Figure 10. PCB – Top View

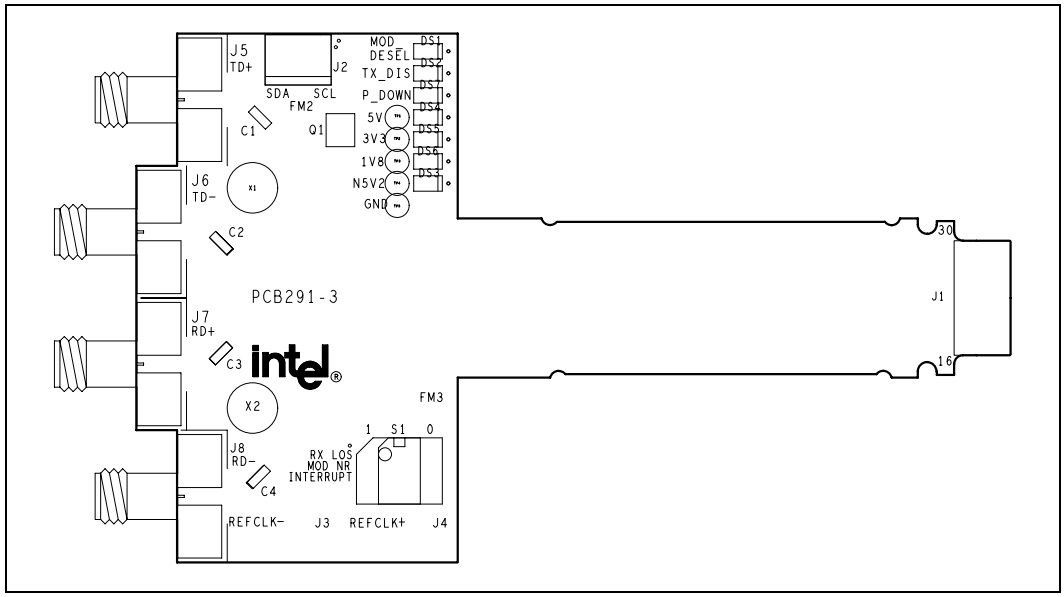
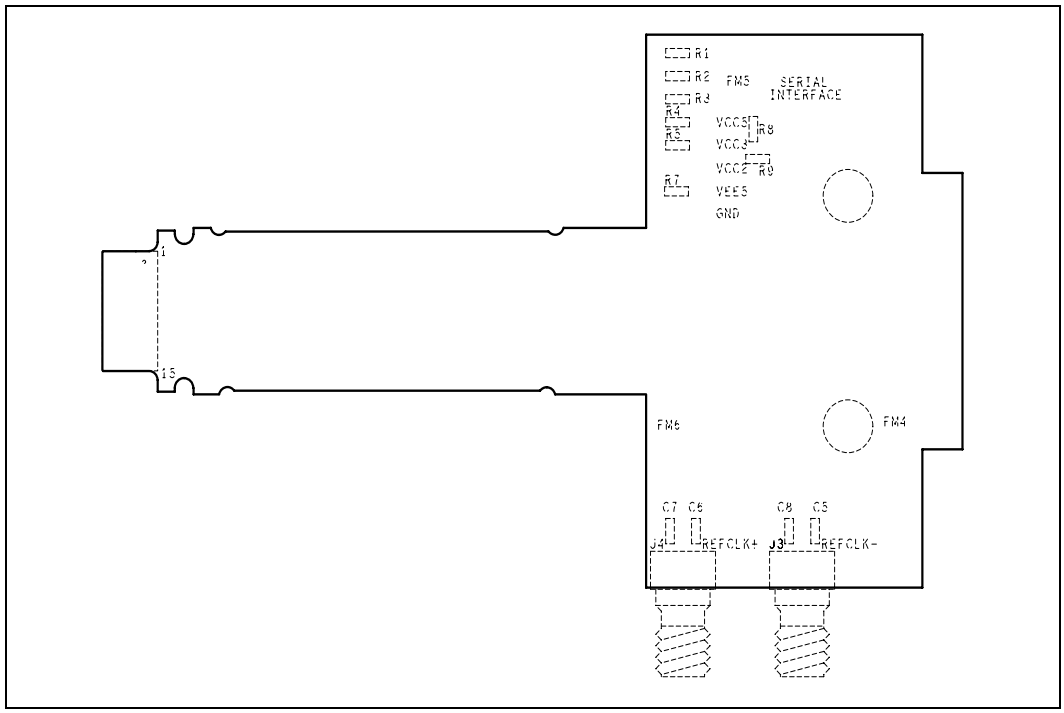


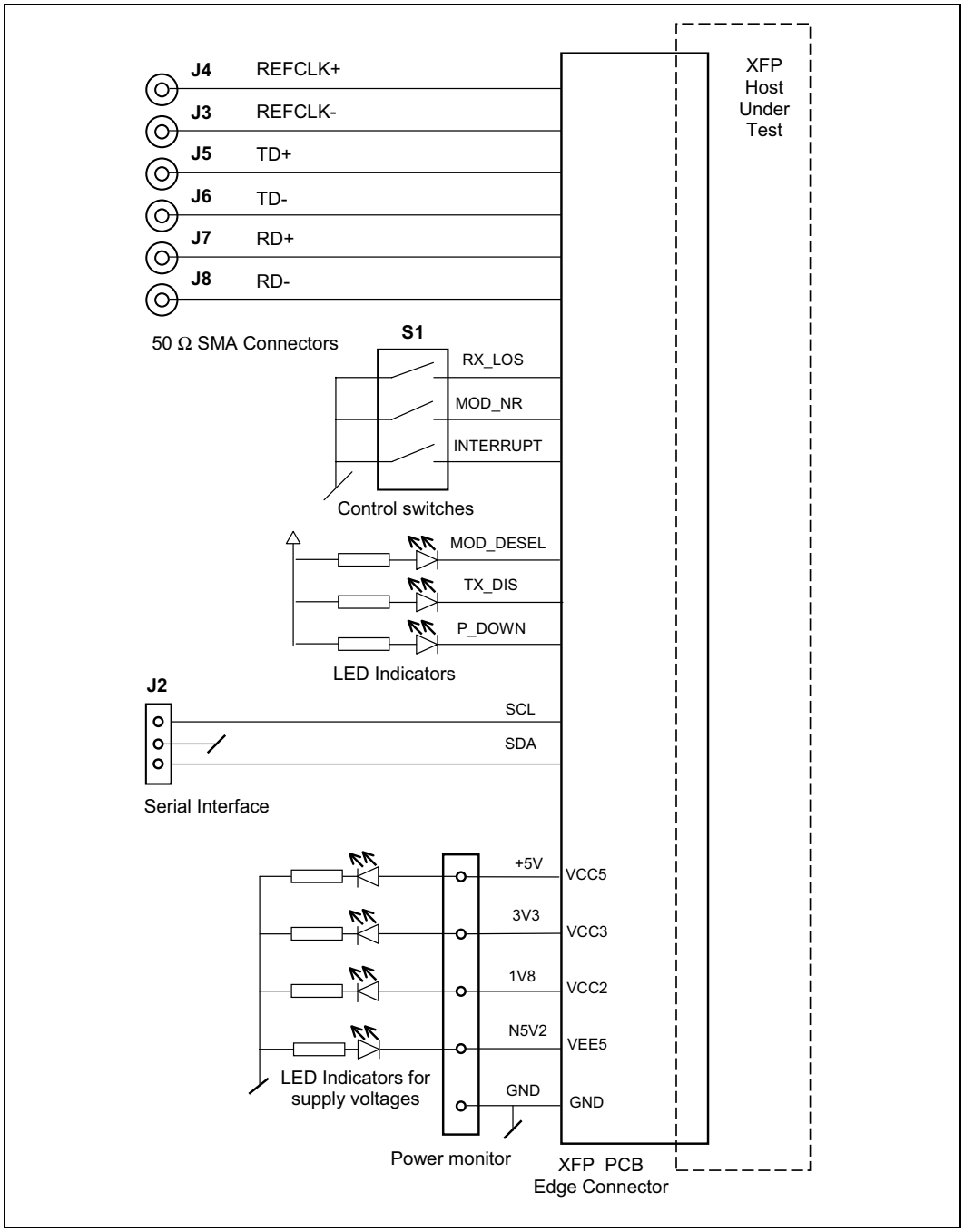
Figure 11. PCB – Bottom View



3.2 Functional Details

An overall functionality of the module board is shown on the block diagram in Figure 12 as a supplement to the more detailed schematics on page 25.

Figure 12. Block Diagram



3.3 Connectors

- SMA connectors for:
  - TD+/-,
  - RD+/-
  - REFCLK+/-.
- Two wire Serial interface (SCL/SDA) connector
- Power Monitor test connector.

3.4 DATA / RefCLK I/Os

- The Transmitter Non-Inverted Data (TD+) is AC coupled to SMA connector (J5)
- The Transmitter Inverted Data (TD-) is AC coupled to SMA connector (J6)

- The Receiver Non-Inverted Data (RD+) is AC coupled to SMA connector (J7)
- The Receiver Inverted Data (RD-) is AC coupled to SMA connector (J8)

- The Reference Clock Non-Inverted (RefCLK+) is DC coupled to SMA connector (J4)
- Reference Clock Inverted (RefCLK-) is DC coupled to SMA connector (J3)

3.5 Power Supply

The power to the HCB is supplied through the XFP connector.

No additional power supply is required for the HCB.

A power monitor connector is available for monitoring of the supply voltages.

3.6 2-Wire Serial Interface

Low-speed serial interface can be connected to J2 on the HCB.

- SCL 2-Wire Serial Interface Clock J2 pin 1
- SDA 2-Wire Serial Interface Data Line J2 pin 3
- GND connection: J2 pin 2.

Serial Clock (SCL):
The host supplied SCL input to XFP transceivers is used to positively edge clock data into each XFP device and negative clock data out of each device.

Serial Data (SDA):
The SDA pin is bi-directional for serial data transfer.

On the 2-wire interface SCL (clock), SDA (Data), the Host board uses pull-up resistors (10 kΩ) connected to V_{CC} of +3.3 V.

3.7 Indicators

There are four blue LED indicators on the module board to indicate if the separate power supply voltages are present.

Also there are three green LED indicators for control signals from the host system described below:

3.7.1 MOD_DESEL

DS1 lights when MOD_DESEL control signal from the Host is “low”.
Module De-select. When held low by the host, this allows the module to respond to 2-wire serial interface commands.

3.7.2 TX_DIS (Transmitter Disable)

DS2 lights when TX_DIS control signal from the Host is “low”.
When TX_DIS is asserted “High” the XFP module transmitter Laser Source is turned off.

3.7.3 P_DOWN (Power Down)

DS7 lights when P_DOWN control signal from the Host is “low”
When high, requires the module to limit power consumption to 1.5 W or below.

3.8 HCB Switch Settings

Multi DIL Switch (S1) has four separate switches.

The settings are control outputs from module to the System Host board.

The XFP module has the following functions to control the host:

- RX_LOS
- MOD_NR
- INTERRUPT

Table 2 below shows the actual S1 (1 to 4) control switch settings.

Table 2. HCB Switch S1 Settings

Name	S1	Settings		Output	Function
RX_LOS	1	1	0	LVTTL_O	Receiver Loss Of Signal
MOD_NR	2	1	0	LVTTL_O	Module Not Ready
Interrupt	3	1	0	LVTTL_O	Interrupt
No function	4				N/A
NOTE: Switch setting “1”= open corresponds to “high” and “0”= closed to “low” signal levels.					

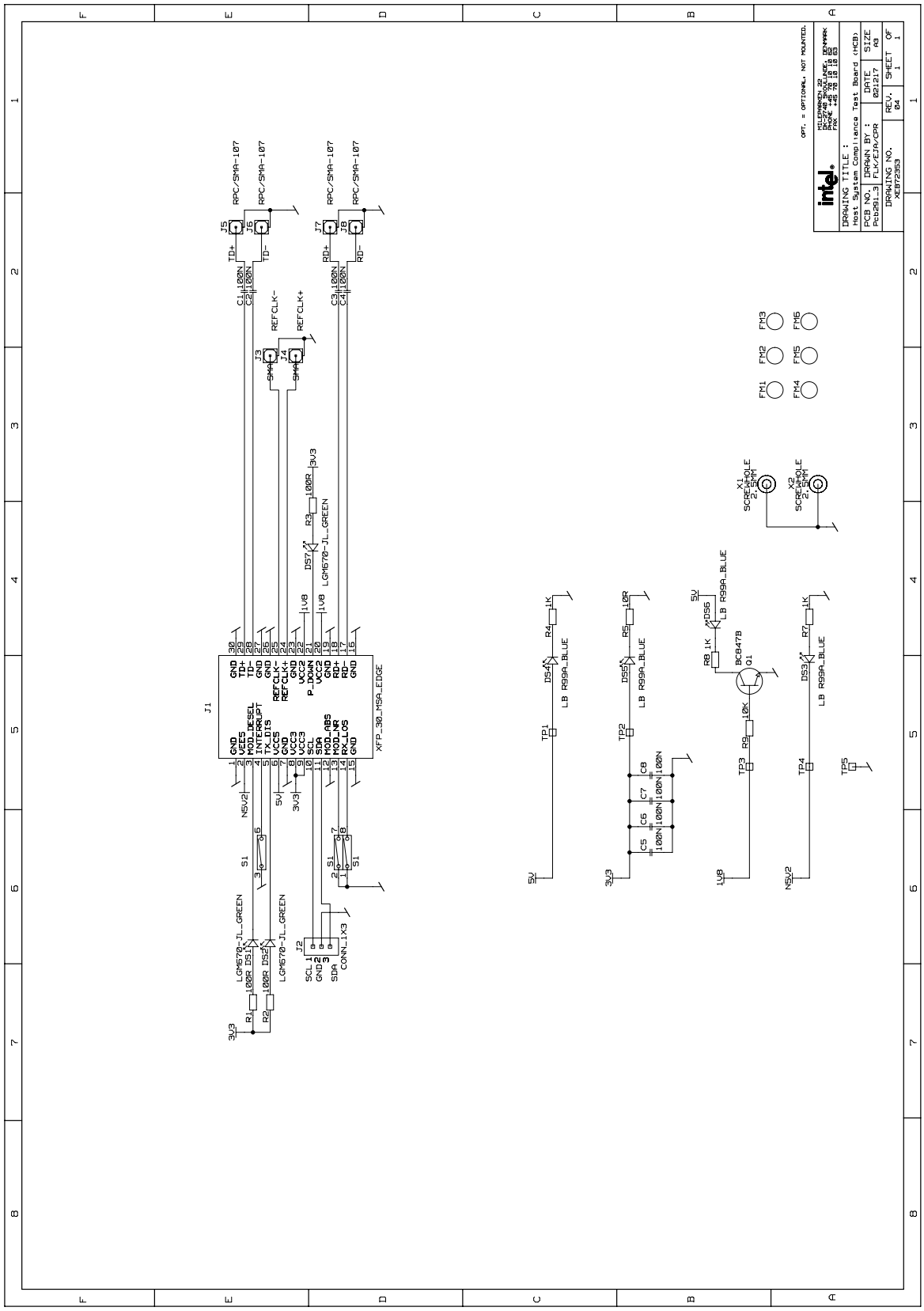
More detailed description on S1 DIL-switch control settings:

- RX_LOS: (XFP connector pin 14)
  When “High” indicates insufficient optical power for reliable signal reception.
  The RX_LOS pin simulates an open collector output and is pulled up to VCC3 on the host board.
- MOD_NR: (XFP connector pin 13)
  The Mod_NR is an output pin that when High, indicates that the module has detected a condition that renders transmitter and or receiver data invalid.
- Interrupt: (XFP connector pin 4)
  Interrupt is an output pin seen from the module. When “Low”, indicates possible module operational fault or a status critical to the host system. The Interrupt switch on the module simulates an open collector output and is pulled up to VCC3 on the host board.

3.9 Stack-up

1. Layer	Primary Side
0.010" Rogers 3003	
2. Layer	Ground
0.005" FR4 Prepreg	
3. Layer	Signal 1
0.006" FR-4 Laminate	
4. Layer	Signal 2
0.005" FR4 Prepeg	
5. Layer	Power
0.010" Rogers 3003	
6. Layer	Secondary Side

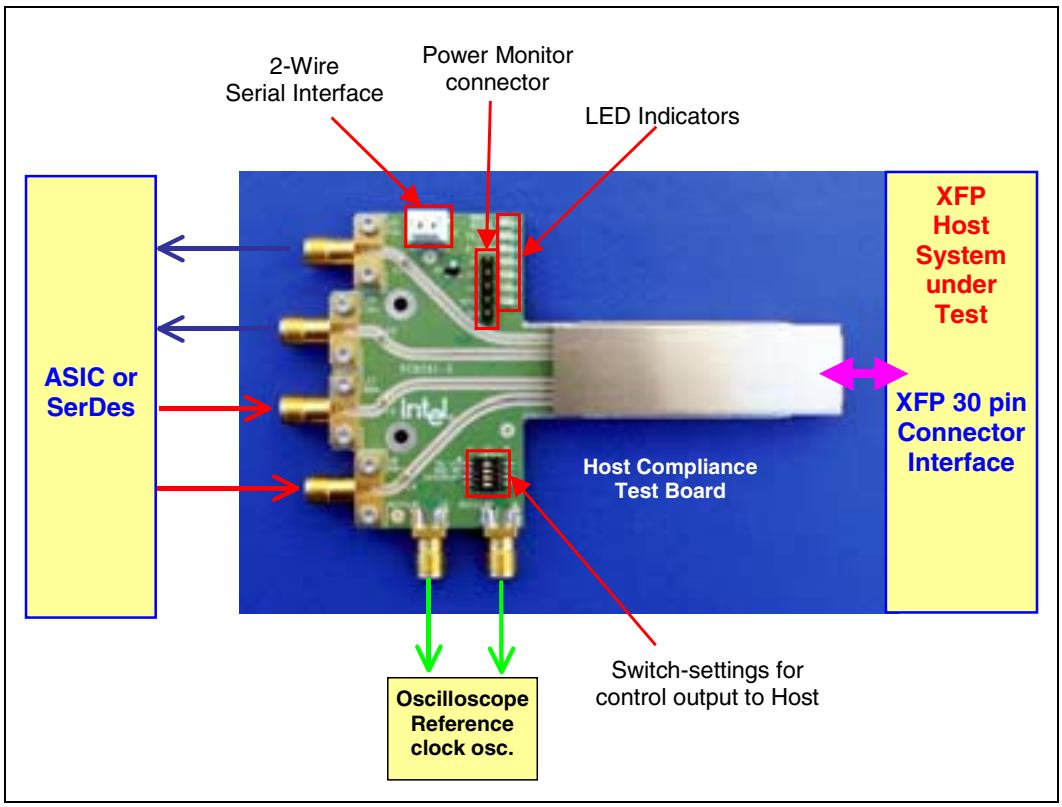
3.10 Schematic – XEB72353



3.11 How to Get Started

In order to get a quick and smooth start, we recommend the set-up outlined in Figure 13.

Figure 13. Test Set-up



This set-up is equivalent to the Host System Compliance Test Diagram in the XFP standard (Appendix-A): shown on 27.

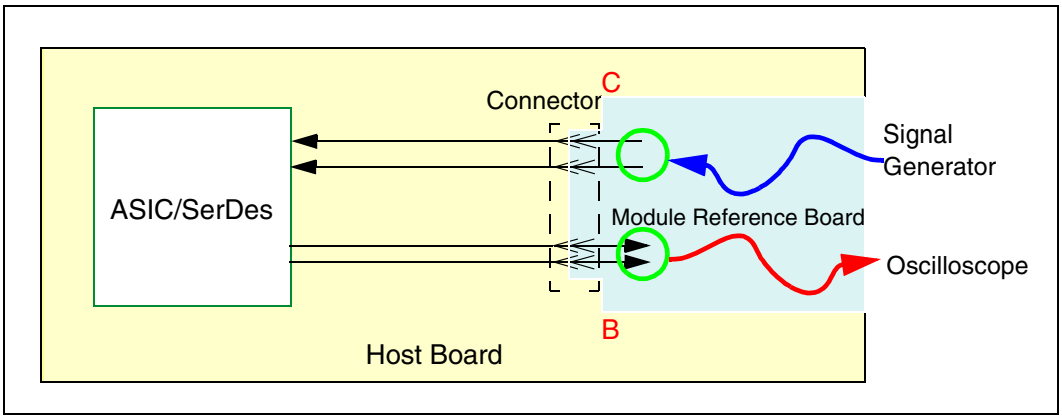
Please note that valid observations at 10 Gbit/s data rates require instruments, test cables, and connectors suitable for microwave operation. In particular, observation of rise/fall times, waveform, and jitter characteristics is not trivial at this transmission rate.

- A single ended data source can be applied to a differential input. In this case the unused input should be terminated.
- Remember to terminate the unused output of a differential signal when you connect a single ended instrument.

3.11.1 XFP Host System Compliance Testing

From the XFP specification - Appendix A: “Host system transmitter and receiver are tested by inserting a Host Test Compliance Board in place of the XFP module.”

Figure 14. Host System Compliance Test Diagram



The compliance point are as the following:

- **B:** Host system Output. The applicable measurements are:
  Output Amplitude
  Output Jitter
  Return Loss S22.
- **C:** Host system Input. The applicable measurements are:
  Input amplitude
  Jitter tolerance
  Return Loss S11.

3.12 Insertion of the HCB into XFP Cage on the MCB

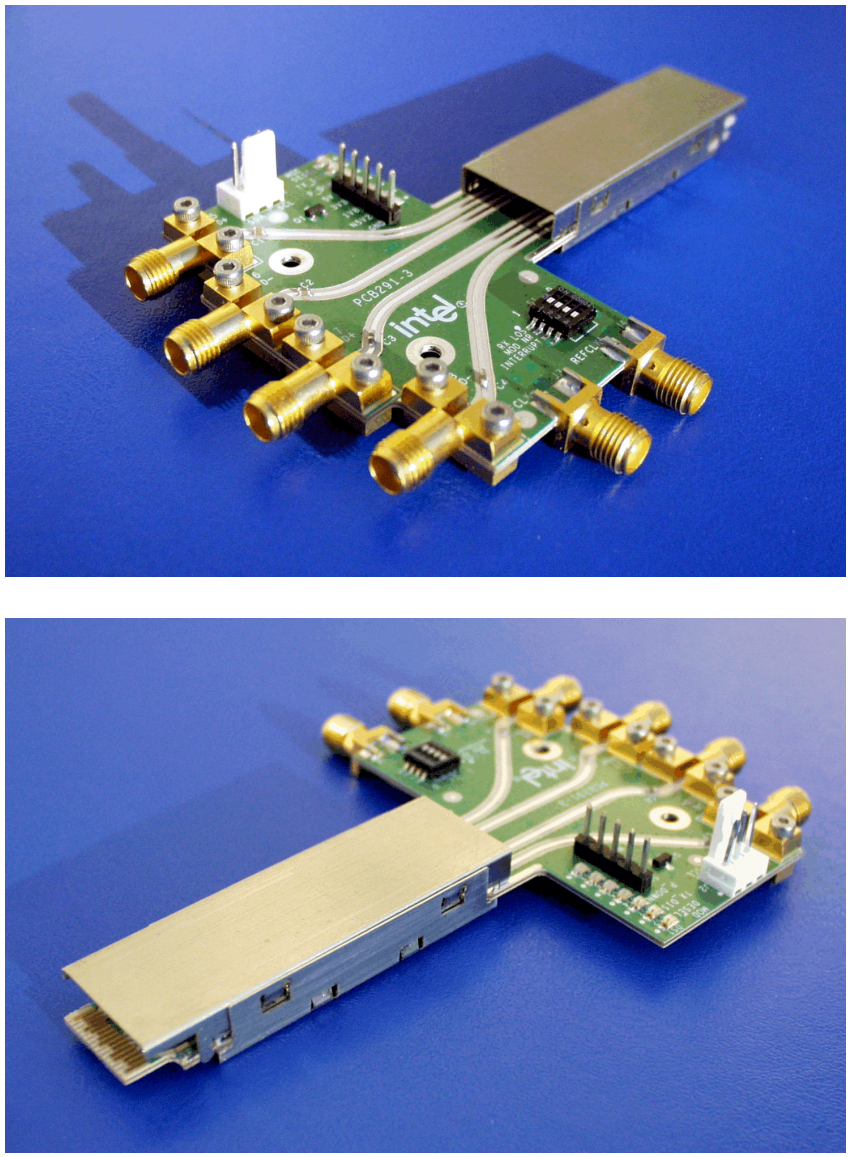
The Host Compliance Test Board is now ready for insertion into the slot (Cage) on the host under test.

Please pay attention to the metal housing around the HCB. The metal house fits exactly into the cage and prevents is to be mounted upside down in the cage slot. The front metal edge of the metal housing acts as a mechanical stop when the board is fully inserted into the Cage.

Please insert the HCB carefully into the cage, parallel to the cage walls.

The HCB described in this section is illustrated in Figure 15.

Figure 15. The Mechanical Components



4.0 Ordering Information

Table 3. Ordering Information

Product Name	Description
XEK66700	The reference kit comprises: XEB60009 board in antistatic bag XEB72353 board in antistatic bag XEK66700 Datasheet (this document) XEK66700 Test report

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