Reference Design:

HFRD-21.0

Rev. 4; 11/08

REFERENCE DESIGN

2.5Gbps Cooled TOSA Evaluation Board

(Includes MAX3735A Laser Driver and MAX8521 TEC Controller)

maxim integrated™

Table of Contents

1 Overview

High Frequency Reference Design (HFRD) 21.0 is designed to evaluate laser assemblies that conform to the 2.5Gbps cooled TOSA MSA. The evaluation board includes the MAX3735A laser driver and the MAX8521 TEC controller. By integrating both devices on one PCB the evaluation of the cooled TOSAs is greatly simplified.

HFRD- 21.0

1.1 Features

- MAX3735A Laser Driver
- MAX8521 TEC Controller
- Monitor Test Points for Bias, Monitor Photodiode and TEC Currents
- SMA Connectors for High-Speed Data
- Schematics and Bill of Materials Provided

2 Obtaining Additional Information

Limited quantities of the cooled TOSA evaluation board (HFRD-21.0) are available. For more information about the reference design or to obtain an evaluation board please email to: https://support.maxim-ic.com/.

3 Reference Design Details

HFRD-21.0 was engineered to evaluate the MAX3735A laser driver and the MAX8521 TEC controller with laser assemblies that comply to the 2.5Gbps Cooled TOSA Multisource Agreement (MSA). The MSA sets guidelines for the package outline, pin function and other aspects of the TOSA design. By complying with the standard, the laser assemblies are mechanically and functionally interchangeable.

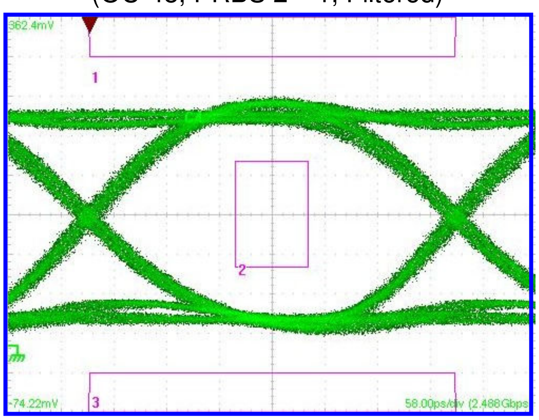
The HFRD-21.0 evaluation board allows straightforward evaluation of a cooled TOSA laser by providing the MAX3735A laser driver, the MAX8521 TEC controller, micro-strip transmission lines, SMA connectors for transmitted and received data and a PCB footprint for attaching a 2.5Gbps cooled TOSA laser. Potentiometers are included on the PCB to adjust the average power, modulation currents, fault levels and laser temperature. Monitoring test points are also available for Laser Bias, Monitor Photodiode and TEC currents.

4 Reference Design Characteristic Graphs

(Diagrams were generated using the JDSU Cooled TOSA Laser, Part # CTR915-118. All eye diagrams were measured at approximately 1.74mW output power and 9.8dB extinction ratio)

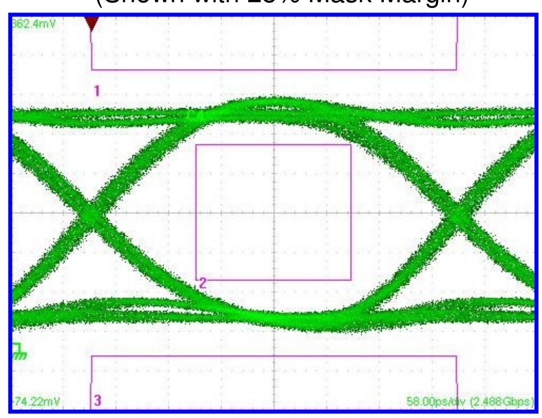
EYE DIAGRAM

(OC-48, PRBS 2^{23}-1, Filtered)



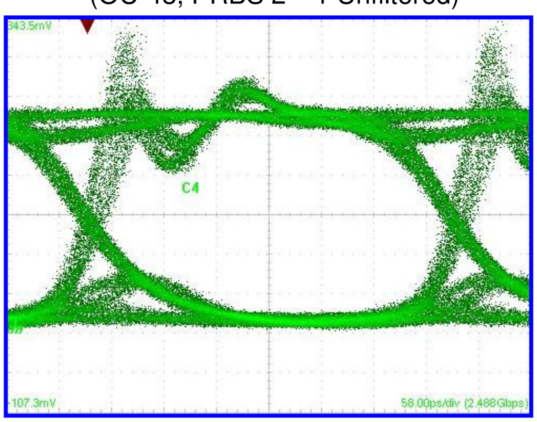
EYE DIAGRAM

(Shown with 28% Mask Margin)



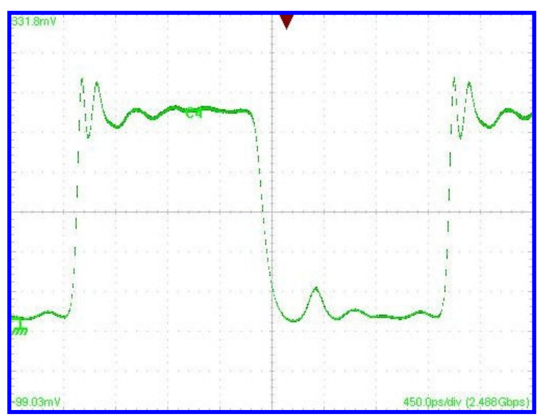
EYE DIAGRAM

(OC-48, PRBS 2^{23}-1 Unfiltered)



Transition Time (20% to 80%)

(Rise Time = 40ps, Fall Time = 106ps)



5 Applications Information

The HFRD-21.0 Cooled TOSA evaluation board can be configured for several different types of output configurations such as single-ended or differential drive (AC or DC coupled). The component values and output configurations are optimized specifically for the JDSU TOSA using a differential drive configuration. Other Cooled TOSAs can work well with this configuration but some adjustments may be needed for optimal performance.

For more information about configuring or optimizing the component values for a specific laser, please see the MAX3735A and MAX8521 data sheets available at www.maxim-ic.com. Additional assistance by sending email questions to: https://support.maxim-ic.com/.

6 Quick Start

To evaluate a cooled TOSA with the HFRD-21.0 evaluation board:

1) Solder the Cooled TOSA laser to the evaluation board.
2) Connect a fiber from the TOSA to the test equipment.
3) Apply a differential input signal ($200mV_{P-P}$ to $2400mV_{P-P}$) between SMA connectors J4 and J5 (IN- and IN+)

WARNING: Many Cooled TOSA lasers can output a very large optical power. Ensure that proper connections are made for eye safe operation and that the output power does not exceed the test equipment capabilities.

Note: When performing the following resistance checks, manually set the ohmmeter to a high range to avoid forward biasing the on-chip ESD protection diodes.

4) Adjust R31, the R_{MODSET} potentiometer, for maximum resistance (≈50kΩ) between TP3 and ground. This will set the modulation current to low value (<10mA). (Refer to the *Design Procedure* section of the MAX3735 data sheet.)
5) Adjust R30, the R_{APCSET} potentiometer, for maximum resistance (≈50kΩ) between TP1 and ground. This will set the photodiode current to a low value (<18µA). (Refer to the *Design Procedure* section of the MAX3735 data sheet.)

WARNING: Consult the laser data sheet to ensure that 18µA of photodiode current and 10mA of modulation current does not correspond to excessive laser power.

6) Adjust R33, the R_{PC_MON} potentiometer, to set the maximum monitor diode current (see below). R_{PC_MON} can be measured from TP16 to ground.

$$R_{PC\_MON} = \frac{1.38V}{I_{MDMAX}}$$

7) Adjust R32, the R_{BC_MON} potentiometer, to set the maximum bias current (see below). R_{BC_MON} can be measured from TP18 to ground.

$$R_{BC\_MON} = \frac{76 \cdot 1.38V}{I_{BIASMAX}}$$

8) Place a jumper on JU1 and remove the jumper from JU16. This disables the TEC controller and the laser driver.
9) Using the equation below adjust R4 (R_{SET}) to the calculated value to set the laser temperature.

$$R_{SET} = 50k \cdot \frac{R_{THERM}}{R_{THERM} + 20k}\Omega$$

Note: R_{SET} is measured from the center contact of the R4 potentiometer to ground. R_{THERM} is the thermistor resistance for the desired case temperature.

10) Connect a +3.3V supply with a 50mA current limit between TP12 (VDD) and TP13 (GND).

11) With the power on, measure the supply current (should be less than 50mA).

12) Adjust the current limit to greater than 400mA (up to 1.2A depending on the required cool TEC startup current) and remove the jumper from JU1. The supply current should ramp up quickly and then slowly settle to a value between 60 and 200mA. The TEC current can be monitored with a multimeter using TP4. See MAX8521 data sheet for additional details.

13) Place a shunt on JU16.

14) Adjust R30 until the desired average optical power is achieved.

15) The MD and BIAS currents can be monitored at TP16 (V_{PC_MON}) and TP18 (V_{BC_MON}) using the equations that follow:

$$I_{MD} = \frac{V_{TP16}}{R_{PC\_MON}}$$

$$I_{BIAS} = \frac{76 \cdot V_{TP18}}{R_{BC\_MON}}$$

Note: If the voltage at TP16 or TP 18 exceeds 1.38V, the TX_FAULT signal will be asserted and the laser currents will be disabled. Toggle TX_DISABLE or cycle power to reset the fault condition.

16) Adjust R31 until the desired optical amplitude is achieved. Optical amplitude can be observed on an oscilloscope connected to an optical/electrical converter (ensuring that the output power does not exceed the converter's rating). Laser overshoot and ringing can be improved by appropriate selection of R14 and C23, as described in the Design Procedure section of the MAX3735 data sheet.

7 I/O and Control Description

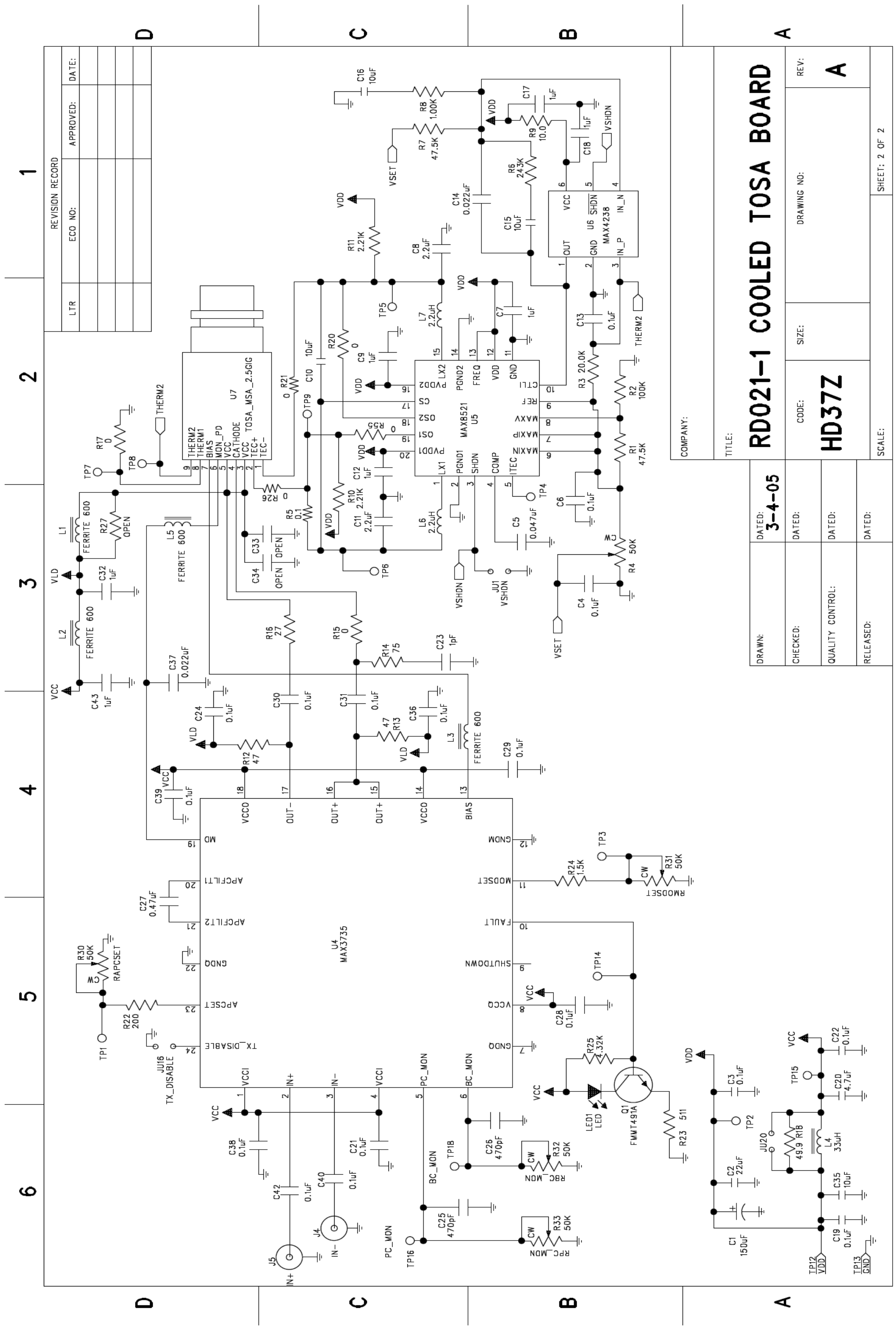
See the MAX3735A and MAX8521 data sheets for additional information.

Component	NAME	FUNCTION
J4	IN-	Transmitted Data Inverted Input, SMA Connector
J5	IN+	Transmitted Data Non-Inverted Input, SMA Connector
JU1	VSHDN	Placing a shunt on JU1 disables the TEC controller. See note in Section 9.
JU16	TX_DISABLE	Placing a shunt on JU16 enables the laser drivers modulation and bias currents.
R4	RSET	Adjust R4 to set the laser case temperature.
R30	RAPCSET	Turn the potentiometer (R30) screw counter clockwise to increase the average optical power. Turn the potentiometer (R30) screw clockwise to decrease the average optical power.
R31	RMODSET	Turn the potentiometer (R31) screw counter clockwise to increase the modulation current. Turn the potentiometer (R31) screw clockwise to decrease the modulation current.
R32	RPC_MON	The laser monitor diode current fault level can be adjusted using R32.
R33	RBC_MON	The laser bias current fault level can be adjusted using R33.
D5	TX_FAULT	LED illuminates when TX_FAULT asserts indicating a laser safety fault.
TP2	VDD	Monitoring Test Point for VDD power supply.
TP4	ITEC	Monitoring Test Point for ITEC. ITEC is a voltage output proportional to the TEC current.
TP12	VDD	+3.3V Power Supply Connection
TP13	GND	Ground Power Supply Connection
TP15	VCC	Monitoring Test Point for VCC. VCC is the filtered VDD input. VCC is applied the laser driver section of the evaluation board.
TP16	PC_MON	Monitoring Test Point for PC_MON (Laser Photodiode Current Monitor) output. The voltage measured at TP16 is proportional to the TOSA photodiode current.
TP18	BC_MON	Monitoring Test Point for BC_MON (Laser Bias Current Monitor) output. The voltage measured at TP18 is proportional to the laser bias current.
TP7, TP8		Monitoring Test Points for the TOSA thermistor resistance.

8 Component List

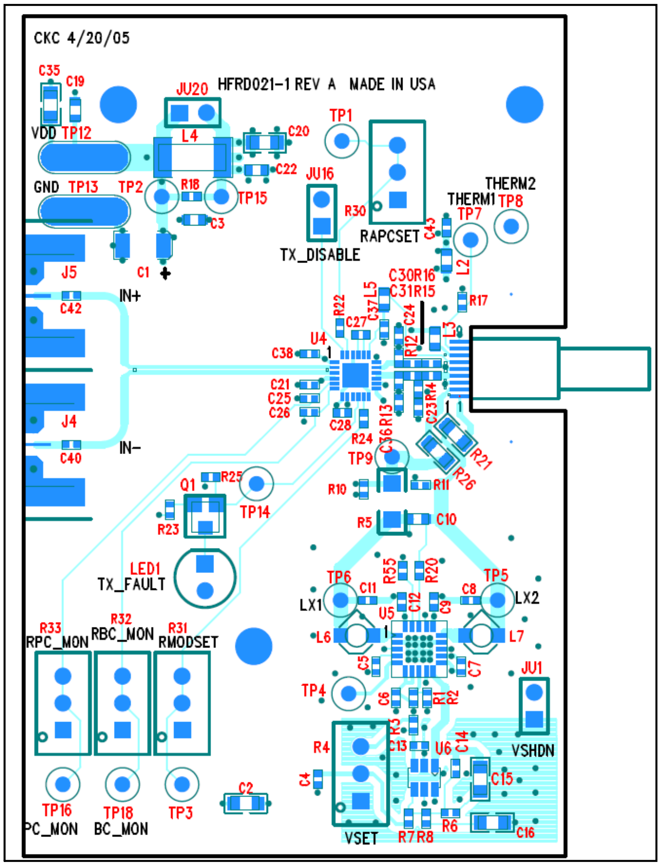
DESIGNATION	QTY	DESCRIPTION
C1	1	150µF ± 20% Tantalum Capacitor (B-Case)
C2	1	22µF ± 20% Ceramic Capacitor (0805)
C3, C19, C22	3	0.1µF ± 10% Ceramic Capacitor (0603)
C4, C6, C13, C21, C24, C28, C29, C31, C36, C38-C40, C42	13	0.1µF ± 10% Ceramic Capacitor (0402)
C5	1	0.047µF ± 10% Ceramic Capacitor (0402)
C7, C9, C12, C17, C18, C32, C43	7	1µF ± 10% Ceramic Capacitor (0402)
C8, C11	2	2.2µF ± 10% Ceramic Capacitor (0402)
C10	1	10µF ± 20% Ceramic Capacitor (0603)
C14, C37	2	0.022µF ± 10% Ceramic Capacitor (0402)
C15, C16, C35	3	10µF ± 10% Ceramic Capacitor (0805)
C20	1	4.7µF ± 10% Ceramic Capacitor (0805)
C23	1	1pF ± 10% Ceramic Capacitor (0402)
C25, C26	2	470pF ± 10% Ceramic Capacitor (0402)
C27	1	0.47µF ± 10% Ceramic Capacitor (0402)
C30	1	Short (0402)
C33, C34	2	Open (0402)
J4, J5	2	PCB Mount SMA Connector, Tab Contact
JU1, JU16, JU20	2	2-Pin Header
L1-L3, L5	4	600Ω Ferrite Bead (0603) Murata BLM18HG601SN1
L4	1	33µH Inductor Coilcraft DO1608
L6, L7	2	2.2µH Inductor Sumida CDRH2D18HP-2R2
LED1	1	Red LED
Q1	1	NPN Transistor Zetex FMMT491A
R1, R7	2	47.5kΩ ±1% Resistor (0402)
R2	1	100kΩ ±1% Resistor (0402)
R3	1	20.0kΩ ±1% Resistor (0402)
R4, R30-R33	5	50kΩ Variable Resistor
R5	1	0.1Ω ±1% Resistor (1206)
R6	1	243kΩ ±1% Resistor (0402)
R8	1	1.00kΩ ±1% Resistor (0402)
R9	1	10Ω ±1% Resistor (0402)
R10, R11	2	2.21kΩ ±1% Resistor (0402)
R12, R13	2	47.5Ω ±1% Resistor (0402)
R14	1	75Ω ±5% Resistor (0402)
R15, R17, R20, R55	4	0Ω ±5% Resistor (0402)
R16	1	27Ω ±5% Resistor (0402)
R18	1	49.9Ω ±1% Resistor (0402)
R21, R26	2	0Ω ±5% Resistor (0805)
R22	1	200Ω ±1% Resistor (0402)
R23	1	511Ω ±1% Resistor (0402)
R24	1	1.5kΩ ±1% Resistor (0402)
R25	1	4.32kΩ ±1% Resistor (0402)
R27	1	Open (0402)
U4	1	MAX3735ATEG
U5	1	MAX8521ETP
U6	1	MAX4238AUT-T
U7	1	Open (MSA TOSA)
	1	HFRD21-1 PCB

9 Schematic

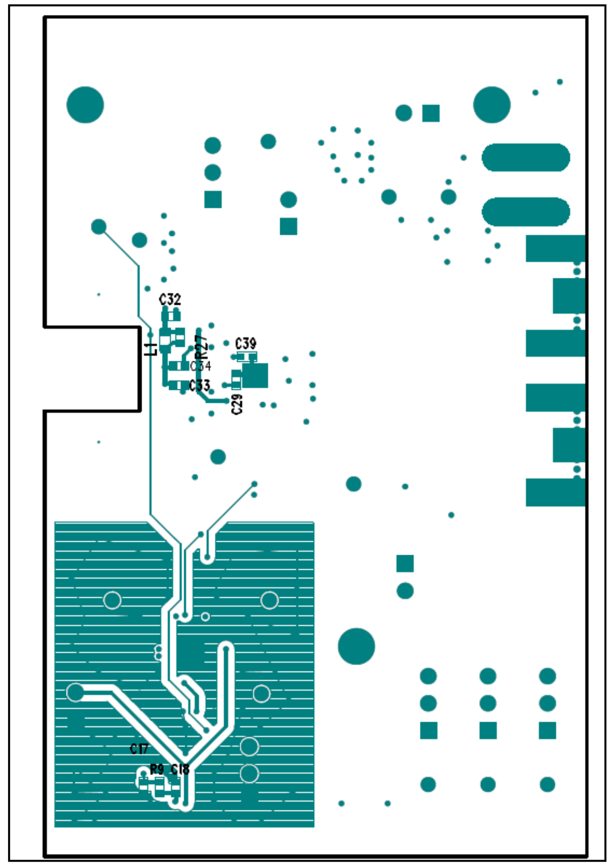


Note: A 4.7kΩ resistor is added to each board from VSHDN to V_{CC} to pull this line high (Enable the TEC controller) when a jumper is not placed on JU1. This resistor is not included on the schematic or layout files.

10 PC Board Layout



Layer 1 Component placement guide

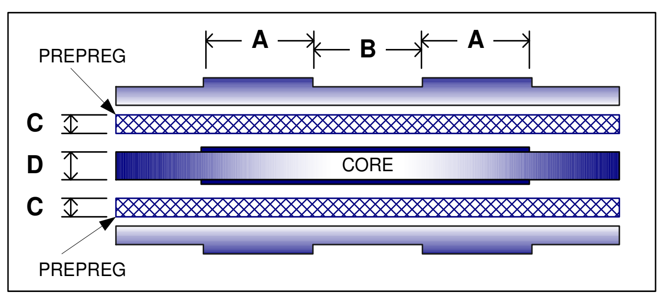


Layer 4 Component placement guide

11 Layer Profile

The HFRD-21.0 Cooled TOSA evaluation board includes controlled-impedance transmission lines. The PCB is constructed with FR4 (dielectric constant of ~ 4.5) and a 1oz copper foil

	SINGLE ENDED	COUPLED
A	27mil	12mil
B	>50mil	7mil
C	15mil	15mil
D	As Needed	As Needed



Layer Profile Diagram