

General Description

This evaluation board is a complete SFP module as defined in the SFP MSA document. The design uses Micrel's MIC3001 controller, SY88982 (pin compatible with SY88782 and SY88932) driver, and SY88343 limiting amplifier, which is pin compatible with an entire family of post amplifiers. A picture of the fully loaded board is shown below.

Data sheets and support documentation can be found on Micrel's web site at: www.micrel.com.

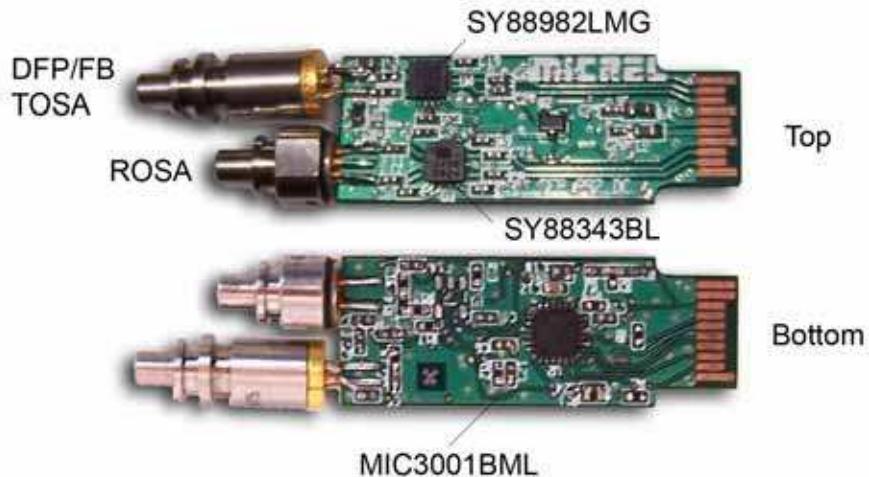
Features

- Compliant with SFP MSA
- Allows for easy and fast evaluation of Micrel's chipset for SFP module

Related Support Documentation

- MIC3001 Data Sheet: SFP module controller featuring digital diagnostic monitoring interface as per SFF-8472 with internal/external calibration and full laser control with bias and modulation current compensation for temperature variations using look up tables.
- SY88982 Data Sheet: Low-power small form factor (3mm x 3mm) laser driver up to 2.7Gbps data rate and 2.3V compliance voltage. SY88782 is a lower speed version up to 1.25Gbps.
- SY88343 Data Sheet: Multi-rate 155Mbps to 3.2Gbps low sensitivity limiting amplifier.
- MIC3001 Software User's Guide.

Evaluation Board



Evaluation Board Setting

Driver Laser Coupling

The laser is DC-coupled to the driver. Compensation for laser parasitic may be improved by installing R10 and C4. The optimal values of these components can vary from one family of lasers to another and is up to the user to tune the values to get the best compensation for the laser used with this board.

Receiver Sensitivity and Hysteresis Setting

SY88343 Limiting Amplifier

The SY88343 limiting amplifier is the default post amplifier installed on the board. It has a receive signal LOS indicator. The hysteresis on the receive signal, LOS, is set by the voltage difference between LOSLVL (pin 14) and VREF (pin 6). That voltage difference can be trimmed by changing the value of R1, which forms a voltage divider with the $2.8k\Omega$ internal resistor between pin 14 and pin 6. Refer to the application note AN-45 entitled "Notes on Sensitivity and Hysteresis in Micrel's Post Amplifiers" at:

http://www.micrel.com/product-info/app_hints+notes.shtml

TOSA and ROSA Installation

Check the pin-out of the laser and receiver and install them according to the diagrams shown on Figure 1.

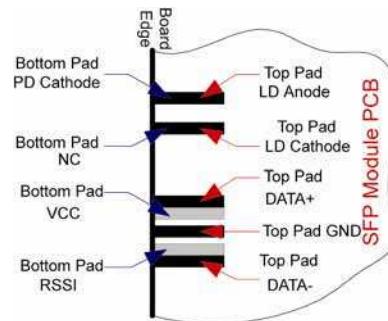


Figure 1. Mounting of Laser and Receiver

Set-Up and Operation

Plug the module into the SFP host board and connect the DATA and CLK lines to the host computer then power the host board. Either OEM or Micrel firmware can be used to communicate with the MIC3001 chip on the board via the serial interface. If the Micrel firmware is used, follow the steps below:

1. Launch the MIC3000/1 software. The **MIC3001 Optical Transceiver Management IC** panel opens with **Panels** and **Help** grayed out and only **Utilities** can be run.
2. Refer to MIC3000/1 Software User's Guide for the detailed settings.
3. On the main window select **Utilities** to open the utilities panel, and then select **SCAN** to read the address of the MIC3001 and **GET** to read the manufacturer ID, Device ID, and Die Revision. If there is a failure in reading one of these parameters, you cannot proceed further. If all the parameters are read correctly, close the **Utilities window** to return to the main window where **Panels** and **Help** are no longer grayed out.
4. Select **Panels** to display the list of setting panels.
5. All the bits displayed on the panels can be read and/or modified on the panels or by accessing the registers directly by selecting **ALL REGISTERS**, enter the serial address, the register address, select **GET** to read the content or type a value and select **SET NEW** to write. In this procedure the bits are set on the panels.
6. Select **OEM CONFIG 0-2** to open the OEM configuration registers 0, 1, and 2 windows. Check the default setting and reset the parameters to their default values as follows if needed.

In OEM Configuration Register 0 window, set **ENABLE/DISABLE** to **DISABLE**, **VMOD REFERENCE** to **GND**, and temperature zone to **INTERNAL**.

In OEM Configuration Register 1 window:

- a. Set **APC OP-AMP TYPE** to **EMITTER FOLLOWER**.
- b. Select the voltage to report in **VINH:VINL**.
- c. Set Feedback voltage source to **1.22V**.
- d. Set **FEEDBACK BIAS REF** and

RES TERMINATION to GND and **VBIAS DRIVE to SOURCE (NPN)**. Set **INTERNAL FEEDBACK RESISTOR** to an arbitrary value (1.6K for example).

7. In **OEM Configuration Register 2**, the MIC3001 address and look-up table offset can be modified. The look-up table covers 128°C. The temperature range for offset = 0 is 0° to +127°C.) This range can be shifted down by 2x the value of the offset. If offset = 15, the temperature range becomes -30° to +97°C.
8. In **OEM Configuration Register 0** window, set **ENABLE/DISABLE** to **ENABLE**.
9. On **Panels** list select **OEM CONFIG 3-4** and select **EXTERNAL CALIBRATION** (default setting), **LOS COMPARATOR ENABLE**, **SHDN**, **RXLUT INPUT TEMPERATURE**, and **RSOUT**. If needed, later set **ISTART** to a different value to speed up the APC loop during laser turn ON after a FAULT occurrence. Close the window to return to main window.
10. On **Panels** list, select **External Calibration**. Set all the **offsets** to 0 and **slopes** to 1. Set **RX_PWR(1)** to 1. These parameters might need to be changed later to correct the measured values (calibration). Return to the main window.
11. On **Panels** list, select **Temperature Compensation**. From appropriate files, load look-up tables for, APC, Modulation, Bias current Fault, and End-of-Life. If no loading is done, the default value 0 is used for all the LUT. Return to the main window.
12. On **Panels** list, select **OEM Settings**. Enter the desired DAC values between 0 and 255 for the displayed parameters then select **SET NEW**. Select **GET CURRENT** to make sure that the set values are written into the registers. You may come back to this panel to mask the faults by checking them at the bottom of the window. Return to the main window.
13. On **Panels** list, select **User**. Check **APC0** in the **USER CONTROL REGISTER** (default setting). All the other parameters can be checked later to verify their functionality. Return to the main window.

14. On **Panels** list, select **Result**. The values of the five monitored parameters as per SFF-8472 are now displayed. Type the **alarm** and **warning** thresholds and select **SET NEW LIMITS**. Select **GET CURRENT LIMITS** to check that the set values are written into the registers. Return to main window.
15. Set modulation current and bias current to get the desired output power and extinction ratio out of the laser. Use **OEM Settings** panel or **TX Setup** panel to do that:
 - a. In **OEM settings** window, set the bias by entering a value from 10 to 255 in **APC SET POINT 0** box and modulation by entering a value from 10 to 255 in MOD DAC setting box followed by SET new.
 - b. In **TX Setup** window, set the bias by entering a value from 10 to 255 in **APCO (DEC)** box and modulation by entering a value from 10 to 255 in MOD DAC setting box followed by SET new.
19. On **Panels** list, select **TX Setup** to calibrate the TX power. Measure the optical power at the output of the VCSEL and enter the value (in mW) in the **MEASURED TX POWER** box, then select **CALIBRATE**. The monitored value is adjusted to display the measured value by automatically changing the slope set in the **EXTERNAL CALIBRATION** window. Reconnect the VOA to the VCSEL and return to the main window.
20. On **Panels** select **RX Calibration**. Measure the input power to receiver at the output of the VOA and enter the measured value (in mW) in the **MEASURED RX POWER** box then select **CALIBRATE**. The monitored value is adjusted to display the measured value by automatically changing the slope set in the **EXTERNAL CALIBRATION** window. Reconnect the VOA to the receiver and return to the main window.
21. At this stage, the masked faults should be unmasked and if there is a fault indication try to find the cause for it and fix it to get the transceiver running fault free and try to measure the performance of the laser driver and post amplifier.

After setting the new value for bias or modulation current, toggle TXDISABLE/TXENABLE on the main window.

16. At this step, there is no received power since no signal is applied at the input of the receiver.
17. Adjust the VOA to bring the optical power to the desired level at the input of the receiver. Then connect the output of the VOA to the input of the receiver using appropriate fiber jumper.
18. If the installed receiver has RSSI signal, a value (needs calibration) of the received power should be displayed now.

Laser Response Tuning

Overshoot/Undershoot

The damping resistors R2 and R18 installed in series with laser are 10Ω . This value might be tuned to a higher value to minimize or suppress any overshoot or undershoot on the optical signal out of the laser, but keep in mind that higher value damping resistors will lead to higher rise/fall time and longer limit for modulation current.

Laser's Package Inductance Compensation

A compensation network comprised of C4/R10 can be used to compensate for the laser package parasitic inductance. There are no specific values indicated on the schematic because the values will depend upon the type of package and lead length. Capacitance from a few pF to $10nF$, combined with resistance from 50Ω to 200Ω , can be used.

Performance

Below figures show optical eye diagram obtained with a Fabry Perrot laser driven differentially at different frequencies:

155Mbps, PRBS = $2^{23}-1$, ER = 11.49dB

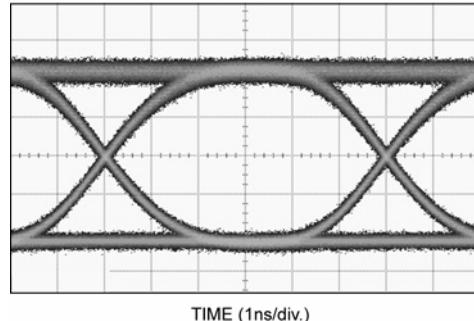


Figure 2. Optical Eye Diagram

622Mbps, PRBS = $2^{23}-1$, ER = 11.42dB

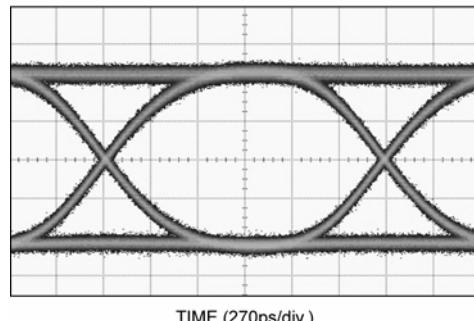


Figure 3. Optical Eye Diagram

2.5Gbps, PRBS = $2^{23}-1$, ER = 10.31dB

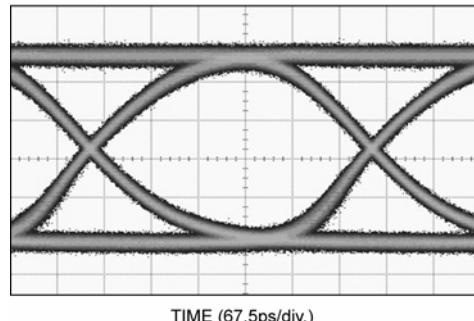


Figure 4. Optical Eye Diagram

Evaluation Board Schematics

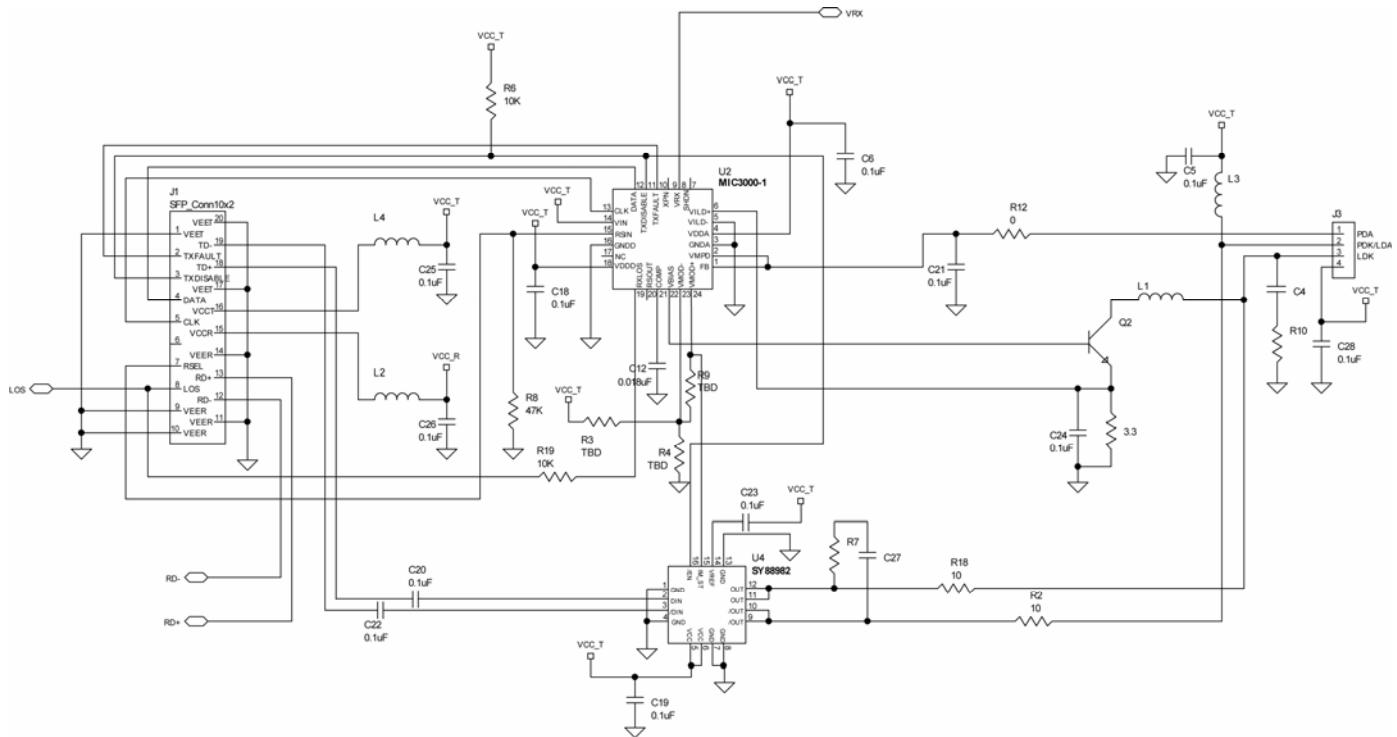


Figure 4. Transmitter

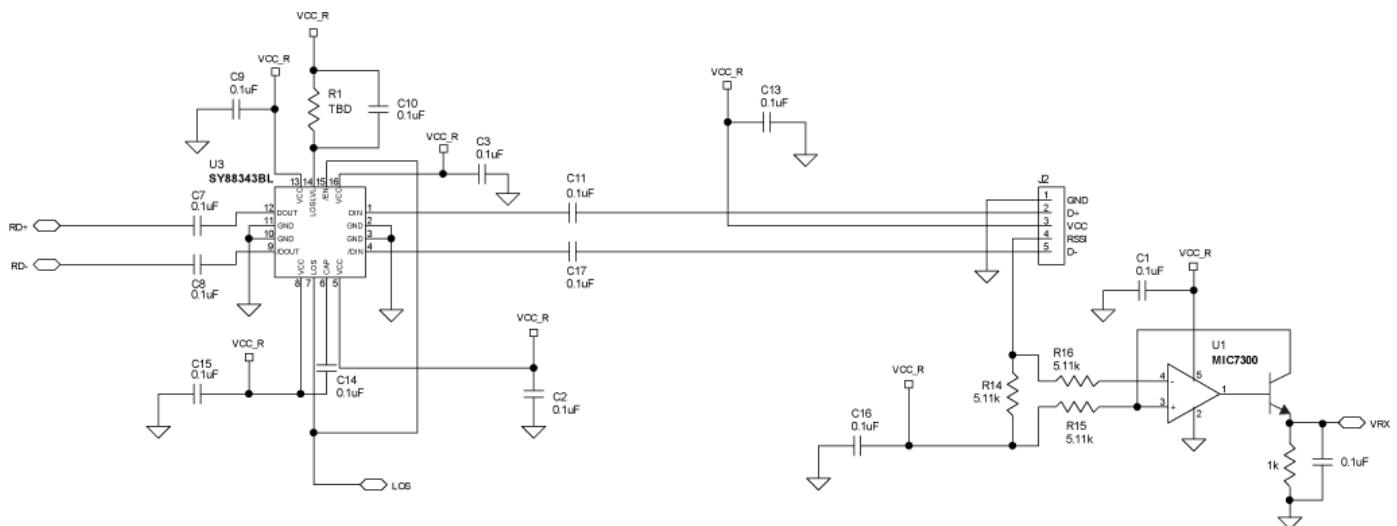
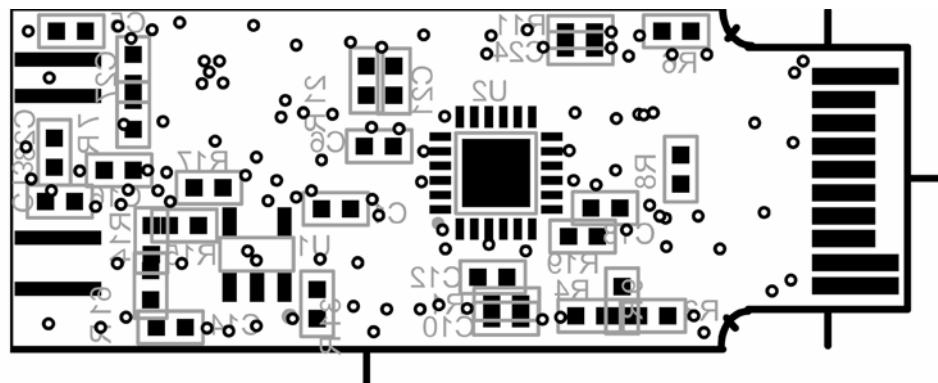
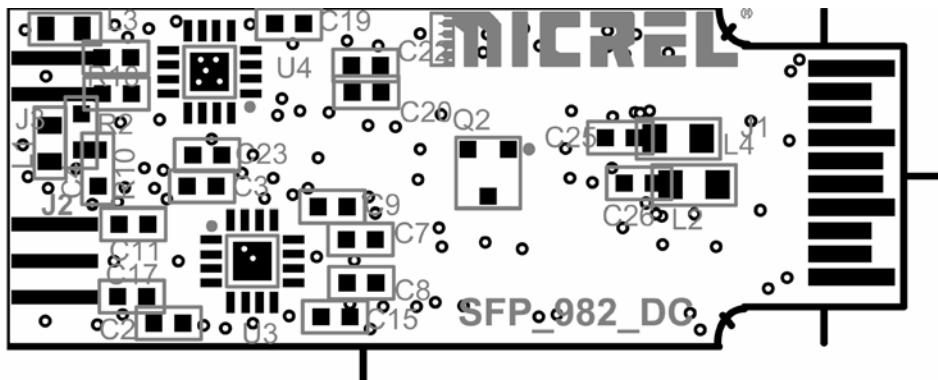


Figure 5. Receiver

PCB Layout/Assembly



Bill of Materials

Driver DC-Coupled to the Laser

Item	Part Number	Manufacturer	Description	Qty.
C1-C3, C5-C11, C13-C26, C28	ECJ0EB1A104K	Panasonic ⁽¹⁾	0.1µF, 0402, ceramic capacitor	25
C12	VJ0402Y182KXXA	Vishay ⁽²⁾	0.018µF, 0402, ceramic capacitor	1
C27	ECJ-0EC1H030C	Panasonic ⁽¹⁾	3pF, 0402, ceramic capacitor	1
J2	D12M-9060-4	Luxnet ⁽³⁾ or any ROSA with compatible pin-out	ROSA	1
J3	FOL137xx-Oxx-x4	Fitel (Furukawa) ⁽⁴⁾ or any laser with compatible pin-out	FP/DFB Laser	1
L1, L3	BLM18HG102SN	Murata ⁽⁵⁾	Inductor	2
L2, L4	IMC 0805 RK 122 J 01	Vishay ⁽²⁾	1.2µH Ferrite bead inductor	2
Q2	MMBT3904WT1	ON Semiconductor ⁽⁶⁾	General purpose NPN transistor	1
R2, R18	CRCW040210R0F	Vishay ⁽²⁾	10Ω, 1% resistor	2
R6, R19	CRCW04021002F	Vishay ⁽²⁾	10kΩ, 5% resistor	2
R7	CRCW04021000F	Vishay ⁽²⁾	68Ω, 1% resistor	1
R8	CRCW04024752F	Vishay ⁽²⁾	47kΩ, 5% resistor	1
R9, R12	CRCW04020R00F	Vishay ⁽²⁾	0Ω resistor	2
R11	CRCW04023R32F	Vishay ⁽²⁾	3.32Ω, 1% resistor	1
R13, R17	CRCW04025111F	Vishay ⁽²⁾	30kΩ, 1% resistor	2
R14			1.5kΩ, 5% resistor	1
R15-16			1kΩ, 5% resistor	2
U1	MIC7300	Micrel, Inc.⁽⁷⁾	High Output Drive Rail-to-Rail Op Amp	1
U2	MIC3001BML	Micrel, Inc.⁽⁷⁾	Optical Transceiver Management IC	1
U3	SY88343BL	Micrel, Inc.⁽⁷⁾	3.2Gbps Limiting Post Amplifier	1
U4	SY88982LMG	Micrel, Inc.⁽⁷⁾	Laser Driver	1

Notes:

1. Panasonic: www.panasonic.com.
2. Vishay: www.vishay.com.
3. Luxnet: www.luxnet.com.
4. Fitel: www.fitel.com.
5. Murata: www.murata.com.
6. On Semiconductor: www.onsemi.com.
7. **Micrel, Inc.:** www.micrel.com.

HBW Support

Hotline: 408-955-1690

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Application Hints and Notes

For application notes on high-speed termination on PECL and LVPECL products, clock synthesizer products, SONET jitter measurement, and other High Bandwidth products go to Micrel's website at <http://www.micrel.com/>. Once in Micrel's website, follow the steps below:

1. Click on "Product Info".
2. In the Applications Information Box, choose "Application Hints and Application Notes."

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