SY88022AL

11.3Gbps Laser Diode Driver

General Description

The SY88022AL is a single 3.3V supply, small form-factor, multi-rate laser driver for telecom/datacom applications using FP/DFB lasers at data rates up to 11.3125Gbps. The driver can deliver a modulation current of up to 75mA into a 15Ω external load with a fast edge rate below 25ps, and a bias current of up to 80mA. Having an equalizer at the input will compensate for the SFP+ connector and line card long traces.

The SY88022AL interfaces with MIC3003, Micrel's highly advanced optical module controller, as an easy-to-use chipset solution for SFP+ optical module applications. The MIC3003 allows for many features, including modulation and bias current control, automatic power control, and temperature compensation using look up tables. The MIC3003 comes in 4mm × 4mm QFN (MIC3003GML) and 3mm × 3mm QFN (MIC3003GFL) packages.

The SY88022AL operates on a single 3.3V power supply and comes in a 3mm × 3mm QFN package.

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

Features

- Operates from a single 3.3V supply
- Data rate operation up to 11.3125Gbps
- Modulation current up to 75mA
- Fast edges rates, below 25ps
- Bias current up to 80mA
- Input equalizer
- Small form factor 3mm × 3mm QFN package

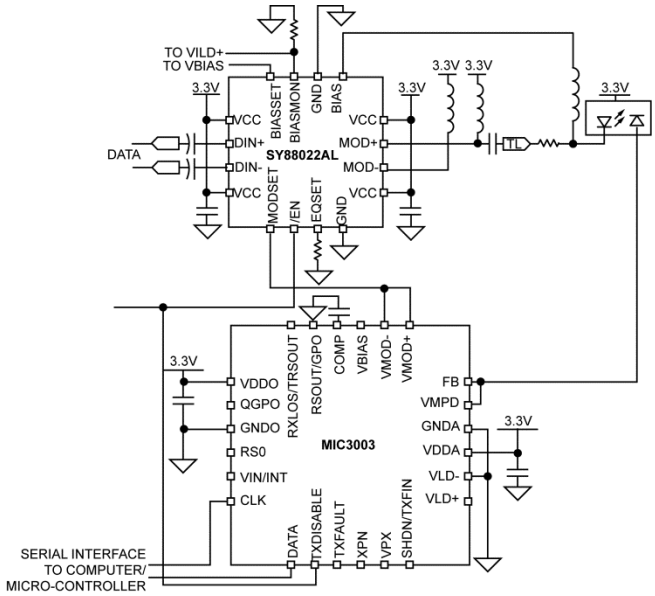
Applications

- Multi-rate LAN, MAN applications up to 11.3Gbps: 8xFC, 10G GbE, SONET OC-192,, and SDH STM-64
- SFP+, XFP, XPAK, XENPAK, X2, MSA 300 optical modules
- OBSAI, CPRI

Markets

- Fibre channel storage area networks
- Datacom/enterprise
- Telecom
- Wireless base stations

Typical Application Circuit



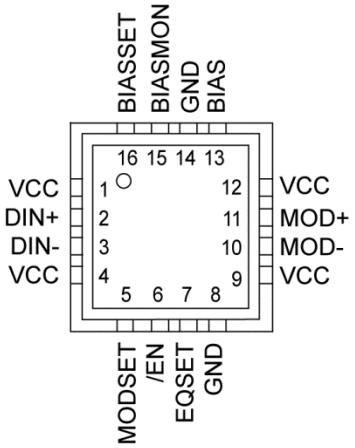
Ordering Information

Part Number	Package Type	Operating Range	Package Marking	Lead Finish
SY88022ALMG	3mm × 3mm QFN-16	Industrial	022A with Pb-Free bar line indicator	NiPdAu Pb-Free
SY88022ALMG TR[1]	3mm × 3mm QFN-16	Industrial	022A with Pb-Free bar line indicator	NiPdAu Pb-Free

Note:

1. Tape and reel.

Pin Configuration



16-Pin 3mm × 3mm QFN
(Top View)

hbwhelp@micrel.com or (408) 955-1690

Pin Description

Pin Number	Pin Name	Pin Function
1, 4, 9, 12	VCC	Supply Voltage. Bypass with a 0.1µF//0.01µF low ESR capacitor as close to VCC pin as possible.
8, 14, Exposed Pad	GND	Ground. Ground and exposed pad must be connected to the plane of the most negative potential.
2	DIN+	Non-inverting input data. Internally terminated with 50Ω.
3	DIN–	Inverting input data. Internally terminated with 50Ω.
5	MODSET	Modulation current setting and control. Apply a voltage within the range 0V - 1.2V to this pin to set the modulation current. Input impedance 25kΩ.
6	/EN	Active Low TTL. Internal 75kΩ pull down to GND. The driver is enabled when this pin is unconnected or /EN asserted low and disabled when /EN asserted high.
7	EQSET	Install a resistor from this pin to GND to set the desired equalization level. 0Ω will provide maximum equalization and 2kΩ or higher will provide negligible equalization. Leave open if no equalization is needed.
10	MOD–	Inverted modulation current output. Provides modulation current when input data is negative. Internally terminated with 25Ω to VCC.
11	MOD+	Non-inverted modulation current output. Provides modulation current when input data is positive. Internally terminated with 25Ω to VCC.
13	BIAS	Bias current output.
15	BIASMON	Bias current monitor. Outputs a current which represents 1/100th of the bias current. Install an external resistor from this pin to GND to convert the output current to a voltage proportional to the bias current.
16	BIASSET	Bias current setting and control. Apply a voltage within the range 0V - 1.2V to this pin to set the bias current. Input impedance 25kΩ.

Truth Table

DIN+	DIN-	/EN	MOD+[2]	MOD-	Laser Output[3]
L	H	L	H	L	L
H	L	L	L	H	H
X	X	H	H	L	L

Notes:

2. I_{MOD} = 0 when MOD+ = H.
3. Assuming that the laser cathode is tied to MOD+.

hbwhelp@micrel.com or (408) 955-1690

Absolute Maximum Ratings[4]

Supply Voltage (V_{IN}) ..... –0.5V to +4.0V
CML Input Voltage (V_{IN}) ..... V_{CC}–1.2V to V_{CC}+0.5V
TTL Control Input Voltage (V_{IN}) ..... 0V to VCC
Lead Temperature (soldering, 20sec.) ..... +260°C
Storage Temperature (Ts) ..... –65°C to +150°C

Operating Ratings[5]

Supply Voltage (V_{CC}) ..... +3.0V to +3.6V
Ambient Temperature (T_A) ..... –40°C to +85°C
Package Thermal Resistance[6]
QFN
(θ_{JA}) Still-Air ..... 60°C/W
(Ψ_{JB}) ..... 33°C/W

DC Electrical Characteristics

T_A = –40°C to +85°C and V_{CC} = +3.0V to +3.6V, unless otherwise noted. 25Ω external load. Typical values are V_{CC} = +3.3V, T_A = 25°C, I_{MOD} = 30mA, I_{BIAS} = 30mA.

Symbol	Parameter	Condition	Min	Typ	Max	Units
I_{CC}	Power Supply Current	Modulation and bias currents excluded		65[7]	85[7]	mA
V_{MOD_MIN}	Minimum Voltage Required at the Driver Output (headroom) for Proper Operation		1.2			V
V_{BIAS_MIN}	Minimum Voltage Required at the BIAS Output (headroom) for Proper Operation		1.2			V
R_{IN}	Input Resistance, Single Ended		45	50	55	Ω
V_{ID}	Differential Input Voltage Swing		200		1000	mV_{pp}
V_{IL}	/EN Input Low				0.8	V
V_{IH}	/EN Input High		2			V
I_{BIAS}	Bias Current		10		80	mA
I_{BIAS_OFF}	Bias OFF Current	Current at BIAS when the device is disabled			150	µA
$I_{BIASMON}$ / I_{BIAS}	$I_{BIASMON}$ to I_{BIAS} Ratio	Resistor installed from BIASMON to GND		10		µA/mA
	Accuracy of $I_{BIASMON}$ to I_{BIAS} ratio	Resistor installed from BIASMON to GND	-5		+5	%
RMODSET	Input Resistance at MODSET pin			25		kΩ
VMODSET	Voltage Range at MODSET Pin	IMOD range 10mA to 60mA			1.2	V
RBIASSET	Input Resistance at BIASSET pin			25		kΩ
VBIASSET	Voltage Range at BIASSET pin	IBIAS range 10mA to 80mA			1.2	V

Note:

4. Exceeding the absolute maximum ratings may damage the device.
5. The device is not guaranteed to function outside its operating rating.
6. Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5kΩ in series with 100pF.
7. I_{MOD} and I_{BIAS} not included. MOD+/- tied to VCC through inductors. Maximum Icc measured with I_{MOD} = 60 mA, I_{BIAS} = 80 mA, and VCC=3.6V.

AC Electrical Characteristics

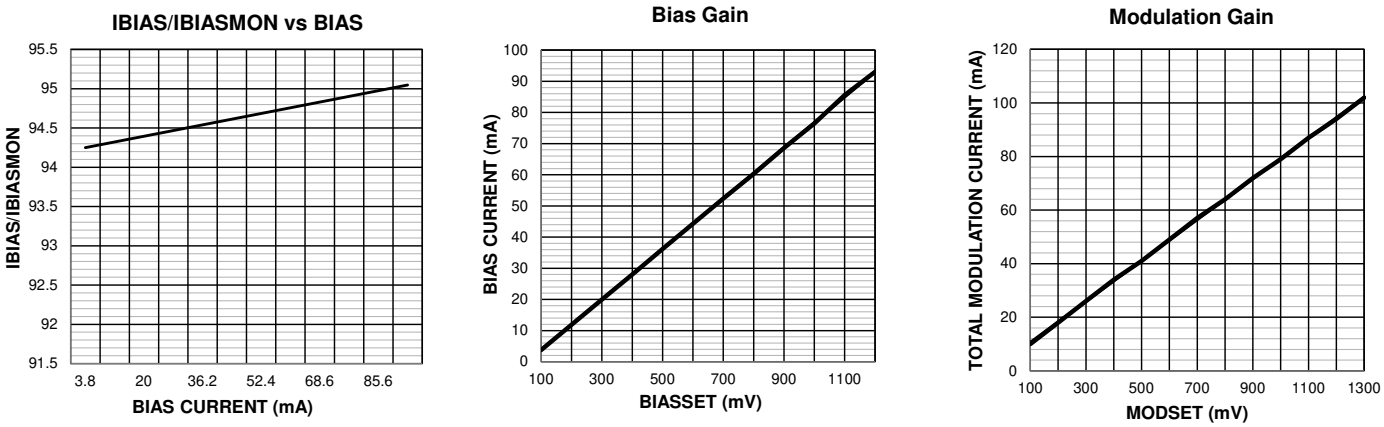
T_A = –40°C to +85°C and V_{CC} = +3.0V to +3.6V, unless otherwise noted. Typical values are V_{CC} = +3.3V, T_A = 25°C, I_{MOD} = 30mA, I_{BIAS} = 30mA.

Symbol	Parameter	Condition	Min	Typ	Max	Units
	Data Rate	NRZ			11.3125	Gbps
I_{MODMAX}[8]	Maximum Modulation Current	AC-coupled into 25Ω external load	60			mA
		AC-coupled into 15Ω external load	75			
		AC-coupled into 10Ω external load	85			
I_{MODMIN}[8]	Minimum Modulation Current	AC-coupled into 25Ω external load			10	mA
I_{MOD_OFF}	Modulation OFF Current	Current at MOD+ and MOD- when the device is disabled			150	µA
t_r	Output Current Rise Time	20% to 80%, 25Ω load		25		ps
t_f	Output Current Fall Time	20% to 80%, 25Ω load		25		ps
DJ	Deterministic Jitter	K25.8 pattern at 11.3Gbps, V_{IN} = 200mVpp		4		ps_{PP}
RJ	Random Jitter	K25.8 pattern at 11.3Gbps, V_{IN} = 200mVpp		0.3		ps_{PP}

Notes:

8. I_{MOD} is defined as the current going into the external load.

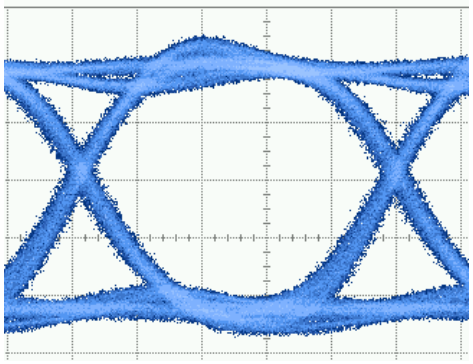
Typical Characteristics[9]



Note:

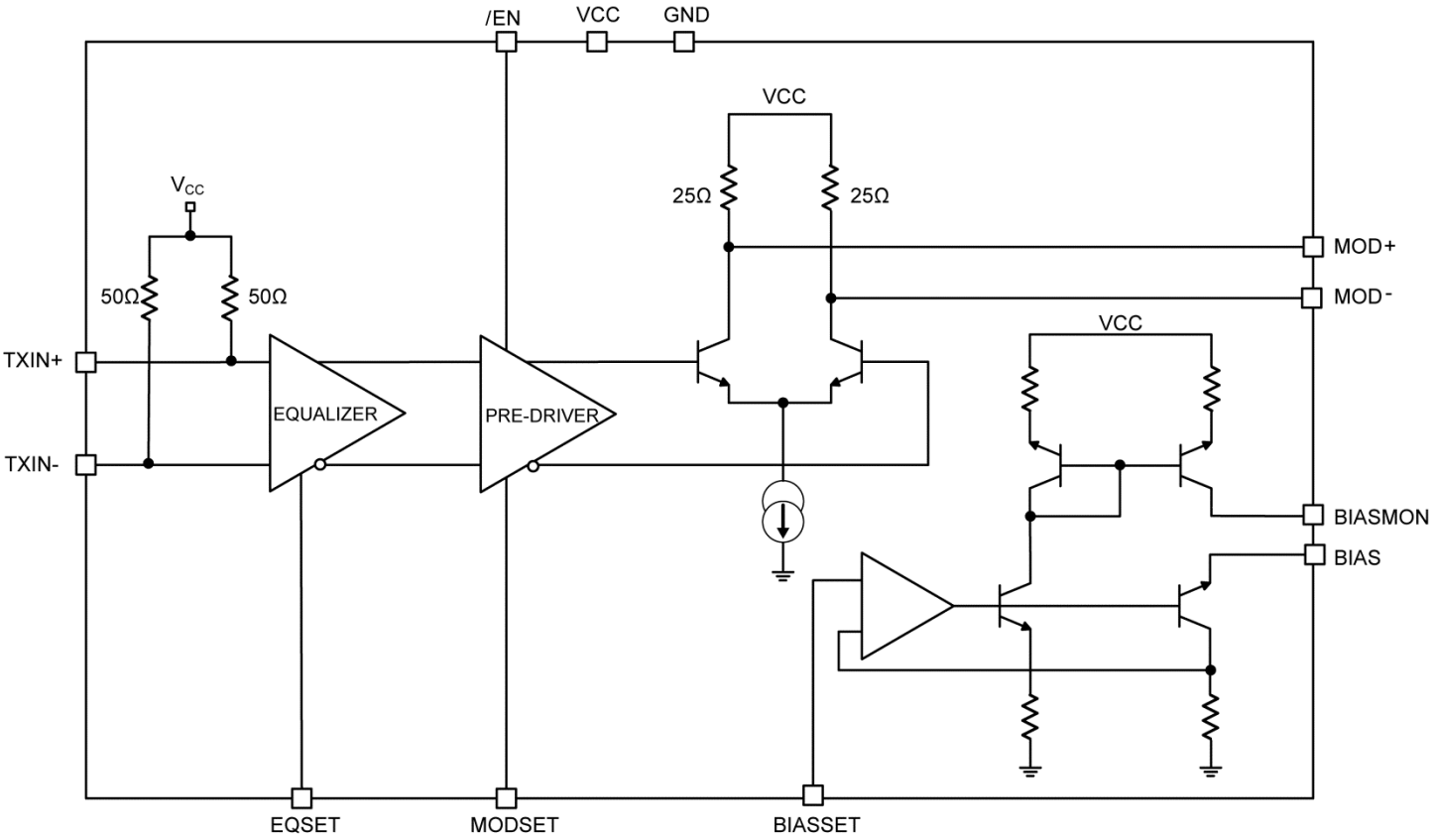
9. The plotted modulation current is the total modulation current which includes the current into the internal 25Ω termination and I_{MOD} into the external load.

Functional Characteristics



Electrical Eye Diagram at 10.3125Gbps

Functional Block Diagram



Input and Output Stages

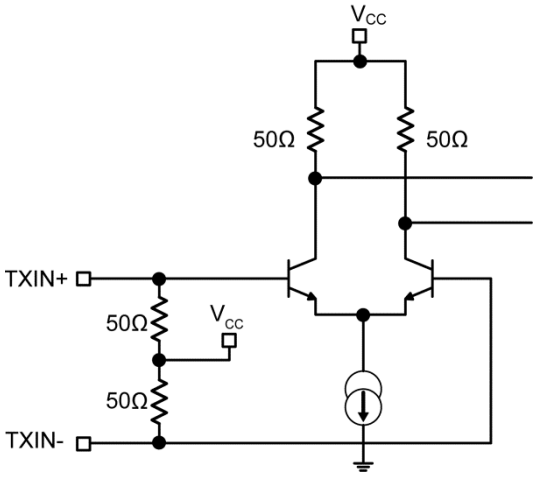


Figure 1. Simplified Input Stage

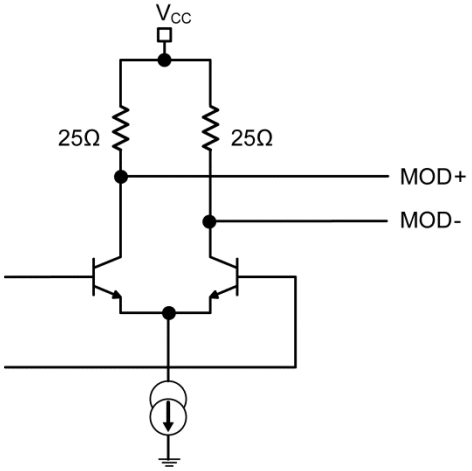


Figure 2. Simplified Output Stage

hbwhelp@micrel.com or (408) 955-1690

Functional Description

As shown in the block diagram, the driver is composed of an input equalizer, a modulation block consisting of a pre-driver, and a current source.

Equalizer

The input equalizer allows for compensation up to 12" of the FR4 microstrip trace or equivalent. In high frequency components, the equalization restores the losses of the signal caused by its travel along the line card traces and through the connectors between the line card and the module before it reaches the input stage. The amount of equalization is programmable with a resistor from Pin 7 to Ground.

Modulator

The modulator consists of a pre-driver and a current source. The modulation current is set in the pre-driver by applying a voltage within the range 0V - 1.2V to Pin 5 (MODSET). The pre-driver provides a current to the output stage. This stage consists of a current source composed from a differential pair in which collectors are connected to MOD+/MOD– pins and have 25Ω internal termination to VCC. The modulation gain curve shows modulation current variation versus the applied voltage at MODSET pin.

Bias

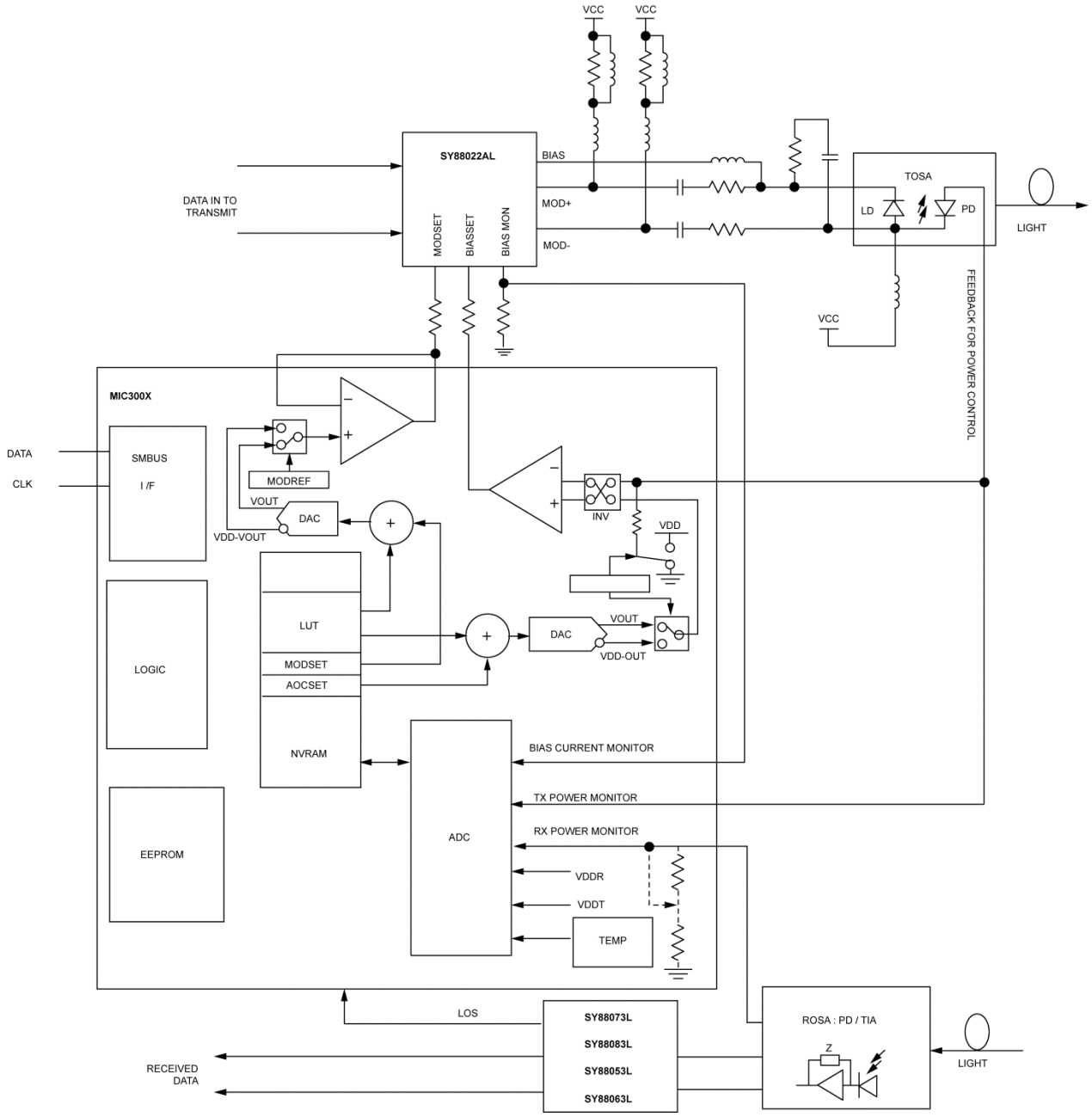
The bias is set by applying a voltage within a 0V - 1.2V range to Pin 16 (BIASSET). The Bias Gain curve on page 6 shows bias current variation versus the applied voltage at Pin 16.

The SY88022AL driver is designed to work with one of the Micrel's MIC300X series of controllers which have a built-in Automatic Power Control (APC) circuit and a serial interface for programming modulation and bias, temperature compensation tables, setting registers, and monitoring registers read back. Refer to the Optical Module Controllers datasheets for more details. The applications section below shows how to set up the driver to work correctly with the MIC300X controller.

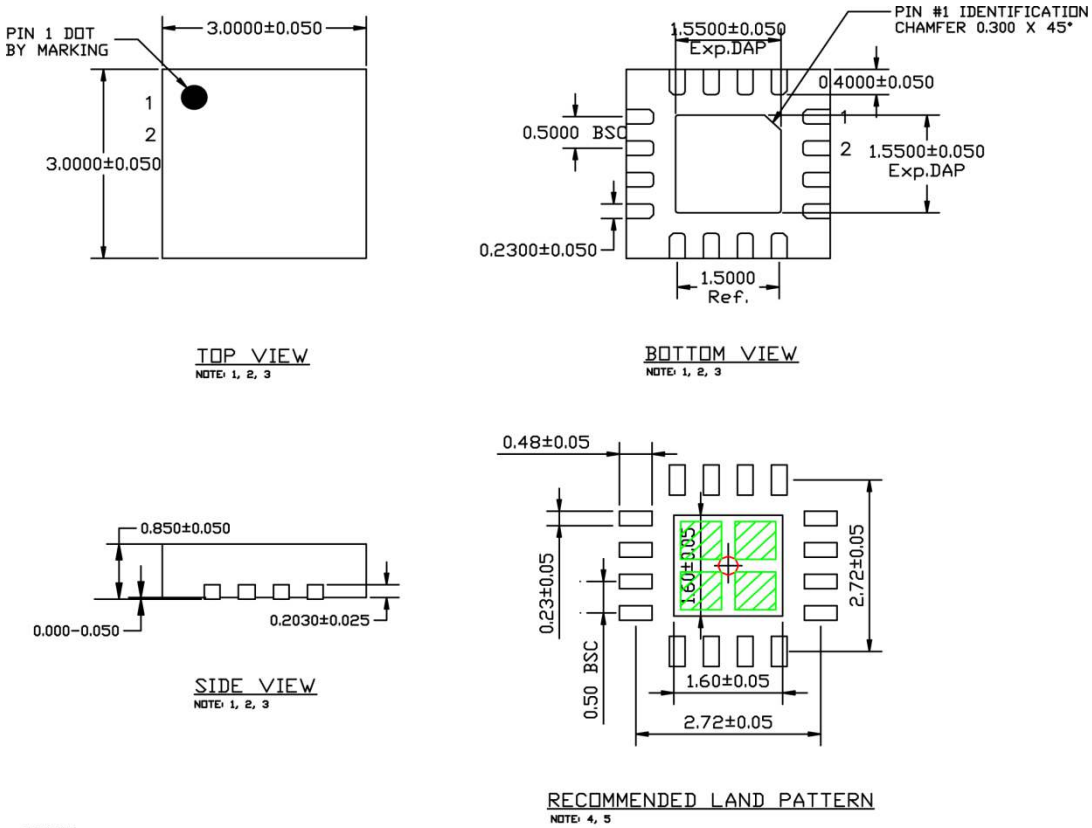
Application Information

The following typical application schematic shows the diagram for a typical 10G optical transceiver using the Micrel's chip set comprised from SY88022AL driver, SY88053CL/073L/063CL/083L post amplifier, and FOM management IC MIC3003.

Typical Application Schematic



Package Information[10]



NOTE:
1. MAX PACKAGE WARPAGE IS 0.05 MM
2. MAX ALLOWABLE BURR IS 0.076MM IN ALL DIRECTIONS
3. PIN #1 IS ON TOP WILL BE LASER MARKED
4. RED CIRCLE IN LAND PATTERN INDICATE THERMAL VIA. SIZE SHOULD BE 0.30-0.3M IN DIAMETER AND SHOULD BE CONNECTED TO GND FOR MAX THERMAL PERFORMANCE
5. GREEN RECTANGLES (SHADED AREA) Indicate SOLDER STENCIL OPENING ON EXPOSED PAD AREA. SIZE SHOULD BE 0.60x0.60 MM IN SIZE, 0.20 MM SPACING.

16-Pin (3mm × 3mm) QFN-16

Note:

10. Package information is correct as of the publication date. For updates and most current information, go to www.micrel.com.

MICREL, INC. 2180 FORTUNE DRIVE SAN JOSE, CA 95131 USA
TEL +1 (408) 944-0800 FAX +1 (408) 474-1000 WEB http://www.micrel.com

Micrel, Inc. is a leading global manufacturer of IC solutions for the worldwide high performance linear and power, LAN, and timing & communications markets. The Company's products include advanced mixed-signal, analog & power semiconductors; high-performance communication, clock management, MEMs-based clock oscillators & crystal-less clock generators, Ethernet switches, and physical layer transceiver ICs. Company customers include leading manufacturers of enterprise, consumer, industrial, mobile, telecommunications, automotive, and computer products. Corporation headquarters and state-of-the-art wafer fabrication facilities are located in San Jose, CA, with regional sales and support offices and advanced technology design centers situated throughout the Americas, Europe, and Asia. Additionally, the Company maintains an extensive network of distributors and reps worldwide.