SY88422L

4.25Gbps Laser Driver with Integrated Bias

General Description

The SY88422L is a single 3.3V supply, small form factor laser driver for telecom/datacom applications up to 4.25Gbps. The driver can deliver modulation current up to 90mA and a bias current up to 100mA.

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

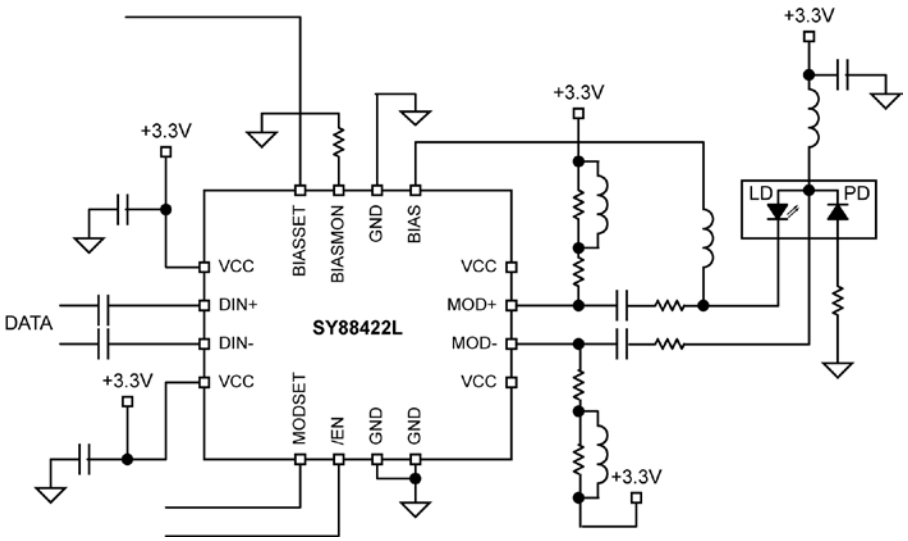
Features

- 35mA power supply current typical
- Operation up to 4.25Gbps
- Modulation current up to 90mA
- Bias current up to 100mA
- Available in 16-pin small form factor (3mm x 3mm) QFN package

Applications

- Multi-rate LAN, MAN applications up to 4.25Gbps: FC, GbE, SONET/SDH
- SFF, SFP, LX-4 Modules

Typical Application



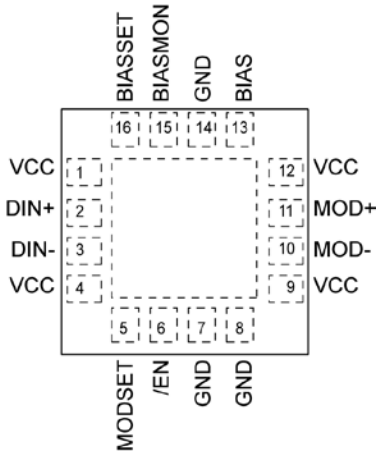
Ordering Information[1]

Part Number	Package Type	Operating Range	Package Marking	Lead Finish
SY88422LMG	QFN-16	Industrial	422L with Pb-Free bar-line indicator	NiPdAu Pb-Free
SY88422LMGTR[2]	QFN-16	Industrial	422L with Pb-Free bar-line indicator	NiPdAu Pb-Free

Notes:

1. Contact factory for die availability. Dice are guaranteed at T_A = +25°C, DC Electricals only.
2. Tape and Reel.

Pin Configuration



16-Pin QFN

Pin Description

Pin Name	Pin Number	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.
7, 8, 14	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 to a reference voltage.
3	DIN–	Inverting input data. Internally terminated with 50Ω to a reference voltage.
5	MODSET	Modulation current setting and control. The voltage applied to this pin will set the modulation current. Input impedance 25kΩ.
6	/EN	Active Low TTL. The driver is disabled when this pin is unconnected or /EN asserted high. The driver is enabled when /EN is asserted low.
10	MOD–	Inverted modulation current output. Outputs modulation current when input data is negative.
11	MOD+	Non-inverted modulation current output. Outputs modulation current when input data is positive.
13	BIAS	BIAS Current Output
15	BIASMON	Bias monitor. 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. The voltage applied to this pin will set the bias current. Input impedance 25kΩ.

Truth Table

DIN+	DIN-	/EN	MOD+[1]	MOD-	Laser Output[2]
L	H	L	H	L	L
H	L	L	L	H	H
X	X	H or NC	H	L	L

Notes:

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

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Absolute Maximum Ratings[1]

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

Operating Ratings[2]

Supply Voltage (V_{CC}) ..... +3.0V to +3.6V
Ambient Temperature (T_A) ..... –40°C to +85°C
Package Thermal Resistance[3]
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. Typical values are V_{CC} = +3.3V, T_A = 25°C, I_{MOD} = 30mA, I_{BIAS} = 20mA.

Symbol	Parameter	Condition	Min	Typ	Max	Units
I_{CC}	Power Supply Current	Modulation currents excluded		35	56[4]	mA
V_{MOD_C}	Compliance Voltage		V_{CC}-1.5		V_{CC}	V
V_{BIAS_C}	Compliance Voltage		V_{CC}-2.3		V_{CC}	V
$R_{IN(DATA)}$	Input Resistance at DIN+, DIN-, Single Ended		45	50	55	Ω
V_{DIFF_IN} (DIN)	Differential Input Voltage Swing		100		2400	mV_{pp}
V_{IL} (/EN)	Input Low Voltage				0.8	V
V_{IH} (/EN)	Input High Voltage		2			V
$R_{IN\ (MODSET)}$	MODSET Input Resistance			25		kΩ
V_{MODSET}	Voltage Range on MODSET Pin	I_{MOD} range 10mA to 90mA			1.2	V
$R_{IN\ (BIASSET)}$	BIASSET Input Resistance			25		kΩ
$V_{BIASSET}$	Voltage Range on BIASSET Pin	I_{BIAS} range 10mA to 100mA			1.2	V

Notes:

1. Permanent device damage may occur if absolute maximum ratings are exceeded. This is a stress rating only and functional operation is not implied at conditions other than those detailed in the operational sections of this data sheet. Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.
2. The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.
3. Package Thermal Resistance assumes exposed pad is soldered (or equivalent) to the devices most negative potential on the PCB. ψ_{JB} uses a 4-layer and θ_{JA} in still air unless otherwise stated.
4. I_{CC} = 56mA for worst-case conditions with I_{MOD} = 90mA and BIAS=100 mA, T_A = +85°C, V_{CC} = 3.6V.

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AC Electrical Characteristics

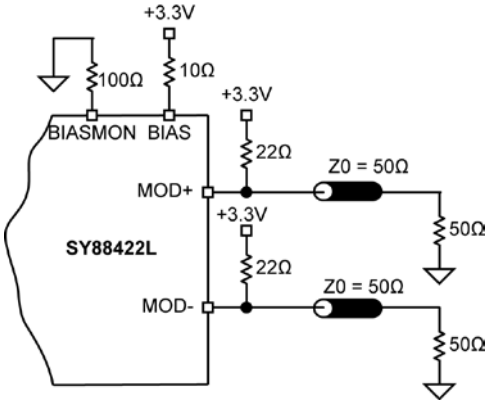
T_A = –40°C to +85°C and V_{CC} = +3.0V to +3.6V, unless otherwise noted. Typical values are V_{CC} = +3.3V, T_A = 25°C, I_{MOD} = 30mA, I_{BIAS} = 20mA.

Symbol	Parameter	Condition	Min	Typ	Max	Units
	Data Rate	NRZ	0.1		4.25	Gbps
I_{MOD}	Modulation Current[5]	Laser or equivalent load AC-coupled to the driver	10		90	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%, 15 Ω load		50	70	ps
t_f	Output Current Fall Time	20% to 80%, 15 Ω load		50	70	ps
	Total Jitter				20	ps_{PP}
I_{BIAS}	Bias Current[5]		5		100	mA
I_{Bias_OFF}	Bias OFF Current	Current at BIAS when the device is disabled			150	µA

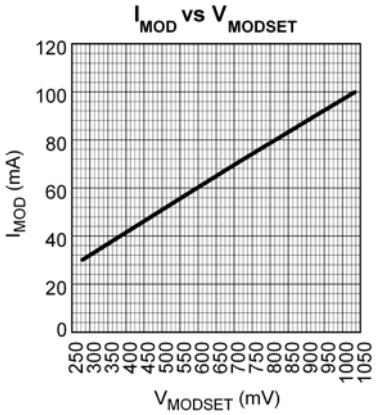
Notes:

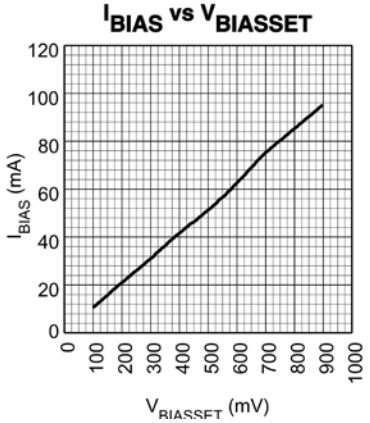
5. Load = 15Ω.

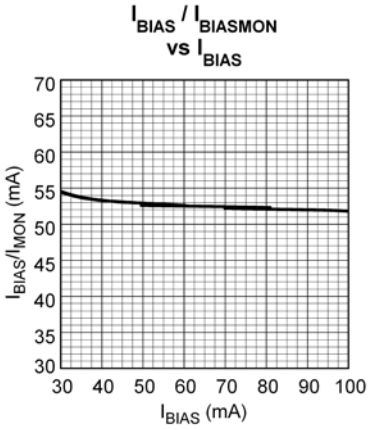
Test Circuit



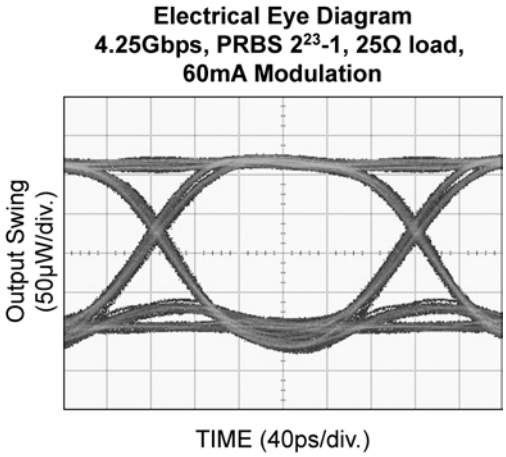
Typical Characteristics

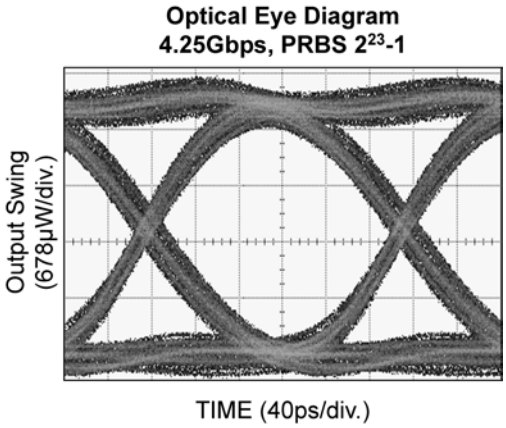




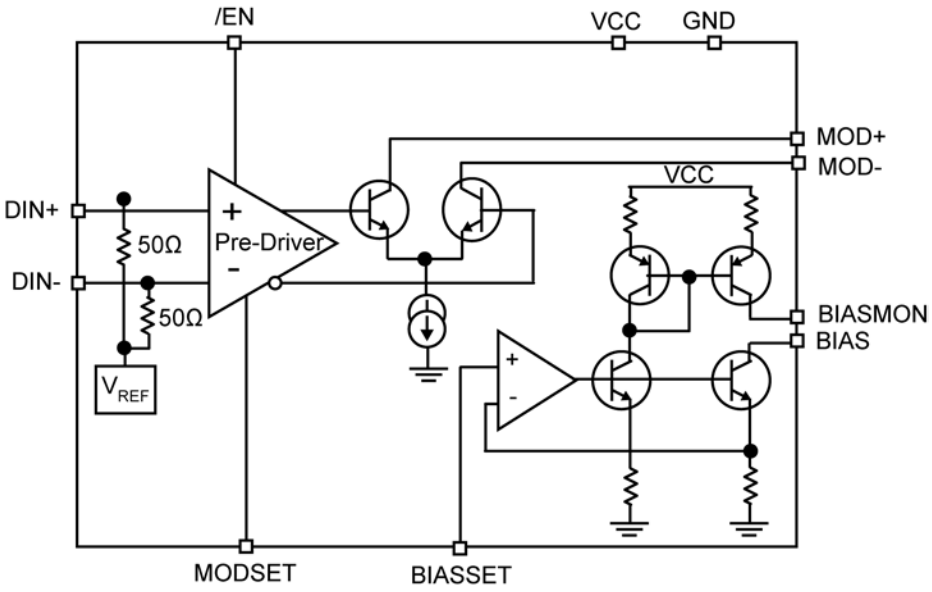


Functional Characteristics





Functional Block Diagram



Input and Output Stages

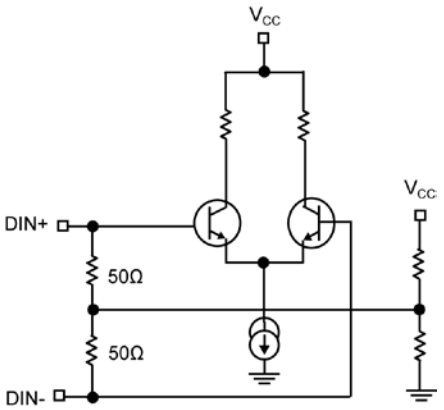


Figure 1a. Simplified Input Stage

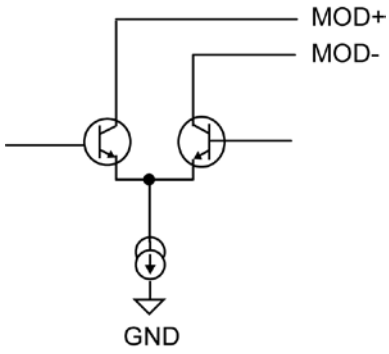


Figure 1b. Simplified Output Stage

Interfacing the Input to Differential Logic Drivers

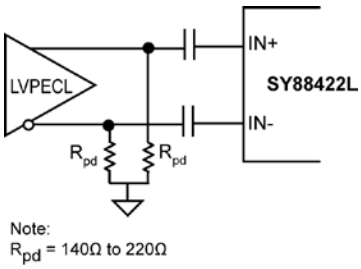


Figure 2a. AC-Coupling to LVPECL Driver

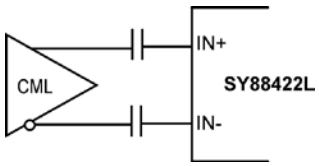


Figure 2b. AC-Coupling to CML Driver

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Application Hints

The typical applications drawing on the front page shows how to connect the driver to the laser differentially. To drive the laser single ended, just disconnect MOD- from the laser anode and pull it up to V_{CC} with a resistor equal to the equivalent resistor of the load on MOD+, damping resistor plus the laser equivalent resistor. Differential drive improves transition time and laser response. Driving the laser differentially will also minimize the cross talk with the rest of the circuitry on the board especially the receiver.

If we refer to Figure 3, the modulation current out of the driver is split between the pull-up network and the laser. If, for example, the total pull-up resistor is twice the sum of the damping resistor and laser equivalent series resistance, only two thirds (2/3) of the modulation current will be used by the laser. To keep most of the modulation current going through the laser, try to keep the total pull-up resistors as high as possible. One solution consists in using an inductor alone as pull-up, presenting a high impedance path for the modulation current and zero ohm (0Ω) path for the DC current offering headroom for the driver equal to V_{CC} and almost all the modulation current goes into the laser. The inductor alone will cause signal distortion, and, to improve that, a combination of resistor and inductor can be used as shown in Figure 3. In this case, the headroom of the driver is VCC – R1 * αI_{mod}, where αI_{mod} is the portion of the modulation current that goes through the pull-up network.

The coupling capacitor creates a low-frequency cutoff in the circuit, and its value must be chosen to accommodate the lowest and the highest data rates. If the value of the cap is too high, it will degrade the performance at higher data rates, and, if its value is too small, it won't be able to hold a constant charge between the first bit and the last bit of a long string of identical bits in a low data rate application. This leads in both cases to higher pattern-dependant jitter in the transmitter signal. 0.01μ-to-0.1μF is found to be good range for all applications from 155Mbps to 4.25Gbps.

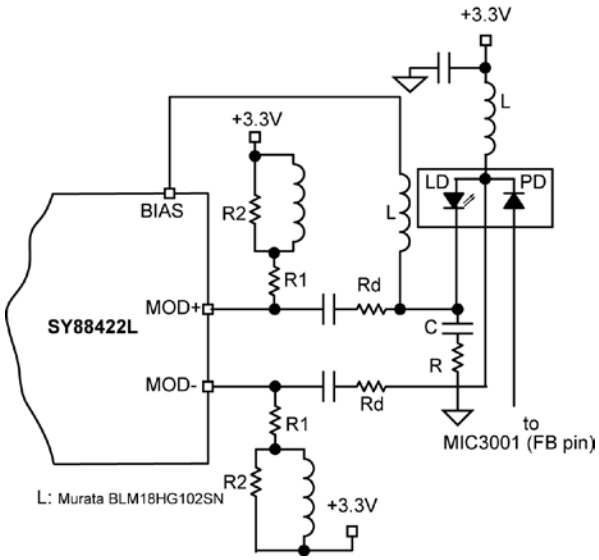

Figure 3. AC-Coupling the Laser to the Driver

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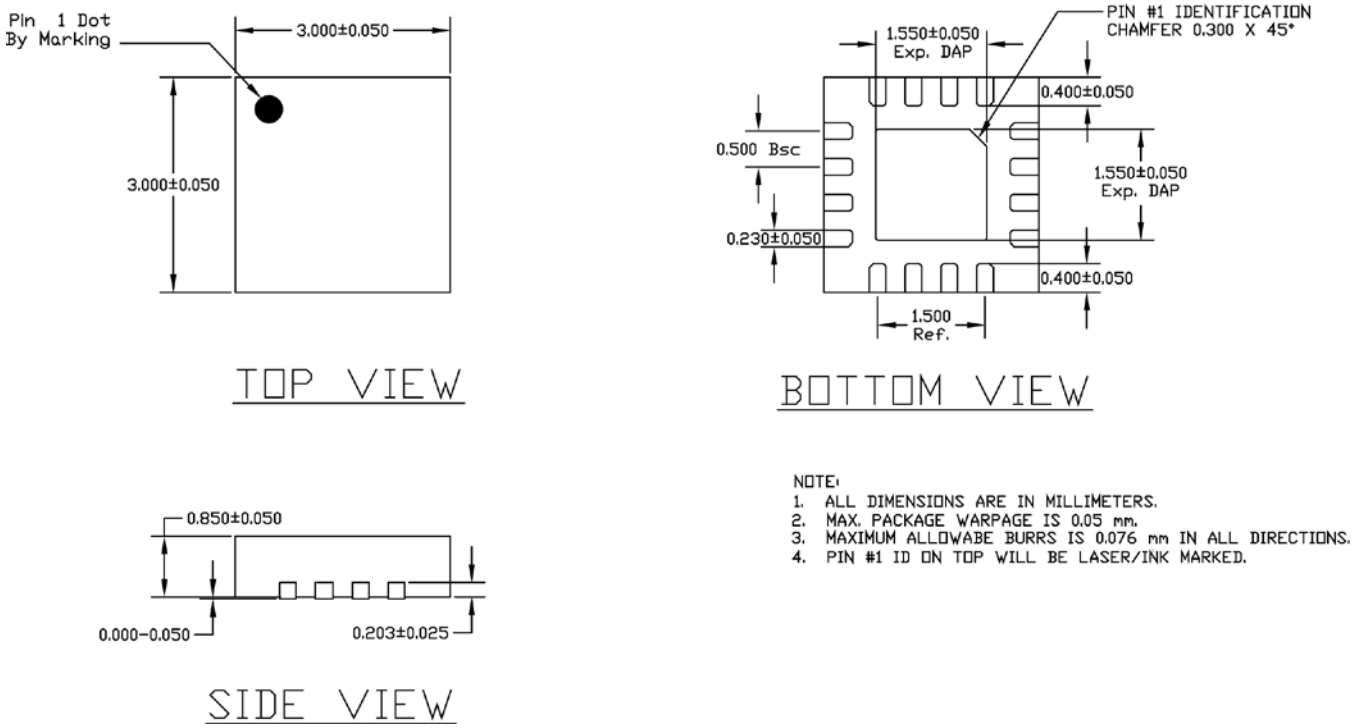
Package Information



16-Pin QFN

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