

# CX02068

## 3.3 Volt Laser Driver IC for 155/622 Mbps Data Sheet

-  Features
-  Description
-  Applications
-  Pin Descriptions
-  Measurement Tables
-  Functional Description

## 3.3 Volt Laser Driver IC for 155/622 Mbps

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3.3 Volt Laser Driver IC for 155/622 Mbps

FEATURES

- ❑ Rise and fall times <180 ps
- ❑ Operates with +3.3 volt supply
- ❑ DC or AC-coupled modulation drive.
- ❑ Independently programmable laser bias (to 100 mA) and modulation currents (to 85 mA).
- ❑ Automatic laser power control, with programmable temperature compensation and 'Slow-Start'.
- ❑ Bias and modulation current monitors
- ❑ Failure monitor
- ❑ Available in BCC+24 , TQFP32 and DIE packages
- ❑ Low cost CMOS

APPLICATIONS

- ❑ OC-3/STM1, SONET/SDH
- ❑ OC-12/STM4, SONET/SDH
- ❑ ATM
- ❑ FTTH

DESCRIPTION

The CX02068 is a highly integrated, programmable laser driver intended for Telecom applications up to 622 Mbps. Using differential PECL data, the CX02068 supplies the bias and modulation current for driving an edge-emitting laser. The modulation output can be DC-coupled to the laser diode, giving a significant power saving over AC-coupled operation.

The CX02068 includes automatic power control (APC) to maintain a constant average laser output power over temperature and life. In addition, the modulation current is temperature compensated to minimize variation in extinction ratio over temperature.

Output flags indicate laser end of life as well as failure of the APC circuitry to maintain average output power.

TABLE 1 ORDERING INFORMATION

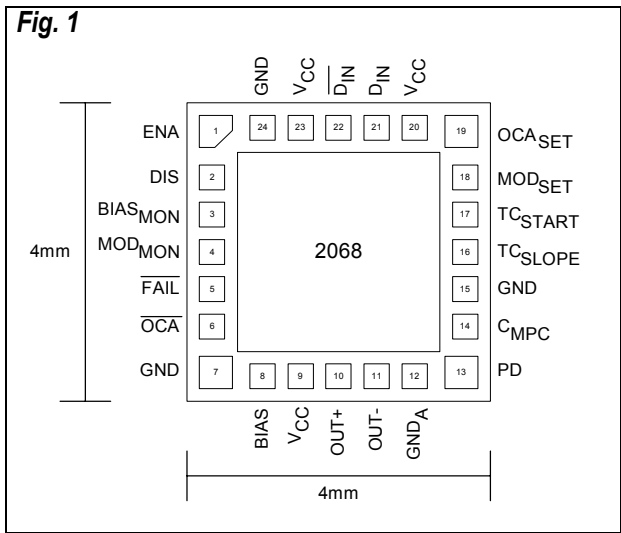
| Part Number  | Pin Package                                |
|--------------|--------------------------------------------|
| CX02068B24   | BCC+24L                                    |
| CX02068TQ32  | TQFP32                                     |
| CX02068DIEWP | Waffle pack                                |
| CX02068WAFER | Expanded whole 8" wafer on a 10" grip ring |
| CX02068EVM   | Evaluation board with a CX02068B24         |

CONNECTIONS

**Note :** For information on Die pad connections please see Fig. 13 on page12.

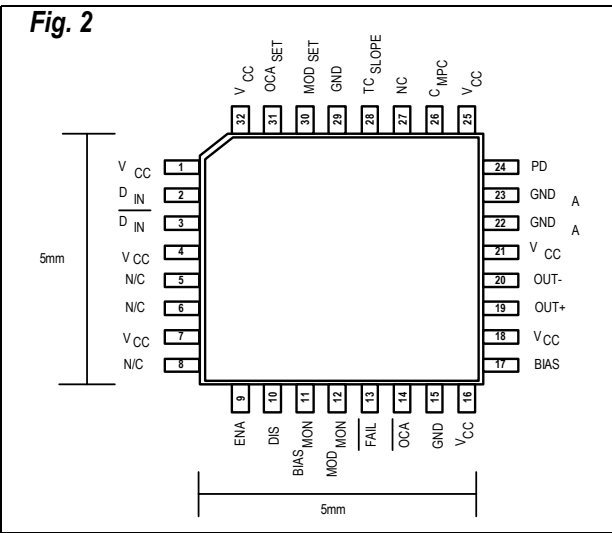
BCC+24L

TOP VIEW



TQFP32

TOP VIEW



## 3.3 Volt Laser Driver IC for 155/622 Mbps

TABLE 2 \_\_\_\_\_ PIN DESCRIPTIONS

| Pin No<br>BCC+24 | Pin No<br>TQFP32 | Name                | Function                                                                                                                                                              |
|------------------|------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -                | 18               | V <sub>CC</sub>     | Power supply. All pins should be connected                                                                                                                            |
| -                | 22               | GNDA                | Ground to output stage.(inductor to ground to optimize output stage performance)                                                                                      |
| -                | 32               | V <sub>CC</sub>     | Power supply. All pins should be connected                                                                                                                            |
| -                | 5, 6, 8, 27      | NC                  | Not connected                                                                                                                                                         |
| -                | 7                | V <sub>CC</sub>     | Power supply. All pins should be connected                                                                                                                            |
| -                | 25               | V <sub>CC</sub>     | Power supply. All pins should be connected                                                                                                                            |
| 1                | 9                | ENA                 | Bias and modulation output enable (TTL/CMOS). HIGH for normal operation                                                                                               |
| 2                | 10               | DIS                 | Bias and modulation output disable (TTL/CMOS). LOW for normal operation                                                                                               |
| 3                | 11               | BIAS <sub>MON</sub> | Bias monitor. Connect a resistor between this pin and V <sub>CC</sub> to monitor. Connect to V <sub>CC</sub> if not in use.                                           |
| 4                | 12               | MOD <sub>MON</sub>  | Modulation monitor. Connect a resistor between this pin and V <sub>CC</sub> to monitor. Connect to V <sub>CC</sub> if not in use.                                     |
| 5                | 13               | FAIL                | Mean power control failure indicator (TTL/CMOS). Goes low when control loop is no longer able to maintain constant current at PD                                      |
| 6                | 14               | OCA                 | Over-Current Alarm (TTL/CMOS). Goes low when I <sub>BIAS</sub> exceeds the preset bias current limit                                                                  |
| 7                | -                | GND                 | Ground. All pins should be connected                                                                                                                                  |
| 8                | 17               | BIAS                | Laser bias current output                                                                                                                                             |
| 9                | 1                | V <sub>CC</sub>     | Power supply. All pins should be connected                                                                                                                            |
| 10               | 19               | OUT+                | Positive modulation current output. Sinks current when D <sub>IN</sub> is HIGH.                                                                                       |
| 11               | 20               | OUT-                | Negative modulation current output. Sinks current when $\overline{D}_{IN}$ is HIGH.                                                                                   |
| 12               | 23               | GNDA                | Ground to output stage.(inductor to ground to optimize output stage performance)                                                                                      |
| 13               | 24               | PD                  | Monitor photodiode input. This input is connected to the monitor photodiode anode for automatic power control.                                                        |
| 14               | 26               | C <sub>MPC</sub>    | Mean power control dominant pole capacitor                                                                                                                            |
| 15               | 15               | GND                 | Ground. All pins should be connected                                                                                                                                  |
| 16               | 28               | TC <sub>SLOPE</sub> | Connecting a resistor between this pin and ground sets the temperature coefficient of I <sub>MODSET</sub> (using the internal IC temperature).                        |
| 17               | -                | TC <sub>START</sub> | Secondary temperature coefficient of I <sub>MOD</sub> . A resistor on this pin to ground sets the threshold temperature at which the temperature compensation starts. |
| 18               | 30               | MOD <sub>SET</sub>  | Modulation current set. Connect a resistor between this pin and ground                                                                                                |
| 19               | 31               | OCA <sub>SET</sub>  | Over current alarm set. Connect a resistor between this pin and ground                                                                                                |
| 20               | 4                | V <sub>CC</sub>     | Power supply. All pins should be connected                                                                                                                            |
| 21               | 2                | D <sub>IN</sub>     | Positive Data Input (PECL). Self biased.                                                                                                                              |
| 22               | 3                | $\overline{D}_{IN}$ | Negative Data Input (PECL). Self biased                                                                                                                               |
| 23               | 16               | V <sub>CC</sub>     | Power supply. All pins should be connected                                                                                                                            |
| 24               | 29               | GND                 | Ground. All pins should be connected                                                                                                                                  |

## 3.3 Volt Laser Driver IC for 155/622 Mbps

TABLE 3 \_\_\_\_\_ ABSOLUTE MAXIMUM RATINGS

| Parameter                                                         | Rating       | Units |
|-------------------------------------------------------------------|--------------|-------|
| Power supply ( $V_{CC-GND}$ )                                     | -0.5 to +6.0 | V     |
| Operating ambient                                                 | -40 to +85   | °C    |
| Storage temperature                                               | -65 to +150  | °C    |
| Maximum bias current                                              | 120          | mA    |
| Maximum laser modulation current (through OUT+/OUT2+, OUT-/OUT2-) | 100          | mA    |

These are the absolute maximum ratings at or beyond which the IC can be expected to fail or be damaged. Functional operation at these levels is not implied.

TABLE 4 \_\_\_\_\_ RECOMMENDED OPERATING CONDITIONS

| Parameter                     | Rating         | Units |
|-------------------------------|----------------|-------|
| Power supply ( $V_{CC-GND}$ ) | $3.3 \pm 10\%$ | V     |
| Junction temperature (die)    | -40 to +120    | °C    |
| Operating ambient             | -40 to +85     | °C    |

## 3.3 Volt Laser Driver IC for 155/622 Mbps

TABLE 5. AC CHARACTERISTICS

| Parameter                                                                    | Conditions                                                                                                      | Min. | Typ. | Max.   | Units  |
|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------|------|--------|--------|
| Differential input voltage                                                   | $=2 \times (D_{IN+HIGH} - D_{IN+LOW})$<br>(clock inputs follow same relationship)                               | 300  | -    | 1860   | mV     |
| Modulation current range                                                     |                                                                                                                 | 5    | -    | 85     | mA     |
| modulation current with output disabled                                      | DIS-HIGH                                                                                                        | -    | -    | 300    | μA     |
| Programmable range for modulation current temperature coefficient            | Adjustable                                                                                                      | 500  | -    | $10^4$ | ppm/°C |
| Programmable temperature at which modulation current TC compensation enables | Programmed by choice of $R_{TCSLOPE}$                                                                           | 20   | -    | 60     | °C     |
| Modulation output rise/fall times                                            | 20% to 80% into $25 \Omega$ , with matching network                                                             | -    | -    | 180    | ps     |
| Overshoot of modulation output current                                       | Into $25 \Omega$ load, with matching network                                                                    | -10  | -    | +10    | %      |
| Modulation output pulse width distortion                                     | Measured using alternating 1-0 pattern                                                                          | -    | -    | 25     | ps     |
| Modulation output deterministic jitter                                       | peak-to-peak. Measured into $25 \Omega$ load using: $2^{23}-1$ PRBS at 622 Mbps includes pulse width distortion | -    | -    | 50     | ps     |

(V<sub>CC</sub>=+3.3 V ± 10%, T<sub>A</sub>=-40 °C to +85 °C, unless otherwise noted)

## 3.3 Volt Laser Driver IC for 155/622 Mbps

TABLE 6 \_\_\_\_\_ DC CHARACTERISTICS

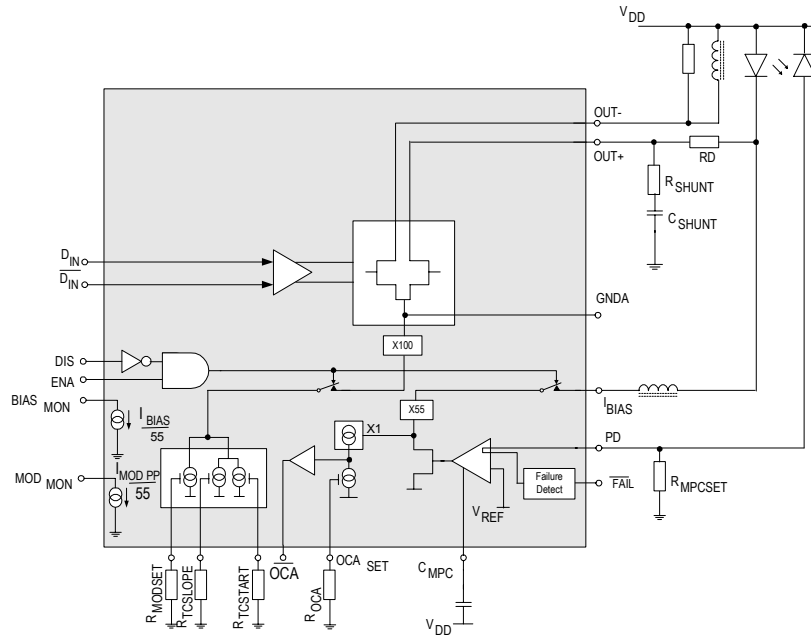
| Parameter                                     | Conditions                                                                          | Min.          | Typ. | Max.                               | Units |
|-----------------------------------------------|-------------------------------------------------------------------------------------|---------------|------|------------------------------------|-------|
| Supply current                                | Excluding $I_{BIAS}$ and $I_{MOD}$ , but with $I_{BIAS}$ and $I_{MOD}$ set to 50 mA | -             | 42   | 47                                 | mA    |
| Bias current adjust range                     | Limited by $I_{REF}$ across temperature range                                       | 4             | -    | 100                                | mA    |
| Bias current with output disabled             | Tx_Dis = HIGH                                                                       | -             | -    | 10                                 | μA    |
| Bias current limit adjustment region          | $T_A = +85\text{ }^{\circ}\text{C}$                                                 | 20            | -    | 100                                | mA    |
| Change in bias current limit over temperature |                                                                                     | 100           | -    | 130                                | μA/°C |
| Monitor diode reverse bias voltage            |                                                                                     | 2             | -    | -                                  | V     |
| Monitor diode current adjustment range        |                                                                                     | 40            | -    | 1000                               | μA    |
| TTL/CMOS input HIGH voltage (enable, disable) |                                                                                     | 2.0           | -    | -                                  | V     |
| TTL/CMOS input LOW voltage (enable, disable)  |                                                                                     | -             | -    | 0.8                                | V     |
| CMOS output HIGH voltage (FAIL, OCA)          |                                                                                     | 2.4           | -    | -                                  | V     |
| CMOS output LOW voltage (FAIL, OCA)           |                                                                                     | -             | -    | 0.4                                | V     |
| Differential input impedance                  | Data and clock inputs                                                               | 2.5           | -    | -                                  | kΩ    |
| Common-mode input voltage                     |                                                                                     | $V_{CC}-1.38$ | -    | $V_{CC} - \frac{V_{IN} (Diff)}{4}$ | V     |
| Self-biased common mode input voltage         | Data and clock inputs                                                               | $V_{CC}-1.38$ | -    | $V_{CC}-0.47$                      | V     |

(V<sub>CC</sub>=+3.3V ± 10%, T<sub>A</sub>=-40 °C to +85 °C, unless otherwise noted)

## 3.3 Volt Laser Driver IC for 155/622 Mbps

### FUNCTIONAL DIAGRAM

Fig. 3



### FUNCTIONAL DESCRIPTION

#### Overview

The CX02068 laser driver consists of a high-speed modulation driver and a laser bias generator with mean power control (MPC). It is optimized for high speed, low power operation at 3.3 V supply.

#### Modulator

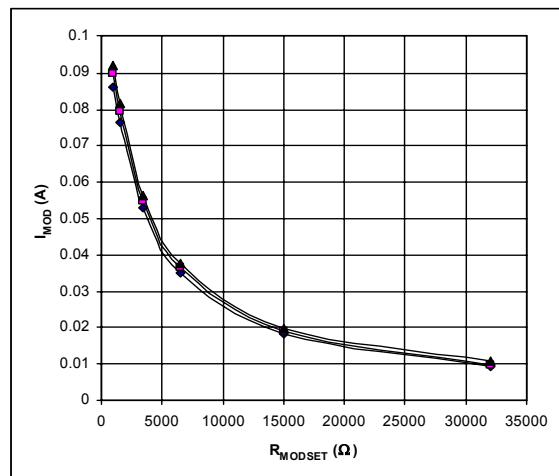
The modulator output stage is designed to drive up to 85 mA in either AC-coupled or DC-coupled mode. DC-coupled performance depends on the laser used.

The CX02068 modulation output is optimized for driving a 25  $\Omega$  dynamic load; the minimum required voltage at OUT+ and OUT- is 0.6 V. To interface with the laser diode, a matching resistor (RD) is required for impedance matching. An RC shunt network is necessary to compensate for the laser diode parasitic inductance, thereby improving the optical eye. Typical values are  $R_{SHUNT} = 51 \Omega$ ,  $C_{SHUNT} = 3.3 \text{ pF}$

Any capacitive loading at the cathode of a laser diode will degrade the optical output performance. An inductor is used to isolate the BIAS pin from the laser cathode.

#### Typical modulation current vs $R_{MODSET}(3.3V)$

Fig. 4

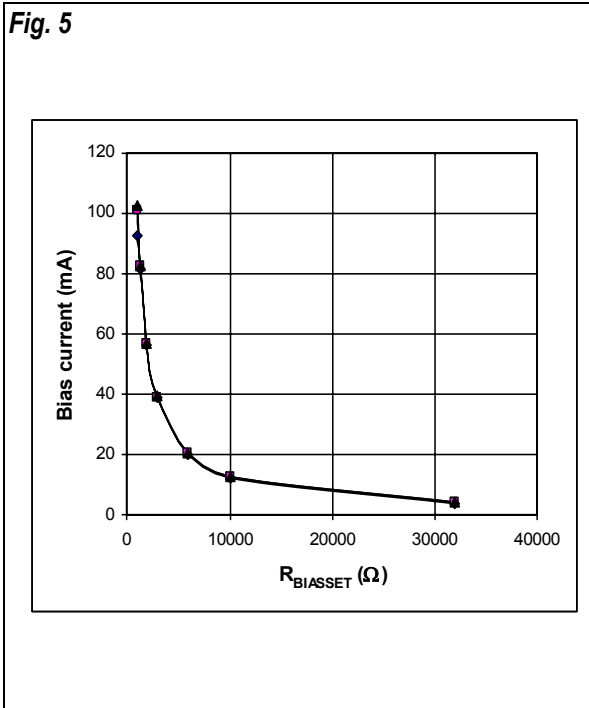


FUNCTIONAL DESCRIPTION

Mean Power Control

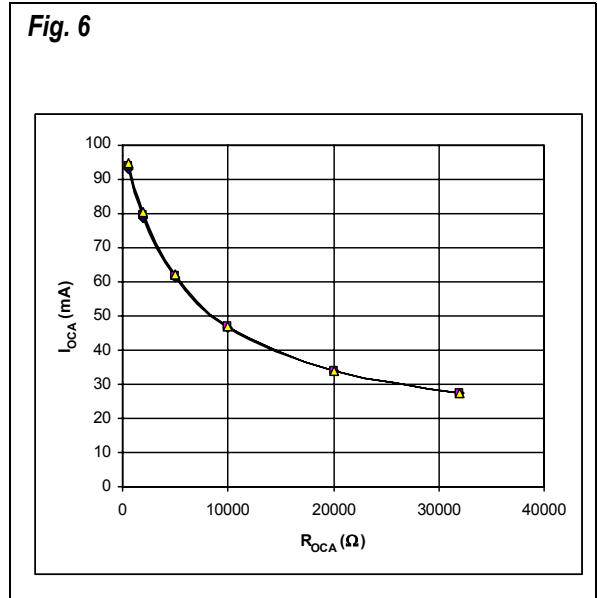
To maintain constant average optical power, the CX02068 incorporates a control loop to compensate for the changes in laser threshold current over temperature and lifetime. A monitor photodiode mounted in the laser package is used to convert the optical power into a photocurrent. The MPC loop adjusts the laser bias current so that the monitor current is matched to a reference current set by a single external resistor ( $R_{MPCSET}$ ). The time constant of the loop is then determined by  $C_{MPC}$ .

Typical bias current vs  $R_{BIASSET}$  (3.3V)

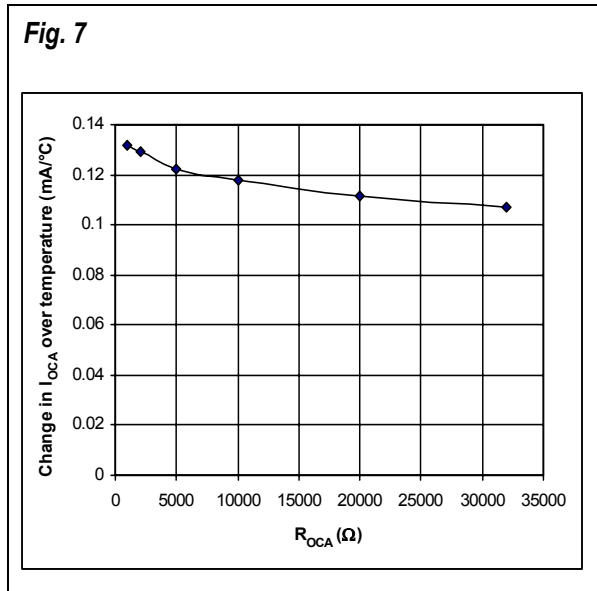


Safety logic is provided in order to limit the maximum bias current. The bias current at which the safety logic trips is set by an external resistor to ground ( $R_{OCA}$ ) from the  $OCA_{SET}$  pin. When the bias current limit is reached alarm flag OCA is asserted LOW. A loop failure alarm is also provided to detect when the bias current can no longer be adjusted to achieve the desired average optical power.

Typical limiting current vs  $R_{OCA}$  (at 25 °C)



Temperature coefficient of  $I_{OCA}$  at different  $R_{OCA}$  settings



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FUNCTIONAL DESCRIPTION

Enable Control

The CX02068 incorporates a dual polarity laser driver enable function. When ENA is LOW or DIS is HIGH, both the bias and modulation currents are off.

Current Monitors

The CX02068 features bias and modulation current monitor outputs. The BIAS<sub>MON</sub> output sinks a current equal to nominally 1/55 of the laser bias current (I<sub>BIAS</sub>). The MOD<sub>MON</sub> output sinks a current equal to nominally 1/55 of the laser modulation current (I<sub>MOD</sub>). BIAS<sub>MON</sub> and MOD<sub>MON</sub> should be connected through a pull-up resistor to V<sub>CC</sub>. Choose a pull-up resistor value that ensures a voltage at BIAS<sub>MON</sub> greater than V<sub>CC</sub> -1.6 V and a voltage at MOD<sub>MON</sub> greater than V<sub>CC</sub> -1.0 V. These pins should be tied to V<sub>CC</sub> if not used.

Slow-Start

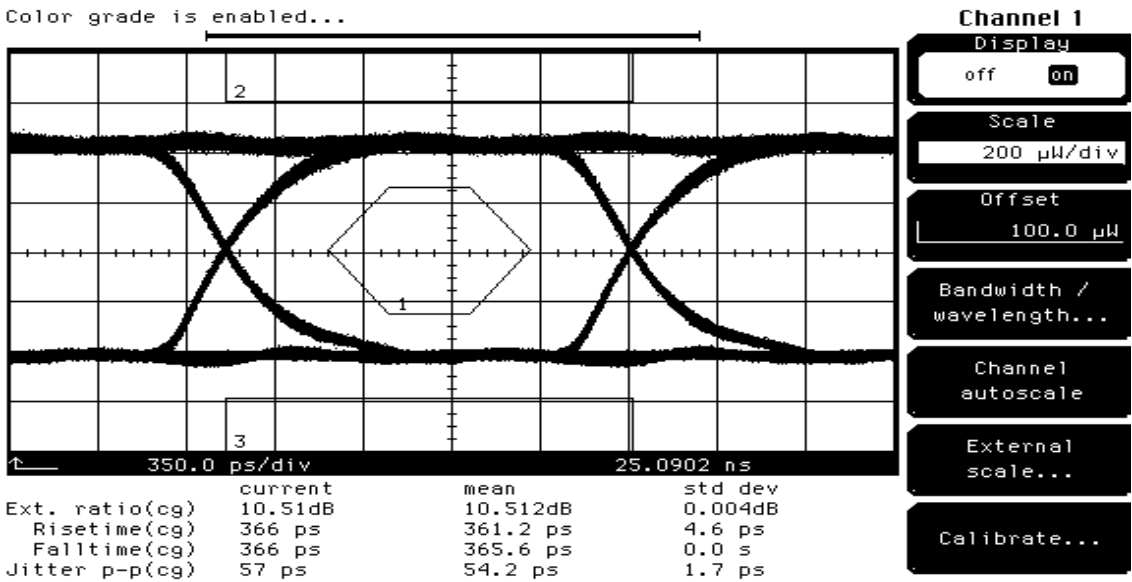
For laser safety and reliability, the CX02068 incorporates a slow-start circuit that provides a delay of approximately 200 ns before enabling the laser diode.

Temperature Compensation

The CX02068 features built in temperature compensation of the modulation current set using external resistors. Current pulled from TC<sub>SLOPE</sub> adjusts the slope of the temperature compensation where as current pulled from TC<sub>START</sub> sets the threshold temperature for the coefficient.

TYPICAL EYE DIAGRAM

Fig. 8



Laser Optical Power -3 dBm , Ext ratio typ 10 dB. Laser Bias current -20.29 mA, Modulation current 25 mA p-p.  
Data :- 622 Mbps , 2<sup>13</sup>-1 pattern with 100 consecutive zero's inserted

3.3 Volt Laser Driver IC for 155/622 Mbps

TEMPERATURE COMPENSATION GRAPHS

Fig. 9

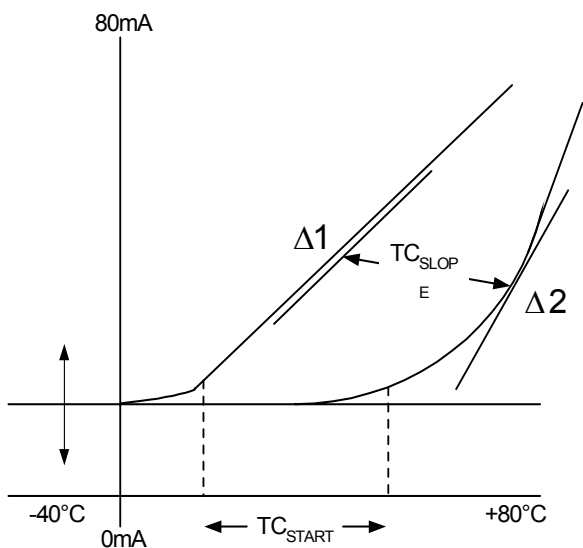
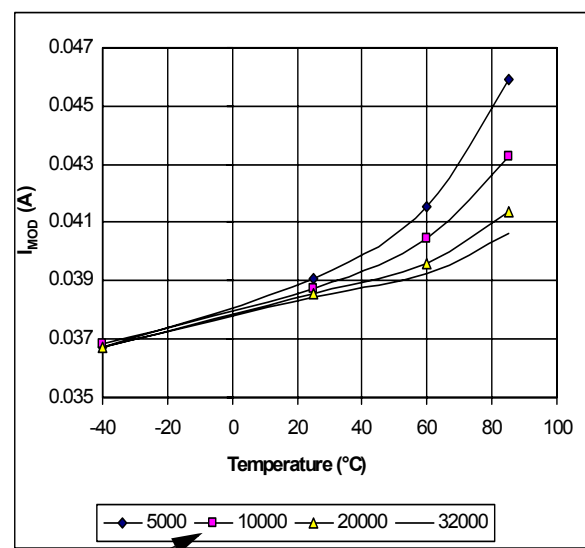
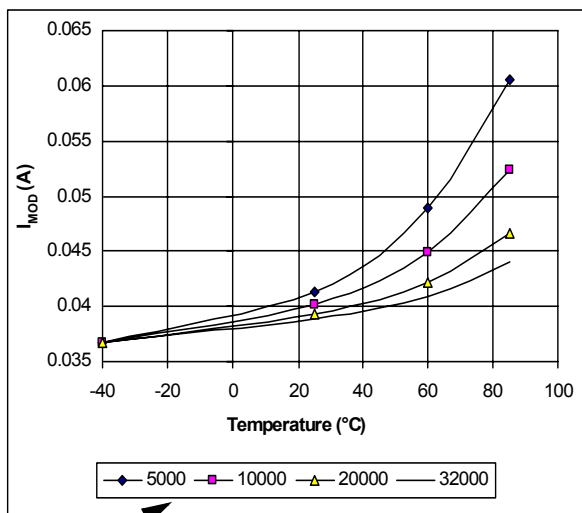


Fig. 10



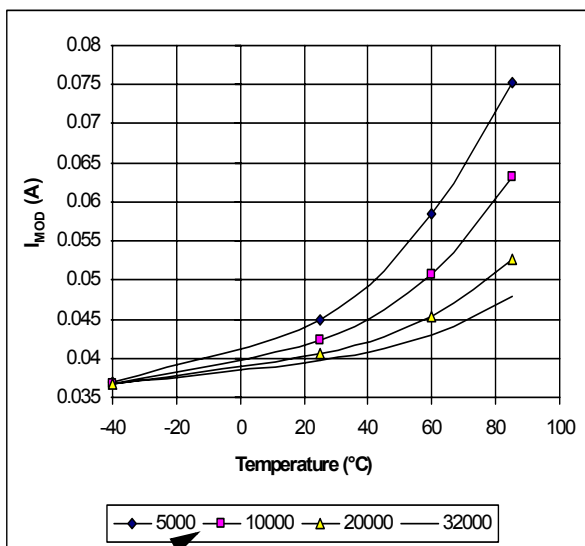
RTC\_SLOPE - Figures shown are in  $\Omega$   
RTC\_START = 0  $\Omega$ ,  $V_{CC} = 3.3V$

Fig. 11



RTC\_SLOPE - Figures shown are in  $\Omega$   
RTC\_START = 250  $\Omega$ ,  $V_{CC} = 3.3V$

Fig. 12



RTC\_SLOPE - Figures shown are in  $\Omega$   
RTC\_START = 400  $\Omega$ ,  $V_{CC} = 3.3V$

3.3 Volt Laser Driver IC for 155/622 Mbps

BARE DIE INFORMATION

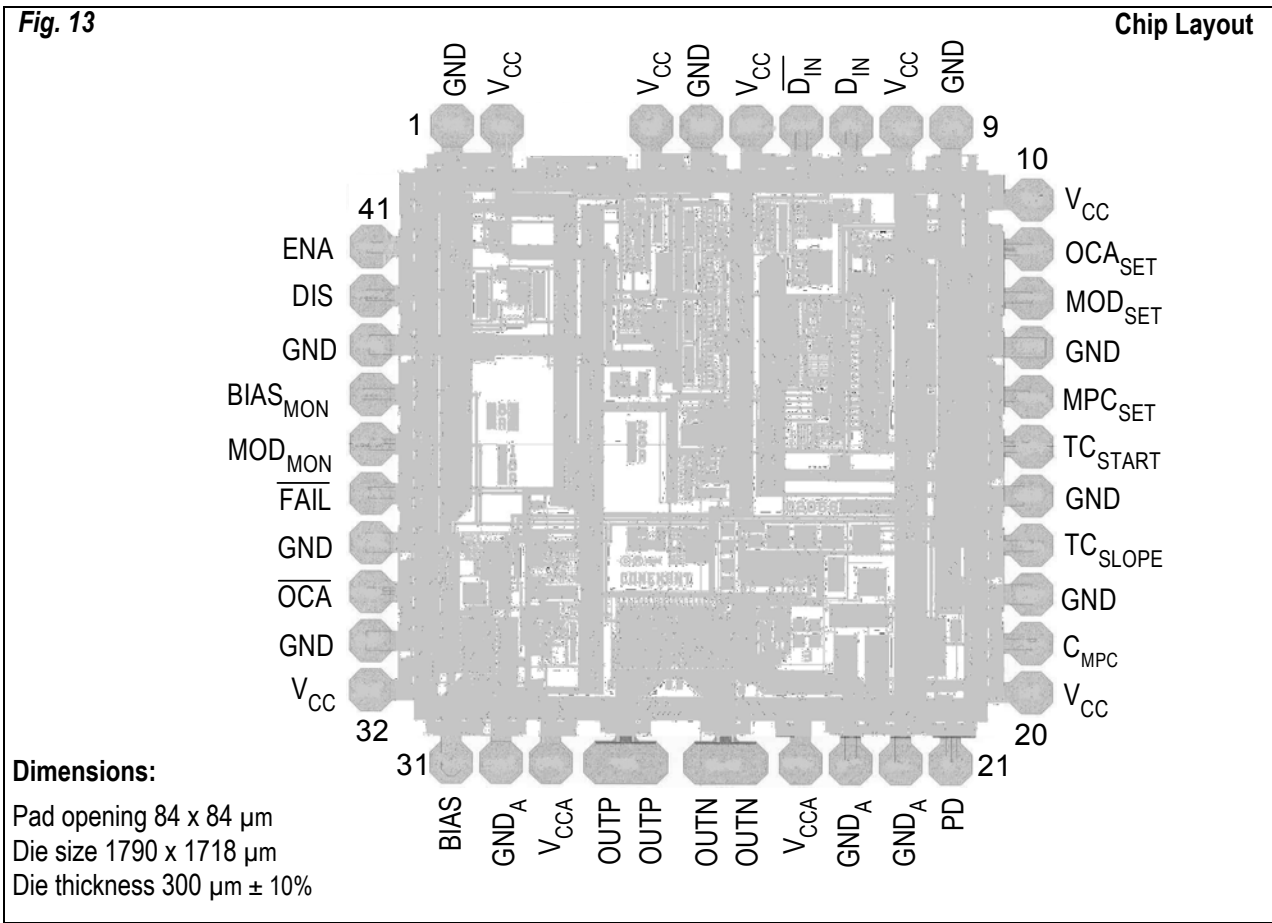


TABLE 7 PAD CENTERS

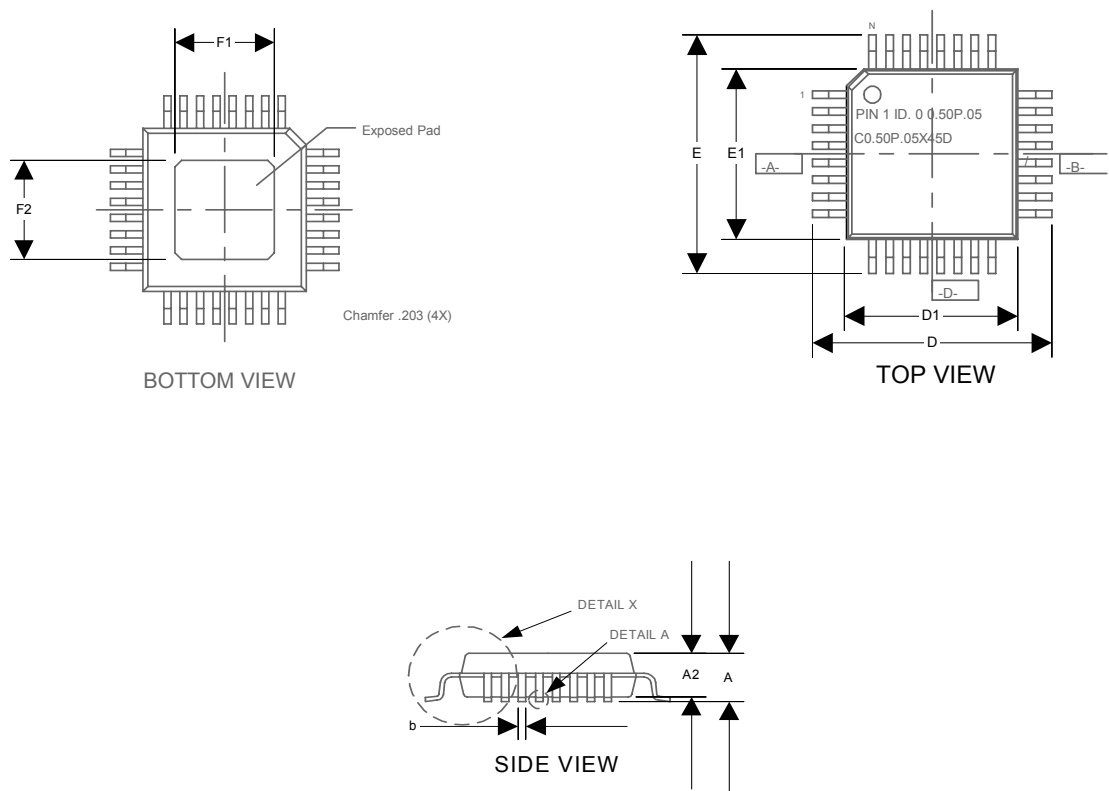
| PIN                 | X    | Y    | PIN              | X    | Y    | PIN                 | X   | Y    | PIN             | X    | Y   |
|---------------------|------|------|------------------|------|------|---------------------|-----|------|-----------------|------|-----|
| ENA                 | -727 | 440  | BIAS             | -550 | -711 | V <sub>CC</sub>     | 727 | -550 | GND             | 550  | 711 |
| DIS                 | -727 | 330  | GND <sub>A</sub> | -440 | -711 | C <sub>MPC</sub>    | 727 | -440 | V <sub>CC</sub> | 440  | 711 |
| GND                 | -727 | 220  | V <sub>CCA</sub> | -330 | -711 | GND                 | 727 | -330 | D <sub>IN</sub> | 330  | 711 |
| BIAS <sub>MON</sub> | -727 | 110  | *OUTP            | -210 | -711 | TC <sub>SLOPE</sub> | 727 | -220 | D <sub>IN</sub> | 220  | 711 |
| MOD <sub>MON</sub>  | -727 | 0    | *OUTP            | -210 | -711 | GND                 | 727 | -110 | V <sub>CC</sub> | 110  | 711 |
| FAIL                | -727 | -110 | *OUTN            | 100  | -711 | TC <sub>START</sub> | 727 | 0    | GND             | 0    | 711 |
| GND                 | -727 | -220 | *OUTN            | 100  | -711 | MPC <sub>SET</sub>  | 727 | 110  | V <sub>CC</sub> | -110 | 711 |
| OCA                 | -727 | -330 | V <sub>CCA</sub> | 220  | -711 | GND                 | 727 | 220  | V <sub>CC</sub> | -440 | 711 |
| GND                 | -727 | -440 | GND <sub>A</sub> | 330  | -711 | MOD <sub>SET</sub>  | 727 | 330  | GND             | -550 | 711 |
| V <sub>CC</sub>     | -727 | -550 | GND <sub>A</sub> | 440  | -711 | OCA <sub>SET</sub>  | 727 | 440  |                 |      |     |
|                     |      |      | PD               | 550  | -711 | V <sub>CC</sub>     | 727 | 550  |                 |      |     |

Note : \* single pad/double bond

3.3 Volt Laser Driver IC for 155/622 Mbps

TQFP32 PACKAGE INFORMATION

Fig. 14



Product Data Sheet

TABLE 8 PACKAGE DIMENSIONS

| Dimensions | Tolerance  | 5 x 5 x 1.0 mm TQFP, +2.00 mm FP |
|------------|------------|----------------------------------|
| N          | Lead count | 32                               |
| A          | Max.       | 1.20                             |
| A2         | ±0.05      | 1.00                             |
| D          | ±0.15      | 7.00                             |
| D1         | ±0.05      | 5.00                             |
| E          | ±0.15      | 7.00                             |
| E1         | ±0.05      | 5.00                             |
| F1         | ±0.10      | 2.67                             |
| F2         | ±0.10      | 2.67                             |

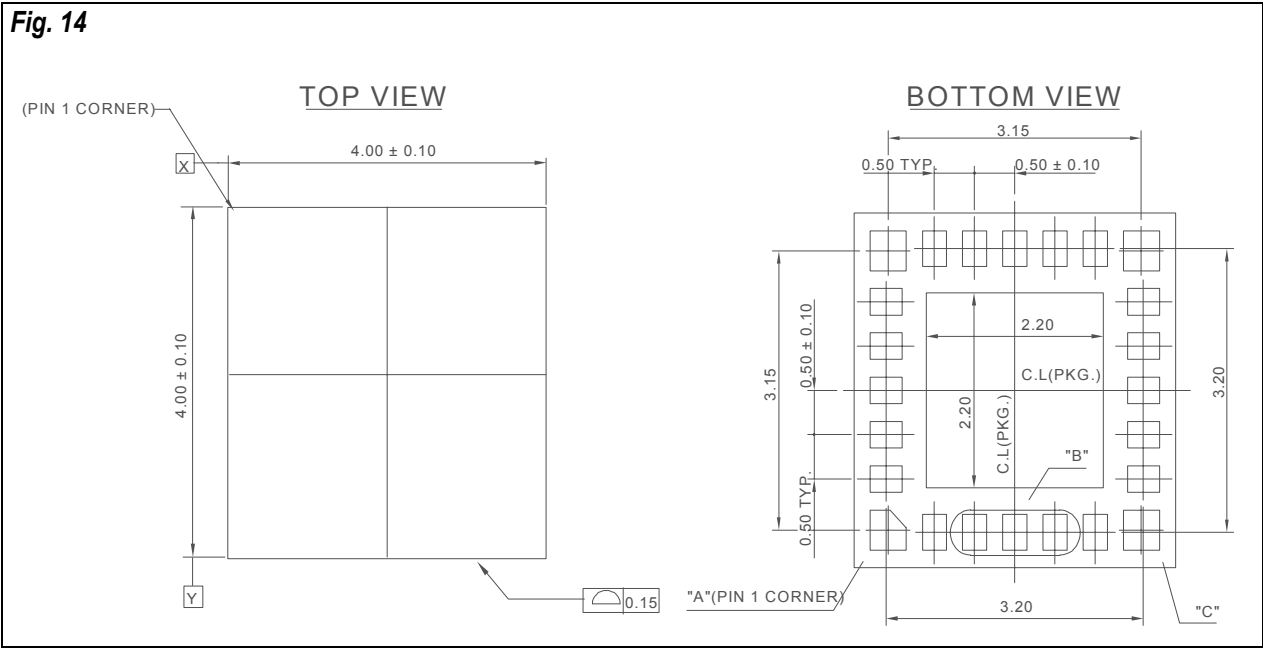
3.3 Volt Laser Driver IC for 155/622 Mbps

BCC+24L PACKAGE INFORMATION

Package Outline BCC+24L

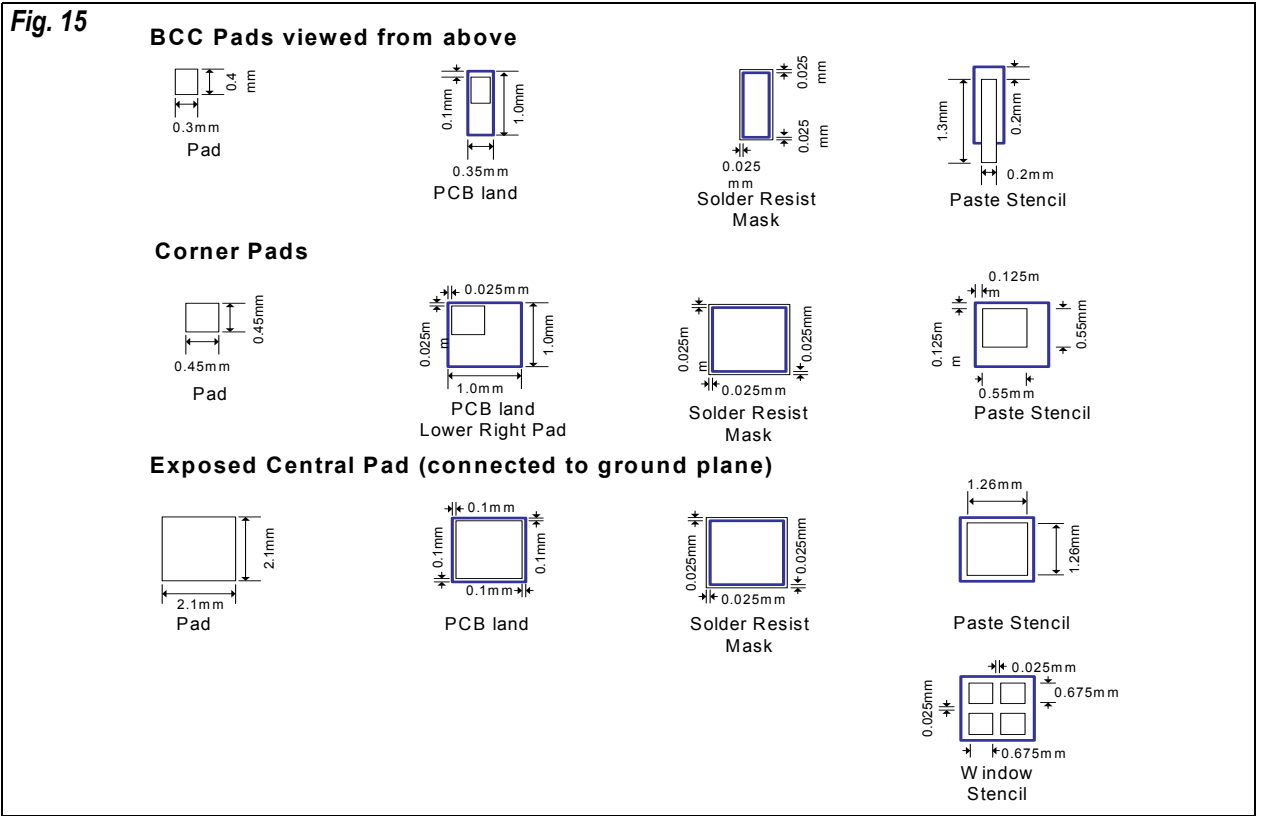
Thermal performance < 50°C

Fig. 14



SMT MOUNTING GUIDES

Fig. 15



## 3.3 Volt Laser Driver IC for 155/622 Mbps

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