

## Revision Information

This document contains information that is subject to change without notice. Contact Technical Publications for latest revision information.

## CX02068

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

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.

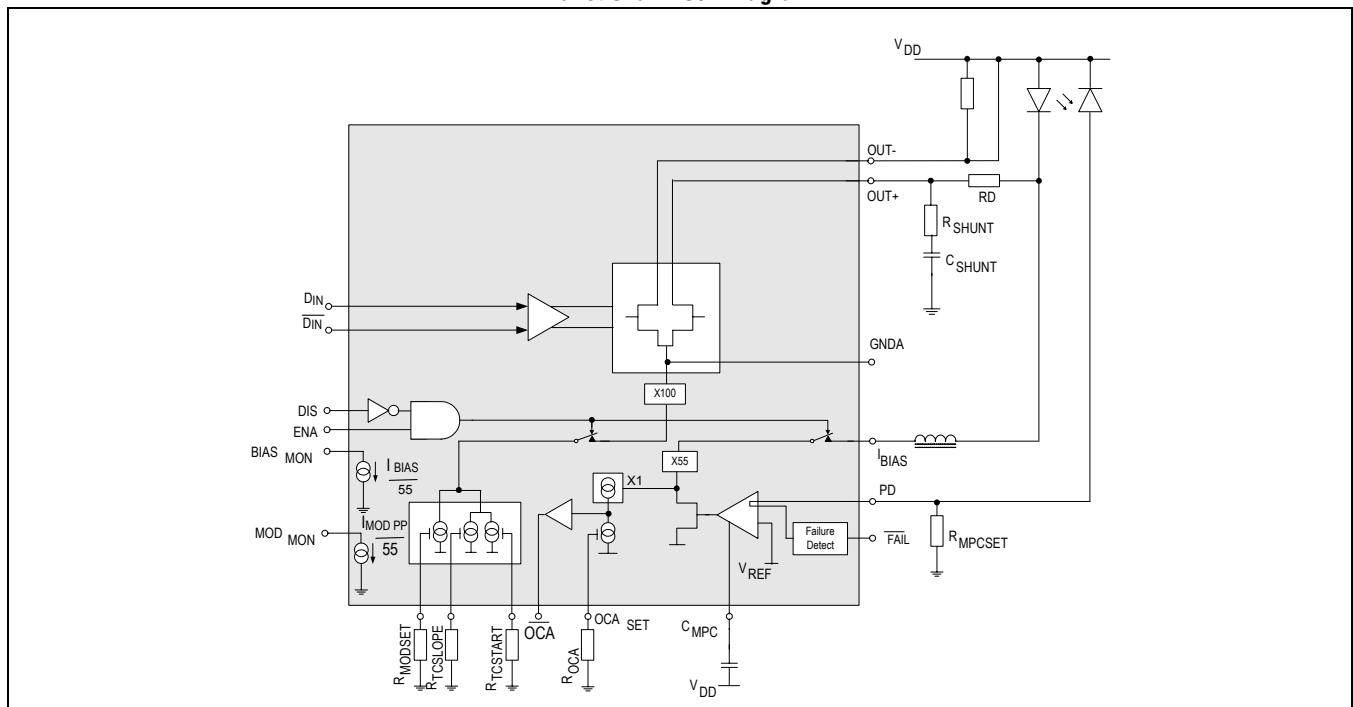
## Features

- 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
- Available in RoHS compliant packages

## Applications

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

Functional Block Diagram



## Ordering Information

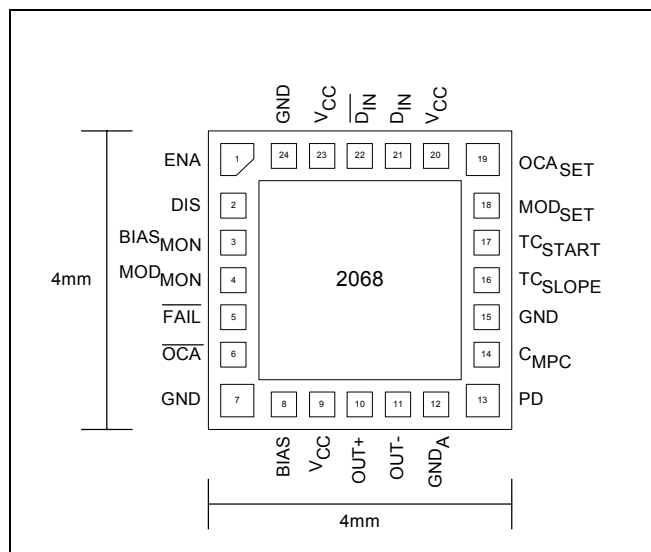
Part Number	Package
CX02068B24	BCC+24L
CX02068TQ32	TQFP32
CX02068G-09-T*	BCC+24L, RoHS
CX02068G-TQ32*	TQFP32, RoHS
CX02068DIEWP	Waffle pack
CX02068WAFER	Whole 8" wafer on a 10" grip ring
CX02068EVM	Evaluation board with a CX02068B24

\* The letter "G" designator after the part number indicates that the device is RoHS-compliant. Refer to [www.mindspeed.com](http://www.mindspeed.com) for additional information.

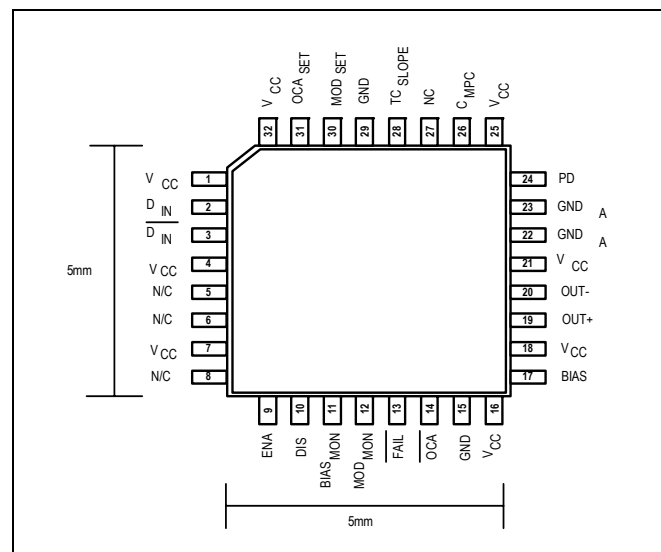
## Revision History

Revision	Level	Date	ASIC Revision	Description
C	Preliminary	April 2006	x	Added RoHS package information, updated format, no specification changes.
B	Preliminary	May 2005	x	Updated to new data sheet format.
A	Advance	October 2003	x	Advance.

**BCC+24L Top View**



**TQFP32 Top View**





# 1.0 Product Specification

---

## 1.1 Absolute Maximum Ratings

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 1-1. 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

## 1.2 Recommended Operating Conditions

**Table 1-2. 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

## 1.3 DC Characteristics

$V_{CC}=+3.3V \pm 10\%$ ,  $T_A=-40\text{ }^\circ\text{C}$  to  $+85\text{ }^\circ\text{C}$ , unless otherwise noted.

**Table 1-3. 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	$\mu A$
Bias current limit adjustment region	$T_A = +85\text{ }^\circ\text{C}$	20	-	100	mA
Change in bias current limit over temperature		100	-	130	$\mu A/^\circ\text{C}$
Monitor diode reverse bias voltage		2	-	-	V
Monitor diode current adjustment range		10	-	1000	$\mu A$
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	-	-	$k\Omega$
Common-mode input voltage		$V_{CC}-1.7$	-	$V_{CC} - \frac{V_{IN} (Diff)}{4}$	V
Self-biased common mode input voltage	Data and clock inputs	$V_{CC}-1.7$	-	$V_{CC}-0.47$	V

## 1.4 AC Characteristics

VCC = +3.3V ±10%, TA = -40 °C to +85 °C, unless otherwise noted.

**Table 1-4. AC Characteristics**

Parameter	Conditions	Min.	Typ.	Max.	Units.
Differential input voltage	$=2 \times (D_{IN+HIGH} - D_{IN+LOW})$ (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 <sup>4</sup>	ppm/°C
Programmable temperature at which modulation current TC compensation enables	Programmed by choice of R <sub>TC SLOPE</sub>	20	-	60	°C
Modulation output rise/fall times	20% to 80% into 25Ω, with matching network	-	-	180	ps
Overshoot of modulation output current	Into 25Ω load, with matching network	-10	-	+10	%
Modulation output pulse width distortion <sup>1</sup>	Measured using alternating 1-0 pattern	-	-	120 <sup>1</sup>	ps
Modulation output deterministic jitter	peak-to-peak. Measured into 25Ω load using: 2 <sup>23</sup> -1 PRBS at 622 Mbps includes pulse width distortion	-	-	140	ps
<b>NOTE:</b>					
1. Contact your Mindspeed sales representative concerning availability of parts with a maximum modulation output pulse width distortion of 80 ps or less					



## 2.0 Pin Description

### 2.1 Pin Descriptions

Table 2-1. Pin Descriptions

Pin No BCC+24	Pin No TQFP32	Name	Function
-	18	V <sub>CC</sub>	Power supply. Connect to VCC, do not leave open.
-	22	GND <sub>A</sub>	Ground to output stage.(inductor to ground to optimize output stage performance)
-	32	V <sub>CC</sub>	Power supply. Connect to VCC, do not leave open.
-	5, 6, 8, 27	NC	Not connected
-	7	V <sub>CC</sub>	Power supply. Connect to VCC, do not leave open.
-	25	V <sub>CC</sub>	Power supply. Connect to VCC, do not leave open.
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	$\overline{\text{FAIL}}$	Mean power control failure indicator (TTL/CMOS). Goes low when control loop is no longer able to maintain constant current at PD
6	14	$\overline{\text{OCA}}$	Over-Current Alarm (TTL/CMOS). Goes low when I <sub>BIAS</sub> exceeds the preset bias current limit
7	-	GND	Ground. Connect to VCC, do not leave open.
8	17	BIAS	Laser bias current output
9	1	V <sub>CC</sub>	Power supply. Connect to VCC, do not leave open.
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 $\overline{\text{D}}_{\text{IN}}$ is HIGH.
12	23	GND <sub>A</sub>	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. Connect to VCC, do not leave open.
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).

Table 2-1. Pin Descriptions (Continued)

Pin No BCC+24	Pin No TQFP32	Name	Function
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. Connect to VCC, do not leave open.
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. Connect to VCC, do not leave open.
24	29	GND	Ground. Connect to VCC, do not leave open.

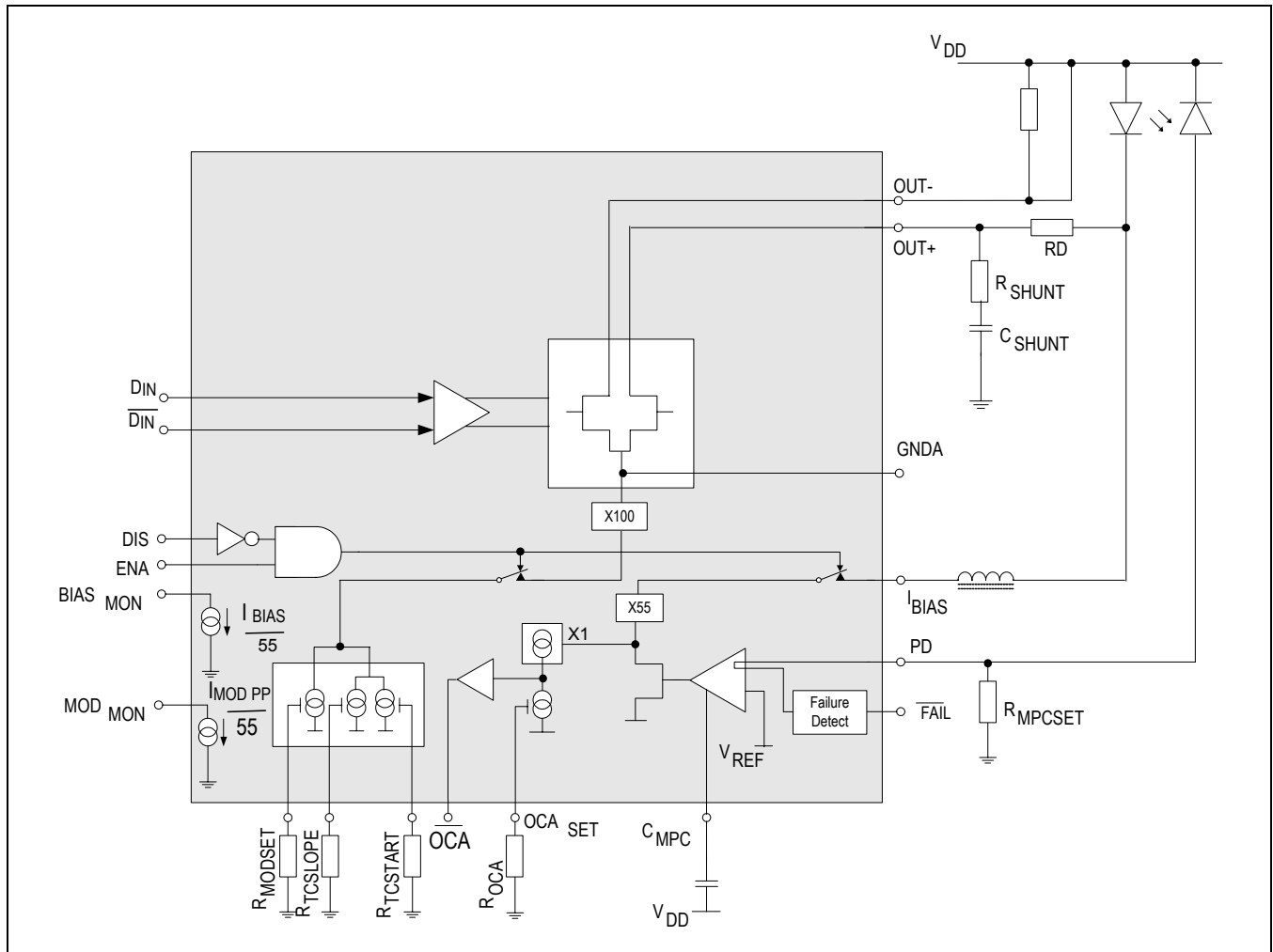


# 3.0 Functional Description

## 3.1 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.

Figure 3-1. CX02068 Block Diagram



## 3.2 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
- Available in RoHS compliant packages

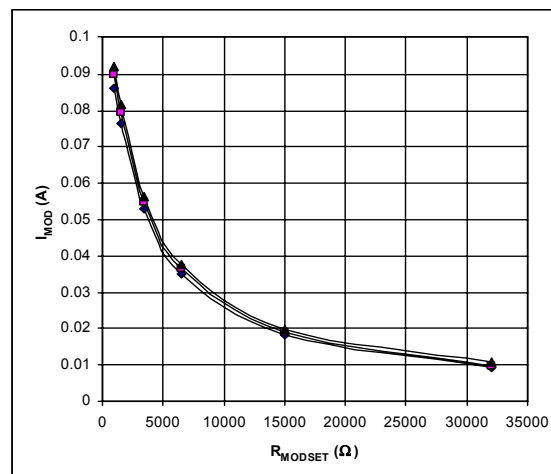
## 3.3 Modulator

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 25Ω 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.

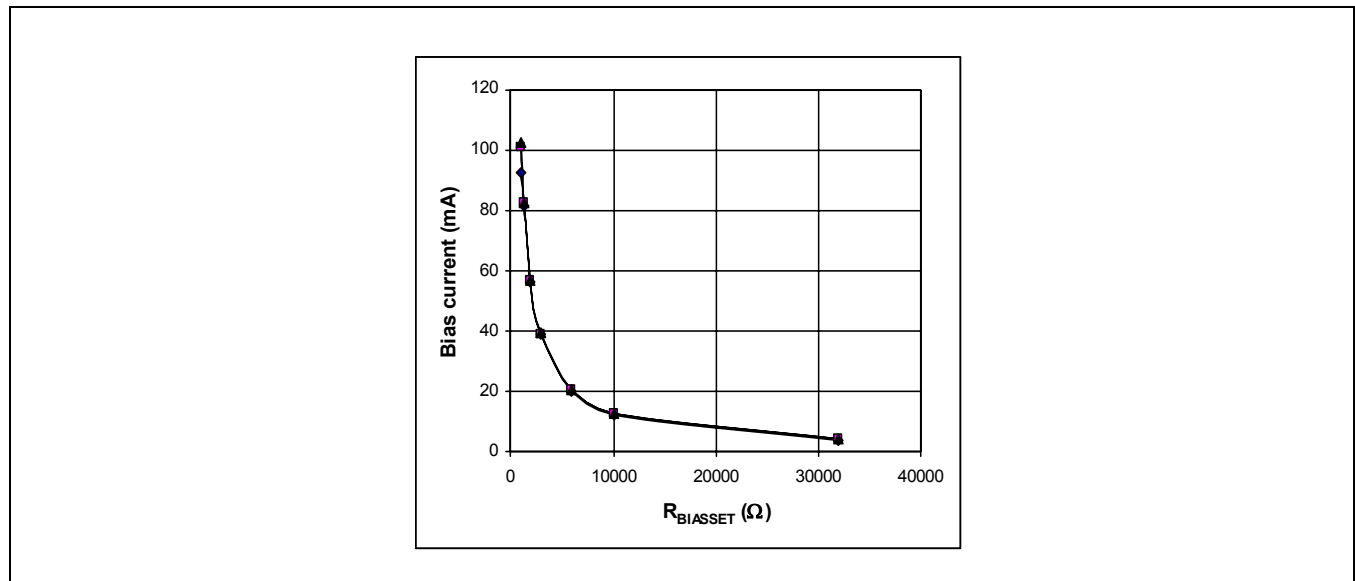
**Figure 3-2. Typical modulation current vs  $R_{MODSET}(3.3V)$**



### 3.4 Mean Power Control Loop

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  $C_{MPC}$ .

**Figure 3-3. 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.

**Figure 3-4. Typical limiting current vs  $R_{OCA}$  (at 25 °C)**

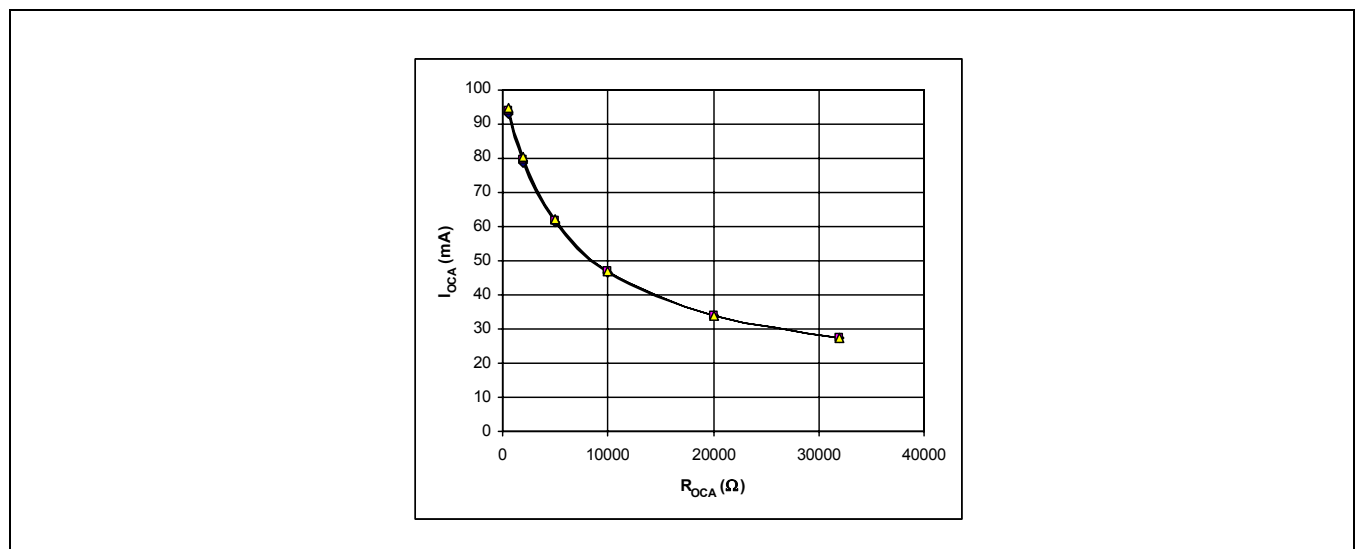


Figure 3-5. Temperature coefficient of  $I_{OCA}$  at different  $R_{OCA}$  settings

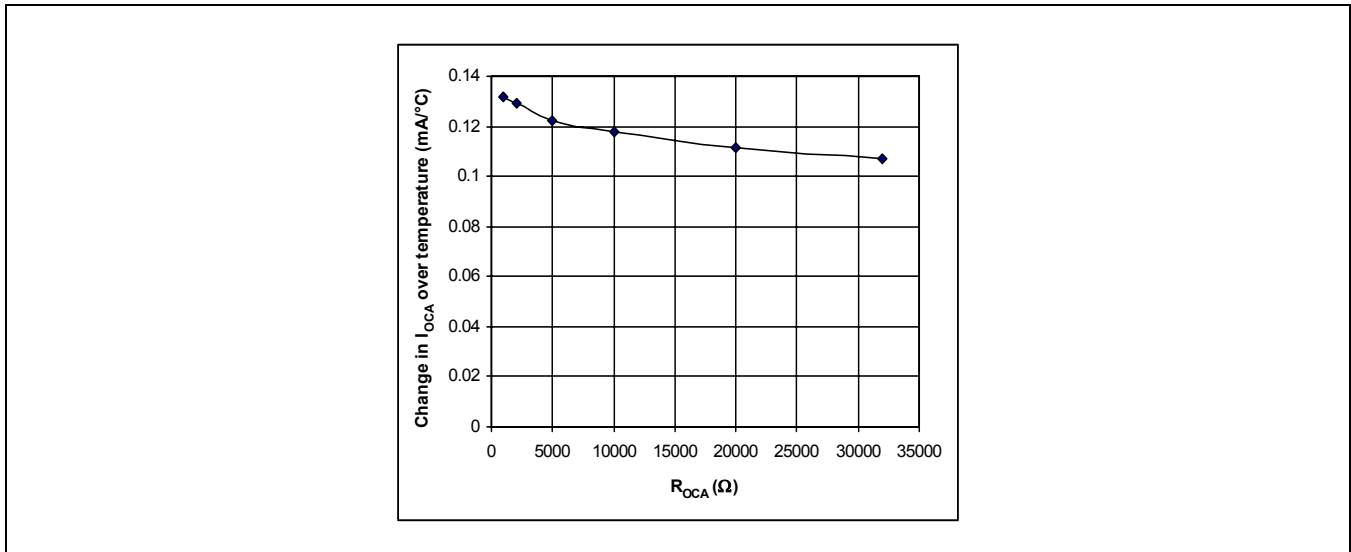
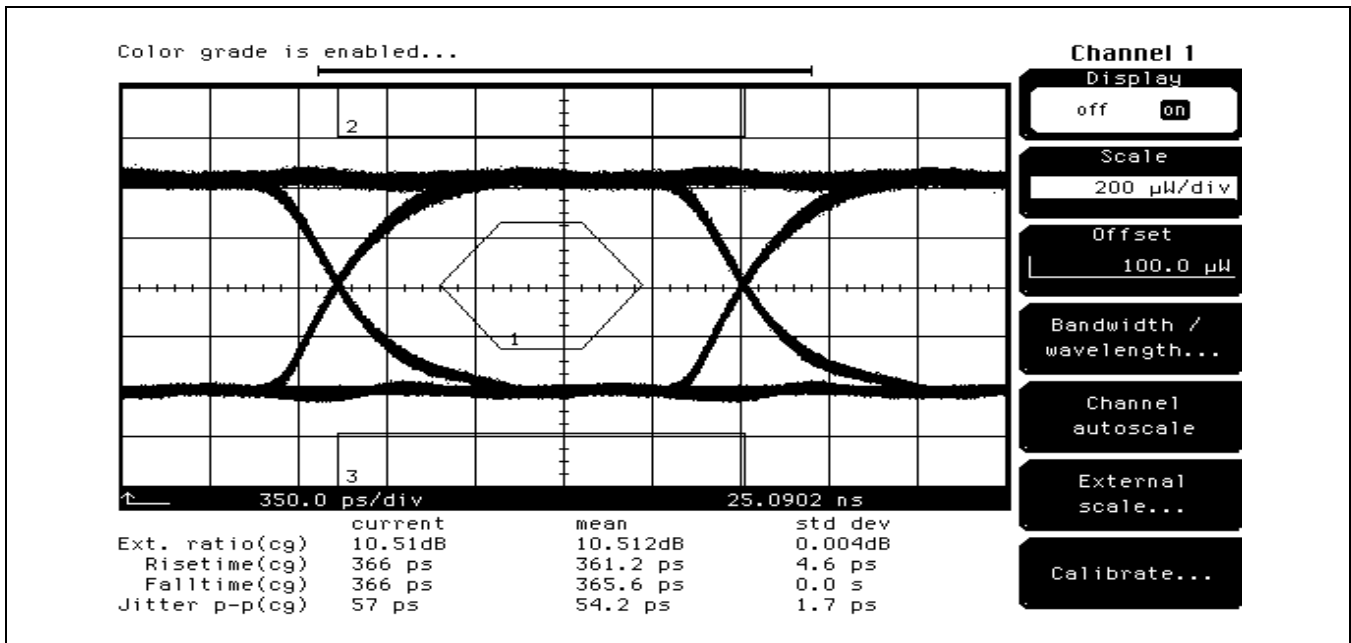


Figure 3-6. Typical Eye Diagram



## 3.5 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.

## 3.6 Current Monitors

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

## 3.7 Slow-Start

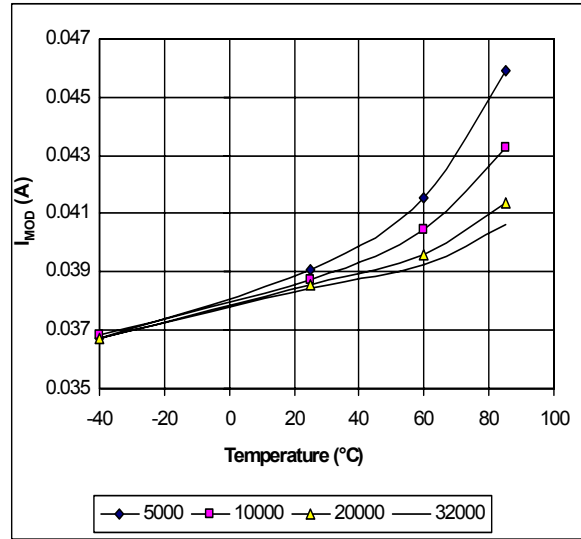
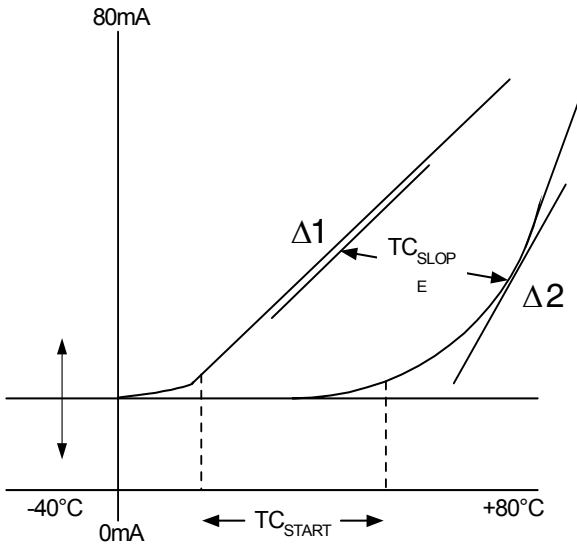
For laser safety and reliability, the CX02068 incorporates a slow-start circuit that provides a delay of approximately 200 ns before enabling the laser diode.

## 3.8 Temperature Compensation

The CX02068 features built in temperature compensation of the modulation current set using external resistors.

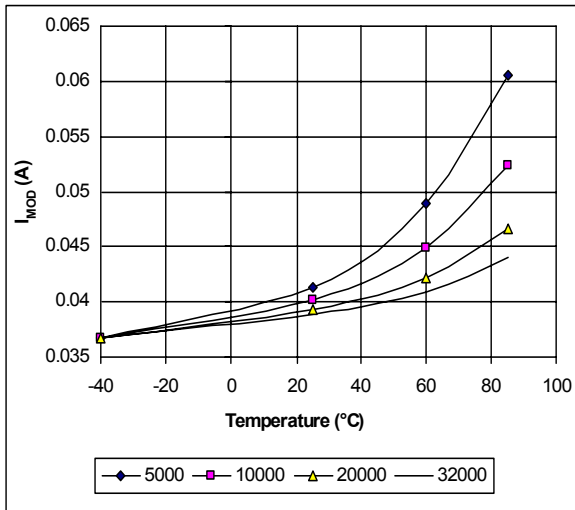
Current pulled from  $TC_{SLOPE}$  adjusts the slope of the temperature compensation where as current pulled from  $TC_{START}$  sets the threshold temperature for the coefficient.

Figure 3-7. Temperature Compensation Graphs



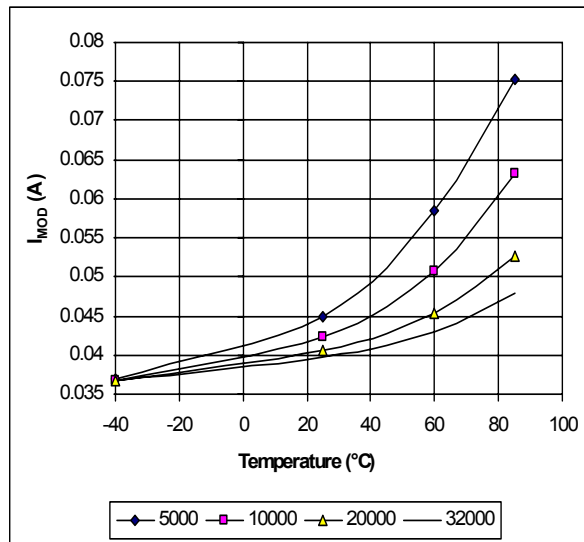
$RTC_{SLOPE}$  - Figures shown are in  $\Omega$

$RTC_{START} = 0\Omega, V_{CC} = 3.3V$



$RTC_{SLOPE}$  - Figures shown are in  $\Omega$

$RTC_{START} = 250\Omega, V_{CC} = 3.3V$



$RTC_{SLOPE}$  - Figures shown are in  $\Omega$

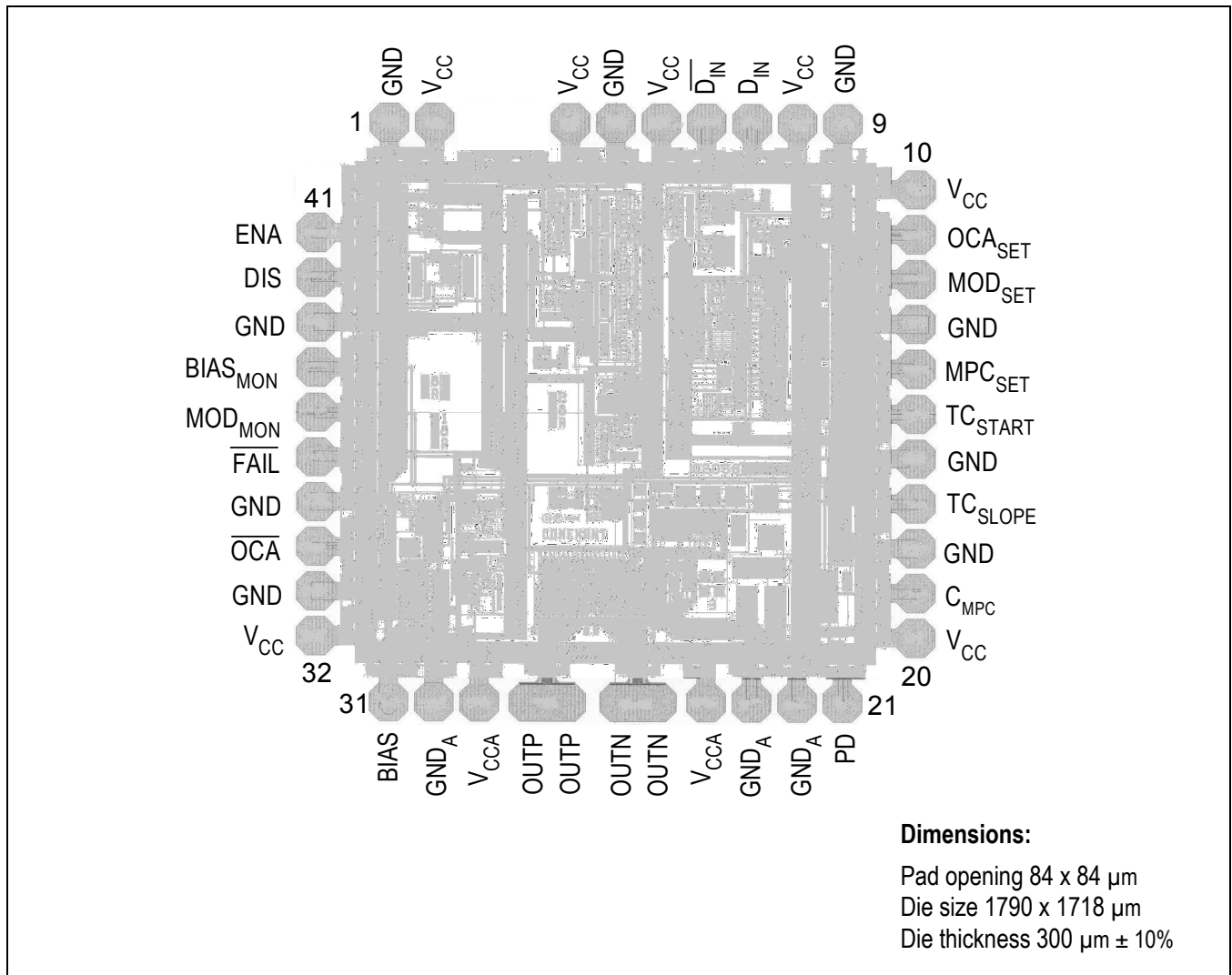
$RTC_{START} = 400\Omega, V_{CC} = 3.3V$



# 4.0 Packaging Specification

## 4.1 Packaging Specification

Figure 4-1. Bare Die Information



**Table 4-1. 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	-33-	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			

Figure 4-2. TQFP32 Package Information

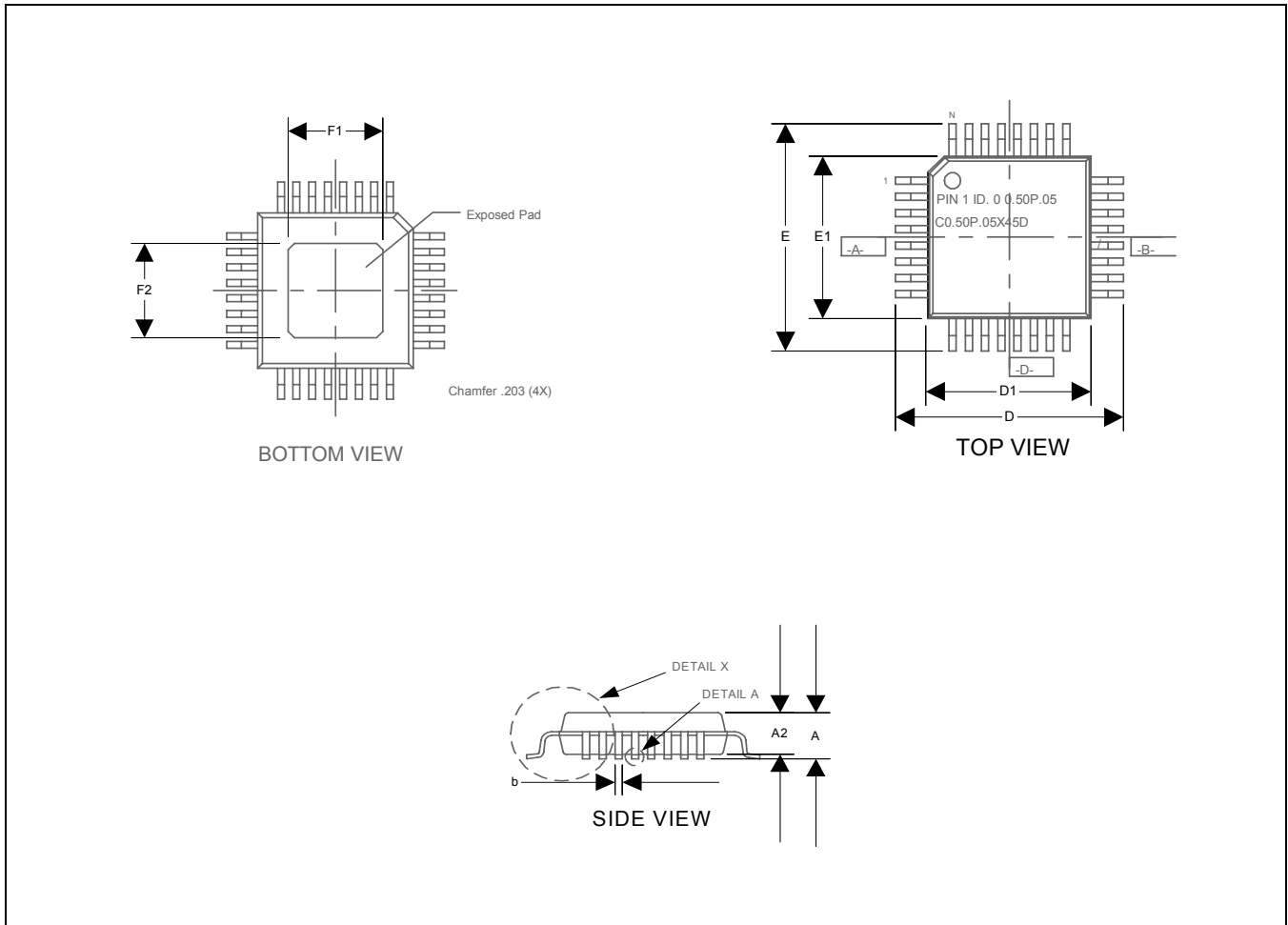


Table 4-2. Package Dimensions

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

Figure 4-3. BCC+24L Package Information

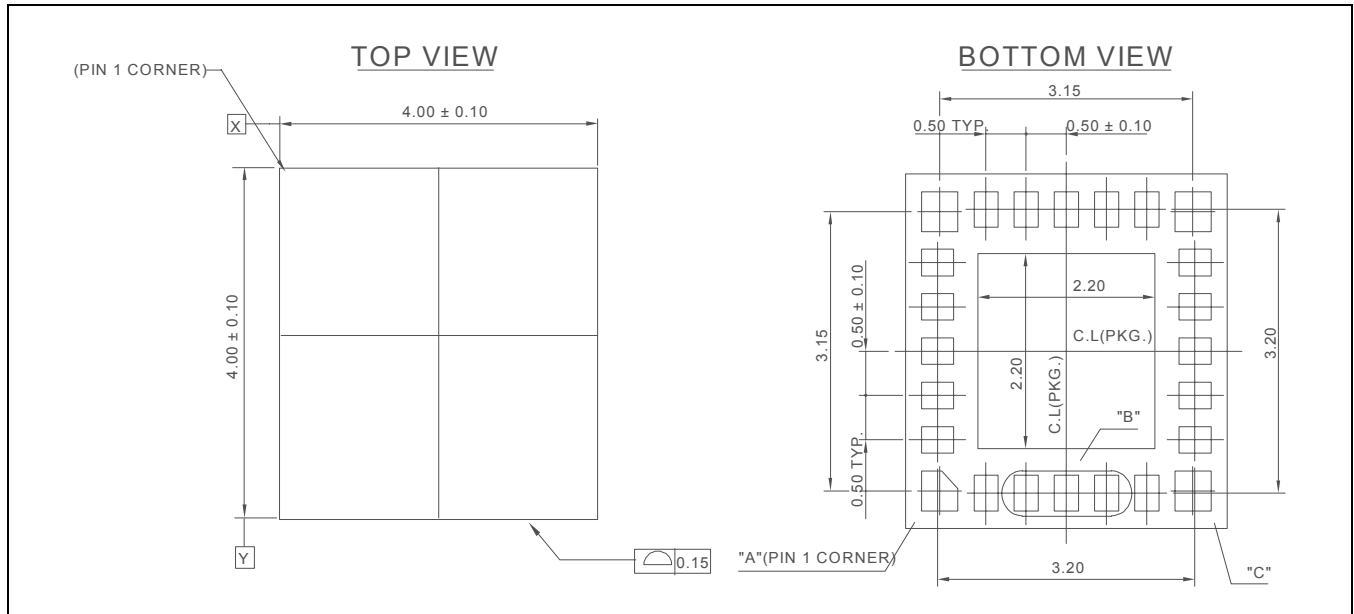
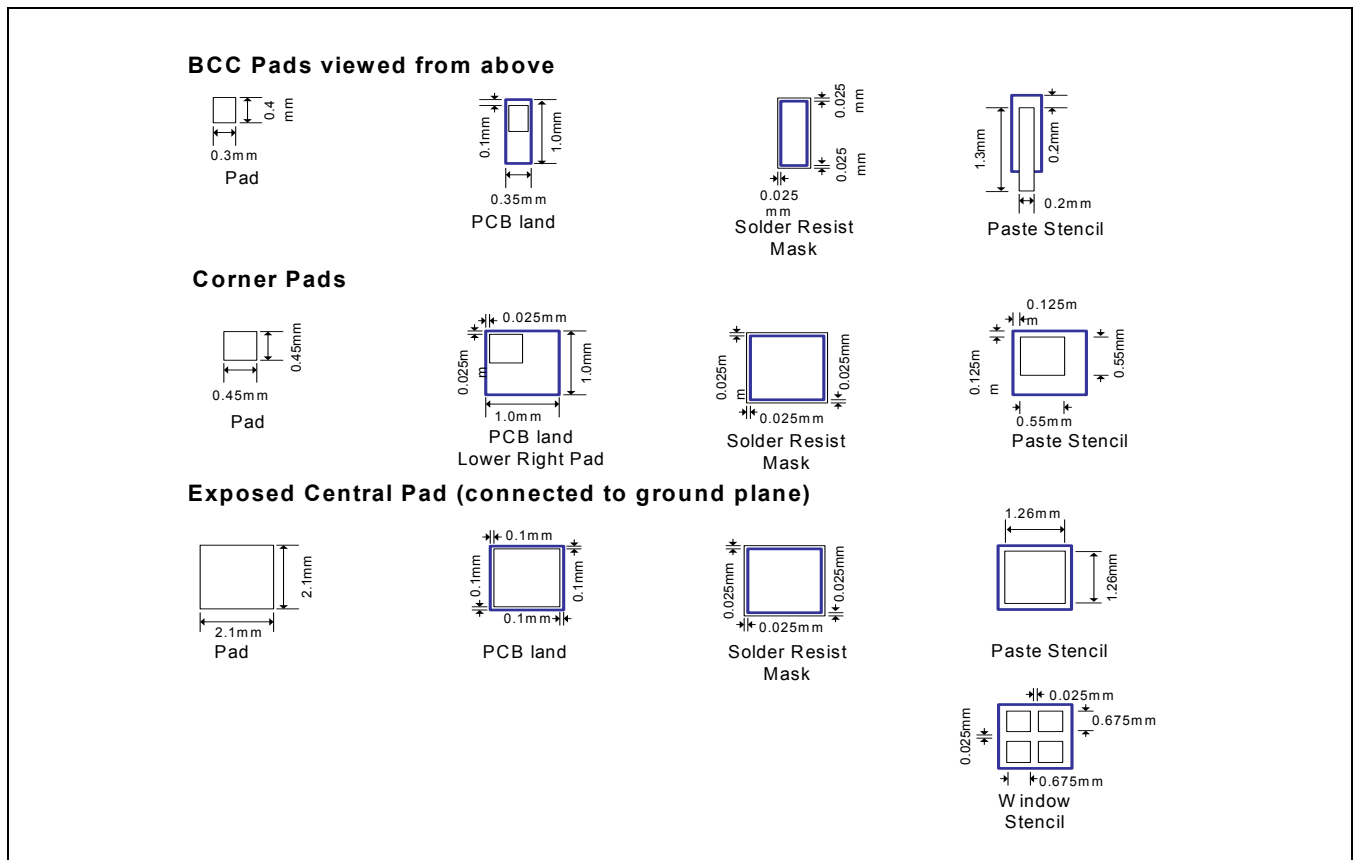


Figure 4-4. SMT Mounting Guides



[www.mindspeed.com](http://www.mindspeed.com)

General Information:  
Telephone: (949) 579-3000  
Headquarters - Newport Beach  
4000 MacArthur Blvd., East Tower  
Newport Beach, CA 92660

© 2006 Mindspeed Technologies<sup>®</sup>, Inc. All rights reserved.

Information in this document is provided in connection with Mindspeed Technologies<sup>®</sup> ("Mindspeed<sup>®</sup>") products. These materials are provided by Mindspeed as a service to its customers and may be used for informational purposes only. Except as provided in Mindspeed's Terms and Conditions of Sale for such products or in any separate agreement related to this document, Mindspeed assumes no liability whatsoever. Mindspeed assumes no responsibility for errors or omissions in these materials. Mindspeed may make changes to specifications and product descriptions at any time, without notice. Mindspeed makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MINDSPEED PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MINDSPEED FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MINDSPEED SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE USE OF THESE MATERIALS.

Mindspeed products are not intended for use in medical, lifesaving or life sustaining applications. Mindspeed customers using or selling Mindspeed products for use in such applications do so at their own risk and agree to fully indemnify Mindspeed for any damages resulting from such improper use or sale.