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DATASHEET

Laser Diode Driver with APC Amplifier for Printers

ISL58113

The ISL58113 is a high-performance laser driver that provides controlled current to grounded laser diodes. A bias current is summed with the switched current at the IOUT output, allowing the user to optimize laser diode performance.

Output switched current flows when the LVDS signal DATA is high. The output current returns to the fixed-threshold value when DATA is low. Complete I_{OUT} shut-off is achieved by holding the CHPEN low, which will override all other control pins.

A fast settling APC amplifier connects directly to the monitor diode. The ISL58113 does not exhibit any time-dependent droop since the calibration gain is stored as a digital number.

Ordering Information

PART NUMBER (Notes 1, 2)	PART MARKING	PACKAGE TAPE & REEL (Pb-free)	PKG. DWG. #
ISL58113CRZ-T13	58113 CRZ	24 Ld QFN	L24.4x5B

NOTES:

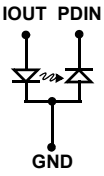
1. Please refer to TB347 for details on reel specifications.
2. These Intersil Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

Features

- Voltage-controlled Output Current Source
- Very Few External Components Needed
- Internal LVDS Termination Resistors
- 200MHz Switching
- Up to 70mA Output Current
- Rise Time < 500ps
- Fall Time < 500ps
- APC Loop for Write Power Control
- Fast Settling APC Amplifier
- Single +3.3V Supply (±10%)
- Disable Feature for Power-Up Protection and Conserving Power
- Zero Droop
- Pb-Free (RoHS compliant)

Load Configuration

- Common-cathode LD, Common-anode PD

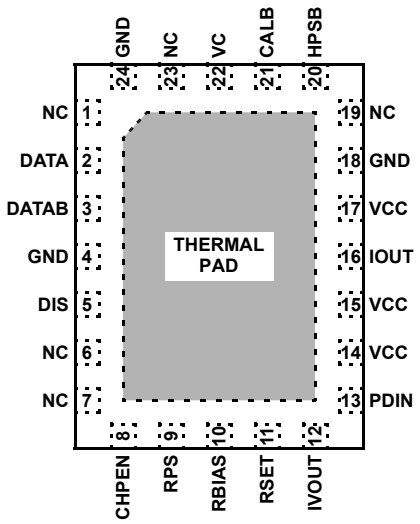


Applications

- Laser Printer Applications
- Laser Diode Current Switching

Pin Configuration

ISL58113
(24 LD QFN)
TOP VIEW



Pin Descriptions

PIN NAME	PIN NUMBER	I/O	TYPE	DESCRIPTION
DATA	2	I	LVDS	Input data to control Laser Switching Control
DATAB	3	I	LVDS	Input data to control Laser Switching Control
GND	4, 18, 24		Ground	Ground
DIS	5	I	Digital	Disable output current
NC	1, 6, 7, 19, 23	I	No connect	No connect
CHPEN	8	I	Digital	Chip Enable; Pull High to Enable
RPS	9	I	Analog	External resistor sets the Hsync detection power
RBIAS	10		Analog	Resistors set bias threshold current. See “Applications Information” on page 7 for more details
RSET	11	O	Analog	Bandgap derived internal reference
IVOUT	12	O	Analog	Calibrate channel with an external trimpot to GND Adjust the IV amplifier gain
PDIN	13	I	Analog	Photo Diode input to the IV amplifier
VCC	14, 15, 17		Power	Supply Voltage
IOUT	16	O	Analog	Laser Current Output
HPSB	20	I	TLL	Hsync Power Select Enable; Active Low. During HPSB is low AND Hsync signal from photo detector is low, the output current is set by RPS
CALB	21	I	TTL	Samples the laser power for APC; Active Low
VC	22	I	Analog	Voltage Controlling Laser Switching Current; 0V to 2V input for 0% to 100% output
Thermal Pad	-			Exposed Thermal Pad should be soldered to GND

NOTE: Pins with the same name are not necessary internally connected together. LDD pins must not be used for connecting together external components or features.

Absolute Maximum Ratings (T_A = +25°C)

Voltages Applied to:

- V_{CC} ..... -0.5V to 4.0V
- All Inputs ..... -0.5V to V_{CC} + 0.5V
- I_{OUT} ..... -0.5V to V_{CC}
- LVDS Max Current Inputs 5mA

ESD Rating

- Human Body Model (Tested per JESD22-A114F) 3kV
- Charged Device Model (Tested per JESD22-C110D) 1.5kV
- Machine Model (Tested per JESD22-A115B) 200V

Latch Up (Tested per JESD78B) 100mA

Recommended Operating Conditions

Thermal Resistance (Typical, Notes 3, 4)	θ_{JA} (°C/W)
24 Ld QFN	42

Operating Ambient Temperature Range ..... 0°C to +85°C

Maximum Junction Temperature ..... +150°C

Storage Temperature Range ..... -65°C to +150°C

Pb-Free Reflow Profile ..... see link below

http://www.intersil.com/pbfree/Pb-FreeReflow.asp

CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

NOTES:

3. θ_{JA} is measured in free air with the component mounted on a high effective thermal conductivity test board with "direct attach" features. See Tech Brief TB379.
4. For θ_{JC}, the "case temp" location is the center of the exposed metal pad on the package underside.

IMPORTANT NOTE: All parameters having Min/Max specifications are guaranteed. Typical values are for information purposes only. Unless otherwise noted, all tests are at the specified temperature and are pulsed tests, therefore: $T_J = T_C = T_A$

Electrical Specifications

V_{CC} = 3.3V, DIS = Lo, T_A = +25°C, R_{SET} = 3.0kΩ, unless otherwise indicated.

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 5)	TYP	MAX (Note 5)	UNIT
V_{CC}	Supply Voltage		3.0	3.3	3.6	V
ISdis	Supply Current (Disabled)	DIS = SLPEN = HPSB = Hi		0.1	1.0	mA
IS2	Supply Current (Standby)	DIS = Hi		17	22	mA
V_{LO}	Low Voltage Threshold	All TTL inputs			1.2	V
V_{HI}	High Voltage Threshold	All TTL inputs	2.8			V
I_{LO}	Input Low Current	All TTL inputs	-10	-5		µA
I_{HI}	Input High Current	All TTL inputs	-1		1	µA
V_{SHUT}	VCC Shut Down Voltage			2.5	2.8	V
V_{LVDS}	LVDS Input Level	Differential, with Vcm = 1.25V		0.2		V
V_{CMR}	LVDS Common Mode Voltage Range	300mV_{P-P}	0.2		2.2	V
V_C	Control Voltage		0.3		1.45	V
$R_{Termination}$	Internal LVDS Termination Resistor			180		Ω

Laser Amplifier Output

V_{CC} = 3.3V, DIS = Lo, T_A = +25°C, R_{SET} = 3.0kΩ, unless otherwise indicated.

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 5)	TYP	MAX (Note 5)	UNIT
I_{OUT}						
$IOUT_{SW-max}$	Switched Output Current	VC = 1.45V	40	47		mA
$IOUT_{BIAS-max}$	Bias Output Current	R_{BIAS} = 1kΩ	25	30		mA
I_{OFF}	Output Off Current	DIS pin set to HIGH	-75	0	+75	µA
$FREQ_{OP}$	Operating Frequency	I_{OUT} = maximum switch current	200	275		MHz
$IOUT_{PSRR}$	I_{OUT} Supply Sensitivity	I_{OUT} = 20mA, V_{CC} = 3.3V ±10%		9		%/V
t_{R-IOUT}	I_{OUT} Rise Time	10% to 90%; typical LD for printer		0.5		ns
t_{F-IOUT}	I_{OUT} Fall Time	90% to 10%; typical LD for printer		0.7		ns
OUTENx_t_{on}	I_{OUT} on Propagation Delay	DATAx crossing to I_{OUT} at 50% of final value		5	7	ns
VC_{BW}	Bandwidth of VC	VC = 1.0V		12		MHz

APC Electrical Specifications

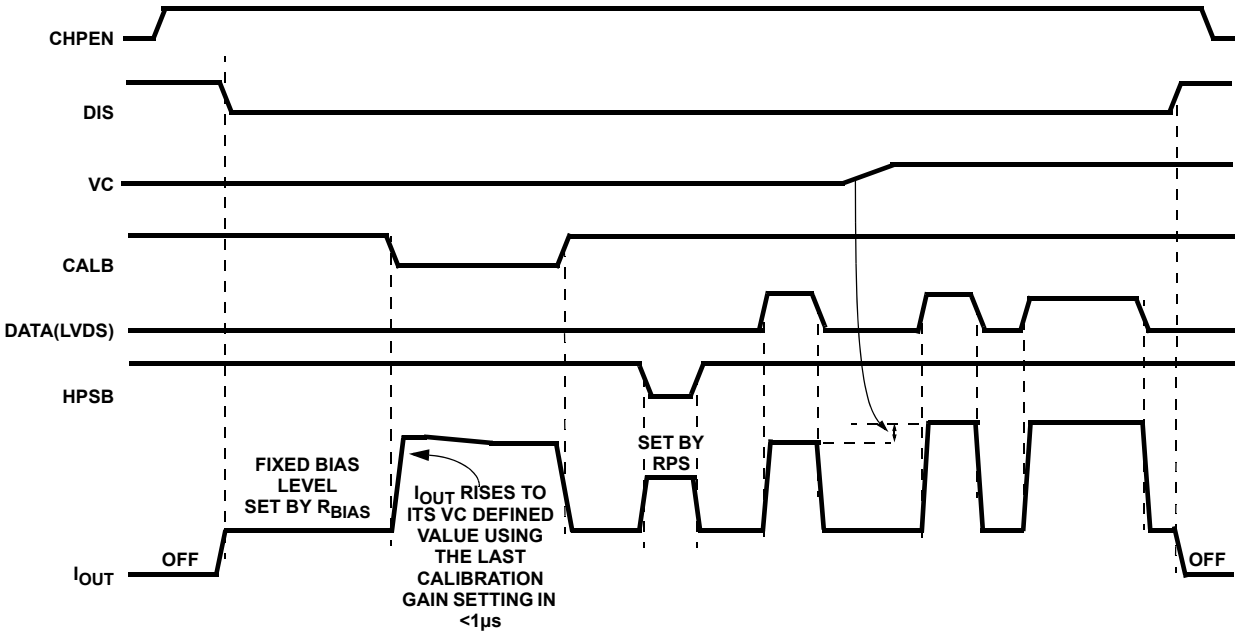
V_{CC} = 3.3V, DIS = Lo, T_A = +25°C, R_{SET} = 3.0kΩ, unless otherwise indicated.

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 5)	TYP	MAX (Note 5)	UNIT
t_{APC-50}	APC Response Time	0.3V to 1V step of VC		7.5		µs
IVgain	IV Amplifier Gain	External resistor RIV = 500Ω		3.1		kΩ

NOTE:

5. Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified. Temperature limits established by characterization and are not production tested.

Timing Diagram

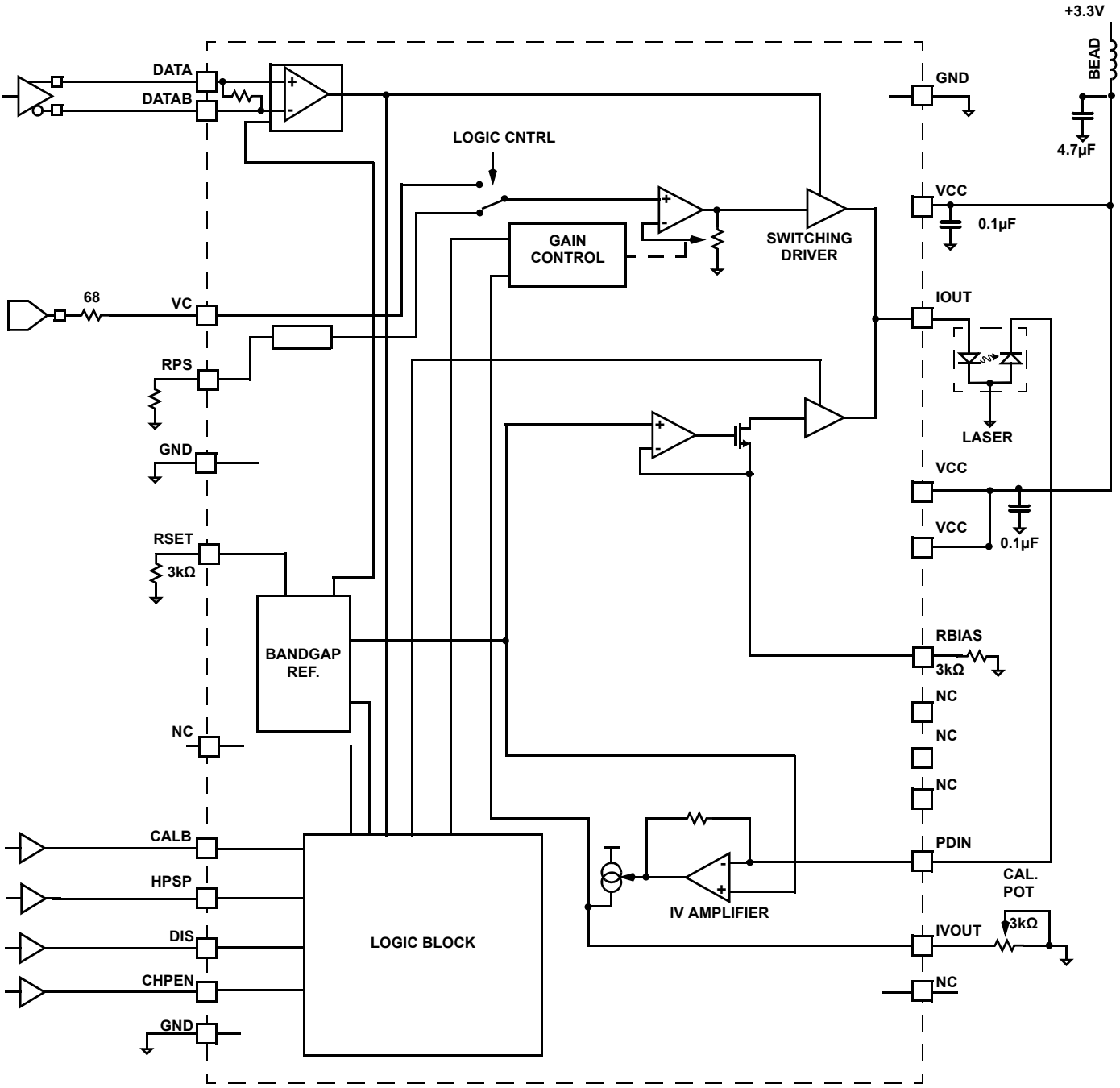


I_{OUT} Control

CHPEN	DIS	DATA	CALB	HPSB	I_{OUT}	COMMENTS
POWER-DOWN (SLEEP MODE)						
0	x	x	x	x	OFF	CHPEN is slow to enable
STANDBY (FULL STANDBY CURRENT, NO I_{OUTS})						
1	1	x	x	x	OFF	Full standby current, no I_{OUT}
NORMAL DRIVE						
1	0	x	1	1	ON, BIAS ONLY	
1	0	x	0	1	ON, CAL to level set by VC	
1	0	1	1	1	ON	
Hsync POWER						
1	0	x	1	0	Hsync power	Output current defined by RPS
INVALID LOGIC COMBINATION						
1	0	x	1	x	INVALID	

NOTE: DATA1 and DATA2: 1 implies DATA>DATAB, 0 implies DATA<DATAB

Typical Application



Applications Information

APC System Overview

As the laser heats up (or ages) its output power declines relative to the applied current, so some form of power control is required. The laser is optically coupled to a photo-diode, so that the laser's optical output can be measured. Laser optical output power is controlled by comparing the externally applied control voltage with the voltage produced by the IV-amplifier which converts the photo-diode's output current into a voltage. Since the calibrated gain is stored as a digital number in a register, the ISL58113 exhibits none of the time-dependent droop that is seen in most printers' laser diode drivers. This is of particular importance during high dot/inch graphics modes where the line may be slowed down very significantly to allow 2400 dots per inch or even more.

Fixed-Threshold Laser Bias Control

When a laser is driven from below threshold to well above threshold, it exhibits a few cycles of a damped oscillation. The amplitude of this oscillation is minimized when the laser is kept above threshold. The "fixed" bias mode is set by asserting a logic Low on the SLPEN pin. To set the laser bias threshold currents, I_{BIAS}, connect external resistors from RBIAS pins to GND. Figure 1 shows value of R_{BIAS} corresponding to desired bias current.

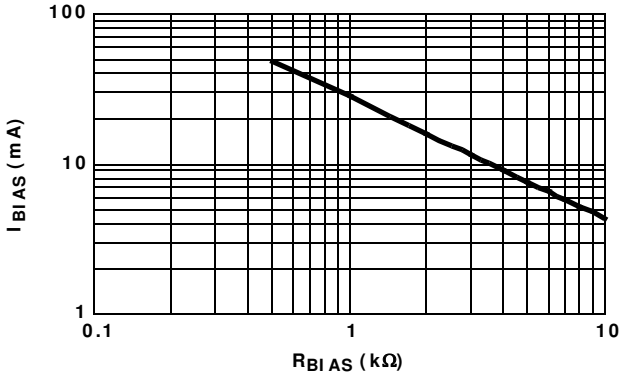


FIGURE 1. R_{BIAS} vs BIAS CURRENT

Scaling External Resistors

R_{SET} is used to scale the switching output current. Switching output current, I_{SW}, is the function of VC and R_{SET}.

$$I_{SW} = I_{SW}Gain \times \left(\frac{VC}{R_{DAC}} - \frac{2}{R_{SET}}\right) \quad \text{(EQ. 1)}$$

Where $I_{SW}Gain$ = ~17, R_{DAC} = 400Ω.

R_{BIAS} sets bias threshold current. Figure 1 exhibits the relationship between I_{BIAS} and R_{BIAS}. The bias current is set as Equation 2:

$$I_{BIAS} = BiasChannelGain \times \frac{InternalVref}{R_{BIAS}} \quad \text{(EQ. 2)}$$

Where BiasChannelGain = ~40, InternalVref = 1.0V.

Controlling the Sampling

The switching levels are sampled independently. This can be done during the "off-paper" period.

During calibration mode, the internal servo control will bring the laser diode output power level to match the voltage control level set by VC voltage.

Horizontal Edge Detection

When HPSB is low, the output current is set by RPS. Asserting HPSB low overrides both channel data inputs. HPSB should not be asserted low during a calibration cycle. When HPSB is low, the desired output current I_{RPS} is governed by the following Equation:

$$IRPS = 40 \times \frac{RPS}{CalDAC} \times \frac{1.05V}{RSET} \quad \text{(EQ. 3)}$$

where the CalDAC setting (from the last write power calibration) ensures laser temperature and aging compensation. The CalDAC's units are ohms. Full scale is about 380Ω and CalDAC is defined as CalDAC = 255/code*380Ω.

The horizontal sync pulse is meant to be a power level that overrides VC calibration and sets the output current to a fixed level.

Typical Application

Upon the printer being powered up, the lasers should be calibrated. This would establish nominal light power outputs, typically a few milliwatts at the laser regardless of the ambient temperature and also any laser aging.

Once everything is ready for printing, the paper is in position and the mirror-motor is phase-locked then the print line(s) can be written. Before, or after, the beam is over the photo-sensitive drum, each laser can be re-calibrated. This continual re-calibration will compensate for any temperature drift of the laser, especially at the initial warming up period.

Since the calibrated gain is stored as a digital number in a register, the ISL58113 exhibits no time-dependent droop. With no droop to degrade performance the only limitation now is the lasers' own temperature change along the line. This in turn can be compensated for to some extent by adding a data-dependent compensation signal to the analog VCx input pin. It may be found that in fast draft modes for example, that the laser temperature change is sufficiently small that many lines can be written before the laser(s) need to be re-calibrated. If the printed page has a low enough duty cycle, no re-calibration may be needed at all.

The ISL58113 has analog voltage inputs to allow the laser power level to be adjusted during the line. Typically this would be driven with a PWM, low bandwidth signal to compensate for the differing beam path length as the beam is swept from one side of the page to the other.

Note on Illegal Logic Combination

In normal use, CALB going low (active) without DIS being low (active) would be meaningless. Likewise with HPSB going low (active). Therefore, a combination of these should be avoided at all times. If this combination is applied, the chip will not work properly. To exit this mode, either set CALB to Low or/and DIS to Hi.

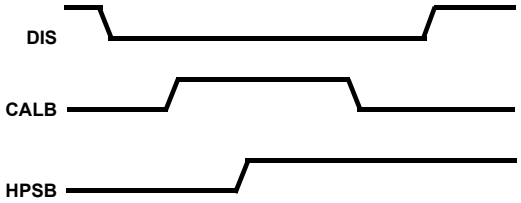


FIGURE 2. ILLEGAL COMBINATION

Power Supply Decoupling

Due to the high values of current being switched rapidly on and off, it is important to ensure that the power supply is well decoupled to ground. During switching, the V_{CC} undergoes severe current transients, thus every effort should be made to decouple the V_{CC} as close to the package as possible. Symptoms that could arise include poor rise/fall times, current overshoot, and poor settling response. It is recommended that VCC inputs should be bypassed with 4.7µF // 100nF // 470pF to GND.

Revision History

The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please go to web to make sure you have the latest Rev.

DATE	REVISION	CHANGE
7/29/13	FN7659.1	Conversion to new Intersil Template.
6/23/10	FN7659.0	Initial release.

About Intersil

Intersil Corporation is a leader in the design and manufacture of high-performance analog, mixed-signal and power management semiconductors. The company's products address some of the largest markets within the industrial and infrastructure, personal computing and high-end consumer markets. For more information about Intersil, visit our website at www.intersil.com.

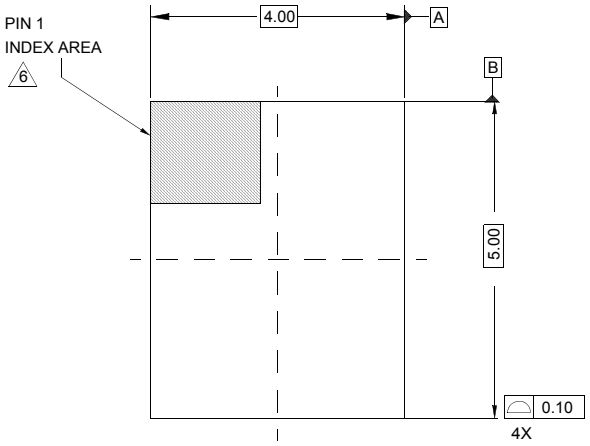
For the most updated datasheet, application notes, related documentation and related parts, please see the respective product information page found at www.intersil.com. You may report errors or suggestions for improving this datasheet by visiting www.intersil.com/en/support/ask-an-expert.html. Reliability reports are also available from our website at http://www.intersil.com/en/support/qualandreliability.html#reliability

Package Outline Drawing

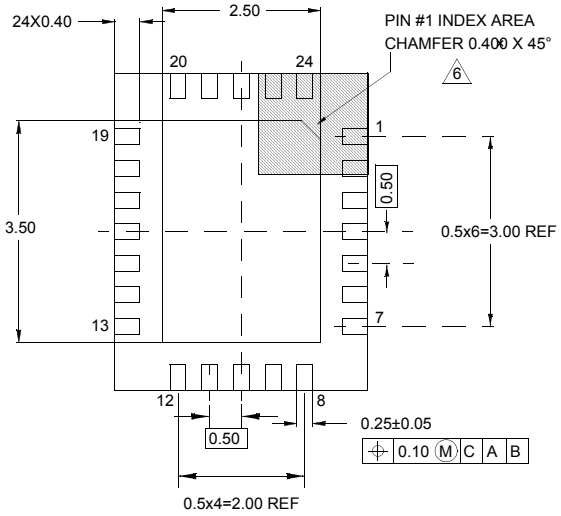
L24.4x5B

24 LEAD QUAD FLAT NO-LEAD PLASTIC PACKAGE

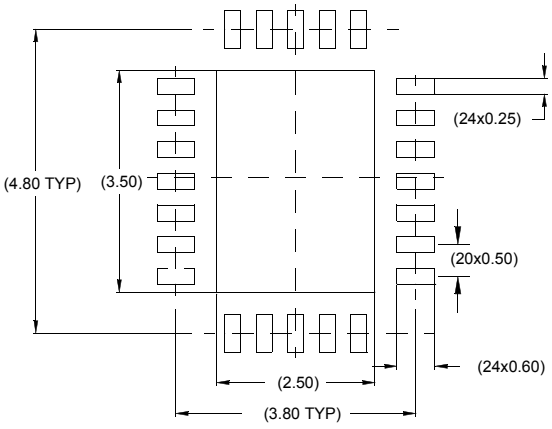
Rev 0, 10/06



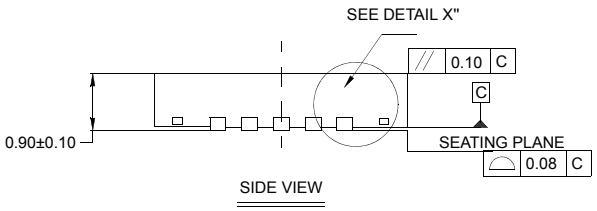
TOP VIEW



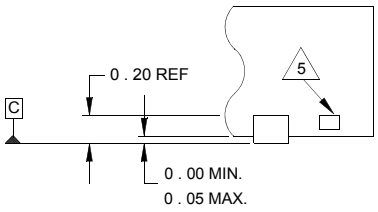
BOTTOM VIEW



TYPICAL RECOMMENDED LAND PATTERN



SIDE VIEW



DETAIL "X"

NOTES:

1. Dimensions are in millimeters.
   Dimensions in ( ) for Reference Only.
2. Dimensioning and tolerancing conform to AMSE Y14.5m-1994.
3. Unless otherwise specified, tolerance : Decimal ± 0.05
4. Dimension b applies to the metallized terminal and is measured between 0.20mm and 0.30mm from the terminal tip.
5. Tiebar shown (if present) is a non-functional feature.
6. The configuration of the pin #1 identifier is optional, but must be located within the zone indicated. The pin #1 indentifier may be either a mold or mark feature.