ISL88694

SMBus Accelerator (SMA)

FN8239
Rev.2.00
Jan 25, 2019

The ISL88694 SMBus accelerator (SMA) is a dual active pull-up bus terminator designed to improve data transmission speed on SMBus or similar 2-wire serial bus interfaces. The ISL88694 is also compatible with the I^2C serial bus.

The SMA detects rising input transitions with two internal voltage references and two comparators per channel. After the voltage on a data line crosses the first threshold (V_{TRIPL}), the boost pull-up current source is activated to speed transition. After the voltage crosses the second threshold (V_{TRIPH}), the boost pull-up current source is de-activated, leaving an active pull-up current of 275µA on the line. When both channels are HIGH, the pull-up current for both lines is reduced to 100µA to save power. Internal logic ensures that the active and boost pull-up current sources are not activated during downward transitions.

The level for V_{TRIPH} is controlled by a bandgap voltage referred to V_{DD}. This feature makes the switching behavior invariant for all power supply voltages between 2.7V and 5.5V.

A noise filter on each channel prevents the circuit from responding to input transitions that do not exceed a voltage-time threshold. To activate the boost circuit, the input must exceed V_{TRIPL} by 100Vns (typical) (See Figure 10).

The SMA permits operation of the bus at frequencies up to 100kHz, despite the capacitive loads of multiple devices and/or long PC board traces. Enhanced ESD protection on the accelerator pins are guaranteed to withstand 8kV ESD (HBM) events.

The SMBus Accelerator provides an essential function in SMBus applications because of distributed capacitance of SMBus and multiple device input capacitances at various nodes. By incorporating SMA, systems using SMBus or I^2C can reliably increase their bus load without the risk of data loss.

Features

- Active termination for SMBus lines
- Enhances system bus signal rise time
- Increases bus capacity while ensuring data integrity
- 2.2mA rise time supply current
- 8kV ESD protection on SDA and SCL pins
- Wide operating voltage range: 2.7V to 5.5V
- 2-Wire SMBus and I^2C compatible (100kHz)
- Small package - SOT23-5
- Pin-for-pin compatible with the LTC1694
- Pb-free available (RoHS compliant)

Target Applications

- Servers
- Data acquisition
- Routers
- Battery chargers
- Portable instrumentation
- Notebook
- PC
- Facilities tracking system

Related Literature

For a full list of related documents, visit our website:

- ISL88694 device page

Ordering Information

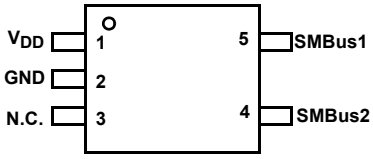
PART NUMBER (Notes 2, 3)	PART MARKING (Note 4)	TEMP RANGE (°C)	TAPE AND REEL (Units) (Note 1)	PACKAGE (RoHS Compliant)	PKG. DWG. #
ISL88694IH5Z-TK	AKM	-40 to +85	1k	5-pin SOT	P5.064

NOTES:

1. See TB347 for details about reel specifications.
2. Pb-free products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. 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.
3. For Moisture Sensitivity Level (MSL), see the ISL88694 device page. For more information about MSL, see TB363.
4. The part marking is located on the bottom of the part.

Pinout

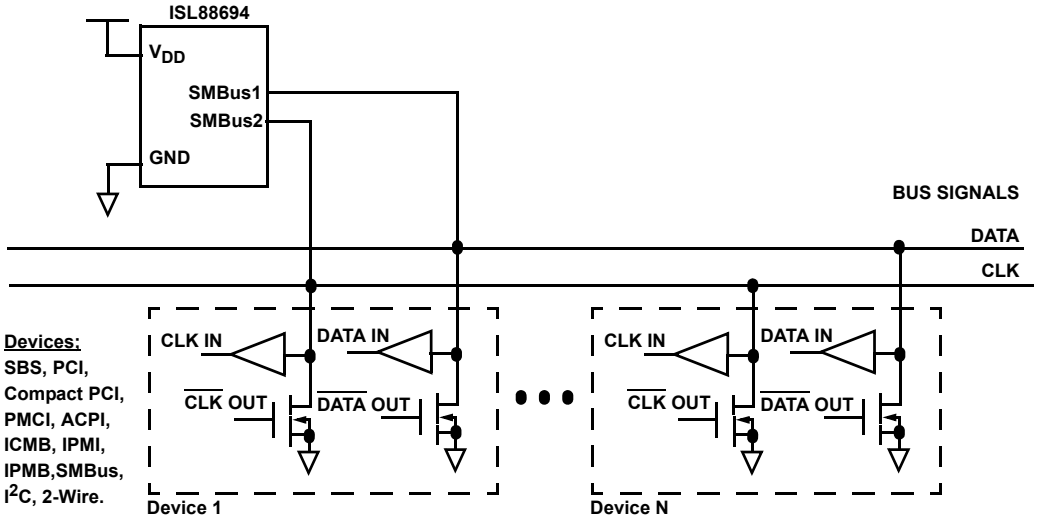
5 LD SOT-23
TOP VIEW



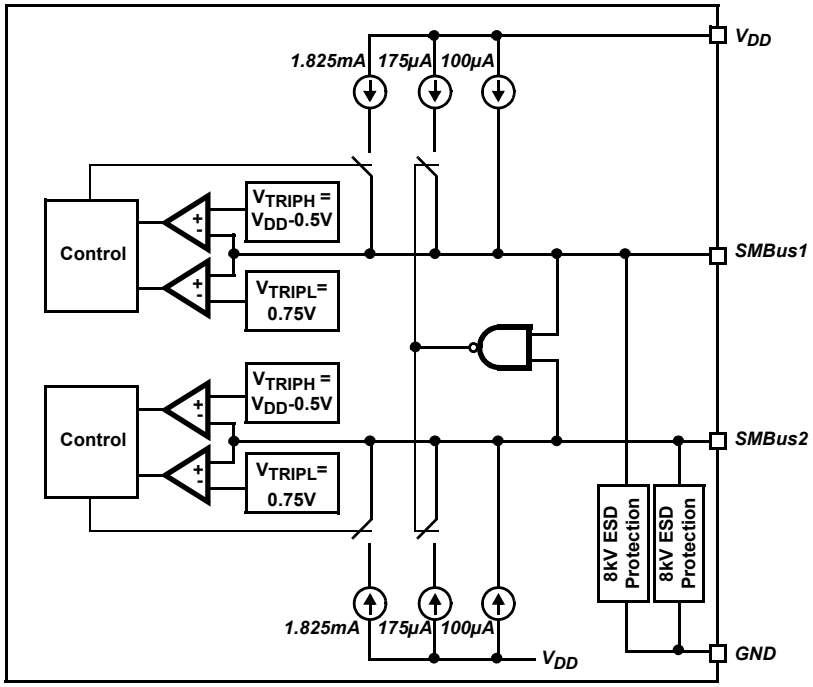
Pin Descriptions

SOT-23	SYMBOL	DESCRIPTION
1	V_{DD}	Supply Voltage
2	GND	Ground
3	N.C.	No Connect
4	SMBus2	Active Pull-Up for SMBus
5	SMBus1	Active Pull-Up for SMBus

System Diagram



IC Block Diagram



Absolute Maximum Ratings

Supply Voltage Range . . . . . -1V to 6.5V
Operating Junction Temperature . . . . . +135°C
Storage Temperature Range . . . . . -65°C to +150°C
Voltage on pins . . . . . -0.3V to V_{DD}+0.3V
Lead temperature (soldering, 10 seconds) . . . . . 300°C
ESD min other pins (HBM). . . . . >2kV
ESD SMBus1 and SMBus2 pins (HBM) . . . . . >8kV

Recommended Operating Conditions

Temperature . . . . . -40°C to +85°C
Supply Voltage. . . . . 2.7V to 5.5V

CAUTION: Absolute Maximum Ratings indicate limits beyond which permanent damage to the device and impaired reliability can occur. These are stress ratings provided for information only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification are not implied.

For assured specifications and test conditions, see Electrical Specifications. The assured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

Electrical Specifications

Over operating conditions unless otherwise specified, Typical values are measured at V_{DD} = 3.3V and T_A = +25°C

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
ANALOG PARAMETERS						
Supply Voltage Range	V_{DD}		2.7		5.5	V
V_{DD} Ramp Rate	$V_{DD\ RAMP}$		0.05		50	V/msec
Supply Current	I_{DD}	SMBus1 = SMBus2 = Open		80	100	µA
Standby Pull-Up Current	I_{OUT_SB}	SMBus1 = SMBus2 = V_{DD}-1.0V		80	125	µA
Active Pull-Up Current	I_{OUT_A1}	SMBus1 = GND; SMBus2 = Open	125	275	350	µA
	I_{OUT_A2}	SMBus1 = Open; SMBus2 = GND	125	275	350	µA
Boost Pull-Up Current (Figure 1)	I_{OUT_B1}	V_{TRIPL}<SMBus1<V_{TRIPH}, SMBus2 = Open	1.6	2.2		mA
	I_{OUT_B2}	V_{TRIPL}<SMBus2<V_{TRIPH}, SMBus1 = Open	1.6	2.2		mA
Input Voltage Threshold Low	V_{TRIPL}		0.65	0.75	0.85	V
Input Voltage Threshold High	V_{TRIPH}		V_{DD}-0.60	V_{DD} - 0.50	V_{DD} - 0.40	V
SMBus Max Frequency	f_{MAX}				100	kHz
Noise Spike Suppression (Note 5) (Figure 10)	NSS			20		V-nsec

NOTES:

5. Measured as area under triangular waveform above V_{TRIPL}, with time as base and V_{IN} as height (see Figure 10 on page 7).

Typical Performance Curves

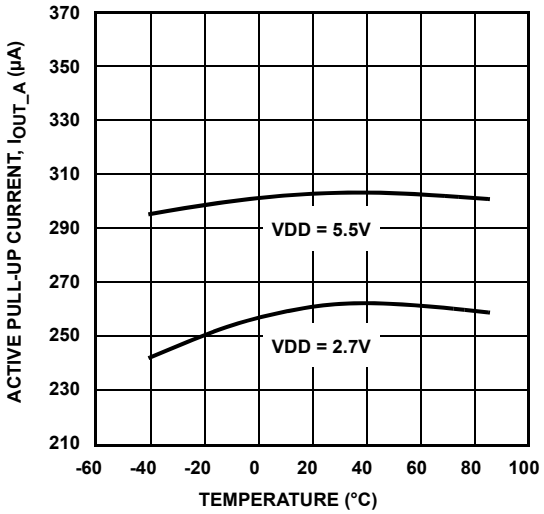


FIGURE 1. ACTIVE PULL-UP CURRENT, SMBus PIN = 0V

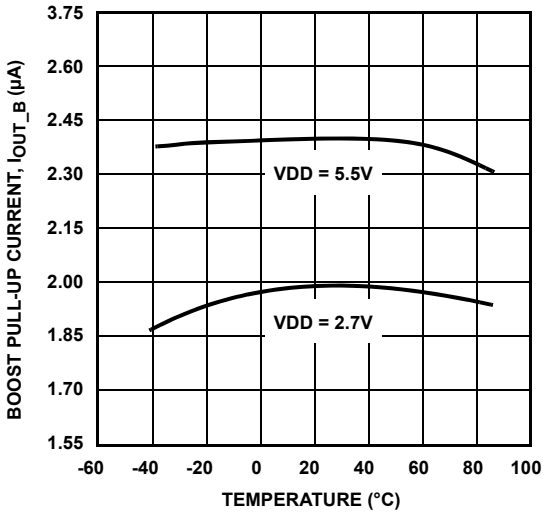


FIGURE 2. BOOST PULL-UP CURRENT, SMBus PIN = $V_{DD}/2$

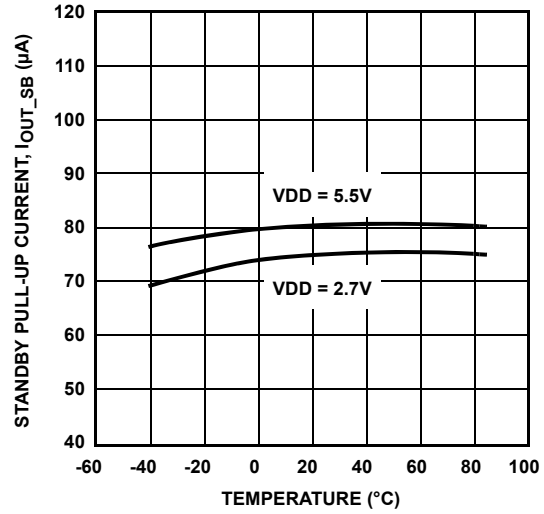


FIGURE 3. STANDBY PULL-UP CURRENT, SMBus1, 2 = V_{DD}-0.5V

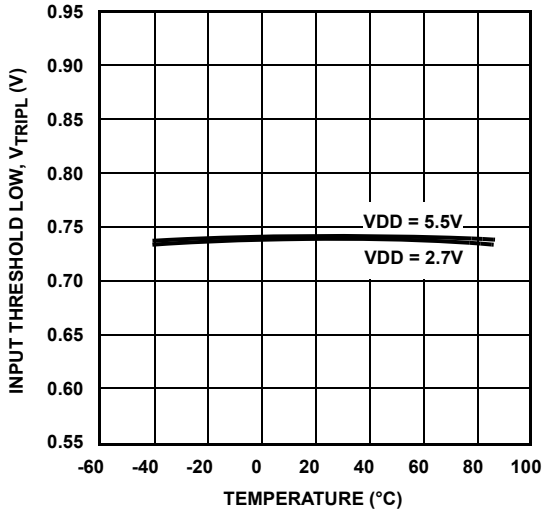


FIGURE 4. V_{TRIPL} VOLTAGE

Typical Performance Curves (Continued)

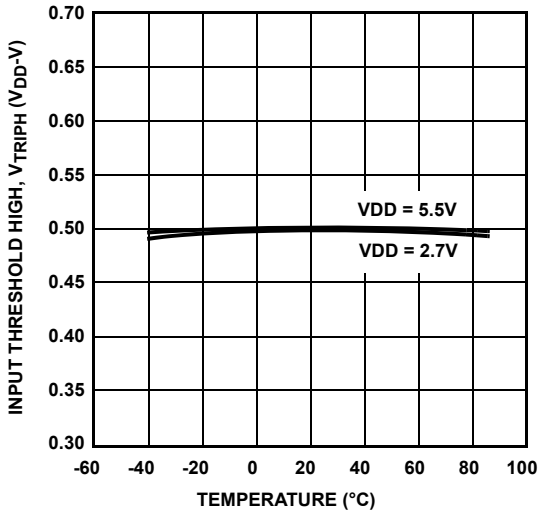


FIGURE 5. V_{TRIPH} VOLTAGE

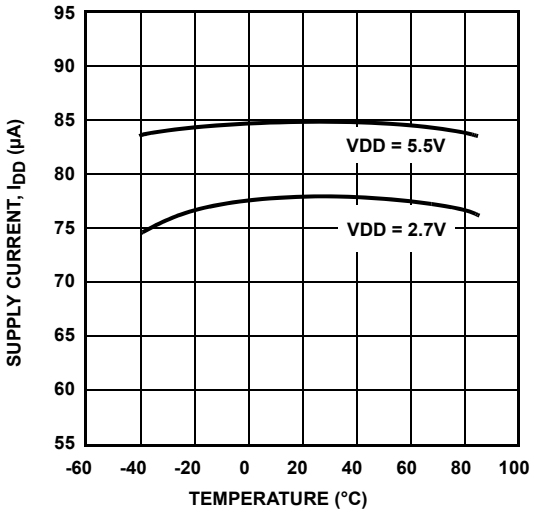


FIGURE 6. I_{DD} CURRENT. SMBus1 = SMBus2 = OPEN

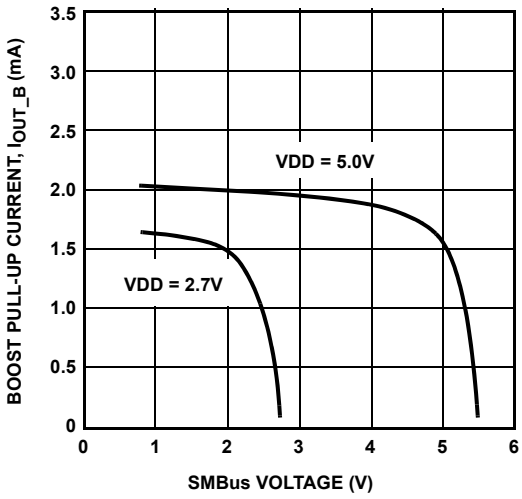


FIGURE 7. BOOST PULL-UP CURRENT vs SMBus VOLTAGE

Functional Description

SMBus Overview

The SMBus or I^2C bus is a 2-wire multimaster bus, meaning that more than one device connected to the bus is capable of controlling it. Master devices communicate to other master or slave devices using one clock and one data line. These are both bidirectional.

To allow multimaster operation without bus contention, it is necessary to allow each bus to be connected to a positive supply voltage through a current-source or pull-up resistor (see "System Diagram" on page 3). When the bus is free, both lines are HIGH. The output stages of devices connected to the bus must have an open-drain or open-collector to perform the wired-AND function.

Simple pull-up resistors on the clock and data lines work well unless there are long signal lines or many devices connected to the bus. Then, the combined capacitance of the bus increases the rise time on the signal so much that the communication becomes unreliable or fails to meet the bus timing specifications. Smaller resistors can sometimes compensate for the extra capacitance, but this increases the current consumption when the signal lines are pulled LOW.

ISL88694 Operation

To improve the operation of the SMBus where larger bus capacitance exists, the ISL88694 provides active pull-up using switched current sources. When the bus is idle and both lines are HIGH, a standby pull-up current of 100µA is used to maintain the signal level while minimizing power consumption. When either of the two signals is pulled LOW, an active pull-up current of 275µA maintains a good V_{OL} noise margin.

When the bus line is released, it is pulled high by the ISL88694 active current until the voltage exceeds the V_{TRIPL} level for a period of time. This voltage-time combination filters out noise on the signal line. When the ISL88694 detects a valid rising edge, a 2.2mA boost current pulls the bus line high very quickly (see Figure 8). This boost current turns off when the input level reaches the V_{TRIPH} threshold and the pull-up current returns to the active level. If both inputs are HIGH, the pull-up current drops to the standby level of 100µA.

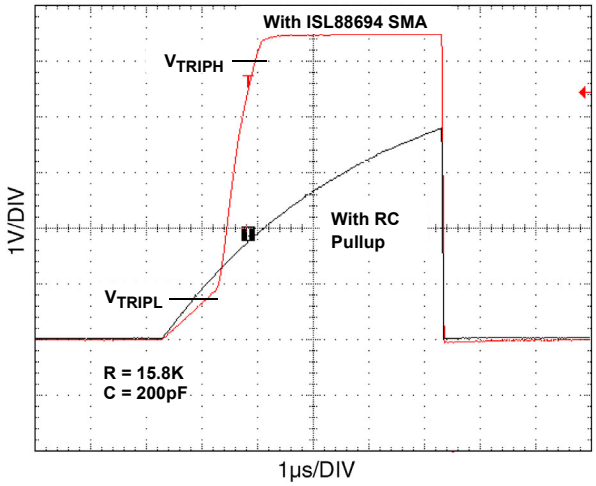


FIGURE 8. ISL88694 SMBus SYSTEM BOOST PULL-UP COMPARED TO RESISTOR PULL-UP (V_{DD} = 5.5V)

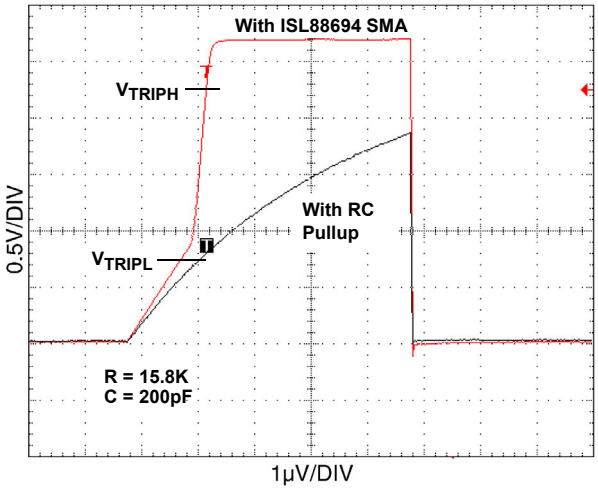


FIGURE 9. ISL88694 SMBus SYSTEM BOOST PULL-UP COMPARED TO RESISTOR PULL-UP (V_{DD} = 2.7V)

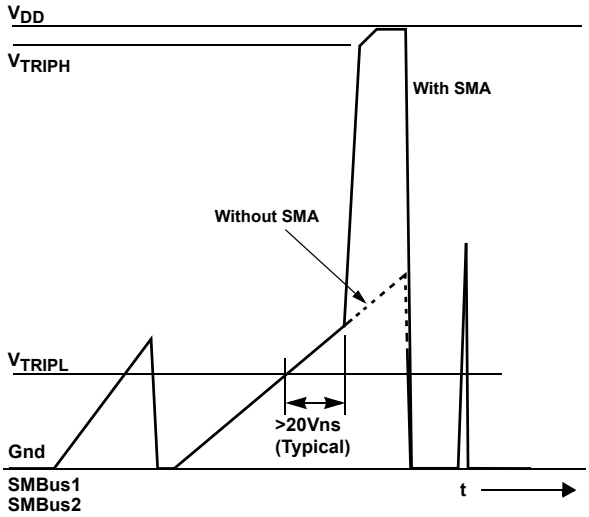


FIGURE 10. NOISE SUPPRESSION. BOOST CURRENT APPLIED WHEN INPUT SIGNAL EXCEEDS 20Vns (TYPICAL)

Revision History

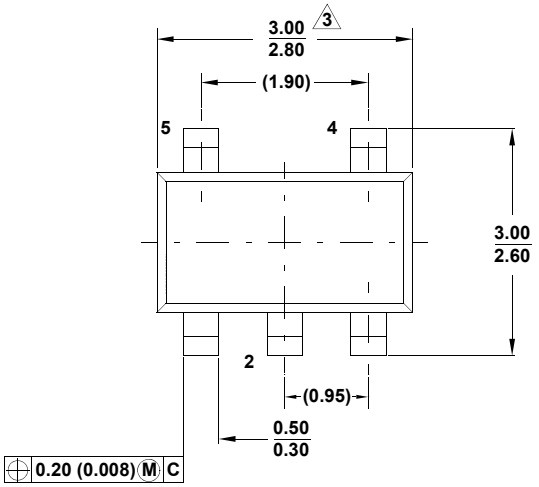
The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please visit our website to make sure you have the latest revision.

DATE	REVISION	CHANGE
Jan 25, 2019	FN8239.2	Added Related Literature section Updated the ordering information by removing parts, adding more columns, updating and adding applicable notes. Updated POD to the correct information. Added Revision History section Updated disclaimer.

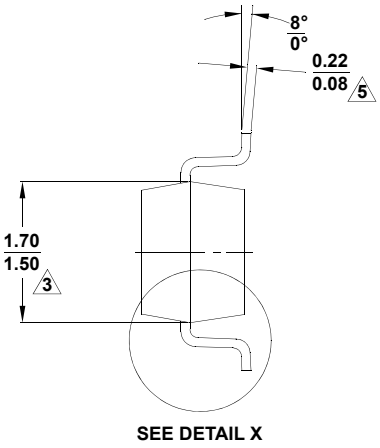
Package Outline Drawing

For the most recent package outline drawing, see P5.064.

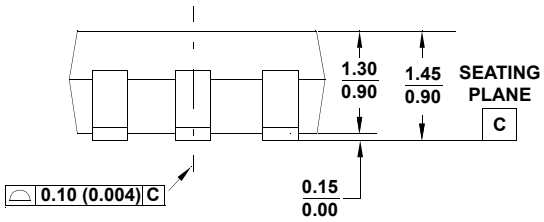
P5.064
5 LEAD SMALL OUTLINE TRANSISTOR PLASTIC PACKAGE
Rev 3, 4/11



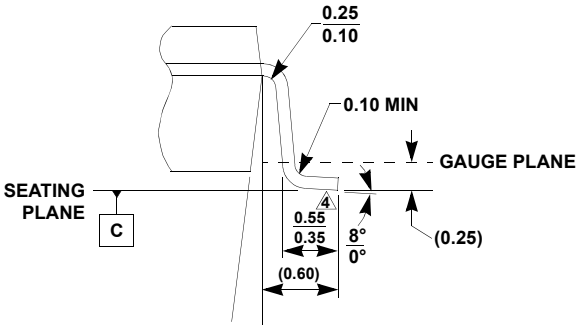
TOP VIEW



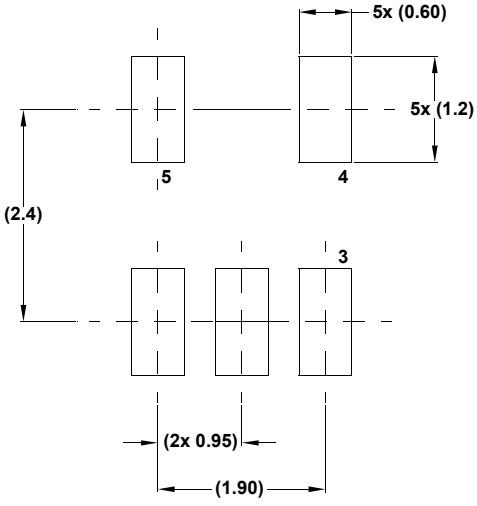
END VIEW



SIDE VIEW



DETAIL "X"



TYPICAL RECOMMENDED LAND PATTERN

NOTES:

1. Dimensioning and tolerance per ASME Y14.5M-1994.
2. Package conforms to EIAJ SC-74 and JEDEC MO178AA.
3. Package length and width are exclusive of mold flash, protrusions, or gate burrs.
4. Footlength measured at reference to gauge plane.
5. Lead thickness applies to the flat section of the lead between 0.08mm and 0.15mm from the lead tip.
6. Controlling dimension: MILLIMETER. Dimensions in ( ) for reference only.

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