DS90LV011AQ Automotive LVDS Differential Driver

Check for Samples: DS90LV011AQ

FEATURES

- **AECQ-100 Grade 1**
- **Conforms to TIA/EIA-644-A Standard**
- **>400Mbps (200MHz) Switching Rates**
- **700 ps (100 ps typical) Maximum Differential Skew**
- **1.5 ns Maximum Propagation Delay**
- **Single 3.3V Power Supply**
- **±350 mV Differential Signaling**
- **Power Off Protection (Outputs in TRI-STATE)**
- **Pinout Simplifies PCB Layout**
- **Low Power Dissipation (23 mW @ 3.3V Typical)**
- **SOT-23 5-Lead Package**
- **Pin Compatible with SN65LVDS1**

DESCRIPTION

The DS90LV011AQ is an LVDS driver optimized for high data rate and low power applications. The DS90LV011AQ is a current mode driver allowing power dissipation to remain low even at high frequency. In addition, the short circuit fault current is also minimized. The device is designed to support data rates in excess of 400Mbps (200MHz) utilizing Low Voltage Differential Signaling (LVDS) technology.

The device is offered in a 5-lead SOT-23 package. The LVDS outputs have been arranged for easy PCB layout. The differential driver outputs provide low EMI with its typical low output swing of 350 mV. The DS90LV011AQ can be paired with its companion single line receiver, the DS90LT012AQ, or with any of TI's LVDS receivers, to provide a high-speed LVDS interface.

Connection Diagram

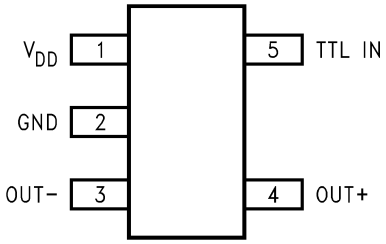
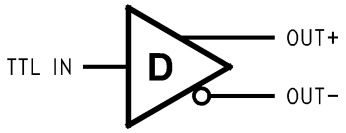


Figure 1. Top View
See Package Number MF05A

Functional Diagram



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings (1)(2)

Supply Voltage (V_{DD})	−0.3V to 4.0V
LVCMOS input voltage (TTL IN)	−0.3V to to (V_{DD} + 0.3V)
LVDS output voltage (OUT±)	−0.3V to +3.9V
LVDS output short circuit current	24mA
Maximum Package Power Dissipation @ +25°C	
DBV Package	794 mW
Derate DBV Package	7.22 mW/°C above +25°C
Package Thermal Resistance (4-Layer, 2 oz. Cu, JEDEC)	
θ_{JA}	138.5°C/Watt
θ_{JC}	107.0°C/Watt
Storage Temperature	−65°C to +150°C
Lead Temperature Range Soldering	
(4 sec.)	+260°C
Maximum Junction Temperature	+135°C
ESD Ratings	
HBM (3)	≥ 8kV
MM (4)	≥ 250V
CDM (5)	≥ 1250V

(1) Absolute Maximum Ratings are those values beyond which the safety of the device cannot be ensured. They are not meant to imply that the devices should be operated at these limits. Electrical Characteristics specifies conditions of device operation.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
(3) Human Body Model, applicable std. JESD22-A114C
(4) Machine Model, applicable std. JESD22-A115-A
(5) Field Induced Charge Device Model, applicable std. JESD22-C101-C

Recommended Operating Conditions

	Min	Typ	Max	Units
Supply Voltage (V_{DD})	3.0	3.3	3.6	V
Temperature (T_A)	−40	+25	+125	°C

Electrical Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified. (1)(2)(3)

Symbol	Parameter	Conditions	Pin	Min	Typ	Max	Units
$\|V_{OD}\|$	Output Differential Voltage	R_L = 100Ω (Figure 2 and Figure 3)	OUT+, OUT−	250	350	450	mV
ΔV_{OD}	V_{OD} Magnitude Change				3	35	mV
V_{OS}	Offset Voltage	R_L = 100Ω (Figure 2)		1.125	1.22	1.375	V
ΔV_{OS}	Offset Magnitude Change			0	1	25	mV
I_{OFF}	Power-off Leakage	V_{OUT} = 3.6V or GND, V_{DD} = 0V			±1	±10	µA
I_{OS}	Output Short Circuit Current (4)	V_{OUT+} and V_{OUT-} = 0V			−6	−24	mA
I_{OSD}	Differential Output Short Circuit Current (4)	V_{OD} = 0V			−5	−12	mA
C_{OUT}	Output Capacitance				3		pF

(1) Current into device pins is defined as positive. Current out of device pins is defined as negative. All voltages are referenced to ground except V_{OD}.
(2) All typicals are given for: V_{DD} = +3.3V and T_A = +25°C.
(3) The DS90LV011AQ is a current mode device and only function with datasheet specification when a resistive load is applied to the drivers outputs.
(4) Output short circuit current (I_{OS}) is specified as magnitude only, minus sign indicates direction only.

Electrical Characteristics (continued)

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified.(1)(2)(3)

Symbol	Parameter	Conditions		Pin	Min	Typ	Max	Units
V_{IH}	Input High Voltage			TTL IN	2.0		V_{DD}	V
V_{IL}	Input Low Voltage				GND		0.8	V
I_{IH}	Input High Current	V_{IN} = 3.3V or 2.4V				±2	±10	µA
I_{IL}	Input Low Current	V_{IN} = GND or 0.5V				±1	±10	µA
V_{CL}	Input Clamp Voltage	I_{CL} = −18 mA			−1.5	−0.6		V
C_{IN}	Input Capacitance					3		pF
I_{DD}	Power Supply Current	No Load	V_{IN} = V_{DD} or GND	V_{DD}		5	8	mA
		R_L = 100Ω				7	10	mA

Switching Characteristics

Over Supply Voltage and Operating Temperature Ranges, unless otherwise specified.(1)(2)(3)(4)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHLD}	Differential Propagation Delay High to Low	R_L = 100Ω, C_L = 15 pF	0.3	1.0	1.5	ns
t_{PLHD}	Differential Propagation Delay Low to High	(Figure 4 and Figure 5)	0.3	1.1	1.5	ns
t_{SKD1}	Differential Pulse Skew $\|t_{PHLD} - t_{PLHD}\|$ (5)		0	0.1	0.7	ns
t_{SKD3}	Differential Part to Part Skew (6)		0	0.2	1.0	ns
t_{SKD4}	Differential Part to Part Skew (7)		0	0.4	1.2	ns
t_{TLH}	Transition Low to High Time		0.2	0.5	1.0	ns
t_{THL}	Transition High to Low Time		0.2	0.5	1.0	ns
f_{MAX}	Maximum Operating Frequency (8)			250		MHz

(1) All typicals are given for: V_{DD} = +3.3V and T_A = +25°C.
(2) These parameters are ensured by design. The limits are based on statistical analysis of the device performance over PVT (process, voltage, temperature) ranges.
(3) C_L includes probe and fixture capacitance.
(4) Generator waveform for all tests unless otherwise specified: f = 1 MHz, Z_O = 50Ω, t_r ≤ 1 ns, t_f ≤ 1 ns (10%-90%).
(5) t_{SKD1}, $|t_{PHLD} - t_{PLHD}|$, is the magnitude difference in differential propagation delay time between the positive going edge and the negative going edge of the same channel.
(6) t_{SKD3}, Differential Part to Part Skew, is defined as the difference between the minimum and maximum specified differential propagation delays. This specification applies to devices at the same V_{DD} and within 5°C of each other within the operating temperature range.
(7) t_{SKD4}, part to part skew, is the differential channel to channel skew of any event between devices. This specification applies to devices over recommended operating temperature and voltage ranges, and across process distribution. t_{SKD4} is defined as |Max − Min| differential propagation delay.
(8) f_{MAX} generator input conditions: t_r = t_f < 1 ns (0% to 100%), 50% duty cycle, 0V to 3V. Output criteria: duty cycle = 45%/55%, V_{OD} > 250mV.

Parameter Measurement Information

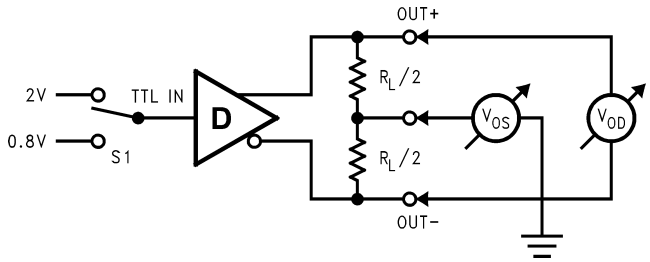


Figure 2. Differential Driver DC Test Circuit

Parameter Measurement Information (continued)

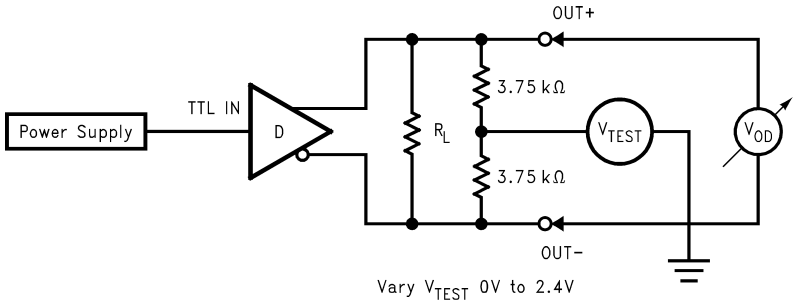


Figure 3. Differential Driver Full Load DC Test Circuit

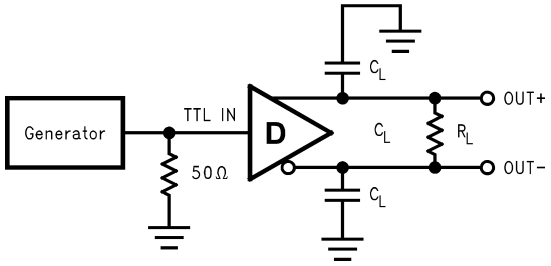


Figure 4. Differential Driver Propagation Delay and Transition Time Test Circuit

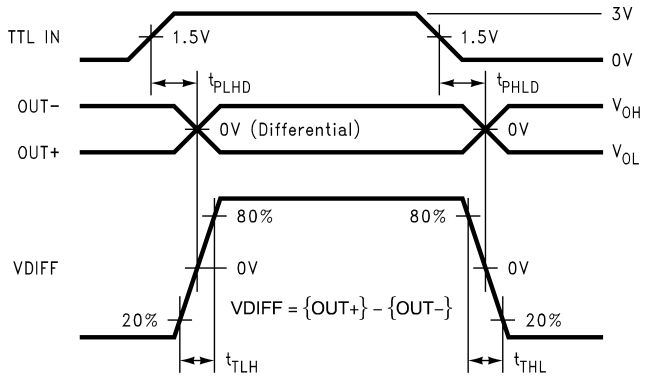


Figure 5. Differential Driver Propagation Delay and Transition Time Waveforms

APPLICATION INFORMATION

DEVICE PIN DESCRIPTIONS

Package Pin Number SOT-23	Pin Name	Description
5	TTL IN	LVTTL/LVCMOS driver input pins
4	OUT+	Non-inverting driver output pin
3	OUT−	Inverting driver output pin
2	GND	Ground pin
1	V_{DD}	Power supply pin, +3.3V ± 0.3V

REVISION HISTORY

Changes from Revision C (April 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format	4

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
DS90LV011AQMF/NOPB	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	N01Q
DS90LV011AQMF/NOPB.A	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	N01Q
DS90LV011AQMFE/NO.A	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	N01Q
DS90LV011AQMFE/NOPB	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	N01Q
DS90LV011AQMFX/NO.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	N01Q
DS90LV011AQMFX/NOPB	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	N01Q

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

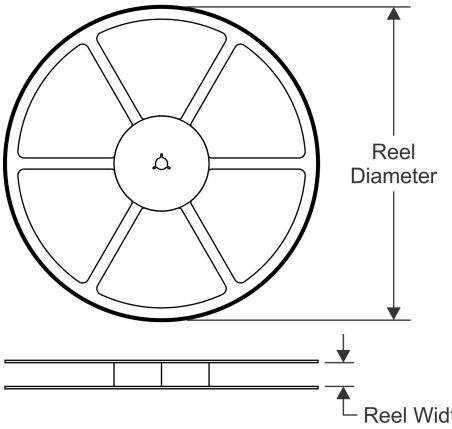
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

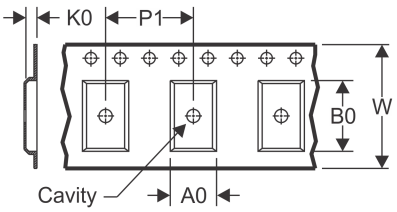
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

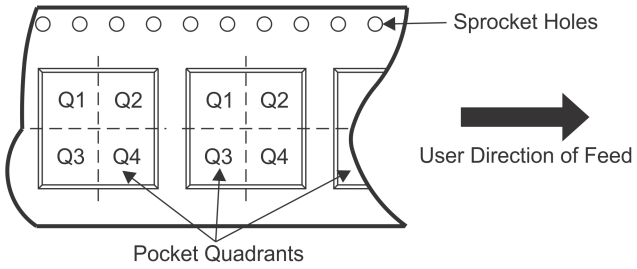


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

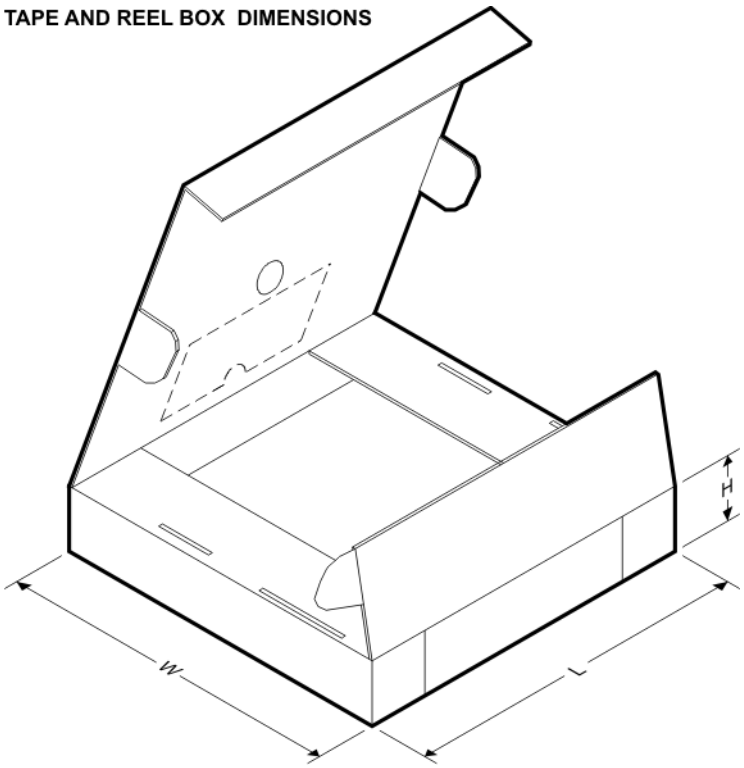
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DS90LV011AQMF/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
DS90LV011AQMFE/NOPB	SOT-23	DBV	5	250	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
DS90LV011AQMFX/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

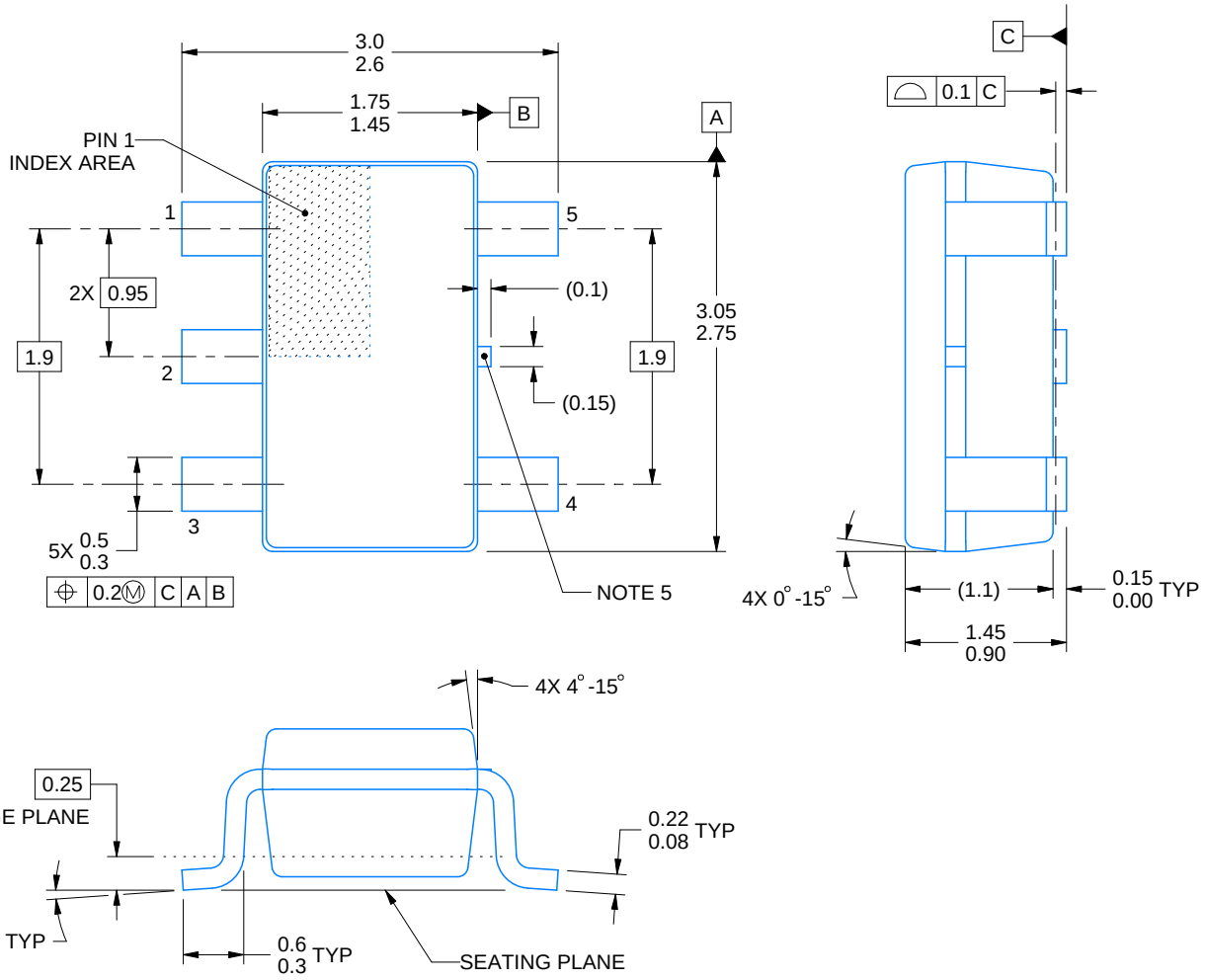
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS90LV011AQMF/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
DS90LV011AQMFE/NOPB	SOT-23	DBV	5	250	210.0	185.0	35.0
DS90LV011AQMFX/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0

PACKAGE OUTLINE

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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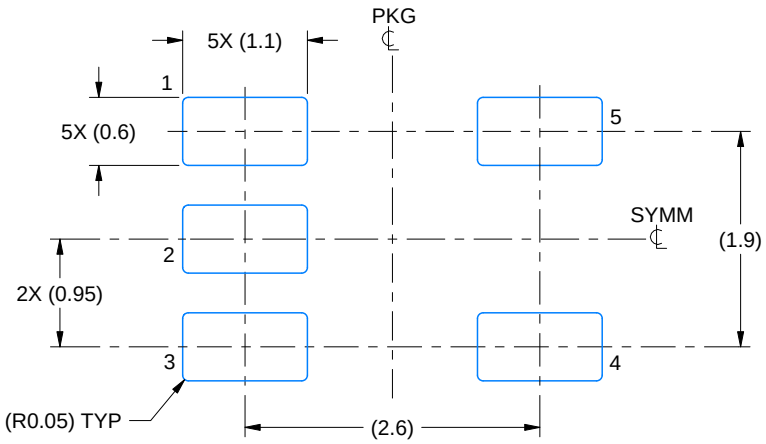
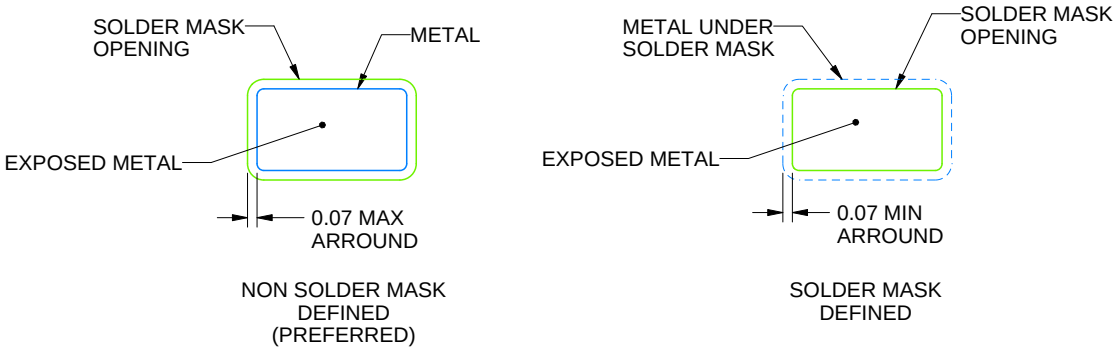
NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Refernce JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

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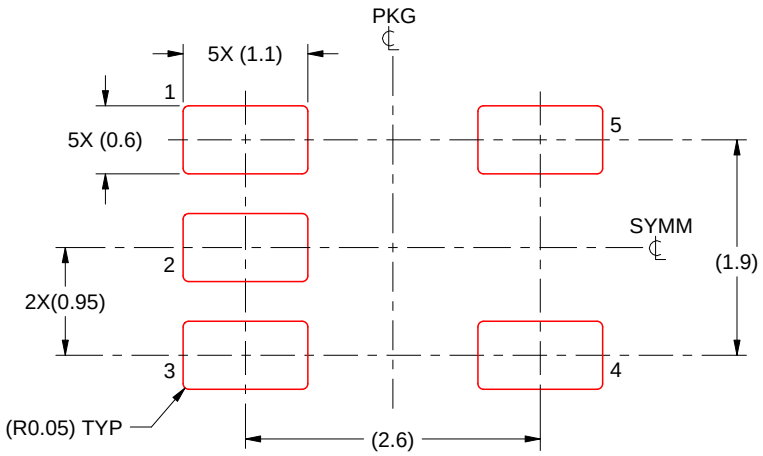
NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265