

## DS92LV090A 9 Channel Bus LVDS Transceiver

Check for Samples: [DS92LV090A](#)

### FEATURES

- Bus LVDS Signaling
- 3.2 Nanosecond Propagation Delay Max
- Chip to Chip Skew  $\pm 800\text{ps}$
- Low Power CMOS Design
- High Signaling Rate Capability (Above 100 Mbps)
- 0.1V to 2.3V Common Mode Range for  $V_{ID} = 200\text{mV}$
- $\pm 100\text{ mV}$  Receiver Sensitivity
- Supports Open and Terminated Failsafe on Port Pins
- 3.3V Operation
- Glitch Free Power Up/Down (Driver & Receiver Disabled)
- Light Bus Loading (5 pF Typical) per Bus LVDS Load
- Designed for Double Termination Applications
- Balanced Output Impedance
- Product Offered in 64 Pin LQFP Package
- High Impedance Bus Pins on Power off ( $V_{CC} = 0\text{V}$ )
- Driver Channel to Channel Skew (Same Device) 230ps Typical
- Receiver Channel to Channel Skew (Same Device) 370ps Typical

### DESCRIPTION

The DS92LV090A is one in a series of Bus LVDS transceivers designed specifically for the high speed, low power proprietary backplane or cable interfaces. The device operates from a single 3.3V power supply and includes nine differential line drivers and nine receivers. To minimize bus loading, the driver outputs and receiver inputs are internally connected. The separate I/O of the logic side allows for loop back support. The device also features a flow through pin out which allows easy PCB routing for short stubs between its pins and the connector.

The driver translates 3V TTL levels (single-ended) to differential Bus LVDS (BLVDS) output levels. This allows for high speed operation, while consuming minimal power with reduced EMI. In addition, the differential signaling provides common mode noise rejection of  $\pm 1\text{V}$ .

The receiver threshold is less than  $\pm 100\text{ mV}$  over a  $\pm 1\text{V}$  common mode range and translates the differential Bus LVDS to standard (TTL/CMOS) levels. (See [Applications Information](#) Section for more details.)

### Simplified Functional Diagram

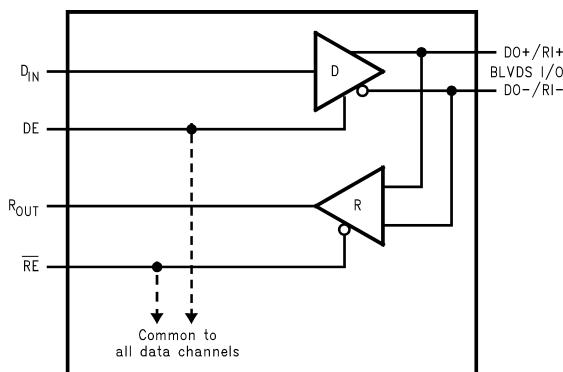


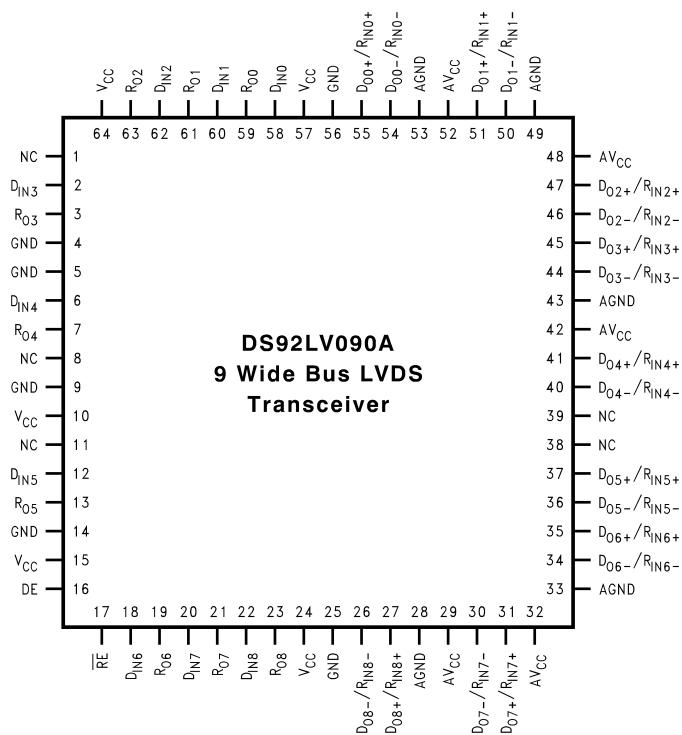
Figure 1.



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## Connection Diagram



**Figure 2. Top View  
Package Number PM0064**

## PIN DESCRIPTIONS

Pin Name	Pin #	Input/Output	Descriptions
DO+/RI+	27, 31, 35, 37, 41, 45, 47, 51, 55	I/O	True Bus LVDS Driver Outputs and Receiver Inputs.
DO-/RI-	26, 30, 34, 36, 40, 44, 46, 50, 54	I/O	Complimentary Bus LVDS Driver Outputs and Receiver Inputs.
D <sub>IN</sub>	2, 6, 12, 18, 20, 22, 58, 60, 62	I	TTL Driver Input.
RO	3, 7, 13, 19, 21, 23, 59, 61, 63	O	TTL Receiver Output.
RE	17	I	Receiver Enable TTL Input (Active Low).
DE	16	I	Driver Enable TTL Input (Active High).
GND	4, 5, 9, 14, 25, 56	Power	Ground for digital circuitry (must connect to GND on PC board). These pins connected internally.
V <sub>CC</sub>	10, 15, 24, 57, 64	Power	V <sub>CC</sub> for digital circuitry (must connect to V <sub>CC</sub> on PC board). These pins connected internally.
AGND	28, 33, 43, 49, 53	Power	Ground for analog circuitry (must connect to GND on PC board). These pins connected internally.
AV <sub>CC</sub>	29, 32, 42, 48, 52	Power	Analog V <sub>CC</sub> (must connect to V <sub>CC</sub> on PC board). These pins connected internally.
NC	1, 8, 11, 38, 39	N/A	Leave open circuit, do not connect.



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 <sup>(1)(2)(3)</sup>**

Supply Voltage ( $V_{CC}$ )		4.0V
Enable Input Voltage (DE, $\overline{RE}$ )		–0.3V to ( $V_{CC}$ +0.3V)
Driver Input Voltage ( $D_{IN}$ )		–0.3V to ( $V_{CC}$ +0.3V)
Receiver Output Voltage ( $R_{OUT}$ )		–0.3V to ( $V_{CC}$ +0.3V)
Bus Pin Voltage (DO/RI $\pm$ )		–0.3V to +3.9V
ESD (HBM 1.5 k $\Omega$ , 100 pF)		>4.5 kV
Driver Short Circuit Duration		momentary
Receiver Short Circuit Duration		momentary
Maximum Package Power Dissipation at 25°C	LQFP	1.74 W
	Derate LQFP Package	13.9 mW/°C
	$\theta_{ja}$	71.7°C/W
	$\theta_{jc}$	10.9°C/W
Junction Temperature		+150°C
Storage Temperature Range		–65°C to +150°C
Lead Temperature (Soldering, 4 sec.)		260°C

- (1) All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to ground unless otherwise specified except  $V_{OD}$ ,  $\Delta V_{OD}$  and  $V_{ID}$ .
- (2) "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. The table of "Electrical Characteristics" provides conditions for actual device operation.
- (3) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.

**Recommended Operating Conditions**

	Min	Max	Units
Supply Voltage ( $V_{CC}$ )	3.0	3.6	V
Receiver Input Voltage	0.0	2.4	V
Operating Free Air Temperature	–40	+85	°C
Maximum Input Edge Rate (20% to 80%) <sup>(1)</sup>			$\Delta t/\Delta V$
Data		1.0	ns/V
Control		3.0	ns/V

- (1) Generator waveforms for all tests unless otherwise specified:  $f = 25$  MHz,  $Z_0 = 50\Omega$ ,  $t_r, t_f = <1.0$  ns (0%–100%). To ensure fastest propagation delay and minimum skew, data input edge rates should be equal to or faster than 1ns/V; control signals equal to or faster than 3ns/V. In general, the faster the input edge rate, the better the AC performance.

## DC Electrical Characteristics

Over recommended operating supply voltage and temperature ranges unless otherwise specified <sup>(1)(2)</sup>

Symbol	Parameter	Conditions	Pin	Min	Typ	Max	Unit s	
$V_{OD}$	Output Differential Voltage	$R_L = 27\Omega$ , Figure 3	DO+/RI+, DO-/RI-	240	300	460	mV	
$\Delta V_{OD}$	$V_{OD}$ Magnitude Change					27	mV	
$V_{OS}$	Offset Voltage			1.1	1.3	1.5	V	
$\Delta V_{OS}$	Offset Magnitude Change				5	10	mV	
$V_{OH}$	Driver Output High Voltage <sup>(3)</sup>				1.4	1.65	V	
$V_{OL}$	Driver Output Low Voltage <sup>(3)</sup>			0.95	1.1		V	
$I_{OSD}$	Output Short Circuit Current <sup>(4)</sup>	$V_{OD} = 0V$ , DE = $V_{CC}$ , Driver outputs shorted together			36	65	mA	
$V_{OH}$	Voltage Output High <sup>(5)</sup>	$V_{ID} = +300$ mV Inputs Open Inputs Terminated, $R_L = 27\Omega$	$R_{OUT}$	$V_{CC}-0.2$			V	
$V_{OL}$	Voltage Output Low	$I_{OL} = 2.0$ mA, $V_{ID} = -300$ mV		$V_{CC}-0.2$			V	
$I_{OD}$	Receiver Output Dynamic Current <sup>(4)</sup>	$V_{ID} = 300$ mV, $V_{OUT} = V_{CC}-1.0$ V $V_{ID} = -300$ mV, $V_{OUT} = 1.0$ V		$V_{CC}-0.2$			V	
$V_{TH}$	Input Threshold High	DE = 0V, $V_{CM} = 1.5$ V	DO+/RI+, DO-/RI-			+100	mV	
$V_{TL}$	Input Threshold Low			-100			mV	
$V_{CMR}$	Receiver Common Mode Range			$ V_{ID} /2$		$2.4 -  V_{ID} /2$	V	
$I_{IN}$	Input Current	$DE = 0V$ , $\bar{RE} = 2.4$ V, $V_{IN} = +2.4$ V or 0V $V_{CC} = 0V$ , $V_{IN} = +2.4$ V or 0V		-20	$\pm 1$	+20	$\mu A$	
$V_{IH}$	Minimum Input High Voltage	-20		$\pm 1$	+20	$\mu A$		
$V_{IL}$	Maximum Input Low Voltage	2.0			$V_{CC}$	V		
$I_{IH}$	Input High Current	$V_{IN} = V_{CC}$ or 2.4V	$D_{IN}$ , DE, $\bar{RE}$	GND		0.8	V	
$I_{IL}$	Input Low Current	$V_{IN} = GND$ or 0.4V		-20	$\pm 10$	+20	$\mu A$	
$V_{CL}$	Input Diode Clamp Voltage	$I_{CLAMP} = -18$ mA		-20	$\pm 10$	+20	$\mu A$	
$I_{CCD}$	Power Supply Current Drivers Enabled, Receivers Disabled	$No Load$ , $DE = \bar{RE} = V_{CC}$ , $DIN = V_{CC}$ or GND		-1.5	-0.8		V	
$I_{CCR}$	Power Supply Current Drivers Disabled, Receivers Enabled	$DE = \bar{RE} = 0V$ , $V_{ID} = \pm 300$ mV			55	80	mA	
$I_{CCZ}$	Power Supply Current, Drivers and Receivers TRI-STATE	$DE = 0V$ ; $\bar{RE} = V_{CC}$ , $DIN = V_{CC}$ or GND			73	80	mA	
$I_{CC}$	Power Supply Current, Drivers and Receivers Enabled	$DE = V_{CC}$ ; $\bar{RE} = 0V$ , $DIN = V_{CC}$ or GND, $R_L = 27\Omega$	$V_{CC}$		35	80	mA	
$I_{OFF}$	Power Off Leakage Current	$V_{CC} = 0V$ or OPEN, $D_{IN}$ , DE, $\bar{RE} = 0V$ or OPEN, $V_{APPLIED} = 3.6$ V (Port Pins)		-20		170	210	mA
$C_{OUTPUT}$	Capacitance @ Bus Pins		DO+/RI+, DO-/RI-			5		$pF$
$C_{OUTPUT}$	Capacitance @ $R_{OUT}$		$R_{OUT}$			7		$pF$

(1) All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to ground unless otherwise specified except  $V_{OD}$ ,  $\Delta V_{OD}$  and  $V_{ID}$ .

(2) All typicals are given for  $V_{CC} = +3.3$ V and  $T_A = +25^\circ C$ , unless otherwise stated.

(3) The DS92LV090A functions within datasheet specification when a resistive load is applied to the driver outputs.

(4) Only one output at a time should be shorted, do not exceed maximum package power dissipation capacity.

(5)  $V_{OH}$  failsafe terminated test performed with  $27\Omega$  connected between RI+ and RI- inputs. No external voltage is applied.

## AC Electrical Characteristics

Over recommended operating supply voltage and temperature ranges unless otherwise specified <sup>(1)</sup>

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>DIFFERENTIAL DRIVER TIMING REQUIREMENTS</b>						
$t_{PHLD}$	Differential Prop. Delay High to Low <sup>(2)</sup>	$R_L = 27\Omega$ , <a href="#">Figure 4</a> , <a href="#">Figure 5</a> , $C_L = 10\text{ pF}$	0.6	1.4	2.2	ns
$t_{PLHD}$	Differential Prop. Delay Low to High <sup>(2)</sup>		0.6	1.4	2.2	ns
$t_{SKD1}$	Differential Skew $ t_{PHLD} - t_{PLHD} $ <sup>(3)</sup>		80			ps
$t_{SKD2}$	Chip to Chip Skew <sup>(4)</sup>				1.6	ns
$t_{SKD3}$	Channel to Channel Skew <sup>(5)</sup>			0.25	0.45	ns
$t_{TLH}$	Transition Time Low to High			0.6	1.2	ns
$t_{THL}$	Transition Time High to Low			0.5	1.2	ns
$t_{PHZ}$	Disable Time High to Z	$R_L = 27\Omega$ , <a href="#">Figure 6</a> , <a href="#">Figure 7</a> , $C_L = 10\text{ pF}$		3	8	ns
$t_{PLZ}$	Disable Time Low to Z			3	8	ns
$t_{PZH}$	Enable Time Z to High			3	8	ns
$t_{PZL}$	Enable Time Z to Low			3	8	ns
<b>DIFFERENTIAL RECEIVER TIMING REQUIREMENTS</b>						
$t_{PHLD}$	Differential Prop. Delay High to Low <sup>(2)</sup>	<a href="#">Figure 8</a> , <a href="#">Figure 9</a> , $C_L = 35\text{ pF}$	1.6	2.4	3.2	ns
$t_{PLHD}$	Differential Prop Delay Low to High <sup>(2)</sup>		1.6	2.4	3.2	ns
$t_{SDK1}$	Differential Skew $ t_{PHLD} - t_{PLHD} $ <sup>(3)</sup>		80			ps
$t_{SDK2}$	Chip to Chip Skew <sup>(4)</sup>				1.6	ns
$t_{SDK3}$	Channel to Channel Skew <sup>(5)</sup>			0.35	0.60	ns
$t_{TLH}$	Transition Time Low to High			1.5	2.5	ns
$t_{THL}$	Transition Time High to Low			1.5	2.5	ns
$t_{PHZ}$	Disable Time High to Z	$R_L = 500\Omega$ , <a href="#">Figure 10</a> , <a href="#">Figure 11</a> , $C_L = 35\text{ pF}$		4.5	10	ns
$t_{PLZ}$	Disable Time Low to Z			3.5	8	ns
$t_{PZH}$	Enable Time Z to High			3.5	8	ns
$t_{PZL}$	Enable Time Z to Low			3.5	8	ns

- (1) Generator waveforms for all tests unless otherwise specified:  $f = 25\text{ MHz}$ ,  $Z_O = 50\Omega$ ,  $t_r, t_f = <1.0\text{ ns}$  (0%–100%). To ensure fastest propagation delay and minimum skew, data input edge rates should be equal to or faster than  $1\text{ ns/V}$ ; control signals equal to or faster than  $3\text{ ns/V}$ . In general, the faster the input edge rate, the better the AC performance.
- (2) Propagation delays are specified by design and characterization.
- (3)  $t_{SKD1}$   $|t_{PHLD} - t_{PLHD}|$  is the worse case skew between any channel and any device over recommended operation conditions.
- (4) Chip to Chip skew is the difference in differential propagation delay between any channels of any devices, either edge.
- (5) Channel to Channel skew is the difference in driver output or receiver output propagation delay between any channels within a device, either edge.

## APPLICATIONS INFORMATION

General application guidelines and hints may be found in the following application notes: AN-808 ([SNLA028](#)), AN-903 ([SNLA034](#)), AN-971 ([SNLA165](#)), AN-977 ([SNLA166](#)), and AN-1108 ([SNLA008](#)).

There are a few common practices which should be implied when designing PCB for Bus LVDS signaling. Recommended practices are:

- Use at least 4 PCB board layer (Bus LVDS signals, ground, power and TTL signals).
- Keep drivers and receivers as close to the (Bus LVDS port side) connector as possible.
- Bypass each Bus LVDS device and also use distributed bulk capacitance between power planes. Surface mount capacitors placed close to power and ground pins work best. Two or three high frequency, multi-layer ceramic (MLC) surface mount (0.1  $\mu$ F, 0.01  $\mu$ F, 0.001  $\mu$ F) in parallel should be used between each  $V_{CC}$  and ground. The capacitors should be as close as possible to the  $V_{CC}$  pin.
  - Multiple vias should be used to connect  $V_{CC}$  and Ground planes to the pads of the by-pass capacitors.
  - In addition, randomly distributed by-pass capacitors should be used.
- Use the termination resistor which best matches the differential impedance of your transmission line.
- Leave unused Bus LVDS receiver inputs open (floating). Limit traces on unused inputs to <0.5 inches.
- Isolate TTL signals from Bus LVDS signals

### MEDIA (CONNECTOR or BACKPLANE) SELECTION:

- Use controlled impedance media. The backplane and connectors should have a matched differential impedance.

**Table 1. Functional Table**

MODE SELECTED	DE	$\overline{RE}$
DRIVER MODE	H	H
RECEIVER MODE	L	L
TRI-STATE MODE	L	H
LOOP BACK MODE	H	L

**Table 2. Transmitter Mode**

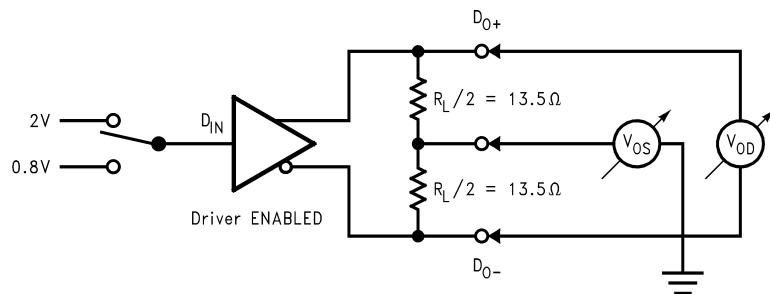
INPUTS		OUTPUTS	
DE	$D_{IN}$	$DO+$	$DO-$
H	L	L	H
H	H	H	L
H	$0.8V < D_{IN} < 2.0V$	X	X
L	X	Z	Z

**Table 3. Receiver Mode<sup>(1)</sup>**

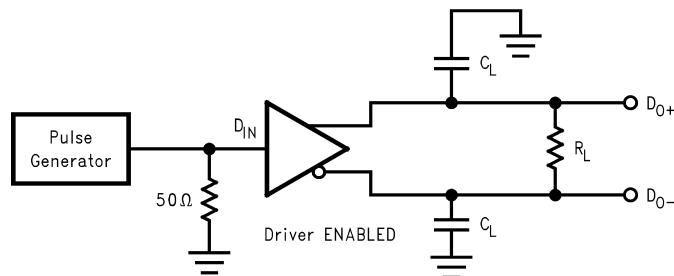
INPUTS		OUTPUT
$\overline{RE}$	$(RI+) - (RI-)$	
L	$L (< -100 \text{ mV})$	L
L	$H (> +100 \text{ mV})$	H
L	$-100 \text{ mV} < V_{ID} < +100 \text{ mV}$	X
H	X	Z

(1) X = High or Low logic state  
 L = Low state  
 Z = High impedance state  
 H = High state

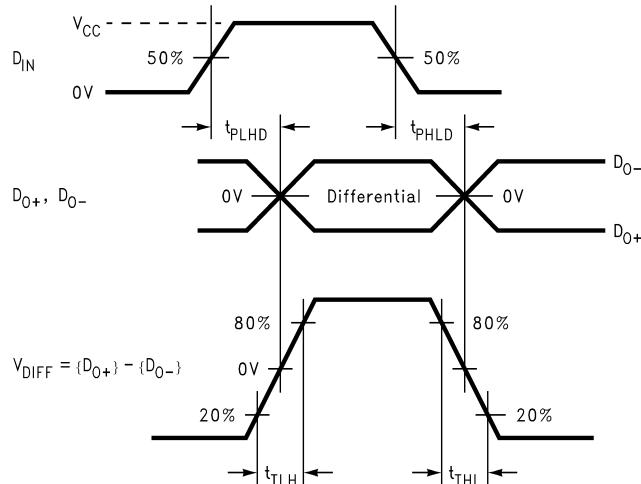
## Test Circuits and Timing Waveforms



**Figure 3. Differential Driver DC Test Circuit**



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



**Figure 5. Differential Driver Propagation Delay and Transition Time Waveforms**

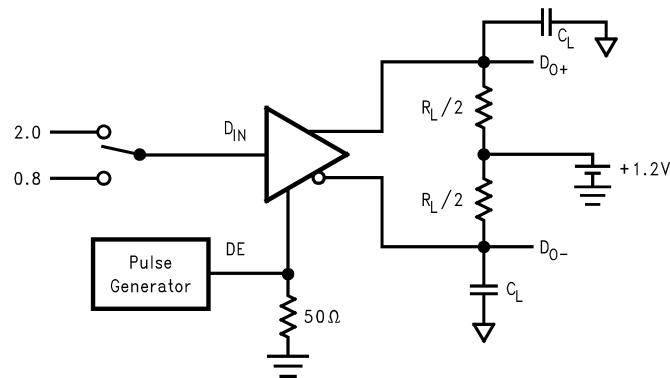


Figure 6. Driver TRI-STATE Delay Test Circuit

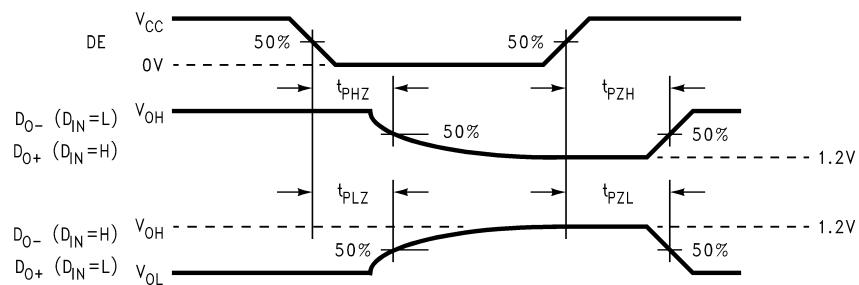


Figure 7. Driver TRI-STATE Delay Waveforms

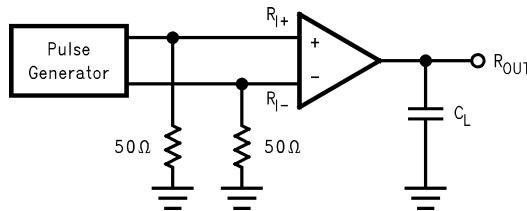


Figure 8. Receiver Propagation Delay and Transition Time Test Circuit

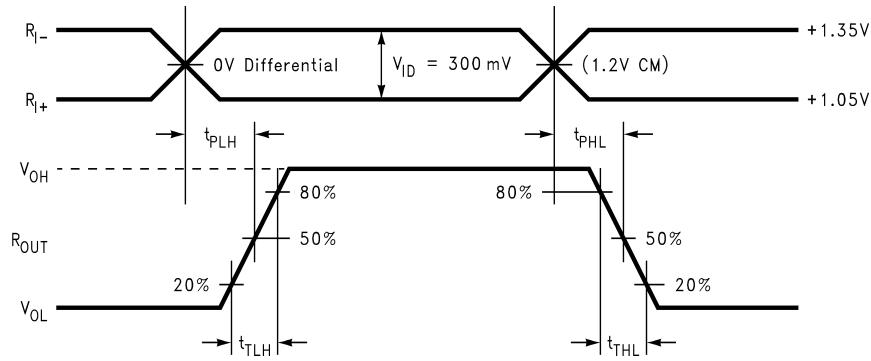
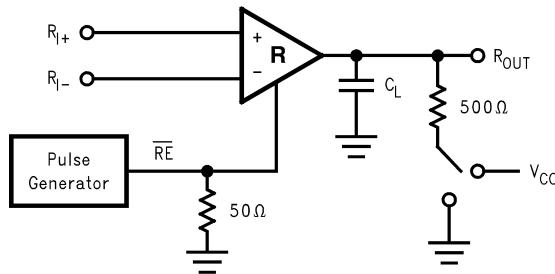
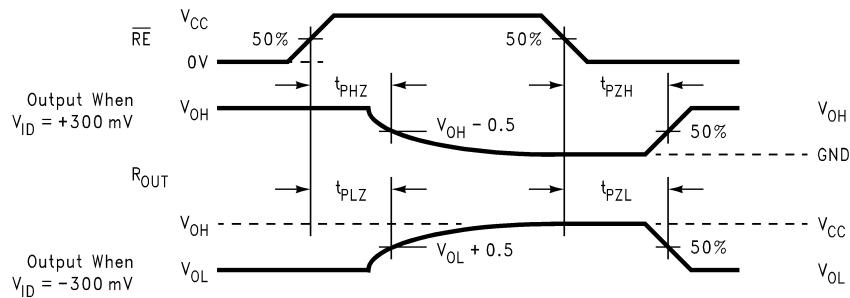


Figure 9. Receiver Propagation Delay and Transition Time Waveforms

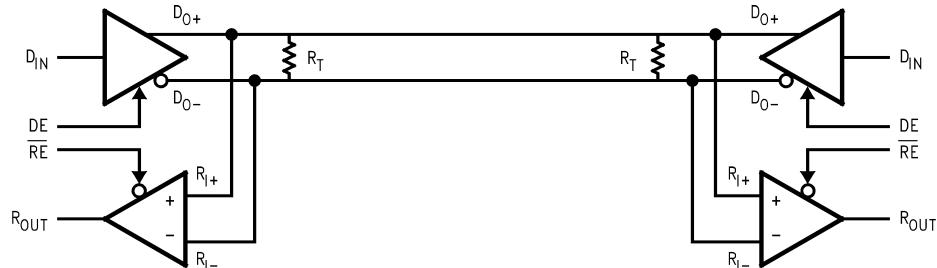


**Figure 10. Receiver TRI-STATE Delay Test Circuit**

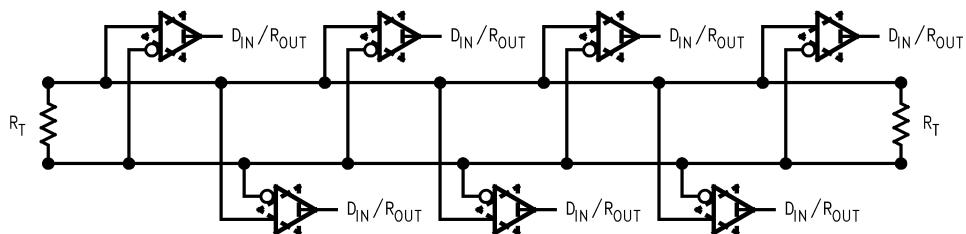


**Figure 11. Receiver TRI-STATE Delay Waveforms**

### Typical Bus Application Configurations



**Figure 12. Bi-Directional Half-Duplex Point-to-Point Applications**



**Figure 13. Multi-Point Bus Applications**

## REVISION HISTORY

Changes from Revision C (April 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format .....	9

**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)
DS92LV090ATVEH/NO.A	Active	Production	LQFP (PM)   64	160   JEDEC TRAY (10+1)	Yes	SN	Level-3-260C-168 HR	-40 to 85	DS92LV090A TVEH
DS92LV090ATVEH/NOPB	Active	Production	LQFP (PM)   64	160   JEDEC TRAY (10+1)	Yes	SN	Level-3-260C-168 HR	-40 to 85	DS92LV090A TVEH
DS92LV090ATVEHX/NO.A	Active	Production	LQFP (PM)   64	1000   LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 85	DS92LV090A TVEH
DS92LV090ATVEHX/NOPB	Active	Production	LQFP (PM)   64	1000   LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 85	DS92LV090A TVEH

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **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.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

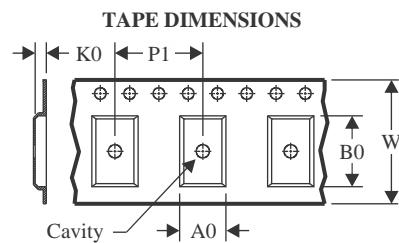
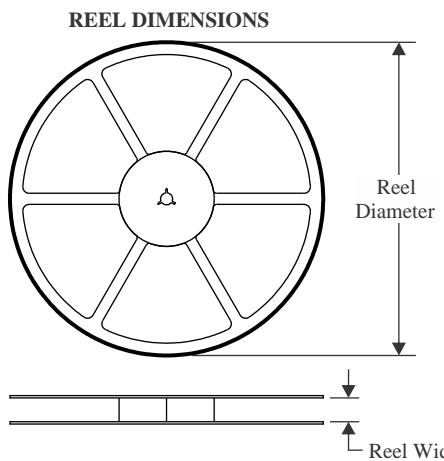
<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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.

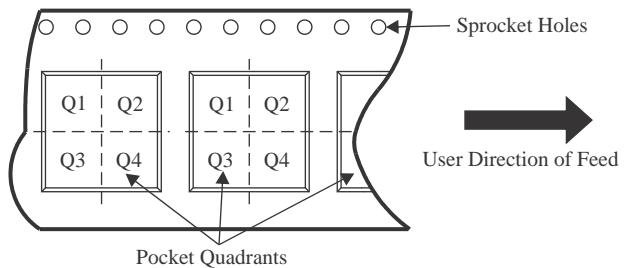
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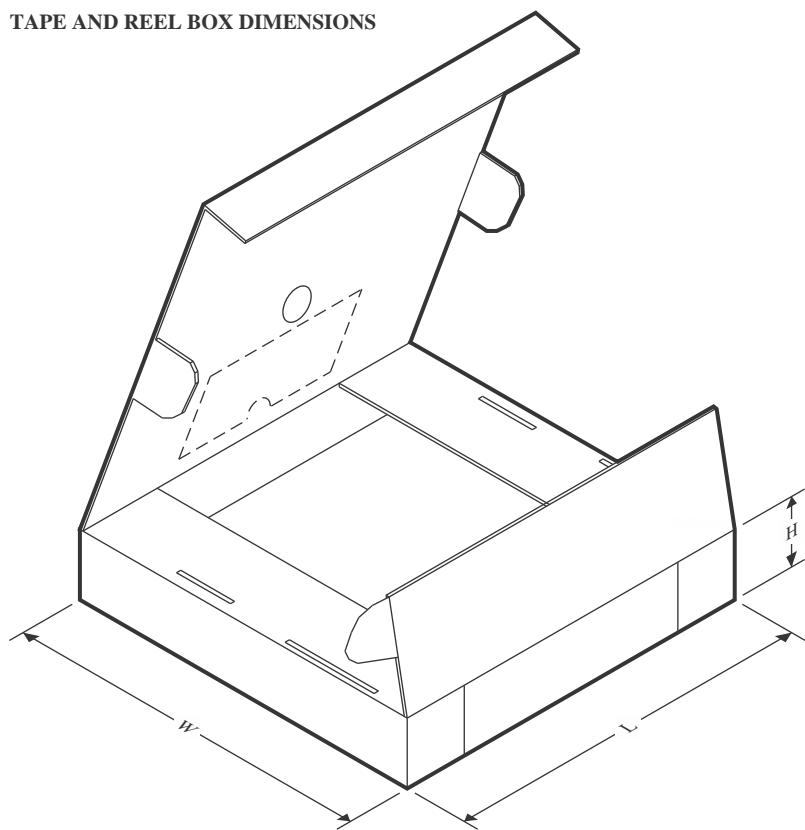
**TAPE AND REEL INFORMATION**


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**


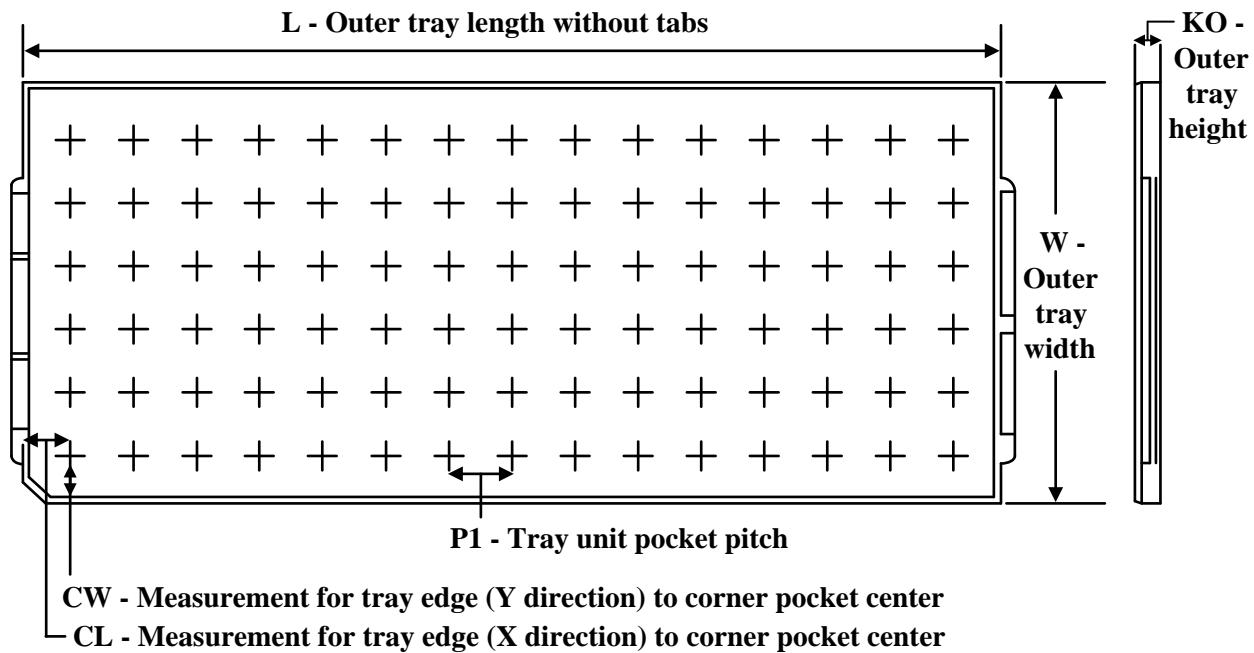
\*All dimensions are nominal

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
DS92LV090ATVEHX/ NOPB	LQFP	PM	64	1000	330.0	24.4	12.35	12.35	2.2	16.0	24.0	Q2

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS92LV090ATVEHX/ NOPB	LQFP	PM	64	1000	356.0	356.0	45.0

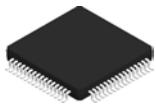
**TRAY**


Chamfer on Tray corner indicates Pin 1 orientation of packed units.

\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (μm)	P1 (mm)	CL (mm)	CW (mm)
DS92LV090ATVEH/NO.A	PM	LQFP	64	160	8 X 20	150	322.6	135.9	7620	15.2	13.1	13
DS92LV090ATVEH/NOPB	PM	LQFP	64	160	8 X 20	150	322.6	135.9	7620	15.2	13.1	13

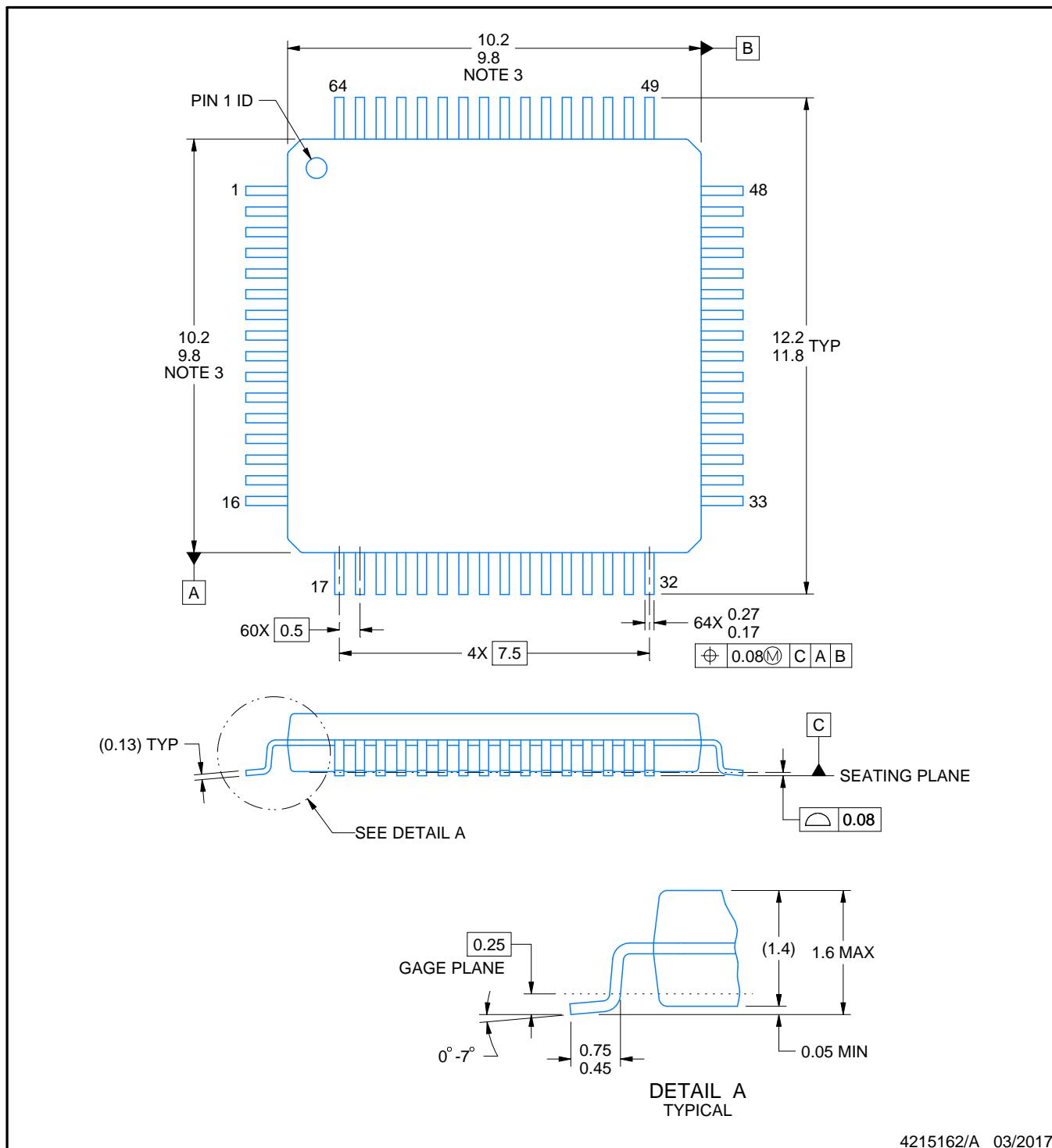
PM0064A



# PACKAGE OUTLINE

LQFP - 1.6 mm max height

PLASTIC QUAD FLATPACK



## NOTES:

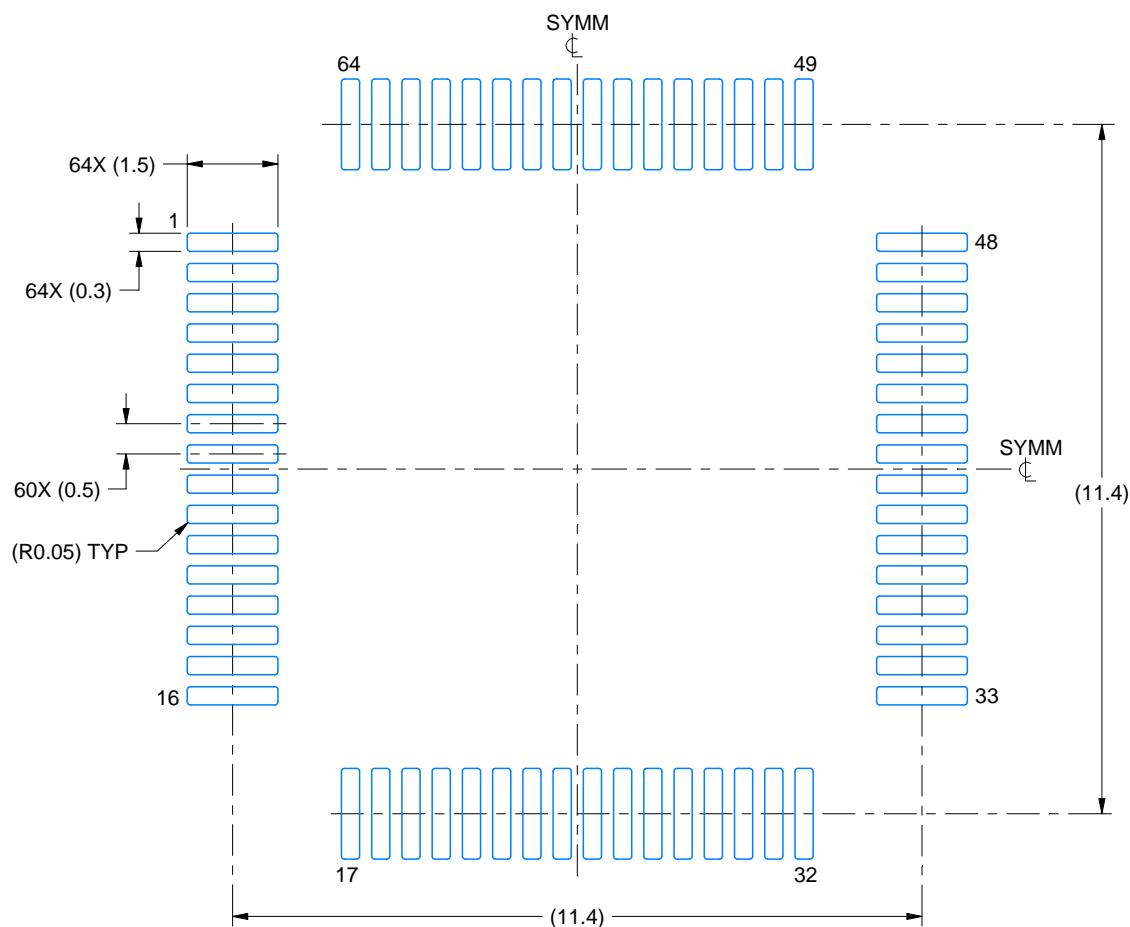
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MS-026.

## EXAMPLE BOARD LAYOUT

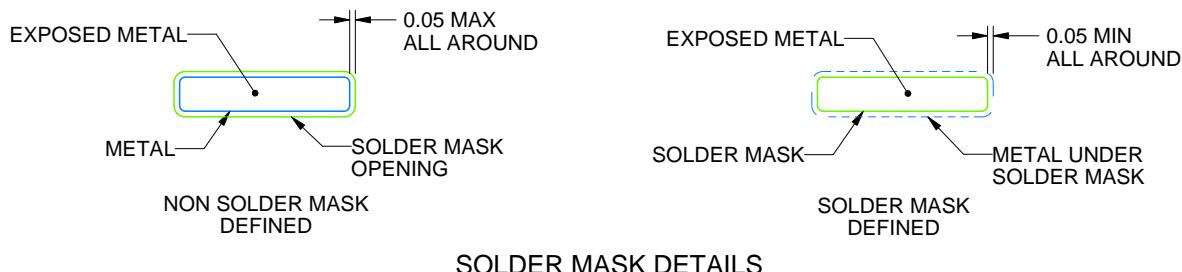
**PM0064A**

## LQFP - 1.6 mm max height

## PLASTIC QUAD FLATPACK



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:8X



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**NOTES: (continued)**

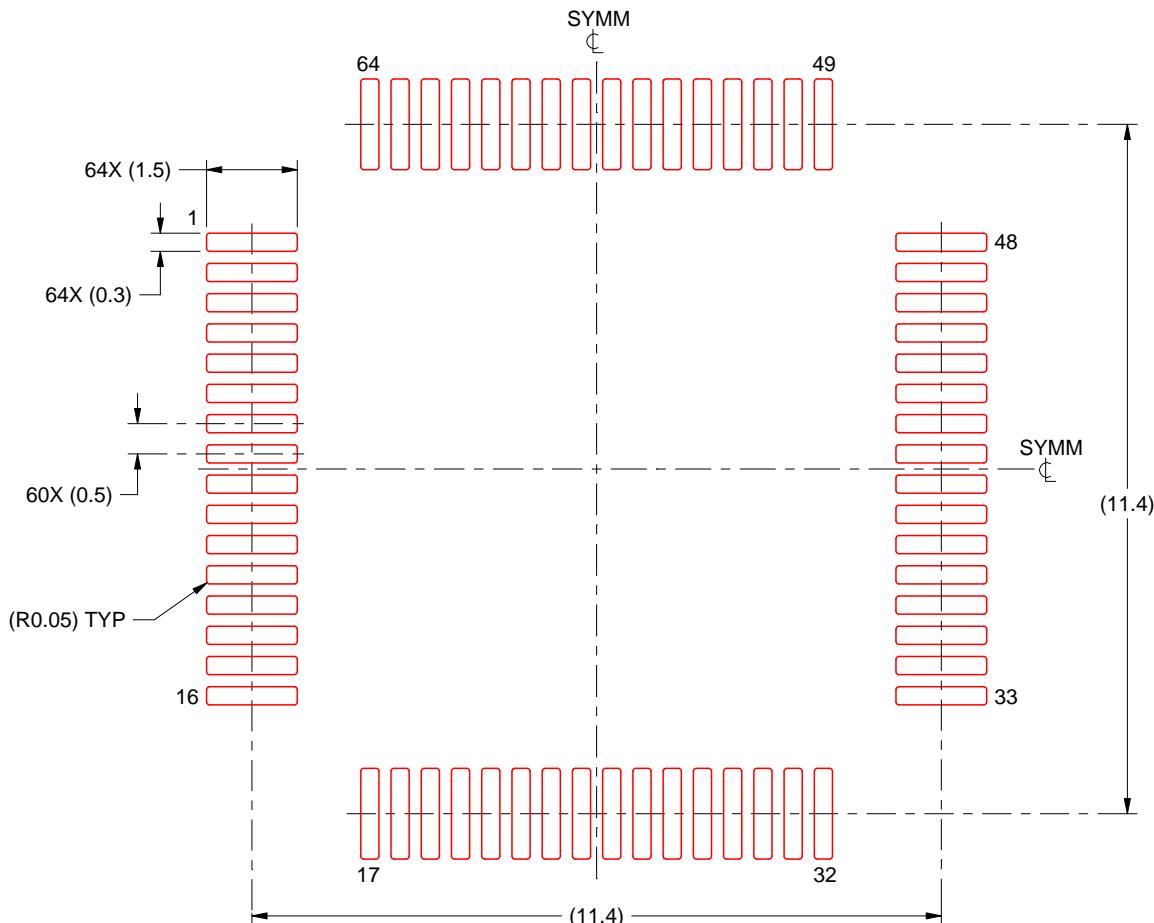
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
7. For more information, see Texas Instruments literature number SLMA004 ([www.ti.com/lit/slma004](http://www.ti.com/lit/slma004)).

# EXAMPLE STENCIL DESIGN

PM0064A

LQFP - 1.6 mm max height

PLASTIC QUAD FLATPACK



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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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Last updated 10/2025