



# 1:9 Differential LVPECL/LVECL/HSTL Clock and Data Driver

MAX9326

## General Description

The MAX9326 low-skew, 1:9 differential driver features extremely low output-to-output skew (50ps max) and part-to-part skew (225ps max). These features make the device ideal for clock and data distribution across a backplane or board. The device repeats an HSTL or LVECL/LVPECL differential input at nine differential outputs. Outputs are compatible with LVECL and LVPECL, and directly drive 50Ω terminated transmission lines.

The differential inputs can be configured to accept a single-ended signal when the unused complementary input is connected to the on-chip reference output voltage V<sub>BB</sub>. All inputs have internal pulldown resistors to V<sub>EE</sub>. The internal pulldowns and a fail-safe circuit ensure differential low default outputs when the inputs are left open or at V<sub>EE</sub>.

The MAX9326 operates over a +2.375V to +3.8V supply range for interfacing to differential HSTL and LVPECL signals. This allows high-performance clock or data distribution in systems with a nominal +2.5V or +3.3V supply. For LVECL operation, the device operates with a -2.375V to -3.8V supply.

The MAX9326 is offered in 28-lead PLCC and space-saving 28-lead QFN packages. The MAX9326 is specified for operation from -40°C to +85°C.

## Applications

- Precision Clock Distribution
- Low-Jitter Data Repeaters

## Features

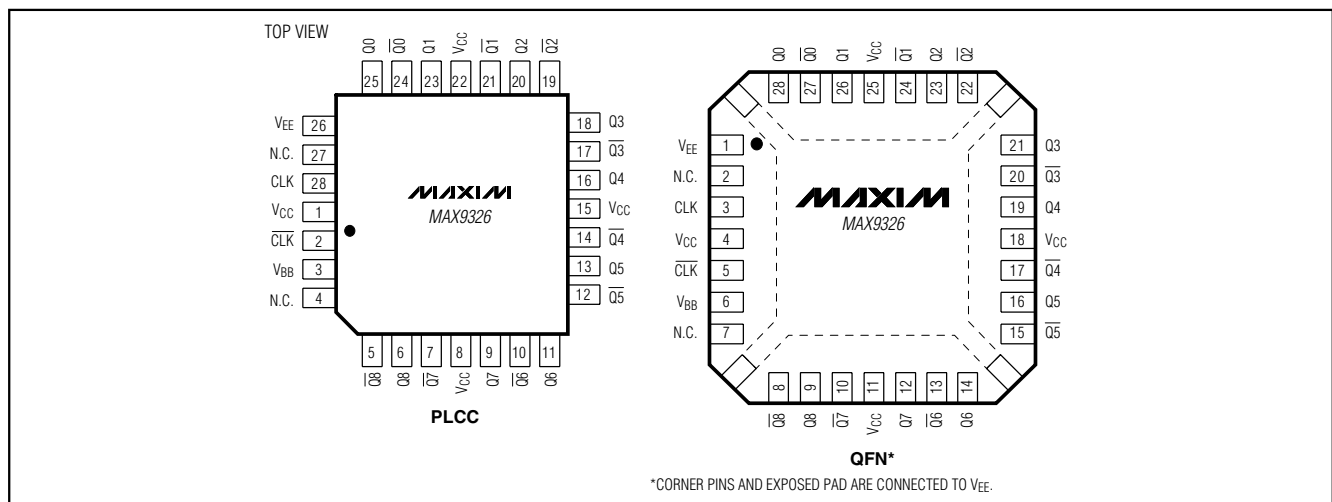
- ◆ 50ps (max) Output-to-Output Skew
- ◆ 1.5ps<sub>RMS</sub> (max) Random Jitter
- ◆ Guaranteed 300mV Differential Output at 1.0GHz
- ◆ +2.375V to +3.8V Supplies for Differential HSTL/LVPECL
- ◆ -2.375V to -3.8V Supplies for Differential LVECL
- ◆ On-Chip Reference for Single-Ended Inputs
- ◆ Outputs Low for Inputs Open or at V<sub>EE</sub>
- ◆ Pin Compatible with MC100LVE111

## Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX9326EQI	-40°C to +85°C	28 PLCC
MAX9326EGI	-40°C to +85°C	28 QFN 5mm x 5mm

Functional Diagram appears at end of data sheet.

## Pin Configurations



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## ABSOLUTE MAXIMUM RATINGS

V <sub>CC</sub> - V <sub>EE</sub> .....	-0.3V to +4.1V	28-Lead QFN (derate 20.8mW/°C above +70°C) .....	1667mW
Inputs (CLK, $\overline{\text{CLK}}$ ) to V <sub>EE</sub> .....	-0.3V to (V <sub>CC</sub> + 0.3V)	θ <sub>JA</sub> in Still Air .....	+48°C/W
CLK to $\overline{\text{CLK}}$ .....	±3.0V	θ <sub>JC</sub> .....	+2°C/W
Continuous Output Current .....	50mA	Operating Temperature Range .....	-40°C to +85°C
Surge Output Current.....	100mA	Junction Temperature .....	+150°C
V <sub>BB</sub> Sink/Source Current.....	±0.65mA	Storage Temperature Range .....	-65°C to +150°C
Continuous Power Dissipation (T <sub>A</sub> = +70°C)		ESD Protection	
28-Lead PLCC (derate 10.5mW/°C above +70°C) .....	842mW	Human Body Model (CLK, $\overline{\text{CLK}}$ , Q <sub>-</sub> , $\overline{\text{Q}}$ ) .....	≥2kV
θ <sub>JA</sub> in Still Air .....	+95°C/W	Soldering Temperature (10s).....	+300°C
θ <sub>JC</sub> .....	+25°C/W		

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## DC ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> - V<sub>EE</sub>) = 2.375V to 3.8V, R<sub>L</sub> = 50Ω ±1% to V<sub>CC</sub> - 2V. Typical values are at (V<sub>CC</sub> - V<sub>EE</sub>) = 3.3V, V<sub>IH</sub> = (V<sub>CC</sub> - 1V), V<sub>IL</sub> = (V<sub>CC</sub> - 1.5V).) (Notes 1-4)

PARAMETER	SYMBOL	CONDITIONS	-40°C			+25°C			+85°C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
<b>DIFFERENTIAL INPUT (CLK<sub>-</sub>, <math>\overline{\text{CLK}}</math>)</b>												
Single-Ended Input High Voltage	V <sub>IH</sub>	Figure 1	V <sub>CC</sub> - 1.165		V <sub>CC</sub>	V <sub>CC</sub> - 1.165		V <sub>CC</sub>	V <sub>CC</sub> - 1.165		V <sub>CC</sub>	V
Single-Ended Input Low Voltage	V <sub>IL</sub>	Figure 1	V <sub>EE</sub>		V <sub>CC</sub> - 1.475	V <sub>EE</sub>		V <sub>CC</sub> - 1.475	V <sub>EE</sub>		V <sub>CC</sub> - 1.475	V
Differential Input High Voltage	V <sub>IHD</sub>	Figure 1	V <sub>EE</sub> + 1.2		V <sub>CC</sub>	V <sub>EE</sub> + 1.2		V <sub>CC</sub>	V <sub>EE</sub> + 1.2		V <sub>CC</sub>	V
Differential Input Low Voltage	V <sub>ILD</sub>	Figure 1	V <sub>EE</sub>		V <sub>CC</sub> - 0.095	V <sub>EE</sub>		V <sub>CC</sub> - 0.095	V <sub>EE</sub>		V <sub>CC</sub> - 0.095	V
Differential Input Voltage	V <sub>IHD</sub> - V <sub>ILD</sub>	(V <sub>CC</sub> - V <sub>EE</sub> ) < 3.0V, Figure 1	0.095		V <sub>CC</sub> - V <sub>EE</sub>	0.095		V <sub>CC</sub> - V <sub>EE</sub>	0.095		V <sub>CC</sub> - V <sub>EE</sub>	V
		(V <sub>CC</sub> - V <sub>EE</sub> ) ≥ 3.0V, Figure 1	0.095		3.0	0.095		3.0	0.095		3.0	
Input Current	I <sub>IN</sub>	V <sub>IH</sub> , V <sub>IL</sub> , V <sub>IHD</sub> , V <sub>ILD</sub>	-10.0		+150.0	-10.0		+150.0	-10.0		+150.0	μA

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## DC ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC} - V_{EE}$ ) = 2.375V to 3.8V,  $R_L = 50\Omega \pm 1\%$  to  $V_{CC} - 2V$ . Typical values are at ( $V_{CC} - V_{EE}$ ) = 3.3V,  $V_{IH} = (V_{CC} - 1V)$ ,  $V_{IL} = (V_{CC} - 1.5V)$ .) (Notes 1–4)

PARAMETER	SYMBOL	CONDITIONS	-40°C			+25°C			+85°C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
<b>OUTPUT (Q<sub>+</sub>, Q<sub>-</sub>)</b>												
Single-Ended Output High Voltage	$V_{OH}$	Figure 2	$V_{CC} - 1.085$	$V_{CC} - 0.977$	$V_{CC} - 0.880$	$V_{CC} - 1.025$	$V_{CC} - 0.949$	$V_{CC} - 0.88$	$V_{CC} - 1.025$	$V_{CC} - 0.929$	$V_{CC} - 0.88$	V
Single-Ended Output Low Voltage	$V_{OL}$	Figure 2	$V_{CC} - 1.810$	$V_{CC} - 1.695$	$V_{CC} - 1.620$	$V_{CC} - 1.810$	$V_{CC} - 1.697$	$V_{CC} - 1.62$	$V_{CC} - 1.810$	$V_{CC} - 1.698$	$V_{CC} - 1.62$	V
Differential Output Voltage	$V_{OH} - V_{OL}$	Figure 2	535	718		595	749		595	769		mV
<b>REFERENCE VOLTAGE OUTPUT (V<sub>BB</sub>)</b>												
Reference Voltage Output	$V_{BB}$	$I_{BB} = \pm 0.5mA$ (Note 5)	$V_{CC} - 1.38$	$V_{CC} - 1.318$	$V_{CC} - 1.26$	$V_{CC} - 1.38$	$V_{CC} - 1.325$	$V_{CC} - 1.26$	$V_{CC} - 1.38$	$V_{CC} - 1.328$	$V_{CC} - 1.26$	V
<b>SUPPLY</b>												
Supply Current	$I_{EE}$	(Note 6)	35	50		39	55		42	65		mA

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## AC ELECTRICAL CHARACTERISTICS—PLCC Package

( $V_{CC} - V_{EE}$ ) = 2.375V to 3.8V,  $R_L = 50\Omega \pm 1\%$  to  $V_{CC} - 2V$ ,  $f_{IN} \leq 500\text{MHz}$ , input transition time = 125ps (20% to 80%). Typical values are at ( $V_{CC} - V_{EE}$ ) = 3.3V,  $V_{IH} = V(V_{CC} - 1V)$ ,  $V_{IL} = (V_{CC} - 1.5V)$ .) (Note 7)

PARAMETER	SYMBOL	CONDITIONS	-40°C			+25°C			+85°C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Differential Input-to-Output Delay	$t_{PLHD}$ $t_{PHLD}$	Figure 2	365		615	375		605	383		653	ps
Single-Ended Input-to-Output Delay	$t_{PLH}$ $t_{PHL}$	Figure 3 (Note 8)	350		635	360		685	360		705	ps
Output-to-Output Skew	$t_{SKOO}$	(Note 9)			50			50			50	ps
Part-to-Part Skew	$t_{SKPP}$	Differential input (Note 10)			190			125			240	ps
Added Random Jitter	$t_{RJ}$	$f_{IN} = 0.5\text{GHz}$ clock pattern (Note 11)			1.5			1.5			1.5	psRMS
Added Deterministic Jitter	$t_{DJ}$	$f_{IN} = 1.0\text{Gbps}$ , $2E^{23} - 1$ PRBS pattern (Note 11)			95			95			95	psP-P
Switching Frequency	$f_{MAX}$	$V_{OH} - V_{OL} \geq 300\text{mV}$ clock pattern	1.5			1.5			1.5			GHz
Output Rise/Fall Time (20% to 80%)	$t_R$ , $t_F$	Figure 2	140		440	140		440	140		440	ps

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## AC ELECTRICAL CHARACTERISTICS—QFN Package

( $V_{CC} - V_{EE}$ ) = 2.375V to 3.8V,  $R_L = 50\Omega \pm 1\%$  to  $V_{CC} - 2V$ ,  $f_{IN} \leq 500\text{MHz}$ , input transition time = 125ps (20% to 80%). Typical values are at ( $V_{CC} - V_{EE}$ ) = 3.3V,  $V_{IH} = V(V_{CC} - 1V)$ ,  $V_{IL} = (V_{CC} - 1.5V)$ .) (Note 7)

PARAMETER	SYMBOL	CONDITIONS	-40°C			+25°C			+85°C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Differential Input-to-Output Delay	$t_{PLHD}$ $t_{PHLD}$	Figure 2	217		541	238		448	249		486	ps
Single-Ended Input-to-Output Delay	$t_{PLH}$ $t_{PHL}$	Figure 3 (Note 8)	213		558	230		506	244		503	ps
Output-to-Output Skew	$t_{SKOO}$	(Note 9)			50			50			50	ps
Part-to-Part Skew	$t_{SKPP}$	Differential input (Note 10)			192			215			218	ps
Added Random Jitter	$t_{RJ}$	$f_{IN} = 0.5\text{GHz}$ clock pattern (Note 11)			1.5			1.5			1.5	psRMS
Added Deterministic Jitter	$t_{DJ}$	$f_{IN} = 1.0\text{Gbps}$ , $2E^{23} - 1$ PRBS pattern (Note 11)			95			95			95	psP-P
Switching Frequency	$f_{MAX}$	$V_{OH} - V_{OL} \geq 300\text{mV}$ clock pattern	1.5			1.5			1.5			GHz
Output Rise/Fall Time (20% to 80%)	$t_R$ , $t_F$	Figure 2	97		411	104		210	111		232	ps

**Note 1:** Measurements are made with the device in thermal equilibrium.

**Note 2:** Current into a pin is defined as positive. Current out of a pin is defined as negative.

**Note 3:** DC parameters production tested at  $T_A = +25^\circ\text{C}$  and guaranteed by design over the full operating temperature range.

**Note 4:** Single-ended input operation using  $V_{BB}$  is limited to ( $V_{CC} - V_{EE}$ ) = 3.0V to 3.8V.

**Note 5:** Use  $V_{BB}$  only for inputs that are on the same device as the  $V_{BB}$  reference.

**Note 6:** All pins open except  $V_{CC}$  and  $V_{EE}$ .

**Note 7:** Guaranteed by design and characterization. Limits are set at  $\pm 6$  sigma.

**Note 8:** Measured from the 50% point of the input signal with the 50% point equal to  $V_{BB}$ , to the 50% point of the output signal.

**Note 9:** Measured between outputs of the same part at the signal crossing points for a same-edge transition. Differential input signal.

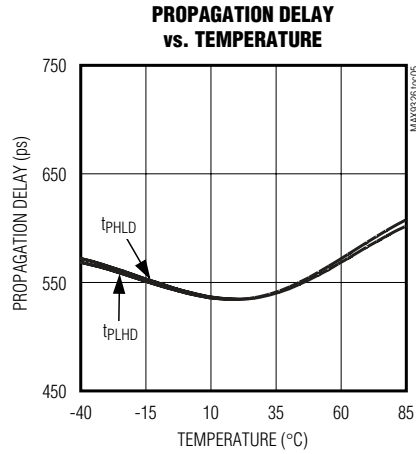
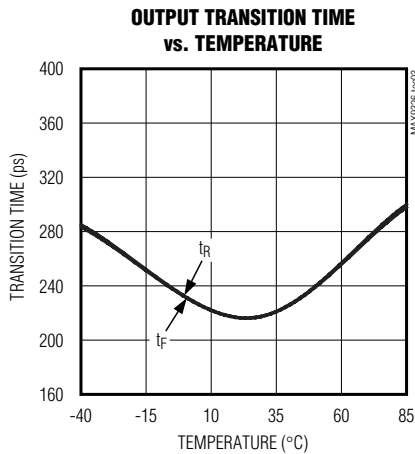
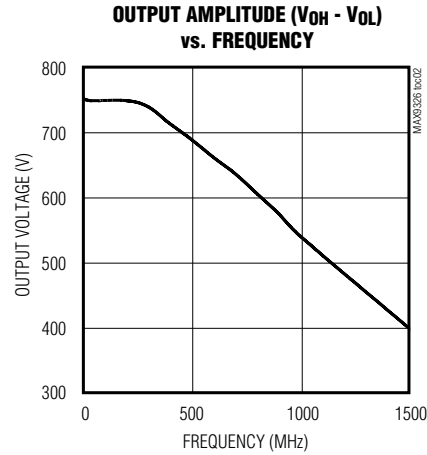
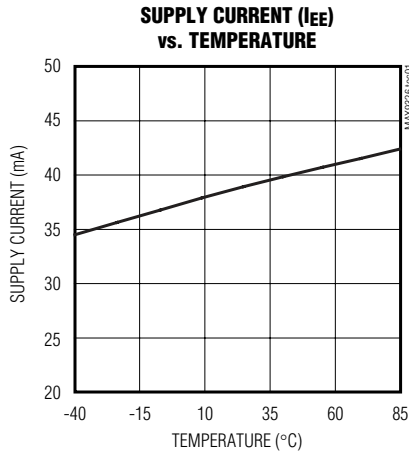
**Note 10:** Measured between outputs of different parts under identical conditions for same-edge transition.

**Note 11:** Device jitter added to the input signal. Differential input signal.

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## Typical Operating Characteristics

(PLCC package, typical values are at  $(V_{CC} - V_{EE}) = 3.3V$ ,  $V_{IH} = (V_{CC} - 1V)$ ,  $V_{IL} = (V_{CC} - 1.5V)$ ,  $R_L = 50\Omega \pm 1\%$  to  $V_{CC} - 2V$ ,  $f_{IN} = 500MHz$ , input transition time = 125ps (20% to 80%.))



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## Pin Description

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PIN		NAME	FUNCTION
PLCC	QFN		
1, 8, 15, 22	4, 11, 18, 25	V <sub>CC</sub>	Positive Supply Voltage. Bypass each V <sub>CC</sub> to V <sub>EE</sub> with 0.1μF and 0.01μF ceramic capacitors. Place the capacitors as close to the device as possible with the smaller value capacitor closest to the device.
2	5	CLK	Inverting Differential Clock Input. Internal 105kΩ pulldown to V <sub>EE</sub> .
3	6	V <sub>BB</sub>	Reference Output Voltage. Connect to the inverting or noninverting clock input to provide a reference for single-ended operation. When used, bypass V <sub>BB</sub> to V <sub>CC</sub> with a 0.01μF ceramic capacitor. Otherwise leave open.
4, 27	2, 7	N.C.	Not Connected
5	8	$\overline{Q8}$	Inverting Q8 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
6	9	Q8	Noninverting Q8 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
7	10	$\overline{Q7}$	Inverting Q7 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
9	12	Q7	Noninverting Q7 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
10	13	$\overline{Q6}$	Inverting Q6 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
11	14	Q6	Noninverting Q6 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
12	15	$\overline{Q5}$	Inverting Q5 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
13	16	Q5	Noninverting Q5 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
14	17	$\overline{Q4}$	Inverting Q4 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
16	19	Q4	Noninverting Q4 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
17	20	$\overline{Q3}$	Inverting Q3 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
18	21	Q3	Noninverting Q3 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
19	22	$\overline{Q2}$	Inverting Q2 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
20	23	Q2	Noninverting Q2 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
21	24	$\overline{Q1}$	Inverting Q1 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
23	26	Q1	Noninverting Q1 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
24	27	$\overline{Q0}$	Inverting Q0 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
25	28	Q0	Noninverting Q0 Output. Typically terminate with 50Ω resistor to V <sub>CC</sub> - 2V.
26	1	V <sub>EE</sub>	Negative Supply Voltage
28	3	CLK	Noninverting Differential Clock Input. Internal 105kΩ pulldown to V <sub>EE</sub> .
—	Exposed Pad	—	Internally Connected to V <sub>EE</sub>

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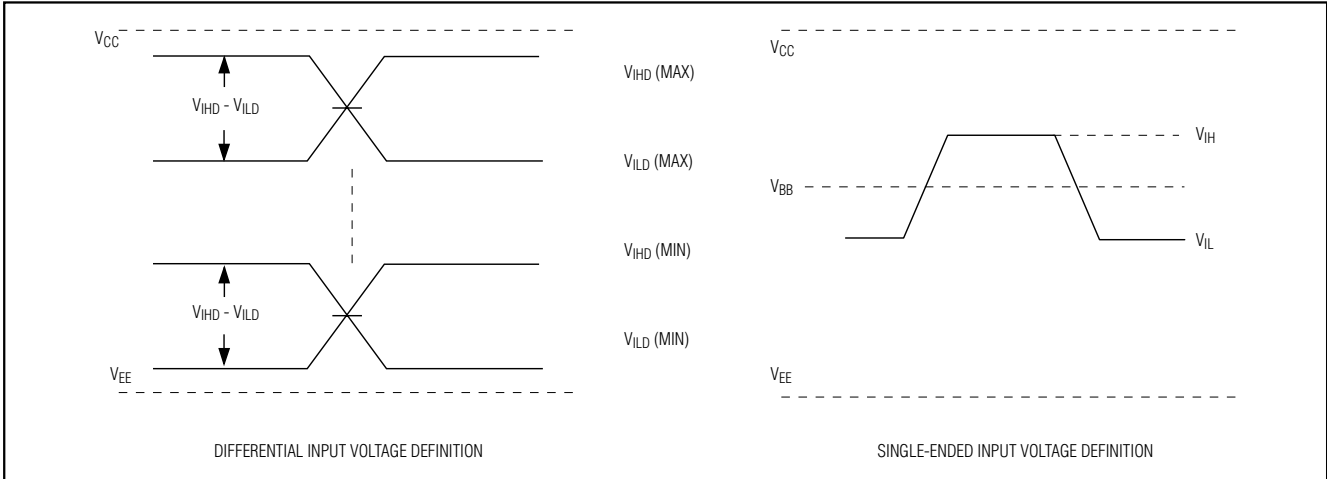


Figure 1. Input Voltage Definitions

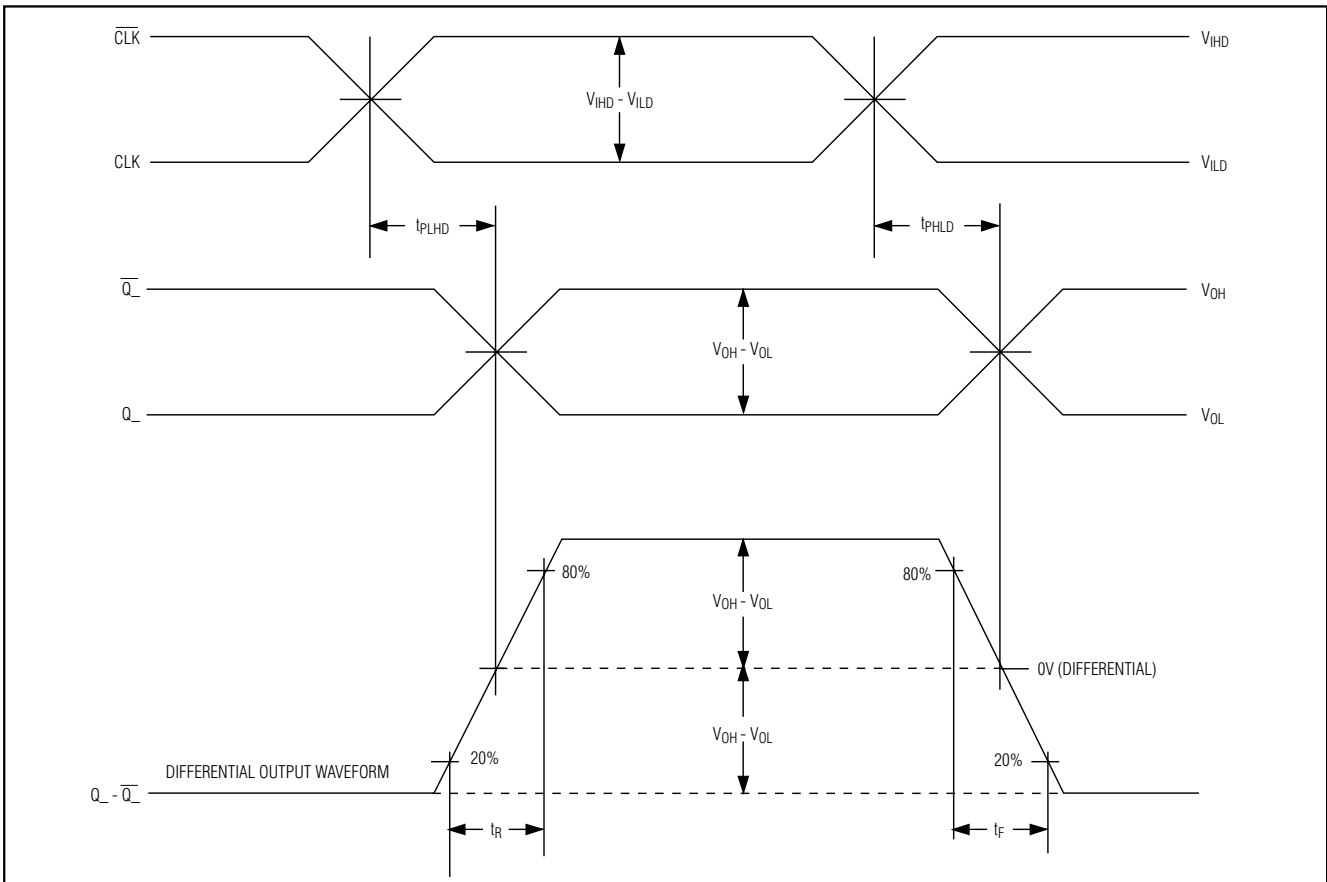


Figure 2. Differential Input (CLK, CLK) to Output (Q-, Q-) Delay Timing Diagram



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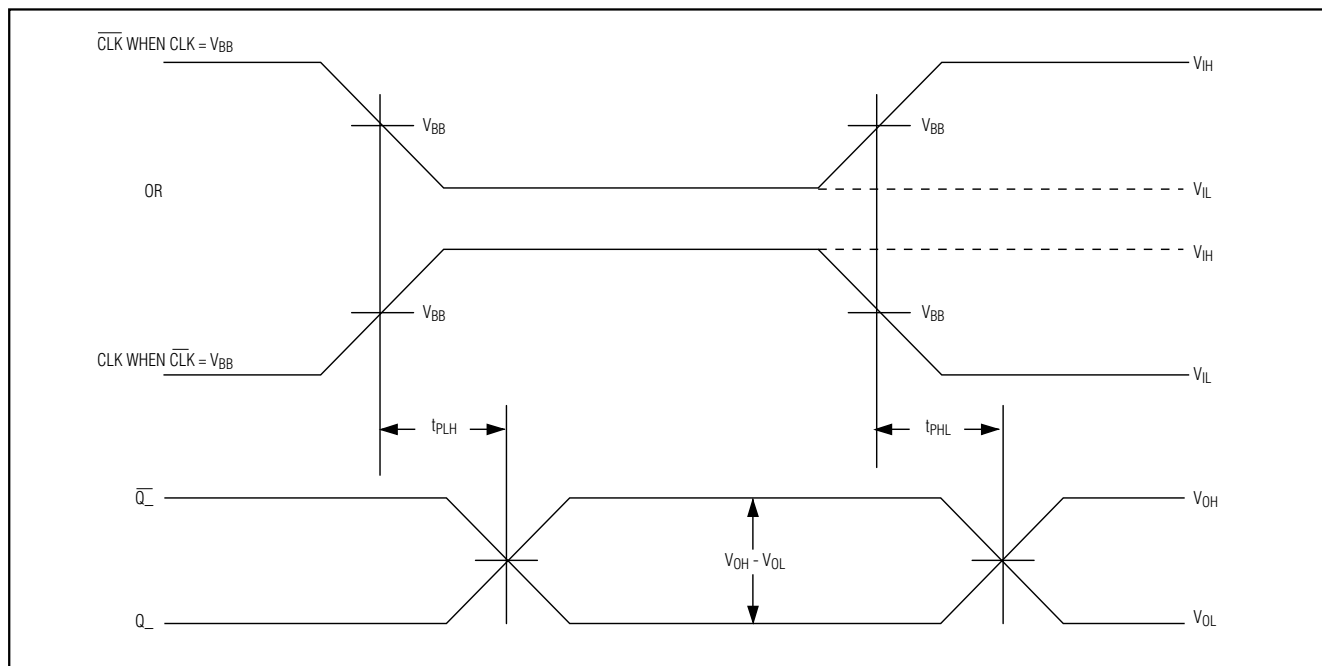


Figure 3. Single-Ended Input (CLK,  $\overline{\text{CLK}}$ ) to Output ( $Q_-$ ,  $\overline{Q_-}$ ) Delay Timing Diagram

## Detailed Description

The MAX9326 low-skew, 1:9 differential driver features extremely low output-to-output skew (50ps max) and part-to-part skew (225ps max). These features make the device ideal for clock and data distribution across a backplane or board. The device repeats an HSTL or LVECL/LVPECL differential input at nine differential outputs. Outputs are compatible with LVECL and LVPECL, and can directly drive 50 $\Omega$  terminated transmission lines.

The differential inputs (CLK,  $\overline{\text{CLK}}$ ) can be configured to accept a single-ended signal when the unused complementary input is connected to the on-chip reference output voltage ( $V_{\text{BB}}$ ). A single-ended input of at least  $V_{\text{BB}} \pm 95\text{mV}$  or a differential input of at least 95mV switches the outputs to the  $V_{\text{OH}}$  and  $V_{\text{OL}}$  levels specified in the *DC Electrical Characteristics*. The maximum magnitude of the differential input from CLK to  $\overline{\text{CLK}}$  is  $\pm 3.0\text{V}$  or  $\pm(V_{\text{CC}} - V_{\text{EE}})$ , whichever is less. This limit also applies to the difference between a single-ended input and any reference voltage input.

All the differential inputs have 105k $\Omega$  pulldowns to  $V_{\text{EE}}$ . Internal pulldowns and a fail-safe circuit ensure differential low default outputs when the inputs are left open or at  $V_{\text{EE}}$ .

Specifications for the high and low voltages of a differential input ( $V_{\text{IH}}^{\text{D}}$  and  $V_{\text{IL}}^{\text{D}}$ ) and the differential input voltage ( $V_{\text{IH}}^{\text{D}} - V_{\text{IL}}^{\text{D}}$ ) apply simultaneously.

For interfacing to differential HSTL and LVPECL signals, these devices operate over a 2.375V to 3.8V supply range, allowing high-performance clock or data distribution in systems with a nominal 2.5V or 3.3V supply. For differential LVECL operation, these devices operate from a -2.375V to -3.8V supply.

## Single-Ended Operation

The differential inputs (CLK,  $\overline{\text{CLK}}$ ) can be configured to accept single-ended inputs when operating at supply voltages greater than 2.58V. The recommended supply voltage for single-ended operation is 3.0V to 3.8V. A differential input is configured for single-ended operation by connecting the on-chip reference voltage,  $V_{\text{BB}}$ , to an unused complementary input as a reference. For example, the differential CLK,  $\overline{\text{CLK}}$  input is converted to a non-inverting, single-ended input by connecting  $V_{\text{BB}}$  to  $\overline{\text{CLK}}$  and connecting the single-ended input to CLK. Similarly, an inverting input is obtained by connecting  $V_{\text{BB}}$  to CLK and connecting the single-ended input to  $\overline{\text{CLK}}$ . With a differential input configured as single ended (using  $V_{\text{BB}}$ ), the single-ended input can be driven to  $V_{\text{CC}}$  or  $V_{\text{EE}}$  or with a single-ended LVPECL/LVECL signal.

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When configuring a differential input as a single-ended input, a user must ensure that the supply voltage ( $V_{CC} - V_{EE}$ ) is greater than 2.58V. This is because the input high minimum level must be at ( $V_{EE} + 1.2V$ ) or higher for proper operation. The reference voltage  $V_{BB}$  must be at least ( $V_{EE} + 1.2V$ ) or higher for the same reason because it becomes the high-level input when the other single-ended input swings below it. The minimum  $V_{BB}$  output for the MAX9326 is ( $V_{CC} - 1.38V$ ). Substituting the minimum  $V_{BB}$  output for ( $V_{BB} = V_{EE} + 1.2V$ ) results in a minimum supply ( $V_{CC} - V_{EE}$ ) of 2.58V. Rounding up to standard supplies gives the single-ended operating supply ranges ( $V_{CC} - V_{EE}$ ) of 3.0V to 3.8V for the MAX9326.

When using the  $V_{BB}$  reference output, bypass it with a 0.01 $\mu F$  ceramic capacitor to  $V_{CC}$ . If not used, leave it open. The  $V_{BB}$  reference can source or sink 0.5mA, which is sufficient to drive two inputs.

## Applications Information

### Output Termination

Terminate the outputs through 50 $\Omega$  to  $V_{CC} - 2V$  or use equivalent Thevenin terminations. Terminate each Q and  $\bar{Q}$  output with identical termination on each for the lowest output distortion. When a single-ended signal is taken from the differential output, terminate both  $Q_{-}$  and  $\bar{Q}_{-}$ .

Ensure that output currents do not exceed the current limits as specified in the *Absolute Maximum Ratings*. Under all operating conditions, the device's total thermal limits should be observed.

### Supply Bypassing

Bypass each  $V_{CC}$  to  $V_{EE}$  with high-frequency surface-mount ceramic 0.1 $\mu F$  and 0.01 $\mu F$  capacitors. Place the capacitors as close to the device as possible with the 0.01 $\mu F$  capacitor closest to the device pins.

Use multiple vias when connecting the bypass capacitors to ground. When using the  $V_{BB}$  reference output, bypass it with a 0.01 $\mu F$  ceramic capacitor to  $V_{CC}$ . If the  $V_{BB}$  reference is not used, it can be left open.

### Traces

Circuit board trace layout is very important to maintain the signal integrity of high-speed differential signals. Maintaining integrity is accomplished in part by reducing signal reflections and skew, and increasing common-mode noise immunity.

Signal reflections are caused by discontinuities in the 50 $\Omega$  characteristic impedance of the traces. Avoid discontinuities by maintaining the distance between differential traces, not using sharp corners or using vias. Maintaining distance between the traces also increases common-mode noise immunity. Reducing signal skew is accomplished by matching the electrical length of the differential traces.

### Exposed-Pad Package

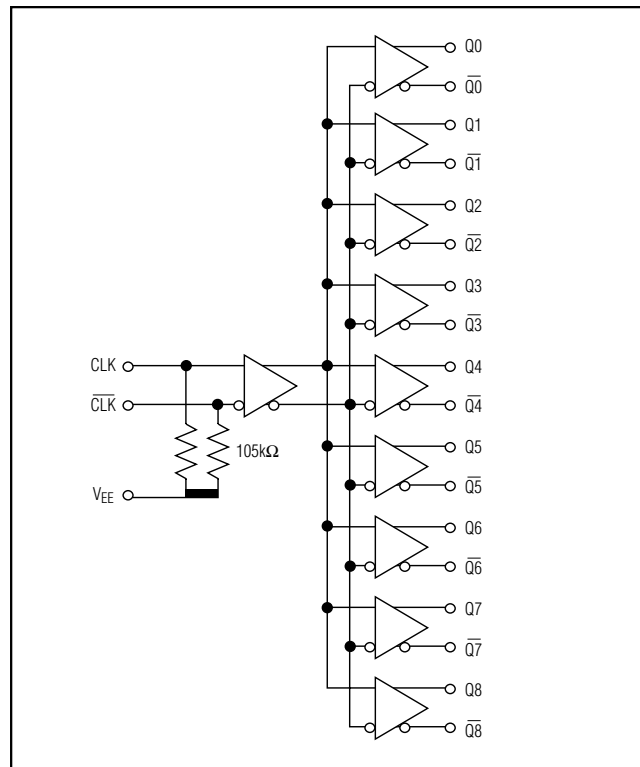
The 28-lead QFN package (MAX9326EG1) has the exposed paddle on the bottom of the package that provides the primary heat removal path from the IC to the PC board, as well as excellent electrical grounding to the PC board. **The MAX9326EG1's exposed pad is internally connected to  $V_{EE}$ . Do not connect the exposed pad to a separate circuit ground plane unless  $V_{EE}$  and the circuit ground are the same.**

## Chip Information

TRANSISTOR COUNT: 1030

PROCESS: Bipolar

## Functional Diagram



# 1:9 Differential LVPECL/LVECL/HSTL Clock and Data Driver

## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

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	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.165	0.180	4.20	4.57
A1	0.090	0.120	2.29	3.04
A2	0.145	0.156	3.69	3.96
A3	0.020	---	0.51	---
B	0.013	0.021	0.33	0.53
B1	0.026	0.032	0.66	0.81
C	0.009	0.011	0.23	0.28
e	0.050		1.27	

	INCHES		MILLIMETERS		N	MO047
	MIN	MAX	MIN	MAX		
D	0.385	0.395	9.78	10.03	20	AA
D1	0.350	0.356	8.89	9.04		
D2	0.290	0.330	7.37	8.38		
D3	0.200	REF	5.08	REF		

	INCHES		MILLIMETERS		N	MO047
	MIN	MAX	MIN	MAX		
D	0.485	0.495	12.32	12.57	28	AB
D1	0.450	0.456	11.43	11.58		
D2	0.390	0.430	9.91	10.92		
D3	0.300	REF	7.62	REF		

	INCHES		MILLIMETERS		N	MO047
	MIN	MAX	MIN	MAX		
D	0.685	0.695	17.40	17.65	44	AC
D1	0.650	0.656	16.51	16.66		
D2	0.590	0.630	14.99	16.00		
D3	0.500	REF	12.70	REF		

	INCHES		MILLIMETERS		N	MO047
	MIN	MAX	MIN	MAX		
D	0.785	0.795	19.94	20.19	52	AD
D1	0.750	0.756	19.05	19.20		
D2	0.690	0.730	17.53	18.54		
D3	0.600	REF	15.24	REF		

	INCHES		MILLIMETERS		N	MO047
	MIN	MAX	MIN	MAX		
D	0.985	0.995	25.02	25.27	68	AE
D1	0.950	0.958	24.13	24.33		
D2	0.890	0.930	22.61	23.62		
D3	0.800	REF	20.32	REF		

**NOTES:**

1. D1 DOES NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .20mm (.008") PER SIDE.
3. LEADS TO BE COPLANAR WITHIN .10mm.
4. CONTROLLING DIMENSION: MILLIMETER
5. MEETS JEDEC MO047-XX AS SHOWN IN TABLE.
6. N = NUMBER OF PINS.

PROPRIETARY INFORMATION

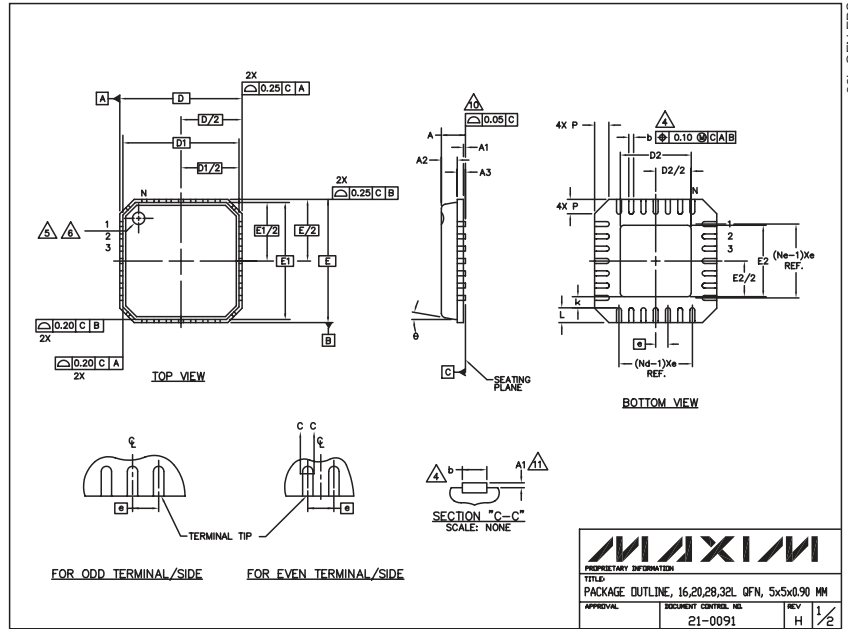
TITLE: FAMILY PACKAGE OUTLINE:  
20L, 28L, 44L, 52L, 68L PLCC

APPROVAL	DOCUMENT CONTROL NO. <b>21-0049</b>	REV. D	1/1
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# 1:9 Differential LVPECL/LVECL/HSTL Clock and Data Driver

## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



COMMON DIMENSIONS												
PKG	16L 5x5			20L 5x5			28L 5x5			32L 5x5		
SYMBOL	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.80	0.90	1.00	0.80	0.90	1.00	0.80	0.90	1.00
A1	0.00	0.01	0.05	0.00	0.01	0.05	0.00	0.01	0.05	0.00	0.01	0.05
A2	0.00	0.65	1.00	0.00	0.65	1.00	0.00	0.65	1.00	0.00	0.65	1.00
A3	0.20 REF			0.20 REF			0.20 REF			0.20 REF		
b	0.28	0.33	0.40	0.23	0.28	0.35	0.18	0.23	0.30	0.18	0.23	0.30
D	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
D1	4.75 BSC			4.75 BSC			4.75 BSC			4.75 BSC		
E	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
E1	4.75 BSC			4.75 BSC			4.75 BSC			4.75 BSC		
e	0.80 BSC			0.65 BSC			0.50 BSC			0.50 BSC		
k	0.25	-	-	0.25	-	-	0.25	-	-	0.25	-	-
L	0.35	0.55	0.75	0.35	0.55	0.75	0.35	0.55	0.75	0.30	0.40	0.50
N	16			20			28			32		
ND	4			5			7			8		
NE	4			5			7			8		
P	0.00	0.42	0.60	0.00	0.42	0.60	0.00	0.42	0.60	0.00	0.42	0.60
ø	0"			12"			0"			12"		

EXPOSED PAD VARIATIONS						
PKG CODES	D2			E2		
	MIN.	NDK.	MAX.	MIN.	NDK.	MAX.
G1655-3	2.95	3.10	3.25	2.95	3.10	3.25
G2055-1	2.55	2.70	2.85	2.55	2.70	2.85
G2055-2	2.95	3.10	3.25	2.95	3.10	3.25
G2855-1	2.55	2.70	2.85	2.55	2.70	2.85
G2855-2	2.95	3.10	3.25	2.95	3.10	3.25
G3255-1	2.95	3.10	3.25	2.95	3.10	3.25

**NOTES:**

- DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
- DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. - 1994.
- N IS THE NUMBER OF TERMINALS.  
Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION & Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
- DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
- THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/LASER MARKED.
- EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
- ALL DIMENSIONS ARE IN MILLIMETERS.
- PACKAGE WARPAGE MAX 0.05mm.
- APPLIED FOR EXPOSED PAD AND TERMINALS.  
EXCLUDE EMBEDDED PART OF EXPOSED PAD FROM MEASURING.
- MEETS JEDEC M0220.
- THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES).

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