

## Low-Voltage 1:10 LVPECL with Selectable Input Clock Driver

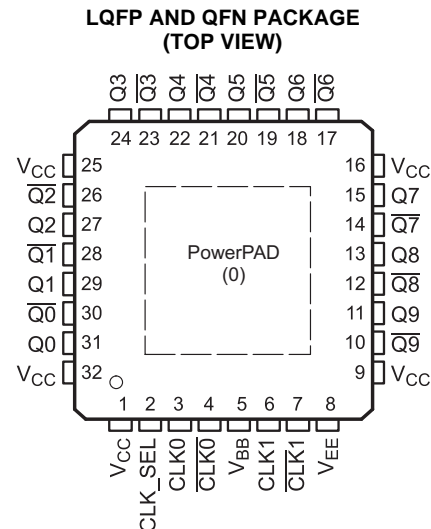
Check for Samples: [CDCLVP111](#)

### FEATURES

- Distributes One Differential Clock Input Pair LVPECL to 10 Differential LVPECL
- Fully Compatible With LVECL/LVPECL
- Supports a Wide Supply Voltage Range From 2.375 V to 3.8 V
- Selectable Clock Input Through CLK\_SEL
- Low-Output Skew (Typ 15 ps) for Clock-Distribution Applications
  - Additive Jitter Less Than 1 ps
  - Propagation Delay Less Than 350 ps
  - Open Input Default State
  - LVDS, CML, SSTL input compatible
- $V_{BB}$  Reference Voltage Output for Single-Ended Clocking
- Available in a 32-Pin LQFP and QFN Package
- Frequency Range From DC to 3.5 GHz
- Pin-to-Pin Compatible With MC100 Series EP111, ES6111, LVEP111, PTN1111

### APPLICATIONS

- Designed for Driving 50  $\Omega$  Transmission Lines
- High Performance Clock Distribution



### DESCRIPTION

The CDCLVP111 clock driver distributes one differential clock pair of LVPECL input, (CLK0, CLK1) to ten pairs of differential LVPECL clock (Q0, Q9) outputs with minimum skew for clock distribution. The CDCLVP111 can accept two clock sources into an input multiplexer. The CDCLVP111 is specifically designed for driving 50- $\Omega$  transmission lines. When an output pin is not used, leaving it open is recommended to reduce power consumption. If only one of the output pins from a differential pair is used, the other output pin must be identically terminated to 50  $\Omega$ .

The  $V_{BB}$  reference voltage output is used if single-ended input operation is required. In this case, the  $V_{BB}$  pin should be connected to CLK0 and bypassed to GND via a 10-nF capacitor.

However, for high-speed performance up to 3.5 GHz, the differential mode is strongly recommended.

The CDCLVP111 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

**Table 1. FUNCTION TABLE**

CLK_SEL	ACTIVE CLOCK INPUT
0	CLK0, $\overline{\text{CLK0}}$
1	CLK1, $\overline{\text{CLK1}}$



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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# CDCLVP111

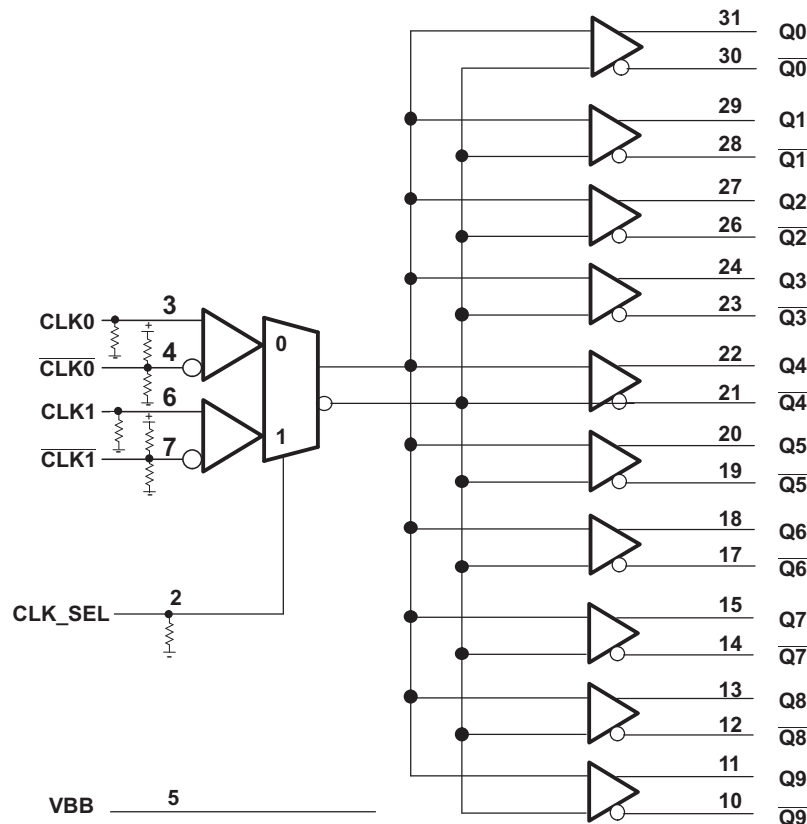
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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## DEVICE INFORMATION



## PIN FUNCTIONS<sup>(1)</sup>

PIN		DESCRIPTION
NAME	NO.	
CLK_SEL	2	Clock select. Used to select between CLK0 and CLK1 input pairs. LVTTTL/LVCMOS functionality compatible.
CLK0, $\overline{\text{CLK0}}$	3, 4	Differential LVECL/LVPECL input pair
CLK1, $\overline{\text{CLK1}}$	6, 7	
Q [9:0]	11, 13, 15, 18, 20, 22, 24, 27, 29, 31	LVECL/LVPECL clock outputs, these outputs provide low-skew copies of CLK <sub>n</sub> .
$\overline{\text{Q}}[9:0]$	10, 12, 14, 17, 19, 21, 23, 26, 28, 30	LVECL/LVPECL complementary clock outputs, these outputs provide copies of $\overline{\text{CLK}}_n$ .
V <sub>BB</sub>	5	Reference voltage output for single-ended input operation
V <sub>CC</sub>	1, 9, 16, 25, 32	Supply voltage
V <sub>EE</sub>	8	Device ground or negative supply voltage in ECL mode
PowerPAD™	0	The PowerPAD of the QFN32 is thermally connected to the die to improve the heat transfer out of the package. The pad of the QFN32 with PowerPAD must be connected to V <sub>EE</sub> .

(1) CLK<sub>n</sub>, CLK\_SEL pull down resistor = 75 kΩ;  $\overline{\text{CLK}}_n$  pull up resistor = 37.5 kΩ;  $\overline{\text{CLK}}_n$  pull down resistor = 50 kΩ.

**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

		VALUE	UNIT
V <sub>CC</sub>	Supply voltage (Relative to V <sub>EE</sub> )	–0.3 to 4.6	V
V <sub>I</sub>	Input voltage	–0.3 to V <sub>CC</sub> + 0.5	V
V <sub>O</sub>	Output voltage	–0.3 to V <sub>CC</sub> + 0.5	V
I <sub>IN</sub>	Input current	±20	mA
V <sub>EE</sub>	Negative supply voltage (Relative to V <sub>CC</sub> )	–4.6 to 0.3	V
I <sub>BB</sub>	Sink/source current	–1 to 1	mA
I <sub>O</sub>	DC output current	–50	mA
T <sub>stg</sub>	Storage temperature range	–65 to 150	°C
T <sub>J</sub>	Maximum operating junction temperature	125	°C

- (1) 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 under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

**RECOMMENDED OPERATING CONDITIONS**

		MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Supply voltage (relative to V <sub>EE</sub> )	2.375	2.5/3.3	3.8	V
T <sub>A</sub>	Operating free-air temperature	–40		85	°C/W
T <sub>J</sub>	Operating junction temperature			110	°C

**PACKAGE THERMAL IMPEDANCE, VF (LQFP)**

		TEST CONDITION	VALUE	UNIT
θ <sub>JA</sub>	Thermal resistance junction to ambient <sup>(1)</sup>	0 LFM	74	°C/W
		150 LFM	66	°C/W
		250 LFM	64	°C/W
		500 LFM	61	°C/W
θ <sub>JC</sub>	Thermal resistance junction to case		39	°C/W

- (1) According to JESD 51-7 standard.

**PACKAGE THERMAL IMPEDANCE, RHB (QFN)**

		TEST CONDITION	VALUE	UNIT
θ <sub>JA</sub>	Thermal resistance junction to ambient <sup>(1)</sup>	0 LFM	49	°C/W
		150 LFM	37	°C/W
		250 LFM	36	°C/W
		500 LFM	32	°C/W
θ <sub>JC</sub>	Thermal resistance junction to case		19	°C/W

- (1) According to JESD 51-7 standard.

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## LVECL DC ELECTRICAL CHARACTERISTICS

Vsupply:  $V_{CC} = 0\text{ V}$ ,  $V_{EE} = -2.375\text{ V}$  to  $-3.8\text{ V}$  over operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
I <sub>EE</sub> Supply internal current	Absolute value of current	−40°C, 25°C, 85°C	40		85	mA
I <sub>CC</sub> Output and internal supply current	All outputs terminated 50 Ω to V <sub>CC</sub> − 2 V	−40°C			354	mA
		25°C			380	
		85°C			405	
I <sub>IN</sub> Input current	Includes pullup/pulldown resistors, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = V <sub>CC</sub> - 2 V	−40°C, 25°C, 85°C	−150		150	μA
V <sub>BB</sub> Internally generated bias voltage	For V <sub>EE</sub> = −3 to −3.8 V, I <sub>BB</sub> = −0.2 mA	−40°C, 25°C, 85°C	−1.45	−1.3	−1.15	V
	V <sub>EE</sub> = −2.375 to −2.75 V, I <sub>BB</sub> = −0.2 mA	−40°C, 25°C, 85°C	−1.4	−1.25	−1.1	
V <sub>IH</sub> High-level input voltage (CLK_SEL)		−40°C, 25°C, 85°C	−1.165		−0.88	V
V <sub>IL</sub> Low-level input voltage (CLK_SEL)		−40°C, 25°C, 85°C	−1.81		−1.475	V
V <sub>ID</sub> Input amplitude (CLKn, CLKn)	Difference of input, See <sup>(1)</sup>  V <sub>IH</sub> − V <sub>IL</sub>	−40°C, 25°C, 85°C	0.5		1.3	V
V <sub>CM</sub> Common-mode voltage (CLKn, CLKn)	DC offset relative to V <sub>EE</sub>	−40°C, 25°C, 85°C	V <sub>EE</sub> + 1		−0.3	V
V <sub>OH</sub> High-level output voltage	I <sub>OH</sub> = −21 mA	−40°C	−1.26		−0.85	V
		25°C	−1.2		−0.85	
		85°C	−1.15		−0.85	
V <sub>OL</sub> Low-level output voltage	I <sub>OL</sub> = −5 mA	−40°C	−1.85		−1.5	V
		25°C	−1.85		−1.45	
		85°C	−1.85		−1.4	
V <sub>OD</sub> Differential output voltage swing	Terminated with 50 Ω to V <sub>CC</sub> −2 V, See <a href="#">Figure 4</a>	−40°C, 25°C, 85°C	600			mV

(1)  $V_{ID}$  minimum and maximum is required to maintain ac specifications, actual device function tolerates a minimum  $V_{ID}$  of 100 mV.

## LVPECL DC ELECTRICAL CHARACTERISTICS

Vsupply:  $V_{CC} = 2.375\text{ V to }3.8\text{ V}$ ,  $V_{EE} = 0\text{ V}$  over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN			TYP			MAX			UNIT
I <sub>EE</sub>	Supply internal current	Absolute value of current		−40°C, 25°C, 85°C		40			85			mA	
I <sub>CC</sub>	Output and internal supply current	All outputs terminated 50 Ω to V <sub>CC</sub> − 2 V		−40°C					354			mA	
				25°C					380				
				85°C					405				
I <sub>IN</sub>	Input current	Includes pullup/pulldown resistors V <sub>IH</sub> =V <sub>CC</sub> , V <sub>IL</sub> = V <sub>CC</sub> −2V		−40°C, 25°C, 85°C		−150			150			μA	
V <sub>BB</sub>	Internally generated bias voltage	V <sub>CC</sub> = 3 to 3.8 V, I <sub>BB</sub> = −0.2 mA		−40°C, 25°C, 85°C		V <sub>CC</sub> − 1.45		V <sub>CC</sub> − 1.3		V <sub>CC</sub> − 1.15		V	
		V <sub>CC</sub> = 2.375 to 2.75 V, I <sub>BB</sub> = −0.2 mA		−40°C, 25°C, 85°C		V <sub>CC</sub> − 1.4		V <sub>CC</sub> − 1.25		V <sub>CC</sub> − 1.1			
V <sub>IH</sub>	High-level input voltage (CLK_SEL)			−40°C, 25°C, 85°C		V <sub>CC</sub> − 1.165				V <sub>CC</sub> − 0.88		V	
V <sub>IL</sub>	Low-level input voltage (CLK_SEL)			−40°C, 25°C, 85°C		V <sub>CC</sub> − 1.81				V <sub>CC</sub> − 1.475		V	
V <sub>ID</sub>	Input amplitude (CLKn, CLKn)	Difference of inpu, see <sup>(1)</sup> , $ V_{IH} - V_{IL} $		−40°C, 25°C, 85°C		0.5				1.3		V	
V <sub>CM</sub>	Common-mode voltage (CLKn, CLKn)	DC offset relative to V <sub>EE</sub>		−40°C, 25°C, 85°C		1				V <sub>CC</sub> − 0.3		V	
V <sub>OH</sub>	High-level output voltage	I <sub>OH</sub> = −21 mA		−40°C		V <sub>CC</sub> − 1.26				V <sub>CC</sub> − 0.85		V	
				25°C		V <sub>CC</sub> − 1.2		V <sub>CC</sub> − 0.85					
				85°C		V <sub>CC</sub> − 1.15		V <sub>CC</sub> − 0.85					
V <sub>OL</sub>	Low-level output voltage	I <sub>OL</sub> = −5 mA		−40°C		V <sub>CC</sub> − 1.85				V <sub>CC</sub> − 1.5		V	
				25°C		V <sub>CC</sub> − 1.85		V <sub>CC</sub> − 1.45					
				85°C		V <sub>CC</sub> − 1.85		V <sub>CC</sub> − 1.4					
V <sub>OD</sub>	Differential output voltage swing	Terminated with 50 Ω to V <sub>CC</sub> - 2 V, See <a href="#">Figure 4</a>		−40°C, 25°C, 85°C		600						mV	

(1)  $V_{ID}$  minimum and maximum is required to maintain ac specifications, actual device function tolerates a minimum  $V_{ID}$  of 100 mV.

## AC ELECTRICAL CHARACTERISTICS

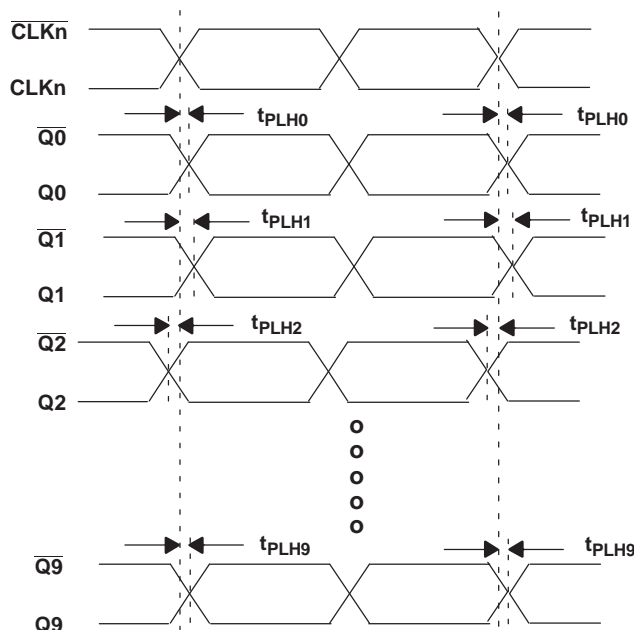
Vsupply:  $V_{CC} = 2.375\text{ V to }3.8\text{ V}$ ,  $V_{EE} = 0\text{ V}$  or LVECL/LVPECL input  $V_{CC} = 0\text{ V}$ ,  $V_{EE} = -2.375\text{ V to }-3.8\text{ V}$  over operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{pd}$ Differential propagation delay CLKn, CLKn to all Q0, Q0... Q9, Q9	See	200		350	ps
$t_{sk(o)}$ Output-to-output skew	See , and Figure 1		15	30	ps
$t_{sk(pp)}$ Part-to-part skew	See , and Figure 1			70	ps
$t_{aj}$ Additive phase jitter	Integration bandwidth of 20 kHz to 20 MHz, $f_{out} = 125\text{ MHz}$ at 25°C		0.04	< 0.8	ps
$f_{(max)}$ Maximum frequency	Functional up to 3.5 GHz, see Figure 4			3500	MHz
$t_r/t_f$ Output rise and fall time (20%, 80%)	See Note D in Figure 1	90		200	ps

# CDCLVP111

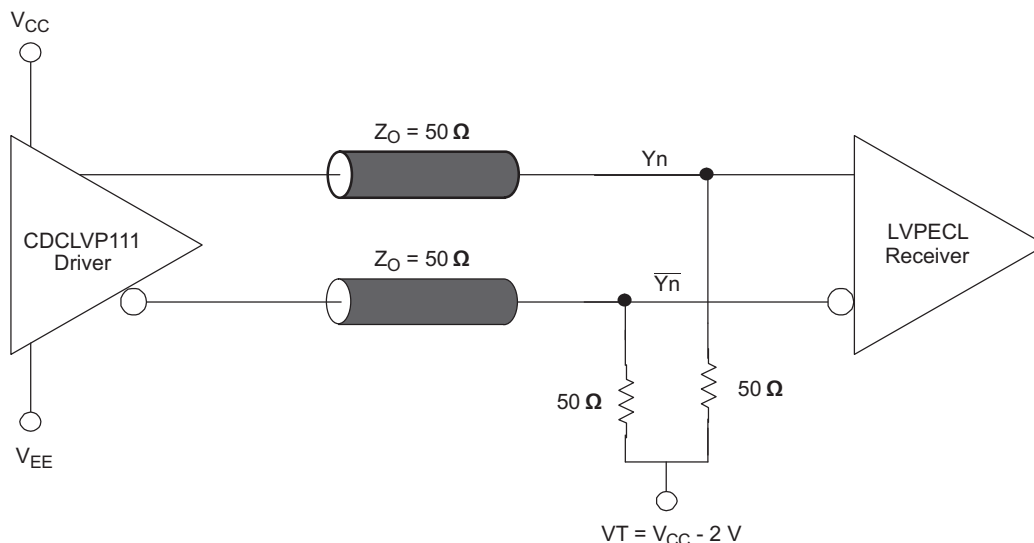
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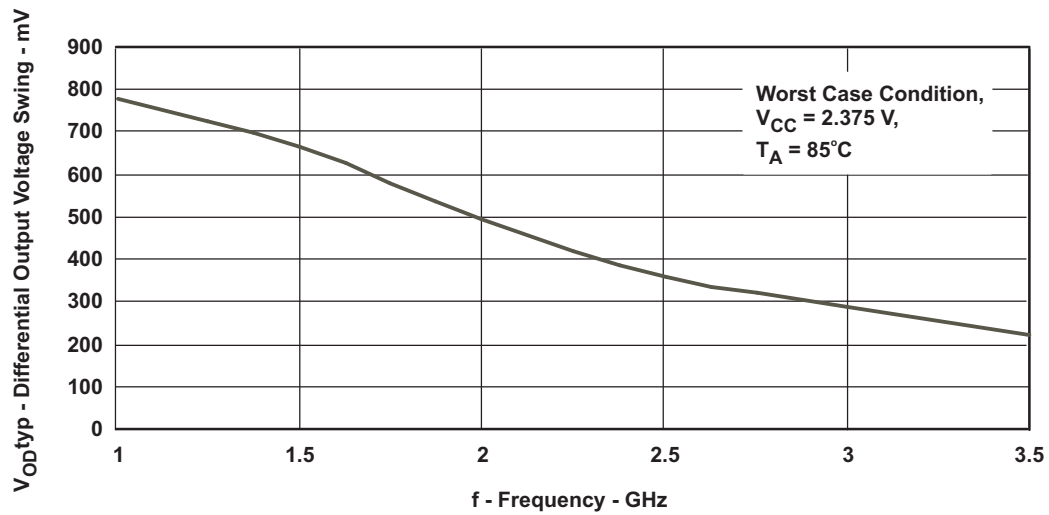
- Output skew is calculated as the greater of: The difference between the fastest and the slowest  $t_{PLHn}$  ( $n = 0, 1, \dots, 9$ ) or the difference between the fastest and the slowest  $t_{PHLn}$  ( $n = 0, 1, \dots, 9$ ).
- Part-to-part skew, is calculated as the greater of: The difference between the fastest and the slowest  $t_{PLHn}$  ( $n = 0, 1, \dots, 9$ ) across multiple devices or the difference between the fastest and the slowest  $t_{PHLn}$  ( $n = 0, 1, \dots, 9$ ) across multiple devices.
- Typical value measured at ambient when clock input is 155.52MHz for an integration bandwidth of 20 kHz to 5 MHz.
- Input conditions:  $V_{CM} = 1\text{ V}$ ,  $V_{ID} = 0.5\text{ V}$  and  $F_{IN} = 1\text{ GHz}$ .

**Figure 1. Waveform for Calculating Both Output and Part-to-Part Skew**



**Figure 2. Typical Termination for Output Driver (See the Interfacing Between LVPECL, LVDS, and CML Application Note, Literature Number [SCAA056](#))**

**Figure 3. DIFFERENTIAL OUTPUT VOLTAGE SWING  
vs  
FREQUENCY**



**Figure 4. LVPECL Input Using CLK0 Pair,  $V_{CM} = 1\text{ V}$ ,  $V_{ID} = 0.5\text{ V}$**

## REVISION HISTORY

### Changes from Original (January 2009) to Revision A Page

- Changed note referneces within the AC ELECTRICAL CHARACTERISTICS table ..... 5
- Added a Typ value of 0.04ps to the Additive phase jitter in the AC ELECTRICAL CHARACTERISTICS ..... 5

### Changes from Revision A (March 2009) to Revision B Page

- Added LVTTTL/LVCMOS functionality compatible. .... 2

### Changes from Revision B (April 2009) to Revision C Page

- Changed PowerPAD information to the Pinout Package ..... 1
- Added PowerPAD information to the Pin Functions table ..... 2

### Changes from Revision C (November 2009) to Revision D Page

- Changed the PowerPAD description in the PIN FUNCTIONS table to include the LQFP package information. .... 2
- Deleted duplicate information covering the PowerPAD from Note 1 of the Pin Functions table. .... 2

### Changes from Revision D (March 2010) to Revision E Page

- Changed the PowerPAD Pin Function Description ..... 2
- Added text "See Note D in Figure 1" to the  $t_r/t_f$  Test Conditions in the AC ELECTRICAL CHARACTERITICS table ..... 5



## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CDCLVP111RHBR	ACTIVE	VQFN	RHB	32	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	LVP111	<a href="#">Samples</a>
CDCLVP111RHBT	ACTIVE	VQFN	RHB	32	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	LVP111	<a href="#">Samples</a>
CDCLVP111VF	ACTIVE	LQFP	VF	32	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVP111	<a href="#">Samples</a>
CDCLVP111VFR	ACTIVE	LQFP	VF	32	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVP111	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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**OTHER QUALIFIED VERSIONS OF CDCLVP111 :**

- Enhanced Product: [CDCLVP111-EP](#)

**NOTE: Qualified Version Definitions:**

- Enhanced Product - Supports Defense, Aerospace and Medical Applications

**TAPE AND REEL INFORMATION**


\*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
CDCLVP111RHBR	VQFN	RHB	32	3000	330.0	12.4	5.3	5.3	1.5	8.0	12.0	Q2
CDCLVP111RHBT	VQFN	RHB	32	250	180.0	12.4	5.3	5.3	1.5	8.0	12.0	Q2
CDCLVP111VFR	LQFP	VF	32	1000	330.0	16.4	9.6	9.6	1.9	12.0	16.0	Q2

## TAPE AND REEL BOX DIMENSIONS

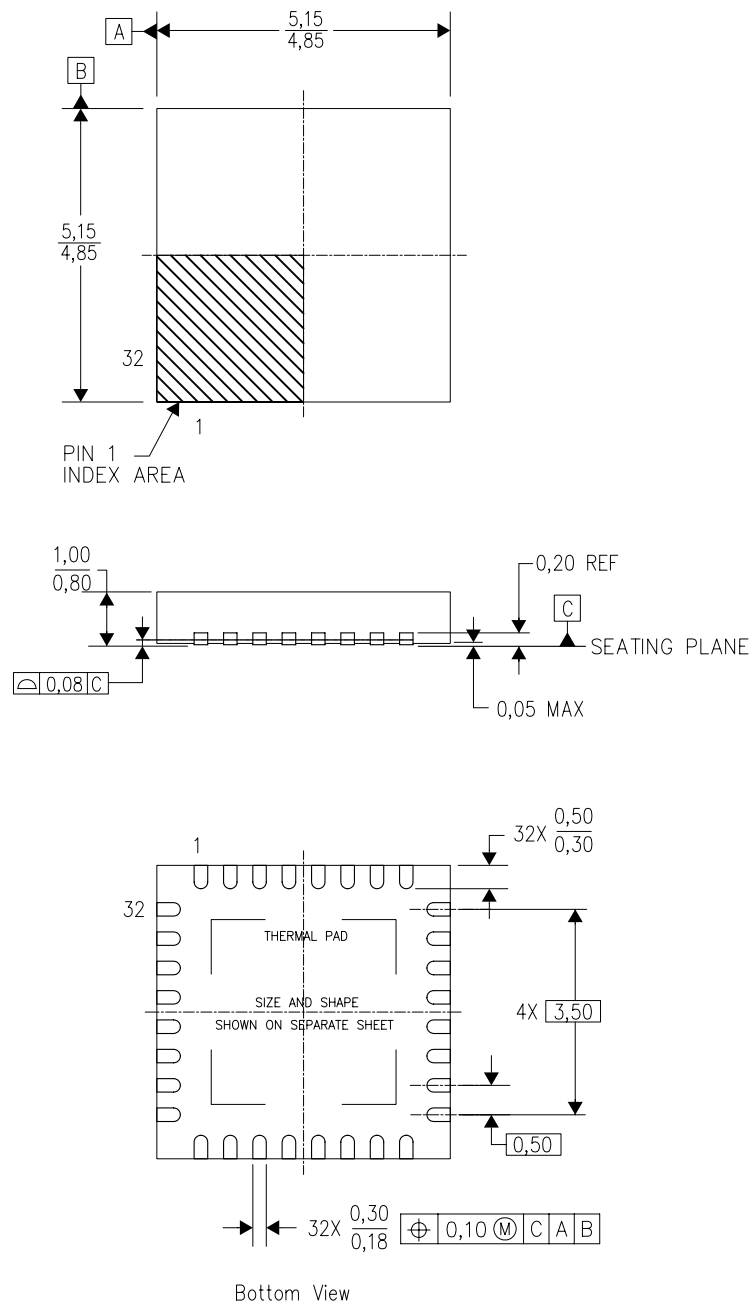


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDCLVP111RHBR	VQFN	RHB	32	3000	338.1	338.1	20.6
CDCLVP111RHBT	VQFN	RHB	32	250	210.0	185.0	35.0
CDCLVP111VFR	LQFP	VF	32	1000	341.0	159.0	123.5

RHB (S-PVQFN-N32)

PLASTIC QUAD FLATPACK NO-LEAD



4204326/D 06/11

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - QFN (Quad Flatpack No-Lead) Package configuration.
  - The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
  - Falls within JEDEC MO-220.

RHB (S-PVQFN-N32)

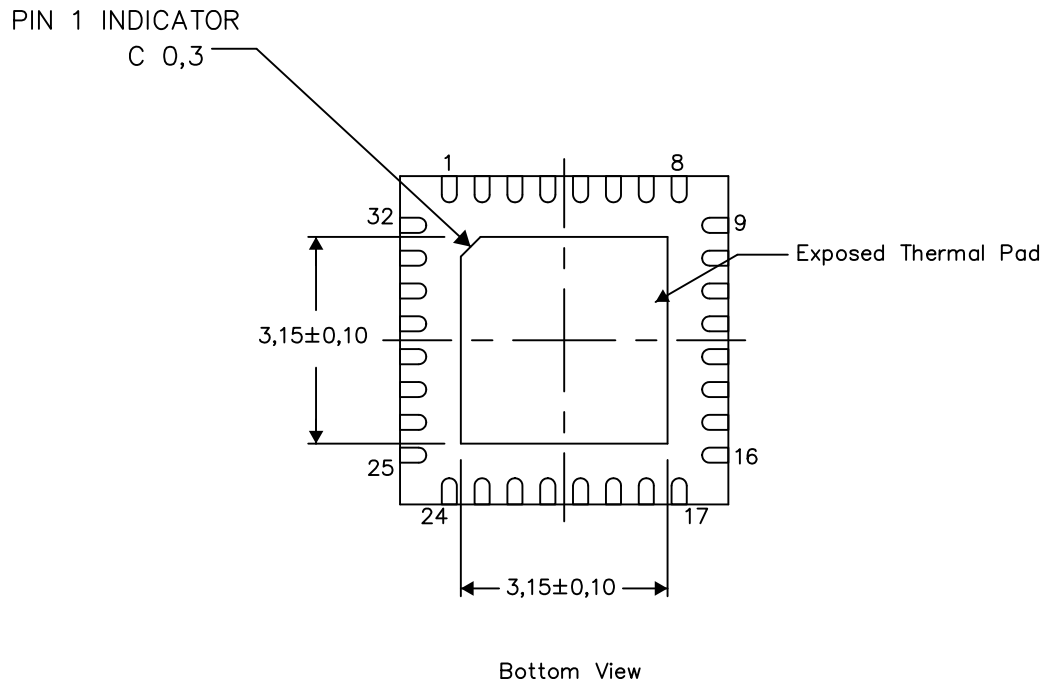
PLASTIC QUAD FLATPACK NO-LEAD

## THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.



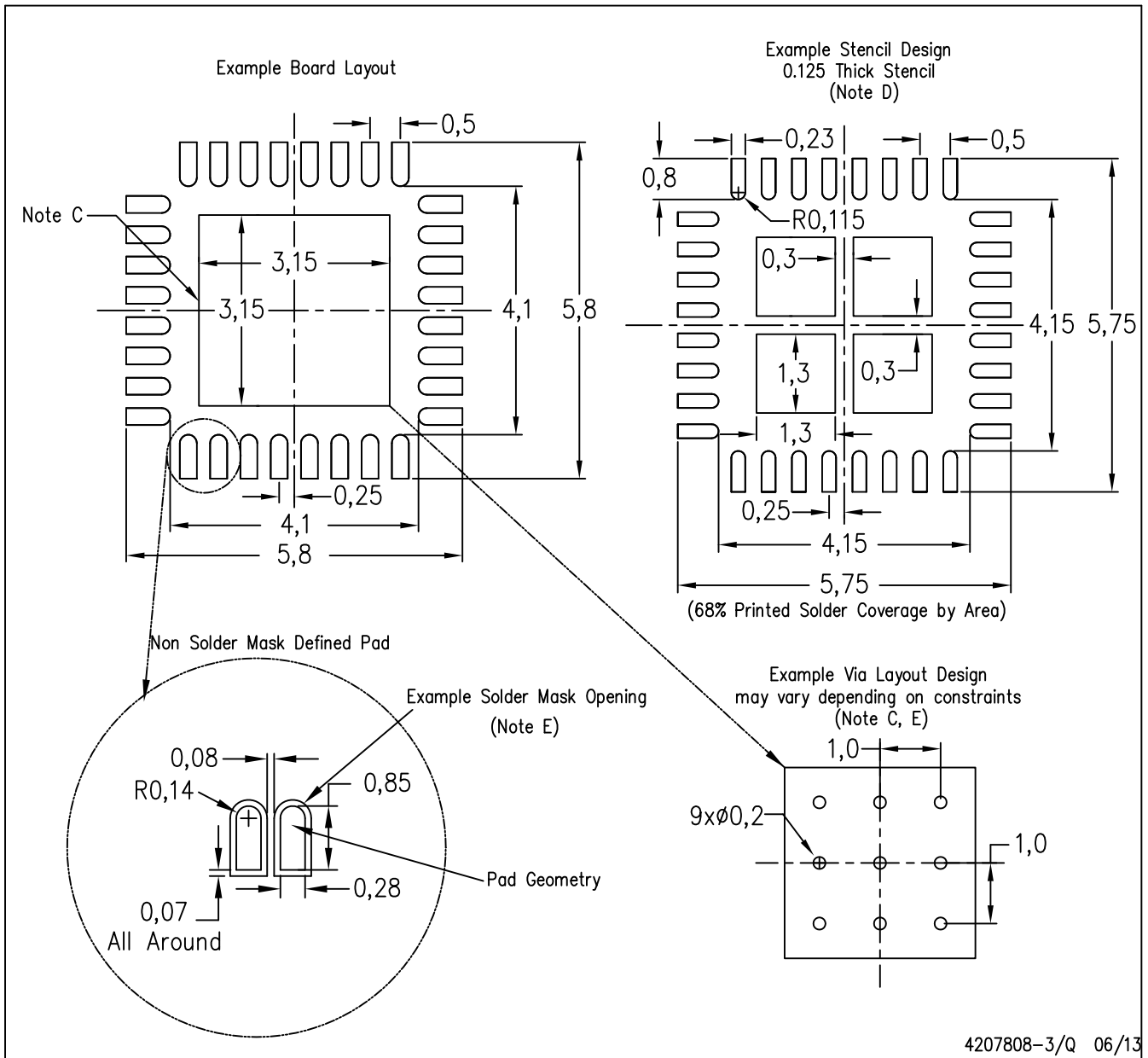
Exposed Thermal Pad Dimensions

4206356-3/Y 06/13

NOTE: A. All linear dimensions are in millimeters

RHB (S-PVQFN-N32)

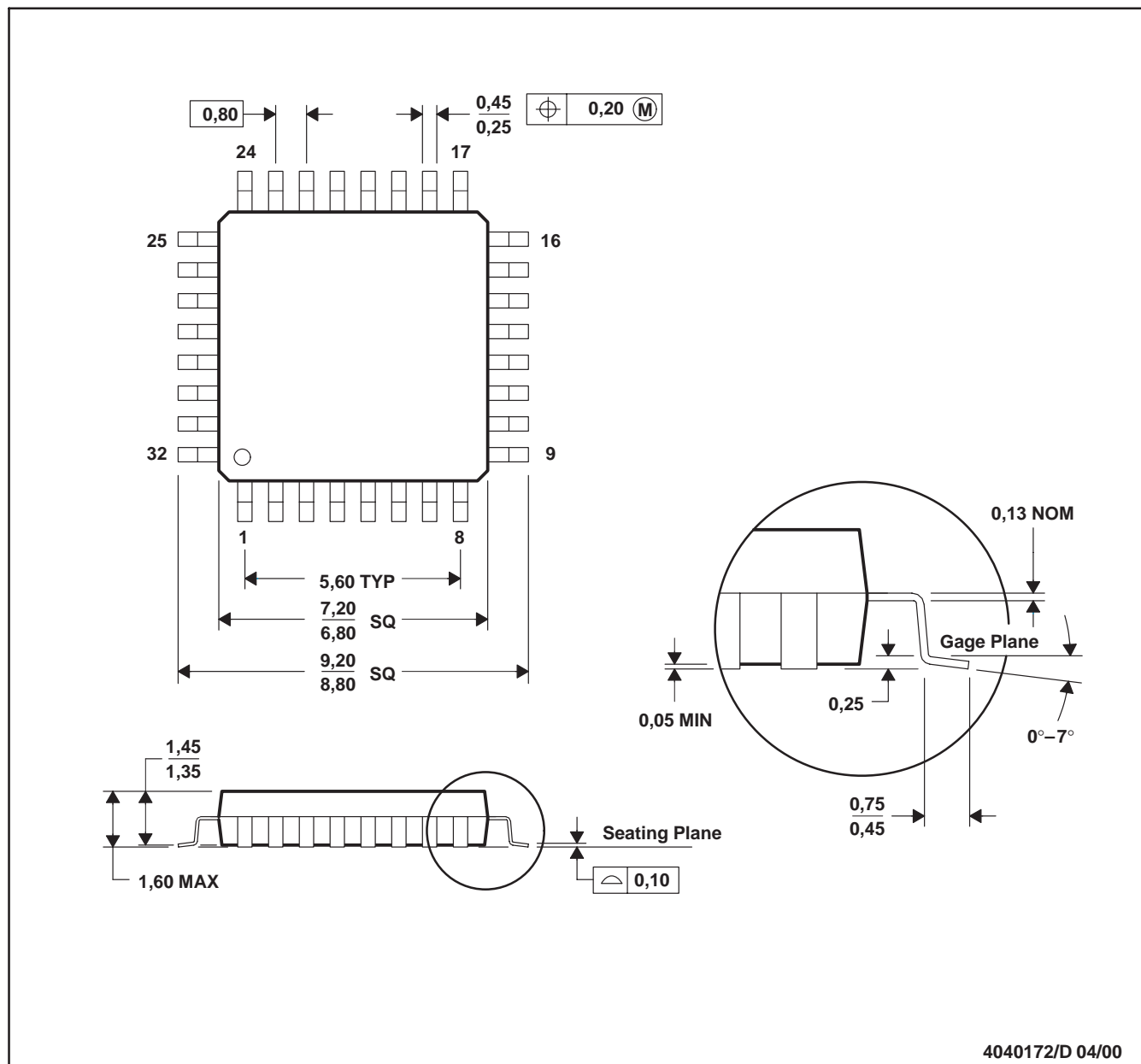
PLASTIC QUAD FLATPACK NO-LEAD



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
  - Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting recommendations for vias placed in the thermal pad.

## VF (S-PQFP-G32)

## PLASTIC QUAD FLATPACK



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.



## IMPORTANT NOTICE

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