

## Low-Voltage 1:10 LVPECL/HSTL With Selectable Input Clock Driver

Check for Samples: [CDCLVP110](#)

### FEATURES

- Distributes One Differential Clock Input Pair LVPECL/HSTL to 10 Differential LVPECL Clock Outputs
- Fully Compatible With LVECL/LVPECL/HSTL
- Single Supply Voltage Required,  $\pm 3.3\text{-V}$  or  $\pm 2.5\text{-V}$  Supply
- Selectable Clock Input Through CLK\_SEL
- Low-Output Skew (Typ 15 ps) for Clock-Distribution Applications
- VBB Reference Voltage Output for Single-Ended Clocking
- Available in a 32-Pin LQFP Package
- Frequency Range From DC to 3.5 GHz
- Pin-to-Pin Compatible With MC100 Series EP111, ES6111, LVEP111, PTN1111

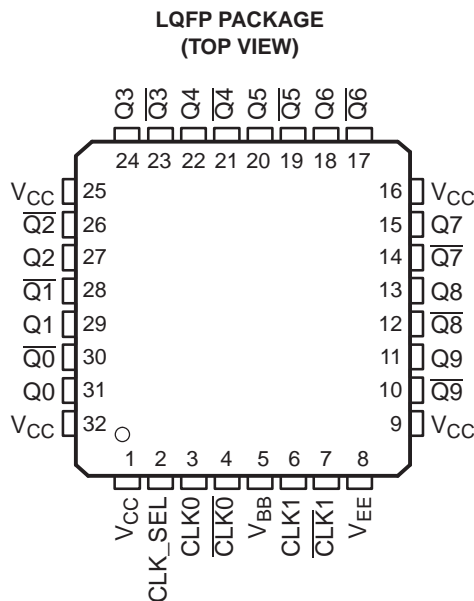
### DESCRIPTION

The CDCLVP110 clock driver distributes one differential clock pair of either LVPECL or HSTL (selectable) input, (CLK0, CLK1) to ten pairs of differential LVPECL clock (Q0, Q9) outputs with minimum skew for clock distribution. The CDCLVP110 can accept two clock sources into an input multiplexer. The CLK0 input accepts either LVECL/LVPECL input signals, while CLK1 accepts an HSTL input signal when operated under LVPECL conditions. The CDCLVP110 is specifically designed for driving 50- $\Omega$  transmission lines.

The VBB reference voltage output is used if single-ended input operation is required. In this case the VBB pin should be connected to  $\overline{\text{CLK0}}$  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 CDCLVP110 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, $\overline{\text{CLK1}}$



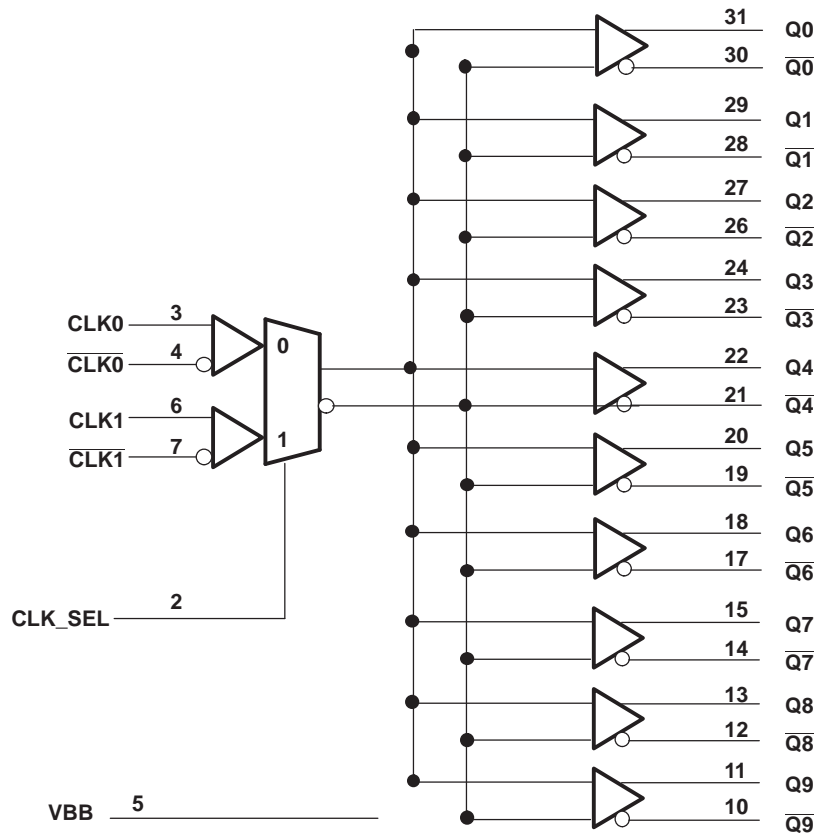
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

# CDCLVP110

SCAS683D – JUNE 2002 – REVISED JANUARY 2011

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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.



## TERMINAL FUNCTIONS

TERMINAL		DESCRIPTION
NAME	NO.	
CLK_SEL	2	Clock select. Used to select between CLK0 and CLK1 input pairs.
CLK0, $\overline{\text{CLK0}}$	3, 4	Differential LVECL/LVPECL input pair
CLK1, $\overline{\text{CLK1}}$	6, 7	Differential HSTL input pair
Q [9:0]	11, 13, 15, 18, 20, 22, 24, 27, 29, 31	LVECL/LVPECL clock outputs, these outputs provide low-skew copies of CLKn.
$\overline{\text{Q}}$ [9:0]	10, 12, 14, 17, 19, 21, 23, 26, 28, 30	LVECL/LVPECL complementary clock outputs, these outputs provide copies of $\overline{\text{CLKn}}$ .
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

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

		VALUE	UNIT
V <sub>CC</sub>	Supply voltage	-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	-0.3 to 4.6	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

- (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> <sup>(1)</sup>	Operating free-air temperature	-40		85	°C

- (1) Operating junction temperature affects device lifetime. The continuous operation junction temperature is recommended to be at max 110°C. The device ac and dc parameters are specified up to 85°C ambient temperature. See the *PCB Layout Guidelines for CDCLVP110* application note, literature number SCAA057 for more details.

**PACKAGE THERMAL IMPEDANCE**

		TEST CONDITIONS	MIN	MAX	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.

**LVECL DC ELECTRICAL CHARACTERISTICS**

V<sub>supply</sub>: V<sub>CC</sub> = 0 V, V<sub>EE</sub> = -2.375 V to -3.8 V

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
I <sub>EE</sub>	Supply internal current Absolute value of current	-40°C	40	78	mA		
		25°C	45	82			
		85°C	48	85			
I <sub>CC</sub>	Output and internal supply current All outputs terminated 50 Ω to V <sub>CC</sub> - 2 V	-40°C		343	mA		
		25°C		370			
		85°C		380			
I <sub>IN</sub>	Input current	-40°C, 25°C, 85°C		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>INPP</sub>	Input amplitude (CLK0, CLK0)	Difference of input 9 V <sub>IH</sub> -V <sub>IL</sub> , See Note <sup>(1)</sup>	-40°C, 25°C, 85°C	0.5	1.3	V	
V <sub>CM</sub>	Common-mode voltage (CLK0, CLK0)	Cross point of input 9 average (V <sub>IH</sub> , V <sub>IL</sub> )	-40°C, 25°C, 85°C	V <sub>EE</sub> + 0.975	-0.3	V	
V <sub>OH</sub>	High-level output voltage	I <sub>OH</sub> = -21 mA	-40°C	-1.26	-0.9	V	
		25°C	-1.2	-0.9			
		85°C	-1.15	-0.9			

- (1) V<sub>INPP</sub> minimum and maximum is required to maintain ac specifications, actual device function tolerates a minimum V<sub>INPP</sub> of 100 mV.

# CDCLVP110

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## LVECL DC ELECTRICAL CHARACTERISTICS (continued)

 $V_{supply}: V_{CC} = 0\text{ V}, V_{EE} = -2.375\text{ V to } -3.8\text{ V}$ 

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{OL}$	Low-level output voltage	$I_{OL} = -5\text{ mA}$	$-40^{\circ}\text{C}$	-1.85		-1.5	V
			$25^{\circ}\text{C}$	-1.85		-1.45	
			$85^{\circ}\text{C}$	-1.85		-1.4	
$V_{OD}$	Differential output voltage swing	Terminated with $50\ \Omega$ to $V_{CC} - 2\text{ V}$ , See <a href="#">Figure 3</a>	$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$	600			V

## LVPECL/HSTL DC ELECTRICAL CHARACTERISTICS

 $V_{supply}: V_{CC} = 2.375\text{ V to } 3.8\text{ V}, V_{EE} = 0\text{ V}$ 

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$I_{EE}$	Supply internal current	Absolute value of current	$-40^{\circ}\text{C}$	40		78	mA
			$25^{\circ}\text{C}$	45		82	
			$85^{\circ}\text{C}$	48		85	
$I_{CC}$	Output and internal supply current	All outputs terminated $50\ \Omega$ to $V_{CC} - 2\text{ V}$	$-40^{\circ}\text{C}$			343	mA
			$25^{\circ}\text{C}$			370	
			$85^{\circ}\text{C}$			380	
$I_{IN}$	Input current		$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$			150	$\mu\text{A}$
$V_{BB}$	Internally generated bias voltage	$V_{EE} = -3\text{ to } -3.8\text{ V}, I_{BB} = -0.2\text{ mA}$	$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$	$V_{CC} - 1.45$	$V_{CC} - 1.3$	$V_{CC} - 1.15$	V
		$V_{EE} = -2.375\text{ to } -2.75\text{ V}, I_{BB} = -0.2\text{ mA}$	$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$	$V_{CC} - 1.4$	$V_{CC} - 1.25$	$V_{CC} - 1.1$	
$V_{IH}$	High-level input voltage (CLK_SEL)		$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$	$V_{CC} - 1.165$		$V_{CC} - 0.88$	V
$V_{IL}$	Low-level input voltage (CLK_SEL)		$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$	$V_{CC} - 1.81$		$V_{CC} - 1.475$	V
$V_{INPP}$	Input amplitude (CLK0, CLK0)	Difference of input 9 $V_{IH} - V_{IL}$ , see Note <sup>(1)</sup>	$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$	0.5		1.3	V
$V_{IC}$	Common-mode voltage (CLK0, CLK0)	Cross point of input 9 average ( $V_{IH}, V_{IL}$ )	$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$	0.975		$V_{CC} - 0.3$	V
$V_{ID}$	Differential input voltage (CLK1, CLK1)	Difference of input $V_{IH} - V_{IL}$ , See Note <sup>(1)</sup>	$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$	0.4		1.9	V
$V_{I(x)}$	Input crossover voltage (CLK1, CLK1)	Cross point of input 9 average ( $V_{IH}, V_{IL}$ )	$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$	0.68		0.9	V
$V_{OH}$	High-level output voltage	$I_{OH} = -21\text{ mA}$	$-40^{\circ}\text{C}$	$V_{CC} - 1.26$		$V_{CC} - 0.9$	V
			$25^{\circ}\text{C}$	$V_{CC} - 1.2$		$V_{CC} - 0.9$	
			$85^{\circ}\text{C}$	$V_{CC} - 1.15$		$V_{CC} - 0.9$	
$V_{OL}$	Low-level output voltage	$I_{OL} = -5\text{ mA}$	$-40^{\circ}\text{C}$	$V_{CC} - 1.85$		$V_{CC} - 1.5$	V
			$25^{\circ}\text{C}$	$V_{CC} - 1.85$		$V_{CC} - 1.45$	
			$85^{\circ}\text{C}$	$V_{CC} - 1.85$		$V_{CC} - 1.4$	
$V_{OD}$	Differential output voltage swing	Terminated with $50\ \Omega$ to $V_{CC} - 2\text{ V}$ , See <a href="#">Figure 4</a>	$-40^{\circ}\text{C}, 25^{\circ}\text{C}, 85^{\circ}\text{C}$	600			mV

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

## AC ELECTRICAL CHARACTERISTICS

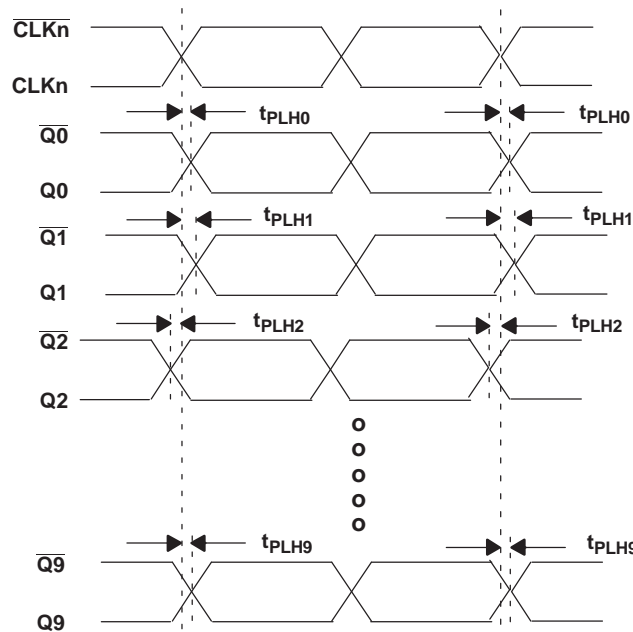
Vsupply:  $V_{CC} = 2.375\text{ V to }3.8\text{ V}$ ,  $V_{EE} = 0\text{ V}$  or LVECL/LVPECL input  $V_{CC} = 0\text{ V}$ ,  $V_{EE} = -2.375\text{ V to }-3.8\text{ V}$

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{pd}$	Differential propagation delay CLK0, CLK0 to all Q0, Q0... Q9, Q9	Input condition: $V_{CM} = 1\text{ V}$ , $V_{PP} = 0.5\text{ V}$	-40°C, 25°C, 85°C	230		350	ps
$t_{sk(pp)}$	Part-to-part skew	See Note B and <a href="#">Figure 1</a>	-40°C, 25°C, 85°C			70	ps
$t_{sk(o)}$	Output-to-output skew	See Note A and <a href="#">Figure 1</a>	-40°C, 25°C, 85°C		15	30	ps
$t_{(JITTER)}$	Cycle-to-cycle RMS jitter		-40°C, 25°C, 85°C			< 1	ps
$f_{(max)}$	Maximum frequency	Functional up to 3.5 GHz, timing specifications apply at 1 GHz, see <a href="#">Figure 3</a>	-40°C, 25°C, 85°C			3500	MHz
$t_r/t_f$	Output rise and fall time (20%, 80%)		-40°C, 25°C, 85°C	100		200	ps

## HSTL INPUT

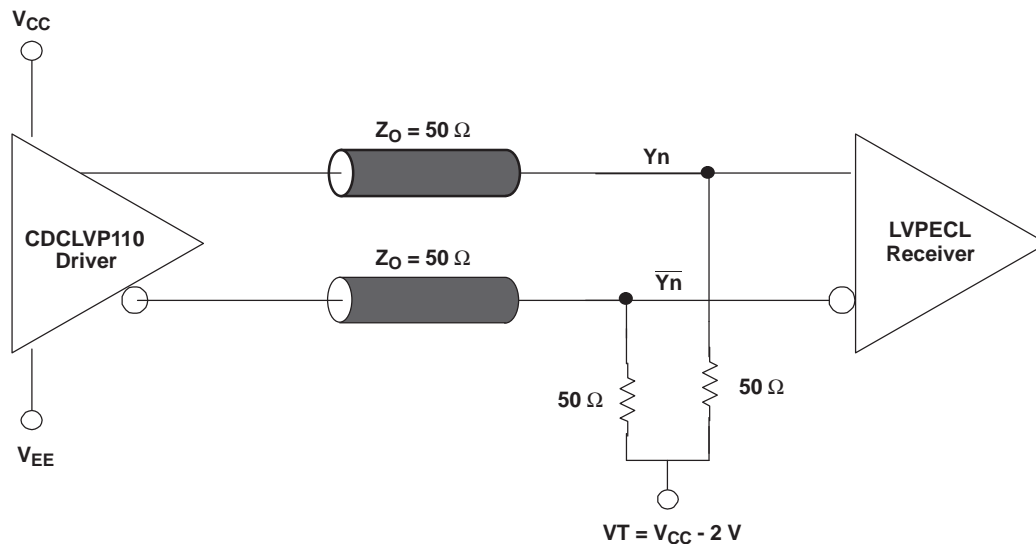
Vsupply:  $V_{CC} = 2.375\text{ V to }3.8\text{ V}$ ,  $V_{EE} = 0\text{ V}$

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{pd}$	Differential propagation delay CLK0, CLK0 to all Q0, Q0... Q9, Q9	Input condition: $V_x = 0.68\text{ V}$ , $V_{dif} = 0.4\text{ V}$	-40°C, 25°C, 85°C	290		370	ps
$t_{sk(pp)}$	Part-to-part skew	See Note B and <a href="#">Figure 1</a>	-40°C, 25°C, 85°C			70	ps
$t_{sk(o)}$	Output to output skew	See Note A and <a href="#">Figure 1</a>	-40°C, 25°C, 85°C		10	30	ps
$t_{(JITTER)}$	Cycle-to-cycle RMS jitter		-40°C, 25°C, 85°C			< 1	ps
$f_{(max)}$	Maximum frequency	Functional up to 3.5 GHz, timing specifications apply at 1 GHz, See <a href="#">Figure 4</a>	-40°C, 25°C, 85°C			3500	MHz
$t_r/t_f$	Output rise and fall time (20%, 80%)		-40°C, 25°C, 85°C	100		200	ps



- 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.

**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)**

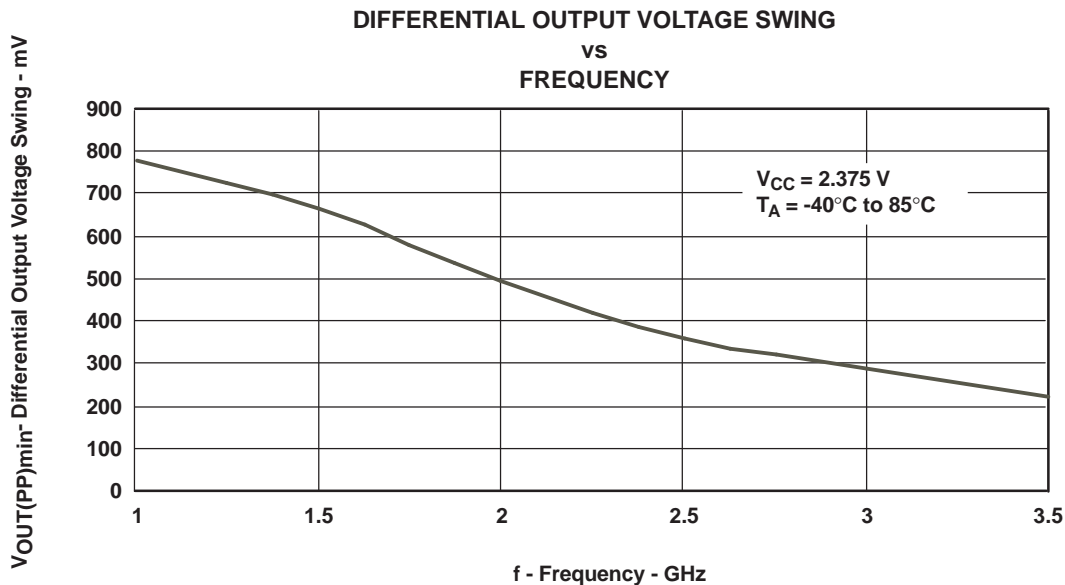


Figure 3. LVPECL Input Using CLK0 Pair, VCM = 1 V, VIN<sub>diff</sub> = 0.5 V

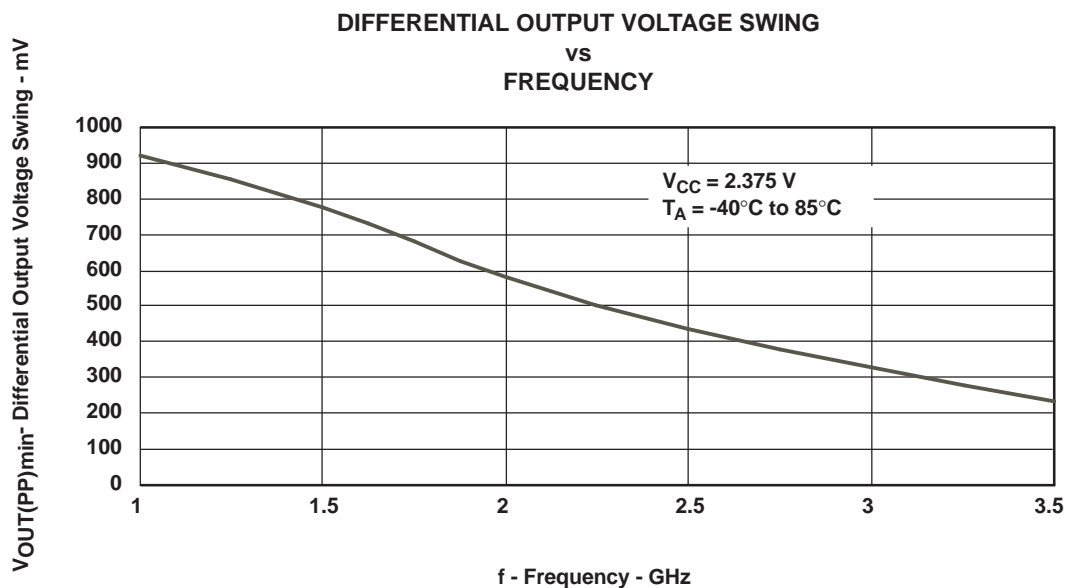


Figure 4. HSTL Input Using CLK1 Pair, VCM = 0.68 V, VIN<sub>diff</sub> = 0.4 V

## REVISION HISTORY

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### Changes from Revision A (August 2002) to Revision B Page

- Changed PACKAGE THERMAL IMPEDANCE max values ..... 3
  - Deleted  $I_{IN}$  test condition ..... 3
  - Deleted  $I_{IN}$  test condition ..... 4
- 

### Changes from Revision B (January 2010) to Revision C Page

- Changed LVECL DC spec for  $V_{BB}$  ( $V_{EE} = -3$  to  $-3.8$  V) from 3 rows to 1 row and added TYP value. .... 3
  - Changed LVECL DC spec for  $V_{BB}$  ( $V_{EE} = -2.375$  to  $-2.75$  V); MIN value from  $-1.38$  V to  $-1.4$  V, MAX from  $-1.16$  V to  $-1.1$  V, and added TYP value of  $-1.25$  V ..... 3
  - Changed LVECL/HSTL DC spec for  $V_{BB}$  ( $V_{EE} = -3$  to  $-3.8$  V) from 3 rows to 1 row and added TYP value. .... 4
  - Changed LVECL/HSTL DC spec for  $V_{BB}$  ( $V_{EE} = -2.375$  to  $-2.75$  V); MIN value from  $V_{CC} -1.38$  V to  $V_{CC} -1.4$  V; MAX from  $V_{CC} -1.16$  V to  $V_{CC} -1.1$  V; and added TYP value of  $V_{CC} -1.25$  V ..... 4
- 

### Changes from Revision C (January 2011) to Revision D Page

- Changed  $V_{CM}$  spec from  $V_{EE}+1$  to  $V_{EE}+0.975$  ..... 3
  - Changed  $V_{IC}$  spec from 1 to 0.975 ..... 4
-



**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)	Top-Side Markings (4)	Samples
CDCLVP110MVFR	ACTIVE	LQFP	VF	32	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVP110	<a href="#">Samples</a>
CDCLVP110MVFRG4	ACTIVE	LQFP	VF	32	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVP110	<a href="#">Samples</a>
CDCLVP110VF	ACTIVE	LQFP	VF	32	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVP110	<a href="#">Samples</a>
CDCLVP110VFG4	ACTIVE	LQFP	VF	32	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVP110	<a href="#">Samples</a>
CDCLVP110VFR	ACTIVE	LQFP	VF	32	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVP110	<a href="#">Samples</a>
CDCLVP110VFRG4	ACTIVE	LQFP	VF	32	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVP110	<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) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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## TAPE AND REEL INFORMATION



### 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
CDCLVP110MVFR	LQFP	VF	32	1000	330.0	16.4	9.6	9.6	1.9	12.0	16.0	Q1
CDCLVP110VFR	LQFP	VF	32	1000	330.0	16.4	9.6	9.6	1.9	12.0	16.0	Q2

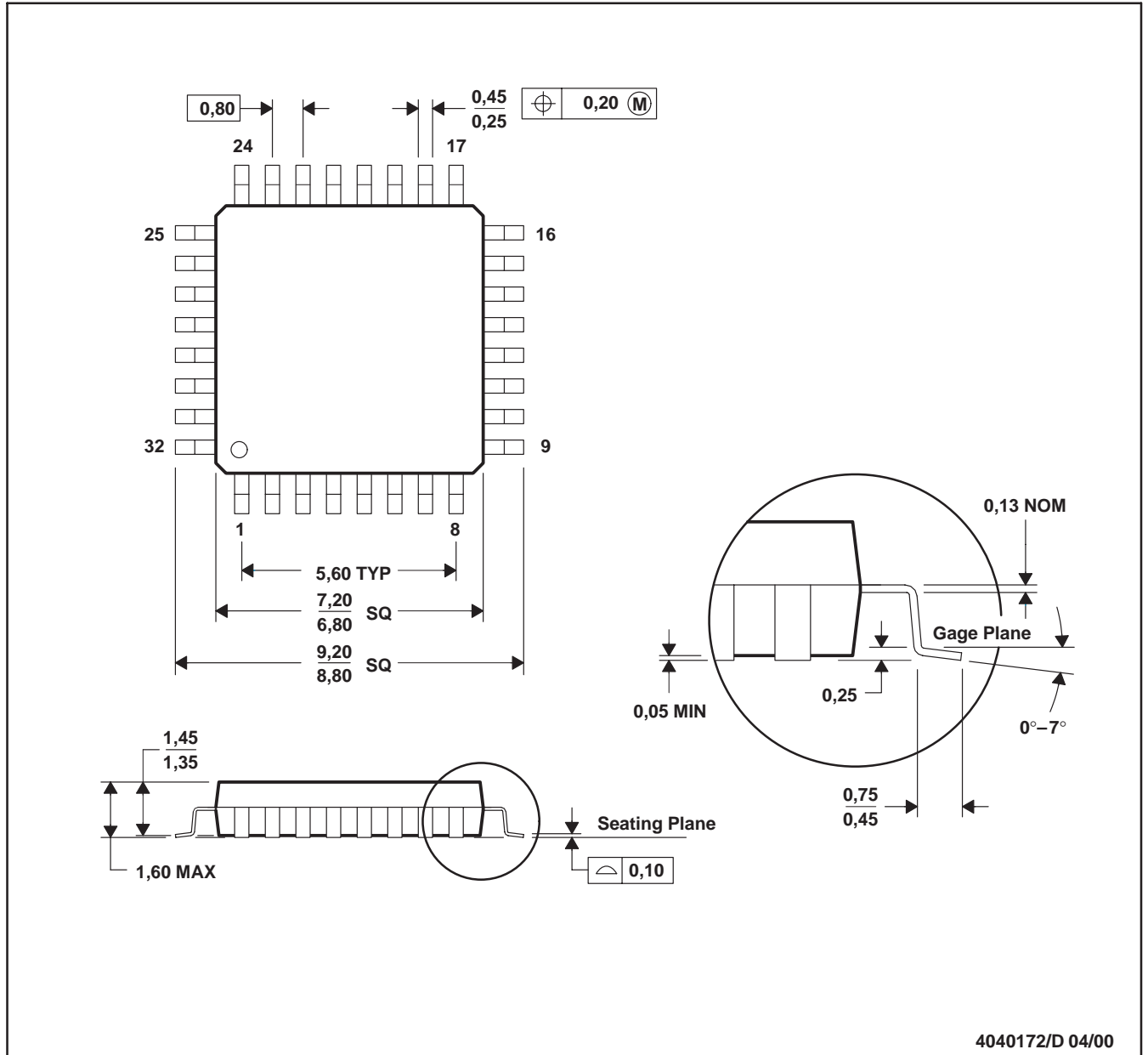
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDCLVP110MVFR	LQFP	VF	32	1000	367.0	367.0	38.0
CDCLVP110VFR	LQFP	VF	32	1000	367.0	367.0	38.0

VF (S-PQFP-G32)

PLASTIC QUAD FLATPACK



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

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