

## LOW-VOLTAGE 1:10 LVPECL/HSTL WITH SELECTABLE INPUT CLOCK DRIVER

### 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

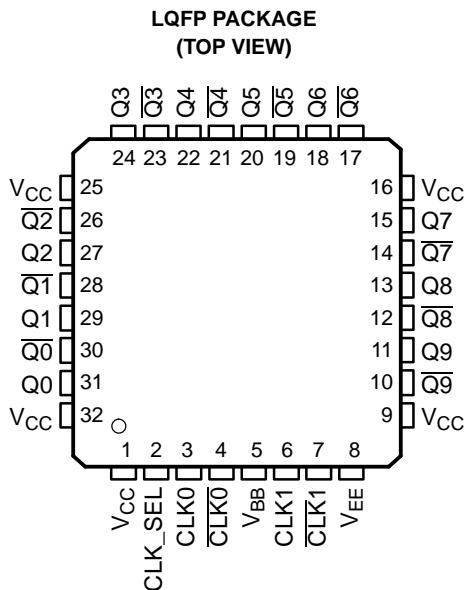
### DESCRIPTION

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  $85^{\circ}\text{C}$ .

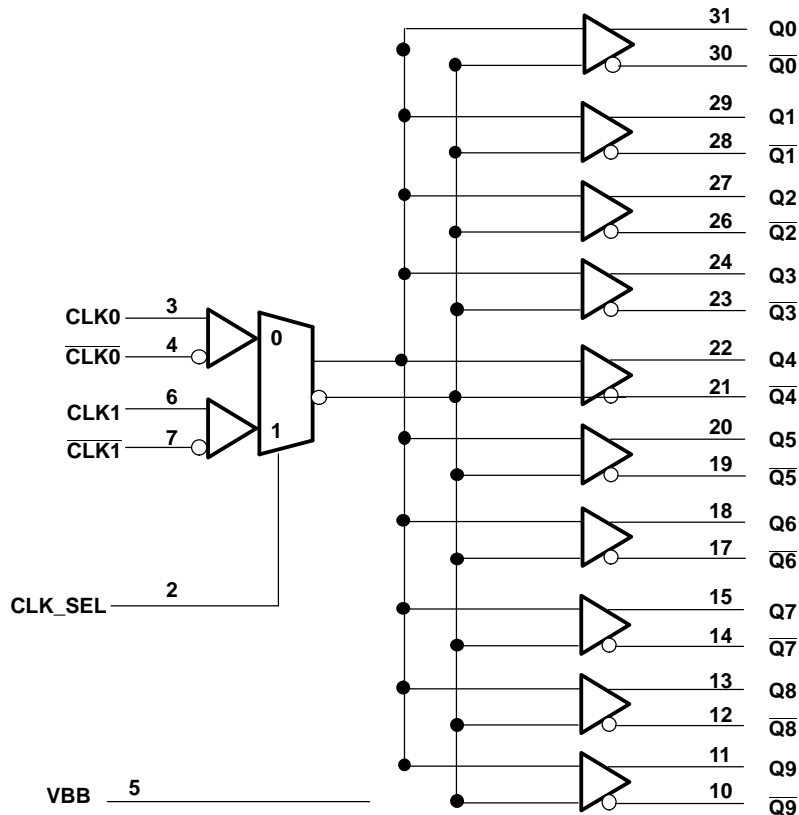


### FUNCTION TABLE

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.



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>**

V <sub>CC</sub>	Supply voltage	-0.3 V to 4.6 V
V <sub>I</sub>	Input voltage	-0.3 V to V <sub>CC</sub> + 0.5 V
V <sub>O</sub>	Output voltage	-0.3 V 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 V 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°C 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 CONDITION	MIN	MAX	UNIT
Θ <sub>JA</sub>	Thermal resistance junction to ambient <sup>(1)</sup>	0 LFM		78	°C/W
		150 LFM		73	°C/W
		250 LFM		71	°C/W
		500 LFM		68	°C/W
Θ <sub>JC</sub>	Thermal resistance junction to case			51	°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 Includes pullup/pulldown resistors	-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	-1.38	-1.26	V
			25°C	-1.42	-1.26	
			85°C	-1.45	-1.26	
		V <sub>EE</sub> = -2.375 to -2.75 V, I <sub>BB</sub> = -0.2 mA	-40°C, 25°C, 85°C	-1.38	-1.16	
V <sub>IH</sub>	High-level input voltage (CLK_SEL)	-40°C, 25°C, 85°C	-1.165	-0.88	V	

**LVECL DC ELECTRICAL CHARACTERISTICS (continued)**Vsupply:  $V_{CC} = 0\text{ V}$ ,  $V_{EE} = -2.375\text{ V}$  to  $-3.8\text{ V}$ 

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{IL}$	Low-level input voltage (CLK_SEL)		-40°C, 25°C, 85°C	-1.81	-1.475	V
$V_{INPP}$	Input amplitude (CLK0, $\overline{\text{CLK0}}$ )	Difference of input 9 $V_{IH}-V_{IL}$ , See Note (1)	-40°C, 25°C, 85°C	0.5	1.3	V
$V_{CM}$	Common-mode voltage (CLK0, $\overline{\text{CLK0}}$ )	Cross point of input 9 average ( $V_{IH}$ , $V_{IL}$ )	-40°C, 25°C, 85°C	$V_{EE} + 1$	-0.3	V
$V_{OH}$	High-level output voltage	$I_{OH} = -21\text{ mA}$	-40°C	-1.26	-0.9	V
			25°C	-1.2	-0.9	
			85°C	-1.15	-0.9	
$V_{OL}$	Low-level output voltage	$I_{OL} = -5\text{ mA}$	-40°C	-1.85	-1.5	V
			25°C	-1.85	-1.45	
			85°C	-1.85	-1.4	
$V_{OD}$	Differential output voltage swing	Terminated with 50 $\Omega$ to $V_{CC} - 2\text{ V}$ , See Figure 3	-40°C, 25°C, 85°C	600		V

(1)  $V_{INPP}$  minimum and maximum is required to maintain ac specifications, actual device function tolerates a minimum  $V_{INPP}$  of 100 mV.**LVPECL/HSTL DC ELECTRICAL CHARACTERISTICS**Vsupply:  $V_{CC} = 2.375\text{ V}$  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°C	40	78	mA
			25°C	45	82	
			85°C	48	85	
$I_{CC}$	Output and internal supply current	All outputs terminated 50 $\Omega$ to $V_{CC} - 2\text{ V}$	-40°C		343	mA
			25°C		370	
			85°C		380	
$I_{IN}$	Input current	Includes pullup/pulldown resistors	-40°C, 25°C, 85°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°C	$V_{CC} - 1.38$	$V_{CC} - 1.26$	V
			25°C	$V_{CC} - 1.42$	$V_{CC} - 1.26$	
			85°C	$V_{CC} - 1.45$	$V_{CC} - 1.26$	
		$V_{EE} = -2.375\text{ to }-2.75\text{ V}$ , $I_{BB} = -0.2\text{ mA}$	-40°C, 25°C, 85°C	$V_{CC} - 1.38$	$V_{CC} - 1.16$	
$V_{IH}$	High-level input voltage (CLK_SEL)	-40°C, 25°C, 85°C		$V_{CC} - 1.165$	$V_{CC} - 0.88$	V
$V_{IL}$	Low-level input voltage (CLK_SEL)	-40°C, 25°C, 85°C		$V_{CC} - 1.81$	$V_{CC} - 1.475$	V
$V_{INPP}$	Input amplitude (CLK0, $\overline{\text{CLK0}}$ )	Difference of input 9 $V_{IH}-V_{IL}$ , see Note (1)	-40°C, 25°C, 85°C	0.5	1.3	V
$V_{IC}$	Common-mode voltage (CLK0, $\overline{\text{CLK0}}$ )	Cross point of input 9 average ( $V_{IH}$ , $V_{IL}$ )	-40°C, 25°C, 85°C	1	$V_{CC} - 0.3$	V

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

**LVPECL/HSTL DC ELECTRICAL CHARACTERISTICS (continued)**

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{ID}$	Differential input voltage (CLK1, $\overline{\text{CLK1}}$ ) Difference of input $V_{IH}-V_{IL}$ , See Note (1)	-40°C, 25°C, 85°C	0.4	1.9	V
$V_{I(x)}$	Input crossover voltage (CLK1, $\overline{\text{CLK1}}$ ) Cross point of input 9 average ( $V_{IH}$ , $V_{IL}$ )	-40°C, 25°C, 85°C	0.68	0.9	V
$V_{OH}$	High-level output voltage $I_{OH} = -21\text{ mA}$	-40°C	$V_{CC} - 1.26$	$V_{CC} - 0.9$	V
		25°C	$V_{CC} - 1.2$	$V_{CC} - 0.9$	
		85°C	$V_{CC} - 1.15$	$V_{CC} - 0.9$	
$V_{OL}$	Low-level output voltage $I_{OL} = -5\text{ mA}$	-40°C	$V_{CC} - 1.85$	$V_{CC} - 1.5$	V
		25°C	$V_{CC} - 1.85$	$V_{CC} - 1.45$	
		85°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 Figure 4	-40°C, 25°C, 85°C	600		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, $\overline{\text{CLK0}}$ to all Q0, $\overline{\text{Q0}}$ ... Q9, $\overline{\text{Q9}}$ 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 Figure 1	-40°C, 25°C, 85°C		70	ps
$t_{sk(o)}$	Output-to-output skew See Note A and Figure 1	-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 Figure 3	-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**

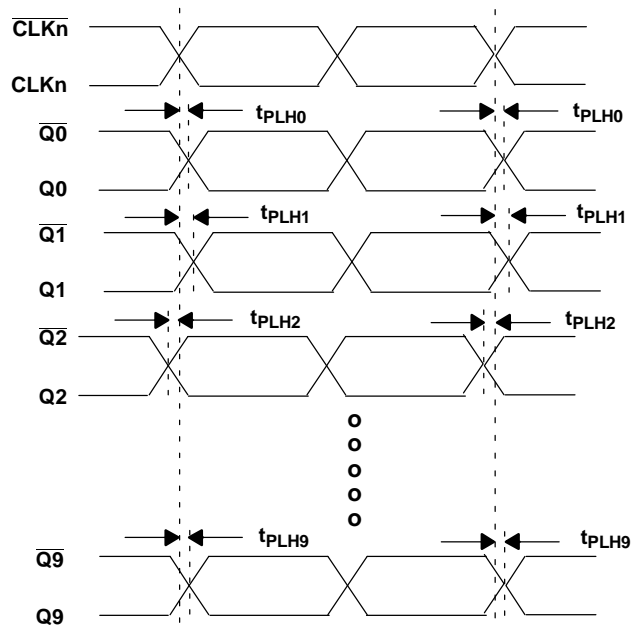
Vsupply:  $V_{CC} = 2.375\text{ V to }3.8\text{ V}$ ,  $V_{EE} = 0\text{ V}$

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{pd}$	Differential propagation delay CLK0, $\overline{\text{CLK0}}$ to all Q0, $\overline{\text{Q0}}$ ... Q9, $\overline{\text{Q9}}$ 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 Figure 1	-40°C, 25°C, 85°C		70	ps
$t_{sk(o)}$	Output to output skew See Note A and Figure 1	-40°C, 25°C, 85°C	10	30	ps
$t_{(JITTER)}$	Cycle-to-cycle RMS jitter	-40°C, 25°C, 85°C		<1	ps

**HSTL INPUT (continued)**

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT	
f <sub>(max)</sub>	Maximum frequency	Functional up to 3.5 GHz, timing specifications apply at 1 GHz, See Figure 4			3500	MHz	
t <sub>r</sub> /t <sub>f</sub>	Output rise and fall time (20%, 80%)				100	200	ps



- A. Output skew is calculated as the greater of: The difference between the fastest and the slowest t<sub>PLHn</sub> (n = 0, 1,...9) or the difference between the fastest and the slowest t<sub>PHLn</sub> (n = 0, 1,...9).
- B. Part-to-part skew, is calculated as the greater of: The difference between the fastest and the slowest t<sub>PLHn</sub> (n = 0, 1,...9) across multiple devices or the difference between the fastest and the slowest t<sub>PHLn</sub> (n = 0, 1,...9) across multiple devices.

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

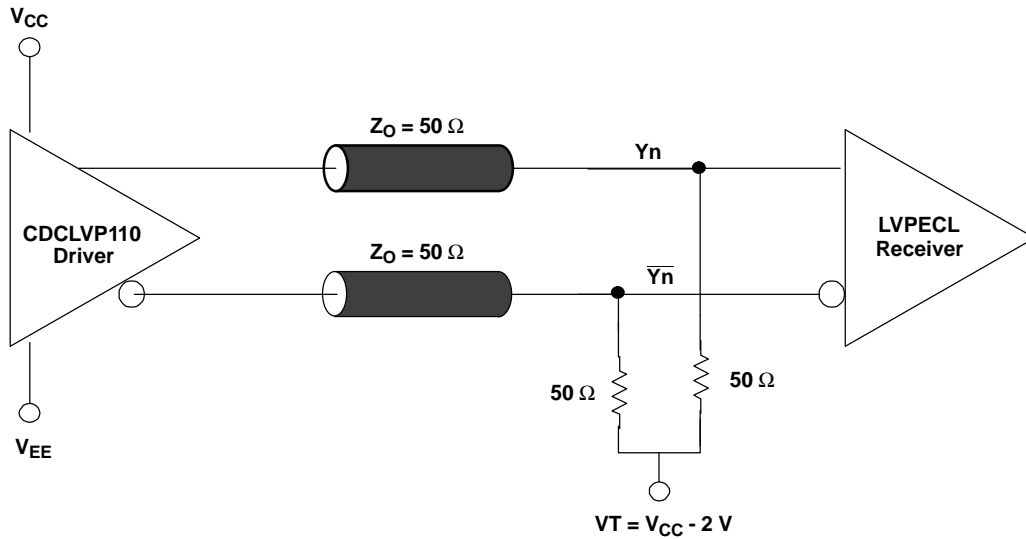


Figure 2. Typical Termination for Output Driver (See the Interfacing Between LVPECL, LVDS, and CML Application Note, Literature Number SCAA056)

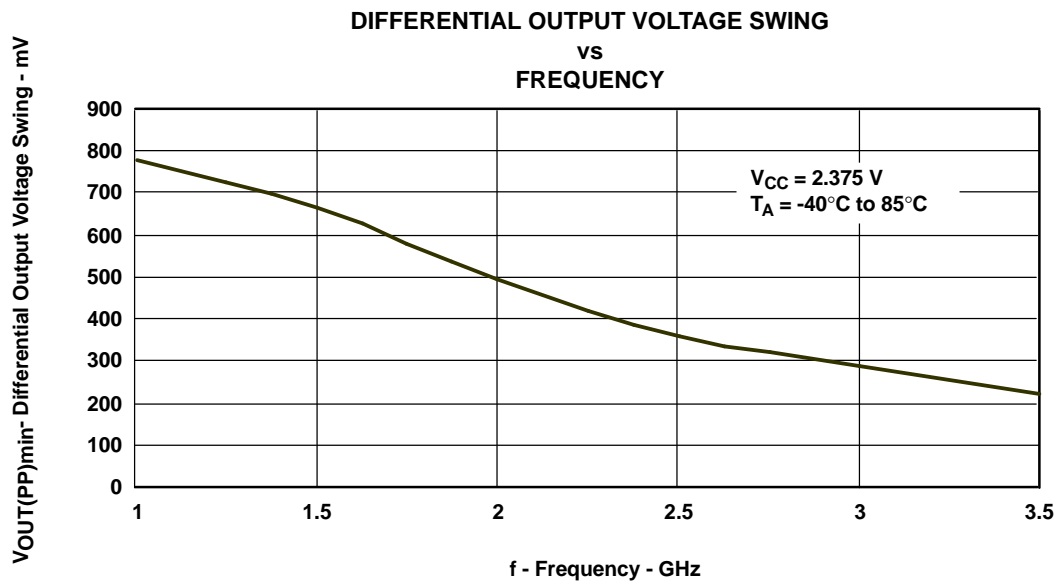


Figure 3. LVPECL Input Using CLK0 Pair,  $V_{CM} = 1 V$ ,  $V_{IN_{dif}} = 0.5 V$

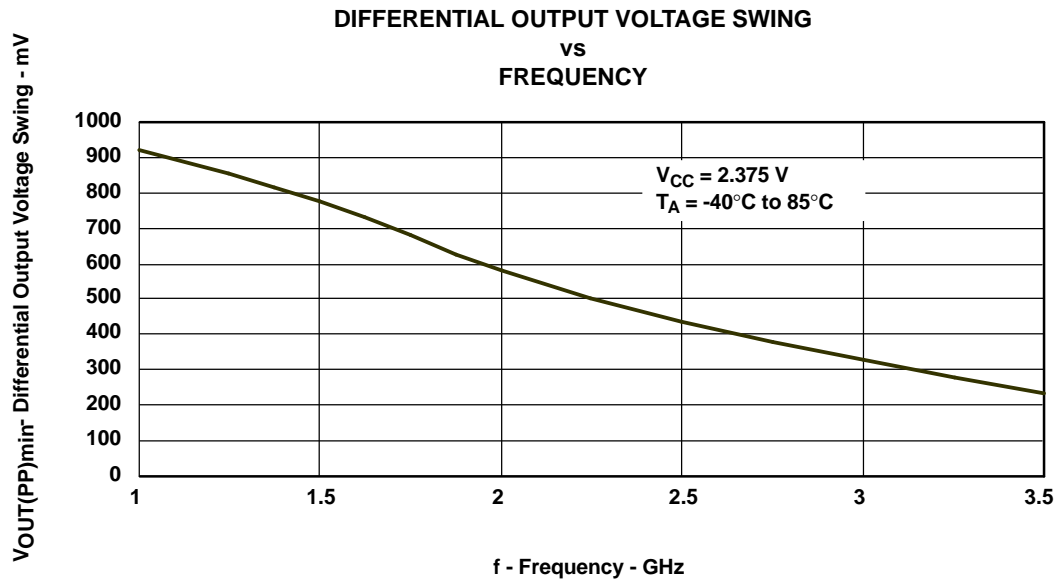


Figure 4. HSTL Input Using CLK1 Pair,  $V_{CM} = 0.68\text{ V}$ ,  $V_{IN_{dif}} = 0.4\text{ V}$



**PACKAGE INFORMATION**

Orderable Device	Status (1)	Pkg Type	Pkg Drawing	Pins	Pkg Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Peak Temp (3)
CDCLVP110VF	ACTIVE	LQFP	VF	32	250	Green (RoHS & no Sb/ Br)	CU NIPDAU	Level-1-260C-UNLIM
CDCLVP110VFG4	ACTIVE	LQFP	VF	32	250	Green (RoHS & no Sb/ Br)	CU NIPDAU	Level-1-260C-UNLIM
CDCLVP110VFR	ACTIVE	LQFP	VF	32	1000	Green (RoHS & no Sb/ Br)	CU NIPDAU	Level-1-260C-UNLIM
CDCLVP110VFRG4	ACTIVE	LQFP	VF	32	1000	Green (RoHS & no Sb/ Br)	CU NIPDAU	Level-1-260C-UNLIM
CDCLVP110MVFR*	ACTIVE	LQFP	VF	32	1000	Green (RoHS & no Sb/ Br)	CU NIPDAU	Level-1-260C-UNLIM

\* CDCLVP110MVFR equivalent to the CDCLVP110VFR except for Pin 1 orientation. Pin 1 for the CDCLVP110MVFR is in Quadrant-1 instead of the standard orientation as in the CDCLVP110VFR where Pin 1 is in Quadrant-2.

(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.

**OBSOLETE** 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 lead frame. 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.

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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**

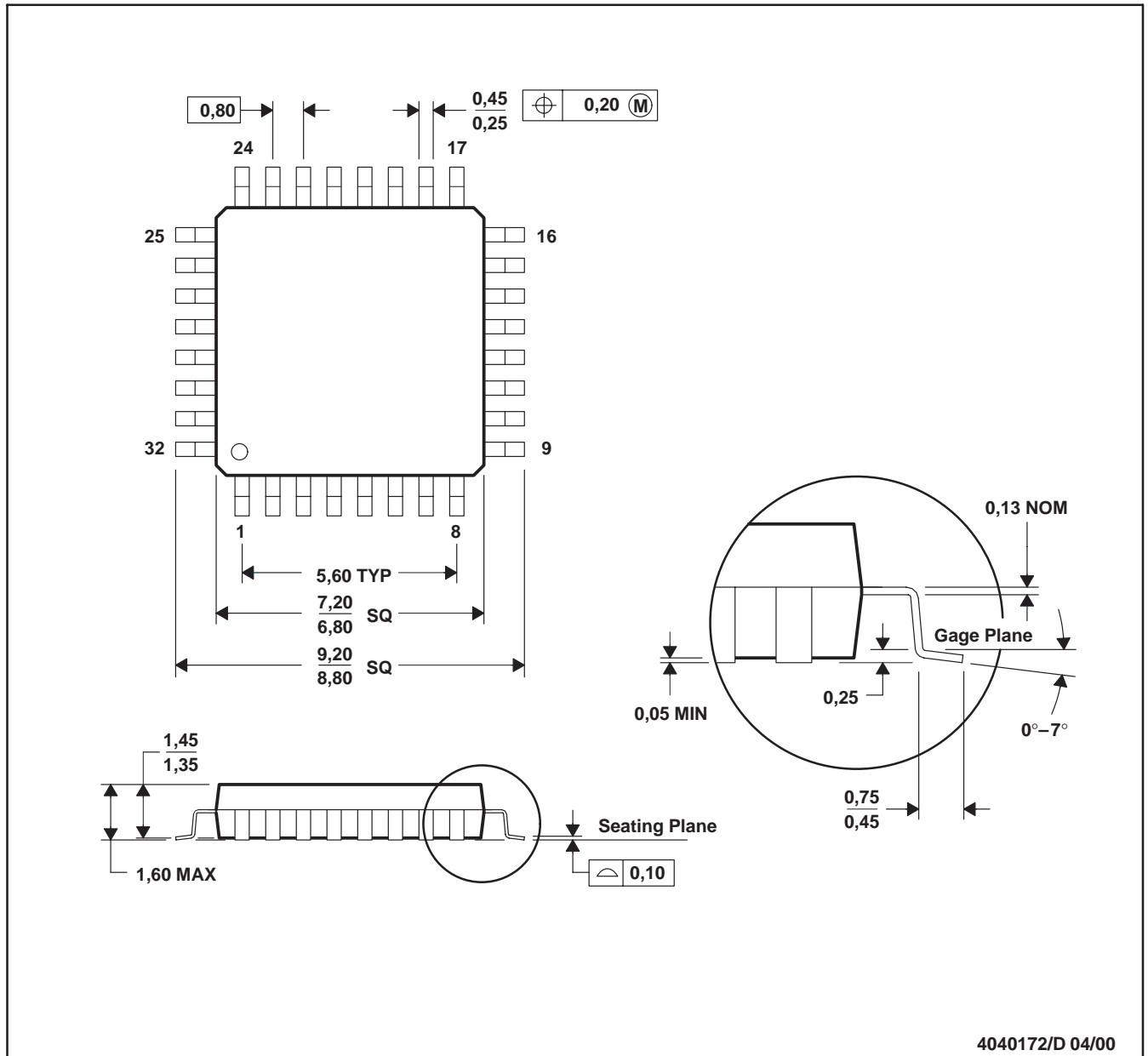


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDCLVP110MVFR	LQFP	VF	32	1000	333.2	345.9	28.6
CDCLVP110VFR	LQFP	VF	32	1000	333.2	345.9	28.6

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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DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
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