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, ±3.3-V or ±2.5-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-Ω 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 $\overline{CLK0}$ 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°C to 85°C.

LQFP PACKAGE
(TOP VIEW)
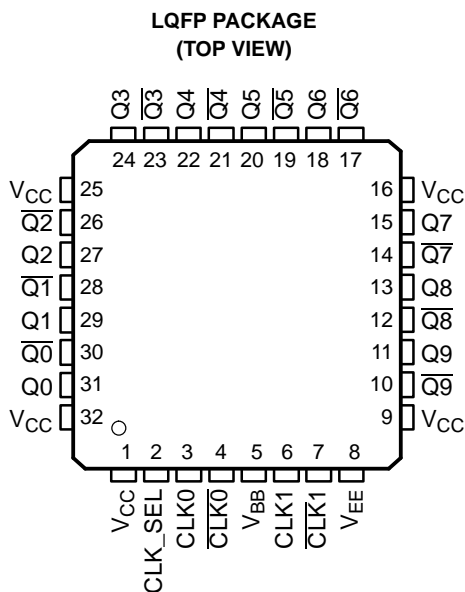
FUNCTION TABLE

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

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.
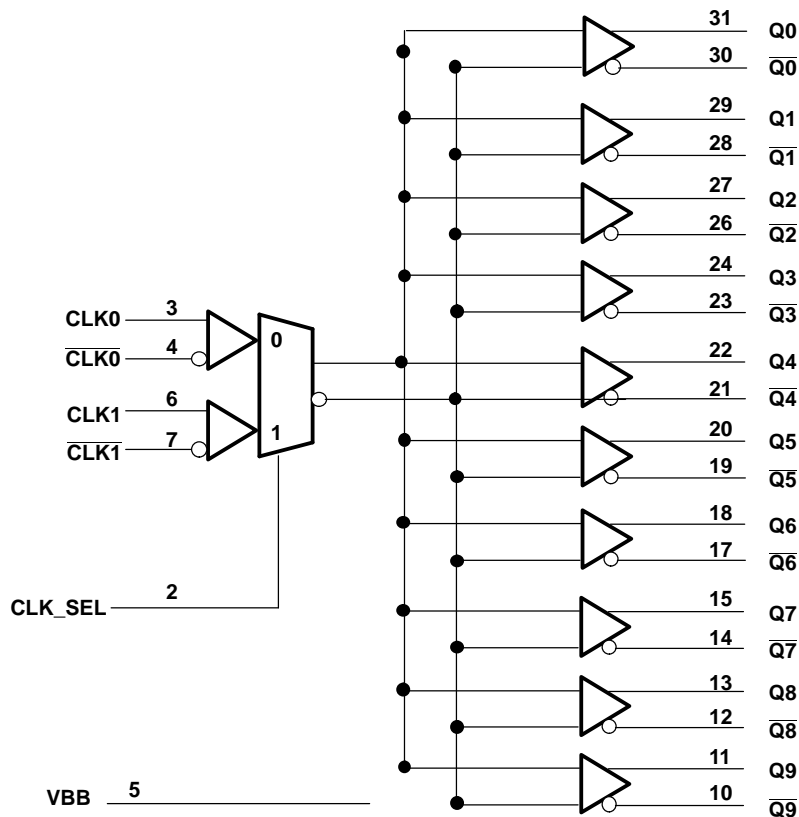
TERMINAL FUNCTIONS

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_{BB}	5	Reference voltage output for single-ended input operation
V_{CC}	1, 9, 16, 25, 32	Supply voltage
V_{EE}	8	Device ground or negative supply voltage in ECL mode

ABSOLUTE MAXIMUM RATINGS[1]

V_{CC}	Supply voltage	-0.3 V to 4.6 V
V_I	Input voltage	-0.3 V to V_{CC} + 0.5 V
V_O	Output voltage	-0.3 V to V_{CC} + 0.5 V
I_{IN}	Input current	±20 mA
V_{EE}	Negative supply voltage	-0.3 V to 4.6 V
I_{BB}	Sink/source current	-1 to 1 mA
I_O	DC output current	-50 mA
T_{stg}	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_{CC}	Supply voltage (relative to V_{EE})	2.375	2.5/3.3	3.8	V
T_A[1]	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_{JA}	Thermal resistance junction to ambient[1]	0 LFM		78	°C/W
		150 LFM		73	°C/W
		250 LFM		71	°C/W
		500 LFM		68	°C/W
Θ_{JC}	Thermal resistance junction to case			51	°C/W

(1) According to JESD 51-7 standard.

LVECL DC ELECTRICAL CHARACTERISTICS

Vsupply: V_{CC} = 0 V, V_{EE} = -2.375 V to -3.8 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 Ω to V_{CC} - 2 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	µA
V_{BB}	Internally generated bias voltage	For V_{EE} = -3 to -3.8 V, I_{BB} = -0.2 mA	-40°C	-1.38		-1.26	V
			25°C	-1.42		-1.26	
			85°C	-1.45		-1.26	
		V_{EE} = -2.375 to -2.75 V, I_{BB} = -0.2 mA	-40°C, 25°C, 85°C	-1.38		-1.16	
V_{IH}	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 V, V_{EE} = -2.375 V to -3.8 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
VIN_{PP}	Input amplitude (CLK0, $\overline{CLK0}$)	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, $\overline{CLK0}$)	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 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 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 Ω to V_{CC} - 2 V, See Figure 3	-40°C, 25°C, 85°C	600			V

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

LVPECL/HSTL DC ELECTRICAL CHARACTERISTICS

Vsupply: V_{CC} = 2.375 V to 3.8 V, V_{EE}= 0 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	
			85C	48		85	
I_{CC}	Output and internal supply current	All outputs terminated 50 Ω to V_{CC} - 2 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	μA
V_{BB}	Internally generated bias voltage	V_{EE} = -3 to -3.8 V, I_{BB}= -0.2 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 to -2.75 V, I_{BB} = -0.2 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
VIN_{PP}	Input amplitude (CLK0, $\overline{CLK0}$)	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, $\overline{CLK0}$)	Cross point of input 9 average (V_{IH}, V_{IL})	-40°C, 25°C, 85°C	1		V_{CC} - 0.3	V

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

LVPECL/HSTL DC ELECTRICAL CHARACTERISTICS (continued)

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

	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{ID}	Differential input voltage (CLK1, $\overline{CLK1}$)	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, $\overline{CLK1}$)	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 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 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 Ω to V_{CC} - 2 V, See Figure 4	-40°C, 25°C, 85°C	600			mV

AC ELECTRICAL CHARACTERISTICS

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

|	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{pd}	Differential propagation delay CLK0, $\overline{CLK0}$ to all Q0, $\overline{Q0}$… Q9, $\overline{Q9}$	Input condition: VCM = 1 V, V_{PP} = 0.5 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 V to 3.8 V, V_{EE} = 0 V

	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{pd}	Differential propagation delay CLK0, $\overline{CLK0}$ to all Q0, $\overline{Q0}$… Q9, $\overline{Q9}$	Input condition: V_x = 0.68 V, V_{dif} = 0.4 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

TEXAS
INSTRUMENTS
www.ti.com

HSTL INPUT (continued)

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

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$f_{(max)}$	Maximum frequency	Functional up to 3.5 GHz, timing specifications apply at 1 GHz, See Figure 4	-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
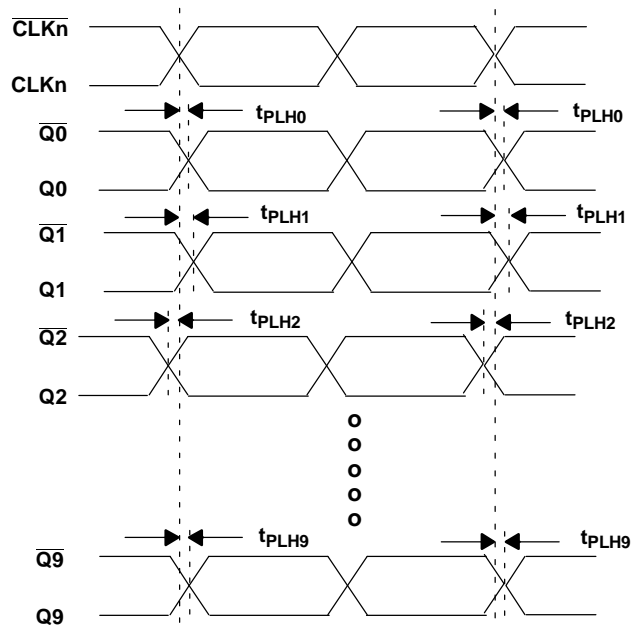
A. Output skew is calculated as the greater of: The difference between the fastest and the slowest t_{PLHn} (n = 0, 1,...9) or the difference between the fastest and the slowest t_{PHLn} (n = 0, 1,...9).

B. Part-to-part skew, is calculated as the greater of: The difference between the fastest and the slowest t_{PLHn} (n = 0, 1,...9) across multiple devices or the difference between the fastest and the slowest t_{PHLn} (n = 0, 1,...9) across multiple devices.

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

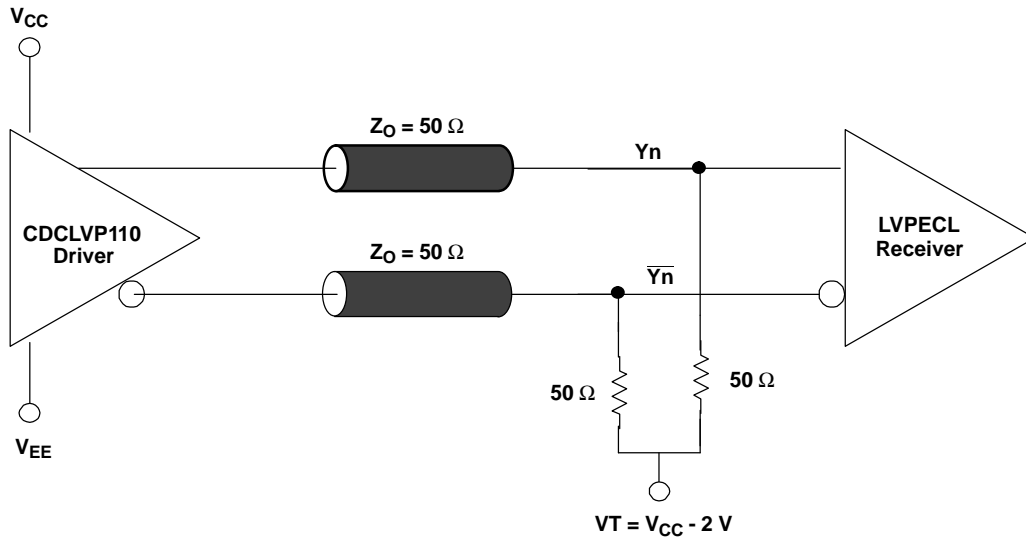**Figure 2. Typical Termination for Output Driver (See the Interfacing Between LVPECL, LVDS, and CML Application Note, Literature Number SCAA056)**
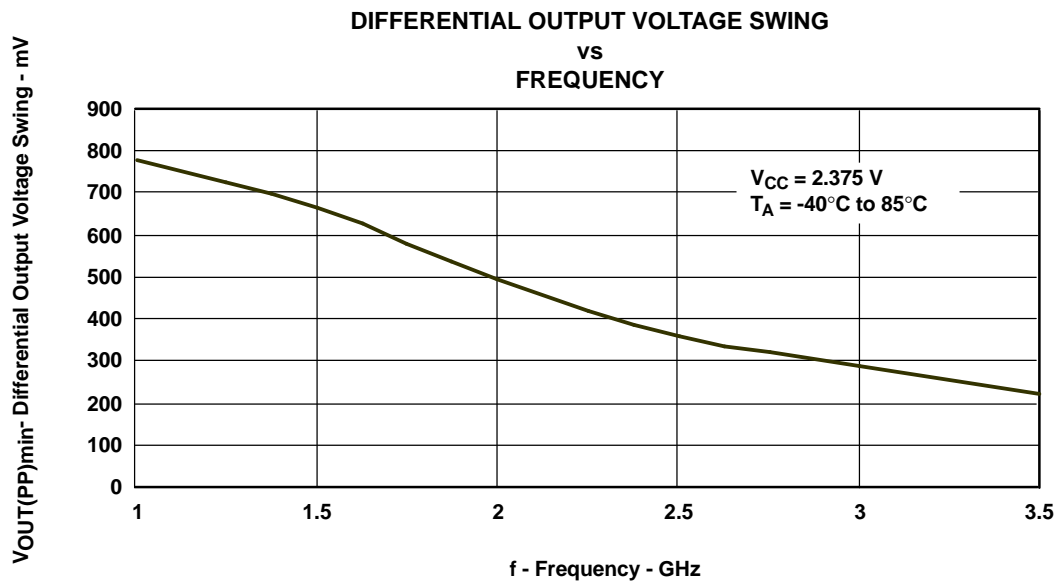

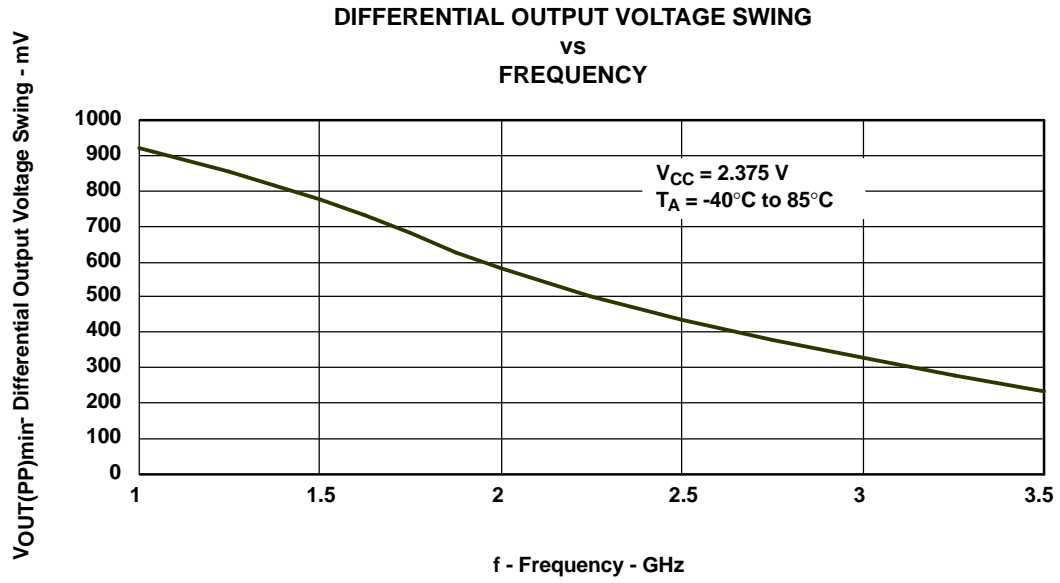**Figure 3. LVPECL Input Using CLK0 Pair, VCM = 1 V, VIN$_{dif}$ = 0.5 V**

TEXAS INSTRUMENTS
www.ti.com

DIFFERENTIAL OUTPUT VOLTAGE SWING
vs
FREQUENCY

Figure 4. HSTL Input Using CLK1 Pair, VCM = 0.68 V, VIN_{dif} = 0.4 V

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
CDCLVP110VF	ACTIVE	LQFP	VF	32	250	None	CU NIPDAU	Level-2-220C-1 YEAR
CDCLVP110VFR	ACTIVE	LQFP	VF	32	1000	None	CU NIPDAU	Level-2-220C-1 YEAR

[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 - May not be currently available - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
None: Not yet available Lead (Pb-Free).
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.
Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

[3] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDECindustry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

VF (S-PQFP-G32)   **PLASTIC QUAD FLATPACK**

4040172/D 04/00
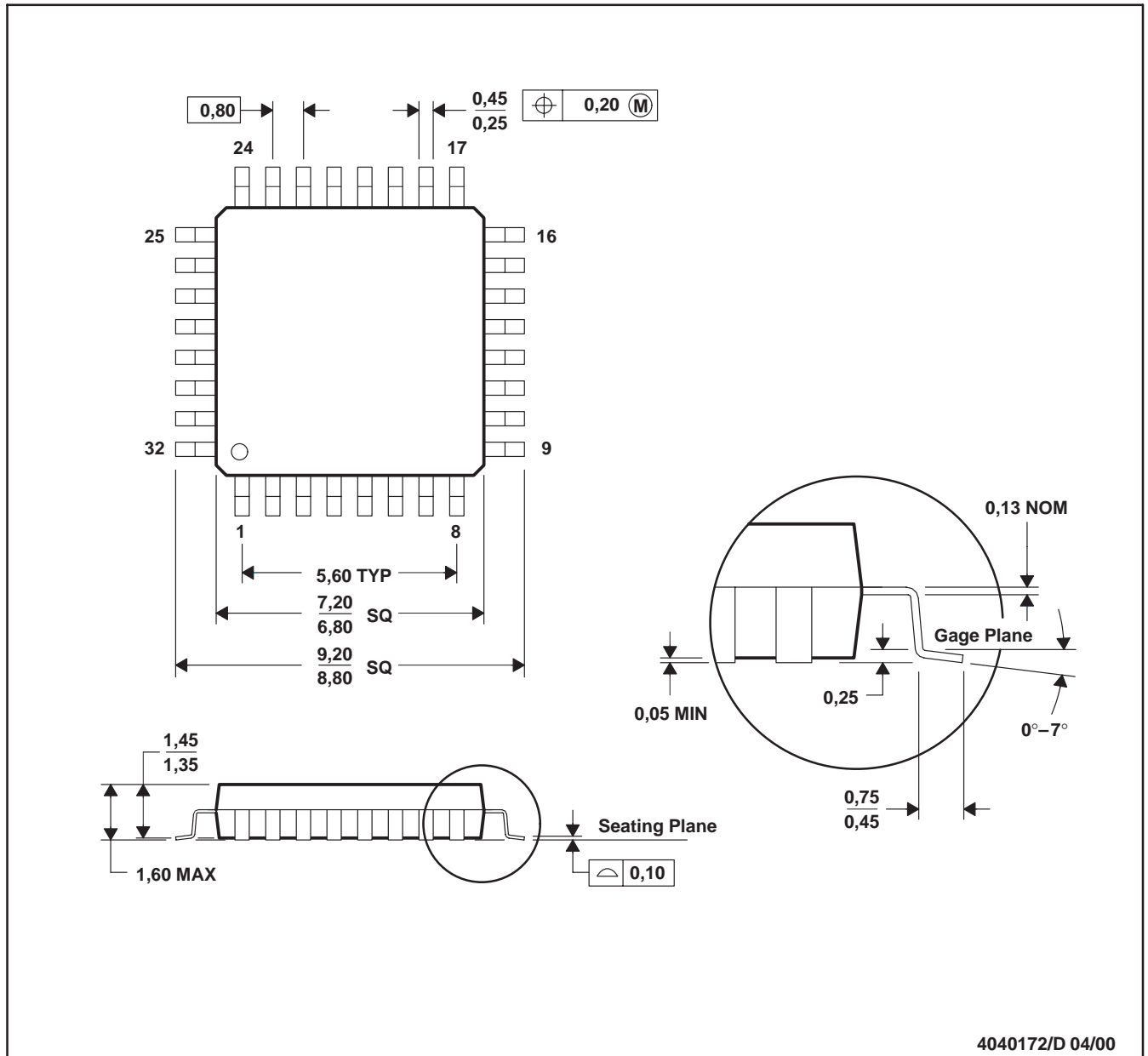
NOTES: A. All linear dimensions are in millimeters.
         B. This drawing is subject to change without notice.

TEXAS
INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

1

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments

Post Office Box 655303 Dallas, Texas 75265