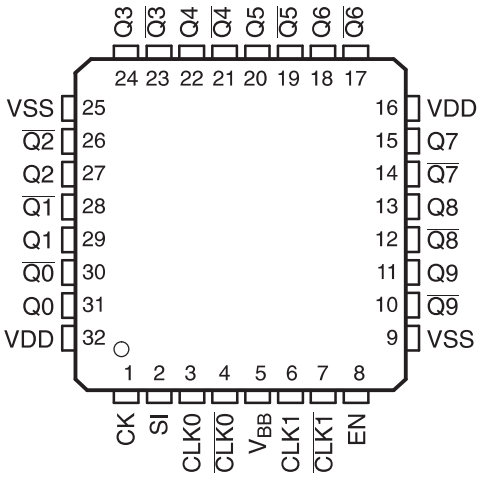
Not Recommended for New Designs
PROGRAMMABLE LOW-VOLTAGE 1:10 LVDS CLOCK DRIVER

FEATURES

- **Low-Output Skew <30 ps (Typical) for Clock-Distribution Applications**
- **Distributes One Differential Clock Input to 10 LVDS Differential Clock Outputs**
- **V_{CC} range 2.5 V ±5%**
- **Typical Signaling Rate Capability of Up to 1.1 GHz**
- **Configurable Register (SI/CK) Individually Enables Disables Outputs, Selectable CLK0, $\overline{\text{CLK0}}$ or CLK1, $\overline{\text{CLK1}}$ Inputs**
- **Full Rail-to-Rail Common-Mode Input Range**
- **Receiver Input Threshold ±100 mV**
- **Available in 32-Pin LQFP Package**
- **Fail-Safe I/O-Pins for V_{DD} = 0 V (Power Down)**

LQFP PACKAGE
(TOP VIEW)



DESCRIPTION

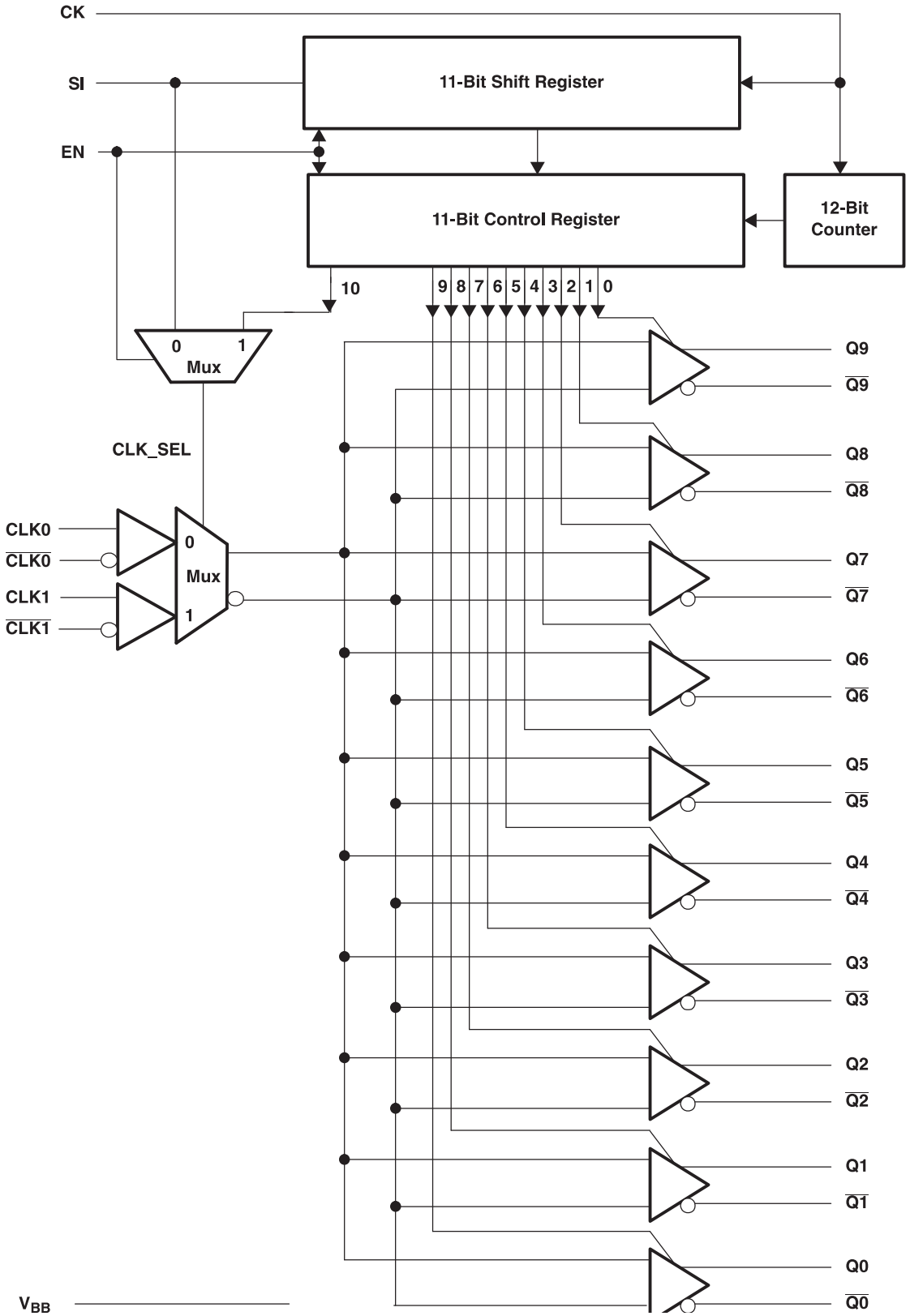
The CDCLVD110 clock driver distributes one pair of differential LVDS clock inputs (either CLK0 or CLK1) to 10 pairs of differential clock outputs (Q0, Q9) with minimum skew for clock distribution. The CDCLVD110 is specifically designed for driving 50-Ω transmission lines.

When the control enable is high (EN = 1), the 10 differential outputs are programmable in that each output can be individually enabled/disabled (3-stated) according to the first 10 bits loaded into the shift register. Once the shift register is loaded, the last bit selects either CLK0 or CLK1 as the clock input. However, when EN = 0, the outputs are not programmable and all outputs are enabled.

The CDCLVD110 is characterized for operation from –40°C to 85°C.

Not Recommended for New Designs. Use CDCLVD110A as a Replacement.

FUNCTIONAL BLOCK DIAGRAM



TERMINAL FUNCTIONS

TERMINAL		I/O	DESCRIPTION
NAME	NO.		
CK	1	I	Control register input clock, features a 120-kΩ pullup resistor
SI	2	I	Control register serial input/CLK Select, features a 120-kΩ pulldown resistor
CLK0	3	I	True differential input, LVDS
$\overline{CLK0}$	4	I	Complementary differential input, LVDS
V_{BB}	5	O	Reference voltage output
CLK1	6	I	True differential input, LVDS
$\overline{CLK1}$	7	I	Complementary differential input, LVDS
EN	8	I	Control enable (for programmability), features a 120-kΩ pulldown resistor, input
V_{SS}	9, 25		Device ground
V_{DD}	16, 32		Supply voltage
Q [9:0]	11, 13, 15, 18, 20, 22, 24, 27, 29, 31	O	Clock outputs, these outputs provide low-skew copies of CLKIN
$\overline{Q[9:0]}$	10, 12, 14, 17, 19, 21,23, 26, 28, 30	O	Complementary clock outputs, these outputs provide low-skew copies of CLKIN

ABSOLUTE MAXIMUM RATINGS(1)

		VALUE	UNIT
V_{DD}	Supply voltage	–0.3 to 2.8	V
V_I	Input voltage	–0.2 to (V_{DD} + 0.2)	V
V_O	VI Output voltage	–0.2 to (V_{DD} + 0.2)	V
Qn, $\overline{Qn}$, I_{OSD}	Driver short circuit current	Continuous	
	Electrostatic discharge (HBM 1.5 kΩ, 100 pF), ESD	>2000	V

(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_{DD}	Supply voltage	2.375	2.5	2.625	V
V_{IC}	Receiver common-mode input voltage	0.5|V_{ID}|		V_{DD} – 0.5|V_{ID}|	V
T_A	Operating free-air temperature	–40		85	°C

ELECTRICAL CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
DRIVER						
|V_{OD}|	Differential output voltage	R_L = 100Ω	250	450	600	mV
ΔV_{OD}	V_{OD} magnitude change				50	mV
V_{OS}	Offset voltage	–40°C to 85°C	0.95	1.2	1.45	V
ΔV_{OS}	V_{OS} magnitude change				350	mV
I_{OS}	Output short circuit current	V_O = 0 V			–20	mA
		|V_{OD}| = 0 V			20	
V_{BB}	Reference output voltage	V_{DD} = 2.5 V, I_{BB} = –100 µA	1.15	1.25	1.35	V
C_O	Output capacitance	V_O = V_{DD} or GND		3		pF

ELECTRICAL CHARACTERISTICS (continued)

over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
RECEIVER							
V_{IDH}	Input threshold high					100	mV
V_{IDL}	Input threshold low			–100			mV
$\|V_{ID}\|$	Input differential voltage			200			mV
I_{IH}	Input current, CLK0/$\overline{CLK0}$, CLK1/$\overline{CLK1}$		$V_I = V_{DD}$	–5		5	µA
I_{IL}			V_I = 0 V				
C_I	Input capacitance		$V_I = V_{DD}$ or GND		3		pF
SUPPLY CURRENT							
I_{DD}	Supply current	Full loaded	All outputs enabled and loaded, R_L = 100 Ω, f = 0 Hz			130	mA
		No load	Outputs enabled, no output load, f = 0 Hz			35	
I_{DDZ}		3-State	All outputs 3-state by control logic, f = 0 Hz			35	

JITTER CHARACTERISTICS

characterized with CDCLVD110 performance EVM, V_{DD} = 3.3 V, OUTPUTS NOT UNDER TEST are terminated to 50Ω

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{jitterLVDS}$	Additive phase jitter from input to LVDS output Q3 and $\overline{Q3}$	12 kHz to 5 MHz, f_{out} = 30.72 MHz		650		fs rms
		12 kHz to 20 MHz, f_{out} = 125 MHz		299		

LVDS — SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, V_{DD} = 2.5 V ±5%

PARAMETER		FROM (INPUT)	TO (OUTPUT)	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay low-to-high	CLK0, $\overline{CLK0}$ CLK1, $\overline{CLK1}$	Qn, $\overline{Qn}$		2	3	ns
t_{PHL}	Propagation delay high-to-low	CLK0, $\overline{CLK0}$ CLK1, $\overline{CLK1}$	Qn, $\overline{Qn}$		2	3	ns
t_{duty}	Duty cycle	CLK0, $\overline{CLK0}$ CLK1, $\overline{CLK1}$	Qn, $\overline{Qn}$	45%		55%	
$t_{sk(o)}$	Output skew		Any Qn, $\overline{Qn}$		30		ps
$t_{sk(p)}$	Pulse skew		Any Qn, $\overline{Qn}$			50	ps
$t_{sk(pp)}$	Part-to-part skew		Any Qn, $\overline{Qn}$			600	ps
t_r	Output rise time, 20% to 80%, R_L = 100 Ω, C_L = 5 pF		Any Qn, $\overline{Qn}$			350	ps
t_f	Output fall time, 20% to 80%, R_L = 100 Ω, C_L = 5 pF		Any Qn, $\overline{Qn}$			350	ps
f_{clk}	Max input frequency	CLK0, $\overline{CLK0}$ CLK1, $\overline{CLK1}$	Any Qn, $\overline{Qn}$	900	1100		MHz

CONTROL REGISTER CHARACTERISTICS

over recommended operating free-air temperature range, V_{DD} = 2.5 V ±5% (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{MAX}	Maximum frequency of shift register		100	150		MHz
t_{su}	Setup time, clock to SI				2	ns
t_h	Hold time, clock to SI				1.5	ns
$t_{removal}$	Removal time, enable to clock				1.5	ns
t_w	Clock pulse width, minimum		3			ns
V_{IH}	Logic input high	V_{DD} = 2.5 V	2			V
V_{IL}	Logic input low	V_{DD} = 2.5 V			0.8	V

CONTROL REGISTER CHARACTERISTICS (continued)

over recommended operating free-air temperature range, V_{DD} = 2.5 V ±5% (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{IH}	Input current, CK pin	$V_I = V_{DD}$	–5		5	µA
	Input current, SI and EN pins		10		–30	
I_{IL}	Input current, CK pin	V_I = GND	–10		30	µA
	Input current, SI and EN pins		–5		5	

SPECIFICATION OF CONTROL REGISTER

The CDCLVD110 is provided with an 11-bit, serial-in shift register and an 11-bit control register. The control Register enables/disables each output clock and selects either CLK0 or CLK1 as the input clock. The CDCLVD110 has two modes of operation:

Programmable Mode (EN=1)

The shift register utilizes a serial input (SI) and a clock input (CK). Once the shift register is loaded with 11 clock pulses, the twelfth clock pulse loads the control register. The first bit (bit 0) on SI enables the Q9, $\overline{Q9}$ output pair, and the tenth bit (bit 9) enables the Q0, $\overline{Q0}$ pair. The eleventh bit (bit 10) on SI selects either CLK0 or CLK1 as the input clock; a bit value of 0 selects CLK0, whereas a bit value of 1 selects CLK1. To restart the control register configuration, a reset of the state machine must be done with a clock pulse on CK (shift register clock input) and EN set to low. The control register can be configured only once after each reset.

Standard Mode (EN=0)

In this mode, the CDCLVD110 is not programmable and all the clock outputs are enabled. The clock input (CLK0 or CLK1) is selected with the SI pin, as is shown in the table entitled control register.

STATE-MACHINE INPUTS			
EN	**SI**	**CK**	**OUTPUT**
L	L	X	All outputs enabled, CLK0 selected, control register disabled, default state
L	H	X	All outputs enabled, CLK1 selected, control register disabled
H	L	↑	First stage stores L, other stage stores data of previous stage
H	H		First stage stores H, other stage stores data of previous stage
L	X		Reset of state machine, shift and control registers

CONTROL REGISTER		
BIT 10	**BITS [0-9]**	**Q_N[0-9]**
L	H	CLK0
H	H	CLK1
X	L	Outputs disabled

SERIAL INPUT (SI) SEQUENCE										
BIT 10	**BIT 9**	**BIT 8**	**BIT 7**	**BIT 6**	**BIT 5**	**BIT 4**	**BIT 3**	**BIT 2**	**BIT 1**	**BIT 0**
CLK_SEL	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9

TRUTH TABLE FOR CONTROL LOGIC								
CK	**EN**	**SI**	**CLK0**	**$\overline{CLK0}$**	**CLK1**	**$\overline{CLK1}$**	**Q(0-9)**	**$\overline{Q(0-9)}$**
L	L	L	L	H	X	X	L	H
L	L	L	H	L	X	X	H	L
L	L	L	Open	Open	X	X	L	H
L	L	H	X	X	L	H	L	H
L	L	H	X	X	H	L	H	L
L	L	H	X	X	Open	Open	L	H
All outputs enabled		X = Don't care						

APPLICATION INFORMATION

Fail-Safe Information

For V_{DD} = 0 V (power-down mode) the CDCLVD110 has fail-safe input and output pins. In power-on mode, fail-safe biasing at input pins can be accomplished with a 10-kΩ pullup resistor from CLK0/CLK1 to VDD and a 10-kΩ pulldown resistor from $\overline{CLK0}$/$\overline{CLK1}$ to GND.

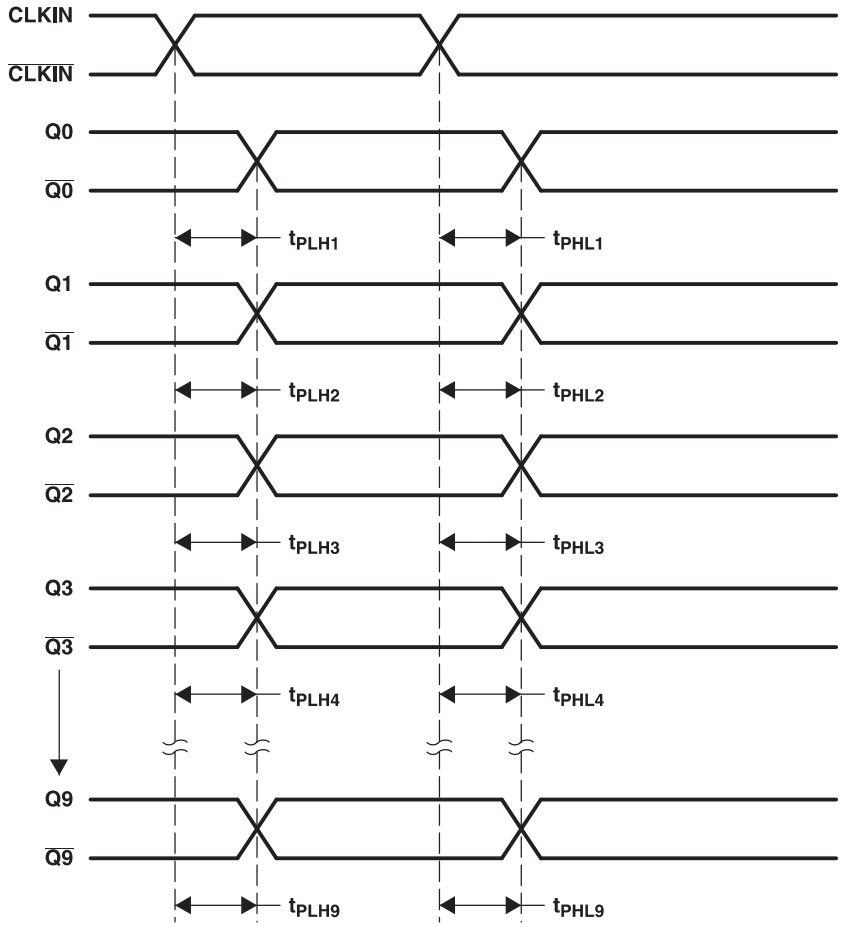
LVDS Receiver Input Termination

The LVDS receiver inputs need to have 100-Ω termination resistors placed as close as possible across the input pins.

Control Inputs Termination

No external termination is required. The CK control input has an internal 120-k. pullup resistor while SI- and EN-control inputs each have an internal 120-kΩ pulldown resistor. If the control pins are left open per the default, all outputs are enabled, CLK0, $\overline{CLK0}$ is selected, and the control register is disabled.

PARAMETER MEASUREMENT INFORMATION



A. Output skew, $t_{sk(o)}$, is calculated as the greater of:
   – The difference between the fastest and the slowest t_{PLHn} (n = 1, 2,...10)
   – The difference between the fastest and the slowest t_{PHLn} (n = 1, 2,...10)

B. Part-to-part skew, $t_{sk(pp)}$, is calculated as the greater of:
   – The difference between the fastest and the slowest t_{PLHn} (n = 1, 2,...10) across multiple devices
   – The difference between the fastest and the slowest t_{PHLn} (n = 1, 2,...10) across multiple devices

C. Pulse skew, $t_{sk(p)}$, is calculated as the magnitude of the absolute time difference between the high-to-low (t_{PHL}) and the low-to-high (t_{PLH}) propagation delays when a single switching input causes one or more outputs to switch, $t_{sk(p)} = | t_{PHL} – t_{PLH} |$. Pulse skew is sometimes referred to as pulse width distortion or duty cycle skew.

Figure 1. Waveforms for Calculation of $t_{sk(o)}$ and $t_{sk(pp)}$

PARAMETER MEASUREMENT INFORMATION (continued)

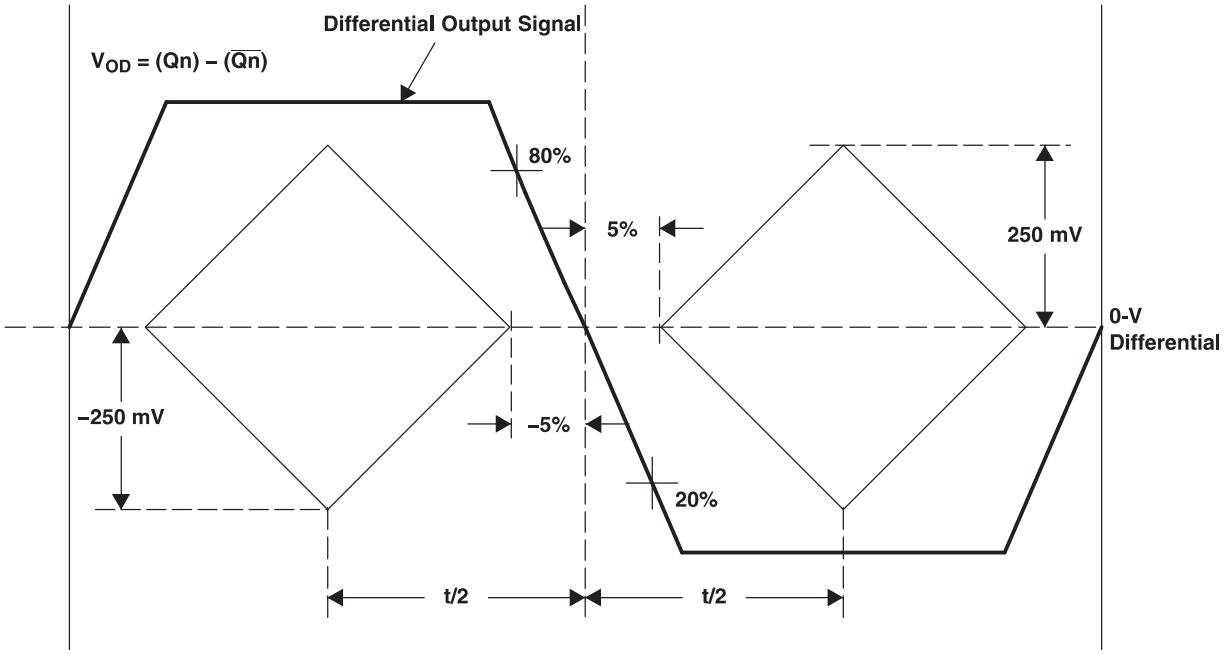


Figure 2. Test Criteria for f_{clk}, Duty Cycle, t_r, t_f, V_{OD}

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CDCLVD110VF	LIFEBUY	LQFP	VF	32	250	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVD110	
CDCLVD110VFR	LIFEBUY	LQFP	VF	32	1000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVD110	
CDCLVD110VFRG4	LIFEBUY	LQFP	VF	32	1000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDCLVD110	

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

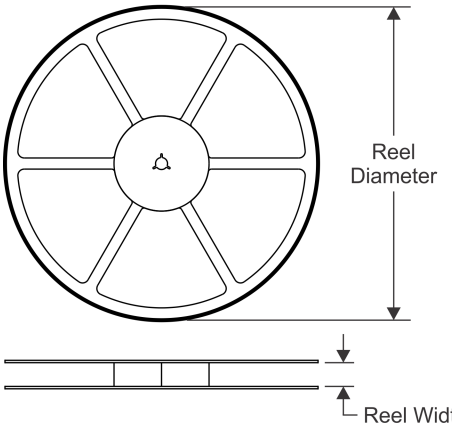
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

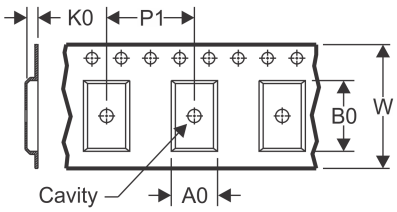
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

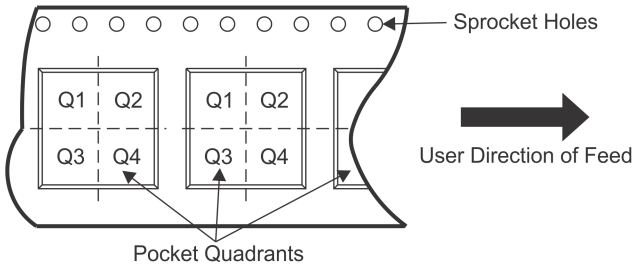


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

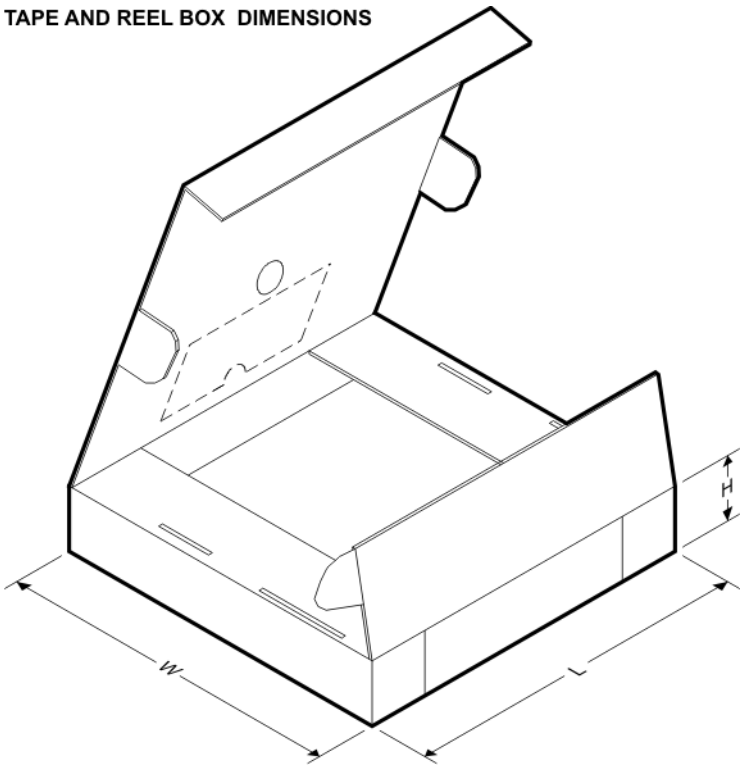
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CDCLVD110VFR	LQFP	VF	32	1000	330.0	16.4	9.6	9.6	1.9	12.0	16.0	Q2

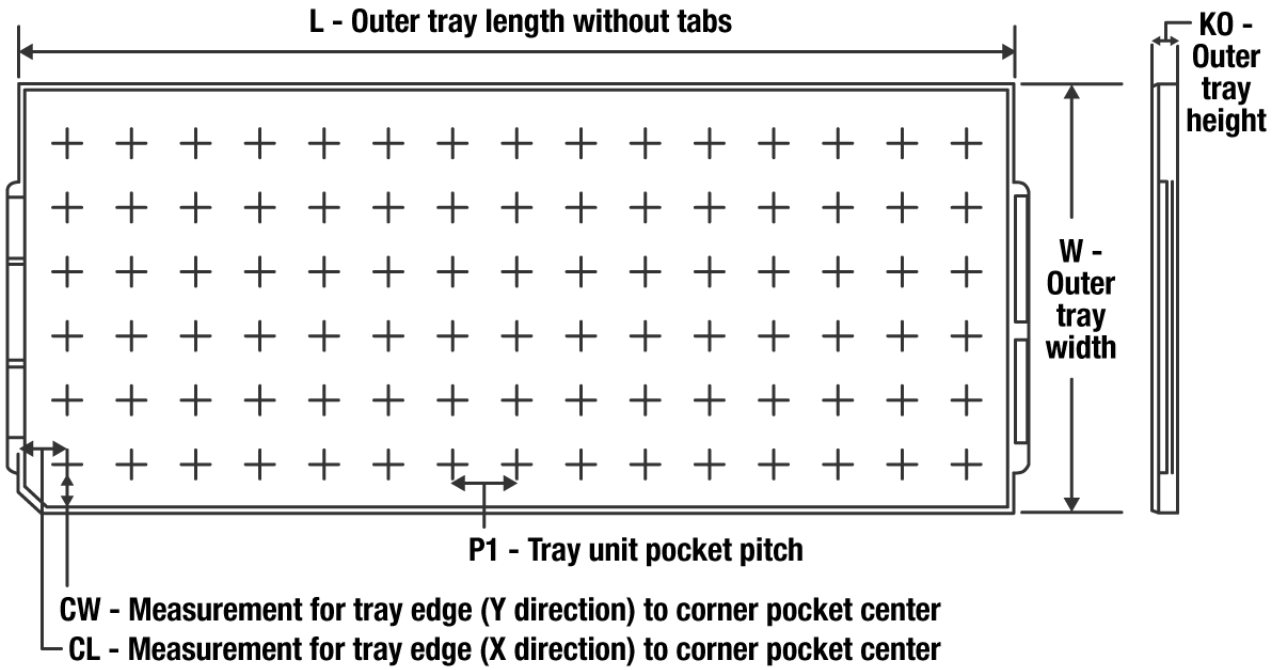
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDCLVD110VFR	LQFP	VF	32	1000	341.0	159.0	123.5

TRAY



Chamfer on Tray corner indicates Pin 1 orientation of packed units.

*All dimensions are nominal

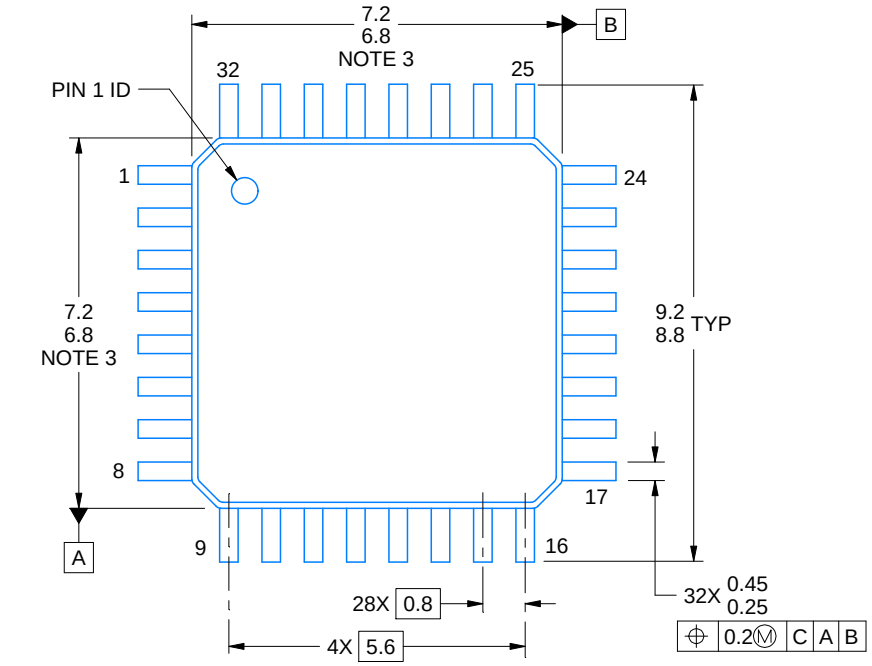
Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (µm)	P1 (mm)	CL (mm)	CW (mm)
CDCLVD110VF	VF	LQFP	32	250	10 x 25	150	315	135.9	7620	12.2	11.1	11.25

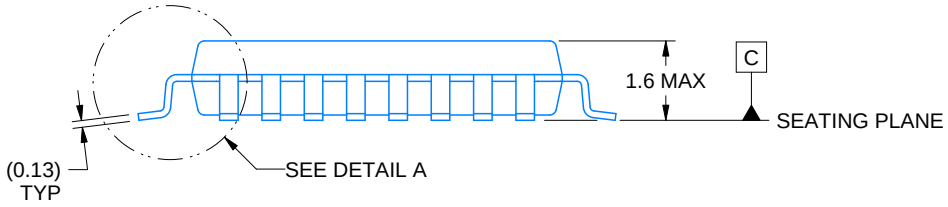
PACKAGE OUTLINE

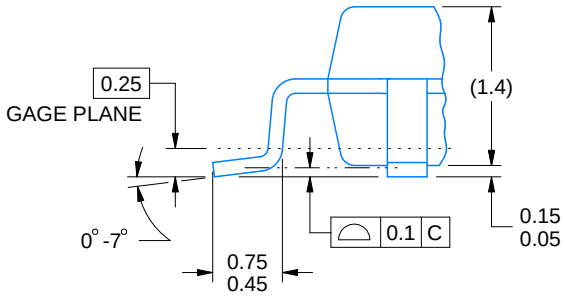
VF0032A

LQFP - 1.6 mm max height

PLASTIC QUAD FLATPACK







DETAIL A
TYPICAL

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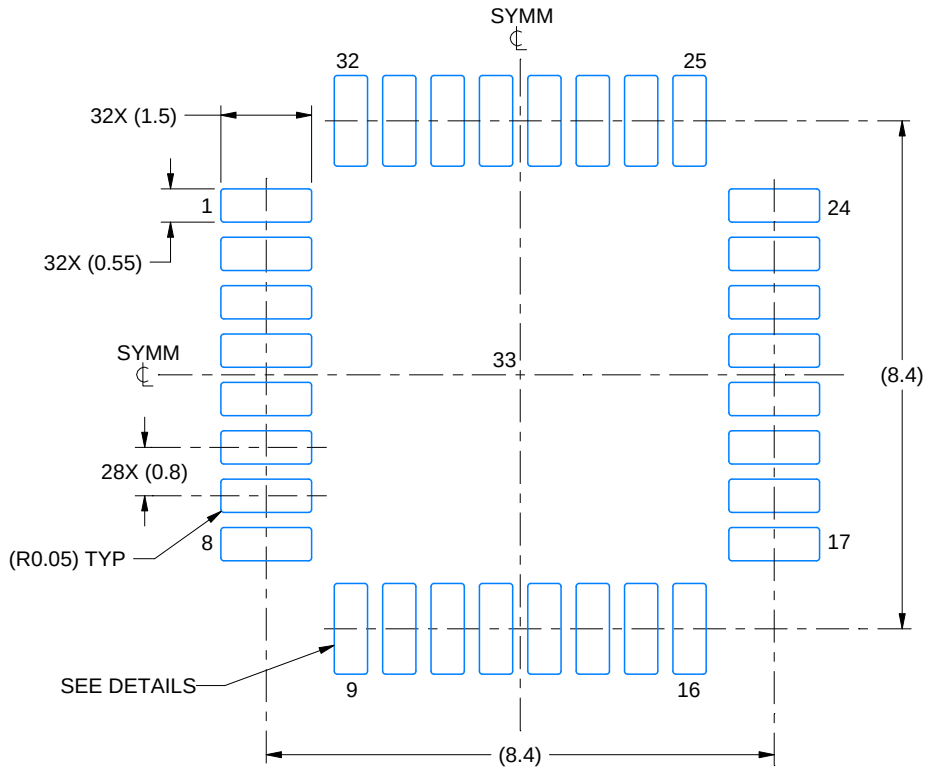
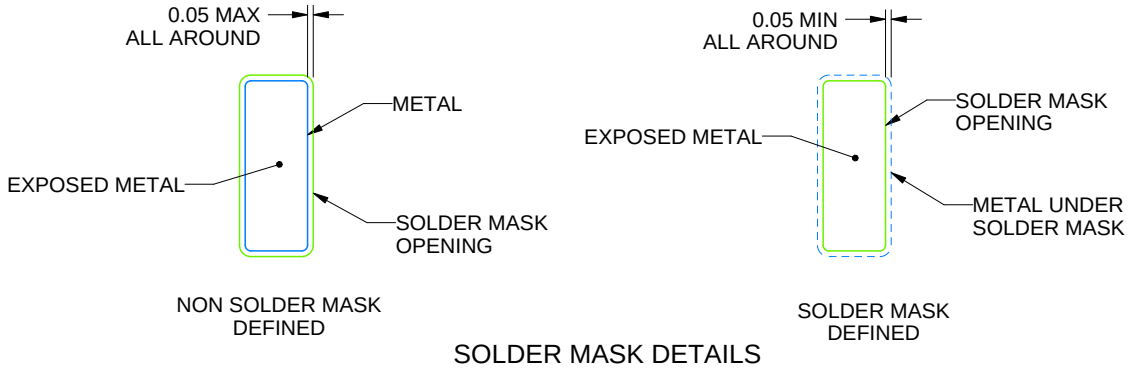
PowerPAD is a trademark of Texas Instruments.

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs.
4. Reference JEDEC registration MS-026.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

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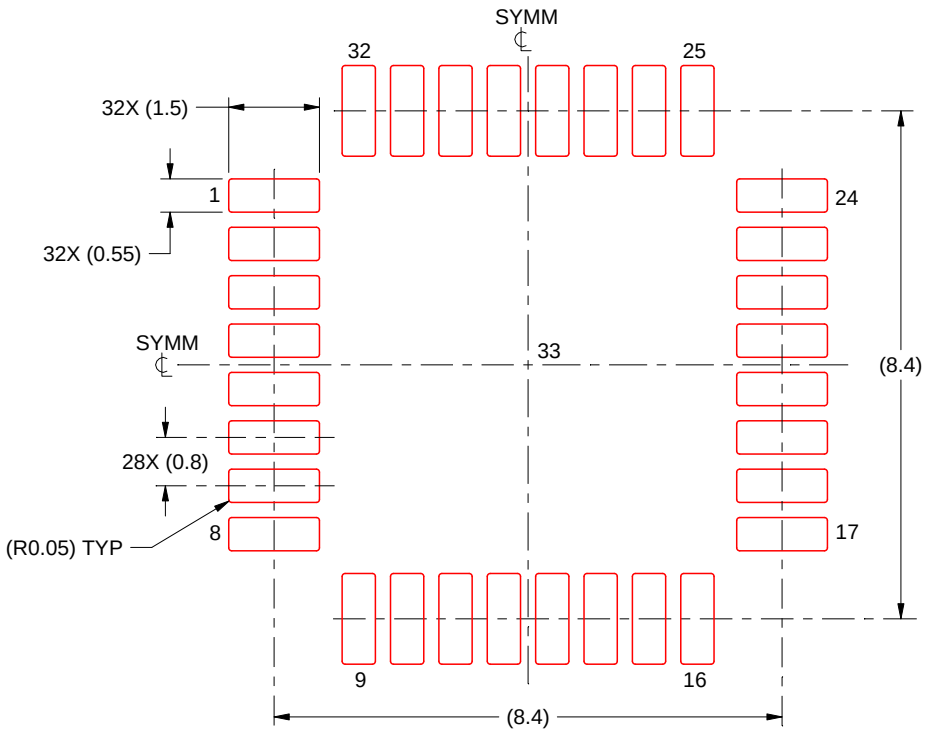
NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
SCALE:8X

4219769/A 04/2019

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

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