

## 14-BIT FULL DUPLEX SERIALIZER/DESERIALIZER

### FEATURES

- 10 MHz to 100 MHz Shift Clock Support
- 175 Mbytes/sec In TX/RX Modes
- Reduces Cable Size, Cost, and System EMI
- Bidirectional Data Communication
- Total Power < 360 mW Typ at 100-MHz Worst Case Pattern
- Power-Down Mode: < 500  $\mu$ W Typ
- No External Components Required for PLL
- Inputs and Outputs Compatible with TIA/EIA-644 LVDS Standard
- ESD Rating > 5 kV (HBM)

- Integrated Termination Resistor
- Supports Spread Spectrum Clocking
- 64-Pin TQFP Package (PAG)

### APPLICATIONS

- Flash Memory Cards
- Plain Paper Copiers
- Printers

### DESCRIPTION

The SN75LVDT1422 Full Duplex Serializer/Deserializer incorporates a 14-bit serializer and a 14-bit deserializer. Operation of the serializer is independent of the operation of the deserializer. The 14-bit serializer accepts 14 TTL input lines and generates 2 LVDS high-speed serial streams plus one LVDS clock signal. The 14-bit deserializer accepts 3 LVDS input signals (2 high-speed serial streams and one LVDS clock signal) and drives out 14 TTL data signals plus one TTL clock.

The serializer loads 14 data bits into registers upon the rising or falling edge of the input clock signal (CLK IN). Rising or falling edge operation can be selected via the R/F select pin for the transmitter only. The frequency of CLK IN is multiplied seven times and then used to unload the data registers in 7-bit slices. The two high-speed serial streams and a phase-locked clock ( $TCLK_{\pm}$ ) are then output to LVDS output drivers. The frequency of  $TCLK_{\pm}$  is the same as the input clock, CLK IN.

The deserializer accepts data on two high-speed LVDS data lines. High-speed data is received and loaded into registers at the rate seven times the LVDS input clock ( $RCLK_{\pm}$ ). The data is then unloaded to a 14-bit wide LVTTTL parallel bus at the  $RCLK_{\pm}$  rate. The SN75LVDT1422 presents valid data on the falling edge of the output clock (CLK OUT).

The SN75LVDT1422 provides three termination resistors for the differential LVDS inputs thus minimizing cost, and board space, while providing better overall signal integrity (SI). The data bus appears the same at the input to the transmitter and output of the receiver with the data transmission transparent to the user(s). The only user interventions are as follows:

Possible use of the TX ENABLE and RX ENABLE feature. Both the TX and RX ENABLE circuits are active-high inputs that independently enable the serializer and deserializer. When TX is disabled, the LVDS outputs go to high impedance. When RX is disabled, the TTL outputs go to a known low state.

The SN75LVDT1422 is characterized for operation over the free-air temperature range of  $-10^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

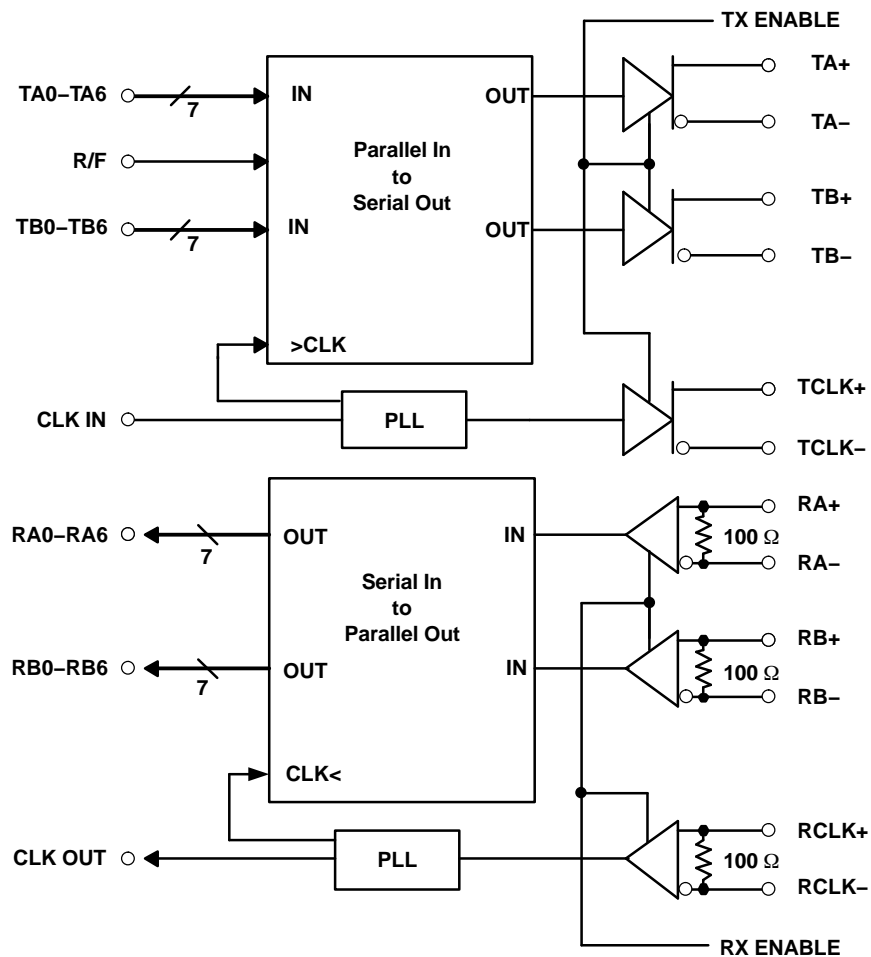


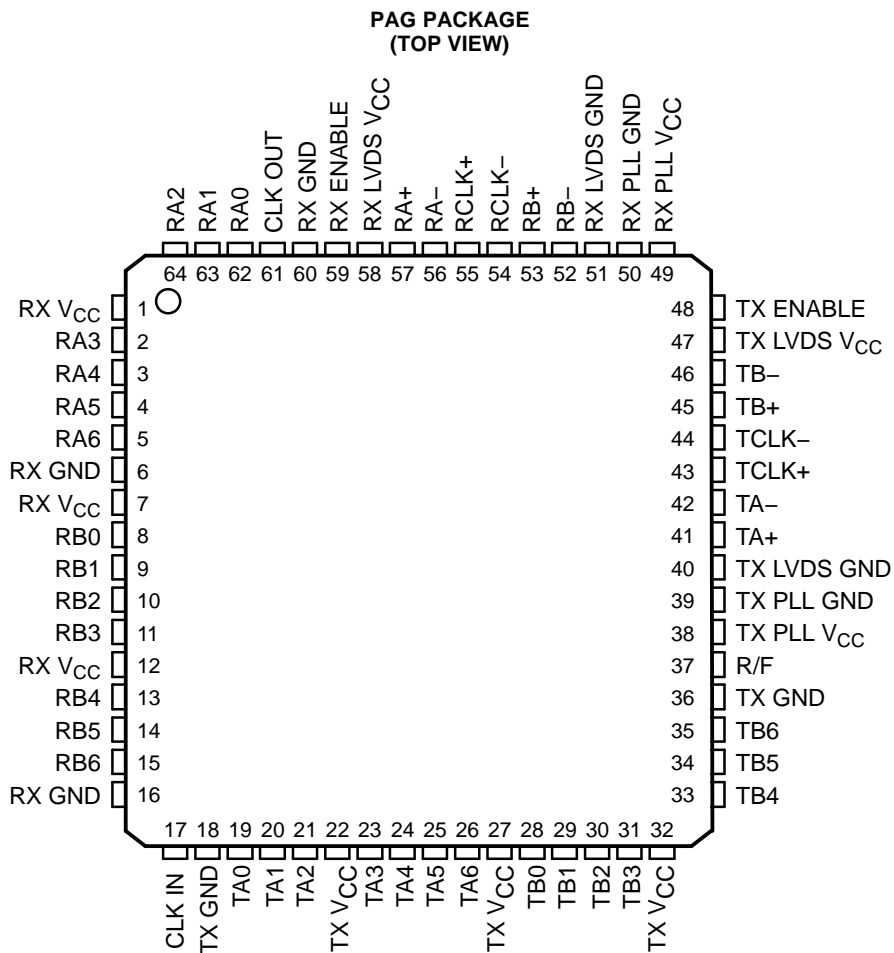
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



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.

### FUNCTIONAL BLOCK DIAGRAM





**TERMINAL FUNCTIONS**

<b>TERMINAL</b>		<b>TYPE</b>	<b>DESCRIPTION</b>
<b>NAME</b>	<b>NO.</b>		
CLK IN	17	LVTTL Input	CMOS/LVTTL Clock input
CLK OUT	61	LVTTL Output	LVTTL Clock output
R/F	37	LVTTL Input	Input clock triggering edge select. High: Rising edge Low: Falling edge
RA+, RA–	57, 56	LVDS Input	LVDS Data inputs
RA[0:6]	62, 63, 64, 2, 3, 4, 5	LVTTL Output	Single-ended data outputs
RB+, RB–	53, 52	LVDS Input	LVDS Data inputs
RB[0:6]	8, 9, 10, 11, 13, 14, 15	LVTTL Output	Single-ended data outputs
RCLK+, RCLK–	55, 54	LVDS Input	LVDS Clock inputs
RX ENABLE	59	LVTTL Input	Receiver enable: When asserted (low input), the receiver outputs go to a known low state.
RX GND	6, 16, 60	Power Supply	Ground pins for RX TTL outputs
RX LVDS GND	51		Ground pin for RX LVDS inputs
RX LVDS V <sub>CC</sub>	58		Power supply pin for RX LVDS inputs
RX PLL GND	50		Ground pin for PLL RX circuitry
RX PLL V <sub>CC</sub>	49		Power supply pin for PLL RX circuitry
RX V <sub>CC</sub>	1, 7, 12		Power supply pins for RX TTL outputs
TA+, TA–	41, 42	LVDS Output	LVDS Data outputs
TA[0:6]	19, 20, 21, 23, 24, 25, 26	LVTTL Input	Single-ended data inputs
TB+, TB–	45, 46	LVDS Output	LVDS Data outputs
TB[0:6]	28, 29, 30, 31, 33, 34, 35	LVTTL Input	Single-ended data inputs
TCLK+, TCLK–	43, 44	LVDS Output	LVDS Clock outputs
TX ENABLE	48	LVTTL Input	Transmitter enable: When asserted (low input), the driver outputs are high-impedance.
TX GND	18, 36	Power Supply	Ground pins for TX TTL inputs
TX LVDS GND	40		Ground pin for TX LVDS outputs
TX LVDS V <sub>CC</sub>	47		Power supply pin for TX LVDS outputs
TX PLL GND	39		Ground pin for PLL TX circuitry
TX PLL V <sub>CC</sub>	38		Power supply pin for PLL TX circuitry
TX V <sub>CC</sub>	22, 27, 32		Power supply pins for TX TTL inputs

**ORDERING INFORMATION<sup>(1)</sup>**

<b>PRODUCT</b>	<b>PACKAGE</b>	<b>ORDERING NUMBER</b>
SN75LVDT1422	TQFP (PAG)	SN75LVDT1422

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at [www.ti.com](http://www.ti.com).

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

		UNIT
Supply voltage range, $V_{CC}$ <sup>(2)</sup>		–0.5 V to 4 V
Voltage range at any terminal		–0.3 V to $V_{CC} + 0.3$ V
Electrostatic discharge	Human Body Model <sup>(3)</sup> (All pins)	±5 kV
	Machine Model <sup>(4)</sup> (All pins)	±200 V
	Charged-Device Model <sup>(5)</sup> (All pins)	±500 V
Continuous power dissipation		See Dissipation Rating Table
Storage temperature range		–65°C to 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.
- (2) All voltage values are with respect to the GND terminals
- (3) In accordance with JEDEC Standard 22, Test Method A114-A.
- (4) In accordance with JEDEC Standard 22, Test Method A115.
- (5) In accordance with JEDEC Standard 22, Test Method C101.

## DISSIPATION RATINGS

PACKAGE	CIRCUIT BOARD MODEL	$T_A \leq 25^\circ\text{C}$	DERATING FACTOR <sup>(1)</sup> ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING
TQFP (PAG)	Low-K <sup>(2)</sup>	813 mW	8.13 mW/°C	448 mW
TQFP (PAG)	High-K <sup>(3)</sup>	1076 mW	10.76 mW/°C	592 mW

- (1) This is the inverse of the junction-to-ambient thermal resistance when board-mounted and with no air flow.
- (2) In accordance with the Low-K thermal metric definitions of EIA/JESD51-2.
- (3) In accordance with the High-K thermal metric definitions of EIA/JESD51-6.

## THERMAL CHARACTERISTICS

PARAMETER			TEST CONDITIONS	VALUE	UNIT
R <sub>θJB</sub>	Junction-to-board thermal resistance			69.5	°C/ W
R <sub>θJC</sub>	Junction-to-case thermal resistance			39.2	
P <sub>D</sub>	Device power dissipation	Typical	V <sub>CC</sub> = 3.3 V, T <sub>A</sub> = 25°C, f = 100 MHz	357.4	mW
		Maximum	V <sub>CC</sub> = 3.6 V, T <sub>A</sub> = 70°C , f = 100 MHz	455.8	

## RECOMMENDED OPERATING CONDITIONS

	MIN	NOM	MAX	UNIT
$V_{CC}$ Supply voltage	3	3.3	3.6	V
$V_{IH}$ High-level input voltage	2		$V_{CC}$	V
$V_{IL}$ Low-level input voltage	GND		0.8	V
$ V_{ID} $ Magnitude of differential input voltage	0.1		0.6	V
$V_{IC}$ Common-mode input voltage range, receiver	$ V_{ID} /2$	2.4 – $ V_{ID} /2$		V
$T_A$ Operating free-air temperature	–10		70	°C
$V_N$ Supply noise voltage, $V_{CC}$	–50		50	mV
$f_c$ Clock frequency	10		100	MHz

## RECEIVER ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
V <sub>IT+</sub>	Positive-going differential input threshold voltage				100	mV
V <sub>IT−</sub>	Negative-going differential input threshold voltage		−100			mV
V <sub>OH</sub>	High-level output voltage	I <sub>OH</sub> = −4 mA	2.4			V
V <sub>OL</sub>	Low-level output voltage	I <sub>OL</sub> = 4 mA			0.4	V
V <sub>IK</sub>	Input clamp voltage	I <sub>I</sub> = −18 mA	−1.5	−0.8		V
I <sub>I</sub>	Input current with integrated termination	V <sub>I</sub> = 0 V or 2.4 V, V <sub>CC</sub> = 3.6 V	−45		45	μA
I <sub>I(OFF)</sub>	Power-off input current	V <sub>CC</sub> = 0 V, V <sub>I</sub> = 2.4 V	−10		10	μA
R <sub>T</sub>	Termination resistance	V <sub>ID</sub> = 100 mV, V <sub>IC</sub> = 0.05 V to 2.4 V	90	110	132	Ω
C <sub>i</sub>	Input capacitance			2		pF

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ .

## TRANSMITTER ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
V <sub>OD</sub>	Differential output voltage magnitude	R <sub>L</sub> = 100 Ω	250	365	450	mV
Δ V <sub>OD</sub>	Change in differential output voltage magnitude between logic states		–35		35	mV
V <sub>OC(SS)</sub>	Steady-state common-mode output voltage		1.125		1.375	V
ΔV <sub>OC(SS)</sub>	Change in steady-state common-mode output voltage between logic states		–35		35	mV
V <sub>OC(PP)</sub>	Peak-to-peak common-mode output voltage			30	80	mV
I <sub>IH</sub>	High-level input current	V <sub>IH</sub> = 2 V			20	μA
I <sub>IL</sub>	Low-level input current	V <sub>IL</sub> = 0.8 V	–10		10	μA
V <sub>IK</sub>	Input clamp voltage	I <sub>I</sub> = –18 mA	–1.5	–0.8		V
I <sub>OS</sub>	Short-circuit output current	V <sub>O+</sub> or V <sub>O–</sub> = 0 V	–24		24	mA
		V <sub>OD</sub> = 0 V	–12		12	
I <sub>O(OFF)</sub>	Power-off output current	V <sub>CC</sub> = 0 V, V <sub>O</sub> = 2.4 V	–10		10	μA
C <sub>i</sub>	Input capacitance			3		pF

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ .

## TRANSMITTER SUPPLY CURRENT

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$I_{CC}$	Supply current (worst case) See <a href="#">Figure 1</a> and <a href="#">Figure 2</a>	$f = 10$ MHz	17	23	mA
		$f = 25$ MHz	19	27	
		$f = 40$ MHz	22	30	
		$f = 65$ MHz	29	34	
		$f = 85$ MHz	34	45	
		$f = 100$ MHz	38	49	

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ .

## RECEIVER SUPPLY CURRENT

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$I_{CC}$ Supply current (worst case)	See <a href="#">Figure 1</a> and <a href="#">Figure 3</a>	f = 10 MHz	19	35	mA
		f = 25 MHz	27	42	
		f = 40 MHz	35	45	
		f = 65 MHz	49	69	
		f = 85 MHz	60	81	
		f = 100 MHz	69	90	

(1) All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

## SUPPLY CURRENT<sup>(1)</sup>

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>(2)</sup>	MAX	UNIT
$I_{CC(DIS)}$ Disable supply current	TX/RX ENABLEs = GND		150	800	$\mu\text{A}$

(1) CMOS inputs have to connect to ground.

(2) All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

## TRANSMITTER INPUT TIMING REQUIREMENTS

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_{I(CLK)}$ Transition time, CLK IN	See <a href="#">Figure 5</a>	1.0		6.0 <sup>(2)</sup>	ns
$t_{C(CLK)}$ Input clock period, CLK IN	See <a href="#">Figure 6</a>	10	T	100	ns
$t_{WH(CLK)}$ Pulse duration, clock high, CLK IN		0.35T	0.5T	0.65T	ns
$t_{WL(CLK)}$ Pulse duration, clock low, CLK IN		0.35T	0.5T	0.65T	ns
$t_{I(EN)}$ Transition time, TX ENABLE, TA/TBx		1.5		6.0	ns

(1) All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

(2) Regulate clock frequency lower than 50 MHz.  $t_{I(CLK)max} = 1/f \times 50\% \times 60\%$ .

## TRANSMITTER SWITCHING CHARACTERISTICS

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_r$ LVDS Rise time	See <a href="#">Figure 4</a>		0.38	0.7	ns
$t_f$ LVDS Fall time	See <a href="#">Figure 4</a>		0.38	0.7	ns
$t_0$ Output pulse position for bit 0	f = 10 MHz, See <a href="#">Figure 12</a>	-0.8	0	0.8	ns
$t_1$ Output pulse position for bit 1		13.49	14.29	15.09	
$t_2$ Output pulse position for bit 2		27.77	28.57	29.37	
$t_3$ Output pulse position for bit 3		42.06	42.86	43.66	
$t_4$ Output pulse position for bit 4		56.34	57.14	57.94	
$t_5$ Output pulse position for bit 5		70.63	71.43	72.23	
$t_6$ Output pulse position for bit 6		84.91	85.71	86.51	
$t_0$ Output pulse position for bit 0	f = 25 MHz, See <a href="#">Figure 12</a>	-0.45	0	0.45	ns
$t_1$ Output pulse position for bit 1		5.26	5.71	6.16	
$t_2$ Output pulse position for bit 2		10.98	11.43	11.83	
$t_3$ Output pulse position for bit 3		16.69	17.14	17.54	
$t_4$ Output pulse position for bit 4		22.41	22.86	23.26	
$t_5$ Output pulse position for bit 5		28.12	28.57	28.97	
$t_6$ Output pulse position for bit 6		33.84	34.29	34.69	

(1) All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

**TRANSMITTER SWITCHING CHARACTERISTICS (continued)**

PARAMETER		TEST CONDITIONS		MIN	TYP <sup>(1)</sup>	MAX	UNIT
t <sub>0</sub>	Output pulse position for bit 0	f = 40 MHz, See <a href="#">Figure 12</a>		−0.25	0	0.25	ns
t <sub>1</sub>	Output pulse position for bit 1			3.32	3.57	3.82	
t <sub>2</sub>	Output pulse position for bit 2			6.89	7.14	7.39	
t <sub>3</sub>	Output pulse position for bit 3			10.46	10.71	10.96	
t <sub>4</sub>	Output pulse position for bit 4			14.04	14.29	14.54	
t <sub>5</sub>	Output pulse position for bit 5			17.61	17.86	18.11	
t <sub>6</sub>	Output pulse position for bit 6			21.18	21.43	21.68	
t <sub>0</sub>	Output pulse position for bit 0	f = 65 MHz, See <a href="#">Figure 12</a>		−0.20	0	0.20	ns
t <sub>1</sub>	Output pulse position for bit 1			2.00	2.20	2.40	
t <sub>2</sub>	Output pulse position for bit 2			4.20	4.40	4.60	
t <sub>3</sub>	Output pulse position for bit 3			6.39	6.59	6.79	
t <sub>4</sub>	Output pulse position for bit 4			8.59	8.79	8.99	
t <sub>5</sub>	Output pulse position for bit 5			10.79	10.99	11.19	
t <sub>6</sub>	Output pulse position for bit 6			12.99	13.19	13.39	
t <sub>0</sub>	Output pulse position for bit 0	f = 85 MHz, See <a href="#">Figure 12</a>		−0.15	0	0.15	ns
t <sub>1</sub>	Output pulse position for bit 1			1.53	1.68	1.83	
t <sub>2</sub>	Output pulse position for bit 2			3.21	3.36	3.51	
t <sub>3</sub>	Output pulse position for bit 3			4.89	5.04	5.19	
t <sub>4</sub>	Output pulse position for bit 4			6.57	6.72	6.87	
t <sub>5</sub>	Output pulse position for bit 5			8.25	8.40	8.55	
t <sub>6</sub>	Output pulse position for bit 6			9.93	10.08	10.23	
t <sub>0</sub>	Output pulse position for bit 0	f = 100 MHz, See <a href="#">Figure 12</a>		−0.2	0	0.2	ns
t <sub>1</sub>	Output pulse position for bit 1			1.23	1.43	1.63	
t <sub>2</sub>	Output pulse position for bit 2			2.66	2.86	3.06	
t <sub>3</sub>	Output pulse position for bit 3			4.09	4.29	4.49	
t <sub>4</sub>	Output pulse position for bit 4			5.51	5.71	5.91	
t <sub>5</sub>	Output pulse position for bit 5			6.94	7.14	7.34	
t <sub>6</sub>	Output pulse position for bit 6			8.37	8.57	8.77	
t <sub>su</sub>	TAx/TBx Setup time to CLK IN	f = 85 MHz or 100 MHz, See <a href="#">Figure 6</a>		1			ns
t <sub>h</sub>	TAx/TBx Hold time to CLK IN			0.25			
t <sub>pd(TCC)</sub>	CLK IN to TCLK± Propagation delay time	See <a href="#">Figure 7</a> and <a href="#">Figure 8</a> <sup>(2)</sup>		f = 10 MHz	1.0	2.98	ns
				f = 25 MHz	1.38	3.21	
				f = 85 MHz	1.60	3.78	
				f = 100 MHz	1.63	3.95	
t <sub>jitt(C-C)</sub>	TCLK± Clock cycle-to-cycle jitter	f = 85 MHz or 100 MHz			50		ps
SSCG	Spread Spectrum Clock support; Modulation frequency with a linear profile <sup>(3)</sup>	f = 10 MHz			100 ±2.5%/−5%		kHz
		f = 25 MHz					
		f = 40 MHz					
		f = 65 MHz					
		f = 85 MHz					
		f = 100 MHz					
t <sub>en(TPLL)</sub>	Phase lock loop enable time	See <a href="#">Figure 9</a>		10		ms	
t <sub>dis(T)</sub>	Transmitter disable time	See <a href="#">Figure 11</a>		100		ns	

(2) Measure from CLK IN rising edge or falling edge to immediately crossing point of differential TCLK±, 50% duty cycle input clock is assumed.

(3) Care must be taken to ensure t<sub>su</sub> and t<sub>h</sub> are met so input data are sampling correctly. This SSCG parameter only shows the performance of tracking spread spectrum clock applied to CLK IN pin, and reflects the result on TCLK+ and TCLK– pins.



## RECEIVER SWITCHING CHARACTERISTICS

PARAMETER			TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_r$	CMOS/LVTTL Rise time	CLK OUT	See <a href="#">Figure 3</a>		1.2	2.5	ns
		RA or RB			2.0	3.5	
$t_f$	CMOS/LVTTL Fall time	CLK OUT	See <a href="#">Figure 3</a>		1.2	2.5	ns
		RA or RB			2.0	3.5	
$t_0$	Input strobe position for bit 0		f = 85 MHz, See <a href="#">Figure 17</a>	0.45	0.84	1.23	ns
$t_1$	Input strobe position for bit 1			2.13	2.52	2.91	
$t_2$	Input strobe position for bit 2			3.81	4.20	4.59	
$t_3$	Input strobe position for bit 3			5.49	5.88	6.27	
$t_4$	Input strobe position for bit 4			7.17	7.56	7.95	
$t_5$	Input strobe position for bit 5			8.85	9.24	9.63	
$t_6$	Input strobe position for bit 6			10.53	10.92	11.31	
$t_0$	Input strobe position for bit 0		f = 100 MHz, See <a href="#">Figure 17</a>	0.40	0.71	1.02	ns
$t_1$	Input strobe position for bit 1			1.83	2.14	2.45	
$t_2$	Input strobe position for bit 2			3.26	3.57	3.88	
$t_3$	Input strobe position for bit 3			4.09	5.00	5.31	
$t_4$	Input strobe position for bit 4			6.12	6.43	6.74	
$t_5$	Input strobe position for bit 5			7.54	7.85	8.16	
$t_6$	Input strobe position for bit 6			8.97	9.28	9.59	
$t_{SK}$	RA/RB± Skew margin <sup>(2)</sup>		f = 85 MHz, See <a href="#">Figure 18</a>	300			ps
			f = 100 MHz, See <a href="#">Figure 18</a>	200			
$t_c$	CLK OUT Typical period range			10	T	100	ns
$t_{WH}$	CLK OUT Pulse duration, clock high		f = 85 MHz, See <a href="#">Figure 13</a>	4.0	5	6.5	ns
$t_{WL}$	CLK OUT Pulse duration, clock low			4.0	5	6.5	
$t_{SU}$	Rax/RBx Setup time to CLK OUT			3.0			
$t_h$	Rax/RBx Hold time to CLK OUT			3.5			
$t_{WH}$	CLK OUT Pulse duration, clock high		f = 100 MHz, See <a href="#">Figure 13</a>	3.0		5.0	ns
$t_{WL}$	CLK OUT Pulse duration, clock low			3.0		5.0	
$t_{SU}$	Rax/RBx Setup time to CLK OUT			2.0			
$t_h$	Rax/RBx Hold time to CLK OUT			2.5			
$t_{pd(RCC)}$	RCLK± to CLK OUT Propagation delay time		At $T_A = 25^\circ\text{C}$ , $V_{CC} = 3.3\text{ V}$ , See <a href="#">Figure 14</a>		6	9	ns
$t_{en(RPLL)}$	Receiver phase lock loop enable time		See <a href="#">Figure 15</a>			10	ms
$t_{dis(R)}$	Receiver disable time		See <a href="#">Figure 16</a>			1	μs

(1) All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

(2) Receiver skew margin is defined as the valid data sampling region at the receiver inputs. This margin takes into account the transmitter pulse positions (min and max) and the receiver input setup and hold time (internal data sampling window - RSPos). This margin allows for LVDS interconnect skew, inter-symbol interference (both dependent on type/length of cable), and clock jitter (less than 150 ps).

## PARAMETER MEASUREMENT INFORMATION

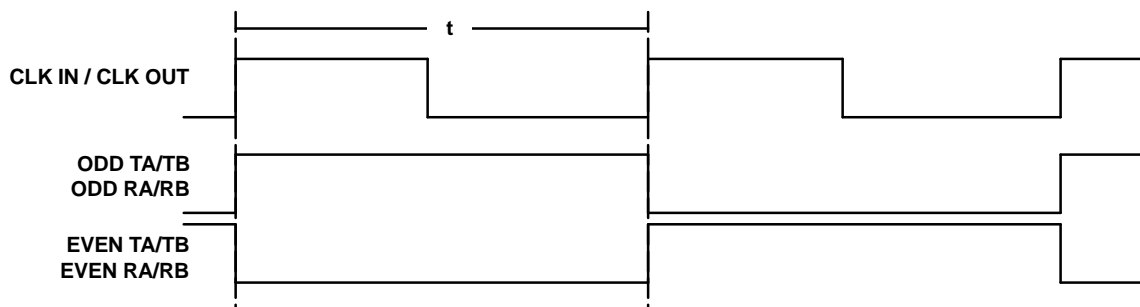


Figure 1. Worst Case Test Pattern

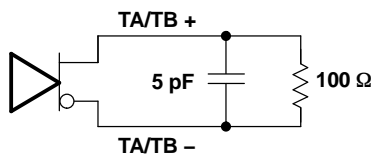


Figure 2. LVDS Output Load

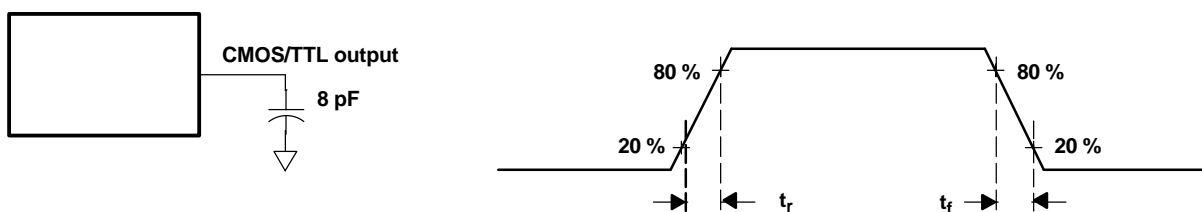


Figure 3. Receiver CMOS/LVTTL Output Load and Transition Times

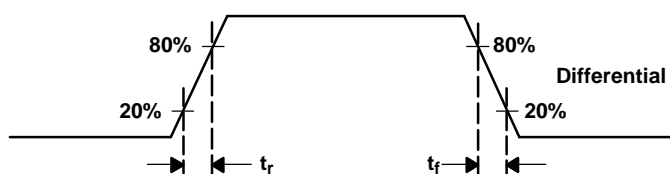


Figure 4. Transmitter LVDS Transition Times

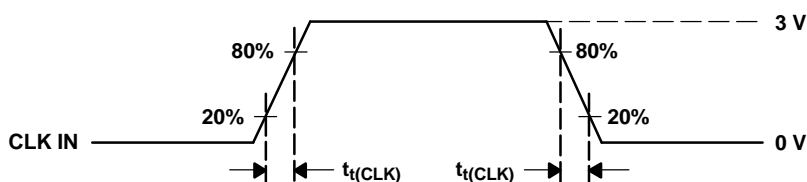


Figure 5. Transmitter Input Clock Transition Time

## PARAMETER MEASUREMENT INFORMATION (continued)

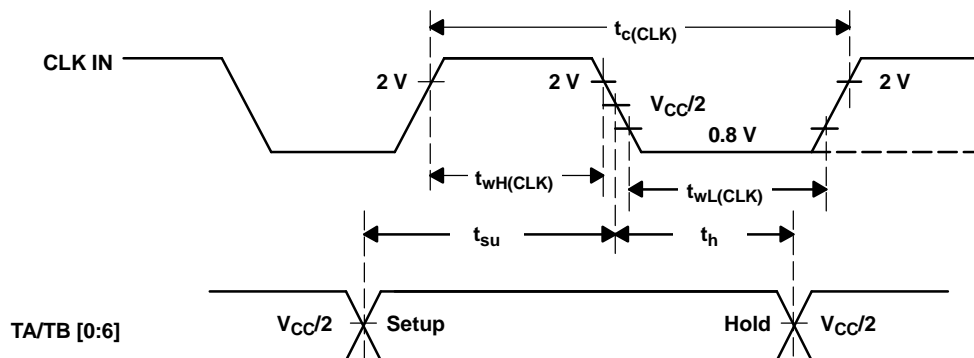


Figure 6. Transmitter Setup/Hold and High/Low Times (Falling Edge Strobe)

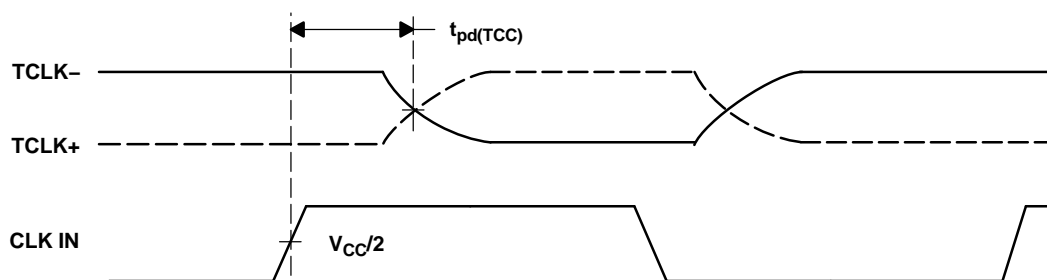


Figure 7. Transmitter Clock In to Clock Out Propagation Delay Time with R/F at  $V_{CC}$

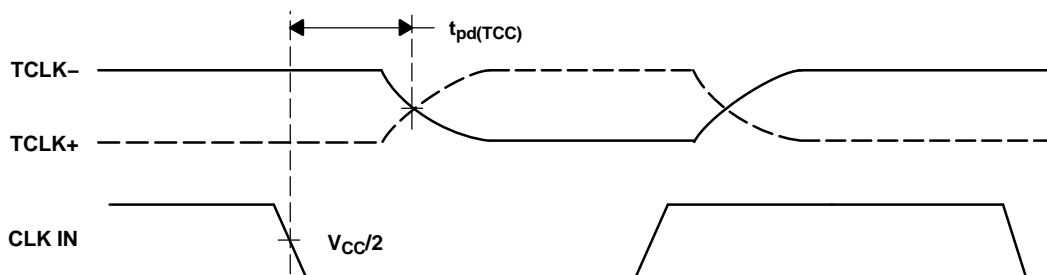


Figure 8. Transmitter Clock In to Clock Out Propagation Delay Time with R/F at GND

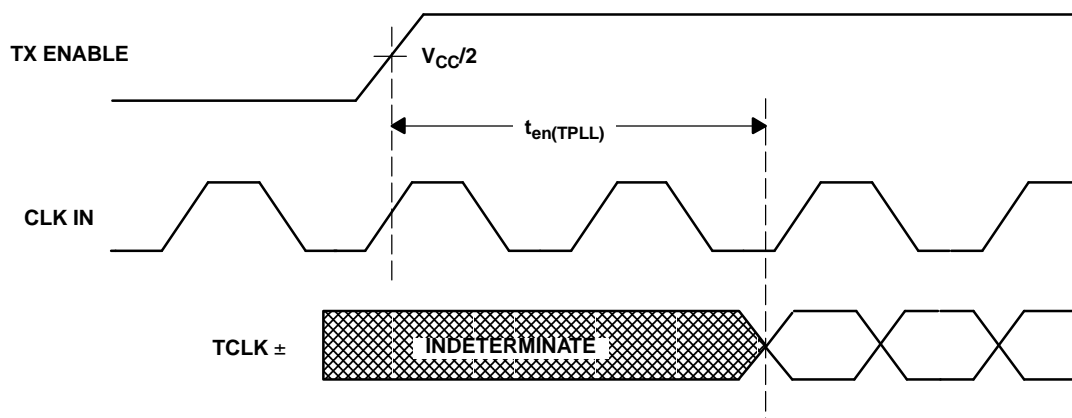
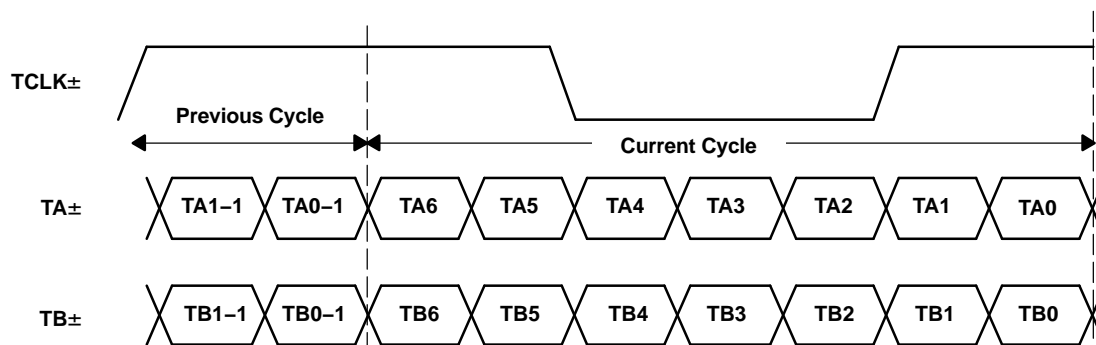
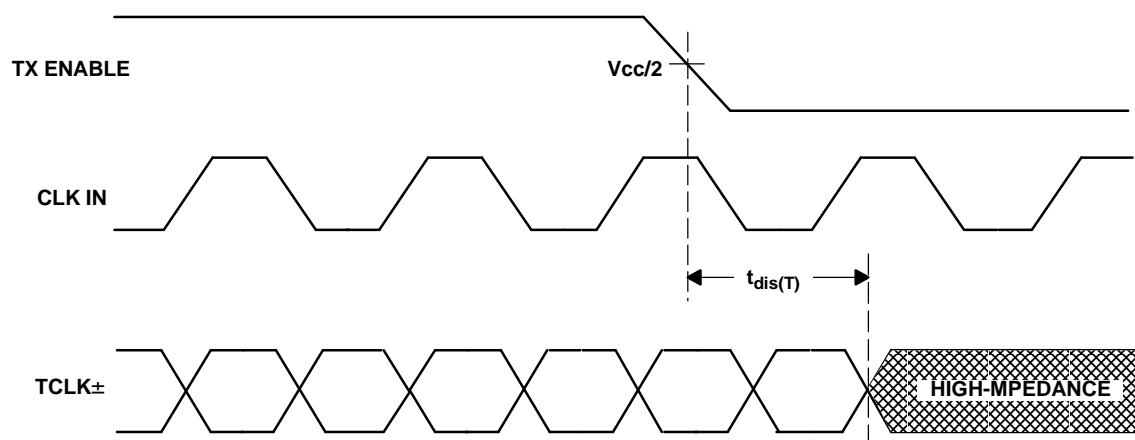


Figure 9. Transmitter Phase Lock Loop Enable Time

**PARAMETER MEASUREMENT INFORMATION (continued)****Figure 10. 14 Parallel TTL Data Inputs Mapped to LVDS Outputs****Figure 11. Transmitter Disable Time**

## PARAMETER MEASUREMENT INFORMATION (continued)

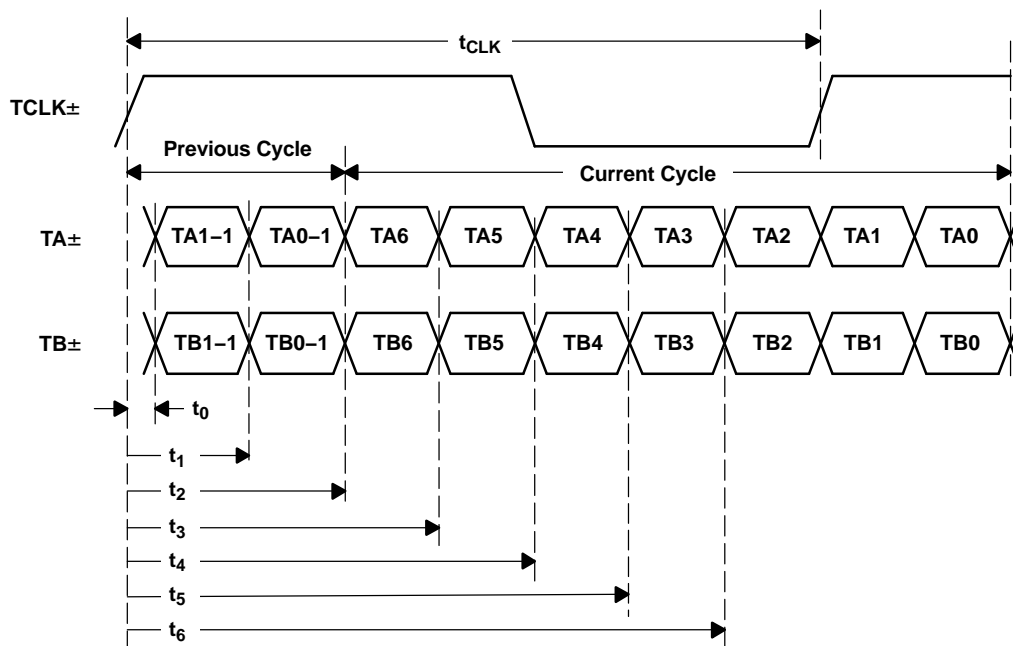


Figure 12. Transmitter LVDS Output Pulse Position Measurement

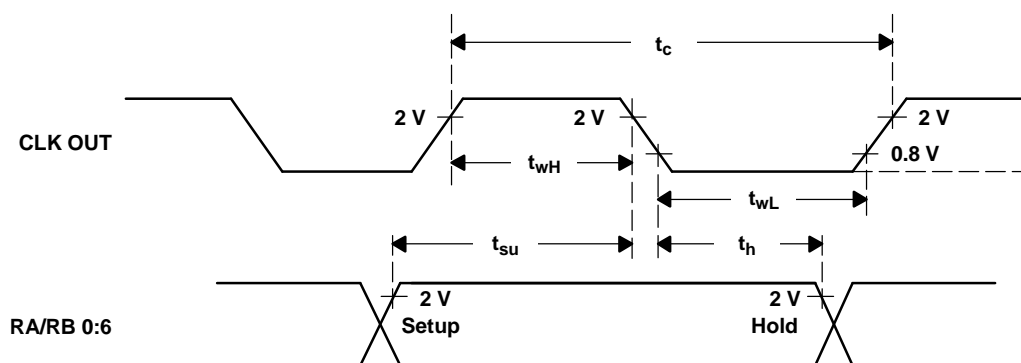


Figure 13. Receiver Setup/Hold and High/Low Times

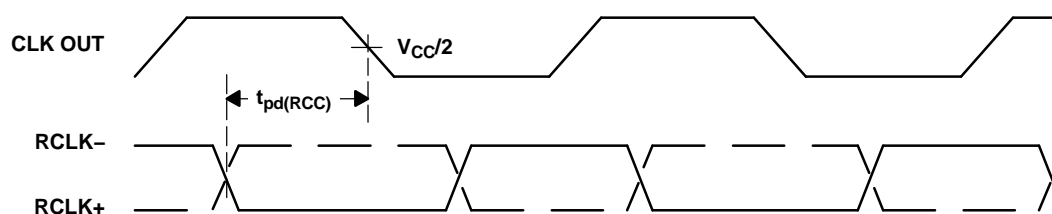


Figure 14. Receiver Clock In to Clock Out Propagation Delay Time

## PARAMETER MEASUREMENT INFORMATION (continued)

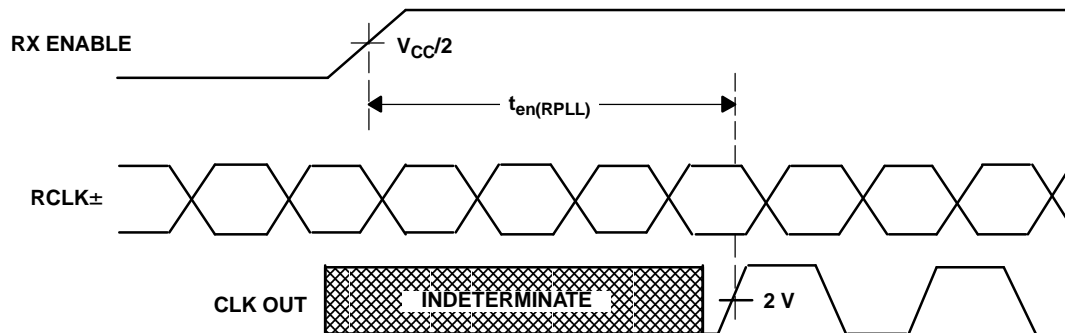


Figure 15. Receiver Phase Lock Loop Enable Time

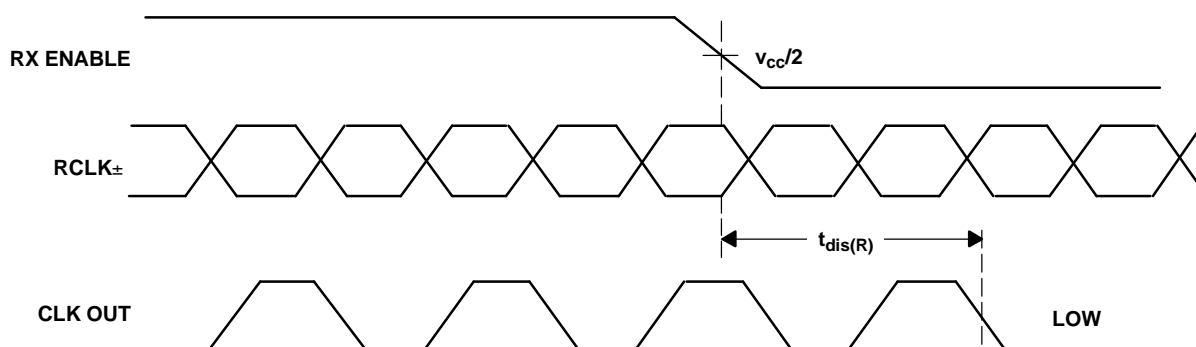


Figure 16. Receiver Disable Time

## PARAMETER MEASUREMENT INFORMATION (continued)

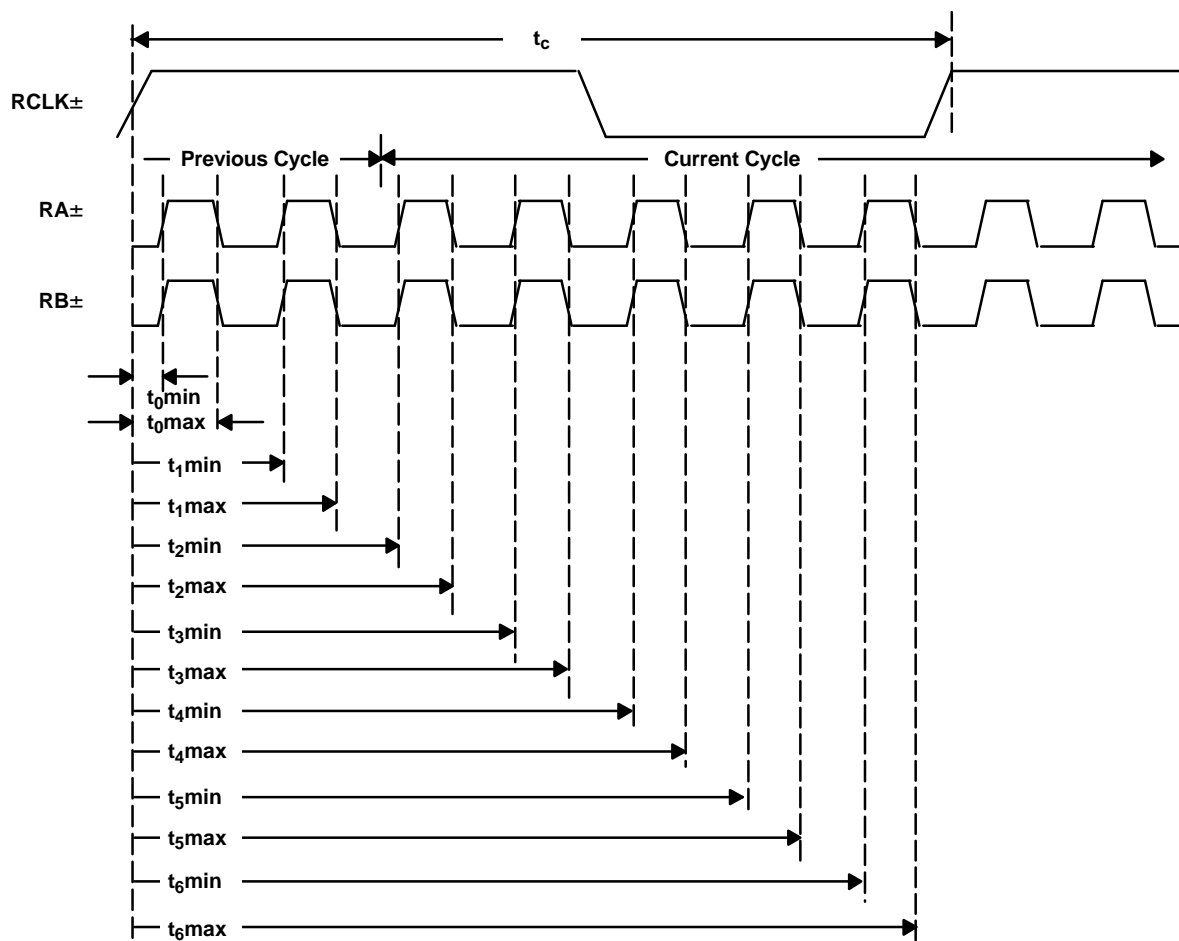
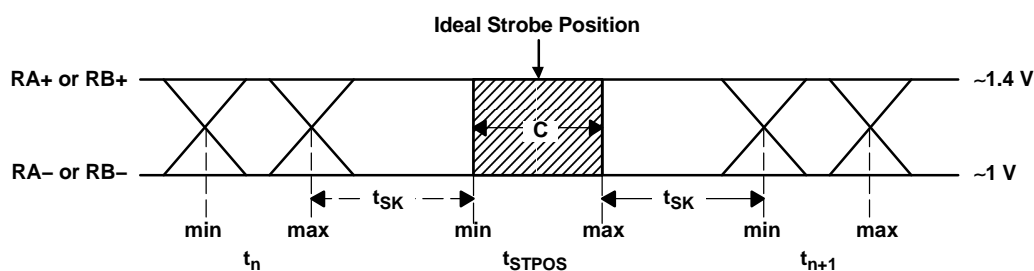


Figure 17. Receiver LVDS Input Strobe Position



- (1) C – Setup and hold time (internal data sampling window) defined by  $t_{STPOS}(\text{receiver input strobe position})$  min and max
- (2)  $t_n$  – Transmitter output pulse position (min and max)
- (3)  $t_{SK}$  = Cable skew (type, length) + source clock jitter (cycle to cycle) <sup>(5)</sup> + ISI (inter-symbol interference) <sup>(6)</sup>
- (4) Cable skew – typically 10 ps to 40 ps per foot, media dependent
- (5) Cycle-to-cycle jitter is less than 150 ps at 85 MHz
- (6) ISI is dependent on interconnect length; may be zero

Figure 18. Receiver LVDS Input Skew Margin

## TYPICAL CHARACTERISTICS

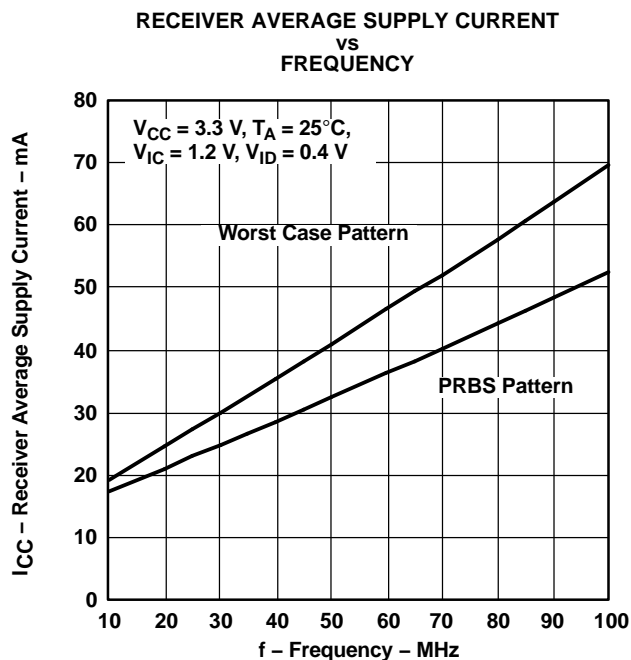


Figure 19.

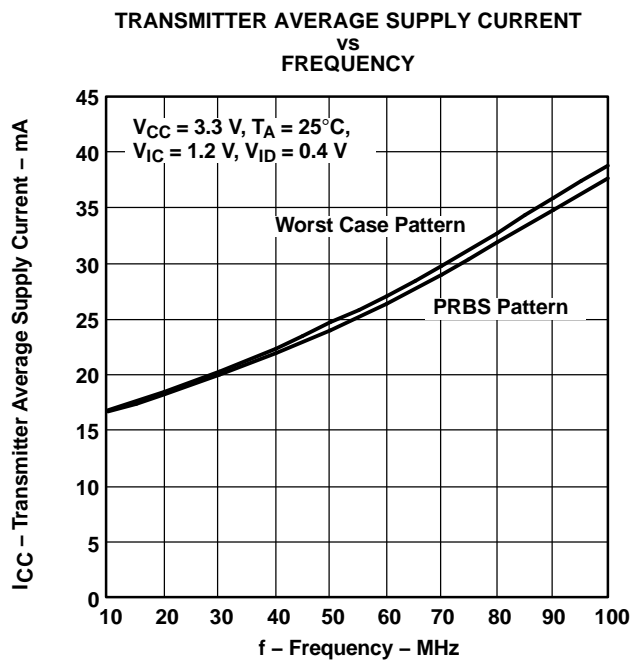


Figure 20.

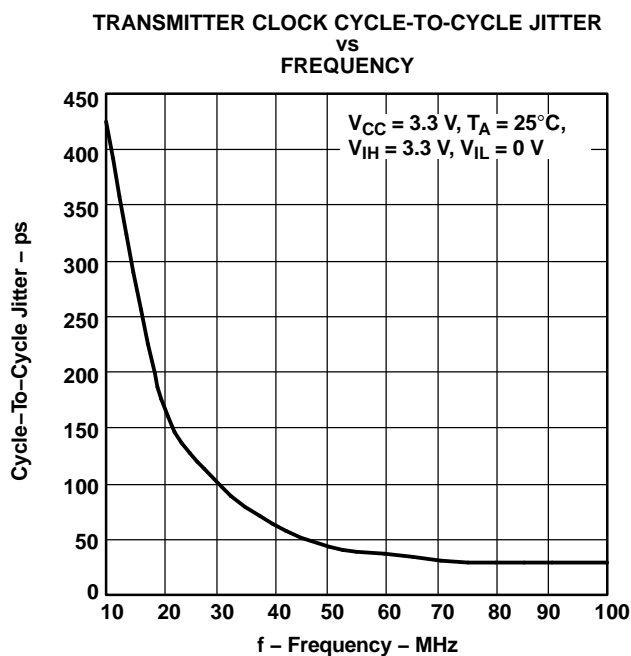


Figure 21.

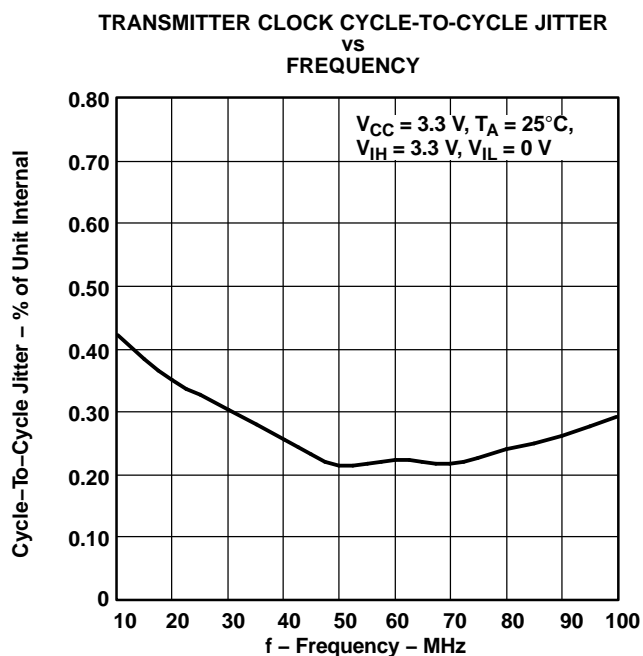


Figure 22.



## APPLICATION INFORMATION

### Power Source Sequence

There is no power-on sequence restriction to  $V_{CC}$ , LVDS  $V_{CC}$ , and PLL  $V_{CC}$ . In most applications, it is recommended to apply the same power source with the separate power planes and decoupling bypass capacitor groups. Use inductors to connect the different power planes.

### Transmitter/Receiver Clock/Data Sequencing

There is no special requirement to the sequence of the input clock/data and enable signals. The input clock/data can be inserted after the enable signal is active. It is not necessary to cycle the enable signal when the clock/data is stopped and reapplied, like with the case of changing video modes within a graphics controller. When TX ENABLE pin is pulled low, the LVDS outputs of a SN75LVDT1422 transmitter are high-impedance, the PLL is shut down, and the transmitter is reset. When RX ENABLE is pulled low, the single-ended outputs of a SN75LVDT1422 receiver are at low status, the PLL is shut down, and the receiver is reset.

### Spread Spectrum Clock Support

The transmitter of the SN75LVDT1422 accepts spread spectrum clocking signal type inputs. The outputs accurately track spread spectrum clock/data inputs with modulation frequencies of up to 100 kHz (max) with either center spread of  $\pm 2.5\%$  or down spread -5% deviations.

### Receiver Failsafe Feature

The receiver input failsafe bias circuitry ensures a stable output with known status while the receiver inputs are left floating.

When the receiver enable pin is active and a valid clock signal appears at the clock input, all of the data outputs are high if the data inputs are floating or idle. When the receiver enable pin is active and the clock input is floating, the last valid state is maintained on the data channels if the inputs are floating or idle. When the receiver enable pin is inactive, both data and clock outputs are kept low without considering the input status.

In an application with an unused data input, it is recommended to leave it open.

**Receiver Failsafe Summary**

RX ENABLE	DATA CHANNEL STATUS	CLOCK CHANNEL STATUS	FAILSAFE RESULT	
			DATA	CLOCK
High	Floating/Idle	Valid clock signal	High	Clock
High	Floating/Idle	Floating/Idle	Last state	Low
Low	Don't Care	Don't Care	Low	Low

### Transmitter Input, Receiver Output Pins

The single-ended I/O pins and control input pins are compatible with LVCMOS and LVTTTL levels only. These pins are not 5-V tolerant.

## 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
SN75LVDT1422PAG	LIFEBUY	TQFP	PAG	64	160	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-10 to 70	LVDT1422	
SN75LVDT1422PAGR	LIFEBUY	TQFP	PAG	64	1500	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-10 to 70	LVDT1422	

(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.

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## 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
SN75LVDT1422PAGR	TQFP	PAG	64	1500	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN75LVDT1422PAGR	TQFP	PAG	64	1500	350.0	350.0	43.0

## TRAY



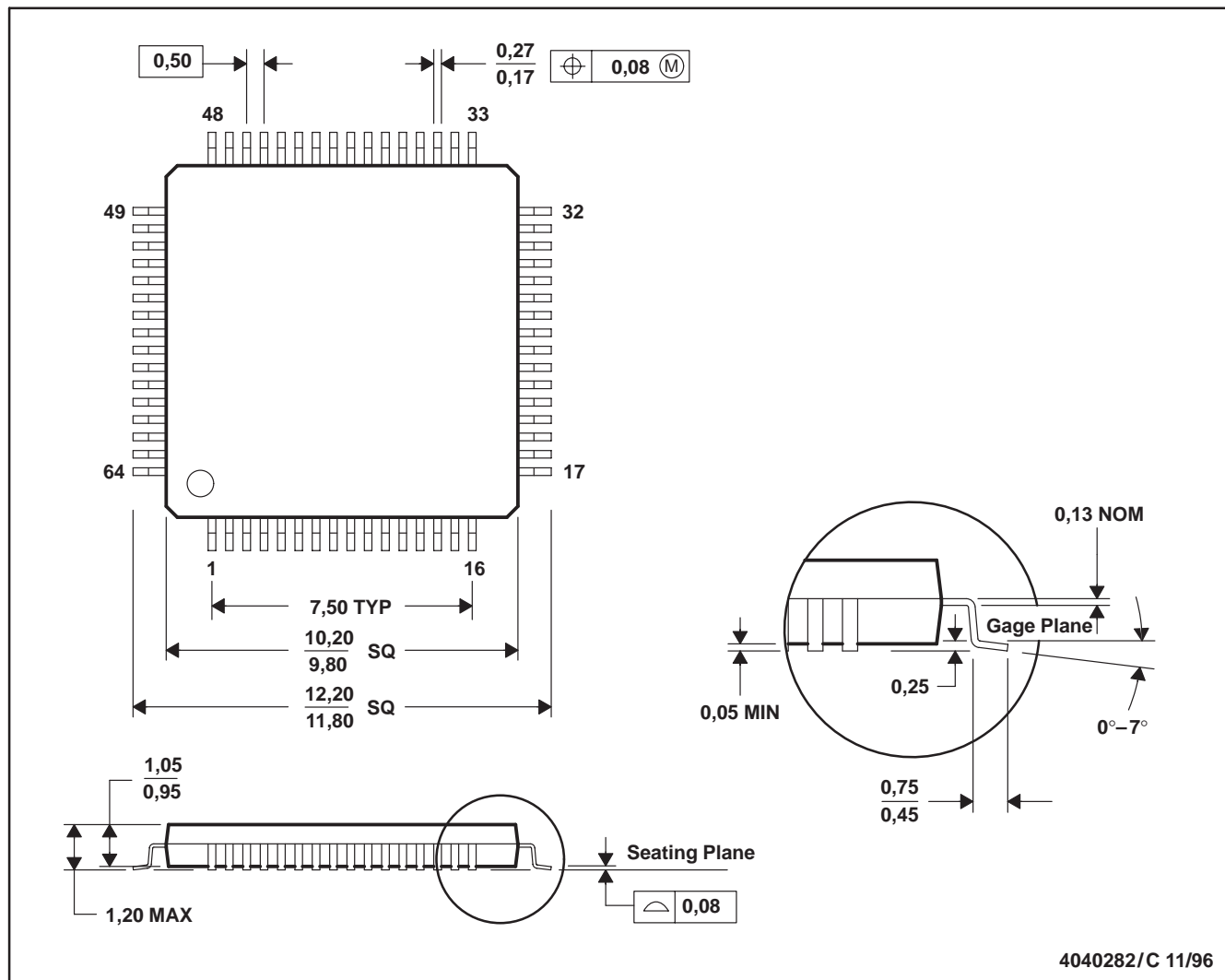
Chamfer on Tray corner indicates Pin 1 orientation of packed units.

\*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)
SN75LVDT1422PAG	PAG	TQFP	64	160	8 x 20	150	315	135.9	7620	15.2	13.1	13

## PAG (S-PQFP-G64)

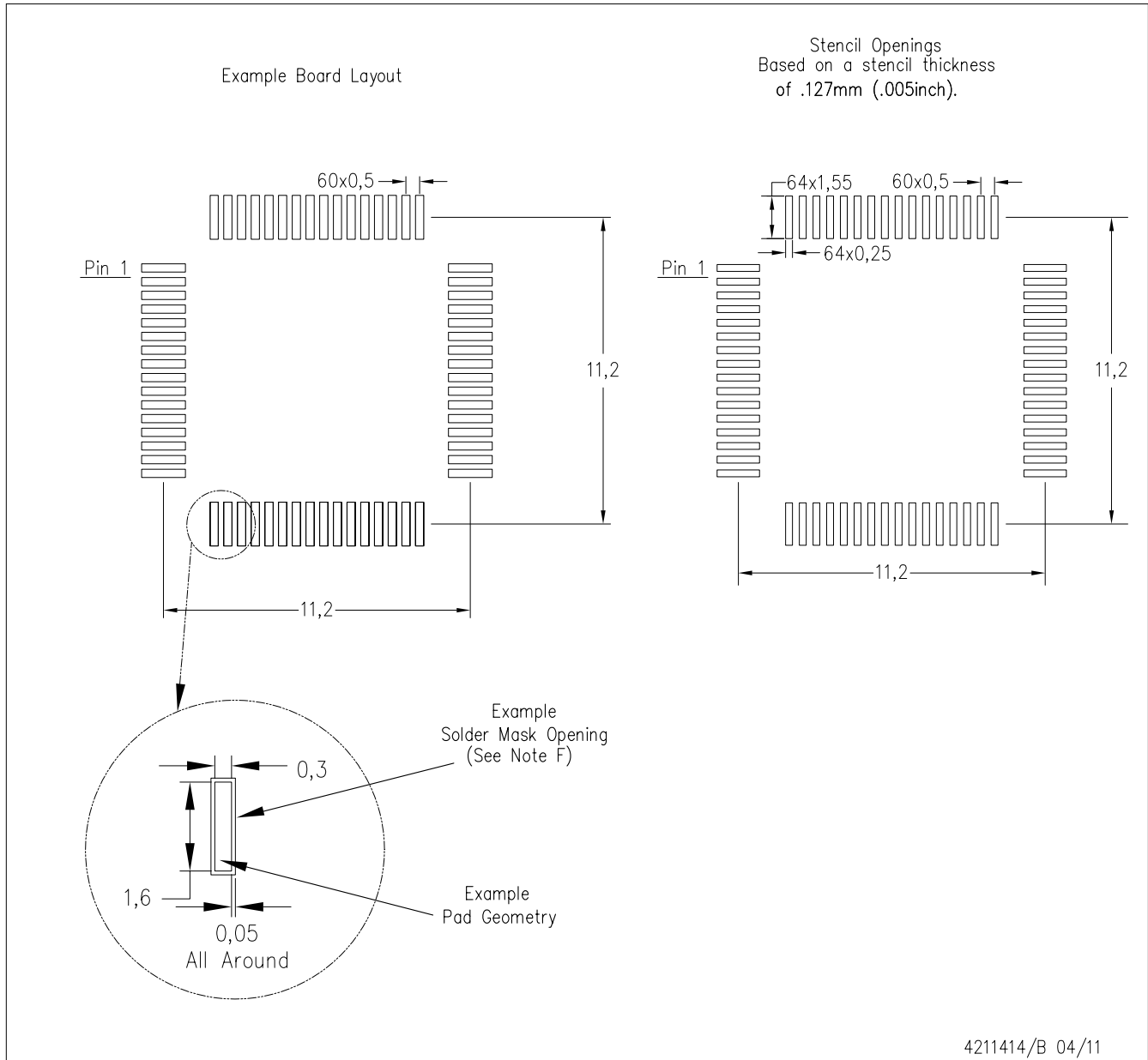
## PLASTIC QUAD FLATPACK



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-026

PAG (S-PQFP-G64)

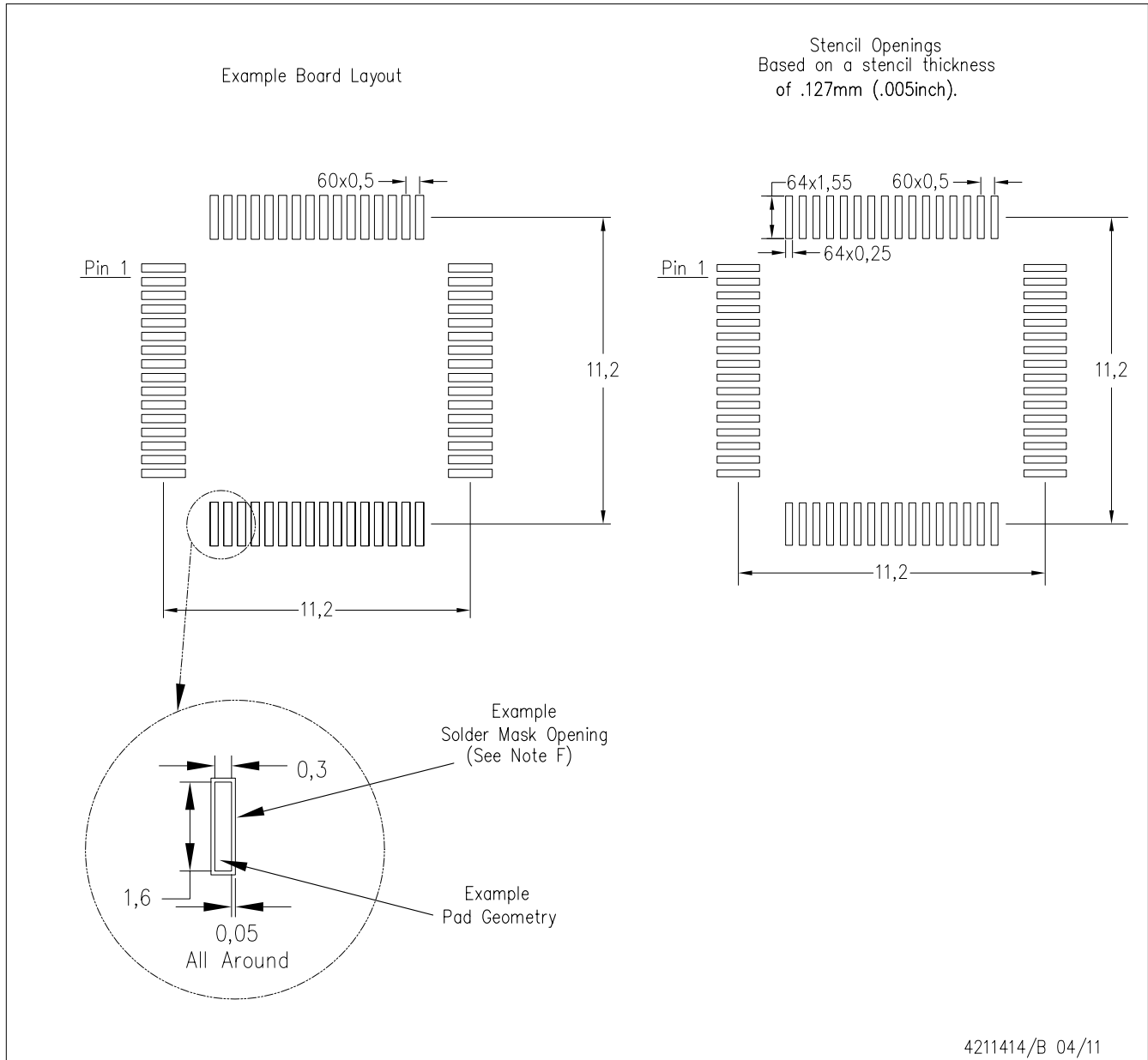
PLASTIC QUAD FLATPACK



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.
  - D. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PAG (S-PQFP-G64)

PLASTIC QUAD FLATPACK



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.
  - D. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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