

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 μ 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:

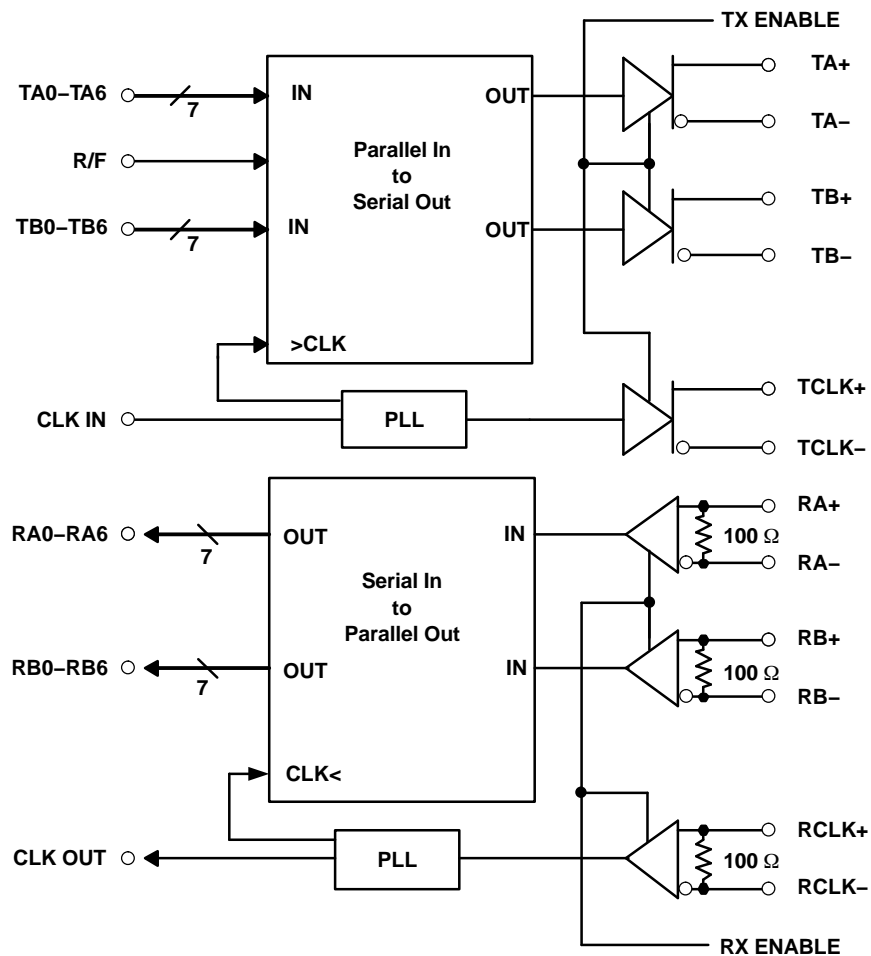
Possible use of the TX ENABLE and RX ENABLE feature. Both the TX and RX ENABLE circuits are active-high inputs that independently enable the serializer and deserializer. When TX is disabled, the LVDS outputs go to high impedance. When RX is disabled, the TTL outputs go to a known low state.

The SN75LVDT1422 is characterized for operation over the free-air temperature range of -10°C to 70°C .

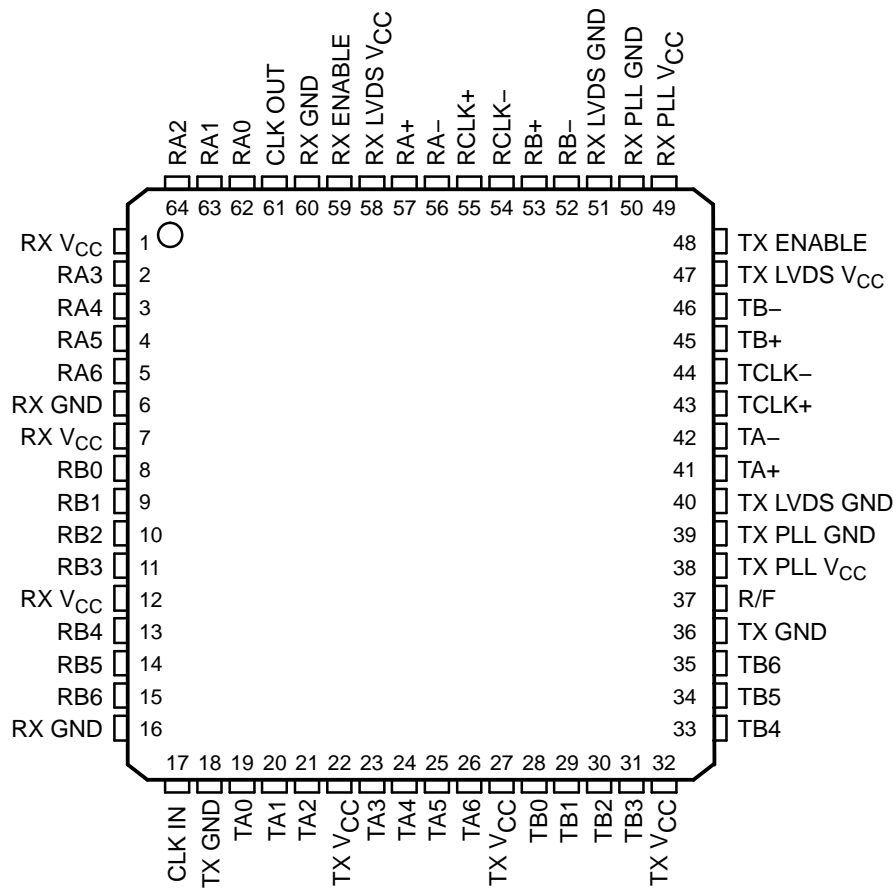


These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

FUNCTIONAL BLOCK DIAGRAM



**PAG PACKAGE
(TOP VIEW)**



TERMINAL FUNCTIONS

| TERMINAL | | TYPE | DESCRIPTION |
|-------------------------|-------------------------------|--------------|---|
| NAME | NO. | | |
| 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 _{CC} | 58 | | Power supply pin for RX LVDS inputs |
| RX PLL GND | 50 | | Ground pin for PLL RX circuitry |
| RX PLL V _{CC} | 49 | | Power supply pin for PLL RX circuitry |
| RX V _{CC} | 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 _{CC} | 47 | | Power supply pin for TX LVDS outputs |
| TX PLL GND | 39 | | Ground pin for PLL TX circuitry |
| TX PLL V _{CC} | 38 | | Power supply pin for PLL TX circuitry |
| TX V _{CC} | 22, 27, 32 | | Power supply pins for TX TTL inputs |

ORDERING INFORMATION⁽¹⁾

| PRODUCT | PACKAGE | ORDERING NUMBER |
|----------------|----------------|------------------------|
| 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.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

| | | UNIT |
|---|--|------------------------------|
| Supply voltage range, V_{CC} ⁽²⁾ | | –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 ⁽³⁾ (All pins) | ±5 kV |
| | Machine Model ⁽⁴⁾ (All pins) | ±200 V |
| | Charged-Device Model ⁽⁵⁾ (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 ⁽¹⁾ ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$ POWER RATING |
|------------|------------------------|-----------------------------|--|--|
| TQFP (PAG) | Low-K ⁽²⁾ | 813 mW | 8.13 mW/°C | 448 mW |
| TQFP (PAG) | High-K ⁽³⁾ | 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 |
|-----------------|--------------------------------------|-----------------|--|-------|
| $R_{\theta JB}$ | Junction-to-board thermal resistance | | 69.5 | °C/ W |
| $R_{\theta JC}$ | Junction-to-case thermal resistance | | 39.2 | |
| P_D | Device power dissipation | Typical | $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$, $f = 100$ MHz | mW |
| | | Maximum | $V_{CC} = 3.6$ V, $T_A = 70^\circ\text{C}$, $f = 100$ MHz | |

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 ⁽¹⁾ | MAX | UNIT |
|---------------------|---|---|------|--------------------|-----|------|
| V _{IT+} | Positive-going differential input threshold voltage | | | | 100 | mV |
| V _{IT−} | Negative-going differential input threshold voltage | | −100 | | | mV |
| V _{OH} | High-level output voltage | I _{OH} = −4 mA | 2.4 | | | V |
| V _{OL} | Low-level output voltage | I _{OL} = 4 mA | | | 0.4 | V |
| V _{IK} | Input clamp voltage | I _I = −18 mA | −1.5 | −0.8 | | V |
| I _I | Input current with integrated termination | V _I = 0 V or 2.4 V, V _{CC} = 3.6 V | −45 | | 45 | μA |
| I _{I(OFF)} | Power-off input current | V _{CC} = 0 V, V _I = 2.4 V | −10 | | 10 | μA |
| R _T | Termination resistance | V _{ID} = 100 mV, V _{IC} = 0.05 V to 2.4 V | 90 | 110 | 132 | Ω |
| C _i | 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 ⁽¹⁾ | MAX | UNIT |
|----------------------|--|---|-------|--------------------|-------|------|
| V _{OD} | Differential output voltage magnitude | R _L = 100 Ω | 250 | 365 | 450 | mV |
| Δ V _{OD} | Change in differential output voltage magnitude between logic states | | –35 | | 35 | mV |
| V _{OC(SS)} | Steady-state common-mode output voltage | | 1.125 | | 1.375 | V |
| ΔV _{OC(SS)} | Change in steady-state common-mode output voltage between logic states | | –35 | | 35 | mV |
| V _{OC(PP)} | Peak-to-peak common-mode output voltage | | | 30 | 80 | mV |
| I _{IH} | High-level input current | V _{IH} = 2 V | | | 20 | μA |
| I _{IL} | Low-level input current | V _{IL} = 0.8 V | –10 | | 10 | μA |
| V _{IK} | Input clamp voltage | I _I = –18 mA | –1.5 | –0.8 | | V |
| I _{OS} | Short-circuit output current | V _{O+} or V _{O–} = 0 V | –24 | | 24 | mA |
| | | V _{OD} = 0 V | –12 | | 12 | |
| I _{O(OFF)} | Power-off output current | V _{CC} = 0 V, V _O = 2.4 V | –10 | | 10 | μA |
| C _i | 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 ⁽¹⁾ | MAX | UNIT |
|-----------|--|---------------|--------------------|-----|------|
| I_{CC} | Supply current (worst case) See Figure 1 and Figure 2 | $f = 10$ 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 ⁽¹⁾ | MAX | UNIT |
|--------------------------------------|---|-------------|--------------------|-----|------|
| I_{CC} Supply current (worst case) | See Figure 1 and Figure 3 | 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⁽¹⁾

| PARAMETER | TEST CONDITIONS | MIN | TYP ⁽²⁾ | MAX | UNIT |
|--------------------------------------|---------------------|-----|--------------------|-----|---------------|
| $I_{CC(DIS)}$ Disable supply current | TX/RX ENABLEs = GND | 150 | 800 | | μA |

(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 ⁽¹⁾ | MAX | UNIT |
|--|------------------------------|-------|--------------------|--------------------|------|
| $t_{i(CLK)}$ Transition time, CLK IN | See Figure 5 | 1.0 | | 6.0 ⁽²⁾ | ns |
| $t_{c(CLK)}$ Input clock period, CLK IN | See Figure 6 | 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 ⁽¹⁾ | MAX | UNIT |
|---------------------------------------|---|-------|--------------------|-------|------|
| t_r LVDS Rise time | See Figure 4 | | 0.38 | 0.7 | ns |
| t_f LVDS Fall time | See Figure 4 | | 0.38 | 0.7 | ns |
| t_0 Output pulse position for bit 0 | f = 10 MHz, See Figure 12 | -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 Figure 12 | -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 ⁽¹⁾ | MAX | UNIT |
|----------------|--|--|------------------|--------------------|-------|------|
| t_0 | Output pulse position for bit 0 | $f = 40$ MHz, See Figure 12 | –0.25 | 0 | 0.25 | ns |
| t_1 | Output pulse position for bit 1 | | 3.32 | 3.57 | 3.82 | |
| t_2 | Output pulse position for bit 2 | | 6.89 | 7.14 | 7.39 | |
| t_3 | Output pulse position for bit 3 | | 10.46 | 10.71 | 10.96 | |
| t_4 | Output pulse position for bit 4 | | 14.04 | 14.29 | 14.54 | |
| t_5 | Output pulse position for bit 5 | | 17.61 | 17.86 | 18.11 | |
| t_6 | Output pulse position for bit 6 | | 21.18 | 21.43 | 21.68 | |
| t_0 | Output pulse position for bit 0 | $f = 65$ MHz, See Figure 12 | –0.20 | 0 | 0.20 | ns |
| t_1 | Output pulse position for bit 1 | | 2.00 | 2.20 | 2.40 | |
| t_2 | Output pulse position for bit 2 | | 4.20 | 4.40 | 4.60 | |
| t_3 | Output pulse position for bit 3 | | 6.39 | 6.59 | 6.79 | |
| t_4 | Output pulse position for bit 4 | | 8.59 | 8.79 | 8.99 | |
| t_5 | Output pulse position for bit 5 | | 10.79 | 10.99 | 11.19 | |
| t_6 | Output pulse position for bit 6 | | 12.99 | 13.19 | 13.39 | |
| t_0 | Output pulse position for bit 0 | $f = 85$ MHz, See Figure 12 | –0.15 | 0 | 0.15 | ns |
| t_1 | Output pulse position for bit 1 | | 1.53 | 1.68 | 1.83 | |
| t_2 | Output pulse position for bit 2 | | 3.21 | 3.36 | 3.51 | |
| t_3 | Output pulse position for bit 3 | | 4.89 | 5.04 | 5.19 | |
| t_4 | Output pulse position for bit 4 | | 6.57 | 6.72 | 6.87 | |
| t_5 | Output pulse position for bit 5 | | 8.25 | 8.40 | 8.55 | |
| t_6 | Output pulse position for bit 6 | | 9.93 | 10.08 | 10.23 | |
| t_0 | Output pulse position for bit 0 | $f = 100$ MHz, See Figure 12 | –0.2 | 0 | 0.2 | ns |
| t_1 | Output pulse position for bit 1 | | 1.23 | 1.43 | 1.63 | |
| t_2 | Output pulse position for bit 2 | | 2.66 | 2.86 | 3.06 | |
| t_3 | Output pulse position for bit 3 | | 4.09 | 4.29 | 4.49 | |
| t_4 | Output pulse position for bit 4 | | 5.51 | 5.71 | 5.91 | |
| t_5 | Output pulse position for bit 5 | | 6.94 | 7.14 | 7.34 | |
| t_6 | Output pulse position for bit 6 | | 8.37 | 8.57 | 8.77 | |
| t_{su} | TAx/TBx Setup time to CLK IN | $f = 85$ MHz or 100 MHz, See Figure 6 | 1 | | | ns |
| t_h | TAx/TBx Hold time to CLK IN | | 0.25 | | | |
| $t_{pd(TCC)}$ | CLK IN to TCLK± Propagation delay time | See Figure 7 and Figure 8 ⁽²⁾ | $f = 10$ 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 | |
| $t_{jit(C-C)}$ | 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 ⁽³⁾ | $f = 10$ MHz | 100 ±2.5%/–5% | | | kHz |
| | | $f = 25$ MHz | | | | |
| | | $f = 40$ MHz | | | | |
| | | $f = 65$ MHz | | | | |
| | | $f = 85$ MHz | | | | |
| | | $f = 100$ MHz | | | | |
| $t_{en(TPLL)}$ | Phase lock loop enable time | See Figure 9 | | | 10 | ms |
| $t_{dis(T)}$ | Transmitter disable time | See Figure 11 | | | 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_{su} and t_h 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 ⁽¹⁾ | MAX | UNIT |
|----------------|---|---|-----------------|-------|--------------------|-------|------|
| t_r | CMOS/LVTTL Rise time | CLK OUT | See Figure 3 | | 1.2 | 2.5 | ns |
| | | RA or RB | | | 2.0 | 3.5 | |
| t_f | CMOS/LVTTL Fall time | CLK OUT | See Figure 3 | | 1.2 | 2.5 | ns |
| | | RA or RB | | | 2.0 | 3.5 | |
| t_0 | Input strobe position for bit 0 | f = 85 MHz, See Figure 17 | | 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 Figure 17 | | 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 ⁽²⁾ | f = 85 MHz, See Figure 18 | | 300 | | | ps |
| | | f = 100 MHz, See Figure 18 | | 200 | | | |
| t_c | CLK OUT Typical period range | | | 10 | T | 100 | ns |
| t_{WH} | CLK OUT Pulse duration, clock high | f = 85 MHz, See Figure 13 | | 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 Figure 13 | | 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 Figure 14 | | | 6 | 9 | ns |
| $t_{en(RPLL)}$ | Receiver phase lock loop enable time | See Figure 15 | | | | 10 | ms |
| $t_{dis(R)}$ | Receiver disable time | See Figure 16 | | | | 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

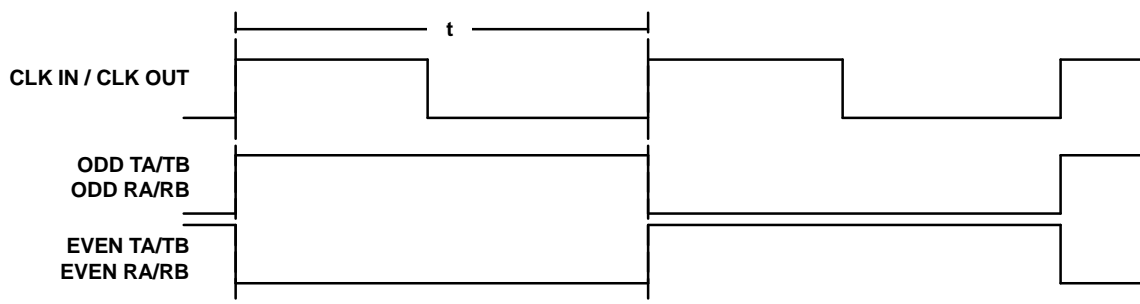


Figure 1. Worst Case Test Pattern

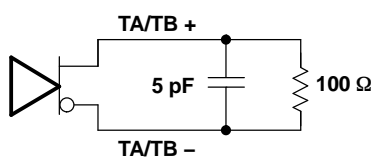


Figure 2. LVDS Output Load

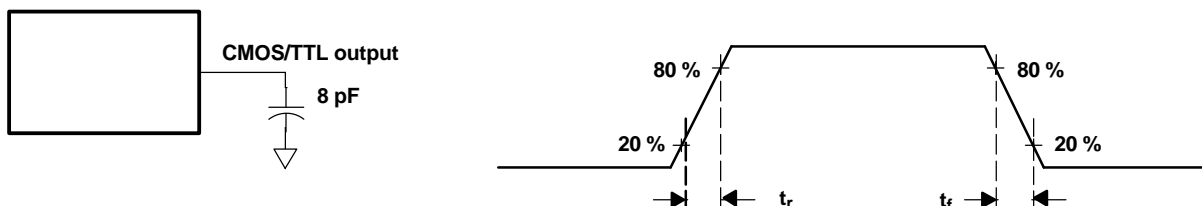


Figure 3. Receiver CMOS/LVTTL Output Load and Transition Times

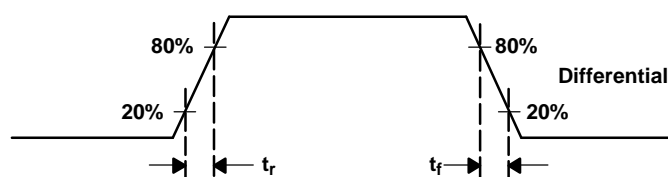


Figure 4. Transmitter LVDS Transition Times

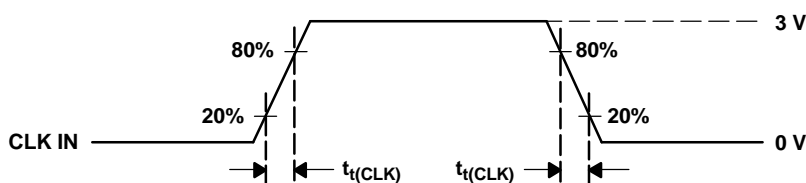


Figure 5. Transmitter Input Clock Transition Time

PARAMETER MEASUREMENT INFORMATION (continued)

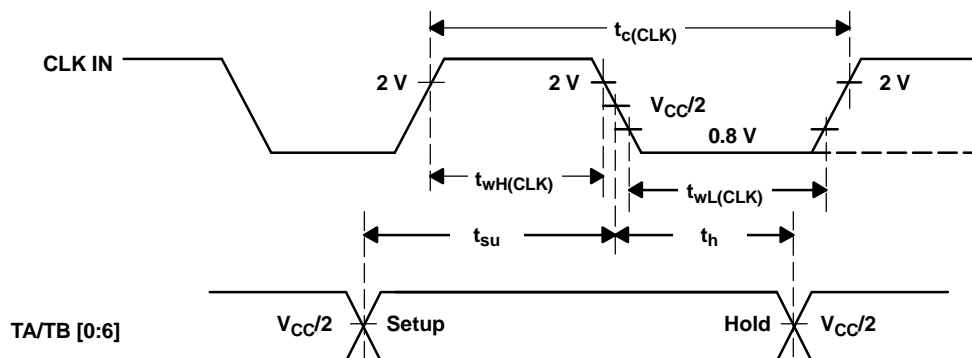


Figure 6. Transmitter Setup/Hold and High/Low Times (Falling Edge Strobe)

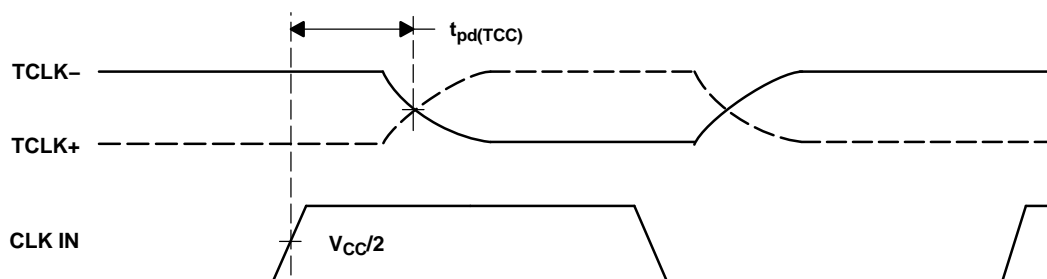


Figure 7. Transmitter Clock In to Clock Out Propagation Delay Time with R/F at V_{CC}

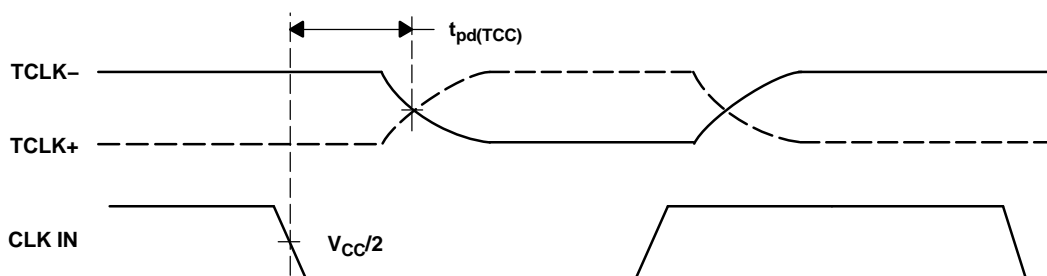


Figure 8. Transmitter Clock In to Clock Out Propagation Delay Time with R/F at GND

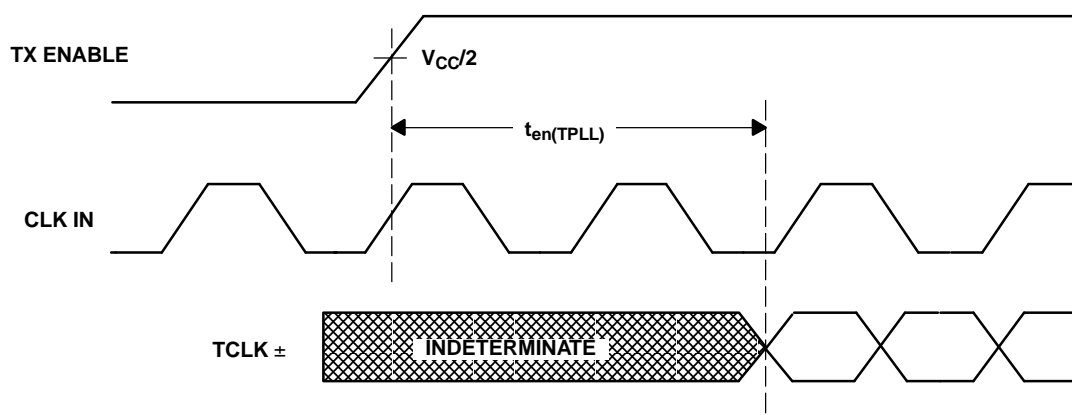


Figure 9. Transmitter Phase Lock Loop Enable Time

PARAMETER MEASUREMENT INFORMATION (continued)

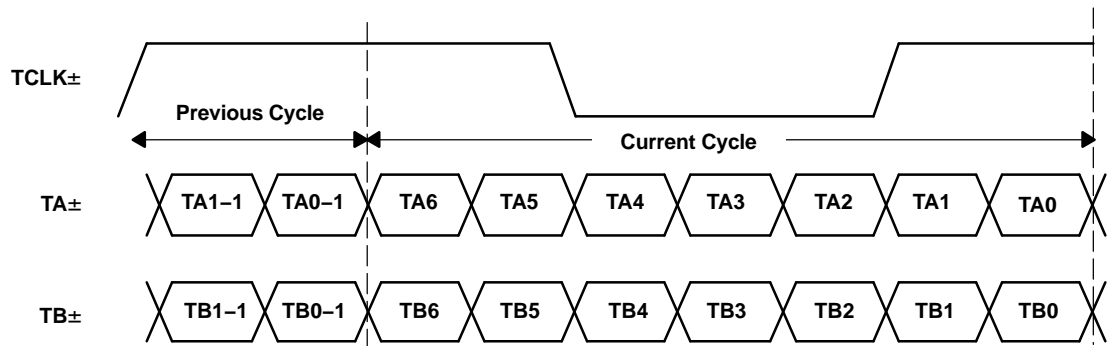


Figure 10. 14 Parallel TTL Data Inputs Mapped to LVDS Outputs

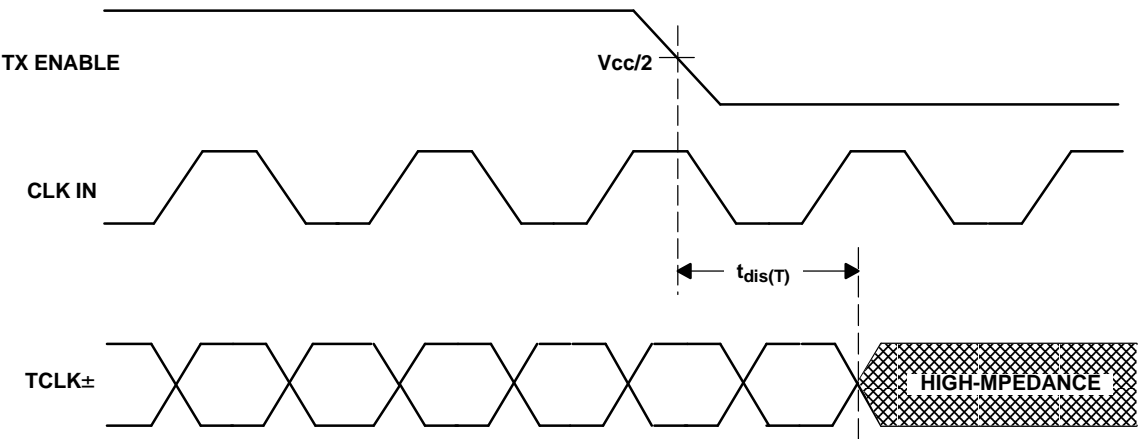


Figure 11. Transmitter Disable Time

PARAMETER MEASUREMENT INFORMATION (continued)

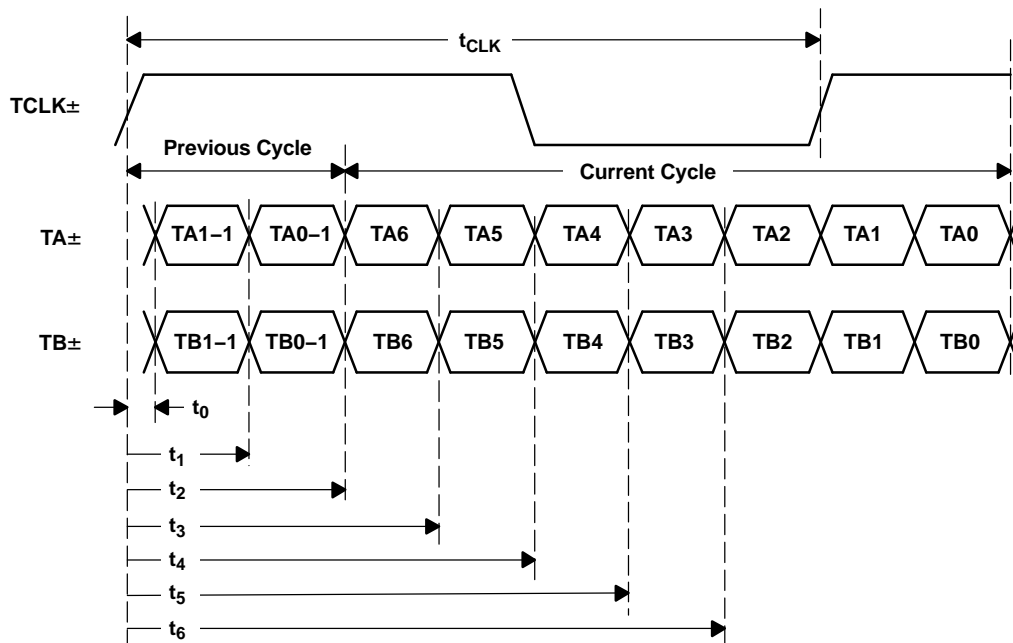


Figure 12. Transmitter LVDS Output Pulse Position Measurement

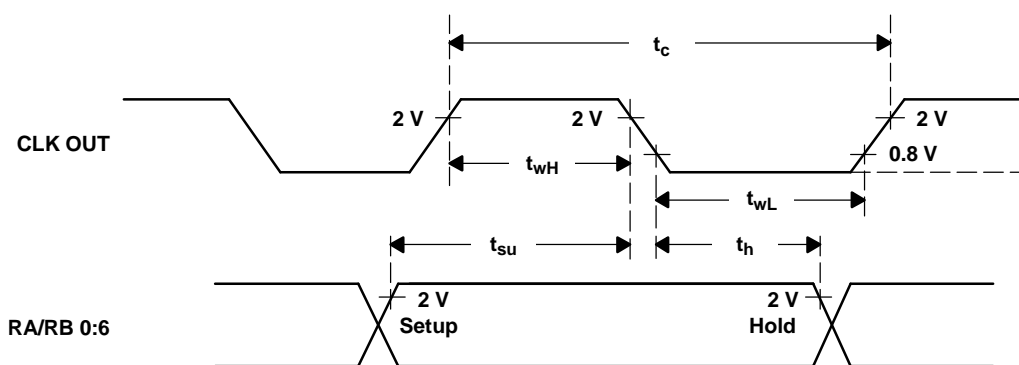


Figure 13. Receiver Setup/Hold and High/Low Times

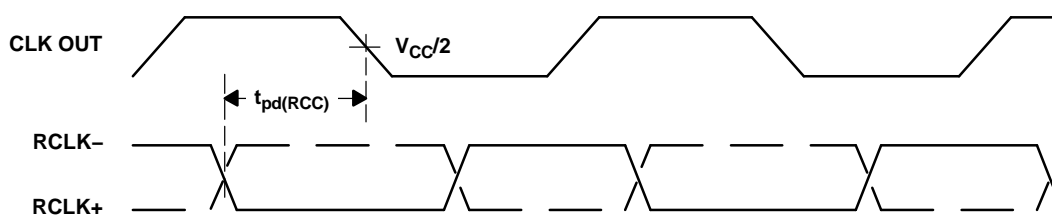
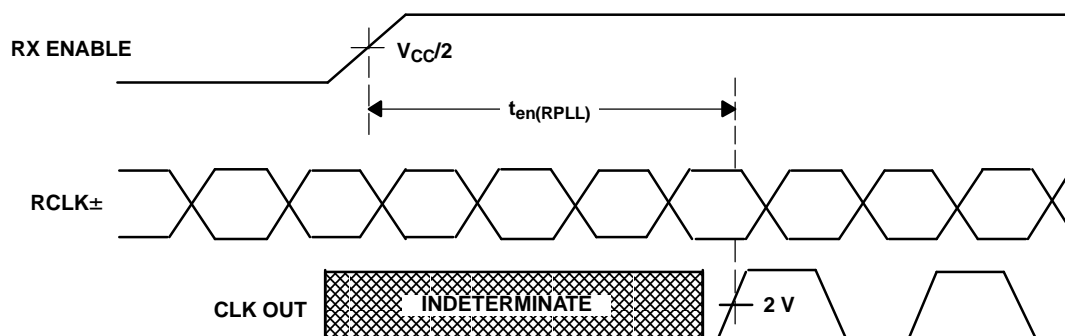
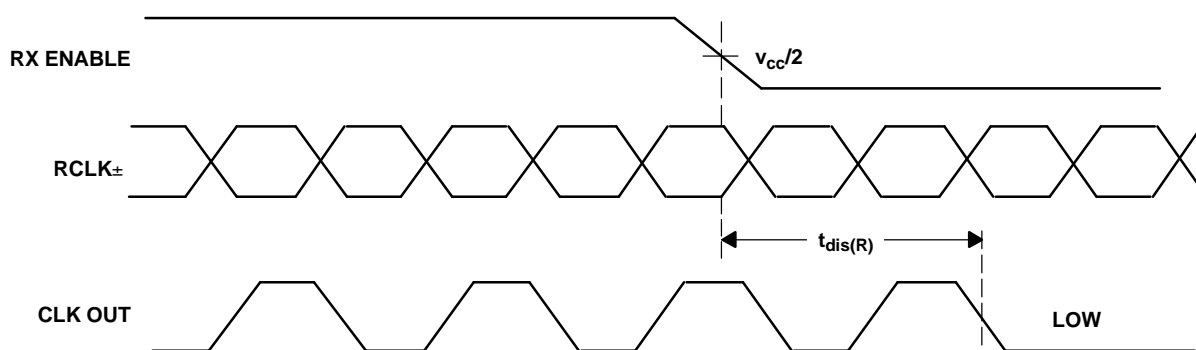


Figure 14. Receiver Clock In to Clock Out Propagation Delay Time

PARAMETER MEASUREMENT INFORMATION (continued)**Figure 15. Receiver Phase Lock Loop Enable Time****Figure 16. Receiver Disable Time**

PARAMETER MEASUREMENT INFORMATION (continued)

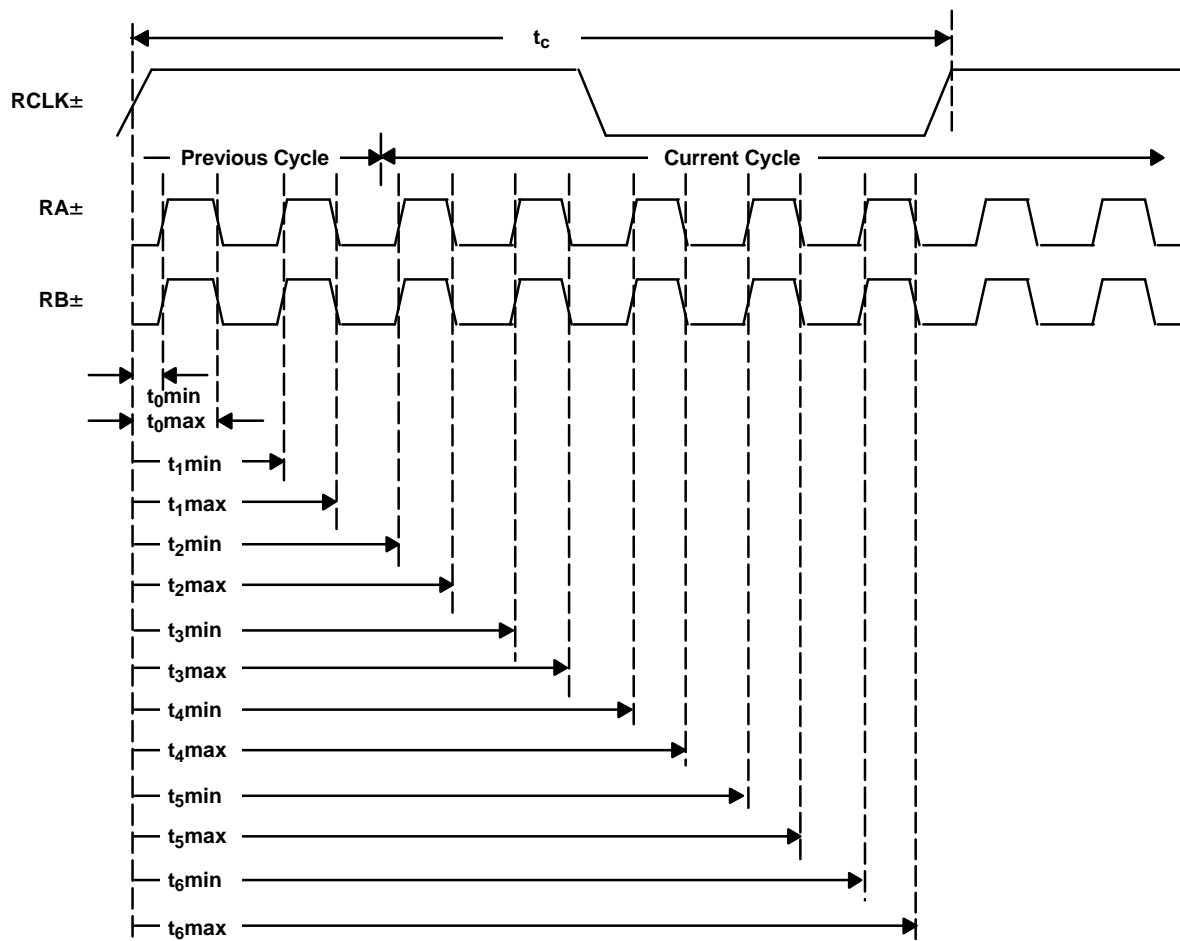
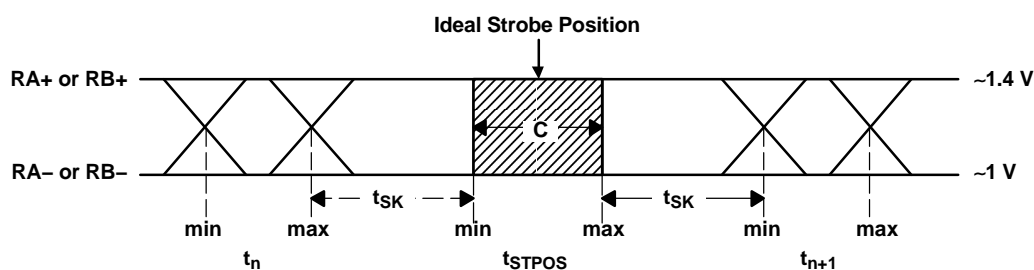


Figure 17. Receiver LVDS Input Strobe Position



- (1) C – Setup and hold time (internal data sampling window) defined by t_{STPOS} (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) ⁽⁵⁾ + ISI (inter-symbol interference) ⁽⁶⁾
- (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

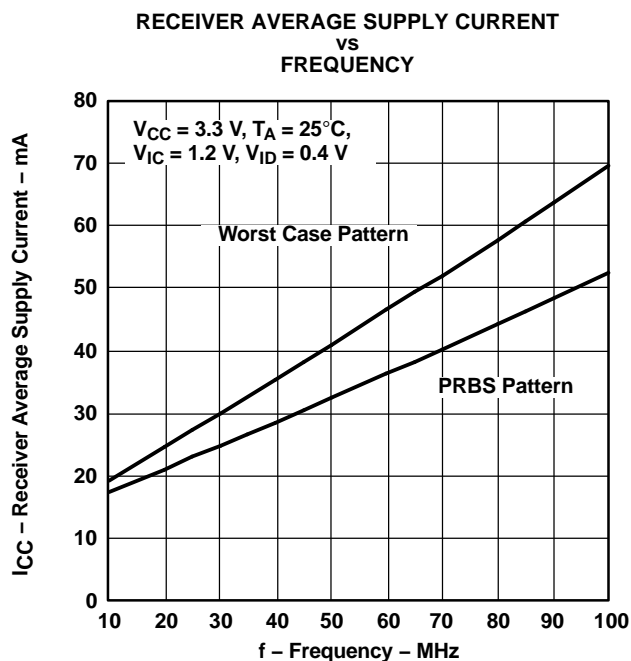


Figure 19.

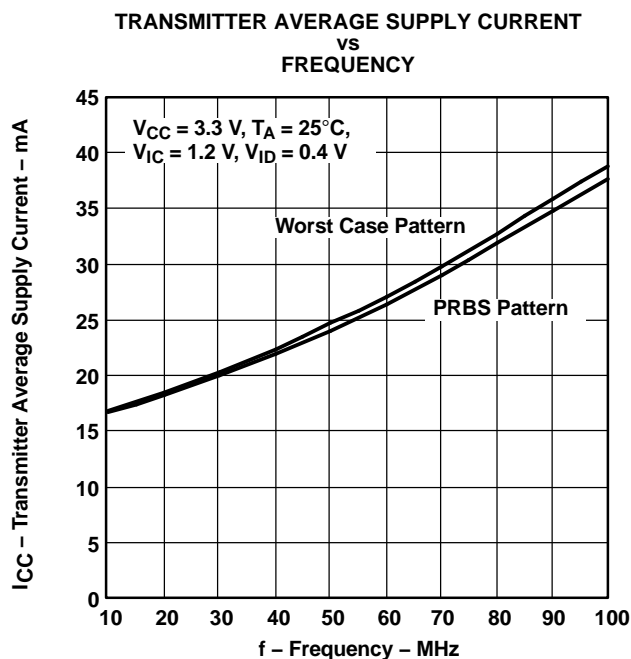


Figure 20.

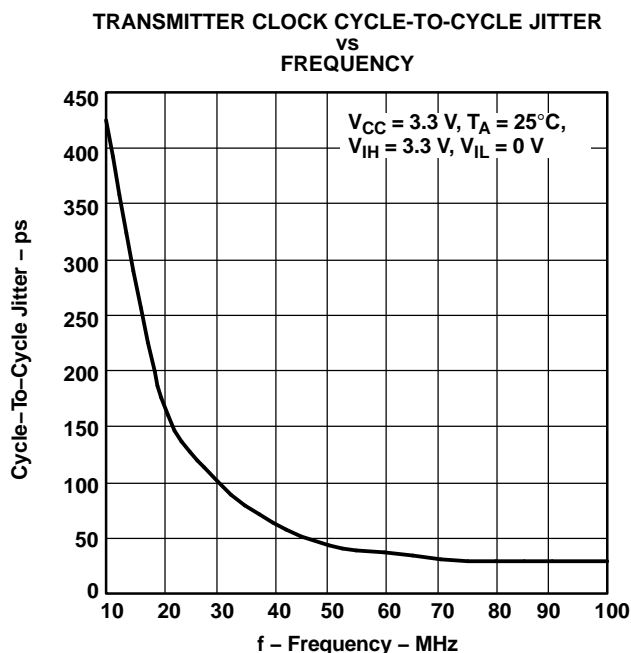


Figure 21.

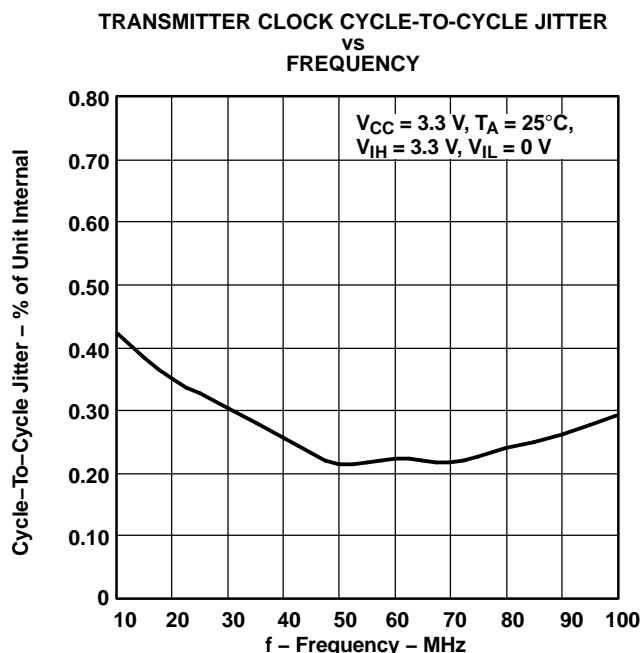


Figure 22.

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 LVTTL 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/Ball Finish | MSL Peak Temp ⁽³⁾ |
|--------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN75LVDT1422PAG | ACTIVE | TQFP | PAG | 64 | 96 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR |
| SN75LVDT1422PAGG4 | ACTIVE | TQFP | PAG | 64 | 96 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR |
| SN75LVDT1422PAGR | ACTIVE | TQFP | PAG | 64 | 1500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR |
| SN75LVDT1422PAGRG4 | ACTIVE | TQFP | PAG | 64 | 1500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR |

⁽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) 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.

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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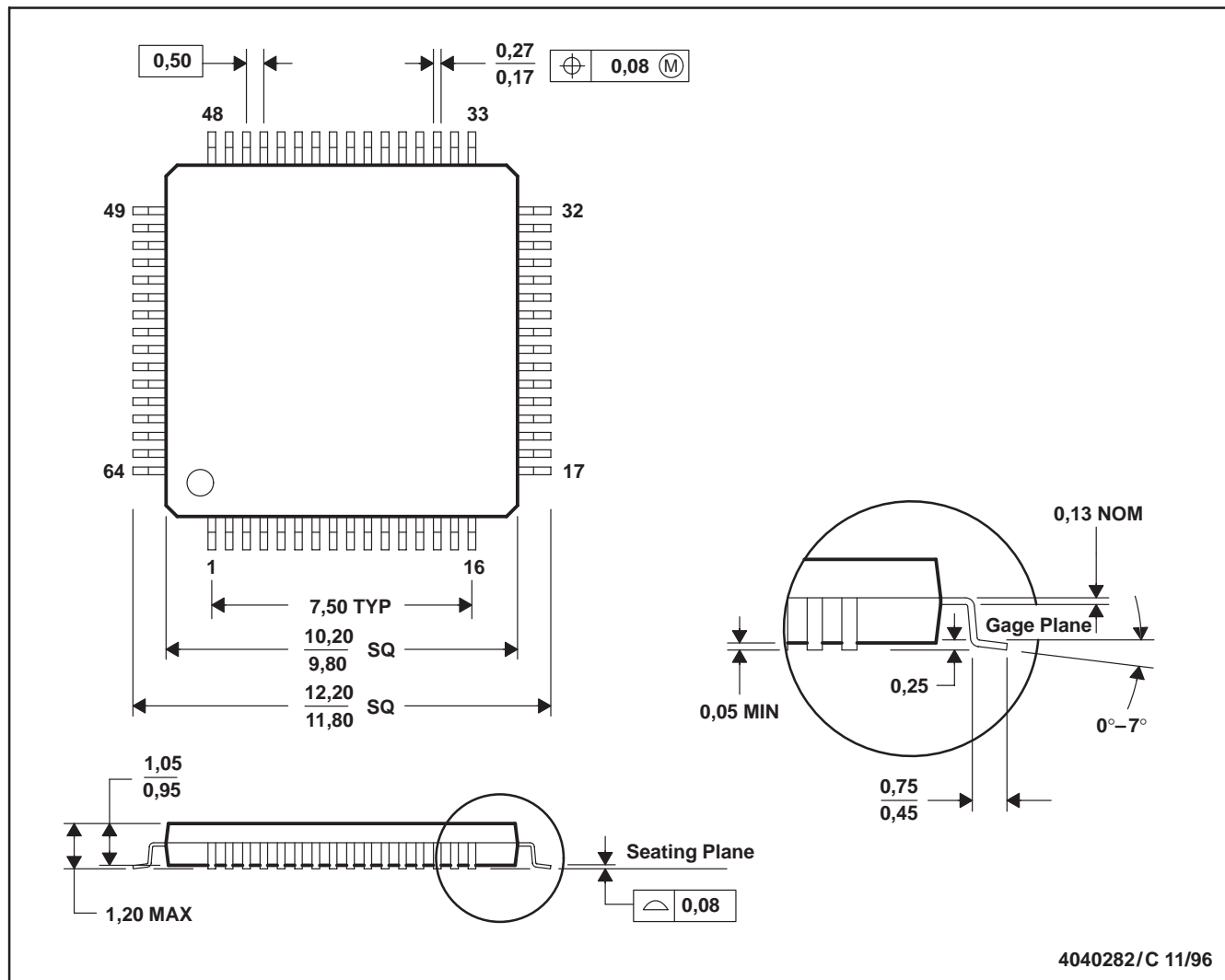
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MECHANICAL DATA

MTQF006A – JANUARY 1995 – REVISED DECEMBER 1996

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

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