

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

- Member of the Texas Instruments Widebus+™ Family
- Pinout Optimizes DDR2 DIMM PCB Layout
- Configurable as 25-Bit 1:1 or 14-Bit 1:2 Registered Buffer
- Chip-Select Inputs Gate the Data Outputs from Changing State and Minimizes System Power Consumption
- Output Edge-Control Circuitry Minimizes Switching Noise in an Unterminated Line
- Supports SSTL_18 Data Inputs
- Differential Clock (CLK and $\overline{\text{CLK}}$) Inputs
- Supports LVCMOS Switching Levels on the Control and $\overline{\text{RESET}}$ Inputs
- Checks Parity on DIMM-Independent Data Inputs
- Able to Cascade with a Second SN74SSTU32866
- $\overline{\text{RESET}}$ Input Disables Differential Input Receivers, Resets All Registers, and Forces All Outputs Low, Except $\overline{\text{QERR}}$
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

description/ordering information

This 25-bit 1:1 or 14-bit 1:2 configurable registered buffer is designed for 1.7-V to 1.9-V V_{CC} operation. In the 1:1 pinout configuration, only one device per DIMM is required to drive nine SDRAM loads. In the 1:2 pinout configuration, two devices per DIMM are required to drive 18 SDRAM loads.

All inputs are SSTL_18, except the reset ($\overline{\text{RESET}}$) and control (Cn) inputs, which are LVCMOS. All outputs are edge-controlled circuits optimized for unterminated DIMM loads and meet SSTL_18 specifications, except the open-drain error ($\overline{\text{QERR}}$) output.

The SN74SSTU32866 operates from a differential clock (CLK and $\overline{\text{CLK}}$). Data are registered at the crossing of CLK going high and $\overline{\text{CLK}}$ going low.

The SN74SSTU32866 accepts a parity bit from the memory controller on the parity bit (PAR_IN) input, compares it with the data received on the DIMM-independent D-inputs (D2–D3, D5–D6, D8–D25 when C0 = 0 and C1 = 0; D2–D3, D5–D6, D8–D14 when C0 = 0 and C1=1; or D1–D6, D8–D13 when C0 = 1 and C1=1) and indicates whether a parity error has occurred on the open-drain $\overline{\text{QERR}}$ pin (active low). The convention is even parity; i.e., valid parity is defined as an even number of ones across the DIMM-independent data inputs, combined with the parity input bit. To calculate parity, all DIMM-independent data inputs must be tied to a known logic state.

When used as a single device, the C0 and C1 inputs are tied low. In this configuration, parity is checked on the PAR_IN input signal, which arrives one cycle after the input data to which it applies. Two clock cycles after the data are registered, the corresponding partial-parity-out (PPO) and $\overline{\text{QERR}}$ signals are generated.

ORDERING INFORMATION

| T _A | PACKAGE† | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|------------------------------|-----------------------|------------------|
| 0°C to 70°C | LFPGA – GKE Tape and reel | SN74SSTU32866GKER | SU866 |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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.

Widebus+ is a trademark of Texas Instruments.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2004, Texas Instruments Incorporated

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

description/ordering information (continued)

When used in pairs, the C0 input of the first register is tied low, and the C0 input of the second register is tied high. The C1 input of both registers are tied high. Parity, which arrives one cycle after the data input to which it applies, is checked on the PAR_IN input signal of the first device. Two clock cycles after the data are registered, the corresponding PPO and \overline{QERR} signals are generated on the second device. The PPO output of the first register is cascaded to the PAR_IN of the second SN74SSTU32866. The \overline{QERR} output of the first SN74SSTU32866 is left floating, and the valid error information is latched on the \overline{QERR} output of the second SN74SSTU32866.

If an error occurs and the \overline{QERR} output is driven low, it stays latched low for a minimum of two clock cycles or until \overline{RESET} is driven low. If two or more consecutive parity errors occur, the \overline{QERR} output is driven low and latched low for a clock duration equal to the parity-error duration or until \overline{RESET} is driven low. The DIMM-dependent signals (\overline{DCKE} , \overline{DCS} , \overline{DODT} , and \overline{CSR}) are not included in the parity-check computation.

The C0 input controls the pinout configuration of the 1:2 pinout from register-A configuration (when low) to register-B configuration (when high). The C1 input controls the pinout configuration from 25-bit 1:1 (when low) to 14-bit 1:2 (when high). C0 and C1 should not be switched during normal operation. They should be hard-wired to a valid low or high level to configure the register in the desired mode. In the 25-bit 1:1 pinout configuration, the A6, D6, and H6 terminals are driven low and are do-not-use (DNU) pins.

In the DDR2 RDIMM application, \overline{RESET} is specified to be completely asynchronous with respect to CLK and \overline{CLK} . Therefore, no timing relationship can be ensured between the two. When entering reset, the register is cleared, and the data outputs are driven low quickly, relative to the time required to disable the differential input receivers. However, when coming out of reset, the register becomes active quickly, relative to the time required to enable the differential input receivers. As long as the data inputs are low, and the clock is stable during the time from the low-to-high transition of \overline{RESET} until the input receivers are fully enabled, the design of the SN74SSTU32866 ensures that the outputs remain low, thus ensuring there will be no glitches on the output.

To ensure defined outputs from the register before a stable clock has been supplied, \overline{RESET} must be held in the low state during power up.

The device supports low-power standby operation. When \overline{RESET} is low, the differential input receivers are disabled, and undriven (floating) data, clock, and reference voltage (V_{REF}) inputs are allowed. In addition, when \overline{RESET} is low, all registers are reset and all outputs are forced low, except \overline{QERR} . The LVCMOS \overline{RESET} and Cn inputs always must be held at a valid logic high or low level.

The device also supports low-power active operation by monitoring both system chip select (\overline{DCS} and \overline{CSR}) inputs and gates the Qn and PPO outputs from changing states when both \overline{DCS} and \overline{CSR} inputs are high. If either \overline{DCS} or \overline{CSR} input is low, the Qn and PPO outputs function normally. Also, if the internal low-power signal ($\overline{LPS1}$) is high (one cycle after \overline{DCS} and \overline{CSR} go high), the device gates the \overline{QERR} output from changing states. If $\overline{LPS1}$ is low, the \overline{QERR} output functions normally. The \overline{RESET} input has priority over the \overline{DCS} and \overline{CSR} control and, when driven low, forces the Qn and PPO outputs low and forces the \overline{QERR} output high. If the \overline{DCS} control functionality is not desired, the \overline{CSR} input can be hard-wired to ground, in which case the setup-time requirement for \overline{DCS} is the same as for the other D data inputs. To control the low-power mode with \overline{DCS} only, the \overline{CSR} input should be pulled up to V_{CC} through a pullup resistor.

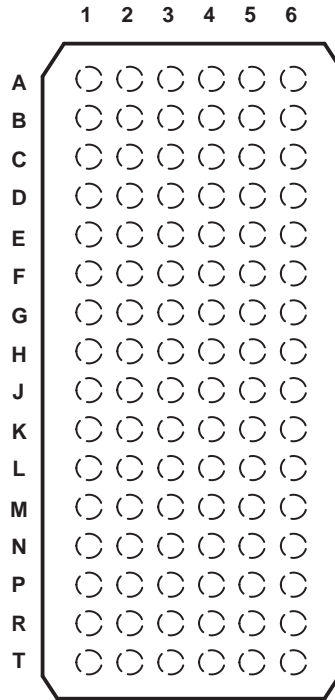
The two V_{REF} pins (A3 and T3) are connected together internally by approximately 150 Ω . However, it is necessary to connect only one of the two V_{REF} pins to the external V_{REF} power supply. An unused V_{REF} pin should be terminated with a V_{REF} coupling capacitor.



SN74SSTU32866
25-BIT CONFIGURABLE REGISTERED BUFFER
WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

GKE PACKAGE
(TOP VIEW)



terminal assignments for 1:1 register (C0 = 0, C1 = 0)

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|------------------|-------------------------|------------------|-----------------|-------------------------|-----|
| A | D1 (DCKE) | PPO | V _{REF} | V _{CC} | Q1 (QCKE) | DNU |
| B | D2 | D15 | GND | GND | Q2 | Q15 |
| C | D3 | D16 | V _{CC} | V _{CC} | Q3 | Q16 |
| D | D4 (DODT) | \overline{QERR} | GND | GND | Q4 (QODT) | DNU |
| E | D5 | D17 | V _{CC} | V _{CC} | Q5 | Q17 |
| F | D6 | D18 | GND | GND | Q6 | Q18 |
| G | PAR_IN | \overline{RESET} | V _{CC} | V _{CC} | C1 | C0 |
| H | CLK | D7 (\overline{DCS}) | GND | GND | Q7 (\overline{QCS}) | DNU |
| J | \overline{CLK} | \overline{CSR} | V _{CC} | V _{CC} | NC | NC |
| K | D8 | D19 | GND | GND | Q8 | Q19 |
| L | D9 | D20 | V _{CC} | V _{CC} | Q9 | Q20 |
| M | D10 | D21 | GND | GND | Q10 | Q21 |
| N | D11 | D22 | V _{CC} | V _{CC} | Q11 | Q22 |
| P | D12 | D23 | GND | GND | Q12 | Q23 |
| R | D13 | D24 | V _{CC} | V _{CC} | Q13 | Q24 |
| T | D14 | D25 | V _{REF} | V _{CC} | Q14 | Q25 |

Each pin name in parentheses indicates the DDR2 DIMM signal name.

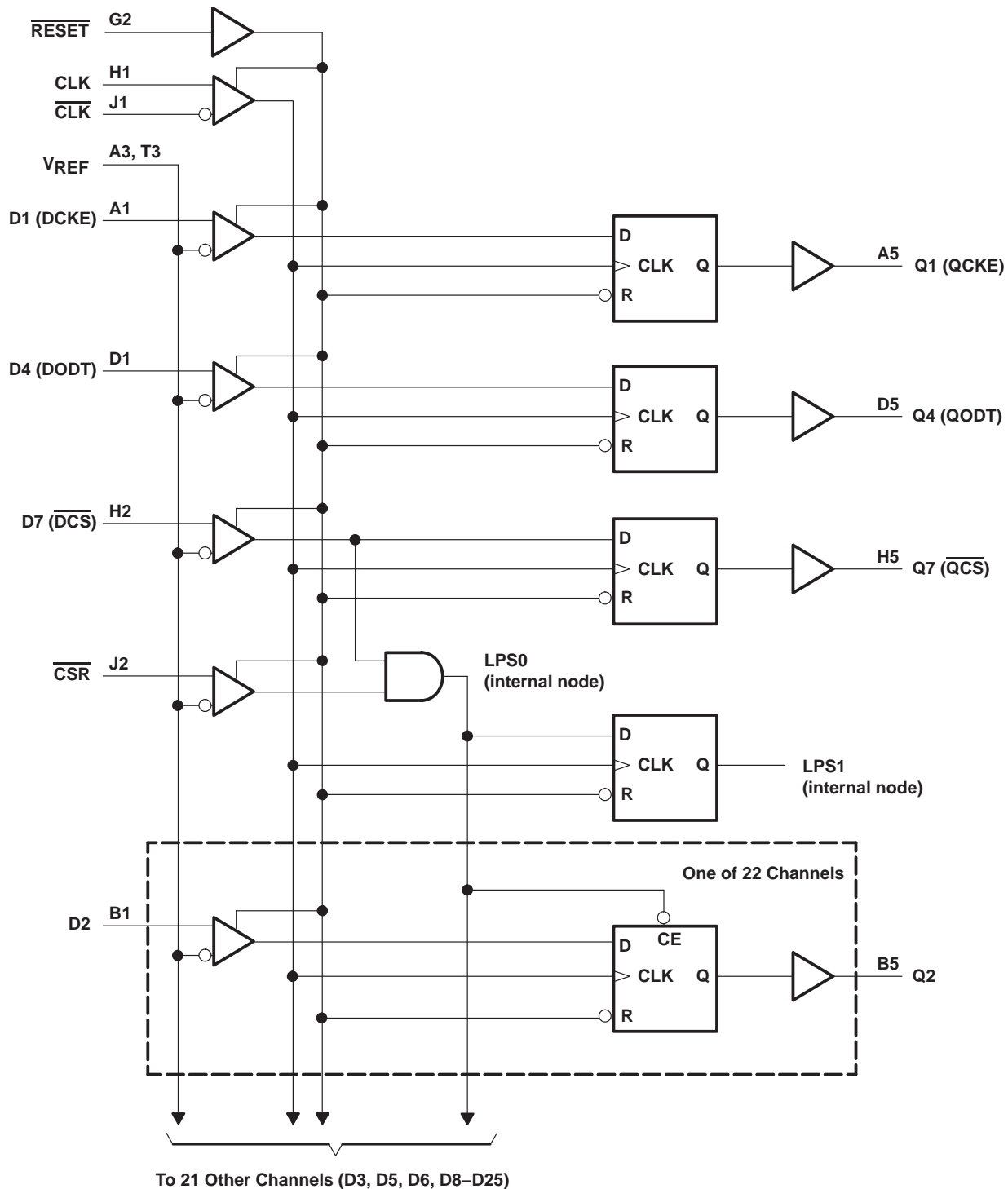
DNU – Do not use

NC – No internal connection

SN74SSTU32866
25-BIT CONFIGURABLE REGISTERED BUFFER
WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

logic diagram for 1:1 register configuration (positive logic); C0 = 0, C1 = 0

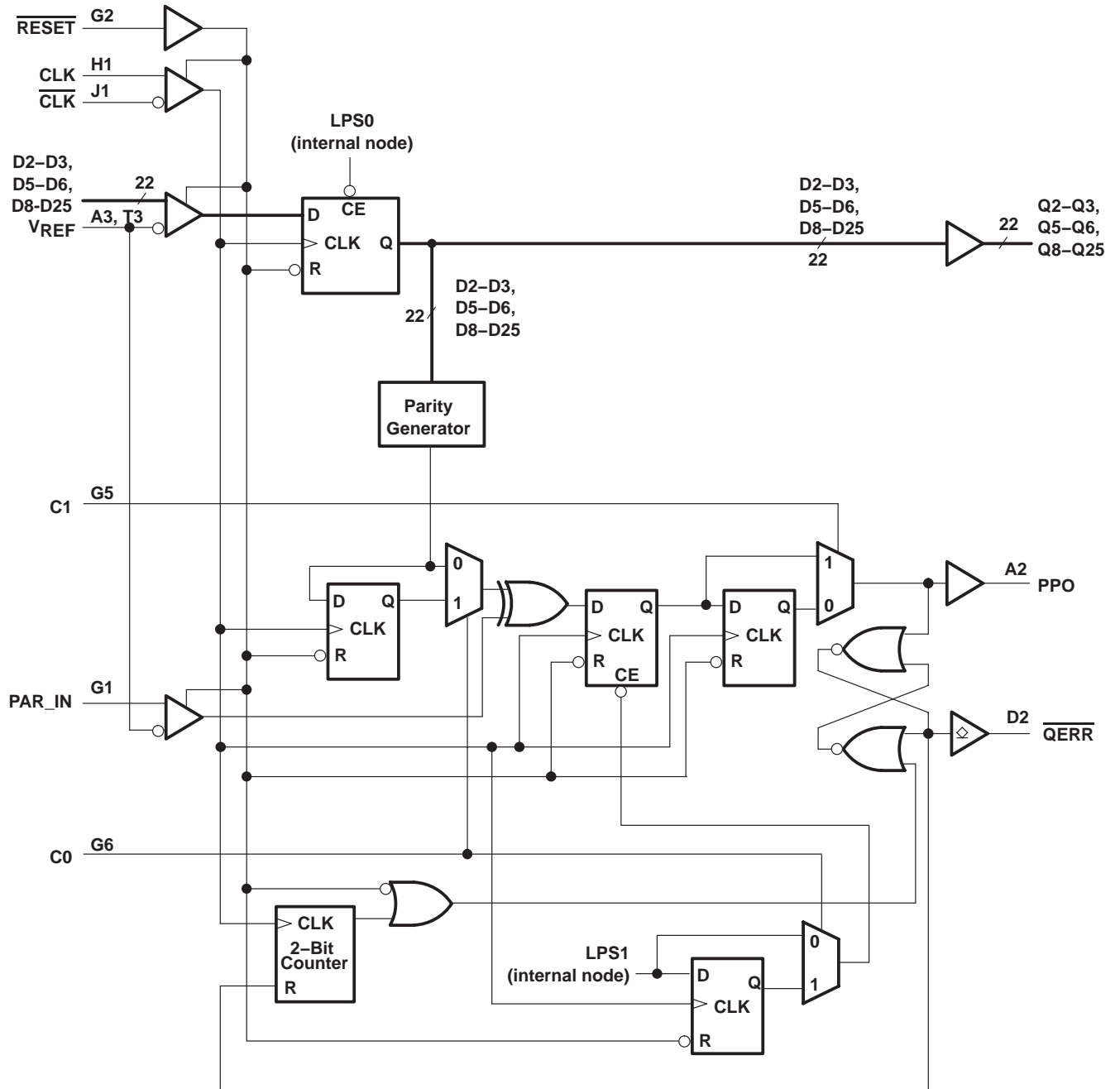


SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

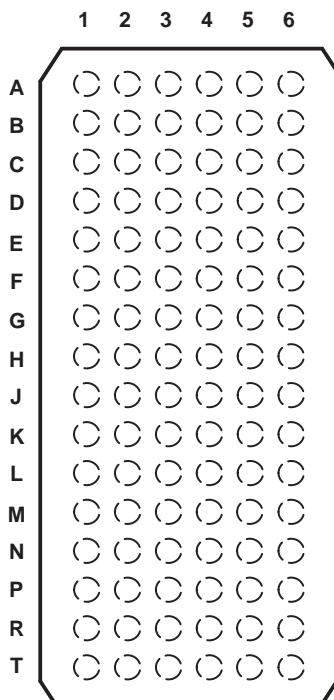
parity logic diagram for 1:1 register configuration (positive logic); C0 = 0, C1 = 0



SN74SSTU32866
25-BIT CONFIGURABLE REGISTERED BUFFER
WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

GKE PACKAGE
(TOP VIEW)



terminal assignments for 1:2 register-A (C0 = 0, C1 = 1)

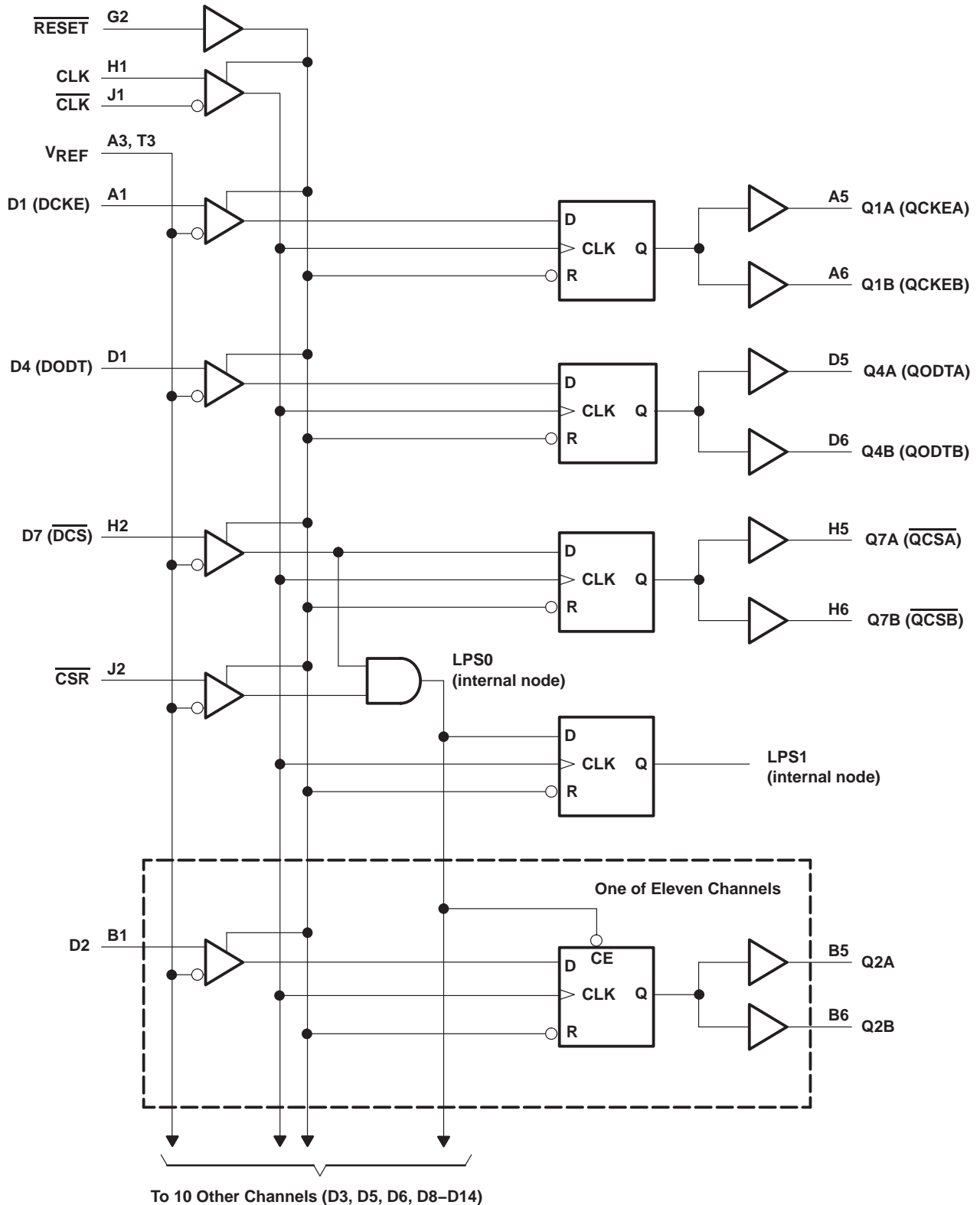
| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|------------------|-------------------------|------|-----|-------------|-------------|
| A | D1 (DCKE) | PPO | VREF | VCC | Q1A (QCKEA) | Q1B (QCKEB) |
| B | D2 | DNU | GND | GND | Q2A | Q2B |
| C | D3 | DNU | VCC | VCC | Q3A | Q3B |
| D | D4 (DODT) | \overline{QERR} | GND | GND | Q4A (QODTA) | Q4B (QODTB) |
| E | D5 | DNU | VCC | VCC | Q5A | Q5B |
| F | D6 | DNU | GND | GND | Q6A | Q6B |
| G | PAR_IN | \overline{RESET} | VCC | VCC | C1 | C0 |
| H | CLK | D7 (\overline{DCS}) | GND | GND | Q7A (QCSA) | Q7B (QCSB) |
| J | \overline{CLK} | \overline{CSR} | VCC | VCC | NC | NC |
| K | D8 | DNU | GND | GND | Q8A | Q8B |
| L | D9 | DNU | VCC | VCC | Q9A | Q9B |
| M | D10 | DNU | GND | GND | Q10A | Q10B |
| N | D11 | DNU | VCC | VCC | Q11A | Q11B |
| P | D12 | DNU | GND | GND | Q12A | Q12B |
| R | D13 | DNU | VCC | VCC | Q13A | Q13B |
| T | D14 | DNU | VREF | VCC | Q14A | Q14B |

Each pin name in parentheses indicates the DDR2 DIMM signal name.
DNU – Do not use
NC – No internal connection

SN74SSTU32866
25-BIT CONFIGURABLE REGISTERED BUFFER
WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

logic diagram for 1:2 register-A configuration (positive logic); C0 = 0, C1 = 1



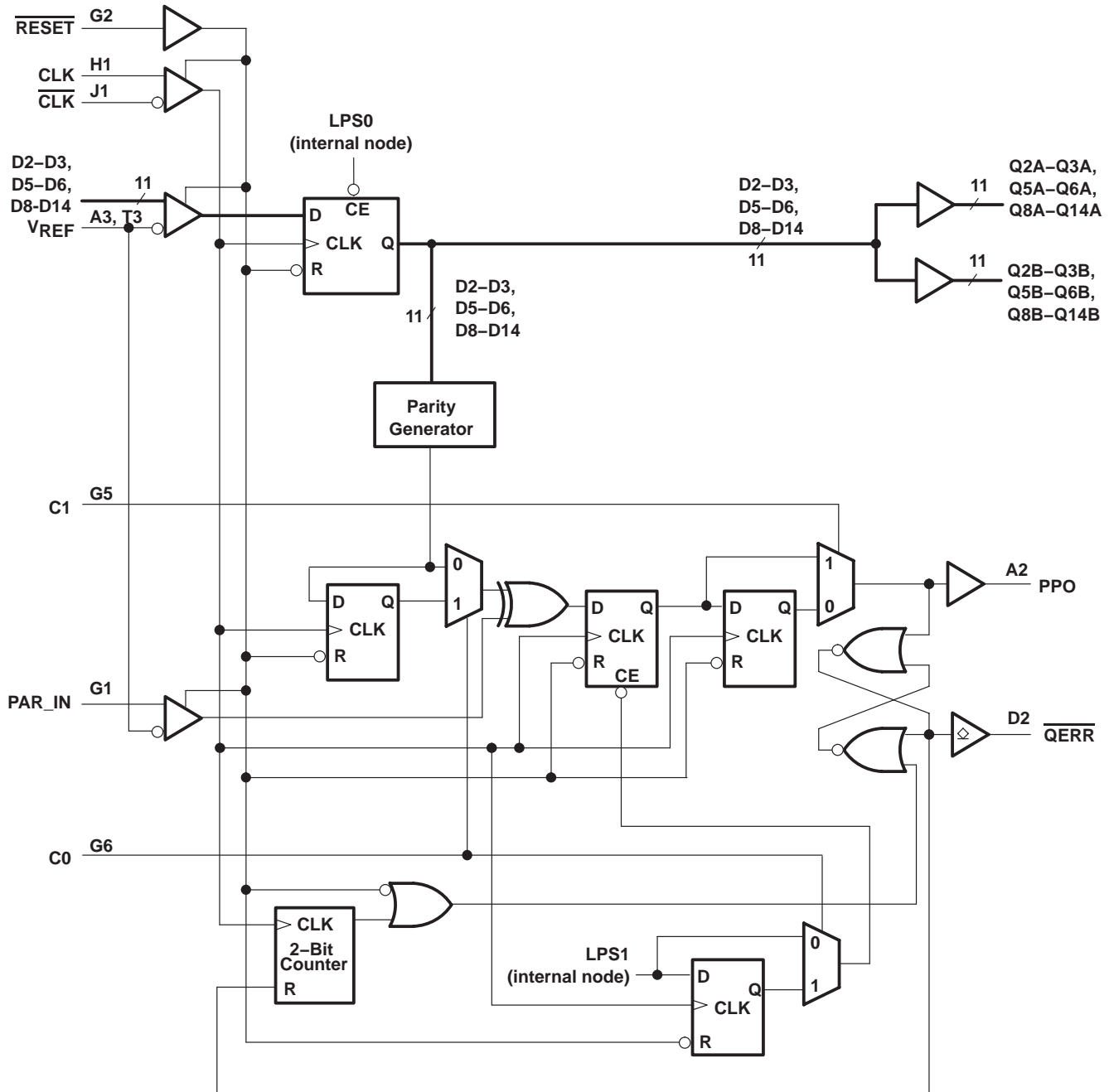
SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER

WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

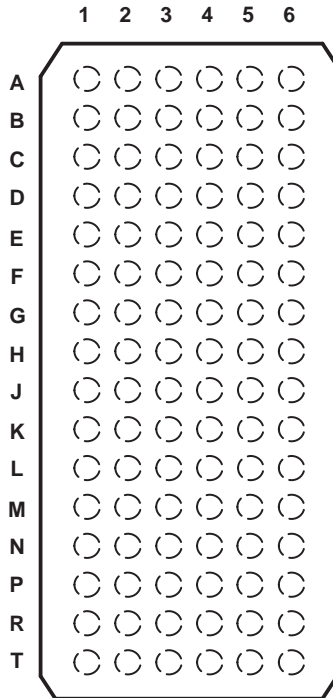
parity logic diagram for 1:2 register-A configuration (positive logic); C0 = 0, C1 = 1



SN74SSTU32866
25-BIT CONFIGURABLE REGISTERED BUFFER
WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

GKE PACKAGE
(TOP VIEW)



terminal assignments for 1:2 register-B (C0 = 1, C1 = 1)

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|------------------|-------------------------|------------------|-----------------|----------------------------|----------------------------|
| A | D1 | PPO | V _{REF} | V _{CC} | Q1A | Q1B |
| B | D2 | DNU | GND | GND | Q2A | Q2B |
| C | D3 | DNU | V _{CC} | V _{CC} | Q3A | Q3B |
| D | D4 | \overline{QERR} | GND | GND | Q4A | Q4B |
| E | D5 | DNU | V _{CC} | V _{CC} | Q5A | Q5B |
| F | D6 | DNU | GND | GND | Q6A | Q6B |
| G | PAR_IN | \overline{RESET} | V _{CC} | V _{CC} | C1 | C0 |
| H | CLK | D7 (\overline{DCS}) | GND | GND | $\overline{Q7A}$ (QCSA) | $\overline{Q7B}$ (QCSB) |
| J | \overline{CLK} | \overline{CSR} | V _{CC} | V _{CC} | NC | NC |
| K | D8 | DNU | GND | GND | Q8A | Q8B |
| L | D9 | DNU | V _{CC} | V _{CC} | Q9A | Q9B |
| M | D10 | DNU | GND | GND | Q10A | Q10B |
| N | D11 (DODT) | DNU | V _{CC} | V _{CC} | Q11A (QODTA) | Q11B (QODTB) |
| P | D12 | DNU | GND | GND | Q12A | Q12B |
| R | D13 | DNU | V _{CC} | V _{CC} | Q13A | Q13B |
| T | D14 (DCKE) | DNU | V _{REF} | V _{CC} | Q14A (QCKEA) | Q14B (QCKEB) |

Each pin name in parentheses indicates the DDR2 DIMM signal name.

DNU – Do not use

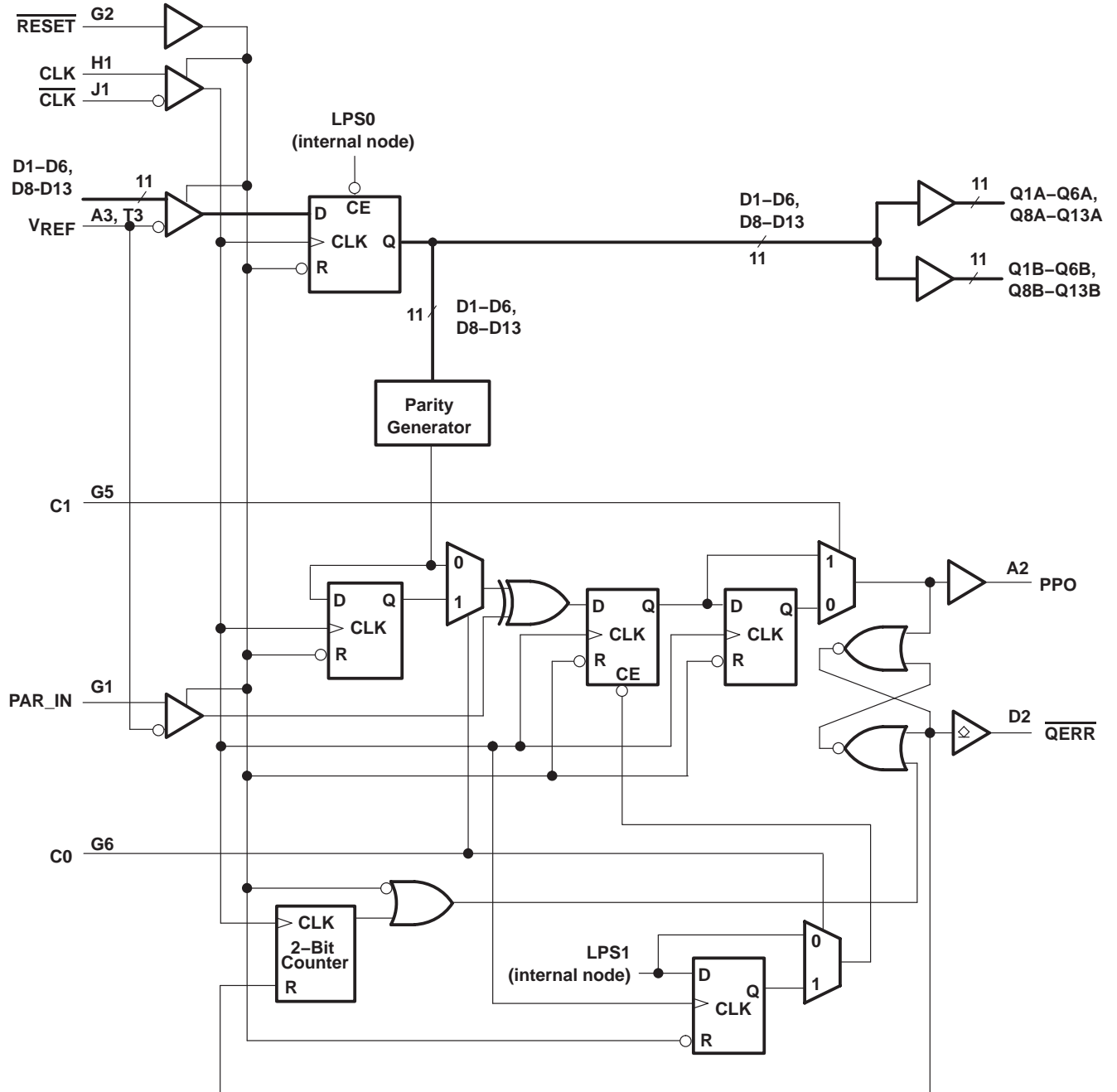
NC – No internal connection

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

parity logic diagram for 1:2 register-B configuration (positive logic); C0 = 1, C1 = 1



SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

TERMINAL FUNCTIONS

| TERMINAL NAME | DESCRIPTION | ELECTRICAL CHARACTERISTICS |
|---|--|----------------------------|
| GND | Ground | Ground input |
| V _{CC} | Power-supply voltage | 1.8 V nominal |
| V _{REF} | Input reference voltage | 0.9 V nominal |
| CLK | Positive master clock input | Differential input |
| $\overline{\text{CLK}}$ | Negative master clock input | Differential input |
| C0, C1 | Configuration control input. Register A or Register B and 1:1 mode or 1:2 mode select. | LVC MOS input |
| $\overline{\text{RESET}}$ | Asynchronous reset input. Resets registers and disables V _{REF} , data, and clock differential-input receivers. When $\overline{\text{RESET}}$ is low, all Q outputs are forced low and the $\overline{\text{QERR}}$ output is forced high. | LVC MOS input |
| D1–D25 | Data input. Clocked in on the crossing of the rising edge of CLK and the falling edge of $\overline{\text{CLK}}$. | SSTL ₁₈ inputs |
| $\overline{\text{CSR}}$, $\overline{\text{DCS}}$ | Chip select inputs. Disables D1–D25 [†] outputs switching when both inputs are high | SSTL ₁₈ inputs |
| DOT | The outputs of this register bit will not be suspended by the $\overline{\text{DCS}}$ and $\overline{\text{CSR}}$ control. | SSTL ₁₈ input |
| DCKE | The outputs of this register bit will not be suspended by the $\overline{\text{DCS}}$ and $\overline{\text{CSR}}$ control. | SSTL ₁₈ input |
| PAR_IN | Parity input. Arrives one clock cycle after the corresponding data input. | SSTL ₁₈ input |
| Q1–Q25 [‡] | Data outputs that are suspended by the $\overline{\text{DCS}}$ and $\overline{\text{CSR}}$ control. | 1.8 V CMOS outputs |
| PPO | Partial parity out. Indicates odd parity of inputs D1–D25. [†] | 1.8 V CMOS output |
| $\overline{\text{QCS}}$ | Data output that will not be suspended by the $\overline{\text{DCS}}$ and $\overline{\text{CSR}}$ control | 1.8 V CMOS output |
| QODT | Data output that will not be suspended by the $\overline{\text{DCS}}$ and $\overline{\text{CSR}}$ control | 1.8 V CMOS output |
| QCKE | Data output that will not be suspended by the $\overline{\text{DCS}}$ and $\overline{\text{CSR}}$ control | 1.8 V CMOS output |
| $\overline{\text{QERR}}$ | Output error bit. Timing is determined by the device mode. | Open-drain output |
| NC | No internal connection | |
| DNU | Do not use. Inputs are in standby-equivalent mode, and outputs are driven low. | |

[†] Data inputs = D2, D3, D5, D6, D8–D25 when C0 = 0 and C1 = 0

Data inputs = D2, D3, D5, D6, D8–D14 when C0 = 0 and C1 = 1

Data inputs = D1–D6, D8–D10, D12, D13 when C0 = 1 and C1 = 1.

[‡] Data outputs = Q2, Q3, Q5, Q6, Q8–Q25 when C0 = 0 and C1 = 0

Data outputs = Q2, Q3, Q5, Q6, Q8–Q14 when C0 = 0 and C1 = 1

Data outputs = Q1–Q6, Q8–Q10, Q12, Q13 when C0 = 1 and C1 = 1.

FUNCTION TABLES

| INPUTS | | | | | | OUTPUTS |
|---------------------------|-------------------------|-------------------------|---------------|-------------------------|----------------|----------------|
| $\overline{\text{RESET}}$ | $\overline{\text{DCS}}$ | $\overline{\text{CSR}}$ | CLK | $\overline{\text{CLK}}$ | D _n | Q _n |
| H | L | X | ↑ | ↓ | L | L |
| H | L | X | ↑ | ↓ | H | H |
| H | X | L | ↑ | ↓ | L | L |
| H | X | L | ↑ | ↓ | H | H |
| H | H | H | ↑ | ↓ | X | Q ₀ |
| H | X | X | L or H | L or H | X | Q ₀ |
| L | X or floating | X or floating | X or floating | X or floating | X or floating | L |



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN74SSTU32866
25-BIT CONFIGURABLE REGISTERED BUFFER
WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

Function Tables (Continued)

| INPUTS | | | | OUTPUTS |
|---------------------------|---------------|-------------------------|---|---|
| $\overline{\text{RESET}}$ | CLK | $\overline{\text{CLK}}$ | $\overline{\text{DCKE}},$ $\overline{\text{DCS}},$ $\overline{\text{DODT}}$ | $\overline{\text{QCKE}},$ $\overline{\text{QCS}},$ $\overline{\text{QODT}}$ |
| H | ↑ | ↓ | H | H |
| H | ↑ | ↓ | L | L |
| H | L or H | L or H | X | Q ₀ |
| L | X or floating | X or floating | X or floating | L |

PARITY AND STANDBY FUNCTION

| INPUTS | | | | | | | OUTPUTS | |
|---------------------------|---------------|-------------------------|-------------------------|-------------------------|---|---------------------|------------------|-------------------------------|
| $\overline{\text{RESET}}$ | CLK | $\overline{\text{CLK}}$ | $\overline{\text{DCS}}$ | $\overline{\text{CSR}}$ | Σ OF INPUTS = H D1–D25 [†] | PAR_IN [‡] | PPO | $\overline{\text{QERR}}^{\S}$ |
| H | ↑ | ↓ | L | X | Even | L | L | H |
| H | ↑ | ↓ | L | X | Odd | L | H | L |
| H | ↑ | ↓ | L | X | Even | H | H | L |
| H | ↑ | ↓ | L | X | Odd | H | L | H |
| H | ↑ | ↓ | H | L | Even | L | L | H |
| H | ↑ | ↓ | H | L | Odd | L | H | L |
| H | ↑ | ↓ | H | L | Even | H | H | L |
| H | ↑ | ↓ | H | L | Odd | H | L | H |
| H | ↑ | ↓ | H | H | X | X | PPO ₀ | $\overline{\text{QERR}}_0$ |
| H | L or H | L or H | X | X | X | X | PPO ₀ | $\overline{\text{QERR}}_0$ |
| L | X or floating | X or floating | X or floating | X or floating | X | X or floating | L | H |

[†] Data inputs = D2–D3, D5–D6, D8–D25 when C0 = 0 and C1 = 0

Data inputs = D2–D3, D5–D6, D8–D14 when C0 = 0 and C1 = 1

Data inputs = D1–D6, D8–D13 when C0 = 1 and C1 = 1

[‡] PAR_IN arrives one clock cycle (C0 = 0) or two clock cycles (C1 = 1) after the data to which it applies.

[§] This transition assumes that QERR is high at the crossing of CLK going high and CLK going low. If QERR goes low, it stays latched low for a minimum of two clock cycles or until RESET is driven low. If two or more consecutive parity errors occur, the QERR output is driven low and latched low for a clock duration equal to the parity duration or until RESET is driven low.

PARITY ERROR DETECT IN LOW-POWER MODE[¶]

| ERROR POSITION | 1:1 MODE (C0 = 0, C1 = 0) | | 1:2 REGISTER-A MODE (C0 = 0, C1 = 1) | | 1:2 REGISTER-B MODE (C0 = 0, C1 = 0) | | CASCADED MODE (Registers A and B) | |
|----------------|------------------------------|-----------------------------------|---|-----------------------------------|---|-----------------------------------|--------------------------------------|-----------------------------------|
| | PPO DURATION | $\overline{\text{QERR}}$ DURATION | PPO DURATION | $\overline{\text{QERR}}$ DURATION | PPO DURATION | $\overline{\text{QERR}}$ DURATION | PPO DURATION | $\overline{\text{QERR}}$ DURATION |
| n – 4 | 1 Cycle | 2 Cycles | 1 Cycle | 2 Cycles | 1 Cycle | 2 Cycles | 1 Cycle | 2 Cycles |
| n – 3 | 1 Cycle | 2 Cycles | 1 Cycle | 2 Cycles | 1 Cycle | 2 Cycles | 1 Cycle | 2 Cycles |
| n – 2 | 1 Cycle | 2 Cycles | 1 Cycle | 2 Cycles | 1 Cycle | 2 Cycles | 1 Cycle | 2 Cycles |
| n – 1 | LPM + 2 | LPM + 2 | LPM + 1 | LPM + 1 | LPM + 2 | LPM + 2 | LPM + 2 | LPM + 2 |
| n | Not detected | Not detected | Not detected | Not detected | Not detected | Not detected | Not detected | Not detected |

[¶] If a parity error occurs before the device enters the low-power mode (LPM), the behavior of PPO and $\overline{\text{QERR}}$ is dependent on the mode of the device and the position of the parity error occurrence. This table illustrates the low-power-mode effect on parity detect. The low-power mode is activated on the n clock cycle when $\overline{\text{DCS}}$ and $\overline{\text{CSR}}$ go high.



SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

| | |
|--|----------------------------|
| Supply voltage range, V_{CC} | -0.5 V to 2.5 V |
| Input voltage range, V_I (see Notes 1 and 2) | -0.5 V to 2.5 V |
| Output voltage range, V_O (see Notes 1 and 2) | -0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) | ± 50 mA |
| Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) | ± 50 mA |
| Continuous output current, I_O ($V_O = 0$ to V_{CC}) | ± 50 mA |
| Continuous current through each V_{CC} or GND | ± 100 mA |
| Package thermal impedance, θ_{JA} (see Note 3) | 36°C/W |
| Storage temperature range, T_{stg} | -65°C to 150°C |

† 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.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
 2. This value is limited to 2.5 V maximum.
 3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4)

| | | MIN | NOM | MAX | UNIT |
|-------------|---------------------------------|--|----------------------|----------------------|------|
| V_{CC} | Supply voltage | 1.7 | | 1.9 | V |
| V_{REF} | Reference voltage | $0.49 \times V_{CC}$ | $0.5 \times V_{CC}$ | $0.51 \times V_{CC}$ | V |
| V_{TT} | Termination voltage | $V_{REF} - 40$ mV | V_{REF} | $V_{REF} + 40$ mV | V |
| V_I | Input voltage | 0 | | V_{CC} | V |
| V_{IH} | AC high-level input voltage | Data inputs, \overline{CSR} , $\overline{PAR_IN}$ | $V_{REF} + 250$ mV | | V |
| V_{IL} | AC low-level input voltage | Data inputs, \overline{CSR} , $\overline{PAR_IN}$ | | $V_{REF} - 250$ mV | V |
| V_{IH} | DC high-level input voltage | Data inputs, \overline{CSR} , $\overline{PAR_IN}$ | $V_{REF} + 125$ mV | | V |
| V_{IL} | DC low-level input voltage | Data inputs, \overline{CSR} , $\overline{PAR_IN}$ | | $V_{REF} - 125$ mV | V |
| V_{IH} | High-level input voltage | \overline{RESET} , C_n | $0.65 \times V_{CC}$ | | V |
| V_{IL} | Low-level input voltage | \overline{RESET} , C_n | | $0.35 \times V_{CC}$ | V |
| V_{ICR} | Common-mode input voltage range | \overline{CLK} , \overline{CLK} | 0.675 | 1.125 | V |
| $V_{I(PP)}$ | Peak-to-peak input voltage | \overline{CLK} , \overline{CLK} | 600 | | mV |
| I_{OH} | High-level output current | Q outputs, PPO | | -8 | mA |
| I_{OL} | Low-level output current | Q outputs, PPO | | 8 | mA |
| | | \overline{QERR} output | | 8 | |
| T_A | Operating free-air temperature | 0 | | 70 | °C |

NOTE 4: The \overline{RESET} and C_n inputs of the device must be held at valid logic voltage levels (not floating) to ensure proper device operation. The differential inputs must not be floating unless \overline{RESET} is low. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



SN74SSTU32866
25-BIT CONFIGURABLE REGISTERED BUFFER
WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

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

| PARAMETER | | TEST CONDITIONS | V _{CC} | MIN | TYP† | MAX | UNIT |
|--------------------|---|---|-----------------|----------------------|------|-----|---------------------------------|
| V _{OH} | Q outputs, PPO | I _{OH} = -100 μA | 1.7 V to 1.9 V | V _{CC} -0.2 | | | V |
| | | I _{OH} = -6 mA | 1.7 V | 1.3 | | | |
| V _{OL} | Q outputs, PPO | I _{OL} = 100 μA | 1.7 V to 1.9 V | 0.2 | | | V |
| | | I _{OL} = 6 mA | 1.7 V | 0.4 | | | |
| | \overline{QERR} output | I _{OL} = 8 mA | 1.7 V | 0.35 | | | |
| I _I | All inputs‡ | V _I = V _{CC} or GND | 1.9 V | ±5 | | | μA |
| I _{OZ} | \overline{QERR} output | V _O = V _{CC} or GND | 1.9 V | ±10 | | | μA |
| I _{CC} | Static standby | $\overline{RESET} = GND$ | 1.9 V | 100 | | | μA |
| | Static operating | $\overline{RESET} = V_{CC}, V_I = V_{IH(AC)} \text{ or } V_{IL(AC)}$ | | 50 | | | mA |
| I _{CCD} | Dynamic operating – clock only | $\overline{RESET} = V_{CC}, V_I = V_{IH(AC)} \text{ or } V_{IL(AC)},$ CLK and CLK switching 50% duty cycle | 1.8 V | 42 | | | μA/ MHz |
| | Dynamic operating – per each data input, 1:1 configuration | $\overline{RESET} = V_{CC}, V_I = V_{IH(AC)} \text{ or } V_{IL(AC)},$ CLK and CLK switching 50% duty cycle, | | 18 | | | μA/ clock MHz/ D input |
| | Dynamic operating – per each data input, 1:2 configuration | one data input switching at one-half clock frequency, 50% duty cycle | | 35 | | | |
| I _{CCDLP} | Chip-select-enabled low-power active mode – clock only | $\overline{RESET} = V_{CC}, V_I = V_{IH(AC)} \text{ or } V_{IL(AC)},$ CLK and CLK switching 50% duty cycle | 1.8 V | 42 | | | μA/ MHz |
| | Chip-select-enabled low-power active mode – 1:1 configuration | $\overline{RESET} = V_{CC}, V_I = V_{IH(AC)} \text{ or } V_{IL(AC)},$ CLK and \overline{CLK} switching 50% duty cycle, | | 2 | | | μA/ clock MHz/ D input |
| | Chip-select-enabled low-power active mode – 1:2 configuration | one data input switching at one-half clock frequency, 50% duty cycle | | 2 | | | |
| C _i | Data inputs, \overline{CSR} , PAR_IN | V _I = V _{REF} ± 250 mV | 1.8 V | 2.5 | 3 | 3.5 | pF |
| | CLK, \overline{CLK} | V _{ICR} = 0.9 V, V _{I(PP)} = 600 mV | | 2 | 3 | | |
| | \overline{RESET} | V _I = V _{CC} or GND | | 2.5 | | | |

† All typical values are at V_{CC} = 1.8 V, T_A = 25°C.

‡ Each V_{REF} pin (A3 or T3) should be tested independently, with the other (untested) pin open.

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1 and Note 5)

| | | $V_{CC} = 1.8\text{ V} \pm 0.1\text{ V}$ | | UNIT |
|--------------------|--|--|-----|------|
| | | MIN | MAX | |
| f_{clock} | Clock frequency | 500 | | MHz |
| t_w | Pulse duration, CLK, $\overline{\text{CLK}}$ high or low | 1 | | ns |
| t_{act} | Differential inputs active time (see Note 6) | 10 | | ns |
| t_{inact} | Differential inputs inactive time (see Note 7) | 15 | | ns |
| t_{su} | Setup time | $\overline{\text{DCS}}$ before CLK \uparrow , $\overline{\text{CLK}}\downarrow$, $\overline{\text{CSR}}$ high; $\overline{\text{CSR}}$ before CLK \uparrow , $\overline{\text{CLK}}\downarrow$, $\overline{\text{DCS}}$ high | | ns |
| | | $\overline{\text{DCS}}$ before CLK \uparrow , $\overline{\text{CLK}}\downarrow$, $\overline{\text{CSR}}$ low | | |
| | | DODT, DCKE, and Data before CLK \uparrow , $\overline{\text{CLK}}\downarrow$ | | |
| | | PAR_IN before CLK \uparrow , $\overline{\text{CLK}}\downarrow$ | | |
| t_h | Hold time | $\overline{\text{DCS}}$, DODT, DCKE, and Data after CLK \uparrow , $\overline{\text{CLK}}\downarrow$ | | ns |
| | | PAR_IN after CLK \uparrow , $\overline{\text{CLK}}\downarrow$ | | |

NOTES: 5. All inputs slew rate is 1 V/ns \pm 20%.

6. V_{REF} must be held at a valid input level, and data inputs must be held low for a minimum time of t_{act} max, after $\overline{\text{RESET}}$ is taken high.

7. V_{REF} , data, and clock inputs must be held at valid voltage levels (not floating) for a minimum time of t_{inact} max, after $\overline{\text{RESET}}$ is taken low.

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

| PARAMETER | | FROM (INPUT) | TO (OUTPUT) | $V_{CC} = 1.8\text{ V} \pm 0.1\text{ V}$ | | UNIT |
|---|--------------|---------------------------------|--------------------------|--|-----|------|
| | | | | MIN | MAX | |
| f_{max} (see Figure 1) | | | | 500 | | MHz |
| t_{pdm}^\dagger (see Figure 1) | | CLK and $\overline{\text{CLK}}$ | Q | 1.4 | 2.5 | ns |
| t_{pd} | see Figure 4 | CLK and $\overline{\text{CLK}}$ | PPO | 0.6 | 1.6 | ns |
| t_{PLH} | see Figure 3 | CLK and $\overline{\text{CLK}}$ | $\overline{\text{QERR}}$ | 1.2 | 3 | ns |
| t_{PHL} | | | | 1 | 2.4 | |
| t_{pdmss}^\dagger (see Figure 1) | | CLK and $\overline{\text{CLK}}$ | Q | 2.7 | | ns |
| t_{RPHL}^\dagger (see Figure 1) | | $\overline{\text{RESET}}$ | Q | 3 | | ns |
| t_{RPHL} (see Figure 4) | | | PPO | 3 | | |
| t_{RPLH} (see Figure 3) | | | $\overline{\text{QERR}}$ | 3 | | |

† Includes 350-ps test-load transmission-line delay.

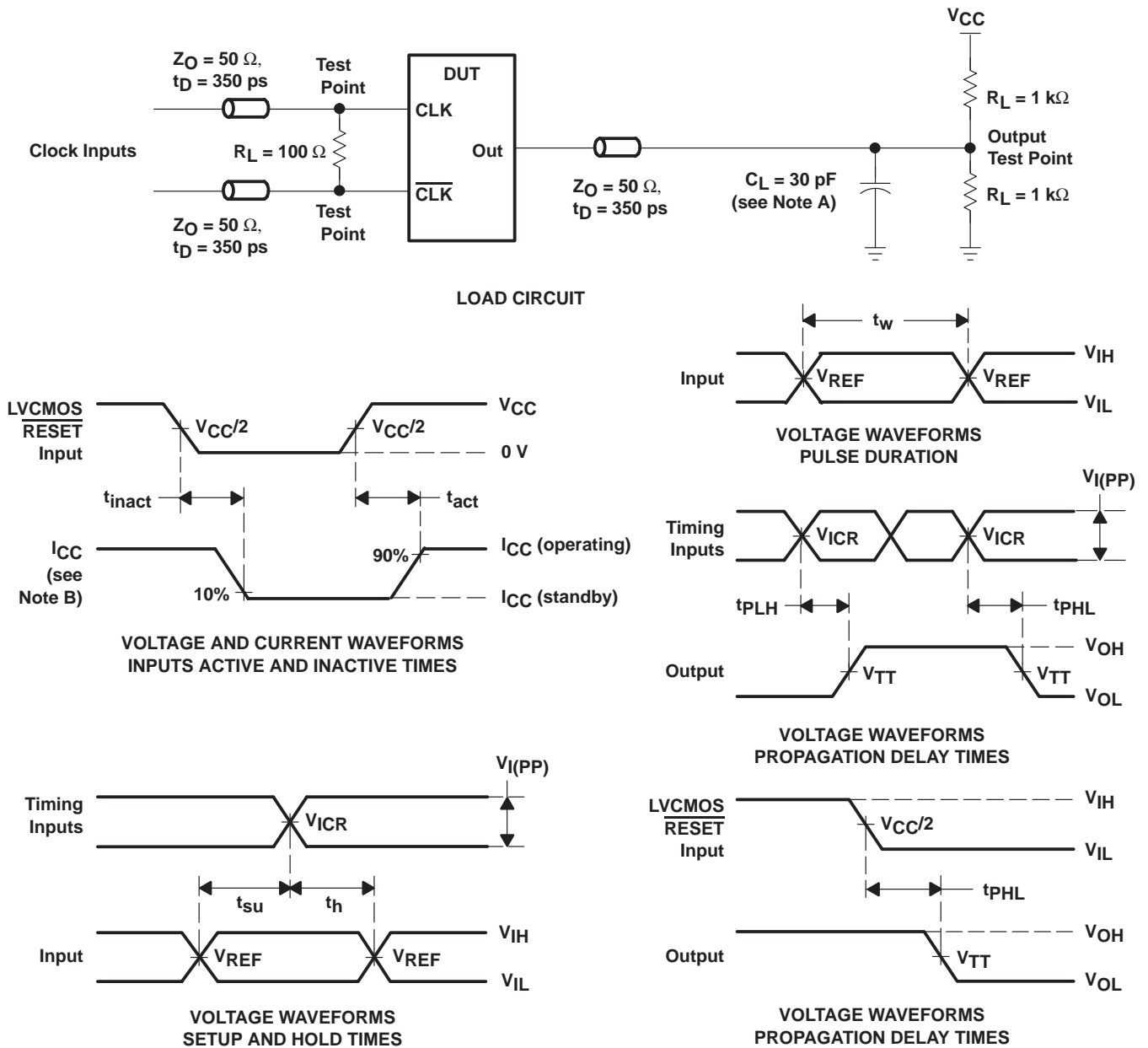
output slew rates over recommended operating free-air temperature range (unless otherwise noted) (see Figure 2)

| PARAMETER | FROM | TO | $V_{CC} = 1.8\text{ V} \pm 0.1\text{ V}$ | | UNIT |
|---------------------------|------------|------------|--|-----|------|
| | | | MIN | MAX | |
| dV/dt_r | 20% | 80% | 1.9 | 4.9 | V/ns |
| dV/dt_f | 80% | 20% | 1.9 | 4.9 | V/ns |
| dV/dt_{Δ}^\ddagger | 20% or 80% | 80% or 20% | 1.5 | | V/ns |

‡ Difference between dV/dt_r (rising edge rate) and dV/dt_f (falling edge rate).



PARAMETER MEASUREMENT INFORMATION



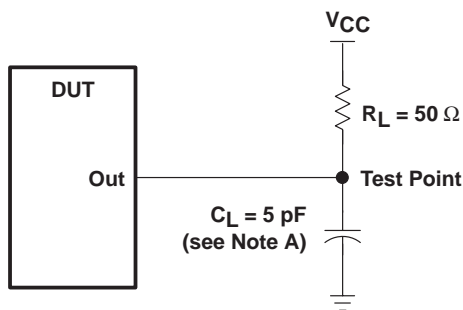
- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. I_{CC} tested with clock and data inputs held at V_{CC} or GND, and $I_O = 0 \text{ mA}$.
 - C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, input slew rate = $1 \text{ V/ns} \pm 20\%$ (unless otherwise noted).
 - D. The outputs are measured one at a time, with one transition per measurement.
 - E. $V_{REF} = V_{TT} = V_{CC}/2$
 - F. $V_{IH} = V_{REF} + 250 \text{ mV}$ (ac voltage levels) for differential inputs. $V_{IH} = V_{CC}$ for LVC MOS input.
 - G. $V_{IL} = V_{REF} - 250 \text{ mV}$ (ac voltage levels) for differential inputs. $V_{IL} = \text{GND}$ for LVC MOS input.
 - H. $V_I(PP) = 600 \text{ mV}$
 - I. t_{PLH} and t_{PHL} are the same as t_{pD} .

Figure 1. Data Output Load Circuit and Voltage Waveforms

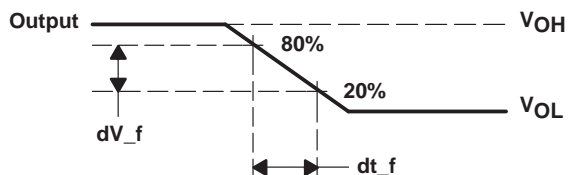
SN74SSTU32866
25-BIT CONFIGURABLE REGISTERED BUFFER
WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

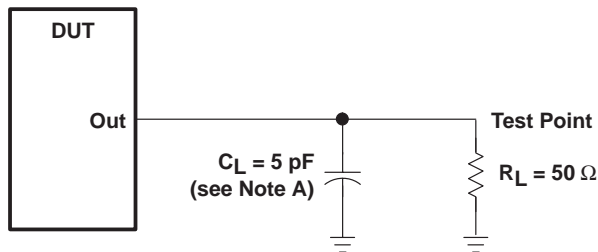
PARAMETER MEASUREMENT INFORMATION



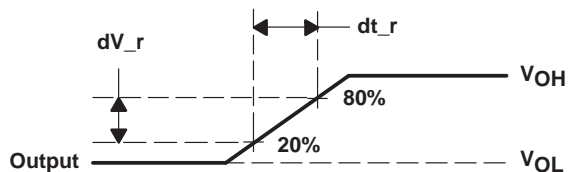
LOAD CIRCUIT
HIGH-TO-LOW SLEW-RATE MEASUREMENT



VOLTAGE WAVEFORMS
HIGH-TO-LOW SLEW-RATE MEASUREMENT



LOAD CIRCUIT
LOW-TO-HIGH SLEW-RATE MEASUREMENT

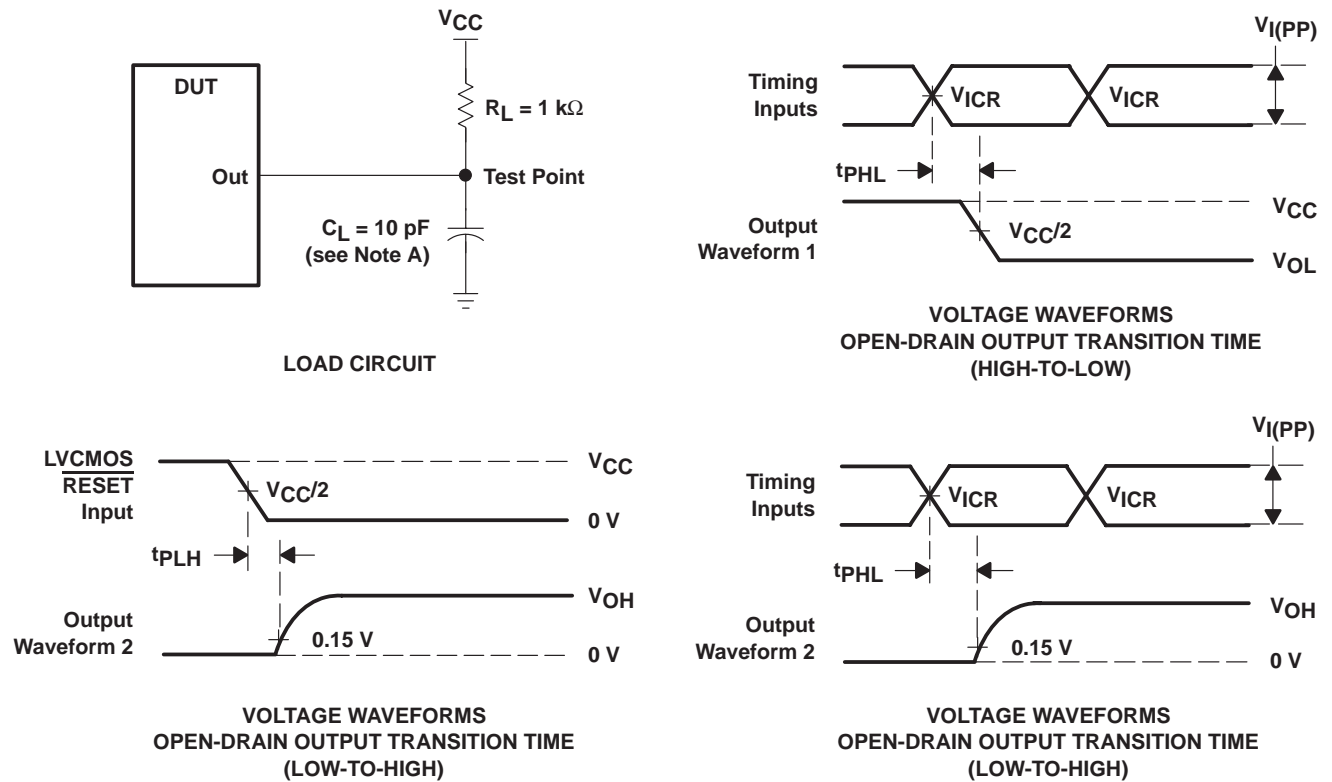


VOLTAGE WAVEFORMS
LOW-TO-HIGH SLEW-RATE MEASUREMENT

- NOTES: A. C_L includes probe and jig capacitance.
 B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10$ MHz, $Z_O = 50 \Omega$, input slew rate = 1 V/ns $\pm 20\%$ (unless otherwise specified).

Figure 2. Data Output Slew-Rate Measurement Information

PARAMETER MEASUREMENT INFORMATION



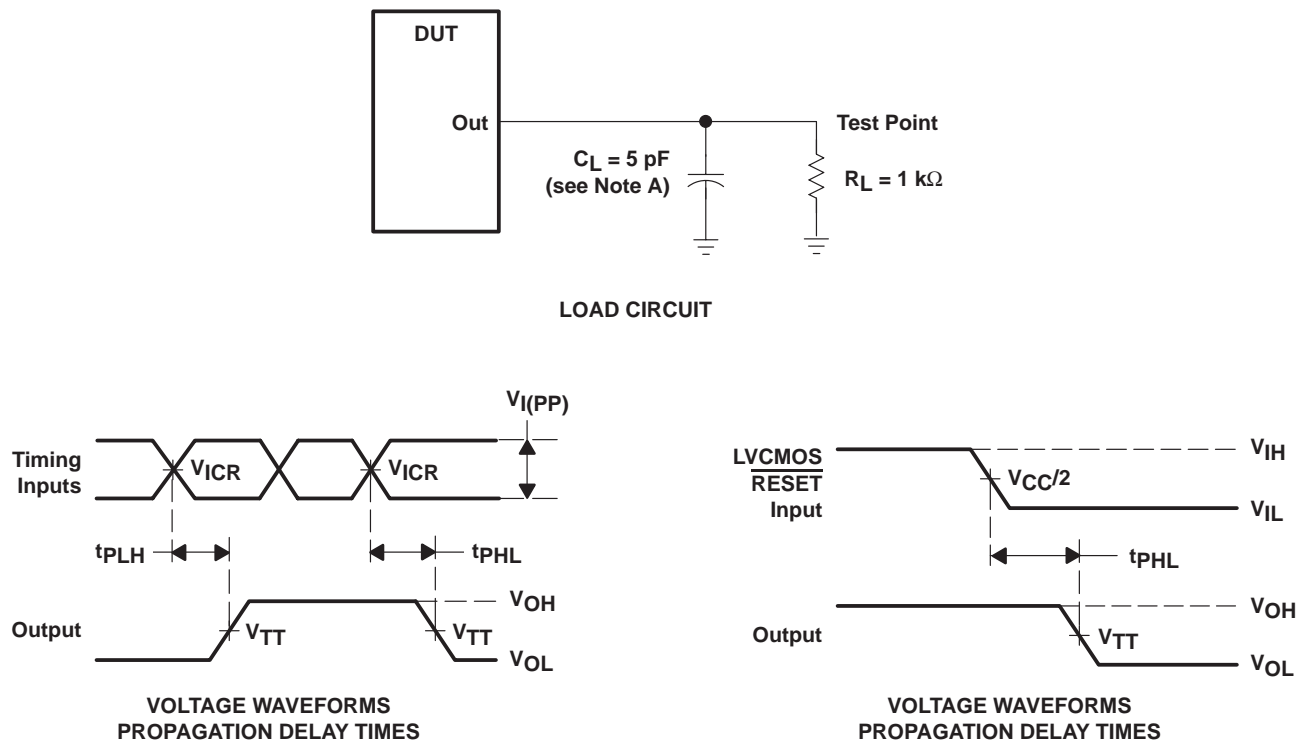
- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, input slew rate = $1\text{ V/ns} \pm 20\%$ (unless otherwise noted).
 - C. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 3. Error Output Load Circuit and Voltage Waveforms

SN74SSTU32866
25-BIT CONFIGURABLE REGISTERED BUFFER
WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10$ MHz, $Z_O = 50 \Omega$, input slew rate = 1 V/ns $\pm 20\%$ (unless otherwise noted).
 - C. $V_{REF} = V_{TT} = V_{CC}/2$
 - D. $V_{IH} = V_{REF} + 250$ mV (ac voltage levels) for differential inputs. $V_{IH} = V_{CC}$ for LVCMOS input.
 - E. $V_{IL} = V_{REF} - 250$ mV (ac voltage levels) for differential inputs. $V_{IL} = GND$ for LVCMOS input.
 - F. $V_{I(PP)} = 600$ mV
 - G. t_{PLH} and t_{PHL} are the same as t_{pd} .

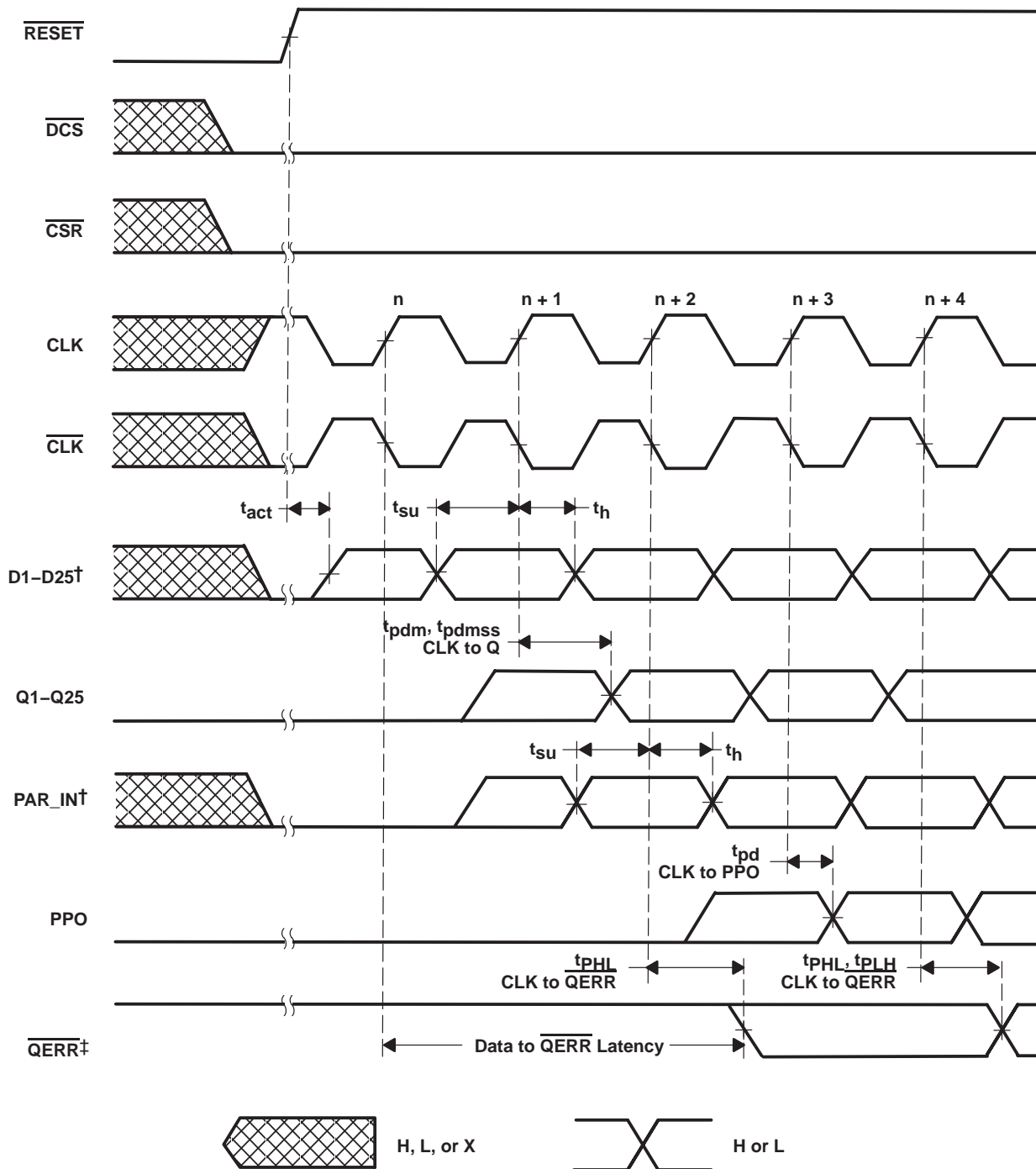
Figure 4. Partial-Parity-Out Load Circuit and Voltage Waveforms

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

timing diagram for SN74SSTU32866 used as a single device; C0 = 0, C1 = 0
(RESET switches from L to H)



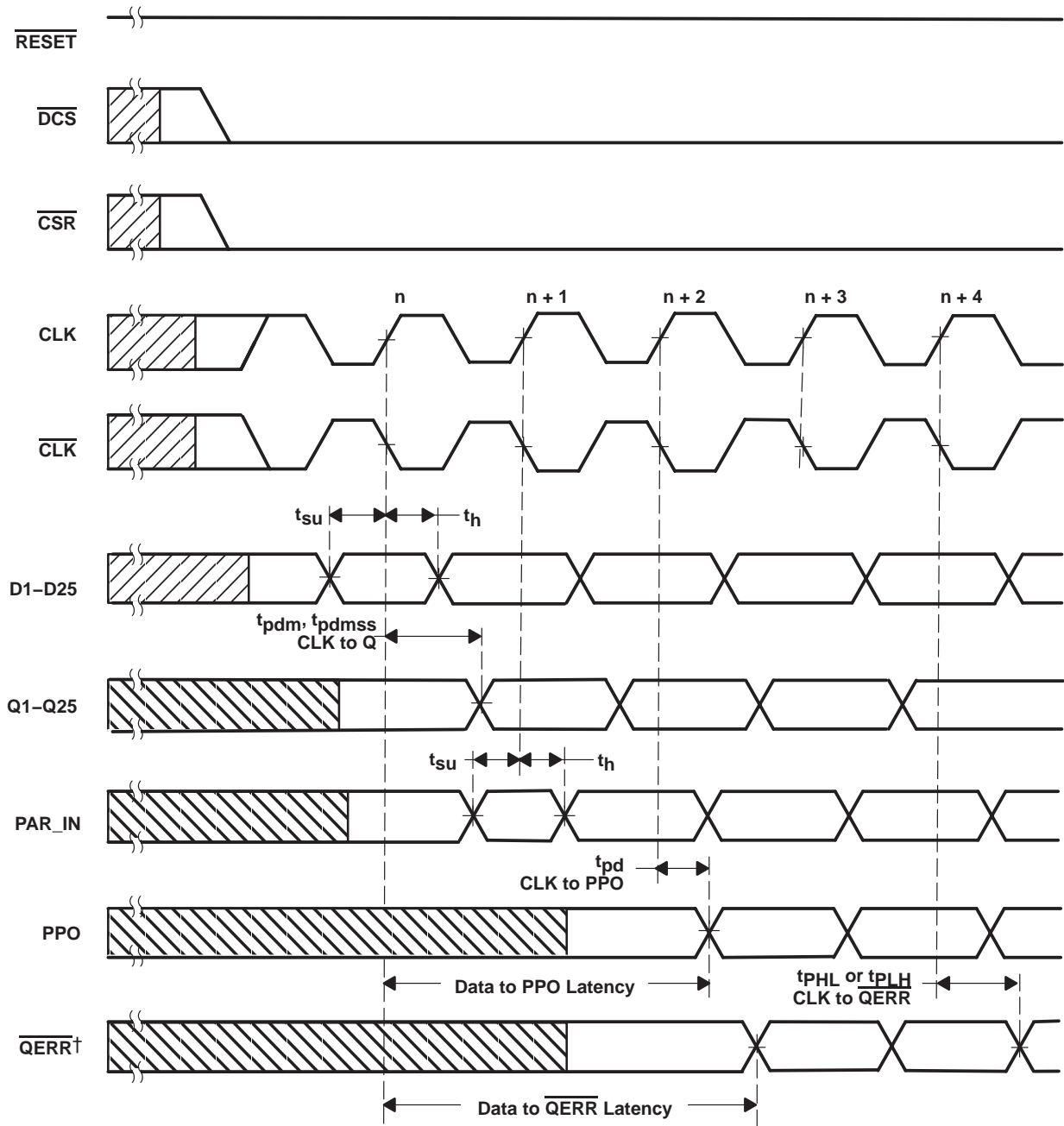
† After RESET is switched from low to high, all data and PAR_IN input signals must be set and held low for a minimum time of t_{act} max, to avoid false error.

‡ If the data is clocked in on the n clock pulse, the QERR output signal will be generated on the n + 2 clock pulse, and it will be valid on the n + 3 clock pulse.

SN74SSTU32866 25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

timing diagram for SN74SSTU32866 used as a single device; C0 = 0, C1 = 0
(RESET = H)



Unknown input event



Output signal is dependent on the prior unknown input event



H or L

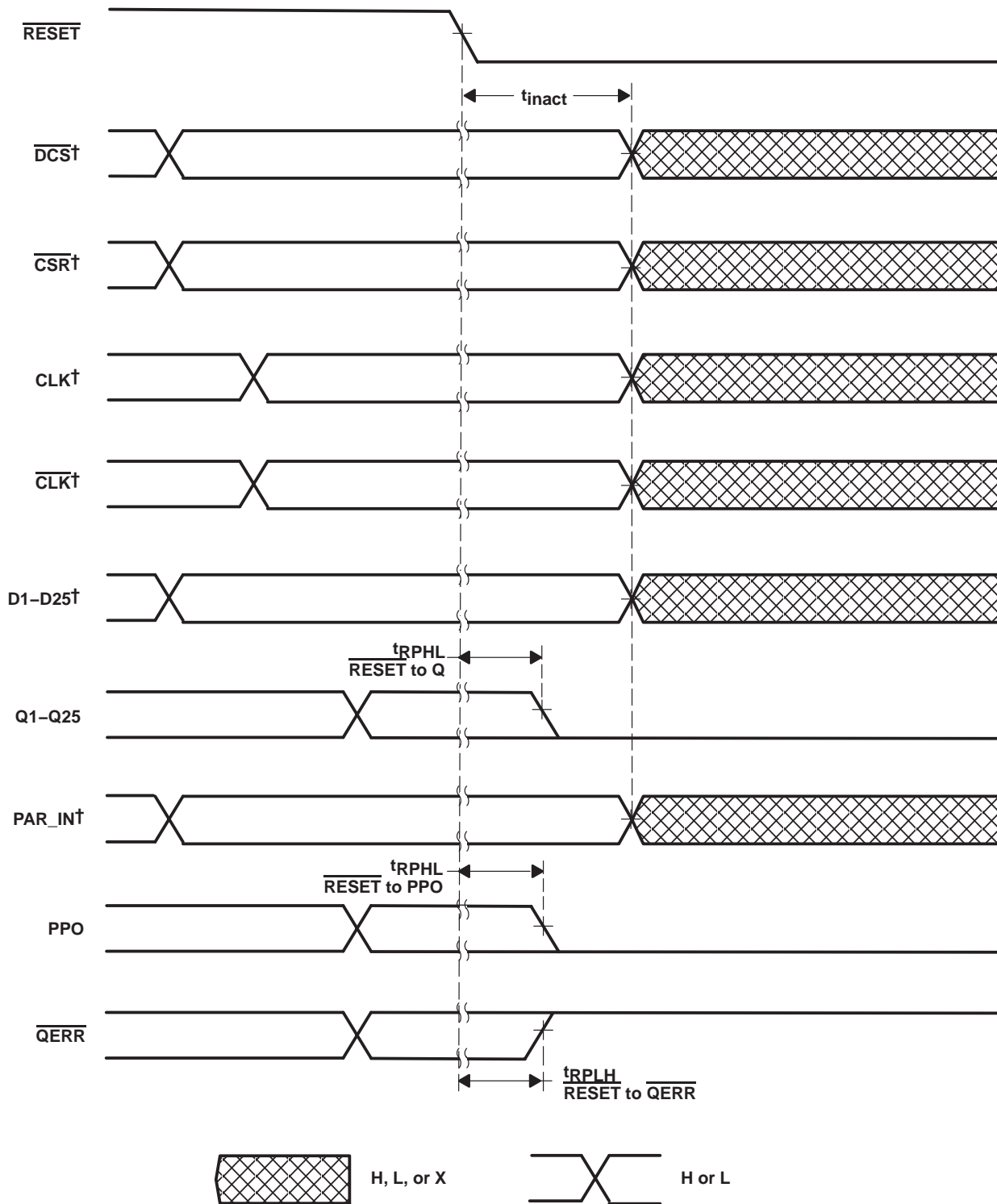
† If the data is clocked in on the n clock pulse, the QERR output signal will be generated on the n + 2 clock pulse, and it will be valid on n + 3 clock pulse. If an error occurs and the QERR output is driven low, it stays latched low for a minimum of two clock cycles or until RESET is driven low.

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCE564A – APRIL 2004 – REVISED NOVEMBER 2007

timing diagram for SN74SSTU32866 used as a single device; C0 = 0, C1 = 0
(RESET switches from H to L)



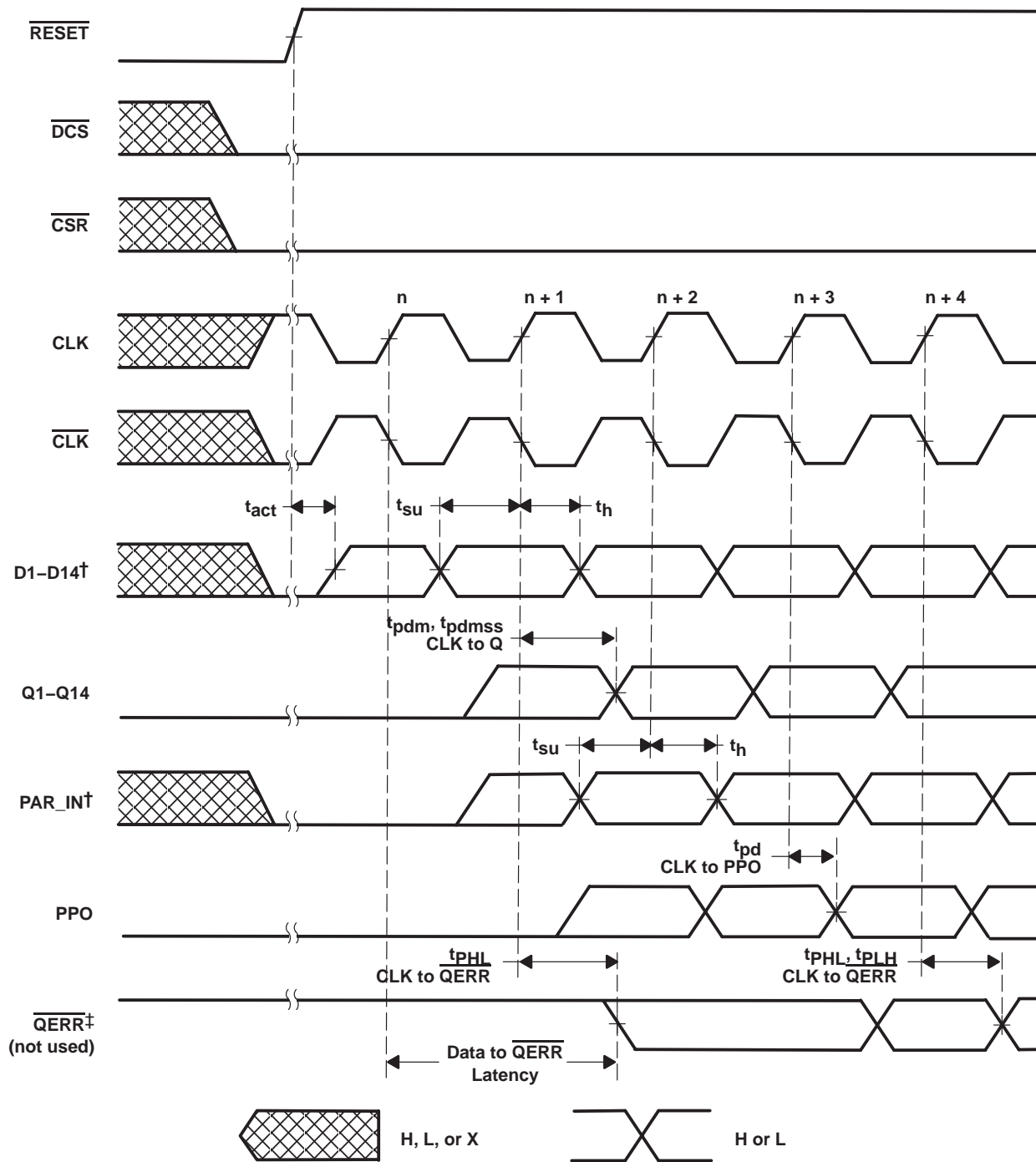
† After $\overline{\text{RESET}}$ is switched from high to low, all data and clock input signals must be held at valid logic levels (not floating) for a minimum time of t_{inact} max.

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

timing diagram for the first SN74SSTU32866 (1:2 Register-A configuration) device used in pair; C0 = 0, C1 = 1 (RESET switches from L to H)



† After $\overline{\text{RESET}}$ is switched from low to high, all data and PAR_IN input signals must be set and held low for a minimum time of t_{act} max, to avoid false error.

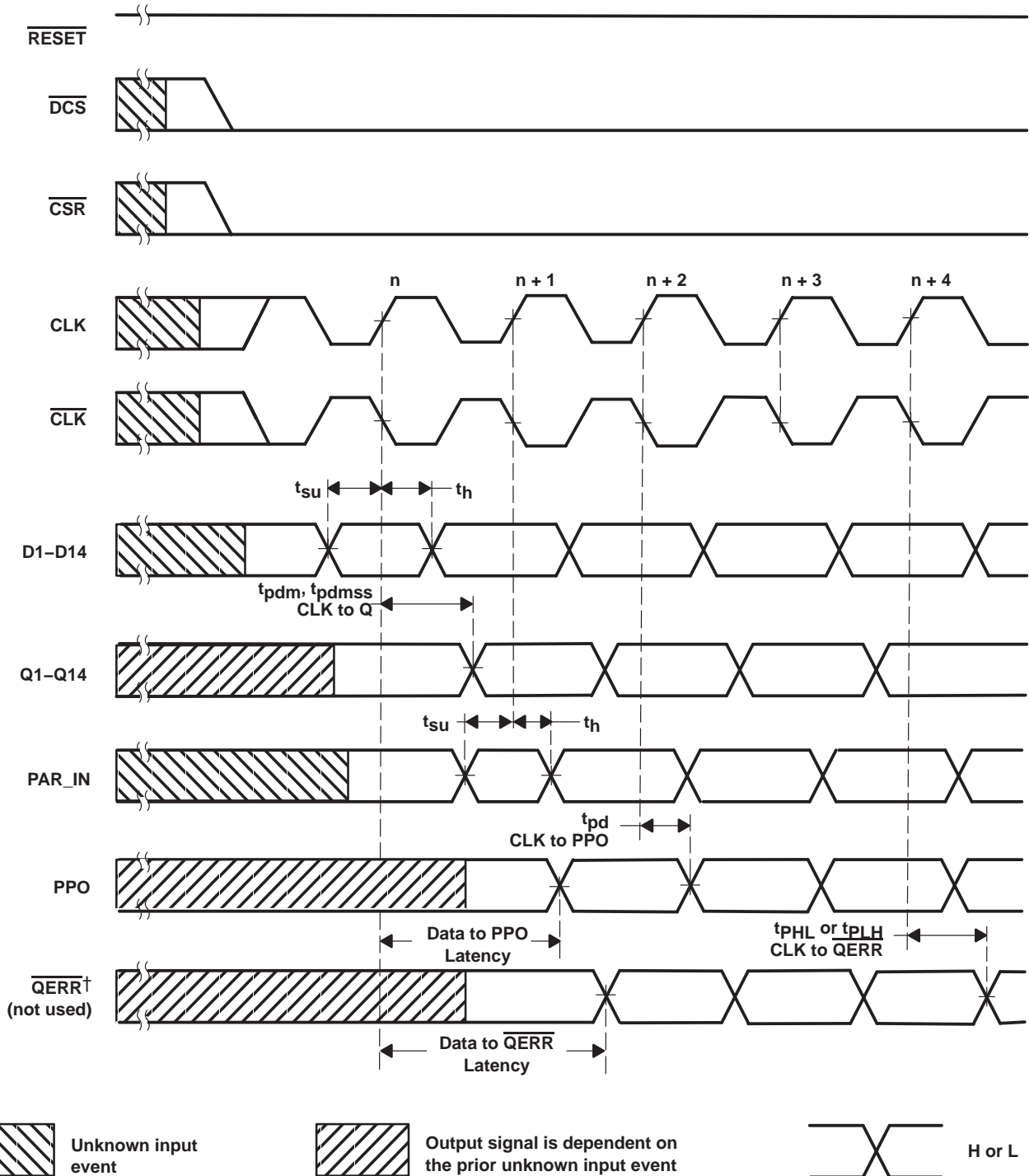
‡ If the data is clocked in on the n clock pulse, the $\overline{\text{QERR}}$ output signal will be generated on the $n + 1$ clock pulse, and it will be valid on the $n + 2$ clock pulse.

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

timing diagram for the first SN74SSTU32866 (1:2 Register-A configuration) device used in pair;
C0 = 0, C1 = 1 (RESET = H)



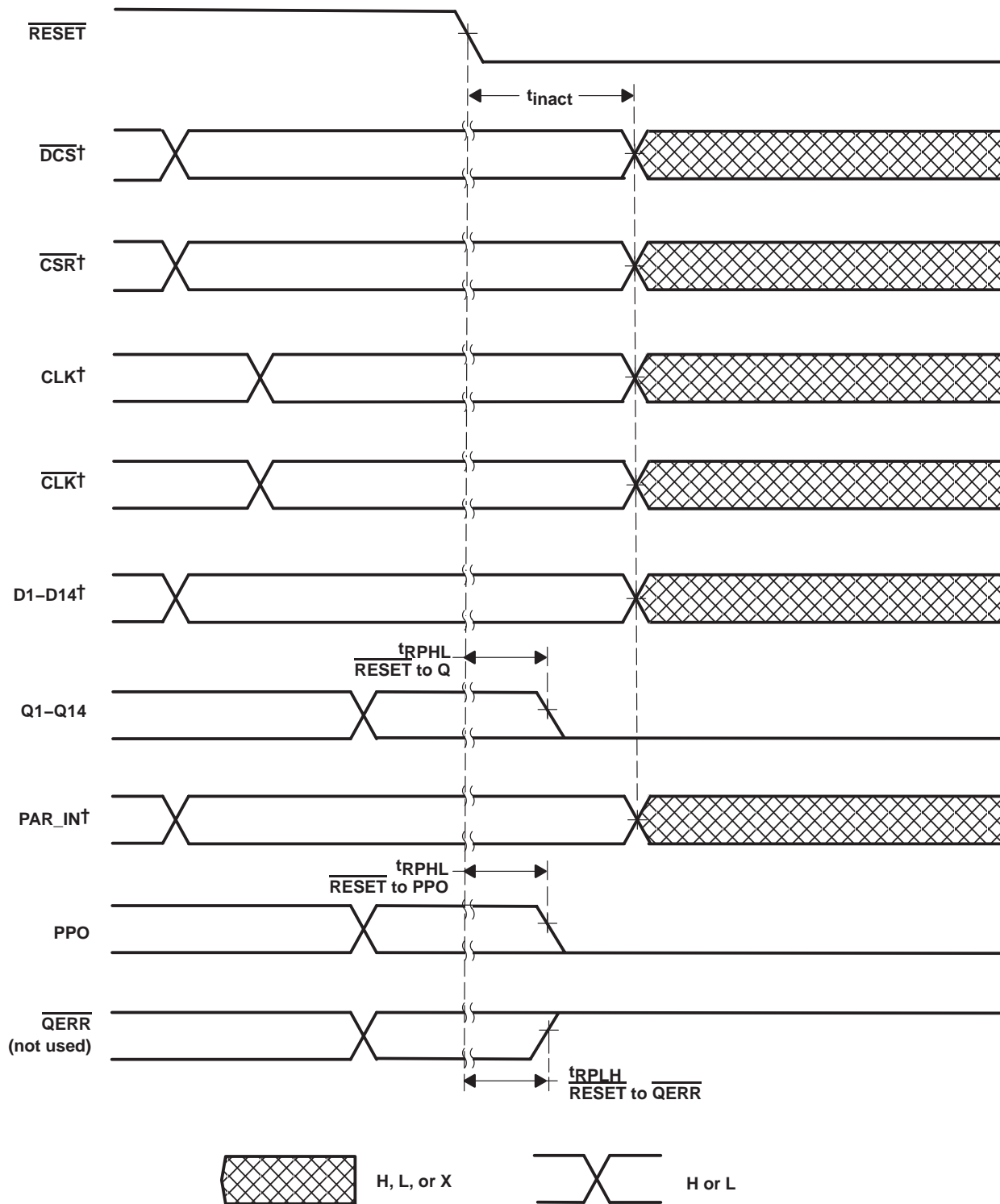
† If the data is clocked in on the n clock pulse, the QERR output signal will be generated on the n + 1 clock pulse, and it will be valid on n + 2 clock pulse. If an error occurs and the QERR output is driven low, it stays latched low for a minimum of two clock cycles or until RESET is driven low.

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCE564A – APRIL 2004 – REVISED NOVEMBER 2007

timing diagram for the first SN74SSTU32866 (1:2 Register-A configuration) device used in pair; C0 = 0, C1 = 1 (RESET switches from H to L)



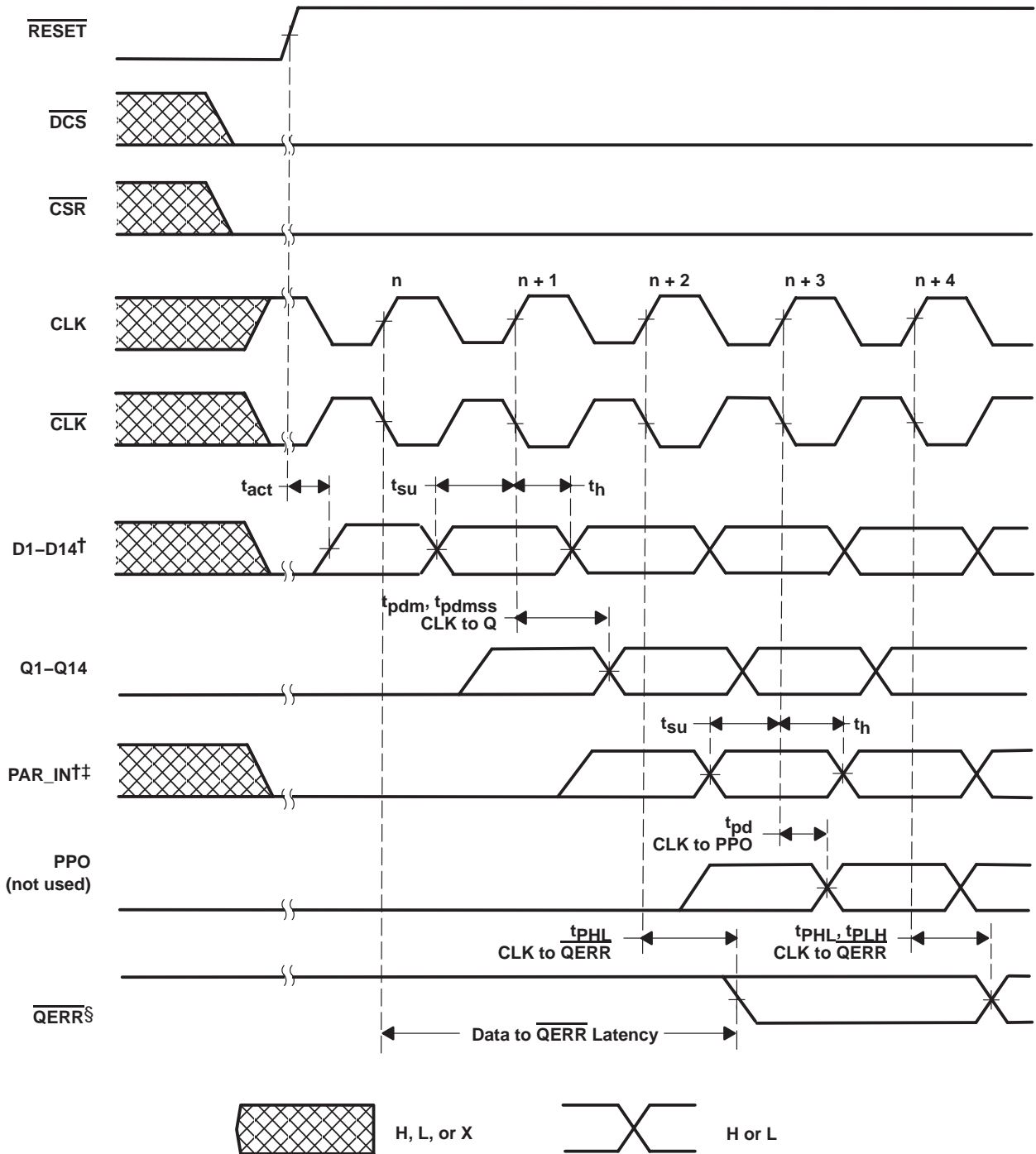
† After $\overline{\text{RESET}}$ is switched from high to low, all data and clock input signals must be held at valid logic levels (not floating) for a minimum time of $t_{\text{inact max}}$.

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

timing diagram for the second SN74SSTU32866 (1:2 Register-B configuration) device used in pair;
C0 = 1, C1 = 1 (RESET switches from L to H)



† After $\overline{\text{RESET}}$ is switched from low to high, all data and PAR_IN input signals must be set and held low for a minimum time of t_{act} max, to avoid false error.

‡ PAR_IN is driven from PPO of the first SN74SSTU32866 device.

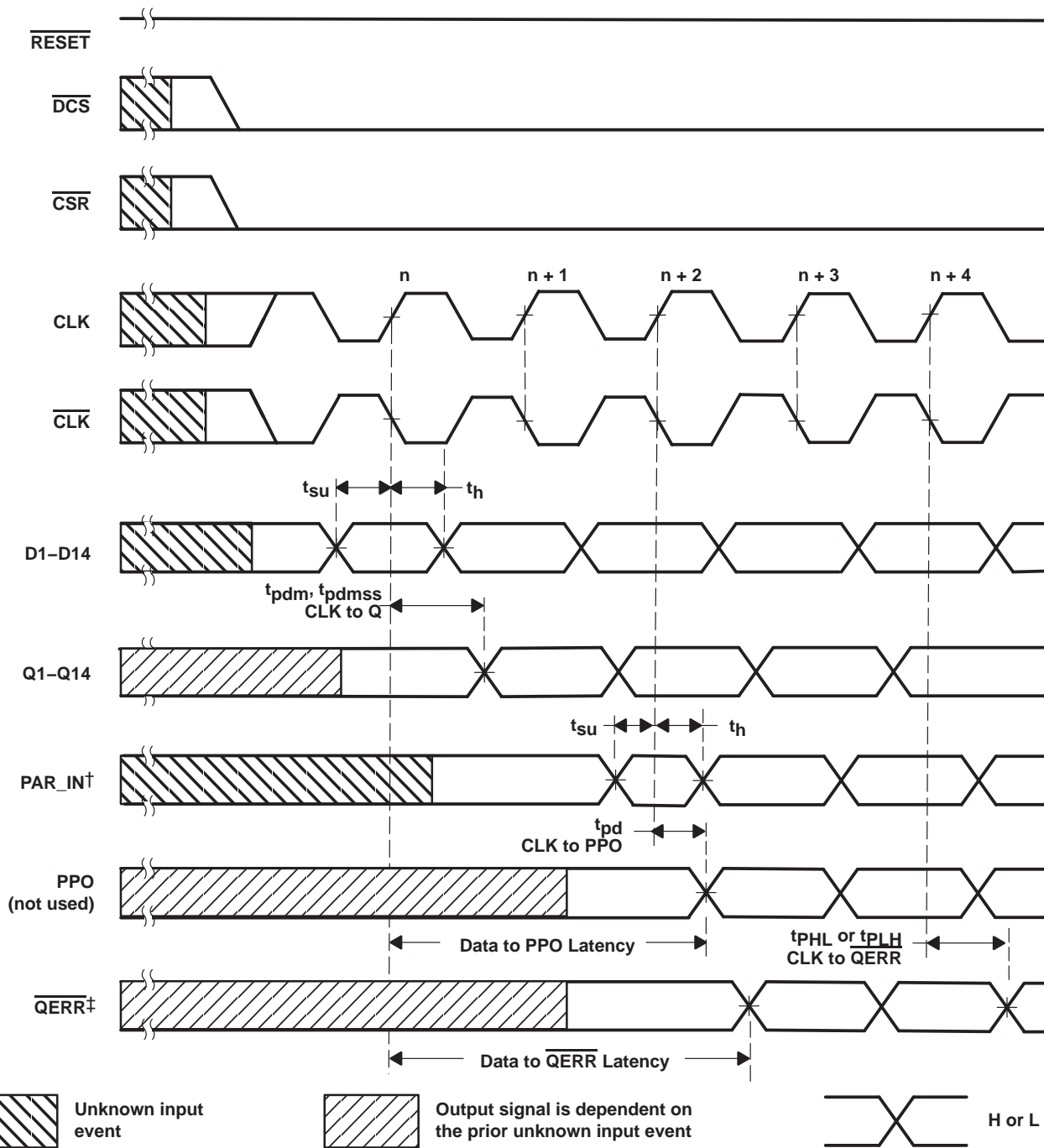
§ If the data is clocked in on the n clock pulse, the $\overline{\text{QERR}}$ output signal will be generated on the $n+2$ clock pulse, and it will be valid on the $n+3$ clock pulse.

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

timing diagram for the second SN74SSTU32866 (1:2 Register-B configuration) device used in pair; C0 = 1, C1 = 1 (RESET = H)



† PAR_IN is driven from PPO of the first SN74SSTU32866 device.

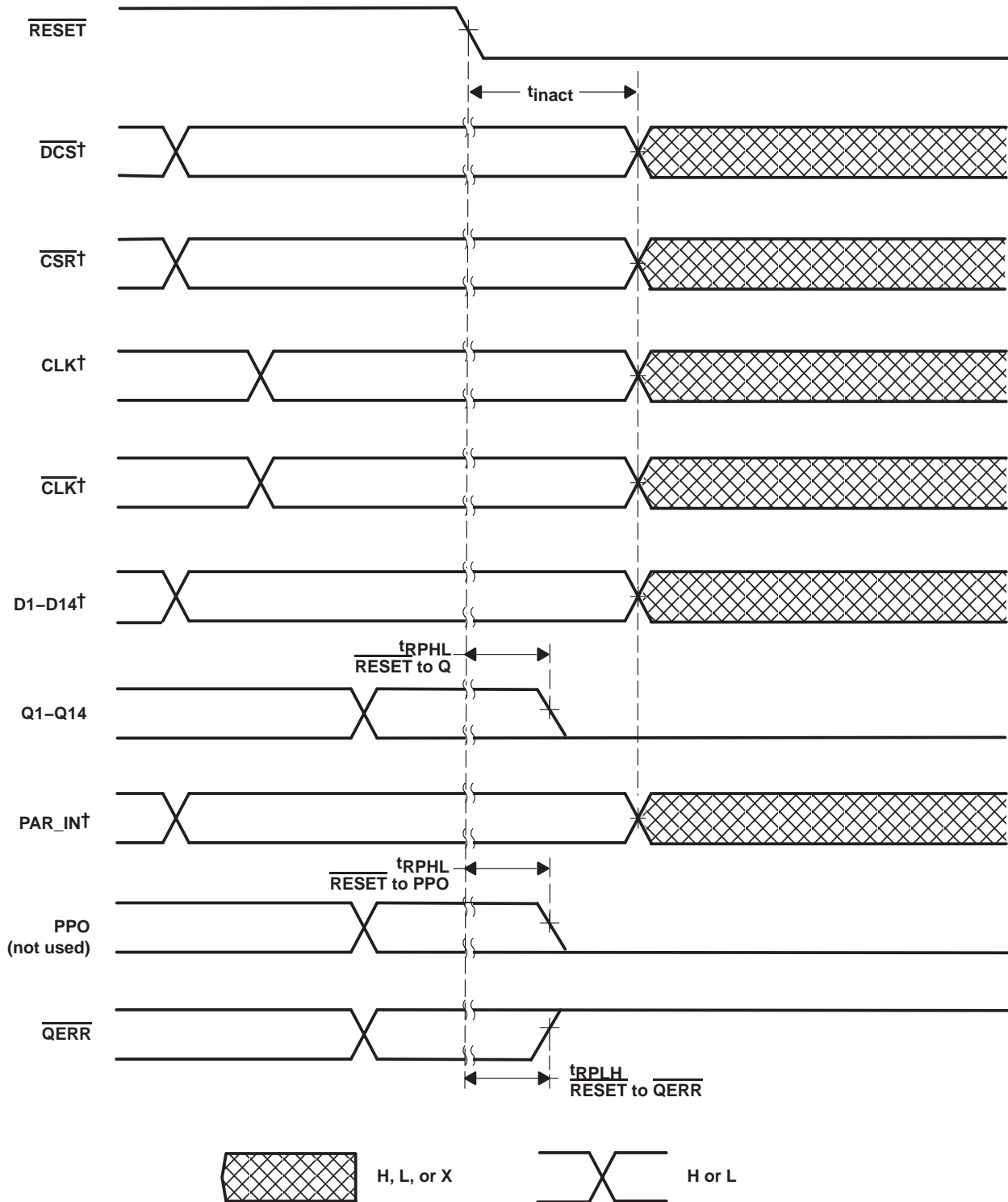
‡ If the data is clocked in on the n clock pulse, the QERR output signal will be generated on the n + 2 clock pulse, and it will be valid on n + 3 clock pulse. If an error occurs and the QERR output is driven low, it stays latched low for a minimum of two clock cycles or until RESET is driven low.

SN74SSTU32866

25-BIT CONFIGURABLE REGISTERED BUFFER WITH ADDRESS-PARITY TEST

SCES564A – APRIL 2004 – REVISED NOVEMBER 2007

timing diagram for the second SN74SSTU32866 (1:2 Register-B configuration) device used in pair;
C0 = 1, C1 = 1 (RESET switches from H to L)



† After $\overline{\text{RESET}}$ is switched from high to low, all data and clock input signals must be held at valid logic levels (not floating) for a minimum time of t_{inact} max.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Top-Side Markings (4) | Samples |
|-------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|--------------|--------------------------|----------------|
| SN74SSTU32866ZKER | ACTIVE | LFBGA | ZKE | 96 | 1000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-3-260C-168 HR | 0 to 70 | SU866 | Samples |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

(4) Only one of markings shown within the brackets will appear on the physical device.

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.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions of TI 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

| | |
|------------------------------|--|
| Audio | www.ti.com/audio |
| Amplifiers | amplifier.ti.com |
| Data Converters | dataconverter.ti.com |
| DLP® Products | www.dlp.com |
| DSP | dsp.ti.com |
| Clocks and Timers | www.ti.com/clocks |
| Interface | interface.ti.com |
| Logic | logic.ti.com |
| Power Mgmt | power.ti.com |
| Microcontrollers | microcontroller.ti.com |
| RFID | www.ti-rfid.com |
| OMAP Applications Processors | www.ti.com/omap |
| Wireless Connectivity | www.ti.com/wirelessconnectivity |

Applications

| | |
|-------------------------------|--|
| Automotive and Transportation | www.ti.com/automotive |
| Communications and Telecom | www.ti.com/communications |
| Computers and Peripherals | www.ti.com/computers |
| Consumer Electronics | www.ti.com/consumer-apps |
| Energy and Lighting | www.ti.com/energy |
| Industrial | www.ti.com/industrial |
| Medical | www.ti.com/medical |
| Security | www.ti.com/security |
| Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Video and Imaging | www.ti.com/video |

TI E2E Community

e2e.ti.com