

### FEATURES:

- RAD-PAK® radiation-hardened against natural space radiation
- Total dose hardness:
  - > 100 krad (Si), depending upon space mission
- Output ports have equivalent 22-Ω series resistors, so no external resistors are required
- Support mixed-mode signal operation (5V input and output voltages with 3.3V V<sub>CC</sub>)
- Support unregulated battery operation down to 2.7V
- Typical V<sub>OLP</sub> (Output ground bounce) < 0.8V at V<sub>CC</sub> = 3.3V, T<sub>A</sub> = 25°C
- I<sub>OFF</sub> and power-up 3-state support hot insertion
- Bus hold on data inputs eliminates the need for external pull-up/pull-down resistors
- Distributed V<sub>CC</sub> and GND pin configuration minimizes high-speed switching noise
- Flow-through architecture optimizes PCB layout
- Package: 48 pin RAD-PAK flat pack

### DESCRIPTION:

DDC's 54LVTH162244 devices are 16-bit buffers and line drivers designed for low-voltage (3.3V) V<sub>CC</sub> operation, but with the capability to provide a TTL interface to a 5V system environment. These devices can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. These devices provide true outputs and symmetrical active-low output-enable ( $\overline{OE}$ ) inputs.

The outputs, which are designed to source or sink up to 12 mA, include equivalent 22-Ω series resistors to reduce overshoot and undershoot. Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

DDC's patented RAD-PAK® packaging technology incorporates radiation shielding in the microcircuit package. It eliminates the need for box shielding while providing the required radiation shielding for a lifetime in orbit or space mission. In a GEO orbit, RAD-PAK provides greater than 100 krad (Si) radiation dose tolerance. This product is available with screening up to Class S.

TABLE 1. PINOUT DESCRIPTION

| PIN                           | SYMBOL               | DESCRIPTION    |
|-------------------------------|----------------------|----------------|
| 1, 48, 25, 24                 | $\overline{1OE-4OE}$ | Output Enable  |
| 2, 3, 5, 6                    | 1Y1-1Y4              | Output         |
| 4, 10, 15, 21, 28, 34, 39, 45 | GND                  | Ground         |
| 7, 18, 31, 42                 | $V_{CC}$             | Supply Voltage |
| 8, 9, 11, 12                  | 2Y1-2Y4              | Output         |
| 13, 14, 16, 17                | 3Y1-3Y4              | Output         |
| 19, 20, 22, 23                | 4Y1-4Y4              | Output         |
| 47, 46, 44, 43                | 1A1-1A4              | Input          |
| 41, 40, 38, 37                | 2A1-2A4              | Input          |
| 36, 35, 33, 32                | 3A1-3A4              | Input          |
| 30, 29, 27, 26                | 4A1-4A4              | Input          |

TABLE 2. 162244 ABSOLUTE MAXIMUM RATINGS <sup>1</sup>

| PARAMETER   | SYMBOL             | MIN              | MAX | UNIT |
|---|--------------------|------------------|-----|------|
| Supply Voltage Range  | $V_{CC}$           | -0.5             | 4.6 | V    |
| Input Voltage Range <sup>2</sup>  | $V_I$              | -0.5             | 7   | V    |
| Voltage range applied to any output in the high-impedance or power-off state <sup>2</sup> | $V_O$              | -0.5             | 7   | V    |
| Voltage range applied to any output in the high state <sup>2</sup>                        | $V_O$              | -0.5 to $V_{CC}$ | 0.5 | V    |
| Current into any output in the low state  | $I_O$              | --               | 30  | mA   |
| Current into any output in the high state <sup>3</sup>                                    | $I_O$              | 30               | --  | mA   |
| Input clamp current   | $I_{IK} (V_I < 0)$ | --               | -50 | mA   |
| Output clamp current  | $I_{OK} (V_O < 0)$ | --               | -50 | mA   |
| Operating Temperature   | $T_A$              | -55              | 125 | °C   |
| Storage Temperature Range   | $T_S$              | -65              | 150 | °C   |
| Operating Temperature Range   | $T_A$              | -55              | 125 | °C   |

1. Stresses beyond 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. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
3. This current flows only when the output is in the high state and  $V_O > V_{CC}$ .

TABLE 3. DELTA LIMITS

| PARAMETER    | VARIATION                          |
|--------------|------------------------------------|
| $I_{CC(OP)}$ | ±10% of specified value on Table 5 |
| $I_{OZH}$    | ±10% of specified value on Table 5 |
| $I_{OZL}$    | ±10% of specified value on Table 5 |

TABLE 4. 162244 RECOMMENDED OPERATING CONDITIONS<sup>1</sup>

| PARAMETER                          | SYMBOL                                 | MIN | MAX | UNIT |
|------------------------------------|--|-----|-----|------|
| Supply Voltage                     | $V_{CC}$                               | 2.7 | 3.6 | V    |
| High-level Input Voltage           | $V_{IH}$                               | 2   | --  | V    |
| Low-level Input Voltage            | $V_{IL}$                               | --  | 0.8 | V    |
| Input Voltage                      | $V_I$                                  | --  | 5.5 | V    |
| High-level output current          | $I_{OH}$                               | --  | -12 | mA   |
| Low-level output current           | $I_{OL}$                               | --  | 12  | mA   |
| Input Transition Rise or Fall Rate | Outputs enabled<br>$\Delta t/\Delta v$ | --  | 10  | ns/V |
| Power-up ramp rate                 | $\Delta t/\Delta V_{CC}$               | 200 | --  | µs/V |
| Operating Temperature              | $T_A$                                  | -55 | 125 | °C   |

1. All unused control inputs of the device must be held at high or low to ensure proper device operation.

TABLE 5. 162244 DC ELECTRICAL CHARACTERISTICS

( $V_{CC} = 3.3V \pm 10\%$ ,  $T_A = -55$  TO  $+125^\circ C$ , UNLESS OTHERWISE SPECIFIED)

| PARAMETER                              | SYMBOL        | TEST CONDITIONS           |                          | MIN            | MAX  | UNIT |    |
|--|---------------|---------------------------|--------------------------|----------------|------|------|----|
| Input Clamp Voltage                    | $V_{IK}$      | $V_{CC} = 2.7$            | $I_I = -18mA$            | --             | -1.2 | V    |    |
| High-Level Output Voltage              | $V_{OH}$      | $V_{CC} = 3V$             | $I_{OH} = -12 mA$        | 2              | --   | V    |    |
| Low-Level Output Voltage               | $V_{OL}$      | $V_{CC} = 3V$             | $I_{OL} = 12 mA$         | --             | 0.8  | V    |    |
| Input Current                          | $I_I$         | $V_{CC} = 0$ or $3.6V$    | $V_I = 5.5V$             | --             | 10   | µA   |    |
|  |               | $V_{CC} = 3.6V$           | $V_I = V_{CC}$ or<br>GND | Control inputs | --   |      | ±1 |
|  |               | $V_{CC} = 3.6V$           | $V_I = V_{CC}$           | Data Inputs    | --   |      | 1  |
| Hold Current                           | $I_{I(HOLD)}$ | $V_{CC} = 3V$             | $V_I = 0.8V$             | Data Inputs    | 75   | --   | µA |
|  |               |                           | $V_I = 2V$               |                | -75  | --   |    |
| Output Disabled Leakage Current - High | $I_{OZH}$     | $V_{CC} = 3.6V, V_O = 3V$ |                          | --             | 5    | µA   |    |

TABLE 5. 162244 DC ELECTRICAL CHARACTERISTICS

 $(V_{CC} = 3.3V \pm 10\%, T_A = -55 \text{ TO } +125^\circ\text{C}, \text{ UNLESS OTHERWISE SPECIFIED})$ 

| PARAMETER                             | SYMBOL            | TEST CONDITIONS   | MIN              | MAX       | UNIT          |    |
|---------------------------------------|-------------------|---|------------------|-----------|---------------|----|
| Output Disabled Leakage Current - Low | $I_{OZL}$         | $V_{CC} = 3.6V, V_O = 0.5V$   | --               | -5        | $\mu\text{A}$ |    |
| Power Up Current                      | $I_{OZPU}^2$      | $V_{CC} = 0 \text{ TO } 1.5V, V_O = 0.5V \text{ TO } 3V, \overline{OE} = \text{don't care}$                                 | --               | $\pm 100$ | $\mu\text{A}$ |    |
| Power Down Current                    | $I_{OZPD}^2$      | $V_{CC} = 1.5V \text{ TO } 0, V_O = 0.5V \text{ TO } 3V, \overline{OE} = \text{don't care}$                                 | --               | $\pm 100$ | $\mu\text{A}$ |    |
| Supply Current                        | $I_{CC}$          | $V_{CC} = 3.6V$   | Outputs high     | --        | 0.19          | mA |
|                                       |                   | $I_O = 0$   | Outputs low      | --        | 5             |    |
|                                       |                   | $V_I = V_{CC} \text{ OR } \text{GND}$   | Outputs disabled | --        | 0.19          |    |
| Delta Supply Current                  | $\Delta I_{CC}^1$ | $V_{CC} = 3V \text{ TO } 3.6V, \text{ One input at } V_{CC} - 0.6V, \text{ Other inputs at } V_{CC} \text{ OR } \text{GND}$ | --               | 0.2       | mA            |    |
| Input Capacitance                     | $C_I^2$           | $V_I = 3V \text{ OR } 0$  | --               | 8         | pF            |    |
| Input Output Capacitance              | $C_O^2$           | $V_O = 3V \text{ OR } 0$  | --               | 15        | pF            |    |

1. This is the increase in supply current for each input that is at the specified TTL voltage level rather than  $V_{CC}$  or GND.
2. Guaranteed by design.

TABLE 6. 162244 AC ELECTRICAL CHARACTERISTICS

 $(T_A = -55 \text{ TO } +125^\circ\text{C}, C_L = 50 \text{ pF}, \text{ UNLESS OTHERWISE SPECIFIED})$ 

| PARAMETER                                   | SYMBOL      | $V_{CC} = 3.3V \pm V$ |     | $V_{CC} = 2.7V$ |     | UNIT |
|---|-------------|-----------------------|-----|-----------------|-----|------|
|   |             | MIN                   | MAX | MIN             | MAX |      |
| Propagation Delay Time<br>A to Y            | $t_{PLH}$   | 1.1                   | 4.6 | --              | 5.1 | ns   |
|   | $t_{PHL}$   | 1.1                   | 3.9 | --              | 4.5 |      |
| Output Enable Time<br>$\overline{OE}$ to Y  | $t_{PZH}$   | 1.1                   | 5.4 | --              | 6.7 | ns   |
|   | $t_{PZL}$   | 1.3                   | 4.9 | --              | 6.1 |      |
| Output Disable Time<br>$\overline{OE}$ to Y | $t_{PHZ}$   | 1.6                   | 5.9 | --              | 6.5 | ns   |
|   | $t_{PLZ}$   | 1                     | 5.9 | --              | 5.8 |      |
| Output Skew                                 | $t_{sk(o)}$ | --                    | --  | --              | --  | ns   |

TABLE 7. FUNCTION TABLE  
(EACH 4-BIT BUFFER)

| INPUTS          |   | OUTPUT |
|-----------------|---|--------|
| $\overline{OE}$ | A | Y      |
| L               | H | H      |
| L               | L | L      |
| H               | X | Z      |

FIGURE 1. LOAD CIRCUIT FOR OUTPUTS

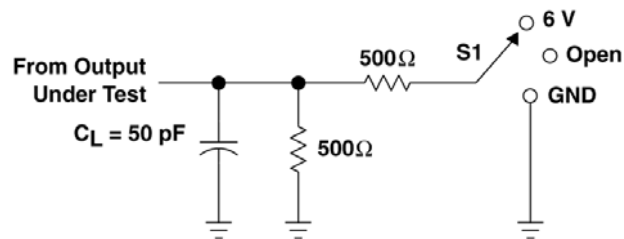


Figure Note:

1.  $C_L$  includes probe and jog capacitance

PARAMETER MEASUREMENT INFORMATION

| TEST              | S1   |
|-------------------|------|
| $t_{PLH}/t_{PHL}$ | Open |
| $t_{PLZ}/t_{PZL}$ | 6V   |
| $t_{PHZ}/t_{PZH}$ | GND  |

FIGURE 2. PULSE DURATION

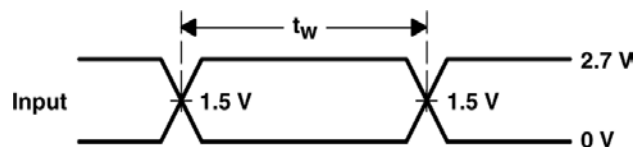


FIGURE 3. SETUP AND HOLD TIMES

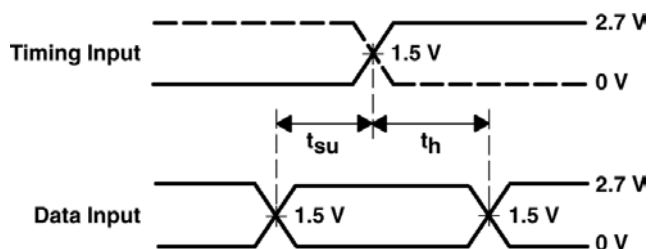


FIGURE 4. PROPAGATION DELAY TIMES INVERTING AND NON-INVERTING OUTPUTS

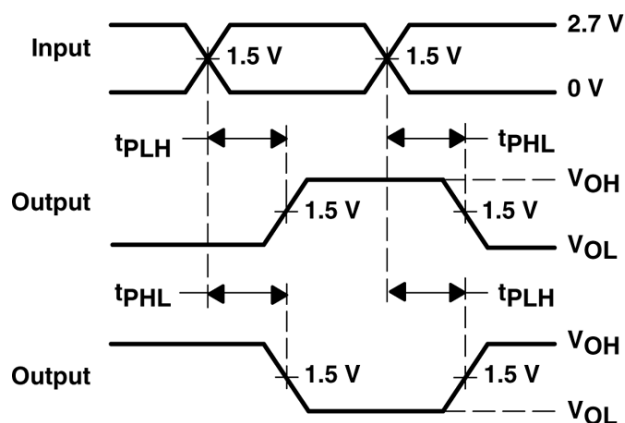


FIGURE 5. OUTPUT ENABLE TIMING

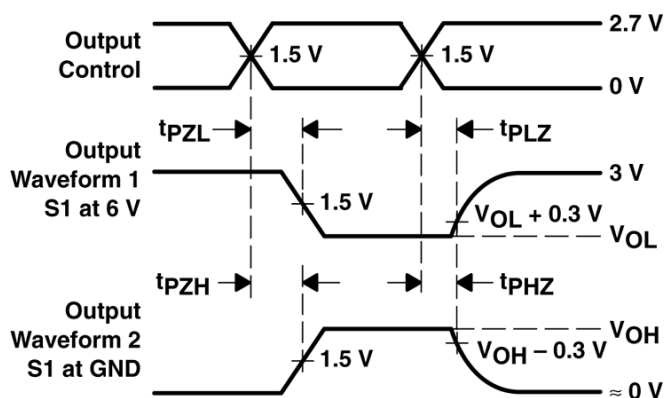
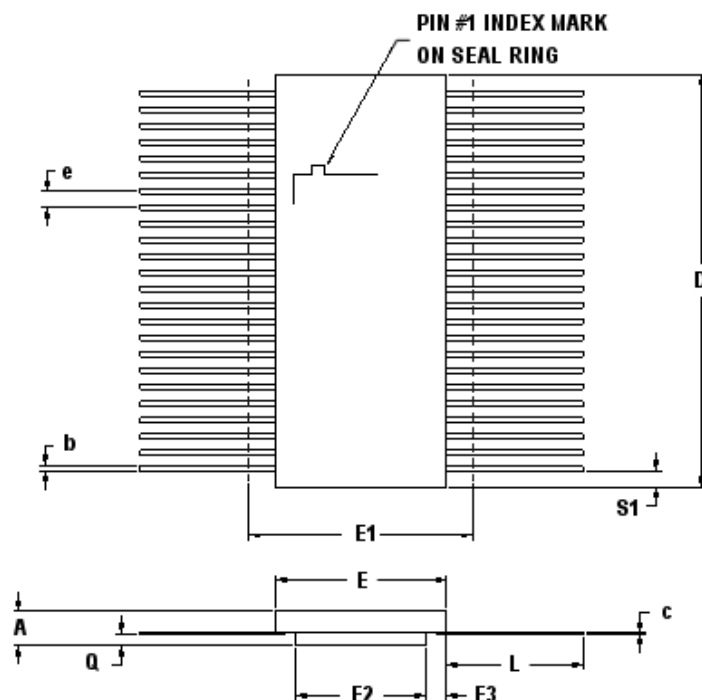


Figure Notes:

2. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_0 = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
3. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
4. The outputs are measured one at a time with one transition per measurement.



48 PIN RAD-PAK® FLAT PACKAGE

| SYMBOL | DIMENSION |       |       |
|--------|-----------|-------|-------|
|        | MIN       | NOM   | MAX   |
| A      | 0.121     | 0.130 | 0.139 |
| b      | 0.008     | 0.010 | 0.014 |
| c      | 0.004     | 0.006 | 0.006 |
| D      | --        | 0.620 | 0.640 |
| E      | 0.370     | 0.380 | 0.390 |
| E1     | --        | --    | 0.410 |
| E2     | 0.200     | 0.210 | 0.220 |
| E3     | 0.075     | 0.085 | --    |
| e      | 0.025 BSC |       |       |
| L      | 0.275     | 0.285 | 0.295 |
| Q      | 0.000     | 0.019 | 0.045 |
| S1     | 0.005     | 0.018 | --    |
| N      | 48        |       |       |

F48-01

Note: All dimensions in inches

### Important Notice:

These data sheets are created using the chip manufacturer's published specifications. DDC verifies functionality by testing key parameters either by 100% testing, sample testing or characterization.

The specifications presented within these data sheets represent the latest and most accurate information available to date. However, these specifications are subject to change without notice and DDC assumes no responsibility for the use of this information.

DDC's products are not authorized for use as critical components in life support devices or systems without express written approval from DDC.

Any claim against DDC must be made within 90 days from the date of shipment from DDC. DDC's liability shall be limited to replacement of defective parts.



## Product Ordering Options

