

February 2000

DS75451/2/3 Series Dual Peripheral Drivers

General Description

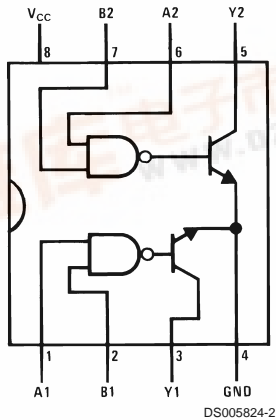
The DS7545X series of dual peripheral drivers is a family of versatile devices designed for use in systems that use TTL logic. Typical applications include high speed logic buffers, power drivers, relay drivers, lamp drivers, MOS drivers, bus drivers and memory drivers.

The DS75451, DS75452 and DS75453 are dual peripheral AND, NAND and NOR drivers, respectively, (positive logic) with the output of the logic gates internally connected to the bases of the NPN output transistors.

Features

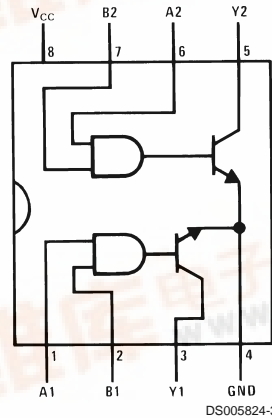
- 300 mA output current capability
- High voltage outputs
- No output latch-up at 20V
- High speed switching
- Choice of logic function
- TTL compatible diode-clamped inputs
- Standard supply voltages
- Replaces TI "A" and "B" series

Connection Diagrams (Dual-In-Line and Metal Can Packages)



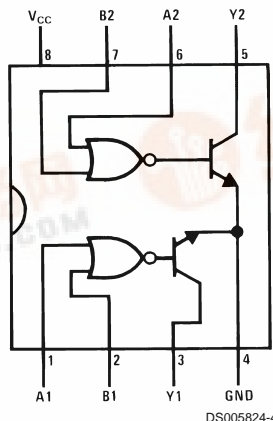
*See (Note 5) and Appendix E regarding S.O. package power dissipation constraints.

Top View
Order Number DS75451M or DS75451N



Top View
Order Number DS75452M or DS75452N

See NS Package Numbers M08A* or N08E



*See (Note 5) and Appendix E regarding S.O. package power dissipation constraints.

Top View
Order Number DS75453M or DS75453N
See NS Package Numbers M08A* or N08E

DS75451/2/3 Series Dual Peripheral Drivers



Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

| | |
|---------------------------------------|--------|
| Supply Voltage, (V_{CC}) (Note 2) | 7.0V |
| Input Voltage | 5.5V |
| Inter-Emitter Voltage (Note 3) | 5.5V |
| Output Voltage (Note 4) | 30V |
| Output Current (Note 5) | 300 mA |
| Maximum Power (Note 5) | |
| Dissipation [†] at 25°C | |

| | |
|--------------------------------------|-----------------|
| Molded DIP Package | 957 mW |
| SO Package | 632 mW |
| Storage Temperature Range | -65°C to +150°C |
| Lead Temperature (Soldering, 4 sec.) | 260°C |

Operating Conditions

| | Min | Max | Units |
|------------------------------|------|------|-------|
| Supply Voltage, (V_{CC}) | 4.75 | 5.25 | V |
| Temperature, (T_A) | 0 | +70 | °C |

[†]Derate molded package 7.7 mW/°C above 25°C, derate SO package 7.56 mW/°C above 25°C.

Electrical Characteristics

(Notes 6, 7)

| Symbol | Parameter | Conditions | | | | Min | Typ | Max | Units |
|-----------|--|--|---------------------------|---------------------------|------------------|------|------|------|---------------|
| V_{IH} | High-Level Input Voltage | (Figure 7) | | | | 2 | | | V |
| V_{IL} | Low-Level Input Voltage | | | | | | | 0.8 | V |
| V_I | Input Clamp Voltage | $V_{CC} = \text{Min}$, $I_I = -12 \text{ mA}$ | | | | | | -1.5 | V |
| V_{OL} | Low-Level Output Voltage | $V_{CC} = \text{Min}$, (Figure 7) | $V_{IL} = 0.8\text{V}$ | $I_{OL} = 100 \text{ mA}$ | DS75451, DS75453 | | 0.25 | 0.4 | V |
| | | | | $I_{OL} = 300 \text{ mA}$ | DS75451, DS75453 | | 0.5 | 0.7 | V |
| | | $V_{IH} = 2\text{V}$ | $I_{OL} = 100 \text{ mA}$ | DS75452 | | 0.25 | 0.4 | V | |
| | | | $I_{OL} = 300 \text{ mA}$ | DS75452 | | 0.5 | 0.7 | V | |
| I_{OH} | High-Level Output Current | $V_{CC} = \text{Min}$, (Figure 7) | $V_{OH} = 30\text{V}$ | $V_{IH} = 2\text{V}$ | DS75451, DS75453 | | | 100 | μA |
| | | | | $V_{IL} = 0.8\text{V}$ | DS75452 | | | 100 | μA |
| I_I | Input Current at Maximum Input Voltage | $V_{CC} = \text{Max}$, $V_I = 5.5\text{V}$, (Figure 9) | | | | | | 1 | mA |
| I_{IH} | High-Level Input Current | $V_{CC} = \text{Max}$, $V_I = 2.4\text{V}$, (Figure 9) | | | | | | 40 | μA |
| I_{IL} | Low-Level Input Current | $V_{CC} = \text{Max}$, $V_I = 0.4\text{V}$, (Figure 8) | | | | | -1 | -1.6 | mA |
| I_{CCH} | Supply Current, Outputs High | $V_{CC} = \text{Max}$, (Figure 10) | $V_I = 5\text{V}$ | DS75451 | | 7 | 11 | mA | |
| | | | $V_I = 0\text{V}$ | DS75452 | | 11 | 14 | mA | |
| | | | $V_I = 5\text{V}$ | DS75453 | | 8 | 11 | mA | |
| I_{CCL} | Supply Current, Outputs Low | $V_{CC} = \text{Max}$, (Figure 10) | $V_I = 0\text{V}$ | DS75451 | | 52 | 65 | mA | |
| | | | $V_I = 5\text{V}$ | DS75452 | | 56 | 71 | mA | |
| | | | $V_I = 0\text{V}$ | DS75453 | | 54 | 68 | mA | |

Switching Characteristics

($V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|-----------|--|--|---------|-----|-----|-------|
| t_{PLH} | Propagation Delay Time, Low-to-High Level Output | $C_L = 15 \text{ pF}$, $R_L = 50\Omega$, $I_O \approx 200 \text{ mA}$, (Figure 14) | DS75451 | 18 | 25 | ns |
| | | | DS75452 | 26 | 35 | ns |
| | | | DS75453 | 18 | 25 | ns |
| t_{PHL} | Propagation Delay Time, High-to-Low Level Output | $C_L = 15 \text{ pF}$, $R_L = 50\Omega$, $I_O \approx 200 \text{ mA}$, (Figure 14) | DS75451 | 18 | 25 | ns |
| | | | DS75452 | 24 | 35 | ns |
| | | | DS75453 | 16 | 25 | ns |
| t_{TLH} | Transition Time, Low-to-High Level Output | $C_L = 15 \text{ pF}$, $R_L = 50\Omega$, $I_O \approx 200 \text{ mA}$, (Figure 14) | | 5 | 8 | ns |
| t_{THL} | Transition Time, High-to-Low Level Output | $C_L = 15 \text{ pF}$, $R_L = 50\Omega$, $I_O \approx 200 \text{ mA}$, (Figure 14) | | 7 | 12 | ns |

Switching Characteristics (Continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|----------|---|---|-------------|-----|-----|-------|
| V_{OH} | High-Level Output Voltage after Switching | $V_S = 20V, I_O \approx 300 \text{ mA}$, (Figure 15) | $V_S - 6.5$ | | | mV |

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

Note 2: Voltage values are with respect to network ground terminal unless otherwise specified.

Note 3: The voltage between two emitters of a multiple-emitter transistor.

Note 4: The maximum voltage which should be applied to any output when it is in the "OFF" state.

Note 5: Both halves of these dual circuits may conduct rated current simultaneously; however, power dissipation averaged over a short time interval must fall within the continuous dissipation rating.

Note 6: Unless otherwise specified min/max limits apply across 0°C to +70°C range. All typicals are given for $V_{CC} = +5V$ and $T_A = 25^\circ\text{C}$.

Note 7: All currents into device pins shown as positive, out of device pins as negative, all voltages referenced to ground unless otherwise noted. All values shown as max or min on absolute value basis.

Truth Tables (H = high level, L = low level)

DS75451

| A | B | Y |
|---|---|---------------|
| L | L | L (ON State) |
| L | H | L (ON State) |
| H | L | L (ON State) |
| H | H | H (OFF State) |

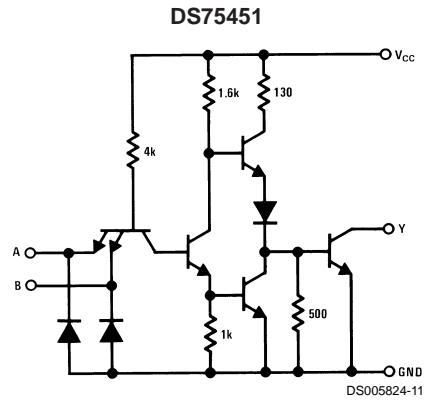
DS75452

| A | B | Y |
|---|---|---------------|
| L | L | H (OFF State) |
| L | H | H (OFF State) |
| H | L | H (OFF State) |
| H | H | L (ON State) |

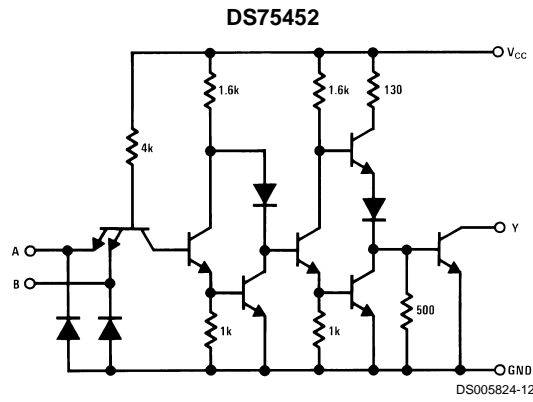
DS75453

| A | B | Y |
|---|---|---------------|
| L | L | L (ON State) |
| L | H | H (OFF State) |
| H | L | H (OFF State) |
| H | H | H (OFF State) |

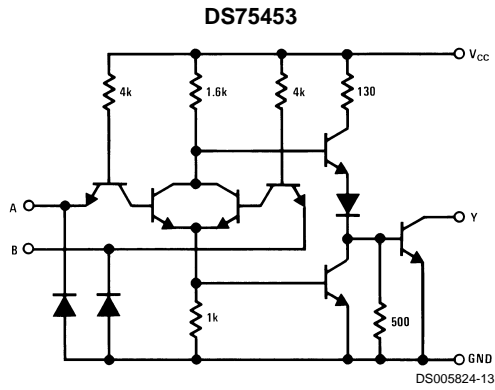
Schematic Diagrams



Resistor values shown are nominal.

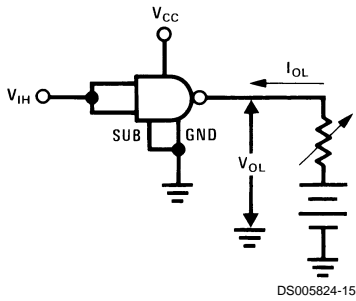


Resistor values shown are nominal.



Resistor values shown are nominal.

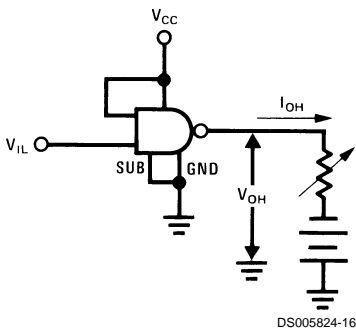
DC Test Circuits



DS005824-15

Both inputs is tested simultaneously.

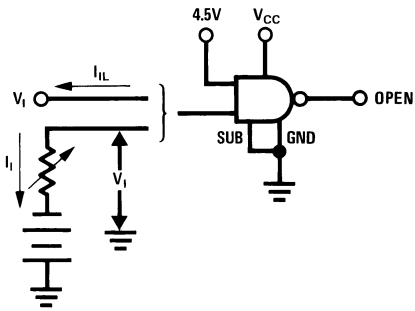
FIGURE 1. V_{IH} , V_{OL}



DS005824-16

Each input is tested separately.

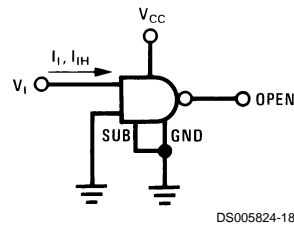
FIGURE 2. V_{IL} , V_{OH}



DS005824-17

Each input is tested separately.

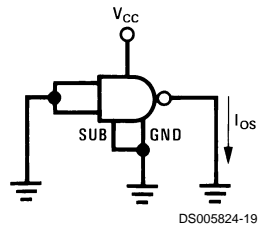
FIGURE 3. V_I , I_{IL}



DS005824-18

Each input is tested separately.

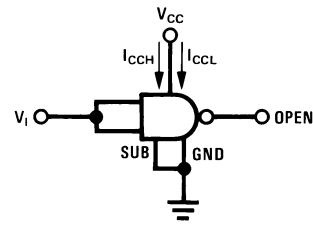
FIGURE 4. I_I , I_{IH}



DS005824-19

Each input is tested separately.

FIGURE 5. I_{OS}

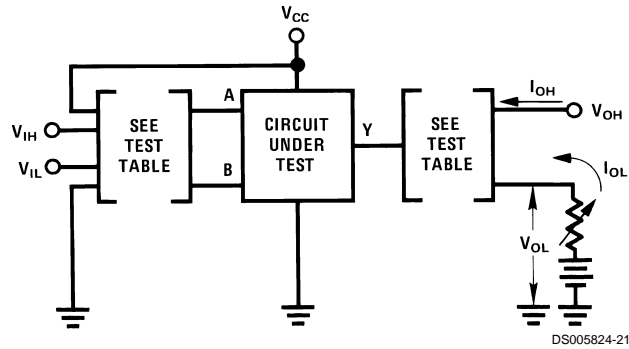


DS005824-20

Both gates are tested simultaneously.

FIGURE 6. I_{CCH} , I_{CCL}

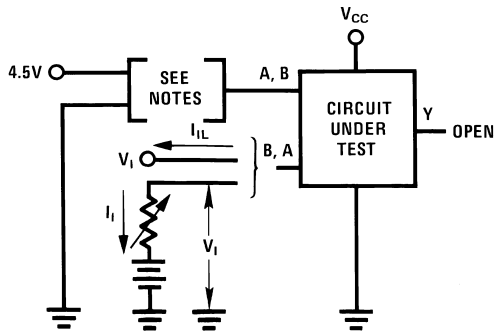
DC Test Circuits (Continued)



DS005824-21

| Circuit | Input Under Test | Other Input | Output | |
|---------|------------------|-------------|----------|----------|
| | | | Apply | Measure |
| DS75451 | V_{IH} | V_{IH} | V_{OH} | I_{OL} |
| | V_{IL} | V_{CC} | I_{OL} | V_{OL} |
| DS75452 | V_{IH} | V_{IH} | I_{OL} | V_{OL} |
| | V_{IL} | V_{CC} | V_{OH} | I_{OH} |
| DS75453 | V_{IH} | Gnd | V_{OH} | I_{OH} |
| | V_{IL} | V_{IL} | I_{OL} | V_{OH} |

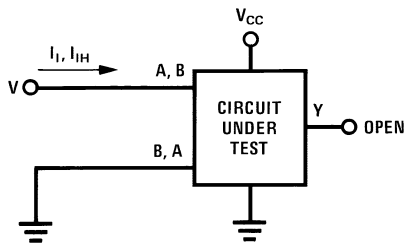
FIGURE 7. V_{IH} , V_{IL} , I_{OH} , V_{OL}



DS005824-22

Note A: Each input is tested separately.
Note B: When testing DS75453 input not under test is grounded. For all other circuits it is at 4.5V.

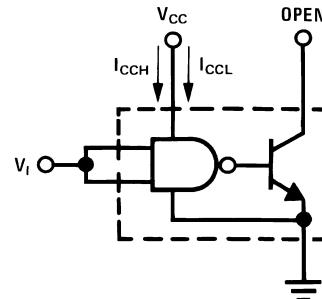
FIGURE 8. V_I , V_{IL}



DS005824-23

Each input is tested separately.

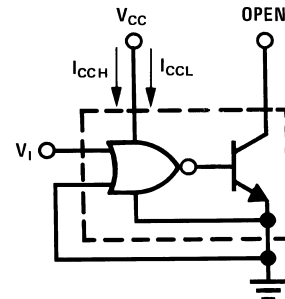
FIGURE 9. I_I , I_{IH}



DS005824-24

Both gates are tested simultaneously.

FIGURE 10. I_{CCH} , I_{CCL} for AND, NAND Circuits

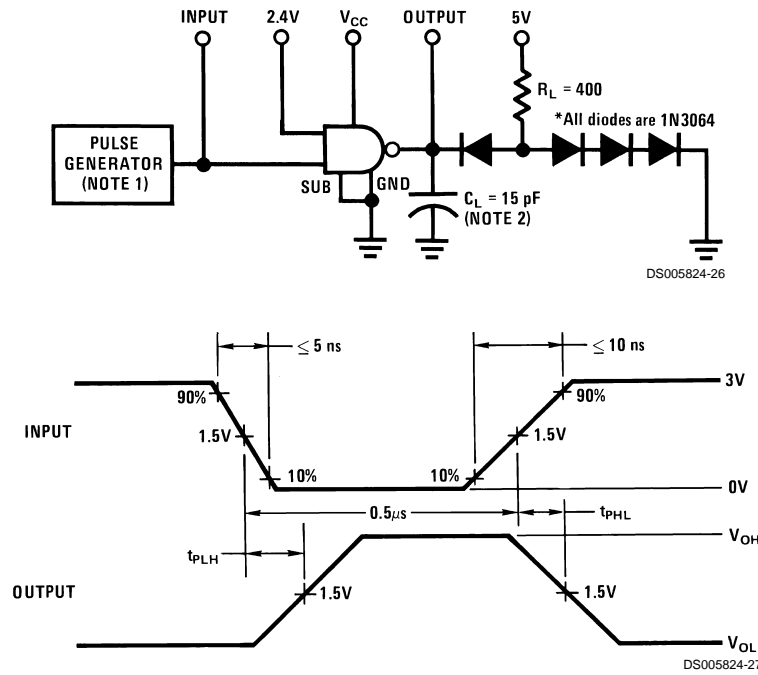


DS005824-25

Both gates are tested simultaneously.

FIGURE 11. I_{CCH} , I_{CCL} for OR, NOR Circuits

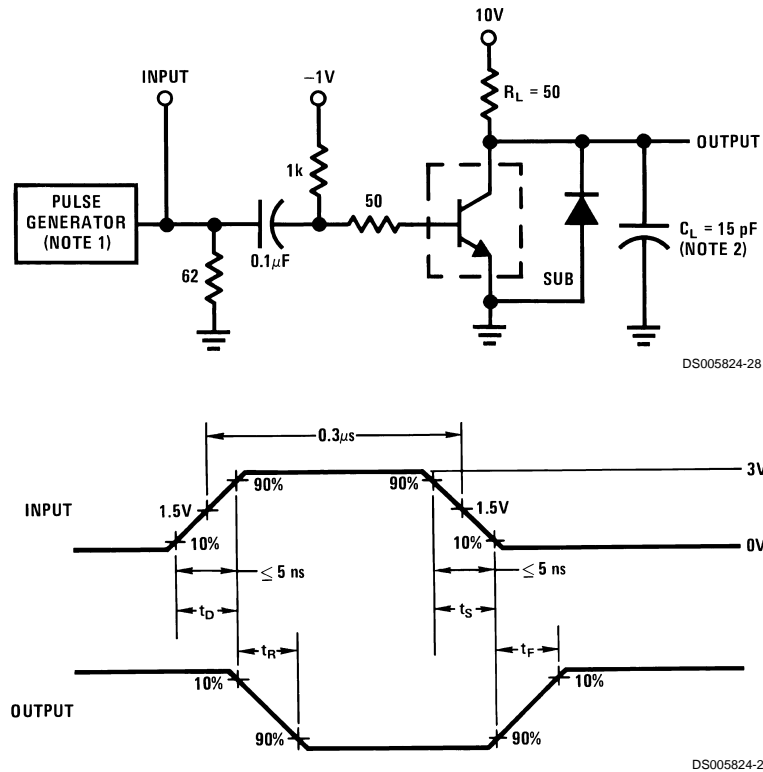
AC Test Circuits and Switching Time Waveforms



Note 1: The pulse generator has the following characteristics: PRR = 1 MHz, $Z_{OUT} = 50\Omega$.

Note 2: C_L includes probe and jig capacitance.

FIGURE 12. Propagation Delay Times, Each Gate

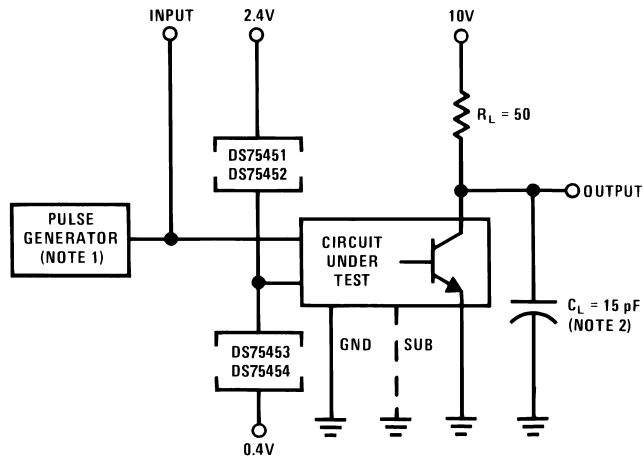


Note 1: The pulse generator has the following characteristics: duty cycle $\leq 1\%$, $Z_{OUT} \approx 50\Omega$.

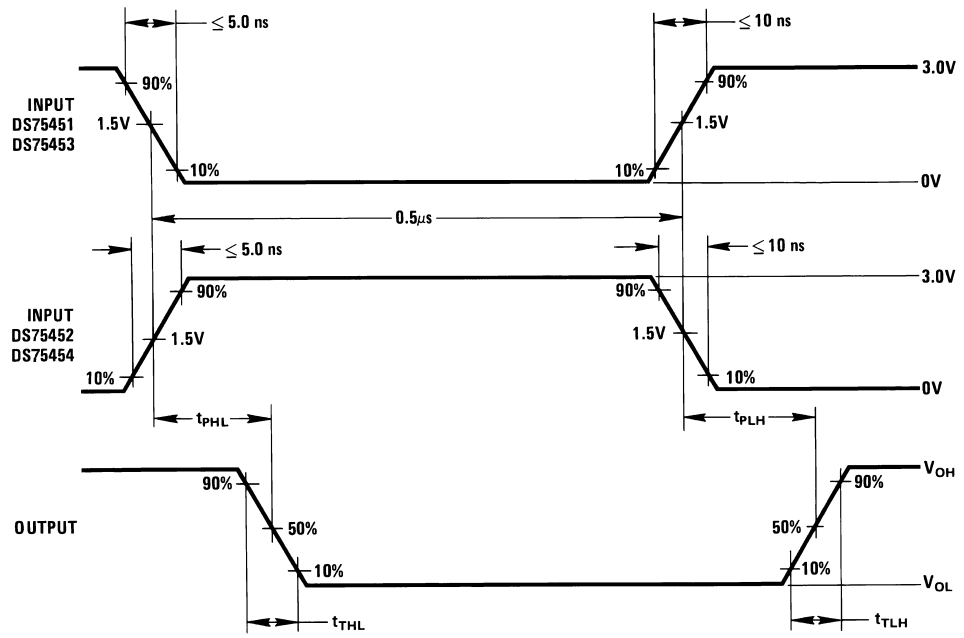
Note 2: C_L includes probe and jig capacitance.

FIGURE 13. Switching Times, Each Transistor

AC Test Circuits and Switching Time Waveforms (Continued)



DS005824-30



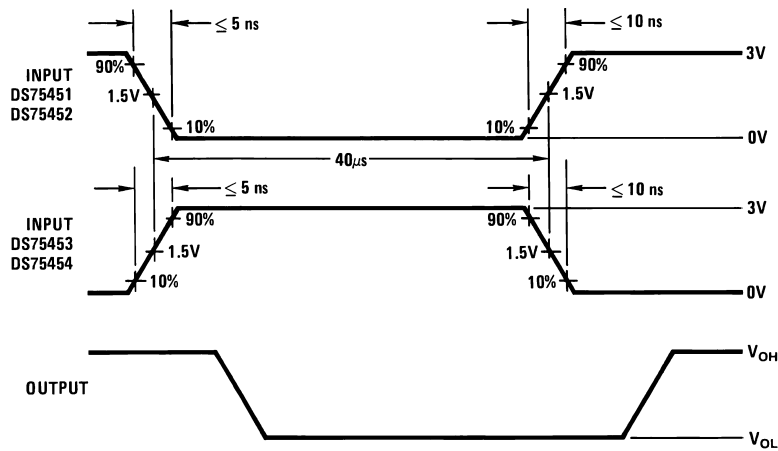
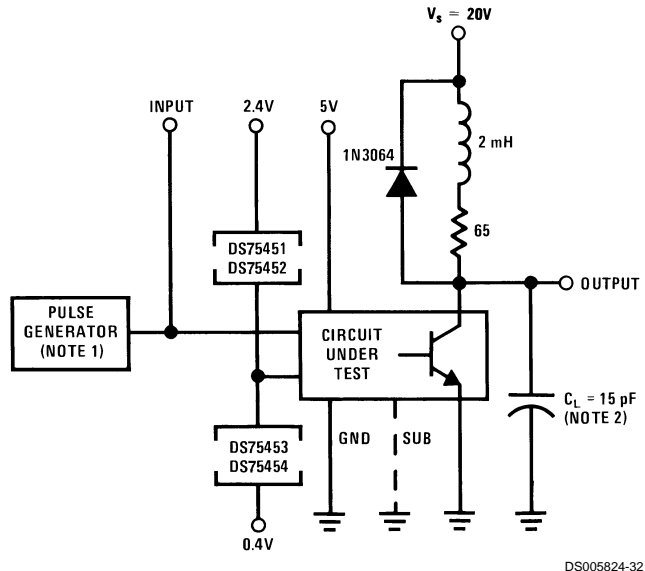
DS005824-31

Note 1: The pulse generator has the following characteristics: PRR = 1.0 MHz, $Z_{OUT} \approx 50\Omega$.

Note 2: C_L includes probe and jig capacitance.

FIGURE 14. Switching Times of Complete Drivers

AC Test Circuits and Switching Time Waveforms (Continued)



Note 1: The pulse generator has the following characteristics: PRR = 12.5 kHz, $Z_{OUT} \approx 50\Omega$.
Note 2: C_L includes probe and jig capacitance.

FIGURE 15. Latch-UP Test of Complete Drivers

Typical Performance Characteristics

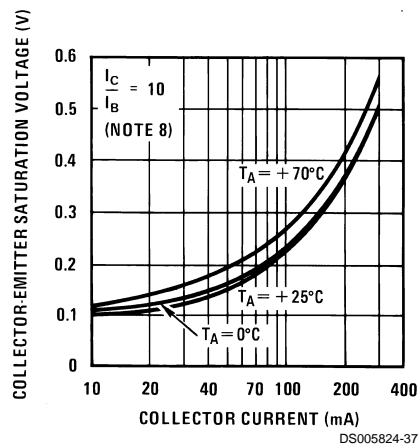
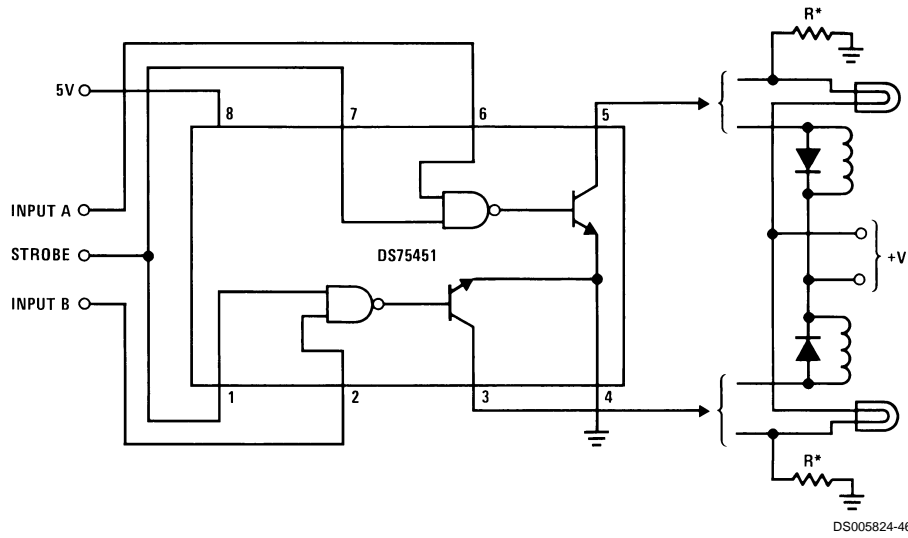


FIGURE 16. Transistor Collector-Emitter Saturation Voltage vs Collector Current

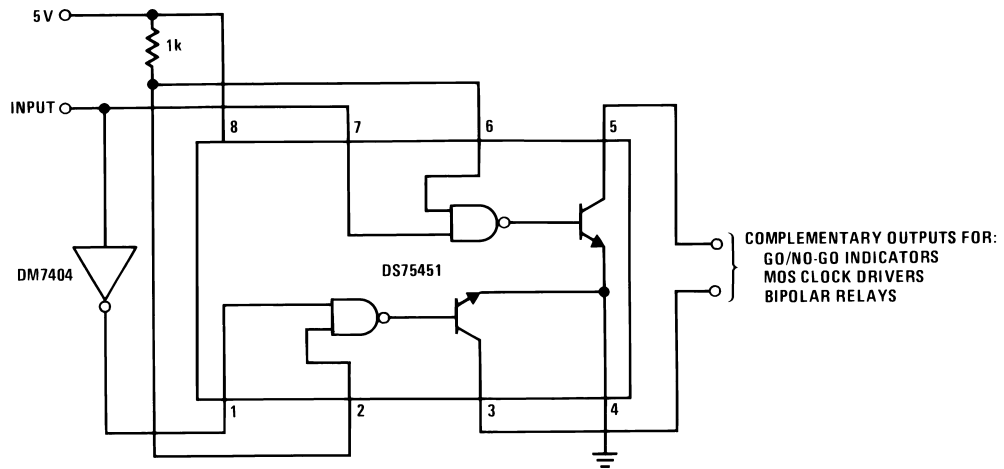
Typical Applications



DS005824-46

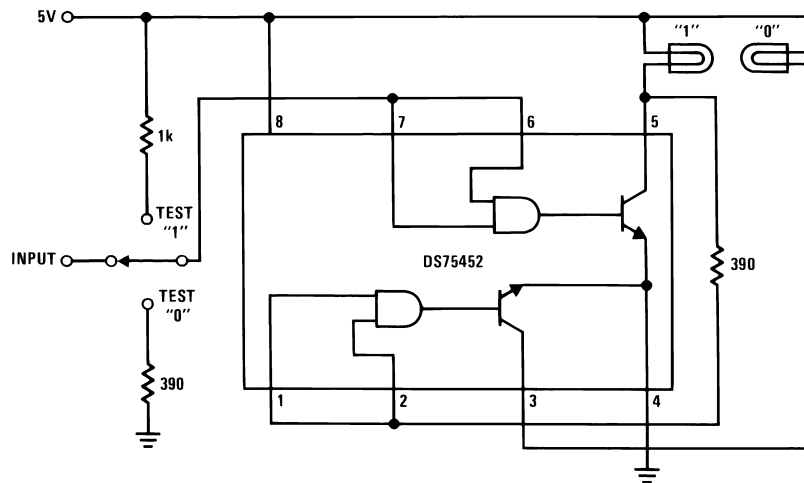
*Optional keep-alive resistors maintain off-state lamp current at $\approx 10\%$ to reduce surge current.

FIGURE 17. Dual Lamp or Relay Driver



DS005824-47

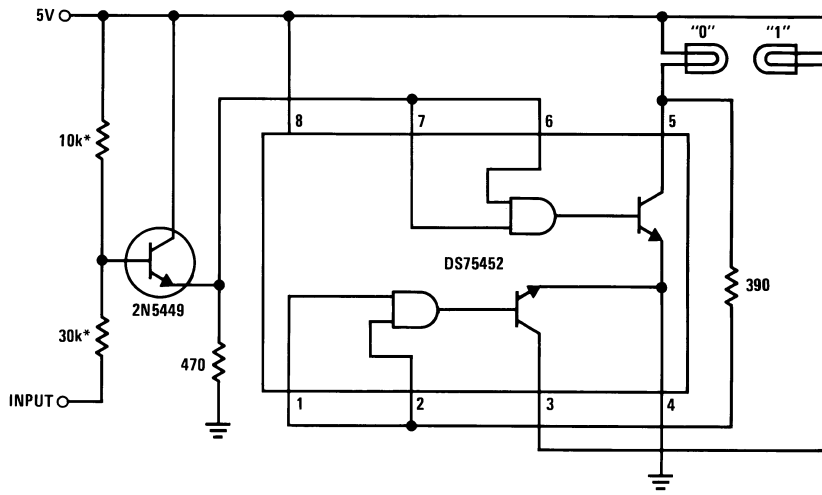
FIGURE 18. Complementary Driver



DS005824-48

FIGURE 19. TTL or DTL Positive Logic-Level Detector

Typical Applications (Continued)

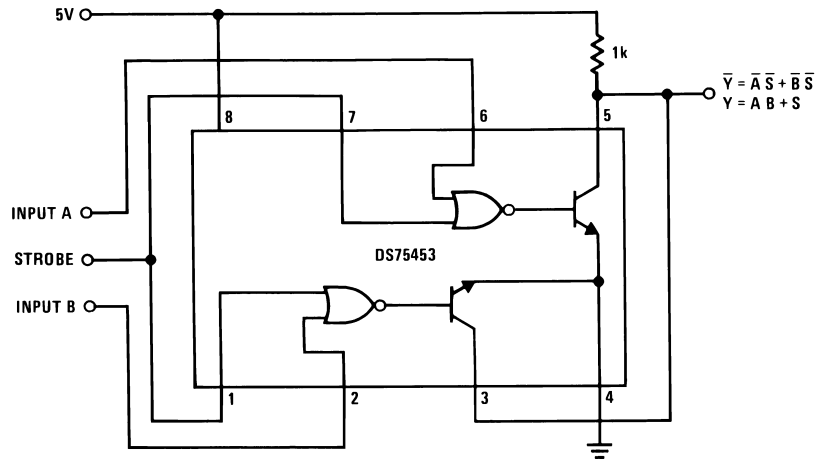


DS005824-49

*The two input resistors must be adjusted for the level of MOS input.

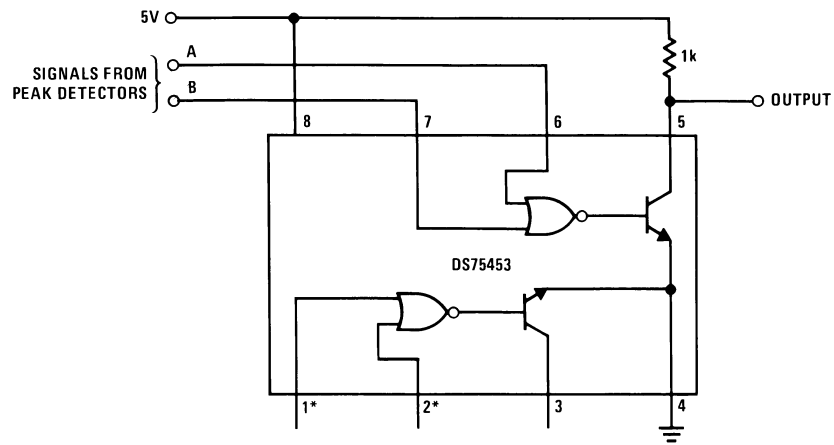
FIGURE 20. MOS Negative Logic-Level Detector

Typical Applications (Continued)



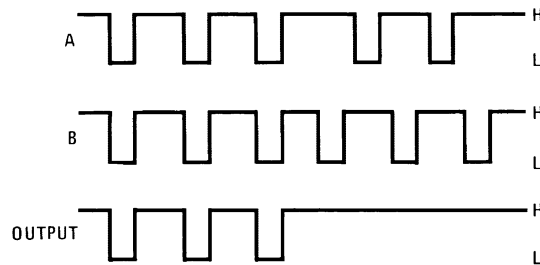
DS005824-50

FIGURE 21. Logic Signal Comparator



DS005824-51

*If inputs are unused, they should be connected to +5V through a 1k resistor.

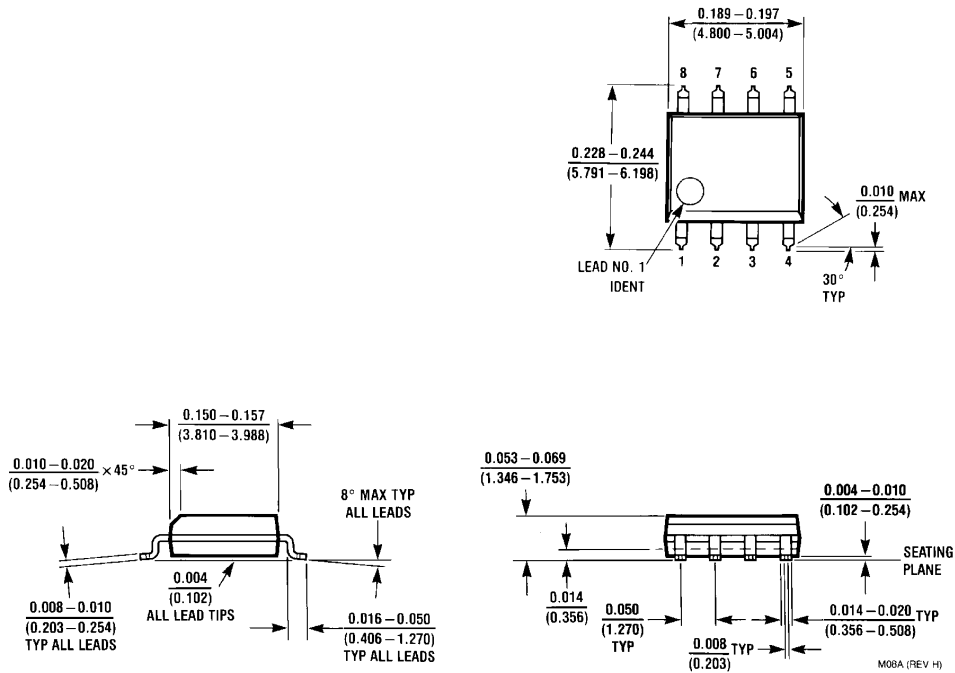


DS005824-52

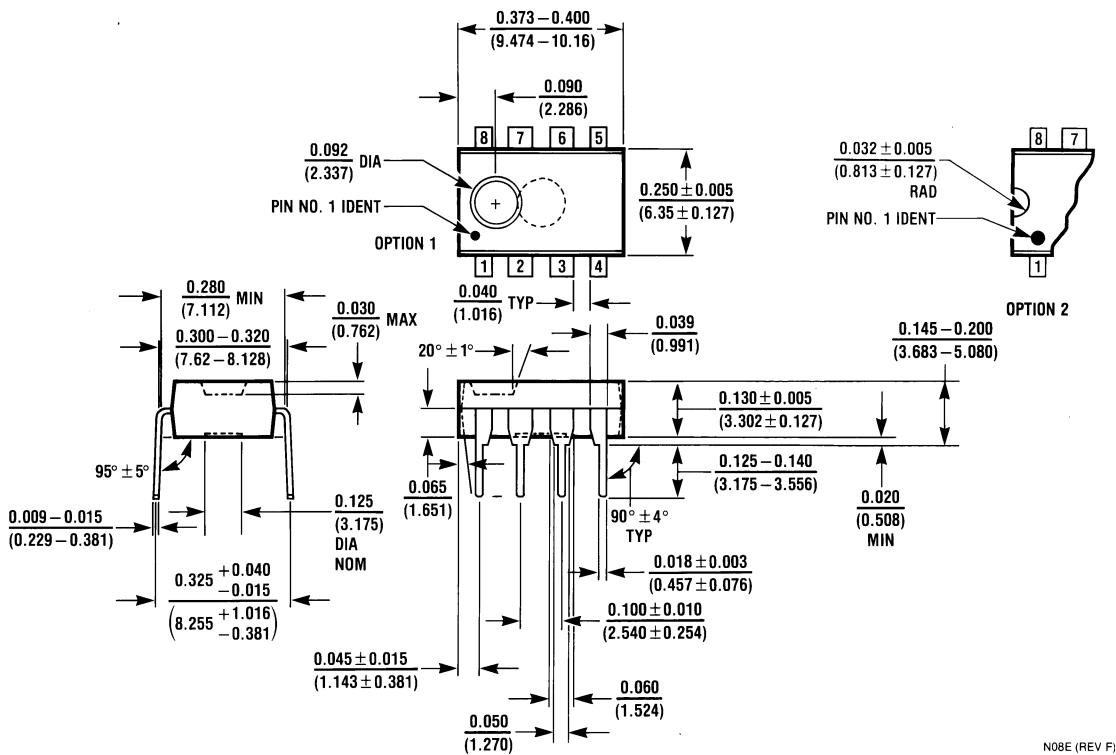
Low output occurs only when inputs are low simultaneously.

FIGURE 22. In-Phase Detector

Physical Dimensions inches (millimeters) unless otherwise noted



SO Package (M)
Order Number DS75451M, DS75452M, DS75453M
NS Package Number M08A



Molded Dual-In-Line Package (N)
Order Number DS75451N, DS75452N, DS75453N
NS Package Number N08E

Notes

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



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