National Semiconductor

February 1995

DS55451/2/3/4, DS75451/2/3/4 Series Dual Peripheral Drivers

General Description

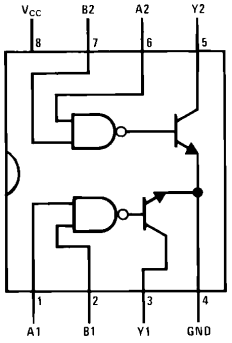
The DS7545X series of dual peripheral drivers is a family of versatile devices designed for use in systems that use TTL logic. Typical applications include high speed logic buffers, power drivers, relay drivers, lamp drivers, MOS drivers, bus drivers and memory drivers.

The DS55451/DS75451, DS55452/DS75452, DS55453/DS75453 and DS55454/DS75454 are dual peripheral AND, NAND, OR and NOR drivers, respectively, (positive logic) with the output of the logic gates internally connected to the bases of the NPN output transistors.

Features

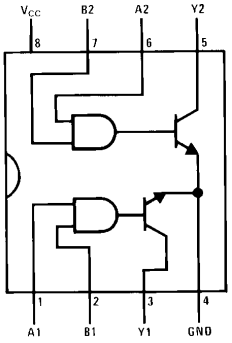
- 300 mA output current capability
- High voltage outputs
- No output latch-up at 20V
- High speed switching
- Choice of logic function
- TTL compatible diode-clamped inputs
- Standard supply voltages
- Replaces TI "A" and "B" series

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



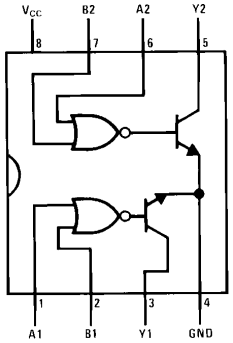
TL/F/5824–2

Top View
Order Number DS55451J-8, DS75451M or DS75451N



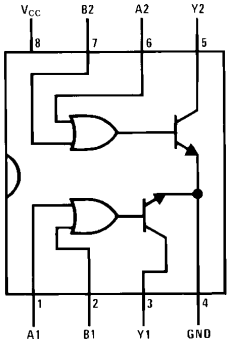
TL/F/5824–3

Top View
Order Number DS55452J-8, DS75452M or DS75452N



TL/F/5824–4

Top View
Order Number DS55453J-8, DS75453M or DS75453N

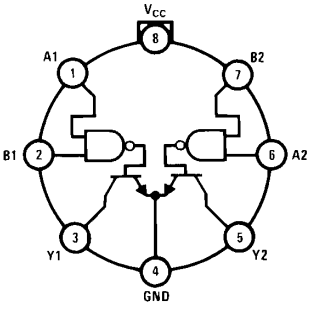


TL/F/5824–5

Top View
Order Number DS55454J-8, DS75454M or DS75454N

See NS Package Numbers J08A, M08A* or N08E

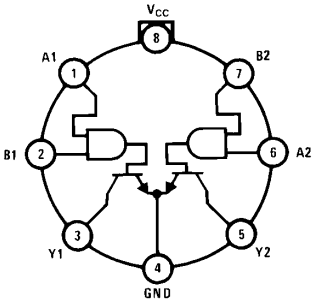
*See Note 5 and Appendix E regarding S.O. package power dissipation constraints.



TL/F/5824–6

Top View

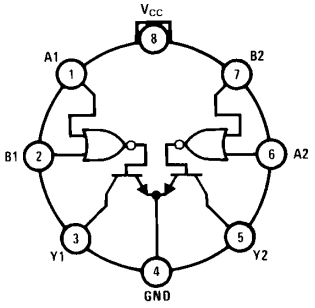
Order Number DS55451H



TL/F/5824–7

Top View

Order Number DS55452H



TL/F/5824–8

Top View

(Pin 4 is in Electrical Contact with the Case)

Order Number DS55453H

See NS Package Number H08C

RRD-B30M105/Printed in U. S. A.

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)	
DS55451/DS75451, DS55452/DS75452, DS55453/DS75453, DS55454/DS75454	30V
Output Current (Note 5)	
DS55451/DS75451, DS55452/DS75452, DS55453/DS75453, DS55454/DS75454	300 mA
DS75451/2/3/4 Maximum Power (Note 5)	
Dissipation† at 25°C	
Cavity Package	1090 mW
Molded DIP Package	957 mW
TO-5 Package	760 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})			
DS5545X	4.5	5.5	V
DS7545X	4.75	5.25	V
Temperature, (T_A)			
DS5545X	−55	+125	°C
DS7545X	0	+70	°C

† Derate cavity package 7.3 mW/°C above 25°C; derate molded package 7.7 mW/°C above 25°C; derate TO-5 package 5.1 mW/°C above 25°C; derate SO package 7.56 mW/°C above 25°C.

Electrical Characteristics

DS55451/DS75451, DS55452/DS75452, DS55453/DS75453, DS55454/DS75454 (Notes 6 and 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} = Min, I_I = −12 mA						−1.5	V
V_{OL}	Low-Level Output Voltage	V_{CC} = Min, *(Figure 7)*	V_{IL} = 0.8V	I_{OL} = 100 mA	DS55451, DS55453		0.25	0.5	V
					DS75451, DS75453		0.25	0.4	V
				I_{OL} = 300 mA	DS55451, DS55453		0.5	0.8	V
					DS75451, DS75453		0.5	0.7	V
			V_{IH} = 2V	I_{OL} = 100 mA	DS55452, DS55454		0.25	0.5	V
					DS75452, DS75454		0.25	0.4	V
				I_{OL} = 300 mA	DS55452, DS55454		0.5	0.8	V
					DS75452, DS75454		0.5	0.7	V
I_{OH}	High-Level Output Current	V_{CC} = Min, *(Figure 7)*	V_{OH} = 30V	V_{IH} = 2V	DS55451, DS55453			300	μA
					DS75451, DS75453			100	μA
				V_{IL} = 0.8V	DS55452, DS55454			300	μA
					DS75452, DS75454			100	μA
I_I	Input Current at Maximum Input Voltage	V_{CC} = Max, V_I = 5.5V, *(Figure 9)*						1	mA
I_{IH}	High-Level Input Current	V_{CC} = Max, V_I = 2.4V, *(Figure 9)*						40	μA
I_{IL}	Low-Level Input Current	V_{CC} = Max, V_I = 0.4V, *(Figure 8)*					−1	−1.6	mA
I_{CCH}	Supply Current, Outputs High	V_{CC} = Max, *(Figure 10)*	V_I = 5V		DS55451/DS75451		7	11	mA
			V_I = 0V		DS55452/DS75452		11	14	mA
			V_I = 5V		DS55453/DS75453		8	11	mA
			V_I = 0V		DS55454/DS75454		13	17	mA
I_{CCL}	Supply Current, Outputs Low	V_{CC} = Max, *(Figure 10)*	V_I = 0V		DS55451/DS75451		52	65	mA
			V_I = 5V		DS55452/DS75452		56	71	mA
			V_I = 0V		DS55453/DS75453		54	68	mA
			V_I = 5V		DS55454/DS75454		61	79	mA

Switching Characteristics

DS55451/DS75451, DS55452/DS75452, DS55453/DS75453, DS55454/DS75454 (V_{CC} = 5V, T_A = 25°C)

Symbol	Parameter	Conditions		Min	Typ	Max	Units
t_{PLH}	Propagation Delay Time, Low-to-High Level Output	C_L = 15 pF, R_L = 50Ω, $I_O \approx$ 200 mA, *(Figure 14)*	DS55451/DS75451		18	25	ns
			DS55452/DS75452		26	35	ns
			DS55453/DS75453		18	25	ns
			DS55454/DS75454		27	35	ns
t_{PHL}	Propagation Delay Time, High-to-Low Level Output	C_L = 15 pF, R_L = 50Ω, $I_O \approx$ 200 mA, *(Figure 14)*	DS55451/DS75451		18	25	ns
			DS55452/DS75452		24	35	ns
			DS55453/DS75453		16	25	ns
			DS55454/DS75454		24	35	ns
t_{TLH}	Transition Time, Low-to-High Level Output	C_L = 15 pF, R_L = 50Ω, $I_O \approx$ 200mA, *(Figure 14)*			5	8	ns
t_{THL}	Transition Time, High-to-Low Level Output	C_L = 15 pF, R_L = 50Ω, $I_O \approx$ 200 mA, *(Figure 14)*			7	12	ns
V_{OH}	High-Level Output Voltage after Switching	V_S = 20V, $I_O \approx$ 300 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 the −55°C to +125°C temperature range for the DS55450 series and across the 0°C to +70°C range for the DS7545X series. All typicals are given for V_{CC} = +5V and T_A = 25°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)

DS55451/DS75451

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

DS55453/DS75453

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

DS55452/DS75452

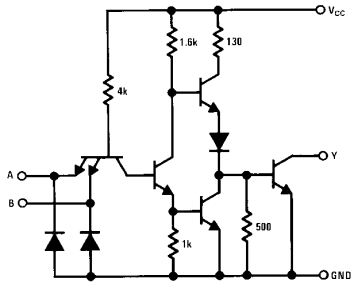
A	B	Y
L	L	H (OFF State)
L	H	H (OFF State)
H	L	H (OFF State)
H	H	L (ON State)

DS55454/DS75454

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

Schematic Diagrams

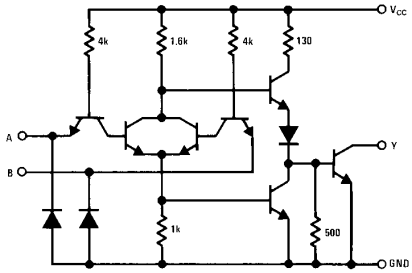
DS55451/DS75451



TL/F/5824–11

Resistor values shown are nominal.

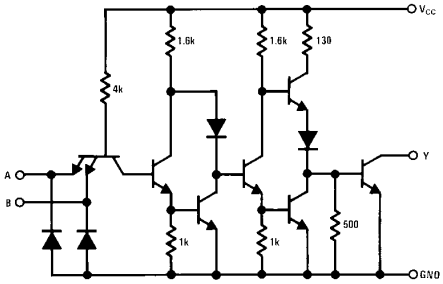
DS55453/DS75453



TL/F/5824–13

Resistor values shown are nominal.

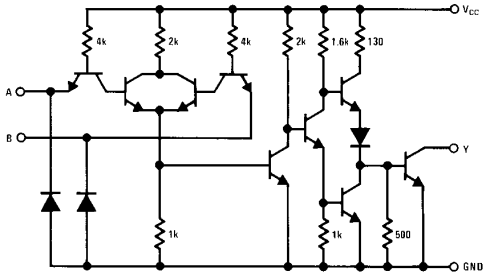
DS55452/DS75452



TL/F/5824–12

Resistor values shown are nominal.

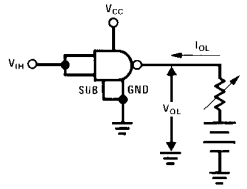
DS55454/DS75454



TL/F/5824–14

Resistor values shown are nominal.

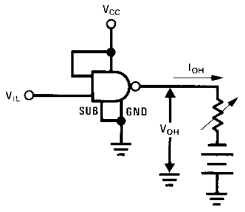
DC Test Circuits



TL/F/5824–15

Both inputs are tested simultaneously.

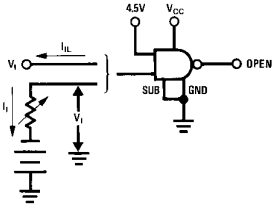
FIGURE 1. V_{IH}, V_{OL}



TL/F/5824–16

Each input is tested separately.

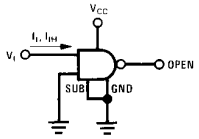
FIGURE 2. V_{IL}, V_{OH}



TL/F/5824–17

Each input is tested separately.

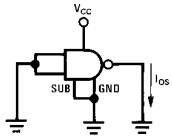
FIGURE 3. V_I, I_{IL}



TL/F/5824–18

Each input is tested separately.

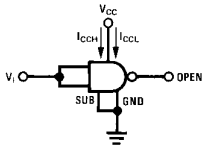
FIGURE 4. I_I, I_{IH}



TL/F/5824–19

Each input is tested separately.

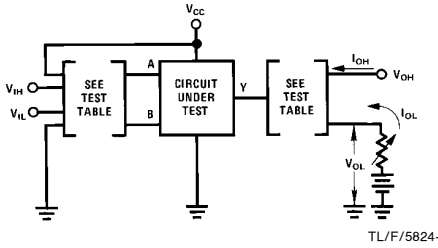
FIGURE 5. I_{OS}



TL/F/5824–20

Both gates are tested simultaneously.

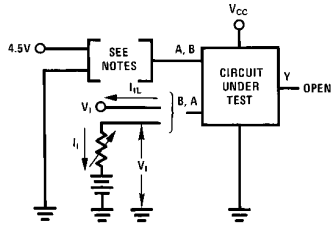
FIGURE 6. I_{CCH}, I_{CCL}



TL/F/5824–21

Circuit	Input Under Test	Other Input	Output	
			Apply	Measure
DS55451	V_{IH}	V_{IH}	V_{OH}	I_{OH}
	V_{IL}	V_{CC}	I_{OL}	V_{OL}
DS55452	V_{IH}	V_{IH}	I_{OL}	V_{OL}
	V_{IL}	V_{CC}	V_{OH}	I_{OH}
DS55453	V_{IH}	Gnd	V_{OH}	I_{OH}
	V_{IL}	V_{IL}	I_{OL}	V_{OH}
DS55454	V_{IH}	Gnd	I_{OL}	V_{OL}
	V_{IL}	V_{IL}	V_{OH}	I_{OH}

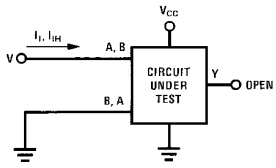
FIGURE 7. V_{IH}, V_{IL}, I_{OH}, V_{OL}



Note A: Each input is tested separately.
Note B: When testing DS55453/DS75453, DS55454/DS75454, input not under test is grounded.
For all other circuits it is at 4.5V.

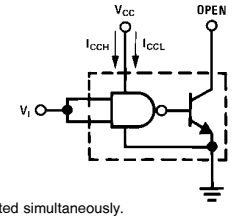
TL/F/5824–22

FIGURE 8. V_I, V_{IL}



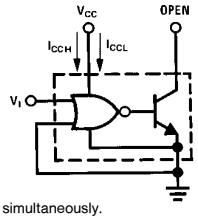
Each input is tested separately. TL/F/5824–23

FIGURE 9. I_I, I_{IH}



Both gates are tested simultaneously. TL/F/5824–24

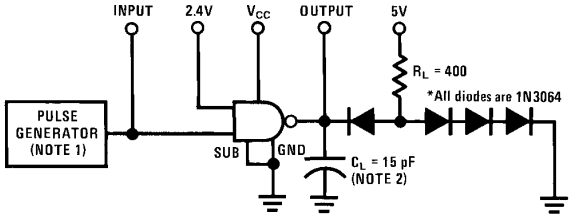
FIGURE 10. I_{CCH}, I_{CCL} for AND, NAND Circuits



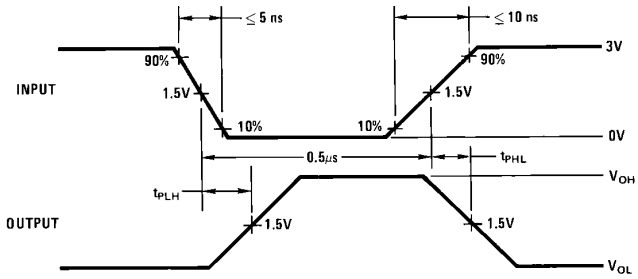
Both gates are tested simultaneously. TL/F/5824–25

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

AC Test Circuits and Switching Time Waveforms



TL/F/5824–26

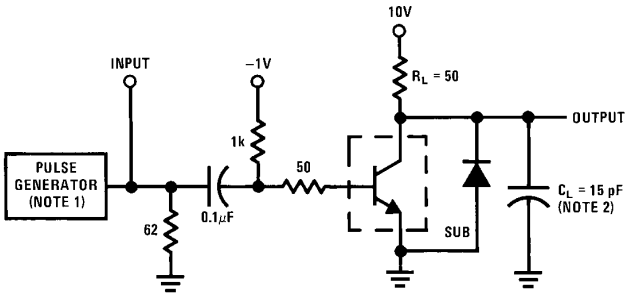


TL/F/5824–27

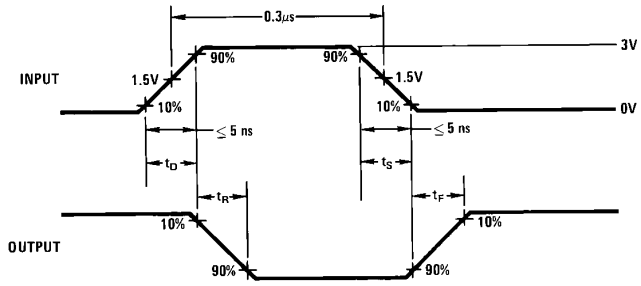
Note 1: The pulse generator has the following characteristics: PRR = 1 MHz, $Z_{OUT} \approx 50\Omega$.

Note 2: C_L includes probe and jig capacitance.

FIGURE 12. Propagation Delay Times, Each Gate



TL/F/5824–28



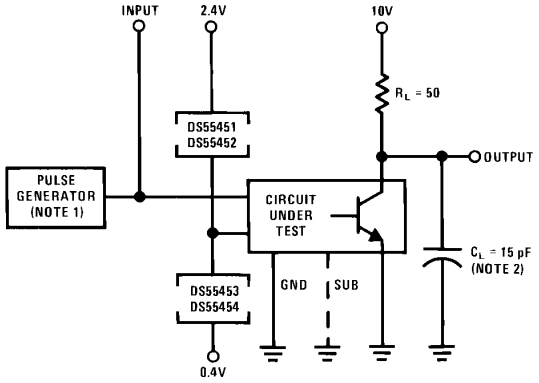
TL/F/5824–29

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

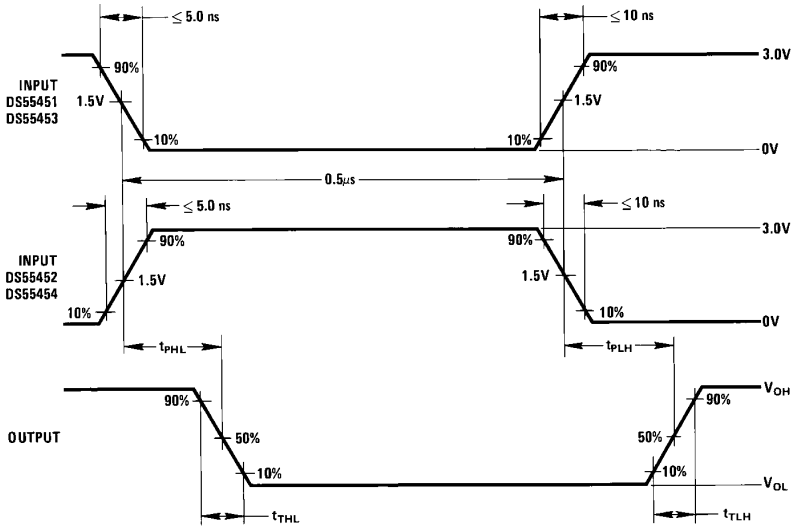
Note 2: C_L includes probe and jig capacitance.

FIGURE 13. Switching Times, Each Transistor

AC Test Circuits and Switching Time Waveforms (Continued)



TL/F/5824–30



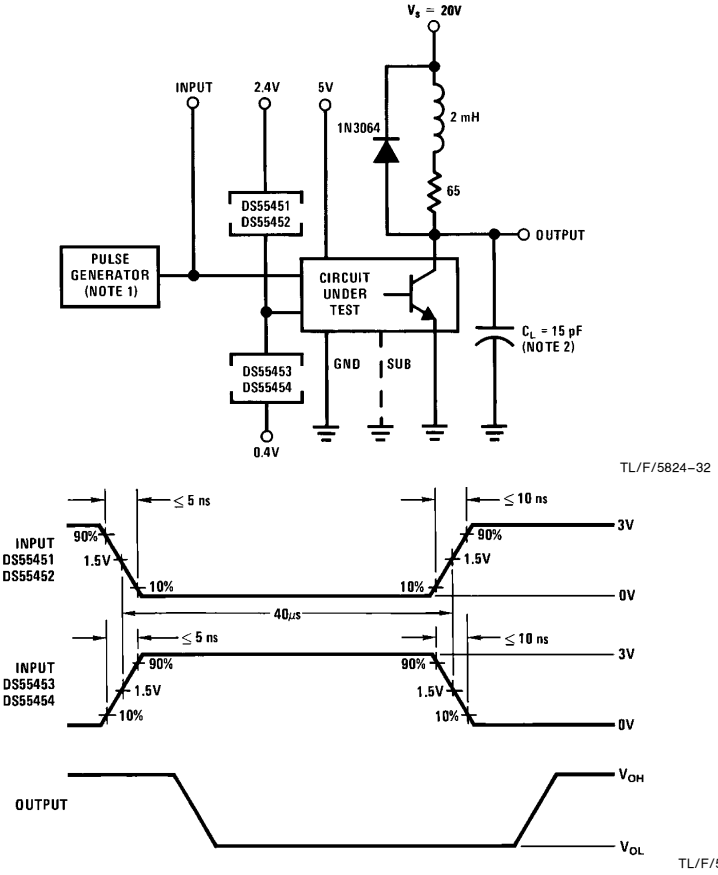
Note 1: The pulse generator has the following characteristics: PRR = 1.0 MHz, $Z_{OUT} \approx 50\Omega$.

TL/F/5824–31

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

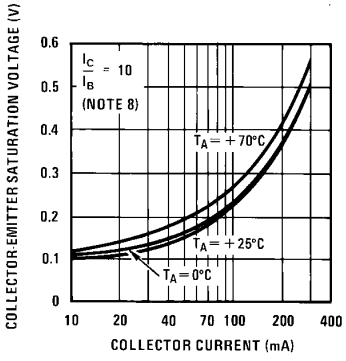
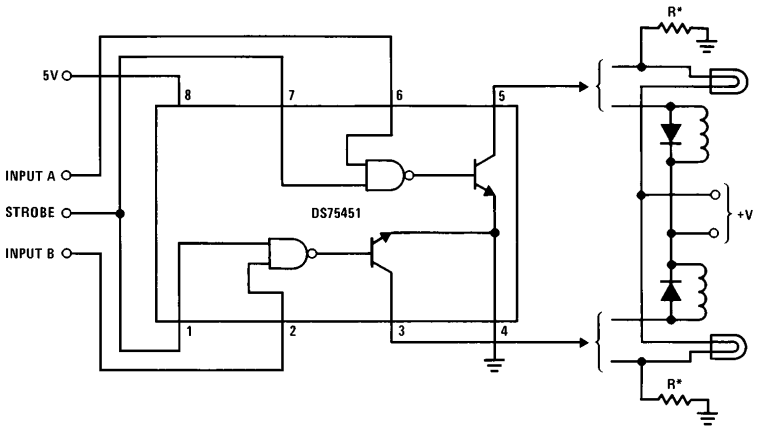


FIGURE 16. Transistor Collector-Emitter Saturation Voltage vs Collector Current

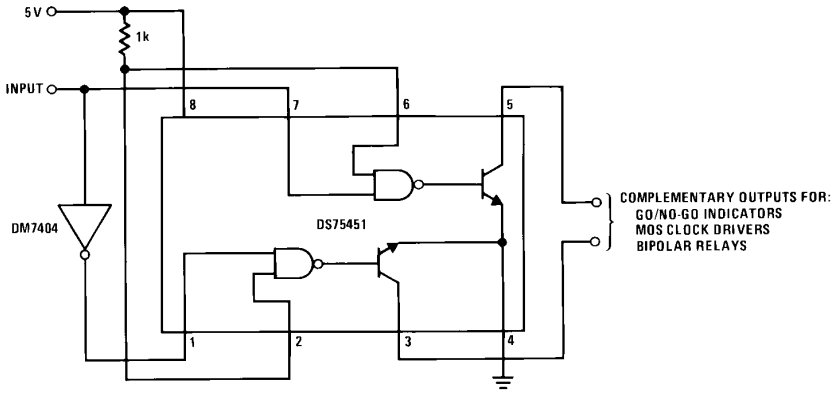
Typical Applications



TL/F/5824–46

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

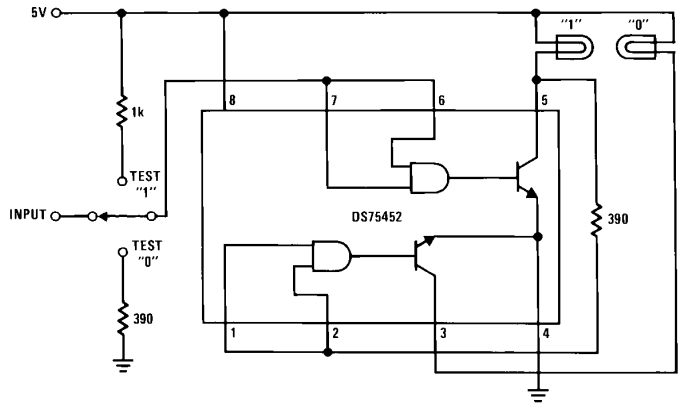
FIGURE 17. Dual Lamp or Relay Driver



TL/F/5824–47

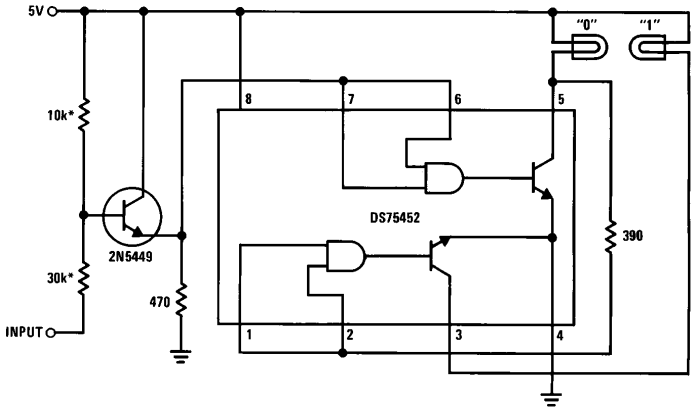
FIGURE 18. Complementary Driver

Typical Applications (Continued)



TL/F/5824–48

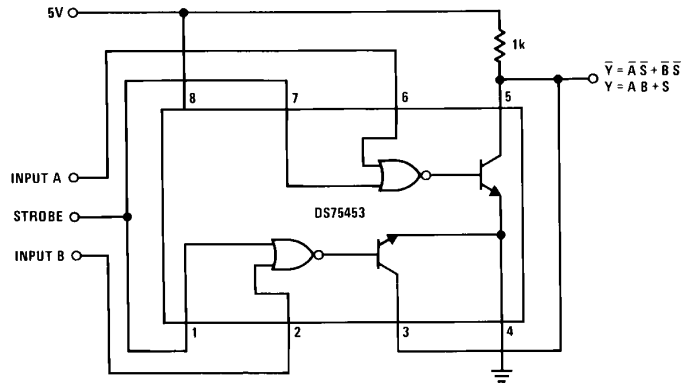
FIGURE 19. TTL or DTL Positive Logic-Level Detector



TL/F/5824–49

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

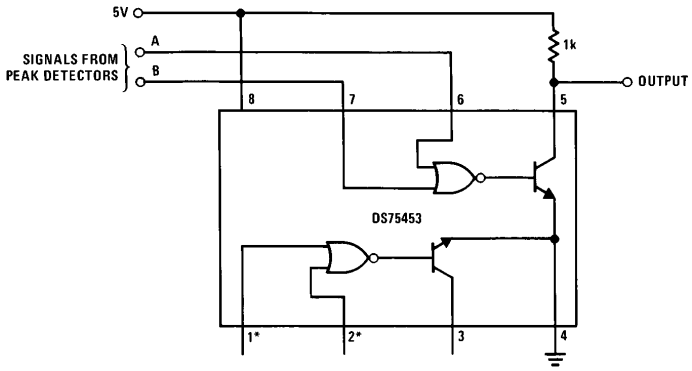
FIGURE 20. MOS Negative Logic-Level Detector



TL/F/5824–50

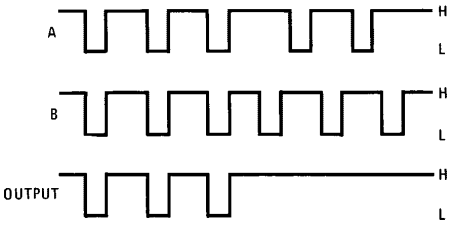
FIGURE 21. Logic Signal Comparator

Typical Applications (Continued)



TL/F/5824–51

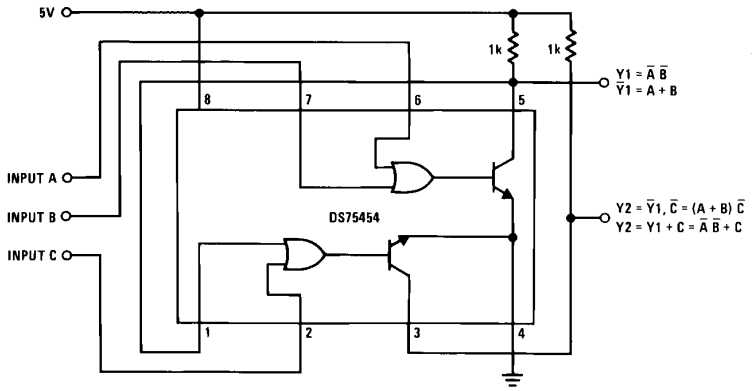
*If inputs are unused, they should be connected to +5V through a 1k resistor.



TL/F/5824–52

Low output occurs only when inputs are low simultaneously.

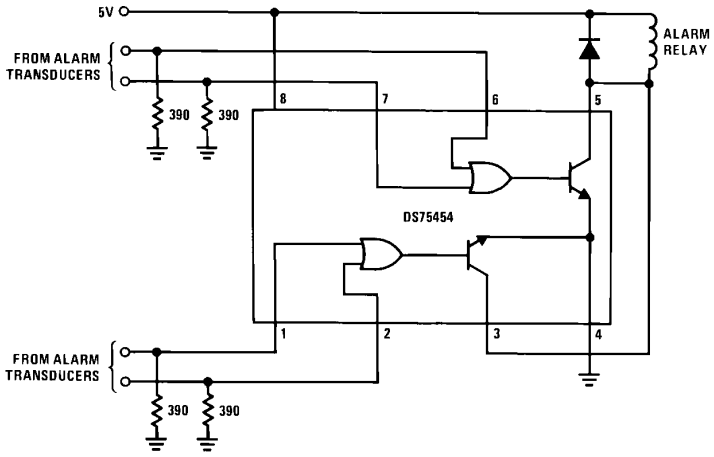
FIGURE 22. In-Phase Detector



TL/F/5824–53

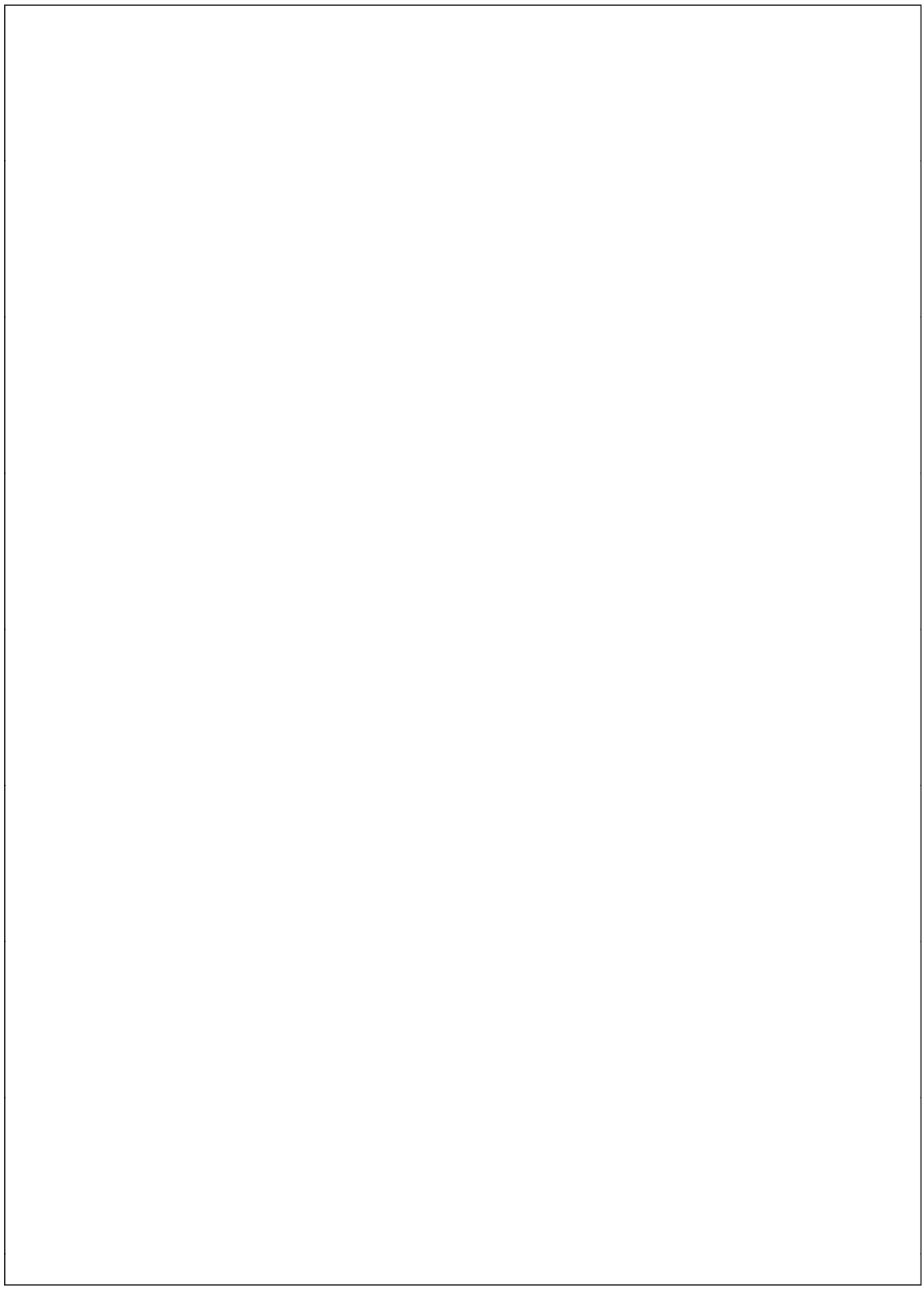
FIGURE 23. Multifunction Logic-Signal Comparator

Typical Applications (Continued)

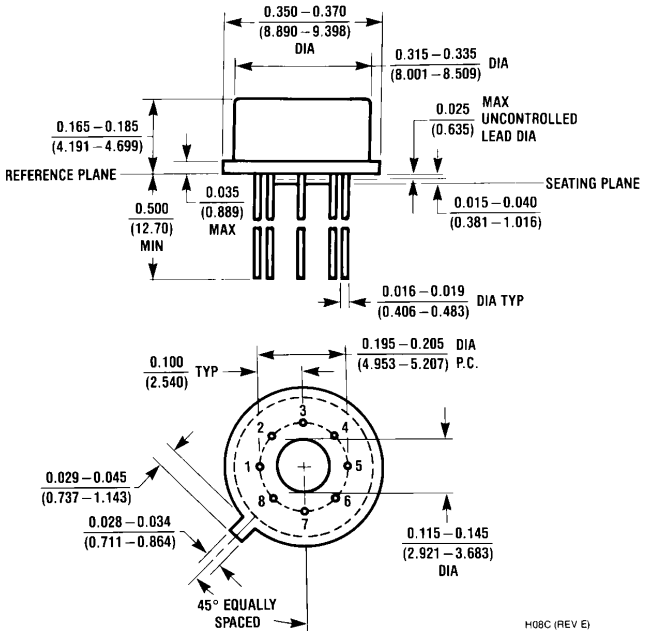


TL/F/5824–54

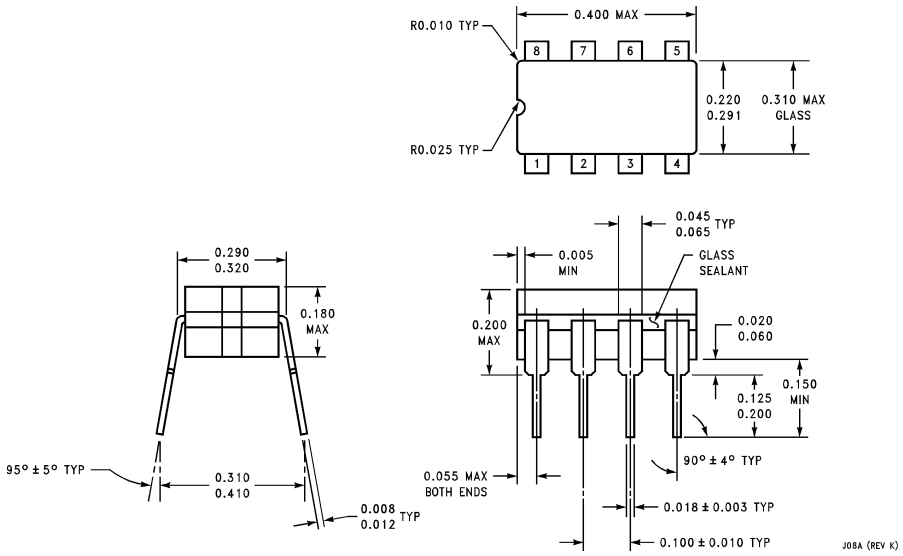
FIGURE 24. Alarm Detector



Physical Dimensions inches (millimeters)

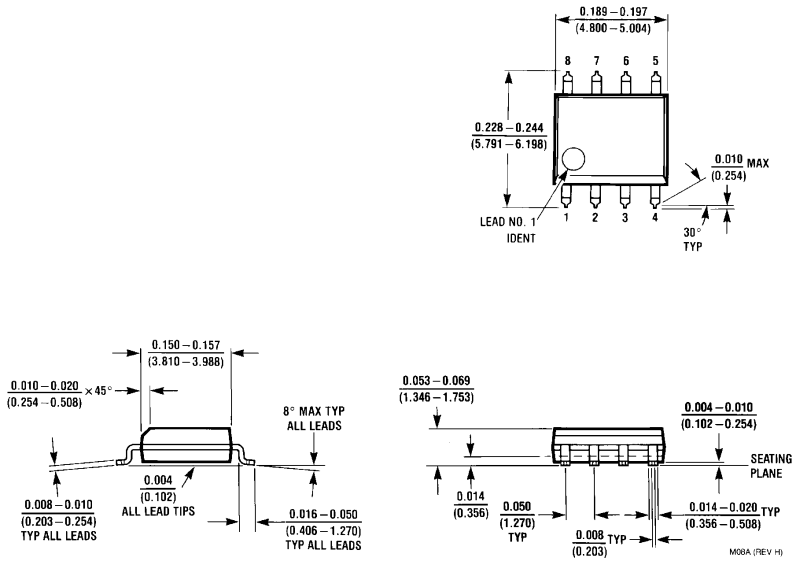


Metal Can Package (H)
Order Number DS55451H, DS55452H or DS55453H,
NS Package Number H08C

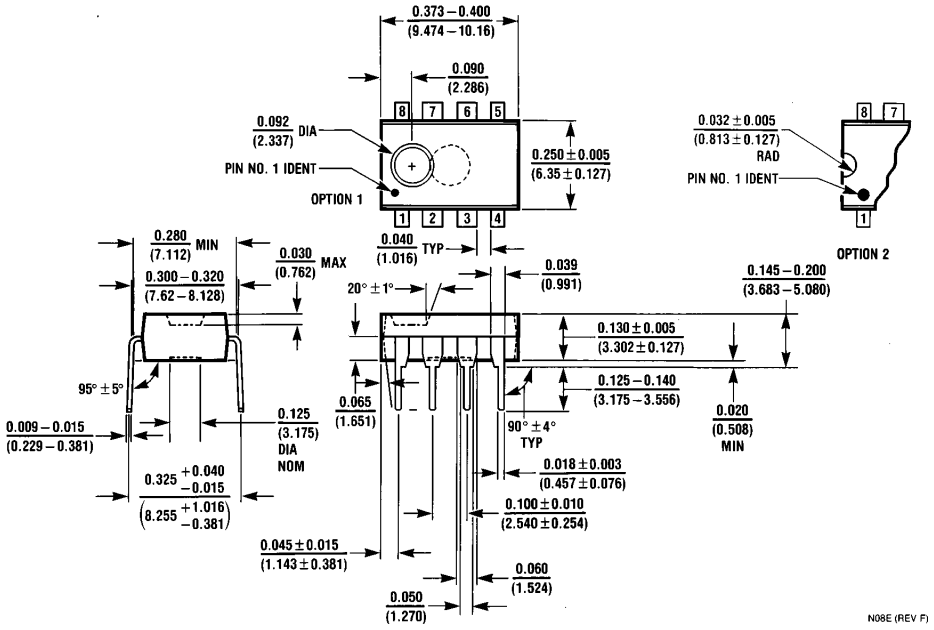


Ceramic Dual-In-Line Package (J)
Order Number DS55451J-8, DS55452J-8,
DS55453J-8 or DS55454J-8
NS Package Number J08A

Physical Dimensions inches (millimeters) (Continued)



SO Package (M)
Order Number DS75451M, DS75452M, DS75453M or DS75454M
NS Package Number M08A



Molded Dual-In-Line Package (N)
Order Number DS75451N, DS75452N, DS75453N, DS75454N
NS Package Number N08E

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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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