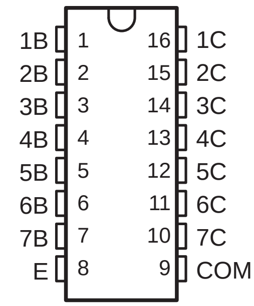
- **500-mA Rated Collector Current (Single Output)**
- **High-Voltage Outputs . . . 50 V**
- **Output Clamp Diodes**
- **Inputs Compatible With Various Types of Logic**
- **Interchangeable With ULN2001A Series**

D OR N PACKAGE
(TOP VIEW)

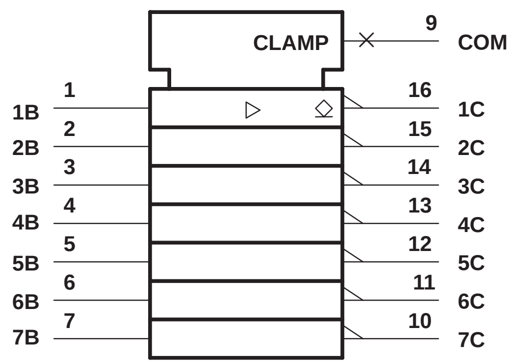


description

The ULQ2003A is a monolithic high-voltage, high-current Darlington transistor array. The device consists of seven npn Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of a single Darlington pair is 500 mA. The Darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers. The ULQ2003A has a 2.7-kΩ series base resistor for each Darlington pair for operation directly with TTL or 5-V CMOS devices.

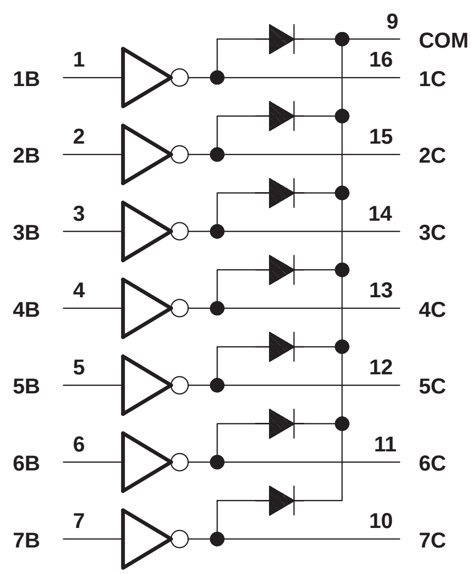
The ULQ2003A is offered in standard 16-pin dual in-line (N) and surface-mount (D) packaging. The device is characterized for operation over the junction temperature range of –40°C to 105°C.

logic symbol†



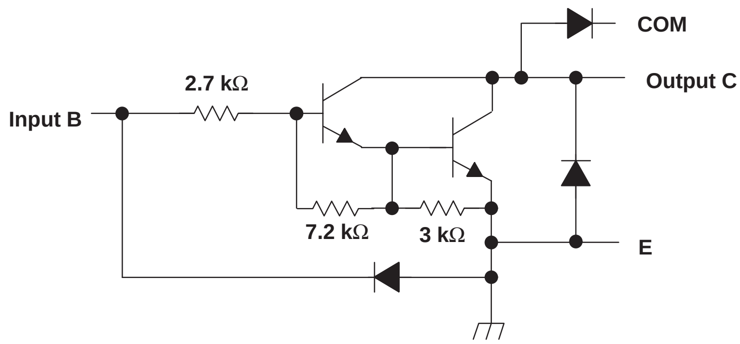
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



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.

schematics (each Darlington pair)



All resistor values shown are nominal.

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

Collector-emitter voltage . . . . 50 V
Clamp diode reverse voltage (see Note 1) . . . . 50 V
Input voltage, V_I (see Note 1) . . . . 30 V
Peak collector current (see Figures 13 and 14) . . . . 500 mA
Output clamp current, I_{OK} . . . . 500 mA
Total emitter-terminal current . . . . –2.5 A
Continuous total power dissipation . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A . . . . –40°C to 85°C
Operating junction temperature range, T_J . . . . –40°C to 105°C
Storage temperature range, T_{stg} . . . . –65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . 260°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.

NOTE 1: All voltage values are with respect to the emitter/substrate terminal E, unless otherwise noted.

DISSIPATION RATING TABLE

PACKAGE	T_A = 25°C POWER RATING	DERATING FACTOR ABOVE T_A = 25°C	T_A = 85°C POWER RATING
D	950 mW	7.6 mW/°C	494 mW
N	1150 mW	9.2 mW/°C	598 mW

electrical characteristics over operating junction temperature range, T_J = – 40°C to 105°C

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{I(on)}$	On-state input voltage	V_{CE} = 2 V, See Figure 5	I_C = 200 mA			2.7	V
			I_C = 250 mA			2.9	
			I_C = 300 mA			3	
$V_{CE(sat)}$	Collector-emitter saturation voltage	I_I = 250 µA, See Figure 4	I_C = 100 mA,		0.9	1.2	V
		I_I = 350 µA, See Figure 4	I_C = 200 mA,		1	1.4	
		I_I = 500 µA, See Figure 4	I_C = 350 mA,		1.2	1.7	
I_{CEX}	Collector cutoff current	V_{CE} = 50 V, See Figure 1	I_I = 0,			100	µA
V_F	Clamp forward voltage	I_F = 350 mA,	See Figure 7		1.7	2.2	V
$I_{I(off)}$	Off-state input current	V_{CE} = 50 V, See Figure 2	I_C = 500 µA,	30	65		µA
I_I	Input current	V_I = 3.85 V,	See Figure 3		0.93	1.35	mA
I_R	Clamp reverse current	V_R = 50 V,	See Figure 6			100	µA
C_i	Input capacitance	V_I = 0,	f = 1 MHz		15	25	pF

switching characteristics over operating junction temperature, T_J = – 40°C to 105°C

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high-level output	See Figure 8			1	10	µs
t_{PHL}	Propagation delay time, high-to-low-level output				1	10	µs
V_{OH}	High-level output voltage after switching	V_S = 50 V, See Figure 9	I_O ≈ 300 mA,	V_S – 500			mV

PARAMETER MEASUREMENT INFORMATION

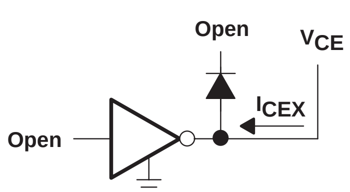


Figure 1. I_{CEX} Test Circuit

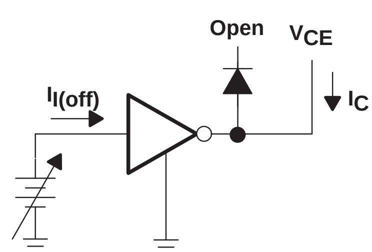


Figure 2. $I_{I(off)}$ Test Circuit

PARAMETER MEASUREMENT INFORMATION

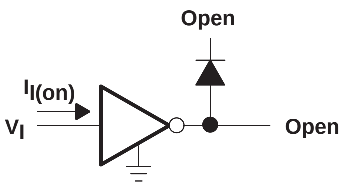


Figure 3. I_I Test Circuit

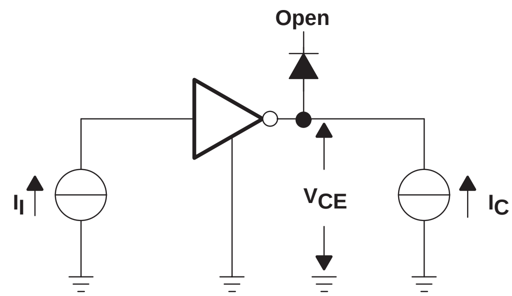


Figure 4. $V_{CE(sat)}$ Test Circuit

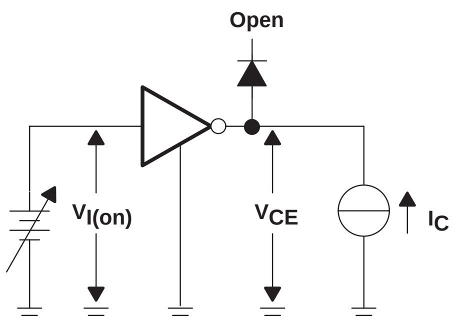


Figure 5. $V_{I(on)}$ Test Circuit

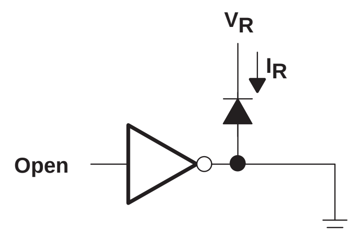


Figure 6. I_R Test Circuit

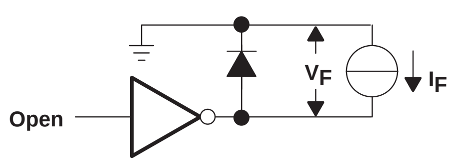


Figure 7. V_F Test Circuit

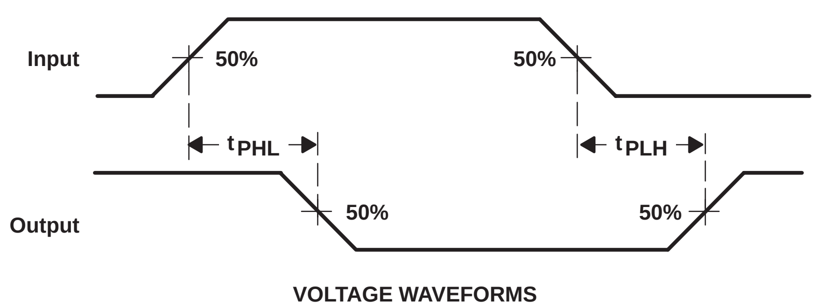
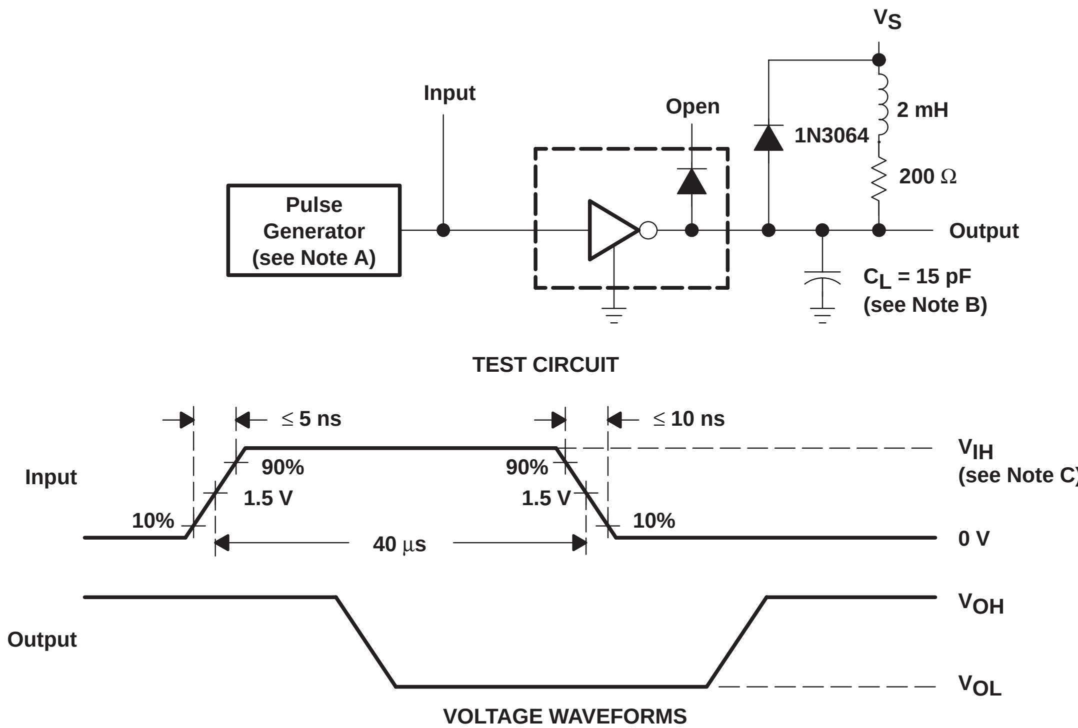


Figure 8. Propagation Delay Time Waveforms

PARAMETER MEASUREMENT INFORMATION



NOTES: A. The pulse generator has the following characteristics: PRR = 12.5 kHz, Z_O = 50 Ω.
B. C_L includes probe and jig capacitance.
C. V_{IH} = 3 V

Figure 9. Latch-Up Test Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

COLLECTOR-EMITTER SATURATION VOLTAGE
vs
COLLECTOR CURRENT
(ONE DARLINGTON)

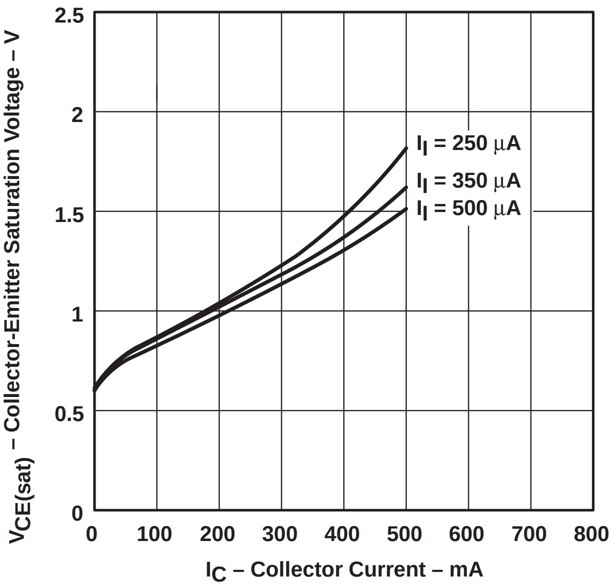


Figure 10

COLLECTOR-EMITTER SATURATION VOLTAGE
vs
TOTAL COLLECTOR CURRENT
(TWO DARLINGTONS PARALLELED)

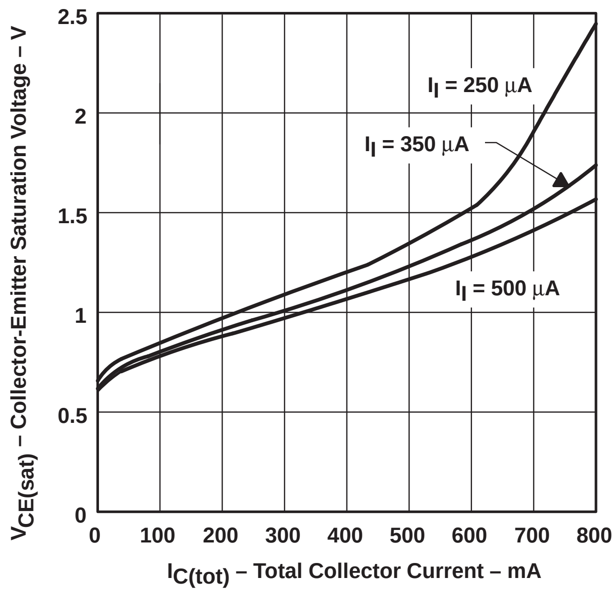


Figure 11

COLLECTOR CURRENT
vs
INPUT CURRENT

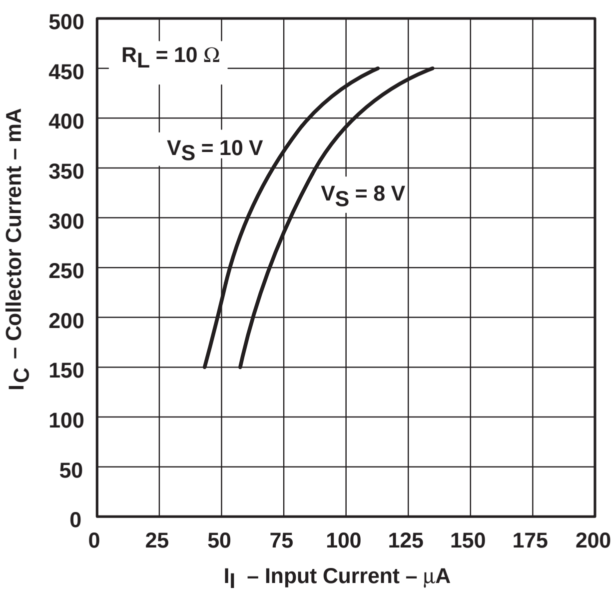


Figure 12

THERMAL INFORMATION

D PACKAGE
MAXIMUM COLLECTOR CURRENT
vs
DUTY CYCLE

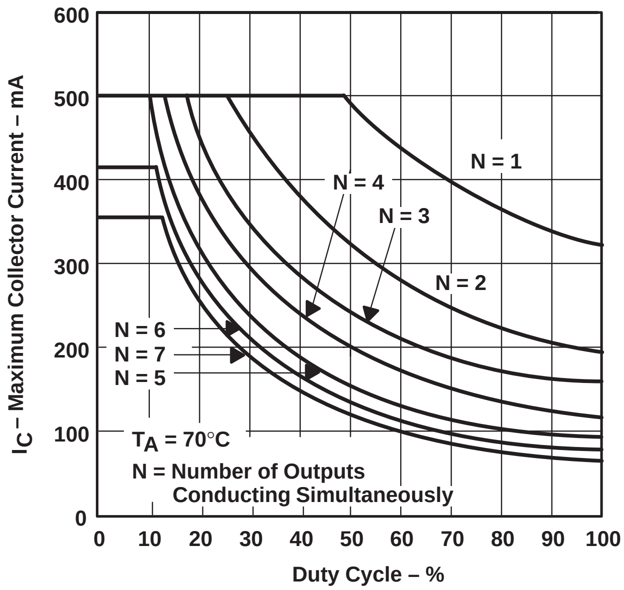


Figure 13

N PACKAGE
MAXIMUM COLLECTOR CURRENT
vs
DUTY CYCLE

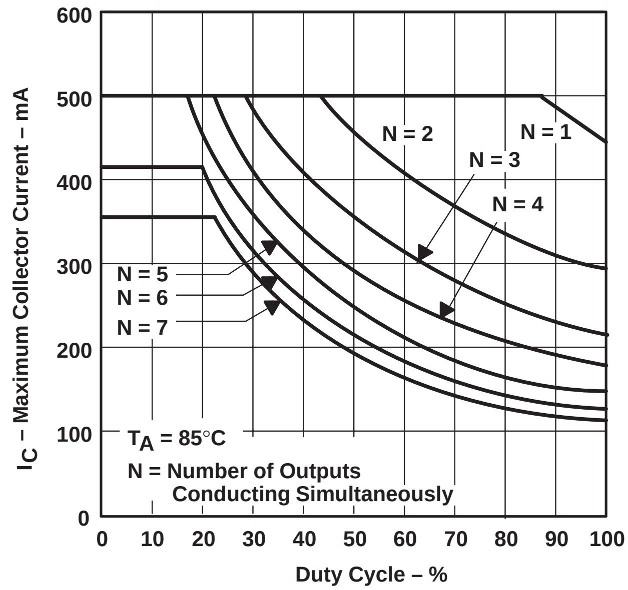


Figure 14

APPLICATION INFORMATION

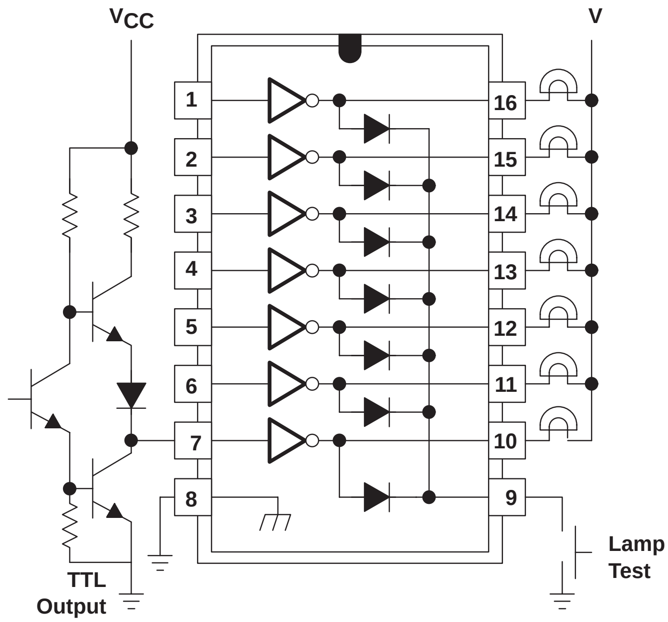


Figure 15. TTL to Load

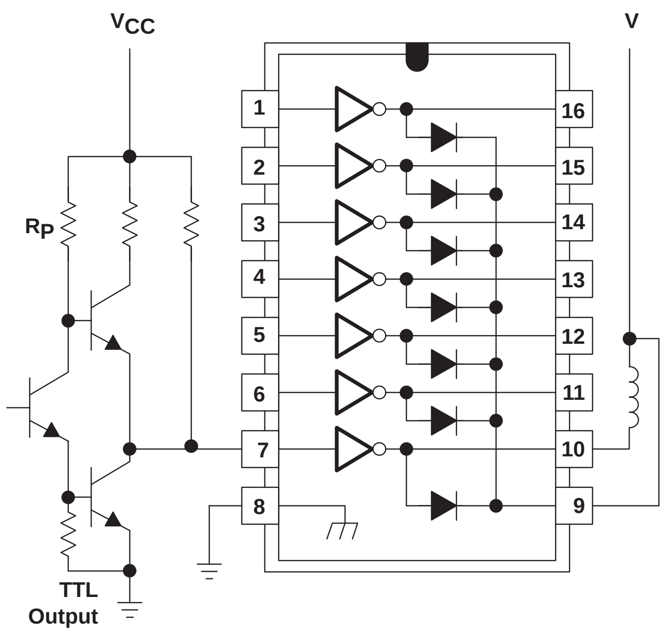


Figure 16. Use of Pullup Resistors to Increase Drive Current

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