National Semiconductor

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DS2003
High Current/Voltage Darlington Drivers

General Description

The DS2003 is comprised of seven high voltage, high current NPN Darlington transistor pairs. All units feature common emitter, open collector outputs. To maximize their effectiveness, these units contain suppression diodes for inductive loads and appropriate emitter base resistors for leakage.

The DS2003 has a series base resistor to each Darlington pair, thus allowing operation directly with TTL or CMOS operating at supply voltages of 5.0V.

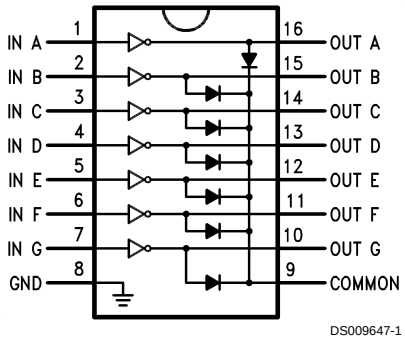
The DS2003 offers solutions to a great many interface needs, including solenoids, relays, lamps, small motors, and LEDs. Applications requiring sink currents beyond the capability of a single output may be accommodated by paralleling the outputs.

Features

- Seven high gain Darlington pairs
- High output voltage (V_{CE} = 50V)
- High output current (I_C = 350 mA)
- TTL, PMOS, CMOS compatible
- Suppression diodes for inductive loads
- Extended temperature range

Connection Diagram

16-Lead DIP



Top View

Order Numbers

N Package Number N16E	M Package Number M16A
DS2003TN	DS2003TM
DS2003CN	DS2003CM

Absolute Maximum Ratings (Note 1)

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

Storage Temperature Range	−65˚C to +150˚C
Operating Temperature Range	
DS2003TN, DS2003TM	−40˚C to +105˚C
DS2003CN, DS2003CM	0˚C to +85˚C
Lead Temperature	
Soldering, 10 seconds	265˚C

Maximum Power Dissipation* at T_A = 25˚C

N16E Package	1330 mW
M16A Package	770 mW
Input Voltage	30V
Output Voltage	55V
Emitter-Base Voltage	6.0V
Continuous Collector Current	500 mA
Continuous Base Current	25 mA

Note: *Derate N16E package 13.3 mW/˚C for T_A above 25˚C. Derate M16A package 7.7 mW/˚C for T_A above 25˚C.

Electrical Characteristics

T_A = 25˚C, unless otherwise specified (Note 2)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
I_{CEX}	Output Leakage Current	T_A = 25˚C, V_{CE} = 50V *(Figure 1)*			20	µA
		T_A = 85˚C, V_{CE} = 50V *(Figure 1)* for DS2003CN, DS2003CM			100	
		T_A = 105˚C, V_{CE} = 50V *(Figure 1)* for DS2003TN, DS2003TM			150	
$V_{CE(Sat)}$	Collector-Emitter Saturation Voltage	I_C = 350 mA, I_B = 500 µA *(Figure 3)* (Note 3)		1.25	1.6	V
		I_C = 200 mA, I_B = 350 µA *(Figure 3)*		1.1	1.3	
		I_C = 100 mA, I_B = 250 µA *(Figure 3)*		0.9	1.1	
$I_{I(ON)}$	Input Current	V_I = 3.85V *(Figure 4)*		0.93	1.35	mA
$I_{I(OFF)}$	Input Current (Note 4)	T_A = 85˚C for DS2003CN, DS2003CM I_C = 500 µA *(Figure 5)*	50	100		µA
$V_{I(ON)}$	Input Voltage (Note 5)	V_{CE} = 2.0V, I_C = 200 mA *(Figure 6)*			2.4	V
		V_{CE} = 2.0V, I_C = 250 mA *(Figure 6)*			2.7	
		V_{CE} = 2.0V, I_C = 300 mA *(Figure 6)*			3.0	
C_I	Input Capacitance			15	30	pF
t_{PLH}	Turn-On Delay	0.5 V_I to 0.5 V_O			1.0	µs
t_{PHL}	Turn-Off Delay	0.5 V_I to 0.5 V_O			1.0	µs
I_R	Clamp Diode Leakage Current	V_R = 50V *(Figure 7)* T_A = 25˚C			50	µA
		T_A = 85˚C			100	µA
V_F	Clamp Diode Forward Voltage	I_F = 350 mA *(Figure 8)*		1.7	2.0	V

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Electrical Characteristics" provide conditions for actual device operation.

Note 2: All limits apply to the complete Darlington series except as specified for a single device type.

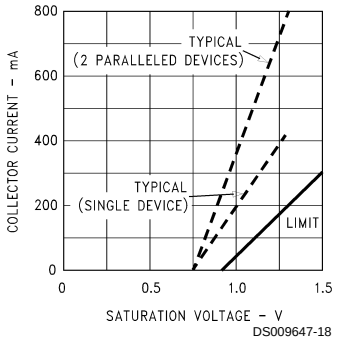
Note 3: Under normal operating conditions these units will sustain 350 mA per output with $V_{CE\ (Sat)}$ = 1.6V at 70˚C with a pulse width of 20 ms and a duty cycle of 30%.

Note 4: The $I_{I(OFF)}$ current limit guaranteed against partial turn-on of the output.

Note 5: The $V_{I(ON)}$ voltage limit guarantees a minimum output sink current per the specified test conditions.

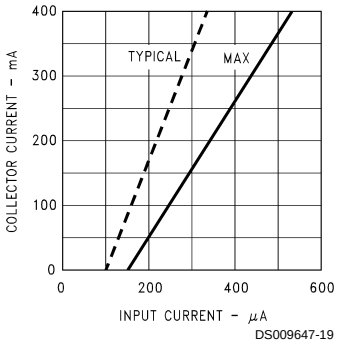
Typical Performance Characteristics

Collector Current vs Saturation Voltage



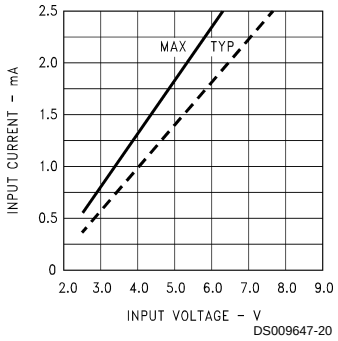
DS009647-18

Collector Current vs Input Current



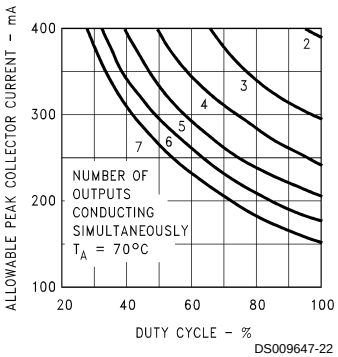
DS009647-19

Input Current vs Input Voltage



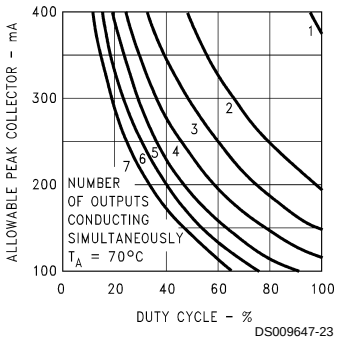
DS009647-20

Peak Collector Current vs Duty Cycle and Number of Outputs (Molded Package)



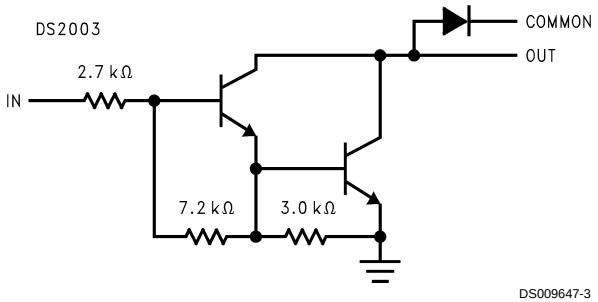
DS009647-22

Peak Collector Current vs Duty Cycle and Number of Outputs (Ceramic Package)



DS009647-23

Equivalent Circuits



DS009647-3

Test Circuits

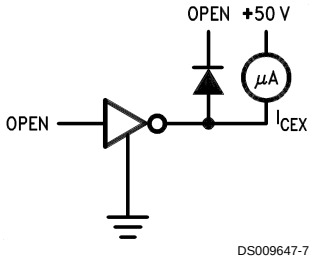


FIGURE 1.

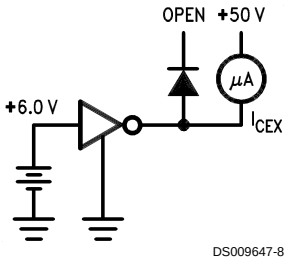


FIGURE 2.

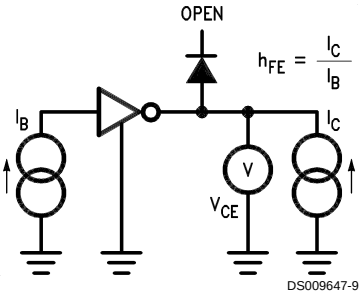


FIGURE 3.

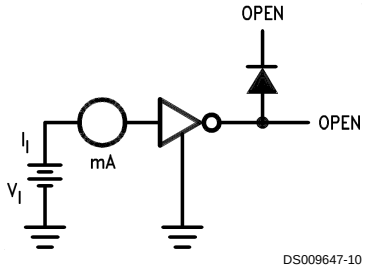


FIGURE 4.

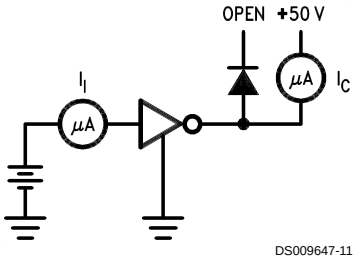


FIGURE 5.

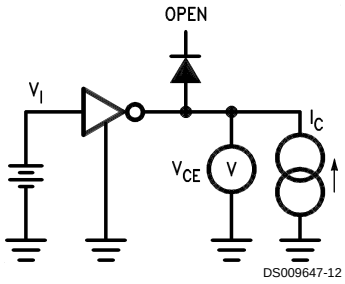


FIGURE 6.

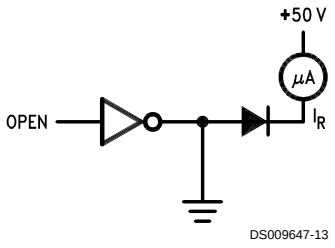


FIGURE 7.

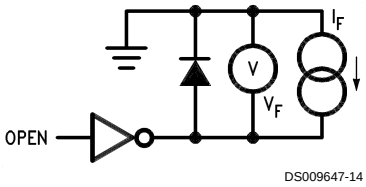
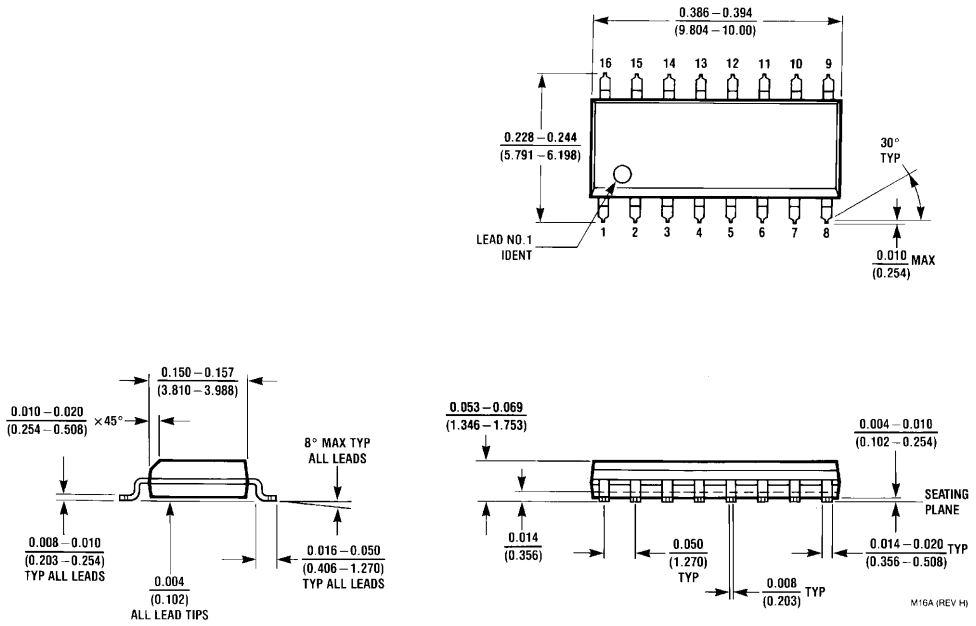
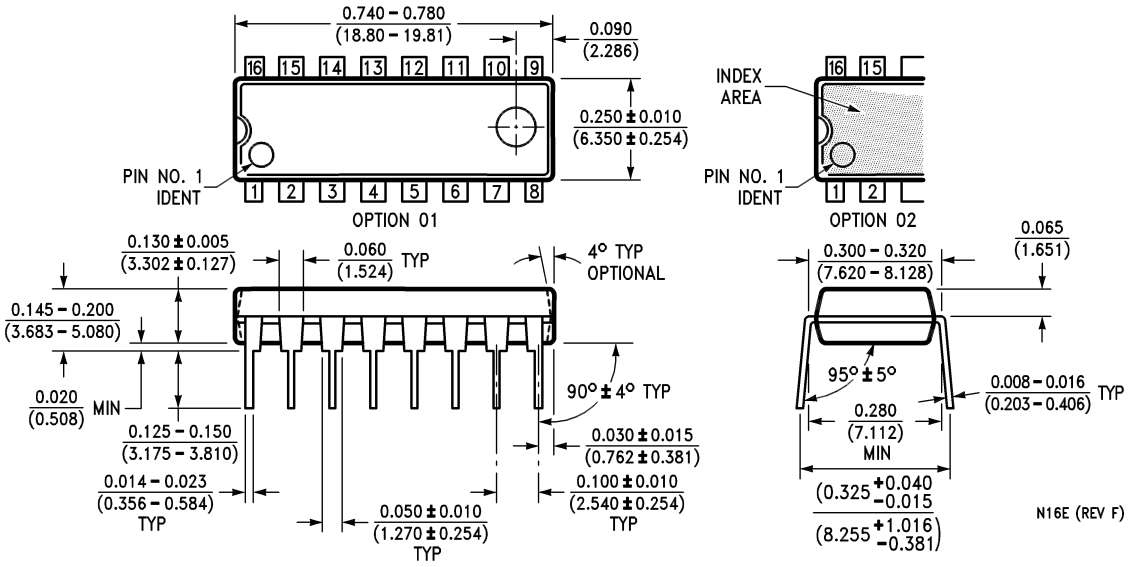


FIGURE 8.

Physical Dimensions inches (millimeters) unless otherwise noted



Surface Mount Package (M)
Order Number DS2003CM, DS2003TM
NS Package Number M16A



Molded Dual-In-Line Package (N)
Order Number DS2003CN, DS2003TN
NS Package Number N16E

Notes

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