

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.

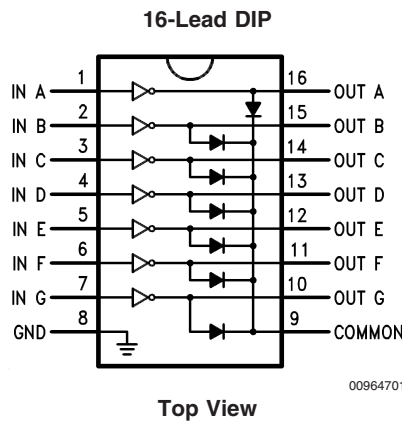
The DS2003 offers solutions to a great many interface needs, including solenoids, relays, lamps, small motors, and

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 ($I_C = 350\text{ mA}$)
- TTL, PMOS, CMOS compatible
- Suppression diodes for inductive loads
- Extended temperature range

Connection Diagram



Order Numbers

Operating Temperature Range	N Package Number N16E	SOIC Package Number M16A	TSSOP Package Number MT16
-40°C to +125°C	DS2003TN	DS2003TM	DS2003TMT
-40°C to +85°C	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, T_A	
DS2003T	-40°C to +125°C
DS2003C	-40°C to +85°C
Junction Temperature Range, T_J	-40°C to +150°C
Lead Temperature	
Soldering, 10 seconds	265°C

ESD Ratings

Human Body Model	+/-2000V
Machine Model	+/- 200V

Package Thermal Dissipation Ratings

MT16 Package θ_{J-A}	130°C/W
N16E Package θ_{J-A}	88°C/W
M16A Package θ_{J-A}	115°C/W
Input Voltage	-0.3V to 30V
Output Voltage	55V
Emitter-Base Voltage	6.0V
Continuous Collector Current	500 mA
Continuous Base Current	25 mA

Electrical Characteristics

$T_A = 25^\circ\text{C}$, unless otherwise specified (Note 2)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
I_{CEX}	Output Leakage Current	$T_A = 25^\circ\text{C}$, $V_{CE} = 50\text{V}$ (Figure 1)			20	μA
		$T_A = 85^\circ\text{C}$, $V_{CE} = 50\text{V}$ (Figure 1)			100	
		$T_A = 125^\circ\text{C}$, $V_{CE} = 50\text{V}$ (Figure 1) for DS2003T			150	
$V_{CE(Sat)}$	Collector-Emitter Saturation Voltage	$I_C = 350\text{mA}$, $I_B = 500\mu\text{A}$ (Figure 3) (Note 3)		1.25	1.6	V
		$I_C = 200\text{mA}$, $I_B = 350\mu\text{A}$ (Figure 3)		1.1	1.3	
		$I_C = 100\text{mA}$, $I_B = 250\mu\text{A}$ (Figure 3)		0.9	1.1	
$I_{I(ON)}$	Input Current	$V_I = 3.85\text{V}$ (Figure 4)		0.93	1.35	mA
$I_{I(OFF)}$	Input Current (Note 4)	$I_C = 500\mu\text{A}$ (Figure 5)	50	100		μA
		$T_A = +25^\circ\text{C}$	50	100		μA
		$T_A = +85^\circ\text{C}$	25	50		μA
		$T_A = +125^\circ\text{C}$ for DS2003T	10	25		μA
$V_{I(ON)}$	Input Voltage (Note 5)	$V_{CE} = 2.0\text{V}$, $I_C = 200\text{mA}$ (Figure 6)			2.4	V
		$V_{CE} = 2.0\text{V}$, $I_C = 250\text{mA}$ (Figure 6)			2.7	
		$V_{CE} = 2.0\text{V}$, $I_C = 300\text{mA}$ (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	$V_R = 50\text{V}$ (Figure 7)				
		$T_A = 25^\circ\text{C}$		5	10	μA
		$T_A = 85^\circ\text{C}$		10	50	μA
		$T_A = 125^\circ\text{C}$ for DS2003T		20	100	μA
V_F	Clamp Diode Forward Voltage	$I_F = 350\text{mA}$ (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.

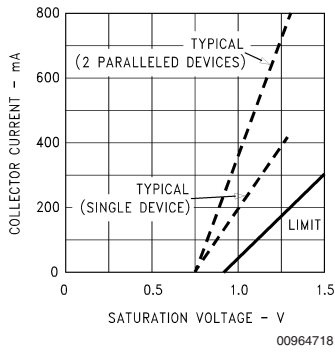
Note 3: Under normal operating conditions these units will sustain 350 mA per output with $V_{CE(Sat)} = 1.6\text{V}$ at 70°C with a pulse width of 20 ms and a duty cycle of 30%.

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

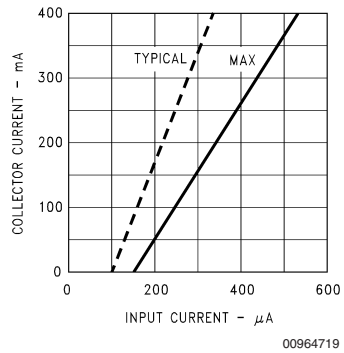
Note 5: The $V_{I(ON)}$ voltage limit guarantees a minimum output sink current per the specified test conditions.

Typical Performance Characteristics

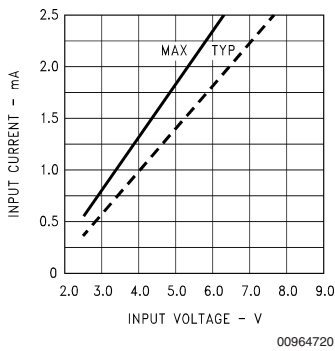
Collector Current vs Saturation Voltage



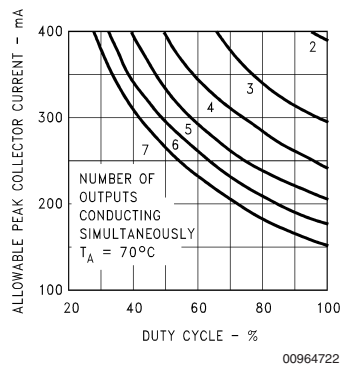
Collector Current vs Input Current



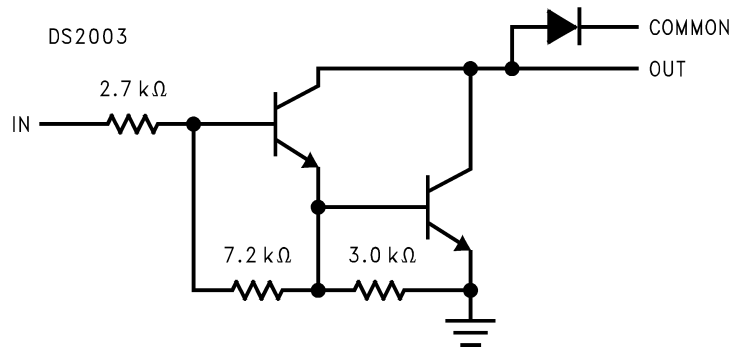
Input Current vs Input Voltage



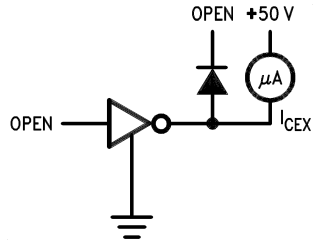
Peak Collector Current vs Duty Cycle and Number of Outputs (N16E Package)



Equivalent Circuits

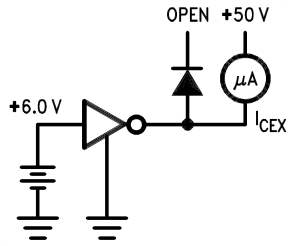


Test Circuits



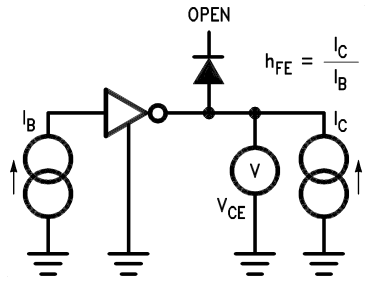
00964707

FIGURE 1.



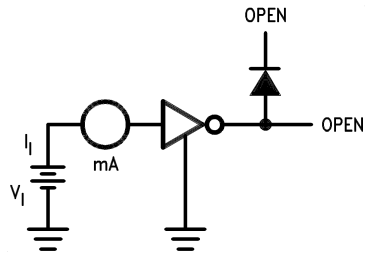
00964708

FIGURE 2.



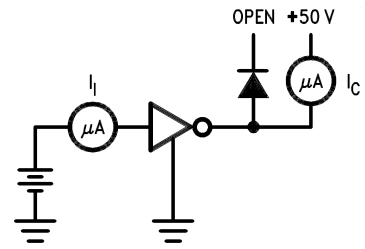
00964709

FIGURE 3.



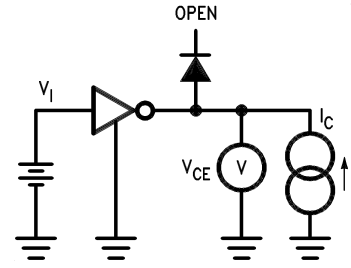
00964710

FIGURE 4.



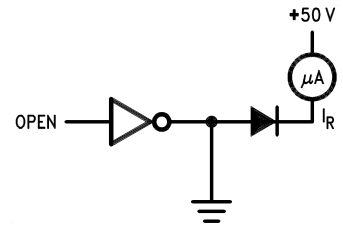
00964711

FIGURE 5.



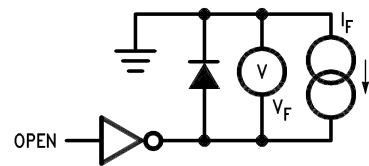
00964712

FIGURE 6.



00964713

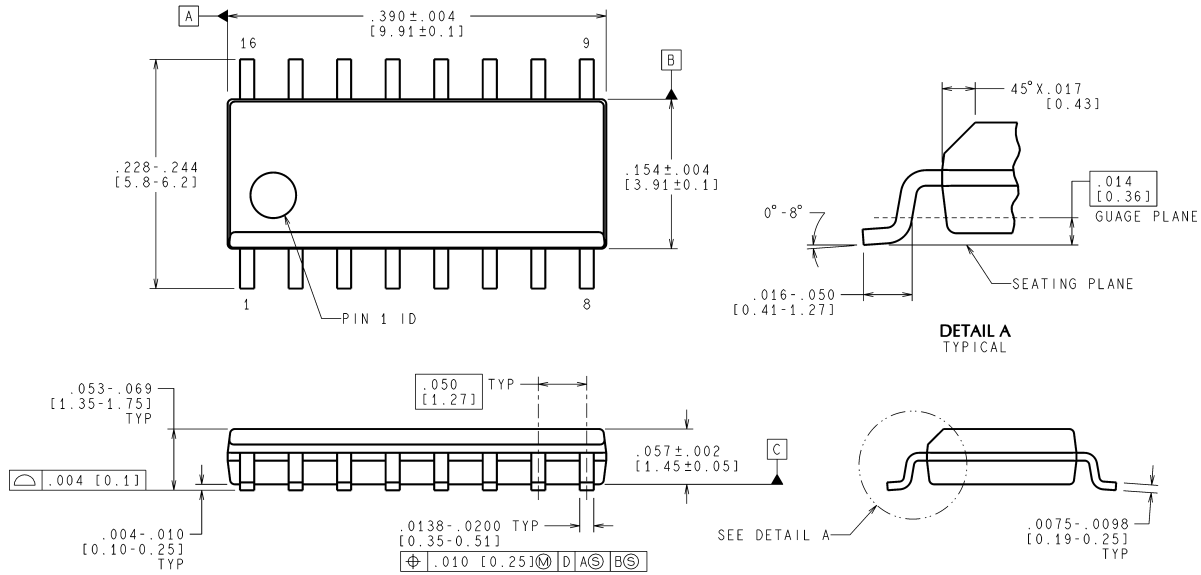
FIGURE 7.



00964714

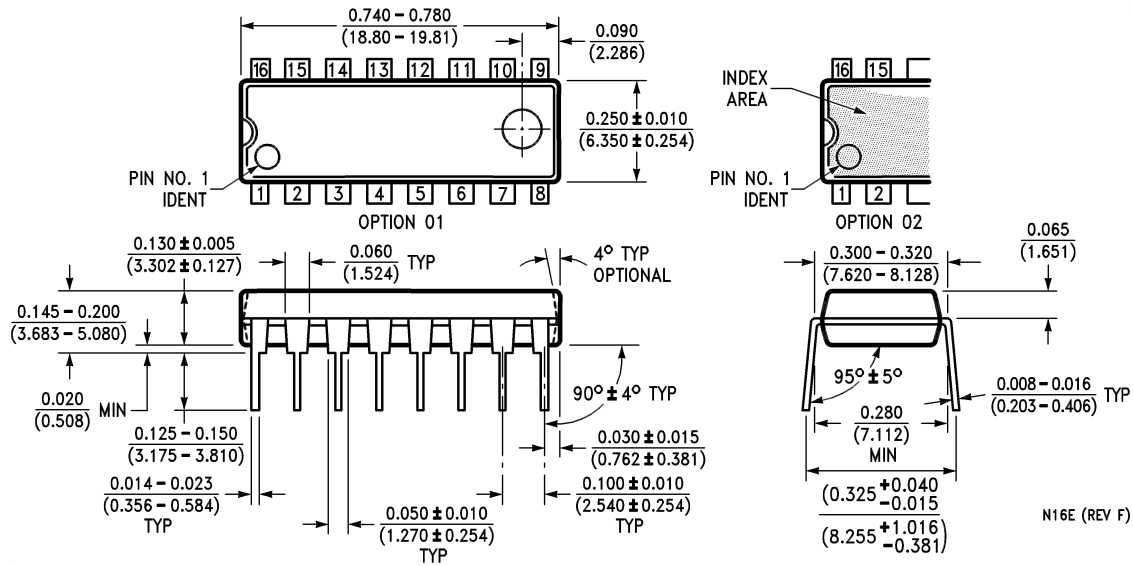
FIGURE 8.

Physical Dimensions inches (millimeters) unless otherwise noted



M16A (Rev J)

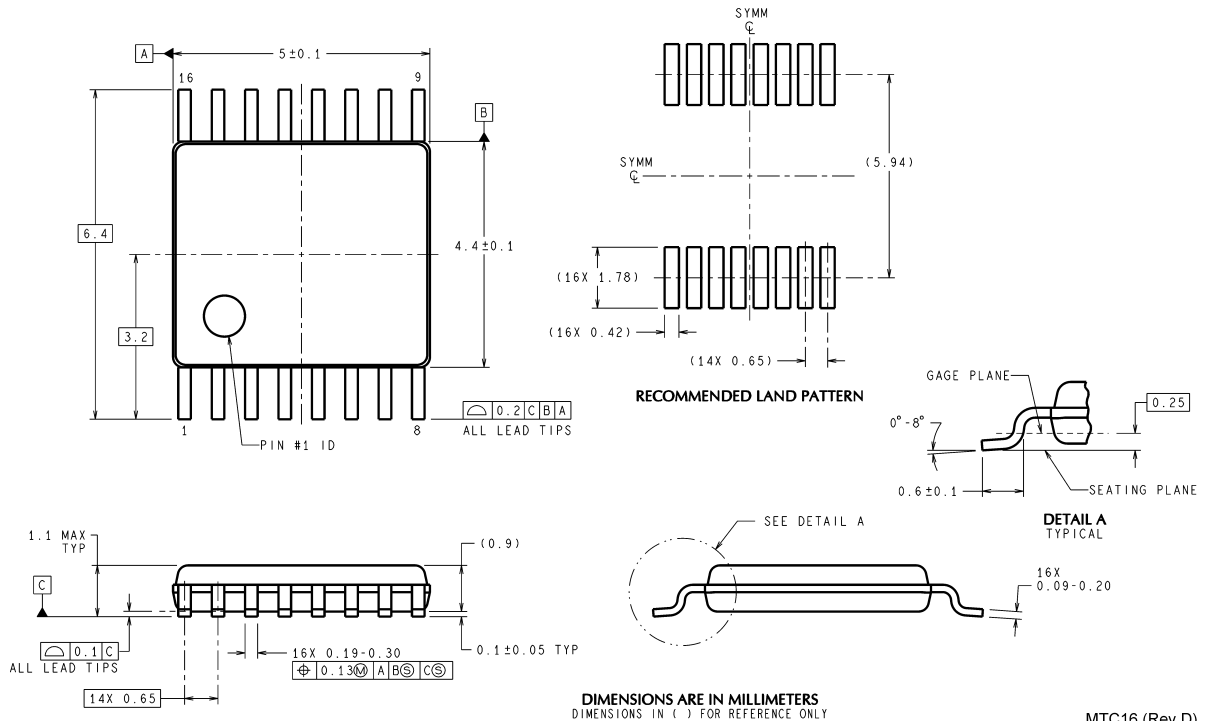
SOIC Package (M)
Order Number DS2003CM, DS2003TM
NS Package Number M16A



N16E (REV F)

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

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



TSSOP Package (MT)
Order Number DS2003TMT
NS Package Number MTC16

MTC16 (Rev D)

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

For the most current product information visit us at www.national.com.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
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.

BANNED SUBSTANCE COMPLIANCE

National Semiconductor manufactures products and uses packing materials that meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.

National Semiconductor
Americas Customer Support Center
 Email: new.feedback@nsc.com
 Tel: 1-800-272-9959

National Semiconductor
Europe Customer Support Center
 Fax: +49 (0) 180-530 85 86
 Email: europa.support@nsc.com
 Deutsch Tel: +49 (0) 69 9508 6208
 English Tel: +44 (0) 870 24 0 2171
 Français Tel: +33 (0) 1 41 91 8790

National Semiconductor
Asia Pacific Customer Support Center
 Email: ap.support@nsc.com

National Semiconductor
Japan Customer Support Center
 Fax: 81-3-5639-7507
 Email: jpn.feedback@nsc.com
 Tel: 81-3-5639-7560