

HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAYS

ILN2003A

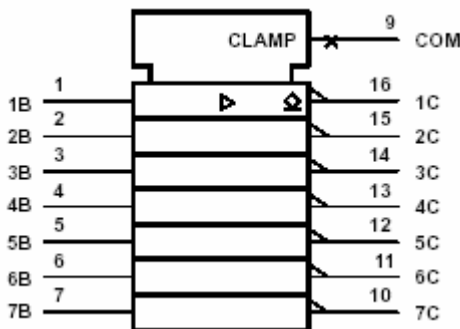
The ILN2003A are monolithic high-voltage, high-current Darlington transistor arrays. Each consists of seven n-p-n Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of a single Darlington pair is 500 mA. The 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 ILN2003A has a 2.7-kΩ series base resistor for each Darlington pair for operation directly with TTL or 5-V CMOS devices.

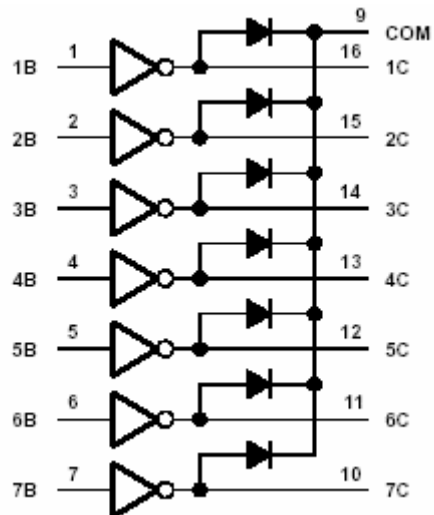
- 500-mA Rated Collector Current (Single Output)
- High-Voltage Outputs . . . 50 V
- Output Clamp Diodes
- Inputs Compatible With Various Types of Logic
- Relay Driver Applications

ORDERING INFORMATION
 ILN2003AN Plastic
 ILN2003AD SOIC
 T_A = -20°C to 85°C for all packages

LOGIC SYMBOL



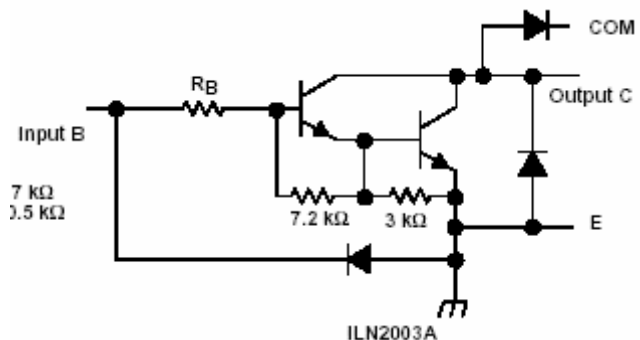
LOGIC DIAGRAM



SCHEMATICS (each Darlington Pair)

All resistor values shown are nominal.

ILN2003A: R_B = 2.7 kΩ



Absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

| | |
|--|------------------------------|
| Collector-emitter voltage | 50 V |
| Input voltage, V_I (see Note 1) | 30 V Peak |
| collector current (see Figures 14 and 15) | 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 | -20°C to 85°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 |

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

DISSIPATION RATING TABLE

| PACKAGE | $T_A = 25^\circ\text{C}$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 85^\circ\text{C}$ POWER RATING |
|---------|--|---|--|
| D | 950 mW | 7.6 mW/°C | 494 mW |
| N | 1150 mW | 9.2 mW/°C | 598 mW |

Electrical characteristics, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

| PARAMETER | TEST FIGURE | TEST CONDITIONS | ILN2003A | | | UNIT |
|--|-------------|---|-----------------------|------|------|---------------|
| | | | MIN | TYP | MAX | |
| $V_{I(on)}$ On-state Input voltage | 6 | $V_{CE} = 2\text{ V}$ | $I_C = 125\text{ mA}$ | | | V |
| | | | $I_C = 200\text{ mA}$ | | 2.4 | |
| | | | $I_C = 250\text{ mA}$ | | 2.7 | |
| | | | $I_C = 275\text{ mA}$ | | | |
| | | | $I_C = 300\text{ mA}$ | | 3 | |
| | | | $I_C = 350\text{ mA}$ | | | |
| $V_{CE(sat)}$ Collector-emitter saturation voltage | 5 | $I_I = 250\ \mu\text{A}, I_C = 100\text{ mA}$ | | 0.9 | 1.1 | V |
| | | $I_I = 350\ \mu\text{A}, I_C = 200\text{ mA}$ | | 1 | 1.3 | |
| | | $I_I = 500\ \mu\text{A}, I_C = 350\text{ mA}$ | | 1.2 | 1.6 | |
| I_{CEX} Collector cutoff current | 1 | $V_{CE} = 50\text{ V}, I_I = 0$ | | | 50 | μA |
| | 2 | $V_{CE} = 50\text{ V}, T_A = 70^\circ\text{C}, V_I = 1\text{ V}, I_I = 0$ | | | 100 | |
| V_F Clamp forward voltage | 8 | $I_F = 350\text{ mA}$ | | 1.7 | 2 | V |
| $I_{I(off)}$ Off-state Input current | 3 | $V_{CE} = 50\text{ V}, I_C = 500\ \mu\text{A}, T_A = 70^\circ\text{C}$ | 50 | 65 | | μA |
| I_I Input current | 4 | $V_I = 3.85\text{ V}$ | | 0.93 | 1.35 | mA |
| | | $V_I = 5\text{ V}$ | | | | |
| | | $V_I = 12\text{ V}$ | | | | |
| I_R Clamp reverse current | 7 | $V_R = 50\text{ V}$ | | | 50 | μA |
| | | $V_R = 50\text{ V}, T_A = 70^\circ\text{C}$ | | | 100 | |
| C_I Input capacitance | | $V_I = 0, f = 1\text{ MHz}$ | | 15 | 25 | pF |

switching characteristics, $T_A = 25^\circ\text{C}$

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|--|---------------------------------------|------|-----|---------------|
| t_{PLH} Propagation delay time, low-to-high-level output | See Figure 9 | | 0.25 | 1 | μs |
| t_{PHL} Propagation delay time, high-to-low-level output | | | 0.25 | 1 | μs |
| V_{OH} High-level output voltage after switching | $V_S = 50\text{ V}$, See Figure 10 | $I_O = 300\text{ mA}$, $V_S - 20$ | | | mV |

PARAMETER MEASUREMENT INFORMATION

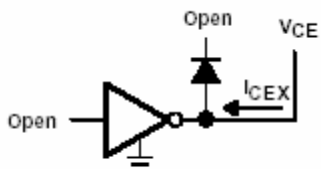


Figure 1. I_{CEX} Test Circuit

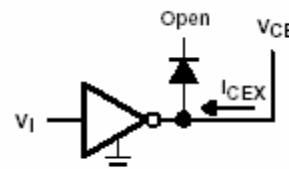


Figure 2. I_{CEX} Test Circuit

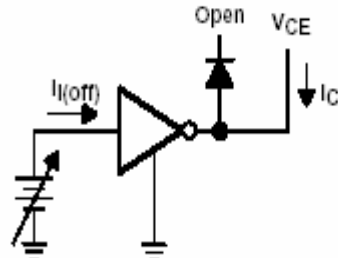


Figure 3. $I_{I(off)}$ Test Circuit

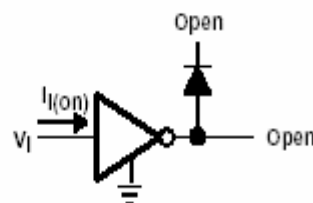
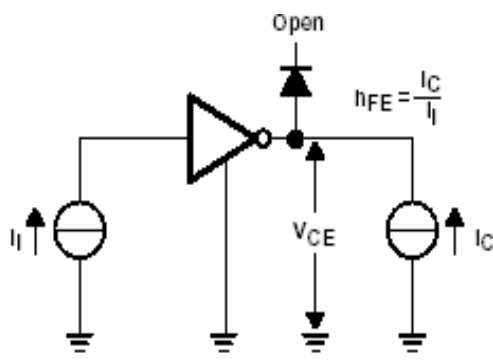


Figure 4. I_I Test Circuit



NOTE: I_I is fixed for measuring $V_{CE(sat)}$, variable for measuring h_{FE} .

Figure 5. h_{FE} , $V_{CE(sat)}$ Test Circuit

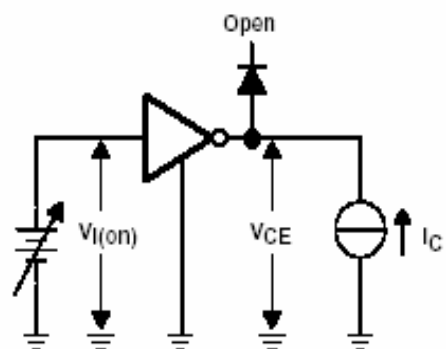


Figure 6. $V_{I(on)}$ Test Circuit

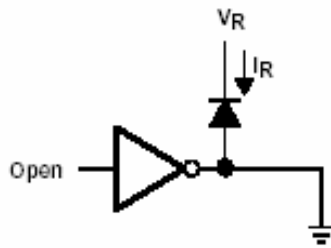


Figure 7. I_R Test Circuit

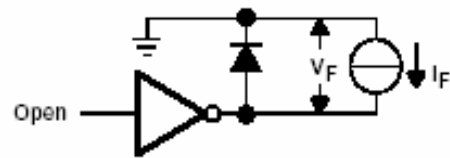


Figure 8. V_F Test Circuit

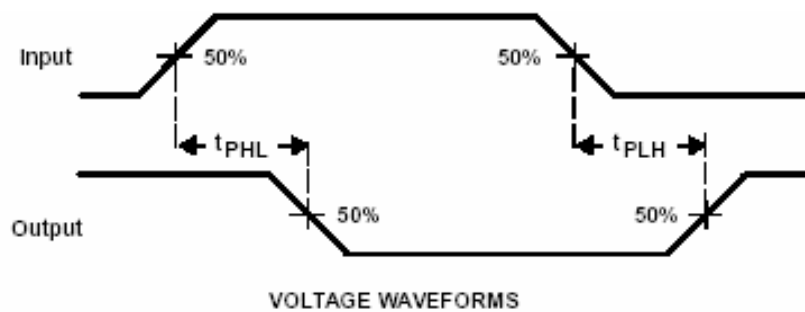
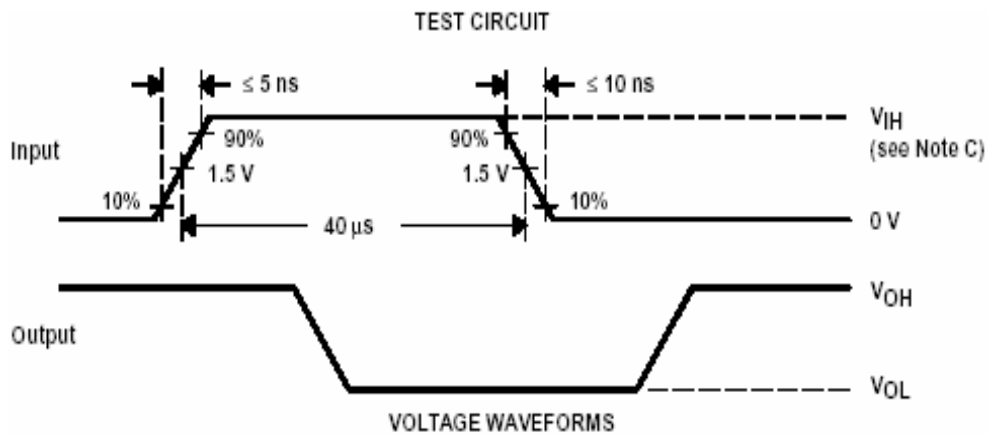


Figure 9. Propagation Delay-Time Waveforms



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

Figure 10. Latch-Up Test Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

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

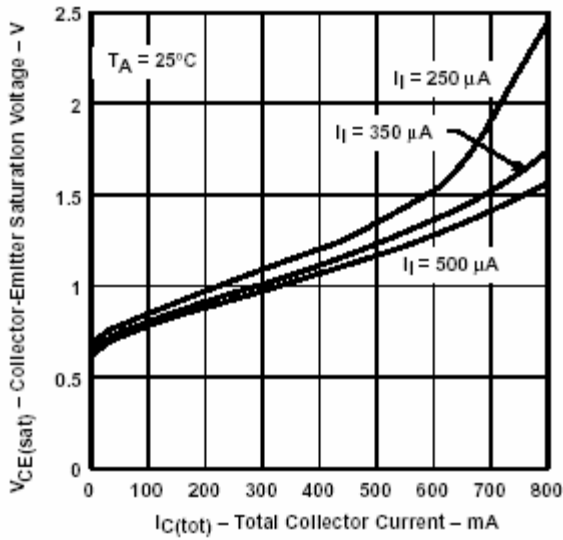


Figure 12

COLLECTOR-EMITTER SATURATION VOLTAGE vs TOTAL COLLECTOR CURRENT

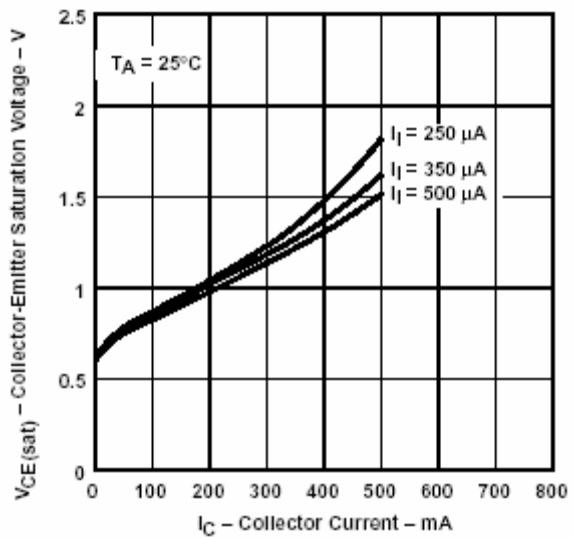


Figure 11

COLLECTOR CURRENT vs INPUT CURRENT

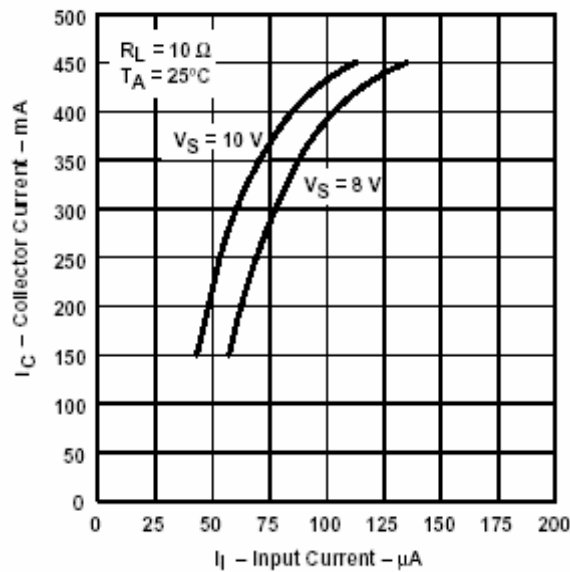


Figure 13

THERMAL INFORMATION

D PACKAGE
MAXIMUM COLLECTOR CURRENT
Vs
DUTY CYCLE

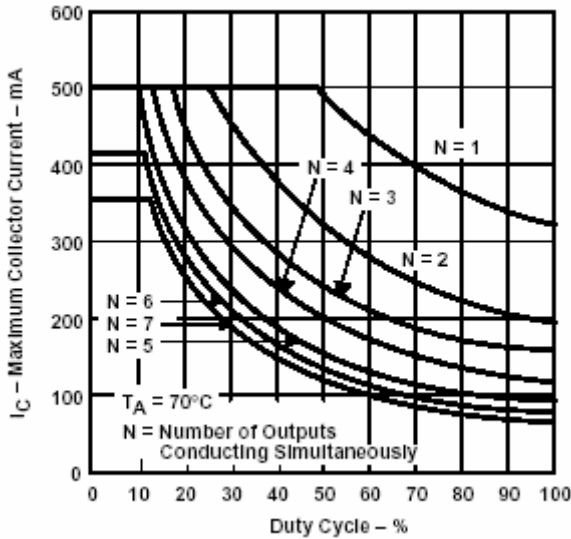


Figure 14

N PACKAGE
MAXIMUM COLLECTOR CURRENT
vs
DUTY CYCLE

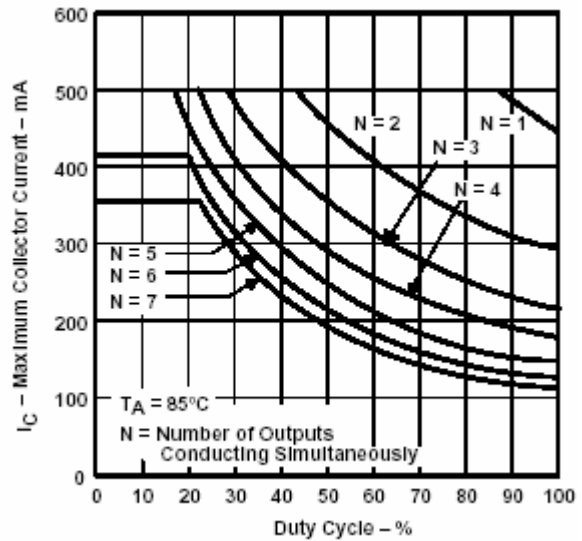


Figure 15

APPLICATION INFORMATION

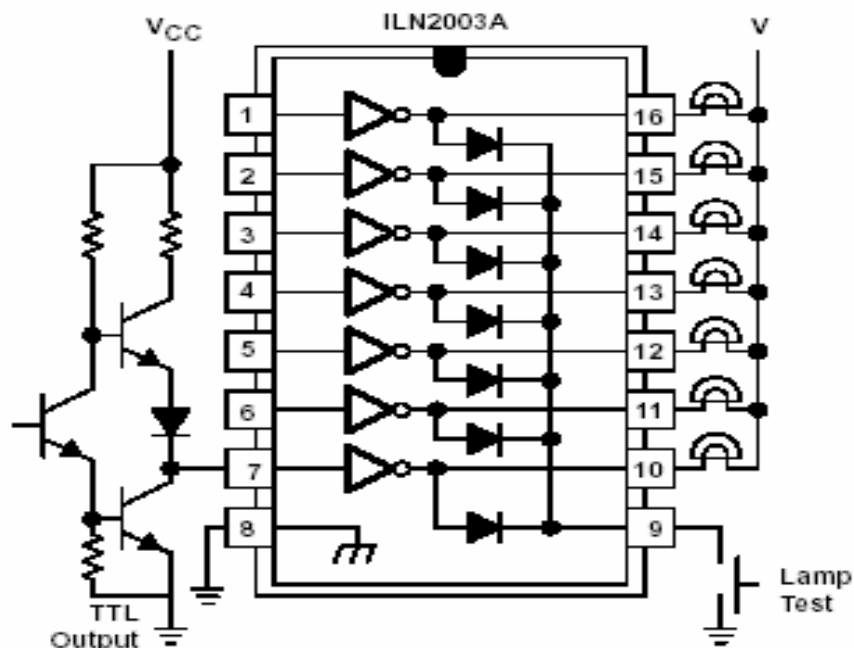


Figure 16. TTL to Load

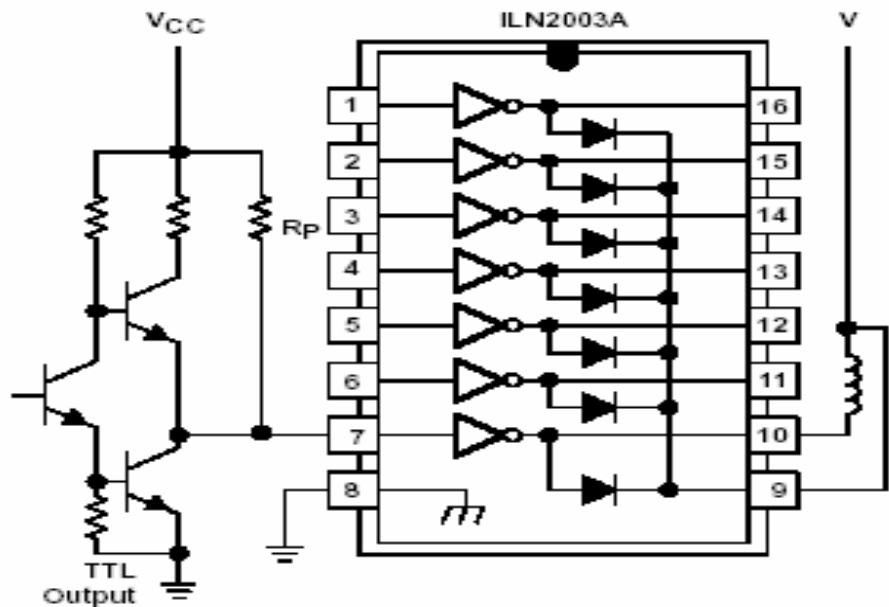
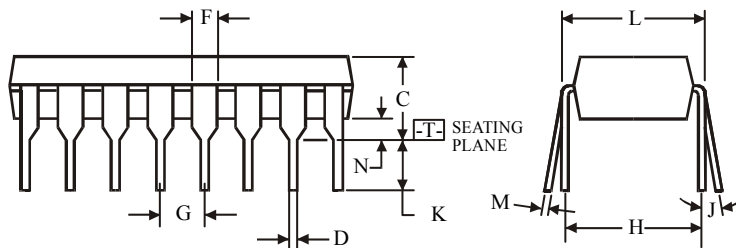
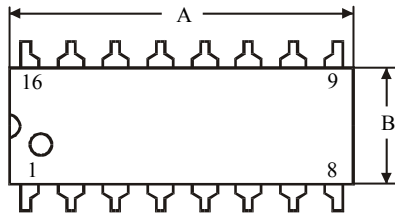
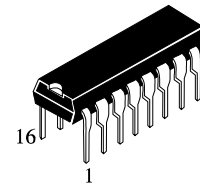


Figure 17. Use of Pullup Resistors to Increase Drive Current

**N SUFFIX PLASTIC DIP
(MS - 001BB)**



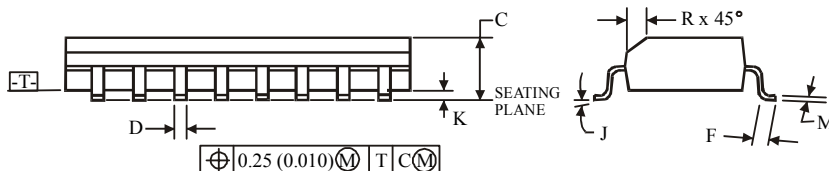
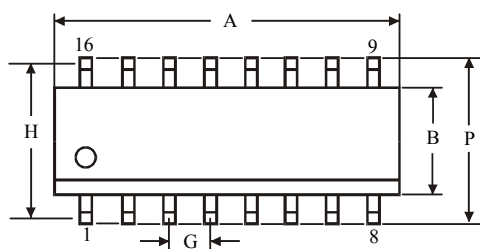
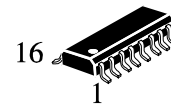
$\oplus 0.25 (0.010) \text{ (M) T}$

NOTES:

- Dimensions "A", "B" do not include mold flash or protrusions.
Maximum mold flash or protrusions 0.25 mm (0.010) per side.

| Symbol | Dimension, mm | |
|--------|---------------|-------|
| | MIN | MAX |
| A | 18.67 | 19.69 |
| B | 6.10 | 7.11 |
| C | | 5.33 |
| D | 0.36 | 0.56 |
| F | 1.14 | 1.78 |
| G | 2.54 | |
| H | 7.62 | |
| J | 0° | 10° |
| K | 2.92 | 3.81 |
| L | 7.62 | 8.26 |
| M | 0.20 | 0.36 |
| N | 0.38 | |

**D SUFFIX SOIC
(MS - 012AC)**



$\oplus 0.25 (0.010) \text{ (M) T (C) (M)}$

NOTES:

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side for A; for B - 0.25 mm (0.010) per side.

| Symbol | Dimension, mm | |
|--------|---------------|-------|
| | MIN | MAX |
| A | 9.80 | 10.00 |
| B | 3.80 | 4.00 |
| C | 1.35 | 1.75 |
| D | 0.33 | 0.51 |
| F | 0.40 | 1.27 |
| G | 1.27 | |
| H | 5.72 | |
| J | 0° | 8° |
| K | 0.10 | 0.25 |
| M | 0.19 | 0.25 |
| P | 5.80 | 6.20 |
| R | 0.25 | 0.50 |