

ON Semiconductor™



High Voltage, High Current Darlington Transistor Arrays

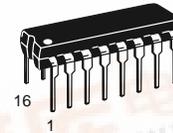
MC1413, B MC1416, B

The seven NPN Darlington connected transistors in these arrays are well suited for driving lamps, relays, or printer hammers in a variety of industrial and consumer applications. Their high breakdown voltage and internal suppression diodes insure freedom from problems associated with inductive loads. Peak inrush currents to 500 mA permit them to drive incandescent lamps.

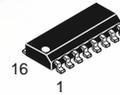
The MC1413, B with a 2.7 kΩ series input resistor is well suited for systems utilizing a 5.0 V TTL or CMOS Logic. The MC1416, B uses a series 10.5 kΩ resistor and is useful in 8.0 to 18 V MOS systems.

PERIPHERAL DRIVER ARRAYS

SEMICONDUCTOR TECHNICAL DATA



P SUFFIX
PLASTIC PACKAGE
CASE 648

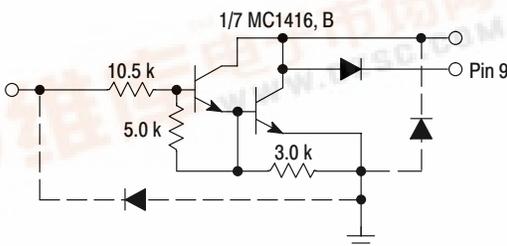
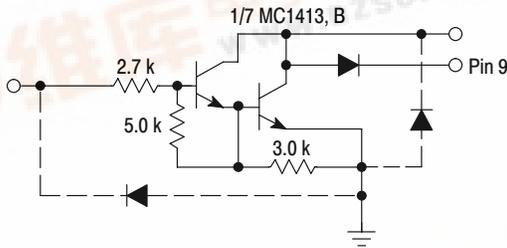


D SUFFIX
PLASTIC PACKAGE
CASE 751B
(SO-16)

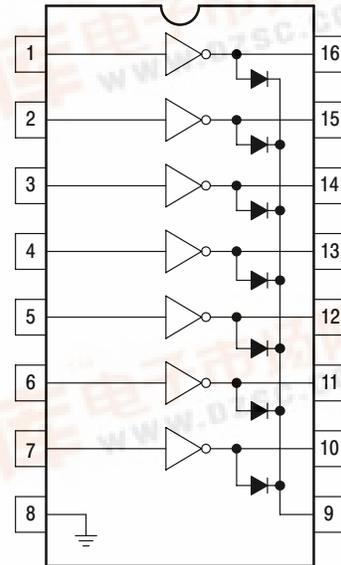
ORDERING INFORMATION

| Plastic DIP | SOIC | Operating Temperature Range |
|--|----------------------|---|
| MC1413P (ULN2003A) MC1416P (ULN2004A) | MC1413D MC1416D | $T_A = -20^\circ \text{ to } +85^\circ\text{C}$ |
| MC1413BP MC1416BP | MC1413BD MC1416BD | $T_A = -40^\circ \text{ to } +85^\circ\text{C}$ |

Representative Schematic Diagrams



PIN CONNECTIONS



(Top View)



MC1413, B MC1416, B

MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$, and rating apply to any one device in the package, unless otherwise noted.)

| Rating | Symbol | Value | Unit |
|--|------------------|--------------------------|---------------------------|
| Output Voltage | V_O | 50 | V |
| Input Voltage | V_I | 30 | V |
| Collector Current – Continuous | I_C | 500 | mA |
| Base Current – Continuous | I_B | 25 | mA |
| Operating Ambient Temperature Range MC1413–16 MC1413B–16B | T_A | –20 to +85 –40 to +85 | $^\circ\text{C}$ |
| Storage Temperature Range | T_{stg} | –55 to +150 | $^\circ\text{C}$ |
| Junction Temperature | T_J | 150 | $^\circ\text{C}$ |
| Thermal Resistance, Junction–to–Ambient Case 648, P Suffix Case 751B, D Suffix | θ_{JA} | 67 100 | $^\circ\text{C}/\text{W}$ |

NOTE: ESD data available upon request.

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|----------------------|------|---------------------|---|---------------|
| Output Leakage Current ($V_O = 50\text{ V}$, $T_A = +85^\circ\text{C}$) ($V_O = 50\text{ V}$, $T_A = +25^\circ\text{C}$) ($V_O = 50\text{ V}$, $T_A = +85^\circ\text{C}$, $V_I = 1.0\text{ V}$) | I_{CEX} | – | – | 100 50 500 | μA |
| Collector–Emitter Saturation Voltage ($I_C = 350\text{ mA}$, $I_B = 500\text{ }\mu\text{A}$) ($I_C = 200\text{ mA}$, $I_B = 350\text{ }\mu\text{A}$) ($I_C = 100\text{ mA}$, $I_B = 250\text{ }\mu\text{A}$) | $V_{\text{CE(sat)}}$ | – | 1.1 0.95 0.85 | 1.6 1.3 1.1 | V |
| Input Current – On Condition ($V_I = 3.85\text{ V}$) ($V_I = 5.0\text{ V}$) ($V_I = 12\text{ V}$) | $I_{\text{I(on)}}$ | – | 0.93 0.35 1.0 | 1.35 0.5 1.45 | mA |
| Input Voltage – On Condition ($V_{\text{CE}} = 2.0\text{ V}$, $I_C = 200\text{ mA}$) ($V_{\text{CE}} = 2.0\text{ V}$, $I_C = 250\text{ mA}$) ($V_{\text{CE}} = 2.0\text{ V}$, $I_C = 300\text{ mA}$) ($V_{\text{CE}} = 2.0\text{ V}$, $I_C = 125\text{ mA}$) ($V_{\text{CE}} = 2.0\text{ V}$, $I_C = 200\text{ mA}$) ($V_{\text{CE}} = 2.0\text{ V}$, $I_C = 275\text{ mA}$) ($V_{\text{CE}} = 2.0\text{ V}$, $I_C = 350\text{ mA}$) | $V_{\text{I(on)}}$ | – | – | 2.4 2.7 3.0 5.0 6.0 7.0 8.0 | V |
| Input Current – Off Condition ($I_C = 500\text{ }\mu\text{A}$, $T_A = 85^\circ\text{C}$) | $I_{\text{I(off)}}$ | 50 | 100 | – | μA |
| DC Current Gain ($V_{\text{CE}} = 2.0\text{ V}$, $I_C = 350\text{ mA}$) | h_{FE} | 1000 | – | – | – |
| Input Capacitance | C_I | – | 15 | 30 | pF |
| Turn–On Delay Time (50% E_I to 50% E_O) | t_{on} | – | 0.25 | 1.0 | μs |
| Turn–Off Delay Time (50% E_I to 50% E_O) | t_{off} | – | 0.25 | 1.0 | μs |
| Clamp Diode Leakage Current ($V_R = 50\text{ V}$) | I_R | – | – | 50 100 | μA |
| Clamp Diode Forward Voltage ($I_F = 350\text{ mA}$) | V_F | – | 1.5 | 2.0 | V |

MC1413, B MC1416, B

TYPICAL PERFORMANCE CURVES – $T_A = 25^\circ\text{C}$

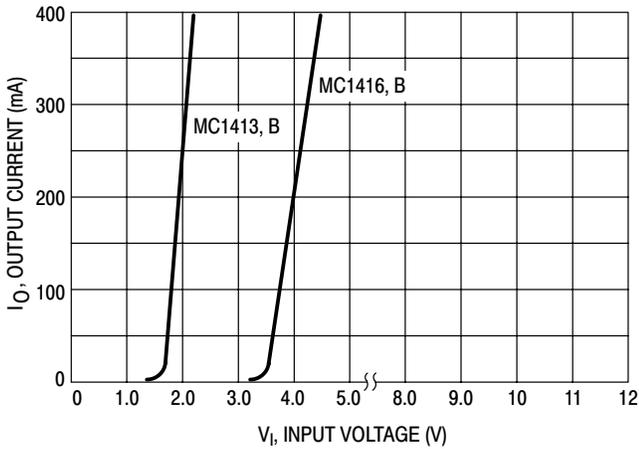


Figure 1. Output Current versus Input Voltage

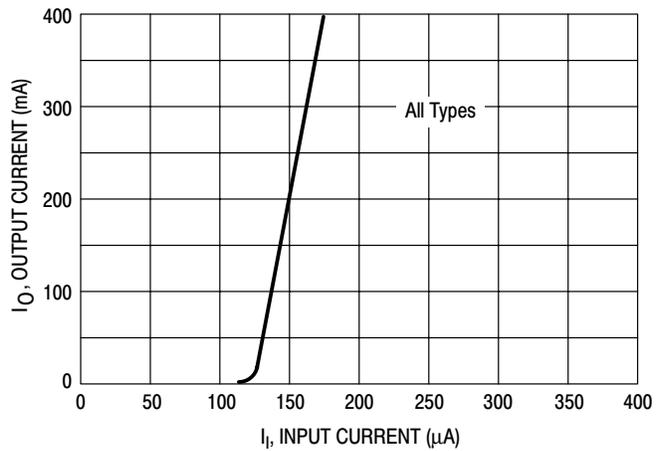


Figure 2. Output Current versus Input Current

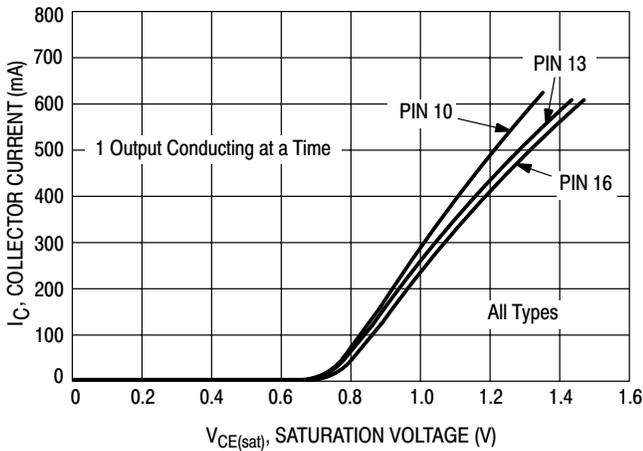


Figure 3. Typical Output Characteristics

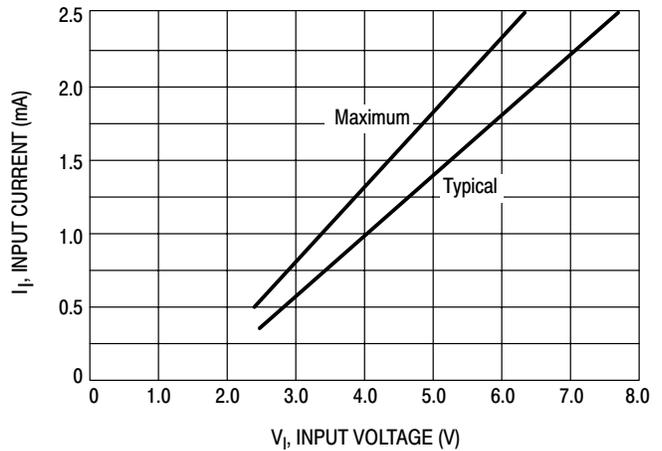


Figure 4. Input Characteristics – MC1413, B

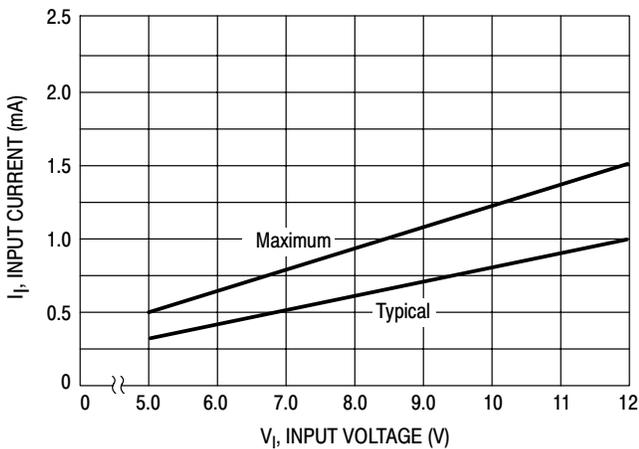


Figure 5. Input Characteristics – MC1416, B

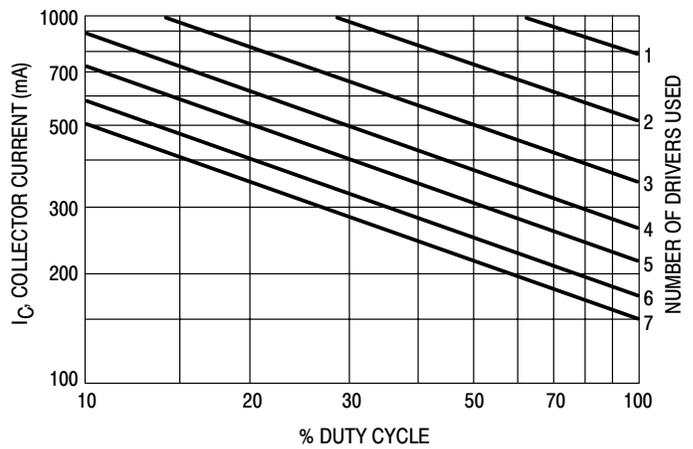
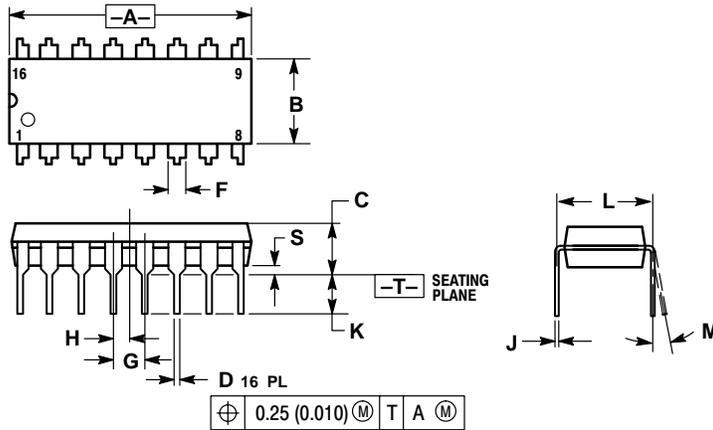


Figure 6. Maximum Collector Current versus Duty Cycle (and Number of Drivers in Use)

MC1413, B MC1416, B

OUTLINE DIMENSIONS

P SUFFIX
 PLASTIC PACKAGE
 CASE 648-08
 ISSUE R



NOTES:

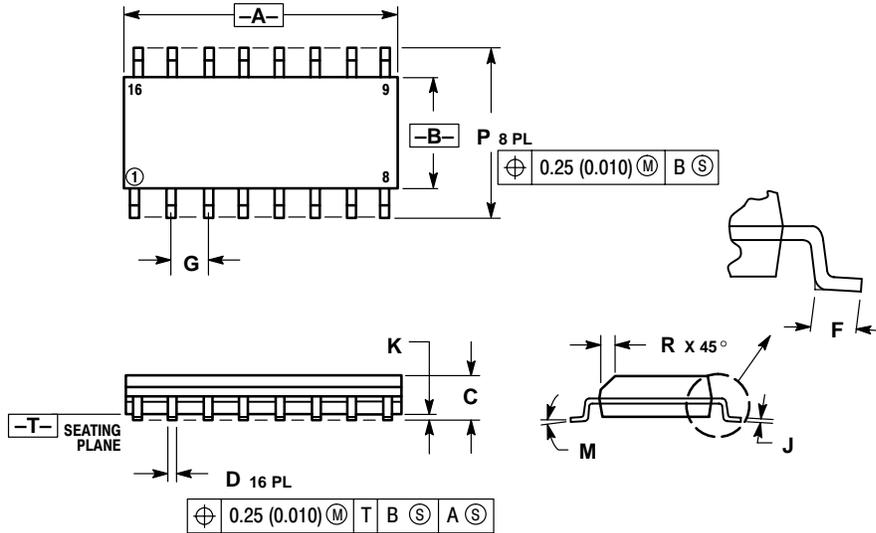
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.740 | 0.770 | 18.80 | 19.55 |
| B | 0.250 | 0.270 | 6.35 | 6.85 |
| C | 0.145 | 0.175 | 3.69 | 4.44 |
| D | 0.015 | 0.021 | 0.39 | 0.53 |
| F | 0.040 | 0.70 | 1.02 | 1.77 |
| G | 0.100 BSC | | 2.54 BSC | |
| H | 0.050 BSC | | 1.27 BSC | |
| J | 0.008 | 0.015 | 0.21 | 0.38 |
| K | 0.110 | 0.130 | 2.80 | 3.30 |
| L | 0.295 | 0.305 | 7.50 | 7.74 |
| M | 0° 10° | | 0° 10° | |
| S | 0.020 | 0.040 | 0.51 | 1.01 |

MC1413, B MC1416, B

OUTLINE DIMENSIONS

D SUFFIX
PLASTIC PACKAGE
 CASE 751B-05
 (SO-16)
 ISSUE J



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 9.80 | 10.00 | 0.386 | 0.393 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.229 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

MC1413, B MC1416, B

Notes

MC1413, B MC1416, B

Notes

MC1413, B MC1416, B

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