



MOTOROLA

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MC1413, B MC1416, B

High Voltage, High Current Darlington Transistor Arrays

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.

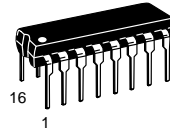
The MC1413, B with a 2.7 kΩ series input resistor is well suited for systems utilizing a 5.0 V TTL or CMOS Logic. The MC1416, B uses a series 10.5 kΩ resistor and is useful in 8.0 to 18 V MOS systems.

PERIPHERAL DRIVER ARRAYS

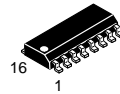
SEMICONDUCTOR TECHNICAL DATA

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	$T_A = -40^\circ \text{ to } +85^\circ\text{C}$

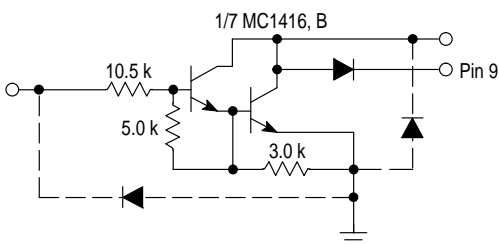
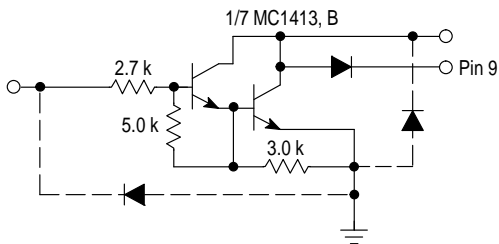


P SUFFIX
PLASTIC PACKAGE
CASE 648

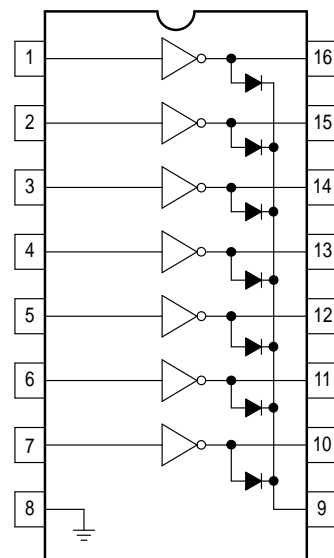


D SUFFIX
PLASTIC PACKAGE
CASE 751B
(SO-16)

Representative Schematic Diagrams



PIN CONNECTIONS



(Top View)

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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 ($V_{\text{R}} = 50\text{ V}$)	I_{R}	–	–	50 100	μA
Clamp Diode Forward Voltage ($I_{\text{F}} = 350\text{ mA}$)	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

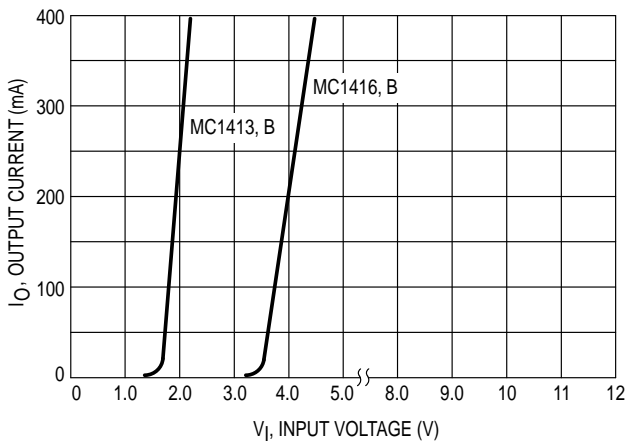


Figure 2. Output Current versus Input Current

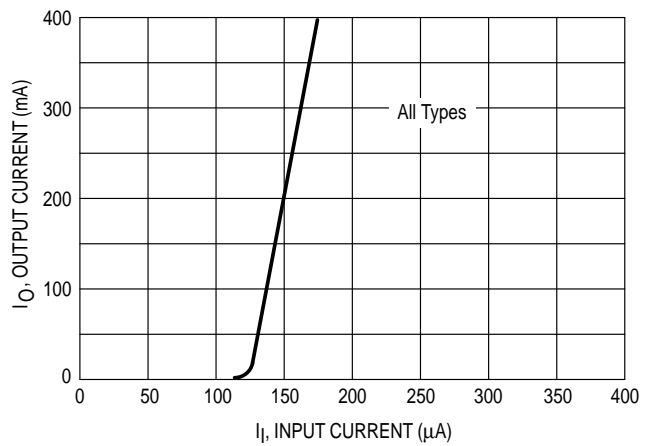


Figure 3. Typical Output Characteristics

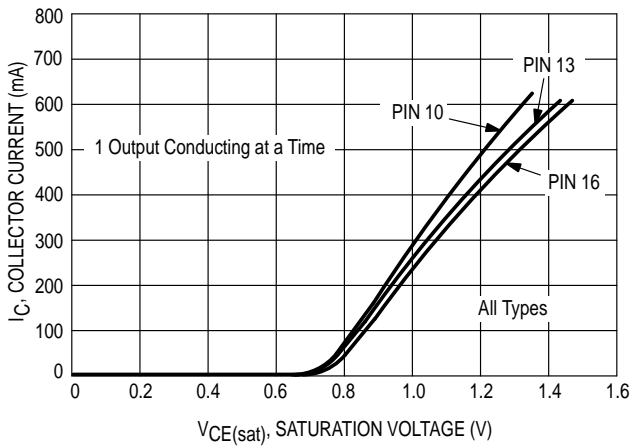


Figure 4. Input Characteristics – MC1413, B

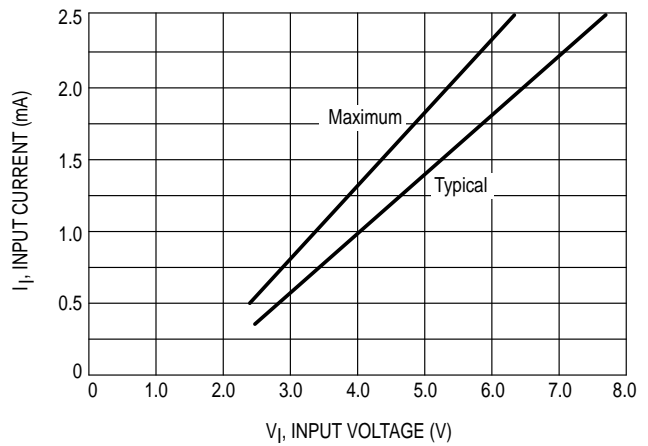


Figure 5. Input Characteristics – MC1416, B

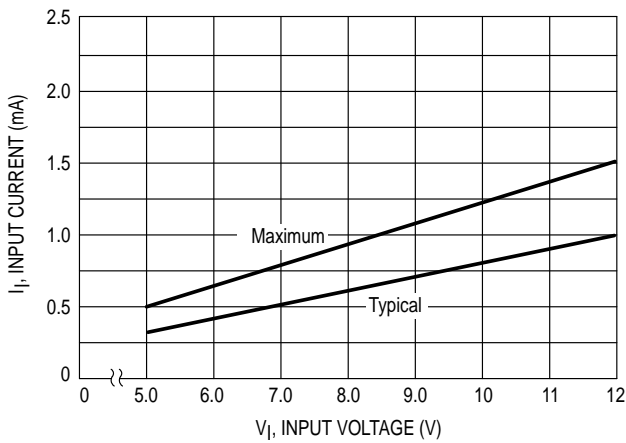
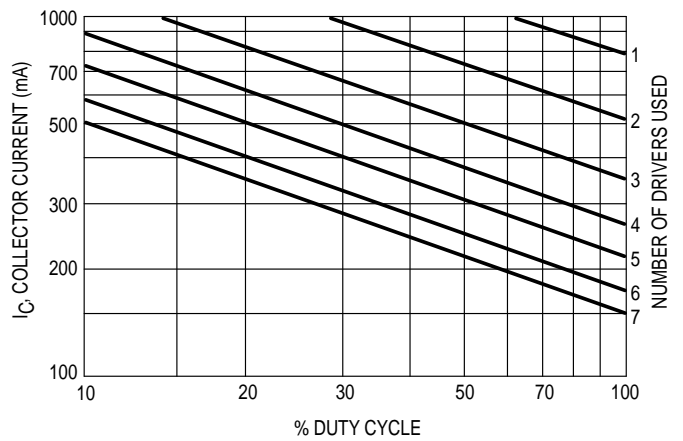


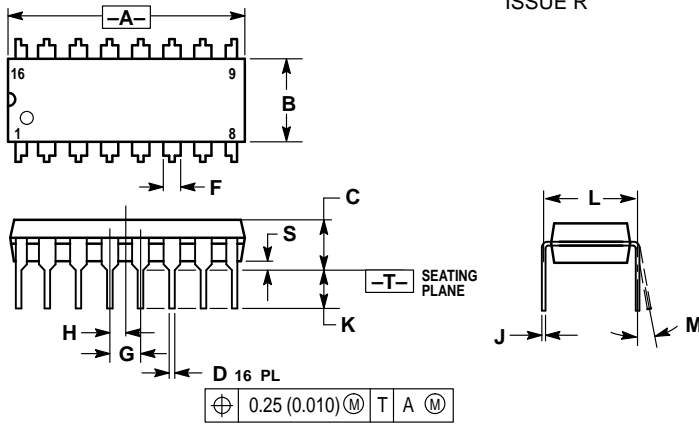
Figure 6. Maximum Collector Current versus Duty Cycle (and Number of Drivers in Use)



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OUTLINE DIMENSIONS

P SUFFIX PLASTIC PACKAGE CASE 648-08 ISSUE R

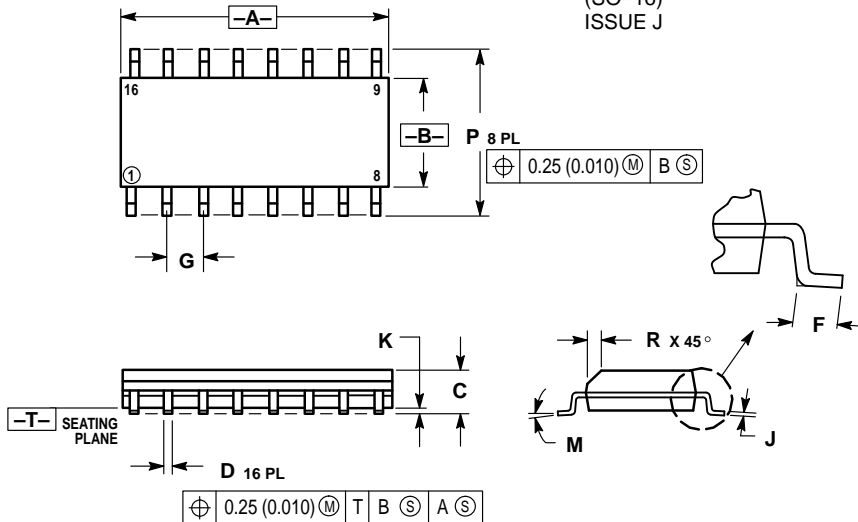


NOTES:

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

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

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USA/EUROPE/Locations Not Listed: Motorola Literature Distribution;
P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447 or 602-303-5454

JAPAN: Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, 6F Seibu-Butsuryu-Center,
3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-81-3521-8315

MFAX: RMFAX0@email.sps.mot.com - TOUCHTONE 602-244-6609
INTERNET: http://Design-NET.com

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51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298



MC1413/D

