

# High Voltage, High Current Darlington Transistor Arrays

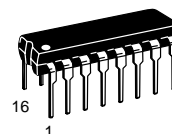
The seven NPN Darlington connected transistors in these arrays are well suited for driving lamps, relays, or printer hammers in a variety of industrial and consumer applications. Their high breakdown voltage and internal suppression diodes insure freedom from problems associated with inductive loads.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

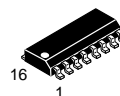
## MC1413, B MC1416, B

### PERIPHERAL DRIVER ARRAYS

#### SEMICONDUCTOR TECHNICAL DATA



**P SUFFIX**  
PLASTIC PACKAGE  
CASE 648

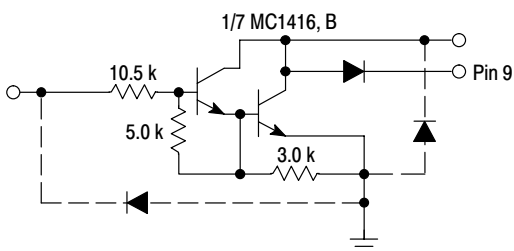
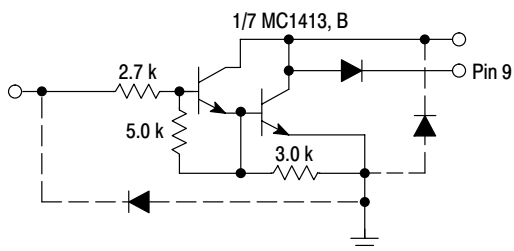


**D SUFFIX**  
PLASTIC PACKAGE  
CASE 751B  
(SO-16)

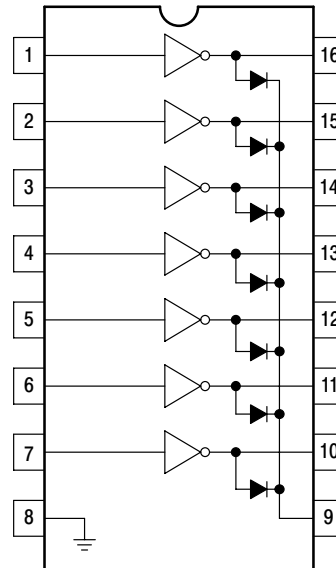
#### ORDERING INFORMATION

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	$\theta_{JA}$	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	$\mu\text{A}$
Collector–Emitter Saturation Voltage ( $I_C = 350\text{ mA}$ , $I_B = 500\text{ }\mu\text{A}$ ) ( $I_C = 200\text{ mA}$ , $I_B = 350\text{ }\mu\text{A}$ ) ( $I_C = 100\text{ mA}$ , $I_B = 250\text{ }\mu\text{A}$ )	$V_{CE(sat)}$	–	1.1 0.95 0.85	1.6 1.3 1.1	V
Input Current – On Condition ( $V_I = 3.85\text{ V}$ ) ( $V_I = 5.0\text{ V}$ ) ( $V_I = 12\text{ V}$ )	$I_{I(on)}$	–	0.93 0.35 1.0	1.35 0.5 1.45	mA
Input Voltage – On Condition ( $V_{CE} = 2.0\text{ V}$ , $I_C = 200\text{ mA}$ ) ( $V_{CE} = 2.0\text{ V}$ , $I_C = 250\text{ mA}$ ) ( $V_{CE} = 2.0\text{ V}$ , $I_C = 300\text{ mA}$ ) ( $V_{CE} = 2.0\text{ V}$ , $I_C = 125\text{ mA}$ ) ( $V_{CE} = 2.0\text{ V}$ , $I_C = 200\text{ mA}$ ) ( $V_{CE} = 2.0\text{ V}$ , $I_C = 275\text{ mA}$ ) ( $V_{CE} = 2.0\text{ V}$ , $I_C = 350\text{ mA}$ )	$V_{I(on)}$	–	–	2.4 2.7 3.0 5.0 6.0 7.0 8.0	V
Input Current – Off Condition ( $I_C = 500\text{ }\mu\text{A}$ , $T_A = 85^\circ\text{C}$ )	$I_{I(off)}$	50	100	–	$\mu\text{A}$
DC Current Gain ( $V_{CE} = 2.0\text{ V}$ , $I_C = 350\text{ mA}$ )	$h_{FE}$	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	$\mu\text{s}$
Turn–Off Delay Time (50% $E_I$ to 50% $E_O$ )	$t_{off}$	–	0.25	1.0	$\mu\text{s}$
Clamp Diode Leakage Current ( $V_R = 50\text{ V}$ )	$I_R$	–	–	50 100	$\mu\text{A}$
Clamp Diode Forward Voltage ( $I_F = 350\text{ mA}$ )	$V_F$	–	1.5	2.0	V

# MC1413, B MC1416, B

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

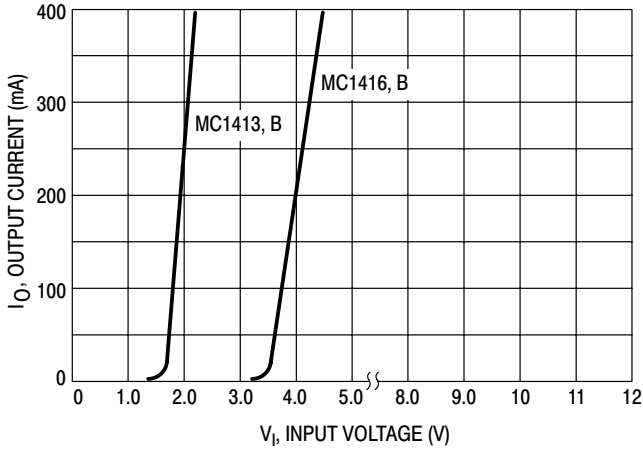


Figure 1. Output Current versus Input Voltage

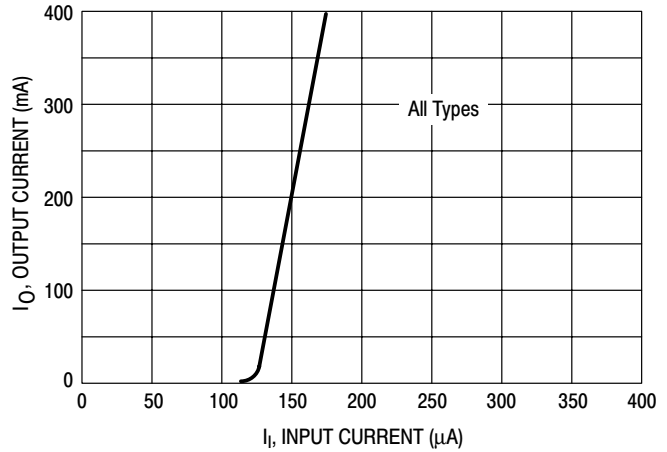


Figure 2. Output Current versus Input Current

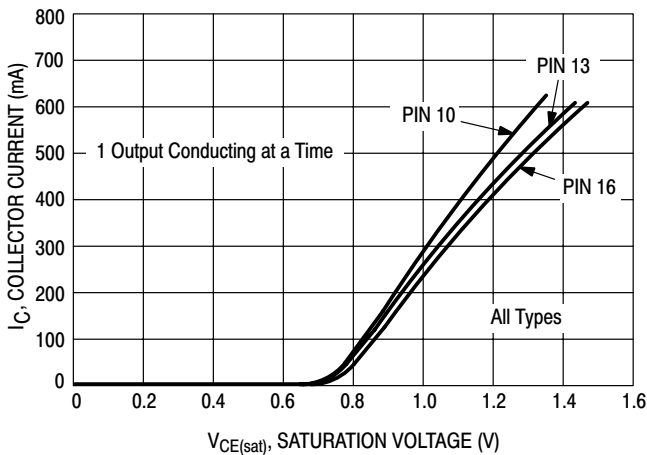


Figure 3. Typical Output Characteristics

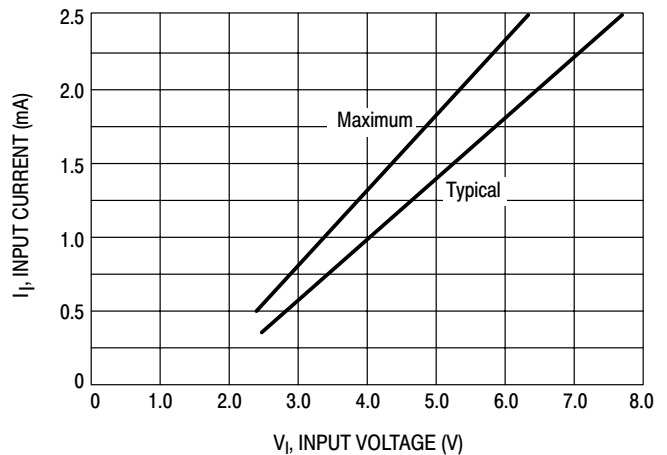


Figure 4. Input Characteristics – MC1413, B

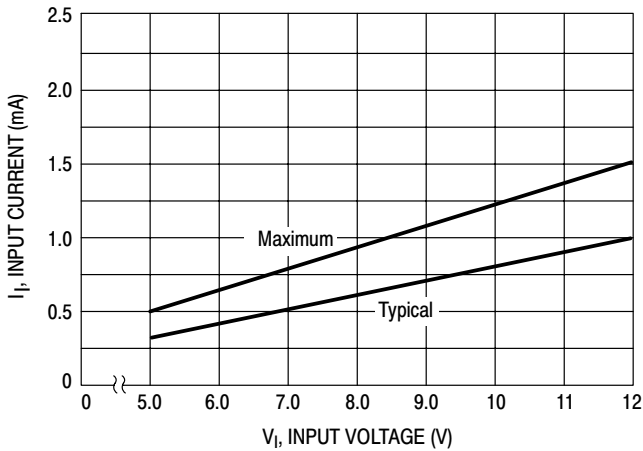


Figure 5. Input Characteristics – MC1416, B

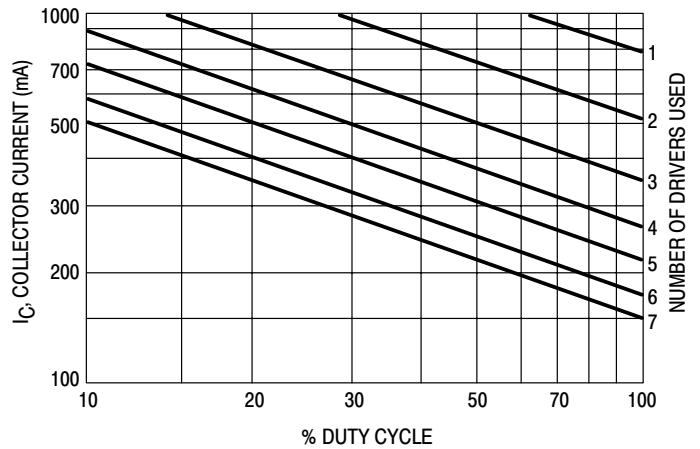
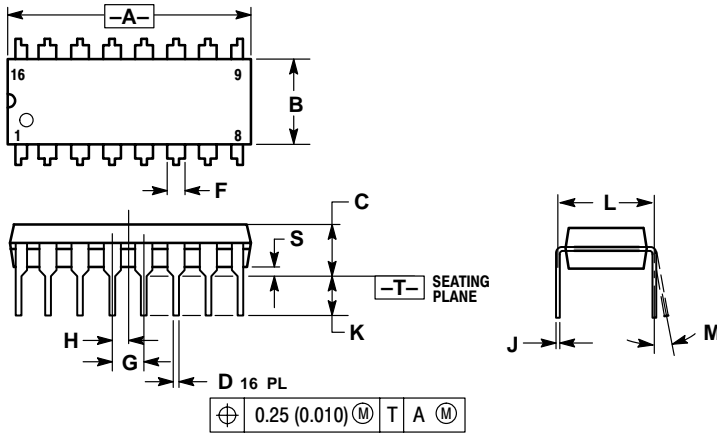


Figure 6. Maximum Collector Current versus Duty Cycle (and Number of Drivers in Use)

# MC1413, B MC1416, B

## OUTLINE DIMENSIONS

P SUFFIX  
 PLASTIC PACKAGE  
 CASE 648-08  
 ISSUE R



NOTES:

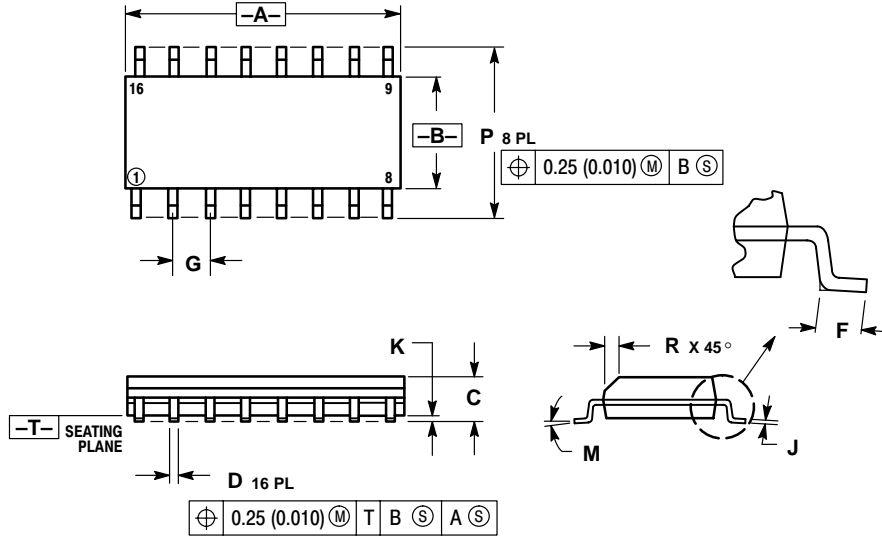
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

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

**Notes**

**Notes**

**ON Semiconductor** and  are trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer.

## PUBLICATION ORDERING INFORMATION

### **NORTH AMERICA Literature Fulfillment:**

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** ONlit@hibbertco.com  
Fax Response Line: 303-675-2167 or 800-344-3810 Toll Free USA/Canada

**N. American Technical Support:** 800-282-9855 Toll Free USA/Canada

**EUROPE:** LDC for ON Semiconductor – European Support

**German Phone:** (+1) 303-308-7140 (Mon-Fri 2:30pm to 7:00pm CET)  
**Email:** ONlit-german@hibbertco.com  
**French Phone:** (+1) 303-308-7141 (Mon-Fri 2:00pm to 7:00pm CET)  
**Email:** ONlit-french@hibbertco.com  
**English Phone:** (+1) 303-308-7142 (Mon-Fri 12:00pm to 5:00pm GMT)  
**Email:** ONlit@hibbertco.com

**EUROPEAN TOLL-FREE ACCESS\*: 00-800-4422-3781**

\*Available from Germany, France, Italy, UK, Ireland

### **CENTRAL/SOUTH AMERICA:**

**Spanish Phone:** 303-308-7143 (Mon-Fri 8:00am to 5:00pm MST)  
**Email:** ONlit-spanish@hibbertco.com  
**Toll-Free from Mexico:** Dial 01-800-288-2872 for Access –  
then Dial 866-297-9322

**ASIA/PACIFIC:** LDC for ON Semiconductor – Asia Support

**Phone:** 1-303-675-2121 (Tue-Fri 9:00am to 1:00pm, Hong Kong Time)  
**Toll Free from Hong Kong & Singapore:**  
**001-800-4422-3781**

**Email:** ONlit-asia@hibbertco.com

**JAPAN:** ON Semiconductor, Japan Customer Focus Center

4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan 141-0031  
**Phone:** 81-3-5740-2700  
**Email:** r14525@onsemi.com

**ON Semiconductor Website:** <http://onsemi.com>

For additional information, please contact your local Sales Representative.