

**MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA**

**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 break-down voltage and internal suppression diodes insure freedom from problems associated with inductive loads. Peak inrush currents to 600 mA permit them to drive incandescent lamps.

The MC1411,B device is a general purpose array for use with DTL, TTL, PMOS, or CMOS Logic. The MC1412,B contains a zener diode and resistor in series with the input to limit input current for use with 14 to 25 Volt PMOS Logic. The MC1413,B with a 2.7 kΩ series input resistor is well suited for systems utilizing a 5 Volt TTL or CMOS Logic. The MC1416,B uses a series 10.5 kΩ resistor and is useful in 8 to 18 Volt MOS systems.

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 (Except MC1411)	V_I	30	V
Collector Current — Continuous	I_C	500	mA
Base Current — Continuous	I_B	25	mA
Operating Ambient Temperature Range MC1411-16 MC1411B-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	$^\circ\text{C/W}$

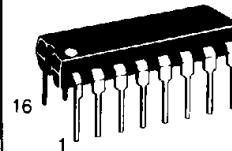
ORDERING INFORMATION

Plastic DIP	SOIC	Ambient Temperature Range
MC1411P (ULN2001A) MC1412P (ULN2002A) MC1413P (ULN2003A) MC1416P (ULN2004A)	MC1411D MC1412D MC1413D MC1416D	-20° to +85°C
MC1411BP MC1412BP MC1413BP MC1416BP	MC1411BD MC1412BD MC1413BD MC1416BD	-40° to +85°C

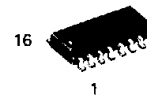
**MC1411,B
MC1412,B
MC1413,B
MC1416,B**

**PERIPHERAL
DRIVER ARRAYS**

**SILICON MONOLITHIC
INTEGRATED CIRCUITS**

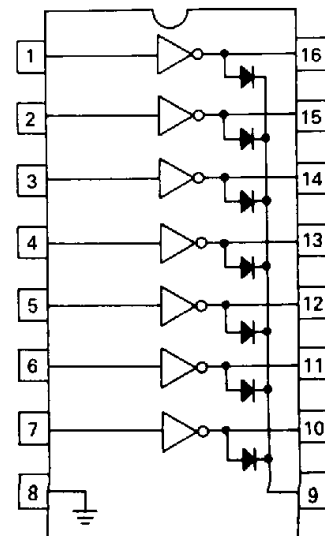


**P SUFFIX
PLASTIC PACKAGE
CASE 648**



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

PIN CONNECTIONS



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MC1411,B, MC1412,B, MC1413,B, MC1416,B

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
Output Leakage Current (V _O = 50 V, T _A = +85°C) (V _O = 50 V, T _A = +25°C) (V _O = 50 V, T _A = +85°C, V _I = 6.0 V) (V _O = 50 V, T _A = +85°C, V _I = 1.0 V)	All Types	I _{CEX}	—	—	100	μA
	All Types		—	—	50	
	MC1412,B		—	—	500	
	MC1416,B		—	—	500	
Collector-Emitter Saturation Voltage (I _C = 350 mA, I _B = 500 μA) (I _C = 200 mA, I _B = 350 μA) (I _C = 100 mA, I _B = 250 μA)	All Types	V _{CE(sat)}	—	1.1	1.6	V
	All Types		—	0.95	1.3	
	All Types		—	0.85	1.1	
Input Current — On Condition (V _I = 17 V) (V _I = 3.85 V) (V _I = 5.0 V) (V _I = 12 V)	MC1412,B	I _{I(on)}	—	0.85	1.3	mA
	MC1413,B		—	0.93	1.35	
	MC1416,B		—	0.35	0.5	
	MC1416,B		—	1.0	1.45	
Input Voltage — On Condition (V _{CE} = 2.0 V, I _C = 300 mA) (V _{CE} = 2.0 V, I _C = 200 mA) (V _{CE} = 2.0 V, I _C = 250 mA) (V _{CE} = 2.0 V, I _C = 300 mA) (V _{CE} = 2.0 V, I _C = 125 mA) (V _{CE} = 2.0 V, I _C = 200 mA) (V _{CE} = 2.0 V, I _C = 275 mA) (V _{CE} = 2.0 V, I _C = 350 mA)	MC1412,B	V _{I(on)}	—	—	13	V
	MC1413,B		—	—	2.4	
	MC1413,B		—	—	2.7	
	MC1413,B		—	—	3.0	
	MC1416,B		—	—	5.0	
	MC1416,B		—	—	6.0	
	MC1416,B		—	—	7.0	
	MC1416,B		—	—	8.0	
Input Current — Off Condition (I _C = 500 μA, T _A = +85°C)	All Types	I _{I(off)}	50	100	—	μA
DC Current Gain (V _{CE} = 2.0 V, I _C = 350 mA)	MC1411,B	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 V)	T _A = +25°C T _A = +85°C	I _R	—	—	50 100	μA
Clamp Diode Forward Voltage (I _F = 350 mA)		V _F	—	1.5	2.0	V

TYPICAL PERFORMANCE CURVES — T_A = 25°C

FIGURE 1 — OUTPUT CURRENT versus INPUT VOLTAGE

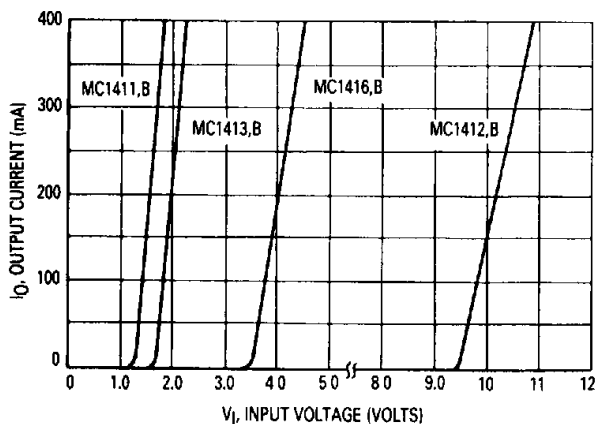
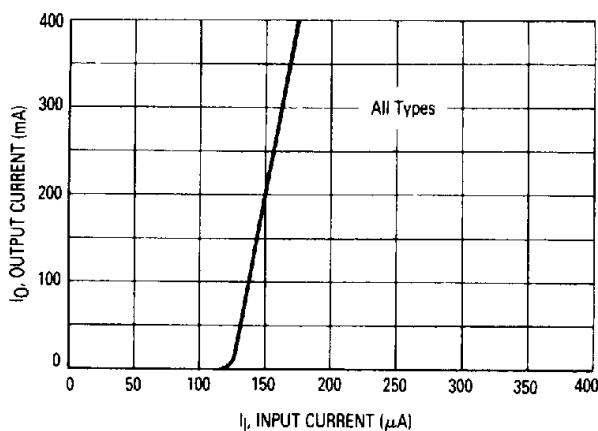


FIGURE 2 — OUTPUT CURRENT versus INPUT CURRENT



MC1411,B, MC1412,B, MC1413,B, MC1416,B

TYPICAL CHARACTERISTIC CURVES - $T_A = 25^\circ\text{C}$ (continued)

FIGURE 3 — TYPICAL OUTPUT CHARACTERISTICS

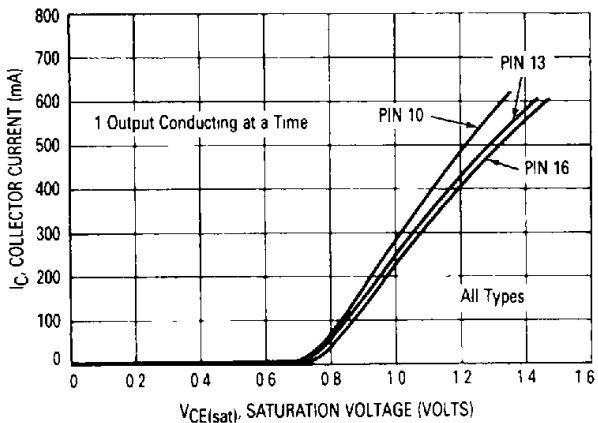


FIGURE 4 — INPUT CHARACTERISTICS — MC1412,B

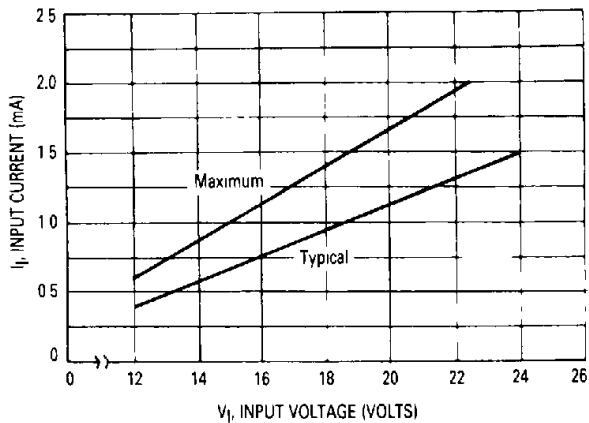


FIGURE 5 — INPUT CHARACTERISTICS — MC1413,B

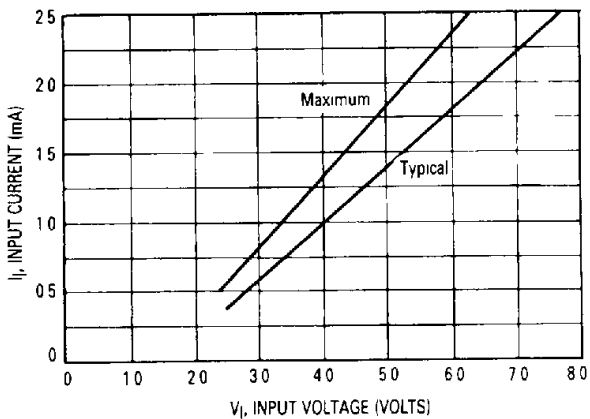


FIGURE 6 — INPUT CHARACTERISTICS — MC1416,B

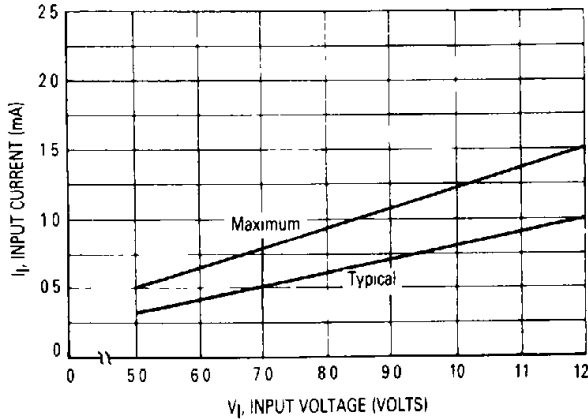
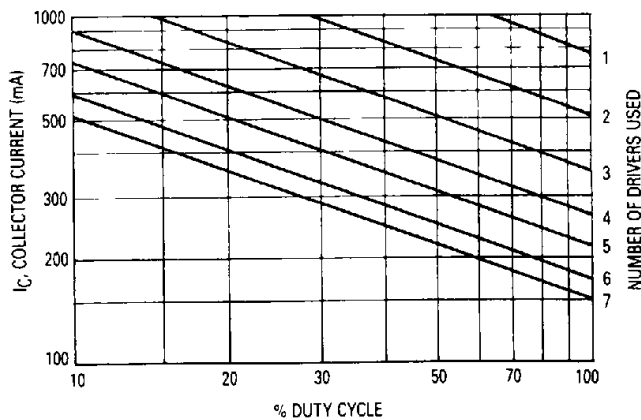
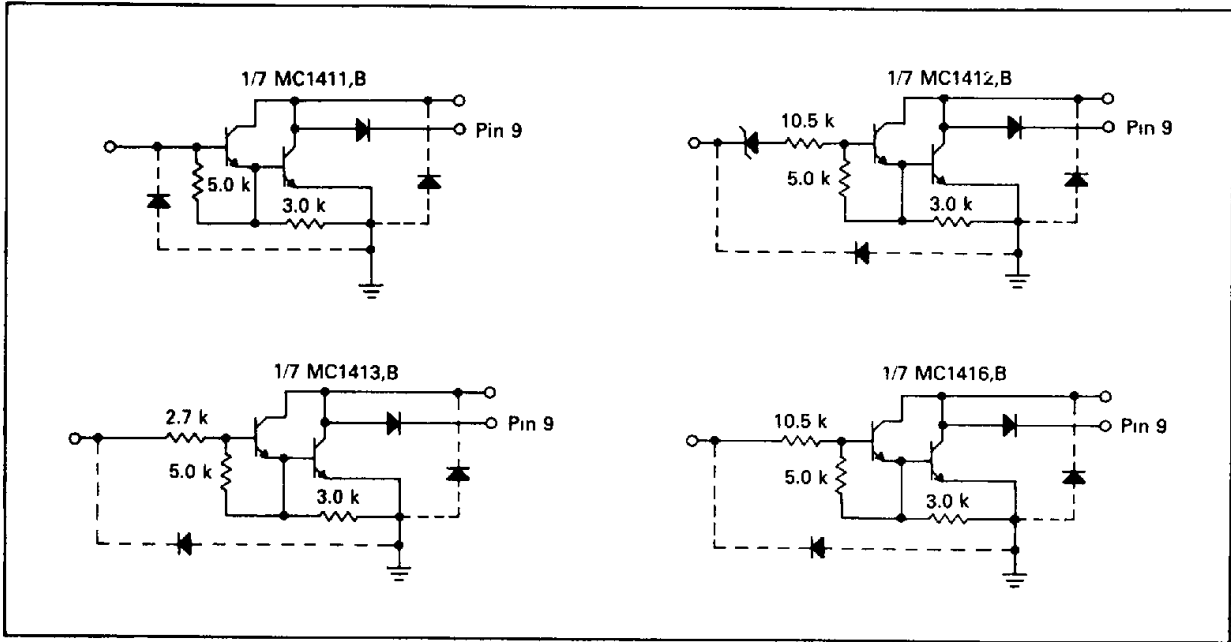


FIGURE 7 — MAXIMUM COLLECTOR CURRENT versus DUTY CYCLE (AND NUMBER OF DRIVERS IN USE)



MC1411,B, MC1412,B, MC1413,B, MC1416,B

FIGURE 8 — REPRESENTATIVE CIRCUIT SCHEMATICS



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