

# MJH11017, MJH11019, MJH11021 (PNP) MJH11018, MJH11020, MJH11022 (NPN)



ON Semiconductor®

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## Complementary Darlington Silicon Power Transistors

These devices are designed for use as general purpose amplifiers, low frequency switching and motor control applications.

### Features

- High DC Current Gain @ 10 Adc —  $h_{FE} = 400$  Min (All Types)
- Collector–Emitter Sustaining Voltage
  - $V_{CE(sus)} = 150$  Vdc (Min) — MJH11018, 17
  - $= 200$  Vdc (Min) — MJH11020, 19
  - $= 250$  Vdc (Min) — MJH11022, 21
- Low Collector–Emitter Saturation Voltage
  - $V_{CE(sat)} = 1.2$  V (Typ) @  $I_C = 5.0$  A
  - $= 1.8$  V (Typ) @  $I_C = 10$  A
- Monolithic Construction
- Pb–Free Packages are Available\*

### MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Collector–Emitter Voltage MJH11018, MJH11017 MJH11020, MJH11019 MJH11022, MJH11021	$V_{CEO}$	150 200 250	Vdc
Collector–Base Voltage MJH11018, MJH11017 MJH11020, MJH11019 MJH11022, MJH11021	$V_{CB}$	150 200 250	Vdc
Emitter–Base Voltage	$V_{EB}$	5.0	Vdc
Collector Current – Continuous – Peak (Note 1)	$I_C$	15 30	Adc
Base Current	$I_B$	0.5	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	150 1.2	W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	–65 to +150	$^\circ\text{C}$

### THERMAL CHARACTERISTICS

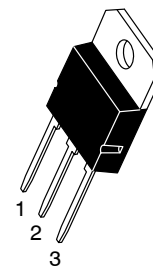
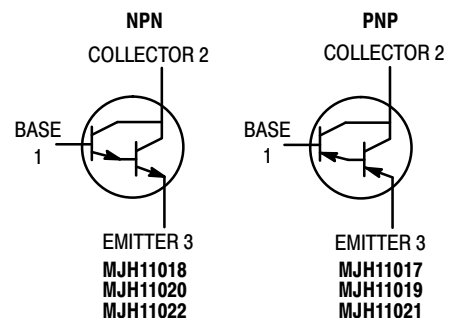
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction–to–Case	$R_{\theta JC}$	0.83	$^\circ\text{C}/\text{W}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

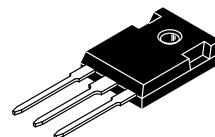
1. Pulse Test: Pulse Width = 5.0 ms, Duty Cycle  $\leq 10\%$ .

\*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## 15 AMPERE DARLINGTON COMPLEMENTARY SILICON POWER TRANSISTORS 150–250 VOLTS, 150 WATTS



SOT-93  
(TO-218)  
CASE 340D  
STYLE 1



TO-247  
CASE 340L  
STYLE 3

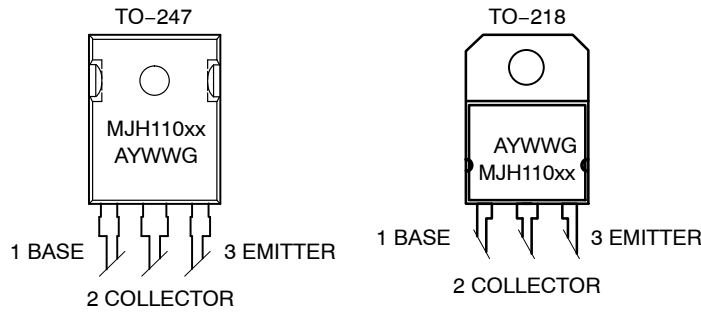
**NOTE:** Effective June 2012 this device will be available only in the TO-247 package. Reference FPCN# 16827.

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

# MJH11017, MJH11019, MJH11021 (PNP) MJH11018, MJH11020, MJH11022 (NPN)

## MARKING DIAGRAMS



A = Assembly Location  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package  
 MJH110xx = Device Code  
 xx = 17, 19, 21, 18, 20, 22

## ORDERING INFORMATION

Device Order Number	Package Type	Shipping
MJH11017G	TO-218 (Pb-Free)	30 Units / Rail
MJH11018G	TO-218 (Pb-Free)	30 Units / Rail
MJH11019G	TO-218 (Pb-Free)	30 Units / Rail
MJH11020G	TO-218 (Pb-Free)	30 Units / Rail
MJH11021G	TO-218 (Pb-Free)	30 Units / Rail
MJH11022G	TO-218 (Pb-Free)	30 Units / Rail
MJH11017G	TO-247 (Pb-Free)	30 Units / Rail
MJH11018G	TO-247 (Pb-Free)	30 Units / Rail
MJH11019G	TO-247 (Pb-Free)	30 Units / Rail
MJH11020G	TO-247 (Pb-Free)	30 Units / Rail
MJH11021G	TO-247 (Pb-Free)	30 Units / Rail
MJH11022G	TO-247 (Pb-Free)	30 Units / Rail

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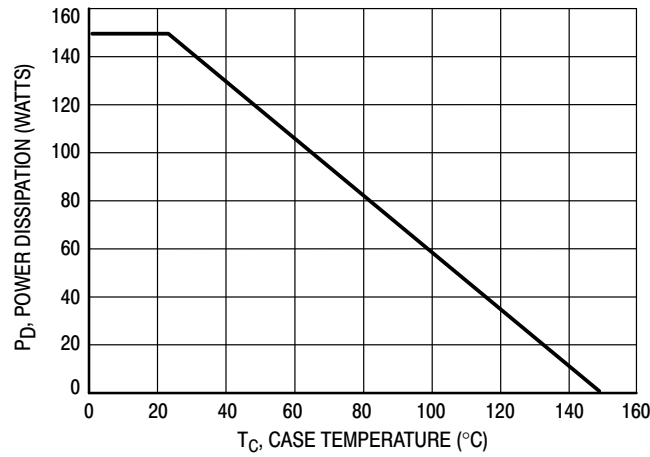


Figure 1. Power Derating

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Sustaining Voltage (Note 2) (I <sub>C</sub> = 0.1 Adc, I <sub>B</sub> = 0)	V <sub>CEO(sus)</sub>	150 200 250	- - -	Vdc
Collector Cutoff Current (V <sub>CE</sub> = 75 Vdc, I <sub>B</sub> = 0) (V <sub>CE</sub> = 100 Vdc, I <sub>B</sub> = 0) (V <sub>CE</sub> = 125 Vdc, I <sub>B</sub> = 0)	I <sub>CEO</sub>	- - -	1.0 1.0 1.0	mAdc
Collector Cutoff Current (V <sub>CE</sub> = Rated V <sub>CB</sub> , V <sub>BE(off)</sub> = 1.5 Vdc) (V <sub>CE</sub> = Rated V <sub>CB</sub> , V <sub>BE(off)</sub> = 1.5 Vdc, T <sub>J</sub> = 150°C)	I <sub>CEV</sub>	- -	0.5 5.0	mAdc
Emitter Cutoff Current (V <sub>BE</sub> = 5.0 Vdc I <sub>C</sub> = 0)	I <sub>EBO</sub>	-	2.0	mAdc

## ON CHARACTERISTICS (Note 2)

DC Current Gain (I <sub>C</sub> = 10 Adc, V <sub>CE</sub> = 5.0 Vdc) (I <sub>C</sub> = 15 Adc, V <sub>CE</sub> = 5.0 Vdc)	h <sub>FE</sub>	400 100	15,000 -	-
Collector-Emitter Saturation Voltage (I <sub>C</sub> = 10 Adc, I <sub>B</sub> = 100 mA) (I <sub>C</sub> = 15 Adc, I <sub>B</sub> = 150 mA)	V <sub>CE(sat)</sub>	- -	2.5 4.0	Vdc
Base-Emitter On Voltage (I <sub>C</sub> = 10 A, V <sub>CE</sub> = 5.0 Vdc)	V <sub>BE(on)</sub>	-	2.8	Vdc
Base-Emitter Saturation Voltage (I <sub>C</sub> = 15 Adc, I <sub>B</sub> = 150 mA)	V <sub>BE(sat)</sub>	-	3.8	Vdc

## DYNAMIC CHARACTERISTICS

Current-Gain Bandwidth Product (I <sub>C</sub> = 10 Adc, V <sub>CE</sub> = 3.0 Vdc, f = 1.0 MHz)	f <sub>T</sub>	3.0	-	-
Output Capacitance (V <sub>CB</sub> = 10 Vdc, I <sub>E</sub> = 0, f = 0.1 MHz)	C <sub>ob</sub>	- -	400 600	pF
Small-Signal Current Gain (I <sub>C</sub> = 10 Adc, V <sub>CE</sub> = 3.0 Vdc, f = 1.0 kHz)	h <sub>fe</sub>	75	-	-

## SWITCHING CHARACTERISTICS

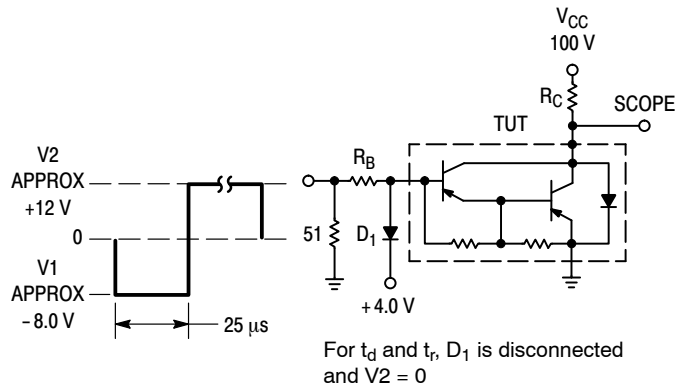
Characteristic	Symbol	Typical		Unit
		NPN	PNP	
Delay Time	t <sub>d</sub>	150	75	ns
Rise Time	t <sub>r</sub>	1.2	0.5	μs
Storage Time	t <sub>s</sub>	4.4	2.7	μs
Fall Time	t <sub>f</sub>	2.5	2.5	μs

(V<sub>CC</sub> = 100 V, I<sub>C</sub> = 10 A, I<sub>B</sub> = 100 mA  
V<sub>BE(off)</sub> = 5.0 V) (See Figure 2)

2. Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

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$R_B$  &  $R_C$  varied to obtain desired current levels  
 $D_1$ , must be fast recovery types, e.g.:  
 1N5825 used above  $I_B \approx 100$  mA  
 MSD6100 used below  $I_B \approx 100$  mA



$t_r, t_f \leq 10$  ns  
 Duty Cycle = 1.0% For NPN test circuit, reverse diode and voltage polarities.

Figure 2. Switching Times Test Circuit

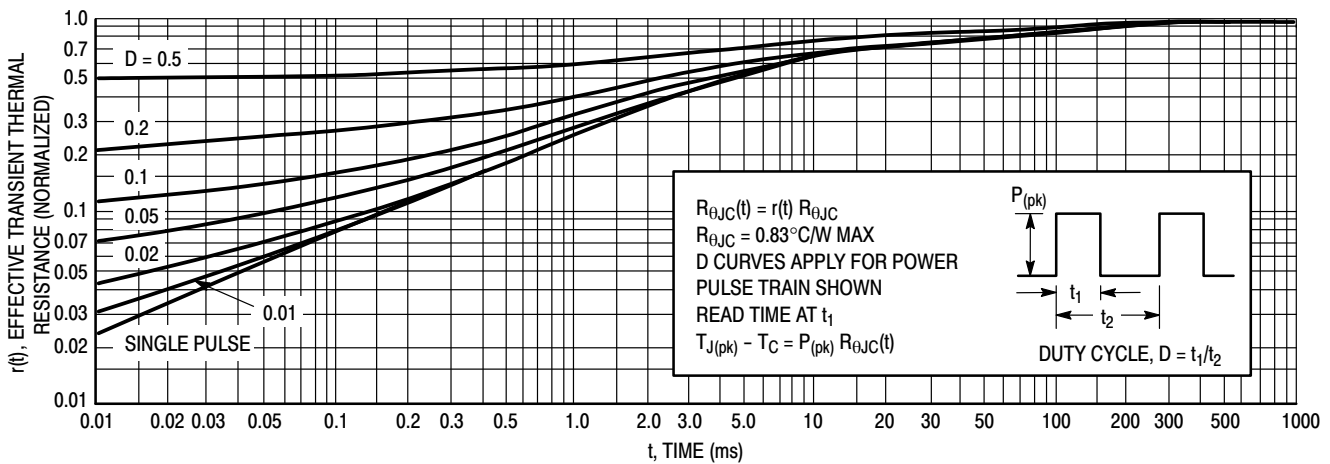


Figure 3. Thermal Response

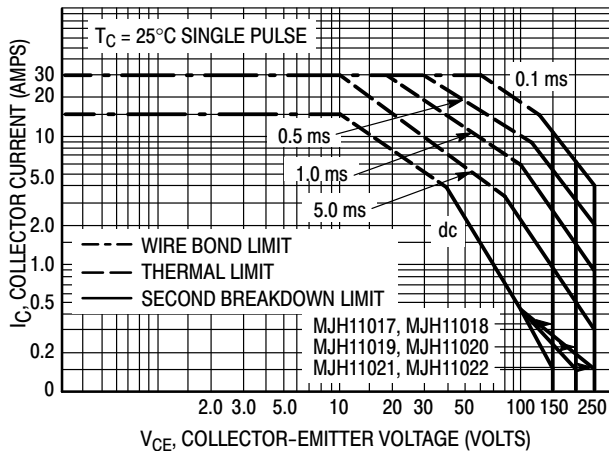


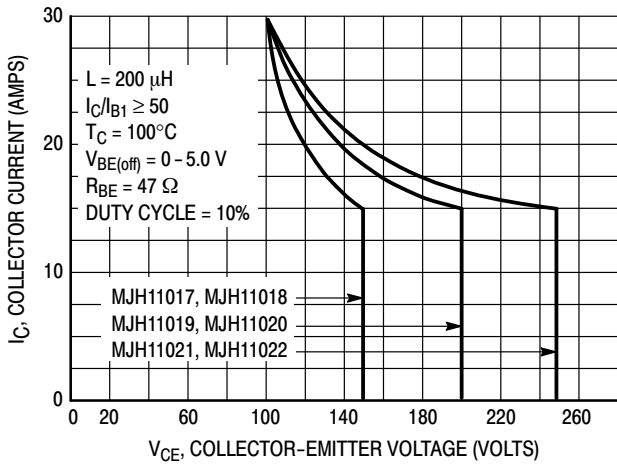
Figure 4. Maximum Rated Forward Bias Safe Operating Area (FBSOA)

## FORWARD BIAS

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate  $I_C - V_{CE}$  limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 4 is based on  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} \leq 150^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 3. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

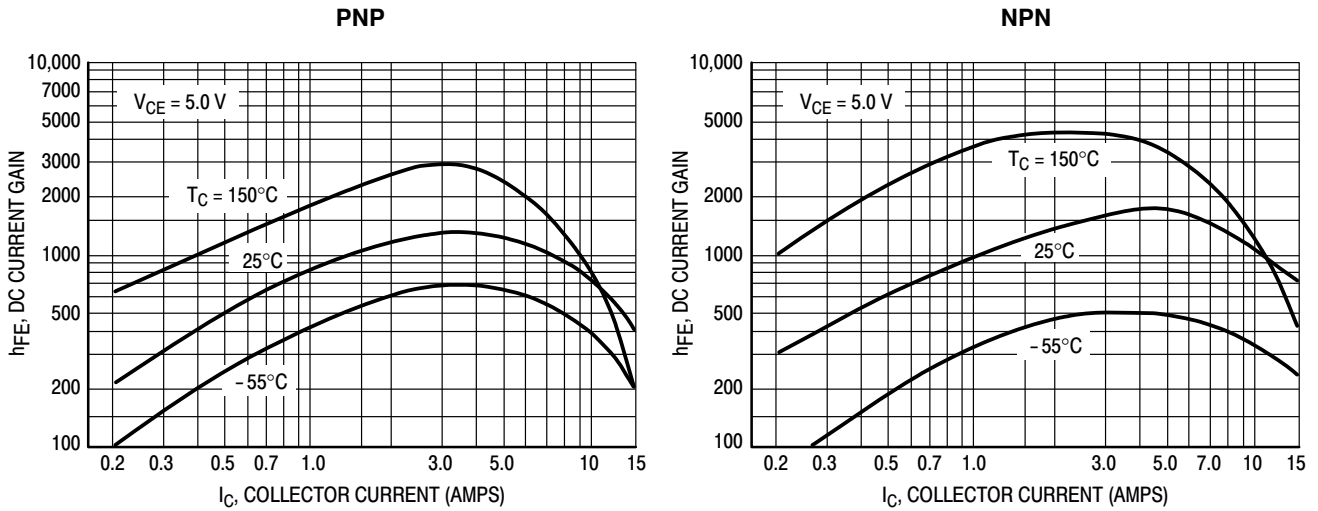
**MJH11017, MJH11019, MJH11021 (PNP) MJH11018, MJH11020, MJH11022 (NPN)**



**Figure 5. Maximum Rated Reverse Bias Safe Operating Area (RBSOA)**

**REVERSE BIAS**

For inductive loads, high voltage and high current must be sustained simultaneously during turn-off, in most cases, with the base to emitter junction reverse biased. Under these conditions the collector voltage must be held to a safe level at or below a specific value of collector current. This can be accomplished by several means such as active clamping, RC snubbing, load line shaping, etc. The safe level for these devices is specified as Reverse Bias Safe Operating Area and represents the voltage-current conditions during reverse biased turn-off. This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode. Figure 5 gives RBSOA characteristics.



**Figure 6. DC Current Gain**

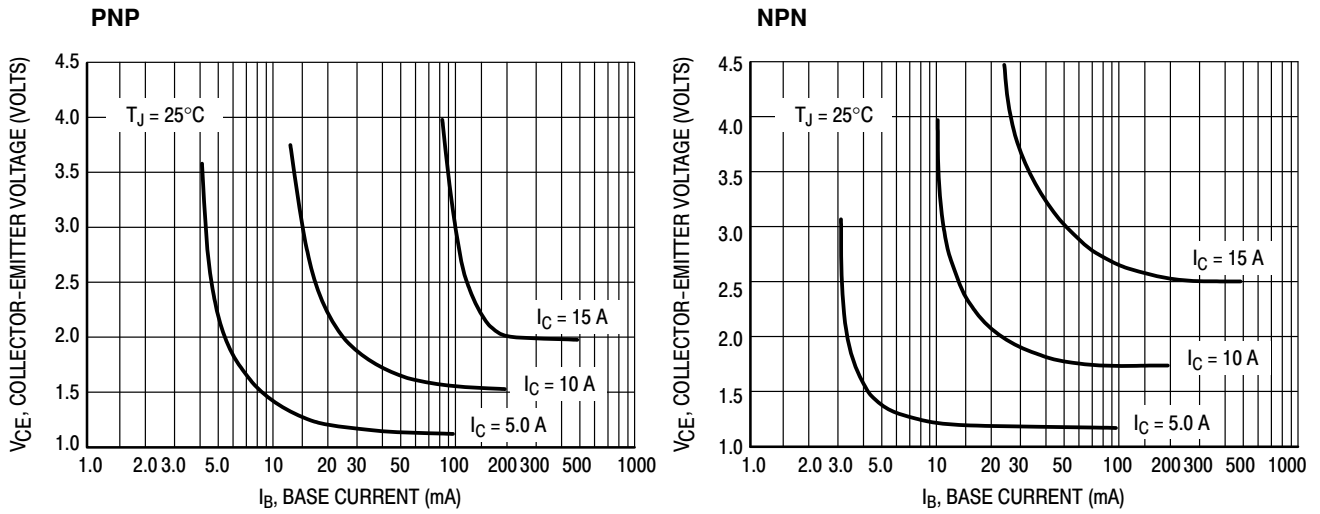


Figure 7. Collector Saturation Region

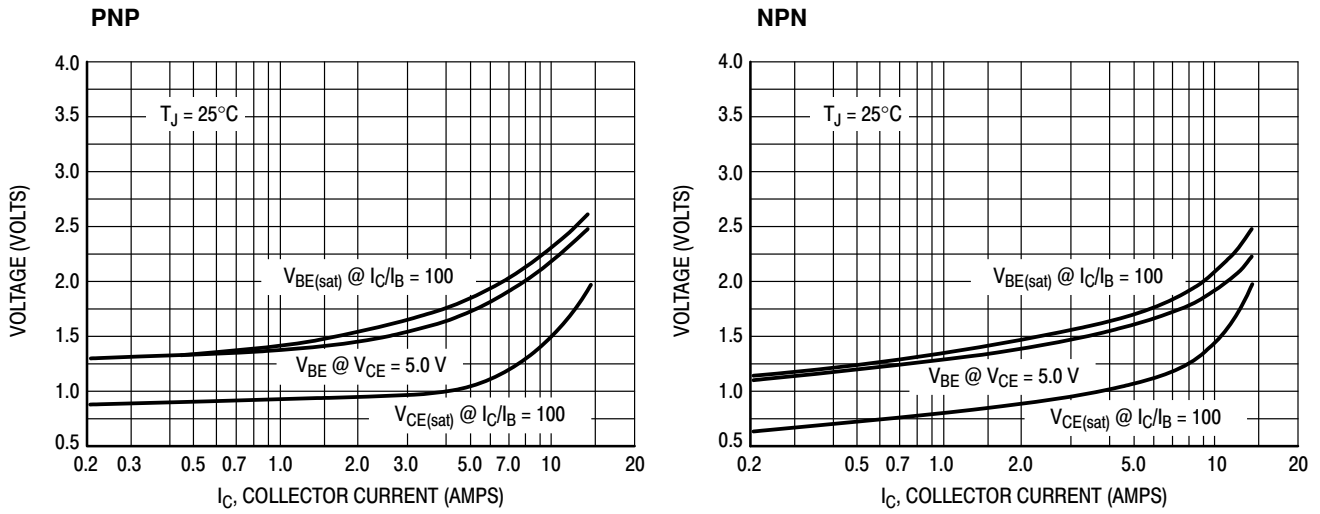


Figure 8. "On" Voltages

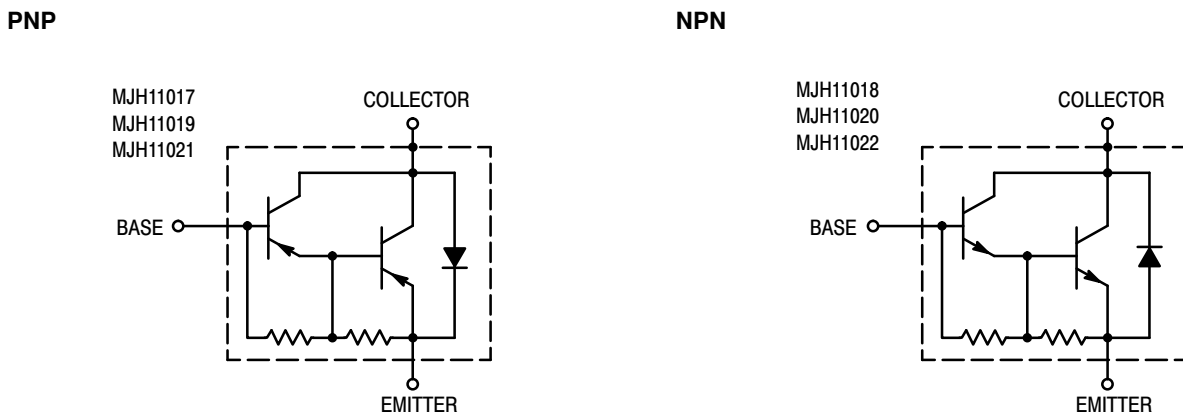
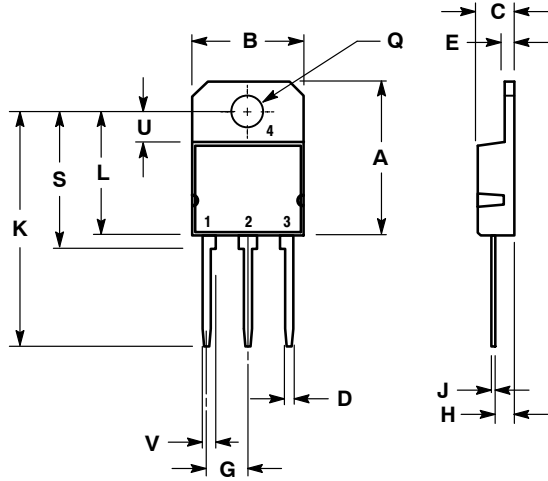


Figure 9. Darlington Schematic

# MJH11017, MJH11019, MJH11021 (PNP) MJH11018, MJH11020, MJH11022 (NPN)

## PACKAGE DIMENSIONS

### SOT-93 (TO-218) CASE 340D-02 ISSUE E

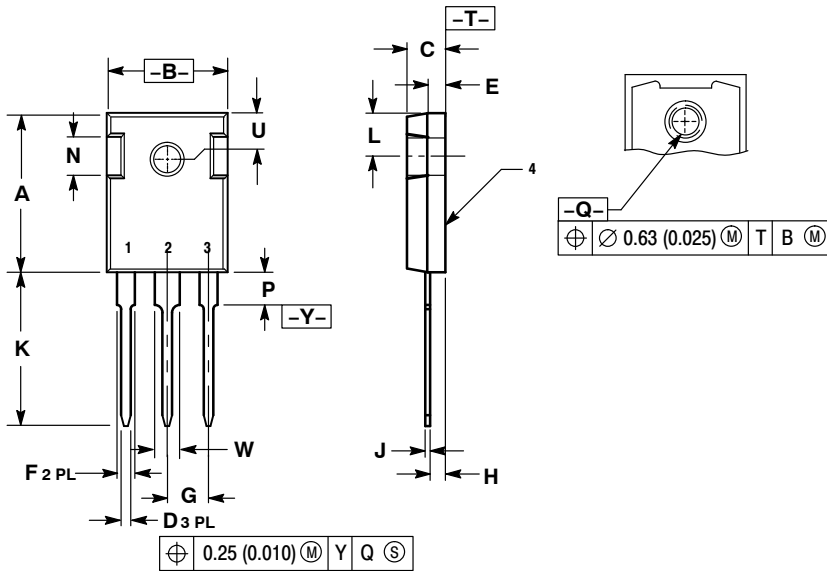


NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	---	20.35	---	0.801
B	14.70	15.20	0.579	0.598
C	4.70	4.90	0.185	0.193
D	1.10	1.30	0.043	0.051
E	1.17	1.37	0.046	0.054
G	5.40	5.55	0.213	0.219
H	2.00	3.00	0.079	0.118
J	0.50	0.78	0.020	0.031
K	31.00 REF		1.220 REF	
L	---	16.20	---	0.638
Q	4.00	4.10	0.158	0.161
S	17.80	18.20	0.701	0.717
U	4.00 REF		0.157 REF	
V	1.75 REF		0.069	

STYLE 1:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

### TO-247 CASE 340L-02 ISSUE F



NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	20.32	21.08	0.800	0.830
B	15.75	16.26	0.620	0.640
C	4.70	5.30	0.185	0.209
D	1.00	1.40	0.040	0.055
E	1.90	2.60	0.075	0.102
F	1.65	2.13	0.065	0.084
G	5.45 BSC		0.215 BSC	
H	1.50	2.49	0.059	0.098
J	0.40	0.80	0.016	0.031
K	19.81	20.83	0.780	0.820
L	5.40	6.20	0.212	0.244
N	4.32	5.49	0.170	0.216
P	---	4.50	---	0.177
Q	3.55	3.65	0.140	0.144
U	6.15 BSC		0.242 BSC	
W	2.87	3.12	0.113	0.123

STYLE 3:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

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