

# Complementary Darlington Power Transistors

DPAK For Surface Mount Applications

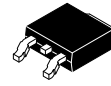
## MJD112 (NPN), MJD117 (PNP)

Designed for general purpose power and switching such as output or driver stages in applications such as switching regulators, converters, and power amplifiers.

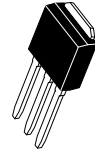
### Features

- Lead Formed for Surface Mount Applications in Plastic Sleeves (No Suffix)
- Straight Lead Version in Plastic Sleeves (“-1” Suffix)
- Electrically Similar to Popular TIP31 and TIP32 Series
- NJV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant\*

SILICON  
 POWER TRANSISTORS  
 2 AMPERES  
 100 VOLTS, 20 WATTS

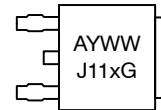


DPAK  
CASE 369C

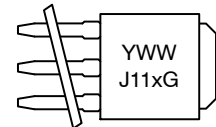


DPAK-3  
CASE 369D

### MARKING DIAGRAMS



DPAK



DPAK-3

- A = Assembly Location
- Y = Year
- WW = Work Week
- x = 2 or 7
- G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

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

## MJD112 (NPN), MJD117 (PNP)

### MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Collector–Emitter Voltage	$V_{CEO}$	100	Vdc
Collector–Base Voltage	$V_{CB}$	100	Vdc
Emitter–Base Voltage	$V_{EB}$	5	Vdc
Collector Current Continuous Peak	$I_C$	2 4	Adc
Base Current	$I_B$	50	mAdc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	20 0.16	W W/ $^\circ\text{C}$
Total Power Dissipation (Note1) @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.75 0.014	W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	–65 to +150	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction–to–Case	$R_{\theta JC}$	6.25	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction–to–Ambient (Note 1)	$R_{\theta JA}$	71.4	$^\circ\text{C}/\text{W}$

1. These ratings are applicable when surface mounted on the minimum pad sizes recommended.

# MJD112 (NPN), MJD117 (PNP)

## 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> = 30 mA <sub>dc</sub> , I <sub>B</sub> = 0)	V <sub>CEO(sus)</sub>	100	–	V <sub>dc</sub>
Collector Cutoff Current (V <sub>CE</sub> = 50 V <sub>dc</sub> , I <sub>B</sub> = 0)	I <sub>CEO</sub>	–	20	μA <sub>dc</sub>
Collector Cutoff Current (V <sub>CB</sub> = 100 V <sub>dc</sub> , I <sub>E</sub> = 0)	I <sub>CBO</sub>	–	20	μA <sub>dc</sub>
Emitter Cutoff Current (V <sub>BE</sub> = 5 V <sub>dc</sub> , I <sub>C</sub> = 0)	I <sub>EBO</sub>	–	2	mA <sub>dc</sub>
Collector–Cutoff Current (V <sub>CB</sub> = 80 V <sub>dc</sub> , I <sub>E</sub> = 0)	I <sub>CBO</sub>	–	10	μA <sub>dc</sub>
Emitter–Cutoff Current (V <sub>BE</sub> = 5 V <sub>dc</sub> , I <sub>C</sub> = 0)	I <sub>EBO</sub>	–	2	mA <sub>dc</sub>

## ON CHARACTERISTICS

DC Current Gain (I <sub>C</sub> = 0.5 A <sub>dc</sub> , V <sub>CE</sub> = 3 V <sub>dc</sub> ) (I <sub>C</sub> = 2 A <sub>dc</sub> , V <sub>CE</sub> = 3 V <sub>dc</sub> ) (I <sub>C</sub> = 4 A <sub>dc</sub> , V <sub>CE</sub> = 3 V <sub>dc</sub> )	h <sub>FE</sub>	500 1000 200	– 12,000 –	–
Collector–Emitter Saturation Voltage (I <sub>C</sub> = 2 A <sub>dc</sub> , I <sub>B</sub> = 8 mA <sub>dc</sub> ) (I <sub>C</sub> = 4 A <sub>dc</sub> , I <sub>B</sub> = 40 mA <sub>dc</sub> )	V <sub>CE(sat)</sub>	– –	2 3	V <sub>dc</sub>
Base–Emitter Saturation Voltage (I <sub>C</sub> = 4 A <sub>dc</sub> , I <sub>B</sub> = 40 mA <sub>dc</sub> )	V <sub>BE(sat)</sub>	–	4	V <sub>dc</sub>
Base–Emitter On Voltage (I <sub>C</sub> = 2 A <sub>dc</sub> , V <sub>CE</sub> = 3 V <sub>dc</sub> )	V <sub>BE(on)</sub>	–	2.8	V <sub>dc</sub>

## DYNAMIC CHARACTERISTICS

Current–Gain – Bandwidth Product (I <sub>C</sub> = 0.75 A <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1 MHz)	f <sub>T</sub>	25	–	MHz
Output Capacitance (V <sub>CB</sub> = 10 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 0.1 MHz) MJD117, NJVMJD117T4G MJD112, NJVMJD112G, NJVMJD112T4G	C <sub>ob</sub>	– –	200 100	pF

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

\*These ratings are applicable when surface mounted on the minimum pad sizes recommended.

# MJD112 (NPN), MJD117 (PNP)

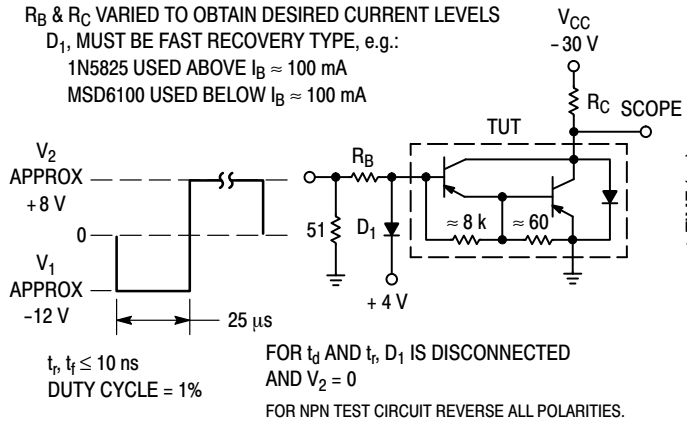


Figure 1. Switching Times Test Circuit

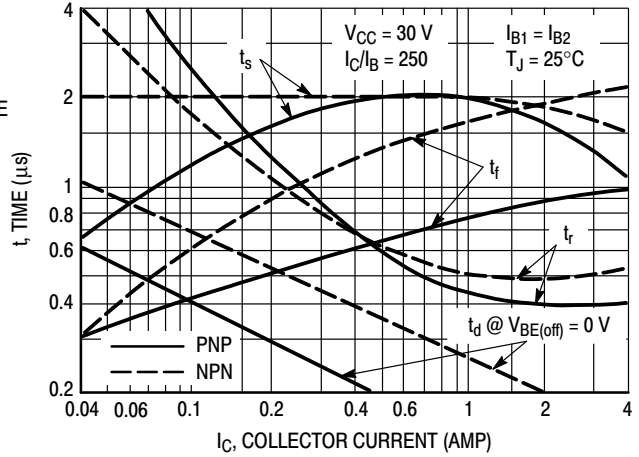


Figure 2. Switching Times

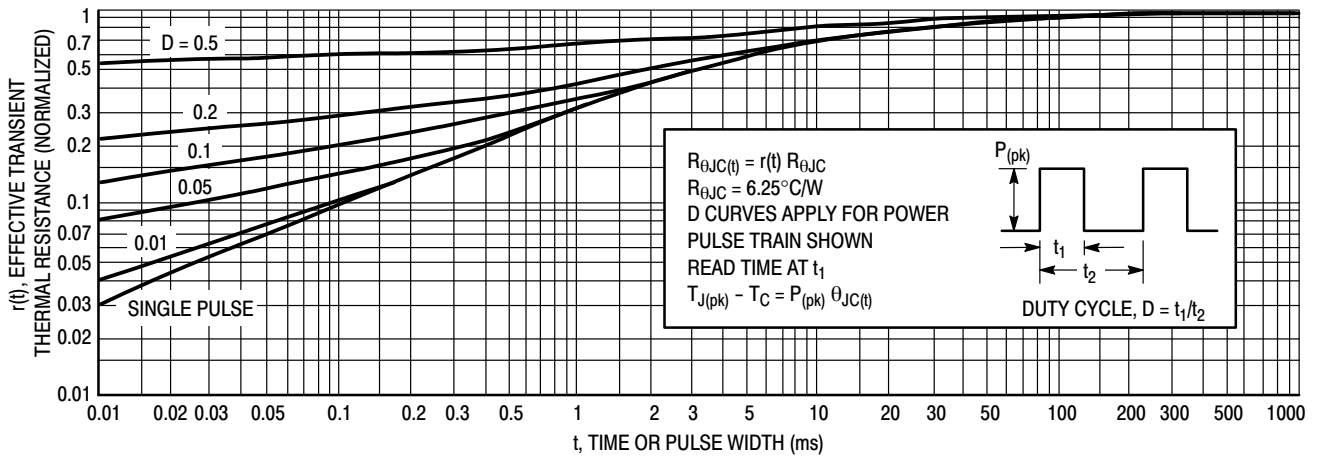
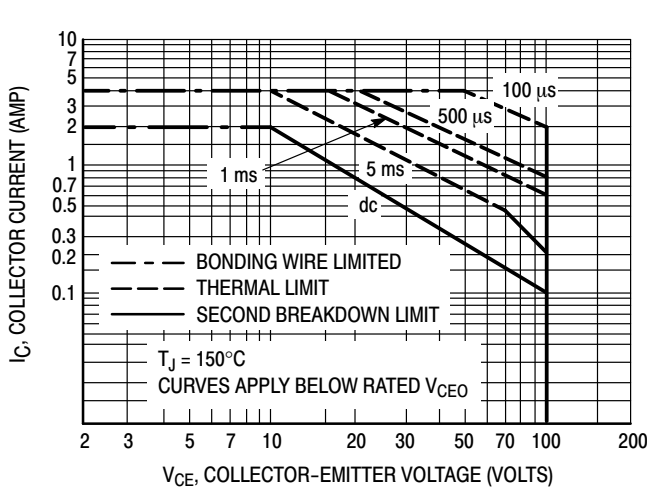


Figure 3. Thermal Response

# MJD112 (NPN), MJD117 (PNP)

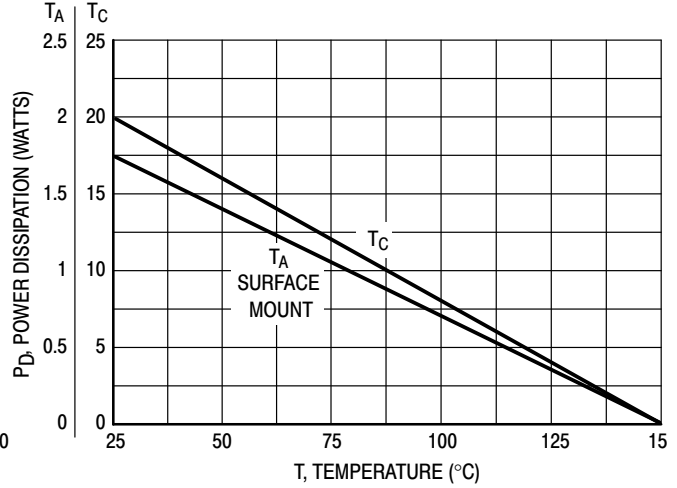
## ACTIVE-REGION SAFE-OPERATING AREA



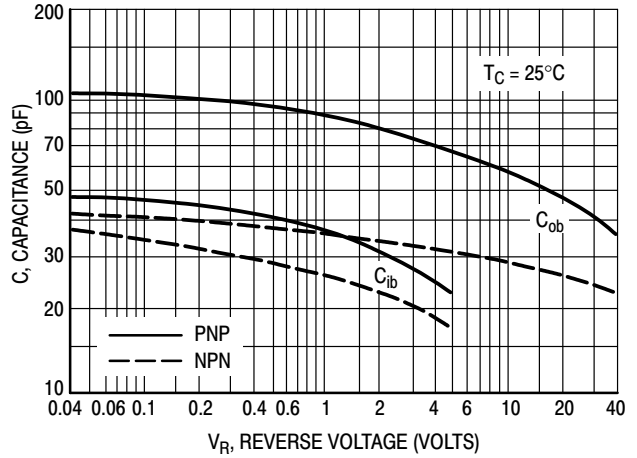
**Figure 4. Maximum Rated Forward Biased Safe Operating Area**

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 Figures 5 and 6 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  $T_{J(pk)} < 150^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.



**Figure 5. Power Derating**



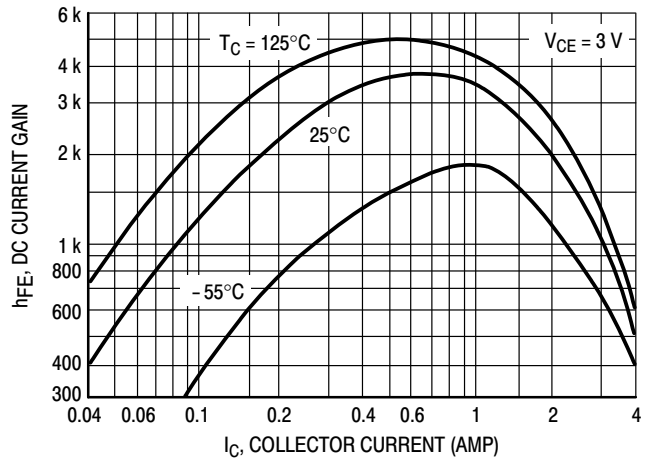
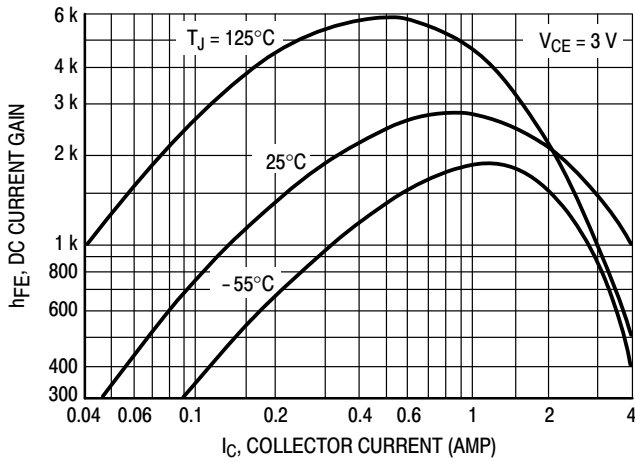
**Figure 6. Capacitance**

# MJD112 (NPN), MJD117 (PNP)

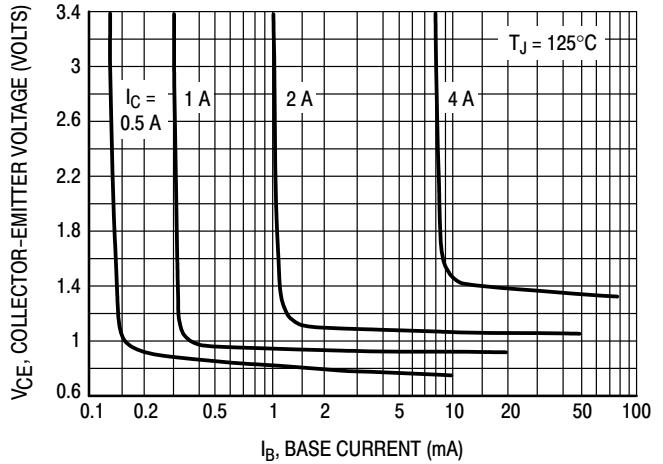
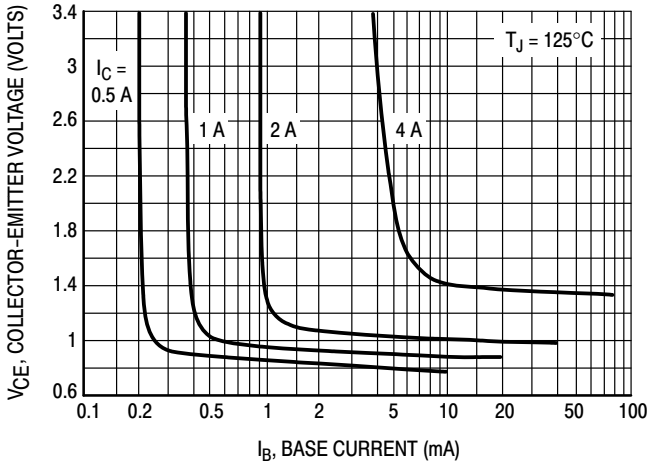
## TYPICAL ELECTRICAL CHARACTERISTICS

**NPN MJD112**

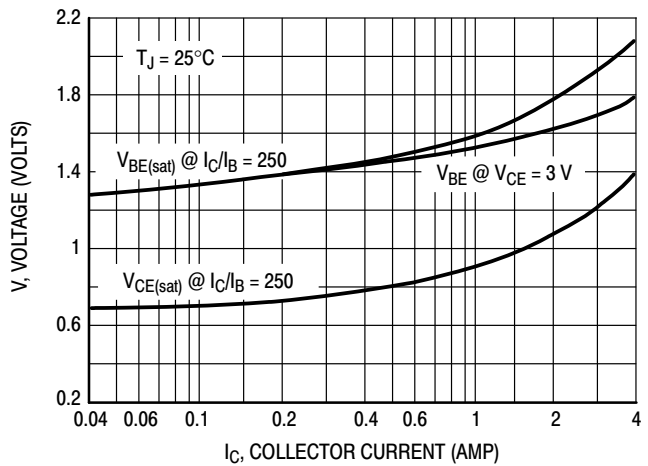
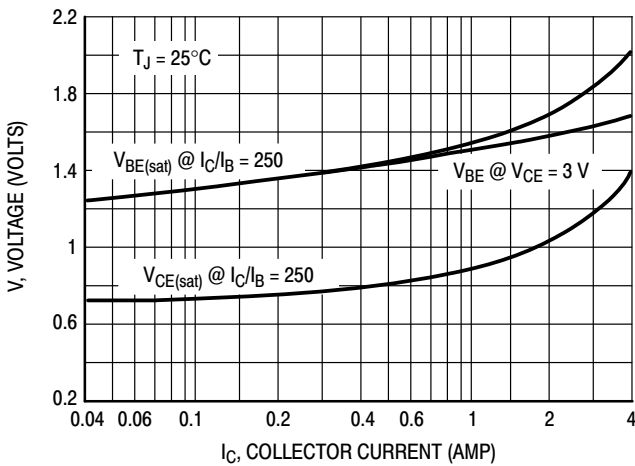
**PNP MJD117**



**Figure 7. DC Current Gain**



**Figure 8. Collector Saturation Region**



**Figure 9. "On Voltages"**

# MJD112 (NPN), MJD117 (PNP)

NPN MJD112

PNP MJD117

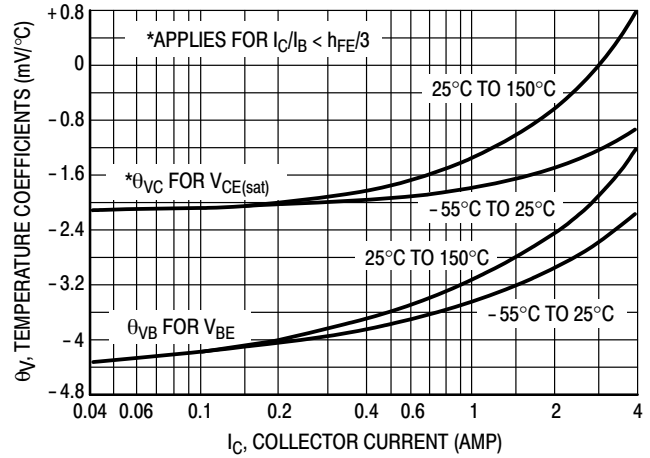
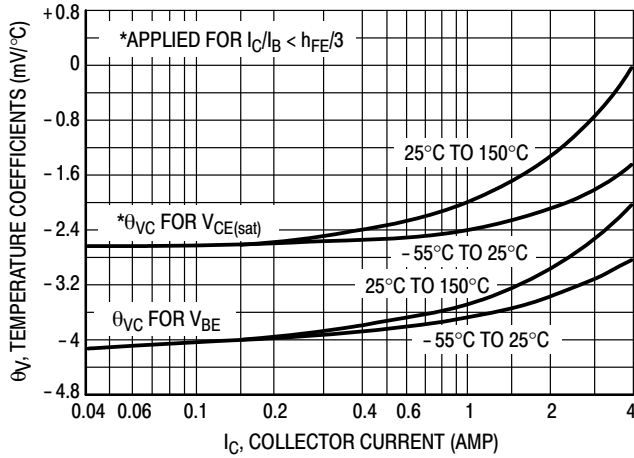


Figure 10. Temperature Coefficients

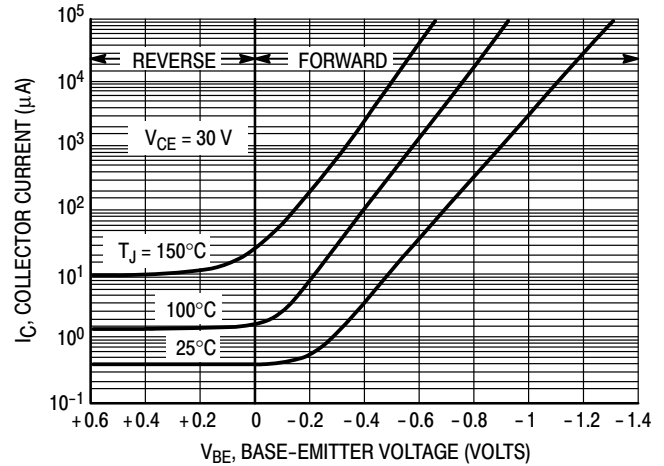
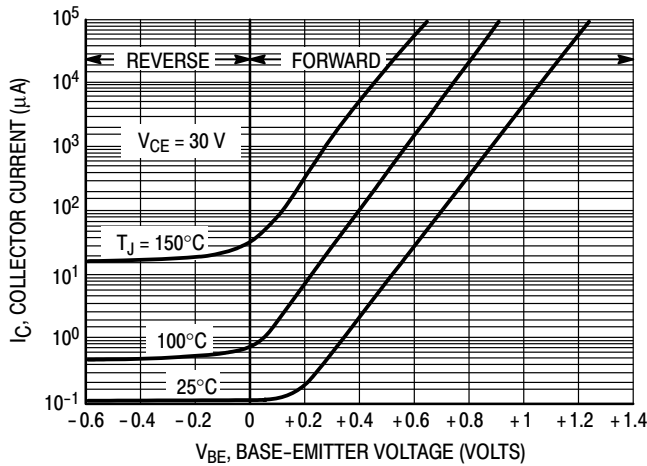


Figure 11. Collector Cut-Off Region

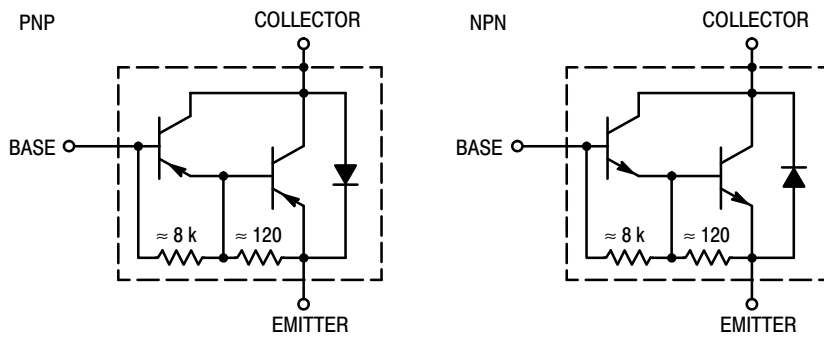


Figure 12. Darlington Schematic

## MJD112 (NPN), MJD117 (PNP)

### ORDERING INFORMATION

Device	Package Type	Package	Shipping <sup>†</sup>
MJD112G	DPAK (Pb-Free)	369C	75 Units / Rail
NJVMJD112G*	DPAK (Pb-Free)	369C	75 Units / Rail
MJD112-1G	DPAK-3 (Pb-Free)	369D	75 Units / Rail
MJD112RLG	DPAK (Pb-Free)	369C	1,800 Tape & Reel
MJD112T4G	DPAK (Pb-Free)	369C	2,500 Tape & Reel
NJVMJD112T4G*	DPAK (Pb-Free)	369C	2,500 Tape & Reel
MJD117G	DPAK (Pb-Free)	369C	75 Units / Rail
MJD117-1G	DPAK-3 (Pb-Free)	369D	75 Units / Rail
MJD117RLG	DPAK (Pb-Free)	369C	1,800 Tape & Reel
MJD117T4G	DPAK (Pb-Free)	369C	2,500 Tape & Reel
NJVMJD117T4G*	DPAK (Pb-Free)	369C	2,500 Tape & Reel

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

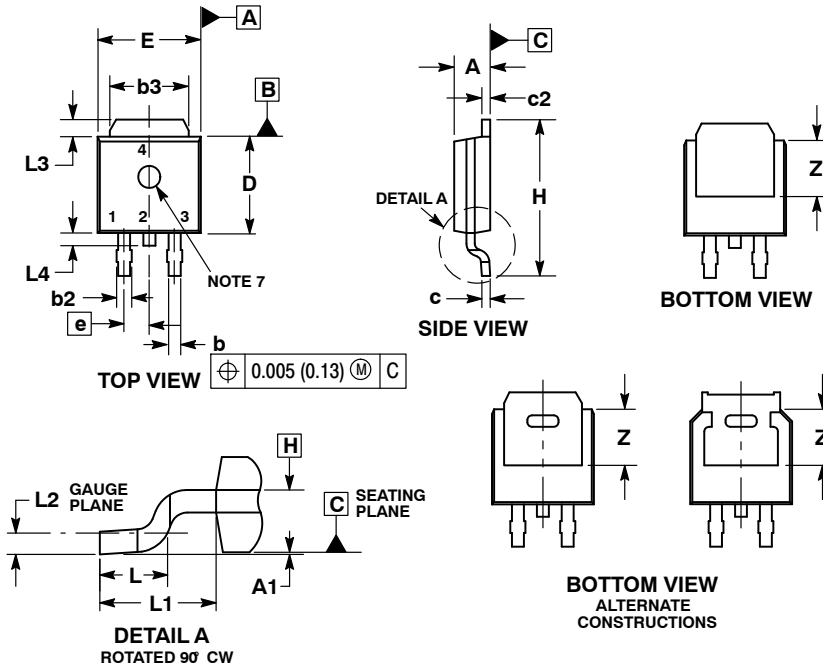
\*NJV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.



# MJD112 (NPN), MJD117 (PNP)

## PACKAGE DIMENSIONS

### DPAK (SINGLE GAUGE) CASE 369C ISSUE F



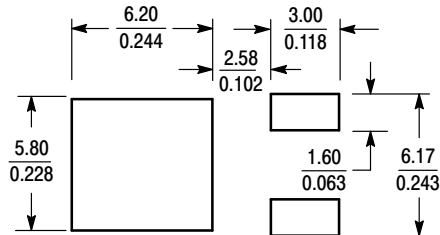
**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.
7. OPTIONAL MOLD FEATURE.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.086	0.094	2.18	2.38
A1	0.000	0.005	0.00	0.13
b	0.025	0.035	0.63	0.89
b2	0.028	0.045	0.72	1.14
b3	0.180	0.215	4.57	5.46
c	0.018	0.024	0.46	0.61
c2	0.018	0.024	0.46	0.61
D	0.235	0.245	5.97	6.22
E	0.250	0.265	6.35	6.73
e	0.090 BSC		2.29 BSC	
H	0.370	0.410	9.40	10.41
L	0.055	0.070	1.40	1.78
L1	0.114 REF		2.90 REF	
L2	0.020 BSC		0.51 BSC	
L3	0.035	0.050	0.89	1.27
L4	---	0.040	---	1.01
Z	0.155	---	3.93	---

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

### SOLDERING FOOTPRINT\*



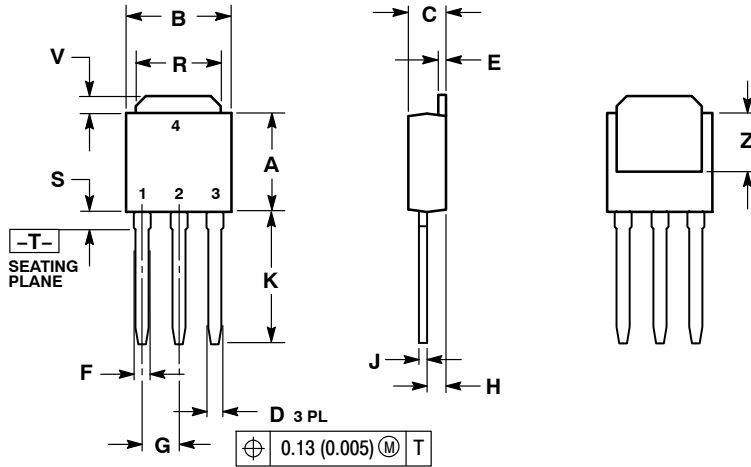
SCALE 3:1  $\left( \frac{\text{mm}}{\text{inches}} \right)$

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

# MJD112 (NPN), MJD117 (PNP)

## PACKAGE DIMENSIONS

### IPAK CASE 369D ISSUE C



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.35
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
G	0.090	BSC	2.29	BSC
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.350	0.380	8.89	9.65
R	0.180	0.215	4.45	5.45
S	0.025	0.040	0.63	1.01
V	0.035	0.050	0.89	1.27
Z	0.155	---	3.93	---

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

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Phone: 00421 33 790 2910  
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