

# Complementary Power Transistors

## DPAK For Surface Mount Applications

### MJD31 (NPN), MJD32 (PNP)

Designed for general purpose amplifier and low speed switching applications.

#### Features

- Lead Formed for Surface Mount Applications in Plastic Sleeves
- Straight Lead Version in Plastic Sleeves (“1” Suffix)
- Lead Formed Version in 16 mm Tape and Reel (“T4” Suffix)
- Electrically Similar to Popular TIP31 and TIP32 Series
- Epoxy Meets UL 94, V-0 @ 0.125 in
- 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

#### MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Collector-Emitter Voltage MJD31, MJD32 MJD31C, MJD32C	$V_{CEO}$	40 100	Vdc
Collector-Base Voltage MJD31, MJD32 MJD31C, MJD32C	$V_{CB}$	40 100	Vdc
Emitter-Base Voltage	$V_{EB}$	5.0	Vdc
Collector Current - Continuous	$I_C$	3.0	Adc
Collector Current - Peak	$I_{CM}$	5.0	Adc
Base Current	$I_B$	1.0	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	15 0.12	W W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.56 0.012	W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +150	$^\circ\text{C}$
ESD - Human Body Model	HBM	3B	V
ESD - Machine Model	MM	C	V

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	$R_{\theta JC}$	8.3	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient*	$R_{\theta JA}$	80	$^\circ\text{C}/\text{W}$
Lead Temperature for Soldering Purposes	$T_L$	260	$^\circ\text{C}$

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

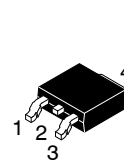
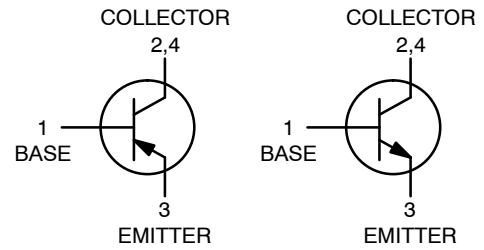


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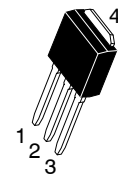
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**15 WATTS**

#### COMPLEMENTARY

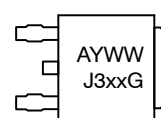


**DPAK**  
**CASE 369C**  
**STYLE 1**

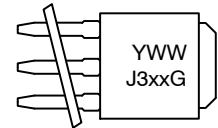


**IPAK**  
**CASE 369D**  
**STYLE 1**

#### MARKING DIAGRAMS



DPAK



IPAK

A = Site Code  
Y = Year  
WW = Work Week  
xx = 1, 1C, 2, or 2C  
G = Pb-Free Package

#### ORDERING INFORMATION

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

## MJD31 (NPN), MJD32 (PNP)

### ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
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#### OFF CHARACTERISTICS

Collector-Emitter Sustaining Voltage (Note 1) ( $I_C = 30\text{ mAdc}$ , $I_B = 0$ ) MJD31, MJD32 MJD31C, MJD32C	$V_{CEO(sus)}$	40 100	– –	Vdc
Collector Cutoff Current ( $V_{CE} = 40\text{ Vdc}$ , $I_B = 0$ ) MJD31, MJD32 ( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ ) MJD31C, MJD32C	$I_{CEO}$	– –	50 50	$\mu\text{A dc}$
Collector Cutoff Current ( $V_{CE} = \text{Rated } V_{CEO}$ , $V_{EB} = 0$ )	ICES	–	20	$\mu\text{A dc}$
Emitter Cutoff Current ( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	–	1	mA dc

#### ON CHARACTERISTICS (Note 1)

DC Current Gain ( $I_C = 1\text{ A dc}$ , $V_{CE} = 4\text{ Vdc}$ ) ( $I_C = 3\text{ A dc}$ , $V_{CE} = 4\text{ Vdc}$ )	$h_{FE}$	25 10	– 50	
Collector-Emitter Saturation Voltage ( $I_C = 3\text{ A dc}$ , $I_B = 375\text{ mA dc}$ )	$V_{CE(sat)}$	–	1.2	Vdc
Base-Emitter On Voltage ( $I_C = 3\text{ A dc}$ , $V_{CE} = 4\text{ Vdc}$ )	$V_{BE(on)}$	–	1.8	Vdc

#### DYNAMIC CHARACTERISTICS

Current Gain – Bandwidth Product (Note 2) ( $I_C = 500\text{ mA dc}$ , $V_{CE} = 10\text{ Vdc}$ , $f_{test} = 1\text{ MHz}$ )	$f_T$	3	–	MHz
Small-Signal Current Gain ( $I_C = 0.5\text{ A dc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1\text{ kHz}$ )	$h_{fe}$	20	–	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
2.  $f_T = |h_{fe}| \cdot f_{test}$ .

# MJD31 (NPN), MJD32 (PNP)

## TYPICAL CHARACTERISTICS



Figure 1. Power Derating



$R_B$  and  $R_C$  VARIED TO OBTAIN DESIRED CURRENT LEVELS  
 $D_1$  MUST BE FAST RECOVERY TYPE, e.g.:  
 1N5825 USED ABOVE  $I_B \approx 100$  mA  
 MSD6100 USED BELOW  $I_B \approx 100$  mA  
 REVERSE ALL POLARITIES FOR PNP.

Figure 2. Switching Time Test Circuit



Figure 3. Turn-On Time



Figure 4. Turn-Off Time



Figure 5. Thermal Response

# MJD31 (NPN), MJD32 (PNP)

## TYPICAL CHARACTERISTICS – MJD31, MJD31C (NPN)

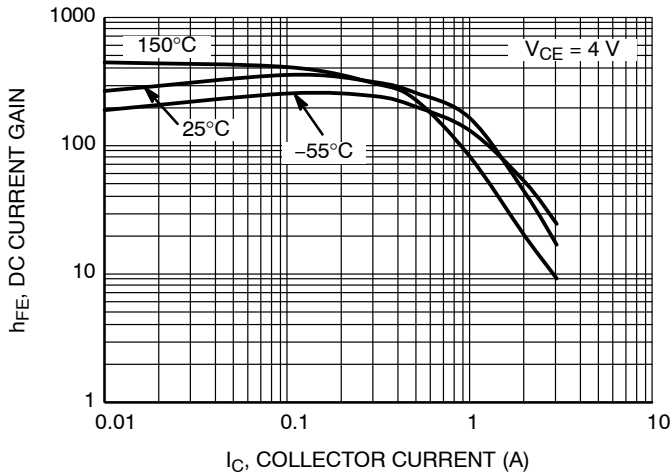


Figure 6. DC Current Gain at  $V_{CE} = 4\text{ V}$

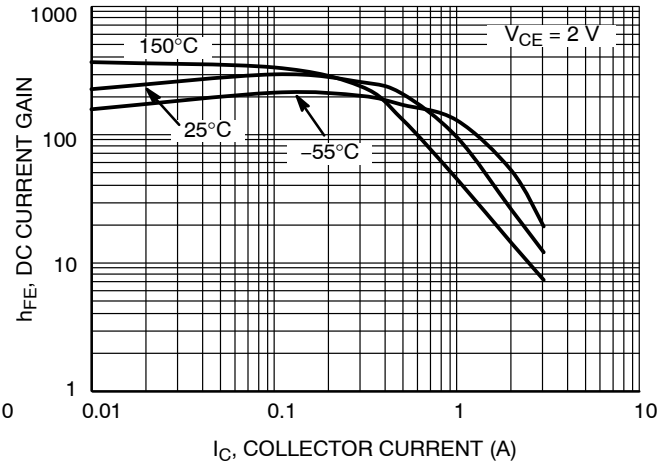


Figure 7. DC Current Gain at  $V_{CE} = 2\text{ V}$



Figure 8. Collector-Emitt Saturation Voltage

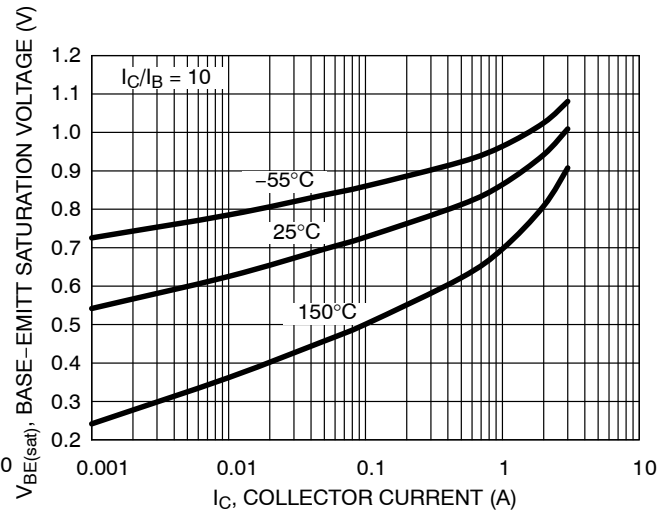


Figure 9. Base-Emitt Saturation Voltage



Figure 10. Base-Emitt "On" Voltage

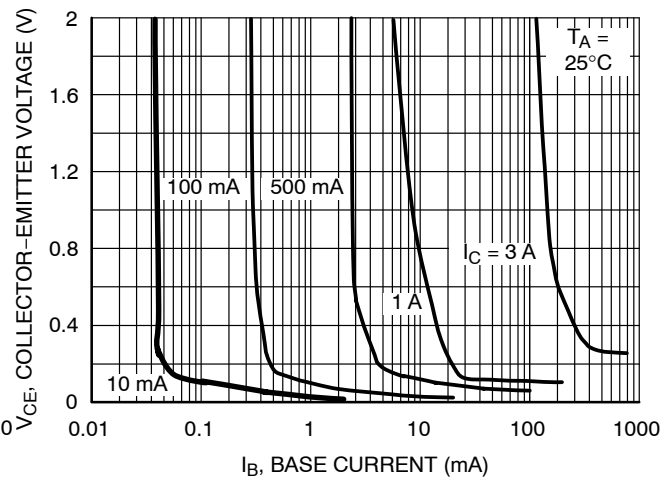


Figure 11. Collector Saturation Region

# MJD31 (NPN), MJD32 (PNP)

## TYPICAL CHARACTERISTICS – MJD31, MJD31C (NPN)

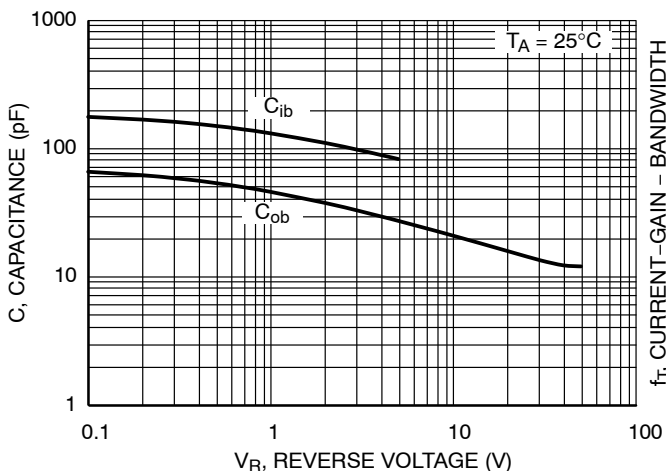


Figure 12. Capacitance

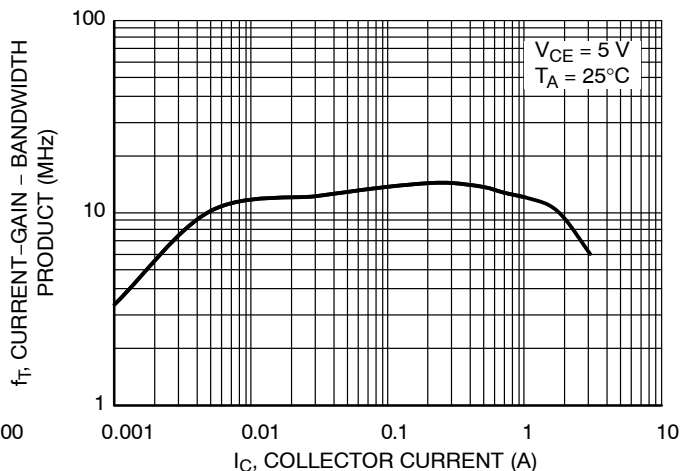


Figure 13. Current-Gain-Bandwidth Product

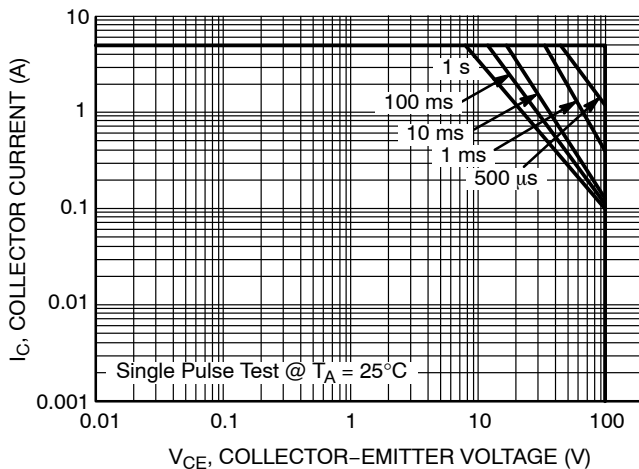


Figure 14. Safe Operating Area

# MJD31 (NPN), MJD32 (PNP)

## TYPICAL CHARACTERISTICS – MJD32, MJD32C (PNP)



Figure 15. DC Current Gain at  $V_{CE} = 4\text{ V}$

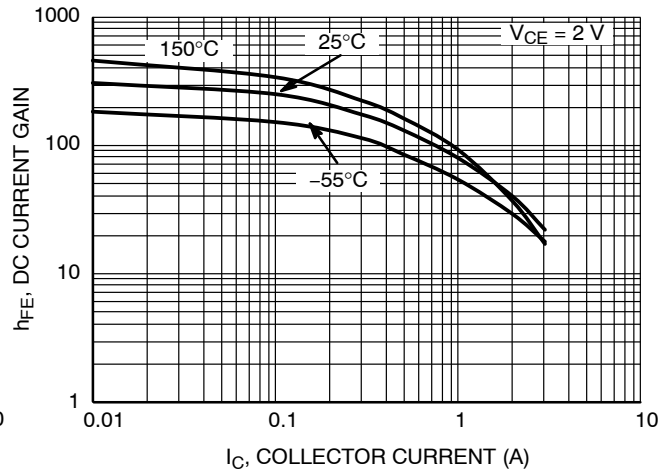


Figure 16. DC Current Gain at  $V_{CE} = 2\text{ V}$



Figure 17. Collector-Emitter Saturation Voltage

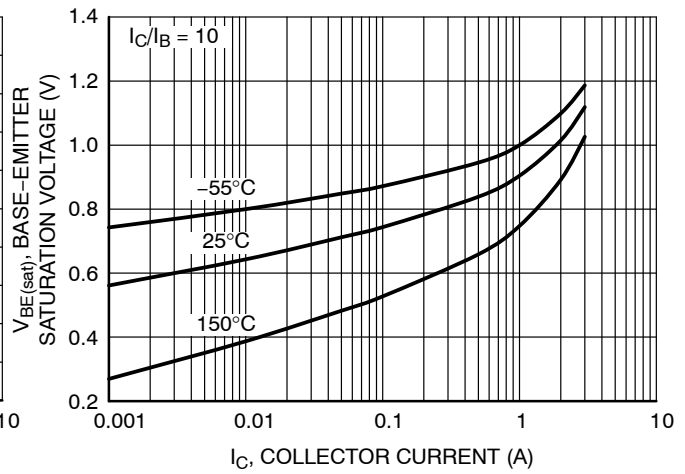


Figure 18. Base-Emitter Saturation Voltage



Figure 19. Base-Emitter "On" Voltage

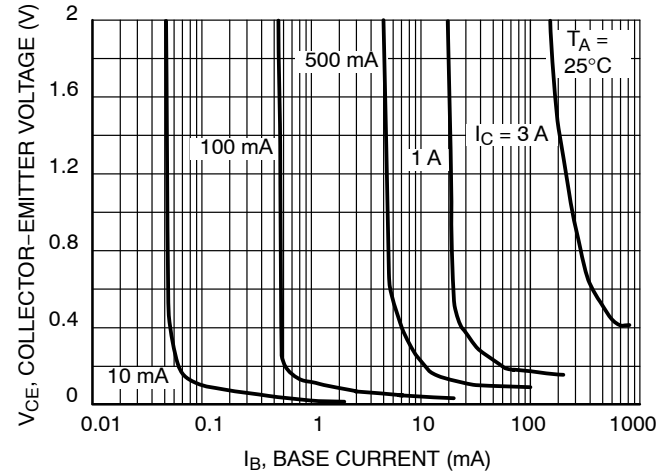


Figure 20. Collector Saturation Region

# MJD31 (NPN), MJD32 (PNP)

## TYPICAL CHARACTERISTICS

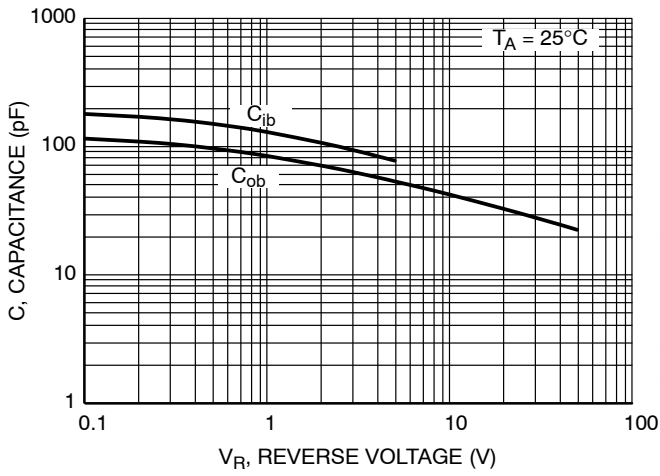


Figure 21. Capacitance



Figure 22. Current-Gain-Bandwidth Product

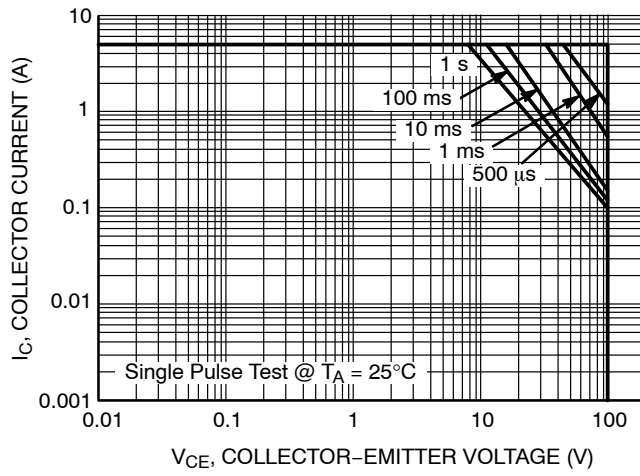


Figure 23. Safe Operating Area

## MJD31 (NPN), MJD32 (PNP)

### ORDERING INFORMATION

Device	Package Type	Package	Shipping <sup>†</sup>
MJD31CG	DPAK (Pb-Free)	369C	75 Units / Rail
NJVMJD31CG*	DPAK (Pb-Free)	369C	75 Units / Rail
MJD31C1G	IPAK (Pb-Free)	369D	75 Units / Rail
MJD31CRLG	DPAK (Pb-Free)	369C	1,800 / Tape & Reel
NJVMJD31CRLG*	DPAK (Pb-Free)	369C	1,800 / Tape & Reel
MJD31CT4G	DPAK (Pb-Free)	369C	2,500 / Tape & Reel
NJVMJD31CT4G*	DPAK (Pb-Free)	369C	2,500 / Tape & Reel
MJD31T4G	DPAK (Pb-Free)	369C	2,500 / Tape & Reel
NJVMJD31T4G*	DPAK (Pb-Free)	369C	2,500 / Tape & Reel
MJD32CG	DPAK (Pb-Free)	369C	75 Units / Rail
NJVMJD32CG*	DPAK (Pb-Free)	369C	75 Units / Rail
MJD32CRLG	DPAK (Pb-Free)	369C	1,800 / Tape & Reel
MJD32CT4G	DPAK (Pb-Free)	369C	2,500 / Tape & Reel
NJVMJD32CT4G*	DPAK (Pb-Free)	369C	2,500 / Tape & Reel
MJD32RLG	DPAK (Pb-Free)	369C	1,800 / Tape & Reel
MJD32T4G	DPAK (Pb-Free)	369C	2,500 / Tape & Reel
NJVMJD32T4G*	DPAK (Pb-Free)	369C	2,500 / Tape & Reel

†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.

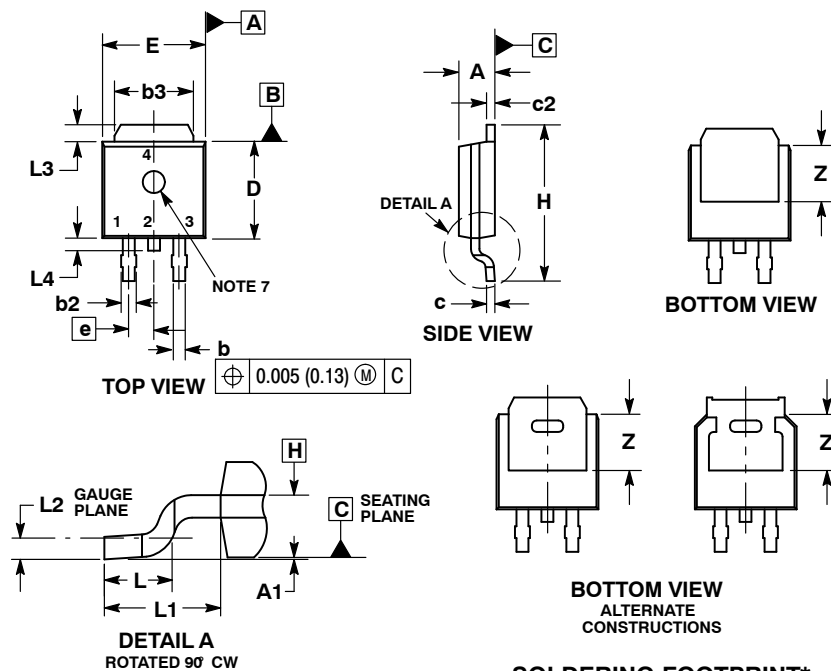
\*NJV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.



# MJD31 (NPN), MJD32 (PNP)

## PACKAGE DIMENSIONS

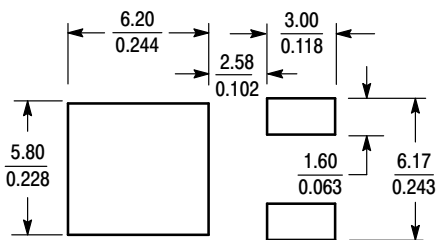
### DPAK (SINGLE GAUGE) CASE 369C ISSUE F



- 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	---

### SOLDERING FOOTPRINT\*



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

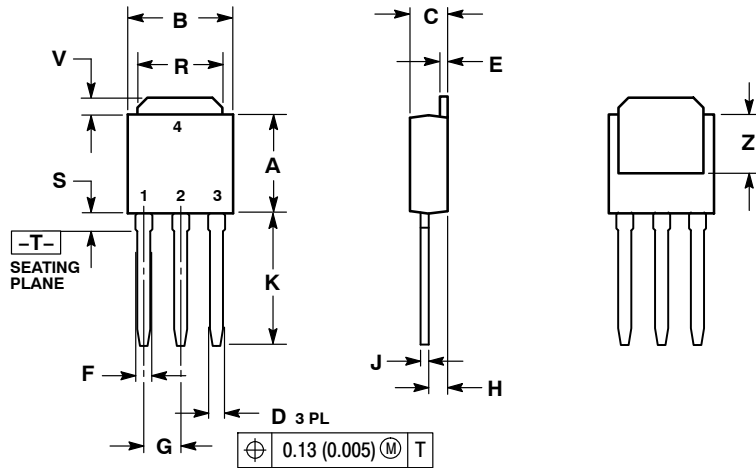
- STYLE 1:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

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

# MJD31 (NPN), MJD32 (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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