

# 2N5038 & 2N5039



## NPN High Power Silicon Transistor

Rev. V3

### Features

- Available in JAN, JANTX, JANTXV per MIL-PRF-19500/439
- TO-3 (TO-204AA) Package
- Ideal for Use in Switching Regulators, Inverters, Power Amplifiers and Oscillators



### Electrical Characteristics ( $T_A = +25^\circ\text{C}$ unless otherwise specified)

Parameter	Test Conditions	Symbol	Units	Min.	Max.
Collector - Emitter Breakdown Voltage	$I_C = 200 \text{ mA dc}$ , 2N5038 $I_C = 200 \text{ mA dc}$ , 2N5039	$V_{(BR)CEO}$	V dc	90 75	—
Collector - Base Cutoff Current	$V_{CE} = 150 \text{ V dc}$ , 2N5038 $V_{CE} = 125 \text{ V dc}$ , 2N5039	$I_{CBO}$	$\mu\text{A dc}$	—	1.0 1.0
Emitter - Base Cutoff Current	$V_{EB} = 5.0 \text{ V dc}$	$I_{EBO}$	$\mu\text{A dc}$	—	100
Collector - Emitter Cutoff Current	$V_{CE} = 100 \text{ V dc}$ , $V_{BE} = -1.5 \text{ V dc}$ , 2N5038 $V_{CE} = 85 \text{ V dc}$ , $V_{BE} = -1.5 \text{ V dc}$ , 2N5039	$I_{CEX1}$	$\mu\text{A dc}$	—	5.0 5.0
Collector - Emitter Cutoff Current	$V_{CE} = 70 \text{ V dc}$ , 2N5038 $V_{CE} = 55 \text{ V dc}$ , 2N5039	$I_{CEO}$	$\mu\text{A dc}$	—	1.0 1.0
Forward Current Transfer Ratio	$I_C = 0.5 \text{ A dc}$ , $V_{CE} = 5 \text{ Vdc}$ 2N5038 2N5039 $I_C = 2.0 \text{ A dc}$ , $V_{CE} = 5 \text{ Vdc}$ 2N5038 2N5039 $I_C = 12 \text{ A dc}$ , $V_{CE} = 5 \text{ Vdc}$ 2N5038 $I_C = 10 \text{ A dc}$ , $V_{CE} = 5 \text{ Vdc}$ 2N5039	$h_{FE}$	-	50 30 50 30 15 15	200 150
Collector - Emitter Saturation Voltage	$I_C = 12 \text{ A dc}$ , $I_B = 1.2 \text{ A dc}$ 2N5038 $I_C = 10 \text{ A dc}$ , $I_B = 1.0 \text{ A dc}$ 2N5039 $I_C = 20 \text{ A dc}$ , $I_B = 5.0 \text{ A dc}$ Both	$V_{CE(sat)1}$	V dc	—	1.0 1.0 2.5
Emitter - Base Breakdown Voltage	$I_E = 25 \text{ mA dc}$	$V_{(BR)EBO}$	V dc	7.0	—
Emitter - Base Saturation Voltage	$I_C = 20 \text{ A dc}$ , $I_B = 5.0 \text{ A dc}$	$V_{BE(sat)}$	V dc	—	3.3
Base - Emitter Voltage (nonsaturated)	$I_C = 12 \text{ A dc}$ , $V_{CE} = 5.0 \text{ V dc}$ 2N5038 $I_C = 10 \text{ A dc}$ , $V_{CE} = 5.0 \text{ V dc}$ 2N5039	$V_{BE}$	V dc	—	1.8 1.8

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Parameter	Test Conditions	Symbol	Units	Min.	Max.
Collector - Emitter Cutoff Current	$T_A = +150^\circ\text{C}$ $V_{CE} = 100\text{ V dc}, V_{BE} = -1.5\text{ V dc}, 2\text{N}5038$ $V_{CE} = 85\text{ V dc}, V_{BE} = -1.5\text{ V dc}, 2\text{N}5039$	$I_{CEX2}$	$\mu\text{A dc}$	—	100 100
Forward Current Transfer Ratio	$T_A = -55^\circ\text{C}$ $V_{CE} = 5\text{ V dc}, I_C = 12\text{ A dc}, 2\text{N}5038$ $V_{CE} = 5\text{ V dc}, I_C = 10\text{ A dc}, 2\text{N}5039$	$h_{FE4}$	-	10 10	
<b>Dynamic Characteristics</b>					
Magnitude of Small-Signal Short-Circuit Forward Current Transfer Ratio	$I_C = 2\text{ A dc}, V_{CE} = 10\text{ V dc}, f = 5\text{ MHz}$	$ h_{FE} $		12	48
Open Circuit Output Capacitance	$V_{CB} = 10\text{ V dc}, I_E = 0\text{ A dc},$ $100\text{ kHz} \leq f \leq 1\text{ MHz}$	$C_{obo}$	pF	—	500

Switching Characteristics	Symbol	Max. Value
$V_{CC} = 30 \pm 2.0\text{V dc}; I_C = 12\text{ A dc}; I_{B1} = 1.2\text{ A dc } 2\text{N}5038$	$t_{on}$	0.5 $\mu\text{S}$
$V_{CC} = 30 \pm 2.0\text{Vdc}; I_C = 10\text{ A dc}; I_{B1} = 1.0\text{ A dc } 2\text{N}5039$	$t_{on}$	0.5 $\mu\text{S}$
$V_{CC} = 30 \pm 2.0\text{Vdc}; I_C = 12\text{ A dc}; I_{B1} = -I_{B2} = 1.2\text{ A dc } 2\text{N}5038$	$t_{off}$	2.0 $\mu\text{S}$
$V_{CC} = 30 \pm 2.0\text{Vdc}; I_C = 10\text{ A dc}; I_{B1} = -I_{B2} = 1.0\text{ A dc } 2\text{N}5039$	$t_{off}$	2.0 $\mu\text{S}$

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### Absolute Maximum Ratings ( $T_A = +25^\circ\text{C}$ unless otherwise specified)

Ratings	Symbol	Value
Collector - Emitter Voltage 2N5038 2N5039	$V_{CE0}$	90 V dc 75 V dc
Collector - Base Voltage 2N5038 2N5039	$V_{CBO}$	150 V dc 125 V dc
Emitter - Base Voltage	$V_{EBO}$	7.0 V dc
Base Current	$I_B$	5.0 A dc
Collector Current	$I_C$	20 A dc
Total Power Dissipation @ $T_C = +25^\circ\text{C}^{(1)}$	$P_T$	140 W
Operating & Storage Temperature Range	$T_J, T_{STG}$	$-65^\circ\text{C}$ to $+200^\circ\text{C}$

### Thermal Characteristics

Characteristics	Symbol	Max. Value
Thermal Resistance, Junction to Case <sup>(2)</sup>	$R_{\theta JC}$	1.25°C/W

(1) Derate linearly 800 mW / °C for  $T_A > +25^\circ\text{C}$

(2) See figure 4 of MIL-PRF-19500/439 for thermal impedance curve.

### Safe Operating Area

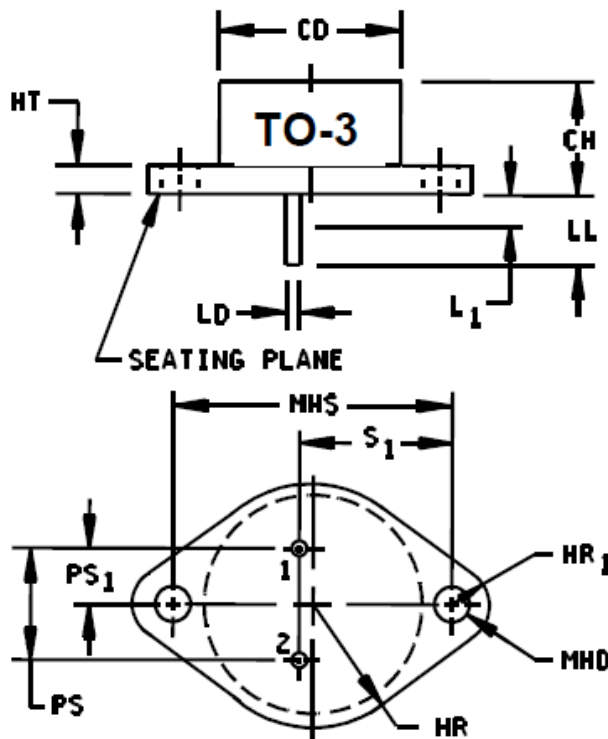
DC Tests:	$T_C = +25^\circ\text{C}$ , 1Cycle, $t = 1.0$ s
Test 1:	$V_{CE} = 28$ V dc, $I_C = 5.0$ A dc
Test 2:	$V_{CE} = 45$ V dc, $I_C = 0.9$ A dc
Test 3:	$V_{CE} = 7.0$ V dc, $I_C = 20$ A dc,
Test 4:	$V_{CE} = 90$ V dc, $I_C = 0.23$ A dc, 2N5038
Test 4:	$V_{CE} = 75$ V dc, $I_C = 0.32$ A dc, 2N5039

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### Outline Drawing (TO-3)



Symbol	Dimension				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.22	
CH	.270	.380	6.86	9.65	
HR	.495	.525	12.57	13.33	4
HR <sub>1</sub>	.131	.188	3.33	4.78	4
HT	.060	.135	1.52	3.43	
LD	.038	.053	0.97	1.35	4, 6
LL	.312	.500	7.92	12.70	
L <sub>1</sub>		.050		1.27	6
MHD	.151	.165	3.84	4.19	4
MHS	1.177	1.197	29.90	30.40	
PS	.420	.440	10.67	11.18	3
PS <sub>1</sub>	.205	.225	5.21	5.72	3
S <sub>1</sub>	.655	.675	16.64	17.15	

#### NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. These dimensions should be measured at points .050 - .055 inch (1.27 mm - 1.40 mm) below seating plane. When gauge is not used, measurement will be made at seating plane.
4. Two places.
5. The seating plane of the header shall be flat within .001 inch (0.03 mm) inside a .930 inch (23.62 mm) diameter circle on the center of the header and flat within .001 inch (0.03 mm) concave to .006 inch (0.15 mm) convex overall.
6. Lead diameter shall not exceed twice LD within L<sub>1</sub>.
7. Terminal 1 is emitter; terminal 2 is base; case is collector.

FIGURE 1. Physical dimensions. (TO-3).

### Outline Drawing

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