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°C unless otherwise specified)

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

Parameter	Test Conditions	Symbol	Units	Min.	Max.
Collector - Emitter Cutoff Current	T_A = +150°C V_{CE} = 100 V dc, V_{BE} = -1.5 V dc, 2N5038 V_{CE} = 85 V dc, V_{BE} = -1.5 V dc, 2N5039	I_{CEX2}	µA dc	— —	100 100
Forward Current Transfer Ratio	T_A = -55°C V_{CE} = 5 V dc, I_C = 12 A dc, 2N5038 V_{CE} = 5 V dc, I_C = 10 A dc, 2N5039	h_{FE4}	-	10 10	
Dynamic Characteristics					
Magnitude of Small-Signal Short-Circuit Forward Current Transfer Ratio	I_C = 2 A dc, V_{CE}= 10 V dc, f = 5 MHz	$\lvert h_{FE} \rvert$		12	48
Open Circuit Output Capacitance	V_{CB} = 10 V dc, I_E = 0 A dc, 100 kHz ≤ f ≤ 1 MHz	C_{obo}	pF	—	500

Switching Characteristics	Symbol	Max. Value
V_{CC} = 30 ± 2.0V dc; I_C = 12 A dc; I_{B1} = 1.2 A dc 2N5038	t_{on}	0.5 µS
V_{CC} = 30 ± 2.0Vdc; I_C = 10 A dc; I_{B1} = 1.0 A dc 2N5039	t_{on}	0.5 µS
V_{CC} = 30 ± 2.0Vdc; I_C = 12 A dc; I_{B1} = -I_{B2} = 1.2 A dc 2N5038	t_{off}	2.0 µS
V_{CC} = 30 ± 2.0Vdc; I_C = 10 A dc; I_{B1} = -I_{B2} = 1.0 A dc 2N5039	t_{off}	2.0 µS

Absolute Maximum Ratings (T_A = +25°C unless otherwise specified)

Ratings	Symbol	Value
Collector - Emitter Voltage 2N5038 2N5039	V_{CEO}	 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°C(1)	P_T	140 W
Operating & Storage Temperature Range	T_J, T_{STG}	-65°C to +200°C

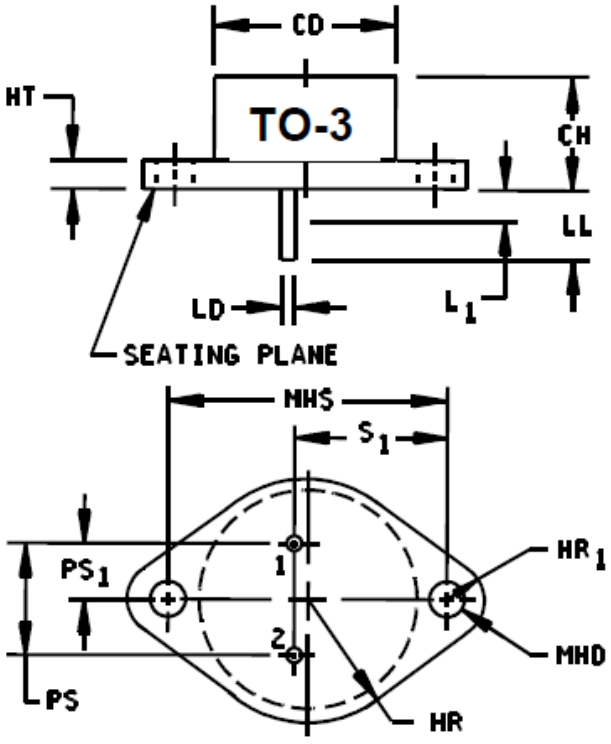
Thermal Characteristics

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

(1) Derate linearly 800 mW / °C for T_A > + 25°C
(2) See figure 4 of MIL-PRF-19500/439 for thermal impedance curve.

Safe Operating Area	
DC Tests:	T_C = +25 °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

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_1	.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_1		.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_1	.205	.225	5.21	5.72	3
S_1	.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_1.
7. Terminal 1 is emitter; terminal 2 is base; case is collector.

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

Outline Drawing