

NPN Silicon Transistors

2N5038

Fast switching speeds and high current capacity ideally suit these parts for use in switching regulators, inverters, wide-band amplifiers and power oscillators in industrial and commercial applications.

Features

- High Speed – $t_f = 0.5 \mu\text{s}$ (Max)
- High Current – $I_{C(\text{max})} = 30$ Amps
- Low Saturation – $V_{CE(\text{sat})} = 2.5$ V (Max) @ $I_C = 20$ Amps
- Pb-Free Package is Available*

MAXIMUM RATINGS (Note 1)

Symbol	Rating	Value	Unit
V_{CEO}	Collector–Emitter Voltage	90	Vdc
V_{CBO}	Collector–Base Voltage	150	Vdc
V_{CEV}	Collector–Emitter Voltage	150	Vdc
V_{EBO}	Emitter–Base Voltage	7	Vdc
I_C I_{CM}	Collector Current – Continuous Peak (Note 2)	20 30	Adc
I_B	Base Current – Continuous	5	Adc
P_D	Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	140 0.8	W W/ $^\circ\text{C}$
T_J, T_{stg}	Operating and Storage Junction Temperature Range	-65 to +200	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Symbol	Characteristics	Max	Unit
$R_{\theta JC}$	Thermal Resistance, Junction–to–Case	1.25	$^\circ\text{C}/\text{W}$

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.

1. Indicates JEDEC Registered Data.
2. Pulse Test: Pulse Width ≤ 10 ms, Duty Cycle $\leq 50\%$.

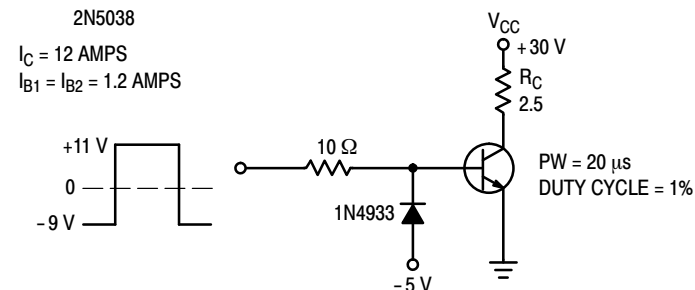
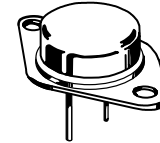


Figure 1. Switching Time Test Circuit

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

20 AMPERE NPN SILICON POWER TRANSISTORS 90 VOLTS – 140 WATTS



TO-204AA (TO-3)
CASE 1-07
STYLE 1

MARKING DIAGRAMS



- G = Pb-Free Package
- A = Assembly Location
- YY = Year
- WW = Work Week
- MEX = Country of Origin

ORDERING INFORMATION

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

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 2.

2N5038

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted) (Note 3)

Symbol	Characteristic	Min	Max	Unit
OFF CHARACTERISTICS				
$V_{CEO(sus)}$	Collector–Emitter Sustaining Voltage (Note 4) ($I_C = 200\text{ mAdc}$, $I_B = 0$)	90	–	Vdc
I_{CEX}	Collector Cutoff Current ($V_{CE} = 140\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ V}$) ($V_{CE} = 100\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$)	–	50 10	mAdc
I_{EBO}	Emitter Cutoff Current ($V_{EB} = 5\text{ Vdc}$, $I_C = 0$) ($V_{EB} = 7\text{ Vdc}$, $I_C = 0$)	–	5 50	mAdc

ON CHARACTERISTICS (Note 4)

h_{FE}	DC Current Gain ($I_C = 12\text{ Adc}$, $V_{CE} = 5\text{ Vdc}$)	20	100	–
$V_{CE(sat)}$	Collector–Emitter Saturation Voltage ($I_C = 20\text{ Adc}$, $I_B = 5\text{ Adc}$)	–	2.5	Vdc
$V_{BE(sat)}$	Base–Emitter Saturation Voltage ($I_C = 20\text{ Adc}$, $I_B = 5\text{ Adc}$)	–	3.3	Vdc

DYNAMIC CHARACTERISTICS

$ h_{fe} $	Magnitude of Common–Emitter Small–Signal Short–Circuit Forward Current Transfer Ratio ($I_C = 2\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 5\text{ MHz}$)	12	–	–
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SWITCHING CHARACTERISTICS

RESISTIVE LOAD

Rise Time	$(V_{CC} = 30\text{ Vdc})$ $(I_C = 12\text{ Adc}, I_{B1} = I_{B2} = 1.2\text{ Adc})$	t_r	–	0.5	μs
Storage Time		t_s	–	1.5	μs

3. Indicates JEDEC Registered Data.

4. Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2\%$.

ORDERING INFORMATION

Device	Package	Shipping
2N5038G	TO–204 (Pb–Free)	100 Units / Tray

DISCONTINUED (Note 5)

2N5038	TO–204	100 Units / Tray
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5. **DISCONTINUED:** This device is not recommended for new design. Please contact your **onsemi** representative for information. The most current information on this device may be available on www.onsemi.com.

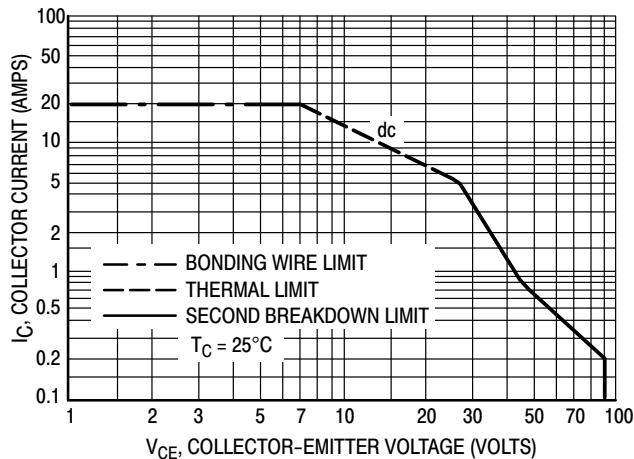


Figure 2. Forward Bias Safe Operating Area

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.

Second breakdown pulse limits are valid for duty cycles to 10%. At high case temperatures, thermal limitations may reduce the power that can be handled to values less than the limitations imposed by second breakdown.

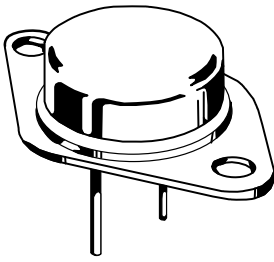
MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor

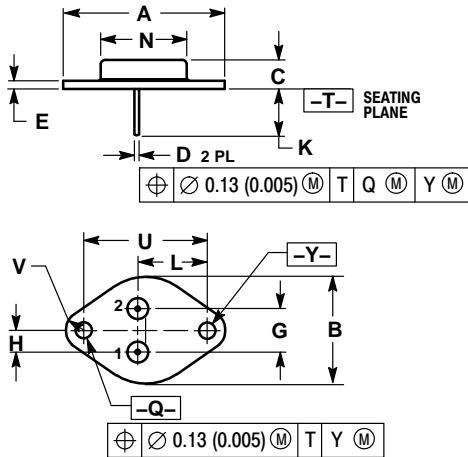


TO-204 (TO-3)
CASE 1-07
ISSUE Z

DATE 05/18/1988



SCALE 1:1



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO-204AA OUTLINE SHALL APPLY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.550 REF	---	39.37 REF	---
B	---	1.050	---	26.67
C	0.250	0.335	6.35	8.51
D	0.038	0.043	0.97	1.09
E	0.055	0.070	1.40	1.77
G	0.430 BSC	---	10.92 BSC	---
H	0.215 BSC	---	5.46 BSC	---
K	0.440	0.480	11.18	12.19
L	---	0.665 BSC	---	16.89 BSC
N	---	0.830	---	21.08
Q	0.151	0.165	3.84	4.19
U	1.187 BSC	---	30.15 BSC	---
V	0.131	0.188	3.33	4.77

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|--|--|---|---|---|
| <p>STYLE 1:
PIN 1. BASE
2. EMITTER
CASE: COLLECTOR</p> | <p>STYLE 2:
PIN 1. BASE
2. COLLECTOR
CASE: EMITTER</p> | <p>STYLE 3:
PIN 1. GATE
2. SOURCE
CASE: DRAIN</p> | <p>STYLE 4:
PIN 1. GROUND
2. INPUT
CASE: OUTPUT</p> | <p>STYLE 5:
PIN 1. CATHODE
2. EXTERNAL TRIP/DELAY
CASE: ANODE</p> |
| <p>STYLE 6:
PIN 1. GATE
2. EMITTER
CASE: COLLECTOR</p> | <p>STYLE 7:
PIN 1. ANODE
2. OPEN
CASE: CATHODE</p> | <p>STYLE 8:
PIN 1. CATHODE #1
2. CATHODE #2
CASE: ANODE</p> | <p>STYLE 9:
PIN 1. ANODE #1
2. ANODE #2
CASE: CATHODE</p> | |

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