NPN Silicon Transistors

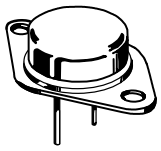
2N5038

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.

20 AMPERE
NPN SILICON
POWER TRANSISTORS
90 VOLTS − 140 WATTS

Features

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



TO−204AA (TO−3)
CASE 1−07
STYLE 1

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°C Derate above 25°C	140 0.8	W W/°C
T_J, T_{stg}	Operating and Storage Junction Temperature Range	−65 to +200	°C

THERMAL CHARACTERISTICS

Symbol	Characteristics	Max	Unit
$R_{\theta JC}$	Thermal Resistance, Junction−to−Case	1.25	°C/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 ≤ 50%.

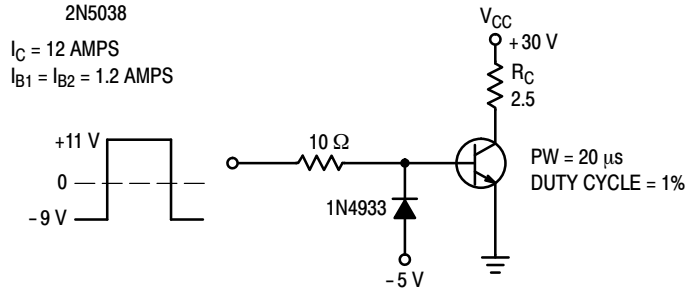


Figure 1. Switching Time Test Circuit

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

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.

ELECTRICAL CHARACTERISTICS (T_C = 25°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 mAdc, I_B = 0)	90	–	Vdc
I_{CEX}	Collector Cutoff Current (V_{CE} = 140 Vdc, $V_{BE(off)}$ = 1.5 V) (V_{CE} = 100 Vdc, $V_{BE(off)}$ = 1.5 Vdc, T_C = 150°C)	– –	50 10	mAdc
I_{EBO}	Emitter Cutoff Current (V_{EB} = 5 Vdc, I_C = 0) (V_{EB} = 7 Vdc, I_C = 0)	– –	5 50	mAdc
ON CHARACTERISTICS (Note 4)				
h_{FE}	DC Current Gain (I_C = 12 Adc, V_{CE} = 5 Vdc)	20	100	–
$V_{CE(sat)}$	Collector−Emitter Saturation Voltage (I_C = 20 Adc, I_B = 5 Adc)	–	2.5	Vdc
$V_{BE(sat)}$	Base−Emitter Saturation Voltage (I_C = 20 Adc, I_B = 5 Adc)	–	3.3	Vdc
DYNAMIC CHARACTERISTICS				
$\|h_{fe}\|$	Magnitude of Common−Emitter Small−Signal Short−Circuit Forward Current Transfer Ratio (I_C = 2 Adc, V_{CE} = 10 Vdc, f = 5 MHz)	12	–	–

SWITCHING CHARACTERISTICS

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

3. Indicates JEDEC Registered Data.
4. Pulse Test: Pulse Width ≤ 300, μs, Duty Cycle ≤ 2%.

ORDERING INFORMATION

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

DISCONTINUED (Note 5)

2N5038	TO−204	100 Units / Tray

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.

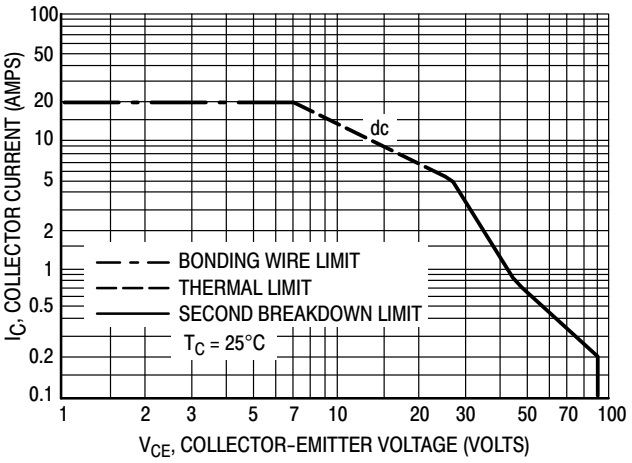
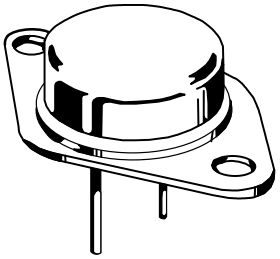


Figure 2. Forward Bias Safe Operating Area

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.

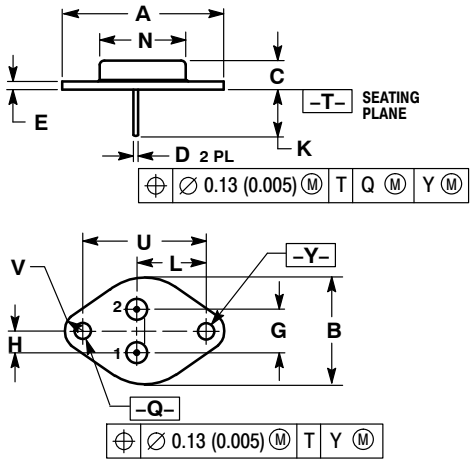
Second breakdown pulse limits are valid for duty cycles to 10%. At high case temperatures, thermal limitations may reduce the power that can be handled to values less than the limitations imposed by second breakdown.



SCALE 1:1

TO−204 (TO−3)
CASE 1−07
ISSUE Z

DATE 10 MAR 2000



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.

	INCHES		MILLIMETERS	
DIM	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

STYLE 1:
PIN 1. BASE
2. EMITTER
CASE: COLLECTOR

STYLE 2:
PIN 1. BASE
2. COLLECTOR
CASE: EMITTER

STYLE 3:
PIN 1. GATE
2. SOURCE
CASE: DRAIN

STYLE 4:
PIN 1. GROUND
2. INPUT
CASE: OUTPUT

STYLE 5:
PIN 1. CATHODE
2. EXTERNAL TRIP/DELAY
CASE: ANODE

STYLE 6:
PIN 1. GATE
2. EMITTER
CASE: COLLECTOR

STYLE 7:
PIN 1. ANODE
2. OPEN
CASE: CATHODE

STYLE 8:
PIN 1. CATHODE #1
2. CATHODE #2
CASE: ANODE

STYLE 9:
PIN 1. ANODE #1
2. ANODE #2
CASE: CATHODE

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales