

2N5684 (PNP), 2N5686 (NPN)

High-Current Complementary Silicon Power Transistors

These packages are designed for use in high-power amplifier and switching circuit applications.

Features

- High Current Capability - I_C Continuous = 50 Amperes
- DC Current Gain - $h_{FE} = 15 - 60 @ I_C = 25 \text{ Adc}$
- Low Collector-Emitter Saturation Voltage -
 $V_{CE(sat)} = 1.0 \text{ Vdc (Max) @ } I_C = 25 \text{ Adc}$
- Pb-Free Packages are Available*

MAXIMUM RATINGS (Note 1)

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	80	Vdc
Collector-Base Voltage	V_{CB}	80	Vdc
Emitter-Base Voltage	V_{EB}	5.0	Vdc
Collector Current - Continuous	I_C	50	Adc
Base Current	I_B	15	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	300 1.715	mW mW/ $^\circ\text{C}$
Operating and Storage Temperature Range	T_J, T_{stg}	-65 to +200	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	θ_{JC}	0.584	$^\circ\text{C/W}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Indicates JEDEC Registered Data.

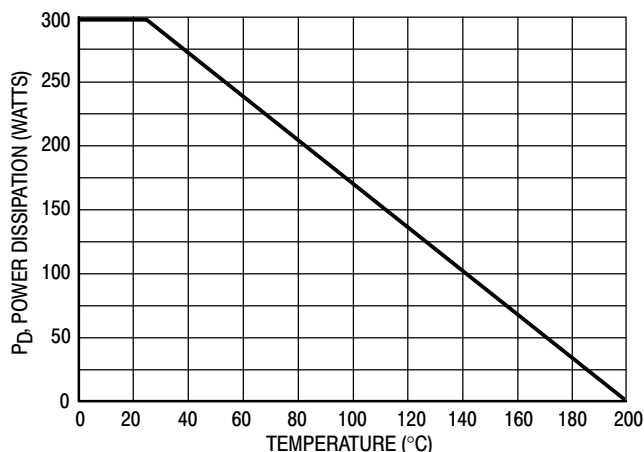


Figure 1. Power Derating

Safe Area Curves are indicated by Figure 5. All limits are applicable and must be observed.

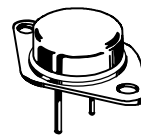


ON Semiconductor®

<http://onsemi.com>

50 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS 60-80 VOLTS, 300 WATTS

MARKING DIAGRAM



TO-204 (TO-3)
CASE 197A
STYLE 1

- 2N568x = Device Code
x = 4 or 6
G = Pb-Free Package
A = Location Code
YY = Year
WW = Work Week
MEX = Country of Origin

ORDERING INFORMATION

Device	Package	Shipping
2N5684G	TO-3 (Pb-Free)	100 Units/Tray
2N5686	TO-3	100 Units/Tray
2N5686G	TO-3 (Pb-Free)	100 Units/Tray

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

2N5684 (PNP), 2N5686 (NPN)

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted) (Note 2)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage (Note 3)	$V_{CEO(sus)}$	80	-	Vdc
Collector Cutoff Current	I_{CEO}	-	1.0	mA
Collector Cutoff Current	I_{CEX}	-	2.0	mA
		-	10	
		-	10	
Collector Cutoff Current	I_{CBO}	-	2.0	mA
Emitter Cutoff Current	I_{EBO}	-	5.0	mA

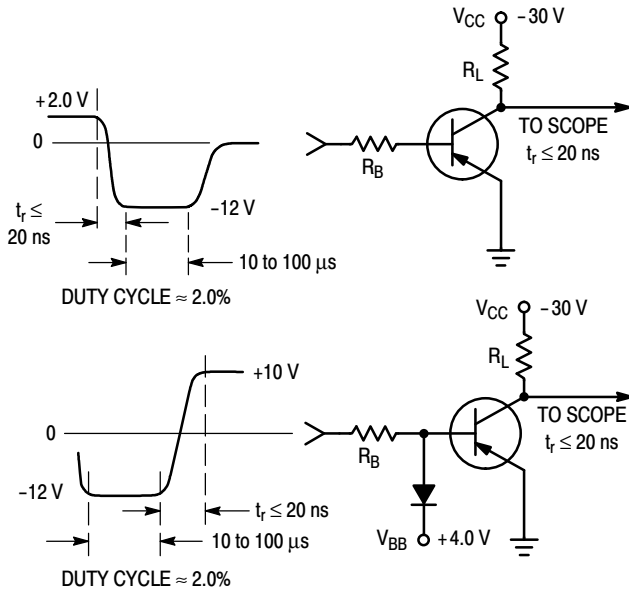
ON CHARACTERISTICS

DC Current Gain (Note 3)	h_{FE}	15	60	-
		5.0	-	
Collector-Emitter Saturation Voltage (Note 3)	$V_{CE(sat)}$	-	1.0	Vdc
		-	5.0	
Base-Emitter Saturation Voltage (Note 2)	$V_{BE(sat)}$	-	2.0	Vdc
Base-Emitter On Voltage (Note 2)	$V_{BE(on)}$	-	2.0	Vdc

DYNAMIC CHARACTERISTICS

Current-Gain - Bandwidth Product	f_T	2.0	-	MHz
Output Capacitance	C_{ob}	-	2000	pF
		-	1200	
Small-Signal Current Gain	h_{fe}	15	-	

2. Indicates JEDEC Registered Data.
 3. Pulse Test: Pulse Width $\leq 300 \mu\text{s}$, Duty Cycle $\leq 2.0\%$.



FOR CURVES OF FIGURES 3 & 6, R_B & R_L ARE VARIED.
 INPUT LEVELS ARE APPROXIMATELY AS SHOWN.
 FOR NPN CIRCUITS, REVERSE ALL POLARITIES.

Figure 2. Switching Time Test Circuit

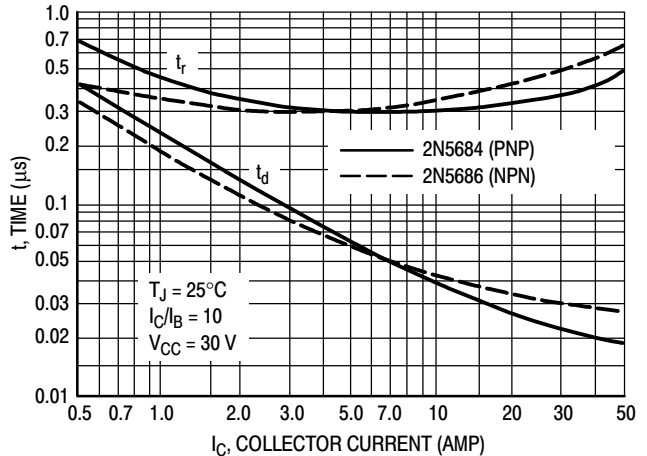


Figure 3. Turn-On Time

2N5684 (PNP), 2N5686 (NPN)

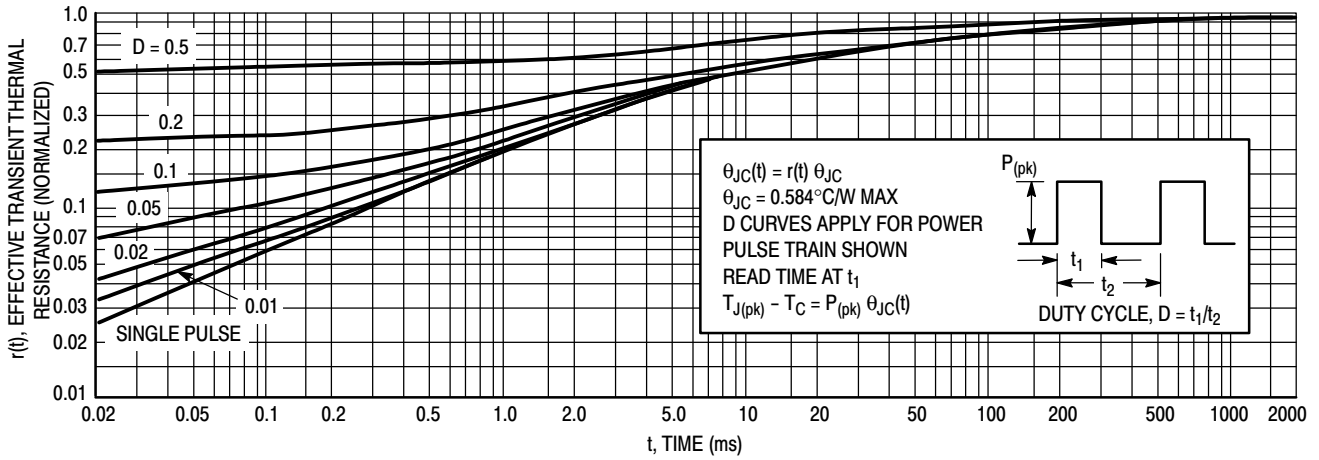


Figure 4. Thermal Response

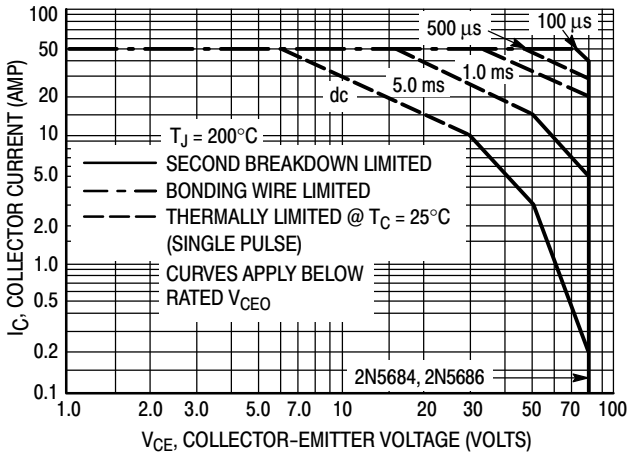


Figure 5. Active-Region Safe Operating Area

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.

The data of Figure 5 is based on $T_{J(pk)} = 200^{\circ}\text{C}$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 200^{\circ}\text{C}$. $T_{J(pk)}$ may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

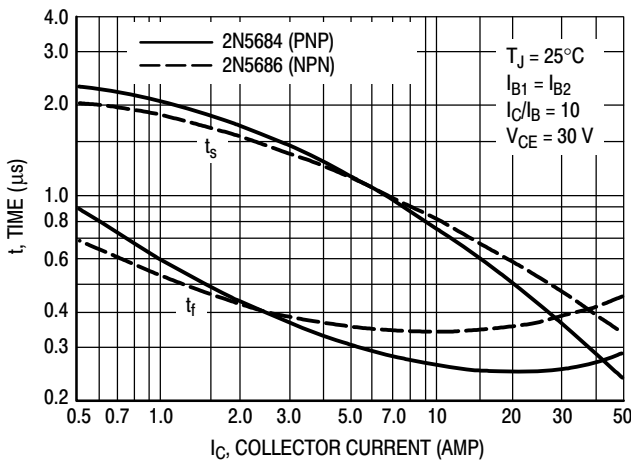


Figure 6. Turn-Off Time

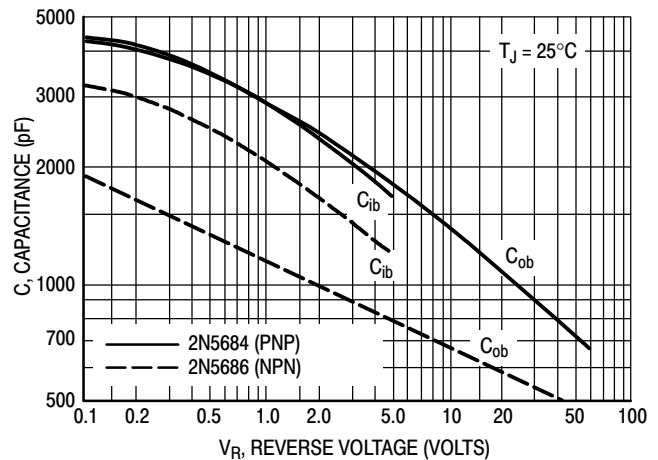


Figure 7. Capacitance

2N5684 (PNP), 2N5686 (NPN)

PNP
2N5684

NPN
2N5686

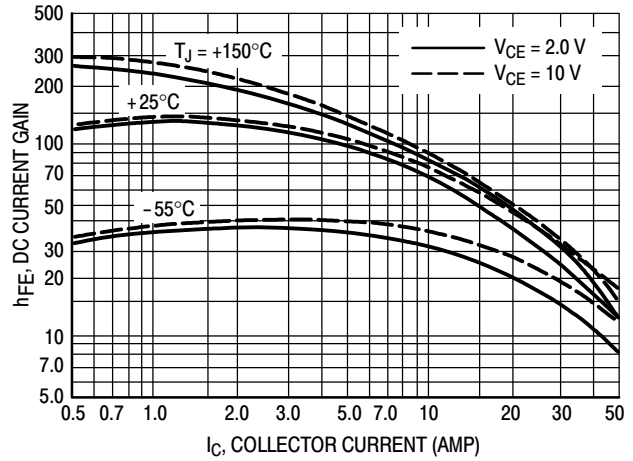
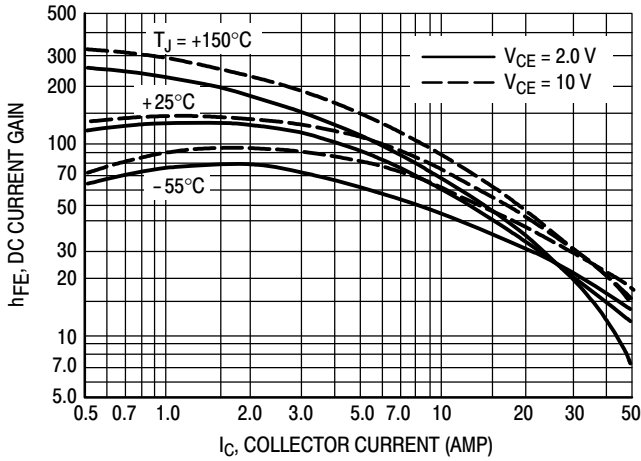


Figure 8. DC Current Gain

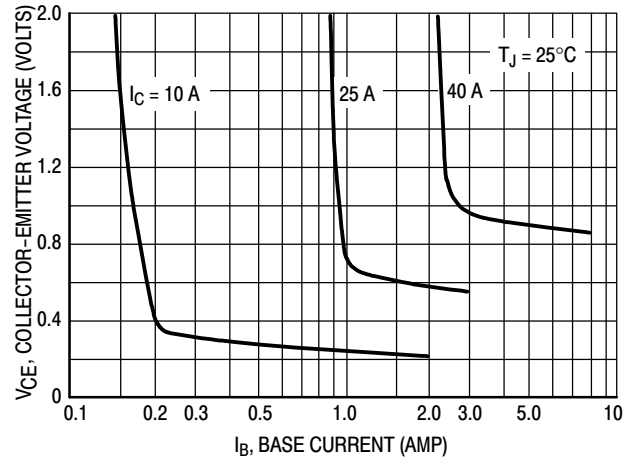
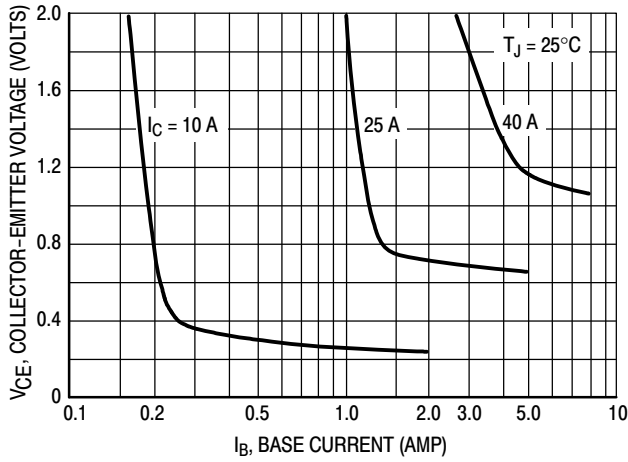


Figure 9. Collector Saturation Region

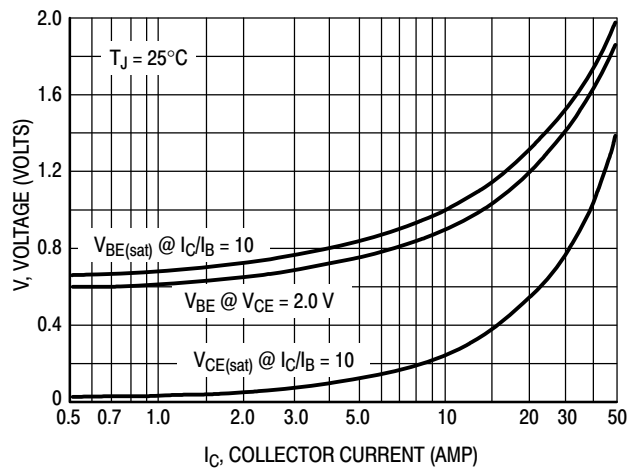
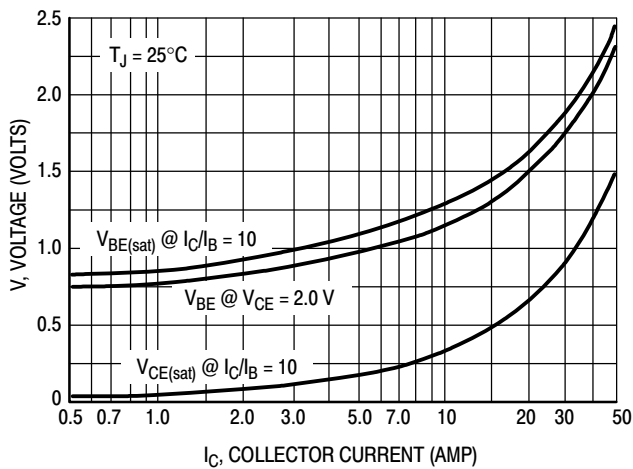
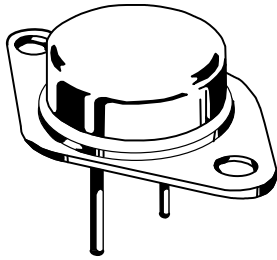


Figure 10. "On" Voltages

**MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS**

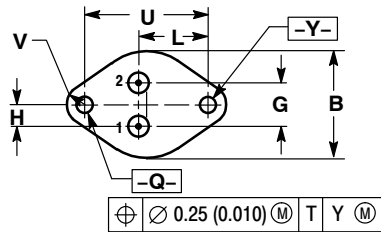
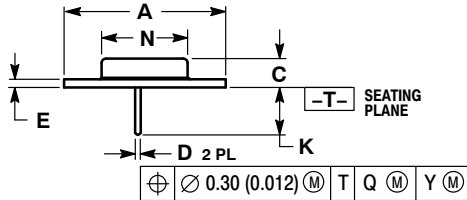
ON Semiconductor®



**TO-204 (TO-3)
CASE 197A-05
ISSUE K**

DATE 21 FEB 2000

SCALE 1:1



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

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

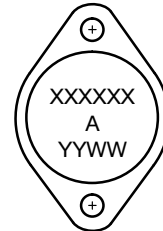
STYLE 3:
PIN 1. GATE
2. SOURCE
CASE: DRAIN

STYLE 4:
PIN 1. ANODE = 1
2. ANODE = 2
CASE: CATHODES

- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.530 REF		38.86 REF	
B	0.990	1.050	25.15	26.67
C	0.250	0.335	6.35	8.51
D	0.057	0.063	1.45	1.60
E	0.060	0.070	1.53	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	0.760	0.830	19.31	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

GENERIC MARKING DIAGRAM*



XXXXXX = Specific Device Code
A = Assembly Location
YY = Year
WW = Work Week

*This information is generic. Please refer to device data sheet for actual part marking.

DOCUMENT NUMBER:	98ASB42128B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
STATUS:	ON SEMICONDUCTOR STANDARD	
NEW STANDARD:		
DESCRIPTION:	TO-204 (TO-3)	PAGE 1 OF 2

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

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