DATA SHEET

NEC

SILICON POWER TRANSISTOR
2SC4331,4331-Z

NPN SILICON EPITAXIAL TRANSISTOR FOR HIGH-SPEED SWITCHING

The 2SC4331 and 2SC4331-Z are mold power transistors developed for high-speed switching and features a very low collector-to-emitter saturation voltage.

This transistor is ideal for use in switching regulators, DC/DC converters, motor drivers, solenoid drivers, and other low-voltage power supply devices, as well as for high-current switching.

FEATURES

- Available for high-current control in small dimension
- Z type is a lead-processed product and is deal for mounting a hybrid IC.
- Low collector saturation voltage
  $V_{CE(sat)}$ = 0.3 V MAX. (I_C = 3.0 A)
- Fast switching speed:
  $t_f \leq 0.4\ \mu s$ MAX. (I_C = 3.0 A)
- High DC current gain and excellent linearity

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

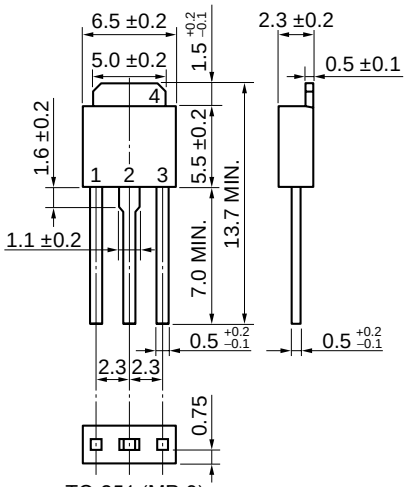
Collector to Base Voltage	V_{CBO}	150	V
Collector to Emitter Voltage	V_{CEO}	100	V
Emitter to Base Voltage	V_{EBO}	7.0	V
Collector Current (DC)	$I_{C(DC)}$	5.0	A
Collector Current (pulse) Note 1	$I_{C(pulse)}$	10	A
Base Current (DC)	$I_{B(DC)}$	2.5	A
Total Power Dissipation (T_C = 25°C)	P_{T1}	15	W
Total Power Dissipation (T_A = 25°C)	P_{T2}	1.0 Note 2, 2.0 Note 3	W
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	−55 to +150	°C

Notes 1. PW ≤ 10 ms, duty cycle ≤ 50%

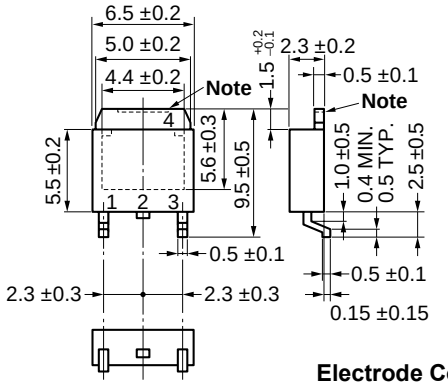
2. Printing board mounted

3. 7.5 $cm^2 \times 0.7$ mm, ceramic board mounted

PACKAGE DRAWING (Unit: mm)



<R> TO-251 (MP-3)



TO-252 (MP-3Z)

Electrode Connectio

1. Base
2. Collector
3. Emitter
4. Collector Fin

Note The depth of notch at the top of the fin is from 0 to 0.2 mm.

Document No. D16136EJ3V0DS00 (3rd edition)
Date Published January 2007 NS CP(K)
Printed in Japan

The mark <R> shows major revised points.

The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

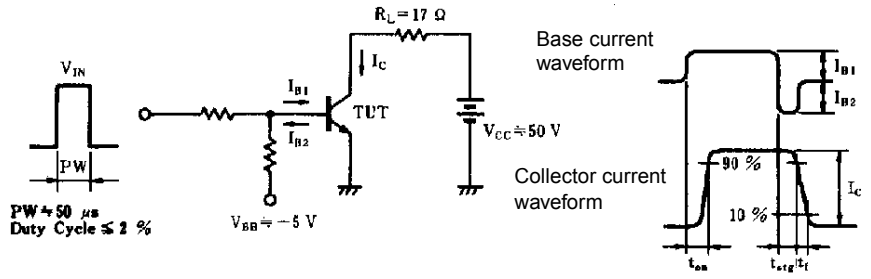
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Collector to emitter voltage	$V_{CEO(SUS)}$	I_C = 2.5 A, I_B = 0.25 A, L = 1 mH	100			V
Collector to emitter voltage	$V_{CEX(SUS)}$	I_C = 2.5 A, I_{B1} = $-I_{B2}$ = 0.25 A, $V_{BE(OFF)}$ = –1.5 V, L = 180 μH, clamped	100			V
Collector cutoff current	I_{CBO}	V_{CE} = 100 V, I_E = 0			10	μA
Collector cutoff current	I_{CER}	V_{CE} = 100 V, R_{BE} = 50 Ω, T_A = 125°C			1.0	mA
Collector cutoff current	I_{CEX1}	V_{CE} = 100 V, $V_{BE(OFF)}$ = –1.5 V			10	μA
Collector cutoff current	I_{CEX2}	V_{CE} = 100 V, $V_{BE(OFF)}$ = –1.5 V, T_A = 125°C			1.0	mA
Emitter cutoff current	I_{EBO}	V_{EB} = 5.0 V, I_C = 0			10	μA
DC current gain Note	h_{FE1}	V_{CE} = 2.0 V, I_C = 0.5 A	100			
DC current gain Note	h_{FE2}	V_{CE} = 2.0 V, I_C = 1.0 A	100	200	400	
DC current gain Note	h_{FE3}	V_{CE} = 2.0 V, I_C = 3.0 A	60			
Collector saturation voltage Note	$V_{CE(sat)1}$	I_C = 3.0 A, I_B = 0.15 A			0.3	V
Collector saturation voltage Note	$V_{CE(sat)2}$	I_C = 4.0 A, I_B = 0.2 A			0.5	V
Base saturation voltage Note	$V_{BE(sat)1}$	I_C = 3.0 A, I_B = 0.15 A			1.2	V
Base saturation voltage Note	$V_{BE(sat)2}$	I_C = 4.0 A, I_B = 0.2 A			1.5	V
Collector capacitance	C_{ob}	V_{CB} = 10 V, I_E = 0, f = 1.0 MHz		60		pF
Gain bandwidth product	f_T	V_{CE} = 10 V, I_E = –0.5 A		150		MHz
Turn-on time	t_{on}	I_C = 3.0 A, R_L = 17 Ω, I_{B1} = $-I_{B2}$ = 0.15 A, V_{CC} ≅ 50 V Refer to the test circuit.			0.3	μs
Storage time	t_{stg}				1.5	μs
Fall time	t_f				0.4	μs

Note Pulse test PW ≤ 350 μs, duty cycle ≤ 2%

h_{FE} CLASSIFICATION

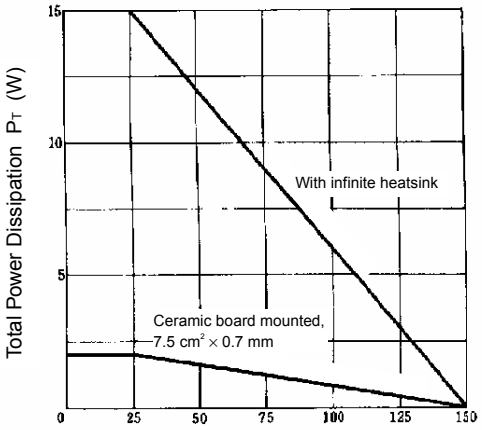
Marking	M	L	K
h_{FE2}	100 to 200	150 to 300	200 to 400

SWITCHING TIME (t_{on}, t_{stg}, t_f) TEST CIRCUIT

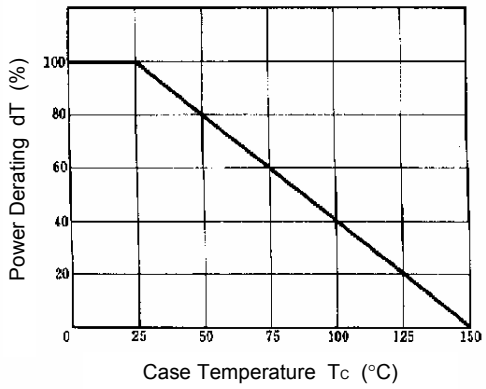


TYPICAL CHARACTERISTICS (T_A = 25°C)

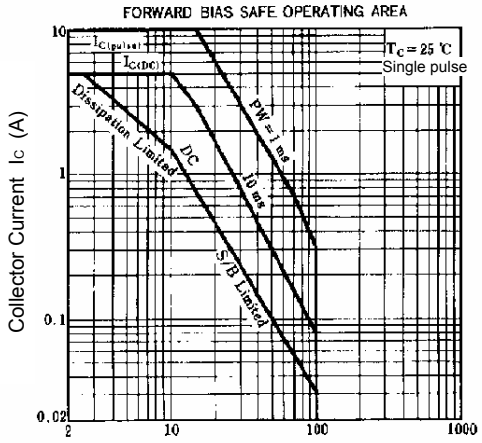
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



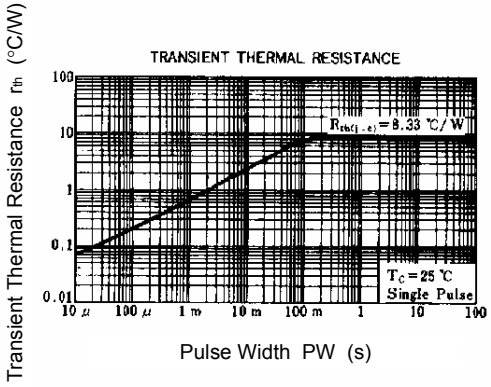
DERATING CURVE OF SAFE OPERATING AREA



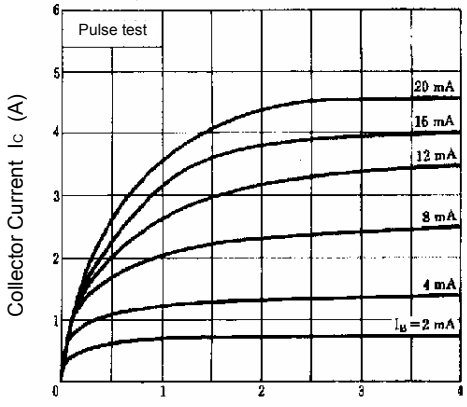
FORWARD BIAS SAFE OPERATING AREA



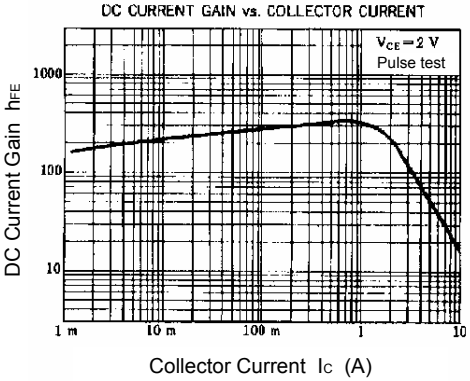
TRANSIENT THERMAL RESISTANCE

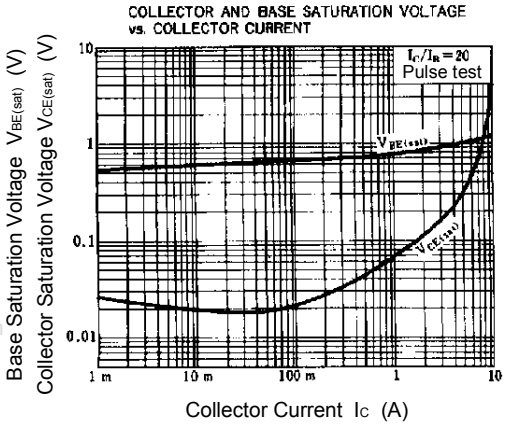


COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



DC CURRENT GAIN vs. COLLECTOR CURRENT





- **The information in this document is current as of January, 2007. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC Electronics data sheets or data books, etc., for the most up-to-date specifications of NEC Electronics products. Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.**
- No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Electronics. NEC Electronics assumes no responsibility for any errors that may appear in this document.
- NEC Electronics does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from the use of NEC Electronics products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Electronics or others.
- Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of a customer's equipment shall be done under the full responsibility of the customer. NEC Electronics assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
- While NEC Electronics endeavors to enhance the quality, reliability and safety of NEC Electronics products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC Electronics products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment and anti-failure features.
- NEC Electronics products are classified into the following three quality grades: "Standard", "Special" and "Specific".

  The "Specific" quality grade applies only to NEC Electronics products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of an NEC Electronics product depend on its quality grade, as indicated below. Customers must check the quality grade of each NEC Electronics product before using it in a particular application.

  "Standard": Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots.

  "Special": Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support).

  "Specific": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.

The quality grade of NEC Electronics products is "Standard" unless otherwise expressly specified in NEC Electronics data sheets or data books, etc. If customers wish to use NEC Electronics products in applications not intended by NEC Electronics, they must contact an NEC Electronics sales representative in advance to determine NEC Electronics' willingness to support a given application.

(Note)

(1) "NEC Electronics" as used in this statement means NEC Electronics Corporation and also includes its majority-owned subsidiaries.

(2) "NEC Electronics products" means any product developed or manufactured by or for NEC Electronics (as defined above).

M8E 02. 11-1