

To our customers,

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## Old Company Name in Catalogs and Other Documents

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On April 1<sup>st</sup>, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: <http://www.renesas.com>

April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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## HIGH SPEED HIGH CURRENT SWITCHING NPN SILICON EPITAXIAL MESA TRANSISTOR

Industrial Use

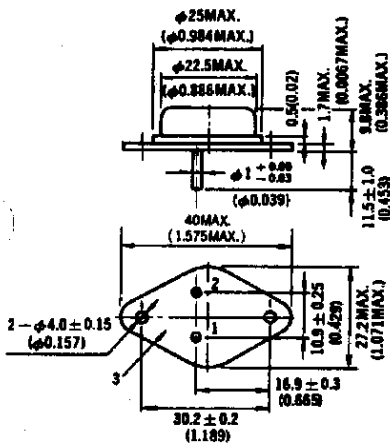
### DESCRIPTION

Suitable for switching regulator, DC-DC converter and ultrasonic appliance applications.

### FEATURES

- High speed switching.
- Low collector saturation voltage.
- Specified of reverse biased S.O.A. with inductive loads.

### PACKAGE DIMENSIONS in millimeters (inches)



1. Base
2. Emitter
3. Collector (Case)

EIAJ :TC-3, TB-3

JEDEC: TO-3

IEC :C14A, B18

### ABSOLUTE MAXIMUM RATINGS

Maximum Voltages and Currents ( $T_a = 25^\circ\text{C}$ )

Collector to Emitter Voltage	$V_{CEX}$	150	V
Collector to Emitter Sustaining Voltage	$V_{CEO(SUS)}$	100	V
Collector to Emitter Sustaining Voltage	$V_{CEX(SUS)}$	150	V
Emitter to Base Voltage	$V_{EBO}$	7.0	V
Continuous Collector Current	$I_C(DC)$	15	A
Peak Collector Current*	$I_C(pulse)$	30	A
Continuous Base Current	$I_B(DC)$	5.0	A
Peak Base Current*	$I_B(pulse)$	10	A

### Maximum Power Dissipations

Total Power Dissipation	$P_T(T_c=25^\circ\text{C})$	150	W
Total Power Dissipation	$P_T(T_c=100^\circ\text{C})$	86	W
Total Power Dissipation	$P_T(T_a=25^\circ\text{C})$	5	W

### Maximum Temperatures

Junction Temperature	$T_j$	200	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-65 to +200	$^\circ\text{C}$
Lead Temperature 1/8 inch from case for 10 seconds	$T_L$	260	$^\circ\text{C}$

### Thermal Resistances

Junction to Case	$R_{th(j-c)}$	1.17	$^\circ\text{C/W}$
Junction to Ambient	$R_{th(j-a)}$	35	$^\circ\text{C/W}$

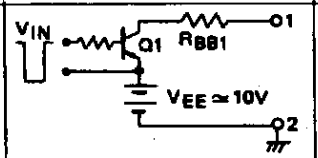
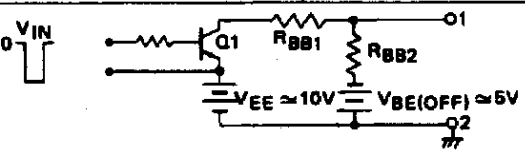
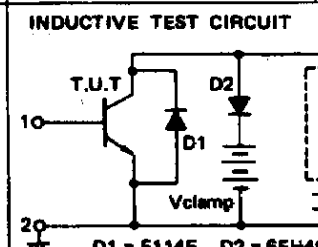
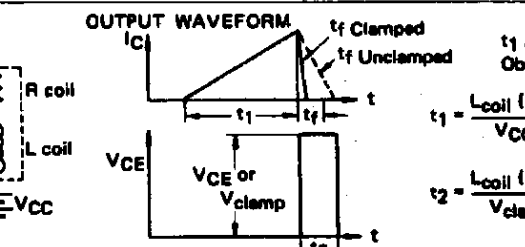
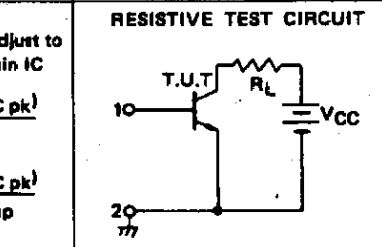
\* Pulsed  $PW \leq 300 \mu\text{s}$ , duty cycle  $\leq 10\%$

**ELECTRICAL CHARACTERISTICS (Ta = 25°C unless otherwise noted)**

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Collector to Emitter Sustaining Voltage	V <sub>CE0(SUS)</sub>	100			V	Table 1. I <sub>C</sub> = 10A, I <sub>B1</sub> = 1A, L = 50μH
	V <sub>CEx(SUS)1</sub>	150			V	Table 1. I <sub>C</sub> = 10A, I <sub>B1</sub> = -I <sub>B2</sub> = 1A V <sub>clamp</sub> = Rated V <sub>CEx</sub> , Ta = 125°C
	V <sub>CEx(SUS)2</sub>	100			V	Table 1. I <sub>C</sub> = 20A, I <sub>B1</sub> = 2A, I <sub>B2</sub> = -1A V <sub>clamp</sub> = Rated V <sub>CEx</sub> , Ta = 125°C
Collector Cutoff Current	I <sub>CER</sub>			2.0	mA	V <sub>CE</sub> = 150V, R <sub>BE</sub> = 50Ω, Ta = 125°C
	I <sub>CEx</sub>			100	μA	V <sub>CE</sub> = 150V, V <sub>BE(OFF)</sub> = -1.5V
	I <sub>CEx</sub>			1.0	mA	V <sub>CE</sub> = 150V, V <sub>BE(OFF)</sub> = -1.5V, Ta = 125°C
Emitter Cutoff Current	I <sub>EBO</sub>			10	μA	V <sub>EB</sub> = 7.0V, I <sub>C</sub> = 0
Second Breakdown Collector Current	I <sub>S/B</sub>	7.5			A	t = 1.0s, V <sub>CE</sub> = 20V, T <sub>c</sub> = 25°C
Second Breakdown Energy	E <sub>S/B</sub>	2			mJ	I <sub>C</sub> = 10A, I <sub>B1</sub> = 1.5A, V <sub>BE(OFF)</sub> = 5V
DC Current Gain	h <sub>FE1</sub>	30		180		V <sub>CE</sub> = 5V, I <sub>C</sub> = 5A **
	h <sub>FE2</sub>	20				V <sub>CE</sub> = 5V, I <sub>C</sub> = 10A **
Collector Saturation Voltage	V <sub>CE(sat)</sub>			1.0	V	I <sub>C</sub> = 10A, I <sub>B</sub> = 1.0A **
	V <sub>CE(sat)</sub>			1.5	V	I <sub>C</sub> = 10A, I <sub>B</sub> = 1.0A, Ta = 125°C **
Base Saturation Voltage	V <sub>BE(sat)</sub>			1.5	V	I <sub>C</sub> = 10A, I <sub>B</sub> = 1.0A **
	V <sub>BE(sat)</sub>			1.5	V	I <sub>C</sub> = 10A, I <sub>B</sub> = 1.0A, Ta = 125°C **
Gain Bandwidth Product	f <sub>T</sub>	20			MHz	V <sub>CE</sub> = 10V, I <sub>C</sub> = 500mA, f <sub>o</sub> = 3.0 MHz, T <sub>c</sub> = 25°C
Output Capacitance	C <sub>ob</sub>			500	pF	V <sub>CB</sub> = 10V, f <sub>o</sub> = 1.0 MHz
Delay Time	t <sub>d</sub>			0.1	μs	Resistive Load (Table 1.)
Rise Time	t <sub>r</sub>			0.7	μs	
Storage Time	t <sub>stg</sub>			2.1	μs	Ta = 125°C
	t <sub>stg</sub>			1.5	μs	I <sub>C</sub> = 10A, I <sub>B1</sub> = -I <sub>B2</sub> = 1.0A R <sub>L</sub> = 3.3Ω, V <sub>CC</sub> ≈ 50V
Fall Time	t <sub>f</sub>			3.0	μs	Ta = 125°C
	t <sub>f</sub>			0.3	μs	PW ≈ 50μs, duty cycle ≤ 2%
				1.2	μs	Ta = 125°C

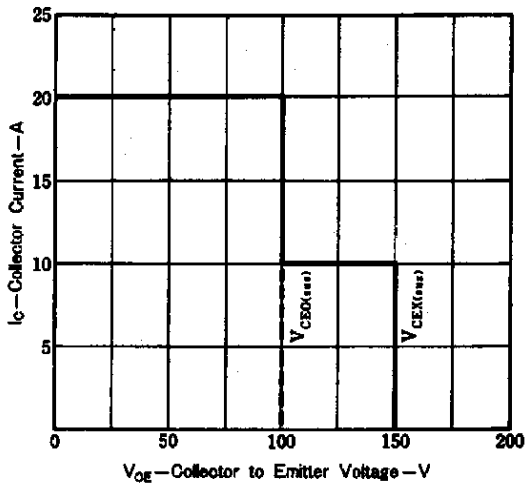
\*\* PW ≤ 350 μs, duty cycle ≤ 2%

**TABLE 1. - TEST CONDITIONS FOR DYNAMIC PERFORMANCE**

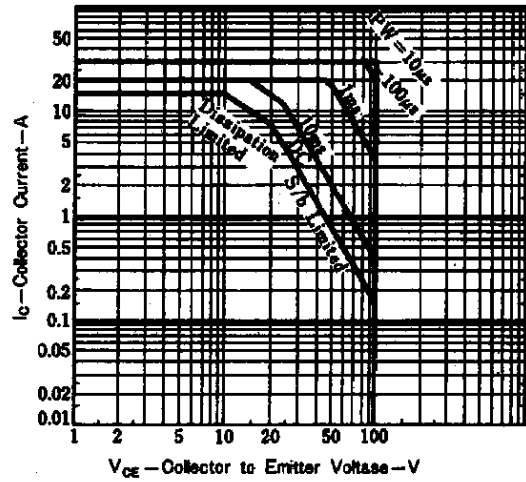
	V <sub>CE0</sub> (SUS)	V <sub>CEx</sub> (SUS)	E <sub>S/B</sub>	RESISTIVE SWITCHING
INPUT CONDITIONS	 <p>PW Varied to Attain I<sub>C</sub> = 10A</p>	 <p>PW Varied to Attain I<sub>C</sub> = 10A duty cycle ≤ 2% Q<sub>1</sub> = 2SA969</p>		
CIRCUIT VALUES	L <sub>coil</sub> = 50 μH, V <sub>CC</sub> = 10V R <sub>coil</sub> = 0.05Ω V <sub>clamp</sub> (Unclamped)	L <sub>coil</sub> = 180 μH, V <sub>CC</sub> = 20V R <sub>coil</sub> = 0.05Ω V <sub>clamp</sub> = Rated V <sub>CEx</sub> Value	L <sub>coil</sub> = 40 μH, V <sub>CC</sub> = 10V R <sub>coil</sub> = 0.05Ω, R <sub>BB2</sub> = 50Ω V <sub>clamp</sub> (Unclamped)	R <sub>L</sub> = 5.0Ω, V <sub>CC</sub> ≈ 50V
TEST CIRCUITS	 <p>D1 = F114F D2 = 6FH4S</p>	 <p>t<sub>1</sub> Adjust to Obtain I<sub>C</sub> t<sub>1</sub> Clamped t<sub>1</sub> Unclamped t<sub>1</sub> = <math>\frac{L_{coil} (I_C pk)}{V_{CC}}</math> t<sub>2</sub> = <math>\frac{L_{coil} (I_C pk)}{V_{clamp}}</math></p>		

# TYPICAL CHARACTERISTICS ( $T_a = 25^\circ\text{C}$ )

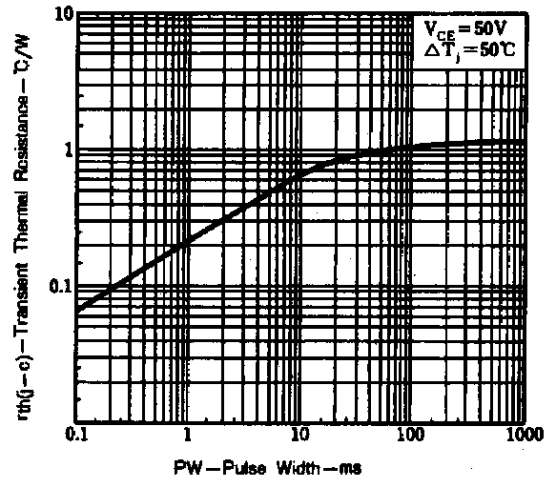
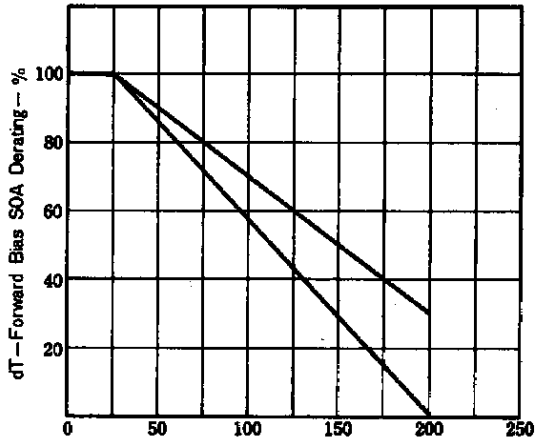
REVERSE BIAS SAFE OPERATING AREA



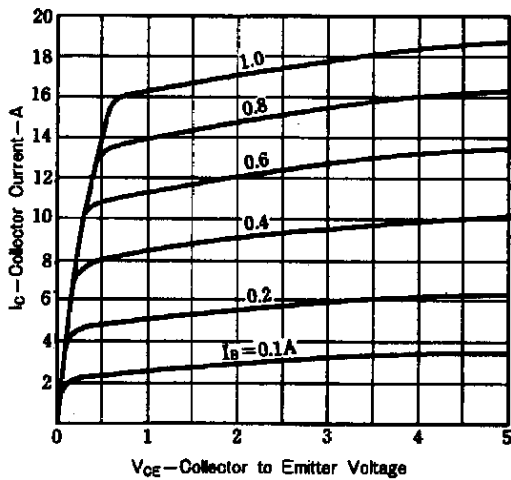
FORWARD BIAS SAFE OPERATING AREA



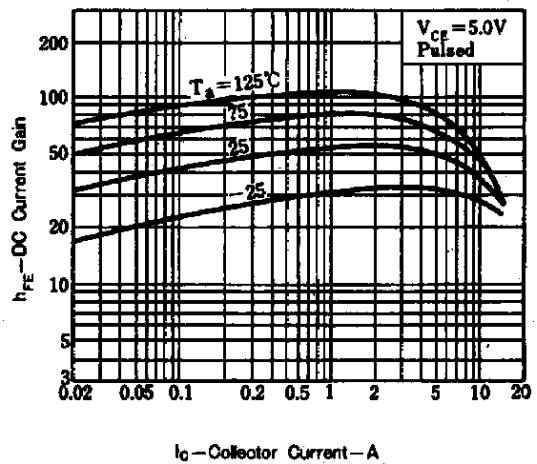
DERATING CURVE OF FORWARD BIAS SAFE OPERATING AREA



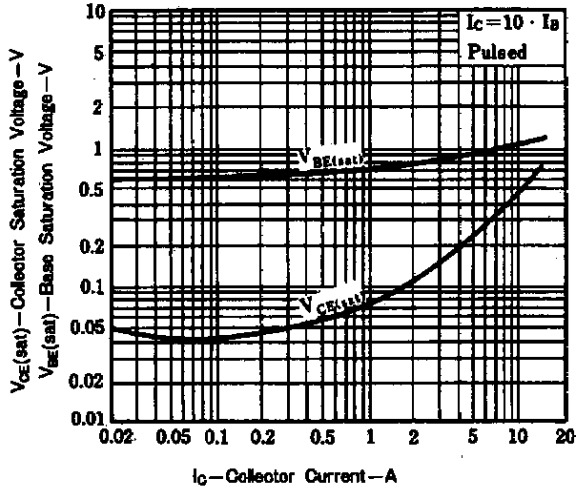
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



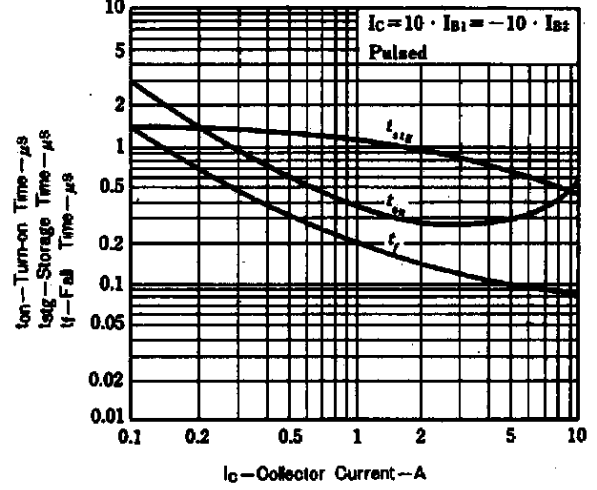
DC CURRENT GAIN vs. COLLECTOR CURRENT



BASE AND COLLECTOR SATURATION VOLTAGE vs. COLLECTOR CURRENT



TURN ON TIME, STORAGE TIME AND FALL TIME vs. COLLECTOR CURRENT



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