T-33-13

January 1990
Edition 1.1

FUJITSU

PRODUCT PROFILE

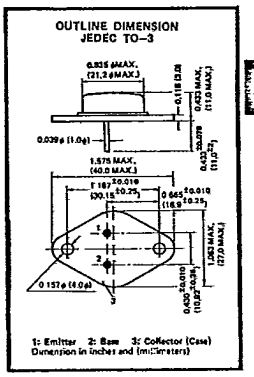
2SC2920, 2SC2429, 2SC2429A, 2SC2964, 2SC2965

Silicon High Speed Power Transistor

DESCRIPTION

This series are silicon NPN planer general purpose, high power switching transistors fabricated with Fujitsu's unique Ring Emitter Transistor (RET) technology. RET devices are constructed with multiple emitters connected through diffused ballast resistors which provide uniform current density. This structure permits the design of high power transistors with superior switching characteristics and frequency response in high current applications.

This series are especially well-suited for high speed/high voltage switching systems or other applications where large SOA is required.



Features

- ★ High voltage
- ★ Ultra-fast switching
- ★ Large safe operating area

Applications

- ★ Switching regulators
- ★ Motor controls
- ★ Ultrasonic oscillators
- ★ Class C and D amplifiers
- ★ Deflection circuits

Outline of the Series (Ta = 25 °C)

Parts Number	V_{CEO} (V) Min.	t_{stg} (μs) Typ. at 10 A	t_f (μs) Typ. at 10 A	Operating Frequency Range of Switching Regulator
2SC2920	400	1.80 *1	0.18 *1	20 ~ 50 kHz
2SC2429	400	1.80 *2	0.11 *2	50 ~ 100 kHz
2SC2429A	450			
2SC2964	400	0.84 *2	0.10 *2	100 ~ 200 kHz
2SC2965	450			

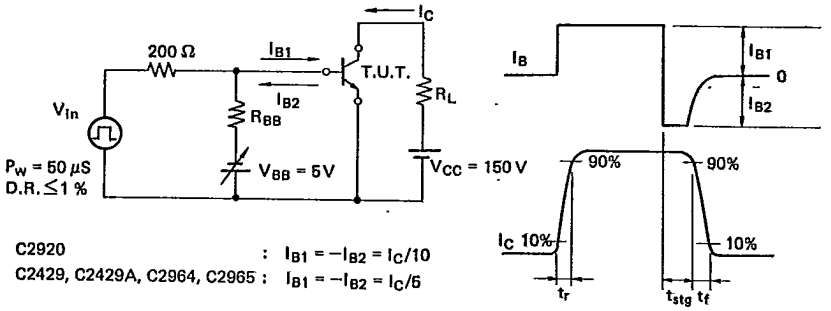
*1: $I_{B1} = -I_{B2} = 1$ A, *2: $I_{B1} = -I_{B2} = 2$ A

Maximum Ratings (Ta = 25 °C)

Item	Symbol	Test Condition	Ratings					Unit
			2SC2920	2SC2429	2SC2429A	2SC2964	2SC2965	
Storage Temperature	T_{stg}		−65 ~ +175					°C
Junction Temperature	T_j		+175					°C
Collector-Base Voltage	V_{CBO}		450		600			V
Emitter-Base Voltage	V_{EBO}		7.0					V
Collector-Emitter Voltage	V_{CEO}		400		450	400	450	V
Collector Current-Continuous	I_C		15					A
Collector Current-Pulsed	I_{CP}	$P_W \leqq 10$ mS D.R. $\leqq 2$ %	20					A
Base Current-Continuous	I_B		5					A
Collector Power Dissipation	P_C	Tc = 25 °C	150					W

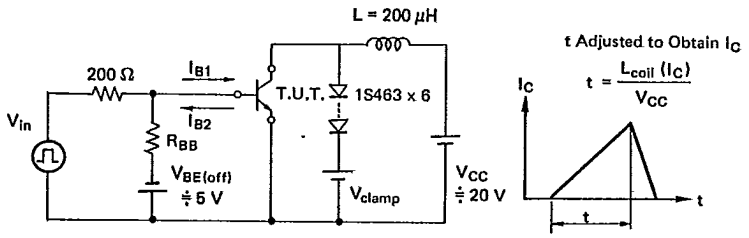
MAY 1982

- **Test Circuit used for Measurement of Switching Time (Resistive)**



C2920 : $I_{B1} = -I_{B2} = I_C/10$
C2429, C2429A, C2964, C2965 : $I_{B1} = -I_{B2} = I_C/5$

- **Test Circuit used for Measurement of $V_{CEX(SUS)}$ and Reverse Bias Safe Operating Area**



ⓐ $V_{CEX(SUS)}$
I_C = 8 A, I_{B1} = 2 A, I_{B2} = −1 A, R_{BB} = 5 Ω, V_{clamp} = 450 V

ⓑ Reverse Bias Safe Operating Area
$I_{B1} \leq 4$ A, I_{B2} = −1 A, R_{BB} = 5 Ω

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Edition 1.1

FUJITSU

PRODUCT PROFILE

T-33-13

2SC2920

Silicon High Speed Power Transistor

ABSOLUTE MAXIMUM RATINGS (Ta = 25 °C)

Rating	Symbol	2SC2920	Unit
Collector to Emitter Voltage	V_{CEO}	400	V
Collector to Base Voltage	V_{CBO}	450	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current-Continuous	I_C	15	A
Collector Current-Pulsed ($P_W \leq 10$ mS, D.R. ≤ 2 %)	I_{CP}	20	A
Base Current-Continuous	I_B	5	A
Collector Power Dissipation (T_C = 25 °C)	P_C	150	W
Junction Temperature	T_j	175	°C
Storage Temperature Range	T_{stg}	−65 ~ +175	°C

ELECTRICAL CHARACTERISTICS (Ta = 25 °C)

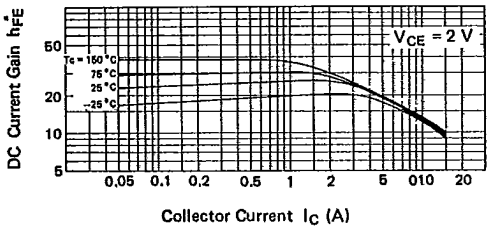
Parameters	Symbols	Test Conditions	Limits			Unit
			Min.	Typ.	Max.	
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	I_C = 100 μA, I_E = 0	450	–	–	V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	I_E = 1 mA, I_C = 0	7	–	–	V
Collector to Emitter Sustaining Voltage	$V_{CEO(SUS)}$	I_C = 1 A, R_{BE} = ∞ Ω	400	–	–	V
Collector to Emitter Sustaining Voltage	$V_{CEX(SUS)}$	I_C = 8 A, I_{B2} = −1 A, L = 200 μH (*1)	450	–	–	V
Collector Cutoff Current	I_{CBO}	V_{CB} = 450 V, I_E = 0	–	–	100	μA
Emitter Cutoff Current	I_{EBO}	V_{EB} = 6 V, I_C = 0	–	–	100	μA
DC Current Gain	h_{FE}	V_{CE} = 2 V, I_C = 10 A (*2)	10	13	30	–
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 10 A, I_B = 1 A (*2)	–	0.56	1.0	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$		–	1.2	1.5	V
Output Capacitance	C_{ob}	V_{CB} = 10 V, I_E = 0, f = 1 MHz	–	240	–	PF
Gain Bandwidth Product	f_T	V_{CE} = 10 V, I_C = 2 A	–	30	–	MHz
Rise Time	t_r	V_{CC} = 150 V (*1) I_C = 10 A, I_{B1} = −I_{B2} = 1 A	–	0.20	0.5	μs
Storage Time	t_{stg}		–	1.80	3.0	μs
Fall Time	t_f		–	0.18	0.3	μs

*1 Test Circuit
*2 Pulsed $P_W \leq 300$ μs, Duty Ratio ≤ 6 %

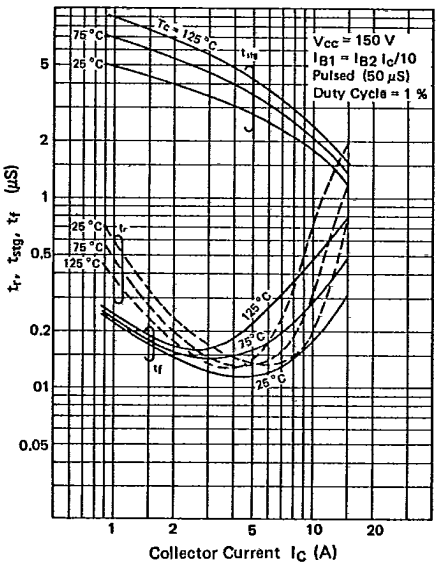
MARCH 1981

2SC2920

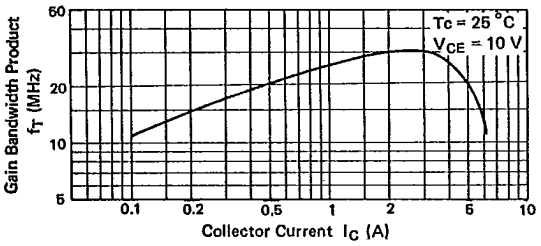
DC Current Gain



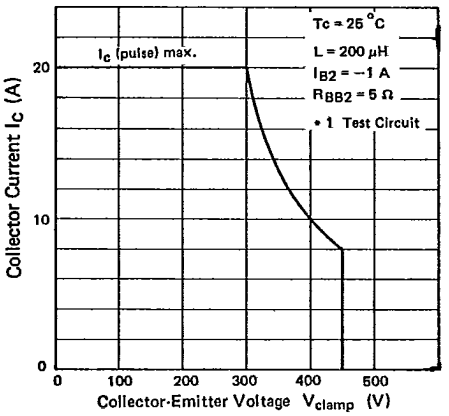
Switching Time



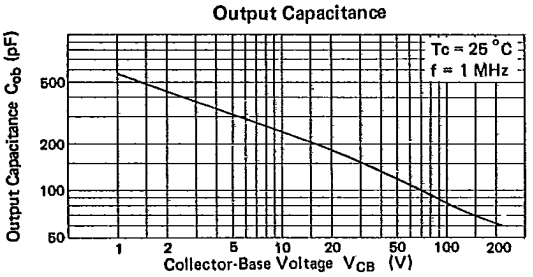
Gain Bandwidth Product



Reverse Bias Safe Operating Area

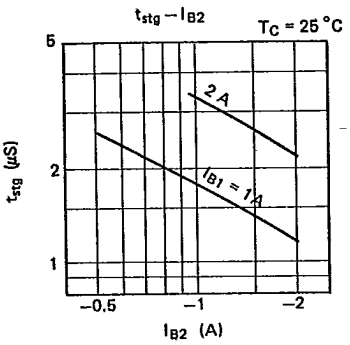


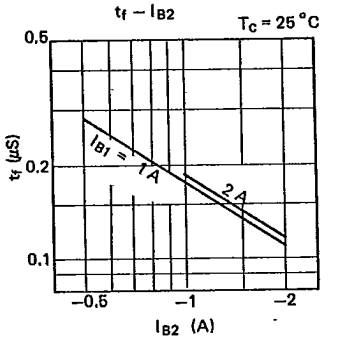
Output Capacitance

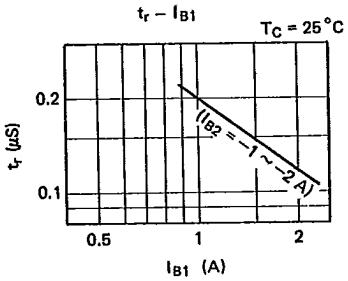


Switching Time

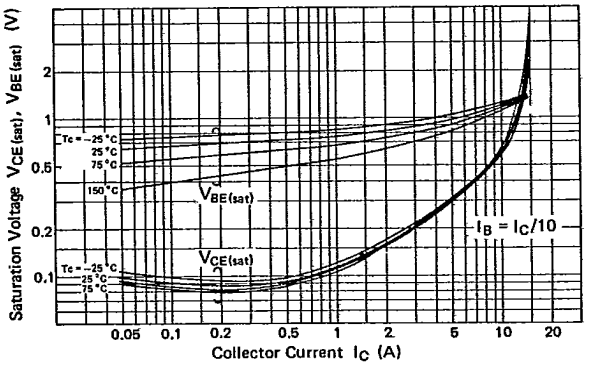
V_{CC} = 150 V
I_C = 10 A
Pulsed (50 μS)
Duty Ratio = 1 %



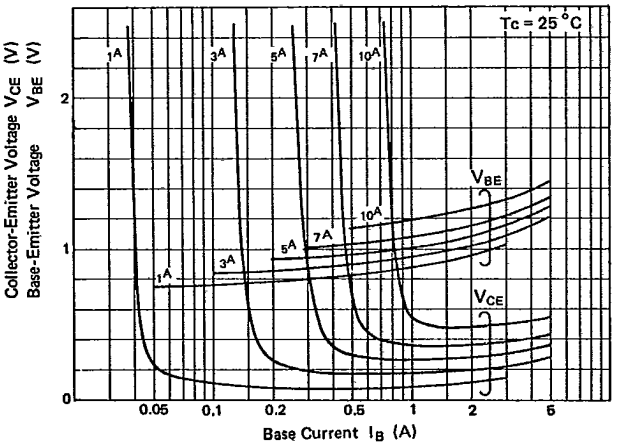




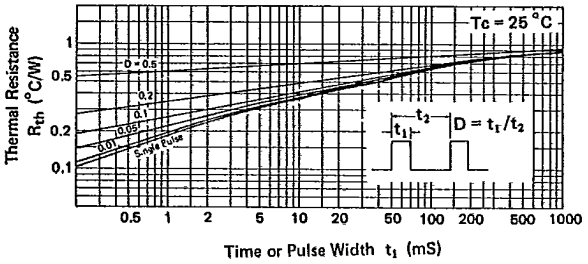
Saturation Voltage



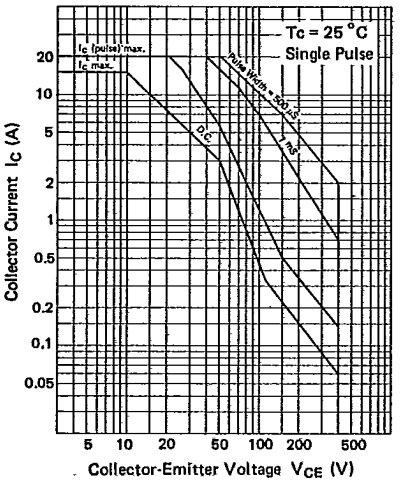
Collector Saturation Region



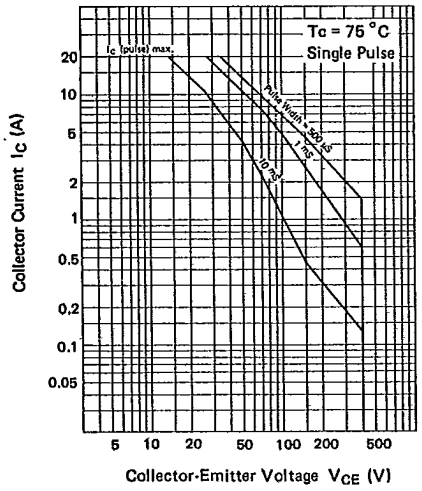
Thermal Response



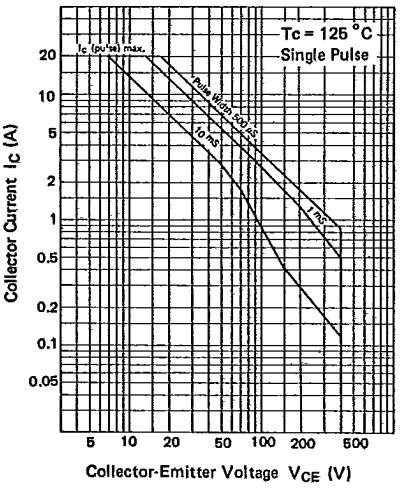
Forward Bias Safe Operating Area



Forward Bias Safe Operating Area



Forward Bias Safe Operating Area



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PRODUCT PROFILE

2SC2429, 2SC2429A

Silicon High Speed Power Transistor

ABSOLUTE MAXIMUM RATINGS (Ta = 25 °C)

Rating	Symbol	2SC2429	2SC2429A	Unit
Collector to Emitter Voltage	V_{CEO}	400	450	V
Collector to Base Voltage	V_{CBO}	450	600	V
Emitter to Base Voltage	V_{EBO}	7	7	V
Collector Current-Continuous	I_C	15	15	A
Collector Current-Pulsed ($P_W \leq 10$ mS, D.R. ≤ 2 %)	I_{CP}	20	20	A
Base Current-Continuous	I_B	5	5	A
Collector Power Dissipation ($T_C = 25°$)	P_C	150	150	W
Junction Temperature	T_j	175	175	°C
Storage Temperature Range	T_{stg}	−65 ~ +175	−65 ~ +175	°C

ELECTRICAL CHARACTERISTICS (Ta = 25 °C)

Parameters	Symbols	Test Conditions	Limits Min.	Limits Typ.	Limits Max.	Unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	2SC2429: $I_C = 100\,\mu A$, $I_E = 0$	450	–	–	V
		2SC2429A: $I_C = 1$ mA, $I_E = 0$	600	–	–	V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 1$ mA, $I_C = 0$	7	–	–	V
Collector Emitter Sustaining Voltage	$V_{CEO(SUS)}$	$I_C = 1$ A, $R_{BE} = \infty\,\Omega$ 2SC2429	400	–	–	V
		2SC2429A	450	–	–	V
Collector to Emitter Sustaining Voltage	$V_{CEX(SUS)}$	$I_C = 8$ A, $I_{B2} = -1$ A, L = 200 μH (*1)	450	–	–	V
Collector Cutoff Current	I_{CBO}	2SC2429: $V_{CB} = 450$ V, $I_E = 0$	–	–	100	μA
		2SC2429A: $V_{CB} = 500$ V, $I_E = 0$	–	–	100	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 6$ V, $I_C = 0$	–	–	100	μA
DC Current Gain	h_{FE}	$V_{CE} = 5$ V, $I_C = 10$ A (*2)	10	15	40	–
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 10$ A, $I_B = 2$ A (*2)	–	0.56	1.0	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	2SC2429	–	1.25	2.0	V
		2SC2429A	–	1.25	1.5	V
Output Capacitance	C_{ob}	$V_{CB} = 10$ V, $I_E = 0$, f = 1 MHz	–	240	–	PF
Gain Bandwidth Product	f_T	$V_{CE} = 10$ V, $I_C = 2$ A	–	30	–	MHz
Rise Time	t_r	$V_{CC} = 150$ V, $I_C = 10$ A, $I_{B1} = -I_{B2} = 2$ A (*1)	–	0.13	0.5	μs
Storage Time	t_{stg}		–	1.80	2.5	μs
Fall Time	t_f		–	0.11	0.3	μs

*1 Test Circuit

*2 Pulsed $P_W \leq 300\,\mu s$, Duty Ratio ≤ 6 %

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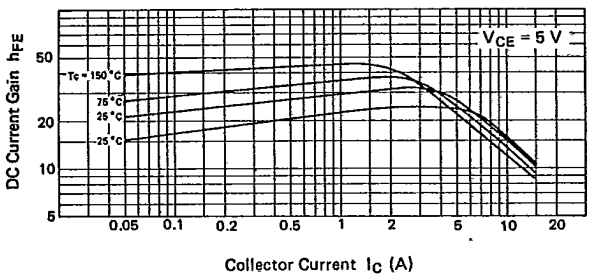
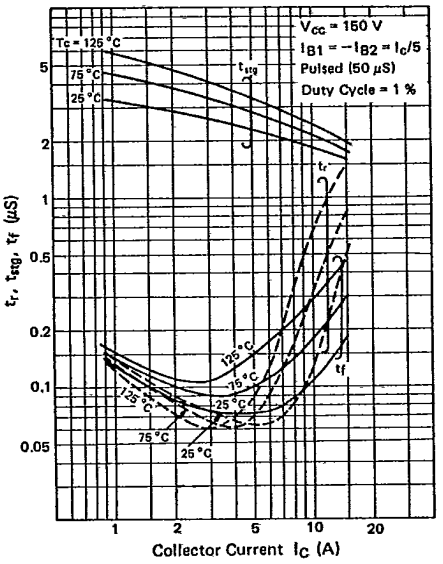
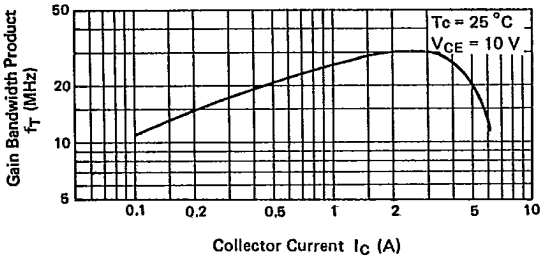
DC Current Gain



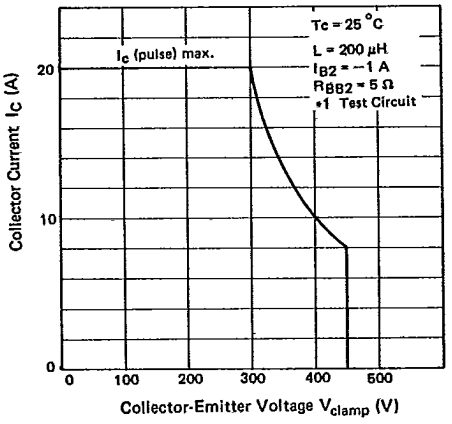
Switching Time



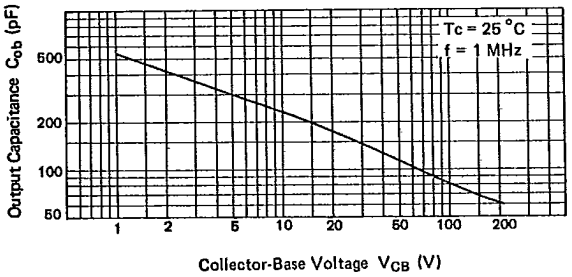
Gain Bandwidth Product



Reverse Bias Safe Operating Area



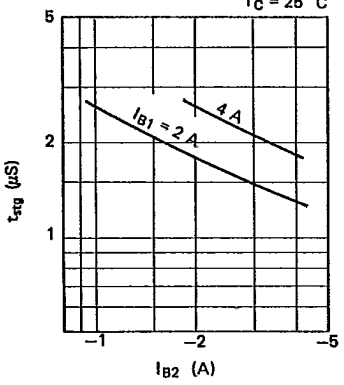
Output Capacitance



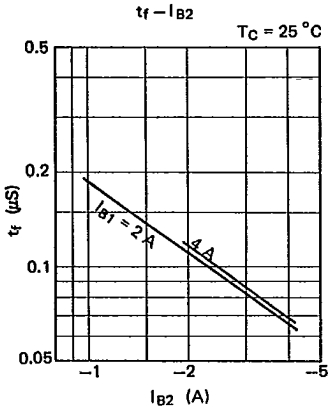
Switching Time

V_{CC} = 150 V
I_C = 10 A
Pulsed (50 μS)
Duty Ratio = 1 %

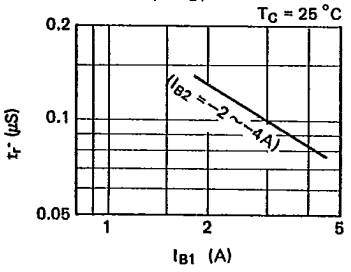
$t_{stg} - I_{B2}$



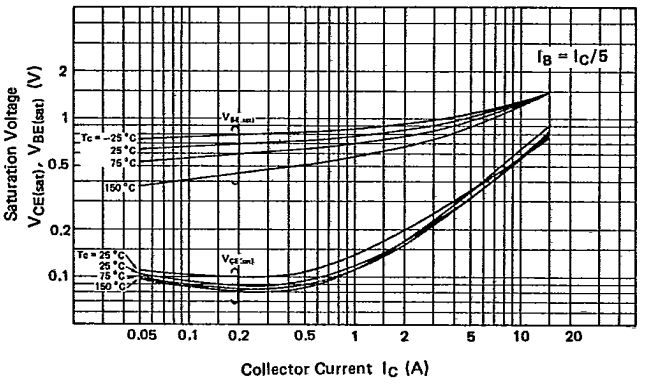
$t_f - I_{B2}$



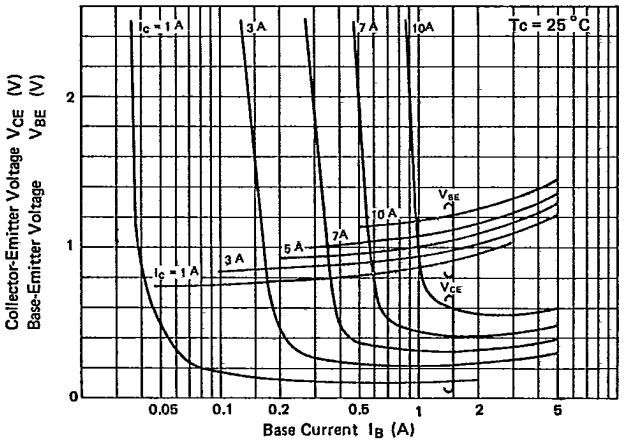
$t_r - I_{B1}$



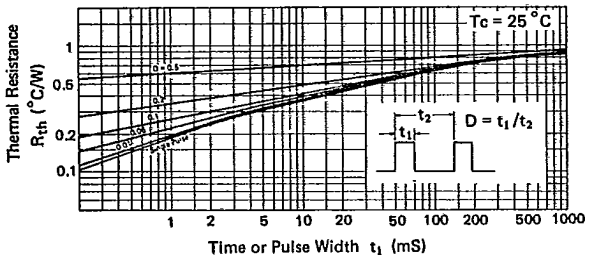
Saturation Voltage



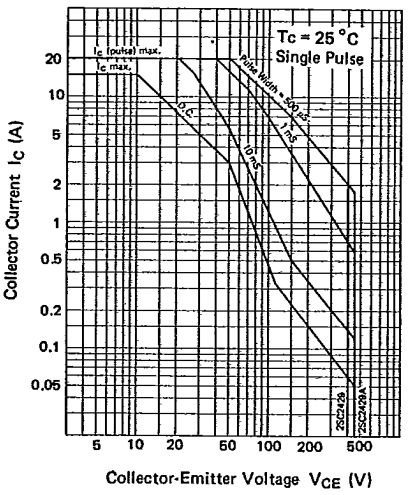
Collector Saturation Region



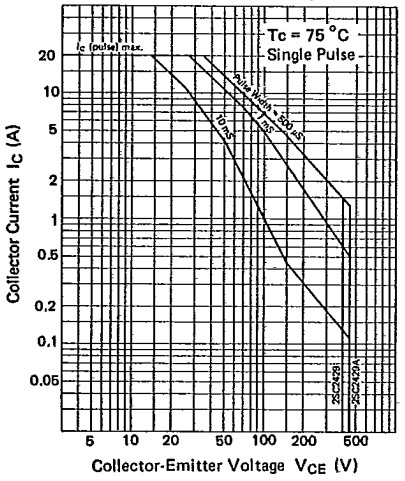
Thermal Response



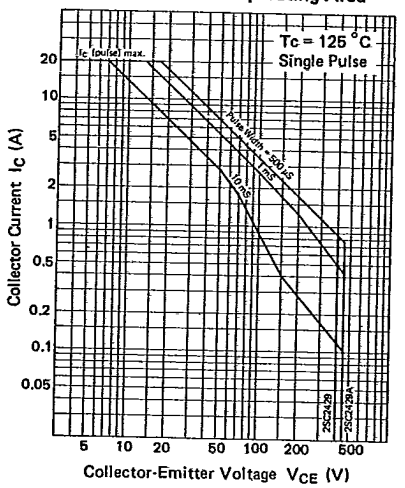
Forward Bias Safe Operating Area



Forward Bias Safe Operating Area



Forward Bias Safe Operating Area



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PRODUCT PROFILE

2SC2964, 2SC2965

Silicon High Speed Power Transistor

ABSOLUTE MAXIMUM RATINGS (Ta = 25 °C)

Rating	Symbol	2SC2964	2SC2965	Unit
Collector to Emittor Voltage	V_{CEO}	400	450	V
Collector Base Voltage	V_{CBO}	600	600	V
Emitter to Base Voltage	V_{EBO}	7	7	V
Collector Current-Continuous	I_C	15	15	A
Collector Current-Pulsed ($\frac{P_W \leq 10\ mS}{D.R. \leq 2\ \%}$)	I_{CP}	20	20	A
Base Current-Continuous	I_B	5	5	A
Collector Power Dissipation (T_C = 25 °C)	P_C	150	150	W
Junction Temperature	T_j	175	175	°C
Storage Temperature Range	T_{stg}	−65 ~ +175	−65 ~ +175	°C

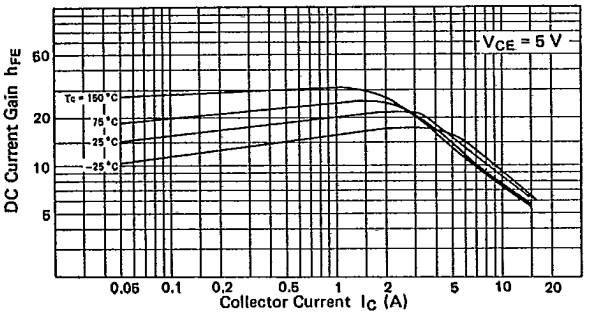
ELECTRICAL CHARACTERISTICS (Ta = 25 °C)

Parameters	Symbols	Test Conditions	Limits			Unit
			Min.	Typ.	Max.	
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	I_C = 1 mA, I_E = 0	600	–	–	V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	I_E = 1 mA, I_C = 0	7	–	–	V
Collector to Emitter Sustaining Voltage	$V_{CEO(SUS)}$	I_C = 0.8 A, R_{BE} = ∞Ω 2SC2964	400	–	–	V
		2SC2965	450	–	–	V
Collector to Emitter Sustaining Voltage	$V_{CEX(SUS)}$	I_C = 8 A, I_{B2} = −1 A, L = 200 μH (*1)	450	–	–	V
Collector Cutoff Current	I_{CBO}	V_{CB} = 500 V, I_E = 0	–	–	100	μA
Emitter Cutoff Current	I_{EBO}	V_{EB} = 6 V, I_C = 0	–	–	100	μA
DC Current Gain	h_{FE}	V_{CE} = 5 V, I_C = 10 A (*2)	7	8.5	20	–
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 10 A, I_B = 2 A (*2)	–	0.75	1.5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$		–	1.25	1.5	V
Output Capacitance	C_{ob}	V_{CB} = 10 V, I_E = 0, f = 1 MHz	–	230	–	pF
Gain Bandwidth Product	f_T	V_{CE} = 10 V, I_C = 2 A	–	28	–	MHz
Rise Time	t_r	V_{CC} = 150 V, I_C = 10 A, $I_{B1} = -I_{B2}$ = 2 A (*1)	–	0.15	0.5	μs
Storage Time	t_{stg}		–	0.84	1.0	μs
Fall Time	t_f		–	0.10	0.3	μs

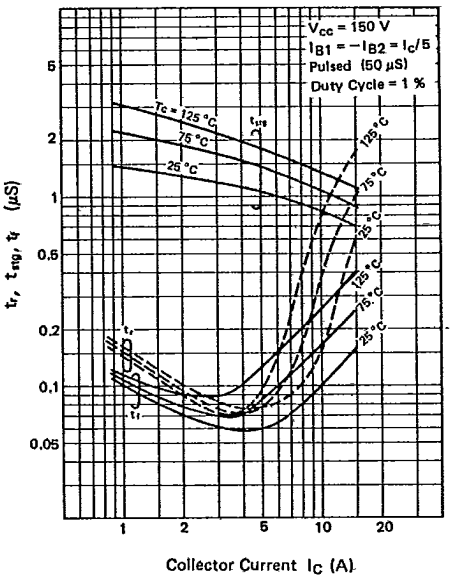
*1 Test Circuit
*2 Pulsed $P_W \leq 300\ \mu s$, Duty Ratio ≤ 6 %

2SC2964, 2SC2965

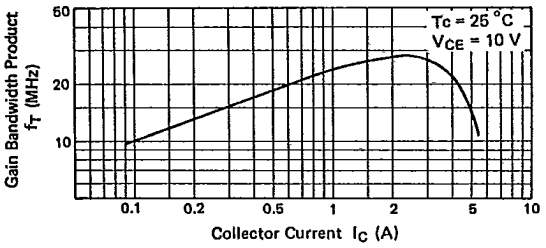
DC Current Gain



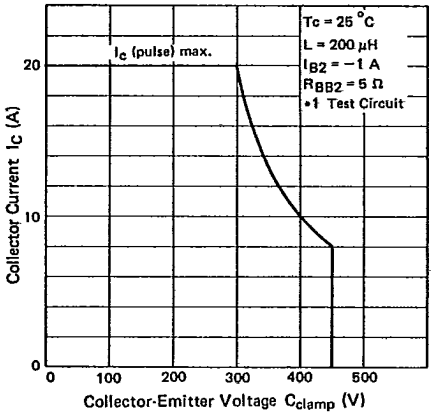
Switching Time



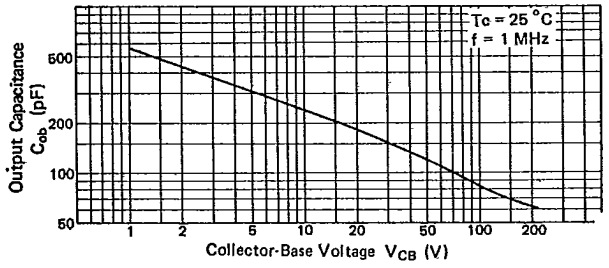
Gain Bandwidth Product



Reverse Bias Safe Operating Area



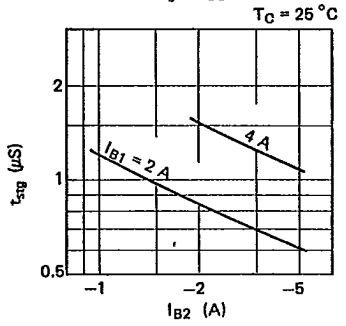
Output Capacitance



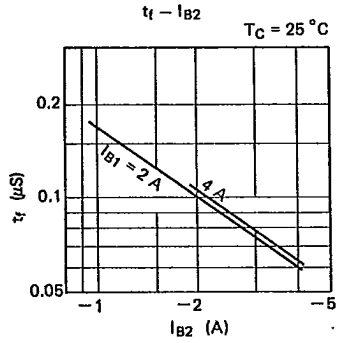
Switching Time

V_{CC} = 150 V
I_C = 10 A
Pulsed (50 μS)
Duty Ratio = 1 %

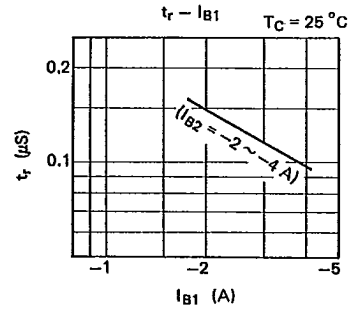
$t_{stg} - I_{B2}$



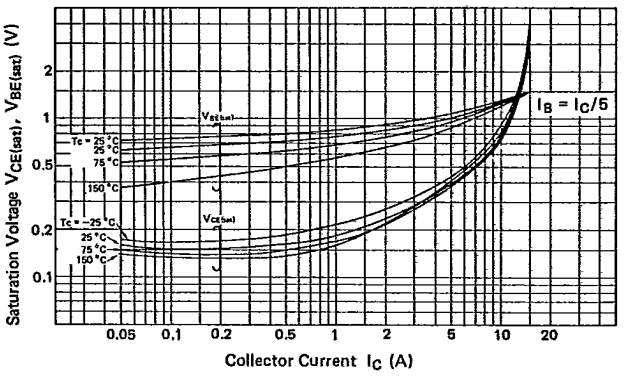
$t_f - I_{B2}$



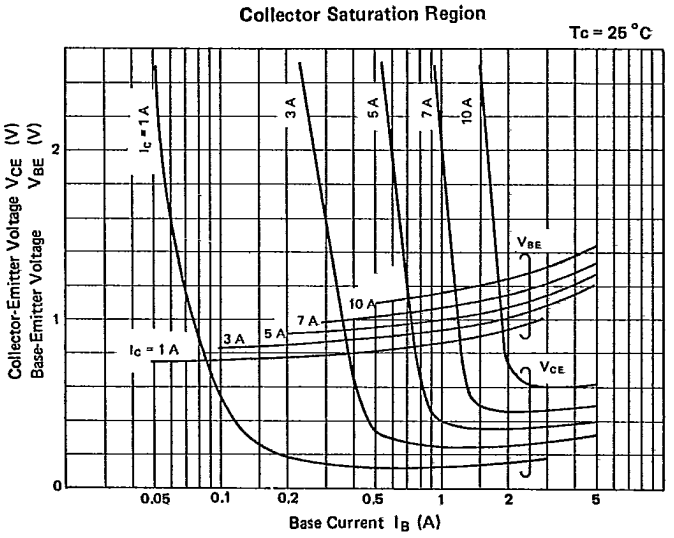
$t_r - I_{B1}$



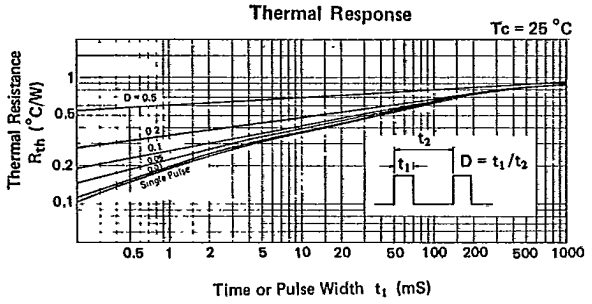
Saturation Voltage



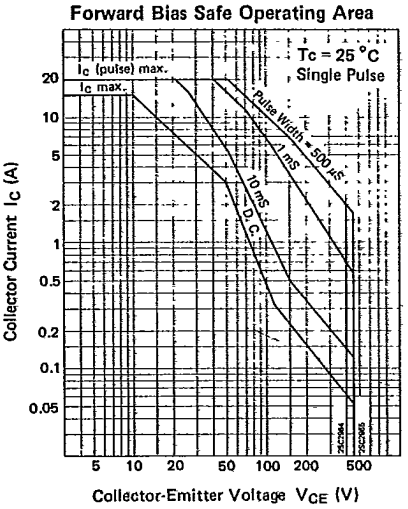
Collector Saturation Region



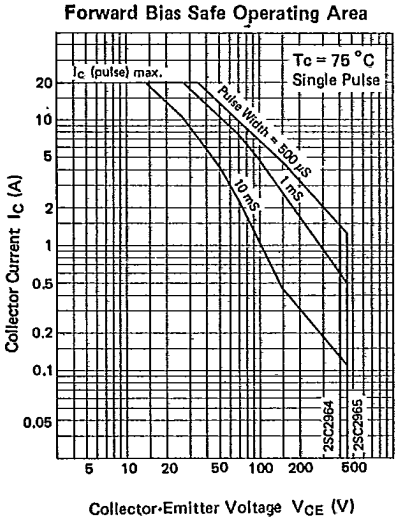
Thermal Response



Forward Bias Safe Operating Area



Forward Bias Safe Operating Area



Forward Bias Safe Operating Area