January 1990 Edition 1.1

PRODUCT PROFILE

2SC3178, 2SC3059, 2SC3060, 2SC3061

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 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

Applications

- High voltage
- Switching regulators Motor controls
- Ultra-fast switching • Large safe operating area
- Ultrasonic oscillators Class C and D amplifiers
- Deflection circuits

Outline of the Series

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Item	Symbol	2SC3178	2SC3059	2SC3060	2SC3061	Unit
Collector to Base Breakdown Voltage	V _{CBO}		12	00		v
Collector to Emitter Breakdown Voltage	V _{CEO}	V _{CEO} 850		v		
Emitter to Base Breakdown Voltage	V _{EBO}		7			>
Collector Current (continuous)	lc 2	2	5	10	Α	
Collector Current (pulsed)	1 _{CP}	4	,	8	20	Α
Collector Power Dissipation	Pc	60	100	150	200	w
Reverse Bias Safe Operating Area @ 900V	RBSOA	2.	5	5	7	A
Rise Time (Typ.)	t,	0.20		L	μs	
Storage Time (Typ.)	t _{stg}	2.50			μs	
Fall Time (Typ.)	t _f	0.07		μs		
Collector to Emitter Saturation Voltage (Typ.)	V _{CE(sat)}		0.	3		V
Base to Emitter Saturation Voltage (Typ.)	V _{BE(sat)}		1.	0		v
Package	_	TO-220		TO-3		-

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2SC3178, 2SC3059, 2SC3060, 2SC3061

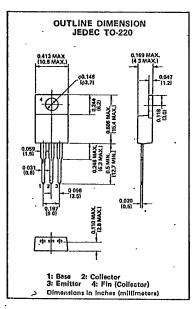
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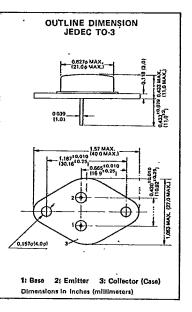


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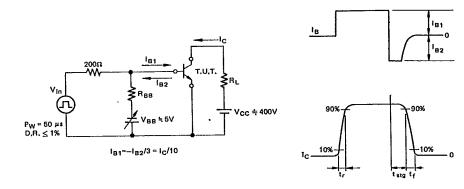
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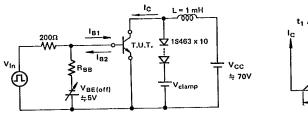
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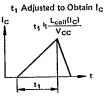
TEST CIRCUIT USED FOR MEASUREMENT OF SWITCHING TIME (RESISTIVE)





TEST CIRCUIT USED FOR MEASUREMENT OF VCEX (SUS) AND REVERSE BIAS SAFE OPERATING AREA





VCEX (SUS)

· L. L. DERRIGHTER

Type No.	I _C (A)	I _{B2} (A)	$R_{BB}(\Omega)$
2SC3178			20
2SC3059	2.5 -0.3	-0.3	20
2SC3060	5,0	-0.6	10
2SC3061	7.0	-1.2	5

V clamp = 900V

REVERSE BIAS SAFE	OPERATING	AREA
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Type No,	IB2(A)	R ₈₈ (Ω)
2SC3178		20
25C3059	-0.3	20
2SC3060	-0.6	10
2\$C3061	-1.2	5

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January 1990 Edition 1.1

PRODUCT PROFILE

2SC3178

Silicon High Speed Power Transistor

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector to Emitter Voltage	V _{CEO}	850	v
Collector to Base Voltage	Vcso	1200	v
Emitter to Base Voltage	V _{EBO}	7	v
Collector Current-Continuous	Ι _c	2	А
Collector Current-Pulsed $P_W \leq 25 \ \mu$ s, D.R. $\leq 50\%$	I _{CP}	4	A
Base Current-Continuous	Ι _B	1	A
Collector Power Dissipation ($T_c = 25^{\circ}C$)	Pc	60	w
Junction Temperature	Т	+150	°C
Storage Temperature Range	T _{stg}	-55~+150	°c

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

		Devision Test Conditions		Limit		Unit	
Parameter	Symbol	Test Conditions	Min.	Тур.	Max.	Onic	
Collector to Base Breakdown Voltage	V _(BR) CBÓ	I _C = 1mA, I _E = 0	1200	-	-	v	
Emitter to Base Breakdown Voltage	V _(BR) EBO	l _E = 1mA, I _C = 0	7		_	v	
Collector to Emitter Sustaining Voltage	V _(BR) CEO	l _c = 10mA, R _{BE} =∞Ω	850	-		V	
Collector to Emitter Sustaining Voltage	V _{CEX} (SUS)	I _C =2.5A, I _{B2} =-0.3A, L=1mH(*1)	900	_	-	V	
Collector Cutoff Current	I _{CBO}	V _{CB} = 1000V, I _E = 0	1	-	100	μA	
Collector Cutoff Current	I _{CBÓ}	$V_{CB} = 1000V, I_E = 0, T_C = 100^{\circ}C$	-	-	1	mA	
Emitter Cutoff Current	I _{EBO}	$V_{EB} = 6V, I_{C} = 0$		-	100	μA	
DC Current Gain	h _{FE}	$V_{CE} = 5V, I_{C} = 1A$ (*2)	10	15	30		
Collector to Emitter Saturation Voltage	V _{CE} (sat)	$ -10 -0.20 ^{2}$		0.3	1.5	V	
Base to Emitter Saturation Voltage	V _{BE} (sat)	$V_{EB} = 6V, I_{C} = 0$ $V_{CE} = 5V, I_{C} = 1A (*2)$ $I_{C} = 1A, I_{B} = 0.2A (*2)$		1.0	2.0	V	
Output Capacitance	Cob	V _{CB} = 10V, I _E = 0, f = 1MHz	-	60		pF	
Gain Bandwidth Product	f _T	V _{CE} = 10V, I _C = 0.2A	-	15	_	MHz	
Rise Time	t,		-	0.2	0.5	μs	
Storage Time	t _{stg}	V _{CC} = 400V (*1) I _C = 1A, 31 _{B1} =I _{B2} = 0.3A	-	2.5	3,5	μs	
Fall Time	t _f		-	0.07	0.3	μs	

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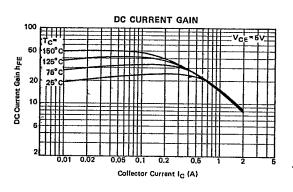
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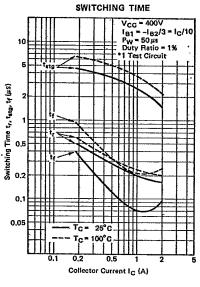
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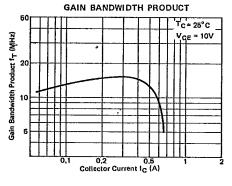
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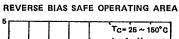
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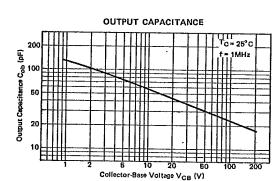
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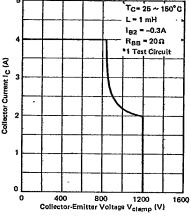












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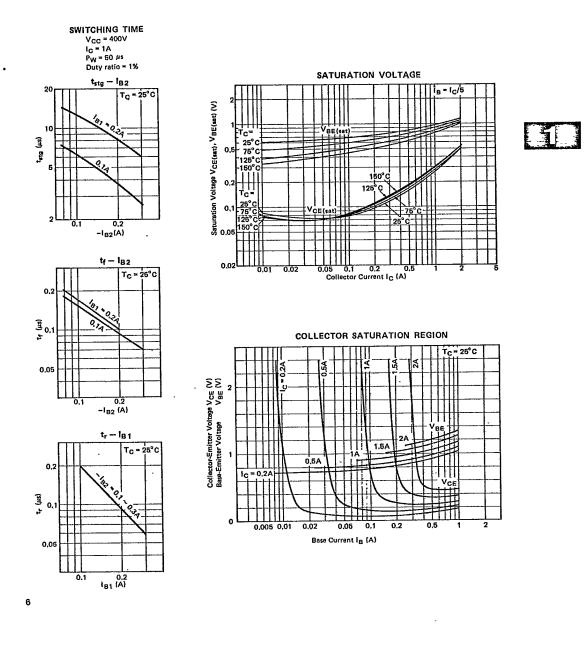
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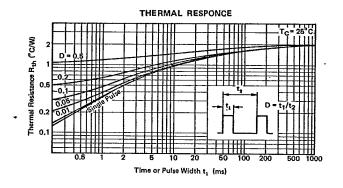


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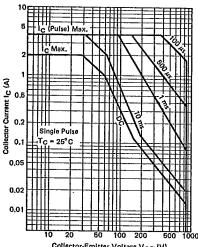
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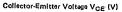
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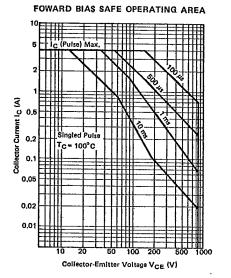














January 1990 Edition 1.1

PRODUCT PROFILE

2SC3059

Silicon High Speed Power Transistor

T-33-01

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ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector to Emitter Voltage	Vceo	850	v
Collector to Base Voltage	V _{сво}	1200	V
Emitter to Base Voltage	VEBO	7	v
Collector Current-Continuous	lc	2	Α
Collector Current-Pulsed $P_W \leq 25 \mu s$, D.R. $\leq 50\%$	I _{CP}	4	A
Base Current-Continuous	l ₈	1	A
Collector Power Dissipation (T _C = 25°C)	Pc	100	w
Junction Temperature	Тј	+175	°c
Storage Temperature Range	Tstg	65~+175	°C

ELECTRICAL CHARACTERISTICS (T_a = 25°C)

	Gumbal	Test Conditions		Limit		Unit
Parameter	Symbol	Test Conditions	Min.	Тур.	Max.	
Collector to Base Breakdown Voltage	V _(ВR) сво	$I_{C} = 1 m A, I_{E} = 0$	1200		-	v
Emitter to Base Breakdown Voltage	V _(вп) ево	$I_E = 1 m A_r I_C = 0$	7	-	-	v
Collector to Emitter Sustaining Voltage	V(BR)CEO	l _c = 10mA, R _{8E} = ∞Ω	850	-	-	v
Collector to Emitter Sustaining Voltage	V _{CEX} (SUS)	I _C =2.5A, I _{B2} =-0.3A, L=1mH(*1)	900	-	-	v
Collector Cutoff Current	I _{CBO}	V _{CB} = 1000V, 1 _E = 0		-	100	μA
Collector Cutoff Current	I _{CBO}	$V_{CB} = 1000V, I_E = 0, T_C = 100^{\circ}C$	-	-	1	mA.
Emitter Cutoff Current	I _{EBO}	$V_{EB} = 6V, I_{C} = 0$	-		100	μA
DC Current Gain -	hfe	V _{CE} = 5V, I _C = 1A (*2)	10	15	30	-
Collector to Emitter Saturation Voltage	V _{CE} (sat)		-	0.3	1.5	v
Base to Emitter Saturation Voltage	V _{BE} (sat)	$l_{\rm C} = 1$ A, $l_{\rm B} = 0.2$ A (*2)	-	1.0	2.0	v
Output Capacitance	Cob	V _{CB} = 10V, I _E 0, f = 1MHz	-	60	-	PF
Gain Bandwidth Product	f _T	V _{CE} = 10V, I _C ≍ 0.2A		15	-	MHz
Rise Time	tr		-	0.2	0.5	μs
Storage Time	t _{stg}	V _{CC} = 400V (*1) I _C = 1A, 3I _{B1} = -I _{B2} = 0.3A	-	2.5	3.5	μs
Fall Time	t _f		-	0.07	0.3	μs

*1 Test Circuit *2 Pulsed $P_{W} \leq 300 \ \mu s$, Duty Ratio $\leq 6\%$

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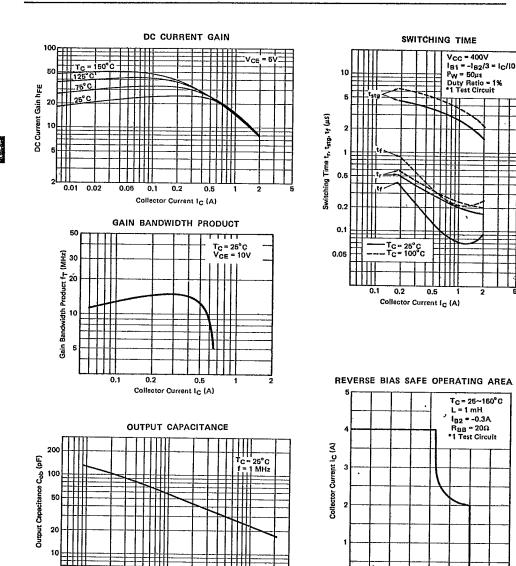
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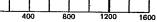
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Collector-Emitter Voltage Vclamp (V)

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Collector-Base Voltage VCB (V)

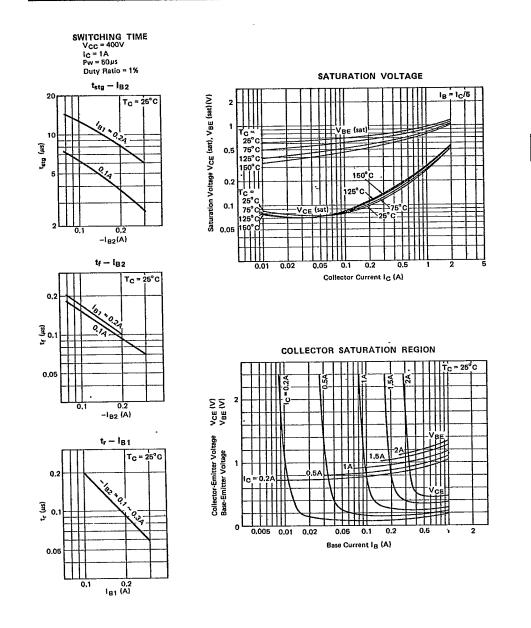
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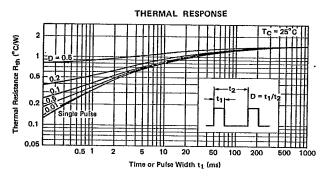




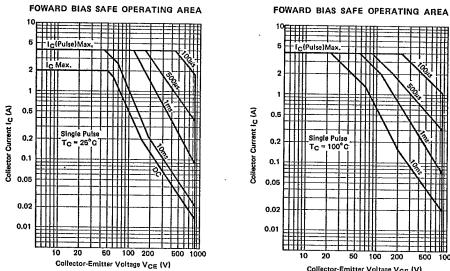
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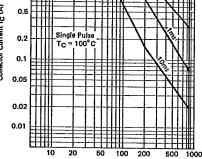
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(Pulse)Max

Collector-Emitter Voltage VCE (V)

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January 1990 Edition 1.1

PRODUCT PROFILE

2SC3060

Silicon High Speed Power Transistor

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector to Emitter Voltage	VCEO	850	v
Collector to Base Voltage	V _{CBO}	1200	v
Emitter to Base Voltage	V _{EBO}	7	V
Collector Current-Continuous	lc	5	A
Collector Current-Pulsed $P_W \leq 25 \mu s$, D.R. $\leq 50\%$	I _{CP}	8	А
Base Current-Continuous	l _B	3	A
Collector Power Dissipation (T _C = 25°C)	Pc	150	w
Junction Temperature	Ті	+175	°C
Storage Temperature Range	T _{stg}	-65~+175	°c

ELECTRICAL CHARACTERISTICS (T_a = 25°C)

		T . O . Kk		Limit Typ. Max, 100 1 100 15 30 0.3 1.5 1.0 2.0 120 15 0.2 0.5	Unit	
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	ome
Collector to Base Breakdown Voltage	V _(вя) сво	$I_{C} = 1mA, I_{E} = 0$	1200			v
Emitter to Base Breakdown Voltage	V _(ВR) ЕВО	$I_{E} = 1mA, I_{C} = 0$	7		-	V
Collector to Emitter Sustaining Voltage	V(BR) CEO	I _C = 10mA, R _{BE} = ∞Ω	850	-		v
Collector to Emitter Sustaining Voltage	V _{CEX} (SUS)	$I_{C} = 5A, I_{B2} = -0.6A, L = 1mH(*1)$	900	-	_	V
Collector Cutoff Current	Ісво	V _{CB} = 1000V, I _E = 0			100	μA
Collector Cutoff Current	I _{сво}	$V_{CB} = 1000V, I_E = 0, T_C = 100^{\circ}C$		-	1	mA
Emitter Cutoff Current	I _{EBO}	V _{EB} = 6V, I _C = 0			100	μA
DC Current Gain	h _{FE}	V _{CE} = 5V, I _C = 2A (*2)	10	15	30	_
Collector to Emitter Saturation Voltage	V _{GE} (sat)	$l_{c} = 2A, [n = 0.4A(*2)]$	-	0.3	1.5	v
Base to Emitter Saturation Voltage	V _{BE} (sat)	$I_{\rm C} = 2A, I_{\rm B} = 0.4A + 2I$		1.0	2.0	V
Output Capacitañce	Cob	V _{CB} = 10V, I _E = 0, f = 1MHz	-	120	_	PF
Gain Bandwidth Product	f _T	V _{CE} = 10V, 1 _C = 0,5A		15		MHz
Rīse Time	t,		-	0.2	0.5	μs
Storage Time	t _{stg}	V _{CC} = 400V (*1) I _C = 2A, 3I _{B1} = - I ₈₂ = 0.6A	_	2.5	3.5	μs
Fall Time	tf		-	0.07	0.3	μs

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

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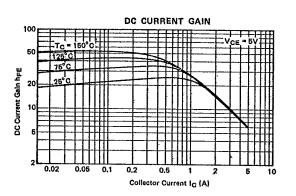
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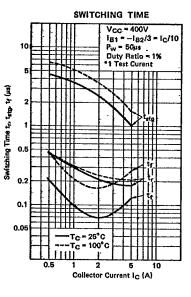
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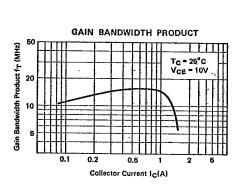
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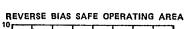
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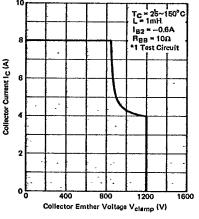
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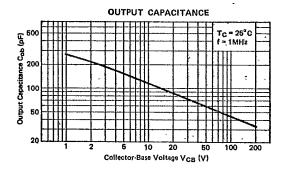








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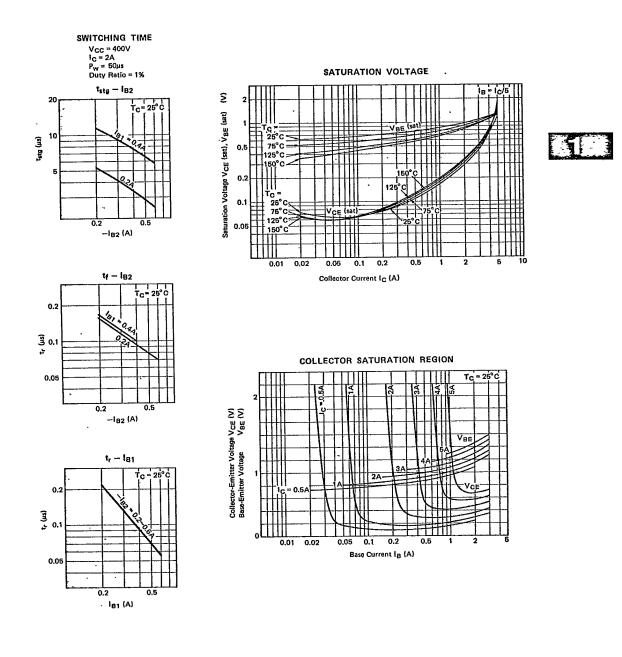
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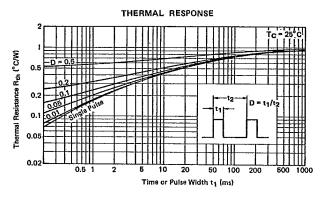
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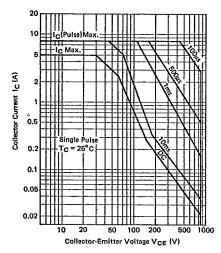


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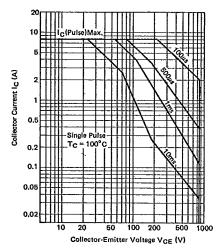
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FORWARD BIAS SAFE OPERATING AREA







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January 1990 Edition 1.1

PRODUCT PROFILE

2SC3061

Silicon High Speed Power Transistor

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector to Emitter Voltage	V _{CEO}	850	v
Collector to Base Voltage	V _{сво}	1200	v
Emitter to Base Voltage	VEBO	7	v
Collector Current-Continuous	lc	10	А
Collector Current-Pulsed $P_W \leq 25 \mu s$, $D_r R \leq 50\%$	· I _{CP}	20	A
Base Current-Continuous	I _B	5	А
Collector Power Dissipation (T _C = 25°C)	Pc	200	w
Junction Temperature	Tj	+175	°C
Storage Temperature Range	T _{stg}	-65~+175	°C

ELECTRICAL CHARACTERISTICS ($T_a = 25^{\circ}C$)

	0	Test Conditions	Limit Min. Typ. 1200 7 850 900 10 15 0.3	Limit			Unit
Parameter	Symbol	Test Conditions	Min.	Тур.	Max.		
Collector to Base Breakdown Voltage	V _(вя) сво	$I_{C} = 1mA, I_{E} = \bar{0}$	1200	-	_	V	
Emitter to Base Breakdown Voltage	V _(BR) E80	I _E = 1mÅ, I _C = 0	7	-	-	v	
Collector to Emitter Sustaining Voltage	V _(BR) CEO	l _c = 10mA, R _{BE} = ∞Ω	850	-	1	V	
Collector to Emitter Sustaining Voltage	V _{CEX} (sus)	I _C = 7A, I _{B2} = −1.2A, L=1mH(*1)	900	_	-	v	
Collector Cutoff Current	I _{CBO}	V _{CB} = 1000V, I _E = 0	-	-	100	μA	
Collector Cutoff Current	I _{сво}	$V_{CB} = 1000V, I_E = 0, T_C = 100^{\circ}C$	-		1	mΑ	
Emitter Cutoff Current	I _{EBO}	$V_{EB} = 6V, I_{C} = 0$	_		100	μA	
DC Current Gain	h _{FE}	$V_{CE} = 5V, I_{C} = 4A(*2)$	10	15	30		
Collector to Emitter Saturation Voltage	V _{CE} (sat)		-	0.3	1,5	v	
Base to Emitter Saturation Voltage	V _{BE} (sat)	$V_{EB} = 6V, I_{C} = 0$ $V_{CE} = 5V, I_{C} = 4A(*2)$ $I_{C} = 4A, I_{B} = 0.8A(*2)$		1.0	2.0	V	
Output Capacitance	Сав	$V_{CB} = 10V, I_E = 0, f = 1MHz$	-	220	-	PF	
Gain Bandwidth Product	f _T	V _{CE} = 10V, I _C = 1A	-	15	-	MHz	
Rise Time	tr		_	0.2	0.5	μs	
Storage Time	t _{stg}	V _{CB} = 10V, I _E = 0, f = 1MHz	-	2.5	3.5	μs	
Fall Time	tr	10 17 19 181 182 112C		0.07	0,3	μs	

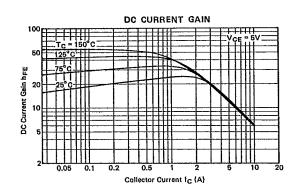
*1 Test Circuit *2 Pulsed $P_W \leq 300 \,\mu$ s, Duty Ratio $\leq 6\%$

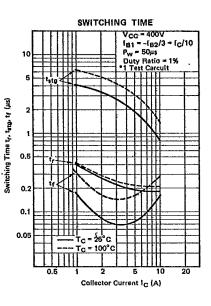
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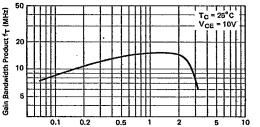
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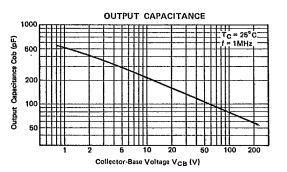




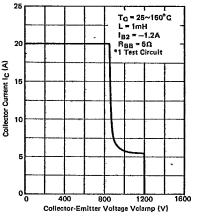
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GAIN BANDWIDTH PRODUCT

Collector Current Ic (A)



REVERSE BIAS SAFE OPERATING AREA



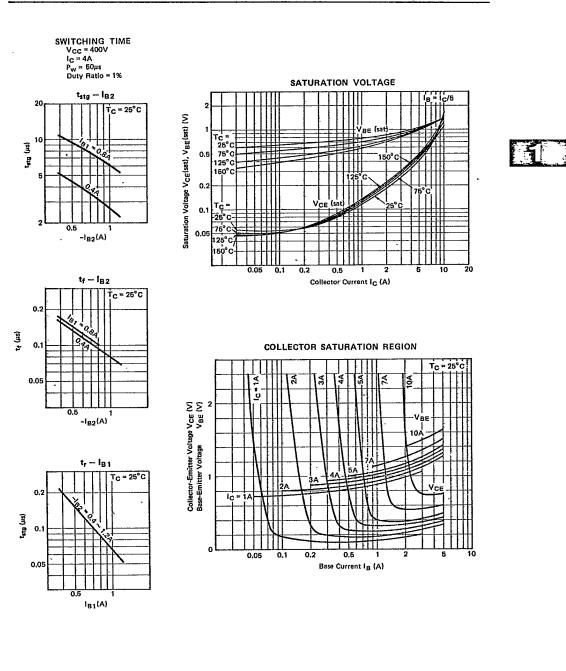
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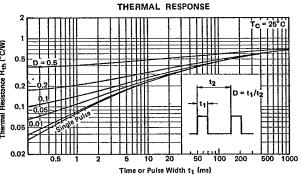


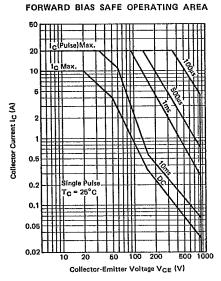
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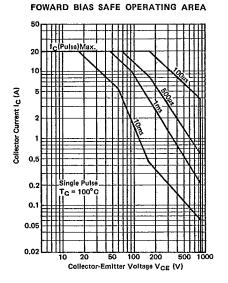
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None AF

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1-112

Thermal Resistance Rth (°C/W)

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