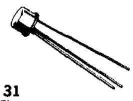
2N5027–3N69

TYPE	MATERIAL	POLARITY	REPLACEMENT	PAGE NUMBER	USE	MAXIMUM RATINGS P_D @ 25°C	Ref Point	T_J °C	V_{CB} (volts)	V_{CE-} (volts)	Subscript	ELECTRICAL CHARACTERISTICS h_{FE} (min)	h_{FE} (max)	@ I_C Units	$V_{CE(SAT)}$ (volts)	@ I_C Units	h_{f-}	Subscript	f_-	Units	Subscript
2N5027	S	N			MSS	320M	A	120		30	O	50	150	150M	0.45	150M					
2N5028	S	N			MSS	320M	A	120		30	O	100	300	150M	0.45	150M					
2N5029	S	N			HSS	320M	A	120		15	O	40	120	10M	0.25	10M					
2N5030	S	N			HSS	320M	A	120		12	O	30		10M	0.25	10M					
2N5034	S	N			LPA	83W	C	150	55	45	R	20	70	2.5A	2.5	6.0A	15	E			
2N5035	S	N			LPA	83W	C	150	55	45	R	20	70	3.0A	3.0	8.0A	15	E			
2N5036	S	N			LPA	83W	C	150	70	60	R	20	70	2.5A	2.5	6.0A	15	E			
2N5037	S	N			LPA	83W	C	150	70	60	R	20	70	3.0A	3.0	8.0A	15	E			
2N5043	G	P				30M	A	125	15	7.0	O		150	3.0M							
2N5044	G	P				30M	A	125	15	7.0	O		150	3.0M							
2N5045 thru 2N5047	Field Effect Transistors, see Table on Page 1-166																				
2N5050	S	N			LPA	40W	C	200		120	O	35	105	0.5A	0.9	0.5A			20M		T
2N5051	S	N			LPA	40W	C	200		150	O	35	105	0.5A	0.9	0.5A			20M		T
2N5052	S	N			LPA	40W	C	200		200	O	35	105	0.5A	0.9	0.5A			20M		T
2N5055	S	P			HSS	200M	A	125	12	12	O	30	100	30M	0.13	1.0M					
2N5056	S	P			HSS	360M	A	200	15	15	O	30	100	30M	0.13	1.0M					
2N5057	S	P			HSS	360M	A	200	15	15	O	40	100	30M	0.13	1.0M					
2N5058	S	N				1.0W	C	200	300	300	O	35	150	30M							
2N5059	S	N				1.0W	C	200	250	250	O	30	150	30M							
2N5060 thru 2N5063	Thyristors, see Table on Page 1-154																				
2N5067	S	N		7-192	LPA	87.5W	C	200	40	40	O	20	80	1.0A	0.4	1.0A	20	E	4.0M		T
2N5068	S	N		7-192	LPA	87.5W	C	200	60	60	O	20	80	1.0A	0.4	1.0A	20	E	4.0M		T
2N5069	S	N		7-192	LPA	87.5W	C	200	80	80	O	20	80	1.0A	0.4	1.0A	20	E	4.0M		T
2N5086	S	P		5-55	LNA	310M	A	135	50	50	O	150	500	0.1M	0.3	10M	150	E	40M		T
2N5087	S	P		5-55	LNA	310M	A	135	50	50	O	250	800	0.1M	0.3	10M	250	E	40M		T
2N5088	S	N		5-59	LNA	310M	A	135	35	30	O	300	900	0.1M	0.5	10M	350	E	50M		T
2N5089	S	N		5-59	LNA	310M	A	135	30	25	O	400	1200	0.1M	0.5	10M	450	E	50M		T
2N5126	S	N			AFC	200M	A	125	20	20	O	20	350	4M	2.0	10M	15	E			
2N5127	S	N			AFC	200M	A	125	20	12	O	15	300	2M	0.3	10M	12	E			
2N5128	S	N			AFA	200M	A	125	15	12	O	35	350	50M	0.25	150M					
2N5129	S	N			AFA	300M	A	125	15	12	O	35	350	50M	0.25	150M					
2N5130	S	N			AFC	200M	A	125	30	12	O	15	250	8M	0.6	10M	12	E			
2N5131	S	N			AFC	200M	A	125	20	15	O	30	500	10M	1.0	10M	25	E			
2N5132	S	N			AFC	200M	A	125	20	20	O	30	400	10M	2.0	10M	20	E			
2N5133	S	N			AFC	200M	A	125	20	18	O	60	1000	1.0M	0.4	1.0M	50	E			
2N5134	S	N			HSS	200M	A	125	20	10	O	20	150	10M	0.2	10M					
2N5135	S	N			AFA	300M	A	125	30	25	O	50	600	10M	1.0	100M					
2N5136	S	N			AFA	220M	A	125	30	20	O	20	400	150M	0.25	150M					
2N5137	S	N			AFA	300M	A	125	30	20	O	20	400	150M	0.25	150M					
2N5138	S	P			AFC	200M	A	125	30	30	O	50	800	100*	0.3	10M	40	E			
2N5139	S	P			HSS	200M	A	125	20	20	O	40		1.0M	0.15	1.0M					
2N5140	S	P			HSS	200M	A	125	5.0	5.0	O	20	140	10M	0.2	10M					
2N5141	S	P			HSS	200M	A	125	6.0	6.0	O	30		30M	0.2	10M					
2N5142	S	P			HSS	300M	A	125	20	20	O	30		50M	0.5	50M					
2N5143	S	P			HSS	200M	A	125	20	20	O	30		50M	0.5	50M					
2N5190	S	N			LPA	40W	C	150		40	O	25	100	0.5A	0.6	1.0A			4.0M		T
2N5191	S	N			LPA	40W	C	150		60	O	25	100	0.5A	0.6	1.0A			4.0M		T
2N5192	S	N			LPA	40W	C	150		80	O	25	100	0.5A	0.6	1.0A			4.0M		T
2N5193	S	P			LPA	40W	C	150		40	O	25	100	1.5A	0.6	1.5A			4.0M		T
2N5194	S	P			LPA	40W	C	150		60	O	25	100	1.5A	0.6	1.5A			4.0M		T
2N5195	S	P			LPA	40W	C	150		80	O	25	100	1.5A	0.6	1.5A			4.0M		T
3N22		N			RFA			85	15								0.96	B			
3N34	S	N				125M			30												
3N35	S	N				125M			30	30	O						25	E			
3N35A	S	N				125M			30	30	O						10	E			
3N39 thru 3N44	Reference Amplifiers, see Table on Page 1-172																				
3N45	G	P			PMS	75W	C	100	60	35		30	120	5.0A	0.4	5.0A	30	E	600K		
3N46	G	P			PMS	75W	C	100	80	50		20	80	5.0A	0.4	5.0A			300K		
3N47	G	P			PMS	75W	C	100	40	25		30	120	5.0A	0.4	5.0A	30	E	500K		
3N48	G	P			PMS	75W	C	100	60	40		20	80	5.0A	0.4	5.0A			300K		
3N49	G	P			PMS	94W	C	100	60	35		30	120	5.0A	0.4	5.0A	30	E	600K		
3N50	G	P			PMS	94W	C	100	80	50		20	80	5.0A	0.4	5.0A			300K		
3N51	G	P			PMS	94W	C	100	40	25		30	120	5.0A	0.4	5.0A	30	E	500K		
3N52	G	P			PMS	94W	C	100	60	40		20	80	5.0A	0.4	5.0A			300K		
3N58 thru 3N60	Thyristors, see Table on Page 1-154																				
3N62	S	N			CHP				10						V_{off} = 200 µV						
3N63	S	N			CHP				10						V_{off} = 100 µV						
3N64	S	N			CHP				10						V_{off} = 50 µV						
3N65	S	N			CHP										V_{off} = 200 µV						
3N66	S	N			CHP										V_{off} = 100 µV						
3N67	S	N			CHP										V_{off} = 50 µV						
3N68	S	N			CHP				10						V_{off} = 200 µV						
3N68A	S	N				100M	A	200	10												
3N69	S	N			CHP				10						V_{off} = 100 µV						

SILICON POWER TRANSISTOR SELECTOR GUIDE (continued)

3.0 AMP ($T_{J(Max)}$ = 200°C)

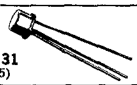


Case 31 (TO-5) Solid Header

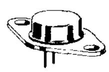
P_D = 6.0 W
f_T — 3.0 MHz
*f_T — 60 MHz

Type NPN PNP	V_{CEO} Volts (Max)	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts (Max)	@ I_C Amp	& I_B Amp
2N3719*	40	25/180	1.0	0.75	1.0	0.1
2N3720*	60	25/180	1.0	0.75	1.0	0.1
2N3867*	40	40/200	1.5	0.75	1.5	0.15
2N3868*	60	30/150	1.5	0.75	1.5	0.15
2N4234	40	30/150	0.25	0.6	1.0	0.125
2N4235	60	30/150	0.25	0.6	1.0	0.125
2N4236	80	30/150	0.25	0.6	1.0	0.125
2N4237	40	30/150	0.25	0.6	1.0	0.1
2N4238	60	30/150	0.25	0.6	1.0	0.1
2N4239	80	30/150	0.25	0.6	1.0	0.1

4.0 AMP ($T_{J(Max)}$ = 200°C)



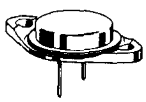
Case 31 (TO-5)



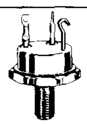
Case 80 (TO-66)

Case / Ratings	Type NPN PNP	V_{CEO} Volts (Max)	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts (Max)	@ I_C Amp	& I_B Amp
Case 31: P_D = 10 W, f_T — 4.0 MHz	2N4877	60	20/100	4.0	1.0	4.0	0.4
Case 80: P_D = 20 W, f_T — 10 MHz	2N3054*	60	25/100	0.5	1.0	0.5	0.05
	2N3766	60	40/160	0.5	1.0	0.5	0.05
	2N3767	80	40/160	0.5	1.0	0.5	0.05
Case 80: P_D = 25 W, *f_T — 1.0 MHz, f_T — 3.0 MHz, **f_T — 4.0 MHz	2N3740	60	30/100	0.25	0.6	1.0	0.125
	2N3741	80	30/100	0.25	0.6	1.0	0.125
	2N4898	40	20/100	0.5	0.6	1.0	0.1
	2N4899	60	20/100	0.5	0.6	1.0	0.1
	2N4900	80	20/100	0.5	0.6	1.0	0.1
	2N4910	40	20/100	0.5	0.6	1.0	0.1
	2N4911	60	20/100	0.5	0.6	1.0	0.1
	2N4912	80	20/100	0.5	0.6	1.0	0.1
	MJ4101**	40	25/100	1.5	1.0	1.5	0.15
Case 80: P_D = 35 W, f_T — 1.0 MHz	2N4231	40	25/100	1.5	0.7	1.5	0.15
	2N4232	60	25/100	1.5	0.7	1.5	0.15
	2N4233	80	25/100	1.5	0.7	1.5	0.15

5.0 AMP ($T_{J(Max)}$ = 200°C)



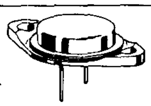
Case 11 (TO-3)



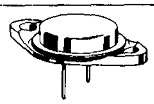
Case 9 (TO-61)

Case / Ratings	Type NPN PNP	V_{CEO} Volts (Max)	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts (Max)	@ I_C Amp	& I_B Amp
Case 11: P_D = 87.5 W, f_T — 4.0 MHz	2N4901	40	20/80	1.0	0.4	1.0	0.1
	2N4902	60	20/80	1.0	0.4	1.0	0.1
	2N4903	80	20/80	1.0	0.4	1.0	0.1
	2N4904	40	25/100	2.5	1.0	2.5	0.25
	2N4905	60	25/100	2.5	1.0	2.5	0.25
	2N4906	80	25/100	2.5	1.0	2.5	0.25
	2N4913	40	25/100	2.5	1.0	2.5	0.25
	2N4914	60	25/100	2.5	1.0	2.5	0.25
	2N4915	80	25/100	2.5	1.0	2.5	0.25
	2N5067	40	20/80	1.0	0.4	1.0	0.1
	2N5068	60	20/80	1.0	0.4	1.0	0.1
	2N5069	80	20/80	1.0	0.4	1.0	0.1
Case 9: P_D = 117 W, f_T — 10 MHz	2N1724	80	20/90	2.0	1.0	2.0	0.2
	2N1725	80	50/150	2.0	1.0	2.0	0.2

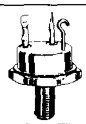
7.5 AMP ($T_{J(Max)}$ = 200°C)



Case 11 (TO-3)



Case 1 (TO-3)

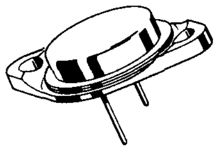


Case 9 (TO-61)

Case / Ratings	Type NPN PNP	V_{CEO} Volts (Max)	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts (Max)	@ I_C Amp	& I_B Amp
Case 11: P_D = 115 W, f_T — 10 MHz	2N3445	60	20/60	3.0	1.5	3.0	0.3
	2N3446	80	20/60	3.0	1.5	3.0	0.3
	2N3447	60	40/120	5.0	1.5	5.0	0.5
	2N3448	80	40/120	5.0	1.5	5.0	0.5
Case 1: P_D = 117 W, f_T — 1.0 MHz	2N3232	60	15/75	3.0	2.5	3.0	0.2
Case 9: P_D = 117 W, f_T — 10 MHz	2N3487	60	20/60	3.0	1.2	3.0	0.3
	2N3488	80	20/60	3.0	1.2	3.0	0.3
	2N3489	100	15/45	3.0	1.2	3.0	0.3
	2N3490	60	40/120	5.0	1.0	3.0	0.3
	2N3491	80	40/120	5.0	1.0	3.0	0.3
	2N3492	100	30/90	5.0	1.0	3.0	0.3

2N5067 (SILICON) 2N5068 2N5069

V_{CEO} = 40-80 V
I_C = 5 A
P_D = 87.5 W



CASE 11
(TO-3)

NPN power transistors for use in power amplifier and switching circuits. Complement to PNP 2N4901 thru 2N4903.

MAXIMUM RATINGS

Rating	Symbol	2N5067	2N5068	2N5069	Unit
Collector-Emitter Voltage	V_{CEO}	40	60	80	Vdc
Collector-Base Voltage	V_{CB}	40	60	80	Vdc
Emitter-Base Voltage	V_{EB}	5.0			Vdc
Collector Current — Continuous	I_C	5.0			Adc
Base Current - Continuous	I_B	1.0			Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	87.5 0.5			Watts W/°C
Operating & Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	2.0	°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Fig. No.	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage* (I_C = 0.2 Adc, I_B = 0) 2N5067 2N5068 2N5069	11	$BV_{CEO(sus)}$*	40 60 80	- - -	Vdc
Collector Cutoff Current (V_{CE} = Rated V_{CEO}, I_B = 0)		I_{CEO}	-	1.0	mAdc
Collector Cutoff Current (V_{CE} = Rated V_{CEO}, $V_{EB(off)}$ = 1.5 Vdc) (V_{CE} = Rated V_{CEO}, $V_{EB(off)}$ = 1.5 Vdc, T_C = 150°C)	5, 6	I_{CEX}	- -	1.0 2.0	mAdc
Collector Cutoff Current (V_{CB} = Rated V_{CB}, I_E = 0)	5, 6	I_{CBO}	-	1.0	mAdc
Emitter Cutoff Current (V_{EB} = 5.0 Vdc, I_C = 0)		I_{EBO}	-	1.0	mAdc

2N5067, 2N5068, 2N5069 (continued)

ELECTRICAL CHARACTERISTICS ($T_C = 25°C$ unless otherwise noted)

Characteristic	Fig. No.	Symbol	Min	Max	Unit
ON CHARACTERISTICS					
DC Current Gain*	1	h_{FE}*			-
(I_C = 1.0 Adc, V_{CE} = 2.0 Vdc)			20	80	
(I_C = 5.0 Adc, V_{CE} = 2.0 Vdc)			7.0	-	
Collector-Emitter Saturation Voltage*	2, 3, 4	$V_{CE(sat)}$*			Vdc
(I_C = 1.0 Adc, I_B = 0.1 Adc)			-	0.4	
(I_C = 5.0 Adc, I_B = 1.0 Adc)			-	1.5	
Base-Emitter On Voltage* (I_C = 1.0 Adc, V_{CE} = 2.0 Vdc)	3, 4	$V_{BE(on)}$*	-	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain—Bandwidth Product (I_C = 1.0 Adc, V_{CE} = 10 Vdc, f = 1.0 MHz)		f_T	4.0	-	MHz
Small-Signal Current Gain (I_C = 500 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)		h_{fe}	20	-	-

* Pulse Test, PW ≈ 300 μs, Duty Cycle ≈ 2.0%

FIGURE 1 — NORMALIZED DC CURRENT GAIN

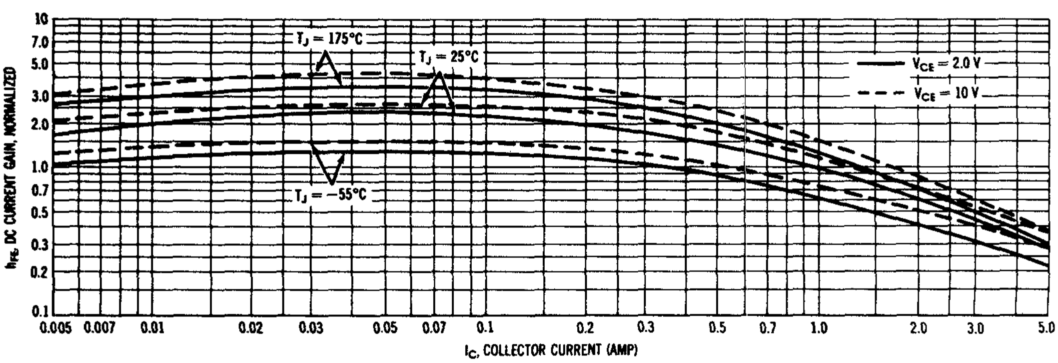
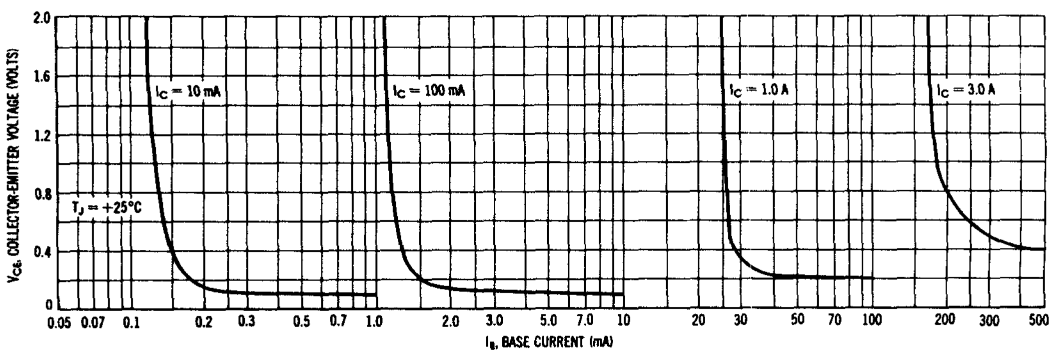


FIGURE 2 — COLLECTOR SATURATION REGION



2N5067, 2N5068, 2N5069 (continued)

FIGURE 3 — "ON" VOLTAGES

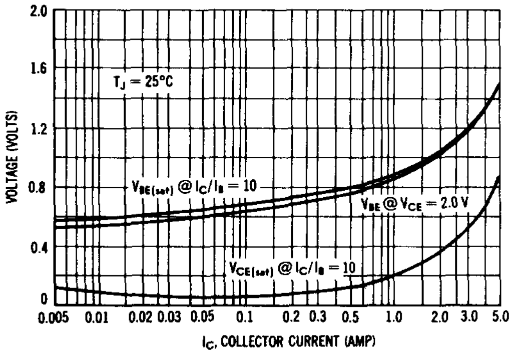
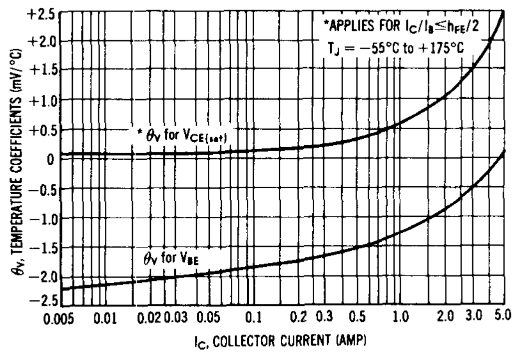


FIGURE 4 — TEMPERATURE COEFFICIENTS



TYPICAL "OFF" REGION CHARACTERISTICS

FIGURE 5 — CUT-OFF REGION

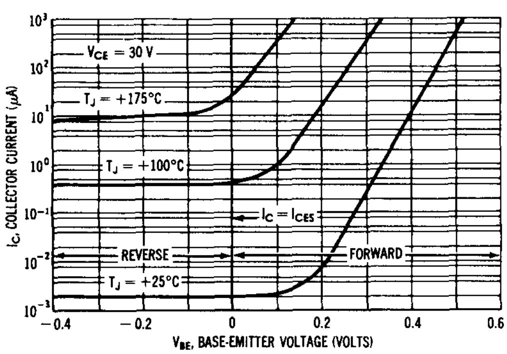


FIGURE 6 — EFFECTS OF BASE-EMITTER RESISTANCE

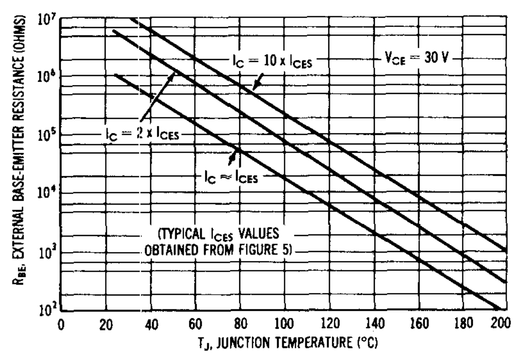


FIGURE 7 — SWITCHING TIME EQUIVALENT CIRCUIT

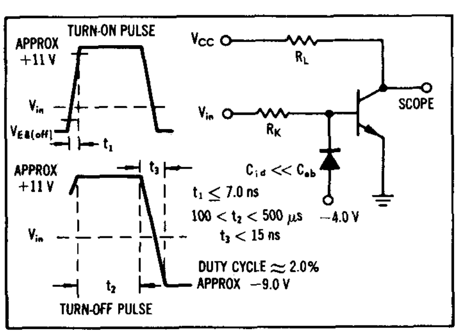
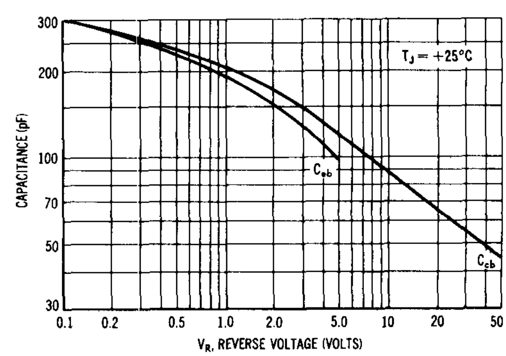


FIGURE 8 — CAPACITANCE



2N5067, 2N5068, 2N5069 (continued)

FIGURE 9 — TURN-ON TIME

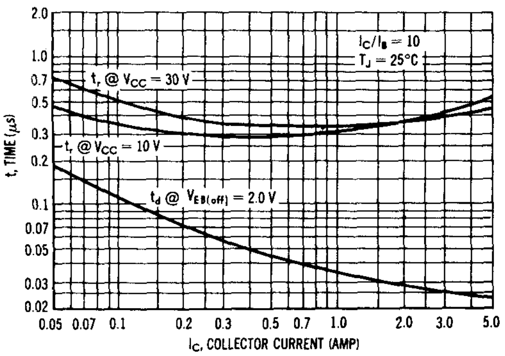
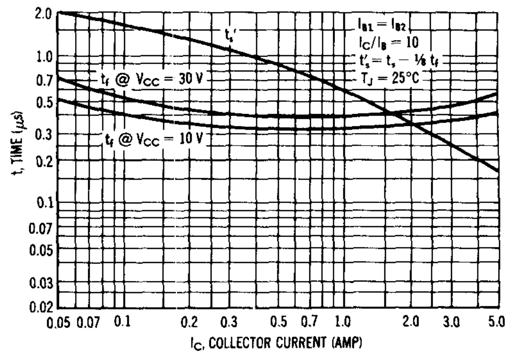
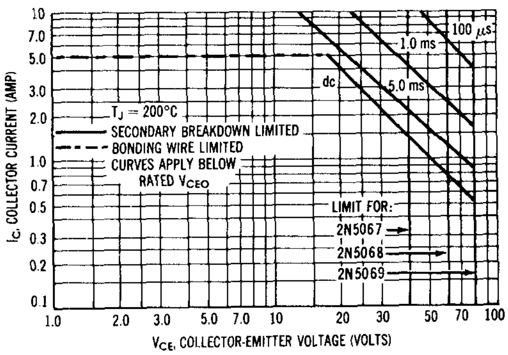


FIGURE 10 — TURN-OFF TIME



RATING AND THERMAL DATA

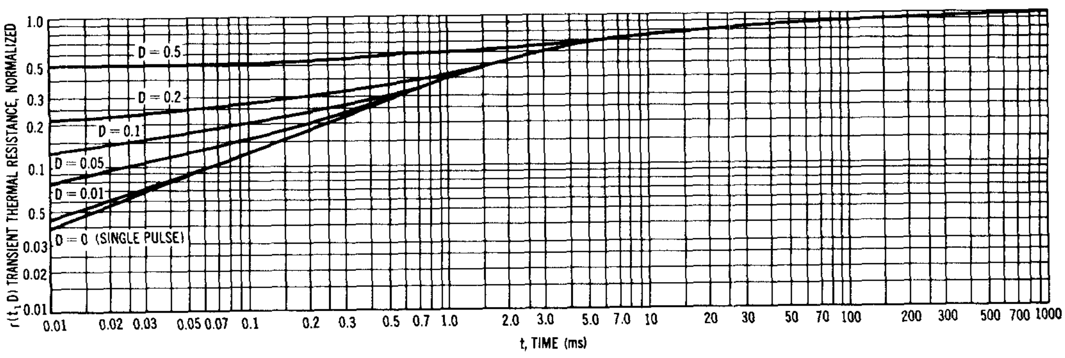
FIGURE 11 — ACTIVE-REGION SAFE OPERATING AREAS



There are two limitations on the power handling ability of a transistor: junction temperature and secondary 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.

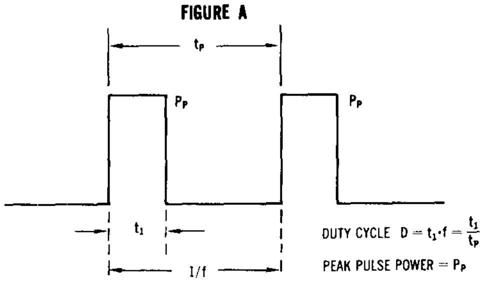
The data of Figure 11 is based on $T_{J(pk)} = 200°C$; T_C is variable depending on conditions. Pulse curves are valid for duty cycles to 10% provided $T_{J(pk)} \leq 200°C$. $T_{J(pk)}$ may be calculated from the data in Figure 12. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by secondary breakdown.

FIGURE 12 — TRANSIENT THERMAL RESISTANCE



DESIGN NOTE: USE OF TRANSIENT THERMAL RESISTANCE DATA

FIGURE A



A train of periodical power pulses can be represented by the model as shown in Figure A. Using the model and the device thermal reponse, the normalized effective transient thermal resistance of Figure 12 was calculated for various duty cycles.

To find $\theta_{JC}(t)$, multiply the value obtained from Figure 12 by the steady state value θ_{JC}.

Example:

The 2N5067 is dissipating 100 watts under the following conditions: $t_1 = 0.1$ ms, $t_P = 0.5$ ms. ($D = 0.2$)

Using Figure 12, at a pulse width of 0.1 ms and D = 0.2, the reading of r (t_1, D) is 0.28.

The peak rise in junction temperature is therefore

$$\Delta T = r(t) \times P_P \times \theta_{JC} = 0.28 \times 100 \times 2.0 = 56°C$$