2N6686, 2N6687, 2N6688

File Number **1171**

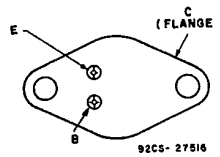
25-A SwitchMax Power Transistors

N-P-N Types for
Power Supplies and Other High-Voltage
Switching Applications

Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *Low V_{CE} (sat)*
- *Steel hermetic TO-204AA Package*

TERMINAL DESIGNATIONS



JEDEC TO-204AA

The RCA-2N6686, 2N6687, and 2N6688* SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for converters, inverters, pulse-width-modulated regulators and a variety of power switching circuits. These high-current, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 125°C as well as at 25°C, to provide information necessary for worst-case design.

The 2N6686, 2N6687, and 2N6688 transistors are supplied in steel JEDEC TO-204AA hermetic packages.

*Formerly RCA Dev. Type Nos. TA9119A, TA9119B, TA9119C, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6686	2N6687	2N6688	
* V_{CEV} V_{BE} = −1.5 V	260	280	300	V
* V_{CEX}(Clamped) V_{BE} = −1.5 V	210	230	250	V
* V_{CEO}	160	180	200	V
* V_{EBO}		8		V
I_{C}(sat)	25	25	20	A
* I_C	25	25	20	A
I_{CM}		50		A
* I_B		8		A
* P_T				
T_C up to 25°C		200		W
T_C above 25°C, derate linearly		1.14		W/°C
* T_{stg}, T_J		−65 to 200		°C
* T_L At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		235		°C

* In accordance with JEDEC registration data.

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ELECTRICAL CHARACTERISTICS T_C = 25°C

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		2N6686		2N6687		2N6688		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
* I_{CEV}	260	-1.5	—	—	—	50	—	—	—	—	μA
	280	-1.5	—	—	—	—	—	50	—	—	
	300	-1.5	—	—	—	—	—	—	—	50	
* I_{EBO}	—	-8	0	—	—	100	—	100	—	100	
* $V_{CEO(sus)}$[b]	—	—	0.2[a]	0	160	—	180	—	200	—	V
* h_{FE}	2	—	1[a]	—	30	—	30	—	25	—	—
	2	—	10[a]	—	25	100	25	100	20	80	
	2	—	20[a]	—	—	—	—	—	15	—	
	2	—	25[a]	—	15	—	15	—	—	—	
* V_{BE}(sat)	—	—	20[a]	2	—	—	—	—	—	1.8	V
	—	—	25[a]	2.5	—	1.8	—	1.8	—	—	
* V_{CE}(sat)	—	—	20[a]	2	—	—	—	—	—	1.5	
	—	—	25[a]	2.5	—	1.5	—	1.5	—	—	
* V_{CEX}[b] (Clamped $E_{S/b}$) L = 25 μH, R_{BB} = 10 Ω	—	-4	25	3	210	—	230	—	250	—	
$I_{S/b}$	18	—	11.1	—	1	—	1	—	1	—	s
* $\|h_{fe}\|$ f = 5 MHz	10	—	1	—	4	20	4	20	4	20	—
f_T	10	—	1	—	20	100	20	100	20	100	MHz
* C_{obo} f = 0.1 MHz	10[c]	—	—	—	300	650	300	650	300	650	pF
* t_d[d]	—	-4	20	2	—	—	—	—	—	0.1	μs
	—	-4	25	2.5	—	0.1	—	0.1	—	—	
* t_r[d]	—	-4	20	2	—	—	—	—	—	0.60	
	—	-4	25	2.5	—	0.60	—	0.60	—	—	
* t_s[d]	—	-4	20	2[e]	—	—	—	—	—	1.50	
	—	-4	25	2.5[e]	—	1.50	—	1.50	—	—	
* t_f[d]	—	-4	20	2[e]	—	—	—	—	—	0.25	
	—	-4	25	2.5[e]	—	0.25	—	0.25	—	—	
* t_c V_{CC} = 80 V, L = 25 μH, $R_C \leq 4$ Ω, Collector clamped to V_{CEX}	—	-4	20	3[e]	—	—	—	—	—	0.5	
	—	-4	25	3[e]	—	0.5	—	0.5	—	—	

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ELECTRICAL CHARACTERISTICS (cont'd)

	CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
		VOLTAGE V dc		CURRENT A dc		2N6686		2N6687		2N6688		
		V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
	T_C = 125°C											
*	I_{CEV}	260	−1.5			–	0.5	–	–	–	–	mA
		280	−1.5			–	–	–	0.5	–	–	
		300	−1.5			–	–	–	–	–	0.5	
*	V_{CE}(sat)			20[a]	2	–	–	–	–	–	1.5	V
				25[a]	2.5	–	1.5	–	1.5	–	–	
*	t_rd		−4	20	2	–	–	–	–	–	0.8	μs
				25	2.5	–	0.8	–	0.8	–	–	
*	t_sd		−4	20	2	–	–	–	–	–	2.5	
				25	2.5[e]	–	2.5	–	2.5	–	–	
*	t_fd		−4	20	2	–	–	–	–	–	0.8	
				25	2.5[e]	–	0.8	–	0.8	–	–	
*	t_c V_{CC}=80 V, L=25 μH, $R_C \leq 4\ \Omega$, Collector Clamped to V_{CEX}		−4	20	3[e]	–	–	–	–	–	0.8	
			−4	25	3[e]	–	0.8	–	0.8	–	–	
*	$R_{\theta JC}$	10		5		–	0.875	–	0.875	–	0.875	°C/W

* In accordance with JEDEC registration data.

[a] Pulsed: pulse duration = 300 μs, duty factor ≤ 2%.

[b] CAUTION: The sustaining voltage V_{CEO}(sus) and V_{CEX} MUST NOT be measured on a curve tracer.

[c] V_{CB} value.

[d] V_{CC} = 80 V, t_p = 20 μs

[e] $I_{B_1} = -I_{B_2}$

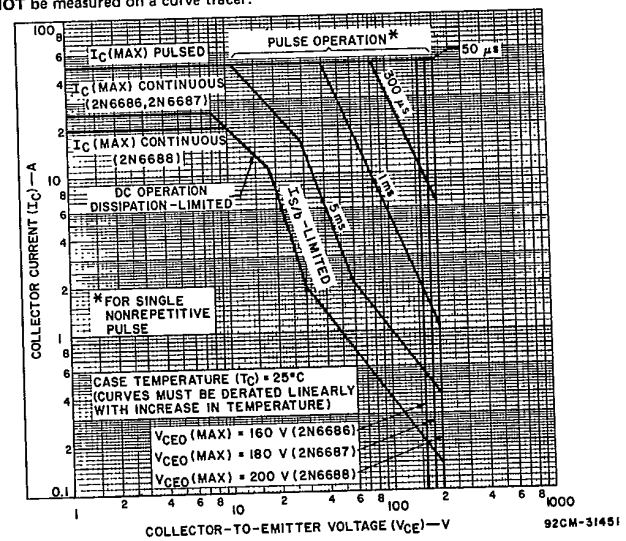

Fig. 1-Maximum operating areas for all types (T_C = 25°C).

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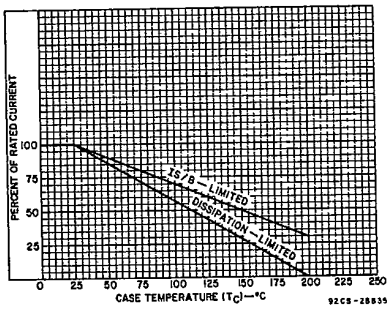

Fig. 2 — Dissipation and $I_{S/b}$ derating curves for all types.

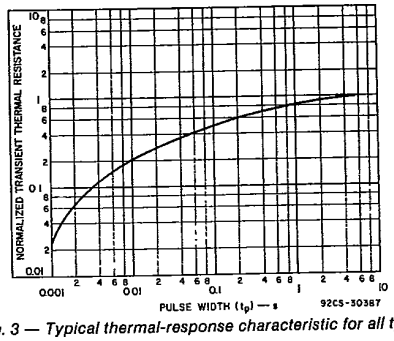

Fig. 3 — Typical thermal-response characteristic for all types.

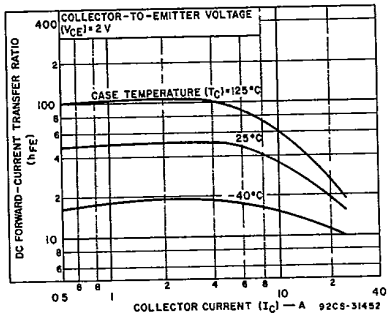

Fig. 4 — Typical dc beta characteristics for all types.

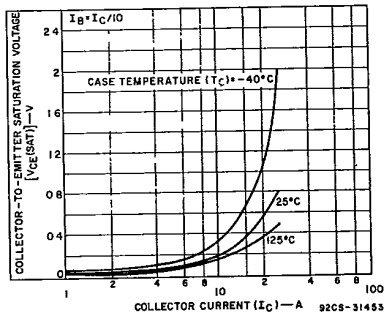

Fig. 5 — Typical collector-to-emitter saturation voltage characteristics for all types.

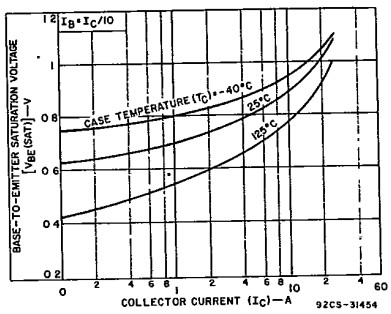

Fig. 6 — Typical base-to-emitter saturation voltage characteristic for all types.

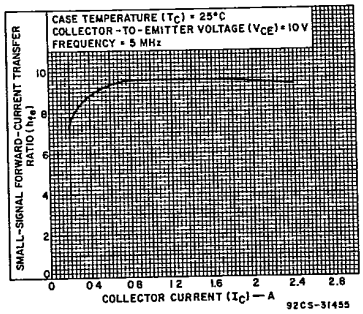

Fig. 7 — Typical small-signal forward-current transfer ratio characteristic for all ypes (f = 5 MHz).

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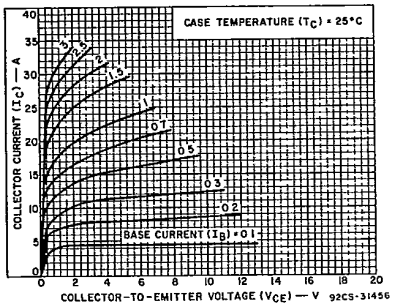

Fig. 8 — Typical output characteristics for all types.

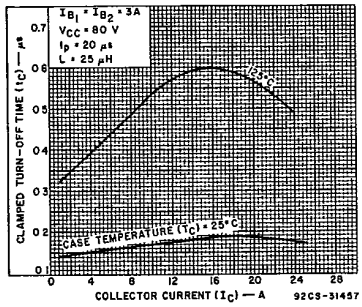

Fig. 9 — Typical clamped turn-off time characteristics for all types.

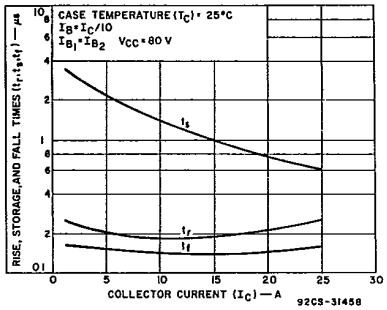

Fig. 10 — Typical saturated-switching-time characteristics as a function of collector current for all types.

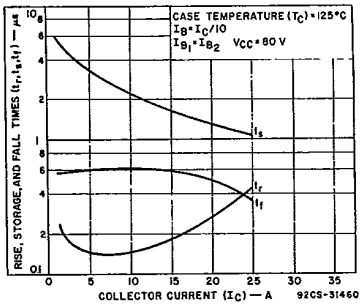

Fig. 11 — Typical saturated-switching-time characteristics at T_C = 125°C as a function of collector current for all types.

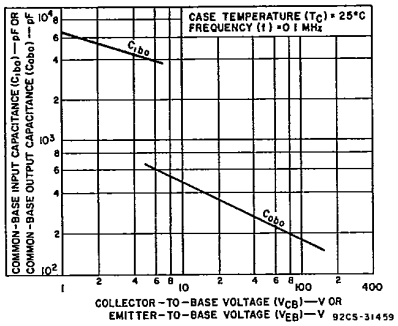

Fig. 12 — Typical common-base input (C_{ibo}) or output (C_{obo}) capacitance characteristic for all types.

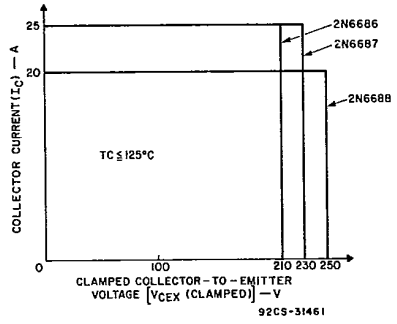

Fig. 13 — Maximum operating conditions for switching between saturation and cutoff for all types.

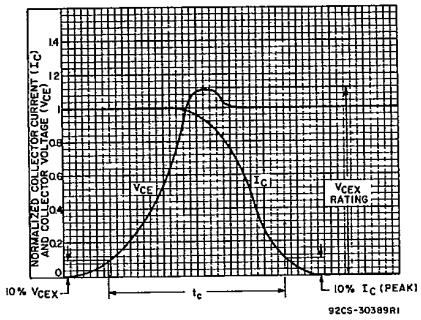

Fig. 14 — Oscilloscope display for normalized measurement of clamped inductive switching time (t_c).

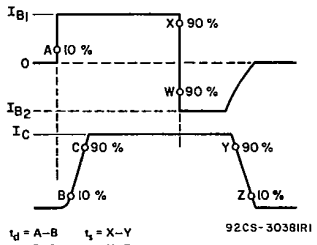

Fig. 15 — Phase relationship between input and output currents showing reference points for specification of switching times.

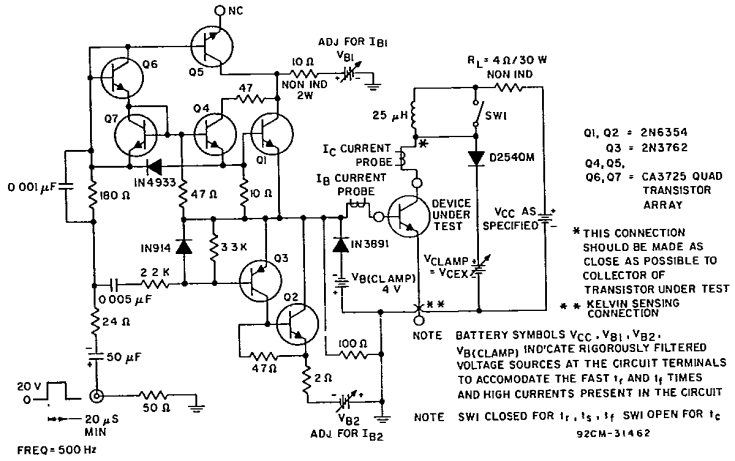

Fig. 16 — Circuit for measuring switching times.