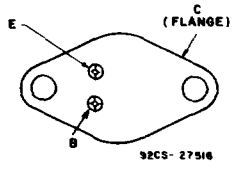
15-A *SwitchMax* Power Transistors

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

Features:
- *Fast switching speed*
- *High voltage ratings:* V_{CEX} = 350 V to 450 V
- *Low* $V_{CE}(sat)$ *at* I_C = 15 A

Applications:
- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



2N6676
2N6677
2N6678

JEDEC TO-204AA

The 2N6676 and 2N6677 and 2N6678 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 off-line power supplies, converter circuits, and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 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 specified at 100°C to provide information necessary for worst-case design.

The 2N6676, 2N6677 and 2N6678 transistors are supplied in steel JEDEC TO-204AA hermetic packages.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6676	2N6677	2N6678	
* V_{CEV}				
V_{BE} = -1.5 V	450	550	650	V
* V_{CEX} (Clamped)				
V_{BE} = -1.5 V	350	400	450	V
* V_{CEO}	300	350	400	V
* V_{EBO}	8			V
$I_C(sat)$	15			A
* I_C	15			A
I_{CM}	20			A
* I_B	5			A
* P_T				
T_C up to 25°C	175			W
T_C above 25°C, derate linearly	1			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
T_L				
At distance ≥ 1/8" in. (3.17 mm) from seating plane for 10 s max.				°C

* In accordance with JEDEC registration data (2N6676, 2N6677, 2N6678 only).

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		2N6676		2N6677		2N6678		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
T_C=25°C											
* I_{CEV}	450	-1.5			—	0.1	—	—	—	—	mA
	550	-1.5			—	—	—	0.1	—	—	
	650	-1.5			—	—	—	—	—	0.1	
* I_{EBO}		-8	0		—	2	—	2	—	2	
* $V_{CEO(sus)}$[b]			0.2[a]	0	300	—	350	—	400	—	V
* h_{FE}	3		15[a]		8	—	8	—	8	—	
* V_{BE}(sat)			15[a]	3	—	1.5	—	1.5	—	1.5	V
* V_{CE}(sat)			15[a]	3	—	1	—	1	—	1	
			15[a]	3	—	1.5	—	1.5	—	1.5	
V_{CEX}[b] (Clamped $E_{S/b}$) L=50 μH, R_{BB}=2 Ω		-6	15	3	350	—	400	—	450	—	
$I_{S/b}$	30		5.9		1	—	1	—	1	—	s
	100		0.25		1	—	1	—	1	—	
* $\|h_{fe}\|$ f=5 MHz	10		1		3	10	3	10	3	10	
f_T	10		1		15	50	15	50	15	50	MHz
* C_{obo} f=0.1 MHz	10[c]				150	500	150	500	150	500	pF
* t_d[d]		-6	15	3	—	0.1	—	0.1	—	0.1	μs
* t_r[d]		-6	15	3	—	0.6	—	0.6	—	0.6	
* t_s[d]		-6	15	3[e]	—	2.5	—	2.5	—	2.5	
* t_f[d]		-6	15	3[e]	—	0.5	—	0.5	—	0.5	
* t_c[f] V_{CC}=200 V, L=50 μH, $R_C \leq 13.5\ \Omega$		-6	15	3[e]	—	0.5	—	0.5	—	0.5	
T_C=100°C											
* I_{CEV}	450	-1.5			—	1	—	—	—	—	mA
	550	-1.5			—	—	—	1	—	—	
	650	-1.5			—	—	—	—	—	1	
* V_{CE}(sat)			15[a]	3	—	2	—	2	—	2	V
* t_r[d]		-6	15	3	—	1	—	1	—	1	μs
* t_s[d]		-6	15	3[e]	—	4	—	4	—	4	
* t_f[d]		-6	15	3[e]	—	1	—	1	—	1	
* t_c[f] V_{CC}=200 V, L=50 μH, $R_C \leq 13.5\ \Omega$		-6	15	3[e]	—	0.8	—	0.8	—	0.8	
* $R\theta_{JC}$ 2N6676, 2N6677, 2N6678	10		5		—	1	—	1	—	1	°C/W

[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.

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[c]V_{CB} value.

[d]V_{CC}=200 V, t_p=20 μs.

[e]I_{B1}=-I_{B2}.

[f]Collector clamped to V_{CEX}.

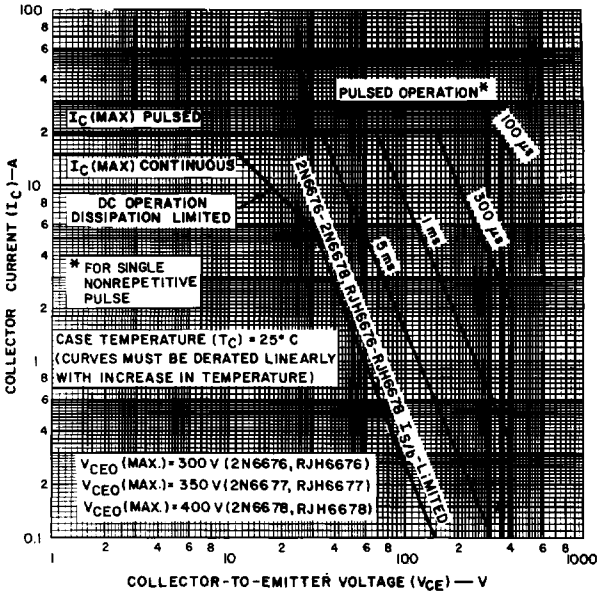

Fig. 1 - Maximum operating areas for all types (T_C = +25°C)

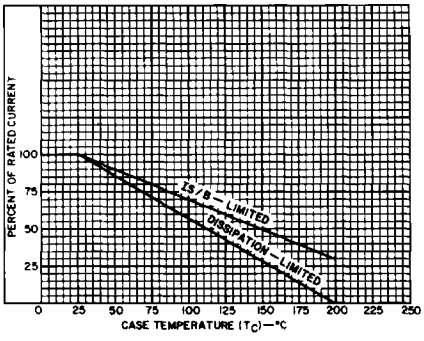

Fig. 2 - Dissipation and $I_{S/b}$ derating curves for 2N6676 and 2N6677 and 2N6678.

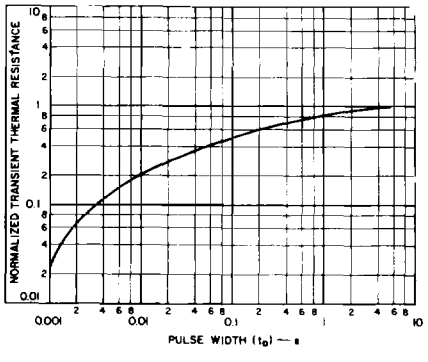

Fig. 3 - Typical thermal-response characteristic for all types.

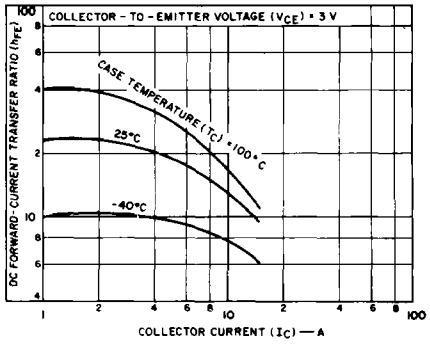

Fig. 4 - Typical dc beta characteristics for all types.

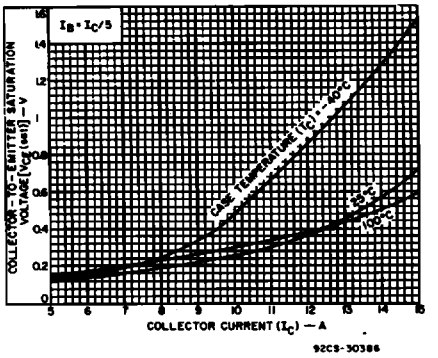

Fig. 5 - Typical collector-to-emitter saturation voltage characteristics for all types.

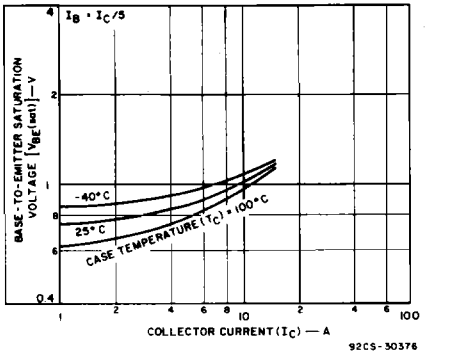

Fig. 6 - Typical base-to-emitter saturation voltage characteristics for all types.

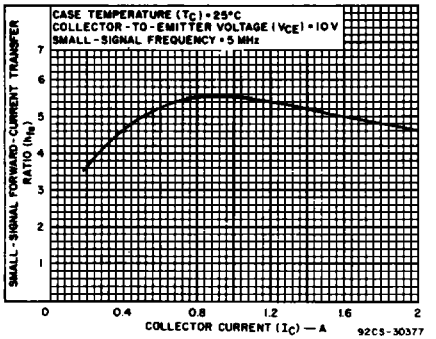

Fig. 7 - Typical small-signal forward current transfer ratio characteristic for all types (f = 5MHz).

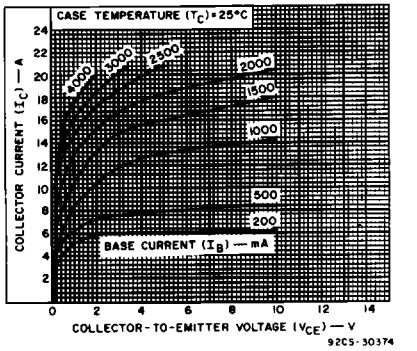

Fig. 8 - Typical output characteristics for all types.

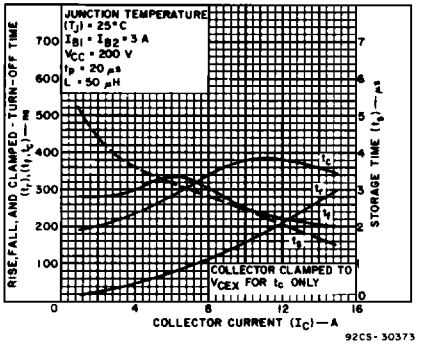

Fig. 9 - Typical saturated-switching-time characteristics at $T_J = 25°C$ as a function of collector current for all types.

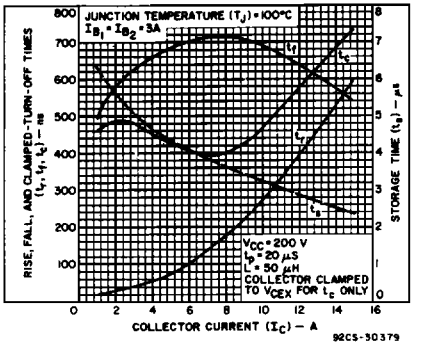

Fig. 10 - Typical saturated-switching-time characteristics at $T_J = 100°C$ as a function of collector current for all types.

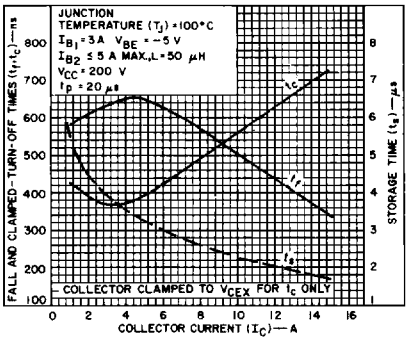

Fig. 11 - Typical saturated-switching-time characteristics at T_J = 100°C as a function of collector current for all types.

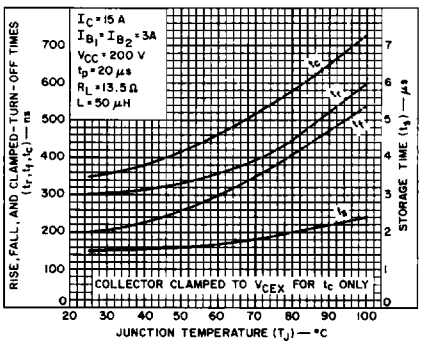

Fig. 12 - Typical saturated-switching-time characteristics as a function of junction temperature for all types.

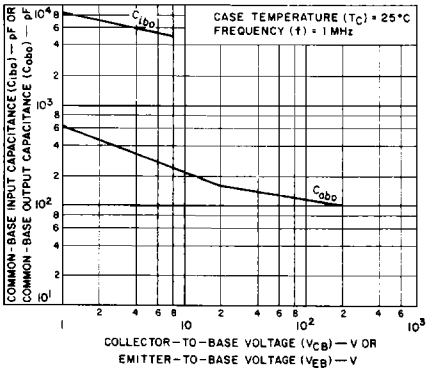

Fig. 13 - Typical common-base input (C_{ibo}) or output (C_{obo}) capacitance characteristics for all types.

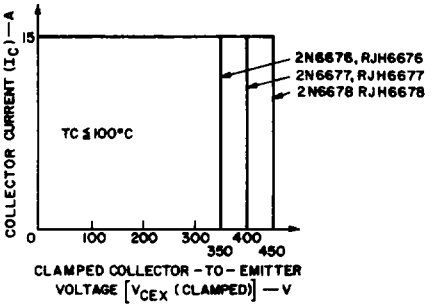

Fig. 14 - Maximum operating conditions for switching between saturation and cutoff for all types.

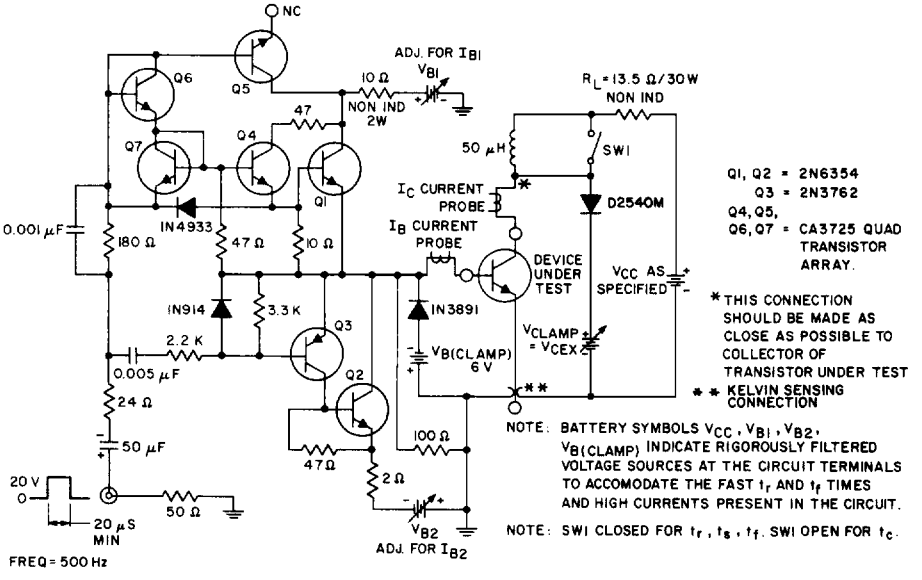

Fig. 15 - Circuit for measuring switching times.

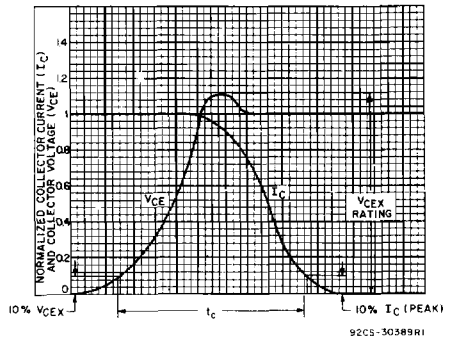

Fig. 16 - Oscilloscope display for normalized measurement of clamped inductive switching time (t_c).

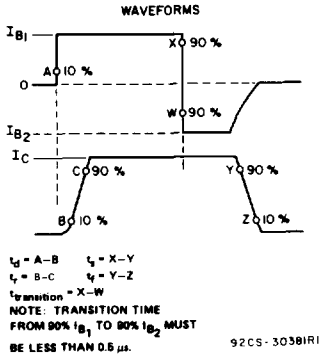

Fig. 17 - Phase relationship between input and output currents showing reference points for specification of switching times.