

2N6676, 2N6677, 2N6678, RJH6676, RJH6677, RJH6678

File Number **1165**

15-A SwitchMax Power Transistors

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

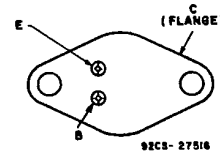
Features:

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

Applications:

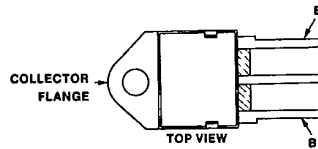
- Off-line power supplies
- High-voltage inverters
- Switching regulators

TERMINAL DESIGNATIONS



2N6676
 2N6677
 2N6678

JEDEC TO-204AA



RJH6676
 RJH6677
 RJH6678

JEDEC TO-218AC

The RCA 2N6676, 2N6677 and 2N6678, RJH6676, RJH6677, and RJH6678 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. The RJH6676, RJH6677, and RJH6678 transistors are supplied in JEDEC TO-218AC plastic packages.

MAXIMUM RATINGS, Absolute-Maximum Values:

	RJH6676	RJH6677	RJH6678	2N6676	2N6677	2N6678	
* V_{CEV}							V
$V_{BE} = -1.5\text{ V}$	450	550	650	450	550	650	
* V_{CEX} (Clamped)							V
$V_{BE} = -1.5\text{ V}$	350	400	450	350	400	450	
* V_{CEO}	300	350	400	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				175			W
T_C up to 25°C					1		W/°C
T_C above 25°C, derate linearly		1.4					
* T_{STG}, T_J		-65 to 150			-65 to 200		°C
* T_L						235	°C
At distance $\geq 1/16$ in. (1.58 mm) from seating plane for 10 s max.							
T_L						235	°C
At distance $\geq 1/8$ " in. (3.17 mm) from seating plane for 10 s max.							

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

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ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE		CURRENT		2N6676		2N6677		2N6678		
	V dc		A dc		RJH6676		RJH6677		RJH6678		
V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.		

$T_C=25^\circ C$

I_{CEV}	450 550 650	-1.5 -1.5 -1.5			—	0.1	—	—	—	—	—	—	mA
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	—	1.5	V
$V_{CE(sat)}$			15 ^a	3	—	1	—	1	—	1	—	1	V
V_{CEX}^b (Clamped $E_{S(b)}$) $L=50 \mu H, R_{BB}=2 \Omega$		-6	15	3	350	—	400	—	450	—	—	—	
$I_{S(b)}$	30 100		5.9 0.25		1 1	—	1 1	—	1 1	—	—	—	s
$ h_{re} $ 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	—	0.1	μs
t_r^d		-6	15	3	—	0.6	—	0.6	—	0.6	—	0.6	
t_s^d		-6	15	3 ^e	—	2.5	—	2.5	—	2.5	—	2.5	
t_f^d		-6	15	3 ^e	—	0.5	—	0.5	—	0.5	—	0.5	
t_c^f $V_{CC}=200 V,$ $L=50 \mu H,$ $R_C \leq 13.5 \Omega$		-6	15	3 ^e	—	0.5	—	0.5	—	0.5	—	0.5	

$T_C=100^\circ C$

I_{CEV}	450 550 650	-1.5 -1.5 -1.5			—	1	—	—	—	—	—	—	mA
$V_{CE(sat)}$			15 ^a	3	—	2	—	2	—	2	—	2	V
t_d^d		-6	15	3	—	1	—	1	—	1	—	1	μs
t_r^d		-6	15	3 ^e	—	4	—	4	—	4	—	4	
t_s^d		-6	15	3 ^e	—	1	—	1	—	1	—	1	
t_f^d		-6	15	3 ^e	—	1	—	1	—	1	—	1	
t_c^f $V_{CC}=200 V,$ $L=50 \mu H,$ $R_C \leq 13.5 \Omega$		-6	15	3 ^e	—	0.8	—	0.8	—	0.8	—	0.8	

$R_{\theta JC}$ 2N6676, 2N6677, 2N6678	10		5		—	1	—	1	—	1		$^\circ C/W$
$R_{\theta JC}$ RJH6676, RJH6677, RJH6678	10		5		—	0.71	—	0.71	—	0.71		$^\circ C/W$

^aPulsed: pulse duration=300 μs , duty factor $\leq 2\%$.
^bCAUTION: The sustaining voltage $V_{CEO(sus)}$ and V_{CEX} MUST NOT be measured on a curve tracer.
^cIn accordance with JEDEC registration data (2N6676, 2N6677, 2N6678 only).
^d V_{CE} value.
^e $V_{CC}=200 V, t_p=20 \mu s$.
^f $I_{B1}=-I_{B2}$.
^gCollector clamped to V_{CEX} .

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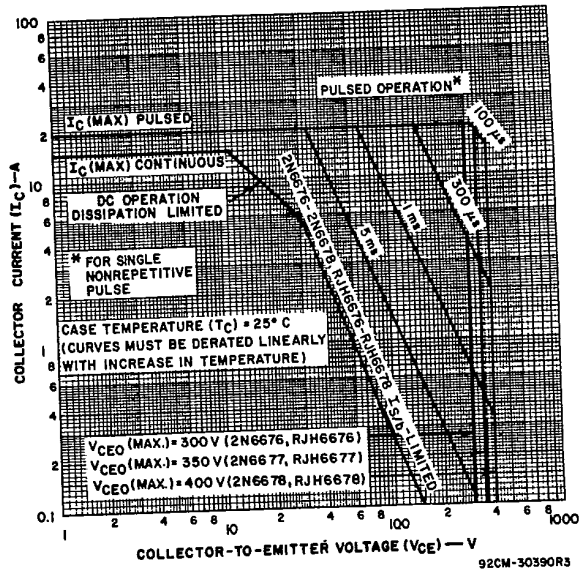


Fig. 1 - Maximum operating areas for all types ($T_c = 25^\circ C$).

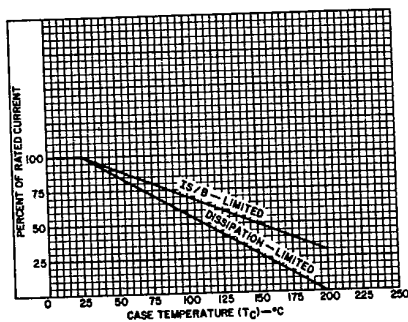


Fig. 2 - Dissipation and I_{S_B} derating curves for 2N6676, 2N6677, and 2N6678.

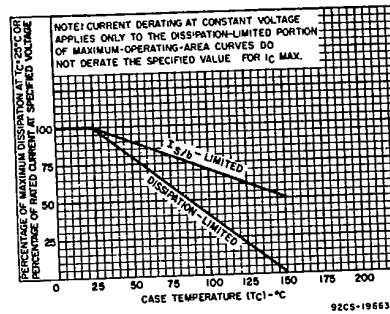


Fig. 3 - Dissipation and I_{S_B} derating curves for RJH6676, RJH6677, and RJH6678.

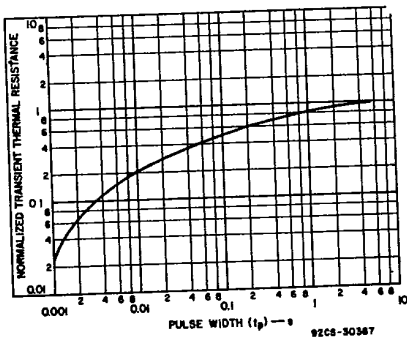


Fig. 4 - Typical thermal-response characteristic for all types.

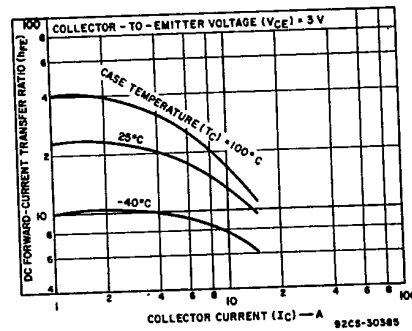


Fig. 5 - Typical dc beta characteristics for all types.

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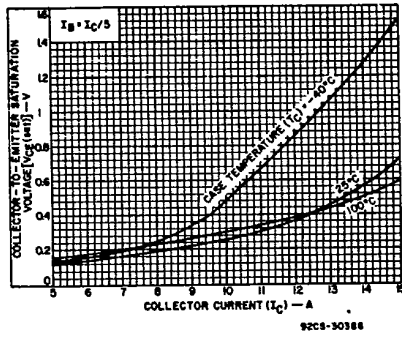


Fig. 6 - Typical collector-to-emitter saturation voltage characteristics for all types.

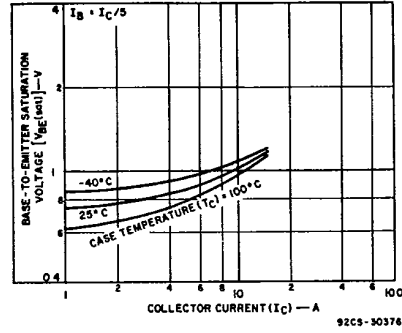


Fig. 7 - Typical base-to-emitter saturation voltage characteristics for all types.

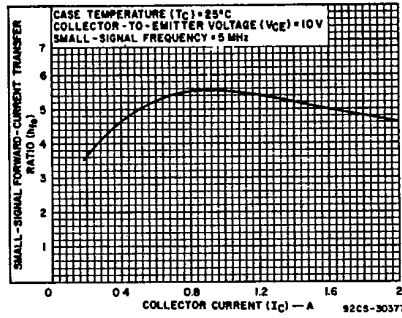


Fig. 8 - Typical small-signal forward current transfer ratio characteristic for all types ($f = 5\text{ MHz}$).

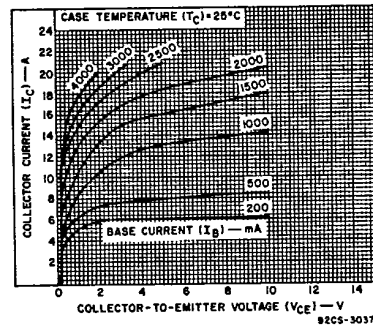


Fig. 9 - Typical output characteristics for all types.

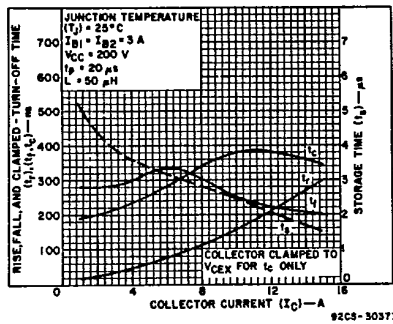


Fig. 10 - Typical saturated-switching-time characteristics at $T_J = 25^\circ\text{C}$ as a function of collector current for all types.

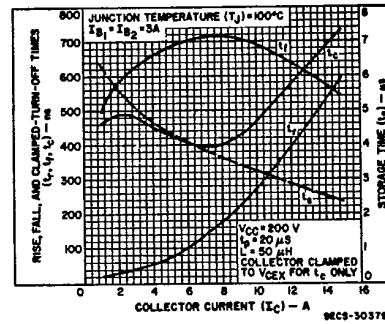


Fig. 11 - Typical saturated-switching-time characteristics at $T_J = 100^\circ\text{C}$ as a function of collector current for all types.

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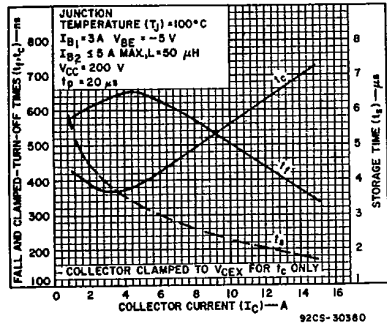


Fig. 12 - Typical saturated-switching-time characteristics at $T_j = 100^\circ C$ as a function of collector current for all types.

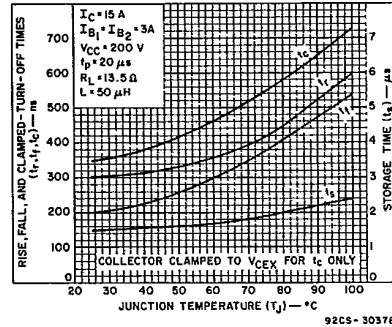


Fig. 13 - Typical saturated-switching-time characteristics as a function of junction temperature for all types.

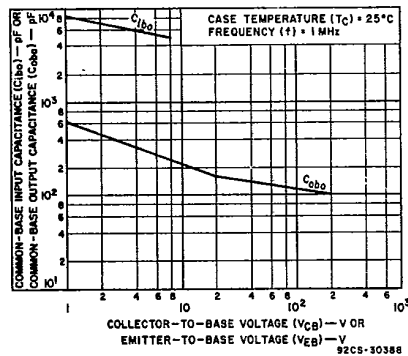


Fig. 14 - Typical common-base input (C_{ibo}) or output (C_{obo}) capacitance characteristics for all types.

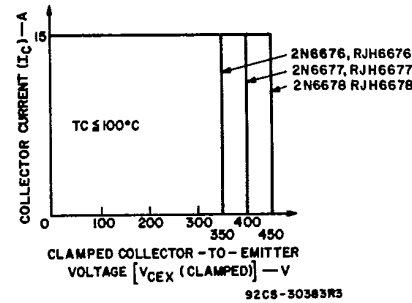


Fig. 15 - Maximum operating conditions for switching between saturation and cutoff for all types.

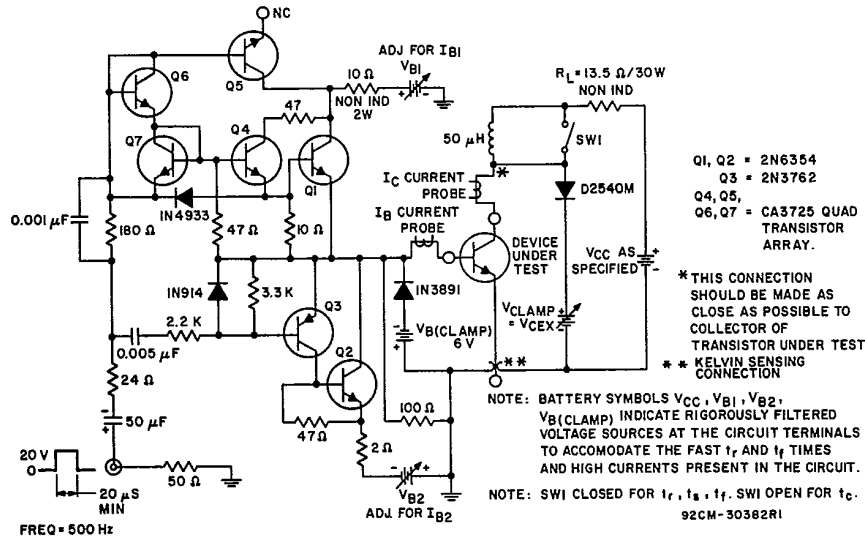


Fig. 16 - Circuit for measurement switching times.

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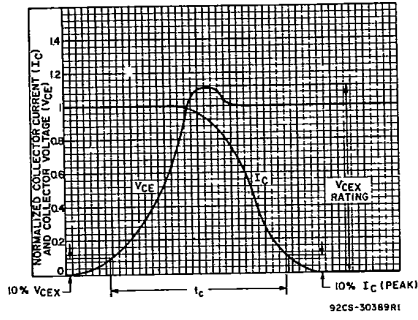


Fig. 17 - Oscilloscope display for normalized measurement of clamped inductive switching time (t_c).

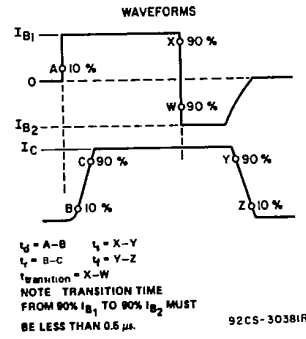


Fig. 18 - Phase relationship between input and output currents showing reference points for specification of switching times.