

2N3878, 2N3879, 2N5202, 2N6500

File Number **766**

**High-Speed, Epitaxial-Collector
Silicon N-P-N Planar Transistors**

For High-Speed Switching and Linear-Amplifier Applications

Features:

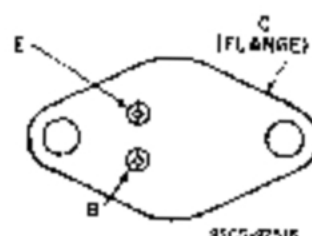
- Maximum-area-of-operation curves for dc and pulse operation
- High sustaining voltage
- Total saturated transition time less than 1 μ s for 2N3879, 2N5202, and 2N6500

RCA-2N3878, 2N3879, 2N5202, and 2N6500* are epitaxial silicon n-p-n transistors. The 2N3878 is an amplifier type intended for audio-, ultrasonic-, and radio-frequency circuits. Types 2N3879, 2N5202, and 2N6500 are switching transistors intended for use in high-current, high-speed switching circuits.

Typical applications for these transistors include: low-distortion power amplifiers, oscillators, switching regulators, series regulators, converters, and inverters.

*Formerly RCA Dev. Type Nos. TA2506, TA2509A, TA7285, and TA8932, respectively.

TERMINAL DESIGNATIONS



JEDEC TO-213AA

MAXIMUM RATINGS, Absolute-Maximum Values:

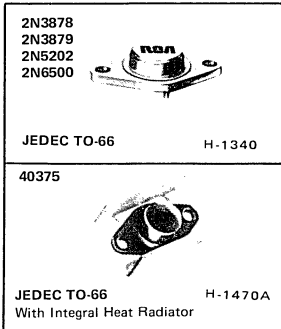
		2N3878	2N3879	2N5202	2N6500	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	120	120	100	120	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE: With external base-to-emitter resistance (R_{BE}) = 50 Ω . With base open,	$V_{CER}(sust)$ $V_{CEO}(sust)$	65 60*	90 75*	75* 60	110* 90*	V V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	0	7	V
*CONTINUOUS COLLECTOR CURRENT	I_C	4	7	4	4	A
PEAK COLLECTOR CURRENT	I_{CM}	10	10	5	5	A
*CONTINUOUS BASE CURRENT	I_B	4	5	2	3	A
*TRANSISTOR DISSIPATION At case temperature (T_C) = 25°C At case temperatures above 25°C For other conditions	P_T	35 Derate linearly at 0.2 W/°C See Figs. 1, 3 and 4	35	35	35	W W
*TEMPERATURE RANGE: Storage & operating (junction)			-65 to 200			°C
*PIN TEMPERATURE: 1/32 in. (0.8 mm) from seating plane for 10 s max.		235	235	235	235	°C

* In accordance with JEDEC registration data format JS-6 RDF-2 (2N3878); JS-6 RDF-1 (2N3879, 2N5202, 2N6500).



Power Transistors

2N3878 2N5202
2N3879 2N6500
40375



High-Speed, Epitaxial-Collector Silicon N-P-N Transistors

For High-Speed Switching and Linear-Amplifier Applications

Features:

- ▣ Maximum-area-of-operation curves for dc and pulse operation
- ▣ Rated for safe operation in both forward- and reverse-bias conditions
- ▣ High sustaining voltage
- ▣ Total saturated transition time less than 1 μ s for 2N3879, 2N5202, and 2N6500

RCA-2N3878, 2N3879, 2N5202, and 2N6500^o are epitaxial silicon n-p-n transistors. The 2N3878 is an amplifier type intended for audio-, ultrasonic-, and radio-frequency circuits. Types 2N3879, 2N5202, and 2N6500 are switching transistors intended for use in high-current, high-speed switching circuits. Type 40375 is a 2N3878 with a factory-attached heat radiator; it is intended for printed circuit-board applications.

Typical applications for these transistors include: low-distortion power amplifiers, oscillators, switching regulators, series regulators, converters, and inverters.

^o Formerly RCA Dev. Type Nos. TA2509, TA2509A, TA7285, and TA8932, respectively.

MAXIMUM RATINGS, Absolute-Maximum Values:

		2N3878 40375	2N3879	2N5202	2N6500	
*COLLECTOR-TO-BASE VOLTAGE	V _{CB0}	120	120	100	120	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE: With external base-to-emitter resistance (R _{BE}) = 50 Ω .	V _{CEr(sus)}	65	90	75*	110*	V
With base open.	V _{CEO(sus)}	50*	75*	50	90*	V
*EMITTER-TO-BASE VOLTAGE	V _{EBO}	7	7	6	7	V
*CONTINUOUS COLLECTOR CURRENT	I _C	4	7	4	4	A
PEAK COLLECTOR CURRENT	I _{CM}	10	10	5	5	A
*CONTINUOUS BASE CURRENT	I _B	4	5	2	3	A
*TRANSISTOR DISSIPATION	P _T					
At case temperature (T _C) = 25 ^o C		35 (2N3878)	35	35	35	W
At case temperatures above 25 ^o C		Derate linearly at 0.2 W/ ^o C				
At ambient temperature (T _A) = 25 ^o C		5.8 (40375)	—	—	—	W
For other conditions		See Figs. 5, 6, 7, and 8				
*TEMPERATURE RANGE: Storage & operating (Junction)			-65 to 200			^o C
*PIN TEMPERATURE: 1/32 in. (0.8 mm) from seating plane for 10 s max.		235	235	235	235	^o C

* In accordance with JEDEC registration data format JS-6 RDF-2 (2N3878); JS-6 RDF-1 (2N3879, 2N5202, 2N6500).

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C) = 25°C unless otherwise specified:

CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS								UNITS
		VOLTAGE V dc		CURRENT A dc		2N3878 40375		2N3879		2N5202		2N6500		
		V _{CE}	V _{BE}	I _C	I _B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
* Collector Cutoff Current: With base-emitter junction reverse-biased	I _{CEV}	100	-1.5			-	-	-	-	-	10	-	-	
		110	0			-	-	-	-	-	-	-	5	
* With base-emitter junction reverse-biased and $T_C = 150^\circ\text{C}$	I _{CEV}	120	-1.5			-	25	-	25	-	-	-	-	
		100	-1.5			-	4	-	4	-	10	-	-	
With base open	I _{CEO}	110	0			-	-	-	-	-	-	-	10	
		40			0	-	5*	-	5	-	-	-	-	
With base open	I _{CEO}	70			0	-	-	-	-	-	-	-	5	
						-	-	-	-	-	-	-	-	
* Emitter Cutoff Current	I _{EBO}		-6			-	10	-	10	-	10	-	25	
Collector-to-Emitter Sustaining Voltage (see Figs.3 and 4): With base open	V _{CEO(sus)}			0.2	0	50 ^a	-	75 ^a	-	50 ^a	-	90 ^a	-	
				0.2	0	65 ^a	-	90 ^a	-	75 ^a	-	110 ^a	-	
With external base-to-emitter resistance (R _{BE}) = 50 Ω	V _{CER(sus)}			0.2	0	65 ^a	-	90 ^a	-	75 ^a	-	110 ^a	-	
DC Forward-Current Transfer Ratio	h _{FE}	1.2		4 ^b		-	-	-	-	10*	100*	-	-	
		2		0.5 ^b		40*	200*	-	-	-	-	-	-	
		2		3 ^b		-	-	-	-	-	-	-	15*	
		2		4 ^b		8*	-	12*	100*	-	-	-	60*	
		5		4 ^b		20*	-	20	80	-	-	-	-	
5		0.5 ^b		50*	200*	40	-	-	-	-	-	-		
* Collector-to-Emitter Saturation Voltage	V _{CE(sat)}			3 ^b	0.3	-	-	-	-	-	-	-	1.5	
Base-to-Emitter Voltage	V _{BE}			4 ^b	0.4	-	2	-	1.2	-	1.2	-	-	
		2		4 ^b	-	-	2.5	-	-	-	-	-	-	
* Base-to-Emitter Saturation Voltage	V _{BE(sat)}			3 ^b	0.3	-	-	-	-	-	-	-	2.5	
Collector-to-Base Output Capacitance : (f = 1 MHz, V _{CB} = 10 V)	C _{ob}			4 ^b	0.4	-	-	2	-	2	-	-	-	
				4 ^b	0.4	-	-	2	-	2	-	-	-	
Collector-to-Base Output Capacitance : (f = 1 MHz, V _{CB} = 10 V)	C _{ob}					-	175*	-	175	-	175	-	175	
Second Breakdown Collector Current: With base forward-biased and 1- μ s nonrepetitive pulse	I _{S/b}	40				750	-	500	-	400	-	400	-	
Second-Breakdown Energy: With base reverse-biased and R _{BE} = 50 Ω, V _{BB} = -4 V At L = 50 μH At L = 125 μH	ES _b ^c					-	-	-	-	0.4	-	-	-	
* Magnitude of Common Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio:(f = 10 MHz)	h _{fe}	10		0.5		4	-	4	-	6	-	6	-	
		30		0.1		40	-	-	-	-	-	-	-	
* Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio:(f = 1 kHz)	h _{fe}	30		0.1		40	-	-	-	-	-	-	-	
Thermal Resistance: Junction-to-case	R _{θJC}					2N3878								
						-	5	-	5	-	5	-	5	
Junction-to-ambient	R _{θJA}					40375								
						-	30	-	-	-	-	-	-	

* In accordance with JEDEC registration data format JS-6 RDF-2 (2N3878); JS-6 RDF-1 (2N3879, 2N5202, 2N6500).

^a CAUTION: Sustaining voltages V_{CEO(sus)} and V_{CER(sus)} MUST NOT be measured on a curve tracer.

^b Pulsed, pulse duration = 300 μs, duty factor ≤ 2 %.

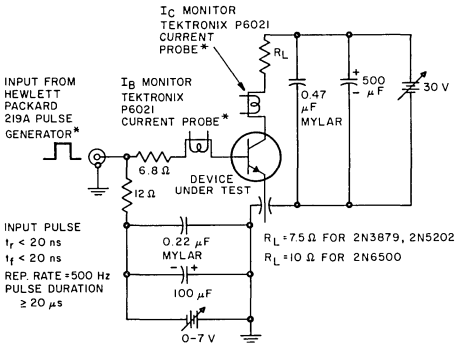
^c ES_b is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. ES_b = 1/2LI² where L is a series load or leakage inductance and I is the peak collector current.

TRANSITION AND STORAGE-TIME CHARACTERISTICS FOR SWITCHING TYPES, At Case Temperature (T_C) = 25°C:

CHARACTERISTIC	SYMBOL	TEST CONDITIONS			LIMITS					UNITS	
		VOLTAGE V dc	CURRENT A dc		2N3879		2N5202		2N6500		
		V _{CC}	I _C	I _B	Min.	Max.	Min.	Max.	Min.		Max.
Saturated Switching Time (see Figs. 1, 2, 18, 20, and 22.) Delay time	t _d	30	3	0.3 ^a	—	—	—	—	—	40	
		30	4	0.4 ^a	—	40	—	—	—	—	
		30	4	0.8 ^a	—	—	—	40	—	—	
Rise time	t _r	30	3	0.3 ^a	—	—	—	—	—	400	
		30	4	0.4 ^a	—	400	—	—	—	—	
		30	4	0.8 ^a	—	—	—	400	—	—	
Storage time	t _s	30	3	0.3 ^a	—	—	—	—	—	1000	
		30	4	0.4 ^a	—	800	—	—	—	—	
		30	4	0.8 ^a	—	—	—	1200	—	—	
Fall time	t _f	30	3	0.3 ^a	—	—	—	—	—	500	
		30	4	0.4 ^a	—	400	—	—	—	—	
		30	4	0.8 ^a	—	—	—	400	—	—	

* In accordance with JEDEC registration data format (JS-6, RDF-1)

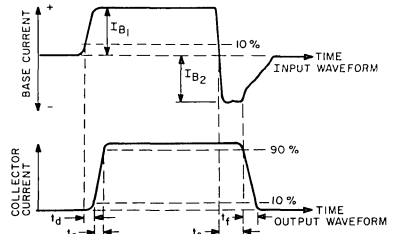
^a I_{B1} = I_{B2}



*OR EQUIVALENT

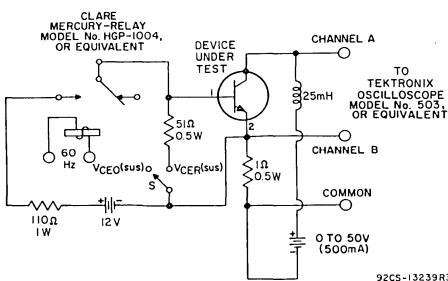
92CS-23754

Fig. 1 — Circuit used to measure switching times for 2N3879, 2N5202, and 2N6500.



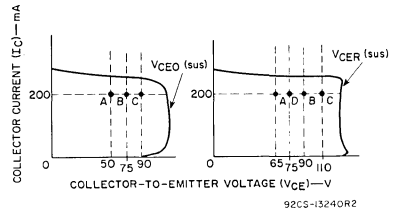
92CS-23760

Fig. 2 — Oscilloscope display for measurement of switching times. (Circuit shown in Fig. 1).



92CS-13259R3

Fig. 3 — Circuit used to measure sustaining voltages, V_{CE0}(sus) and V_{CEP}(sus) for all types.



92CS-13240R2

The sustaining voltages V_{CE0}(sus) and V_{CEP}(sus) are acceptable when the traces fall to the right and above point "A" for types 2N3878, 40375, and 2N5202; point "B" for type 2N3879; and point "C" for type 2N6500. The sustaining voltage V_{CEP}(sus) is acceptable when the trace falls to the right and above point "D" for type 2N5202.

Fig. 4 — Oscilloscope display for measurement of sustaining voltages. (Circuit shown in Fig. 3.)

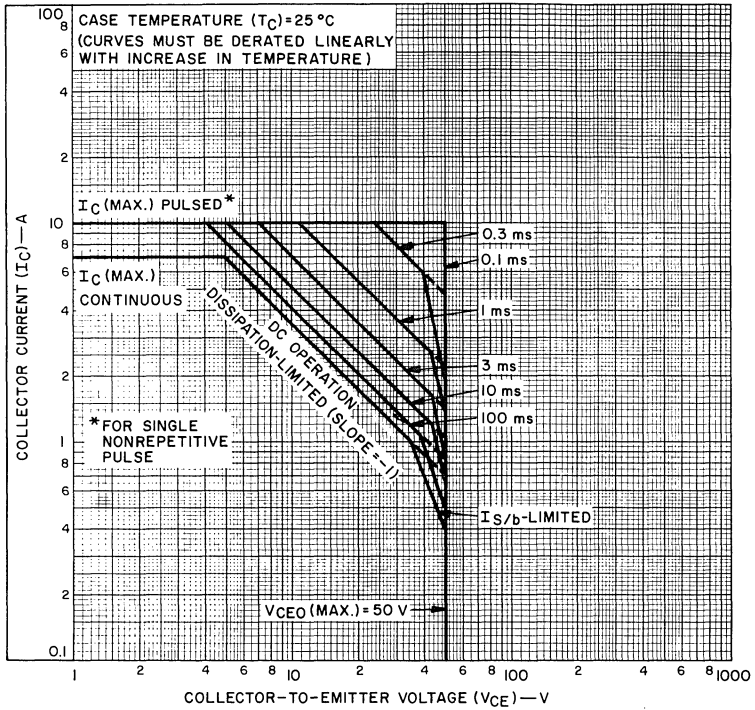
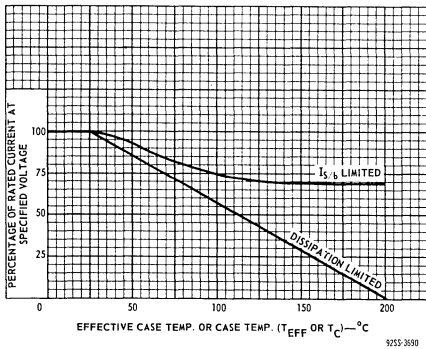


Fig. 5 - Maximum operating areas for 2N3878.

92CS-23755



Note: Use ambient temperature for derating 40375.

Fig. 6 - Dissipation derating for all types.

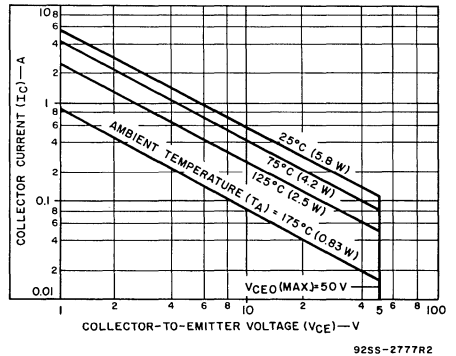
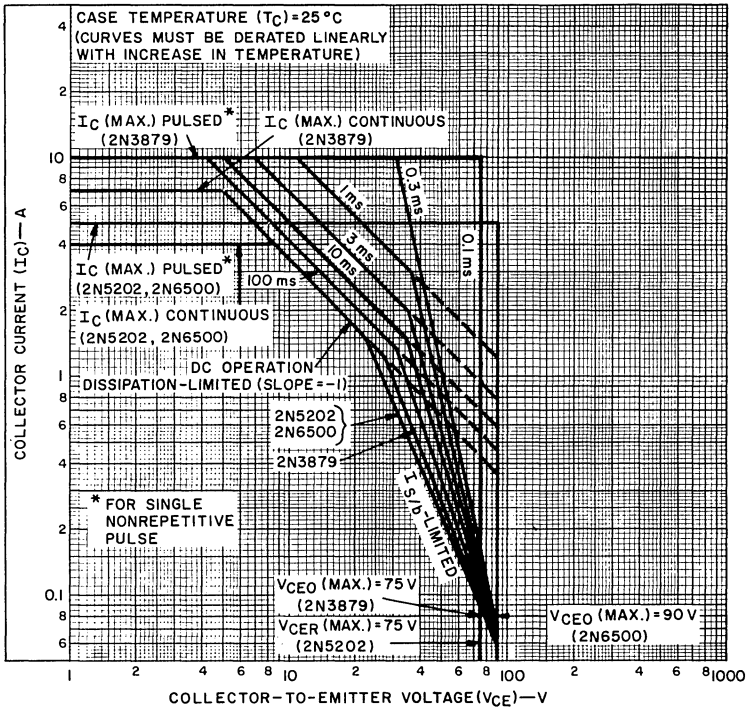


Fig. 7 - Maximum operating areas for 40375.

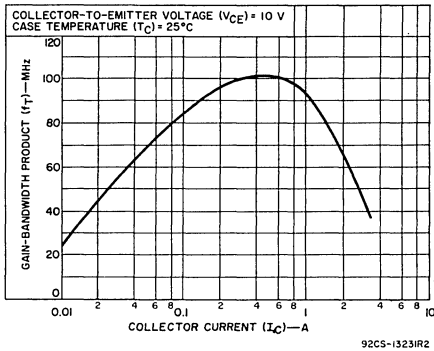
TERMINAL CONNECTIONS

- Pin 1 - Base
- Pin 2 - Emitter
- Heat Radiator - Collector (40375)
- Case, Mounting Flange - Collector (2N3878, 2N3879, 2N5202, 2N6500)



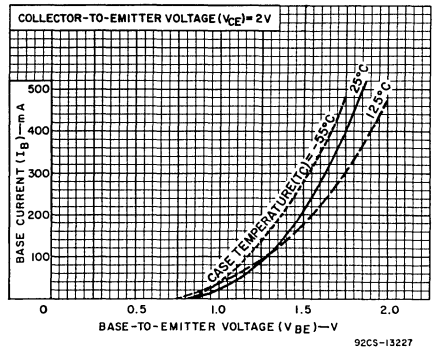
92CS-23756

Fig. 8 — Maximum operating areas for 2N3879, 2N5202, and 2N6500.



92CS-13231R2

Fig. 9 — Typical gain-bandwidth product for all types.



92CS-13227

Fig. 10 — Typical input characteristics for all types.

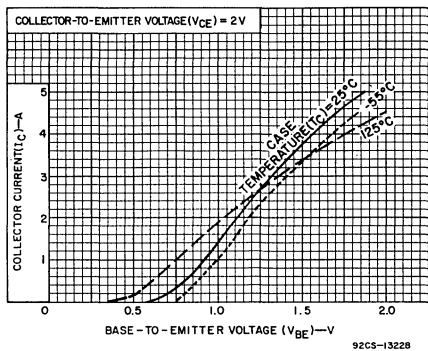


Fig. 11 - Typical transfer characteristics for all types.

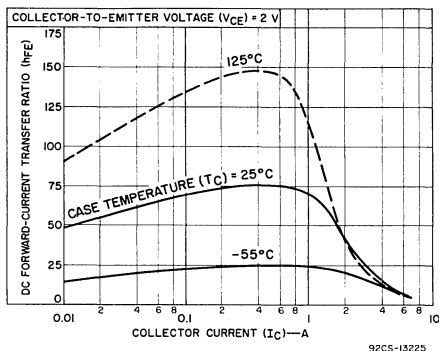


Fig. 12 - Typical dc beta characteristics for 2N3878, 2N3879, and 40375.

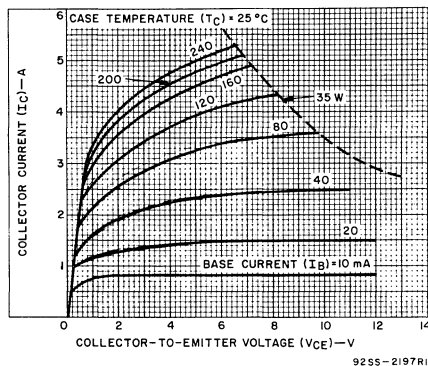


Fig. 13 - Typical output characteristics for 2N3878, 2N3879, 2N5202, and 40375.

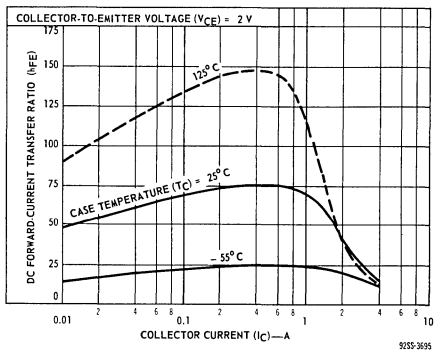


Fig. 14 - Typical dc beta characteristics for 2N5202.

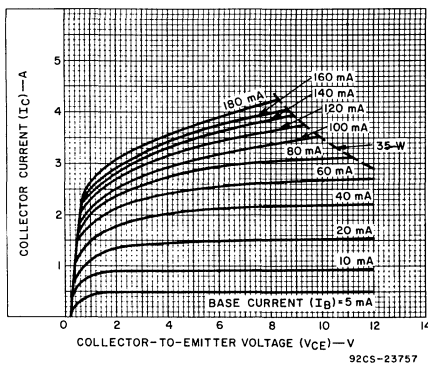


Fig. 15 - Typical output characteristics for 2N6500.

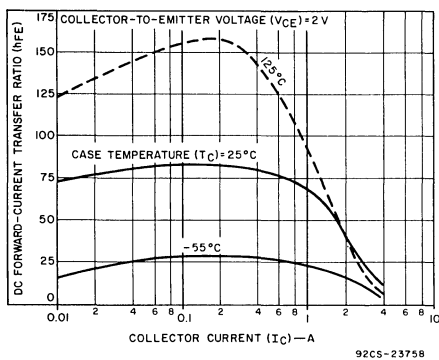


Fig. 16 - Typical dc beta characteristics for 2N6500.

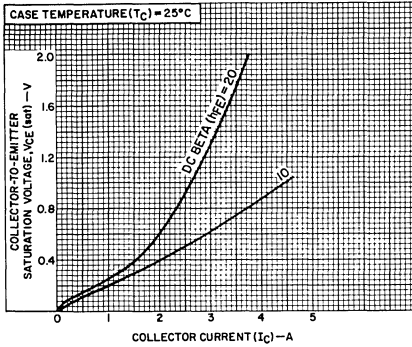


Fig.17 — Typical saturation-voltage characteristics for 2N3878, and 2N3879.

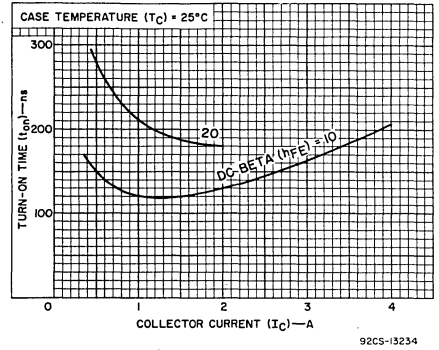


Fig.18 — Typical turn-on time for 2N3879, 2N5202, and 2N6500.

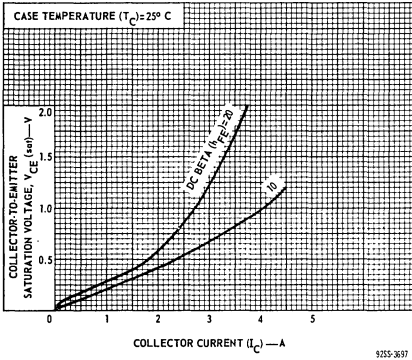


Fig.19 — Typical saturation-voltage characteristics for 2N5202.

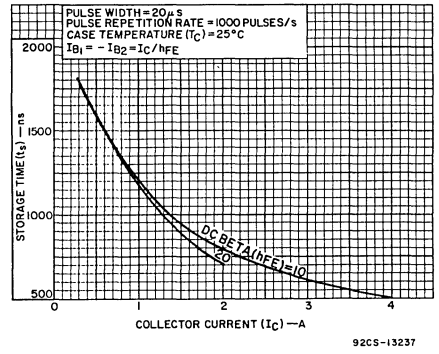


Fig.20 — Typical storage time for 2N3879, 2N5202, and 2N6500.

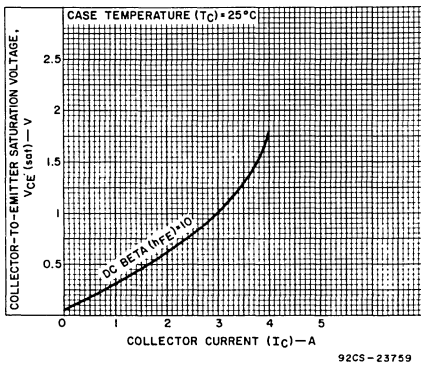


Fig.21 — Typical saturation-voltage characteristics for 2N6500.

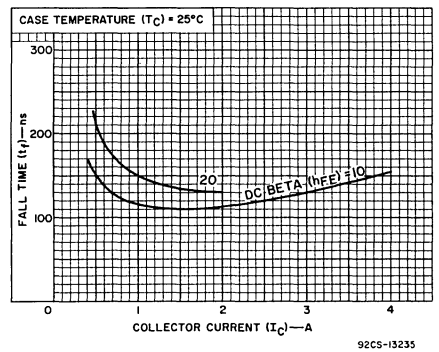


Fig.22 — Typical fall time for 2N3879, 2N5202, and 2N6500.