RCA
Solid State
Division

Power Transistors
2N3878 2N5202
2N3879 2N6500
40375

2N3878
2N3879
2N5202
2N6500

JEDEC TO-66 H-1340

40375

JEDEC TO-66 H-1470A
With Integral Heat Radiator

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 μs 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. 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.

° 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_{CBO}	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°C		35 (2N3878)	35	35	35	W
At case temperatures above 25°C		Derate linearly at 0.2 W/°C				
At ambient temperature (T_A) = 25°C		5.8 (40375)	–	–	–	W
For other conditions		See Figs. 5, 6, 7, and 8				
*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).

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:	I_{CEV}													mA
*	With base-emitter junction reverse-biased		100	−1.5			–	–	–	–	–	10	–	–	
			110	0			–	–	–	–	–	–	–	5	
			120	−1.5			–	25	–	25	–	–	–	–	
*	With base-emitter junction reverse-biased and T_C = 150°C		100	−1.5			–	4	–	4	–	10	–	–	
			110	0			–	–	–	–	–	–	–	10	
	With base open	I_{CEO}	40			0	–	5*	–	5	–	–	–	–	mA
			70			0	–	–	–	–	–	–	–	5	
*	Emitter Cutoff Current	I_{EBO}		−6			–	–	–	–	–	10	–	–	mA
				−7			–	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]*	–	V
	With external base-to-emitter resistance (R_{BE}) = 50 Ω	$V_{CER}(sus)$			0.2	0	65[a]	–	90[a]	–	75[a]	–	110[a]		V
	DC Forward-Current Transfer Ratio	h_{FE}	1.2		4[b]		–	–	–	–	10*	100*	–	–	
			2		0.5[b]		40*	200*	–	–	–	–	–	–	
			2		3[b]		–	–	–	–	–	–	15*	60*	
			2		4[b]		8*	–	12*	100*	–	–	–	–	
			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	V
					4[b]	0.4	–	2	–	1.2	–	1.2	–	–	
*	Base-to-Emitter Voltage	V_{BE}	2		4[b]	–	–	2.5	–	–	–	–	–	–	V
*	Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$			3[b]	0.3	–	–	–	–	–	–	–	2.5	V
					4[b]	0.4	–	–	–	2	–	2	–	–	
	Collector-to-Base Output Capacitance : (f = 1 MHz, V_{CB} = 10 V)	C_{ob}					–	175*	–	175	–	175	–	175	pF
	Second Breakdown Collector Current: With base forward-biased and 1-s nonrepetitive pulse	$I_{S/b}$	40				750	–	500	–	400	–	400	–	mA
	Second-Breakdown Energy: With base reverse-biased and R_{BE} = 50 Ω, V_{BB} = −4 V	$E_{S/b}$[c]													mJ
	At L = 50 μH						–	–	–	–	0.4	–	–	–	
	At L = 125 μH						1	–	1	–	–	–	0.5	–	
*	Magnitude of Common Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio:(f = 10 MHz)	$\lvert h_{fe} \rvert$	10		0.5		4	–	4	–	6	–	6	–	
*	Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio:(f = 1 kHz)	h_{fe}	30		0.1		40	–	–	–	–	–	–	–	
	Thermal Resistance: Junction-to-case	$R_{\theta JC}$					2N3878 – | 5		–	5	–	5	–	5	°C/W
	Junction-to-ambient	$R_{\theta JA}$					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] $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b} = 1/2LI^2$ 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	ns
			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] $I_{B_1} = I_{B_2}$

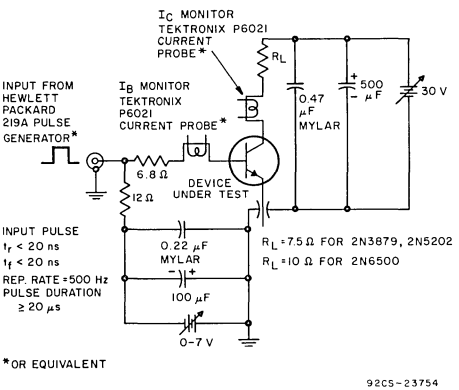


Fig.1 – Circuit used to measure switching times for 2N3879, 2N5202, and 2N6500.

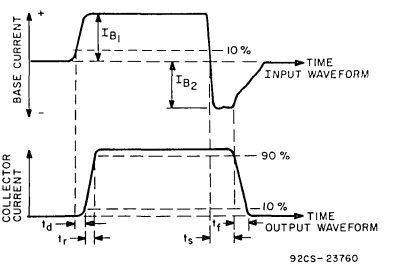


Fig.2 – Oscilloscope display for measurement of switching times. (Circuit shown in Fig.1).

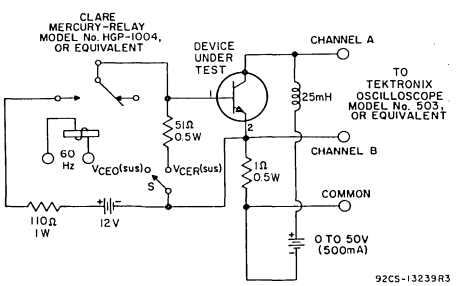
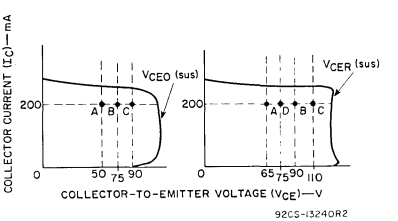


Fig.3 – Circuit used to measure sustaining voltages, $V_{CEO}(sus)$ and $V_{CER}(sus)$ for all types.



The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ 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 $V_{CER}(sus)$ 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.)

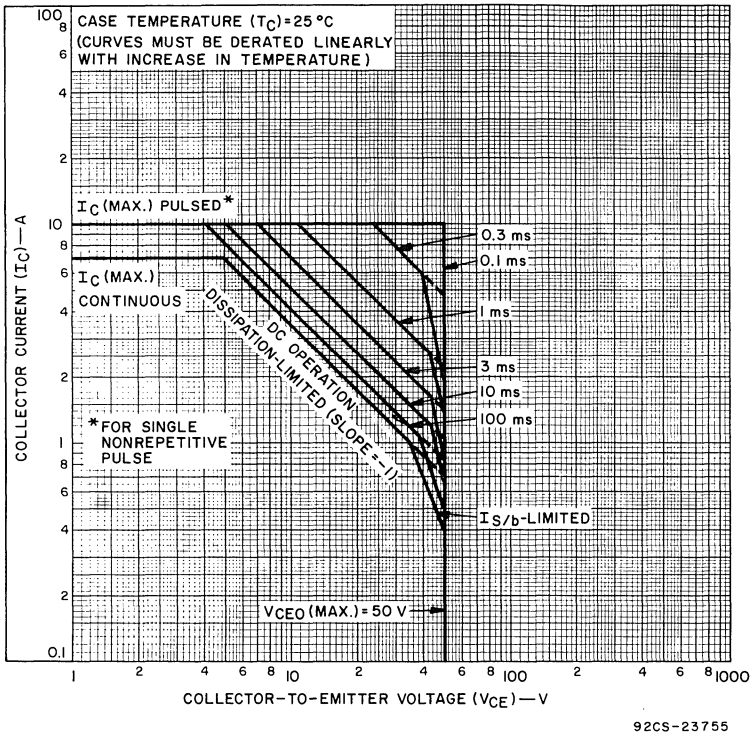
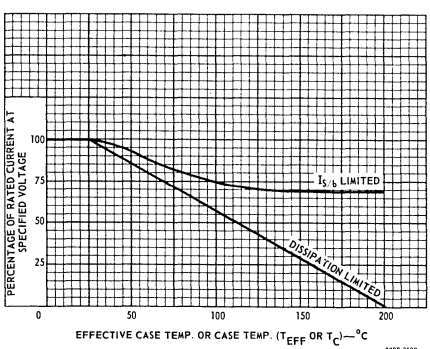


Fig.5 – Maximum operating areas for 2N3878.



Note: Use ambient temperature for derating 40375.

Fig.6 – Dissipation derating for all types.

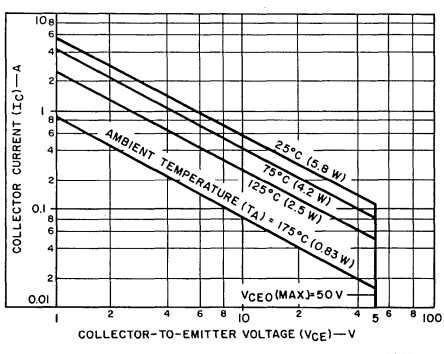


Fig.7 – Maximum operating areas for 40375.

TERMINAL CONNECTIONS

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

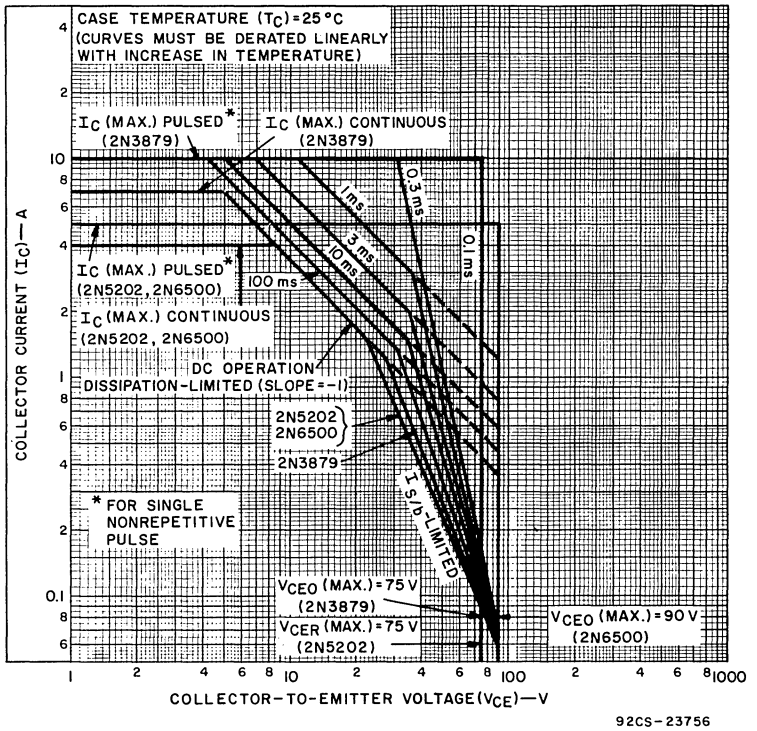


Fig.8 — Maximum operating areas for 2N3879, 2N5202, and 2N6500.

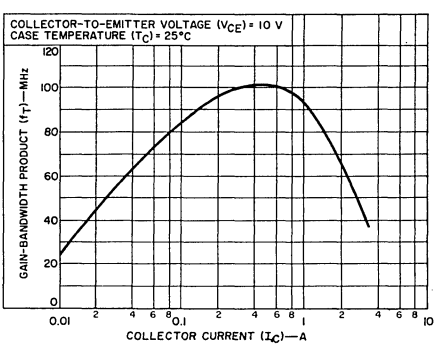


Fig.9 — Typical gain-bandwidth product for all types.

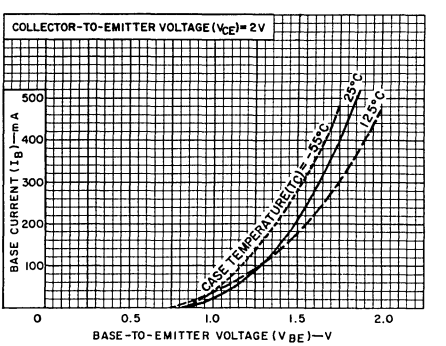


Fig.10 — Typical input characteristics for all types.

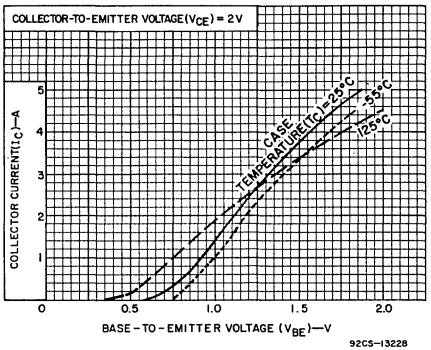


Fig.11 – Typical transfer characteristics for all types.

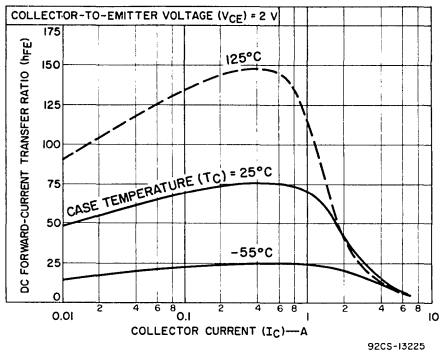


Fig.12 – Typical dc beta characteristics for 2N3878, 2N3879, and 40375.

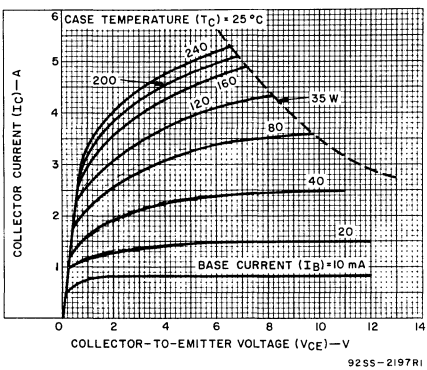


Fig.13 – Typical output characteristics for 2N3878, 2N3879, 2N5202, and 40375.

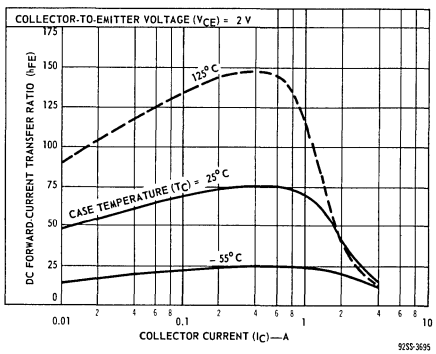


Fig.14 – Typical dc beta characteristics for 2N5202.

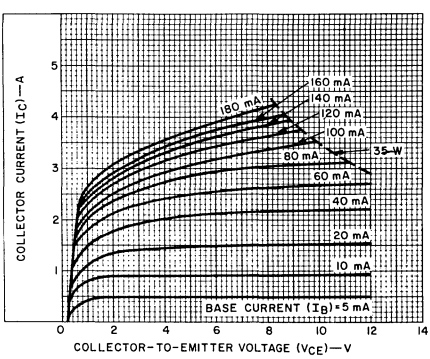


Fig.15 – Typical output characteristics for 2N6500.

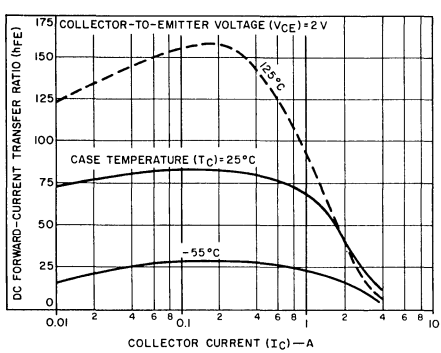


Fig.16 – Typical dc beta characteristics for 2N6500.

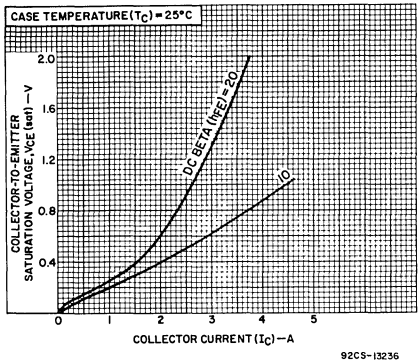


Fig.17 — Typical saturation-voltage characteristics for 2N3878, and 2N3879.

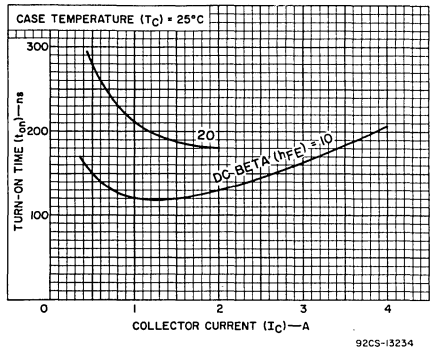


Fig.18 — Typical turn-on time for 2N3879, 2N5202, and 2N6500.

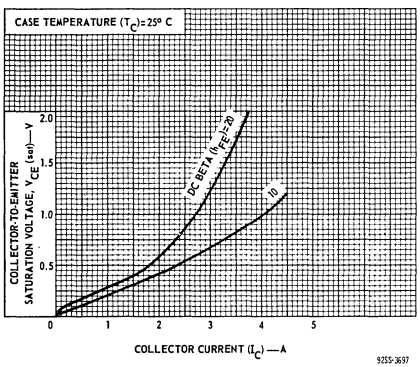


Fig.19 — Typical saturation-voltage characteristics for 2N5202.

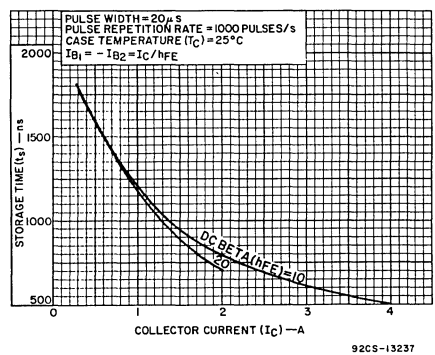


Fig.20 — Typical storage time for 2N3879, 2N5202, and 2N6500.

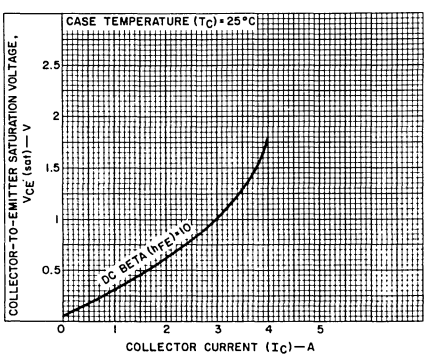


Fig.21 — Typical saturation-voltage characteristics for 2N6500.

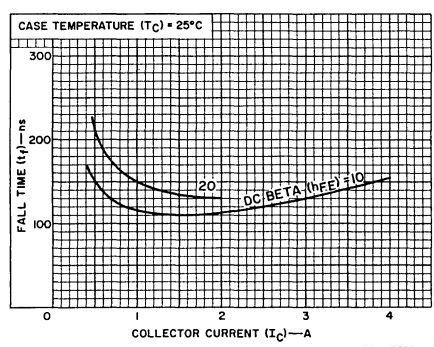


Fig.22 — Typical fall time for 2N3879, 2N5202, and 2N6500.