RCA
Solid State Division

Power Transistors

2N6510-2N6514

JEDEC TO-3

H-1570

High-Voltage, High-Current Silicon N-P-N Power-Switching Transistors

For Switching Applications in Industrial Commercial and Military Equipment

Features:

- Fast switching speed
- Epitaxial pi-nu construction
- Hermetic steel package—JEDEC TO-3
- Maximum-safe-area-of-operation curves
- Thermal-cycling rating chart

The RCA-2N6510, -2N6511, -2N6512, -2N6513, and -2N6514[o] are epitaxial silicon n-p-n power transistors with pi-nu construction. They are especially designed for use in electronic ignition circuits and other applications requiring high-voltage, high-energy, and fast-switching-speed capability.

These devices are hermetically sealed in a steel JEDEC TO-3 package. They differ from each other in breakdown-voltage ratings, leakage, and beta characteristics.

[o]Formerly RCA Dev. Nos. TA8847D, TA8847A, TA8847B, TA8847C, and TA8847E, respectively.

TERMINAL CONNECTIONS

Pin 1 — Base
Pin 2 — Emitter
Case — Collector
Mounting Flange — Collector

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N6510	2N6511	2N6512	2N6513	2N6514	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	250	300	350	400	350	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:							
With external base-to-emitter resistance R_{BE} = 50 Ω	$V_{CER(sus)}$	250	300	350	400	350	V
* With base open	$V_{CEO(sus)}$	200	250	300	350	300	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	6	6	6	6	6	V
*CONTINUOUS COLLECTOR CURRENT	I_C	7	7	7	7	7	A
*CONTINUOUS BASE CURRENT	I_B	3	3	3	3	3	A
*EMITTER CURRENT	I_E	10	10	10	10	10	A
*TRANSISTOR DISSIPATION:	P_T						
At case temperatures up to 25°C		120	120	120	120	120	W
At case temperatures above 25°C		See Figs. 1 and 2.					
*TEMPERATURE RANGE:							
Storage and Operating (Junction)		−65 to +200					°C
*PIN TEMPERATURE (During Soldering):							
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230					°C

*In accordance with JEDEC registration data format JC-25 RDF-1.

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C Unless Otherwise Specified*

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS						UNITS
			VOLTAGE V dc		CURRENT A dc		2N6510			2N6511			
			V_{CE}	V_{BE}	I_C	I_B	Min.	Typ.	Max.	Min.	Typ.	Max.	
	Collector-Cutoff Current:	I_{CEO}											
	With base open		150				–	–	5	–	–	–	mA
			200				–	–	–	–	–	5	
*	With base-emitter junction reverse biased	I_{CEV}	250	−1.5			–	–	5	–	–	–	mA
			300	−1.5			–	–	–	–	–	5	
*	With base-emitter junction reverse biased, T_C = 100°C		250	−1.5			–	–	10	–	–	–	
			300	−1.5			–	–	–	–	–	10	
*	Emitter-Cutoff Current	I_{EBO}		−6			–	–	3	–	–	3	mA
	Collector-to-Emitter Sustaining Voltage:												
*	With base open	$V_{CEO(sus)}$			0.2		200[b]	–	–	250[b]	–	–	V
	With external base-to-emitter resistance: R_{BE} = 50 Ω	$V_{CER(sus)}$			0.2		250[b]	–	–	300[b]	–	–	
*	Emitter-to-Base Voltage: I_E = 3 mA	V_{EBO}					6	–	–	6	–	–	V
*	DC Forward-Current Transfer Ratio	h_{FE}	3		3[a]		10	–	50	–	–	–	
			3		4[a]		–	–	–	10	–	50	
*	Base-to-Emitter Saturation Voltage	$V_{BE(sat)}$			3[a]	0.6	–	–	1.7	–	–	–	V
					4[a]	0.8	–	–	–	–	–	1.7	
*	Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$			3[a]	0.6	–	–	1.5	–	–	–	V
					4[a]	0.8	–	–	–	–	–	1.5	
					7[a]	3	–	1.5	2.5	–	1.5	2.5	
*	Output Capacitance: V_{CB} = 10 V, f = 1 MHz	C_{obo}					100	–	200	100	–	200	pF
*	Magnitude of Common Emitter, Small-Signal Short-Circuit, Forward-Current Transfer Ratio: f = 1 MHz	$\lvert h_{fe} \rvert$	10		1		3	–	9	3	–	9	MHz
*	Forward-Bias, Second-Breakdown Collector Current: t = 1 s, nonrepetitive	$I_{S/b}$	38				3.16	–	–	3.16	–	–	A
			200				0.1	–	–	0.1	–	–	
*	Switching Time:[c] (V_{CC} = 200 V, I_{B1} = I_{B2}):												
	Delay Time	t_d			3	0.6	–	0.1	0.2	–	–	–	
					4	0.8	–	–	–	–	0.1	0.2	
	Rise Time	t_r			3	0.6	–	0.7	1.5	–	–	–	
					4	0.8	–	–	–	–	0.7	1.5	
	Storage Time	t_s			3	0.6	–	3	5	–	–	–	μs
					4	0.8	–	–	–	–	3	5	
	Fall Time	t_f			3	0.6	–	0.5	1.5	–	–	–	
					4	0.8	–	–	–	–	0.5	1.5	
*	Thermal Resistance: Junction-to-Case	$R_{\theta JC}$	20		5		–	–	1.46	–	–	1.46	°C/W

* Minimum and maximum values and test conditions in accordance with JEDEC registration data format JC-25 RDF-1.

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

[b] CAUTION: The sustaining voltages $V_{CEO(sus)}$ and $V_{CER(sus)}$ MUST NOT be measured on a curve tracer. These sustaining voltages should be measured by means of the test circuit shown in Fig. 11.

[c] See Figs. 8-10.

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C Unless Otherwise Specified*

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS						UNITS
			VOLTAGE V dc		CURRENT A dc		2N6512 2N6514			2N6513			
			V_{CE}	V_{BE}	I_C	I_B	Min.	Typ.	Max.	Min.	Typ.	Max.	
	Collector-Cutoff Current:												
	With base open	I_{CEO}	250 300				– –	– –	5 –	– –	– –	– 5	mA
*	With base-emitter junction reverse biased	I_{CEV}	350 400	–1.5 –1.5			– –	– –	5 –	– –	– –	– 5	mA
*	With base-emitter junction reverse biased, T_C = 100°C	I_{CEV}	350 400	–1.5 –1.5			– –	– –	10 –	– –	– –	– 10	mA
*	Emitter-Cutoff Current	I_{EBO}		–6			–	–	3	–	–	3	mA
	Collector-to-Emitter Sustaining Voltage:												
*	With base open	$V_{CEO(sus)}$			0.2		300[b]	–	–	350[b]	–	–	V
	With external base-to-emitter resistance: R_{BE} = 50 Ω	$V_{CER(sus)}$			0.2		350[b]	–	–	400[b]	–	–	V
*	Emitter-to-Base Voltage: I_E = 3 mA	V_{EBO}					6	–	–	6	–	–	V
*	DC Forward-Current Transfer Ratio:												
	2N6512, 2N6513	h_{FE}	3		4[a]		10	–	50	10	–	50	
	2N6514		3		5[a]		10	–	50	–	–	–	
*	Base-to-Emitter Saturation Voltage:												
	2N6512, 2N6513	$V_{BE(sat)}$			4[a]	0.8	–	–	1.7	–	–	1.7	V
	2N6514				5[a]	1	–	–	1.7	–	–	–	V
*	Collector-to-Emitter Saturation Voltage:												
	2N6512, 2N6513	$V_{CE(sat)}$			4[a]	0.8	–	–	1.5	–	–	1.5	V
	2N6514				5	1	–	–	1.5	–	–	–	V
	All types				7	3	–	1.5	2.5	–	1.5	2.5	V
*	Output Capacitance: V_{CB} = 10 V, f = 1 MHz	C_{obo}					100	–	200	100	–	200	pF
*	Magnitude of Common Emitter, Small-Signal Short-Circuit, Forward-Current Transfer Ratio: f = 1 MHz	$\lvert h_{fe} \rvert$	10		1		3	–	9	3	–	9	MHz
*	Forward-Bias, Second-Breakdown Collector Current: t = 1 s, nonrepetitive	$I_{S/b}$	38 200				3.16 0.1	– –	– –	3.16 0.1	– –	– –	A

* Minimum and maximum values and test conditions in accordance with JEDEC registration data format JC-25 RDF-1.

[a] Pulsed; pulse duration = 300 μs, duty factor ⩽ 2%.

[b] CAUTION: The sustaining voltages $V_{CEO(sus)}$ and $V_{CER(sus)}$ MUST NOT be measured on a curve tracer. These sustaining voltages should be measured by means of the test circuit shown in Fig. 11.

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C Unless Otherwise Specified (Cont'd)*

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS						UNITS
			VOLTAGE V dc		CURRENT A dc		2N6512 2N6514			2N6513			
			V_{CE}	V_{BE}	I_C	I_B	Min.	Typ.	Max.	Min.	Typ.	Max.	
*	Switching Time:[c] (V_{CC} = 200 V, I_{B1} = I_{B2}): Delay Time:												
	2N6512, 2N6513	t_d			4	0.8	–	0.1	0.2	–	0.1	0.2	
	2N6514				5	1	–	0.1	0.2	–	–	–	
	Rise Time:												
	2N6512, 2N6513	t_r			4	0.8	–	0.7	1.5	–	0.7	1.5	
	2N6514				5	1	–	0.7	1.5	–	–	–	
	Storage Time:												μs
	2N6512, 2N6513	t_s			4	0.8	–	3	5	–	3	5	
	2N6514				5	1	–	3	5	–	–	–	
	Fall Time:												
	2N6512, 2N6513	t_f			4	0.8	–	0.5	1.5	–	0.5	1.5	
	2N6514				5	1	–	0.5	1.5	–	–	–	
*	Thermal Resistance: Junction-to-Case	$R_{\theta JC}$	20		5		–	–	1.46	–	–	1.46	°C/W

* Minimum and maximum values and test conditions in accordance with JEDEC registration data format JC-25 RDF-1.

c See Figs. 8-10.

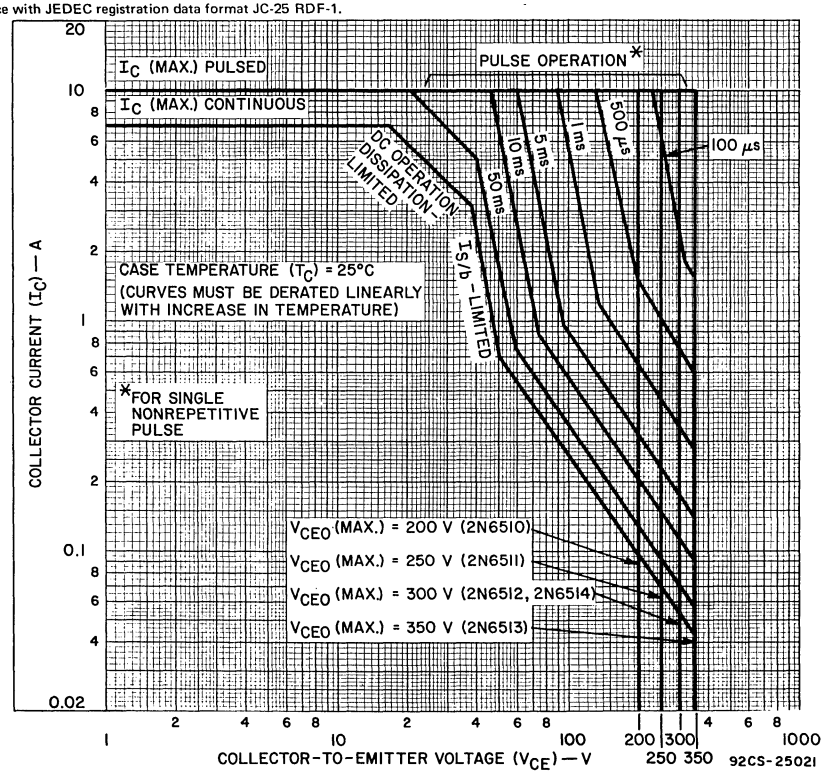


Fig. 1—Maximum operating areas for all types.

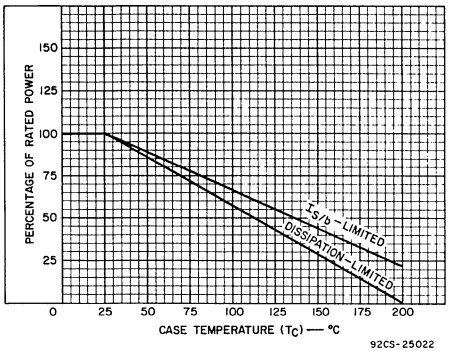


Fig. 2—Derating curve for all types.

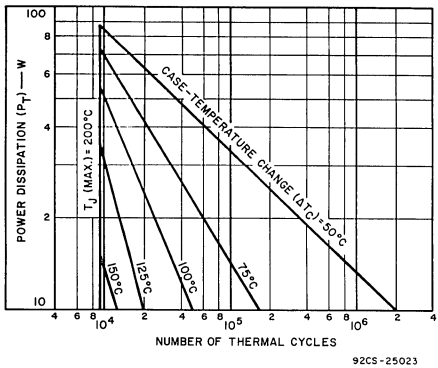


Fig. 3—Thermal-cycling rating chart for all types.

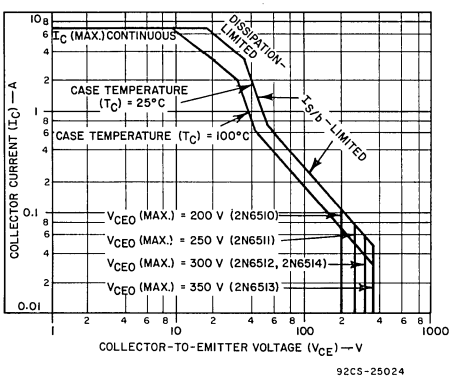


Fig. 4—Maximum operating areas for all types at 25°C and 100°C.

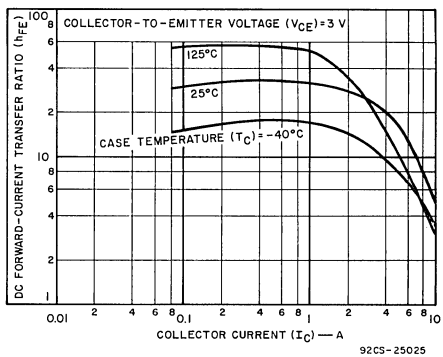


Fig. 5—Typical dc beta characteristic for all types.

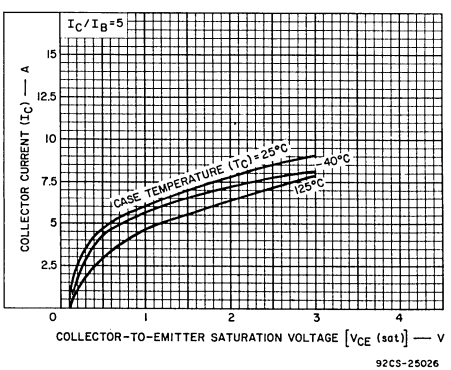


Fig. 6—Typical collector-to-emitter saturation-voltage characteristics for all types.

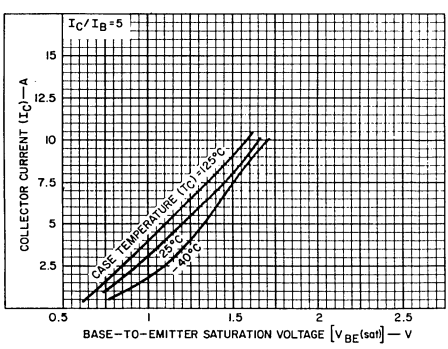


Fig. 7—Typical base-to-emitter saturation-voltage characteristics for all types.

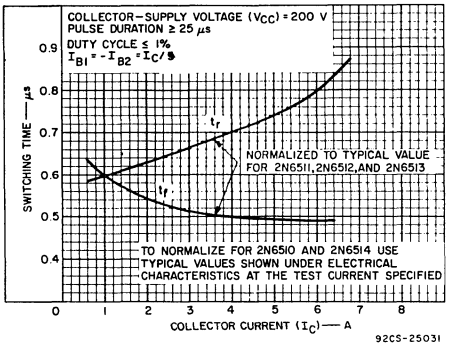


Fig. 8– Typical rise- and fall-time characteristics for all types.

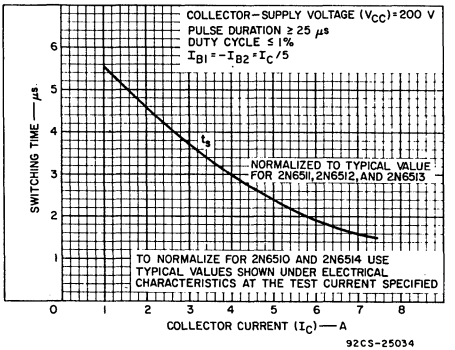
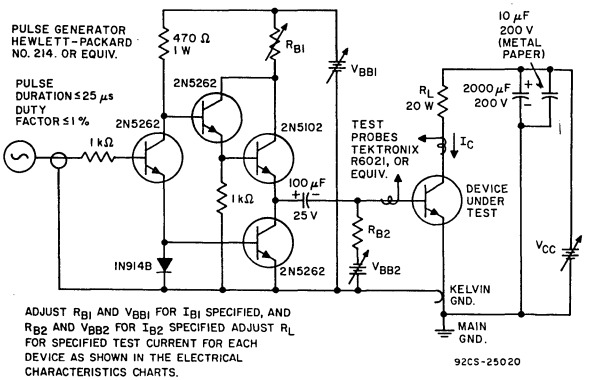


Fig. 9– Typical storage-time characteristic for all types.



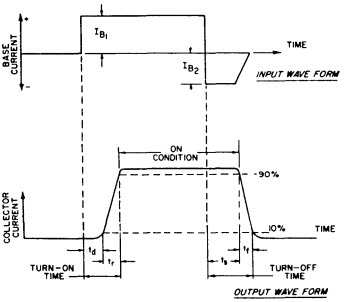


Fig. 10—Circuit used to measure switching times for all types.

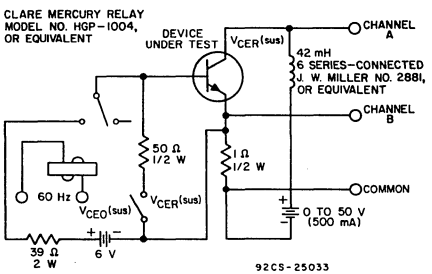
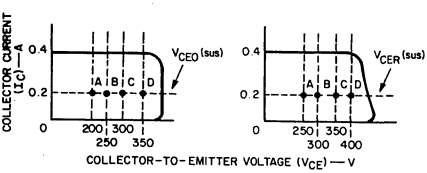


Fig. 11—Circuit used to measure sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ for all types.



The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ are acceptable when the traces fall to the right of point "A" for 2N6510; point "B" for 2N6511; point "C" for 2N6512 and 2N6514; and point "D" for 2N6513.

Fig. 12—Oscilloscope display for measurement of sustaining voltages. (Test circuit shown in Fig.11.)