2N5838, 2N5839, 2N5840

File Number **410**

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

For Switching and Linear Applications in Military, Industrial, and Commercial Equipment

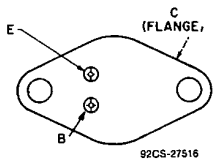
Features:
- *Maximum safe-area-of-operation curves*
- *Low saturation voltages*
- *High voltage ratings*
  $V_{CER}[sus]$ = *375 V [2N5840]*
  300 V [2N5839]
  275 V [2N5838]
- *High dissipation rating*
  P_T = *100 W*

RCA-2N5838, 2N5839 and 2N5840** are epitaxial silicon n-p-n power transistors. These devices employ the popular JEDEC TO-204AA package; they differ mainly in voltage, current-gain, and V_{CE}(sat) ratings.

Featuring high breakdown voltage ratings and low-saturation voltage values, the 2N5838, 2N5839 and 2N5840 are especially suitable for use in inverters, deflection circuits, switching regulators, high-voltage bridged amplifiers, ignition circuits, and other high-voltage switching applications.

** Formerly RCA Dev. types TA7513, TA7530, and TA7420 respectively.

TERMINAL DESIGNATIONS



JEDEC TO-204AA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N5838	2N5839	2N5840	
*COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	275	300	375	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:				
With base open $V_{CEO}(sus)$	250	275	350	V
* With reverse bias (V_{BE}) of -1.5 V, (V_{CEV}) (sus) •	275	300	375	V
With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω, $V_{CER}(sus)$	275	300	375	V
*EMITTER-TO-BASE VOLTAGE, V_{EBO}	6	6	6	V
*COLLECTOR CURRENT, I_C				
Continuous	3	3	3	A
Peak	5	5	5	A
*CONTINUOUS BASE CURRENT, I_B	1.5	1.5	1.5	A
*TRANSISTOR DISSIPATION, P_T:				
At case temperature up to 25°C and V_{CE} up to 40 V	100	100	100	W
At case temperatures up to 25°C and V_{CE} above 40 V	See Fig. 1.			
At case temperatures up to 25°C and V_{CE} above 40 V	See Figs. 1 & 2.			
*TEMPERATURE RANGE: Storage and operating (Junction)	-65 to +200			°C
*PIN TEMPERATURE (During soldering): At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max	230			°C

* In accordance with JEDEC registration data format (JS-6, RDF-1).
• Shown as $V_{CEX}(sus)$ in JEDEC Registration Data.

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Characteristic	Symbol	Test Conditions						Limits									Units
		DC Collector Voltage (V)	DC Emitter or Base Voltage (V)		DC Current (A)			Type 2N5838			Type 2N5839			Type 2N5840			
		V_{CE}	V_{EB}	V_{BE}	I_C	I_B	I_E	Min	Max	Typ	Min	Max	Typ	Min	Max	Typ.	
Collector-Cutoff Current: With base open	I_{CEO}	200 250						- -	2	- -	- -	- 2	- -	- -	- 2	- -	mA
* With base-emitter junction reverse biased	I_{CEV}	265 290 360		-1 5 -1 5 -1 5				- - -	5 - -	- - -	- - -	- 2 -	- - -	- - -	- - 2	- - -	mA
* With base-emitter junction reverse biased	I_{CEV} T_C 100 °C	265 290 360		1 5 1 5 1 5					8			5		-	- 5	-	mA
* Emitter-Cutoff Current	I_{EBO}		-6						1			1			1	-	mA
* Collector-to Emitter Sustaining Voltage (See Figs. 4, 5, & 6) With base open	$V_{CEO(sus)}$[a]				0 2			250[b]			275[b]	-		350[b]	-	-	V
* With base-emitter junction reversed biased	$V_{CEX(sus)}$[a]			1 5	0 1			275[b]	-	-	300[b]	-	-	375[b]	-	-	
With external base-to-emitter resistance (R_{BE}) - 50 Ω	$V_{CER(sus)}$[a]				0 2			275[b]	-	-	300[b]	-	-	375[b]	-	-	
* Emitter-to-Base Voltage	V_{EBO}						0.02	6	-	-	6	-	-	6	-	-	V
* DC Forward-Current Transfer Ratio	h_{FE}	5 3 2			0.5[b] 2[b] 3[b]			20 - 8	- - 40	- - -	20 10 -	- 50 -	- - -	20 10 -	- 50 -	- - -	
* Base-to-Emitter Saturation Voltage	$V_{BE(sat)}$				2 3	0 2 0 375		-	2		- -	2			2 -		V
* Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$				2 3	0 2 0 375			1	-		1 5		- -	1.5		V
Output Capacitance (At 1 MHz)	C_{obo}		100				0		150			150	-	-	150		pF
* Magnitude of Common-Emitter, Small-Signal, Short Circuit, Forward Current Transfer Ratio (f 1 MHz)	$\lvert h_{fe} \rvert$	10			0 2			5			5			5		-	
Second Breakdown Collector Current (With base forward biased) Pulse duration (non-repetitive) 1 s	$I_{s/b}$[c]	40						2 5			2 5			2 5	-		A
Switching Times: Delay	t_d	V_{CC} = 200			2 3	0.2[e] 0 375[e]		- -	- -	- 0.06	- -	- -	0.07 -	- -	- -	0.07 -	
* Rise	t_r	V_{CC} - 200			2 3	0 2[e] 0 375[e]		-	- 1 5	- 0 8	- -	1 5 -	0 6 -	- -	1.75 -	0.6 -	μs
* Storage	t_s	V_{CC} - 200			2 3	0 2[e] 0 375[e]		-	- 3 0	- 1 0	-	3.75	1.75	- -	3.0 -	1.75 -	
* Fall	t_f	V_{CC} - 200			2 3	0 2[e] 0 375[e]		- -	- 1 5	- 0 4	- -	1.5 -	0.35 -	- -	1.5 -	0.35 -	
Thermal Resistance (Junction-to-Case)	θ_{J-C}	10			5				1.75	-	-	1 75	-	-	1.75		°C W

a Pulsed; pulse duration ≤ 350 μs, Duty factor = 2%.

b CAUTION: This sustaining voltages $V_{CEO(sus)}$, $V_{CEX(sus)}$ and $V_{CER(sus)}$, MUST NOT be measured on a curve tracer.

c $I_{s/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward biased for transistor operation in the active region.

d V_{CB}

e $I_{B1} = I_{B2}$ = value shown.

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

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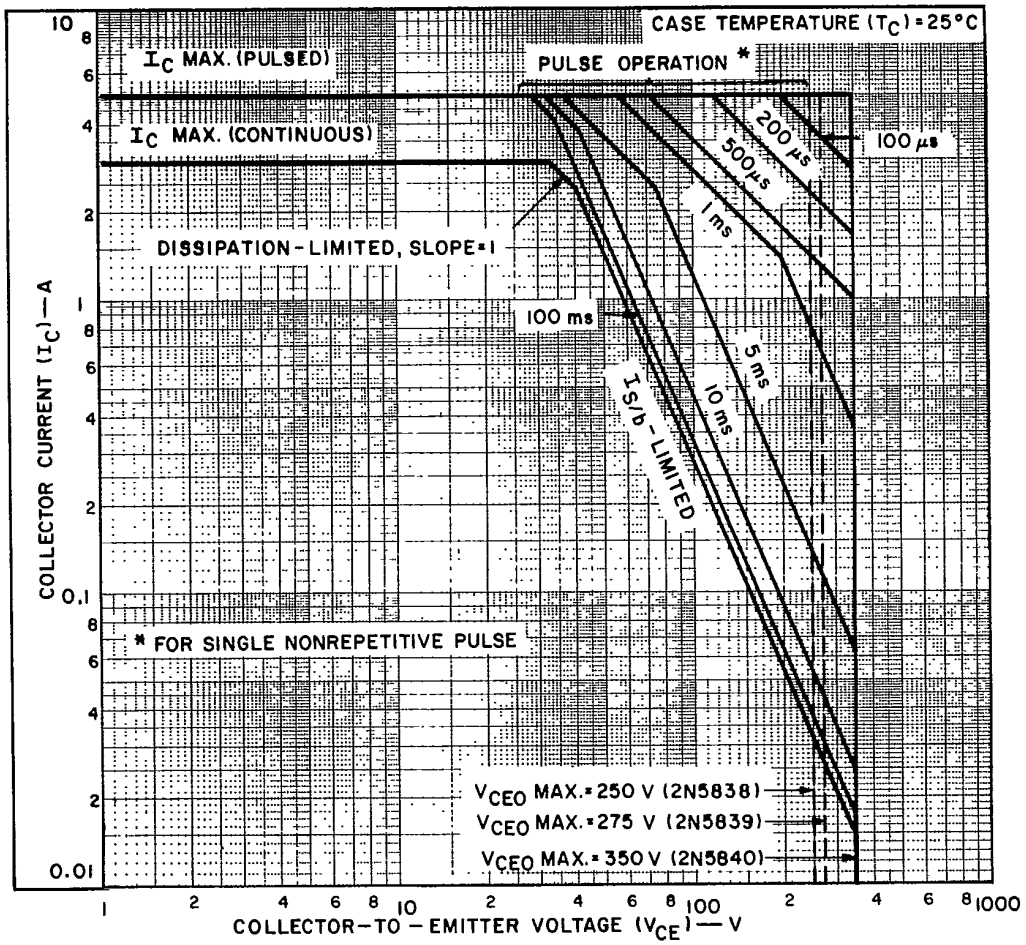

Fig. 1 — Maximum operating areas for all types.

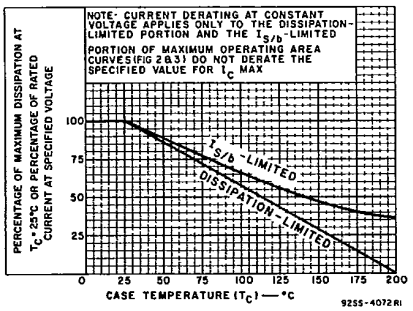

Fig. 2 — Derating curves for all types.

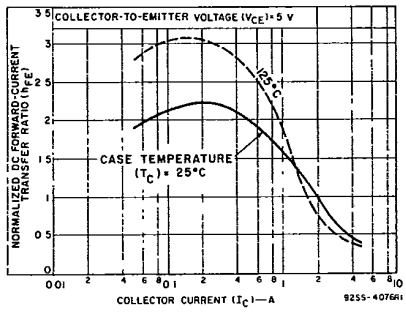

Fig. 3 — Typical normalized dc beta characteristics for all types.

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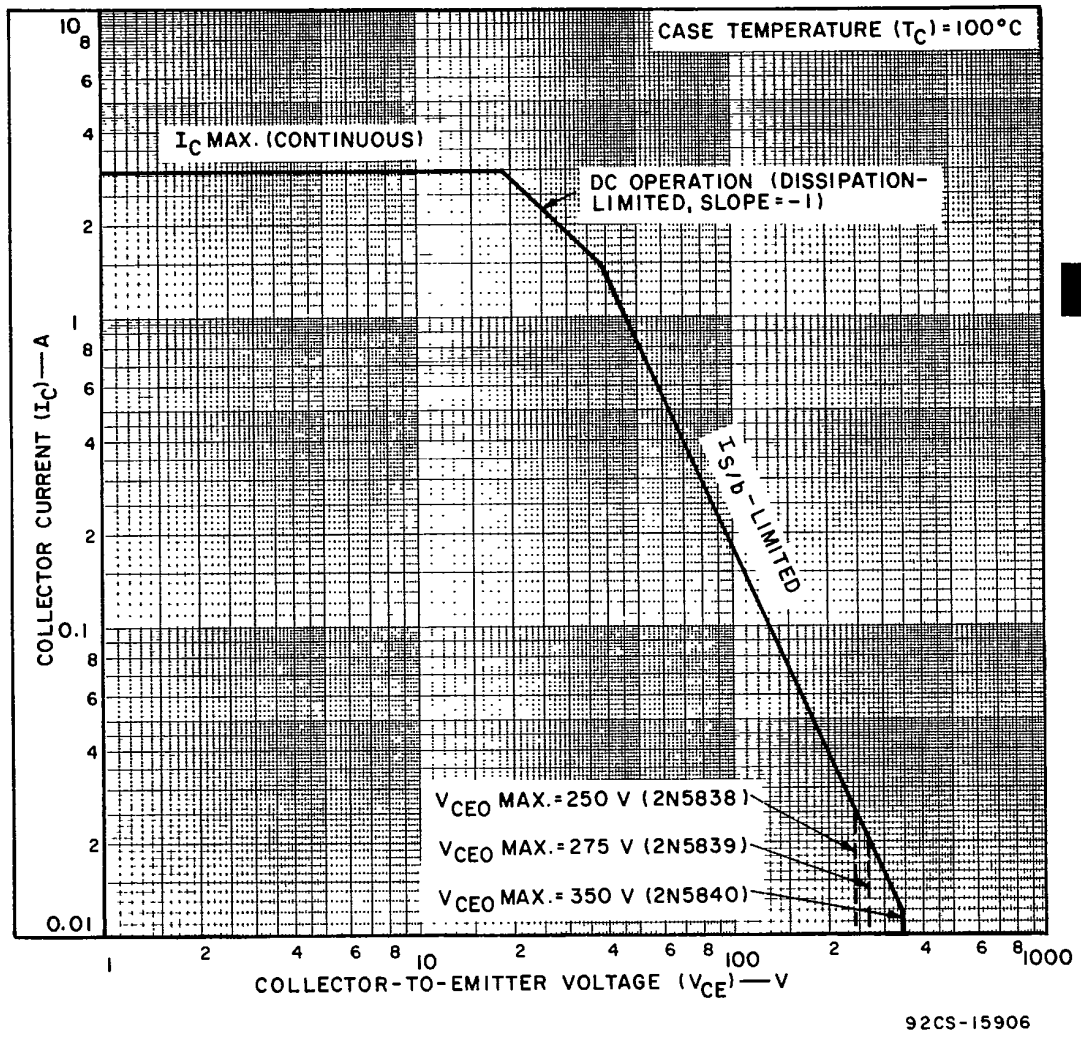

Fig. 4 — Maximum operating areas for all types.

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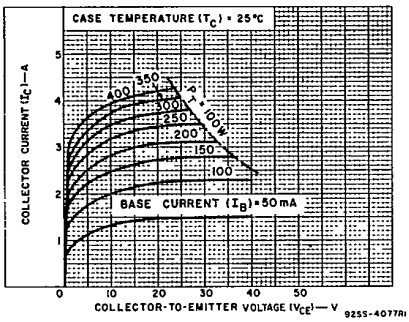

Fig. 5 — Typical output characteristics for all types.

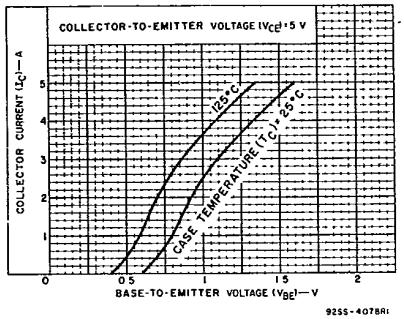

Fig. 6 — Typical transfer characteristics for all types.

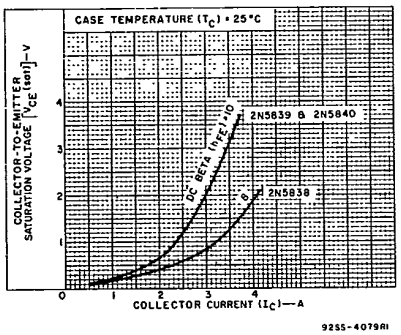

Fig. 7 — Typical saturation voltage characteristics for for all types.

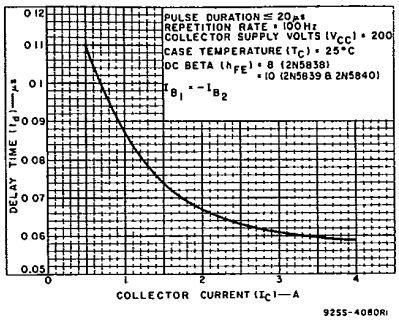

Fig. 8 — Typical delay-time characteristics for all types.

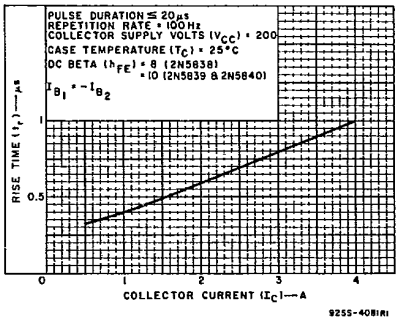

Fig. 9 — Typical rise-time characteristics for all types.

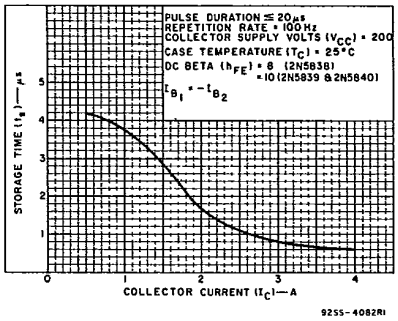

Fig. 10 — Typical storage-time characteristics for all types.

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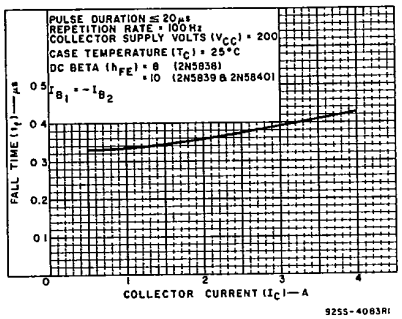
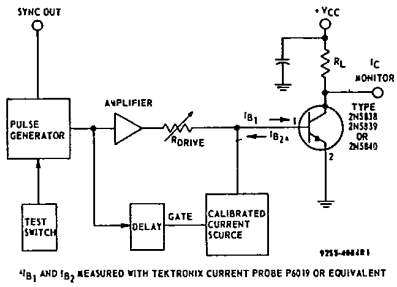


Fig. 11 — Typical fall-time characteristics for all types.



$^{1}I_{B_1}$ AND I_{B_2} MEASURED WITH TEKTRONIX CURRENT PROBE P6019 OR EQUIVALENT

Fig. 12 — Circuit used to measure switching times for all types.

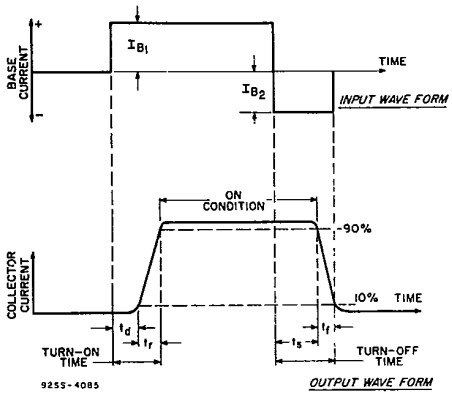


Fig. 13 — Phase relationship between input and output currents showing reference points for specification of switching times.

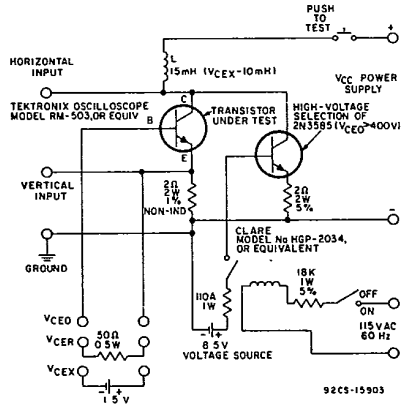
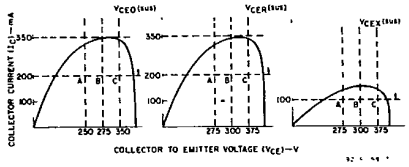


Fig. 14 — Circuit used to measure sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEX}(sus)$ for all types.



The sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEX}(sus)$ are acceptable when the traces fall to the right and above point "A" for type 2N5838, point "B" for type 2N5839, and point "C" for type 2N5840.

Fig. 15 — Oscilloscope display for measurement of sustaining voltages.