

# High-Voltage, High-Power silicon N-P-N Power Transistors

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

The RCA413, RCA423, and RCA431 are epitaxial silicon n-p-n transistors utilizing a multiple-emitter-site structure.

The transistors feature high breakdown-voltage ratings and low saturation-voltage values, making them especially suitable for use in inverters, deflection circuits,

switching regulators, high-voltage bridge amplifiers, ignition circuits, and other high-voltage switching applications.

The RCA413, RCA423, and RCA431 transistors are supplied in steel JEDEC TO-204MA hermetic packages.

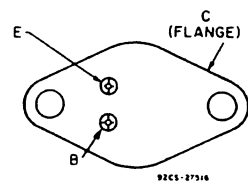
### MAXIMUM RATINGS, Absolute-Maximum Values:

$V_{CBO}$ .....	400 V
$V_{CEO(sus)}$ .....	325 V
$V_{EBO}$ .....	5 V
$I_C$ .....	7 A
$I_{CM}$ .....	10 A
$I_B$ .....	2 A
$P_T$	
$T_C$ up to 25°C .....	125 W
$T_C$ above 25°C, derate linearly .....	0.714 W/°C
$T_{stg}, T_J$ .....	-65 to +200°C
$T_L$	
At distance $\geq 1/32$ in. (0.8 mm) from seating plane for 10 s max. ....	230°C

### Features:

- Maximum safe-area-of-operation curves
- Low saturation voltage:  
 $V_{CE(sat)}=0.8$  V (max.)  
 - RCA413, RCA423  
 $V_{CE(sat)}=0.7$  V (max.)  
 - RCA431
- High voltage rating:  $V_{CEO(sus)}=325$  V
- High dissipation rating:  $P_T=125$  W

### TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "A".)

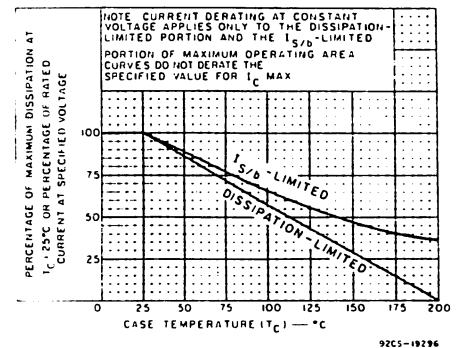


Fig. 2 — Dissipation and current derating curves.

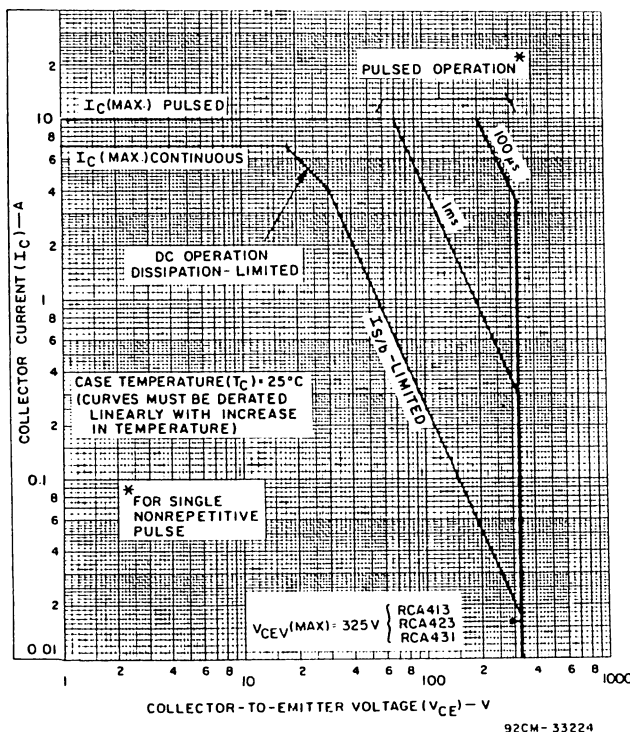


Fig. 1 — Maximum operating areas.

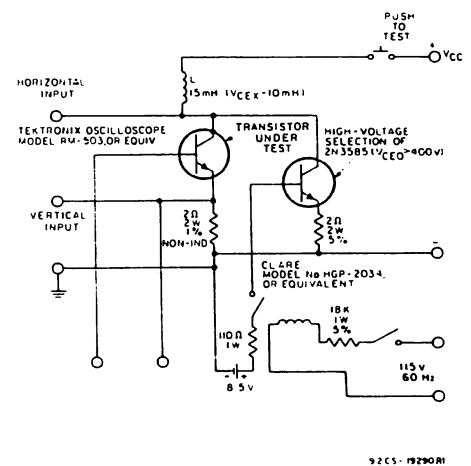


Fig. 3 — Circuit used to measure sustaining voltage,  $V_{CEO(sus)}$ .

POWER TRANSISTORS

RCA413, RCA423, RCA431

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

Characteristic Symbol	Test Conditions				Limits									Units
	Voltage (V)		DC Current (A)		RCA413			RCA423			RCA431			
	$V_{CE}$	$V_{BE}$	$I_C$	$I_B$	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
$I_{CEO}$	300				—	—	0.25	—	—	0.25	—	—	2.5	
$I_{CEV}$	400	-1.5			—	—	0.25	—	—	0.25	—	—	2.5	
$I_{CEV}$ ( $T_C=125^\circ\text{C}$ )	400	-1.5			—	—	0.5	—	—	0.5	—	—	5	
$I_{EBO}$		-5			—	—	5	—	—	5	—	—	2	
$h_{FE}$	5		0.5 <sup>a</sup>		20	—	80	—	—	—	—	—	—	
	5		1 <sup>a</sup>		15	—	—	30	—	90	—	—	—	
	5		2.5 <sup>a</sup>		—	—	—	10	—	—	15	—	35	
	5		3.5 <sup>a</sup>		—	—	—	—	—	—	10	—	—	
$V_{CE(sus)}^b$ (Figs. 3 & 4)			0.1		325 <sup>b</sup>	—	—	325 <sup>b</sup>	—	—	325 <sup>b</sup>	—	—	
$V_{BE(sat)}$			0.5 <sup>a</sup>	0.05	—	0.8	1.5	—	—	—	—	—	—	
			1 <sup>a</sup>	0.1	—	—	—	0.9	1.5	—	—	—	—	
			2.5 <sup>a</sup>	0.5	—	—	—	—	—	—	1.1	1.5	—	
$V_{CE(sat)}$			0.5 <sup>a</sup>	0.05	—	0.15	0.8	—	—	—	—	—	—	
			1 <sup>a</sup>	0.1	—	—	—	0.2	0.8	—	—	—	—	
			2.5 <sup>a</sup>	0.5	—	—	—	—	—	—	0.25	0.7	—	
$I_{S/b}^c$ Pulse duration (non-repetitive)=1 s	150				0.1	—	—	0.1	—	—	0.1	—	—	
$f_T$	10		0.2		—	4	—	—	4	—	—	4	MHz	
$t_r$ (Figs. 12, 13, 16, 17)			1	0.1 ( $I_{B1}$ )	—	0.35	—	—	0.35	—	—	—	—	
			2.5	0.5 ( $I_{B1}$ )	—	—	—	—	—	—	—	0.35	—	
$t_s$ (Figs. 14, 15, 16, 17)			1	0.1 ( $I_{B1}$ )	—	1.4	—	—	1.4	—	—	—	—	
			2.5	-0.5 ( $I_{B2}$ ) 0.5 ( $I_{B1}$ ) <sup>d</sup>	—	—	—	—	—	—	—	1.8	—	
$t_f$ (Figs. 10, 11, 16, 17)			1	0.1 ( $I_{B1}$ )	—	0.15	—	—	0.15	—	—	—	—	
			2.5	-0.5 ( $I_{B2}$ ) 0.5 ( $I_{B1}$ ) <sup>d</sup>	—	—	—	—	—	—	—	0.4	—	
$R_{\theta JC}$	10		5		—	—	1.4	—	—	1.4	—	—	1.4 °C/W	

<sup>a</sup>Pulsed; pulse duration  $\leq 350 \mu\text{s}$ , duty factor = 2%.

<sup>b</sup>CAUTION: The sustaining voltage  $V_{CE(sus)}$  MUST NOT be measured on a curve tracer. The sustaining voltage should be measured by means of the test circuit shown in Fig. 3.

<sup>c</sup> $I_{S/b}$  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.

<sup>d</sup> $I_{B1} = -I_{B2} =$  value shown.

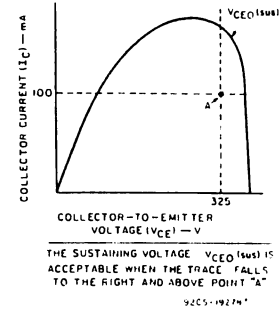


Fig. 4 - Oscilloscope display for measurement of sustaining voltage (test circuit shown in Fig. 3).

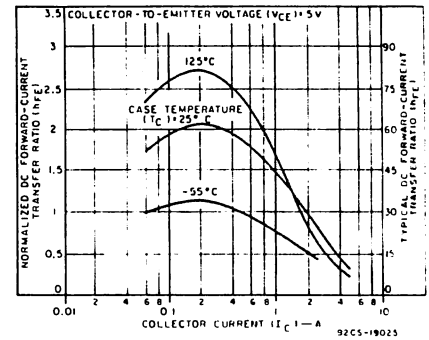


Fig. 5 - Typical dc beta characteristics for all types.

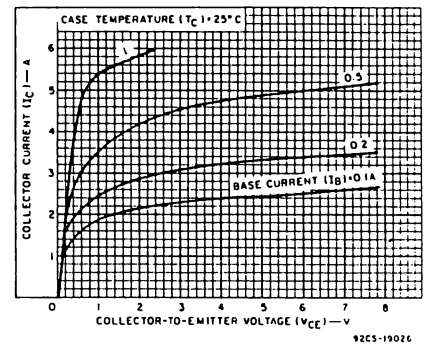


Fig. 6 - Typical output characteristics for all types.

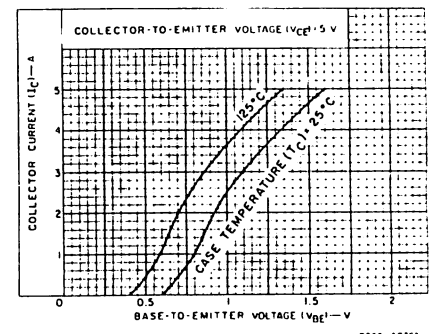


Fig. 7 - Typical transfer characteristics for all types.

RCA413, RCA423, RCA431

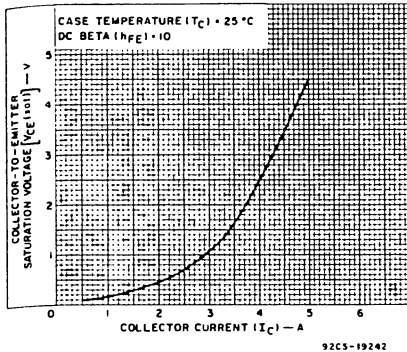


Fig. 8 - Typical saturation voltage vs. collector current for RCA413 and RCA423.

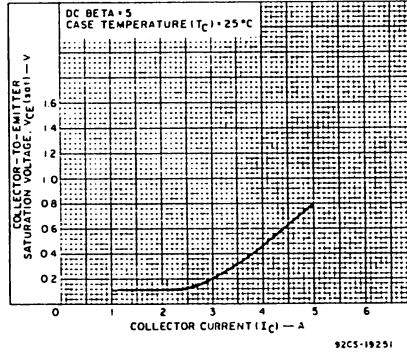


Fig. 9 - Typical saturation voltage vs. collector current for RCA431.

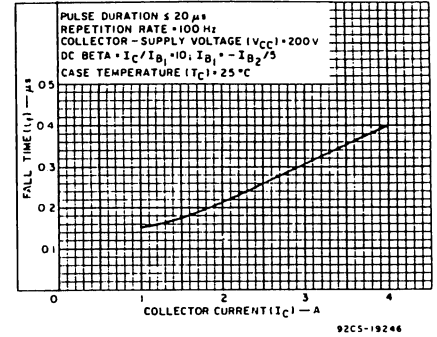


Fig. 10 - Typical fall time vs. collector current for RCA413 and RCA423.

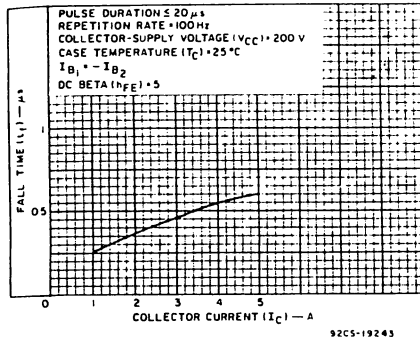


Fig. 11 - Typical fall-time vs. collector current for RCA431.

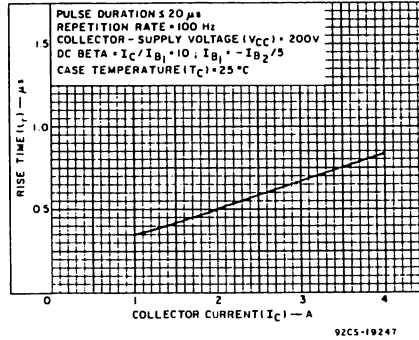


Fig. 12 - Typical rise time vs. collector current for RCA413 and RCA423.

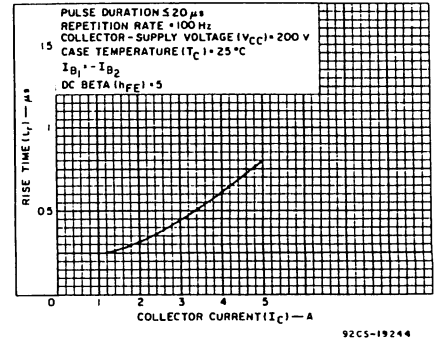


Fig. 13 - Typical rise time vs. collector current for RCA431.

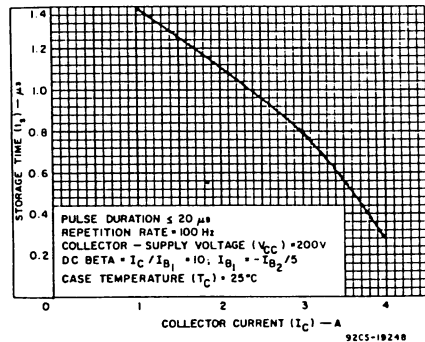


Fig. 14 - Typical storage time vs. collector current for RCA413 and RCA423.

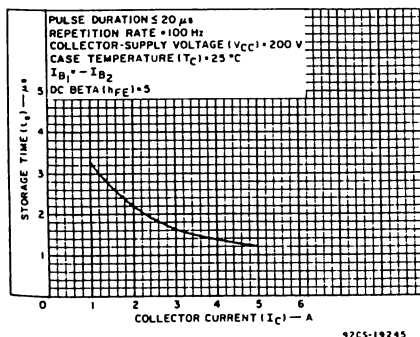


Fig. 15 - Typical storage time vs. collector current for RCA431.

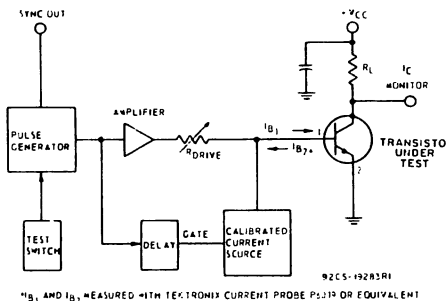


Fig. 16 - Circuit used to measure switching times.

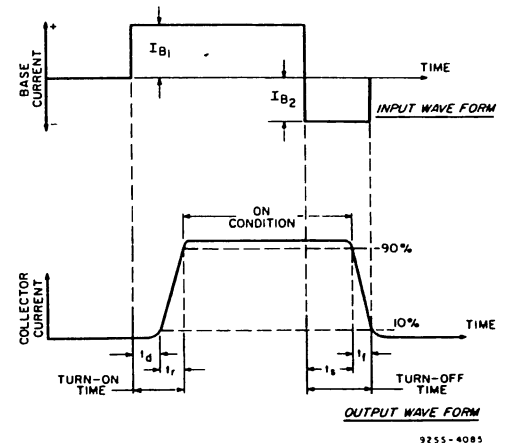
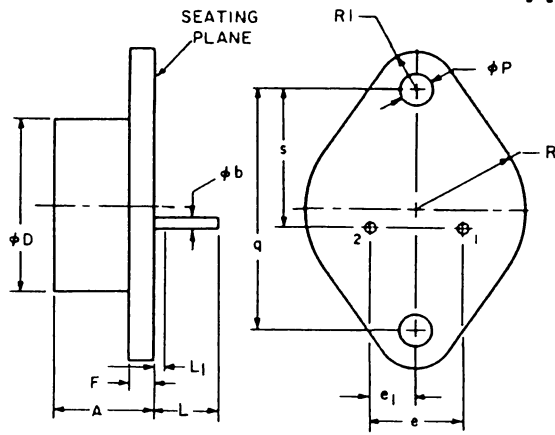


Fig. 17 - Phase relationship between input and output currents showing reference points for specification of switching times. (Test circuit shown in Fig. 16).

TO-204MA/TO-3



**A**

92CS-15222R3

Notes:

1:  $\phi b$  applies between  $L_1$  and  $L$ . Diameter is uncontrolled in  $L_1$ .

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.450	6.35	11.35	
$\phi b$	0.038	0.043	0.96	1.092	1
$\phi D$	-	0.875	-	22.22	
e	0.420	0.440	10.67	11.17	2
$e_1$	0.205	0.225	5.21	5.71	2
F	0.060	0.135	1.53	3.42	
L	0.312	0.500	7.93	12.70	
$L_1$	-	0.050	-	1.27	1
$\phi P$	0.151	0.161	3.836	4.089	
q	1.177	1.197	29.90	30.40	
R	0.495	0.525	12.58	13.33	
$R_1$	0.131	0.188	3.33	4.77	
s	0.655	0.675	16.64	17.14	

2: These dimensions should be measured at points 0.050 in. (1.270 mm) to 0.055 in. (1.397 mm) below seating plane. When gage is not used, measurement will be made at seating plane.