

# Bipolar Transistor

(-)100 V, (-)2 A, Low  $V_{CE(sat)}$ , (PNP)NPN  
Single TP/TP-FA

## 2SA1593 / 2SC4135

### Features

- Adoption of FBET, MBIT Process
- Fast Switching Speed
- Small and Slim Package Permitting 2SA1593 / 2SC4135 – Applied Sets to be Made More Compact
- High Breakdown Voltage and Large Current Capacity

### Applications

- Power Supplies, Relay Drivers, Lamp Drivers

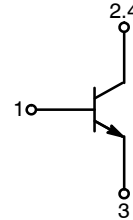
**SPECIFICATIONS** ( ): 2SA1593

**ABSOLUTE MAXIMUM RATINGS** at  $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Collector-to-Base Voltage	$V_{CBO}$	-	(-)120	V
Collector-to-Emitter Voltage	$V_{CEO}$	-	(-)100	V
Emitter-to-Base Voltage	$V_{EBO}$	-	(-)6.0	V
Collector Current	$I_C$	-	(-)2.0	A
Collector Current (Pulse)	$I_{CP}$	-	(-)3.0	A
Collector Dissipation	$P_C$	-	1.0	W
		$T_C = 25^\circ\text{C}$	15	W
Junction Temperature	$T_j$	-	150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-	- 55 to +150	$^\circ\text{C}$

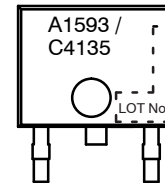
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### ELECTRICAL CONNECTION



DPAK / TP-FA  
CASE 369AH

### MARKING DIAGRAM



### ORDERING INFORMATION

Device	Package	Shipping†
2SA1593S-TL-E	DPAK / TP-FA	700 / Tape & Reel
2SC4135T-TL-E	DPAK / TP-FA	700 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

## 2SA1593 / 2SC4135

### ELECTRICAL CHARACTERISTICS (at Ta = 25°C)

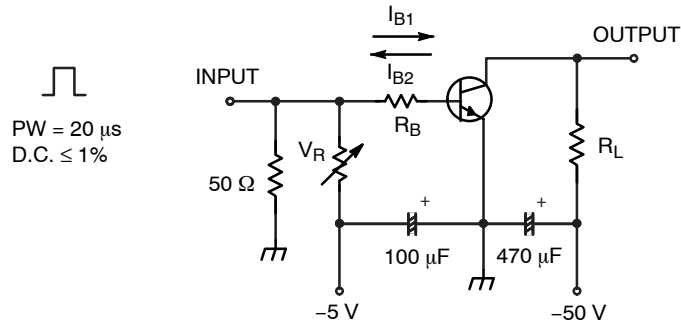
Parameter	Symbol	Conditions	Ratings			Unit
			Min	Typ	Max	
Collector Cutoff Current	$I_{CBO}$	$V_{CB} = (-)100\text{ V}, I_E = 0\text{ A}$	-	-	(-) $100$	nA
Emitter Cutoff Current	$I_{EBO}$	$V_{EB} = (-)4\text{ V}, I_C = 0\text{ A}$	-	-	(-) $100$	nA
DC Current Gain	$h_{FE}$	$V_{CE} = (-)5\text{ V}, I_C = (-)100\text{ mA}$	100*	-	400*	
Gain-Bandwidth Product	$f_T$	$V_{CE} = (-)10\text{ V}, I_C = (-)100\text{ mA}$	-	120	-	MHz
Output Capacitance	$C_{ob}$	$V_{CB} = (-)10\text{ V}, f = 1\text{ MHz}$	-	(25) $16$	-	pF
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)1\text{ A}, I_B = (-)100\text{ mA}$	-	(-0.22) $0.13$	(-0.6) $0.4$	mV
Base-to-Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = (-)1\text{ A}, I_B = (-)100\text{ mA}$	-	(-) $0.85$	(-) $1.2$	V
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)10\text{ }\mu\text{A}, I_E = 0\text{ A}$	(-) $120$	-	-	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 1\text{ mA}, R_{BE} = \infty$	(-) $100$	-	-	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 10\text{ }\mu\text{A}, I_C = 0\text{ A}$	(-) $6$	-	-	V
Turn-On Time	$t_{on}$	See specified Test Circuit	-	(80) $80$	-	ns
Storage Time	$t_{stg}$		-	(750) $1000$	-	ns
Fall Time	$t_f$		-	(40) $50$	-	ns

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

\* The 2SA1593/ 2SC4135 are classified by 100 mA  $h_{FE}$  as follows :

Rank	R	S	T
$h_{FE}$	100 to 200	140 to 280	200 to 400

### Switching Time Test Circuit



$$I_C = 10I_{B1} = -10I_{B2} = 0.7\text{ A}$$

(For PNP, the polarity is reversed)

**Figure 1. Test Circuit**

TYPICAL CHARACTERISTICS

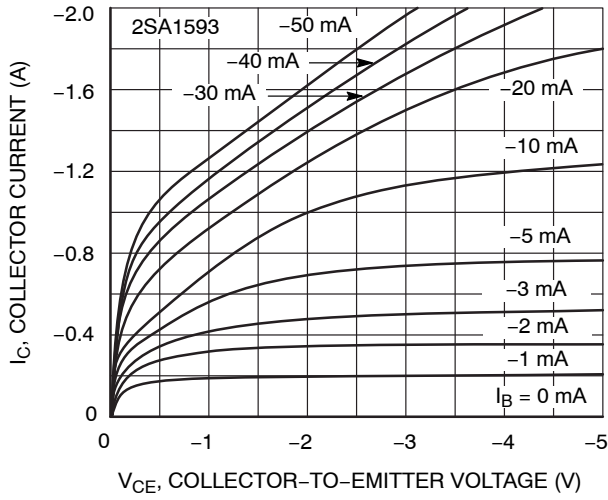


Figure 2.  $I_C - V_{CE}$

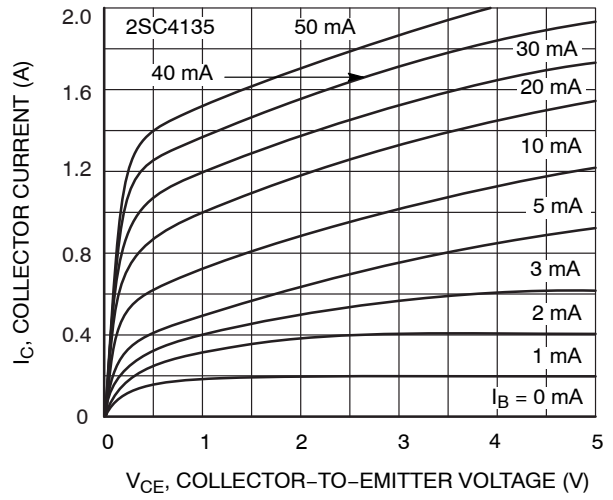


Figure 3.  $I_C - V_{CE}$

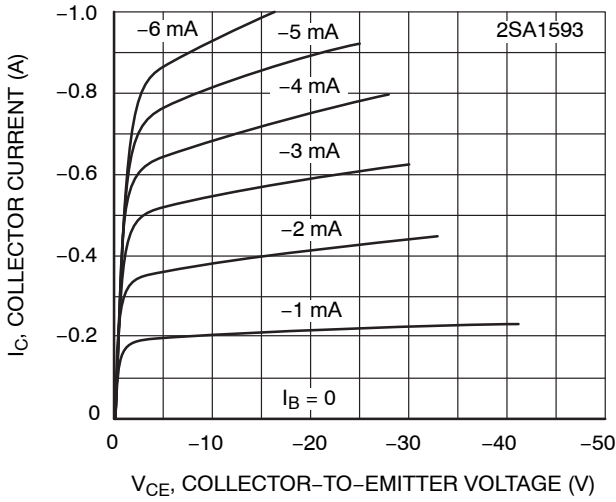


Figure 4.  $I_C - V_{CE}$

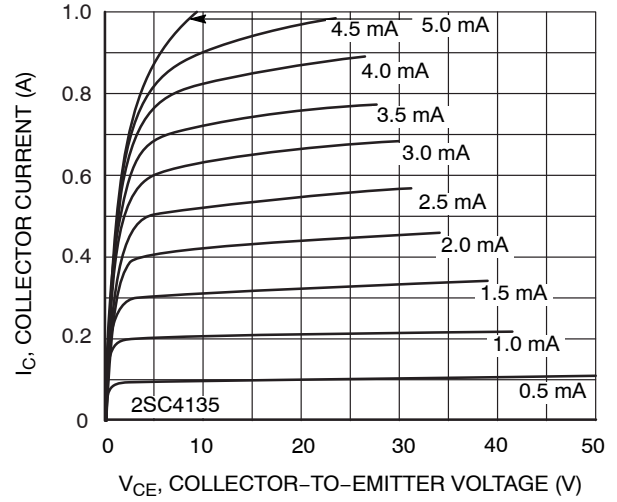


Figure 5.  $I_C - V_{CE}$

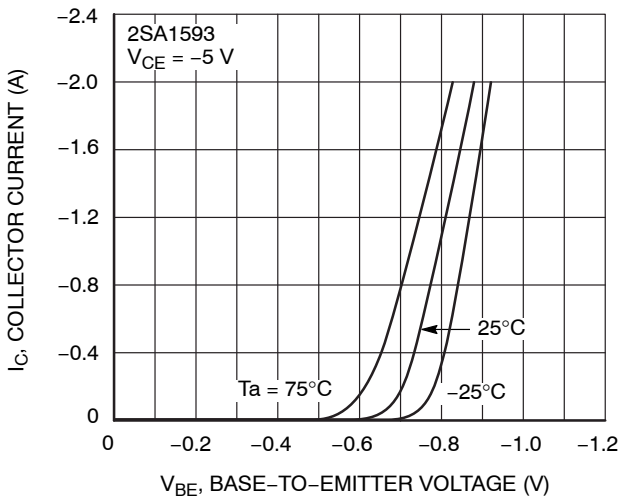


Figure 6.  $I_C - V_{BE}$

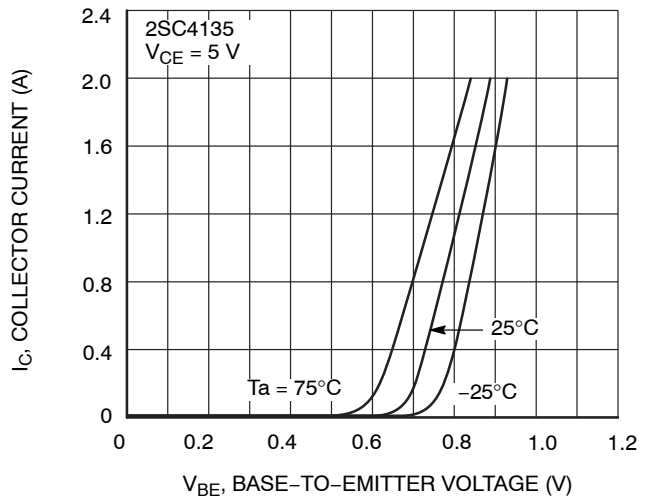


Figure 7.  $I_C - V_{BE}$

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## TYPICAL CHARACTERISTICS (CONTINUED)

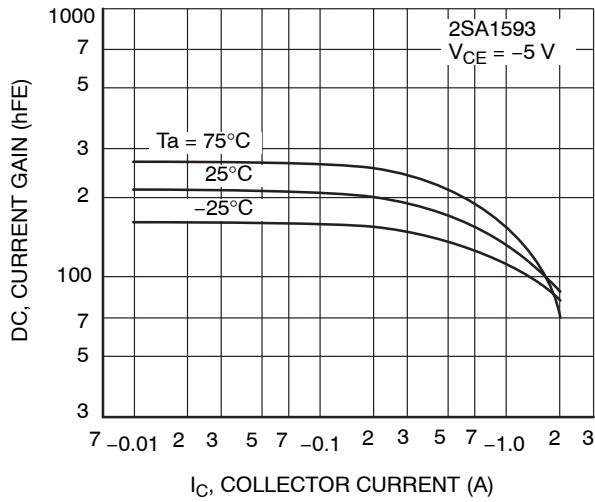


Figure 8.  $h_{FE} - I_C$

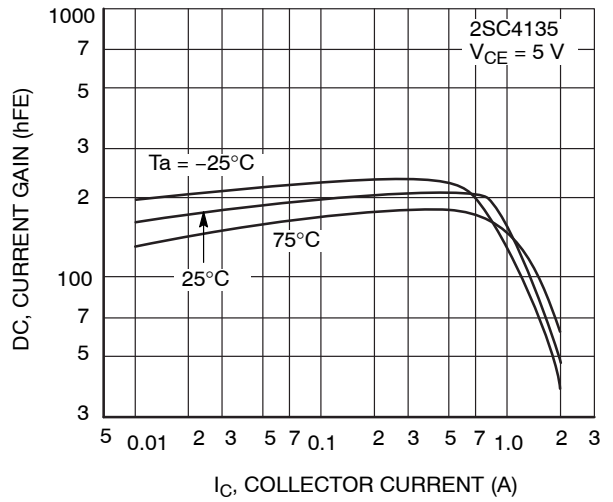


Figure 9.  $h_{FE} - I_C$

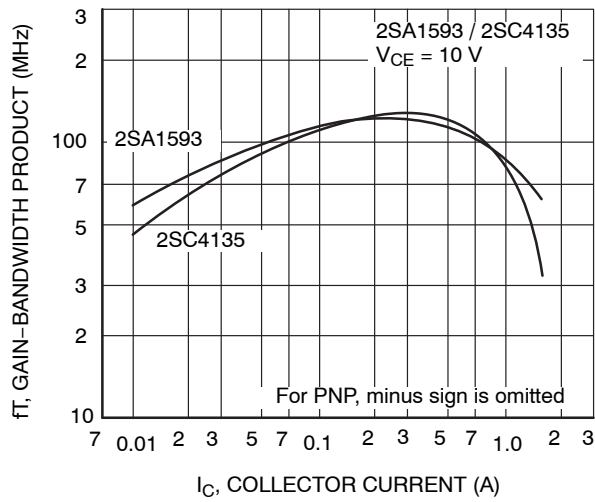


Figure 10.  $f_T - I_C$

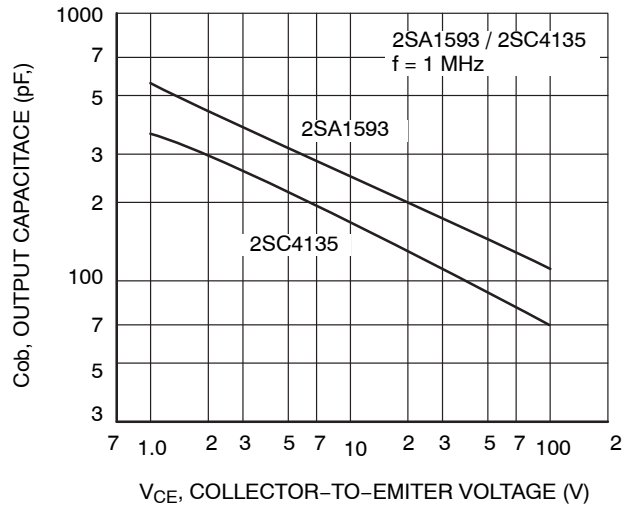


Figure 11.  $C_{ob} - V_{CE}$

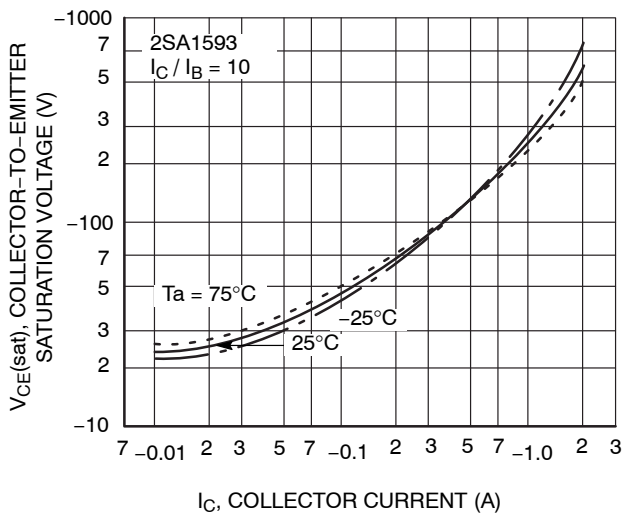


Figure 12.  $V_{CE(sat)} - I_C$

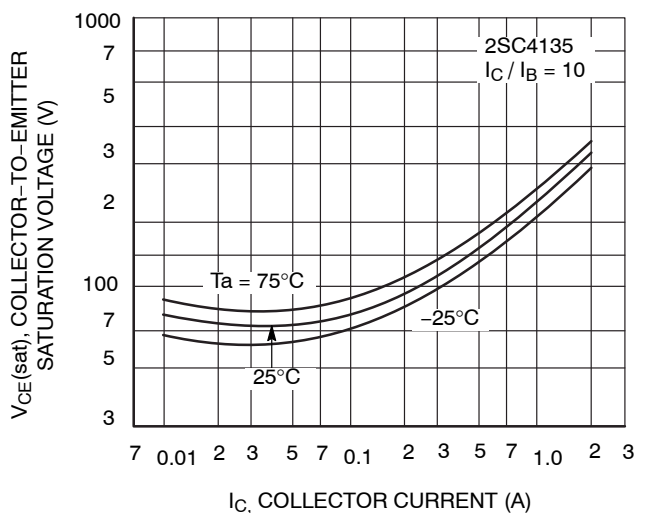


Figure 13.  $V_{CE(sat)} - I_C$

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## TYPICAL CHARACTERISTICS (CONTINUED)

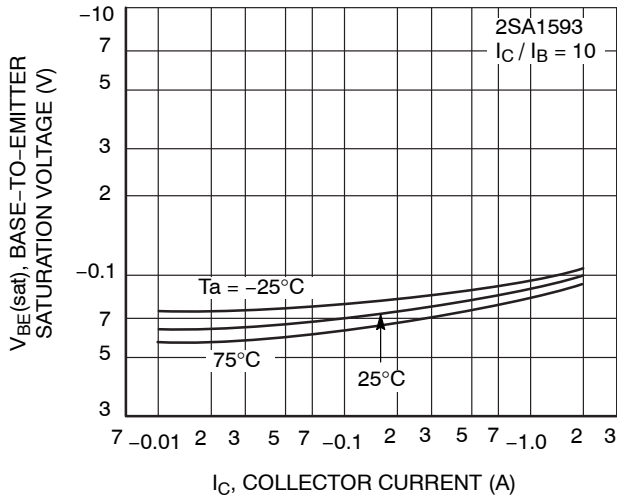


Figure 14.  $V_{BE(sat)} - I_C$

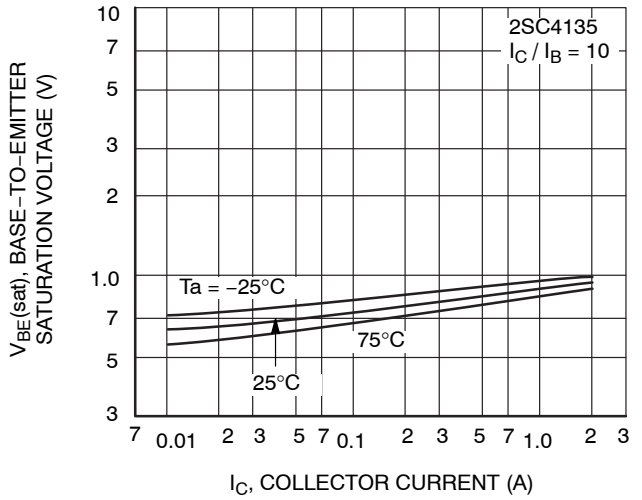


Figure 15.  $V_{BE(sat)} - I_C$

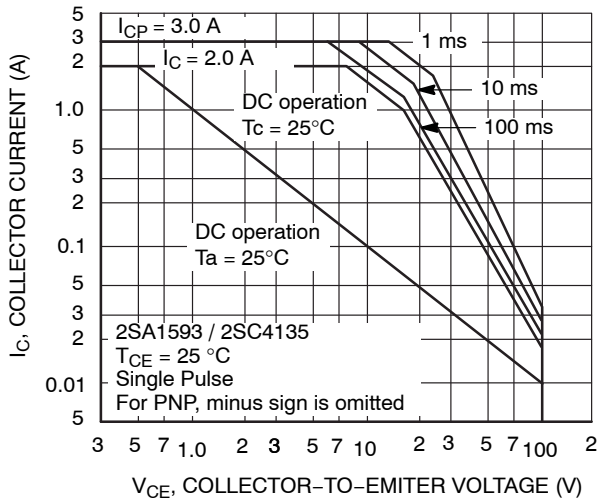


Figure 16. ASO

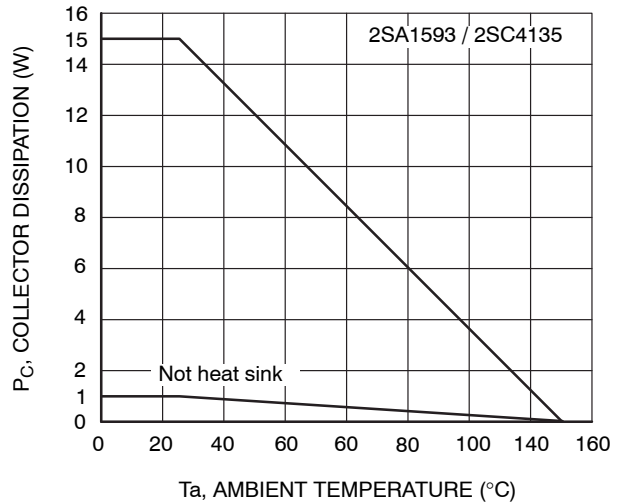


Figure 17.  $P_C - T_a$



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