

# Bipolar Transistor

(-)50 V, (-)4 A, Low  $V_{CE(sat)}$ , (PNP) NPN  
Single PCP

## 2SA2013, 2SC5566

### Features

- Adoption of FBET and MBIT Processes
- Low Collector-to-Emitter Saturation Voltage
- Ultrasmall Package Facilitates Miniaturization in End Products
- High Allowable Power Dissipation
- Large Current Capacity
- High-speed Switching

### Applications

- Relay Drivers, Lamp Drivers, Motor Drivers, Flash

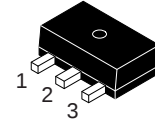
### Specifications

( ): 2SA2013

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ )

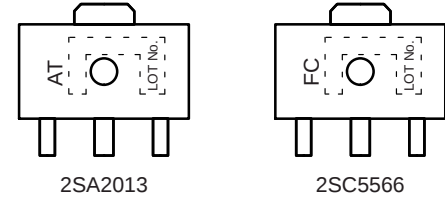
| Parameter                    | Symbol    | Conditions                                                       | Ratings     | Unit             |
|------------------------------|-----------|------------------------------------------------------------------|-------------|------------------|
| Collector-to-Base Voltage    | $V_{CBO}$ |                                                                  | (-)50 100   | V                |
| Collector-to-Emitter Voltage | $V_{CES}$ |                                                                  | (-)50 100   | V                |
| Collector-to-Emitter Voltage | $V_{CEO}$ |                                                                  | (-)50       | V                |
| Emitter-to-Base Voltage      | $V_{EBO}$ |                                                                  | (-)6        | V                |
| Collector Current            | $I_C$     |                                                                  | (-)4        | A                |
| Collector Current (Pulse)    | $I_{CP}$  |                                                                  | (-)7        | A                |
| Base Current                 | $I_B$     |                                                                  | (-)600      | mA               |
| Collector Dissipation        | $P_C$     | When mounted on ceramic substrate (250 mm <sup>2</sup> x 0.8 mm) | 1.3         | W                |
|                              |           | $T_c = 25^\circ\text{C}$                                         | 3.5         | 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.

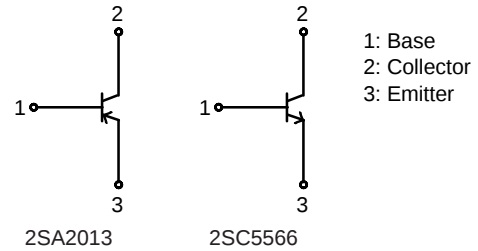


SOT-89 / PCP-1  
CASE 419AU

### MARKING DIAGRAM



### ELECTRICAL CONNECTION



### ORDERING INFORMATION

| Device       | Package Type (JEITA, JEDEC) | Shipping <sup>†</sup> |
|--------------|-----------------------------|-----------------------|
| 2SA2013-TD-E | PCP (Pb-Free)               | 1000 / Tape & Reel    |
| 2SC5566-TD-E |                             |                       |

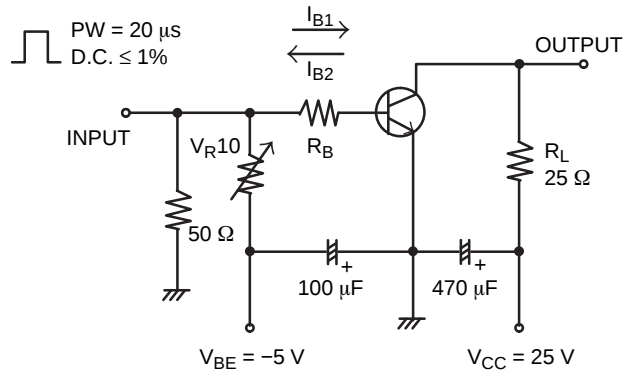
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )

| Parameter                               | Symbol         | Conditions                                                  | Ratings   |            |            | Unit          |
|-----------------------------------------|----------------|-------------------------------------------------------------|-----------|------------|------------|---------------|
|                                         |                |                                                             | Min       | Typ        | Max        |               |
| Collector Cutoff Current                | $I_{CBO}$      | $V_{CB} = (-)40\text{ V}, I_E = 0\text{ A}$                 | –         | –          | (–)1       | $\mu\text{A}$ |
| Emitter Cutoff Current                  | $I_{EBO}$      | $V_{EB} = (-)4\text{ V}, I_C = 0\text{ A}$                  | –         | –          | (–)1       | $\mu\text{A}$ |
| DC Current Gain                         | $h_{FE}$       | $V_{CE} = (-)2\text{ V}, I_C = (-)500\text{ mA}$            | 200       | –          | 560        |               |
| Gain–Bandwidth Product                  | $f_T$          | $V_{CE} = (-)10\text{ V}, I_C = (-)500\text{ mA}$           | –         | (360) 400  | –          | MHz           |
| Output Capacitance                      | $C_{ob}$       | $V_{CB} = (-)10\text{ V}, f = 1\text{ MHz}$                 | –         | (24) 15    | –          | pF            |
| Collector–to–Emitter Saturation Voltage | $V_{CE(sat)1}$ | $I_C = (-)1\text{ A}, I_B = (-)50\text{ mA}$                | –         | (–105) 85  | (–180) 130 | mV            |
|                                         | $V_{CE(sat)2}$ | $I_C = (-)2\text{ A}, I_B = (-)100\text{ mA}$               | –         | (–200) 150 | (–340) 225 | mV            |
| Base–to–Emitter Saturation Voltage      | $V_{BE(sat)}$  | $I_C = (-)2\text{ A}, I_B = (-)100\text{ mA}$               | –         | (–) 0.89   | (–)1.2     | V             |
| Collector–to–Base Breakdown Voltage     | $V_{(BR)CBO}$  | $I_C = (-)10\text{ }\mu\text{A}, I_E = 0\text{ A}$          | (–50) 100 | –          | –          | V             |
| Collector–to–Emitter Breakdown Voltage  | $V_{(BR)CES}$  | $I_C = (-)100\text{ }\mu\text{A}, R_{BE} = 0\text{ }\Omega$ | (–50) 100 | –          | –          | V             |
| Collector–to–Emitter Breakdown Voltage  | $V_{(BR)CEO}$  | $I_C = (-)1\text{ mA}, R_{BE} = \infty$                     | (–)50     | –          | –          | 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.                                 | –         | (30) 35    | –          | ns            |
| Storage Time                            | $t_{stg}$      |                                                             | –         | (230) 300  | –          | ns            |
| Fall Time                               | $t_f$          |                                                             | –         | (15) 20    | –          | 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.

Switching Time Test Circuit



$I_C = 10I_{B1} = -10I_{B2} = 1\text{ A}$   
For PNP, the polarity is reversed.

Figure 1. Switching Time Test Circuit

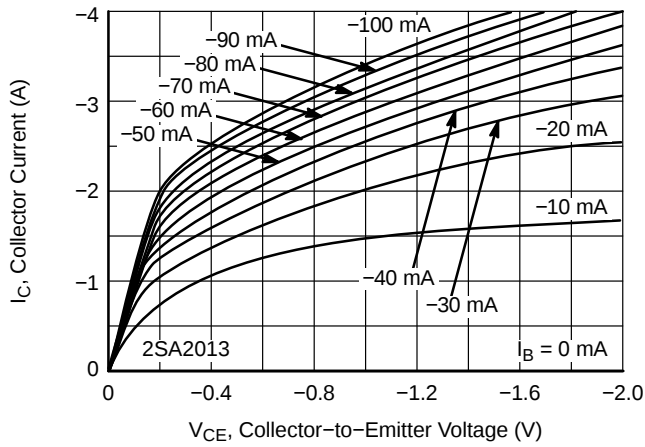


Figure 2.  $I_C - V_{CE}$

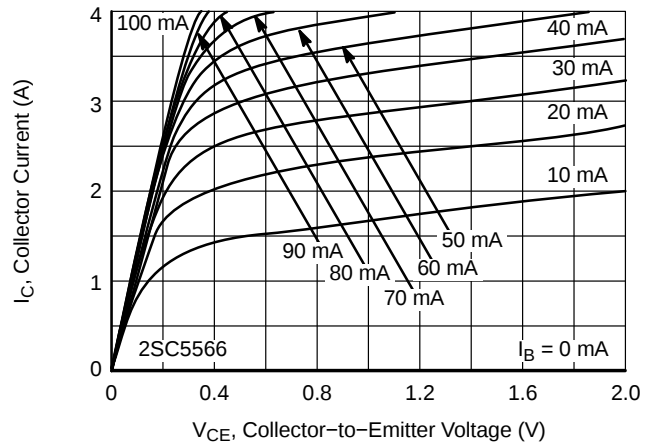


Figure 3.  $I_C - V_{CE}$

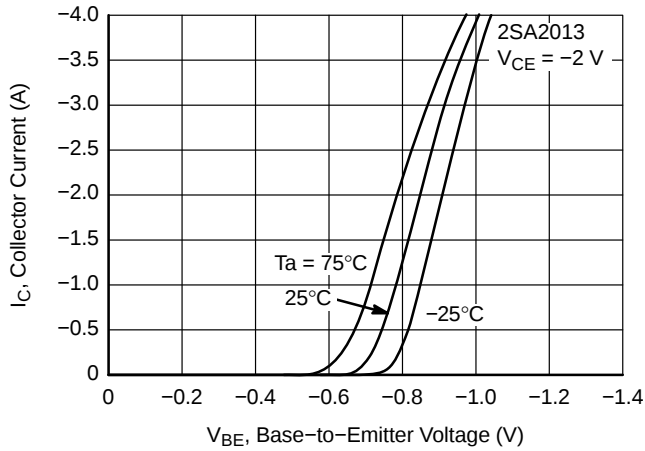


Figure 4.  $I_C - V_{BE}$

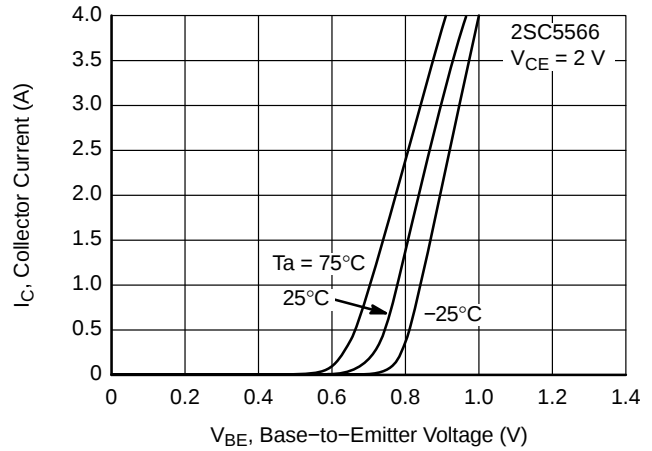


Figure 5.  $I_C - V_{BE}$

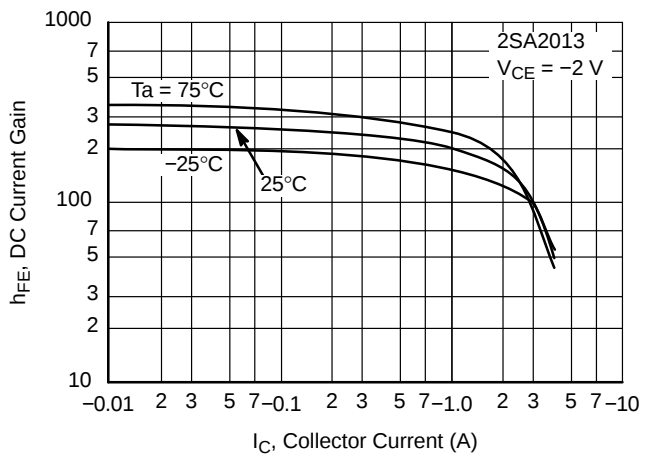


Figure 6.  $h_{FE} - I_C$

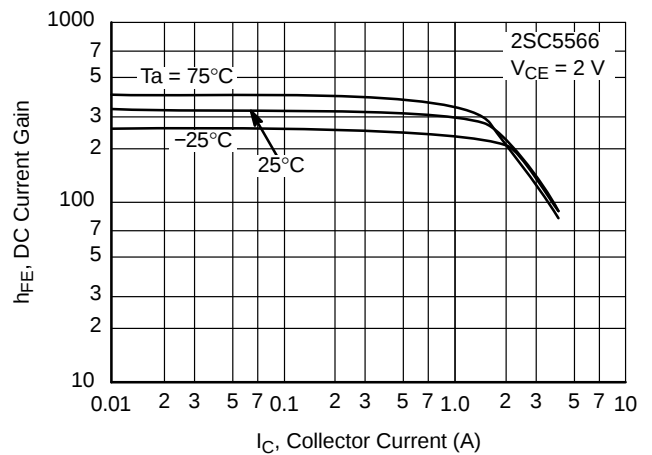


Figure 7.  $h_{FE} - I_C$

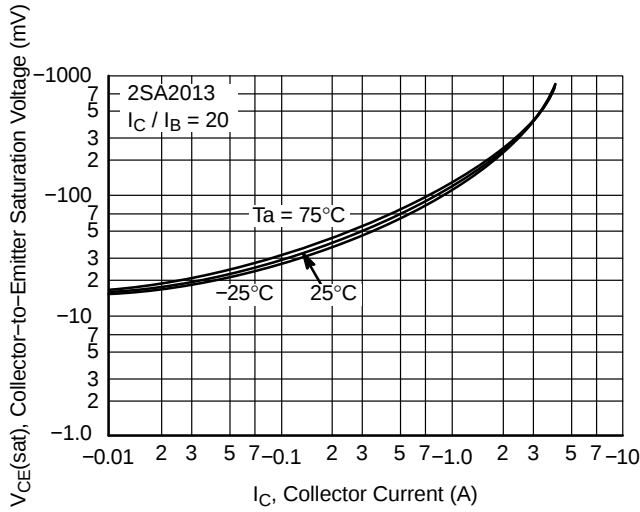


Figure 8.  $V_{CE(sat)} - I_C$

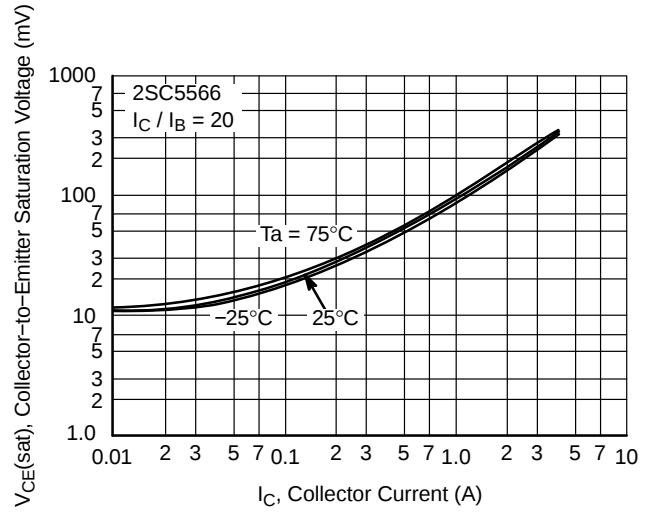


Figure 9.  $V_{CE(sat)} - I_C$

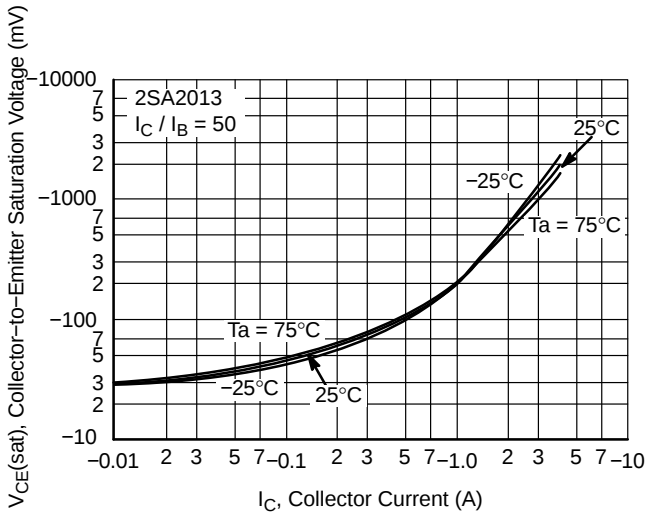


Figure 10.  $V_{CE(sat)} - I_C$

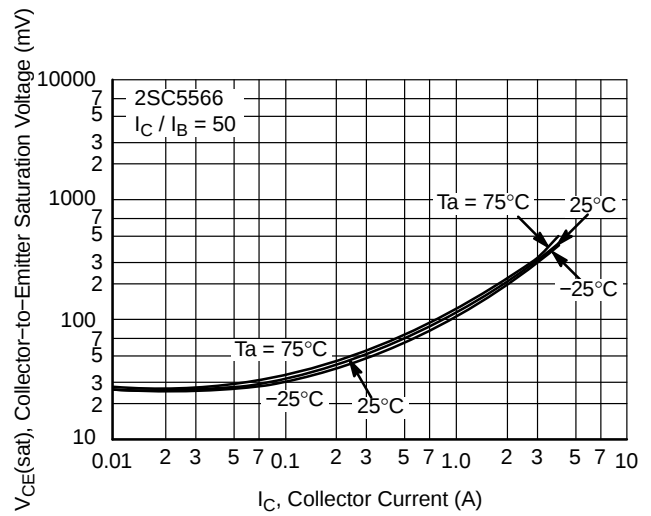


Figure 11.  $V_{CE(sat)} - I_C$

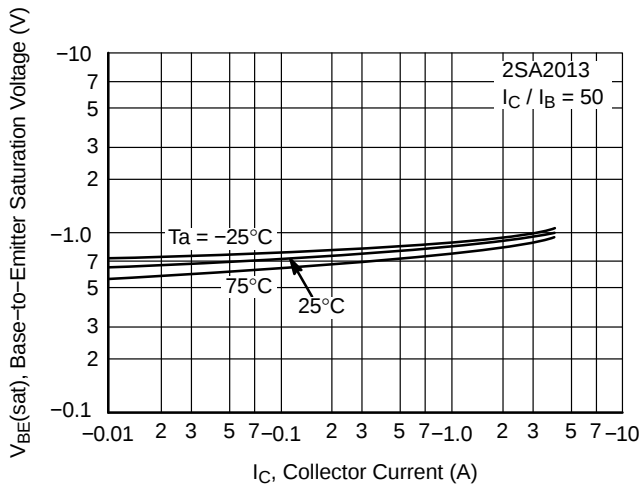


Figure 12.  $V_{BE(sat)} - I_C$

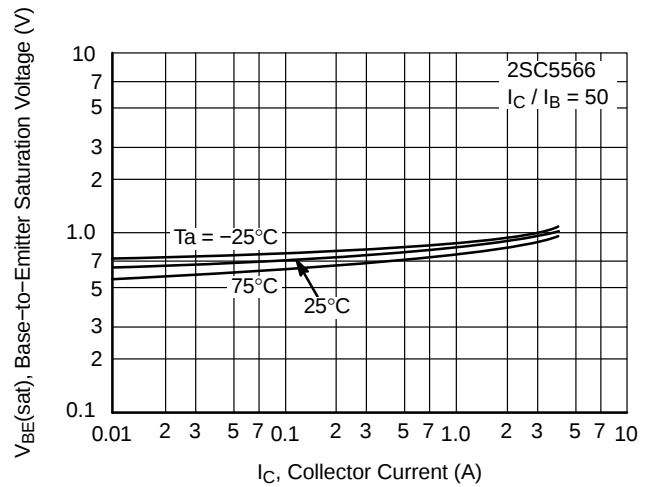


Figure 13.  $V_{BE(sat)} - I_C$

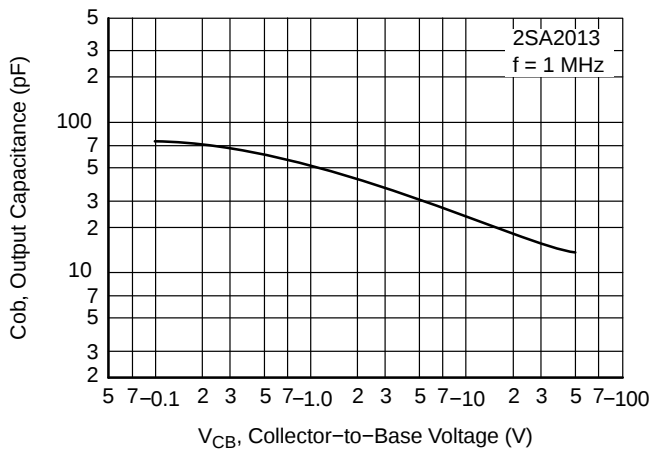


Figure 14. Cob -  $V_{CB}$

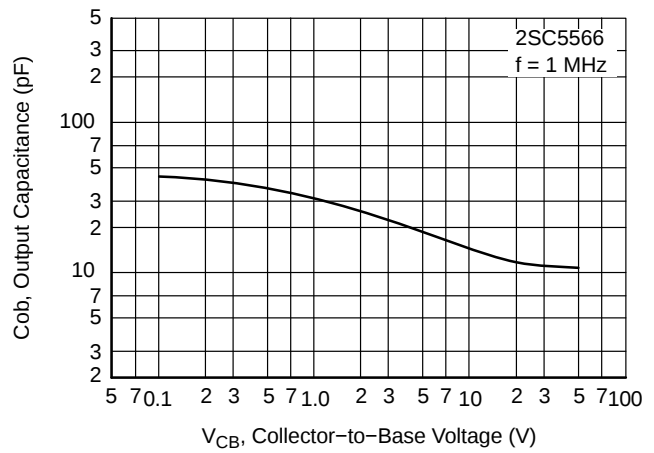


Figure 15. Cob -  $V_{CB}$

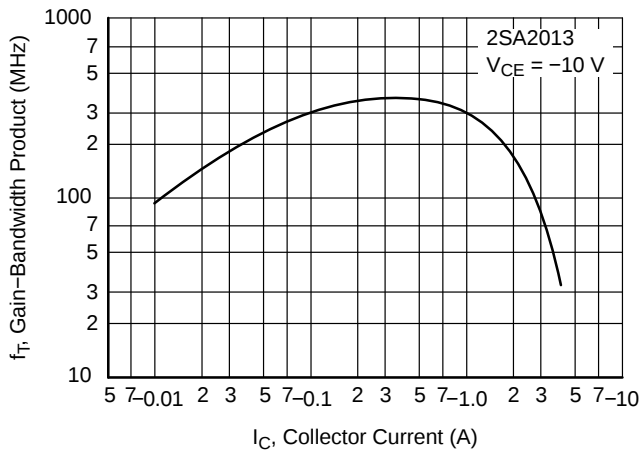


Figure 16.  $f_T$  -  $I_C$

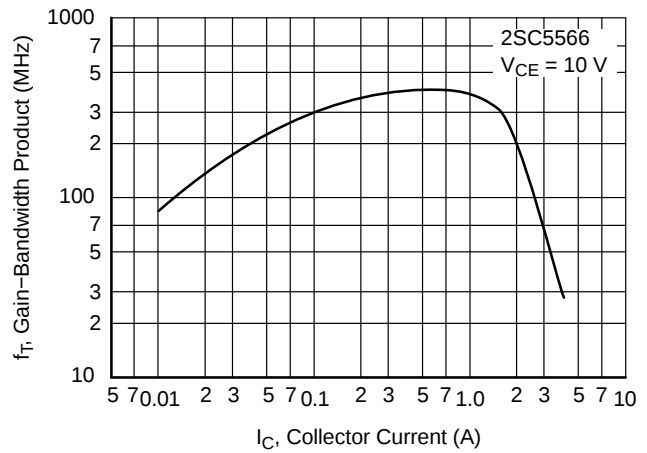


Figure 17.  $f_T$  -  $I_C$

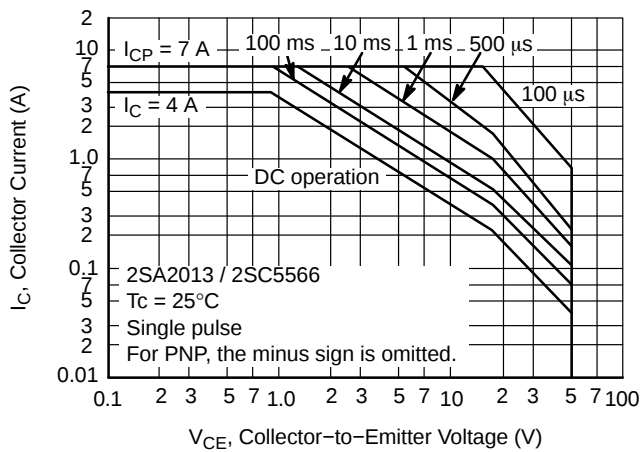


Figure 18. ASO

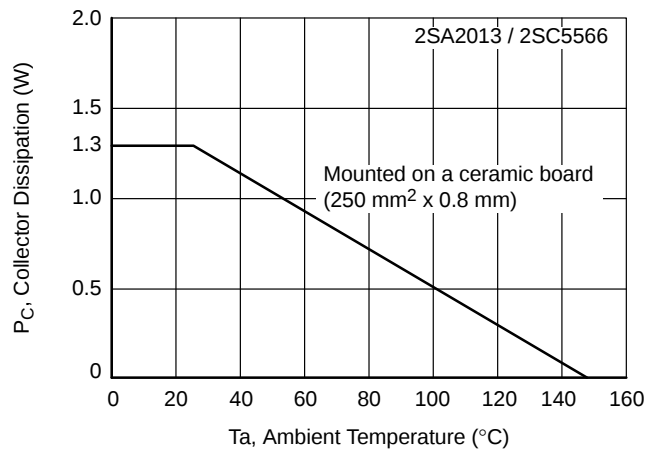
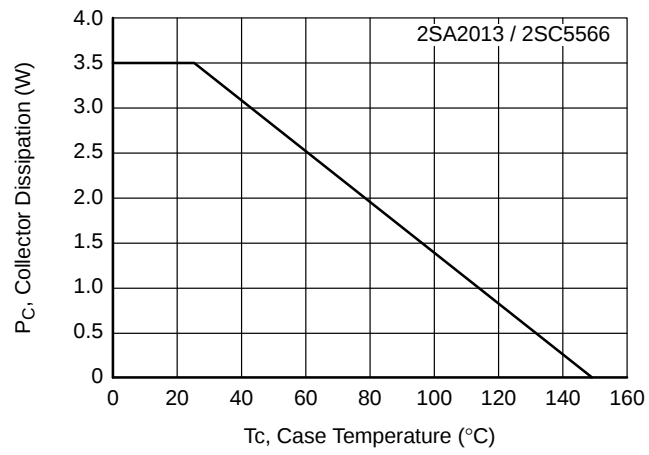
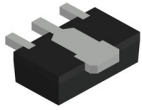


Figure 19.  $P_C$  -  $T_a$

## 2SA2013, 2SC5566

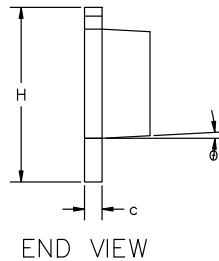
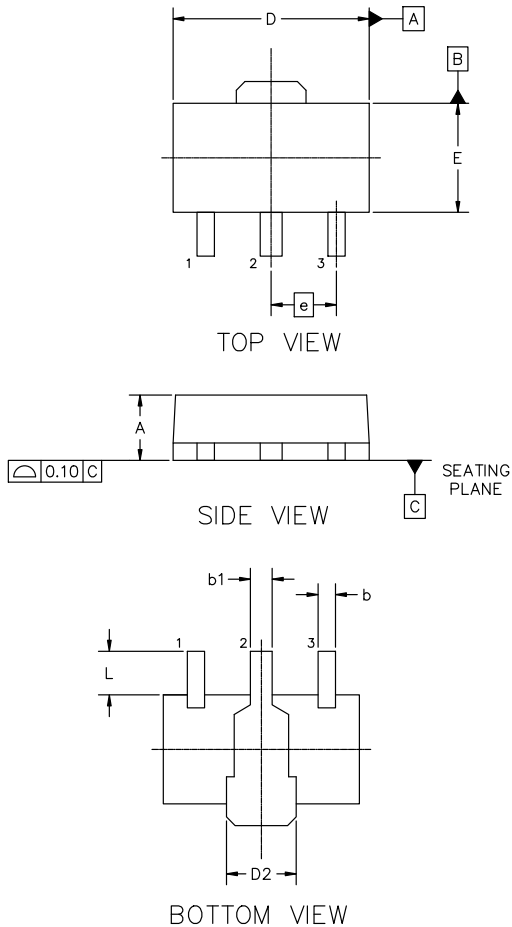


**Figure 20.  $P_C - T_C$**



**SOT-89 4.50x2.50x1.50 1.50P**  
**CASE 419AU**  
**ISSUE A**

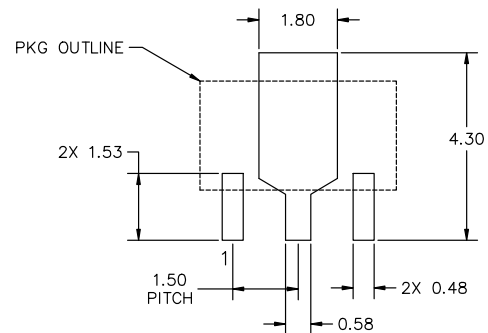
DATE 21 MAY 2025



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. LEAD THICKNESS INCLUDES LEAD FINISH.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| MILLIMETERS |          |      |      |
|-------------|----------|------|------|
| DIM         | MIN      | NOM  | MAX  |
| A           | 1.40     | 1.50 | 1.60 |
| b           | 0.35     | 0.40 | 0.48 |
| b1          | 0.40     | 0.50 | 0.55 |
| c           | 0.37     | 0.40 | 0.43 |
| D           | 4.40     | 4.50 | 4.60 |
| D2          | 1.40     | 1.60 | 1.80 |
| E           | 2.40     | 2.50 | 2.60 |
| e           | 1.50 BSC |      |      |
| H           | 3.80     | 4.00 | 4.20 |
| L           | 0.80     | 1.00 | 1.20 |
| θ           | 0°       | ---  | 3°   |



RECOMMENDED MOUNTING FOOTPRINT

\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

|                         |                                    |                                                                                                                                                                                     |
|-------------------------|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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