

# Bipolar Transistor

(-)100 V, (-)1 A, Low  $V_{CE(sat)}$ ,  
(PNP)NPN Single PCP

## 2SA1416, 2SC3646

### Features

- Adoption of FBET and MBIT Processes
- High Breakdown Voltage and Large Current Capacity
- Fast Switching Speed
- Ultrasmall Size Making it Easy to Provide High-Density Small-Sized Hybrid IC's
- These Devices are Pb-Free and are RoHS Compliant

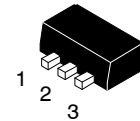
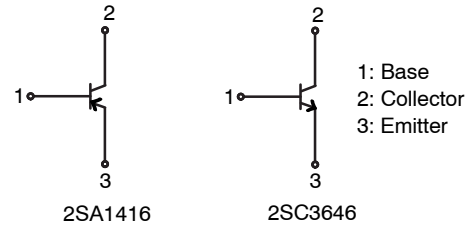
### SPECIFICATIONS ( ): 2SA1416 ABSOLUTE MAXIMUM RATINGS at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Value	Unit
Collector to Base Voltage	$V_{CBO}$	(-) 120	V
Collector to Emitter Voltage	$V_{CEO}$	(-) 100	V
Emitter to Base Voltage	$V_{EBO}$	(-) 6	V
Collector Current	$I_C$	(-) 1	A
Collector Current (Pulse)	$I_{CP}$	(-) 2	A
Collector Dissipation	$P_C$	500	mW
Collector Dissipation (Note 1)		1.3	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.

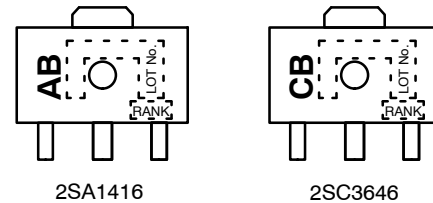
1. Surface mounted on ceramic substrate (250 mm<sup>2</sup> x 0.8 mm).

### ELECTRICAL CONNECTION



SOT-89 / PCP-1  
CASE 419AU

### MARKING DIAGRAM



### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

## 2SA1416, 2SC3646

### ELECTRICAL CHARACTERISTICS at $T_A = 25^\circ\text{C}$

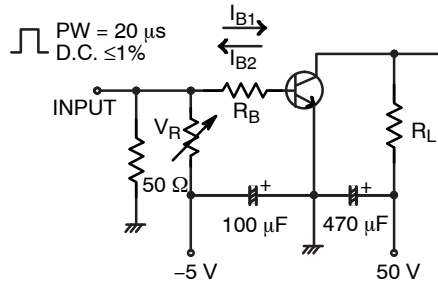
Parameter	Symbol	Conditions	Ratings			Unit
			Min	Typ	Max	
Collector Cutoff Current	$I_{CBO}$	$V_{CB} = (-)100\text{ V}$ , $I_E = 0\text{ A}$			(-)100	nA
Emitter Cutoff Current	$I_{EBO}$	$V_{EB} = (-)4\text{ V}$ , $I_C = 0\text{ A}$			(-)100	nA
DC Current Gain	$h_{FE}$	$V_{CE} = (-)5\text{ V}$ , $I_C = (-)100\text{ mA}$	100*		400*	
Gain-Bandwidth Product	$f_T$	$V_{CE} = (-)10\text{ V}$ , $I_C = (-)100\text{ mA}$		120		MHz
Output Capacitance	$C_{ob}$	$V_{CB} = (-)10\text{ V}$ , $f = 1\text{ MHz}$		(13)8.5		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)400\text{ mA}$ , $I_B = (-)40\text{ mA}$		(-0.2)0.1	(-0.6)0.4	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = (-)400\text{ mA}$ , $I_B = (-)40\text{ mA}$		(-)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	$t_{stg}$			(700)850		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 2SA1416/2SC3646 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



$I_C = 10\text{ mA}$   $I_{B1} = -10\text{ mA}$   $I_{B2} = 400\text{ mA}$   
(For PNP, the polarity is reversed)

TYPICAL CHARACTERISTICS

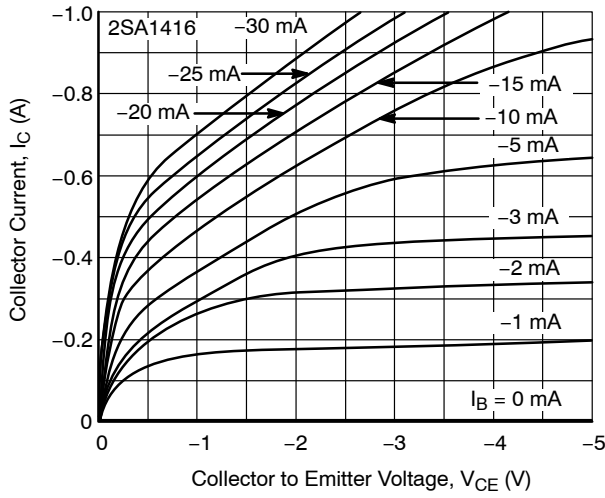


Figure 1.  $I_C - V_{CE}$

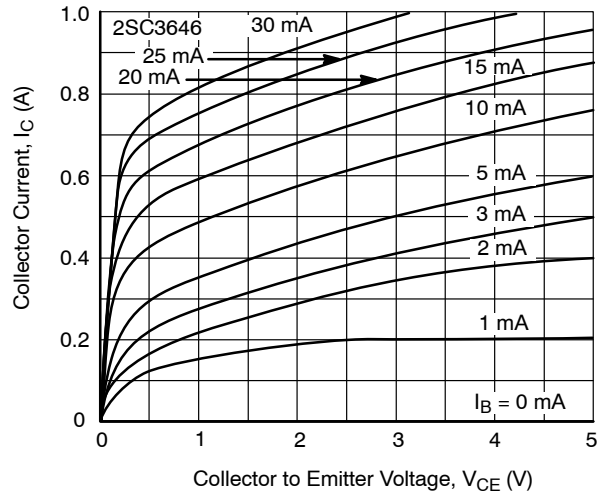


Figure 2.  $I_C - V_{CE}$

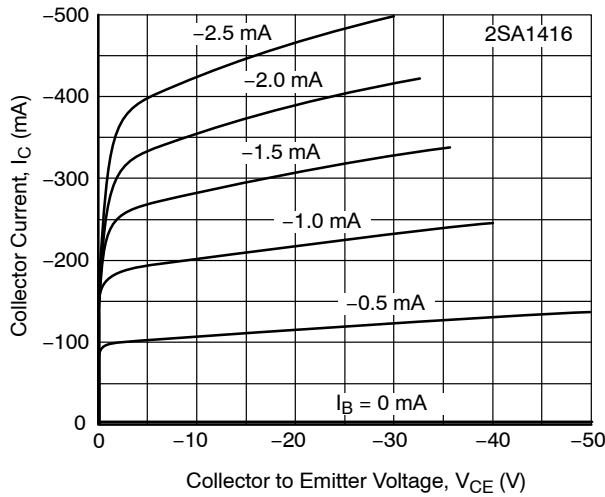


Figure 3.  $I_C - V_{CE}$

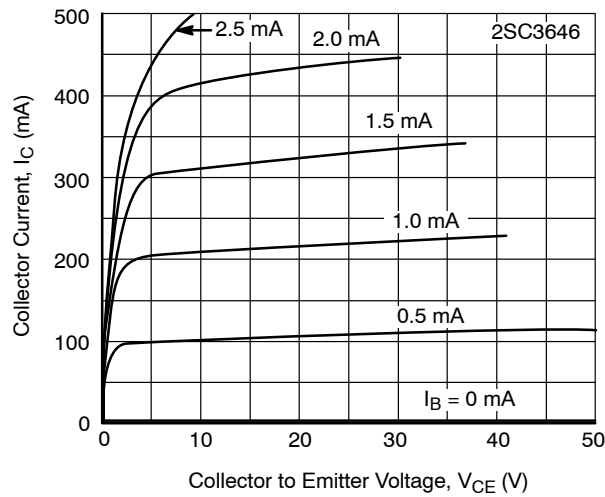


Figure 4.  $I_C - V_{CE}$

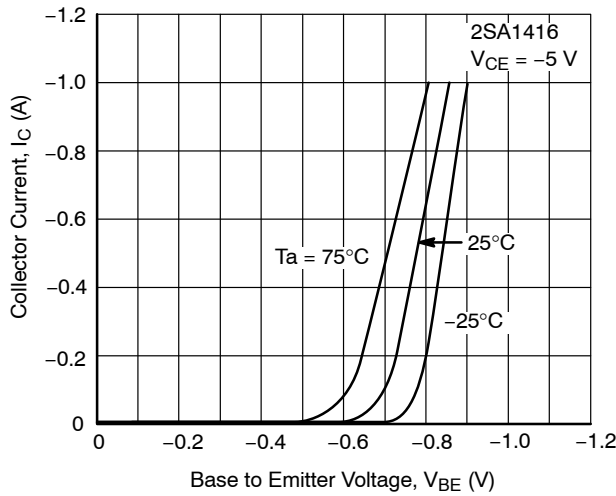


Figure 5.  $I_C - V_{BE}$

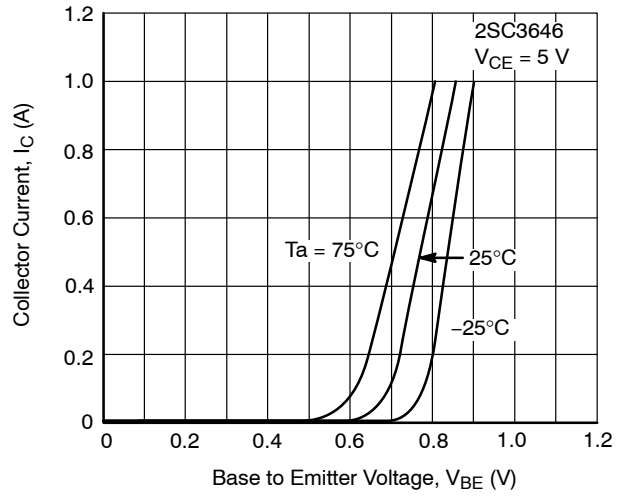


Figure 6.  $I_C - V_{BE}$

# 2SA1416, 2SC3646

## TYPICAL CHARACTERISTICS (continued)

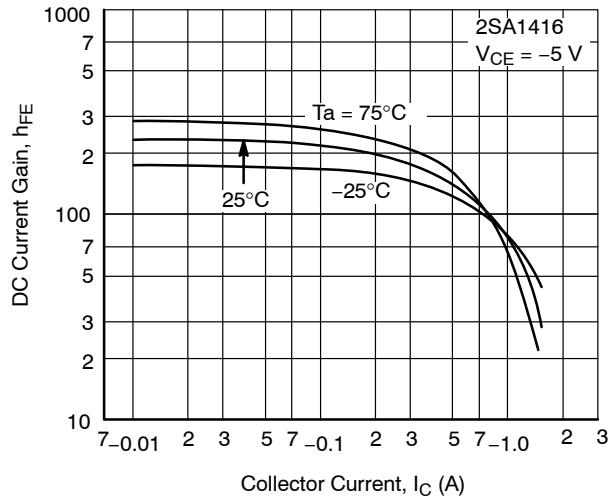


Figure 7.  $h_{FE} - I_C$

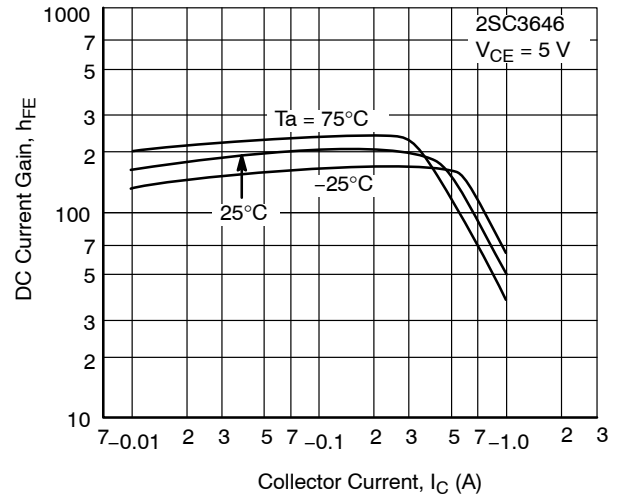


Figure 8.  $h_{FE} - I_C$

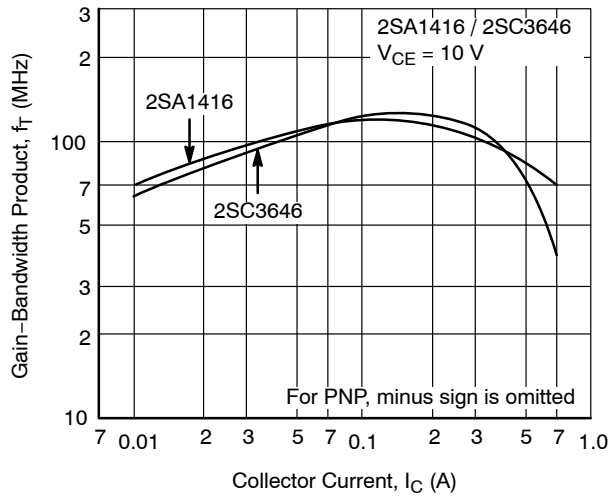


Figure 9.  $f_T - I_C$

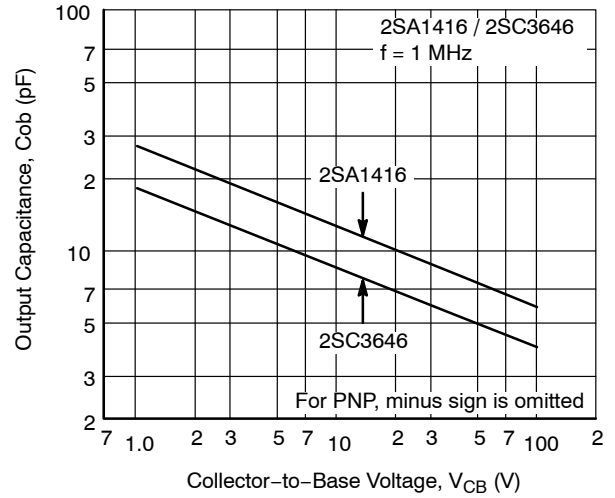


Figure 10.  $C_{ob} - V_{CB}$

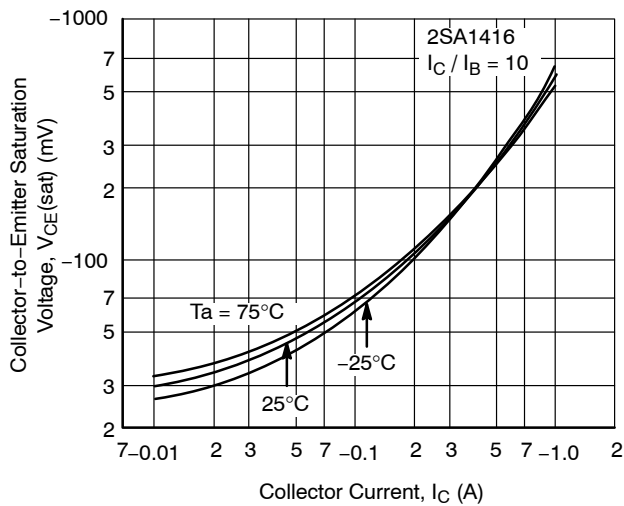


Figure 11.  $V_{CE(sat)} - I_C$

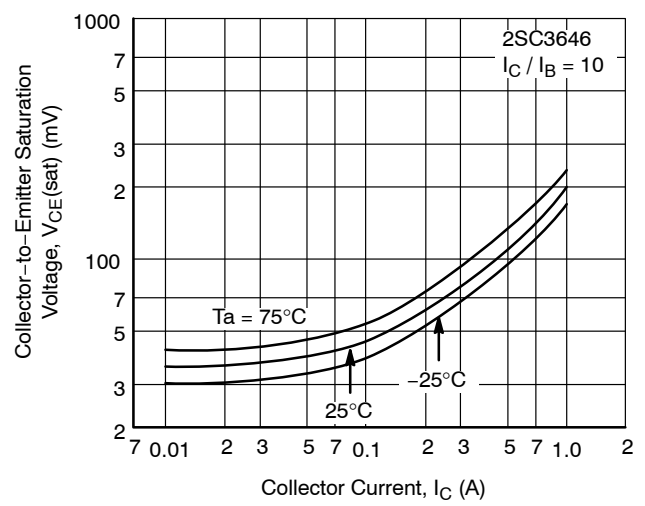


Figure 12.  $V_{CE(sat)} - I_C$

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## TYPICAL CHARACTERISTICS (continued)

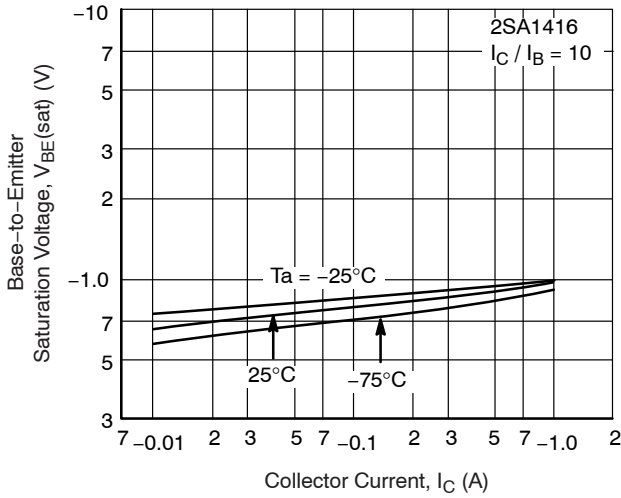


Figure 13.  $V_{BE(sat)} - I_C$

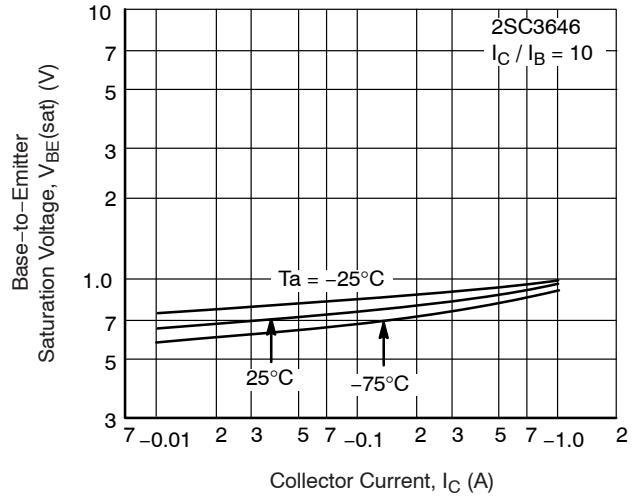


Figure 14.  $V_{BE(sat)} - I_C$

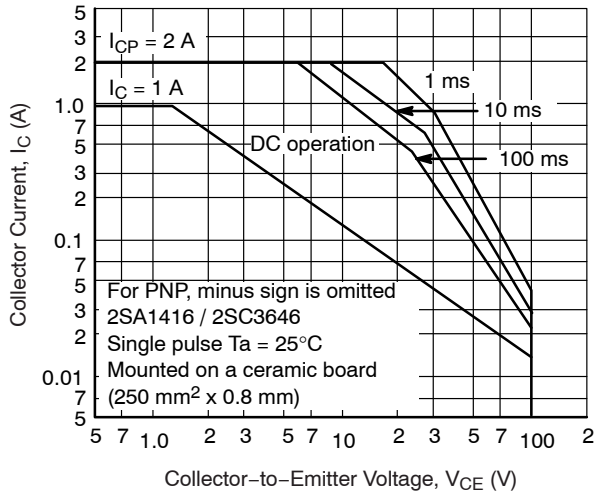


Figure 15. ASO

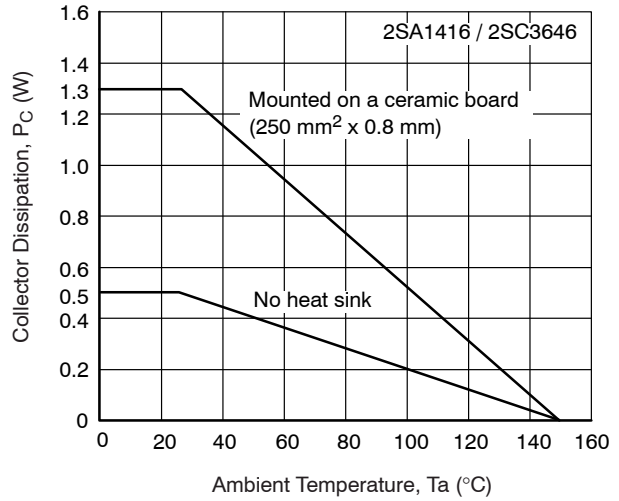


Figure 16.  $P_C - T_a$

## 2SA1416, 2SC3646

### ORDERING INFORMATION

Device	Marking	Package	Shipping <sup>†</sup>
2SA1416S-TD-E	AB	SOT-89 / PCP-1 (Pb-Free)	1000 / Tape & Reel
2SA1416T-TD-E			
2SC3646S-TD-E	CB		
2SC3646T-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.

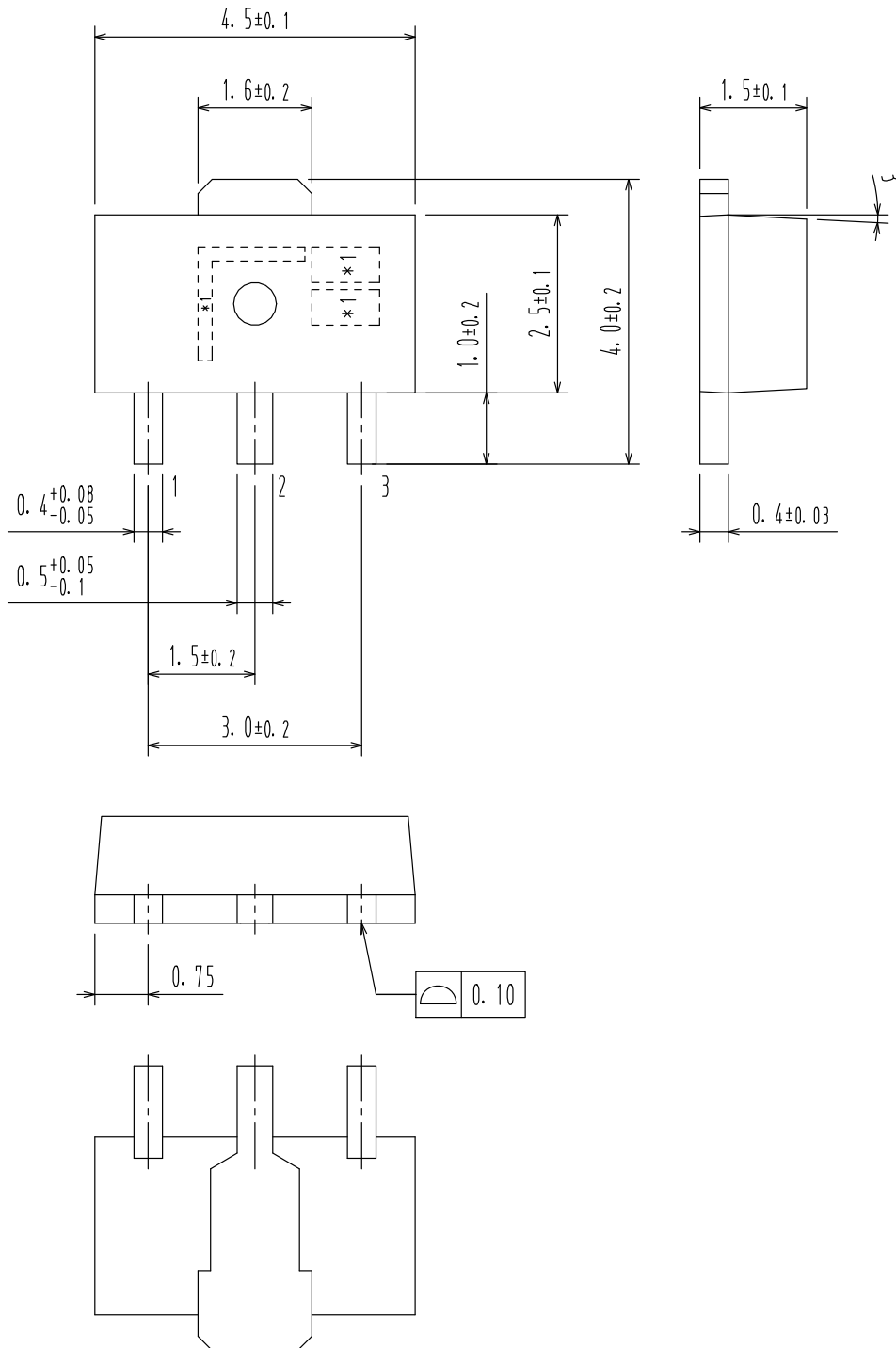
**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**

ON Semiconductor®



**SOT-89 / PCP-1**  
**CASE 419AU**  
**ISSUE O**

DATE 30 APR 2012



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