

**COMPLEMENTARY 60V NPN/PNP MEDIUM POWER TRANSISTORS IN SOT26**
**Features**
**NPN Transistor**

- $BV_{CEO} > 60V$
- $I_C = 1A$  Continuous Collector Current
- Low Saturation Voltage (500mV max @ 1A)
- $h_{FE}$  characterised up to 2A
- $R_{SAT} = 210m\Omega @ 1A$  for a Low Equivalent On-Resistance

**PNP Transistor**

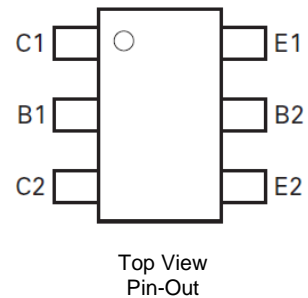
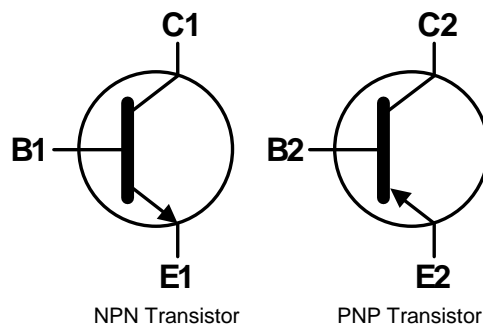
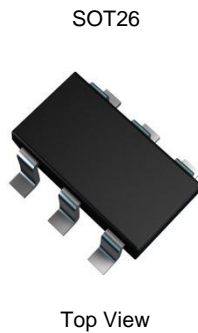
- $BV_{CEO} > -60V$
- $I_C = -1A$  Continuous Collector Current
- Low Saturation Voltage (-600mV max @ -1A)
- $h_{FE}$  characterised up to 2A
- $R_{SAT} = 355m\Omega @ 1A$  for a Low Equivalent On-Resistance
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**

**Mechanical Data**

- Case: SOT26
- Case Material: Molded Plastic, "Green" Molding Compound; UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads;
- Solderable per MIL-STD-202, Method 208③
- Weight: 0.015 grams (Approximate)

**Applications**

- MOSFET Gate Driver
- Low Power Motor Drive
- Low Power DC-DC Converters

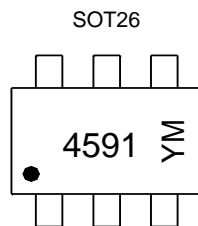


Device Symbol

**Ordering Information** (Note 4)

Product	Compliance	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXTD4591E6TA	AEC-Q101	4591	7	8	3,000

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
  4. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

**Marking Information**


4591 = Product Type Marking Code  
 YM = Date Code Marking  
 Y or  $\bar{Y}$  = Year (ex: C = 2015)  
 M or  $\bar{M}$  = Month (ex: 9 = September)

**Date Code Key**

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
Code	C	D	E	F	G	H	I	J	K	L	M	
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	O	N	D

**NPN - Absolute Maximum Ratings** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V <sub>CBO</sub>	80	V
Collector-Emitter Voltage	V <sub>CEO</sub>	60	V
Emitter-Base Voltage	V <sub>EBO</sub>	7	V
Peak Pulse Current	I <sub>CM</sub>	2	A
Continuous Collector Current	I <sub>C</sub>	1	A
Base Current	I <sub>B</sub>	500	mA

**PNP - Absolute Maximum Ratings** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V <sub>CBO</sub>	-80	V
Collector-Emitter Voltage	V <sub>CEO</sub>	-60	V
Emitter-Base Voltage	V <sub>EBO</sub>	-7	V
Peak Pulse Current	I <sub>CM</sub>	-2	A
Continuous Collector Current	I <sub>C</sub>	-1	A
Base Current	I <sub>B</sub>	-500	mA

**Thermal Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Power Dissipation Linear Derating Factor	P <sub>D</sub>	1.1	W
		8.8	
Thermal Resistance, Junction to Ambient	R <sub>θJA</sub>	1.7	mW/°C
		13.6	
Thermal Resistance, Junction To Lead	R <sub>θJL</sub>	113	°C/W
		73	
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to +150	°C

**ESD Ratings** (Note 9)

Characteristic	Symbol	Value	Unit	JEDEC Class
Electrostatic Discharge - Human Body Model	ESD HBM	4,000	V	3A
Electrostatic Discharge - Machine Model	ESD MM	400	V	C

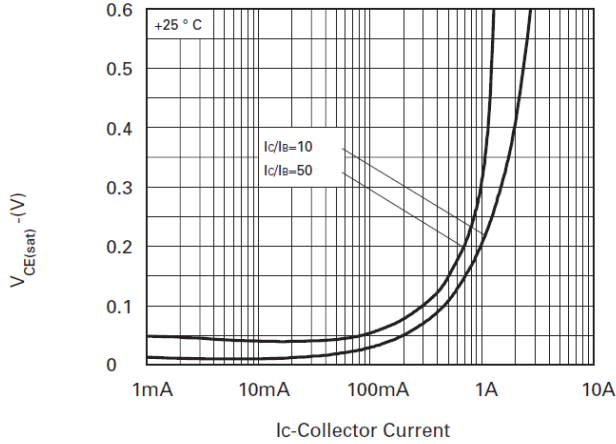
- Notes:
6. For a device mounted with the collector lead on 25mm x 25mm 1oz copper that is on a single-sided 1.6mm FR4 PCB; the device is measured under still air conditions whilst operating in a steady-state. Two active dice running at equal power with heatsink split 50% to each collector.
  7. Same as Note 6, except the device is measured at t < 5 seconds.
  8. Thermal resistance from junction to solder-point (at the end of the collector lead).
  9. Refer to JEDEC specification JESD22-A114 and JESD22-A115.

**NPN - Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

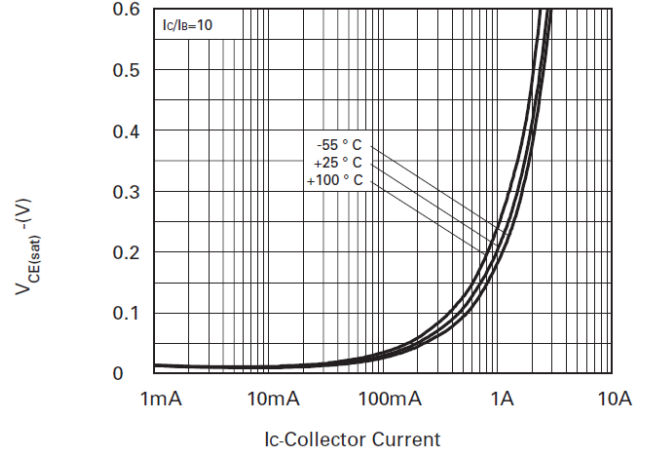
Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS</b>						
Collector-Base Breakdown Voltage	BV <sub>CBO</sub>	80	—	—	V	I <sub>C</sub> = 100μA, I <sub>E</sub> = 0
Collector-Emitter Breakdown Voltage (Note 10)	BV <sub>CEO</sub>	60	—	—	V	I <sub>C</sub> = 10mA, I <sub>B</sub> = 0
Emitter-Base Breakdown Voltage	BV <sub>EBO</sub>	7	—	—	V	I <sub>E</sub> = 100μA, I <sub>C</sub> = 0
Collector Cut-Off Current	I <sub>CBO</sub>	—	—	100	nA	V <sub>CB</sub> = 60V
Emitter Cut-Off Current	I <sub>EBO</sub>	—	—	100	nA	V <sub>EB</sub> = 5.6
Emitter Cut-Off Current	I <sub>CES</sub>	—	—	100	nA	V <sub>CE</sub> = 60V
<b>ON CHARACTERISTICS (Note 10)</b>						
DC Current Gain	h <sub>FE</sub>	100 100 80 30	— — — —	— 300 — —	—	I <sub>C</sub> = 1mA, V <sub>CE</sub> = 5V I <sub>C</sub> = 500mA, V <sub>CE</sub> = 5V I <sub>C</sub> = 1A, V <sub>CE</sub> = 5V I <sub>C</sub> = 2A, V <sub>CE</sub> = 5V
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	—	—	0.25 0.5	V V	I <sub>C</sub> = 500mA, I <sub>B</sub> = 50mA I <sub>C</sub> = 1A, I <sub>B</sub> = 100mA
Base-Emitter Saturation Voltage	V <sub>BE(sat)</sub>	—	—	1.1	V	I <sub>C</sub> = 1A, I <sub>B</sub> = 100mA
Base-Emitter Turn-On Voltage	V <sub>BE(on)</sub>	—	—	1.0	V	I <sub>C</sub> = 1, V <sub>CE</sub> = 5V
<b>SMALL SIGNAL CHARACTERISTICS</b>						
Output Capacitance	C <sub>obo</sub>	—	—	10	pF	V <sub>CB</sub> = 10V, f = 1.0MHz
Current Gain Bandwidth Product	f <sub>T</sub>	180	—	—	MHz	I <sub>C</sub> = 50mA, V <sub>CE</sub> = 10V f = 100MHz

Note: 10. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

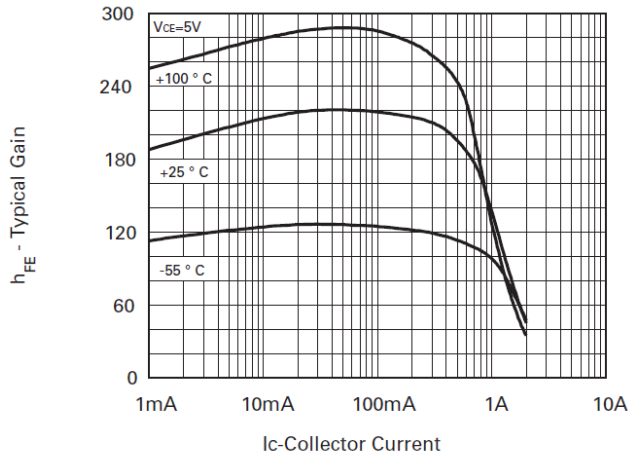
**NPN - Typical Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)



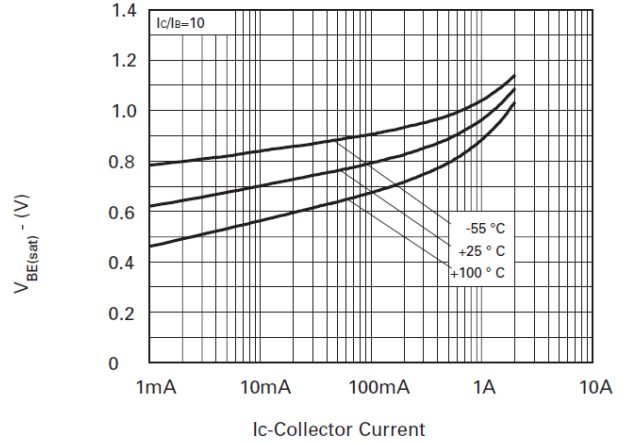
**VCE(sat) v IC**



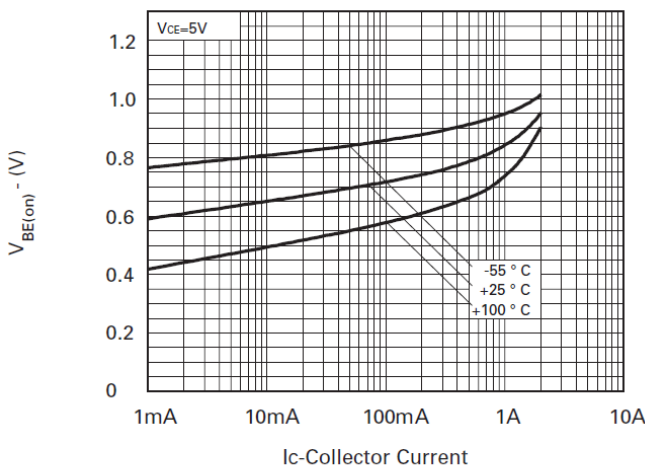
**VCE(sat) v IC**



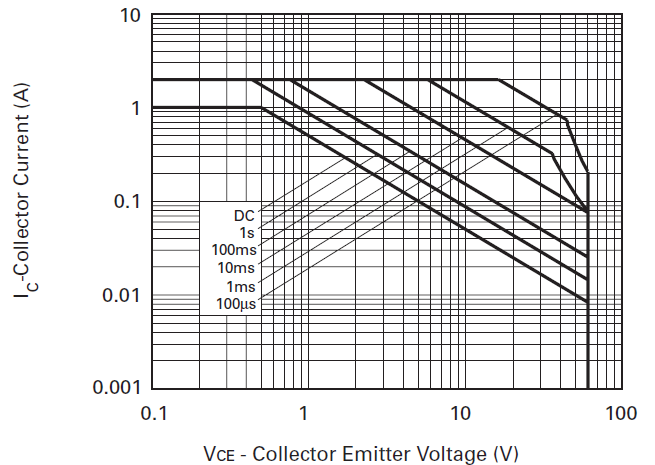
**hFE V IC**



**VBE(sat) v IC**



**VBE(on) v IC**



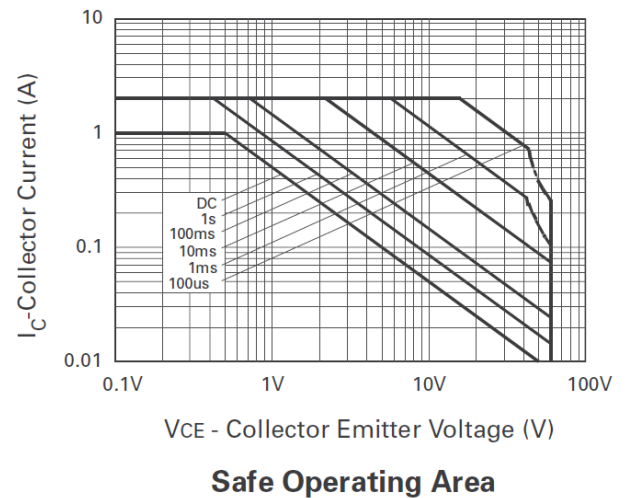
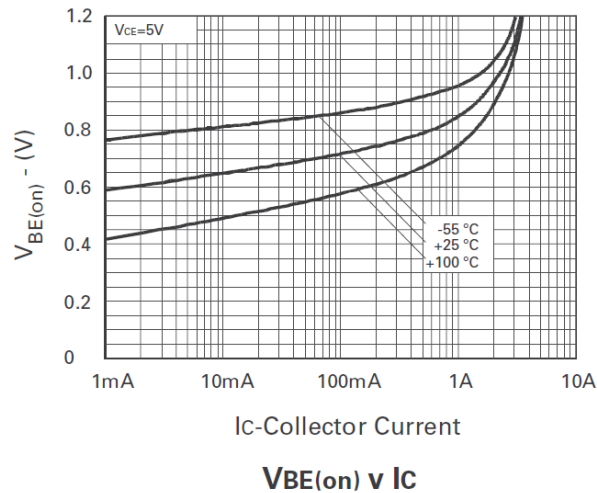
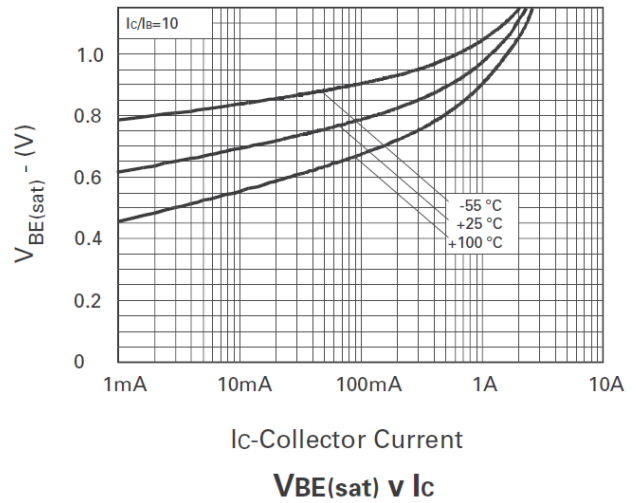
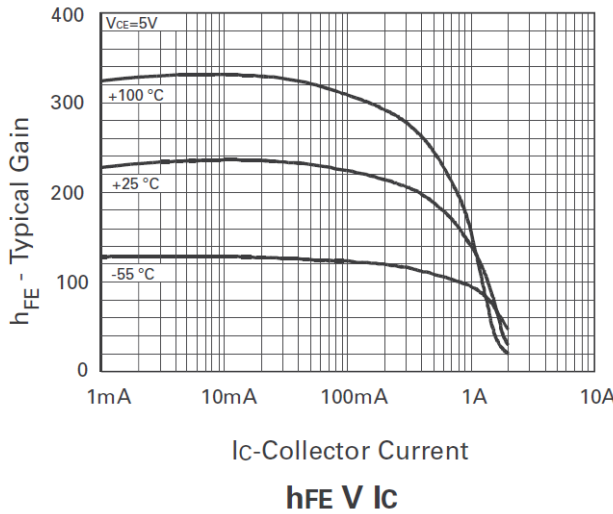
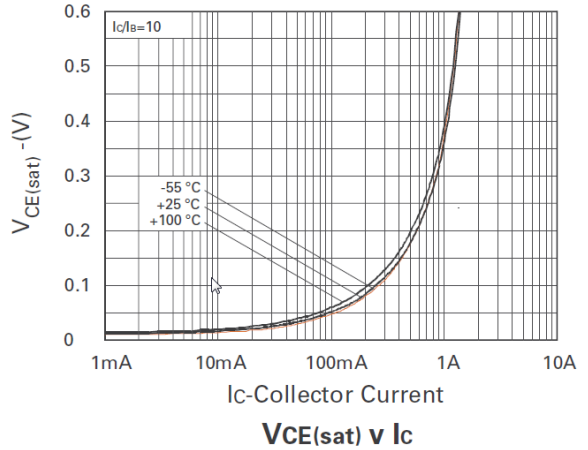
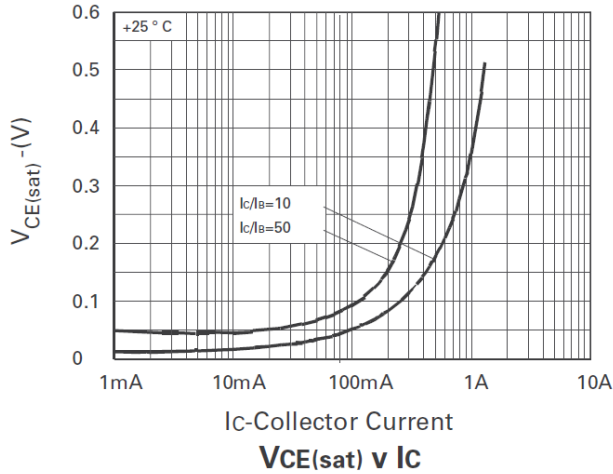
**Safe Operating Area**

**PNP - Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS</b>						
Collector-Base Breakdown Voltage	$BV_{CBO}$	-80	—	—	V	$I_C = -100\mu\text{A}$ , $I_E = 0$
Collector-Emitter Breakdown Voltage (Note 10)	$BV_{CEO}$	-60	—	—	V	$I_C = -10\text{mA}$ , $I_B = 0$
Emitter-Base Breakdown Voltage	$BV_{EBO}$	-7	—	—	V	$I_E = -100\mu\text{A}$ , $I_C = 0$
Collector Cut-Off Current	$I_{CBO}$	—	—	-100	nA	$V_{CB} = -60\text{V}$
Emitter Cut-Off Current	$I_{EBO}$	—	—	-100	nA	$V_{EB} = -5.6\text{V}$
Emitter Cut-Off Current	$I_{CES}$	—	—	-100	nA	$V_{CE} = -60\text{V}$
<b>ON CHARACTERISTICS</b> (Note 10)						
DC Current Gain	$h_{FE}$	100	—	—	—	$I_C = -1\text{mA}$ , $V_{CE} = -5\text{V}$
		100	—	300		$I_C = -500\text{mA}$ , $V_{CE} = -5\text{V}$
		80	—	—		$I_C = -1\text{A}$ , $V_{CE} = -5\text{V}$
		15	—	—		$I_C = -2\text{A}$ , $V_{CE} = -5\text{V}$
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	—	—	-0.3	V	$I_C = -500\text{mA}$ , $I_B = -50\text{mA}$
		—	—	-0.6	V	$I_C = -1\text{A}$ , $I_B = -100\text{mA}$
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	—	—	-1.2	V	$I_C = -1\text{A}$ , $I_B = -100\text{mA}$
Base-Emitter Turn-On Voltage	$V_{BE(on)}$	—	—	-1.0	V	$I_C = -1\text{A}$ , $V_{CE} = -5\text{V}$
<b>SMALL SIGNAL CHARACTERISTICS</b>						
Output Capacitance	$C_{obo}$	—	—	10	pF	$V_{CB} = -10\text{V}$ , $f = 1.0\text{MHz}$
Current Gain Bandwidth Product	$f_T$	150	—	—	MHz	$I_C = -50\text{mA}$ , $V_{CE} = -10\text{V}$ $f = 100\text{MHz}$

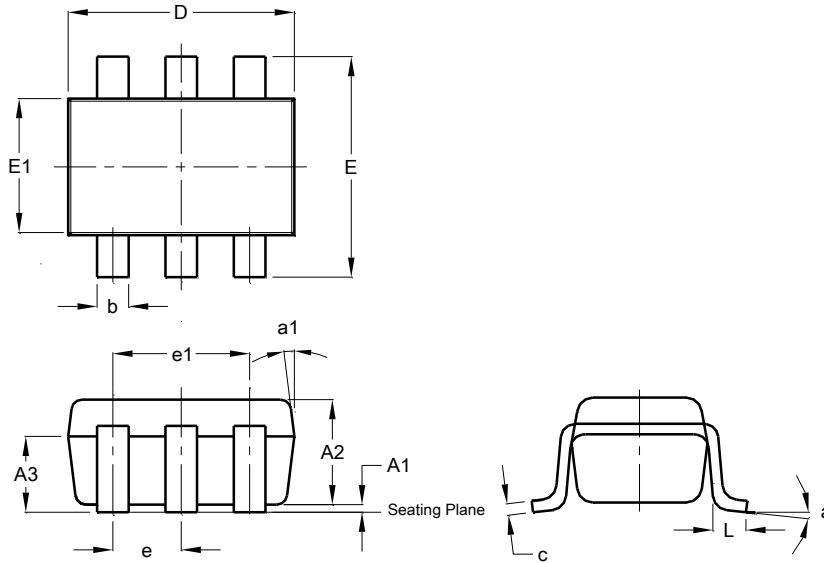
Note: 10. Measured under pulsed conditions. Pulse width  $\leq 300\mu\text{s}$ . Duty cycle  $\leq 2\%$ .

**PNP - Typical Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)



**Package Outline Dimensions**

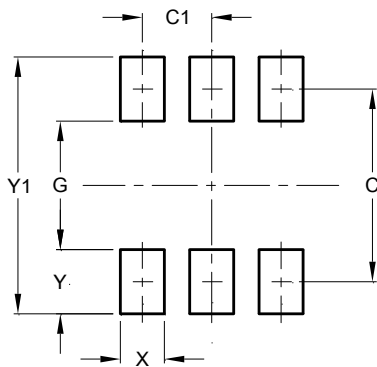
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.



SOT26			
Dim	Min	Max	Typ
A1	0.013	0.10	0.05
A2	1.00	1.30	1.10
A3	0.70	0.80	0.75
b	0.35	0.50	0.38
c	0.10	0.20	0.15
D	2.90	3.10	3.00
e	-	-	0.95
e1	-	-	1.90
E	2.70	3.00	2.80
E1	1.50	1.70	1.60
L	0.35	0.55	0.40
a	-	-	8°
a1	-	-	7°
All Dimensions in mm			

**Suggested Pad Layout**

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.



Dimensions	Value (in mm)
C	2.40
C1	0.95
G	1.60
X	0.55
Y	0.80
Y1	3.20

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