

### COMPLEMENTARY 60V NPN/PNP MEDIUM POWER TRANSISTORS IN SOT26

### **Features**

### **NPN Transistor**

- BV<sub>CEO</sub> > 60V
- I<sub>C</sub> = 1A Continuous Collector Current
- Low Saturation Voltage (500mV max @ 1A)
- h<sub>FE</sub> characterised up to 2A
- R<sub>SAT</sub> = 210mΩ @1A for a Low Equivalent On-Resistance

### **PNP Transistor**

- BV<sub>CEO</sub> > -60V
- I<sub>C</sub> = -1A Continuous Collector Current
- Low Saturation Voltage (-600mV max @ -1A)
- hFE characterised up to 2A

 $R_{SAT} = 355 m\Omega$  @1A for a Low Equivalent On-Resistance

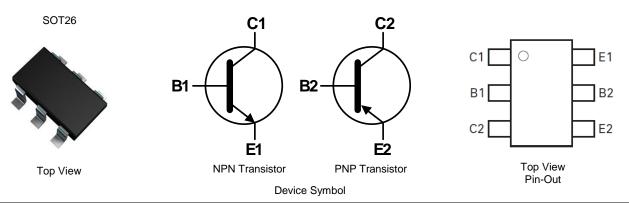
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- Qualified to AEC-Q101 Standards for High Reliability

## **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 208 (3)
- Weight: 0.015 grams (Approximate)

## **Applications**

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



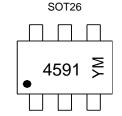
## **Ordering Information** (Note 4)

ĺ	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 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  $\overline{Y}$  = Year (ex: C = 2015) M or  $\overline{M}$  = Month (ex: 9 = September)

Date Code Key

	Year	2015	5 2	016	2017	2018	2019	2020	202	1 20	22 2	2023	2024	2025
	Code	С		D	Е	F	G	Н		,	J	K	L	М
	Montl	h	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ſ	Code	<u>,</u>	1	2	3	4	5	6	7	8	9	0	N	D



## NPN - Absolute Maximum Ratings (@TA = +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	Α
Continuous Collector Current	Ic	1	Α
Base Current	I <sub>B</sub>	500	mA

## PNP - Absolute Maximum Ratings (@TA = +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	Ісм	-2	Α
Continuous Collector Current	Ic	-1	Α
Base Current	I <sub>B</sub>	-500	mA

# Thermal Characteristics (@ $T_A = +25$ °C, unless otherwise specified.)

Characteristic		Symbol	Value	Unit	
Power Dissipation	(Note 6)	D	1.1 8.8	W	
Linear Derating Factor	(Note 7)	P <sub>D</sub>	1.7 13.6	mW/°C	
Thermal Resistance, Junction to Ambient	(Note 6)	Ъ	113	°C/W	
Thermal Resistance, Junction to Ambient	(Note 7)	$R_{ heta JA}$	73	C/VV	
Thermal Resistance, Junction To Lead	$R_{ hetaJL}$	74	°C/W		
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	С

- 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.



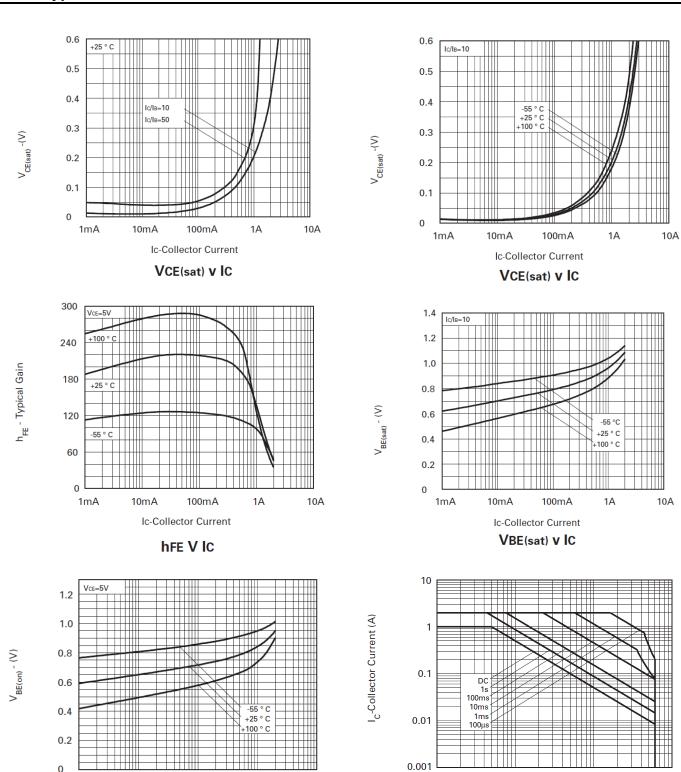
# NPN - Electrical Characteristics (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Min	Тур	Max	Unit	Test Condition
OFF CHARACTERISTICS						
Collector-Base Breakdown Voltage	$BV_{CBO}$	80	_		٧	$I_C = 100\mu A, I_E = 0$
Collector-Emitter Breakdown Voltage (Note 10)	$BV_{CEO}$	60	_		V	$I_C = 10 \text{mA}, I_B = 0$
Emitter-Base Breakdown Voltage	BV <sub>EBO</sub>	7	_	_	V	$I_E = 100 \mu A, I_C = 0$
Collector Cut-Off Current	I <sub>CBO</sub>	_	_	100	nA	$V_{CB} = 60V$
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	$V_{CE} = 60V$
ON CHARACTERISTICS (Note 10)						
DC Current Gain	h <sub>FE</sub>	100 100 80 30		300 —	_	$\begin{split} I_{C} &= 1 \text{mA}, \ V_{CE} = 5 \text{V} \\ I_{C} &= 500 \text{mA}, \ V_{CE} = 5 \text{V} \\ I_{C} &= 1 \text{A}, \ V_{CE} = 5 \text{V} \\ I_{C} &= 2 \text{A}, \ V_{CE} = 5 \text{V} \end{split}$
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	_		0.25 0.5	> >	$I_C = 500$ mA, $I_B = 50$ mA $I_C = 1$ A, $I_B = 100$ mA
Base-Emitter Saturation Voltage	V <sub>BE(sat)</sub>	_	_	1.1	V	$I_C = 1A$ , $I_B = 100mA$
Base-Emitter Turn-On Voltage	$V_{BE(on)}$	_	_	1.0	V	$I_C = 1, V_{CE} = 5V$
SMALL SIGNAL CHARACTERISTICS						
Output Capacitance	$C_{obo}$	_	_	10	pF	$V_{CB} = 10V, f = 1.0MHz$
Current Gain Bandwidth Product	f <sub>T</sub>	180	_	_	MHz	$I_C = 50 \text{mA}, V_{CE} = 10 \text{V}$ f = 100MHz

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



## NPN - Typical Electrical Characteristics (@TA = +25°C, unless otherwise specified.)



10A

1mA

10mA

100mA

**Ic-Collector Current** 

1A

0

0.1

100

10

VcE - Collector Emitter Voltage (V)

Safe Operating Area



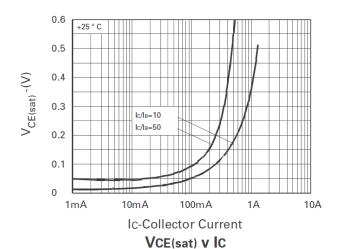
# PNP - Electrical Characteristics (@T<sub>A</sub> = +25°C, unless otherwise specified.)

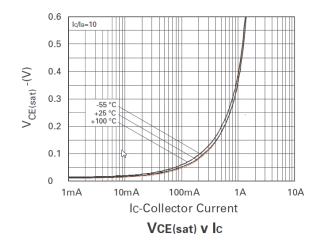
Characteristic	Symbol	Min	Тур	Max	Unit	Test Condition
OFF CHARACTERISTICS						
Collector-Base Breakdown Voltage	$BV_{CBO}$	-80	_	_	V	$I_C = -100\mu A, I_E = 0$
Collector-Emitter Breakdown Voltage (Note 10)	$BV_CEO$	-60	_	_	V	$I_C = -10 \text{mA}, I_B = 0$
Emitter-Base Breakdown Voltage	BV <sub>EBO</sub>	-7	_	_	V	$I_E = -100\mu A, I_C = 0$
Collector Cut-Off Current	I <sub>CBO</sub>	_		-100	nA	$V_{CB} = -60V$
Emitter Cut-Off Current	I <sub>EBO</sub>	_	_	-100	nA	$V_{EB} = -5.6V$
Emitter Cut-Off Current	I <sub>CES</sub>	_	_	-100	nA	V <sub>CE</sub> = -60V
ON CHARACTERISTICS (Note 10)						
DC Current Gain	h <sub>FE</sub>	100 100 80 15		300 —		$\begin{split} I_{C} &= -1 \text{mA, } V_{CE} = -5 \text{V} \\ I_{C} &= -500 \text{mA, } V_{CE} = -5 \text{V} \\ I_{C} &= -1 \text{A, } V_{CE} = -5 \text{V} \\ I_{C} &= -2 \text{A, } V_{CE} = -5 \text{V} \end{split}$
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	_		-0.3 -0.6	>	$I_C = -500 \text{mA}, I_B = -50 \text{mA}$ $I_C = -1 \text{A}, I_B = -100 \text{mA}$
Base-Emitter Saturation Voltage	V <sub>BE(sat)</sub>	_		-1.2	V	$I_C = -1A$ , $I_B = -100mA$
Base-Emitter Turn-On Voltage	$V_{BE(on)}$	_	_	-1.0	V	$I_C = -1A$ , $V_{CE} = -5V$
SMALL SIGNAL CHARACTERISTICS						
Output Capacitance	$C_obo$		_	10	рF	$V_{CB} = -10V, f = 1.0MHz$
Current Gain Bandwidth Product	f <sub>T</sub>	150	_	_	MHz	$I_C = -50 \text{mA}, V_{CE} = -10 \text{V}$ f = 100MHz

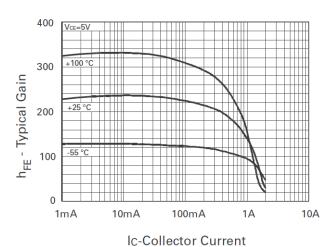
Note: 10. Measured under pulsed conditions. Pulse width  $\leq$  300 $\mu$ s. Duty cycle  $\leq$  2%.

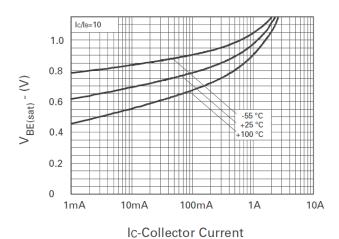


# PNP - Typical Electrical Characteristics (@T<sub>A</sub> = +25°C, unless otherwise specified.)



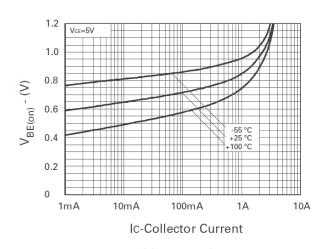


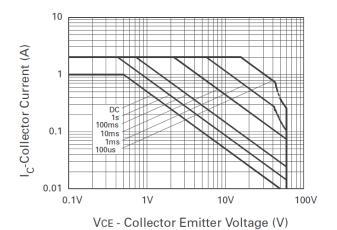




# hFE V IC

## VBE(sat) v Ic





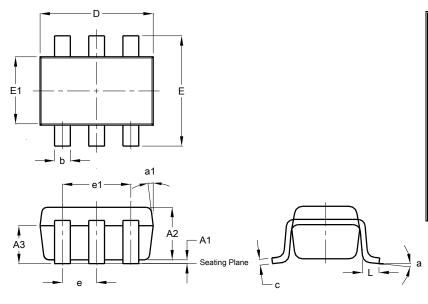
VBE(on) v IC

Safe Operating Area



## **Package Outline Dimensions**

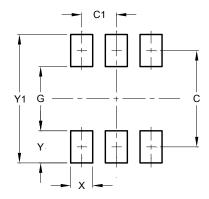
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.



SOT26						
Dim	Min	Max	Тур			
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			
С	0.10	0.20	0.15			
D	2.90	3.10	3.00			
е	-	-	0.95			
e1	-	-	1.90			
Е	2.70	3.00	2.80			
E1	1.50	1.70	1.60			
L	0.35	0.55	0.40			
а	-	-	8°			
a1	-	-	7°			
All	Dimen	sions	in mm			

# **Suggested Pad Layout**

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



Dimensions	Value (in mm)
С	2.40
C1	0.95
G	1.60
Х	0.55
Υ	0.80
Y1	3 20



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