Lead-free Green

# 40V PNP HIGH GAIN LOW SATURATION MEDIUM POWER TRANSISTOR

## Description

This bipolar junction transistor (BJT) is designed to meet the stringent requirement of automotive applications.

## Mechanical Data

- Case: SOT89
- Case Material: Molded Plastic. "Green" Molding Compound. UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish—Matte Tin Plated Leads. Solderable per MIL-STD-202, Method 208 (e3)
- Weight: 0.05 grams (Approximate)

## Features

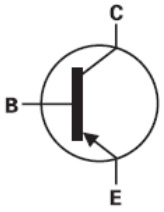
- $BV_{CEO}$ > -40V
- $I_C$ = -5.5A Continuous Collector Current
- $I_{CM}$ = -15A Peak Pulse Current
- Very Low Saturation Voltage $V_{CE(SAT)}$ < -60mV max @ -1A
- $R_{SAT}$ = 29mΩ @ -5.5A for Low Equivalent On-Resistance
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

## Applications

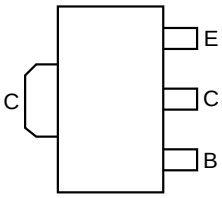
- DC-DC Converters
- MOSFET Gate Drivers
- Charging Circuits
- Power Switches
- Motor Control

**SOT89**

Top View




Device Schematic




Pin-Out Top View

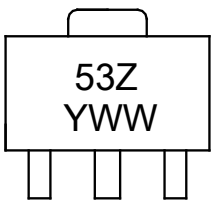
## Ordering Information (Notes 4 and 5)

| Part Number | Marking | Reel Size (inches) | Tape Width (mm) | Quantity per Reel |
|---|---|---|---|---|
| ZXTP2009ZQTA | 53Z | 7 | 12 | 1000 |

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ 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. Automotive products are AEC-Q10x qualified and are PPAP capable. Refer to https://www.diodes.com/quality/.
5. For packaging details, go to our website at http://www.diodes.com/products/packages.html.

## Marking Information

SOT89




53Z = Product Type Marking Code
YWW = Date Code Marking
Y = Last digit of year (ex: 8 = 2018)
WW = Week code (01 – 53)

## Absolute Maximum Ratings (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Base Voltage | $V_{CBO}$ | -50 | V |
| Collector-Base Voltage | $V_{CBS}$ | -50 | V |
| Collector-Emitter Voltage | $V_{CEO}$ | -40 | V |
| Emitter-Base Voltage | $V_{EBO}$ | -7 | V |
| Continuous Collector Current | $I_C$ | -5.5 | A |
| Peak Pulse Current | $I_{CM}$ | -15 | A |

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

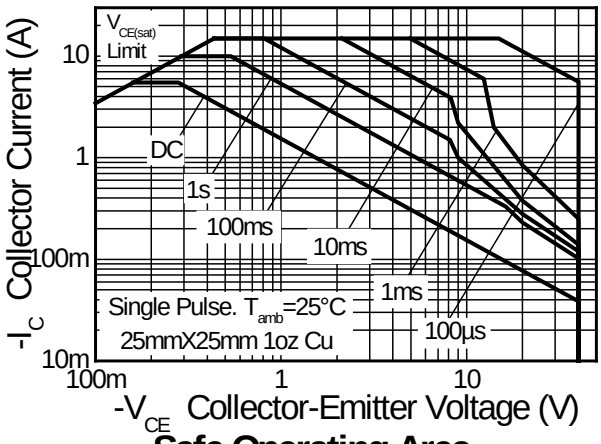
| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Power Dissipation<br>Linear Derating Factor | (Note 6) | $P_D$ | 0.9<br>7.2 | W<br>mW/°C |
| | (Note 7) | | 1.5<br>12 | |
| | (Note 8) | | 2.1<br>16.8 | |
| | (Note 9) | | 3<br>24 | |
| Thermal Resistance, Junction to Ambient | (Note 6) | $R_{\Theta JA}$ | 139 | °C/W |
| | (Note 7) | — | 83 | |
| | (Note 8) | — | 60 | |
| | (Note 9) | $R_{\Theta JA}$ | 42 | |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +150 | °C |

## ESD Ratings (Note 10)

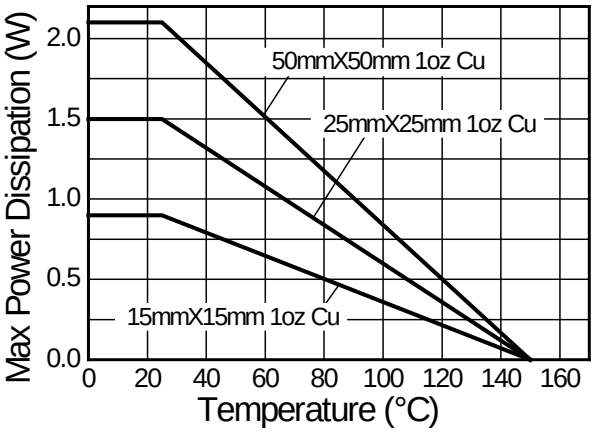
| Characteristic | Symbol | Value | Unit | JEDEC Class |
|---|---|---|---|---|
| Electrostatic Discharge—Human Body Model | ESD HBM | 4000 | V | 3A |
| Electrostatic Discharge—Machine Model | ESD MM | 400 | V | C |

Notes:
6. For a device mounted with the collector lead on 15mm × 15mm 1oz copper that is on a single-sided 1.6mm FR-4 PCB; device is measured under still air conditions whilst operating in steady-state.
7. Same as Note 6, except the device is mounted on 25mm × 25mm 1oz copper.
8. Same as Note 6, except the device is mounted on 50mm × 50mm 1oz copper.
9. Same as Note 6, except the device is mounted on 25mm × 25mm measured at t<5 secs.
10. Refer to JEDEC specification JESD22-A114 and JESD22-A115.

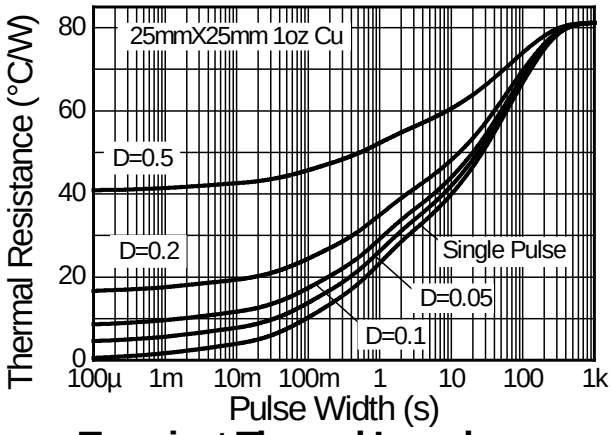
## Thermal Characteristics and Derating Information



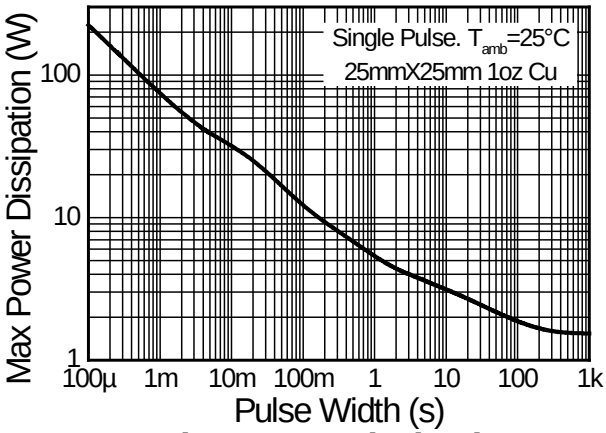

**Safe Operating Area**




**Derating Curve**




**Transient Thermal Impedance**



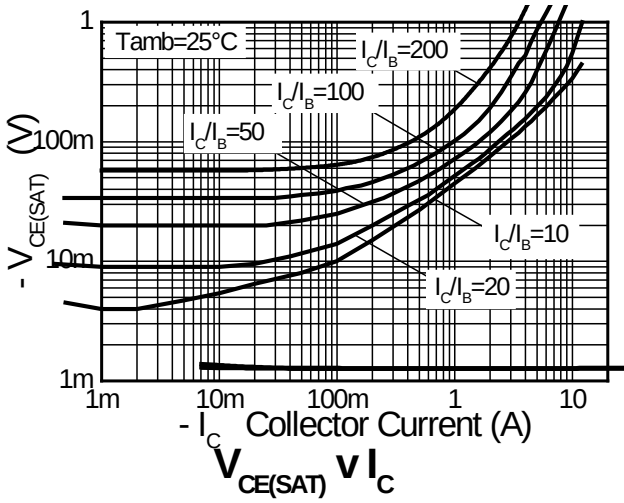

**Pulse Power Dissipation**

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

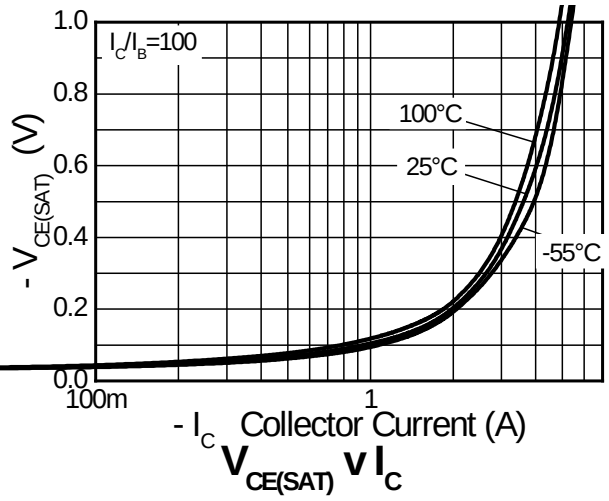
| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| Collector-Base Breakdown Voltage | $BV_{CBO}$ | -50 | -90 | — | V | $I_C$ = -100µA |
| Collector-Emitter Breakdown Voltage | $BV_{CER}$ | -50 | -90 | — | V | $I_C$ = -1µA, $R_B \leq 1k\Omega$ |
| Collector-Emitter Breakdown Voltage (Note 11) | $BV_{CEO}$ | -40 | -58 | — | V | $I_C$ = -10mA |
| Emitter-Base Breakdown Voltage | $BV_{EBO}$ | -7.5 | -8.3 | — | V | $I_E$ = -100µA |
| Collector Cutoff Current | $I_{CBO}$ | — | < -1 | -20 | nA | $V_{CB}$ = -40V |
| Collector Cutoff Current | $I_{CES}$ | — | < -1 | -20 | nA | $V_{CB}$ = -32V |
| Emitter Cutoff Current | $I_{EBO}$ | — | < -1 | -20 | nA | $V_{EB}$ = -6V |
| Collector-Emitter Saturation Voltage (Note 11) | $V_{CE(SAT)}$ | — | -15<br>-44<br>-50<br>-120<br>-70<br>-125<br>-130<br>-162 | -30<br>-60<br>-70<br>-165<br>-80<br>-175<br>-175<br>-185 | mV | $I_C$ = -0.1A, $I_B$ = -10mA<br>$I_C$ = -1A, $I_B$ = -100mA<br>$I_C$ = -1A, $I_B$ = -50mA<br>$I_C$ = -1A, $I_B$ = -10mA<br>$I_C$ = -2A, $I_B$ = -200mA<br>$I_C$ = -2A, $I_B$ = -40mA<br>$I_C$ = -3.5A, $I_B$ = -175mA<br>$I_C$ = -5.5A, $I_B$ = -550mA |
| Base-Emitter Saturation Voltage (Note 11) | $V_{BE(SAT)}$ | — | -820<br>-1000 | -900<br>-1075 | mV | $I_C$ = -2A, $I_B$ = -40mA<br>$I_C$ = -5.5A, $I_B$ = -550mA |
| Base-Emitter Turn-On Voltage (Note 11) | $V_{BE(ON)}$ | — | -778<br>-869 | -850<br>-950 | mV | $I_C$ = -2A, $V_{CE}$ = -2V<br>$I_C$ = -5.5A, $V_{CE}$ = -2V |
| DC Current Gain (Note 11) | $h_{FE}$ | 200<br>200<br>170<br>110 | 390<br>350<br>290<br>175 | 550 | — | $I_C$ = -10mA, $V_{CE}$ = -2V<br>$I_C$ = -0.5A, $V_{CE}$ = -2V<br>$I_C$ = -2A, $V_{CE}$ = -2V<br>$I_C$ = -5.5A, $V_{CE}$ = -2V |
| Transition Frequency | $f_T$ | — | 152 | — | MHz | $V_{CE}$ = -10V, $I_C$ = -50mA, f = 100MHz |
| Output Capacitance (Note 11) | $C_{OBO}$ | — | 53 | — | pF | $V_{CB}$ = -10V, f = 1MHz |
| Switching Times | $t_d$ | — | 18 | — | ns | $V_{CC}$ = -10V, $I_C$ = -1A, $I_{B1}$ = -$I_{B2}$ = -100mA |
| | $t_r$ | — | 17 | — | | |
| | $t_s$ | — | 325 | | | |
| | $t_r$ | — | 60 | — | | |
| Switching Times | $t_d$ | — | 55 | — | ns | $V_{CC}$ = -30V, $I_C$ = -2A, $I_{B1}$ = -$I_{B2}$ = -20mA |
| | $t_r$ | — | 107 | — | | |
| | $t_s$ | — | 264 | — | | |
| | $t_r$ | — | 103 | — | | |

Note: 11. Measured under pulsed conditions. Pulse width ≤ 300µs. Duty cycle ≤ 2%.

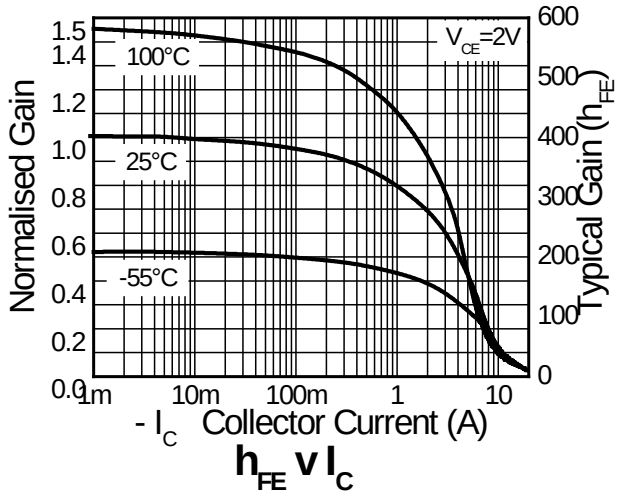
## Typical Electrical Characteristics (@$T_A$ = +25°C, unless otherwise specified.)



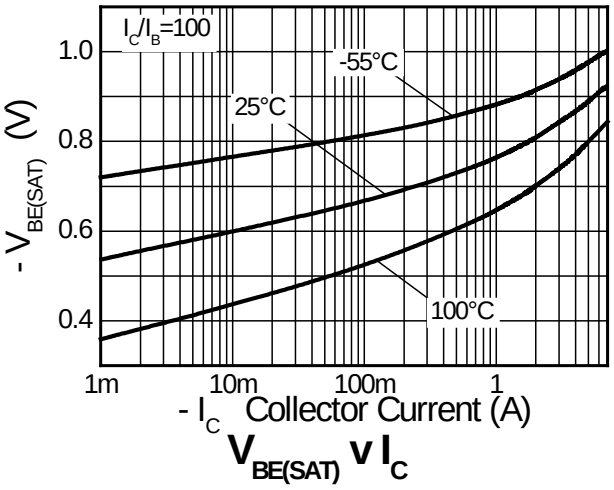

$V_{CE(SAT)}$ v $I_C$



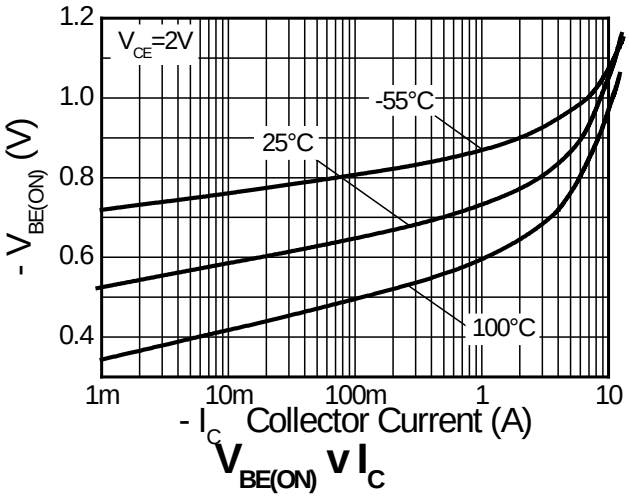

$V_{CE(SAT)}$ v $I_C$




$h_{FE}$ v $I_C$




$V_{BE(SAT)}$ v $I_C$

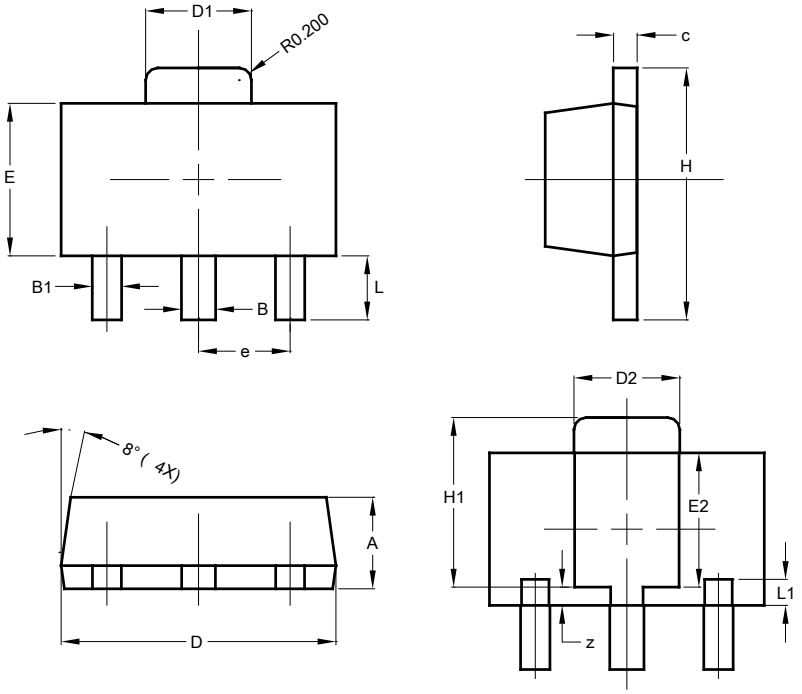



$V_{BE(ON)}$ v $I_C$

## Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

**SOT89**

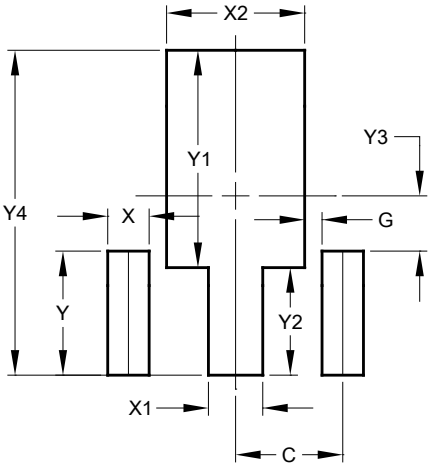



| SOT89 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 1.40 | 1.60 | 1.50 |
| **B** | 0.50 | 0.62 | 0.56 |
| **B1** | 0.42 | 0.54 | 0.48 |
| **c** | 0.35 | 0.43 | 0.38 |
| **D** | 4.40 | 4.60 | 4.50 |
| **D1** | 1.62 | 1.83 | 1.733 |
| **D2** | 1.61 | 1.81 | 1.71 |
| **E** | 2.40 | 2.60 | 2.50 |
| **E2** | 2.05 | 2.35 | 2.20 |
| **e** | — | — | 1.50 |
| **H** | 3.95 | 4.25 | 4.10 |
| **H1** | 2.63 | 2.93 | 2.78 |
| **L** | 0.90 | 1.20 | 1.05 |
| **L1** | 0.327 | 0.527 | 0.427 |
| **z** | 0.20 | 0.40 | 0.30 |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

**SOT89**




| Dimensions | Value (in mm) |
|---|---|
| **C** | 1.500 |
| **G** | 0.244 |
| **X** | 0.580 |
| **X1** | 0.760 |
| **X2** | 1.933 |
| **Y** | 1.730 |
| **Y1** | 3.030 |
| **Y2** | 1.500 |
| **Y3** | 0.770 |
| **Y4** | 4.530 |

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