

## Excellent Integrated System Limited

Stocking Distributor

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[Diodes Incorporated](#)  
[2N7002K-7](#)

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### Product Summary

| $V_{(BR)DSS}$ | $R_{DS(ON) \text{ max}}$ | $I_D \text{ max}$<br>$T_A = +25^\circ\text{C}$ |
|---------------|--------------------------|--|
| 60V           | $2\Omega @ V_{GS} = 10V$ | 380mA  |
|               | $3\Omega @ V_{GS} = 5V$  | 310mA  |

### Description

This MOSFET has been designed to minimize the on-state resistance ( $R_{DS(on)}$ ) and yet maintain superior switching performance, making it ideal for high efficiency power management applications.

### Applications

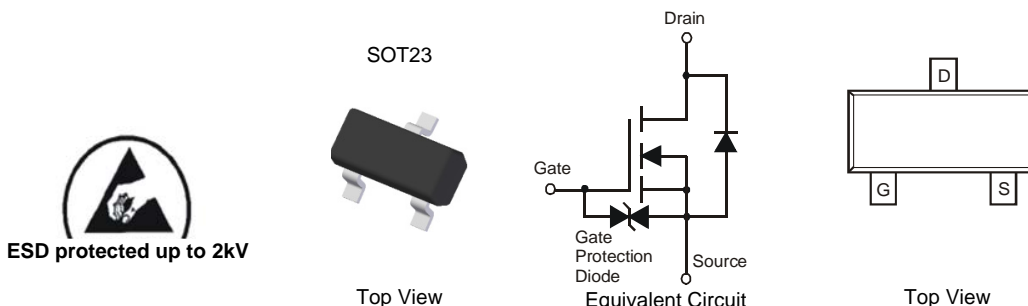
- Motor Control
- Power Management Functions
- Backlighting

### Features and Benefits

- Low On-Resistance
- Low Input Capacitance
- Fast Switching Speed
- Low Input/Output Leakage
- **ESD Protected Up To 2kV**
- **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: SOT23
- 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 annealed over Alloy 42 leadframe. Solderable per MIL-STD-202, Method 208 <sup>e3</sup>
- Weight: 0.008 grams (approximate)

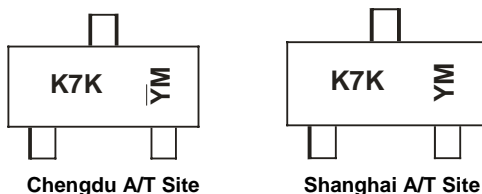


### Ordering Information (Note 4)

| Part Number | Compliance | Case  | Packaging         |
|-------------|------------|-------|-------------------|
| 2N7002K-7   | Standard   | SOT23 | 3000/Tape & Reel  |
| 2N7002KQ-7  | Automotive | SOT23 | 3000/Tape & Reel  |
| 2N7002K-13  | Standard   | SOT23 | 10000/Tape & Reel |
| 2N7002KQ-13 | Automotive | SOT23 | 10000/Tape & Reel |

- 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



K7K = Product Type Marking Code  
 YM = Date Code Marking for SAT (Shanghai Assembly/ Test site)  
 YM = Date Code Marking for CAT (Chengdu Assembly/ Test site)  
 Y or Y = Year (ex: A = 2013)  
 M = Month (ex: 9 = September)

#### Date Code Key

| Year  | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| Code  | T    | U    | V    | W    | X    | Y    | Z    | A    | B    | C    | D    | E    |
| 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    |

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

| Characteristic  |  | Symbol           | Value      | Units |
|---|--|------------------|------------|-------|
| Drain-Source Voltage  |  | V <sub>DSS</sub> | 60         | V     |
| Gate-Source Voltage   |  | V <sub>GSS</sub> | ±20        | V     |
| Continuous Drain Current (Note 6) V <sub>GS</sub> = 10V     | Steady State<br>T <sub>A</sub> = +25°C<br>T <sub>A</sub> = +70°C | I <sub>D</sub>   | 380<br>300 | mA    |
|   | t < 5s<br>T <sub>A</sub> = +25°C<br>T <sub>A</sub> = +70°C       | I <sub>D</sub>   | 430<br>340 | mA    |
| Continuous Drain Current (Note 6) V <sub>GS</sub> = 5V      | Steady State<br>T <sub>A</sub> = +25°C<br>T <sub>A</sub> = +70°C | I <sub>D</sub>   | 310<br>240 | mA    |
|   | t < 5s<br>T <sub>A</sub> = +25°C<br>T <sub>A</sub> = +70°C       | I <sub>D</sub>   | 350<br>270 | mA    |
| Maximum Continuous Body Diode Forward Current (Note 6)      |  | I <sub>S</sub>   | 0.5        | A     |
| Pulsed Drain Current (10µs pulse, duty cycle = 1%) (Note 6) |  | I <sub>DM</sub>  | 1.2        | A     |

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

| Characteristic                                   |              | Symbol                            | Value       | Units |
|--|--------------|-----------------------------------|-------------|-------|
| Total Power Dissipation (Note 5)                 |              | P <sub>D</sub>                    | 370         | mW    |
| Thermal Resistance, Junction to Ambient (Note 5) | Steady State | R <sub>θJA</sub>                  | 357         | °C/W  |
|  | t < 5s       |                                   | 292         |       |
| Total Power Dissipation (Note 6)                 |              | P <sub>D</sub>                    | 540         | mW    |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady State | R <sub>θJA</sub>                  | 240         | °C/W  |
|  | t < 5s       |                                   | 197         |       |
| Thermal Resistance, Junction to Case (Note 6)    |              | R <sub>θJC</sub>                  | 91          |       |
| Operating and Storage Temperature Range          |              | T <sub>J</sub> , T <sub>STG</sub> | -55 to +150 | °C    |

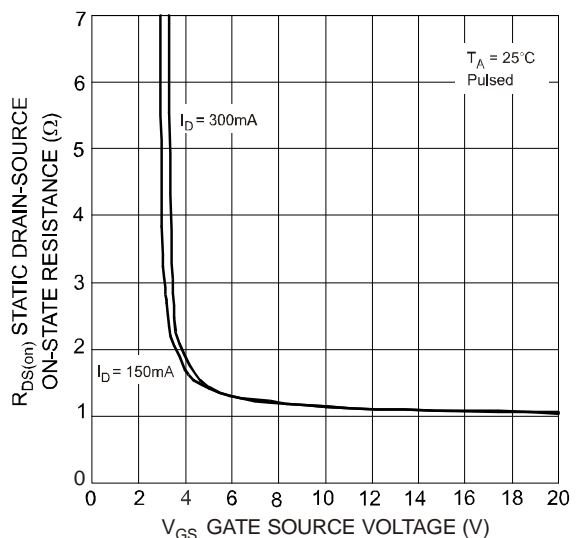
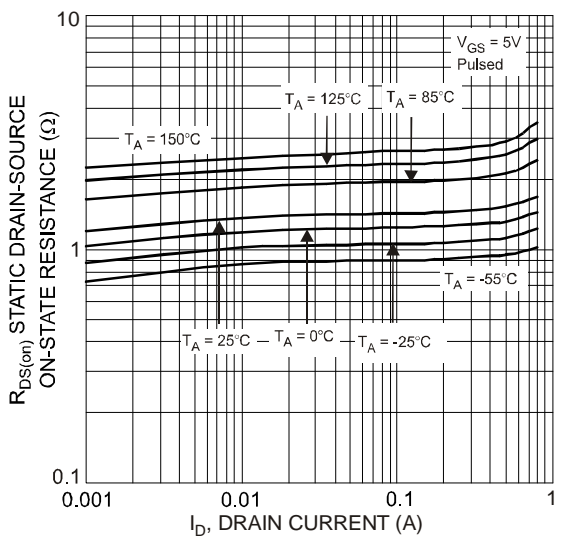
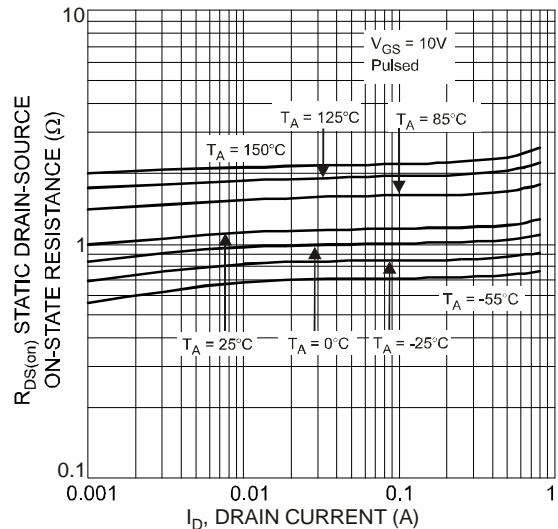
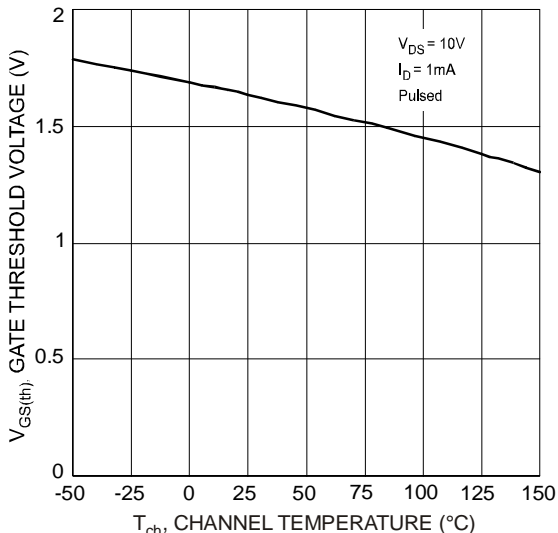
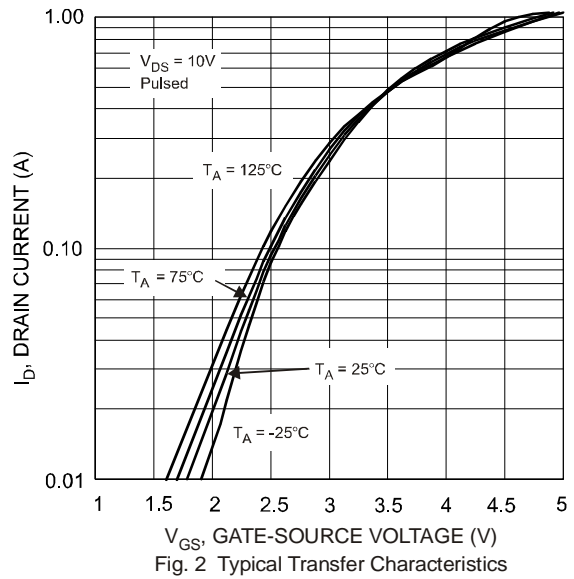
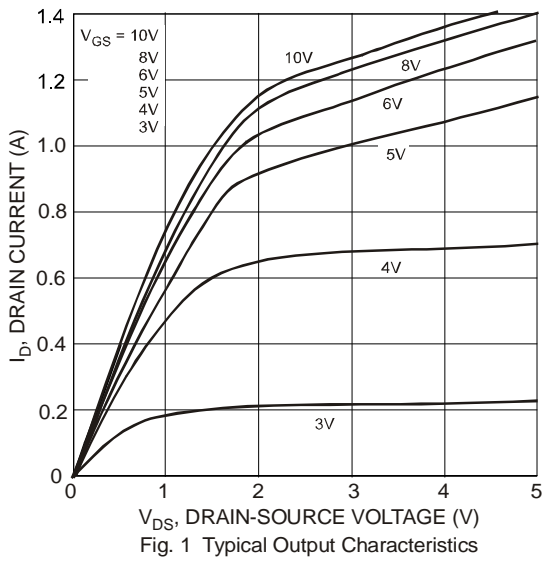
**Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                          | Symbol              | Min | Typ  | Max | Unit | Test Condition  |
|---|---------------------|-----|------|-----|------|---|
| <b>OFF CHARACTERISTICS (Note 7)</b>     |                     |     |      |     |      |   |
| Drain-Source Breakdown Voltage          | BV <sub>DSS</sub>   | 60  | —    | —   | V    | V <sub>GS</sub> = 0V, I <sub>D</sub> = 10µA   |
| Zero Gate Voltage Drain Current         | I <sub>DSS</sub>    | —   | —    | 1.0 | µA   | V <sub>DS</sub> = 60V, V <sub>GS</sub> = 0V   |
| Gate-Source Leakage                     | I <sub>GSS</sub>    | —   | —    | ±10 | µA   | V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V  |
| <b>ON CHARACTERISTICS (Note 7)</b>      |                     |     |      |     |      |   |
| Gate Threshold Voltage                  | V <sub>GS(th)</sub> | 1.0 | 1.6  | 2.5 | V    | V <sub>DS</sub> = 10V, I <sub>D</sub> = 1mA   |
| Static Drain-Source On-Resistance       | R <sub>DS(on)</sub> | —   | —    | 2.0 | Ω    | V <sub>GS</sub> = 10V, I <sub>D</sub> = 0.5A  |
|   |                     |     |      | 3.0 |      | V <sub>GS</sub> = 5V, I <sub>D</sub> = 0.05A  |
| Forward Transfer Admittance             | Y <sub>fs</sub>     | 80  | —    | —   | ms   | V <sub>DS</sub> = 10V, I <sub>D</sub> = 0.2A  |
| Diode Forward Voltage                   | V <sub>SD</sub>     | —   | 0.75 | 1.1 | V    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 115mA  |
| <b>DYNAMIC CHARACTERISTICS (Note 8)</b> |                     |     |      |     |      |   |
| Input Capacitance                       | C <sub>iss</sub>    | —   | 30   | 50  | pF   | V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V<br>f = 1.0MHz                                     |
| Output Capacitance                      | C <sub>oss</sub>    | —   | 4.2  | 25  | pF   |   |
| Reverse Transfer Capacitance            | C <sub>rss</sub>    | —   | 2.9  | 5.0 | pF   | f = 1MHz, V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V  |
| Gate Resistance                         | R <sub>g</sub>      | —   | 133  | —   | Ω    |   |
| Total Gate Charge                       | Q <sub>g</sub>      | —   | 0.3  | —   | nC   | V <sub>GS</sub> = 4.5V, V <sub>DS</sub> = 10V,<br>I <sub>D</sub> = 250mA                      |
| Gate-Source Charge                      | Q <sub>gs</sub>     | —   | 0.2  | —   | nC   |   |
| Gate-Drain Charge                       | Q <sub>gd</sub>     | —   | 0.08 | —   | nC   |   |
| Turn-On Delay Time                      | t <sub>D(on)</sub>  | —   | 3.9  | —   | ns   | V <sub>DD</sub> = 30V, V <sub>GS</sub> = 10V,<br>R <sub>G</sub> = 25Ω, I <sub>D</sub> = 200mA |
| Turn-On Rise Time                       | t <sub>r</sub>      | —   | 3.4  | —   | ns   |   |
| Turn-Off Delay Time                     | t <sub>D(off)</sub> | —   | 15.7 | —   | ns   |   |
| Turn-Off Fall Time                      | t <sub>f</sub>      | —   | 9.9  | —   | ns   |   |

- Notes:
- Device mounted on FR-4 PCB, with minimum recommended pad layout
  - Device mounted on 1" x 1" FR-4 PCB with high coverage 2oz. Copper, single sided.
  - Short duration pulse test used to minimize self-heating effect.
  - Guaranteed by design. Not subject to product testing.



**2N7002K**





**2N7002K**

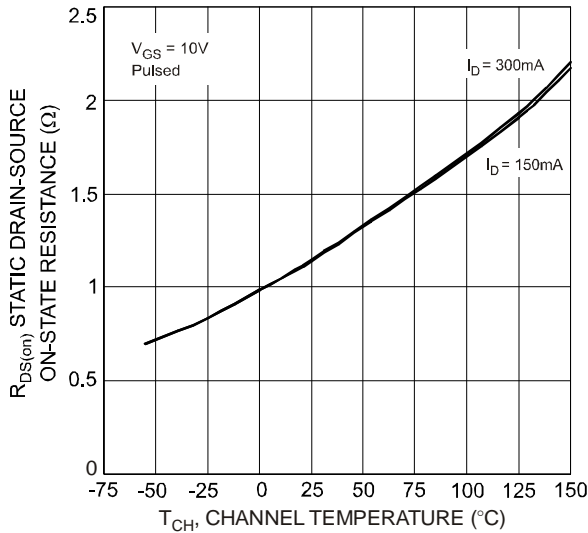


Fig. 7 Static Drain-Source On-State Resistance vs. Channel Temperature

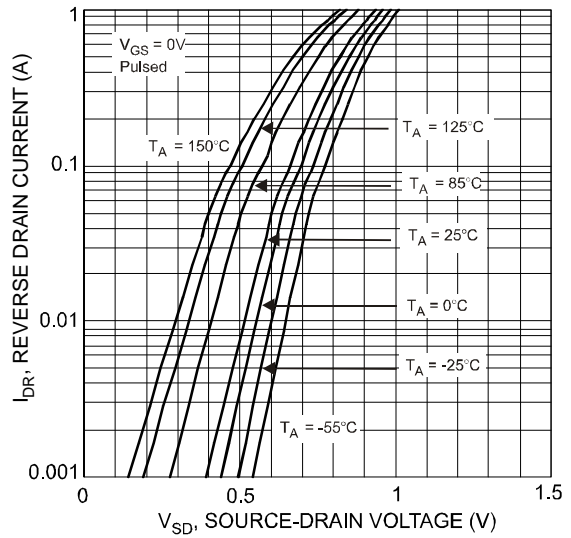


Fig. 8 Reverse Drain Current vs. Source-Drain Voltage

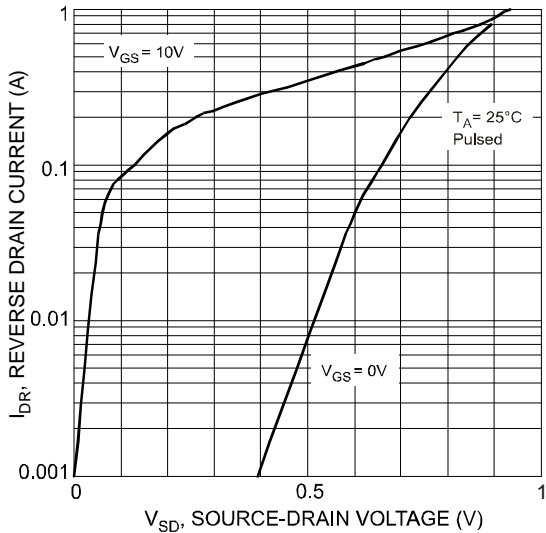


Fig. 9 Reverse Drain Current vs. Source-Drain Voltage

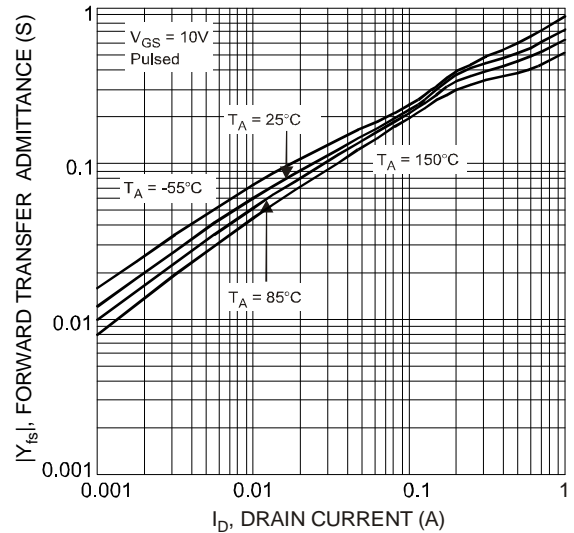


Fig. 10 Forward Transfer Admittance vs. Drain Current

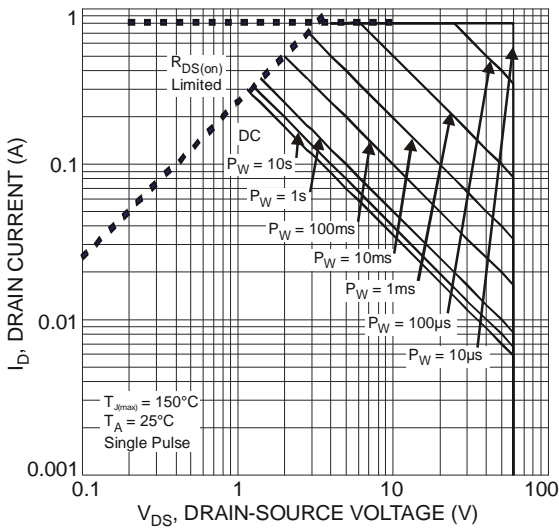


Fig. 11 Safe Operation Area

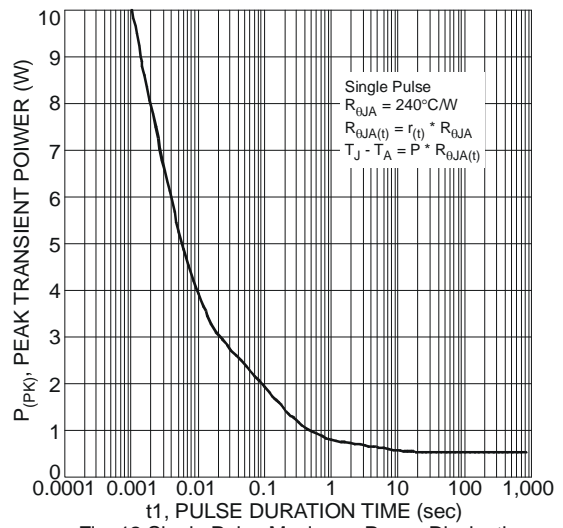
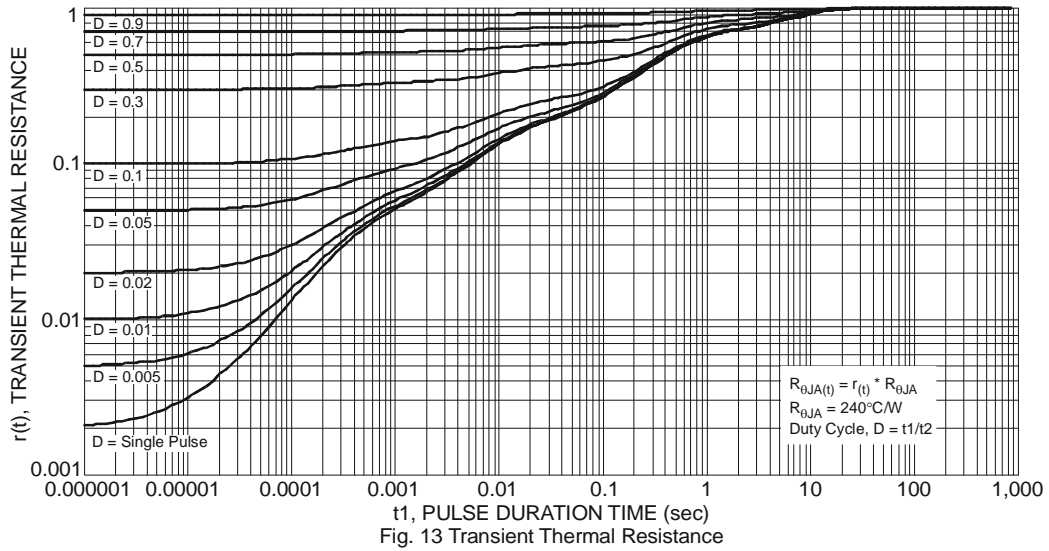
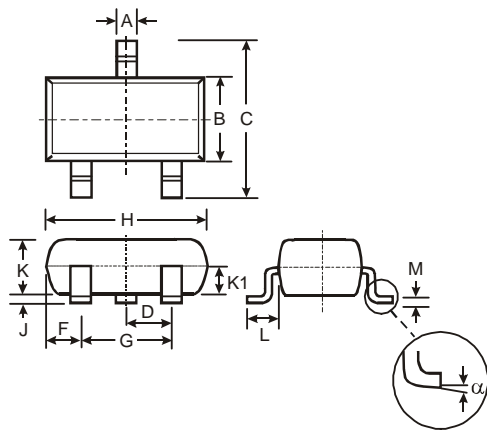


Fig. 12 Single Pulse Maximum Power Dissipation



**Package Outline Dimensions**

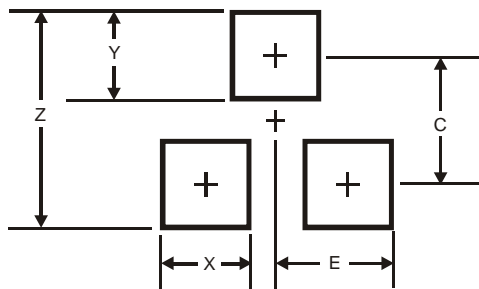
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.



| SOT23                |       |      |       |
|----------------------|-------|------|-------|
| Dim                  | Min   | Max  | Typ   |
| A                    | 0.37  | 0.51 | 0.40  |
| B                    | 1.20  | 1.40 | 1.30  |
| C                    | 2.30  | 2.50 | 2.40  |
| D                    | 0.89  | 1.03 | 0.915 |
| F                    | 0.45  | 0.60 | 0.535 |
| G                    | 1.78  | 2.05 | 1.83  |
| H                    | 2.80  | 3.00 | 2.90  |
| J                    | 0.013 | 0.10 | 0.05  |
| K                    | 0.903 | 1.10 | 1.00  |
| K1                   | -     | -    | 0.400 |
| L                    | 0.45  | 0.61 | 0.55  |
| M                    | 0.085 | 0.18 | 0.11  |
| α                    | 0°    | 8°   | -     |
| 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) |
|------------|---------------|
| Z          | 2.9           |
| X          | 0.8           |
| Y          | 0.9           |
| C          | 2.0           |
| E          | 1.35          |

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