## Product Summary

| $V_{(BR)DSS}$ | $R_{DS(on)TYP}$ | $I_D$ |
|---|---|---|
| 60V | 1.6Ω@10V | 300mA |
| | 1.8Ω@4.5V | |

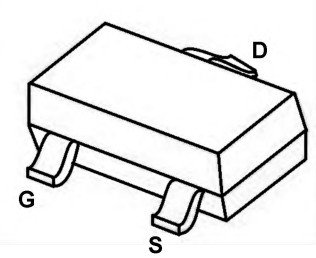
## Feature

- High power and current handing capability
- Surface mount package
- ESD protected 2KV

## Application

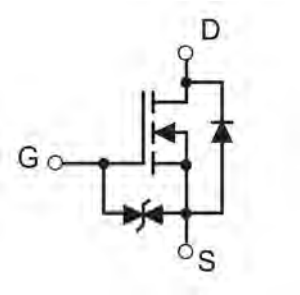
- Battery Switch
- DC/DC Converter

## Package

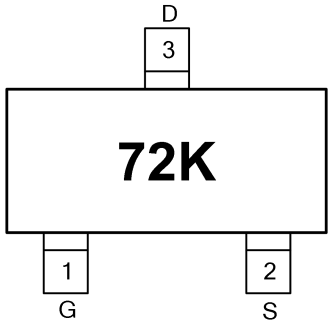



SOT-23

## Circuit diagram




## Marking




72K :Device Code

## Order Information

| Device | Package | Unit/Tape |
|---|---|---|
| 2N7002BK-CN | SOT-23 | 3000 |

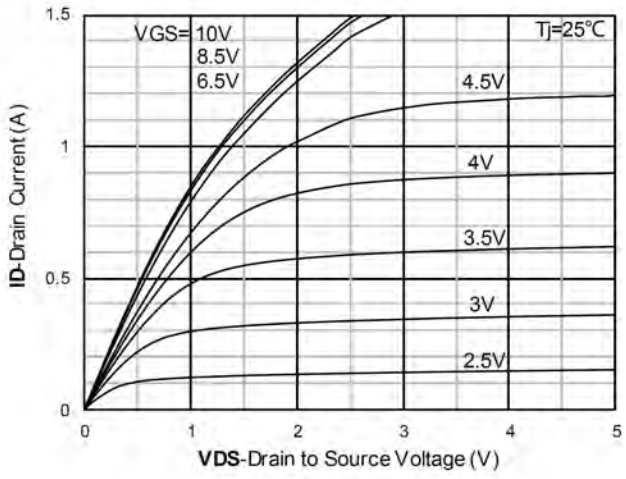
## Absolute maximum ratings (Ta=25℃, unless otherwise noted)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DSS}$ | 60 | V |
| Gate-Source Voltage | $V_{GSS}$ | ±20 | V |
| Continuous Drain Current (Ta=25℃) | $I_D$ | 300 | mA |
| Continuous Drain Current (Ta=100℃) | $I_D$ | 200 | mA |
| Pulse Drain Current Tested | $I_{DM}$ | 1200 | mA |
| Power Dissipation (Ta=25℃) | $P_D$ | 350 | mW |
| Power Dissipation (Ta=100℃) | $P_D$ | 140 | mW |
| Thermal Resistance Junction-to-Ambient | $R_{\theta JA}$ | 357 | °C/W |
| Storage Temperature Range | $T_{STG}$ | -55 to 150 | °C |
| Operating Junction Temperature Range | $T_J$ | -55 to 150 | °C |

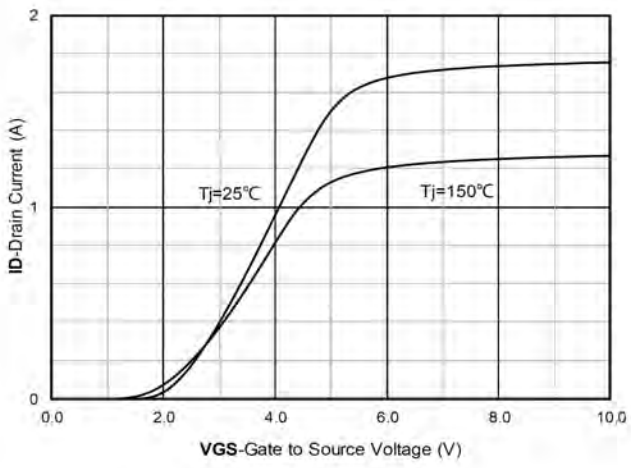
## Electrical characteristics (Ta=25℃, unless otherwise noted)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | VGS=0V , ID=250μA | 60 | - | - | V |
| Drain-Source Leakage Current | $I_{DSS}$ | VDS=48V , VGS=0V | - | - | 1 | uA |
| Gate-Source Leakage Current | $I_{GSS}$ | VGS=±20V , VDS=0V | - | - | ±10 | uA |
| Gate Threshold Voltage | $V_{GS(th)}$ | VDS=VGS , ID=250μA | 1 | 1.6 | 2.2 | V |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | VGS=10V , ID=200mA | - | 1.6 | 2 | Ω |
| | | VGS=4.5V , ID=200mA | - | 1.8 | 2.4 | |
| **Dynamic characteristics** | | | | | | |
| Input Capacitance | $C_{iss}$ | VDS=30V , VGS=0V , f=1MHz | - | 28 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 10 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 5 | - | |
| Total Gate Charge | $Q_g$ | VDS=30V , VGS=10V , ID=300mA | - | 1.7 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 0.35 | - | |
| Gate-Drain Charge | $Q_{gd}$ | | - | 0.5 | - | |
| Gate Plateau Voltage | $V_{plateau}$ | | - | 3.2 | - | V |
| **Switching Characteristics** | | | | | | |
| Turn-On Delay Time | $t_{d(on)}$ | VDD=30V , VGS=10V , RG=25Ω , ID=300mA | - | 3 | - | nS |
| Turn-On Rise Time | $t_r$ | | - | 17 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 10 | - | |
| Turn-Off Fall Time | $t_f$ | | - | 21 | - | |
| **Source-Drain Diode characteristics** | | | | | | |
| Diode Forward Voltage | $V_{SD}$ | VGS=0V , IS=1A , TJ=25℃ | - | - | 1.2 | V |

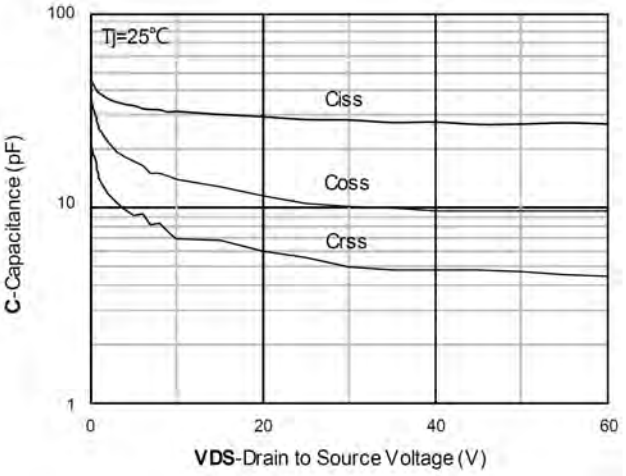
## Typical Characteristics



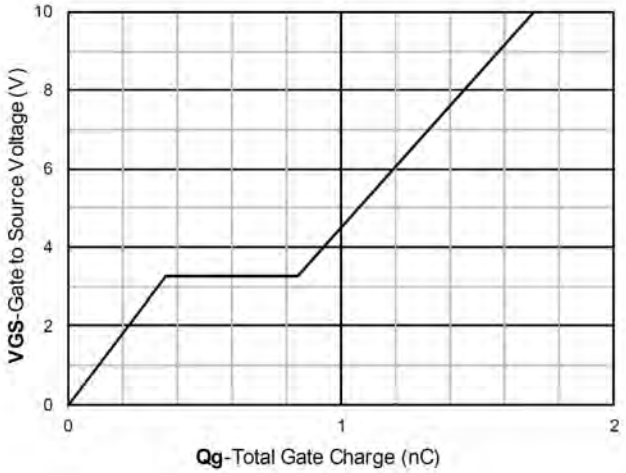

Output Characteristics



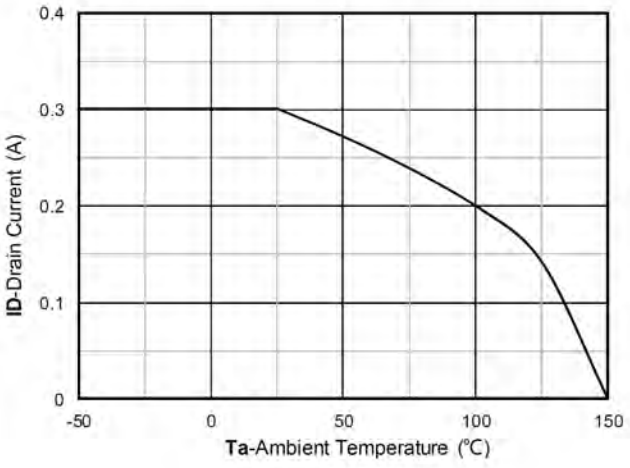

Transfer Characteristics



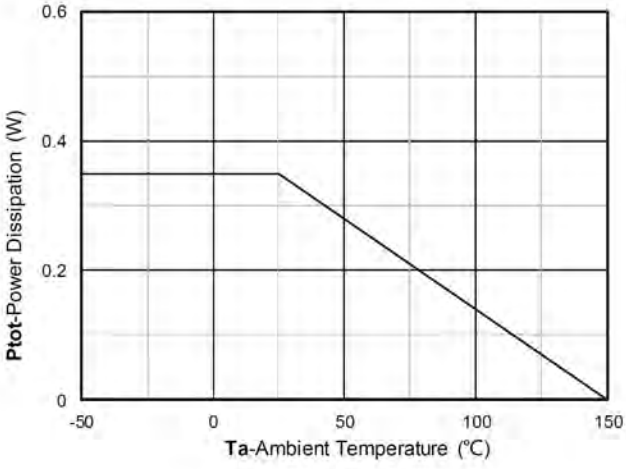

Capacitance Characteristics



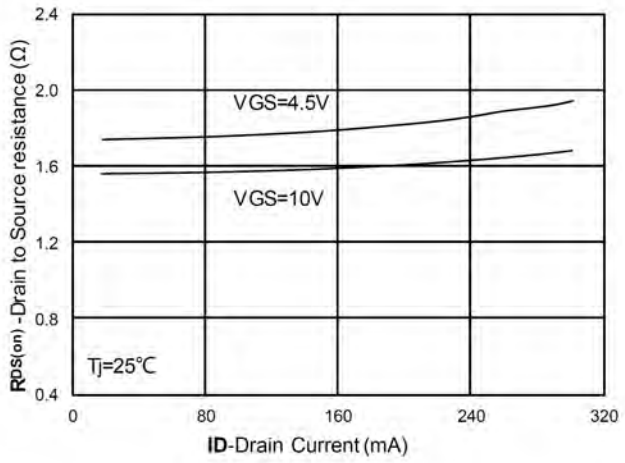

Gate Charge



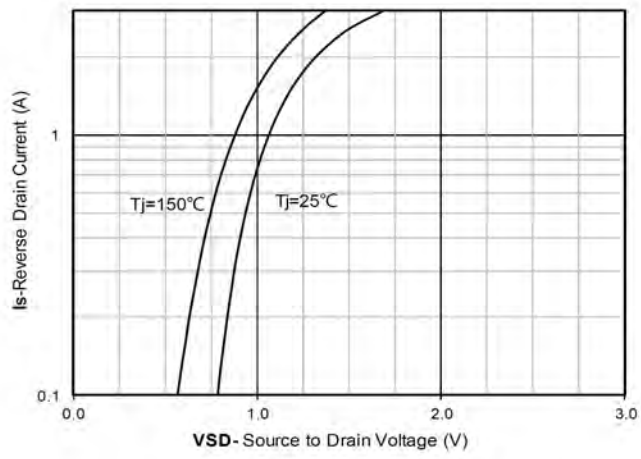

Current dissipation



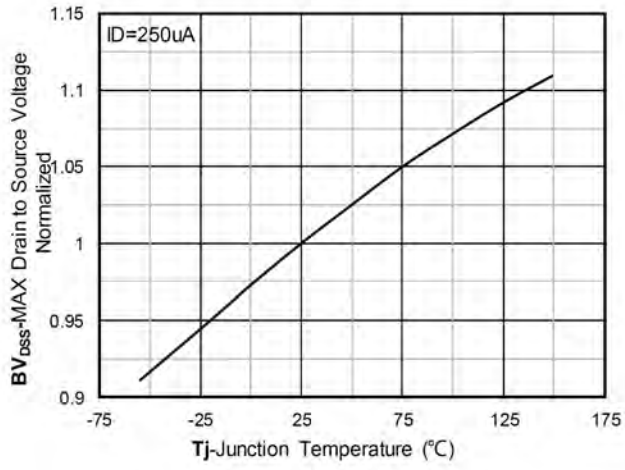

Power dissipation



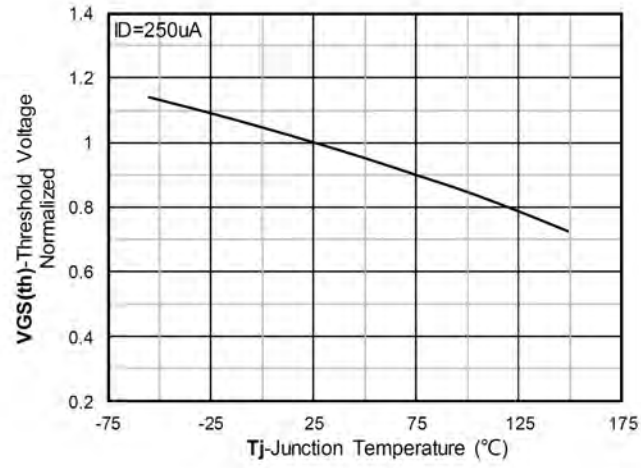

RDS(on) VS Drain Current



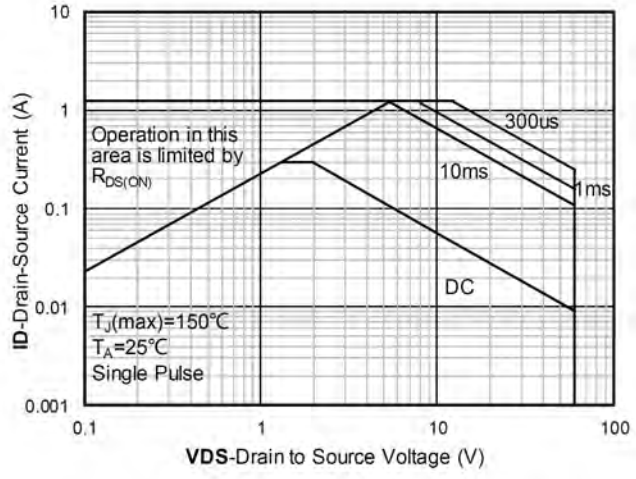

Forward characteristics of reverse diode



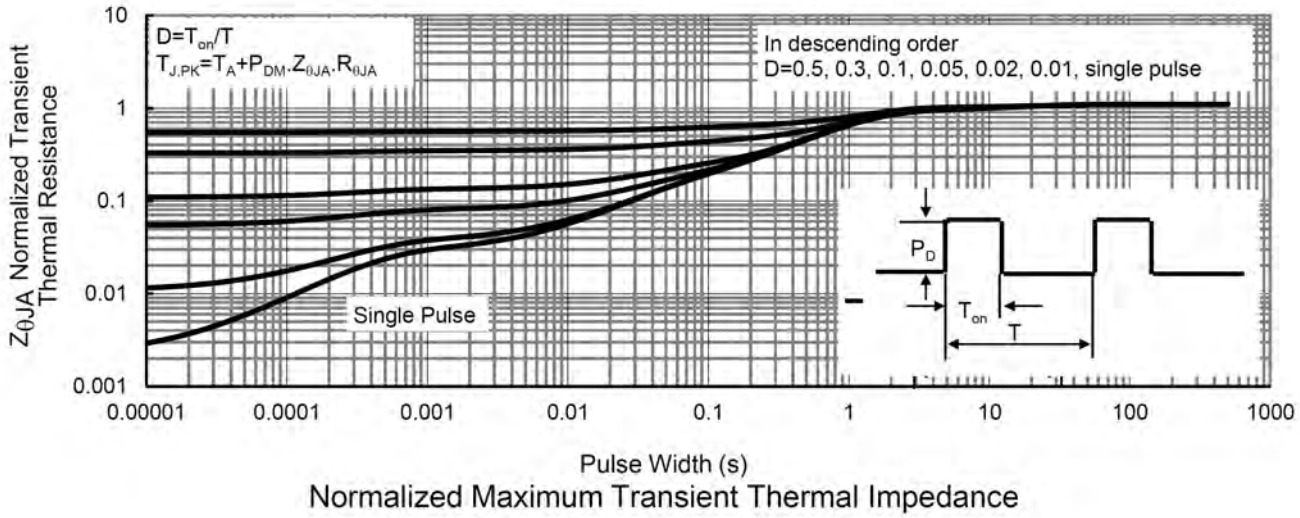

Normalized breakdown voltage




Normalized Threshold voltage

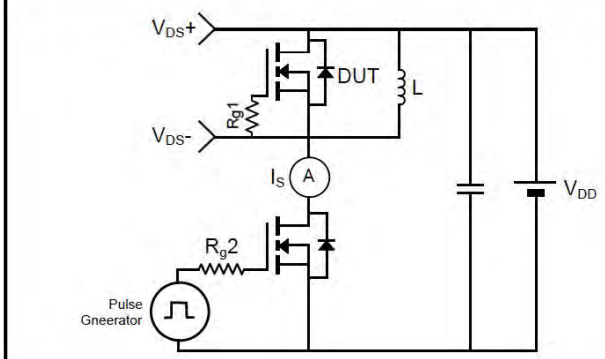


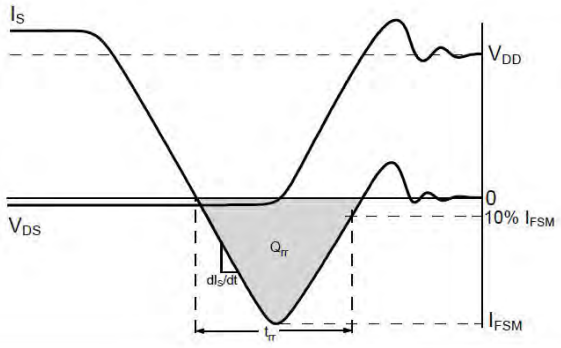

Safe Operation Area




Normalized Maximum Transient Thermal Impedance

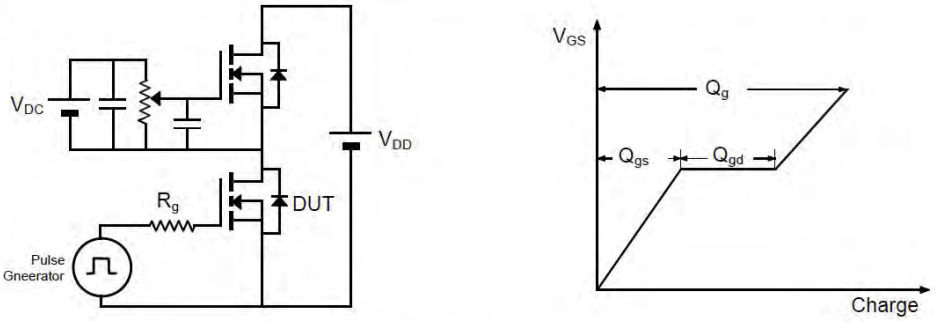
**Drain-Source Body Diode Reverse Recovery**



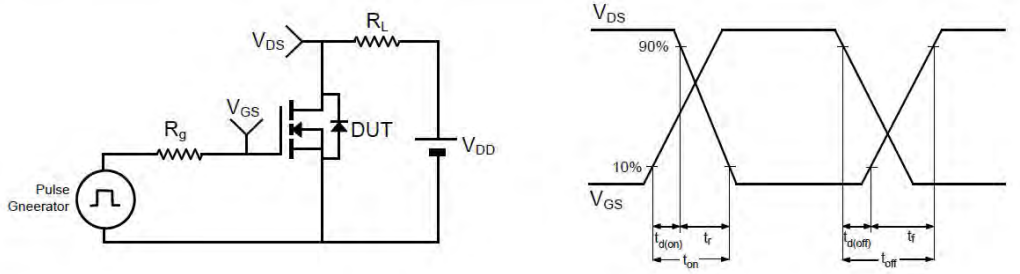



## Test Circuit

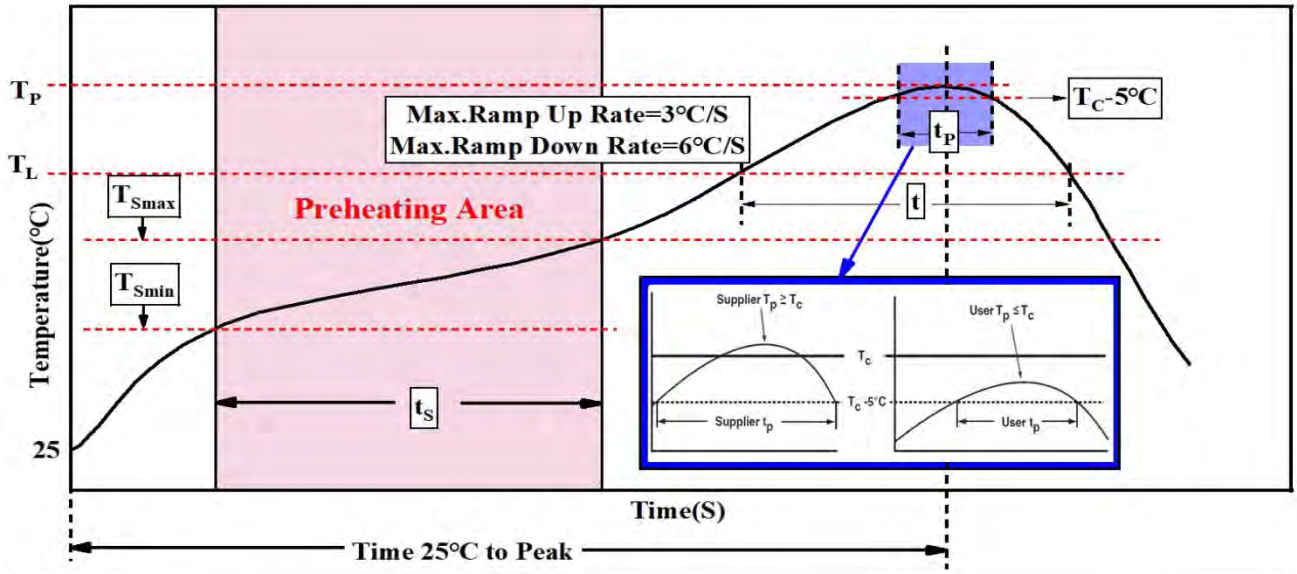
### Gate Charge




### Resistive Load Switching Time



## Temperature Profile for IR Reflow Soldering




| Profile Feature | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|---|---|---|
| **Preheat & Soak**<br>Temperature min (Tsmin)<br>Temperature max (Tsmax)<br>Time (Tsmin to Tsmax) (ts) | <br>100°C<br>150°C<br>60-120 seconds | <br>150°C<br>200°C<br>60-120 seconds |
| Average ramp-up rate (Tsmax to Tp) | 3 °C/second max. | 3°C/second max. |
| Liquidous temperature (TL)<br>Time at liquidous (tL) | 183 °C<br>60-150 seconds | 217°C<br>60-150 seconds |
| Peak package body Temperature e (Tp)* | See Classification Temp in table 1 | See Classification Temp in table 2 |
| Time (tp)** within 5°C of the specified classification temperature (Tc) | 20** seconds | 30** seconds |
| Average ramp-down rate (Tp to Tsmax) | 6 °C/second max. | 6 °C/second max. |
| Time 25°C to peak temperature | 6 minutes max. | 8 minutes max. |
| * Tolerance for peak profile Temperature (Tp) is defined as a supplier minimum and a user maximum.<br>** Tolerance for time at peak profile temperature (tp) is defined as a supplier minimum and a user maximum | | |

Table 1. SnPb Eutectic Process – Classification Temperatures (Tc)

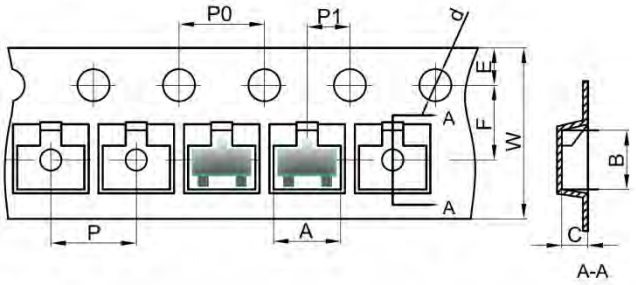
| Package Thickness | Volume $mm^3$ <350 | Volume $mm^3$ ≥350 |
|---|---|---|
| <2.5 mm | 235 °C | 220 °C |
| ≥2.5 mm | 220 °C | 220 °C |

Table 2. Pb-free Process – Classification Temperatures (Tc)

| Package Thickness | Volume $mm^3$ <350 | Volume $mm^3$ 350-2000 | Volume $mm^3$ >2000 |
|---|---|---|---|
| <1.6 mm | 260 °C | 260 °C | 260 °C |
| 1.6 mm – 2.5 mm | 260 °C | 250 °C | 245 °C |
| ≥2.5 mm | 250 °C | 245 °C | 245 °C |

## SOT-23 Tape and Reel

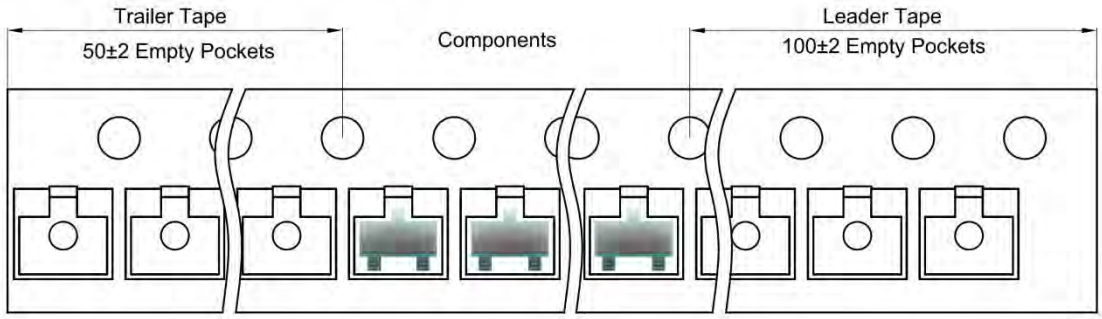
### SOT-23 Embossed Carrier Tape



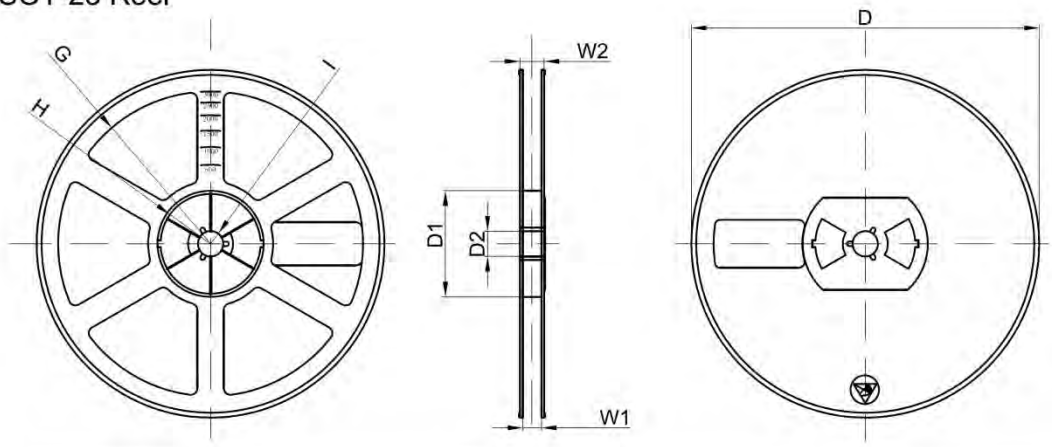

Packaging Description:
SOT-23 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 3,000 units per 7" or 17.8cm diameter reel. The reels are clear in color and is made of polystyrene plastic (anti-static coated).

| Dimensions are in millimeter | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pkg type | A | B | C | d | E | F | P0 | P | P1 | W |
| SOT-23 | 3.15 | 2.77 | 1.22 | Ø1.50 | 1.75 | 3.50 | 4.00 | 4.00 | 2.00 | 8.00 |

### SOT-23 Tape Leader and Trailer



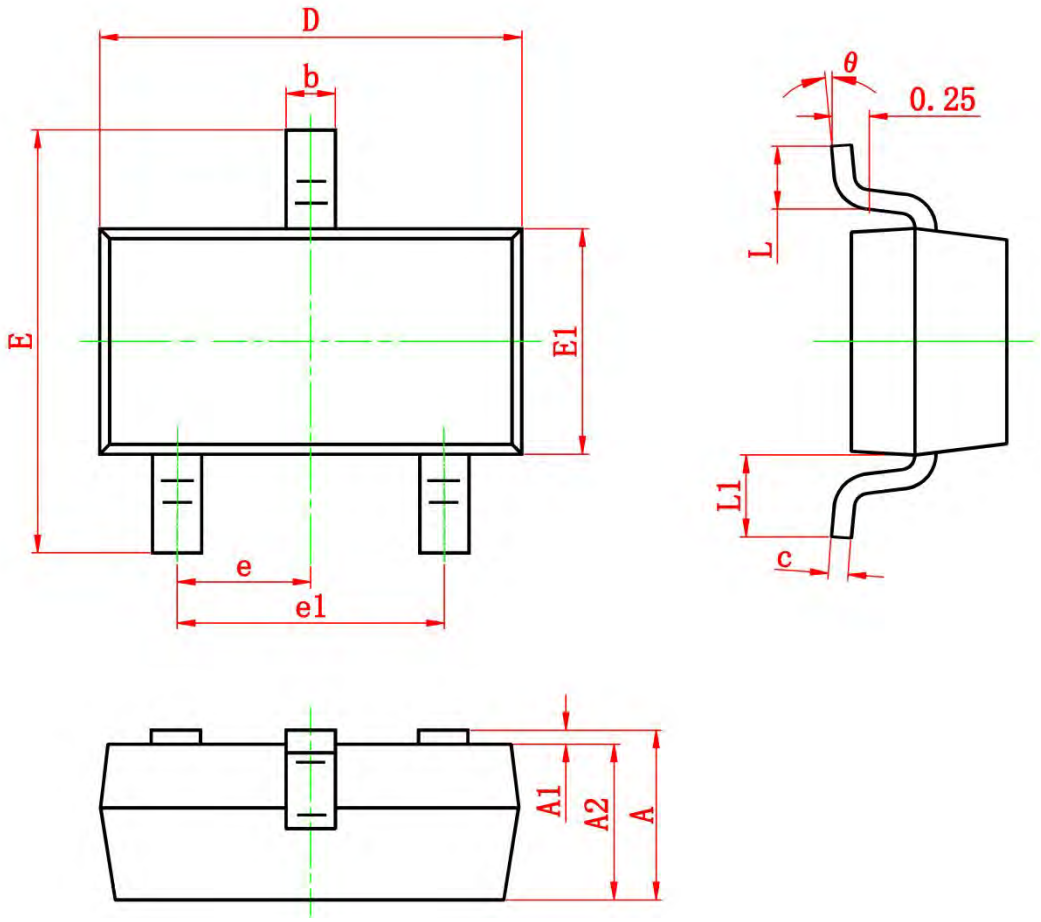

### SOT-23 Reel




| Dimensions are in millimeter | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Reel Option | D | D1 | D2 | G | H | I | W1 | W2 |
| 7"Dia | Ø178.00 | 54.40 | 13.00 | R78.00 | R25.60 | R6.50 | 9.50 | 12.30 |

| REEL | Reel Size | Box | Box Size(mm) | Carton | Carton Size(mm) | G.W.(kg) |
|---|---|---|---|---|---|---|
| 3000 pcs | 7 inch | 45,000 pcs | 203×203×195 | 180,000 pcs | 438×438×220 | |

## SOT-23 Package Information




| Symbol | Dimensions In Millimeters | |
|---|---|---|
| | Min. | Max. |
| A | 0.90 | 1.15 |
| A1 | 0.00 | 0.125 |
| A2 | 0.90 | 1.050 |
| b | 0.30 | 0.50 |
| c | 0.08 | 0.15 |
| D | 2.80 | 3.00 |
| E1 | 1.20 | 1.40 |
| E | 2.25 | 2.55 |
| e | 0.95 REF. | |
| e1 | 1.80 | 2.00 |
| L | 0.55 REF. | |
| L1 | 0.30 | 0.50 |
| θ | 0° | 8° |

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