



# 2N7002K

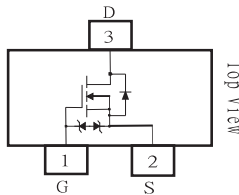
## 60V N-Channel Enhancement Mode MOSFET - ESD Protected

### FEATURES

- $R_{DS(ON)}$ ,  $V_{GS}@10V, I_{DS}@500mA=3\Omega$
- $R_{DS(ON)}$ ,  $V_{GS}@4.5V, I_{DS}@200mA=4\Omega$
- Advanced Trench Process Technology
- High Density Cell Design For Ultra Low On-Resistance
- Very Low Leakage Current In Off Condition
- Specially Designed for Battery Operated Systems, Solid-State Relays Drivers : Relays, Displays, Lamps, Solenoids, Memories, etc.
- ESD Protected 2KV HBM
- Lead free in compliance with EU RoHS 2.0
- Green molding compound as per IEC 61249 standard

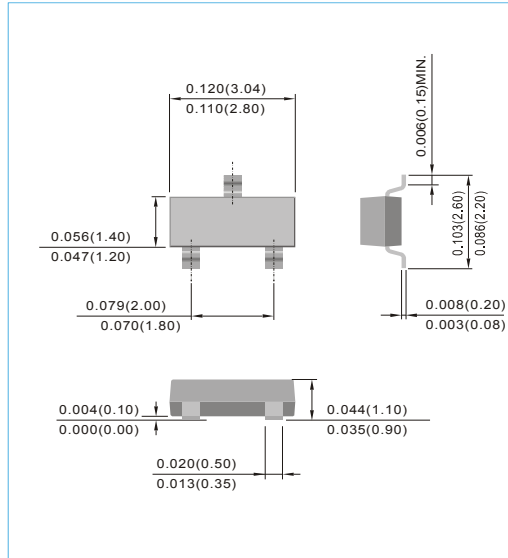
### MECHANICAL DATA

- Case: SOT-23 Package
- Terminals: Solderable per MIL-STD-750, Method 2026
- Marking: K72
- Approx. Weight: 0.0003 ounce, 0.0084 gram



### SOT-23

Unit : inch(mm)



### Maximum RATINGS and Thermal Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| PARAMETER  | Symbol          | Limit        | Units                     |
|--|-----------------|--------------|---------------------------|
| Drain-Source Voltage   | $V_{DS}$        | 60           | V                         |
| Gate-Source Voltage  | $V_{GS}$        | $\pm 20$     | V                         |
| Continuous Drain Current   | $I_D$           | 300          | mA                        |
| Pulsed Drain Current <sup>1)</sup>                               | $I_{DM}$        | 2000         | mA                        |
| Maximum Power Dissipation  | $P_D$           | 350<br>210   | mW                        |
| Operating Junction and Storage Temperature Range                 | $T_J, T_{STG}$  | -55 to + 150 | $^\circ\text{C}$          |
| Junction-to Ambient Thermal Resistance(PCB mounted) <sup>2</sup> | $R_{\theta JA}$ | 357          | $^\circ\text{C}/\text{W}$ |

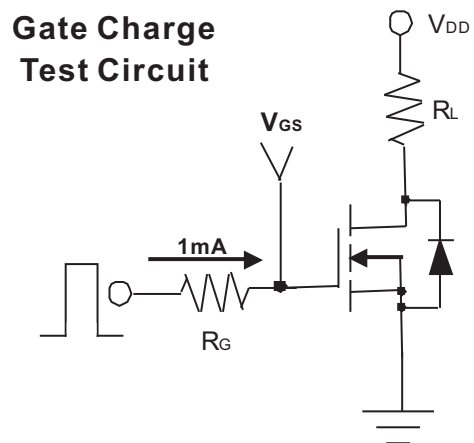
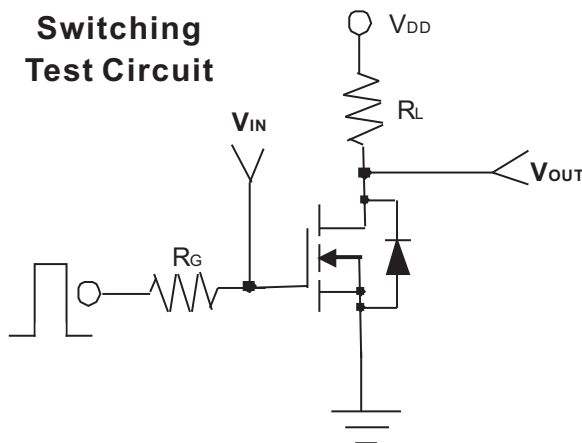
- Note: 1. Maximum DC current limited by the package  
 2. Surface mounted on FR4 board,  $t \leq 10$  sec  
 3. Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$



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## ELECTRICAL CHARACTERISTICS

| Parameter                        | Symbol       | Test Condition  | Min. | Typ. | Max.     | Units    |
|----------------------------------|--------------|---|------|------|----------|----------|
| Static                           |              |   |      |      |          |          |
| Drain-Source Breakdown Voltage   | $BV_{DSS}$   | $V_{GS}=0V, I_D=10\mu A$  | 60   | -    | -        | V        |
| Gate Threshold Voltage           | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$   | 1    | -    | 2.5      | V        |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=4.5V, I_D=200mA$  | -    | -    | 4.0      | $\Omega$ |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=500mA$   | -    | -    | 3.0      |          |
| Zero Gate Voltage Drain Current  | $I_{DSS}$    | $V_{DS}=60V, V_{GS}=0V$   | -    | -    | 1        | $\mu A$  |
| Gate Body Leakage                | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$   | -    | -    | $\pm 10$ | $\mu A$  |
| Forward Transconductance         | $g_{fs}$     | $V_{DS}=15V, I_D=250mA$   | 100  | -    | -        | mS       |
| Dynamic                          |              |   |      |      |          |          |
| Total Gate Charge                | $Q_g$        | $V_{DS}=15V, I_D=200mA$<br>$V_{GS}=5V$                                    | -    | -    | 0.8      | nC       |
| Turn-On Time                     | $t_{on}$     | $V_{DD}=30V, R_L=150\Omega$<br>$I_D=200mA, V_{GEN}=10V$<br>$R_G=10\Omega$ | -    | -    | 20       | ns       |
| Turn-Off Time                    | $t_{off}$    |   | -    | -    | 40       |          |
| Input Capacitance                | $C_{iss}$    | $V_{DS}=25V, V_{GS}=0V$<br>$f=1.0MHz$                                     | -    | -    | 35       | pF       |
| Output Capacitance               | $C_{oss}$    |   | -    | -    | 10       |          |
| Reverse Transfer Capacitance     | $C_{rss}$    |   | -    | -    | 5        |          |
| Source-Drain Diode               |              |   |      |      |          |          |
| Diode Forward Voltage            | $V_{SD}$     | $I_S=200mA, V_{GS}=0V$  | -    | 0.82 | 1.3      | V        |
| Continuous Diode Forward Current | $I_S$        | -   | -    | -    | 300      | mA       |
| Pulse Diode Forward Current      | $I_{SM}$     | -   | -    | -    | 2000     | mA       |





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Typical Characteristics Curves ( $T_J=25^\circ\text{C}$ , unless otherwise noted)

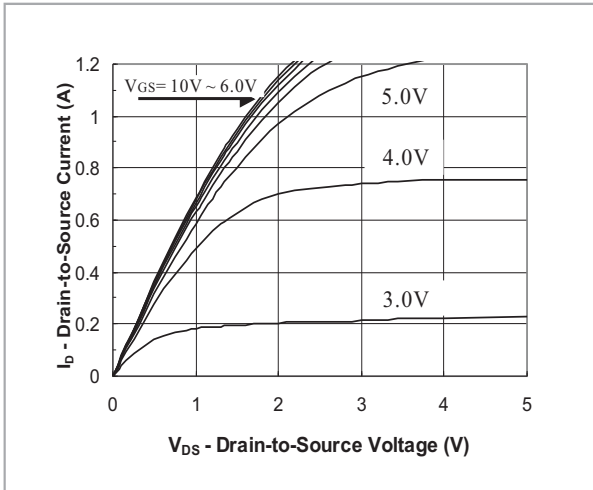


FIG.1- Output Characteristic

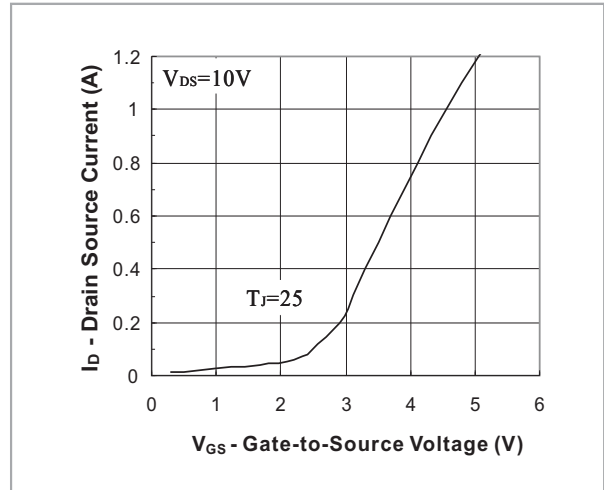


FIG.2- Transfer Characteristic

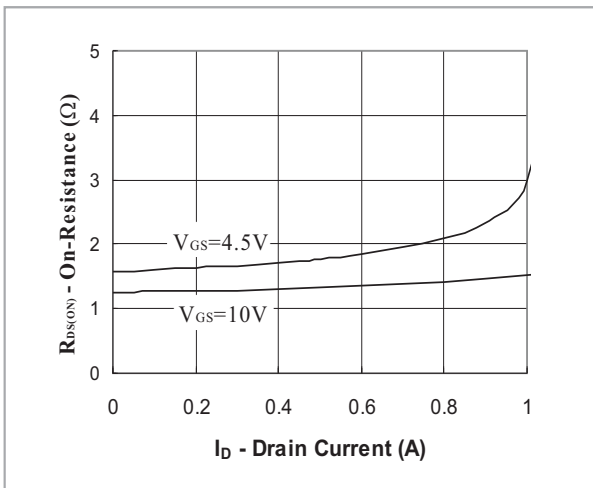


FIG.3- On Resistance vs Drain Current

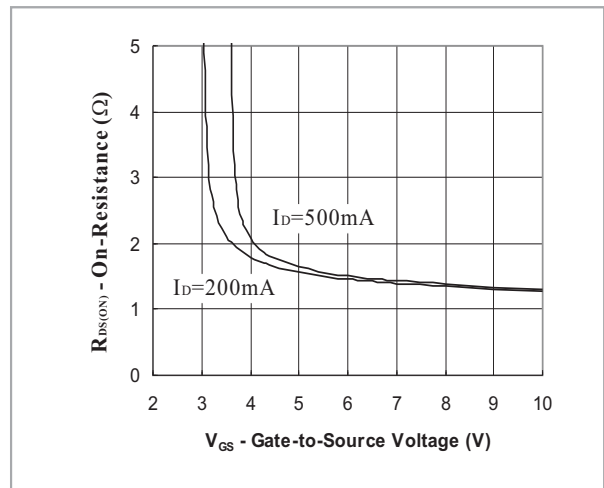


FIG.4- On Resistance vs Gate to Source Voltage

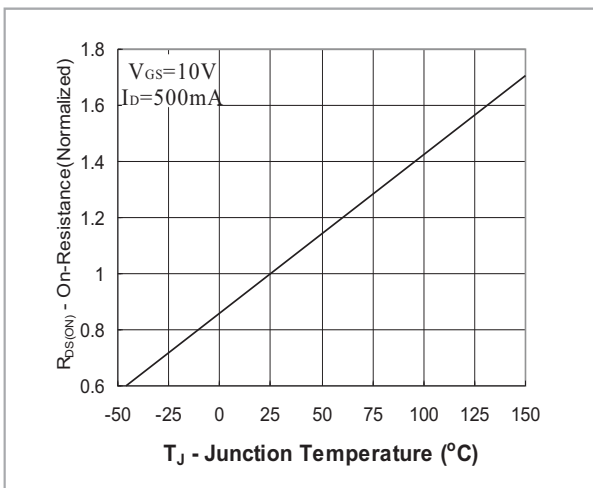


FIG.5- On Resistance vs Junction Temperature



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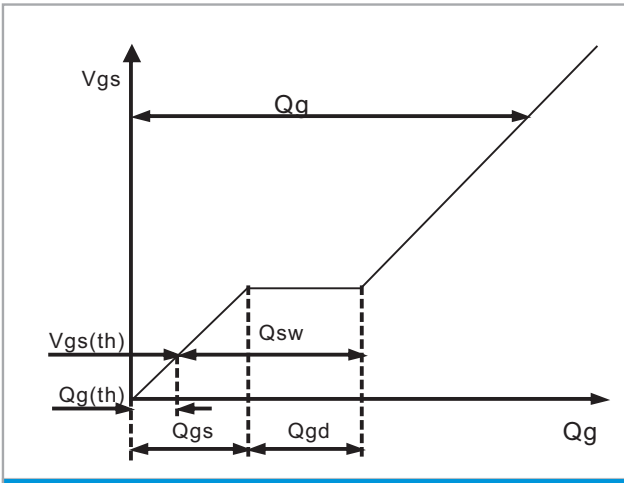


Fig.6 - Gate Charge Waveform

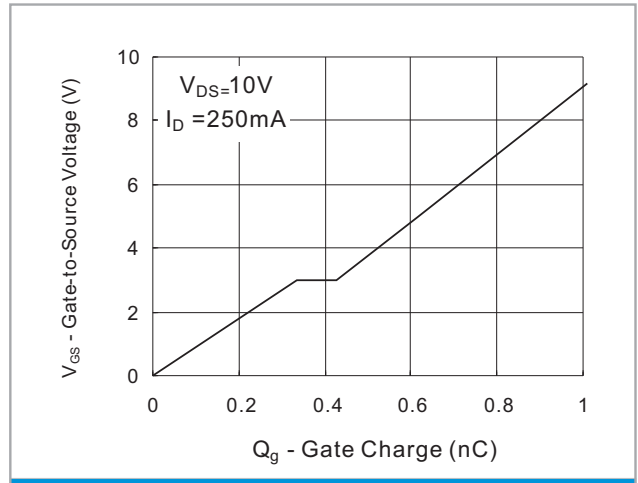


Fig.7 - Gate Charge

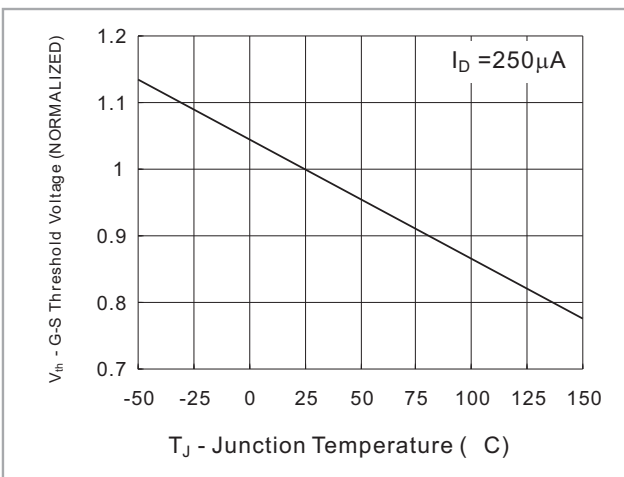


Fig.8 - Threshold Voltage vs Temperature

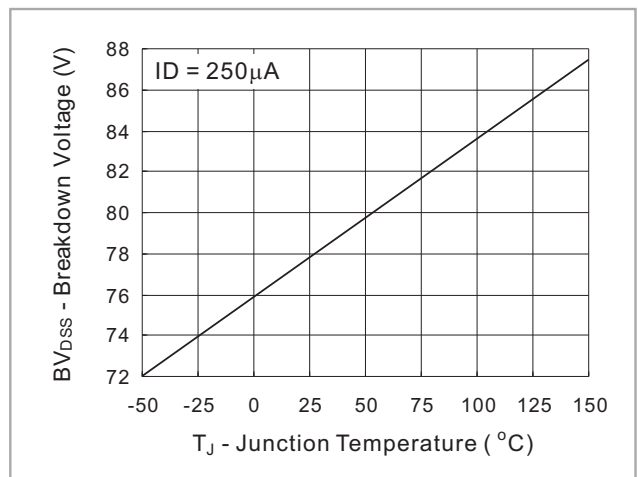


Fig.9 - Breakdown Voltage vs Junction Temperature

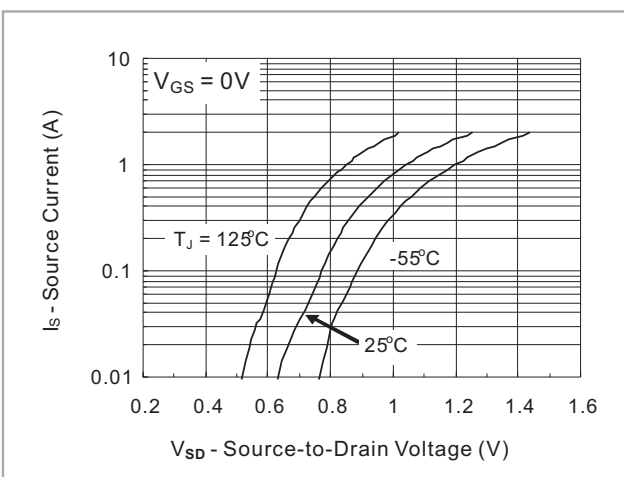


Fig.10 - Source-Drain Diode Forward Voltage

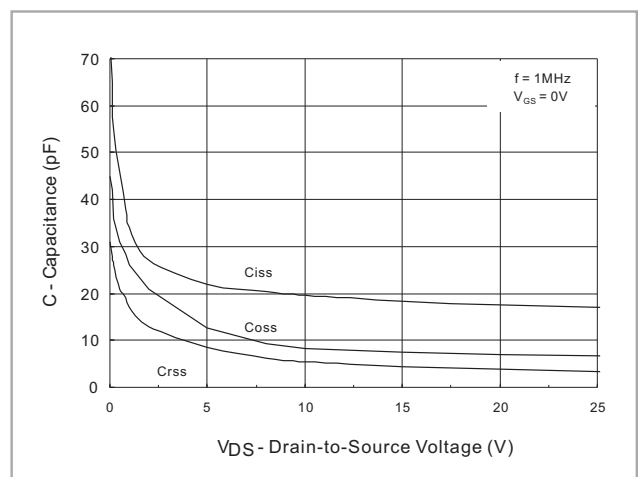
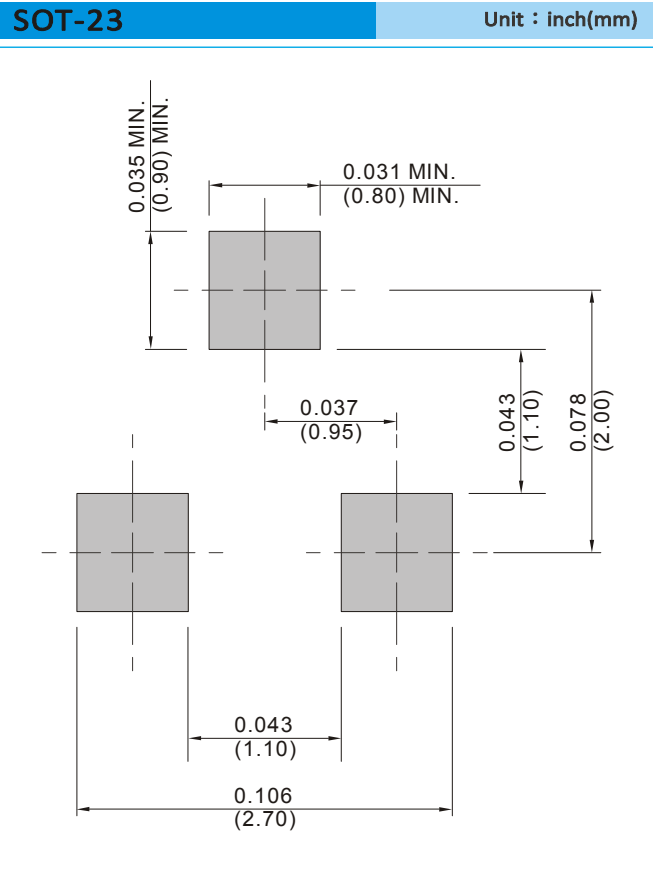


Fig.11 - Capacitance vs Drain to Source Voltage



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## MOUNTING PAD LAYOUT



## ORDER INFORMATION

- Packing information
  - T/R - 12K per 13" plastic Reel
  - T/R - 3K per 7" plastic Reel



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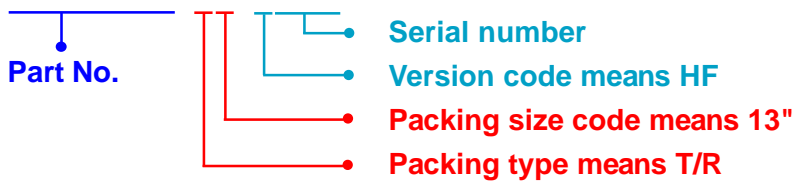
## Part No\_packing code\_Version

2N7002K\_R1\_00001

2N7002K\_R2\_00001

For example :

**RB500V-40\_R2\_00001**



| Packing Code <b>XX</b>               |                      |                                  |                      | Version Code <b>XXXXX</b> |                      |                                       |
|--------------------------------------|----------------------|----------------------------------|----------------------|---------------------------|----------------------|---------------------------------------|
| Packing type                         | 1 <sup>st</sup> Code | Packing size code                | 2 <sup>nd</sup> Code | HF or RoHS                | 1 <sup>st</sup> Code | 2 <sup>nd</sup> ~5 <sup>th</sup> Code |
| Tape and Ammunition Box (T/B)        | A                    | N/A                              | 0                    | HF                        | 0                    | serial number                         |
| Tape and Reel (T/R)                  | R                    | 7"                               | 1                    | RoHS                      | 1                    | serial number                         |
| Bulk Packing (B/P)                   | B                    | 13"                              | 2                    |                           |                      |                                       |
| Tube Packing (T/P)                   | T                    | 26mm                             | X                    |                           |                      |                                       |
| Tape and Reel (Right Oriented) (TRR) | S                    | 52mm                             | Y                    |                           |                      |                                       |
| Tape and Reel (Left Oriented) (TRL)  | L                    | PANASERT T/B CATHODE UP (PBCU)   | U                    |                           |                      |                                       |
| FORMING                              | F                    | PANASERT T/B CATHODE DOWN (PBCD) | D                    |                           |                      |                                       |



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