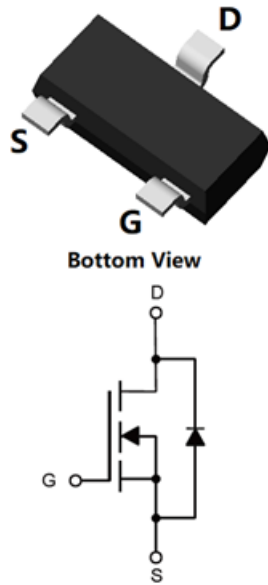
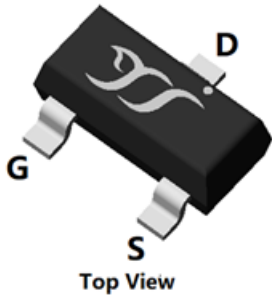


## N-Channel Enhancement Mode Field Effect Transistor



**SOT-23**

### Product Summary

|                                    |              |
|------------------------------------|--------------|
| • $V_{DS}$                         | 60V          |
| • $I_D$                            | 0.55A        |
| • $R_{DS(ON)}$ (at $V_{GS}=10V$ )  | $<1.6\Omega$ |
| • $R_{DS(ON)}$ (at $V_{GS}=4.5V$ ) | $<2.5\Omega$ |

### General Description

- Voltage controlled small signal switch
- Low input capacitance
- Fast switching speed
- Moisture Sensitivity Level 1
- Epoxy Meets UL 94 V-0 Flammability Rating
- Halogen Free
- Part no. with suffix "Q" means AEC-Q101 qualified

### Applications

- Relay driver
- High-speed line driver
- Low-side loadswitch
- Switching circuits

### Limiting Values

| Parameter                              | Conditions                                |                                            | Symbol                           | Min | Max  | Unit |
|----------------------------------------|-------------------------------------------|--------------------------------------------|----------------------------------|-----|------|------|
| Drain-source Voltage                   |                                           |                                            | V <sub>DS</sub>                  | -   | 60   | V    |
| Gate-source Voltage                    |                                           |                                            | V <sub>GS</sub>                  | -20 | 20   |      |
| Continuous Drain Current (Note 1,2)    | Steady-State                              | T <sub>A</sub> =25°C,V <sub>GS</sub> =10V  | I <sub>D</sub>                   | -   | 0.55 | A    |
|                                        |                                           | T <sub>A</sub> =100°C,V <sub>GS</sub> =10V |                                  | -   | 0.39 |      |
| Pulsed Drain Current                   | T <sub>A</sub> =25°C,t <sub>p</sub> ≤10μs |                                            | I <sub>DM</sub>                  | -   | 2.2  |      |
| Maximum Body-Diode Continuous Current  | T <sub>A</sub> =25°C                      |                                            | I <sub>S</sub>                   |     | 0.55 |      |
| Total Power Dissipation (Note 1,2)     | Steady-State                              | T <sub>A</sub> =25°C                       | P <sub>D</sub>                   | -   | 1.08 | W    |
|                                        |                                           | T <sub>A</sub> =100°C                      |                                  | -   | 0.54 |      |
| Junction and Storage Temperature Range |                                           |                                            | T <sub>J</sub> ,T <sub>STG</sub> | -55 | 175  | °C   |

### Thermal Resistance

| Parameter                                       |              | Symbol          | Typ | Max | Units              |
|-------------------------------------------------|--------------|-----------------|-----|-----|--------------------|
| Thermal Resistance Junction-to-Ambient (Note 2) | Steady-State | $R_{\theta JA}$ | -   | 139 | $^\circ\text{C/W}$ |



# 2N7002CHQ

## ■ Electrical Characteristics

| Parameter                         | Symbol              | Conditions                                                                                                   | Min | Typ  | Max  | Units |
|-----------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------|-----|------|------|-------|
| Static Parameter                  |                     |                                                                                                              |     |      |      |       |
| Drain-Source Breakdown Voltage    | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA, T <sub>j</sub> =25°C                                             | 60  | -    | -    | V     |
| Zero Gate Voltage Drain Current   | I <sub>DSS</sub>    | V <sub>DS</sub> =60V, V <sub>GS</sub> =0V, T <sub>j</sub> =25°C                                              | -   | -    | 1    | μA    |
|                                   |                     | V <sub>DS</sub> =60V, V <sub>GS</sub> =0V, T <sub>j</sub> =125°C                                             | -   | -    | 100  |       |
| Gate-Source Leakage Current       | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V, T <sub>j</sub> =25°C                                             | -   | -    | ±100 | nA    |
| Gate Threshold Voltage            | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA, T <sub>j</sub> =25°C                               | 1.1 | 1.7  | 2.4  | V     |
| Static Drain-Source On-Resistance | R <sub>DS(on)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =0.3A, T <sub>j</sub> =25°C                                             | -   | 0.87 | 1.6  | Ω     |
|                                   |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =0.2A, T <sub>j</sub> =25°C                                            | -   | 1.07 | 2.5  | Ω     |
| Diode Forward Voltage             | V <sub>SD</sub>     | I <sub>S</sub> =0.3A, V <sub>GS</sub> =0V, T <sub>j</sub> =25°C                                              | -   | 0.85 | 1.2  | V     |
| Gate Resistance                   | R <sub>G</sub>      | f=1MHz, T <sub>j</sub> =25°C                                                                                 | -   | 8    | -    | Ω     |
| Dynamic Parameters                |                     |                                                                                                              |     |      |      |       |
| Input Capacitance                 | C <sub>iss</sub>    | V <sub>DS</sub> =30V, V <sub>GS</sub> =0V, f=1MHz, T <sub>j</sub> =25°C                                      | -   | 27   | -    | pF    |
| Output Capacitance                | C <sub>oss</sub>    |                                                                                                              | -   | 4.8  | -    |       |
| Reverse Transfer Capacitance      | C <sub>rss</sub>    |                                                                                                              | -   | 2.2  | -    |       |
| Switching Parameters              |                     |                                                                                                              |     |      |      |       |
| Total Gate Charge                 | Q <sub>g</sub>      | V <sub>GS</sub> =10V, V <sub>DS</sub> =30V, I <sub>D</sub> =0.3A, T <sub>j</sub> =25°C                       | -   | 0.98 | -    | nC    |
| Gate-Source Charge                | Q <sub>gs</sub>     |                                                                                                              | -   | 0.2  | -    |       |
| Gate-Drain Charge                 | Q <sub>gd</sub>     |                                                                                                              | -   | 0.34 | -    |       |
| Reverse Recovery Charge           | Q <sub>rr</sub>     | I <sub>F</sub> =0.3A, di/dt=100A/μs, V <sub>GS</sub> =0V, V <sub>R</sub> =30V, T <sub>j</sub> =25°C          | -   | 4.8  | -    | nC    |
| Reverse Recovery Time             | t <sub>rr</sub>     |                                                                                                              | -   | 10.7 | -    | ns    |
| Turn-on Delay Time                | t <sub>D(on)</sub>  | V <sub>GS</sub> =10V, V <sub>DS</sub> =30V, I <sub>D</sub> =0.3A, R <sub>GEN</sub> =3Ω, T <sub>j</sub> =25°C | -   | 2    | -    | ns    |
| Turn-on Rise Time                 | t <sub>r</sub>      |                                                                                                              | -   | 2.4  | -    |       |
| Turn-off Delay Time               | t <sub>D(off)</sub> |                                                                                                              | -   | 4.9  | -    |       |
| Turn-off Fall Time                | t <sub>f</sub>      |                                                                                                              | -   | 29   | -    |       |

### Note:

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. The value of  $R_{\theta JA}$  is measured with the device mounted on the 40mm\*40mm\*1.1mm single layer FR-4 PCB board with 1 in<sup>2</sup> pad of 2oz. Copper, in the still air environment with  $T_A=25^\circ C$ . The maximum allowed junction temperature of  $175^\circ C$ . The value in any given application depends on the user's specific board design.

## ■ Typical Electrical and Thermal Characteristics Diagrams

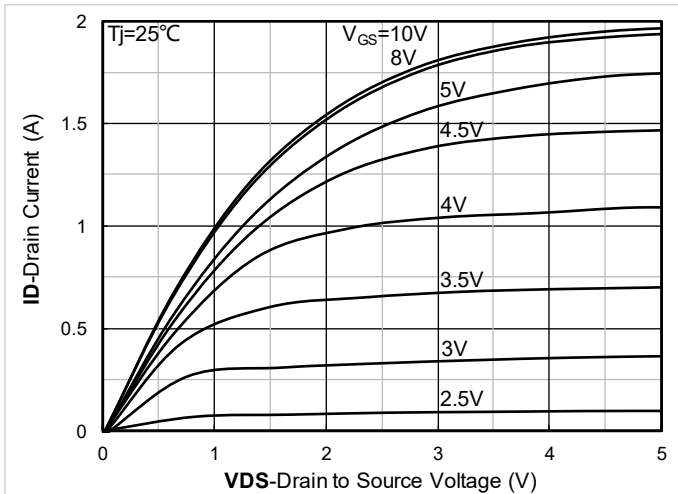


Figure 1. Output Characteristics; typical values

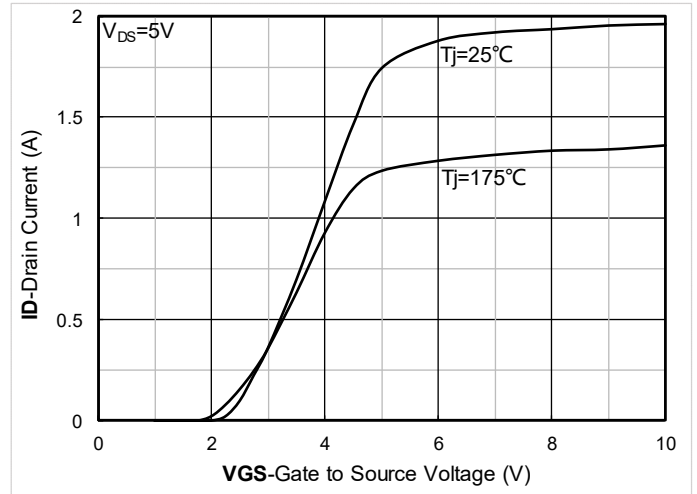


Figure 2. Transfer Characteristics; typical values

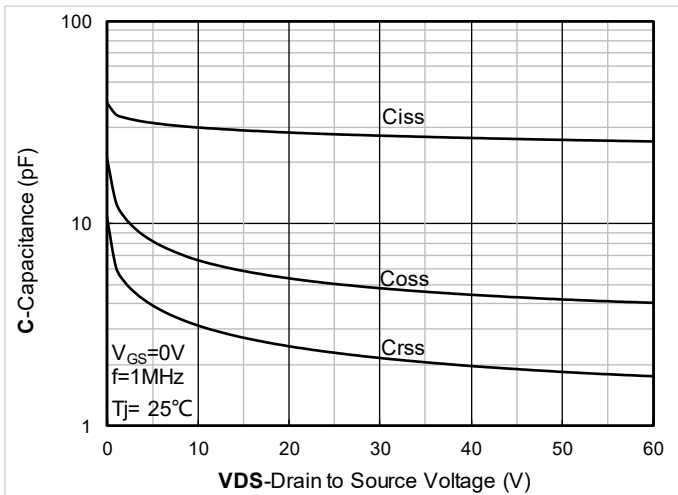


Figure 3. Capacitance Characteristics; typical values

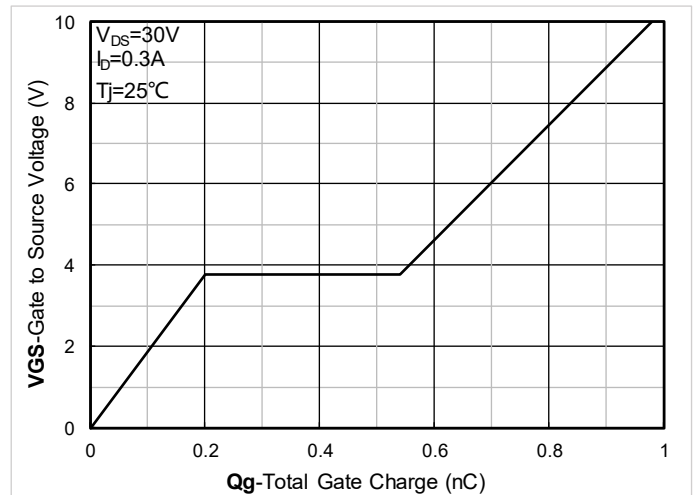


Figure 4. Gate Charge; typical values

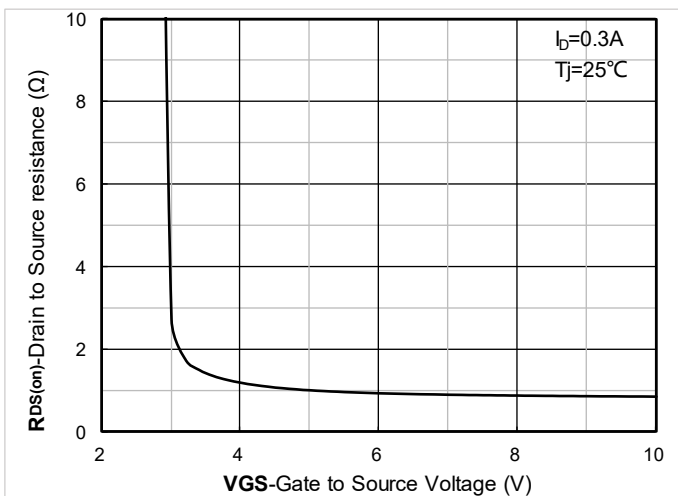


Figure 5. On-Resistance vs. Gate to Source Voltage; typical values

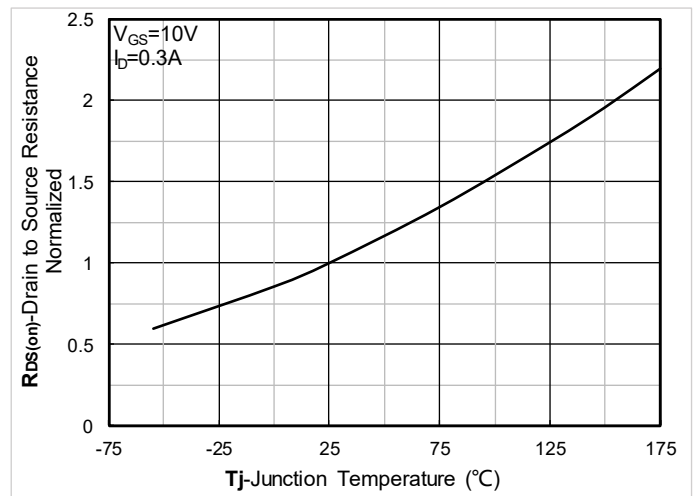


Figure 6. Normalized On-Resistance

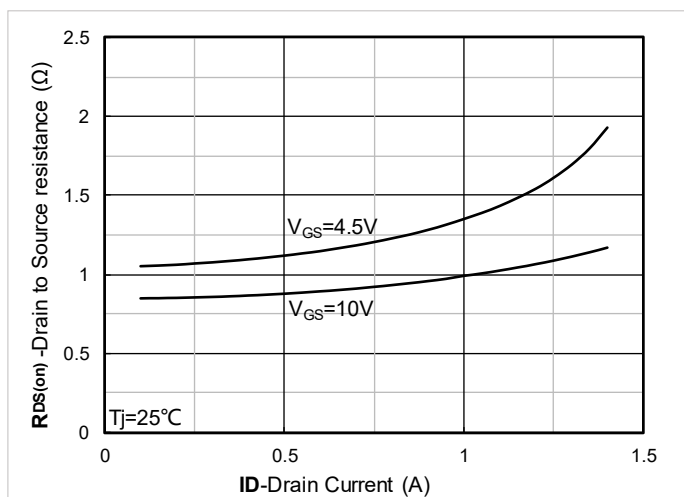


Figure 7.  $R_{DS(on)}$  vs. Drain Current; typical values

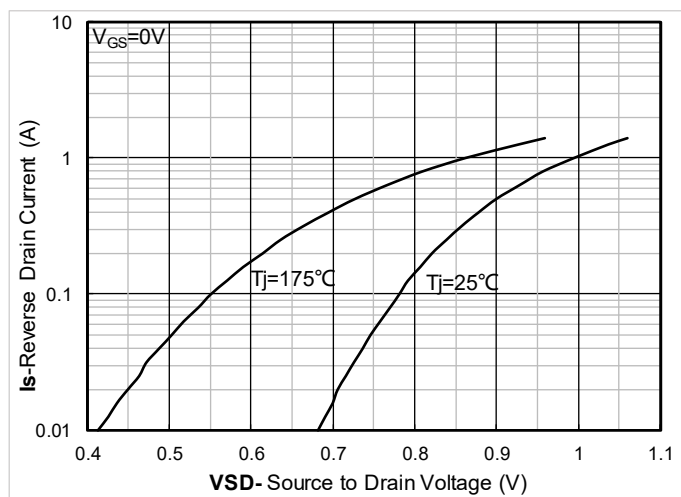


Figure 8. Forward characteristics of reverse diode; typical values

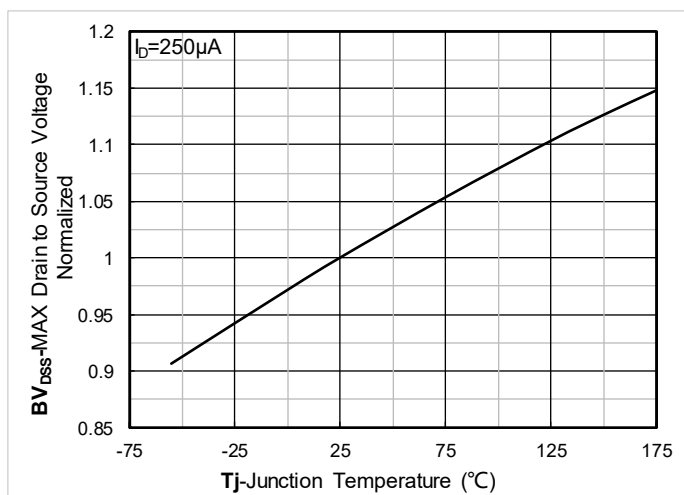


Figure 9. Normalized breakdown voltage

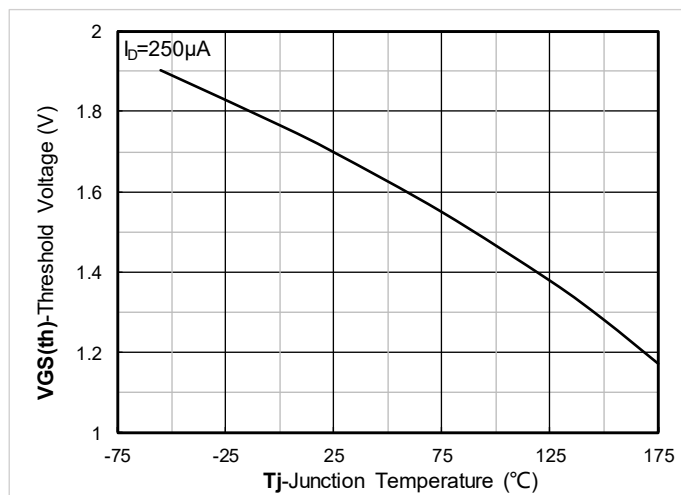


Figure 10. Gate Threshold voltage; typical values

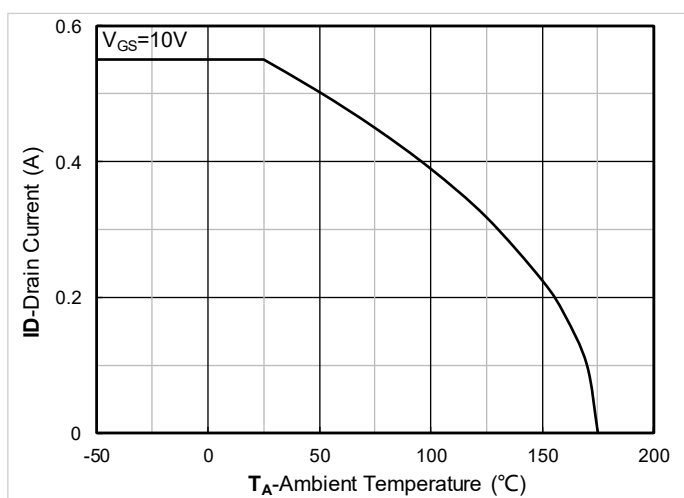


Figure 11. Current dissipation

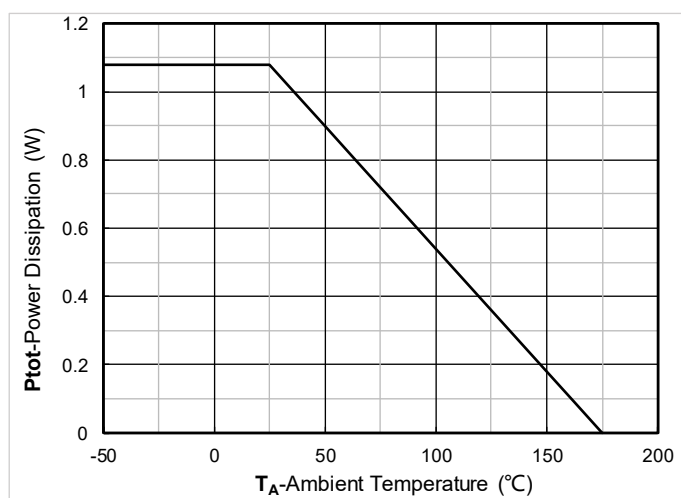


Figure 12. Power dissipation

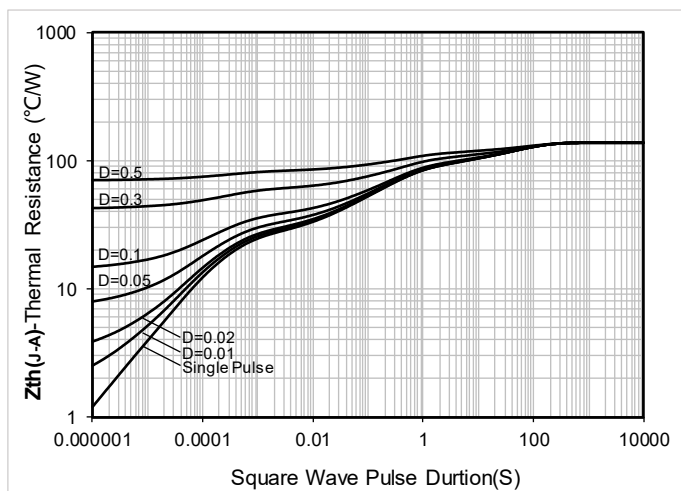


Figure 13. Maximum Transient Thermal Impedance

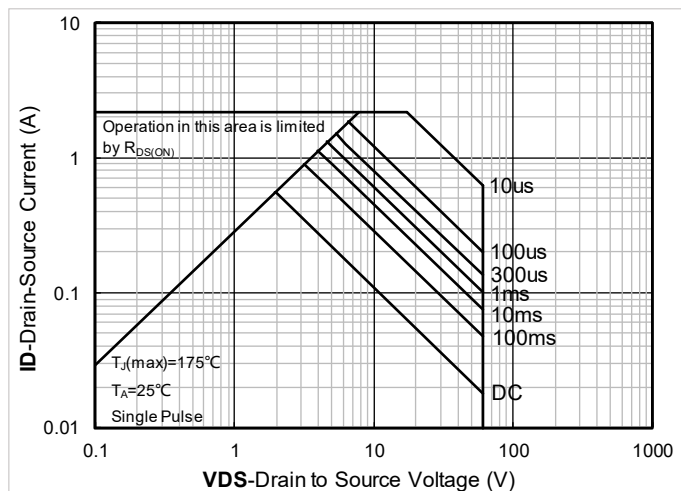


Figure 14. Safe Operation Area

## ■ Test Circuits & Waveforms

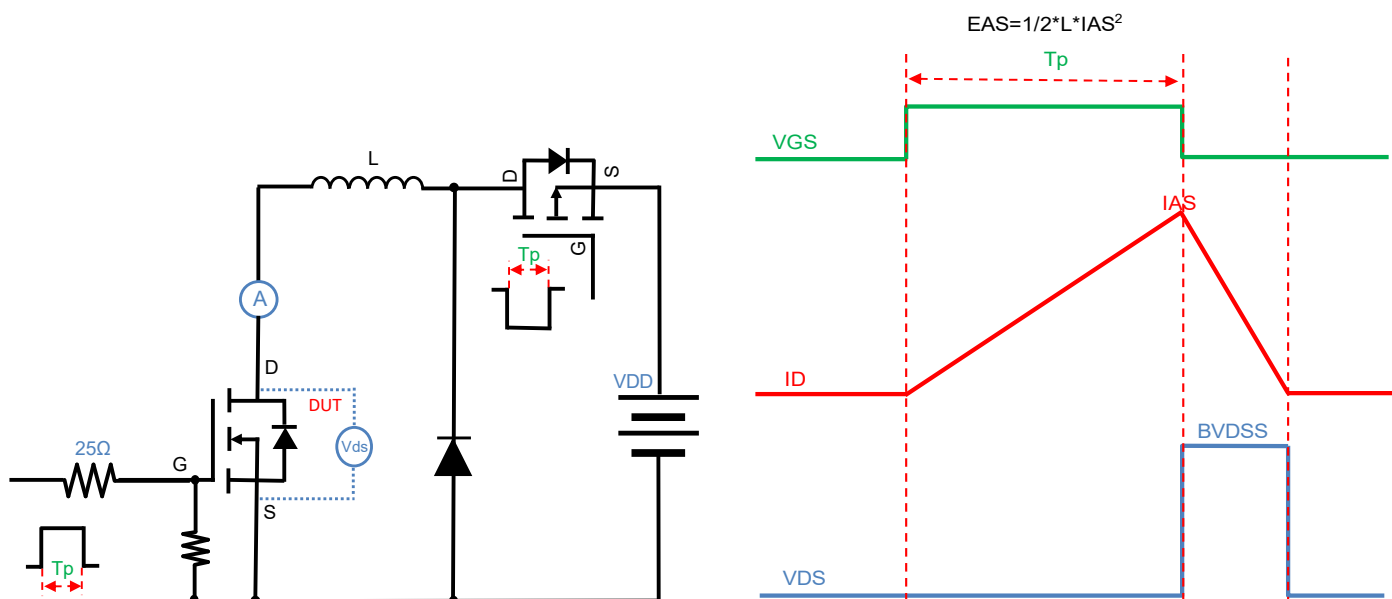


Figure A. Unclamped Inductive Switching (UIS) Test Circuit & Waveform

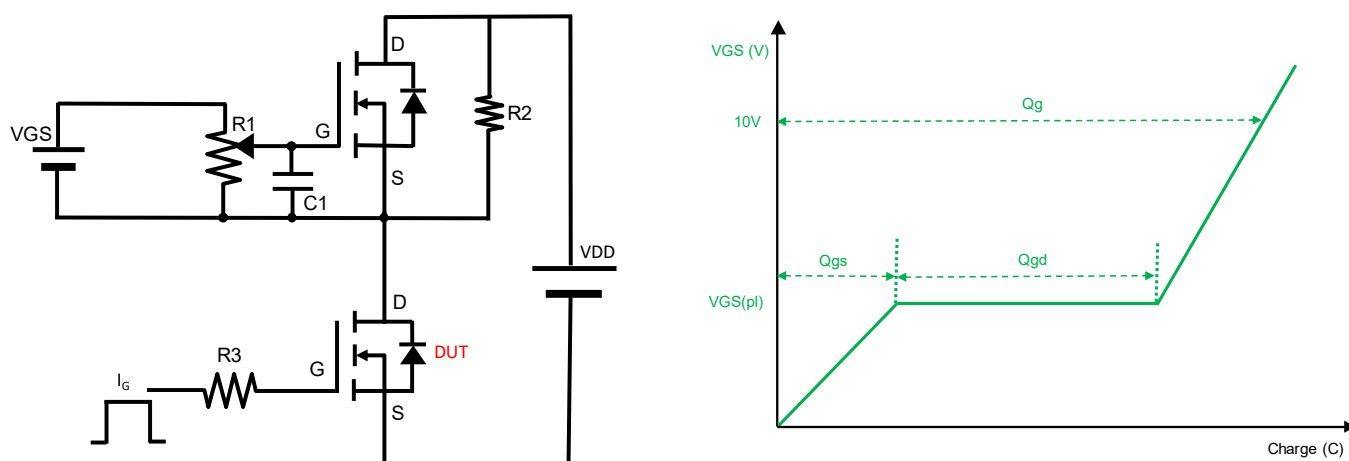


Figure B. Gate Charge Test Circuit & Waveform

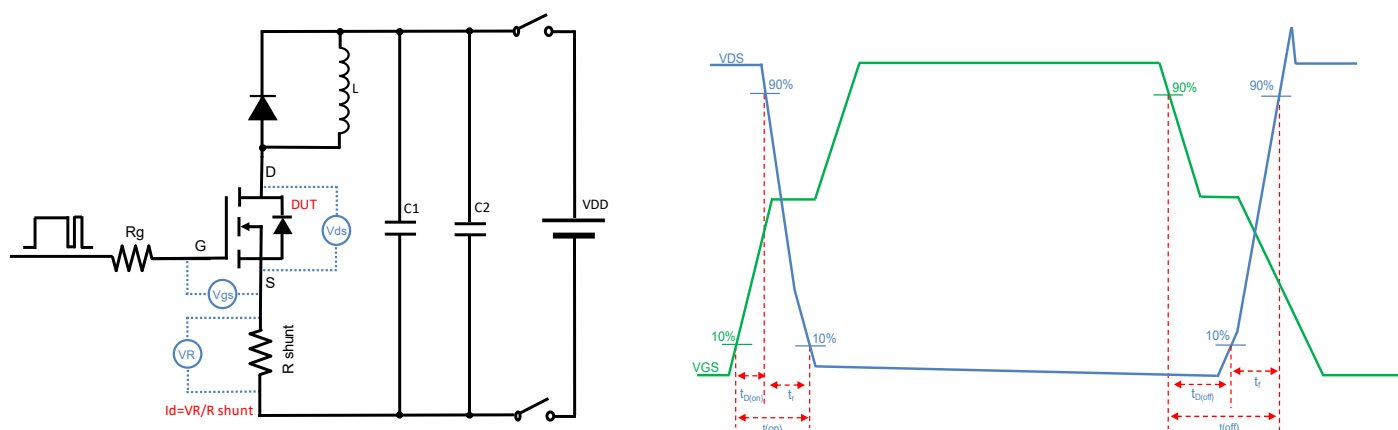


Figure C. Resistive Switching Test Circuit & Waveform

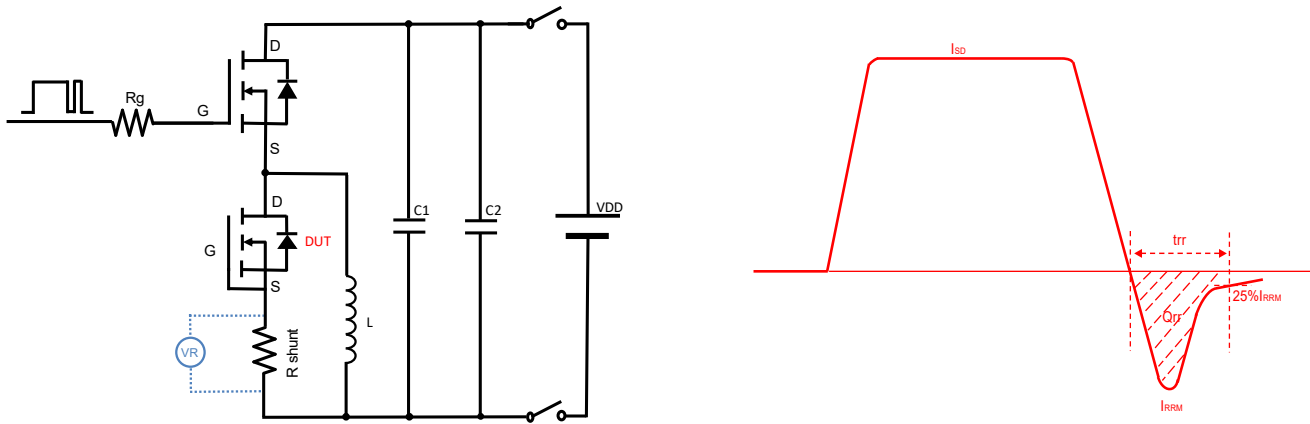
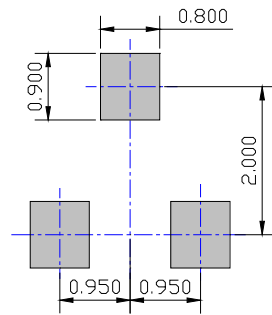
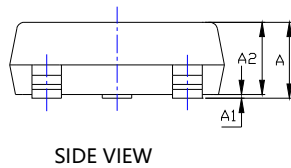
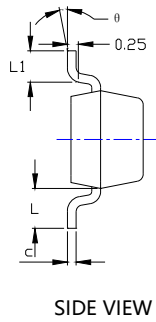
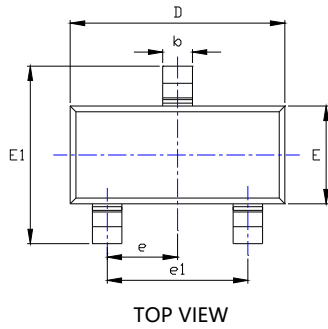


Figure D. Diode Recovery Test Circuit & Waveform



## 2N7002CHQ

### ■ SOT-23 Package information



UNIT: mm

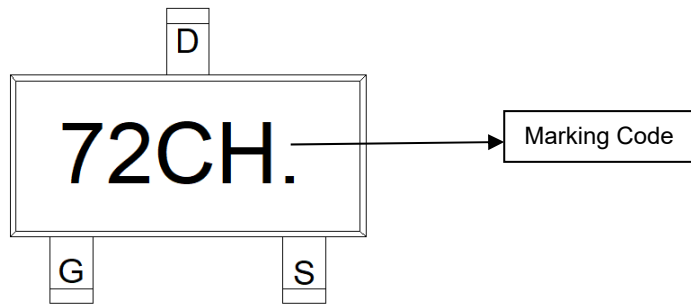
| SYMBOL | DIMENSIONS |       |            |       |
|--------|------------|-------|------------|-------|
|        | INCHES     |       | Millimeter |       |
|        | MIN.       | MAX.  | MIN.       | MAX.  |
| A      | 0.035      | 0.045 | 0.900      | 1.150 |
| A1     | 0.000      | 0.004 | 0.000      | 0.100 |
| A2     | 0.035      | 0.041 | 0.900      | 1.050 |
| b      | 0.012      | 0.020 | 0.300      | 0.500 |
| c      | 0.004      | 0.008 | 0.100      | 0.200 |
| D      | 0.110      | 0.118 | 2.800      | 3.000 |
| E      | 0.047      | 0.055 | 1.200      | 1.400 |
| E1     | 0.089      | 0.100 | 2.250      | 2.550 |
| e      | 0.037TYP   |       | 0.950TYP   |       |
| e1     | 0.071      | 0.079 | 1.800      | 2.000 |
| L      | 0.022REF   |       | 0.550REF   |       |
| L1     | 0.012      | 0.020 | 0.300      | 0.500 |
| θ      | 0°         | 8°    | 0°         | 8°    |

NOTE:

1.PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS.

2.TOLERANCE 0.1mm UNLESS OTHERWISE SPECIFIED.

3.THE PAD LAYOUT IS FOR REFERENCE PURPOSES ONLY.

**■ Marking Information****Note:**

1. All marking is at middle of the product body
2. All marking is in laser printing
3. 72CH. is marking code
4. Body color: Black



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