

## Product Summary

| $V_{(BR)DSS}$ | $R_{DS(on)MAX}$ | $I_D$ |
|---------------|-----------------|-------|
| -60V          | 160mΩ@-10V      | -1.5A |
|               | 220mΩ@-4.5V     |       |

## Feature

- Surface-mounted package
- Advanced trench cell design
- Suffix "-Q1" for AEC-Q101

## Application

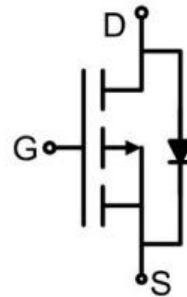
- Portable appliances
- High speed switch
- Battery management
- Low power DC to DC Converter

## Package

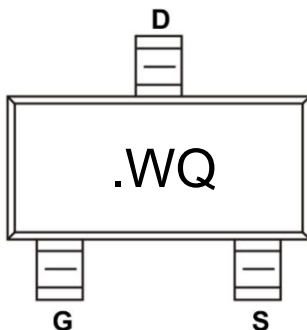


SOT-23

## Circuit diagram



## Marking



### Absolute maximum ratings (T<sub>A</sub>=25°C unless otherwise noted)

| Parameter                                                 | Symbol           | Value      | Unit |
|-----------------------------------------------------------|------------------|------------|------|
| Drain-Source Voltage                                      | V <sub>DS</sub>  | -60        | V    |
| Gate-Source Voltage                                       | V <sub>GS</sub>  | ±20        | V    |
| Continuous Drain Current                                  | I <sub>D</sub>   | -1.5       | A    |
| Pulsed Drain Current <sup>1)</sup>                        | I <sub>DM</sub>  | -10        | A    |
| Power Dissipation <sup>2)</sup>                           | P <sub>D</sub>   | 0.5        | W    |
| Thermal Resistance from Junction to Ambient <sup>2)</sup> | R <sub>θJA</sub> | 250        | °C/W |
| Junction Temperature                                      | T <sub>J</sub>   | 150        | °C   |
| Storage Temperature                                       | T <sub>STG</sub> | -55 ~ +150 | °C   |

### Electrical characteristics (T<sub>A</sub>=25 °C, unless otherwise noted)

| Parameter                                   | Symbol               | Test Condition                                                                                | Min. | Typ. | Max. | Unit |
|---------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------|------|------|------|------|
| <b>Static Characteristics</b>               |                      |                                                                                               |      |      |      |      |
| Drain-source breakdown voltage              | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA                                                 | -60  |      |      | V    |
| Zero gate voltage drain current             | I <sub>DSS</sub>     | V <sub>DS</sub> = -48V, V <sub>GS</sub> = 0V                                                  |      |      | -1   | μA   |
| Gate-body leakage current                   | I <sub>GSS</sub>     | V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V                                                  |      |      | ±100 | nA   |
| Gate threshold voltage                      | V <sub>GS(th)</sub>  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA                                   | -1.0 |      | -3.0 | V    |
| Drain-source on-resistance                  | R <sub>DS(on)</sub>  | V <sub>GS</sub> = -10V, I <sub>D</sub> = -1.5A                                                |      |      | 160  | mΩ   |
|                                             |                      | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -1A                                                 |      |      | 220  |      |
| Forward transconductance                    | g <sub>FS</sub>      | V <sub>DS</sub> = -5V, I <sub>D</sub> = -1A                                                   |      | 4    |      | S    |
| <b>Dynamic characteristics<sup>3)</sup></b> |                      |                                                                                               |      |      |      |      |
| Input Capacitance                           | C <sub>iss</sub>     | V <sub>DS</sub> = -30V, V <sub>GS</sub> = 0V, f = 1MHz                                        |      | 361  |      | pF   |
| Output Capacitance                          | C <sub>oss</sub>     |                                                                                               |      | 25   |      |      |
| Reverse Transfer Capacitance                | C <sub>rss</sub>     |                                                                                               |      | 20   |      |      |
| Gate Charge                                 | Q <sub>g</sub>       | V <sub>DS</sub> = -30V, V <sub>GS</sub> = -10V, I <sub>D</sub> = -1.5A                        |      | 7    |      | nC   |
| Gate-Source Charge                          | Q <sub>gs</sub>      |                                                                                               |      | 1.6  |      |      |
| Gate-Drain Charge                           | Q <sub>gd</sub>      |                                                                                               |      | 1.3  |      |      |
| Gate resistance                             | R <sub>g</sub>       | f = 1.0MHz                                                                                    |      | 11   |      | Ω    |
| Turn-on delay time                          | t <sub>d(on)</sub>   | V <sub>DD</sub> = -30V, V <sub>GS</sub> = -10V, I <sub>D</sub> = -1.5A, R <sub>G</sub> = 3.3Ω |      | 5.7  |      | nS   |
| Turn-on rise time                           | t <sub>r</sub>       |                                                                                               |      | 3.4  |      |      |
| Turn-off delay time                         | t <sub>d(off)</sub>  |                                                                                               |      | 7.5  |      |      |
| Turn-off fall time                          | t <sub>f</sub>       |                                                                                               |      | 1.8  |      |      |
| <b>Source-Drain Diode characteristics</b>   |                      |                                                                                               |      |      |      |      |
| Diode Forward Current                       | I <sub>S</sub>       |                                                                                               |      |      | -1.5 | A    |
| Diode Forward Voltage                       | V <sub>SD</sub>      | V <sub>GS</sub> = 0V, I <sub>S</sub> = -1A                                                    |      |      | -1.4 | V    |
| Reverse Recovery Charge                     | Q <sub>rr</sub>      | I <sub>S</sub> = -1.5A, di/dt = 100A/μs                                                       |      | 3.6  |      | nC   |
| Reverse Recovery Charge                     | T <sub>rr</sub>      |                                                                                               |      |      | 8    |      |

Notes:

- 1) Pulse Test: Pulse Width ≤ 100us, Duty Cycle ≤ 2%, Repetitive rating, pulse width limited by junction temperature T<sub>J(MAX)</sub> = 150°C.
- 2) Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in still air.
- 3) Guaranteed by design, not subject to production testing.

## Typical Characteristics

Fig. 1 Typical Output Characteristics

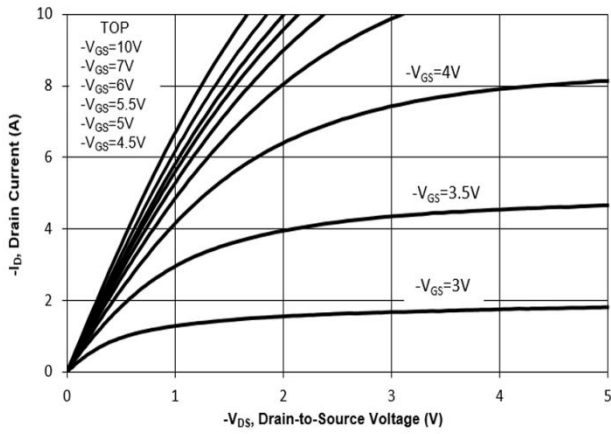


Fig. 2 Typical Transfer Characteristics

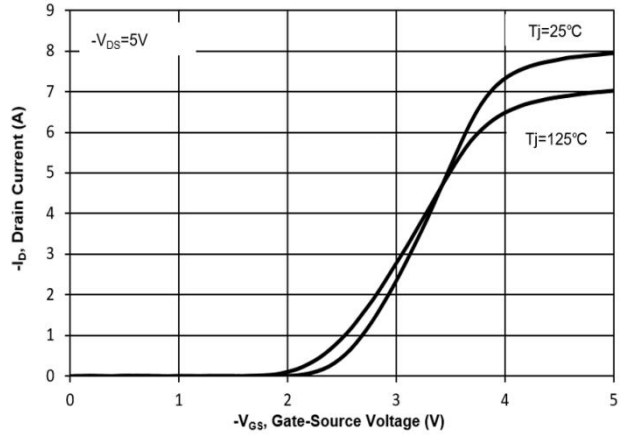


Fig. 3 on-Resistance vs. Drain Current

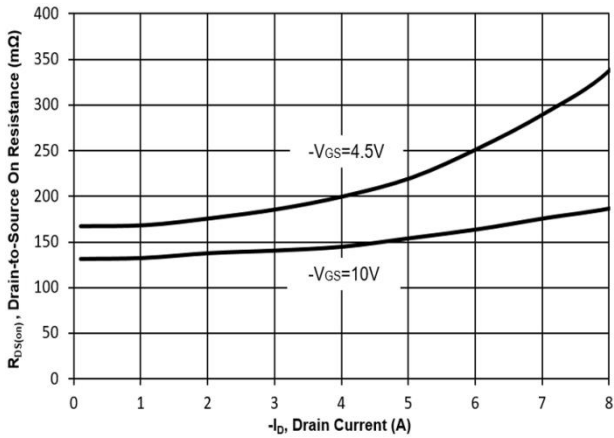


Fig. 4 on-Resistance vs. Gate-Source Voltage

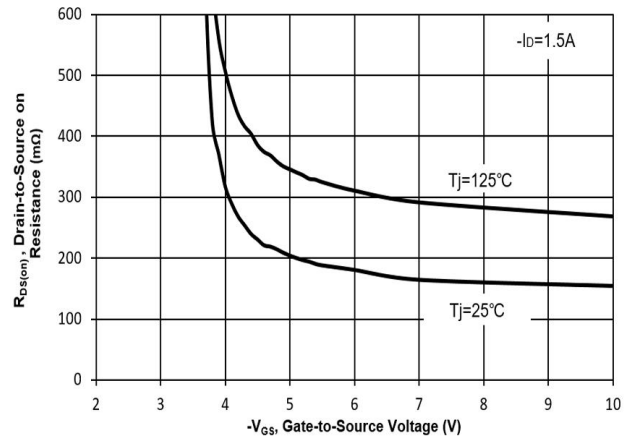


Fig. 5 on-Resistance vs.  $T_J$

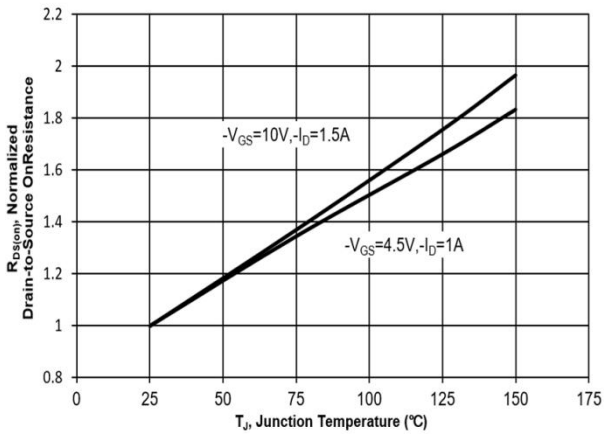
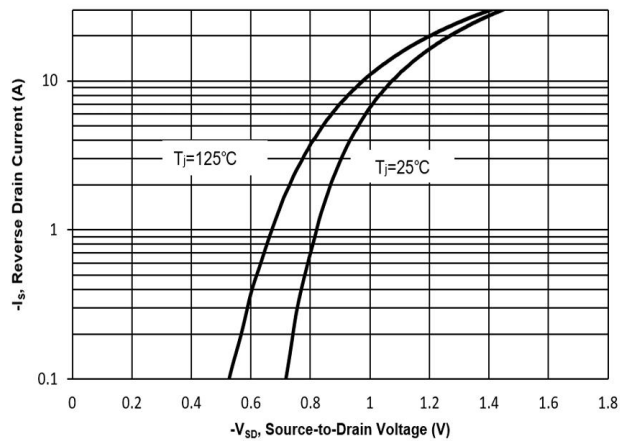


Fig. 6 Typical Body-Diode Forward Characteristics



## Typical Characteristics

Fig. 7 Typical Junction Capacitance

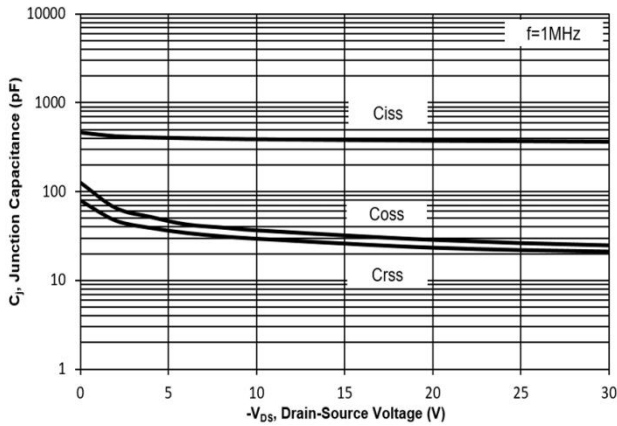


Fig. 8 Drain-Source Leakage Current vs. T<sub>j</sub>

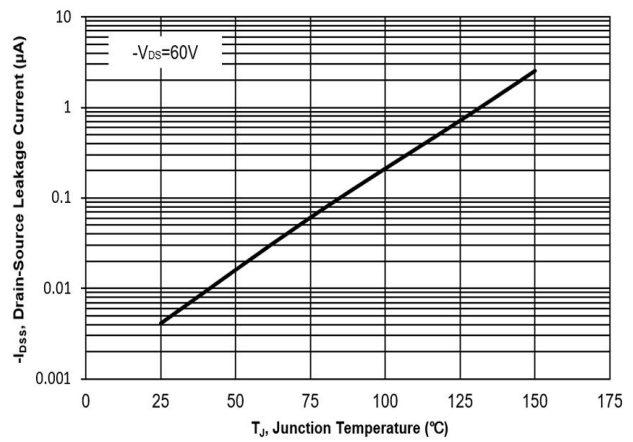


Fig. 9 V<sub>(BR)DSS</sub> vs. Junction Temperature

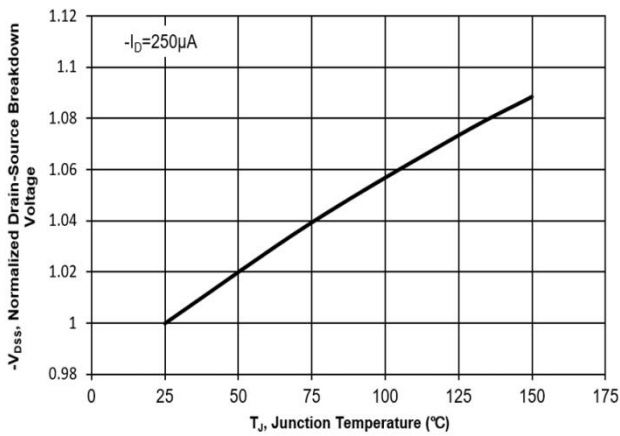


Fig. 10 Gate Threshold Variation vs. T<sub>j</sub>

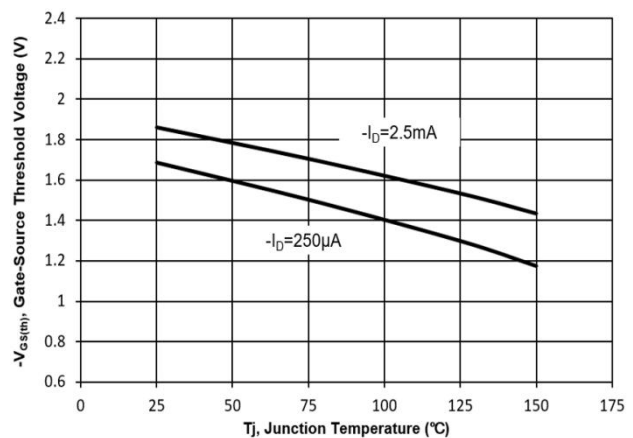
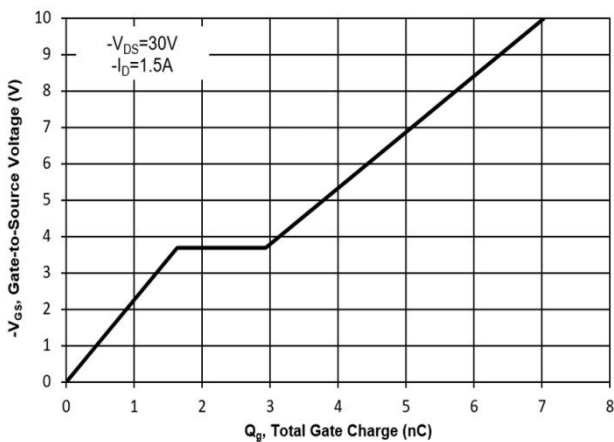
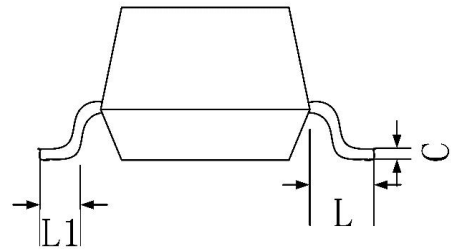
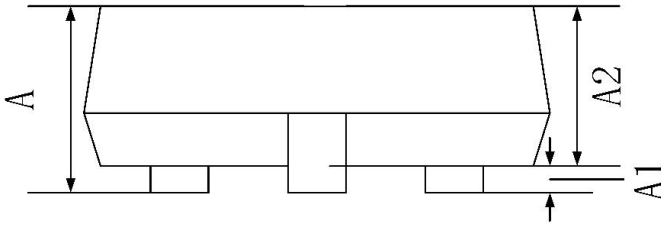
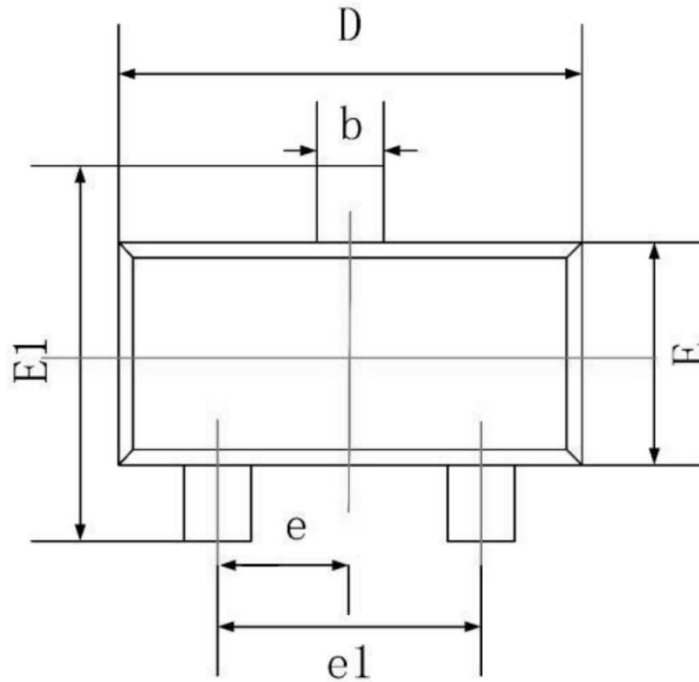


Fig. 11 Gate Charge



## SOT-23 Package Information



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min.                      | Max.  | Min.                 | Max.  |
| A      | 0.890                     | 1.200 | 0.035                | 0.047 |
| A1     | 0.000                     | 0.100 | 0.000                | 0.004 |
| A2     | 0.900                     | 1.050 | 0.035                | 0.041 |
| b      | 0.300                     | 0.510 | 0.012                | 0.020 |
| c      | 0.080                     | 0.200 | 0.003                | 0.008 |
| D      | 2.800                     | 3.040 | 0.110                | 0.120 |
| E      | 1.200                     | 1.400 | 0.047                | 0.055 |
| E1     | 2.200                     | 2.600 | 0.087                | 0.102 |
| e      | 0.950 TYP.                |       | 0.037 TYP.           |       |
| e1     | 1.780                     | 2.040 | 0.070                | 0.080 |
| L      | 0.550 REF.                |       | 0.022 REF.           |       |
| L1     | 0.200                     | 0.500 | 0.008                | 0.020 |