



## Product Summary

| $V_{(BR)DSS}$ | $R_{DS(on)TYP}$ | $I_D$  |
|---------------|-----------------|--------|
| 20V           | 250mΩ@4.5V      | 0.75A  |
|               | 350mΩ@2.5V      |        |
| -20V          | 430mΩ@-4.5V     | -0.66A |
|               | 620mΩ@-2.5V     |        |

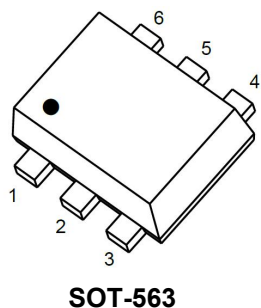
## Feature

- Trench Technology
- Supper high density cell design for extremely low  $R_{ds(on)}$
- Exceptional ON resistance and maximum DC current capability
- ESD protected Gate HBM 2KV

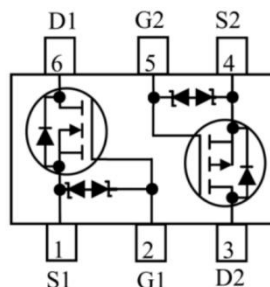
## Application

- Driver: Relays, Solenoids, Lamps, Hammers
- Power supply converters circuit
- Load/Power Switching for potable device

## Package



## Circuit diagram



## Marking



24K =Device Code

**Absolute maximum ratings (Ta=25°C unless otherwise noted)**

| Parameter                                   | Symbol          | Value     | Unit |
|---------------------------------------------|-----------------|-----------|------|
| Power Dissipation                           | $P_D$           | 0.15      | W    |
| Thermal Resistance from Junction to Ambient | $R_{\theta JA}$ | 833       | °C/W |
| Junction Temperature                        | $T_J$           | 150       | °C   |
| Storage Temperature                         | $T_{STG}$       | -55~ +150 | °C   |

**Maximum Ratings - N-Channel Q1 (Ta=25°C unless otherwise noted)**

| Parameter                | Symbol   | Value | Unit |
|--------------------------|----------|-------|------|
| Drain-Source Voltage     | $V_{DS}$ | 20    | V    |
| Gate-Source Voltage      | $V_{GS}$ | ±12   | V    |
| Continuous Drain Current | $I_D$    | 0.75  | A    |

**Maximum Ratings - P-Channel Q2 (Ta=25°C unless otherwise noted)**

| Parameter                | Symbol   | Value | Unit |
|--------------------------|----------|-------|------|
| Drain-Source Voltage     | $V_{DS}$ | -20   | V    |
| Gate-Source Voltage      | $V_{GS}$ | ±10   | V    |
| Continuous Drain Current | $I_D$    | -0.66 | A    |

**Electrical characteristics - N-Channel Q1 (Ta=25 °C, unless otherwise noted)**

| Parameter                       | Symbol               | Test Condition                                                                             | Min. | Typ. | Max. | Unit |
|---------------------------------|----------------------|--------------------------------------------------------------------------------------------|------|------|------|------|
| Static Characteristics          |                      |                                                                                            |      |      |      |      |
| Drain-source breakdown voltage  | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0V, I <sub>D</sub> =250μA                                                | 20   |      |      | V    |
| Zero gate voltage drain current | I <sub>DSS</sub>     | V <sub>DS</sub> =16V,V <sub>GS</sub> = 0V                                                  |      |      | 1    | μA   |
| Gate-body leakage current       | I <sub>GSS</sub>     | V <sub>GS</sub> =±10V, V <sub>DS</sub> = 0V                                                |      |      | ±10  | uA   |
| Gate threshold voltage          | V <sub>GS(th)</sub>  | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                   | 0.35 | 0.65 | 1    | V    |
| Drain-source on-resistance      | R <sub>DS(on)</sub>  | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 0.5A                                              |      | 0.25 | 0.38 | Ω    |
|                                 |                      | V <sub>GS</sub> =2.5V, I <sub>D</sub> = 0.2A                                               |      | 0.35 | 0.45 |      |
|                                 |                      | V <sub>GS</sub> =1.8V, I <sub>D</sub> = 0.1A                                               |      | 0.4  |      |      |
| Dynamic characteristics         |                      |                                                                                            |      |      |      |      |
| Input Capacitance               | C <sub>iss</sub>     | V <sub>DS</sub> =16V,V <sub>GS</sub> =0V,<br>f=1MHz                                        |      | 79   | 120  | pF   |
| Output Capacitance              | C <sub>oss</sub>     |                                                                                            |      | 13   | 20   |      |
| Reverse Transfer Capacitance    | C <sub>rss</sub>     |                                                                                            |      | 9    | 15   |      |
| Switching Characteristics       |                      |                                                                                            |      |      |      |      |
| Turn-on delay time              | t <sub>d(on)</sub>   | V <sub>GS</sub> =4.5V,V <sub>DS</sub> =10V,<br>I <sub>D</sub> =500mA,R <sub>GEN</sub> =10Ω |      | 6.7  |      | ns   |
| Turn-on rise time               | t <sub>r</sub>       |                                                                                            |      | 4.8  |      |      |



|                                           |              |                       |      |     |   |
|-------------------------------------------|--------------|-----------------------|------|-----|---|
| Turn-off delay time                       | $t_{d(off)}$ |                       | 17.3 |     |   |
| Turn-off fall time                        | $t_f$        |                       | 7.4  |     |   |
| <b>Source-Drain Diode characteristics</b> |              |                       |      |     |   |
| Body Diode Voltage                        | $V_{SD}$     | $I_S=0.5A, V_{GS}=0V$ | 0.7  | 1.3 | V |

**Electrical characteristics - P-Channel Q2 ( $T_A=25^\circ C$ , unless otherwise noted)**

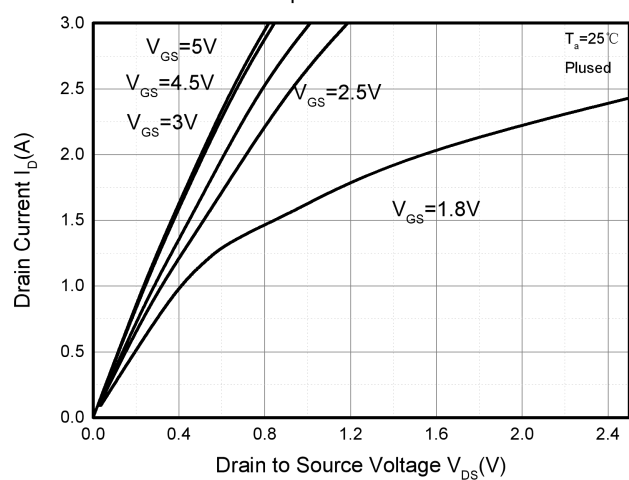
| Parameter                                | Symbol        | Test Condition                                                | Min.  | Typ. | Max.     | Unit     |
|------------------------------------------|---------------|---------------------------------------------------------------|-------|------|----------|----------|
| Static Characteristics                   |               |                                                               |       |      |          |          |
| Drain-source breakdown voltage           | $V_{(BR)DSS}$ | $V_{GS} = 0V, I_D = -250\mu A$                                | -20   |      |          | V        |
| Zero gate voltage drain current          | $I_{DSS}$     | $V_{DS} = -16V, V_{GS} = 0V$                                  |       |      | -1       | $\mu A$  |
| Gate-body leakage current                | $I_{GSS}$     | $V_{GS} = \pm 10V, V_{DS} = 0V$                               |       |      | $\pm 10$ | $\mu A$  |
| Gate threshold voltage                   | $V_{GS(th)}$  | $V_{DS} = V_{GS}, I_D = -250\mu A$                            | -0.35 |      | -1.0     | V        |
| Drain-source on-resistance <sup>1)</sup> | $R_{DS(on)}$  | $V_{GS} = -4.5V, I_D = -0.5A$                                 |       | 0.43 | 0.52     | $\Omega$ |
|                                          |               | $V_{GS} = -2.5V, I_D = -0.2A$                                 |       | 0.62 | 0.7      |          |
|                                          |               | $V_{GS} = -1.8V, I_D = -0.1A$                                 |       | 0.95 |          |          |
| Dynamic characteristics <sup>2)</sup>    |               |                                                               |       |      |          |          |
| Input Capacitance                        | $C_{iss}$     | $V_{DS} = -16V, V_{GS} = 0V, f = 1MHz$                        |       | 113  |          | pF       |
| Output Capacitance                       | $C_{oss}$     |                                                               |       | 15   |          |          |
| Reverse Transfer Capacitance             | $C_{rss}$     |                                                               |       | 9    |          |          |
| Turn-on delay time                       | $t_{d(on)}$   | $V_{DS} = -10V, I_D = -200mA, V_{GS} = -4.5V, R_G = 10\Omega$ |       | 9    |          | ns       |
| Turn-on rise time                        | $t_r$         |                                                               |       | 5.7  |          |          |
| Turn-off delay time                      | $t_{d(off)}$  |                                                               |       | 32.6 |          |          |
| Turn-off fall time                       | $t_f$         |                                                               |       | 20.3 |          |          |
| Source-Drain Diode characteristics       |               |                                                               |       |      |          |          |
| Diode Forward voltage                    | $V_{SD}$      | $V_{GS} = 0V, I_S = -0.5A$                                    |       |      | -1.2     | V        |

Notes:

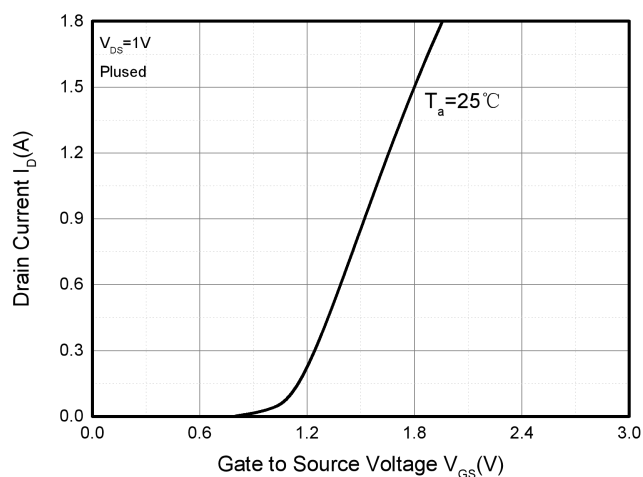
1. Pulse Test: Pulse Width  $< 300\mu s$ , Duty Cycle  $\leq 2\%$ .
2. Guaranteed by design, not subject to production testing.

**Typical Characteristics - N-Channel Q1**

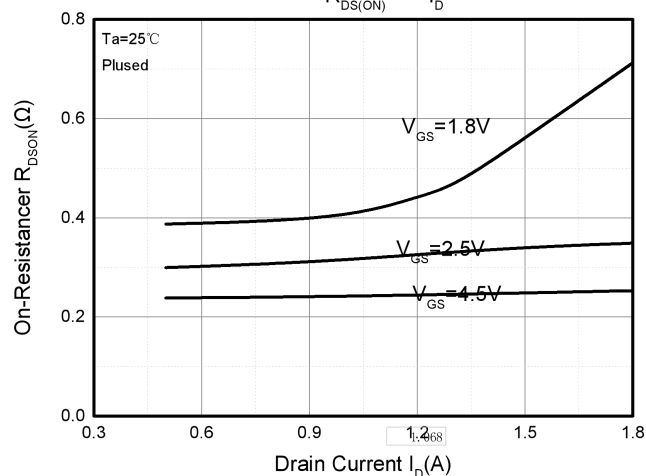
Output Characteristics



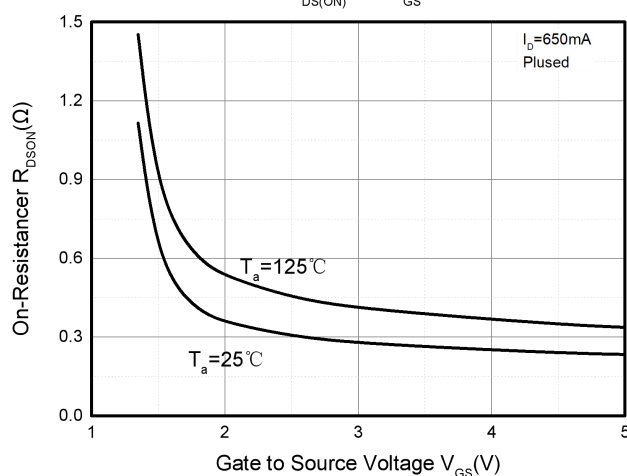
Transfer Characteristics



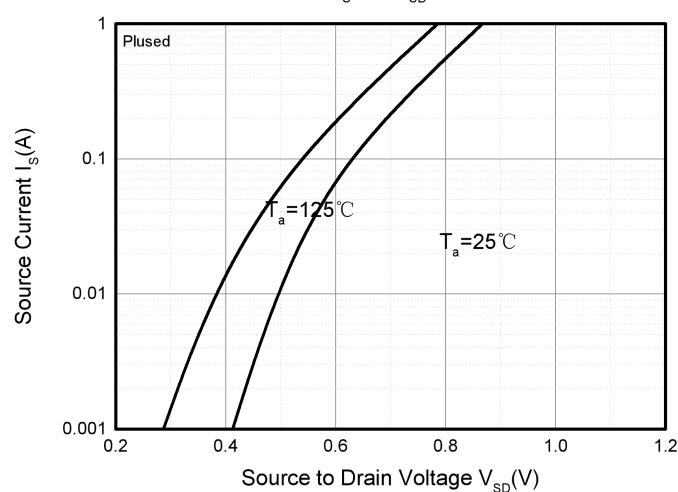
$R_{DS(ON)} - I_D$



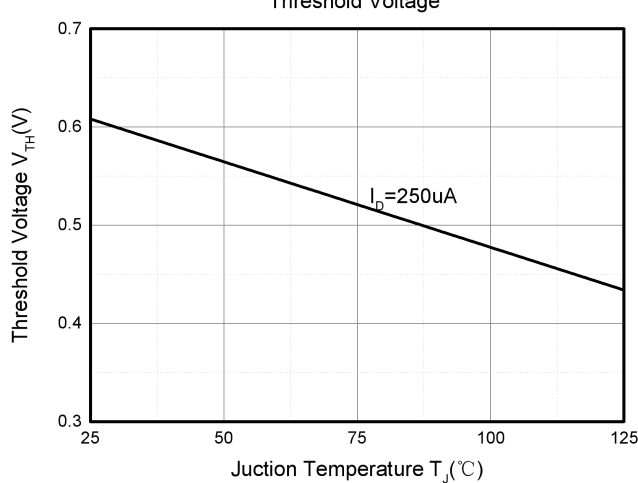
$R_{DS(ON)} - V_{GS}$



$I_S - V_{SD}$

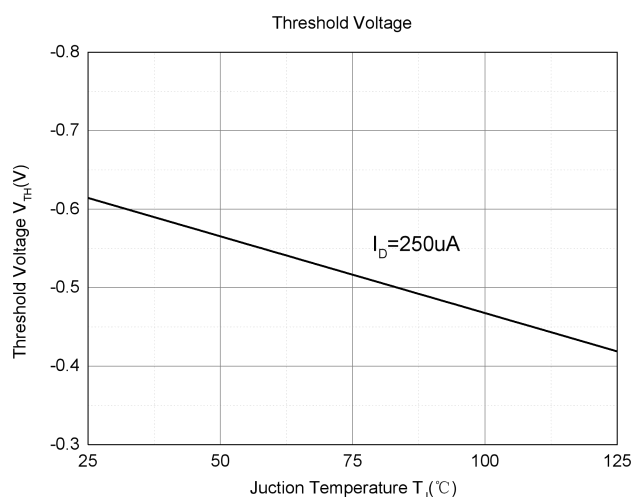
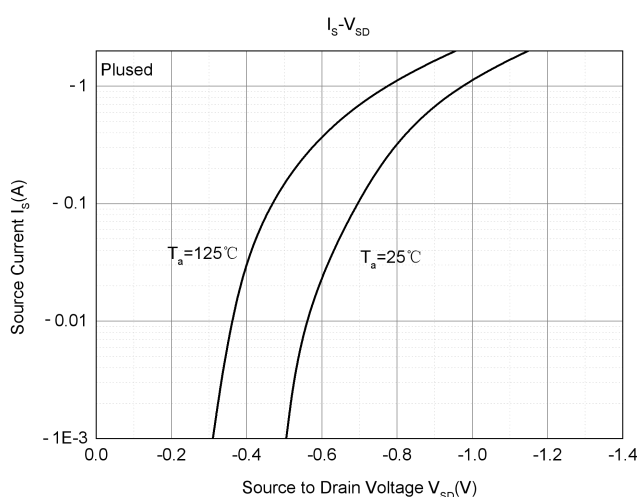
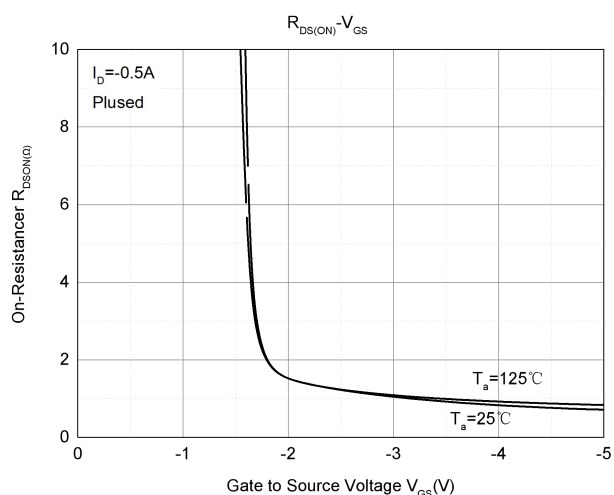
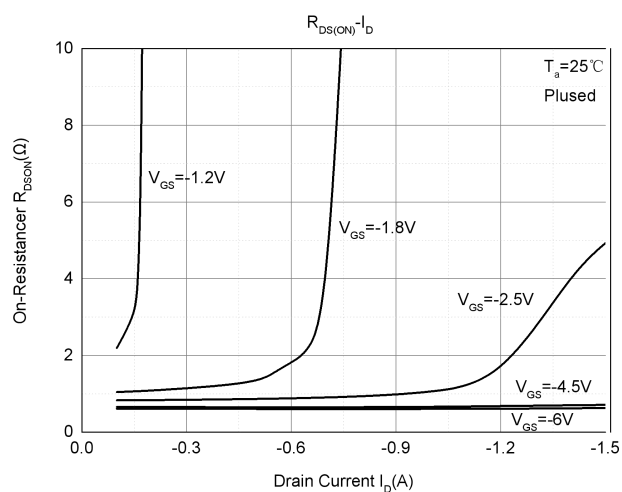
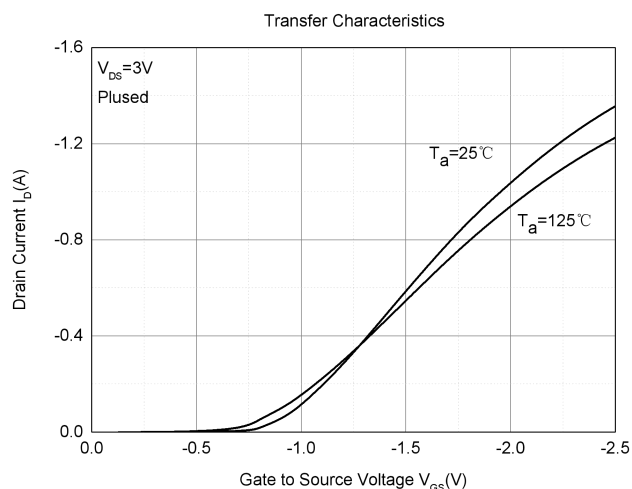
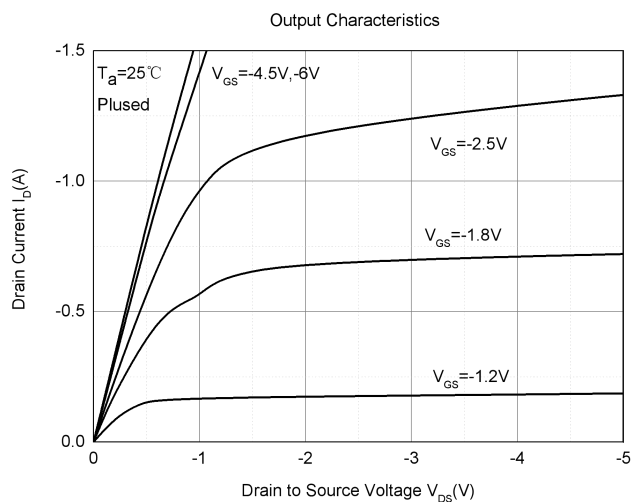


Threshold Voltage



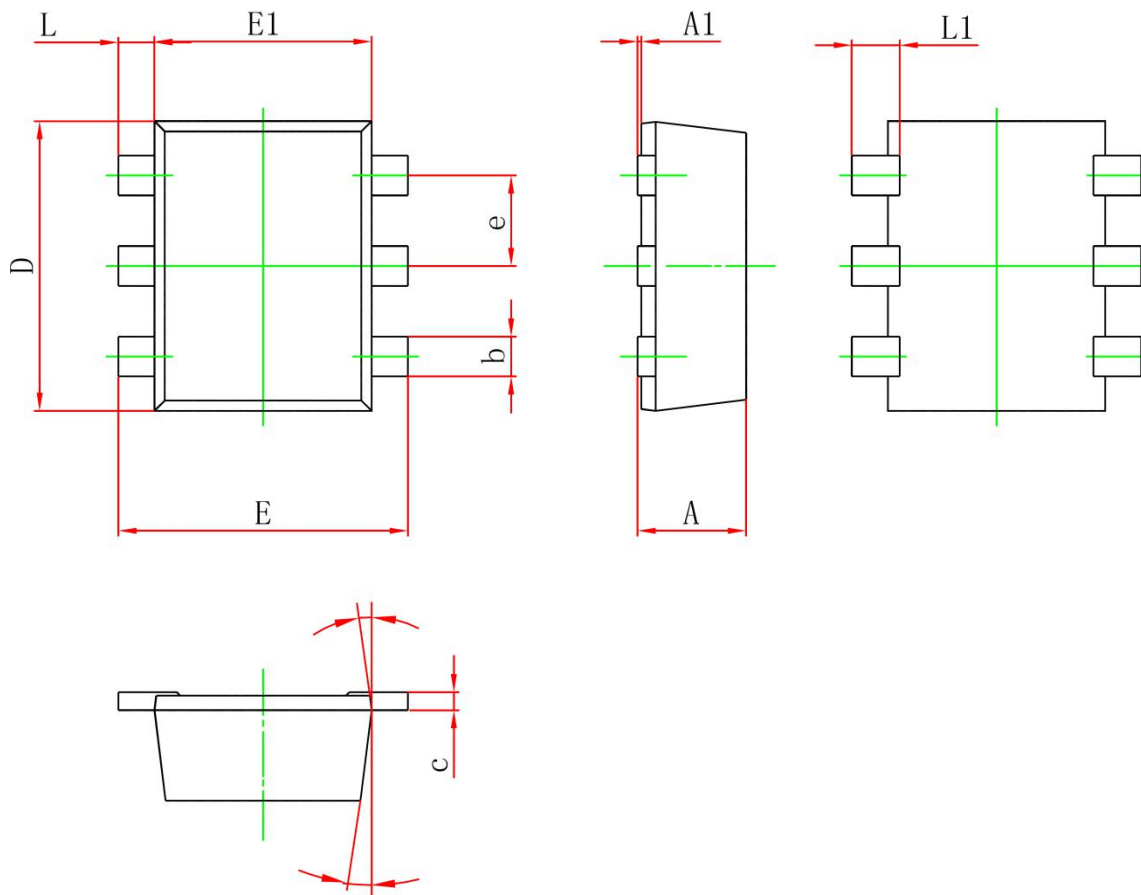


Typical Characteristics - P-Channel Q2





SOT-563 Package Information



| Symbol | Dimensions In Millimeters |       |
|--------|---------------------------|-------|
|        | Min                       | Max   |
| A      | 0.525                     | 0.600 |
| A1     | 0.000                     | 0.050 |
| e      | 0.450                     | 0.550 |
| c      | 0.090                     | 0.160 |
| D      | 1.500                     | 1.700 |
| b      | 0.170                     | 0.270 |
| E1     | 1.100                     | 1.300 |
| E      | 1.500                     | 1.700 |
| L      | 0.100                     | 0.300 |
| L1     | 0.200                     | 0.400 |
| θ      | 7°Ref.                    |       |