

# GSM6604

## 20V N & P Pair Enhancement Mode MOSFET

### Product Description

GSM6604, N & P Pair enhancement mode MOSFET, uses Advanced Trench Technology to provide excellent  $R_{DS(ON)}$ , low gate charge.

These devices are particularly suited for low voltage power management, and low in-line power loss are needed in commercial industrial surface mount applications.

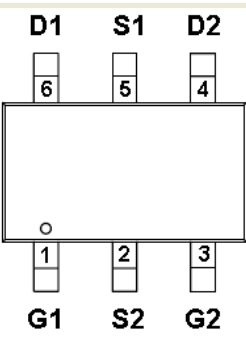
### Features

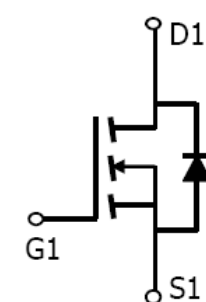
- N-Channel  
20V/3.5A,  $R_{DS(ON)}=52m\Omega@V_{GS}=4.5V$   
20V/2.6A,  $R_{DS(ON)}=62m\Omega@V_{GS}=2.5V$
- P-Channel  
-20V/-3.0A,  $R_{DS(ON)}=105m\Omega@V_{GS}=-4.5V$   
-20V/-2.4A,  $R_{DS(ON)}=150m\Omega@V_{GS}=-2.5V$
- Super high density cell design for extremely low  $R_{DS(ON)}$
- Exceptional on-resistance and maximum DC current capability
- TSOP-6P package design

### Applications

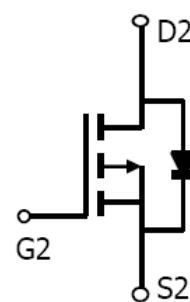
- Power Management in Note book
- Portable Equipment
- Battery Powered System
- DC/DC Converter
- Load Switch
- DSC
- LCD Display inverter

### Packages & Pin Assignments

| GSM6604TSF (TSOP-6P)                                                                |        |             |
|-------------------------------------------------------------------------------------|--------|-------------|
|  |        |             |
| Pin                                                                                 | Symbol | Description |
| 1                                                                                   | G1     | Gate 1      |
| 2                                                                                   | S2     | Source 2    |
| 3                                                                                   | G2     | Gate 2      |
| 4                                                                                   | D2     | Drain 2     |
| 5                                                                                   | S1     | Source 1    |
| 6                                                                                   | D1     | Drain1      |

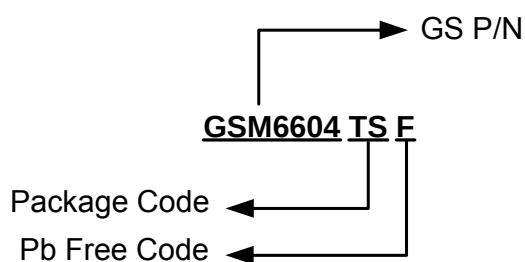


n-channel

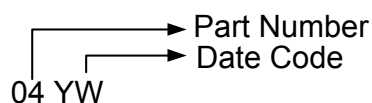


p-channel

## Ordering Information



## Marking Information



| Part Number | Package | Quantity Reel |
|-------------|---------|---------------|
| GSM6604TSF  | TSOP-6P | 3000 PCS      |

## Absolute Maximum Ratings

T<sub>A</sub>=25°C Unless otherwise noted

| Symbol           | Parameter                                       |                      | Typical   |           | Unit |
|------------------|-------------------------------------------------|----------------------|-----------|-----------|------|
|                  |                                                 |                      | N-Channel | P-Channel |      |
| V <sub>DSS</sub> | Drain-Source Voltage                            |                      | 20        | -20       | V    |
| V <sub>GSS</sub> | Gate –Source Voltage                            |                      | ±12       | ±12       | V    |
| I <sub>D</sub>   | Continuous Drain Current(T <sub>J</sub> =150°C) | T <sub>A</sub> =25°C | 3.5       | -3.0      | A    |
|                  |                                                 | T <sub>A</sub> =70°C | 2.6       | -2.4      |      |
| I <sub>DM</sub>  | Pulsed Drain Current                            |                      | 15        | -15       | A    |
| I <sub>S</sub>   | Continuous Source Current (Diode Conduction)    |                      | 1.5       | -1.5      | A    |
| P <sub>D</sub>   | Power Dissipation                               | T <sub>A</sub> =25°C | 2.0       |           | W    |
|                  |                                                 | T <sub>A</sub> =70°C | 1.3       |           |      |
| T <sub>J</sub>   | Operating Junction Temperature                  |                      | 150       |           | °C   |
| T <sub>STG</sub> | Storage Temperature Range                       |                      | -55/150   |           | °C   |
| R <sub>θJA</sub> | Thermal Resistance-Junction to Ambient          |                      | 120       |           | °C/W |

## Electrical Characteristics (N-Channel)

(T<sub>A</sub>=25°C unless otherwise noted)

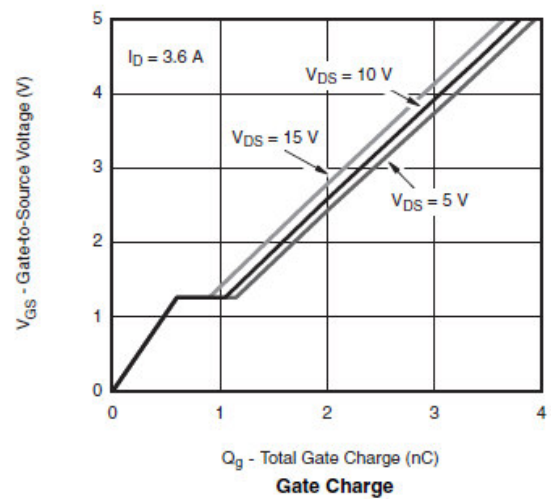
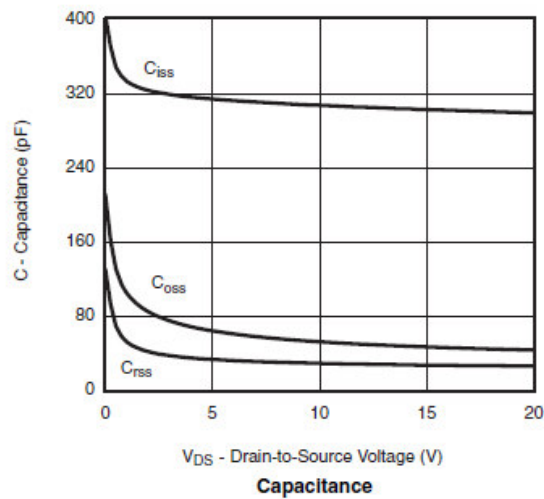
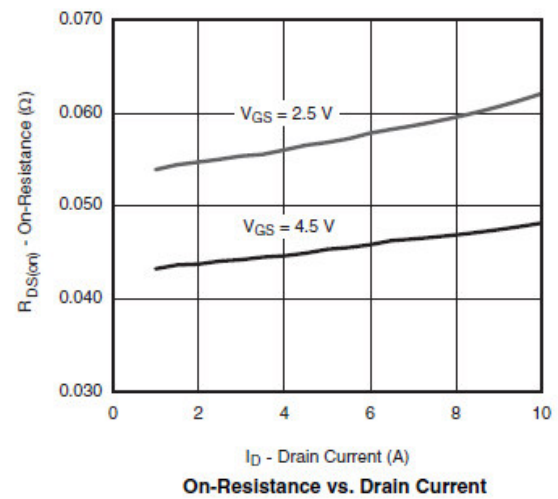
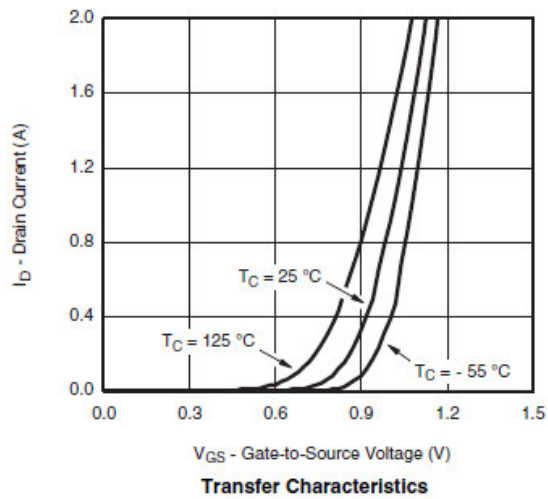
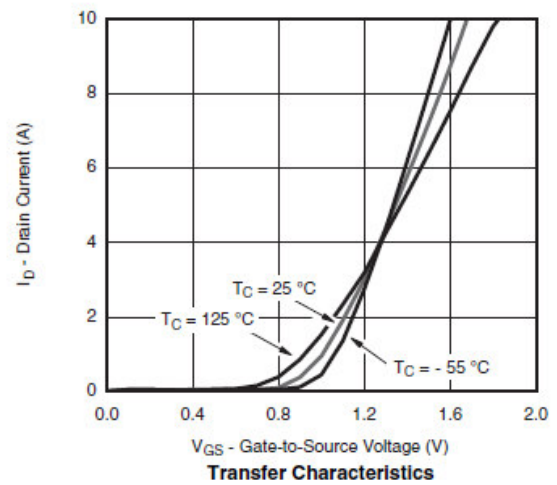
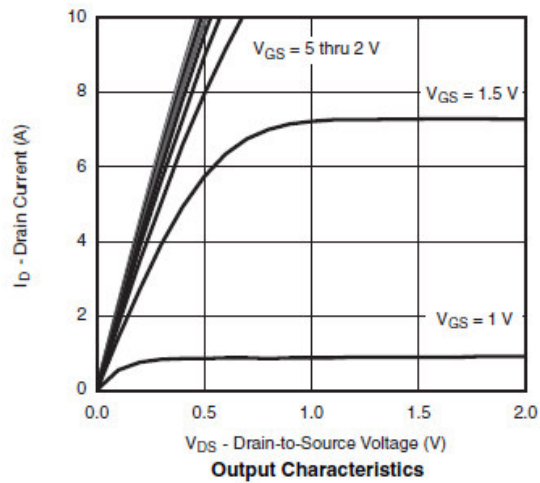
| Symbol               | Parameter                       | Conditions                                                                                                       | Min | Typ  | Max  | Unit |
|----------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------|-----|------|------|------|
| Static               |                                 |                                                                                                                  |     |      |      |      |
| V <sub>(BR)DSS</sub> | Drain-Source Breakdown Voltage  | V <sub>GS</sub> =0V,I <sub>D</sub> =250uA                                                                        | 20  |      |      | V    |
| V <sub>GS(th)</sub>  | Gate Threshold Voltage          | V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =250uA                                                          | 0.3 |      | 0.8  |      |
| I <sub>GSS</sub>     | Gate Leakage Current            | V <sub>DS</sub> =0V,V <sub>GS</sub> =±12V                                                                        |     |      | ±100 | nA   |
| I <sub>DSS</sub>     | Zero Gate Voltage Drain Current | V <sub>DS</sub> =16V,V <sub>GS</sub> =0V                                                                         |     |      | 1    | uA   |
|                      |                                 | V <sub>DS</sub> =16V,V <sub>GS</sub> =0V,<br>T <sub>J</sub> =85°C                                                |     |      | 10   |      |
| I <sub>D(on)</sub>   | On-State Drain Current          | V <sub>DS</sub> ≥5V,V <sub>GS</sub> =4.5V                                                                        | 6   |      |      | A    |
|                      |                                 | V <sub>DS</sub> ≥5V,V <sub>GS</sub> =2.5V                                                                        | 4   |      |      |      |
| R <sub>DS(on)</sub>  | Drain-Source On-Resistance      | V <sub>GS</sub> =4.5V,I <sub>D</sub> =3.5A                                                                       |     | 44   | 52   | mΩ   |
|                      |                                 | V <sub>GS</sub> =2.5V,I <sub>D</sub> =2.6A                                                                       |     | 52   | 62   |      |
| g <sub>FS</sub>      | Forward Transconductance        | V <sub>DS</sub> =5V,I <sub>D</sub> =3.6A                                                                         |     | 10   |      | S    |
| V <sub>SD</sub>      | Diode Forward Voltage           | I <sub>S</sub> =1.6A,V <sub>GS</sub> =0V                                                                         |     | 0.85 | 1.2  | V    |
| Dynamic              |                                 |                                                                                                                  |     |      |      |      |
| C <sub>iss</sub>     | Input Capacitance               | V <sub>DS</sub> =10V,<br>V <sub>GS</sub> =0V,f=1MHz                                                              |     | 340  |      | pF   |
| C <sub>oss</sub>     | Output Capacitance              |                                                                                                                  |     | 115  |      |      |
| C <sub>rss</sub>     | Reverse Transfer Capacitance    |                                                                                                                  |     | 33   |      |      |
| Q <sub>g</sub>       | Total Gate Charge               | V <sub>DS</sub> =10V,<br>V <sub>GS</sub> =4.5V,I <sub>D</sub> =3.6A                                              |     | 4.2  | 5.0  | nC   |
| Q <sub>gs</sub>      | Gate-Source Charge              |                                                                                                                  |     | 0.6  |      |      |
| Q <sub>gd</sub>      | Gate-Drain Charge               |                                                                                                                  |     | 0.4  |      |      |
| t <sub>d(on)</sub>   | Turn-On Time                    | V <sub>DD</sub> =10V,<br>R <sub>L</sub> =2.8Ω,I <sub>D</sub> =3.6A,<br>V <sub>GEN</sub> =4.5V,R <sub>G</sub> =1Ω |     | 8    | 15   | ns   |
| T <sub>r</sub>       |                                 |                                                                                                                  |     | 8    | 15   |      |
| t <sub>d(off)</sub>  | Turn-Off Time                   |                                                                                                                  |     | 25   | 40   |      |
| T <sub>f</sub>       |                                 |                                                                                                                  |     | 8    | 15   |      |

## Electrical Characteristics (P-Channel)

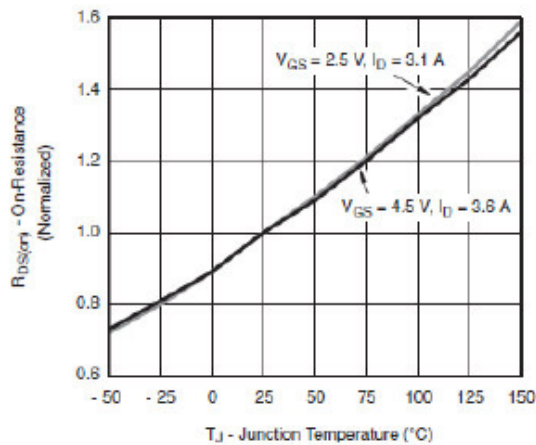
(T<sub>A</sub>=25°C unless otherwise noted)

| Symbol               | Parameter                       | Conditions                                                                                                       | Min  | Typ   | Max  | Unit |
|----------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------|------|-------|------|------|
| Static               |                                 |                                                                                                                  |      |       |      |      |
| V <sub>(BR)DSS</sub> | Drain-Source Breakdown Voltage  | V <sub>GS</sub> =0V,I <sub>D</sub> =-250uA                                                                       | -20  |       |      | V    |
| V <sub>GS(th)</sub>  | Gate Threshold Voltage          | V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =-250uA                                                         | -0.5 |       | -1.0 |      |
| I <sub>GSS</sub>     | Gate Leakage Current            | V <sub>DS</sub> =0V,V <sub>GS</sub> =±12V                                                                        |      |       | ±100 | nA   |
| I <sub>DSS</sub>     | Zero Gate Voltage Drain Current | V <sub>DS</sub> =-16V,V <sub>GS</sub> =0V                                                                        |      |       | -1   | uA   |
|                      |                                 | V <sub>DS</sub> =-16V,V <sub>GS</sub> =0V,<br>T <sub>J</sub> =85°C                                               |      |       | -30  |      |
| I <sub>D(on)</sub>   | On-State Drain Current          | V <sub>DS</sub> ≤-5V,V <sub>GS</sub> =-4.5V                                                                      | -6   |       |      | A    |
|                      |                                 | V <sub>DS</sub> ≤-5V,V <sub>GS</sub> =-2.5V                                                                      | -3   |       |      |      |
| R <sub>DS(on)</sub>  | Drain-Source On-Resistance      | V <sub>GS</sub> =-4.5V,I <sub>D</sub> =-3.0A                                                                     |      | 96    | 105  | mΩ   |
|                      |                                 | V <sub>GS</sub> =-2.5V,I <sub>D</sub> =-2.4A                                                                     |      | 138   | 150  |      |
| g <sub>FS</sub>      | Forward Transconductance        | V <sub>DS</sub> =-5V,I <sub>D</sub> =-2.8A                                                                       |      | 6.5   |      | S    |
| V <sub>SD</sub>      | Diode Forward Voltage           | I <sub>S</sub> =-1.25A,V <sub>GS</sub> =0V                                                                       |      | -0.75 | -1.3 | V    |
| Dynamic              |                                 |                                                                                                                  |      |       |      |      |
| C <sub>iss</sub>     | Input Capacitance               | V <sub>DS</sub> =-6V,<br>V <sub>GS</sub> =0V,f=1MHz                                                              |      | 415   |      | pF   |
| C <sub>Oss</sub>     | Output Capacitance              |                                                                                                                  |      | 223   |      |      |
| C <sub>rss</sub>     | Reverse Transfer Capacitance    |                                                                                                                  |      | 87    |      |      |
| Q <sub>g</sub>       | Total Gate Charge               | V <sub>DS</sub> =-6V,<br>V <sub>GS</sub> =-4.5V,I <sub>D</sub> =-2.8A                                            |      | 5.8   | 10   | nC   |
| Q <sub>gs</sub>      | Gate-Source Charge              |                                                                                                                  |      | 0.85  |      |      |
| Q <sub>gd</sub>      | Gate-Drain Charge               |                                                                                                                  |      | 1.7   |      |      |
| t <sub>d(on)</sub>   | Turn-On Time                    | V <sub>DD</sub> =-6V,<br>R <sub>L</sub> =6Ω,I <sub>D</sub> =-1.0A,<br>V <sub>GEN</sub> =-4.5V,R <sub>G</sub> =6Ω |      | 13    | 25   | ns   |
| T <sub>r</sub>       |                                 |                                                                                                                  |      | 36    | 60   |      |
| t <sub>d(off)</sub>  | Turn-Off Time                   |                                                                                                                  |      | 42    | 70   |      |
| T <sub>f</sub>       |                                 |                                                                                                                  |      | 34    | 60   |      |

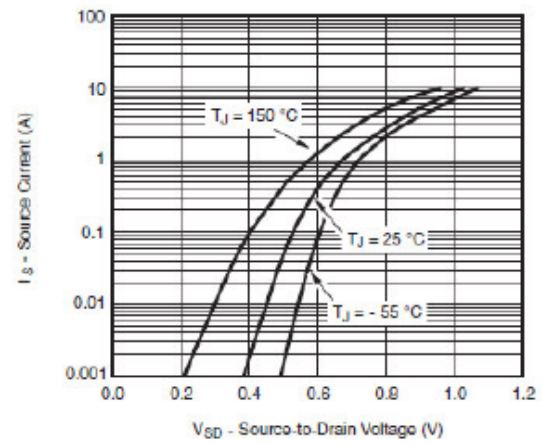
## Typical Performance Characteristics (N-Channel)



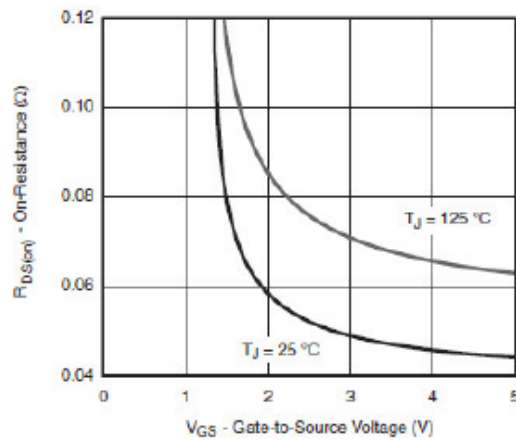
## Typical Performance Characteristics (N-Channel Continue)



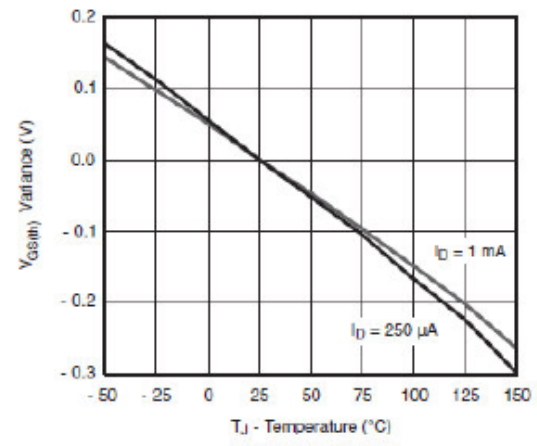
On-Resistance vs. Junction Temperature



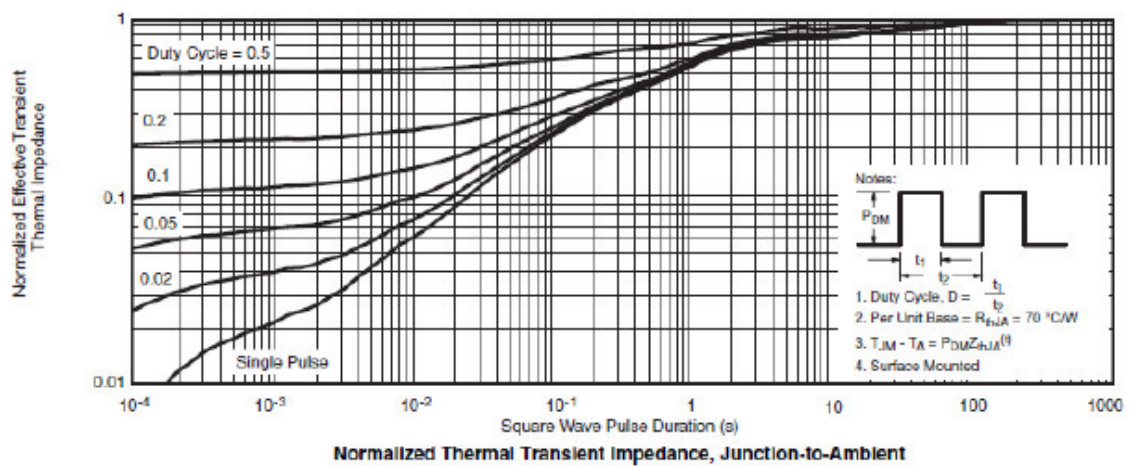
Source-Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage



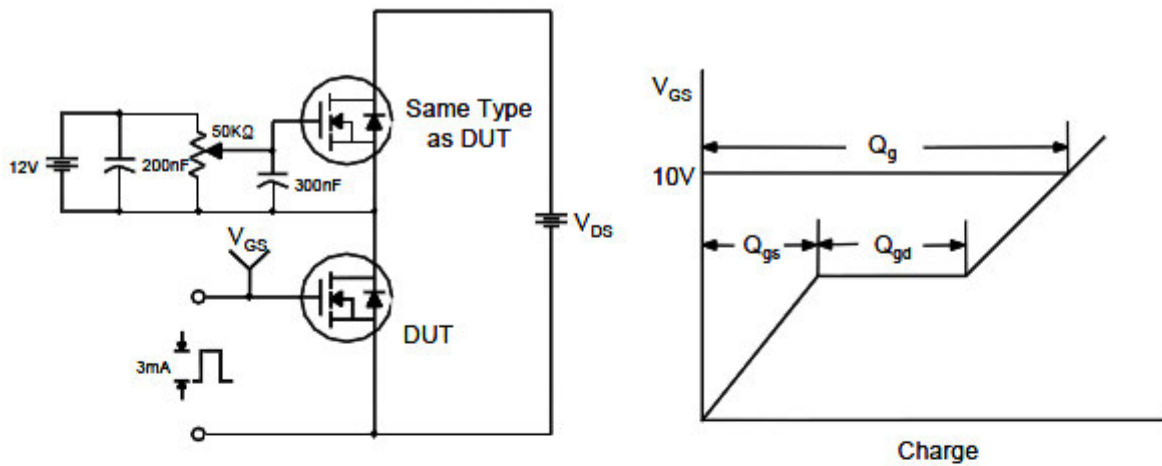
Threshold Voltage



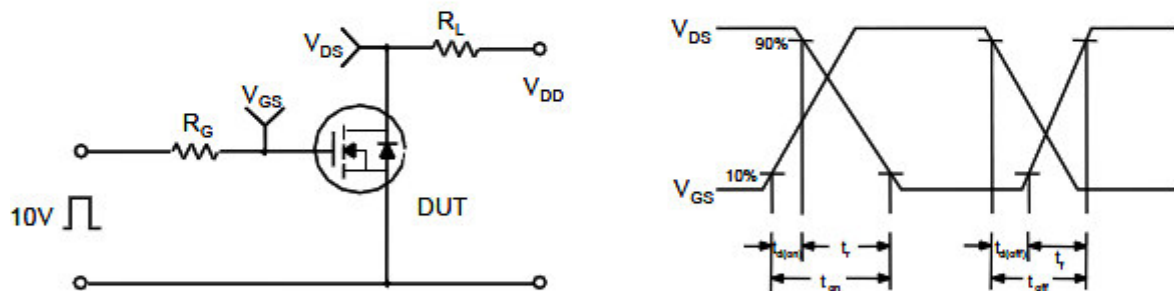
Normalized Thermal Transient Impedance, Junction-to-Ambient

## Typical Performance Characteristics (N-Channel Continue)

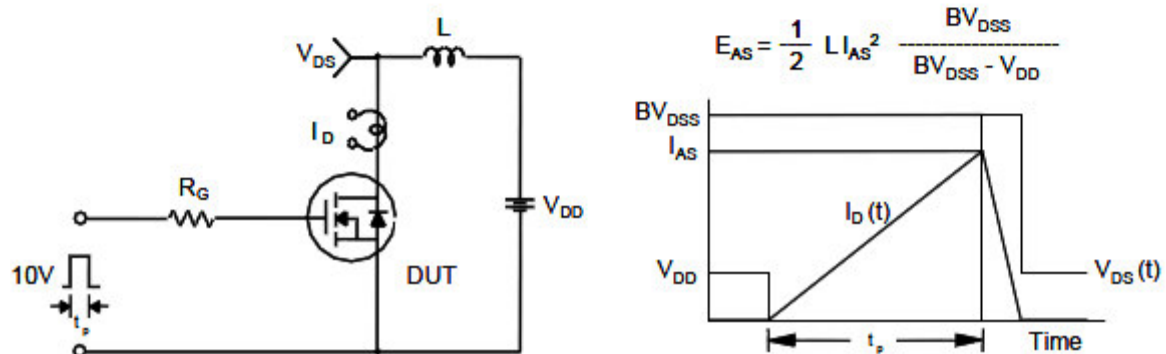
Gate Charge Test Circuit & Waveform



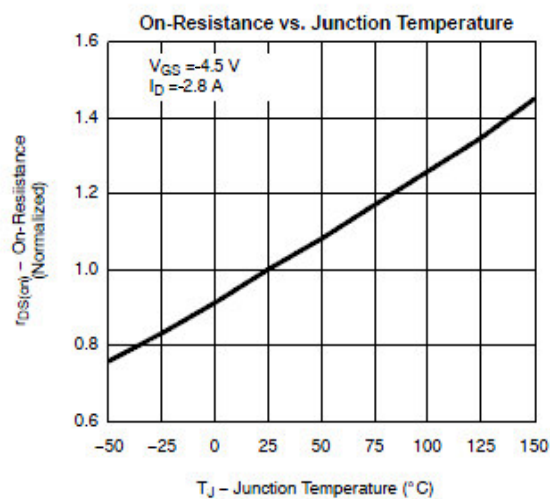
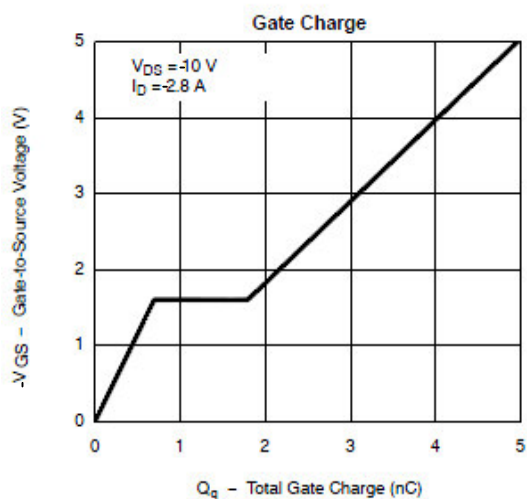
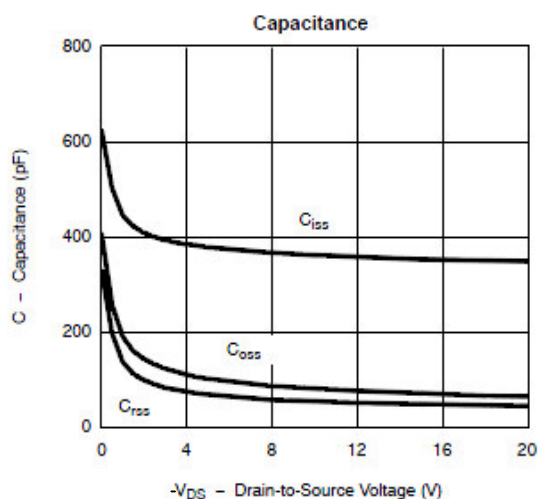
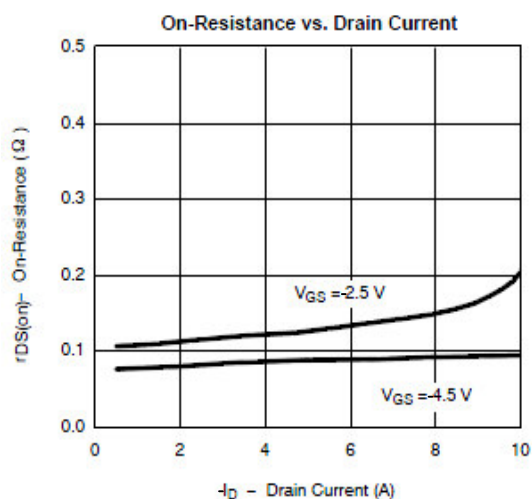
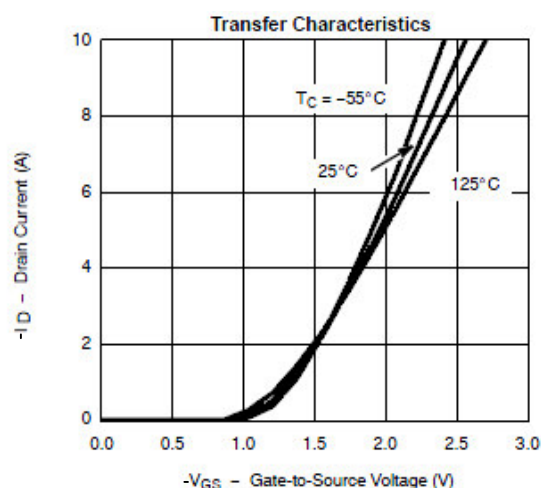
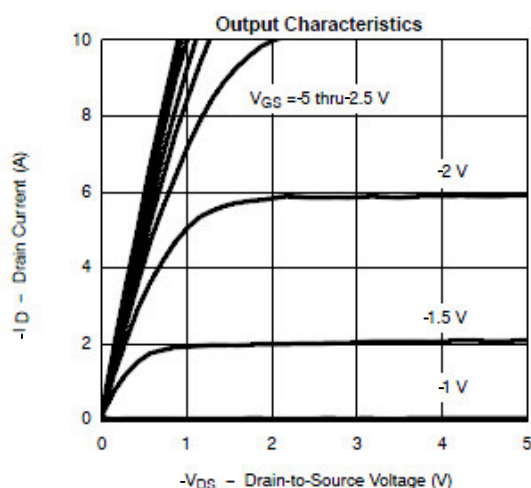
Resistive Switching Test Circuit & Waveforms



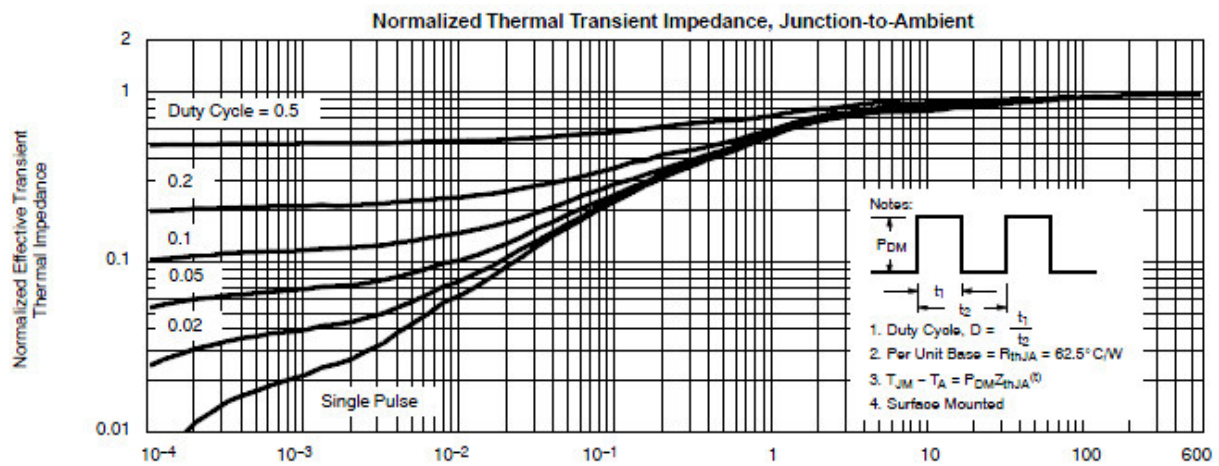
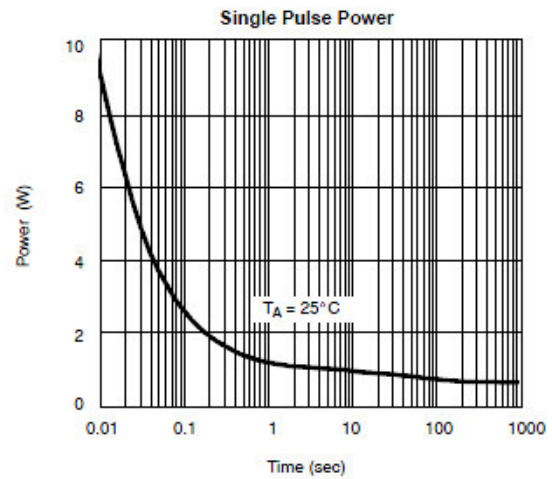
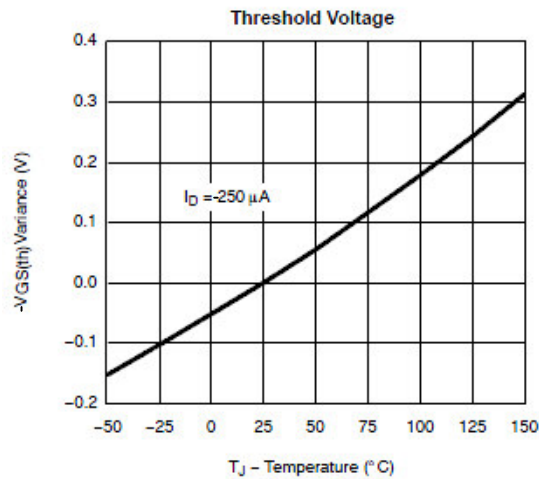
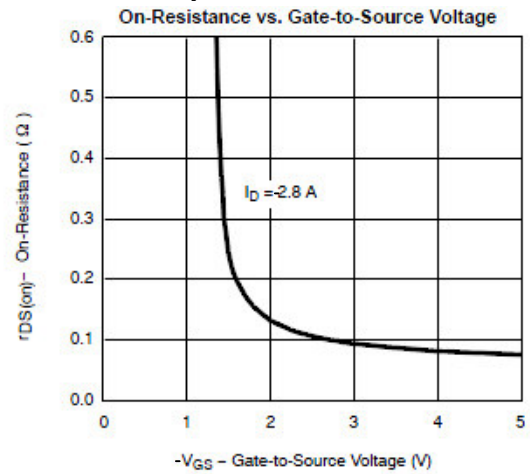
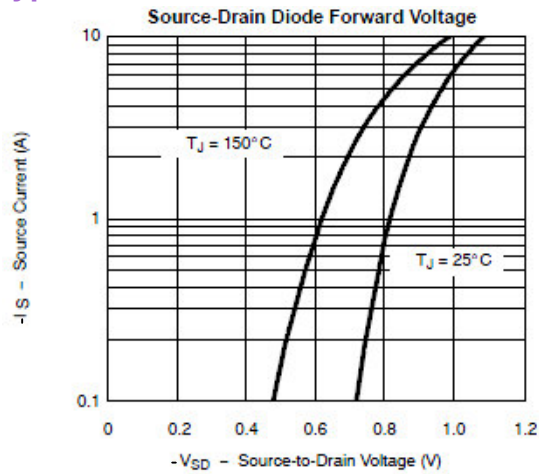
Unclamped Inductive Switching Test Circuit & Waveforms



## Typical Performance Characteristics (P-Channel)

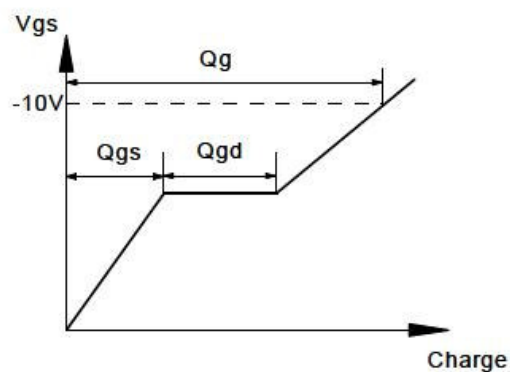
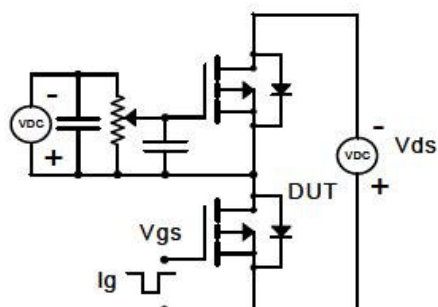


## Typical Performance Characteristics (P-Channel Continue)

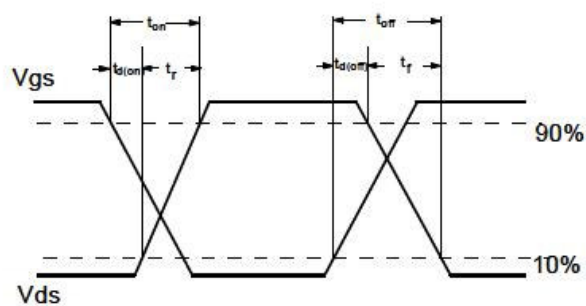
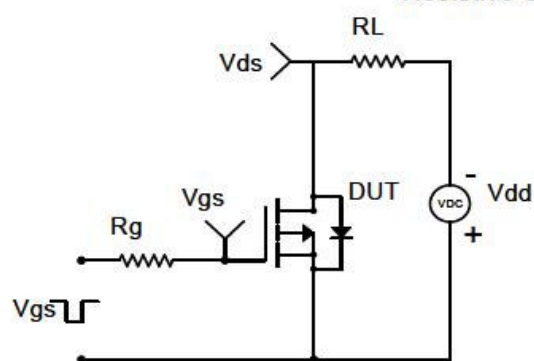


## Typical Performance Characteristics (P-Channel Continue)

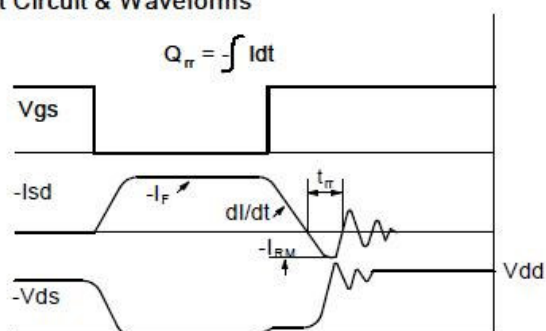
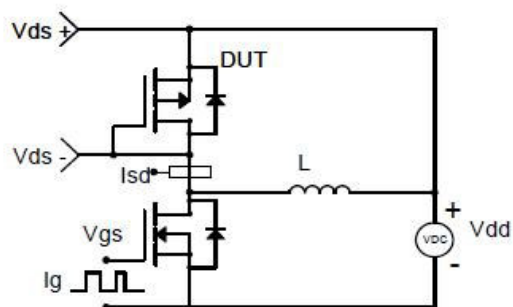
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms

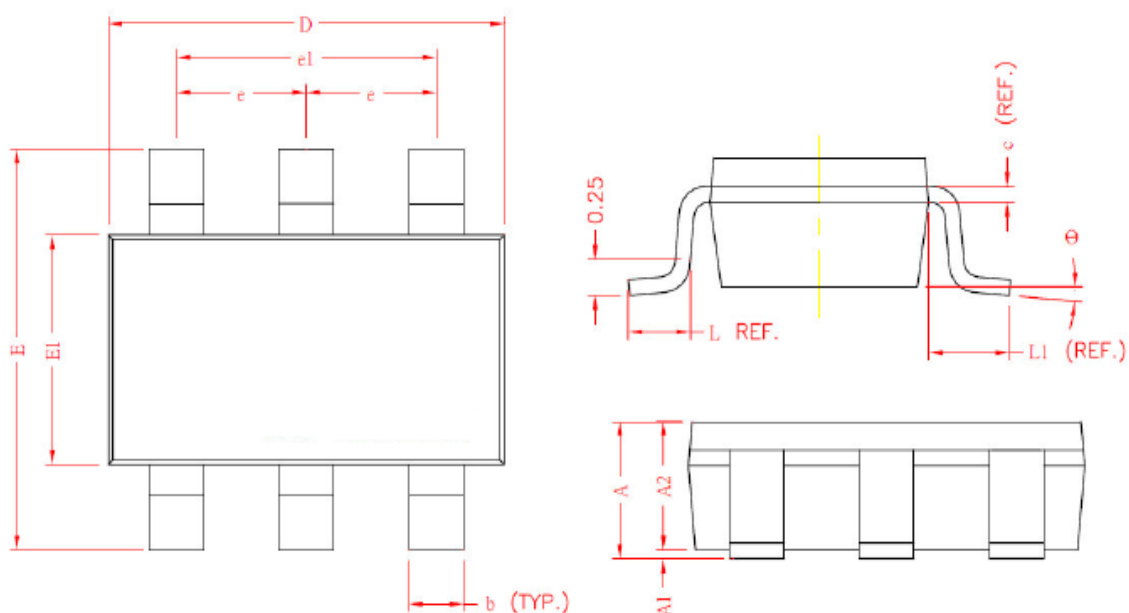


Diode Recovery Test Circuit & Waveforms



## Package Dimension

### TSOP-6P



| Dimensions                 |             |      |             |       |
|----------------------------|-------------|------|-------------|-------|
| Symbol                     | Millimeters |      | Inches      |       |
|                            | Min         | Max  | Min         | Max   |
| <b>A</b>                   | -           | 1.45 | -           | 0.057 |
| <b>A1</b>                  | 0.00        | 0.10 | 0.000       | 0.004 |
| <b>A2</b>                  | 0.70        | 1.35 | 0.028       | 0.053 |
| <b>c</b>                   | 0.12 (REF)  |      | 0.005 (REF) |       |
| <b>D</b>                   | 2.70        | 3.10 | 0.106       | 0.122 |
| <b>E</b>                   | 2.60        | 3.00 | 0.102       | 0.118 |
| <b>E1</b>                  | 1.40        | 1.80 | 0.055       | 0.071 |
| <b>L</b>                   | 0.45 (REF)  |      | 0.018 (REF) |       |
| <b>L1</b>                  | 0.60 (REF)  |      | 0.024 (REF) |       |
| <b><math>\theta</math></b> | 0°          | 10°  | 0°          | 10°   |
| <b>b</b>                   | 0.30        | 0.50 | 0.012       | 0.020 |
| <b>e</b>                   | 0.95 (REF)  |      | 0.037 (REF) |       |
| <b>e1</b>                  | 1.90 (REF)  |      | 0.075 (REF) |       |

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