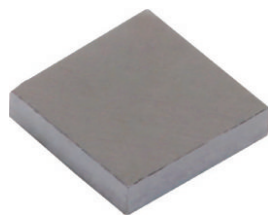
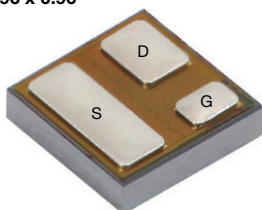


## 7 V (D-S), N-Channel Switch in WCSP3

WCSP3 0.96 x 0.96



Top View



Bottom View

### PRODUCT SUMMARY

| V <sub>DS</sub> (V) | R <sub>DS(on)</sub> (mΩ) MAX.    | I <sub>D</sub> (A) | Q <sub>g</sub> (TYP.) |
|---------------------|----------------------------------|--------------------|-----------------------|
| 7                   | 20 at V <sub>GS</sub> = 3 V      | 5                  | 2.5 nC                |
|                     | 21.6 at V <sub>GS</sub> = 2.65 V | 5                  |                       |
|                     | 22 at V <sub>GS</sub> = 2.1 V    | 5                  |                       |
|                     | 29 at V <sub>GS</sub> = 1.8 V    | 1                  |                       |

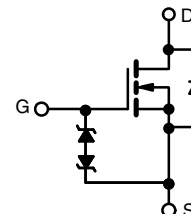
### FEATURES

- Ultra compact 0.96 mm x 0.96 mm outline
- Ultra thin; 0.27 mm
- Low gate drive voltage
- ESD protection: 7 kV HBM, 1 kV CDM
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### APPLICATIONS

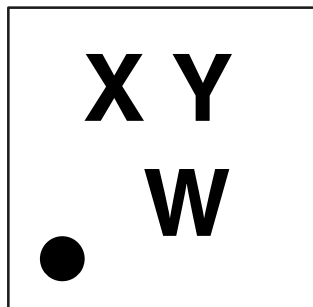
- Low side load switching with minimized voltage drop
- Smart phones, tablet, portable media players



### ORDERING INFORMATION

|                                 |                   |
|---------------------------------|-------------------|
| Package                         | WCSP3 0.96 x 0.96 |
| Lead (Pb)-free and halogen-free | SiP32481DB-T2-GE1 |

### PART MARKING INFORMATION



- = designates location of the gate pin
- XY = part number code (AA for SiP32481)
- W = week code

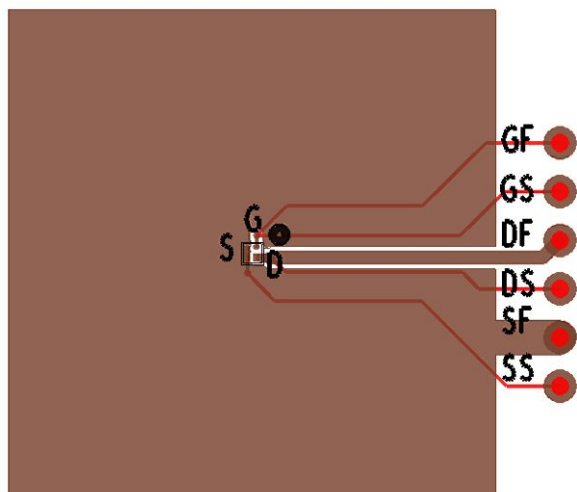
### ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C, unless otherwise noted)

| PARAMETER                                                   | SYMBOL           | LIMIT             | UNIT |
|-------------------------------------------------------------|------------------|-------------------|------|
| Drain-source voltage                                        | V <sub>DS</sub>  | 7                 | V    |
| Gate-source voltage °                                       | V <sub>GS</sub>  | ± 7               |      |
| Continuous drain current, V <sub>GS</sub> = 2.65 V          | I <sub>D</sub>   | 6.5 <sup>a</sup>  | A    |
|                                                             |                  | 5.2 <sup>a</sup>  |      |
|                                                             |                  | 3.9 <sup>b</sup>  |      |
|                                                             |                  | 3.1 <sup>b</sup>  |      |
| Pulsed drain current (t = 300 μs), V <sub>GS</sub> = 2.65 V | I <sub>DM</sub>  | 20                |      |
| Maximum power dissipation, V <sub>GS</sub> = 2.65 V         | P <sub>D</sub>   | 1.3 <sup>a</sup>  | W    |
|                                                             |                  | 0.86 <sup>a</sup> |      |
|                                                             |                  | 0.47 <sup>b</sup> |      |
|                                                             |                  | 0.3 <sup>b</sup>  |      |
| Operating junction temperature range                        | T <sub>J</sub>   | -40 to +150       | °C   |
| Storage temperature range                                   | T <sub>stg</sub> | -55 to +150       |      |
| Soldering recommendation (peak temperature)                 |                  | 260               |      |
| ESD / HBM                                                   | ESD / HBM        | 7000              | V    |
| ESD / CDM                                                   | ESD / CDM        | 1000              |      |

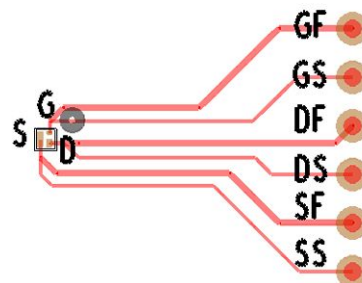
| THERMAL RESISTANCE RATINGS |                   |                            |       |      |      |
|----------------------------|-------------------|----------------------------|-------|------|------|
| PARAMETER                  | SYMBOL            | CONDITION                  | LIMIT |      | UNIT |
|                            |                   |                            | TYP.  | MAX. |      |
| Junction to ambient        | R <sub>thJA</sub> | Steady state, test board a | 75    | 93   | °C/W |
|                            |                   | t = 10 s, test board a     | 45    | 56   |      |
|                            |                   | Steady state, test board b | 210   | 262  |      |
|                            |                   | t = 10 s, test board b     | 154   | 192  |      |

**Notes**

- a. Surface mounted on 1.5" x 1.5" FR4 board with single sided 1" x 1" 2 oz. copper  
b. Surface mounted on 1.5" x 1.5" FR4 board with minimum 2 oz. copper pad

**BOARD LAYOUTS**


Test board a, 75 °C/W (typical)



Test board b, 210 °C/W (typical)



| SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted) |                     |                                                                                                |      |      |      |      |
|-----------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------|------|------|------|------|
| PARAMETER                                                       | SYMBOL              | TEST CONDITIONS                                                                                | MIN. | TYP. | MAX. | UNIT |
| Static                                                          |                     |                                                                                                |      |      |      |      |
| Drain-source breakdown voltage                                  | V <sub>DS</sub>     | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                 | 8    | -    | -    | V    |
| Gate-source threshold voltage                                   | V <sub>GS(th)</sub> | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                    | 0.45 | -    | 0.8  |      |
| Gate-source leakage                                             | I <sub>GSS</sub>    | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 5.5 V                                               | -0.2 | -    | 0.2  | μA   |
| On-state drain current <sup>a</sup>                             | I <sub>D(on)</sub>  | V <sub>DS</sub> = 5.5 V, V <sub>GS</sub> = 4.5 V                                               | 10   | -    | -    | A    |
| Zero gate voltage drain current                                 | I <sub>DSS</sub>    | V <sub>DS</sub> = 5.5 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 25 °C                         | -    | 0.02 | 1    | μA   |
|                                                                 |                     | V <sub>DS</sub> = 5.5 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 85 °C                         | -    | -    | 1.8  |      |
|                                                                 |                     | V <sub>DS</sub> = 5.5 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                        | -    | -    | 18   |      |
|                                                                 |                     | V <sub>DS</sub> = 5.5 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C                        | -    | 35   | 72   |      |
| Drain-source on-state resistance <sup>a</sup>                   | R <sub>DS(on)</sub> | V <sub>GS</sub> = 3 V, I <sub>D</sub> = 5 A, T <sub>J</sub> = 25 °C                            | -    | 13   | 20   | mΩ   |
|                                                                 |                     | V <sub>GS</sub> = 3 V, I <sub>D</sub> = 5 A, T <sub>J</sub> = 150 °C                           | -    | 19.6 | 31   |      |
|                                                                 |                     | V <sub>GS</sub> = 2.65 V, I <sub>D</sub> = 5 A, T <sub>J</sub> = 25 °C                         | -    | 13.8 | 21.6 |      |
|                                                                 |                     | V <sub>GS</sub> = 2.65 V, I <sub>D</sub> = 5 A, T <sub>J</sub> = 150 °C                        | -    | 21   | 31.3 |      |
|                                                                 |                     | V <sub>GS</sub> = 2.1 V, I <sub>D</sub> = 5 A, T <sub>J</sub> = 25 °C                          | -    | 15.2 | 22   |      |
|                                                                 |                     | V <sub>GS</sub> = 2.1 V, I <sub>D</sub> = 5 A, T <sub>J</sub> = 150 °C                         | -    | 23.9 | 38   |      |
|                                                                 |                     | V <sub>GS</sub> = 1.8 V, I <sub>D</sub> = 5 A, T <sub>J</sub> = 25 °C                          | -    | 17.5 | 29   |      |
| Forward transconductance <sup>a</sup>                           | g <sub>fs</sub>     | V <sub>DS</sub> = 4 V, I <sub>D</sub> = 1 A                                                    | -    | 9    | -    | S    |
|                                                                 |                     | V <sub>DS</sub> = 5.5 V, I <sub>D</sub> = 4 A                                                  | -    | 20   | -    |      |
| Dynamic <sup>b</sup>                                            |                     |                                                                                                |      |      |      |      |
| Input capacitance                                               | C <sub>iss</sub>    | V <sub>DS</sub> = 4 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                        | -    | 450  | 680  | pF   |
| Output capacitance                                              | C <sub>oss</sub>    | V <sub>DS</sub> = 4 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                        | -    | 293  | -    |      |
| Reverse transfer capacitance                                    | C <sub>rss</sub>    |                                                                                                | -    | 91   | -    |      |
| Total gate charge                                               | Q <sub>g</sub>      | V <sub>DS</sub> = 4 V, I <sub>D</sub> = 4 A, V <sub>GS</sub> = 3 V                             | -    | 2.7  | -    | nC   |
| Gate-source charge                                              | Q <sub>gs</sub>     |                                                                                                | -    | 0.63 | -    |      |
| Gate-drain charge                                               | Q <sub>gd</sub>     |                                                                                                | -    | 0.76 | -    |      |
| Gate resistance                                                 | R <sub>g</sub>      | V <sub>GS</sub> = 0.1 V, f = 1 MHz                                                             | -    | 0.73 | -    | Ω    |
| Turn-on delay time                                              | t <sub>d(on)</sub>  | V <sub>DS</sub> = 4 V, R <sub>L</sub> = 2 Ω,<br>V <sub>GEN</sub> = 2.5 V, R <sub>g</sub> = 1 Ω | -    | -    | 20   | ns   |
| Rise time                                                       | t <sub>r</sub>      |                                                                                                | -    | -    | 30   |      |
| Turn-off delay time                                             | t <sub>d(off)</sub> |                                                                                                | -    | -    | 80   |      |
| Fall time                                                       | t <sub>f</sub>      |                                                                                                | -    | -    | 20   |      |
| Drain-Source Body Diode Characteristics                         |                     |                                                                                                |      |      |      |      |
| Continuous source-drain diode current                           | I <sub>S</sub>      | T <sub>A</sub> = 25 °C                                                                         | -    | -    | 1.5  | A    |
| Pulse diode forward current <sup>b</sup>                        | I <sub>SM</sub>     | t = 300 μs, at 25 °C                                                                           | -    | -    | 10   |      |
| Body diode voltage                                              | V <sub>SD</sub>     | I <sub>S</sub> = 1.5 A, V <sub>GD</sub> = 0 V                                                  | -    | 0.65 | 1.2  | V    |
| Body diode reverse recovery time <sup>b</sup>                   | t <sub>rr</sub>     | I <sub>F</sub> = 2 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C                                 | -    | 102  | 200  | ns   |
| Body diode reverse recovery charge <sup>b</sup>                 | Q <sub>rr</sub>     |                                                                                                | -    | 0.03 | 0.1  | nC   |
| Reverse recovery fall time <sup>b</sup>                         | t <sub>a</sub>      |                                                                                                | -    | 17   | -    | ns   |
| Reverse recovery rise time <sup>b</sup>                         | t <sub>b</sub>      |                                                                                                | -    | 85   | -    |      |

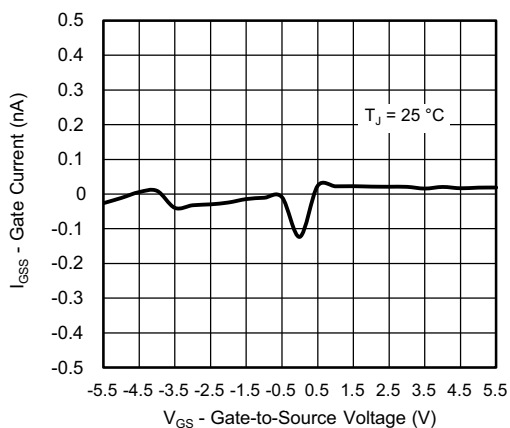
**Notes**

- a. Pulse test: pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$   
b. Guaranteed by design, not subject to production testing

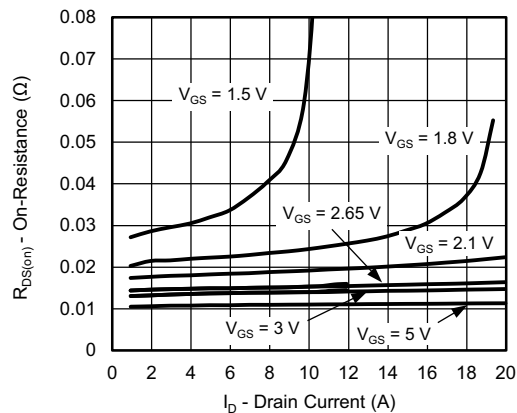
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.



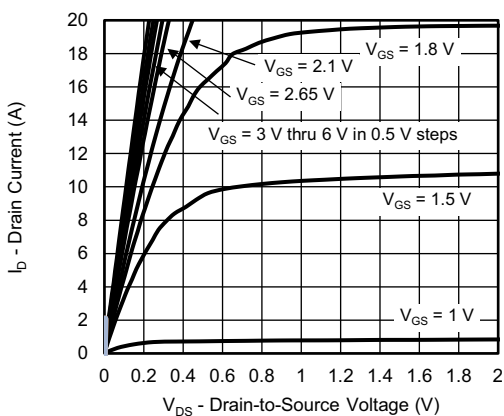
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



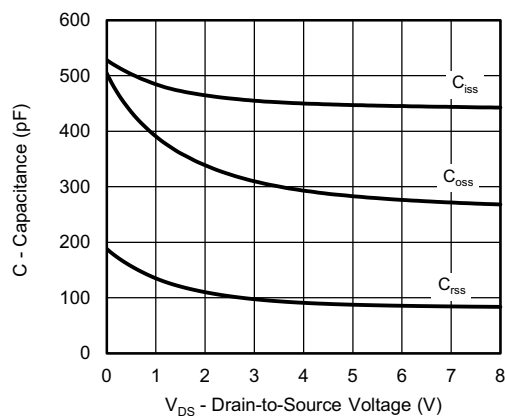
**Gate Current vs. Gate-to-Source Voltage**



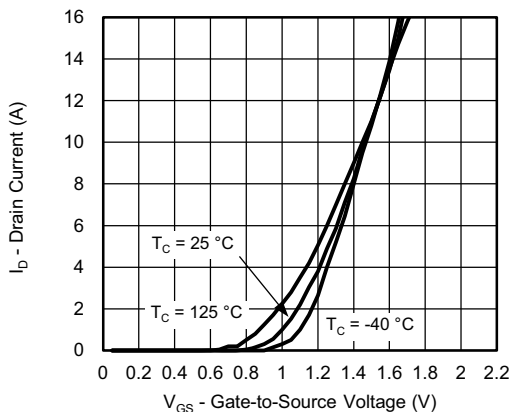
**On-Resistance vs. Drain Current and Gate Voltage**



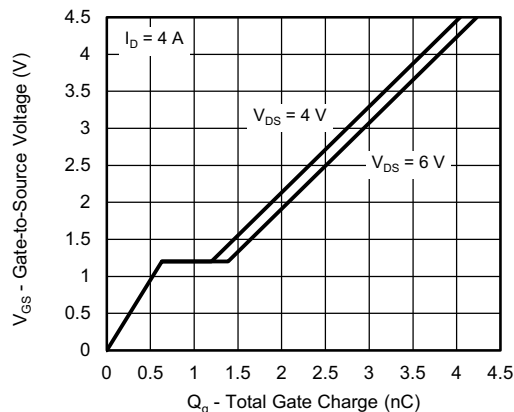
**Output Characteristics**



**Capacitance**



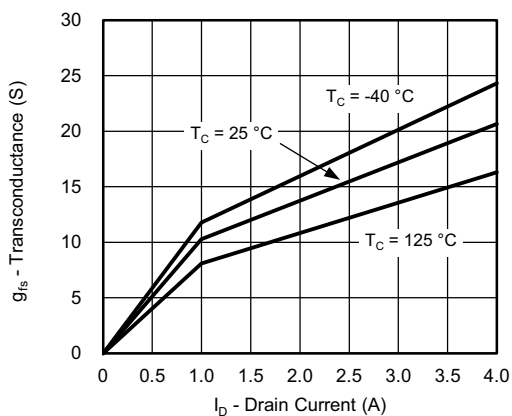
**Transfer Characteristics**



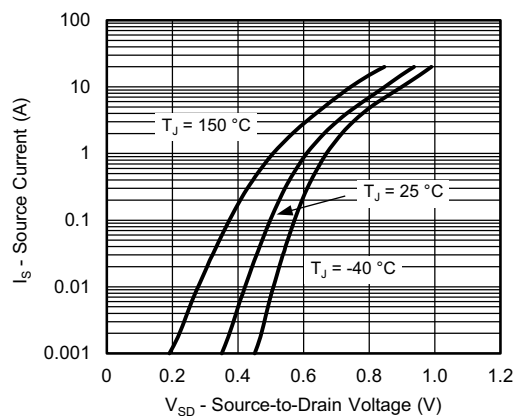
**Gatecharge**



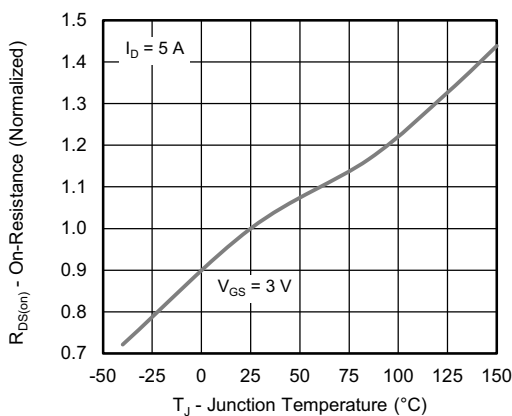
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



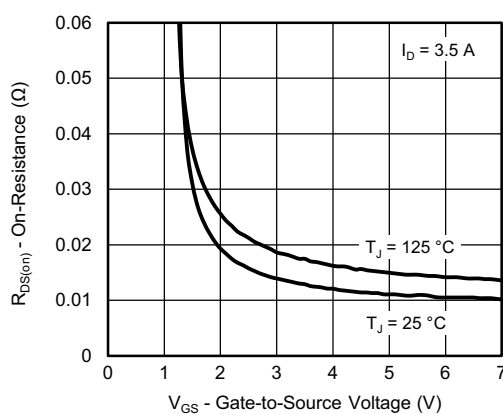
**Transconductance**



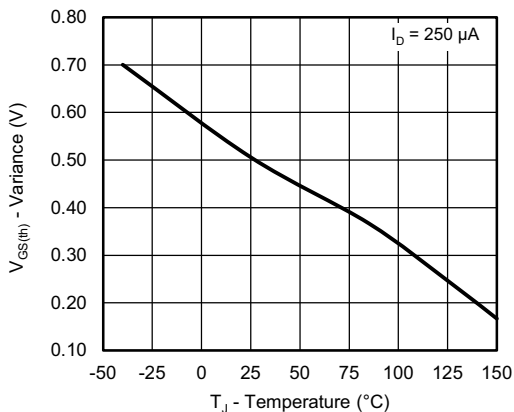
**Forward Diode Voltage**



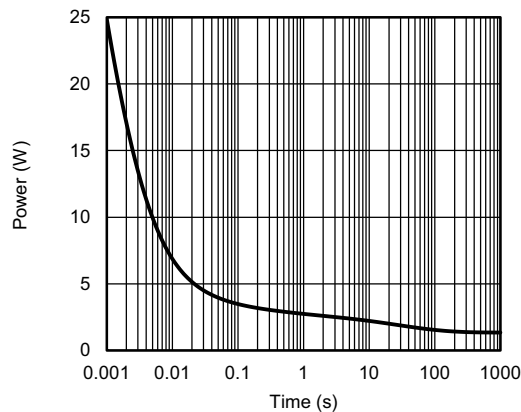
**$R_{DS(on)}$  - On-Resistance (Normalized) vs. Junction Temperature**



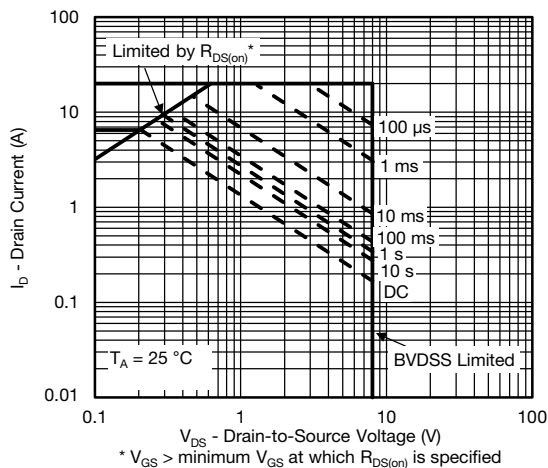
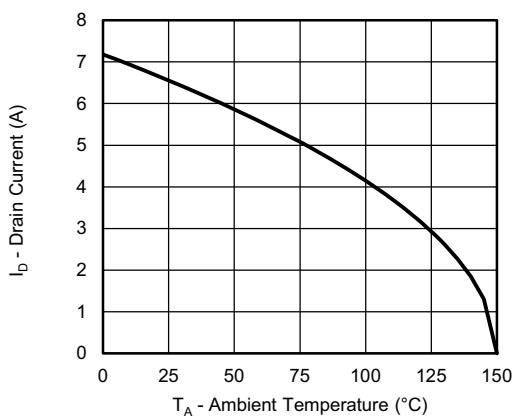
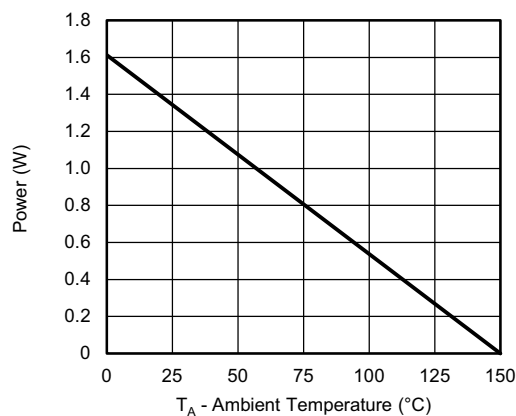
**On-Resistance vs. Gate-to-Source Voltage**



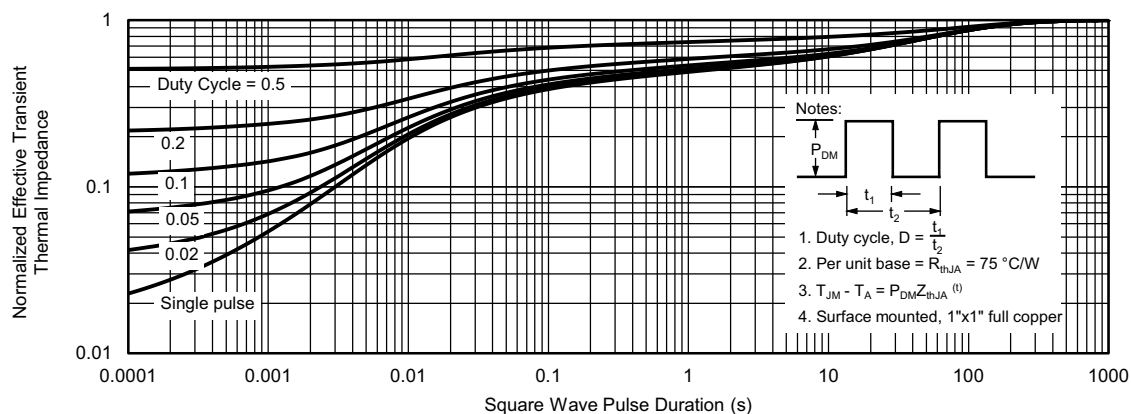
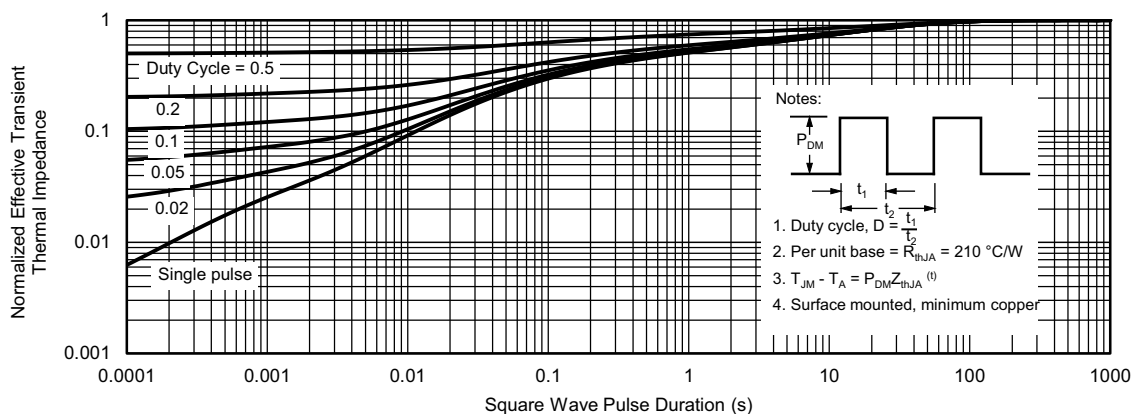
**Threshold Voltage vs. Junction Temperature**



**Single Pulse Power, Junction-to-Ambient**

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Safe Operating Area, Junction-to-Ambient**

**Current Derating <sup>a</sup>**

**Power Derating <sup>a</sup>**
**Note**

- The power dissipation  $P_D$  is based on  $T_A$  max. = 150 °C, using junction-to-ambient thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Normalized Thermal Transient Impedance, Junction-to-Ambient (Test Board a)**

**Normalized Thermal Transient Impedance, Junction-to-Ambient (Test Board b)**

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