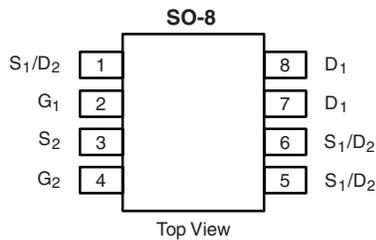


## Dual N-Channel 30-V (D-S) MOSFET with Schottky Diode

| PRODUCT SUMMARY |                     |                                  |                                    |                       |
|-----------------|---------------------|----------------------------------|------------------------------------|-----------------------|
|                 | V <sub>DS</sub> (V) | R <sub>DS(on)</sub> (Ω)          | I <sub>D</sub> (A) <sup>a, e</sup> | Q <sub>g</sub> (Typ.) |
| Channel-1       | 30                  | 0.018 at V <sub>GS</sub> = 10 V  | 8.0                                | 10.5                  |
|                 |                     | 0.022 at V <sub>GS</sub> = 4.5 V | 8.0                                |                       |
| Channel-2       | 30                  | 0.018 at V <sub>GS</sub> = 10 V  | 8.0                                | 10.5                  |
|                 |                     | 0.022 at V <sub>GS</sub> = 4.5 V | 8.0                                |                       |

| SCHOTTKY PRODUCT SUMMARY |  |                                 |
|--------------------------|--|---------------------------------|
| V <sub>DS</sub> (V)      | V <sub>SD</sub> (V)<br>Diode Forward Voltage | I <sub>F</sub> (A) <sup>a</sup> |
| 30                       | 0.43 V at 1.0 A                              | 2.8                             |



Ordering Information: Si4650DY-T1-E3 (Lead (Pb)-free)  
 Si4650DY-T1-GE3 (Lead (Pb)-free and Halogen-free)

### FEATURES

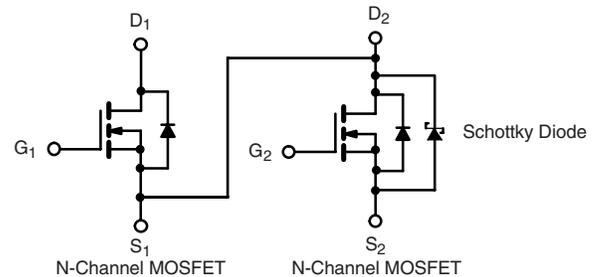
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET<sup>®</sup> Power MOSFET
- 100 % R<sub>g</sub> and UIS Tested
- Compliant to RoHS Directive 2002/95/EC



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

### APPLICATIONS

- Notebook Logic dc-to-dc
- Low Current dc-to-dc



| ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted |                                   |                        |                     |                     |
|---|-----------------------------------|------------------------|---------------------|---------------------|
| Parameter   | Symbol                            | Channel-1              | Channel-2           | Unit                |
| Drain-Source Voltage  | V <sub>DS</sub>                   | 30                     | 30                  | V                   |
| Gate-Source Voltage   | V <sub>GS</sub>                   | ± 20                   | ± 20                | V                   |
| Continuous Drain Current (T <sub>J</sub> = 150 °C)                      | I <sub>D</sub>                    | T <sub>C</sub> = 25 °C | 8.0 <sup>e</sup>    | 8.0 <sup>e</sup>    |
|   |                                   | T <sub>C</sub> = 70 °C | 7.8                 | 7.8                 |
|   |                                   | T <sub>A</sub> = 25 °C | 7.8 <sup>b, c</sup> | 7.8 <sup>b, c</sup> |
|   |                                   | T <sub>A</sub> = 70 °C | 6.2 <sup>b, c</sup> | 6.2 <sup>b, c</sup> |
| Pulsed Drain Current (10 μs Pulse Width)                                | I <sub>DM</sub>                   | 30                     | 30                  | A                   |
| Source-Drain Current Diode Current                                      | I <sub>S</sub>                    | T <sub>C</sub> = 25 °C | 2.8                 | 2.8                 |
|   |                                   | T <sub>A</sub> = 25 °C | 1.8 <sup>b, c</sup> | 1.8 <sup>b, c</sup> |
| Pulsed Source-Drain Current   | I <sub>SM</sub>                   | 30                     | 30                  | A                   |
| Single Pulse Avalanche Current  | I <sub>AS</sub>                   | 20                     | 20                  | A                   |
| Single Pulse Avalanche Energy   | E <sub>AS</sub>                   | 20                     | 20                  | mJ                  |
| Maximum Power Dissipation   | P <sub>D</sub>                    | T <sub>C</sub> = 25 °C | 3.1                 | 3.1                 |
|   |                                   | T <sub>C</sub> = 70 °C | 2                   | 2                   |
|   |                                   | T <sub>A</sub> = 25 °C | 2 <sup>b, c</sup>   | 2 <sup>b, c</sup>   |
|   |                                   | T <sub>A</sub> = 70 °C | 1.2 <sup>b, c</sup> | 1.2 <sup>b, c</sup> |
| Operating Junction and Storage Temperature Range                        | T <sub>J</sub> , T <sub>stg</sub> | - 55 to 150            |                     | °C                  |

| THERMAL RESISTANCE RATINGS                  |                   |           |      |           |      |      |
|---|-------------------|-----------|------|-----------|------|------|
| Parameter                                   | Symbol            | Channel-1 |      | Channel-2 |      | Unit |
|   |                   | Typ.      | Max. | Typ.      | Max. |      |
| Maximum Junction-to-Ambient <sup>b, d</sup> | R <sub>thJA</sub> | 52        | 62.5 | 52        | 62.5 | °C/W |
| Maximum Junction-to-Foot (Drain)            | R <sub>thJF</sub> | 35        | 40   | 35        | 40   | °C/W |

Notes:

- Based on T<sub>C</sub> = 25 °C.
- Surface mounted on 1" x 1" FR4 board.
- t = 10 s.
- Maximum under steady state conditions is 110 °C/W (Channel-1) and 110 °C/W (Channel-2).
- Package limited.

| SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted |                         |  |      |                   |       |                      |    |
|--|-------------------------|--|------|-------------------|-------|----------------------|----|
| Parameter  | Symbol                  | Test Conditions  | Min. | Typ. <sup>a</sup> | Max.  | Unit                 |    |
| <b>Static</b>  |                         |  |      |                   |       |                      |    |
| Drain-Source Breakdown Voltage   | $V_{DS}$                | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$                                     | Ch-1 | 30                |       | V                    |    |
|  |                         | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$                                     | Ch-2 | 30                |       |                      |    |
| $V_{DS}$ Temperature Coefficient   | $\Delta V_{DS}/T_J$     | $I_D = 250\text{ }\mu\text{A}$   | Ch-1 |                   | 35    | mV/ $^\circ\text{C}$ |    |
| $V_{GS(th)}$ Temperature Coefficient                                     | $\Delta V_{GS(th)}/T_J$ | $I_D = 250\text{ }\mu\text{A}$   | Ch-1 |                   | - 6   |                      |    |
| Gate Threshold Voltage   | $V_{GS(th)}$            | $V_{DS} = V_{GS}, I_D = 1\text{ mA}$   | Ch-1 | 1                 |       | 3                    |    |
|  |                         | $V_{DS} = V_{GS}, I_D = 1\text{ mA}$   | Ch-2 | 1                 |       | 3                    |    |
| Gate-Body Leakage  | $I_{GSS}$               | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$                              | Ch-1 |                   |       | 100                  |    |
|  |                         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$                              | Ch-2 |                   |       | 100                  |    |
| Zero Gate Voltage Drain Current  | $I_{DSS}$               | $V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$                                  | Ch-1 |                   |       | 0.001                |    |
|  |                         | $V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$                                  | Ch-2 |                   | 0.06  | 0.5                  |    |
|  |                         | $V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}, T_J = 100\text{ }^\circ\text{C}$ | Ch-1 |                   |       | 0.025                |    |
|  |                         | $V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}, T_J = 100\text{ }^\circ\text{C}$ | Ch-2 |                   | 5     | 20                   |    |
| On-State Drain Current <sup>b</sup>                                      | $I_{D(on)}$             | $V_{DS} = 5\text{ V}, V_{GS} = 10\text{ V}$                                  | Ch-1 | 20                |       | A                    |    |
|  |                         | $V_{DS} = 5\text{ V}, V_{GS} = 10\text{ V}$                                  | Ch-2 | 20                |       |                      |    |
| Drain-Source On-State Resistance <sup>b</sup>                            | $R_{DS(on)}$            | $V_{GS} = 10\text{ V}, I_D = 8\text{ A}$                                     | Ch-1 |                   | 0.014 | 0.018                |    |
|  |                         | $V_{GS} = 10\text{ V}, I_D = 8\text{ A}$                                     | Ch-2 |                   | 0.014 | 0.018                |    |
|  |                         | $V_{GS} = 4.5\text{ V}, I_D = 5\text{ A}$                                    | Ch-1 |                   | 0.017 | 0.022                |    |
|  |                         | $V_{GS} = 4.5\text{ V}, I_D = 5\text{ A}$                                    | Ch-2 |                   | 0.017 | 0.022                |    |
| Forward Transconductance <sup>b</sup>                                    | $g_{fs}$                | $V_{DS} = 15\text{ V}, I_D = 8\text{ A}$                                     | Ch-1 |                   | 40    | S                    |    |
|  |                         | $V_{DS} = 15\text{ V}, I_D = 8\text{ A}$                                     | Ch-2 |                   | 40    |                      |    |
| <b>Dynamic<sup>a</sup></b>   |                         |  |      |                   |       |                      |    |
| Input Capacitance  | $C_{iss}$               | Channel-1<br>$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$   | Ch-1 |                   | 1550  | pF                   |    |
| Output Capacitance   | $C_{oss}$               |  | Ch-2 |                   | 1550  |                      |    |
| Reverse Transfer Capacitance   | $C_{rss}$               | Channel-2<br>$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$   | Ch-1 |                   | 220   |                      |    |
|  |                         |  | Ch-2 |                   | 275   |                      |    |
| Total Gate Charge  | $Q_g$                   | $V_{DS} = 15\text{ V}, V_{GS} = 10\text{ V}, I_D = 8\text{ A}$               | Ch-1 |                   | 80    | nC                   |    |
|  |                         | $V_{DS} = 15\text{ V}, V_{GS} = 10\text{ V}, I_D = 8\text{ A}$               | Ch-2 |                   | 80    |                      |    |
|  |                         | Channel-1<br>$V_{DS} = 15\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 8\text{ A}$ | Ch-1 |                   | 25.5  |                      | 40 |
|  |                         |  | Ch-2 |                   | 25.5  |                      | 40 |
| Gate-Source Charge   | $Q_{gs}$                | Channel-1<br>$V_{DS} = 15\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 8\text{ A}$ | Ch-1 |                   | 10.5  |                      | 16 |
|  |                         |  | Ch-2 |                   | 10.5  |                      | 16 |
| Gate-Drain Charge  | $Q_{gd}$                | Channel-2<br>$V_{DS} = 15\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 8\text{ A}$ | Ch-1 |                   | 5     |                      |    |
|  |                         |  | Ch-2 |                   | 5     |                      |    |
| Gate Resistance  | $R_g$                   | $f = 1\text{ MHz}$   | Ch-1 |                   | 2.5   |                      |    |
|  |                         |  | Ch-2 |                   | 2.5   |                      |    |
|  |                         |  | Ch-1 |                   | 1.8   | 3.0                  |    |
|  |                         |  | Ch-2 |                   | 1.8   | 3.0                  |    |

Notes:

a. Guaranteed by design, not subject to production testing.

b. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .



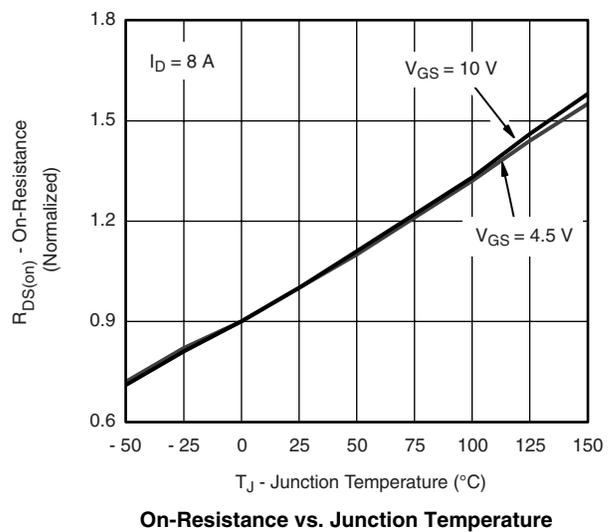
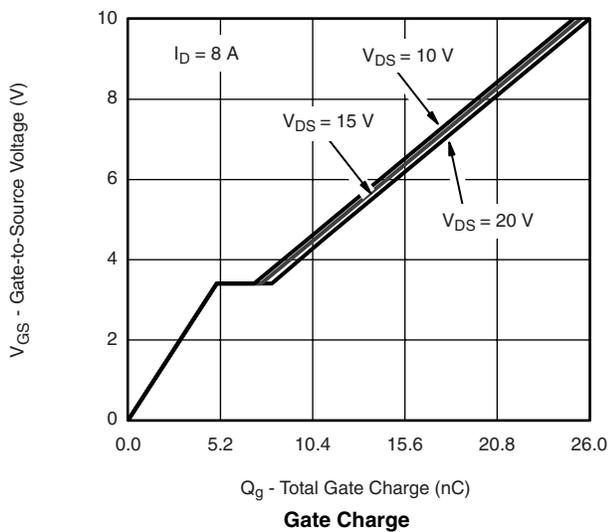
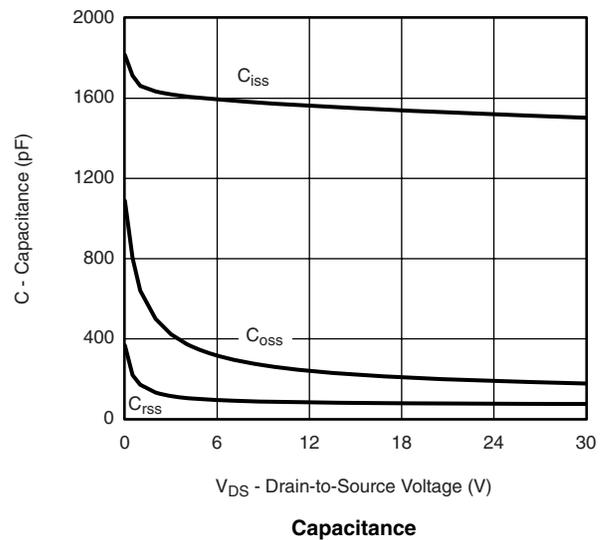
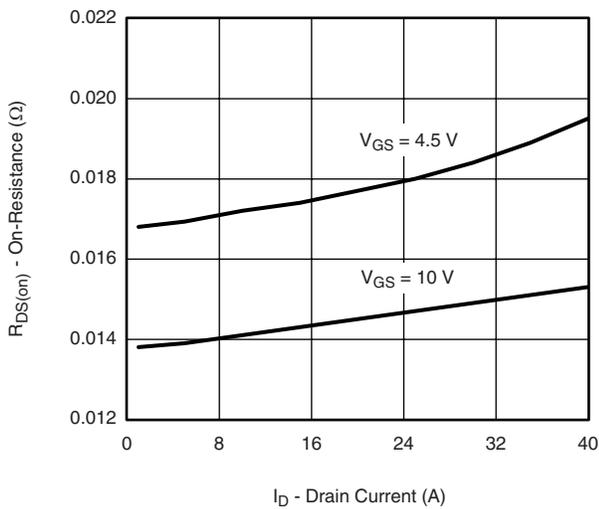
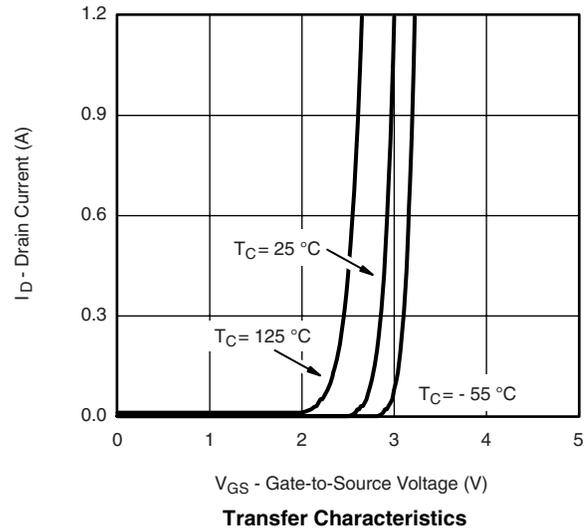
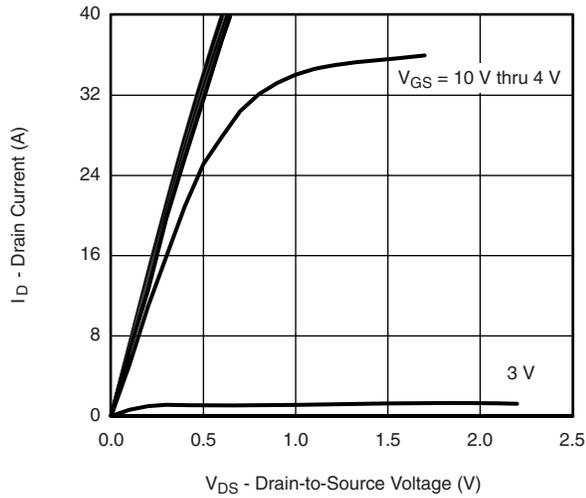
| <b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted |              |  |      |                   |      |      |    |
|---|--------------|--|------|-------------------|------|------|----|
| Parameter   | Symbol       | Test Conditions  | Min. | Typ. <sup>a</sup> | Max. | Unit |    |
| <b>Dynamic<sup>a</sup></b>  |              |  |      |                   |      |      |    |
| Turn-On Delay Time  | $t_{d(on)}$  | Channel-1<br>$V_{DD} = 15\text{ V}, R_L = 3\ \Omega$<br>$I_D \cong 5\text{ A}, V_{GEN} = 10\text{ V}, R_g = 1\ \Omega$<br><br>Channel-2<br>$V_{DD} = 15\text{ V}, R_L = 3\ \Omega$<br>$I_D \cong 5\text{ A}, V_{GEN} = 10\text{ V}, R_g = 1\ \Omega$<br><br>Channel-1<br>$V_{DD} = 15\text{ V}, R_L = 3\ \Omega$<br>$I_D \cong 5\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\ \Omega$<br><br>Channel-2<br>$V_{DD} = 15\text{ V}, R_L = 3\ \Omega$<br>$I_D \cong 5\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\ \Omega$ | Ch-1 |                   | 7    | 14   | ns |
|   |              |  | Ch-2 |                   | 7    | 14   |    |
| Rise Time   | $t_r$        |  | Ch-1 |                   | 29   | 45   |    |
|   |              |  | Ch-2 |                   | 29   | 45   |    |
| Turn-Off Delay Time   | $t_{d(off)}$ |  | Ch-1 |                   | 19   | 30   |    |
|   |              |  | Ch-2 |                   | 19   | 30   |    |
| Fall Time   | $t_f$        |  | Ch-1 |                   | 8    | 16   |    |
|   |              |  | Ch-2 |                   | 8    | 16   |    |
| Turn-On Delay Time  | $t_{d(on)}$  | Ch-1   |      | 32                | 50   |      |    |
|   |              | Ch-2   |      | 32                | 50   |      |    |
| Rise Time   | $t_r$        | Ch-1   |      | 130               | 200  |      |    |
|   |              | Ch-2   |      | 130               | 200  |      |    |
| Turn-Off Delay Time   | $t_{d(off)}$ | Ch-1   |      | 19                | 30   |      |    |
|   |              | Ch-2   |      | 19                | 30   |      |    |
| Fall Time   | $t_f$        | Ch-1   |      | 34                | 55   |      |    |
|   |              | Ch-2   |      | 34                | 55   |      |    |
| <b>Drain-Source Body Diode Characteristics</b>                                  |              |  |      |                   |      |      |    |
| Continuous Source-Drain Diode Current   | $I_S$        | $T_C = 25\text{ }^\circ\text{C}$   | Ch-1 |                   |      | 2.8  | A  |
|   |              |  | Ch-2 |                   |      | 2.8  |    |
| Pulse Diode Forward Current <sup>a</sup>  | $I_{SM}$     |  | Ch-1 |                   |      | 30   |    |
|   |              |  | Ch-2 |                   |      | 30   |    |
| Body Diode Voltage  | $V_{SD}$     | $I_S = 2\text{ A}$<br>$I_S = 1\text{ A}$   | Ch-1 |                   | 0.77 | 1.1  | V  |
|   |              |  | Ch-2 |                   | 0.37 | 0.43 |    |
| Body Diode Reverse Recovery Time  | $t_{rr}$     | Channel-1<br>$I_F = 4\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$<br><br>Channel-2<br>$I_F = 4\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$   | Ch-1 |                   | 25   | 40   | ns |
| Ch-2  |              |  | 23   | 40                |      |      |    |
| Body Diode Reverse Recovery Charge  | $Q_{rr}$     |  | Ch-1 |                   | 18   | 30   | nC |
|   |              |  | Ch-2 |                   | 13   | 20   |    |
| Reverse Recovery Fall Time  | $t_a$        | Ch-1   |      | 14                |      | ns   |    |
|   |              | Ch-2   |      | 11                |      |      |    |
| Reverse Recovery Rise Time  | $t_b$        | Ch-1   |      | 11                |      |      |    |
|   |              | Ch-2   |      | 12                |      |      |    |

Notes:

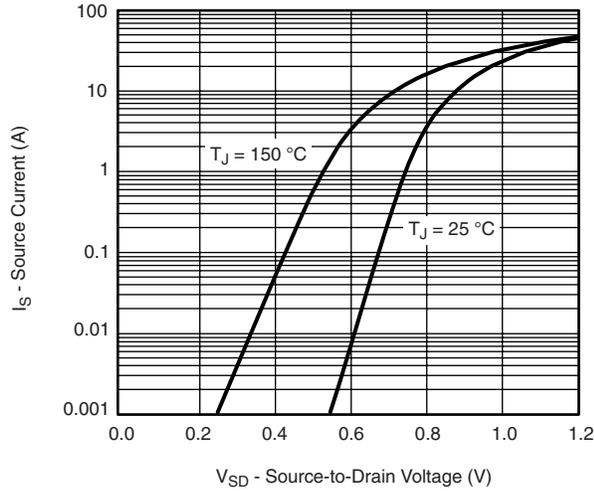
- a. Guaranteed by design, not subject to production testing.
- b. Pulse test; pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

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.

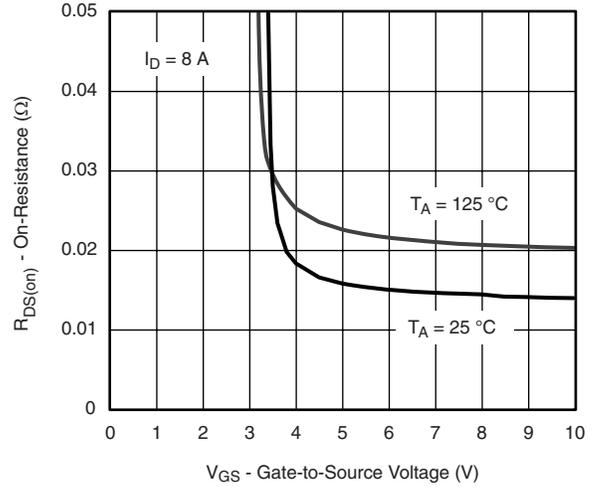
## CHANNEL-1 TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



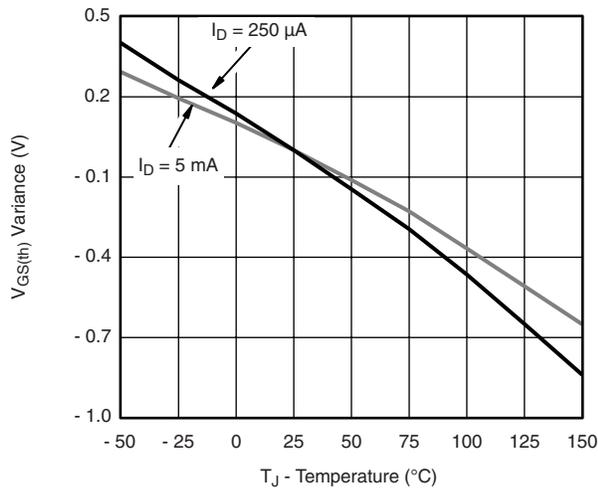
## CHANNEL-1 TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



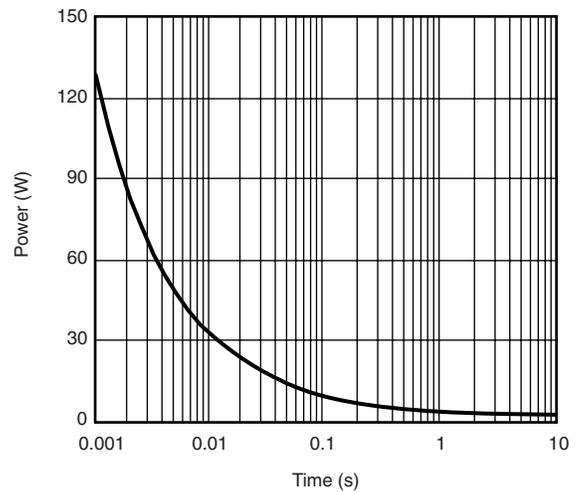
Source-Drain Diode Forward Voltage



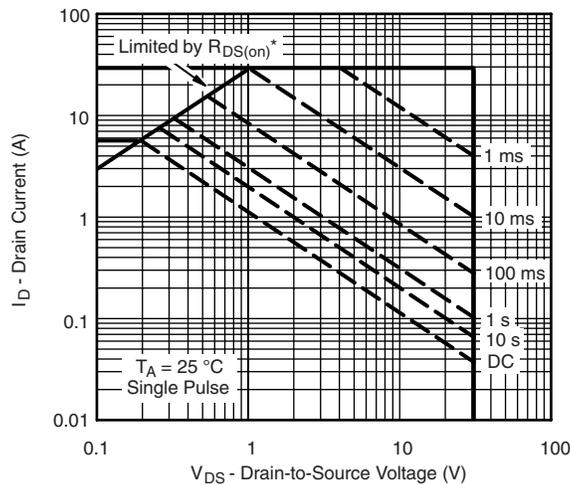
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



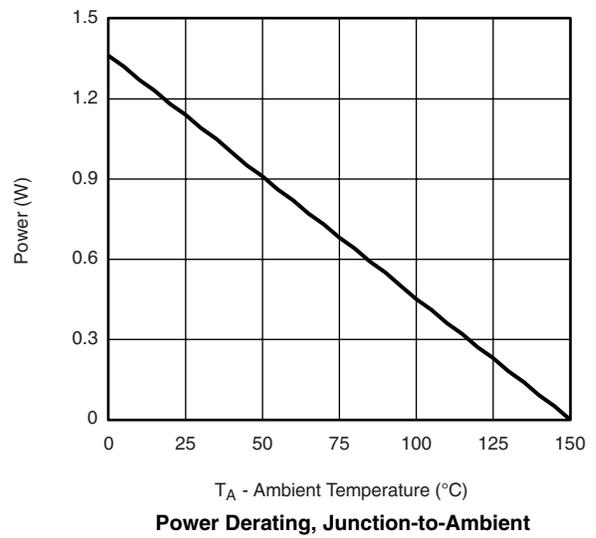
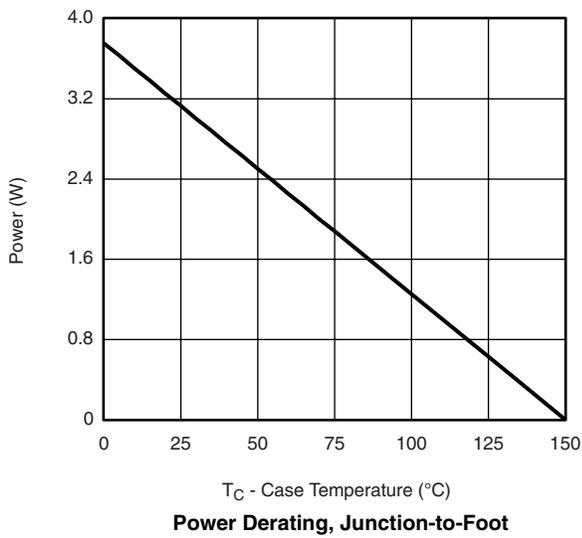
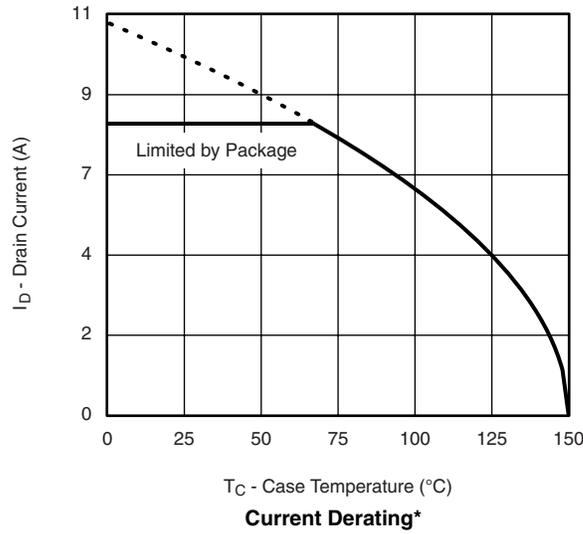
Single Pulse Power, Junction-to-Ambient



\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

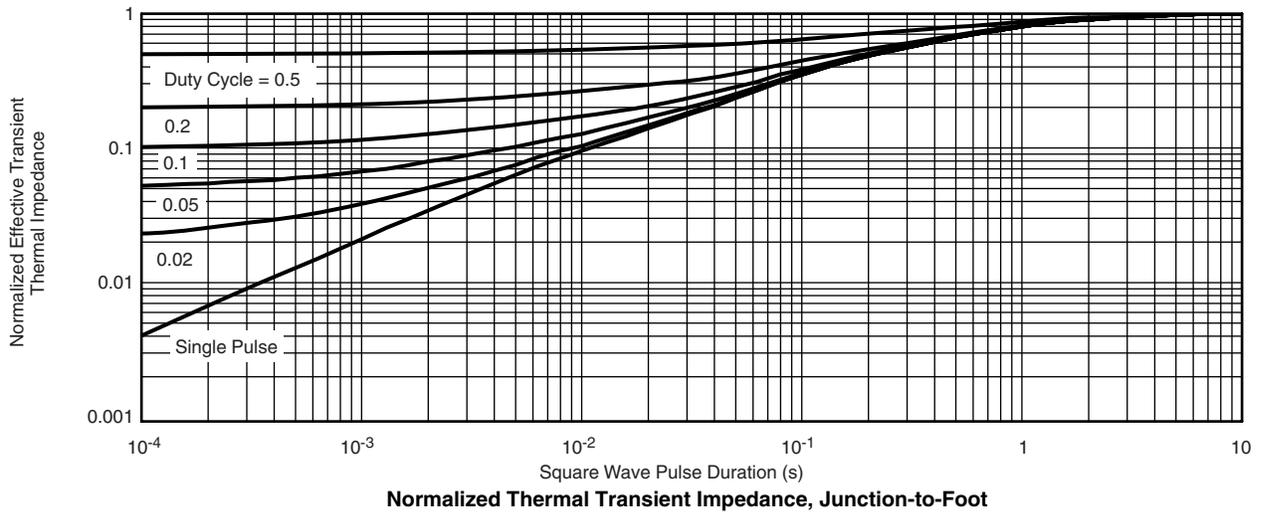
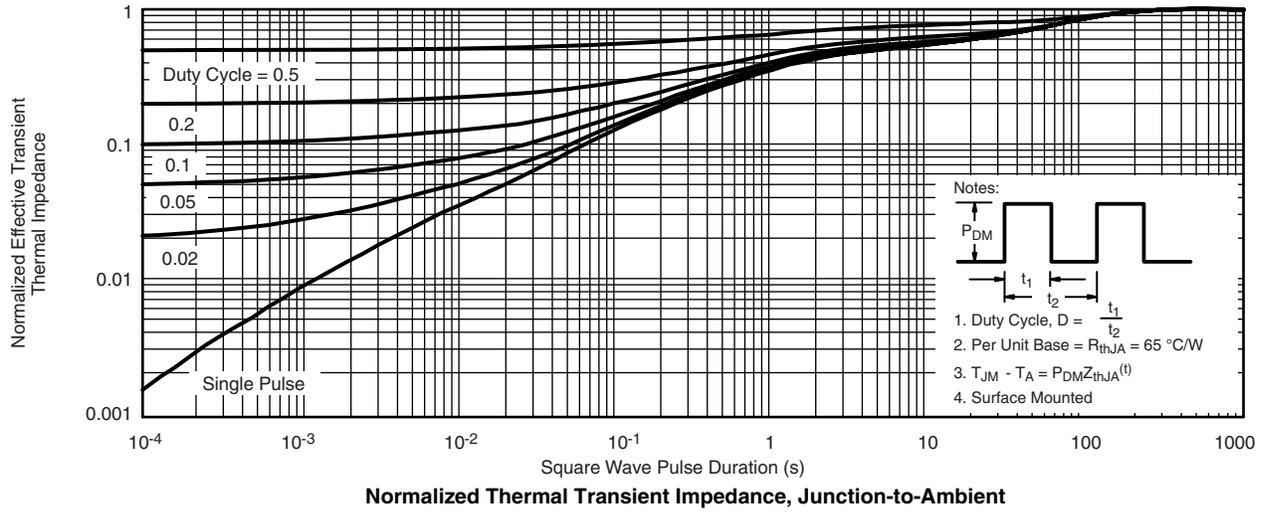
Safe Operating Area, Junction-to-Ambient

## CHANNEL-1 TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

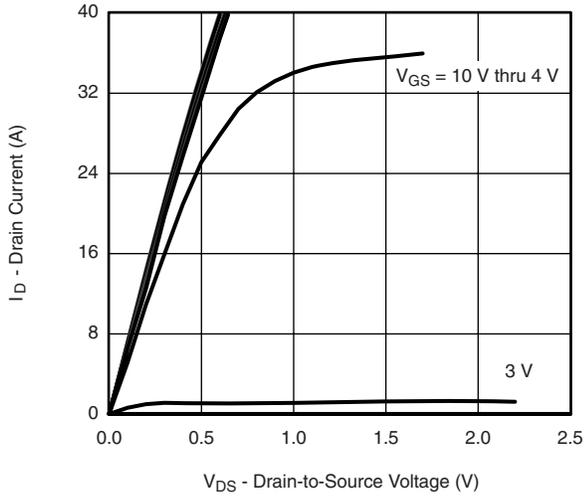


\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package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

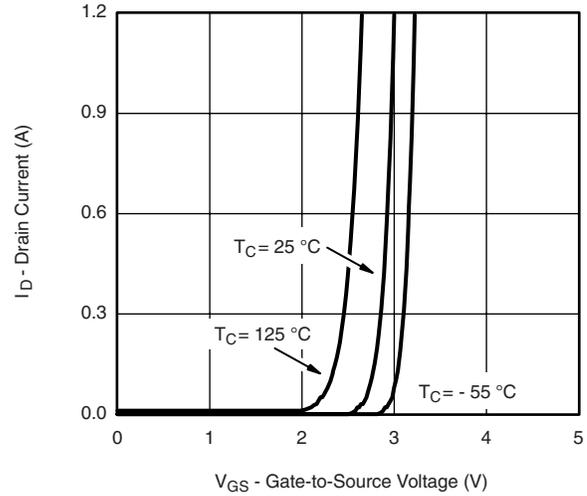
**CHANNEL-1 TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



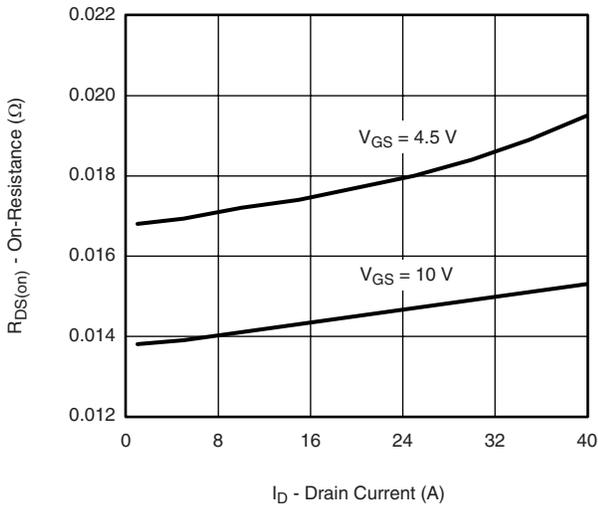
## CHANNEL-2 TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



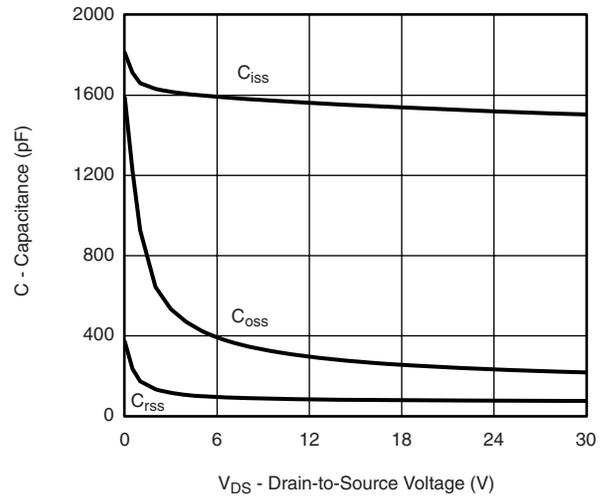
**Output Characteristics**



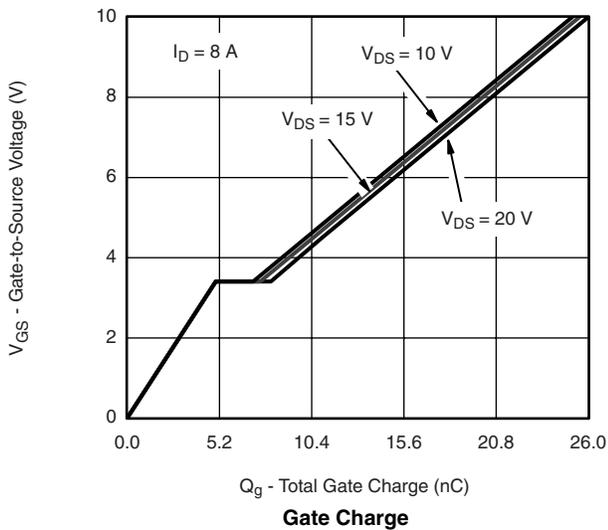
**Transfer Characteristics**



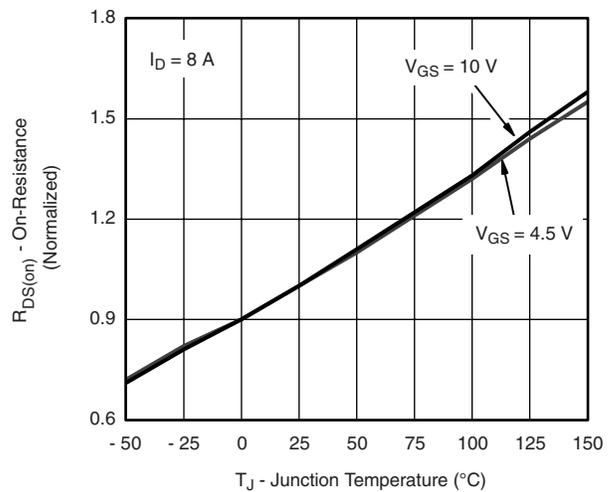
**On-Resistance vs. Drain Current**



**Capacitance**

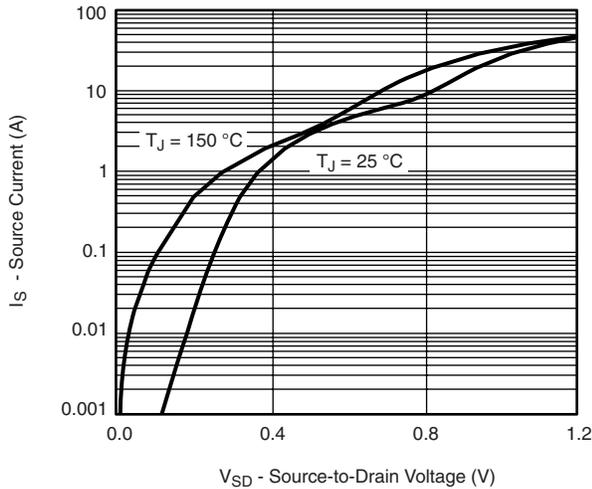


**Gate Charge**

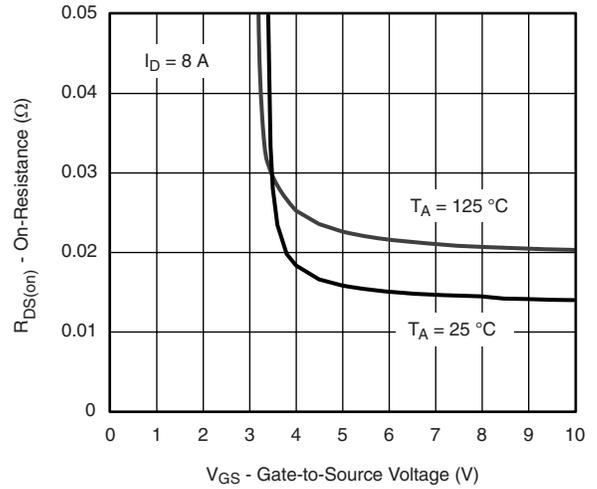


**On-Resistance vs. Junction Temperature**

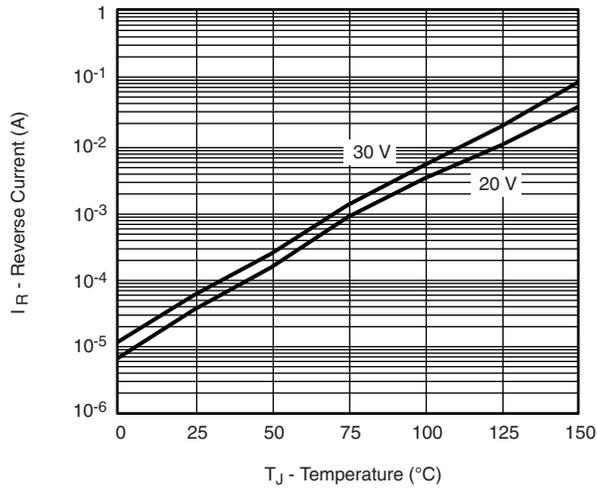
## CHANNEL-2 TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



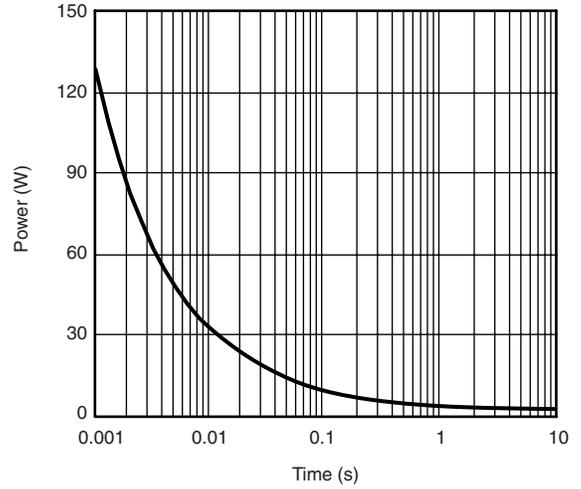
Source-Drain Diode Forward Voltage



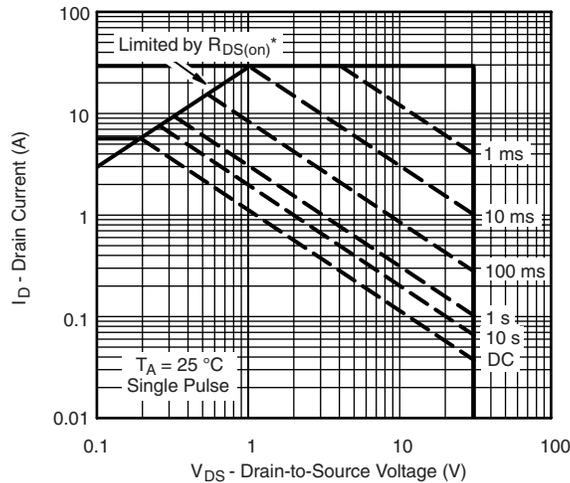
On-Resistance vs. Gate-to-Source Voltage



Reverse Current



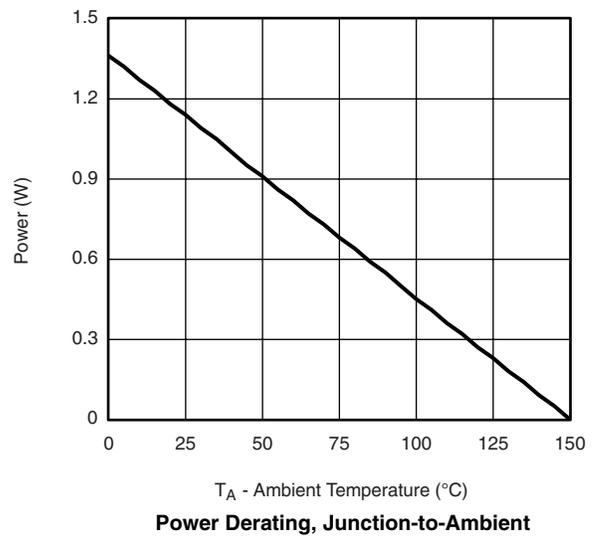
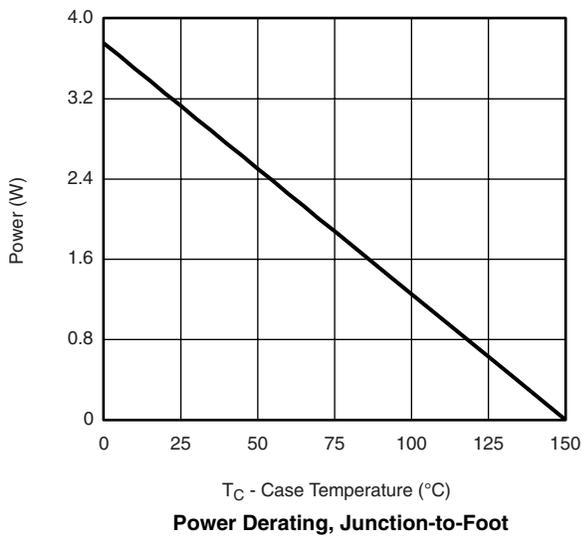
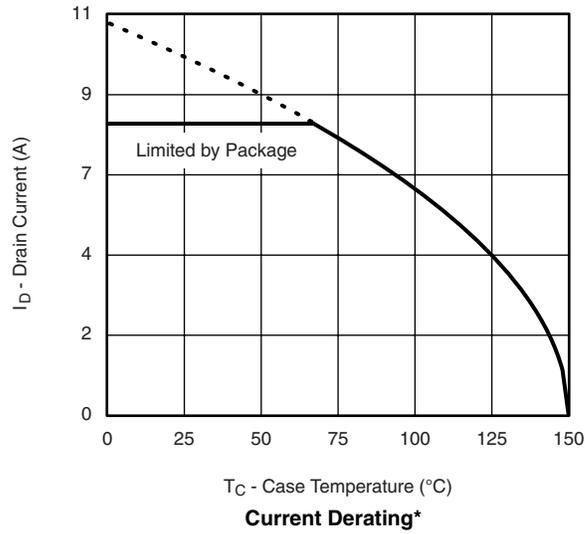
Single Pulse Power, Junction-to-Ambient



\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

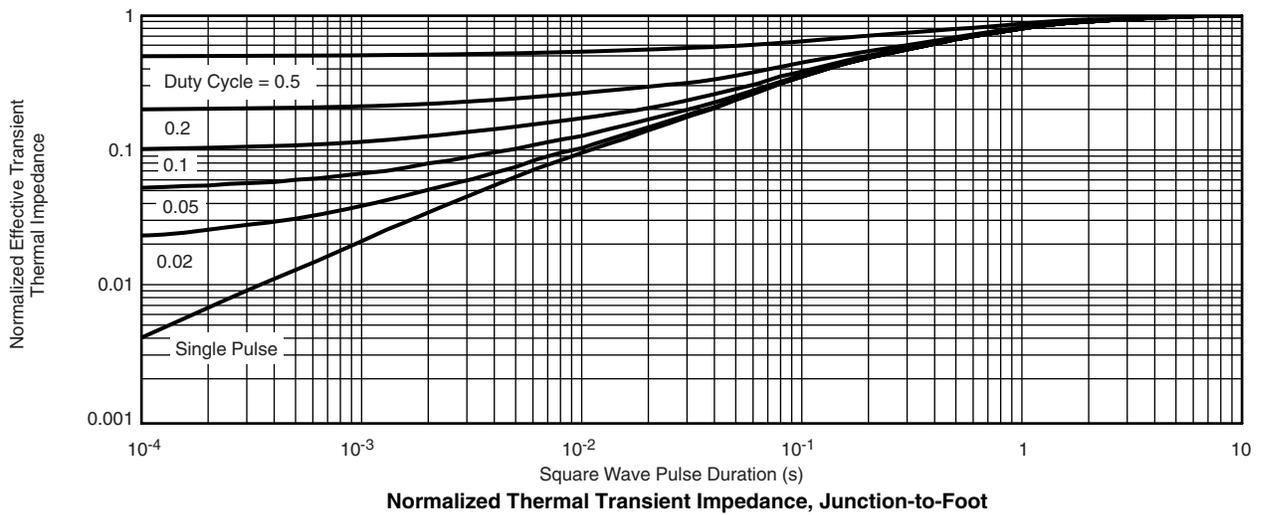
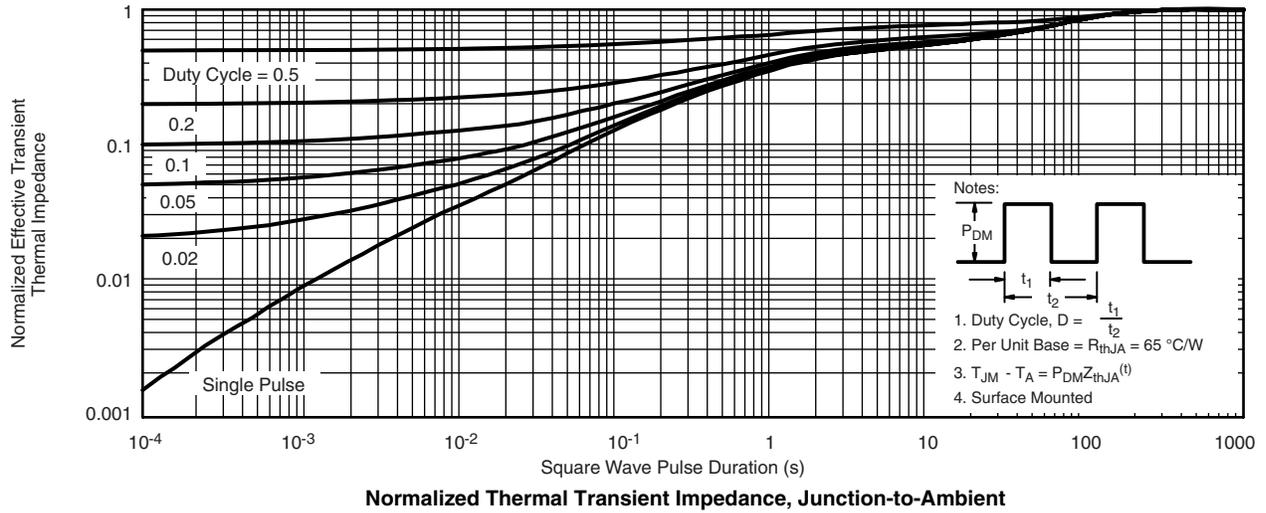
Safe Operating Area, Junction-to-Ambient

## CHANNEL-2 TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-case 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.

**CHANNEL-2 TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



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