

## Automotive P-Channel 60 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY                              |        |
|--|--------|
| $V_{DS}$ (V)                                 | - 60   |
| $R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = 10$ V | 0.065  |
| $I_D$ (A)                                    | - 5.7  |
| Configuration                                | Single |

### FEATURES

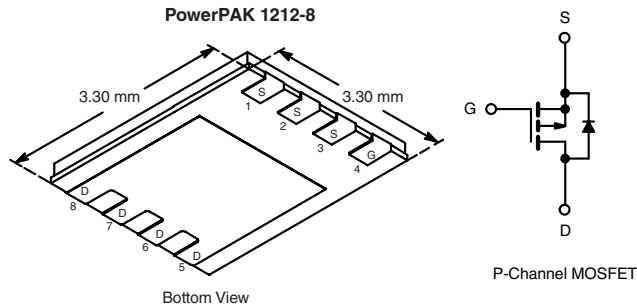
- TrenchFET® Power MOSFET
- Package with Low Thermal Resistance

### AEC-Q101 RELIABILITY

- Passed all AEC-Q101 Reliability Testing



Available  
**RoHS\***  
COMPLIANT



| ORDERING INFORMATION |                 |
|----------------------|-----------------|
| Package              | PowerPAK 1212-8 |
| Lead (Pb)-free       | SQ7415EN-T1-E3  |
| SnPb                 | SQ7415EN-T1     |

| ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted |               |                |                    |      |
|--|---------------|----------------|--------------------|------|
| PARAMETER  |               | SYMBOL         | LIMIT              | UNIT |
| Drain-Source Voltage   |               | $V_{DS}$       | - 60               | V    |
| Gate-Source Voltage  |               | $V_{GS}$       | $\pm 20$           |      |
| Continuous Drain Current <sup>a</sup>                          | $T_C = 25$ °C | $I_D$          | - 3.6 <sup>a</sup> | A    |
|  | $T_C = 70$ °C |                | - 2.9 <sup>a</sup> |      |
| Continuous Source Current (Diode Conduction) <sup>a</sup>      |               | $I_S$          | - 1.3 <sup>a</sup> |      |
| Pulsed Drain Current <sup>b</sup>                              |               | $I_{DM}$       | - 30               |      |
| Single Pulse Avalanche Energy                                  | L = 0.1 mH    | $E_{AS}$       | -                  | mJ   |
| Single Pulse Avalanche Current                                 |               | $I_{AS}$       | -                  | A    |
| Maximum Power Dissipation <sup>b</sup>                         | $T_C = 25$ °C | $P_D$          | 1.5                | W    |
|  | $T_A = 70$ °C |                | 0.8                |      |
| Operating Junction and Storage Temperature Range               |               | $T_J, T_{stg}$ | - 55 to + 175      | °C   |

| THERMAL RESISTANCE RATINGS |                        |            |       |      |
|----------------------------|------------------------|------------|-------|------|
| PARAMETER                  |                        | SYMBOL     | LIMIT | UNIT |
| Junction-to-Ambient        | PCB Mount <sup>c</sup> | $R_{thJA}$ | 81    | °C/W |
| Junction-to-Case (Drain)   |                        | $R_{thJC}$ | 2.4   |      |

### Notes

- Package limited.
- Pulse test; pulse width  $\leq 300$   $\mu$ s, duty cycle  $\leq 2$  %.
- When mounted on 1" square PCB (FR-4 material).

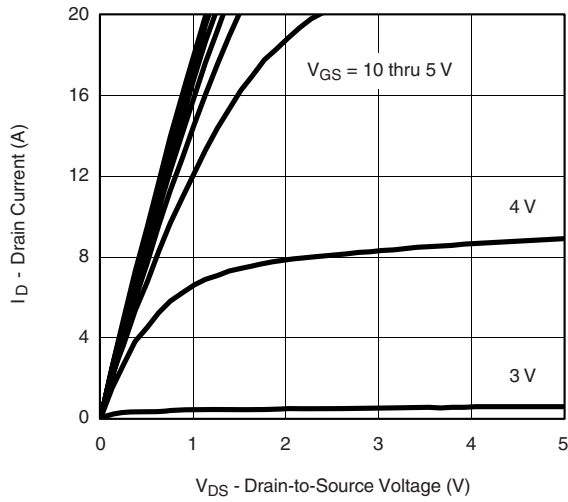
| <b>SPECIFICATIONS</b> $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted                     |               |  |   |      |           |       |               |
|---|---------------|--|---|------|-----------|-------|---------------|
| PARAMETER   | SYMBOL        | TEST CONDITIONS  | MIN.  | TYP. | MAX.      | UNIT  |               |
| <b>Static</b>   |               |  |   |      |           |       |               |
| Drain-Source Breakdown Voltage  | $V_{DS}$      | $V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$  | -   | -    | -         | V     |               |
| Gate-Source Threshold Voltage   | $V_{GS(th)}$  | $V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{A}$  | - 1.5   | -    | - 3.0     |       |               |
| Gate-Source Leakage   | $I_{GSS}$     | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$   | -   | -    | $\pm 100$ | nA    |               |
| Zero Gate Voltage Drain Current   | $I_{DSS}$     | $V_{GS} = 0\text{ V}$  | $V_{DS} = -60\text{ V}$                                     | -    | -         | - 1.0 | $\mu\text{A}$ |
|   |               | $V_{GS} = 0\text{ V}$  | $V_{DS} = -60\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$ | -    | -         | - 5.0 |               |
|   |               | $V_{GS} = 0\text{ V}$  | $V_{DS} = -60\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$ | -    | -         | -     |               |
| On-State Drain Current <sup>a</sup>   | $I_{D(on)}$   | $V_{GS} = -10\text{ V}$  | $V_{DS} \leq -5\text{ V}$                                   | - 20 | -         | -     | A             |
| Drain-Source On-State Resistance <sup>a</sup>   | $R_{DS(on)}$  | $V_{GS} = -10\text{ V}$  | $I_D = -5.7\text{ A}$                                       | -    | 0.054     | 0.065 | $\Omega$      |
|   |               | $V_{GS} = -10\text{ V}$  | $I_D = 30\text{ A}$ , $T_J = 125\text{ }^\circ\text{C}$     | -    | -         | -     |               |
|   |               | $V_{GS} = -10\text{ V}$  | $I_D = 30\text{ A}$ , $T_J = 175\text{ }^\circ\text{C}$     | -    | -         | -     |               |
| Forward Transconductance <sup>a</sup>   | $g_{fs}$      | $V_{DS} = -15\text{ V}$ , $I_D = -5.7\text{ A}$  |   | 11   | -         | -     | S             |
| <b>Dynamic<sup>b</sup></b>  |               |  |   |      |           |       |               |
| Input Capacitance   | $C_{iss}$     | $V_{GS} = 0\text{ V}$  | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$                 | -    | -         | -     | pF            |
| Output Capacitance  | $C_{oss}$     |  |   | -    | -         | -     |               |
| Reverse Transfer Capacitance  | $C_{rss}$     |  |   | -    | -         | -     |               |
| Total Gate Charge <sup>c</sup>  | $Q_g$         | $V_{GS} = -10\text{ V}$  | $V_{DS} = -30\text{ V}$ , $I_D = -5.7\text{ A}$             | -    | 15        | 25    | nC            |
| Gate-Source Charge <sup>c</sup>   | $Q_{gs}$      |  |   | -    | 4         | -     |               |
| Gate-Drain Charge <sup>c</sup>  | $Q_{gd}$      |  |   | -    | 3.2       | -     |               |
| Turn-On Delay Time <sup>c</sup>   | $t_{d(on)}$   | $V_{DD} = -30\text{ V}$ , $R_L = 30\text{ }\Omega$<br>$I_D \cong -1\text{ A}$ , $V_{GEN} = -10\text{ V}$ , $R_g = 6\text{ }\Omega$ |   | -    | 12        | 20    | ns            |
| Rise Time <sup>c</sup>  | $t_r$         |  |   | -    | 12        | 20    |               |
| Turn-Off Delay Time <sup>c</sup>  | $t_{d(off)}$  |  |   | -    | 22        | 35    |               |
| Fall Time <sup>c</sup>  | $t_f$         |  |   | -    | 16        | 25    |               |
| <b>Source-Drain Diode Ratings and Characteristics</b> $T_C = 25\text{ }^\circ\text{C}$ <sup>b</sup> |               |  |   |      |           |       |               |
| Pulsed Current <sup>a</sup>   | $I_{SM}$      |  |   | -    | -         | -     | A             |
| Forward Voltage   | $V_{SD}$      | $I_F = 85\text{ A}$ , $V_{GS} = 0\text{ V}$  |   | -    | -         | -     | V             |
| Reverse Recovery Time   | $t_{rr}$      | $I_F = -3.2\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$   |   | -    | 45        | 90    | ns            |
| Peak Reverse Recovery Current   | $I_{RM(REC)}$ |  |   | -    | -         | -     | A             |
| Reverse Recovery Charge   | $Q_{rr}$      |  |   | -    | -         | -     | $\mu\text{C}$ |

### Notes

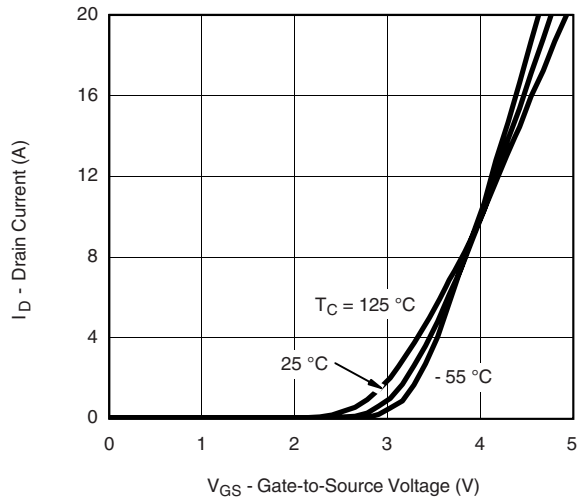
- Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Guaranteed by design, not subject to production testing.
- Independent of operating temperature.

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.

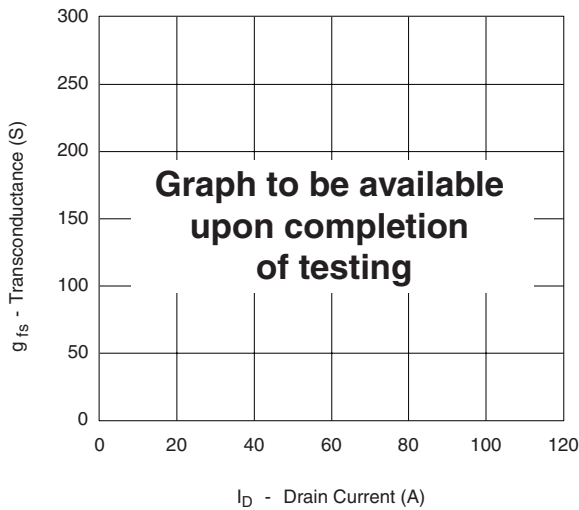
**TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



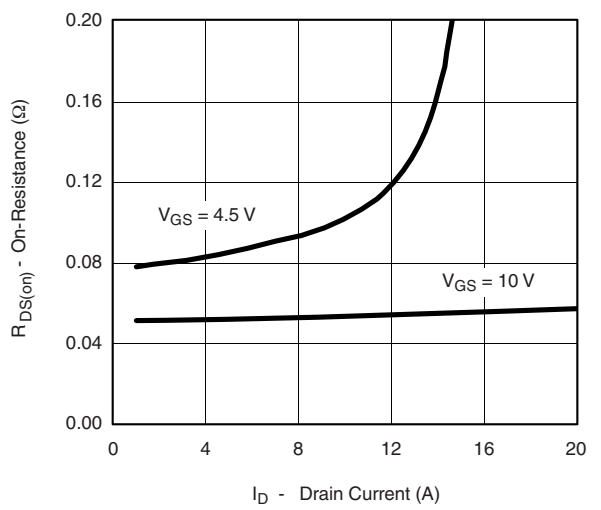
**Output Characteristics**



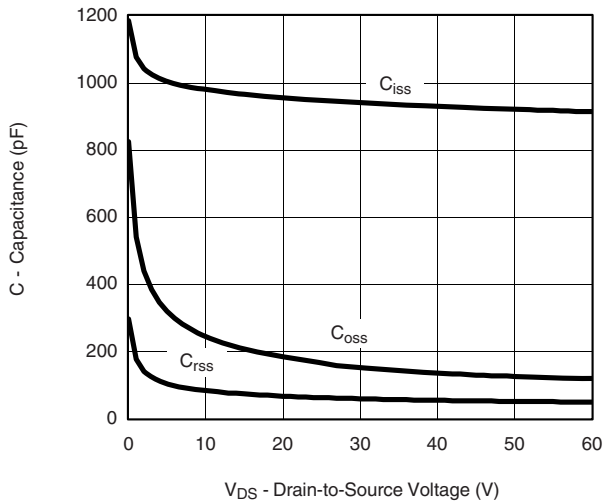
**Transfer Characteristics**



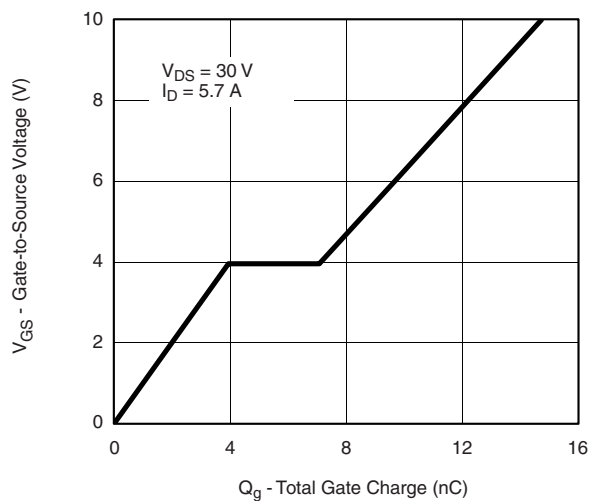
**Transconductance**



**On-Resistance vs. Drain Current**

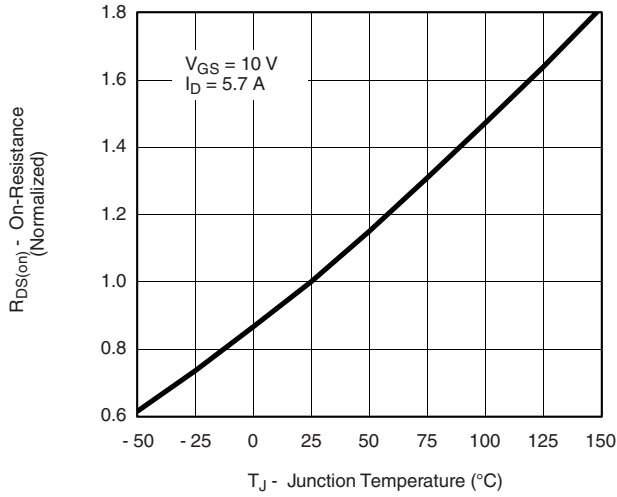


**Capacitance**

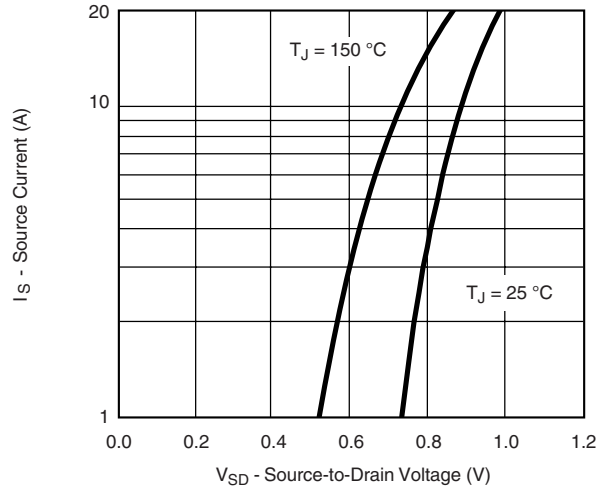


**Gate Charge**

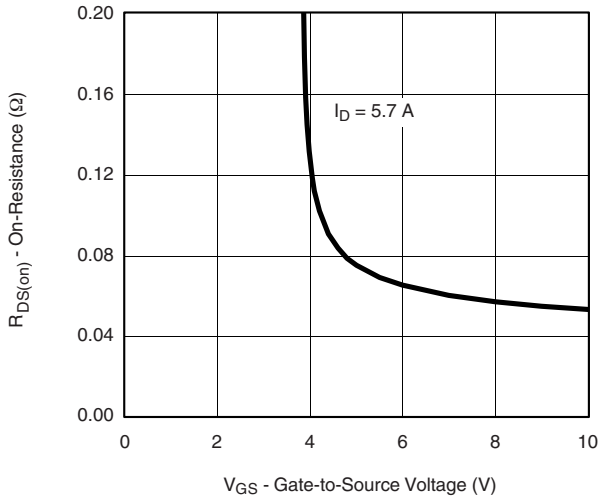
**TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



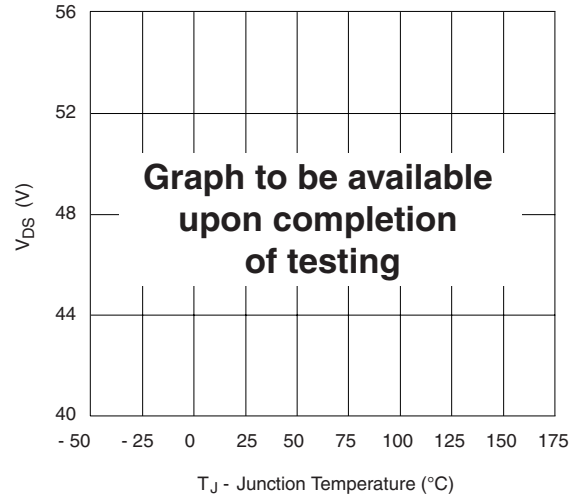
**On-Resistance vs. Junction Temperature**



**Source Drain Diode Forward Voltage**

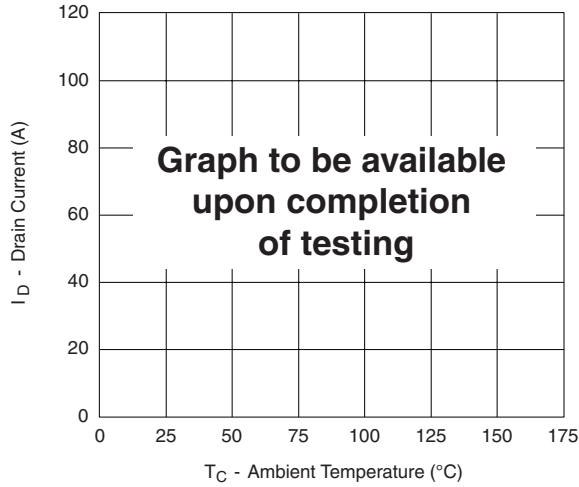


**On-Resistance vs. Gate-to-Source Voltage**

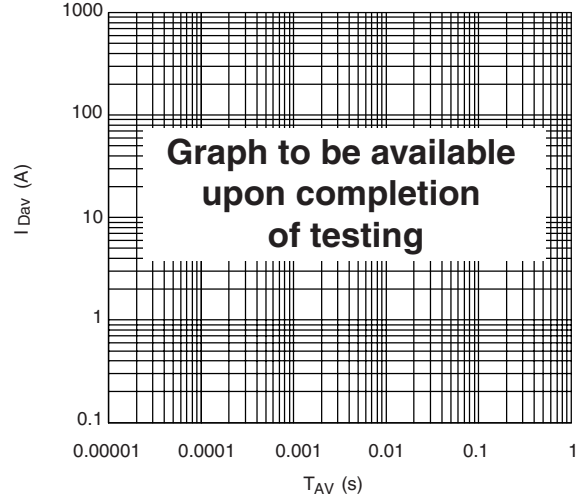


**Drain Source Breakdown vs. Junction Temperature**

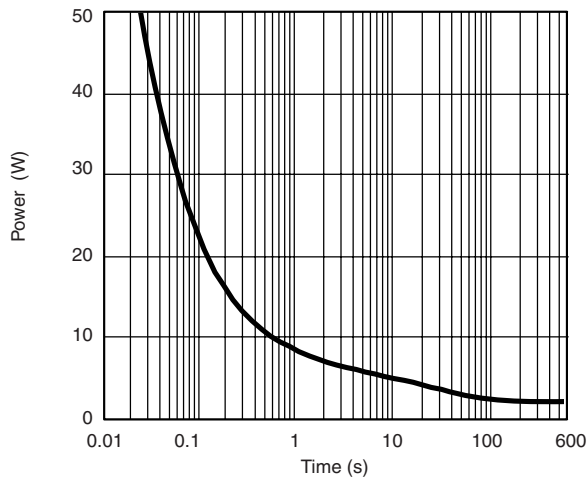
**THERMAL RATINGS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



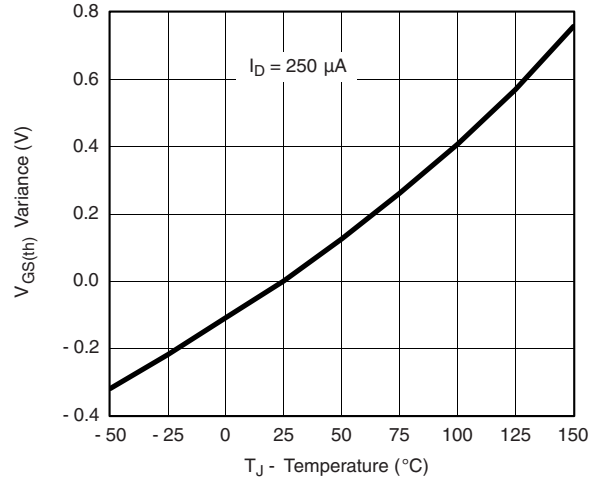
**Maximum Drain Current vs. Ambient Temperature**



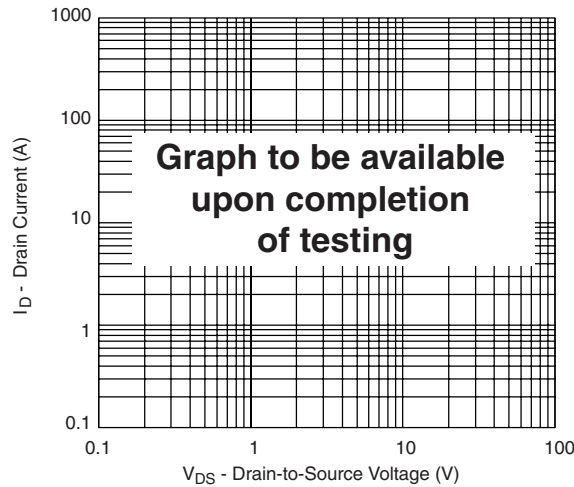
**Avalanche Current vs. Time**



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



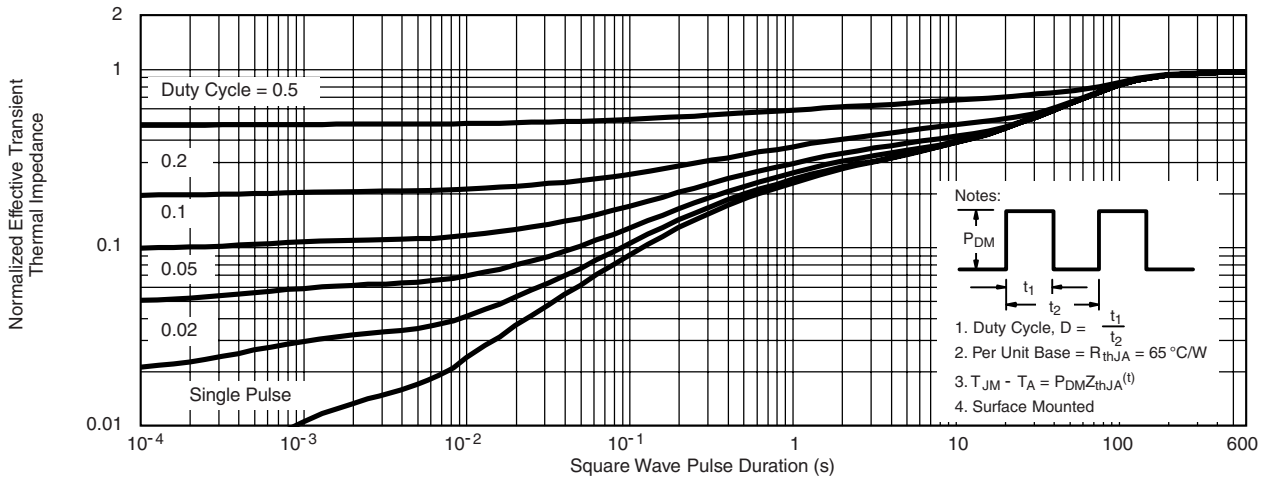
**Threshold Voltage**



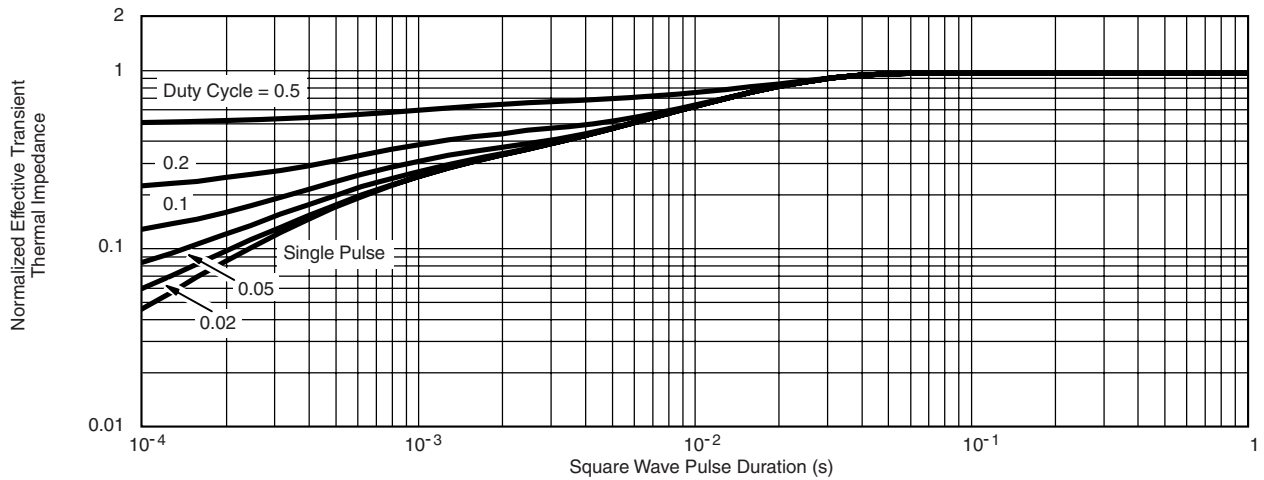
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

**Safe Operating Area**

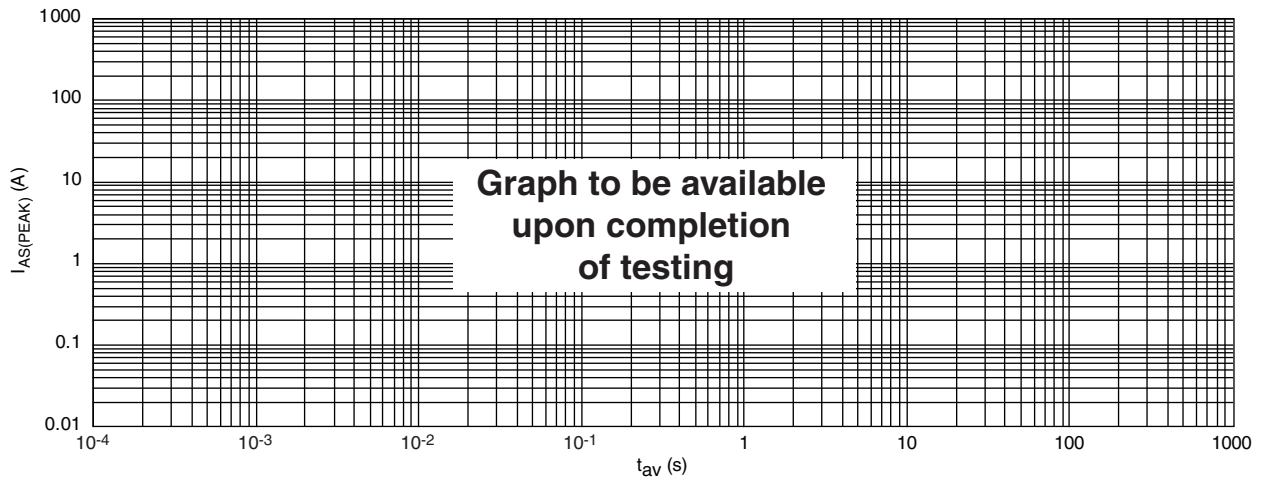
**THERMAL RATINGS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



Normalized Thermal Transient Impedance, Junction-to-Case

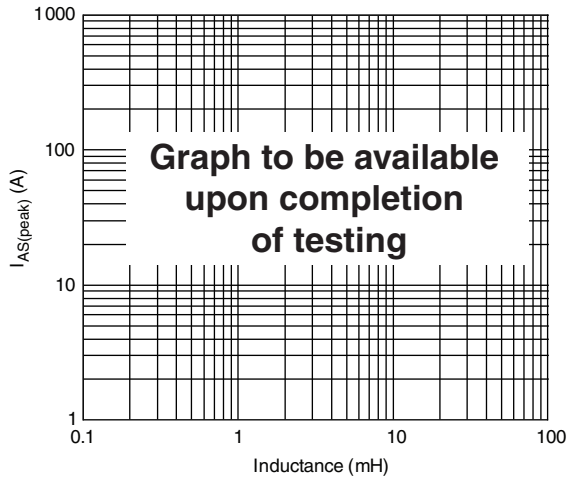


Normalized Thermal Transient Impedance, Junction-to-Ambient

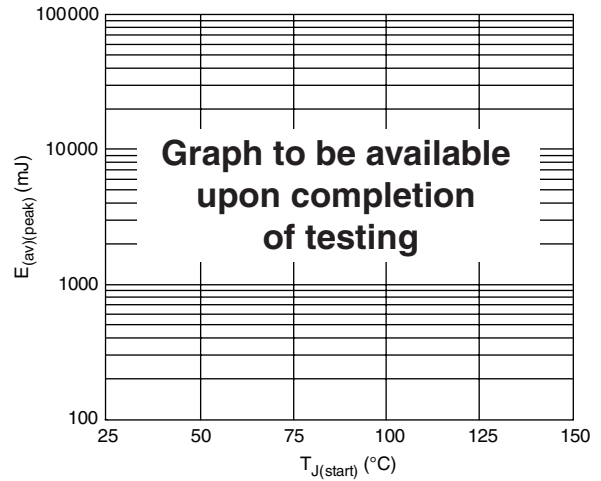


Single Pulse Avalanche Current (Peak) vs. Time in Avalanche

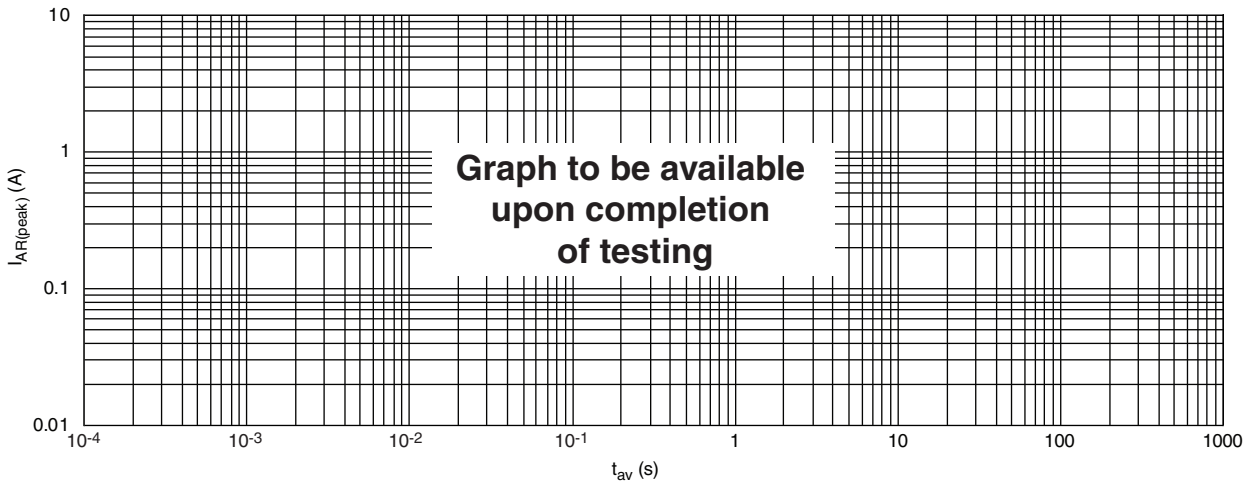
**THERMAL RATINGS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



**Single Pulse Avalanche Current (Peak) vs. Inductance**

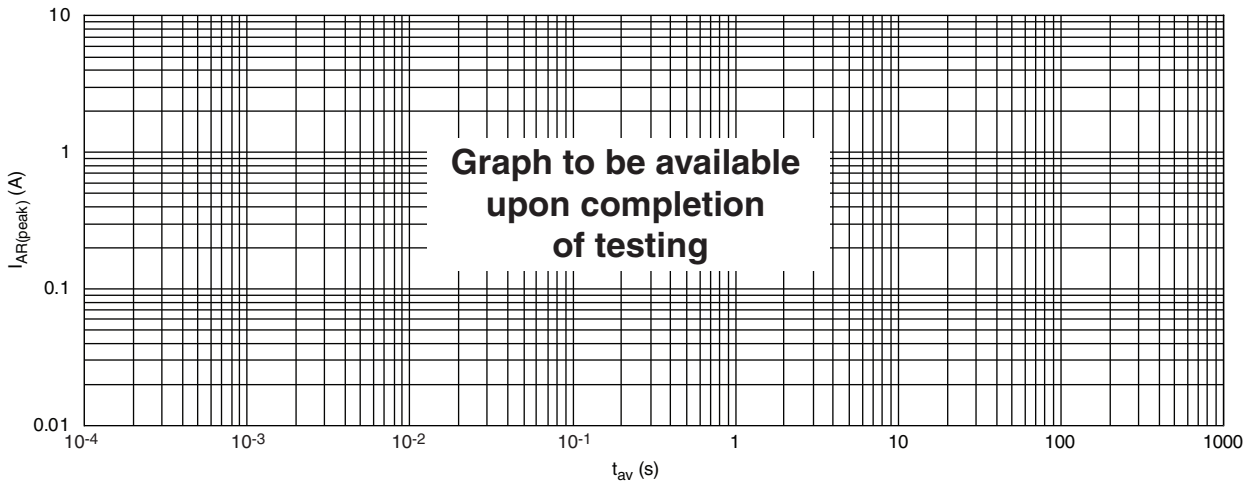


**Single Pulse Avalanche Energy (Peak) vs.  $T_{J(\text{start})}$**



**Repetitive Avalanche Current (Peak) vs. Time in Avalanche at  $T_A = 25\text{ }^\circ\text{C}$**

**THERMAL RATINGS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



**Repetitive Avalanche Current (Peak) vs. Time in Avalanche at  $T_A = 150\text{ }^\circ\text{C}$**

**Note**

The characteristics shown in the six graphs

- Normalized Transient Thermal Impedance Junction to Ambient ( $25\text{ }^\circ\text{C}$ )
- Single Pulse Avalanche Current (Peak) vs. Time in Avalanche
- Single Pulse Avalanche Current (Peak) vs. Inductance
- Single Pulse Avalanche Energy (Peak) vs.  $T_{J(\text{start})}$
- Repetitive Avalanche Current (Peak) vs. Time in Avalanche at  $T_A = 25\text{ }^\circ\text{C}$
- Repetitive Avalanche Current (Peak) vs. Time in Avalanche at  $T_A = 150\text{ }^\circ\text{C}$

are given for general guidelines only to enable the user to get a "ball park" indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see <http://www.vishay.com/ppg?74488>.*





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