



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

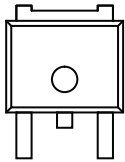


| PRODUCT SUMMARY                                    |        |
|--|--------|
| V <sub>DS</sub> (V)                                | 60     |
| R <sub>DS(on)</sub> (Ω) at V <sub>GS</sub> = 10 V  | 0.009  |
| R <sub>DS(on)</sub> (Ω) at V <sub>GS</sub> = 4.5 V | 0.013  |
| I <sub>D</sub> (A)                                 | 50     |
| Configuration                                      | Single |

### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET
- 100 % R<sub>g</sub> and UIS Tested
- Compliant to RoHS Directive 2002/95/EC
- AEC-Q101 Qualified<sup>d</sup>

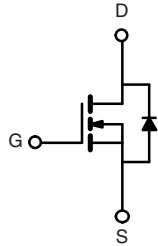
TO-252



G D S

Top View

Drain Connected to Tab



N-Channel MOSFET

| ORDERING INFORMATION            |                  |
|---------------------------------|------------------|
| Package                         | TO-252           |
| Lead (Pb)-free and Halogen-free | SQD50N06-09L-GE3 |

| ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted) |                                     |                                   |               |      |
|---|-------------------------------------|-----------------------------------|---------------|------|
| PARAMETER   |                                     | SYMBOL                            | LIMIT         | UNIT |
| Drain-Source Voltage  |                                     | V <sub>DS</sub>                   | 60            | V    |
| Gate-Source Voltage   |                                     | V <sub>GS</sub>                   | ± 20          |      |
| Continuous Drain Current  | T <sub>C</sub> = 25 °C <sup>a</sup> | I <sub>D</sub>                    | 50            | A    |
|   | T <sub>C</sub> = 125 °C             |                                   | 49            |      |
| Continuous Source Current (Diode Conduction) <sup>a</sup>                 |                                     | I <sub>S</sub>                    | 50            |      |
| Pulsed Drain Current <sup>b</sup>   |                                     | I <sub>DM</sub>                   | 200           |      |
| Single Pulse Avalanche Energy   | L = 0.1 mH                          | I <sub>AS</sub>                   | 48            |      |
| Single Pulse Avalanche Current  |                                     | E <sub>AS</sub>                   | 115           |      |
| Maximum Power Dissipation <sup>b</sup>                                    | T <sub>C</sub> = 25 °C              | P <sub>D</sub>                    | 136           | W    |
|   | T <sub>C</sub> = 125 °C             |                                   | 45            |      |
| Operating Junction and Storage Temperature Range                          |                                     | T <sub>J</sub> , T <sub>stg</sub> | - 55 to + 175 | °C   |

| THERMAL RESISTANCE RATINGS |                        |                   |       |      |
|----------------------------|------------------------|-------------------|-------|------|
| PARAMETER                  |                        | SYMBOL            | LIMIT | UNIT |
| Junction-to-Ambient        | PCB Mount <sup>c</sup> | R <sub>thJA</sub> | 50    | °C/W |
| Junction-to-Case (Drain)   |                        | R <sub>thJC</sub> | 1.1   |      |

### Notes

- Package limited.
- Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %.
- When mounted on 1" square PCB (FR-4 material).
- Parametric verification ongoing.



| SPECIFICATIONS (T <sub>C</sub> = 25 °C, unless otherwise noted)   |                     |  |   |      |        |        |      |
|---|---------------------|--|---|------|--------|--------|------|
| PARAMETER   | SYMBOL              | TEST CONDITIONS  |   | MIN. | TYP.   | MAX.   | UNIT |
| <b>Static</b>   |                     |  |   |      |        |        |      |
| Drain-Source Breakdown Voltage                                    | V <sub>DS</sub>     | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA   |   | 60   | -      | -      | V    |
| Gate-Source Threshold Voltage                                     | V <sub>GS(th)</sub> | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA  |   | 1.5  | 2.0    | 2.5    |      |
| Gate-Source Leakage   | I <sub>GSS</sub>    | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V  |   | -    | -      | ± 100  | nA   |
| Zero Gate Voltage Drain Current                                   | I <sub>DSS</sub>    | V <sub>GS</sub> = 0 V  | V <sub>DS</sub> = 60 V                          | -    | -      | 1.0    | μA   |
|   |                     | V <sub>GS</sub> = 0 V  | V <sub>DS</sub> = 60 V, T <sub>J</sub> = 125 °C | -    | -      | 50     |      |
|   |                     | V <sub>GS</sub> = 0 V  | V <sub>DS</sub> = 60 V, T <sub>J</sub> = 175 °C | -    | -      | 250    |      |
| On-State Drain Current <sup>a</sup>                               | I <sub>D(on)</sub>  | V <sub>GS</sub> = 10 V   | V <sub>DS</sub> ≥ 5 V                           | 50   | -      | -      | A    |
| Drain-Source On-State Resistance <sup>a</sup>                     | R <sub>DS(on)</sub> | V <sub>GS</sub> = 10 V   | I <sub>D</sub> = 20 A                           | -    | 0.0071 | 0.0090 | Ω    |
|   |                     | V <sub>GS</sub> = 10 V   | I <sub>D</sub> = 20 A, T <sub>J</sub> = 125 °C  | -    | -      | 0.016  |      |
|   |                     | V <sub>GS</sub> = 10 V   | I <sub>D</sub> = 20 A, T <sub>J</sub> = 175 °C  | -    | -      | 0.019  |      |
|   |                     | V <sub>GS</sub> = 4.5 V  | I <sub>D</sub> = 10 A                           | -    | 0.0094 | 0.013  |      |
| Forward Transconductance <sup>b</sup>                             | g <sub>fs</sub>     | V <sub>DS</sub> = 15 V, I <sub>D</sub> = 20 A  |   | -    | 62     | -      | S    |
| <b>Dynamic<sup>b</sup></b>  |                     |  |   |      |        |        |      |
| Input Capacitance   | C <sub>iss</sub>    | V <sub>GS</sub> = 0 V  | V <sub>DS</sub> = 25 V, f = 1 MHz               | -    | 2451   | 3065   | pF   |
| Output Capacitance  | C <sub>oss</sub>    |  |   | -    | 435    | 545    |      |
| Reverse Transfer Capacitance                                      | C <sub>rss</sub>    |  |   | -    | 192    | 240    |      |
| Total Gate Charge <sup>c</sup>                                    | Q <sub>g</sub>      | V <sub>GS</sub> = 10 V   | V <sub>DS</sub> = 30 V, I <sub>D</sub> = 50 A   | -    | 48     | 72     | nC   |
| Gate-Source Charge <sup>c</sup>                                   | Q <sub>gs</sub>     |  |   | -    | 7.1    | -      |      |
| Gate-Drain Charge <sup>c</sup>                                    | Q <sub>gd</sub>     |  |   | -    | 13.5   | -      |      |
| Gate Resistance   | R <sub>g</sub>      | f = 1 MHz  |   | 0.85 | 1.7    | 2.6    | Ω    |
| Turn-On Delay Time <sup>c</sup>                                   | t <sub>d(on)</sub>  | V <sub>DD</sub> = 30 V, R <sub>L</sub> = 0.6 Ω<br>I <sub>D</sub> ≅ 50 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω |   | -    | 10     | 15     | ns   |
| Rise Time <sup>c</sup>  | t <sub>r</sub>      |  |   | -    | 11     | 17     |      |
| Turn-Off Delay Time <sup>c</sup>                                  | t <sub>d(off)</sub> |  |   | -    | 27     | 41     |      |
| Fall Time <sup>c</sup>  | t <sub>f</sub>      |  |   | -    | 8      | 12     |      |
| <b>Source-Drain Diode Ratings and Characteristics<sup>b</sup></b> |                     |  |   |      |        |        |      |
| Pulsed Current <sup>a</sup>                                       | I <sub>SM</sub>     |  |   | -    | -      | 200    | A    |
| Forward Voltage   | V <sub>SD</sub>     | I <sub>F</sub> = 20 A, V <sub>GS</sub> = 0 V   |   | -    | 0.82   | 1.5    | V    |

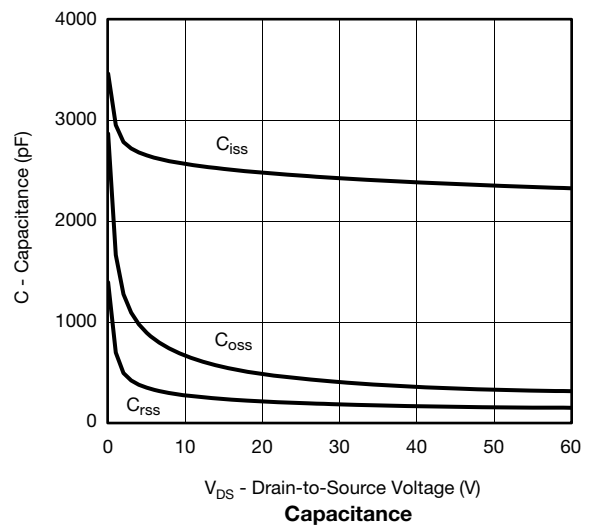
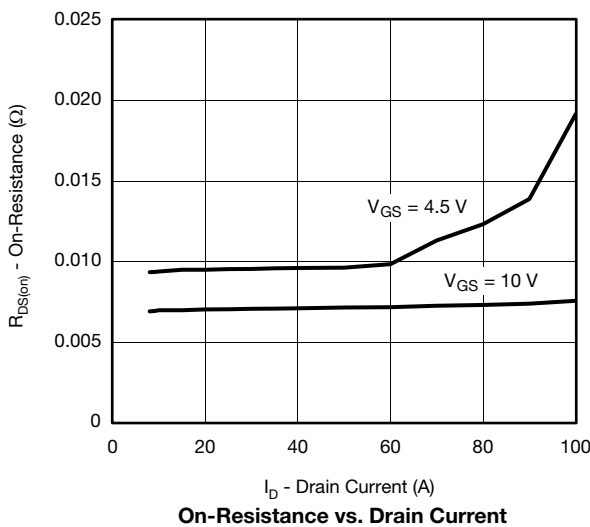
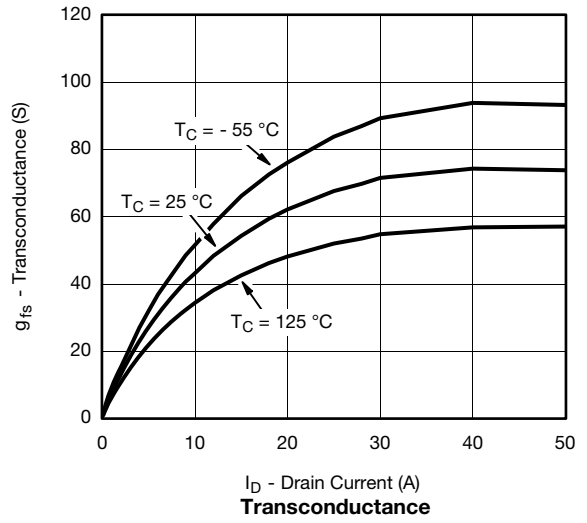
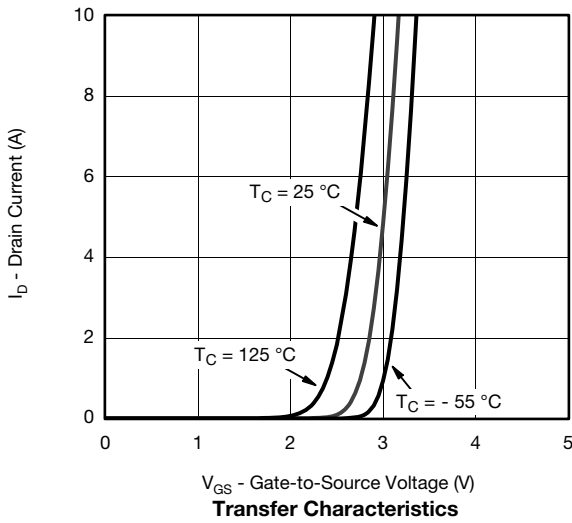
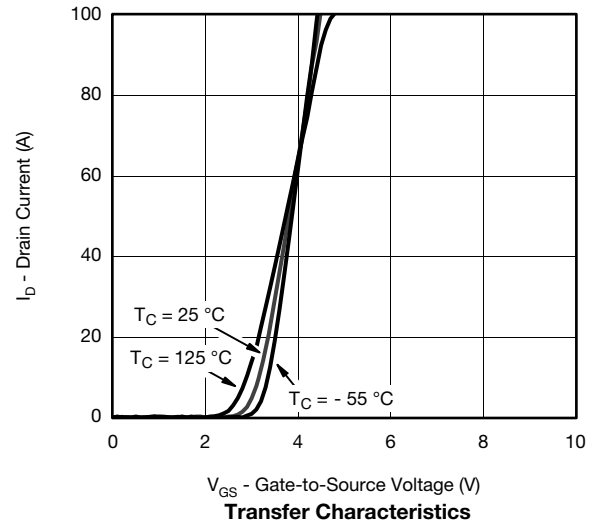
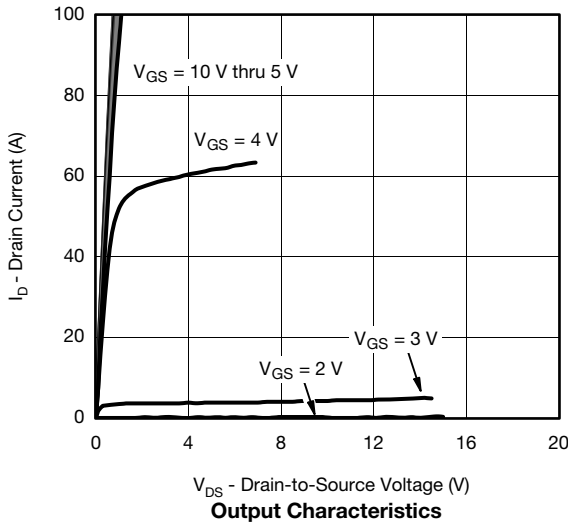
**Notes**

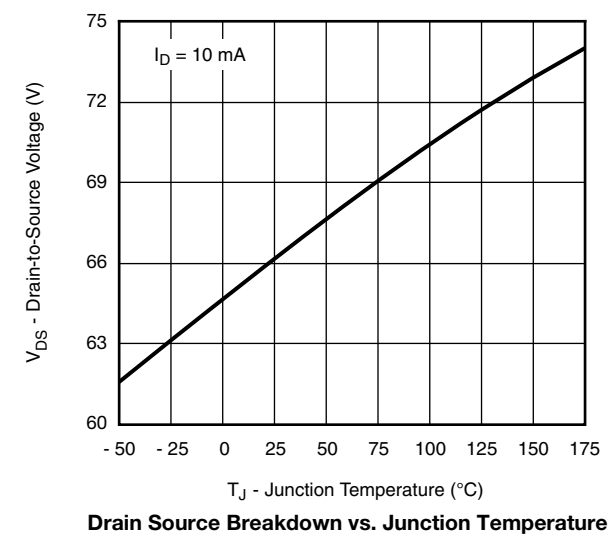
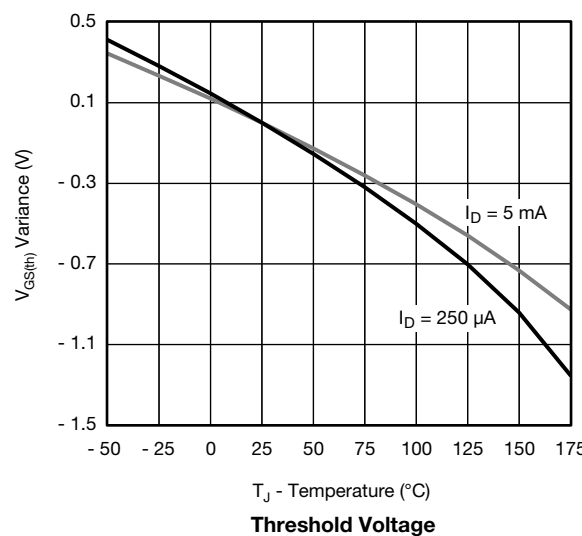
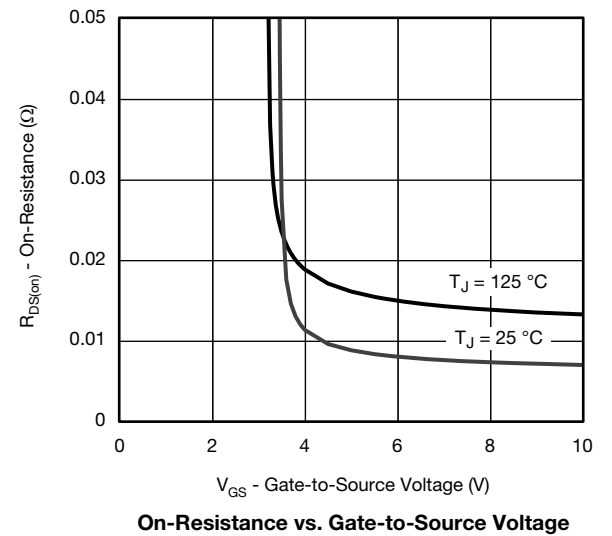
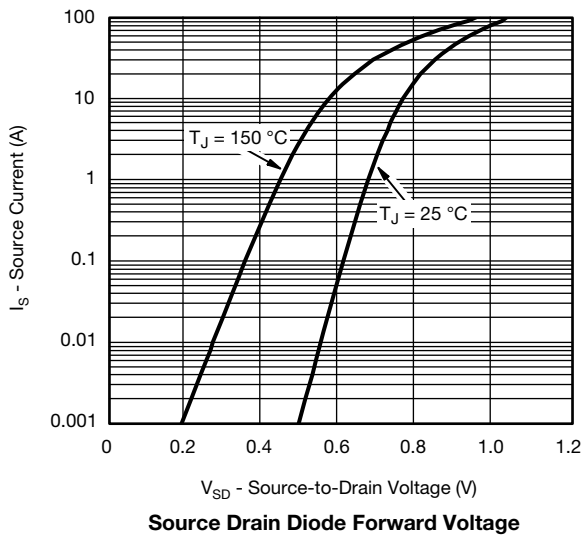
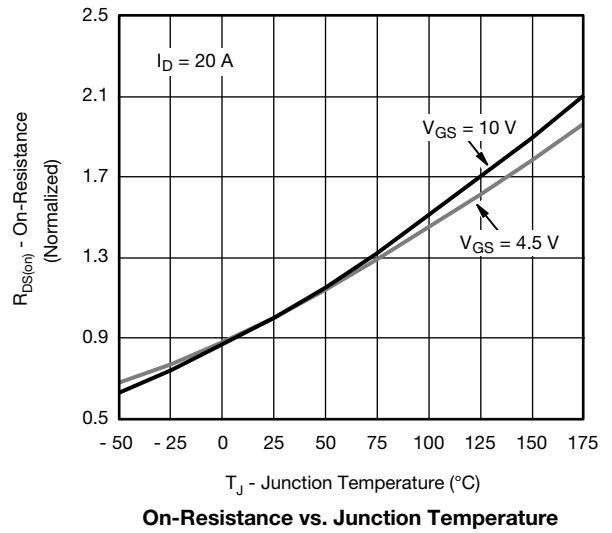
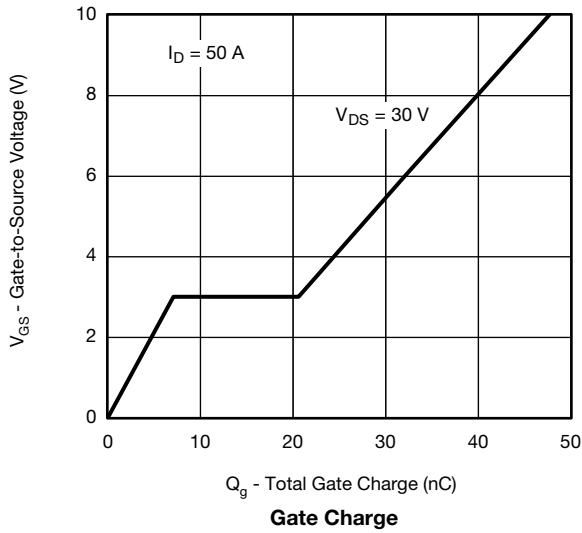
- a. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %.
- b. Guaranteed by design, not subject to production testing.
- c. Independent of operating temperature.

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.



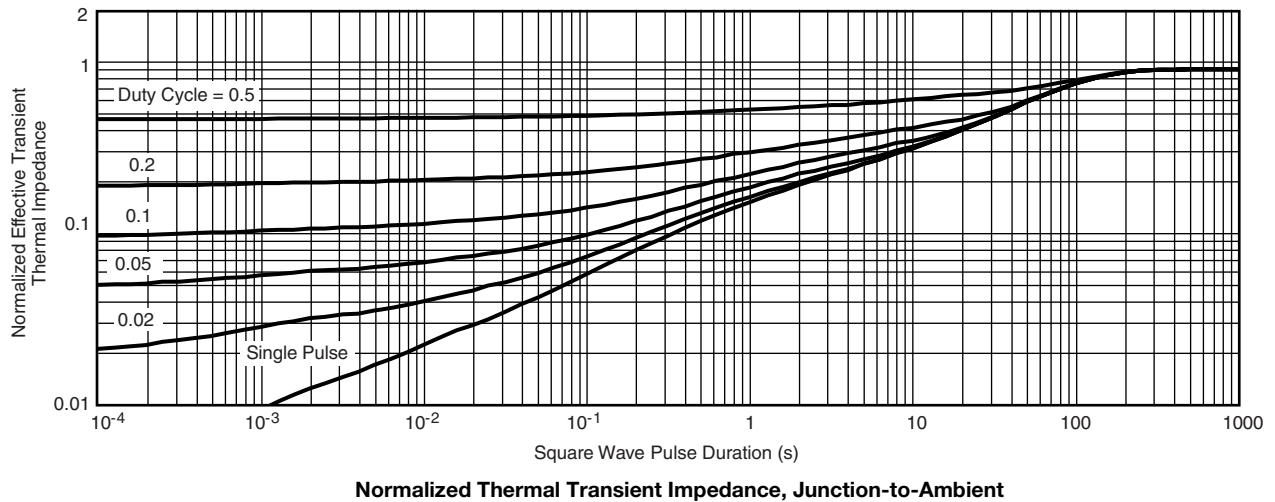
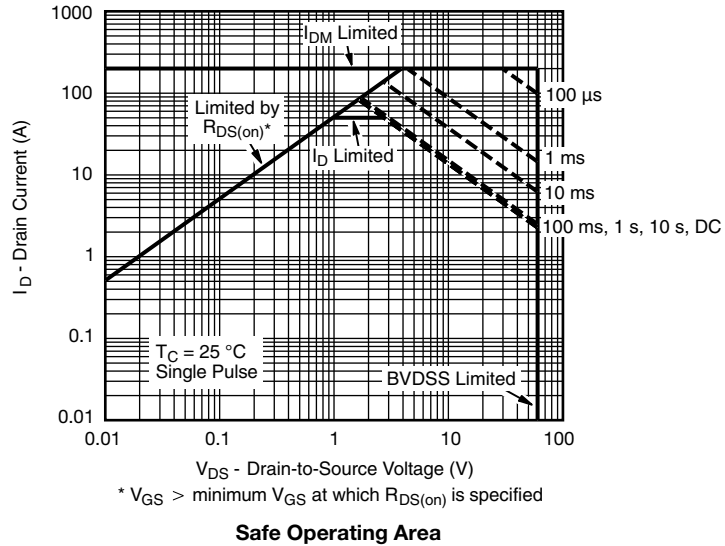
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



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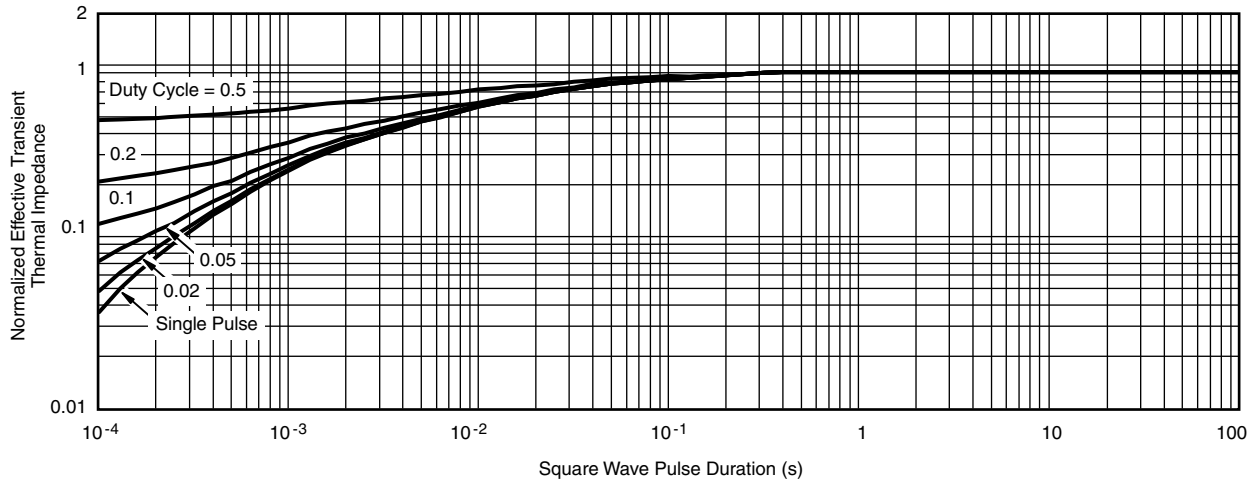


**THERMAL RATINGS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)





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



**Normalized Thermal Transient Impedance, Junction-to-Case**

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Case (25 °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 [www.vishay.com/ppg?68901](http://www.vishay.com/ppg?68901).



DPAK / TO-252 and Reverse DPAK

Ordering codes for the SQ rugged series power MOSFETs in the DPAK / TO-252 and Reverse DPAK packages:

Table with 3 columns: DATASHEET PART NUMBER, OLD ORDERING CODE a, NEW ORDERING CODE. Lists various MOSFET part numbers and their corresponding ordering codes.

Note

a. Old ordering code is obsolete and no longer valid for new orders



### TO-252AA Case Outline



| DIM.                            | MILLIMETERS |       | INCHES    |       |
|---------------------------------|-------------|-------|-----------|-------|
|                                 | MIN.        | MAX.  | MIN.      | MAX.  |
| A                               | 2.18        | 2.38  | 0.086     | 0.094 |
| A1                              | -           | 0.127 | -         | 0.005 |
| b                               | 0.64        | 0.88  | 0.025     | 0.035 |
| b2                              | 0.76        | 1.14  | 0.030     | 0.045 |
| b3                              | 4.95        | 5.46  | 0.195     | 0.215 |
| C                               | 0.46        | 0.61  | 0.018     | 0.024 |
| C2                              | 0.46        | 0.89  | 0.018     | 0.035 |
| D                               | 5.97        | 6.22  | 0.235     | 0.245 |
| D1                              | 4.10        | -     | 0.161     | -     |
| E                               | 6.35        | 6.73  | 0.250     | 0.265 |
| E1                              | 4.32        | -     | 0.170     | -     |
| H                               | 9.40        | 10.41 | 0.370     | 0.410 |
| e                               | 2.28 BSC    |       | 0.090 BSC |       |
| e1                              | 4.56 BSC    |       | 0.180 BSC |       |
| L                               | 1.40        | 1.78  | 0.055     | 0.070 |
| L3                              | 0.89        | 1.27  | 0.035     | 0.050 |
| L4                              | -           | 1.02  | -         | 0.040 |
| L5                              | 1.01        | 1.52  | 0.040     | 0.060 |
| ECN: T13-0592-Rev. A, 02-Sep-13 |             |       |           |       |
| DWG: 6019                       |             |       |           |       |

**Note**

- Dimension L3 is for reference only.



## RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads  
Dimensions in Inches/(mm)

[Return to Index](#)



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