

## SQD19P06-60L-T4GE3-VB Datasheet

### P-Channel 60 V (D-S) MOSFET

#### PRODUCT SUMMARY

| $V_{DS}$ (V) | $R_{DS(on)}$ ( $\Omega$ )   | $I_D$ (A) <sup>d</sup> | $Q_g$ (Typ) |
|--------------|-----------------------------|------------------------|-------------|
| - 60         | 0.046 at $V_{GS} = - 10$ V  | - 35                   | 26          |
|              | 0.058 at $V_{GS} = - 4.5$ V | - 30                   |             |

#### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Trench Power MOSFET
- 100 % UIS Tested
- Compliant to RoHS Directive 2002/95/EC



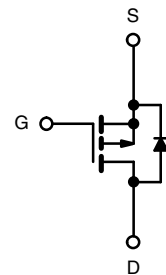
**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
Available

#### APPLICATIONS

- High Side Switch for Full Bridge Converter
- DC/DC Converter for LCD Display



Drain Connected to Tab



P-Channel MOSFET

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise note)

| Parameter                                              | Symbol         | Limit          | Unit |
|--------------------------------------------------------|----------------|----------------|------|
| Drain-Source Voltage                                   | $V_{DS}$       | - 60           | V    |
| Gate-Source Voltage                                    | $V_{GS}$       | $\pm 20$       |      |
| Continuous Drain Current ( $T_J = 150$ °C)             | $I_D$          | $T_C = 25$ °C  | A    |
|                                                        |                | $T_C = 125$ °C |      |
| Pulsed Drain Current                                   | $I_{DM}$       | - 100          |      |
| Avalanche Current, Single Pulse                        | $I_{AS}$       | - 22           |      |
| Repetitive Avalanche Energy, Single Pulse <sup>a</sup> | $E_{AS}$       | 24.2           | mJ   |
| Power Dissipation                                      | $P_D$          | $T_C = 25$ °C  | W    |
|                                                        |                | $T_A = 25$ °C  |      |
| Operating Junction and Storage Temperature Range       | $T_J, T_{stg}$ | - 55 to 150    | °C   |

#### THERMAL RESISTANCE RATINGS

| Parameter                                | Symbol     | Typical | Maximum | Unit |
|------------------------------------------|------------|---------|---------|------|
| Maximum Junction-to-Ambient <sup>b</sup> | $R_{thJA}$ | 17      | 21      | °C/W |
|                                          |            | 45      | 55      |      |
| Maximum Junction-to-Case                 | $R_{thJC}$ | 2.7     | 3.25    |      |

Notes:

- Duty cycle  $\leq 1$  %.
- When mounted on 1" square PCB (FR-4 material).
- See SOA curve for voltage derating.
- Based up on  $T_C = 25$  °C.

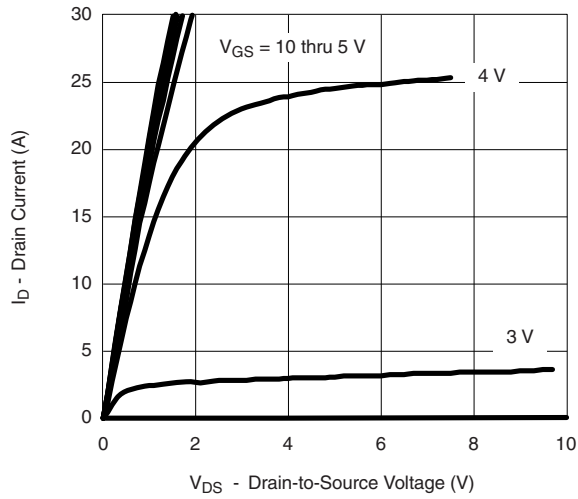
| SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise note)                    |                     |                                                                                                                              |       |       |       |      |
|-----------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|------|
| 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                                                                             | - 60  |       |       | V    |
| Gate Threshold Voltage                                                            | V <sub>GS(th)</sub> | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = - 250 μA                                                                | - 1   |       | - 3   | V    |
| Gate-Body 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>DS</sub> = - 60 V, V <sub>GS</sub> = 0 V                                                                              |       |       | - 1   | μA   |
|                                                                                   |                     | V <sub>DS</sub> = - 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                     |       |       | - 50  |      |
|                                                                                   |                     | V <sub>DS</sub> = - 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C                                                     |       |       | - 125 |      |
| On-State Drain Current <sup>a</sup>                                               | I <sub>D(on)</sub>  | V <sub>DS</sub> = - 5 V, V <sub>GS</sub> = - 10 V                                                                            | - 20  |       |       | A    |
| Drain-Source On-State Resistance <sup>a</sup>                                     | R <sub>DS(on)</sub> | V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 10 A                                                                            |       | 0.046 |       | Ω    |
|                                                                                   |                     | V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 10 A, T <sub>J</sub> = 125 °C                                                   |       | 0.095 |       |      |
|                                                                                   |                     | V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 10 A, T <sub>J</sub> = 150 °C                                                   |       | 0.115 |       |      |
|                                                                                   |                     | V <sub>GS</sub> = - 4.5 V, I <sub>D</sub> = - 5 A                                                                            |       | 0.058 |       |      |
| Forward Transconductance <sup>a</sup>                                             | g <sub>fs</sub>     | V <sub>DS</sub> = - 15 V, I <sub>D</sub> = - 10 A                                                                            |       | 22    |       | S    |
| Dynamic <sup>b</sup>                                                              |                     |                                                                                                                              |       |       |       |      |
| Input Capacitance                                                                 | C <sub>iss</sub>    | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = - 25 V, f = 1 MHz                                                                   |       | 1900  |       | pF   |
| Output Capacitance                                                                | C <sub>oss</sub>    |                                                                                                                              |       | 130   |       |      |
| Reverse Transfer Capacitance                                                      | C <sub>rss</sub>    |                                                                                                                              |       | 90    |       |      |
| Total Gate Charge <sup>c</sup>                                                    | Q <sub>g</sub>      | V <sub>DS</sub> = - 30 V, V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 10 A                                                  |       | 26    | 40    | nC   |
| Gate-Source Charge <sup>c</sup>                                                   | Q <sub>gs</sub>     |                                                                                                                              |       | 4.5   |       |      |
| Gate-Drain Charge <sup>c</sup>                                                    | Q <sub>gd</sub>     |                                                                                                                              |       | 7     |       |      |
| Gate Resistance                                                                   | R <sub>g</sub>      | f = 1 MHz                                                                                                                    |       | 7     |       | Ω    |
| Turn-On Delay Time <sup>c</sup>                                                   | t <sub>d(on)</sub>  | V <sub>DD</sub> = - 30 V, R <sub>L</sub> = 3 Ω<br>I <sub>D</sub> ≅ - 19 A, V <sub>GEN</sub> = - 10 V, R <sub>g</sub> = 2.5 Ω |       | 8     | 15    | ns   |
| Rise Time <sup>c</sup>                                                            | t <sub>r</sub>      |                                                                                                                              |       | 9     | 15    |      |
| Turn-Off Delay Time <sup>c</sup>                                                  | t <sub>d(off)</sub> |                                                                                                                              |       | 65    | 100   |      |
| Fall Time <sup>c</sup>                                                            | t <sub>f</sub>      |                                                                                                                              |       | 30    | 45    |      |
| Drain-Source Body Diode and Characteristics (T <sub>C</sub> = 25 °C) <sup>b</sup> |                     |                                                                                                                              |       |       |       |      |
| Continuous Current                                                                | I <sub>S</sub>      |                                                                                                                              |       |       | - 20  | A    |
| Pulsed Current                                                                    | I <sub>SM</sub>     |                                                                                                                              |       |       | - 30  |      |
| Forward Voltage <sup>a</sup>                                                      | V <sub>SD</sub>     | I <sub>F</sub> = - 19 A, V <sub>GS</sub> = 0 V                                                                               |       | - 1   | - 1.5 | V    |
| Reverse Recovery Time                                                             | t <sub>rr</sub>     | I <sub>F</sub> = - 19 A, di/dt = 100 A/μs                                                                                    |       | 41    | 61    | ns   |

Notes:

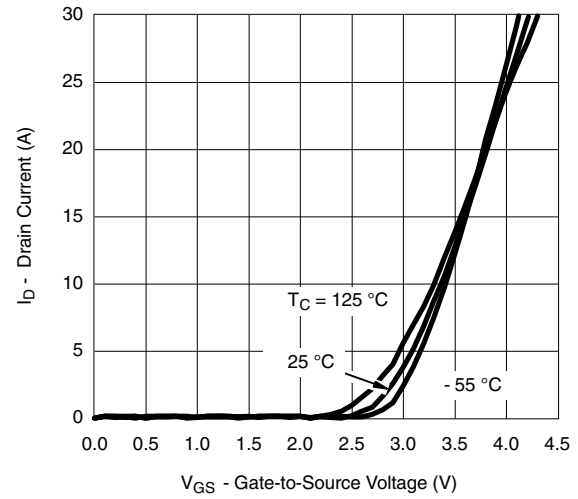
- Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %.
- Guaranteed by design, not subject to production testing.
- Independent of operating temperature.

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.

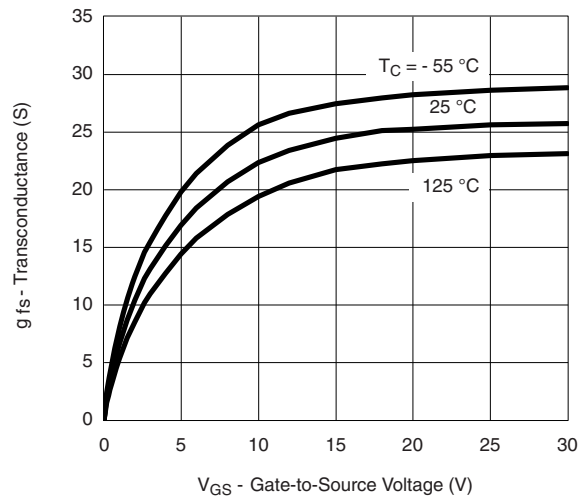
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



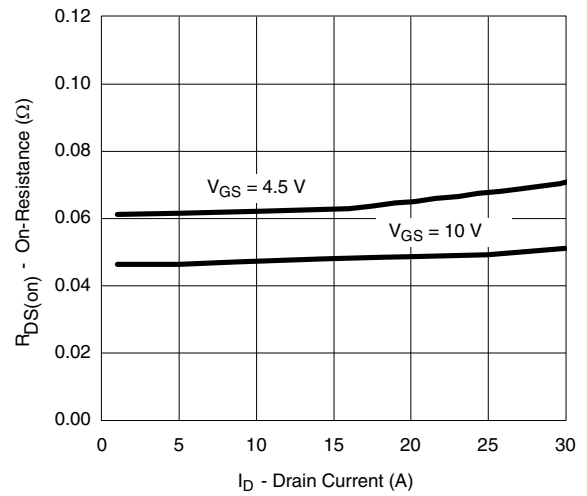
**Output Characteristics**



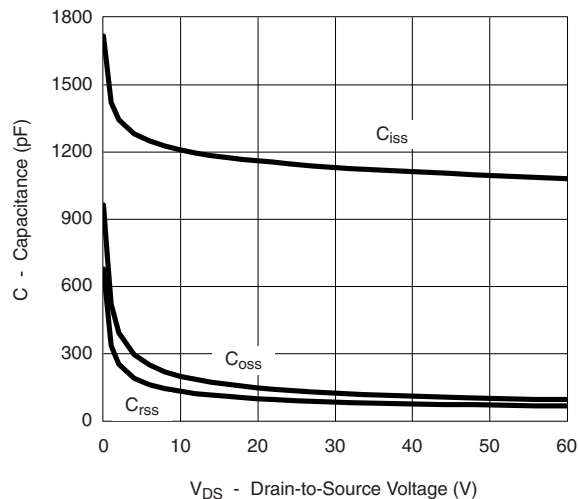
**Transfer Characteristics**



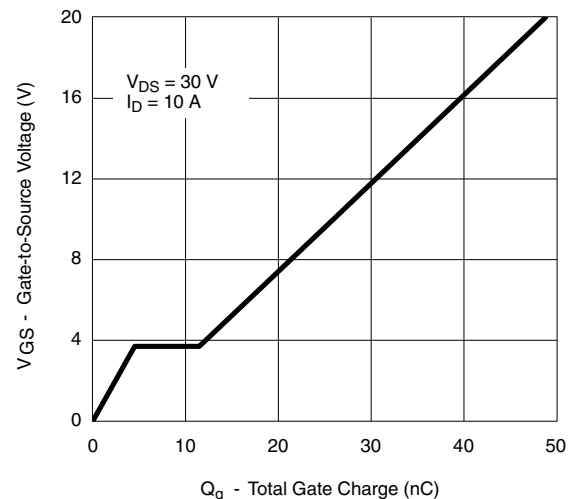
**Transconductance**



**On-Resistance vs. Drain Current**

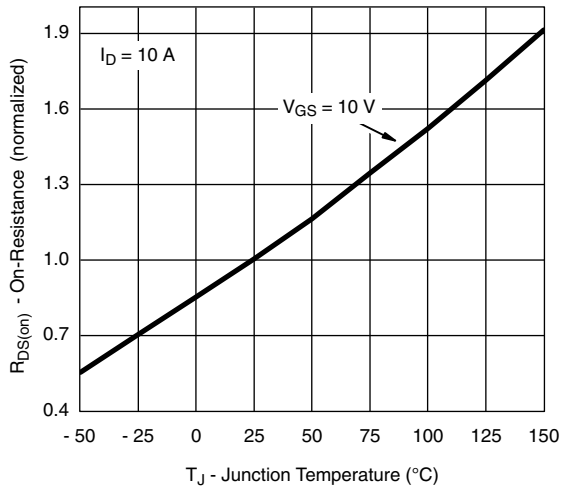


**Capacitance**

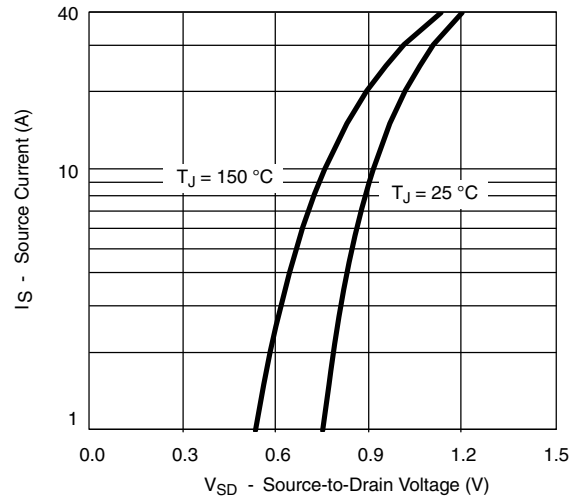


**Gate Charge**

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

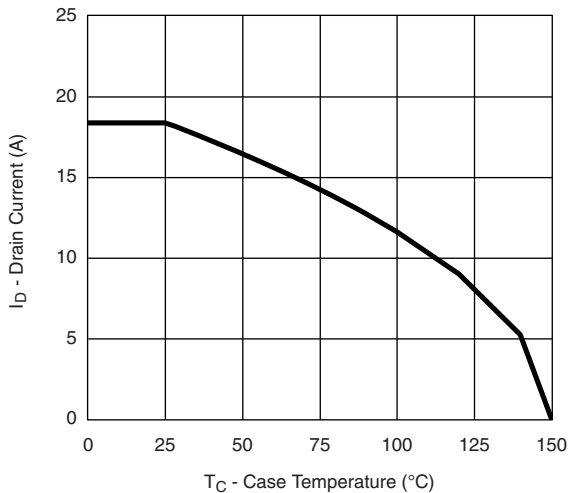


On-Resistance vs. Junction Temperature

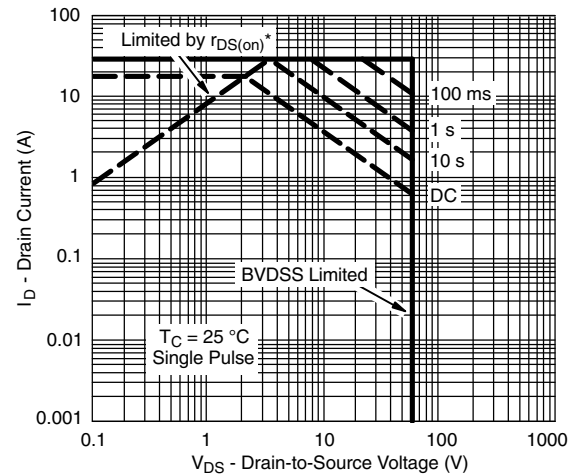


Source-Drain Diode Forward Voltage

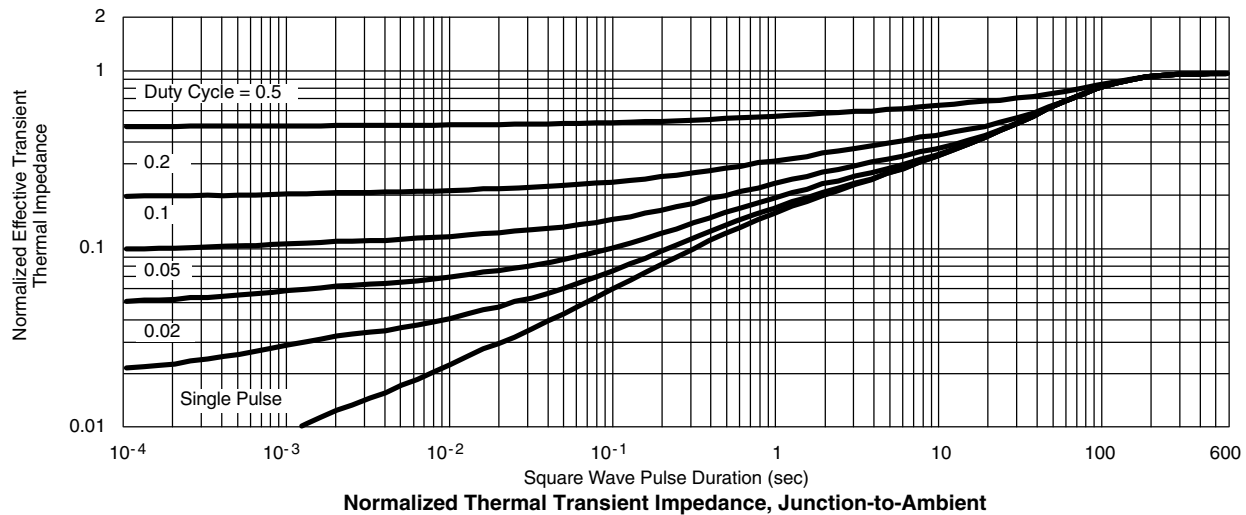
**THERMAL RATINGS**



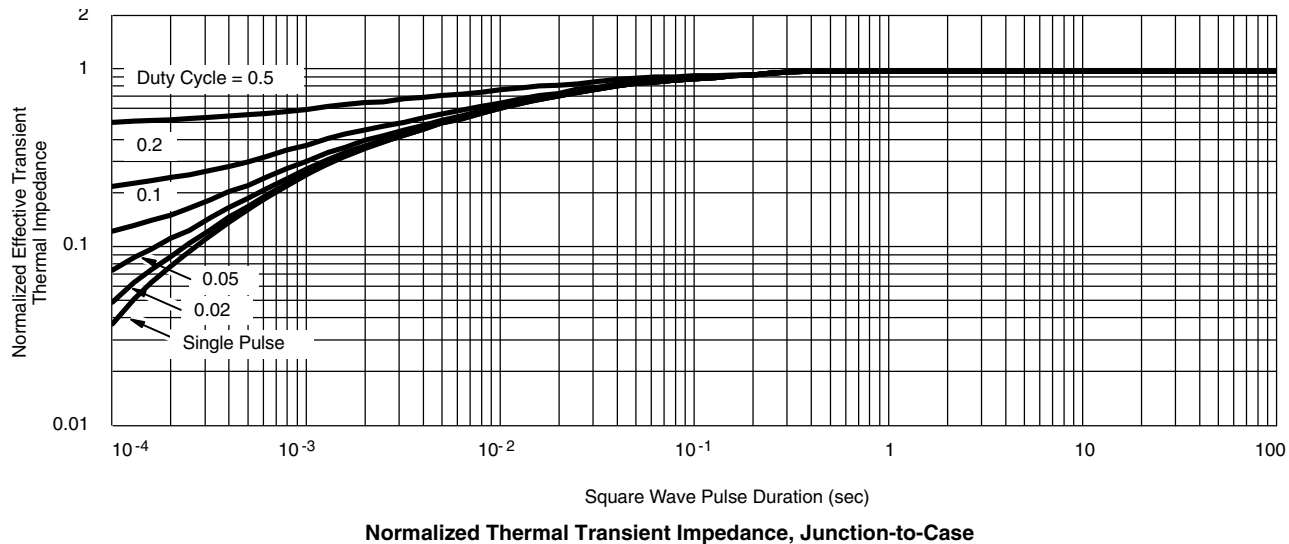
Maximum Drain Current  
vs. Case Temperature



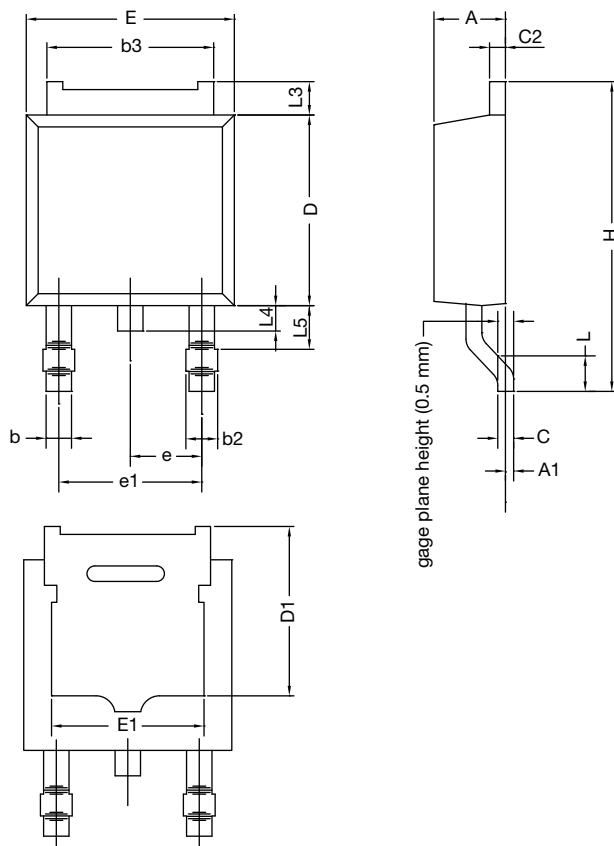
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $r_{DS(on)}$  is specified  
Safe Operating Area



## THERMAL RATINGS



## TO-252AA Case Outline

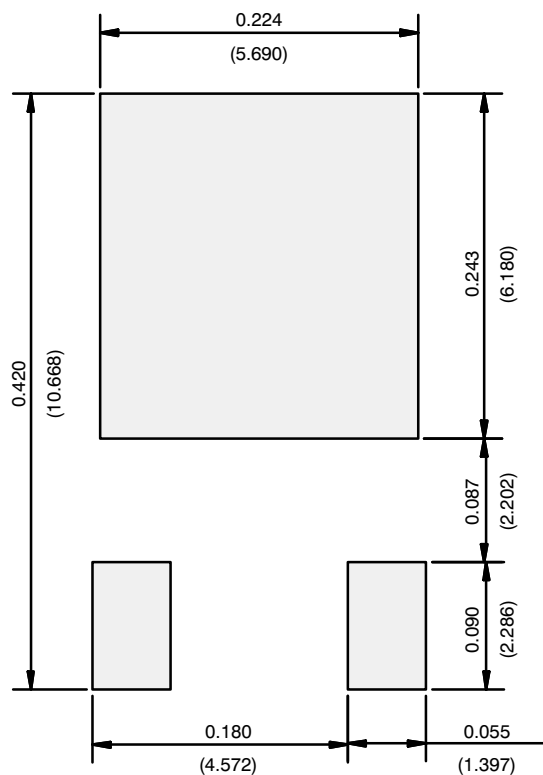


| DIM.                                         | MILLIMETERS |       | INCHES    |       |
|----------------------------------------------|-------------|-------|-----------|-------|
|                                              | MIN.        | MAX.  | MIN.      | MAX.  |
| A                                            | 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: T16-0236-Rev. P, 16-May-16<br>DWG: 5347 |             |       |           |       |

### Notes

- Dimension L3 is for reference only.

RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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