

Automotive P-Channel 40 V (D-S) 175 °C MOSFET

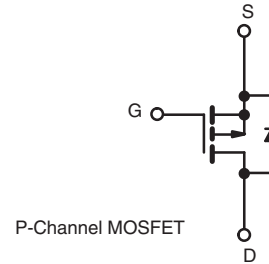
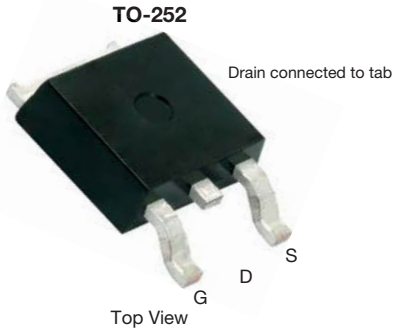
 AUTOMOTIVE
GRADE

RoHS
COMPLIANT
HALOGEN
FREE

| PRODUCT SUMMARY | |
|--|--------|
| V_{DS} (V) | -40 |
| $R_{DS(on)}$ (Ω) at $V_{GS} = -10$ V | 0.013 |
| $R_{DS(on)}$ (Ω) at $V_{GS} = -4.5$ V | 0.022 |
| I_D (A) | -50 |
| Configuration | Single |

FEATURES

- TrenchFET® power MOSFET
- Package with low thermal resistance
- 100 % R_g and UIS tested
- AEC-Q101 qualified^d
- Material categorization:
for definitions of compliance please see
www.vishay.com/doc?99912



| ORDERING INFORMATION | |
|---------------------------------|------------------|
| Package | TO-252 |
| Lead (Pb)-free and Halogen-free | SQD50P04-13L-GE3 |

| ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted) | | | | |
|---|----------------|----------------------------|---------------|----|
| PARAMETER | SYMBOL | LIMIT | UNIT | |
| Drain-Source Voltage | V_{DS} | -40 | V | |
| Gate-Source Voltage | V_{GS} | ± 20 | | |
| Continuous Drain Current | I_D | $T_C = 25$ °C ^a | -50 | |
| | | $T_C = 125$ °C | -39 | |
| Continuous Source Current (Diode Conduction) ^a | I_S | -50 | A | |
| Pulsed Drain Current ^b | I_{DM} | -200 | | |
| Single Pulse Avalanche Current | I_{AS} | -40 | | |
| Single Pulse Avalanche Energy | E_{AS} | L = 0.1 mH | 80 | mJ |
| Maximum Power Dissipation ^b | | | $T_A = 25$ °C | |
| | $T_C = 25$ °C | 136 | | |
| | $T_C = 125$ °C | 45 | | |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | -55 to +175 | °C | |

| THERMAL RESISTANCE RATINGS | | | |
|----------------------------|------------|-------|------|
| PARAMETER | SYMBOL | LIMIT | UNIT |
| Junction-to-Ambient | R_{thJA} | 50 | °C/W |
| Junction-to-Case (Drain) | | | |

Notes

- Package limited.
- Pulse test; pulse width ≤ 300 μ s, duty cycle ≤ 2 %.
- When mounted on 1" square PCB (FR4 material).
- Parametric verification ongoing.



| SPECIFICATIONS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | | | |
|---|--------------|--|------|-------|-----------|---------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
| Static | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0\text{ V}$, $I_D = -250\text{ }\mu\text{A}$ | -40 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D = -250\text{ }\mu\text{A}$ | -1.5 | - | -2.5 | |
| Gate-Source Leakage | I_{GSS} | $V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$ | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{GS} = 0\text{ V}$, $V_{DS} = -40\text{ V}$ | - | - | -1 | μA |
| | | $V_{GS} = 0\text{ V}$, $V_{DS} = -40\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ | - | - | -50 | |
| | | $V_{GS} = 0\text{ V}$, $V_{DS} = -40\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$ | - | - | -150 | |
| On-State Drain Current ^a | $I_{D(on)}$ | $V_{GS} = -10\text{ V}$, $V_{DS} \leq -5\text{ V}$ | -50 | - | - | A |
| Drain-Source On-State Resistance ^a | $R_{DS(on)}$ | $V_{GS} = -10\text{ V}$, $I_D = -17\text{ A}$ | - | 0.010 | 0.013 | Ω |
| | | $V_{GS} = -10\text{ V}$, $I_D = -50\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$ | - | - | 0.017 | |
| | | $V_{GS} = -10\text{ V}$, $I_D = -50\text{ A}$, $T_J = 175\text{ }^\circ\text{C}$ | - | - | 0.020 | |
| | | $V_{GS} = -4.5\text{ V}$, $I_D = -14\text{ A}$ | - | 0.016 | 0.022 | |
| Forward Transconductance ^a | g_{fs} | $V_{DS} = -15\text{ V}$, $I_D = -17\text{ A}$ | - | 61 | - | S |
| Dynamic^b | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}$, $V_{DS} = -25\text{ V}$, $f = 1\text{ MHz}$ | - | 2872 | 3950 | μF |
| Output Capacitance | C_{oss} | | - | 508 | 635 | |
| Reverse Transfer Capacitance | C_{rss} | | - | 352 | 440 | |
| Total Gate Charge ^c | Q_g | $V_{GS} = -10\text{ V}$, $V_{DS} = -30\text{ V}$, $I_D = -50\text{ A}$ | - | 60 | 80 | nC |
| Gate-Source Charge ^c | Q_{gs} | | - | 5.7 | 8.6 | |
| Gate-Drain Charge ^c | Q_{gd} | | - | 14.7 | 22 | |
| Gate Resistance | R_g | $f = 1\text{ MHz}$ | 1.5 | 3 | 4.5 | Ω |
| Turn-On Delay Time ^c | $t_{d(on)}$ | $V_{DD} = -20\text{ V}$, $R_L = 0.4\text{ }\Omega$ $I_D \cong -50\text{ A}$, $V_{GEN} = -10\text{ V}$, $R_g = 1\text{ }\Omega$ | - | 10 | 15 | ns |
| Rise Time ^c | t_r | | - | 12 | 18 | |
| Turn-Off Delay Time ^c | $t_{d(off)}$ | | - | 40 | 60 | |
| Fall Time ^c | t_f | | - | 16 | 24 | |
| Source-Drain Diode Ratings and Characteristics^b | | | | | | |
| Pulsed Current ^a | I_{SM} | | - | - | -200 | A |
| Forward Voltage | V_{SD} | $I_F = -50\text{ A}$, $V_{GS} = 0\text{ V}$ | - | -1 | -1.5 | V |

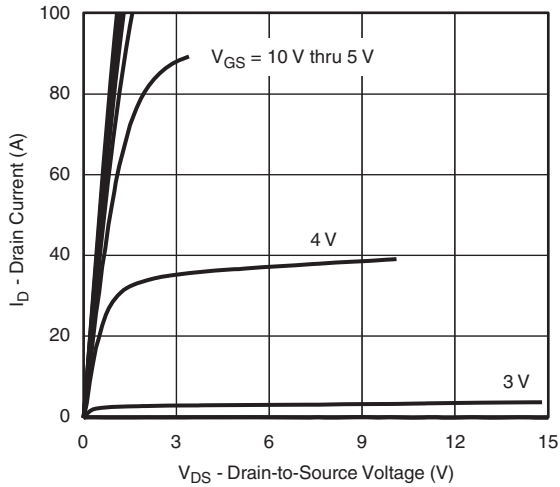
Notes

- 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.

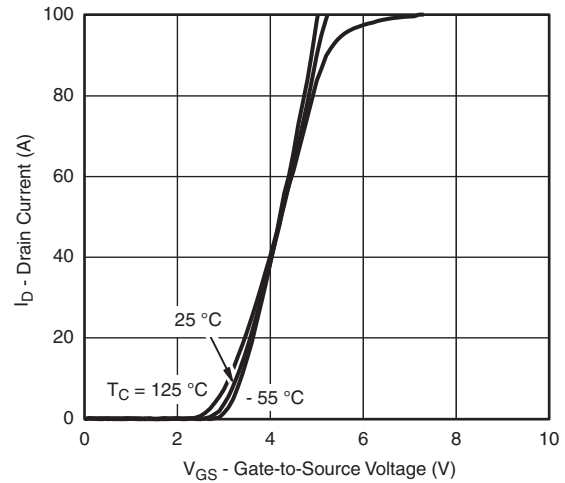
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



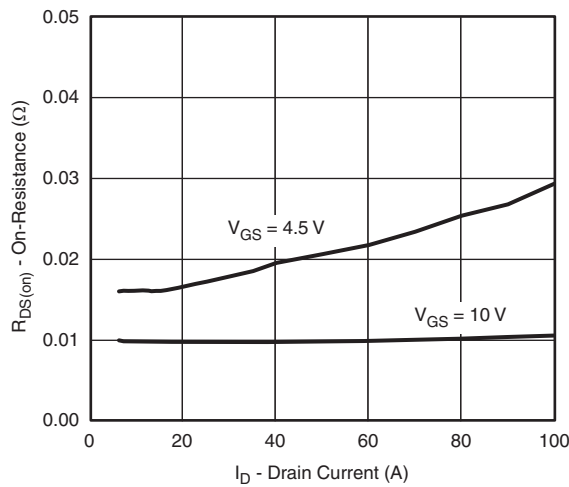
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



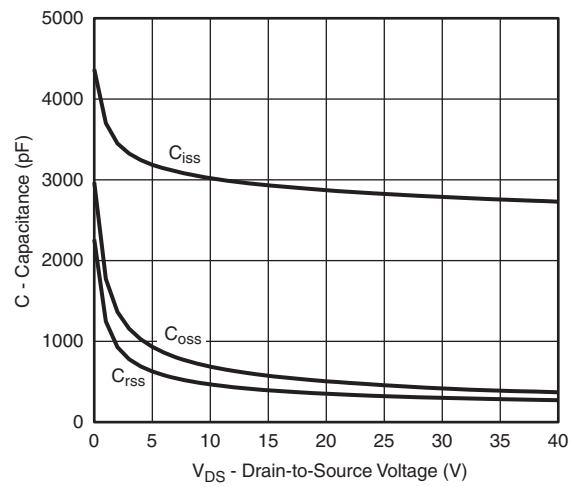
Output Characteristics



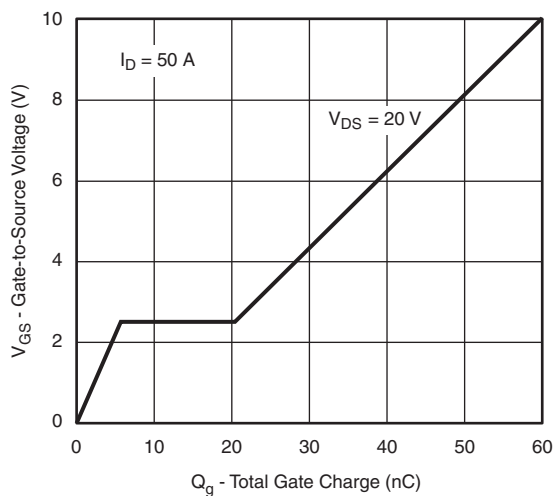
Transfer Characteristics



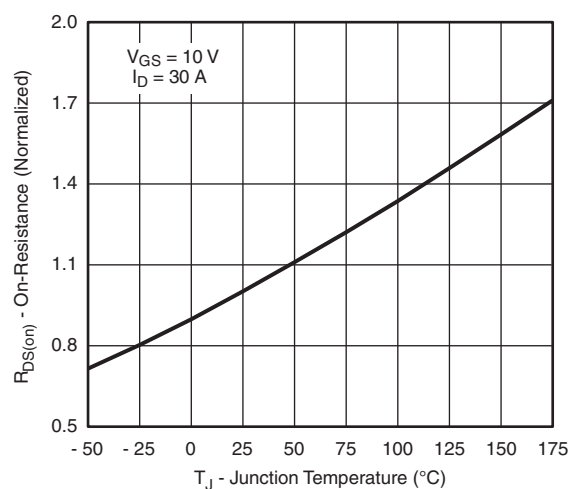
On-Resistance vs. Drain Current



Capacitance



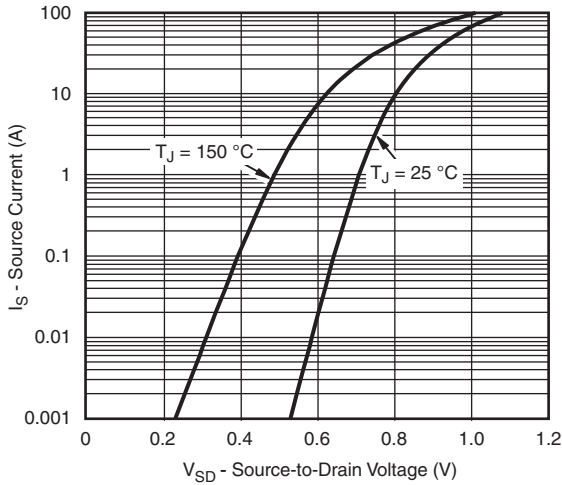
Gate Charge



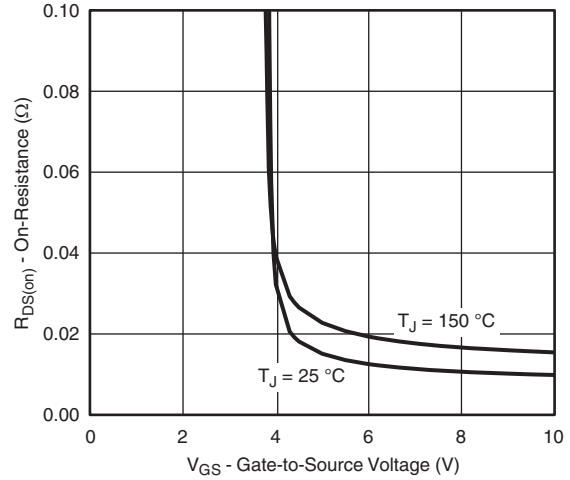
On-Resistance vs. Junction Temperature



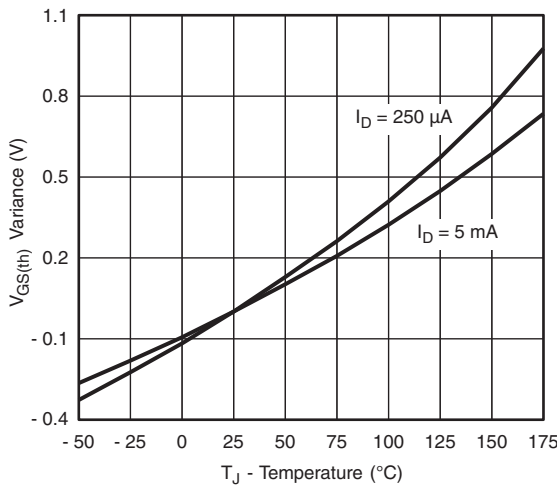
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



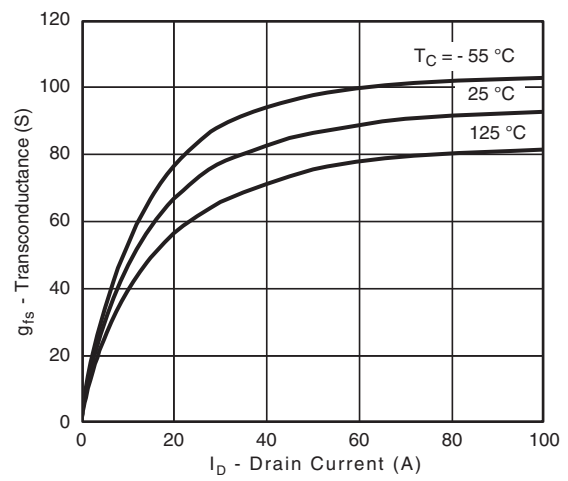
Source Drain Diode Forward Voltage



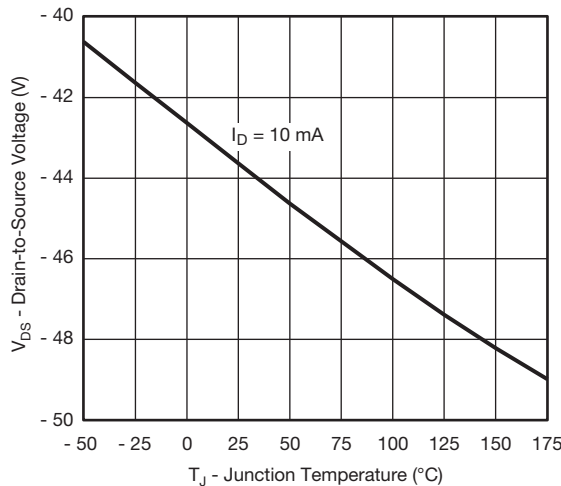
On-Resistance vs. Gate-to Source Voltage



Threshold Voltage



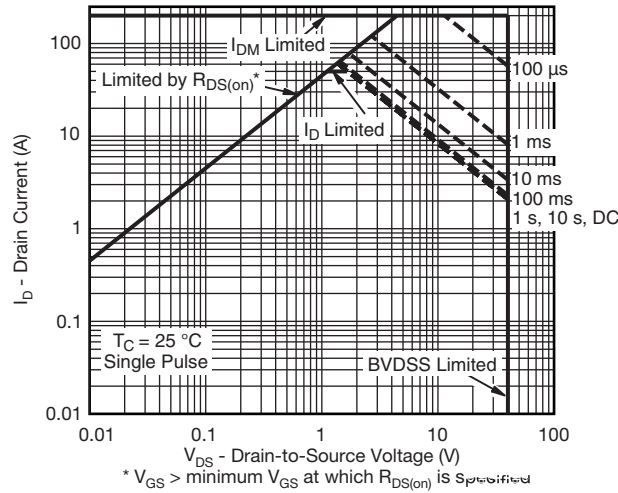
Transconductance



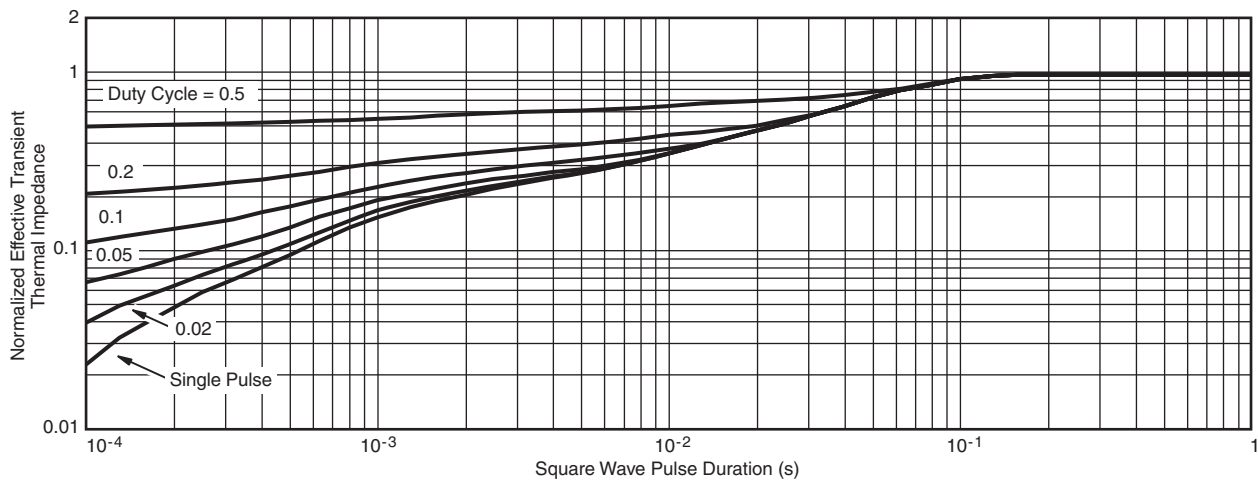
Drain Source Breakdown vs. Junction Temperature



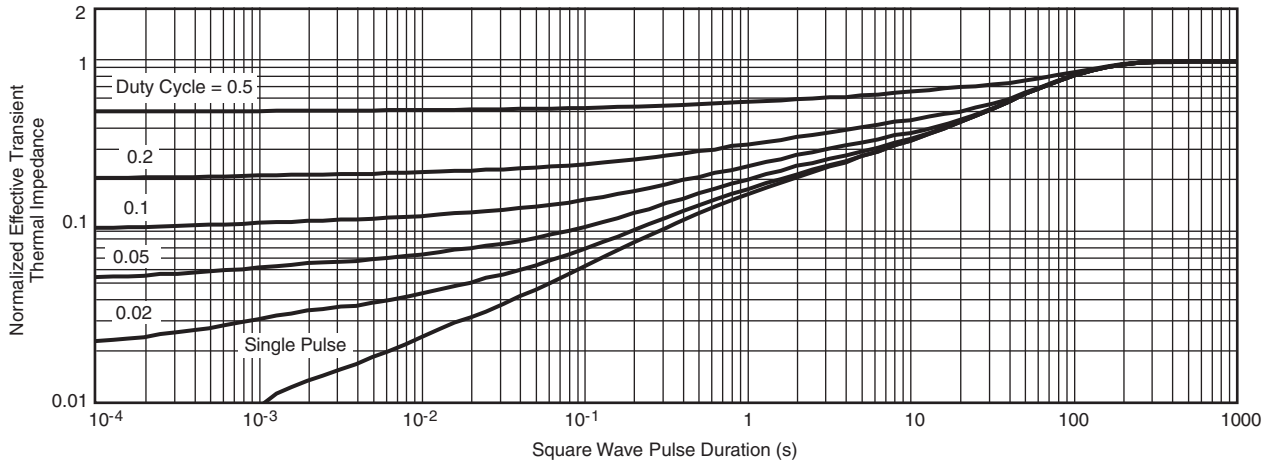
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Case



Normalized Thermal Transient Impedance, Junction-to-Ambient

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.

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| REVISION HISTORY ^a | | |
|-------------------------------|-----------|---|
| REVISION | DATE | DESCRIPTION OF CHANGE |
| D | 12-Dec-14 | • I_D and P_D ($T_C = 125\text{ }^\circ\text{C}$), UIS , R_{thJC} , $R_{DS(on)}$ ($V_{GS} = 10\text{ V}$ for $T_J = 125\text{ }^\circ\text{C}$ and $175\text{ }^\circ\text{C}$) and g_{fs} modified |

Note

a. As of April 2014



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)

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