

HAT1021RJ-VB Datasheet

P-Channel 20-V (D-S) MOSFET

PRODUCT SUMMARY

| V_{DS} (V) | $R_{DS(on)}$ (Ω) | I_D (A) | Q_g (Typ.) |
|--------------|-----------------------------|-------------------|--------------|
| - 20 | 0.015 at $V_{GS} = - 4.5$ V | - 13 ^a | 20 nC |
| | 0.021 at $V_{GS} = - 2.5$ V | - 10 ^a | |
| | 0.040 at $V_{GS} = - 1.8$ V | - 8 | |

FEATURES

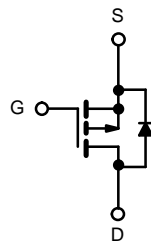
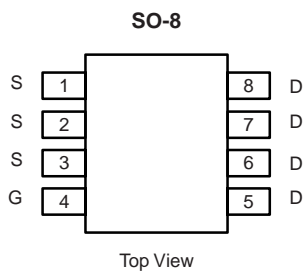
- Halogen-free According to IEC 61249-2-21 Definition
- Trench Power MOSFET
- 100 % R_g Tested
- Compliant to RoHS Directive 2002/95/EC



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Portable Devices
- Load Switch
- Battery Switch
- Charger Switch



P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted

| Parameter | Symbol | Limit | Unit |
|--|----------------|-----------------------|------|
| Drain-Source Voltage | V_{DS} | - 20 | V |
| Gate-Source Voltage | V_{GS} | ± 12 | |
| Continuous Drain Current ($T_J = 150$ °C) | $T_C = 25$ °C | - 13 ^a | A |
| | $T_C = 70$ °C | - 10 ^a | |
| | $T_A = 25$ °C | - 8 ^{b, c} | |
| | $T_A = 70$ °C | - 7.1 ^{b, c} | |
| Pulsed Drain Current | I_{DM} | - 50 | |
| Continuous Source-Drain Diode Current | $T_C = 25$ °C | - 6 ^a | |
| | $T_A = 25$ °C | - 2.9 ^{b, c} | |
| Maximum Power Dissipation | $T_C = 25$ °C | 19 | W |
| | $T_C = 70$ °C | 12 | |
| | $T_A = 25$ °C | 3.5 ^{b, c} | |
| | $T_A = 70$ °C | 2.2 ^{b, c} | |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to 150 | °C |
| Soldering Recommendations (Peak Temperature) ^{d, e} | | 260 | |

THERMAL RESISTANCE RATINGS

| Parameter | Symbol | Typical | Maximum | Unit |
|---|--------------|------------|---------|------|
| Maximum Junction-to-Ambient ^{b, e} | $t \leq 5$ s | R_{thJA} | 28 | °C/W |
| Maximum Junction-to-Case (Drain) | Steady State | R_{thJC} | 5.3 | |

Notes:

a. Package limited.

b. Surface Mounted on 1" x 1" FR4 board.

c. $t = 5$ s.

d. Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.

e. Maximum under Steady State conditions is 80 °C/W.

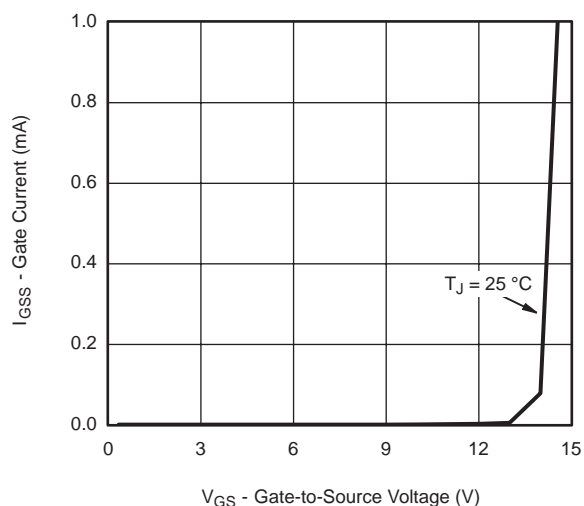
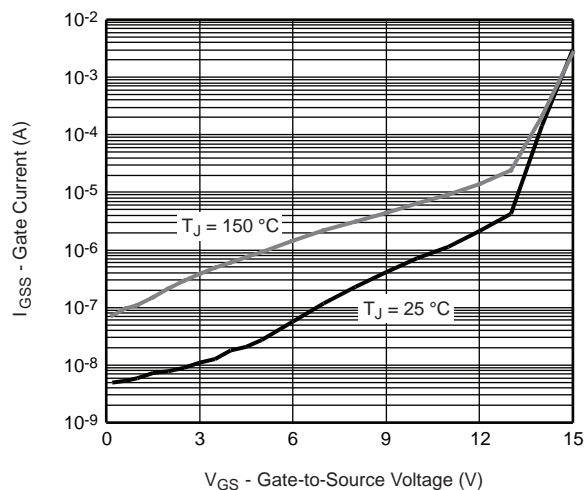
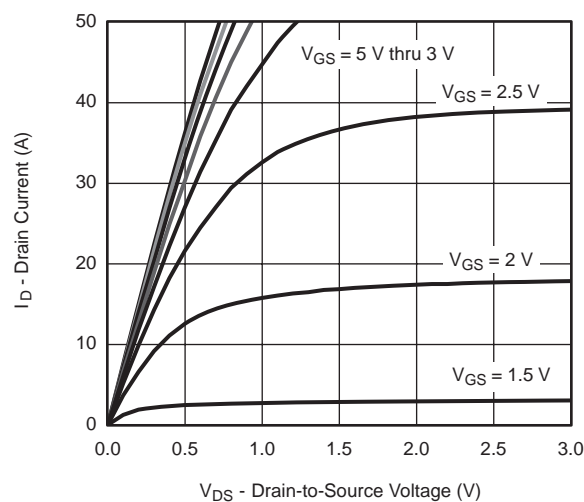
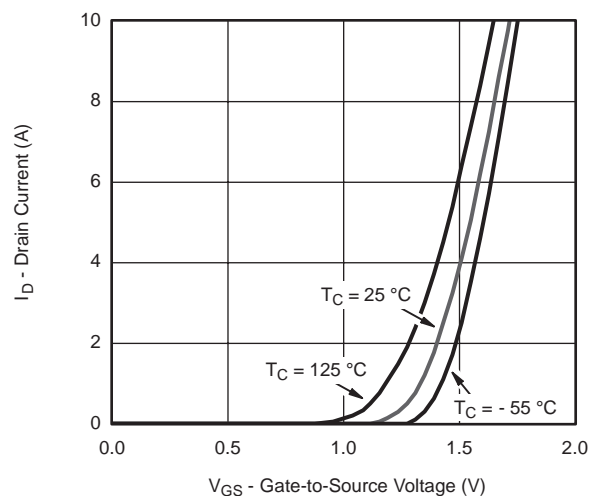
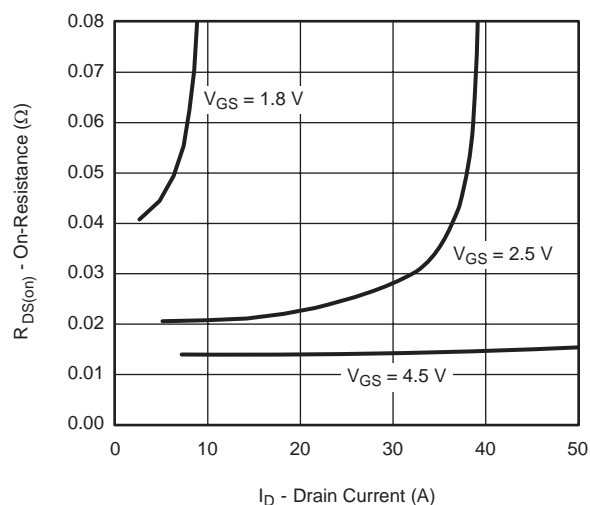
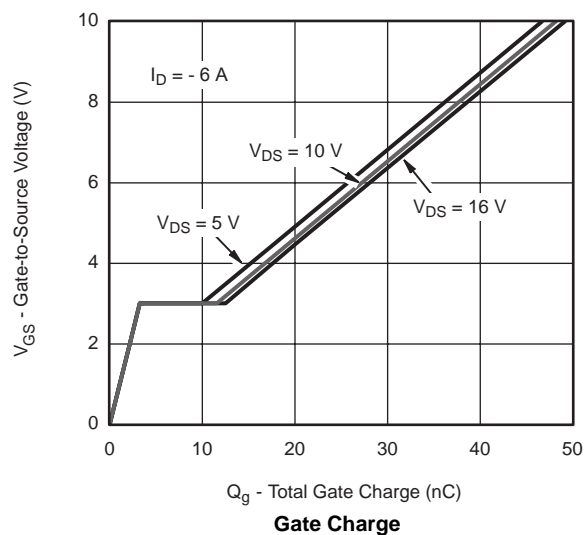
| SPECIFICATIONS $T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted | | | | | | |
|--|-------------------------|---|------|-------|-----------|------------------------|
| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
| Static | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$ | -20 | | | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | $I_D = -250\text{ }\mu\text{A}$ | | -12 | | mV/ $^{\circ}\text{C}$ |
| $V_{GS(th)}$ Temperature Coefficient | $\Delta V_{GS(th)}/T_J$ | | | 3 | | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$ | -0.5 | | -1.2 | V |
| Gate-Source Leakage | I_{GSS} | $V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$ | | | ± 20 | μA |
| | | $V_{DS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$ | | | ± 0.5 | |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$ | | | -1 | |
| | | $V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^{\circ}\text{C}$ | | | -10 | |
| On-State Drain Current ^a | $I_{D(on)}$ | $V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$ | -20 | | | A |
| Drain-Source On-State Resistance ^a | $R_{DS(on)}$ | $V_{GS} = -4.5\text{ V}, I_D = -5.6\text{ A}$ | | 0.015 | | Ω |
| | | $V_{GS} = -2.5\text{ V}, I_D = -5.3\text{ A}$ | | 0.021 | | |
| | | $V_{GS} = -1.8\text{ V}, I_D = -2.5\text{ A}$ | | 0.040 | | |
| Forward Transconductance ^a | g_{fs} | $V_{DS} = -10\text{ V}, I_D = -5.6\text{ A}$ | | 35 | | S |
| Dynamic ^b | | | | | | |
| Total Gate Charge | Q_g | $V_{DS} = -10\text{ V}, V_{GS} = -8\text{ V}, I_D = -5\text{ A}$ | | 50 | 75 | nC |
| Gate-Source Charge | | $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -5\text{ A}$ | | 20 | 30 | |
| | Q_{gs} | | | 3.3 | | |
| Gate-Drain Charge | Q_{gd} | | | 8.4 | | |
| Gate Resistance | R_g | $f = 1\text{ MHz}$ | 0.2 | 1 | 2 | k Ω |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = -10\text{ V}, R_L = 1\text{ }\Omega$ $I_D \cong -5\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$ | | 0.71 | 1.1 | μs |
| Rise Time | t_r | | | 1.7 | 2.6 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 6 | 9 | |
| Fall Time | t_f | | | 3.2 | 5 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = -10\text{ V}, R_L = 1\text{ }\Omega$ $I_D \cong -5\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$ | | 0.3 | 0.45 | |
| Rise Time | t_r | | | 0.6 | 0.9 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 10 | 15 | |
| Fall Time | t_f | | | 3.5 | 5.5 | |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous Source-Drain Diode Current | I_S | $T_C = 25\text{ }^{\circ}\text{C}$ | | | -6 | A |
| Pulse Diode Forward Current | I_{SM} | | | | -50 | |
| Body Diode Voltage | V_{SD} | $I_S = -5\text{ A}, V_{GS} = 0\text{ V}$ | | -0.85 | -1.2 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $I_F = 6\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^{\circ}\text{C}$ | | 30 | 60 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | | 20 | 40 | nC |
| Reverse Recovery Fall Time | t_a | | | 13 | | ns |
| Reverse Recovery Rise Time | t_b | | | 17 | | |

Notes:

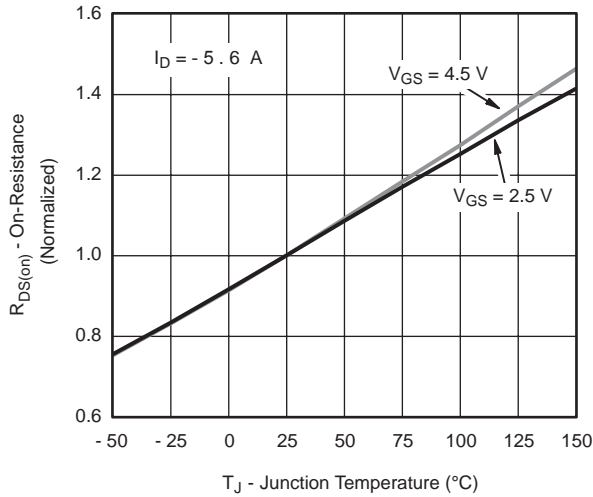
a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.

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

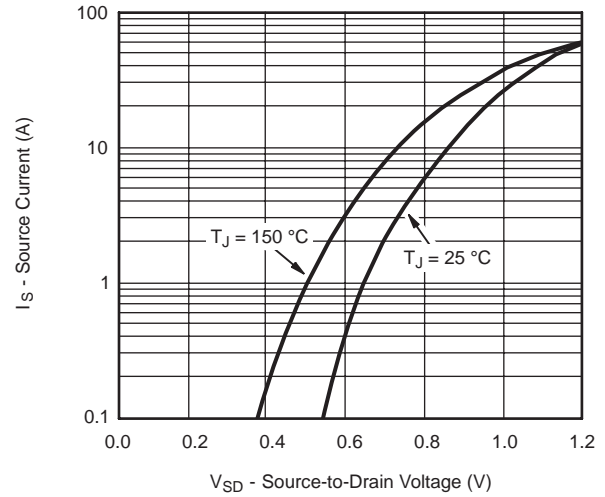
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

Gate Current vs. Gate-Source Voltage

Gate Current vs. Gate-Source Voltage

Output Characteristics

Transfer Characteristics

On-Resistance vs. Drain Current

Gate Charge

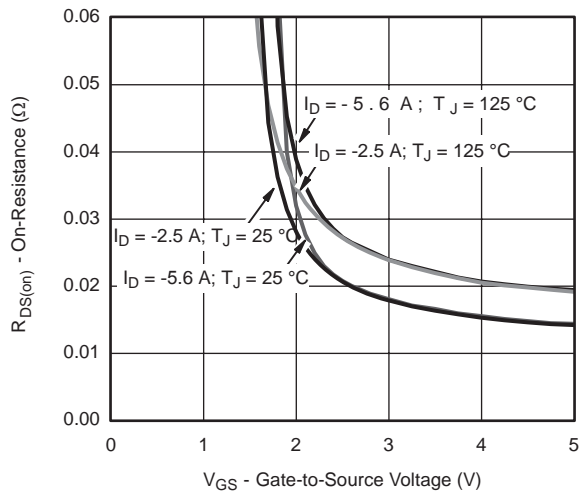
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



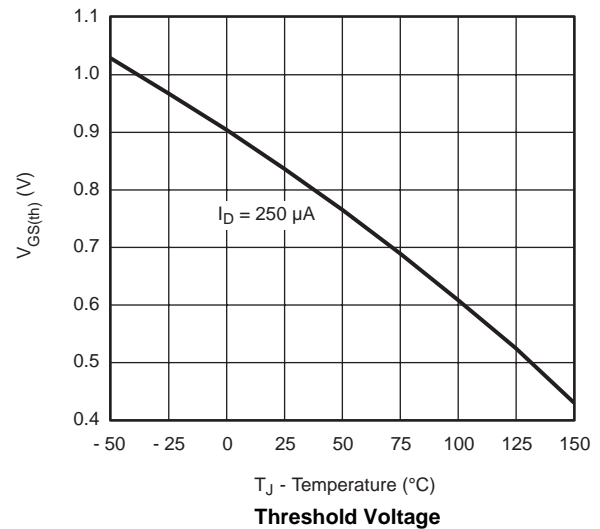
On-Resistance vs. Junction Temperature



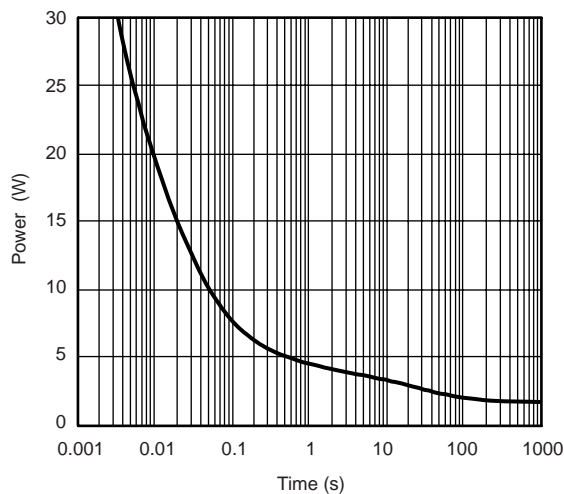
Source-Drain Diode Forward Voltage



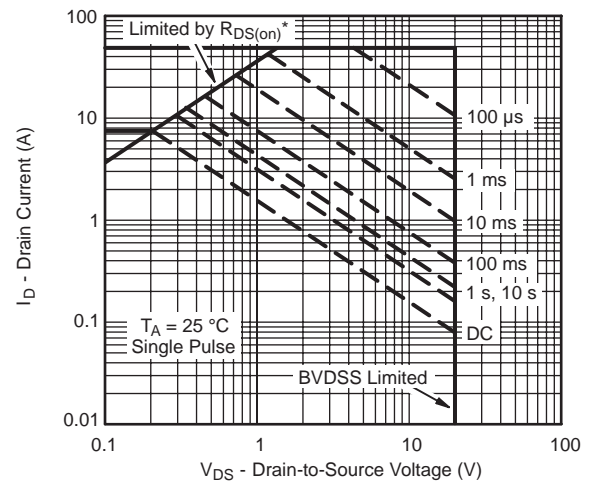
On-Resistance vs. Gate-to-Source Voltage



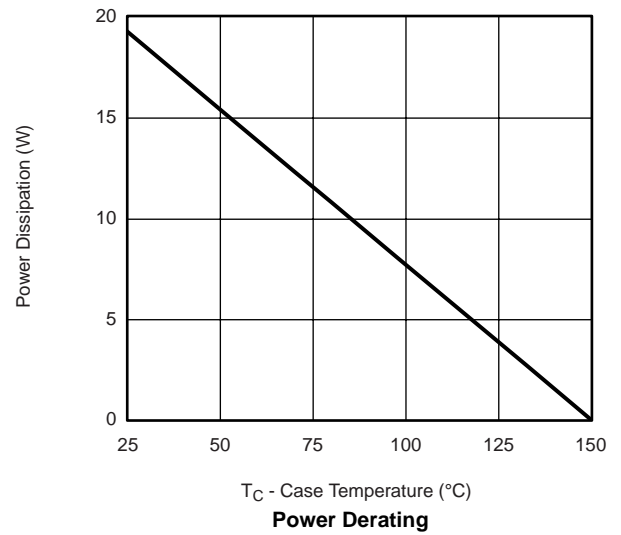
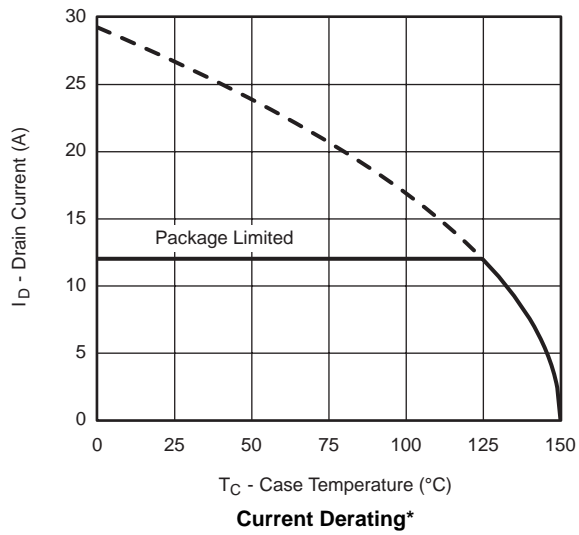
Threshold Voltage



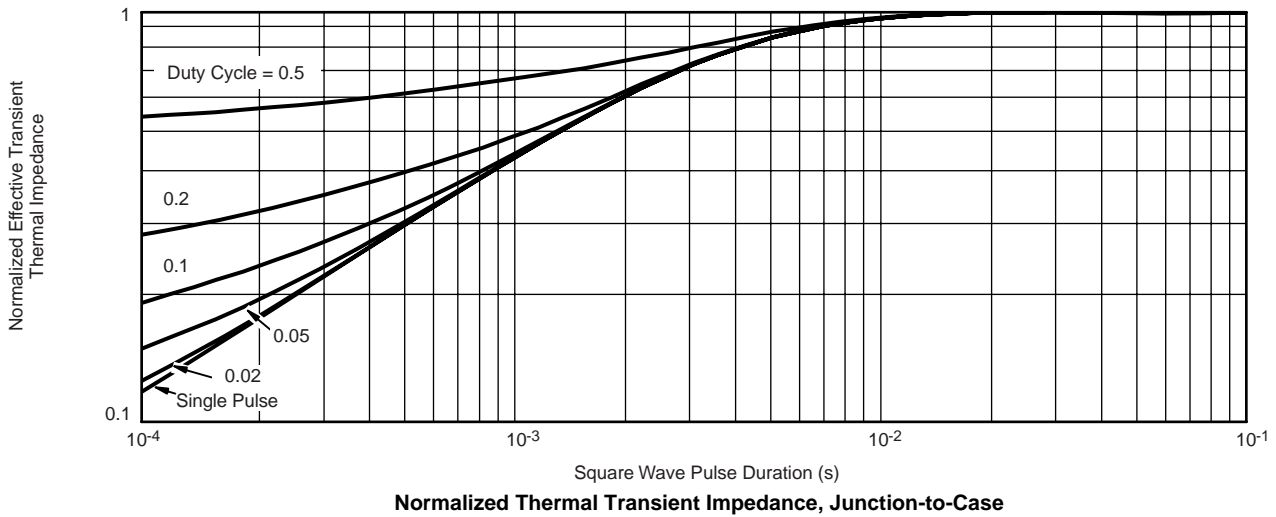
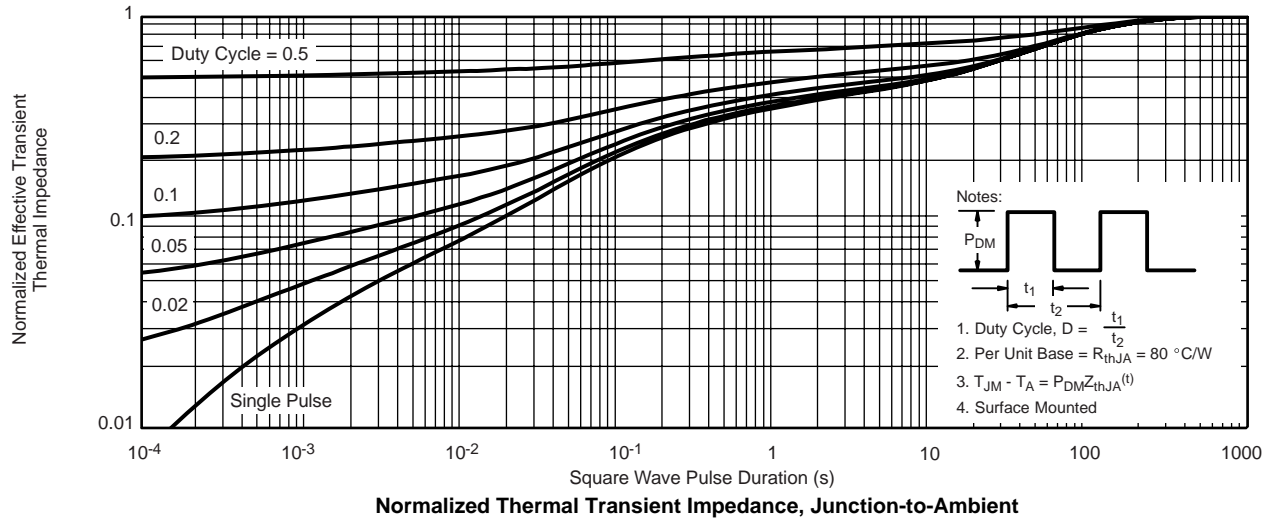
Single Pulse Power, Junction-to-Ambient



Safe Operating Area, Junction-to-Ambient
* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

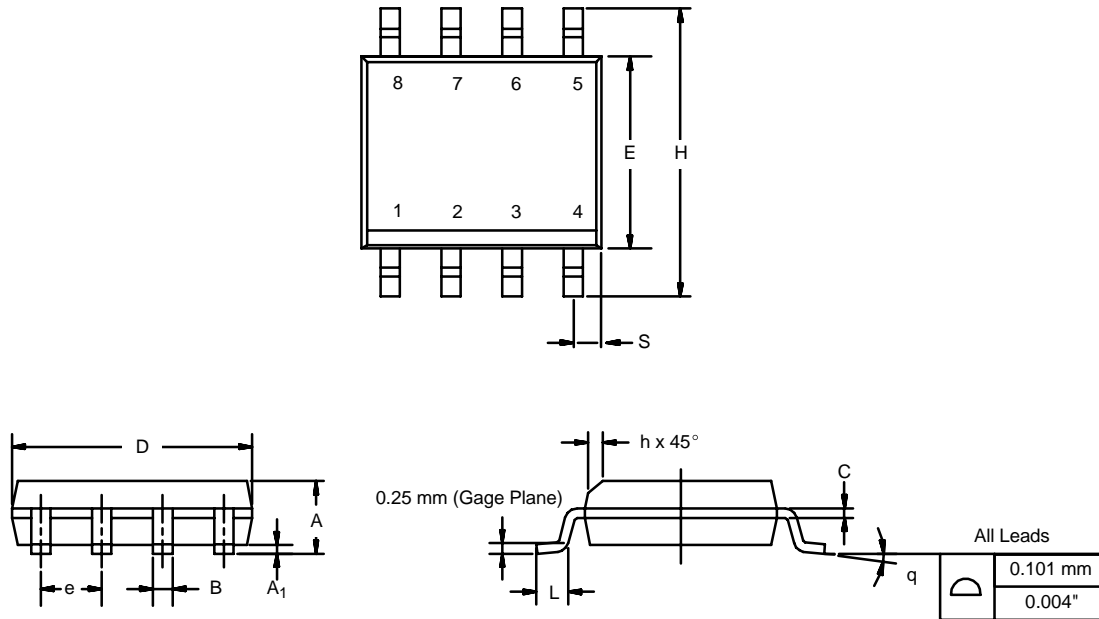
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

* 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.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted


SOIC (NARROW): 8-LEAD

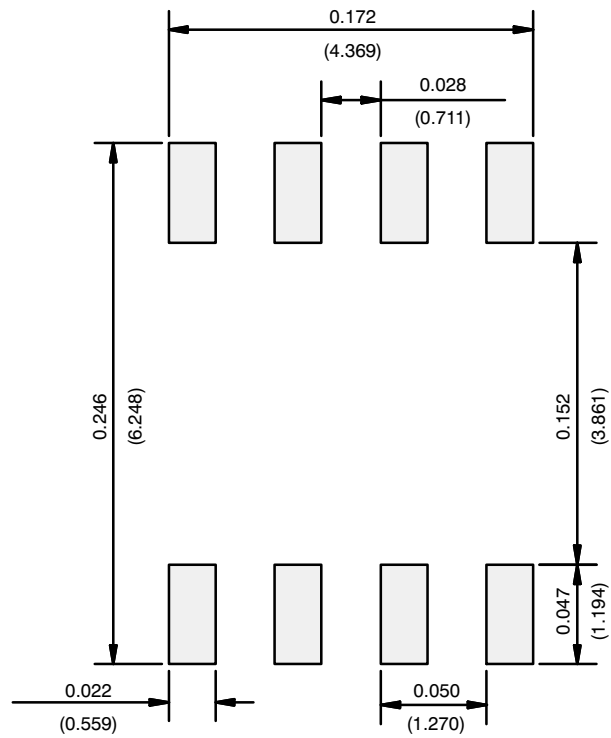
JEDEC Part Number: MS-012



| DIM | MILLIMETERS | | INCHES | |
|----------------|-------------|------|-----------|-------|
| | Min | Max | Min | Max |
| A | 1.35 | 1.75 | 0.053 | 0.069 |
| A ₁ | 0.10 | 0.20 | 0.004 | 0.008 |
| B | 0.35 | 0.51 | 0.014 | 0.020 |
| C | 0.19 | 0.25 | 0.0075 | 0.010 |
| D | 4.80 | 5.00 | 0.189 | 0.196 |
| E | 3.80 | 4.00 | 0.150 | 0.157 |
| e | 1.27 BSC | | 0.050 BSC | |
| H | 5.80 | 6.20 | 0.228 | 0.244 |
| h | 0.25 | 0.50 | 0.010 | 0.020 |
| L | 0.50 | 0.93 | 0.020 | 0.037 |
| q | 0° | 8° | 0° | 8° |
| S | 0.44 | 0.64 | 0.018 | 0.026 |

ECN: C-06527-Rev. I, 11-Sep-06
DWG: 5498

RECOMMENDED MINIMUM PADS FOR SO-8



Recommended Minimum Pads
Dimensions in Inches/(mm)

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