

N-Channel 60-V (D-S) MOSFET



RoHS
COMPLIANT

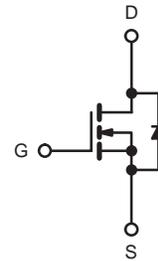
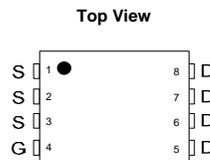
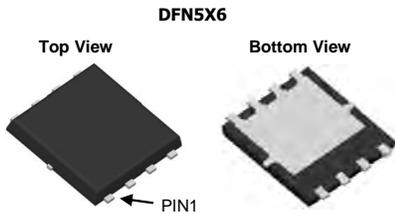
| PRODUCT SUMMARY | |
|---|--------------------|
| V_{DS} (V) | 60 |
| $R_{DS(on)}$ (Ω) at $V_{GS} = 10$ V | 0.024 |
| $R_{DS(on)}$ (Ω) at $V_{GS} = 4.5$ V | 0.028 |
| Q_g typ. (nC) | 5.2 |
| I_D (A) | 15 ^{a, g} |
| Configuration | Single |

FEATURES

- Halogen-free According to IEC 61249-2-21 Available
- TrenchFET[®] Power MOSFET
- 100 % R_g Tested
- 100 % UIS Tested

APPLICATIONS

- Battery Switch
- DC/DC Converter



N-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS ($T_A = 25$ °C, unless otherwise noted) | | | |
|---|----------------|---------------|----------------------|
| PARAMETER | SYMBOL | LIMIT | UNIT |
| Drain-source voltage | V_{DS} | 60 | V |
| Gate-source voltage | V_{GS} | ± 20 | |
| Continuous drain current ($T_J = 150$ °C) | I_D | $T_C = 25$ °C | 15 ^a |
| | | $T_C = 70$ °C | 9 ^a |
| | | $T_A = 25$ °C | 10.3 ^{b, c} |
| | | $T_A = 70$ °C | 8.1 ^{b, c} |
| Pulsed drain current ($t = 100$ μ s) | I_{DM} | 40 | A |
| Continuous source-drain diode current | I_S | $T_C = 25$ °C | |
| | | $T_A = 25$ °C | 3 ^{b, c} |
| Single pulse avalanche current | I_{AS} | 15 | mJ |
| Single pulse avalanche energy | E_{AS} | 11.3 | |
| Maximum power dissipation | P_D | $T_C = 25$ °C | 35.7 |
| | | $T_C = 70$ °C | 22.9 |
| | | $T_A = 25$ °C | 3.6 ^{b, c} |
| | | $T_A = 70$ °C | 2.3 ^{b, c} |
| Operating junction and storage temperature range | T_J, T_{stg} | -55 to +150 | °C |
| Soldering recommendations (peak temperature) ^c | | 260 | |

| THERMAL RESISTANCE RATINGS | | | | | |
|--|---------------|------------|---------|---------|------|
| PARAMETER | | SYMBOL | TYPICAL | MAXIMUM | UNIT |
| Maximum junction-to-ambient ^b | $t \leq 10$ s | R_{thJA} | 25 | 35 | °C/W |
| Maximum junction-to-case (drain) | Steady state | R_{thJC} | 2.7 | 3.5 | |

Notes

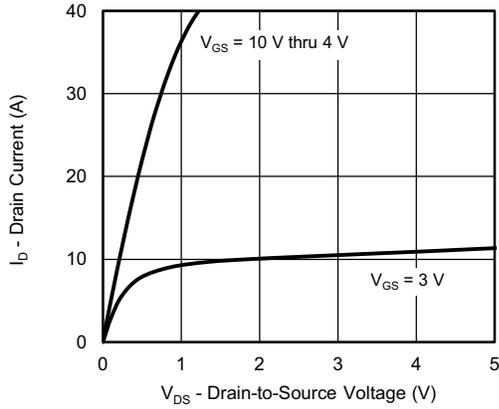
- a. Package limited
- b. Surface mounted on 1" x 1" FR4 board
- c. $t = 10$ s

| 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} | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 60 | - | - | V |
| V_{DS} temperature coefficient | $\Delta V_{DS}/T_J$ | $I_D = 250\text{ }\mu\text{A}$ | - | 33 | - | mV/ $^\circ\text{C}$ |
| $V_{GS(th)}$ temperature coefficient | $\Delta V_{GS(th)}/T_J$ | | - | -4.8 | - | |
| Gate-source threshold voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 1 | - | 2.8 | V |
| 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} | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$ | - | - | 1 | μA |
| | | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}, T_J = 70\text{ }^\circ\text{C}$ | - | - | 10 | |
| On-state drain current ^a | $I_{D(on)}$ | $V_{DS} \geq 5\text{ V}, V_{GS} = 10\text{ V}$ | 10 | - | - | A |
| Drain-source on-state resistance ^a | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}, I_D = 10\text{ A}$ | - | 0.024 | - | Ω |
| | | $V_{GS} = 4.5\text{ V}, I_D = 5\text{ A}$ | - | 0.028 | - | |
| Forward transconductance ^a | g_{fs} | $V_{DS} = 10\text{ V}, I_D = 10\text{ A}$ | - | 39 | - | S |
| Dynamic ^b | | | | | | |
| Input capacitance | C_{iss} | $V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | - | 790 | - | pF |
| Output capacitance | C_{oss} | | - | 330 | - | |
| Reverse transfer capacitance | C_{rss} | | - | 14 | - | |
| Total gate charge | Q_g | $V_{DS} = 30\text{ V}, V_{GS} = 10\text{ V}, I_D = 5\text{ A}$ | - | 11.1 | 17 | nC |
| Gate-source charge | Q_{gs} | $V_{DS} = 30\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 5\text{ A}$ | - | 5.2 | 8 | |
| Gate-drain charge | Q_{gd} | | - | 2.2 | - | |
| Gate resistance | R_g | $f = 1\text{ MHz}$ | 0.1 | 0.6 | 1.2 | Ω |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 30\text{ V}, R_L = 6\text{ }\Omega, I_D \cong 5\text{ A}, V_{GEN} = 10\text{ V}, R_g = 1\text{ }\Omega$ | - | 7 | 15 | ns |
| Rise time | t_r | | - | 21 | 40 | |
| Turn-off delay time | $t_{d(off)}$ | | - | 10 | 20 | |
| Fall time | t_f | | - | 10 | 20 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 30\text{ V}, R_L = 6\text{ }\Omega, I_D \cong 5\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\text{ }\Omega$ | - | 13 | 25 | |
| Rise time | t_r | | - | 25 | 50 | |
| Turn-off delay time | $t_{d(off)}$ | | - | 10 | 20 | |
| Fall time | t_f | | - | 22 | 45 | |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous source-drain diode current | I_S | $T_C = 25\text{ }^\circ\text{C}$ | - | 15 | - | A |
| Pulse diode forward current | I_{SM} | | - | - | 40 | |
| Body diode voltage | V_{SD} | $I_S = 5\text{ A}, V_{GS} = 0\text{ V}$ | - | 0.79 | 1.2 | V |
| Body diode reverse recovery time | t_{rr} | $I_F = 5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$ | - | 30 | 60 | ns |
| Body diode reverse recovery charge | Q_{rr} | | - | 60 | 120 | nC |
| Reverse recovery fall time | t_a | | - | 15 | - | ns |
| Reverse recovery rise time | t_b | | - | 15 | - | |

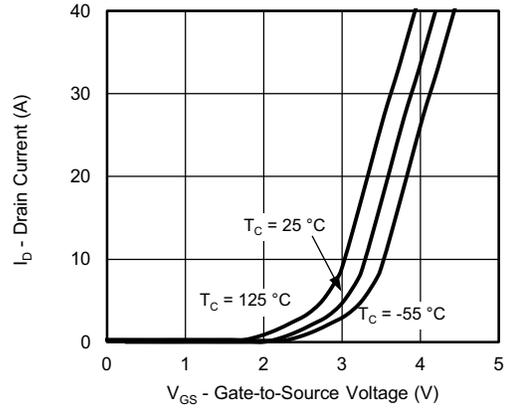
Notes

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

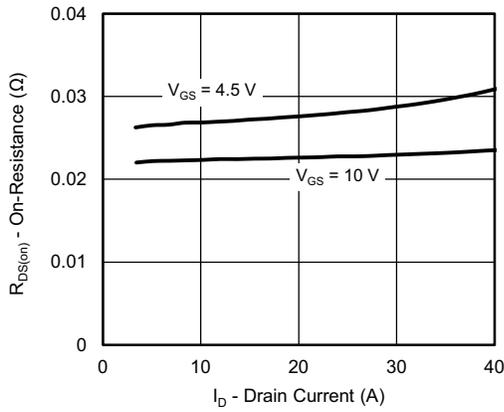
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



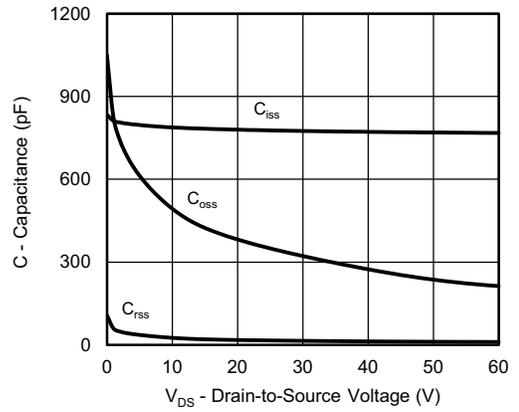
Output Characteristics



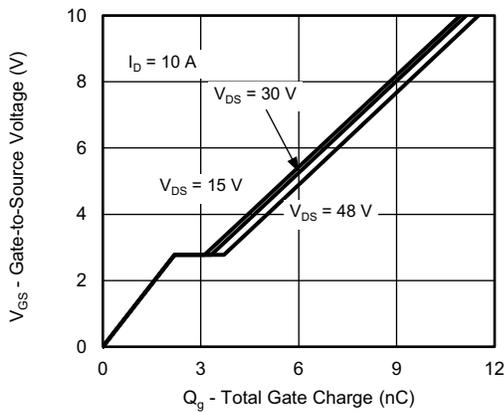
Transfer Characteristics



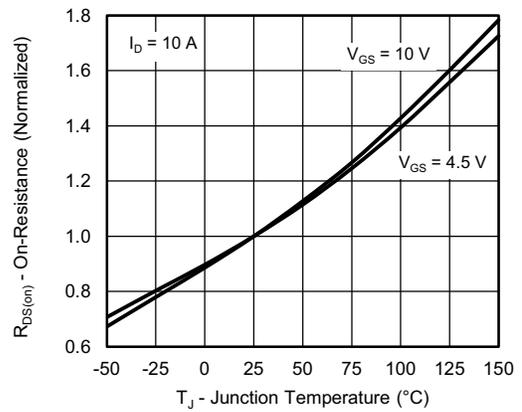
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

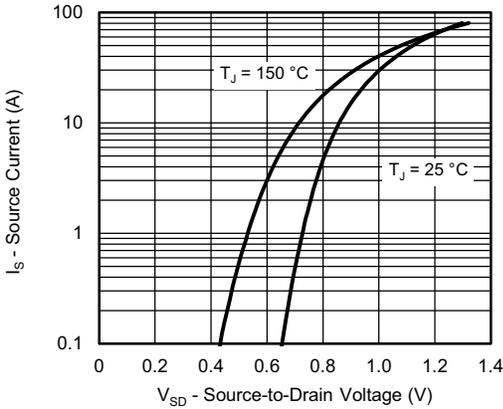


Gate Charge

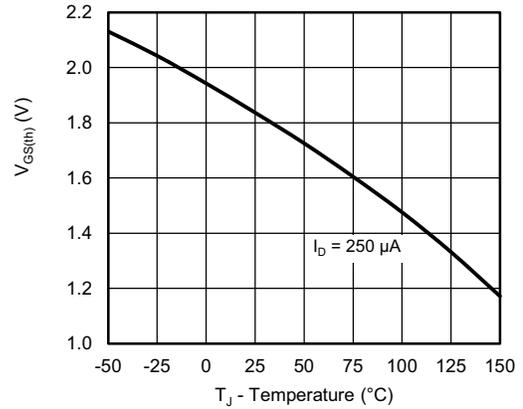


On-Resistance vs. Junction Temperature

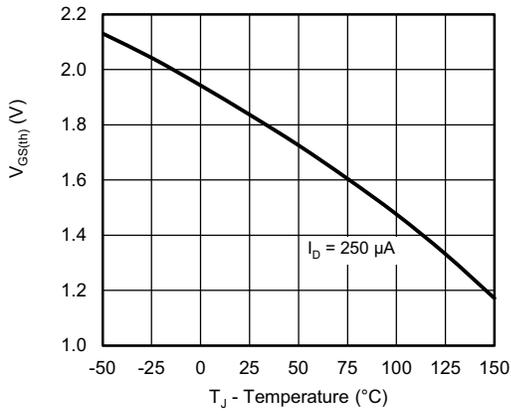
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



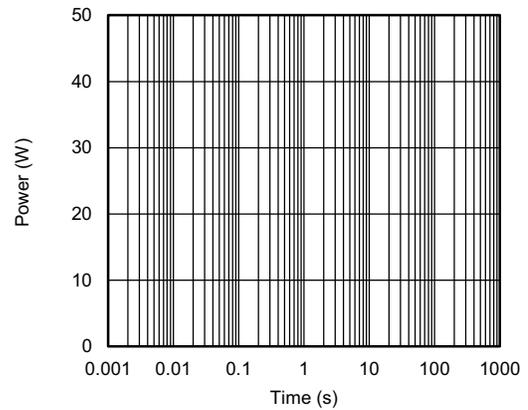
Source-Drain Diode Forward Voltage



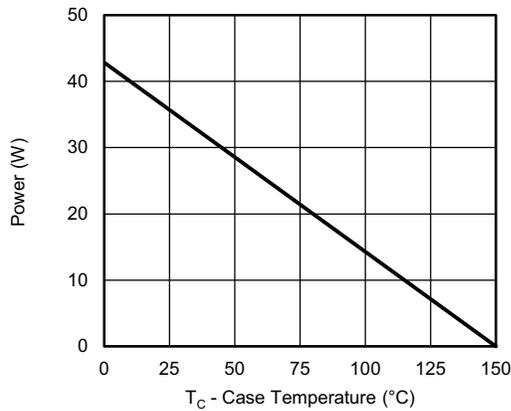
Threshold Voltage



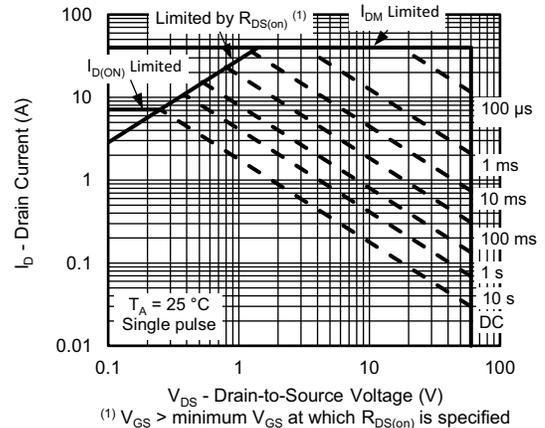
Threshold Voltage



Single Pulse Power, Junction-to-Ambient

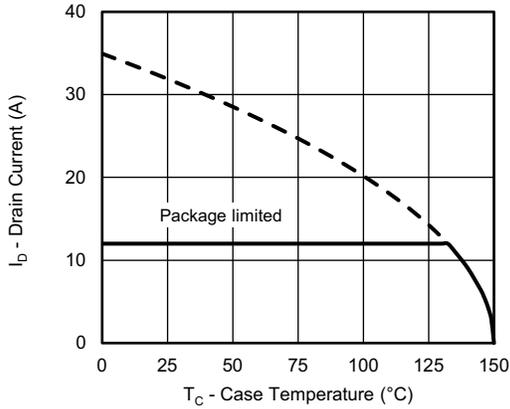


Power, Junction-to-Case



Safe Operating Area, Junction-to-Ambient

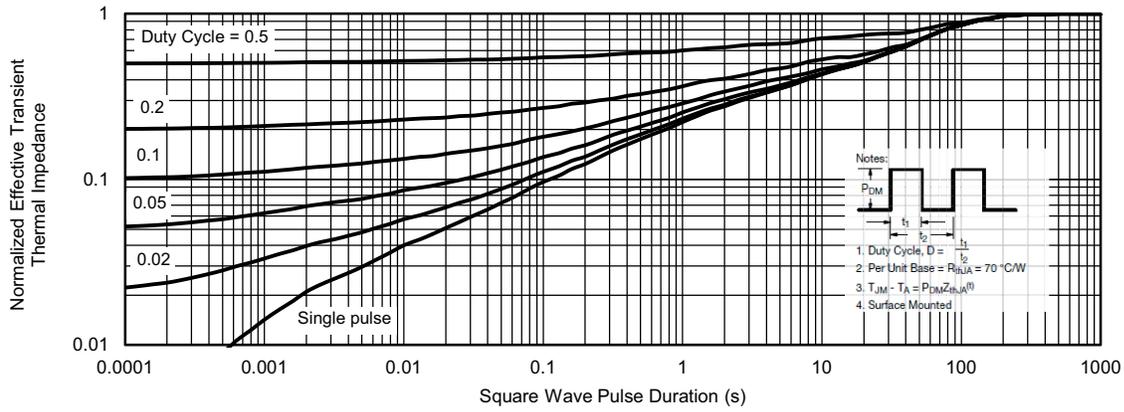
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



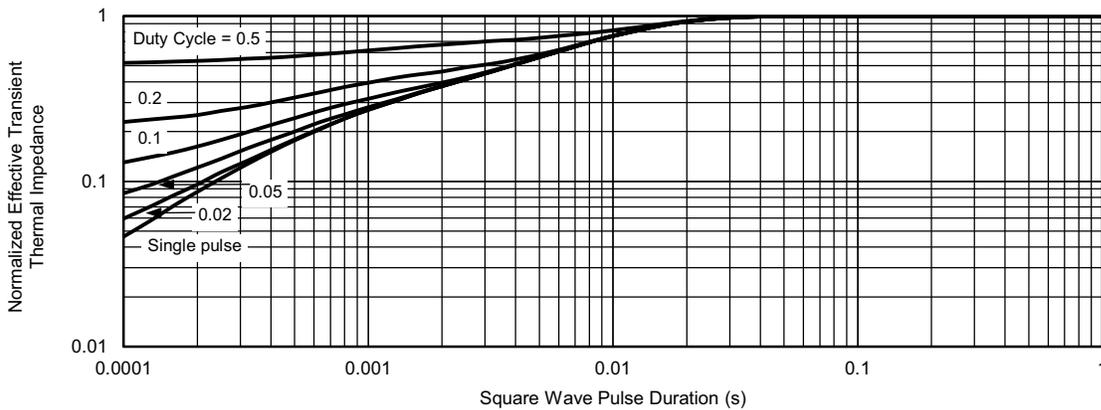
Note

- a. 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

Current Derating ^a



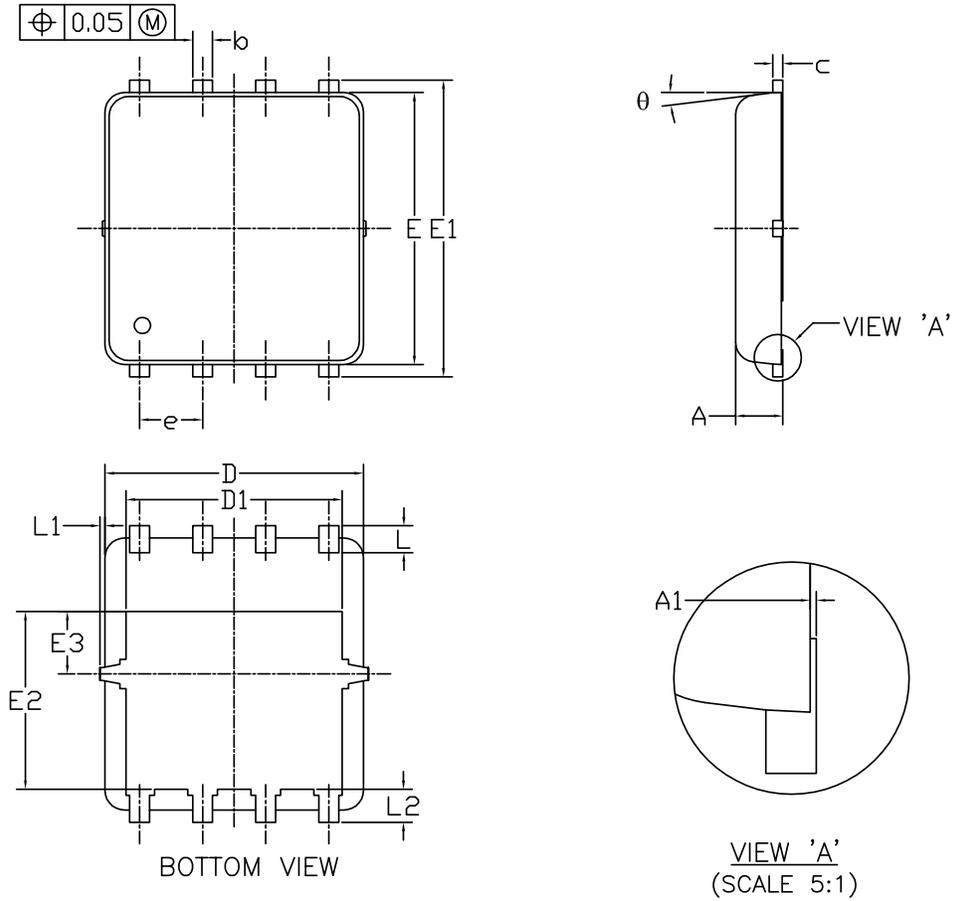
Normalized Thermal Transient Impedance, Junction-to-Ambient



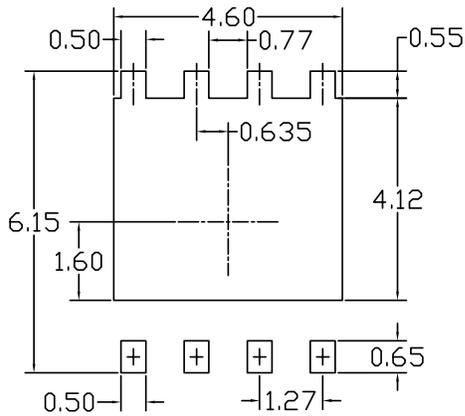
Normalized Thermal Transient Impedance, Junction-to-Foot

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DFN5x6_8L_EP1_P PACKAGE OUTLIN



RECOMMENDED LAND PATTERN



| SYMBOLS | DIMENSIONS IN MILLIMETERS | | | DIMENSIONS IN INCHES | | |
|---------|---------------------------|-------|-------|----------------------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.85 | 0.95 | 1.00 | 0.033 | 0.037 | 0.039 |
| A1 | 0.00 | --- | 0.05 | 0.000 | --- | 0.002 |
| b | 0.30 | 0.40 | 0.50 | 0.012 | 0.016 | 0.020 |
| c | 0.15 | 0.20 | 0.25 | 0.006 | 0.008 | 0.010 |
| D | 5.10 | 5.20 | 5.30 | 0.201 | 0.205 | 0.209 |
| D1 | 4.25 | 4.35 | 4.45 | 0.167 | 0.171 | 0.175 |
| E | 5.45 | 5.55 | 5.65 | 0.215 | 0.219 | 0.222 |
| E1 | 5.95 | 6.05 | 6.15 | 0.234 | 0.238 | 0.242 |
| E2 | 3.525 | 3.625 | 3.725 | 0.139 | 0.143 | 0.147 |
| E3 | 1.175 | 1.275 | 1.375 | 0.046 | 0.050 | 0.054 |
| e | 1.27 BSC | | | 0.050 BSC | | |
| L | 0.45 | 0.55 | 0.65 | 0.018 | 0.022 | 0.026 |
| L1 | 0 | --- | 0.15 | 0 | --- | 0.006 |
| L2 | 0.68 REF | | | 0.027 REF | | |
| θ | 0° | --- | 10° | 0° | --- | 10° |

NOTE

UNIT: mm

1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS.
MOLD FLASH AT THE NON-LEAD SIDES SHOULD BE LESS THAN 6 MILS EACH.
2. CONTROLLING DIMENSION IS MILLIMETER.
CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT

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