

VS4610AE-VB Datasheet

N-Channel 40 V (D-S) MOSFET

PRODUCT SUMMARY

| V_{DS} (V) | $R_{DS(on)}$ (Ω) | I_D (A) ^f | Q_g (Typ.) |
|--------------|----------------------------|------------------------|--------------|
| 40 | 0.0045 at $V_{GS} = 10$ V | 40 ^g | 9.8 nC |
| | 0.0062 at $V_{GS} = 4.5$ V | 40 ^g | |

FEATURES

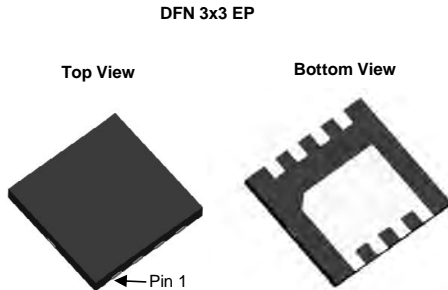
- Trench Power MOSFET
- 100 % R_g and UIS Tested
- Capable of Operating with 5 V Gate Drive



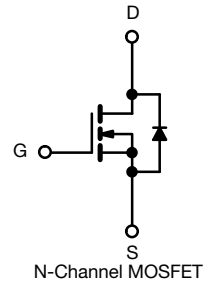
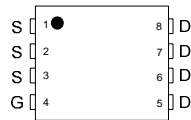
RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Synchronous Rectification
- Synchronous Buck Converters
- ORing
- Load Switching
- Motor Drive Switch



Top View



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

| Parameter | Symbol | Limit | Unit |
|--|----------------|---------------|---------------------|
| Drain-Source Voltage | V_{DS} | 40 | V |
| Gate-Source Voltage | V_{GS} | ± 20 | |
| Continuous Drain Current ($T_J = 150$ °C) | I_D | $T_C = 25$ °C | A |
| | | $T_C = 70$ °C | |
| | | $T_A = 25$ °C | |
| | | $T_A = 70$ °C | |
| Pulsed Drain Current ($t = 100$ μ s) | I_{DM} | 100 | A |
| Continuous Source-Drain Diode Current | I_S | $T_C = 25$ °C | |
| | | $T_A = 25$ °C | 3.1 ^{a, b} |
| Single Pulse Avalanche Current | I_{AS} | 20 | mJ |
| Single Pulse Avalanche Energy | E_{AS} | 20 | |
| Maximum Power Dissipation | P_D | $T_C = 25$ °C | W |
| | | $T_C = 70$ °C | |
| | | $T_A = 25$ °C | |
| | | $T_A = 70$ °C | |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to 150 | °C |
| Soldering Recommendations (Peak Temperature) ^{c, d} | | 260 | |

THERMAL RESISTANCE RATINGS

| Parameter | Symbol | Typical | Maximum | Unit |
|---|------------|---------|---------|------|
| Maximum Junction-to-Ambient ^{a, e} | R_{thJA} | 26 | 33 | °C/W |
| Maximum Junction-to-Case (Drain) | R_{thJC} | 1.9 | 2.4 | |

Notes:

a. Surface mounted on 1" x 1" FR4 board.

b. $t = 10$ s.

c. The DFN 3 x 3 EP is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper tip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.

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

e. Maximum under steady state conditions is 81 °C/W.

f. Based on $T_C = 25$ °C.

g. Package limited.

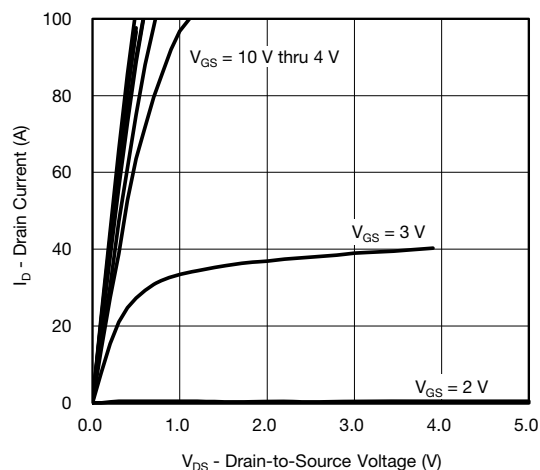
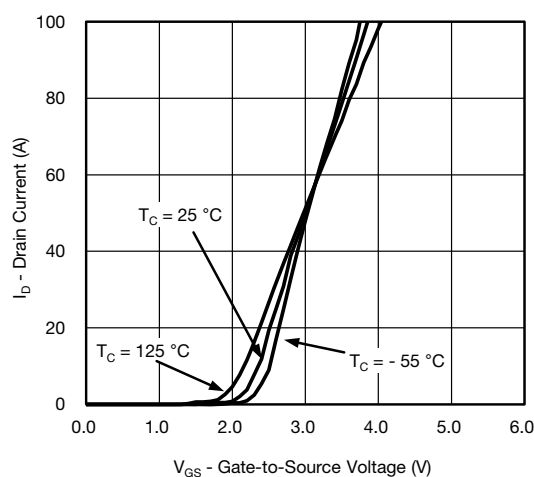
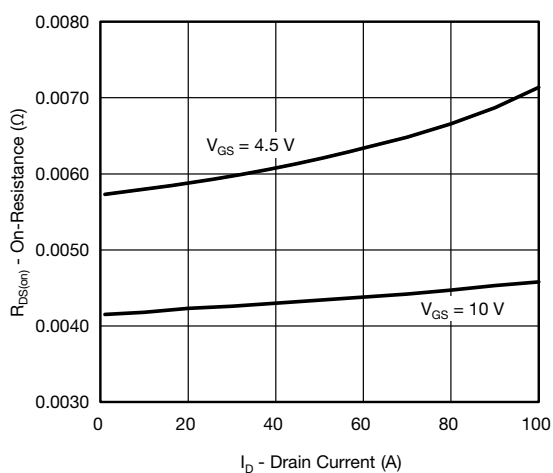
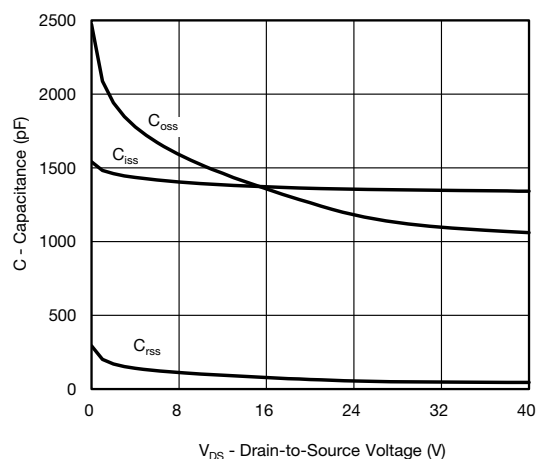
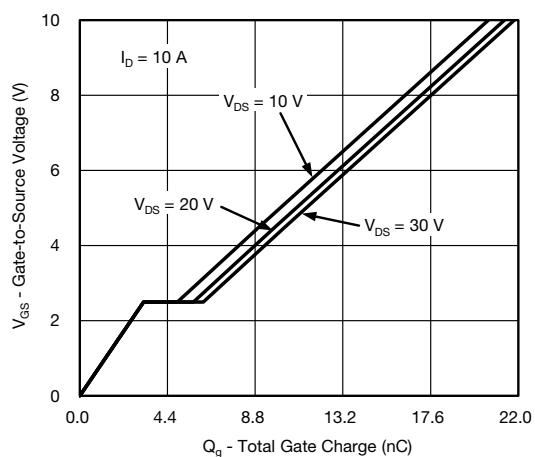
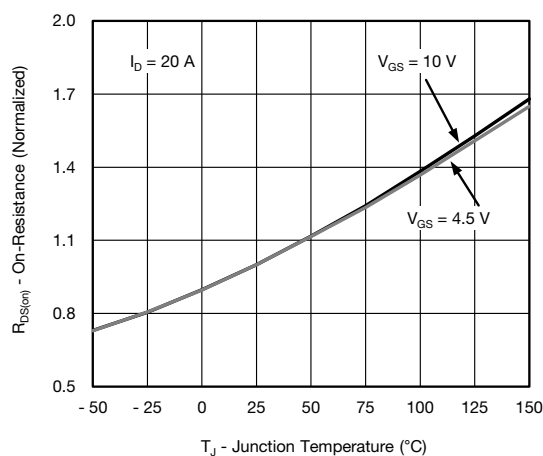
| SPECIFICATIONS (T _J = 25 °C, unless otherwise noted) | | | | | | |
|---|--------------------------------------|---|------|--------|-------|-------|
| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
| Static | | | | | | |
| Drain-Source Breakdown Voltage | V _{DS} | V _{GS} = 0 V, I _D = 250 μA | 40 | | | V |
| V _{DS} Temperature Coefficient | ΔV _{DS} /T _J | I _D = 250 μA | | 56 | | mV/°C |
| V _{GS(th)} Temperature Coefficient | ΔV _{GS(th)} /T _J | | | - 6 | | |
| Gate-Source Threshold Voltage | V _{GS(th)} | V _{DS} = V _{GS} , I _D = 250 μA | 1.1 | | 2.2 | V |
| Gate-Source Leakage | I _{GSS} | V _{DS} = 0 V, V _{GS} = ± 20 V | | | ± 100 | nA |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} = 40 V, V _{GS} = 0 V | | | 1 | μA |
| | | V _{DS} = 40 V, V _{GS} = 0 V, T _J = 55 °C | | | 10 | |
| On-State Drain Current ^a | I _{D(on)} | V _{DS} ≥ 5 V, V _{GS} = 10 V | 20 | | | A |
| Drain-Source On-State Resistance ^a | R _{DS(on)} | V _{GS} = 10 V, I _D = 20 A | | 0.0045 | | Ω |
| | | V _{GS} = 4.5 V, I _D = 10 A | | 0.0062 | | |
| Forward Transconductance ^a | g _{fs} | V _{DS} = 15 V, I _D = 20 A | | 65 | | S |
| Dynamic ^b | | | | | | |
| Input Capacitance | C _{iss} | V _{DS} = 20 V, V _{GS} = 0 V, f = 1 MHz | | 1330 | | pF |
| Output Capacitance | C _{oss} | | | 1200 | | |
| Reverse Transfer Capacitance | C _{rss} | | | 66 | | |
| Total Gate Charge | Q _g | V _{DS} = 20 V, V _{GS} = 10 V, I _D = 10 A | | 21.3 | 32 | nC |
| | | V _{DS} = 20 V, V _{GS} = 4.5 V, I _D = 10 A | | 9.8 | 15 | |
| Q _{gs} | | | 3.2 | | | |
| Q _{gd} | | | 2.5 | | | |
| Output Charge | Q _{oss} | V _{DS} = 20 V, V _{GS} = 0 V | | 32 | 48 | |
| Gate Resistance | R _g | f = 1 MHz | 0.2 | 0.9 | 1.5 | Ω |
| Turn-On Delay Time | t _{d(on)} | V _{DD} = 20 V, R _L = 2 Ω I _D ≅ 10 A, V _{GEN} = 4.5 V, R _g = 1 Ω | | 22 | 44 | ns |
| Rise Time | t _r | | | 65 | 120 | |
| Turn-Off Delay Time | t _{d(off)} | | | 24 | 45 | |
| Fall Time | t _f | | | 9 | 18 | |
| Turn-On Delay Time | t _{d(on)} | V _{DD} = 20 V, R _L = 2 Ω I _D ≅ 10 A, V _{GEN} = 10 V, R _g = 1 Ω | | 11 | 22 | |
| Rise Time | t _r | | | 11 | 22 | |
| Turn-Off Delay Time | t _{d(off)} | | | 22 | 44 | |
| Fall Time | t _f | | | 9 | 18 | |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous Source-Drain Diode Current | I _S | T _C = 25 °C | | | 40 | A |
| Pulse Diode Forward Current (t = 100 μs) | I _{SM} | | | | 100 | |
| Body Diode Voltage | V _{SD} | I _S = 4 A, V _{GS} = 0 V | | 0.75 | 1.2 | V |
| Body Diode Reverse Recovery Time | t _{rr} | I _F = 10 A, dI/dt = 100 A/μs, T _J = 25 °C | | 31 | 60 | ns |
| Body Diode Reverse Recovery Charge | Q _{rr} | | | 17 | 34 | nC |
| Reverse Recovery Fall Time | t _a | | | 13 | | ns |
| Reverse Recovery Rise Time | t _b | | | 18 | | |

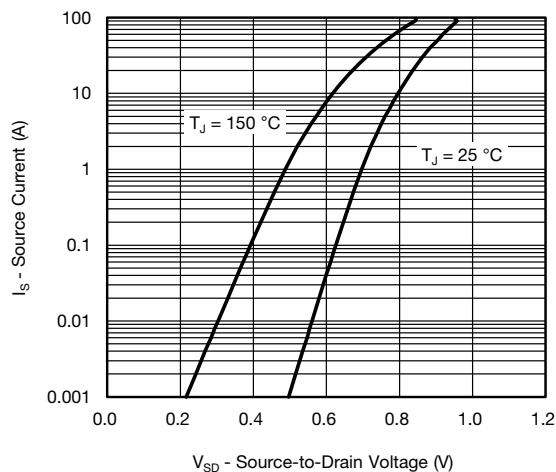
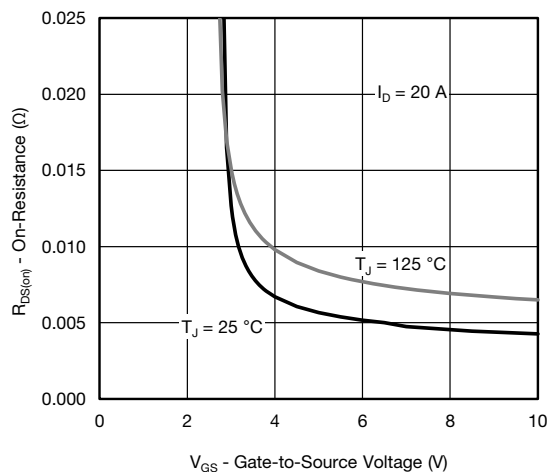
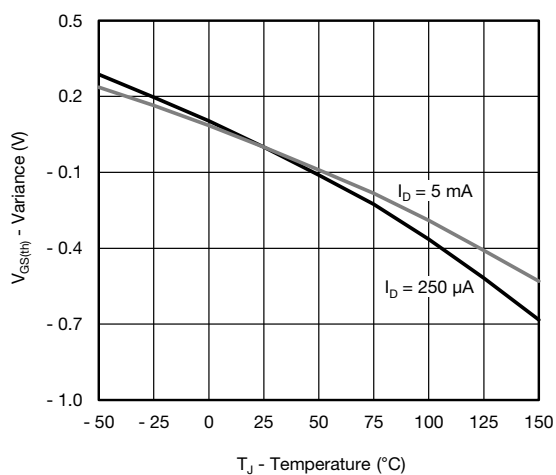
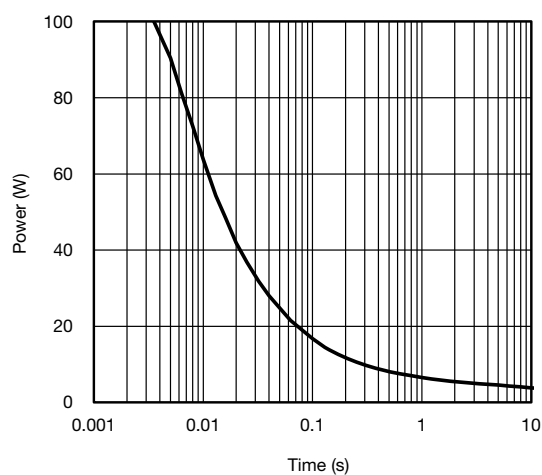
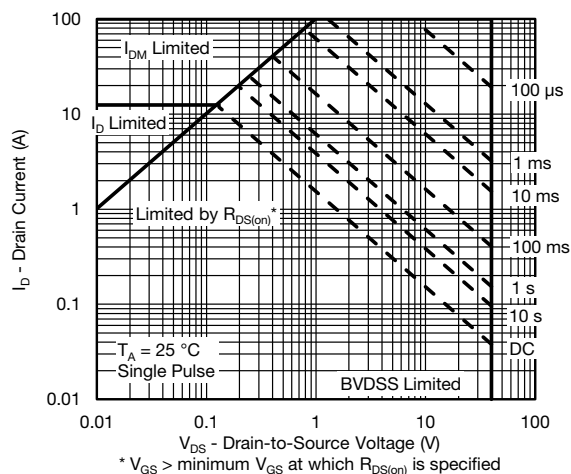
Notes:

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

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

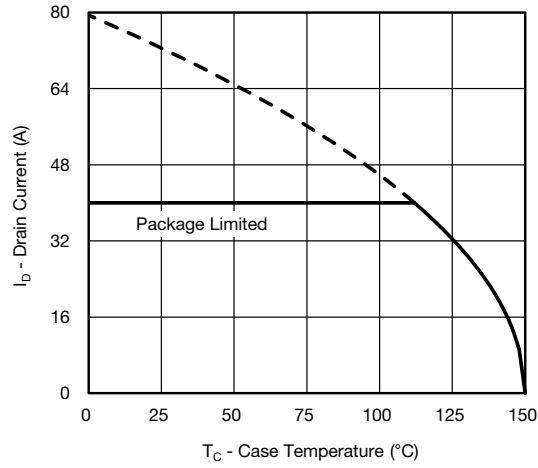
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

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

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

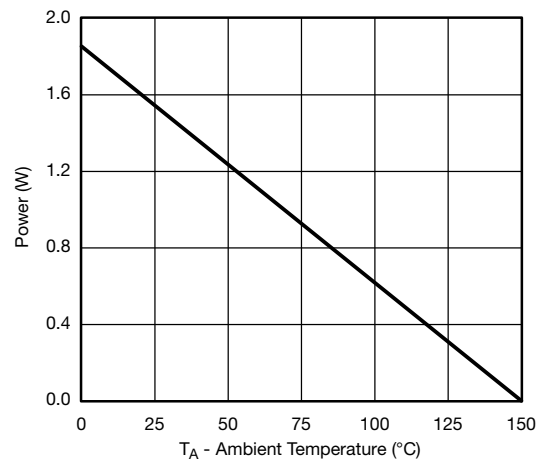
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Current Derating*

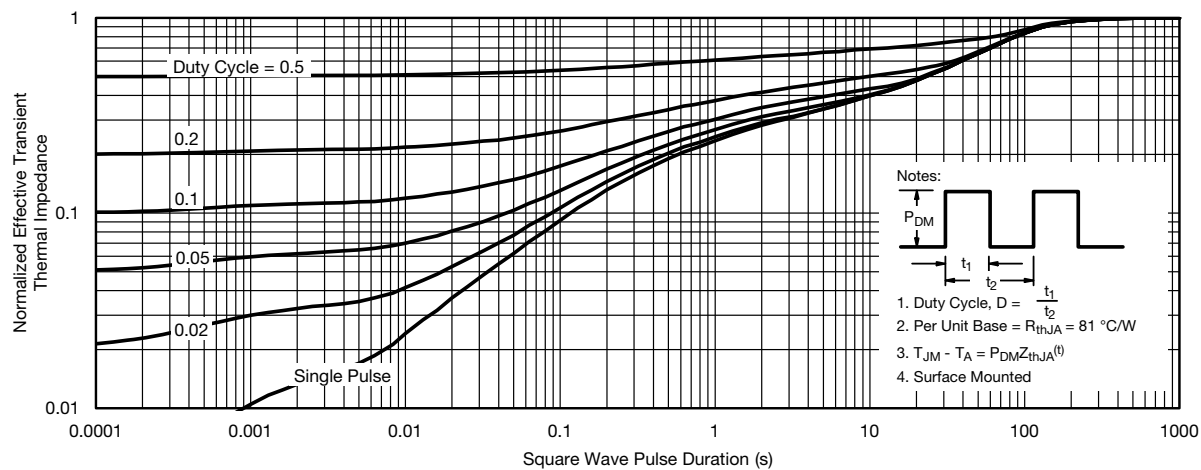
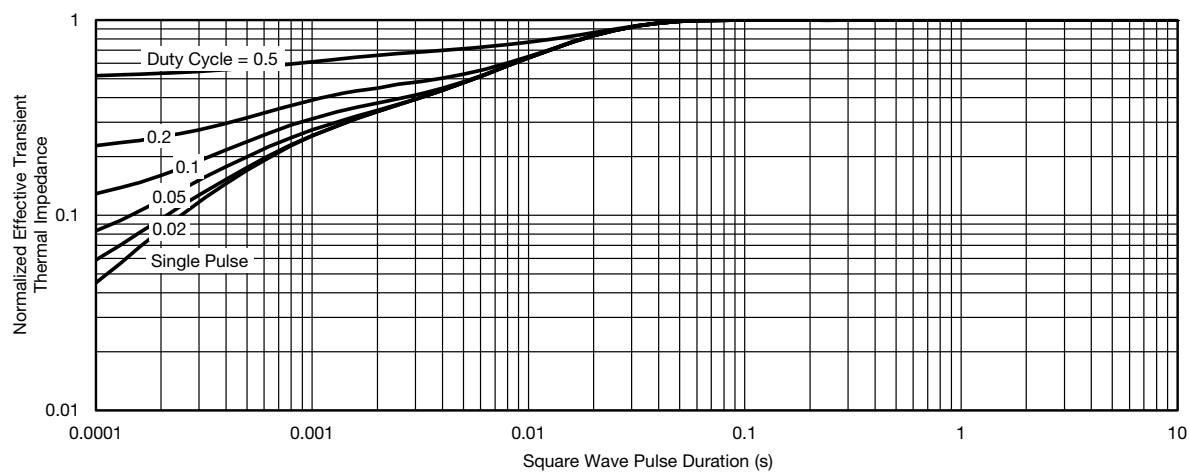


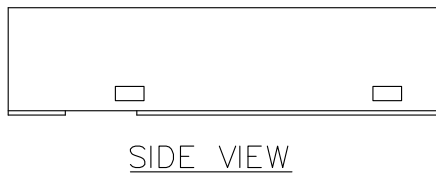
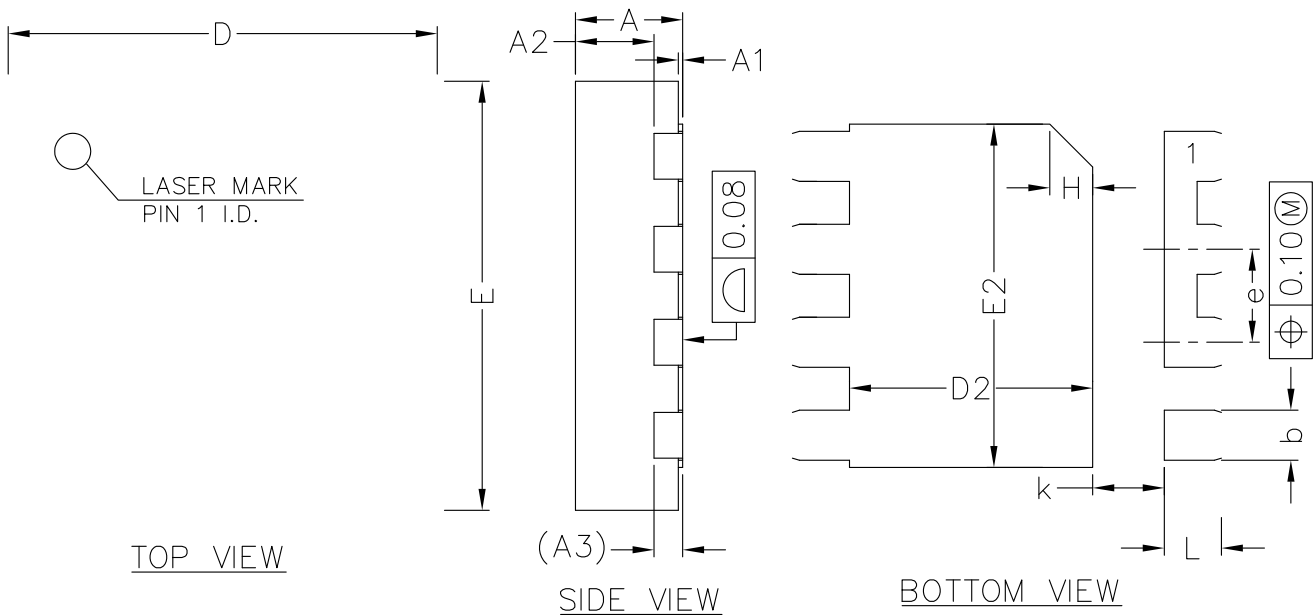
Power, Junction-to-Case



Power, Junction-to-Ambient

* 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)

Normalized Thermal Transient Impedance, Junction-to-Ambient

Normalized Thermal Transient Impedance, Junction-to-Case



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|--------|---------|------|------|
| A | 0.70 | 0.75 | 0.80 |
| A1 | 0.00 | 0.02 | 0.05 |
| A2 | 0.50 | 0.55 | 0.60 |
| A3 | 0.20REF | | |
| b | 0.30 | 0.35 | 0.40 |
| D | 2.90 | 3.00 | 3.10 |
| E | 2.90 | 3.00 | 3.10 |
| D2 | 1.60 | 1.70 | 1.80 |
| E2 | 2.30 | 2.40 | 2.50 |
| e | 0.55 | 0.65 | 0.75 |
| K | 0.40 | 0.50 | 0.60 |
| L | 0.35 | 0.40 | 0.45 |

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