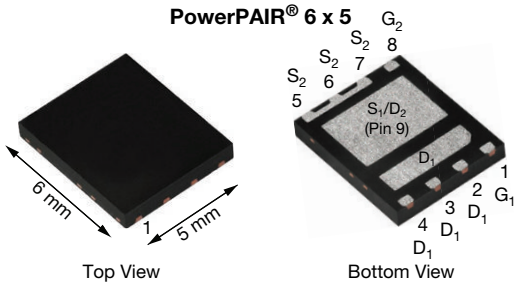
# Dual N-Channel 30 V (D-S) MOSFET With Schottky Diode




Top View Bottom View

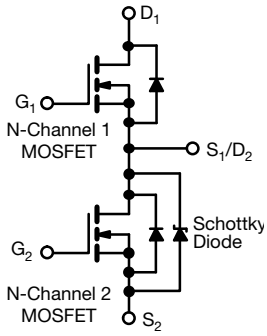
## FEATURES

- TrenchFET® Gen IV power MOSFET
- SkyFET® low side MOSFET with integrated Schottky
- Very low $R_{DS}$ x $Q_g$ FOM improves efficiency
- 100 % $R_g$ and UIS tested
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT
HALOGEN FREE

## APPLICATIONS

- CPU core power
- Computer / server peripherals
- POL
- Synchronous buck converter
- Telecom DC/DC




## PRODUCT SUMMARY

| | CHANNEL-1 | CHANNEL-2 |
|---|---|---|
| $V_{DS}$ (V) | 30 | 30 |
| $R_{DS(on)}$ max. (Ω) at $V_{GS}$ = 10 V | 0.00439 | 0.0024 |
| $R_{DS(on)}$ max. (Ω) at $V_{GS}$ = 4.5 V | 0.00712 | 0.0038 |
| $Q_g$ typ. (nC) | 5.7 | 14.6 |
| $I_D$ (A) [a] | 54.8 | 94.6 |
| Configuration | Dual plus integrated Schottky (SkyFET) | |

## ORDERING INFORMATION

| | |
|---|---|
| Package | PowerPAIR 6 x 5 |
| Lead (Pb)-free and halogen-free | SiZ998BDT-T1-GE3 |

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

| PARAMETER | | SYMBOL | CHANNEL-1 | CHANNEL-2 | UNIT |
|---|---|---|---|---|---|
| Drain-source voltage | | $V_{DS}$ | 30 | 30 | V |
| Gate-source voltage | | $V_{GS}$ | +20, -16 | +20, -16 | |
| Continuous drain current ($T_J$ = 150 °C) | $T_C$ = 25 °C | $I_D$ | 54.8 | 94.6 | A |
| | $T_C$ = 70 °C | | 43.8 | 75.7 | |
| | $T_A$ = 25 °C | | 23.7 [b, c] | 36.2 [b, c] | |
| | $T_A$ = 70 °C | | 19 [b, c] | 28.9 [b, c] | |
| Pulsed drain current (t = 100 µs) | | $I_{DM}$ | 90 | 130 | |
| Continuous source-drain diode current | $T_C$ = 25 °C | $I_S$ | 16.7 | 27.4 | |
| | $T_A$ = 25 °C | | 3.2 [b, c] | 4 [b, c] | |
| Single pulse avalanche current | L = 0.1 mH | $I_{AS}$ | 15 | 20 | |
| Single pulse avalanche energy | | $E_{AS}$ | 11.2 | 20 | mJ |
| Maximum power dissipation | $T_C$ = 25 °C | $P_D$ | 20 | 32.9 | W |
| | $T_C$ = 70 °C | | 12.9 | 21.1 | |
| | $T_A$ = 25 °C | | 3.8 [b, c] | 4.8 [b, c] | |
| | $T_A$ = 70 °C | | 2.4 [b, c] | 3.1 [b, 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 | CHANNEL-1 | | CHANNEL-2 | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | TYP. | MAX. | TYP. | MAX. | |
| Maximum junction-to-ambient [b, f] | t ≤ 10 s | $R_{thJA}$ | 26 | 33 | 21 | 26 | °C/W |
| Maximum junction-to-case (drain) | Steady state | $R_{thJC}$ | 4.7 | 6.2 | 3 | 3.8 | |

**Notes**

a. $T_C$ = 25°C
b. Surface mounted on 1" x 1" FR4 board
c. t = 10 s
d. See solder profile (www.vishay.com/doc?73257). The PowerPAIR 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
e. Rework conditions: manual soldering with a soldering iron is not recommended for leadless components
f. Maximum under steady state conditions is 68 °C/W for channel-1 and 57 °C/W for channel-2



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**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, $I_D$ = 5 mA | Ch-1 | 30 | - | - | V |
| | | | Ch-2 | 30 | - | - | |
| Drain-source breakdown voltage (transient) [c] | $V_{DSt}$ | $V_{GS}$ = 0 V, $t_{transient} \leq$ 1 µs | Ch-1 | 36 | - | - | |
| | | | Ch-2 | 36 | - | - | |
| Gate-source threshold voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | Ch-1 | 1.2 | - | 2.2 | |
| | | | Ch-2 | 1.1 | - | 2.2 | |
| Gate-source leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = +20 V, -16 V | Ch-1 | - | - | ± 100 | nA |
| | | | Ch-2 | - | - | ± 100 | |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ = 30 V, $V_{GS}$ = 0 V | Ch-1 | - | - | 1 | µA |
| | | | Ch-2 | - | 40 | 200 | |
| | | $V_{DS}$ = 30 V, $V_{GS}$ = 0 V, $T_J$ = 55 °C | Ch-1 | - | - | 5 | |
| | | | Ch-2 | - | 200 | 2000 | |
| On-state drain current [b] | $I_{D(on)}$ | $V_{DS} \geq$ 5 V, $V_{GS}$ = 10 V | Ch-1 | 20 | - | - | A |
| | | | Ch-2 | 20 | - | - | |
| Drain-source on-state resistance [b] | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 15 A | Ch-1 | - | 0.00338 | 0.00439 | Ω |
| | | $V_{GS}$ = 10 V, $I_D$ = 19 A | Ch-2 | - | 0.0018 | 0.0024 | |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 12 A | Ch-1 | - | 0.00547 | 0.00712 | |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 15 A | Ch-2 | - | 0.0026 | 0.0038 | |
| Forward transconductance [b] | $g_{fs}$ | $V_{DS}$ = 10 V, $I_D$ = 15 A | Ch-1 | - | 55 | - | S |
| | | $V_{DS}$ = 10 V, $I_D$ = 19 A | Ch-2 | | 230 | - | |
| **Dynamic [a]** | | | | | | | |
| Input capacitance | $C_{iss}$ | Channel-1 $V_{DS}$ = 15 V, $V_{GS}$ = 0 V, f = 1 MHz<br>Channel-2 $V_{DS}$ = 15 V, $V_{GS}$ = 0 V, f = 1 MHz | Ch-1 | - | 790 | - | pF |
| | | | Ch-2 | - | 2130 | - | |
| Output capacitance | $C_{oss}$ | | Ch-1 | - | 390 | - | |
| | | | Ch-2 | - | 1050 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | Ch-1 | - | 38 | - | |
| | | | Ch-2 | - | 40 | - | |
| $C_{rss}/C_{iss}$ ratio | | | Ch-1 | - | 0.046 | 0.092 | |
| | | | Ch-2 | | 0.019 | 0.038 | |
| Total gate charge | $Q_g$ | $V_{DS}$ = 15 V, $V_{GS}$ = 10 V, $I_D$ = 19 A | Ch-1 | - | 12 | 18 | nC |
| | | $V_{DS}$ = 15 V, $V_{GS}$ = 10 V, $I_D$ = 19 A | Ch-2 | - | 31.1 | 46.7 | |
| | | $V_{DS}$ = 15 V, $V_{GS}$ = 4.5 V, $I_D$ = 19 A | Ch-1 | | 5.7 | 8.6 | |
| | | $V_{DS}$ = 15 V, $V_{GS}$ = 4.5 V, $I_D$ = 19 A | Ch-2 | - | 14.6 | 21.9 | |
| Gate-source charge | $Q_{gs}$ | Channel-1 $V_{DS}$ = 15 V, $V_{GS}$ = 4.5 V, $I_D$ = 19 A<br>Channel-2 $V_{DS}$ = 15 V, $V_{GS}$ = 4.5 V, $I_D$ = 19 A | Ch-1 | - | 3 | - | |
| | | | Ch-2 | - | 7.1 | - | |
| Gate-drain charge | $Q_{gd}$ | | Ch-1 | - | 1.4 | - | |
| | | | Ch-2 | - | 3.4 | - | |
| Output charge | $Q_{oss}$ | $V_{DS}$ = 15 V, $V_{GS}$ = 0 V | Ch-1 | - | 10 | - | |
| | | | Ch-2 | - | 30 | - | |
| Gate resistance | $R_g$ | f = 1 MHz | Ch-1 | 0.2 | 1.1 | 2.2 | Ω |
| | | | Ch-2 | 0.16 | 0.8 | 1.6 | |


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| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Dynamic** [a] | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | Channel-1 $V_{DD}$ = 15 V, $R_L$ = 1.5 Ω, $I_D \cong$ 10 A, $V_{GEN}$ = 4.5 V, $R_g$ = 1 Ω | Ch-1 | - | 20 | 40 | ns |
| | | | Ch-2 | - | 30 | 60 | |
| Rise time | $t_r$ | | Ch-1 | - | 100 | 200 | |
| | | | Ch-2 | - | 120 | 240 | |
| Turn-off delay time | $t_{d(off)}$ | Channel-2 $V_{DD}$ = 15 V, $R_L$ = 1.5 Ω, $I_D \cong$ 10 A, $V_{GEN}$ = 4.5 V, $R_g$ = 1 Ω | Ch-1 | - | 15 | 30 | |
| | | | Ch-2 | - | 40 | 80 | |
| Fall time | $t_f$ | | Ch-1 | - | 12 | 24 | |
| | | | Ch-2 | - | 18 | 36 | |
| Turn-on delay time | $t_{d(on)}$ | Channel-1 $V_{DD}$ = 15 V, $R_L$ = 1.5 Ω, $I_D \cong$ 10 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | Ch-1 | - | 10 | 20 | |
| | | | Ch-2 | - | 15 | 30 | |
| Rise time | $t_r$ | | Ch-1 | - | 20 | 40 | |
| | | | Ch-2 | - | 10 | 20 | |
| Turn-off delay time | $t_{d(off)}$ | Channel-2 $V_{DD}$ = 15 V, $R_L$ = 1.5 Ω, $I_D \cong$ 10 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | Ch-1 | - | 20 | 40 | |
| | | | Ch-2 | - | 30 | 60 | |
| Fall time | $t_f$ | | Ch-1 | - | 10 | 20 | |
| | | | Ch-2 | - | 10 | 20 | |
| **Drain-Source Body Diode Characteristics** | | | | | | | |
| Continuous source-drain diode current | $I_S$ | $T_C$ = 25 °C | Ch-1 | - | - | 16.7 | A |
| | | | Ch-2 | - | - | 27.4 | |
| Pulse diode forward current [a] | $I_{SM}$ | | Ch-1 | - | - | 90 | |
| | | | Ch-2 | - | - | 130 | |
| Body diode voltage | $V_{SD}$ | $I_S$ = 10 A, $V_{GS}$ = 0 V | Ch-1 | - | 0.8 | 1.2 | V |
| | | | Ch-2 | - | 0.47 | 0.71 | |
| Body diode reverse recovery time | $t_{rr}$ | Channel-1 $I_F$ = 10 A, di/dt = 100 A/µs, $T_J$ = 25 °C | Ch-1 | - | 18 | 36 | ns |
| | | | Ch-2 | - | 27 | 54 | |
| Body diode reverse recovery charge | $Q_{rr}$ | | Ch-1 | - | 18 | 36 | nC |
| | | | Ch-2 | - | 17 | 34 | |
| Reverse recovery fall time | $t_a$ | Channel-2 $I_F$ = 10 A, di/dt = 100 A/µs, $T_J$ = 25 °C | Ch-1 | - | 10 | - | ns |
| | | | Ch-2 | - | 15 | - | |
| Reverse recovery Rise time | $t_b$ | | Ch-1 | - | 8 | - | |
| | | | Ch-2 | - | 12 | - | |

**Notes**

a. Guaranteed by design, not subject to production testing
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %
c. Derived from UIS characterization data at time of product release. Production data log is not available

*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.*


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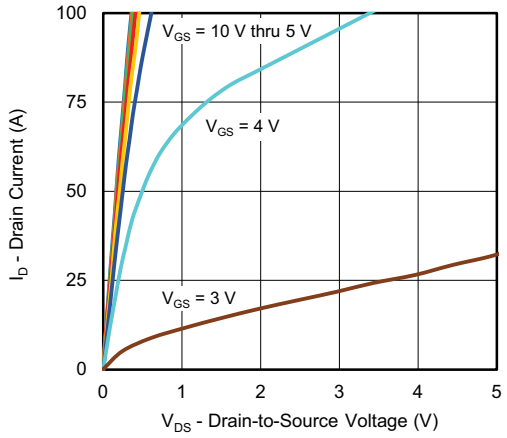
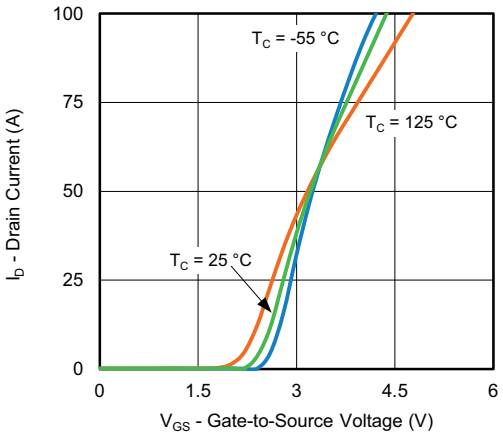
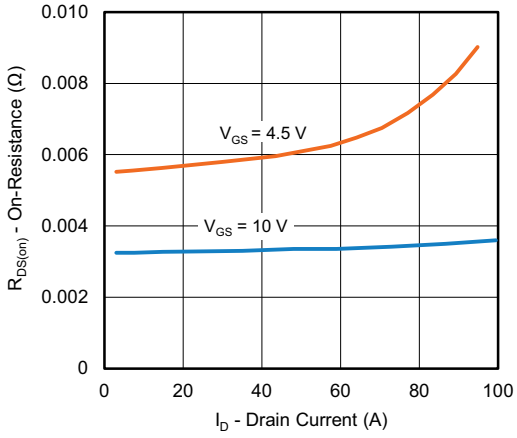
## CHANNEL-1 TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



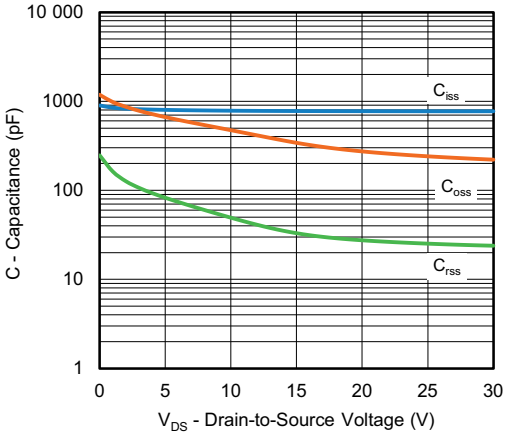

**Output Characteristics**



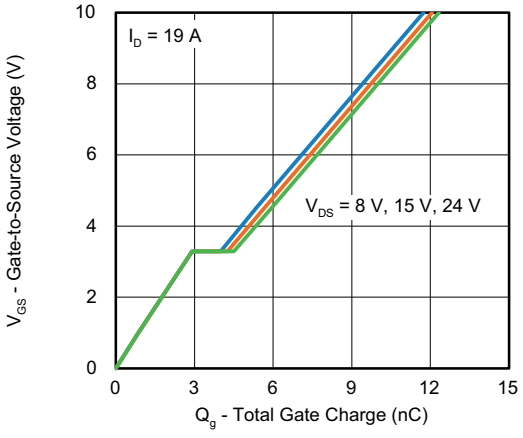

**Transfer Characteristics**



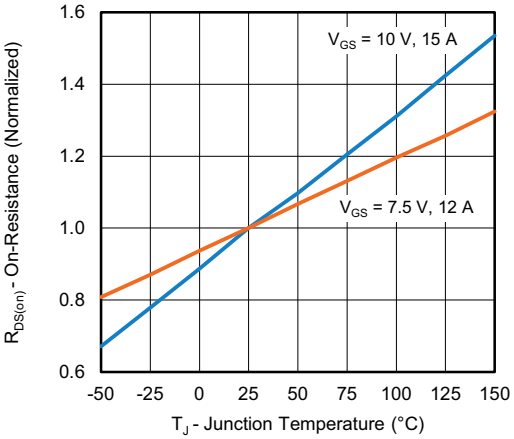

**On-Resistance vs. Drain Current**




**Capacitance**




**Gate Charge**




**On-Resistance vs. Junction Temperature**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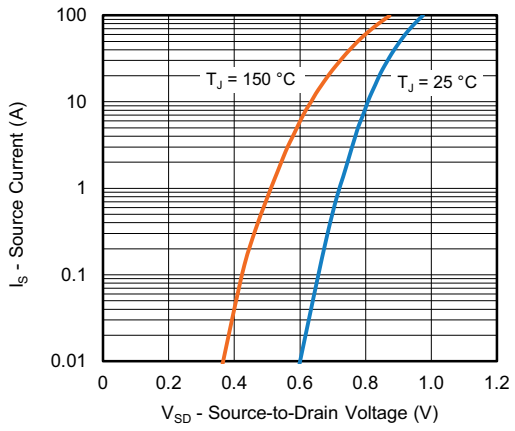
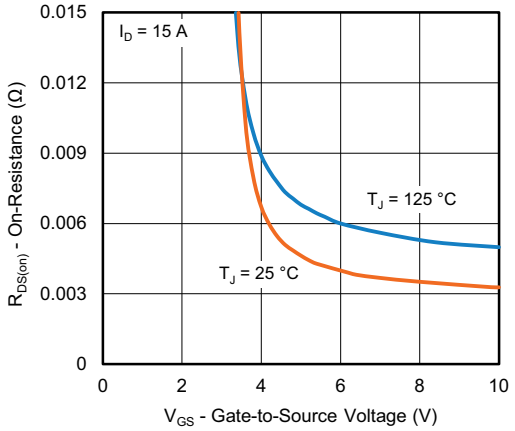
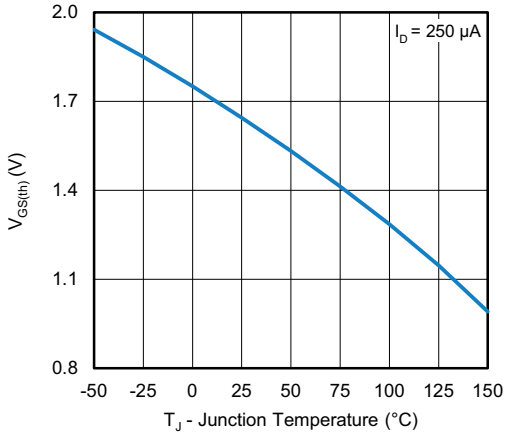
## CHANNEL-1 TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



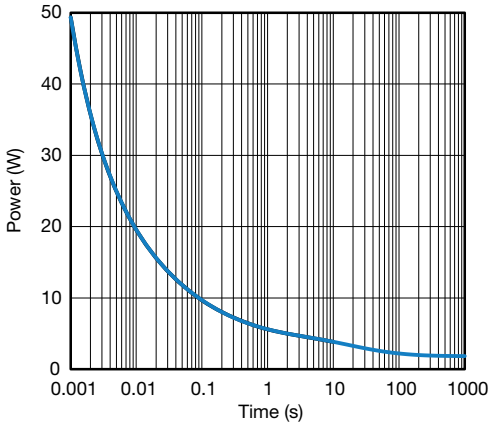

**Source-Drain Diode Forward Voltage**



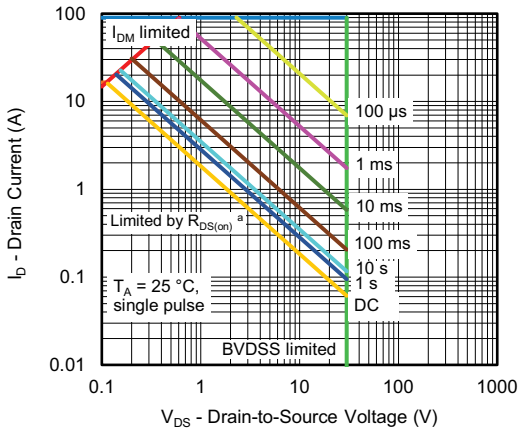

**On-Resistance vs. Gate-to-Source Voltage**




**Threshold Voltage**




**Single Pulse Power, Junction-to-Ambient**




**Safe Operating Area, Junction-to-Ambient**

**Note**

a. $V_{GS}$ > minimum $V_{GS}$ at which $R_{DS(on)}$ is specified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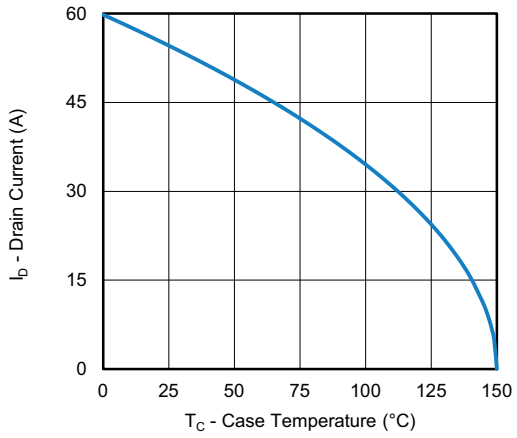
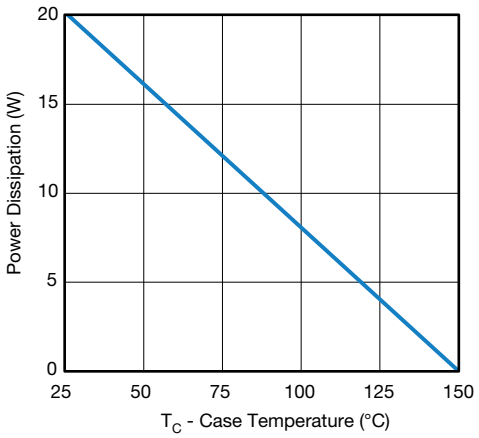



**Current Derating [a]**




**Power, Junction-to-Case**

**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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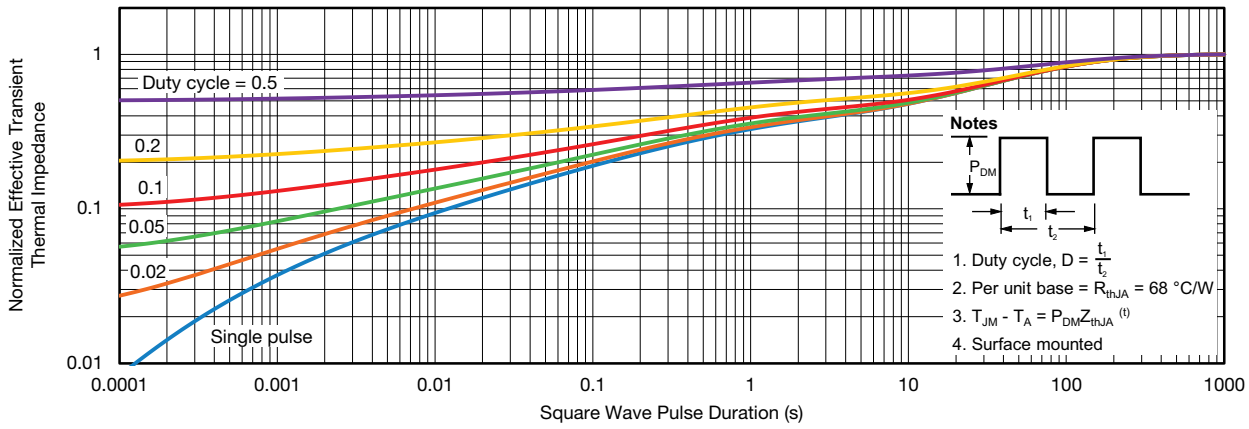
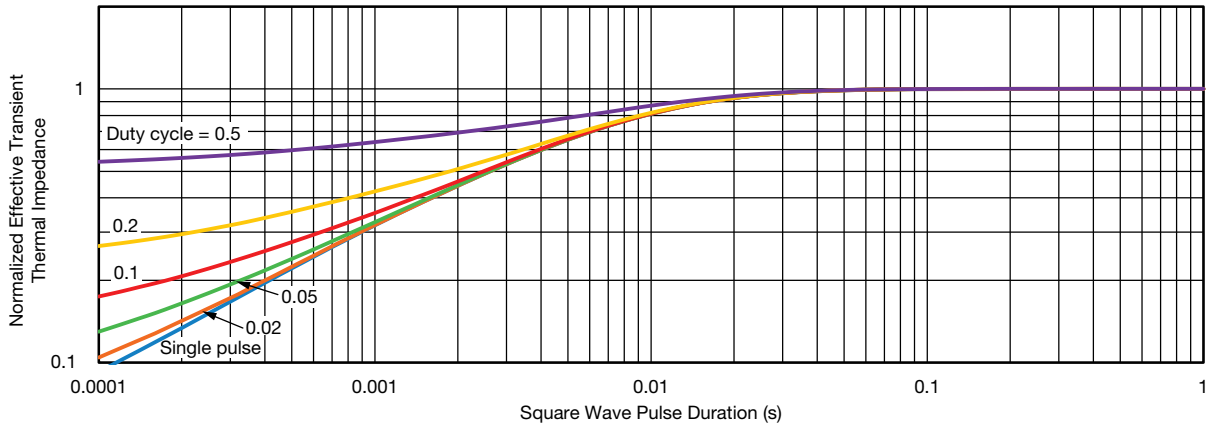



**Normalized Thermal Transient Impedance, Junction-to-Ambient**




**Normalized Thermal Transient Impedance, Junction-to-Case**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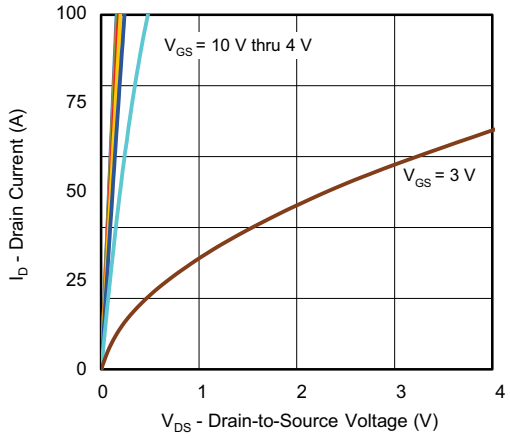
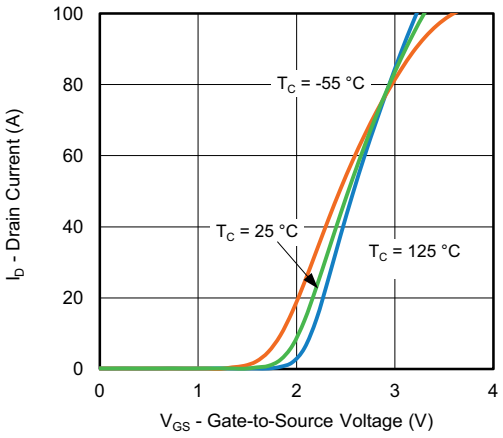
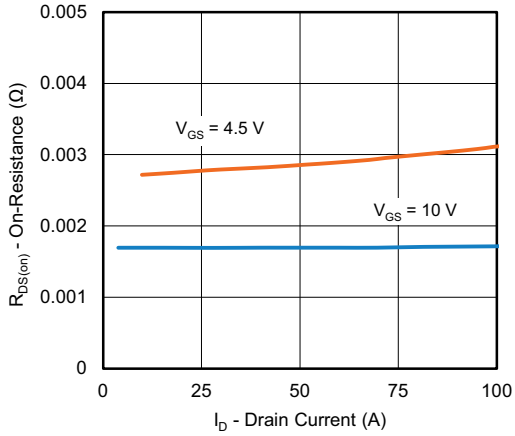
## CHANNEL-2 TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



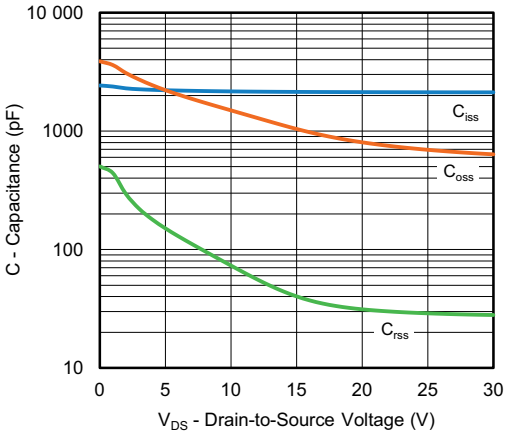

**Output Characteristics**



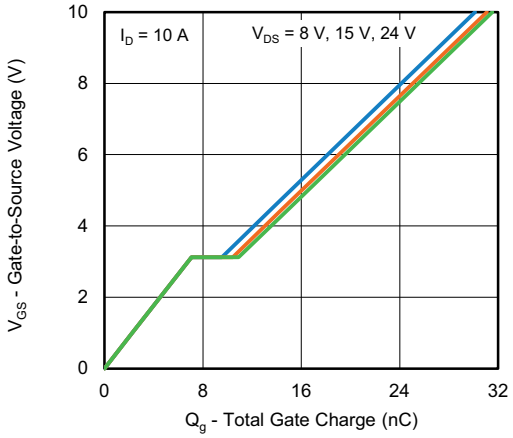

**Transfer Characteristics**



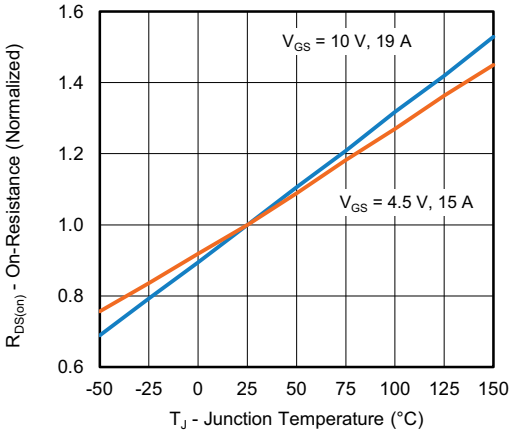

**On-Resistance vs. Drain Current**




**Capacitance**




**Gate Charge**




**On-Resistance vs. Junction Temperature**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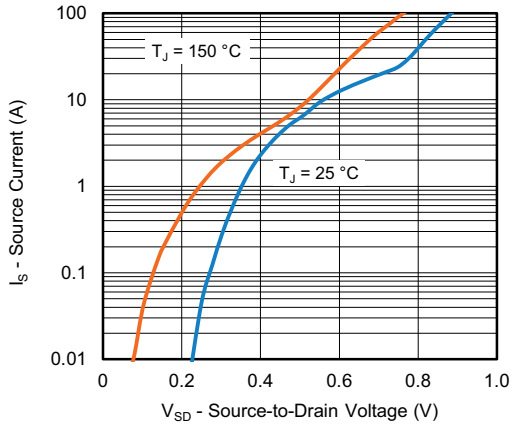
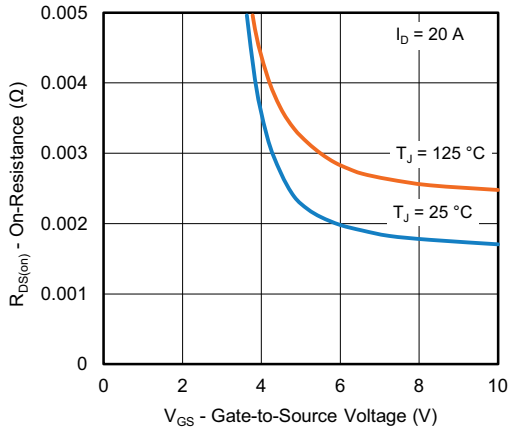
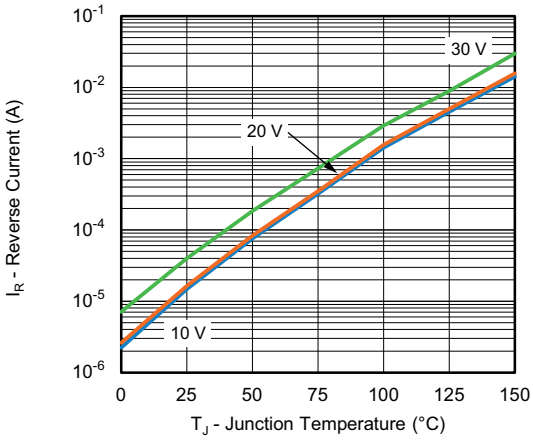
## CHANNEL-2 TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



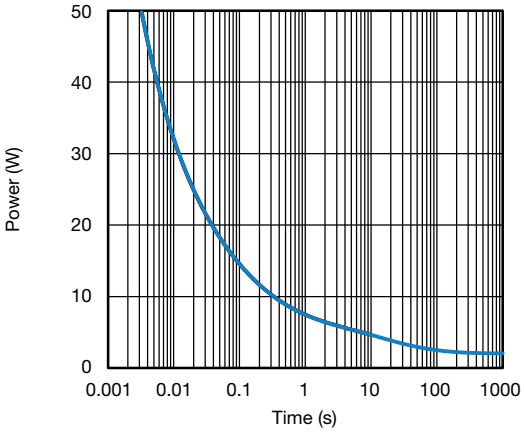

**Source-Drain Diode Forward Voltage**



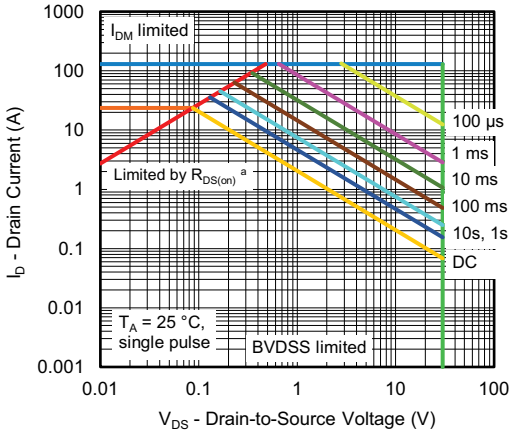

**On-Resistance vs. Gate-to-Source Voltage**




**Reverse Current (Schottky)**




**Single Pulse Power, Junction-to-Ambient**




**Safe Operating Area, Junction-to-Ambient**

**Note**

a. $V_{GS}$ > minimum $V_{GS}$ at which $R_{DS(on)}$ is specified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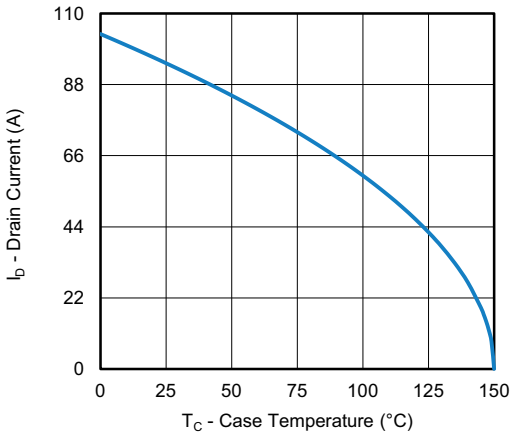
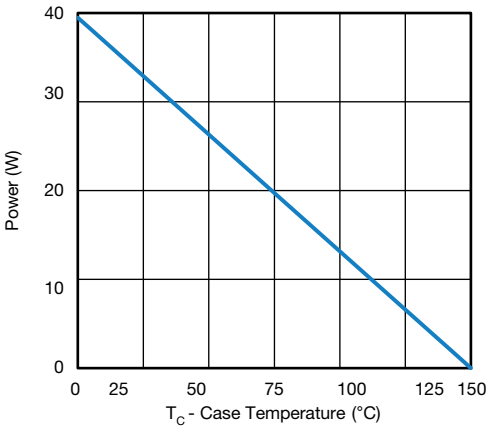
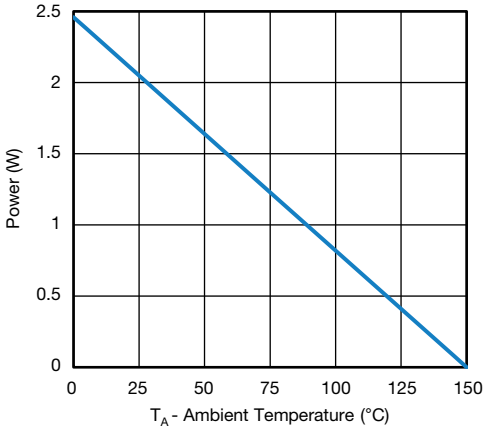
## CHANNEL-2 TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)




**Current Derating [a]**




**Power, Junction-to-Case**




**Power, Junction-to-Ambient**

**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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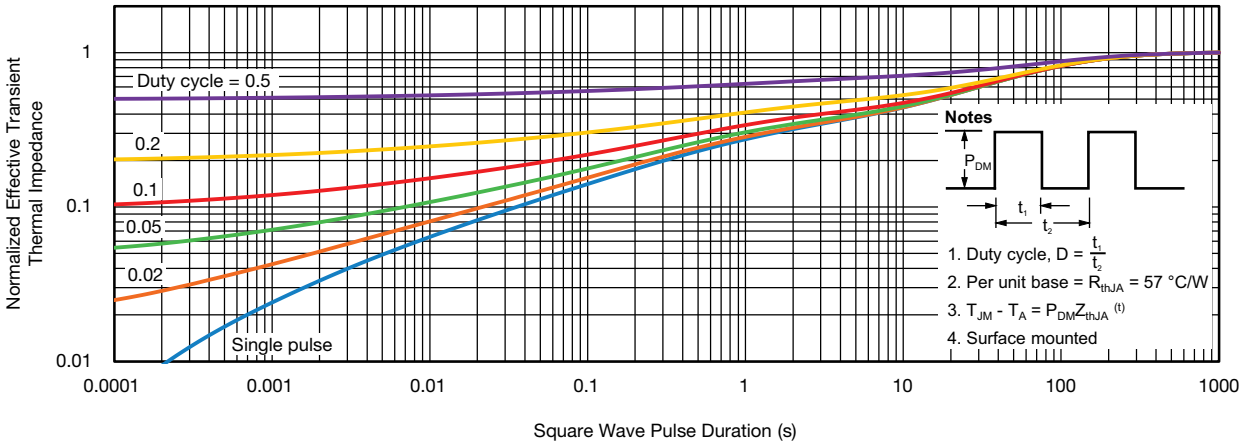
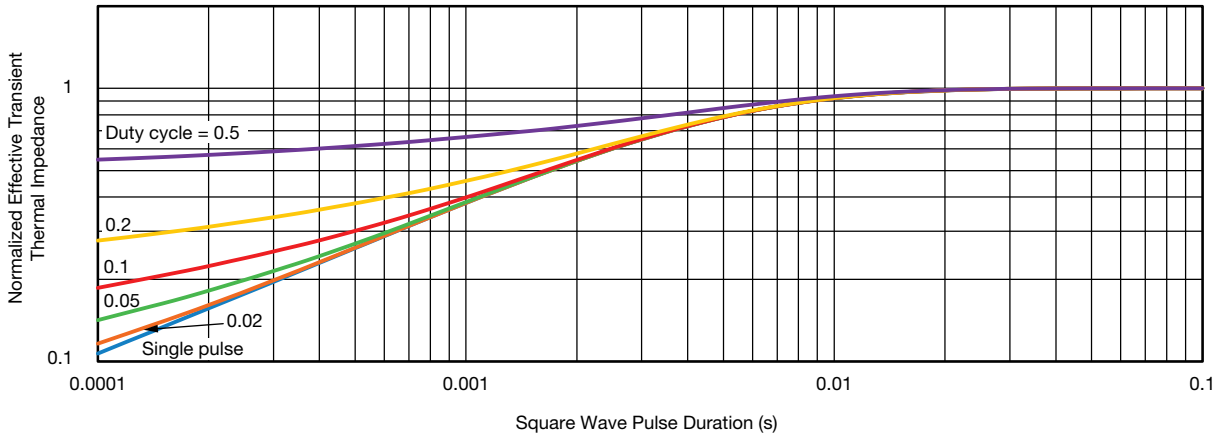
## CHANNEL-2 TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)




**Normalized Thermal Transient Impedance, Junction-to-Ambient**




**Normalized Thermal Transient Impedance, Junction-to-Case**

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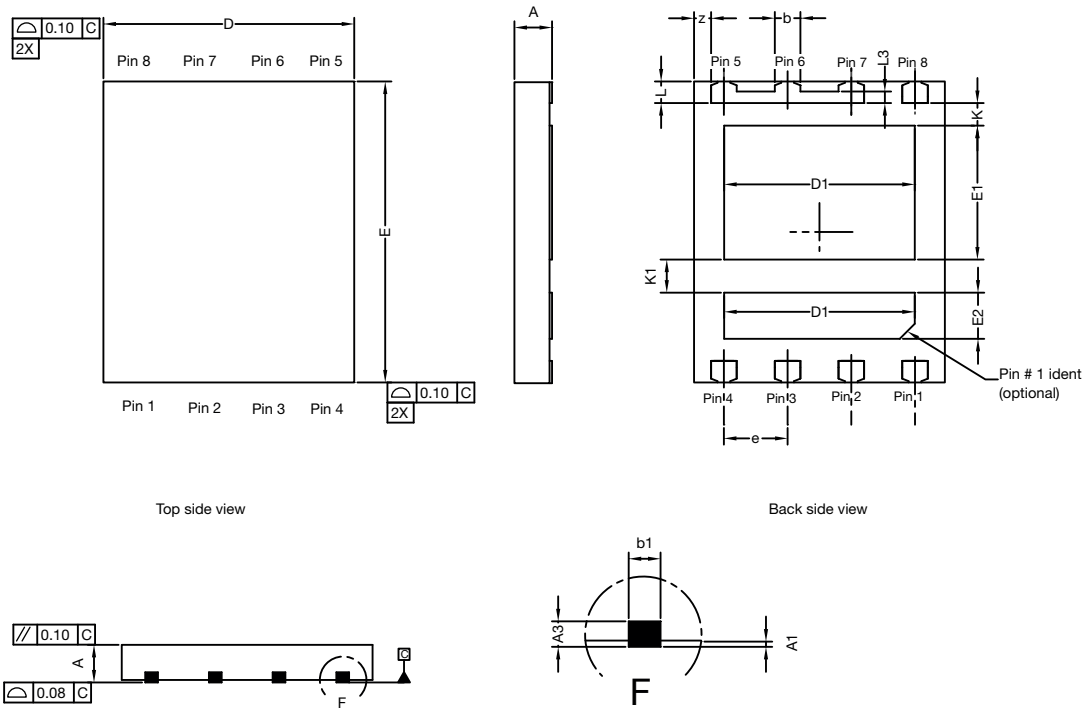
# PowerPAIR® 6 x 5 Case Outline




| DIM. | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 0.70 | 0.75 | 0.80 | 0.028 | 0.030 | 0.032 |
| A1 | 0.00 | - | 0.10 | 0.000 | - | 0.004 |
| A3 | 0.15 | 0.20 | 0.25 | 0.006 | 0.007 | 0.009 |
| b | 0.43 | 0.51 | 0.61 | 0.017 | 0.020 | 0.024 |
| b1 | | 0.25 BSC | | | 0.010 BSC | |
| D | 4.90 | 5.00 | 5.10 | 0.192 | 0.196 | 0.200 |
| D1 | 3.75 | 3.80 | 3.85 | 0.148 | 0.150 | 0.152 |
| E | 5.90 | 6.00 | 6.10 | 0.232 | 0.236 | 0.240 |
| E1 Option AA (for W/B) | 2.62 | 2.67 | 2.72 | 0.103 | 0.105 | 0.107 |
| E1 Option AB (for BWL) | 2.42 | 2.47 | 2.52 | 0.095 | 0.097 | 0.099 |
| E2 | 0.87 | 0.92 | 0.97 | 0.034 | 0.036 | 0.038 |
| e | | 1.27 BSC | | | 0.050 BSC | |
| K Option AA (for W/B) | | 0.45 typ. | | | 0.018 typ. | |
| K Option AB (for BWL) | | 0.65 typ. | | | 0.025 typ. | |
| K1 | | 0.66 typ. | | | 0.025 typ. | |
| L | 0.33 | 0.43 | 0.53 | 0.013 | 0.017 | 0.020 |
| L3 | | 0.23 BSC | | | 0.009 BSC | |
| z | | 0.34 BSC | | | 0.013 BSC | |
| ECN: T14-0782-Rev. C, 22-Dec-14<br>DWG: 6005 | | | | | | |



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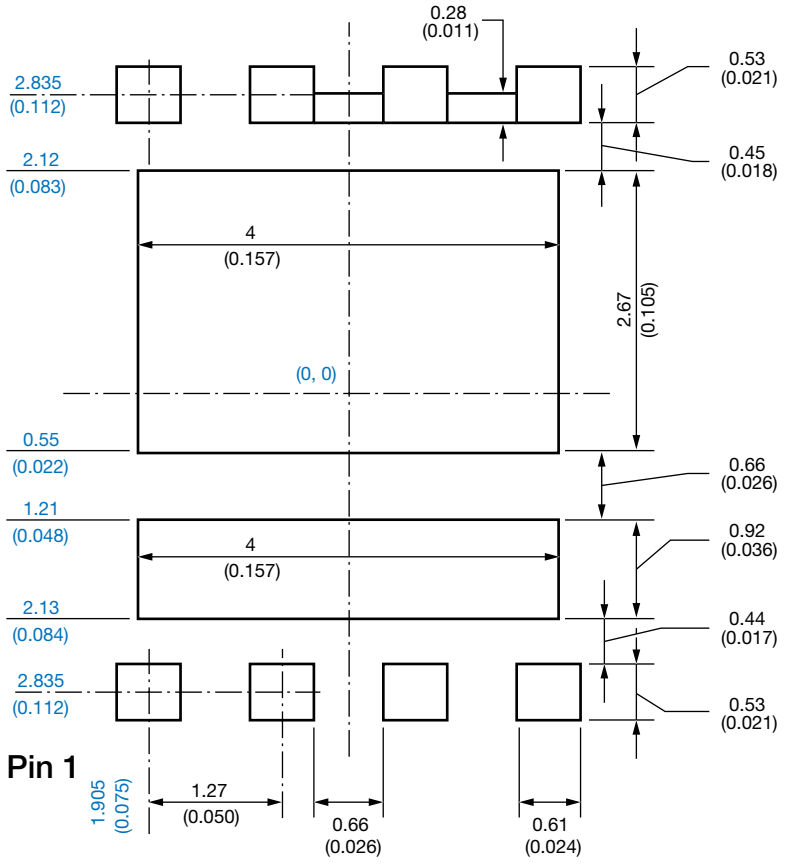
# Recommended Minimum PAD for PowerPAIR® 6 x 5




Dimensions in millimeters (inch)

**Note**

- Linear dimensions are in black, the same information is provided in ordinate dimensions which are in blue.



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