

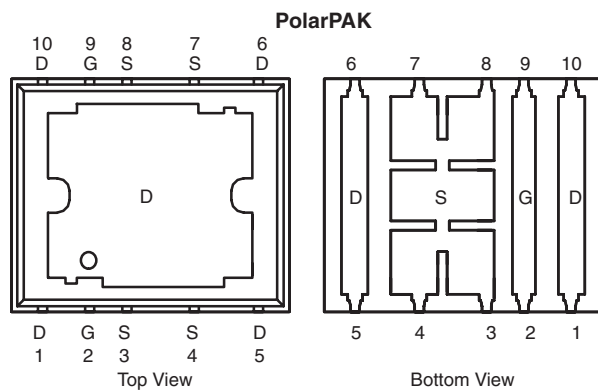


## N-Channel 60-V (D-S) MOSFET

### PRODUCT SUMMARY

| $V_{DS}$ (V) | $R_{DS(on)}$ ( $\Omega$ ) | $I_D$ (A)     |               | $Q_g$ (Typ.) |
|--------------|---------------------------|---------------|---------------|--------------|
|              |                           | Silicon Limit | Package Limit |              |
| 60           | 0.0074 at $V_{GS} = 10$ V | 95            | 60            | 51 nC        |

Package Drawing  
[www.vishay.com/doc?72945](http://www.vishay.com/doc?72945)



Top surface is connected to pins 1, 5, 6, and 10

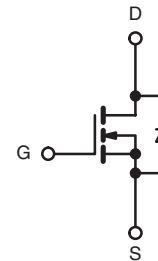
**Ordering Information:** SiE816DF-T1-E3 (Lead (Pb)-free)  
 SiE816DF-T1-GE3 (Lead (Pb)-free and Halogen-free)

### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET
- Ultra Low Thermal Resistance Using Top-Exposed PolarPAK® Package for Double-Sided Cooling
- Leadframe-Based New Encapsulated Package
  - Die Not Exposed
  - Same Layout Regardless of Die Size
- Low  $Q_{gd}/Q_{gs}$  Ratio Helps Prevent Shoot-Through
- 100 %  $R_g$  and UIS Tested
- Compliant to RoHS directive 2002/95/EC

### APPLICATIONS

- Primary Side Switch
- Half-Bridge



N-Channel MOSFET  
 For Related Documents  
[www.vishay.com/ppg?68641](http://www.vishay.com/ppg?68641)

### ABSOLUTE MAXIMUM RATINGS $T_A = 25^\circ\text{C}$ , unless otherwise noted

| Parameter                                                    | Symbol         | Limit                           | Unit             |
|--------------------------------------------------------------|----------------|---------------------------------|------------------|
| Drain-Source Voltage                                         | $V_{DS}$       | 60                              | V                |
| Gate-Source Voltage                                          | $V_{GS}$       | $\pm 20$                        | V                |
| Continuous Drain Current ( $T_J = 150^\circ\text{C}$ )       | $I_D$          | 95 (Silicon Limit)              | A                |
|                                                              |                | 60 <sup>a</sup> (Package Limit) |                  |
|                                                              |                | 60 <sup>a</sup>                 |                  |
|                                                              |                | 19.8 <sup>b, c</sup>            |                  |
| Pulsed Drain Current                                         | $I_{DM}$       | 14.8 <sup>b, c</sup>            | A                |
|                                                              |                | 60                              |                  |
| Continuous Source-Drain Diode Current                        | $I_S$          | 60 <sup>a</sup>                 | A                |
|                                                              |                | 4.3 <sup>b, c</sup>             |                  |
| Single Pulse Avalanche Current                               | $I_{AS}$       | 50                              | A                |
| Single Pulse Avalanche Energy                                | $E_{AS}$       | 125                             | mJ               |
| Maximum Power Dissipation                                    | $P_D$          | 125                             | W                |
|                                                              |                | 80                              |                  |
|                                                              |                | 5.2 <sup>b, c</sup>             |                  |
|                                                              |                | 3.3 <sup>b, c</sup>             |                  |
| Operating Junction and Storage Temperature Range             | $T_J, T_{stg}$ | - 55 to 150                     | $^\circ\text{C}$ |
| Soldering Recommendations (Peak Temperature) <sup>d, e</sup> |                | 260                             | $^\circ\text{C}$ |

Notes:

- Package limited.
- Surface Mounted on 1" x 1" FR4 board.
- $t = 10$  s.
- See Solder Profile ([www.vishay.com/ppg?73257](http://www.vishay.com/ppg?73257)). The PolarPAK 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.
- Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.

## SiE816DF

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## THERMAL RESISTANCE RATINGS

| Parameter                                         |               | Symbol              | Typical | Maximum | Unit |
|---------------------------------------------------|---------------|---------------------|---------|---------|------|
| Maximum Junction-to-Ambient <sup>a, b</sup>       | $t \leq 10$ s | $R_{thJA}$          | 20      | 24      | °C/W |
| Maximum Junction-to-Case (Drain Top)              | Steady State  | $R_{thJC}$ (Drain)  | 0.8     | 1       |      |
| Maximum Junction-to-Case (Source) <sup>a, c</sup> |               | $R_{thJC}$ (Source) | 2.2     | 2.7     |      |

Notes:

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

b. Maximum under Steady State conditions is 68 °C/W.

c. Measured at source pin (on the side of the package).

SPECIFICATIONS  $T_J = 25$  °C, unless otherwise noted

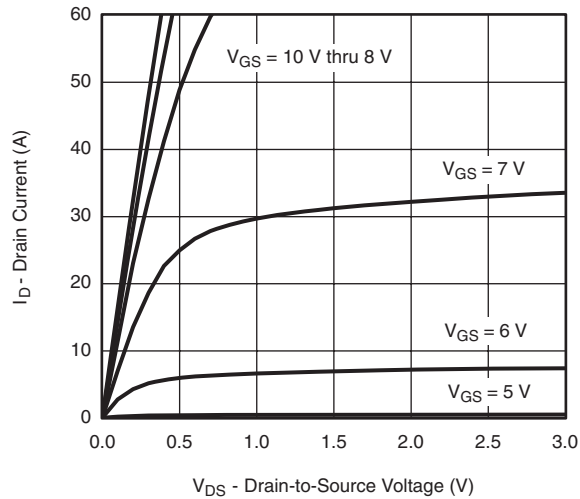
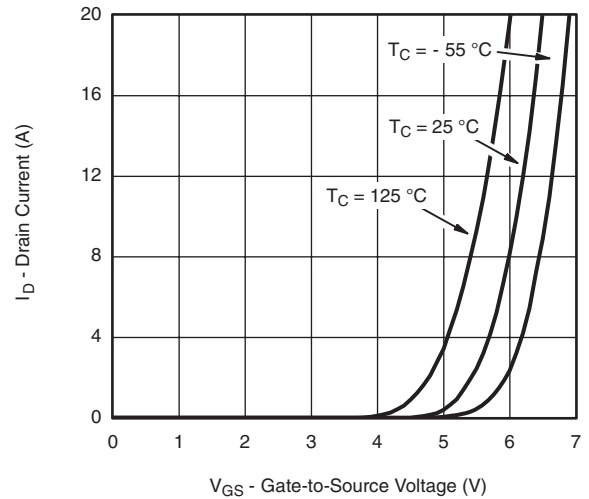
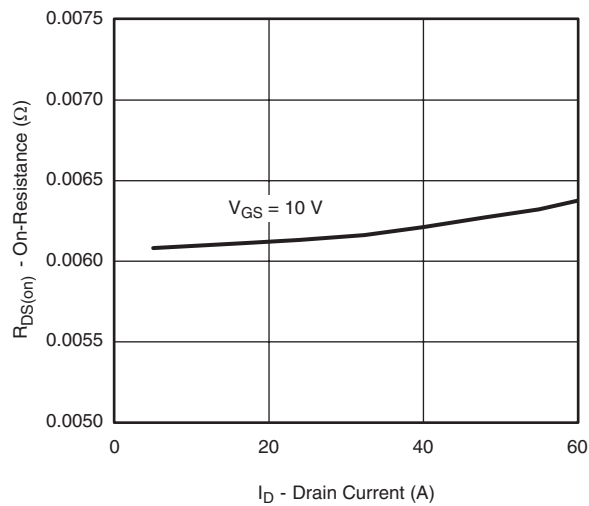
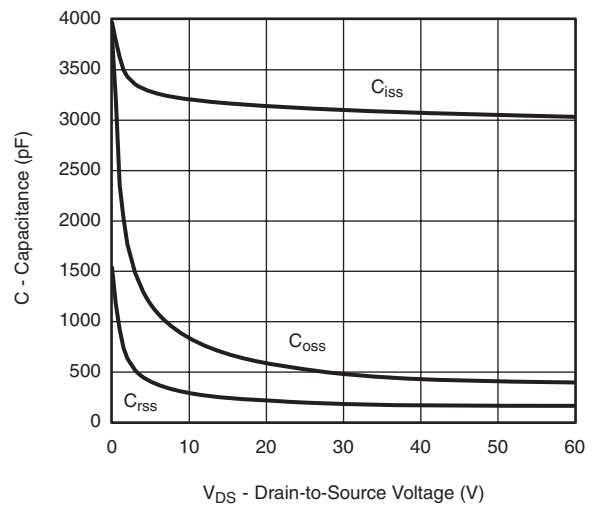
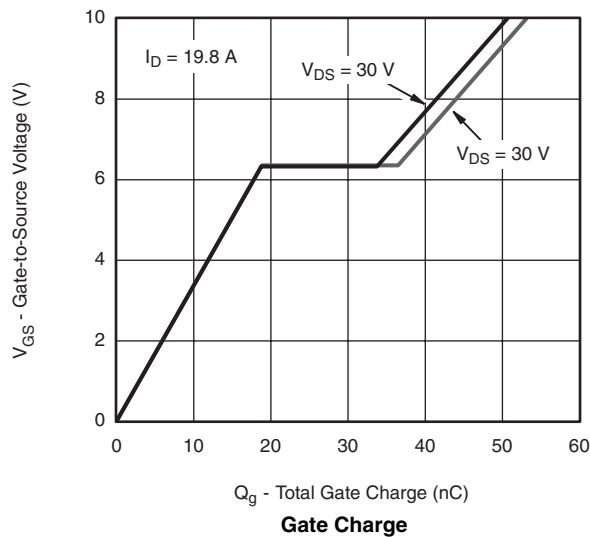
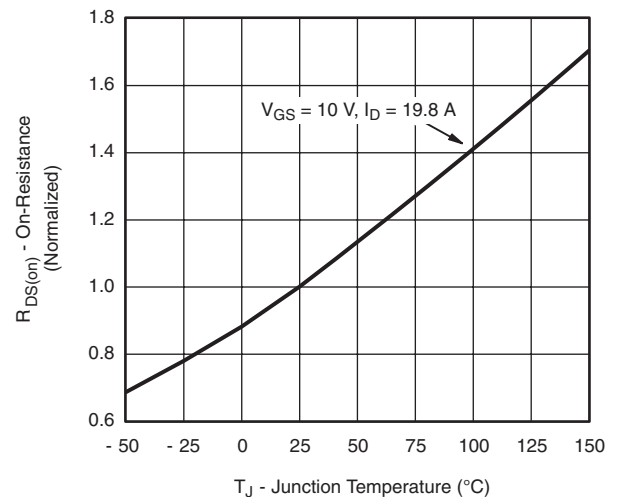
| Parameter                                     | Symbol                               | Test Conditions                                                                                                      | Min. | Typ.   | Max.   | Unit  |
|-----------------------------------------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------------|------|--------|--------|-------|
| Static                                        |                                      |                                                                                                                      |      |        |        |       |
| Drain-Source Breakdown Voltage                | V <sub>DS</sub>                      | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                       | 60   |        |        | V     |
| V <sub>DS</sub> Temperature Coefficient       | ΔV <sub>DS</sub> /T <sub>J</sub>     | I <sub>D</sub> = 250 μA                                                                                              |      | 70     |        | mV/°C |
| V <sub>GS(th)</sub> Temperature Coefficient   | ΔV <sub>GS(th)</sub> /T <sub>J</sub> |                                                                                                                      |      | - 9    |        |       |
| Gate-Source Threshold Voltage                 | V <sub>GS(th)</sub>                  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                          | 2.5  |        | 4.4    | V     |
| Gate-Source Leakage                           | I <sub>GSS</sub>                     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V                                                                      |      |        | ± 100  | nA    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>                     | V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V                                                                        |      |        | 1      | μA    |
|                                               |                                      | V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C                                                |      |        | 10     |       |
| On-State Drain Current <sup>a</sup>           | I <sub>D(on)</sub>                   | V <sub>DS</sub> ≥ 5 V, V <sub>GS</sub> = 10 V                                                                        | 25   |        |        | A     |
| Drain-Source On-State Resistance <sup>a</sup> | R <sub>DS(on)</sub>                  | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 19.8 A                                                                      |      | 0.0061 | 0.0074 | Ω     |
| Forward Transconductance <sup>a</sup>         | g <sub>fs</sub>                      | V <sub>DS</sub> = 15 V, I <sub>D</sub> = 19.8 A                                                                      |      | 30     |        | S     |
| Dynamic <sup>b</sup>                          |                                      |                                                                                                                      |      |        |        |       |
| Input Capacitance                             | C <sub>iss</sub>                     | V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                                             |      | 3100   |        | pF    |
| Output Capacitance                            | C <sub>oss</sub>                     |                                                                                                                      |      | 480    |        |       |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>                     |                                                                                                                      |      | 180    |        |       |
| Total Gate Charge                             | Q <sub>g</sub>                       | V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 19.8 A                                              |      | 51     | 77     | nC    |
| Gate-Source Charge                            | Q <sub>gs</sub>                      |                                                                                                                      |      | 19     |        |       |
| Gate-Drain Charge                             | Q <sub>gd</sub>                      |                                                                                                                      |      | 15     |        |       |
| Gate Resistance                               | R <sub>g</sub>                       | f = 1 MHz                                                                                                            |      | 1.1    | 2.2    | Ω     |
| Turn-On Delay Time                            | t <sub>d(on)</sub>                   | V <sub>DD</sub> = 30 V, R <sub>L</sub> = 3 Ω<br>I <sub>D</sub> ≅ 10 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω |      | 22     | 30     | ns    |
| Rise Time                                     | t <sub>r</sub>                       |                                                                                                                      |      | 10     | 15     |       |
| Turn-Off Delay Time                           | t <sub>d(off)</sub>                  |                                                                                                                      |      | 25     | 40     |       |
| Fall Time                                     | t <sub>f</sub>                       |                                                                                                                      |      | 10     | 15     |       |
| Drain-Source Body Diode Characteristics       |                                      |                                                                                                                      |      |        |        |       |
| Continuous Source-Drain Diode Current         | I <sub>S</sub>                       | T <sub>C</sub> = 25 °C                                                                                               |      |        | 60     | A     |
| Pulse Diode Forward Current <sup>a</sup>      | I <sub>SM</sub>                      |                                                                                                                      |      |        | 60     |       |
| Body Diode Voltage                            | V <sub>SD</sub>                      | I <sub>S</sub> = 10 A                                                                                                |      | 0.8    | 1.2    | V     |
| Body Diode Reverse Recovery Time              | t <sub>rr</sub>                      | I <sub>F</sub> = 10 A, dI/dt = 100 A/μs, T <sub>J</sub> = 25 °C                                                      |      | 60     | 90     | ns    |
| Body Diode Reverse Recovery Charge            | Q <sub>rr</sub>                      |                                                                                                                      |      | 135    | 205    | nC    |
| Reverse Recovery Fall Time                    | t <sub>a</sub>                       |                                                                                                                      |      | 42     |        | ns    |
| Reverse Recovery Rise Time                    | t <sub>b</sub>                       |                                                                                                                      |      | 18     |        |       |

Notes:

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

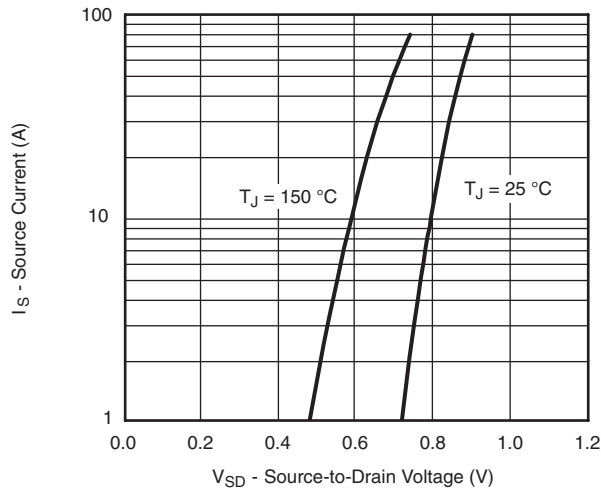
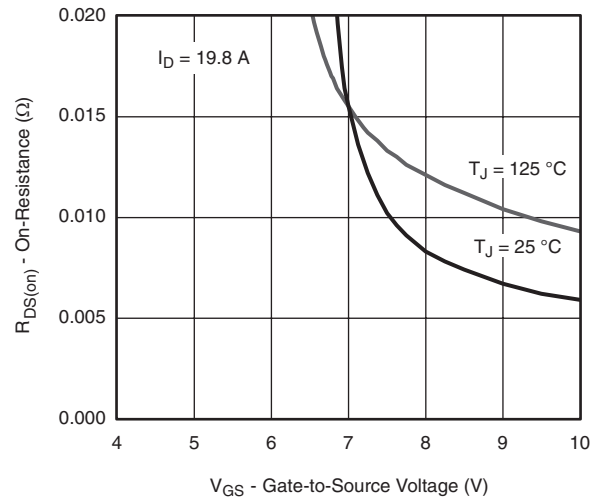
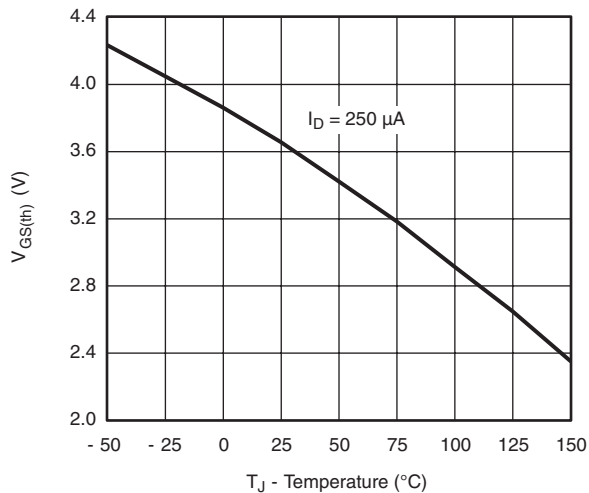
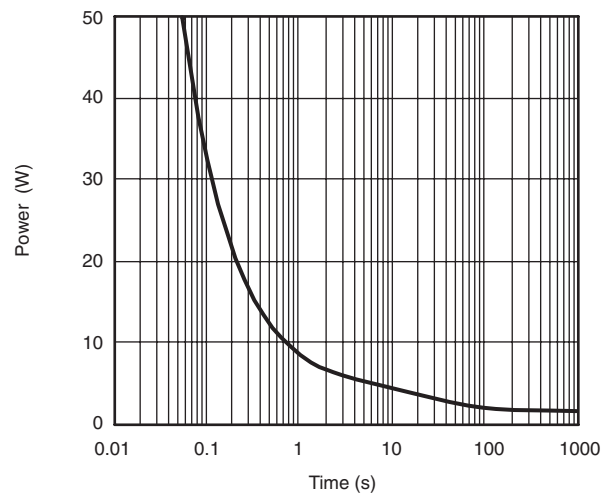
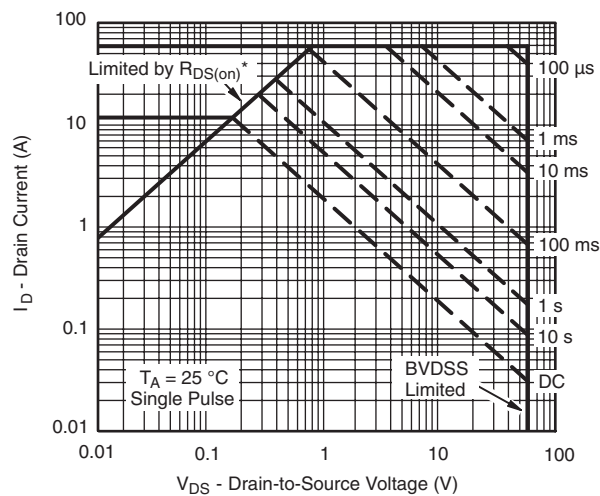
b. Guaranteed by design, not subject to production testing.

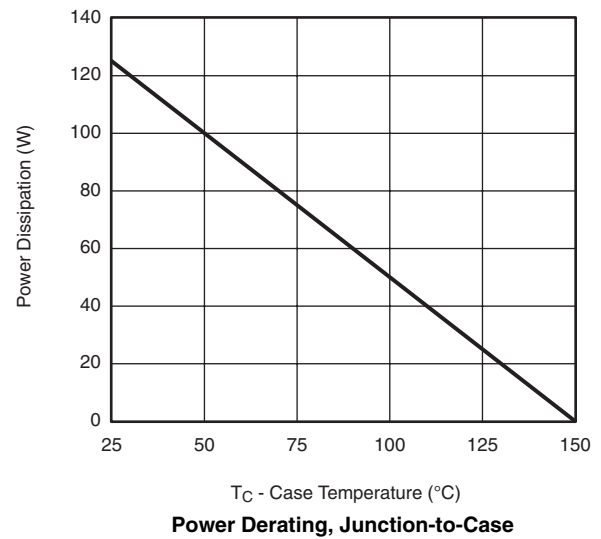
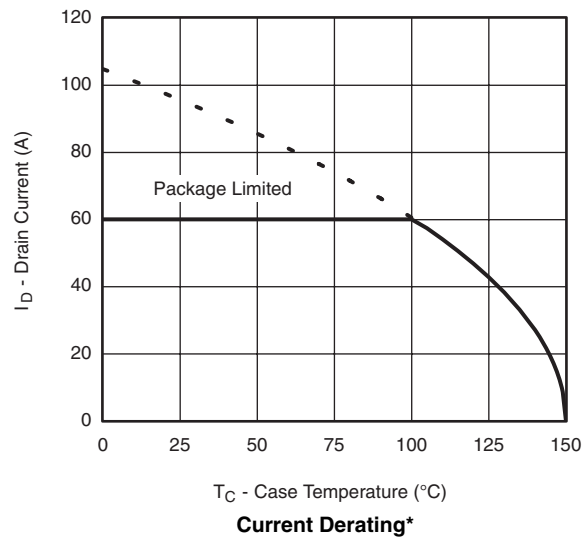
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

**SiE816DF**

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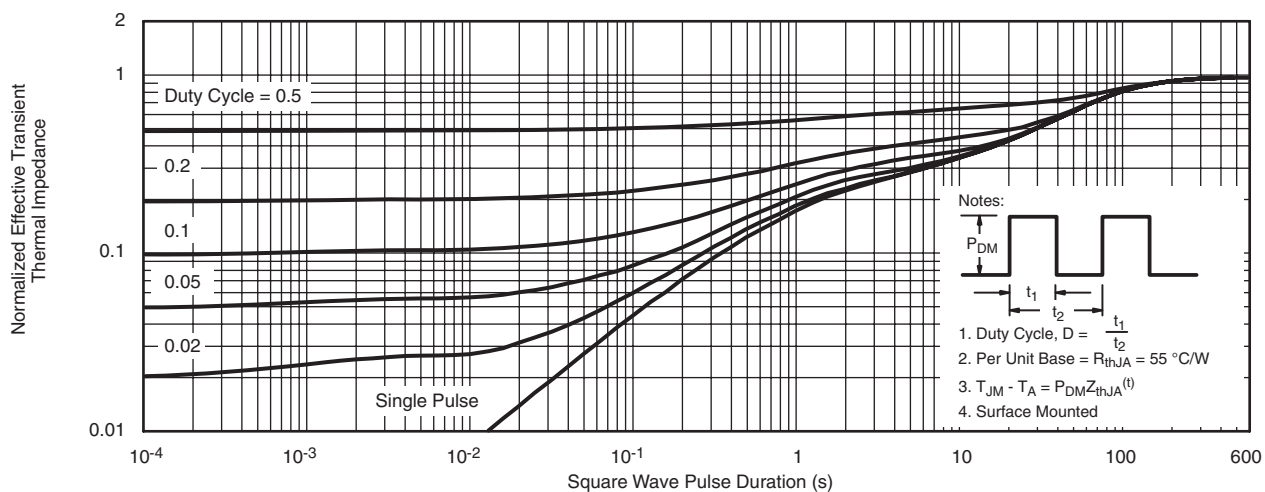
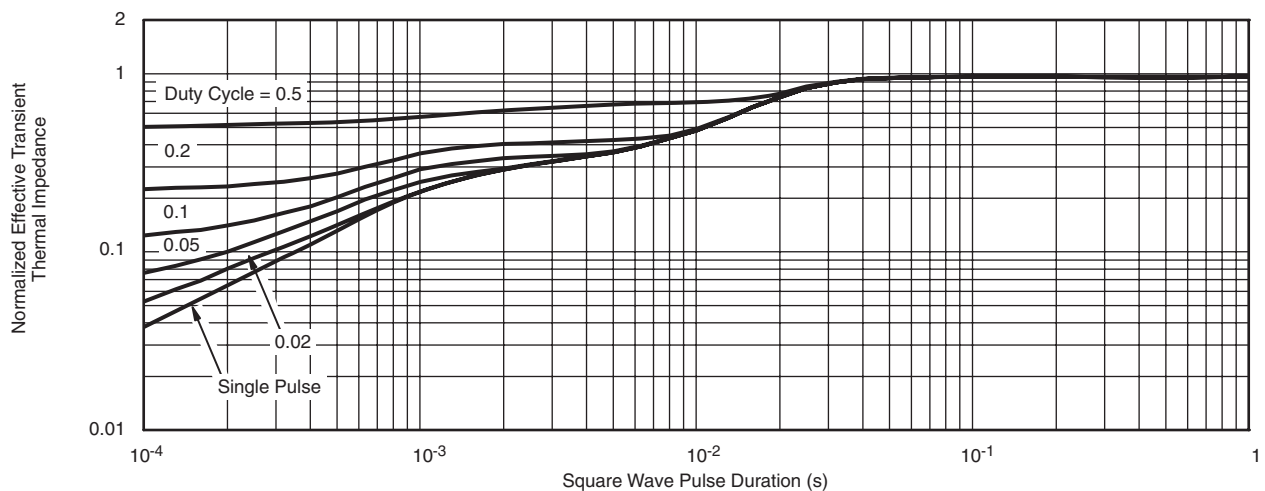
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted**Source-Drain Diode Forward Voltage****On-Resistance vs. Gate-to-Source Voltage****Threshold Voltage****Single Pulse Power, Junction-to-Ambient**\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified**Safe Operating Area, Junction-to-Ambient**


**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.

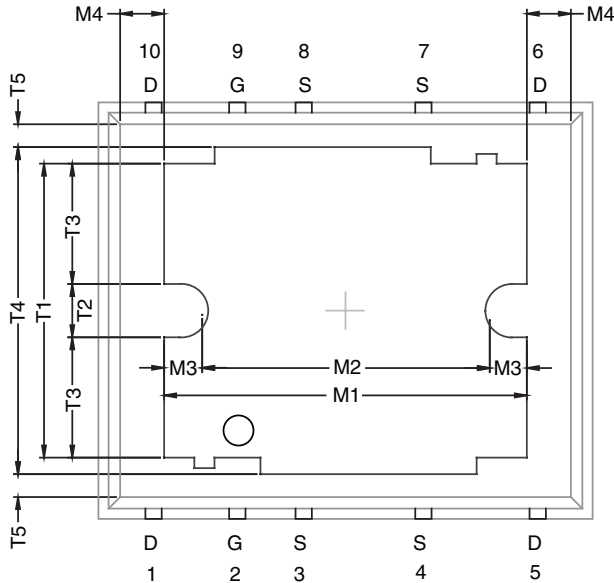
## SiE816DF

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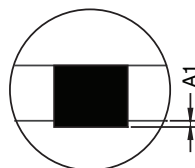
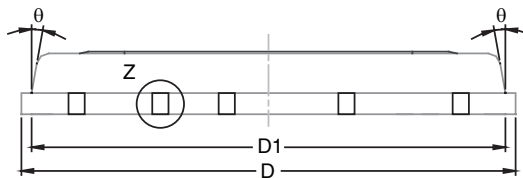
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted**Normalized Thermal Transient Impedance, Junction-to-Ambient****Normalized Thermal Transient Impedance, Junction-to-Case (Drain Top)**

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?68641](http://www.vishay.com/ppg?68641).

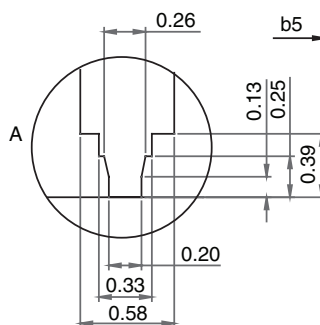
## POLARPAK™ OPTION L



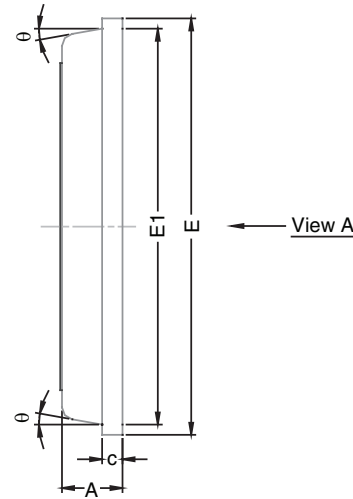
(Top View)



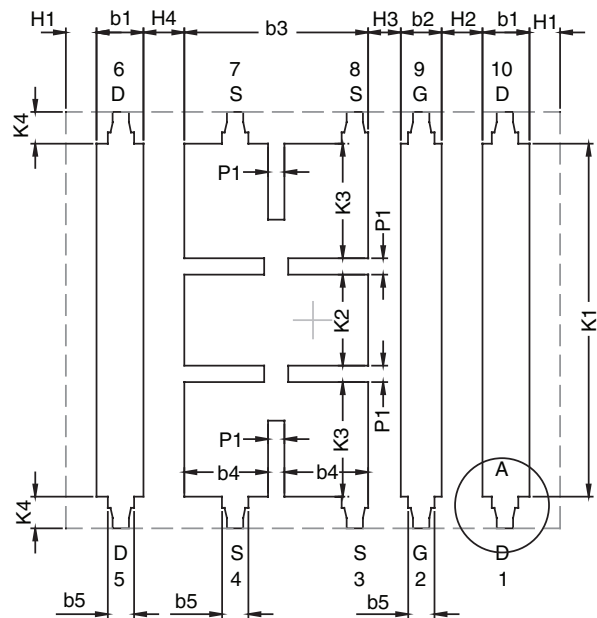
DETAIL Z



Product datasheet/information page contain links to applicable package drawing.



View A



View A  
(Bottom View)

# Package Information

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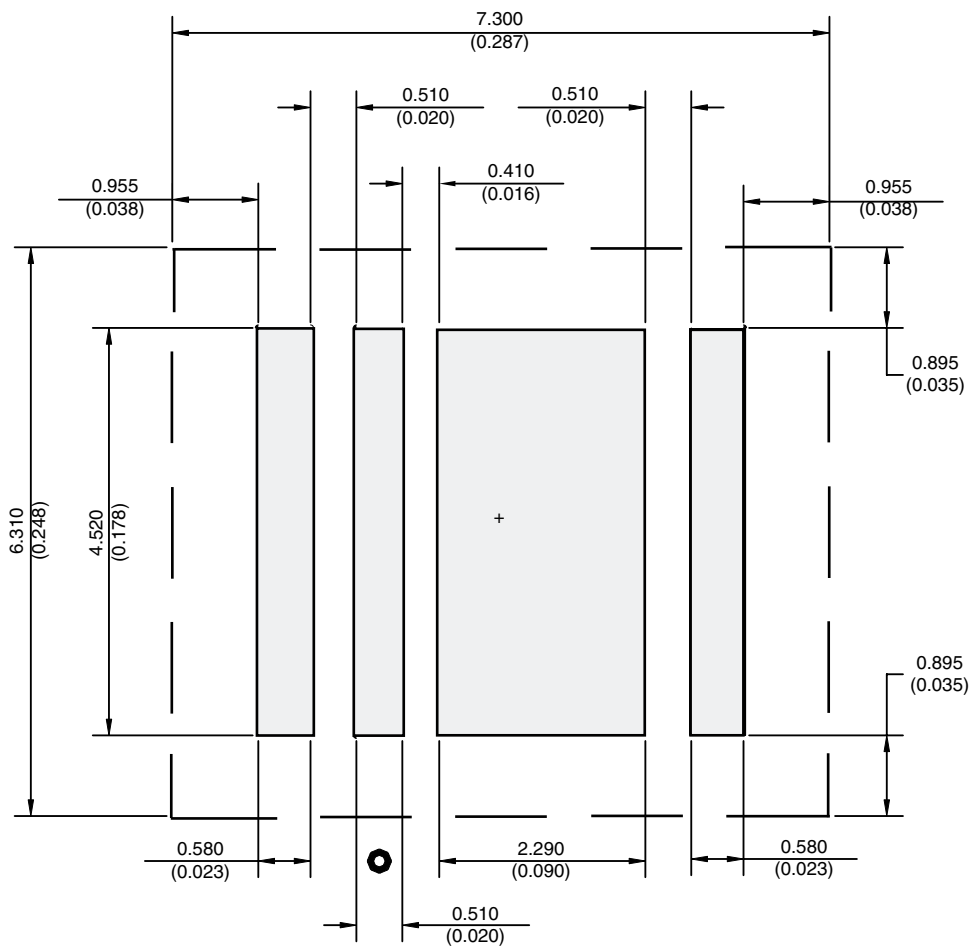


| DIM                                         | MILLIMETERS |      |      | INCHES |       |       |
|---------------------------------------------|-------------|------|------|--------|-------|-------|
|                                             | MIN.        | NOM. | MAX. | MIN.   | NOM.  | MAX.  |
| A                                           | 0.75        | 0.80 | 0.85 | 0.030  | 0.031 | 0.033 |
| A1                                          | 0.00        | -    | 0.05 | 0.000  | -     | 0.002 |
| b1                                          | 0.48        | 0.58 | 0.68 | 0.019  | 0.023 | 0.027 |
| b2                                          | 0.41        | 0.51 | 0.61 | 0.016  | 0.020 | 0.024 |
| b3                                          | 2.19        | 2.29 | 2.39 | 0.086  | 0.090 | 0.094 |
| b4                                          | 0.89        | 1.04 | 1.19 | 0.035  | 0.041 | 0.047 |
| b5                                          | 0.23        | 0.33 | 0.43 | 0.009  | 0.013 | 0.017 |
| c                                           | 0.20        | 0.25 | 0.30 | 0.008  | 0.010 | 0.012 |
| D                                           | 6.00        | 6.15 | 6.30 | 0.236  | 0.242 | 0.248 |
| D1                                          | 5.74        | 5.89 | 6.04 | 0.226  | 0.232 | 0.238 |
| E                                           | 5.01        | 5.16 | 5.31 | 0.197  | 0.203 | 0.209 |
| E1                                          | 4.75        | 4.90 | 5.05 | 0.187  | 0.193 | 0.199 |
| H1                                          | 0.23        | -    | -    | 0.009  | -     | -     |
| H2                                          | 0.45        | -    | 0.56 | 0.018  | -     | 0.022 |
| H3                                          | 0.31        | 0.41 | 0.51 | 0.012  | 0.016 | 0.020 |
| H4                                          | 0.45        | -    | 0.56 | 0.018  | -     | 0.022 |
| K1                                          | 4.22        | 4.37 | 4.52 | 0.166  | 0.172 | 0.178 |
| K2                                          | 1.08        | 1.13 | 1.18 | 0.043  | 0.044 | 0.046 |
| K3                                          | 1.37        | -    | -    | 0.054  | -     | -     |
| K4                                          | 0.24        | -    | -    | 0.009  | -     | -     |
| M1                                          | 4.30        | 4.50 | 4.70 | 0.169  | 0.177 | 0.185 |
| M2                                          | 3.43        | 3.58 | 3.73 | 0.135  | 0.141 | 0.147 |
| M3                                          | 0.22        | -    | -    | 0.009  | -     | -     |
| M4                                          | 0.05        | -    | -    | 0.002  | -     | -     |
| P1                                          | 0.15        | 0.20 | 0.25 | 0.006  | 0.008 | 0.010 |
| T1                                          | 3.48        | 3.64 | 4.10 | 0.137  | 0.143 | 0.161 |
| T2                                          | 0.56        | 0.76 | 0.95 | 0.022  | 0.030 | 0.037 |
| T3                                          | 1.20        | -    | -    | 0.047  | -     | -     |
| T4                                          | 3.90        | -    | -    | 0.153  | -     | -     |
| T5                                          | 0           | 0.18 | 0.36 | 0.000  | 0.007 | 0.014 |
| θ                                           | 0°          | 10°  | 12°  | 0°     | 10°   | 12°   |
| ECN: T-08441-Rev. C, 11-Aug-08<br>DWG: 5946 |             |      |      |        |       |       |

## Notes

Millimeters govern over inches.

## RECOMMENDED MINIMUM PADS FOR PolarPAK® Option L and S



Recommended Minimum for PolarPAK Option L and S  
 Dimensions in mm/(Inches)  
 No External Traces within Broken Lines  
 Dot indicates Gate Pin (Part Marking)



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**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**