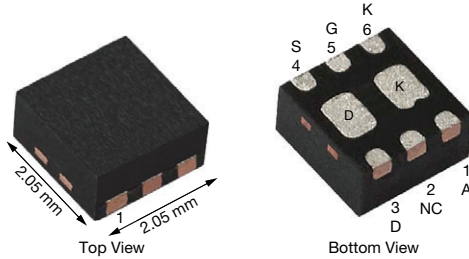


## P-Channel 30 V (D-S) MOSFET with Schottky Diode

PowerPAK® SC-70-6L Dual with Schottky Diode



Marking code: HE

| PRODUCT SUMMARY                                     |                               |
|---|-------------------------------|
| <b>MOSFET</b>                                       |                               |
| $V_{DS}$ (V)  | -30                           |
| $R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = -10$ V  | 0.065                         |
| $R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = -4.5$ V | 0.080                         |
| $R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = -3.7$ V | 0.092                         |
| $R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = -2.5$ V | 0.125                         |
| $Q_g$ typ. (nC)                                     | 6.6                           |
| $I_D$ (A) <sup>a</sup>                              | -4.5                          |
| <b>SCHOTTKY</b>                                     |                               |
| $V_{KA}$ (V)  | 30                            |
| $V_F$ (V) at 1 A                                    | 0.56                          |
| $I_F$ (A) <sup>a</sup>                              | 2                             |
| Configuration                                       | Dual plus integrated Schottky |

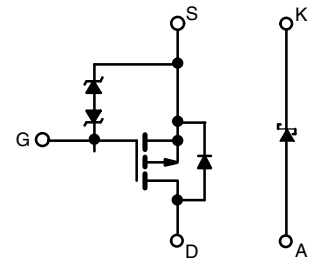
### FEATURES

- LITTLE FOOT® plus Schottky power MOSFET
- Thermally enhanced PowerPAK® SC-70 package
  - Small footprint area
  - Low on-resistance
  - Thin 0.75 mm profile
- Typical ESD protection (MOSFET): 1500 V (HBM)
- 100 %  $R_g$  tested
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
 COMPLIANT  
 HALOGEN  
**FREE**

### APPLICATIONS

- Portable devices such as smart phones, tablet PCs, and mobile computing
  - Battery charger switch
  - Buck converter
  - Power management



P-Channel MOSFET

| ORDERING INFORMATION            |                  |
|---------------------------------|------------------|
| Package                         | PowerPAK SC-70   |
| Lead (Pb)-free and halogen-free | SiA817EDJ-T1-GE3 |

| ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted) |                |                |                      |   |
|---|----------------|----------------|----------------------|---|
| PARAMETER   | SYMBOL         | LIMIT          | UNIT                 |   |
| Drain-source voltage (MOSFET)                                     | $V_{DS}$       | -30            | V                    |   |
| Reverse voltage (Schottky)  | $V_{KA}$       | 30             |                      |   |
| Gate-source voltage (MOSFET)                                      | $V_{GS}$       | $\pm 12$       |                      |   |
| Continuous drain current ( $T_J = 150$ °C) (MOSFET)               | $I_D$          | $T_C = 25$ °C  | -4.5 <sup>a</sup>    | A |
|   |                | $T_C = 70$ °C  | -4.5 <sup>a</sup>    |   |
|   |                | $T_A = 25$ °C  | -4.2 <sup>b, c</sup> |   |
|   |                | $T_A = 70$ °C  | -3.4 <sup>b, c</sup> |   |
| Pulsed drain current (MOSFET) ( $t = 300$ $\mu$ s)                | $I_{DM}$       | -15            |                      |   |
| Continuous source-drain diode current (MOSFET diode conduction)   | $I_S$          | $T_C = 25$ °C  | -4.5 <sup>a</sup>    |   |
|   |                | $T_A = 25$ °C  | -1.6 <sup>b, c</sup> |   |
| Average forward current (Schottky)                                | $I_F$          | 2 <sup>b</sup> |                      |   |
| Pulsed forward current (Schottky)                                 | $I_{FM}$       | 3              |                      |   |
| Maximum power dissipation (MOSFET)                                | $P_D$          | $T_C = 25$ °C  | 6.5                  | W |
|   |                | $T_C = 70$ °C  | 5                    |   |
|   |                | $T_A = 25$ °C  | 1.9 <sup>b, c</sup>  |   |
|   |                | $T_A = 70$ °C  | 1.2 <sup>b, c</sup>  |   |
| Maximum power dissipation (Schottky)                              | $P_D$          | $T_C = 25$ °C  | 6.8                  |   |
|   |                | $T_C = 70$ °C  | 4.3                  |   |
|   |                | $T_A = 25$ °C  | 1.6 <sup>b, c</sup>  |   |
|   |                | $T_A = 70$ °C  | 1 <sup>b, c</sup>    |   |
| Operating junction and storage temperature range                  | $T_J, T_{stg}$ | -55 to +150    | °C                   |   |
| Soldering recommendations (peak temperature) <sup>d, e</sup>      |                | 260            |                      |   |



| THERMAL RESISTANCE RATINGS                             |              |                   |         |         |      |
|--|--------------|-------------------|---------|---------|------|
| PARAMETER  |              | SYMBOL            | TYPICAL | MAXIMUM | UNIT |
| Maximum junction-to-ambient (MOSFET) <sup>b, f</sup>   | t ≤ 5 s      | R <sub>thJA</sub> | 52      | 65      | °C/W |
| Maximum junction-to-case (drain) (MOSFET)              | Steady state | R <sub>thJC</sub> | 12.5    | 16      |      |
| Maximum junction-to-ambient (Schottky) <sup>b, f</sup> | t ≤ 5 s      | R <sub>thJA</sub> | 62      | 76      |      |
| Maximum junction-to-case (drain) (Schottky)            | Steady state | R <sub>thJC</sub> | 15      | 18.5    |      |

**Notes**

- a. Package limited
- b. Surface mounted on 1" x 1" FR4 board
- c. t = 10 s
- d. See solder profile ([www.vishay.com/doc?73257](http://www.vishay.com/doc?73257)). The PowerPAK SC-70 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 110 °C/W

| SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted) |                                      |   |      |       |       |       |
|---|--------------------------------------|---|------|-------|-------|-------|
| PARAMETER   | SYMBOL                               | TEST CONDITIONS   | MIN. | TYP.  | MAX.  | UNIT  |
| <b>Static</b>   |                                      |   |      |       |       |       |
| Drain-source breakdown voltage                                  | V <sub>DS</sub>                      | V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA   | -30  | -     | -     | V     |
| V <sub>DS</sub> temperature coefficient                         | ΔV <sub>DS</sub> /T <sub>J</sub>     | I <sub>D</sub> = -250 μA  | -    | -23   | -     | mV/°C |
| V <sub>GS(th)</sub> temperature coefficient                     | ΔV <sub>GS(th)</sub> /T <sub>J</sub> |   | -    | 2.7   | -     |       |
| Gate-source threshold voltage                                   | V <sub>GS(th)</sub>                  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA  | -0.6 | -     | -1.3  | V     |
| Gate-source leakage   | I <sub>GSS</sub>                     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 4.5 V  | -    | -     | ± 0.5 | μA    |
|   |                                      | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 12 V   | -    | -     | ± 10  |       |
| Zero gate voltage drain current                                 | I <sub>DSS</sub>                     | V <sub>DS</sub> = -30 V, V <sub>GS</sub> = 0 V  | -    | -     | -1    |       |
|   |                                      | V <sub>DS</sub> = -30 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  | -8   | -     | -     | A     |
| Drain-source on-state resistance <sup>a</sup>                   | R <sub>DS(on)</sub>                  | V <sub>GS</sub> = -10 V, I <sub>D</sub> = -3 A  | -    | 0.054 | 0.065 | Ω     |
|   |                                      | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -2 A   | -    | 0.065 | 0.080 |       |
|   |                                      | V <sub>GS</sub> = -3.7 V, I <sub>D</sub> = -1 A   | -    | 0.070 | 0.092 |       |
|   |                                      | V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -1 A   | -    | 0.095 | 0.125 |       |
| Forward transconductance <sup>a</sup>                           | g <sub>fs</sub>                      | V <sub>DS</sub> = -10 V, I <sub>D</sub> = -3 A  | -    | 9     | -     | S     |
| <b>Dynamic <sup>b</sup></b>                                     |                                      |   |      |       |       |       |
| Input capacitance   | C <sub>iss</sub>                     | V <sub>DS</sub> = -15 V, V <sub>GS</sub> = 0 V, f = 1 MHz   | -    | 600   | -     | pF    |
| Output capacitance  | C <sub>oss</sub>                     |   | -    | 55    | -     |       |
| Reverse transfer capacitance                                    | C <sub>rss</sub>                     |   | -    | 50    | -     |       |
| Total gate charge   | Q <sub>g</sub>                       | V <sub>DS</sub> = -15 V, V <sub>GS</sub> = -10 V, I <sub>D</sub> = -4.2 A   | -    | 14    | 23    | nC    |
| Gate-source charge  | Q <sub>gs</sub>                      | V <sub>DS</sub> = -5 V, V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -4.2 A   | -    | 6.6   | 10    |       |
| Gate-drain charge   | Q <sub>gd</sub>                      |   | -    | 1.3   | -     |       |
| Gate resistance   | R <sub>g</sub>                       | f = 1 MHz   | 1.1  | 5.5   | 11    | Ω     |
| Turn-on delay time  | t <sub>d(on)</sub>                   | V <sub>DD</sub> = -15 V, R <sub>L</sub> = 4.4 Ω<br>I <sub>D</sub> ≅ -3.4 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω | -    | 20    | 40    | ns    |
| Rise time   | t <sub>r</sub>                       |   | -    | 20    | 40    |       |
| Turn-off delay time   | t <sub>d(off)</sub>                  |   | -    | 23    | 45    |       |
| Fall time   | t <sub>f</sub>                       |   | -    | 10    | 20    |       |
| Turn-on delay time  | t <sub>d(on)</sub>                   | V <sub>DD</sub> = -15 V, R <sub>L</sub> = 4.4 Ω<br>I <sub>D</sub> ≅ -3.4 A, V <sub>GEN</sub> = -10 V, R <sub>g</sub> = 1 Ω  | -    | 10    | 20    |       |
| Rise time   | t <sub>r</sub>                       |   | -    | 10    | 20    |       |
| Turn-off delay time   | t <sub>d(off)</sub>                  |   | -    | 25    | 50    |       |
| Fall time   | t <sub>f</sub>                       |   | -    | 7     | 15    |       |



| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |          |   |      |      |      |      |
|---|----------|---|------|------|------|------|
| PARAMETER   | SYMBOL   | TEST CONDITIONS   | MIN. | TYP. | MAX. | UNIT |
| <b>Drain-Source Body Diode Characteristics</b>                              |          |   |      |      |      |      |
| Continuous source-drain diode current                                       | $I_S$    | $T_C = 25\text{ }^\circ\text{C}$  | -    | -    | -4.5 | A    |
| Pulse diode forward current   | $I_{SM}$ |   | -    | -    | -15  |      |
| Body diode voltage  | $V_{SD}$ | $I_S = -3.4\text{ A}, V_{GS} = 0\text{ V}$  | -    | -0.9 | -1.2 | V    |
| Body diode reverse recovery time  | $t_{rr}$ | $I_F = -3.4\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$ | -    | 16   | 30   | ns   |
| Body diode reverse recovery charge  | $Q_{rr}$ |   | -    | 8    | 15   | nC   |
| Reverse recovery fall time  | $t_a$    |   | -    | 9    | -    | ns   |
| Reverse recovery rise time  | $t_b$    |   | -    | 7    | -    |      |

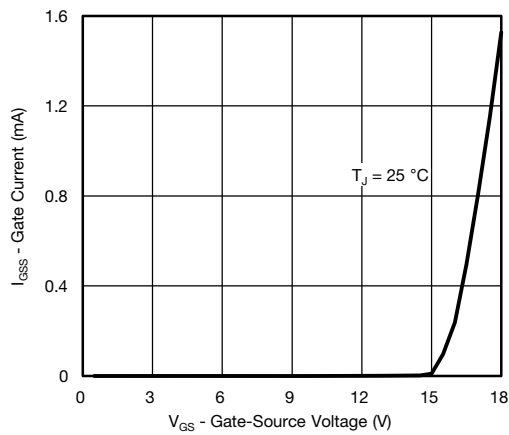
**Notes**

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

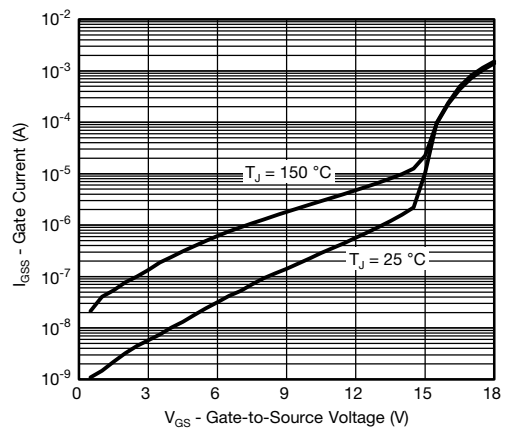
| SCHOTTKY SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |          |   |      |       |       |      |
|--|----------|---|------|-------|-------|------|
| PARAMETER  | SYMBOL   | TEST CONDITIONS                                       | MIN. | TYP.  | MAX.  | UNIT |
| Forward voltage drop   | $V_F$    | $I_F = 0.5\text{ A}$                                  | -    | 0.37  | 0.45  | V    |
|  |          | $I_F = 0.5\text{ A}, T_J = 125\text{ }^\circ\text{C}$ | -    | 0.31  | 0.37  |      |
|  |          | $I_F = 1\text{ A}$                                    | -    | 0.46  | 0.56  |      |
|  |          | $I_F = 1\text{ A}, T_J = 125\text{ }^\circ\text{C}$   | -    | 0.41  | 0.50  |      |
| Maximum reverse leakage current  | $I_{rm}$ | $V_r = 30\text{ V}$                                   | -    | 0.025 | 0.100 | mA   |
|  |          | $V_r = 30\text{ V}, T_J = 85\text{ }^\circ\text{C}$   | -    | 0.6   | 6     |      |
| Junction capacitance   | $C_T$    | $V_r = 15\text{ V}$                                   | -    | 35    | -     | pF   |

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.

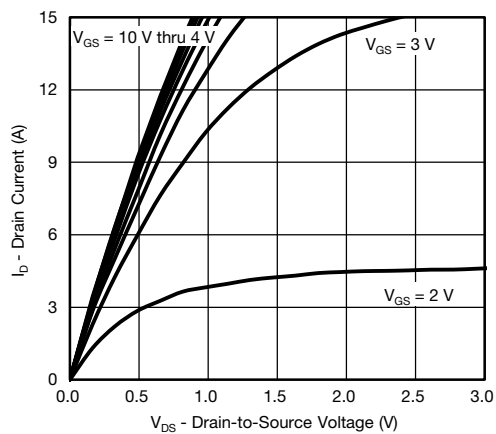
**MOSFET TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



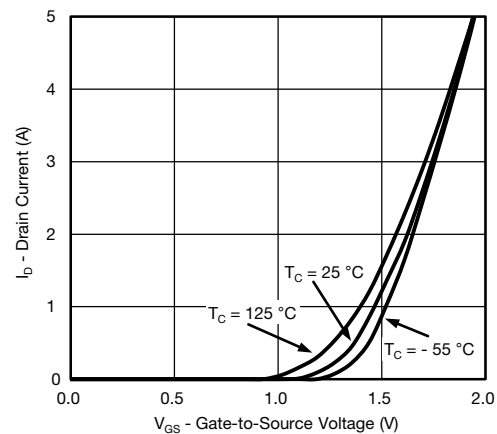
**Gate-Source Voltage vs. Gate Current**



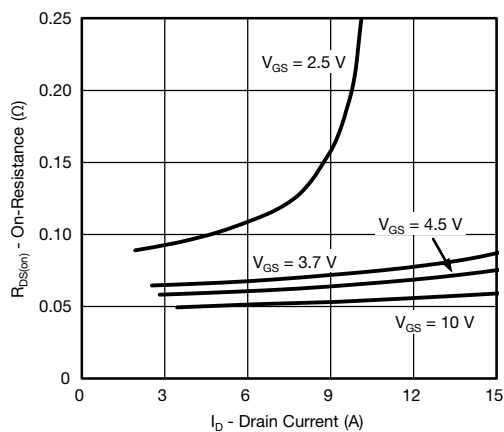
**Gate-Source Voltage vs. Gate Current**



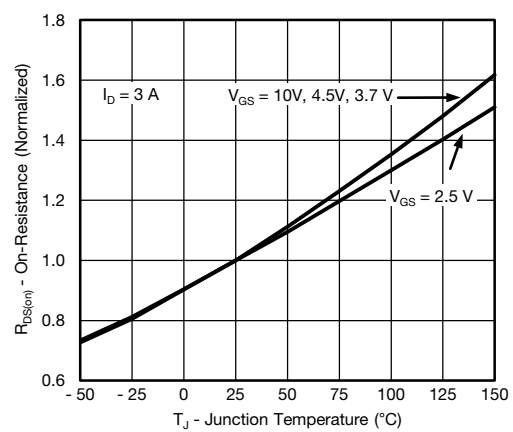
**Output Characteristics**



**Transfer Characteristics**



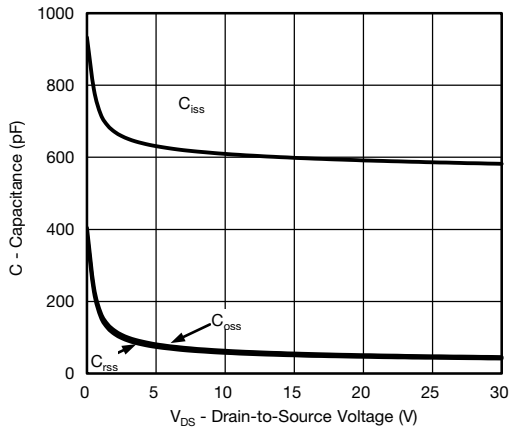
**On-Resistance vs. Drain Current and Gate Voltage**



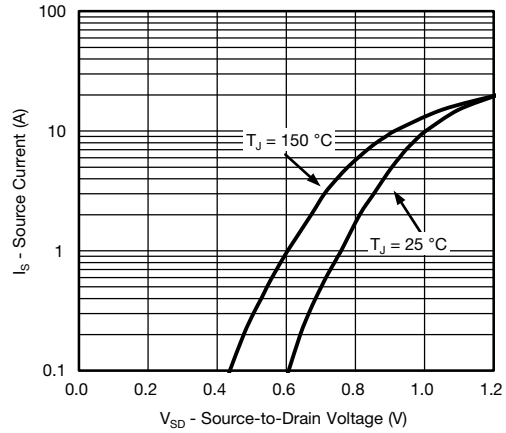
**On-Resistance vs. Junction Temperature**



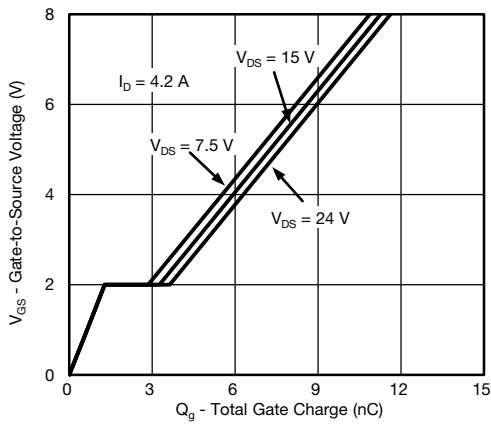
**MOSFET TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



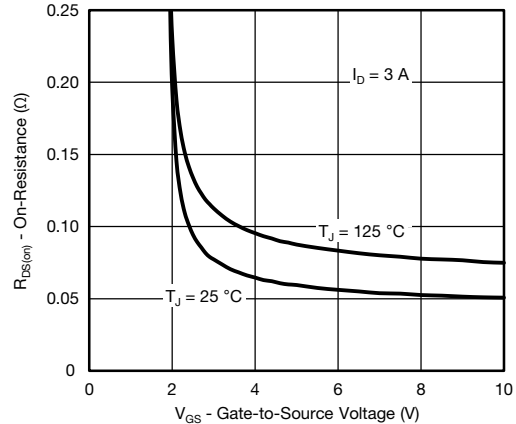
**Capacitance**



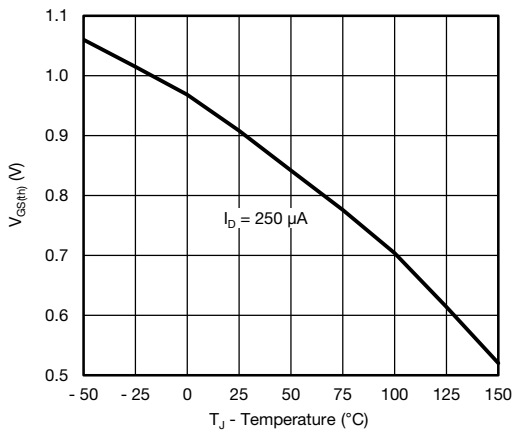
**Source-Drain Diode Forward Voltage**



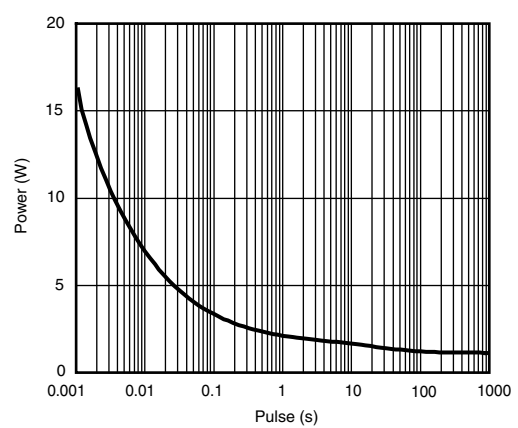
**Gate Charge**



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



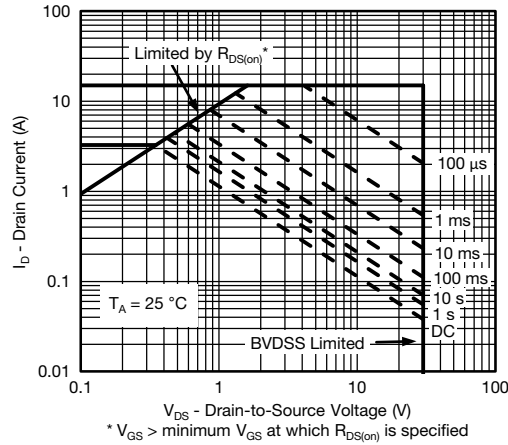
**Threshold Voltage**



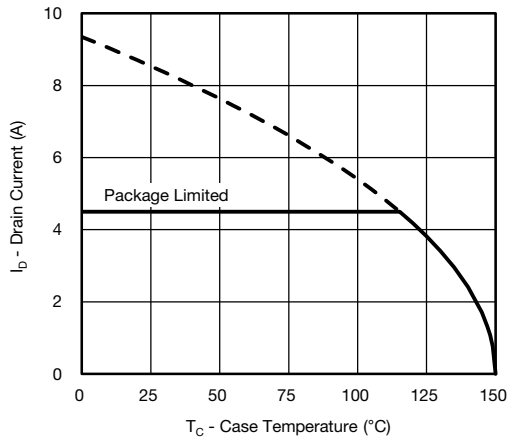
**Single Pulse Power, Junction-to-Ambient**



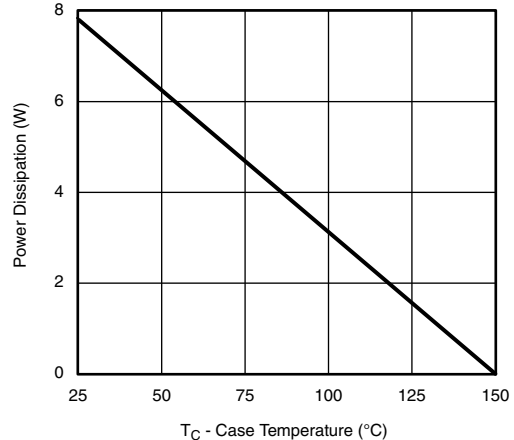
**MOSFET TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



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



**Current Derating<sup>a</sup>**



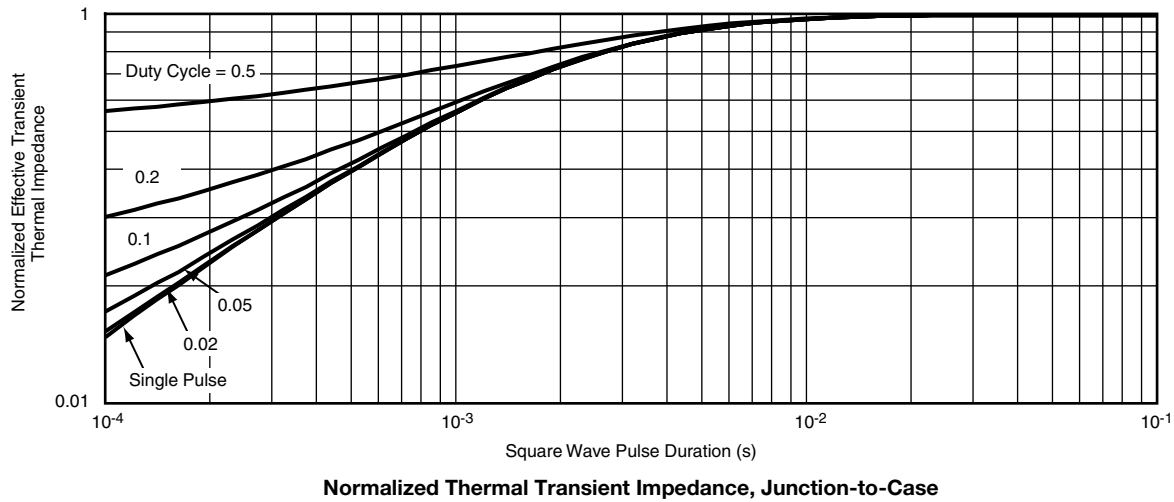
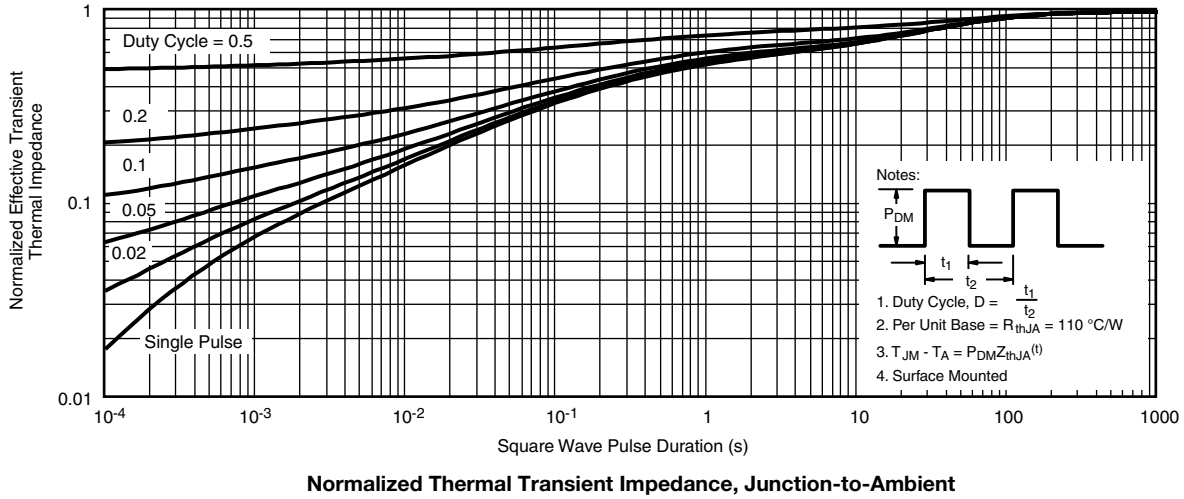
**Power Derating**

**Note**

- a. The power dissipation  $P_D$  is based on  $T_J \text{ max.} = 150\text{ }^\circ\text{C}$ , 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

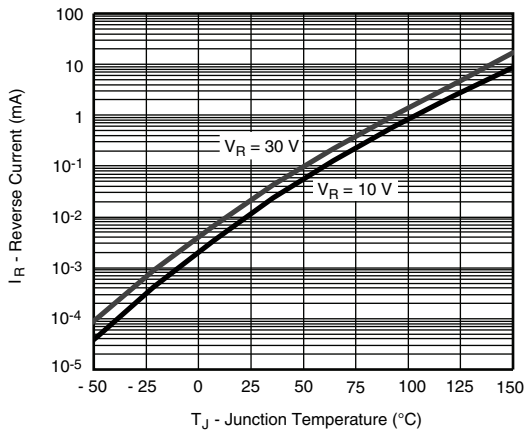


**MOSFET TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)

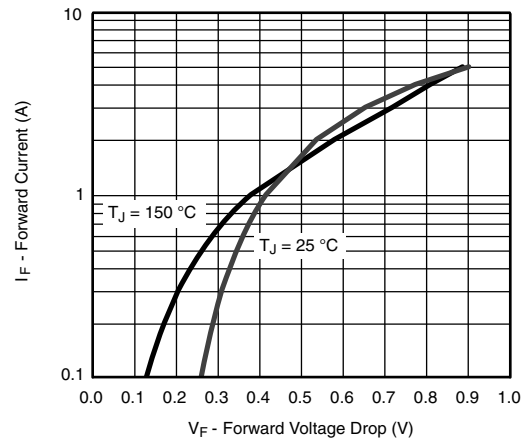




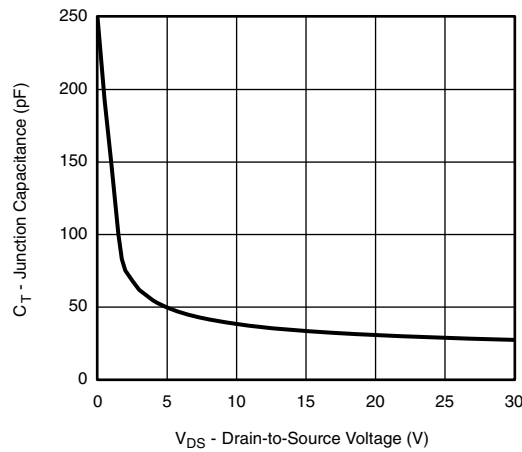
**SCHOTTKY TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



**Reverse Current vs. Junction Temperature**



**Forward Voltage Drop**

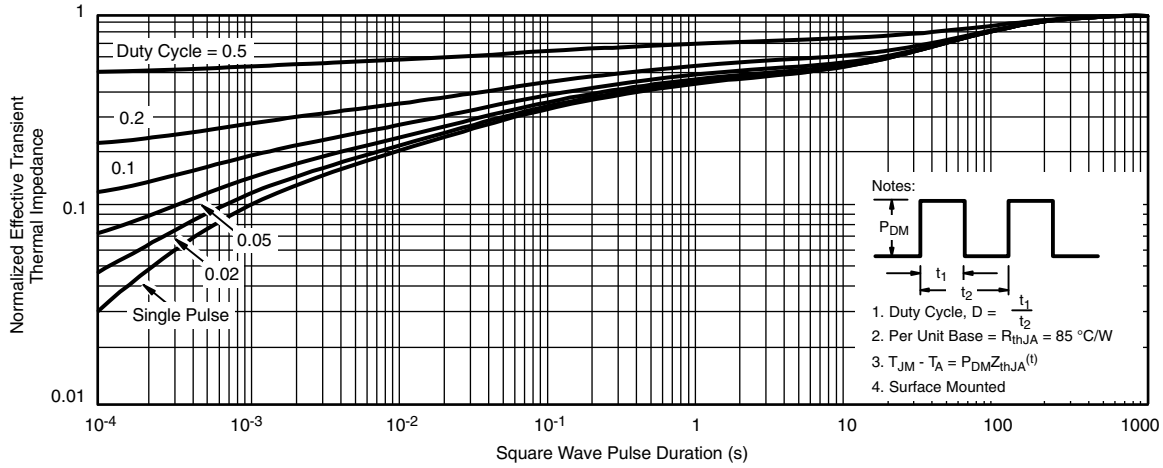


**Capacitance**

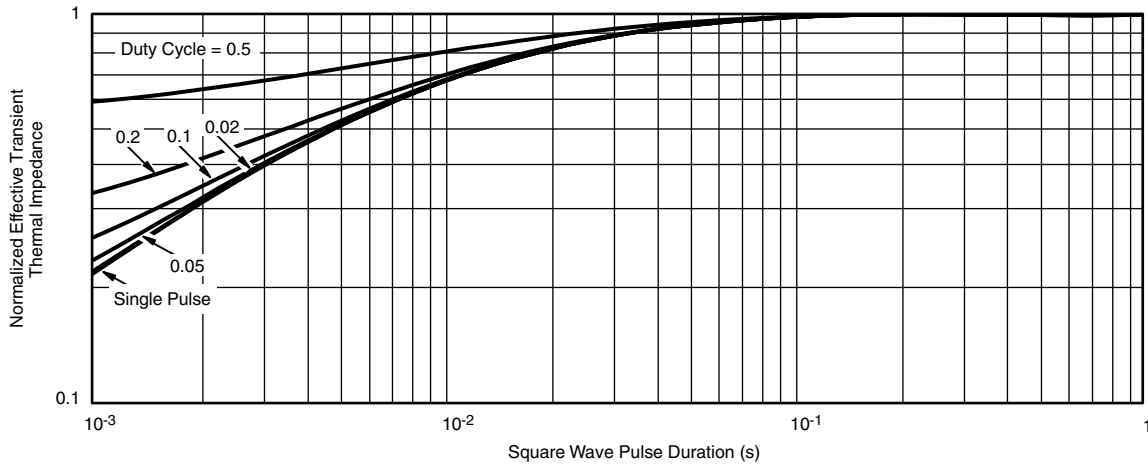




**SCHOTTKY TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



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

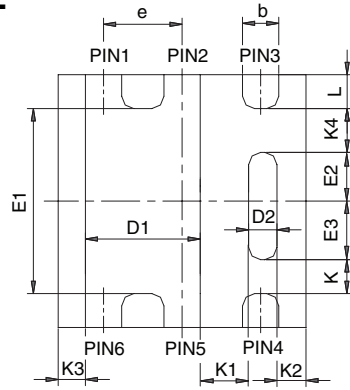


**Normalized Thermal Transient Impedance, Junction-to-Case**

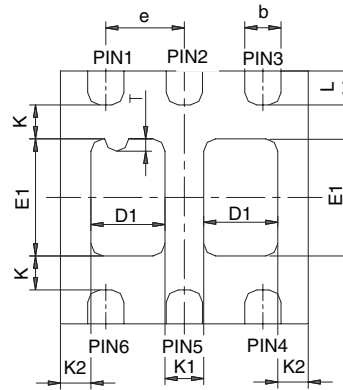
Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package / tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?62820](http://www.vishay.com/ppg?62820).



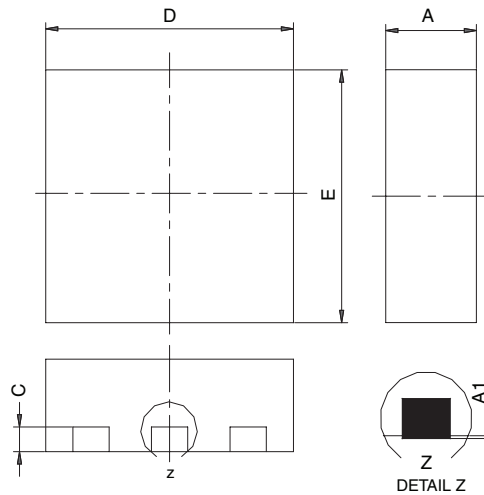
PowerPAK® SC70-6L



BACKSIDE VIEW OF SINGLE



BACKSIDE VIEW OF DUAL

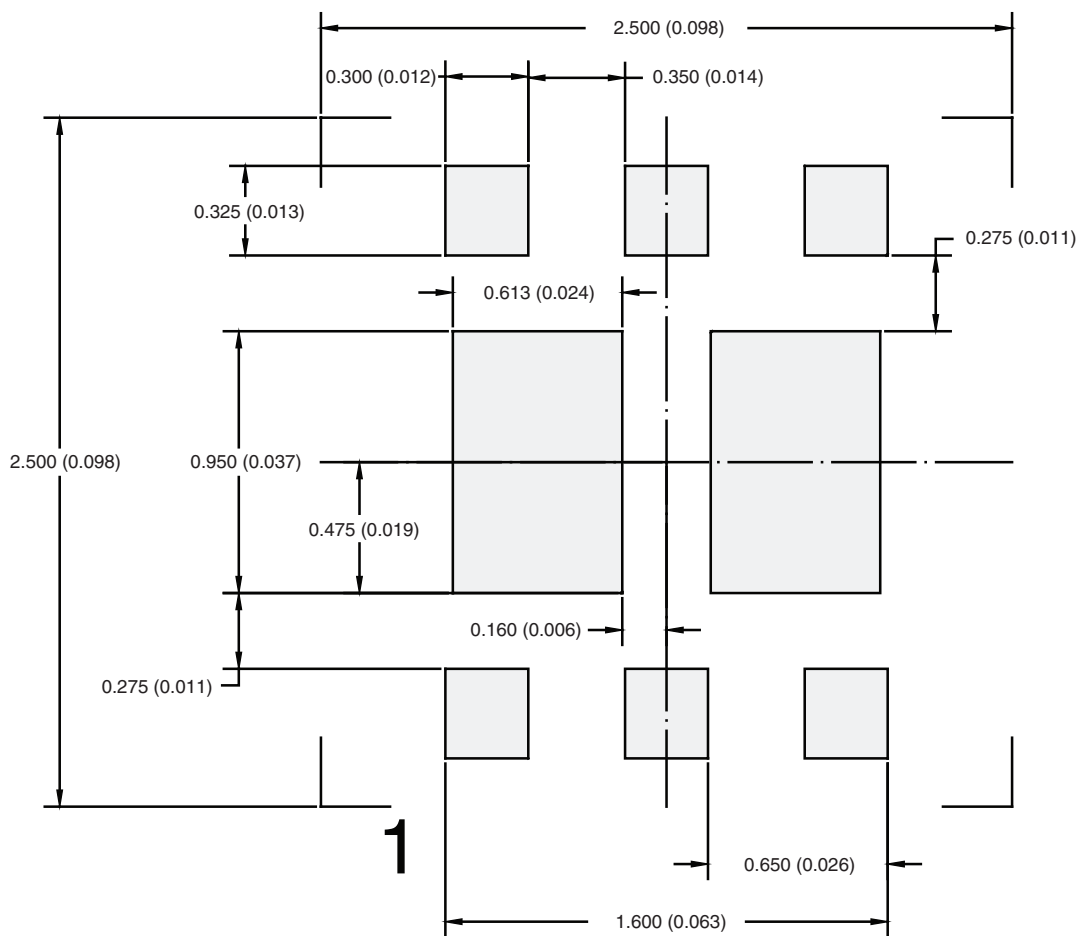


- Notes:  
 1. All dimensions are in millimeters  
 2. Package outline exclusive of mold flash and metal burr  
 3. Package outline inclusive of plating

| DIM | SINGLE PAD  |       |       |           |       |       | DUAL PAD    |       |       |           |       |       |
|-----|-------------|-------|-------|-----------|-------|-------|-------------|-------|-------|-----------|-------|-------|
|     | MILLIMETERS |       |       | INCHES    |       |       | MILLIMETERS |       |       | INCHES    |       |       |
|     | Min         | Nom   | Max   | Min       | Nom   | Max   | Min         | Nom   | Max   | Min       | Nom   | Max   |
| A   | 0.675       | 0.75  | 0.80  | 0.027     | 0.030 | 0.032 | 0.675       | 0.75  | 0.80  | 0.027     | 0.030 | 0.032 |
| A1  | 0           | -     | 0.05  | 0         | -     | 0.002 | 0           | -     | 0.05  | 0         | -     | 0.002 |
| b   | 0.23        | 0.30  | 0.38  | 0.009     | 0.012 | 0.015 | 0.23        | 0.30  | 0.38  | 0.009     | 0.012 | 0.015 |
| C   | 0.15        | 0.20  | 0.25  | 0.006     | 0.008 | 0.010 | 0.15        | 0.20  | 0.25  | 0.006     | 0.008 | 0.010 |
| D   | 1.98        | 2.05  | 2.15  | 0.078     | 0.081 | 0.085 | 1.98        | 2.05  | 2.15  | 0.078     | 0.081 | 0.085 |
| D1  | 0.85        | 0.95  | 1.05  | 0.033     | 0.037 | 0.041 | 0.513       | 0.613 | 0.713 | 0.020     | 0.024 | 0.028 |
| D2  | 0.135       | 0.235 | 0.335 | 0.005     | 0.009 | 0.013 |             |       |       |           |       |       |
| E   | 1.98        | 2.05  | 2.15  | 0.078     | 0.081 | 0.085 | 1.98        | 2.05  | 2.15  | 0.078     | 0.081 | 0.085 |
| E1  | 1.40        | 1.50  | 1.60  | 0.055     | 0.059 | 0.063 | 0.85        | 0.95  | 1.05  | 0.033     | 0.037 | 0.041 |
| E2  | 0.345       | 0.395 | 0.445 | 0.014     | 0.016 | 0.018 |             |       |       |           |       |       |
| E3  | 0.425       | 0.475 | 0.525 | 0.017     | 0.019 | 0.021 |             |       |       |           |       |       |
| e   | 0.65 BSC    |       |       | 0.026 BSC |       |       | 0.65 BSC    |       |       | 0.026 BSC |       |       |
| K   | 0.275 TYP   |       |       | 0.011 TYP |       |       | 0.275 TYP   |       |       | 0.011 TYP |       |       |
| K1  | 0.400 TYP   |       |       | 0.016 TYP |       |       | 0.320 TYP   |       |       | 0.013 TYP |       |       |
| K2  | 0.240 TYP   |       |       | 0.009 TYP |       |       | 0.252 TYP   |       |       | 0.010 TYP |       |       |
| K3  | 0.225 TYP   |       |       | 0.009 TYP |       |       |             |       |       |           |       |       |
| K4  | 0.355 TYP   |       |       | 0.014 TYP |       |       |             |       |       |           |       |       |
| L   | 0.175       | 0.275 | 0.375 | 0.007     | 0.011 | 0.015 | 0.175       | 0.275 | 0.375 | 0.007     | 0.011 | 0.015 |
| T   |             |       |       |           |       |       | 0.05        | 0.10  | 0.15  | 0.002     | 0.004 | 0.006 |

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## RECOMMENDED PAD LAYOUT FOR PowerPAK® SC70-6L Dual



Dimensions in mm (inches)

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APPLICATION NOTE



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