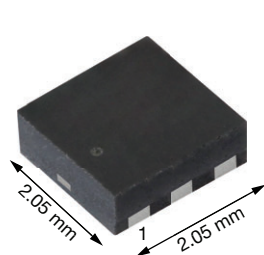
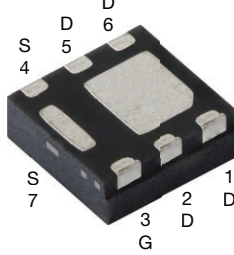


# Automotive P-Channel 20 V (D-S) 175 °C MOSFET

**PowerPAK® SC-70W-6L Single**


Top View



Bottom View

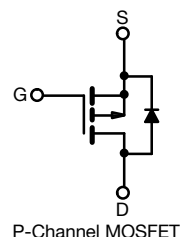
**Marking Code:** Q5XXXX

## PRODUCT SUMMARY

|                                                |        |
|------------------------------------------------|--------|
| $V_{DS}$ (V)                                   | -20    |
| $R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -4.5$ V | 0.0380 |
| $R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -2.5$ V | 0.0624 |
| $I_D$ (A)                                      | -7.5   |
| Configuration                                  | Single |

## FEATURES

- TrenchFET® power MOSFET
- AEC-Q101 qualified
- Wettable flank terminals
- 100 %  $R_g$  and UIS tested
- Material categorization:  
for definitions of compliance please see  
[www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


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


P-Channel MOSFET

## ORDERING INFORMATION

|                                 |                                                                                                                              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Package                         | PowerPAK SC-70W-6L                                                                                                           |
| Lead (Pb)-free and halogen-free | SQA413CEJW<br>(for detailed order number please see <a href="http://www.vishay.com/doc?79776">www.vishay.com/doc?79776</a> ) |

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

| PARAMETER                                                    | SYMBOL         | LIMIT          | UNIT |
|--------------------------------------------------------------|----------------|----------------|------|
| Drain-source voltage                                         | $V_{DS}$       | -20            | V    |
| Gate-source voltage <sup>f</sup>                             | $V_{GS}$       | $\pm 12$       |      |
| Continuous drain current <sup>a</sup>                        | $I_D$          | $T_C = 25$ °C  | -7.5 |
|                                                              |                | $T_C = 125$ °C | -7.5 |
| Continuous source current (diode conduction) <sup>a</sup>    | $I_S$          | -7.5           | A    |
| Pulsed drain current <sup>b</sup>                            | $I_{DM}$       | -30            |      |
| Single pulse avalanche current                               | $I_{AS}$       | -11            |      |
| Single pulse avalanche energy                                | $E_{AS}$       | 6.05           | mJ   |
| Maximum power dissipation                                    | $P_D$          | $T_C = 25$ °C  | 13.6 |
|                                                              |                | $T_C = 125$ °C | 4.5  |
| Operating junction and storage temperature range             | $T_J, T_{stg}$ | -55 to +175    | °C   |
| Soldering recommendations (peak temperature) <sup>d, e</sup> |                | 260            |      |

## THERMAL RESISTANCE RATINGS

| PARAMETER                | SYMBOL     | LIMIT | UNIT |
|--------------------------|------------|-------|------|
| Junction-to-ambient      | $R_{thJA}$ | 90    | °C/W |
| Junction-to-case (drain) | $R_{thJF}$ | 11    |      |

### Notes

- Package limited
- Pulse test; pulse width  $\leq 300$   $\mu$ s, duty cycle  $\leq 2$  %
- When mounted on 1" square PCB (FR4 material)
- See solder profile ([www.vishay.com/doc?73257](http://www.vishay.com/doc?73257)). The PowerPAK SC-70W-6L is a leadless package and features wettable flank terminals. The end of the lead terminal is plated with tin
- Rework conditions: manual soldering with a soldering iron is not recommended for leadless components
- Not intended for continuous use with positive gate voltage  $> 3.0$  V



| SPECIFICATIONS (T <sub>C</sub> = 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, I <sub>D</sub> = -250 μA                                                                             |                                                  | -20  | -      | -      | V    |
| 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 | -1.0   | -1.3   |      |
| Gate-source leakage                                             | I <sub>GSS</sub>     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 12 V                                                                           |                                                  | -    | -      | ± 100  | nA   |
| Zero gate voltage drain current                                 | I <sub>DSS</sub>     | V <sub>GS</sub> = 0 V                                                                                                     | V <sub>DS</sub> = -20 V                          | -    | -      | -1     | μA   |
|                                                                 |                      | V <sub>GS</sub> = 0 V                                                                                                     | V <sub>DS</sub> = -20 V, T <sub>J</sub> = 125 °C | -    | -      | -50    |      |
|                                                                 |                      | V <sub>GS</sub> = 0 V                                                                                                     | V <sub>DS</sub> = -20 V, T <sub>J</sub> = 175 °C | -    | -      | -150   |      |
| On-state drain current <sup>a</sup>                             | I <sub>D(on)</sub>   | V <sub>GS</sub> = -4.5 V                                                                                                  | V <sub>DS</sub> ≥ 5 V                            | -7.5 | -      | -      | A    |
| Drain-source on-state resistance <sup>a</sup>                   | R <sub>DS(on)</sub>  | V <sub>GS</sub> = -4.5 V                                                                                                  | I <sub>D</sub> = -4.5 A                          | -    | 0.0308 | 0.0380 | Ω    |
|                                                                 |                      | V <sub>GS</sub> = -4.5 V                                                                                                  | I <sub>D</sub> = -4.5 A, T <sub>J</sub> = 125 °C | -    | -      | 0.0518 |      |
|                                                                 |                      | V <sub>GS</sub> = -4.5 V                                                                                                  | I <sub>D</sub> = -4.5 A, T <sub>J</sub> = 175 °C | -    | -      | 0.0586 |      |
|                                                                 |                      | V <sub>GS</sub> = -2.5 V                                                                                                  | I <sub>D</sub> = -3 A                            | -    | 0.0506 | 0.0624 |      |
| Forward transconductance <sup>b</sup>                           | g <sub>fs</sub>      | V <sub>DS</sub> = -10 V, I <sub>D</sub> = -4 A                                                                            |                                                  | -    | 14     | -      | S    |
| Dynamic <sup>b</sup>                                            |                      |                                                                                                                           |                                                  |      |        |        |      |
| Input capacitance                                               | C <sub>iss</sub>     | V <sub>GS</sub> = 0 V                                                                                                     | V <sub>DS</sub> = -10 V, f = 1 MHz               | -    | 938    | 1350   | pF   |
| Output capacitance                                              | C <sub>oss</sub>     |                                                                                                                           |                                                  | -    | 155    | 225    |      |
| Reverse transfer capacitance                                    | C <sub>rss</sub>     |                                                                                                                           |                                                  | -    | 133    | 190    |      |
| Total gate charge <sup>c</sup>                                  | Q <sub>g</sub>       | V <sub>GS</sub> = -4.5 V                                                                                                  | V <sub>DS</sub> = -10 V, I <sub>D</sub> = -8 A   | -    | 10.1   | 16     | nC   |
| Gate-source charge <sup>c</sup>                                 | Q <sub>gs</sub>      |                                                                                                                           |                                                  | -    | 2.4    | -      |      |
| Gate-drain charge <sup>c</sup>                                  | Q <sub>gd</sub>      |                                                                                                                           |                                                  | -    | 3.0    | -      |      |
| Gate resistance                                                 | R <sub>g</sub>       | f = 1 MHz                                                                                                                 |                                                  | 1.6  | 3.2    | 4.8    | Ω    |
| Turn-on delay time <sup>c</sup>                                 | t <sub>d(on)</sub>   | V <sub>DD</sub> = -10 V, R <sub>L</sub> = 4 Ω<br>I <sub>D</sub> ≡ -2.5 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω |                                                  | -    | 13     | 20     | ns   |
| Rise time <sup>c</sup>                                          | t <sub>r</sub>       |                                                                                                                           |                                                  | -    | 19     | 29     |      |
| Turn-off delay time <sup>c</sup>                                | t <sub>d(off)</sub>  |                                                                                                                           |                                                  | -    | 24     | 36     |      |
| Fall time <sup>c</sup>                                          | t <sub>f</sub>       |                                                                                                                           |                                                  | -    | 7      | 12     |      |
| Source-Drain Diode Ratings and Characteristics                  |                      |                                                                                                                           |                                                  |      |        |        |      |
| Pulsed current <sup>a</sup>                                     | I <sub>SM</sub>      |                                                                                                                           |                                                  | -    | -      | -30    | A    |
| Forward voltage                                                 | V <sub>SD</sub>      | I <sub>F</sub> = -4.5 A, V <sub>GS</sub> = 0                                                                              |                                                  | -    | -0.83  | -1.2   | V    |
| Body diode reverse recovery time                                | t <sub>rr</sub>      | I <sub>F</sub> = -2 A, di/dt = 100 A/μs                                                                                   |                                                  | -    | 10     | 20     | ns   |
| Body diode reverse recovery charge                              | Q <sub>rr</sub>      |                                                                                                                           |                                                  | -    | 4      | 8      | nC   |
| Reverse recovery fall time                                      | t <sub>a</sub>       |                                                                                                                           |                                                  | -    | 5      | -      | ns   |
| Reverse recovery rise time                                      | t <sub>b</sub>       |                                                                                                                           |                                                  | -    | 5      | -      |      |
| Body diode peak reverse recovery current                        | I <sub>RM(REC)</sub> |                                                                                                                           |                                                  | -    | -0.7   | -      | A    |

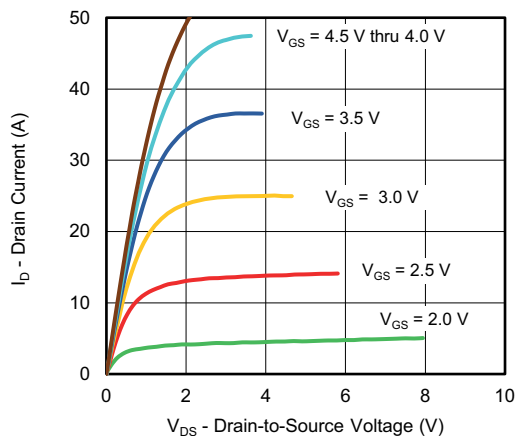
**Notes**

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

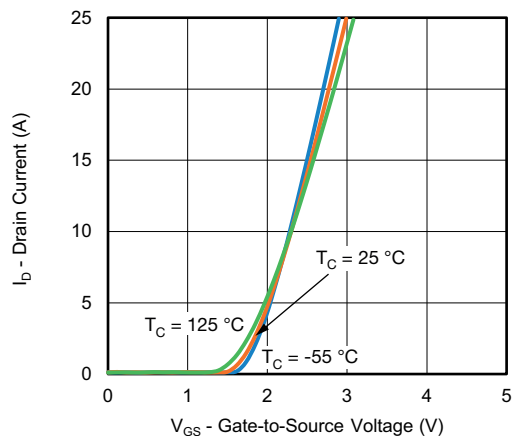
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



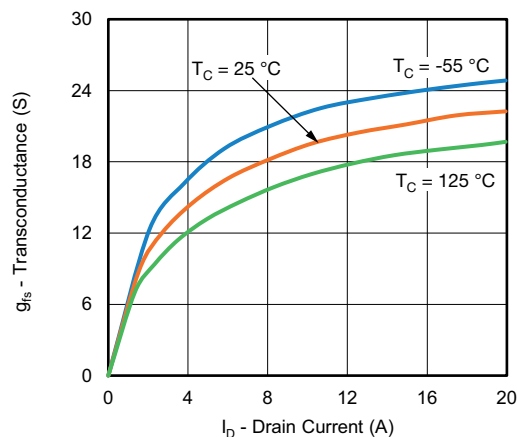
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



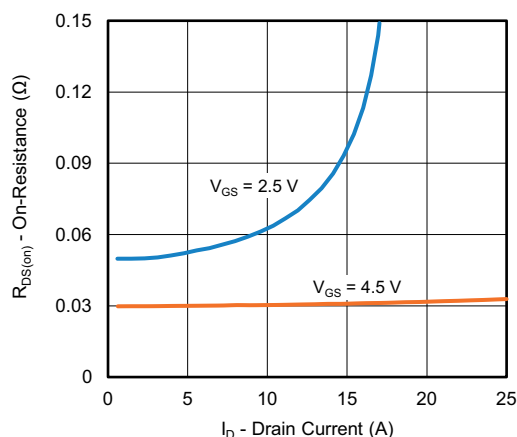
**Output Characteristics**



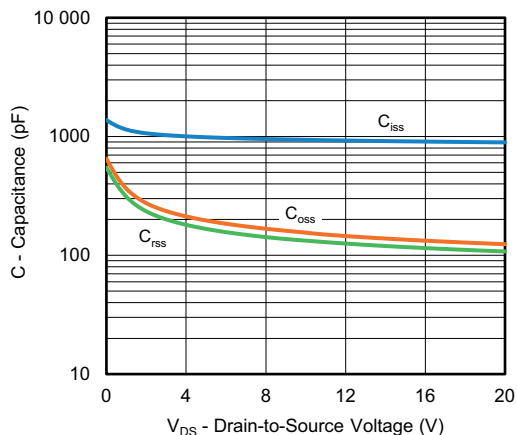
**Transfer Characteristics**



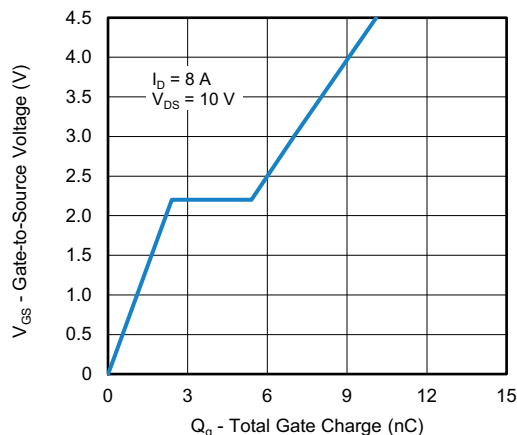
**Transconductance**



**On-Resistance vs. Drain Current**



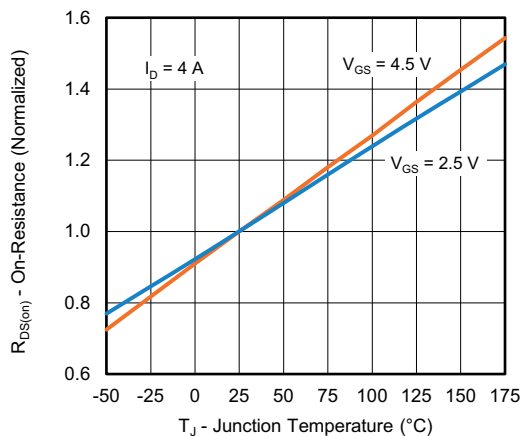
**Capacitance**



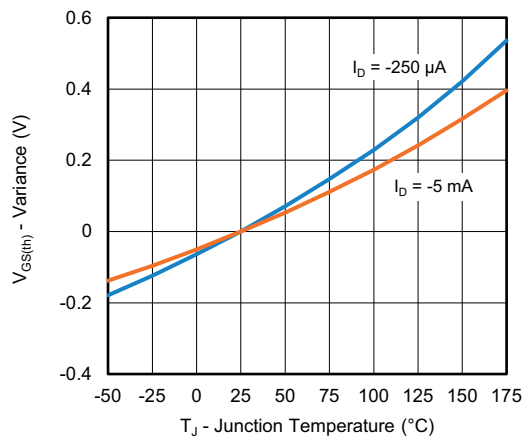
**Gate Charge**



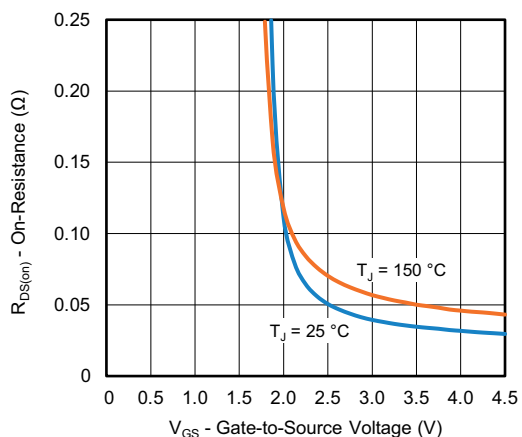
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



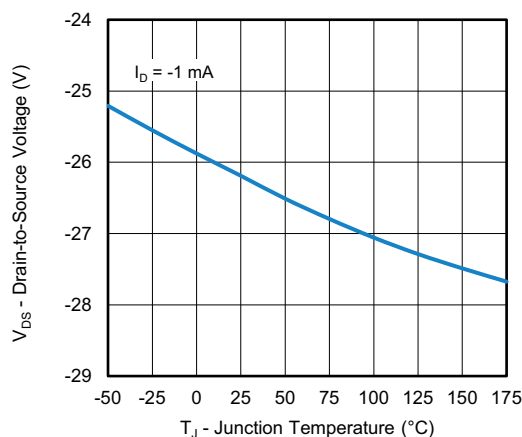
**On-Resistance vs. Junction Temperature**



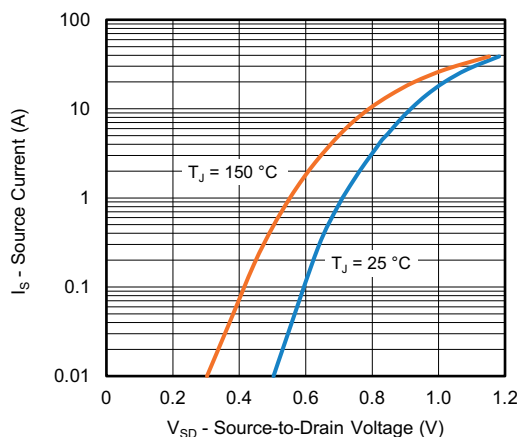
**Threshold Voltage**



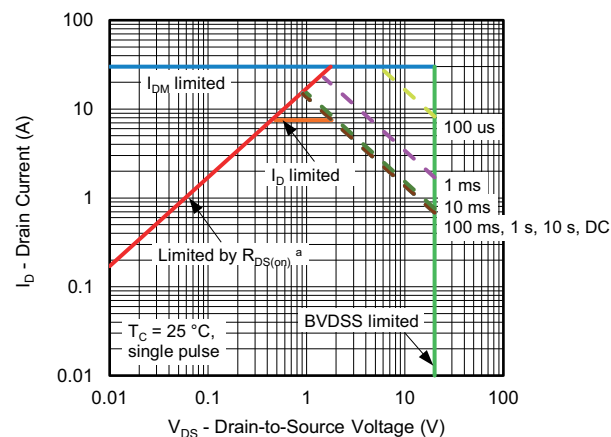
**On-Resistance vs. Gate-to-Source Voltage**



**Drain Source Breakdown vs. Junction Temperature**



**Source-Drain Diode Forward Voltage**



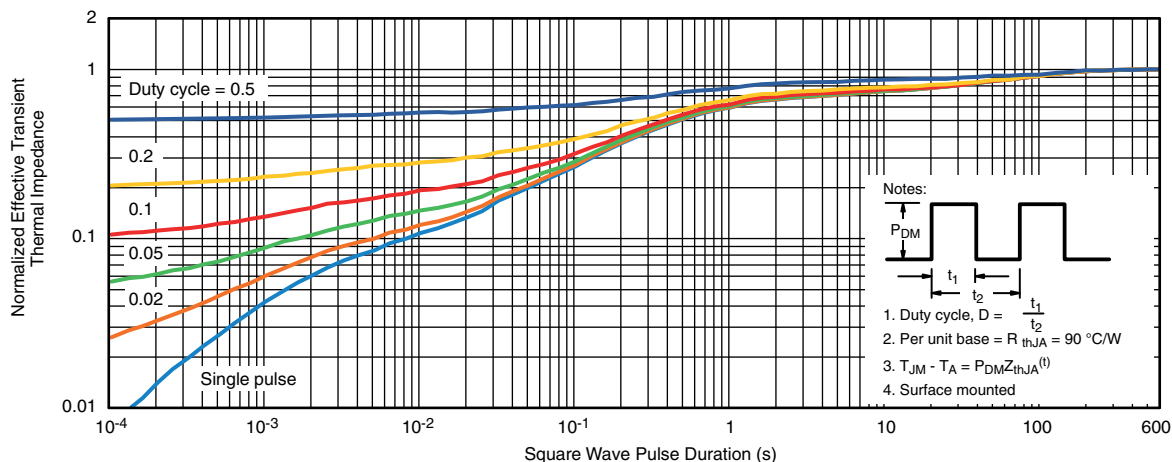
**Safe Operating Area**

**Note**

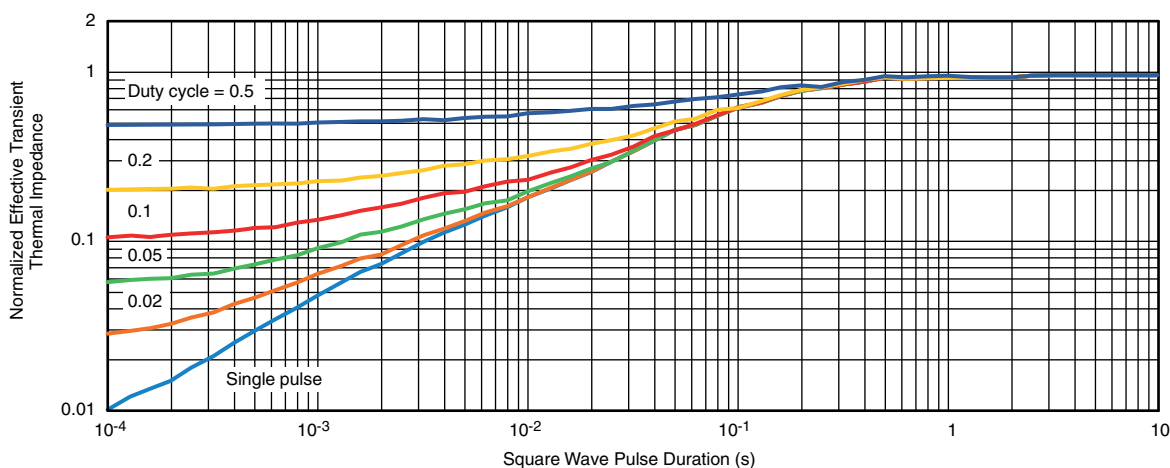
a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified



**THERMAL RATINGS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



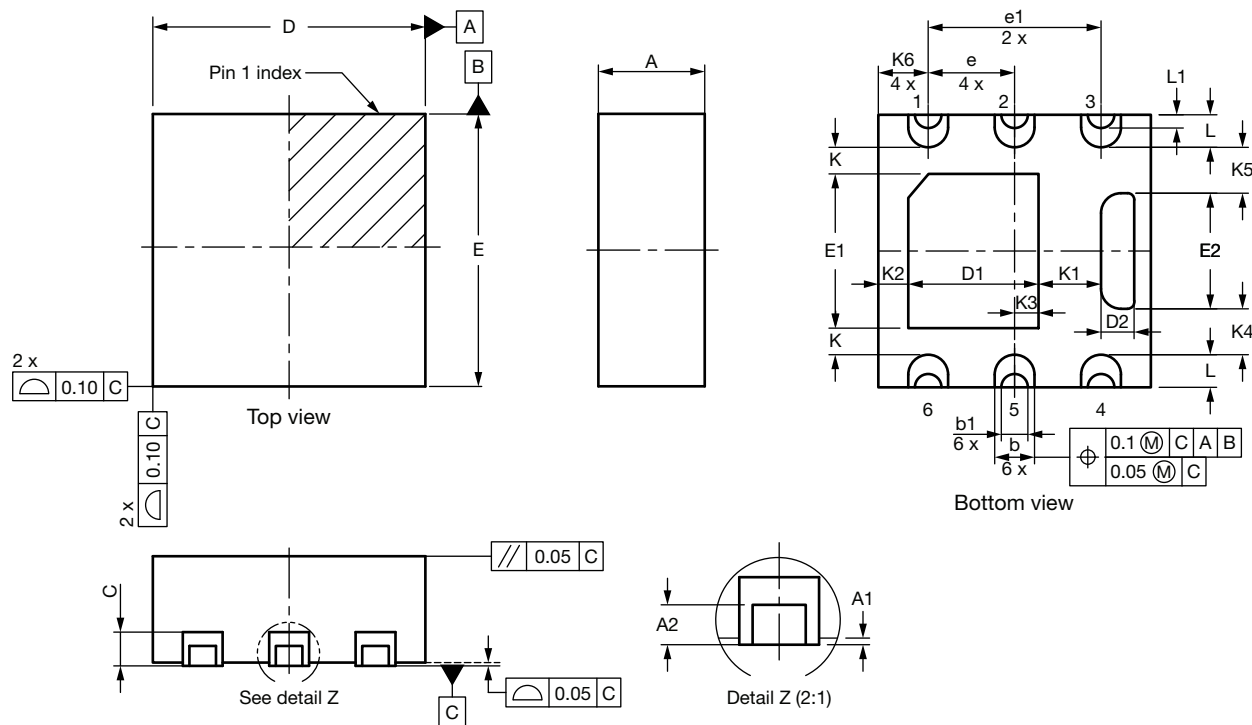
**Normalized Thermal Transient Impedance, Junction-to-Ambient**



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

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## PowerPAK® SC70W-6L SIDEWETTABLE



| DIM. | MILLIMETERS |      |      | INCHES     |       |       |
|------|-------------|------|------|------------|-------|-------|
|      | MIN.        | NOM. | MAX. | MIN.       | NOM.  | MAX.  |
| A    | 0.70        | 0.80 | 0.90 | 0.027      | 0.031 | 0.035 |
| A1   | 0.00        | 0.02 | 0.05 | 0.000      | 0.001 | 0.002 |
| A2   | 0.10        | -    | -    | 0.004      | -     | -     |
| b    | 0.25        | 0.30 | 0.35 | 0.010      | 0.012 | 0.014 |
| b1   | 0.15        | 0.20 | 0.23 | 0.006      | 0.008 | 0.009 |
| C    | 0.20        | 0.25 | 0.30 | 0.008      | 0.010 | 0.012 |
| D    | 1.95        | 2.05 | 2.15 | 0.077      | 0.081 | 0.085 |
| D1   | 0.88        | 0.98 | 1.08 | 0.035      | 0.039 | 0.043 |
| D2   | 0.20        | 0.25 | 0.30 | 0.008      | 0.010 | 0.012 |
| E    | 1.95        | 2.05 | 2.15 | 0.077      | 0.081 | 0.085 |
| E1   | 1.06        | 1.16 | 1.26 | 0.042      | 0.046 | 0.050 |
| E2   | 0.82        | 0.87 | 0.92 | 0.032      | 0.034 | 0.036 |
| e    | 0.65 BSC    |      |      | 0.026 BSC  |       |       |
| e1   | 1.30 BSC    |      |      | 0.051 BSC  |       |       |
| K    | 0.20 typ.   |      |      | 0.008 typ. |       |       |
| K1   | 0.47 typ.   |      |      | 0.019 typ. |       |       |
| K2   | 0.23 typ.   |      |      | 0.009 typ. |       |       |
| K3   | 0.18 typ.   |      |      | 0.007 typ. |       |       |
| K4   | 0.35 typ.   |      |      | 0.014 typ. |       |       |
| K5   | 0.35 typ.   |      |      | 0.014 typ. |       |       |
| K6   | 0.38 typ.   |      |      | 0.015 typ. |       |       |
| L    | 0.15        | 0.25 | 0.35 | 0.006      | 0.010 | 0.014 |
| L1   | -           | 0.10 | -    | -          | 0.004 | -     |

ECN: C19-1644-Rev. A, 10-Jan-2020  
DWG: 6076

### Notes

- Package outline exclusive of mold flash and metal burr
- Package outline inclusive of plating



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