

# C3D04065E

## 650 V, 4 A Silicon Carbide Schottky Diode

### Features

- 650-Volt Schottky rectifier
- Optimized for PFC boost diode application
- Zero reverse recovery current
- Zero forward recovery voltage
- High-frequency operation
- Temperature-independent switching behavior
- Extremely fast switching
- Positive temperature coefficient on  $V_f$



TO-252-2



Package Types: TO-252-2

Marking: C3D04065

Wolfspeed, Inc. is in the process of rebranding its products and related materials pursuant to the entity name change from Cree, Inc. to Wolfspeed, Inc. During this transition period, products received may be marked with either the Cree name and/or logo or the Wolfspeed name and/or logo.

### Applications

- Switch mode power supplies (SMPS)
- Boost diodes in PFC or DC/DC stages
- Free wheeling diodes in inverter stages
- AC/DC converters

### Benefits

- Replace bipolar with unipolar rectifiers
- Essentially no switching losses
- Higher efficiency
- Reduction of heat sink requirements
- Parallel devices without thermal runaway

### Maximum Ratings ( $T_c = 25^\circ\text{C}$ Unless Otherwise Specified)

| Parameter                                  | Symbol         | Value       | Unit                 | Test Conditions                                                   | Note   |
|--------------------------------------------|----------------|-------------|----------------------|-------------------------------------------------------------------|--------|
| Repetitive Peak Reverse Voltage            | $V_{RRM}$      | 650         | V                    |                                                                   |        |
| Surge Peak Reverse Voltage                 | $V_{RSM}$      | 650         |                      |                                                                   |        |
| DC Blocking Voltage                        | $V_{DC}$       | 650         |                      |                                                                   |        |
| Continuous Forward Current                 | $I_F$          | 13.5        | A                    | $T_c = 25^\circ\text{C}$                                          | Fig. 3 |
|                                            |                | 6           |                      | $T_c = 135^\circ\text{C}$                                         |        |
|                                            |                | 4           |                      | $T_c = 155^\circ\text{C}$                                         |        |
| Repetitive Peak Forward Surge Current      | $I_{FRM}$      | 17          |                      | $T_c = 25^\circ\text{C}$ , $t_p = 10\text{ ms}$ , Half Sine Wave  |        |
|                                            |                | 12          |                      | $T_c = 110^\circ\text{C}$ , $t_p = 10\text{ ms}$ , Half Sine Wave |        |
| Non-Repetitive Peak Forward Surge Current  | $I_{FSM}$      | 25          |                      | $T_c = 25^\circ\text{C}$ , $t_p = 10\text{ ms}$ , Half Sine Wave  | Fig. 8 |
|                                            |                | 19          |                      | $T_c = 110^\circ\text{C}$ , $t_p = 10\text{ ms}$ , Half Sine Wave |        |
| Non-Repetitive Peak Forward Surge Current  | $I_{F,Max}$    | 220         |                      | $T_c = 25^\circ\text{C}$ , $t_p = 10\text{ }\mu\text{s}$ , Pulse  | Fig. 8 |
|                                            |                | 160         |                      | $T_c = 110^\circ\text{C}$ , $t_p = 10\text{ }\mu\text{s}$ , Pulse |        |
| Power Dissipation                          | $P_{tot}$      | 52          | W                    | $T_c = 25^\circ\text{C}$                                          | Fig. 4 |
|                                            |                | 22.5        |                      | $T_c = 110^\circ\text{C}$                                         |        |
| Diode $dV/dt$ Ruggedness                   | $dV/dt$        | 200         | V/ns                 | $V_R = 0-650\text{ V}$                                            |        |
| $i^2t$ Value                               | $\int i^2 dt$  | 3.1         | $\text{A}^2\text{s}$ | $T_c = 25^\circ\text{C}$ , $t_p = 10\text{ ms}$                   |        |
|                                            |                | 1.8         |                      | $T_c = 110^\circ\text{C}$ , $t_p = 10\text{ ms}$                  |        |
| Operating Junction and Storage Temperature | $T_J, T_{stg}$ | -55 to +175 | $^\circ\text{C}$     |                                                                   |        |



## Electrical Characteristics

| Parameter                 | Symbol | Typ. | Max. | Unit          | Test Conditions                                                                                                | Note   |
|---------------------------|--------|------|------|---------------|----------------------------------------------------------------------------------------------------------------|--------|
| Forward Voltage           | $V_F$  | 1.4  | 1.7  | V             | $I_F = 4 \text{ A}$ , $T_J = 25^\circ\text{C}$                                                                 | Fig. 1 |
|                           |        | 1.7  | 2.4  |               | $I_F = 4 \text{ A}$ , $T_J = 175^\circ\text{C}$                                                                |        |
| Reverse Current           | $I_R$  | 6    | 30   | $\mu\text{A}$ | $V_R = 650 \text{ V}$ , $T_J = 25^\circ\text{C}$                                                               | Fig. 2 |
|                           |        | 12   | 120  |               | $V_R = 650 \text{ V}$ , $T_J = 175^\circ\text{C}$                                                              |        |
| Total Capacitive Charge   | $Q_C$  | 10   |      | nC            | $V_R = 400 \text{ V}$ , $I_F = 4 \text{ A}$<br>$di/dt = 500 \text{ A}/\mu\text{S}$<br>$T_J = 25^\circ\text{C}$ | Fig. 5 |
| Total Capacitance         | C      | 231  |      | pF            | $V_R = 0 \text{ V}$ , $T_J = 25^\circ\text{C}$ , $f = 1 \text{ MHz}$                                           | Fig. 6 |
|                           |        | 18.5 |      |               | $V_R = 200 \text{ V}$ , $T_J = 25^\circ\text{C}$ , $f = 1 \text{ MHz}$                                         |        |
|                           |        | 15   |      |               | $V_R = 400 \text{ V}$ , $T_J = 25^\circ\text{C}$ , $f = 1 \text{ MHz}$                                         |        |
| Capacitance Stored Energy | $E_C$  | 1.4  |      | $\mu\text{J}$ | $V_R = 400 \text{ V}$                                                                                          | Fig. 7 |

Note: This is a majority carrier diode, so there is no reverse recovery charge.

## Thermal Characteristics

| Parameter                                | Symbol          | Typ. | Unit                      | Note   |
|------------------------------------------|-----------------|------|---------------------------|--------|
| Thermal Resistance from Junction to Case | $R_{\theta JC}$ | 2.9  | $^\circ\text{C}/\text{W}$ | Fig. 9 |

## Typical Performance

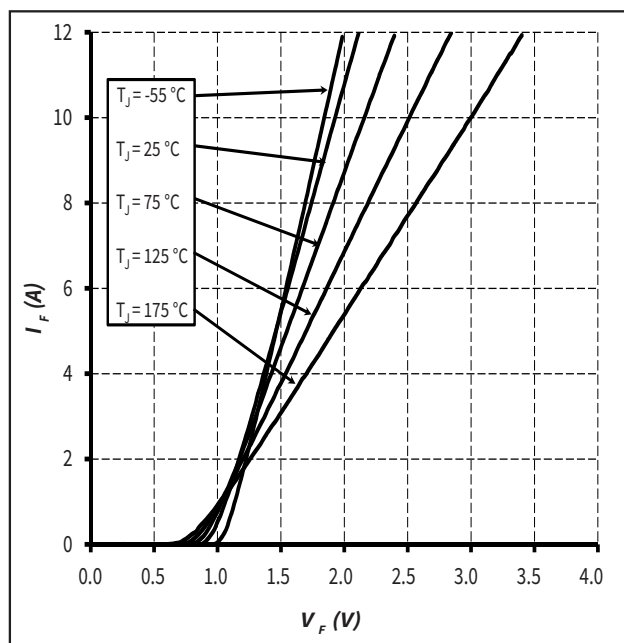


Figure 1. Forward Characteristics

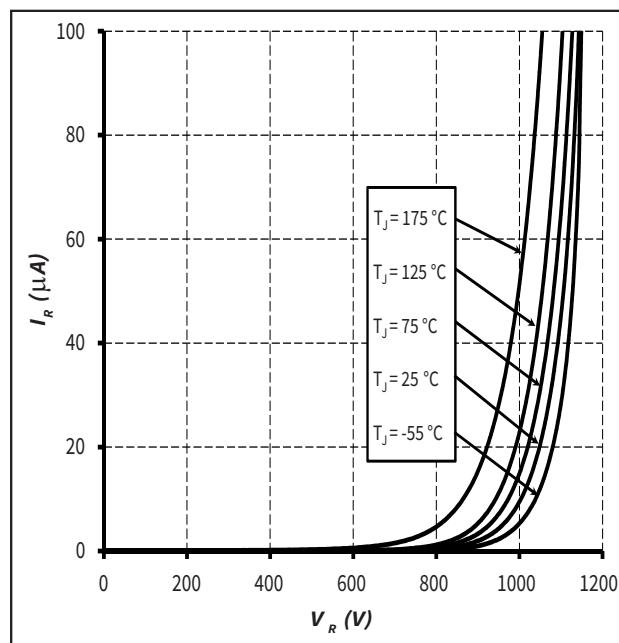


Figure 2. Reverse Characteristics



Typical Performance

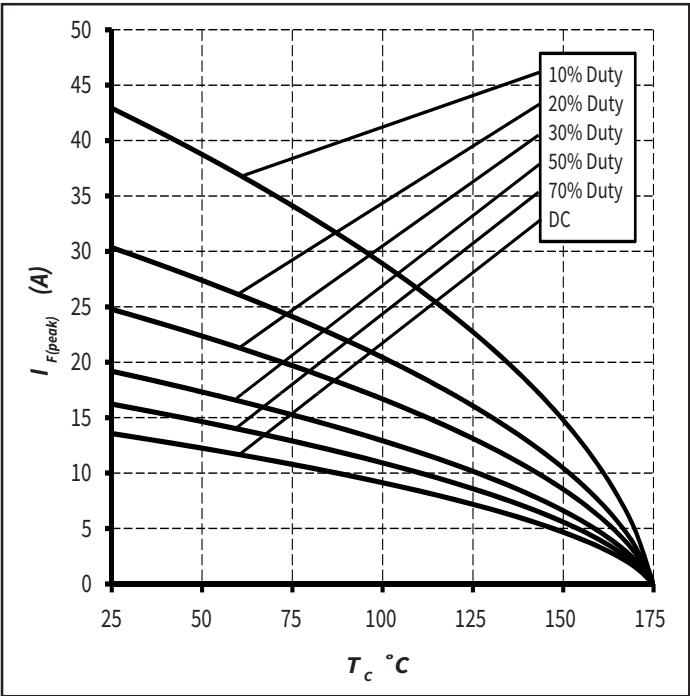


Figure 3. Current Derating

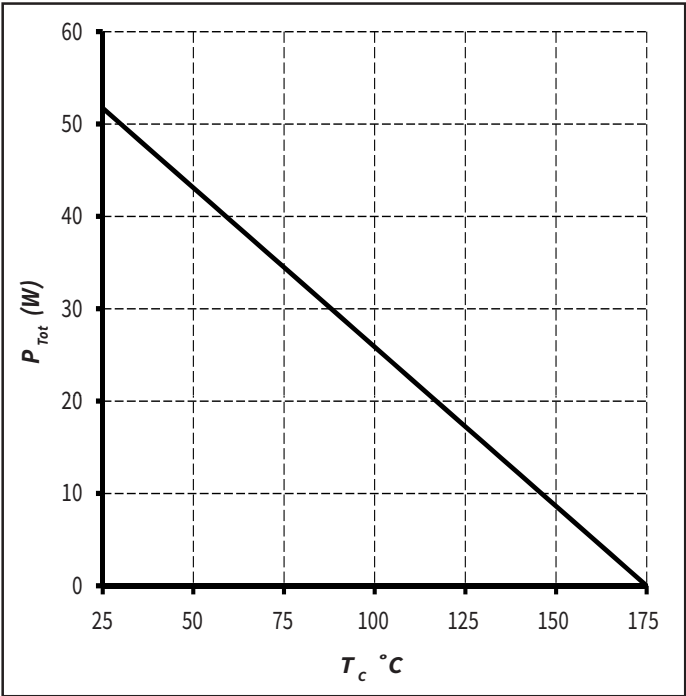


Figure 4. Power Derating

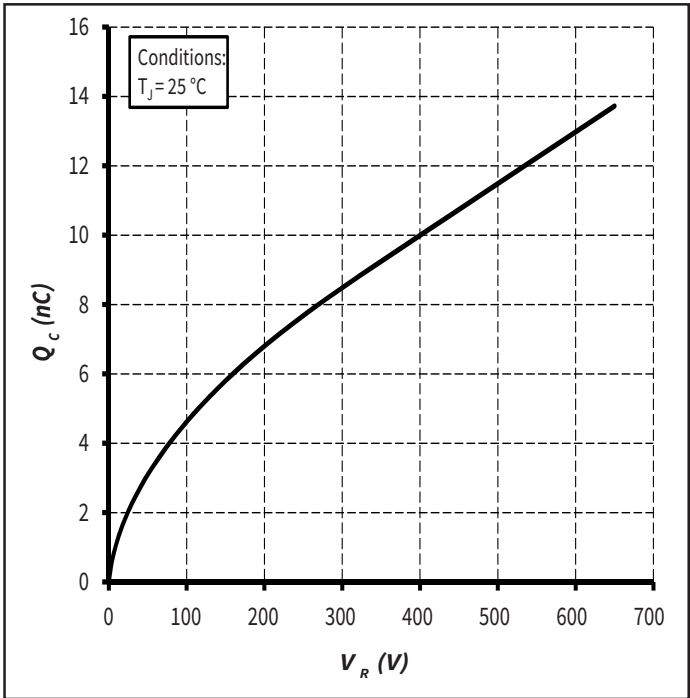


Figure 5. Total Capacitance Charge vs. Reverse Voltage

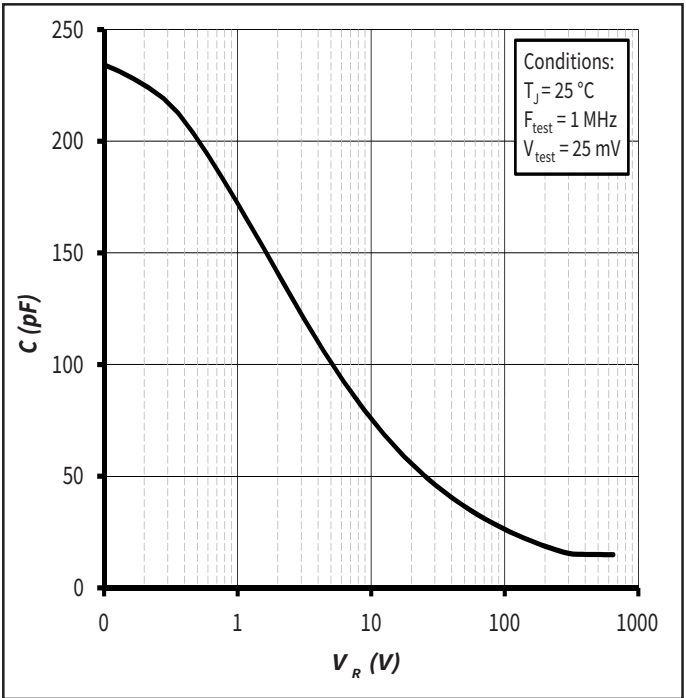


Figure 6. Capacitance vs. Reverse Voltage



Typical Performance

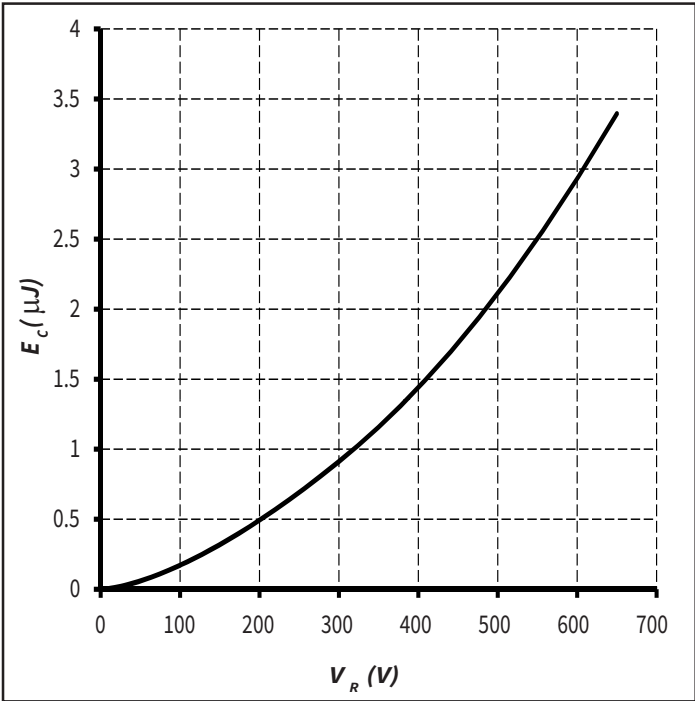


Figure 7. Capacitance Stored Energy

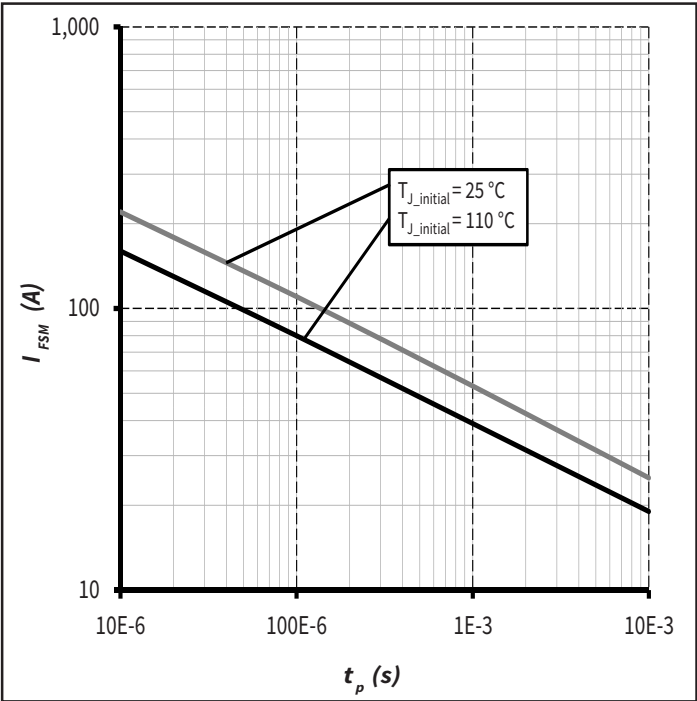


Figure 8. Non-Repetitive Peak Forward Surge Current Versus Pulse Duration (Sinusoidal Waveform)

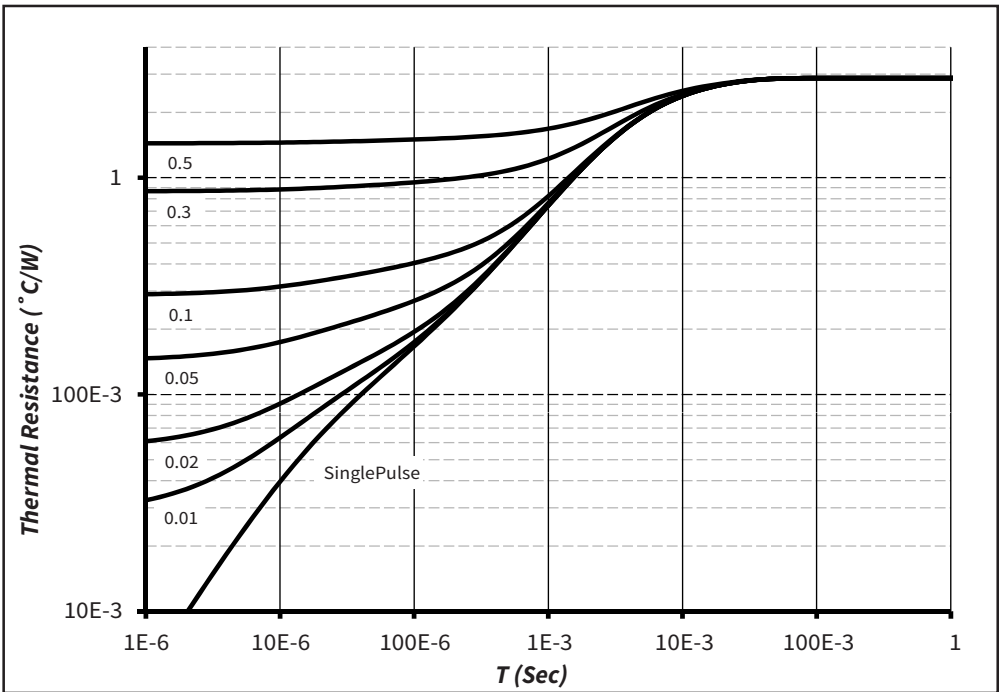
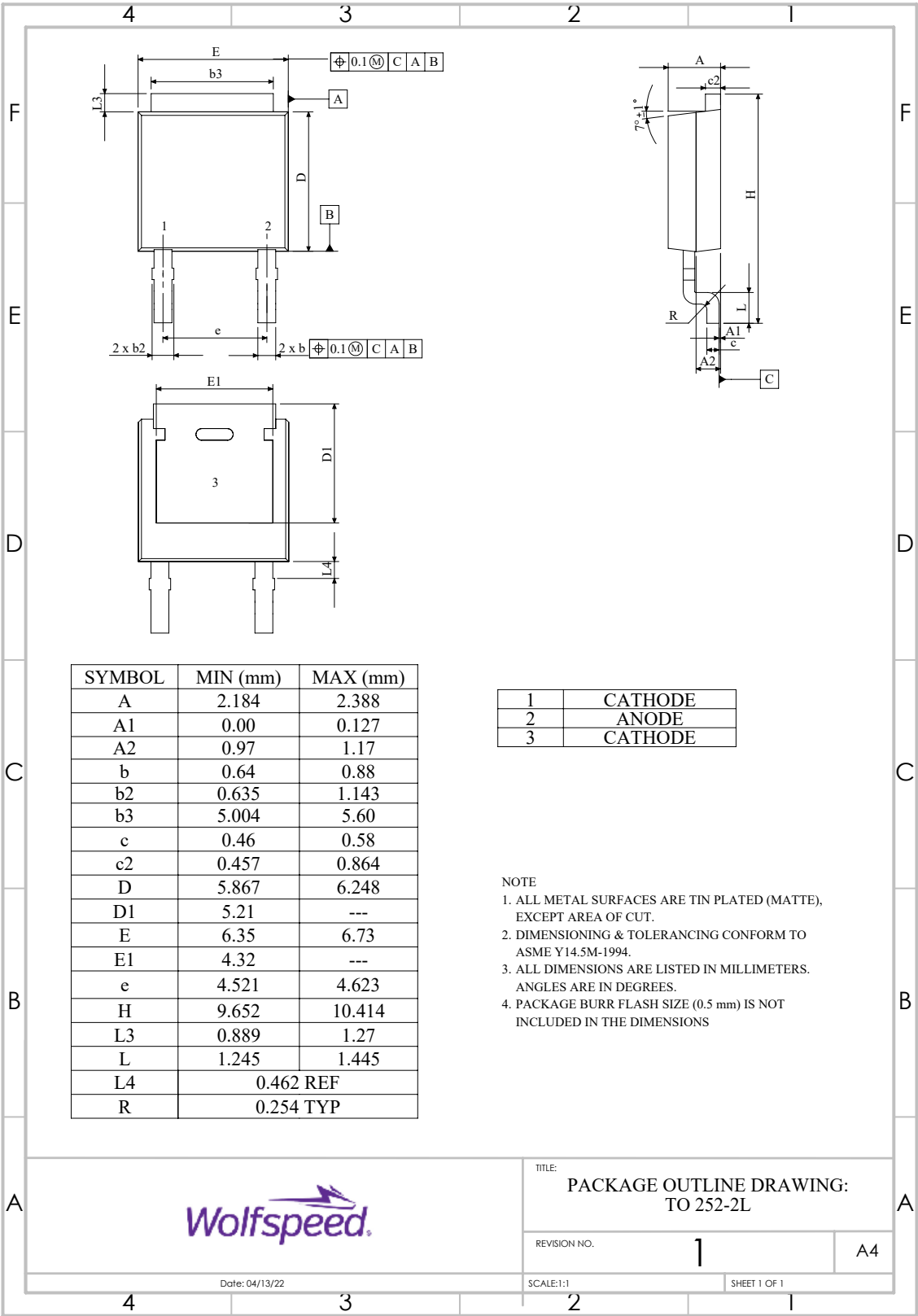


Figure 9. Transient Thermal Impedance

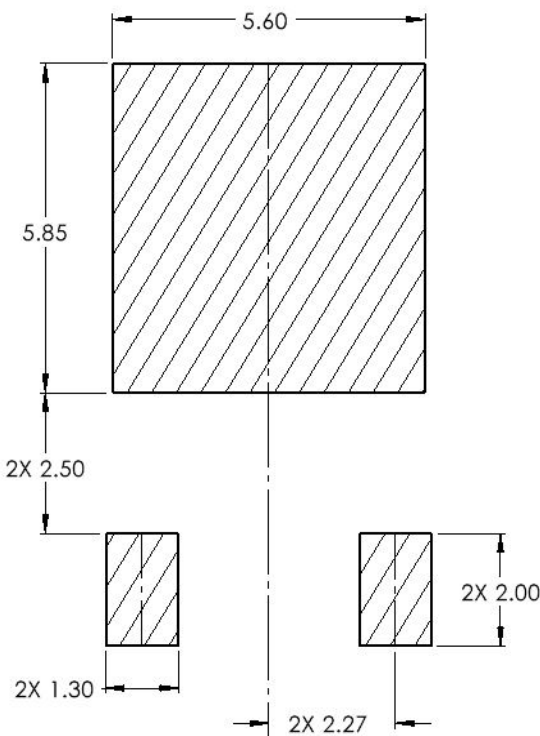
Package Dimensions

Package: TO-252-2



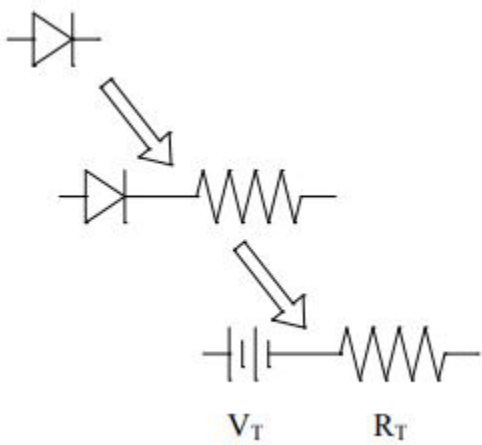


Recommended Solder Pad Layout



| Part Number | Package  | Marking  |
|-------------|----------|----------|
| C3D04065E   | TO-252-2 | C3D04065 |

Diode Model



$$V_{fT} = V_T + I_f * R_T$$
$$V_T = 1.00 + (T_j * -1.1 * 10^{-3})$$
$$R_T = 0.069 + (T_j * 8.3 * 10^{-4})$$

Note:  $T_j$  = Diode Junction Temperature In Degrees Celsius, valid from 25°C to 175°C



Revision History

| Current Revision | Date of Release | Description of Changes                                                                      |
|------------------|-----------------|---------------------------------------------------------------------------------------------|
| 5                | September-2023  | Updated Wolfspeed branding, package drawing, and solder pad layout, Removed AEC-Q101 banner |
| 6                | October-2023    | Corrected solder pad layout and diode model                                                 |



## Notes & Disclaimer

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