

**Trench Field Stop Fast IGBT Co-packed with Thin SiC Schottky Diode**

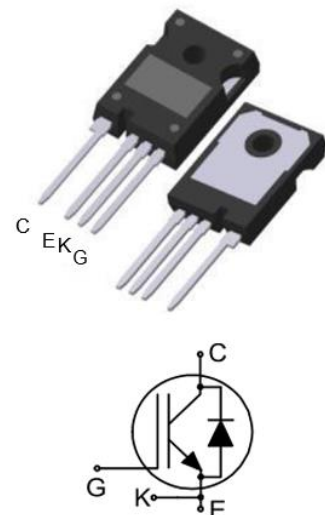
| Type           | $V_{CE}$ | $I_C$ | $V_{CEsat}, T_{vj}=25^{\circ}C$ | $T_{vjmax}$ | Package  |
|----------------|----------|-------|---------------------------------|-------------|----------|
| SKIS75N65-T7-4 | 650V     | 75A   | 1.69V                           | 175°C       | TO247-4L |

**Features and Benefits**

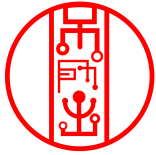
- Low switching losses due to the combination of trench field stop fast IGBT and thin SiC Schottky Diode
- Better efficiency and cost balance than SiC MOSFET solution
- High ruggedness

**Applications**

- Charger
- Solar inverter
- Energy storage
- Industrial UPS



|                  | Parameter                                         |      | Unit |
|------------------|---------------------------------------------------|------|------|
| $V_{CE}$         | Max Collector-Emitter Voltage                     | 650  | V    |
| $I_{C(Nominal)}$ | Max DC Collector Current                          | 75   | A    |
| $V_f$            | SiC Schottky Diode Typical Forward Voltage at 30A | 1.35 | V    |
| $Q_c$            | SiC Schottky Diode Total Capacitive Charge        | 51.8 | nC   |



### Maximum Ratings

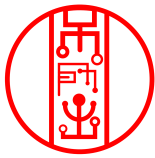
|               | Parameter                                                                          | Min. | Typ. | Max. | Unit        |
|---------------|------------------------------------------------------------------------------------|------|------|------|-------------|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage                                             | 650  | —    | —    | V           |
| $I_C$         | DC collector current limited by $T_{jmax}$                                         |      |      |      |             |
|               | $T_c = 25^{\circ}C$                                                                | —    | 150  | —    | A           |
|               | $T_c = 100^{\circ}C$                                                               | —    | 75   | —    | A           |
| $I_F$         | Diode Forward current, limited by $T_{jmax}$                                       |      |      |      |             |
|               | $T_c = 25^{\circ}C$                                                                | —    | 75   | —    | A           |
|               | $T_c = 100^{\circ}C$                                                               | —    | 42   | —    | A           |
| $V_{GE}$      | Continuous Gate-emitter voltage                                                    | -20  | —    | 20   | V           |
| $V_{GE}$      | Transient Gate-emitter voltage                                                     | -30  | —    | 30   | V           |
| $I_{Fpulse}$  | Diode Pulsed Current, $t_p$ limited by $T_{jmax}$<br>$t_p = 10$ ms, Half Sine Wave | —    | 110  | —    | A           |
| $P_{tot}$     | Power dissipation , $T_j=25^{\circ}C$                                              | —    | —    | 300  | W           |
| $T_{vj}$      | Operating junction temperature                                                     | -40  | —    | 175  | $^{\circ}C$ |
| $T_{stg}$     | Storage temperature -                                                              | -55  | —    | 150  | $^{\circ}C$ |

### Thermal Resistance

| Parameter                                    | Symbol            | Max. Value | Unit |
|----------------------------------------------|-------------------|------------|------|
| IGBT thermal resistance<br>junction - case   | $R_{\theta(j-c)}$ | 0.5        | K/W  |
| Diode thermal resistance,<br>junction - case | $R_{\theta(j-c)}$ | 1          | K/W  |
| Thermal resistance,<br>junction - ambient    | $R_{\theta(j-a)}$ | 38         | K/W  |

### Static Characteristics. $T_J=25^{\circ}C$

|               | Parameter                                 | Min. | Typ. | Max. | Unit | Conditions                                         |
|---------------|-------------------------------------------|------|------|------|------|----------------------------------------------------|
| $V_{CE(sat)}$ | Collector-to-Emitter<br>Saturated Voltage | —    | 1.69 | —    | V    | $V_{GE} = 15V, I_C = 75A$                          |
|               |                                           | —    | 2.06 | —    |      | $T_J=25^{\circ}C$<br>$T_J=150^{\circ}C$            |
| $V_{GE(th)}$  | Gate-Emitter<br>Threshold Voltage         | 4.2  | 5.2  | 6.2  | V    | $I_C = 250\mu A, V_{GE} = V_{CE}$                  |
| $I_{CES}$     | Zero Gate Voltage<br>Collector Current    | —    | —    | 1    | mA   | $V_{CE} = 650V, V_{GE} = 0V,$<br>$T_J=25^{\circ}C$ |
| $I_{GES}$     | Gate Emitter Leakage<br>Current           | —    | —    | 200  | nA   | $V_{CE} = 0V, V_{GE} = 20V$                        |
| $C_{ies}$     | Input Capacitance                         | —    | 1190 | —    | pF   | $V_{GE} = 0V, V_{CE}=25V, f=25kHz$                 |
| $C_{oes}$     | Output Capacitance                        | —    | 367  | —    |      |                                                    |
| $C_{res}$     | Reverse Transfer<br>Capacitance           | —    | 65   | —    |      |                                                    |
| $Q_g$         | Gate charge                               | —    | 438  | —    | nC   | $V_{CC}=520V, I_C=75A, V_{GE}=15V$                 |



### Switching Characteristic, Inductive Load (T<sub>J</sub>=25°C)

| Parameter                      | Symbol              | Min. | Typ. | Max. | Unit | Conditions                                                                                         |
|--------------------------------|---------------------|------|------|------|------|----------------------------------------------------------------------------------------------------|
| Turn-on delay time             | t <sub>d(on)</sub>  | —    | 74   | —    | ns   | V <sub>CC</sub> = 400V, I <sub>C</sub> = 37.5A,<br>V <sub>GE</sub> = 0/15V,<br>R <sub>g</sub> =10Ω |
| Rise time                      | t <sub>r</sub>      | —    | 42   | —    | ns   |                                                                                                    |
| Turn-off delay time            | t <sub>d(off)</sub> | —    | 482  | —    | ns   |                                                                                                    |
| Fall time                      | t <sub>f</sub>      | —    | 24   | —    | ns   |                                                                                                    |
| Turn-on energy E <sub>on</sub> | E <sub>on</sub>     | —    | 0.61 | —    | mJ   |                                                                                                    |
| Turn-off energy                | E <sub>off</sub>    | —    | 0.55 | —    | mJ   |                                                                                                    |
| Total switching energy         | E <sub>ts</sub>     | —    | 1.17 | —    | mJ   |                                                                                                    |

| Parameter                      | Symbol              | Min. | Typ. | Max. | Unit | Conditions                                                                                       |
|--------------------------------|---------------------|------|------|------|------|--------------------------------------------------------------------------------------------------|
| Turn-on delay time             | t <sub>d(on)</sub>  | —    | 81   | —    | ns   | V <sub>CC</sub> = 400V, I <sub>C</sub> = 75A,<br>V <sub>GE</sub> = 0/15V,<br>R <sub>g</sub> =10Ω |
| Rise time                      | t <sub>r</sub>      | —    | 99   | —    | ns   |                                                                                                  |
| Turn-off delay time            | t <sub>d(off)</sub> | —    | 450  | —    | ns   |                                                                                                  |
| Fall time                      | t <sub>f</sub>      | —    | 77   | —    | ns   |                                                                                                  |
| Turn-on energy E <sub>on</sub> | E <sub>on</sub>     | —    | 1.99 | —    | mJ   |                                                                                                  |
| Turn-off energy                | E <sub>off</sub>    | —    | 2.05 | —    | mJ   |                                                                                                  |
| Total switching energy         | E <sub>ts</sub>     | —    | 4.04 | —    | mJ   |                                                                                                  |

### Switching Characteristic, Inductive Load (T<sub>J</sub>=150°C)

| Parameter                      | Symbol              | Min. | Typ. | Max. | Unit | Conditions                                                                                         |
|--------------------------------|---------------------|------|------|------|------|----------------------------------------------------------------------------------------------------|
| Turn-on delay time             | t <sub>d(on)</sub>  | —    | 70   | —    | ns   | V <sub>CC</sub> = 400V, I <sub>C</sub> = 37.5A,<br>V <sub>GE</sub> = 0/15V,<br>R <sub>g</sub> =10Ω |
| Rise time                      | t <sub>r</sub>      | —    | 40   | —    | ns   |                                                                                                    |
| Turn-off delay time            | t <sub>d(off)</sub> | —    | 523  | —    | ns   |                                                                                                    |
| Fall time                      | t <sub>f</sub>      | —    | 38   | —    | ns   |                                                                                                    |
| Turn-on energy E <sub>on</sub> | E <sub>on</sub>     | —    | 0.62 | —    | mJ   |                                                                                                    |
| Turn-off energy                | E <sub>off</sub>    | —    | 0.73 | —    | mJ   |                                                                                                    |
| Total switching energy         | E <sub>ts</sub>     | —    | 1.35 | —    | mJ   |                                                                                                    |

| Parameter                      | Symbol              | Min. | Typ. | Max. | Unit | Conditions                                                                                       |
|--------------------------------|---------------------|------|------|------|------|--------------------------------------------------------------------------------------------------|
| Turn-on delay time             | t <sub>d(on)</sub>  | —    | 77   | —    | ns   | V <sub>CC</sub> = 400V, I <sub>C</sub> = 75A,<br>V <sub>GE</sub> = 0/15V,<br>R <sub>g</sub> =10Ω |
| Rise time                      | t <sub>r</sub>      | —    | 94   | —    | ns   |                                                                                                  |
| Turn-off delay time            | t <sub>d(off)</sub> | —    | 484  | —    | ns   |                                                                                                  |
| Fall time                      | t <sub>f</sub>      | —    | 78   | —    | ns   |                                                                                                  |
| Turn-on energy E <sub>on</sub> | E <sub>on</sub>     | —    | 1.90 | —    | mJ   |                                                                                                  |
| Turn-off energy                | E <sub>off</sub>    | —    | 2.27 | —    | mJ   |                                                                                                  |
| Total switching energy         | E <sub>ts</sub>     | —    | 4.17 | —    | mJ   |                                                                                                  |

**Diode Characteristic**

|                | Parameter               | Min. | Typ. | Max. | Unit | Conditions                                         |
|----------------|-------------------------|------|------|------|------|----------------------------------------------------|
| V <sub>f</sub> | Forward Voltage         |      | 1.35 |      | V    | I <sub>F</sub> =30A, T <sub>J</sub> = 25°C         |
|                |                         |      | 2.08 |      |      | I <sub>F</sub> =75A, T <sub>J</sub> = 25°C         |
|                |                         | —    | 1.68 | —    |      | I <sub>F</sub> =30A, T <sub>J</sub> = 150°C        |
|                |                         | —    | 3.08 | —    |      | I <sub>F</sub> =75A, T <sub>J</sub> = 150°C        |
| Q <sub>c</sub> | Total Capacitive Charge | —    | 51.8 | —    | nC   | V <sub>R</sub> =400V                               |
| C              | Total Capacitance       | —    | 1210 | —    | pF   | V <sub>R</sub> =0V, T <sub>J</sub> =25°C, f=1MHz   |
|                |                         | —    | 101  | —    |      | V <sub>R</sub> =200V, T <sub>J</sub> =25°C, f=1MHz |
|                |                         | —    | 90   | —    |      | V <sub>R</sub> =400V, T <sub>J</sub> =25°C, f=1MHz |

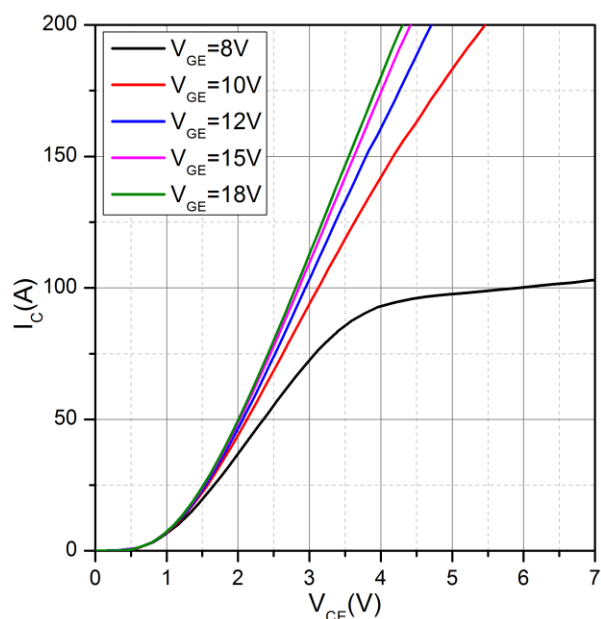
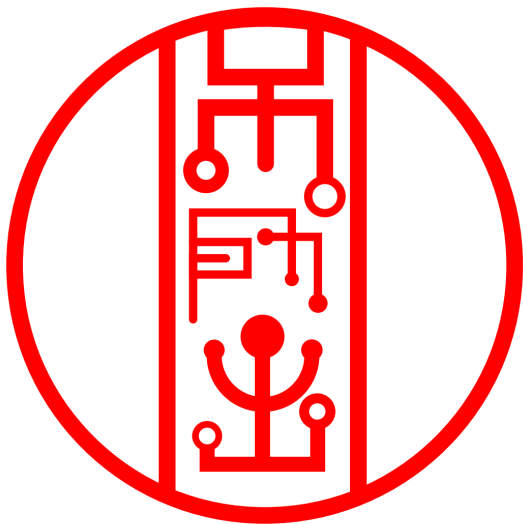


Figure 2. Typical output characteristics( $T_{vj}=150^{\circ}\text{C}$ )

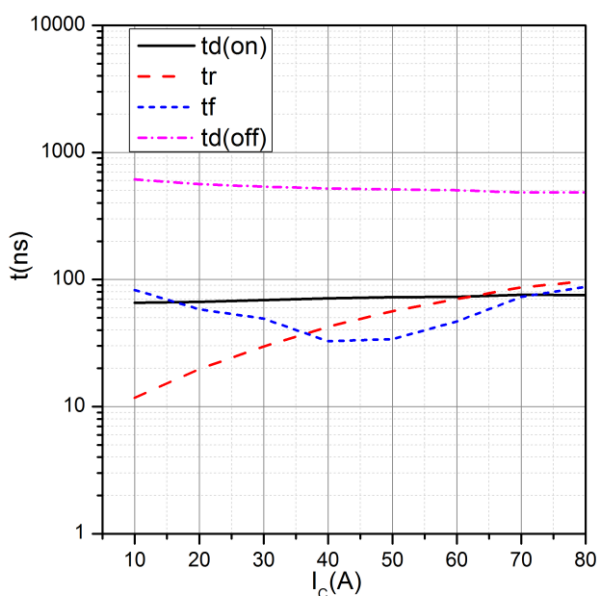


Figure 3. Typical switching times as function of collector current(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $R_G=10\Omega$ , Dynamic test circuit in figure E)

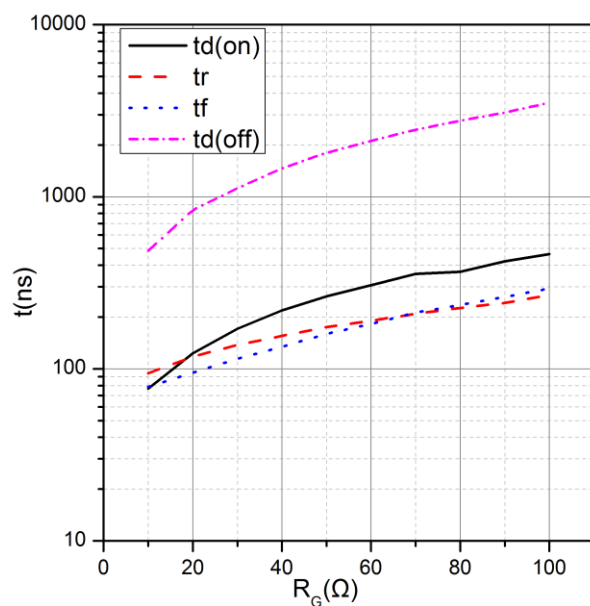


Figure 4. Typical switching times as function of gate resistor(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=75\text{A}$ , Dynamic test circuit in figure E)

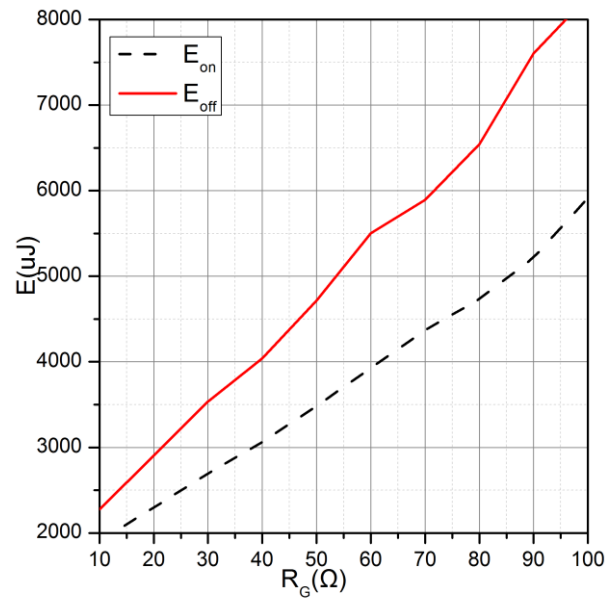
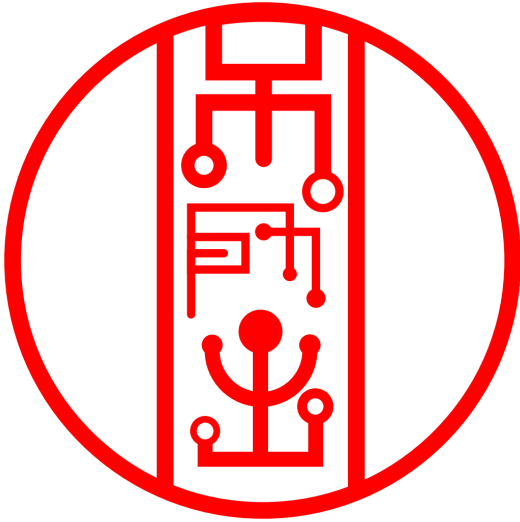


Figure 6. Typical energy losses as function of gate resistor(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=75\text{A}$ , Dynamic test circuit in figure E)

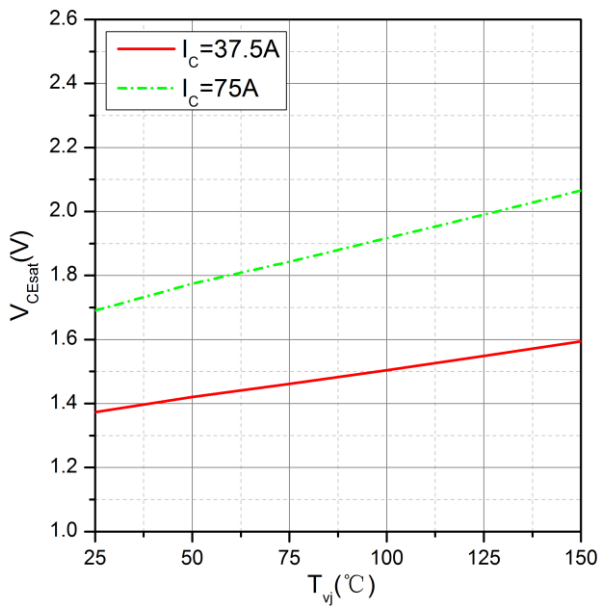


Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature( $V_{GE}=15\text{V}$ )

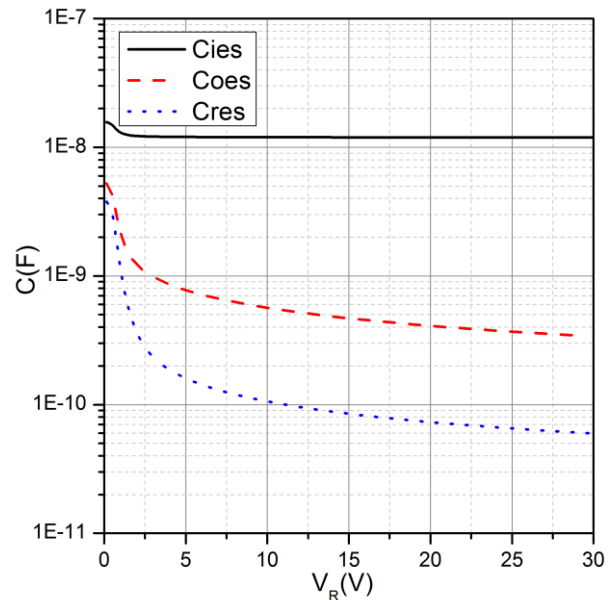


Figure 8. Typical capacitance as a function of collector-emitter voltage( $V_{GE}=0\text{V}$ ,  $f=250\text{kHz}$ )

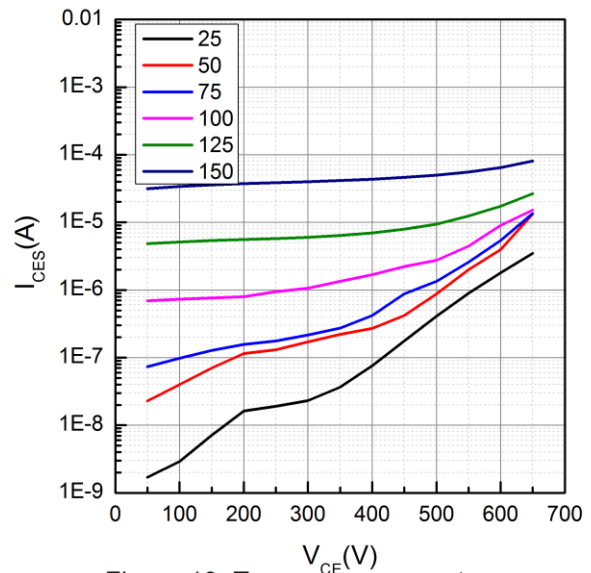
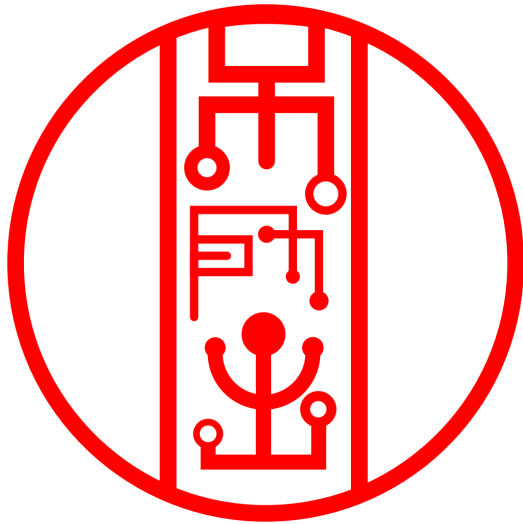


Figure 10. Typ.reverse current vs reverse voltage as a function of  $T_j$

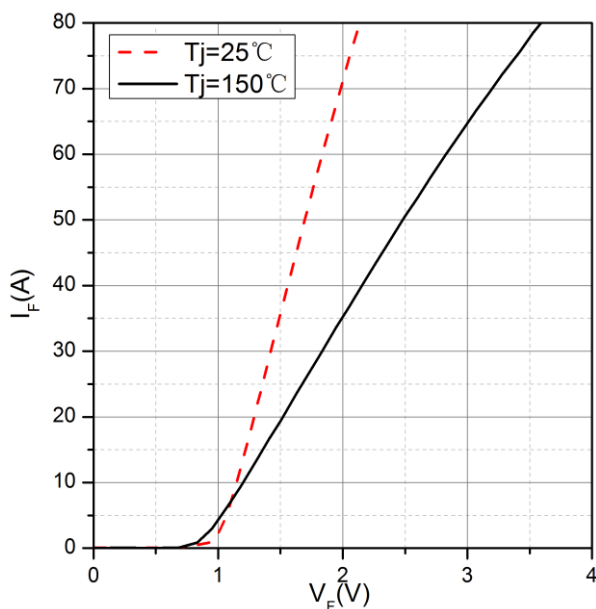


Figure 11. Typical diode forward current as a function of forward voltage

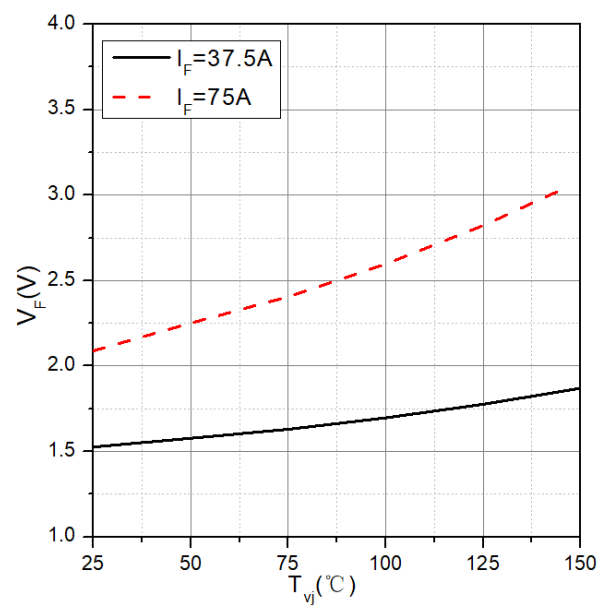


Figure 12. Typical diode forward voltage as a function of junction temperature

