

## Description

The DFH50FB12P3H1 offer lower losses and higher energy for application such as motor drive、 inverter and soft switching applications.



## Features

- 1200V50 A,  $V_{CE(sat)}(typ.) = 1.6V$
- Lower losses and higher energy
- Excellent short-circuit capability

## Applications

- Motor drive
- Inverter
- Welding machines
- UPS

## Circuit diagram

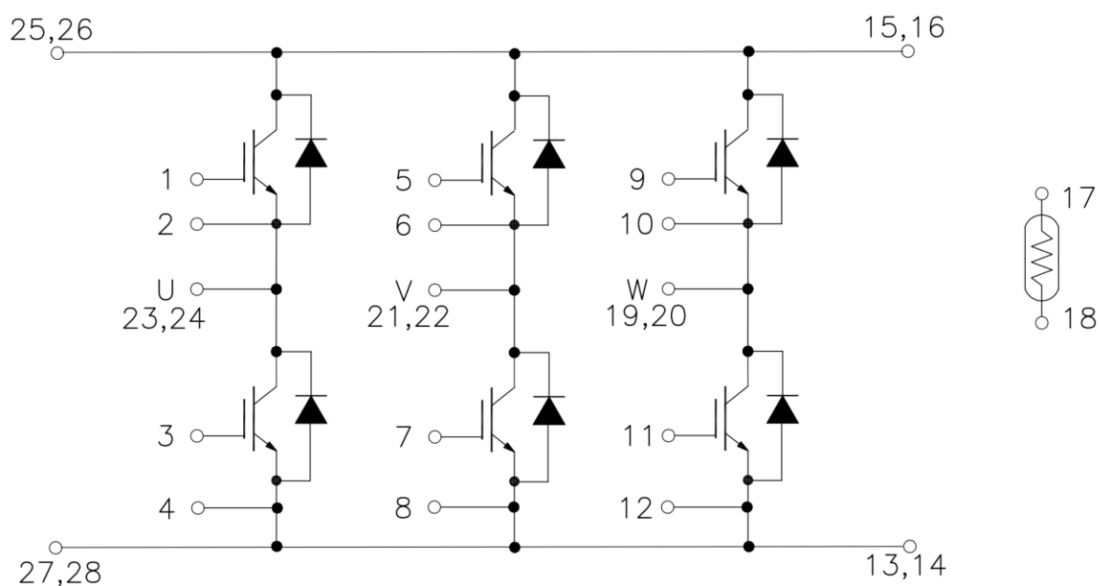


Figure 1. Out drawing & circuit diagram for DFH50FB12P3H1

## Pin Configuration and Marking Information

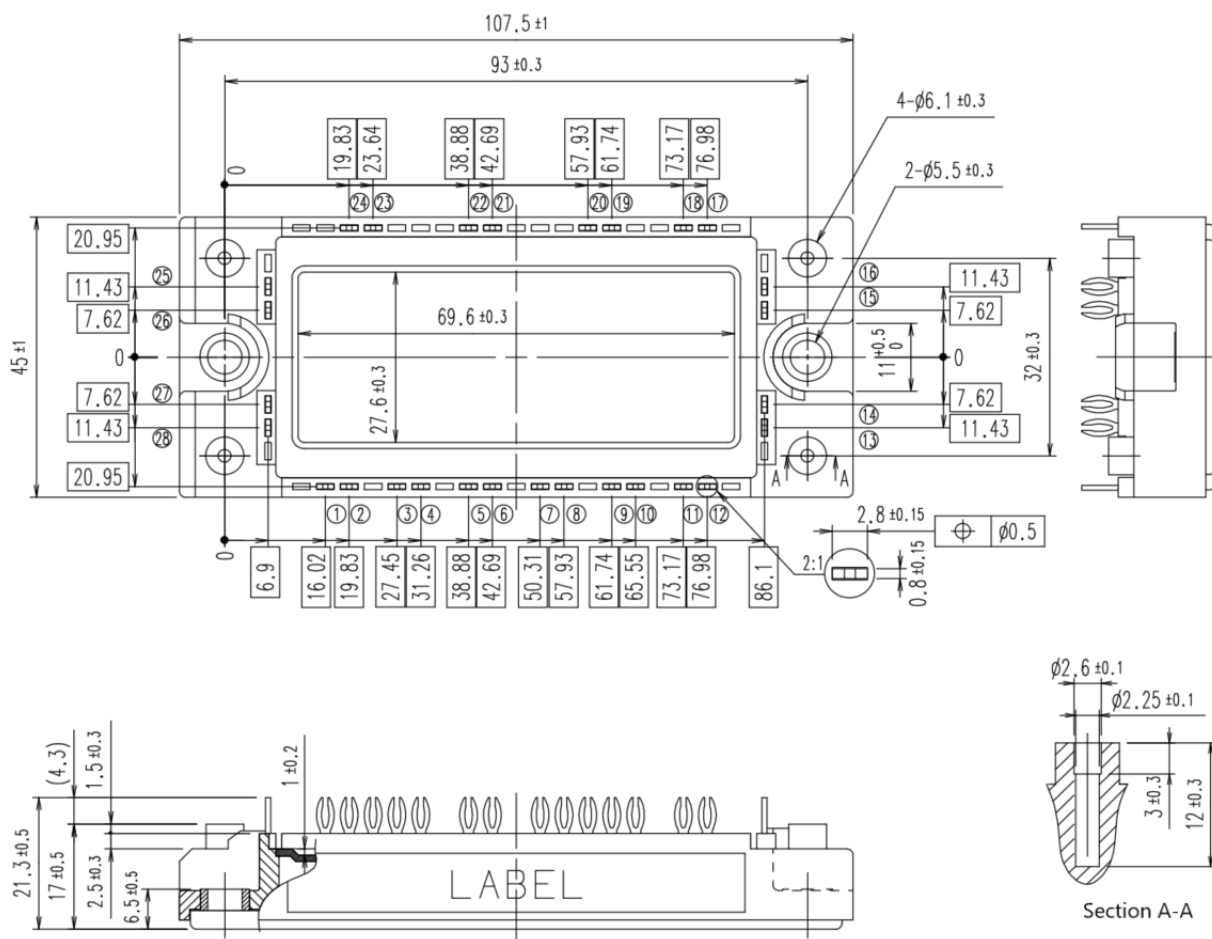


Figure 2. Pin configuration

## Module

| Parameter                                | Conditions              | Value | Unit |
|------------------------------------------|-------------------------|-------|------|
| Isolation Voltage                        | RMS, f = 50Hz, t = 1min | 2.5   | kV   |
| CTI                                      | -                       | >200  | -    |
| Module lead resistance, terminals – chip | T <sub>C</sub> = 25°C   | 0.8   | mΩ   |
| Mounting torque for module mounting      | M5                      | 3.5   | Nm   |
| Weight                                   | -                       | 155   | g    |

### Maximum Ratings ( $T_j = 25^\circ\text{C}$ unless otherwise specified)

| Symbol     | Parameter                       | Conditions                                                        | Ratings          | Unit             |
|------------|---------------------------------|-------------------------------------------------------------------|------------------|------------------|
| $V_{CES}$  | Collector-Emitter Voltage       | G-E Short                                                         | 1200             | V                |
| $V_{GES}$  | Gate-Emitter Voltage            | C-E Short                                                         | $\pm 20\text{V}$ | V                |
| $I_C$      | DC Continuous Collector Current | $T_C = 115^\circ\text{C}$ , $T_{vjop} = 150^\circ\text{C}$ (IGBT) | 50               | A                |
| $I_{CM}$   | Pulse Collector Current         | $t_p = 1\text{ms}$ , Note1                                        | 100              | A                |
| $P_C$      | Maximum Power Dissipation       | $T_C = 25^\circ\text{C}$ , $T_{vjop} = 150^\circ\text{C}$ (IGBT)  | 160              | W                |
| $I_F$      | Diode forward Current           | -                                                                 | 50               | A                |
| $I_{FRM}$  | Repetitive peak forward Current | $t_p = 1\text{ms}$ , Note1                                        | 100              | A                |
| $t_{sc}$   | Short Circuit Withstand Time    | $V_{GE} = 15\text{V}$ , $V_{CE} = 600\text{V}$                    | 10               | $\mu\text{s}$    |
| $T_{jmax}$ | Max junction temperature        | -                                                                 | 175              | $^\circ\text{C}$ |
| $T_{vjop}$ | Operating junction temperature  | -                                                                 | -40 to 150       | $^\circ\text{C}$ |
| $T_{sig}$  | Storage temperature             | -                                                                 | -40 to 125       | $^\circ\text{C}$ |

Note1: Pulse width limited by maximum junction temperature

### NTC characteristics

| Symbol       | Parameter              | Condition                                                      | Value |      |      | Unit             |
|--------------|------------------------|----------------------------------------------------------------|-------|------|------|------------------|
|              |                        |                                                                | Min.  | Typ. | Max. |                  |
| $R_{25}$     | Resistance             | $T_C = 25^\circ\text{C}$                                       | -     | 5    | -    | $\text{k}\Omega$ |
| $\Delta R/R$ | Deviation of $R_{100}$ | $T_C = 100^\circ\text{C}$ , $R_{100} = 493\Omega$              | -5    | -    | 5    | %                |
| $P_{25}$     | Power dissipation      | $T_C = 25^\circ\text{C}$                                       | -     | -    | 20   | mW               |
| $B_{25/50}$  | B-value                | $R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$  | -     | 3375 | -    | K                |
| $B_{25/80}$  | B-value                | $R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$  | -     | 3411 | -    | K                |
| $B_{25/100}$ | B-value                | $R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$ | -     | 3433 | -    | K                |

### IGBT Electrical characteristics (T<sub>j</sub>=25°C unless otherwise specified, chip)

| Symbol               | Item                                                         | Condition                                                                                                                               |                       | Value |      |     | Unit |
|----------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------|------|-----|------|
|                      |                                                              |                                                                                                                                         |                       | Min.  | Typ. | Max |      |
| V <sub>CE(sat)</sub> | Collector-Emitter Saturation Voltage                         | I <sub>C</sub> =50A<br>V <sub>GE</sub> =15V                                                                                             | T <sub>j</sub> =25°C  | -     | 1.40 | -   | V    |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =125°C | -     | 1.60 | -   | V    |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =150°C | -     | 1.65 | -   | V    |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =175°C | -     | 1.95 | -   | V    |
| V <sub>GE(th)</sub>  | Gate-Emitter threshold Voltage                               | I <sub>C</sub> =5.7mA, V <sub>CE</sub> =V <sub>GE</sub>                                                                                 |                       | 5.0   | 5.8  | 6.5 | V    |
| Q <sub>G</sub>       | Gate charge                                                  | V <sub>GE</sub> = -15V to +15V                                                                                                          |                       | -     | 864  | -   | nC   |
| R <sub>Gint</sub>    | Internal gate resistor                                       | -                                                                                                                                       | T <sub>j</sub> =25°C  | -     | 1.1  | -   | Ω    |
| C <sub>ies</sub>     | Input Capacitance                                            | V <sub>CE</sub> =25V, V <sub>GE</sub> =0V<br>f =1MHz                                                                                    | T <sub>j</sub> =25°C  | -     | 10.8 | -   | nF   |
| C <sub>oes</sub>     | Output Capacitance                                           |                                                                                                                                         |                       | -     | 0.3  | -   | nF   |
| C <sub>res</sub>     | Reverse transfer Capacitance                                 |                                                                                                                                         |                       | -     | 0.1  | -   | nF   |
| I <sub>CES</sub>     | Collector- Emitter Cut off Current                           | V <sub>CE</sub> =1200V, V <sub>GE</sub> =0V                                                                                             | T <sub>j</sub> =25°C  | -     | -    | 1   | mA   |
| I <sub>GES</sub>     | Gate-Emitter Leakage Current                                 | V <sub>GE</sub> =20V, V <sub>CE</sub> =0V                                                                                               | T <sub>j</sub> =25°C  | -     | -    | 1   | μA   |
| t <sub>d(on)</sub>   | Turn-on delay time                                           | V <sub>CC</sub> =600V<br>I <sub>C</sub> =50A<br>V <sub>GE</sub> =+15V/-8V<br>R <sub>Gon</sub> = R <sub>Goff</sub> =4Ω<br>Inductive load | T <sub>j</sub> =25°C  | -     | 235  | -   | ns   |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =125°C | -     | 271  | -   |      |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =150°C | -     | 278  | -   |      |
| t <sub>r</sub>       | Rise time                                                    |                                                                                                                                         | T <sub>j</sub> =25°C  | -     | 69   | -   | ns   |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =125°C | -     | 94   | -   |      |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =150°C | -     | 96   | -   |      |
| t <sub>d(off)</sub>  | Turn-off delay time                                          |                                                                                                                                         | T <sub>j</sub> =25°C  | -     | 281  | -   | ns   |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =125°C | -     | 314  | -   |      |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =150°C | -     | 328  | -   |      |
| t <sub>f</sub>       | Fall time                                                    |                                                                                                                                         | T <sub>j</sub> =25°C  | -     | 154  | -   | ns   |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =125°C | -     | 190  | -   |      |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =150°C | -     | 196  | -   |      |
| E <sub>on</sub>      | Turn-on power dissipation                                    |                                                                                                                                         | T <sub>j</sub> =25°C  | -     | 1.72 | -   | mJ   |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =125°C | -     | 2.3  | -   |      |
|                      |                                                              |                                                                                                                                         | T <sub>j</sub> =150°C | -     | 2.7  | -   |      |
| E <sub>off</sub>     | Turn-off power dissipation                                   |                                                                                                                                         | T <sub>j</sub> =25°C  | -     | 5.52 | -   | mJ   |
|                      |                                                              | T <sub>j</sub> =125°C                                                                                                                   | -                     | 6.1   | -    |     |      |
|                      |                                                              | T <sub>j</sub> =150°C                                                                                                                   | -                     | 6.4   | -    |     |      |
| R <sub>th(j-c)</sub> | Thermal Resistance, Junction to Case (IGBT)                  |                                                                                                                                         |                       | -     | 0.20 | -   | K/W  |
| R <sub>th(c-s)</sub> | Thermal Resistance, Case to sink (Conductive Grease applied) |                                                                                                                                         |                       | -     | 0.05 | -   | K/W  |

### SiC SBD Electrical characteristics (T<sub>j</sub>=25°C unless otherwise specified, chip)

| Symbol               | Item                                                         | Condition                                                                                                |                       | Value |      |     | Unit |
|----------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------|-------|------|-----|------|
|                      |                                                              |                                                                                                          |                       | Min.  | Typ. | Max |      |
| V <sub>F</sub>       | Diode Forward Voltage                                        | I <sub>F</sub> =50A, V <sub>GE</sub> =0V                                                                 | T <sub>J</sub> =25°C  | -     | 1.65 | -   | V    |
|                      |                                                              |                                                                                                          | T <sub>J</sub> =125°C | -     | 2.15 | -   |      |
|                      |                                                              |                                                                                                          | T <sub>J</sub> =150°C | -     | 2.35 | -   |      |
|                      |                                                              |                                                                                                          | T <sub>J</sub> =175°C | -     | 2.55 | -   |      |
| t <sub>rr</sub>      | Diode Reverse Recovery Time                                  | (Switch side)<br>V <sub>CC</sub> =600V, I <sub>C</sub> =50A<br>V <sub>GE</sub> =+15V/-8V                 | T <sub>J</sub> =25°C  |       | 27   | -   | ns   |
|                      |                                                              |                                                                                                          | T <sub>J</sub> =125°C | -     | 49   | -   |      |
|                      |                                                              |                                                                                                          | T <sub>J</sub> =150°C |       | 54   |     |      |
| Q <sub>rr</sub>      | Recovered charge                                             | R <sub>Gon</sub> = R <sub>Goff</sub> =4Ω<br>(SiC SBD side)<br>V <sub>rr</sub> =600V, I <sub>F</sub> =50A | T <sub>J</sub> =25°C  | -     | 0.73 | -   | μC   |
|                      |                                                              |                                                                                                          | T <sub>J</sub> =125°C | -     | 0.82 | -   |      |
|                      |                                                              |                                                                                                          | T <sub>J</sub> =150°C | -     | 0.86 | -   |      |
| E <sub>rr</sub>      | Reverse recovered energy                                     | V <sub>GE</sub> =-8V<br>Inductive load<br>switching operation                                            | T <sub>J</sub> =25°C  | -     | 0.10 | -   | mJ   |
|                      |                                                              |                                                                                                          | T <sub>J</sub> =125°C | -     | 0.16 | -   |      |
|                      |                                                              |                                                                                                          | T <sub>J</sub> =150°C | -     | 0.18 | -   |      |
| R <sub>th(j-c)</sub> | Thermal Resistance, Junction to Case (SiC SBD)               |                                                                                                          |                       | -     | 0.45 | -   | K/W  |
| R <sub>th(c-s)</sub> | Thermal Resistance, Case to sink (Conductive Grease applied) |                                                                                                          |                       | -     | 0.05 | -   | K/W  |

### Test Conditions

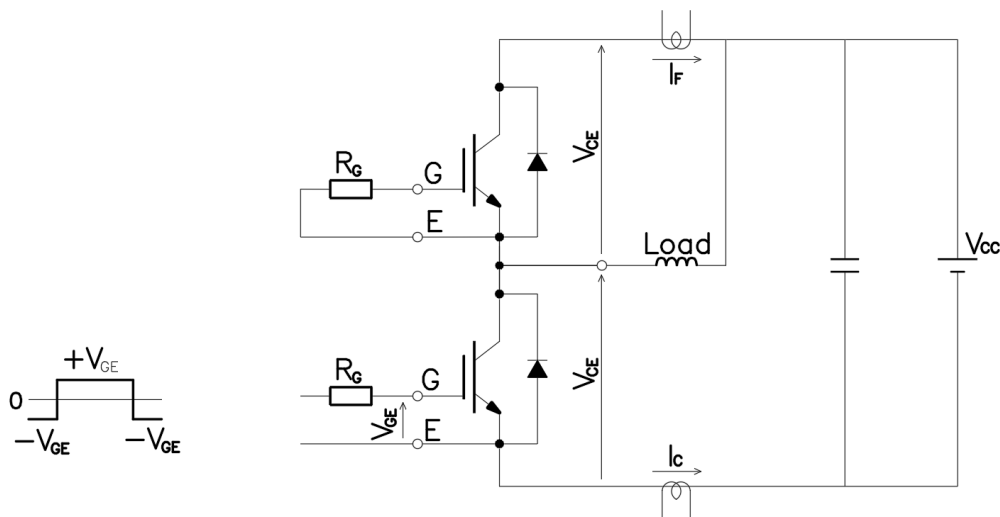


Figure 3. Switching time measure circuit

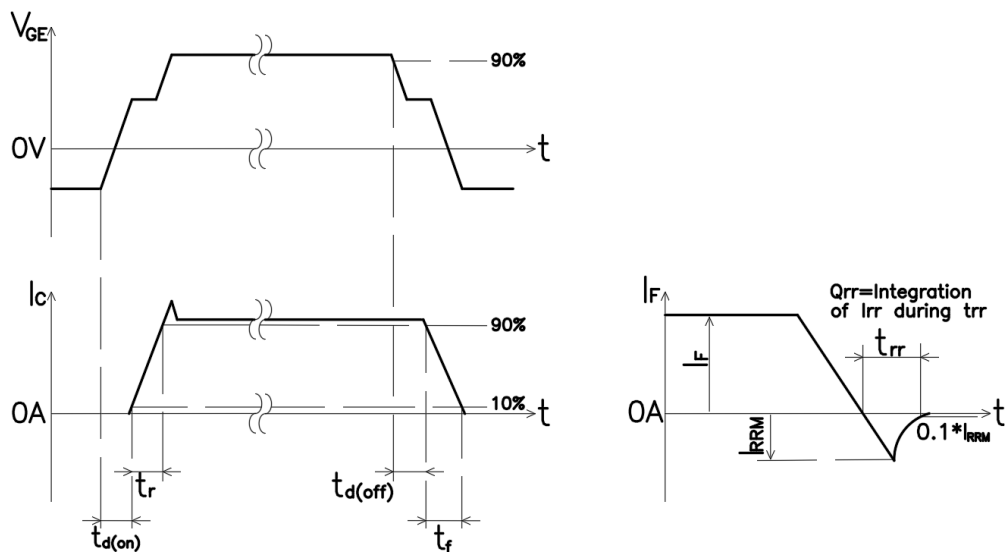


Figure 4. Switching time definition

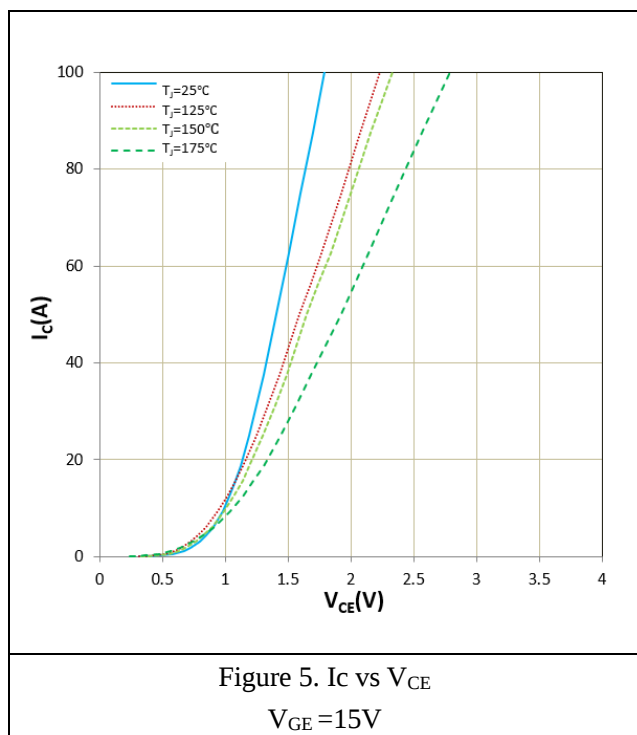


Figure 5.  $I_c$  vs  $V_{CE}$   
 $V_{GE} = 15V$

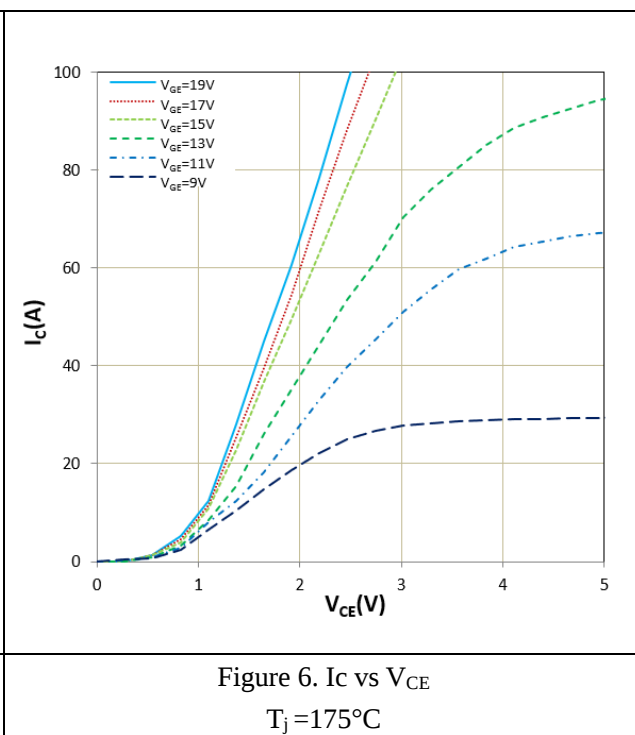


Figure 6.  $I_c$  vs  $V_{CE}$   
 $T_j = 175^\circ C$

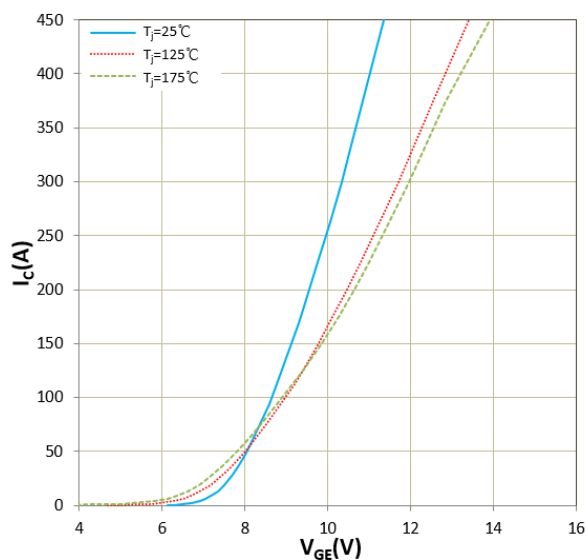


Figure 7.  $I_c$  vs  $V_{GE}$   
 $V_{CE}=20V$

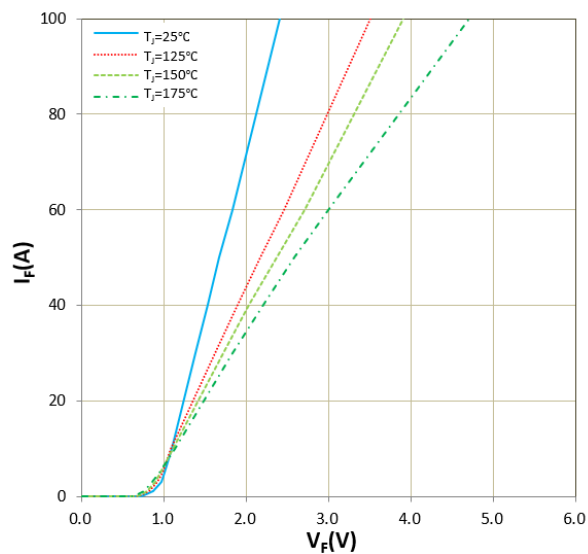


Figure 8.  $I_F$  vs  $V_F$

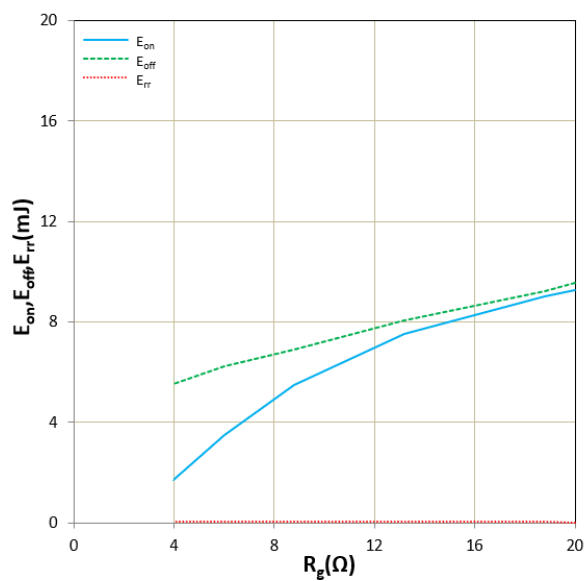


Figure 9.  $E_{on}$ ,  $E_{off}$ ,  $E_{tr}$  vs  $R_g$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $I_c=50A$ ,  $T_j=25^\circ C$   
Inductive Load

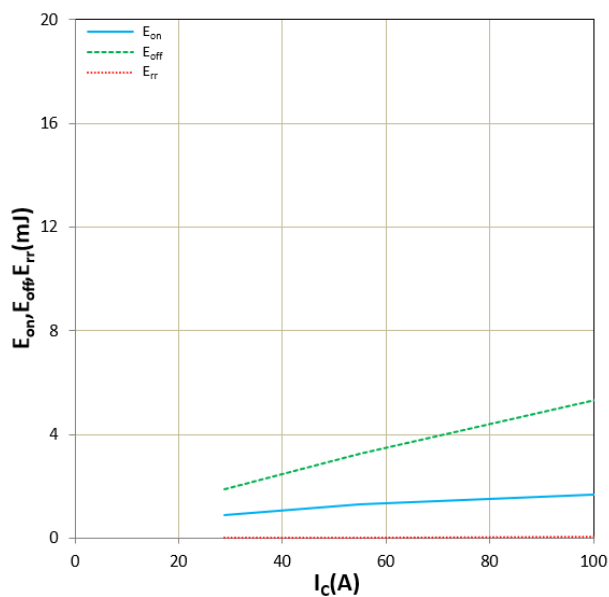


Figure 10.  $E_{on}$ ,  $E_{off}$ ,  $E_{tr}$  vs  $I_c$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $R_g=4\Omega$ ,  $T_j=25^\circ C$   
Inductive Load

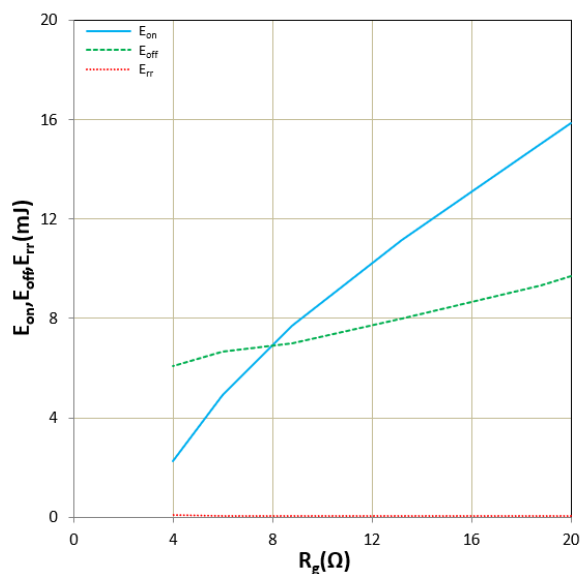


Figure 11.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_g$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $I_C=50A$ ,  $T_j=125^\circ C$   
 Inductive Load

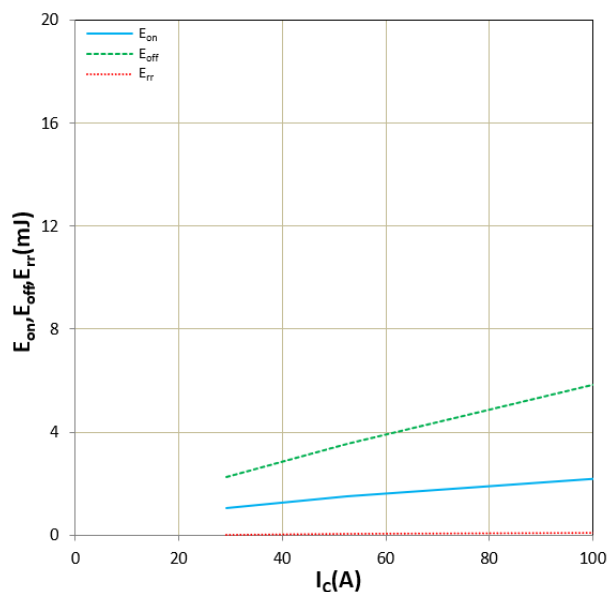


Figure 12.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_c$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $R_g=4\Omega$ ,  $T_j=125^\circ C$   
 Inductive Load

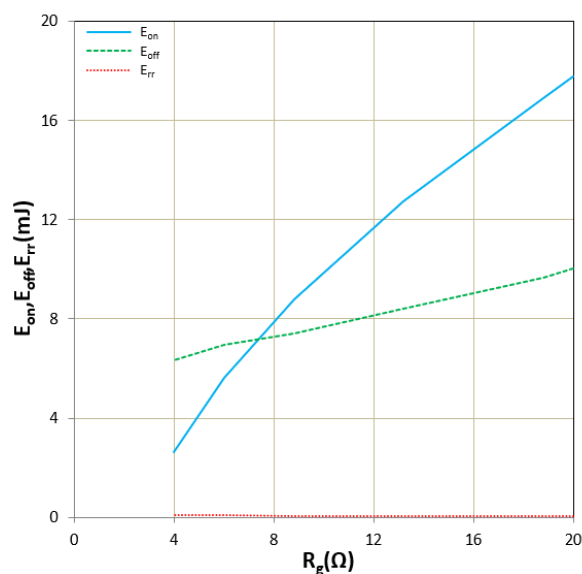


Figure 13.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_g$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $I_C=50A$ ,  $T_j=150^\circ C$   
 Inductive Load

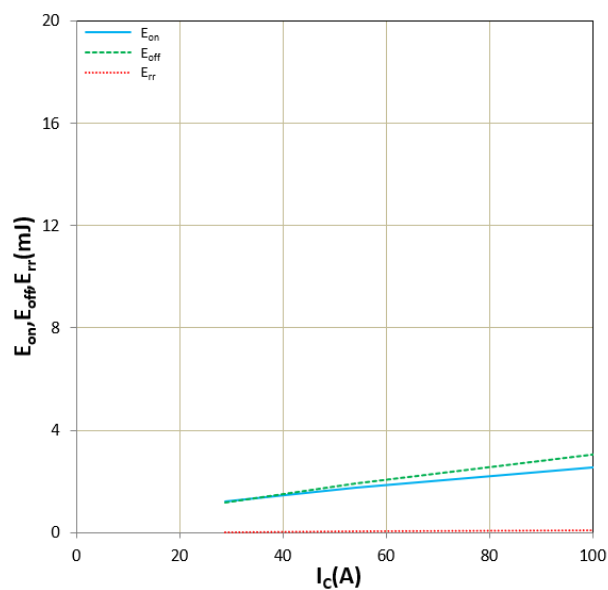


Figure 14.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_c$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $R_g=4\Omega$ ,  $T_j=150^\circ C$   
 Inductive Load

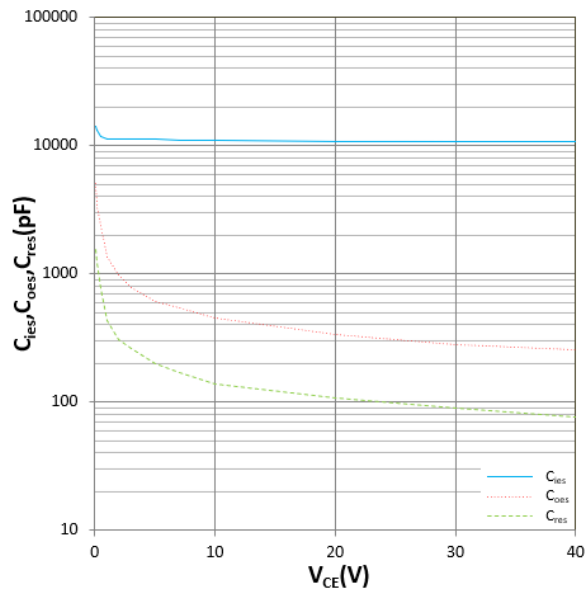


Figure 15.  $C_{ies}$ ,  $C_{oes}$ ,  $C_{res}$  vs  $V_{CE}$   
 $T_j = 25^\circ\text{C}$ ,  $f = 1\text{MHz}$

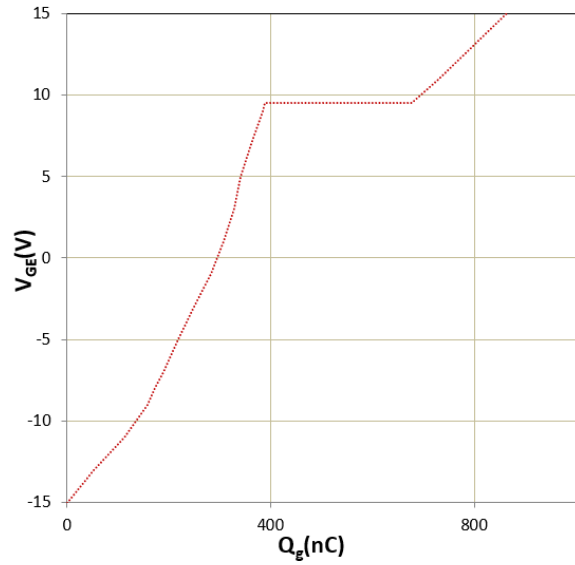


Figure 16. Gate charge  
 $T_j = 25^\circ\text{C}$

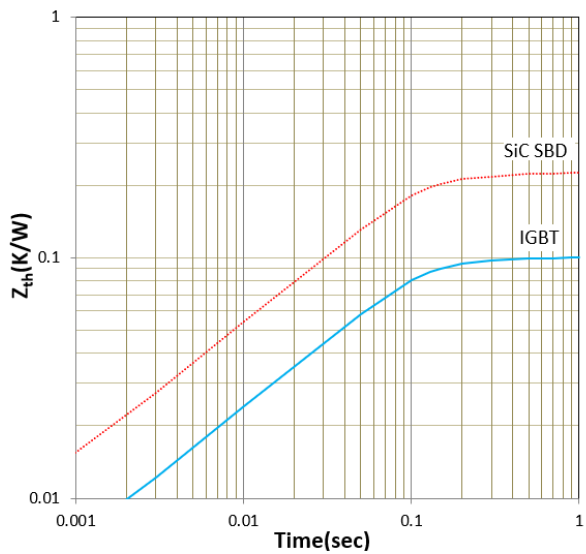


Figure 17. Transient thermal resistance

### IMPORTANT NOTICE:

This product data sheet describes the characteristics of this product for which a warranty is granted. Any such warranty is granted exclusively under the terms and conditions of the supply agreement. There will be no guarantee or of any kind for the product and its characteristics.

The data contained in this document is exclusively intended for technically trained staff. You and your technical departments will have to evaluate the product's suitability for the intended application and the completeness of the product data concerning such application.

Due to technical requirements, our product may contain dangerous substances. For information on the types in question, please contact the sales staff responsible for you.

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