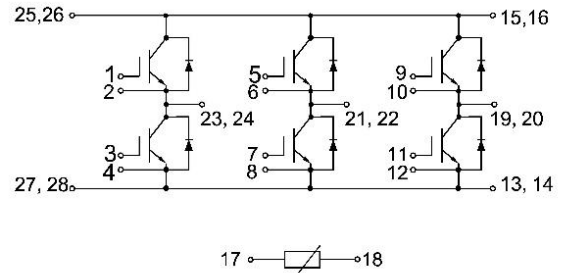


## Circuit Diagram



## IGBT Module

## Features:

- $V_{CES}=1200V$   $I_C=50A$  Trench & Field Stop IGBT Module
- Short Circuit Capability
- Low Switching Loss
- 100% RBSOA Tested( $2 \times I_C$ )
- Low Stray Inductance
- Lead Free, Compliant with RoHS Requirement

## Applications:

- Auxiliary Inverters
- Motor Drives
- Servo Drives



| Type         | Package | Marking      |
|--------------|---------|--------------|
| GT50FF120T5H | T5      | GT50FF120T5H |

## IGBT, Inverter

Maximum Rated Values ( $T_C=25^\circ C$  unless otherwise specified)

|           |                                                       |                                        |          |   |
|-----------|-------------------------------------------------------|----------------------------------------|----------|---|
| $V_{CES}$ | Collector-Emitter Blocking Voltage                    |                                        | 1200     | V |
| $V_{GES}$ | Gate-Emitter Voltage                                  |                                        | $\pm 20$ | V |
| $I_C$     | Continuous Collector Current<br>Limited by $T_{Jmax}$ | $T_C=100^\circ C$                      | 50       | A |
|           |                                                       | $T_C=25^\circ C$                       | 100      | A |
| $I_{CM}$  | Peak Collector Current Repetitive                     | $T_p$ limited by $T_{Jmax}$            | 100      | A |
| $P_D$     | Maximum Power Dissipation (IGBT)                      | $T_C=25^\circ C, T_{Jmax}=175^\circ C$ | 390      | W |

# GT50FF120T5H

## IGBT Module Datasheet



### Electrical Characteristics of IGBT ( $T_C=25^{\circ}\text{C}$ unless otherwise specified)

#### Static Characteristics

| Symbol        | Description                          | Conditions                                                               | Min.                      | Typ. | Max. | Units |
|---------------|--------------------------------------|--------------------------------------------------------------------------|---------------------------|------|------|-------|
| $V_{GE(th)}$  | Gate-Emitter Threshold Voltage       | $I_C=1.7\text{mA}$ , $V_{CE}=V_{GE}$                                     | 5.0                       | 5.8  | 6.6  | V     |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C=50\text{A}$ ,<br>$V_{GE}=15\text{V}$                                | $T_J=25^{\circ}\text{C}$  | 1.73 | 2.10 | V     |
|               |                                      |                                                                          | $T_J=125^{\circ}\text{C}$ | 2.18 |      | V     |
|               |                                      |                                                                          | $T_J=175^{\circ}\text{C}$ | 2.30 |      | V     |
| $I_{CES}$     | Collector-Emitter Leakage Current    | $V_{GE}=0\text{V}$ ,<br>$V_{CE}=1200\text{V}$ , $T_J=25^{\circ}\text{C}$ |                           |      | 1    | mA    |
| $I_{GES}$     | Gate-Emitter Leakage Current         | $V_{GE}=20\text{V}$ ,<br>$V_{CE}=0\text{V}$ , $T_J=25^{\circ}\text{C}$   |                           |      | 200  | nA    |
| $C_{ies}$     | Input Capacitance                    | $V_{CE}=25\text{V}$ , $V_{GE}=0\text{V}$ ,<br>$f=100\text{kHz}$          |                           | 5.41 |      | nF    |
| $C_{oes}$     | Output Capacitance                   |                                                                          |                           | 0.69 |      | nF    |
| $C_{res}$     | Reverse Transfer Capacitance         |                                                                          |                           | 0.06 |      | nF    |

#### Switching Characteristics

|              |                        |                                                                                                                           |                    |     |     |    |    |
|--------------|------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------|-----|-----|----|----|
| $t_{d(ON)}$  | Turn-on Delay Time     | $V_{CC}=600V, I_C=50A,$<br>$R_{Gon}=10\Omega, V_{GE}=\pm 15V,$<br>Inductive Load                                          | $T_J=25^{\circ}C$  |     | 67  |    | ns |
|              |                        |                                                                                                                           | $T_J=125^{\circ}C$ |     | 69  |    |    |
|              |                        |                                                                                                                           | $T_J=175^{\circ}C$ |     | 69  |    |    |
| $t_r$        | Rise Time              |                                                                                                                           | $T_J=25^{\circ}C$  |     | 26  |    | ns |
|              |                        |                                                                                                                           | $T_J=125^{\circ}C$ |     | 29  |    |    |
|              |                        |                                                                                                                           | $T_J=175^{\circ}C$ |     | 32  |    |    |
| $t_{d(OFF)}$ | Turn-off Delay Time    |                                                                                                                           | $T_J=25^{\circ}C$  |     | 178 |    | ns |
|              |                        |                                                                                                                           | $T_J=125^{\circ}C$ |     | 206 |    |    |
|              |                        |                                                                                                                           | $T_J=175^{\circ}C$ |     | 218 |    |    |
| $t_f$        | Fall Time              | $T_J=25^{\circ}C$                                                                                                         |                    | 136 |     | ns |    |
|              |                        | $T_J=125^{\circ}C$                                                                                                        |                    | 241 |     |    |    |
|              |                        | $T_J=175^{\circ}C$                                                                                                        |                    | 316 |     |    |    |
| $E_{on}$     | Turn-on Switching Loss | $V_{CC}=600V, I_C=50A,$<br>$R_{Gon}=10\Omega, V_{GE}=\pm 15V,$<br>$di/dt=1250A/\mu s(T_J=175^{\circ}C)$<br>Inductive Load | $T_J=25^{\circ}C$  |     | 3.6 |    | mJ |
|              |                        | $T_J=125^{\circ}C$                                                                                                        |                    | 4.8 |     |    |    |
|              |                        | $T_J=175^{\circ}C$                                                                                                        |                    | 5.9 |     |    |    |

# GT50FF120T5H

## IGBT Module Datasheet



|                      |                                                                                                   |                                                                                                                                                          |                       |  |       |       |      |
|----------------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--|-------|-------|------|
| E <sub>off</sub>     | Turn-off Switching Loss                                                                           | V <sub>CC</sub> =600V, I <sub>C</sub> =50A,<br>R <sub>Goff</sub> =10Ω, V <sub>GE</sub> =±15V,<br>du/dt=5400V/μs(T <sub>J</sub> =175°C)<br>Inductive Load | T <sub>J</sub> =25°C  |  | 3.1   |       | mJ   |
|                      |                                                                                                   |                                                                                                                                                          | T <sub>J</sub> =125°C |  | 4.2   |       |      |
|                      |                                                                                                   |                                                                                                                                                          | T <sub>J</sub> =175°C |  | 4.5   |       |      |
| Q <sub>g</sub>       | Total Gate Charge                                                                                 | V <sub>GE</sub> =+15V...-15V                                                                                                                             | T <sub>J</sub> =25°C  |  | 301   |       | nC   |
| R <sub>G (int)</sub> | Internal Gate Resistance                                                                          |                                                                                                                                                          | T <sub>J</sub> =25°C  |  | 3.0   |       | Ω    |
| T <sub>SC</sub>      | V <sub>CC</sub> =600V, V <sub>GE</sub> =±15V, T <sub>J</sub> =175°C <sup>note1</sup>              |                                                                                                                                                          |                       |  |       | 10    | us   |
| R <sub>θJC</sub>     | IGBT Thermal Resistance: Junction-to-Case (per IGBT)                                              |                                                                                                                                                          |                       |  |       | 0.384 | °C/W |
| R <sub>θCS</sub>     | IGBT Thermal Resistance: Case-to-Sink (per IGBT)<br>(per IGBT, λ <sub>grease</sub> = 1 W/(m · K)) |                                                                                                                                                          |                       |  | 0.190 |       | °C/W |

note1: Short circuit withstand time cannot exceed 10us under specified condition

### Diode, Inverter

#### Maximum Rated Values of Diode (T<sub>C</sub>=25°C unless otherwise specified)

|                  |                                  |                      |      |   |
|------------------|----------------------------------|----------------------|------|---|
| V <sub>RRM</sub> | Repetitive Peak Reverse Voltage  | T <sub>J</sub> =25°C | 1200 | V |
| I <sub>F</sub>   | Diode Continuous Forward Current |                      | 50   | A |
| I <sub>FM</sub>  | Diode Maximum Forward Current    | tp=1ms               | 100  | A |

#### Electrical Characteristics of Diode (T<sub>C</sub>=25°C unless otherwise specified)

| Symbol          | Description                   | Conditions                                                                                                         |                       | Min. | Typ. | Max. | Units |
|-----------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------|------|------|------|-------|
| V <sub>FM</sub> | Forward Voltage               | I <sub>F</sub> =50A                                                                                                | T <sub>J</sub> =25°C  |      | 1.66 | 2.00 | V     |
|                 |                               |                                                                                                                    | T <sub>J</sub> =125°C |      | 1.79 |      |       |
|                 |                               |                                                                                                                    | T <sub>J</sub> =175°C |      | 1.75 |      |       |
| t <sub>rr</sub> | Reverse Recovery Time         | I <sub>F</sub> =50A,<br>-diF/dt=1300A/μs(T <sub>J</sub> =175°C),<br>V <sub>R</sub> =600V,<br>V <sub>GE</sub> =-15V | T <sub>J</sub> =25°C  |      | 343  |      | ns    |
|                 |                               |                                                                                                                    | T <sub>J</sub> =125°C |      | 435  |      |       |
|                 |                               |                                                                                                                    | T <sub>J</sub> =175°C |      | 564  |      |       |
| I <sub>rr</sub> | Peak Reverse Recovery Current |                                                                                                                    | T <sub>J</sub> =25°C  |      | 46   |      | A     |
|                 |                               |                                                                                                                    | T <sub>J</sub> =125°C |      | 47   |      |       |
|                 |                               |                                                                                                                    | T <sub>J</sub> =175°C |      | 48   |      |       |
| Q <sub>rr</sub> | Reverse Recovery Charge       |                                                                                                                    | T <sub>J</sub> =25°C  |      | 5.4  |      | μC    |
|                 |                               |                                                                                                                    | T <sub>J</sub> =125°C |      | 8.5  |      |       |
|                 |                               |                                                                                                                    | T <sub>J</sub> =175°C |      | 11.2 |      |       |



# GT50FF120T5H

## IGBT Module Datasheet

|                  |                                                                                          |                                                                                                                    |                       |  |       |       |      |
|------------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------|--|-------|-------|------|
| E <sub>rec</sub> | Reverse Recovery Energy                                                                  | I <sub>F</sub> =50A,<br>-diF/dt=1300A/μs(T <sub>J</sub> =175°C),<br>V <sub>R</sub> =600V,<br>V <sub>GE</sub> =-15V | T <sub>J</sub> =25°C  |  | 2.0   |       | mJ   |
|                  |                                                                                          |                                                                                                                    | T <sub>J</sub> =125°C |  | 3.3   |       |      |
|                  |                                                                                          |                                                                                                                    | T <sub>J</sub> =175°C |  | 4.5   |       |      |
| R <sub>θJC</sub> | Diode Thermal Resistance: Junction-to-Case (per Diode)                                   |                                                                                                                    |                       |  |       | 0.723 | °C/W |
| R <sub>θCS</sub> | Diode Thermal Resistance: Case-to-Sink<br>(per Diode, λ <sub>grease</sub> = 1 W/(m • K)) |                                                                                                                    |                       |  | 0.358 |       | °C/W |

### Internal NTC-Thermistor Characteristics

| Symbol              | Conditions                                                                               | Min. | Typ. | Max. | Units. |
|---------------------|------------------------------------------------------------------------------------------|------|------|------|--------|
| R <sub>25</sub>     | T <sub>C</sub> =25°C                                                                     |      | 5    |      | kΩ     |
| ΔR/R                | T <sub>C</sub> =100°C, R <sub>100</sub> =465Ω                                            | -5   |      | +5   | %      |
| P <sub>25</sub>     | T <sub>C</sub> =25°C                                                                     |      |      | 10   | mW     |
| B <sub>25/50</sub>  | R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/50</sub> (1/T <sub>2</sub> -1/(298.15K))]  |      | 3380 |      | K      |
| B <sub>25/80</sub>  | R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/80</sub> (1/T <sub>2</sub> -1/(298.15K))]  |      | 3440 |      | K      |
| B <sub>25/100</sub> | R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/100</sub> (1/T <sub>2</sub> -1/(298.15K))] |      | 3545 |      | K      |

### Module

| Symbol           | Description                                                   | Min.             | Typ. | Max. | Units |
|------------------|---------------------------------------------------------------|------------------|------|------|-------|
| V <sub>iso</sub> | Isolation Voltage (All Terminals Shorted)                     | RMS, f=50Hz, 60s |      | 2500 | V     |
| T <sub>J</sub>   | Maximum Junction Temperature                                  | -40              |      | 175  | °C    |
| T <sub>JOP</sub> | Maximum Operating Junction Temperature Range <sup>note2</sup> | -40              |      | 150  | °C    |
| T <sub>stg</sub> | Storage Temperature                                           | -40              |      | 125  | °C    |
| CTI              | Comparative Tracking Index                                    | 200              |      |      |       |
| T                | Power Terminals Screw:M5                                      | 3                |      | 5    | N·m   |
| T                | Mounting Screw:M6                                             | 4                |      | 6    | N·m   |
| G                | Weight                                                        |                  | 150  |      | g     |

note2: T<sub>JOP</sub>> 150°C is only allowed for operation at overload conditions.



# GT50FF120T5H

## IGBT Module Datasheet

### Ordering Information Table

|             |   |   |    |    |     |    |   |
|-------------|---|---|----|----|-----|----|---|
| Device code | G | T | 50 | FF | 120 | T5 | H |
|             | ① | ② | ③  | ④  | ⑤   | ⑥  | ⑦ |

- ① - IGBT Module
- ② - Field Stop Trench Gate IGBT
- ③ - Rated Current (50=50A)
- ④ - Circuit Configuration:FF (Full Bridge)
- ⑤ - Rated Voltage (120=1200V)
- ⑥ - Package Type
- ⑦ - Test Level (Pass the Important Reliability Test-Industrial Grade)



### Characteristic diagram

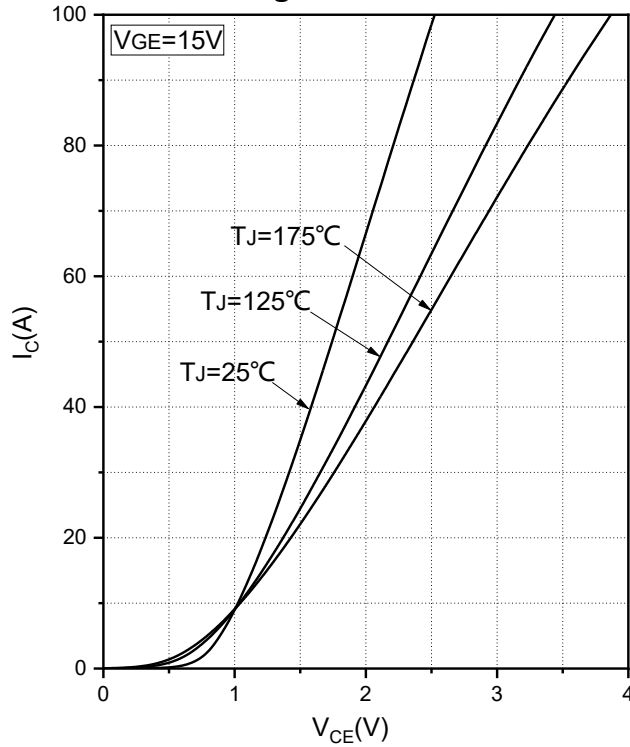


Fig.1 Typical Saturation Voltage Characteristics

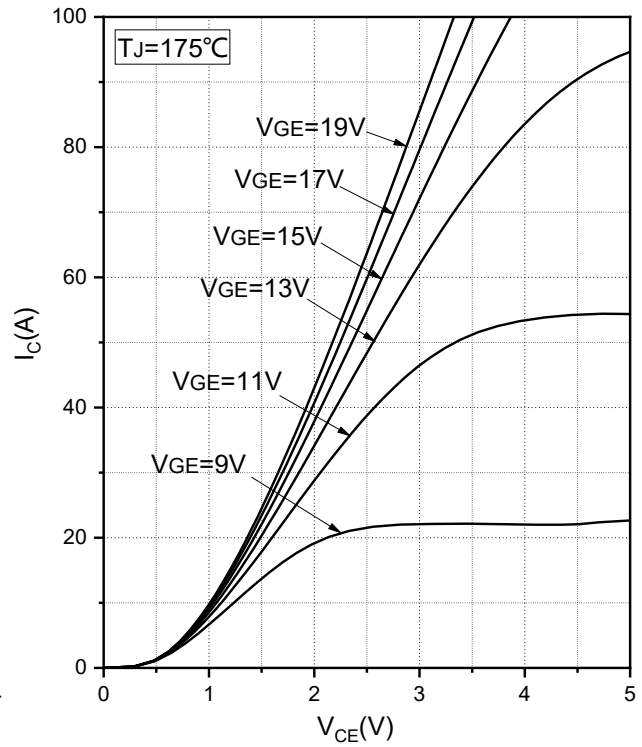


Fig.2 Typical Output Characteristics

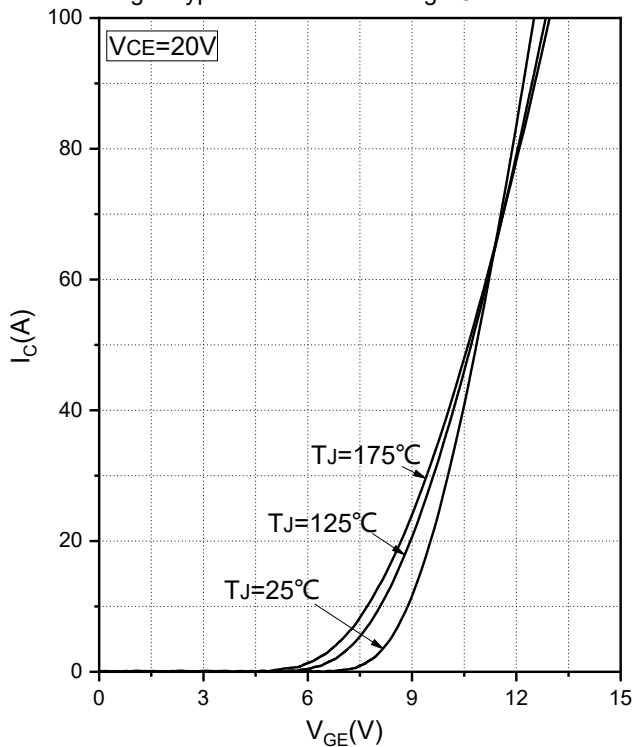


Fig.3 Transfer Characteristic

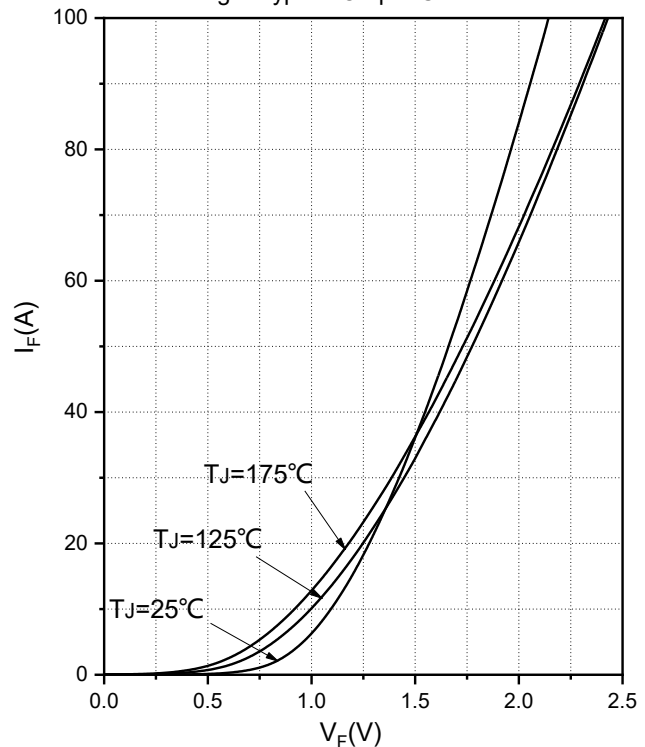


Fig.4 Forward Characteristics of Diode

# GT50FF120T5H

## IGBT Module Datasheet

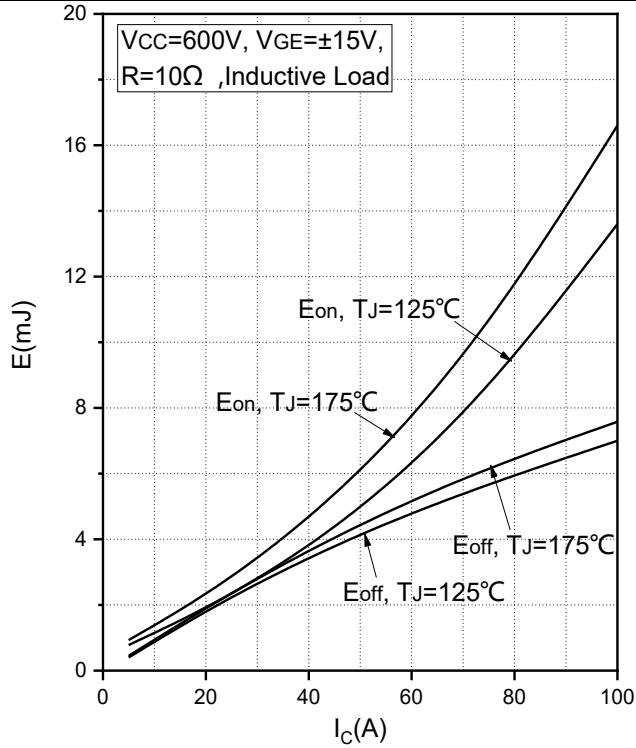


Fig.5 Typical Switching Loss vs. Collector Current

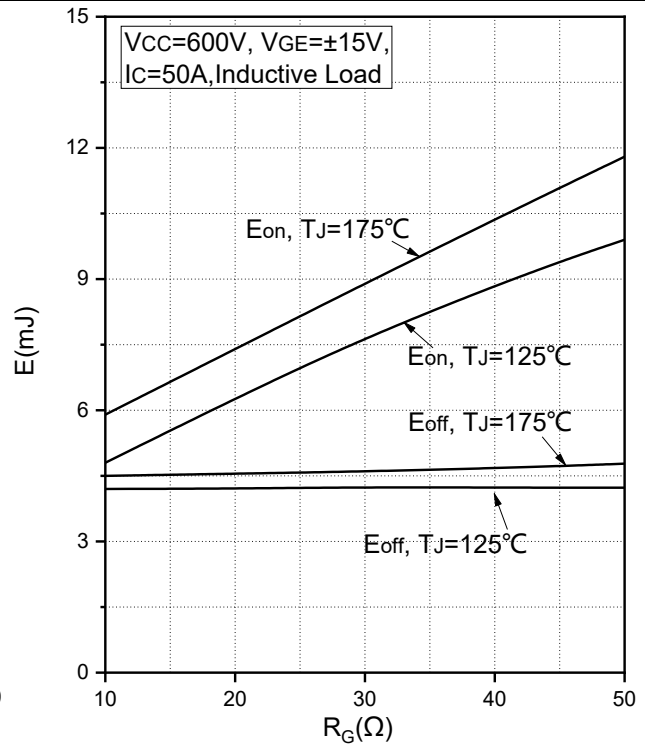


Fig.6 Typical Switching Loss vs. Gate Resistance

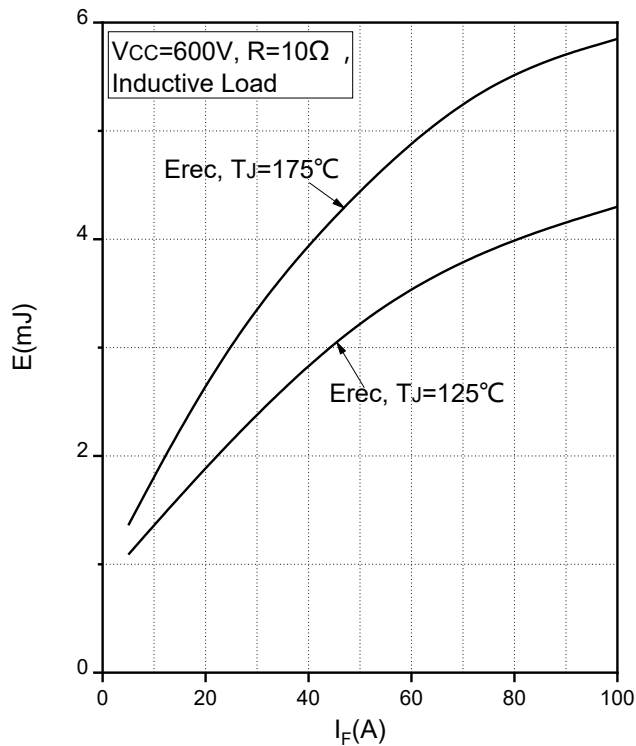


Fig.7 Typical Switching Loss vs. Forward Current

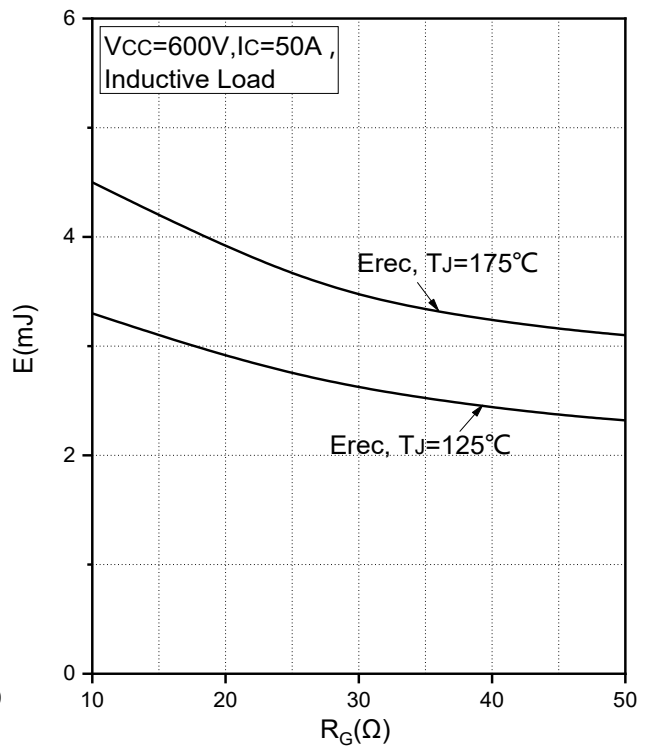


Fig.8 Typical Switching Loss vs. Gate Resistance

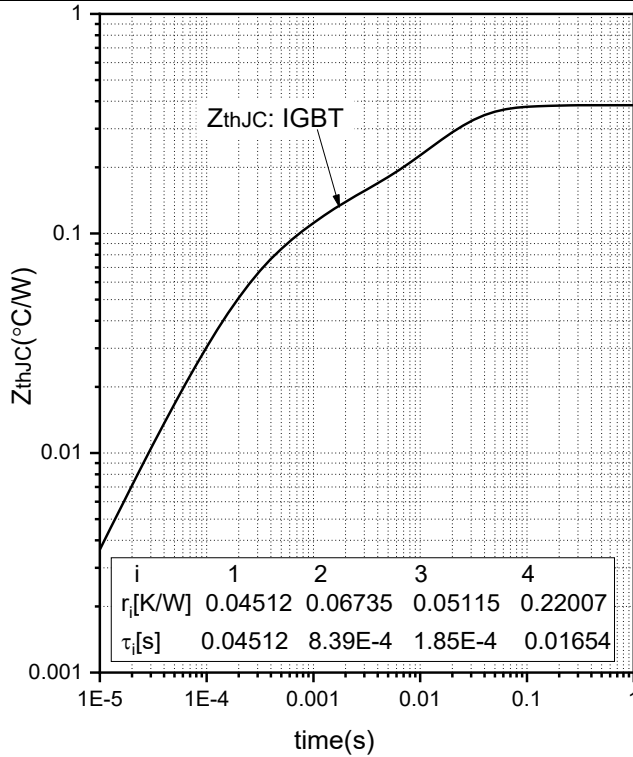


Fig.9 Transient Thermal Impedance (IGBT)

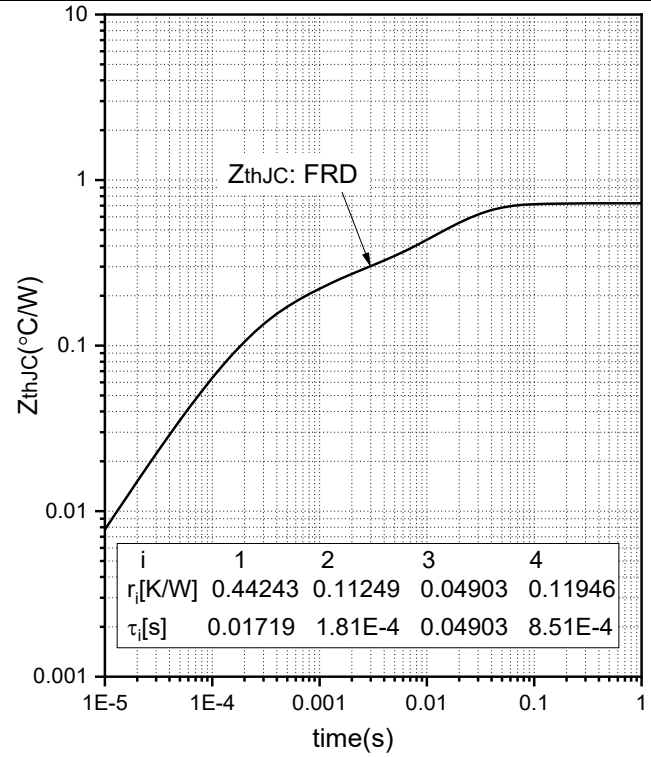


Fig.10 Transient Thermal Impedance (Diode)

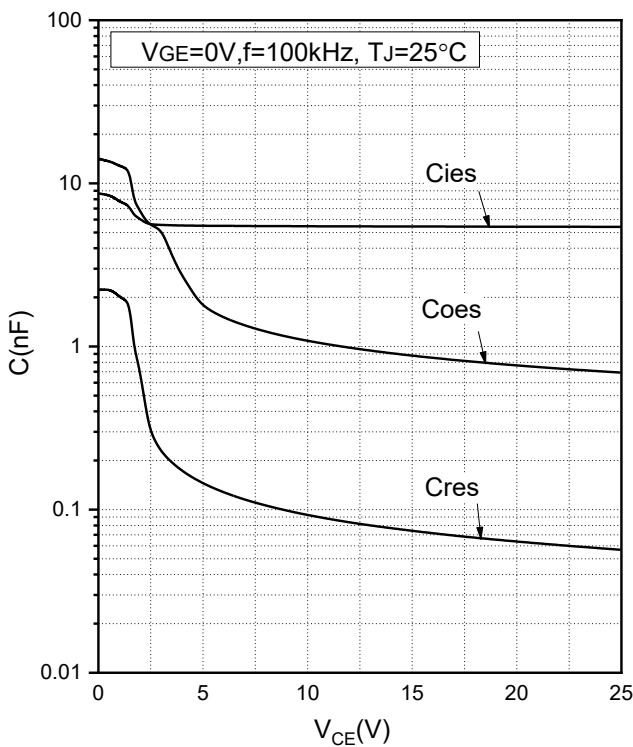


Fig.11 Capacitance Characteristics

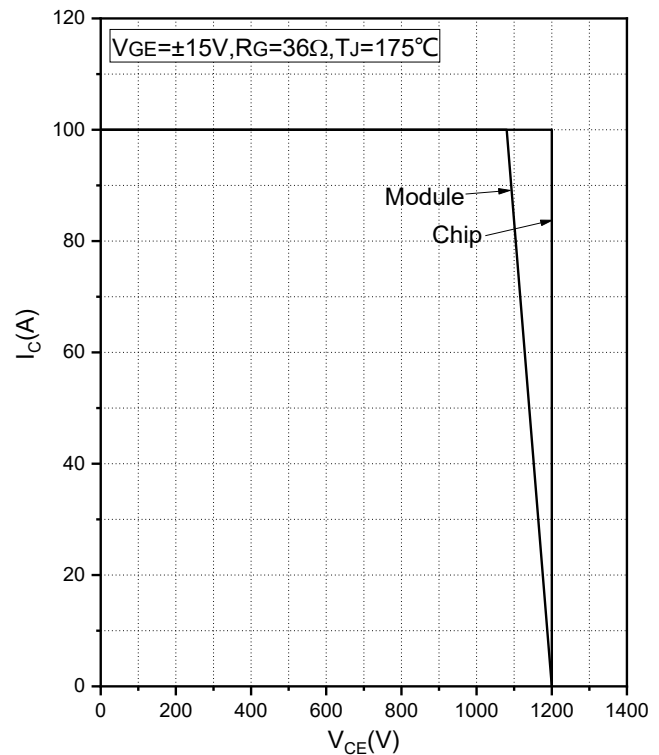


Fig.12 Reverse Bias Safe Operation Area (RBSOA)

# GT50FF120T5H

## IGBT Module Datasheet

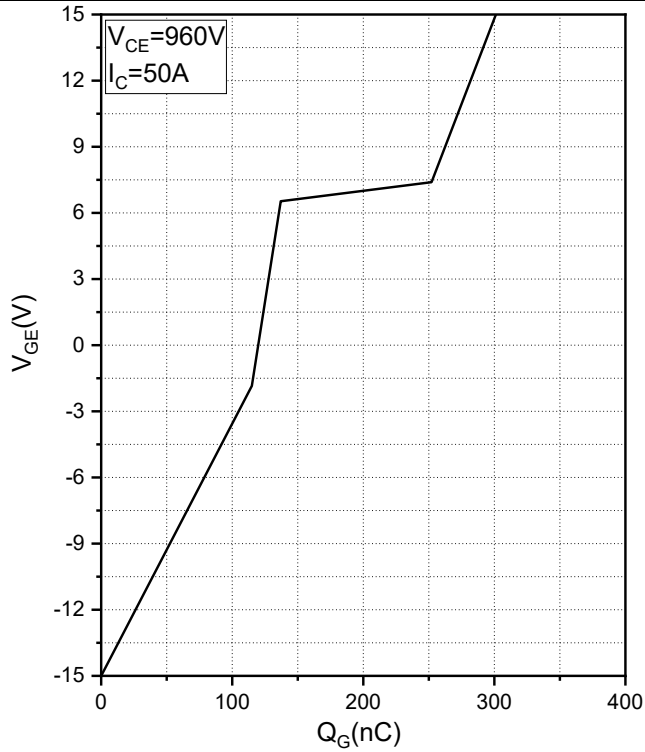


Fig.13 Gate Charge Characteristics

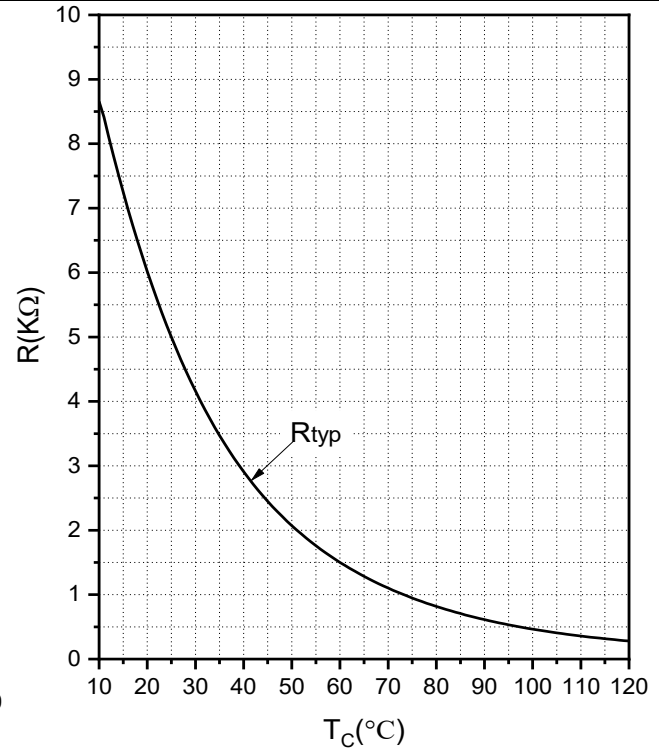


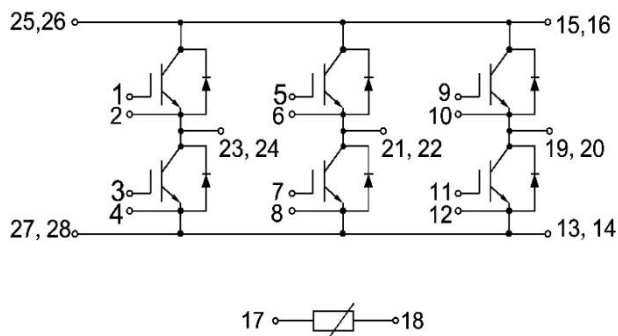
Fig.14 NTC Temperature Characteristics



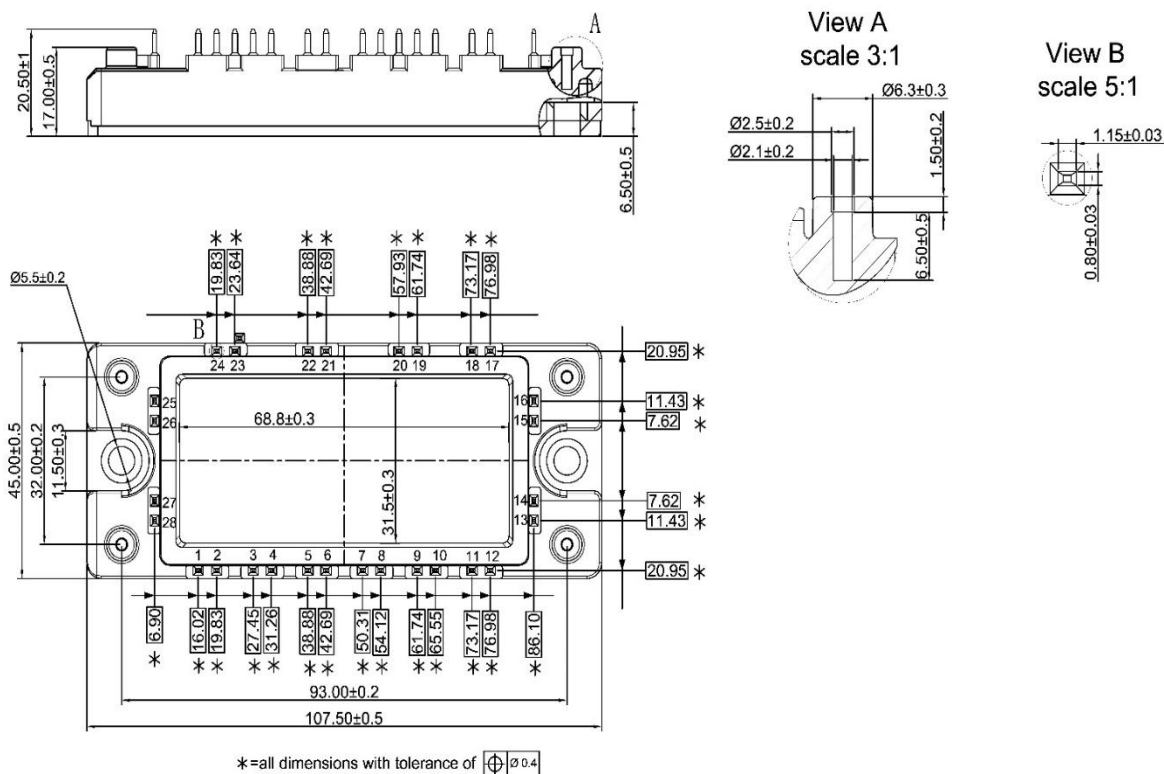
# GT50FF120T5H

## IGBT Module Datasheet

### Internal Circuit:



### Package Outline (Unit: mm):





| Revision | Notes                          |
|----------|--------------------------------|
| A        | Fina Datasheet Initial Release |
|          |                                |

### Announcement

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