



# GT40FF120C7H

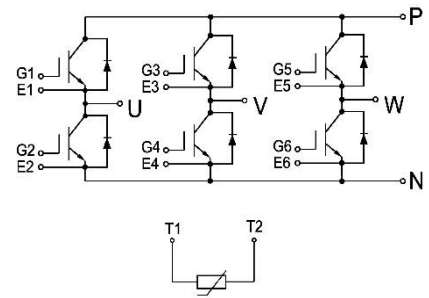
## IGBT Module

Preliminary Data

### Features:

- Trench & Field Stop IGBT
- Short Circuit Rated  $>10\mu\text{s}$
- Low Saturation Voltage
- Low Switching Loss
- 100% RBSOA Tested( $2\times I_c$ )
- Low Stray Inductance
- Lead Free, Compliant with RoHS Requirement

### Circuit Diagram



### Applications:

- Motor Drives
- Power Generation
- UPS

### IGBT, Inverter Maximum Rated Values

|           |                                    |                                                        |          |   |
|-----------|------------------------------------|--------------------------------------------------------|----------|---|
| $V_{CES}$ | Collector-Emitter Blocking Voltage |                                                        | 1200     | V |
| $V_{GES}$ | Gate-Emitter Voltage               |                                                        | $\pm 20$ | V |
| $I_c$     | Continuous Collector Current       | $T_c=100^\circ\text{C}$                                | 40       | A |
|           |                                    | $T_c=25^\circ\text{C}$                                 | 75       | A |
| $I_{CM}$  | Peak Collector Current Repetitive  | $t_p=1\text{ms}$                                       | 80       | A |
| $P_D$     | Maximum Power Dissipation (IGBT)   | $T_c=25^\circ\text{C}$<br>$T_{Jmax}=175^\circ\text{C}$ | 283      | W |



## Electrical Characteristics of IGBT

### Static Characteristics

| Symbol        | Description                          | Conditions                                                     | Min.               | Typ. | Max.      | Units |
|---------------|--------------------------------------|----------------------------------------------------------------|--------------------|------|-----------|-------|
| $V_{GE(th)}$  | Gate-Emitter Threshold Voltage       | $I_C=1.2mA$ , $V_{CE}=V_{GE}$ , $T_J=25^{\circ}C$              | 5.0                | 5.6  | 6.5       | V     |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C=40A$ ,<br>$V_{GE}=15V$                                    | $T_J=25^{\circ}C$  | 1.90 | 2.20      | V     |
|               |                                      |                                                                | $T_J=125^{\circ}C$ | 2.40 |           |       |
|               |                                      |                                                                | $T_J=150^{\circ}C$ | 2.50 |           |       |
| $I_{CES}$     | Collector-Emitter Leakage Current    | $V_{GE}=0V$ ,<br>$V_{CE}=V_{CES}$ , $T_J=25^{\circ}C$          |                    |      | 1         | mA    |
| $I_{GES}$     | Gate-Emitter Leakage Current         | $V_{GE}=\pm 20V$ ,<br>$V_{CE}=0V$ , $T_J=25^{\circ}C$          |                    |      | $\pm 200$ | nA    |
| $C_{ies}$     | Input Capacitance                    | $V_{CE}=25V$ , $V_{GE}=0V$ ,<br>$f=100kHz$ , $T_J=25^{\circ}C$ |                    | 2.19 |           | nF    |
| $C_{oes}$     | Output Capacitance                   |                                                                |                    | 0.19 |           |       |
| $C_{res}$     | Reverse Transfer Capacitance         |                                                                |                    | 0.04 |           |       |

### Switching Characteristics

|              |                        |                                                                                                                           |                    |  |     |  |    |
|--------------|------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------|--|-----|--|----|
| $t_{d(on)}$  | Turn-on Delay Time     | $V_{CC}=600V, I_C=40A,$<br>$R_{Gon}=36\Omega, V_{GE}=\pm 15V,$<br>Inductive Load                                          | $T_J=25^{\circ}C$  |  | 114 |  | ns |
|              |                        |                                                                                                                           | $T_J=125^{\circ}C$ |  | 126 |  |    |
|              |                        |                                                                                                                           | $T_J=150^{\circ}C$ |  | 130 |  |    |
| $t_r$        | Rise Time              |                                                                                                                           | $T_J=25^{\circ}C$  |  | 88  |  | ns |
|              |                        |                                                                                                                           | $T_J=125^{\circ}C$ |  | 96  |  |    |
|              |                        |                                                                                                                           | $T_J=150^{\circ}C$ |  | 102 |  |    |
| $t_{d(off)}$ | Turn-off Delay Time    | $V_{CC}=600V, I_C=40A,$<br>$R_{Goff}=36\Omega, V_{GE}=\pm 15V,$<br>Inductive Load                                         | $T_J=25^{\circ}C$  |  | 338 |  | ns |
|              |                        |                                                                                                                           | $T_J=125^{\circ}C$ |  | 362 |  |    |
|              |                        |                                                                                                                           | $T_J=150^{\circ}C$ |  | 364 |  |    |
| $t_f$        | Fall Time              |                                                                                                                           | $T_J=25^{\circ}C$  |  | 90  |  | ns |
|              |                        |                                                                                                                           | $T_J=125^{\circ}C$ |  | 110 |  |    |
|              |                        |                                                                                                                           | $T_J=150^{\circ}C$ |  | 114 |  |    |
| $E_{on}$     | Turn-on Switching Loss | $V_{CC}=600V, I_C=40A,$<br>$R_{Gon}=36\Omega, V_{GE}=\pm 15V,$<br>$di/dt=385A/\mu s(T_J=150^{\circ}C),$<br>Inductive Load | $T_J=25^{\circ}C$  |  | 3.7 |  | mJ |
|              |                        |                                                                                                                           | $T_J=125^{\circ}C$ |  | 4.1 |  |    |
|              |                        |                                                                                                                           | $T_J=150^{\circ}C$ |  | 4.3 |  |    |



|                     |                                                                                           |                                                                                                                                                           |                       |  |     |      |      |
|---------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--|-----|------|------|
| E <sub>off</sub>    | Turn-off Switching Loss                                                                   | V <sub>CC</sub> =600V, I <sub>C</sub> =40A,<br>R <sub>Goff</sub> =36Ω, V <sub>GE</sub> =±15V,<br>du/dt=3855V/μs(T <sub>J</sub> =150°C),<br>Inductive Load | T <sub>J</sub> =25°C  |  | 2.3 |      | mJ   |
|                     |                                                                                           |                                                                                                                                                           | T <sub>J</sub> =125°C |  | 2.5 |      |      |
|                     |                                                                                           |                                                                                                                                                           | T <sub>J</sub> =150°C |  | 2.9 |      |      |
| Q <sub>g</sub>      | Total Gate Charge                                                                         | V <sub>GE</sub> =-15V...+15V                                                                                                                              | T <sub>J</sub> =25°C  |  | 457 |      | nC   |
| R <sub>G(int)</sub> | Internal Gate Resistor                                                                    |                                                                                                                                                           | T <sub>J</sub> =25°C  |  | 0   |      | Ω    |
| I <sub>SC</sub>     | V <sub>CC</sub> =600V, V <sub>GE</sub> =±15V, t <sub>p</sub> =10us, T <sub>J</sub> =150°C |                                                                                                                                                           |                       |  | 162 |      | A    |
| R <sub>θJH</sub>    | Thermal Resistance: Junction-to-Heatsink<br>(per IGBT, λgrease=3.4W/(m·K))                |                                                                                                                                                           |                       |  |     | 0.53 | °C/W |

## Diode, Inverter

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

| Symbol           | Description                      | Conditions            | Values | Units |
|------------------|----------------------------------|-----------------------|--------|-------|
| V <sub>RRM</sub> | Repetitive Peak Reverse Voltage  | T <sub>J</sub> =25°C  | 1200   | V     |
| I <sub>F</sub>   | Diode Continuous Forward Current | T <sub>C</sub> =100°C | 40     | A     |
| I <sub>FM</sub>  | Peak Diode Current Repetitive    | t <sub>p</sub> =1ms   | 80     | A     |

### Electrical Characteristics of FWD (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> =40A                                                                                             | T <sub>J</sub> =25℃  |      | 1.70 |      | V     |
|                 |                               |                                                                                                                 | T <sub>J</sub> =125℃ |      | 1.85 |      |       |
|                 |                               |                                                                                                                 | T <sub>J</sub> =150℃ |      | 1.85 |      |       |
| I <sub>rr</sub> | Peak Reverse Recovery Current | I <sub>F</sub> =40A,<br>di/dt=432A/μs(T <sub>J</sub> =150℃),<br>V <sub>rr</sub> =600V,<br>V <sub>GE</sub> =-15V | T <sub>J</sub> =25℃  |      | 24.3 |      | A     |
|                 |                               |                                                                                                                 | T <sub>J</sub> =125℃ |      | 25.4 |      |       |
|                 |                               |                                                                                                                 | T <sub>J</sub> =150℃ |      | 25.8 |      |       |
| t <sub>rr</sub> | Reverse Recovery Time         |                                                                                                                 | T <sub>J</sub> =25℃  |      | 174  |      | ns    |
|                 |                               |                                                                                                                 | T <sub>J</sub> =125℃ |      | 190  |      |       |
|                 |                               |                                                                                                                 | T <sub>J</sub> =150℃ |      | 208  |      |       |
| Q <sub>rr</sub> | Reverse Recovery Charge       |                                                                                                                 | T <sub>J</sub> =25℃  |      | 2.2  |      | μC    |
|                 |                               |                                                                                                                 | T <sub>J</sub> =125℃ |      | 2.4  |      |       |
|                 |                               |                                                                                                                 | T <sub>J</sub> =150℃ |      | 2.8  |      |       |



|                  |                                                                              |                                                                                                                 |                      |  |      |      |     |
|------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------|--|------|------|-----|
| E <sub>rec</sub> | Reverse Recovery Energy                                                      | I <sub>F</sub> =40A,<br>di/dt=432A/μs(T <sub>J</sub> =150℃),<br>V <sub>rr</sub> =600V,<br>V <sub>GE</sub> =-15V | T <sub>J</sub> =25℃  |  | 0.17 |      | mJ  |
|                  |                                                                              |                                                                                                                 | T <sub>J</sub> =125℃ |  | 0.18 |      |     |
|                  |                                                                              |                                                                                                                 | T <sub>J</sub> =150℃ |  | 0.20 |      |     |
| R <sub>θJH</sub> | Thermal Resistance: Junction-to- Heatsink<br>(per Diode, λgrease=3.4W/(m·K)) |                                                                                                                 |                      |  |      | 0.85 | ℃/W |

## Internal NTC-Thermistor Characteristics

| Symbol              | Conditions                                       | Min. | Typ. | Max. | Units |
|---------------------|--------------------------------------------------|------|------|------|-------|
| R <sub>25</sub>     | T <sub>C</sub> =25°C                             |      | 22   |      | kΩ    |
| ΔR/R                | T <sub>C</sub> =100°C, R <sub>100</sub> =1481Ω   | -5   |      | 5    | %     |
| P <sub>25</sub>     | T <sub>C</sub> =25°C                             |      |      | 200  | mW    |
| B <sub>25/50</sub>  | $R_2=R_{25} \exp[B_{25/50}(1/T_2-1/(298.15K))]$  |      | 3950 |      | K     |
| B <sub>25/80</sub>  | $R_2=R_{25} \exp[B_{25/80}(1/T_2-1/(298.15K))]$  |      | 3982 |      | K     |
| B <sub>25/100</sub> | $R_2=R_{25} \exp[B_{25/100}(1/T_2-1/(298.15K))]$ |      | 3998 |      | K     |

## Module

| Symbol             | Description                                  | Conditions           | Min.                           | Typ. | Max. | Units |
|--------------------|----------------------------------------------|----------------------|--------------------------------|------|------|-------|
| V <sub>iso</sub>   | Isolation Voltage (All Terminals Shorted)    | RMS, f=50Hz, 1minute | 2500                           |      |      | V     |
| Internal Isolation |                                              |                      | Al <sub>2</sub> O <sub>3</sub> |      |      |       |
| d <sub>creep</sub> | Creepage Distance                            |                      | 12.7                           |      |      | mm    |
| d <sub>clear</sub> | Clearance                                    |                      | 12.7                           |      |      | mm    |
| T <sub>J</sub>     | Maximum Junction Temperature                 |                      |                                |      | 175  | °C    |
| T <sub>JOP</sub>   | Maximum Operating Junction Temperature Range |                      | -40                            |      | +150 | °C    |
| T <sub>stg</sub>   | Storage Temperature                          |                      | -40                            |      | +125 | °C    |
| CTI                | Comparative Tracking Index                   |                      | 225                            |      |      |       |
| M                  | Mounting Screw:M4                            |                      | 1.0                            |      | 1.5  | N·m   |
| G                  | Weight                                       |                      |                                | 39   |      | g     |



## Ordering Information Table

Device code

|   |   |    |    |     |    |   |
|---|---|----|----|-----|----|---|
| G | T | 40 | FF | 120 | C7 | H |
| ① | ② | ③  | ④  | ⑤   | ⑥  | ⑦ |

- ① - IGBT Module
- ② - Trench, Low Switching Losses IGBT
- ③ - Rated Current (40=40A)
- ④ - Circuit Configuration (FF=Full Bridge)
- ⑤ - Rated Voltage (120=1200V)
- ⑥ - Package Type
- ⑦ - Test Level (Pass the Important Reliability Test-Industrial Grade)

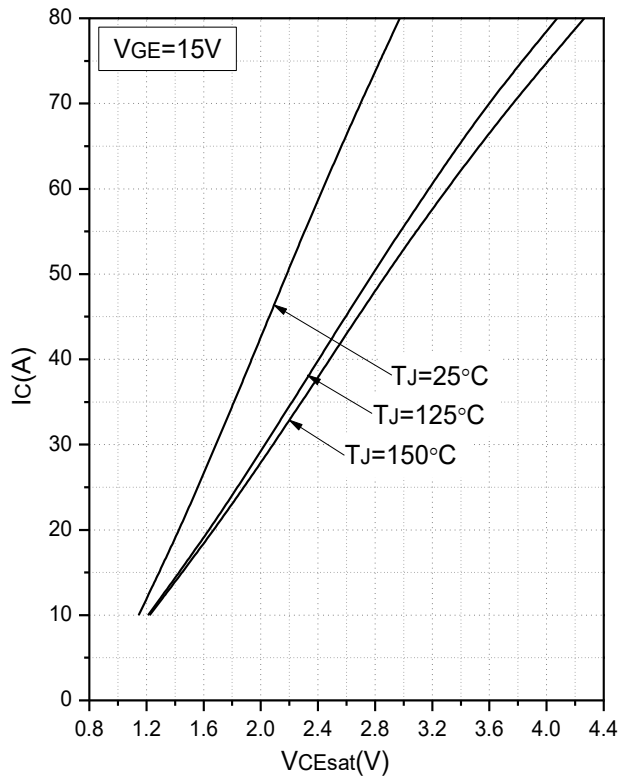


Fig.1 Typical Saturation Voltage Characteristics

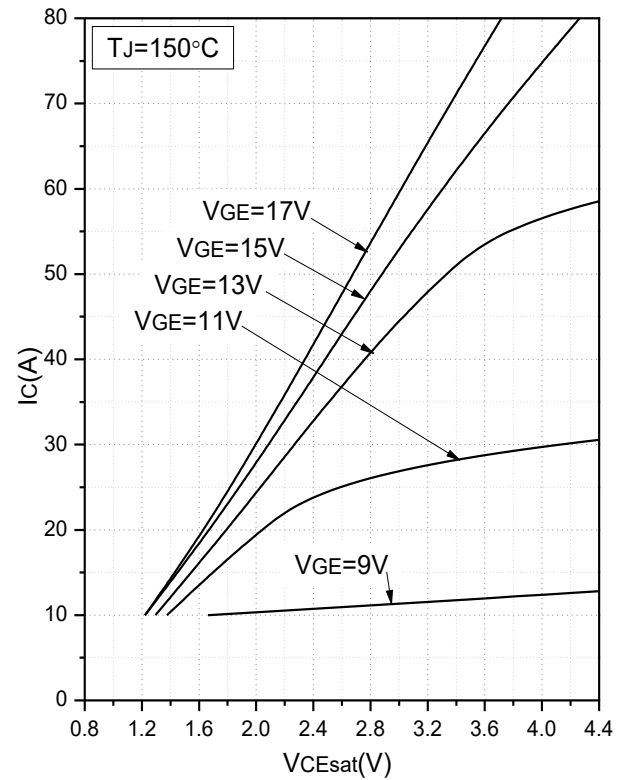


Fig.2 Typical Output Characteristics

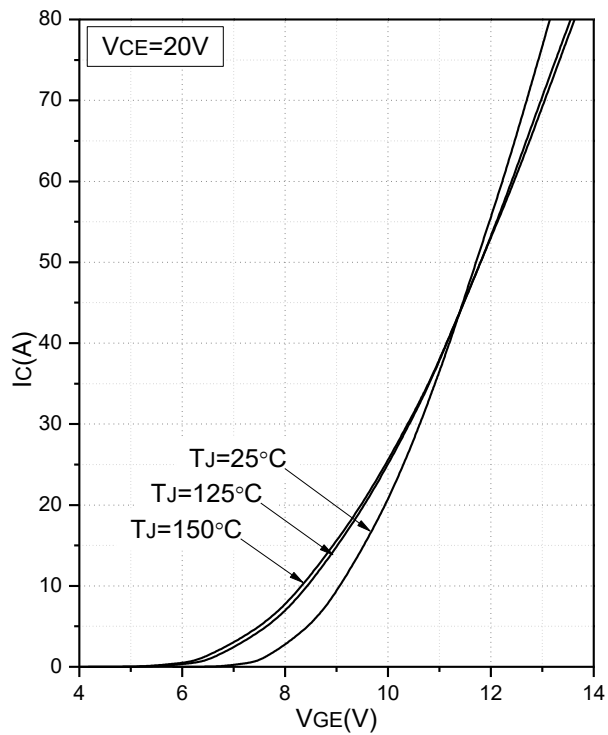


Fig.3 Transfer Characteristic

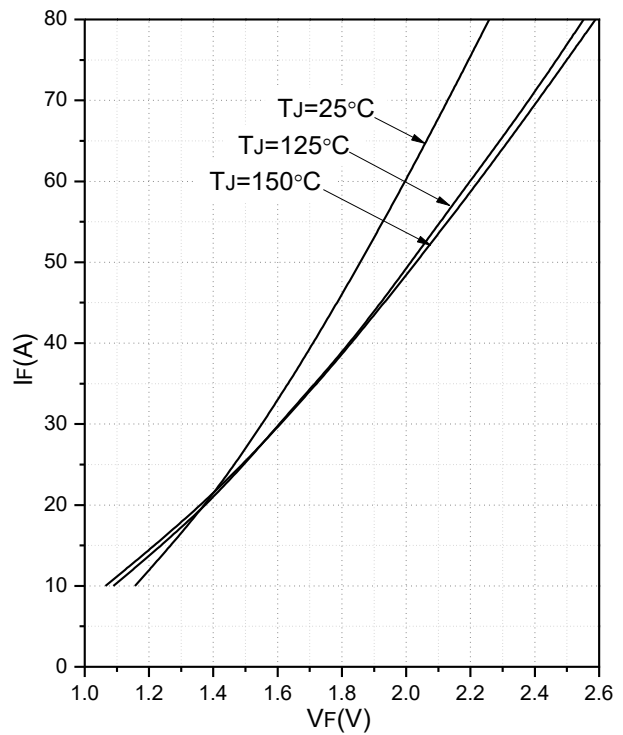


Fig.4 Forward Characteristics of Diode

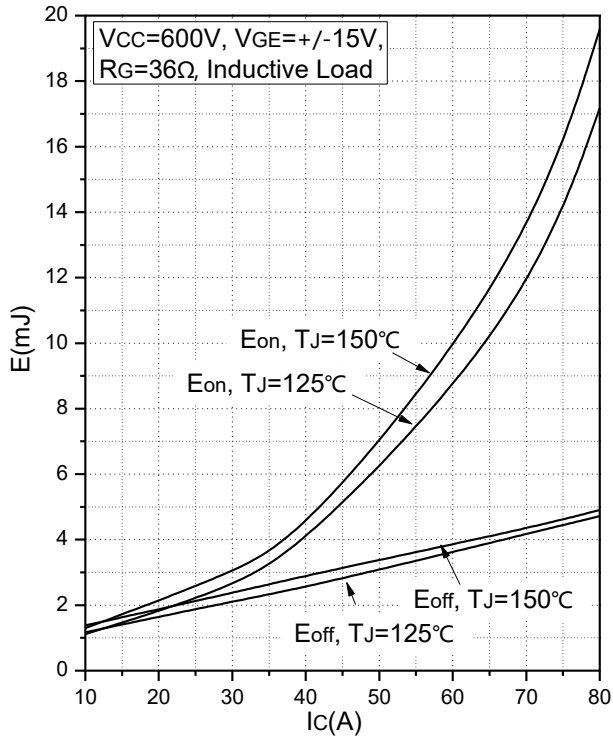


Fig.5 Typical Switching Loss vs. Collector Current

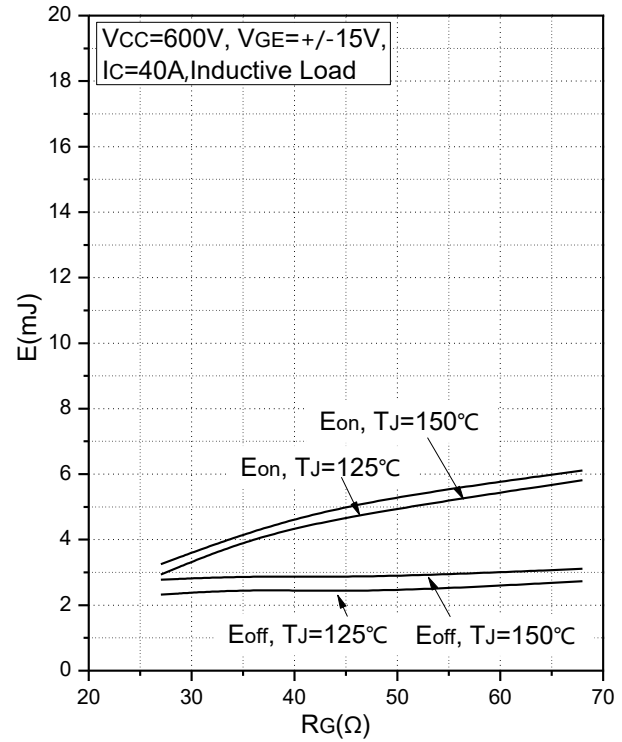


Fig.6 Typical Switching Loss vs. Gate Resistance

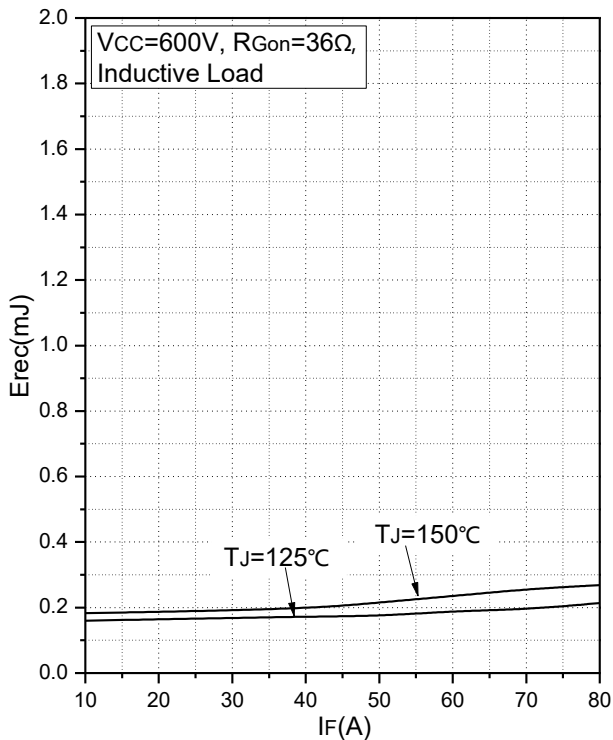


Fig.7 Typical Switching Loss vs. Forward Current

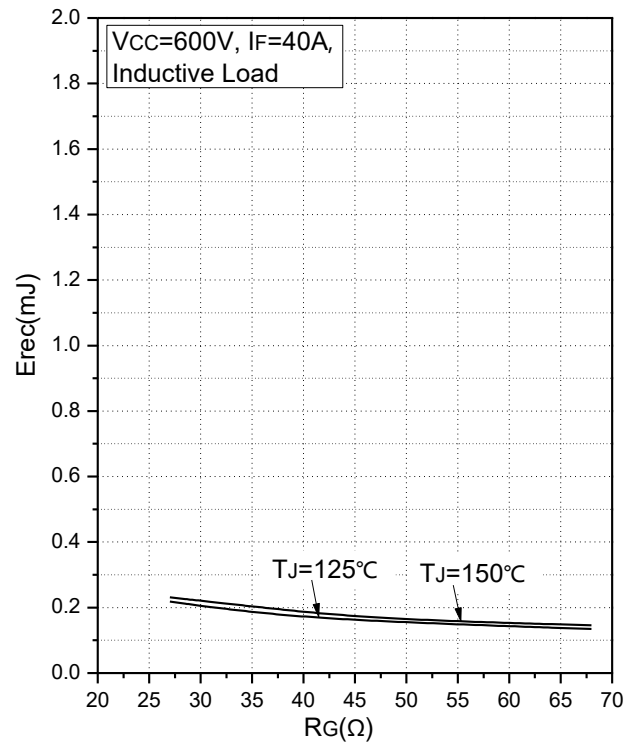


Fig.8 Typical Switching Loss vs. Gate Resistance

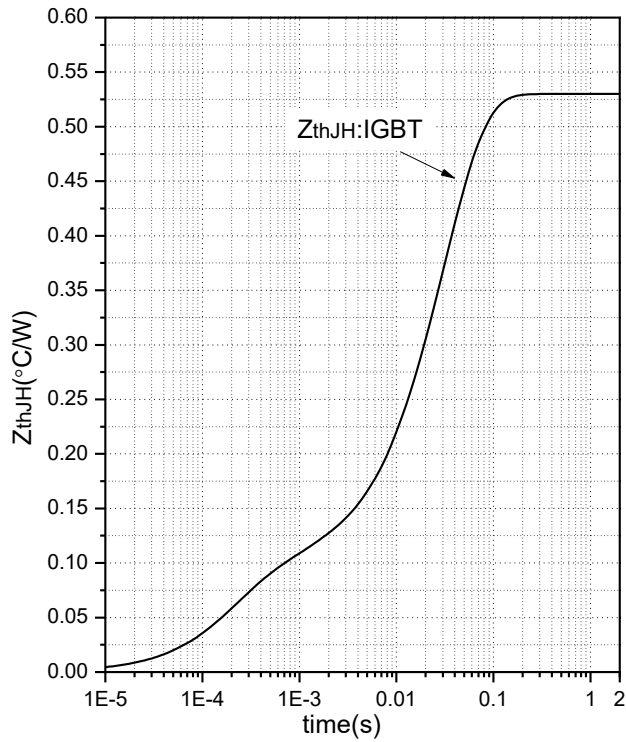


Fig.9 Transient Thermal Impedance

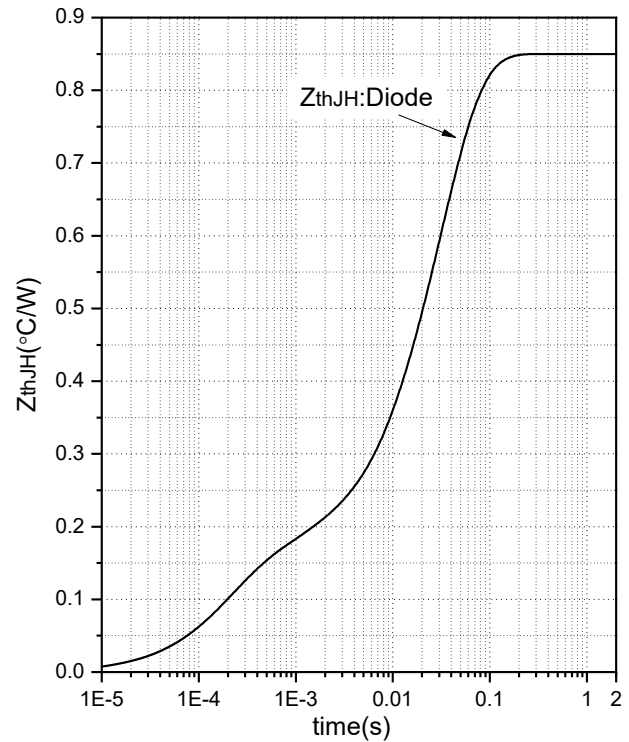


Fig.10 Transient Thermal Impedance

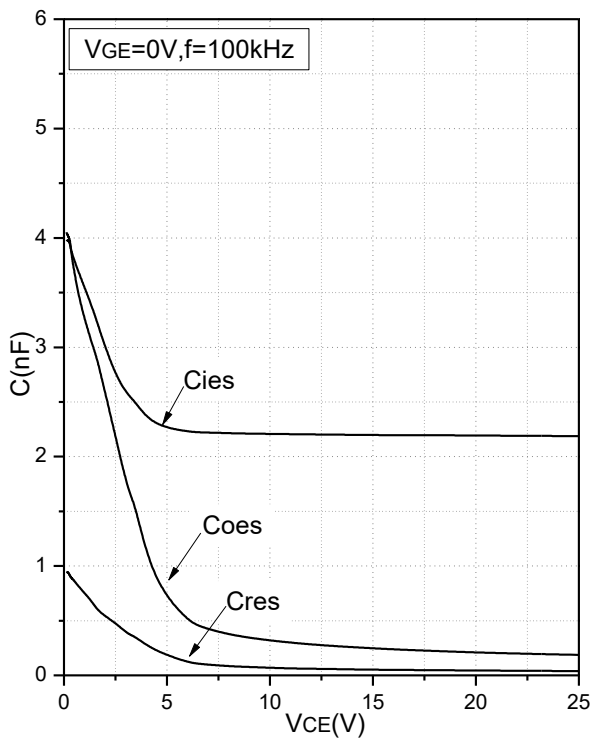


Fig.11 Capacitance Characteristics

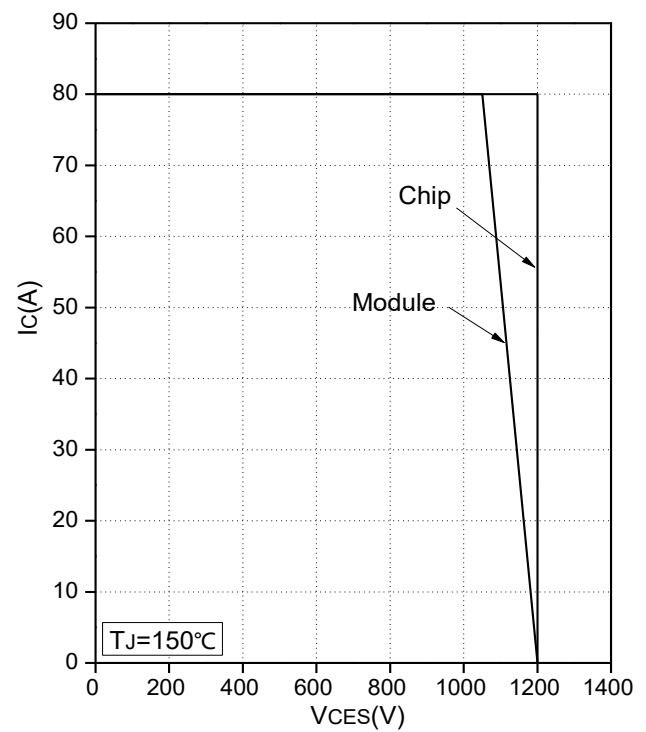


Fig.12 Reverse Bias Safe Operation Area (RBSOA)

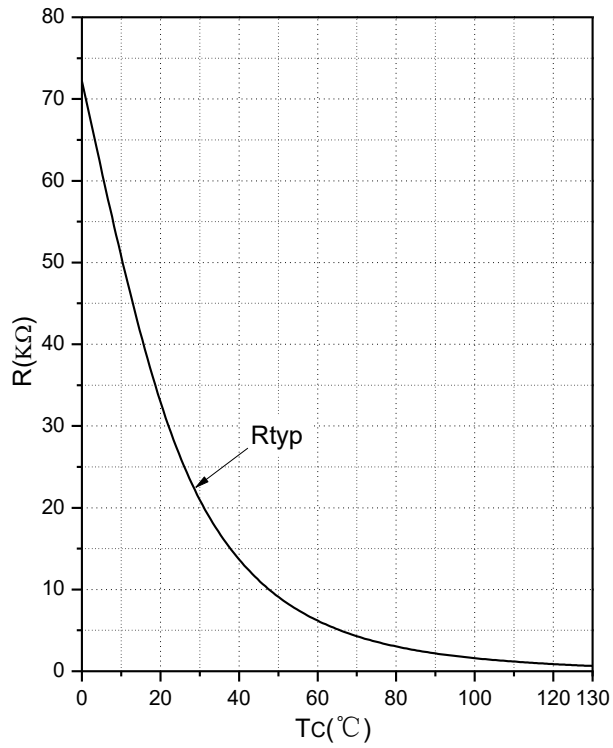
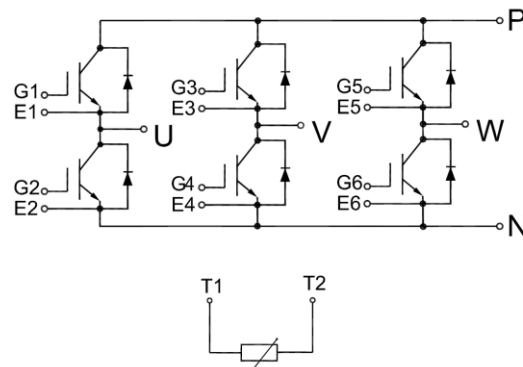


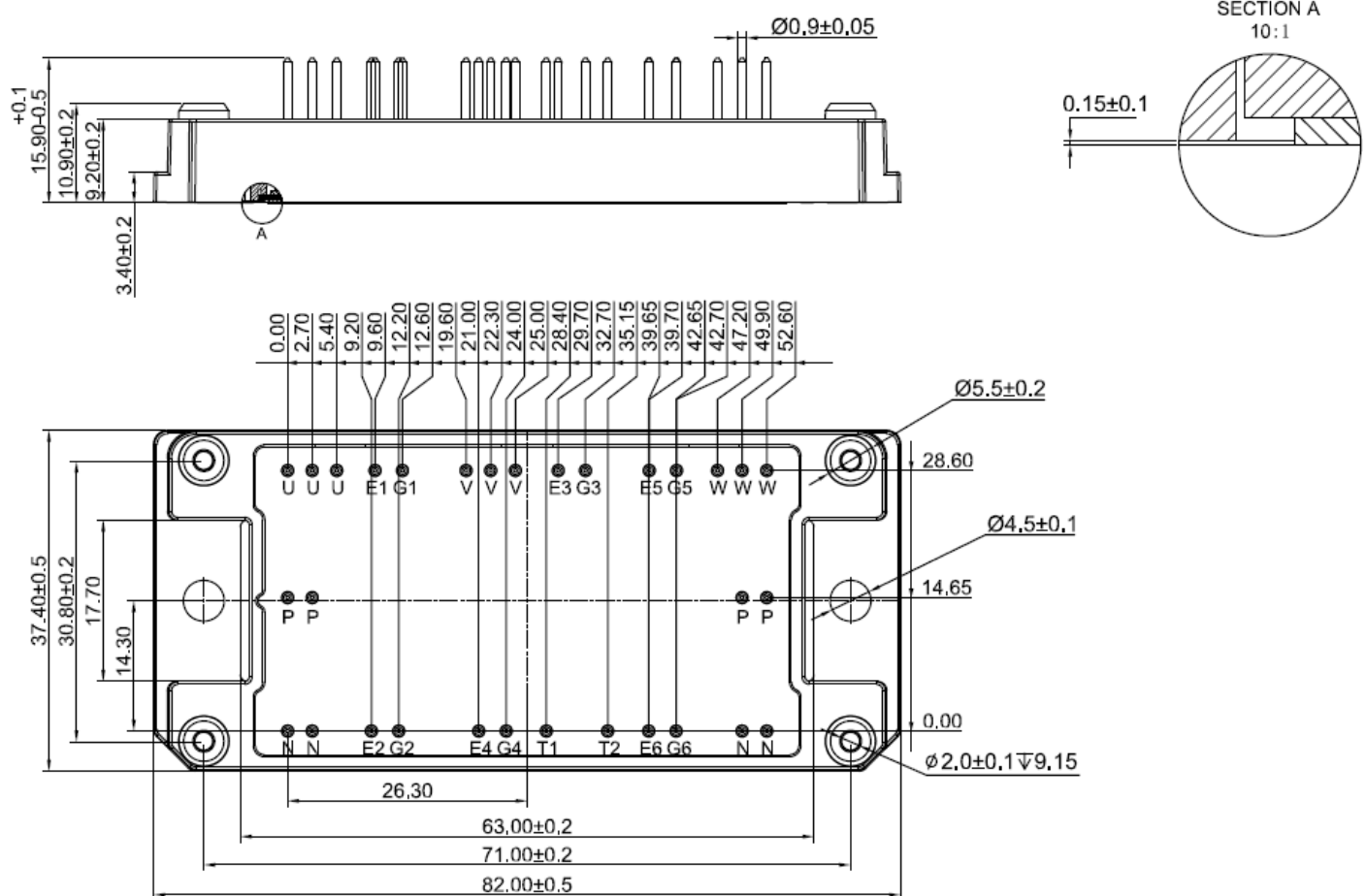
Fig.13 NTC Temperature Characteristics



## Internal Circuit:



## Package Outline (Unit: mm):





| Revision | Notes           |
|----------|-----------------|
| 01       | Initial Release |
|          |                 |

## **Announcements**

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