

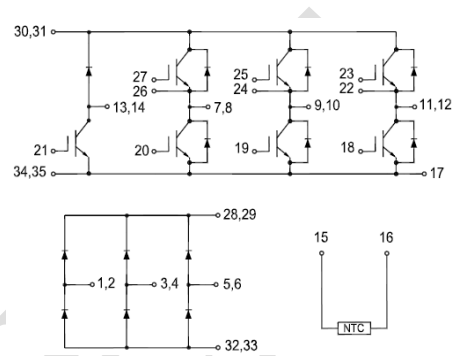


GT50PI120T6H-M

IGBT Module

Features:

- Field Stop Trench Gate IGBT
- Short Circuit Rated >10 μ s
- Low Saturation Voltage
- Low Switching Loss
- 100% RBSOA Tested(2xIc)
- Low Stray Inductance
- Lead Free, Compliant with RoHS Requirement



Applications:

- Industrial Inverters
- Servo Applications

IGBT, Inverter

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

| | | | | |
|-----------|------------------------------------|------------------------------|----------|---------------|
| V_{CES} | Collector-Emitter Blocking Voltage | | 1200 | V |
| V_{GES} | Gate-Emitter Voltage | | ± 20 | V |
| I_C | Continuous Collector Current | $T_C=100^\circ\text{C}$ | 50 | A |
| | | $T_C=25^\circ\text{C}$ | 100 | A |
| I_{CM} | Peak Collector Current Repetitive | $T_J=175^\circ\text{C}$ | 100 | A |
| t_{sc} | Short Circuit Withstand Time | | >10 | μs |
| P_D | Maximum Power Dissipation (IGBT) | $T_C=25^\circ\text{C}$ | 398 | W |
| | | $T_{Jmax}=175^\circ\text{C}$ | | |



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

Static Characteristics

| Symbol | Description | Conditions | Min | Typ | Max | Unit |
|---------------|--------------------------------------|--|-------------------------|------|------|------|
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C=1\text{mA}$, $V_{CE}=V_{GE}$ | 5.0 | 5.6 | 6.6 | V |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C=50\text{A}$, $V_{GE}=15\text{V}$ | $T_J=25^\circ\text{C}$ | 1.70 | 2.00 | V |
| | | | $T_J=125^\circ\text{C}$ | 1.90 | | V |
| | | | $T_J=150^\circ\text{C}$ | 1.90 | | V |
| I_{CES} | Collector-Emitter Leakage Current | $V_{GE}=0\text{V}$, $V_{CE}=V_{CES}$, $T_J=25^\circ\text{C}$ | | | 1 | mA |
| I_{GES} | Gate-Emitter Leakage Current | $V_{GE}=\pm 20\text{V}$, $V_{CE}=0\text{V}$, $T_J=25^\circ\text{C}$ | | | 200 | nA |
| C_{ies} | Input Capacitance | $V_{CE}=25\text{V}$, $V_{GE}=0\text{V}$, $f=1\text{MHz}$ | | 3.65 | | nF |
| C_{oes} | Output Capacitance | | | 0.50 | | nF |
| C_{res} | Reveres Transfer Capacitance | | | 0.31 | | nF |

Switching Characteristics

| | | | | | | |
|--------------|------------------------|---|-------------------------|------|----|----|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{CC}=600\text{V}$, $I_C=50\text{A}$, $R_{Gon}=15\Omega$, $V_{GE}=\pm 15\text{V}$, Inductive Load | $T_J=25^\circ\text{C}$ | 154 | | ns |
| | | | $T_J=125^\circ\text{C}$ | 169 | | |
| | | | $T_J=150^\circ\text{C}$ | 174 | | |
| t_r | Rise Time | | $T_J=25^\circ\text{C}$ | 51 | | ns |
| | | | $T_J=125^\circ\text{C}$ | 54 | | |
| | | | $T_J=150^\circ\text{C}$ | 56 | | |
| $t_{d(off)}$ | Turn-off Delay Time | $T_J=25^\circ\text{C}$ | 202 | | ns | |
| | | $T_J=125^\circ\text{C}$ | 216 | | | |
| | | $T_J=150^\circ\text{C}$ | 225 | | | |
| t_f | Fall Time | $T_J=25^\circ\text{C}$ | 220 | | ns | |
| | | $T_J=125^\circ\text{C}$ | 379 | | | |
| | | $T_J=150^\circ\text{C}$ | 407 | | | |
| E_{on} | Turn-on Switching Loss | $V_{CC}=600\text{V}$, $I_C=50\text{A}$, $R_{Gon}=15\Omega$, $V_{GE}=\pm 15\text{V}$, $di/dt=791\text{A}/\mu\text{s}$ ($T_J=150^\circ\text{C}$), Inductive Load | $T_J=25^\circ\text{C}$ | 3.37 | | mJ |
| | | | $T_J=125^\circ\text{C}$ | 5.10 | | |
| | | | $T_J=150^\circ\text{C}$ | 5.53 | | |



| | | | | | |
|-------------------------|---|---|-----------------------|-----------|------|
| E _{off} | Turn-off Switching Loss | V _{CC} =600V, I _C =50A, R _{Goff} =15Ω, V _{GE} =±15V, du/dt=3488V/μs(T _J =150°C), Inductive Load | T _J =25°C | 2.42 | mJ |
| | | | T _J =125°C | 4.09 | |
| | | | T _J =150°C | 4.52 | |
| Q _g | Total Gate Charge | V _{GE} =+15V...-15V | T _J =25°C | 504 | nC |
| R _{g internal} | Internal Gate Resistance | | T _J =25°C | 4 | Ω |
| RBSOA | I _C =100A, V _{CC} =1050V, V _p =1200V, R _G =15Ω, V _{GE} =+15V to 0V, T _J =150°C | | | Trapezoid | |
| SC data | V _{CC} =600V, t _p =10us, V _{ge} =+/-15V, R _{Gon} =15ohm, R _{Goff} =15ohm, T _J =25°C | | | 256 | A |
| R _{θJC} | IGBT Thermal Resistance: Junction-To-Case | | | 0.38 | °C/W |

Diode, Inverter

Maximum Rated Values (T_C = 25°C unless otherwise specified)

| | | | |
|------------------|----------------------------------|------|---|
| V _{RRM} | Repetitive Peak Reverse Voltage | 1200 | V |
| I _F | Diode Continuous Forward Current | 50 | A |
| I _{FM} | Peak FWD Current Repetitive | 100 | A |

Electrical Characteristics of FWD (T_C=25°C unless otherwise specified)

| Symbol | Description | Conditions | Min | Typ | Max | Unit |
|-----------------|-------------------------------|---|-----------------------|------|-----|------|
| V _{FM} | Forward Voltage | I _F =50A | T _J =25°C | 1.40 | | V |
| | | | T _J =125°C | 1.50 | | |
| | | | T _J =150°C | 1.45 | | |
| t _{rr} | Reverse Recovery Time | I _F =50A, -diF/dt =1197A/μs(T _J =150°C), V _R =600V, V _{GE} =-15V | T _J =25°C | 318 | | ns |
| | | | T _J =125°C | 539 | | |
| | | | T _J =150°C | 554 | | |
| I _{rr} | Peak Reverse Recovery Current | I _F =50A, -diF/dt =1197A/μs(T _J =150°C), V _R =600V, V _{GE} =-15V | T _J =25°C | 57 | | A |
| | | | T _J =125°C | 60 | | |
| | | | T _J =150°C | 65 | | |



| | | | | | | | |
|------------------|--|---|-----------------------|--|-------|------|----|
| Q _{rr} | Reverse Recovery Charge | I _F =50A, -diF/dt =1197A/μs(T _J =150°C), V _R =600V, V _{GE} =-15V | T _J =25°C | | 7.95 | | μC |
| | | | T _J =125°C | | 12.78 | | |
| | | | T _J =150°C | | 14.17 | | |
| E _{rec} | Reverse Recovery Energy | | T _J =25°C | | 3.15 | | mJ |
| | | | T _J =125°C | | 5.21 | | |
| | | | T _J =150°C | | 6.05 | | |
| R _{θJC} | Diode Thermal Resistance: Junction-To-Case | | | | 0.51 | °C/W | |

IGBT, Brake-Chopper Maximum Rated Values (T_C=25°C unless otherwise specified)

| | | | | |
|------------------|------------------------------------|--|------|----|
| V _{CEs} | Collector-Emitter Blocking Voltage | T _C =25°C | 1200 | V |
| V _{GES} | Gate-Emitter Voltage | | ±20 | V |
| I _C | Continuous Collector Current | T _C =100°C | 25 | A |
| | | T _C =25°C | 50 | A |
| I _{CM} | Peak Collector Current Repetitive | T _J =150°C | 50 | A |
| t _{sc} | Short Circuit Withstand Time | | >10 | μs |
| P _D | Maximum Power Dissipation (IGBT) | T _C =25°C T _{Jmax} =175°C | 260 | W |

Electrical Characteristics of IGBT (T_C=25°C unless otherwise specified)

Static Characteristics

| Symbol | Description | Conditions | Min | Typ | Max | Unit |
|----------------------|--------------------------------------|--|-----------------------|------|------|------|
| V _{GE(th)} | Gate-Emitter Threshold Voltage | I _C =1 mA, V _{CE} =V _{GE} | 5.0 | 5.5 | 6.0 | V |
| V _{CE(sat)} | Collector-Emitter Saturation Voltage | I _C =25A, V _{GE} =15V | T _J =25°C | 1.90 | 2.20 | V |
| | | | T _J =125°C | 2.20 | | V |
| I _{CEs} | Collector-Emitter Leakage Current | V _{GE} =0V, V _{CE} =V _{CEs} , T _J =25°C | | | 1 | mA |
| I _{GES} | Gate-Emitter Leakage Current | V _{GE} =±20V, V _{CE} =0V, T _J =25°C | | | 100 | nA |
| C _{ies} | Input Capacitance | V _{CE} =25V, V _{GE} =0V, f=1MHz | | 3.40 | | nF |
| C _{res} | Reveres Transfer Capacitance | | | 0.13 | | nF |



Switching Characteristics

| | | | | | |
|--------------------------|--|--|-------------------|-----------|--------------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{CC}=600V, I_C=25A,$ $R_{Gon}=15\Omega, V_{GE}=\pm 15V,$ Inductive Load | $T_J=25^\circ C$ | 140 | ns |
| | | | $T_J=125^\circ C$ | 140 | |
| t_r | Rise Time | | $T_J=25^\circ C$ | 45 | ns |
| | | | $T_J=125^\circ C$ | 50 | |
| $t_{d(off)}$ | Turn-off Delay Time | $V_{CC}=600V, I_C=25A,$ $R_{Goff}=15\Omega, V_{GE}=\pm 15V,$ Inductive Load | $T_J=25^\circ C$ | 165 | ns |
| | | | $T_J=125^\circ C$ | 170 | |
| t_f | Fall Time | | $T_J=25^\circ C$ | 220 | ns |
| | | | $T_J=125^\circ C$ | 330 | |
| E_{on} | Turn-on Switching Loss | $V_{CC}=600V, I_C=25A,$ $R_{Gon}=15\Omega, V_{GE}=\pm 15V,$ $di/dt=556A/\mu s(T_J=125^\circ C),$ Inductive Load | $T_J=25^\circ C$ | 1.76 | mJ |
| | | | $T_J=125^\circ C$ | 2.13 | |
| E_{off} | Turn-off Switching Loss | | $T_J=25^\circ C$ | 1.02 | mJ |
| | | | $T_J=125^\circ C$ | 1.72 | |
| Q_g | Total Gate Charge | $V_{GE}=+15V \dots -15V$ | $T_J=25^\circ C$ | 120 | nC |
| $R_{g \text{ internal}}$ | Internal Gate Resistance | | $T_J=25^\circ C$ | 0 | Ω |
| RBSOA | $I_C=50A, V_{CC}=1050V, V_p=1200V, R_{Goff}=15\Omega, V_{GE}=+15V \text{ to } 0V, T_J=150^\circ C$ | | | Trapezoid | |
| SCSOA | $V_{CC}=600V, V_{GE}=15V, T_J=150^\circ C$ | | | 10 | μs |
| $R_{\theta JC}$ | IGBT Thermal Resistance: Junction-To-Case | | | 0.52 | $^\circ C/W$ |

Diode, Brake-Chopper

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

| | | | |
|-----------|----------------------------------|------|---|
| V_{RRM} | Repetitive Peak Reverse Voltage | 1200 | V |
| I_F | Diode Continuous Forward Current | 25 | A |
| I_{FM} | Peak FWD Current Repetitive | 50 | A |



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

| Symbol | Description | Conditions | Min | Typ | Max | Unit |
|-----------------|--|--|-------------------------|------|------|---------------------------|
| V_{FM} | Forward Voltage | $I_F=25\text{A}$ | $T_J=25^\circ\text{C}$ | 1.80 | 2.10 | V |
| | | | $T_J=125^\circ\text{C}$ | 2.00 | | |
| t_{rr} | Reverse Recovery Time | $I_F=25\text{A}$, $-di_F/dt = 659\text{A}/\mu\text{s}(T_J=150^\circ\text{C})$, $V_R=600\text{V}$, $V_{GE}=-15\text{V}$ | $T_J=25^\circ\text{C}$ | 118 | | ns |
| | | | $T_J=125^\circ\text{C}$ | 157 | | |
| I_{rr} | Peak Reverse Recovery Current | | $T_J=25^\circ\text{C}$ | 15 | | A |
| | | | $T_J=125^\circ\text{C}$ | 20 | | |
| Q_{rr} | Reverse Recovery Charge | | $T_J=25^\circ\text{C}$ | 1.05 | | μC |
| | | | $T_J=125^\circ\text{C}$ | 2.19 | | |
| E_{rec} | Reverse Recovery Energy | $T_J=25^\circ\text{C}$ | 0.39 | | mJ | |
| | | $T_J=125^\circ\text{C}$ | 0.95 | | | |
| $R_{\theta JC}$ | Diode Thermal Resistance: Junction-To-Case | | | | 0.80 | $^\circ\text{C}/\text{W}$ |

Diode, Rectifier

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

| | | | | |
|-------------|---|-------------------------|------|----------------------|
| V_{RRM} | Repetitive Peak Reverse Voltage | $T_J=25^\circ\text{C}$ | 1800 | V |
| I_{FRMSM} | Maximum RMS Forward Current Per Chip | $T_J=80^\circ\text{C}$ | 55 | A |
| I_{RMSM} | Maximum RMS Current At Rectifier Output | $T_J=80^\circ\text{C}$ | 65 | A |
| I_{FSM} | Surge Current @ $t_p=10\text{ms}$ | $T_J=25^\circ\text{C}$ | 630 | A |
| | | $T_J=150^\circ\text{C}$ | 550 | |
| I^2t | I^2t - Value | $T_J=25^\circ\text{C}$ | 1960 | A^2s |
| | | $T_J=150^\circ\text{C}$ | 1500 | |



Electrical Characteristics of Diode (T_C=25°C unless otherwise specified)

| Symbol | Description | Conditions | | Min | Typ | Max | Unit |
|------------------|---|-----------------------|-----------------------|-----|------|------|------|
| V _F | Forward Voltage | I _F =35 A | T _J =25°C | | 1.05 | | V |
| | | | T _J =125°C | | 0.98 | | |
| | | | T _J =150°C | | 0.97 | | |
| I _R | Reverse Current | V _R =1800V | T _J =25°C | | | 1 | mA |
| R _{θJC} | IGBT Thermal Resistance: Junction-To-Case | | | | | 0.55 | °C/W |

Internal NTC-Thermistor Characteristics

| Symbol | Description | | Min. | Typ. | Max. | Units. |
|--------------------|-------------------|---|------|------|------|--------|
| R ₂₅ | Rated Resistance | T _C =25°C | | 5 | | kΩ |
| ΔR/R | Deviation of R100 | T _C =100°C, R ₁₀₀ =481Ω | -5 | | 5 | % |
| P ₂₅ | Power Dissipation | T _C =25°C | | | 10 | mW |
| B _{25/50} | B-Value | $R_2=R_{25} \exp[B_{25/50}(1/T_2-1/(298.15K))]$ | | 3380 | | K |
| B _{25/80} | B-Value | $R_2=R_{25} \exp[B_{25/80}(1/T_2-1/(298.15K))]$ | | 3440 | | K |

Module

| Symbol | Description | Conditions | Min | Typ | Max | Unit |
|------------------|--|---|------|-----|------|------|
| V _{iso} | Isolation Voltage (All Terminals Shorted) | RMS, f=50Hz, 1minute | 2500 | | | V |
| T _J | Maximum Junction Temperature | | | | 175 | °C |
| T _{JOP} | Maximum Operating Junction Temperature Range | | -40 | | +150 | °C |
| T _{stg} | Storage Temperature | | -40 | | +125 | °C |
| CTI | Comparative Tracking Index | | 200 | | | V |
| R _{θCS} | Case-To-Sink Thermally (Conductive Grease Applied) | | | | 0.02 | °C/W |
| M | Mounting Torque for Module Mounting | Screw M5--Mounting according to valid application note | 3.0 | | 6.0 | N·m |
| G | Weight | | | 300 | | g |

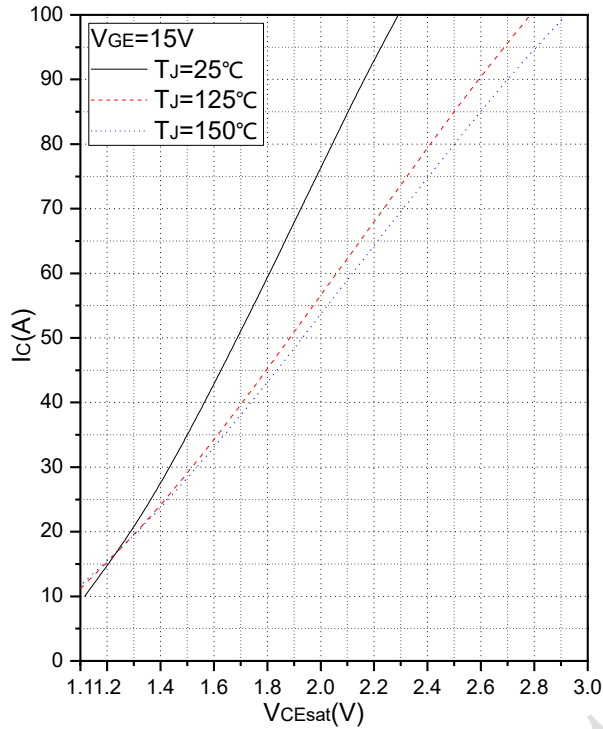


Fig.1 Typical Saturation Voltage Characteristics (Inverter)

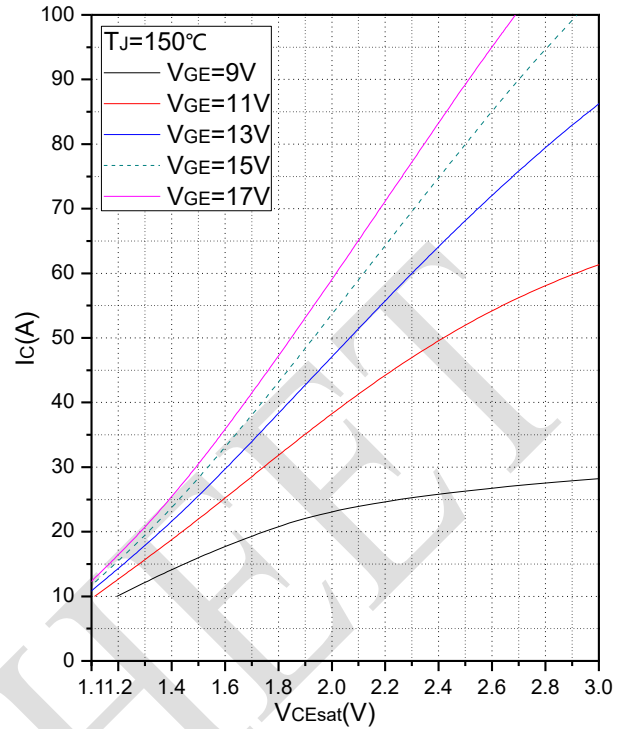


Fig.2 Typical Output Characteristics (Inverter)

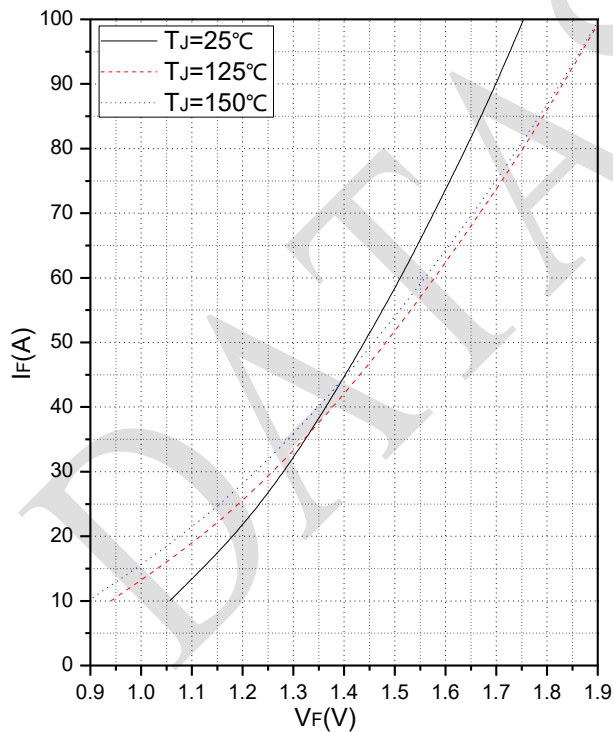


Fig.3 Forward Characteristics of FWD (Inverter)

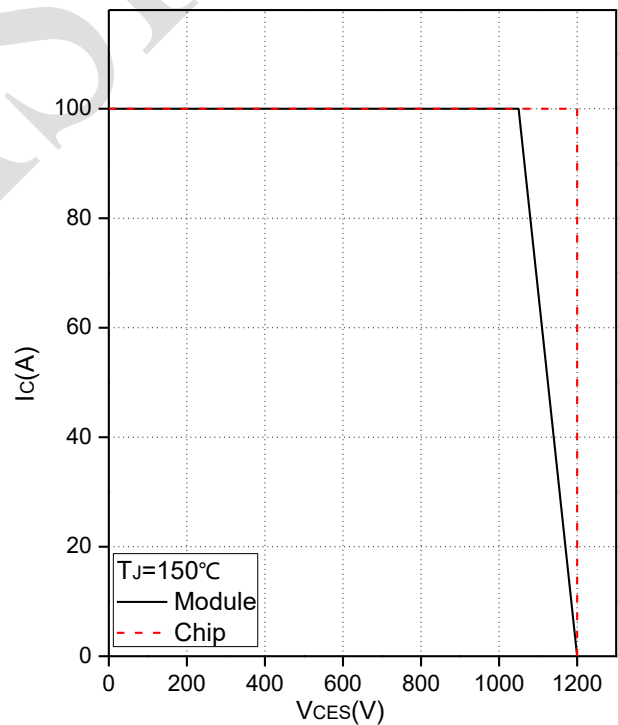


Fig.4 Reverse Bias Safe Operation Area (RBSOA)

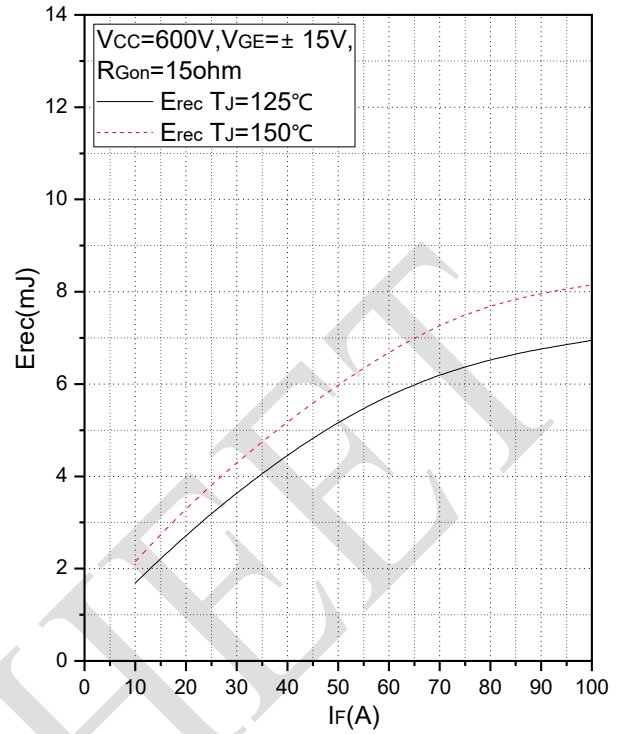
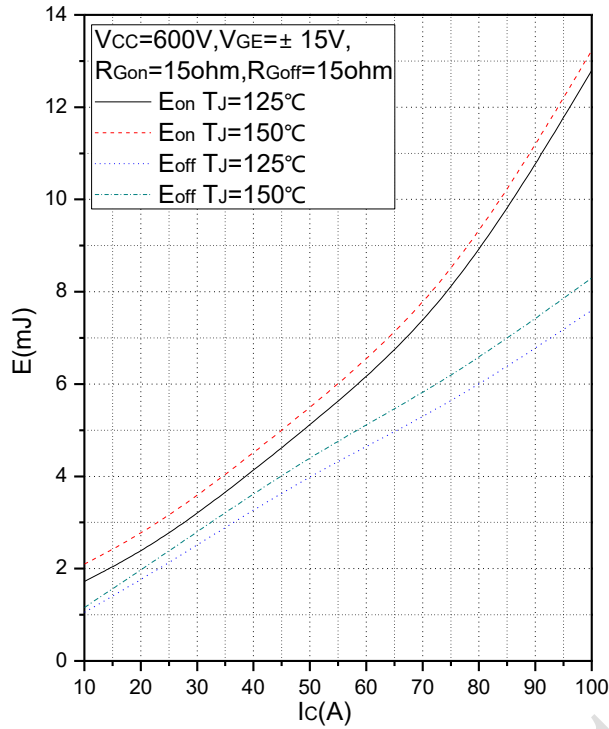


Fig.5 Typical Switching Loss vs. Collector Current (Inverter) Fig.6 Typical Switching Loss vs. Forward Current (Inverter)

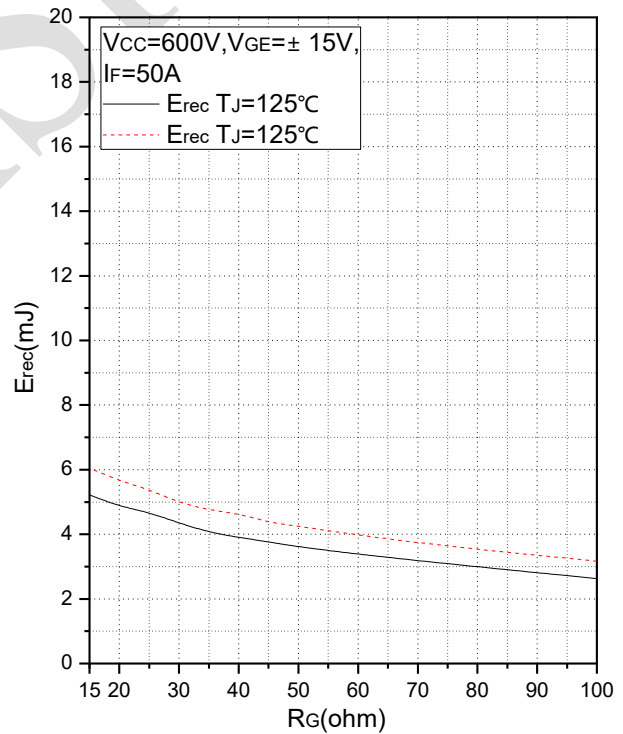
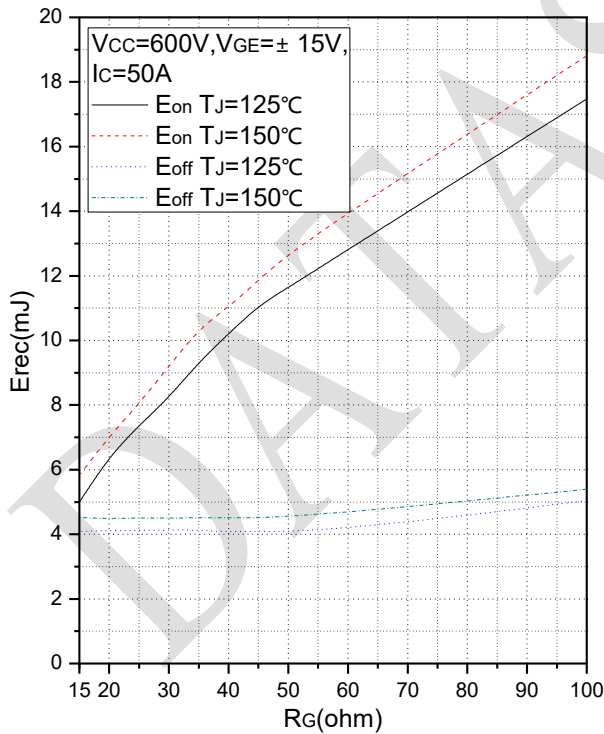


Fig.7 Typical Switching Loss vs. Gate Resistance (Inverter) Fig.8 Typical Switching Loss vs. Gate Resistance (Inverter)

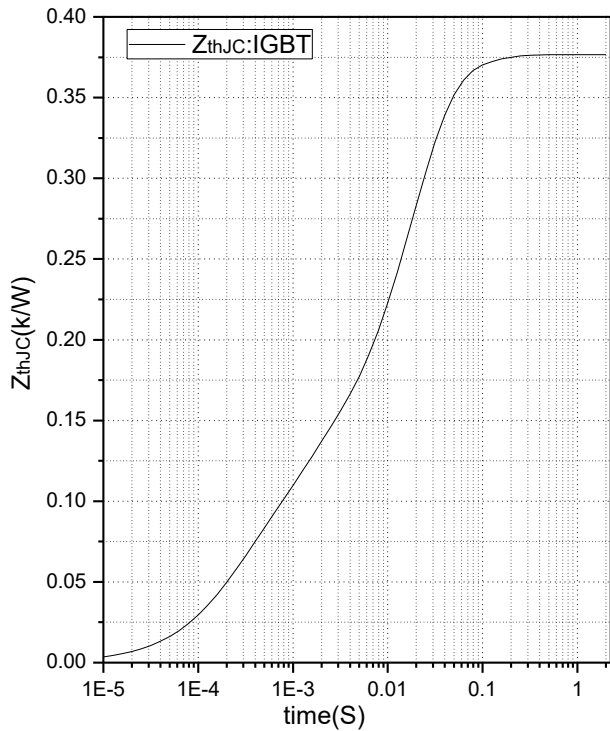


Fig.9 Transient Thermal Impedance (Inverter- IGBT)

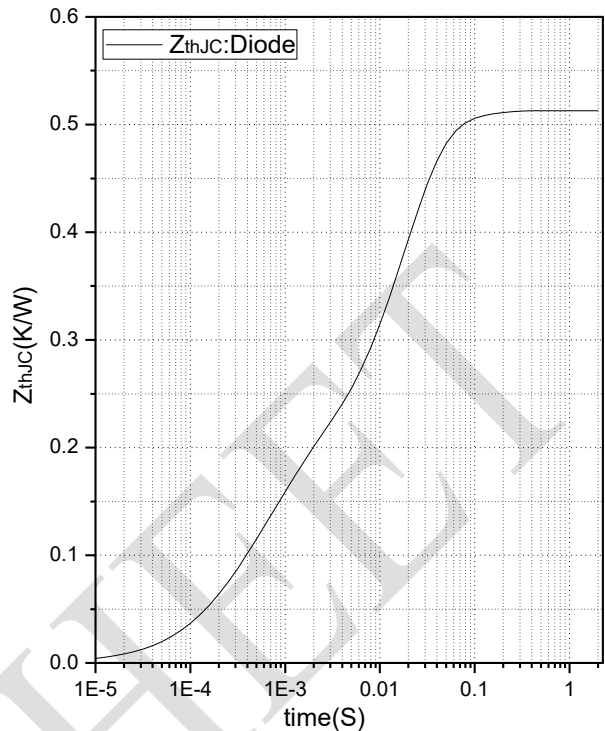


Fig.10 Transient Thermal Impedance (Inverter- Diode)

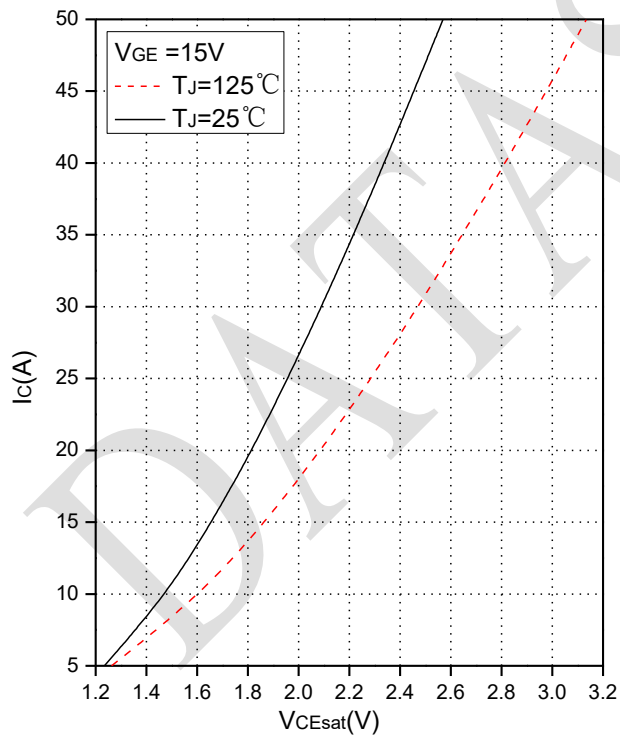


Fig.11 Typical Saturation Voltage Characteristics (Brake-Chopper)

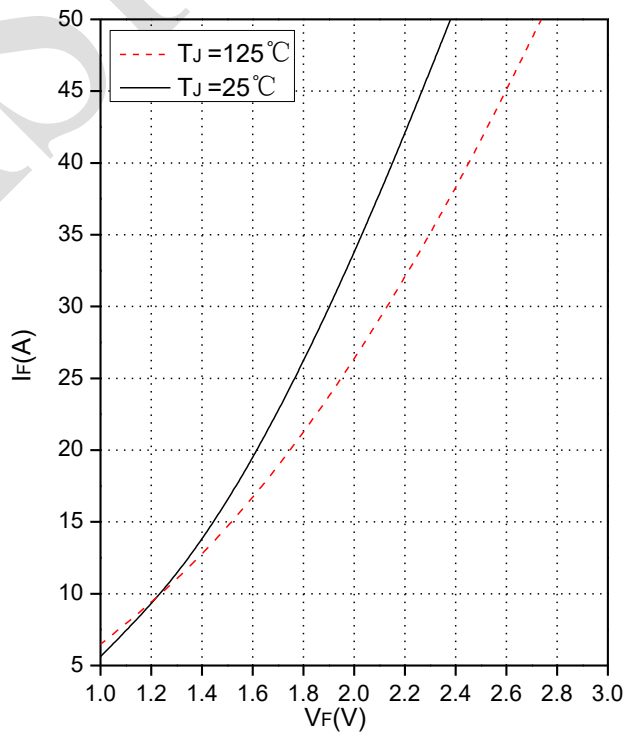


Fig.12 Forward Characteristics of Diode (Brake-Chopper)

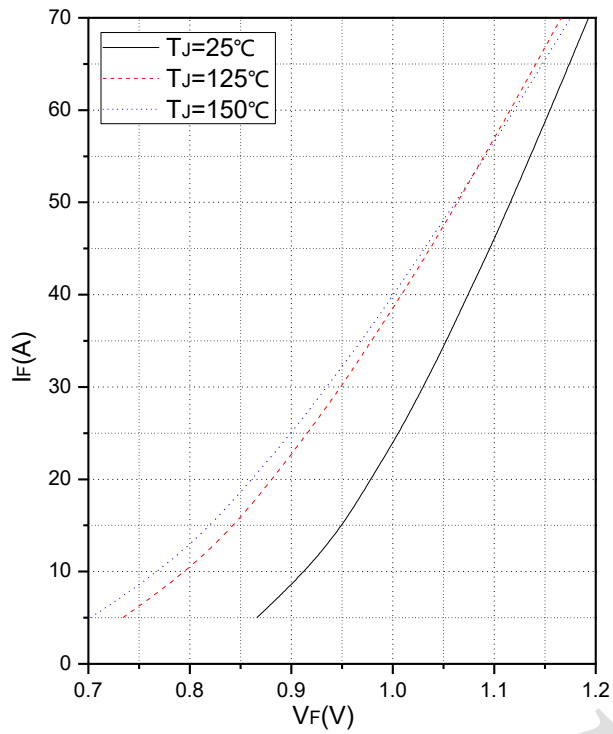


Fig.13 Forward Characteristics of Diode (Rectifier)

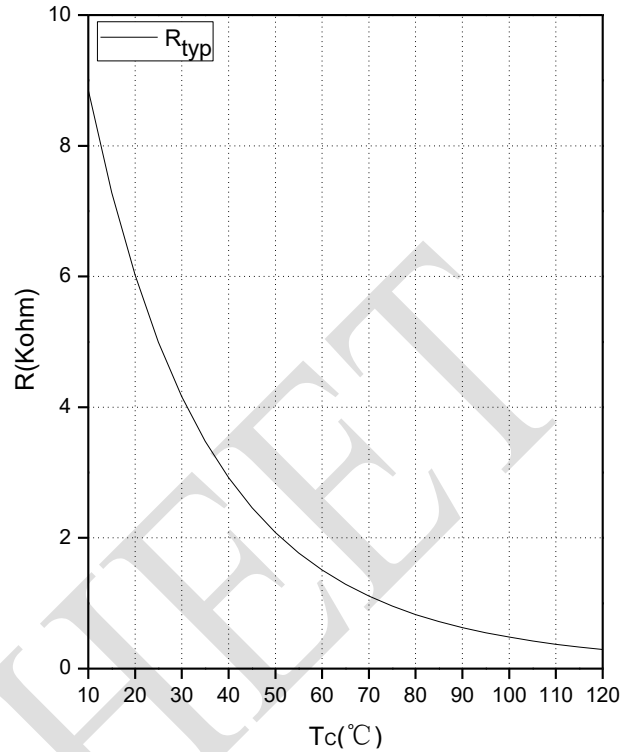


Fig.14 NTC Temperature Characteristics

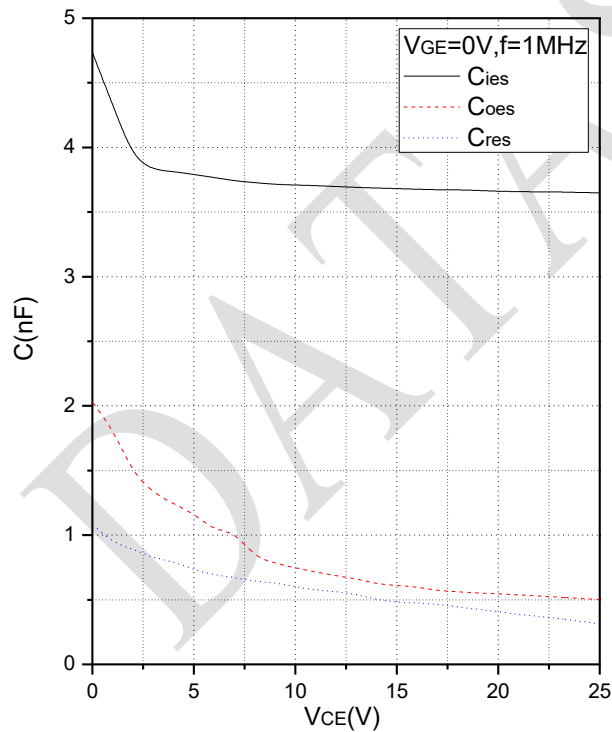
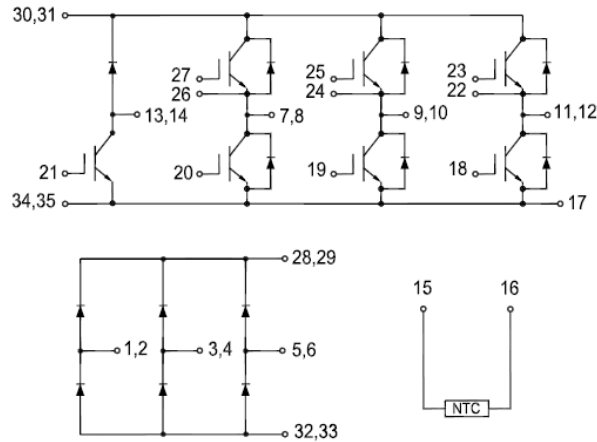


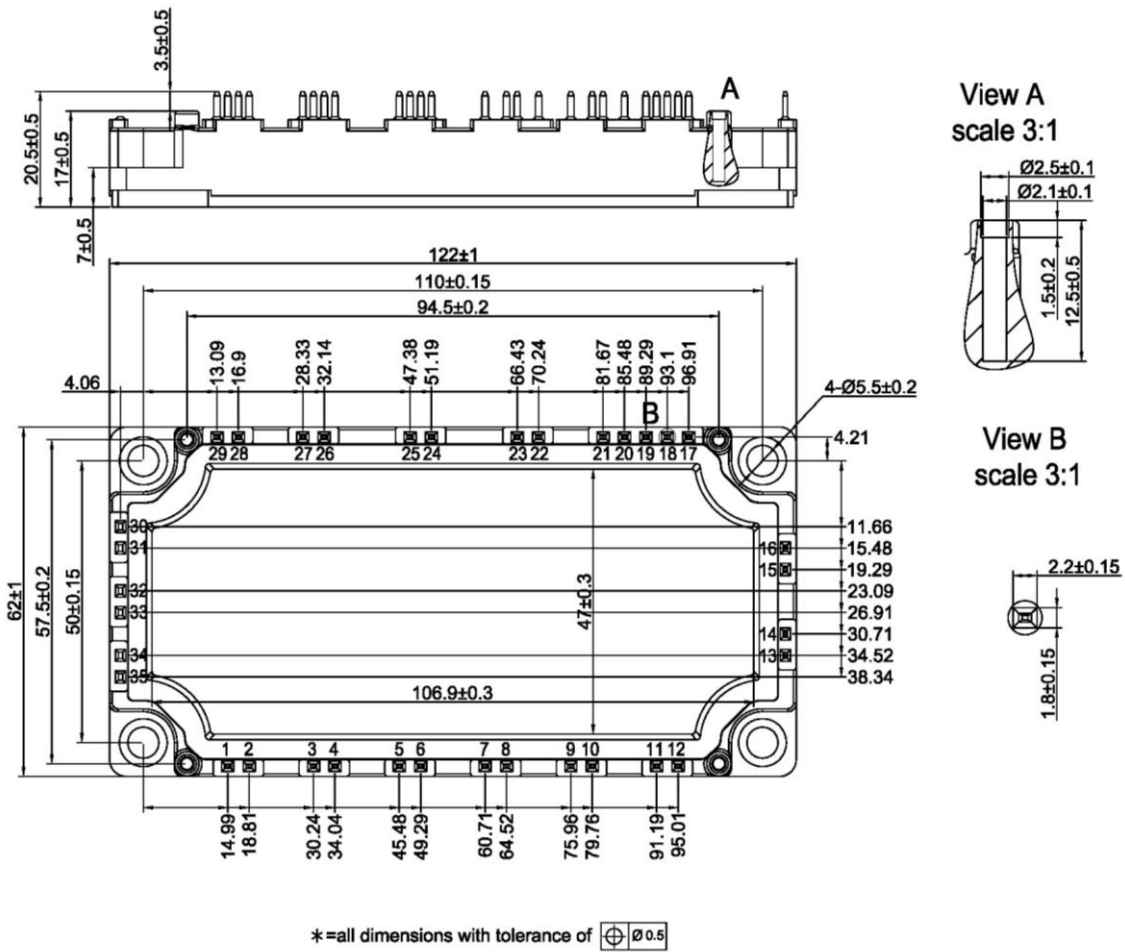
Fig.15 Capacitance Characteristics



Internal Circuit:



Package Outline (Unit: mm):





| Date | Revision | Notes |
|------------|----------|---------------|
| 11/22/2020 | A | Final Version |
| | | |

Announcement

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