

# IGBT

## GD25PIK120C5S

### Molding Type Module

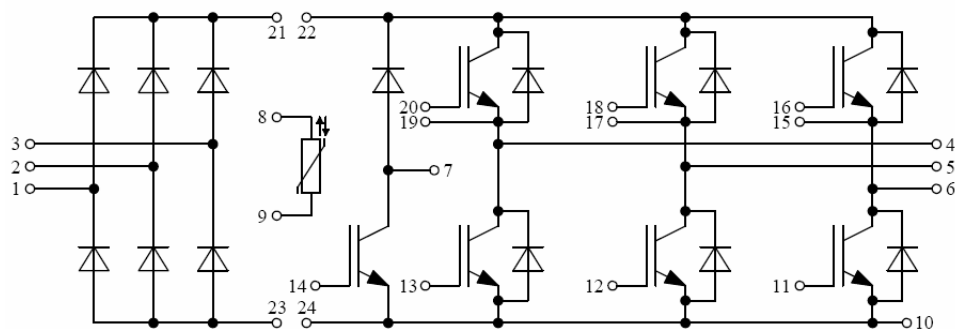
### 1200V/25A PIM in one-package



### Features

- 10 $\mu$ s short circuit capability
- $V_{CE(sat)}$  with positive temperature coefficient
- Square RBSOA
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology

### Equivalent Circuit Schematic



### Typical Applications

- Inverter for motor drive
- AC and DC servo drive amplifier
- Uninterruptible power supply

**IGBT-inverter**  $T_C=25^{\circ}\text{C}$  unless otherwise noted**Maximum Rated Values**

| Symbol    | Description                                              | GD25PIK120C5S    | Units         |
|-----------|----------------------------------------------------------|------------------|---------------|
| $V_{CES}$ | Collector-Emitter Voltage @ $T_J=25^{\circ}\text{C}$     | 1200             | V             |
| $V_{GES}$ | Gate-Emitter Voltage                                     | $\pm 20\text{V}$ | V             |
| $I_C$     | Collector Current @ $T_C=25^{\circ}\text{C}$             | 40               | A             |
|           | @ $T_C=80^{\circ}\text{C}$                               | 25               |               |
| $I_{CM}$  | Pulsed Collector Current @ $T_C=80^{\circ}\text{C}$      | 50               | A             |
| $P_{tot}$ | Total Power Dissipation @ $T_J=150^{\circ}\text{C}$      | 208              | W             |
| $T_{SC}$  | Short Circuit Withstand Time @ $T_J=150^{\circ}\text{C}$ | 10               | $\mu\text{s}$ |

**Off Characteristics**

| Symbol     | Parameter                           | Test Conditions                                                 | Min. | Typ. | Max. | Units |
|------------|-------------------------------------|-----------------------------------------------------------------|------|------|------|-------|
| $BV_{CES}$ | Collector-Emitter Breakdown Voltage | $T_J=25^{\circ}\text{C}$                                        | 1200 |      |      | V     |
| $I_{CES}$  | Collector Cut-Off Current           | $V_{CE}=V_{CES}, V_{GE}=0\text{V},$<br>$T_J=25^{\circ}\text{C}$ |      |      | 5.0  | mA    |
| $I_{GES}$  | Gate-Emitter Leakage Current        | $V_{GE}=V_{GES}, V_{CE}=0\text{V},$<br>$T_J=25^{\circ}\text{C}$ |      |      | 400  | nA    |

**On Characteristics**

| Symbol        | Parameter                               | Test Conditions                                                   | Min. | Typ. | Max. | Units |
|---------------|-----------------------------------------|-------------------------------------------------------------------|------|------|------|-------|
| $V_{GE(th)}$  | Gate-Emitter Threshold Voltage          | $I_C=250\mu\text{A}, V_{CE}=V_{GE},$<br>$T_J=25^{\circ}\text{C}$  | 4.0  | 5.0  | 6.0  | V     |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C=25\text{A}, V_{GE}=15\text{V},$<br>$T_J=25^{\circ}\text{C}$  |      | 2.35 | 2.50 | V     |
|               |                                         | $I_C=25\text{A}, V_{GE}=15\text{V},$<br>$T_J=125^{\circ}\text{C}$ |      | 2.75 |      |       |

**Switching Characteristics**

| Symbol    | Parameter               | Test Conditions                                                                                              | Min. | Typ. | Max. | Units         |
|-----------|-------------------------|--------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $E_{on}$  | Turn-On Switching Loss  | $V_{CC}=600\text{V}, I_C=25\text{A},$<br>$R_G=10\Omega, V_{GE}=\pm 15\text{V},$<br>$T_J=25^{\circ}\text{C}$  |      | 2220 | 4260 | $\mu\text{J}$ |
| $E_{off}$ | Turn-Off Switching Loss |                                                                                                              |      | 1850 | 3100 | $\mu\text{J}$ |
| $E_{tot}$ | Total Switching Loss    |                                                                                                              |      | 4070 | 7360 | $\mu\text{J}$ |
| $E_{on}$  | Turn-On Switching Loss  | $V_{CC}=600\text{V}, I_C=25\text{A},$<br>$R_G=10\Omega, V_{GE}=\pm 15\text{V},$<br>$T_J=125^{\circ}\text{C}$ |      | 3150 | 5120 | $\mu\text{J}$ |
| $E_{off}$ | Turn-Off Switching Loss |                                                                                                              |      | 2720 | 4260 | $\mu\text{J}$ |
| $E_{tot}$ | Total Switching Loss    |                                                                                                              |      | 5870 | 9380 | $\mu\text{J}$ |

**GD25PIK120C5S****IGBT Module**

|              |                              |                                                                                            |  |      |     |    |
|--------------|------------------------------|--------------------------------------------------------------------------------------------|--|------|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time           | $V_{CC}=600V, I_C=25A,$<br>$R_G=10\Omega, V_{GE} = \pm 15V,$<br>$T_j=125^\circ C$          |  | 60   | 80  | ns |
| $t_r$        | Rise Time                    |                                                                                            |  | 30   | 45  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time          |                                                                                            |  | 450  | 850 | ns |
| $t_f$        | Fall Time                    |                                                                                            |  | 200  | 320 | ns |
| $C_{ies}$    | Input Capacitance            | $V_{CE} = 30V, f=1Mhz,$<br>$V_{GE} = 0V$                                                   |  | 2370 |     | pF |
| $C_{oes}$    | Output Capacitance           |                                                                                            |  | 455  |     | pF |
| $C_{res}$    | Reverse Transfer Capacitance |                                                                                            |  | 60   |     | pF |
| $I_{SC}$     | SC Data                      | $T_P \leq 10\mu s, V_{GE}=15V,$<br>$T_j=125^\circ C, V_{CC}=900V,$<br>$V_{CEM} \leq 1200V$ |  | 100  |     | A  |

**DIODE-inverter**  $T_C=25^\circ C$  unless otherwise noted**Maximum Rated Values**

| Symbol    | Description                                                           | GD25PIK120C5S | Units  |
|-----------|-----------------------------------------------------------------------|---------------|--------|
| $V_{RRM}$ | Collector-Emitter Voltage @ $T_j=25^\circ C$                          | 1200          | V      |
| $I_F$     | DC Forward Current @ $T_C=25^\circ C$<br>@ $T_C=80^\circ C$           | 40<br>25      | A      |
| $I_{FRM}$ | Repetitive Peak Forward Current<br>$V_R=0V, t_p=10ms, T_C=80^\circ C$ | 50            | A      |
| $I^2t$    | $I^2t$ -value, $V_R=0V, t_p=10ms, T_j=125^\circ C$                    | 170           | $A^2s$ |

**Characteristics Values**

| Symbol           | Parameter                           | Test Conditions                                                                           |                       | Min. | Typ. | Max. | Units |
|------------------|-------------------------------------|-------------------------------------------------------------------------------------------|-----------------------|------|------|------|-------|
| V <sub>F</sub>   | Diode Forward Voltage               | I <sub>F</sub> =25A, V <sub>GE</sub> =0V                                                  | T <sub>j</sub> =25°C  |      | 1.9  | 2.4  | V     |
|                  |                                     |                                                                                           | T <sub>j</sub> =125°C |      | 2.0  |      |       |
| Q <sub>r</sub>   | Diode Reverse Recovered charge      | I <sub>F</sub> =25A,<br>V <sub>R</sub> =600V,<br>di/dt=-700A/μs,<br>V <sub>GE</sub> =-15V | T <sub>j</sub> =25°C  |      | 2.80 |      | μC    |
|                  |                                     |                                                                                           | T <sub>j</sub> =125°C |      | 5.00 |      |       |
| I <sub>RM</sub>  | Diode Peak Reverse Recovery Current |                                                                                           | T <sub>j</sub> =25°C  |      | 26.0 |      | A     |
|                  |                                     |                                                                                           | T <sub>j</sub> =125°C |      | 24.0 |      |       |
| E <sub>rec</sub> | Reverse Recovery Energy             |                                                                                           | T <sub>j</sub> =25°C  |      | 0.90 |      | mJ    |
|                  |                                     |                                                                                           | T <sub>j</sub> =125°C |      | 1.80 |      |       |

**DIODE-rectifier**  $T_C=25^{\circ}\text{C}$  unless otherwise noted**Maximum Rated Values**

| Symbol              | Description                                                                           | GD25PIK120C5S | Units                |
|---------------------|---------------------------------------------------------------------------------------|---------------|----------------------|
| $V_{RRM}$           | Collector-Emitter Voltage @ $T_j=25^{\circ}\text{C}$                                  | 1700          | V                    |
| $I_{F(AV)}$         | DC Forward Current @ $T_C=80^{\circ}\text{C}$                                         | 25            | A                    |
| $I_{F\text{ RMSM}}$ | Forward Current RMS Maximum Per Diode<br>@ $T_C=80^{\circ}\text{C}$                   | 50            | A                    |
| $I_{FSM}$           | Surge Forward Current $V_R=0\text{V}$ , $t_p=10\text{ms}$ , $T_j=150^{\circ}\text{C}$ | 270           | A                    |
| $I^2t$              | $I^2t$ -value, $V_R=0\text{V}$ , $t_p=10\text{ms}$ , $T_j=150^{\circ}\text{C}$        | 360           | $\text{A}^2\text{s}$ |

**Characteristics Values**

| Symbol | Parameter             | Test Conditions                                | Min. | Typ. | Max. | Units |
|--------|-----------------------|------------------------------------------------|------|------|------|-------|
| $V_F$  | Diode Forward Voltage | $I_F=25\text{A}$ , $T_j=150^{\circ}\text{C}$   |      | 1.25 |      | V     |
| $I_R$  | Reverse Current       | $T_j=125^{\circ}\text{C}$ , $V_R=1700\text{V}$ |      |      | 2.0  | mA    |

**IGBT-brake-chopper**  $T_C=25^{\circ}\text{C}$  unless otherwise noted**Maximum Rated Values**

| Symbol    | Description                                                                | GD25PIK120C5S    | Units         |
|-----------|----------------------------------------------------------------------------|------------------|---------------|
| $V_{CES}$ | Collector-Emitter Voltage @ $T_j=25^{\circ}\text{C}$                       | 1200             | V             |
| $V_{GES}$ | Gate-Emitter Voltage                                                       | $\pm 20\text{V}$ | V             |
| $I_C$     | Collector Current @ $T_C=25^{\circ}\text{C}$<br>@ $T_C=80^{\circ}\text{C}$ | 25<br>15         | A             |
| $I_{CM}$  | Pulsed Collector Current @ $T_C=80^{\circ}\text{C}$                        | 30               | A             |
| $P_{tot}$ | Total Power Dissipation @ $T_j=150^{\circ}\text{C}$                        | 140              | W             |
| $T_{SC}$  | Short Circuit Withstand Time @ $T_j=150^{\circ}\text{C}$                   | 10               | $\mu\text{s}$ |

**Off Characteristics**

| Symbol     | Parameter                           | Test Conditions                                                     | Min. | Typ. | Max. | Units |
|------------|-------------------------------------|---------------------------------------------------------------------|------|------|------|-------|
| $BV_{CES}$ | Collector-Emitter Breakdown Voltage | $T_j=25^{\circ}\text{C}$                                            | 1200 |      |      | V     |
| $I_{CES}$  | Collector Cut-Off Current           | $V_{CE}=V_{CES}$ , $V_{GE}=0\text{V}$ ,<br>$T_j=25^{\circ}\text{C}$ |      |      | 5.0  | mA    |
| $I_{GES}$  | Gate-Emitter Leakage Current        | $V_{GE}=V_{GES}$ , $V_{CE}=0\text{V}$ ,<br>$T_j=25^{\circ}\text{C}$ |      |      | 400  | nA    |

## On Characteristics

| Symbol        | Parameter                               | Test Conditions                                    | Min. | Typ. | Max. | Units |
|---------------|-----------------------------------------|----------------------------------------------------|------|------|------|-------|
| $V_{GE(th)}$  | Gate-Emitter Threshold Voltage          | $I_C=250\mu A, V_{CE}=V_{GE},$<br>$T_J=25^\circ C$ | 4.0  | 5.0  | 6.0  | V     |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C=15A, V_{GE}=15V,$<br>$T_J=25^\circ C$         |      | 2.51 | 2.88 | V     |
|               |                                         | $I_C=15A, V_{GE}=15V,$<br>$T_J=125^\circ C$        |      | 2.96 | 3.14 |       |

## Switching Characteristics

| Symbol       | Parameter                    | Test Conditions                                                                            | Min. | Typ. | Max. | Units   |
|--------------|------------------------------|--------------------------------------------------------------------------------------------|------|------|------|---------|
| $E_{on}$     | Turn-On Switching Loss       | $V_{CC}=600V, I_C=15A,$<br>$R_G=22\Omega, V_{GE}=\pm 15V,$<br>$T_J=25^\circ C$             |      | 1100 | 1650 | $\mu J$ |
| $E_{off}$    | Turn-Off Switching Loss      |                                                                                            |      | 670  | 1000 | $\mu J$ |
| $E_{tot}$    | Total Switching Loss         |                                                                                            |      | 1770 | 2660 | $\mu J$ |
| $E_{on}$     | Turn-On Switching Loss       | $V_{CC}=600V, I_C=15A,$<br>$R_G=22\Omega, V_{GE}=\pm 15V,$<br>$T_J=125^\circ C$            |      | 1400 | 2100 | $\mu J$ |
| $E_{off}$    | Turn-Off Switching Loss      |                                                                                            |      | 1100 | 1650 | $\mu J$ |
| $E_{tot}$    | Total Switching Loss         |                                                                                            |      | 2500 | 3750 | $\mu J$ |
| $t_{d(on)}$  | Turn-On Delay Time           | $V_{CC}=600V, I_C=15A,$<br>$R_G=22\Omega, V_{GE}=\pm 15V,$<br>$T_J=125^\circ C$            |      | 125  | 190  | ns      |
| $t_r$        | Rise Time                    |                                                                                            |      | 24   | 36   | ns      |
| $t_{d(off)}$ | Turn-Off Delay Time          |                                                                                            |      | 150  | 225  | ns      |
| $t_f$        | Fall Time                    |                                                                                            |      | 241  | 360  | ns      |
| $C_{ies}$    | Input Capacitance            | $V_{CE}=30V, f=1Mhz,$<br>$V_{GE}=0V$                                                       |      | 1320 |      | pF      |
| $C_{oes}$    | Output Capacitance           |                                                                                            |      | 280  |      | pF      |
| $C_{res}$    | Reverse Transfer Capacitance |                                                                                            |      | 35   |      | pF      |
| $I_{SC}$     | SC Data                      | $T_P \leq 10\mu s, V_{GE}=15V,$<br>$T_J=125^\circ C, V_{CC}=900V,$<br>$V_{CEM} \leq 1200V$ |      | 60   |      | A       |

**DIODE-brake-chopper**  $T_C=25^{\circ}\text{C}$  unless otherwise noted**Maximum Rated Values**

| Symbol    | Description                                                                                       | GD25PIK120C5S | Units                |
|-----------|---------------------------------------------------------------------------------------------------|---------------|----------------------|
| $V_{RRM}$ | Collector-Emitter Voltage @ $T_J=25^{\circ}\text{C}$                                              | 1200          | V                    |
| $I_F$     | DC Forward Current @ $T_C=25^{\circ}\text{C}$<br>@ $T_C=80^{\circ}\text{C}$                       | 25<br>15      | A                    |
| $I_{FRM}$ | Repetitive Peak Forward Current<br>$V_R=0\text{V}$ , $t_p=10\text{ms}$ , $T_C=80^{\circ}\text{C}$ | 30            | A                    |
| $I^2t$    | $I^2t$ -value, $V_R=0\text{V}$ , $t_p=10\text{ms}$ , $T_J=125^{\circ}\text{C}$                    | 60            | $\text{A}^2\text{s}$ |

**Characteristics Values**

| Symbol           | Parameter                           | Test Conditions                                                                           |                       | Min. | Typ. | Max. | Units |
|------------------|-------------------------------------|-------------------------------------------------------------------------------------------|-----------------------|------|------|------|-------|
| V <sub>F</sub>   | Diode Forward Voltage               | I <sub>F</sub> =15A, V <sub>GE</sub> =0V                                                  | T <sub>J</sub> =25°C  |      | 2.04 | 2.72 | V     |
|                  |                                     |                                                                                           | T <sub>J</sub> =125°C |      | 2.16 | 2.74 |       |
| Q <sub>r</sub>   | Diode Reverse Recovered charge      | I <sub>F</sub> =15A,<br>V <sub>R</sub> =600V,<br>di/dt=-400A/μs,<br>V <sub>GE</sub> =-15V | T <sub>J</sub> =25°C  |      | 1.80 |      | μC    |
|                  |                                     |                                                                                           | T <sub>J</sub> =125°C |      | 3.00 |      |       |
| I <sub>RM</sub>  | Diode Peak Reverse Recovery Current |                                                                                           | T <sub>J</sub> =25°C  |      | 16.0 |      | A     |
|                  |                                     |                                                                                           | T <sub>J</sub> =125°C |      | 15.0 |      |       |
| E <sub>rec</sub> | Reverse Recovery Energy             |                                                                                           | T <sub>J</sub> =25°C  |      | 0.55 |      | mJ    |
|                  |                                     |                                                                                           | T <sub>J</sub> =125°C |      | 1.10 |      |       |

**Electrical Characteristics of NTC**  $T_C=25^{\circ}\text{C}$  unless otherwise noted

| Symbol       | Parameter              | Test Conditions                                       | Min. | Typ. | Max. | Units            |
|--------------|------------------------|-------------------------------------------------------|------|------|------|------------------|
| $R_{25}$     | Rated resistance       |                                                       |      | 5.0  |      | $\text{k}\Omega$ |
| $\Delta R/R$ | Deviation of $R_{100}$ | $R_{100}=439\Omega$                                   | 5    |      | 5    | %                |
| $P_{25}$     | Power dissipation      |                                                       |      |      | 20.0 | mW               |
| $B_{25/50}$  | B-value                | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$ |      | 3375 |      | K                |

## IGBT Module

| Symbol               | Parameter                                                         | Min. | Typ. | Max. | Units |
|----------------------|-------------------------------------------------------------------|------|------|------|-------|
| V <sub>ISO</sub>     | Isolation Voltage RMS, f=50Hz, t=1min                             |      | 2500 |      | V     |
| L <sub>CE</sub>      | Stray inductance                                                  |      | 60   |      | nH    |
| R <sub>CC'+EE'</sub> | Module lead resistance, terminal to chip<br>@ T <sub>C</sub> =25℃ |      | 4.00 |      | mΩ    |
| R <sub>θJC</sub>     | Junction-to-Case (per IGBT-inverter)                              |      |      | 0.60 | K/W   |
|                      | Junction-to-Case (per DIODE-inverter)                             |      |      | 0.89 |       |
|                      | Junction-to-Case (per DIODE-rectifier)                            |      |      | 0.98 |       |
|                      | Junction-to-Case (per IGBT-brake-chopper)                         |      |      | 0.95 |       |
|                      | Junction-to-Case (per IGBT-brake-chopper)                         |      |      | 1.51 |       |
| R <sub>θCS</sub>     | Case-to-Sink (Conductive grease applied)                          |      | 0.02 |      | K/W   |
| T <sub>j</sub>       | Operating Junction Temperature                                    | -40  |      | 150  | ℃     |
| T <sub>STG</sub>     | Storage Temperature Range                                         | -40  |      | 125  | ℃     |
| Mounting             | Power Terminal Screw:M5                                           | 2.5  |      | 5.0  | N.m   |
| Torque               | Mounting Screw:M6                                                 | 3.0  |      | 6.0  | N.m   |
| G                    | Weight of Module                                                  |      | 180  |      | g     |

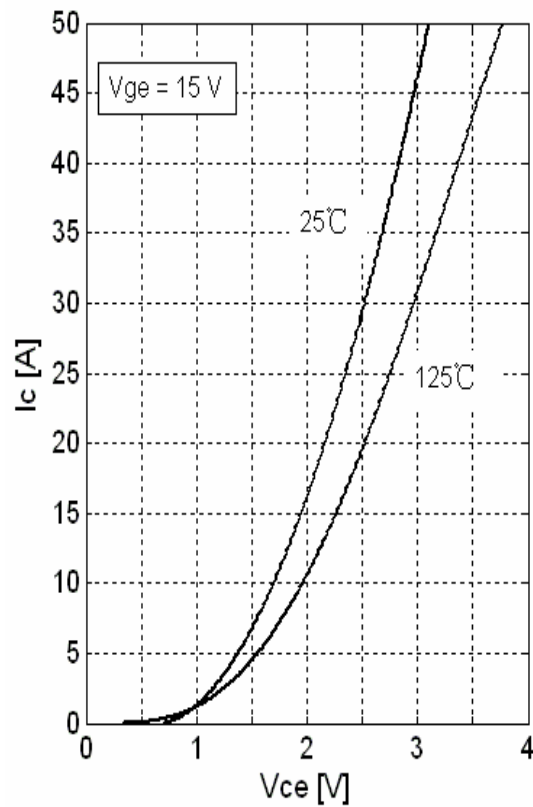


Fig 1. Typical IGBT-inverter Output Characteristics

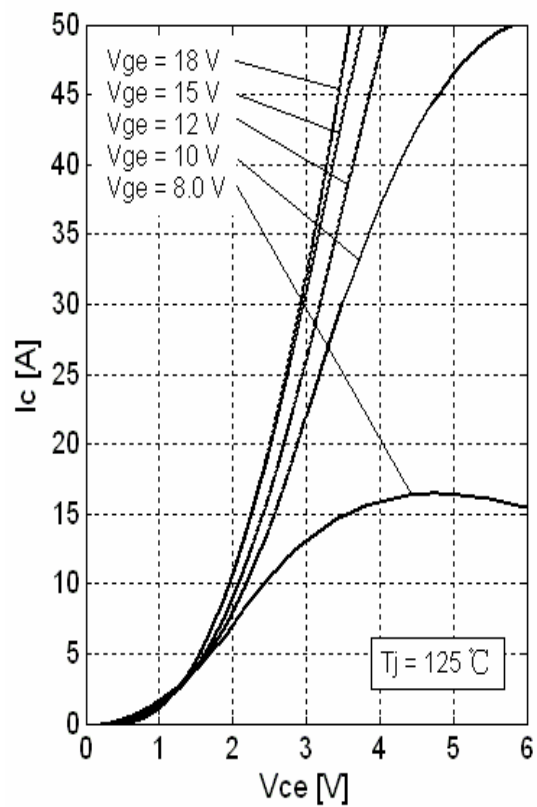


Fig 2. Typical IGBT-inverter Output Characteristics

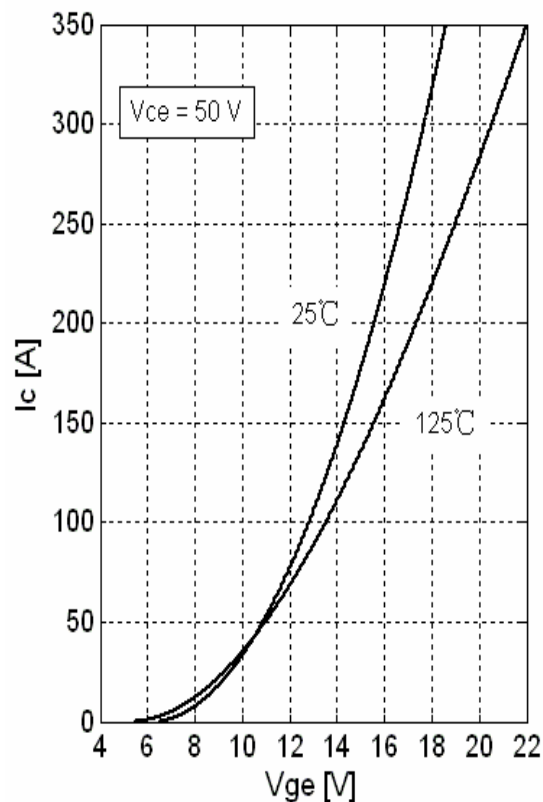


Fig 3. Typical IGBT-inverter Transfer Characteristics

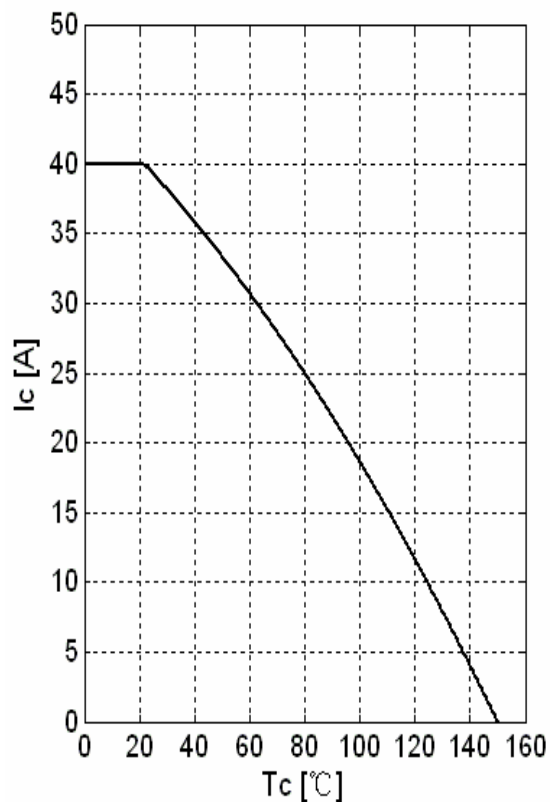


Fig 4. IGBT-inverter Maximum DC Collector vs. Case Temperature

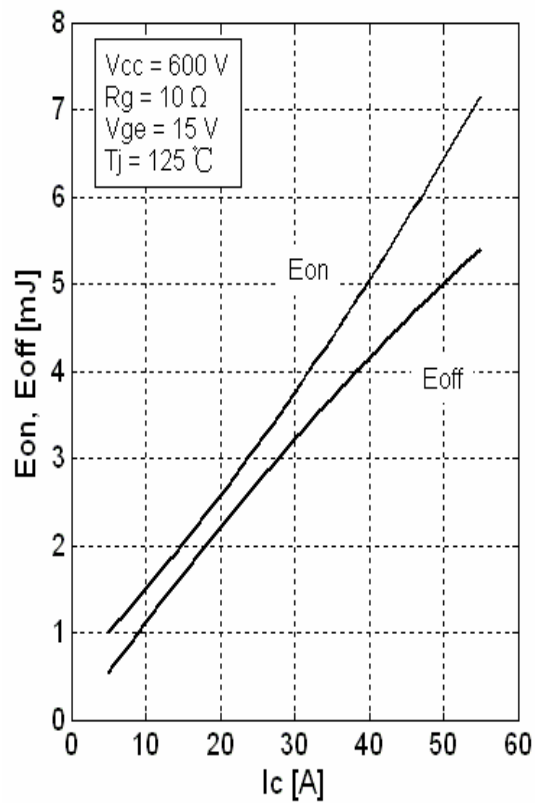


Fig 5. IGBT-inverter Switching Loss  
vs. Collector Current

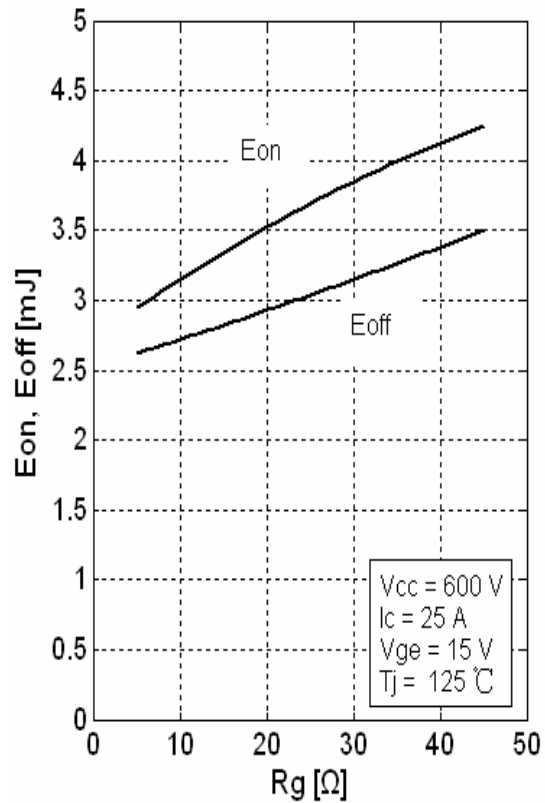


Fig 6. IGBT-inverter Switching Loss  
vs. Gate Resistor

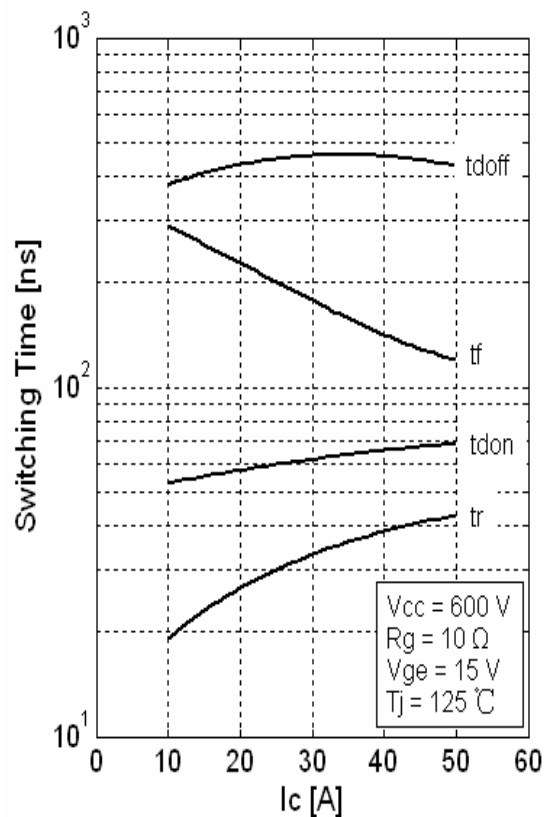


Fig 7. Typical IGBT-inverter Switching  
Times vs.  $I_c$

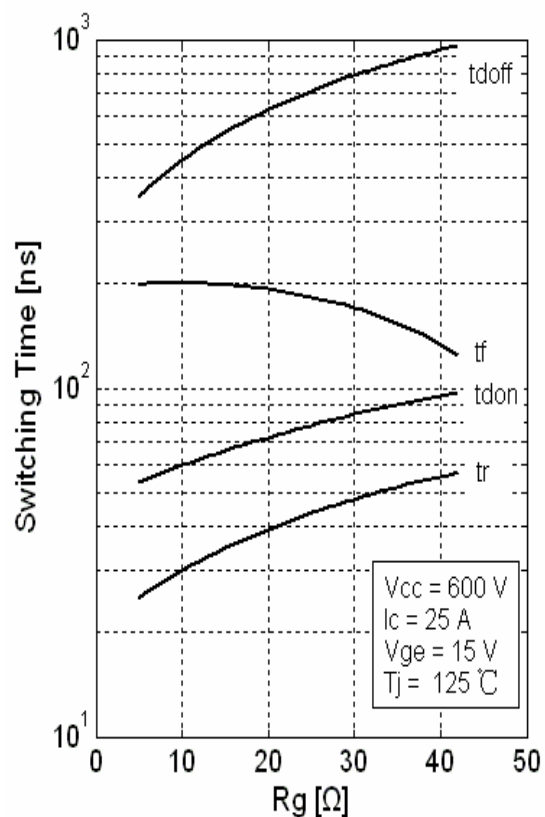


Fig 8. Typical IGBT-inverter Switching  
Times vs. Gate Resistance  $R_g$

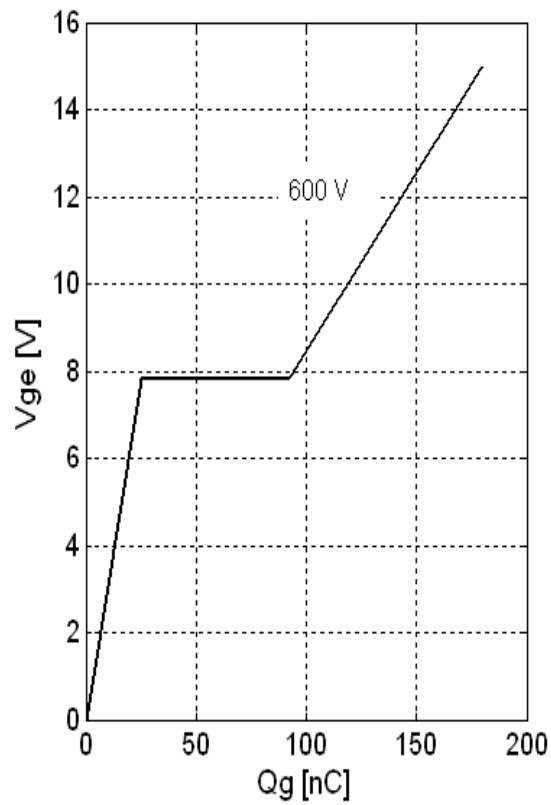


Fig 9. IGBT-inverter Gate Charge Characteristics

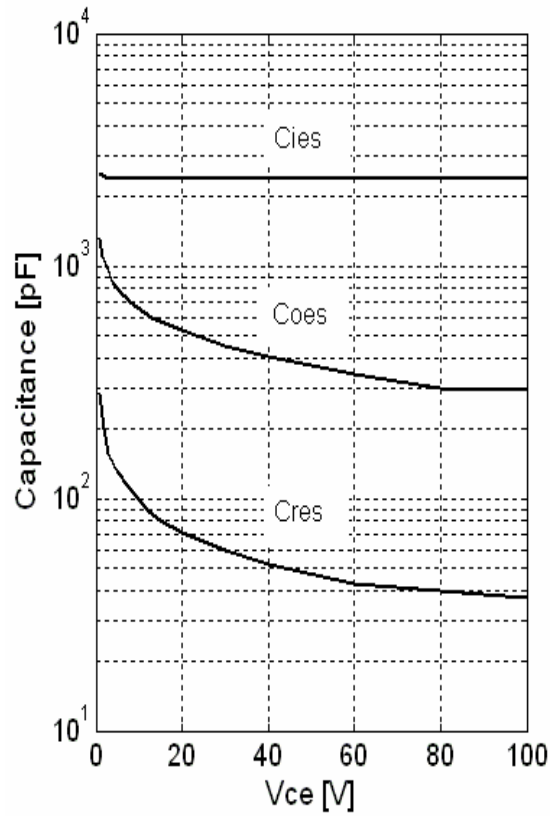


Fig 10. Typical IGBT-inverter Capacitance vs.  $V_{CE}$

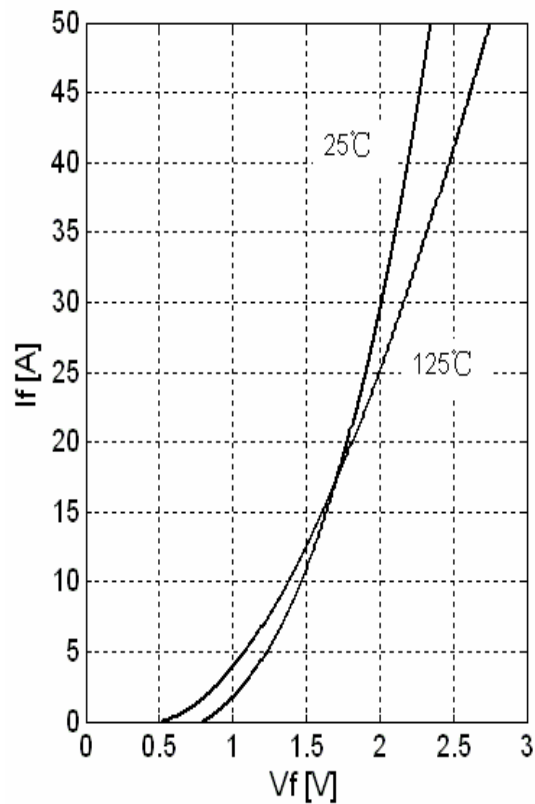


Fig 11. Typical DIODE-inverter Forward Characteristics

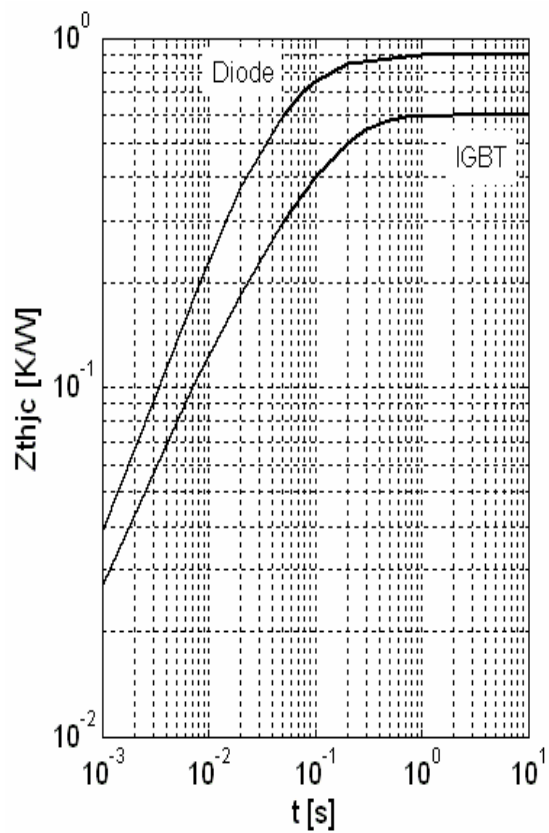


Fig 12. Transient thermal impedance (inverter)

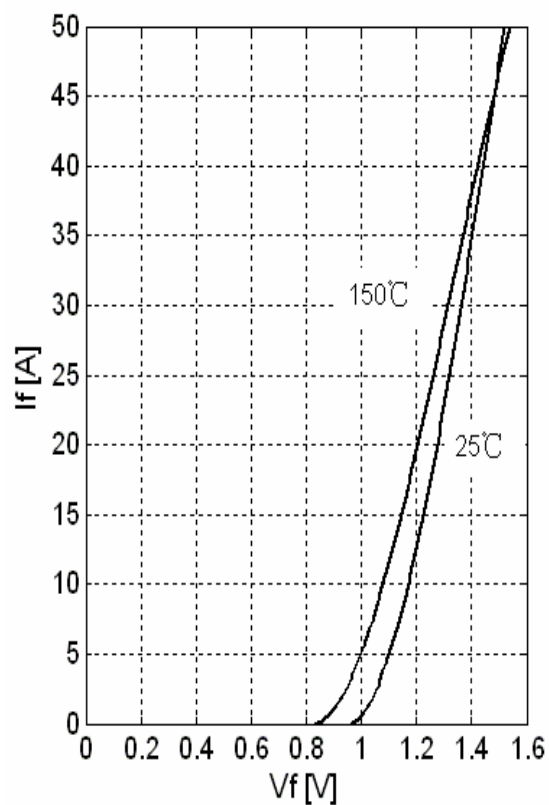


Fig 13. Typical DIODE-rectifier  
Forward Characteristics

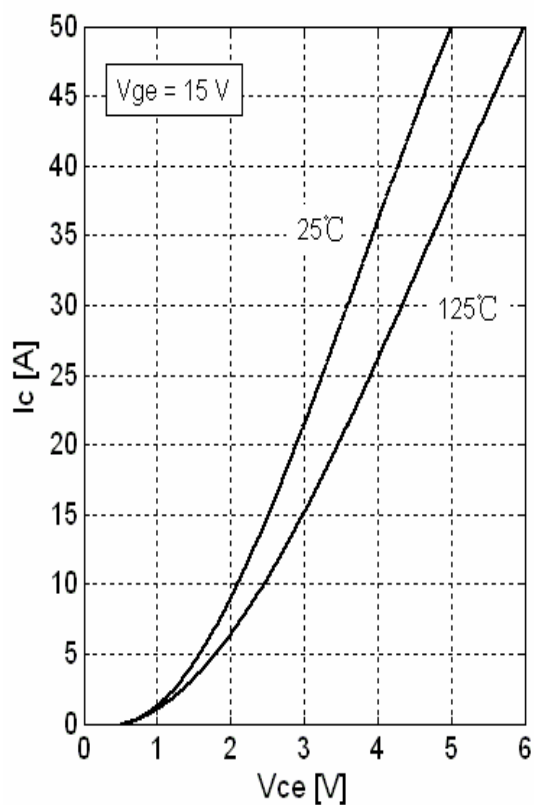


Fig 14. Typical IGBT-brake-chopper  
Output Characteristics

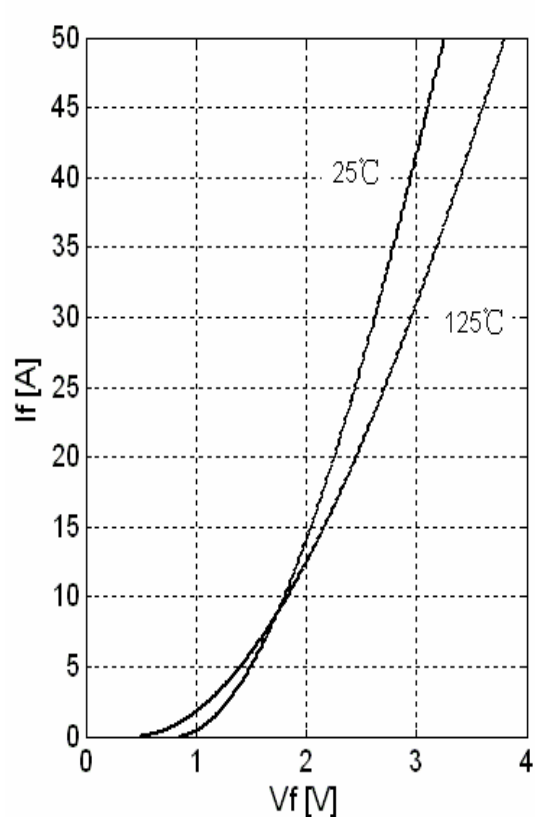


Fig 15. Typical DIODE-brake-chopper  
Forward Characteristics

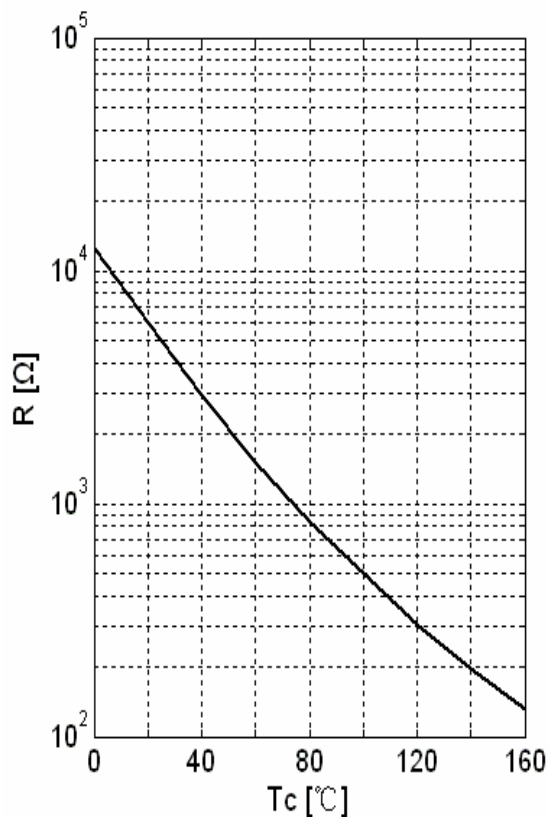


Fig 16. Typical NTC-temperature  
characteristic

## Package Dimension

Dimensions in Millimeters

