

## Silicon Field Stop(FS) Planar IGBT

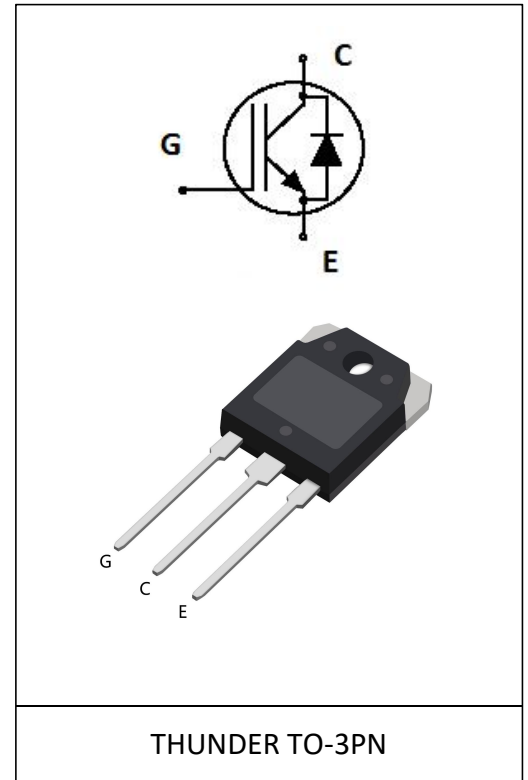
### Description

The THG20N135RB is use advanced RC field stop(FS) technology.

The 1350V FS IGBT offers superior conduction and switching performances.

### General Features

- 1350V Breakdown Voltage
- Low saturation voltage:  $V_{CE(sat)}$ , typ=2.3V@ $I_C=20A$
- FS Planar Technology, Positive temperature coefficient
- High speed switch & Low power loss



### Application

- General purpose inverters
- Induction heating
- UPS

### Product Summary

|               |       |
|---------------|-------|
| $V_{CE}$      | 1350V |
| $V_{CE(sat)}$ | 2.3V  |
| $I_C$         | 20A   |

### MAXIMUM RATINGS ( $T_J = 25^\circ C$ unless otherwise noted)

| Parameter                    |                   | Symbol   | Value    | Unit |
|------------------------------|-------------------|----------|----------|------|
| Collector-to-Emitter Voltage |                   | $V_{CE}$ | 1350     | V    |
| Gate-to-Emitter Voltage      |                   | $V_{GE}$ | $\pm 30$ | V    |
| Collector Current            | $T_C=25^\circ C$  | $I_C$    | 40       | A    |
|                              | $T_C=100^\circ C$ |          | 20       |      |
| Power Dissipation            | $T_C=25^\circ C$  | $P_D$    | 300      | W    |
|                              | $T_C=100^\circ C$ |          | 150      |      |

|                                                                                                          |                                                          |                |                      |                    |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------|----------------------|--------------------|
| Pulsed Collector Current                                                                                 | $T_C=25^{\circ}\text{C}$<br>$t_p=10\mu\text{s}$ (Note 1) | $I_{CM}$       | 60                   | A                  |
| Diode Forward Current                                                                                    | $T_C=25^{\circ}\text{C}$                                 | $I_F$          | 40                   |                    |
|                                                                                                          | $T_C=100^{\circ}\text{C}$                                |                | 20                   |                    |
| Pulsed Diode Forward Current                                                                             | $T_C=25^{\circ}\text{C}$<br>$t_p=10\mu\text{s}$ (Note 1) | $I_{FM}$       | 60                   |                    |
| Short Circuit Withstand Time<br>$V_{GE} = 15\text{ V}, V_{CC} = 800\text{ V}, T_C = 150^{\circ}\text{C}$ |                                                          | $T_{SC}$       | 10                   | $\mu\text{s}$      |
| Operating Junction and Storage Temperature Range                                                         |                                                          | $T_J, T_{stg}$ | -55<br>$T_o$<br>+175 | $^{\circ}\text{C}$ |
| Lead Temperature for Soldering Purposes                                                                  |                                                          | $T_L$          | 270                  |                    |

## THERMAL CHARACTERISTICS

| Parameter                                     | Symbol     | Value | Unit                        |
|-----------------------------------------------|------------|-------|-----------------------------|
| Thermal Resistance, Junction-to-Case for IGBT | $R_{thJC}$ | 0.5   | $^{\circ}\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Ambient       | $R_{thJA}$ | 62.5  |                             |

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^{\circ}\text{C}$ unless otherwise specified)

| Parameter | Symbol | Value |      |      | Unit | Test Condition |
|-----------|--------|-------|------|------|------|----------------|
|           |        | min.  | typ. | max. |      |                |

### OFF CHARACTERISTICS

|                                        |            |      |   |           |               |                                             |
|----------------------------------------|------------|------|---|-----------|---------------|---------------------------------------------|
| Collector-to-Emitter Breakdown Voltage | $BV_{CES}$ | 1350 | - | -         | V             | $V_{GE}=0\text{ V}, I_C=1\text{ mA}$        |
| Zero Gate Voltage Collector Current    | $I_{CES}$  | -    | - | 40        | $\mu\text{A}$ | $V_{GE}=0\text{ V}, V_{CE}=V_{CES}$         |
| Gate-to-Emitter leakage Current        | $I_{GES}$  | -    | - | $\pm 400$ | nA            | $V_{GE}=\pm 30\text{ V}, V_{CE}=0\text{ V}$ |

### ON CHARACTERISTICS

|                                         |               |     |     |     |   |                                                               |
|-----------------------------------------|---------------|-----|-----|-----|---|---------------------------------------------------------------|
| Gate-to-Emitter Threshold Voltage       | $V_{GE(th)}$  | 5.3 | -   | 6.9 | V | $V_{GE}=V_{CE}, I_C=1\text{ mA}, T_J=25^{\circ}\text{C}$      |
| Collector-to-Emitter Saturation Voltage | $V_{CE(sat)}$ | -   | 2.3 | 2.8 | V | $V_{GE}=15\text{ V}, I_C=20\text{ A}, T_J=25^{\circ}\text{C}$ |

**DYNAMIC CHARACTERISTICS**

|                              |           |   |      |   |    |                                                                       |
|------------------------------|-----------|---|------|---|----|-----------------------------------------------------------------------|
| Input Capacitance            | $C_{IES}$ | - | 1190 | - | pF | $V_{CE} = 15\text{ V}, V_{GE} = 0\text{ V},$<br>$f = 1\text{ MHz}$    |
| Output Capacitance           | $C_{OES}$ | - | 96   | - |    |                                                                       |
| Reverse Transfer Capacitance | $C_{RES}$ | - | 33   | - |    |                                                                       |
| Total Gate Charge            | $Q_G$     | - | 80   | - | nC | $V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$<br>$I_C = 20\text{ A}$ |

**SWITCHING CHARACTERISTICS**

|                         |              |   |     |   |    |                                                                                                                                |
|-------------------------|--------------|---|-----|---|----|--------------------------------------------------------------------------------------------------------------------------------|
| Turn-On Delay Time      | $t_{d(on)}$  | - | 82  | - | ns | $V_{CE} = 600\text{ V}$<br>$V_{GE} = 0/15\text{ V}$<br>$I_C = 20\text{ A}$<br>$R_G = 30\ \Omega$<br>$T_J = 25^{\circ}\text{C}$ |
| Turn-Off Delay Time     | $t_{d(off)}$ | - | 119 | - |    |                                                                                                                                |
| Rise time               | $t_r$        | - | 56  | - |    |                                                                                                                                |
| Fall time               | $t_f$        | - | 209 | - |    |                                                                                                                                |
| Turn-On Switching Loss  | $E_{on}$     | - | 3.6 | - | mJ |                                                                                                                                |
| Turn-Off Switching Loss | $E_{off}$    | - | 0.5 | - |    |                                                                                                                                |
| Total Switching Loss    | $E_{ts}$     | - | 4.1 | - |    |                                                                                                                                |

**ELECTRICAL CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$  unless otherwise specified) (continued)

| Parameter | Symbol | Value |      |      | Unit | Test Condition |
|-----------|--------|-------|------|------|------|----------------|
|           |        | min.  | typ. | max. |      |                |

**SWITCHING CHARACTERISTICS**
**DIODE CHARACTERISTICS**

|                       |       |   |     |     |   |                                             |
|-----------------------|-------|---|-----|-----|---|---------------------------------------------|
| Diode Forward Voltage | $V_F$ | - | 2.2 | 2.8 | - | $I_F = 20\text{ A}, T_J = 25^\circ\text{C}$ |
|-----------------------|-------|---|-----|-----|---|---------------------------------------------|

**DIODE SWITCHING CHARACTERISTICS, INDUCTIVE LOAD**

|                               |           |   |      |   |    |                                                                                                              |
|-------------------------------|-----------|---|------|---|----|--------------------------------------------------------------------------------------------------------------|
| Reverse Recovery Time         | $t_{rr}$  | - | 144  | - | ns | $V_R = 600\text{ V}, I_F = 20\text{ A},$<br>$dI_F/dt = 200\text{ A}/\mu\text{s}$<br>$T_J = 25^\circ\text{C}$ |
| Reverse Recovery Charge       | $Q_{rr}$  | - | 3568 | - | nC |                                                                                                              |
| Reverse Recovery Energy       | $E_{rec}$ | - | 0.4  | - | mJ |                                                                                                              |
| Peak Reverse Recovery Current | $I_{RRM}$ | - | 40   | - | A  |                                                                                                              |

## Typical Performance Characteristics

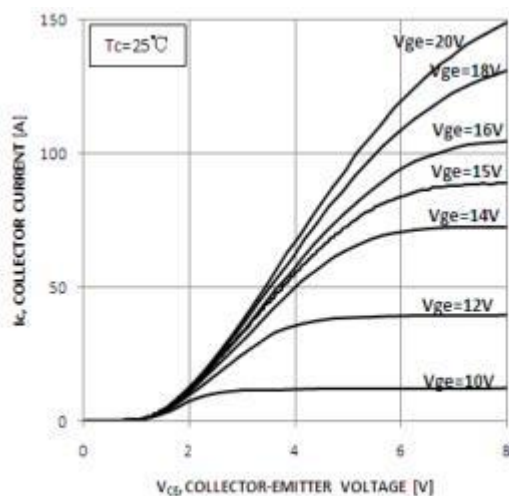


Figure 1. Typical Output Characteristics

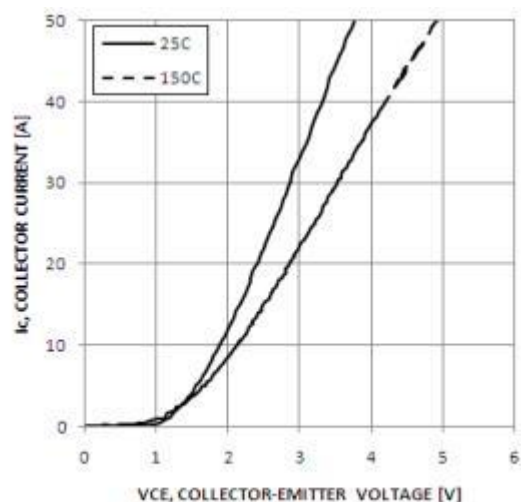


Figure 2. Typical Output Characteristics

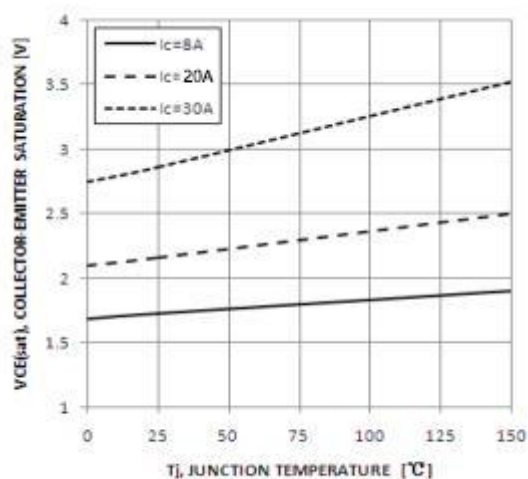


Figure 3. Typical Saturation Voltage vs. Junction Temperature

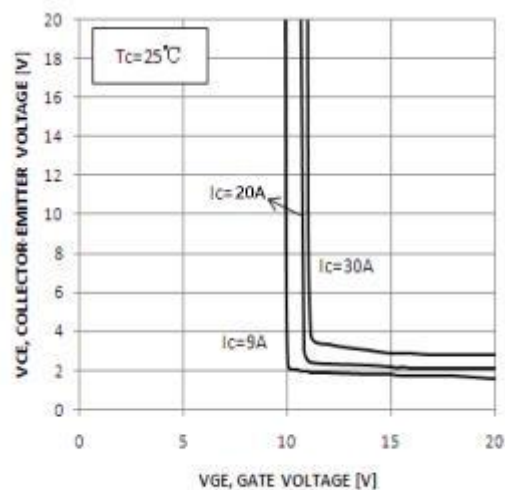


Figure 4. Typical Saturation Voltage vs. Gate-Emitter Voltage

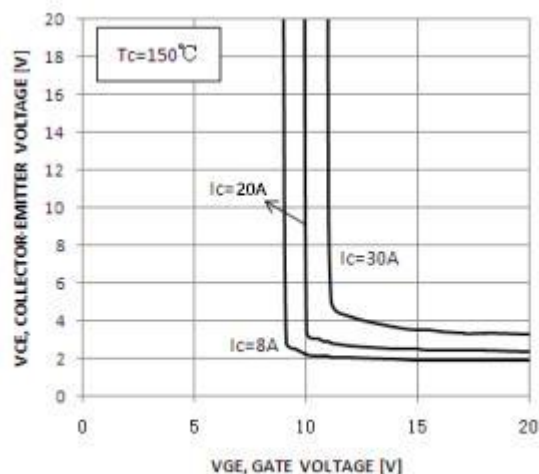


Figure 5. Typical Saturation Voltage vs. Gate-Emitter Voltage

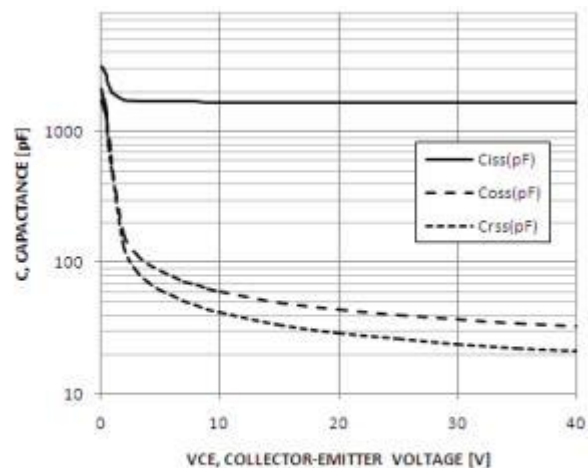


Figure 6. Typical Capacitance Characteristics

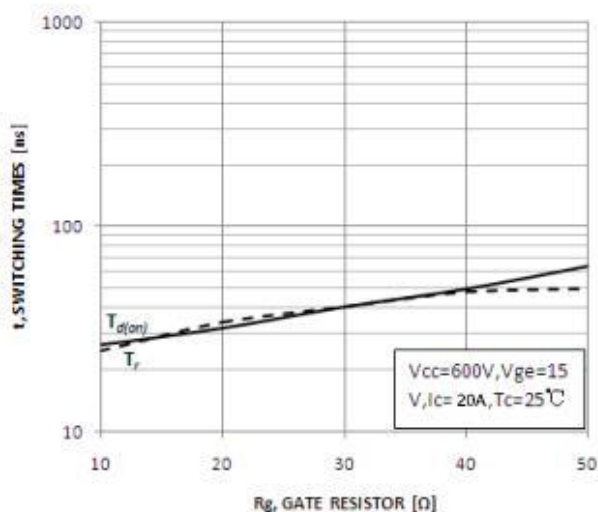


Figure 7. Typical Turn-On Characteristics vs. Gate Resistance

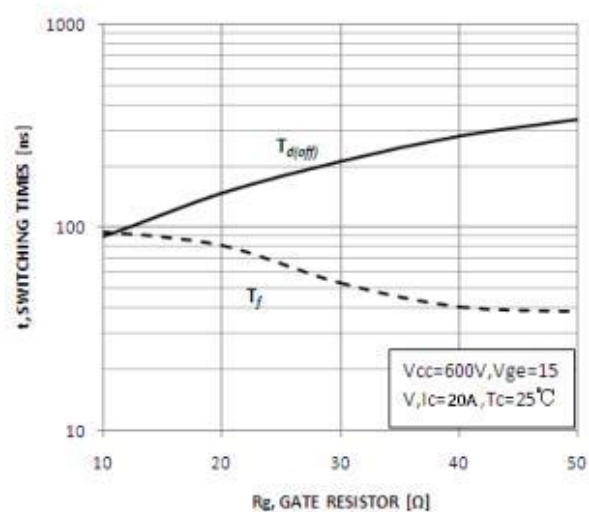


Figure 8. Typical Turn-Off Characteristics vs. Gate Resistance

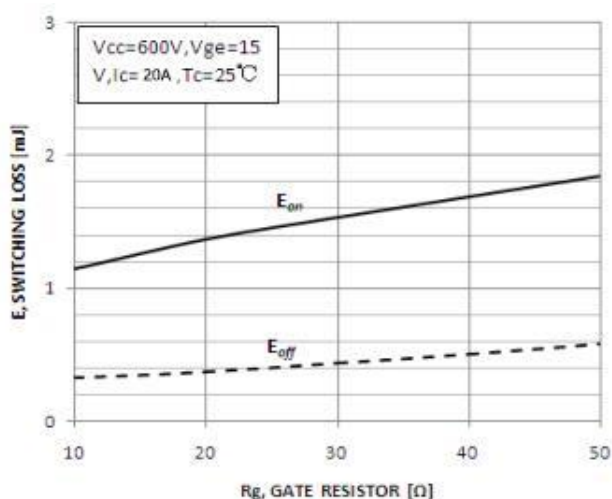


Figure 9. Typical Switching Losses vs. Gate Resistance

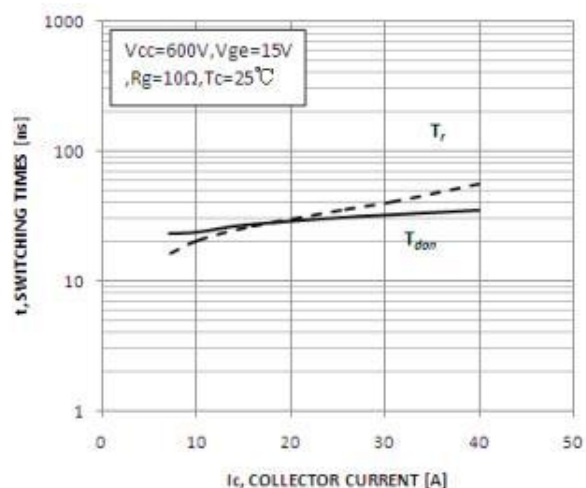


Figure 10. Typical Turn-On Characteristics vs. Collector Current

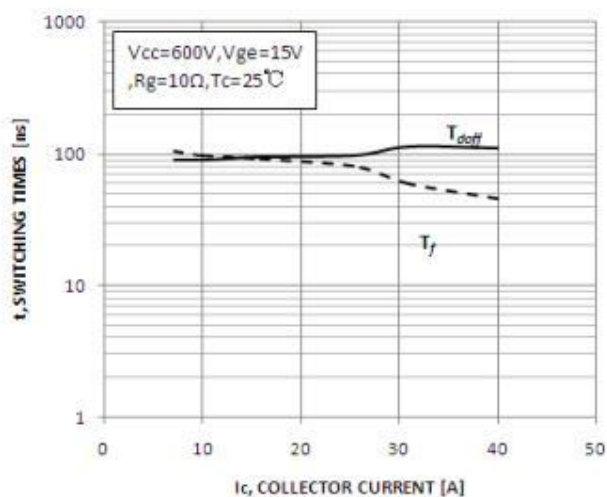


Figure 11. Typical Turn-Off Characteristics vs. Collector Current

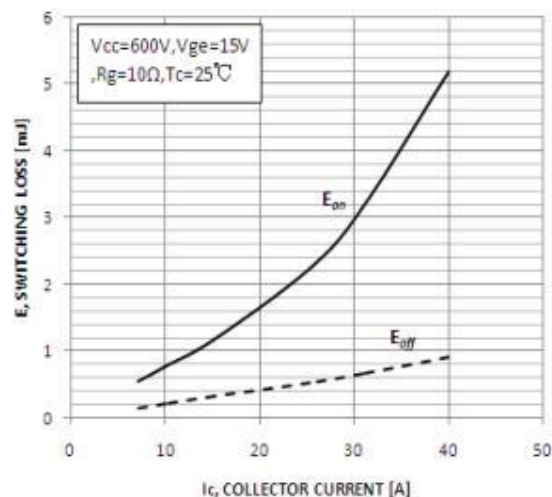


Figure 12. Typical Switching Losses vs. Collector Current

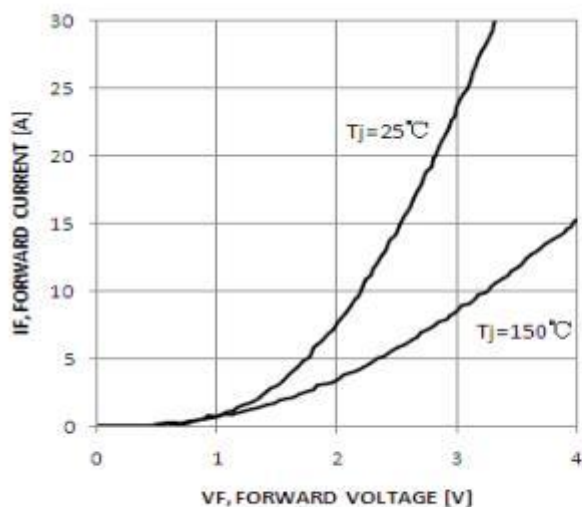


Figure 13. Typical Diode Forward Characteristics

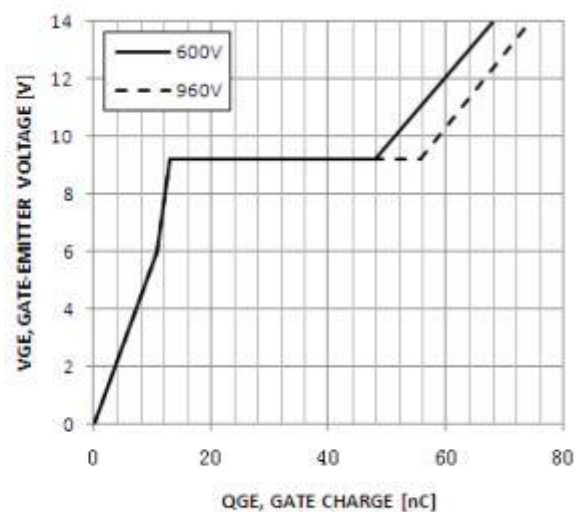


Figure 14. Typical Gate Charge

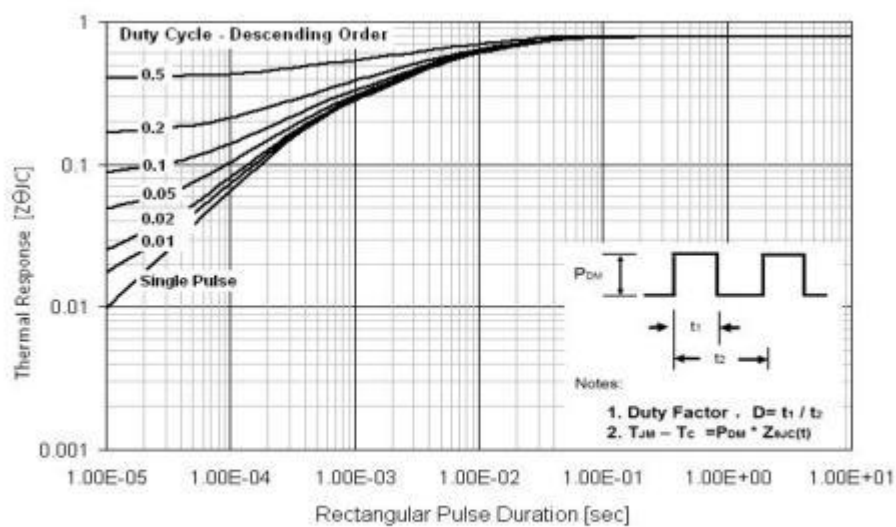


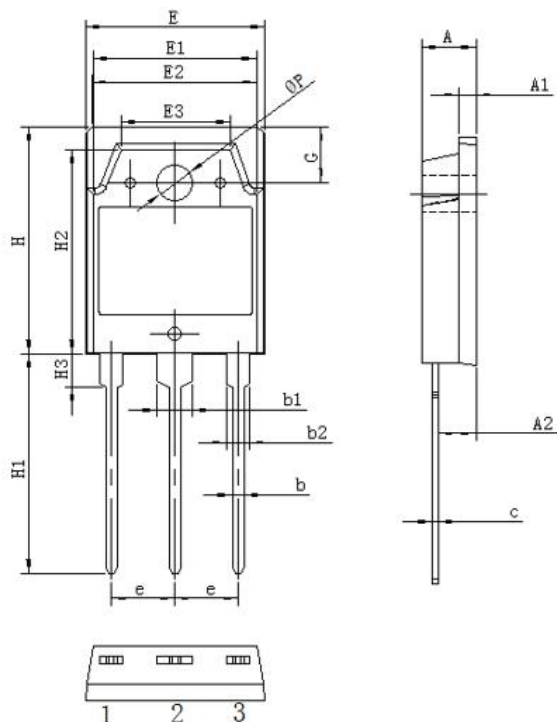
Figure 15. Transient Thermal Impedance of IGBT



## Package Information

### TO-3PN PACKAGE

基本尺寸



| Symbol   | 单位 mm |      |      |
|----------|-------|------|------|
|          | Min   | Nom  | Max  |
| A        | 4.60  | 4.80 | 5.00 |
| A1       | 1.3   | 1.5  | 1.7  |
| A2       | 2.20  | 2.40 | 2.60 |
| b        | 0.80  | 1.0  | 1.20 |
| b1       | 2.90  | 3.10 | 3.30 |
| b2       | 1.90  | 2.10 | 2.30 |
| c        | 0.50  | 0.60 | 0.70 |
| e        | 5.25  | 5.45 | 5.65 |
| E        | 15.2  | 15.6 | 16.0 |
| E1       | 13.2  | 13.4 | 13.6 |
| E2       | 13.1  | 13.3 | 13.5 |
| E3       | 9.1   | 9.3  | 9.5  |
| H        | 19.8  | 20.0 | 20.2 |
| H1       | 19.4  | 19.8 | 20.2 |
| H2       | 18.5  | 18.7 | 18.9 |
| H3       | 2.9   | 3.1  | 3.3  |
| G        | 4.8   | 5.0  | 5.2  |
| $\Phi P$ | 3.00  | 3.20 | 3.40 |

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