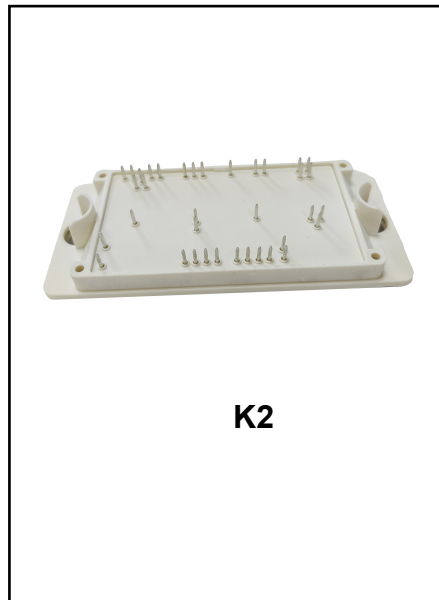


## 3-Level NPC Inverter Module with 650V Trench Stop IGBTs

### Features

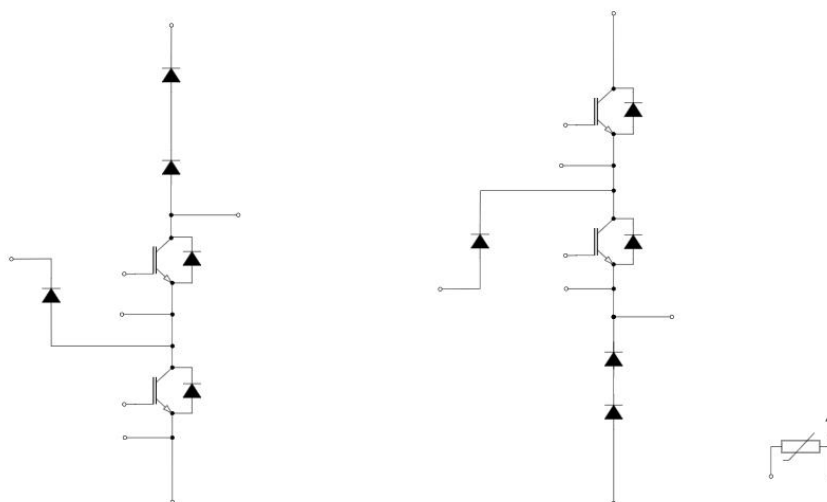
- Electrical features
  - Neutral Point Clamped Three-level Inverter Module
  - 650V Field Stop IGBTs
  - Low Inductive layout
  - Solderable Pins/Press-fit Pins
  - Thermistor
  - Pb-Free, Halogen Free/BFR Free and RoHS Compliant



### Typical Applications

- Uninterruptable Power Supplies Systems
- Energy Storage System

### Description



**Package Insulation coordination**

| Parameter                                  | Symbol      | Note or test condition        | Values     | Unit |
|--------------------------------------------|-------------|-------------------------------|------------|------|
| Isolation test voltage                     | $V_{ISOL}$  | DC Test Voltage ( $t_p=2s$ )  | 6.0        | kV   |
|                                            |             | AC Test Voltage ( $t_p=60s$ ) | 2.5        |      |
| Creepage distance                          | $d_{creep}$ |                               | > 12.7     | mm   |
| Clearance                                  | $d_{clear}$ |                               | > 12.7     | mm   |
| Comparative tracking index<br>(electrical) | $CTI$       |                               | $\geq 200$ |      |

**Package Characteristic values**

| Parameter                           | Symbol | Note or test condition                        |           | Values |       |      | Unit |
|-------------------------------------|--------|-----------------------------------------------|-----------|--------|-------|------|------|
|                                     |        |                                               |           | Min.   | Typ.  | Max. |      |
| Mounting torque for module mounting | $M$    | -Mounting according to valid application note | M5, Screw | 3      |       | 5    | Nm   |
| Weight                              | $G$    |                                               |           |        | 179.7 |      | g    |

**MAXIMUM RATINGS** (Note 1)

| Symbol | Rating | Value | Unit |
|--------|--------|-------|------|
|--------|--------|-------|------|

**BUCK Switch**

|            |                                                                                |           |            |
|------------|--------------------------------------------------------------------------------|-----------|------------|
| $V_{CES}$  | Collector-Emitter Voltage                                                      | 650       | V          |
| $V_{GE}$   | Gate-Emitter Voltage                                                           | $\pm 20V$ | V          |
| $I_C$      | Continuous Collector Current @ $T_c = 80^\circ C$ ( $T_{JMAX} = 175^\circ C$ ) | 300       | A          |
| $I_{CRM}$  | Repetitive peak collector current (tp limited by $T_{jmax}$ )                  | 900       | A          |
| $P_{tot}$  | Maximum Power Dissipation @ $T_c = 80^\circ C$ ( $T_{JMAX} = 175^\circ C$ )    | 401       | W          |
| $T_{JMAX}$ | Maximum Operating Junction Temperature                                         | 175       | $^\circ C$ |

**BUCK Diode**

|            |                                                                              |     |            |
|------------|------------------------------------------------------------------------------|-----|------------|
| $V_{RRM}$  | Peak Repetitive Reverse Voltage                                              | 650 | V          |
| $I_F$      | Continuous Forward Current @ $T_c = 80^\circ C$ ( $T_{JMAX} = 175^\circ C$ ) | 300 | A          |
| $I_{FRM}$  | Repetitive Peak Forward Current (tp limited by $T_{jmax}$ )                  | 600 | A          |
| $P_{tot}$  | Maximum Power Dissipation @ $T_c = 80^\circ C$ ( $T_{JMAX} = 175^\circ C$ )  | 539 | W          |
| $T_{JMAX}$ | Maximum Operating Junction Temperature                                       | 175 | $^\circ C$ |

**BUCK Sw.Protection Diode**

|            |                                                                             |     |            |
|------------|-----------------------------------------------------------------------------|-----|------------|
| $V_{RRM}$  | Peak Repetitive Reverse Voltage                                             | 650 | V          |
| $I_F$      | Continuous Forward Current @ $T_c = 80^\circ C$ ( $T_J = 175^\circ C$ )     | 30  | A          |
| $I_{FRM}$  | Repetitive Peak Forward Current (tp limited by $T_{jmax}$ )                 | 60  | A          |
| $P_{tot}$  | Maximum Power Dissipation @ $T_c = 80^\circ C$ ( $T_{JMAX} = 175^\circ C$ ) | 102 | W          |
| $T_{JMAX}$ | Maximum Operating Junction Temperature                                      | 175 | $^\circ C$ |

| Symbol | Rating | Value | Unit |
|--------|--------|-------|------|
|--------|--------|-------|------|

**Boost Switch**

|            |                                                                                |          |            |
|------------|--------------------------------------------------------------------------------|----------|------------|
| $V_{CES}$  | Collector-Emitter Voltage                                                      | 650      | V          |
| $V_{GE}$   | Gate-Emitter Voltage                                                           | $\pm 20$ | V          |
| $I_C$      | Continuous Collector Current @ $T_c = 80^\circ C$ ( $T_{JMAX} = 175^\circ C$ ) | 300      | A          |
| $I_{CRM}$  | Repetitive peak collector current (tp limited by $T_{jmax}$ )                  | 900      | A          |
| $P_{tot}$  | Maximum Power Dissipation @ $T_c = 80^\circ C$ ( $T_{JMAX} = 175^\circ C$ )    | 409      | W          |
| $T_{JMAX}$ | Maximum Operating Junction Temperature                                         | 175      | $^\circ C$ |

**Boost Diode**

|            |                                                                              |     |            |
|------------|------------------------------------------------------------------------------|-----|------------|
| $V_{RRM}$  | Peak Repetitive Reverse Voltage                                              | 650 | V          |
| $I_F$      | Continuous Forward Current @ $T_c = 80^\circ C$ ( $T_{JMAX} = 175^\circ C$ ) | 220 | A          |
| $I_{FRM}$  | Repetitive Peak Forward Current (tp limited by $T_{jmax}$ )                  | 600 | A          |
| $P_{tot}$  | Maximum Power Dissipation @ $T_c = 80^\circ C$ ( $T_{JMAX} = 175^\circ C$ )  | 448 | W          |
| $T_{JMAX}$ | Maximum Operating Junction Temperature                                       | 175 | $^\circ C$ |

**Boost Sw.Protection Diode**

|            |                                                                             |     |            |
|------------|-----------------------------------------------------------------------------|-----|------------|
| $V_{RRM}$  | Peak Repetitive Reverse Voltage                                             | 650 | V          |
| $I_F$      | Continuous Forward Current @ $T_c = 80^\circ C$ ( $T_J = 175^\circ C$ )     | 30  | A          |
| $I_{FRM}$  | Repetitive Peak Forward Current (tp limited by $T_{jmax}$ )                 | 60  | A          |
| $P_{tot}$  | Maximum Power Dissipation @ $T_c = 80^\circ C$ ( $T_{JMAX} = 175^\circ C$ ) | 103 | W          |
| $T_{JMAX}$ | Maximum Operating Junction Temperature                                      | 175 | $^\circ C$ |

## THERMAL PROPERTIES

|              |                                       |            |    |
|--------------|---------------------------------------|------------|----|
| $T_{stg}$    | Storage Temperature Range             | -40 to 125 | °C |
| $T_{vj\ op}$ | Temperature under switching condition | -40 to 150 | °C |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.

## RECOMMENDED OPERATING RANGES

| Symbol | Rating                                | Min | Max | Unit |
|--------|---------------------------------------|-----|-----|------|
| $T_J$  | Module Operating Junction Temperature | -40 | 175 | °C   |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)(AC test is three-level test mode)

| Symbol | Parameter | Test Condition | Min | Typ | Max | Unit |
|--------|-----------|----------------|-----|-----|-----|------|
|--------|-----------|----------------|-----|-----|-----|------|

### BUCK Switch

|               |                                      |                                                                                                                                |     |       |      |               |
|---------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----|-------|------|---------------|
| $I_{CES}$     | Collector-Emitter Cutoff Current     | $V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$                                                                                   | --  | --    | 200  | $\mu\text{A}$ |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $V_{GE} = 15\text{ V}, I_C = 300\text{ A}, T_J = 25^\circ\text{C}$                                                             | --  | 1.50  | 1.85 | V             |
|               |                                      | $V_{GE} = 15\text{ V}, I_C = 300\text{ A}, T_J = 150^\circ\text{C}$                                                            | --  | 1.75  | --   |               |
| $V_{GE(TH)}$  | Gate-Emitter Threshold Voltage       | $V_{GE} = V_{CE}, I_C = 3\text{ mA}$                                                                                           | 4.2 | 4.8   | 5.4  | V             |
| $I_{GES}$     | Gate Leakage Current                 | $V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$                                                                                    | --  | --    | 300  | nA            |
| $t_{d(on)}$   | Turn-On Delay Time                   | $T_J = 25^\circ\text{C}$<br>$V_{CE} = 350\text{ V}, I_C = 200\text{ A}$<br>$V_{GE} = 15\text{ V}/-5\text{ V}, R_G = 10\Omega$  | --  | 180   | --   | ns            |
| $t_r$         | Rise Time                            |                                                                                                                                | --  | 40    | --   |               |
| $t_{d(off)}$  | Turn-off Delay Time                  |                                                                                                                                | --  | 500   | --   |               |
| $t_f$         | Fall Time                            |                                                                                                                                | --  | 30    | --   |               |
| $E_{on}$      | Turn-On Switching Loss per Pulse     |                                                                                                                                | --  | 2.37  | --   | mJ            |
| $E_{off}$     | Turn Off Switching Loss per Pulse    |                                                                                                                                | --  | 6.99  | --   |               |
| $t_{d(on)}$   | Turn-On Delay Time                   | $T_J = 150^\circ\text{C}$<br>$V_{CE} = 350\text{ V}, I_C = 200\text{ A}$<br>$V_{GE} = 15\text{ V}/-5\text{ V}, R_G = 10\Omega$ | --  | 170   | --   | ns            |
| $t_r$         | Rise Time                            |                                                                                                                                | --  | 41    | --   |               |
| $t_{d(off)}$  | Turn-off Delay Time                  |                                                                                                                                | --  | 550   | --   |               |
| $t_f$         | Fall Time                            |                                                                                                                                | --  | 40    | --   |               |
| $E_{on}$      | Turn-on Switching Loss per Pulse     |                                                                                                                                | --  | 4.25  | --   | mJ            |
| $E_{off}$     | Turn Off Switching Loss per Pulse    |                                                                                                                                | --  | 7.45  | --   |               |
| $C_{ies}$     | Input Capacitance                    | $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ Mhz}$                                                                  | --  | 19300 | --   | nF            |
| $C_{oes}$     | Output Capacitance                   |                                                                                                                                | --  | 616   | --   |               |
| $C_{res}$     | Reverse Transfer Capacitance         |                                                                                                                                | --  | 120   | --   |               |
| $Q_g$         | Total Gate Charge                    | $V_{CC} = 600\text{ V}, I_C = 300\text{ A}, V_{GE} = \pm 15\text{ V}$                                                          | --  | 588   | --   | nC            |
| $R_{thJC}$    | Thermal Resistance – Chip-to-Case    | Thermal grease, Thickness = 2 Mil $\pm 2\%$ ,<br>$\lambda_{paste} = 3.4\text{ W/mK}$                                           | --  | 0.237 | --   | °C/W          |

### BUCK Diode

|            |                                   |                                                                                              |    |       |      |               |
|------------|-----------------------------------|----------------------------------------------------------------------------------------------|----|-------|------|---------------|
| $V_F$      | Diode Forward Voltage             | $I_F = 300\text{ A}, T_J = 25^\circ\text{C}$                                                 | -- | 1.30  | 1.80 | V             |
|            |                                   | $I_F = 300\text{ A}, T_J = 150^\circ\text{C}$                                                | -- | 1.20  | --   |               |
| $I_R$      | Reverse leakage current           | $V_R = 650\text{ V}$                                                                         | -- | --    | 15   | $\mu\text{A}$ |
| $t_{rr}$   | Reverse Recovery Time             | $T_J = 25^\circ\text{C}$<br>$V_{CE} = 350\text{ V}, I_C = 200\text{ A}$<br>$R_G = 10\Omega$  | -- | 37    | --   | ns            |
| $Q_r$      | Reverse Recovery Charge           |                                                                                              | -- | 4.45  | --   | $\mu\text{C}$ |
| $I_{RM}$   | Peak Reverse Recovery Current     |                                                                                              | -- | 179   | --   | A             |
| $E_{rec}$  | Reverse recovered energy          |                                                                                              | -- | 2.55  | --   | mJ            |
| $t_{rr}$   | Reverse Recovery Time             | $T_J = 150^\circ\text{C}$<br>$V_{CE} = 350\text{ V}, I_C = 200\text{ A}$<br>$R_G = 10\Omega$ | -- | 63.1  | --   | ns            |
| $Q_r$      | Reverse Recovery Charge           |                                                                                              | -- | 10.53 | --   | $\mu\text{C}$ |
| $I_{RM}$   | Peak Reverse Recovery Current     |                                                                                              | -- | 252   | --   | A             |
| $E_{rec}$  | Reverse recovered energy          |                                                                                              | -- | 5.85  | --   | mJ            |
| $R_{thJC}$ | Thermal Resistance – Chip-to-Case | Thermal grease, Thickness = 2 Mil $\pm 2\%$ ,<br>$\lambda_{paste} = 3.4\text{ W/mK}$         | -- | 0.175 | --   | °C/W          |

**BUCK Sw.Protection Diode**

|                   |                                   |                                                                         |    |       |     |      |
|-------------------|-----------------------------------|-------------------------------------------------------------------------|----|-------|-----|------|
| V <sub>F</sub>    | Diode Forward Voltage             | I <sub>F</sub> = 30 A, T <sub>J</sub> = 25°C                            | -- | 1.20  | 1.6 | V    |
|                   |                                   | I <sub>F</sub> = 30 A, T <sub>J</sub> = 150°C                           | -- | 1.05  | --  |      |
| I <sub>R</sub>    | Reverse leakage current           | V <sub>r</sub> = 650V                                                   | -- | --    | 0.5 | μA   |
| R <sub>thJC</sub> | Thermal Resistance – Chip-to-Case | Thermal grease, Thickness = 2 Mil ±2%,<br>λ <sub>paste</sub> = 3.4 W/mK | -- | 0.935 | --  | °C/W |

**ELECTRICAL CHARACTERISTICS** (T<sub>J</sub> = 25°C unless otherwise noted)(AC test is three-level test mode)

| Symbol | Parameter | Test Condition | Min | Typ | Max | Unit |
|--------|-----------|----------------|-----|-----|-----|------|
|--------|-----------|----------------|-----|-----|-----|------|

**Boost Switch**

|                      |                                      |                                                                                                                             |     |       |      |      |
|----------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----|-------|------|------|
| I <sub>CES</sub>     | Collector-Emitter Cutoff Current     | V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 650 V                                                                              | --  | --    | 200  | μA   |
| V <sub>CE(sat)</sub> | Collector-Emitter Saturation Voltage | V <sub>GE</sub> = 15 V, I <sub>C</sub> = 300 A, T <sub>J</sub> = 25°C                                                       | --  | 1.45  | 1.80 | V    |
|                      |                                      | V <sub>GE</sub> = 15 V, I <sub>C</sub> = 300 A, T <sub>J</sub> = 150°C                                                      | --  | 1.70  | --   |      |
| V <sub>GE(TH)</sub>  | Gate-Emitter Threshold Voltage       | V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 3 mA                                                                   | 4.2 | 4.8   | 5.4  | V    |
| I <sub>GES</sub>     | Gate Leakage Current                 | V <sub>GE</sub> = 20 V, V <sub>CE</sub> = 0 V                                                                               | --  | --    | 300  | nA   |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   | T <sub>J</sub> = 25°C<br>V <sub>CE</sub> = 350 V, I <sub>C</sub> = 200A<br>V <sub>GE</sub> = 15V/-5V, R <sub>G</sub> = 10Ω  | --  | 190   | --   | ns   |
| t <sub>r</sub>       | Rise Time                            |                                                                                                                             | --  | 40    | --   |      |
| t <sub>d(off)</sub>  | Turn-off Delay Time                  |                                                                                                                             | --  | 510   | --   |      |
| t <sub>f</sub>       | Fall Time                            |                                                                                                                             | --  | 40    | --   |      |
| E <sub>on</sub>      | Turn-On Switching Loss per Pulse     |                                                                                                                             | --  | 2.02  | --   | mJ   |
| E <sub>off</sub>     | Turn Off Switching Loss per Pulse    |                                                                                                                             | --  | 8.62  | --   |      |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   | T <sub>J</sub> = 150°C<br>V <sub>CE</sub> = 350 V, I <sub>C</sub> = 200A<br>V <sub>GE</sub> = 15V/-5V, R <sub>G</sub> = 10Ω | --  | 180   | --   | ns   |
| t <sub>r</sub>       | Rise Time                            |                                                                                                                             | --  | 50    | --   |      |
| t <sub>d(off)</sub>  | Turn-off Delay Time                  |                                                                                                                             | --  | 560   | --   |      |
| t <sub>f</sub>       | Fall Time                            |                                                                                                                             | --  | 40    | --   |      |
| E <sub>on</sub>      | Turn-on Switching Loss per Pulse     |                                                                                                                             | --  | 2.94  | --   | mJ   |
| E <sub>off</sub>     | Turn Off Switching Loss per Pulse    |                                                                                                                             | --  | 8.99  | --   |      |
| C <sub>ies</sub>     | Input Capacitance                    | V <sub>CE</sub> = 25 V, V <sub>GE</sub> = 0 V, f = 1 Mhz                                                                    | --  | 19300 | --   | nF   |
| C <sub>oes</sub>     | Output Capacitance                   |                                                                                                                             | --  | 616   | --   |      |
| C <sub>res</sub>     | Reverse Transfer Capacitance         |                                                                                                                             | --  | 120   | --   |      |
| Q <sub>g</sub>       | Total Gate Charge                    | V <sub>CC</sub> = 600 V, I <sub>C</sub> = 300 A, V <sub>GE</sub> = ± 15 V                                                   | --  | 588   | --   | nC   |
| R <sub>thJC</sub>    | Thermal Resistance – Chip-to-Case    | Thermal grease, Thickness = 2 Mil ±2%,<br>λ <sub>paste</sub> = 3.4 W/mK                                                     | --  | 0.231 | --   | °C/W |

**Boost Diode**

|                   |                                   |                                                                                                  |    |       |      |      |
|-------------------|-----------------------------------|--------------------------------------------------------------------------------------------------|----|-------|------|------|
| V <sub>F</sub>    | Diode Forward Voltage             | I <sub>F</sub> = 300 A, T <sub>J</sub> = 25°C                                                    | -- | 2.70  | 3.20 | V    |
|                   |                                   | I <sub>F</sub> = 300 A, T <sub>J</sub> = 150°C                                                   | -- | 2.50  | --   |      |
| I <sub>R</sub>    | Reverse leakage current           | V <sub>r</sub> = 1300V                                                                           | -- | --    | 15   | μA   |
| t <sub>rr</sub>   | Reverse Recovery Time             | T <sub>J</sub> = 25°C<br>V <sub>CE</sub> = 350 V, I <sub>C</sub> = 200A<br>R <sub>G</sub> = 10Ω  | -- | 47    | --   | ns   |
| Q <sub>r</sub>    | Reverse Recovery Charge           |                                                                                                  | -- | 3.8   | --   | μC   |
| I <sub>RM</sub>   | Peak Reverse Recovery Current     |                                                                                                  | -- | 127   | --   | A    |
| E <sub>rec</sub>  | Reverse recovered energy          |                                                                                                  | -- | 2.45  | --   | mJ   |
| t <sub>rr</sub>   | Reverse Recovery Time             |                                                                                                  | -- | 71    | --   | ns   |
| Q <sub>r</sub>    | Reverse Recovery Charge           | T <sub>J</sub> = 150°C<br>V <sub>CE</sub> = 350 V, I <sub>C</sub> = 200A<br>R <sub>G</sub> = 10Ω | -- | 8.56  | --   | μC   |
| I <sub>RM</sub>   | Peak Reverse Recovery Current     |                                                                                                  | -- | 178   | --   | A    |
| E <sub>rec</sub>  | Reverse recovered energy          |                                                                                                  | -- | 5.85  | --   | mJ   |
| R <sub>thJC</sub> | Thermal Resistance – Chip-to-Case | Thermal grease, Thickness = 2 Mil ±2%,<br>λ <sub>paste</sub> = 3.4 W/mK                          | -- | 0.212 | --   | °C/W |

**Boost Sw.Protection Diode**

|                   |                                   |                                                                         |    |       |      |      |
|-------------------|-----------------------------------|-------------------------------------------------------------------------|----|-------|------|------|
| V <sub>F</sub>    | Diode Forward Voltage             | I <sub>F</sub> = 30 A, T <sub>J</sub> = 25°C                            | -- | 1.20  | 1.60 | V    |
|                   |                                   | I <sub>F</sub> = 30 A, T <sub>J</sub> = 150°C                           | -- | 1.05  | --   |      |
| I <sub>R</sub>    | Reverse leakage current           | V <sub>r</sub> = 650V                                                   | -- | --    | 0.5  | μA   |
| R <sub>thJC</sub> | Thermal Resistance – Chip-to-Case | Thermal grease, Thickness = 2 Mil ±2%,<br>λ <sub>paste</sub> = 3.4 W/mK | -- | 0.915 | --   | °C/W |

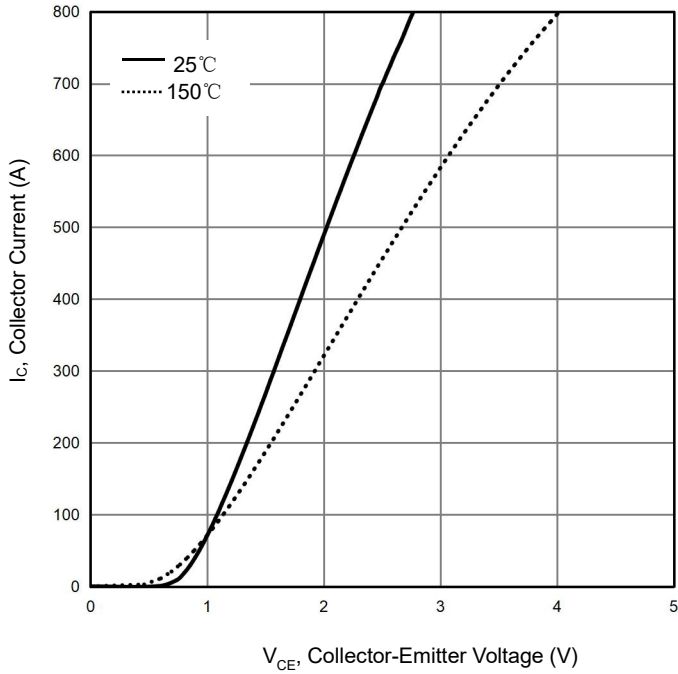
**THERMISTOR PROPERTIES**

|                  |                              |                                       |    |      |    |      |
|------------------|------------------------------|---------------------------------------|----|------|----|------|
| R <sub>25</sub>  | Nominal Resistance           | T = 25°C                              | -- | 22   | -- | kΩ   |
| R <sub>100</sub> | Nominal Resistance           | T = 100°C                             | -- | 1486 | -- | Ω    |
| R/R              | Deviation of R <sub>25</sub> |                                       | -5 | --   | -5 | %    |
| PD               | Power Dissipation            |                                       | -- | 200  | -- | mW   |
|                  | Power Dissipation Constant   |                                       | -- | 2    | -- | mW/K |
|                  | B-value                      | B <sub>(25/50)</sub> , tolerance ±1%  | -- | 3950 | -- | K    |
|                  | B-value                      | B <sub>(25/100)</sub> , tolerance ±1% | -- | 3998 | -- | K    |

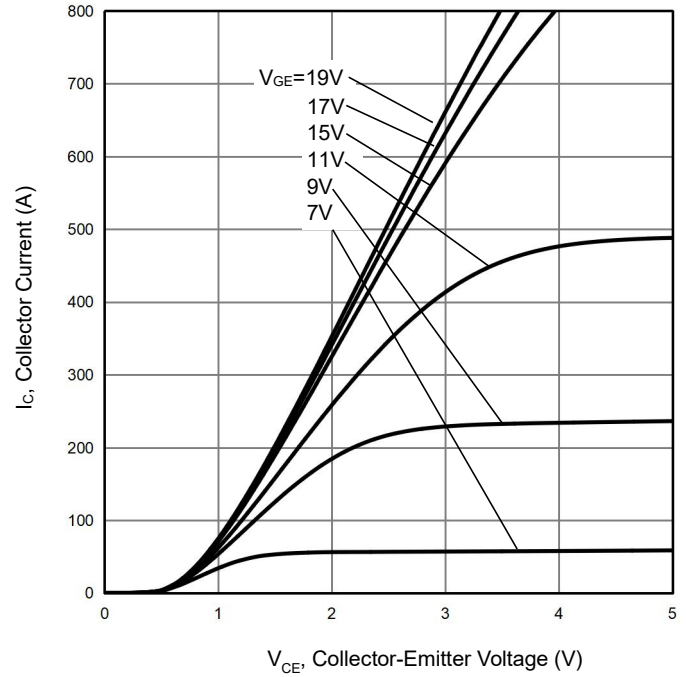
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted.  
Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

**BUCK Switch Characteristics**

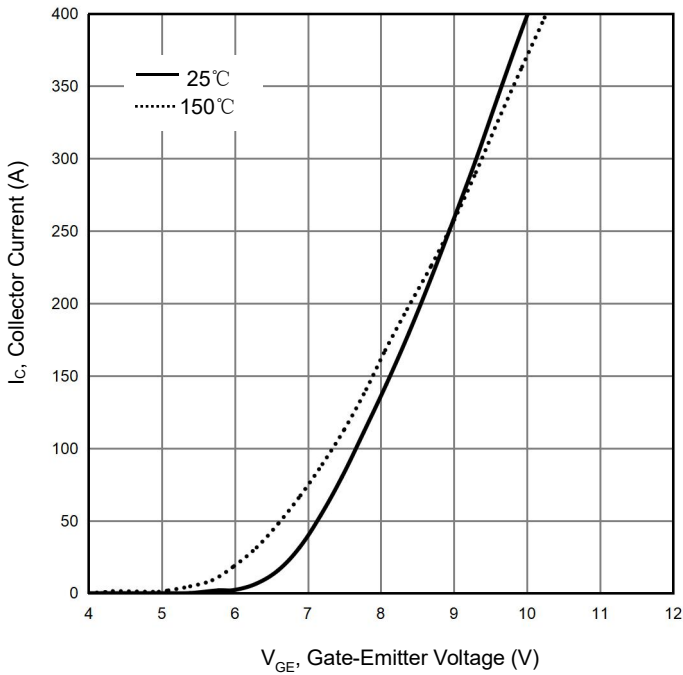
**Figure 1. Typical Output Characteristics**  
 $V_G = 15V$



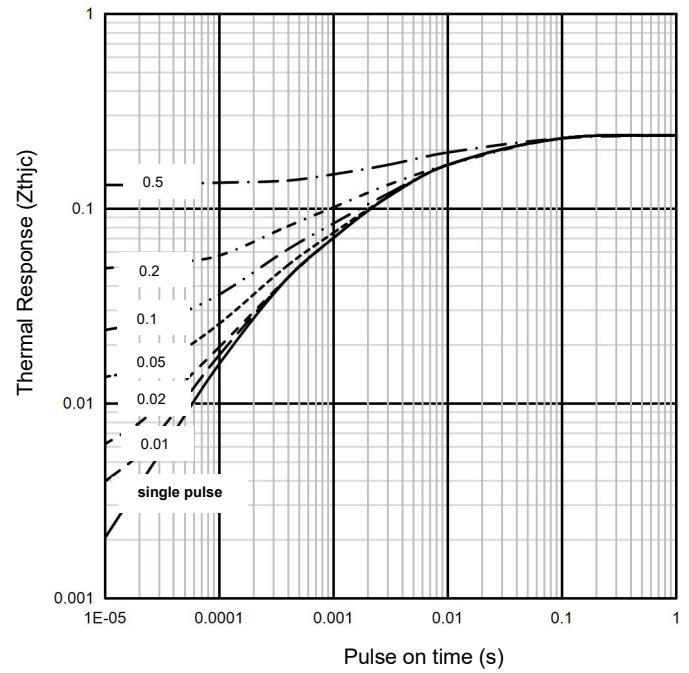
**Figure 2. Typical Output Characteristics**  
 $T_j = 150^\circ C$



**Figure 3. Typical Transfer Characteristics**  
 $V_{CE} = 20V$



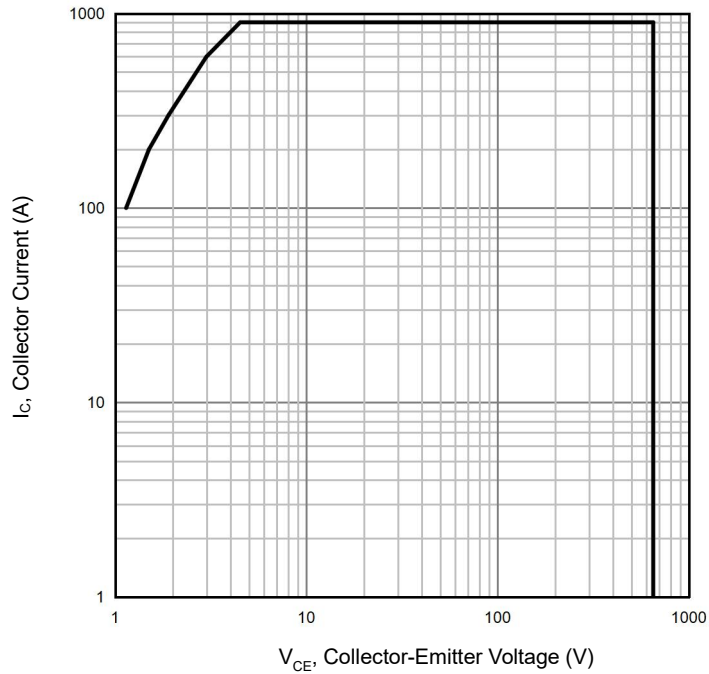
**Figure 4. Transient thermal impedance as a function of pulse width**



## BUCK Switch Characteristics

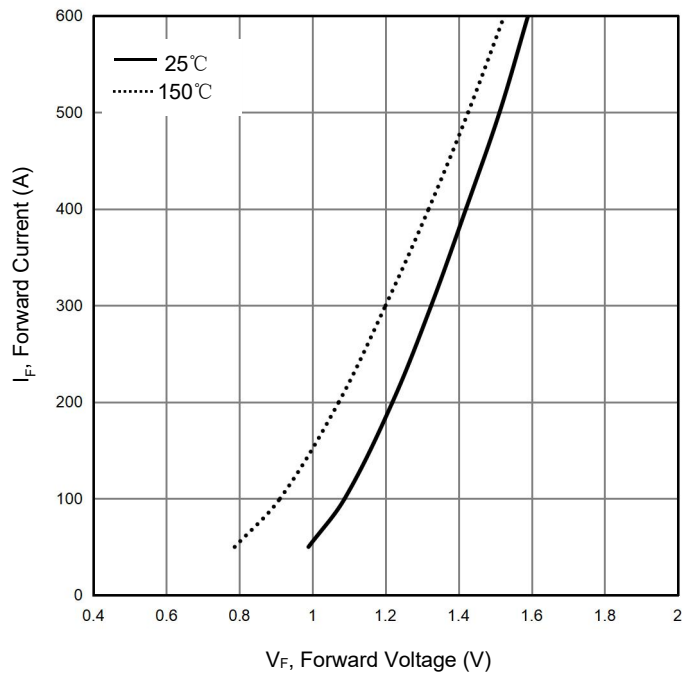
**Figure 5. Forward Bias Safe Operating Area**

$T_C = 80^\circ\text{C}$ ,  $T_J \leq T_{J \text{ max}}$ ,  $V_G = 15\text{V}$

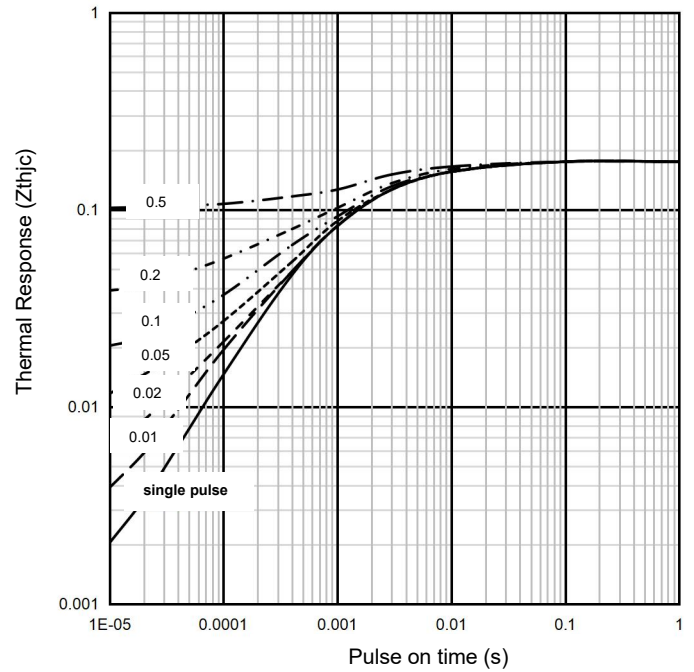


## BUCK Diode Characteristics

**Figure 6. Typical forward characteristics**

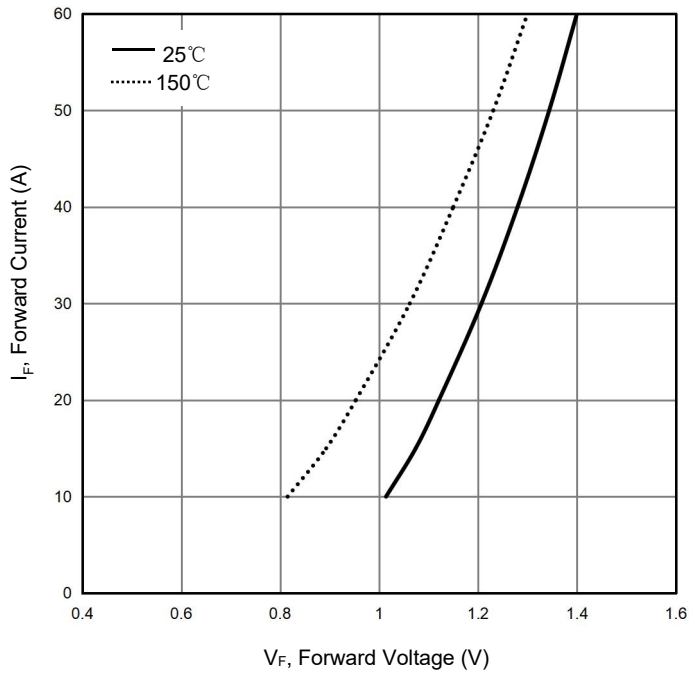


**Figure 7. Transient thermal impedance as a function of pulse width**

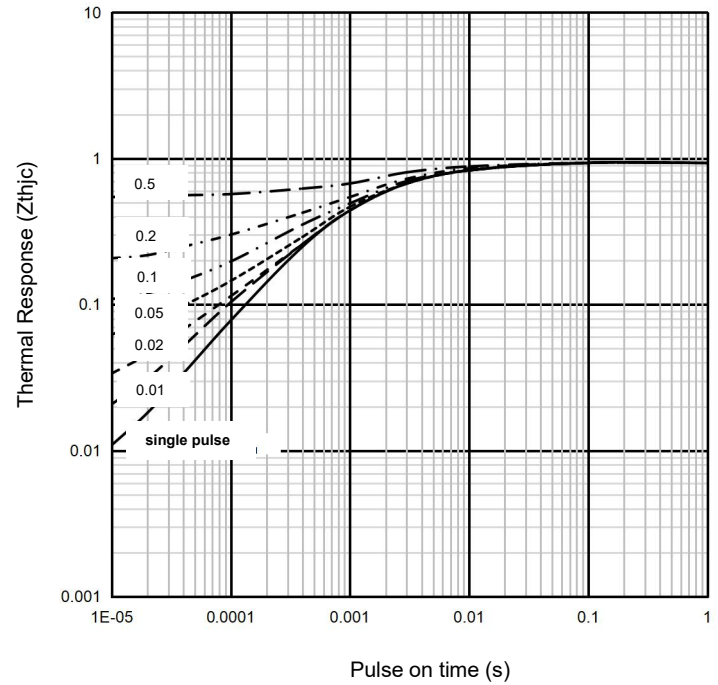


## Buck Sw. Protection Diode Characteristics

**Figure 8. Typical forward characteristics**



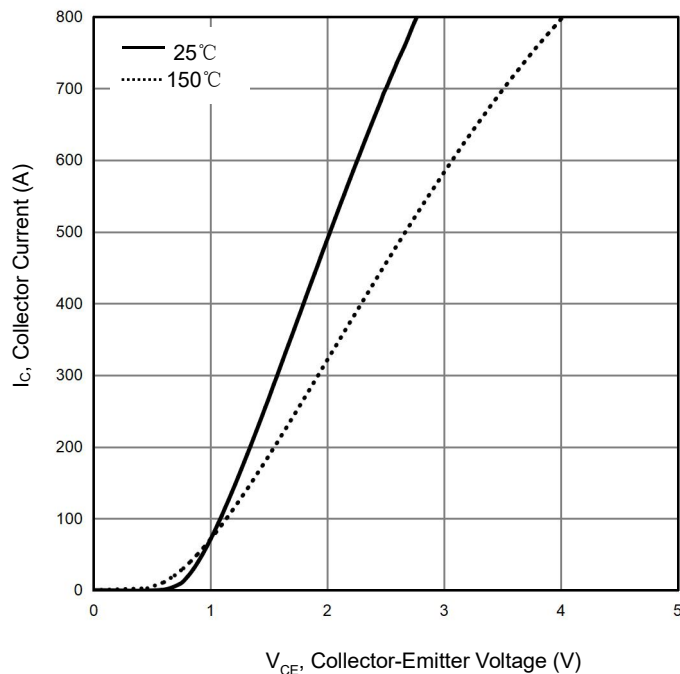
**Figure 9. Transient thermal impedance as a function of pulse width**



## Boost Switch Characteristics

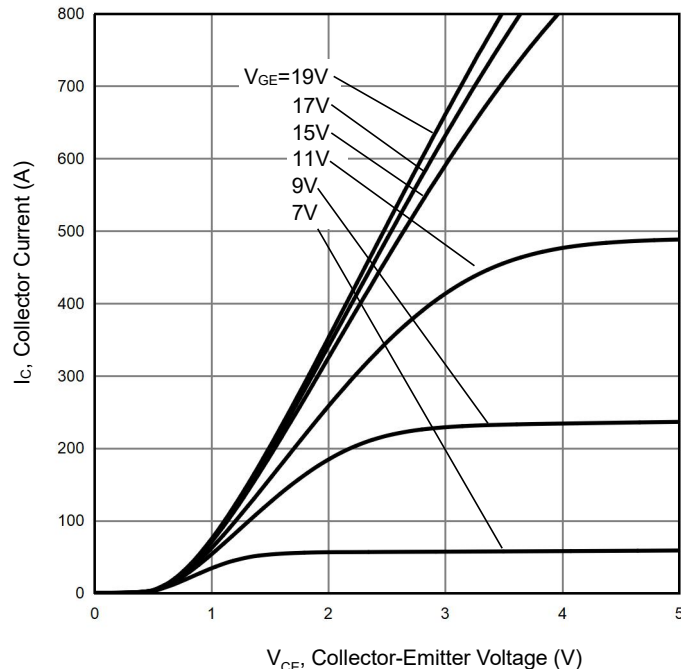
**Figure 10. Typical Output Characteristics**

$V_G = 15V$

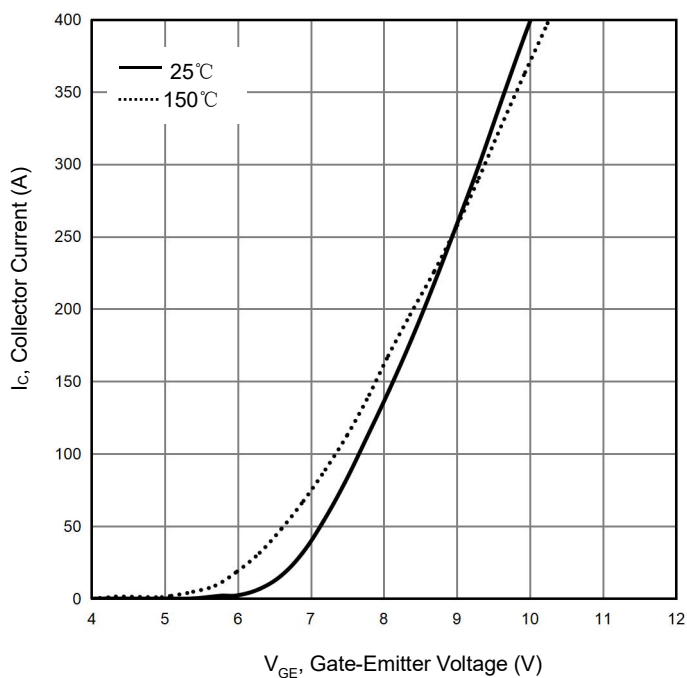


**Figure 11. Typical Output Characteristics**

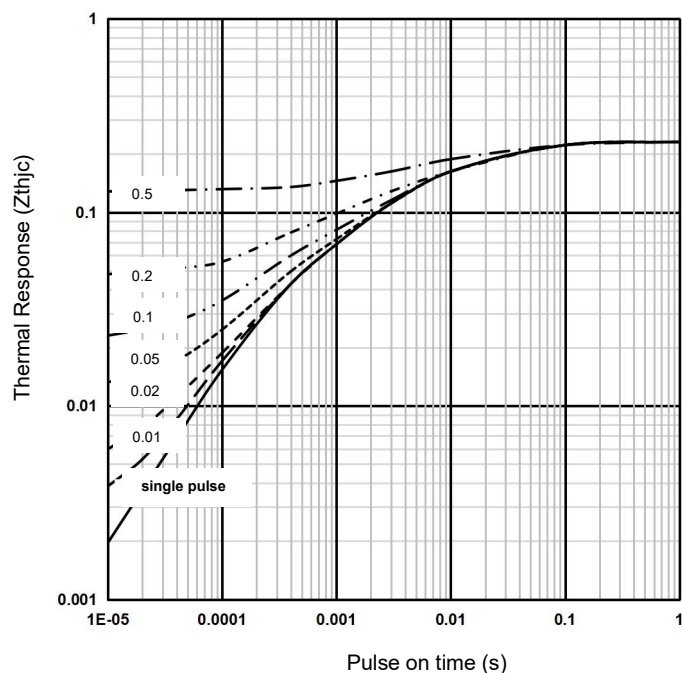
$T_j = 150^\circ\text{C}$



**Figure 12. Typical Transfer Characteristics**



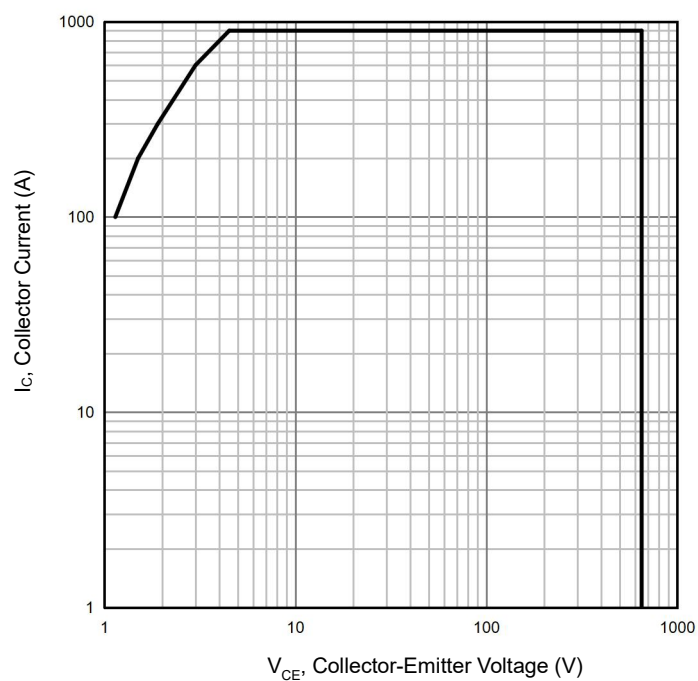
**Figure 13. Transient thermal impedance as a function of pulse width**



## Boost Switch Characteristics

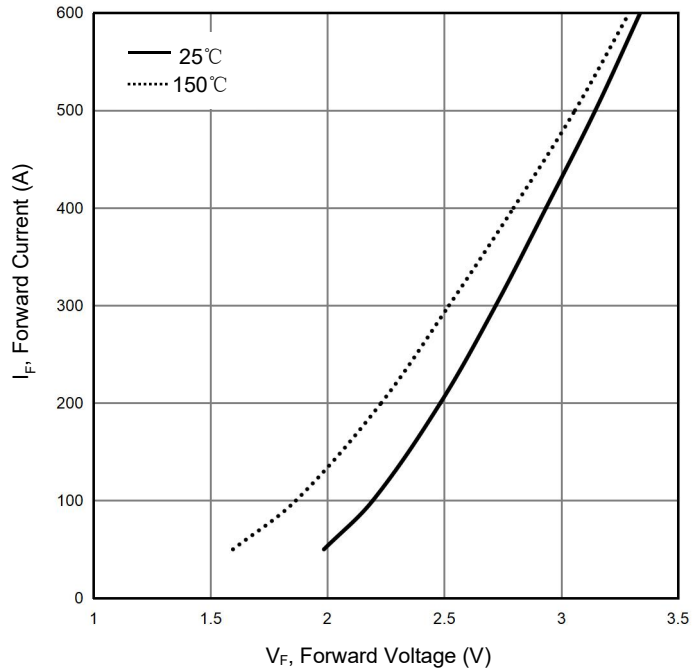
**Figure 14. Forward Bias Safe Operating Area**

$T_C = 80^\circ\text{C}$ ,  $T_J \leq T_{J \text{ max}}$ ,  $V_G = 15\text{V}$

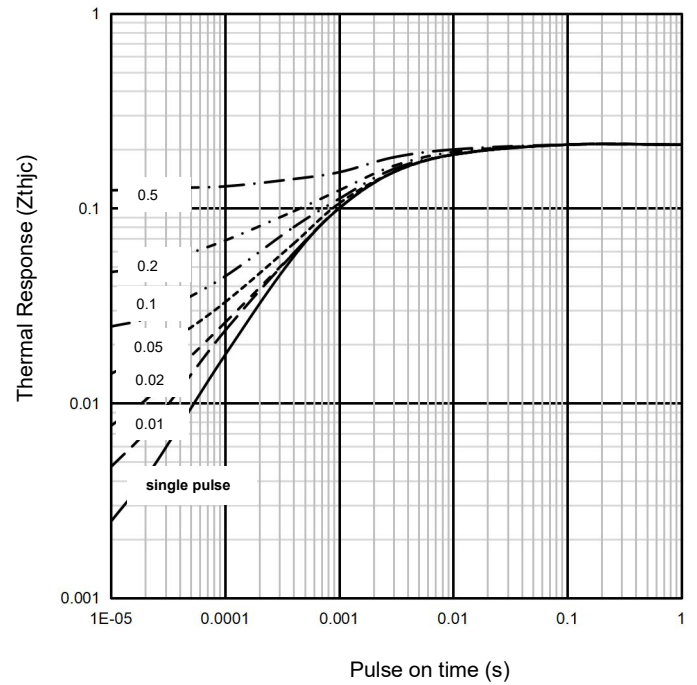


## Boost Diode Characteristics

**Figure 15. Typical forward characteristics**

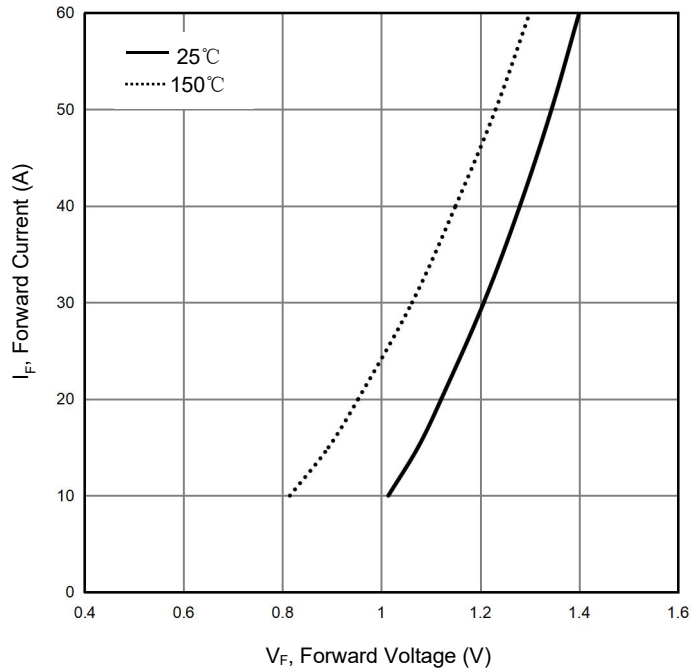


**Figure 16. Transient thermal impedance as a function of pulse width**

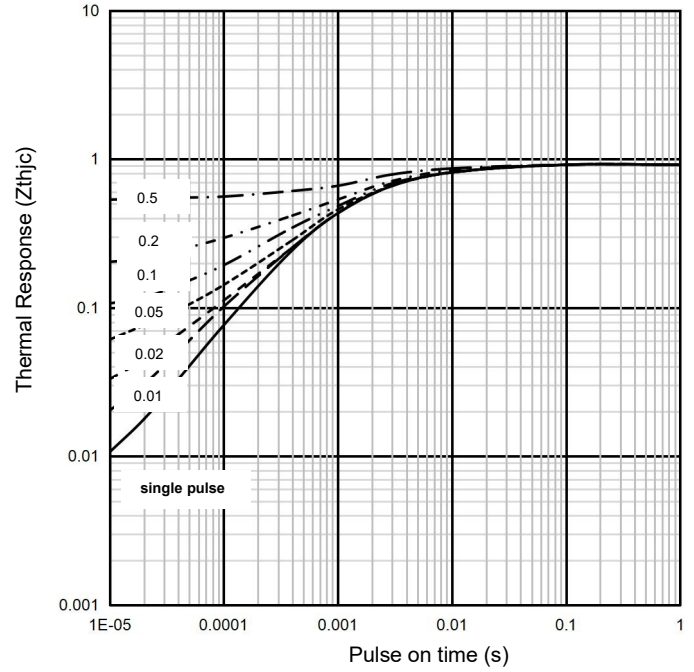


## Boost Sw. Protection Diode Characteristics

**Figure 17. Typical forward characteristics**

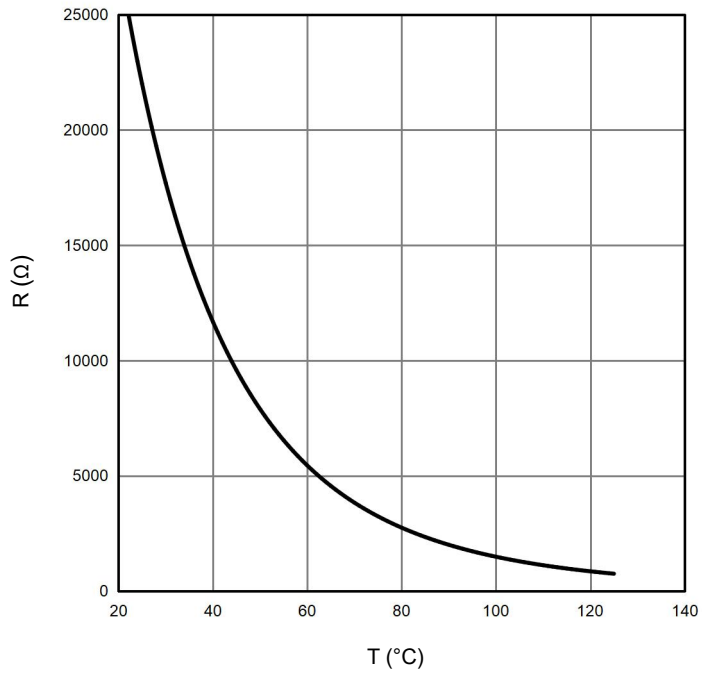


**Figure 18. Transient thermal impedance as a function of pulse width**



## Thermistor Characteristics

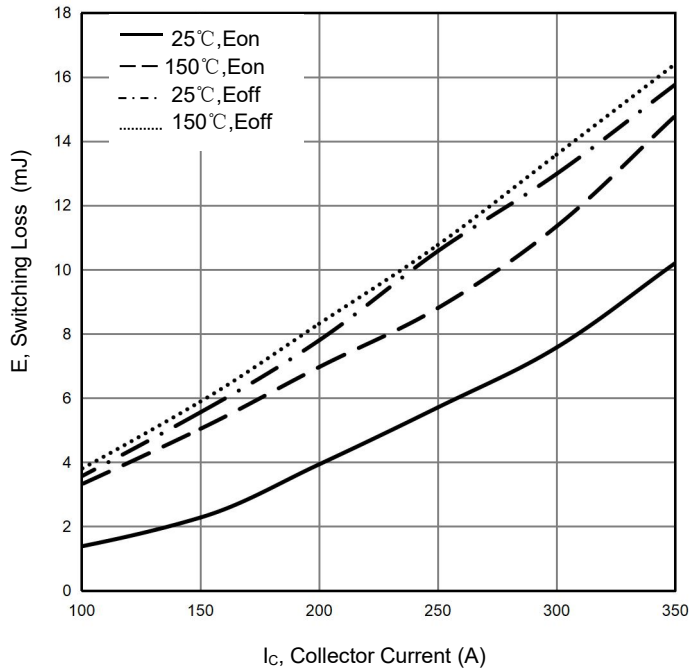
**Figure 19.**Typical NTC characteristic as function of temperature



## Buck Switching Characteristics

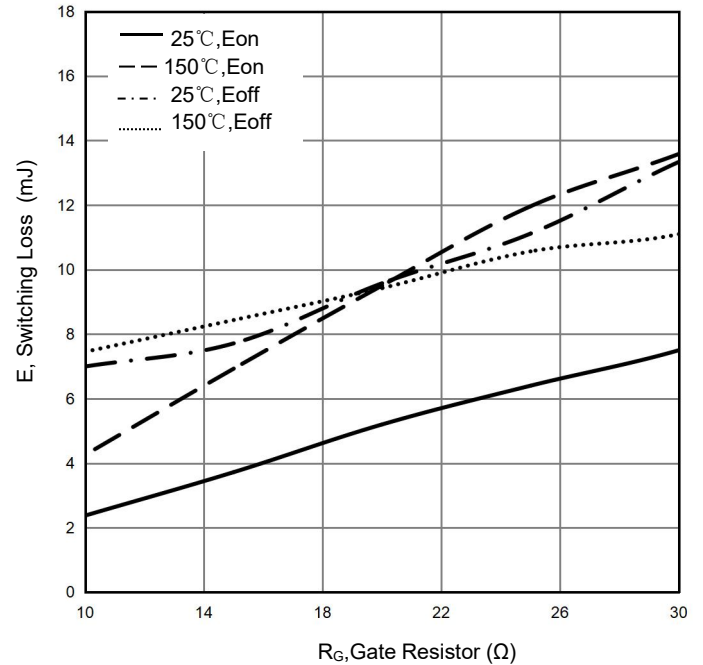
**Figure 20. Typical switching energy losses as a function of collector current Characteristics**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V$



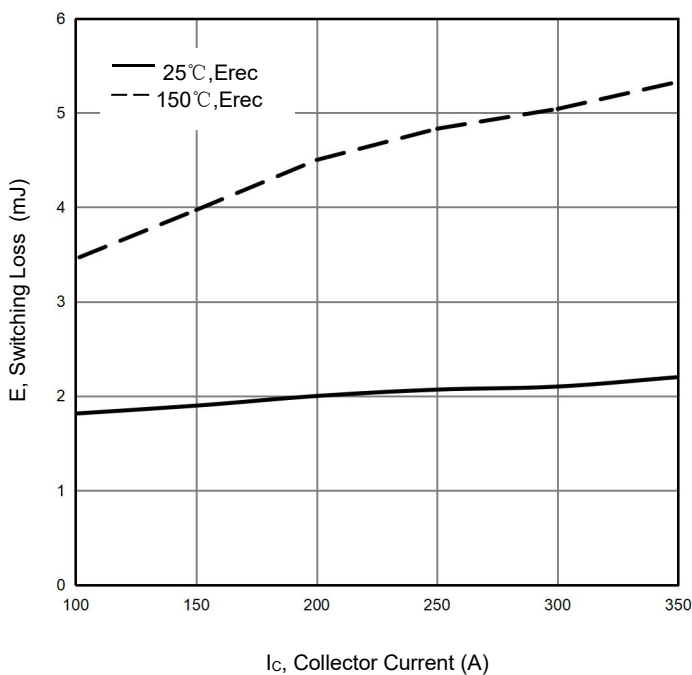
**Figure 21. Typical switching energy losses as a function of IGBT turn on gate resistor**

$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V$



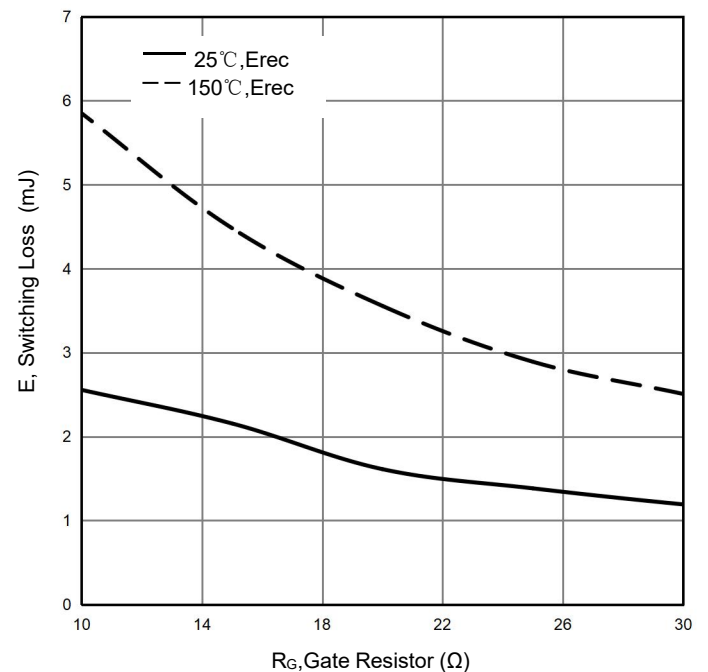
**Figure 22. Typical reverse recovered energy loss as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V$



**Figure 23. Typical reverse recovered energy loss as a function of IGBT turn on gate**

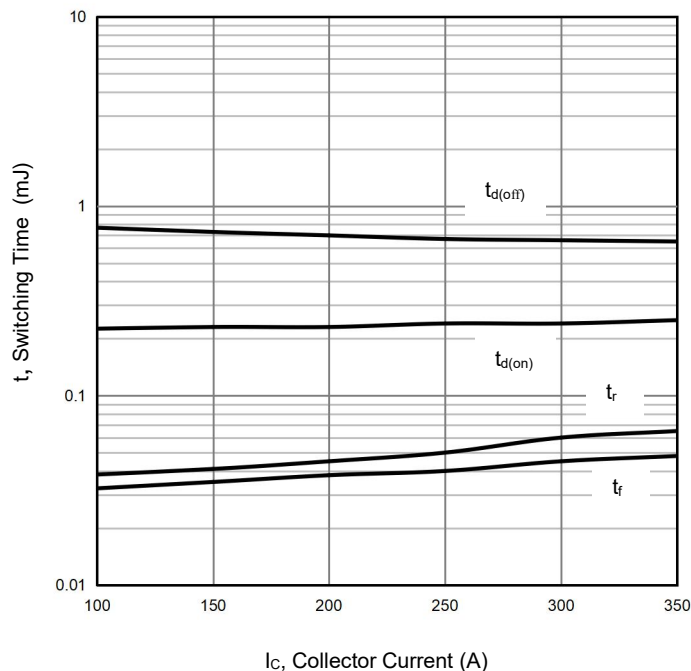
$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V$



## Buck Switching Characteristics

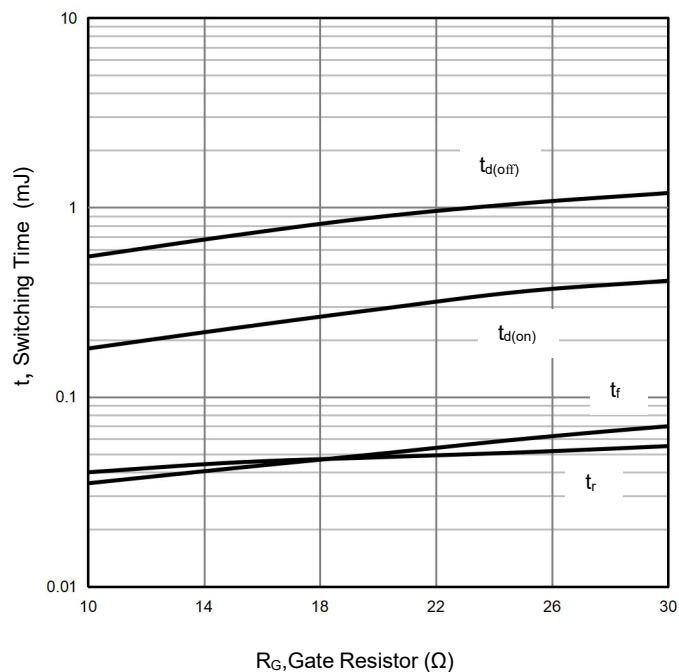
**Figure 24. Typical switching times as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V, T_j = 150^\circ C$



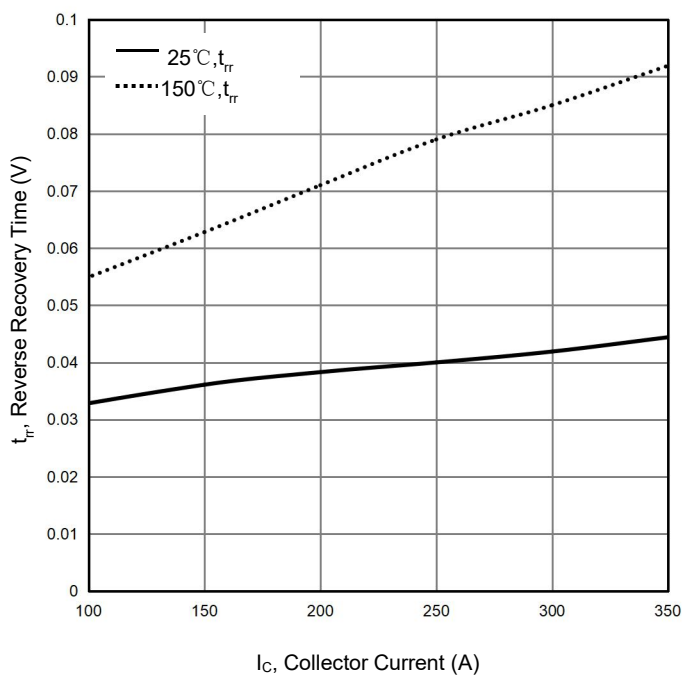
**Figure 25. Typical switching times as a function of IGBT turn on gate resistor**

$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V, T_j = 150^\circ C$



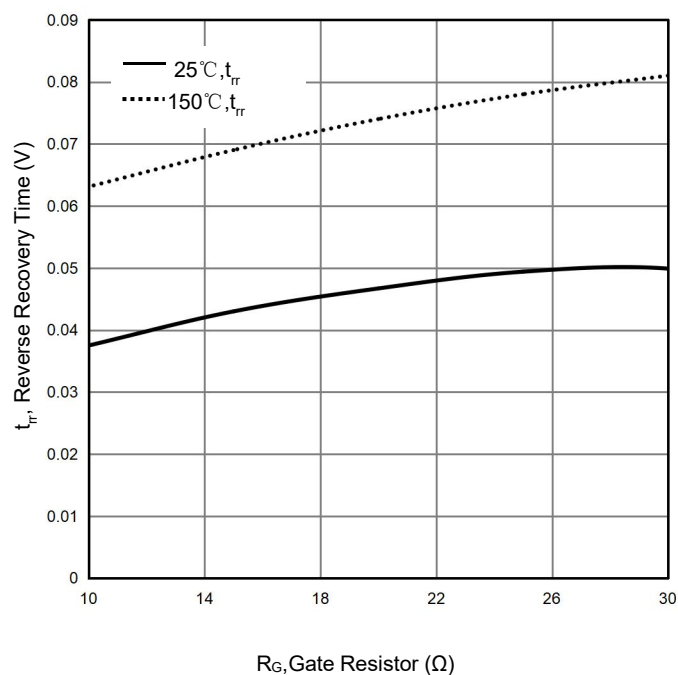
**Figure 26. Typical reverse recovery time as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V$



**Figure 27. Typical reverse recovery time as a function of IGBT turn on gate resistor**

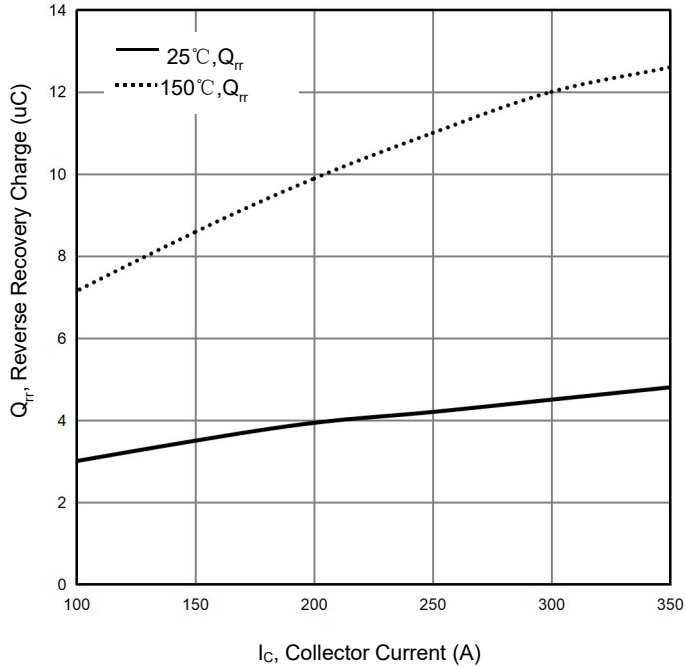
$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V$



## Buck Switching Characteristics

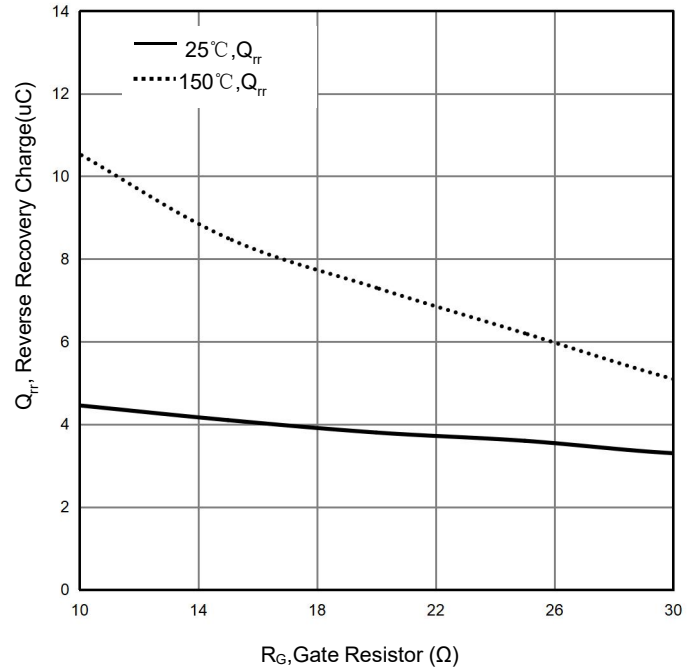
**Figure 28. Typical recovered charge as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V$



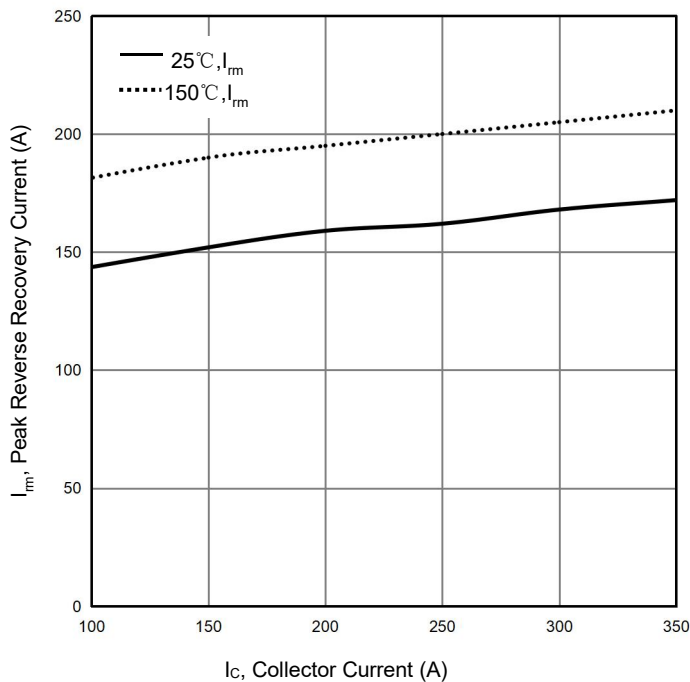
**Figure 29. Typical recovered charge as a function of IGBT turn on gate resistor**

$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V$



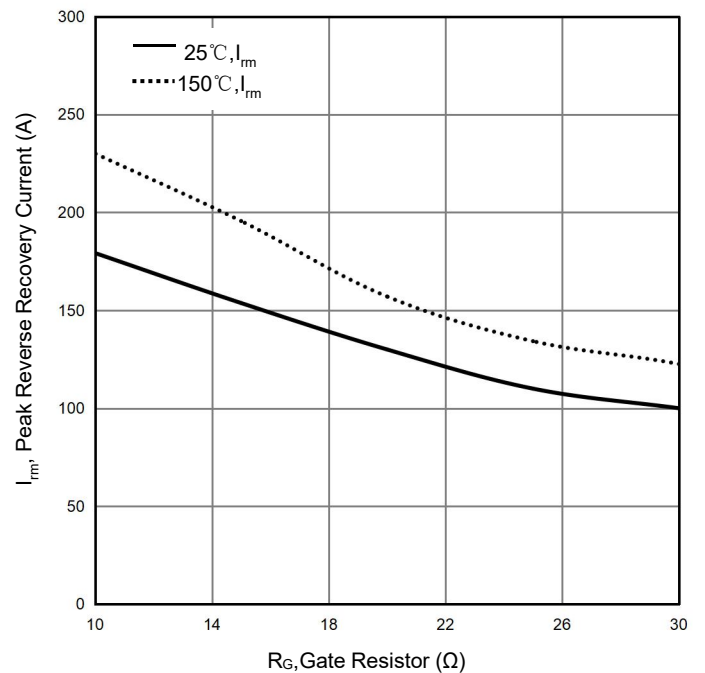
**Figure 30. Typical peak reverse recovery current as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V$



**Figure 31. Typical peak reverse recovery current as a function of IGBT turn on gate resistor**

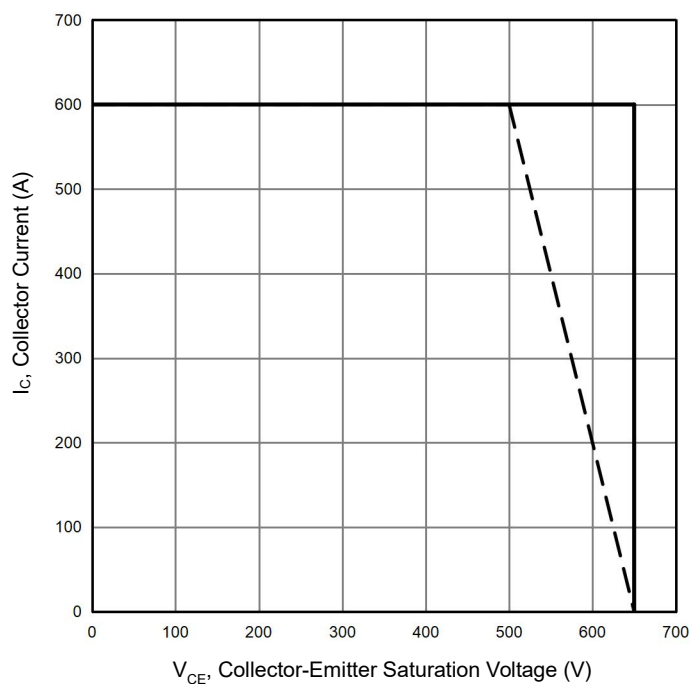
$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V$



## Buck Switching Characteristics

**Figure 32. Reverse bias safe operating area**

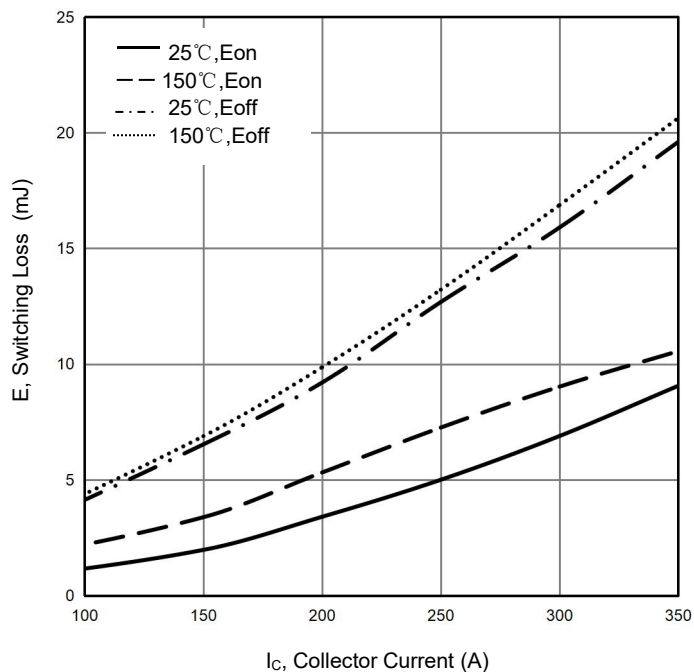
$V_{G(on)} = 15V, V_{G(off)} = -5V, T_j = 150^{\circ}C, R_G = 25\Omega$



## Boost Switching Characteristics

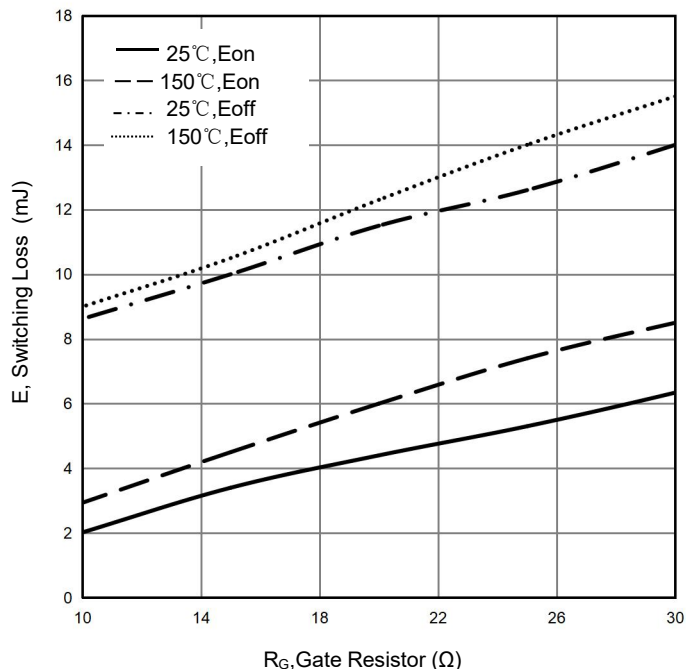
**Figure 33. Typical switching energy losses as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V$



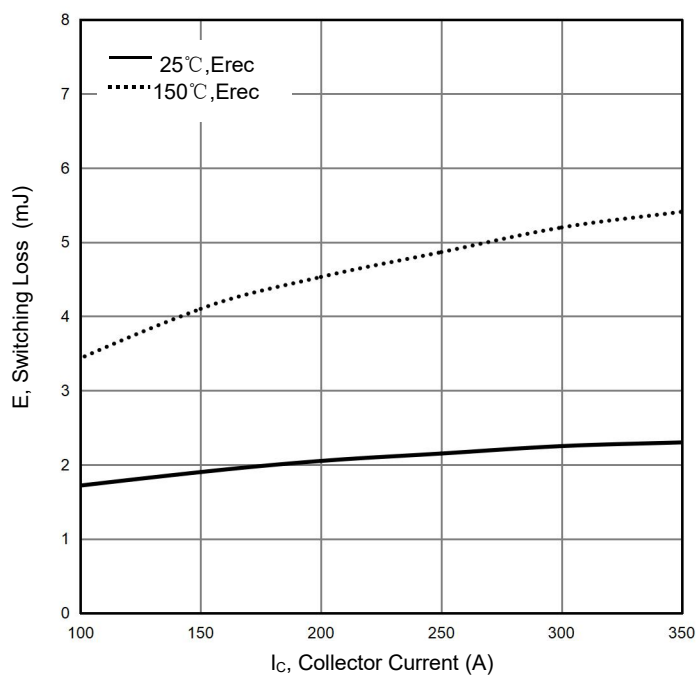
**Figure 34. Typical switching energy losses as a function of IGBT turn on gate resistor**

$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V$



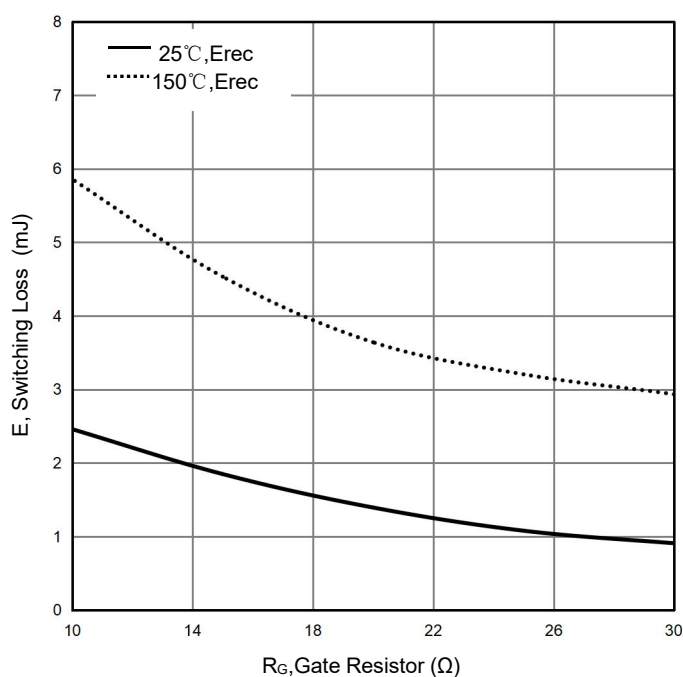
**Figure 35. Typical reverse recovered energy loss as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V$



**Figure 36. Typical reverse recovered energy loss as a function of IGBT turn on gate**

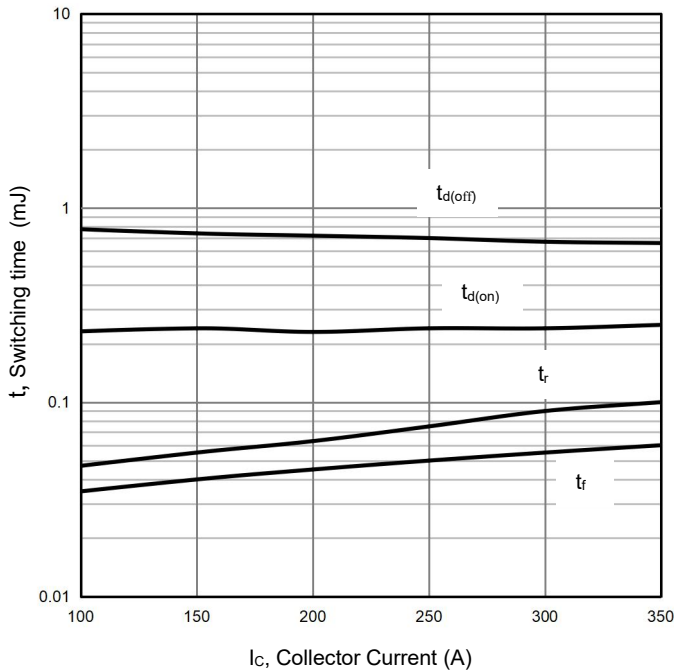
$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V$



## Boost Switching Characteristics

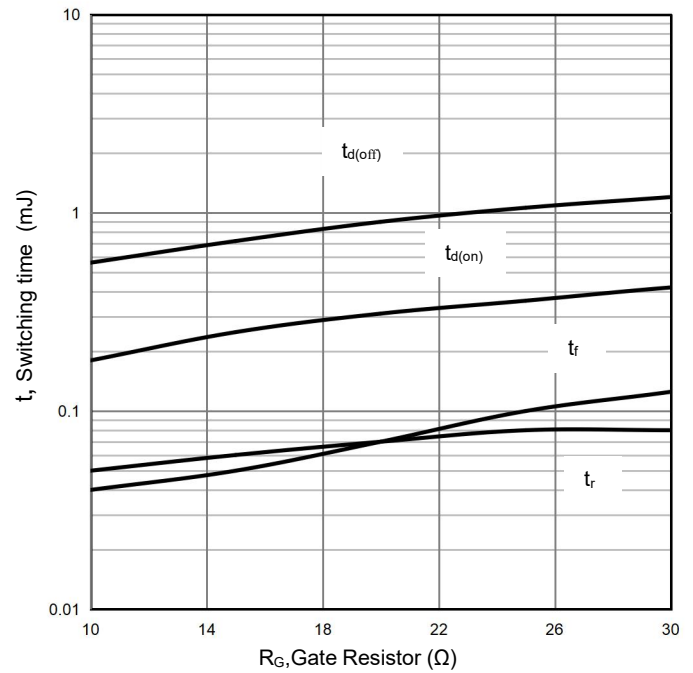
**Figure 37. Typical reverse recovery time as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V, T_J = 150^\circ C$



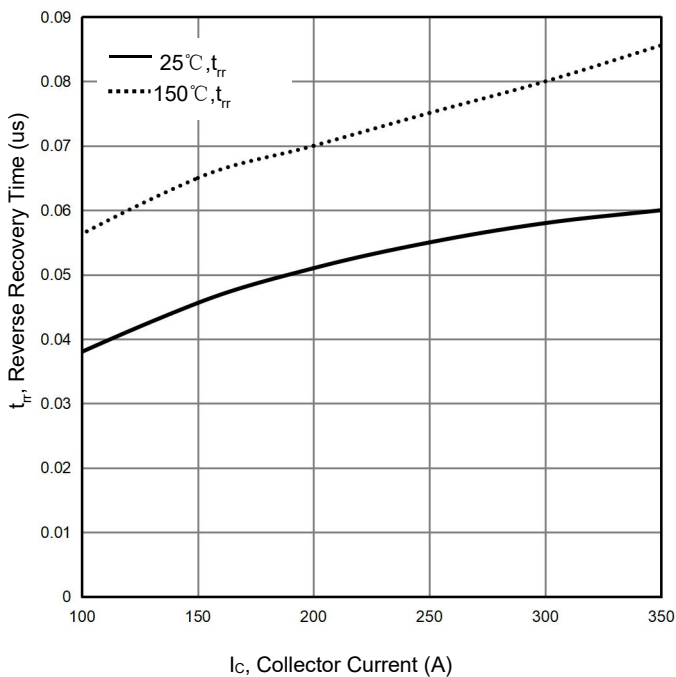
**Figure 38. Typical reverse recovery time as a function of collector current**

$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V, T_J = 150^\circ C$



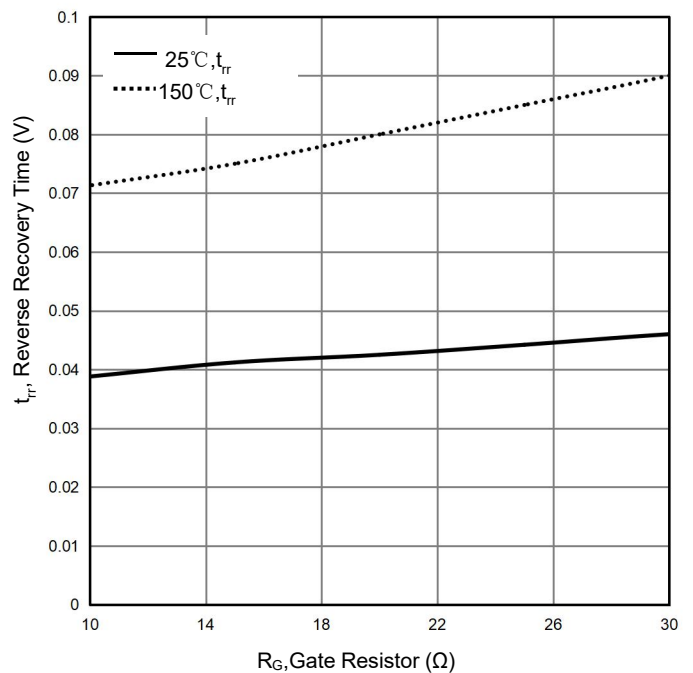
**Figure 39. Typical reverse recovery time as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V$



**Figure 40. Typical reverse recovery time as a function of IGBT turn on gate resistor**

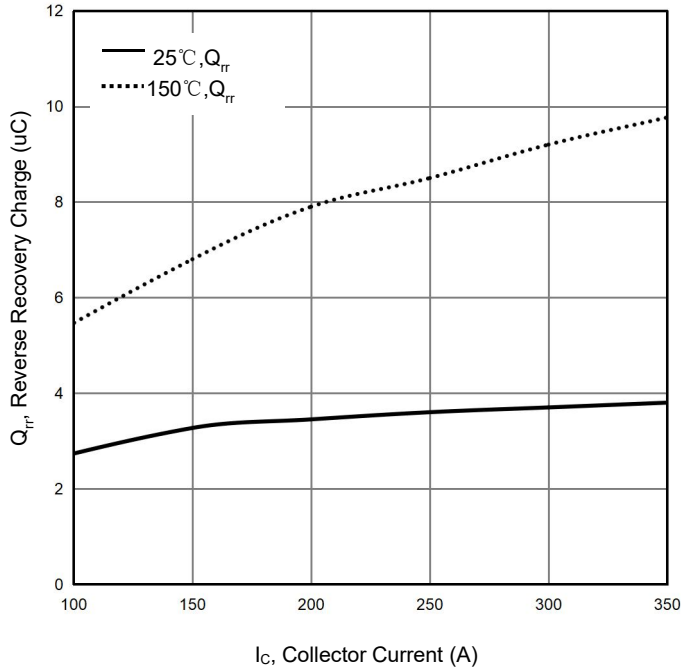
$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V$



## Boost Switching Characteristics

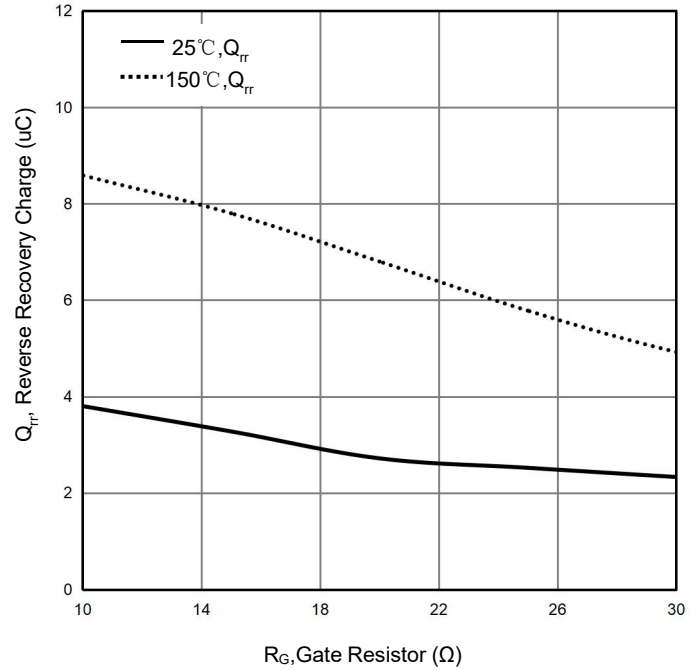
**Figure 41. Typical recovered charge as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V$



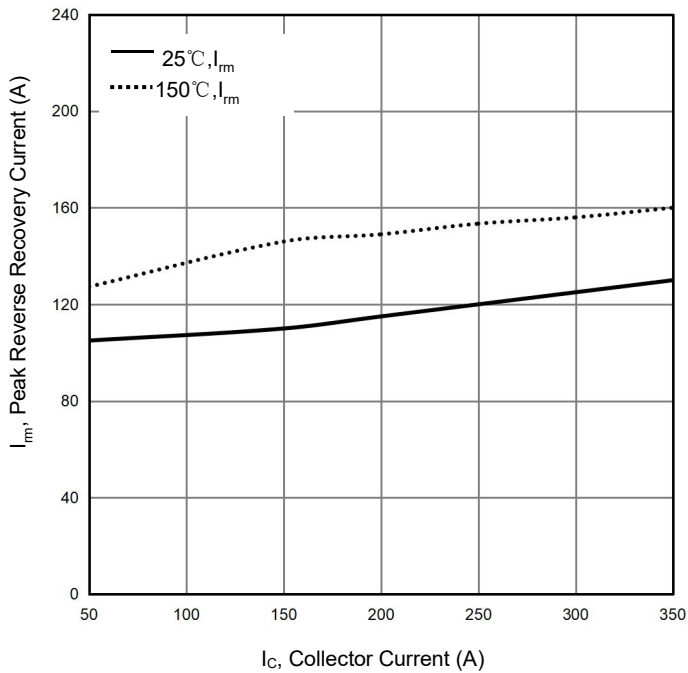
**Figure 42. Typical recovered charge as a function of IGBT turn on gate resistor**

$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V$



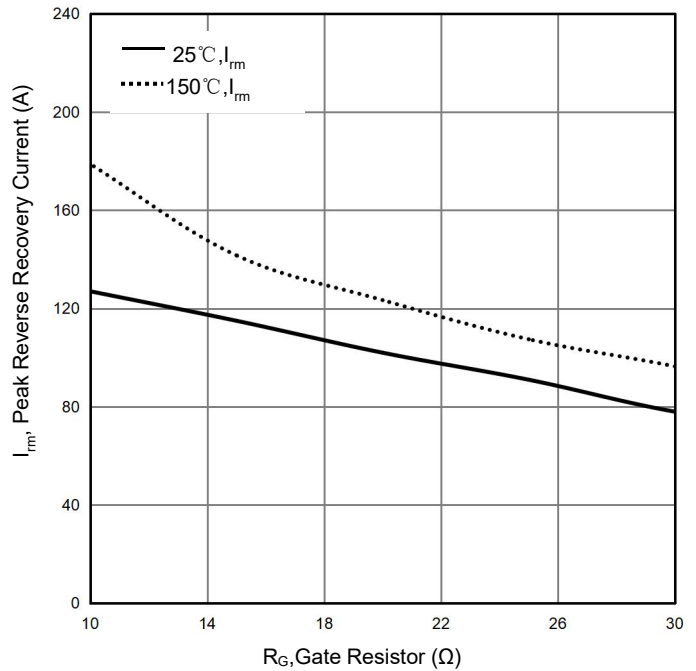
**Figure 43. Typical peak reverse recovery current as a function of collector current**

$V_{CE} = 350V, R_G = 15\Omega, V_{G(on)} = 15V, V_{G(off)} = -5V$



**Figure 44. Typical peak reverse recovery current as a function of IGBT turn on gate resistor**

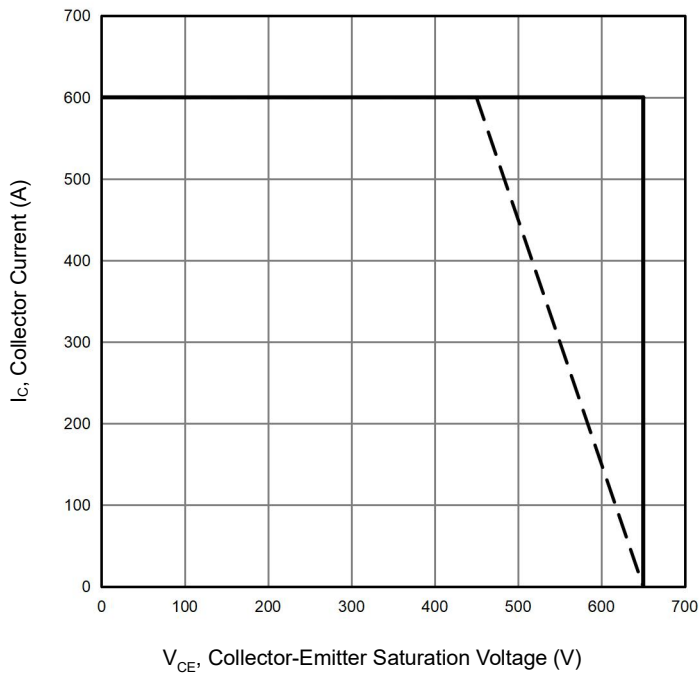
$V_{CE} = 350V, I_C = 200A, V_{G(on)} = 15V, V_{G(off)} = -5V$



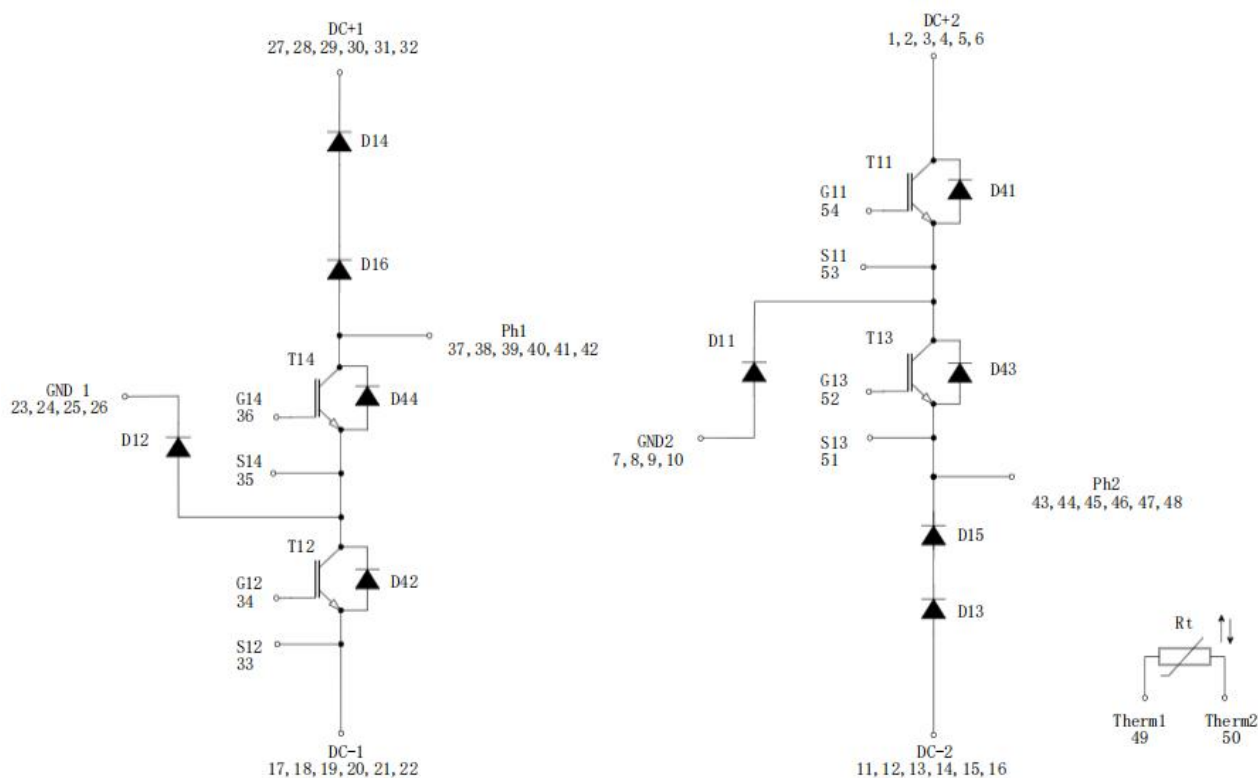
## Boost Switching Characteristics

**Figure 45.Reverse bias safe operating area**

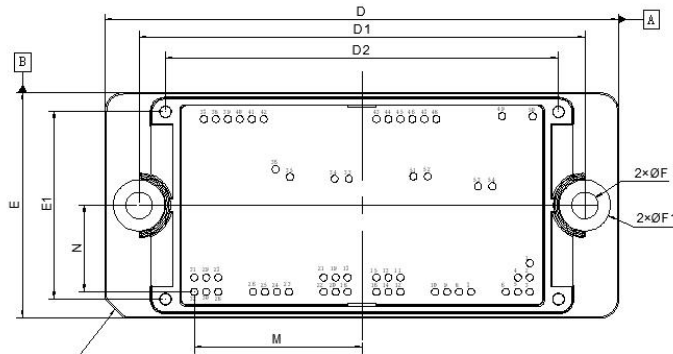
$V_{G(on)} = 15V, V_{G(off)} = -5V, T_j = 150^{\circ}C, R_G = 25\Omega$



**CIRCUIT DIAGRAM**

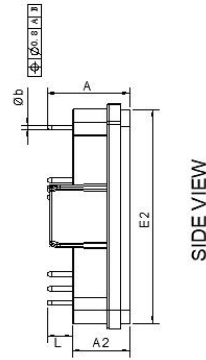


## PACKAGE DIMENSIONS



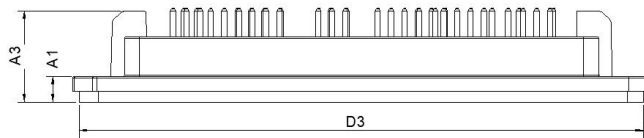
PACKAGE  
ORIENTATION FEATURE

TOP VIEW



SIDE VIEW

| DIM | MILLIMETERS |        |        |
|-----|-------------|--------|--------|
|     | MIN.        | NOM.   | MAX.   |
| A   | 16.63       | 17.23  | 17.83  |
| A1  | 4.50        | 4.70   | 4.90   |
| A2  | 11.60       | 12.00  | 12.40  |
| A3  | 16.40       | 16.70  | 17.00  |
| b   | 0.95        | 1.00   | 1.05   |
| D   | 106.80      | 107.20 | 107.60 |
| D1  | 92.90       | 93.00  | 93.10  |
| M   | 35 REF      |        |        |
| D2  | 81.80       | 82.00  | 82.20  |
| D3  | 104.35      | 104.75 | 105.15 |
| E   | 46.60       | 47.00  | 47.40  |
| E1  | 38.80       | 39.00  | 39.20  |
| N   | 18 REF      |        |        |
| E2  | 44.30       | 44.60  | 44.90  |
| F   | 5.40        | 5.50   | 5.60   |
| F1  | 10.70 REF   |        |        |
| L   | 5.03        | 5.23   | 5.43   |

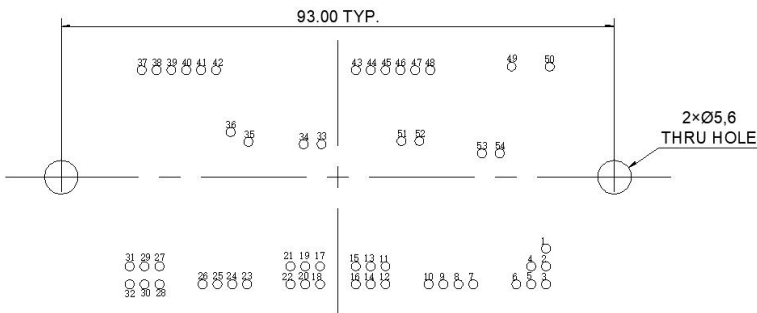


SIDE VIEW

| PIN | PIN POSITION |   |
|-----|--------------|---|
|     | X            | Y |
| 1   | 70           | 6 |
| 2   | 70           | 3 |
| 3   | 70           | 0 |
| 4   | 67.5         | 3 |
| 5   | 67.5         | 0 |
| 6   | 65           | 0 |
| 7   | 57.75        | 0 |
| 8   | 55.25        | 0 |
| 9   | 52.75        | 0 |
| 10  | 50.25        | 0 |
| 11  | 43           | 3 |
| 12  | 43           | 0 |
| 13  | 40.5         | 3 |
| 14  | 40.5         | 0 |
| 15  | 38           | 3 |
| 16  | 38           | 0 |
| 17  | 32           | 3 |
| 18  | 32           | 0 |
| 19  | 29.5         | 3 |
| 20  | 29.5         | 0 |
| 21  | 27           | 3 |
| 22  | 27           | 0 |
| 23  | 19.75        | 0 |
| 24  | 17.25        | 0 |

| PIN | PIN POSITION |       |
|-----|--------------|-------|
|     | X            | Y     |
| 25  | 14.75        | 0     |
| 26  | 12.25        | 0     |
| 27  | 5            | 3     |
| 28  | 5            | 0     |
| 29  | 2.5          | 3     |
| 30  | 2.5          | 0     |
| 31  | 0            | 3     |
| 32  | 0            | 0     |
| 33  | 32.25        | 23.55 |
| 34  | 29.25        | 23.55 |
| 35  | 19.95        | 23.95 |
| 36  | 16.95        | 25.55 |
| 37  | 2            | 36    |
| 38  | 4.5          | 36    |
| 39  | 7            | 36    |
| 40  | 9.5          | 36    |
| 41  | 12           | 36    |
| 42  | 14.5         | 36    |
| 43  | 38           | 36    |
| 44  | 40.5         | 36    |
| 45  | 43           | 36    |
| 46  | 45.5         | 36    |
| 47  | 48           | 36    |
| 48  | 50.5         | 36    |

| PIN | PIN POSITION |       |
|-----|--------------|-------|
|     | X            | Y     |
| 49  | 64.2         | 36.6  |
| 50  | 70.6         | 36.55 |
| 51  | 45.7         | 24.05 |
| 52  | 48.7         | 24.05 |
| 53  | 59.2         | 22    |
| 54  | 62.2         | 22    |



RECOMMENDED MOUNTING PATTERN