# MPBW40N120EH

## 1200V 40A Trench and Field Stop IGBT

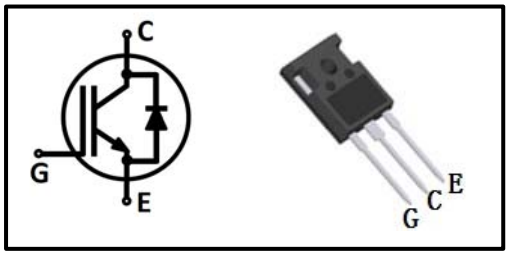
## Features

- Easy parallel switching capability due to positive temperature coefficient in $V_{CEsat}$
- Low $V_{CEsat}$, fast switching
- High ruggedness, good thermal stability
- Very tight parameter distribution

## Applications

- Solar Inverter
- Welding Machine
- UPS
- PFC
- PTC heater
- Climate compressor

| Type | Marking | Package Code |
|---|---|---|
| MPBW40N120EH | MP40N120EH | TO-247-3 |




## Maximum Rated Values

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage | $V_{CE}$ | 1200 | V |
| DC collector current, limited by $T_{vjmax}$<br>$T_C$=25℃<br>$T_C$=130℃ | $I_C$ | <br>80<br>40 | A |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ [1)] | $I_{Cpuls}$ | 160 | |
| Diode forward current, limited by $T_{vjmax}$<br>$T_C$=25℃<br>$T_C$=100℃ | $I_F$ | <br>80<br>40 | |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$ [1)] | $I_{Fpuls}$ | 160 | |
| Gate-emitter voltage | $V_{GE}$ | ±20 | V |
| Transient Gate-emitter voltage（$t_p$≤10us,D<0.01) | | ±30 | |
| Power dissipation $T_C$=25℃ | $P_{tot}$ | 428 | W |
| Power dissipation $T_C$=100℃ | | 214 | |
| Operating junction temperature | $T_{vj}$ | -40~175 | ℃ |
| Storage temperature | $T_{stg}$ | -55~150 | |
| Soldering temperature,<br>wave soldering 1.6mm (0.063in.) from case for 10s | | 260 | |
| Mounting torque, M3 screw<br>Maximum of mounting processes: 3 | M | 0.6 | Nm |

[1)] Defined by design. Not subject to production test.

## Thermal Characteristics

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| IGBT thermal resistance, junction-case | $R_{thJC}$ | - | 0.28 | 0.35 | K/W |
| Diode thermal resistance, junction-case | $R_{thJCD}$ | - | - | 0.80 | |
| Thermal Resistance, junction-ambient | $R_{thJA}$ | - | - | 40 | |

## Electrical Characteristics（at $T_{vj}$=25℃, unless otherwise specified）

## Static Characteristics

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE}$=0V, $I_C$=0.25mA | 1200 | - | - | V |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}$=15V, $I_C$=40A $T_{vj}$=25℃ | - | 1.9 | 2.2 | |
| | | $T_{vj}$=150℃ | - | 2.3 | - | |
| | | $T_{vj}$=175℃ | - | 2.45 | - | |
| G-E threshold voltage | $V_{GE(th)}$ | $I_C$=1.5mA, $V_{CE}$=$V_{GE}$ | 5.0 | 5.8 | 6.5 | |
| C-E leakage current | $I_{CES}$ | $V_{CE}$=1200V, $V_{GE}$=0V $T_{vj}$=25℃ | - | - | 0.01 | mA |
| | | $T_{vj}$=175℃ | - | - | 4.0 | |
| G-E leakage current | $I_{GES}$ | $V_{CE}$=0V, $V_{GE}$=20V | - | - | 250 | nA |

## Dynamic Characteristics

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Input capacitance | $C_{iss}$ | $V_{CE}$=25V, $V_{GE}$=0V, f=1MHz | - | 5348 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 130 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 46 | - | |
| Gate charge | $Q_G$ | $V_{CC}$=400V, $I_C$=40A, $V_{GE}$=15V | - | 251 | - | nC |

## IGBT Switching Characteristics

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Turn-on delay time | $t_{d(on)}$ | $T_{vj}$=25℃, $V_{CC}$=600V, $I_C$=40A, $V_{GE}$=0/15V, $R_G$=10Ω, Inductive load | - | 125 | - | ns |
| Rise time | $t_r$ | | - | 64 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 323 | - | |
| Fall time | $t_f$ | | - | 70 | - | |
| Turn-on energy | $E_{on}$ | | - | 1.98 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 1.46 | - | |
| Total switching energy | $E_{ts}$ | | - | 3.44 | - | |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj}$=175℃, $V_{CC}$=600V, $I_C$=40A, $V_{GE}$=0/15V, $R_G$=10Ω, Inductive load | - | 102 | - | ns |
| Rise time | $t_r$ | | - | 63 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 392 | - | |
| Fall time | $t_f$ | | - | 110 | - | |
| Turn-on energy | $E_{on}$ | | - | 3.35 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 2.21 | - | |
| Total switching energy | $E_{ts}$ | | - | 5.56 | - | |

## Diode Characteristics

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Diode forward voltage | $V_F$ | $V_{GE}$=0V，$I_F$=40A $T_{vj}$=25℃ | - | 2.4 | 2.8 | V |
| | | $T_{vj}$=150℃ | - | 2.1 | - | |
| | | $T_{vj}$=175℃ | - | 2.0 | - | |
| Diode reverse recovery time | $t_{rr}$ | $T_{vj}$=25℃, $V_R$=600V, $I_F$=40A, $di_F/dt$=550A/μs | - | 164 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 1.49 | - | μC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 20.0 | - | A |
| Diode reverse recovery time | $t_{rr}$ | $T_{vj}$=175℃, $V_R$=600V, $I_F$=40A, $di_F/dt$=550A/μs | - | 286 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 3.52 | - | μC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 28.8 | - | A |

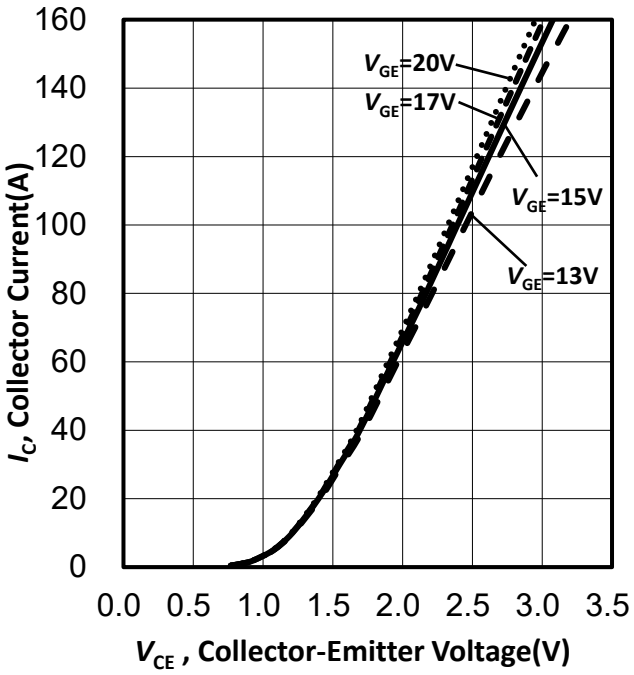



**Figure 1. Typical output characteristic**
（$T_{vj}$=25℃）

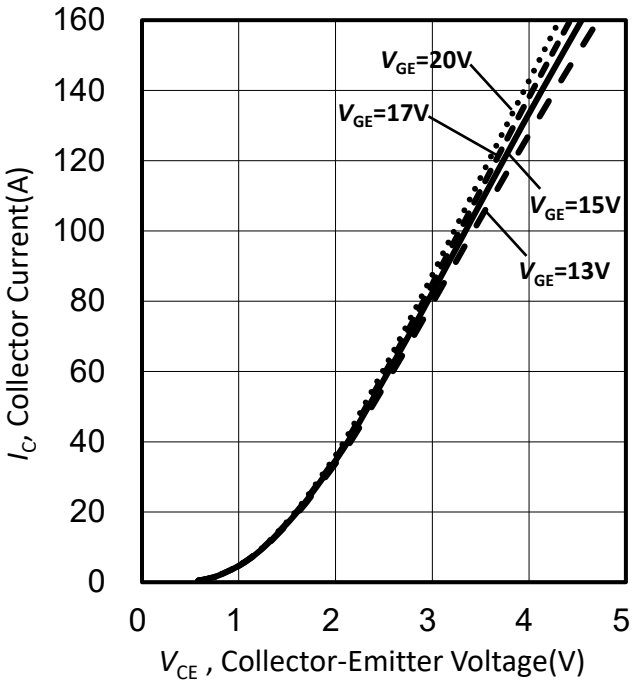



**Figure 2. Typical output characteristic**
（$T_{vj}$=125℃）

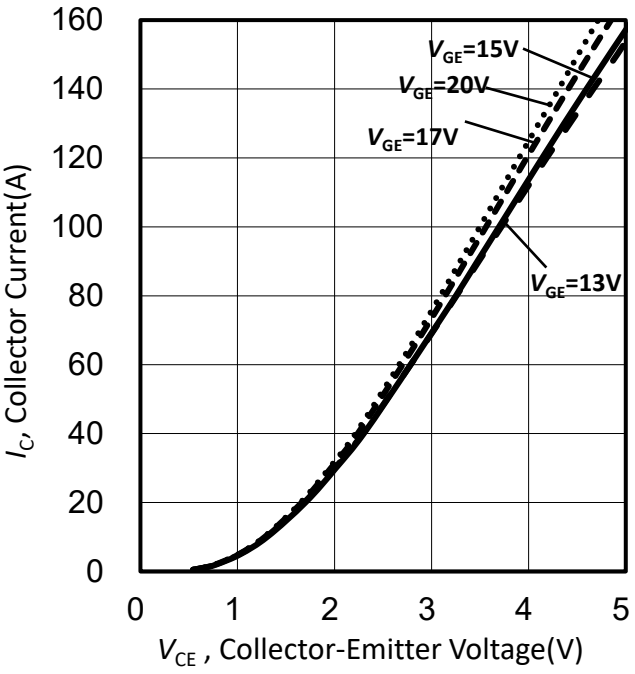



**Figure 3. Typical output characteristic**
（$T_{vj}$=150℃）

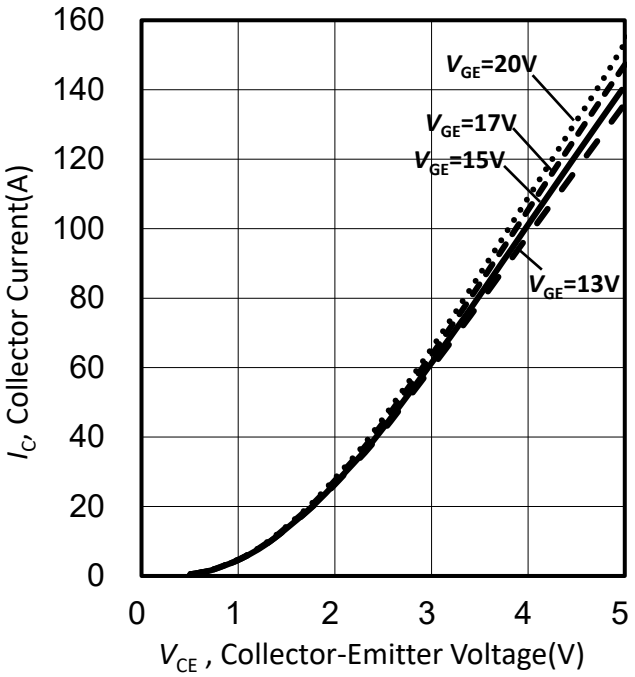



**Figure 4. Typical output characteristic**
（$T_{vj}$=175℃）

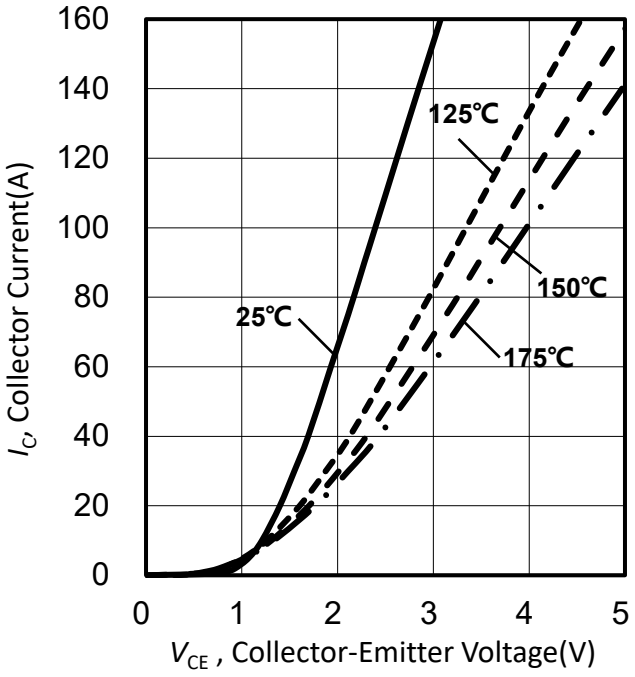



**Figure 5. Typical $V_{CE(sat)}$-$I_c$ characteristic**
（$V_{GE}$=15V）

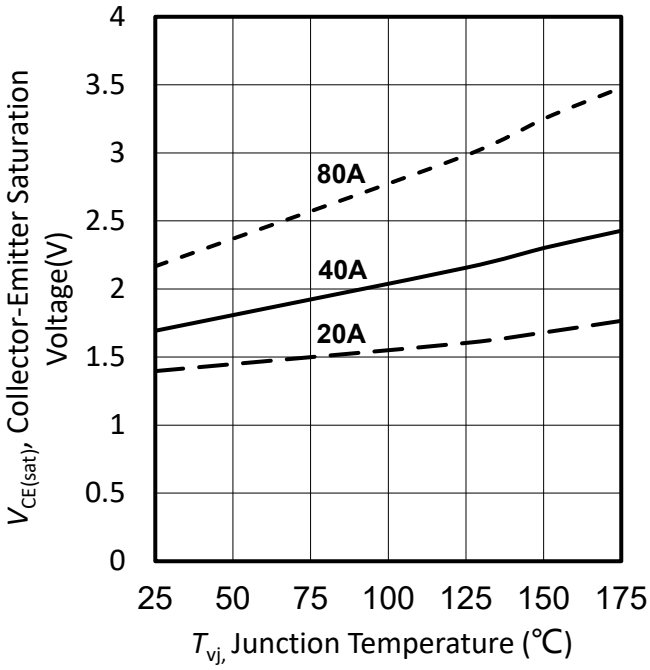



**Figure 6. Typical $V_{CE(sat)}$-$T_j$ characteristic**
（$V_{GE}$=15V）

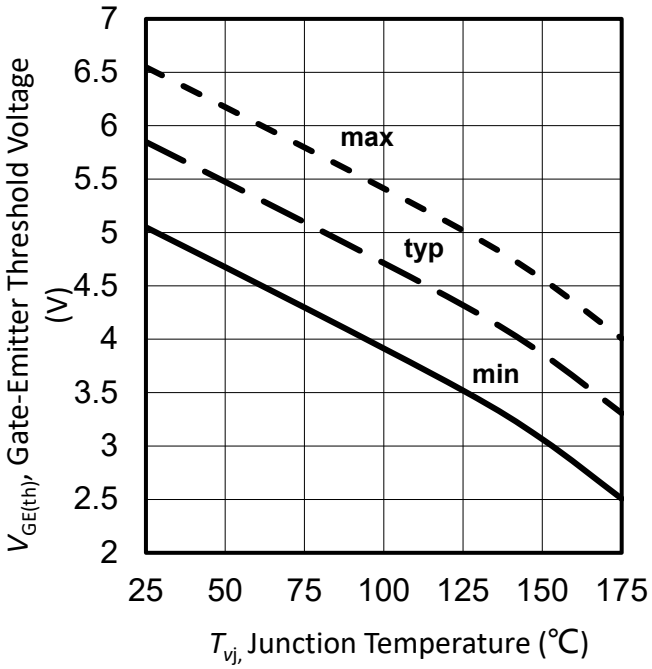



**Figure 7.$V_{GE(th)}$-$T_j$ characteristic**
（$I_c$=1.5mA）

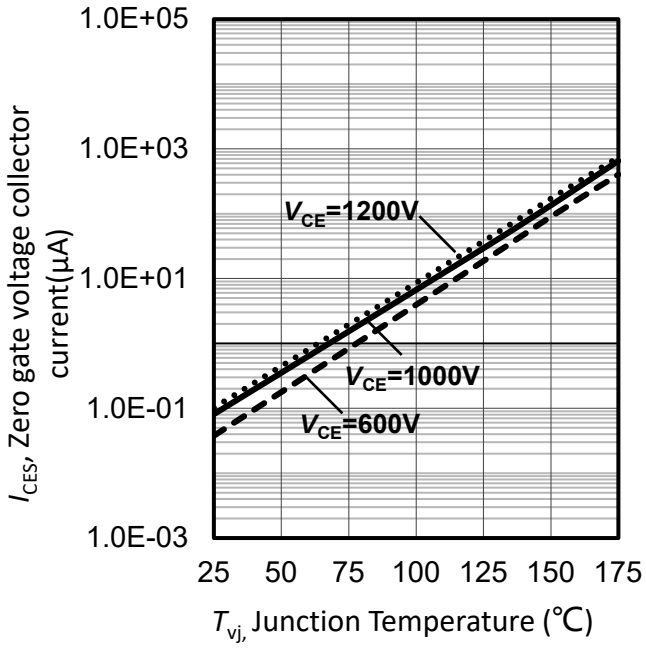



**Figure 8. Typical $I_{CES}$-$T_j$ characteristic**
（$V_{GE}$=0V）

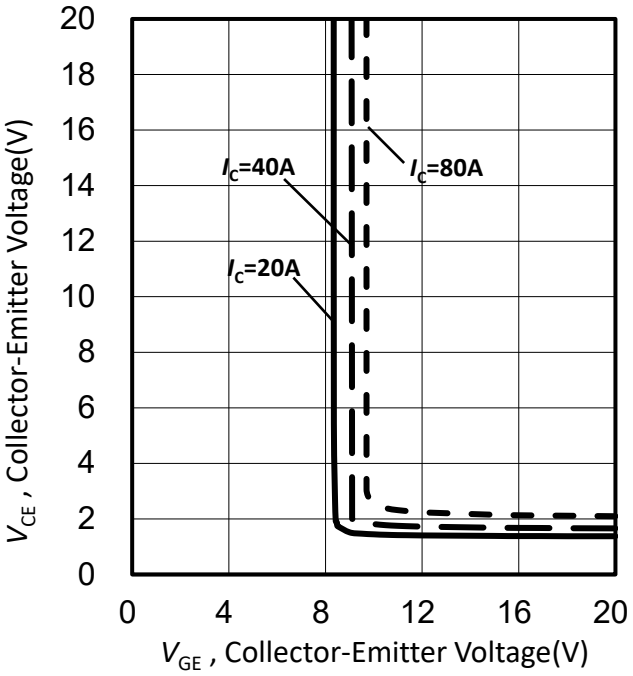



**Figure 9. Typical $V_{CE(sat)}$-$V_{GE(th)}$ characteristic**
($T_{vj}$=25℃)

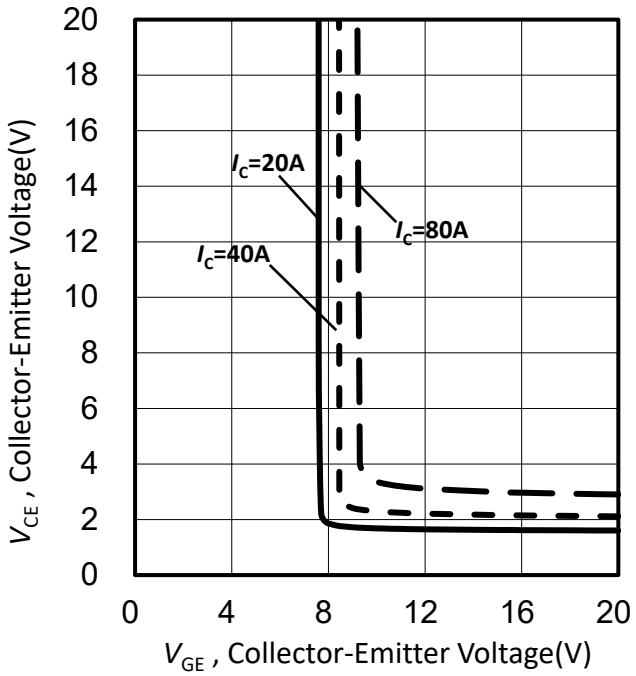



**Figure 10. Typical $V_{CE(sat)}$-$V_{GE(th)}$ characteristic**
($T_{vj}$=125℃)

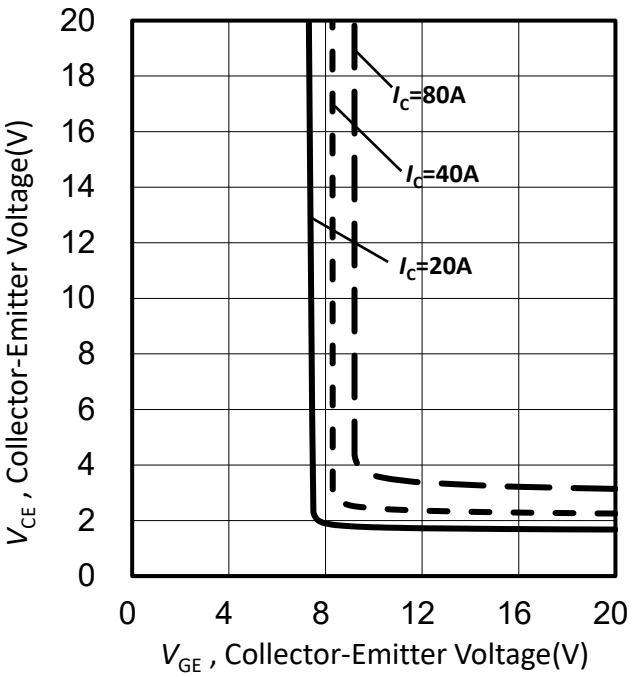



**Figure 11. Typical $V_{CE(sat)}$-$V_{GE(th)}$ characteristic**
($T_{vj}$=150℃)

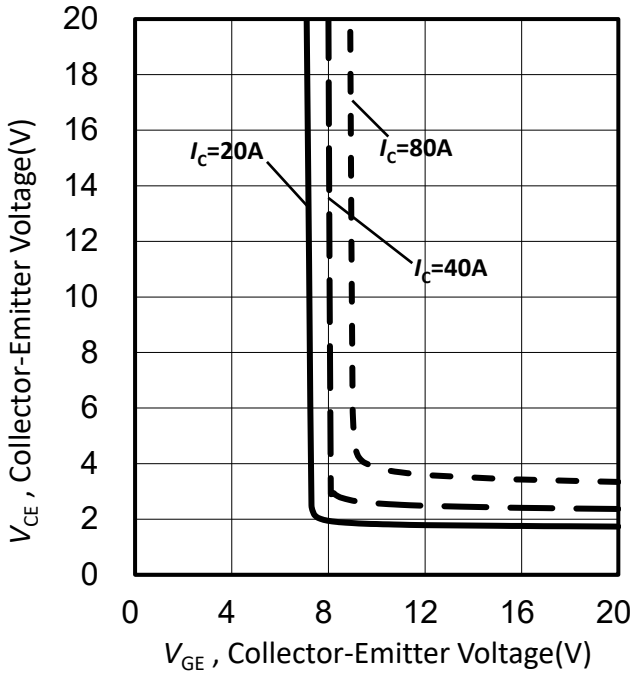



**Figure 12. Typical $V_{CE(sat)}$-$V_{GE(th)}$ characteristic**
($T_{vj}$=175℃)

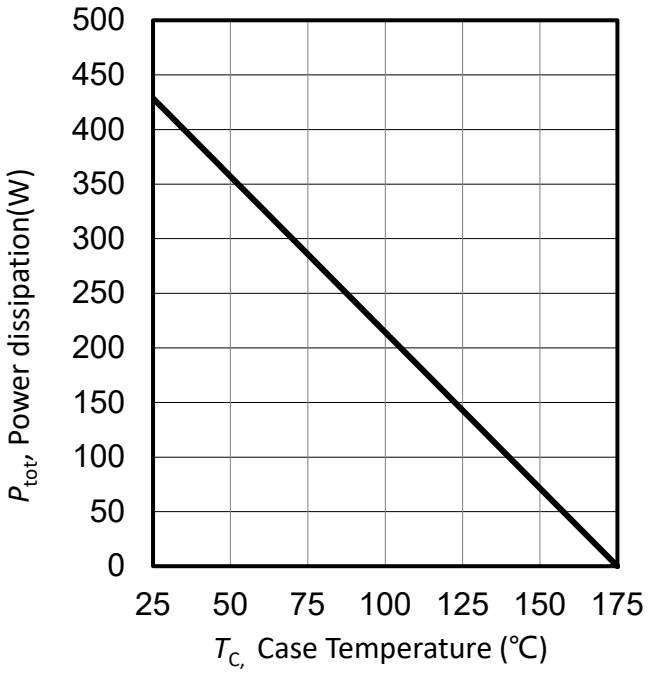



**Figure 13. Power dissipation as a function of case temperature（$T_{vj}$≤175℃）**

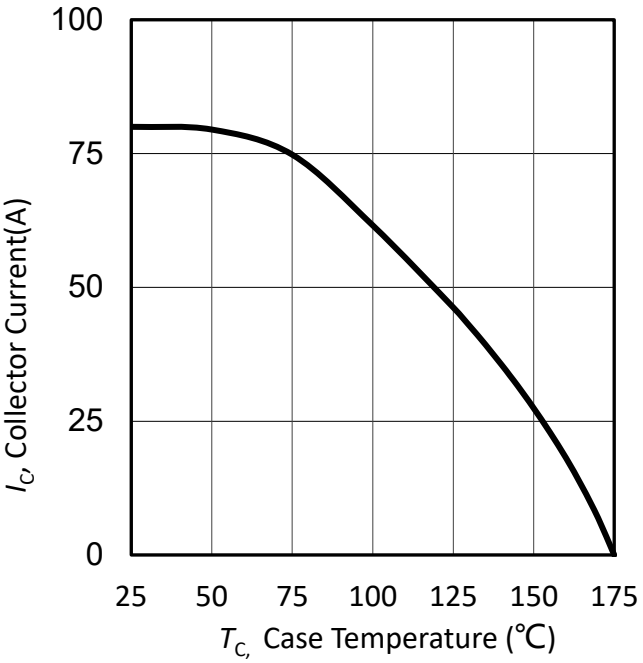



**Figure 14. Collector current as a function of case temperature**
($T_{vj}$≤175℃ ,$V_{GE}$≥15V)

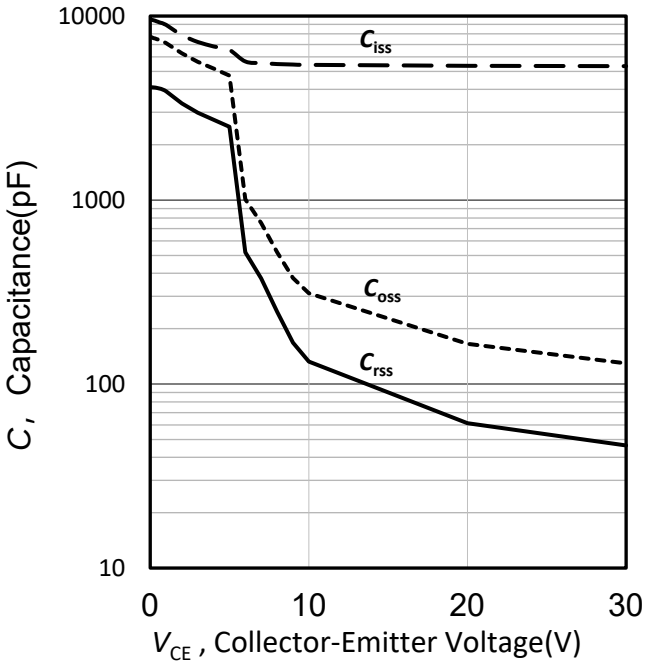



**Figure 15. Typical capacitance as a function of collector-emitter voltage**
($V_{GE}$=0V, $f$=1MHz)

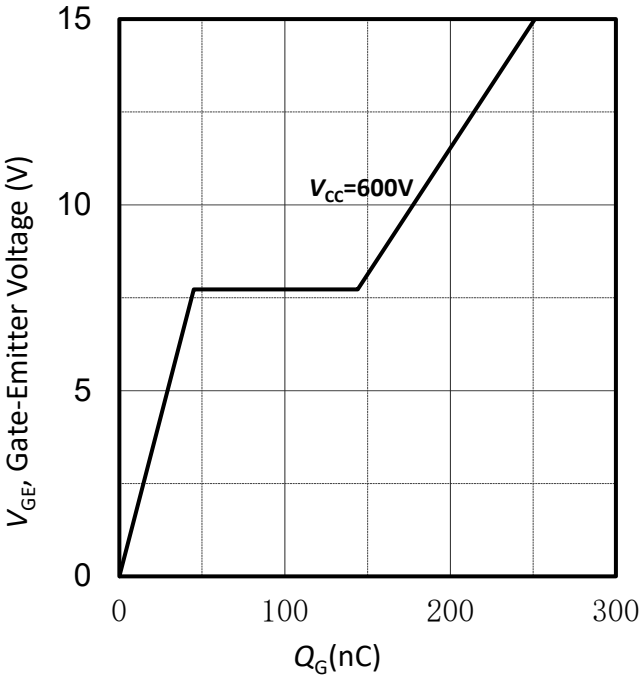



**Figure 16. Typical gate charge**

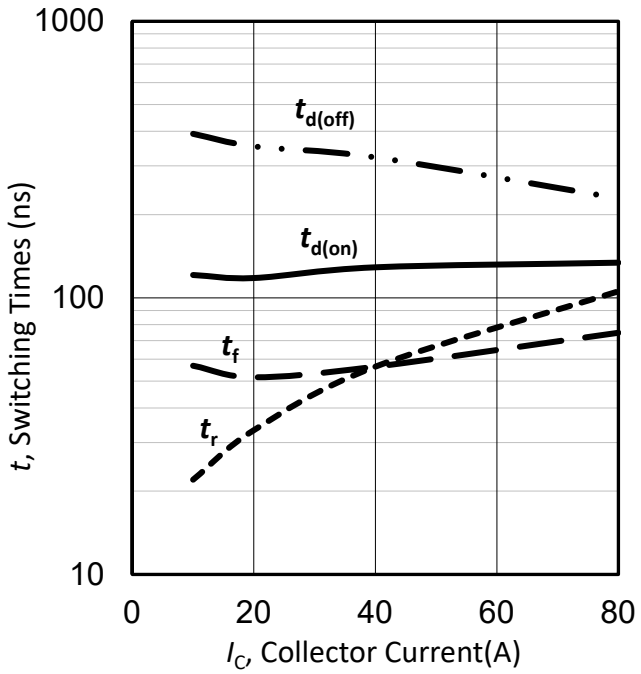



**Figure 17. Typical switching times as a function of collector current**
(inductive load, $T_{vj}$=25℃, $V_{CE}$=600V, $V_{GE}$=-0/15V, $R_G$=10Ω)

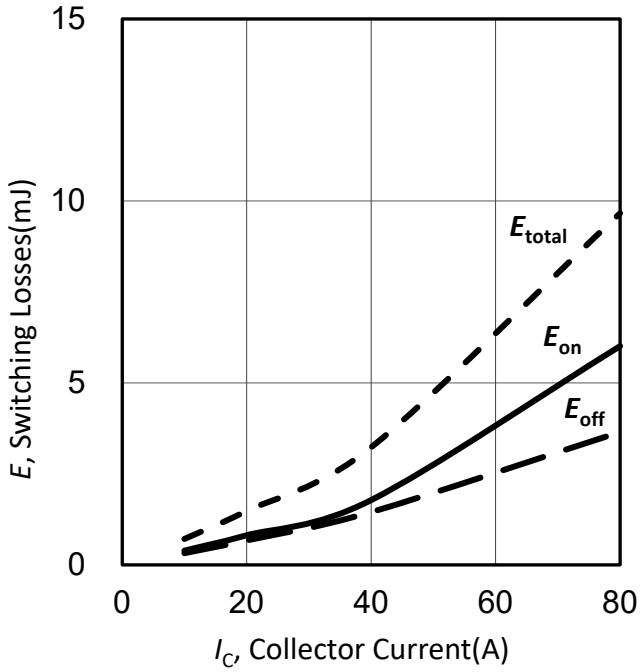



**Figure 18. Typical switching times as a function of collector current**
(inductive load, $T_{vj}$=25℃, $V_{CE}$=600V, $V_{GE}$=0/15V, $R_G$=10Ω)

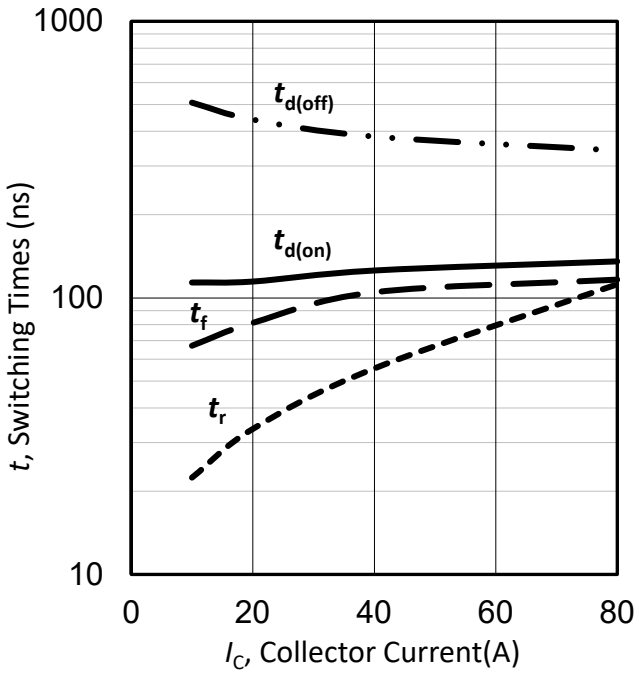



**Figure 19. Typical switching times as a function of collector current**
(inductive load, $T_{vj}$=175℃, $V_{CE}$=600V, $V_{GE}$=0/15V, $R_G$=10Ω)

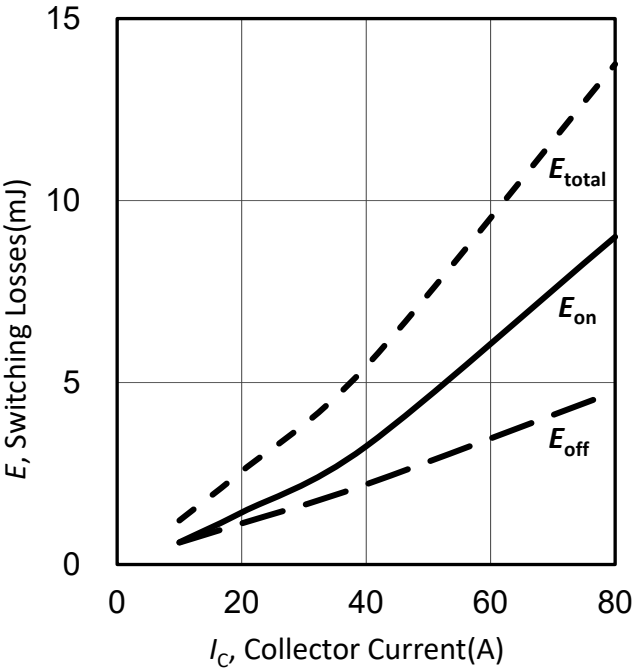



**Figure 20. Typical switching times as a function of collector current**
(inductive load, $T_{vj}$=175℃, $V_{CE}$=600V, $V_{GE}$=0/15V, $R_G$=10Ω)

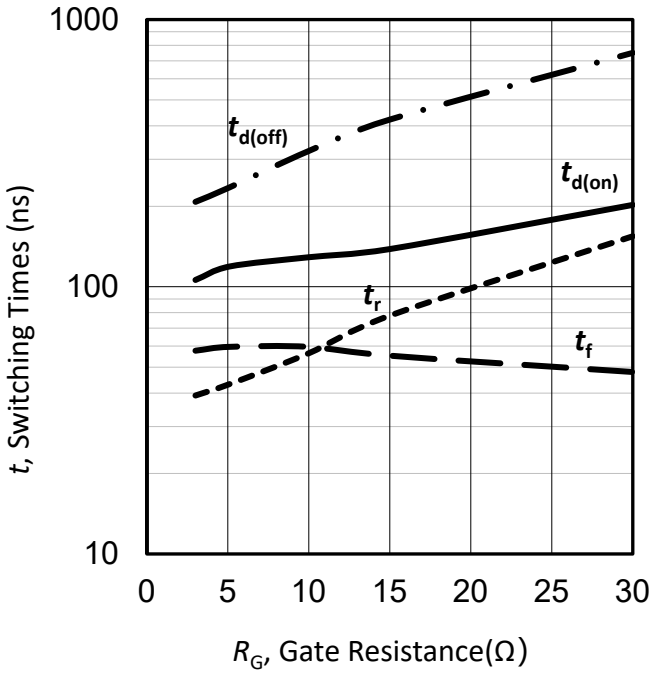



**Figure 21. Typical switching times as a function of gate resistor**
(inductive load, $T_{vj}$=25℃, $V_{CE}$=600V, $V_{GE}$=0/15V, $I_C$=40A)

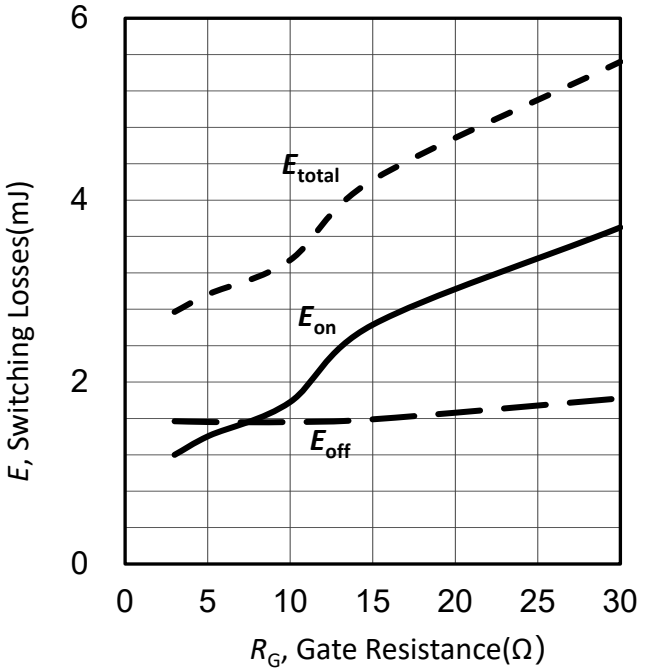



**Figure 22. Typical switching energy losses as a function of gate resistor**
(inductive load, $T_{vj}$=25℃, $V_{CE}$=600V, $V_{GE}$=0/15V, $I_C$=40A)

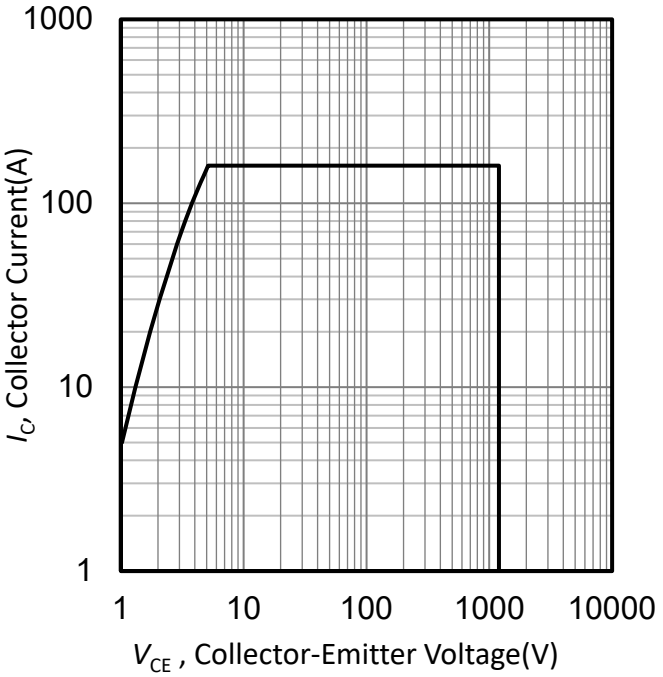



**Figure 23. IGBT reverse bias safe operating area**
($T_{vj}$≤175℃,$V_{GE}$=15V)

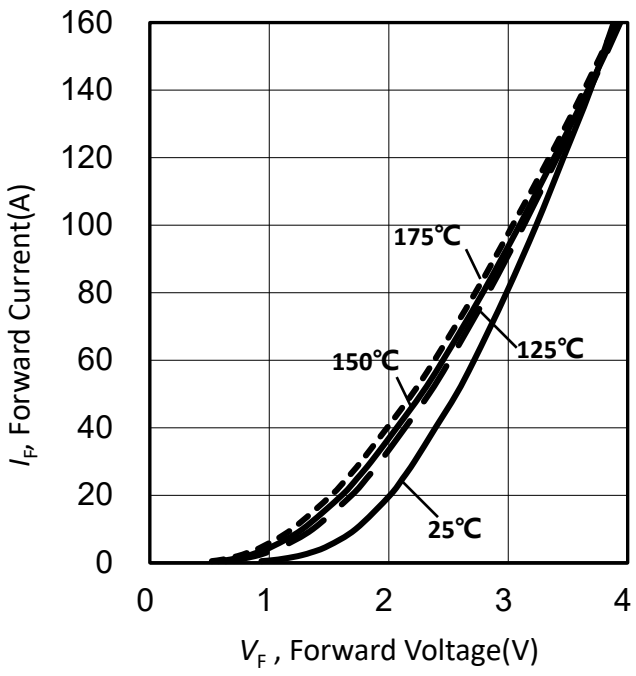



**Figure 24. Typical diode forward current as a function of forward voltage**

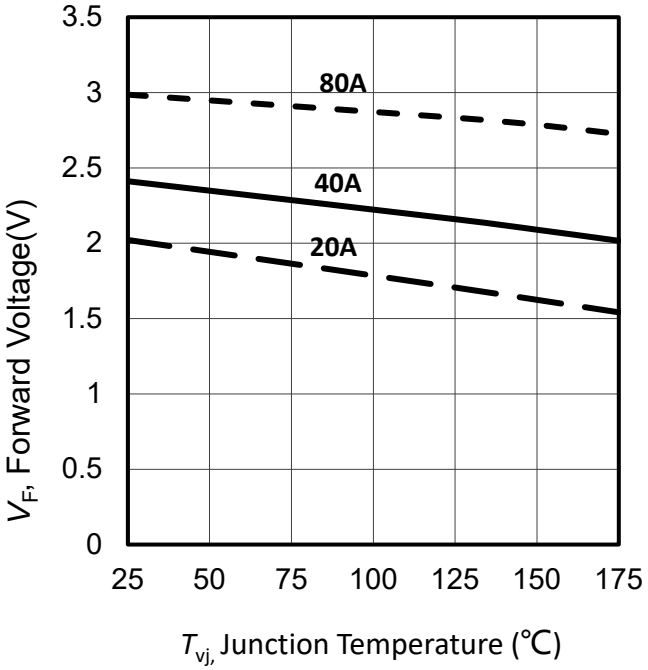



**Figure 25. Typical diode forward voltage as a function of junction temperature**

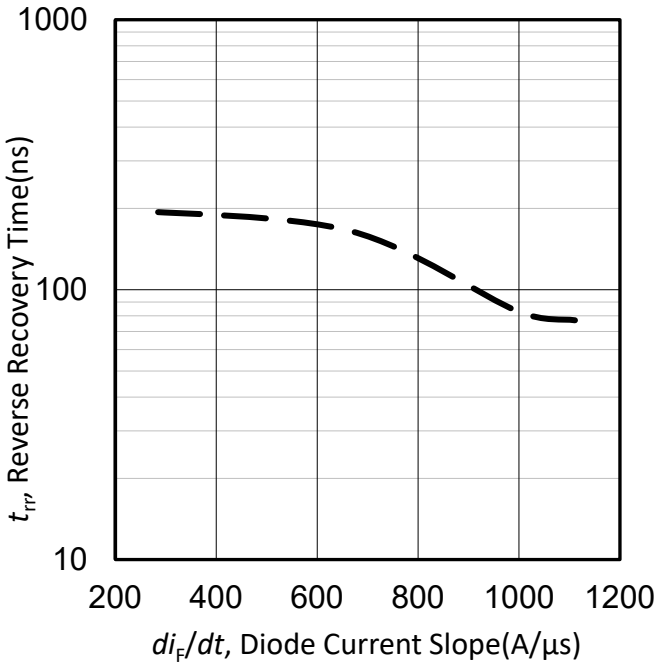



**Figure 26. Typical reverse recovery time as a function of diode current slope**
($V_R$=600V， $I_F$=40A， $T_{vj}$=25℃ )

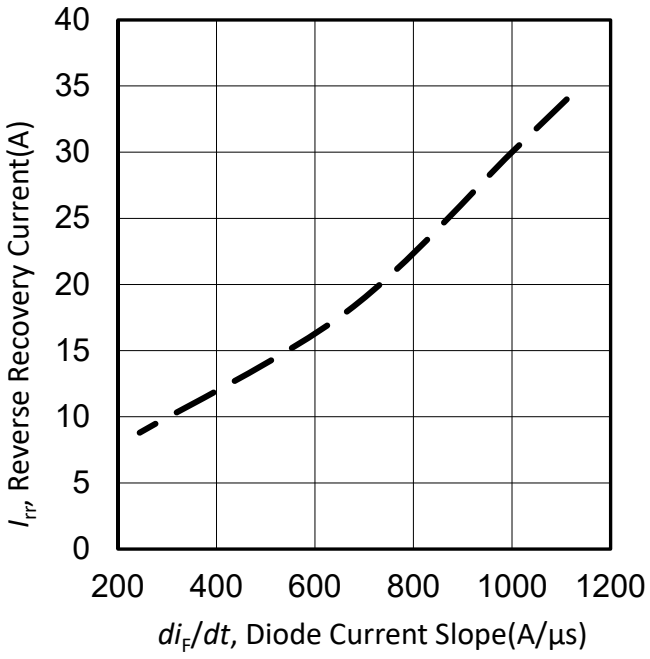



**Figure 27. Typical reverse recovery current as a function of diode current slope**
($V_R$=600V， $I_F$=40A ， $T_{vj}$=25℃)

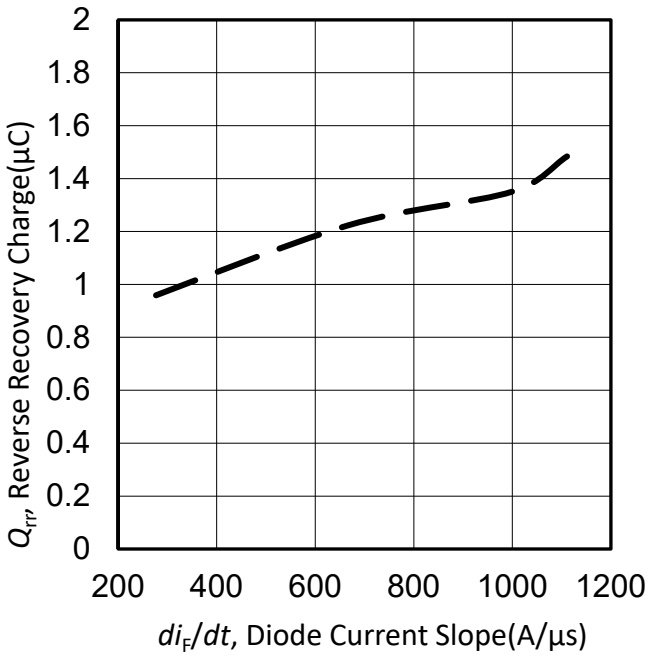



**Figure 28. Typical reverse recovery charge as a function of diode current slope**
($V_R$=600V， $I_F$=40A， $T_{vj}$=25℃ )

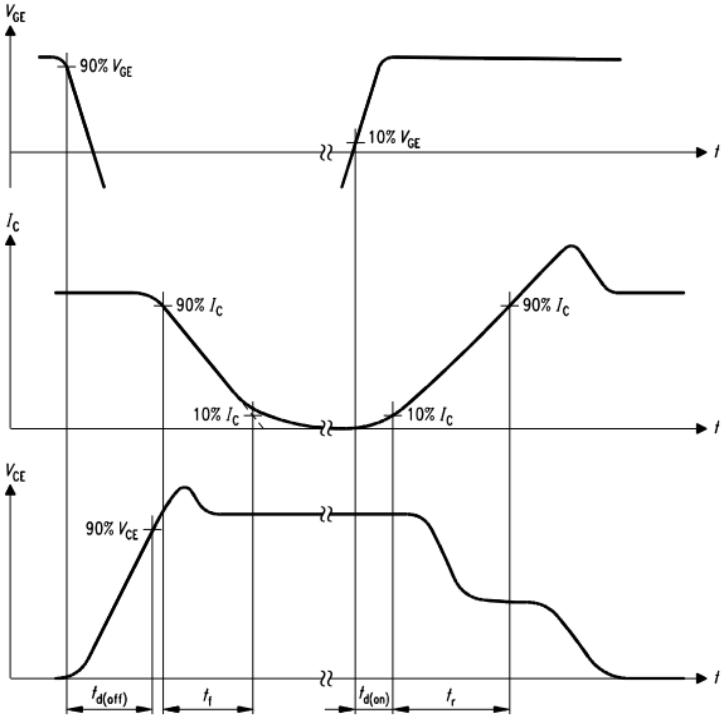



**Figure A. Definition of switching times**

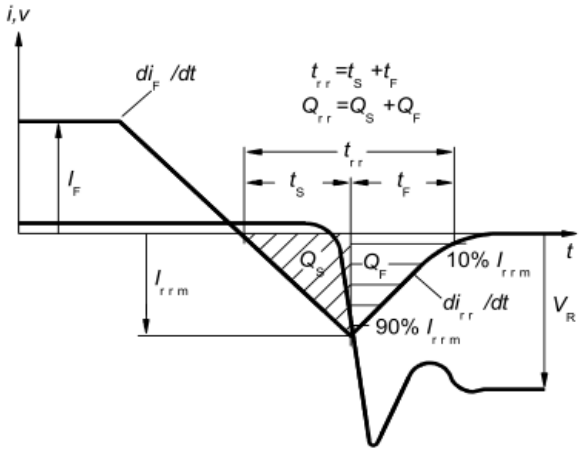



**Figure C. Definition of diodes switching characteristics**

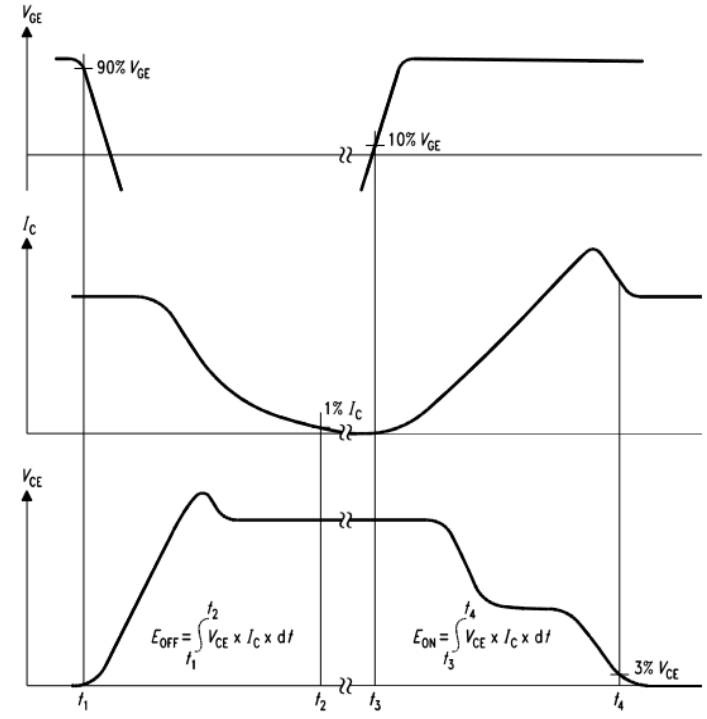



**Figure B. Definition of switching losses**

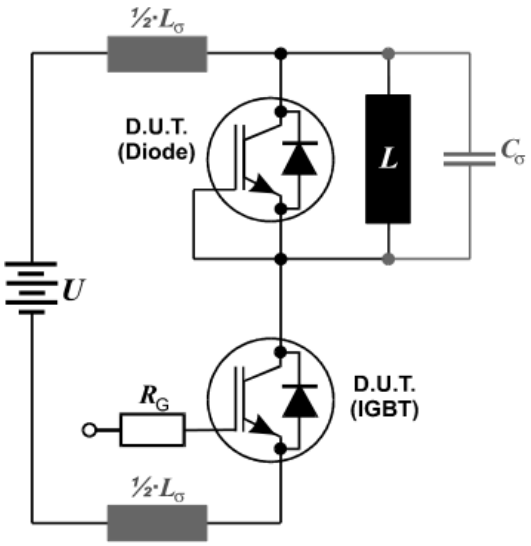
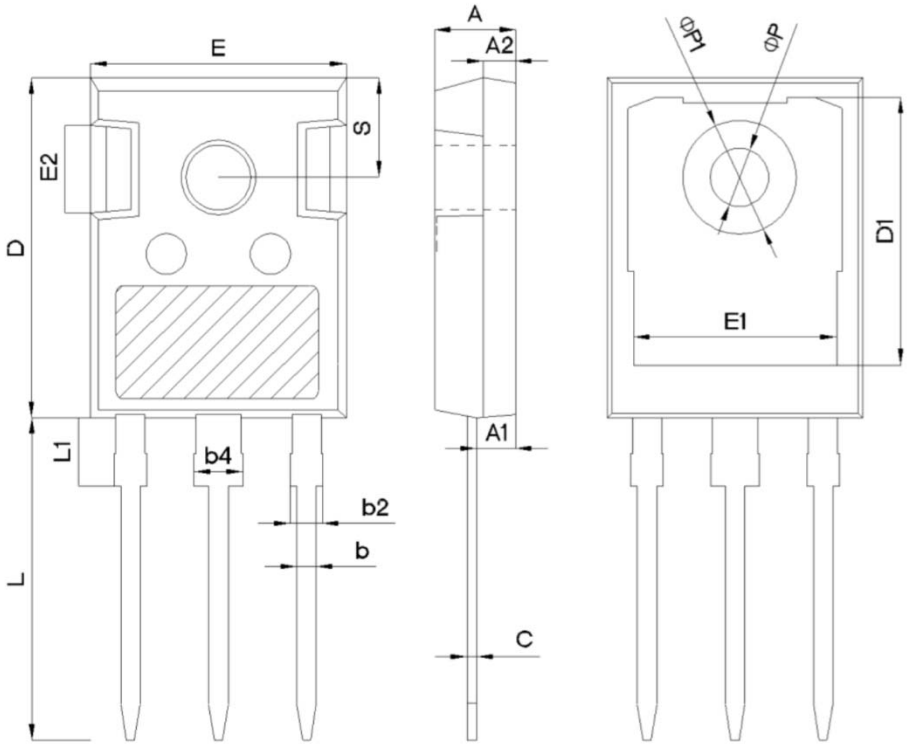



**Figure D. Switching test circuit**

# TO-247-3




| SYMBOL | mm | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.80 | 5.00 | 5.20 |
| A1 | 2.21 | 2.41 | 2.61 |
| A2 | 1.85 | 2.00 | 2.15 |
| b | 1.11 | 1.21 | 1.36 |
| b2 | 1.91 | 2.01 | 2.21 |
| b4 | 2.91 | 3.01 | 3.21 |
| c | 0.51 | 0.61 | 0.75 |
| D | 20.70 | 21.00 | 21.30 |
| D1 | 16.25 | 16.55 | 16.85 |
| E | 15.50 | 15.80 | 16.10 |
| E1 | 13.00 | 13.30 | 13.60 |
| E2 | 4.80 | 5.00 | 5.20 |
| E3 | 2.30 | 2.50 | 2.70 |
| e | 5.44BSC | | |
| L | 19.62 | 19.92 | 20.22 |
| L1 | - | - | 4.30 |
| ΦP | 3.40 | 3.60 | 3.80 |
| ΦP1 | - | - | 7.30 |
| S | 6.15BSC | | |

## Revision History

| Revision | Subjects (major changes since last revision) | Date |
|---|---|---|
| 1.0 | Initial version | 2021.11 |
| 1.1 | Update electrical characteristics and charts | 2021.12 |
| 1.2 | Add charts | 2022.3 |

## Terms & Conditions of usage

1. The product specifications, characteristics, data, materials and structures given in this datasheet are subject to change without notice.

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