



## Insulated Gate Bi-Polar Transistor Type T0600TB45A

### Absolute Maximum Ratings

|                       | VOLTAGE RATINGS                                | MAXIMUM LIMITS | UNITS |
|-----------------------|------------------------------------------------|----------------|-------|
| $V_{CES}$             | Collector – emitter voltage                    | 4500           | V     |
| $V_{DC \text{ link}}$ | Permanent DC voltage for 100 FIT failure rate. | 2800           | V     |
| $V_{GES}$             | Peak gate – emitter voltage                    | $\pm 20$       | V     |

|                | RATINGS                                                                                | MAXIMUM LIMITS | UNITS              |
|----------------|----------------------------------------------------------------------------------------|----------------|--------------------|
| $I_{C(DC)}$    | DC collector current, IGBT                                                             | 600            | A                  |
| $I_{CRM}$      | Repetitive peak collector current, $t_p=1\text{ms}$ , IGBT                             | 1200           | A                  |
| $I_{F(DC)}$    | Continuous DC forward current, Diode                                                   | 600            | A                  |
| $I_{FRM}$      | Repetitive peak forward current, $t_p=1\text{ms}$ , Diode                              | 1200           | A                  |
| $I_{FSM}$      | Peak non-repetitive surge $t_p=10\text{ms}$ , $V_{RM}=60\%V_{RRM}$ , Diode (Note 4)    | 9.4            | kA                 |
| $I_{FSM2}$     | Peak non-repetitive surge $t_p=10\text{ms}$ , $V_{RM}\leq 10\text{V}$ , Diode (Note 4) | 10.3           | kA                 |
| $P_{MAX}$      | Maximum power dissipation, IGBT (Note 2)                                               | 4.8            | W                  |
| $(di/dt)_{cr}$ | Critical diode $di/dt$ (note 3)                                                        | 2000           | A/ $\mu\text{s}$   |
| $T_j$          | Operating temperature range.                                                           | -40 to +125    | $^{\circ}\text{C}$ |
| $T_{stg}$      | Storage temperature range.                                                             | -40 to +125    | $^{\circ}\text{C}$ |

#### Notes: -

- 1) Unless otherwise indicated  $T_j = 125^{\circ}\text{C}$ .
- 2)  $T_{sink} = 25^{\circ}\text{C}$ , double side cooled.
- 3) Maximum commutation loop inductance 600nH.
- 4) Half-sinewave,  $125^{\circ}\text{C}$   $T_j$  initial.

## Characteristics

### IGBT Characteristics

|               | PARAMETER                              | MIN | TYP  | MAX     | TEST CONDITIONS                                                                                                                                                                                                    | UNITS      |
|---------------|----------------------------------------|-----|------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| $V_{CE(sat)}$ | Collector – emitter saturation voltage | -   | 2.9  | 3.3     | $I_C = 600A, V_{GE} = 15V, T_J = 25^\circ C$                                                                                                                                                                       | V          |
|               |                                        | -   | 3.7  | 4.1     | $I_C = 600A, V_{GE} = 15V$                                                                                                                                                                                         | V          |
| $V_{T0}$      | Threshold voltage                      | -   | -    | 1.8     | Current range: 200 – 600A                                                                                                                                                                                          | V          |
| $r_T$         | Slope resistance                       | -   | -    | 3.84    |                                                                                                                                                                                                                    | m $\Omega$ |
| $V_{GE(TH)}$  | Gate threshold voltage                 | -   | 5.3  | -       | $V_{CE} = V_{GE}, I_C = 60mA$                                                                                                                                                                                      | V          |
| $I_{CES}$     | Collector – emitter cut-off current    | -   | 13   | 30      | $V_{CE} = V_{CES}, V_{GE} = 0V$                                                                                                                                                                                    | mA         |
| $I_{GES}$     | Gate leakage current                   | -   | -    | $\pm 7$ | $V_{GE} = \pm 20V$                                                                                                                                                                                                 | $\mu A$    |
| $C_{ies}$     | Input capacitance                      | -   | 100  | -       | $V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$                                                                                                                                                                              | nF         |
| $t_{d(on)}$   | Turn-on delay time                     | -   | 1.6  | -       | $I_C = 600A, V_{CE} = 2800V, di/dt = 2000A/\mu s$<br>$V_{GE} = \pm 15V, L_S = 200nH$<br>$R_{g(ON)} = 6.8\Omega, R_{g(OFF)} = 11\Omega, C_{GE} = 68nF$<br>Integral diode used as freewheel diode<br>(Note 3, 4 & 5) | $\mu s$    |
| $t_r(V)$      | Rise time                              | -   | 2.7  | -       |                                                                                                                                                                                                                    | $\mu s$    |
| $Q_{g(on)}$   | Turn-on gate charge                    | -   | 8    | -       |                                                                                                                                                                                                                    | $\mu C$    |
| $E_{on}$      | Turn-on energy                         | -   | 4.6  | -       |                                                                                                                                                                                                                    | J          |
| $t_{d(off)}$  | Turn-off delay time                    | -   | 3.4  | -       |                                                                                                                                                                                                                    | $\mu s$    |
| $t_f(I)$      | Fall time                              | -   | 2.5  | -       |                                                                                                                                                                                                                    | $\mu s$    |
| $Q_{g(off)}$  | Turn-off gate charge                   | -   | 3    | -       |                                                                                                                                                                                                                    | $\mu C$    |
| $E_{off}$     | Turn-off energy                        | -   | 2.9  | -       |                                                                                                                                                                                                                    | J          |
| $I_{SC}$      | Short circuit current                  | -   | 1900 | -       | $V_{GE} = +15V, V_{CC} = 2800V, V_{CEmax} \leq V_{CES}, t_p \leq 10\mu s$                                                                                                                                          | A          |

### Diode Characteristics

|          | PARAMETER                        | MIN | TYP | MAX  | TEST CONDITIONS                                     | UNITS      |
|----------|----------------------------------|-----|-----|------|-----------------------------------------------------|------------|
| $V_F$    | Forward voltage                  | -   | 3.6 | 3.9  | $I_F = 600A, T_J = 25^\circ C$                      | V          |
|          |                                  | -   | 3.7 | 4.0  | $I_F = 600A$                                        | V          |
| $V_{T0}$ | Threshold voltage                | -   | -   | 2.18 | Current range 200-600A                              | V          |
| $r_T$    | Slope resistance                 | -   | -   | 3.03 |                                                     | m $\Omega$ |
| $I_{rm}$ | Peak reverse recovery current    | -   | 640 | -    | $I_F = 600A, V_{GE} = \pm 15V, di/dt = 2000A/\mu s$ | A          |
| $Q_{rr}$ | Recovered charge                 | -   | 700 | -    |                                                     | $\mu C$    |
| $t_{rr}$ | Reverse recovery time, 50% chord | -   | 1.2 | -    |                                                     | $\mu s$    |
| $E_r$    | Reverse recovery energy          | -   | 0.9 | -    |                                                     | J          |

### Thermal Characteristics

|            | PARAMETER                                  | MIN | TYP | MAX  | TEST CONDITIONS       | UNITS |
|------------|--------------------------------------------|-----|-----|------|-----------------------|-------|
| $R_{thJK}$ | Thermal resistance junction to sink, IGBT  | -   | -   | 21.8 | Double side cooled    | K/kW  |
|            |                                            | -   | -   | 36.8 | Collector side cooled | K/kW  |
|            |                                            | -   | -   | 53.5 | Emitter side cooled   | K/kW  |
| $R_{thJK}$ | Thermal resistance junction to sink, Diode | -   | -   | 43.2 | Double side cooled    | K/kW  |
|            |                                            | -   | -   | 68   | Cathode side cooled   | K/kW  |
|            |                                            | -   | -   | 118  | Anode side cooled     | K/kW  |
| F          | Mounting force                             | 15  | 20  | 25   | Note 2                | kN    |
| $W_t$      | Weight                                     | -   | 1.2 | -    |                       | kg    |

Notes:-

- 1) Unless otherwise indicated  $T_J = 125^\circ C$ .
- 2) Consult application note 2008AN01 for detailed mounting requirements
- 3)  $C_{GE}$  is additional gate – emitter capacitance added to output of gate drive
- 4)  $E_{on}$  integration time 15 $\mu s$  from 10% rising  $I_G$ .
- 5)  $E_{off}$  integration time 15 $\mu s$  from 90% falling  $V_{GE}$ .

## Curves

Figure 1 – Typical collector-emitter saturation voltage characteristics

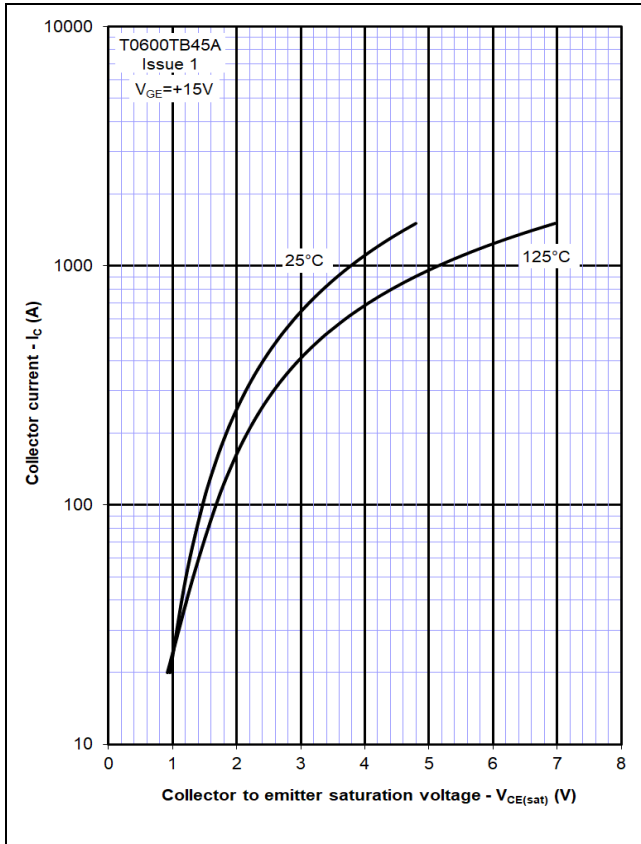


Figure 2 – Typical output characteristic

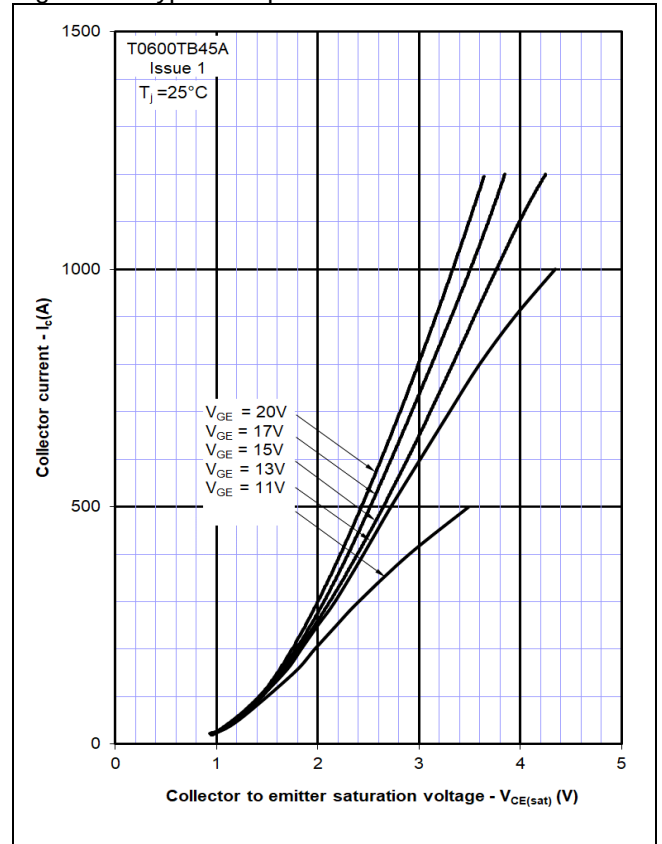


Figure 3 – Typical output characteristic

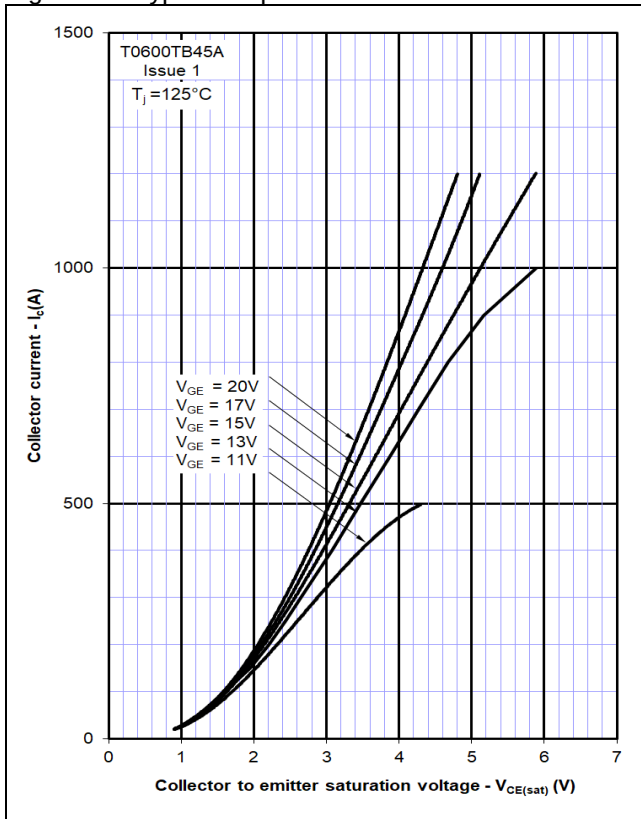


Figure 4 – Typical turn-on delay time vs gate resistance

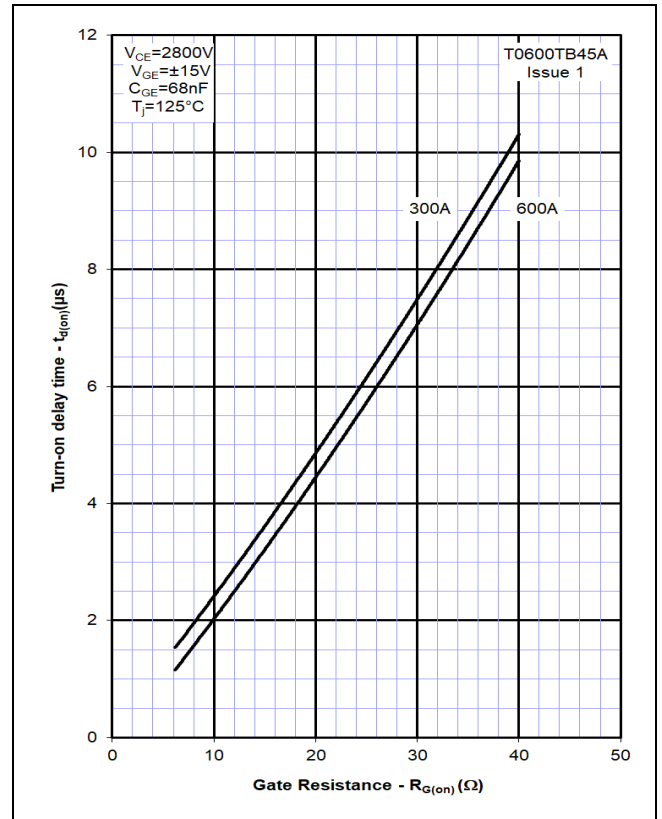


Figure 5 – Typical turn-off delay time vs. gate resistance

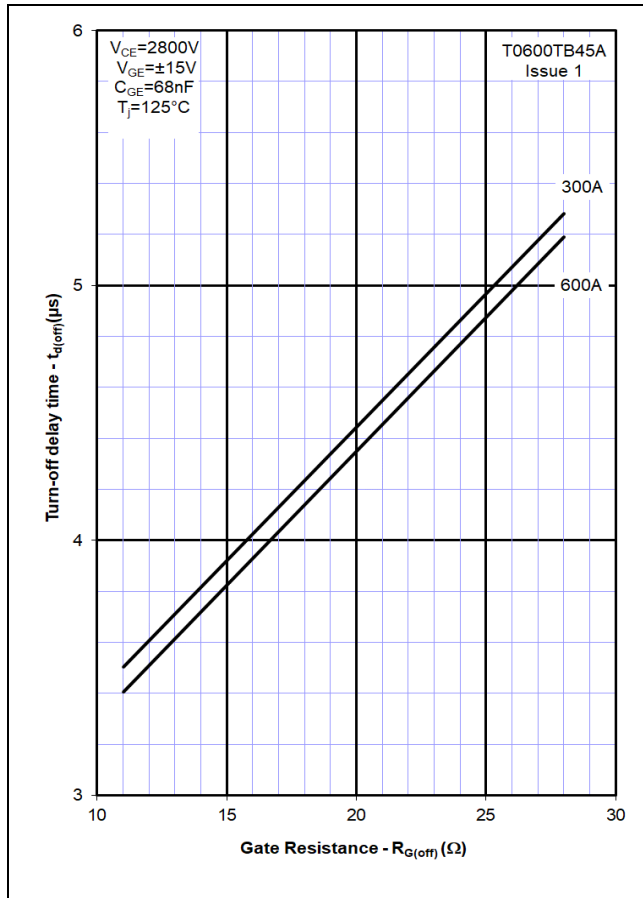


Figure 6 – Typical turn-on energy vs. collector current

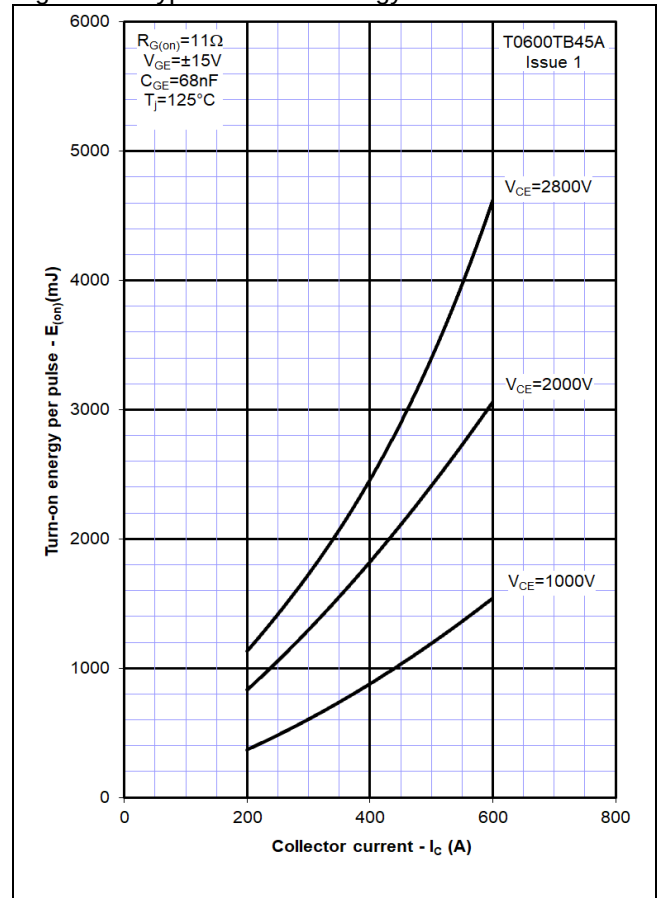


Figure 7 – Typical turn-on energy vs. di/dt

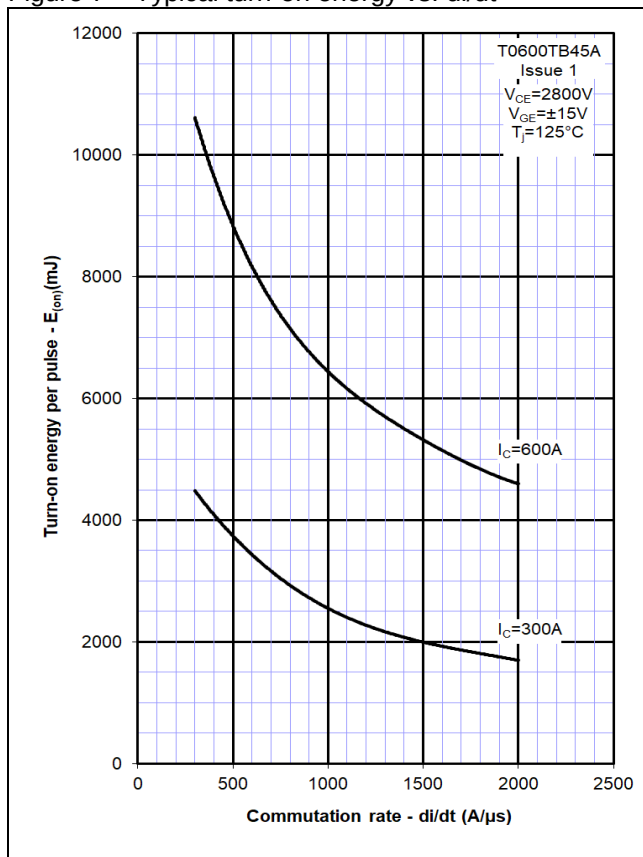


Figure 8 – Typical turn-off energy vs. collector current

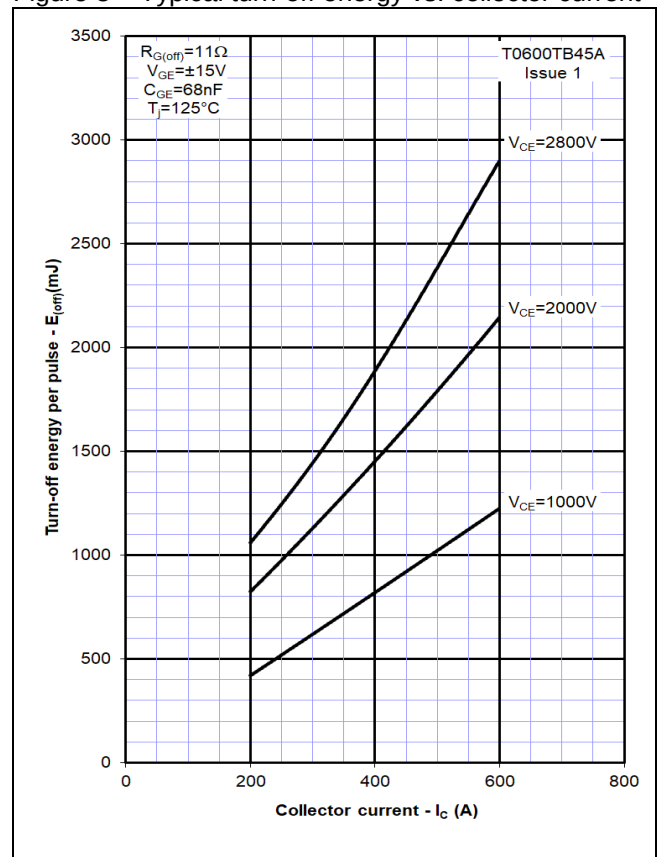


Figure 9 – Turn-off energy vs voltage

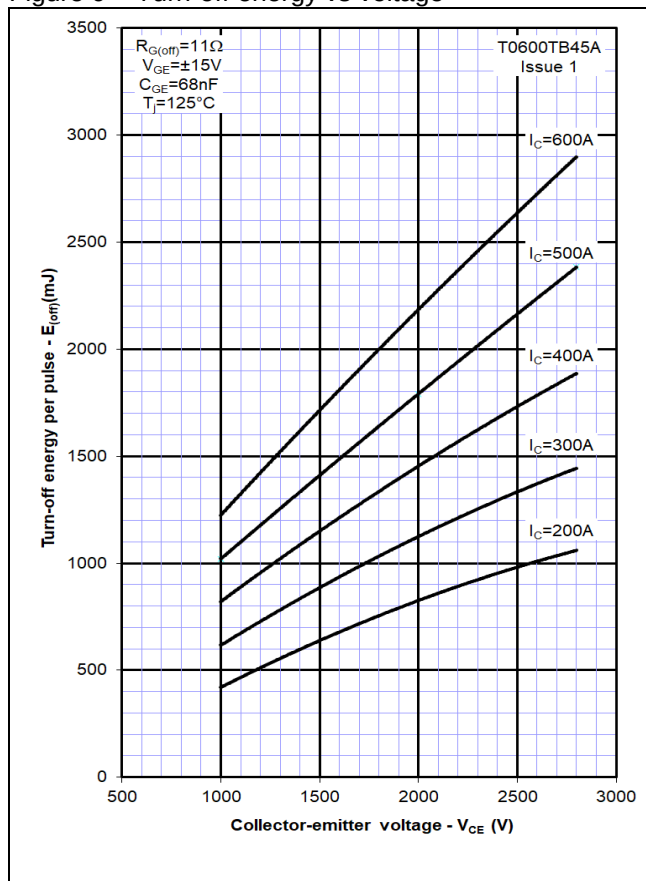


Figure 10 – Safe operating area (IGBT)

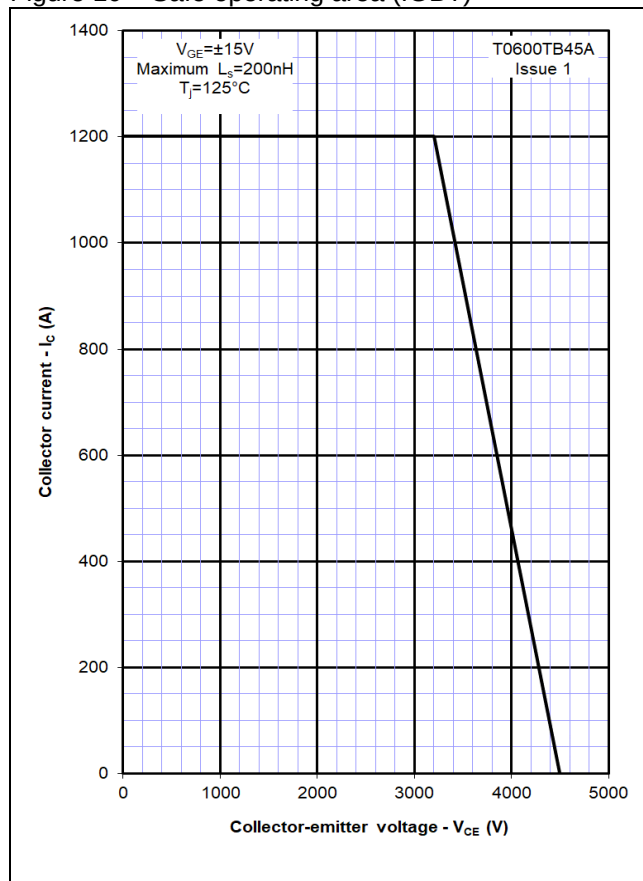


Figure 11 – Typical diode forward characteristics

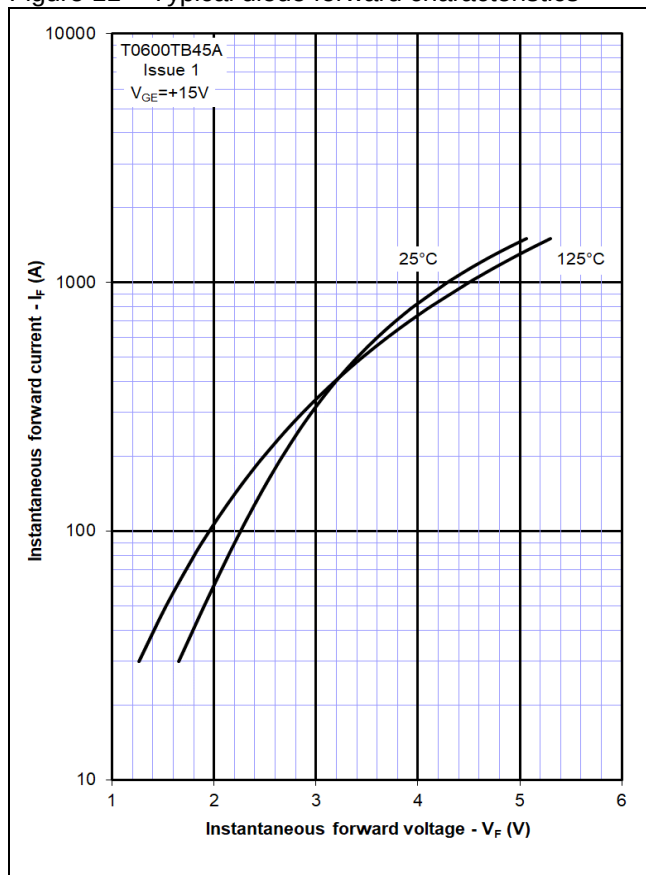


Figure 12 – Typical recovered charge

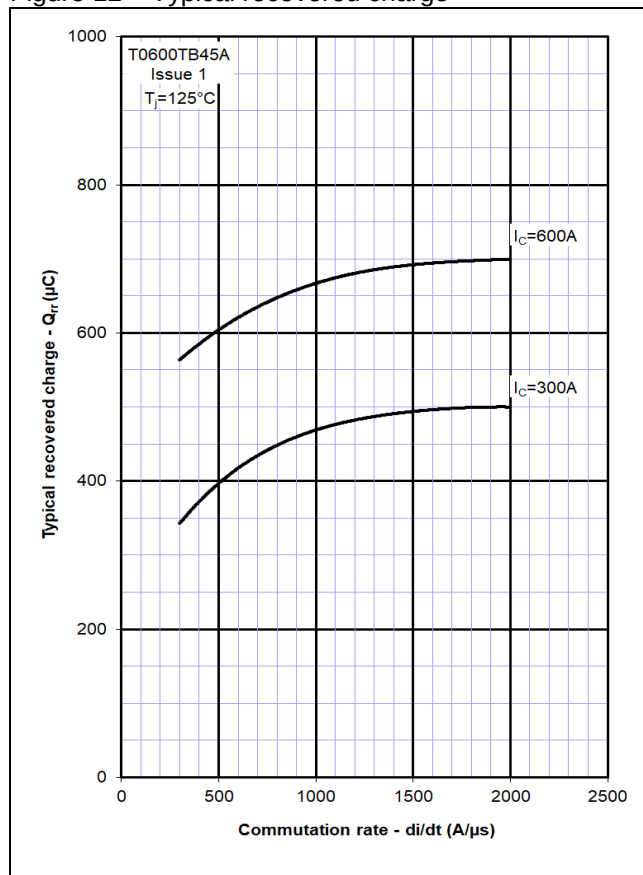


Figure 13 – Typical reverse recovery current

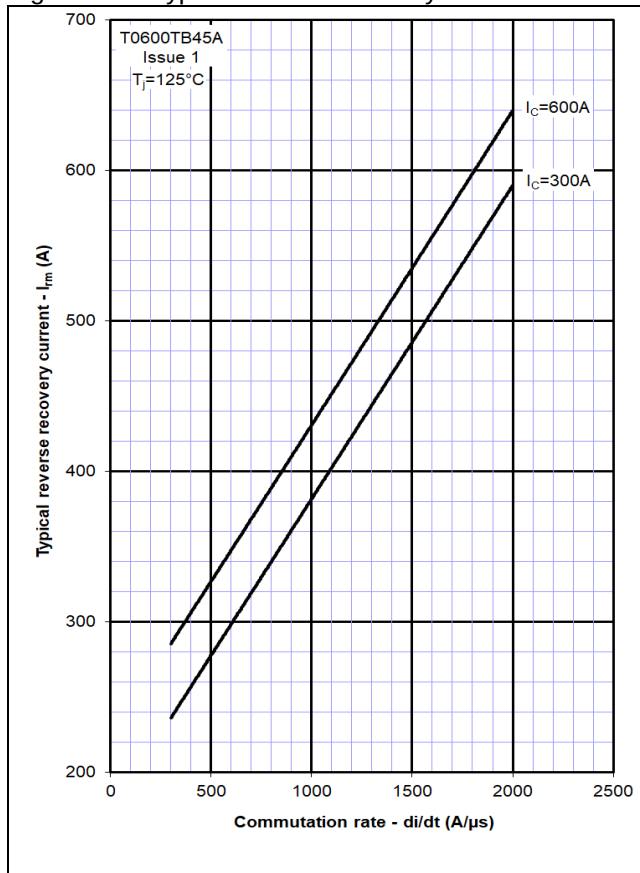


Figure 14 – Typical reverse recovery time

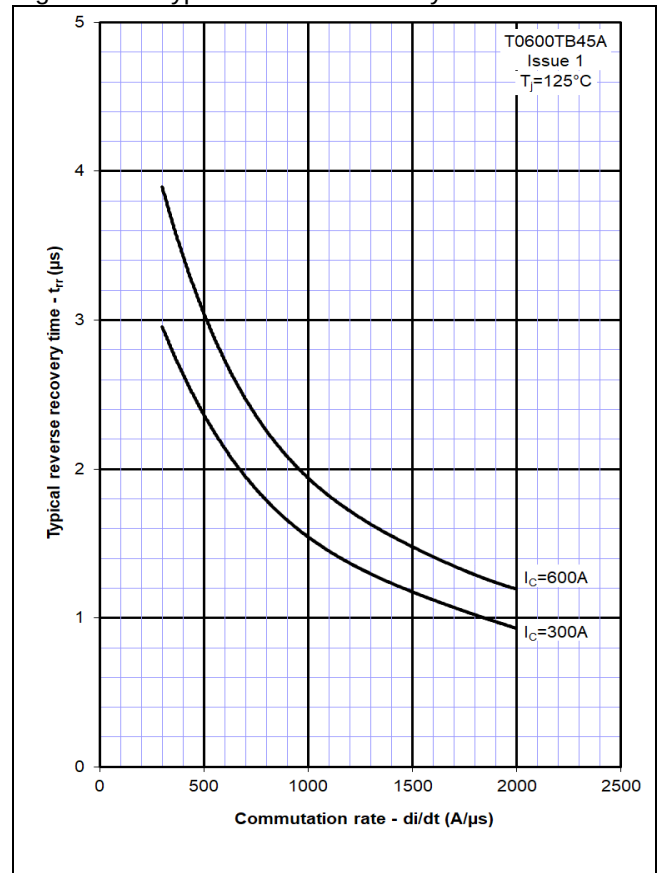


Figure 15 – Typical reverse recovery energy

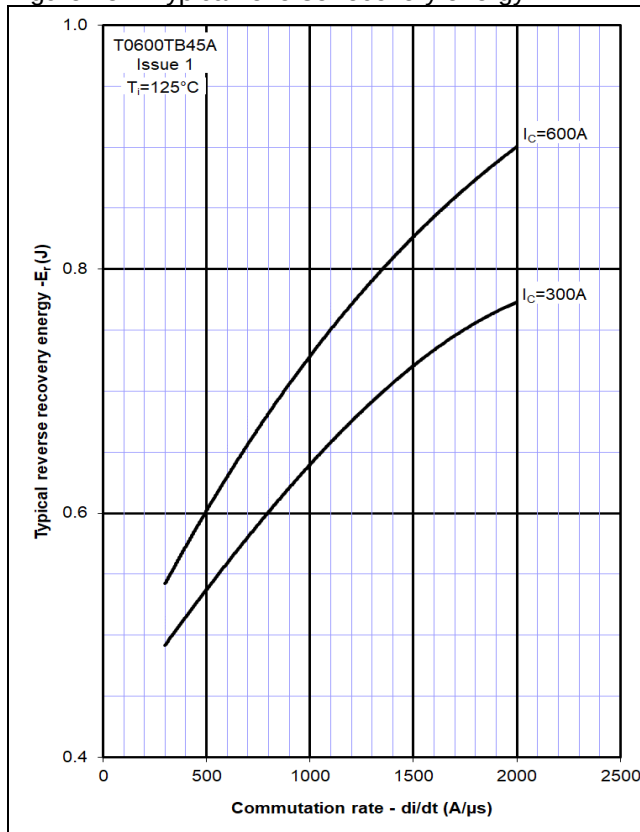


Figure 16 – Safe operating area (Diode)

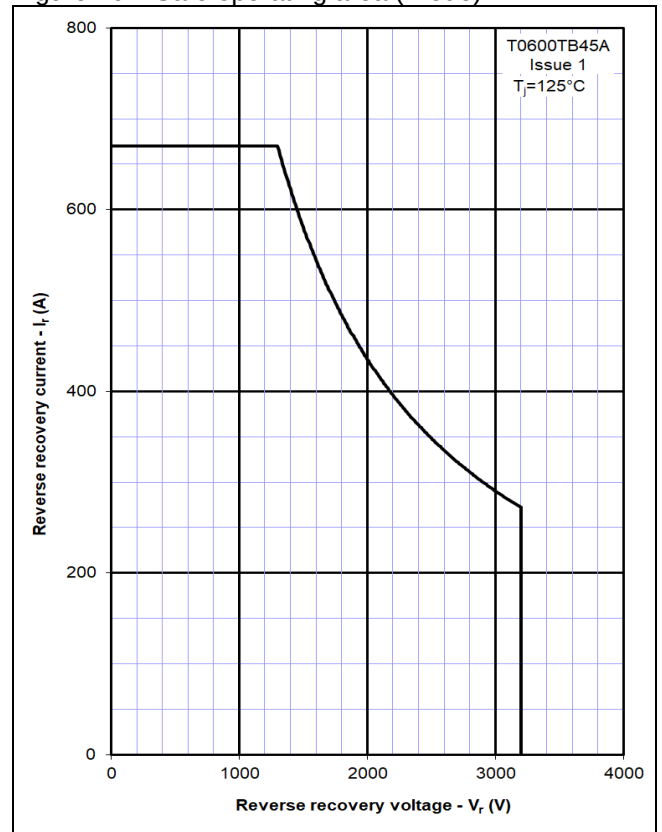


Figure 17 – Transient thermal impedance (IGBT)

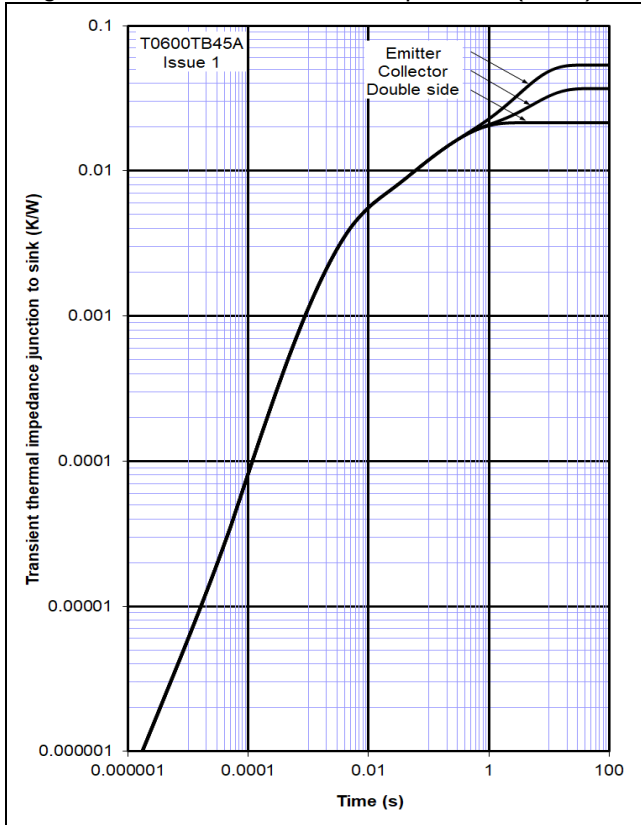
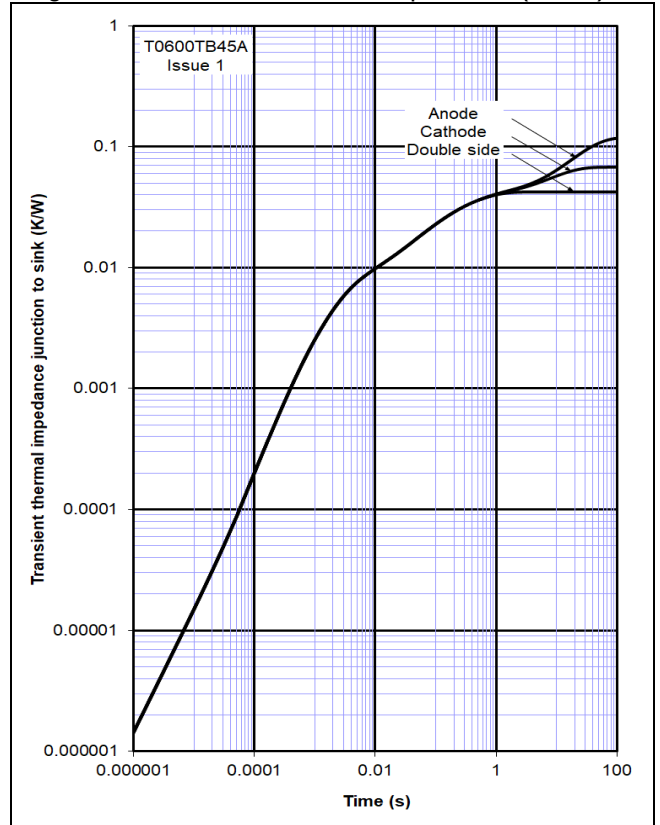
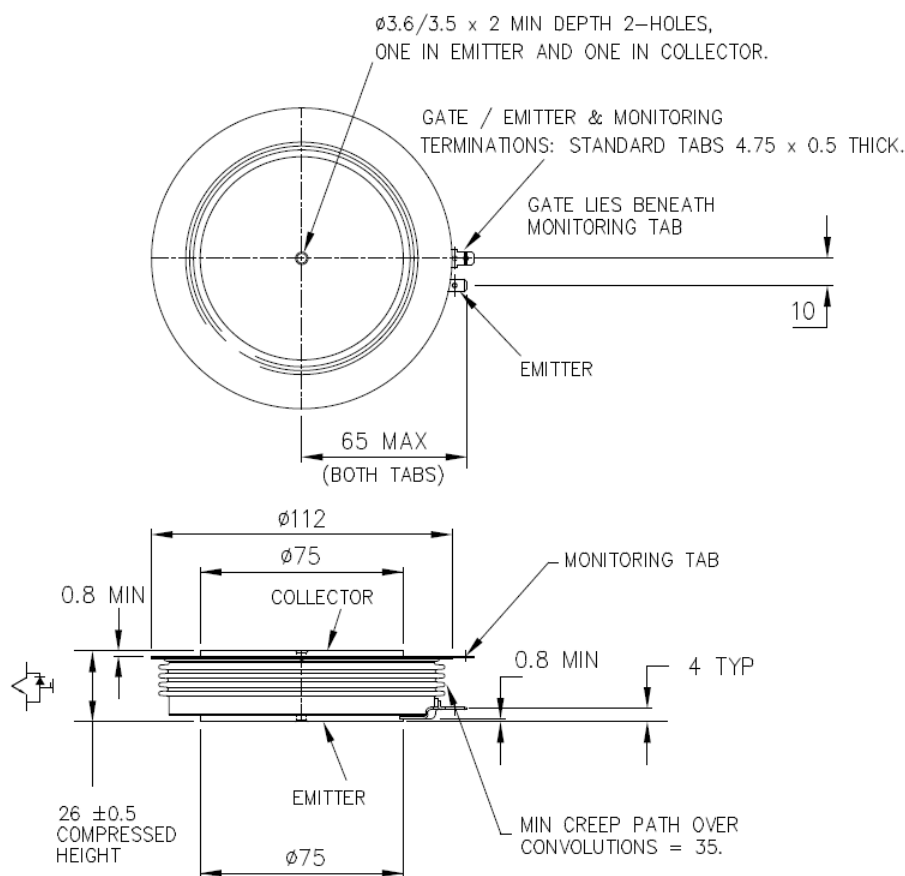


Figure 18 – Transient thermal impedance (Diode)



## Outline Drawing & Ordering Information



171A108

### ORDERING INFORMATION

(Please quote 10 digit code as below)

| T0600              | TB                    | 45                                   | A                 |
|--------------------|-----------------------|--------------------------------------|-------------------|
| Fixed type<br>Code | Fixed Outline<br>Code | Voltage Grade<br>$V_{CES}/100$<br>45 | Fixed format code |

 Typical order code: T0600TB45A ( $V_{CES} = 4500V$ )

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