



# IXYS

A Littelfuse Technology

Date:- 04 Oct, 2019

Data Sheet Issue:- P2

Tentative data

## Insulated Gate Bi-Polar Transistor Type T1000EC33G

### Absolute Maximum Ratings

|                      | VOLTAGE RATINGS                                | MAXIMUM LIMITS | UNITS |
|----------------------|--|----------------|-------|
| V <sub>CES</sub>     | Collector – emitter voltage                    | 3300           | V     |
| V <sub>DC link</sub> | Permanent DC voltage for 100 FIT failure rate. | 1800           | V     |
| V <sub>GES</sub>     | Peak gate – emitter voltage                    | ±20            | V     |

|                       | RATINGS   | MAXIMUM LIMITS | UNITS |
|-----------------------|---|----------------|-------|
| I <sub>C(DC)</sub>    | DC collector current, IGBT  | 1000           | A     |
| I <sub>CRM</sub>      | Repetitive peak collector current, t <sub>p</sub> =1ms, IGBT  | 2000           | A     |
| I <sub>F(DC)</sub>    | Continuous DC forward current, Diode  | 1000           | A     |
| I <sub>FRM</sub>      | Repetitive peak forward current, t <sub>p</sub> =1ms, Diode   | 2000           | A     |
| I <sub>FSM</sub>      | Peak non-repetitive surge t <sub>p</sub> =10ms, V <sub>RM</sub> =60%V <sub>RRM</sub> , Diode (Note 4) | 6000           | A     |
| I <sub>FSM2</sub>     | Peak non-repetitive surge t <sub>p</sub> =10ms, V <sub>RM</sub> ≤10V, Diode (Note 4)                  | 6600           | A     |
| P <sub>MAX</sub>      | Maximum power dissipation, IGBT (Note 2)  | 6.4            | kW    |
| P <sub>D</sub>        | Maximum power dissipation, Diode (Note 2)   | 4.05           | kW    |
| (di/dt) <sub>cr</sub> | Critical diode di/dt (note 3)   | 2000           | A/μs  |
| T <sub>j</sub>        | Operating temperature range.  | -40 to +125    | °C    |
| T <sub>stg</sub>      | Storage temperature range.  | -40 to +125    | °C    |

Notes: -

- 1) Unless otherwise indicated T<sub>j</sub> = 125°C.
- 2) T<sub>sink</sub> = 25°C, double side cooled.
- 3) Maximum commutation loop inductance 200nH.
- 4) Half-sinewave, 125°C T<sub>j</sub> initial.

## Characteristics

### IGBT Characteristics

|                      | PARAMETER                              | MIN | TYP  | MAX  | TEST CONDITIONS   | UNITS  |   |
|----------------------|--|-----|------|------|---|--|---|
| V <sub>CE(sat)</sub> | Collector – emitter saturation voltage | -   | 2.57 | 2.97 | I <sub>C</sub> = 1000A, V <sub>GE</sub> = 15V, T <sub>j</sub> = 25°C  | V  |   |
|                      |  | -   | 3.40 | 3.80 | I <sub>C</sub> = 1000A, V <sub>GE</sub> = 15V   | V  |   |
| V <sub>0</sub>       | Threshold voltage                      | -   | -    | 1.84 | Current range: 333 – 1000A  | V  |   |
| r <sub>s</sub>       | Slope resistance                       | -   | -    | 1.97 |   | mΩ   |   |
| V <sub>GE(TH)</sub>  | Gate threshold voltage                 | -   | 5.3  | -    | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 85mA   | V  |   |
| I <sub>CES</sub>     | Collector – emitter cut-off current    | -   | 10   | 25   | V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V   | mA   |   |
| I <sub>GES</sub>     | Gate leakage current                   | -   | -    | ±10  | V <sub>GE</sub> = ±20V  | μA   |   |
| C <sub>ies</sub>     | Input capacitance                      | -   | 135  | -    | V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz   | nF   |   |
| t <sub>d(on)</sub>   | Turn-on delay time                     | -   | 1.7  | -    | I <sub>C</sub> = 1000A, V <sub>CE</sub> = 1800V, di/dt = 2000A/μs<br>V <sub>GE</sub> = ±15V, L <sub>S</sub> = 200nH<br>R <sub>G(ON)</sub> = 2.2Ω, R <sub>G(OFF)</sub> = 15Ω, C <sub>GE</sub> = 430nF<br>Integral diode used as freewheel diode<br>(Note 3, 4 & 5) | μs   |   |
| t <sub>r(V)</sub>    | Rise time                              | -   | 1.8  | -    |   | μs   |   |
| Q <sub>g(on)</sub>   | Turn-on gate charge                    | -   | 21   | -    |   | μC   |   |
| E <sub>on</sub>      | Turn-on energy                         | -   | 2.6  | -    |   | J  |   |
| t <sub>d(off)</sub>  | Turn-off delay time                    | -   | 5.3  | -    |   | μs   |   |
| t <sub>f(I)</sub>    | Fall time                              | -   | 1.5  | -    |   | μs   |   |
| Q <sub>g(off)</sub>  | Turn-off gate charge                   | -   | 13   | -    |   | μC   |   |
| E <sub>off</sub>     | Turn-off energy                        | -   | 2.7  | -    |   | J  |   |
| I <sub>SC</sub>      | Short circuit current                  | -   | 3000 | -    |   | V <sub>GE</sub> = +15V, V <sub>CC</sub> = 1800V, V <sub>CEmax</sub> ≤ V <sub>CES</sub> , t <sub>p</sub> ≤ 10μs | A |

### Diode Characteristics

|                 | PARAMETER                        | MIN | TYP  | MAX  | TEST CONDITIONS  | UNITS |
|-----------------|----------------------------------|-----|------|------|--|-------|
| V <sub>F</sub>  | Forward voltage                  | -   | 2.66 | 2.95 | I <sub>F</sub> = 1000A, T <sub>j</sub> = 25°C                    | V     |
|                 |                                  | -   | 3.0  | 3.3  | I <sub>F</sub> = 1000A   | V     |
| V <sub>0</sub>  | Threshold voltage                | -   | -    | 1.71 | Current range 333 - 1000A  | V     |
| r <sub>s</sub>  | Slope resistance                 | -   | -    | 1.59 |  | mΩ    |
| I <sub>rm</sub> | Peak reverse recovery current    | -   | 470  | -    | I <sub>F</sub> = 1000A, V <sub>GE</sub> = ±15V, di/dt = 2000A/μs | A     |
| Q <sub>rr</sub> | Recovered charge                 | -   | 1040 | -    |  | μC    |
| t <sub>rr</sub> | Reverse recovery time, 50% chord | -   | 1.7  | -    |  | μs    |
| E <sub>r</sub>  | Reverse recovery energy          | -   | 1.2  | -    |  | J     |

### Thermal Characteristics

|                   | PARAMETER                                  | MIN | TYP | MAX  | TEST CONDITIONS       | UNITS |
|-------------------|--|-----|-----|------|-----------------------|-------|
| R <sub>thJK</sub> | Thermal resistance junction to sink, IGBT  | -   | -   | 15.6 | Double side cooled    | K/kW  |
|                   |  | -   | -   | 25.4 | Collector side cooled | K/kW  |
|                   |  | -   | -   | 40.5 | Emitter side cooled   | K/kW  |
| R <sub>thJK</sub> | Thermal resistance junction to sink, Diode | -   | -   | 24.7 | Double side cooled    | K/kW  |
|                   |  | -   | -   | 37.9 | Cathode side cooled   | K/kW  |
|                   |  | -   | -   | 70.8 | Anode side cooled     | K/kW  |
| F                 | Mounting force                             | 25  | -   | 35   | Note 2                | kN    |
| W <sub>t</sub>    | Weight                                     | -   | 1.2 | -    |                       | kg    |

#### Notes:-

- 1) Unless otherwise indicated T<sub>j</sub> = 125°C.
- 2) Consult application note 2008AN01 for detailed mounting requirements
- 3) C<sub>GE</sub> is additional gate – emitter capacitance added to output of gate drive
- 4) E<sub>on</sub> integration time 15μs from 10% rising I<sub>C</sub>.
- 5) E<sub>off</sub> integration time 15μs from 90% falling V<sub>GE</sub>.

**Curves**

Figure 1 – Typical collector-emitter saturation voltage characteristics

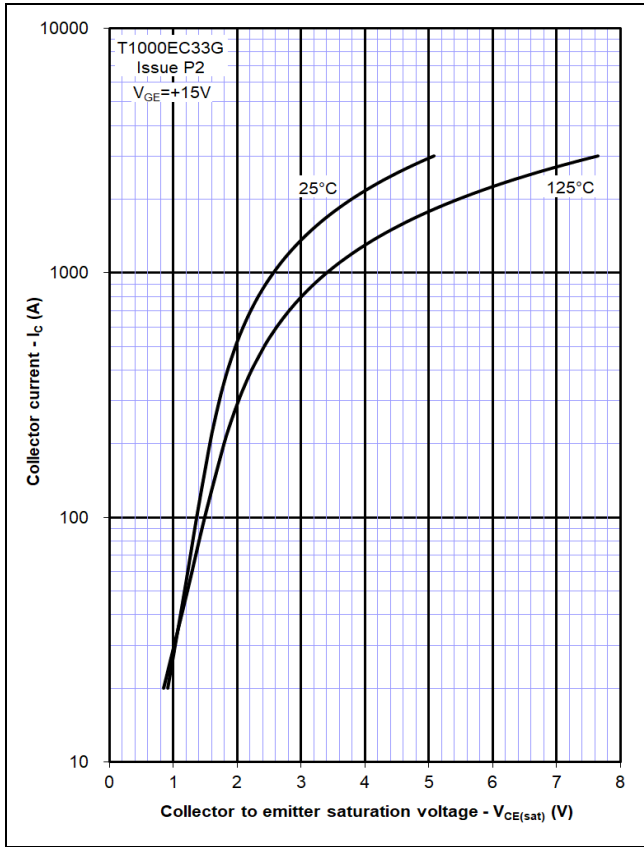


Figure 2 – Typical output characteristic

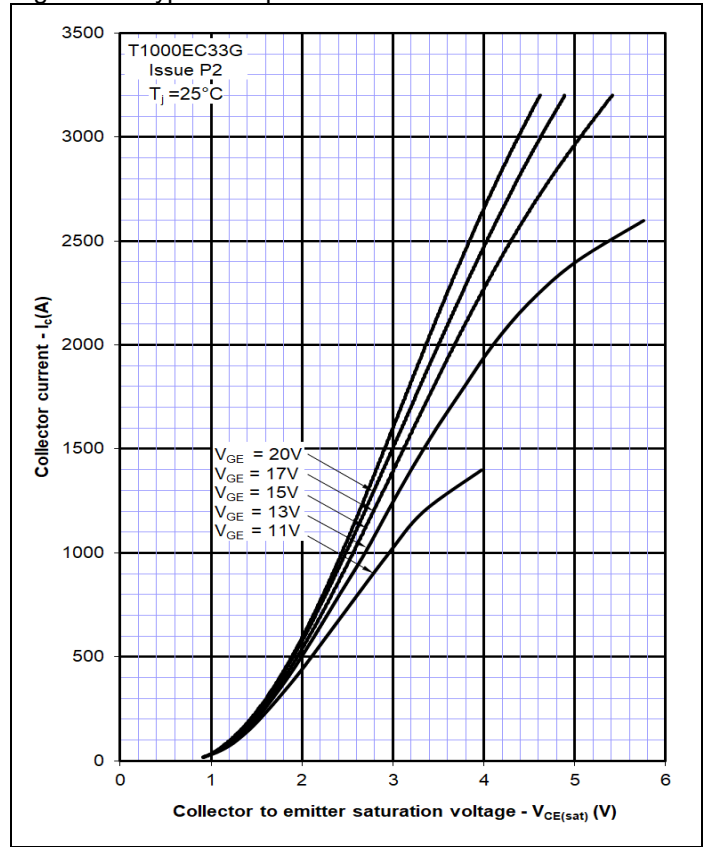


Figure 3 – Typical output characteristic

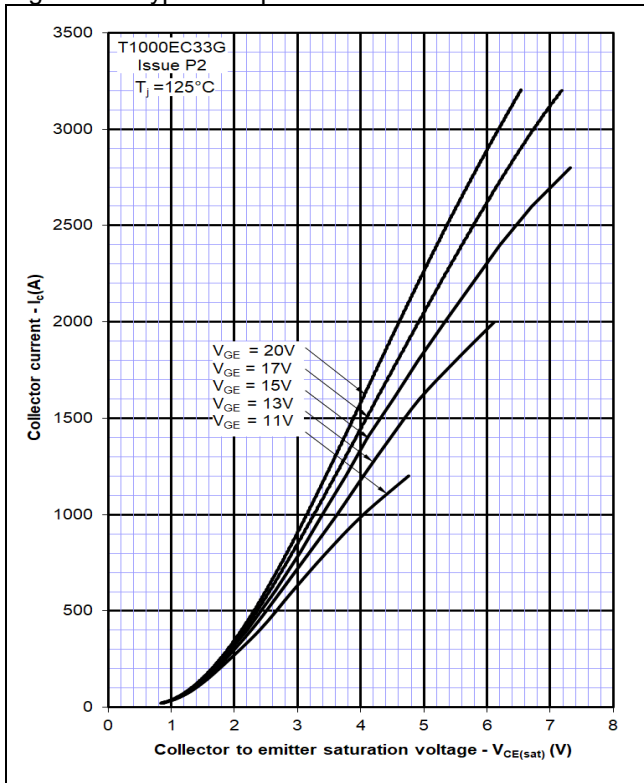


Figure 4 – Typical turn-on delay time vs gate resistance

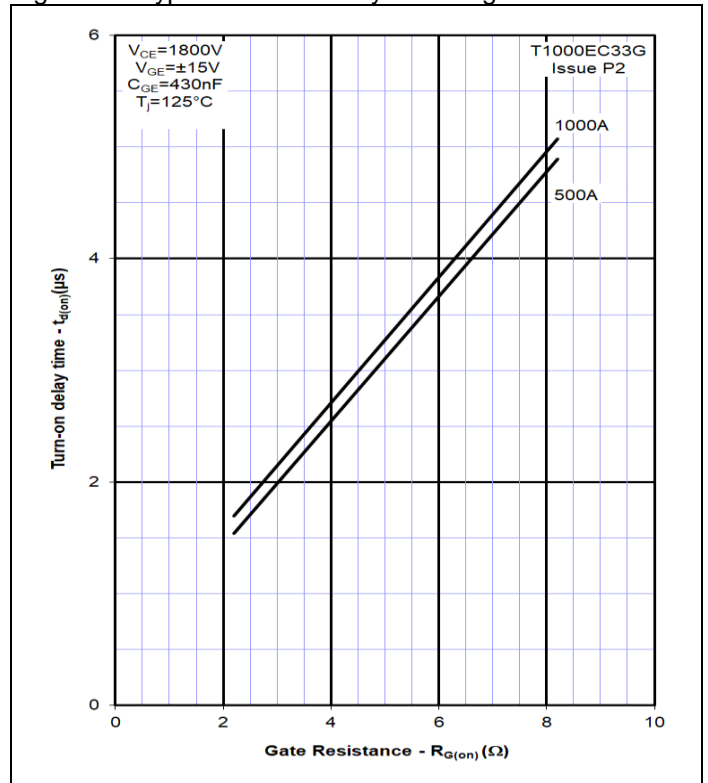


Figure 5 – Typical turn-off delay time vs. gate resistance

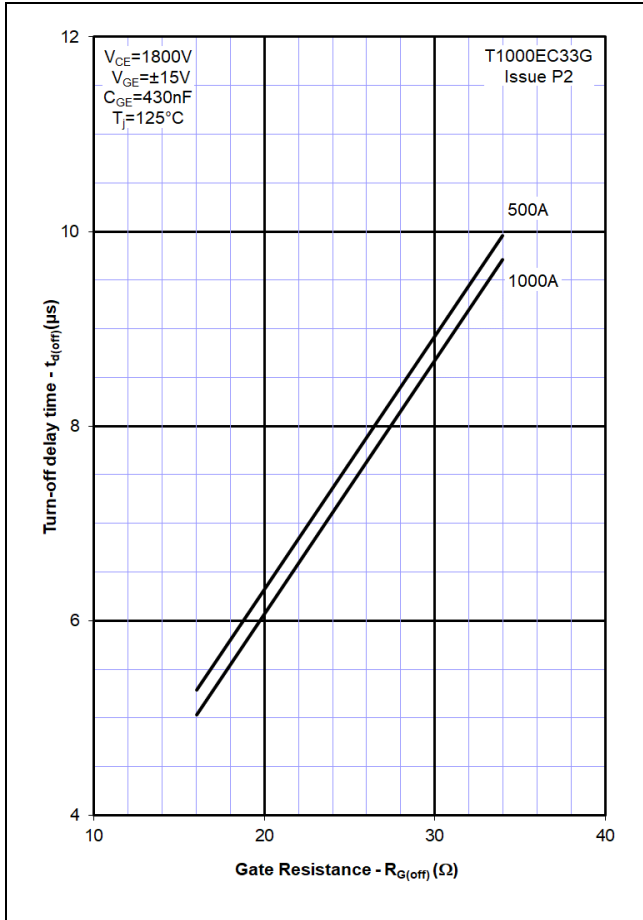


Figure 6 – Typical turn-on energy vs. collector current

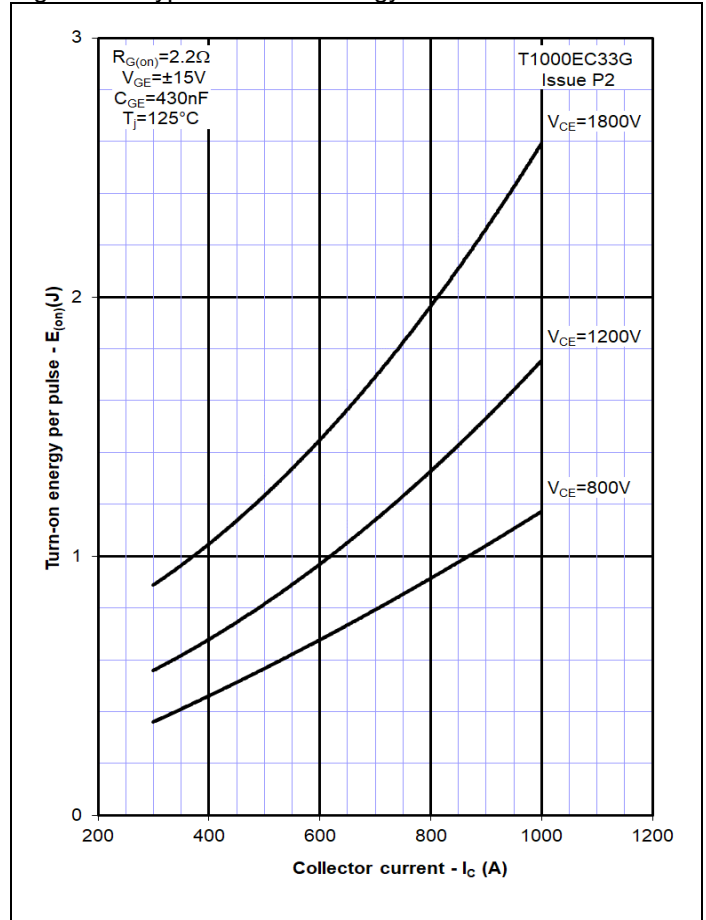


Figure 7 – Typical turn-on energy vs. di/dt

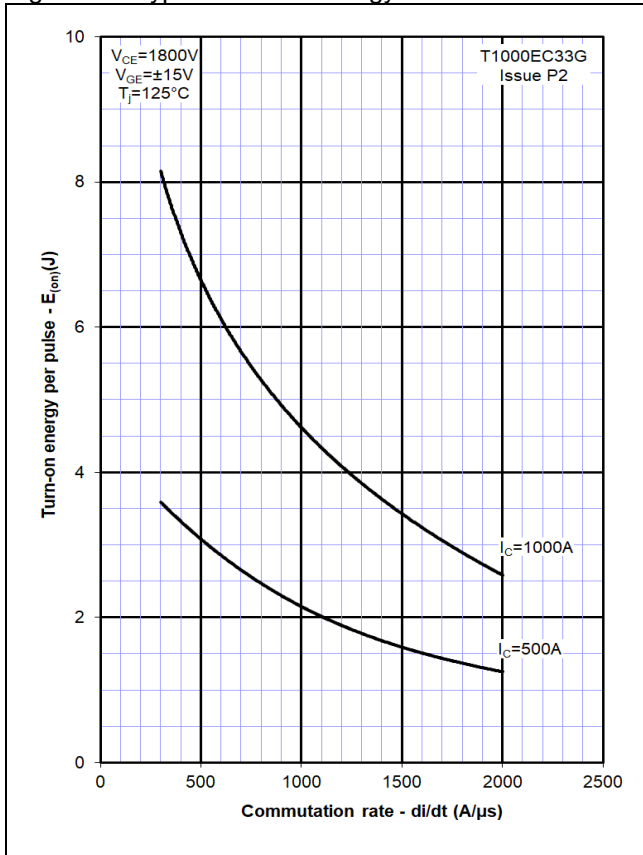


Figure 8 – Typical turn-off energy vs. collector current

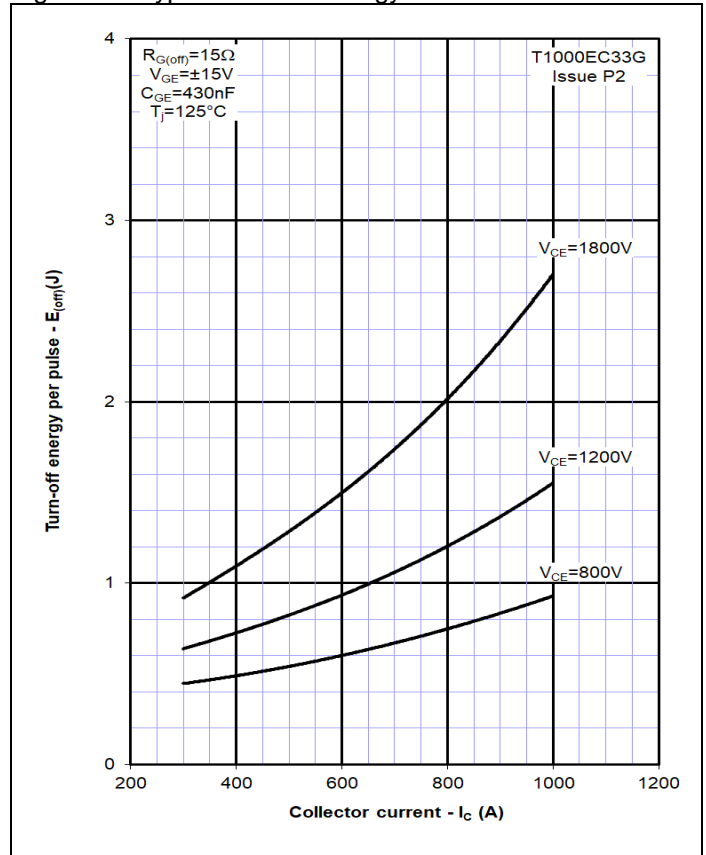


Figure 9 – Turn-off energy vs voltage

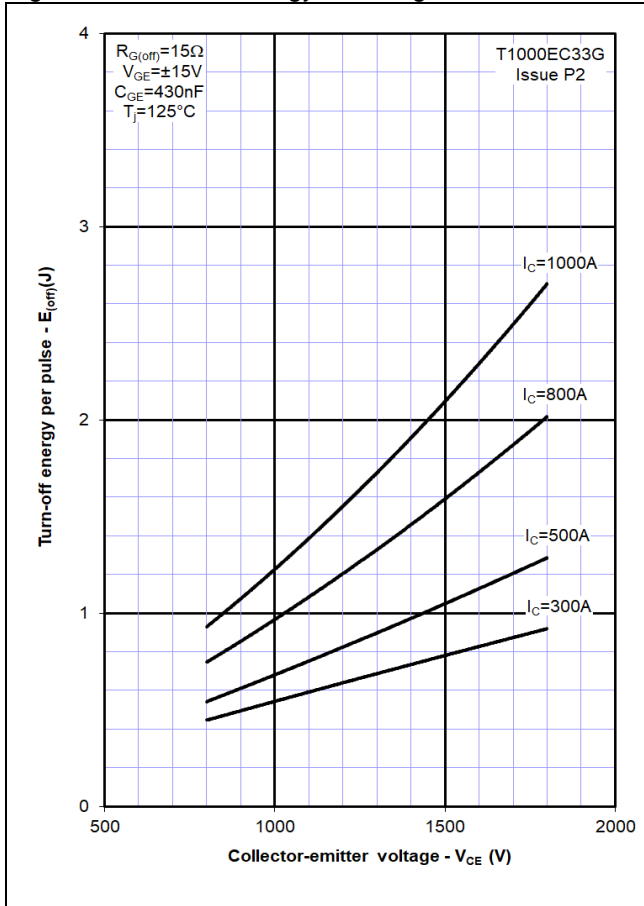


Figure 10 – Safe operating area (IGBT)

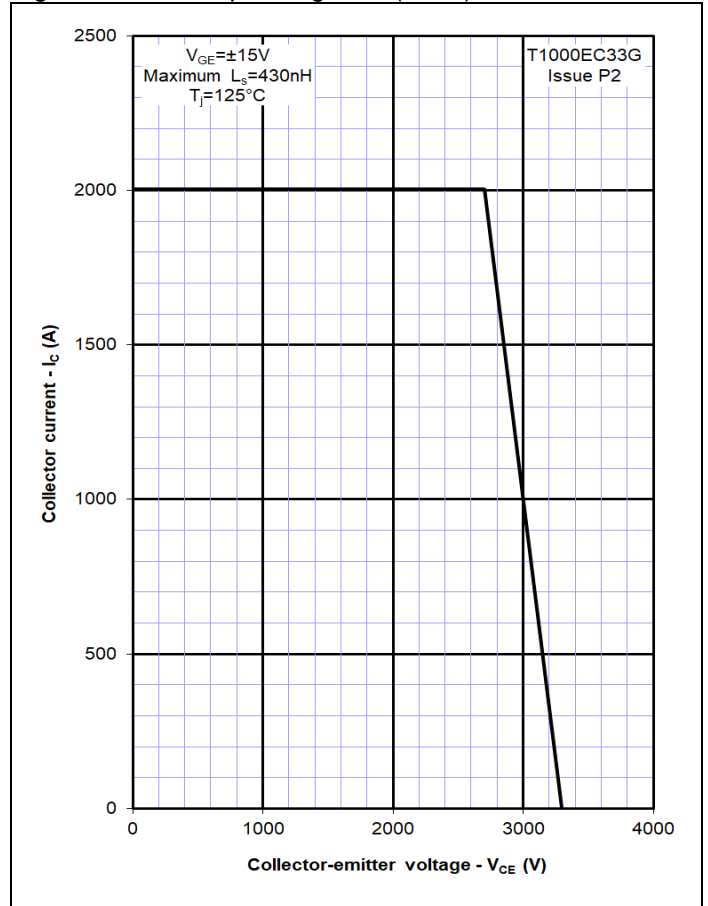


Figure 11 – Typical diode forward characteristics

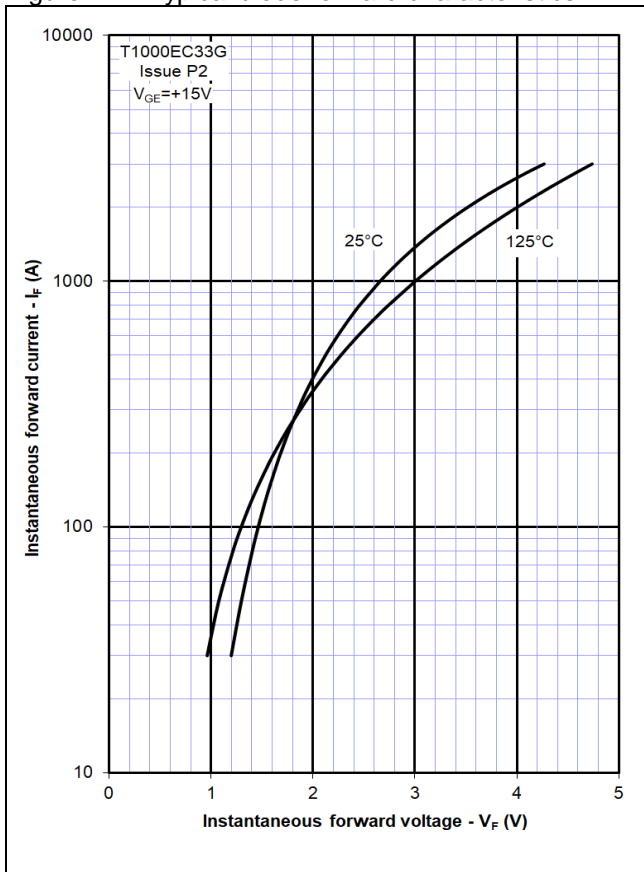


Figure 12 – Typical recovered charge

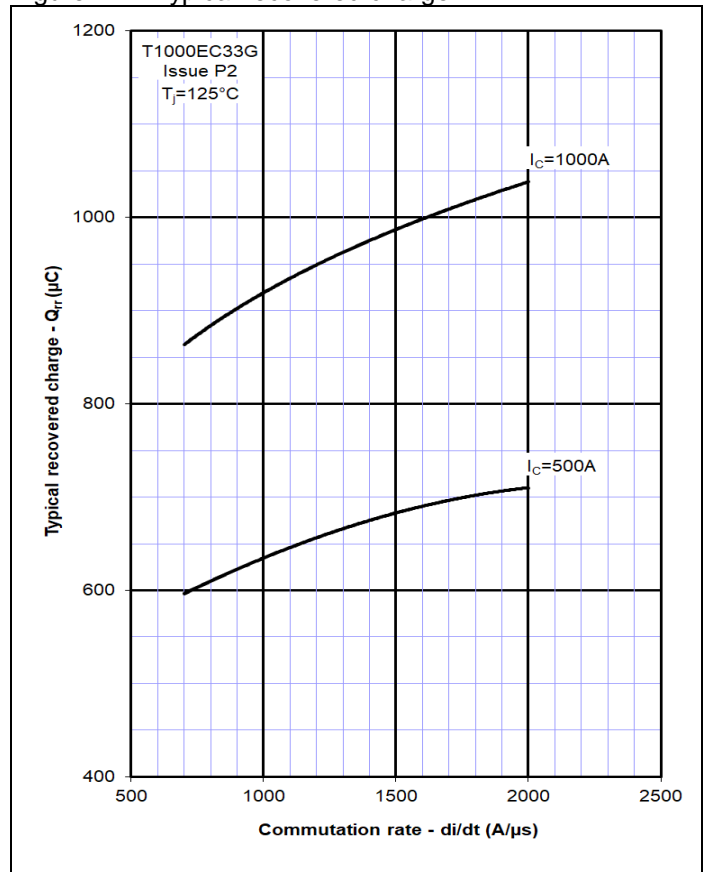


Figure 13 – Typical reverse recovery current

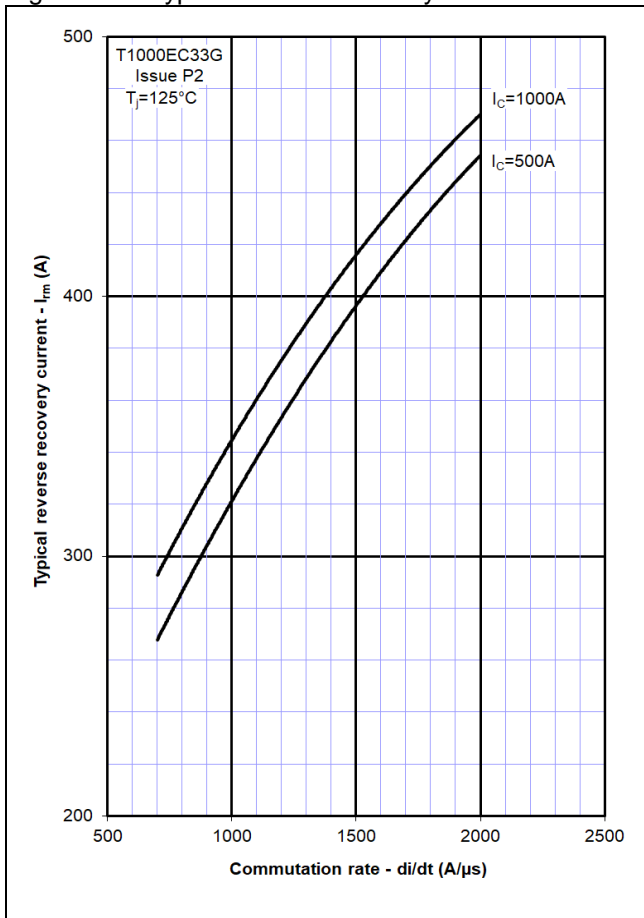


Figure 14 – Typical reverse recovery time

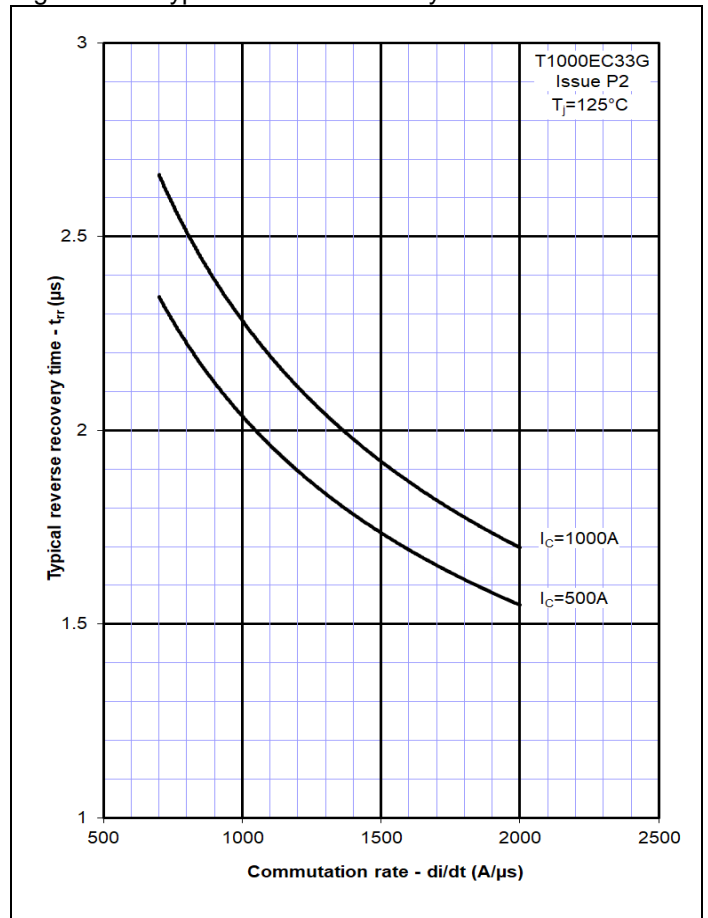


Figure 15 – Typical reverse recovery energy

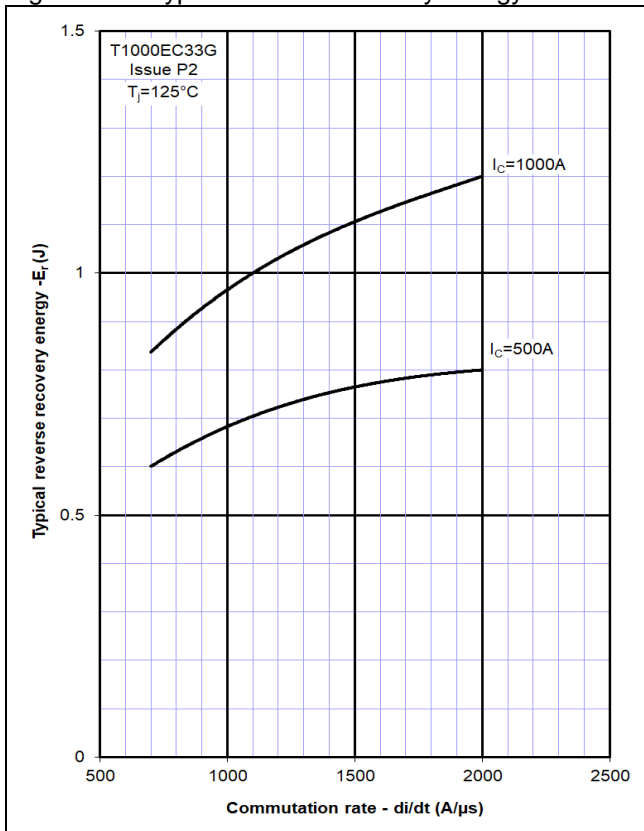


Figure 16 – Safe operating area (Diode)

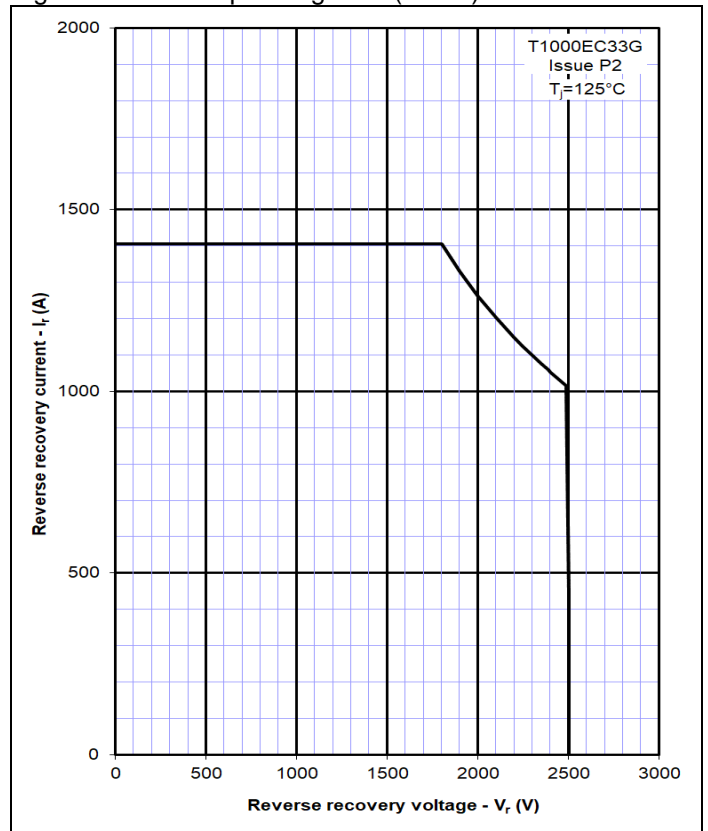


Figure 17 – Transient thermal impedance (IGBT)

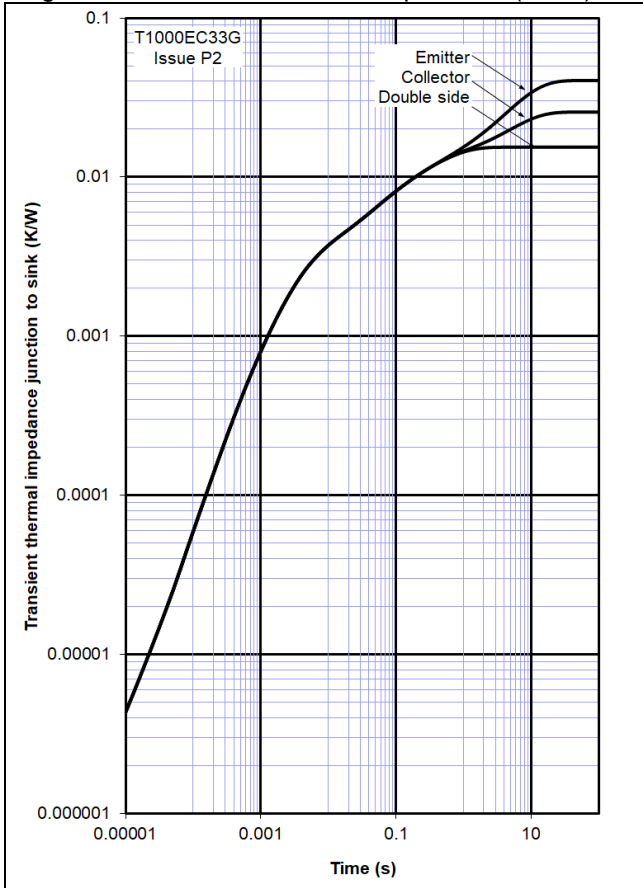
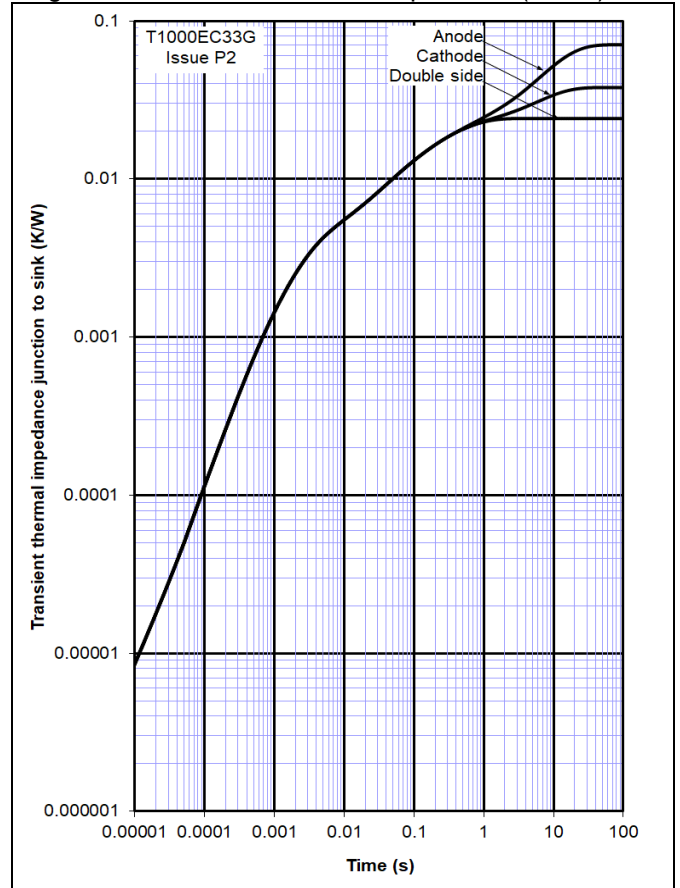
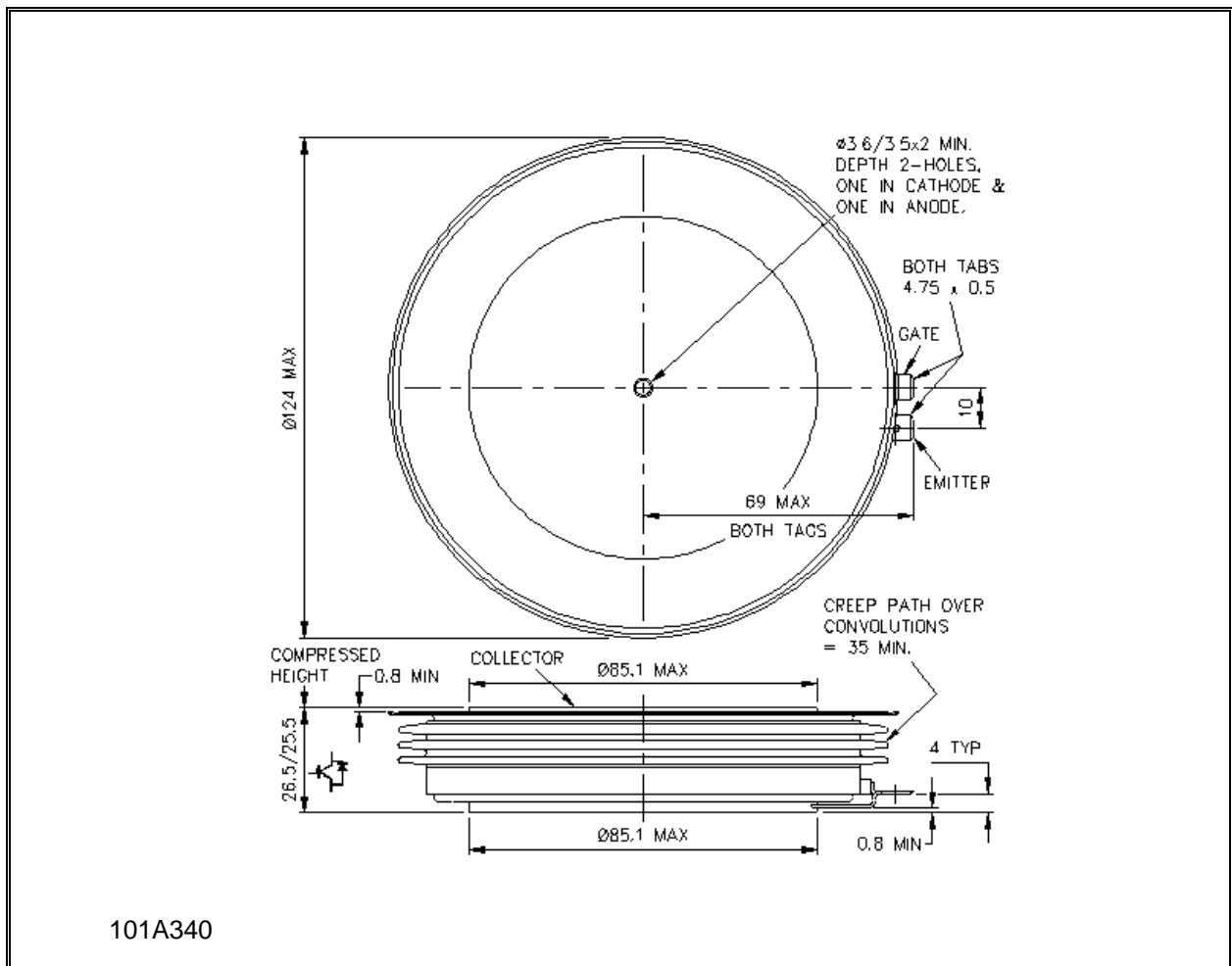


Figure 18 – Transient thermal impedance (Diode)



## Outline Drawing & Ordering Information



### ORDERING INFORMATION

(Please quote 10 digit code as below)

| T1000           | EC                 | 33                                   | G                 |
|-----------------|--------------------|--------------------------------------|-------------------|
| Fixed type Code | Fixed Outline Code | Voltage Grade<br>$V_{CES}/100$<br>33 | Fixed format code |

 Typical order code: T1000EC33G ( $V_{CES} = 3300V$ )

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