



# Insulated Gate Bi-Polar Transistor Type T2960BB45E

## Absolute Maximum Ratings

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

	RATINGS	MAXIMUM LIMITS	UNITS
$I_C$	Continuous DC collector current, IGBT	3000	A
$I_{CRM}$	Repetitive peak collector current, $t_p=1ms$ , IGBT	6000	A
$I_{ECO}$	Maximum reverse emitter current, $t_p=100\mu s$ , (note 2 & 3)	3000	A
$P_{MAX}$	Maximum power dissipation, IGBT (note 2)	23.8	kW
$T_{j\ op}$	Operating temperature range	-40 to +125	°C
$T_{stg}$	Storage temperature range	-40 to +125	°C

Notes: -

- 1) Unless otherwise indicated  $T_j = 125^\circ C$ .
- 2)  $T_{sink} = 25^\circ C$ , double side cooled.
- 3) Maximum commutation loop inductance 200nH.
- 4) Half-sinewave,  $125^\circ C$   $T_j$  initial.

## Characteristics

### IGBT Characteristics

	PARAMETER	MIN	TYP	MAX	TEST CONDITIONS	UNITS	
V <sub>CE(sat)</sub>	Collector – emitter saturation voltage	-	2.75	3.15	I <sub>C</sub> = 3000A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 25°C	V	
		-	3.6	4.0	I <sub>C</sub> = 3000A, V <sub>GE</sub> = 15V	V	
V <sub>T0</sub>	Threshold voltage	-	-	1.84	Current range: 1000A – 3000A	V	
r <sub>T</sub>	Slope resistance	-	-	0.73		mΩ	
V <sub>GE(TH)</sub>	Gate threshold voltage	-	5.1	-	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 300mA	V	
I <sub>CES</sub>	Collector – emitter cut-off current	-	55	85	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V	mA	
I <sub>GES</sub>	Gate leakage current	-	-	±35	V <sub>GE</sub> = ±20V	μA	
C <sub>ies</sub>	Input capacitance	-	495	-	V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz	nF	
t <sub>d(on)</sub>	Turn-on delay time	-	1.1	-	I <sub>C</sub> = 3000A, V <sub>CE</sub> = 2800V, di/dt = 5000A/μs V <sub>GE</sub> = ±15V, L <sub>S</sub> = 200nH R <sub>g(ON)</sub> = 1.3Ω, R <sub>g(OFF)</sub> = 6.8Ω, C <sub>GE</sub> = 330nF Freewheel diode type E2400TC45C at T <sub>J</sub> = 125°C. (Notes 3, 4 & 5)	μs	
t <sub>r(V)</sub>	Rise time	-	2.2	-		μs	
Q <sub>g(on)</sub>	Turn-on gate charge	-	21	-		μC	
E <sub>on</sub>	Turn-on energy	-	11.5	-		J	
t <sub>d(off)</sub>	Turn-off delay time	-	5.3	-		μs	
t <sub>f(I)</sub>	Fall time	-	2.5	-		μs	
Q <sub>g(off)</sub>	Turn-off gate charge	-	18	-		μC	
E <sub>off</sub>	Turn-off energy	-	17.5	-		J	
I <sub>SC</sub>	Short circuit current	-	10.9	-		V <sub>GE</sub> = +15V, V <sub>CC</sub> = 2800V, V <sub>CEmax</sub> ≤ V <sub>CES</sub> , t <sub>p</sub> ≤ 10μs	kA

### Thermal Characteristics

	PARAMETER	MIN	TYP	MAX	TEST CONDITIONS	UNITS
R <sub>thJK</sub>	Thermal resistance junction to sink, IGBT	-	-	4.2	Double side cooled	K/kW
		-	-	6.87	Collector side cooled	K/kW
		-	-	10.9	Emitter side cooled	K/kW
F	Mounting force	75	-	85	Note 2	kN
W <sub>t</sub>	Weight	-	2.8	-		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 circuit.
- 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

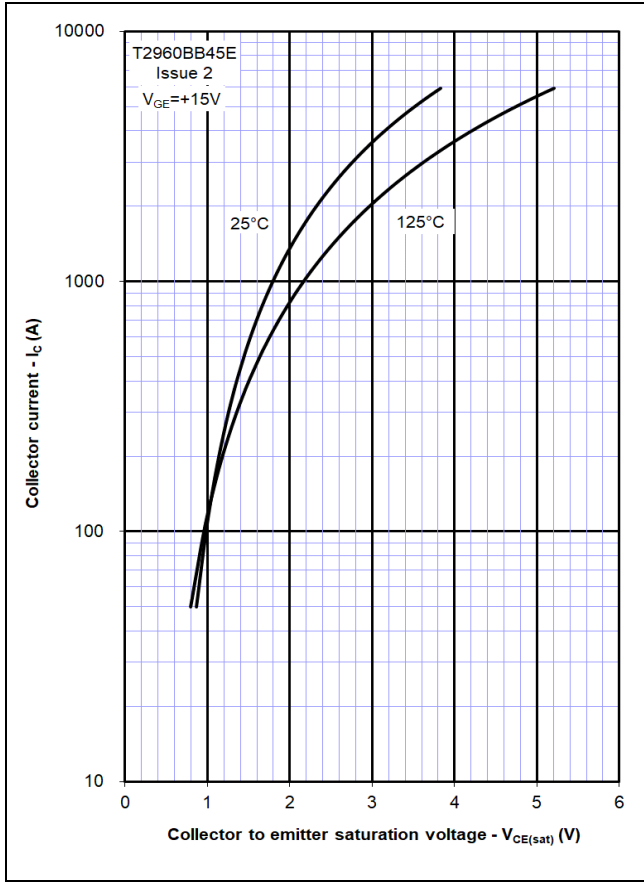


Figure 2 – Typical output characteristic

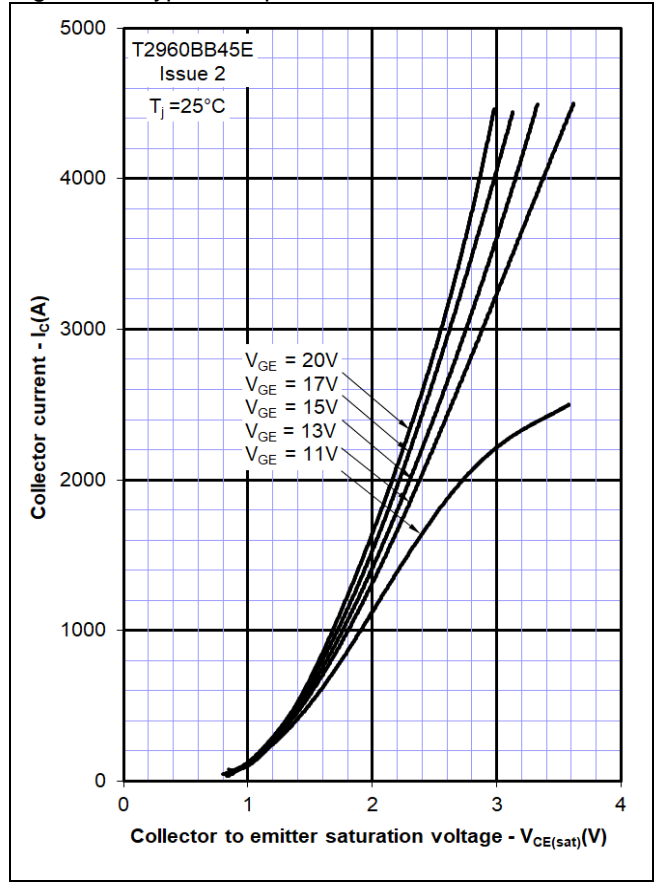


Figure 3 – Typical output characteristic

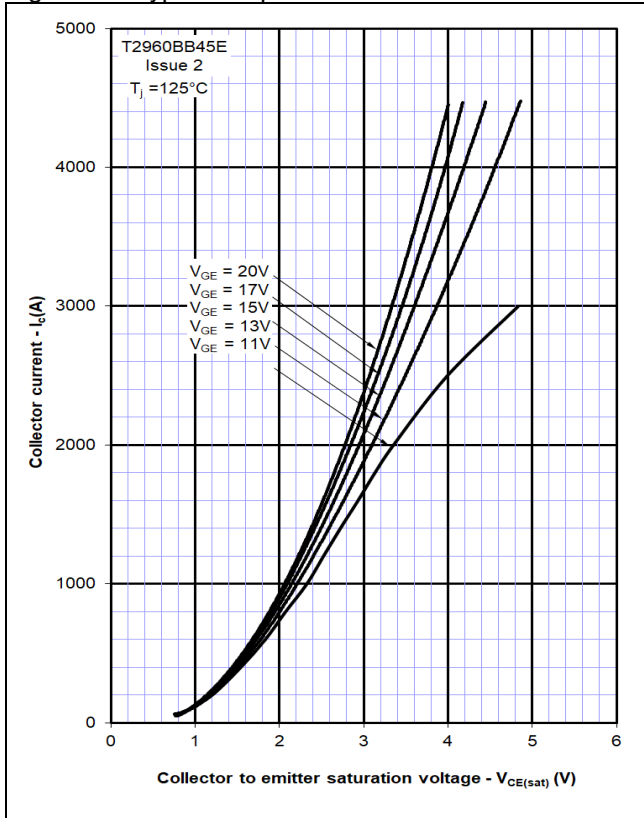


Figure 4 – Typical turn-on delay time vs gate resistance

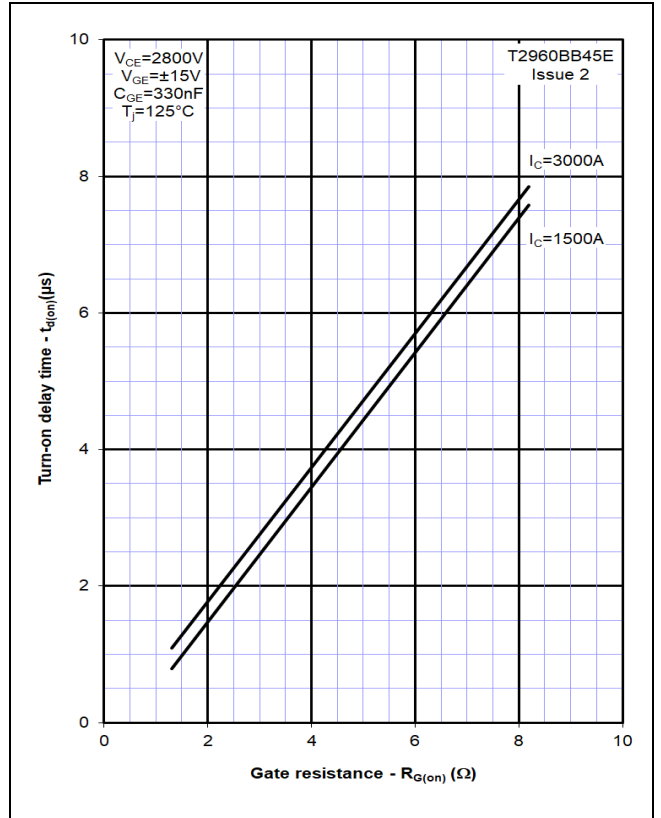


Figure 5 – Typical turn-off delay time vs. gate resistance

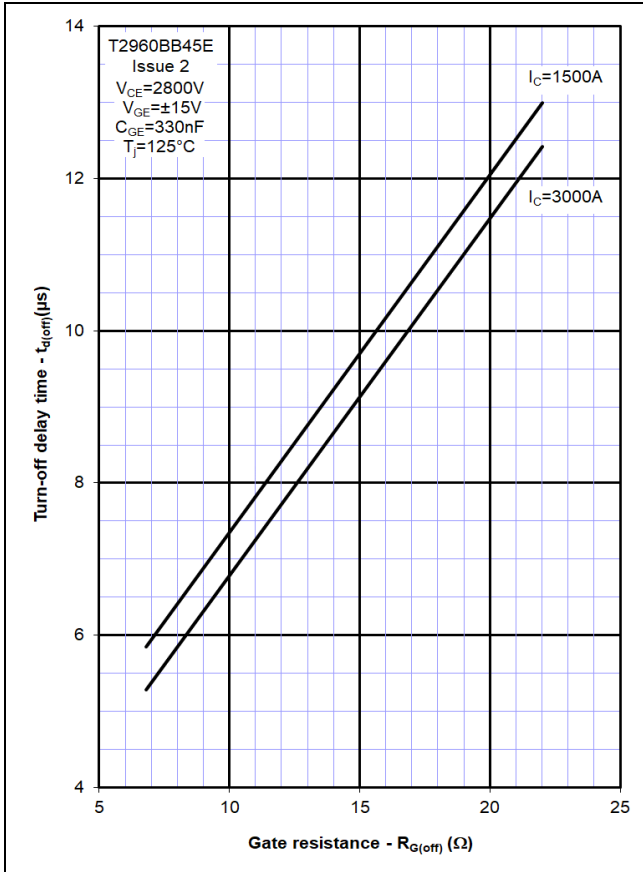


Figure 6 – Typical turn-on energy vs. collector current

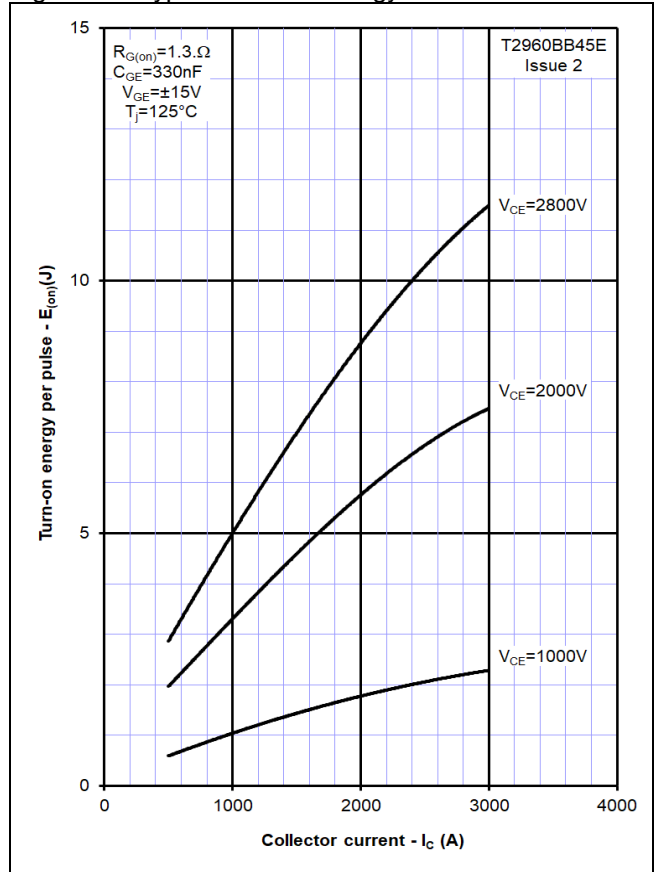


Figure 7 – Typical turn-on energy vs. di/dt

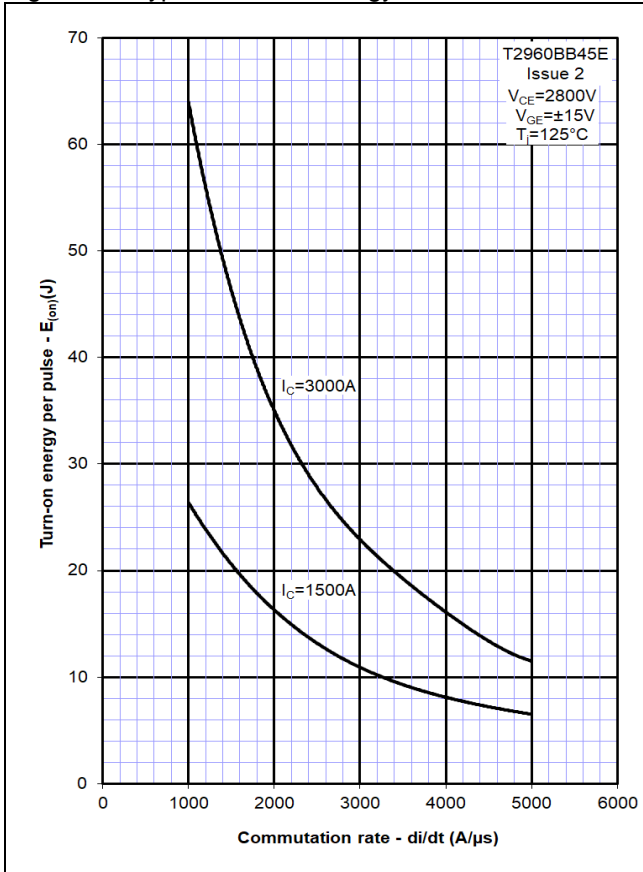


Figure 8 – Typical turn-off energy vs. collector current

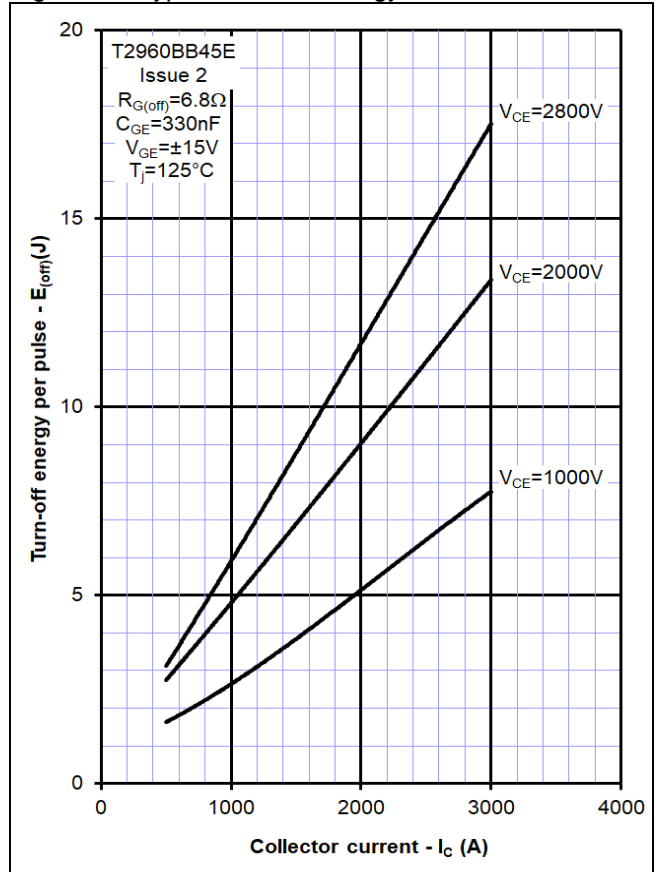


Figure 9 – Turn-off energy vs voltage

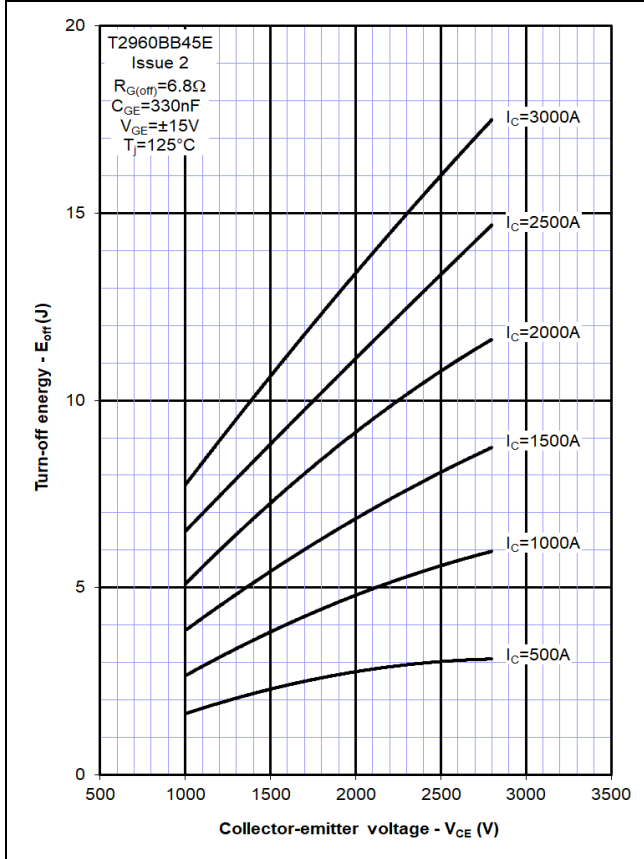


Figure 10 – Safe operating area

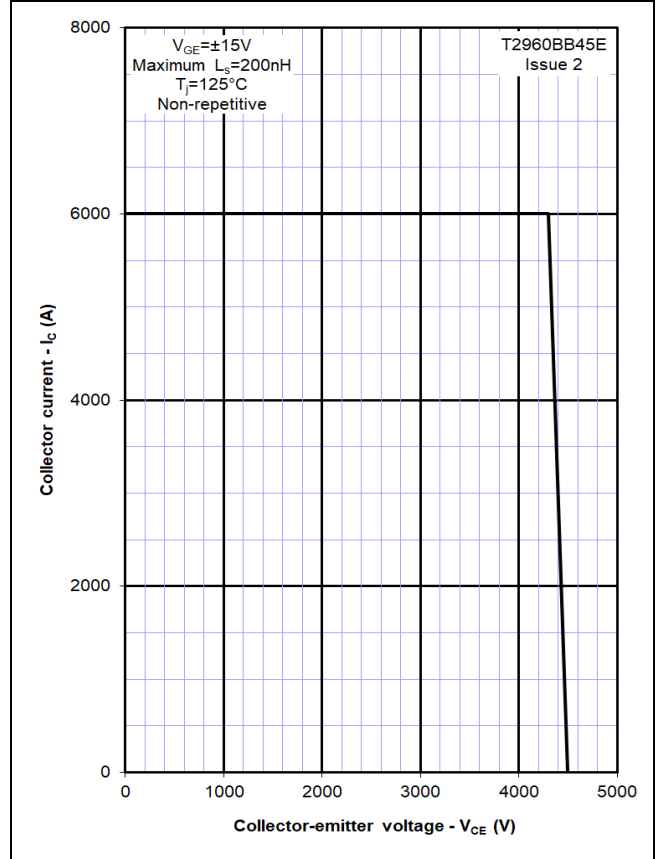
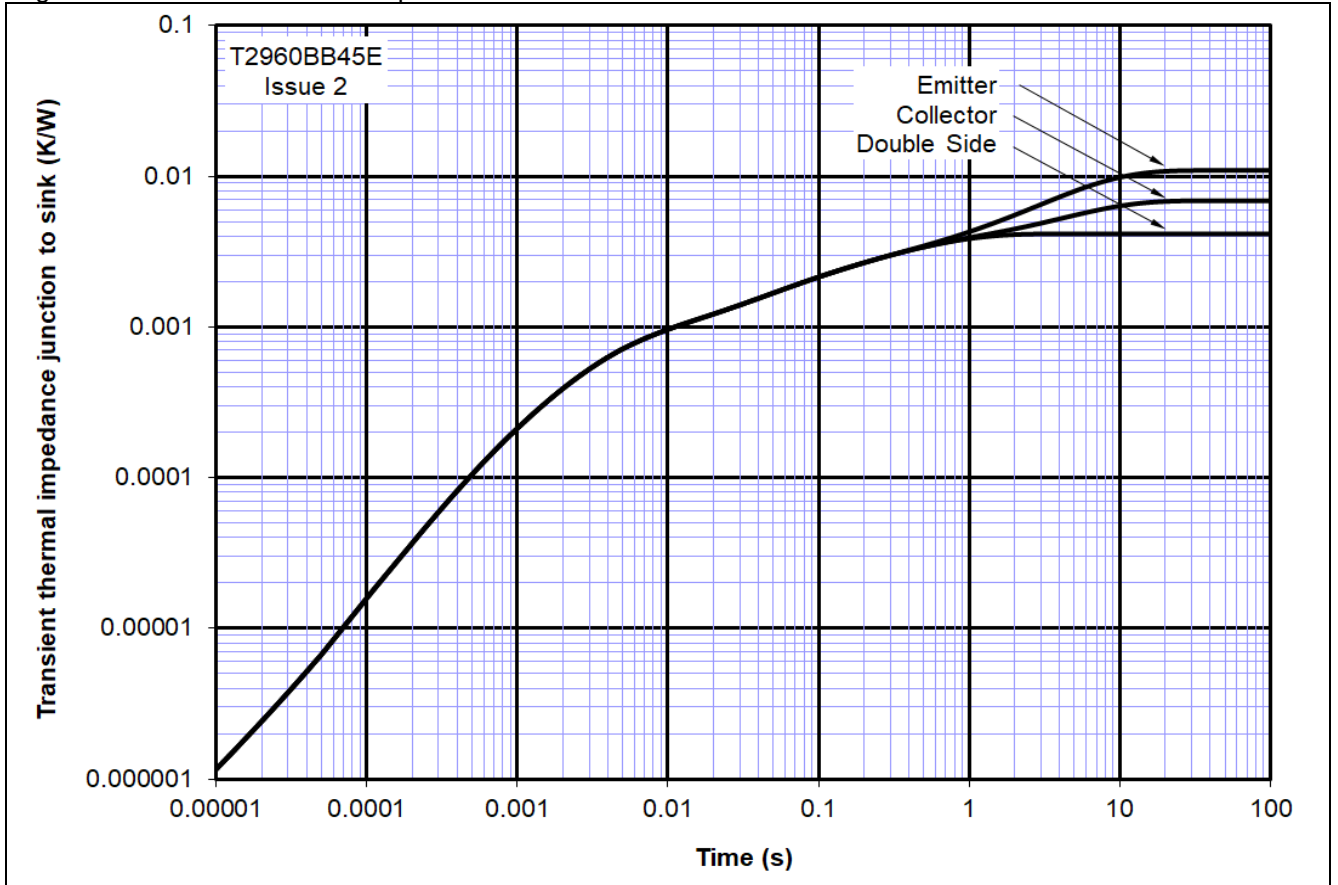
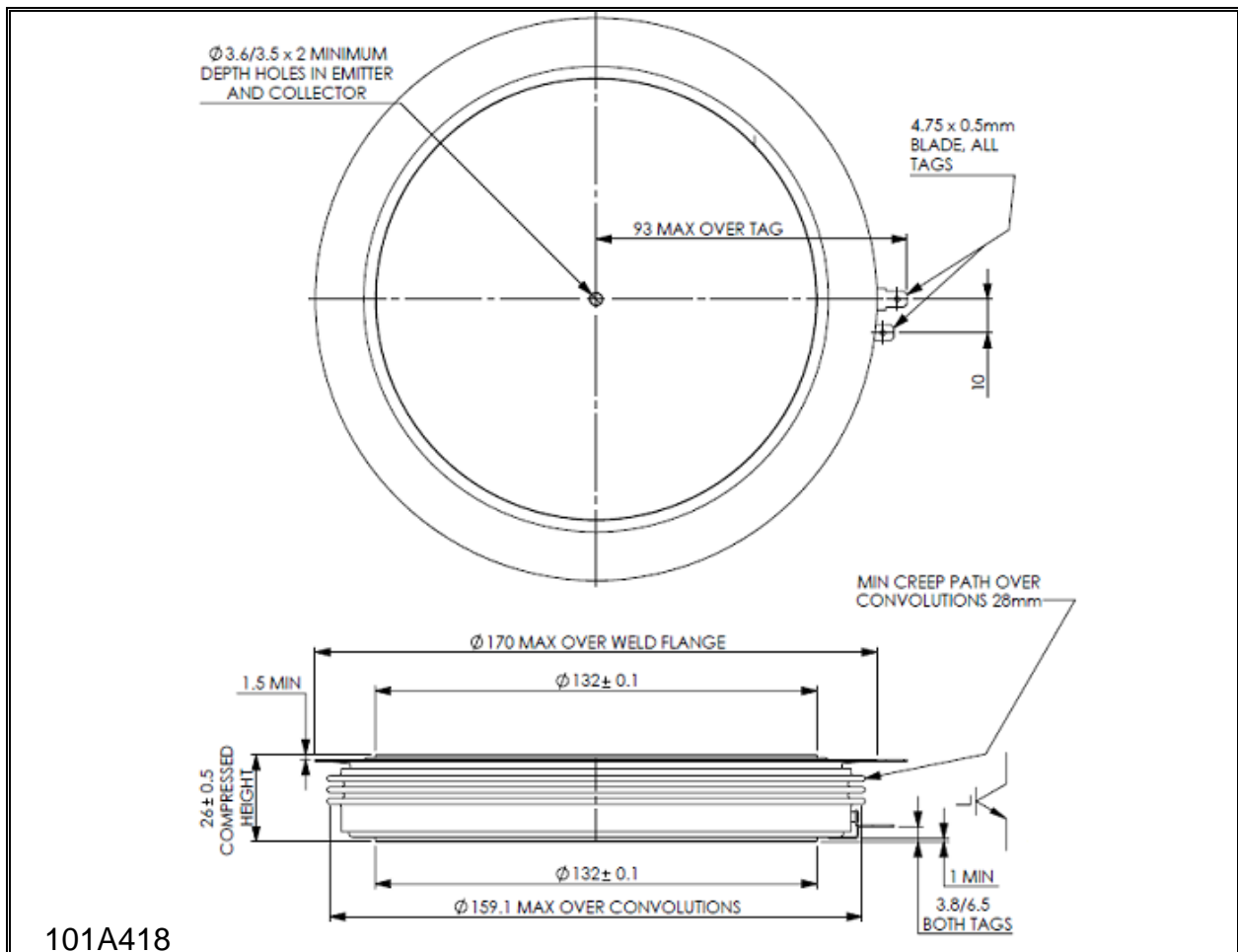


Figure 11 – Transient thermal impedance



## Outline Drawing & Ordering Information



### ORDERING INFORMATION

(Please quote 10 digit code as below)

T2960	BB	45	E
Fixed type Code	Fixed Outline Code	Voltage Grade $V_{CES}/100$ 45	Fixed format code

 Typical order code: T2960BB45E ( $V_{CES} = 4500V$ )

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