



Key Parameters

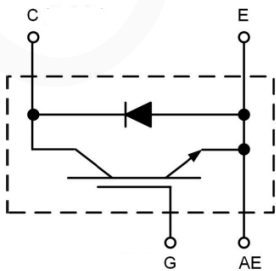
V_{CE} = 4500V
 I_C = 2000A

Features

- 4500V Planar Gate & Field Stop Structure
- High Robustness
- High Reliability
- Positive Temperature Coefficient
- High Short Circuit Capability

Applications

- HVDC flexible system
- Offshore wind power generation



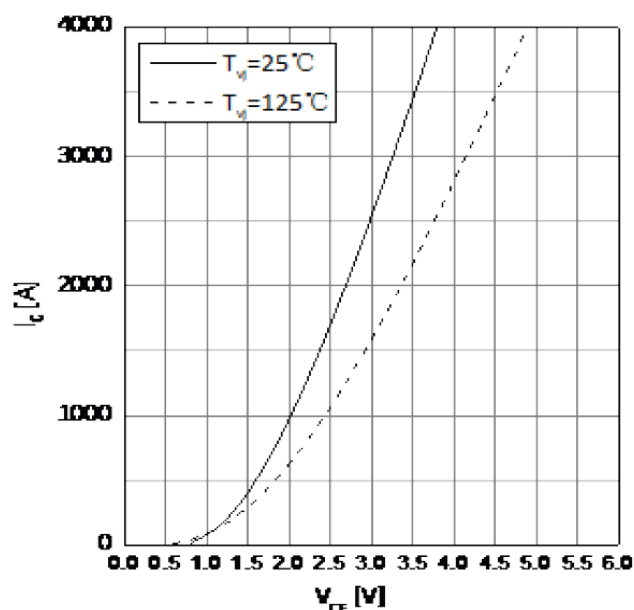
Equivalent Circuit Schematic

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Absolute Maximum Ratings							
Symbol	Characteristic		Value			Unit	
V _{CES}	Collector-Emitter Voltage		4500			V	
I _{CDC}	Continuous DC Collector Current (T _c =100°C, T _j =125°C)		2000			A	
I _{CRM}	Peak Collector Current (tp=1ms)		4000			A	
V _{GES}	Gate-Emitter Voltage		±20			V	
P _{tot}	Total Power Dissipation (T _c =25°C, T _j =125°C)		20800			W	
IGBT Characteristics							
Symbol	Characteristic	Conditions	Value			Unit	
			Min.	Typ.	Max.		
BV _{CES}	Collector-Emitter breakdown Voltage	V _{GE} =0V, I _C =10mA, T _{vj} =25°C	4500			V	
V _{CE(sat)}	Collector-Emitter Saturation Voltage	I _C =2000A, V _{GE} =15V, T _{vj} =25°C		2.70	3.05	V	
		I _C =2000A, V _{GE} =15V, T _{vj} =125°C		3.35	3.85	V	
V _{GE(th)}	Gate-emitter Threshold Voltage	V _{GE} =V _{CE} , I _C =320mA, T _{vj} =25°C	6.7		7.7	V	
I _{CES}	Collector-Emitter leakage Current	V _{CE} =4500V, V _{GE} =0V, T _{vj} =25°C			1	mA	
		V _{CE} =4500V, V _{GE} =0V, T _{vj} =125°C		15	100	mA	
I _{GES}	Gate-Emitter leakage Current	V _{CE} =0V, V _{GE} =±20V, T _{vj} =125°C	-500		500	ηA	
Q _G	Gate Charge	V _{GE} =±15V, T _{vj} =25°C		10		μC	
C _{ies}	Input Capacitance	V _{CE} =25V, V _{GE} =0V, f=500KHz, T _{vj} =25°C		213		ηF	
C _{oes}	Output Capacitance			15.3		ηF	
C _{res}	Reverse Transfer Capacitance			4.7		ηF	
t _{d(on)}	Turn-on Delay Time	I _C =2000A V _{CE} = 2800 V V _{GE} = ±15V R _{Gon} = 1.8Ω R _{Goff} = 8.2Ω C _{ge} =330nF L _S =140nH Inductive Load	T _{vj} =25°C		1100	ηs	
			T _{vj} =125°C		900		
t _r	Rise Time		T _{vj} =25°C		400	ηs	
			T _{vj} =125°C		450		
t _{d(off)}	Turn-off Delay Time		T _{vj} =25°C		3800	ηs	
			T _{vj} =125°C		4100		
t _f	Fall Time		T _{vj} =25°C		1200	ηs	
			T _{vj} =125°C		1400		
E _{on}	Energy Dissipation During Turn-on Time		T _{vj} =25°C		14240	mJ	
			T _{vj} =125°C		15730		
E _{off}	Energy Dissipation During Turn-off Time		T _{vj} =25°C		6960	mJ	
			T _{vj} =125°C		8180		
I _{SC}	SC Data	t _{sc} ≤10μs, V _{GE} ≤15V, T _{vj} =125°C, V _{cc} ≤3400V		8400		kA	
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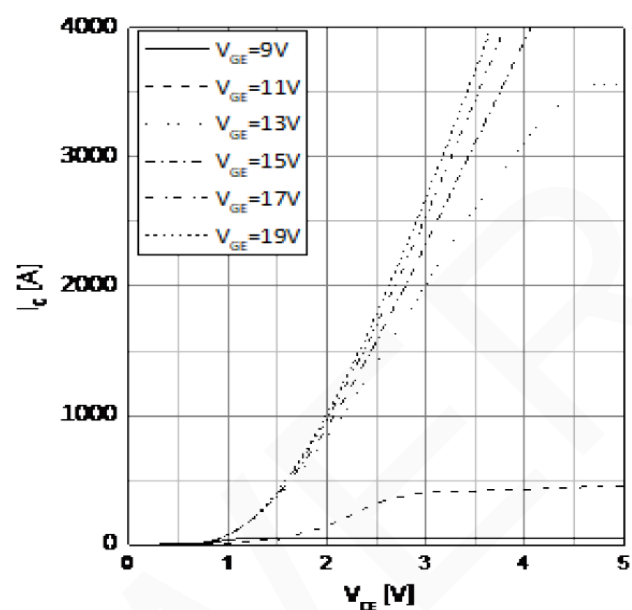
Diode Characteristics							
Symbol	Characteristic	Conditions		Value			Unit
				Min.	Typ.	Max.	
I _F	Diode DC Forward Current				2000		A
I _{FRM}	Diode Peak Forward Current	tp=1ms			4000		A
V _F	Forward Voltage	I _F =2000A,T _{Vj} =25°C			2.60		V
		I _F =2000A,T _{Vj} =125°C			2.85		V
I _{rr}	Peak Reverse Recovery Current	I _F =2000A V _R =2800V Inductive Load	T _{Vj} =25°C		1620		A
			T _{Vj} =125°C		1970		
Q _{rr}	Recovered Charge		T _{Vj} =25°C		1750		μC
			T _{Vj} =125°C		2700		
t _{rr}	Reverse Recovery time		T _{Vj} =25°C		4.0		ns
			T _{Vj} =125°C		5.1		
E _{rec}	Reverse Recovery Energy		T _{Vj} =25°C		2350		J
			T _{Vj} =125°C		3860		
Module Characteristics							
Symbol	Characteristic	Conditions		Value			Unit
				Min.	Typ.	Max.	
T _{jmax}	Maximum Junction Temperature					125	°C
T _{Vj op}	Operating Junction Temperature			-40		125	°C
T _{stg}	Storage Temperature			-40		70	°C
R _{θjc}	Junction-to Case	per IGBT-inverter				0.0048	°C/W
		per Diode-inverter				0.0091	°C/W
R _{θcs}	Case to Sink	per IGBT-inverter			0.0011		°C/W
		per Diode-inverter			0.0023		°C/W
F _m	Mounting Torque			60		75	kN
G	Weight of Module				3440		g
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Typical output characteristics,chip level



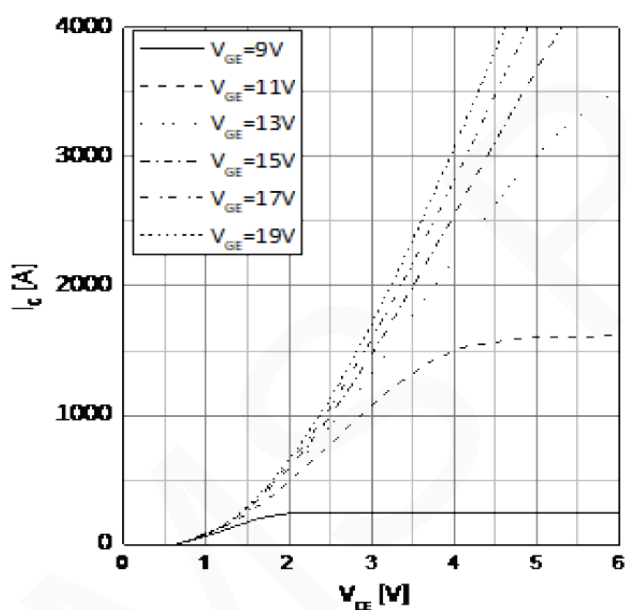
Typical output characteristics,chip level

$$I_C = f(V_{CE}), T_{vj}=25^\circ\text{C}$$



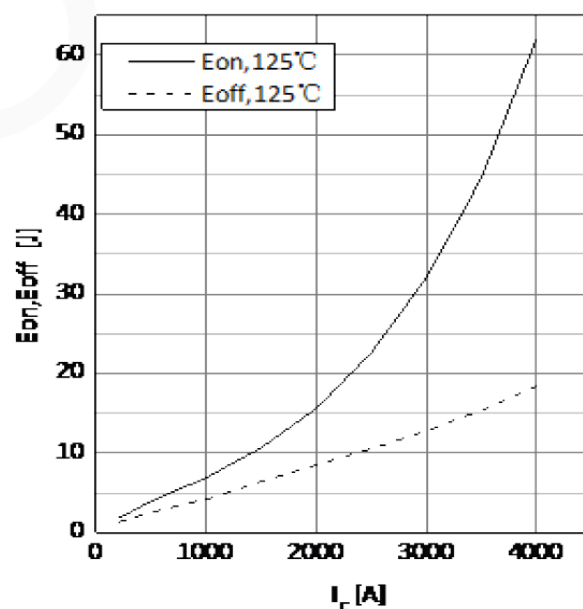
Typical output characteristics,chip level

$$I_C = f(V_{CE}), T_{vj}=125^\circ\text{C}$$



Switching losses IGBT

$$E = f(I_C), V_{GE} = \pm 15\text{V}, R_{Gon} = 1.8\Omega, R_{Goff} = 8.2\Omega, C_{ge} = 330\text{nF}, V_{CE} = 2800\text{V}$$



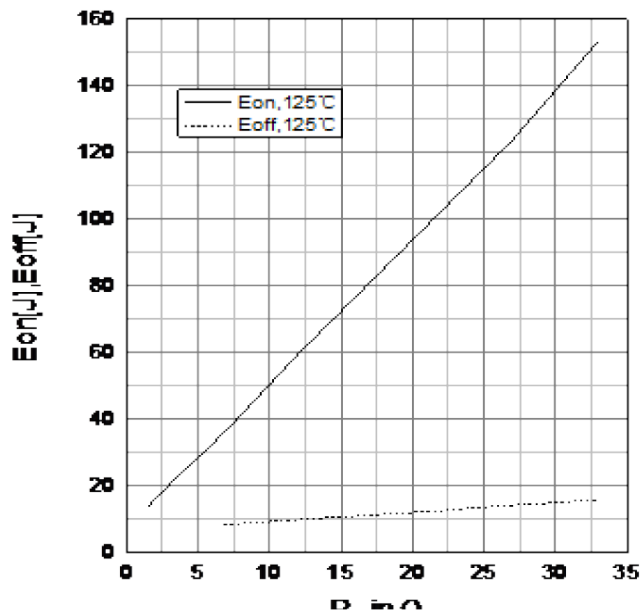
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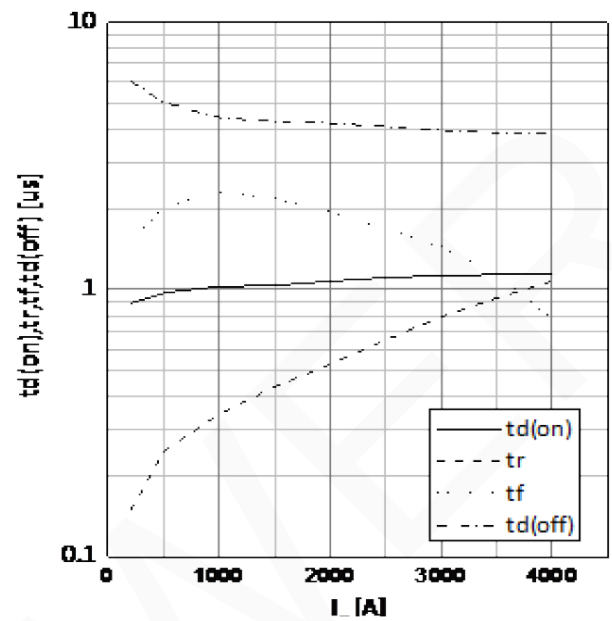
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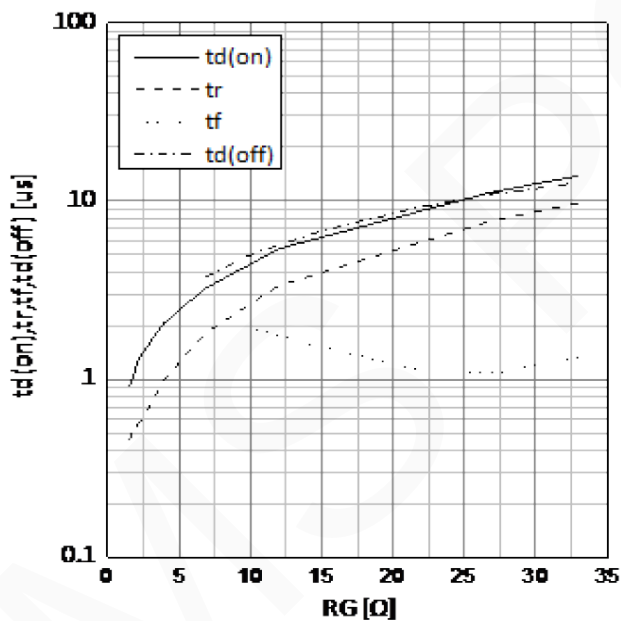
Switching losses IGBT
 $V_{GE} = \pm 15V$,
 $I_C = 2000A$, $C_{ge} = 330nF$, $V_{CE} = 2800V$



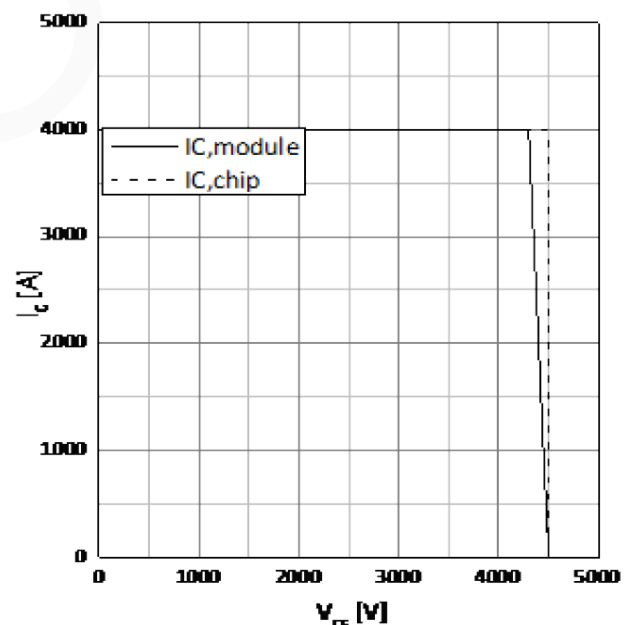
Typical switching time per pulse vs. collector current



Typical switching time per pulse vs. gate resistor



Turn-off safe operating area (RBSOA)
 $V_{GE} = \pm 15V$, $R_{Goff} = 8.2\Omega$, $T_j = 125^\circ C$



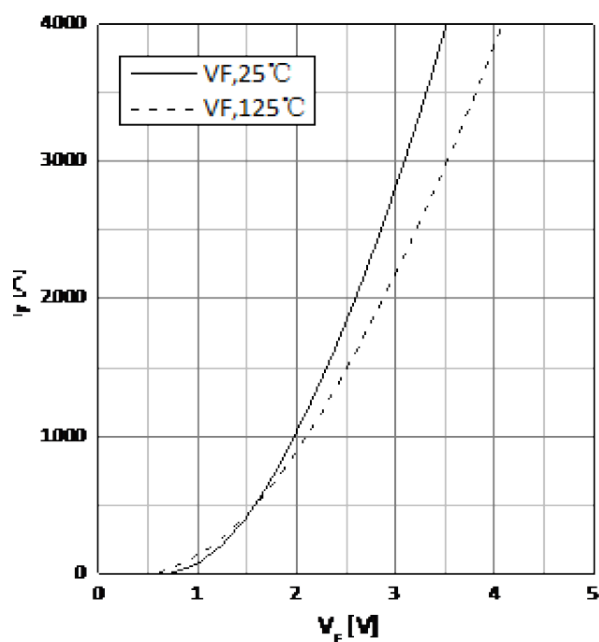
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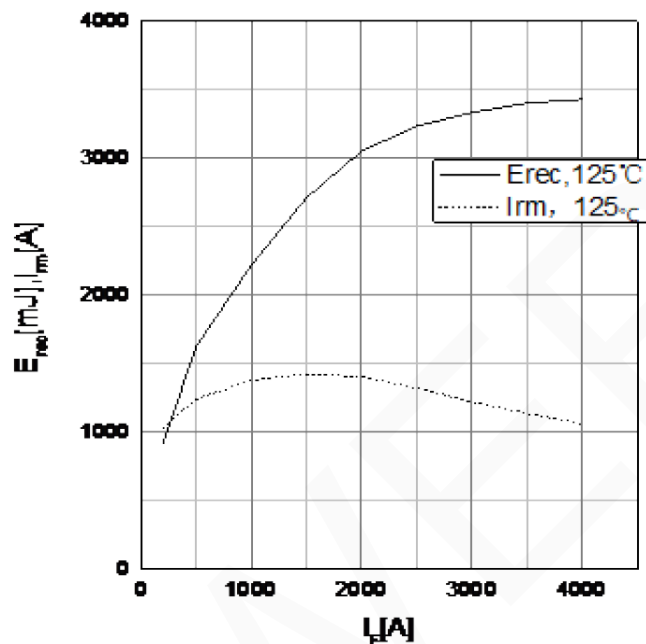
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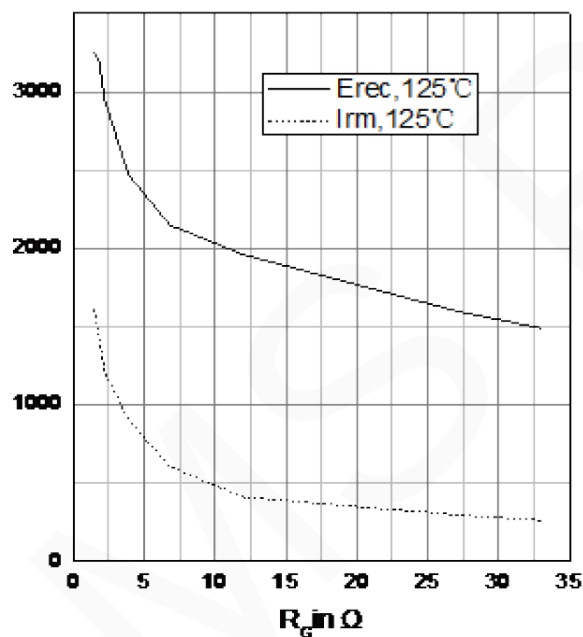
Typical diode forward characteristic, chip level



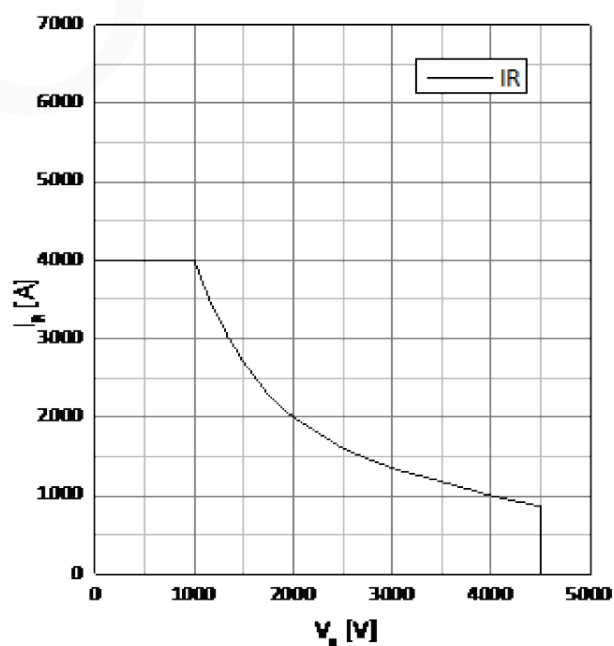
Typical reverse recovery characteristics vs. forward current



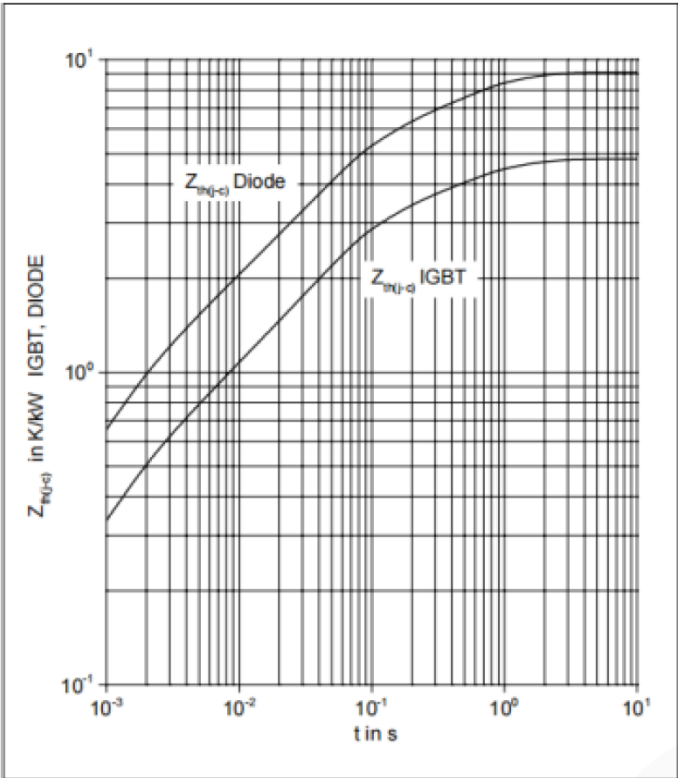
Typical switching energies per pulse vs. gate resistor



safe operating area diode (RRSOA)



Transient thermal impedance
ZthJC = f (t)

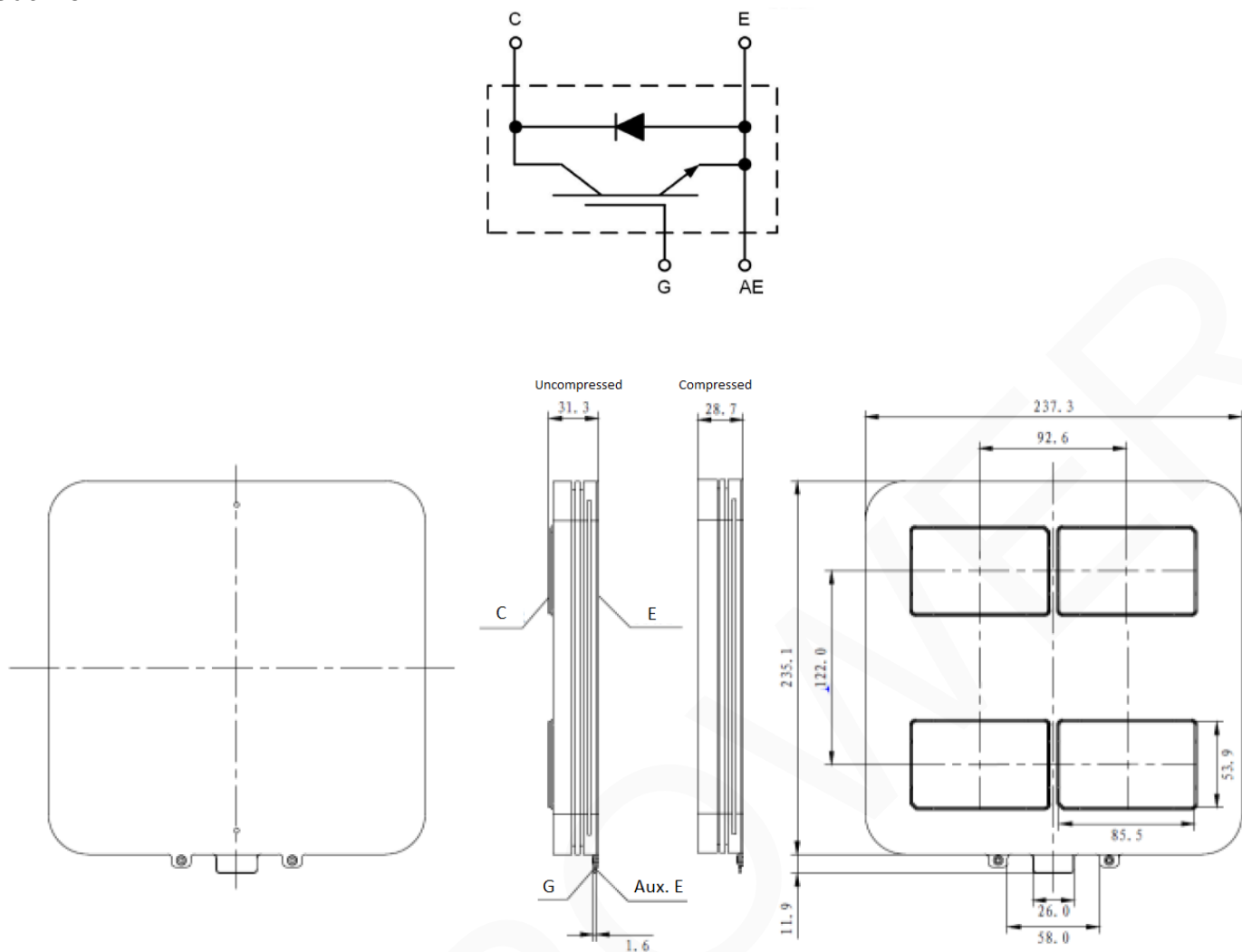


Analytical function for transient thermal impedance:

$$Z_{th(j-c)}(t) = \sum_{i=1}^n R_i (1 - e^{-t/\tau_i})$$

IGBT	i	1	2	3	4	5
	R _i in K/kW	1.801	2.234	0.403	0.369	
DIODE	τ _i in s	0.581	0.059	0.006	0.001	
	R _i in K/kW	3.614	3.958	0.803	0.727	
	τ _i in s	0.584	0.059	0.006	0.001	

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