



SEMITRANS® 10

IGBT4 Modules

SKM1200MLI12TE4

Features*

- High efficient MLI topology
- Symmetrical current sharing
- Low-inductive module design
- High mechanical robustness
- UL recognized, file no. E63532

Typical Applications

- 1500V Solar inverters

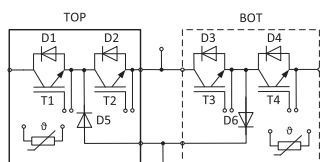
Remarks*

- TOP-Switch
- Recommended $T_{jop} = -40 \dots 150^\circ\text{C}$
- IGBT1 : outer IGBTs T1 & T4
- IGBT2 : inner IGBTs T2 & T3
- Diode1 : outer diodes D1 & D4
- Diode2 : inner diodes D2 & D3
- Diode5 : clamping diodes D5 & D6

Footnotes

¹⁾Please find further technical information on the SEMIKRON website.

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT1				
V _{CES}	T _J = 25 °C		1200	V
I _C	T _J = 175 °C	T _c = 25 °C	2078	A
		T _c = 100 °C	1383	A
I _{Cnom}			1200	A
I _{CRM}			2400	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V, V _{GE} ≤ 15 V, T _J = 150 °C, V _{CES} ≤ 1200 V		10	µs
T _J			-40 ... 175	°C
IGBT2				
V _{CES}	T _J = 25 °C		1200	V
I _C	T _J = 175 °C	T _c = 25 °C	2078	A
		T _c = 100 °C	1383	A
I _{Cnom}			1200	A
I _{CRM}			2400	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V, V _{GE} ≤ 15 V, T _J = 150 °C, V _{CES} ≤ 1200 V		10	µs
T _J			-40 ... 175	°C
Diode1				
V _{RRM}	T _J = 25 °C		1200	V
I _F	T _J = 175 °C	T _c = 25 °C	1057	A
		T _c = 100 °C	676	A
I _{FRM}			1800	A
I _{FSM}	t _p = 10 ms, sin 180°, T _J = 25 °C		4128	A
T _J			-40 ... 175	°C
Diode2				
V _{RRM}	T _J = 25 °C		1200	V
I _F	T _J = 175 °C	T _c = 25 °C	1057	A
		T _c = 100 °C	676	A
I _{FRM}			1800	A
I _{FSM}	t _p = 10 ms, sin 180°, T _J = 25 °C		4128	A
T _J			-40 ... 175	°C
Diode5				
V _{RRM}	T _J = 25 °C		1200	V
I _F	T _J = 175 °C	T _c = 25 °C	1328	A
		T _c = 100 °C	848	A
I _{FRM}			2400	A
I _{FSM}	t _p = 10 ms, sin 180°, T _J = 25 °C		5280	A
T _J			-40 ... 175	°C
Module				
T _{stg}	module without TIM		-40 ... 150	°C
V _{isol}	AC sinus 50 Hz, t = 1 min		4000	V



MLI TOP-Switch



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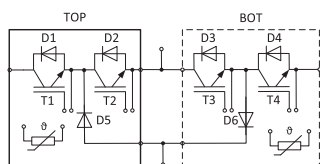
Remarks*

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- IGBT1 : outer IGBTs T1 & T4
- IGBT2 : inner IGBTs T2 & T3
- Diode1 : outer diodes D1 & D4
- Diode2 : inner diodes D2 & D3
- Diode5 : clamping diodes D5 & D6

Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
V _{CE(sat)}	I _C = 1200 A	T _j = 25 °C		1.80	2.05	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.05	2.30	V
V _{CE0}	chiplevel	T _j = 25 °C		0.87	1.01	V
		T _j = 150 °C		0.77	0.90	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		0.78	0.87	mΩ
	chiplevel	T _j = 150 °C		1.07	1.17	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 44.4 mA		5.1	5.8	6.3	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				5	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		75.0		nF
C _{oes}		f = 1 MHz		7		nF
C _{res}		f = 1 MHz		4.08		nF
Q _G	V _{GE} = - 8 V...+ 15 V			6900		nC
R _{Gint}	T _j = 25 °C			0.9		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		249		ns
t _r	I _C = 1200 A	T _j = 150 °C		83		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		108		mJ
	R _{G on} = 1 Ω	T _j = 150 °C				
t _{d(off)}	R _{G off} = 2 Ω	T _j = 150 °C		887		ns
t _f	di/dt _{on} = 15500 A/μs	T _j = 150 °C		130		ns
E _{off}	di/dt _{off} = 7500 A/μs dv/dt = 3300 V/μs	T _j = 150 °C		189		mJ
R _{th(j-c)}	per IGBT				0.021	K/W
R _{th(c-s)}	per IGBT (λgrease= 0.81 W/(m*K))			0.0137		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			-		K/W
IGBT2						
V _{CE(sat)}	I _C = 1200 A	T _j = 25 °C		1.80	2.05	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.05	2.30	V
V _{CE0}	chiplevel	T _j = 25 °C		0.87	1.01	V
		T _j = 150 °C		0.77	0.90	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		0.78	0.87	mΩ
	chiplevel	T _j = 150 °C		1.07	1.17	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 44.4 mA		5.1	5.8	6.3	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				5	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		75.0		nF
C _{oes}		f = 1 MHz		7		nF
C _{res}		f = 1 MHz		4.08		nF
Q _G	V _{GE} = - 8 V...+ 15 V			6900		nC
R _{Gint}	T _j = 25 °C			0.9		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		422		ns
t _r	I _C = 1200 A	T _j = 150 °C		162		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		101		mJ
	R _{G on} = 1 Ω	T _j = 150 °C				
t _{d(off)}	R _{G off} = 5.1 Ω	T _j = 150 °C		1544		ns
t _f	di/dt _{on} = 6400 A/μs	T _j = 150 °C		155		ns
	di/dt _{off} = 7600 A/μs					
E _{off}	dv/dt = 2000 V/μs	T _j = 150 °C		238		mJ
R _{th(j-c)}	per IGBT				0.021	K/W
R _{th(c-s)}	per IGBT (λgrease= 0.81 W/(m*K))			0.0137		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			-		K/W



MLI TOP-Switch

SKM1200MLI12TE4



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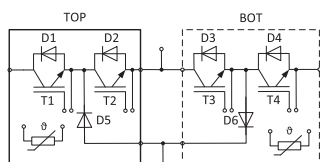
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
V _F = V _{EC}	I _F = 1200 A	T _j = 25 °C		2.46	2.82	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.51	2.86	V
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
r _F	chiplevel	T _j = 25 °C		0.97	1.10	mΩ
		T _j = 150 °C		1.34	1.47	mΩ
I _{RRM}	I _F = 1200 A	T _j = 150 °C		595		A
Q _{rr}	di/dt _{off} = 6400 A/μs	T _j = 150 °C		127		μC
E _{rr}	V _{CC} = 600 V V _{GE} = +15/-15 V	T _j = 150 °C		76		mJ
R _{th(j-c)}	per diode			0.057		K/W
R _{th(c-s)}	per Diode (λgrease= 0.81 W/(m*K))			0.0178		K/W
R _{th(c-s)}	per Diode, pre-applied phase change material			-		K/W
Diode2						
V _F = V _{EC}	I _F = 1200 A	T _j = 25 °C		2.46	2.82	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.51	2.86	V
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
r _F	chiplevel	T _j = 25 °C		0.97	1.10	mΩ
		T _j = 150 °C		1.34	1.47	mΩ
I _{RRM}	I _F = 1200 A	T _j = 150 °C		595		A
Q _{rr}	di/dt _{off} = 6400 A/μs	T _j = 150 °C		127		μC
E _{rr} 1)	V _R = 600 V V _{GE} = +15/-15 V	T _j = 150 °C		-		mJ
R _{th(j-c)}	per diode			0.057		K/W
R _{th(c-s)}	per Diode (λgrease= 0.81 W/(m*K))			0.0178		K/W
R _{th(c-s)}	per Diode, pre-applied phase change material			-		K/W
Diode5						
V _F = V _{EC}	I _F = 1200 A	T _j = 25 °C		2.20	2.52	V
	chiplevel	T _j = 150 °C		2.15	2.47	V
V _{F0}		T _j = 25 °C		1.30	1.50	V
	chiplevel	T _j = 150 °C		0.90	1.10	V
r _F		T _j = 25 °C		0.75	0.85	mΩ
	chiplevel	T _j = 150 °C		1.04	1.14	mΩ
I _{RRM}		T _j = 150 °C		1022		A
Q _{rr}	di/dt _{off} = 15500 A/μs	T _j = 150 °C		194		μC
E _{rr}	V _R = 600 V V _{GE} = +15/-15 V	T _j = 150 °C		96		mJ
R _{th(j-c)}	per diode			0.046		K/W
R _{th(c-s)}	per Diode (λgrease= 0.81 W/(m*K))			0.0164		K/W
R _{th(c-s)}	per Diode, pre-applied phase change material			-		K/W



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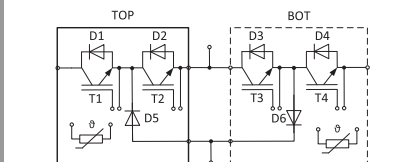
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Module						
L _{sCE1}				10		nH
L _{sCE2}				50		nH
R _{CC'+EE'}	measured per switch	T _C = 25 °C		0.1		mΩ
		T _C = 125 °C		0.15		mΩ
R _{th(c-s)1}	calculated without thermal coupling (λ _{grease} =0.81 W/(m*K))			0.0031		K/W
R _{th(c-s)2}	including thermal coupling, T _s underneath module (λ _{grease} =0.81 W/(m*K))			0.005		K/W
R _{th(c-s)2}	including thermal coupling, T _s underneath module, pre-applied phase change material			-		K/W
M _s	to heat sink M5		4		6	Nm
M _t		to terminals M8	8		10	Nm
		to terminals M4	1.8		2.1	Nm
w					1250	g
Temperature Sensor						
R ₁₀₀	T _C =100°C (R ₂₅ =5 kΩ)			493 ± 5%		Ω
B _{100/125}	R(T)=R ₁₀₀ exp[B _{100/125} (1/T-1/T ₁₀₀)]; T[K];			3550 ±2%		K



MLI TOP-Switch

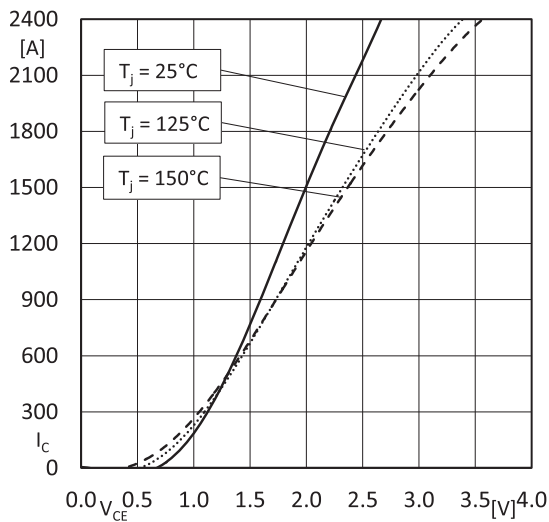


Fig. 1: Typ. IGBT1 output characteristics $I_C=f(V_{CE})$, $V_{GE}=15V$ (chipelevel)

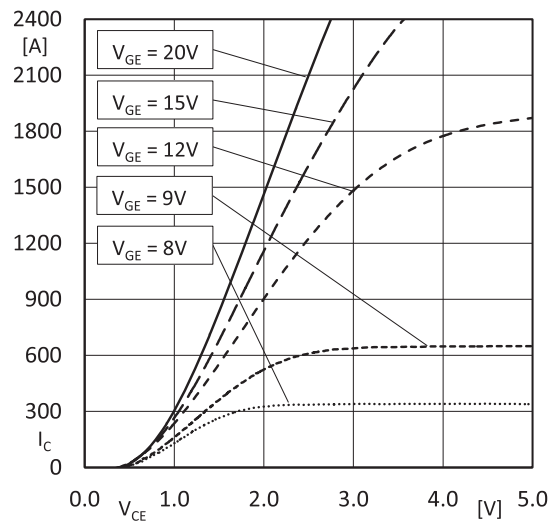


Fig. 2: Typ. IGBT1 output characteristics $I_C=f(V_{CE})$, $T_j=150^\circ C$ (chipelevel)

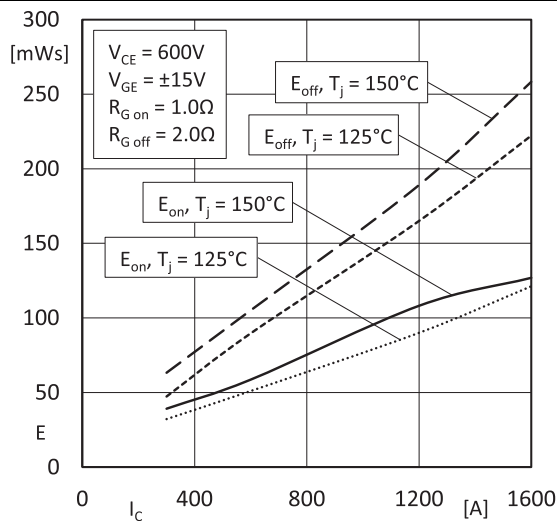


Fig. 3: Typ. IGBT1 switching losses $E=f(I_C)$

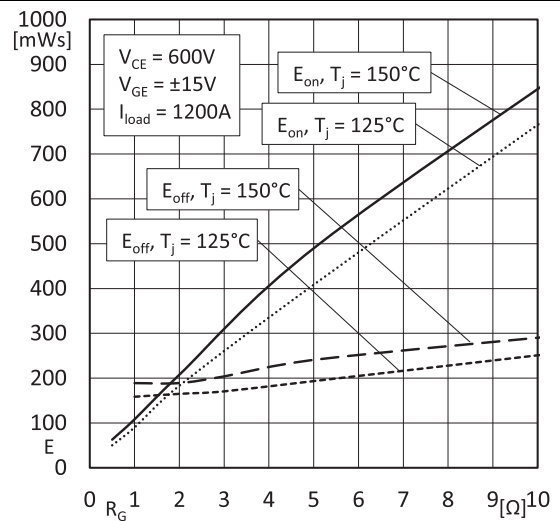


Fig. 4: Typ. IGBT1 switching losses $E=f(R_G)$

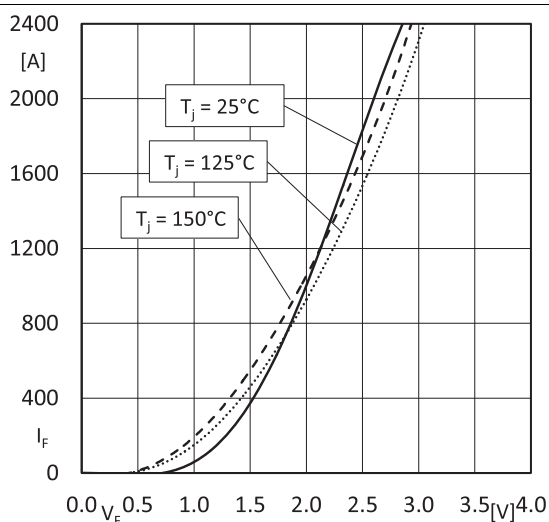


Fig. 5: Typ. Diode5 forward characteristics $I_F=f(V_F)$ (chipelevel)

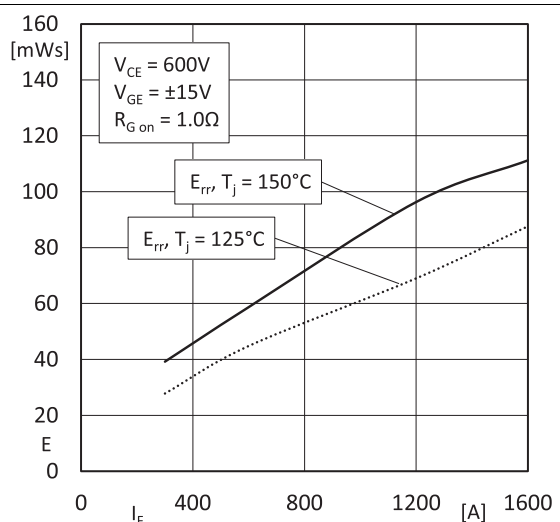


Fig. 6: Typ. Diode5 switching losses $E=f(I_F)$

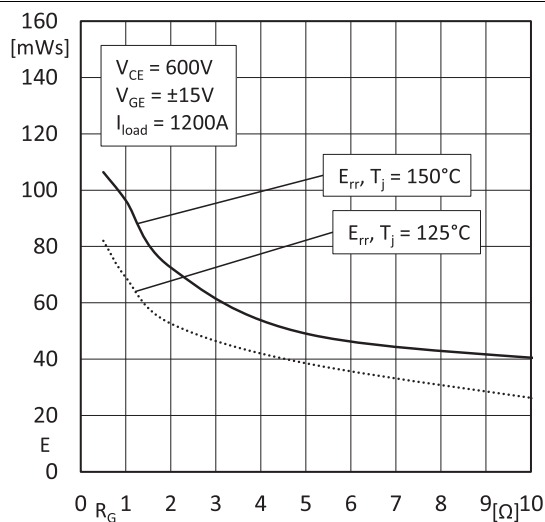


Fig. 7: Typ. Diode5 switching losses $E=f(R_G)$

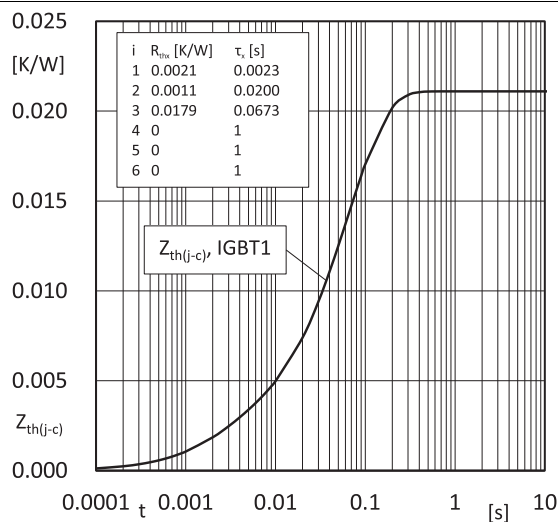


Fig. 8: IGBT1 transient thermal impedance

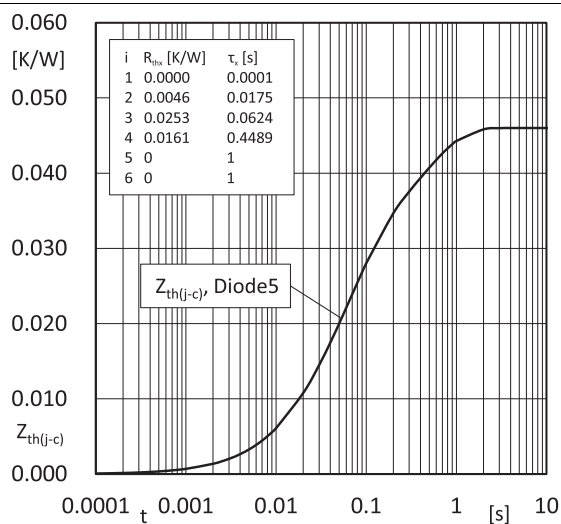


Fig. 9: Diode5 transient thermal impedance

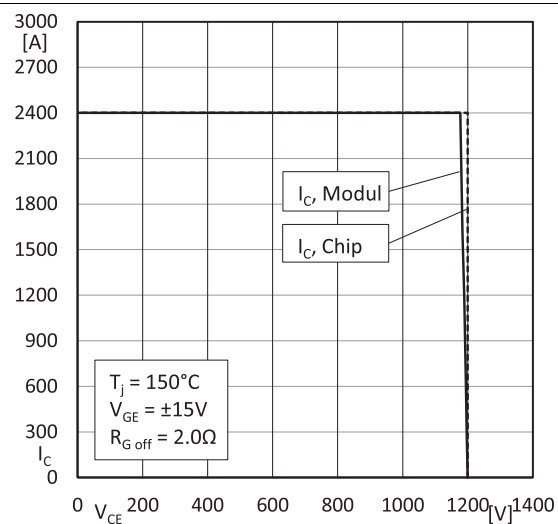


Fig. 10: RBSOA IGBT1

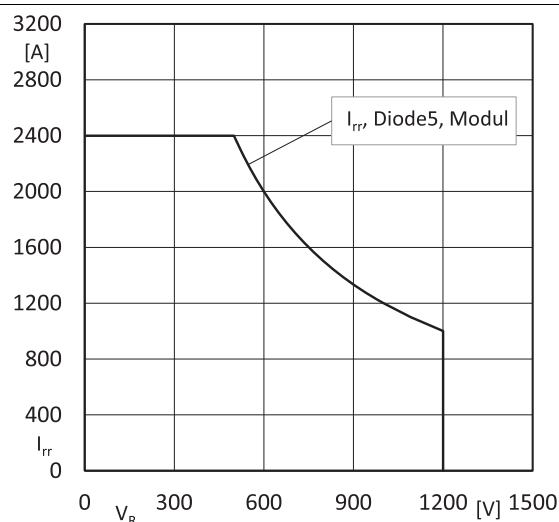


Fig. 11: RBSOA Diode5

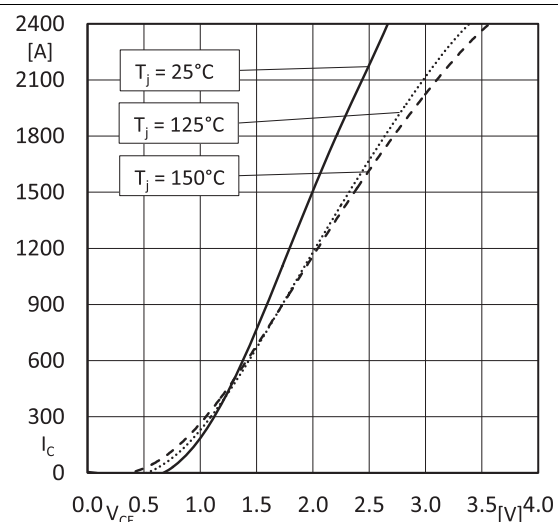


Fig. 12: Typ. IGBT2 output characteristics $I_C=f(V_{CE})$, $V_{GE}=15V$ (chipelevel)

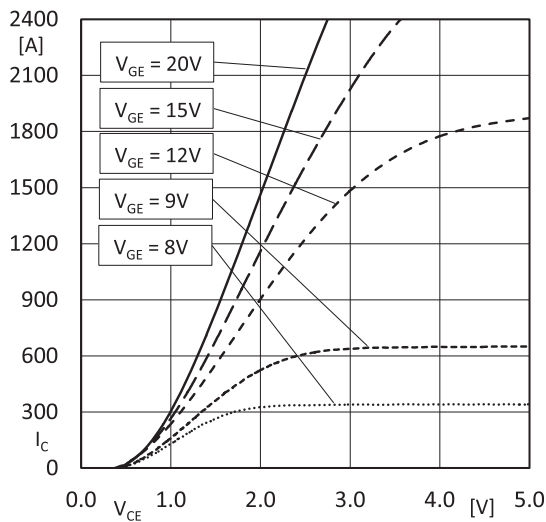


Fig. 13: Typ. IGBT2 output characteristics $I_C=f(V_{CE})$, $T_J=150^\circ\text{C}$ (chipelevel)

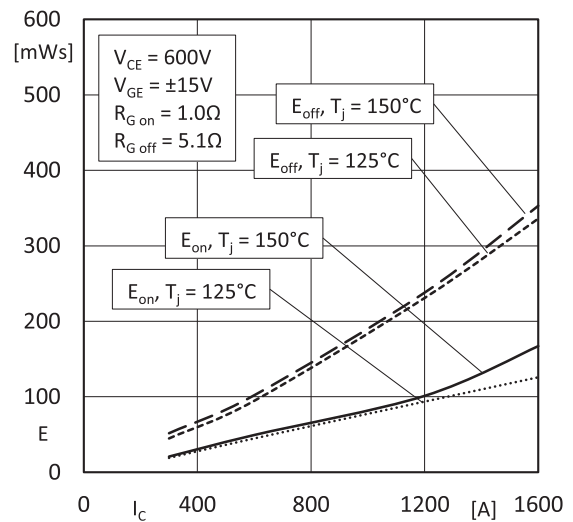


Fig. 14: Typ. IGBT2 switching losses $E=f(I_C)$

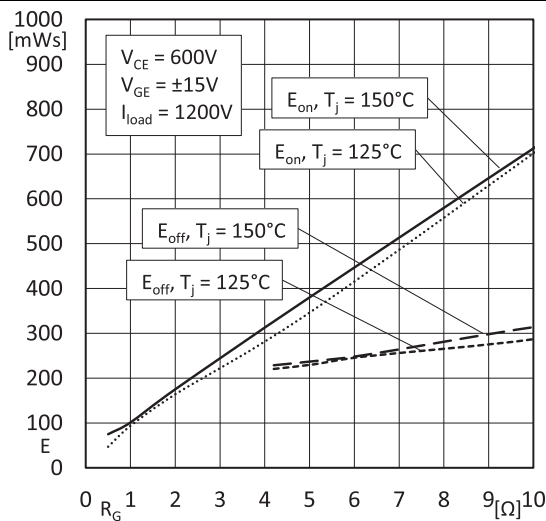


Fig. 15: Typ. IGBT2 switching losses $E=f(R_G)$

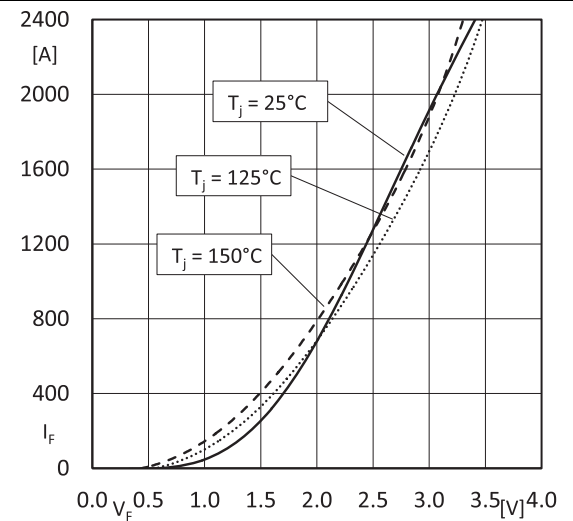


Fig. 16: Typ. Diode1 forward characteristics $I_F=f(V_F)$ (chipelevel)

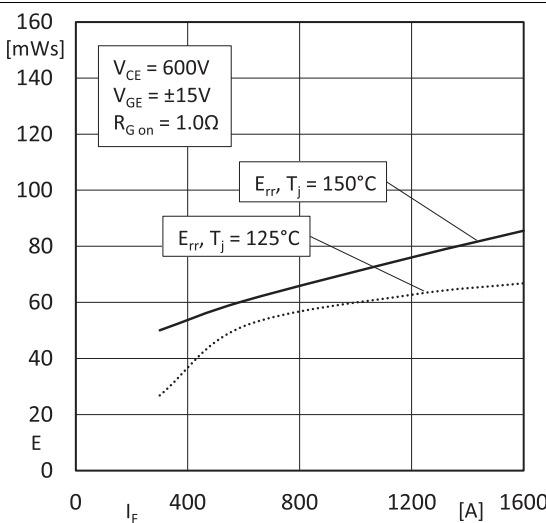


Fig. 17: Typ. Diode1 switching losses $E=f(I_F)$

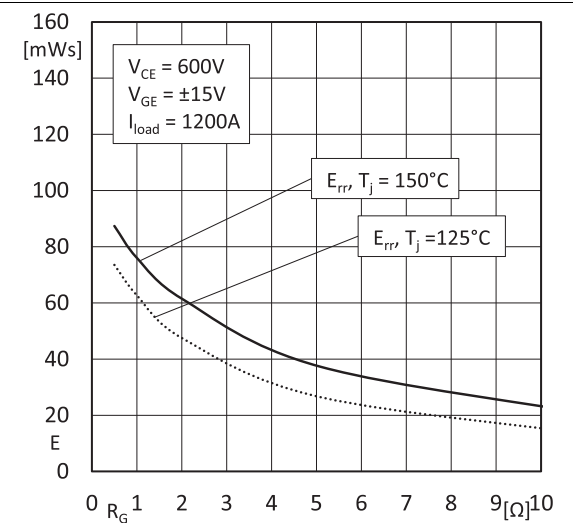


Fig. 18: Typ. Diode1 switching losses $E=f(R_G)$

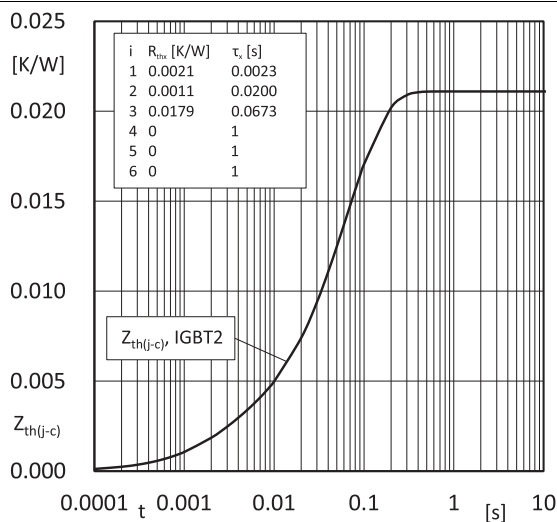


Fig. 19: IGBT2 transient thermal impedance

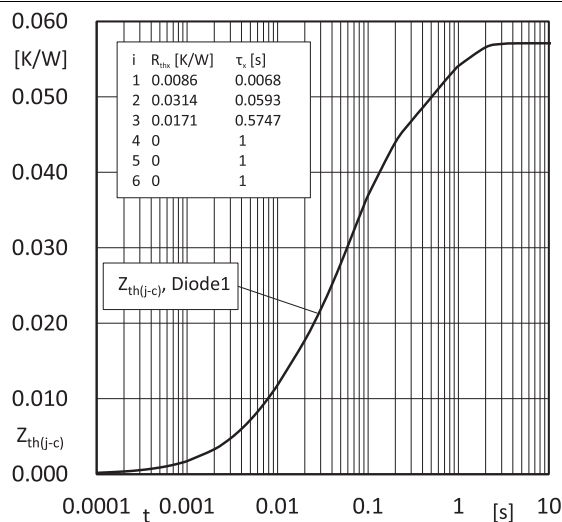


Fig. 20: Diode1 transient thermal impedance

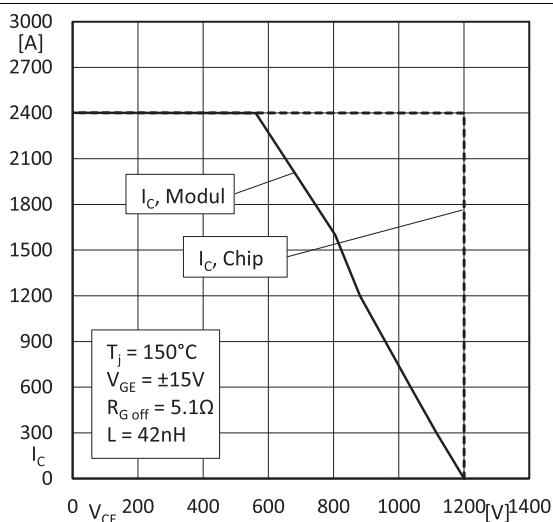


Fig. 21: RBSOA IGBT2

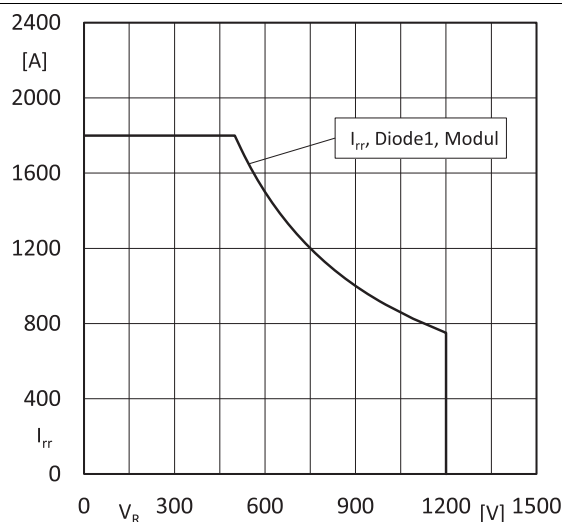


Fig. 22: RBSOA Diode1

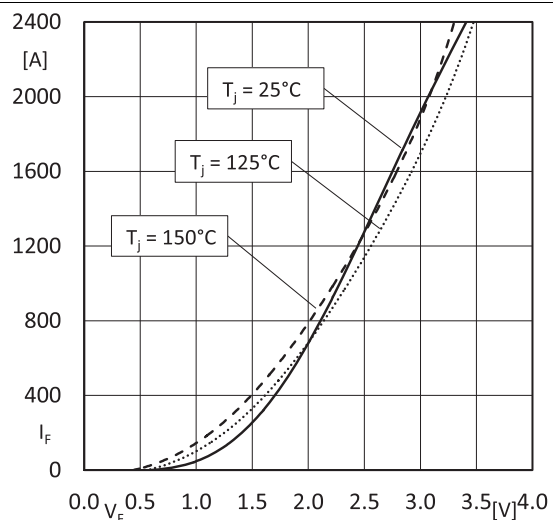


Fig. 23: Typ. Diode2 forward characteristics $I_F=f(V_F)$ (chiplevel)

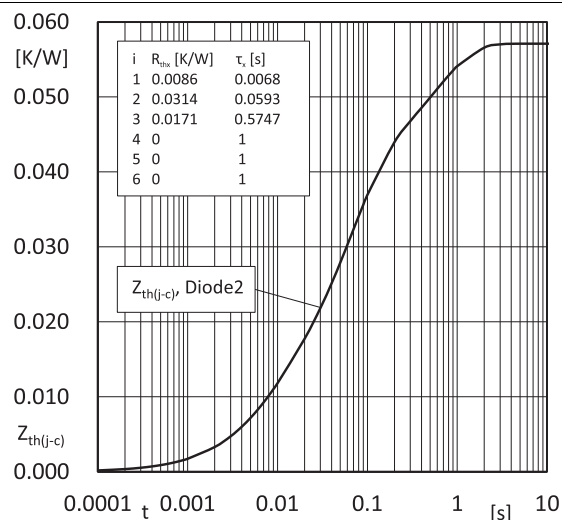


Fig. 24: Diode2 transient thermal impedance

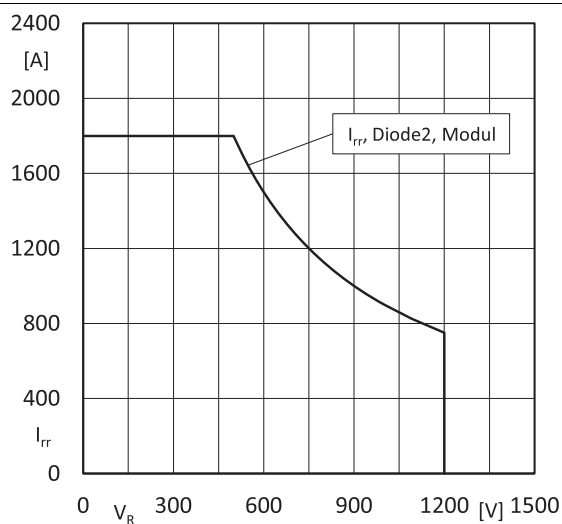


Fig. 25: RBSOA Diode2

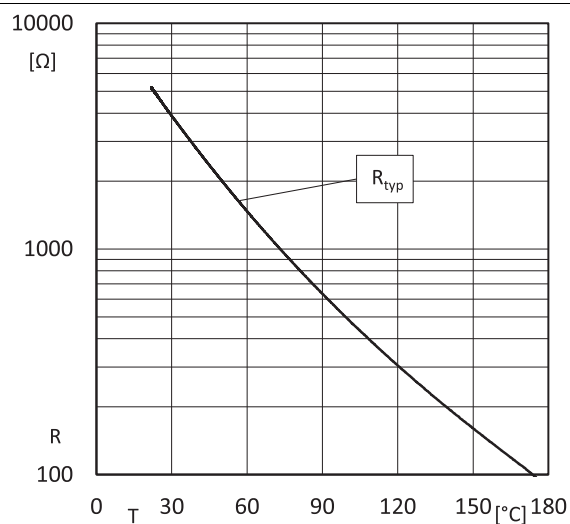
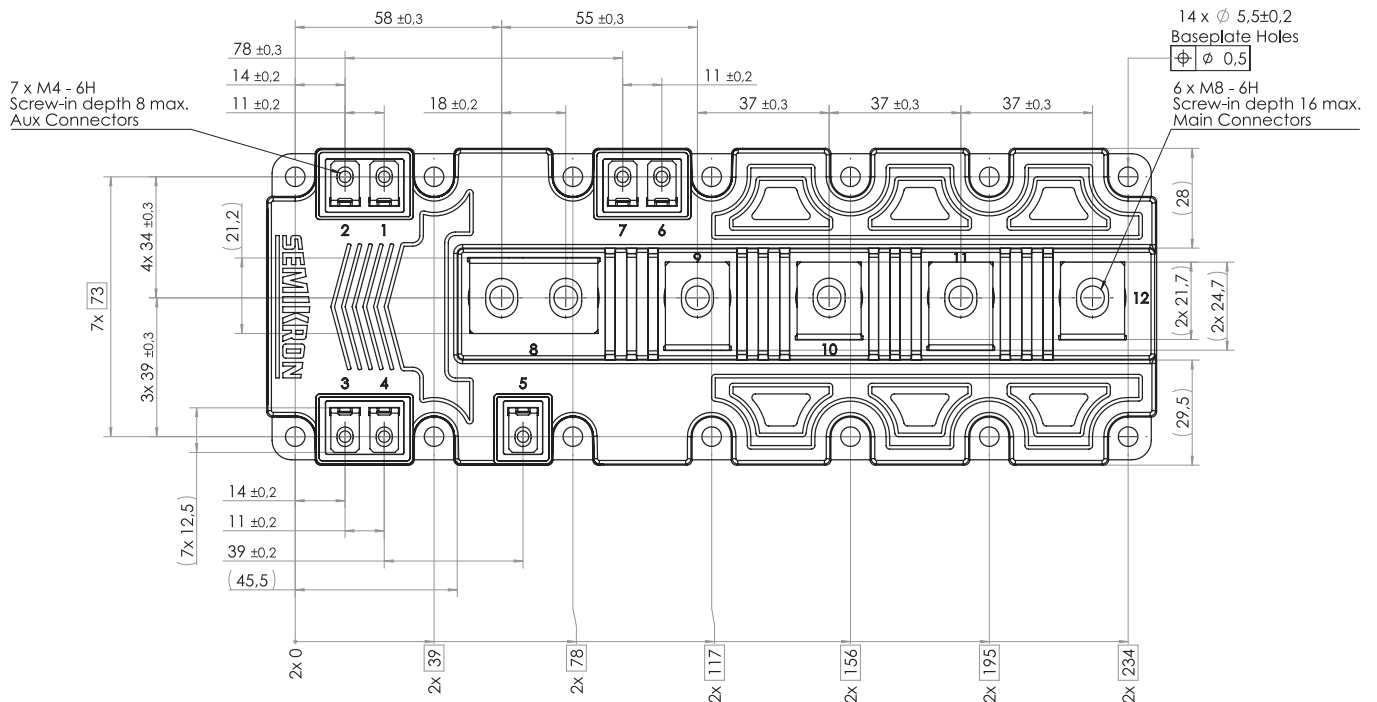
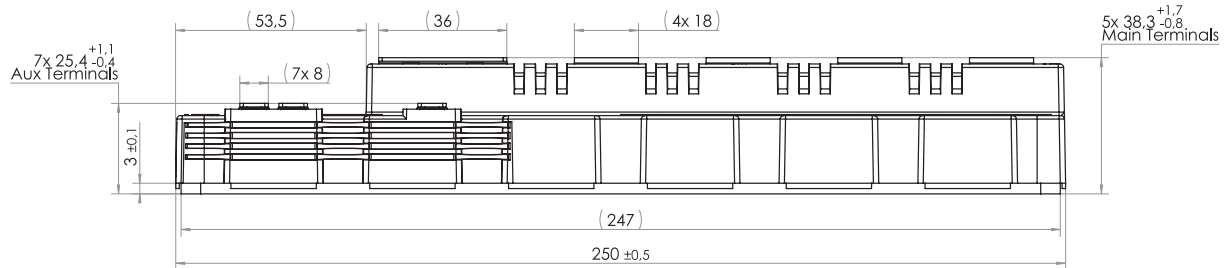
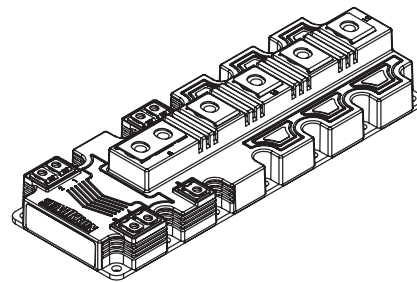
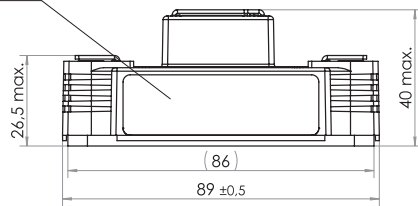


Fig. 26: Typ. NTC characteristics

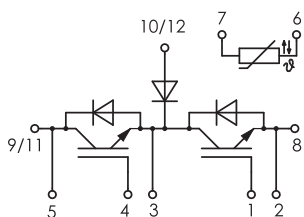
SKM1200MLI12TE4

Module label



- Dimensions in mm
- General tolerances ± 0.5 mm

SEMITRANS 10



TOP MLI

This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

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