

SKM1400MLI12TM7



SEMITRANS® 10

IGBT M7 Modules

SKM1400MLI12TM7

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

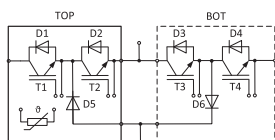
Remarks*

- TOP-Switch
- Recommended $T_{jop} = -40 \dots 150^\circ\text{C}$
- $I_{DC} \leq 1000\text{A}$ for $T_{Terminal} = 100^\circ\text{C}$
- 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	1770	A
		T _c = 100 °C	1163	A
I _{Cnom}			1400	A
I _{CRM}			2800	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V, V _{GE} ≤ 15 V, T _j = 25 °C, V _{CES} ≤ 1200 V		8	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	1770	A
		T _c = 100 °C	1163	A
I _{Cnom}			1400	A
I _{CRM}			2800	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V, V _{GE} ≤ 15 V, T _j = 25 °C, V _{CES} ≤ 1200 V		8	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	1831	A
		T _c = 100 °C	1171	A
I _{FRM}			2800	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 25 °C		7296	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	1831	A
		T _c = 100 °C	1171	A
I _{FRM}			2800	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 25 °C		7296	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	1831	A
		T _c = 100 °C	1171	A
I _{FRM}			2800	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 25 °C		7296	A
T _j			-40 ... 175	°C
Module				
I _{t(RMS)}			1000	A
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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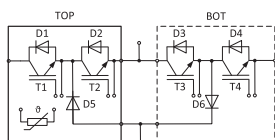
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Footnotes

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MLI TOP-Switch

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
V _{CE(sat)}	I _C = 1400 A	T _j = 25 °C		1.55	1.94	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		1.81	2.48	V
V _{CE0}	chiplevel	T _j = 25 °C		0.86	0.96	V
		T _j = 150 °C		0.75	0.93	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		0.49	0.70	mΩ
	chiplevel	T _j = 150 °C		0.76	1.11	mΩ
V _{GE(th)}	V _{CE} = 10 V, I _C = 138 mA		5.4	6	6.6	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				5	mA
C _{ies}	V _{CE} = 10 V V _{GE} = 0 V	f = 1 MHz		264.0		nF
C _{oes}		f = 1 MHz		8.29		nF
C _{res}		f = 1 MHz		3.24		nF
Q _G	V _{GE} = -15V ... +15V			12300		nC
R _{Gint}	T _j = 25 °C			0.5		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		486		ns
t _r	I _C = 1400 A	T _j = 150 °C		183		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		268		mJ
	R _{G on} = 1.2 Ω	T _j = 150 °C				
t _{d(off)}	R _{G off} = 1 Ω	T _j = 150 °C		684		ns
t _f	di/dt _{on} = 7800 A/μs	T _j = 150 °C		100		ns
	di/dt _{off} = 12400 A/μs	T _j = 150 °C				
E _{off}	dv/dt = 5000 V/μs			177		mJ
R _{th(j-c)}	per IGBT				0.028	K/W
R _{th(c-s)}	per IGBT (λgrease= 0.81 W/(m*K))			0.017		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			0.013		K/W
IGBT2						
V _{CE(sat)}	I _C = 1400 A	T _j = 25 °C		1.55	1.94	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		1.81	2.48	V
V _{CE0}	chiplevel	T _j = 25 °C		0.86	0.96	V
		T _j = 150 °C		0.75	0.93	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		0.49	0.70	mΩ
	chiplevel	T _j = 150 °C		0.75	1.11	mΩ
V _{GE(th)}	V _{CE} = 10 V, I _C = 138 mA		5.4	6	6.6	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				5	mA
C _{ies}	V _{CE} = 10 V V _{GE} = 0 V	f = 1 MHz		264.0		nF
C _{oes}		f = 1 MHz		8.29		nF
C _{res}		f = 1 MHz		3.24		nF
Q _G	V _{GE} = -15V ... +15V			12300		nC
R _{Gint}	T _j = 25 °C			0.5		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		509		ns
t _r	I _C = 1400 A	T _j = 150 °C		244		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		202		mJ
	R _{G on} = 1.4 Ω	T _j = 150 °C				
t _{d(off)}	R _{G off} = 5.1 Ω	T _j = 150 °C		1716		ns
t _f	di/dt _{on} = 6500 A/μs	T _j = 150 °C		194		ns
	di/dt _{off} = 7700 A/μs	T _j = 150 °C				
E _{off}	dv/dt = 2600 V/μs			287		mJ
R _{th(j-c)}	per IGBT				0.028	K/W
R _{th(c-s)}	per IGBT (λgrease= 0.81 W/(m*K))			0.017		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			0.013		K/W

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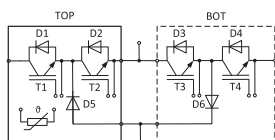
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- $I_{DC} \leq 1000\text{A}$ for $T_{Terminal} = 100^\circ\text{C}$
- IGBT1 : outer IGBTs T1 & T4
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
V _F = V _{EC}	I _F = 1400 A	T _j = 25 °C		2.07	2.38	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		1.97	2.28	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		0.55	0.63	mΩ
		T _j = 150 °C		0.77	0.84	mΩ
I _{RRM}	I _F = 1400 A	T _j = 150 °C		667		A
Q _{rr}	di/dt _{off} = 6500 A/μs	T _j = 150 °C		187		μC
E _{rr}	V _{CC} = 600 V V _{GE} = +15/-15 V	T _j = 150 °C		76		mJ
R _{th(j-c)}	per diode			0.033		K/W
R _{th(c-s)}	per Diode (λgrease= 0.81 W/(m*K))			0.0195		K/W
R _{th(c-s)}	per Diode, pre-applied phase change material			0.015		K/W
Diode2						
V _F = V _{EC}	I _F = 1400 A	T _j = 25 °C		2.07	2.38	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		1.97	2.28	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		0.55	0.63	mΩ
		T _j = 150 °C		0.77	0.84	mΩ
I _{RRM}	I _F = 1400 A	T _j = 150 °C		667		A
Q _{rr}	di/dt _{off} = 6500 A/μs	T _j = 150 °C		187		μC
E _{rr} 1)	V _{GE} = +15/-15 V	T _j = 150 °C		-		mJ
R _{th(j-c)}	per diode			0.033		K/W
R _{th(c-s)}	per Diode (λgrease= 0.81 W/(m*K))			0.0195		K/W
R _{th(c-s)}	per Diode, pre-applied phase change material			0.015		K/W
Diode5						
V _F = V _{EC}	I _F = 1400 A	T _j = 25 °C		2.07	2.38	V
	chiplevel	T _j = 150 °C		1.97	2.28	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		0.55	0.63	mΩ
	chiplevel	T _j = 150 °C		0.77	0.84	mΩ
I _{RRM}		I _F = 1400 A	T _j = 150 °C		632	A
Q _{rr}	di/dt _{off} = 7870 A/μs	T _j = 150 °C		185		μC
E _{rr}	V _R = 600 V V _{GE} = +15/-15 V	T _j = 150 °C		66		mJ
R _{th(j-c)}	per diode			0.033		K/W
R _{th(c-s)}	per Diode (λgrease= 0.81 W/(m*K))			0.0195		K/W
R _{th(c-s)}	per Diode, pre-applied phase change material			0.015		K/W



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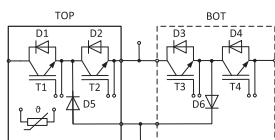
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Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Module						
L _{sCE1}				14		nH
L _{sCE2}				42		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))			0.0037		K/W
R _{th(c-s)2}	including thermal coupling, T _s underneath module (λ _{grease} =0.81 W/(m*K))			0.006		K/W
R _{th(c-s)2}	including thermal coupling, T _s underneath module, pre-applied phase change material			0.005		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

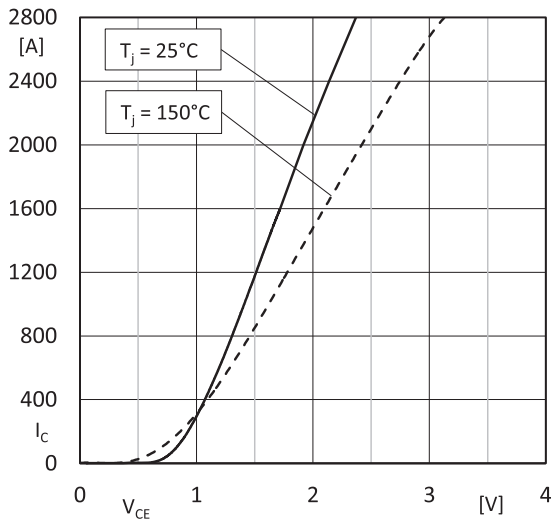


Fig. 1: Typ. IGBT1 output characteristics $I_C=f(V_{CE})$, $V_{GE}=15V$ (chipevel)

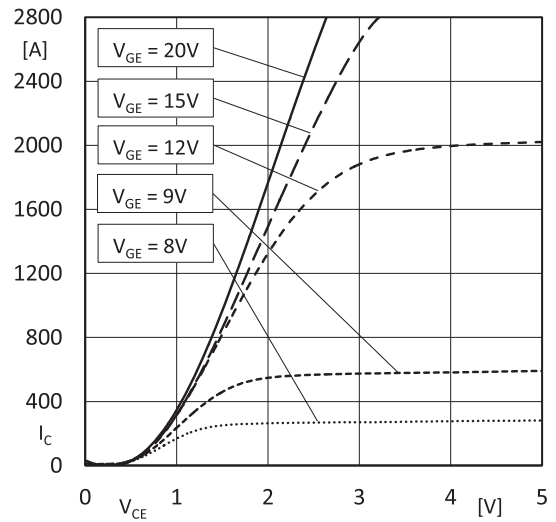


Fig. 2: Typ. IGBT1 output characteristics $I_C=f(V_{CE})$, $T_j=150^\circ C$ (chipevel)

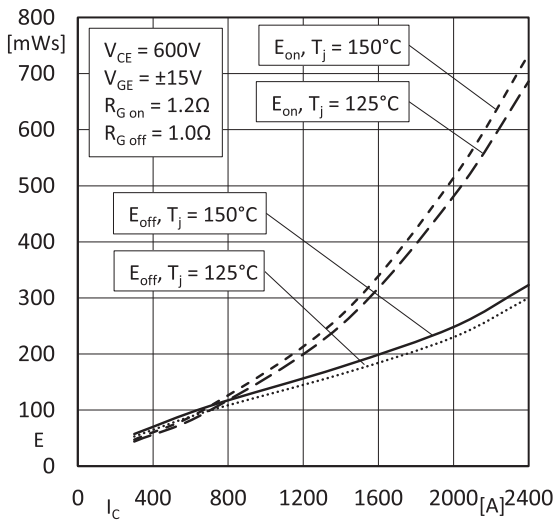


Fig. 3: Typ. IGBT1 switching losses $E=f(I_C)$

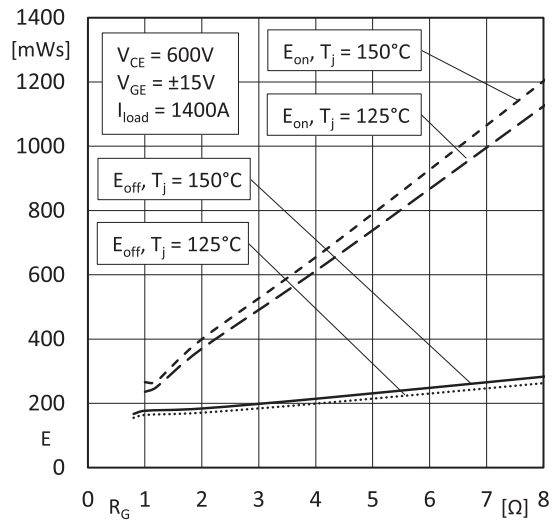


Fig. 4: Typ. IGBT1 switching losses $E=f(R_G)$

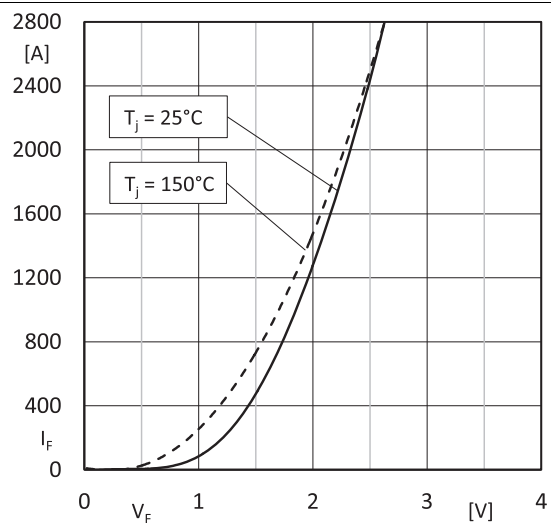


Fig. 5: Typ. Diode5 forward characteristics $I_F=f(V_F)$ (chipevel)

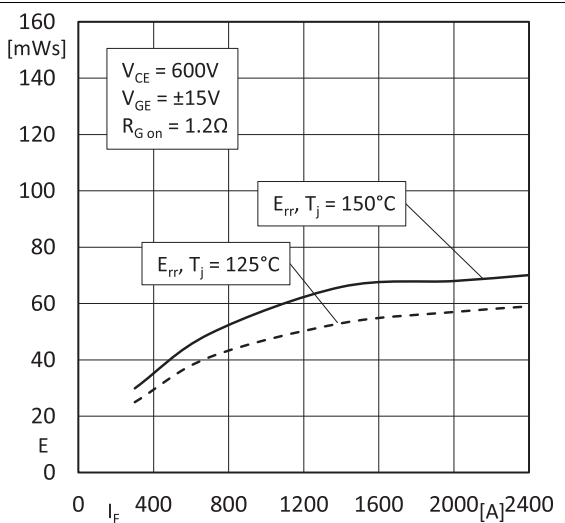


Fig. 6: Typ. Diode5 switching losses $E=f(I_F)$

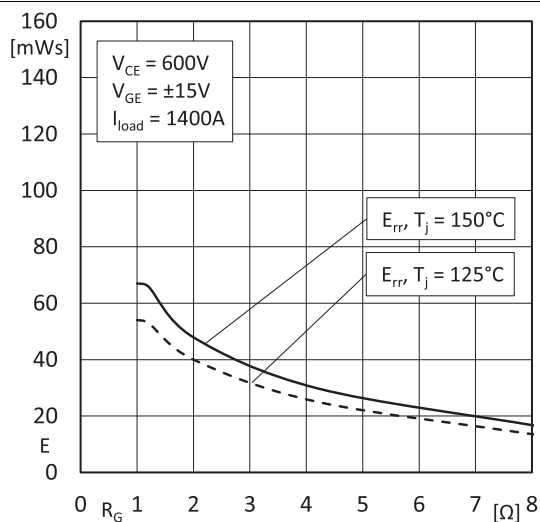


Fig. 7: Typ. Diode5 switching losses $E=f(R_G)$

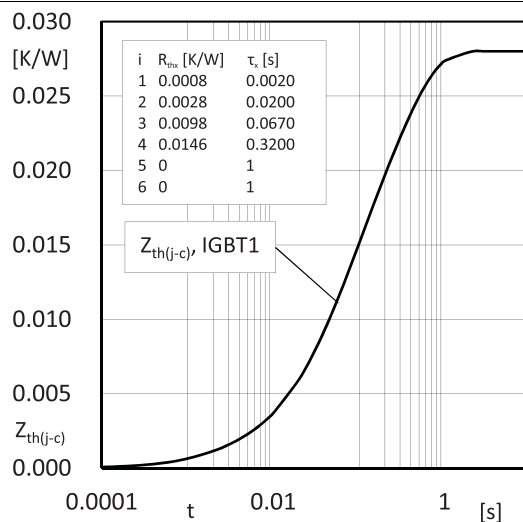


Fig. 8: IGBT1 transient thermal impedance

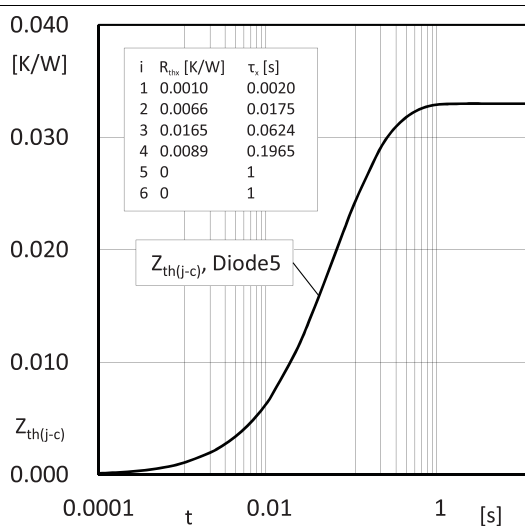


Fig. 9: Diode5 transient thermal impedance

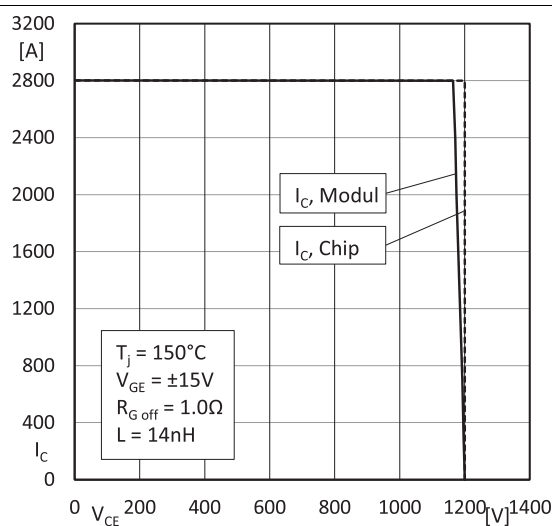


Fig. 10: RBSOA IGBT1

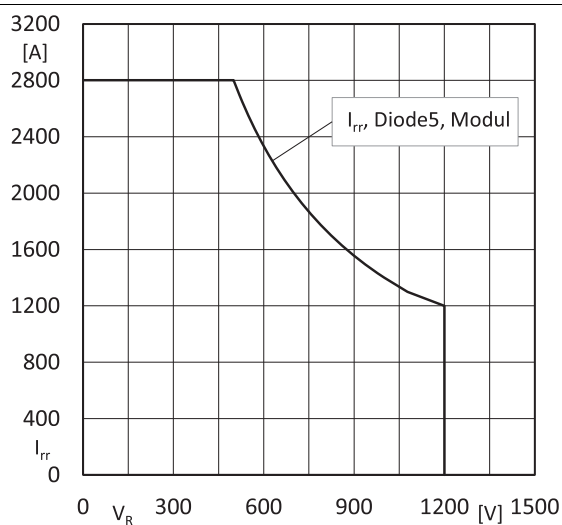


Fig. 11: RBSOA Diode5

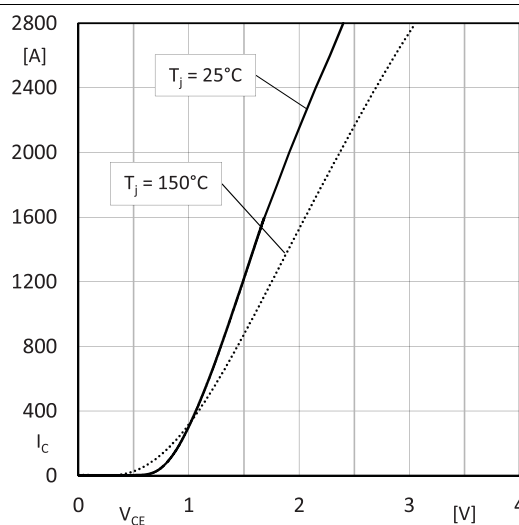


Fig. 12: Typ. IGBT2 output characteristics $I_C=f(V_{CE})$, $V_{GE}=15V$ (chipelevel)

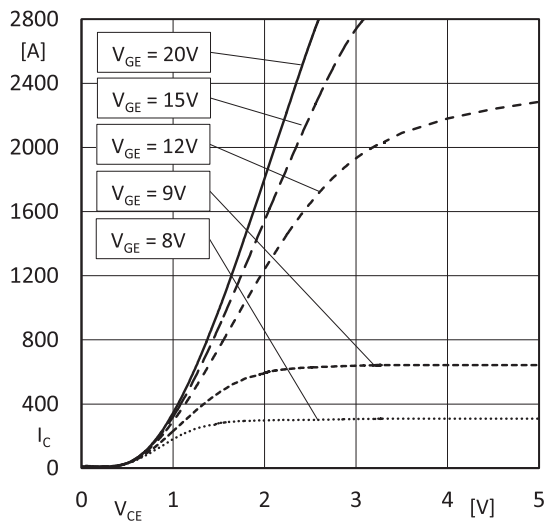


Fig. 13: Typ. IGBT2 output characteristics $I_C=f(V_{CE})$, $T_J=150^\circ\text{C}$ (chipelevel)

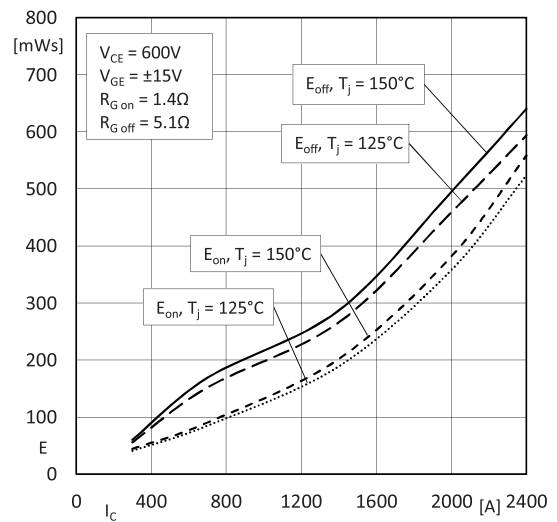


Fig. 14: Typ. IGBT2 switching losses $E=f(I_C)$

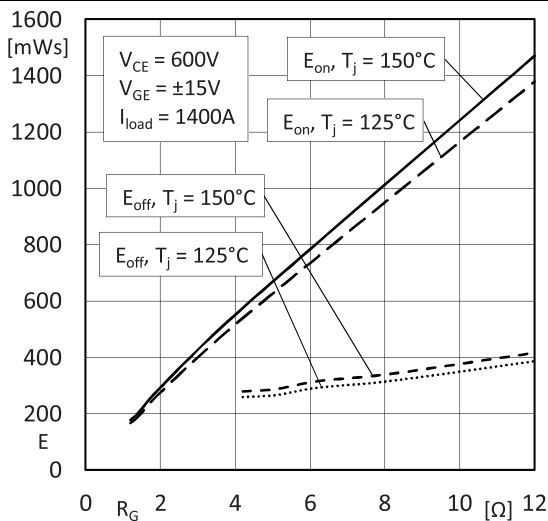


Fig. 15: Typ. IGBT2 switching losses $E=f(R_G)$

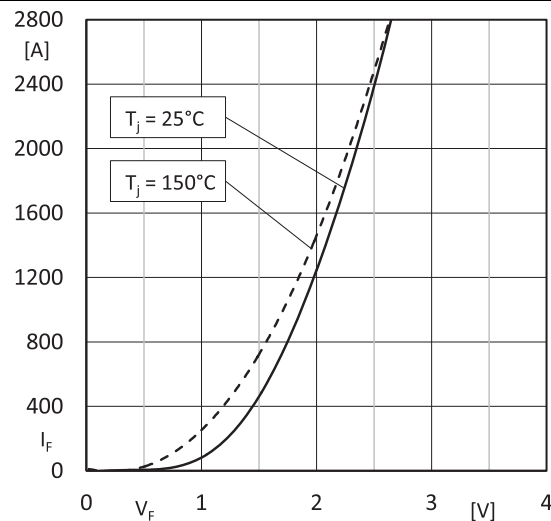


Fig. 16: Typ. Diode1 forward characteristics $I_F=f(V_F)$ (chipelevel)

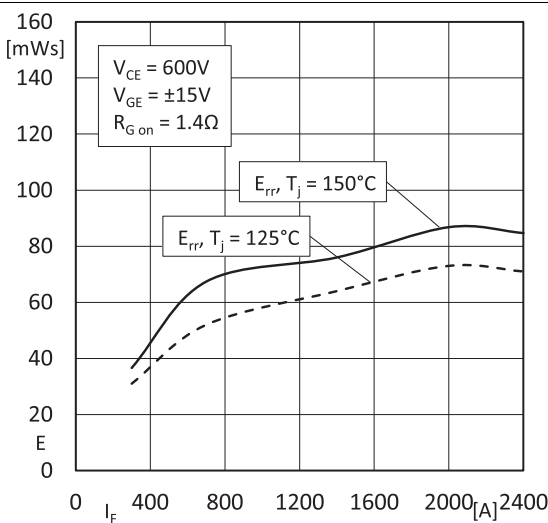


Fig. 17: Typ. Diode1 switching losses $E=f(I_F)$

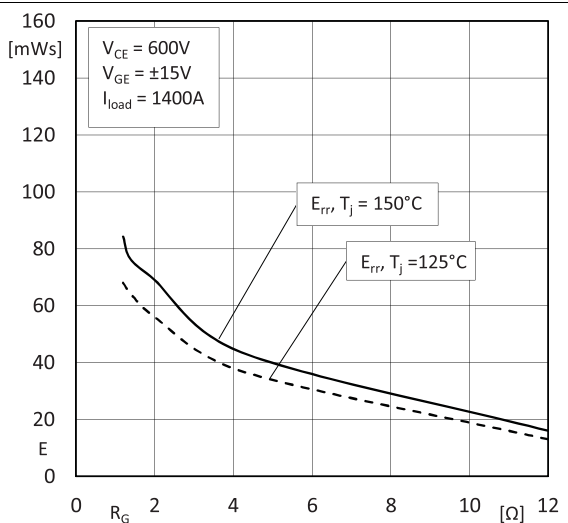


Fig. 18: Typ. Diode1 switching losses $E=f(R_G)$

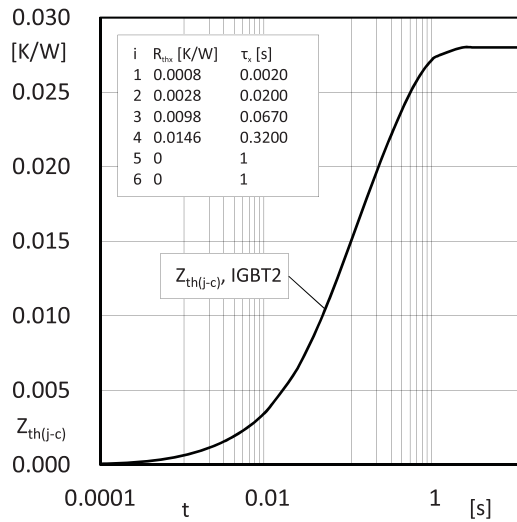


Fig. 19: IGBT2 transient thermal impedance

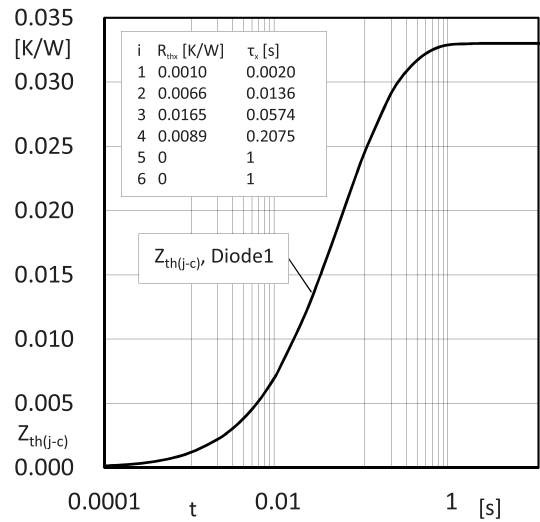


Fig. 20: Diode1 transient thermal impedance

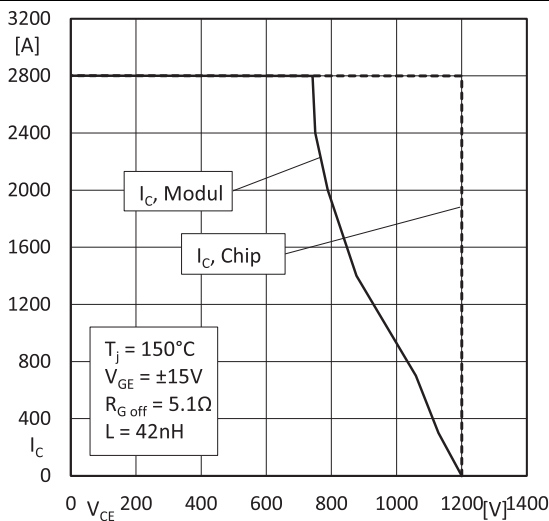


Fig. 21: RBSOA IGBT2

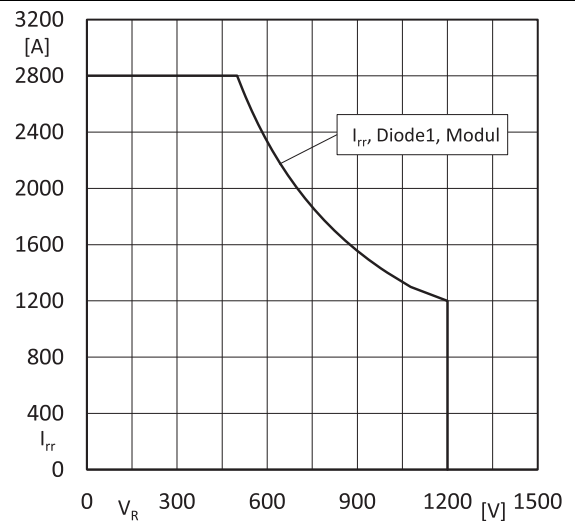


Fig. 22: RBSOA Diode1

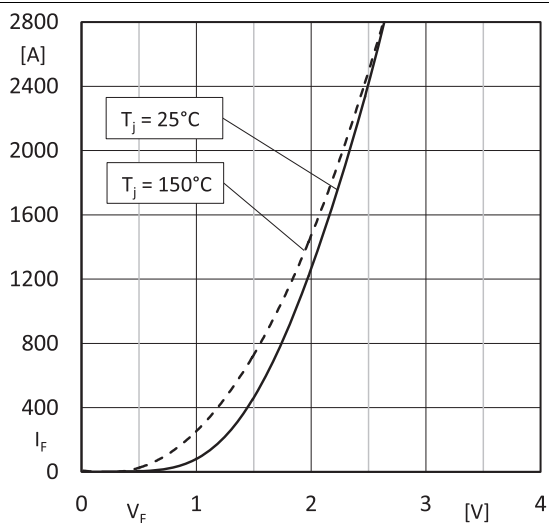


Fig. 23: Typ. Diode2 forward characteristics $I_F=f(V_F)$ (chipevel)

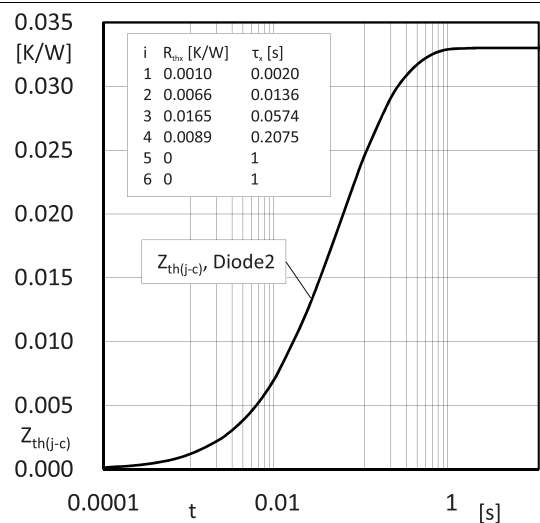


Fig. 24: Diode2 transient thermal impedance

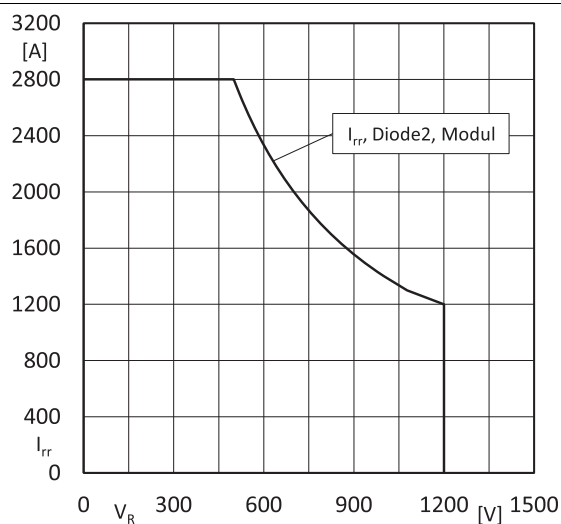


Fig. 25: RBSOA Diode2

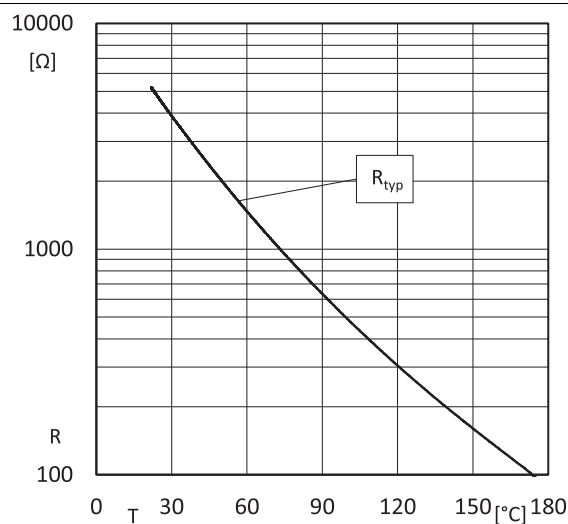


Fig. 26: Typ. NTC characteristics

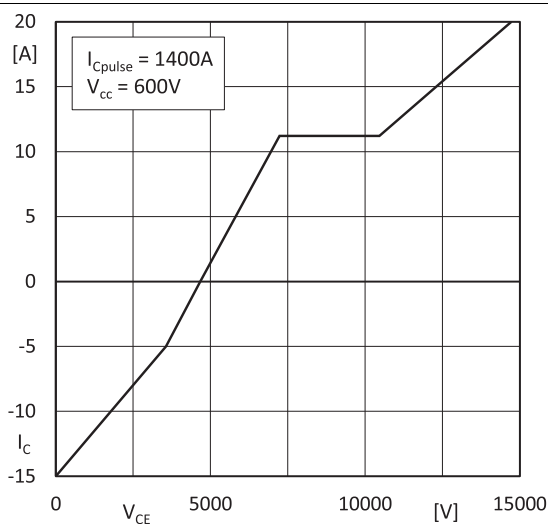


Fig. 27: Typ. gate charge characteristic of IGBT1

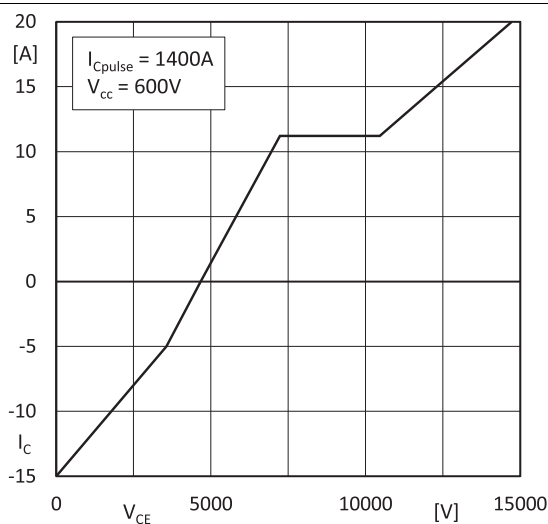


Fig. 28: Typ. gate charge characteristic of IGBT2

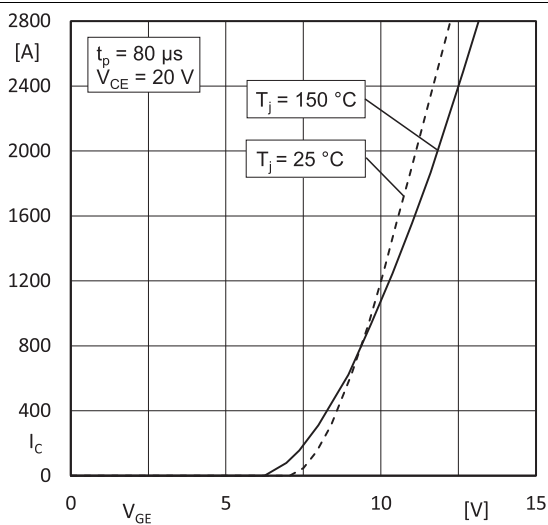
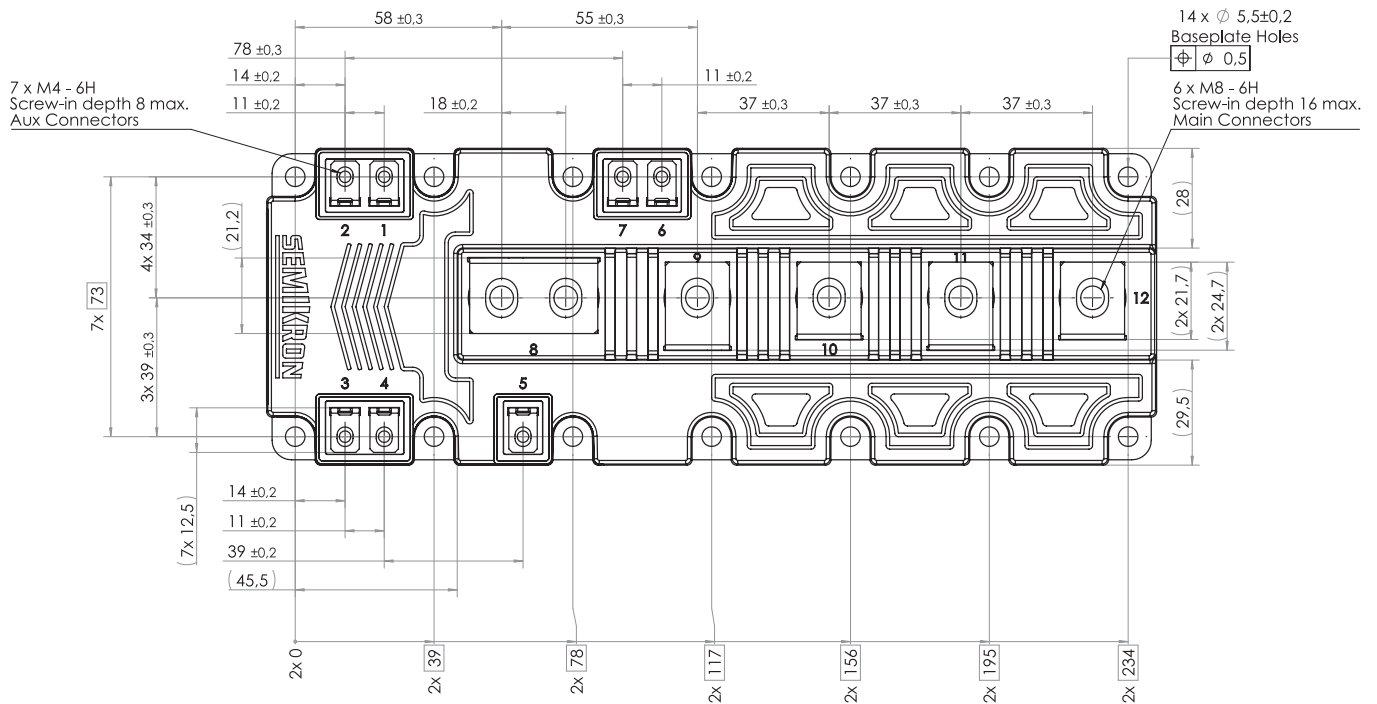
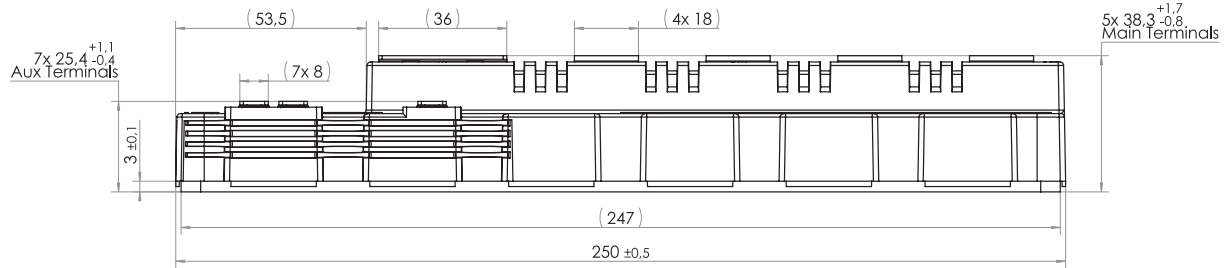
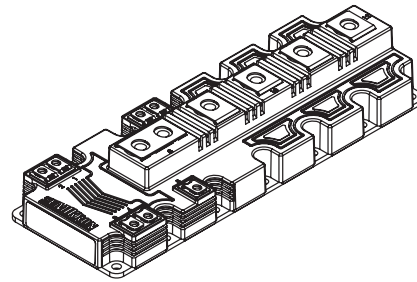
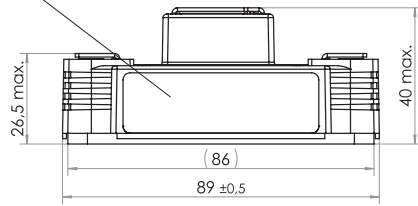


Fig. 29: Typ. transfer characteristic

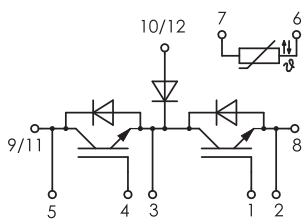
SKM1400MLI12TM7

Module label



- Dimensions in mm
- General tolerances ± 0.5 mm

SEMITRANS 10



TOP MLI

This is an electrostatic discharge sensitive device (ESDS) due to international standard IEC 61340.

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