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*

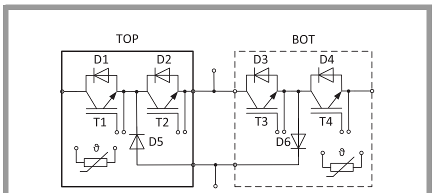
- TOP-Switch
- Recommended T_{jop} = -40 … 150°C
- IGBT1 : outer IGBTs T1 & T4
- IGBT2 : inner IGBTs T2 & T3
- Diode1 : outer diodes D1 & D4
- Diode2 : inner diodes D2 & D3
- Diode5 : clamping diodes D5 & D6

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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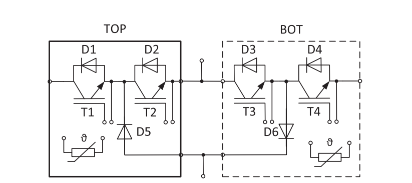

MLI TOP-Switch

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
$V_{CE(sat)}$	I_C = 1200 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.80	2.05	V
		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, chiplevel	T_j = 25 °C		0.78	0.87	mΩ
		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, I_C = 1200 A, V_{GE} = +15/-15 V, $R_{G\ on}$ = 1 Ω, $R_{G\ off}$ = 2 Ω, di/dt_{on} = 15500 A/µs, di/dt_{off} = 7500 A/µs, dv/dt = 3300 V/µs	T_j = 150 °C		249		ns
t_r		T_j = 150 °C		83		ns
E_{on}		T_j = 150 °C		108		mJ
$t_{d(off)}$		T_j = 150 °C		887		ns
t_f		T_j = 150 °C		130		ns
E_{off}		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, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.80	2.05	V
		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, chiplevel	T_j = 25 °C		0.78	0.87	mΩ
		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, I_C = 1200 A, V_{GE} = +15/-15 V, $R_{G\ on}$ = 1 Ω, $R_{G\ off}$ = 5.1 Ω, di/dt_{on} = 6400 A/µs, di/dt_{off} = 7600 A/µs, dv/dt = 2000 V/µs	T_j = 150 °C		422		ns
t_r		T_j = 150 °C		162		ns
E_{on}		T_j = 150 °C		101		mJ
$t_{d(off)}$		T_j = 150 °C		1544		ns
t_f		T_j = 150 °C		155		ns
E_{off}		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

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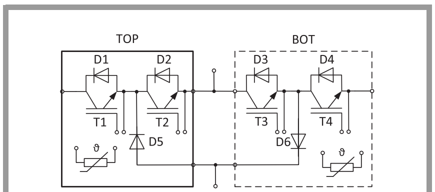

MLI TOP-Switch

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Diode1						
$V_F = V_{EC}$	I_F = 1200 A V_{GE} = 0 V chiplevel	T_j = 25 °C		2.46	2.82	V
		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 di/dt$_{off}$ = 6400 A/µs V_{CC} = 600 V V_{GE} = +15/-15 V	T_j = 150 °C		595		A
Q_{rr}		T_j = 150 °C		127		µC
E_{rr}		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 V_{GE} = 0 V chiplevel	T_j = 25 °C		2.46	2.82	V
		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 di/dt$_{off}$ = 6400 A/µs V_R = 600 V V_{GE} = +15/-15 V	T_j = 150 °C		595		A
Q_{rr}		T_j = 150 °C		127		µC
E_{rr} [1)]		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 chiplevel	T_j = 25 °C		2.20	2.52	V
		T_j = 150 °C		2.15	2.47	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		0.75	0.85	mΩ
		T_j = 150 °C		1.04	1.14	mΩ
I_{RRM}	I_F = 1200 A di/dt$_{off}$ = 15500 A/µs V_R = 600 V V_{GE} = +15/-15 V	T_j = 150 °C		1022		A
Q_{rr}		T_j = 150 °C		194		µC
E_{rr}		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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Footnotes

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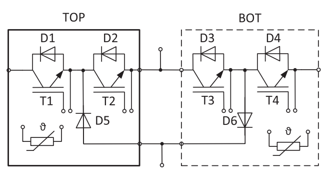


MLI TOP-Switch

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

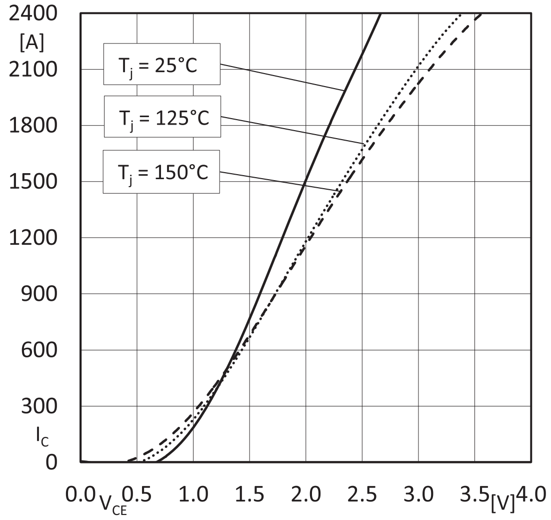


Fig. 1: Typ. IGBT1 output characteristics I_C=f(V_{CE}), V_{GE}=15V (chiplevel)

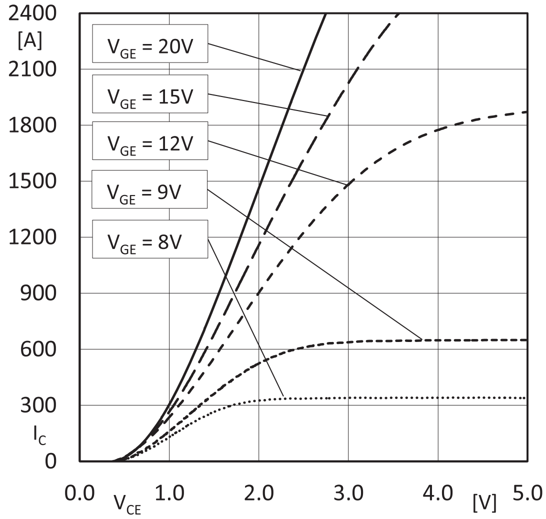


Fig. 2: Typ. IGBT1 output characteristics I_C=f(V_{CE}), T_j=150°C (chiplevel)

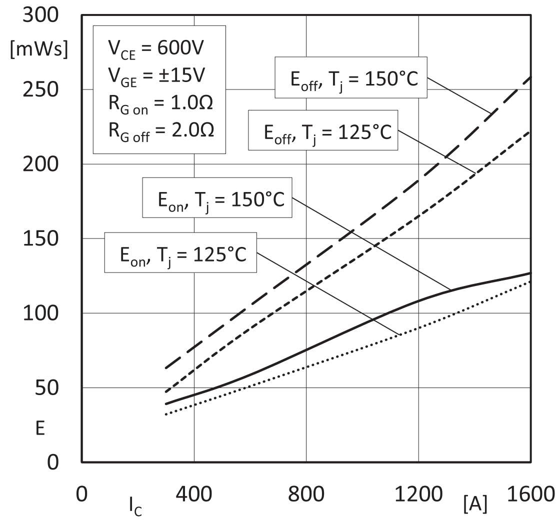


Fig. 3: Typ. IGBT1 switching losses E=f(I_C)

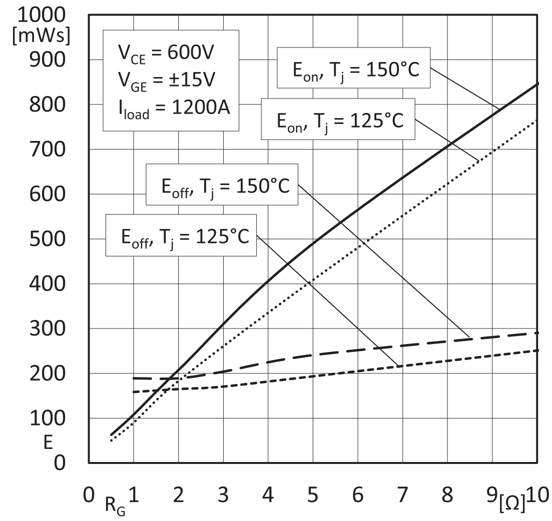


Fig. 4: Typ. IGBT1 switching losses E=f(R_G)

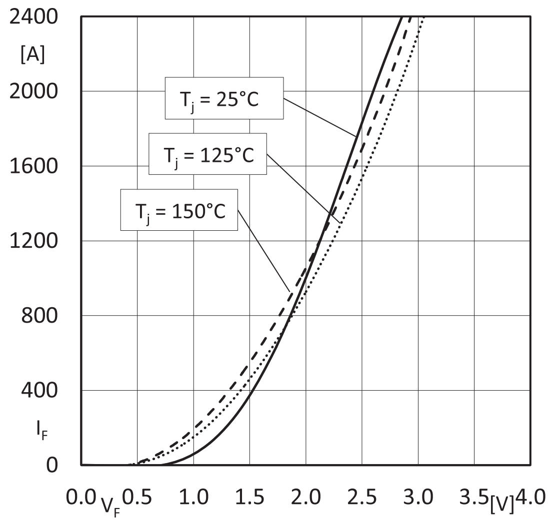


Fig. 5: Typ. Diode5 forward characteristics I_F=f(V_F) (chiplevel)

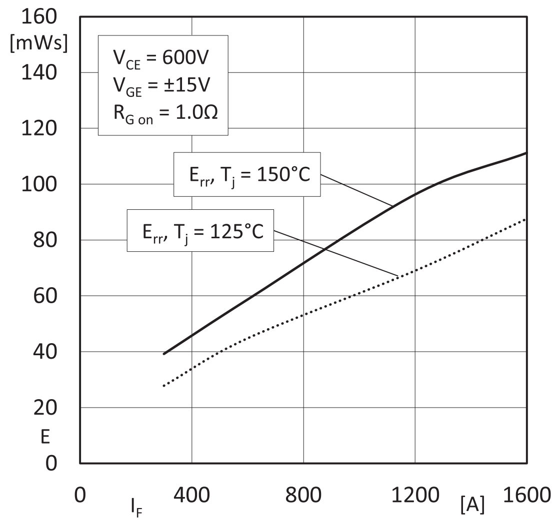


Fig. 6: Typ. Diode5 switching losses E=f(I_F)

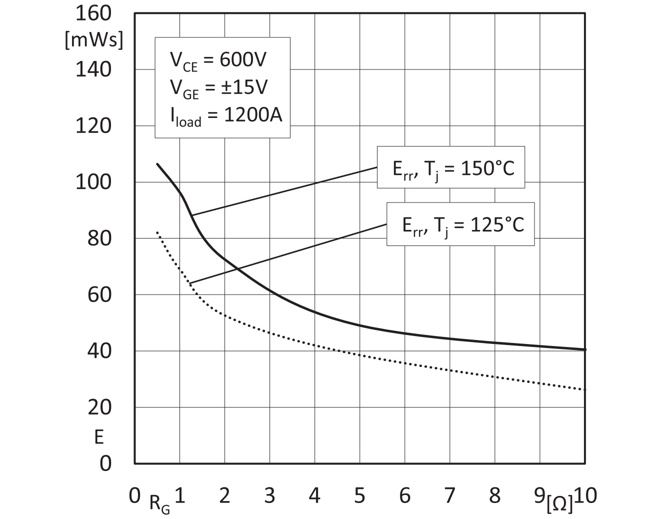


Fig. 7: Typ. Diode5 switching losses $E=f(R_G)$

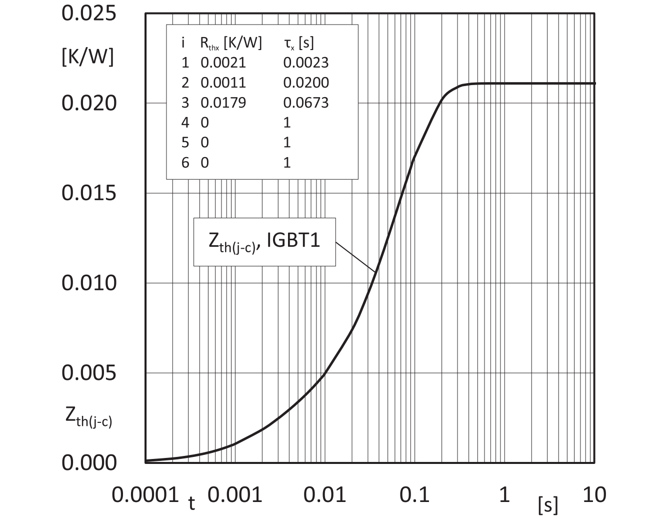


Fig. 8: IGBT1 transient thermal impedance

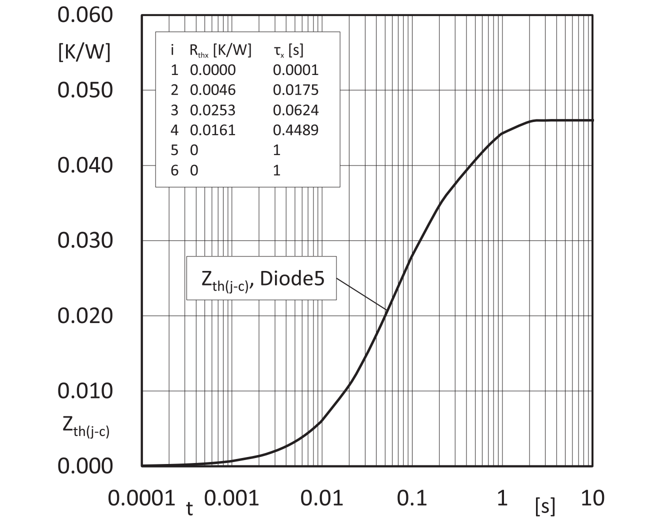


Fig. 9: Diode5 transient thermal impedance

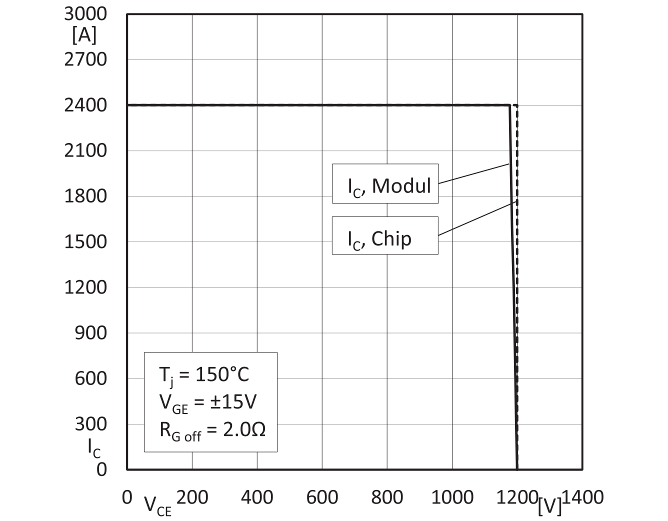


Fig. 10: RBSOA IGBT1

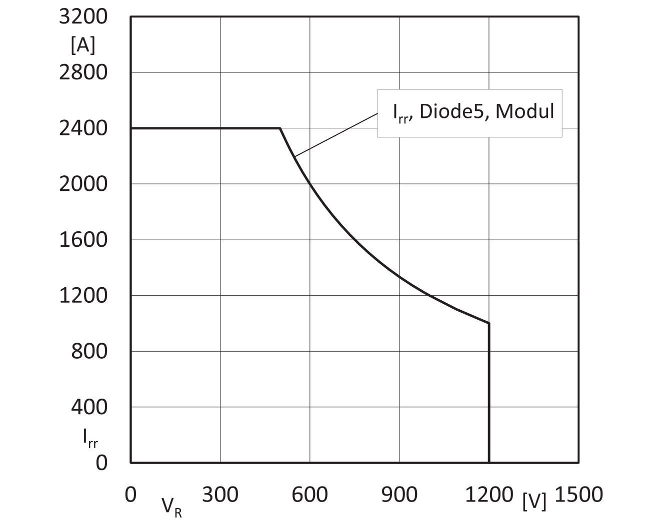


Fig. 11: RBSOA Diode5

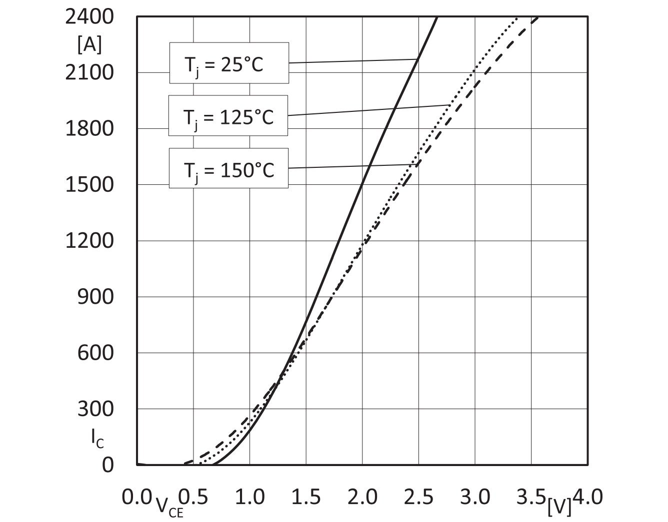


Fig. 12: Typ. IGBT2 output characteristics $I_C=f(V_{CE})$, $V_{GE}=15V$ (chiplevel)

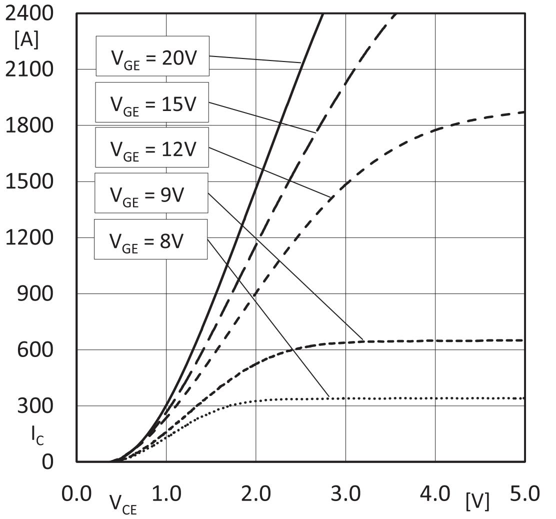


Fig. 13: Typ. IGBT2 output characteristics I_C=f(V_{CE}), T_j=150°C (chiplevel)

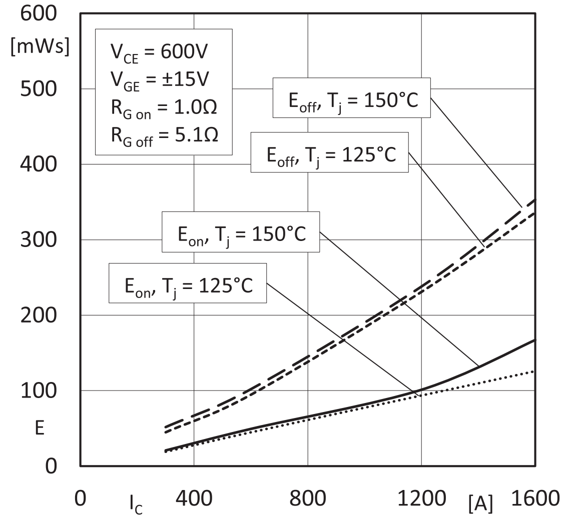


Fig. 14: Typ. IGBT2 switching losses E=f(I_C)

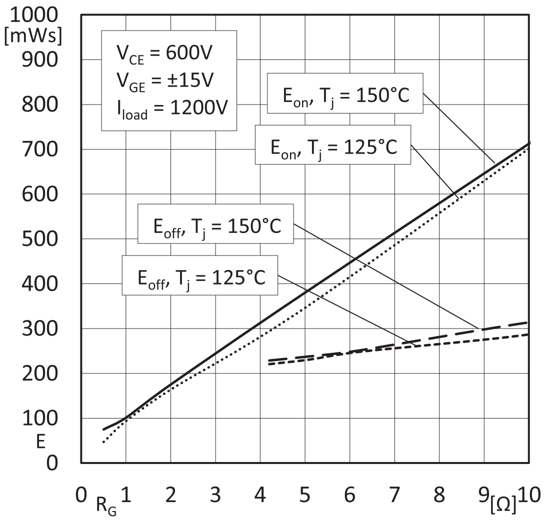


Fig. 15: Typ. IGBT2 switching losses E=f(R_G)

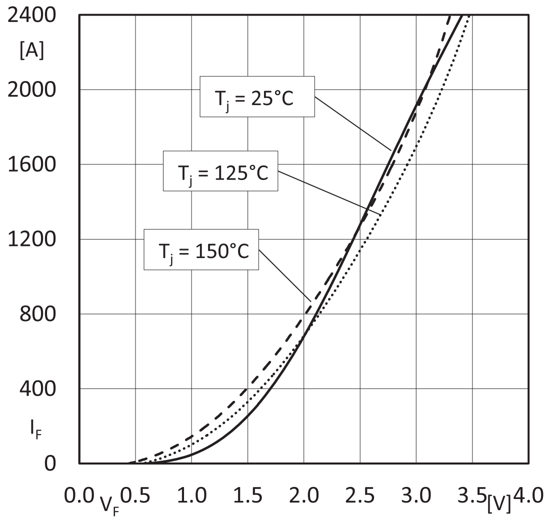


Fig. 16: Typ. Diode1 forward characteristics I_F=f(V_F) (chiplevel)

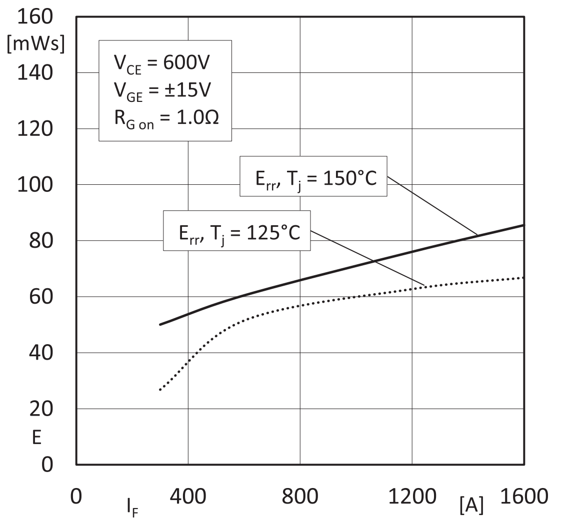


Fig. 17: Typ. Diode1 switching losses E=f(I_F)

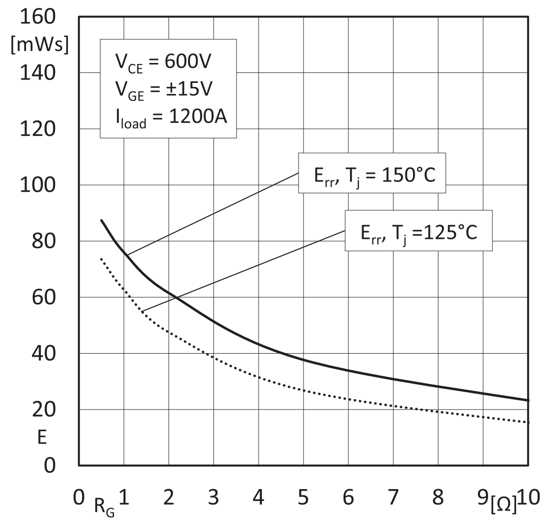


Fig. 18: Typ. Diode1 switching losses E=f(R_G)

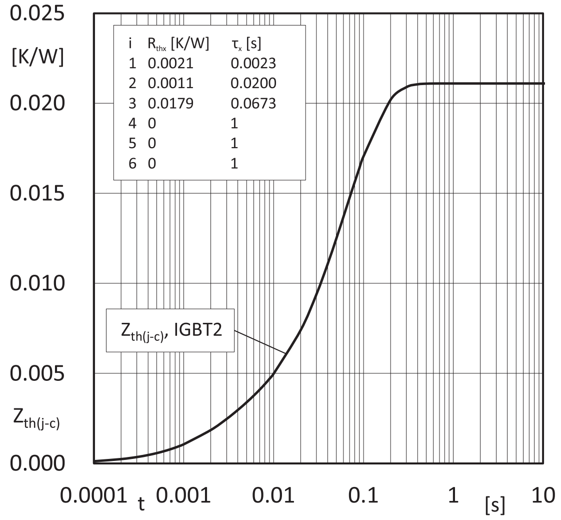


Fig. 19: IGBT2 transient thermal impedance

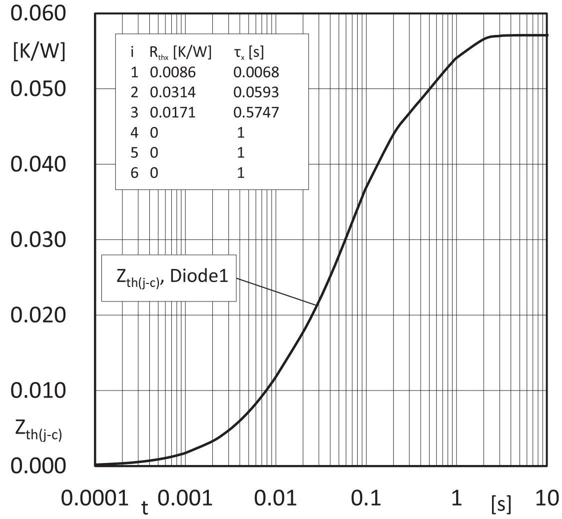


Fig. 20: Diode1 transient thermal impedance

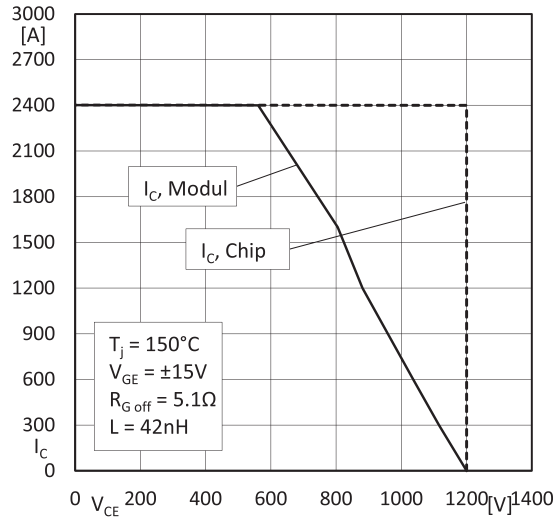


Fig. 21: RBSOA IGBT2

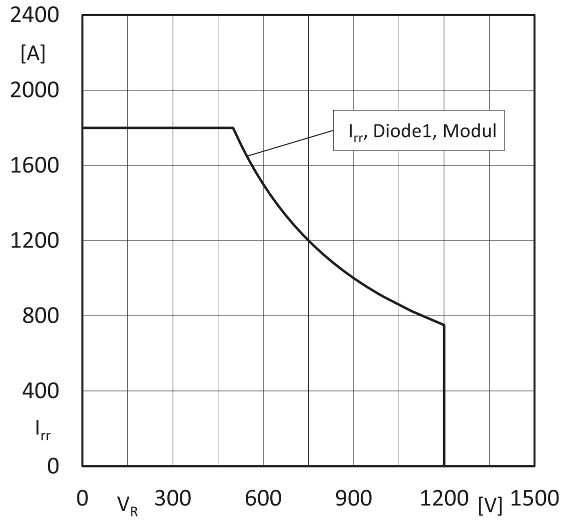


Fig. 22: RBSOA Diode1

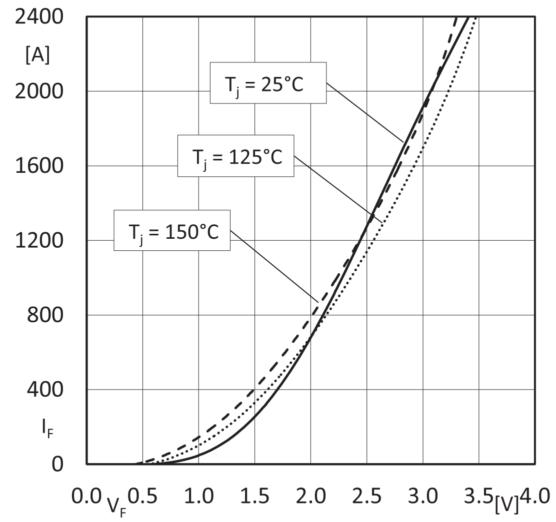


Fig. 23: Typ. Diode2 forward characteristics $I_F=f(V_F)$ (chiplevel)

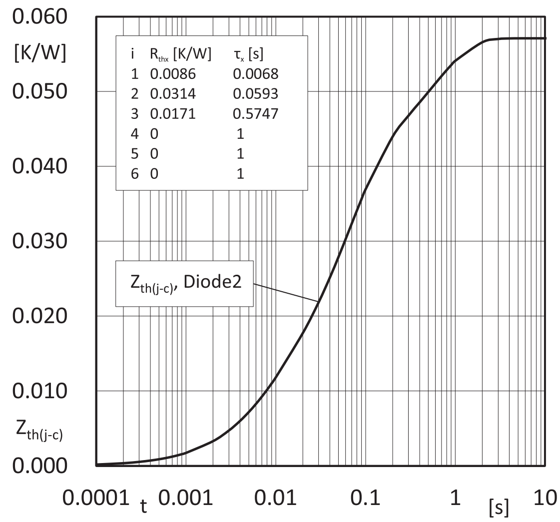


Fig. 24: Diode2 transient thermal impedance

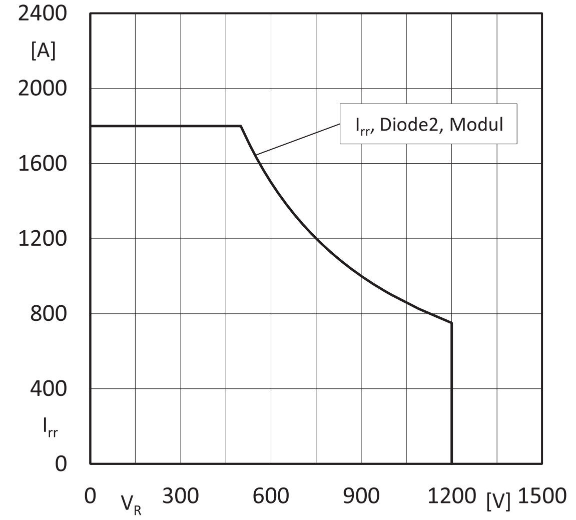


Fig. 25: RBSOA Diode2

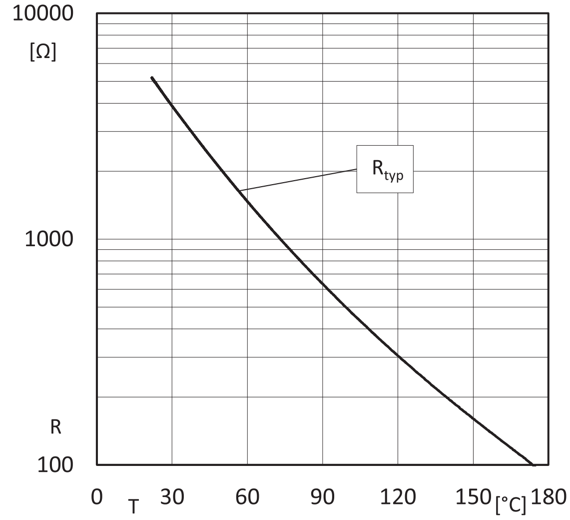
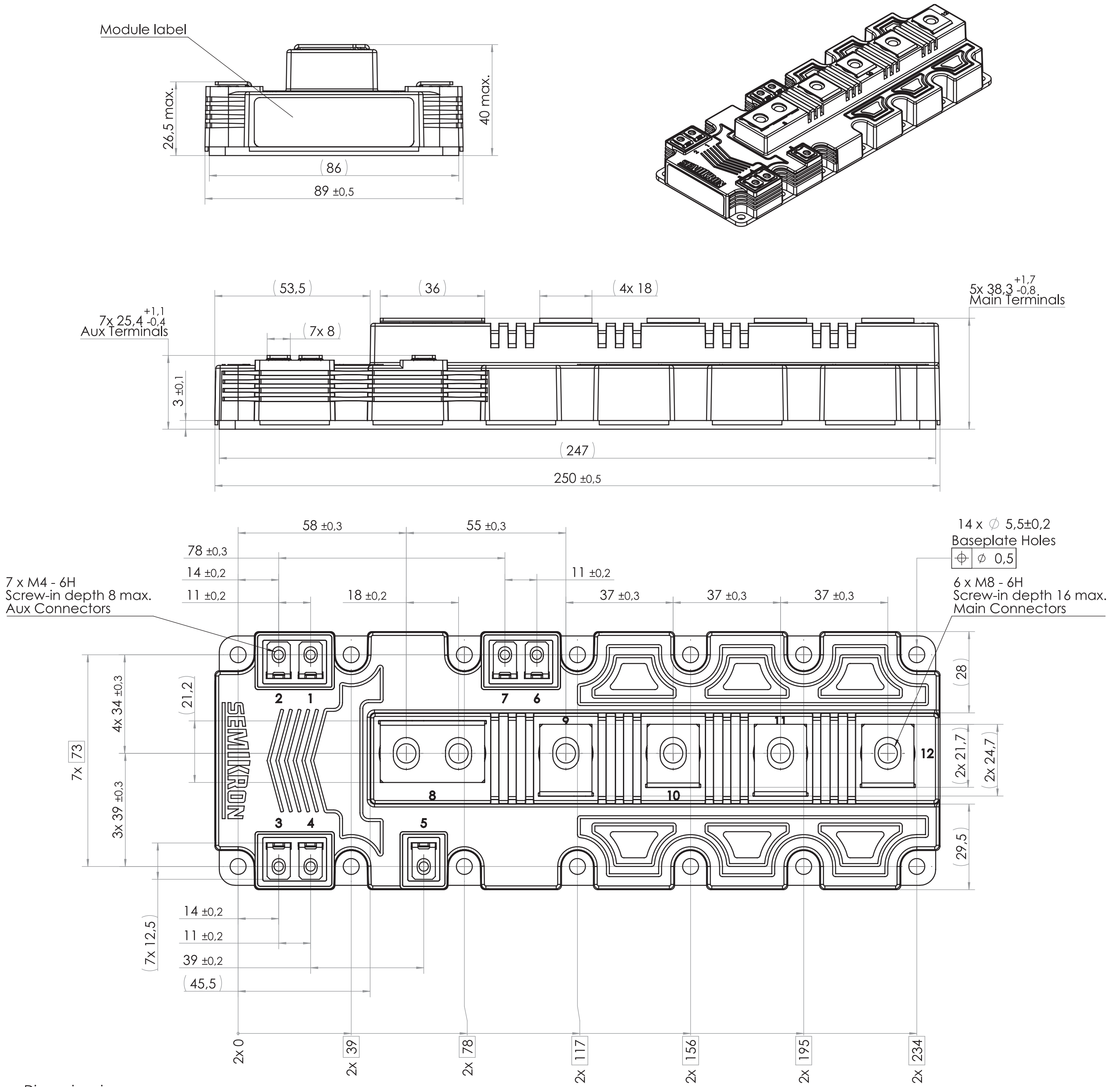
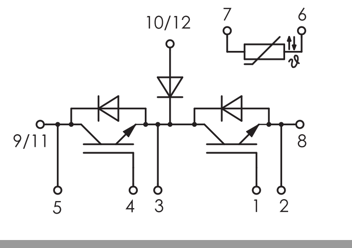


Fig. 26: Typ. NTC characteristics



• Dimensions in mm
• General tolerances ±0,5mm

SEMITRANS 10



TOP MLI

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

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