SEMITRANS® 10

IGBT M7 Modules

SKM1400MLI12BM7

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*

- BOT-Switch
- Recommended T_{jop} = -40 ... 150°C
- I_{DC} ≤ 1000A for $T_{Terminal}$ = 100°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

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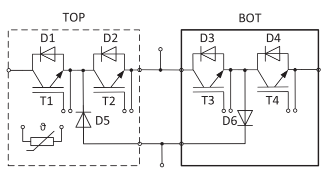

MLI BOT-Switch

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

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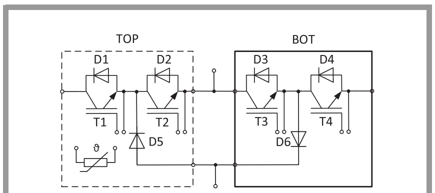
[1)]Please find further technical information on the SEMIKRON website.



MLI BOT-Switch

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
$V_{CE(sat)}$	I_C = 1400 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.55	1.94	V
		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, chiplevel	T_j = 25 °C		0.49	0.70	mΩ
		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, I_C = 1400 A, V_{GE} = +15/-15 V, $R_{G\ on}$ = 1.2 Ω, $R_{G\ off}$ = 1 Ω, di/dt_{on} = 7800 A/µs, di/dt_{off} = 12400 A/µs, dv/dt = 5000 V/µs	T_j = 150 °C		486		ns
t_r		T_j = 150 °C		183		ns
E_{on}		T_j = 150 °C		268		mJ
$t_{d(off)}$		T_j = 150 °C		684		ns
t_f		T_j = 150 °C		100		ns
E_{off}		T_j = 150 °C		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, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.55	1.94	V
		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, chiplevel	T_j = 25 °C		0.49	0.70	mΩ
		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, I_C = 1400 A, V_{GE} = +15/-15 V, $R_{G\ on}$ = 1.4 Ω, $R_{G\ off}$ = 5.1 Ω, di/dt_{on} = 6500 A/µs, di/dt_{off} = 7700 A/µs, dv/dt = 2600 V/µs	T_j = 150 °C		509		ns
t_r		T_j = 150 °C		244		ns
E_{on}		T_j = 150 °C		202		mJ
$t_{d(off)}$		T_j = 150 °C		1716		ns
t_f		T_j = 150 °C		194		ns
E_{off}		T_j = 150 °C		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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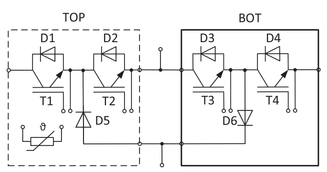

MLI BOT-Switch

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
$V_F = V_{EC}$	I_F = 1400 A V_{GE} = 0 V chiplevel	T_j = 25 °C		2.07	2.38	V
		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 di/dt_{off} = 6500 A/µs V_{CC} = 600 V V_{GE} = +15/-15 V	T_j = 150 °C		667		A
Q_{rr}		T_j = 150 °C		187		µC
E_{rr}		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 V_{GE} = 0 V chiplevel	T_j = 25 °C		2.07	2.38	V
		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 di/dt_{off} = 6500 A/µs V_R = 600 V V_{GE} = +15/-15 V	T_j = 150 °C		667		A
Q_{rr}		T_j = 150 °C		187		µC
E_{rr} 1)		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 chiplevel	T_j = 25 °C		2.07	2.38	V
		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 di/dt_{off} = 7870 A/µs V_R = 600 V V_{GE} = +15/-15 V	T_j = 150 °C		632		A
Q_{rr}		T_j = 150 °C		185		µC
E_{rr}		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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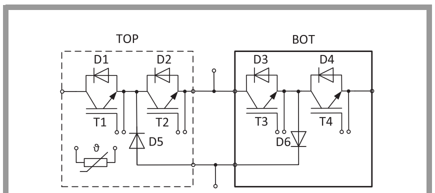


MLI BOT-Switch

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

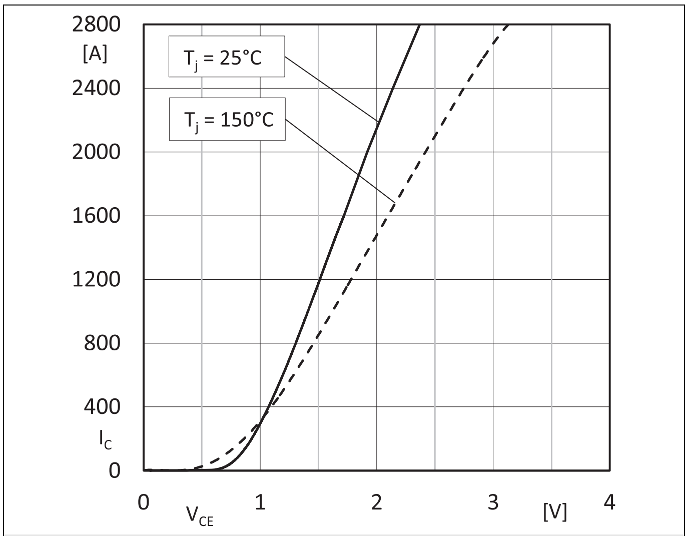


Fig. 1: Typ. IGBT1 output characteristics I_C=f(V_{CE}), V_{GE}=15V (chiplevel)

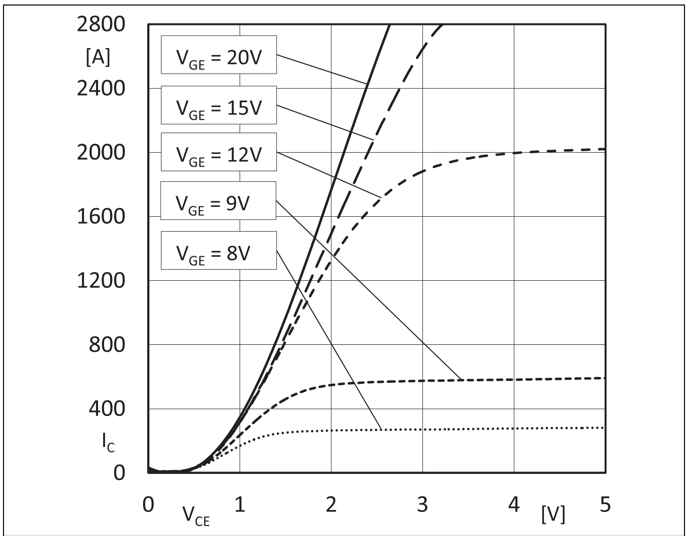


Fig. 2: Typ. IGBT1 output characteristics I_C=f(V_{CE}), T_j=150°C (chiplevel)

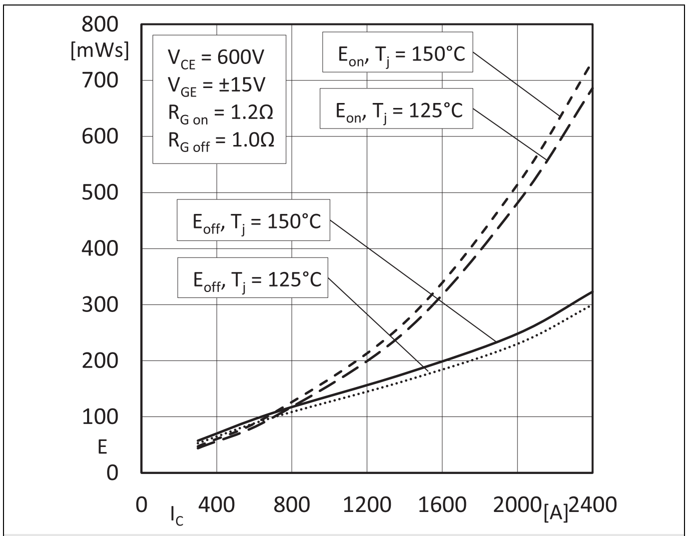


Fig. 3: Typ. IGBT1 switching losses E=f(I_C)

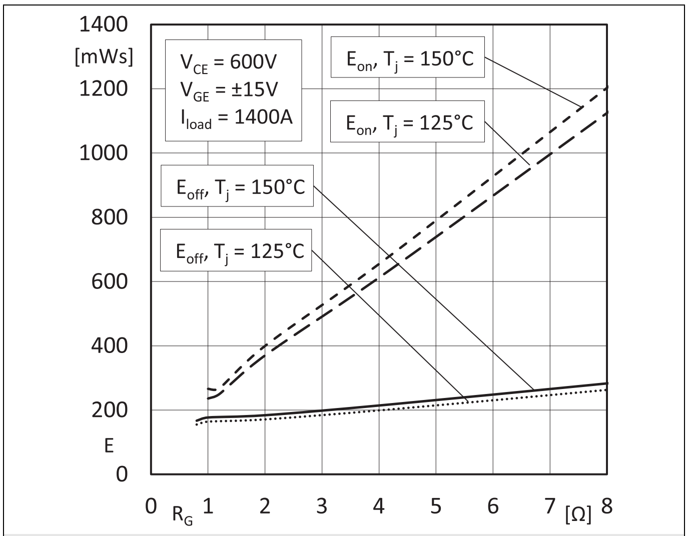


Fig. 4: Typ. IGBT1 switching losses E=f(R_G)

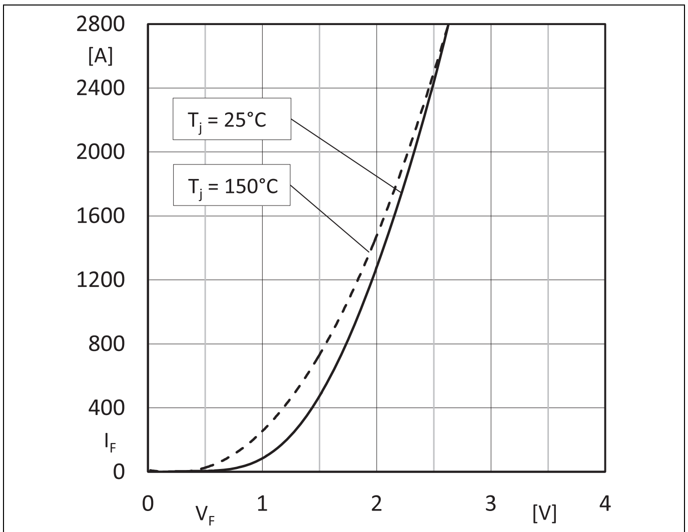


Fig. 5: Typ. Diode5 forward characteristics I_F=f(V_F) (chiplevel)

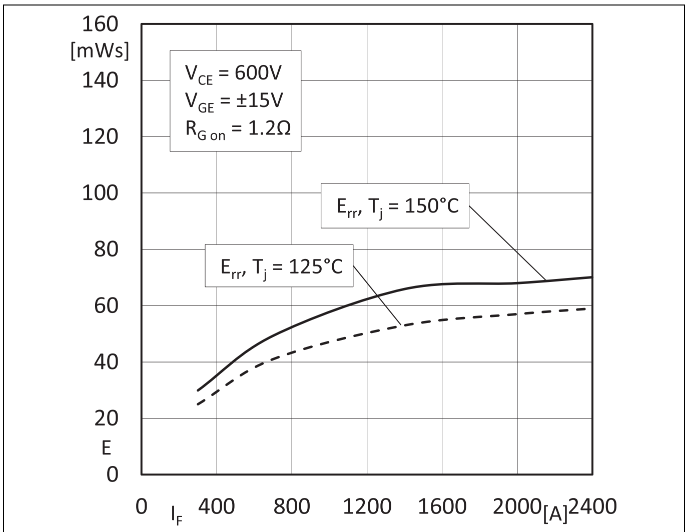


Fig. 6: Typ. Diode5 switching losses E=f(I_F)

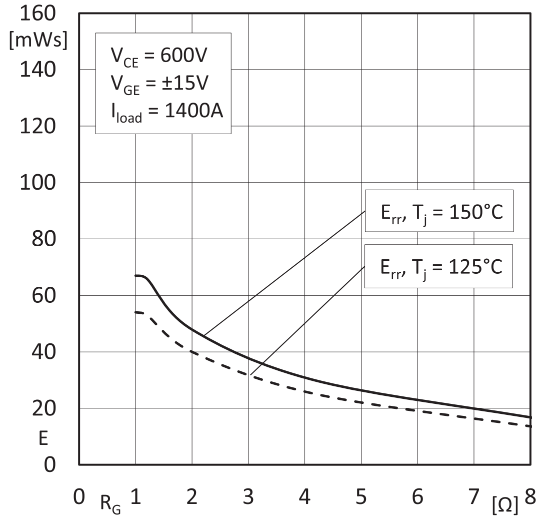


Fig. 7: Typ. Diode5 switching losses E=f(R_G)

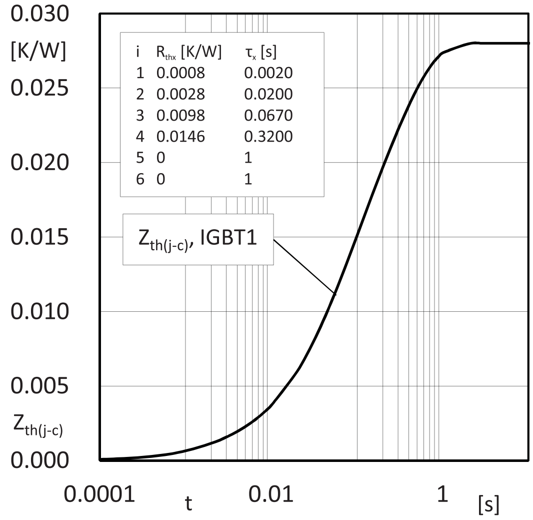


Fig. 8: IGBT1 transient thermal impedance

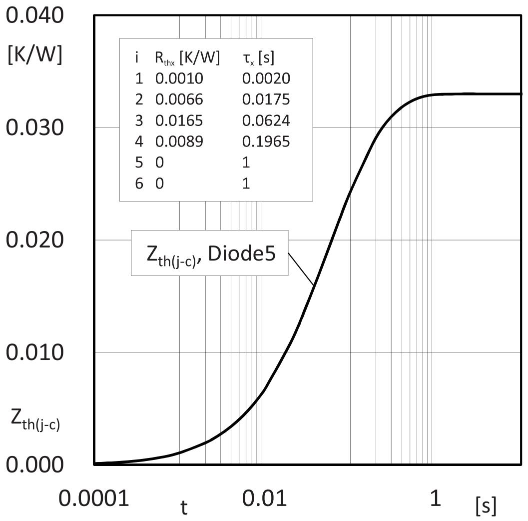


Fig. 9: Diode5 transient thermal impedance

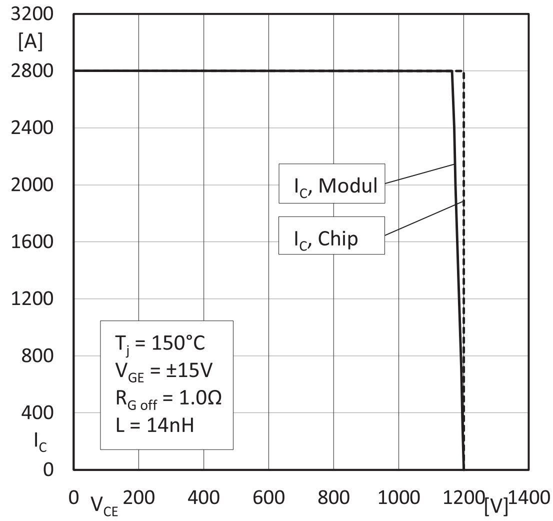


Fig. 10: RBSOA IGBT1

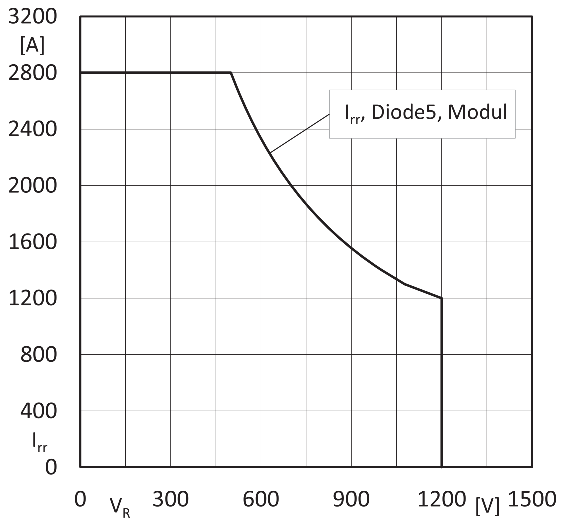


Fig. 11: RBSOA Diode5

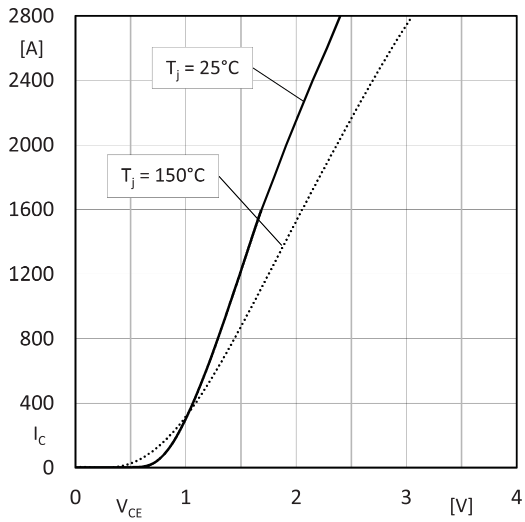


Fig. 12: Typ. IGBT2 output characteristics I_C=f(V_{CE}), V_{GE}=15V (chiplevel)

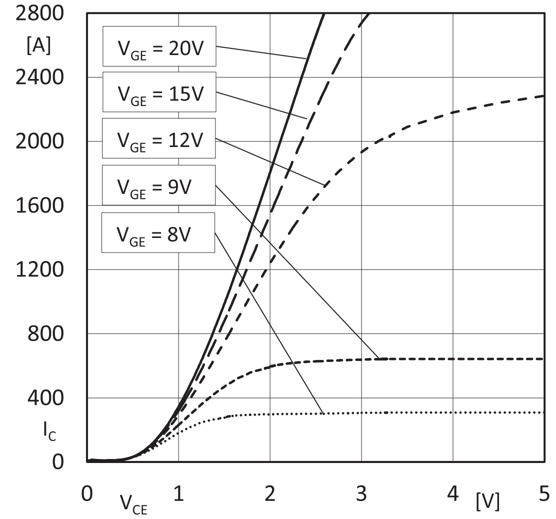


Fig. 13: Typ. IGBT2 output characteristics I_C=f(V_{CE}), T_j=150°C (chiplevel)

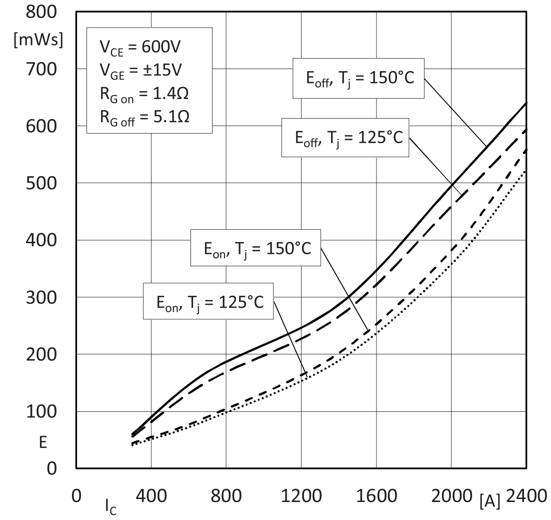


Fig. 14: Typ. IGBT2 switching losses E=f(I_C)

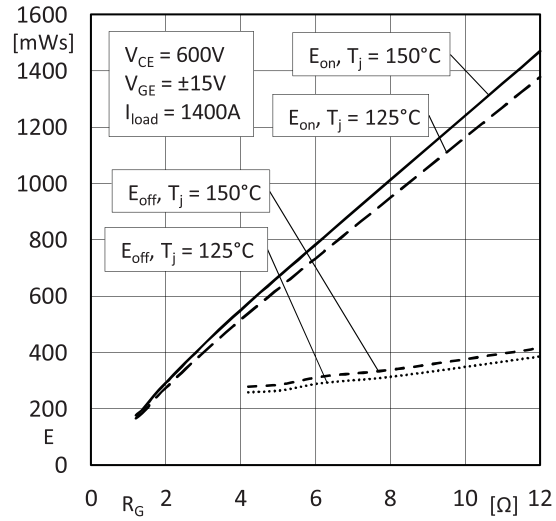


Fig. 15: Typ. IGBT2 switching losses E=f(R_G)

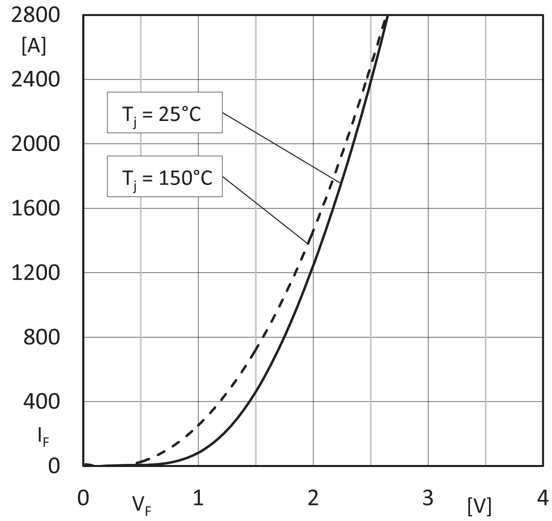


Fig. 16: Typ. Diode1 forward characteristics I_F=f(V_F) (chiplevel)

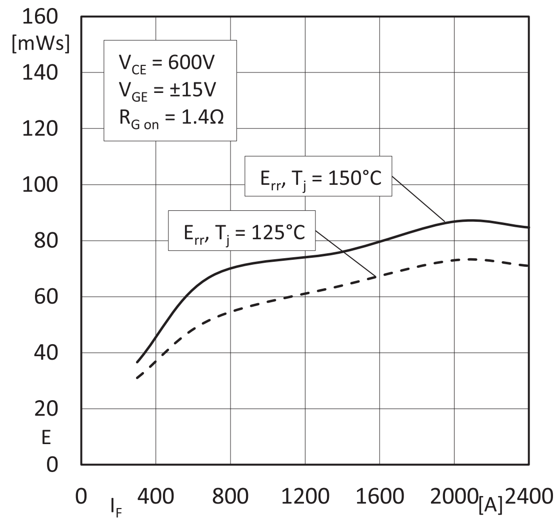


Fig. 17: Typ. Diode1 switching losses E=f(I_F)

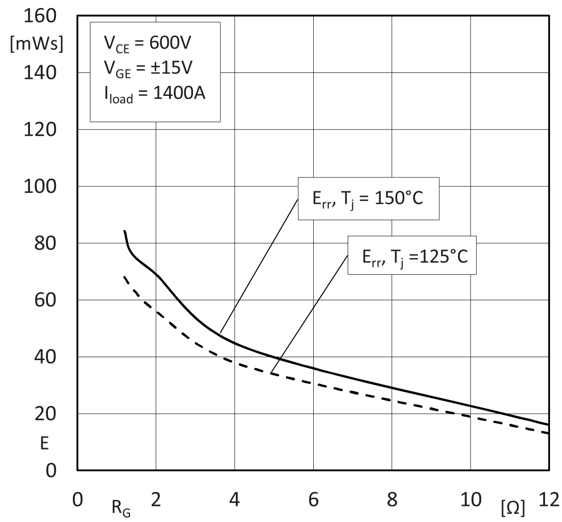


Fig. 18: Typ. Diode1 switching losses E=f(R_G)

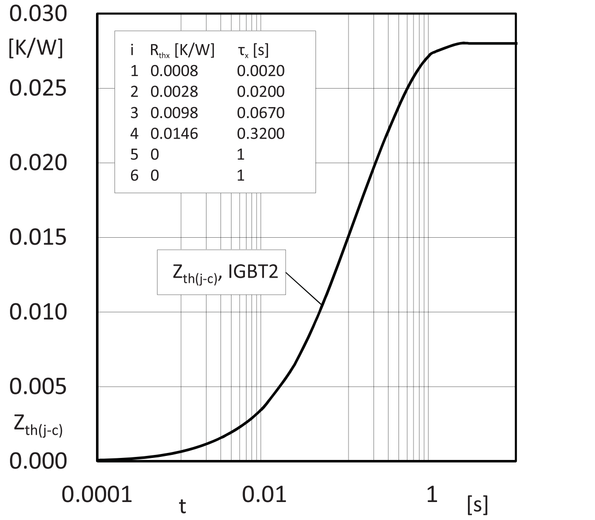


Fig. 19: IGBT2 transient thermal impedance

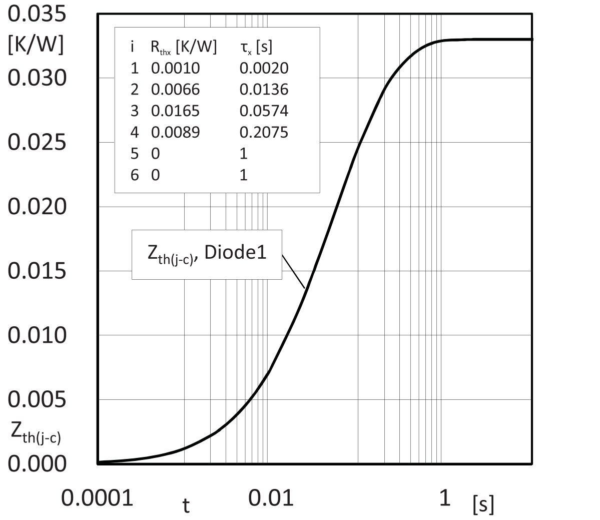


Fig. 20: Diode1 transient thermal impedance

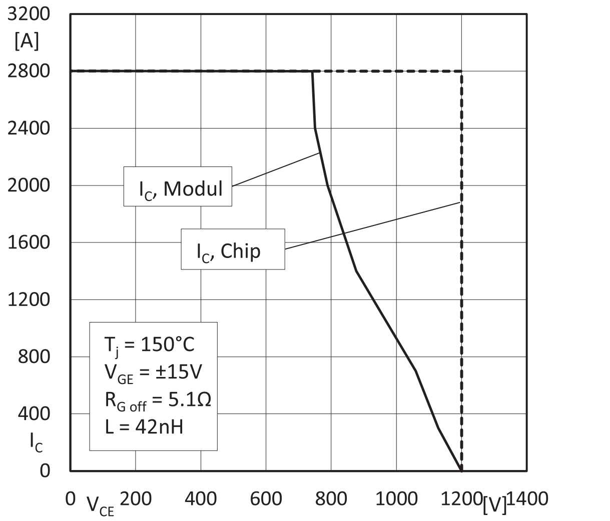


Fig. 21: RBSOA IGBT2

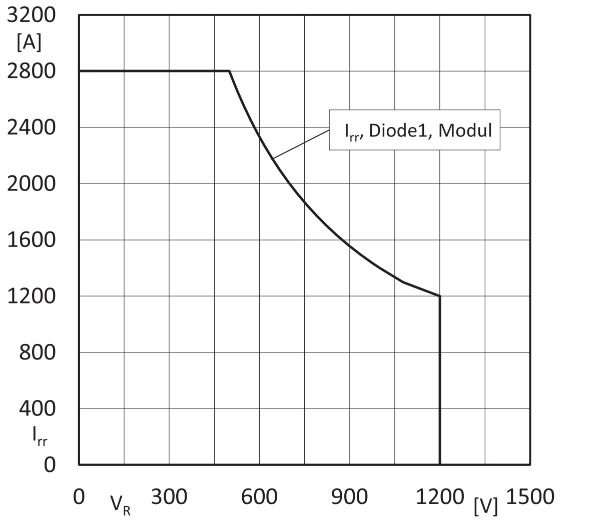


Fig. 22: RBSOA Diode1

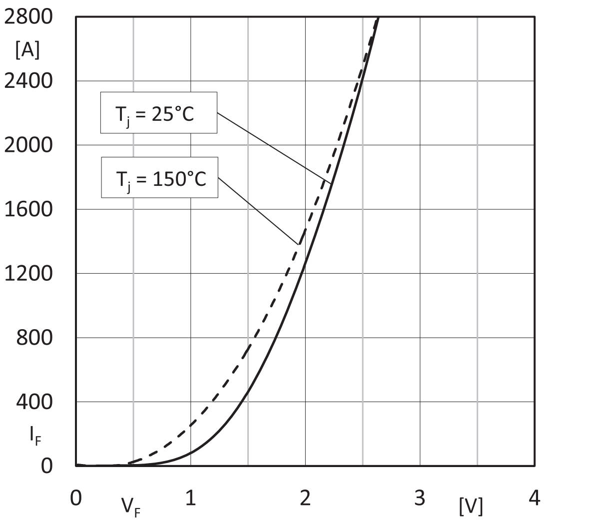


Fig. 23: Typ. Diode2 forward characteristics I_F=f(V_F) (chiplevel)

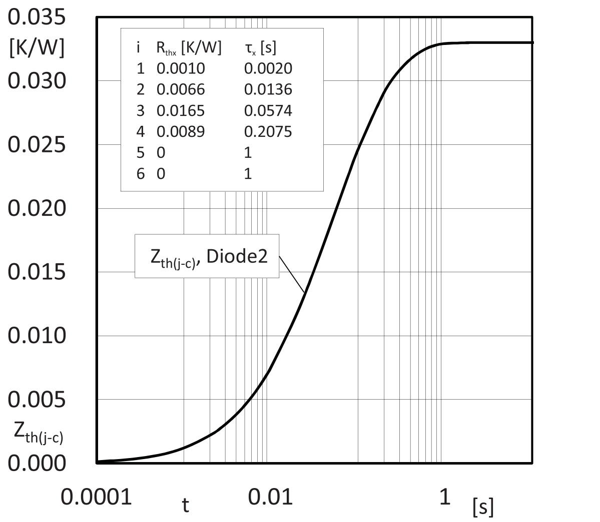


Fig. 24: Diode2 transient thermal impedance

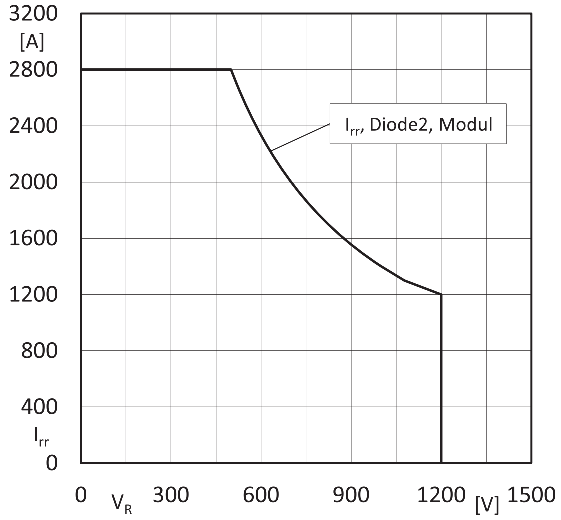


Fig. 25: RBSOA Diode2

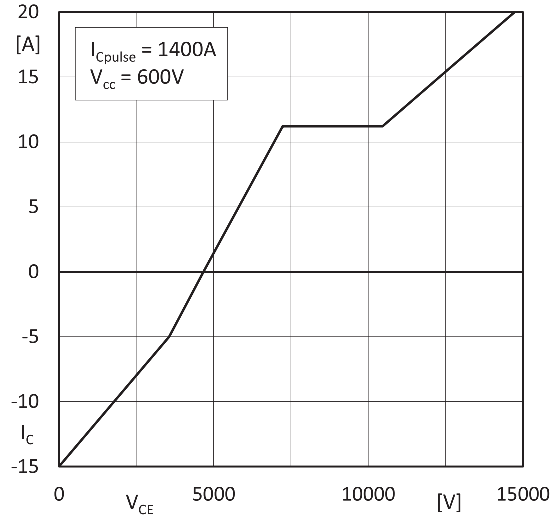


Fig. 27: Typ. gate charge characteristic of IGBT1

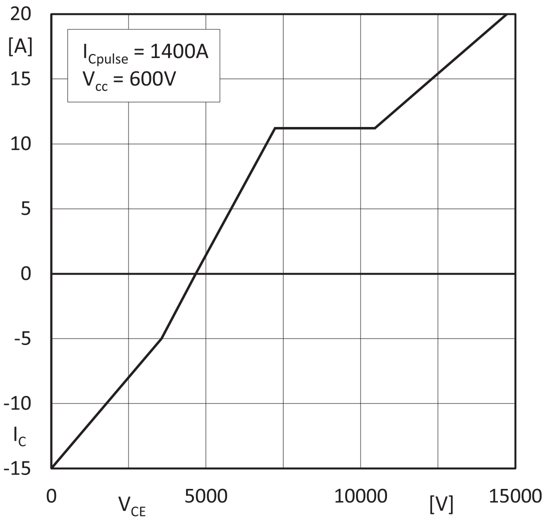


Fig. 28: Typ. gate charge characteristic of IGBT2

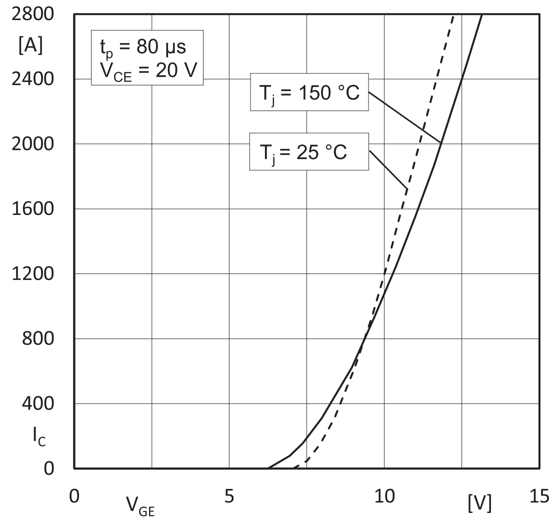
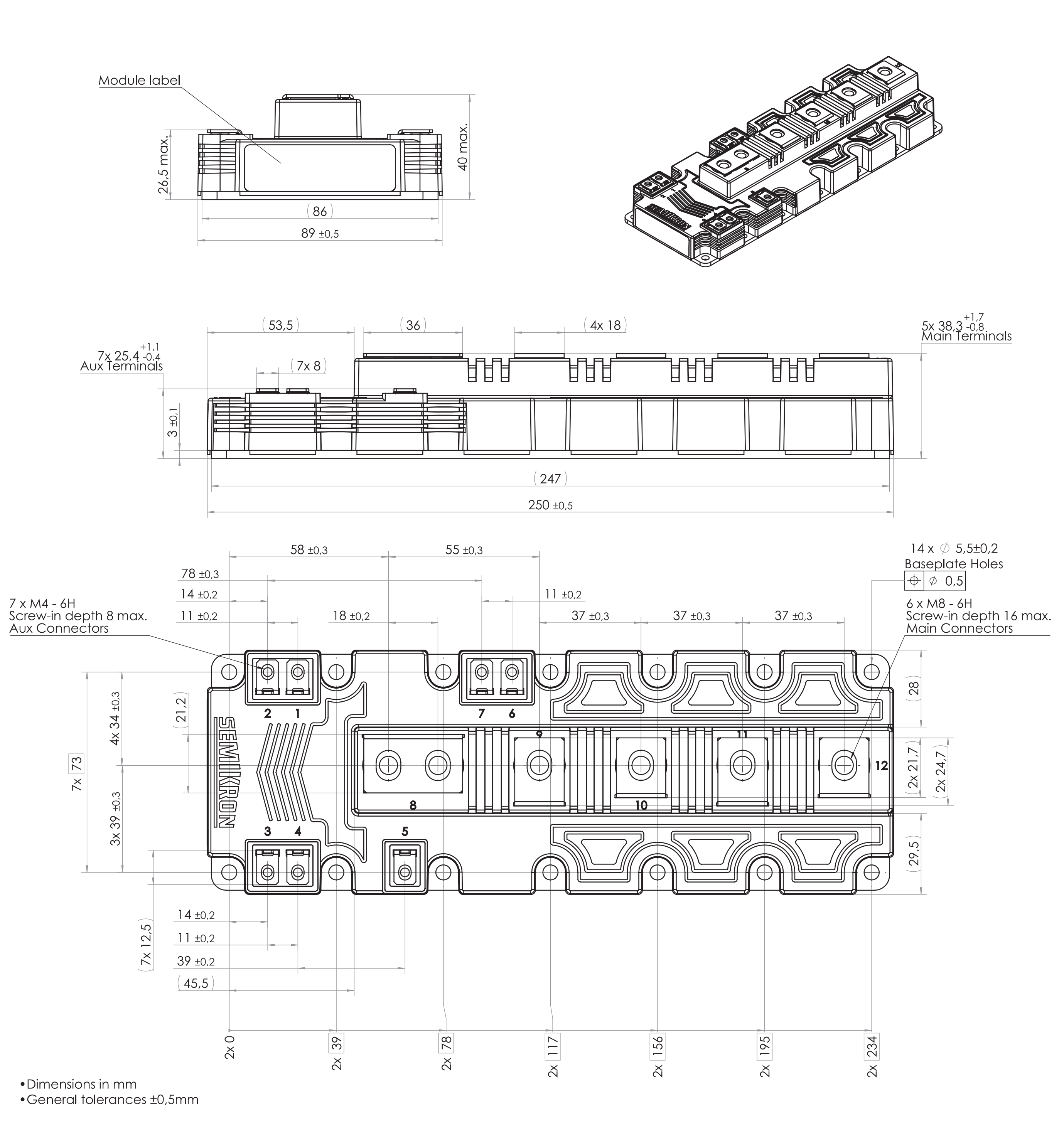


Fig. 29: Typ. transfer characteristic



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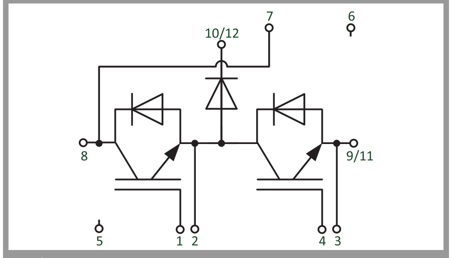

BOT MLI

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

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