

SKM1400MLI12BM7



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

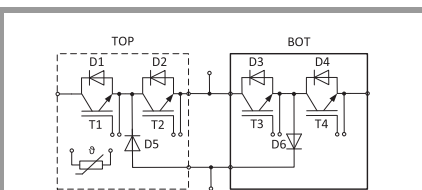
Remarks*

- BOT-Switch
- Recommended $T_{jop} = -40 \dots 150^\circ\text{C}$
- $I_{DC} \leq 1000\text{A}$ 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}	$T_j = 25^\circ\text{C}$	1200	V
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	1770
		$T_c = 100^\circ\text{C}$	1163
I_{Cnom}		1400	A
I_{CRM}		2800	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}, V_{GE} \leq 15\text{ V}, T_j = 25^\circ\text{C}, V_{CES} \leq 1200\text{ V}$	8	μs
T_j		-40 ... 175	$^\circ\text{C}$
IGBT2			
V_{CES}	$T_j = 25^\circ\text{C}$	1200	V
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	1770
		$T_c = 100^\circ\text{C}$	1163
I_{Cnom}		1400	A
I_{CRM}		2800	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}, V_{GE} \leq 15\text{ V}, T_j = 25^\circ\text{C}, V_{CES} \leq 1200\text{ V}$	8	μs
T_j		-40 ... 175	$^\circ\text{C}$
Diode1			
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	1831
		$T_c = 100^\circ\text{C}$	1171
I_{FRM}		2800	A
I_{FSM}	$t_p = 10\text{ ms}, \sin 180^\circ, T_j = 25^\circ\text{C}$	7296	A
T_j		-40 ... 175	$^\circ\text{C}$
Diode2			
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	1831
		$T_c = 100^\circ\text{C}$	1171
I_{FRM}		2800	A
I_{FSM}	$t_p = 10\text{ ms}, \sin 180^\circ, T_j = 25^\circ\text{C}$	7296	A
T_j		-40 ... 175	$^\circ\text{C}$
Diode5			
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	1831
		$T_c = 100^\circ\text{C}$	1171
I_{FRM}		2800	A
I_{FSM}	$t_p = 10\text{ ms}, \sin 180^\circ, T_j = 25^\circ\text{C}$	7296	A
T_j		-40 ... 175	$^\circ\text{C}$
Module			
$I_{t(RMS)}$		1000	A
T_{stg}	module without TIM	-40 ... 150	$^\circ\text{C}$
V_{isol}	AC sinus 50 Hz, $t = 1\text{ min}$	4000	V



MLI BOT-Switch

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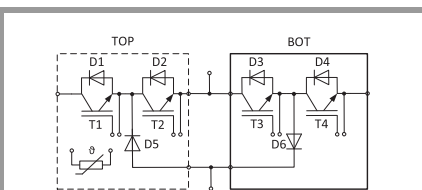
- 1500V Solar inverters

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Footnotes

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MLI BOT-Switch

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
$V_{CE(sat)}$	$I_C = 1400\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		1.55	1.94	V
		$T_j = 150^\circ\text{C}$		1.81	2.48	V
V_{CE0}	chipelevel	$T_j = 25^\circ\text{C}$		0.86	0.96	V
		$T_j = 150^\circ\text{C}$		0.75	0.93	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		0.49	0.70	m Ω
		$T_j = 150^\circ\text{C}$		0.76	1.11	m Ω
$V_{GE(th)}$	$V_{CE} = 10\text{ V}, I_C = 138\text{ mA}$		5.4	6	6.6	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$				5	mA
C_{ies}	$V_{CE} = 10\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		264.0		nF
C_{oes}		$f = 1\text{ MHz}$		8.29		nF
C_{res}		$f = 1\text{ MHz}$		3.24		nF
Q_G	$V_{GE} = -15\text{ V} \dots +15\text{ V}$			12300		nC
R_{Gint}	$T_j = 25^\circ\text{C}$			0.5		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		486		ns
t_r	$I_C = 1400\text{ A}$	$T_j = 150^\circ\text{C}$		183		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		268		mJ
$t_{d(off)}$	$R_{G on} = 1.2\ \Omega$	$T_j = 150^\circ\text{C}$		684		ns
t_f	$R_{G off} = 1\ \Omega$	$T_j = 150^\circ\text{C}$		100		ns
E_{off}	$di/dt_{on} = 7800\text{ A}/\mu\text{s}$ $di/dt_{off} = 12400\text{ A}/\mu\text{s}$ $dv/dt = 5000\text{ V}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		177		mJ
		$T_j = 150^\circ\text{C}$				
$R_{th(j-c)}$	per IGBT				0.028	K/W
$R_{th(c-s)}$	per IGBT ($\lambda_{grease} = 0.81\text{ W}/(\text{m}^2\text{K})$)			0.017		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material			0.013		K/W
IGBT2						
$V_{CE(sat)}$	$I_C = 1400\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		1.55	1.94	V
		$T_j = 150^\circ\text{C}$		1.81	2.48	V
V_{CE0}	chipelevel	$T_j = 25^\circ\text{C}$		0.86	0.96	V
		$T_j = 150^\circ\text{C}$		0.75	0.93	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		0.49	0.70	m Ω
		$T_j = 150^\circ\text{C}$		0.75	1.11	m Ω
$V_{GE(th)}$	$V_{CE} = 10\text{ V}, I_C = 138\text{ mA}$		5.4	6	6.6	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$				5	mA
C_{ies}	$V_{CE} = 10\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		264.0		nF
C_{oes}		$f = 1\text{ MHz}$		8.29		nF
C_{res}		$f = 1\text{ MHz}$		3.24		nF
Q_G	$V_{GE} = -15\text{ V} \dots +15\text{ V}$			12300		nC
R_{Gint}	$T_j = 25^\circ\text{C}$			0.5		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		509		ns
t_r	$I_C = 1400\text{ A}$	$T_j = 150^\circ\text{C}$		244		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		202		mJ
$t_{d(off)}$	$R_{G on} = 1.4\ \Omega$	$T_j = 150^\circ\text{C}$		1716		ns
t_f	$R_{G off} = 5.1\ \Omega$	$T_j = 150^\circ\text{C}$		194		ns
E_{off}	$di/dt_{on} = 6500\text{ A}/\mu\text{s}$ $di/dt_{off} = 7700\text{ A}/\mu\text{s}$ $dv/dt = 2600\text{ V}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		287		mJ
		$T_j = 150^\circ\text{C}$				
$R_{th(j-c)}$	per IGBT				0.028	K/W
$R_{th(c-s)}$	per IGBT ($\lambda_{grease} = 0.81\text{ W}/(\text{m}^2\text{K})$)			0.017		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material			0.013		K/W

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Typical Applications

- 1500V Solar inverters

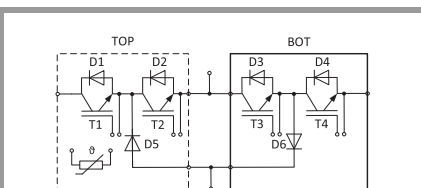
Remarks*

- BOT-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

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
$V_F = V_{EC}$	$I_F = 1400\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	2.07	2.38		V
		$T_j = 150^\circ\text{C}$	1.97	2.28		V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$	1.30	1.50		V
		$T_j = 150^\circ\text{C}$	0.90	1.10		V
r_F	chipelevel	$T_j = 25^\circ\text{C}$	0.55	0.63		mΩ
		$T_j = 150^\circ\text{C}$	0.77	0.84		mΩ
I_{RRM}	$I_F = 1400\text{ A}$	$T_j = 150^\circ\text{C}$	667			A
Q_{rr}	$di/dt_{off} = 6500\text{ A}/\mu\text{s}$ $V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$	187			μC
E_{rr}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	76			mJ
$R_{th(j-c)}$	per diode				0.033	K/W
$R_{th(c-s)}$	per Diode ($\lambda_{grease} = 0.81\text{ W}/(\text{m}^*\text{K})$)			0.0195		K/W
$R_{th(c-s)}$	per Diode, pre-applied phase change material			0.015		K/W
Diode2						
$V_F = V_{EC}$	$I_F = 1400\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	2.07	2.38		V
		$T_j = 150^\circ\text{C}$	1.97	2.28		V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$	1.30	1.50		V
		$T_j = 150^\circ\text{C}$	0.90	1.10		V
r_F	chipelevel	$T_j = 25^\circ\text{C}$	0.55	0.63		mΩ
		$T_j = 150^\circ\text{C}$	0.77	0.84		mΩ
I_{RRM}	$I_F = 1400\text{ A}$	$T_j = 150^\circ\text{C}$	667			A
Q_{rr}	$di/dt_{off} = 6500\text{ A}/\mu\text{s}$ $V_R = 600\text{ V}$	$T_j = 150^\circ\text{C}$	187			μC
$E_{rr} \text{ } ^1)$	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	-			mJ
$R_{th(j-c)}$	per diode				0.033	K/W
$R_{th(c-s)}$	per Diode ($\lambda_{grease} = 0.81\text{ W}/(\text{m}^*\text{K})$)			0.0195		K/W
$R_{th(c-s)}$	per Diode, pre-applied phase change material			0.015		K/W
Diode5						
$V_F = V_{EC}$	$I_F = 1400\text{ A}$ chipelevel	$T_j = 25^\circ\text{C}$	2.07	2.38		V
		$T_j = 150^\circ\text{C}$	1.97	2.28		V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$	1.30	1.50		V
		$T_j = 150^\circ\text{C}$	0.90	1.10		V
r_F	chipelevel	$T_j = 25^\circ\text{C}$	0.55	0.63		mΩ
		$T_j = 150^\circ\text{C}$	0.77	0.84		mΩ
I_{RRM}	$I_F = 1400\text{ A}$	$T_j = 150^\circ\text{C}$	632			A
Q_{rr}	$di/dt_{off} = 7870\text{ A}/\mu\text{s}$ $V_R = 600\text{ V}$	$T_j = 150^\circ\text{C}$	185			μC
E_{rr}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	66			mJ
$R_{th(j-c)}$	per diode				0.033	K/W
$R_{th(c-s)}$	per Diode ($\lambda_{grease} = 0.81\text{ W}/(\text{m}^*\text{K})$)			0.0195		K/W
$R_{th(c-s)}$	per Diode, pre-applied phase change material			0.015		K/W



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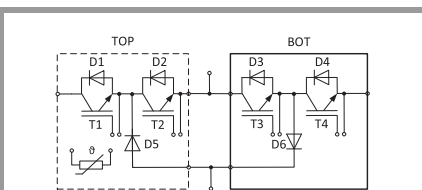
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Module						
L_{sCE1}				14		nH
L_{sCE2}				42		nH
$R_{CC'+EE'}$	measured per switch	$T_C = 25^\circ\text{C}$		0.1		m Ω
		$T_C = 125^\circ\text{C}$		0.15		m Ω
$R_{th(c-s)1}$	calculated without thermal coupling ($\lambda_{grease}=0.81 \text{ W}/(\text{m}^2\text{K})$)			0.0037		K/W
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module ($\lambda_{grease}=0.81 \text{ W}/(\text{m}^2\text{K})$)			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



MLI BOT-Switch

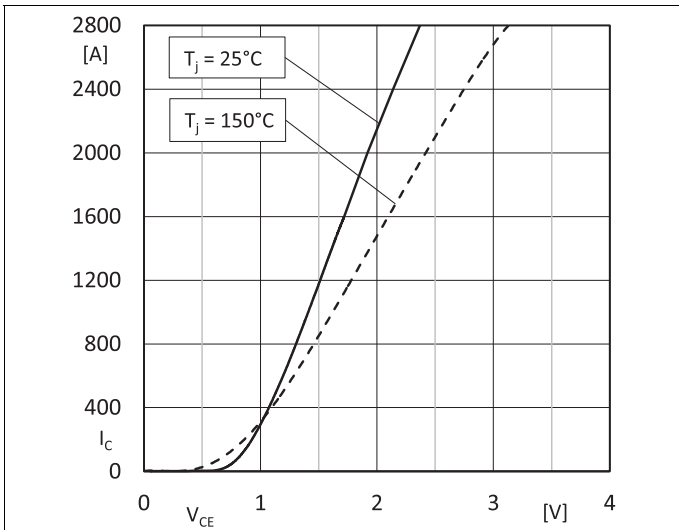


Fig. 1: Typ. IGBT1 output characteristics $I_C=f(V_{CE})$, $V_{GE}=15V$ (chipelevel)

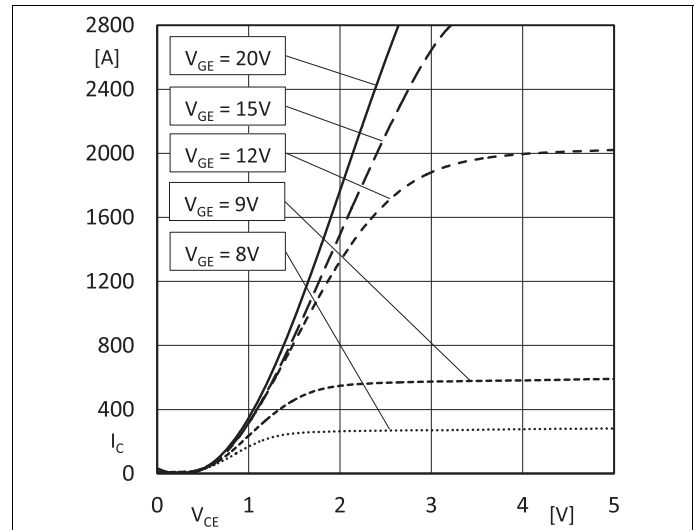


Fig. 2: Typ. IGBT1 output characteristics $I_C=f(V_{CE})$, $T_j=150^\circ C$ (chipelevel)

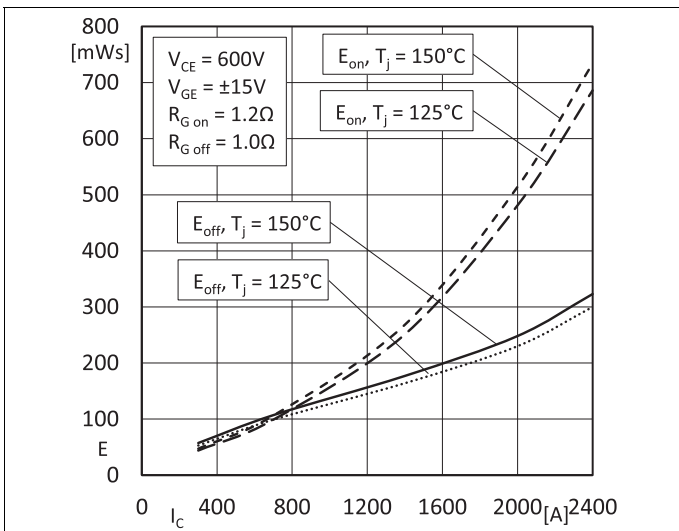


Fig. 3: Typ. IGBT1 switching losses $E=f(I_C)$

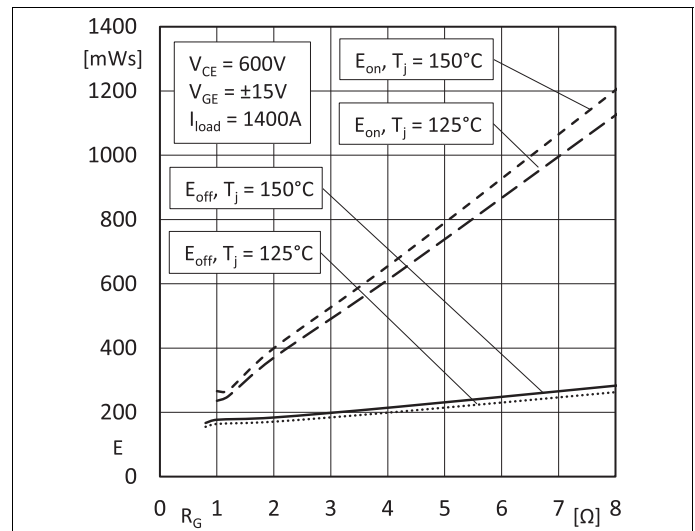


Fig. 4: Typ. IGBT1 switching losses $E=f(R_G)$

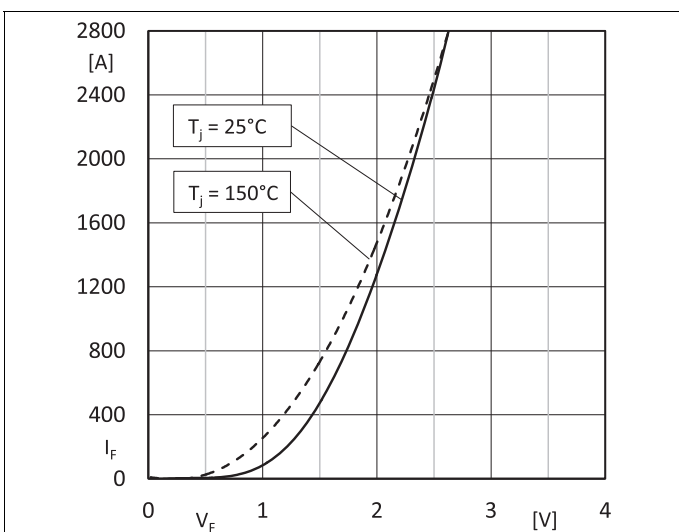


Fig. 5: Typ. Diode5 forward characteristics $I_F=f(V_F)$ (chipelevel)

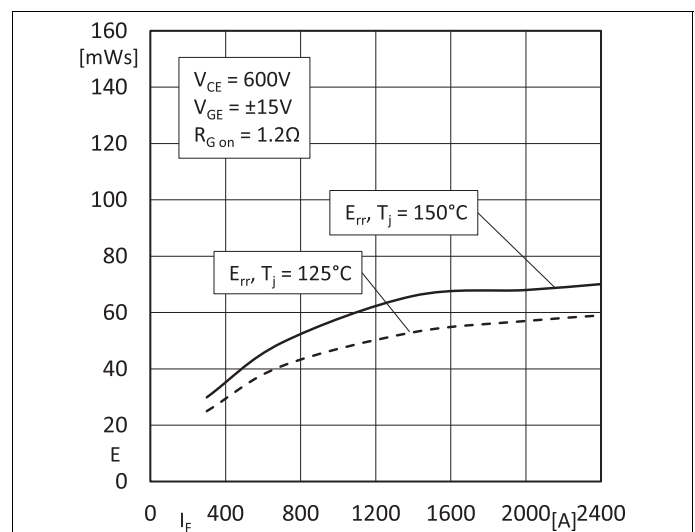


Fig. 6: Typ. Diode5 switching losses $E=f(I_F)$

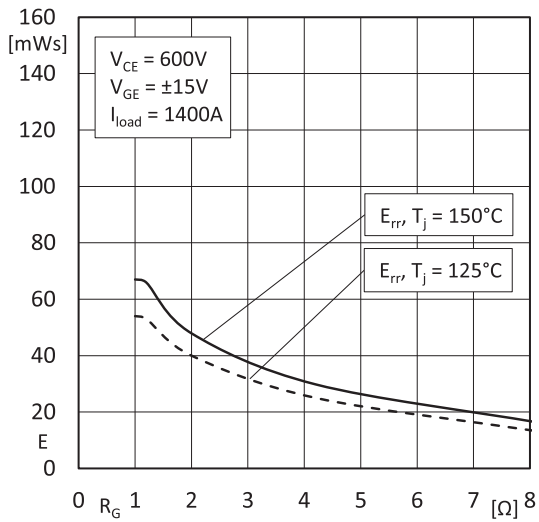


Fig. 7: Typ. Diode5 switching losses $E=f(R_G)$

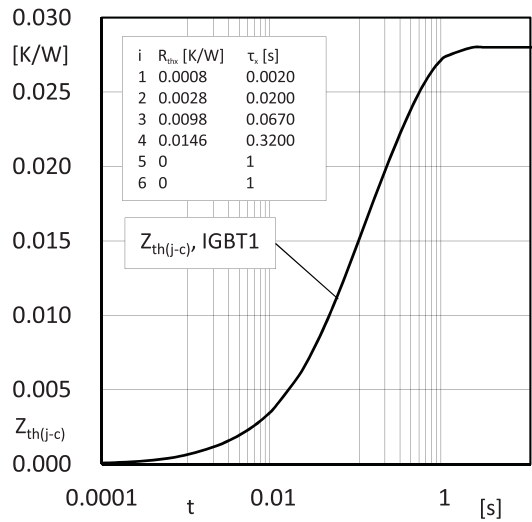


Fig. 8: IGBT1 transient thermal impedance

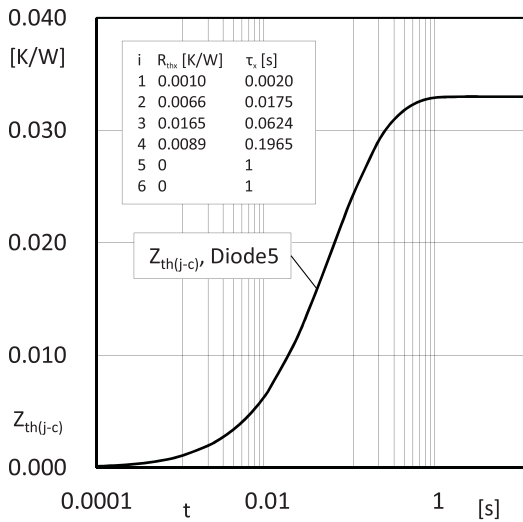


Fig. 9: Diode5 transient thermal impedance

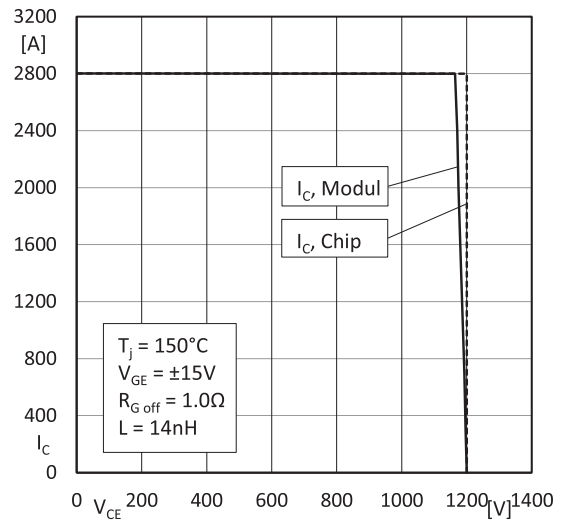


Fig. 10: RBSOA IGBT1

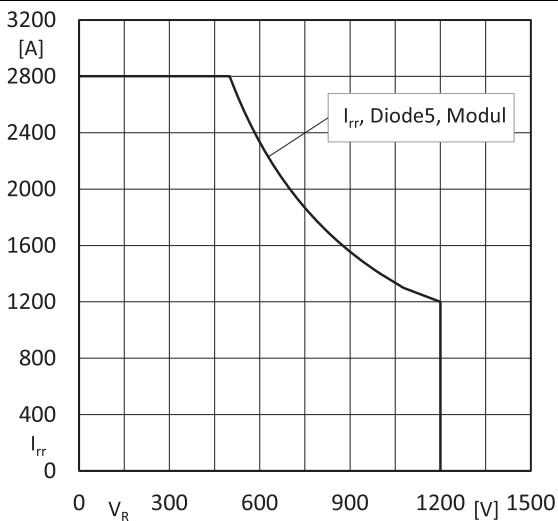


Fig. 11: RBSOA Diode5

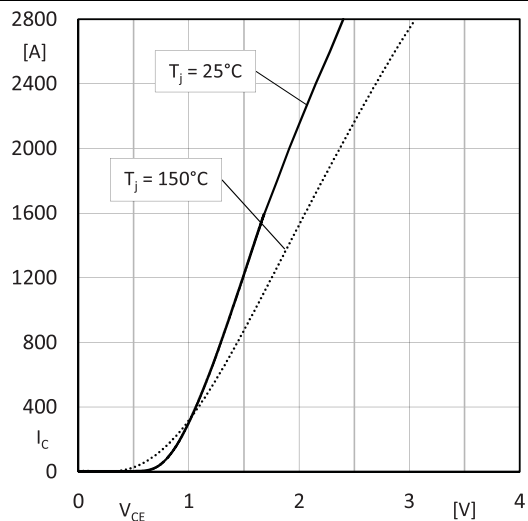


Fig. 12: Typ. IGBT2 output characteristics $I_C=f(V_{CE})$, $V_{GE}=15V$ (chipllevel)

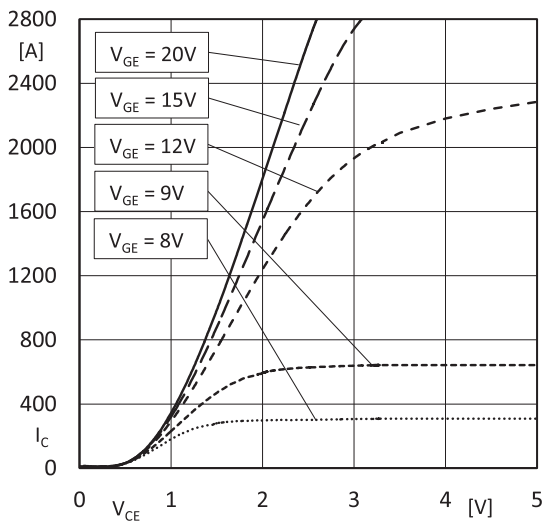


Fig. 13: Typ. IGBT2 output characteristics $I_C=f(V_{CE})$, $T_j=150^\circ\text{C}$ (chipevel)

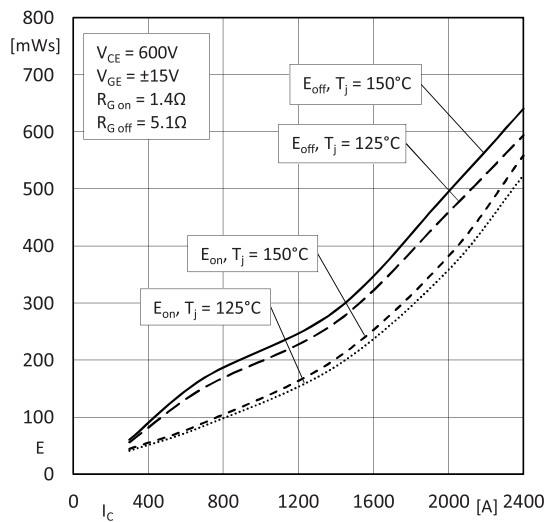


Fig. 14: Typ. IGBT2 switching losses $E=f(I_C)$

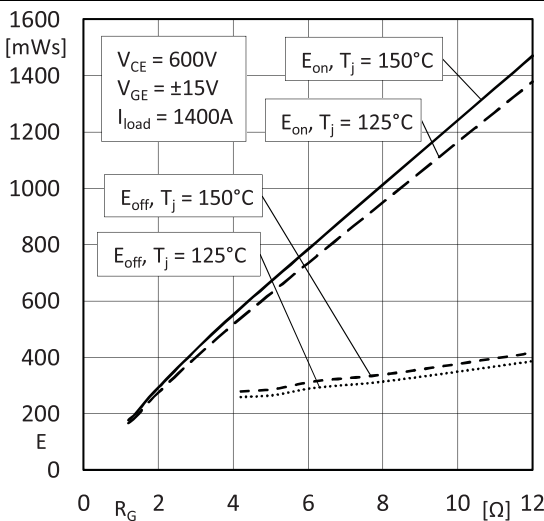


Fig. 15: Typ. IGBT2 switching losses $E=f(R_G)$

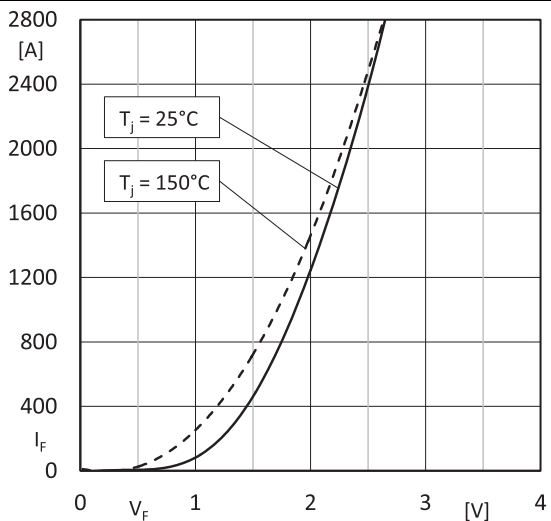


Fig. 16: Typ. Diode1 forward characteristics $I_F=f(V_F)$ (chipevel)

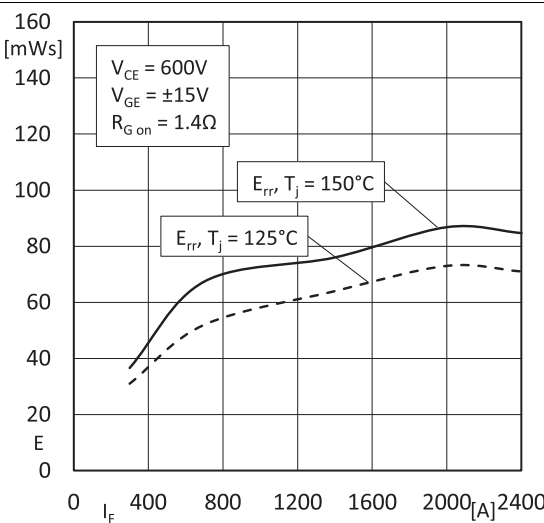


Fig. 17: Typ. Diode1 switching losses $E=f(I_F)$

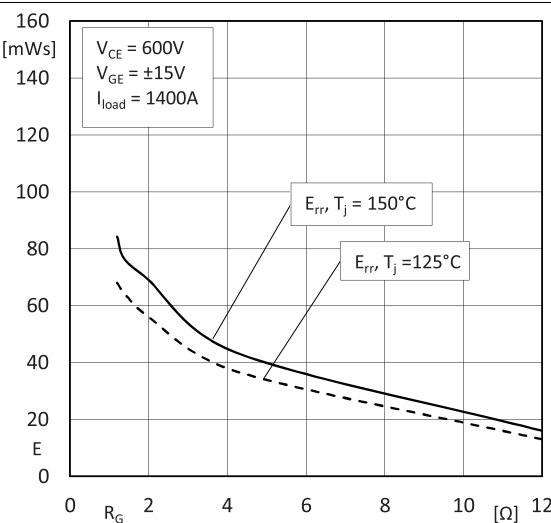


Fig. 18: Typ. Diode1 switching losses $E=f(R_G)$

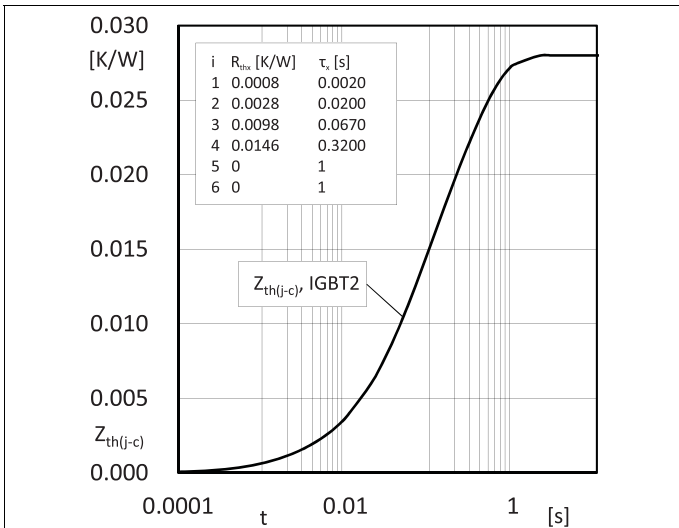


Fig. 19: IGBT2 transient thermal impedance

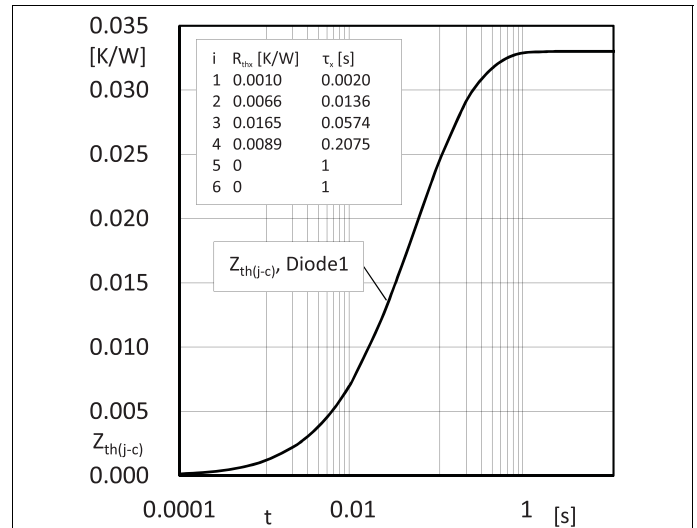


Fig. 20: Diode1 transient thermal impedance

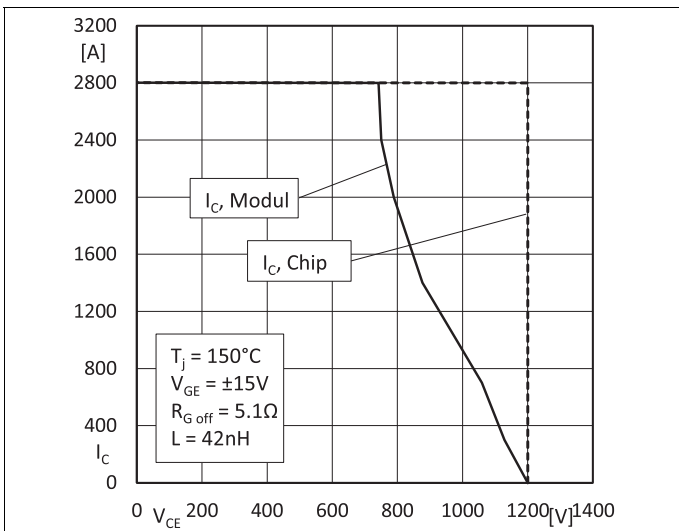


Fig. 21: RBSOA IGBT2

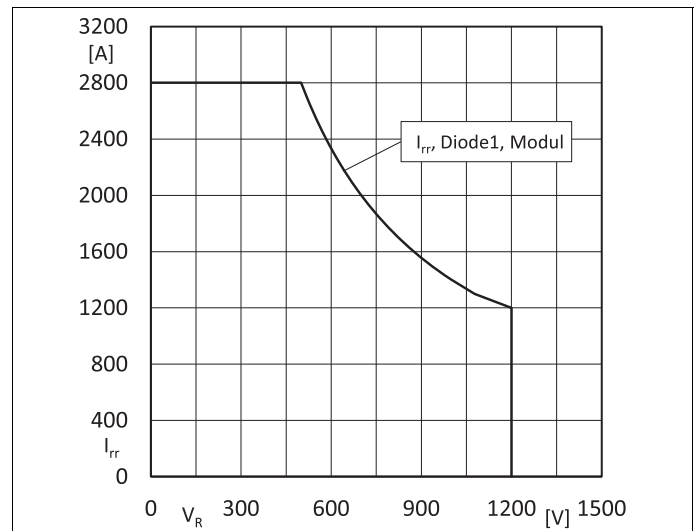


Fig. 22: RBSOA Diode1

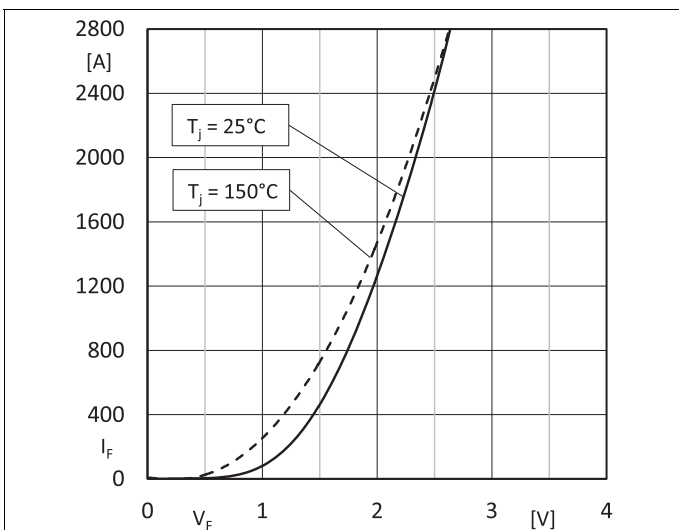


Fig. 23: Typ. Diode2 forward characteristics $I_F=f(V_F)$ (chipllevel)

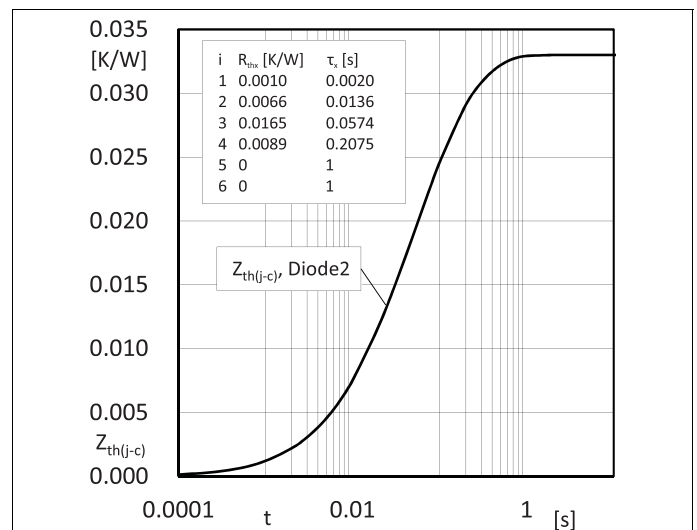


Fig. 24: Diode2 transient thermal impedance

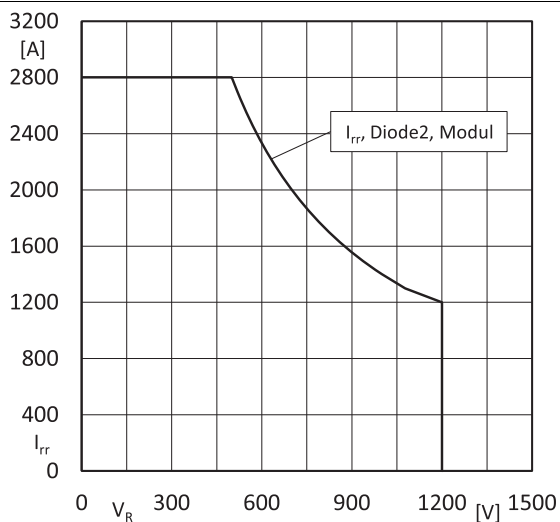


Fig. 25: RBSOA Diode2

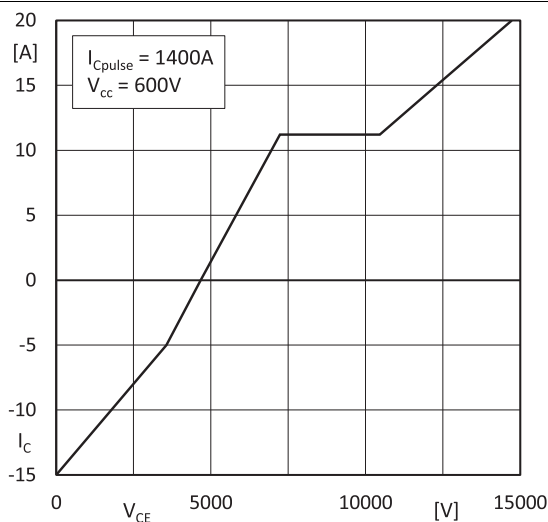


Fig. 27: Typ. gate charge characteristic of IGBT1

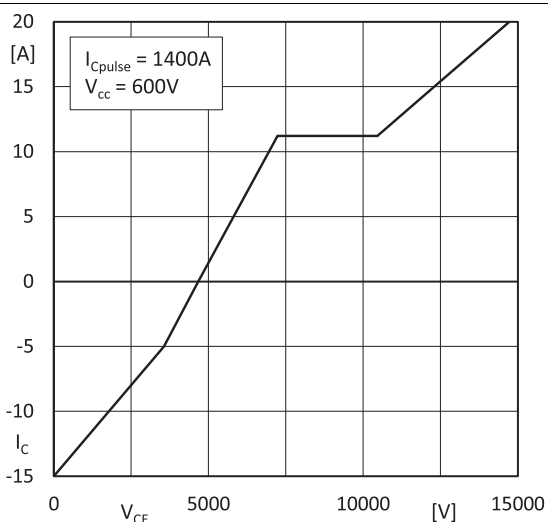


Fig. 28: Typ. gate charge characteristic of IGBT2

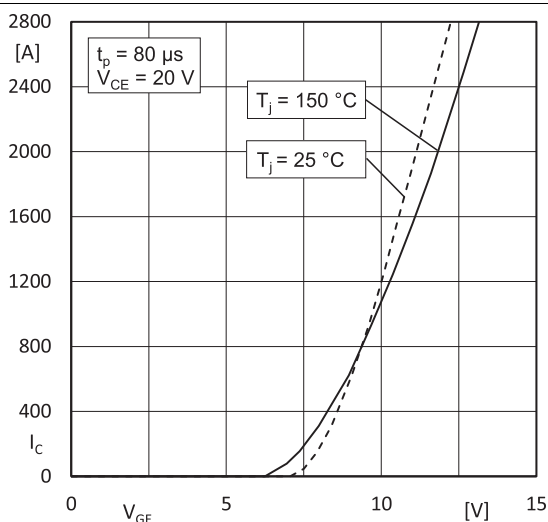
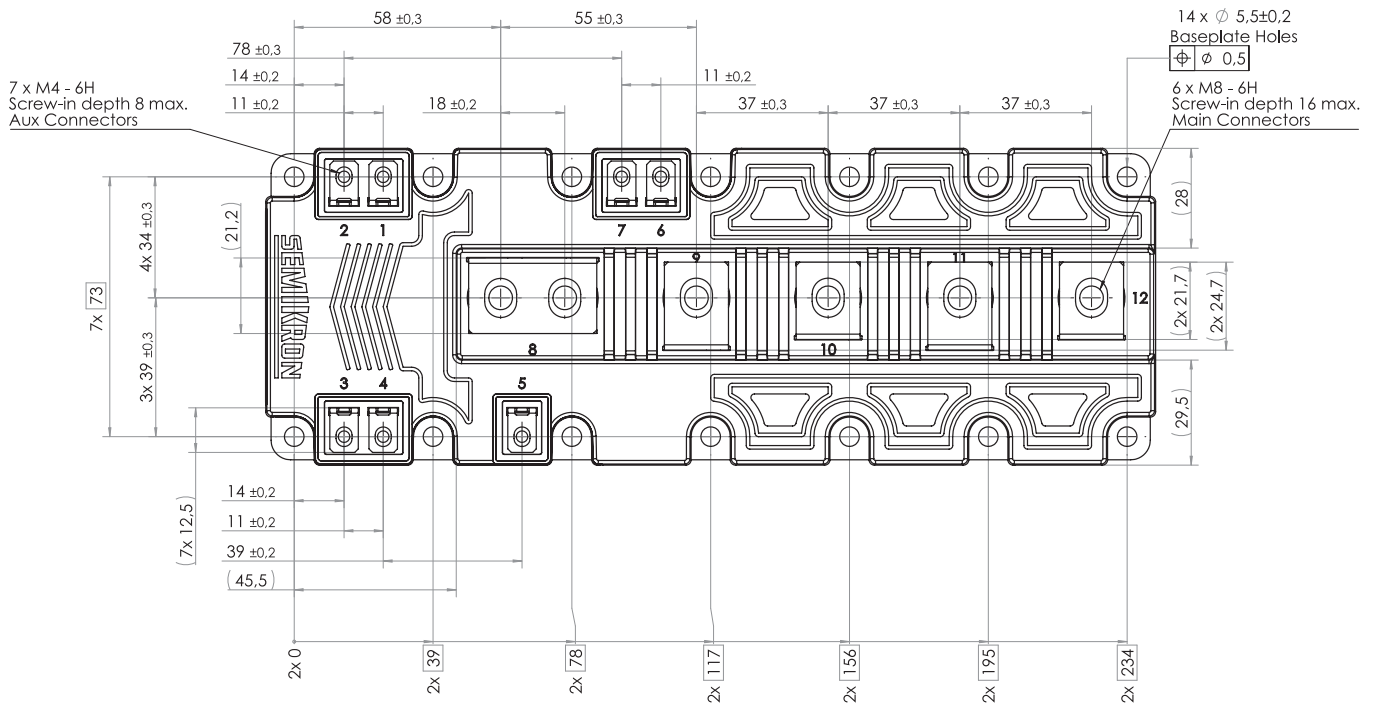
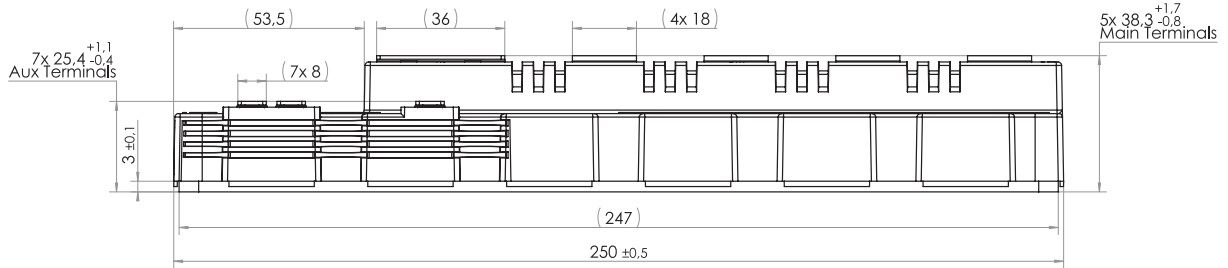
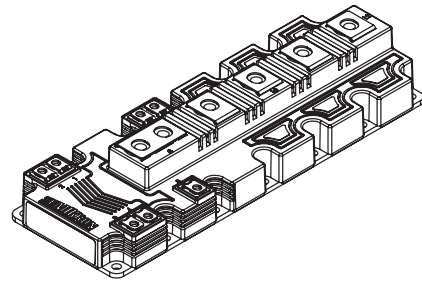
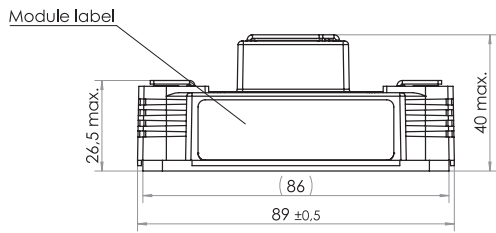


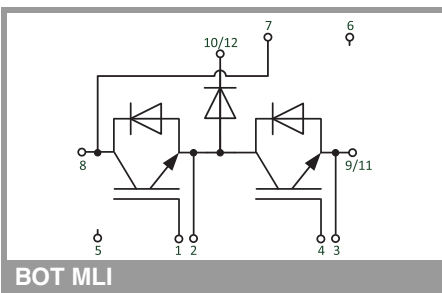
Fig. 29: Typ. transfer characteristic

SKM1400MLI12BM7



- Dimensions in mm
- General tolerances \pm 0.5mm

SEMITRANS 10



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

***IMPORTANT INFORMATION AND WARNINGS**

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