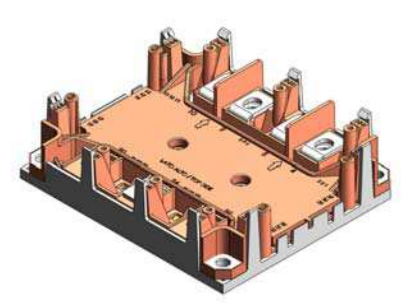


SKiM® 4

Trench IGBT Modules

SKiM401TMLI12E4B

Features

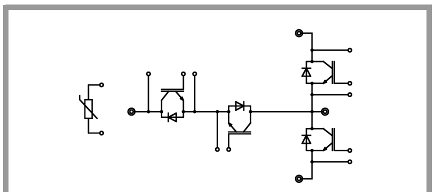
- IGBT 4 Trench Gate Technology
- Solder technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Low inductance case
- Isolated by Al_2O_3 DCB (Direct Copper Bonded) ceramic substrate
- Pressure contact technology for thermal contacts
- Spring contact system to attach driver PCB to the control terminals
- High short circuit capability, self limiting to 6 x I_C
- Integrated temperature sensor

Typical Applications*

- Automotive inverter
- High reliability AC inverter wind
- High reliability AC inverter drives

Remarks

- Case temperature limited to T_s = 125°C max; T_c = T_s (for baseplateless modules)
- Recommended T_{op} = -40 … +150°C



TMLI

Absolute Maximum Ratings

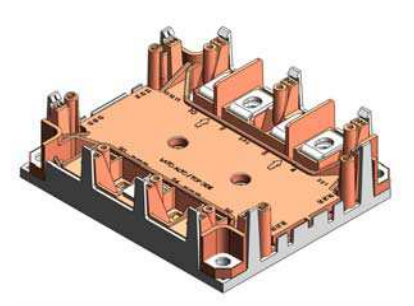
Symbol	Conditions		Values	Unit
IGBT 1				
V_{CES}	T_j = 25 °C		1200	V
I_C	T_j = 150 °C	T_s = 25 °C	348	A
		T_s = 70 °C	264	A
I_C	T_j = 175 °C	T_s = 25 °C	388	A
		T_s = 70 °C	312	A
I_{Cnom}			400	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		1200	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 800 V $V_{GE} \leq$ 15 V $V_{CES} \leq$ 1200 V	T_j = 150 °C	10	µs
T_j			-40 ... 175	°C

Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
IGBT 2				
V_{CES}	T_j = 25 °C		650	V
I_C	T_j = 150 °C	T_s = 25 °C	283	A
		T_s = 70 °C	209	A
I_C	T_j = 175 °C	T_s = 25 °C	319	A
		T_s = 70 °C	252	A
I_{Cnom}			400	A
I_{CRM}	I_{CRM} = 2 x I_{Cnom}		800	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 360 V $V_{GE} \leq$ 15 V $V_{CES} \leq$ 650 V	T_j = 150 °C	10	µs
T_j			-40 ... 175	°C

Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
Module			
$I_{t(RMS)}$	$T_{terminal}$ = 80 °C,	400	A
T_{stg}		-40 ... 125	°C
V_{isol}	AC sinus 50 Hz, t = 1 min	2500	V



SKiM® 4

Trench IGBT Modules

SKiM401TMLI12E4B

Features

- IGBT 4 Trench Gate Technology
- Solder technology
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Remarks

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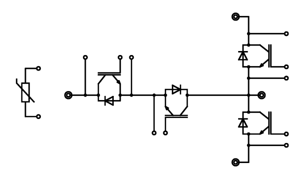

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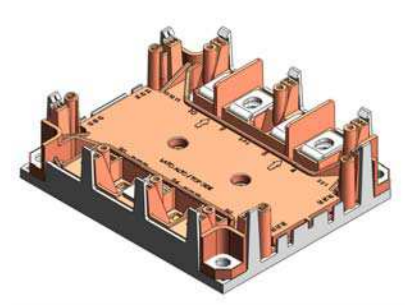
Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
Diode 1				
V_{RRM}	T_j = 25 °C		1200	V
I_F	T_j = 175 °C	T_s = 25 °C	311	A
		T_s = 70 °C	245	A
I_F	T_j = 175 °C	T_s = 25 °C	311	A
		T_s = 70 °C	245	A
I_{Fnom}			400	A
I_{FRM}	I_{FRM} = 3 x I_{Fnom}		1200	A
I_{FSM}	10 ms, sin 180°, T_j = 150 °C		1980	A
T_j			-40 ... 175	°C

Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
Diode 2				
V_{RRM}	T_j = 25 °C		650	V
I_F	T_j = 175 °C	T_s = 25 °C	334	A
		T_s = 70 °C	256	A
I_F	T_j = 175 °C	T_s = 25 °C	334	A
		T_s = 70 °C	256	A
I_{Fnom}			400	A
I_{FRM}	I_{FRM} = 2xI_{Fnom}		800	A
I_{FSM}	10 ms sin 180°	T_j = 25 °C	2646	A
		T_j = 150 °C	2322	A
T_j			-40 ... 175	°C



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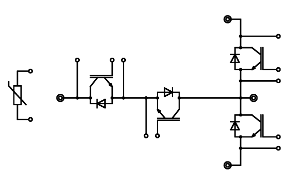

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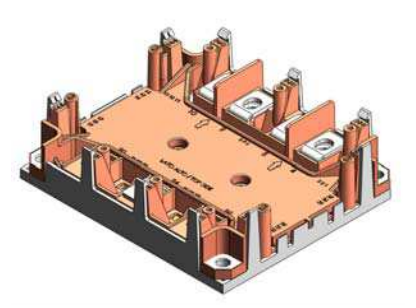
Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT 1						
$V_{CE(sat)}$	I_C = 400 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.80	2.05	V
		T_j = 150 °C		2.20	2.40	V
V_{CE0}	chiplevel	T_j = 25 °C		0.8	0.9	V
		T_j = 150 °C		0.7	0.8	V
r_{CE}	V_{GE} = 15 V chiplevel	T_j = 25 °C		2.5	2.9	mΩ
		T_j = 150 °C		3.8	4.0	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE} V, I_C = 15.2 mA		5	5.8	6.5	V
I_{CES}	V_{GE} = 0 V V_{CE} = 1200 V	T_j = 25 °C				mA
						mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		24.6		nF
C_{oes}		f = 1 MHz		1.62		nF
C_{res}		f = 1 MHz		1.38		nF
Q_G	- 8 V...+ 15 V			2242.3		nC
R_{Gint}	T_j = 25 °C			1.88		Ω
$t_{d(on)}$	V_{CE} = 300 V I_C = 400 A $R_{G\ on}$ = 2 Ω $R_{G\ off}$ = 2 Ω di/dt$_{on}$ = 4822 A/µs di/dt$_{off}$ = 2259 A/µs $V_{GE\ neg}$ = -15 V $V_{GE\ pos}$ = 15 V	T_j = 150 °C		290.57		ns
t_r		T_j = 150 °C		92.57		ns
E_{on}		T_j = 150 °C		8.83		mJ
$t_{d(off)}$		T_j = 150 °C		474		ns
t_f		T_j = 150 °C		121.7		ns
E_{off}		T_j = 150 °C		25.83		mJ
$R_{th(j-s)}$	per IGBT			0.16		K/W

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT 2						
$V_{CE(sat)}$	I_C = 400 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.55	1.95	V
		T_j = 150 °C		1.75	2.1	V
V_{CE0}	chiplevel	T_j = 25 °C		0.9	1	V
		T_j = 150 °C		0.82	0.9	V
r_{CE}	V_{GE} = 15 V chiplevel	T_j = 25 °C		1.6	2.4	mΩ
		T_j = 150 °C		2.3	3.0	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE} V, I_C = 8 mA		5.1	5.8	6.4	V
I_{CES}	V_{GE} = 0 V V_{CE} = 650 V	T_j = 25 °C				mA
		T_j = 150 °C				mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		24.67		nF
C_{oes}		f = 1 MHz				nF
C_{res}		f = 1 MHz		0.732		nF
Q_G	- 8 V...+ 15 V			2718.25		nC
R_{Gint}	T_j = 25 °C			1.00		Ω
$t_{d(on)}$	V_{CE} = 300 V I_C = 400 A $R_{G\ on}$ = 2 Ω $R_{G\ off}$ = 2 Ω di/dt$_{on}$ = 5566 A/µs di/dt$_{off}$ = 1547 A/µs $V_{GE\ neg}$ = -15 V $V_{GE\ pos}$ = 15 V	T_j = 150 °C		149.14		ns
t_r		T_j = 150 °C		79.7		ns
E_{on}		T_j = 150 °C		3.32		mJ
$t_{d(off)}$		T_j = 150 °C		420		ns
t_f		T_j = 150 °C		180		ns
E_{off}		T_j = 150 °C		20.91		mJ
$R_{th(j-s)}$	per IGBT			0.25		K/W



SKiM® 4

Trench IGBT Modules

SKiM401TMLI12E4B

Features

- IGBT 4 Trench Gate Technology
- Solder technology
- $V_{CE(sat)}$ with positive temperature coefficient
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- Isolated by Al_2O_3 DCB (Direct Copper Bonded) ceramic substrate
- Pressure contact technology for thermal contacts
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- Integrated temperature sensor

Typical Applications*

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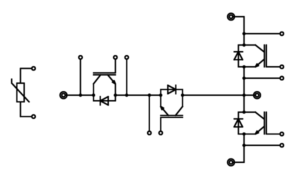
- High reliability AC inverter wind
- High reliability AC inverter drives

Remarks

- Case temperature limited to T_s = 125°C max; $T_c = T_s$ (for baseplateless modules)
- Recommended T_{op} = -40 … +150°C



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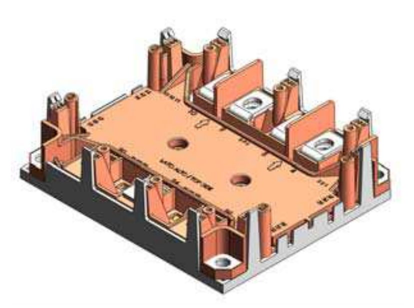
Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Diode 1						
$V_F = V_{EC}$	I_F = 400 A V_{GE} = 15 V 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	1.1	1.3	1.5	V
		T_j = 150 °C	0.7	0.9	1.1	V
r_F	chiplevel	T_j = 25 °C	2.0	2.3	2.5	mΩ
		T_j = 150 °C	2.6	3.1	3.4	mΩ
I_{RRM}	I_F = 400 A di/dt$_{off}$ = 1430 A/µs			176.57		A
Q_{rr}				28.63		µC
E_{rr}	V_R = 300 V			2.391		mJ
$R_{th(j-s)}$	per DIODE			0.24		K/W

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Diode 2						
$V_F = V_{EC}$	I_F = 400 A chiplevel	T_j = 25 °C		1.4	1.80	V
		T_j = 150 °C		1.38	1.76	V
V_{F0}	chiplevel	T_j = 25 °C	0.95	1.04	1.236	V
		T_j = 150 °C		0.85	0.99	V
r_F	chiplevel	T_j = 25 °C	0.6	0.9	1.3	mΩ
		T_j = 150 °C		1.3	1.9	mΩ
I_{RRM}	I_F = 400 A di/dt$_{off}$ = 1182 A/µs			168.85		A
Q_{rr}				31.66		µC
E_{rr}	V_R = 300 V			2.26		mJ
$R_{th(j-s)}$	per DIODE			0.29		K/W



SKiM® 4

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Module						
L_{CE}				18		nH
$R_{CC'+EE'}$	terminal-chip	T_s = 25 °C		1.35		mΩ
		T_s = 125 °C		1.75		mΩ
$R_{th(c-s)}$	per module					K/W
M_s	to heat sink (M5)		2		3	Nm
M_t		to terminals M6	4		5	Nm
						Nm
w				317		g

Trench IGBT Modules

SKiM401TMLI12E4B

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Remarks

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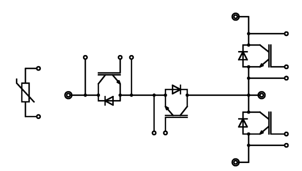
- Recommended T_{op} = -40 … +150°C

Characteristics					
Symbol	**Conditions**	**min.**	**typ.**	**max.**	**Unit**
Temperature Sensor					
R_{100}	T_r = 100 °C, tolerance = 3 %		493 ± 5%		Ω
$B_{100/125}$	$R_{(T)}=R_{100}exp[B_{100/125}(1/T-1/T_{100})]$; T[K];		3550 ±2%		K



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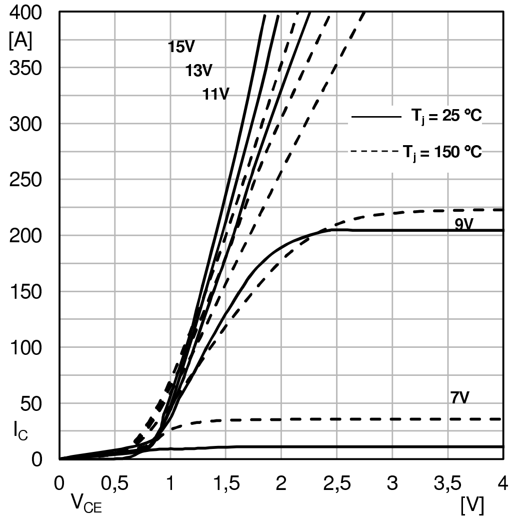


Fig. 1: Typ. IGBT 1 output characteristic, incl. $R_{CC'+ EE'}$

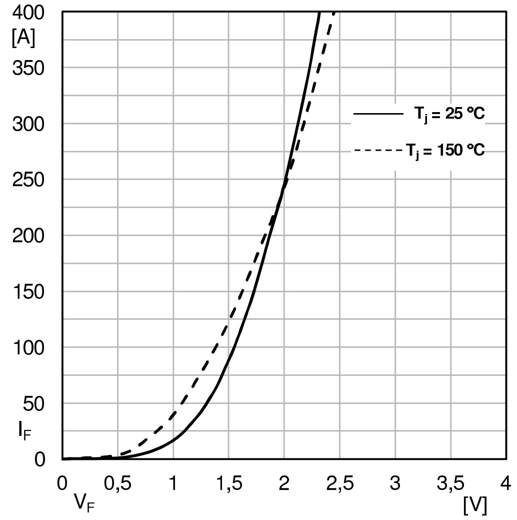


Fig. 2: Typ. Diode 1 output characteristics

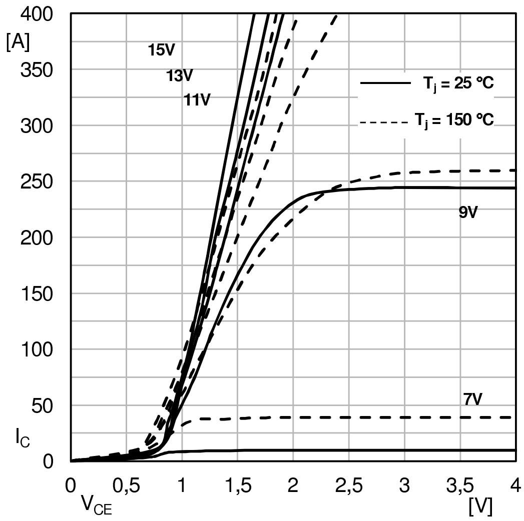


Fig. 3: Typ. IGBT 2 output characteristic, inclusive $R_{CC'+ EE'}$

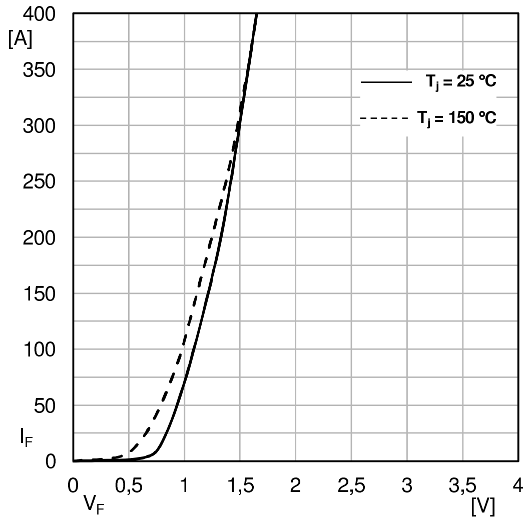


Fig.4: Typ. Diode 2 output characteristic

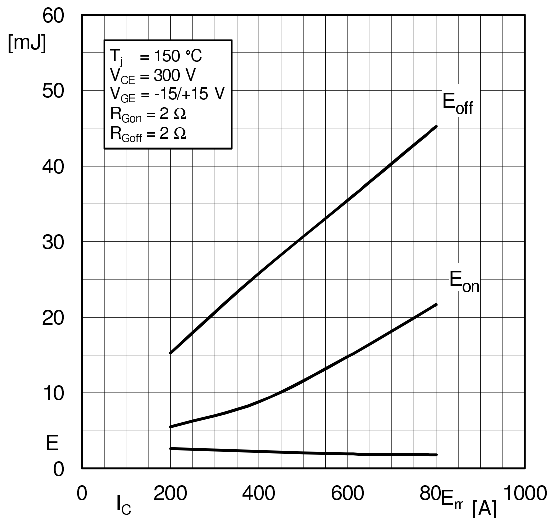


Fig. 5: Typ. IGBT 1 turn-on /-off energy = f (I_C)

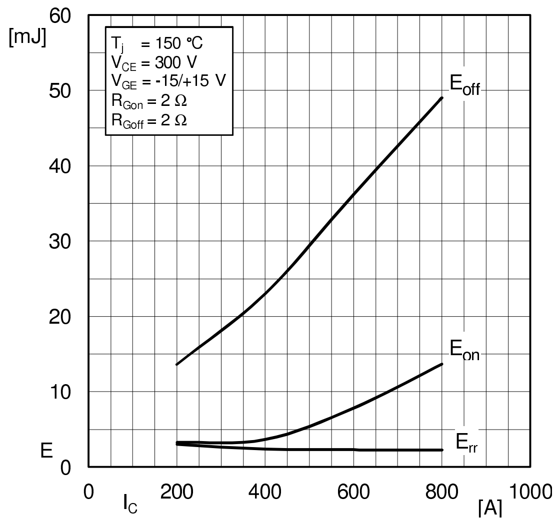


Fig. 6: Typ. IGBT 2 turn-on /-off energy = f (I_C)

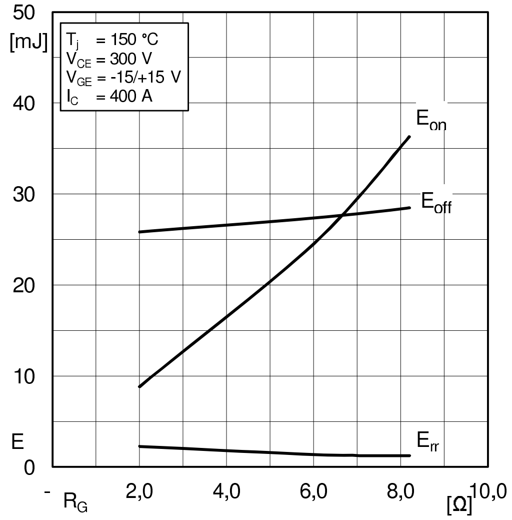


Fig. 7: Typ. IGBT 1 turn-on /-off energy = f (R_G)

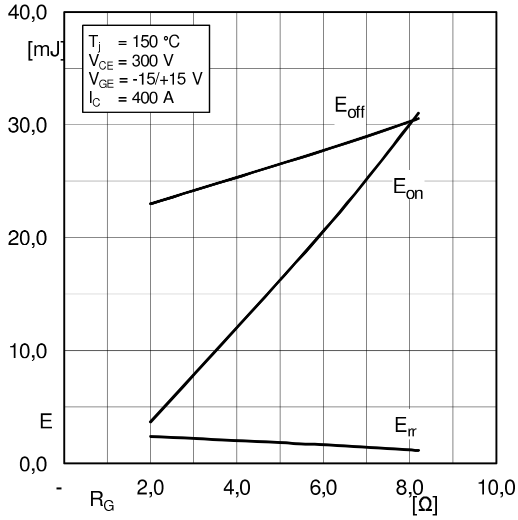


Fig. 8: Typ. IGBT 2 turn-on /-off energy = f (R_G)

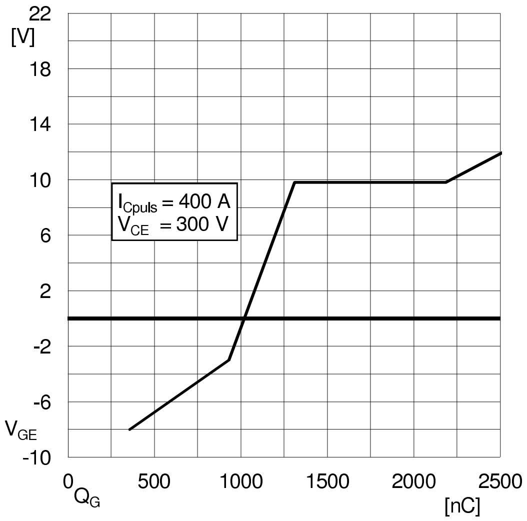


Fig. 9: Typ. IGBT 1 gate charge characteristic

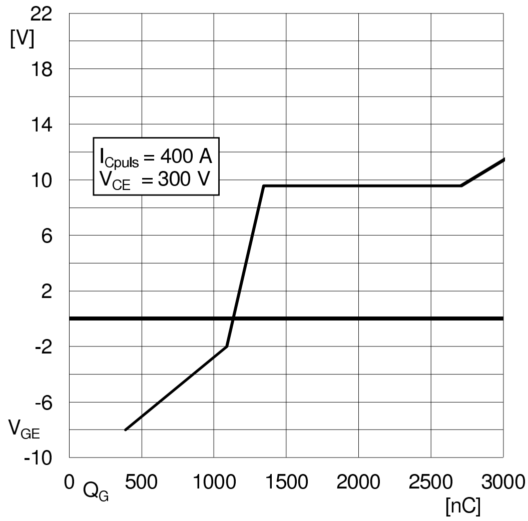


Fig. 10: Typ. IGBT 2 gate charge characteristic

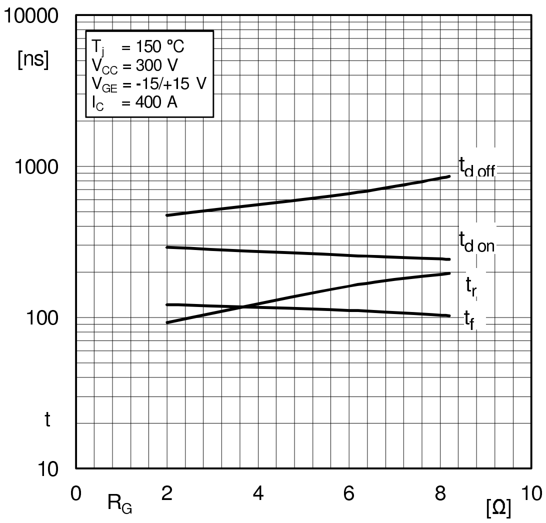


Fig. 11: Typ. IGBT 1 switching times vs. gate resistor R_G

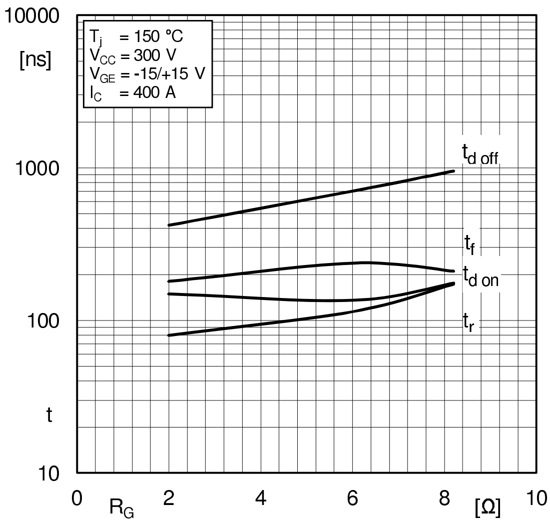


Fig. 12: Typ. IGBT 2 switching times vs. gate resistor R_G

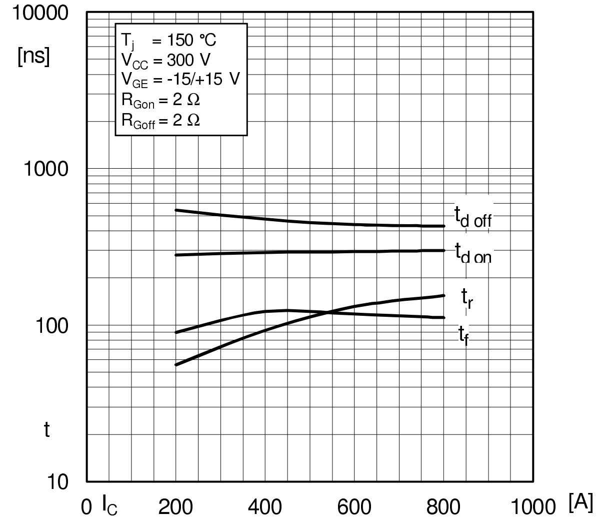


Fig. 13: Typ. IGBT 1 switching times vs. I_C

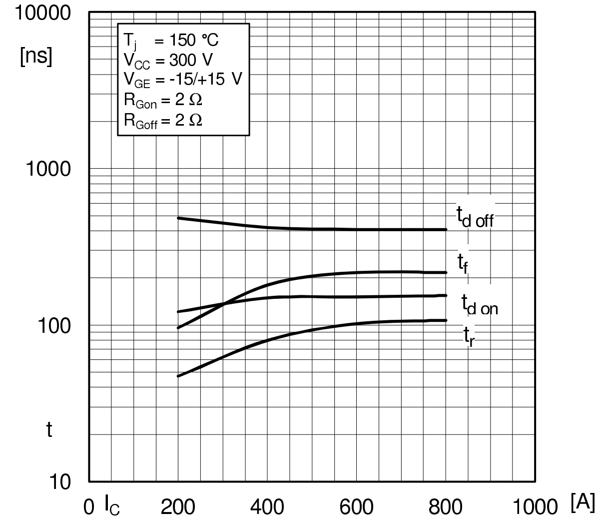


Fig. 14: Typ. IGBT 2 switching times vs. I_C

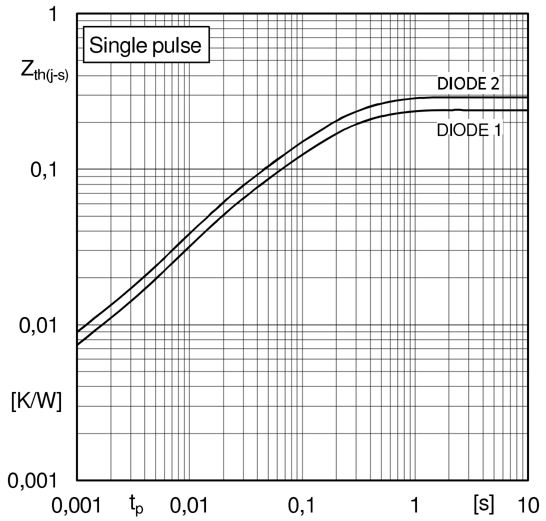


Fig.15: Typ. DIODEs transient thermal impedence

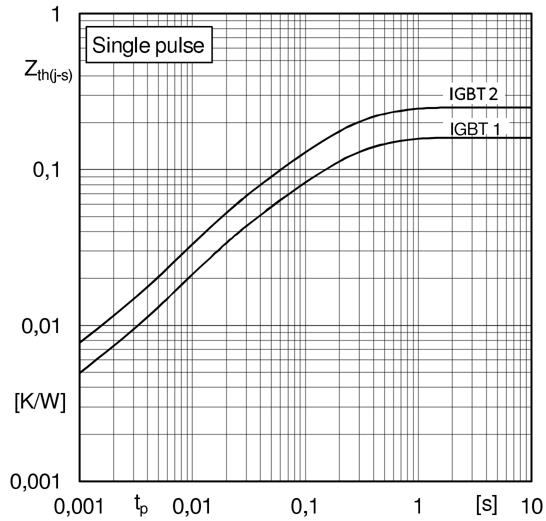
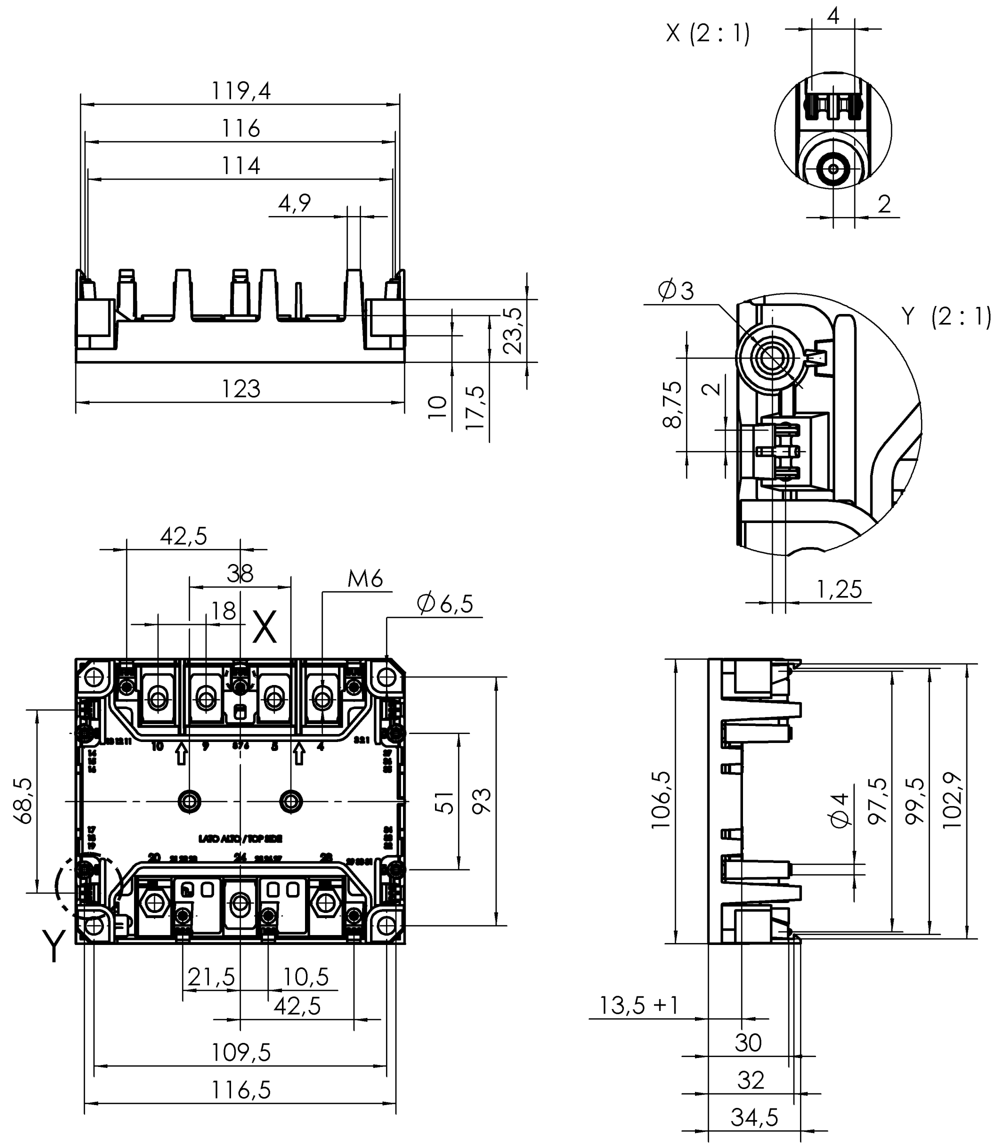
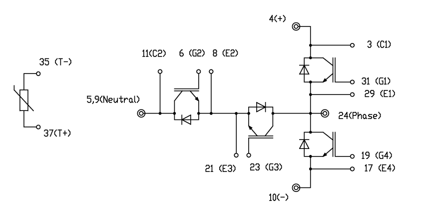


Fig. 16: Typ. IGBTs transient thermal impedence





TMLI

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

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.