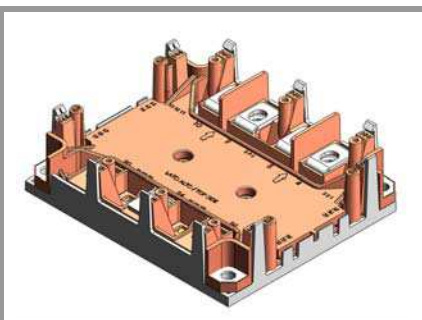


SKiM401TMLI12E4B



SKiM® 4

Trench IGBT Modules

SKiM401TMLI12E4B

Features

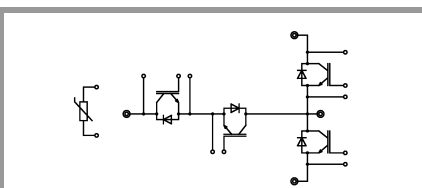
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Typical Applications*

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

Remarks

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



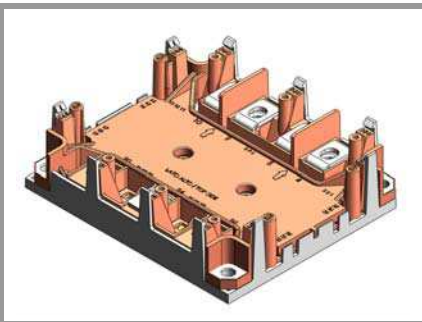
TMLI

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

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

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

SKiM401TMLI12E4B



SKiM® 4

Trench IGBT Modules

SKiM401TMLI12E4B

Features

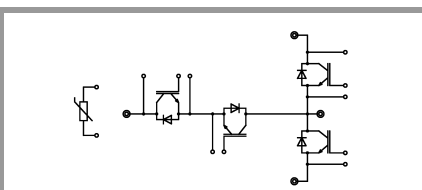
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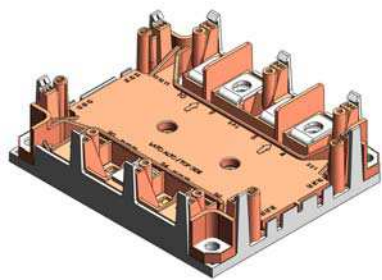


TMLI

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

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

SKiM401TMLI12E4B



SKiM® 4

Trench IGBT Modules

SKiM401TMLI12E4B

Features

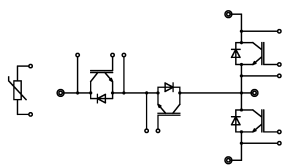
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Remarks

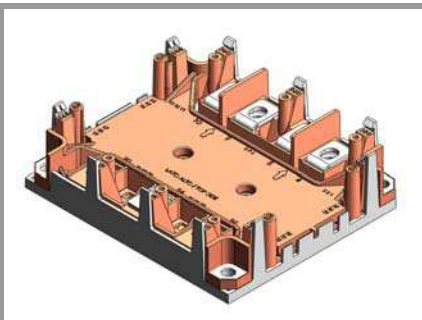
- Case temperature limited to $T_s = 125^\circ C$ max; $T_C = T_s$ (for baseplateless modules)
- Recommended $T_{op} = -40 \dots +150^\circ C$



TMI

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

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



SKiM® 4

Trench IGBT Modules

SKiM401TMLI12E4B

Features

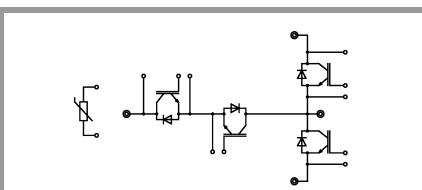
- IGBT 4 Trench Gate Technology
- Solder technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Low inductance case
- Isolated by Al_2O_3 DCB (Direct Copper Bonded) ceramic substrate
- Pressure contact technology for thermal contacts
- Spring contact system to attach driver PCB to the control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

Typical Applications*

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

Remarks

- Case temperature limited to $T_s = 125^\circ C$ max; $T_C = T_s$ (for baseplateless modules)
- Recommended $T_{op} = -40 \dots +150^\circ C$

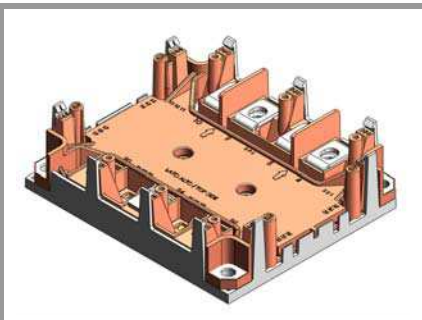


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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode 1						
$V_F = V_{EC}$	$I_F = 400 A$ $V_{GE} = 15 V$ chipelevel	$T_j = 25^\circ C$		2.20	2.52	V
		$T_j = 150^\circ C$		2.15	2.47	V
V_{F0}	chipelevel	$T_j = 25^\circ C$	1.1	1.3	1.5	V
		$T_j = 150^\circ C$	0.7	0.9	1.1	V
r_F	chipelevel	$T_j = 25^\circ C$	2.0	2.3	2.5	m Ω
		$T_j = 150^\circ C$	2.6	3.1	3.4	m Ω
I_{RRM}	$I_F = 400 A$			176.57		A
Q_{rr}	$di/dt_{off} = 1430 A/\mu s$			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						
$V_F = V_{EC}$	$I_F = 400 A$ chipelevel	$T_j = 25^\circ C$		1.4	1.80	V
		$T_j = 150^\circ C$		1.38	1.76	V
V_{F0}	chipelevel	$T_j = 25^\circ C$	0.95	1.04	1.236	V
		$T_j = 150^\circ C$		0.85	0.99	V
r_F	chipelevel	$T_j = 25^\circ C$	0.6	0.9	1.3	m Ω
		$T_j = 150^\circ C$		1.3	1.9	m Ω
I_{RRM}	$I_F = 400 A$			168.85		A
Q_{rr}	$di/dt_{off} = 1182 A/\mu s$			31.66		μC
E_{rr}	$V_R = 300 V$			2.26		mJ
$R_{th(j-s)}$	per DIODE			0.29		K/W

SKiM401TMLI12E4B



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 $6 \times I_C$
- Integrated temperature sensor

Typical Applications*

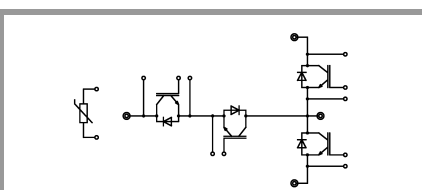
- Automotive inverter
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Remarks

- Case temperature limited to $T_s = 125^\circ C$ max; $T_C = T_s$ (for baseplateless modules)
- Recommended $T_{op} = -40 \dots +150^\circ C$

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

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



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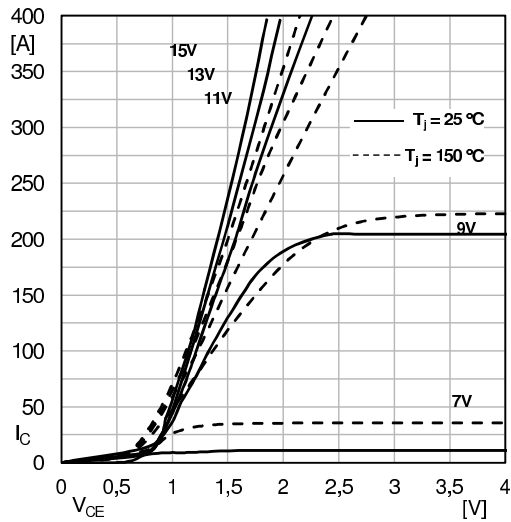


Fig. 1: Typ. IGBT 1 output characteristic, incl. $R_{CC'+EE'}$

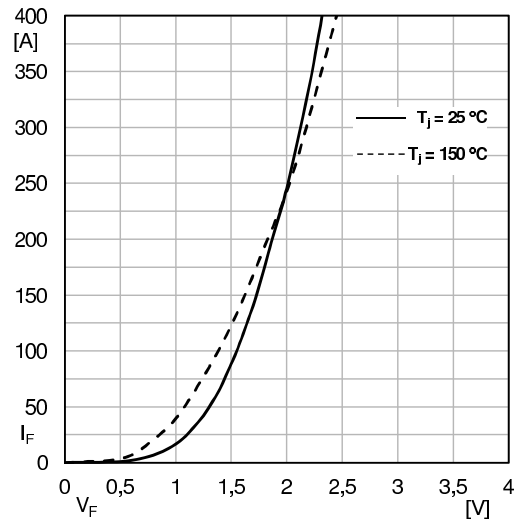


Fig. 2: Typ. Diode 1 output characteristics

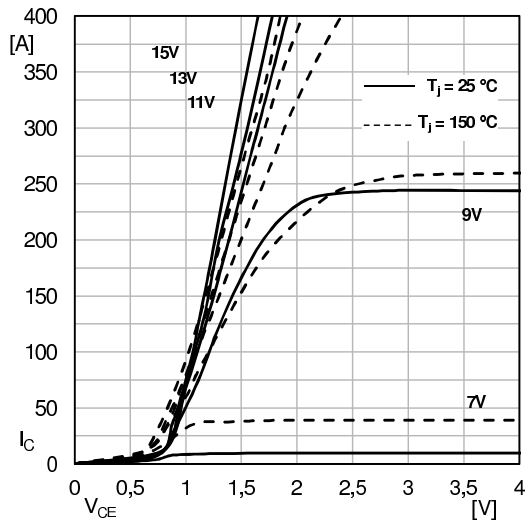


Fig. 3: Typ. IGBT 2 output characteristic, inclusive $R_{CC'+EE'}$

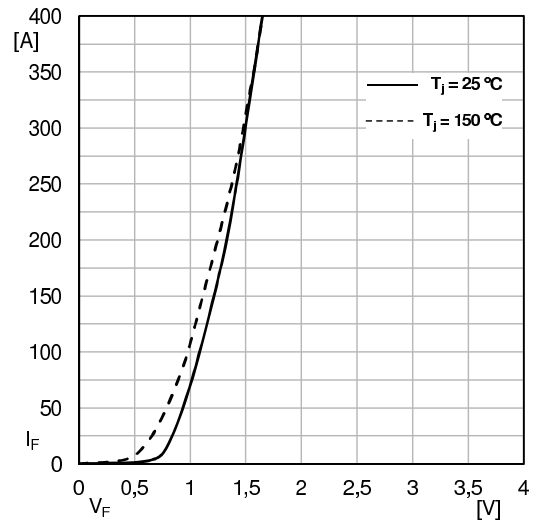


Fig. 4: Typ. Diode 2 output characteristic

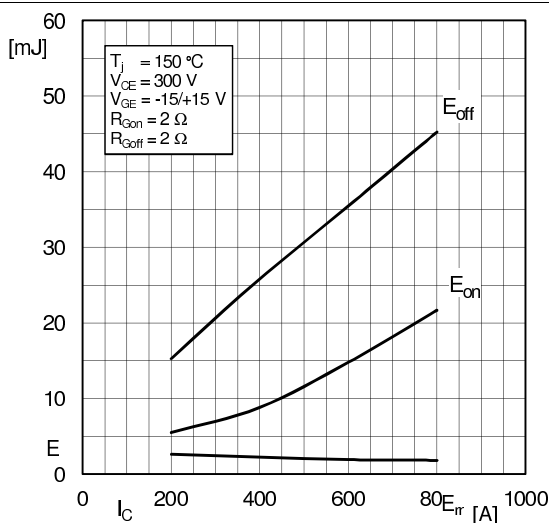


Fig. 5: Typ. IGBT 1 turn-on /-off energy = $f(I_C)$

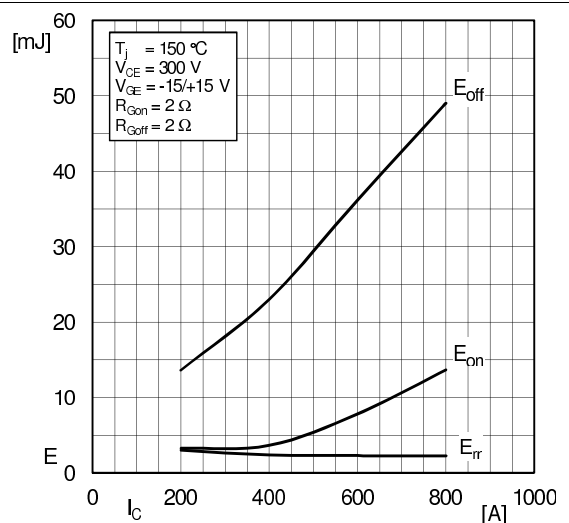


Fig. 6: Typ. IGBT 2 turn-on /-off energy = $f(I_C)$

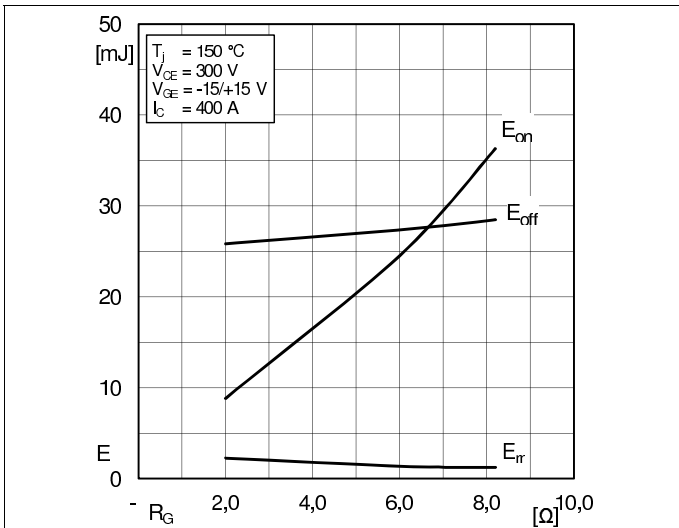


Fig. 7: Typ. IGBT 1 turn-on /-off energy = f (R_G)

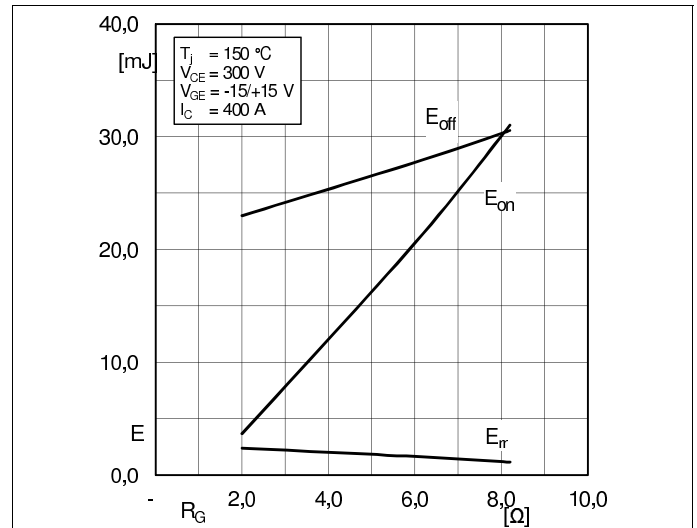


Fig. 8: Typ. IGBT 2 turn-on /-off energy = f (R_G)

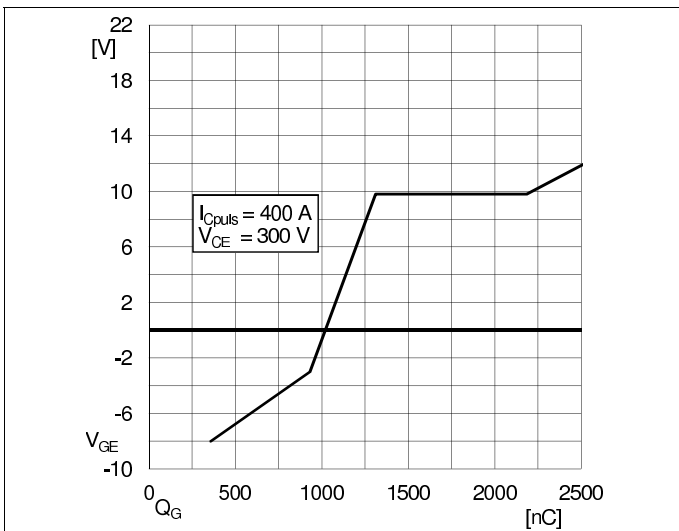


Fig. 9: Typ. IGBT 1 gate charge characteristic

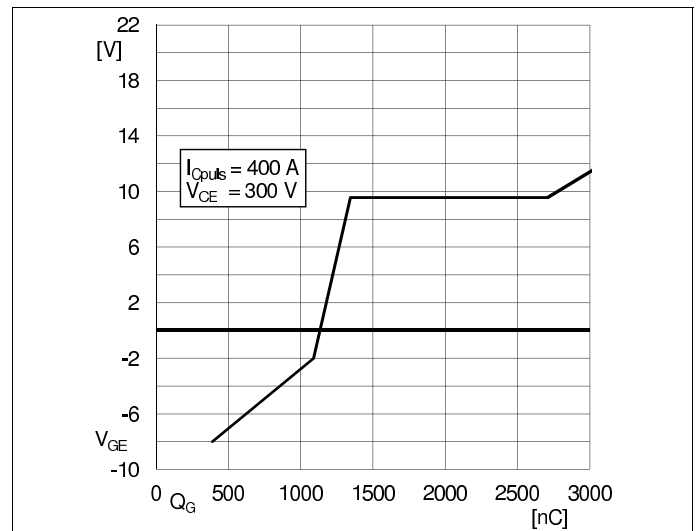


Fig. 10: Typ. IGBT 2 gate charge characteristic

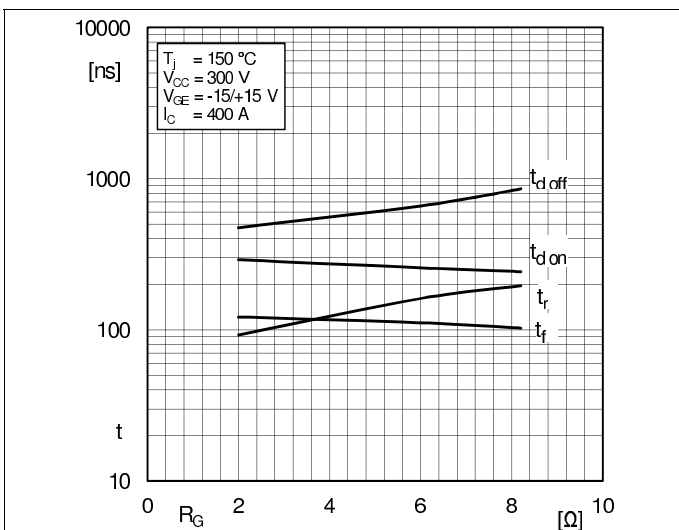


Fig. 11: Typ. IGBT 1 switching times vs. gate resistor R_G

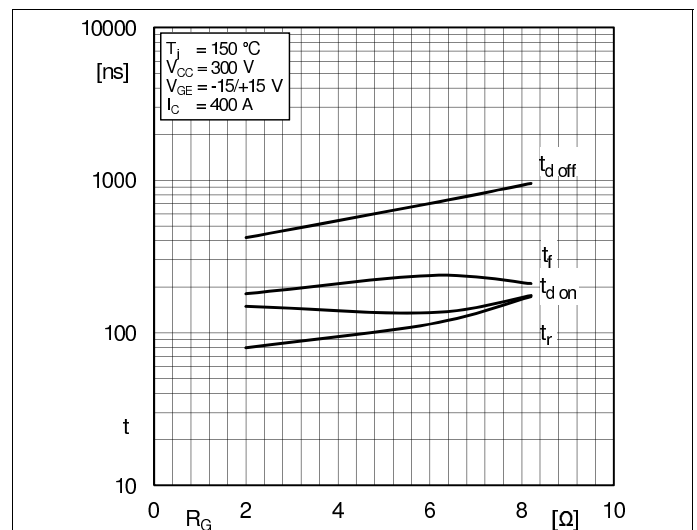


Fig. 12: Typ. IGBT 2 switching times vs. gate resistor R_G

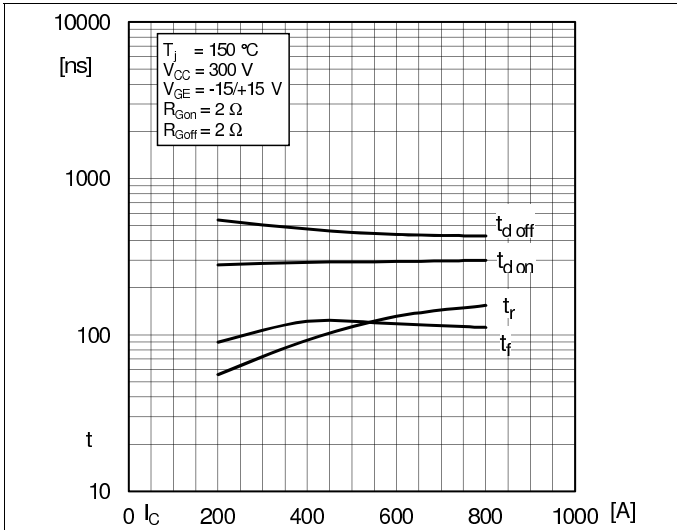


Fig. 13: Typ. IGBT 1 switching times vs. I_C

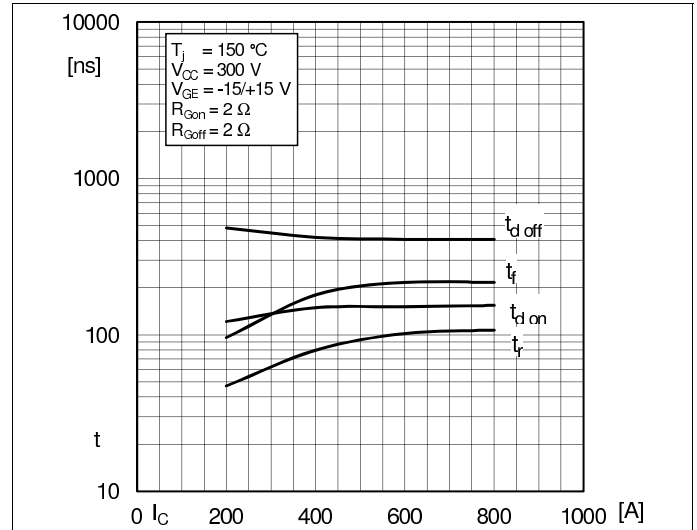


Fig. 14: Typ. IGBT 2 switching times vs. I_C

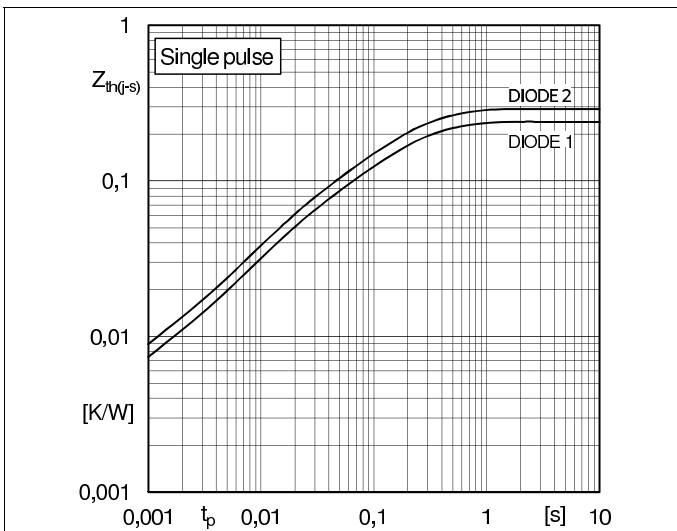


Fig. 15: Typ. DIODEs transient thermal impedance

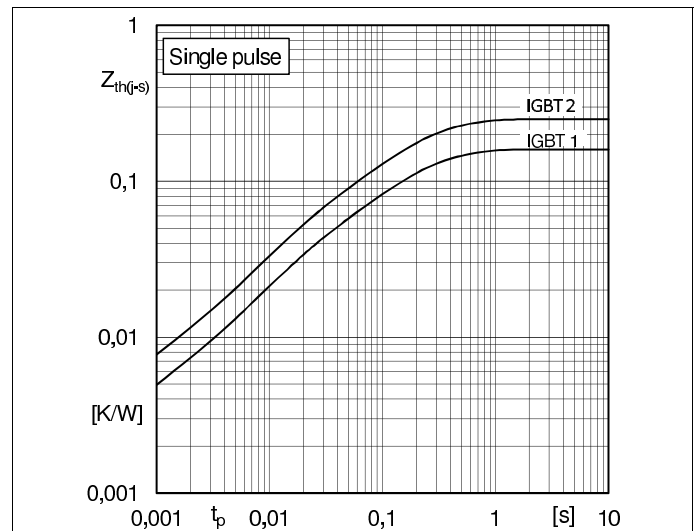
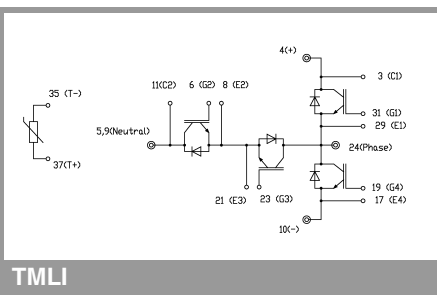
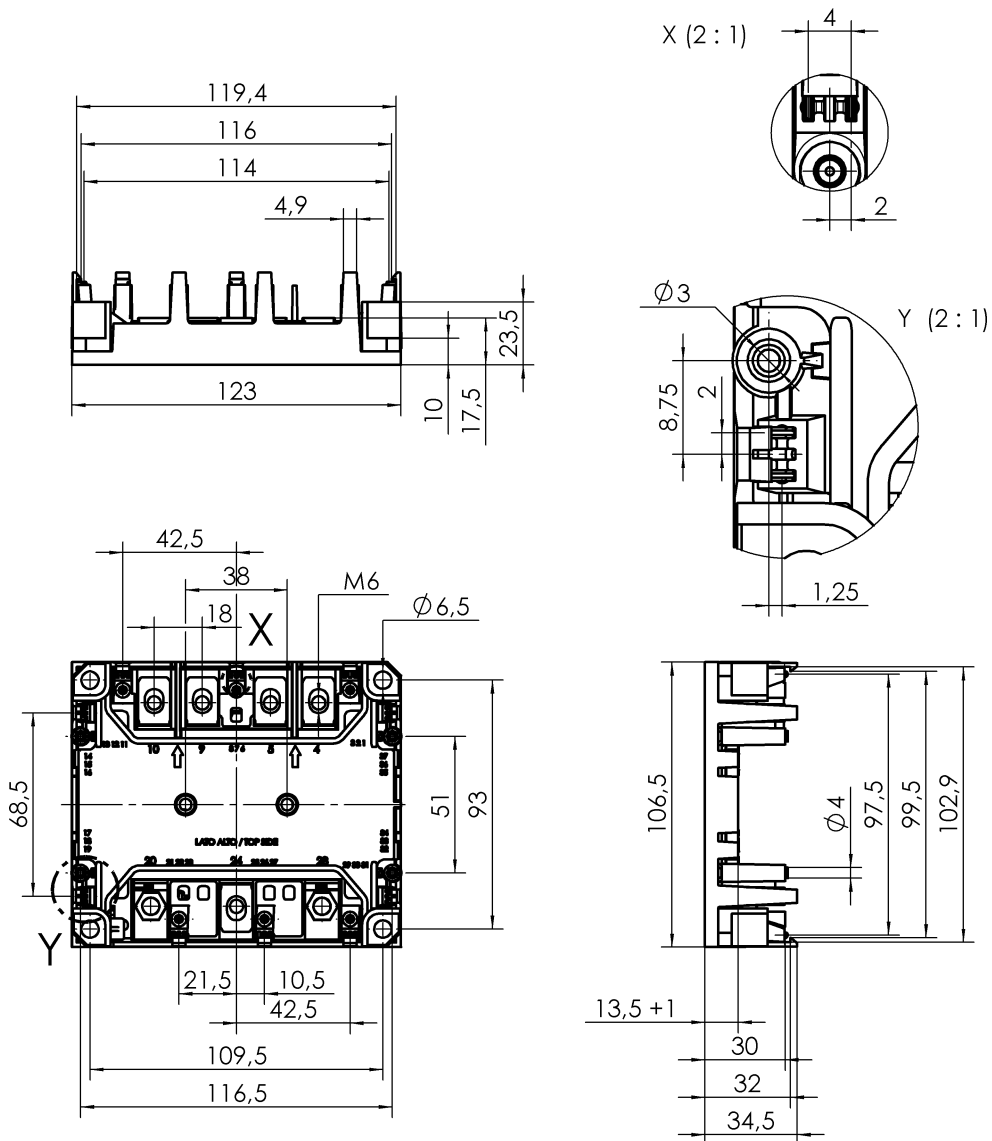


Fig. 16: Typ. IGBTs transient thermal impedance

SKiM401TMLI12E4B



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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.