

SEMiX305MLI12E4V2



SEMiX® 5

3-Level NPC IGBT-Module

SEMiX305MLI12E4V2

Features*

- Solderless assembling solution with PressFIT signal pins and screw power terminals
- IGBT 4 Trench Gate Technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Low inductance case
- Reliable mechanical design with injection moulded terminals and reliable internal connections
- UL recognized file no. E63532
- NTC temperature sensor inside

Typical Applications

- Solar, Power Supply

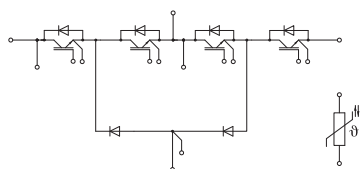
Remarks*

- Case temperature limited to $T_c = 125^\circ\text{C}$ max.
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +150^\circ\text{C}$)
- 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
- For storage and case temperature with TIM see document "TP(HALA P8) SEMiX 5p"

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	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	451
		$T_c = 80^\circ\text{C}$	347
I_{Cnom}		300	A
I_{CRM}		900	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}, V_{GE} \leq 15\text{ V}, T_j = 150^\circ\text{C}, V_{CES} \leq 1200\text{ V}$	10	μs
T_j		-40 ... 175	$^\circ\text{C}$
IGBT2			
V_{CES}	$T_j = 25^\circ\text{C}$	1200	V
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	453
		$T_c = 80^\circ\text{C}$	348
I_{Cnom}		300	A
I_{CRM}		900	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}, V_{GE} \leq 15\text{ V}, T_j = 150^\circ\text{C}, V_{CES} \leq 1200\text{ V}$	10	μs
T_j		-40 ... 175	$^\circ\text{C}$
Diode1			
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	344
		$T_c = 80^\circ\text{C}$	257
I_{FRM}		600	A
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$	1620	A
T_j		-40 ... 175	$^\circ\text{C}$
Diode2			
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	344
		$T_c = 80^\circ\text{C}$	257
I_{FRM}		600	A
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$	1620	A
T_j		-40 ... 175	$^\circ\text{C}$
Diode5			
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	344
		$T_c = 80^\circ\text{C}$	257
I_{FRM}		600	A
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$	1620	A
T_j		-40 ... 175	$^\circ\text{C}$
Module			
$I_{t(RMS)}$		340	A
T_{stg}	module without TIM	-40 ... 125	$^\circ\text{C}$
V_{isol}	AC sinus 50Hz, t = 1 min	4000	V



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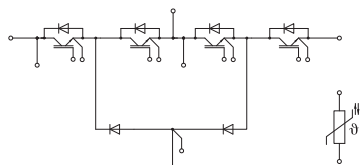
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Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
$V_{CE(sat)}$	$I_C = 300\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	1.80	2.05		V
		$T_j = 150^\circ\text{C}$	2.20	2.40		V
V_{CE0}	chipllevel	$T_j = 25^\circ\text{C}$	0.80	0.90		V
		$T_j = 150^\circ\text{C}$	0.70	0.80		V
r_{CE}	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	3.3	3.8		m Ω
		$T_j = 150^\circ\text{C}$	5.0	5.3		m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 12\text{ mA}$		5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$				4.0	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		18.6		nF
C_{oes}		$f = 1\text{ MHz}$		1.16		nF
C_{res}		$f = 1\text{ MHz}$		1.02		nF
Q_G	$V_{GE} = -8V\dots+15V$			1700		nC
R_{Gint}	$T_j = 25^\circ\text{C}$			2.5		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 300\text{ A}$	$T_j = 150^\circ\text{C}$		71		ns
t_r	$V_{GE} = +15/-8\text{ V}$	$T_j = 150^\circ\text{C}$		51		ns
E_{on}	$R_{G on} = 0.5\ \Omega$	$T_j = 150^\circ\text{C}$		17.4		mJ
$t_{d(off)}$	$R_{G off} = 1.5\ \Omega$	$T_j = 150^\circ\text{C}$		488		ns
t_f	$di/dt_{on} = 5700\text{ A}/\mu\text{s}$ $di/dt_{off} = 2300\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		148		ns
E_{off}	$dv/dt = 3500\text{ V}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		38.7		mJ
$R_{th(j-c)}$	per IGBT				0.1	K/W
$R_{th(c-s)}$	per IGBT ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.077		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material			0.037		K/W
IGBT2						
$V_{CE(sat)}$	$I_C = 300\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	1.80	2.05		V
		$T_j = 150^\circ\text{C}$	2.20	2.40		V
V_{CE0}	chipllevel	$T_j = 25^\circ\text{C}$	0.80	0.90		V
		$T_j = 150^\circ\text{C}$	0.70	0.80		V
r_{CE}	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	3.3	3.8		m Ω
		$T_j = 150^\circ\text{C}$	5.0	5.3		m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 12\text{ mA}$		5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$				4.0	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		18.6		nF
C_{oes}		$f = 1\text{ MHz}$		1.16		nF
C_{res}		$f = 1\text{ MHz}$		1.02		nF
Q_G	$V_{GE} = -8V\dots+15V$			1700		nC
R_{Gint}	$T_j = 25^\circ\text{C}$			2.5		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 300\text{ A}$	$T_j = 150^\circ\text{C}$		116		ns
t_r	$V_{GE} = +15/-8\text{ V}$	$T_j = 150^\circ\text{C}$		58		ns
E_{on}	$R_{G on} = 0.5\ \Omega$	$T_j = 150^\circ\text{C}$		17.6		mJ
$t_{d(off)}$	$R_{G off} = 1.5\ \Omega$	$T_j = 150^\circ\text{C}$		520		ns
t_f	$di/dt_{on} = 4500\text{ A}/\mu\text{s}$ $di/dt_{off} = 2100\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		158		ns
E_{off}	$dv/dt = 4000\text{ V}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		40.6		mJ
$R_{th(j-c)}$	per IGBT				0.1	K/W
$R_{th(c-s)}$	per IGBT ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.09		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material			0.047		K/W

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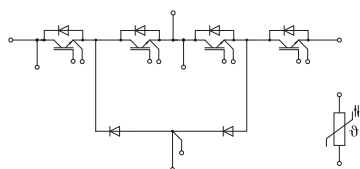
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Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
$V_F = V_{EC}$	$I_F = 300\text{ A}$ $V_{GE} = 0\text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$		2.14	2.46	V
		$T_j = 150^\circ\text{C}$		2.07	2.38	V
V_{F0}	chiplevel	$T_j = 25^\circ\text{C}$		1.30	1.50	V
		$T_j = 150^\circ\text{C}$		0.90	1.10	V
r_F	chiplevel	$T_j = 25^\circ\text{C}$		2.8	3.2	m Ω
		$T_j = 150^\circ\text{C}$		3.9	4.3	m Ω
I_{RRM}	$I_F = 300\text{ A}$	$T_j = 150^\circ\text{C}$		306		A
Q_{rr}	$di/dt_{off} = 4500\text{ A}/\mu\text{s}$ $V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		46		μC
E_{rr}	$V_{GE} = +15/-8\text{ V}$	$T_j = 150^\circ\text{C}$		22		mJ
$R_{th(j-c)}$	per diode				0.18	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.074		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material			0.058		K/W
Diode2						
$V_F = V_{EC}$	$I_F = 300\text{ A}$ $V_{GE} = 0\text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$		2.14	2.46	V
		$T_j = 150^\circ\text{C}$		2.07	2.38	V
V_{F0}	chiplevel	$T_j = 25^\circ\text{C}$		1.30	1.50	V
		$T_j = 150^\circ\text{C}$		0.90	1.10	V
r_F	chiplevel	$T_j = 25^\circ\text{C}$		2.8	3.2	m Ω
		$T_j = 150^\circ\text{C}$		3.9	4.3	m Ω
I_{RRM}	$I_F = 300\text{ A}$	$T_j = 150^\circ\text{C}$		306		A
Q_{rr}	$di/dt_{off} = 6000\text{ A}/\mu\text{s}$ $V_R = 600\text{ V}$	$T_j = 150^\circ\text{C}$		46		μC
$E_{rr} \text{ }^1)$	$V_{GE} = +15/-8\text{ V}$	$T_j = 150^\circ\text{C}$		-		mJ
$R_{th(j-c)}$	per diode				0.18	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.098		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material			0.054		K/W
Diode5						
$V_F = V_{EC}$	$I_F = 300\text{ A}$ chiplevel	$T_j = 25^\circ\text{C}$		2.14	2.46	V
		$T_j = 150^\circ\text{C}$		2.07	2.38	V
V_{F0}	chiplevel	$T_j = 25^\circ\text{C}$		1.30	1.50	V
		$T_j = 150^\circ\text{C}$		0.90	1.10	V
r_F	chiplevel	$T_j = 25^\circ\text{C}$		2.8	3.2	m Ω
		$T_j = 150^\circ\text{C}$		3.9	4.3	m Ω
I_{RRM}	$I_F = 300\text{ A}$	$T_j = 150^\circ\text{C}$		406		A
Q_{rr}	$di/dt_{off} = 5700\text{ A}/\mu\text{s}$ $V_R = 600\text{ V}$	$T_j = 150^\circ\text{C}$		46		μC
E_{rr}	$V_{GE} = +15/-8\text{ V}$	$T_j = 150^\circ\text{C}$		24.2		mJ
$R_{th(j-c)}$	per diode				0.18	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.109		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material			0.081		K/W



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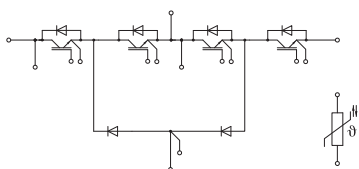
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Module						
L_{sCE1}				27		nH
L_{sCE2}				34		nH
$R_{CC'+EE'}$	measured between terminal 5 and 1	$T_C = 25^\circ\text{C}$		0.8		m Ω
		$T_C = 125^\circ\text{C}$		1.1		m Ω
$R_{th(c-s)1}$	calculated without thermal coupling			0.009		K/W
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)			0.014		K/W
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module, pre-applied phase change material			0.008		K/W
M_s	to heat sink (M5)		3		6	Nm
M_t		to terminals (M6)	3		6	Nm
						Nm
W				398		g
Temperature Sensor						
R_{100}	$T_C=100^\circ\text{C}$ ($R_{25}=5\text{ k}\Omega$)			$493 \pm 5\%$		Ω
$B_{100/125}$	$R(T)=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$; $T[\text{K}]$;			$3550 \pm 2\%$		K



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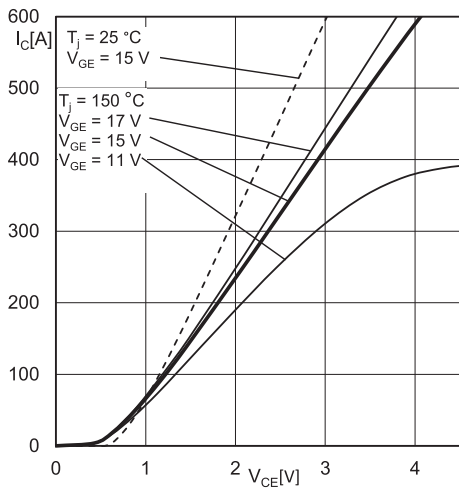


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

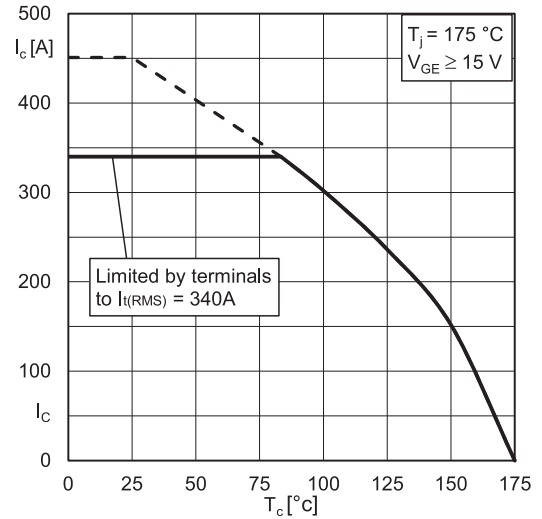


Fig. 2: IGBT1 rated current vs. Temperature $I_c=f(T_c)$

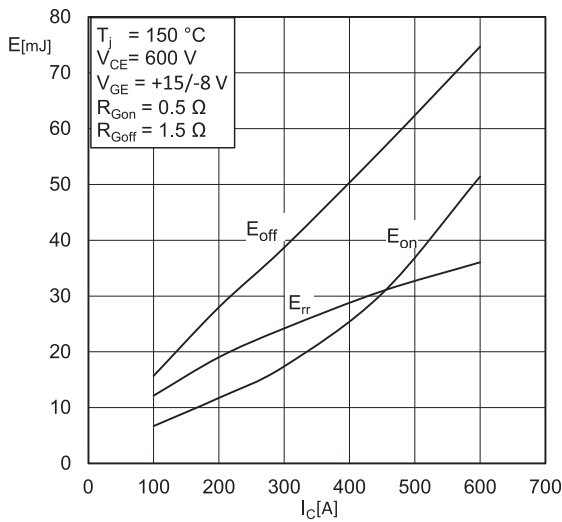


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_c)$

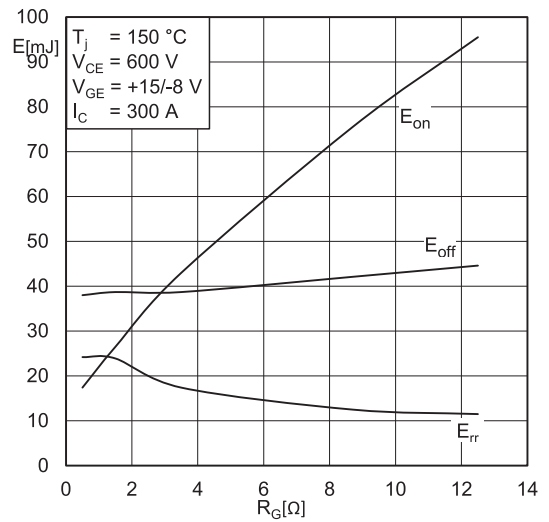


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(R_G)$

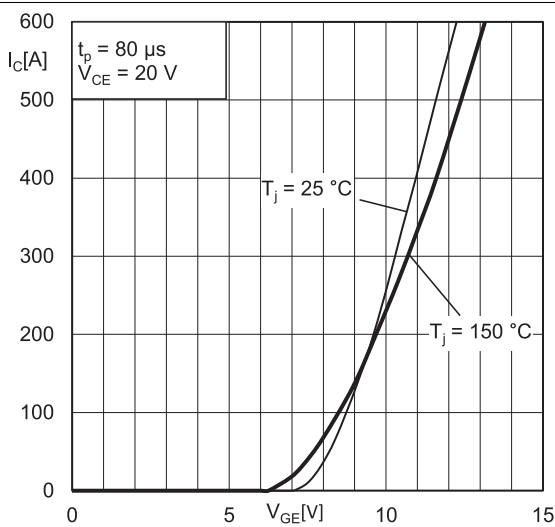


Fig. 5: Typ. IGBT1 transfer characteristic

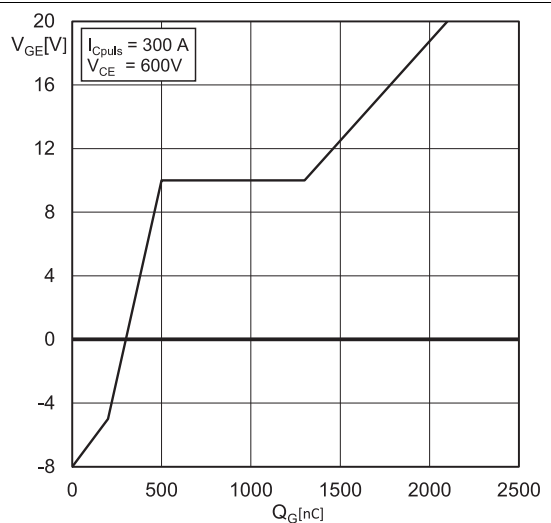


Fig. 6: Typ. IGBT1 gate charge characteristic

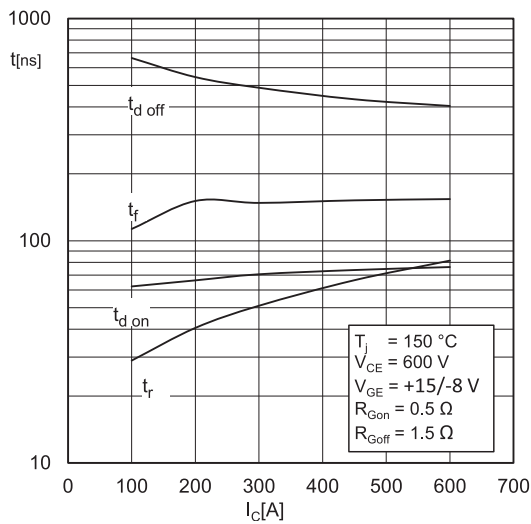


Fig. 7: Typ. IGBT1 switching times vs. I_c

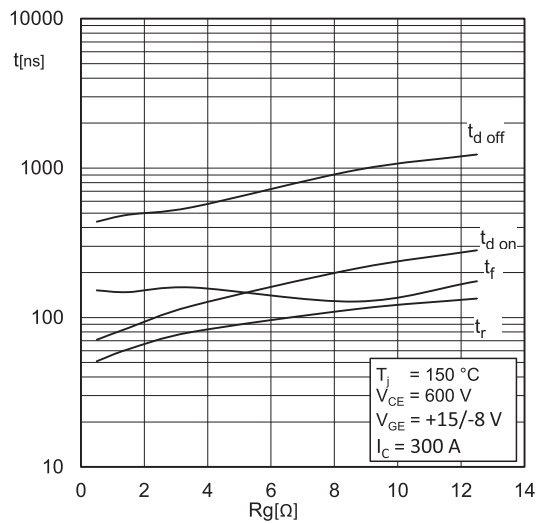


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

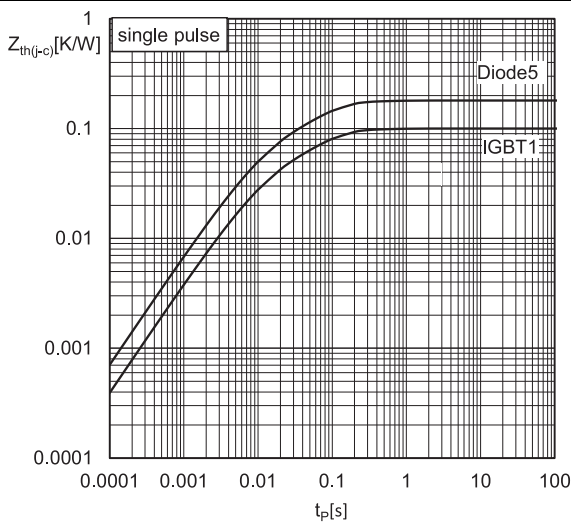


Fig. 9: Transient thermal impedance of IGBT1 & Diode5

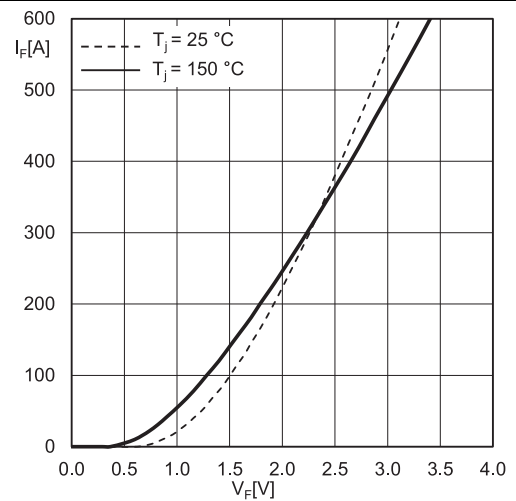


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC+EE'}$

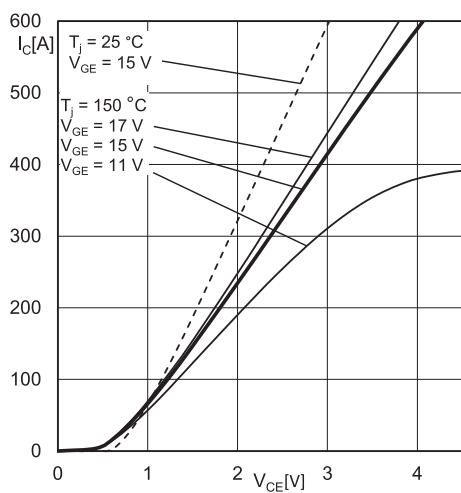


Fig. 13: Typ. IGBT2 output characteristic, incl. $R_{CC+EE'}$

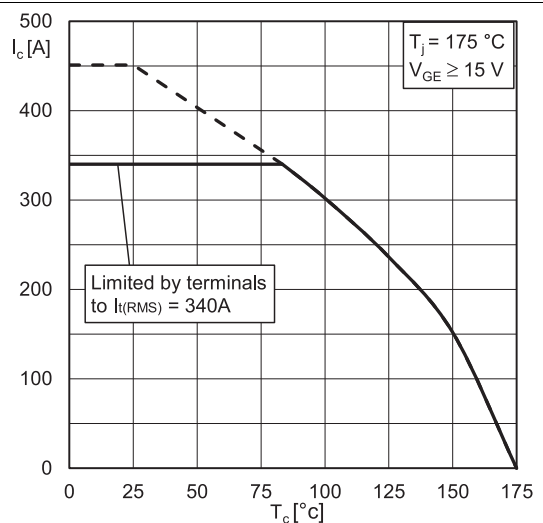


Fig. 14: IGBT2 rated current vs. Temperature $I_c = f(T_c)$

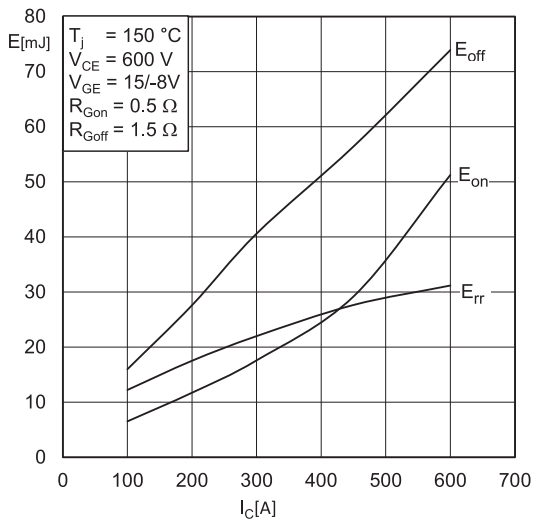


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(I_C)$

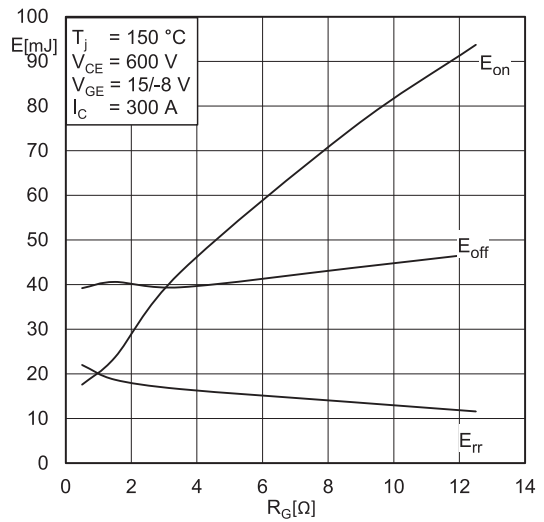


Fig. 16: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(R_G)$

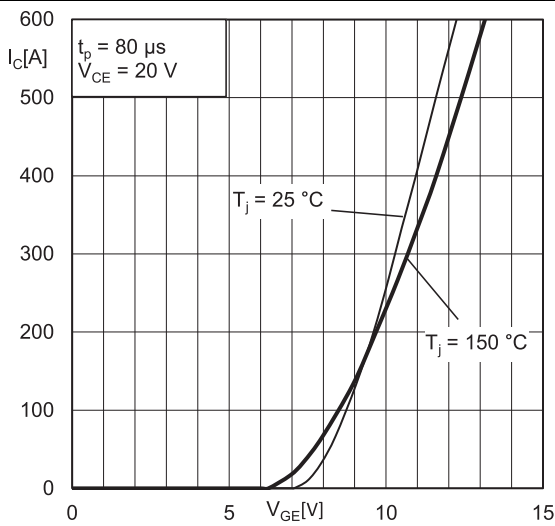


Fig. 17: Typ. IGBT2 transfer characteristic

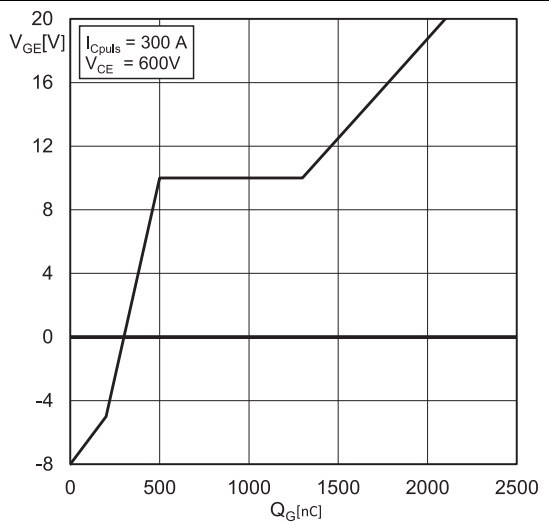


Fig. 18: Typ. IGBT2 gate charge characteristic

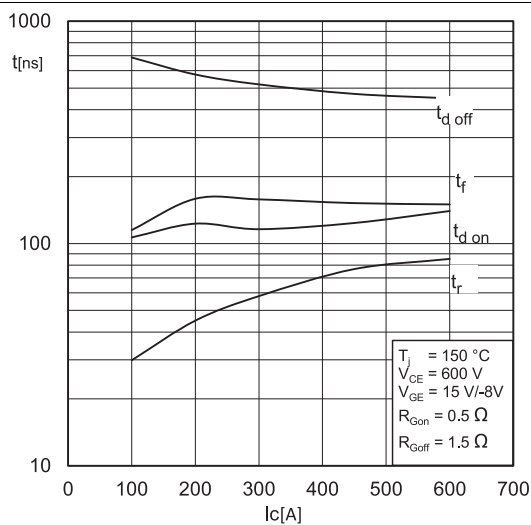


Fig. 19: Typ. IGBT2 switching times vs. I_C

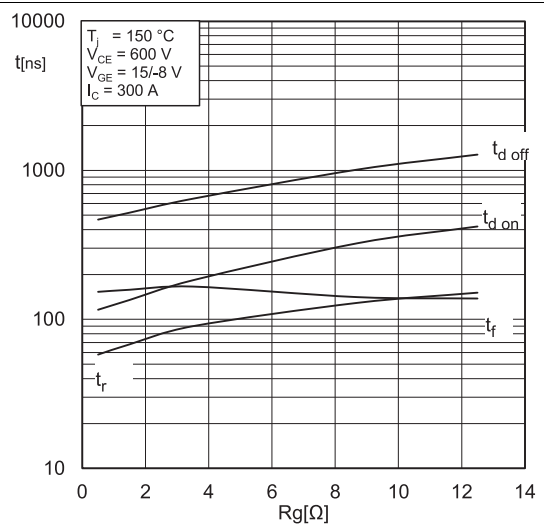


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

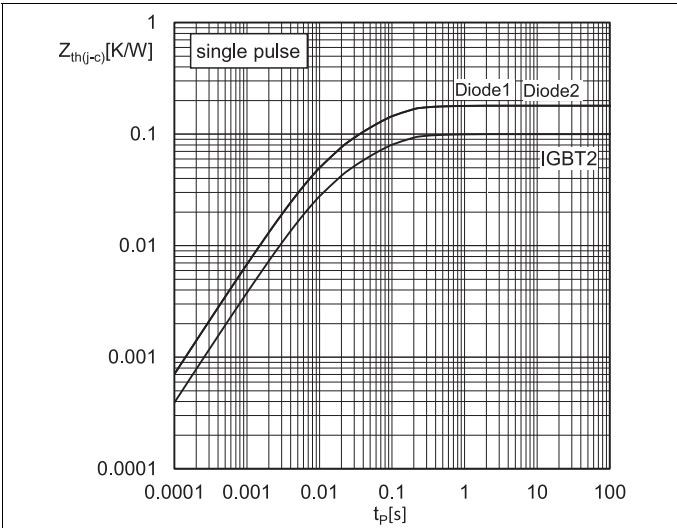


Fig. 21: Transient thermal impedance of IGBT2, Diode1 & Diode2

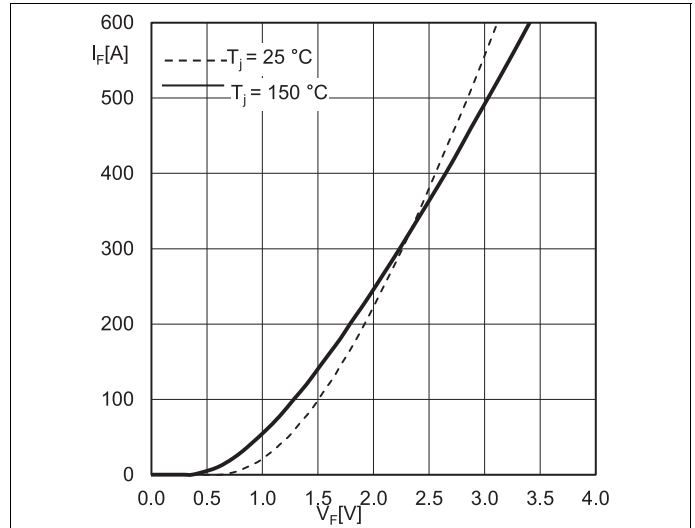
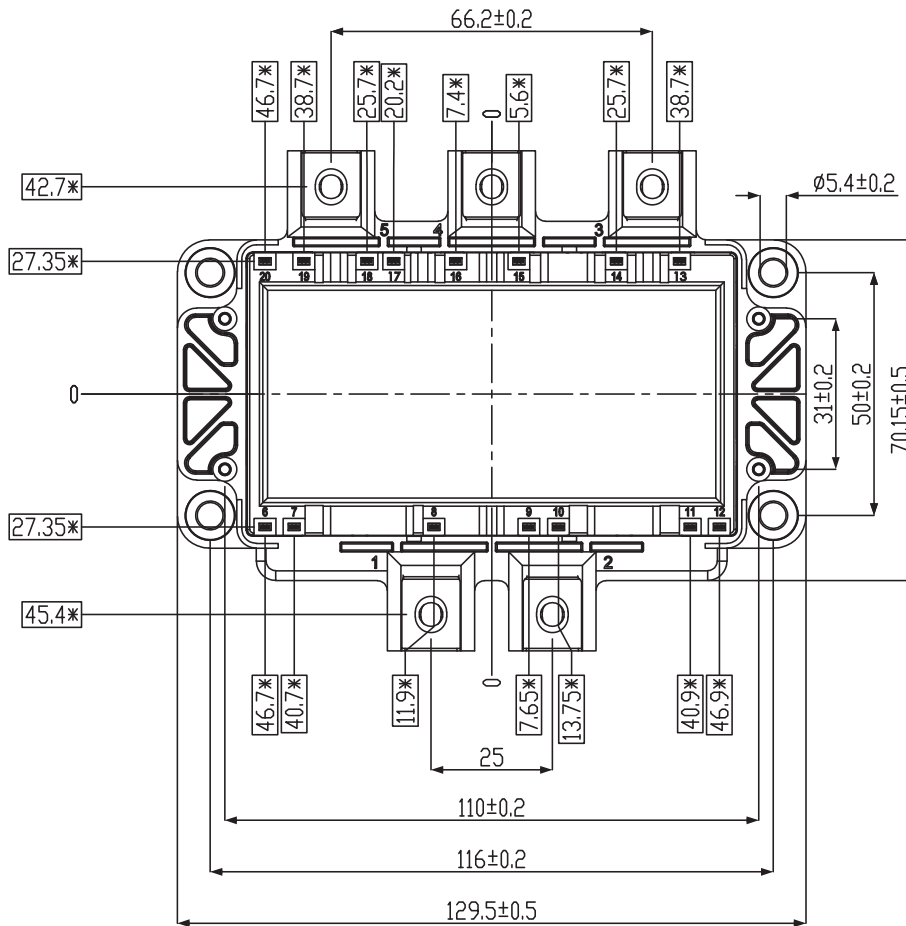
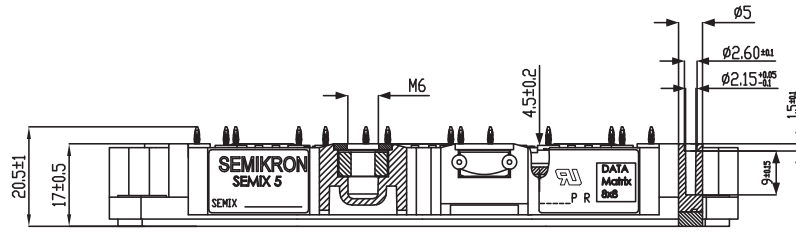


Fig. 22: Typ. Diode1 & Diode2 forward characteristic, incl. $R_{CC+EE'}$

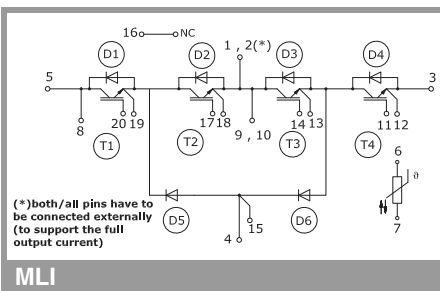
SEMiX305MLI12E4V2



* = Dimensions in mm with tolerance of ± 0.4

For technical details please refer
to SEMiX(R)5 Mounting Instruction

SEMiX5p



MLI

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

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