



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*

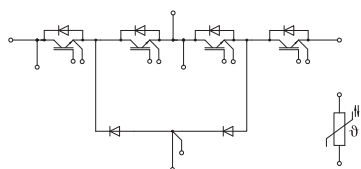
- Case temperature limited to $T_C=125^\circ\text{C}$ max.
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +150^\circ\text{C}$)
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & 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 °C		1200	V
I _C	T _j = 175 °C	T _c = 25 °C	451	A
		T _c = 80 °C	347	A
I _{Cnom}			300	A
I _{CRM}			900	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V, V _{GE} ≤ 15 V, T _j = 150 °C, V _{CES} ≤ 1200 V		10	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	453	A
		T _c = 80 °C	348	A
I _{Cnom}			300	A
I _{CRM}			900	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V, V _{GE} ≤ 15 V, T _j = 150 °C, V _{CES} ≤ 1200 V		10	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	344	A
		T _c = 80 °C	257	A
I _{FRM}			600	A
I _{FSM}	10 ms, sin 180°, T _j = 25 °C		1620	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	344	A
		T _c = 80 °C	257	A
I _{FRM}			600	A
I _{FSM}	10 ms, sin 180°, T _j = 25 °C		1620	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	344	A
		T _c = 80 °C	257	A
I _{FRM}			600	A
I _{FSM}	10 ms, sin 180°, T _j = 25 °C		1620	A
T _j			-40 ... 175	°C
Module				
I _{t(RMS)}			340	A
T _{stg}	module without TIM		-40 ... 125	°C
V _{isol}	AC sinus 50Hz, t = 1 min		4000	V



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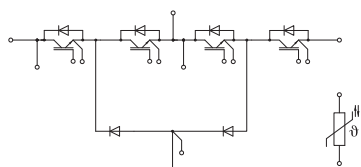
- Solar, Power Supply

Remarks*

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
V _{CE(sat)}	I _C = 300 A	T _j = 25 °C		1.80	2.05	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.20	2.40	V
V _{CE0}	chiplevel	T _j = 25 °C		0.80	0.90	V
		T _j = 150 °C		0.70	0.80	V
r _{CE}	V _{GE} = 15 V chiplevel	T _j = 25 °C		3.3	3.8	mΩ
		T _j = 150 °C		5.0	5.3	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 12 mA		5	5.8	6.5	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				4.0	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		18.6		nF
C _{oes}		f = 1 MHz		1.16		nF
C _{res}		f = 1 MHz		1.02		nF
Q _G	V _{GE} = -8V...+15V			1700		nC
R _{Gint}	T _j = 25 °C			2.5		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		71		ns
t _r	I _C = 300 A	T _j = 150 °C		51		ns
E _{on}	V _{GE} = +15/-8 V	T _j = 150 °C		17.4		mJ
t _{d(off)}	R _{G on} = 0.5 Ω	T _j = 150 °C		488		ns
t _f	R _{G off} = 1.5 Ω	T _j = 150 °C		148		ns
E _{off}	di/dt _{on} = 5700 A/μs di/dt _{off} = 2300 A/μs dv/dt = 3500 V/μs	T _j = 150 °C		38.7		mJ
R _{th(j-c)}	per IGBT				0.1	K/W
R _{th(c-s)}	per IGBT (λgrease=0.81 W/(m*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 A	T _j = 25 °C		1.80	2.05	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.20	2.40	V
V _{CE0}	chiplevel	T _j = 25 °C		0.80	0.90	V
		T _j = 150 °C		0.70	0.80	V
r _{CE}	V _{GE} = 15 V chiplevel	T _j = 25 °C		3.3	3.8	mΩ
		T _j = 150 °C		5.0	5.3	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 12 mA		5	5.8	6.5	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				4.0	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		18.6		nF
C _{oes}		f = 1 MHz		1.16		nF
C _{res}		f = 1 MHz		1.02		nF
Q _G	V _{GE} = -8V...+15V			1700		nC
R _{Gint}	T _j = 25 °C			2.5		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		116		ns
t _r	I _C = 300 A	T _j = 150 °C		58		ns
E _{on}	V _{GE} = +15/-8 V	T _j = 150 °C		17.6		mJ
t _{d(off)}	R _{G on} = 0.5 Ω	T _j = 150 °C		520		ns
t _f	R _{G off} = 1.5 Ω	T _j = 150 °C		158		ns
E _{off}	di/dt _{on} = 4500 A/μs di/dt _{off} = 2100 A/μs dv/dt = 4000 V/μs	T _j = 150 °C		40.6		mJ
R _{th(j-c)}	per IGBT				0.1	K/W
R _{th(c-s)}	per IGBT (λgrease=0.81 W/(m*K))			0.09		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			0.047		K/W



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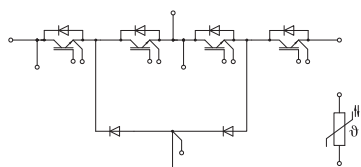
Remarks*

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- 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
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Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
V _F = V _{EC}	I _F = 300 A	T _j = 25 °C		2.14	2.46	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.07	2.38	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		2.8	3.2	mΩ
		T _j = 150 °C		3.9	4.3	mΩ
I _{RRM}	I _F = 300 A	T _j = 150 °C		306		A
Q _{rr}	di/dt _{off} = 4500 A/μs	T _j = 150 °C		46		μC
E _{rr}	V _{CC} = 600 V	T _j = 150 °C		22		mJ
	V _{GE} = +15/-8 V					
R _{th(j-c)}	per diode				0.18	K/W
R _{th(c-s)}	per diode (λgrease=0.81 W/(m*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 A	T _j = 25 °C		2.14	2.46	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.07	2.38	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		2.8	3.2	mΩ
		T _j = 150 °C		3.9	4.3	mΩ
I _{RRM}	I _F = 300 A	T _j = 150 °C		306		A
Q _{rr}	di/dt _{off} = 6000 A/μs	T _j = 150 °C		46		μC
E _{rr} ¹⁾	V _R = 600 V	T _j = 150 °C		-		mJ
	V _{GE} = +15/-8 V					
R _{th(j-c)}	per diode				0.18	K/W
R _{th(c-s)}	per diode (λgrease=0.81 W/(m*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 A	T _j = 25 °C		2.14	2.46	V
	chiplevel	T _j = 150 °C		2.07	2.38	V
V _{F0}		T _j = 25 °C		1.30	1.50	V
	chiplevel	T _j = 150 °C		0.90	1.10	V
r _F		T _j = 25 °C		2.8	3.2	mΩ
	chiplevel	T _j = 150 °C		3.9	4.3	mΩ
I _{RRM}		I _F = 300 A	T _j = 150 °C		406	A
Q _{rr}	di/dt _{off} = 5700 A/μs	T _j = 150 °C		46		μC
E _{rr}	V _R = 600 V	T _j = 150 °C		24.2		mJ
	V _{GE} = +15/-8 V					
R _{th(j-c)}	per diode				0.18	K/W
R _{th(c-s)}	per diode (λgrease=0.81 W/(m*K))			0.109		K/W
R _{th(c-s)}	per diode, pre-applied phase change material			0.081		K/W



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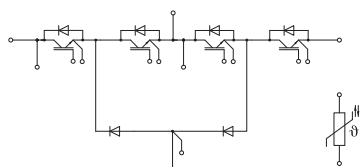
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Footnotes

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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	mΩ
		$T_C = 125^\circ\text{C}$	1.1	mΩ
$R_{th(c-s)1}$	calculated without thermal coupling		0.009	K/W
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module ($\lambda_{grease}=0.81 \text{ W/(m}^2\text{K)}$)		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
$B_{100/125}$	$R(T)=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$; $T[K]$		$3550 \pm 2\%$	K



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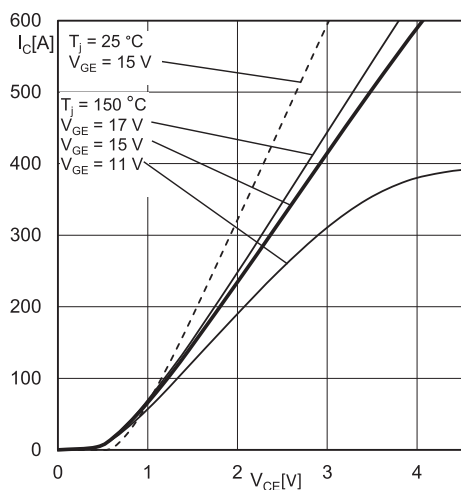


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC}'+EE'$

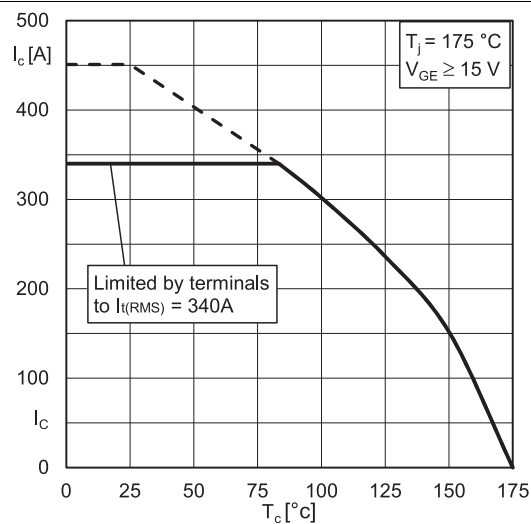


Fig. 2: IGBT1 rated current vs. Temperature $I_c=f(T_c)$

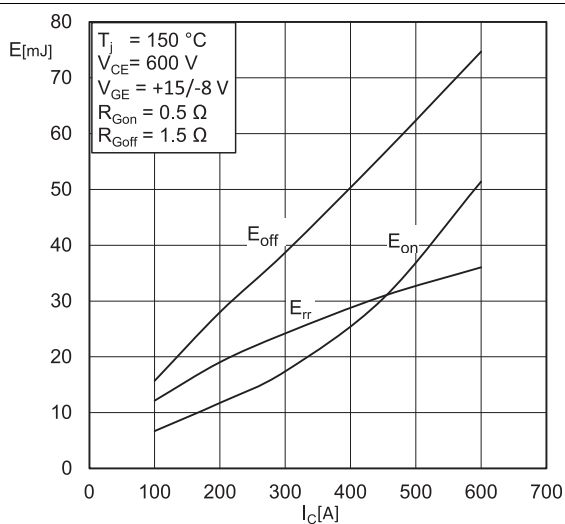


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_C)$

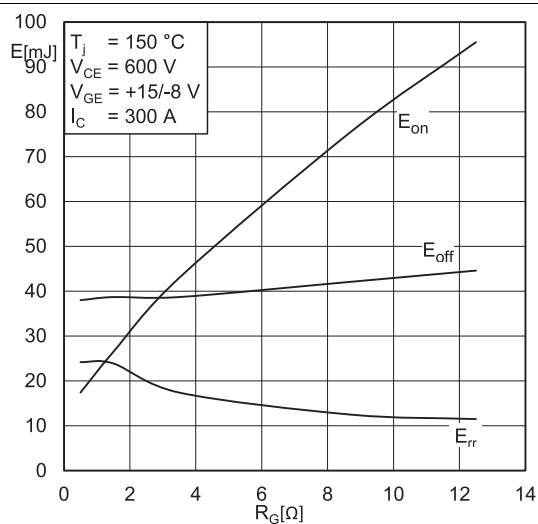


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(R_G)$

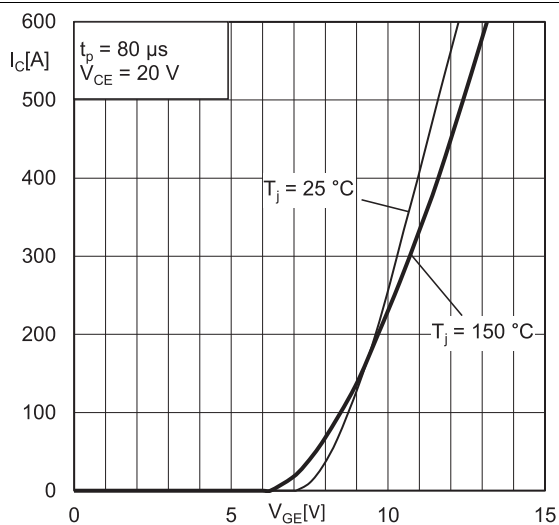


Fig. 5: Typ. IGBT1 transfer characteristic

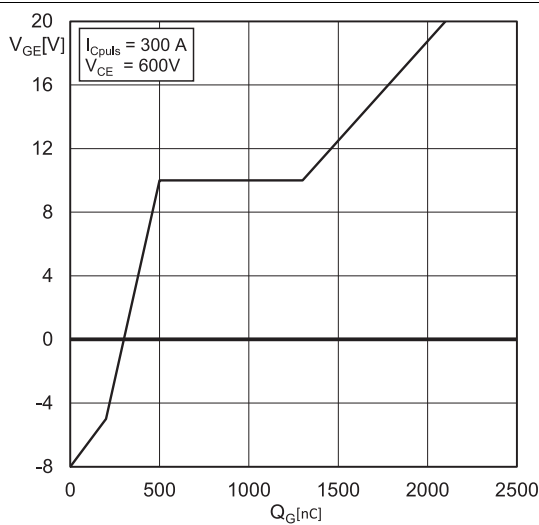
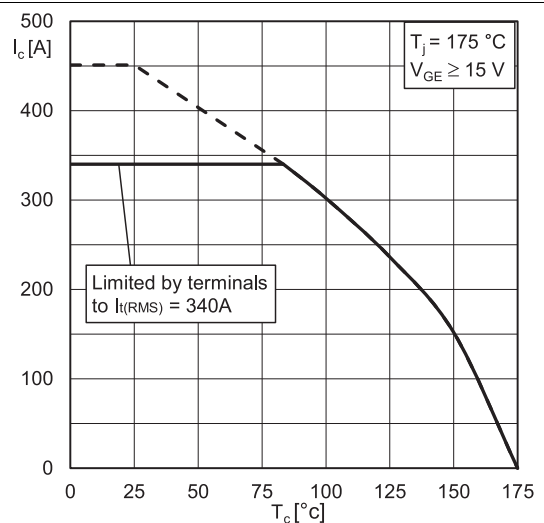
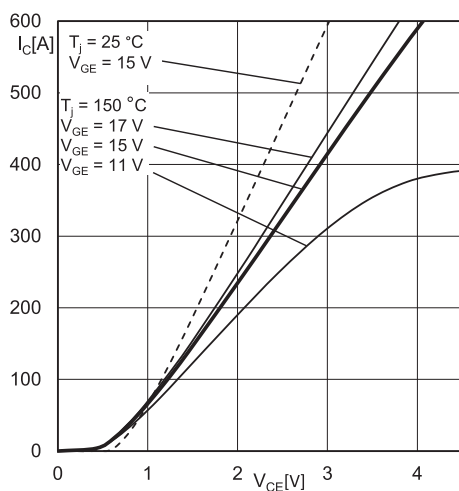
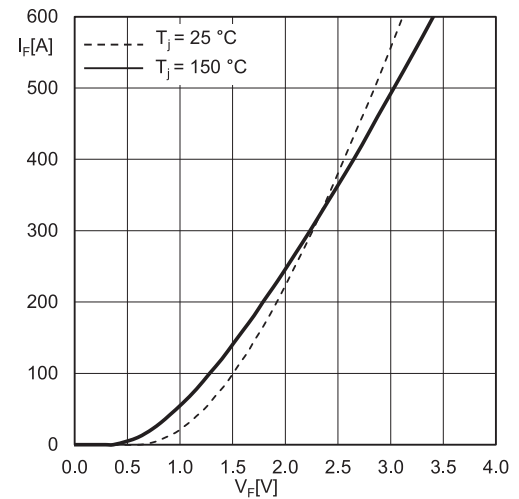
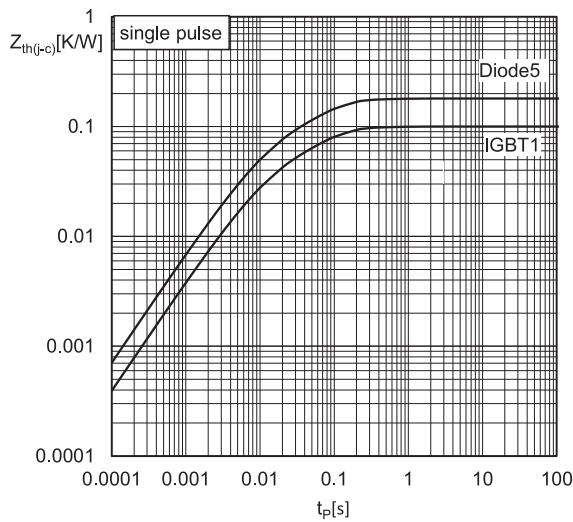
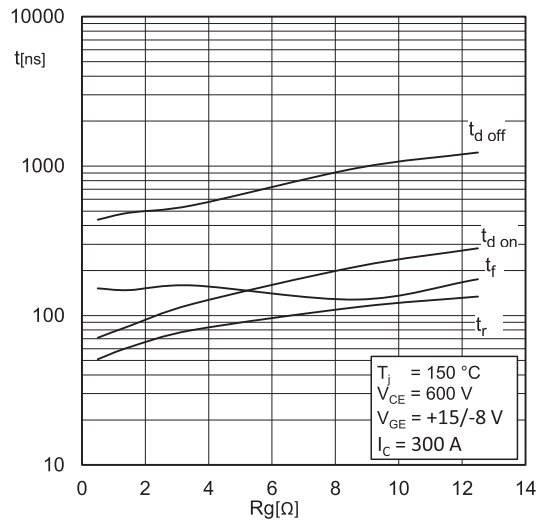
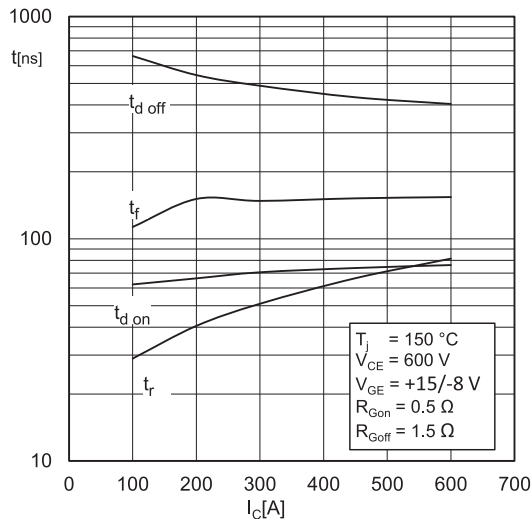


Fig. 6: Typ. IGBT1 gate charge characteristic



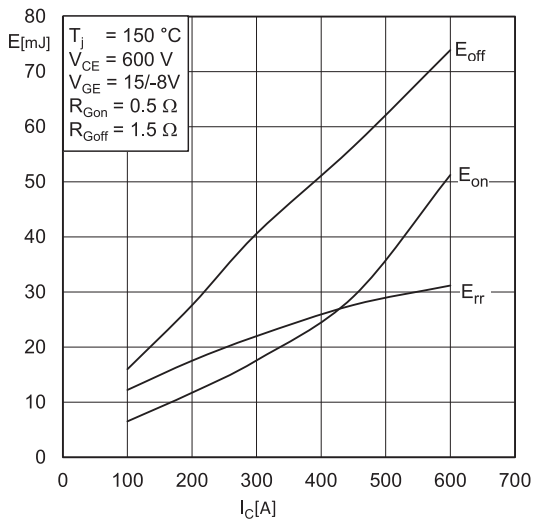


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(I_C)$

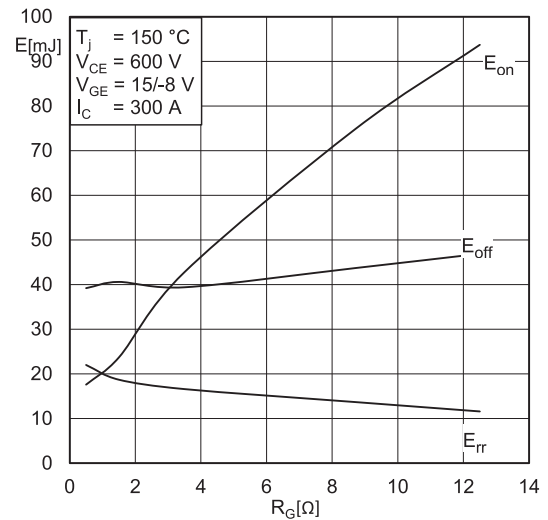


Fig. 16: Typ. IGBT2 & Diode1 turn-on / -off energy = $f(R_G)$

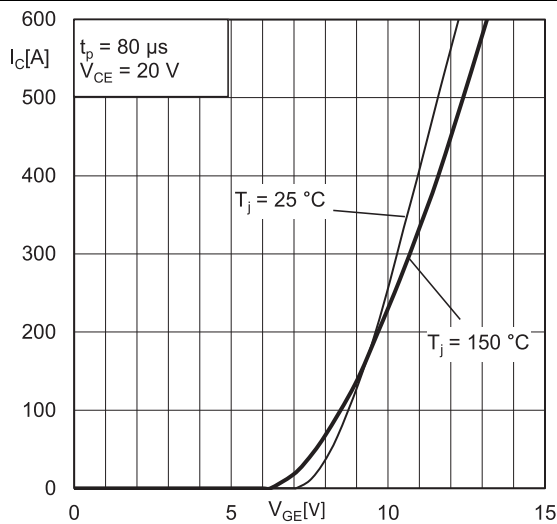


Fig. 17: Typ. IGBT2 transfer characteristic

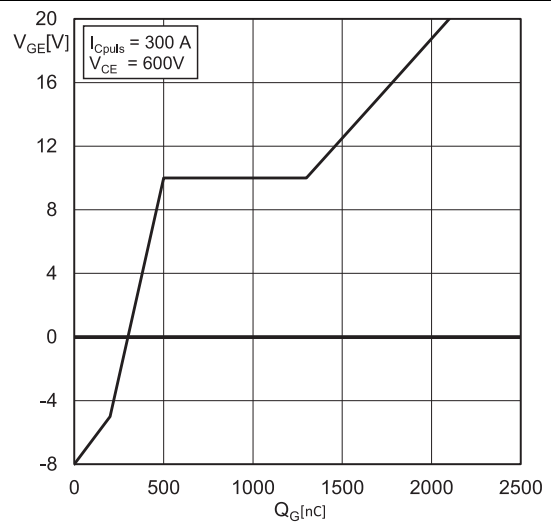


Fig. 18: Typ. IGBT2 gate charge characteristic

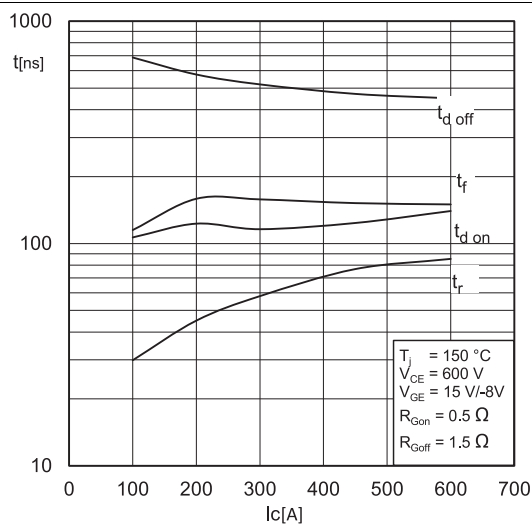


Fig. 19: Typ. IGBT2 switching times vs. I_C

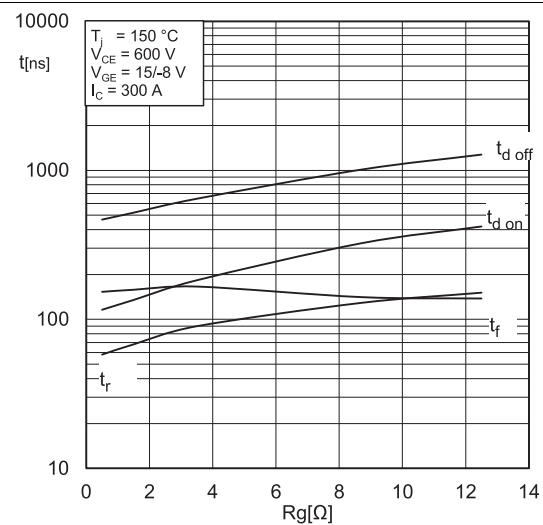


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

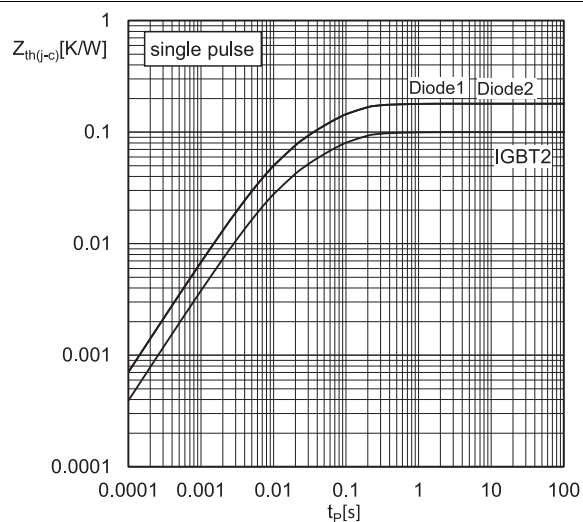


Fig. 21: Transient thermal impedance of IGBT2, Diode1 & Diode2

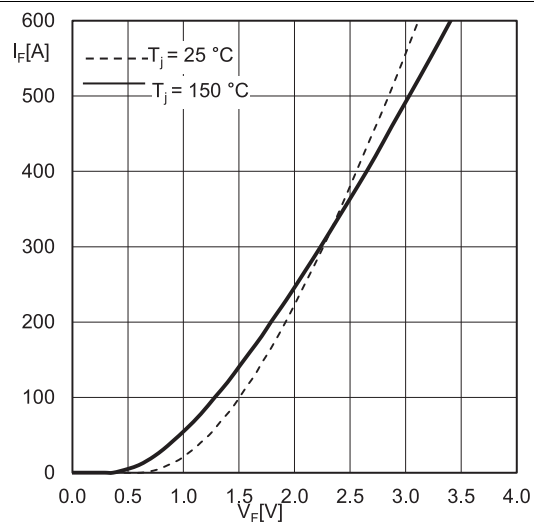
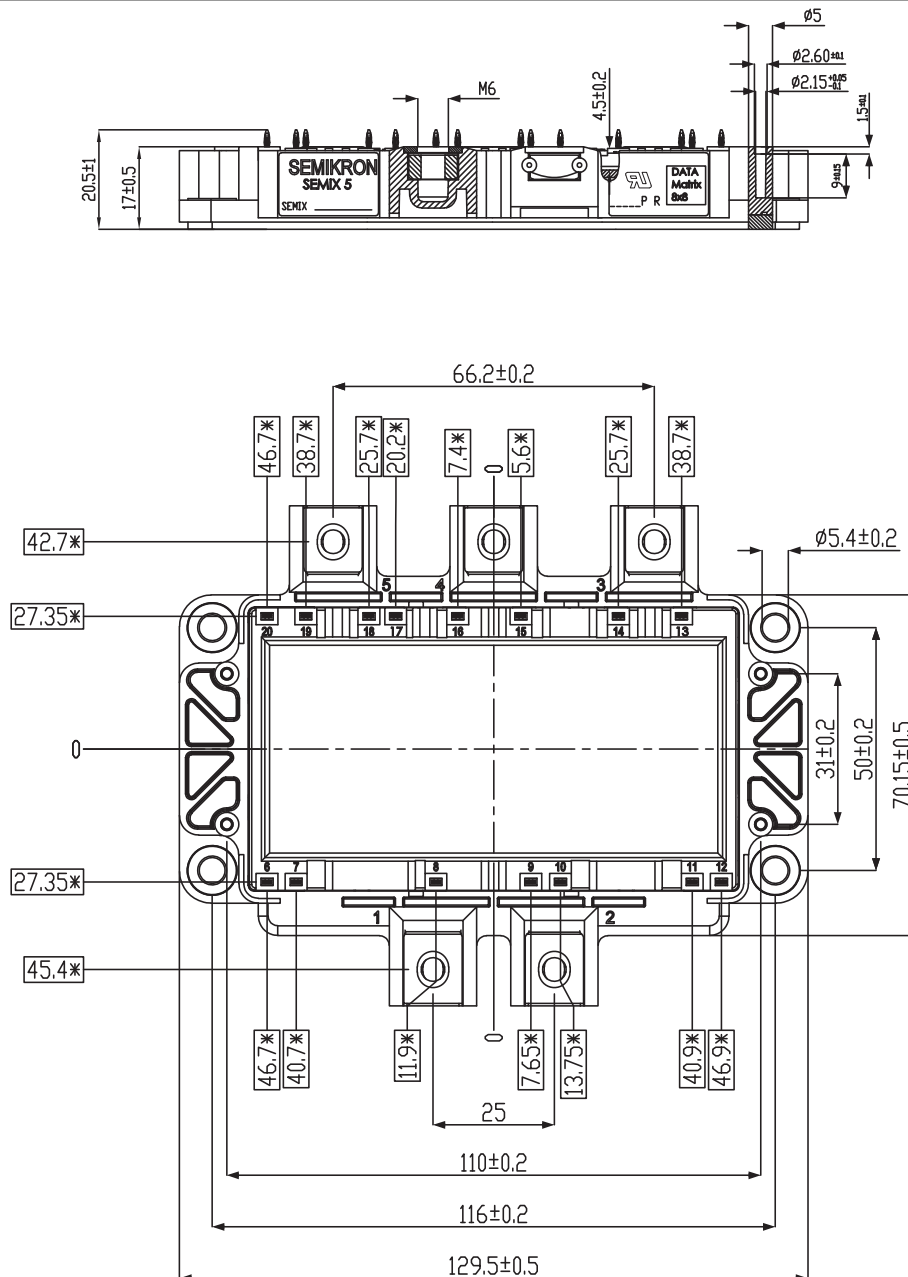


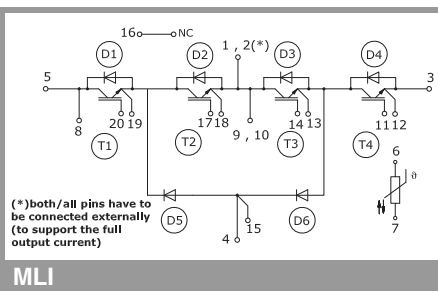
Fig. 22: Typ. Diode1 & Diode2 forward characteristic, incl. $R_{CC'+EE'}$



* = Dimensions in mm with tolerance of ± 0.4

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

SEMiX5p



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

***IMPORTANT INFORMATION AND WARNINGS**

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