



SEMiX® 5

3-Level NPC IGBT-Module

SEMiX355MLI12M7

Features*

- Solderless assembling solution with PressFIT signal pins and screw power terminals
- Trenchgate 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

- UPS
- Solar

Remarks*

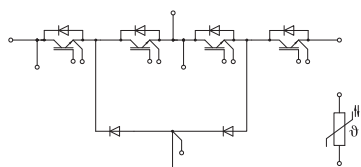
- Case temperature limited to $T_C=125^{\circ}\text{C}$ max.
- Product reliability results valid for $T_j \leq 150^{\circ}\text{C}$ (recommended $T_{j,op} = -40 \dots +150^{\circ}\text{C}$)
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes 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	$T_j = 175^{\circ}\text{C}$	$T_c = 25^{\circ}\text{C}$	448
		$T_c = 80^{\circ}\text{C}$	341
I_{Cnom}		350	A
I_{CRM}		700	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}, V_{GE} \leq 15\text{ V}, T_j = 150^{\circ}\text{C}, V_{CES} \leq 1200\text{ V}$	8	μs
T_j		-40 ... 175	$^{\circ}\text{C}$
IGBT2			
V_{CES}	$T_j = 25^{\circ}\text{C}$	1200	V
I_C	$T_j = 175^{\circ}\text{C}$	$T_c = 25^{\circ}\text{C}$	425
		$T_c = 80^{\circ}\text{C}$	323
I_{Cnom}		350	A
I_{CRM}		700	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}, V_{GE} \leq 15\text{ V}, T_j = 150^{\circ}\text{C}, V_{CES} \leq 1200\text{ V}$	8	μs
T_j		-40 ... 175	$^{\circ}\text{C}$
Diode1			
V_{RRM}	$T_j = 25^{\circ}\text{C}$	1200	V
I_F	$T_j = 175^{\circ}\text{C}$	$T_c = 25^{\circ}\text{C}$	344
		$T_c = 80^{\circ}\text{C}$	257
I_{FRM}		700	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	$T_j = 175^{\circ}\text{C}$	$T_c = 25^{\circ}\text{C}$	322
		$T_c = 80^{\circ}\text{C}$	239
I_{FRM}		700	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	$T_j = 175^{\circ}\text{C}$	$T_c = 25^{\circ}\text{C}$	322
		$T_c = 80^{\circ}\text{C}$	239
I_{FRM}		700	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, $t = 1\text{ min}$	4000	V



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Typical Applications

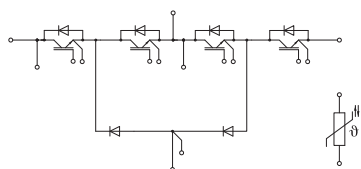
- UPS
- Solar

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 $T_{j,op} = -40 \dots +150^\circ\text{C}$)
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Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
V _{CE(sat)}	I _C = 350 A	T _j = 25 °C		1.59	1.91	V
	V _{GE} = 15 V chipelevel	T _j = 150 °C		1.85	2.39	V
V _{CE0}	chipelevel	T _j = 25 °C		0.87	0.94	V
		T _j = 150 °C		0.77	0.90	V
r _{CE}	V _{GE} = 15 V chipelevel	T _j = 25 °C		2.1	2.8	mΩ
		T _j = 150 °C		3.1	4.3	mΩ
V _{GE(th)}	V _{CE} = 10 V, I _C = 35 mA		5.4	6	6.6	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				3.5	mA
C _{ies}	V _{CE} = 10 V V _{GE} = 0 V	f = 1 MHz		66.0		nF
C _{oes}		f = 1 MHz		2.08		nF
C _{res}		f = 1 MHz		0.82		nF
Q _G	V _{GE} = - 8 V...+ 15 V			2920		nC
R _{Gint}	T _j = 25 °C			1.0		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		181		ns
t _r	I _C = 350 A	T _j = 150 °C		42		ns
E _{on}	V _{GE} = +15/-8 V	T _j = 150 °C		13.2		mJ
t _{d(off)}	R _{G on} = 0.5 Ω	T _j = 150 °C		389		ns
t _f	R _{G off} = 0.5 Ω	T _j = 150 °C		101		ns
E _{off}	di/dt _{on} = 8300 A/μs di/dt _{off} = 2780 A/μs dv/dt = 5860 V/μs L _s = 27 nH	T _j = 150 °C		37		mJ
R _{th(j-c)}	per IGBT				0.114	K/W
R _{th(c-s)}	per IGBT (λgrease=0.81 W/(m*K))			0.073		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			0.033		K/W
IGBT2						
V _{CE(sat)}	I _C = 350 A	T _j = 25 °C		1.59	1.91	V
	V _{GE} = 15 V chipelevel	T _j = 150 °C		1.85	2.39	V
V _{CE0}	chipelevel	T _j = 25 °C		0.87	0.94	V
		T _j = 150 °C		0.77	0.90	V
r _{CE}	V _{GE} = 15 V chipelevel	T _j = 25 °C		2.1	2.8	mΩ
		T _j = 150 °C		3.1	4.3	mΩ
V _{GE(th)}	V _{CE} = 10 V, I _C = 35 mA		5.4	6	6.6	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				3.5	mA
C _{ies}	V _{CE} = 10 V V _{GE} = 0 V	f = 1 MHz		66.0		nF
C _{oes}		f = 1 MHz		2.08		nF
C _{res}		f = 1 MHz		0.82		nF
Q _G	V _{GE} = - 8 V...+ 15 V			2920		nC
R _{Gint}	T _j = 25 °C			1.0		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		209		ns
t _r	I _C = 350 A	T _j = 150 °C		50		ns
E _{on}	V _{GE} = +15/-8 V	T _j = 150 °C		15.4		mJ
t _{d(off)}	R _{G on} = 1 Ω	T _j = 150 °C		394		ns
t _f	R _{G off} = 0.5 Ω	T _j = 150 °C		108		ns
E _{off}	di/dt _{on} = 7022 A/μs di/dt _{off} = 2580 A/μs dv/dt = 5960 V/μs L _s = 27 nH	T _j = 150 °C		34.6		mJ
R _{th(j-c)}	per IGBT				0.124	K/W
R _{th(c-s)}	per IGBT (λgrease=0.81 W/(m*K))			0.076		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			0.035		K/W



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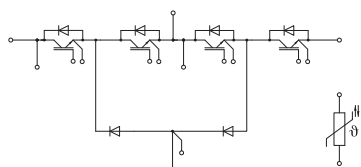
Remarks*

- 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
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- For storage and case temperature with TIM see document "TP(HALA P8) SEMiX 5p"

Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
V _F = V _{EC}	I _F = 350 A	T _j = 25 °C		2.28	2.62	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.27	2.59	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 = 350 A	T _j = 150 °C		306		A
Q _{rr}	di/dt _{off} = 7022 A/μs V _{CC} = 600 V	T _j = 150 °C		53.7		μC
E _{rr}	V _{GE} = +15/-8 V	T _j = 150 °C		26.4		mJ
R _{th(j-c)}	per diode				0.18	K/W
R _{th(c-s)}	per diode (λgrease=0.81 W/(m*K))			0.06		K/W
R _{th(c-s)}	per diode, pre-applied phase change material			0.047		K/W
Diode2						
V _F = V _{EC}	I _F = 350 A	T _j = 25 °C		2.28	2.62	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.27	2.59	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 = 350 A	T _j = 150 °C		306		A
Q _{rr}	di/dt _{off} = 6000 A/μs V _R = 600 V	T _j = 150 °C		46		μC
E _{rr} ¹⁾	V _{GE} = +15/-8 V	T _j = 150 °C		-		mJ
R _{th(j-c)}	per diode				0.2	K/W
R _{th(c-s)}	per diode (λgrease=0.81 W/(m*K))			0.06		K/W
R _{th(c-s)}	per diode, pre-applied phase change material			0.033		K/W
Diode5						
V _F = V _{EC}	I _F = 350 A	T _j = 25 °C		2.28	2.62	V
	chiplevel	T _j = 150 °C		2.27	2.59	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 = 350 A	T _j = 150 °C		407	A
Q _{rr}	di/dt _{off} = 8300 A/μs V _R = 600 V	T _j = 150 °C		52		μC
E _{rr}	V _{GE} = +15/-8 V	T _j = 150 °C		26		mJ
R _{th(j-c)}	per diode				0.2	K/W
R _{th(c-s)}	per diode (λgrease=0.81 W/(m*K))			0.07		K/W
R _{th(c-s)}	per diode, pre-applied phase change material			0.052		K/W



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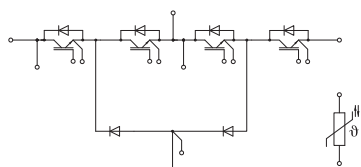
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Footnotes

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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	$T_C = 25^\circ\text{C}$	0.27	mΩ
		$T_C = 125^\circ\text{C}$	0.72	mΩ
$R_{th(c-s)1}$	calculated without thermal coupling		0.007	K/W
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module ($\lambda_{grease}=0.81 \text{ W/(m}^2\text{K)}$)		0.013	K/W
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module, pre-applied phase change material		0.006	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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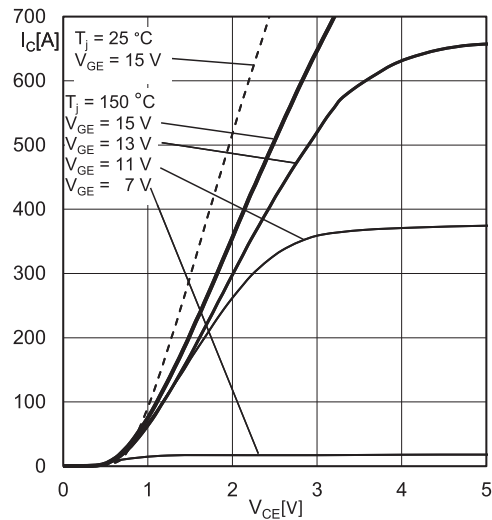


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

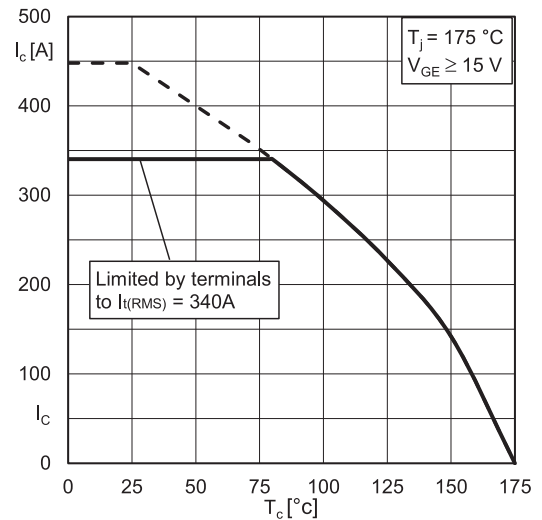


Fig. 2: IGBT1 rated current vs. Temperature $I_C=f(T_c)$

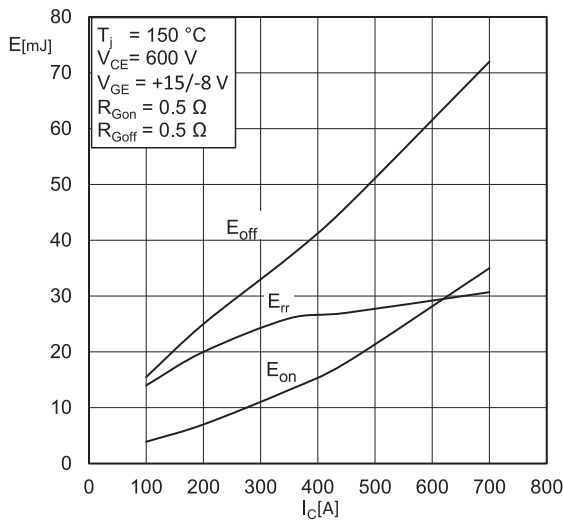


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_C)$

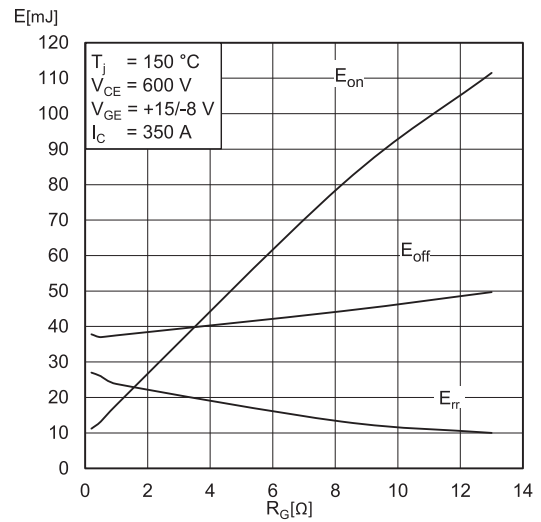


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(R_G)$

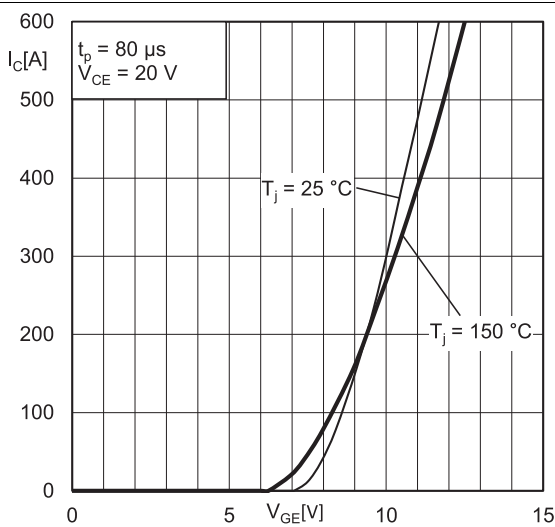


Fig. 5: Typ. IGBT1 transfer characteristic

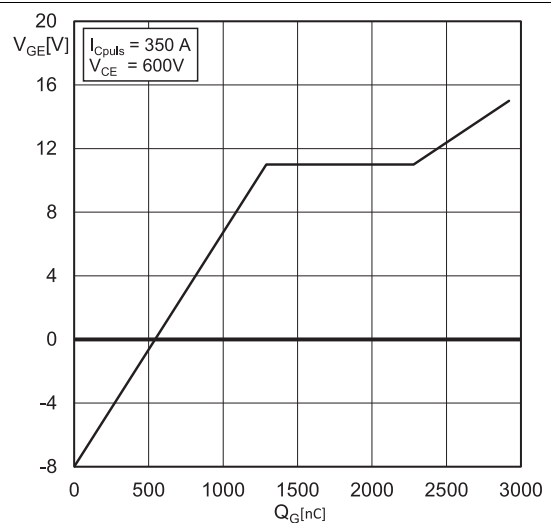


Fig. 6: Typ. IGBT1 gate charge characteristic

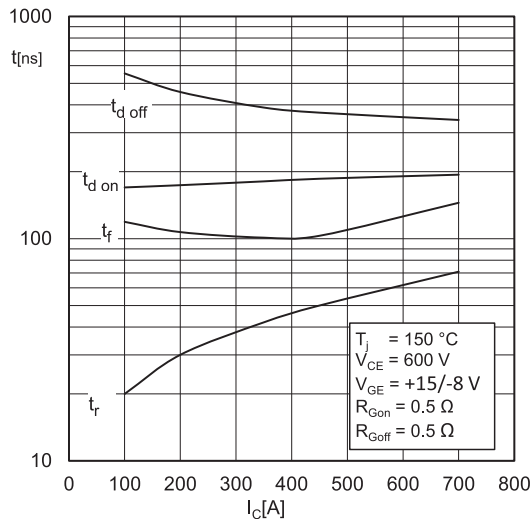


Fig. 7: Typ. IGBT1 switching times vs. I_C

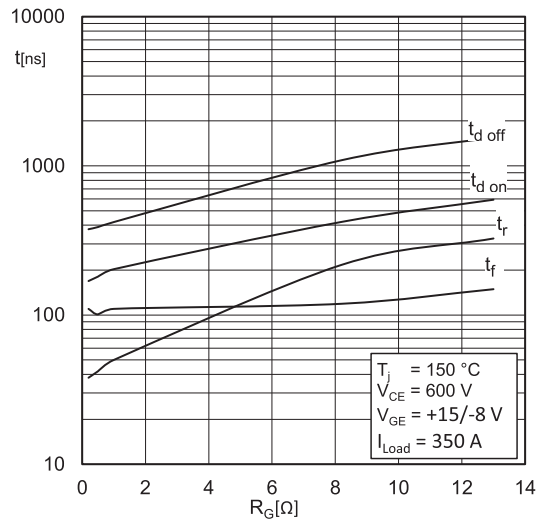


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

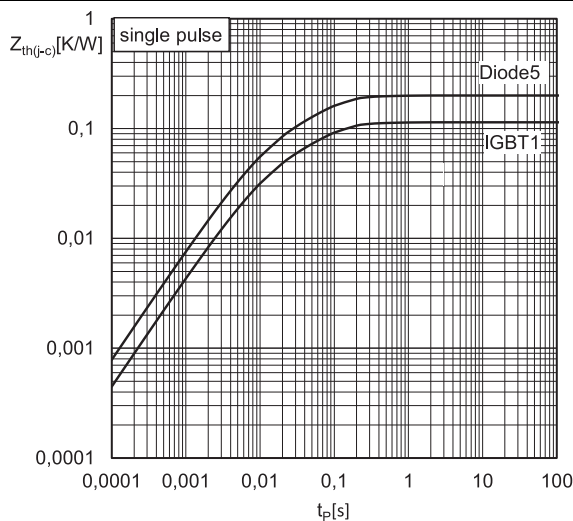


Fig. 9: Typ. transient thermal impedance of IGBT1 & Diode5

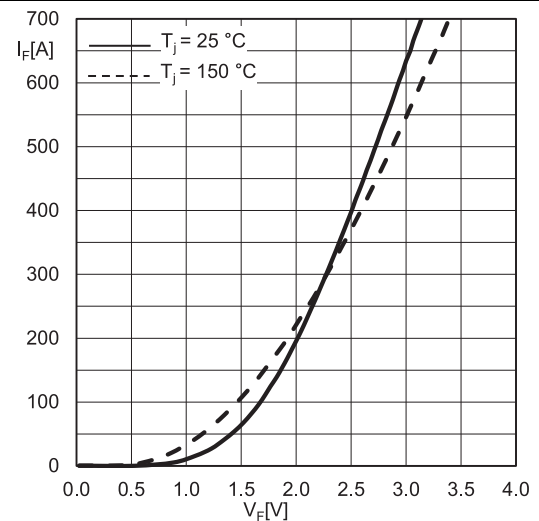


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC'+EE'}$

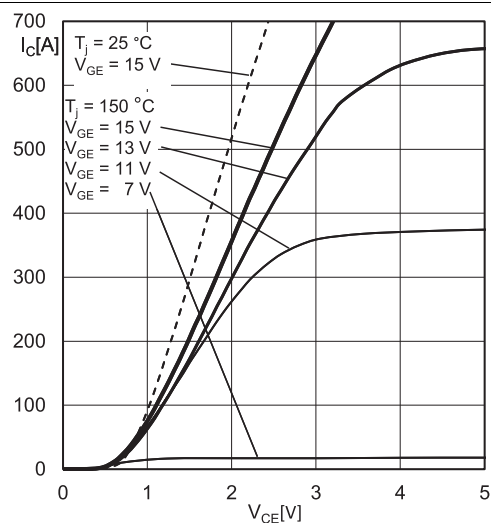


Fig. 13: Typ. IGBT2 output characteristic, incl. $R_{CC'+EE'}$

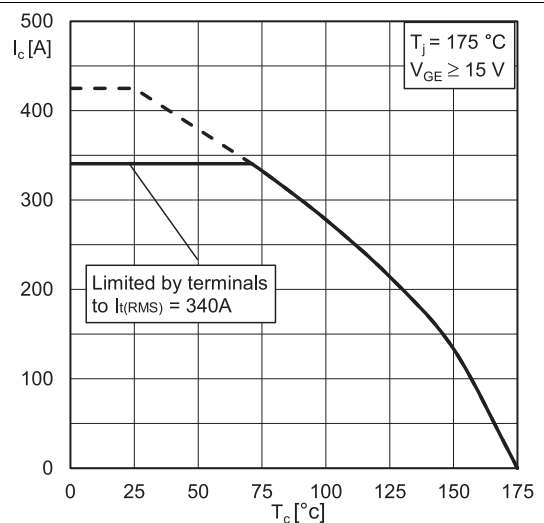


Fig. 14: IGBT2 rated current vs. Temperature $I_C = f(T_C)$

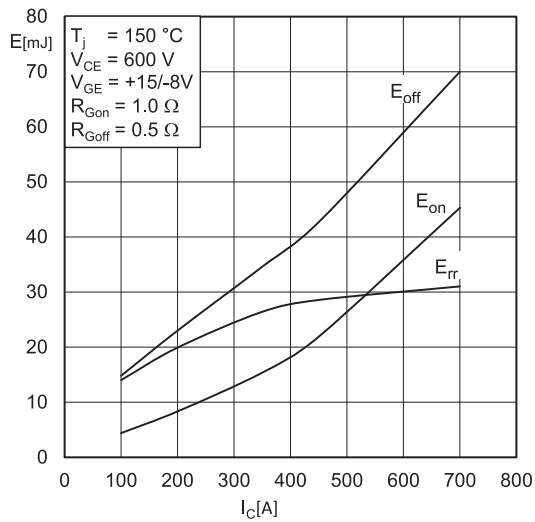


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(I_C)$

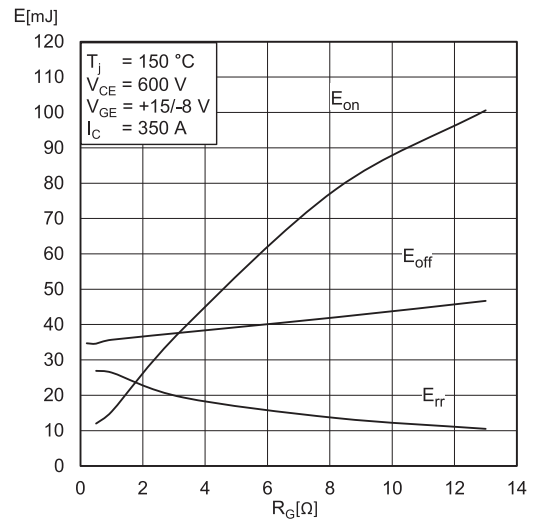


Fig. 16: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(R_G)$

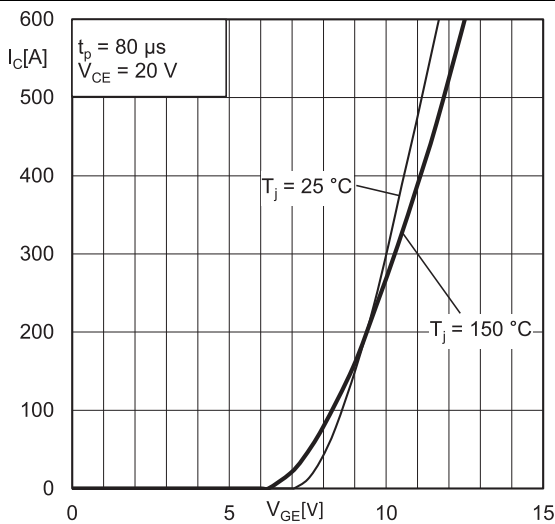


Fig. 17: Typ. IGBT2 transfer characteristic

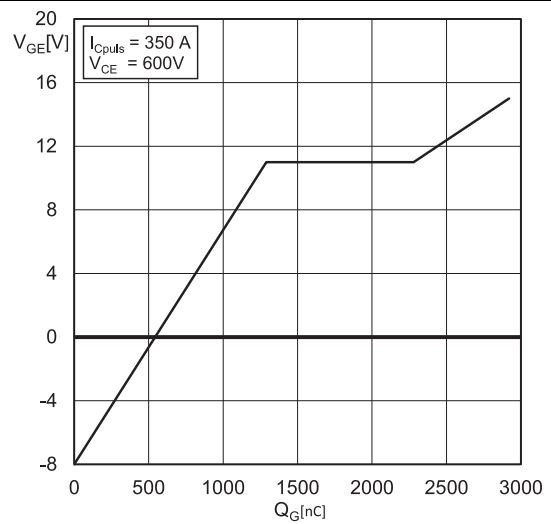


Fig. 18: Typ. IGBT2 gate charge characteristic

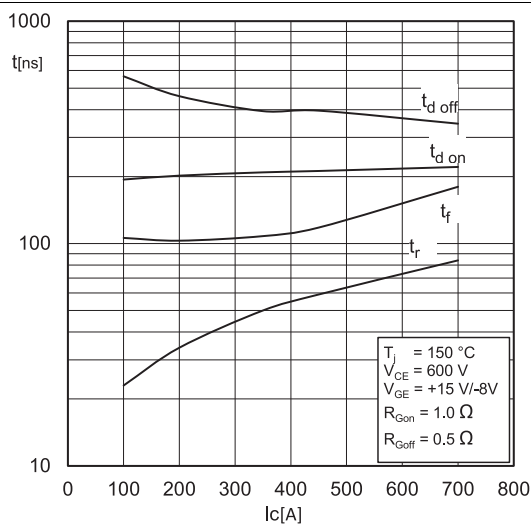


Fig. 19: Typ. IGBT2 switching times vs. I_C

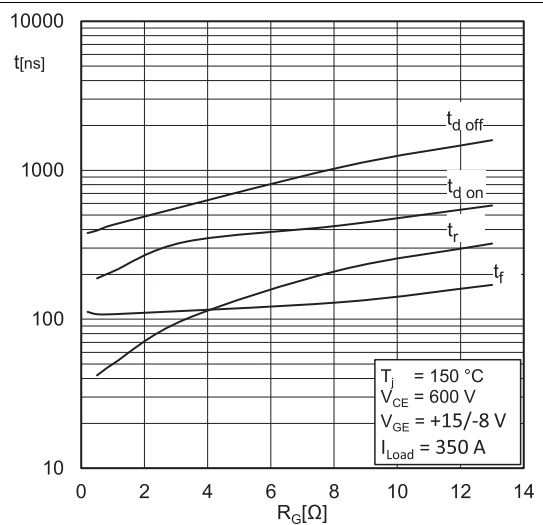


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

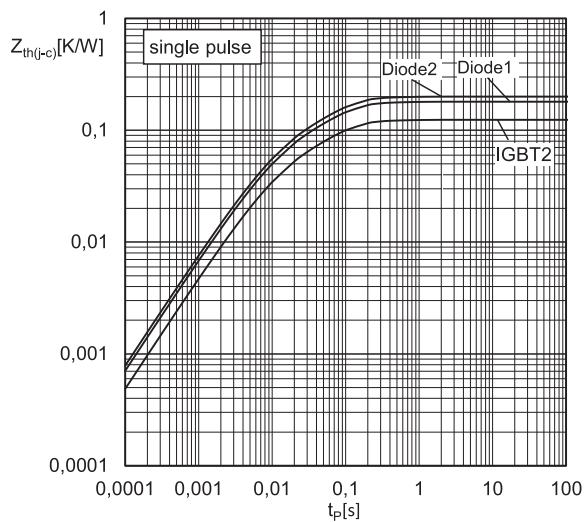


Fig. 21: Transient thermal impedance of IGBT2, Diode1 & Diode2

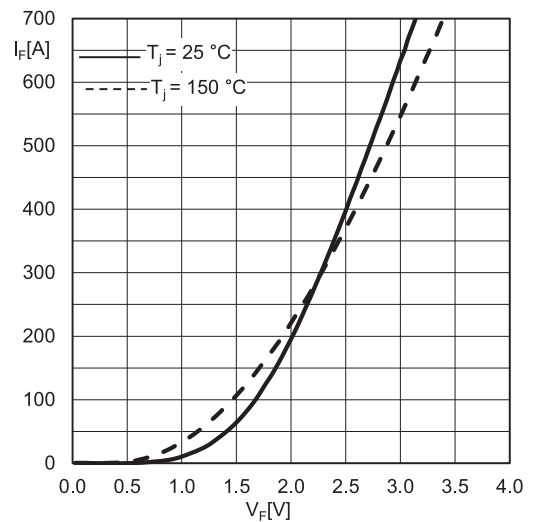
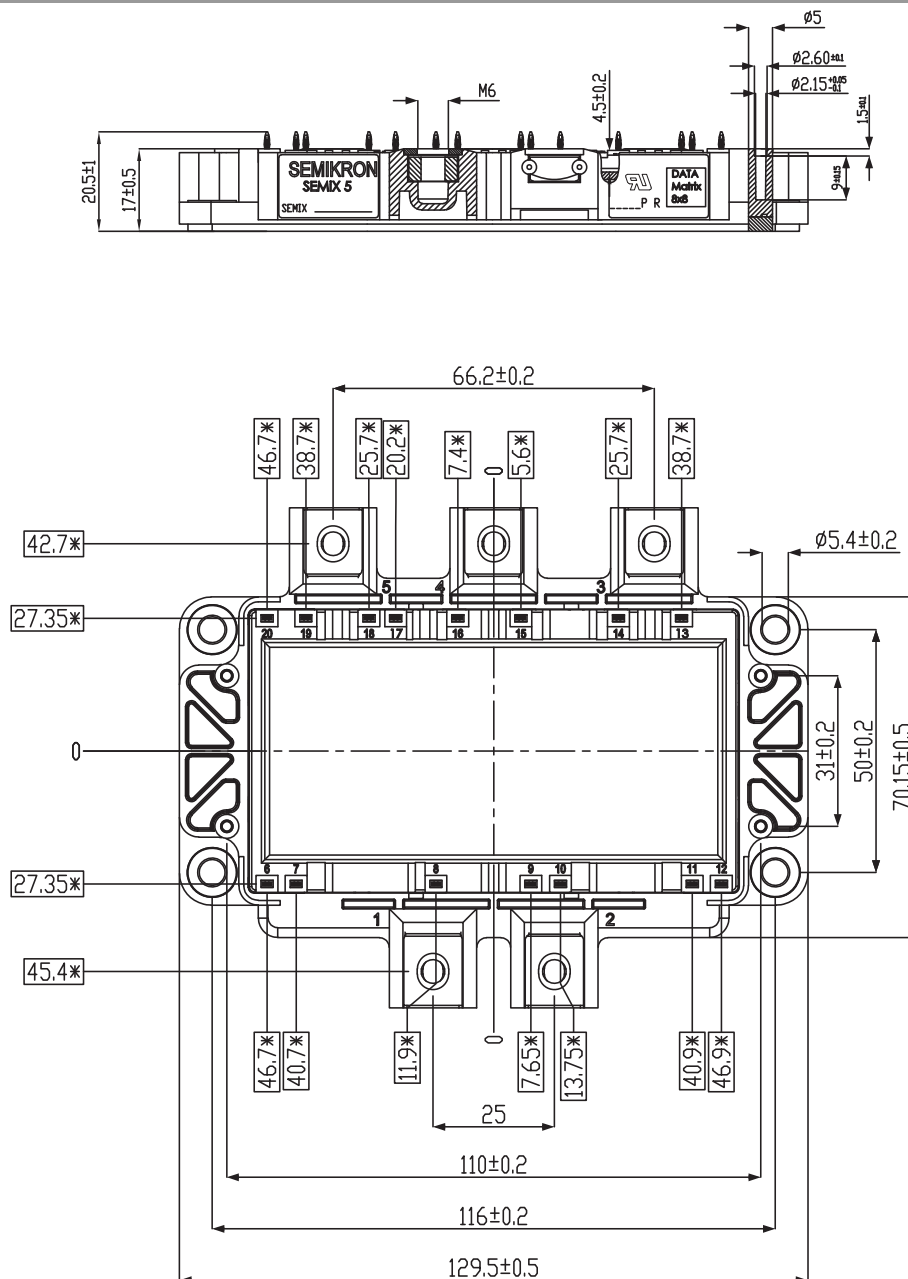


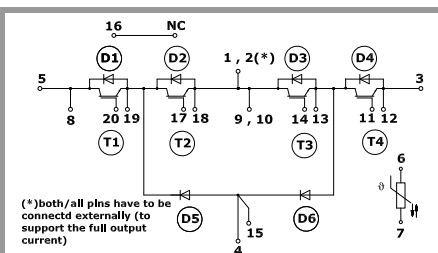
Fig. 22: Typ. Diode1 & Diode2 forward characteristic, incl. $R_{CC'+EE'}$



* = 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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