



SEMiX® 5

3-Level NPC IGBT-Module

SEMiX205MLI12E4V2

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

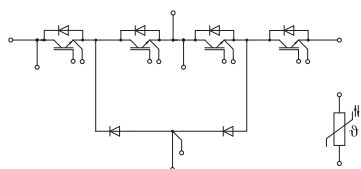
Remarks*

- 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	313	A
		T _c = 80 °C	241	A
I _{Cnom}			200	A
I _{CRM}			600	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	289	A
		T _c = 80 °C	222	A
I _{Cnom}			200	A
I _{CRM}			600	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	229	A
		T _c = 80 °C	172	A
I _{FRM}			400	A
I _{FSM}	10 ms, sin 180°, T _J = 25 °C		990	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	214	A
		T _c = 80 °C	160	A
I _{FRM}			400	A
I _{FSM}	10 ms, sin 180°, T _J = 25 °C		990	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	219	A
		T _c = 80 °C	163	A
I _{FRM}			400	A
I _{FSM}	10 ms, sin 180°, T _J = 25 °C		990	A
T _J			-40 ... 175	°C
Module				
I _{t(RMS)}			300	A
T _{stg}	module without TIM		-40 ... 125	°C
V _{isol}	AC sinus 50Hz, t = 1 min		4000	V



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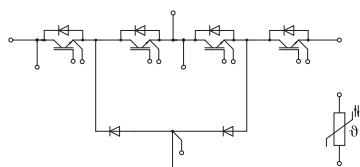
- Solar, Power Supply

Remarks*

- 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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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
V _{CE(sat)}	I _C = 200 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	T _j = 25 °C		5.0	5.8	mΩ
	chiplevel	T _j = 150 °C		7.5	8.0	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 7.6 mA		5	5.8	6.5	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				2.7	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		12.3		nF
C _{oes}		f = 1 MHz		0.81		nF
C _{res}		f = 1 MHz		0.69		nF
Q _G	V _{GE} = -8V...+15V			1130		nC
R _{Gint}	T _j = 25 °C			3.8		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		78		ns
t _r	I _C = 200 A	T _j = 150 °C		54		ns
E _{on}	V _{GE} = +15/-8 V	T _j = 150 °C		12.8		mJ
t _{d(off)}	R _{G on} = 0.5 Ω	T _j = 150 °C		490		ns
t _f	R _{G off} = 1 Ω	T _j = 150 °C		114		ns
E _{off}	di/dt _{on} = 3610 A/μs di/dt _{off} = 1530 A/μs dv/dt = 3530 V/μs	T _j = 150 °C		24.6		mJ
R _{th(j-c)}	per IGBT				0.14	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			0.046		K/W
IGBT2						
V _{CE(sat)}	I _C = 200 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	T _j = 25 °C		5.0	5.8	mΩ
	chiplevel	T _j = 150 °C		7.5	8.0	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 7.6 mA		5	5.8	6.5	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				2.7	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		12.3		nF
C _{oes}		f = 1 MHz		0.81		nF
C _{res}		f = 1 MHz		0.69		nF
Q _G	V _{GE} = -8V...+15V			1130		nC
R _{Gint}	T _j = 25 °C			3.8		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		85		ns
t _r	I _C = 200 A	T _j = 150 °C		57		ns
E _{on}	V _{GE} = +15/-8 V	T _j = 150 °C		8.4		mJ
t _{d(off)}	R _{G on} = 0.5 Ω	T _j = 150 °C		504		ns
t _f	R _{G off} = 1 Ω	T _j = 150 °C		120		ns
E _{off}	di/dt _{on} = 3450 A/μs di/dt _{off} = 1430 A/μs dv/dt = 3560 V/μs	T _j = 150 °C		25.4		mJ
R _{th(j-c)}	per IGBT				0.16	K/W
R _{th(c-s)}	per IGBT (λgrease=0.81 W/(m*K))			0.087		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			0.052		K/W



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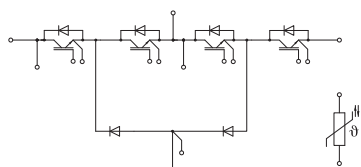
Remarks*

- 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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Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
V _F = V _{EC}	I _F = 200 A	T _j = 25 °C		2.20	2.52	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.15	2.47	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		4.5	5.1	mΩ
		T _j = 150 °C		6.3	6.9	mΩ
I _{RRM}	I _F = 200 A	T _j = 150 °C		158		A
Q _{rr}	di/dt _{off} = 3450 A/μs V _{CC} = 600 V	T _j = 150 °C		23.9		μC
E _{rr}	V _{GE} = +15/-8 V	T _j = 150 °C		5.8		mJ
R _{th(j-c)}	per diode				0.26	K/W
R _{th(c-s)}	per diode (λgrease=0.81 W/(m*K))			0.09		K/W
R _{th(c-s)}	per diode, pre-applied phase change material			0.065		K/W
Diode2						
V _F = V _{EC}	I _F = 200 A	T _j = 25 °C		2.20	2.52	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.15	2.47	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		4.5	5.1	mΩ
		T _j = 150 °C		6.3	6.9	mΩ
I _{RRM}	I _F = 200 A	T _j = 150 °C		158		A
Q _{rr}	V _R = 600 V V _{GE} = +15/-8 V	T _j = 150 °C		23.9		μC
E _{rr} ¹⁾		T _j = 150 °C		-		mJ
R _{th(j-c)}	per diode				0.29	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			0.071		K/W
Diode5						
V _F = V _{EC}	I _F = 200 A	T _j = 25 °C		2.20	2.52	V
	chiplevel	T _j = 150 °C		2.15	2.47	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		4.5	5.1	mΩ
	chiplevel	T _j = 150 °C		6.3	6.9	mΩ
I _{RRM}		I _F = 200 A	T _j = 150 °C		185	A
Q _{rr}	di/dt _{off} = 3610 A/μs V _R = 600 V	T _j = 150 °C		28.7		μC
E _{rr}	V _{GE} = +15/-8 V	T _j = 150 °C		16		mJ
R _{th(j-c)}	per diode				0.28	K/W
R _{th(c-s)}	per diode (λgrease=0.81 W/(m*K))			0.103		K/W
R _{th(c-s)}	per diode, pre-applied phase change material			0.074		K/W



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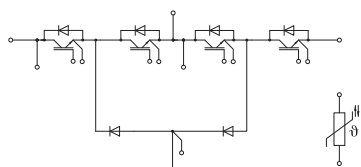
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Footnotes

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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		0.009	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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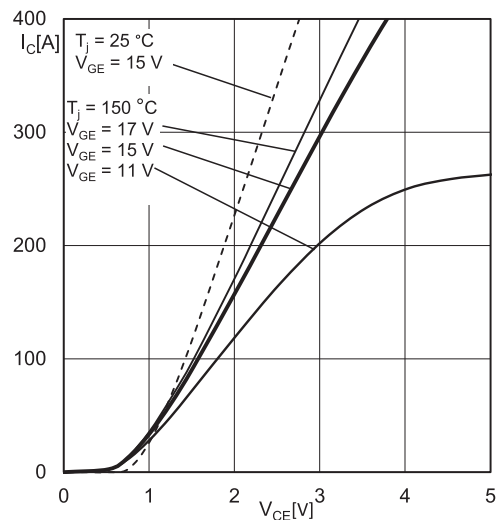


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

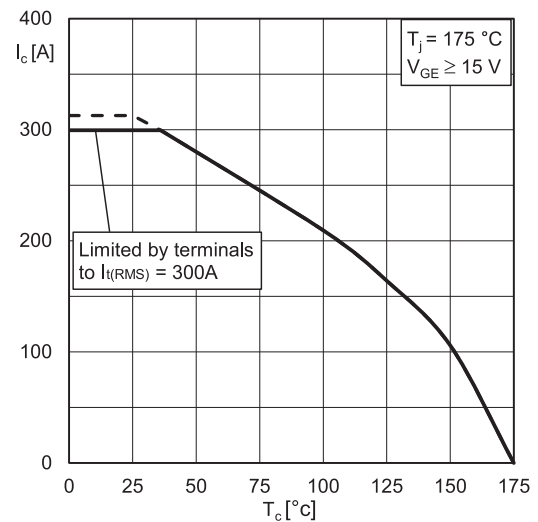


Fig. 2: IGBT1 rated current vs. Temperature $I_C=f(T_C)$

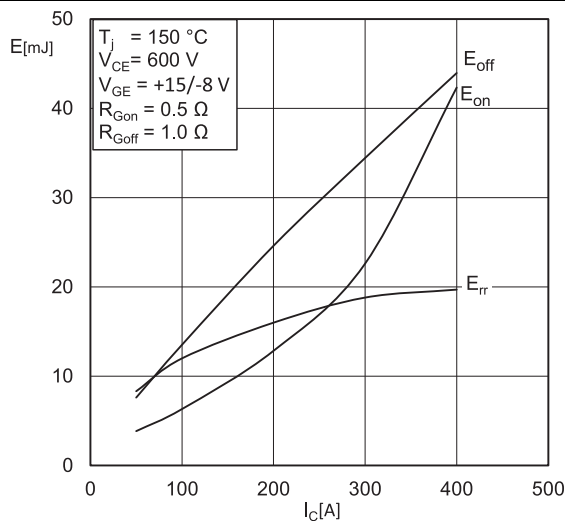


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_C)$

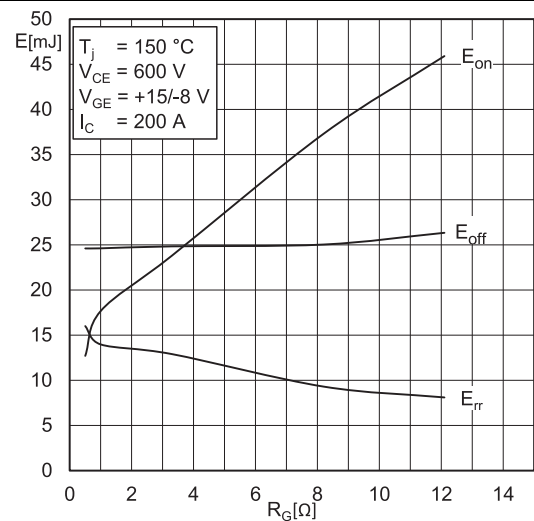


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(R_G)$

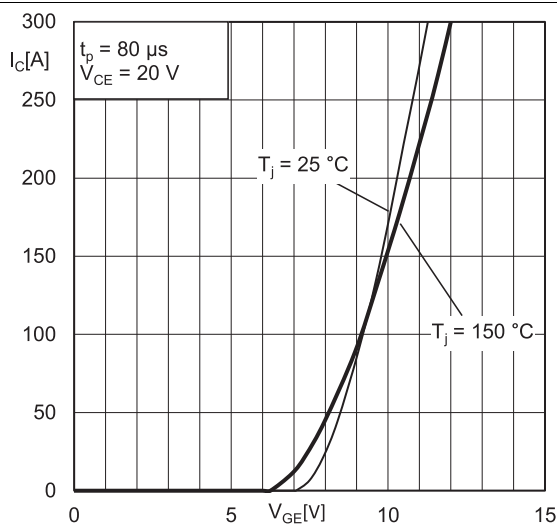


Fig. 5: Typ. IGBT1 transfer characteristic

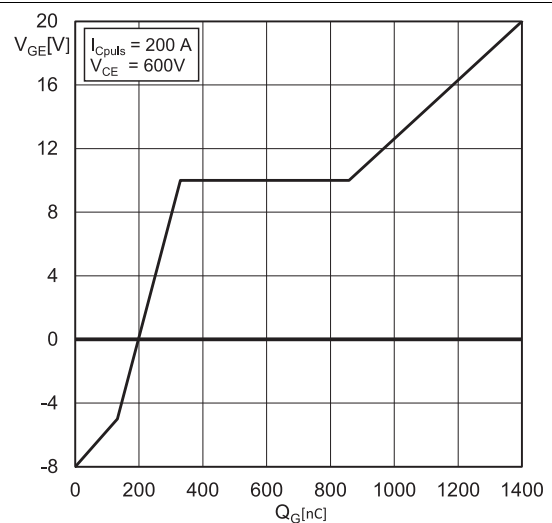


Fig. 6: Typ. IGBT1 gate charge characteristic

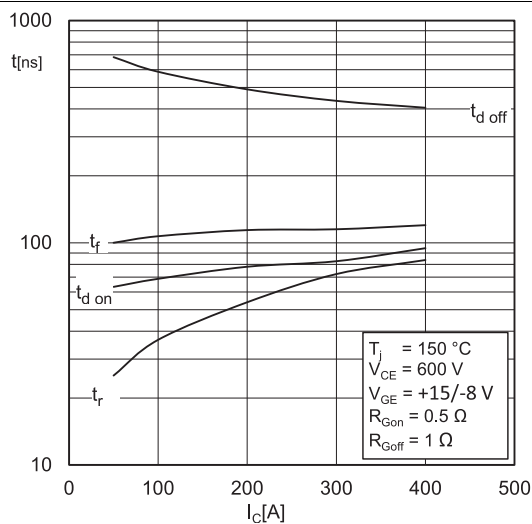


Fig. 7: Typ. IGBT1 switching times vs. I_C

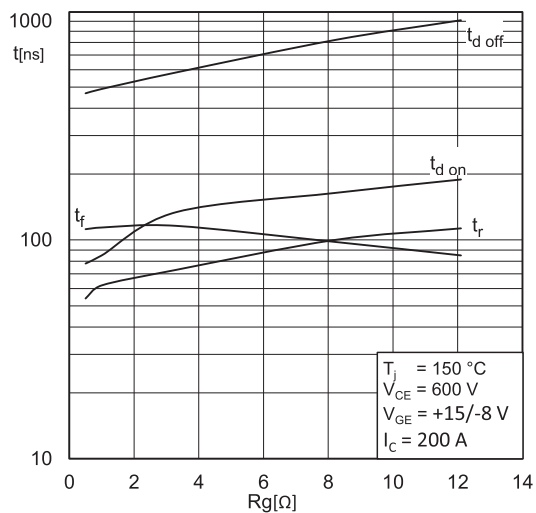


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

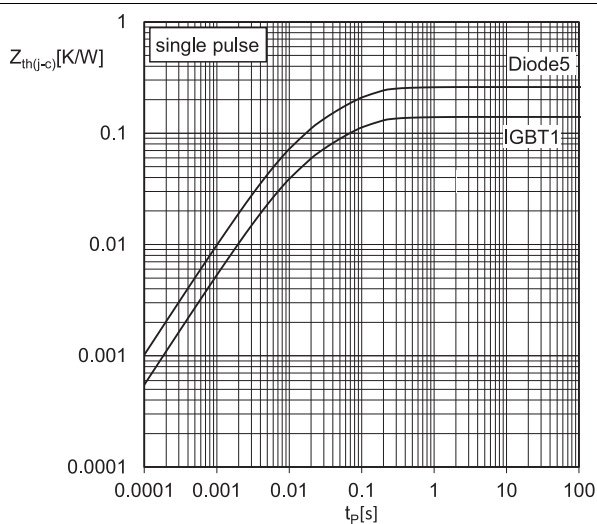


Fig. 9: Transient thermal impedance of IGBT1 & Diode5

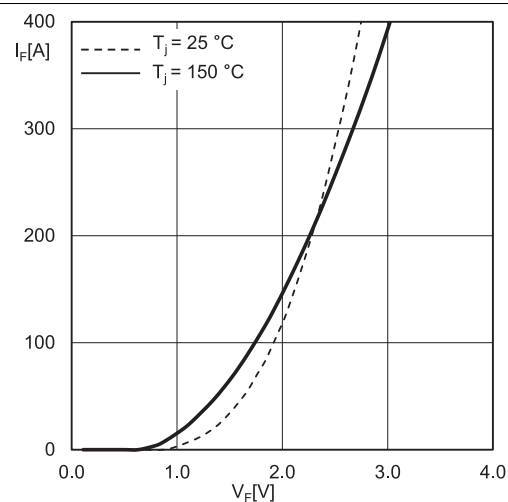


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC'+EE'}$

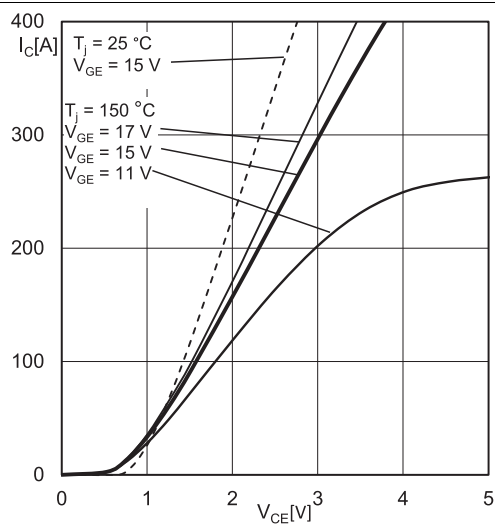


Fig. 13: Typ. IGBT2 output characteristic, incl. $R_{CC'+EE'}$

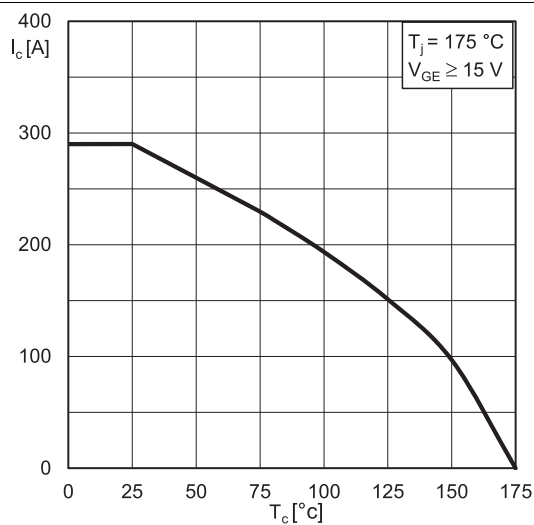


Fig. 14: IGBT2 rated current vs. Temperature $I_C = f(T_C)$

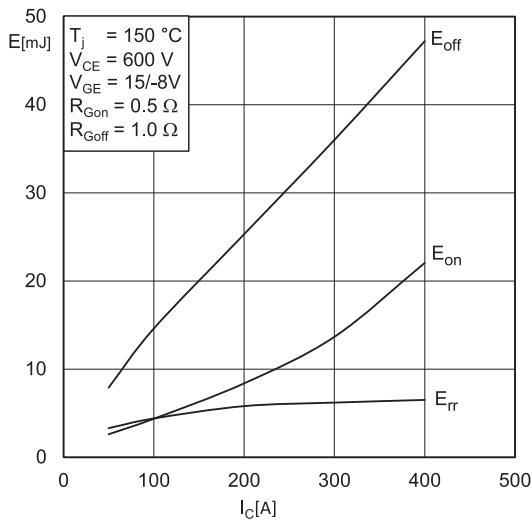


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(I_C)$

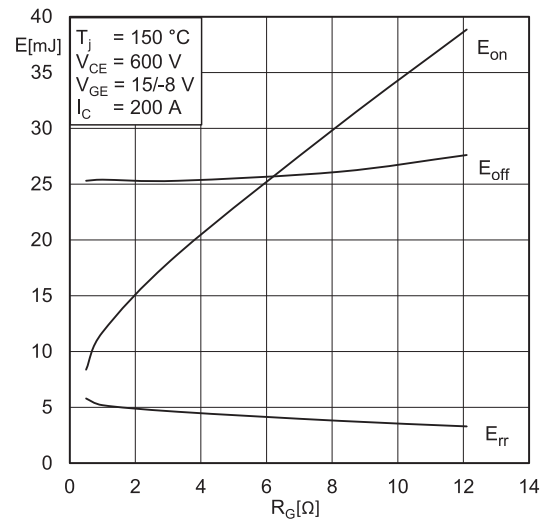


Fig. 16: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(R_G)$

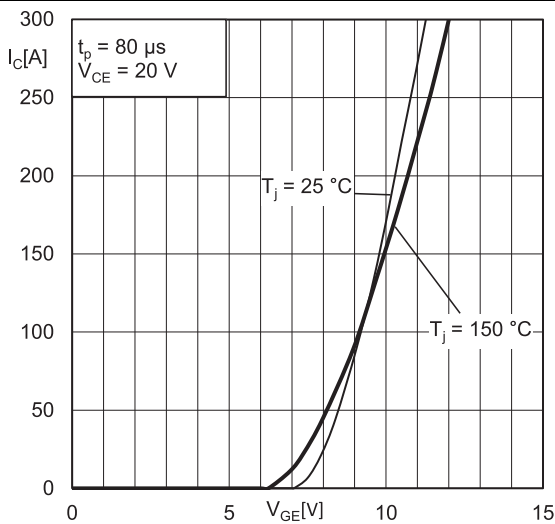


Fig. 17: Typ. IGBT2 transfer characteristic

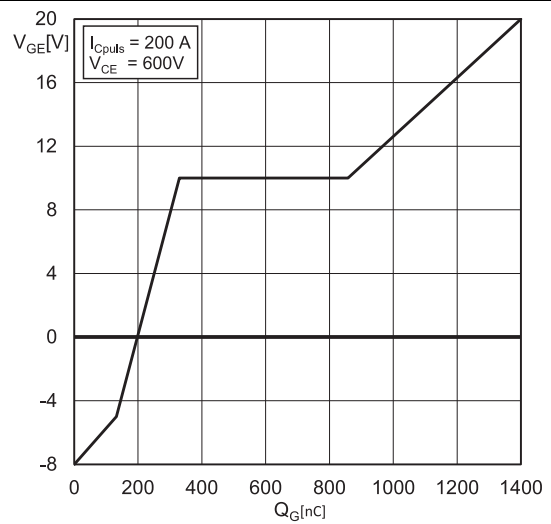


Fig. 18: Typ. IGBT2 gate charge characteristic

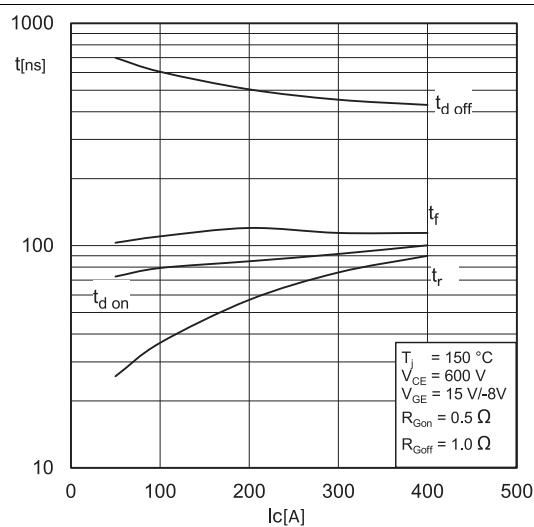


Fig. 19: Typ. IGBT2 switching times vs. I_C

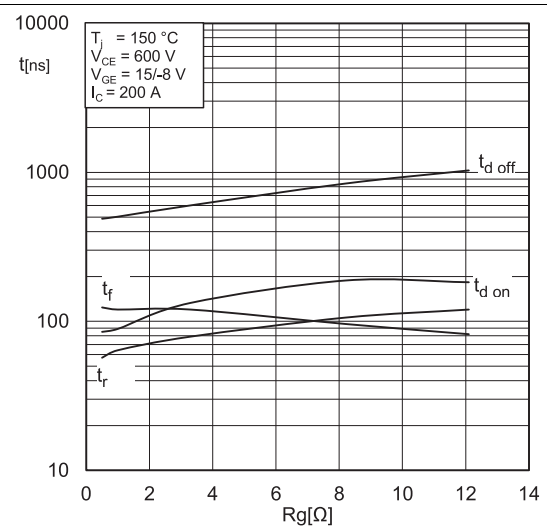


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

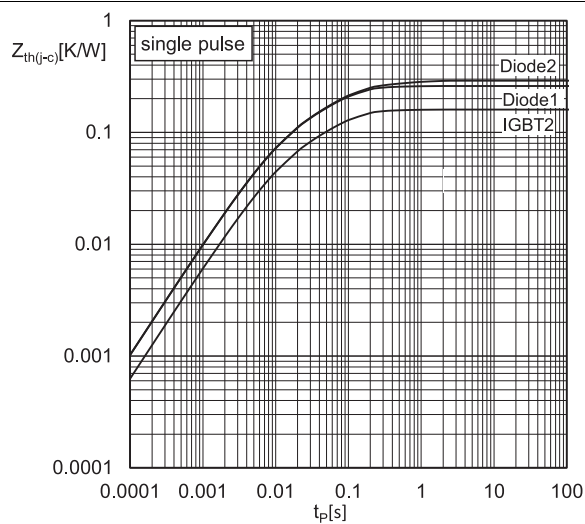


Fig. 21: Transient thermal impedance of IGBT2, Diode1 & Diode2

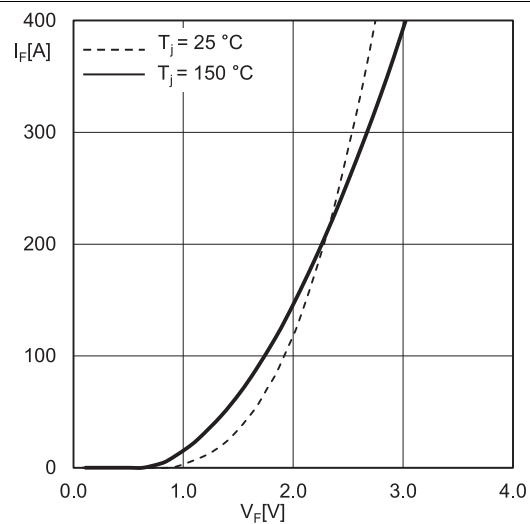
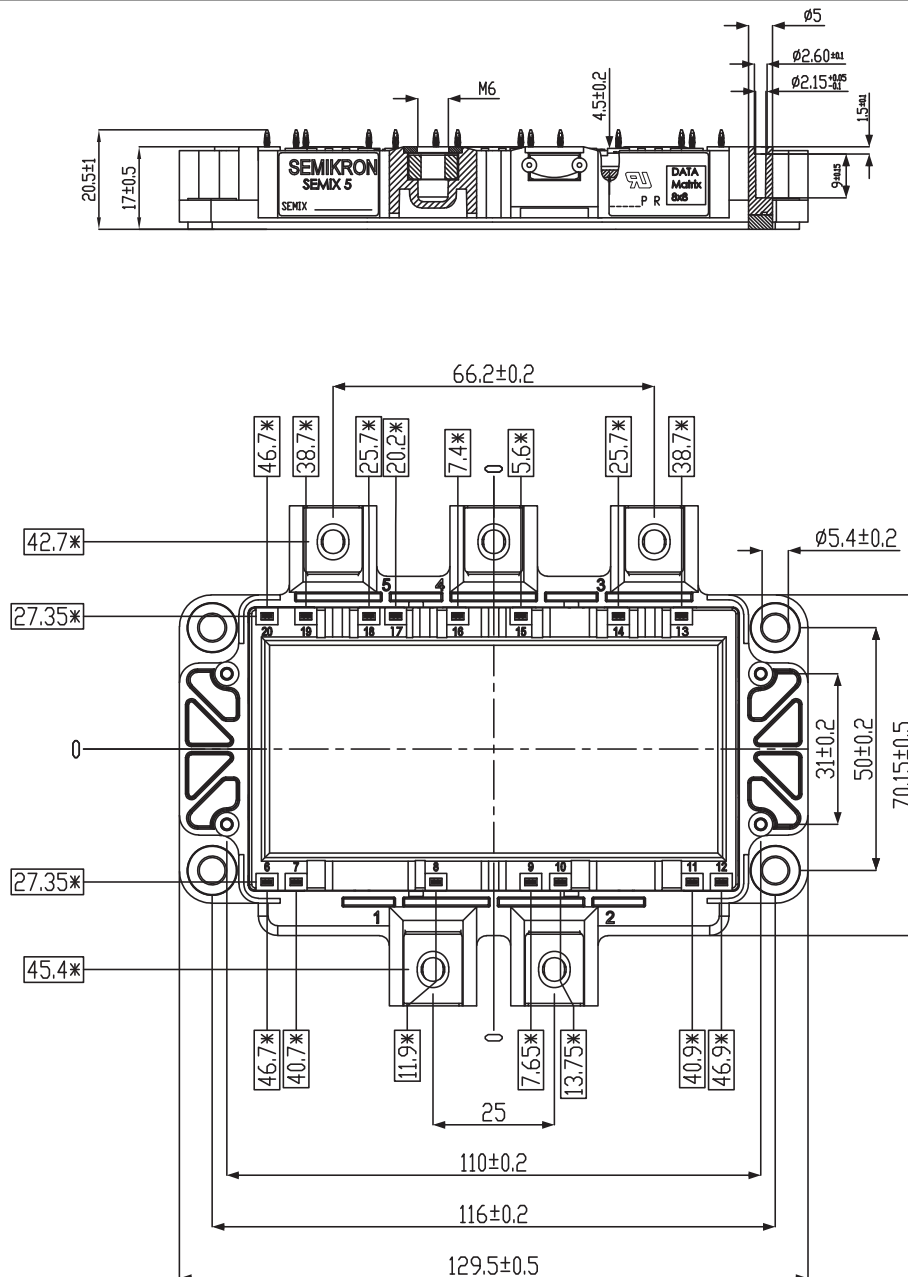


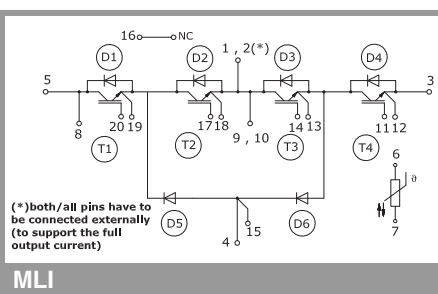
Fig. 22: Typ. Diode1 & Diode2 forward characteristic, incl. $R_{CC'+EE'}$



* = 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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