



SEMiX® 5

3-Level TNPC IGBT-Module

SEMiX205TMLI12E4B

Features

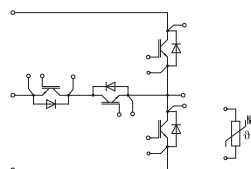
- Solderless assembling solution with PressFIT signal pins and screw power terminals
- IGBT 4 Trench Gate Technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Low inductance case
- Reliable mechanical design with injection moulded terminals and reliable internal connections
- UL recognized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

Remarks*

- Case temperature limited to $T_C=125^{\circ}\text{C}$ max.
- Product reliability results are valid for $T_{jop}=150^{\circ}\text{C}$
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & D3
- For storage and case temperature with TIM see document "TP(HALA P8) SEMiX 5p"

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	318	A
		T _c = 80 °C	245	A
I _{Cnom}			200	A
I _{CRM}	I _{CRM} = 3 x I _{Cnom}		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		650	V
I _C	T _j = 175 °C	T _c = 25 °C	237	A
		T _c = 80 °C	178	A
I _{Cnom}			200	A
I _{CRM}	I _{CRM} = 3 x I _{Cnom}		600	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 360 V, V _{GE} ≤ 15 V, T _j = 150 °C, V _{CES} ≤ 650 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 _{Fnom}			200	A
I _{FRM}	I _{FRM} = 2 x I _{Fnom}		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		650	V
I _F	T _j = 175 °C	T _c = 25 °C	235	A
		T _c = 80 °C	171	A
I _{Fnom}			200	A
I _{FRM}	I _{FRM} = 2 x I _{Fnom}		400	A
I _{FSM}	10 ms, sin 180°, T _j = 25 °C		1476	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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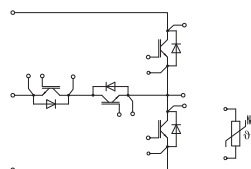
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
V _{CE(sat)}	I _C = 200 A	T _j = 25 °C		1.80	2.05	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.20	2.40	V
V _{CE0}	chiplevel	T _j = 25 °C		0.80	0.90	V
		T _j = 150 °C		0.70	0.80	V
r _{CE}	V _{GE} = 15 V chiplevel	T _j = 25 °C		5.0	5.8	mΩ
		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} = - 15 V...+ 15 V			1513		nC
R _{Gint}	T _j = 25 °C			3.8		Ω
t _{d(on)}	V _{CC} = 300 V	T _j = 150 °C		232		ns
t _r	I _C = 200 A	T _j = 150 °C		128		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		3		mJ
t _{d(off)}	R _{G on} = 3 Ω	T _j = 150 °C		422		ns
t _f	R _{G off} = 3 Ω	T _j = 150 °C		121		ns
E _{off}	di/dt _{on} = 2437 A/μs di/dt _{off} = 3000 A/μs	T _j = 150 °C		14		mJ
R _{th(j-c)}	per IGBT				0.136	K/W
R _{th(c-s)}	per IGBT (λgrease=0.81 W/(m*K))			0.06		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		1.55	1.95	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		1.75	2.15	V
V _{CE0}	chiplevel	T _j = 25 °C		0.90	1.00	V
		T _j = 150 °C		0.82	0.90	V
r _{CE}	V _{GE} = 15 V chiplevel	T _j = 25 °C		3.3	4.8	mΩ
		T _j = 150 °C		4.7	6.3	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 8 mA		5.1	5.8	6.4	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 650 V, T _j = 25 °C				0.2	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		12.3		nF
C _{oes}		f = 1 MHz		0.77		nF
C _{res}		f = 1 MHz		0.37		nF
Q _G	V _{GE} = - 15 V...+ 15 V			2212		nC
R _{Gint}	T _j = 25 °C			1.0		Ω
t _{d(on)}	V _{CC} = 300 V	T _j = 150 °C		170		ns
t _r	I _C = 200 A	T _j = 150 °C		118		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		1.5		mJ
t _{d(off)}	R _{G on} = 3 Ω	T _j = 150 °C		380		ns
t _f	R _{G off} = 3 Ω	T _j = 150 °C		127		ns
E _{off}	di/dt _{on} = 3100 A/μs di/dt _{off} = 2800 A/μs	T _j = 150 °C		11.5		mJ
R _{th(j-c)}	per IGBT				0.26	K/W
R _{th(c-s)}	per IGBT (λgrease=0.81 W/(m*K))			0.072		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			0.067		K/W

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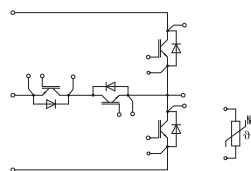
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Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
Diode1					
$V_F = V_{EC}$	$I_F = 200\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	2.20	2.52	V
		$T_j = 150^\circ\text{C}$	2.15	2.47	V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$	1.30	1.50	V
		$T_j = 150^\circ\text{C}$	0.90	1.10	V
r_F	chipelevel	$T_j = 25^\circ\text{C}$	4.5	5.1	mΩ
		$T_j = 150^\circ\text{C}$	6.3	6.9	mΩ
I_{RRM}	$I_F = 200\text{ A}$	$T_j = 150^\circ\text{C}$	106		A
Q_{rr}	$di/dt_{off} = 3100\text{ A}/\mu\text{s}$ $V_{CC} = 300\text{ V}$	$T_j = 150^\circ\text{C}$	27.5		μC
E_{rr}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	5.9		mJ
$R_{th(j-c)}$	per diode			0.26	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)		0.07		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material		0.065		K/W
Diode2					
$V_F = V_{EC}$	$I_F = 200\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.40	1.76	V
		$T_j = 150^\circ\text{C}$	1.38	1.77	V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$	1.04	1.24	V
		$T_j = 150^\circ\text{C}$	0.85	0.99	V
r_F	chipelevel	$T_j = 25^\circ\text{C}$	1.78	2.6	mΩ
		$T_j = 150^\circ\text{C}$	2.7	3.9	mΩ
I_{RRM}	$I_F = 200\text{ A}$	$T_j = 150^\circ\text{C}$	121		A
Q_{rr}	$di/dt_{off} = 2437\text{ A}/\mu\text{s}$ $V_R = 300\text{ V}$	$T_j = 150^\circ\text{C}$	23		μC
E_{rr}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	5.5		mJ
$R_{th(j-c)}$	per diode			0.35	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)		0.065		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material		0.063		K/W
Module					
L_{sCE1}			31		nH
L_{CE}			42		nH
$R_{CC'+EE'}$	measured between terminal 5 and 1	$T_C = 25^\circ\text{C}$	1.2		mΩ
		$T_C = 125^\circ\text{C}$	1.65		mΩ
$R_{th(c-s)1}$	calculated without thermal coupling		0.008		K/W
$R_{th(c-s)2}$	including thermal coupling, Ts underneath module ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)		0.0133		K/W
$R_{th(c-s)2}$	including thermal coupling, Ts underneath module, pre-applied phase change material		0.0118		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

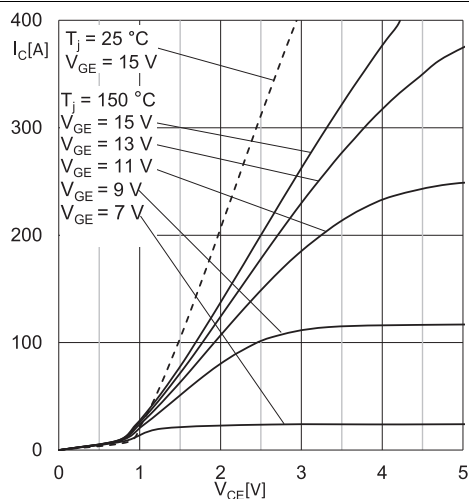


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC}'+EE'$

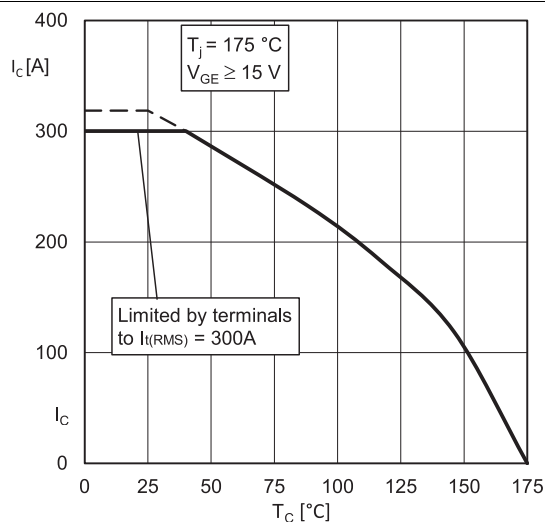


Fig. 2: IGBT1 rated current vs. Temperature $I_c=f(T_c)$

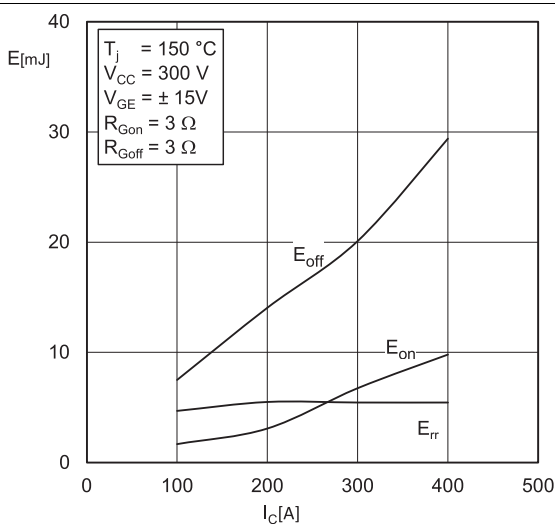


Fig. 3: Typ. IGBT1 & Diode2 turn-on /-off energy = $f(I_c)$

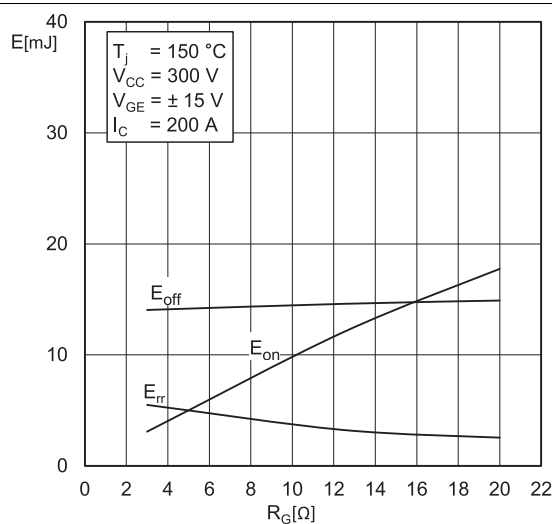


Fig. 4: Typ. IGBT1 & Diode2 turn-on /-off energy = $f(R_G)$

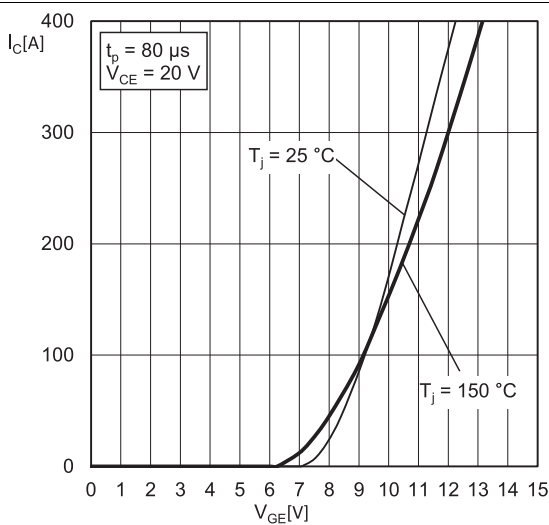


Fig. 5: Typ. IGBT1 transfer characteristic

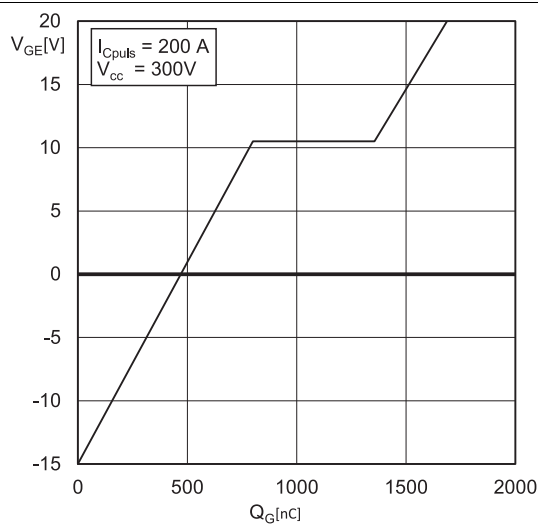
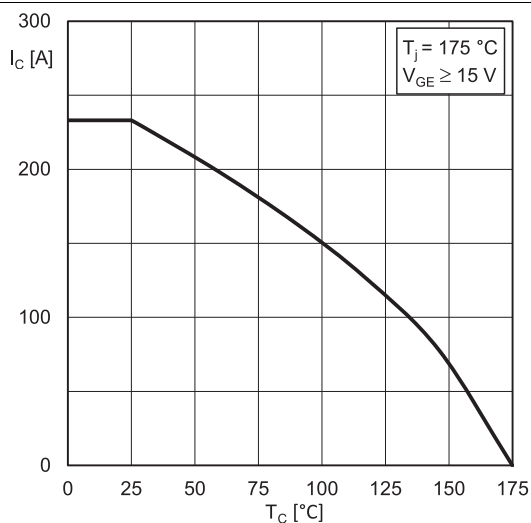
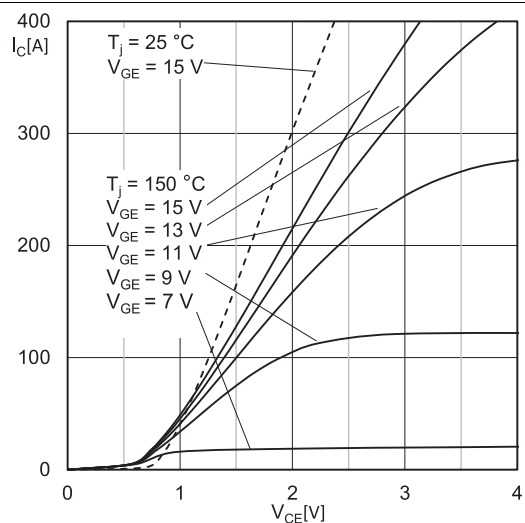
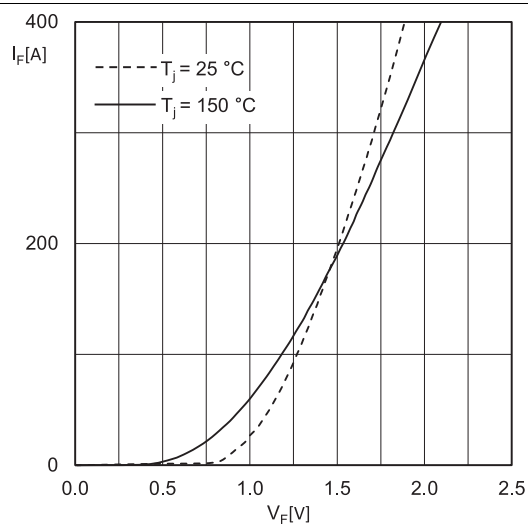
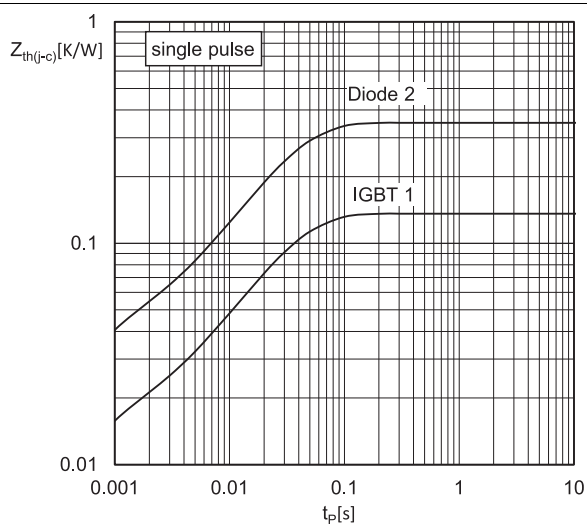
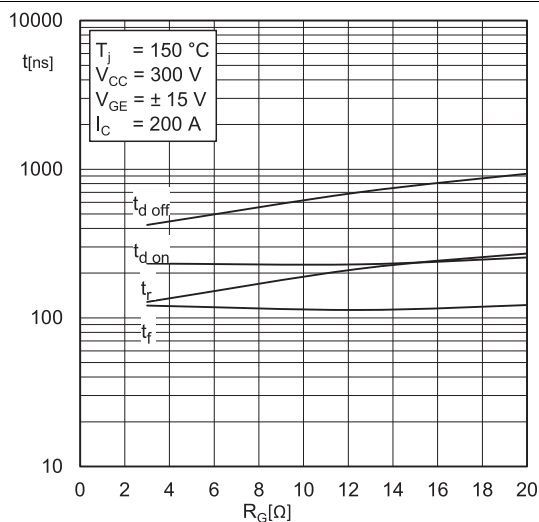
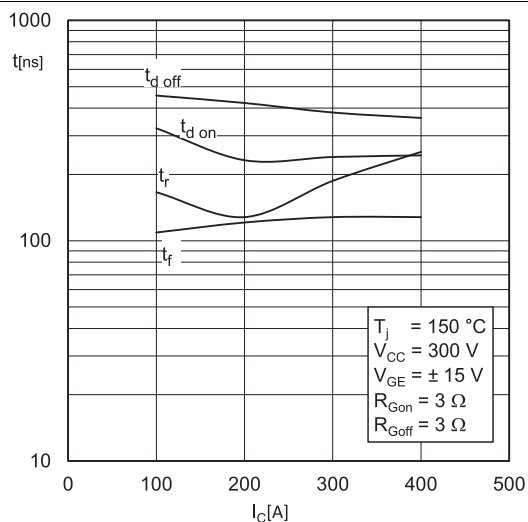


Fig. 6: Typ. IGBT1 gate charge characteristic



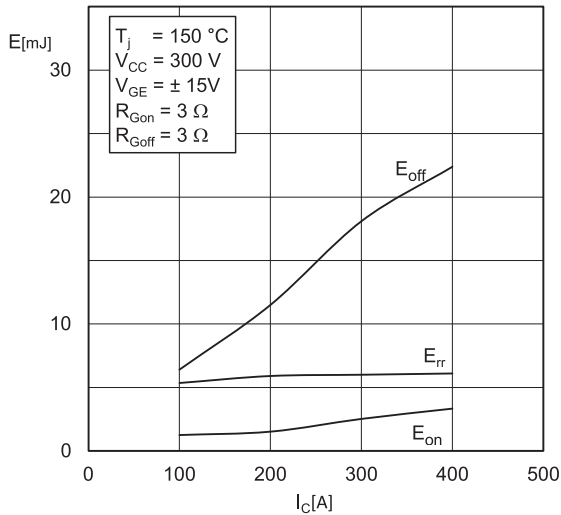


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(I_C)$

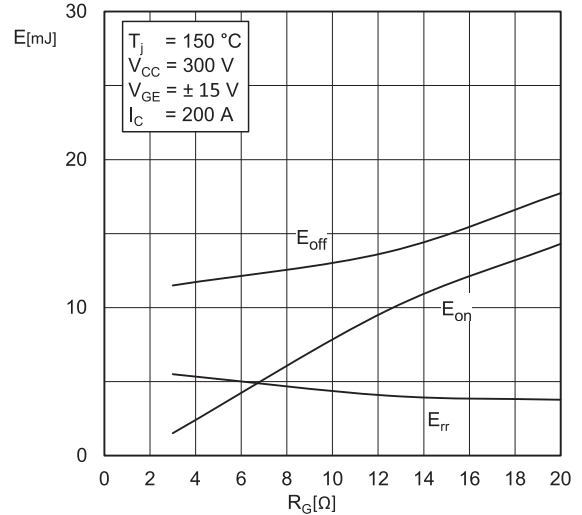


Fig. 16: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(R_G)$

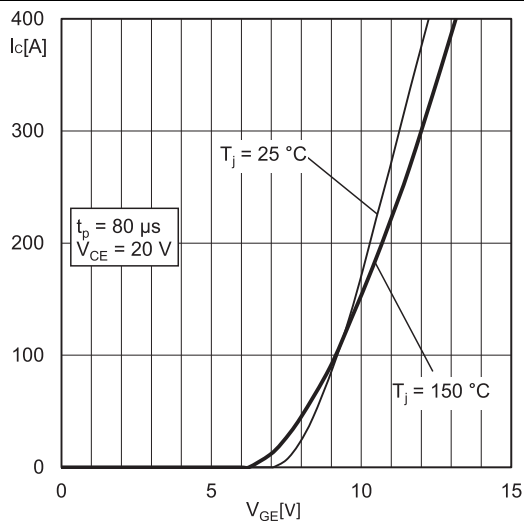


Fig. 17: Typ. IGBT2 transfer characteristic

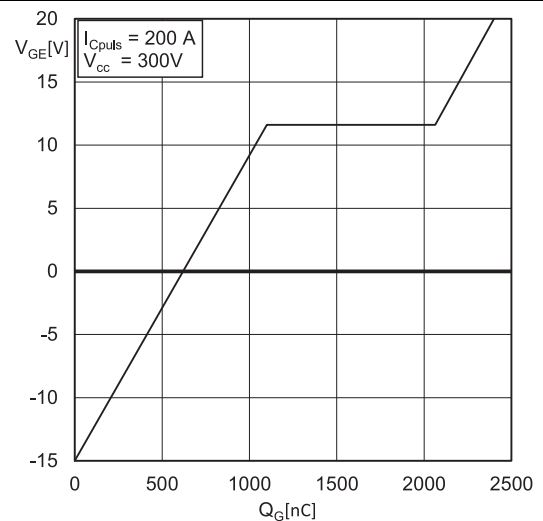


Fig. 18: Typ. IGBT2 gate charge characteristic

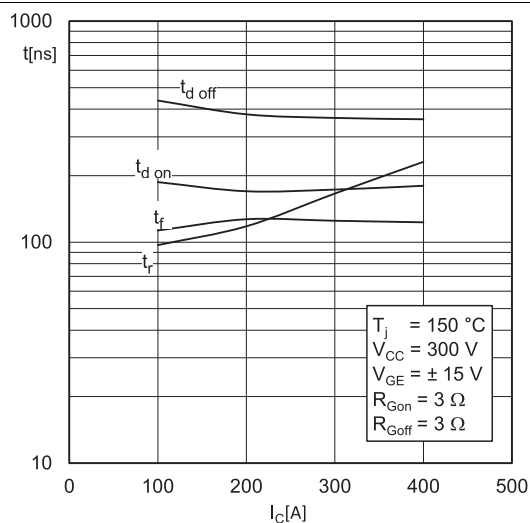


Fig. 19: Typ. IGBT2 switching times vs. I_C

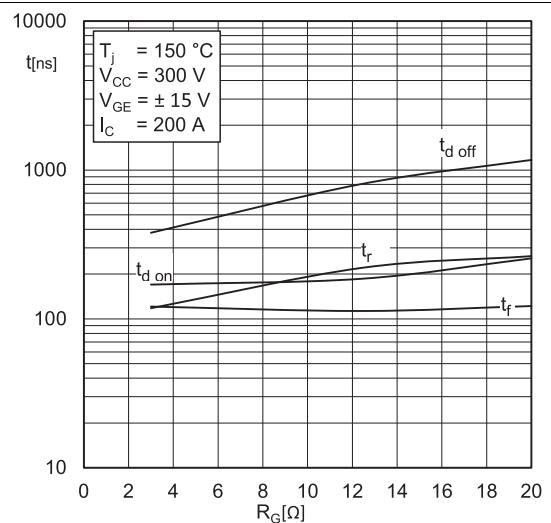
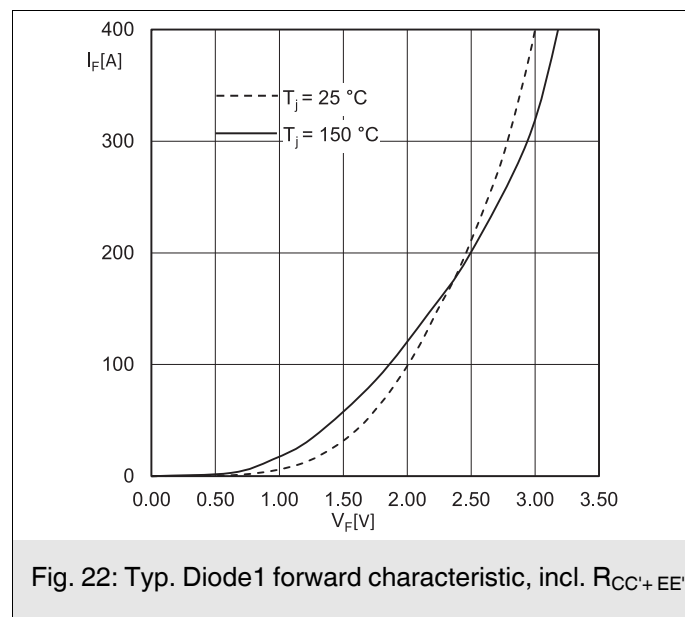
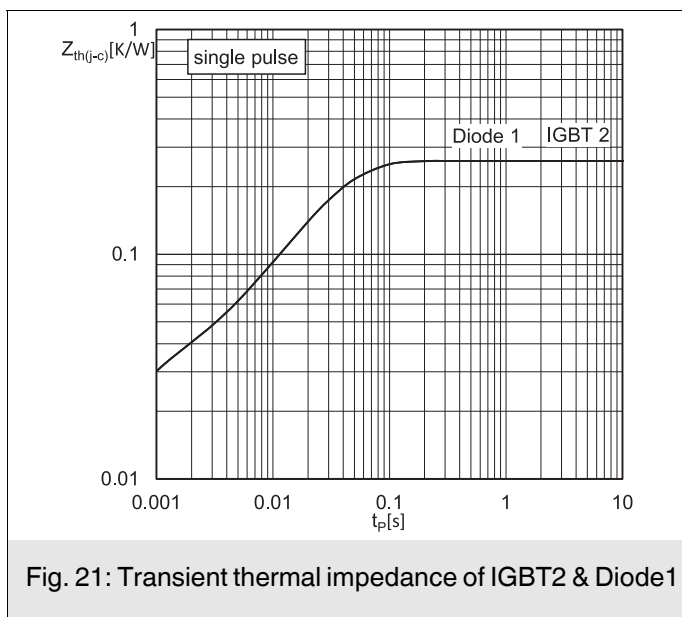
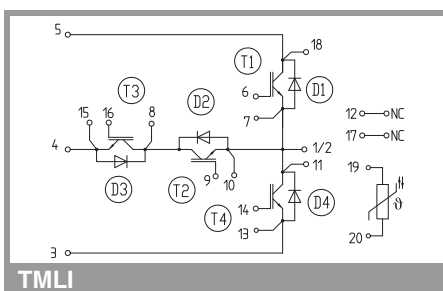
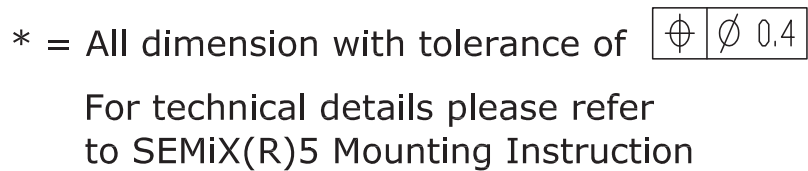


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G





This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

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