



SEMiX® 3p

Trench IGBT Modules

SEMiX603GB12E4pV1

Features*

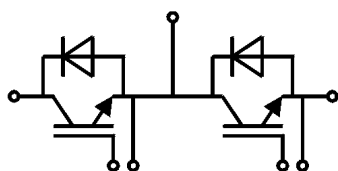
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability
- Press-fit pins as auxiliary contacts
- Thermally optimized ceramic
- UL recognized, file no. E63532

Typical Applications

- AC inverter drives
- UPS
- Renewable energy systems

Remarks

- Product reliability results are valid for $T_j = 150^\circ\text{C}$
- V_{isol} between temperature sensor and power section is only 2500V
- For storage and case temperature with TIM see document "TP(*) SEMiX 3p"



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Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
IGBT				
V _{CES}	T _j = 25 °C		1200	V
I _C	T _j = 175 °C	T _c = 25 °C	1062	A
		T _c = 80 °C	815	A
I _{Cnom}			600	A
I _{CRM}			1800	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V V _{GE} ≤ 15 V V _{CES} ≤ 1200 V	T _j = 150 °C	10	μs
T _j			-40 ... 175	°C
Inverse diode				
V _{RRM}	T _j = 25 °C		1200	V
I _F	T _j = 175 °C	T _c = 25 °C	656	A
		T _c = 80 °C	494	A
I _{FRM}			1200	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 25 °C		3130	A
T _j			-40 ... 175	°C
Module				
I _{t(RMS)}			600	A
T _{stg}	module without TIM		-40 ... 125	°C
V _{isol}	AC sinus 50Hz, t = 1 min		4000	V

Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
IGBT					
$V_{CE(sat)}$	$I_C = 600\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.80	2.05	V
		$T_j = 150^\circ\text{C}$	2.03	2.30	V
V_{CE0}	chipelevel	$T_j = 25^\circ\text{C}$	0.87	1.01	V
		$T_j = 150^\circ\text{C}$	0.77	0.90	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.55	1.73	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	2.1	2.3	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 22.2\text{ mA}$	5.1	5.8	6.3	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$			5	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	37.5		nF
C_{oes}		$f = 1\text{ MHz}$	2.31		nF
C_{res}		$f = 1\text{ MHz}$	2.04		nF
Q_G	$V_{GE} = -8\text{ V...} + 15\text{ V}$		3450		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		1.2		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$	170		ns
t_r	$I_C = 600\text{ A}$	$T_j = 150^\circ\text{C}$	80		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$ $R_{G on} = 1.5\text{ }\Omega$	$T_j = 150^\circ\text{C}$	58		mJ
$t_{d(off)}$	$R_{G off} = 1.5\text{ }\Omega$	$T_j = 150^\circ\text{C}$	530		ns
t_f	$di/dt_{on} = 6500\text{ A}/\mu\text{s}$ $di/dt_{off} = 3800\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	130		ns
E_{off}	$dv/dt = 3400\text{ V}/\mu\text{s}$ $L_s = 21\text{ nH}$	$T_j = 150^\circ\text{C}$	80		mJ
$R_{th(j-c)}$	per IGBT			0.04	K/W
$R_{th(c-s)}$	per IGBT ($\lambda_{grease} = 0.81\text{ W}/(\text{m}^2\text{K})$)		0.035		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material		0.025		K/W



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Typical Applications

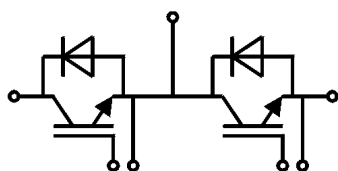
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Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
Inverse diode					
$V_F = V_{EC}$	$I_F = 600\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	2.21	2.59	V
		$T_j = 150^\circ\text{C}$	2.29	2.74	V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$	1.33	1.53	V
		$T_j = 150^\circ\text{C}$	1.03	1.13	V
r_F	chipelevel	$T_j = 25^\circ\text{C}$	1.46	1.77	mΩ
		$T_j = 150^\circ\text{C}$	2.1	2.7	mΩ
I_{RRM}	$I_F = 600\text{ A}$	$T_j = 150^\circ\text{C}$	418		A
Q_{rr}	$di/dt_{off} = 6400\text{ A}/\mu\text{s}$ $V_{GE} = -15\text{ V}$	$T_j = 150^\circ\text{C}$	82		μC
E_{rr}	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$	31		mJ
$R_{th(j-c)}$	per diode			0.08	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)		0.039		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material		0.031		K/W
Module					
L_{CE}			20		nH
$R_{CC'+EE'}$	measured per switch	$T_C = 25^\circ\text{C}$	0.95		mΩ
		$T_C = 125^\circ\text{C}$	1.25		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 ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)		0.014		K/W
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module, pre-applied phase change material		0.011		K/W
M_s	to heat sink (M5)	3		6	Nm
M_t	to terminals (M6)	3		6	Nm
					Nm
w				350	g
Temperature Sensor					
R_{100}	$T_c=100^\circ\text{C}$ ($R_{25}=5\text{ k}\Omega$)		493 ± 5%		Ω
$B_{100/125}$	$R_{(T)}=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$; $T[\text{K}]$		3550 ± 2%		K



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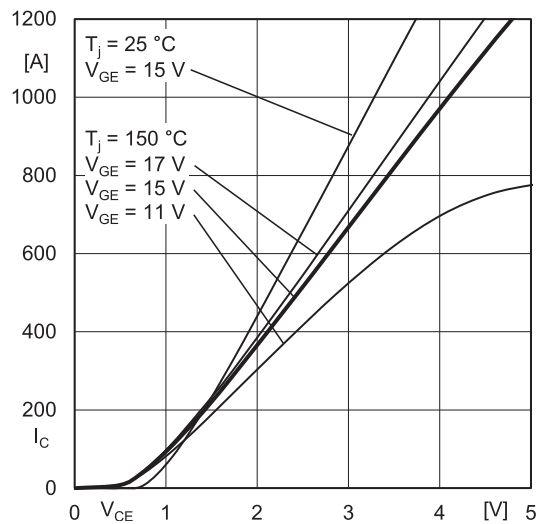
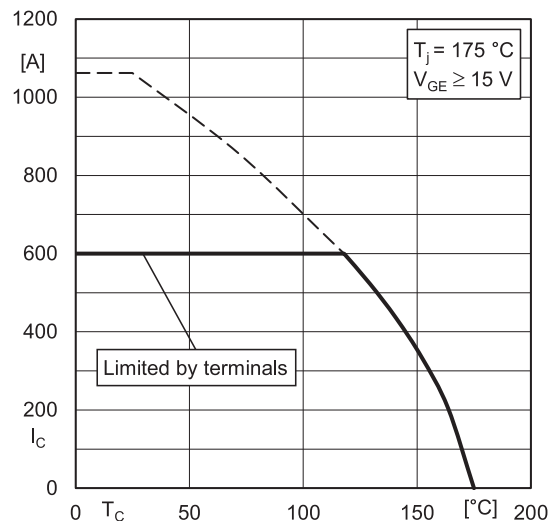
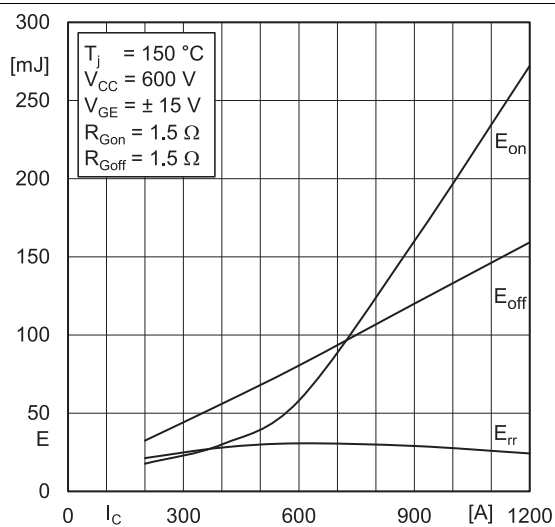
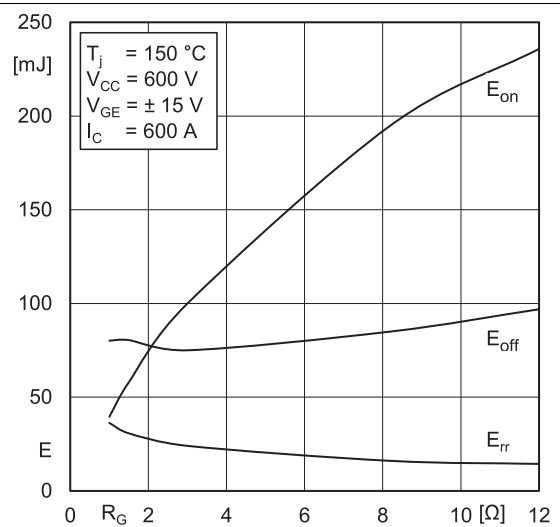
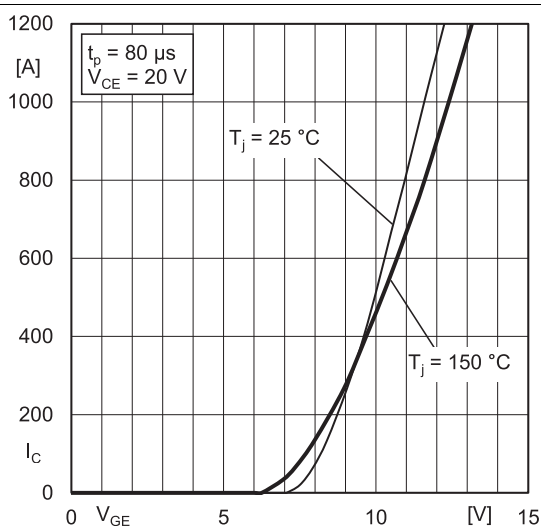
Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$ Fig. 2: Rated current vs. temperature $I_C = f(T_C)$ Fig. 3: Typ. turn-on /-off energy = $f(I_C)$ Fig. 4: Typ. turn-on /-off energy = $f(R_G)$ 

Fig. 5: Typ. transfer characteristic

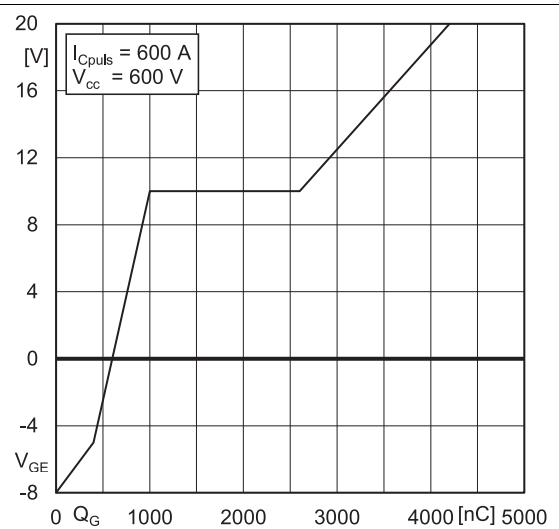


Fig. 6: Typ. gate charge characteristic

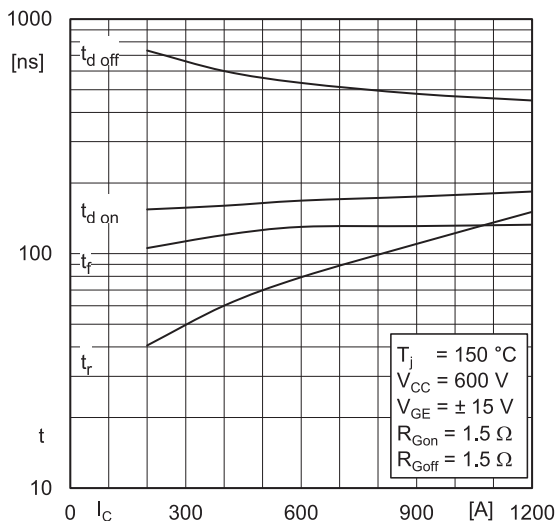


Fig. 7: Typ. switching times vs. I_C

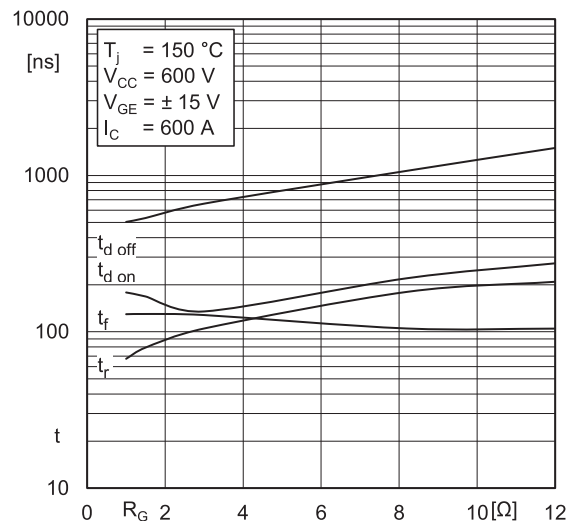


Fig. 8: Typ. switching times vs. gate resistor R_G

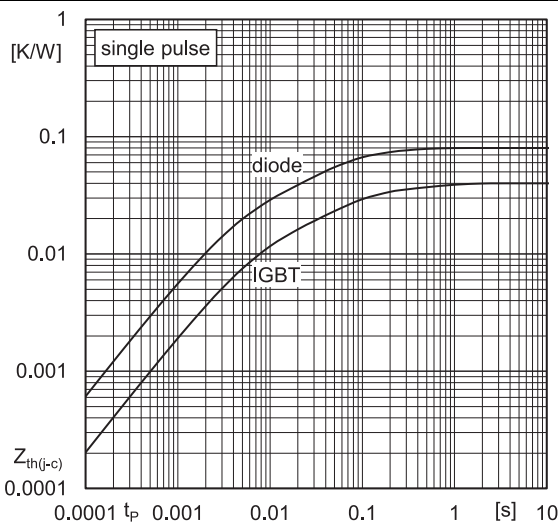


Fig. 9: Transient thermal impedance

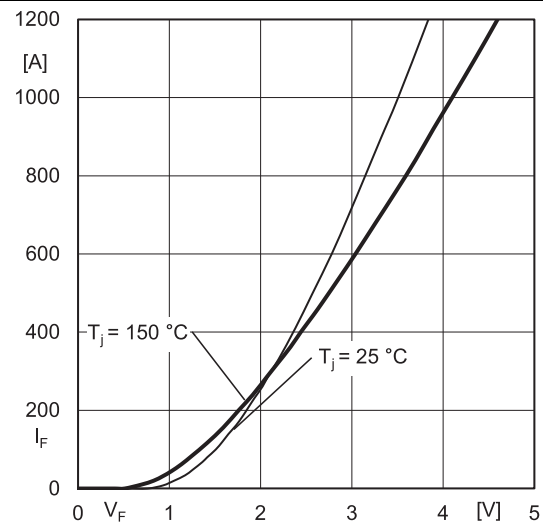


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC}'+EE'$

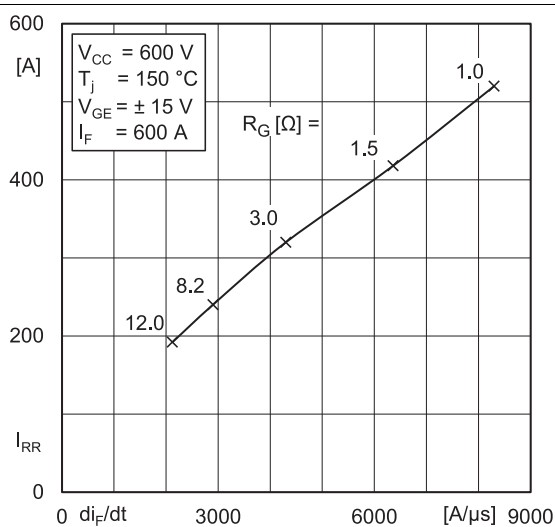


Fig. 11: Typ. CAL diode peak reverse recovery current

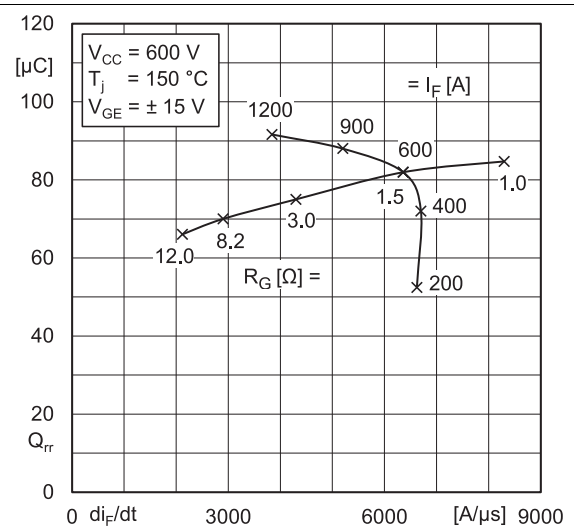


Fig. 12: Typ. CAL diode recovery charge

□	0,3 connector 3-4/10-11	
//	0,2 each single connector	A



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

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