



SEMiX® 3p

Trench IGBT Modules

SEMiX453GM12E4p

Features

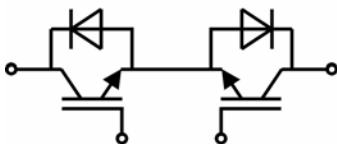
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability
- Press-fit pins as auxiliary contacts
- UL recognized, file no. E63532

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
- Pin #13 is not used in GM topology
- For storage and case temperature with TIM see document "TP(*) SEMiX 3p"



GM

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	678	A
		T _c = 80 °C	521	A
I _{Cnom}			450	A
I _{CRM}	I _{CRM} = 3xI _{Cnom}		1350	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	544	A
		T _c = 80 °C	407	A
I _{Fnom}			450	A
I _{FRM}	I _{FRM} = 3xI _{Fnom}		1350	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 25 °C		2430	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 = 450 A	T _J = 25 °C		1.80	2.05	V
	V _{GE} = 15 V chiplevel	T _J = 150 °C		2.19	2.40	V
V _{CE0}	chiplevel	T _J = 25 °C		0.8	0.9	V
		T _J = 150 °C		0.7	0.8	V
r _{CE}	V _{GE} = 15 V	T _J = 25 °C		2.2	2.6	mΩ
	chiplevel	T _J = 150 °C		3.3	3.6	mΩ
V _{GE(th)}	V _{GE} =V _{CE} , I _C = 18 mA		5	5.8	6.5	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _J = 25 °C				5	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		27.9		nF
C _{oes}		f = 1 MHz		1.74		nF
C _{res}		f = 1 MHz		1.53		nF
Q _G	V _{GE} = - 8 V...+ 15 V			2550		nC
R _{Gint}	T _J = 25 °C			1.7		Ω
t _{d(on)}	V _{CC} = 600 V	T _J = 150 °C		155		ns
t _r	I _C = 450 A	T _J = 150 °C		80		ns
E _{on}	V _{GE} = +15/-15 V R _{G on} = 1.1 Ω	T _J = 150 °C		11		mJ
t _{d(off)}	R _{G off} = 1.1 Ω	T _J = 150 °C		510		ns
t _f	di/dt _{on} = 4600 A/μs	T _J = 150 °C		120		ns
E _{off}	di/dt _{off} = 2500 A/μs du/dt = 3500 V/μs L _s = 21 nH	T _J = 150 °C		66		mJ
R _{th(j-c)}	per IGBT				0.066	K/W
R _{th(c-s)}	per IGBT (λ _{grease} =0.81 W/(m*K))			0.03		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			0.021		K/W



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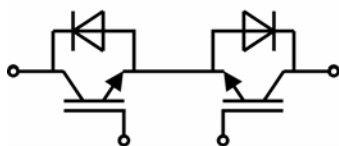
- AC inverter drives
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Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
Inverse diode					
$V_F = V_{EC}$	$I_F = 450\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	2.14	2.46	V
		$T_j = 150^\circ\text{C}$	2.07	2.38	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	$T_j = 25^\circ\text{C}$	1.87	2.1	m Ω
		$T_j = 150^\circ\text{C}$	2.6	2.8	m Ω
I_{RRM}	$I_F = 450\text{ A}$	$T_j = 150^\circ\text{C}$	390		A
Q_{rr}	$di/dt_{off} = 4900\text{ A}/\mu\text{s}$ $V_{GE} = -15\text{ V}$	$T_j = 150^\circ\text{C}$	64		μC
E_{rr}	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$	32		mJ
$R_{th(j-c)}$	per diode			0.11	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)		0.045		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material		0.036		K/W
Module					
L_{CE}			20		nH
$R_{CC'+EE'}$	measured per switch	$T_C = 25^\circ\text{C}$	1.2		m Ω
		$T_C = 125^\circ\text{C}$	1.65		m Ω
$R_{th(c-s)1}$	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 \pm 5%		Ω
$B_{100/125}$	$R_{(T)}=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$; $T[\text{K}]$		3550 \pm 2%		K



GM

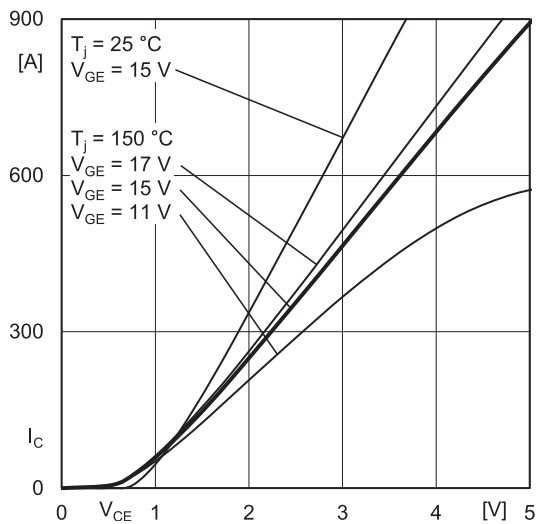
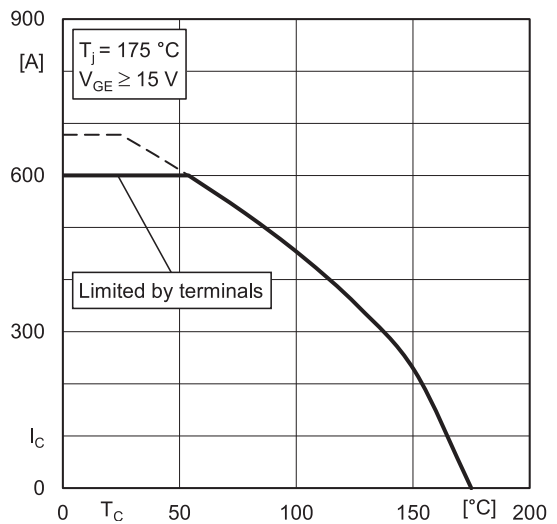
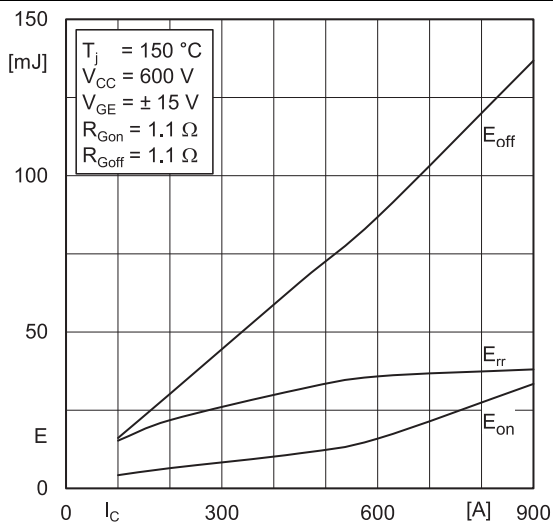
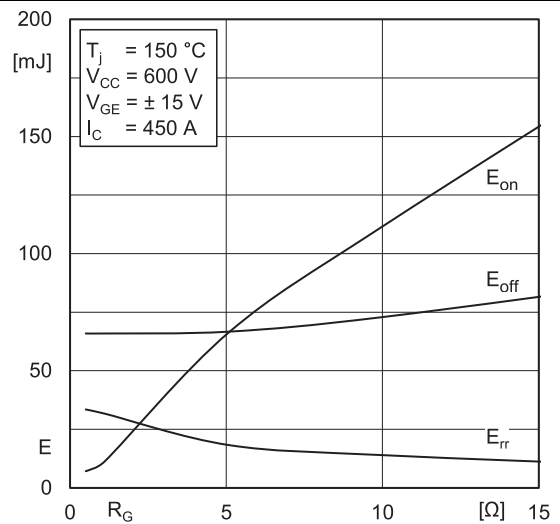
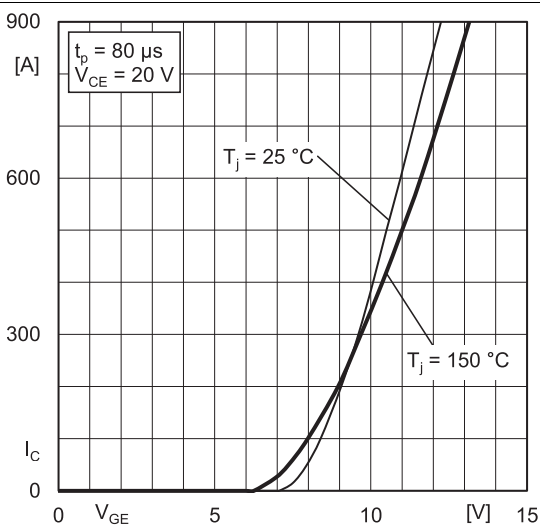
Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$ Fig. 2: Rated current vs. temperature $I_C = f(T_C)$ Fig. 3: Typ. turn-on /-off energy = $f(I_C)$ Fig. 4: Typ. turn-on /-off energy = $f(R_G)$ 

Fig. 5: Typ. transfer characteristic

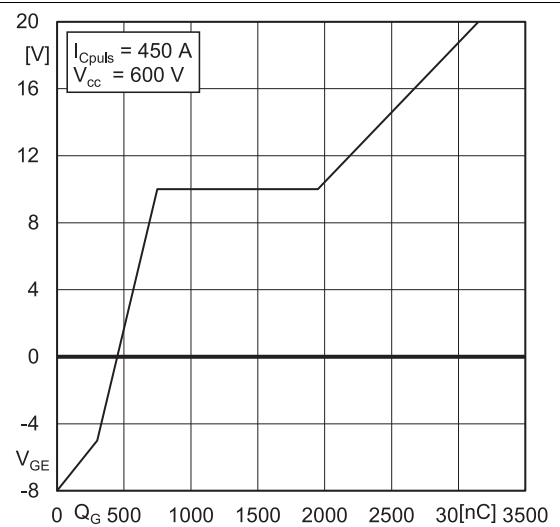


Fig. 6: Typ. gate charge characteristic

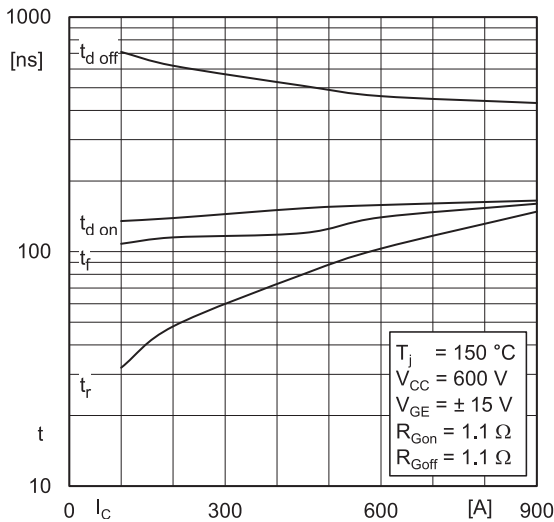


Fig. 7: Typ. switching times vs. I_C

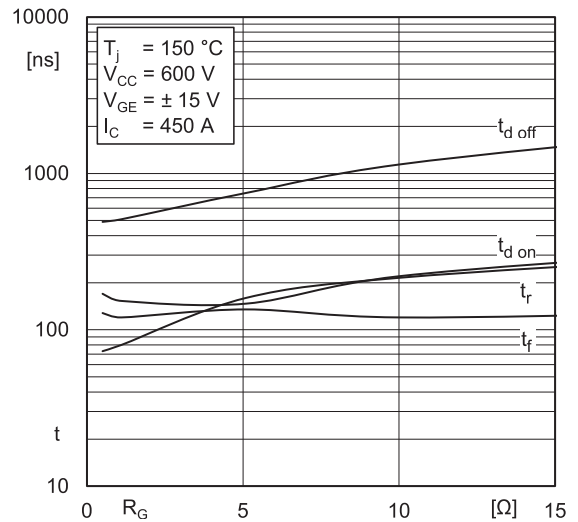


Fig. 8: Typ. switching times vs. gate resistor R_G

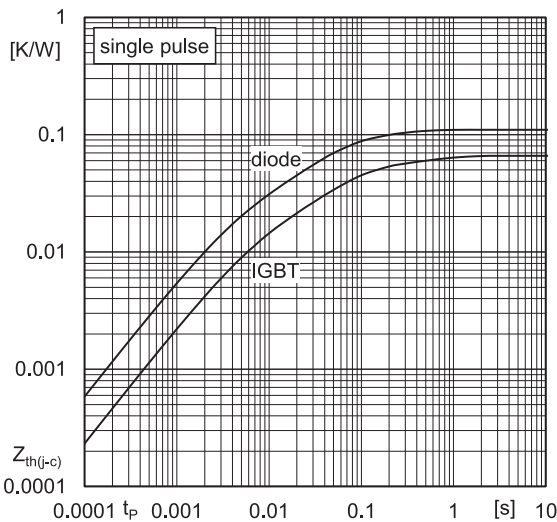


Fig. 9: Transient thermal impedance

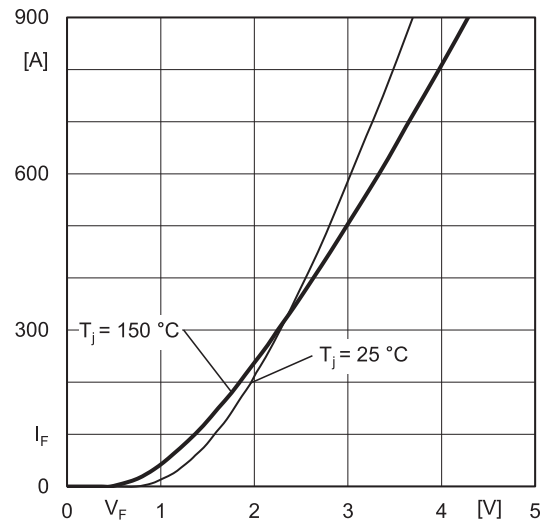


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

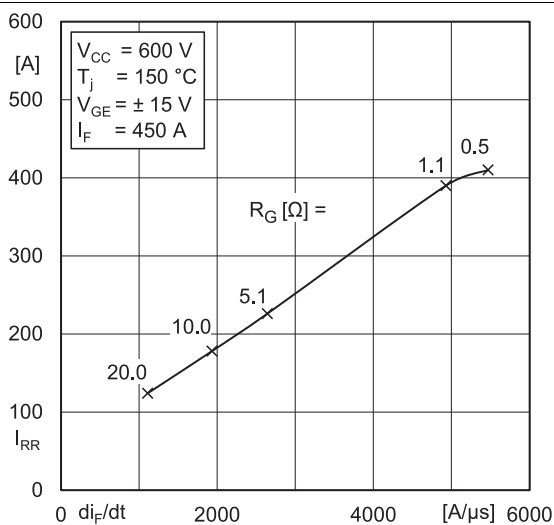


Fig. 11: Typ. CAL diode peak reverse recovery current

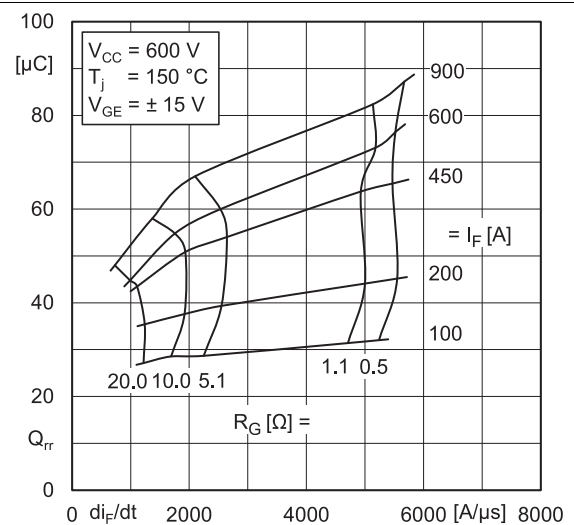


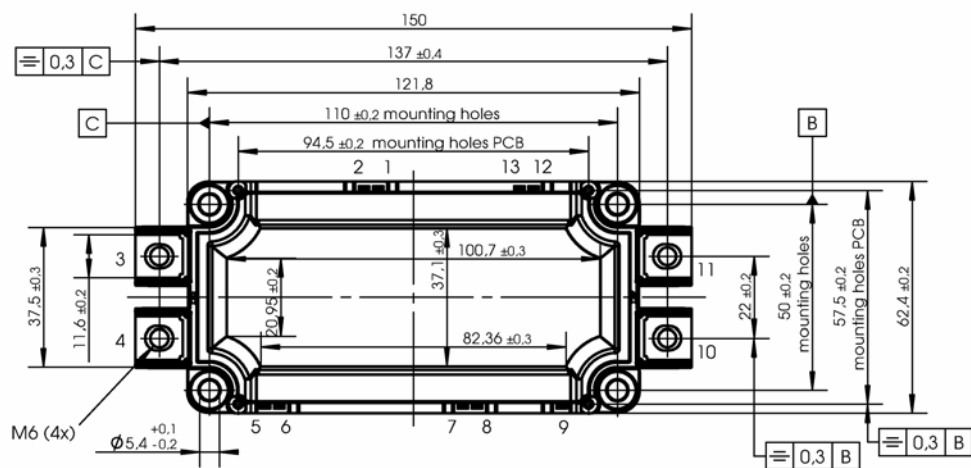
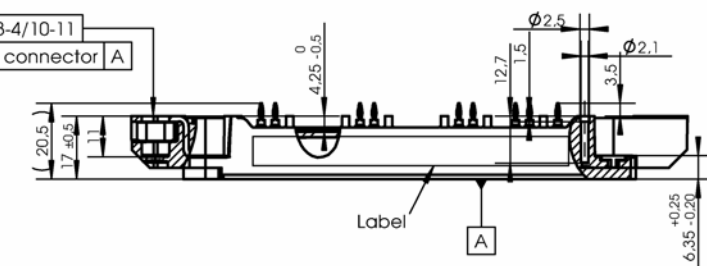


Fig. 12: Typ. CAL diode recovery charge

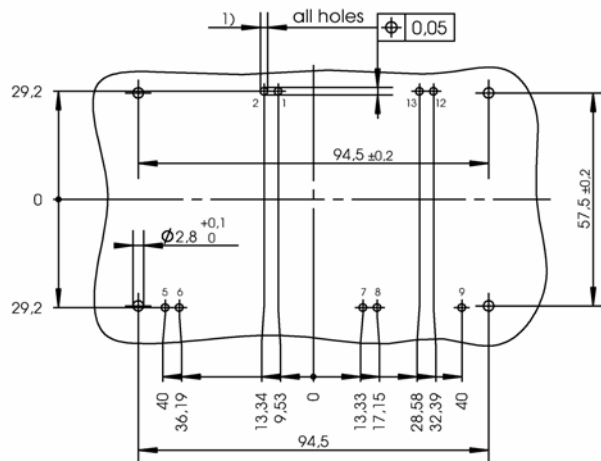
SEMiX453GM12E4p

Package outline

-  0.3 connector 3-4/10-11
-  0.2 each single connector A



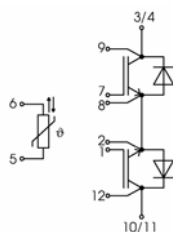
PCB drillhole pattern



Dimensions valid in mounted status

1) PCB hole specification see Mounting Instructions SEMiX press-fit

SEMiX 3p



pinout

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

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