



SEMiX® 3p shunt

Trench IGBT Modules

SEMiX453GB12E4I33p

Features*

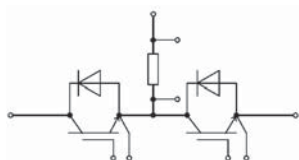
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability
- Press-fit pins as auxiliary contacts
- Current sensing shunt resistor
- UL recognized, file no. E63532

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"



GB + shunt

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} = 3 x I _{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	578			A
		T _c = 80 °C	433			A
I _{Fnom}			450			A
I _{FRM}	I _{FRM} = 2xI _{Fnom}		900			A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 25 °C		2430			A
T _j			-40 ... 175			°C
Module						
I _{t(RMS)}	T _c = 80°C		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 V _{GE} = 15 V chiplevel	T _j = 25 °C		1.80	2.05	V
		T _j = 150 °C		2.19	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		2.2	2.6	mΩ
		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 I _C = 450 A	T _j = 150 °C		195		ns
t _r		V _{GE} = +15/-15 V	T _j = 150 °C		67	
E _{on}	R _{G on} = 1.1 Ω R _{G off} = 1.1 Ω	T _j = 150 °C		33		mJ
t _{d(off)}		T _j = 150 °C		505		ns
t _f		T _j = 150 °C		110		ns
E _{off}	di/dt _{on} = 6600 A/μs di/dt _{off} = 3400 A/μs dv/dt = 4800 V/μs L _s = 21 nH	T _j = 150 °C		57		mJ
R _{th(j-c)}	per IGBT				0.066	K/W
R _{th(c-s)}	per IGBT (λ _{grease} =0.81 W/(m²K))			0.03		K/W
R _{th(c-s)}	per IGBT, pre-applied phase change material			0.021		K/W



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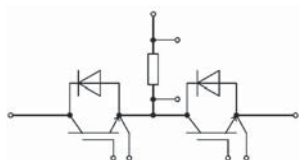
- AC inverter drives
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- Renewable energy systems

Remarks

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- V_{isol} between temperature sensor and power section is only 2500V
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse diode						
V _F = V _{EC}	I _F = 450 A	T _j = 25 °C		2.14	2.46	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.07	2.38	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		1.87	2.1	mΩ
		T _j = 150 °C		2.6	2.8	mΩ
I _{RRM}	I _F = 450 A	T _j = 150 °C		455		A
Q _{rr}	di/dt _{off} = 6800 A/μs	T _j = 150 °C		85		μC
E _{rr}	V _{GE} = -15 V	T _j = 150 °C		39		mJ
	V _{CC} = 600 V					
R _{th(j-c)}	per diode				0.1	K/W
R _{th(c-s)}	per diode (λ _{grease} =0.81 W/(m*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, shunt excluded	T _C = 25 °C		0.95		mΩ
		T _C = 125 °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, Ts underneath module (λ _{grease} =0.81 W/(m*K))			0.014		K/W
R _{th(c-s)2}	including thermal coupling, Ts underneath module, pre-applied phase change material			0.010		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°C (R ₂₅ =5 kΩ)			493 ± 5%		Ω
B _{100/125}	R _(T) =R ₁₀₀ exp[B _{100/125} (1/T-1/T ₁₀₀)]; T[K];			3550 ±2%		K

Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
Shunt					
R _{Shunt}	Tolerance = ±1 %, T _c = 20°C		0.33		mΩ
α				50	ppm/K
T _{Shunt}				170	°C
R _{th(r-c)}				2.5	K/W
P _{Shunt}	T _c = 80 °C			36	W



GB + shunt

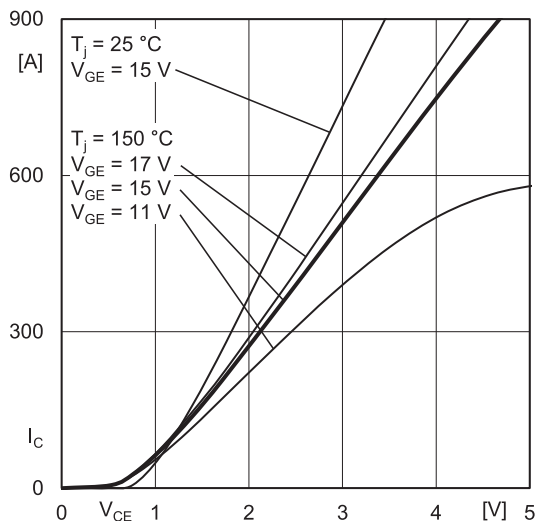


Fig. 1: Typ. output characteristic, inclusive $R_{CC'} + E_{E'}$

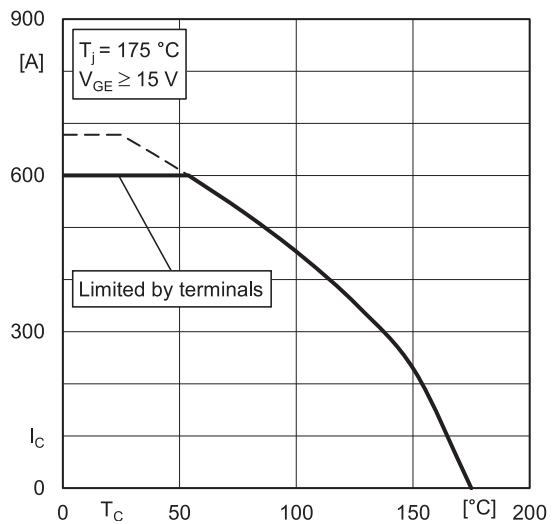


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

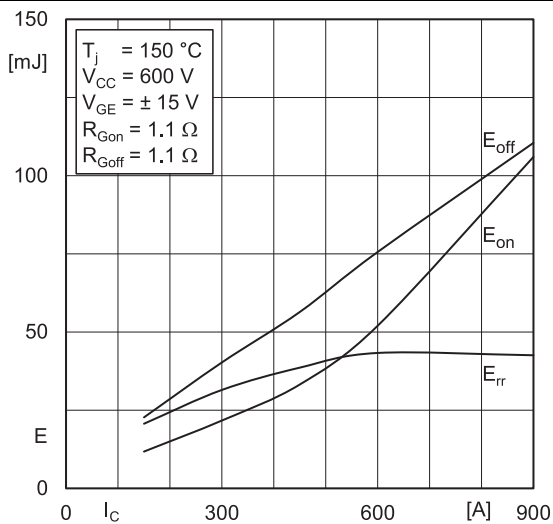


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

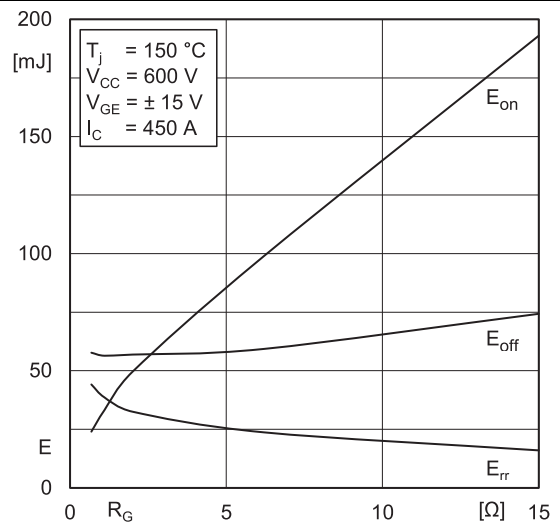


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

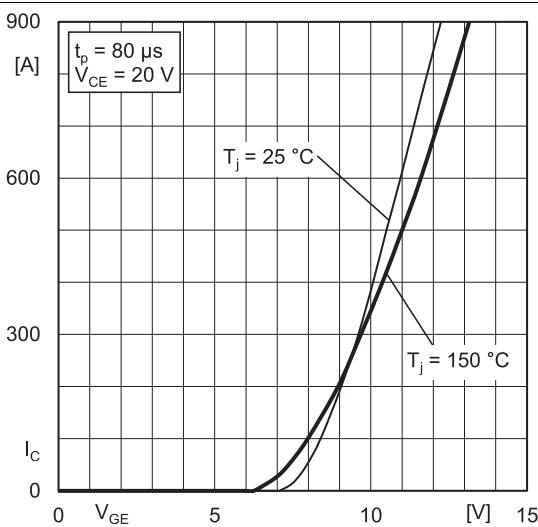


Fig. 5: Typ. transfer characteristic

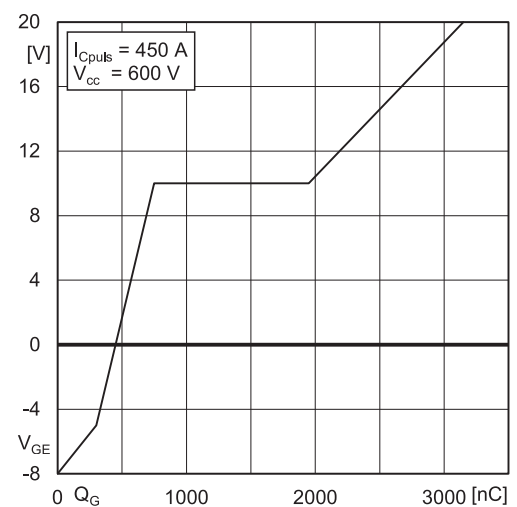


Fig. 6: Typ. gate charge characteristic

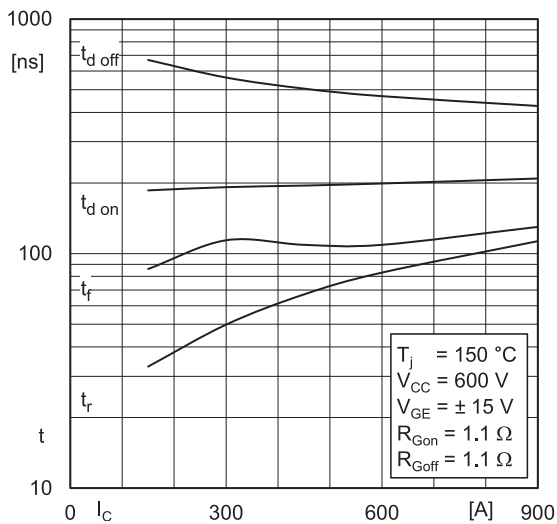


Fig. 7: Typ. switching times vs. I_C

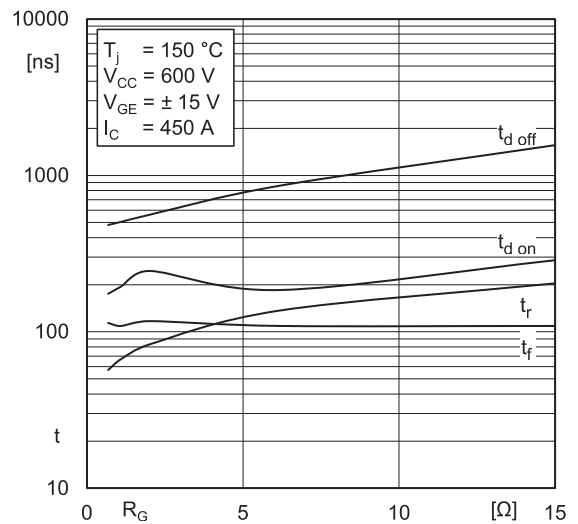


Fig. 8: Typ. switching times vs. gate resistor R_G

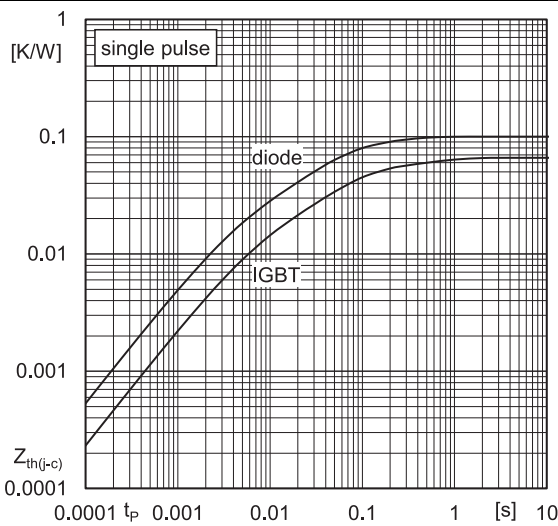


Fig. 9: Transient thermal impedance

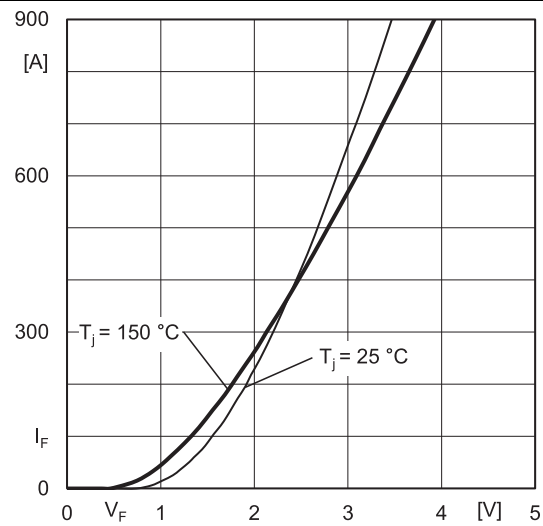


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

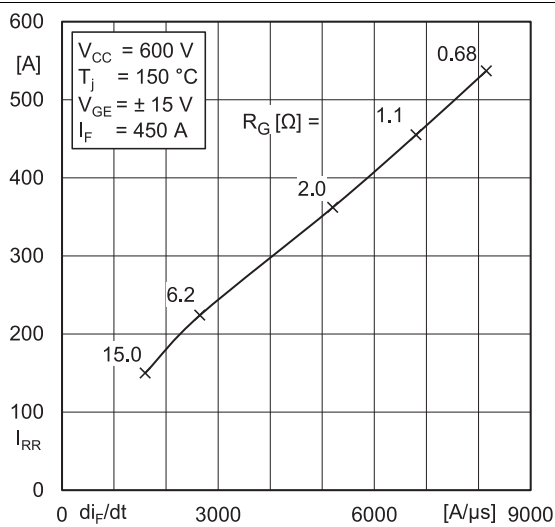


Fig. 11: Typ. CAL diode peak reverse recovery current

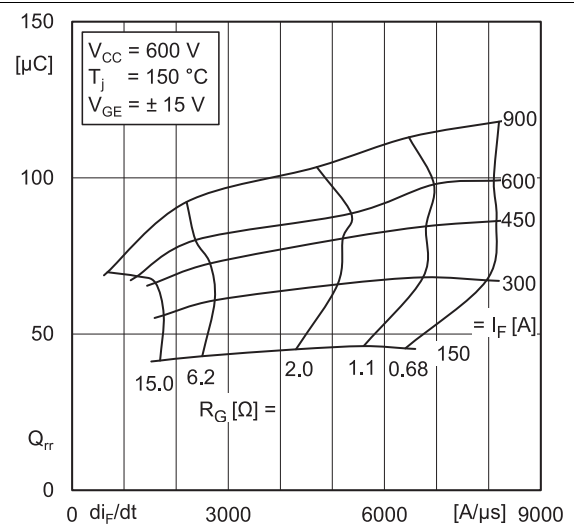
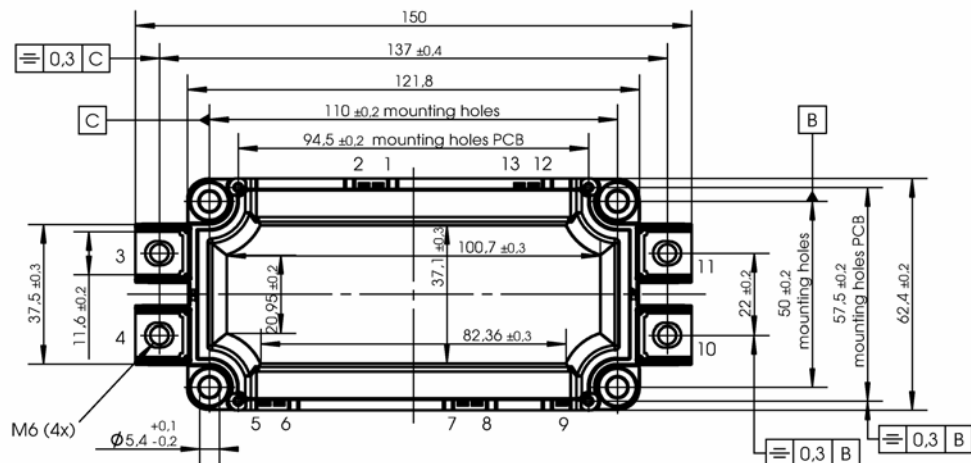
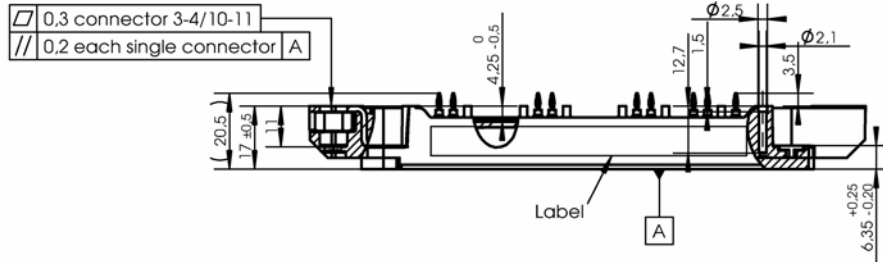
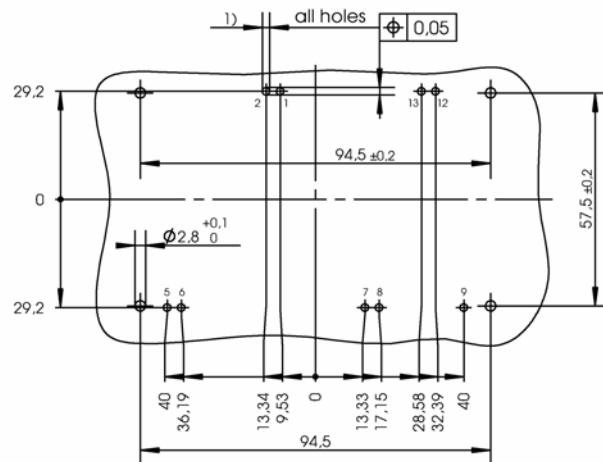


Fig. 12: Typ. CAL diode recovery charge

Package outline



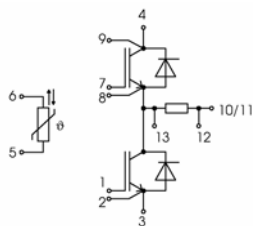
PCB drillhole pattern



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

Dimensions valid in mounted status

SEMiX 3p shunt



pinout

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

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