SEMiX® 3p shunt

Trench IGBT Modules

SEMiX453GB12E4Ip

Features

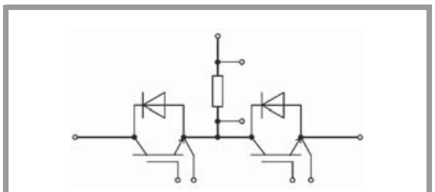
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability
- Press-fit pins as auxiliary contacts
- Current sensing shunt resistor
- UL recognized, file no. E63532

Typical Applications*

- AC inverter drives
- UPS
- Renewable energy systems

Remarks

- Product reliability results are valid for T_j=150°C
- V_{isol} between temperature sensor and power section is only 2500V



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} = 3xI_{Cnom}		1350	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 800 V V_{GE} ≤ 20 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} = 3xI_{Fnom}		1350	A
I_{FSM}	t_p = 10 ms, sin 180°, T_j = 25 °C		2430	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$			294	A
T_{stg}			-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		0.8	0.9	V
		T_j = 150 °C		0.7	0.8	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
		T_j = 150 °C				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			1.67		Ω
$t_{d(on)}$	V_{CC} = 600 V I_C = 450 A V_{GE} = +15/-15 V $R_{G\,on}$ = 1.1 Ω $R_{G\,off}$ = 1.1 Ω di/dt$_{on}$ = 6600 A/µs di/dt$_{off}$ = 3400 A/µs du/dt = 4800 V/µs L_s = 21 nH	T_j = 150 °C		195		ns
t_r		T_j = 150 °C		67		ns
E_{on}		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}		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/(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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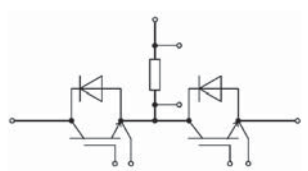
Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Inverse diode						
$V_F = V_{EC}$	I_F = 450 A V_{GE} = 0 V chiplevel	T_j = 25 °C		2.14	2.46	V
		T_j = 150 °C		2.07	2.38	V
V_{F0}	chiplevel	T_j = 25 °C	1.1	1.3	1.5	V
		T_j = 150 °C	0.7	0.9	1.1	V
r_F	chiplevel	T_j = 25 °C	1.4	1.9	2.1	mΩ
		T_j = 150 °C	2.3	2.6	2.8	mΩ
I_{RRM}	I_F = 450 A di/dt_{off} = 6800 A/µs V_{GE} = -15 V V_{CC} = 600 V	T_j = 150 °C		455		A
Q_{rr}		T_j = 150 °C		85		µC
E_{rr}		T_j = 150 °C		39		mJ
$R_{th(j-c)}$	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
$R_{CC'+EE'}$	res. terminal-chip, shunt excluded	T_C = 25 °C		1.2		mΩ
		T_C = 125 °C		1.65		mΩ
$Rth_{(c-s)1}$	calculated without thermal coupling			0.009		K/W
$Rth_{(c-s)2}$	including thermal coupling, Ts underneath module (λ_{grease}=0.81 W/(m*K))			0.014		K/W
$Rth_{(c-s)2}$	including thermal coupling, Ts 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°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					
I_{Shunt}	T_c = 100 °C, $T_{Shunt,max}$ = 170 °C, R_{th} = 2.9 K/W			294	A
R_{Shunt}	Tolerance = ±1 %		0.29		mΩ
α				50	ppm/K



GB + shunt

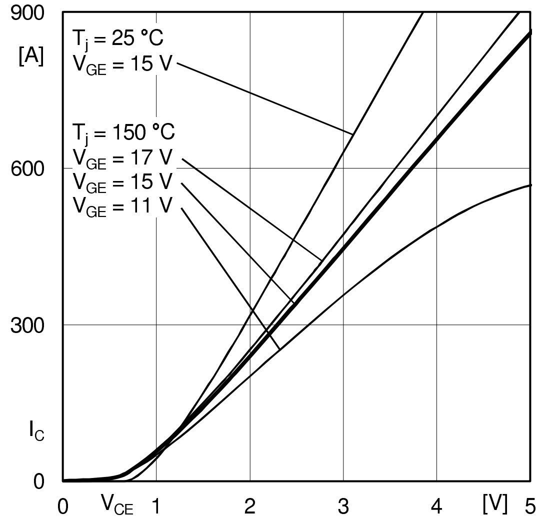


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+ EE'}$

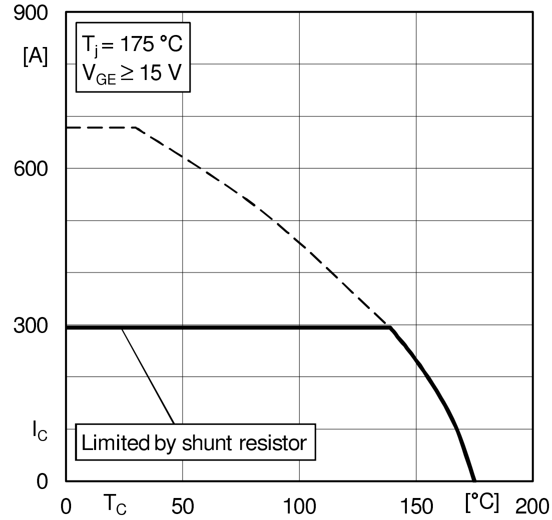


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

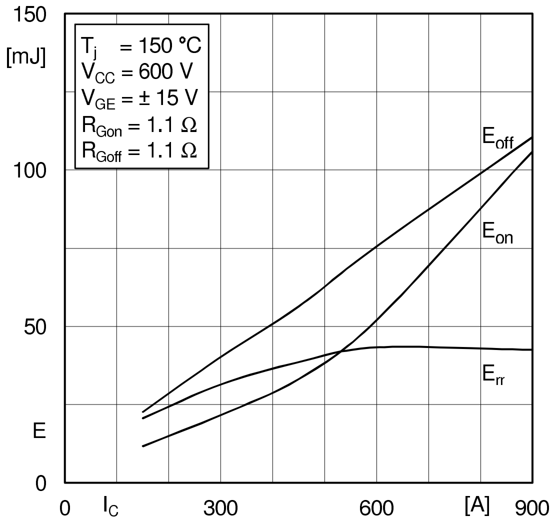


Fig. 3: Typ. turn-on /-off energy = f (I_C)

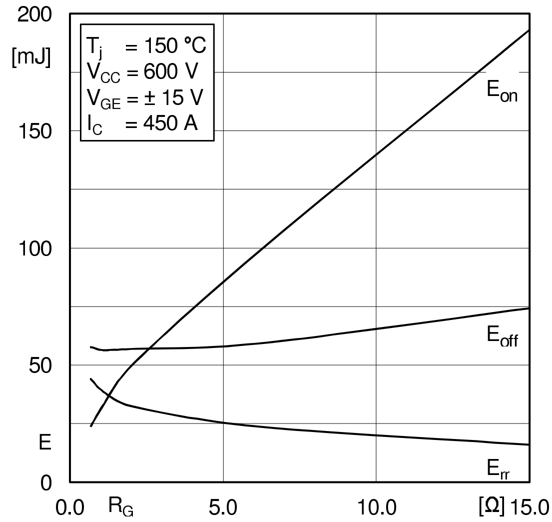


Fig. 4: Typ. turn-on /-off energy = f (R_G)

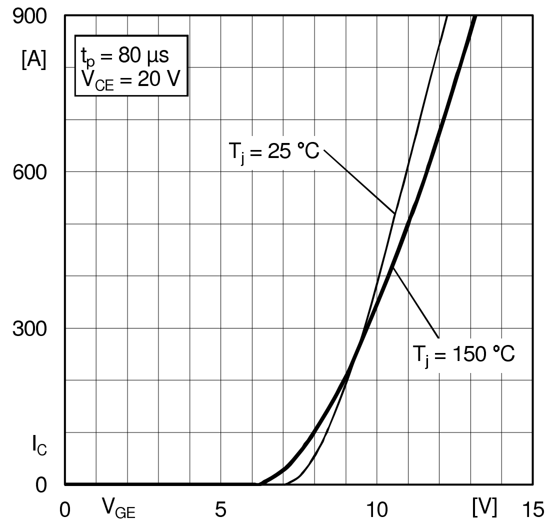


Fig. 5: Typ. transfer characteristic

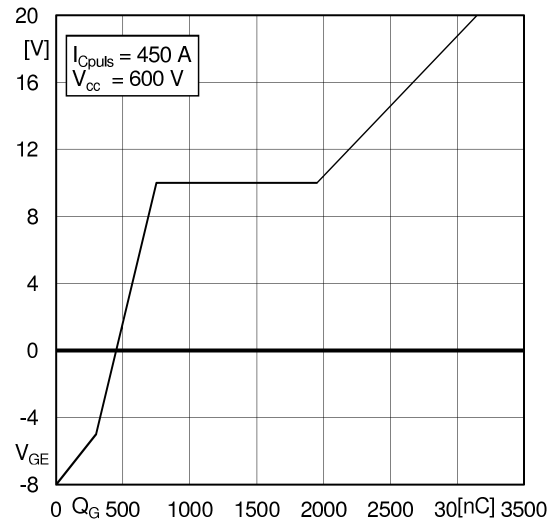


Fig. 6: Typ. gate charge characteristic

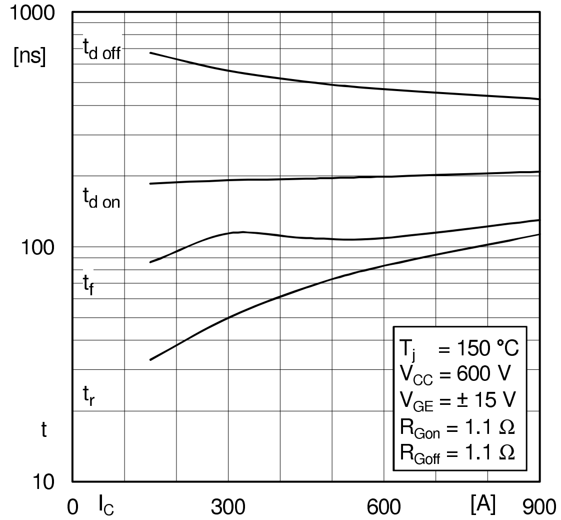


Fig. 7: Typ. switching times vs. I_C

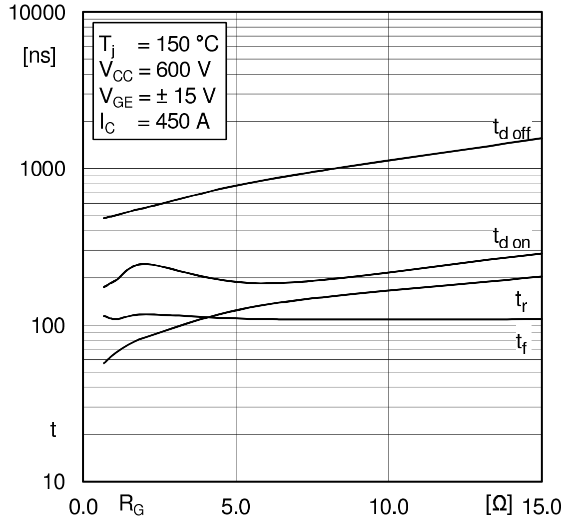


Fig. 8: Typ. switching times vs. gate resistor R_G

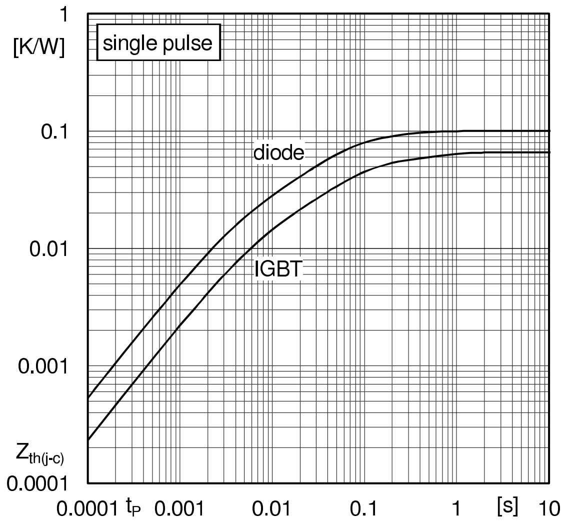


Fig. 9: Typ. transient thermal impedance

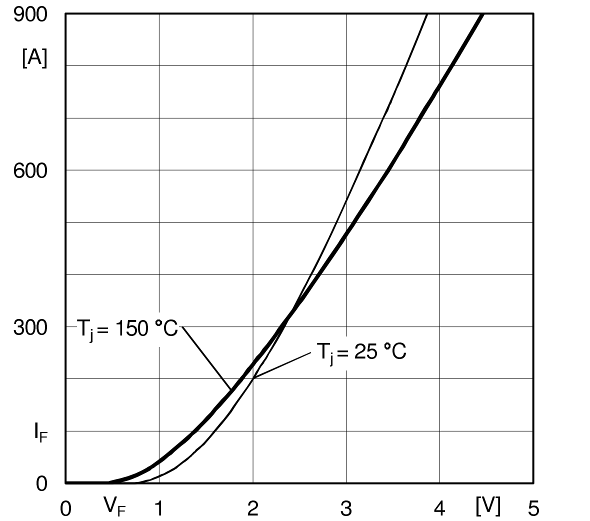


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

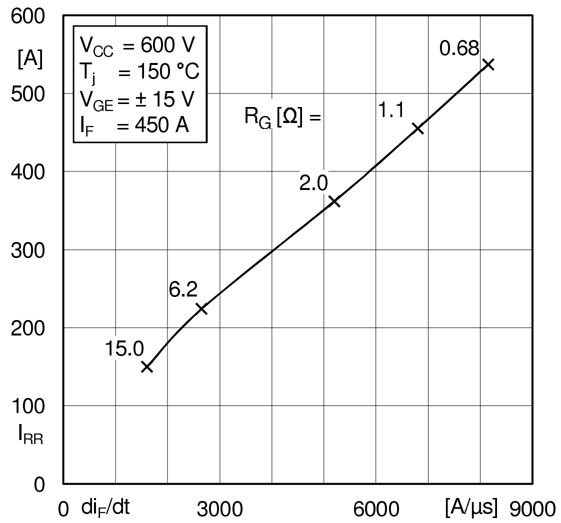


Fig. 11: Typ. CAL diode peak reverse recovery current

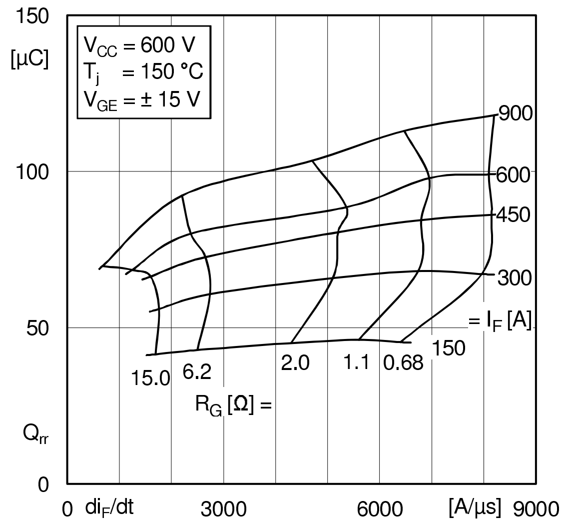
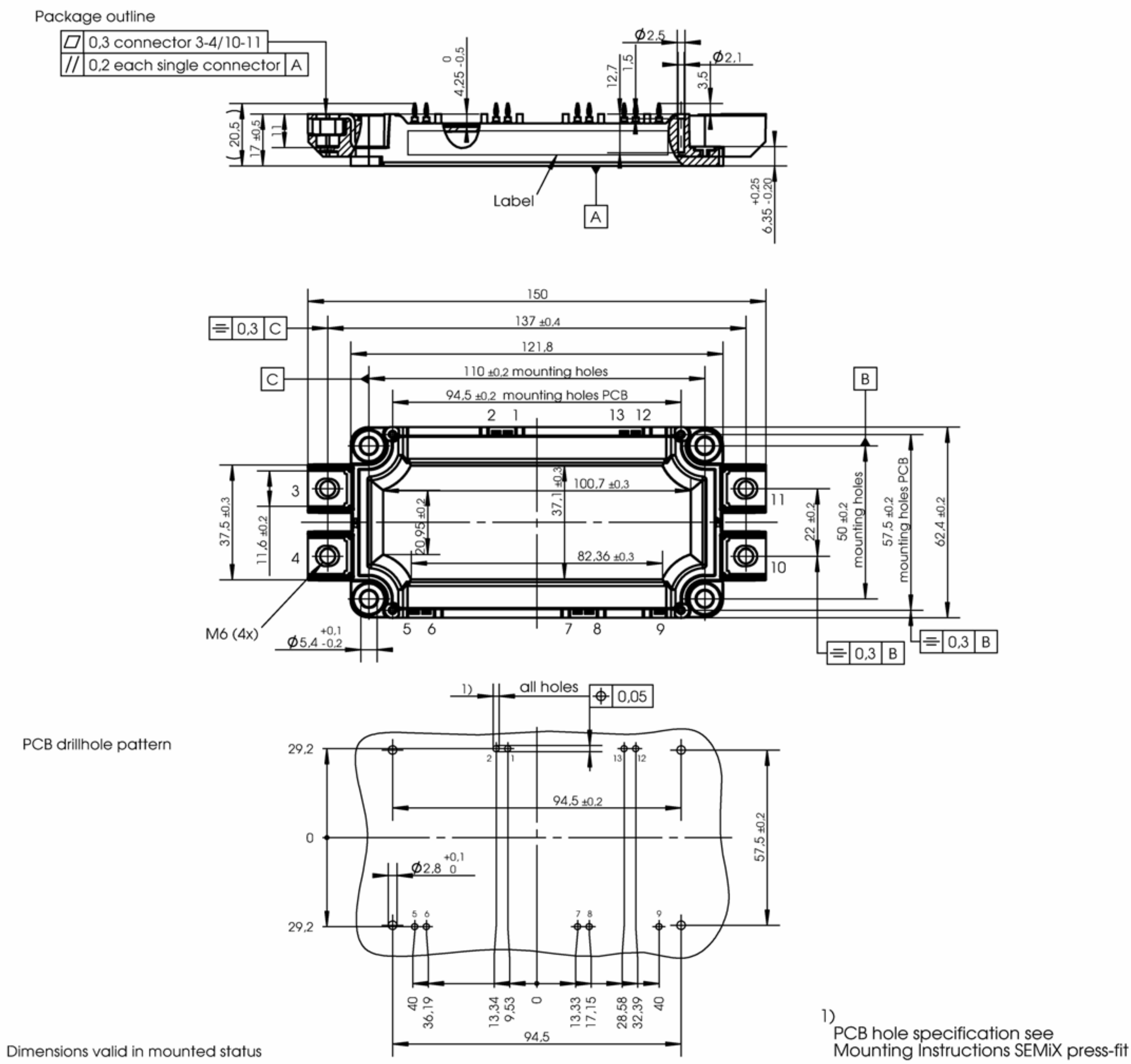
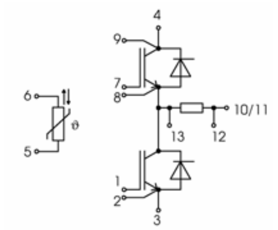


Fig. 12: Typ. CAL diode recovery charge



SEMiX 3p shunt



pinout

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

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.