

SEMiX453GM12E4p



SEMiX® 3p

Trench IGBT Modules

SEMiX453GM12E4p

Features

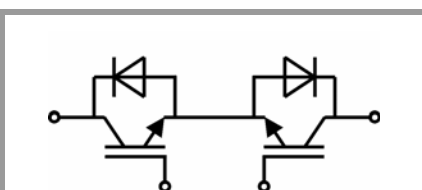
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability
- Press-fit pins as auxiliary contacts
- UL recognized, file no. E63532

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}	$T_j = 25^\circ\text{C}$	1200	V	
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	678	A
		$T_c = 80^\circ\text{C}$	521	A
I_{Cnom}		450	A	
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	1350	A	
V_{GES}		-20 ... 20	V	
t_{psc}	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1200\text{ V}$	$T_j = 150^\circ\text{C}$	10	μs
	T_j			
Inverse diode				
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V	
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	544	A
		$T_c = 80^\circ\text{C}$	407	A
I_{Fnom}		450	A	
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$	1350	A	
I_{FSM}	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$	2430	A	
T_j		-40 ... 175	$^\circ\text{C}$	
Module				
$I_{t(RMS)}$		600	A	
T_{stg}	module without TIM	-40 ... 125	$^\circ\text{C}$	
V_{isol}	AC sinus 50Hz, $t = 1\text{ min}$	4000	V	

Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
IGBT					
$V_{CE(sat)}$	$I_C = 450\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	1.80	2.05	V
		$T_j = 150^\circ\text{C}$	2.19	2.40	V
V_{CE0}	chipllevel	$T_j = 25^\circ\text{C}$	0.8	0.9	V
		$T_j = 150^\circ\text{C}$	0.7	0.8	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	2.2	2.6	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	3.3	3.6	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE}=V_{CE}, I_C = 18\text{ mA}$	5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$			5	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	27.9		nF
C_{oes}		$f = 1\text{ MHz}$	1.74		nF
C_{res}		$f = 1\text{ MHz}$	1.53		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		2550		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		1.7		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 450\text{ A}$	$T_j = 150^\circ\text{C}$	155		ns
t_r	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	80		ns
E_{on}	$R_{Gon} = 1.1\ \Omega$	$T_j = 150^\circ\text{C}$	11		mJ
$t_{d(off)}$	$R_{Goff} = 1.1\ \Omega$	$T_j = 150^\circ\text{C}$	510		ns
t_f	$di/dt_{on} = 4600\text{ A}/\mu\text{s}$ $di/dt_{off} = 2500\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	120		ns
E_{off}	$du/dt = 3500\text{ V}/\mu\text{s}$ $L_s = 21\text{ nH}$	$T_j = 150^\circ\text{C}$	66		mJ
$R_{th(j-c)}$	per IGBT			0.066	K/W
$R_{th(c-s)}$	per IGBT ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)		0.03		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material		0.021		K/W

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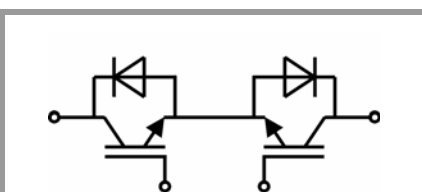
Typical Applications*

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse diode						
$V_F = V_{EC}$	$I_F = 450\text{ A}$ $V_{GE} = 0\text{ V}$ 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}	$di/dt_{off} = 4900\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		64		μC
E_{rr}	$V_{GE} = -15\text{ V}$ $V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		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

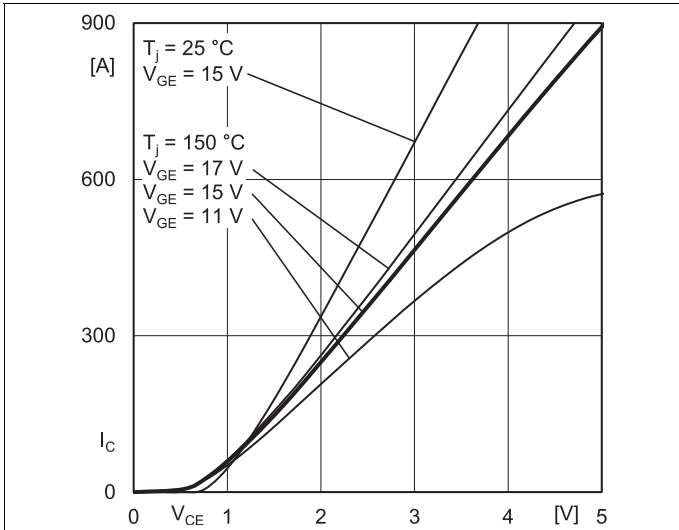


Fig. 1: Typ. output characteristic, inclusive R_{CC'+EE'}

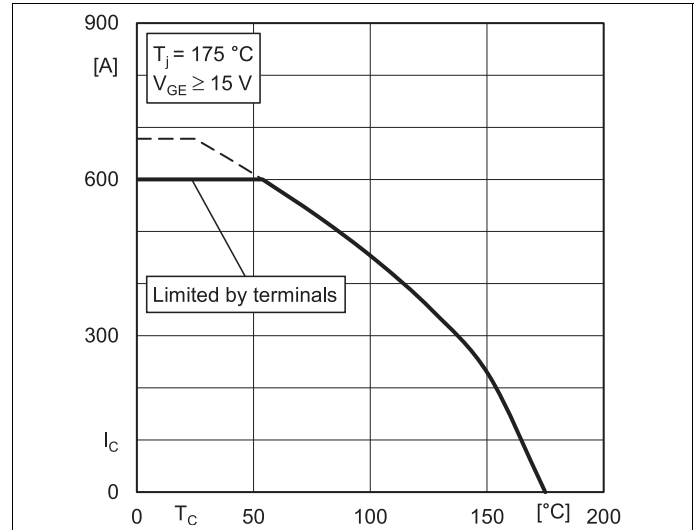


Fig. 2: Rated current vs. temperature I_C = f(T_C)

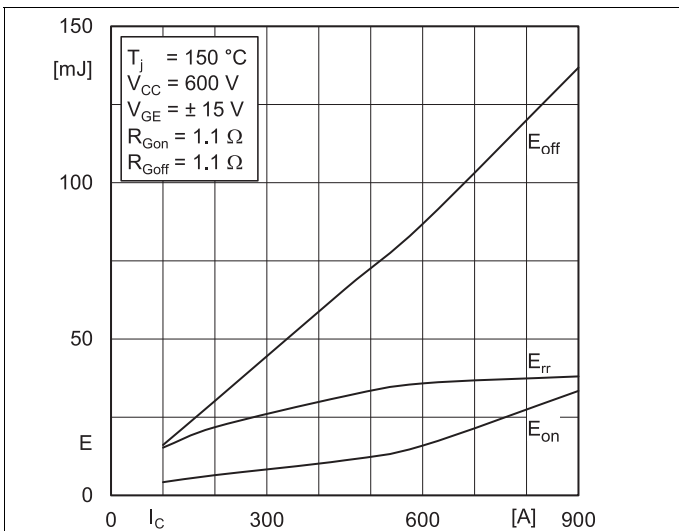


Fig. 3: Typ. turn-on /-off energy = f(I_C)

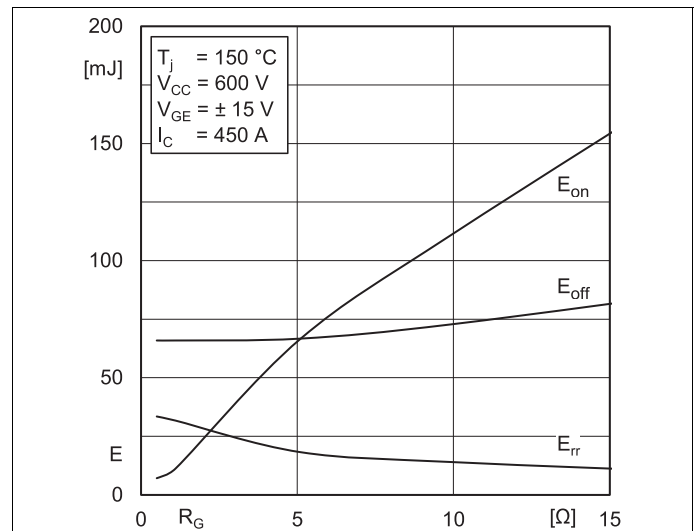


Fig. 4: Typ. turn-on /-off energy = f(R_G)

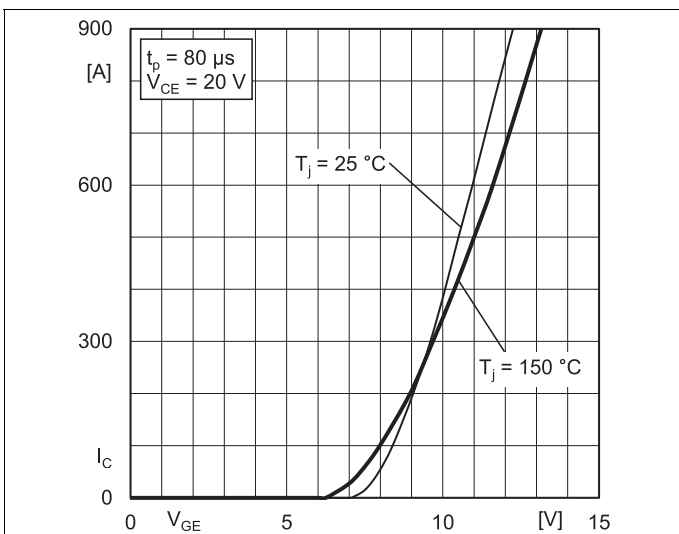


Fig. 5: Typ. transfer characteristic

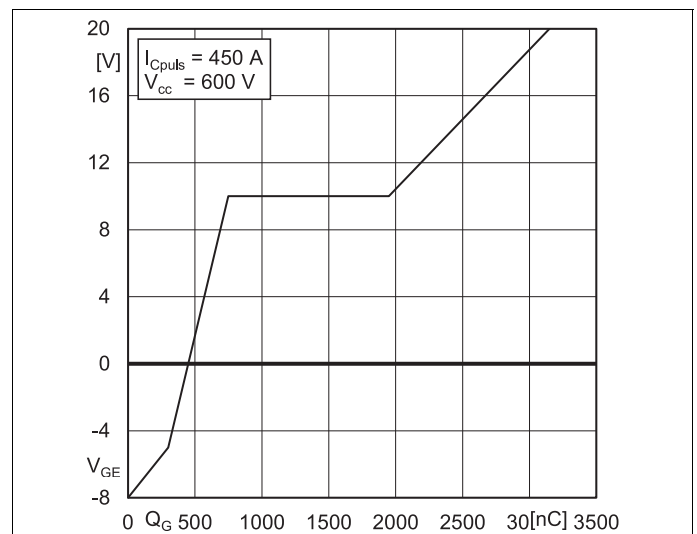


Fig. 6: Typ. gate charge characteristic

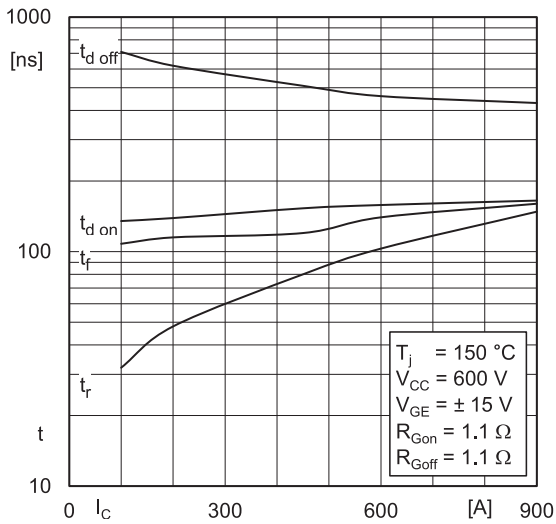


Fig. 7: Typ. switching times vs. I_C

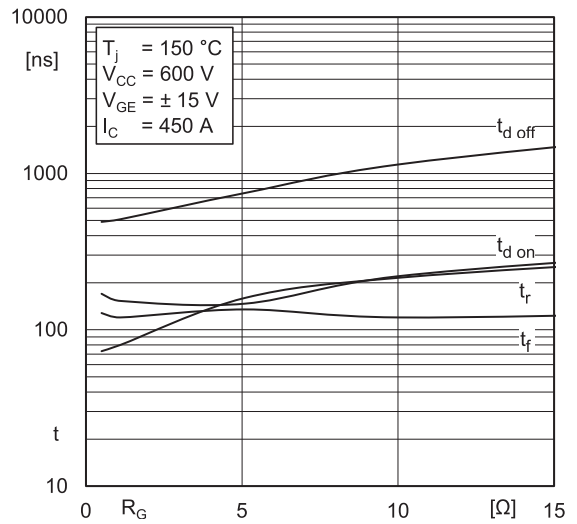


Fig. 8: Typ. switching times vs. gate resistor R_G

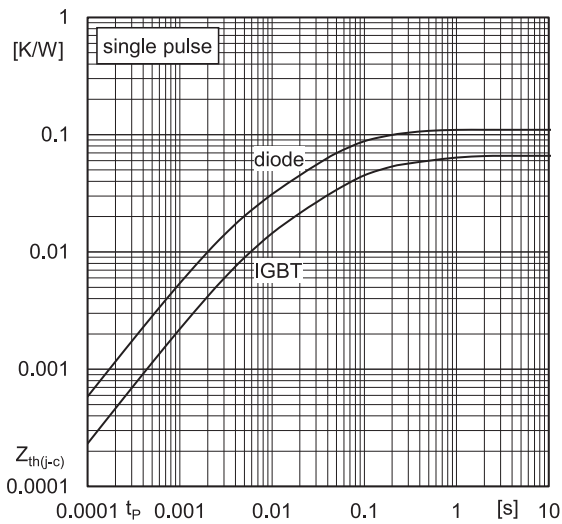


Fig. 9: Transient thermal impedance

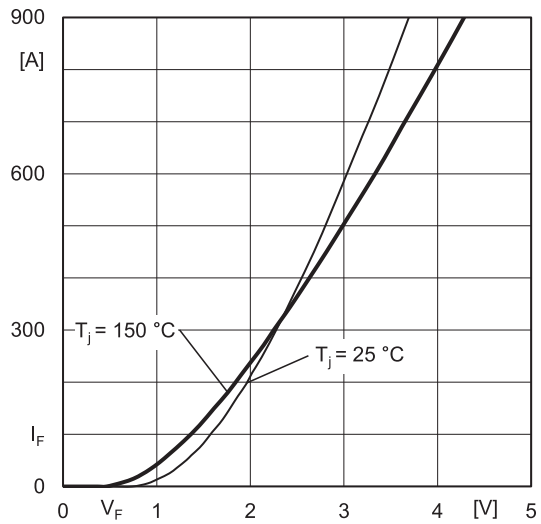


Fig. 10: Typ. CAL diode forward charact., incl. R_{CC+EE}

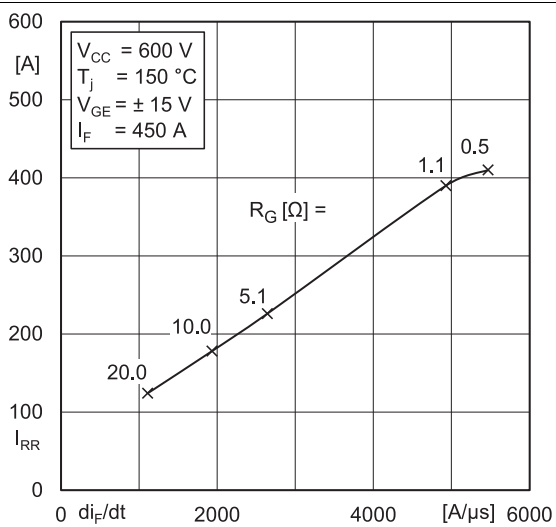


Fig. 11: Typ. CAL diode peak reverse recovery current

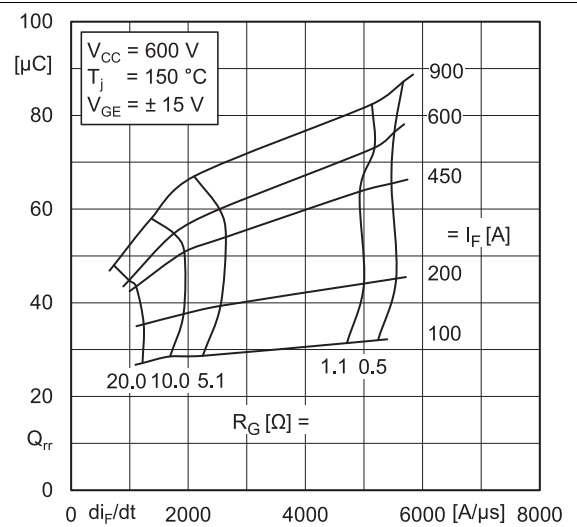
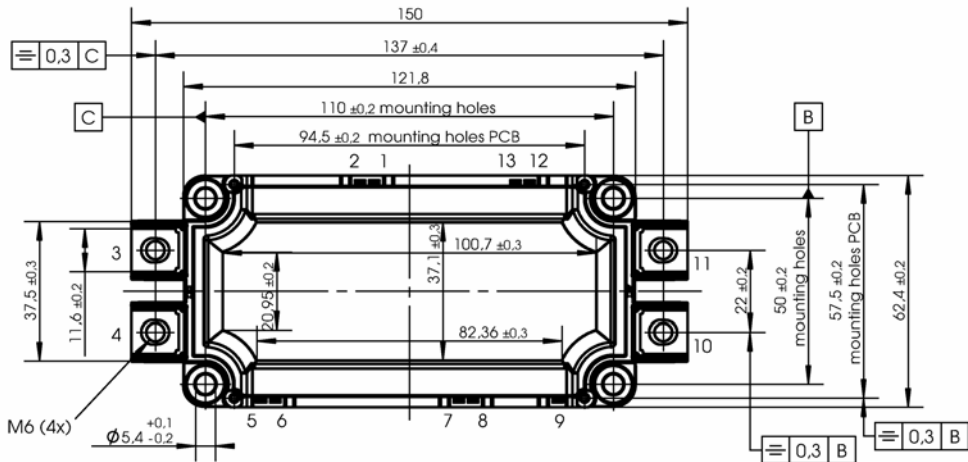
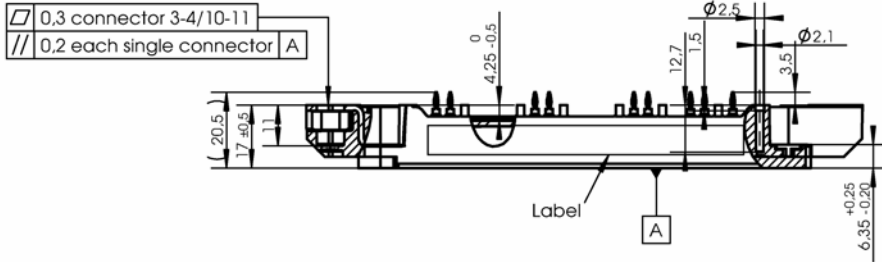


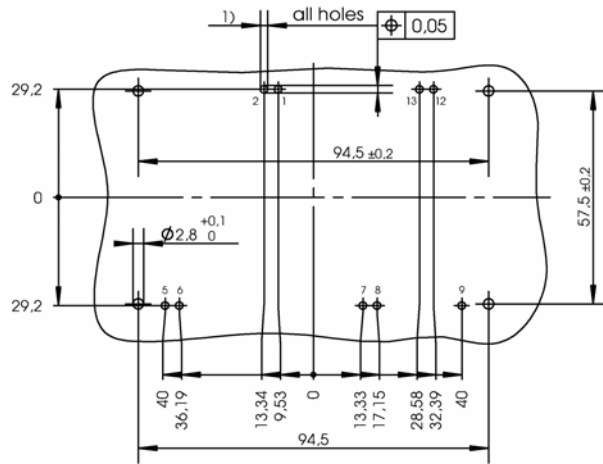
Fig. 12: Typ. CAL diode recovery charge

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Package outline



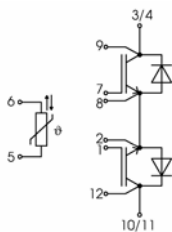
PCB drillhole pattern



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

Dimensions valid in mounted status

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pinout

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

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