

# SEMiX603GAR12E4p



SEMiX® 3p

## Trench IGBT Modules

### SEMiX603GAR12E4p

#### Features

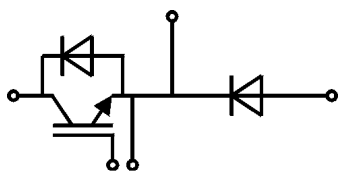
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$  with positive temperature coefficient
- High short circuit capability
- Press-fit pins as auxiliary contacts
- Thermally optimized ceramic
- UL recognized, file no. E63532

#### 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
<b>IGBT</b>			
$V_{CES}$	$T_j = 25^\circ\text{C}$	1200	V
$I_C$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	1110
		$T_c = 80^\circ\text{C}$	853
$I_{Cnom}$		600	A
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$	1800	A
$V_{GES}$		-20 ... 20	V
$t_{psc}$	$V_{CC} = 800\text{ V}$	$T_j = 150^\circ\text{C}$	10
	$V_{GE} \leq 15\text{ V}$		
	$V_{CES} \leq 1200\text{ V}$		
$T_j$		-40 ... 175	$^\circ\text{C}$
<b>Inverse diode</b>			
$V_{RRM}$	$T_j = 25^\circ\text{C}$	1200	V
$I_F$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	856
		$T_c = 80^\circ\text{C}$	640
$I_{Fnom}$		600	A
$I_{FRM}$	$I_{FRM} = 2 \times I_{Fnom}$	1200	A
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$	3456	A
$T_j$		-40 ... 175	$^\circ\text{C}$
<b>Freewheeling diode</b>			
$V_{RRM}$	$T_j = 25^\circ\text{C}$	1200	V
$I_F$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	856
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$T_j$		-40 ... 175	$^\circ\text{C}$
<b>Module</b>			
$I_{t(RMS)}$		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
<b>IGBT</b>					
$V_{CE(sat)}$	$I_C = 600\text{ A}$ $V_{GE} = 15\text{ V}$ 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	0.9	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	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE}=V_{CE}, I_C = 22.2\text{ mA}$	5.3	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		$\Omega$



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- Press-fit pins as auxiliary contacts
- Thermally optimized ceramic
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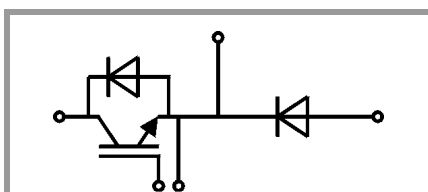
#### Typical Applications\*

- 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"

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>IGBT</b>						
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		160		ns
$t_r$	$I_C = 600\text{ A}$	$T_j = 150^\circ\text{C}$		80		ns
$E_{on}$	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		64		mJ
$t_{d(off)}$	$R_{G\ on} = 1.5\ \Omega$	$T_j = 150^\circ\text{C}$		540		ns
$t_f$	$R_{G\ off} = 1.5\ \Omega$	$T_j = 150^\circ\text{C}$		130		ns
$E_{off}$	$di/dt_{on} = 7270\text{ A}/\mu\text{s}$ $di/dt_{off} = 4240\text{ A}/\mu\text{s}$ $du/dt = 3500\text{ V}/\mu\text{s}$ $L_s = 21\text{ nH}$	$T_j = 150^\circ\text{C}$		76		mJ
$R_{th(j-c)}$	per IGBT				0.037	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
<b>Inverse diode</b>						
$V_F = V_{EC}$	$I_F = 600\text{ A}$	$T_j = 25^\circ\text{C}$		2.08	2.44	V
	$V_{GE} = 0\text{ V}$ chipelevel	$T_j = 150^\circ\text{C}$		2.08	2.34	V
$V_{F0}$	chipelevel	$T_j = 25^\circ\text{C}$		1.39	1.59	V
		$T_j = 150^\circ\text{C}$		1.08	1.18	V
$r_F$	chipelevel	$T_j = 25^\circ\text{C}$		1.16	1.42	m $\Omega$
		$T_j = 150^\circ\text{C}$		1.67	1.93	m $\Omega$
$I_{RRM}$	$I_F = 600\text{ A}$	$T_j = 150^\circ\text{C}$		490		A
$Q_{rr}$	$di/dt_{off} = 7170\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		93		$\mu\text{C}$
$E_{rr}$	$V_{GE} = -15\text{ V}$ $V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		32		mJ
$R_{th(j-c)}$	per diode				0.065	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
<b>Freewheeling diode</b>						
$V_F = V_{EC}$	$I_F = 600\text{ A}$	$T_j = 25^\circ\text{C}$		2.08	2.44	V
	$V_{GE} = 0\text{ V}$ chipelevel	$T_j = 150^\circ\text{C}$		2.08	2.34	V
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$R_{th(c-s)}$	per diode, pre-applied phase change material			0.031		K/W



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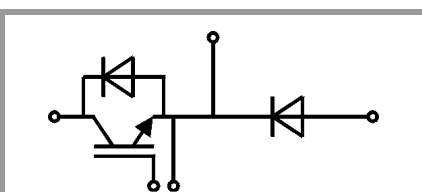
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Module</b>						
$L_{CE}$				20		nH
$R_{CC'+EE'}$	measured per switch	$T_C = 25^\circ\text{C}$		1.2		m $\Omega$
		$T_C = 125^\circ\text{C}$		1.65		m $\Omega$
$R_{th(c-s)1}$	calculated without thermal coupling			0.009		K/W
$R_{th(c-s)2}$	including thermal coupling, $T_s$ underneath module ( $\lambda_{grease}=0.81\text{ W/(m}^2\text{K)}$ )			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
<b>Temperature Sensor</b>						
$R_{100}$	$T_C=100^\circ\text{C}$ ( $R_{25}=5\text{ k}\Omega$ )			$493 \pm 5\%$		$\Omega$
$B_{100/125}$	$R_{(T)}=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$ ; $T[\text{K}]$			$3550 \pm 2\%$		K



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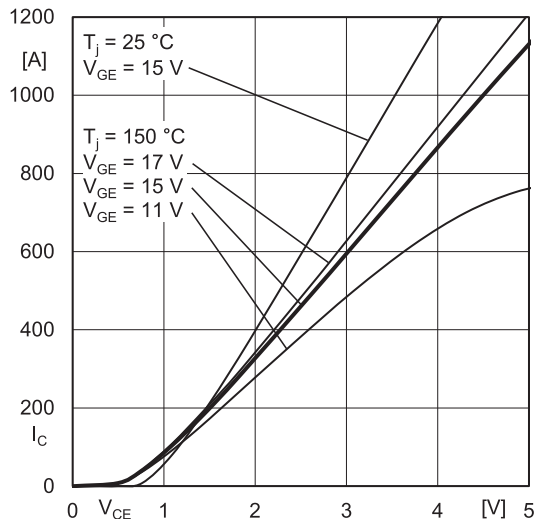


Fig. 1: Typ. output characteristic, inclusive  $R_{CC+EE}$

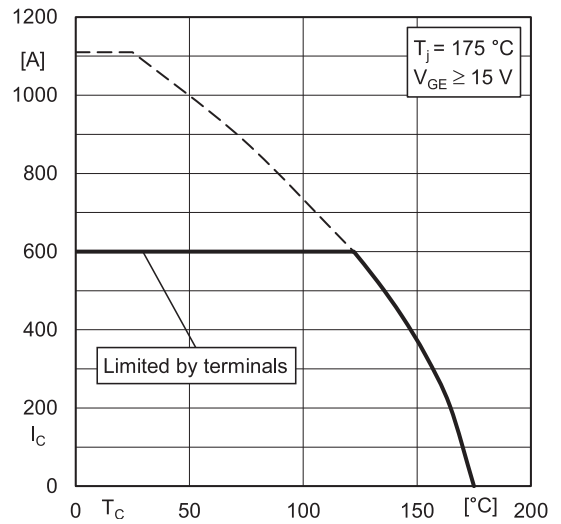


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

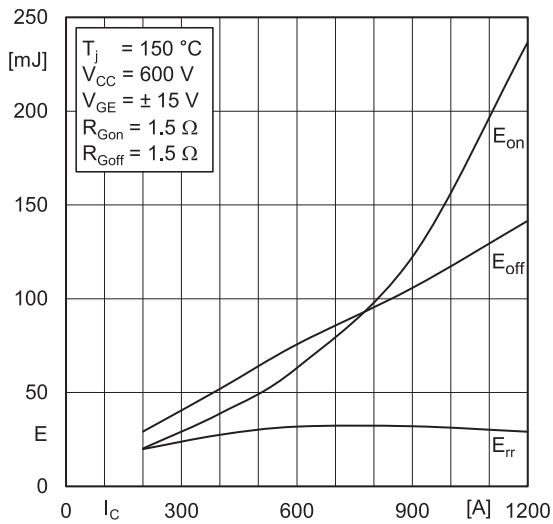


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

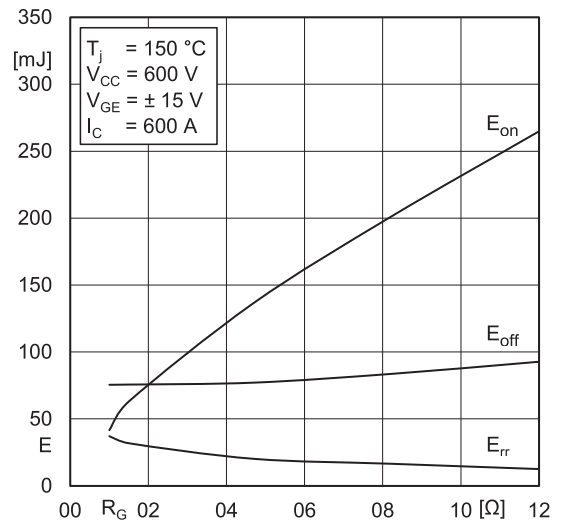


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

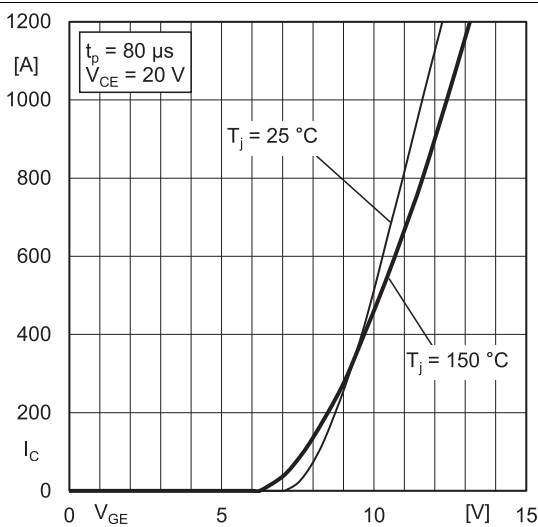


Fig. 5: Typ. transfer characteristic

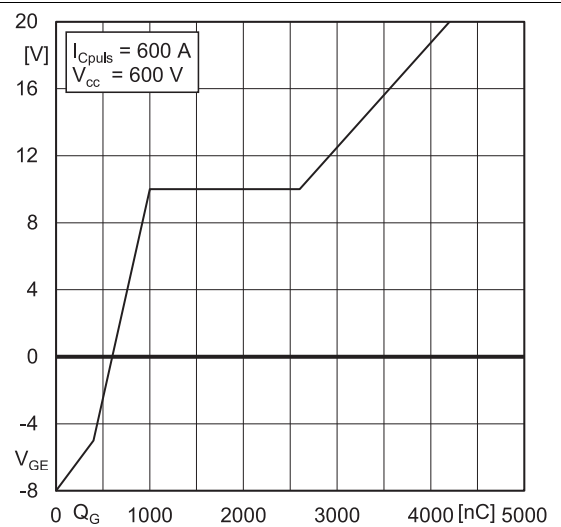


Fig. 6: Typ. gate charge characteristic

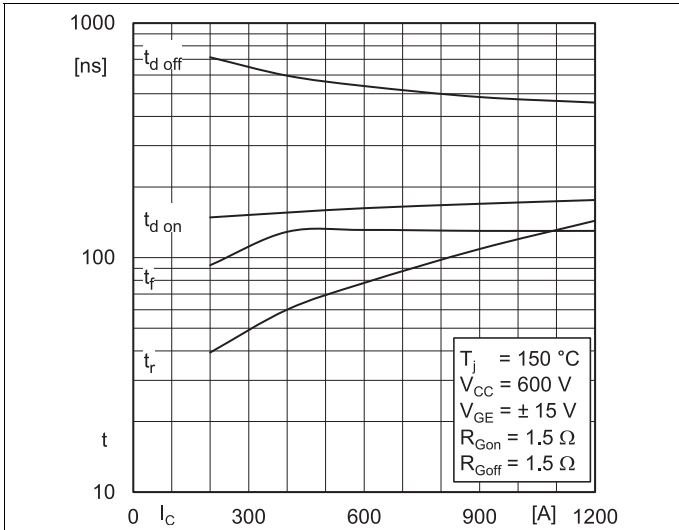


Fig. 7: Typ. switching times vs.  $I_C$

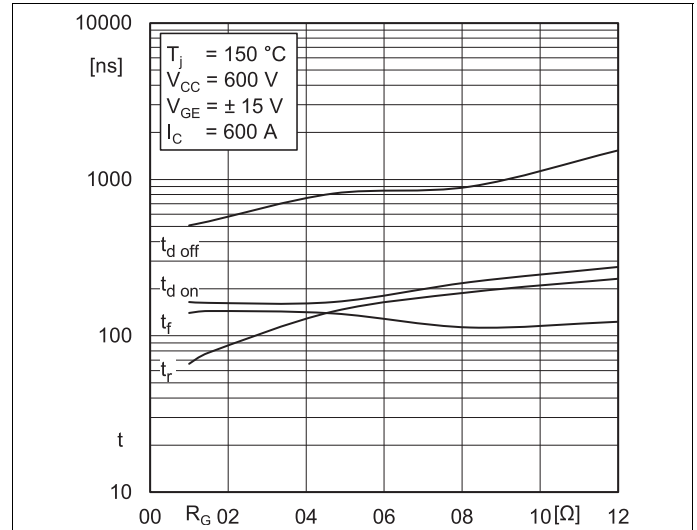


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

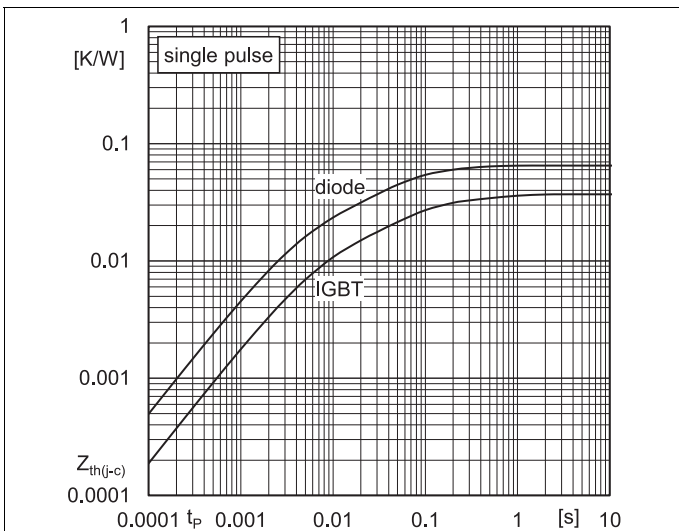


Fig. 9: Transient thermal impedance

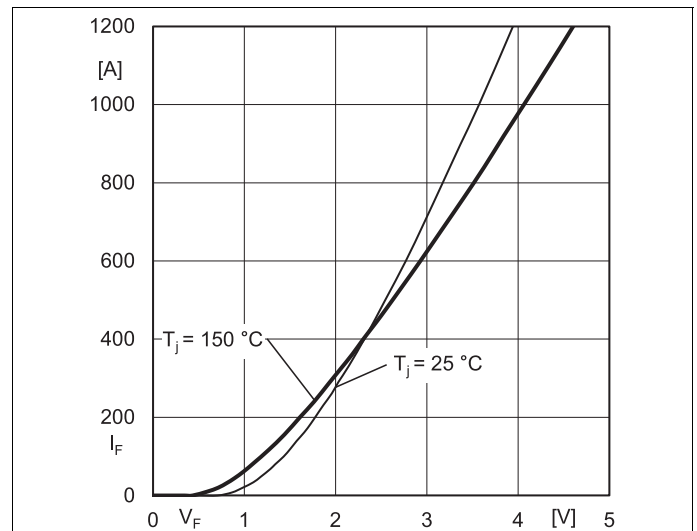


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC+EE}$

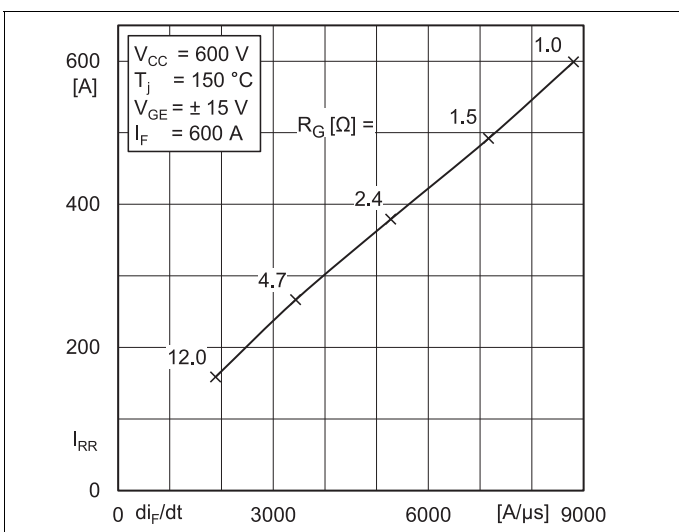


Fig. 11: Typ. CAL diode peak reverse recovery current

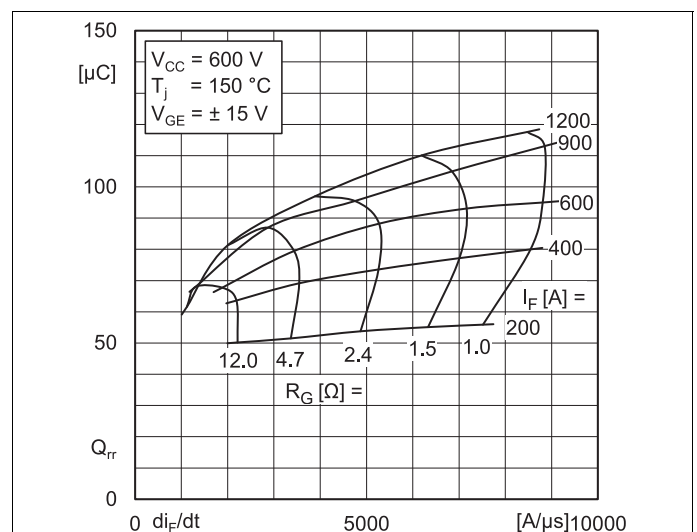


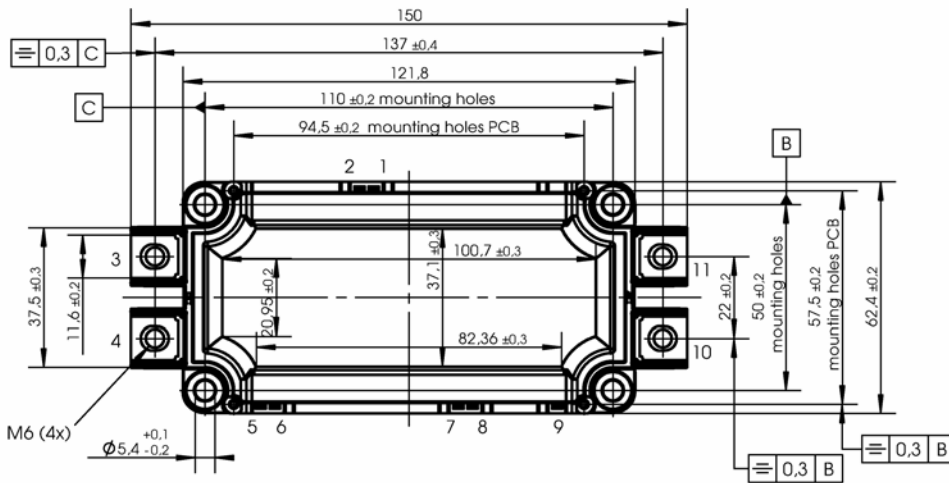
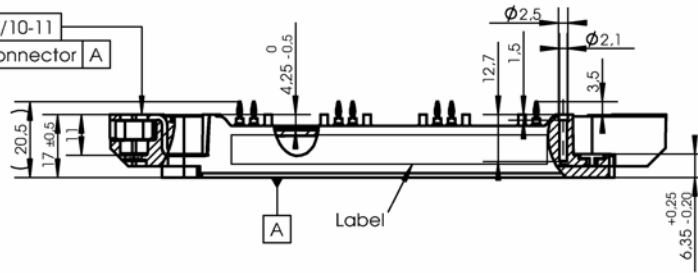


Fig. 12: Typ. CAL diode recovery charge

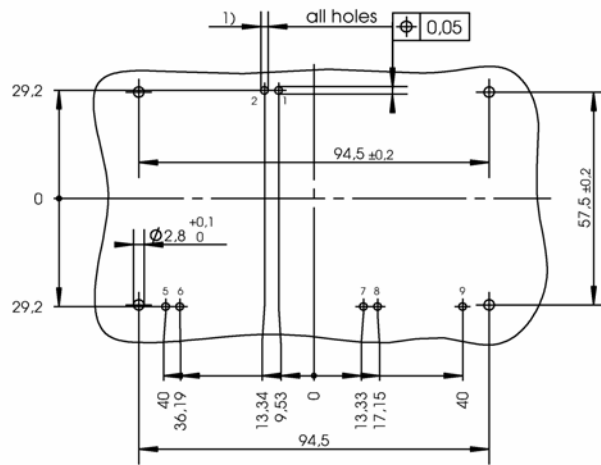
# SEMiX603GAR12E4p

Package outline

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



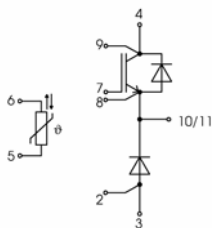
PCB drillhole pattern



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.

## **\*IMPORTANT INFORMATION AND WARNINGS**

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