



SEMITRANS® 5

IGBT4 Modules

Engineering Sample SKM600GAE12E4

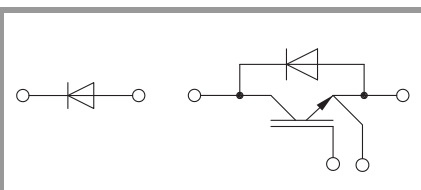
Target Data

Features

- IGBT4 = 4. generation medium fast trench IGBT
- CAL4F = Soft switching 4. generation CAL-diode
- Enhanced 900A free-wheeling diode
- With integrated gate resistor
- Isolated copper baseplate using DBC technology (Direct Bonded Copper)
- UL recognized, file no. E63532

Remarks

- Case temperature limited to $T_c = 125^\circ\text{C}$ max
- Recommended $T_{op} = -40 \dots +150^\circ\text{C}$
- Product reliability results valid for $T_j = 150^\circ$



GAE

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT				
V_{CES}	$T_j = 25^\circ\text{C}$		1200	V
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	913	A
		$T_c = 80^\circ\text{C}$	702	A
I_{Cnom}			600	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$		1800	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1200\text{ V}$	$T_j = 150^\circ\text{C}$	10	μs
T_j			-40 ... 175	$^\circ\text{C}$
Inverse diode				
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	54	A
		$T_c = 80^\circ\text{C}$	41	A
I_{Fnom}			50	A
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$		100	A
I_{FSM}	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$		180	A
T_j			-40 ... 175	$^\circ\text{C}$
Freewheeling diode				
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	936	A
		$T_c = 80^\circ\text{C}$	695	A
I_{Fnom}			900	A
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$		1800	A
I_{FSM}	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$		4320	A
T_j			-40 ... 175	$^\circ\text{C}$
Module				
$I_{t(RMS)}$			500	A
T_{stg}			-40 ... 125	$^\circ\text{C}$
V_{isol}	AC sinus 50 Hz, $t = 1\text{ min}$		2500	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT						
$V_{CE(sat)}$	$I_C = 600\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	1.80	2.05		V
		$T_j = 150^\circ\text{C}$	2.20	2.42		V
V_{CE0}	chipllevel	$T_j = 25^\circ\text{C}$	0.80	0.90		V
		$T_j = 150^\circ\text{C}$	0.70	0.80		V
r_{CE}	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	1.67	1.92		$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	2.5	2.7		$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 24\text{ mA}$		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
		$T_j = 150^\circ\text{C}$			-	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		37.2		nF
C_{oes}		$f = 1\text{ MHz}$		2.32		nF
C_{res}		$f = 1\text{ MHz}$		2.04		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$			3400		nC
R_{Gint}	$T_j = 25^\circ\text{C}$			1.3		Ω



SEMITRANS® 5

IGBT4 Modules

Engineering Sample SKM600GAE12E4

Target Data

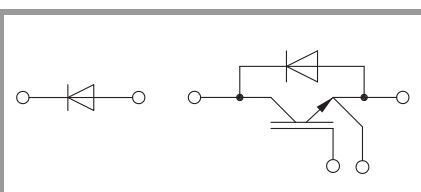
Features

- IGBT4 = 4. generation medium fast trench IGBT
- CAL4F = Soft switching 4. generation CAL-diode
- Enhanced 900A free-wheeling diode
- With integrated gate resistor
- Isolated copper baseplate using DBC technology (Direct Bonded Copper)
- UL recognized, file no. E63532

Remarks

- Case temperature limited to $T_c = 125^\circ\text{C}$ max
- Recommended $T_{op} = -40 \dots +150^\circ\text{C}$
- Product reliability results valid for $T_j = 150^\circ$

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		195		ns
t_r	$I_C = 600\text{ A}$	$T_j = 150^\circ\text{C}$		91		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		81		mJ
$t_{d(off)}$	$R_{G\ on} = 2\ \Omega$	$T_j = 150^\circ\text{C}$		695		ns
t_f	$R_{G\ off} = 2\ \Omega$	$T_j = 150^\circ\text{C}$		131		ns
E_{off}	$di/dt_{on} = 6000\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		83		mJ
	$di/dt_{off} = 5200\text{ A}/\mu\text{s}$					
$R_{th(j-c)}$	per IGBT				0.049	K/W
Inverse diode						
$V_F = V_{EC}$	$I_F = 50\text{ A}$	$T_j = 25^\circ\text{C}$		2.41	2.74	V
	$V_{GE} = 0\text{ V}$	$T_j = 150^\circ\text{C}$		2.45	2.79	V
	chiplevel					
V_{F0}		$T_j = 25^\circ\text{C}$		1.30	1.50	V
	chiplevel	$T_j = 150^\circ\text{C}$		0.90	1.10	V
r_F		$T_j = 25^\circ\text{C}$		22	25	m Ω
	chiplevel	$T_j = 150^\circ\text{C}$		31	34	m Ω
I_{RRM}	$I_F = 50\text{ A}$	$T_j = 150^\circ\text{C}$				A
Q_{rr}	$di/dt_{off} = 5500\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$				μC
E_{rr}	$V_{GE} = \pm 15\text{ V}$	$T_j = 150^\circ\text{C}$				mJ
	$V_{CC} = 600\text{ V}$					
$R_{th(j-c)}$	per diode				1	K/W
Freewheeling diode						
$V_F = V_{EC}$	$I_F = 900\text{ A}$	$T_j = 25^\circ\text{C}$		2.14	2.46	V
	$V_{GE} = 0\text{ V}$	$T_j = 150^\circ\text{C}$		2.07	2.38	V
	chiplevel					
V_{F0}		$T_j = 25^\circ\text{C}$		1.3	1.5	V
	chiplevel	$T_j = 150^\circ\text{C}$		0.9	1.1	V
r_F		$T_j = 25^\circ\text{C}$		0.93	1.07	m Ω
	chiplevel	$T_j = 150^\circ\text{C}$		1.30	1.42	m Ω
I_{RRM}	$I_F = 600\text{ A}$	$T_j = 150^\circ\text{C}$		384		A
Q_{rr}	$di/dt_{off} = 5500\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		83		μC
E_{rr}	$V_{GE} = \pm 15\text{ V}$	$T_j = 150^\circ\text{C}$		47		mJ
	$V_{CC} = 600\text{ V}$					
$R_{th(j-c)}$	per diode				0.07	K/W
Module						
L_{CE}				15		nH
R_{CC+EE}	measured per switch	$T_C = 25^\circ\text{C}$		0.18		m Ω
		$T_C = 125^\circ\text{C}$		0.22		m Ω
$R_{th(c-s)}$	calculated without thermal coupling			0.02	0.038	K/W
M_s	to heat sink M6		3		5	Nm
M_t		to terminals M6	2.5		5	Nm
						Nm
w					310	g



GAE

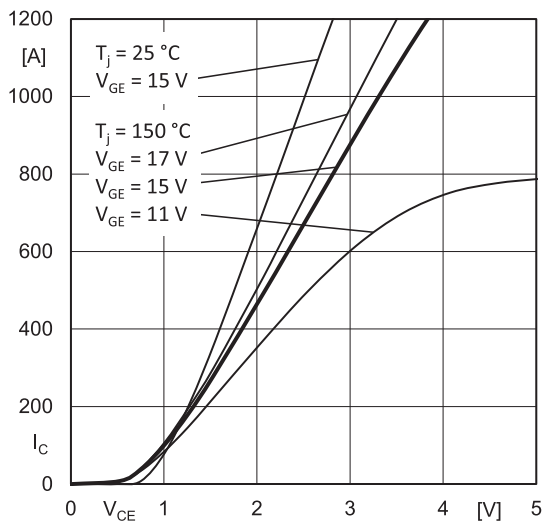


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

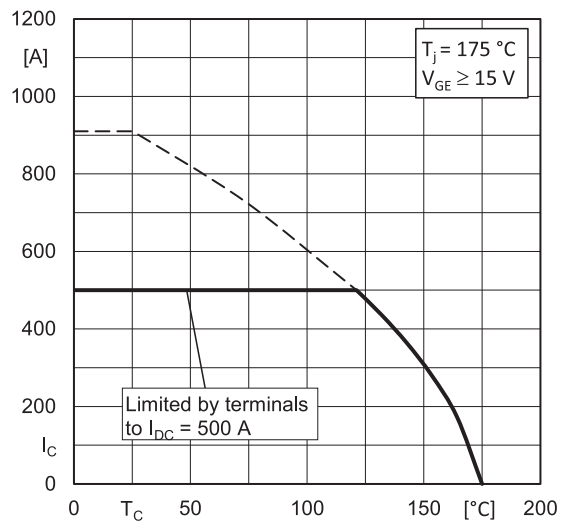


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

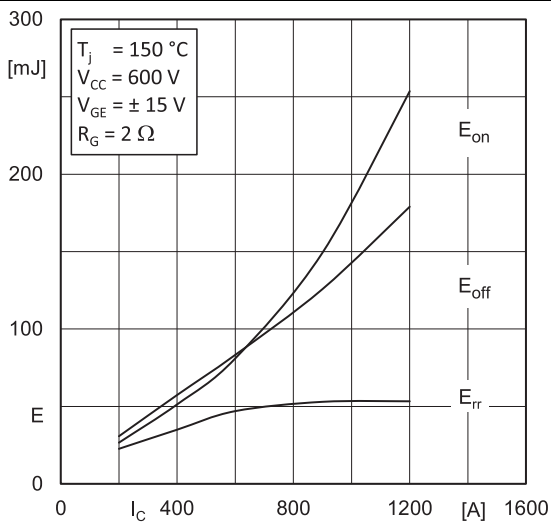


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

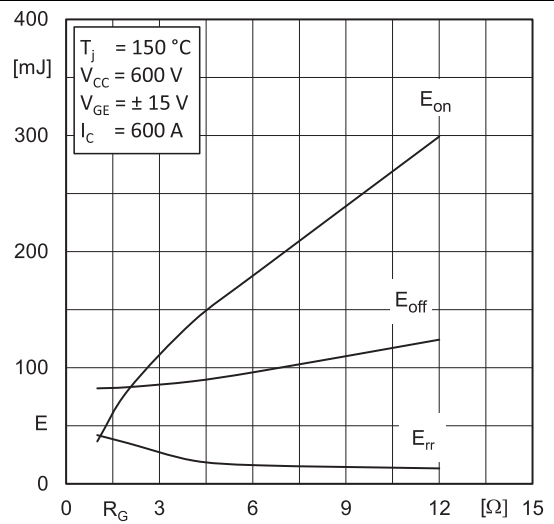


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

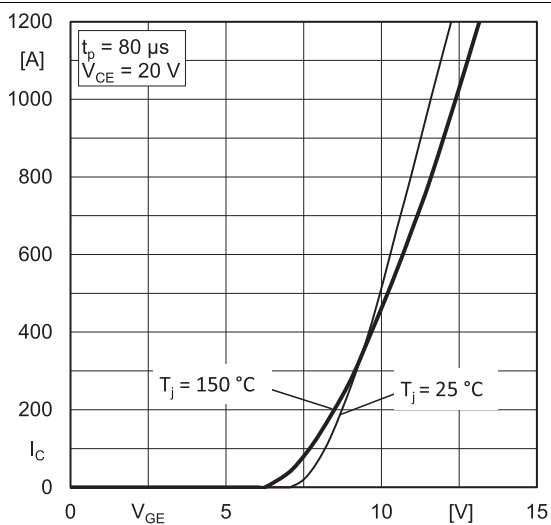


Fig. 5: Typ. transfer characteristic

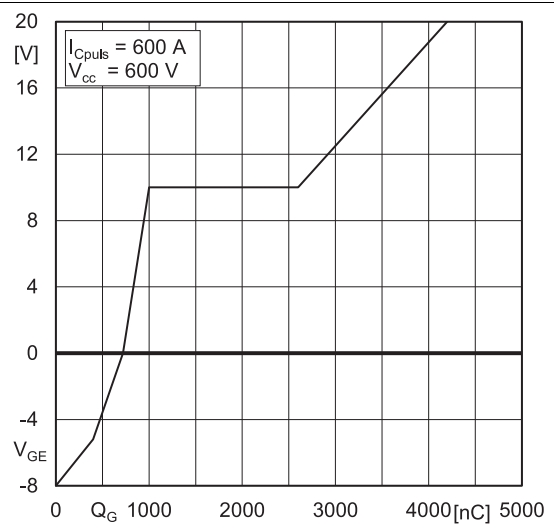


Fig. 6: Typ. gate charge characteristic

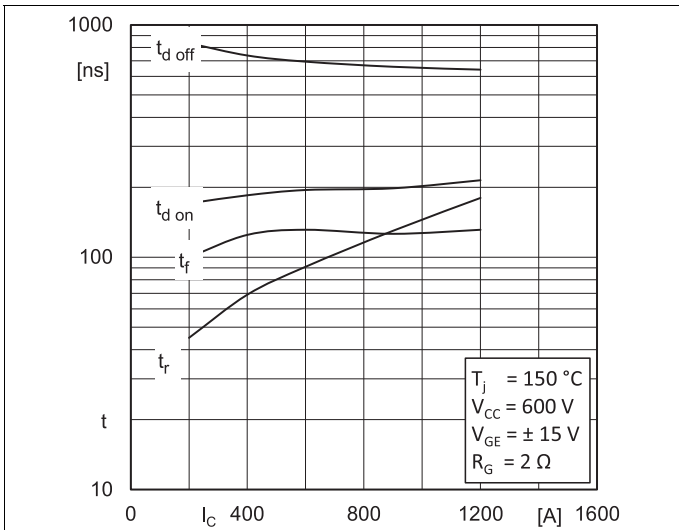


Fig. 7: Typ. switching times vs. I_C

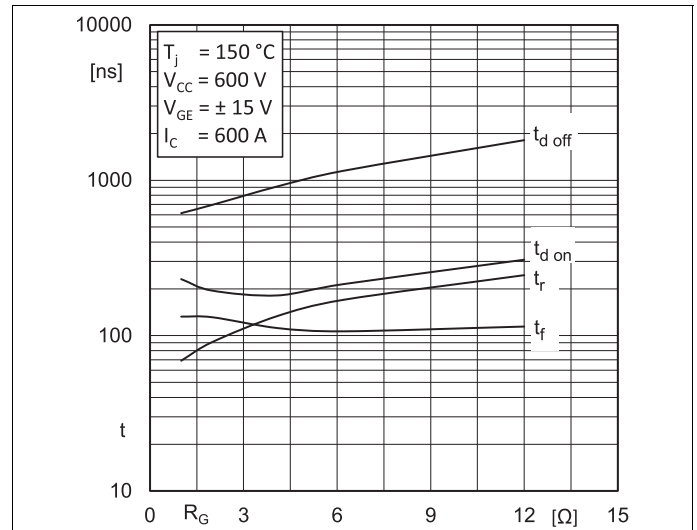


Fig. 8: Typ. switching times vs. gate resistor R_G

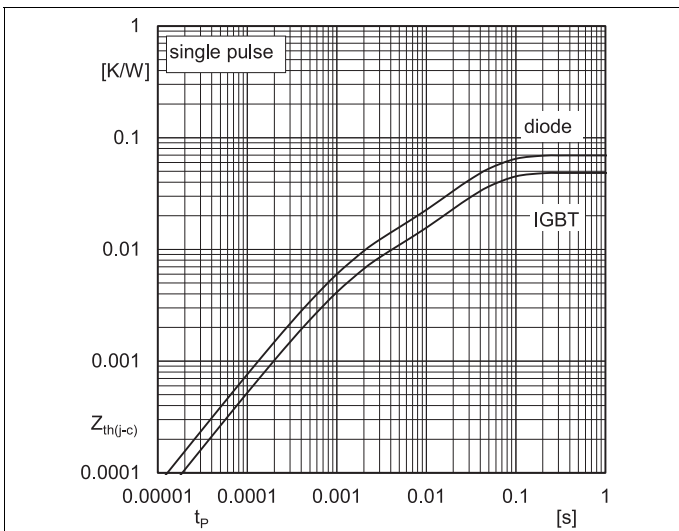


Fig. 9: Transient thermal impedance

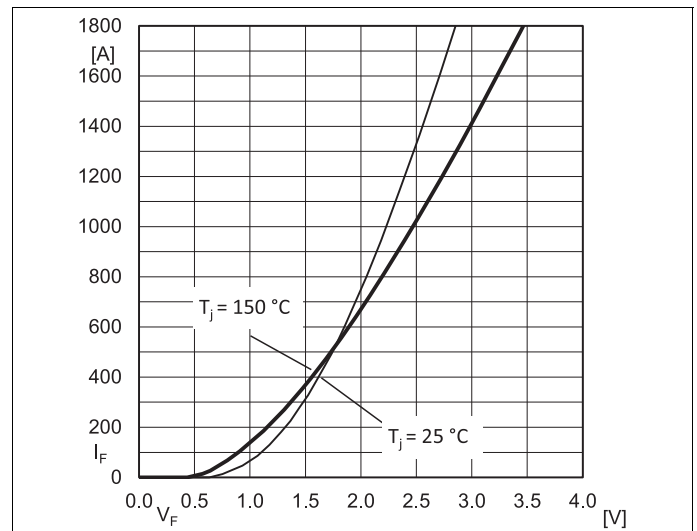


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC+EE'}$

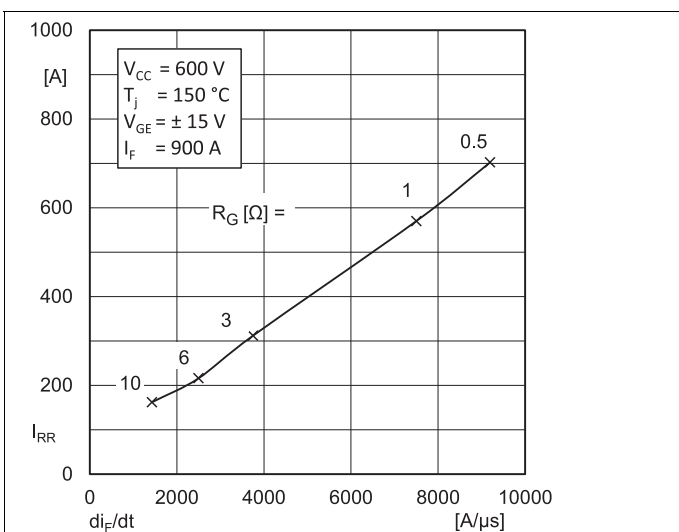


Fig. 11: CAL diode peak reverse recovery current

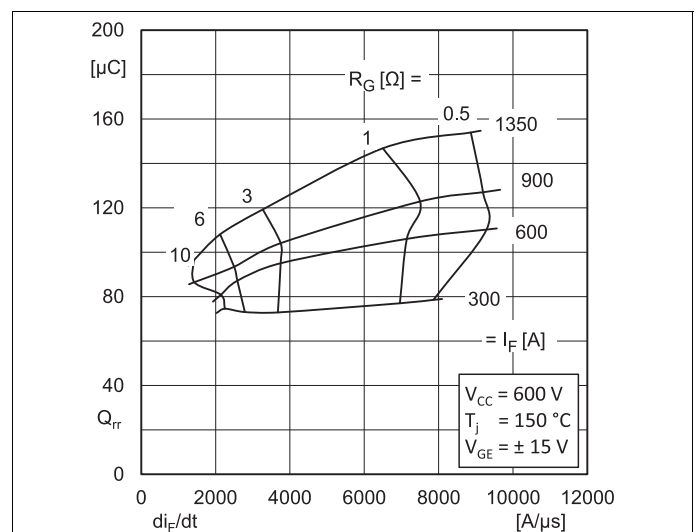
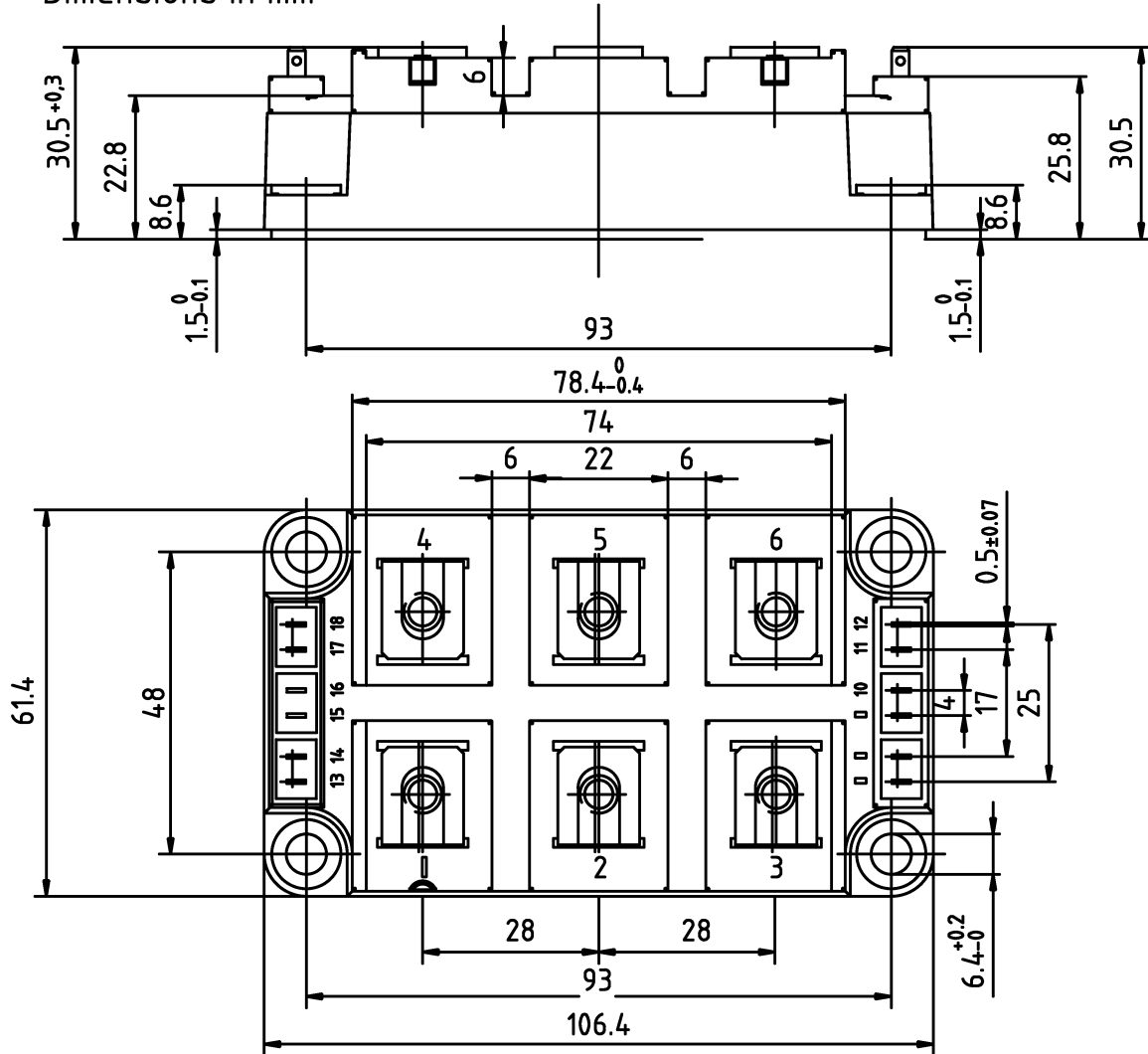


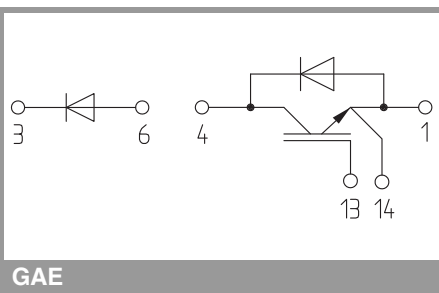
Fig. 12: Typ. CAL diode peak reverse recovery charge

SKM600GAE12E4

Dimensions in mm



SEMITRANS 5



GAE

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

***IMPORTANT INFORMATION AND WARNINGS**

The specifications of SEMIKRON products may not be considered as guarantee or assurance of product characteristics ("Beschaffenheitsgarantie"). The specifications of SEMIKRON products describe only the usual characteristics of products to be expected in typical applications, which may still vary depending on the specific application. Therefore, products must be tested for the respective application in advance. Application adjustments may be necessary. The user of SEMIKRON products is responsible for the safety of their applications embedding SEMIKRON products and must take adequate safety measures to prevent the applications from causing a physical injury, fire or other problem if any of SEMIKRON products become faulty. The user is responsible to make sure that the application design is compliant with all applicable laws, regulations, norms and standards. Except as otherwise explicitly approved by SEMIKRON in a written document signed by authorized representatives of SEMIKRON, SEMIKRON products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury. No representation or warranty is given and no liability is assumed with respect to the accuracy, completeness and/or use of any information herein, including without limitation, warranties of non-infringement of intellectual property rights of any third party. SEMIKRON does not assume any liability arising out of the applications or use of any product; neither does it convey any license under its patent rights, copyrights, trade secrets or other intellectual property rights, nor the rights of others. SEMIKRON makes no representation or warranty of non-infringement or alleged non-infringement of intellectual property rights of any third party which may arise from applications. Due to technical requirements our products may contain dangerous substances. For information on the types in question please contact the nearest SEMIKRON sales office. This document supersedes and replaces all information previously supplied and may be superseded by updates. SEMIKRON reserves the right to make changes.

In accordance with the quality guidelines of SEMIKRON, we would like to point out that the products are engineering samples. These engineering samples are not yet produced under quality conditions approaching those of series production, and are at the present time not included in the SEMIKRON quality monitoring and control process. Neither the product nor the production process has to date gone completely through the SEMIKRON internal authorization procedure. SEMIKRON may make any amendments without any prior notification. SEMIKRON cannot and shall not promise or commit itself to release and/or make available a final version or series product after the development phase. SEMIKRON cannot and will not assume any responsibility with regard to freedom from defects, functionality, and adaptation to and interaction with possible applications of the user or with regard to any other potential risks resulting from the use of engineering samples. Therefore SEMIKRON explicitly excludes any warranty and liability; as far as legally possible. The customer shall fully indemnify and hold harmless SEMIKRON from any and all risks, damages, losses, expenses and costs directly or indirectly resulting out of or in connection with the commissioning, operation, system integration, sale, dissemination or any other kind of use of engineering samples by the customer and/or any third party, which has come into possession of engineering samples through or because of the customer. All know-how and all registerable and non-registerable copyrights and industrial property rights arising from or in connection with these engineering samples remain the exclusive property of SEMIKRON.