

# SKM195GAR07E3



**SEMITRANS® 2**

## Trench IGBT Modules

### SKM195GAR07E3

#### Features

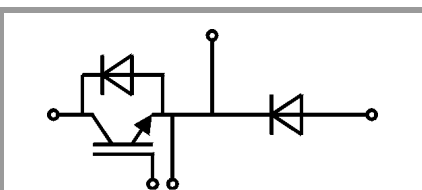
- $V_{CE(sat)}$  with positive temperature coefficient
- High short circuit capability, self limiting to  $6 \times I_{Cnom}$
- Fast & soft inverse CAL diodes
- Insulated copper baseplate using DBC Technology (Direct Copper Bonding)
- With integrated gate resistor

#### Typical Applications\*

- Electronic welders
- DC/DC – converter
- Brake chopper
- Switched reluctance motor

#### 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  $T_j = 150^\circ\text{C}$
- Use of soft  $R_G$  necessary



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#### Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
<b>IGBT</b>			
$V_{CES}$	$T_j = 25^\circ\text{C}$	650	V
$I_C$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	266
		$T_c = 80^\circ\text{C}$	201
$I_{Cnom}$		200	A
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$	600	A
$V_{GES}$		-20 ... 20	V
$t_{psc}$	$V_{CC} = 360\text{ V}$	$T_j = 150^\circ\text{C}$	6
	$V_{GE} \leq 15\text{ V}$		
	$V_{CES} \leq 650\text{ V}$		
$T_j$		-40 ... 175	$^\circ\text{C}$

#### Inverse diode

$V_{RRM}$	$T_j = 25^\circ\text{C}$	650	V
$I_F$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	217
		$T_c = 80^\circ\text{C}$	157
$I_{Fnom}$		200	A
$I_{FRM}$	$I_{FRM} = 2 \times I_{Fnom}$	400	A
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$	1470	A
$T_j$		-40 ... 175	$^\circ\text{C}$

#### Freewheeling diode

$V_{RRM}$	$T_j = 25^\circ\text{C}$	650	V
$I_F$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	217
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$T_j$		-40 ... 175	$^\circ\text{C}$

#### Module

$I_{t(RMS)}$		200	A
$T_{stg}$	module without TIM	-40 ... 125	$^\circ\text{C}$
$V_{isol}$	AC sinus 50 Hz, $t = 1\text{ min}$	4000	V

#### Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
<b>IGBT</b>					
$V_{CE(sat)}$	$I_C = 200\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.46	1.90	V
		$T_j = 150^\circ\text{C}$	1.70	2.10	V
$V_{CE0}$	chipelevel	$T_j = 25^\circ\text{C}$	0.90	1.00	V
		$T_j = 150^\circ\text{C}$	0.82	0.90	V
$r_{CE}$	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	2.8	4.5	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	4.4	6.0	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 3.2\text{ mA}$	5.1	5.8	6.4	V
$I_{CES}$	$V_{GE} = 0\text{ V}$ $V_{CE} = 650\text{ V}$	$T_j = 25^\circ\text{C}$		0.3	$\text{mA}$
		$T_j = 150^\circ\text{C}$		-	$\text{mA}$
$C_{ies}$	$V_{CE} = 25\text{ V}$		12.3		nF
$C_{oes}$	$V_{GE} = 0\text{ V}$		0.77		nF
$C_{res}$			0.37		nF
$Q_G$	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		1600		nC
$R_{Gint}$	$T_j = 25^\circ\text{C}$		2.0		$\Omega$



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#### Features

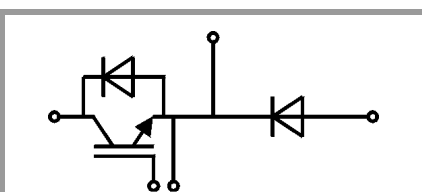
- $V_{CE(sat)}$  with positive temperature coefficient
- High short circuit capability, self limiting to  $6 \times I_{cnom}$
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>IGBT</b>						
$t_{d(on)}$	$V_{CC} = 300\text{ V}$	$T_j = 150^\circ\text{C}$		122		ns
$t_r$	$I_C = 200\text{ A}$	$T_j = 150^\circ\text{C}$		52		ns
$E_{on}$	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		6.3		mJ
$t_{d(off)}$	$R_{G\ on} = 1\ \Omega$	$T_j = 150^\circ\text{C}$		650		ns
$t_f$	$R_{G\ off} = 5.6\ \Omega$	$T_j = 150^\circ\text{C}$		62		ns
$E_{off}$	$di/dt_{on} = 3810\text{ A}/\mu\text{s}$ $di/dt_{off} = 3260\text{ A}/\mu\text{s}$ $du/dt = 2090\text{ V}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		8.3		mJ
$R_{th(j-c)}$	per IGBT				0.22	K/W
$R_{th(c-s)}$	per IGBT ( $\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$ )			0.064		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material			0.054		K/W
<b>Inverse diode</b>						
$V_F = V_{EC}$	$I_F = 200\text{ A}$	$T_j = 25^\circ\text{C}$		1.39	1.75	V
	$V_{GE} = 0\text{ V}$ chipllevel	$T_j = 150^\circ\text{C}$		1.38	1.76	V
$V_{F0}$	chipllevel	$T_j = 25^\circ\text{C}$		1.04	1.24	V
		$T_j = 150^\circ\text{C}$		0.85	0.99	V
$r_F$	chipllevel	$T_j = 25^\circ\text{C}$		1.76	2.6	m $\Omega$
		$T_j = 150^\circ\text{C}$		2.6	3.9	m $\Omega$
$I_{RRM}$	$I_F = 200\text{ A}$	$T_j = 150^\circ\text{C}$		200		A
$Q_{rr}$	$di/dt_{off} = 3885\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		22		$\mu\text{C}$
$E_{rr}$	$V_{GE} = \pm 15\text{ V}$ $V_{CC} = 300\text{ V}$	$T_j = 150^\circ\text{C}$		4.5		mJ
$R_{th(j-c)}$	per diode				0.4	K/W
$R_{th(c-s)}$	per diode ( $\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$ )			0.069		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material			0.061		K/W
<b>Freewheeling diode</b>						
$V_F = V_{EC}$	$I_F = 200\text{ A}$	$T_j = 25^\circ\text{C}$		1.39	1.75	V
	$V_{GE} = 0\text{ V}$ chipllevel	$T_j = 150^\circ\text{C}$		1.38	1.76	V
$V_{F0}$	chipllevel	$T_j = 25^\circ\text{C}$		1.04	1.24	V
		$T_j = 150^\circ\text{C}$		0.85	0.99	V
$r_F$	chipllevel	$T_j = 25^\circ\text{C}$		1.76	2.6	m $\Omega$
		$T_j = 150^\circ\text{C}$		2.6	3.9	m $\Omega$
$I_{RRM}$	$I_F = 200\text{ A}$	$T_j = 150^\circ\text{C}$		200		A
$Q_{rr}$	$di/dt_{off} = 3885\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		22		$\mu\text{C}$
$E_{rr}$	$V_{GE} = \pm 15\text{ V}$ $V_{CC} = 300\text{ V}$	$T_j = 150^\circ\text{C}$		4.5		mJ
$R_{th(j-c)}$	per diode				0.4	K/W
$R_{th(c-s)}$	per diode ( $\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$ )			0.069		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material			0.061		K/W



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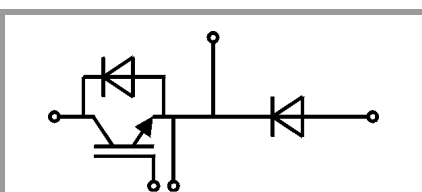
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Characteristics							
Symbol	Conditions		min.	typ.	max.	Unit	
<b>Module</b>							
$L_{CE}$				30		nH	
$R_{CC'+EE'}$	measured per switch	$T_c = 25^\circ\text{C}$		0.65		m $\Omega$	
		$T_c = 125^\circ\text{C}$		1.09		m $\Omega$	
$R_{th(c-s)1}$	calculated without thermal coupling ( $\lambda_{grease}=0.81 \text{ W}/(\text{m}^2\text{K})$ )			0.033		K/W	
$R_{th(c-s)2}$	including thermal coupling, $T_s$ underneath module ( $\lambda_{grease}=0.81 \text{ W}/(\text{m}^2\text{K})$ )			0.037		K/W	
$R_{th(c-s)2}$	including thermal coupling, $T_s$ underneath module, pre-applied phase change material			0.032		K/W	
$M_s$	to heat sink M6		3		5	Nm	
$M_t$			to terminals M5		2.5	5	Nm
							Nm
w					160	g	



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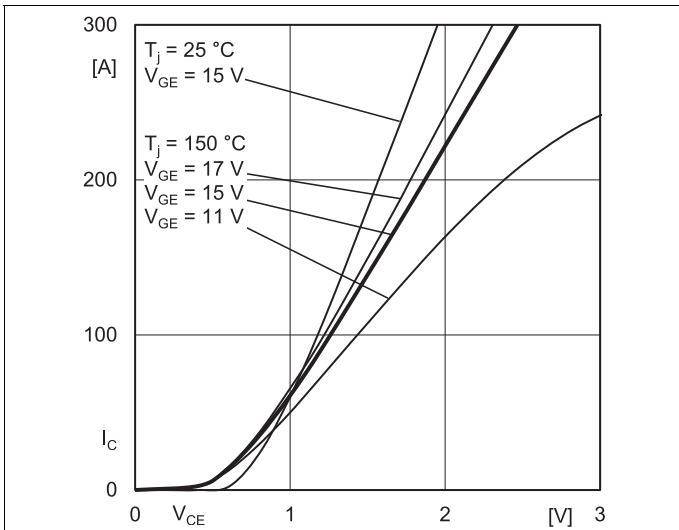


Fig. 1: Typ. output characteristic, inclusive  $R_{CC+EE}$

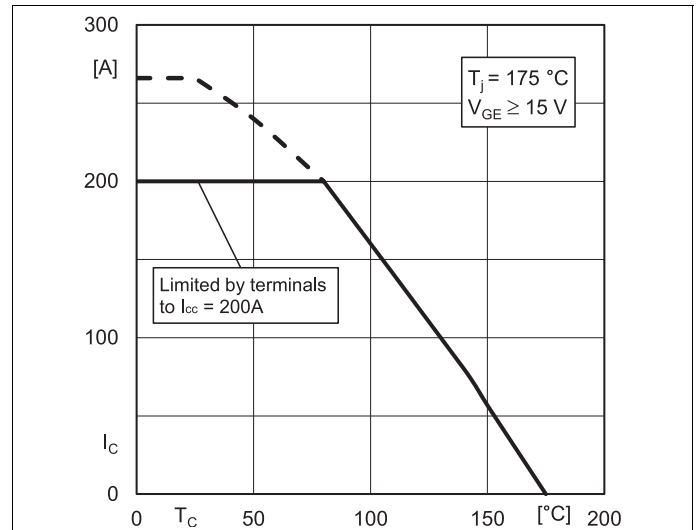


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

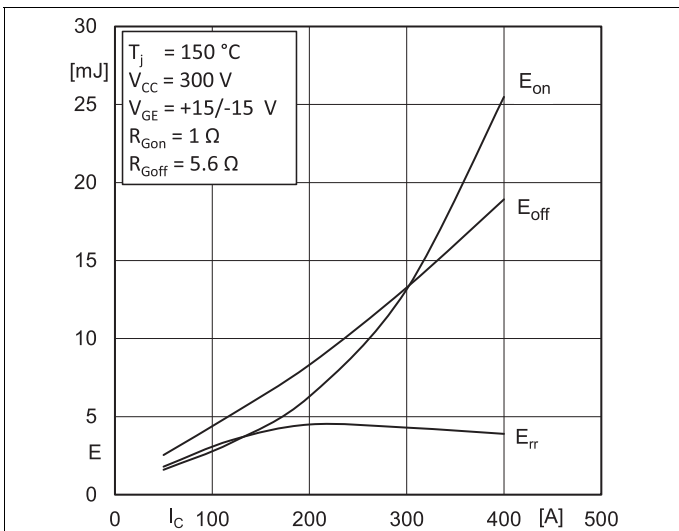


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

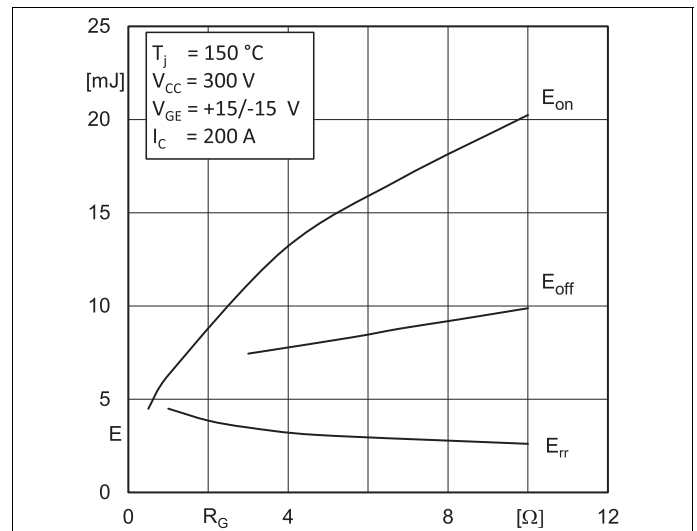


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

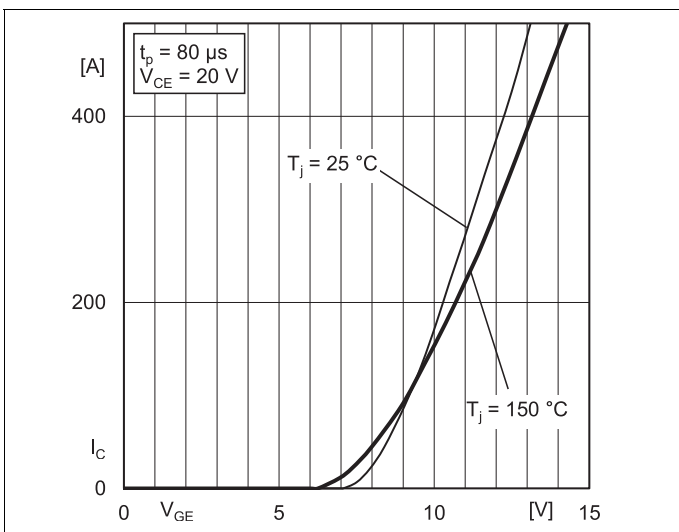


Fig. 5: Typ. transfer characteristic

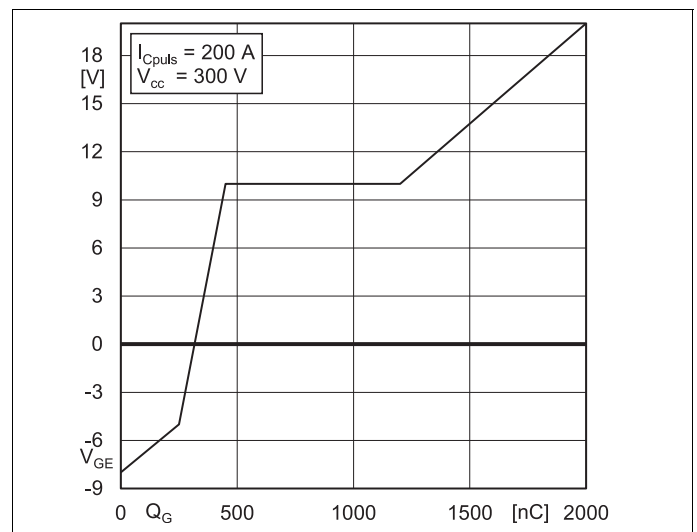


Fig. 6: Typ. gate charge characteristic

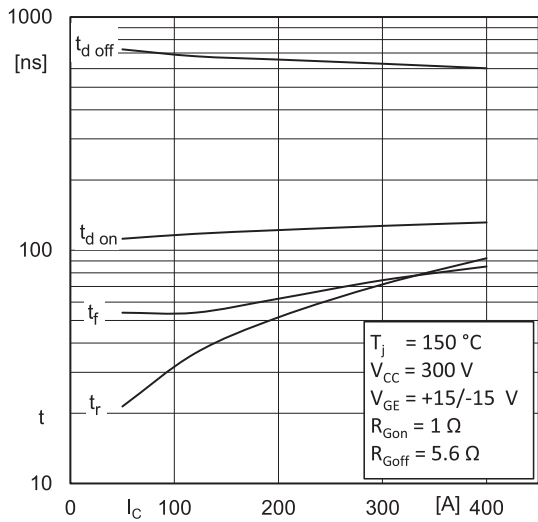


Fig. 7: Typ. switching times vs.  $I_C$

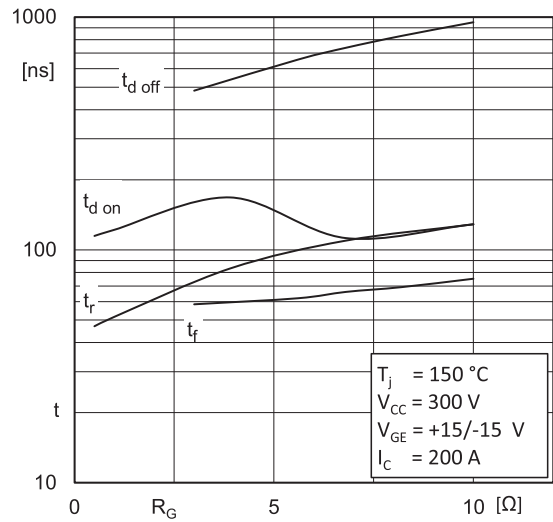


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

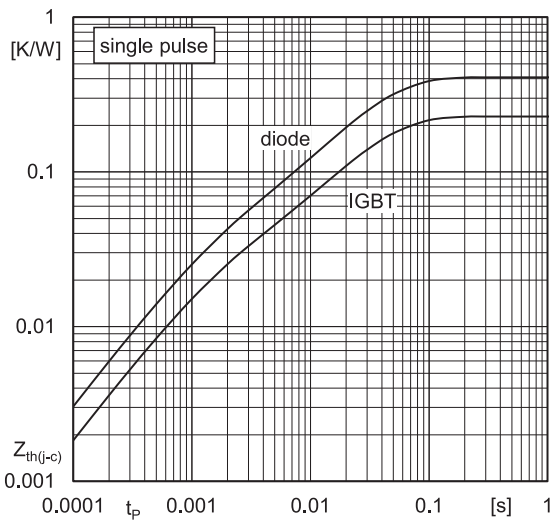


Fig. 9: Transient thermal impedance

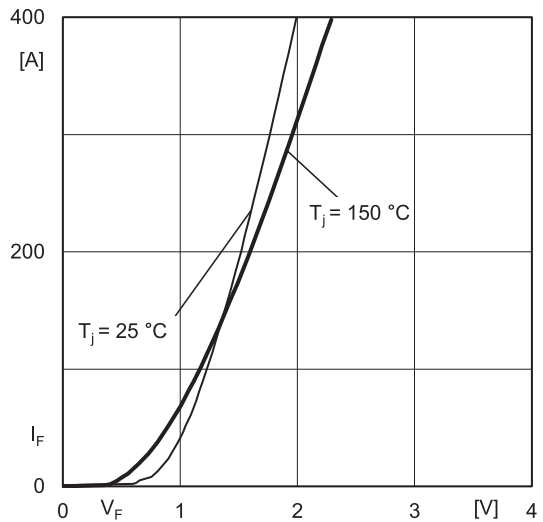


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC+EE}$

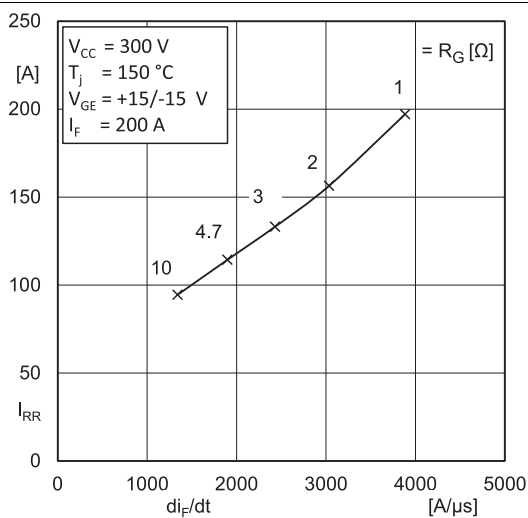


Fig. 11: CAL diode peak reverse recovery current

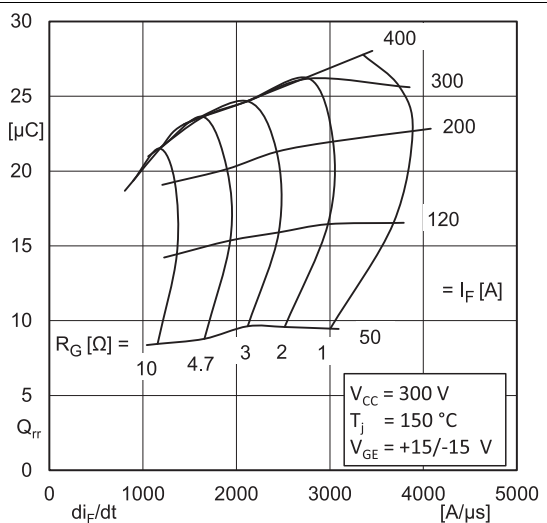
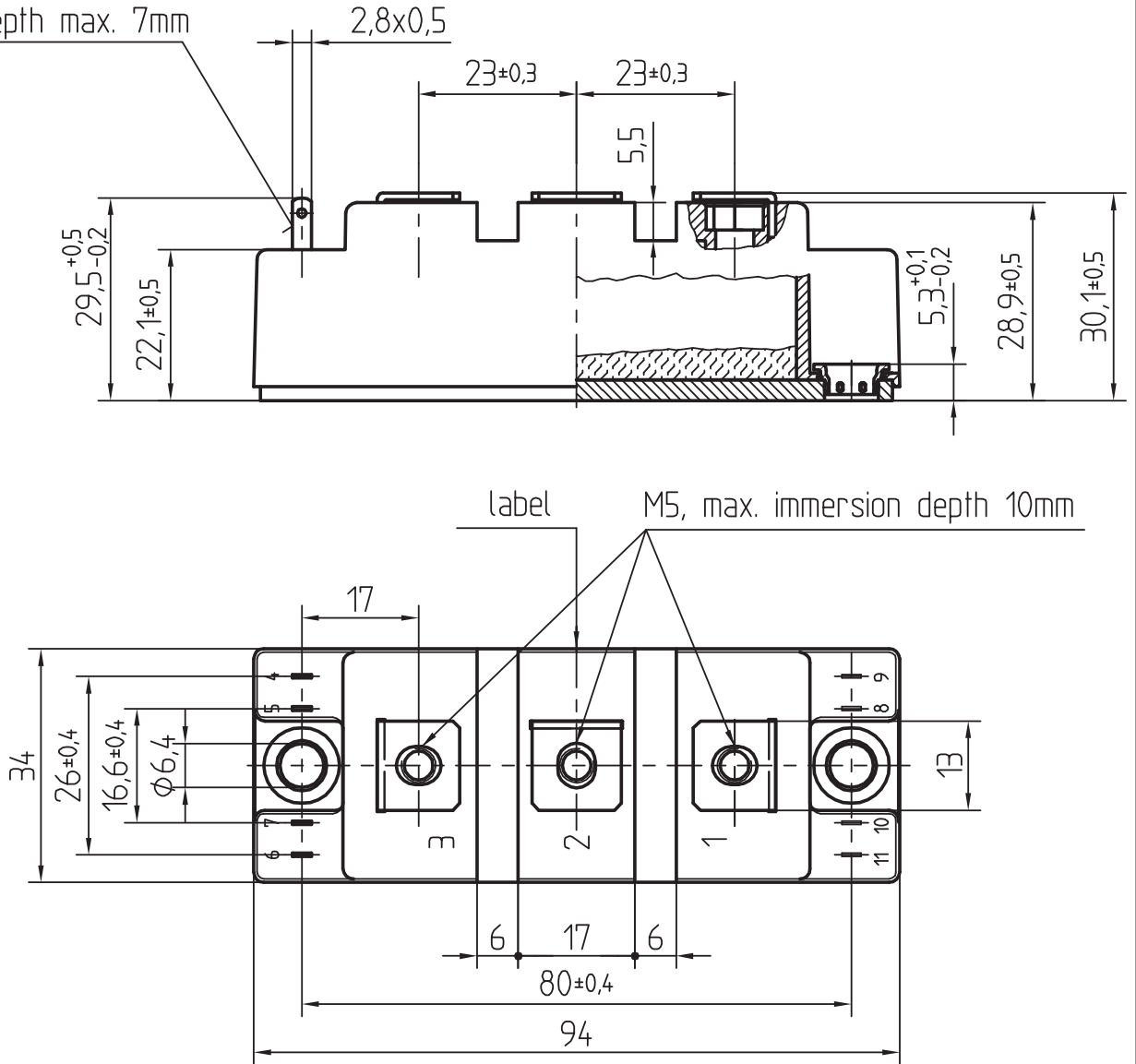


Fig. 12: Typ. CAL diode peak reverse recovery charge

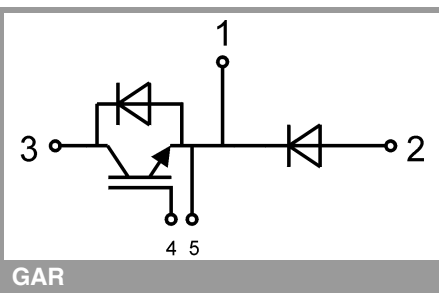
# SKM195GAR07E3

Dimensions in mm

Plug in depth max. 7mm



General tolerance +/- 0,5 mm



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

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

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