

# SKM150GAL12V



SEMITRANS® 2

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### Features

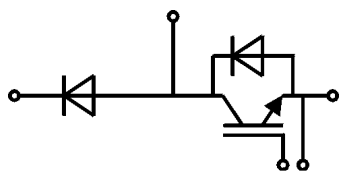
- V-IGBT = 6. Generation Trench V-IGBT (Fuji)
- CAL4 = Soft switching 4. Generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Copper Bonding)
- Increased power cycling capability
- With integrated gate resistor
- UL recognized, file no. E63532
- Lowest switching losses at High di/dt

### Typical Applications\*

- DC/DC – converter
- Brake chopper
- Switched reluctance motor
- DC – 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  $T_j = 150^\circ\text{C}$



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### Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
IGBT				
V <sub>CES</sub>	T <sub>j</sub> = 25 °C		1200	V
I <sub>C</sub>	T <sub>j</sub> = 175 °C	T <sub>c</sub> = 25 °C	231	A
		T <sub>c</sub> = 80 °C	176	A
I <sub>Cnom</sub>			150	A
I <sub>CRM</sub>	I <sub>CRM</sub> = 3 x I <sub>Cnom</sub>		450	A
V <sub>GES</sub>			-20 ... 20	V
t <sub>psc</sub>	V <sub>CC</sub> = 720 V V <sub>GE</sub> ≤ 15 V V <sub>CES</sub> ≤ 1200 V	T <sub>j</sub> = 125 °C	10	μs
T <sub>j</sub>			-40 ... 175	°C
Inverse diode				
I <sub>F</sub>	T <sub>j</sub> = 175 °C	T <sub>c</sub> = 25 °C	189	A
		T <sub>c</sub> = 80 °C	141	A
I <sub>Fnom</sub>			150	A
I <sub>FRM</sub>	I <sub>FRM</sub> = 3xI <sub>Fnom</sub>		450	A
I <sub>FSM</sub>	t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 25 °C		900	A
T <sub>j</sub>			-40 ... 175	°C
Freewheeling diode				
I <sub>F</sub>	T <sub>j</sub> = 175 °C	T <sub>c</sub> = 25 °C	189	A
		T <sub>c</sub> = 80 °C	141	A
I <sub>Fnom</sub>			150	A
I <sub>FRM</sub>	I <sub>FRM</sub> = 3xI <sub>Fnom</sub>		450	A
I <sub>FSM</sub>	t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 25 °C		900	A
T <sub>j</sub>			-40 ... 175	°C
Module				
I <sub>t(RMS)</sub>			200	A
T <sub>stg</sub>			-40 ... 125	°C
V <sub>isol</sub>	AC sinus 50 Hz, t = 1 min		4000	V

### Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
<b>IGBT</b>					
$V_{CE(sat)}$	$I_C = 150\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.75	2.20	V
		$T_j = 150^\circ\text{C}$	2.20	2.48	V
$V_{CE0}$	chipelevel	$T_j = 25^\circ\text{C}$	0.94	1.04	V
		$T_j = 150^\circ\text{C}$	0.88	0.98	V
$r_{CE}$	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	5.4	7.7	m $\Omega$
		$T_j = 150^\circ\text{C}$	8.8	10	m $\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 6\text{ mA}$	5.5	6	6.5	V
$I_{CES}$	$V_{GE} = 0\text{ V}$ $V_{CE} = 1200\text{ V}$	$T_j = 25^\circ\text{C}$		0.3	mA
		$T_j = 150^\circ\text{C}$	-		mA
$C_{ies}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	9.0		nF
$C_{oes}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	0.89		nF
$C_{res}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	0.88		nF
$Q_G$	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		1650		nC
$R_{Gint}$	$T_j = 25^\circ\text{C}$		5.0		$\Omega$



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- Switched reluctance motor
- DC – 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  $T_j = 150^\circ\text{C}$

### Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 150\text{ A}$ $T_j = 150^\circ\text{C}$		258		ns
$t_r$	$V_{GE} = +15/-15\text{ V}$ $R_{G on} = 1.5\ \Omega$ $T_j = 150^\circ\text{C}$		32		ns
$E_{on}$	$R_{G off} = 1.5\ \Omega$ $T_j = 150^\circ\text{C}$		13.5		mJ
$t_{d(off)}$	$di/dt_{on} = 5400\text{ A}/\mu\text{s}$ $T_j = 150^\circ\text{C}$		388		ns
$t_f$	$di/dt_{off} = 1800\text{ A}/\mu\text{s}$ $T_j = 150^\circ\text{C}$		62		ns
$E_{off}$	$du/dt = 8100\text{ V}/\mu\text{s}$ $T_j = 150^\circ\text{C}$		14.2		mJ
$R_{th(j-c)}$	per IGBT			0.19	K/W

### Inverse diode

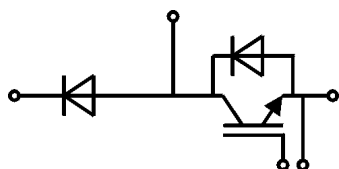
$V_F = V_{EC}$	$I_F = 150\text{ A}$ $V_{GE} = 0\text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	2.14 2.07	2.46 2.38	V
$V_{F0}$	chiplevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	1.30 0.90	1.50 1.10	V
$r_F$	chiplevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	5.6 7.8	6.4 8.5	m $\Omega$
$I_{RRM}$	$I_F = 150\text{ A}$ $T_j = 150^\circ\text{C}$		165		A
$Q_{rr}$	$di/dt_{off} = 5800\text{ A}/\mu\text{s}$ $V_{GE} = \pm 15\text{ V}$ $T_j = 150^\circ\text{C}$		22		$\mu\text{C}$
$E_{rr}$	$V_{CC} = 600\text{ V}$ $T_j = 150^\circ\text{C}$		8.5		mJ
$R_{th(j-c)}$	per diode			0.31	K/W

### Freewheeling diode

$V_F = V_{EC}$	$I_F = 150\text{ A}$ $V_{GE} = 0\text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	2.14 2.07	2.46 2.38	V
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$Q_{rr}$	$di/dt_{off} = 5800\text{ A}/\mu\text{s}$ $V_{GE} = \pm 15\text{ V}$ $T_j = 150^\circ\text{C}$		22		$\mu\text{C}$
$E_{rr}$	$V_{CC} = 600\text{ V}$ $T_j = 150^\circ\text{C}$		8.5		mJ
$R_{th(j-c)}$	per diode			0.31	K/W

### Module

$L_{CE}$			30		nH
$R_{CC+EE'}$	measured per switch	$T_c = 25^\circ\text{C}$ $T_c = 125^\circ\text{C}$	0.65 1.09		m $\Omega$
$R_{th(c-s)}$	calculated without thermal coupling ( $\lambda_{grease} = 0.81\text{ W}/(\text{m}^2\text{K})$ )		0.04	0.05	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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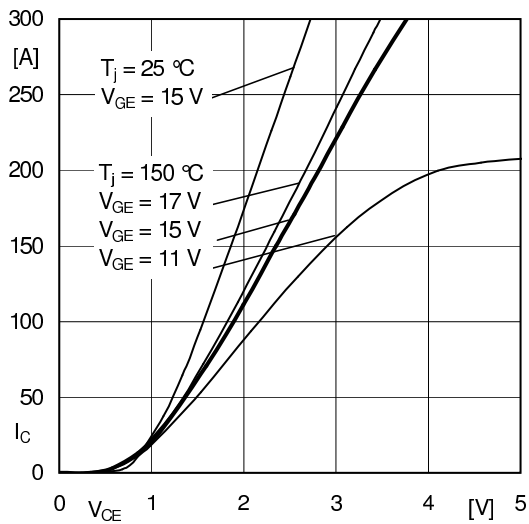


Fig. 1: Typ. output characteristic, inclusive  $R_{CC'} + EE'$

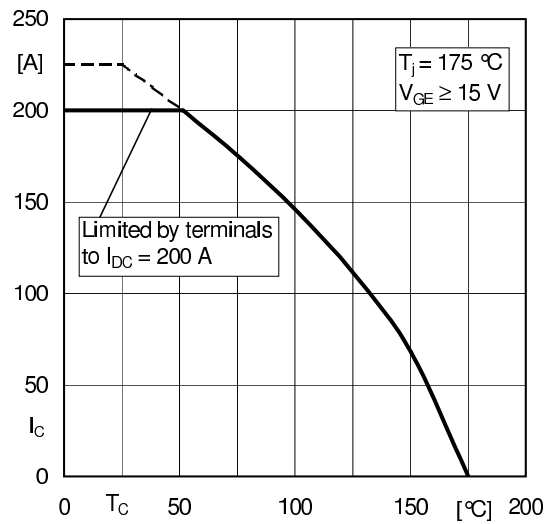


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

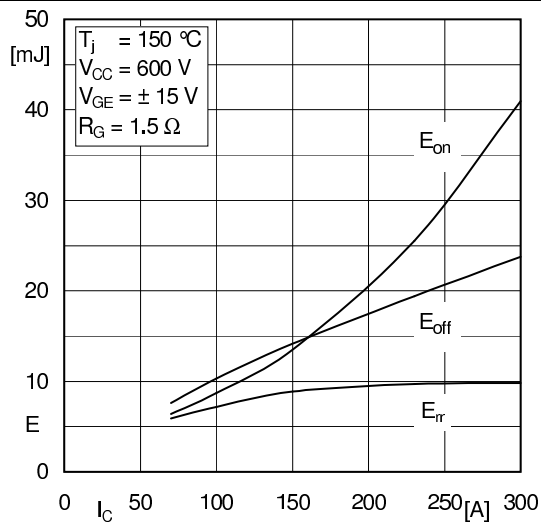


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

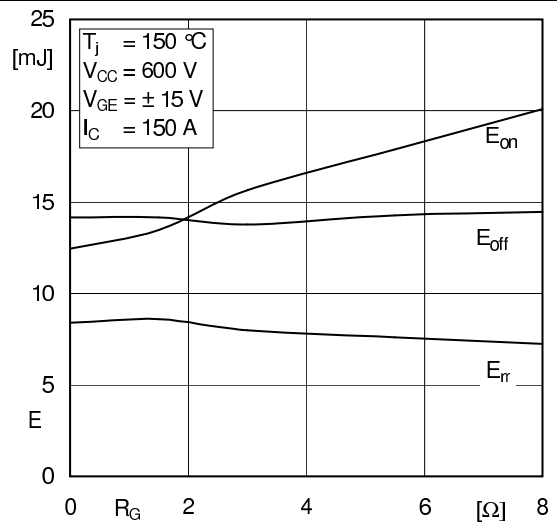


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

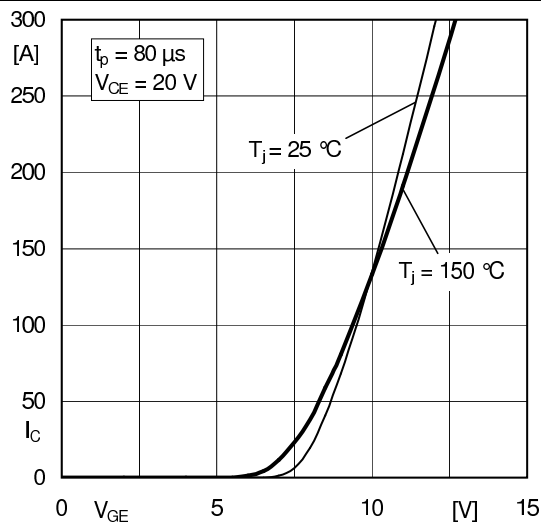


Fig. 5: Typ. transfer characteristic

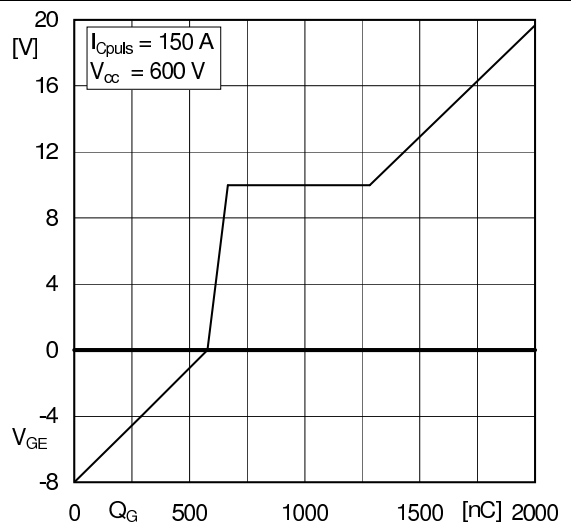


Fig. 6: Typ. gate charge characteristic

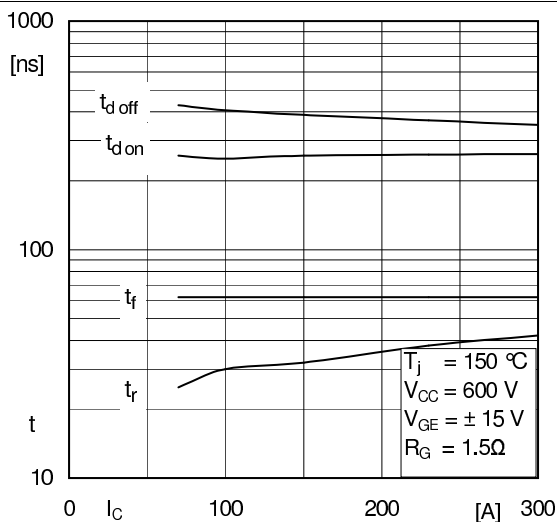


Fig. 7: Typ. switching times vs.  $I_C$

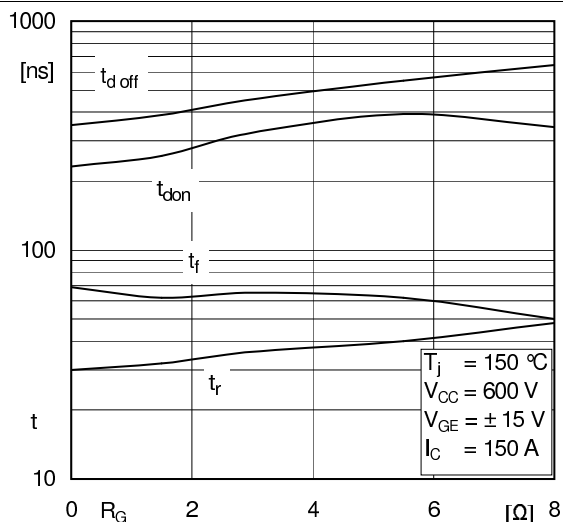


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

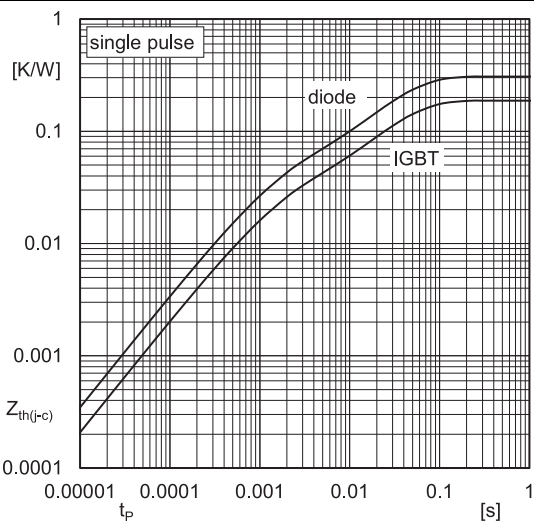


Fig. 9: Transient thermal impedance

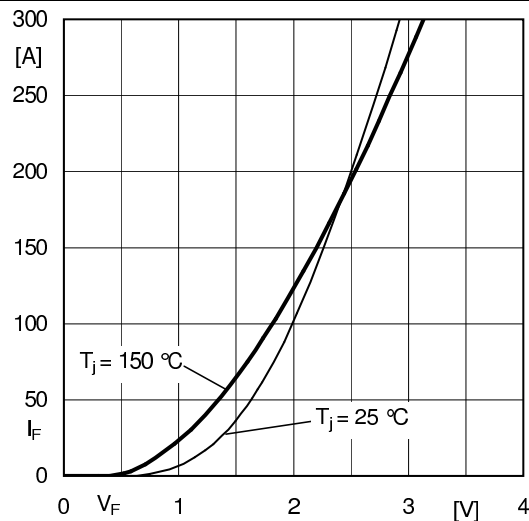


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC'}+EE'$

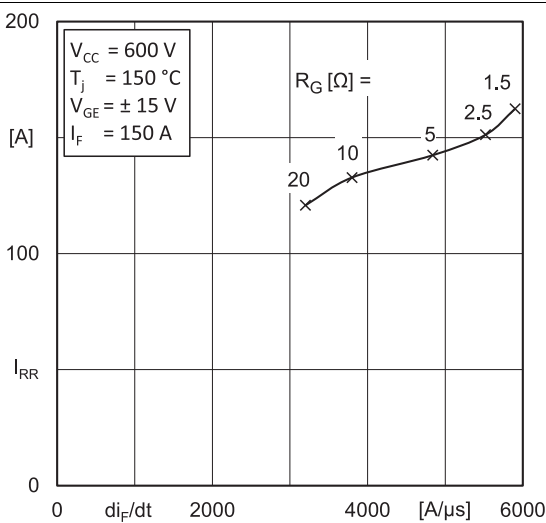


Fig. 11: CAL diode peak reverse recovery current

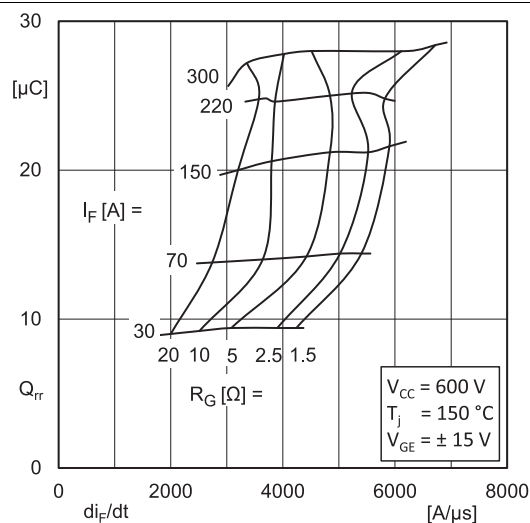
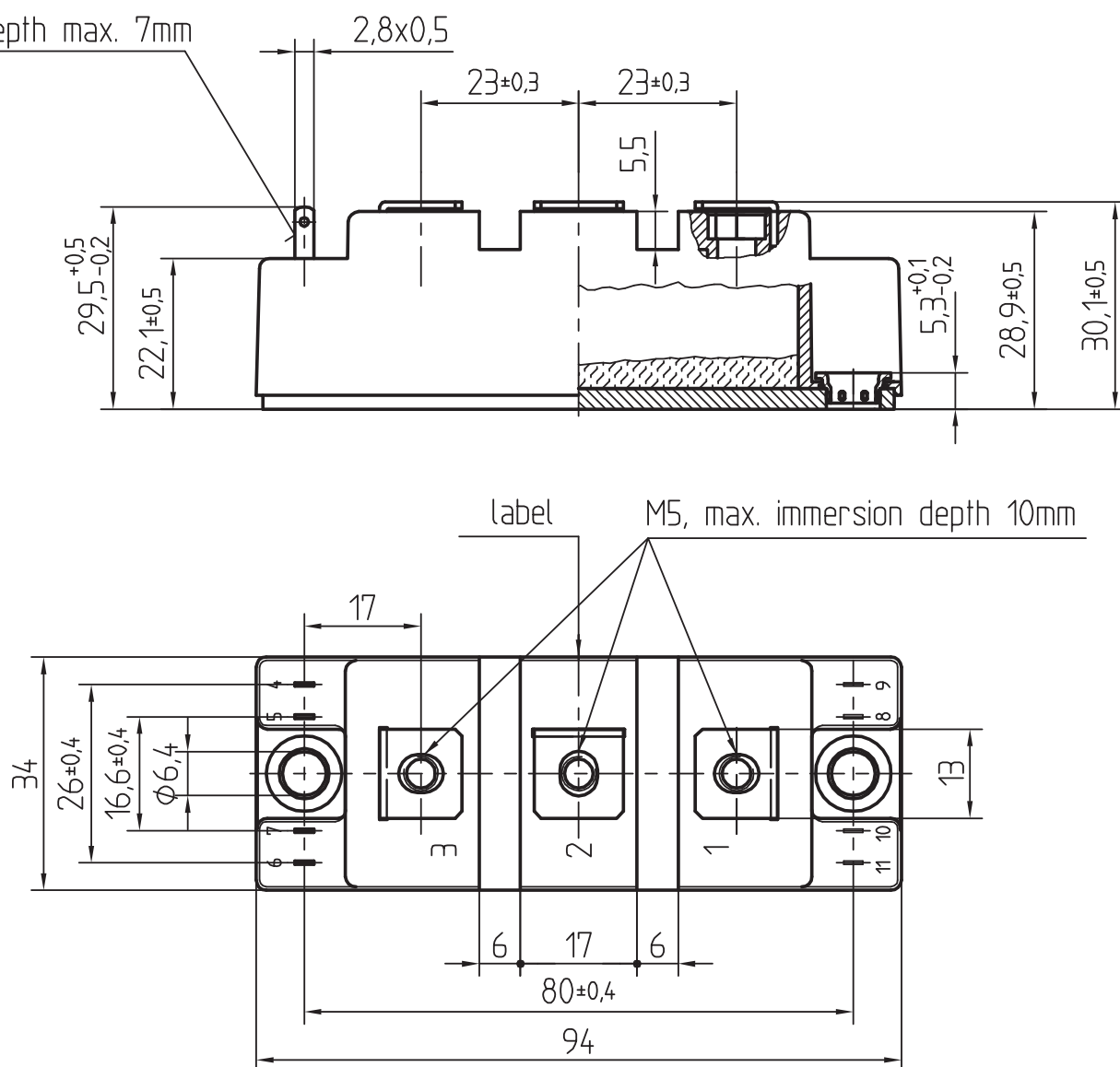


Fig. 12: Typ. CAL diode peak reverse recovery charge

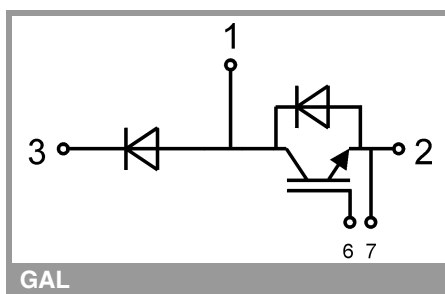
Dimensions in mm

Plug in depth max. 7mm



General tolerance  $\pm 0,5$  mm

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

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

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