



SKiM® 93

Trench IGBT Modules

SKiM609GAL12E4

Features

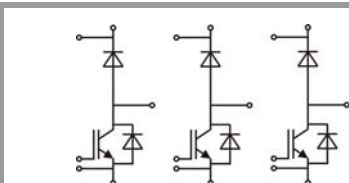
- IGBT 4 Trench Gate Technology
- Solderless sinter technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Low inductance case
- Isolated by Al_2O_3 DCB (Direct Copper Bonded) ceramic substrate
- Pressure contact technology for thermal contacts
- Spring contact system to attach driver PCB to the control terminals
- High short circuit capability, self limiting to $6 \times I_C$
- Integrated temperature sensor

Typical Applications*

- Automotive inverter
- High reliability AC inverter wind
- High reliability AC inverter drives

Remarks

- Case temperature limited to $T_s = 125^\circ C$ max; $T_c = T_s$ (for baseplateless modules)
- Recommended $T_{op} = -40 \dots +150^\circ C$



GAL

Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
IGBT			
V_{CES}		1200	V
I_C	$T_j = 175^\circ C$	$T_s = 25^\circ C$ $T_s = 70^\circ C$	A A
I_{Cnom}		600	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	1800	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800 V$ $V_{GE} \leq 15 V$ $V_{CES} \leq 1200 V$	$T_j = 150^\circ C$	μs
T_j		-40 ... 175	$^\circ C$
Inverse diode			
I_F	$T_j = 175^\circ C$	$T_s = 25^\circ C$ $T_s = 70^\circ C$	A A
I_{Fnom}		600	A
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$	1800	A
I_{FSM}	$t_p = 10 ms, \sin 180^\circ, T_j = 25^\circ C$	900	A
T_j		-40 ... 175	$^\circ C$
Freewheeling diode			
I_F	$T_j = 175^\circ C$	$T_s = 25^\circ C$ $T_s = 70^\circ C$	A A
I_{Fnom}		1350	A
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$	4050	A
I_{FSM}	$t_p = 10 ms, \sin 180^\circ, T_j = 25^\circ C$	6480	A
T_j		-40 ... 175	$^\circ C$
Module			
$I_{t(RMS)}$	$T_{terminal} = 80^\circ C$	700	A
T_{stg}		-40 ... 125	$^\circ C$
V_{isol}	AC sinus 50 Hz, $t = 1 min$	2500	V

Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
IGBT					
$V_{CE(sat)}$	$I_C = 600 A$ $V_{GE} = 15 V$ chipelevel	$T_j = 25^\circ C$	1.85	2.10	V
		$T_j = 150^\circ C$	2.25	2.45	V
V_{CE0}		$T_j = 25^\circ C$	0.8	0.9	V
		$T_j = 150^\circ C$	0.7	0.8	V
r_{CE}	$V_{GE} = 15 V$	$T_j = 25^\circ C$	1.8	2.0	m Ω
		$T_j = 150^\circ C$	2.6	2.8	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 24 mA$	5	5.8	6.5	V
I_{CES}	$V_{GE} = 0 V$ $V_{CE} = 1200 V$	$T_j = 25^\circ C$	0.1	0.3	mA
		$T_j = 150^\circ C$			mA
C_{ies}	$V_{CE} = 25 V$ $V_{GE} = 0 V$	$f = 1 MHz$	35.20		nF
C_{oes}		$f = 1 MHz$	2.32		nF
C_{res}		$f = 1 MHz$	1.88		nF
Q_G	$V_{GE} = -8 V \dots +15 V$		3400		nC
R_{Gint}	$T_j = 25^\circ C$		1.3		Ω



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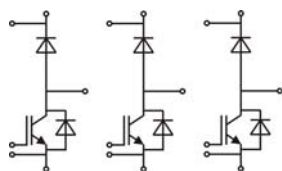
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- Automotive inverter
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Remarks

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- Recommended $T_{op} = -40 \dots +150^\circ C$

Characteristics					
Symbol	Conditions		min.	typ.	max. Unit
$t_{d(on)}$	$V_{CC} = 600 V$	$T_j = 150^\circ C$		150	ns
t_r	$I_C = 600 A$	$T_j = 150^\circ C$		121	ns
E_{on}	$V_{GE} = \pm 15 V$	$T_j = 150^\circ C$		136	mJ
$t_{d(off)}$	$R_{G on} = 4.1 \Omega$	$T_j = 150^\circ C$		808	ns
t_f	$R_{G off} = 4.1 \Omega$	$T_j = 150^\circ C$		100	ns
E_{off}	$di/dt_{on} = 5000 A/\mu s$	$T_j = 150^\circ C$		83	mJ
$R_{th(j-s)}$	$di/dt_{off} = 4400 A/\mu s$	$T_j = 150^\circ C$			0.068 K/W
	per IGBT				
Inverse diode					
$V_F = V_{EC}$	$I_F = 150 A$	$T_j = 25^\circ C$		2.1	2.5 V
	$V_{GE} = 0 V$	$T_j = 150^\circ C$		2.1	2.4 V
	chipelevel				
V_{F0}		$T_j = 25^\circ C$	1.1	1.3	1.5 V
		$T_j = 150^\circ C$	0.7	0.9	1.1 V
r_F		$T_j = 25^\circ C$	4.3	5.6	6.4 mΩ
		$T_j = 150^\circ C$	6.7	7.8	8.5 mΩ
I_{RRM}	$I_F = 150 A$	$T_j = 150^\circ C$		153	A
Q_{rr}	$di/dt_{off} = 3300 A/\mu s$	$T_j = 150^\circ C$		15	μC
E_{rr}	$V_{GE} = -15 V$	$T_j = 150^\circ C$		9	mJ
	$V_{CC} = 600 V$				
$R_{th(j-s)}$	per diode			0.501	K/W
Freewheeling diode					
$V_F = V_{EC}$	$I_F = 600 A$	$T_j = 25^\circ C$		1.7	1.9 V
	$V_{GE} = 0 V$	$T_j = 150^\circ C$		1.4	1.7 V
	chipelevel				
V_{F0}		$T_j = 25^\circ C$	1.1	1.3	1.5 V
		$T_j = 150^\circ C$	0.7	0.9	1.1 V
r_F		$T_j = 25^\circ C$	0.5	0.6	0.7 mΩ
		$T_j = 150^\circ C$	0.7	0.9	0.9 mΩ
I_{RRM}	$I_F = 600 A$	$T_j = 150^\circ C$		510	A
Q_{rr}	$di/dt_{off} = 5300 A/\mu s$	$T_j = 150^\circ C$		123	μC
E_{rr}	$V_{GE} = -15 V$	$T_j = 150^\circ C$		39	mJ
	$V_{CC} = 600 V$				
$R_{th(j-s)}$	per diode			0.048	K/W
Module					
L_{CE}				10	15 nH
$R_{CC'+EE'}$	terminal-chip	$T_s = 25^\circ C$		0.3	mΩ
		$T_s = 125^\circ C$		0.5	mΩ
w				1042	g
Temperature Sensor					
R_{100}	$T_{Sensor} = 100^\circ C (R_{25} = 5 k\Omega)$			339	Ω
$B_{100/125}$	$R_{(T)} = R_{100} \exp[B_{100/125}(1/T - 1/373)];$ $T[K];$			4096	K



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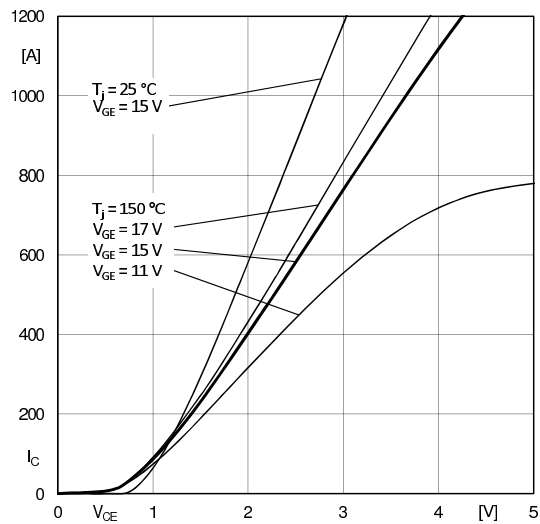


Fig. 1: Typ. output characteristic, inclusive $R_{CC'} + E_{E'}$

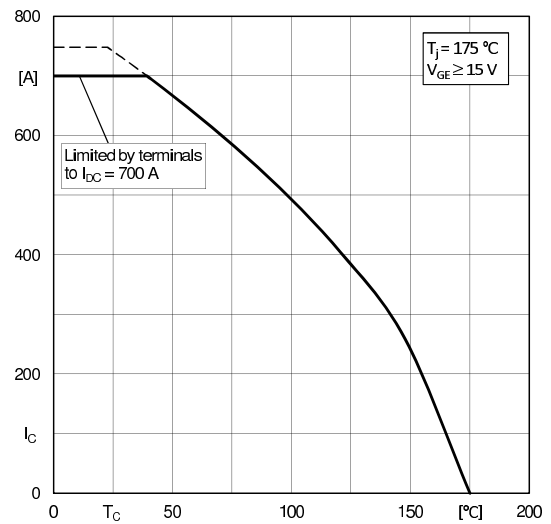


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

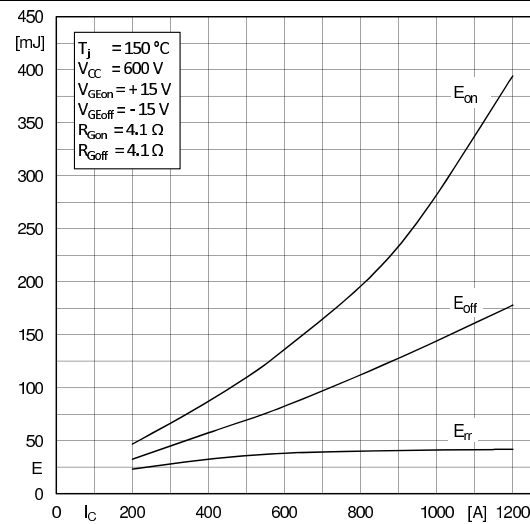


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

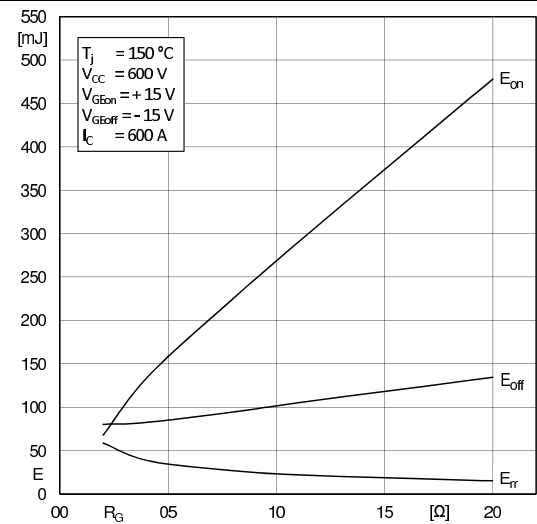


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

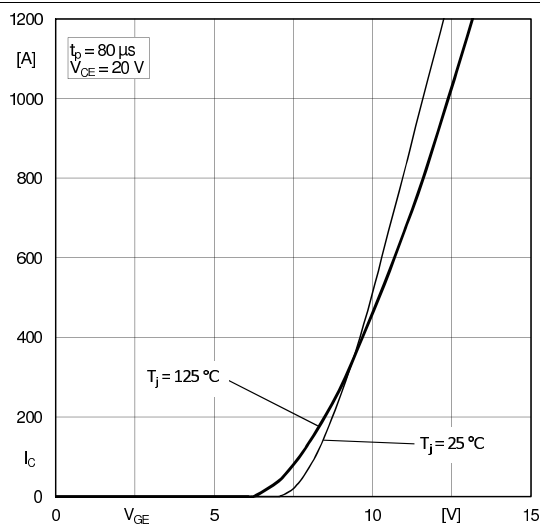


Fig. 5: Typ. transfer characteristic

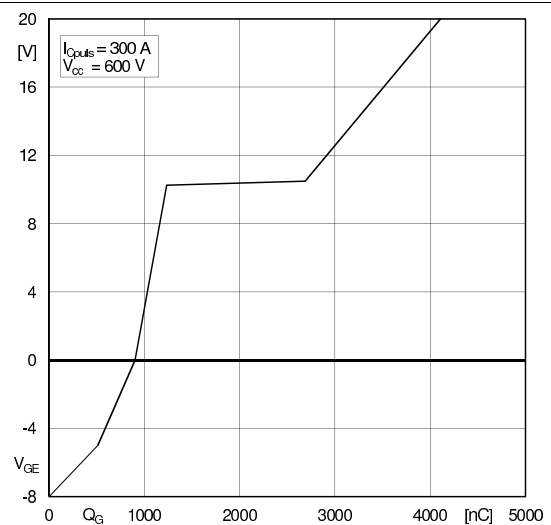


Fig. 6: Typ. gate charge characteristic

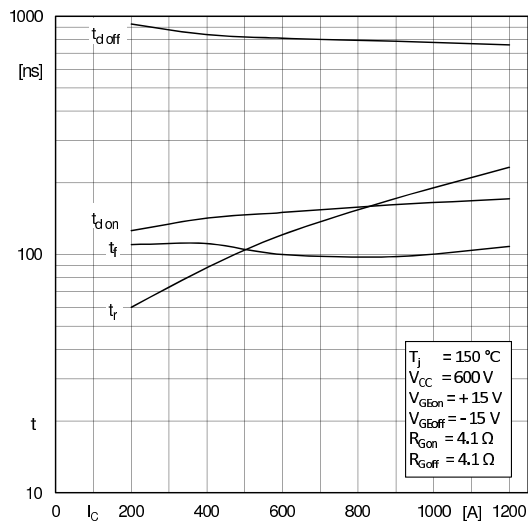


Fig. 7: Typ. switching times vs. I_C

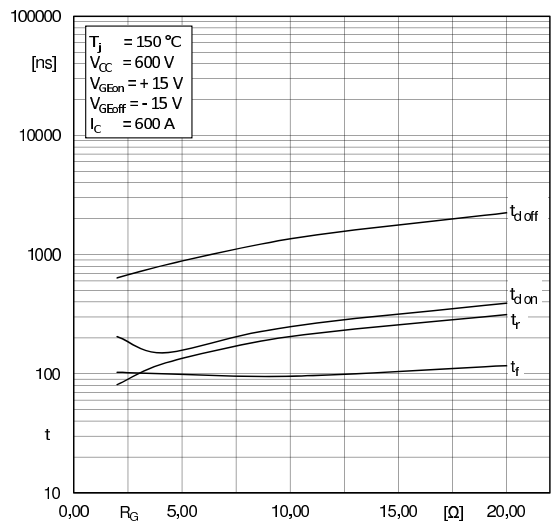


Fig. 8: Typ. switching times vs. gate resistor R_G

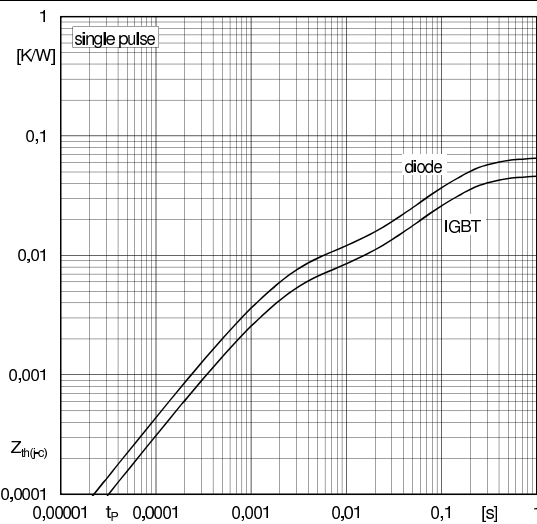


Fig. 9: Typ. transient thermal impedance

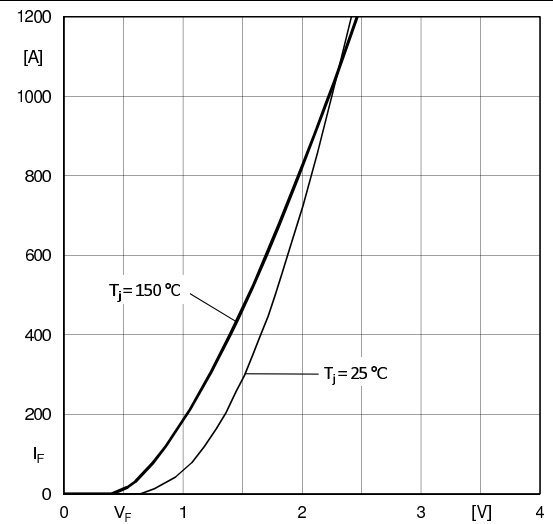


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

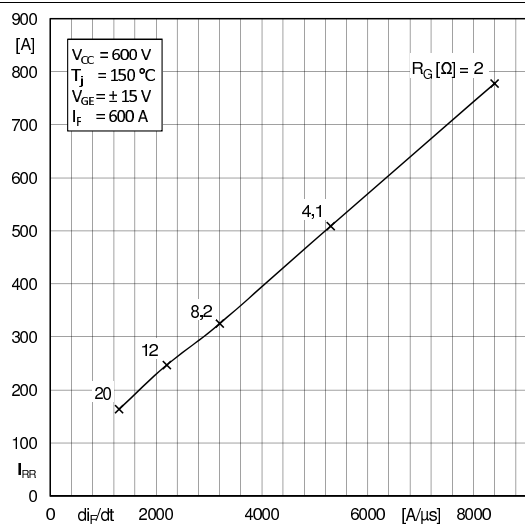


Fig. 11: Typ. CAL diode peak reverse recovery current

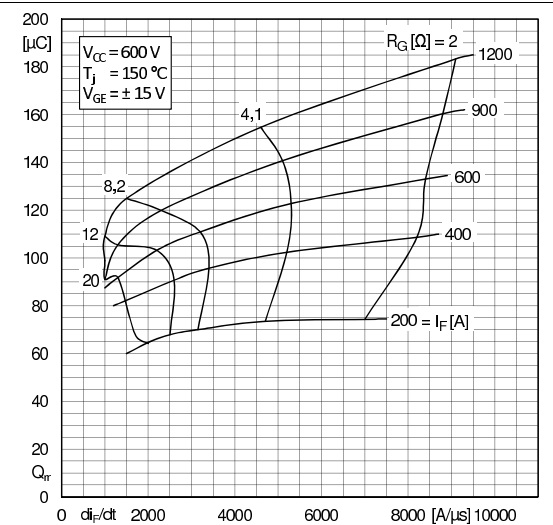
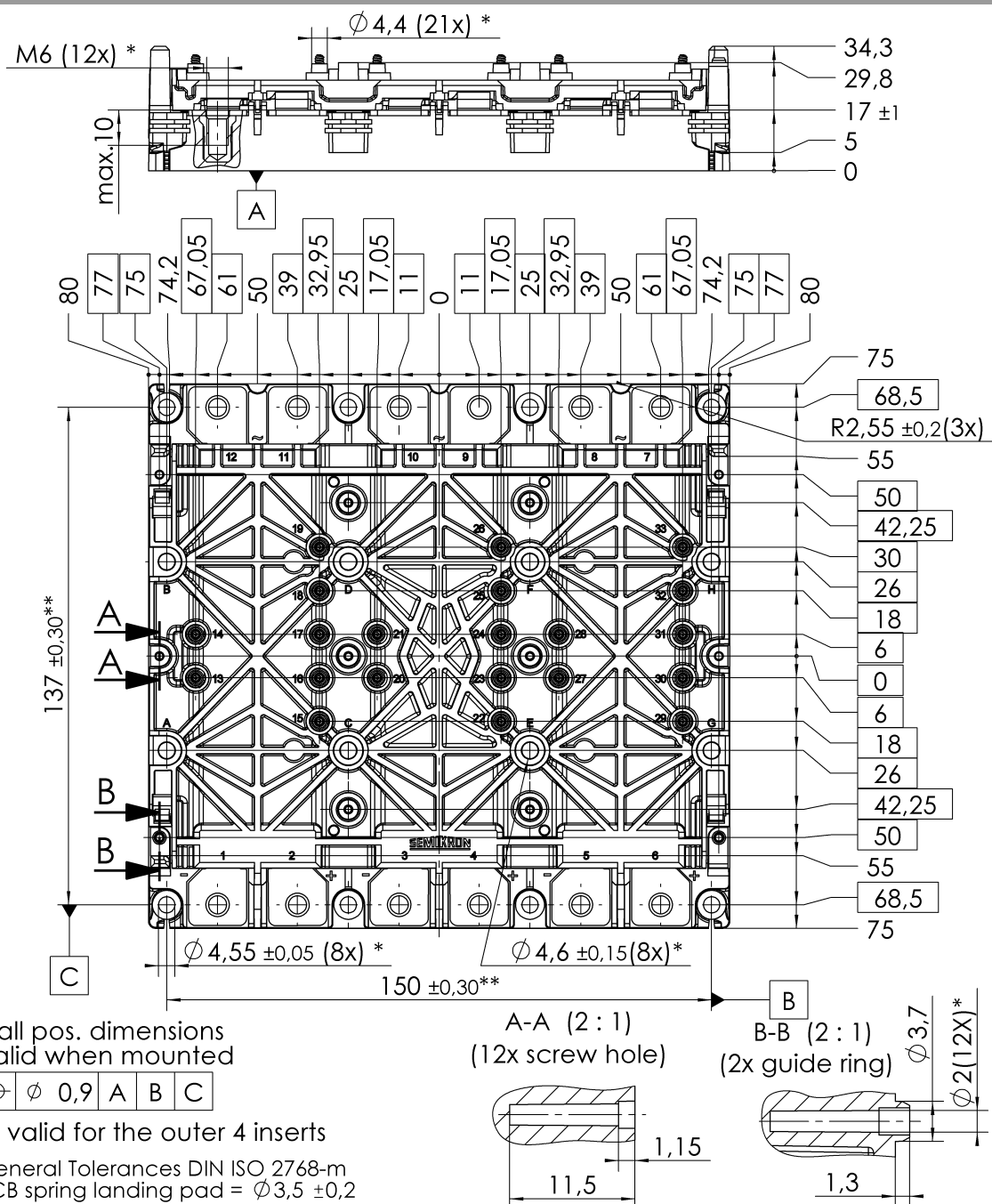
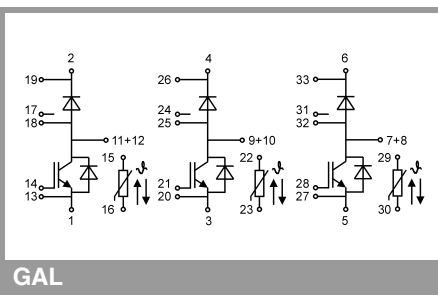


Fig. 12: Typ. CAL diode recovery charge



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

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.