



IGBT4 Modules

SKM1400GAL12P4

Features*

- Symmetrical current sharing
- Low-inductive module design
- High mechanical robustness
- UL recognized, file no. E63532

Typical Applications

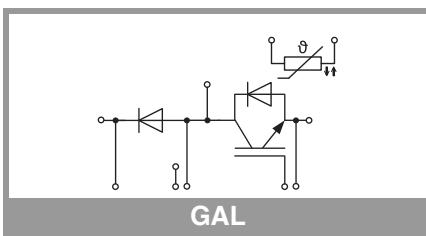
- Brake chopper
- Windturbines

Remarks

Recommended T_{jop} = -40 ... +150°C

Absolute Maximum Ratings		Values		Unit
Symbol	Conditions			
IGBT				
V_{CES}	$T_j = 25^\circ\text{C}$		1200	V
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	2165	A
		$T_c = 100^\circ\text{C}$	1453	A
I_{Cnom}			1400	A
I_{CRM}			2800	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				
V_{RRM}	$T_j = 25^\circ\text{C}$		1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	1849	A
		$T_c = 100^\circ\text{C}$	1181	A
I_{IFRM}			2800	A
I_{FSM}	$t_p = 10\text{ ms, sin }180^\circ$, $T_j = 25^\circ\text{C}$		7296	A
T_j			-40 ... 175	$^\circ\text{C}$
Freewheeling diode				
V_{RRM}	$T_j = 25^\circ\text{C}$		1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	1849	A
		$T_c = 100^\circ\text{C}$	1181	A
I_{IFRM}			2800	A
I_{FSM}	$t_p = 10\text{ ms, sin }180^\circ$, $T_j = 25^\circ\text{C}$		7296	A
T_j			-40 ... 175	$^\circ\text{C}$
Module				
T_{stg}			-40 ... 150	$^\circ\text{C}$
V_{isol}	AC sinus 50 Hz, $t = 1\text{ min}$		4000	V

Characteristics		min.	typ.	max.	Unit
Symbol	Conditions				
IGBT					
$V_{CE(sat)}$	$I_C = 1400\text{ A}$ $V_{GE} = 15\text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$	1.75	2.07	V
		$T_j = 150^\circ\text{C}$	2.18	2.44	V
V_{CE0}	chiplevel	$T_j = 25^\circ\text{C}$	0.80	0.90	V
		$T_j = 150^\circ\text{C}$	0.70	0.80	V
r_{CE}	$V_{GE} = 15\text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$	0.68	0.83	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	1.06	1.17	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE}=V_{CE}$, $I_C = 49.2\text{ mA}$		5.1	5.8	6.4
I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_j = 25^\circ\text{C}$			5	mA
C_{ies}	$V_{CE} = 25\text{ V}$	$f = 1\text{ MHz}$	81.6		nF
C_{oes}	$V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	5.28		nF
C_{res}		$f = 1\text{ MHz}$	4.50		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		7500		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		0.6		Ω





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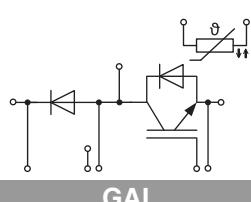
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- Windturbines

Remarks

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Characteristics		Conditions	min.	typ.	max.	Unit
IGBT						
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$ $I_C = 1400 \text{ A}$	$T_j = 150 \text{ °C}$		355		ns
t_r	$V_{GE} = +15/-15 \text{ V}$	$T_j = 150 \text{ °C}$		120		ns
E_{on}	$R_{G\ on} = 1 \Omega$	$T_j = 150 \text{ °C}$		150		mJ
$t_{d(off)}$	$R_{G\ off} = 1 \Omega$	$T_j = 150 \text{ °C}$		800		ns
t_f	$di/dt_{on} = 11 \text{ kA/}\mu\text{s}$ $di/dt_{off} = 7.4 \text{ kA/}\mu\text{s}$	$T_j = 150 \text{ °C}$		155		ns
E_{off}	$dv/dt = 3100 \text{ V/}\mu\text{s}$ $L_s = 25 \text{ nH}$	$T_j = 150 \text{ °C}$		290		mJ
$R_{th(j-c)}$	per IGBT			0.02		K/W
$R_{th(c-s)}$	per IGBT ($\lambda_{grease} = 0.81 \text{ W/(m*K)}$)			0.008		K/W
Inverse diode						
$V_F = V_{EC}$	$I_F = 1400 \text{ A}$ $V_{GE} = 0 \text{ V}$ chiplevel	$T_j = 25 \text{ °C}$ $T_j = 150 \text{ °C}$		2.07	2.38	V
V_{F0}	chiplevel	$T_j = 25 \text{ °C}$ $T_j = 150 \text{ °C}$		1.98	2.28	V
r_F	chiplevel	$T_j = 25 \text{ °C}$ $T_j = 150 \text{ °C}$		1.30	1.50	V
				0.90	1.10	V
I_{RRM}	$I_F = 1400 \text{ A}$	$T_j = 150 \text{ °C}$		0.55	0.63	mΩ
Q_{rr}	$V_{GE} = -15 \text{ V}$	$T_j = 150 \text{ °C}$		0.77	0.84	mΩ
E_{rr}	$di/dt_{off} = 11 \text{ kA/}\mu\text{s}$	$T_j = 150 \text{ °C}$		1020		A
	$V_R = 600 \text{ V}$	$T_j = 150 \text{ °C}$		260		μC
$R_{th(j-c)}$	per diode			110		mJ
$R_{th(c-s)}$	per diode ($\lambda_{grease} = 0.81 \text{ W/(m*K)}$)			0.033		K/W
				0.01		K/W
Freewheeling diode						
$V_F = V_{EC}$	$I_F = 1400 \text{ A}$ $V_{GE} = 0 \text{ V}$ level = chiplevel	$T_j = 25 \text{ °C}$ $T_j = 150 \text{ °C}$		2.07	2.38	V
V_{F0}	chiplevel	$T_j = 25 \text{ °C}$ $T_j = 150 \text{ °C}$		1.98	2.28	V
r_F	chiplevel	$T_j = 25 \text{ °C}$ $T_j = 150 \text{ °C}$		1.30	1.50	V
				0.90	1.10	V
I_{RRM}	$I_F = 1400 \text{ A}$	$T_j = 150 \text{ °C}$		0.55	0.63	mΩ
Q_{rr}	$di/dt_{off} = 11 \text{ kA/}\mu\text{s}$	$T_j = 150 \text{ °C}$		0.77	0.84	mΩ
E_{rr}	$V_{GE} = -15 \text{ V}$	$T_j = 150 \text{ °C}$		1020		A
	$V_R = 600 \text{ V}$	$T_j = 150 \text{ °C}$		260		μC
$R_{th(j-c)}$	per diode			110		mJ
$R_{th(c-s)}$	per diode ($\lambda_{grease} = 0.81 \text{ W/(m*K)}$)			0.033		K/W
				0.010		K/W
Module						
L_{CE}				10		nH
$R_{CC+EE'}$	measured per switch, $T_C = 25 \text{ °C}$			0.2		mΩ
$R_{th(c-s)1}$	calculated without thermal coupling ($\lambda_{grease} = 0.81 \text{ W/(m*K)}$)			0.004		K/W
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module ($\lambda_{grease} = 0.81 \text{ W/(m*K)}$)			0.004		K/W
M_s	to heat sink M5			4	6	Nm
M_t		to terminals M8		8	10	Nm
		to terminals M4		1.8	2.1	Nm
w					1250	g





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Characteristics		min.	typ.	max.	Unit
Symbol	Conditions				
Temperature Sensor					
R_{100}	$T_c=100^\circ\text{C}$ ($R_{25}=5\text{ k}\Omega$)			$493 \pm 5\%$	Ω
$B_{100/125}$	$R(T)=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$; $T[\text{K}]$;			$3550 \pm 2\%$	K

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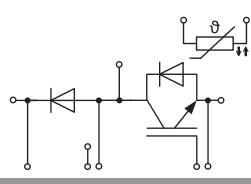
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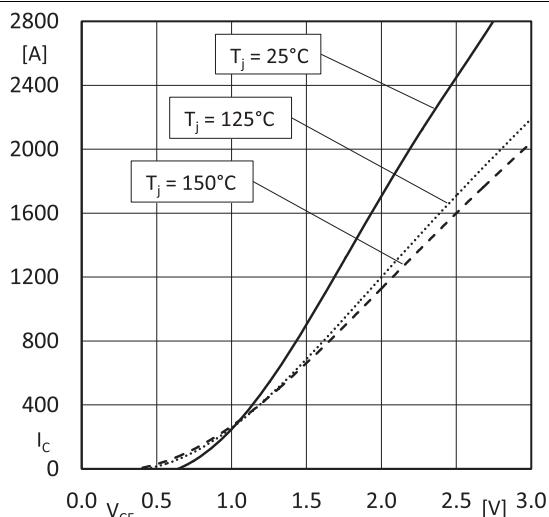


Fig. 1: Output characteristics IGBT (typical); $I_C = f (V_{CE})$; $V_{GE} = 15V$; (chiplevel)

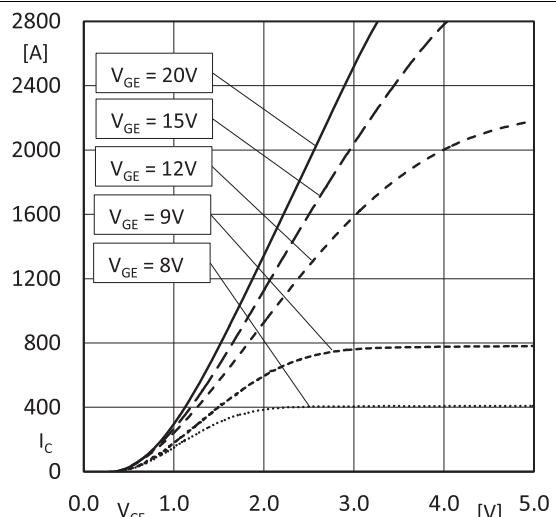


Fig. 2: Output characteristics IGBT (typical); $I_C = f (V_{CE})$; $T_j = 150 ^\circ C$; (chiplevel)

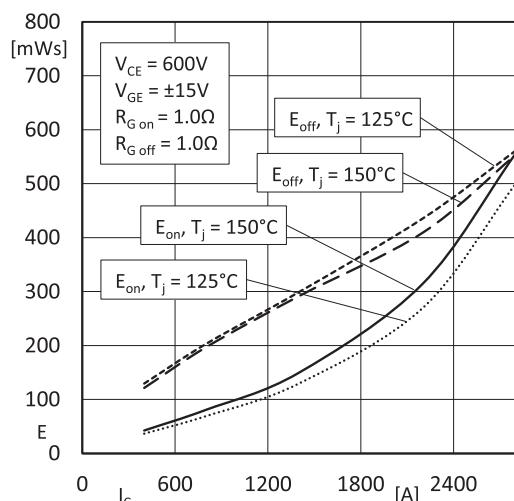


Fig. 3: Switching losses IGBT (typical); $E = f(I_C)$

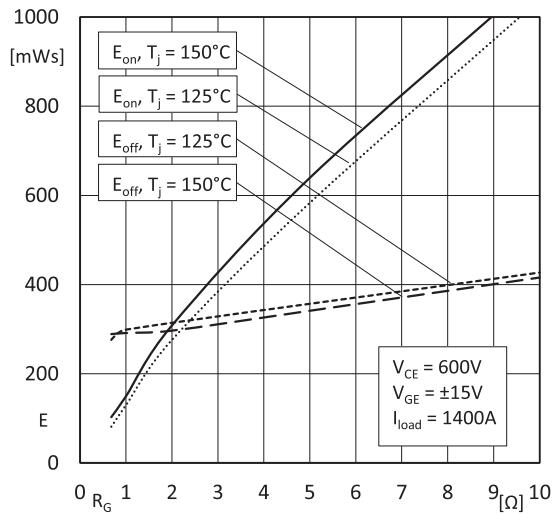


Fig. 4: Switching losses IGBT (typical); $E = f(R_G)$

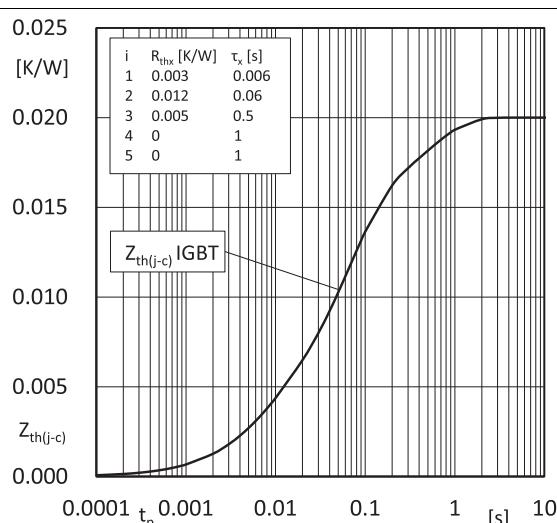


Fig. 5: Transient thermal impedance IGBT

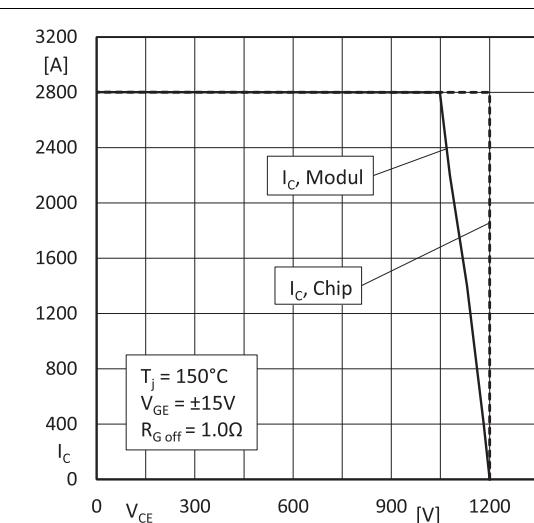


Fig. 6: RBSOA IGBT

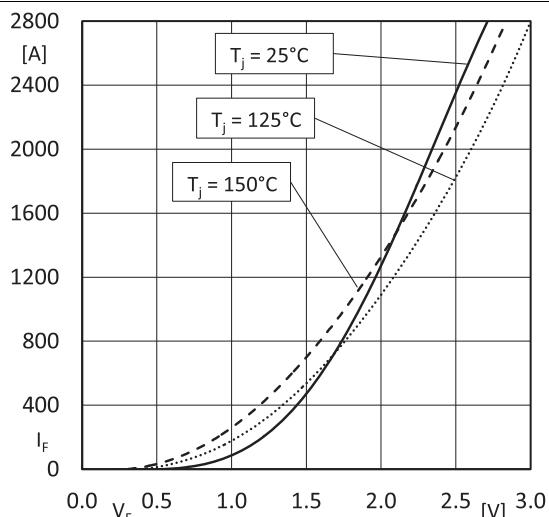


Fig. 7: Forward charact. Diode (typical); $I_F=f(V_F)$; (chiplevel)

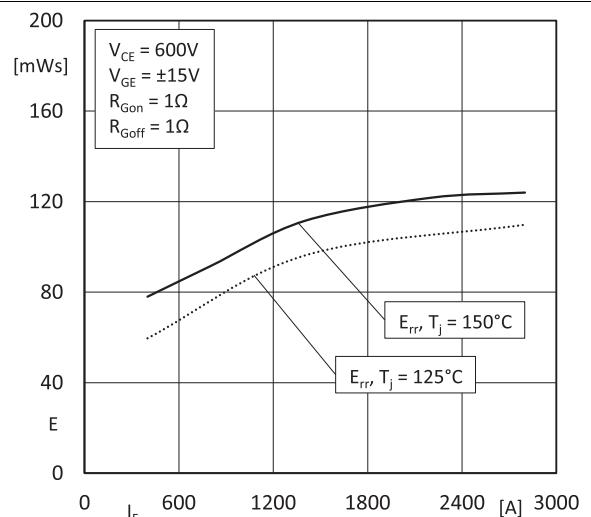


Fig. 8: Switching losses Diode (typical); $E=f(I_F)$

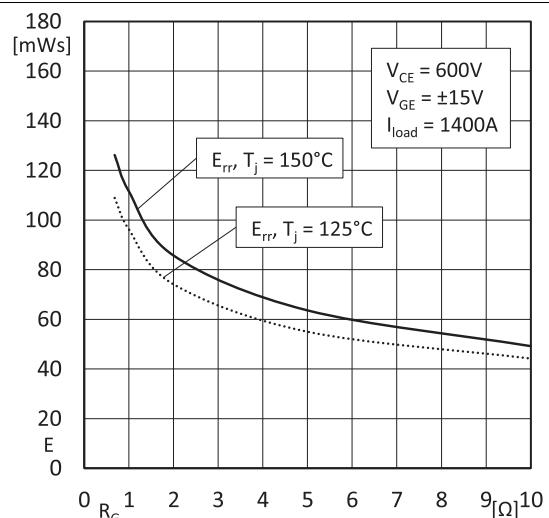


Fig. 9: Switching losses Diode (typical); $E=f(R_G)$

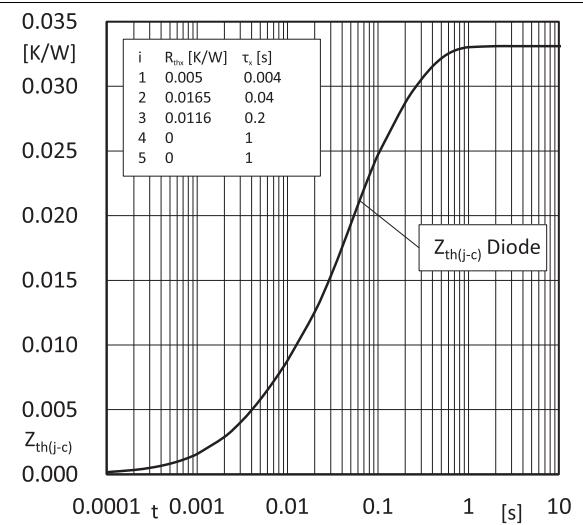


Fig. 10: Transient thermal impedance Diode

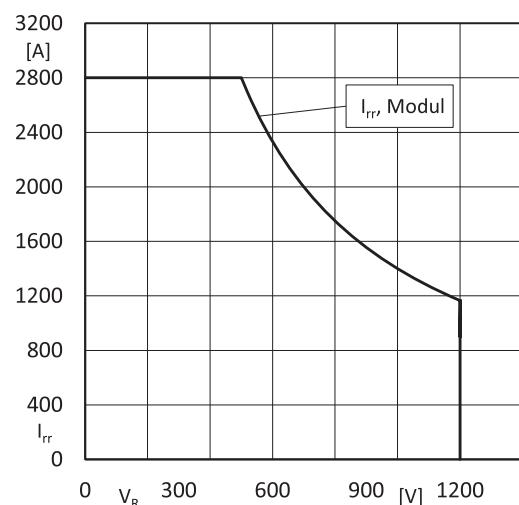


Fig. 11: RBSOA Diode

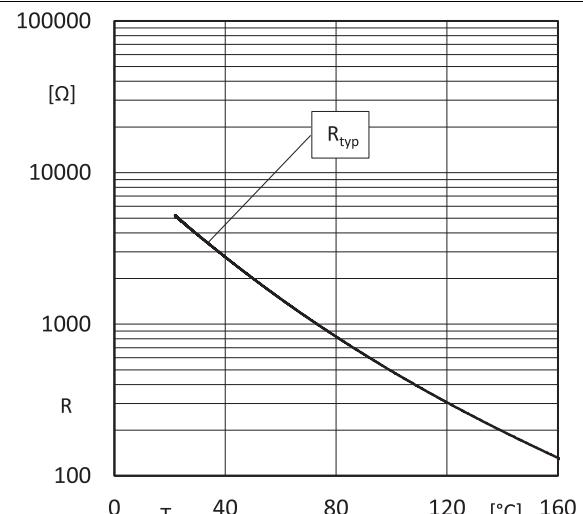


Fig. 12: NTC characteristics (typical)

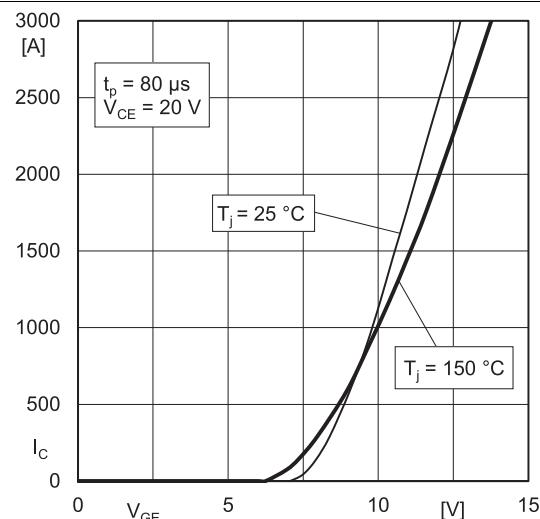


Fig. 13: Typ. transfer characteristic

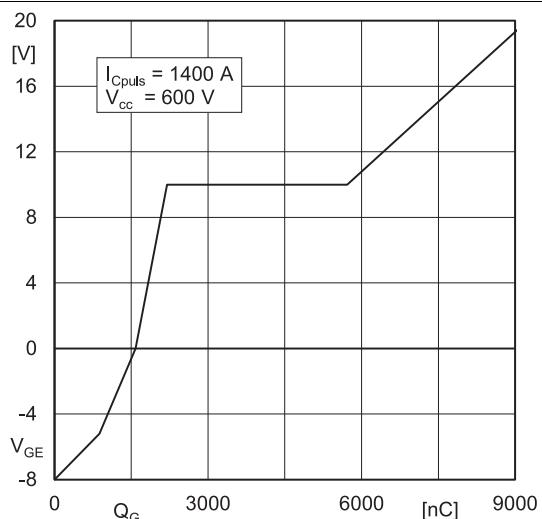
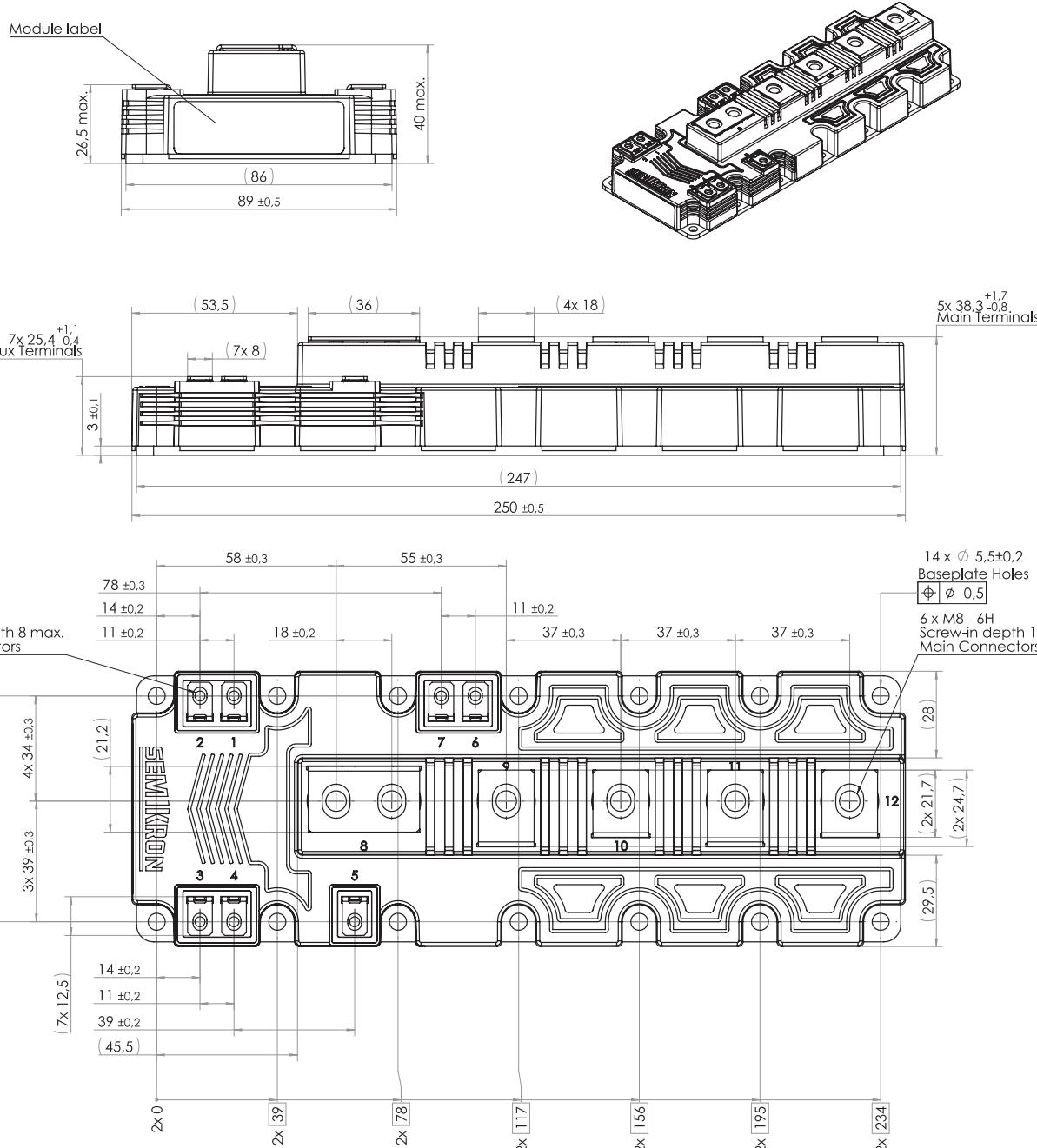
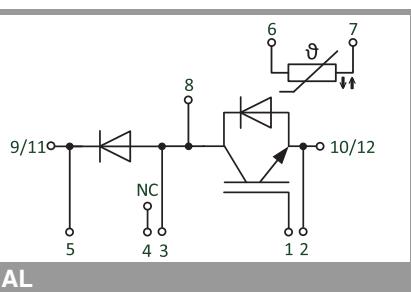


Fig. 14: Typ. gate charge characteristic



- Dimensions in mm
- General tolerances $\pm 0,5\text{mm}$

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This is an electrostatic discharge sensitive device (ESDS) due to international standard IEC 61340.

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