



SEMiX® 4s

Trench IGBT Modules

SEMiX604GB12E4s

Features

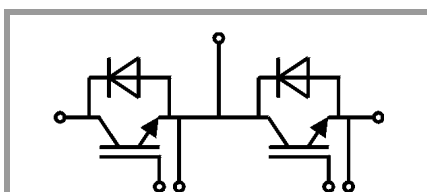
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability
- UL recognized, file no. E63532

Typical Applications*

- AC inverter drives
- UPS
- Electronic Welding

Remarks

- Case temperature limited to $T_C=125^\circ\text{C}$ max.
- Product reliability results are valid for $T_j=150^\circ\text{C}$
- Dynamic values apply to the following combination of resistors:
 $R_{Gon,main} = 1,0 \Omega$
 $R_{Goff,main} = 6,2 \Omega$
 $R_{G,X} = 2,2 \Omega$
 $R_{E,X} = 0,5 \Omega$



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Absolute Maximum Ratings

Symbol	Conditions	Values	Unit	
IGBT				
V_{CES}		1200	V	
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	916	A
		$T_c = 80^\circ\text{C}$	704	A
I_{Cnom}		600	A	
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	1800	A	
V_{GES}		-20 ... 20	V	
t_{psc}	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 20\text{ V}$ $V_{CES} \leq 1200\text{ V}$	$T_j = 150^\circ\text{C}$	10	μs
T_j		-40 ... 175	$^\circ\text{C}$	
Inverse diode				
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	707	A
		$T_c = 80^\circ\text{C}$	529	A
I_{Fnom}		600	A	
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$	1800	A	
I_{FSM}	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$	3240	A	
T_j		-40 ... 175	$^\circ\text{C}$	
Module				
$I_{t(RMS)}$		600	A	
T_{stg}		-40 ... 125	$^\circ\text{C}$	
V_{isol}	AC sinus 50Hz, t = 1 min	4000	V	

Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
IGBT					
$V_{CE(sat)}$	$I_C = 600\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.8	2.05	V
		$T_j = 150^\circ\text{C}$	2.2	2.4	V
V_{CE0}		$T_j = 25^\circ\text{C}$	0.8	0.9	V
		$T_j = 150^\circ\text{C}$	0.7	0.8	V
r_{CE}	$V_{GE} = 15\text{ V}$	$T_j = 25^\circ\text{C}$	1.7	1.9	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	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}	$V_{GE} = 0\text{ V}$ $V_{CE} = 1200\text{ V}$	$T_j = 25^\circ\text{C}$	0.12	0.36	mA
		$T_j = 150^\circ\text{C}$			mA
C_{ies}	$V_{CE} = 25\text{ V}$		37.2		nF
C_{oes}	$V_{GE} = 0\text{ V}$		2.32		nF
C_{res}			2.04		nF
Q_G	$V_{GE} = -8\text{ V...} + 15\text{ V}$		3400		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		1.25		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 600\text{ A}$	$T_j = 150^\circ\text{C}$	374		ns
		$T_j = 150^\circ\text{C}$	85		ns
E_{on}	$R_{Gon} = 1.7\ \Omega$	$T_j = 150^\circ\text{C}$	35		mJ
$t_{d(off)}$	$R_{Goff} = 6.9\ \Omega$	$T_j = 150^\circ\text{C}$	1277		ns
t_f	$di/dt_{on} = 7100\text{ A}/\mu\text{s}$ $di/dt_{off} = 6350\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	114		ns
		$T_j = 150^\circ\text{C}$	110.4		mJ
$R_{th(j-c)}$	per IGBT			0.049	K/W



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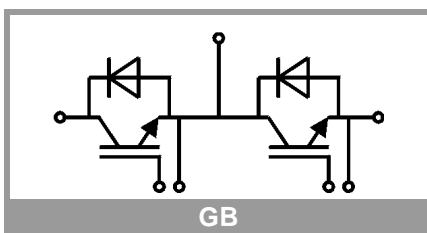
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse diode						
$V_F = V_{EC}$	$I_F = 600 \text{ A}$ $V_{GE} = 0 \text{ V}$ chip	$T_j = 25^\circ\text{C}$		2.1	2.46	V
		$T_j = 150^\circ\text{C}$		2.1	2.4	V
V_{F0}		$T_j = 25^\circ\text{C}$	1.1	1.3	1.5	V
		$T_j = 150^\circ\text{C}$	0.7	0.9	1.1	V
r_F		$T_j = 25^\circ\text{C}$	1.1	1.4	1.6	m Ω
		$T_j = 150^\circ\text{C}$	1.7	1.9	2.1	m Ω
I_{RRM}	$I_F = 600 \text{ A}$	$T_j = 150^\circ\text{C}$		430		A
Q_{rr}	$di/dt_{off} = 6000 \text{ A}/\mu\text{s}$ $V_{GE} = -15 \text{ V}$	$T_j = 150^\circ\text{C}$		100		μC
E_{rr}	$V_{CC} = 600 \text{ V}$	$T_j = 150^\circ\text{C}$		44		mJ
$R_{th(j-c)}$	per diode				0.086	K/W
Module						
L_{CE}				22		nH
$R_{CC'+EE'}$	res., terminal-chip	$T_C = 25^\circ\text{C}$		0.7		m Ω
		$T_C = 125^\circ\text{C}$		1		m Ω
$R_{th(c-s)}$	per module			0.03		K/W
M_s	to heat sink (M5)		3		5	Nm
M_t		to terminals (M6)	2.5		5	Nm
w					400	g
Temperatur 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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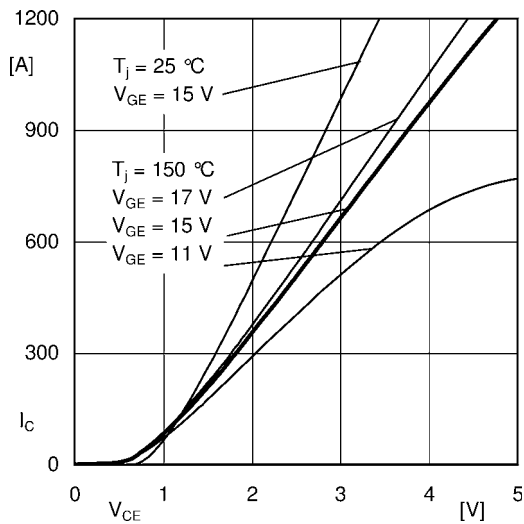


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

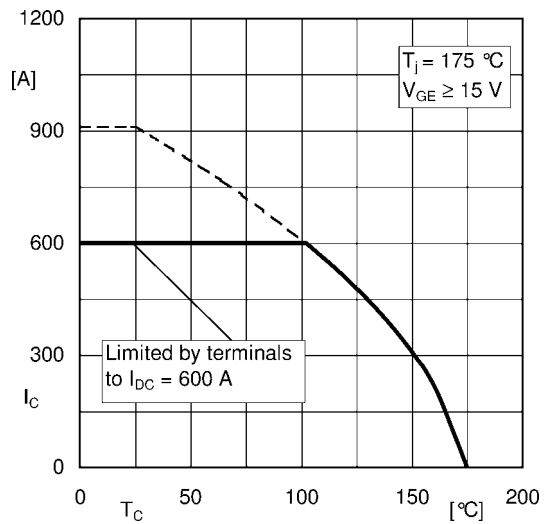


Fig. 2: Rated current vs. temperature $I_c = f(T_c)$

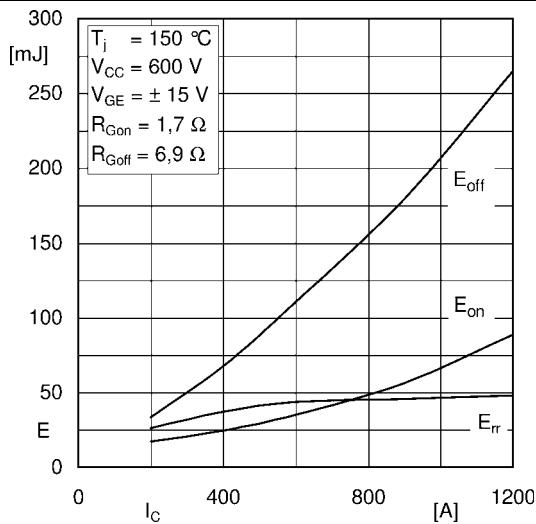


Fig. 3: Typ. turn-on /-off energy = $f(I_c)$

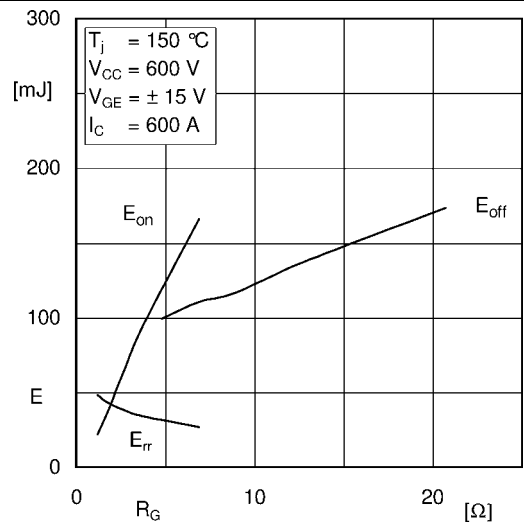


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

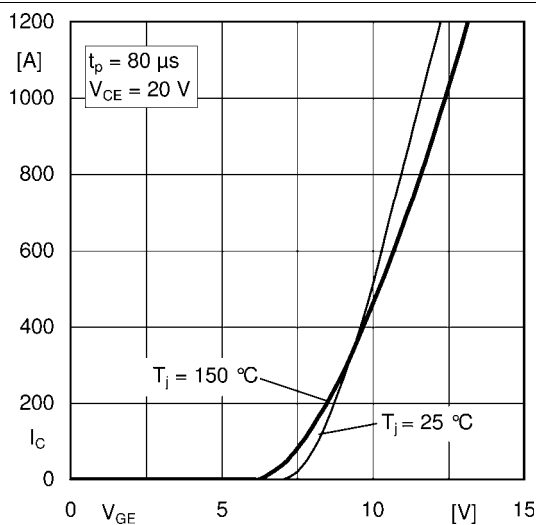


Fig. 5: Typ. transfer characteristic

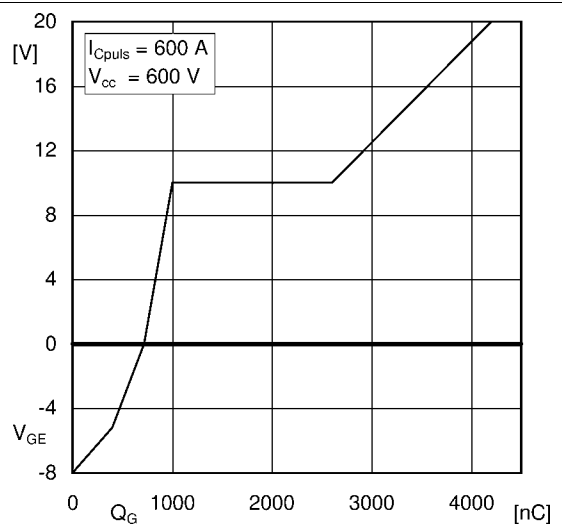


Fig. 6: Typ. gate charge characteristic

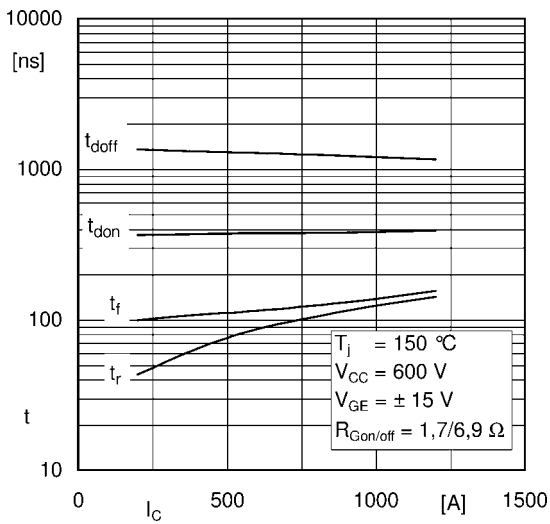


Fig. 7: Typ. switching times vs. I_C

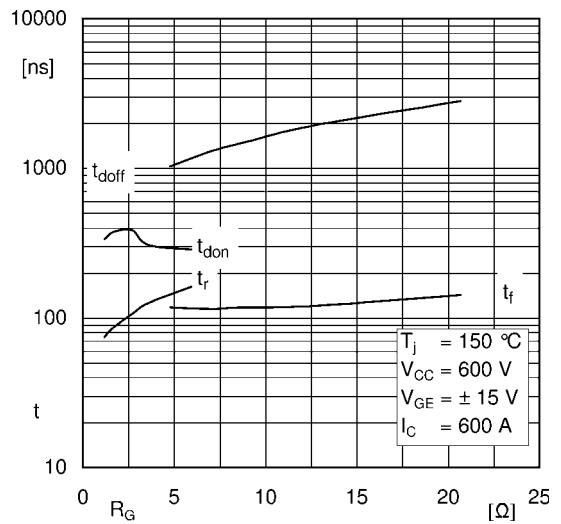


Fig. 8: Typ. switching times vs. gate resistor R_G

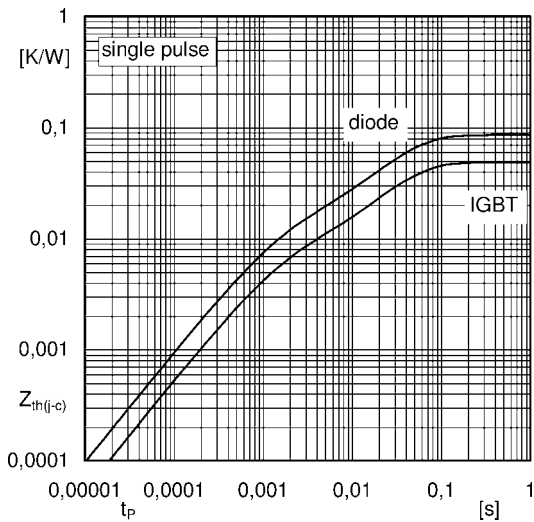


Fig. 9: Typ. transient thermal impedance

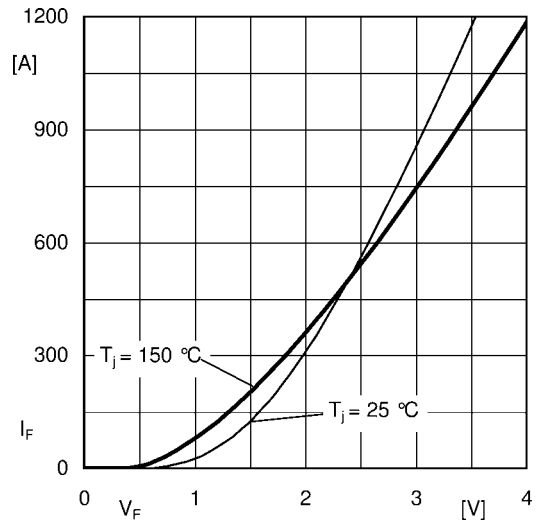


Fig. 10: Typ. CAL diode forward charact., incl. R_{CC+EE}

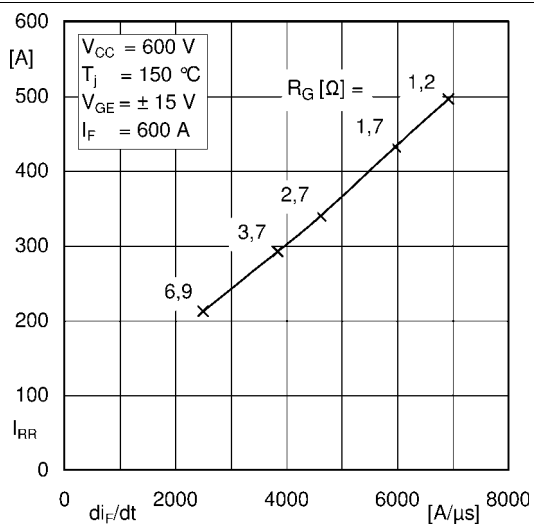


Fig. 11: Typ. CAL diode peak reverse recovery current

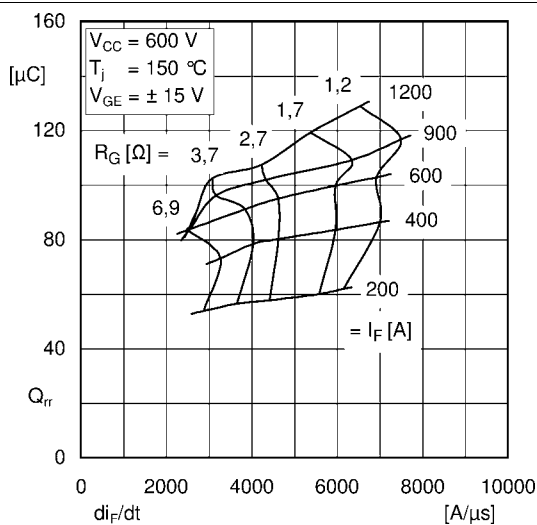
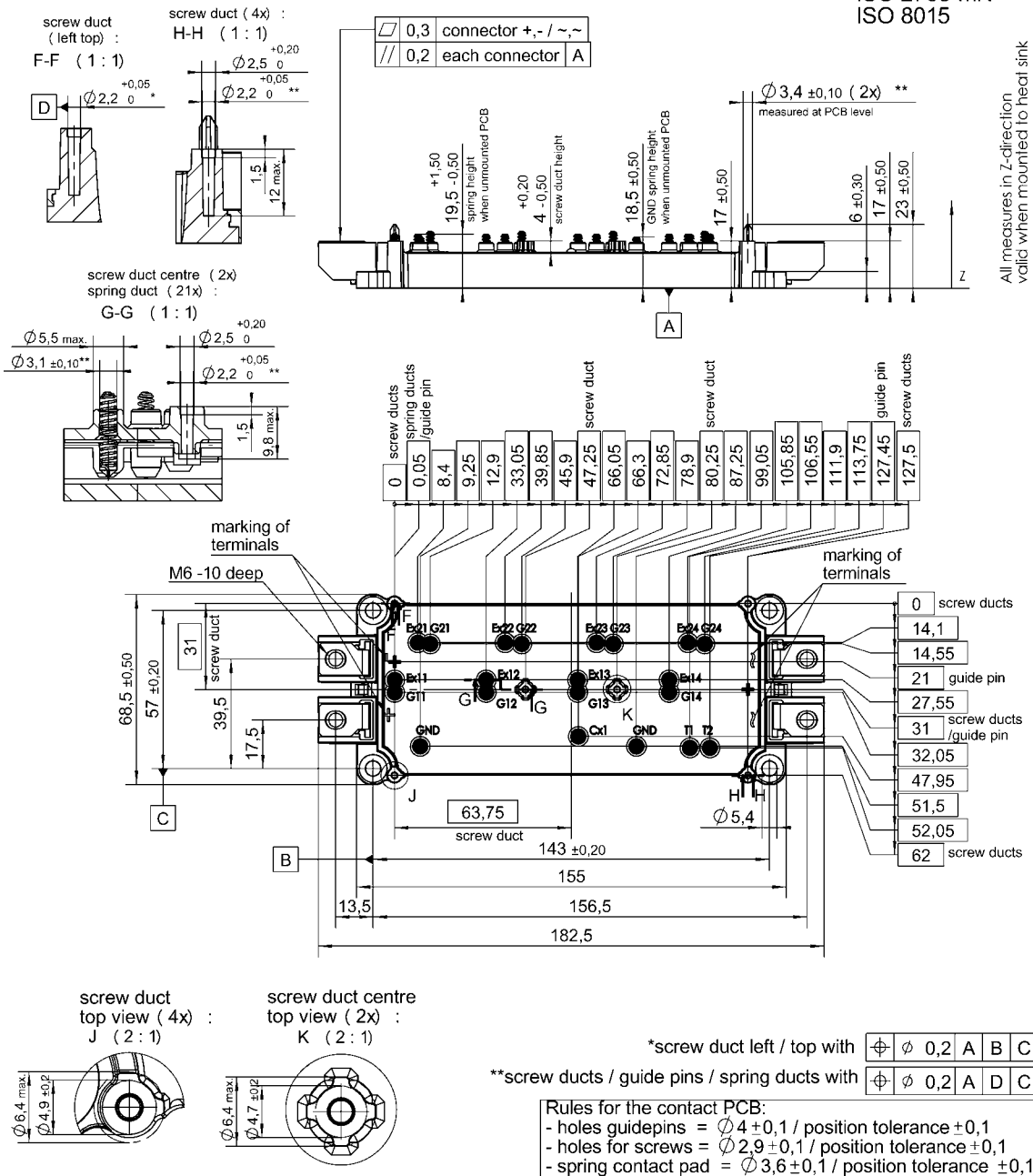


Fig. 12: Typ. CAL diode recovery charge

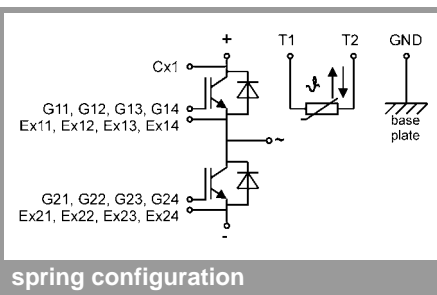
Case: SEMiX 4s

general tolerance:
ISO 2768-mK
ISO 8015



All measures in Z-direction valid when mounted to heat sink

SEMiX 4s



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 personal.