



SEMiX® 2s

Trench IGBT Modules

SEMiX402GAR066HDs

Features

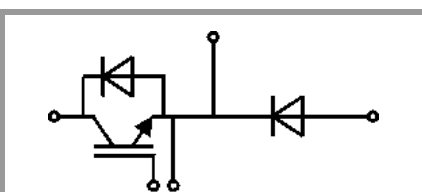
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$ with positive temperature coefficient
- UL recognised file no. E63532

Typical Applications*

- Matrix Converter
- Resonant Inverter
- Current Source Inverter

Remarks

- Case temperature limited to $T_C=125^\circ\text{C}$ max.
- Product reliability results are valid for $T_J=150^\circ\text{C}$
- For short circuit: Soft R_{Goff} recommended
- Take care of over-voltage caused by stray inductance



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Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
IGBT				
V _{CES}	T _j = 25 °C		600	V
I _C	T _j = 175 °C	T _c = 25 °C	502	A
		T _c = 80 °C	379	A
I _{Cnom}			400	A
I _{CRM}	I _{CRM} = 2xI _{Cnom}		800	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 360 V V _{GE} ≤ 15 V V _{CES} ≤ 600 V	T _j = 150 °C	6	μs
T _j			-40 ... 175	°C
Inverse diode				
I _F	T _j = 175 °C	T _c = 25 °C	543	A
		T _c = 80 °C	397	A
I _{Fnom}			400	A
I _{FRM}	I _{FRM} = 2xI _{Fnom}		800	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 25 °C		1800	A
T _j			-40 ... 175	°C
Freewheeling diode				
I _F	T _j = 175 °C	T _c = 25 °C	566	A
		T _c = 80 °C	412	A
I _{Fnom}			400	A
I _{FRM}	I _{FRM} = 2xI _{Fnom}		800	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 25 °C		1800	A
T _j			-40 ... 175	°C
Module				
I _{t(RMS)}	T _{terminal} = 80 °C		600	A
T _{stg}			-40 ... 125	°C
V _{isol}	AC sinus 50Hz, t = 1 min		4000	V

Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
IGBT					
$V_{CE(sat)}$	$I_C = 400\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_J = 25^\circ\text{C}$	1.45	1.85	V
		$T_J = 150^\circ\text{C}$	1.7	2.1	V
V_{CE0}		$T_J = 25^\circ\text{C}$	0.9	1	V
		$T_J = 150^\circ\text{C}$	0.85	0.9	V
r_{CE}	$V_{GE} = 15\text{ V}$	$T_J = 25^\circ\text{C}$	1.4	2.1	$\text{m}\Omega$
		$T_J = 150^\circ\text{C}$	2.1	3.0	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE}=V_{CE}, I_C = 6.4\text{ mA}$	5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}$ $V_{CE} = 600\text{ V}$	$T_J = 25^\circ\text{C}$	0.15	0.45	mA
		$T_J = 150^\circ\text{C}$			mA
C_{ies}	$V_{CE} = 25\text{ V}$	$f = 1\text{ MHz}$	24.7		nF
C_{oes}	$V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	1.54		nF
C_{res}		$f = 1\text{ MHz}$	0.73		nF
Q_G	$V_{GE} = -8\text{ V...} + 15\text{ V}$		3200		nC
R_{Gint}	$T_J = 25^\circ\text{C}$		1.00		Ω



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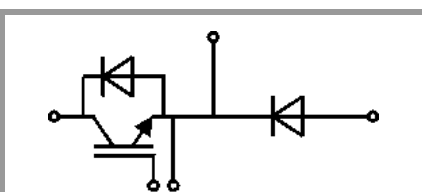
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- Matrix Converter
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Remarks

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- For short circuit: Soft R_{Goff} recommended
- Take care of over-voltage caused by stray inductance

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
t _{d(on)}	V _{CC} = 300 V	T _j = 150 °C		150		ns
t _r	I _C = 400 A	T _j = 150 °C		125		ns
E _{on}	V _{GE} = ±15 V	T _j = 150 °C		22		mJ
t _{d(off)}	R _{G on} = 4.5 Ω	T _j = 150 °C		900		ns
t _f	R _{G off} = 4.5 Ω	T _j = 150 °C		65		ns
E _{off}		T _j = 150 °C		24		mJ
R _{th(j-c)}	per IGBT				0.12	K/W
Inverse diode						
V _F = V _{EC}	I _F = 400 A	T _j = 25 °C		1.4	1.60	V
	V _{GE} = 0 V	T _j = 150 °C		1.4	1.6	V
	chip					
V _{F0}		T _j = 25 °C	0.9	1	1.1	V
		T _j = 150 °C	0.75	0.85	0.95	V
r _F		T _j = 25 °C	0.8	1.0	1.3	mΩ
		T _j = 150 °C	1.1	1.4	1.6	mΩ
I _{RRM}	I _F = 400 A	T _j = 150 °C		250		A
Q _{rr}	di/dt _{off} = 3700 A/μs	T _j = 150 °C		47		μC
E _{rr}	V _{GE} = -8 V	T _j = 150 °C		10		mJ
	V _{CC} = 300 V					
R _{th(j-c)}	per diode				0.15	K/W
Freewheeling diode						
V _F = V _{EC}	I _F = 400 A	T _j = 25 °C		1.3	1.53	V
	V _{GE} = 0 V	T _j = 150 °C		1.3	1.5	V
	chip					
V _{F0}		T _j = 25 °C	0.9	1	1.1	V
		T _j = 150 °C	0.75	0.85	0.95	V
r _F		T _j = 25 °C	0.7	0.9	1.1	mΩ
		T _j = 150 °C	1.0	1.2	1.4	mΩ
I _{RRM}	I _F = 400 A	T _j = 150 °C		250		A
Q _{rr}	di/dt _{off} = 3700 A/μs	T _j = 150 °C		47		μC
E _{rr}	V _{GE} = -8 V	T _j = 150 °C		10		mJ
	V _{CC} = 300 V					
R _{th(j-c)}	per diode				0.15	K/W
Module						
L _{CE}				18		nH
R _{CC'+EE'}	res., terminal-chip	T _C = 25 °C		0.7		mΩ
		T _C = 125 °C		1		mΩ
R _{th(c-s)}	per module			0.045		K/W
M _s	to heat sink (M5)		3		5	Nm
M _t		to terminals (M6)	2.5		5	Nm
						Nm
w					250	g
Temperatur Sensor						
R ₁₀₀	T _C =100°C (R ₂₅ =5 kΩ)			493 ± 5%		Ω
B _{100/125}	R(T)=R ₁₀₀ exp[B _{100/125} (1/T-1/T ₁₀₀)]; T[K];			3550 ±2%		K



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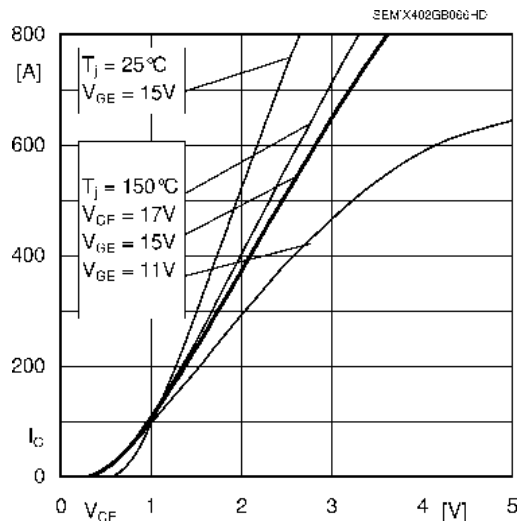


Fig. 1: Typ. output characteristic, inclusive $R_{CC} + EE'$

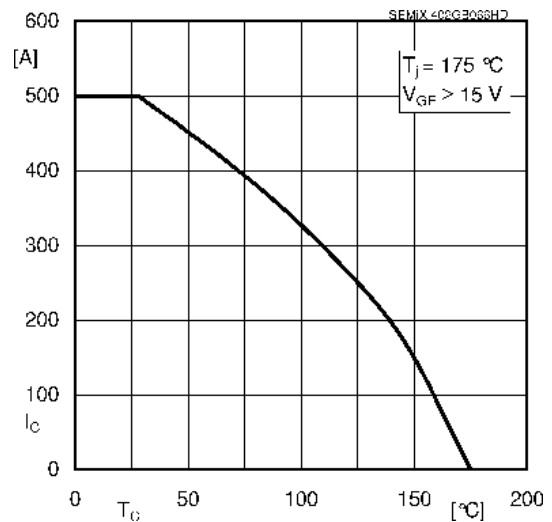


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

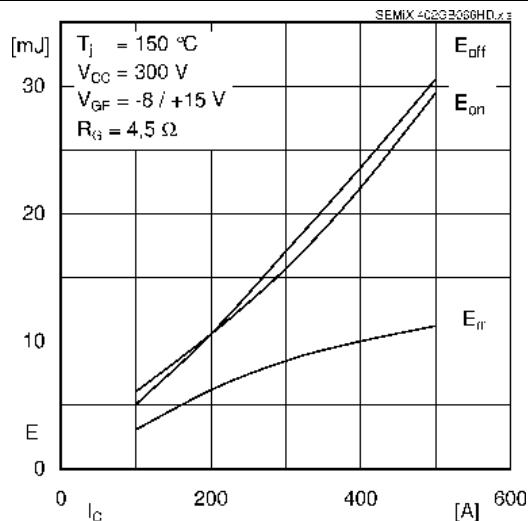


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

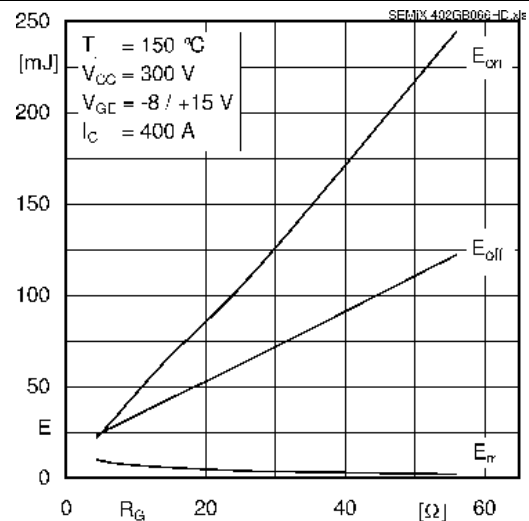


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

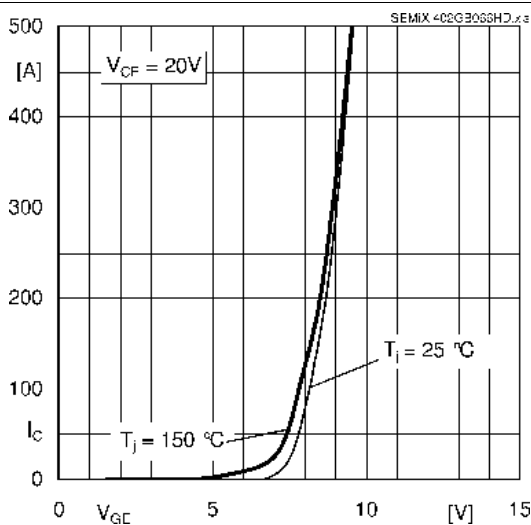


Fig. 5: Typ. transfer characteristic

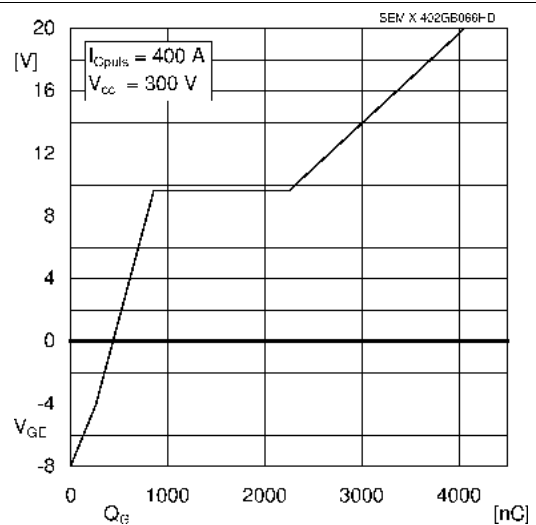


Fig. 6: Typ. gate charge characteristic

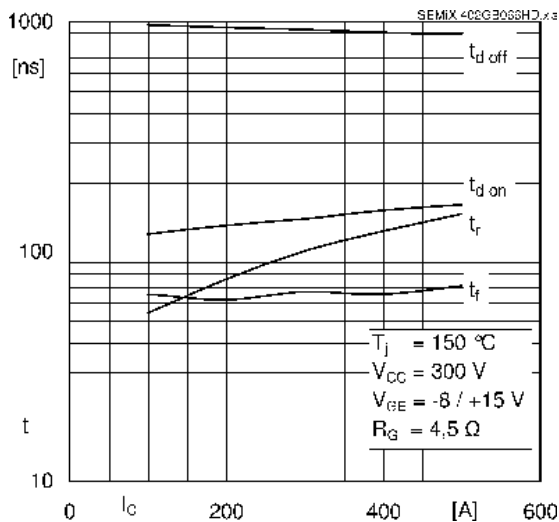


Fig. 7: Typ. switching times vs. I_C

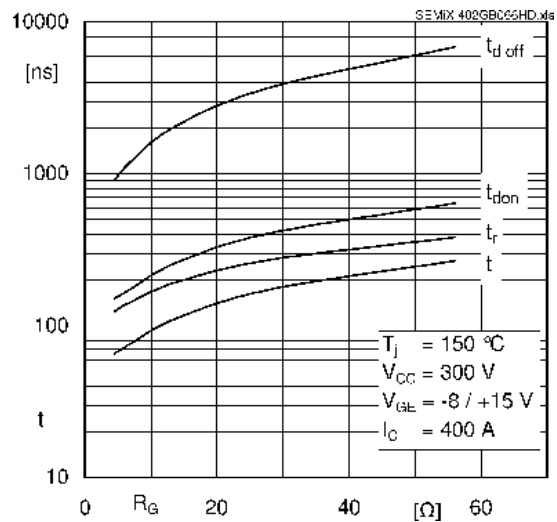


Fig. 8: Typ. switching times vs. gate resistor R_G

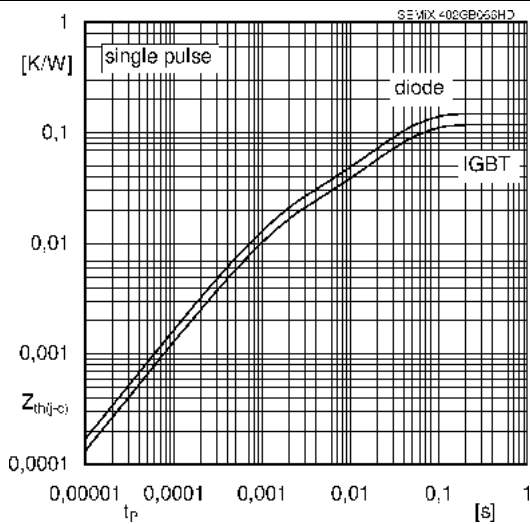


Fig. 9: Typ. transient thermal impedance

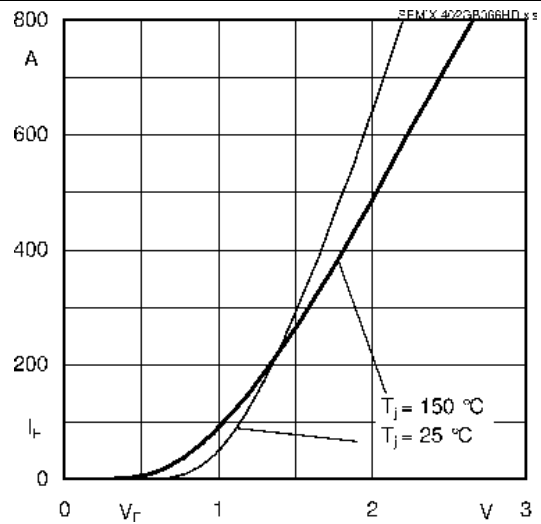


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

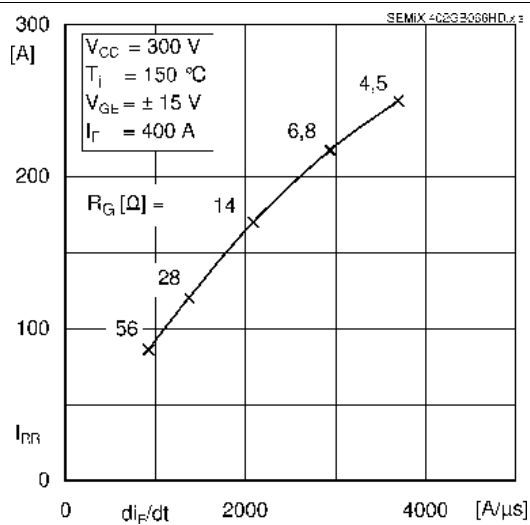


Fig. 11: Typ. CAL diode peak reverse recovery current

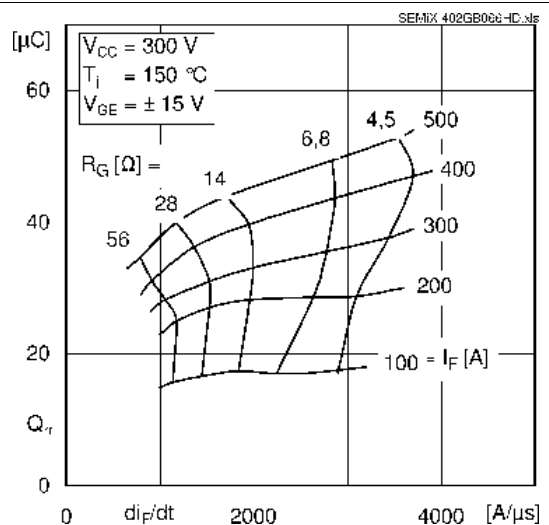
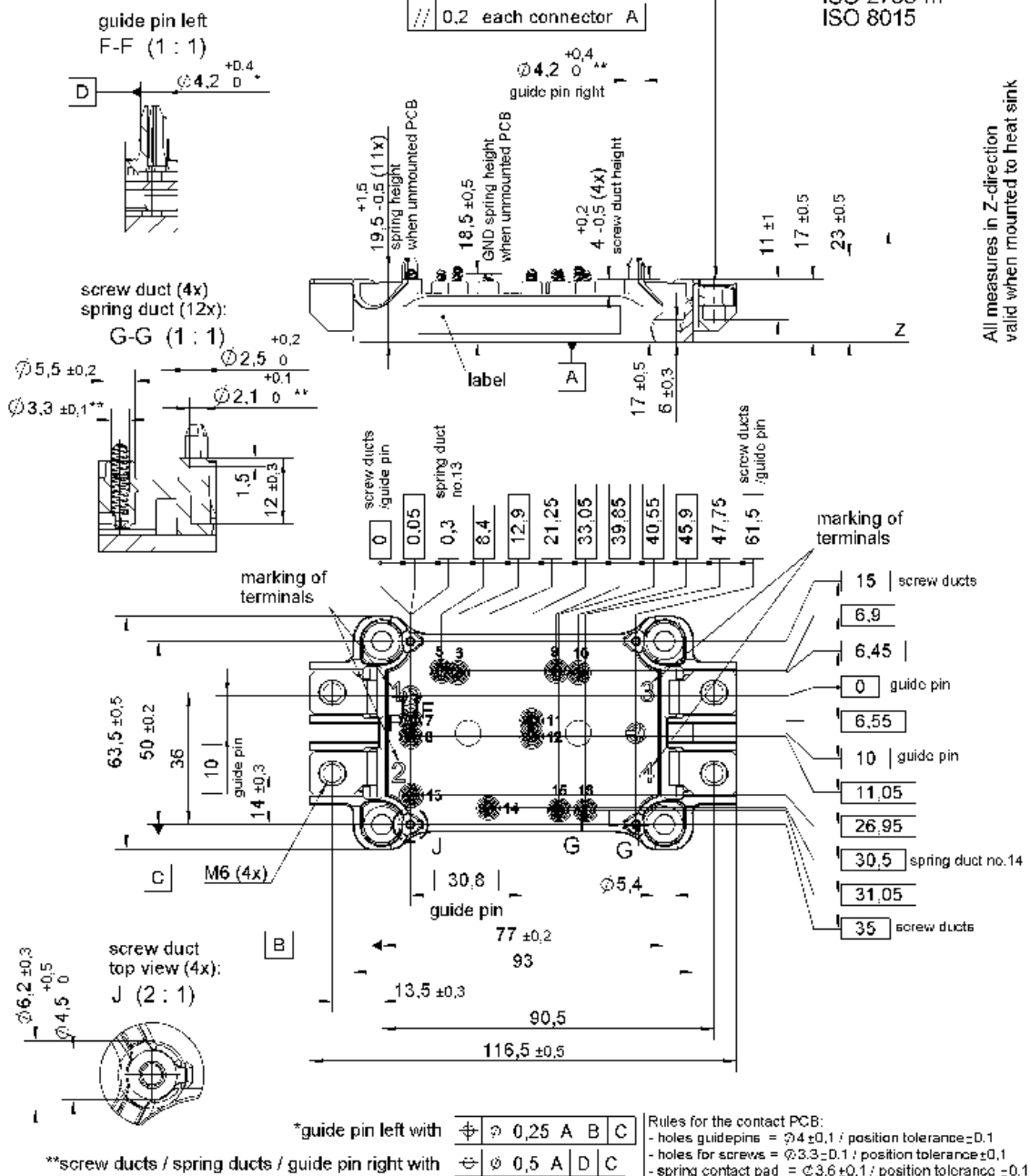


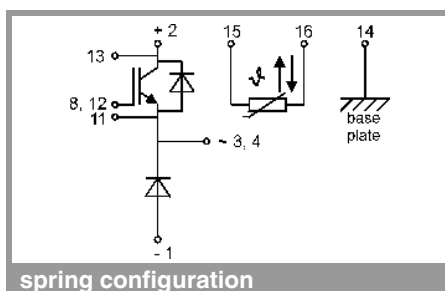
Fig. 12: Typ. CAL diode recovery charge

SEMiX402GAR066HDs

Case: SEMiX 2s



SEMiX 2s



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.