1. SEMIPACK® Thyristor/Diode Modules

Features

- UL recognized; file no. E 63 532

SEMIPACK® 0, 1, 2 and 3 (without pressure contact)

- Heat transfer through aluminium oxide ceramic isolated metal baseplate
- Without hard mould. Exception: SEMIPACK® 0 and few SEMIPACK® 1

SEMIPACK® 3, 4 and 5 (with pressure contact)

- Heat transfer through aluminium nitride ceramic isolated metal baseplate
- Precious metal pressure contacts for high reliability
- Thyristors with amplifying gate
- Without hard mould

Typical Applications

- Soft starters for induction motors
- Input rectifier for inverter drives
- Line rectifiers for transistorized AC motor controllers
- Non-controllable rectifiers for AC/AC converters
- DC motor control (e. g. for machine tools)
- Field supply for DC motors
- Temperature control (e.g. for ovens, chemical processes)
- Professional light dimming (studios, theaters)
- UPS

Type Designation System

SK K H 56 / 14 E H

SEMIKRON component — SK

Circuit — K
- E: One single element
- K: followed by T = Series connection with center terminal (pair of arms)
- K: followed by Q = antiparallel connection
- N: Center tap connection (anodes connected)
- M: Center tap connection (cathodes connected)

Functional elements and configuration — H
- D: All diodes
- E: Single diode
- H: Thyristor (cathode side) + diode
- L: Thyristor (anode side) + diode
- Q: antiparallel thyristors
- T: All thyristors

Type number (Approx. current I_{TAV} [A]) — 56

Voltage grade (V_{RRM} [V]/100) — 14

dv/dt grade — E
- D: 500 V/µs
- E: 1000 V/µs

Special type digits — H
- H: special selection
- L: special production, mech. change

1. SEMIPACK® Thyristor/Diode Modules

Captions of the Figures

Fig. 1 **Left:** Mean power dissipation P_{TAV} against mean on-state current I_{TAV} for half sinewaves (sin. 180), continuous current (cont.) and rectangular waves (rec. 15 ... 180) for a single thyristor.

Right: Mean power dissipation P_{TAV} against ambient temperature T_{amb} (temperature of the cooling air) for various total thermal resistances (junction to ambient) R_{thja} of a single thyristor together with its share of the heatsink.

Fig. 2 **Left:** Total power dissipation P_{VTOT} of one SEMIPACK® module in an a.c. controller connection (W 1) against the r.m.s. working current IRMS at full conduction angle.

Right: Case temperature T_{case} against ambient temperature T_{amb}. Parameter: Heatsink thermal resistance R_{thca} case to air (including the total contact thermal resistance ½ R_{thch}). For the power dissipation given on the l.h.s. vertical the case temperature given on the r.h.s. vertical is allowable.

Fig. 3 **Left:** Total power dissipation P_{VTOT} of two SEMIPACK® modules in a two-pulse bridge connection (B 2) against the output direct current I_D at full conduction angle for resistive (R) and inductive (L) load.

Right: Case temperature T_{case} against ambient temperature T_{amb}. Parameter: Heatsink thermal resistance R_{thca} case to air (including the total contact thermal resistance ¼ R_{thch}). For the power dissipation given on the l.h.s. vertical the case temperature given on the r.h.s. vertical is allowable.

Fig. 4 **Left:** Total power dissipation P_{VTOT} of three SEMIPACK® modules in a six-pulse bridge connection (B 6) and in a three phase a.c. controller connection (W 3) against the direct output current I_D and the r.m.s. working current per phase I_{RMS} respectively.

Right: Case temperature T_{case} against ambient temperature T_{amb}. Parameter: Heatsink thermal resistance R_{thca} case to air (including the total contact thermal resistance 1/6 R_{thch}). For the power dissipation given on the l.h.s. vertical the case temperature given on the r.h.s. vertical is allowable.

Fig. 5 Recovered charge Q_{rr} against rate of decrease of on-state current $-di_T/dt$ at maximum virtual junction temperature. Parameter: On-state current before turn-off.

Fig. 6 Transient thermal impedance junction to case Z_{thjc} and junction to heatsink Z_{thjh} of a single thyristor against the time t elapsed after a step change in power dissipation.

Fig. 7 Thermal resistance junction to case R_{thjc} of a single thyristor against conduction angle Θ with half sinewaves (sin.) and rectangular pulses (rec.) of repetition frequencies 40 ... 200 Hz. $[R_{thjc}]_{cont.}$ is valid for pure d.c.

Fig. 8 On-state characteristics of a single thyristor. Typical and maximum values.

Fig. 9 Permissible overload current values $I_{T(OV)}$ (peak values, half sinewaves), divided by the surge on-state current I_{TSM} for 10 ms, against duration of overload. Parameter: Peak value of reverse voltage reapplied between conduction periods.

Fig. 10 Gate voltage V_G against gate current I_G showing the region of possible (BMZ) and certain (BSZ) triggering for various virtual junction temperatures T_{vj}. The current and voltage of the triggering pulses must lie in the region of certain triggering (BSZ), but the peak pulse power $\hat{P}_G$ used must not exceed that given for the pulse length t_p.

The curve 20 V; 20 Ω is the output characteristic of an adequate trigger equipment.

Fig. 11 **Left:** Mean power dissipation P_{FAV} against mean forward current I_{FAV} for half sinewaves (sin. 180), continuous current (cont.) and rectangular waves (rec. 15 ... 180) for a single diode.

Right: Mean power dissipation P_{FAV} against ambient temperature T_{amb} (temperature of the cooling air) for various total thermal resistances (junction to ambient) R_{thja} of a single diode together with its share of the heatsink.

Fig. 12 **Left:** Total power dissipation P_{VTOT} of two SEMIPACK® modules in a two-pulse bridge connection (B 2) against the output direct current I_D for resistive (R) and inductive (L) load.

Right: Case temperature T_{case} against ambient temperature T_{amb}. Paramter: Heatsink thermal resistance R_{thca} case to air (including the total contact thermal resistance ¼ R_{thch}).

Fig. 13 **Left:** Total power dissipation P_{VTOT} of three SEMIPACK® modules in a six-pulse bridge connection (B 6) against the direct output current I_D.

Right: Case temperature T_{case} against ambient temperature T_{amb}. Parameter: Heatsink thermal resistance R_{thca} case to air (including the total contact thermal resistance 1/6 R_{thch}).

Fig. 14 Transient thermal impedances junction to case Z_{thjc} and junction to heatsink Z_{thjh} of a single diode against the time t elapsed after a step change in power dissipation.

Fig. 15 Forward characteristics of a single diode. Typical and maximum values.

Fig. 16 Permissible overload current values $I_{F(OV)}$ (peak values, half sinewaves), divided by the surge forward current I_{FSM} for 10 ms, against duration of overload. Parameter: Peak value of reverse voltage reapplied between conduction periods.

Fig. 17 **Left:** Total power dissipation P_{VTOT} (thyristor + diode) against braking direct current I_D at full conduction of the thyristor.

Right: P_{VTOT} against ambient temperature T_{amb} for various total thermal resistances R_{thtot} (junction to ambient).

1. SEMIPACK® Thyristor/Diode Modules

Technical Explanations

Non-repetitive peak reverse voltage V_{RSM}

Maximum allowable peak value of reverse voltage which should not be exceeded by short term transients.

Repetitive peak off-state and reverse voltages V_{DRM} and V_{RRM}

Maximum allowable peak values of repetitive transient off-state and reverse voltages.

Mean on-state current I_{TAV}[1)]

Absolute maximum value of continuous on-state current of the diodes or thyristors contained in the SEMIPACK® for the current waveforms, temperatures and cooling conditions stated, with no margins allowed for overload.

The values given in the data sheet are valid only for half sinewaves and at the stipulated case temperature T_{case}. Values for other conditions must be deduced from fig. 1 or 11. In fig. 1 or 11 the figure which must be inserted for R_{thja} is for one semiconductor element i. e. half of the SEMIPACK® module, and is built up as follows:

$R_{thja} = R_{thjc} + R_{thch} + N \cdot R_{thha}$

Here R_{thjc} is the junction to case thermal resistance for a single semiconductor element. It is given in the data sheet for pure d. c. (cont), for half sinewaves (sin 180) and 120° rectangular pulses (rec. 120). For other conduction angles it can be taken from fig. 7.

R_{thch} is the contact thermal resistance case to heatsink. It is given in the data sheet. N is the number of semiconductor elements (i. e. half SEMIPACK® modules) which will be mounted on the one heatsink. If not all elements are in operation simultaneously for example as is the case with four quadrant convertors then N is the number of elements which could be in operation at any one time. Finally R_{thha} is the thermal resistance of the complete heatsink. With natural cooling it depends upon the total dissipation $P_{VTOT} = N \cdot P_{TAV}$ or correspondingly $N \cdot P_{FAV}$; with forced cooling it depends upon the air flow V_{air}/t.

In both cases the total number of modules n on the common heatsink plays a part. The more modules that are mounted on one heatsink the better is the heat distributed, so the effective thermal resistance of the heatsink is reduced. Naturally, it is a condition that the modules are equally spaced on the heatsink and are not mounted close together.

For quick determination of the maximum allowable direct current I_D for bridge circuits or correspondingly I_{RMS} for a. c. controllers figs. 2 to 4, 12 and 13 can be used. They are valid for the complete circuits at full conduction. On the r.h.s. the thermal resistance case to air R_{thca} is given. It is built up as follows:

$$R_{thca} = R_{thha} + \frac{1}{N} \cdot R_{thch}$$

The meaning of the symbols is as above.

In practical applications, to allow for current or voltage overloads, for degradation of cooling conditions, and for increases in the ambient temperature by, for example, local heating due to adjacent components, it is recommended that only 80 % of maximum mean on-state current as given in figs. 1, 2, 3, 4, 11, 12 and 13 is utilized.

Example: A fully controllable six-pulse bridge using three modules SKKT 41 is to supply 80 A at full conduction. Each thyristor takes 27 A, but to give a safety factor 33 A will be used. Fig. 1 gives P_{TAV} = 48 W for rectangular pulses 120°. At T_{amb} = 40 °C, R_{thja} = 1.8 °C/W. From the data sheet R_{thjc} = 0.73 °C/W and R_{thch} = 0.2 °C/W; N = 6. Therefore:

$$R_{thha} = \frac{R_{thja} - R_{thjc} - R_{thch}}{N} = \frac{0,87}{6}$$

= 0.145 °C/W

This is the required thermal resistance of the heatsink.

With full conduction one can also determine the required heatsink thermal resistance from fig. 4. With I_D = 99 A and T_{amb} = 40 °C it shows that R_{thca} = 0.18 °C/W. But R_{thha} is required. The total contact thermal resistance of all three SEMIPACKs must be deducted.

$$R_{thha} = R_{thca} - \frac{R_{thch}}{N} = 0,18 - 0,033$$

= 0.147 °C/W.

1) for rectifier diodes, replace “on-state” by “forward” and with the letter symbols replace the subscript T by F.

The two values agree well bearing in mind the accuracy of reading the graphs.

RMS on-state current I_{TRMS}[1)]

Absolute maximum allowable value of rms current for continuous operation at the required conduction angle, current waveform and cooling conditions. It should never be exceeded in continuous operation even with very good cooling. This is taken account of in figs. 1, 2, 3, 4, 11, 12 and 13 where the curves for mean on-state current end when the maximum allowable r.m.s. current is reached.

Allowable overload currents

The overload currents which are permissible at frequencies below 40 Hz, for short-time overloads or for intermittent duty may be calculated by means of the transient thermal impendance or the thermal impedance under pulse conditions (fig. 6, 14) so that the virtual junction temperature at no instant exceeds the maximum value. The dissipation values necessary for this calculation may be calculated from the threshold voltage and on-state slope resistance (see below).

Surge on-state current I_{TSM}[1)]

Maximum peak value of a single half sinewave current surge of 10 ms duration. After occasional current surges up to this limiting value the thyristor/diode will withstand the peak reverse voltages given in figs. 9 and 16.

Surge current characteristics $I_{T(OV)}$[1)]

Allowable peak values of complete or part half sinewaves of durations from 1 to 10 ms, or correspondingly a series of half sinewaves up to 10 ms duration, which the thyristor/ diode can withstand under fault conditions. These conditions should only occur rarely, and the control of the thyristor may be temporarily lost (figs. 9 and 16).

I^2t value

The i^2t value is given to assist in the selection of suitable fuses to protect against damage due to short circuits. The i^2t value of the fuse over the specified time interval for the input voltage used must be less than the value for the thyristor/diode.

As the i^2t value of the fuse falls more rapidly than that of the thyristor/diode with increasing operating temperature it is usually sufficient to take the i^2t value of the semiconductor element at 25 °C for comparison with that of the (un-loaded) fuse.

Critical rate of rise of on-state current $(di/dt)_{cr}$

Immediately after the triggering of the thyristor the on-state current flows only in the region of the gate connection, and to avoid excessive dissipation near this gate connection the rate of rise of this current must be limited to below the critical values given. The specified critical values are valid for frequencies 50 to 60 Hz and for a peak current value equal to the crest value of the permissible on-state current for half sinewaves. A gate triggering current at least five times the minimum trigger current I_{GT} should be applied and it should have a rate of rise of at least 1 A/µs. The triggering pulse should last at least 10 µs.

The critical rate of rise of current reduces at higher frequencies but increases with lower peak current values. On these grounds, at frequencies above 60 Hz the peak current values must be reduced if a high rate of rise of current is required.

Critical rate of rise of off-state voltage $(dv/dt)_{cr}$

The given values are valid for an exponential increase in off-state voltage to $^2/_3\ V_{DRM}$. If this dv/dt value is exceeded the thyristor may break over and self trigger.

Recovered charge Q_{rr}

During the reverse recovery time t_{rr} the recovered charge is discharged into the main circuit. Fig. 5 shows its dependance on the peak value I_{TM} of the on-state current before switch-off, and on the rate of fall of current – di_T/dt.

Holding current I_H

The minimum anode current which will still hold the thyristor in its on-state. If the thyristor is switched on from cold at below 25 °C the value of holding current may initially be slightly higher. The maximum values given are not exceeded for 98 % of devices delivered.

Latching current I_L

The minimum anode current which will hold the thyristor in its on-state immediately after triggering with a 10 µs gate pulse. The triggering conditions stipulated in the section on “critical rate of rise of on-state current” must be adhered to. The given maximum values are not exceeded for 98 % of devices delivered.

Threshold voltage $V_{T(TO)}$ and on-state slope resistance r_T[1)]

These values define the on-state characteristics (maximum spread values) and may be used to calculate the peak (P_T) and average (P_{TAV}) on-state power dissipation:

$$P_T = V_{T(TO)} \cdot i_T + r_T \cdot i_T^2$$

$$P_{TAV} = V_{T(TO)} \cdot I_{TAV} + r_T \cdot I_{TRMS}^2$$

$$\frac{I_{TRMS}^2}{I_{TAV}^2} = \frac{360°}{\Theta} \quad \text{for rectangular pulses,}$$

$$\frac{I_{TRMS}^2}{I_{TAV}^2} = \left(\frac{\pi}{2}\right)^2 \cdot \frac{180°}{\Theta} \quad \text{for part half sinewaves.}$$

In the above equations:

Θ – conduction angle

i_T – instantaneous on-state current

I_{TAV} – mean on-state current

I_{TRMS} – rms on-state current

Thermal resistance R_{thjc}, R_{thch}

The internal thermal resistance from junction to case R_{thjc} and the contact thermal resistance between the case and the heatsink R_{thch} are given, the latter being valid only if the assembly instructions stipulated below are followed. R_{thjc} depends upon the current waveform and the conduction angle (see fig. 7); with diodes this effect can be neglected.

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1) for rectifier diodes, replace “on-state” by “forward” and with the letter symbols replace the subscript T by F.

Transient thermal impedance $Z_{(th)t}$

The transient thermal impedances junction to case Z_{thjc} and junction to heatsink Z_{thjh} are given in Fig. 6 and Fig.14 against the time t. For times longer than 1 s (10° s) the appropriate share of the heatsink transient thermal impedance (**without** the contact thermal resistance component to heatsink) must be added to Z_{thjh}.

For the SEMIKRON heatsinks the total transient impedances are given against time in diagrams. In order to calculate the share of each single element as needed for the above calculation, the values read from the diagram are multiplied by the number N of single elements (thyristors and/or rectifier diodes) working on the common heatsink.

Temperatures

The most important reference point for calculating limiting values is the maximum virtual junction temperature T_{vj}. This temperature may be exceeded only in case of a fault (see section on surge on-state current). Another important parameter for on-state load conditions is the case temperature T_{case} which may be measured at a convenient point on the copper base.

Minimum gate trigger voltage V_{GT} and trigger current I_{GT}

These are the lowest values of gate voltage and current with a 100 µs pulse and anode voltage of 6 V which will ensure firing. These figures are increased by a factor of 1,5 to 2 for 10 µs trigger pulses. Triggering circuits should provide pulses which exceed I_{GT} four to five times.

Maximum gate non-trigger voltage V_{GD} and non-trigger current I_{GD}

These are the highest values of gate voltage and current which will not cause the thyristor to fire. Interfering signals in the gate circuit must be restricted to amplitudes below these values.

Gate controlled delay time t_{gd}

This is the delay time between the leading edge of the triggering pulse and the commencement of the thyristor firing.

Protection against over-voltage

RC snubber networks and/or ZnO surge suppressors should be used to protect against over-voltage. Details see page B1 – 5 and on B14 – 1 Section 14 chapter B14.6 Metall oxide Varistors and B14.8 RC-Snubbers.

Protection against over-current and short circuits

Fast operating fuses should be used to protect against short circuit whereas magnetic or thermally actuated circuit breakers may be employed to protect against slowly increasing overloads.

In particular thermally operated circuit breakers should be used when forced cooling is employed to prevent damage to the semiconductor in event of a failure of the fan. Another way of protecting a thyristor is to inhibit triggering when overload occurs.

Important assembly instructions

In order to guarantee good thermal contact and to keep the contact thermal resistance values specified in the data sheets the contact area of the heatsink must be clean and free from particles. The unevenness remaining after grinding those areas must be less than 20 µm, the roughness less than 10 µm.

Before mounting on the heatsink the mounting surfaces should be coated with thermal compound (e.g. Wacker-Chemie P12 i.e. Ident No. 30106620). It is recommended to use a rubber squeegee.

The SEMIPACK® modules are secured with M5 high tensile steel screws which withstand the specified mounting torque. Flat and spring washers (e.g. to DIN 127) should always be used. (→ B1 – 5)

After a period of 3 hours the screws should be again tightened up to the specified torque as the thermal compound spreads out under the mounting pressure.

Busbars should be connected to the heavy current terminals. The use of lugs for direct connection to the terminals is not recommended. If required the cable lugs can be connected to busbars which in turn can be screwed down on to the SEMIPACK®. Also here high tensile screws with washers should be used and the specified torque applied.

Care must be taken that the busbar screws penetrate sufficiently into their tapped hole to give a secure fixing, and also that the screws do not bottom on this blind tapped hole such that the busbars are not held tightly.

Insulation testing

The insulation between the live parts and the baseplate of every SEMIPACK® module is tested before delivery for one second at 3600 V a.c, resp. 3000 V according to UL 1557, see datasheet.

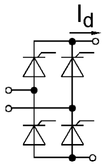
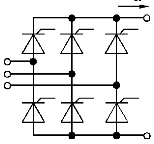
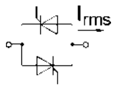
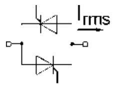
The specifications on isolation voltage for equipment are included in IEC Publication IEC 146-1-1: 1991, respectively with EN 60146-1-1: 1993 clause 4.2.1.
(= VDE 0558 T1-1: 1993-04) or EN 50 178: 11.1997 =
DIN EN 50 178 (VDE 0160) 4.1998

During the test all electrical terminals including the gate terminals must be connected with each other in order to avoid damage by inductively or capacitively induced voltage transients. The test voltage is applied between the connected terminals and the baseplate.

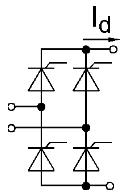
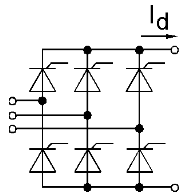
SEMIKRON

Current Ratings (Limiting Values)

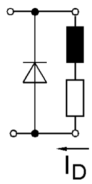
T_{amb} = 45 °C for natural cooling
T_{amb} = 35 °C for forced air cooling

SEMIPACK Type		T_{amb} °C	I_d  A	I_d  A	W1C  A	W3C 3 x  A
SKKT 15 **SKKH 15**	P 13A/100 P 13A/125	45 45	14 15	17 19	21 23	3 x 12 3 x 14
SKKT 19; 20; 20 B	P 3/120 P 3/180 P 3/180 F	45 45 35	28 31 46	35 38 60	38 42 56	3 x 27 3 x 30 3 x 47
SKKT 26; 27; 27 B **SKKH 26; 27**	P 3/120 P 3/180 P 3/180 F	45 45 35	35 38 60	43 50 77	47 52 74	3 x 33 3 x 37 3 x 60
SKKT 41; 42; 42 B **SKKH 41; 42**	P 3/120 P 3/180 P 3/180 F	45 45 35	43 50 85	52 60 110	65 70 110	3 x 40 3 x 45 3 x 85
SKKT 56; 57; 57 B **SKKH 56; 57**	P 3/120 P 3/180 P 3/180 F	45 45 35	50 57 100	60 68 130	75 82 130	3 x 46 3 x 52 3 x 100
SKKT 71; 72; 72 B **SKKH 71; 72**	P 3/120 P 3/180 P 3/180 F	45 45 35	55 62 115	65 75 145	85 92 155	3 x 50 3 x 56 3 x 115
SKKT 91; 92; 92 B **SKKH 91; 92**	P 3/120 P 3/180 P 3/180 F	45 45 35	60 70 140	75 85 175	100 110 190	3 x 60 3 x 65 3 x 135
SKKT 105; 106; 106 B **SKKH 105;106**	P 3/180 F P 16/200 F	35 35	145 190	180 260	200 250	3 x 140 3 x 200
SKKT 122 **SKKH 122**	P 3/180 P 3/180 F P 16/200 F	45 35 35	82 170 235	105 200 315	– 235 295	– 3 x 160 3 x 245
SKKT 132 **SKKH 132**	P 3/180 P 3/180 F P 16/200 F	45 35 35	77 170 250	100 200 320	110 240 305	3 x 75 3 x 163 3 x 250
SKKT 162 **SKKH 162**	P 3/180 F P 16/200 F	35 35	190 290	230 360	265 333	3 x 185 3 x 312
SKKT 131 **SKKH 131**	P 16/170 F P 16/200 F P 16/300 F	35 35 35	295 300 –	375 380 390	340 385 –	3 x 290 3 x 312 3 x 318
SKKT 161 **SKKH 161**	P 16/170 F P 16/200 F P 16/300 F	35 35 35	325 330 –	410 415 425	380 385 –	3 x 310 3 x 337 3 x 344
SKKT 213 **SKKH 213**	P 16/200 F	35	354	456	425	3 x 360
SKKT 253 **SKKH 253**	P 16/200 F	35	387	502	465	3 x 400
SKKT 210 **SKKH 210**	P 16/200 F P 16/300 F	35 35	420 –	550 570	526 –	3 x 440 3 x 451
SKKT 250 **SKKH 250**	P 16/200 F P 16/300 F	35 35	450 –	585 600	566 –	3 x 471 3 x 484
SKKT 500 **SKKH 500**	P 16/200 F P 16/300 F	35 35	665 –	845 –	– 850	– 3 x 670

Current Ratings (Limiting Values)

SEMIPACK Type		T_{amb} °C	 A	 A
SKKD 15	P 13A/100 P 13A/125	45 45	16,5 18	20 22,5
SKKD 26	P 3/120 P 3/180	45 45	44 53	48 59
SKKD 46	P 3/120 P 3/180 P 3/180 F	45 45 35	50 54 95	60 66 120
SKKD 81	P 3/120 P 3/180 P 3/180 F	45 45 35	63 70 135	70 85 175
SKKD 100	P 3/120 P 3/180 P 3/180 F	45 45 35	65 73 150	75 91 190
SKKD 162	P 3/180 P 3/180 F P 16/200 F	45 35 35	90 210 320	115 260 425
SKKD 201	P 16/200 F P 16/300 F	35 35	385 –	515 525
SKKD 260	P 16/200 F	35	490	655

Free-Wheeling Diodes

			 A
SKKE 15	P 13/75 P 13/100 P 13/125	45 45 45	cont. 17 cont. 18 cont. 19
SKKE 81	P 3/120 P 3/180 P 3/180 F	45 45 35	cont. 70 cont. 80 cont. 120
SKKE 162	P 3/180 P 3/180 F P 16/200 F	45 35 35	cont. 110 cont. 200 cont. 230
SKKE 201	P 16/200 F	35	cont. 300
SKKE 260	P 16/200 F	35	cont. 385

Recommended RC Snubber Networks for SEMIPACK® Modules

SEMIPACK®	$V_{VRMS} \leq 250$ V C	R	$V_{VRMS} \leq 400$ V C	R	$V_{VRMS} \leq 500$ V C	R	$V_{VRMS} \leq 660$ V C	R
SKKT 15, 19, 20, 26, 27 **SKKH 15, 26, 27** **SKKD 15, 26** **SKKE 15**	0,22 µF	68 Ω 6 W	0,22 µF	68 Ω 6 W	0,1 µF	100 Ω 10 W	–	–
SKKT 41, 42, 56, 57, 71, 72, 91, 92, 105, 106 **SKKH 41, 42, 56, 57, 71, 72, 91, 92, 105, 106** **SKKD 46, 81, 100** **SKKE 81**	0,22 µF	33 Ω 10 W	0,22 µF	47 Ω 10 W	0,1 µF	68 Ω 10 W	0,1 µF	100 Ω 10 W
SKKT 122, 131, 132, 161, 162, 210, 213, 250, 253 **SKKH 122, 131, 132, 161, 162, 210, 213, 250, 253** **SKKD 162, 201, 260** **SKKE 162, 201, 260**	0,22 µF[1)]	33 Ω[1)] 10 W	0,22 µF[1)]	47 Ω[1)] 10 W	0,1 µF[1)]	68 Ω[1)] 10 W	0,1 µF[1)]	100 Ω[1)] 20 W
SKKT 122, 131, 132, 161, 162, 210, 213, 250, 253, 500 **SKKH 122, 131, 132, 161, 162, 210, 213, 250, 253, 500** **SKKD 162, 201, 260** **SKKE 162, 201, 260** **SKET 330, 400**	0,47 µF	33 Ω 25 W	0,47 µF	33 Ω 25 W	0,22 µF	47 Ω 25 W	0,22 µF	68 Ω 50 W

[1)] Only with heatsink P3

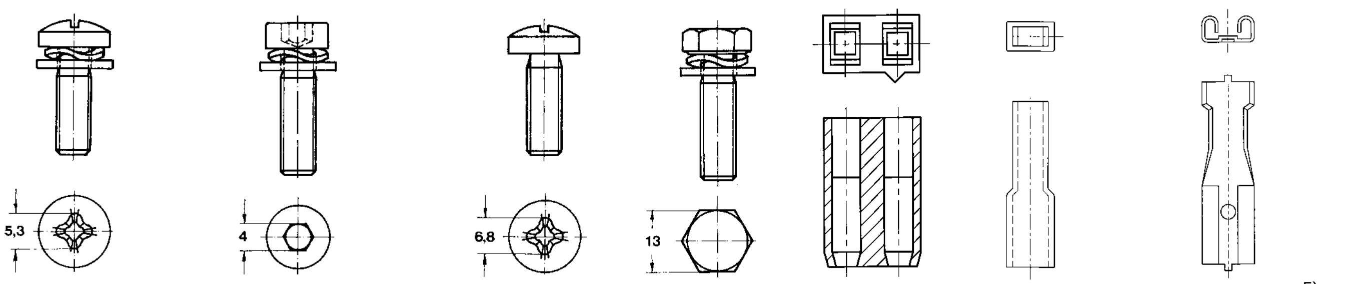
Mounting Hardware for SEMIPACK® Modules

For further accessories see Section 14

Hardware needed for **one** SEMIPACK®	**SEMIPACK® 1** a) SKKD/E 26..100 b) SKKT/H/L 19..105 b) SKKT/H/L 20..106	**SEMIPACK® 2** SKKT/H 122 ... 162 SKKD/E 162, SKND 165, SKMD 202E, etc.	**SEMIPACK® 3** SKKT/H/L 131 ... 253 SKKD/E 201, 206 SKKD 170M etc.	**SEMIPACK® 4** SKET 330, 400 SKKE 400, 400F
Gate female plug Insulating sleeve Double plug caps Baseplate screws Terminal screws Washers Spring washers	b: 2 pcs. 2,8 x 0,8 mm [4)] b: 4 pcs. - (see page B14-125) 2 pcs M5 x 18 socket head 3 pcs. M5 x 10, pozidrive head captive captive	4 pcs. 2,8 x 0,8 mm [5)] – 2 pcs. (right + left) 2 pcs. M 5 x 18 socket head 3 pcs. M 6 x 12, pozidrive head (3 pcs. 6,4 mm ∅) (3 pcs. 6,4 mm ∅)	4 pcs. 2,8 x 0,8 mm [5)] – 2 pcs. (right + left) 4 pcs. M 5 x 18 [3)] socket head 3 pcs. M 8 x 16, hexagon head captive captive	2 pcs. 2,8 x 0,8 mm [5)] – 1 pcs. (right) 4 pcs. M 5 x 18 [3)] socket head 2 pcs. M 10 x 50 [2)] 2 pcs. 10,5 mm ∅
Part No.of the complete kit	for 12 SEMIPACKs a: **33704200** b: **33403900**	for 8 SEMIPACKs **33404000**	for 3 SEMIPACKs **33404100**	for 3 SEMIPACKs **33404500**

[2)] Spindle No. 30143660 with 2 nuts M 10

[3)] For SEMIPACK 3 with 10 mm thick baseplates and SEMIPACK 4 **on heatsink P3,** use M5 x 20 (No. 30145490), available on request



4) 5)

gate plug

M 5 x 10	M 5 x 18	M 5 x 20[3)]	M 6 x 12	M 8 x 16	double	insula-	B2,8-1	A2,8-0,25
DIN	DIN	DIN	DIN	DIN	plug caps	ting	DIN	DIN
7985-4.8	7984-8.8	7984-8.8	7985-8.8	933-8.8	**32769800** (r)	sleeve	46247	46330
31947900	**31823300**	**30145490**	**32584700**	**31944400**	**32769900** (l)	**32890700**	**32020200**	**32381400**