FAST HIGH VOLTAGE THYRISTOR SWITCHES

These solid-state switches are designed for high voltage high peak current switching applications such as shock wave generators, flash lamp drivers, crow bar circuits and surge generators. The switching modules contain a large number of reverse blocking thyristors (SCR) connected in series and in parallel. Each single thyristor is controlled by its own low-impedance gate drive, which allows an extremely large di/dt without reduction of reliability and life expectancy.

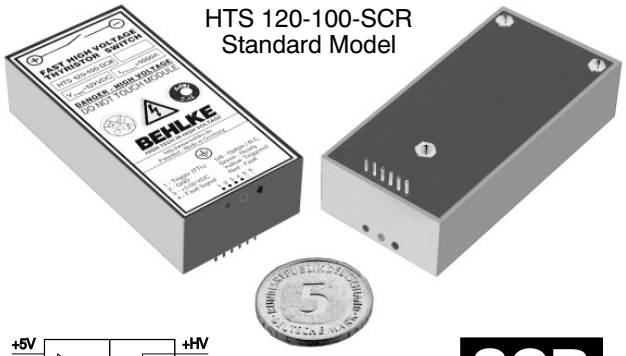
The safe and synchronous control of all SCR's is performed by a patented driver which also provides the high galvanic isolation necessary for high-side circuits and safety-relevant applications.

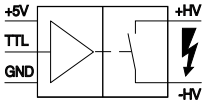
In contrast to conventional high voltage switches like spark gaps, electron tubes, gas discharge tubes and mechanical switches, thyristor switches of the HTS-SCR series show very low jitter and stable switching characteristics independent of temperature and age. The mean time between failures (MTBF) is by several orders of magnitude higher than that of the classical HV switches.

An interference-proof control circuit provides signal conditioning, auxiliary voltage monitoring, frequency limitation and temperature protection. In case of false operating conditions the switches are immediately inhibited and a fault signal is generated. Three LED's indicate the operating state.

The switches are triggered by a positive going pulse of 3-6 Volts. The switching behaviour will not be influenced by the trigger rise time or the trigger amplitude. After being triggered the switches remain in on-state until the load current drops below the holding current (typical thyristor behaviour). Therefore the turn-off process requires a current commutation, a current limitation or a current bypass. Capacitor discharge applications with charging currents less than the holding current do not require special turn-off measures. In all other cases the switches can be turned off by a slight current reversal, which is given in most pulsed power applications anyway. If the current reversal is higher than 10% and if the periodic duration of the current is shorter than 1 ms, a free-wheeling diode (e.g. Behlke FDA) must be used to avoid hard turn-off, which can damage the switching module under certain circumstances. Please also compare the application note below. For further design recommen-dations please refer to the general instructions for use.

HTS 60-200-SCR 6 kVDC / 2 kA pk.
HTS 120-100-SCR 12 kVDC / 1kA pk.

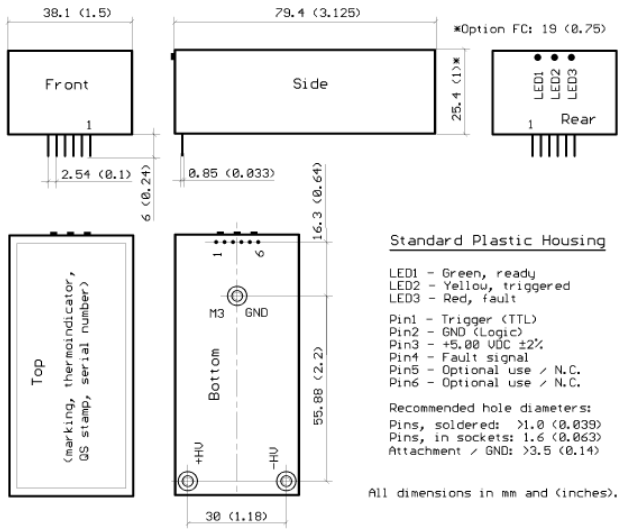




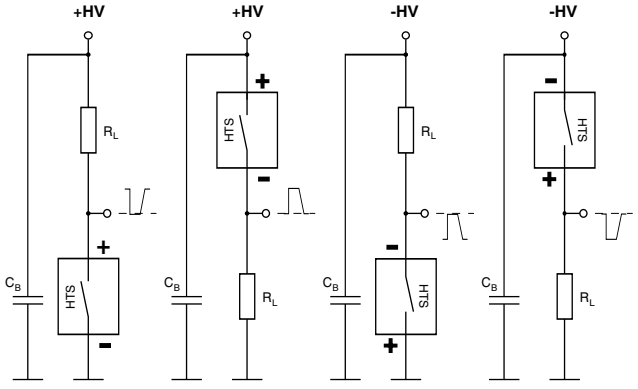
SCR TECHNOLOGY

- Patented -
Made in Germany

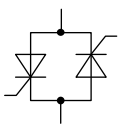
Compact Design
Extremely High di/dt
High Surge Current Capability



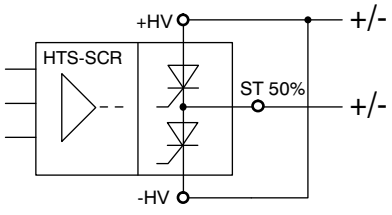
Basic Circuits



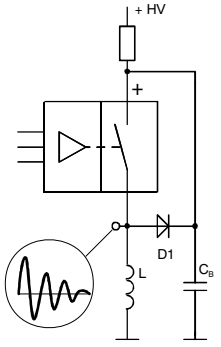
Antiparallel Circuit using Option ST



An antiparallel circuit can simply be realized by use of the stage tapping option ST (50%). The thyristor stack will be electrically divided into two identical switching paths and connected as shown below. The Max. Operating Voltage will consequently be reduced to half the value.



Inductive Load



Note: D1 is a fast recovery diode with kiloamps peak current capability, e.g. Behlke FDA 640-xxx or FDA 800-xxx

HVP
High Voltage Products. High Voltage Experts.

BEHLKE
HIGH-TECH IN HIGH VOLTAGE

Specification	Symb.	Condition / Comment		60-200-SCR	120-100-SCR	Unit
Maximum Operating Voltage	$V_{O(max)}$	I_{off} < 100 µADC, T_{case} = 70°C		6000	12000	VDC
Minimum Operating Voltage	$V_{O(min)}$			0		VDC
Typical Breakdown Voltage	V_{br}	I_{off} > 3 mADC, T_{case} = 70 °C		6600	13200	VDC
Maximum Off-State Current	I_{off}	0.8 x V_O, T_{case} = 25°C		140	70	µADC
Galvanic Isolation	V_I	HV side against control side, continuously		15000		VDC
Maximum Turn-On Peak Current	$I_{P(max)}$	T_{case} /T_{flange} = 25°C, half sine. Please consult factory for further data.	t_p< 100 µs, duty cycle <1% t_p< 500 µs, duty cycle <1% t_p< 1 ms, duty cycle <1% t_p< 10 ms, duty cycle <1%	2000 1000 640 400	1000 500 340 200	ADC
Max. Non-repetitive Peak Current	$I_{P(nr)}$	T_{case} / T_{flange} = 25°C	Half sine single pulse, tp<200µs Half sine single pulse, tp< 20µs	4000 8000	2000 4000	ADC
Max. Continuous Load Current	I_L	T_{case} / T_{flange} = 25°C	Standard plastic case With option GCF, cooling flange	0.72 52	0.36 26	ADC
Typical Holding Current			T_{case} / T_{flange} = 25°C T_{case} / T_{flange} = 70°C	50 35		mADC
Typical On-State Voltage	V_{sat}	T_{case} / T_{flange} = 25°C t_p< 10µs, duty cycle <1%	0.001 x $I_{P(max)}$ 0.01 x $I_{P(max)}$ 0.1 x $I_{P(max)}$ 1.0 x $I_{P(max)}$	6.2 7.2 12 32	12.4 14.4 24 64	VDC
Typical Turn-On Delay Time	$t_{d(on)}$	0.1 $I_{P(max)}$, 0.8 x $V_{O(max)}$ resistive load, 50-50%		150		ns
Typical Turn-On Rise Time	$t_{r(on)}$	Resistive load, 10-80 %	0.1 x $V_{O(max)}$, 0.1 x $I_{P(max)}$ 0.8 x $V_{O(max)}$, 0.1 x $I_{P(max)}$ 0.8 x $V_{O(max)}$, 1.0 x $I_{P(max)}$	280 65 140	290 65 170	ns
Typical Turn-Off Time	t_{off}, t_q	T_{case} / T_{flange} = 25°C, inductive load / free wheeling diode	0.01x $I_{P(max)}$ 0.1 x $I_{P(max)}$ 1.0 x $I_{P(max)}$	10 35 90		µs
Critical Rate-of-Rise of Off-State Voltage	dv/dt	@ $V_{O(max)}$, exponential waveform		40	80	kV/µs
Maximum On-Time	$t_{on(max)}$	Depends on holding current only. See product description		unlimited		
Internal Driver Recovery Time	t_{rc}	Standard devices With option HFB		100 10		µs
Typical Turn-On Jitter	$t_{j(on)}$	V_{aux} / V_{tr} = 5.00 VDC		100		ps
Max. Cont. Switching Frequency	$f_{(max)}$	Please note $P_{d(max)}$ limitations, increased $f_{(max)}$ on request		5		kHz
Maximum Burst Frequency (Triggered)	$f_{b(max)}$	With option HFB, 1.0 x $I_{P(max)}$ With option HFB, 0.1 x $I_{P(max)}$		10 30		kHz
Maximum Continuous Power Dissipation	$P_{d(max)}$	Standard plastic case, case temperature kept at 25°C With opt. GCF, cooling flange temperature kept at 25°C		5 400		Watts
Linear Derating		Above 25°C	Standard plastic case With option GCF, grounded cooling flange	0.111 8,88		W/K
Operating Temperature Range	T_O			-40...70		°C
Storage Temperature Range	T_{ST}			-50…90		°C
Coupling Capacitance	C_C	HV side against control side		10		pF
Auxiliary Supply Voltage	V_{aux}	Stabilized to ± 2%, max. operating range 4.75-5.25 VDC		5.00		VDC
Auxiliary Supply Current	I_{aux}	@ $f_{(max)}$		400		mADC
Trigger Voltage Range	V_{tr}	Switching behaviour is not influenced by trigger quality		3-10		VDC
Fault Signal Output		Short circuit proof, source/sink current max.10mADC. See product description.	Ready = High Fault = Low	>4.0 <0.8		VDC
Fault Detection		By internal protection circuits. In case of fault the switch will be inhibited for approx. 1 sec respectively for the duration of fault. Reset time for thermal overload is ~5 min		- Over temperature - Bad auxiliary voltage (<4.75 V) - Too high switching frequencies		
Operating Mode Indication		Built-in LEDs.		Green: Ready for trigger Yellow: Thyristors triggered Red: Fault, switch is inhibited		
High Voltage Connection		Standard plastic case With option GCF, grounded cooling flange		Threated tabs at bottom for PCBs Threated tabs (metric M3) on top		
Control Connection		Standard plastic case With option GCF, grounded cooling flange		6 gold plated pins at bottom Pigtail with 5-pole miniature plug		
Dimensions		Standard plastic case Option FC, flat case Option GCF, grounded cooling flange (overall dimension)		79 x 38 x 25 79 x 38 x 19 99 x 58 x 33		mm^3
Weight		Standard plastic case Option FC, flat case Option GCF, grounded cooling flange		145 120 425		g

ORDERING INFORMATION

HTS 60-200-SCR	Thyristor switch, 6 kVDC, 2 kA (pk)	**Option UL94**	Flame retardend casting resin according to UL 94-V0
HTS 120-100-SCR	Thyristor switch, 12kVDC, 1 kA (pk)	**Option GCF**	Grounded Cooling Flange: The module can be attached directly to heat sinks without any insulation measure. Coupling capacitance wil be increased by approx.150%.
Option HFB	High frequency burst		
Option FC	Flat case, 19 mm height		

Further information and mechanical drawings on request. All data and specifications subject to change without notice.

120-100-SCR-07.01