FAST HIGH VOLTAGE THYRISTOR SWITCHES

HTS 120-1600-SCR 12000 V / 16000 A
HTS 160-1600-SCR 16000 V / 16000 A

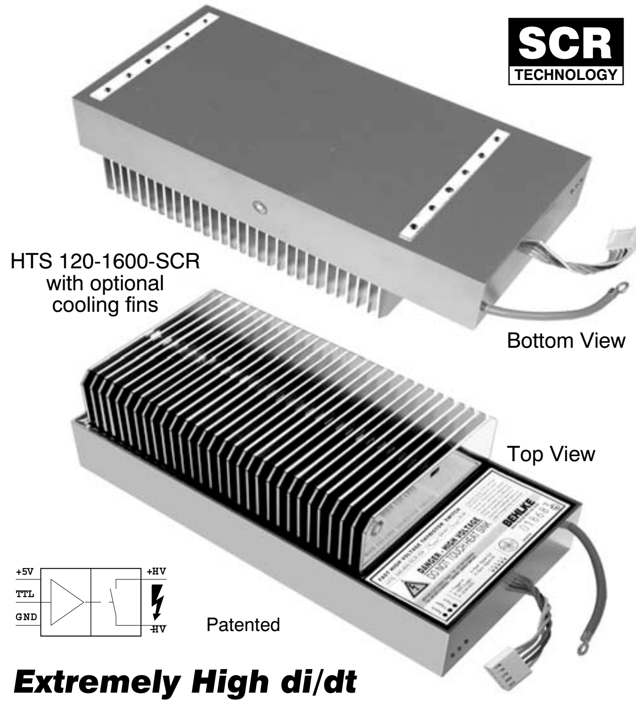
These solid-state switches are designed for high voltage high peak current switching applications such as shock wave generators, flash lamp drivers, crow bar circuits and surge generators. The switching modules contain a large number of reverse blocking thyristors (SCR) with a special chip architecture for high surge conditions. Several hundred of these SCR's, each with its own low-impedance gate drive, are connected in series and in parallel to ensure the extreme di/dt of up to 32 kA/µs. The safe and synchronous control of all SCR's is performed by a patented driver which provides also 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 series HTS-SCR 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. A special synchronization input/output (Sync.) allows a simple parallel connection of up to 50 switching modules to multiply the turn-on peak current capability.

The switches are triggered by a positive going pulse of 3-10 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). The turn-off process requires insofar 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 the 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 compare also the application note below.

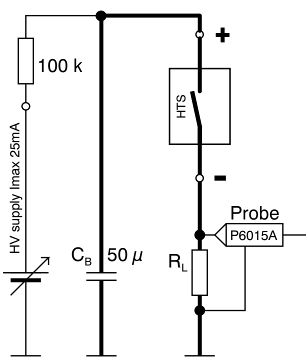
The plastic case is the cost-effective standard package in low frequency applications with low average power. For higher load the Maximum Continuous Power Dissipation $P_{d(max)}$ can be increased by optional cooling fins which are available in different sizes for a Pd(max) of up to 1.5 kW in air (forced convection >4m/s) and approximately up to 15 kW in liquids. For further design recommendations please refer to the general instructions.



Patented

Extremely High di/dt
High Surge Current Capability

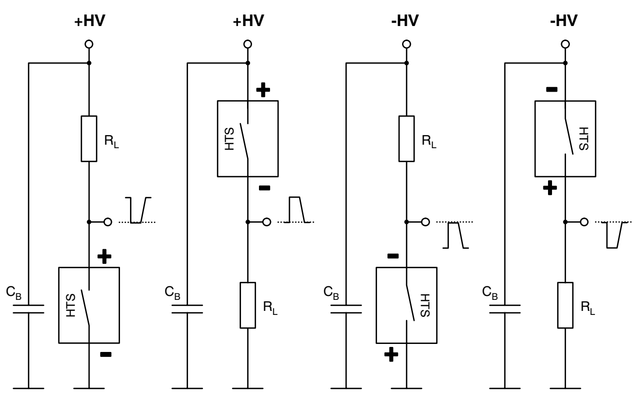
Test Circuit for $t_{r(on)}$



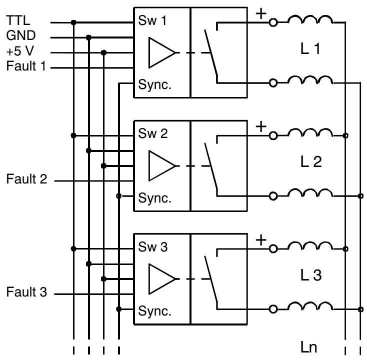
Notes:

1. Total wiring inductance < 50 nH
2. C_B is a MAXWELL low inductance energy storage capacitor (<10 nH)
3. R_L depends on voltage and peak current test conditions. Low inductance mass resistors, CESIWID series 900, washer style, 3 inch disc diameter, E_{max}=27600 J /disc.
4. High-voltage probe TEKTRONIX P 6015 A must be connected by the Kelvin method to exclude measurement errors.

Basic Circuits

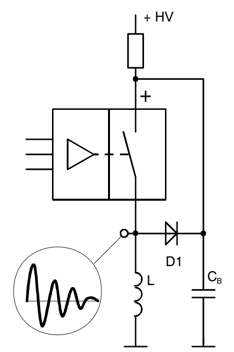


Parallel Connection



Note: Symetrical layout is recommended for good dynamic current sharing (Wiring inductance L1 to Ln should be equal).

Inductive Load



Note: D1 is a fast recovery diode with Kiloamps peak current capability (E.g. Behlke Series FDA)

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TECHNICAL DATA

Specification	Symb.	Condition / Comment		120-1600-SCR	160-1600-SCR	Unit
Maximum Operating Voltage	$V_{O(max)}$	I_{off} < 600 σADC, T_{case} = 70°C		12000	16000	VDC
Minimum Operating Voltage	$V_{O(min)}$			0		VDC
Typical Breakdown Voltage	V_{br}	I_{off} > 3 mADC, T_{case} = 70 °C		13200	17600	VDC
Maximum Off-State Current	I_{off}	0.8 x V_O, T_{case} = 25°C		100		µADC
Galvanic Isolation	V_I	HV side against control side, continuously		40000	40000	VDC
Maximum Turn-On Peak Current	$I_{P(max)}$	T_{case} / T_{fin} = 25°C, half sine.	t_p< 100 µs, duty cycle <1%	16000		
		Pls.consult factory for	t_p< 500 µs, duty cycle <1%	8000		
		higher temperatures and	t_p< 1 ms, duty cycle <1%	5440		
		other waveshapes.	t_p< 10 ms, duty cycle <1%	3200		ADC
Max. Non-repetitive Peak Current	$I_{P(nr)}$	T_{case} / T_{fin} = 25°C	Half sine single pulse, tp<200µs	32000		
			Half sine single pulse, tp< 20µs	64000		ADC
Max. Continuous Load Current	I_L	T_{case} / T_{fin} = 25°C	Standard plastic case	5.76		
			Opt. 04, cooling fins (air >4m/s)	56		ADC
Typical Holding Current			T_{case} / T_{fin}= 25°C	100		
			T_{case} / T_{fin}= 70°C	70		mADC
Typical On-State Voltage	V_{sat}	T_{case} / T_{fin} = 25°C	0.001 x $I_{P(max)}$	13	17	
		t_p< 10µs, duty cycle <1%	0.01 x $I_{P(max)}$	14	19	
			0.1 x $I_{P(max)}$	23	30	
			1.0 x $I_{P(max)}$	60	80	VDC
Typical Turn-On Delay Time	$t_{d(on)}$	0.1 $I_{P(max)}$, 0.8 x $V_{O(max)}$ resistive load, 50-50%		450	470	ns
Typical Turn-On Rise Time	$t_{r(on)}$	Resistive load, 10-80 %	0.1 x $V_{O(max)}$, 0.1 x $I_{P(max)}$	550	550	
			0.8 x $V_{O(max)}$, 0.1 x $I_{P(max)}$	170	170	
			0.8 x $V_{O(max)}$, 1.0 x $I_{P(max)}$	450	490	ns
Typical Turn-Off Time	t_{off}, t_q	T_{case} / T_{fin} = 25°C, inductive	0.01x $I_{P(max)}$	10		
		load / free wheeling diode	0.1 x $I_{P(max)}$	35		
			1.0 x $I_{P(max)}$	90		µs
Critical Rate-of-Rise of Off-State Voltage	dv/dt	@ $V_{O(max)}$, exponential waveform		75	100	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		1000		
		With option 01		100		µs
Typical Turn-On Jitter	$t_{j(on)}$	V_{aux} / V_{tr} = 5.0 VDC		1		ns
Max. Cont. Switching Frequency	$f_{(max)}$	Please note $P_{d(max)}$ limitations, increased $f_{(max)}$ on request		500	350	Hz
Maximum Burst Frequency	$f_{b(max)}$	With option 01, $I_{P(max)}$ < 16kA, please consult factory		1		
(Triggered)		With option 01, $I_{P(max)}$ < 1kA, please consult factory)		10		kHz
Maximum Continuous Power	$P_{d(max)}$	T_{case} = 25°C	Standard plastic case	52	65	
Dissipation		T_{fin} = 25°C	Option 04, cooling fins (air stream >4m/s)	450	600	Watts
Linear Derating		Above 25°C	Standard plastic case	0.866	1.083	
		T_{case} / T_{fin}	Option 04, cooling fins (air stream > 4m/s)	10	13.33	W/K
Temperature Range	T_O	Standard plastic case		-40...85		°C
Coupling Capacitance	C_C	HV side against control side		210	290	pF
Auxiliary Supply Voltage	V_{aux}	Stabilized to ∂ 5%		5.0 (∂ 5%)		VDC
Auxiliary Supply Current	I_{aux}	@ $f_{(max)}$		600		mADC
Trigger Voltage Range	V_{tr}	Switching behaviour cannot be influenced by trigger quality		3-10		VDC
Fault Signal Output		Short circuit proof, source/sink current	Ready = High	>4.0		
		max.10mADC. See product description.	Fault = Low	<0.8		VDC
Synchronization Input/Output		Short circuit proof, output pulse 4 VDC / 1ms		-		-
Operating Mode Indication		By LED's: Green=Ready, Yellow=Trigger, Red=Failure		-		-
High Voltage Connection		Low inductance srew terminals for printed circuit boards		-		-
Dimensions		Standard plastic case, reduced size on request.		204x103x31	253x103x31	
		With option 04 (Please consult factory for detailed drawings)		204x103x66	253x103x66	mm^3
Weight		Standard plastic case, reduced weight on request.		1950	2400	
		With option 04.		2590	3250	g

Ordering Informations

HTS 120-1600-SCR	Thyristor switch, 12 kVDC, 16 kA(pk)	**Option 02**	Flame retardend casting resin UL 94-V0
HTS 320-800-SCR	Thyristor switch, 16 kVDC, 8 kA (pk)	**Option 03**	Increased thermal conductivity (plastic case only)
Option 01	High frequency burst	**Option 04**	Cooling fins (Fins are on high voltage potential!)

All data and specifications subject to change without notice. Custom designed devices on request.