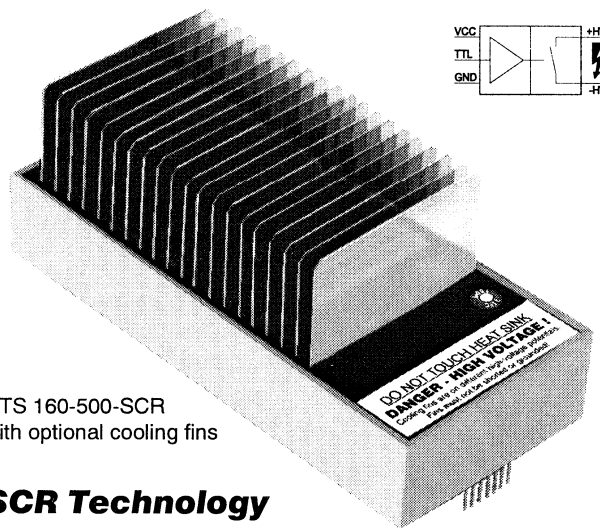


FAST HIGH VOLTAGE THYRISTOR SWITCHES

These solid-state switches are designed for high voltage high peak current switching applications such as piezo drivers, flash lamp drivers, crowbar circuits and surge generators. The switching modules described here are developed on the basis of a special type of SCR (Silicon Controlled Rectifier) with a very high surge current capability. Each switching module consists of a large number of these SCR's which are connected in series and in parallel. The extremely fast and synchronous turn-on of all SCR's is performed by a special low impedance driver circuit, which provides also galvanic isolation from the control input. Internal current paths are optimized regarding stray inductance which allows extremely high rates of change of turn-on current. 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 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 turned-off and a fault signal is generated. A special synchronization input allows the parallel interconnection of up to 50 switching modules to multiply the turn-on peak current of a single module. The switches are triggered by a positive going signal of 3 to 10 volts amplitude. After being triggered the SCR switches remain in on-state until the load current falls below the holding current (Typical thyristor behavior). The turn-off process requires insofar a current commutation, a current limitation or a current bypass. In most discharge applications the turn-off process can be performed simply by keeping the charging current of the energy storage capacitor below the holding current of the switch. Charging currents higher than the holding current require a bypass switch, preferably in MOSFET technology. If operated with inductive loads respectively in case of alternating current the thyristor switch turns off automatically if the load current commutates, provided the negative half wave lasts longer than the Turn-off Time t_{off} . If the periodic duration is less than 1 ms a fast free-wheeling diode should be connected in parallel with the switch to avoid dangerous overvoltage spikes during turn-off. Due to the galvanic isolation the switches may simply be operated also in high-side circuits. The plastic case is the cost-effective standard package in applications with a low power dissipation. To increase the Maximum Continuous Power Dissipation $P_{d(max)}$ the modules can be additionally fitted with non-isolated cooling fins (Option O4). For detailed design recommendations please refer to the general instructions.

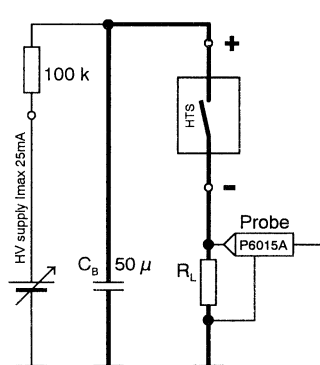
- HTS 80-500-SCR** 8000 V / 5000 A (pk)
- HTS 120-500-SCR** 12000 V / 5000 A (pk)
- HTS 160-500-SCR** 16000 V / 5000 A (pk)



HTS 160-500-SCR with optional cooling fins

SCR Technology
Extremely High di/dt
High Surge Current Capability Patented

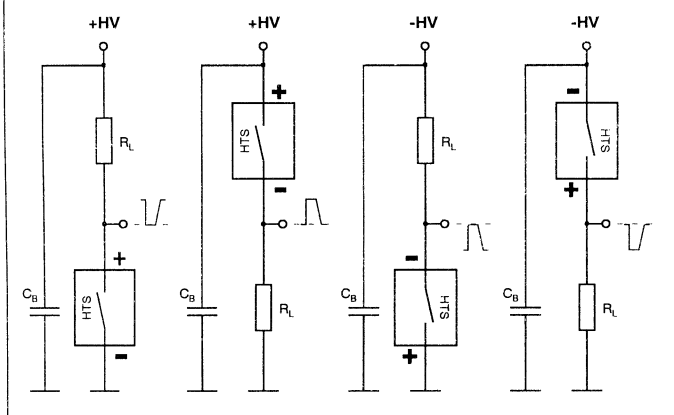
Test Circuit for $t_{r(on)}$



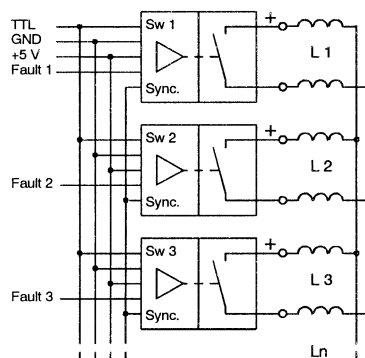
Notes:

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

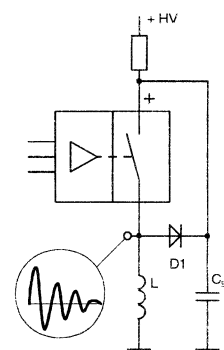


Parallel Connection



Note: Symmetrical 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)

TECHNICAL DATA

Specification	Symb.	Condition / Comment	80-500-SCR	120-500-SCR	160-500-SCR	Unit
Maximum Operating Voltage	$V_{O(max)}$	$I_{off} < 300 \mu ADC$, $T_{case} = 70^\circ C$	8000	12000	16000	VDC
Minimum Operating Voltage	$V_{O(min)}$			0		VDC
Typical Breakdown Voltage	V_{br}	$I_{off} > 3 mADC$, $T_{case} = 70^\circ C$	8800	13200	17600	VDC
Maximum Off-State Current	I_{off}	$0.8 \times V_O$, $T_{case} = 25^\circ C$		100		μADC
Galvanic Isolation	V_I	HV side against control side, continuously	10000	15000	20000	VDC
Maximum Turn-On Peak Current	$I_{P(max)}$	$T_{case}=25^\circ C$ $t_p < 100 \mu s$, duty cycle $< 1\%$ $t_p < 500 \mu s$, duty cycle $< 1\%$ $t_p < 1 ms$, duty cycle $< 1\%$ $t_p < 10 ms$, duty cycle $< 1\%$		5000 2500 1700 1000		ADC
Max. Non-repetitive Peak Current	$I_{P(nr)}$	$T_{case}=25^\circ C$ Half sine single pulse, $t_p < 200 \mu s$ Half sine single pulse, $t_p < 20 \mu s$		10000 20000		ADC
Max. Continuous Load Current	I_L	$T_{case}=25^\circ C$ $T_{fin} = 25^\circ C$ Standard plastic case Opt. 04, cooling fins (air $> 4m/s$)	1.75 16	1.6 16	1.6 16	ADC
Typical Holding Current				50 35		mADC
Typical On-State Voltage	V_{sat}	$T_{case} = 25^\circ C$ $t_p < 10 \mu s$, duty cycle $< 1\%$	$0.001 \times I_{P(max)}$ 7.5 $0.01 \times I_{P(max)}$ 9 $0.1 \times I_{P(max)}$ 14 $1.0 \times I_{P(max)}$ 40	12 14 23 64	15 18 28 80	VDC
Typical Turn-On Delay Time	$t_{d(on)}$	$0.1 I_{P(max)}$, $0.8 \times V_{O(max)}$ resistive load, 50-50%	170	180	195	ns
Typical Turn-On Rise Time	$t_{r(on)}$	Resistive load, 10-80 %	$0.1 \times V_{O(max)}$, $0.1 \times I_{P(max)}$ 440 $0.8 \times V_{O(max)}$, $0.1 \times I_{P(max)}$ 130 $0.8 \times V_{O(max)}$, $1.0 \times I_{P(max)}$ 250	450 140 320	470 155 360	ns
Typical Turn-Off Time	t_{off} , t_q	$T_{case} / T_{fin} = 25^\circ C$, inductive load / free wheeling diode		35 90		μs
Critical Rate-of-Rise of Off-State Voltage	dv/dt	@ $V_{O(max)}$, exponential waveform	50	75	100	kV/ μs
Maximum On-Time	$t_{on(max)}$	Please note $P_{d(max)}$ limitations	Depending on holding current flow only			
Switch Recovery Time	t_{rc}	$t_{rc} + t_{on(min)}$ = minimum pulse spacing		500		ns
Typical Turn-On Jitter	$t_{j(on)}$	$V_{aux} / V_{tr} = 5.0 VDC$		1		ns
Max. Switching Frequency	$f_{(max)}$	Please note $P_{d(max)}$ limitations	5	3.5	2.5	kHz
Maximum Burst Frequency	$f_{b(max)}$	With option 01 only, $0.1 \times I_{P(max)}$		25		kHz
Maximum Continuous Power Dissipation	$P_{d(max)}$	$T_{case} = 25^\circ C$ $T_{fin} = 25^\circ C$ Standard plastic case Opt. 04, cooling fins (air $> 4m/s$)	15 130	20 210	26 260	Watts
Linear Derating		Above $25^\circ C$ T_{case} / T_{fin} Standard plastic case Opt. 04, cooling fins (air $> 4m/s$)	0.33 2.89	0.44 4.66	0.58 5.77	W/K
Temperature Range	T_O	Extended range on request		-40...70		$^\circ C$
Coupling Capacitance	C_C	HV side against control side	50	80	100	pF
Auxiliary Supply Voltage	V_{aux}	Stabilized to $\pm 5\%$		5.0 ($\pm 5\%$)		VDC
Auxiliary Supply Current	I_{aux}	@ f_{max}		500		mADC
Control Signal	V_{tr}			3-10		VDC
Fault Signal		L=Fault		H= 4 V, L= 0.5 V		VDC
Dimensions		Standard case, reduced size on request With option 04 (cooling fins)	89x64x31 89x64x66	122x64x31 122x64x66	178x64x31 178x64x66	mm ³
Weight		Standard case, reduced weight on request With option 04 (cooling fins)	400 500	550 710	760 960	g

Ordering Informations

HTS 80-500-SCR	Thyristor switch, 8000 VDC, 5000 A (pk)	Option 02	Flame retardend casting resin UL94-VO
HTS 120-500-SCR	Thyristor switch, 12000 VDC, 5000 A (pk)	Option 03	Increased thermal conductivity (plastic case only)
HTS 160-500-SCR	Thyristor switch, 16000 VDC, 5000 A (pk)	Option 04	Cooling fins (fins are on high voltage potential)
Option 01 A	High frequency burst		
Option 01 B	Synchronization input/output		

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