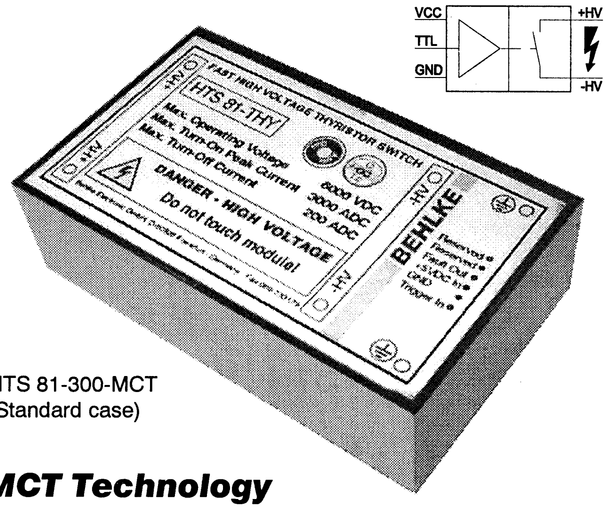
FAST HIGH VOLTAGE THYRISTOR SWITCHES

These solid-state switches are designed for high voltage high peak current switching applications such as piezo drivers, flash lamp drivers, crowbar circuits and power pulse generators. The switching modules described here are developed on the basis of a new type of thyristor, the so called MCT (MOS Controlled Thyristor). Thyristor switches made of MCT's combine low on-state conduction loss, high surge current capability and a certain capability for active turn-off. The turn-off capability is specified by the Maximum Controllable Turn-off Current rating $I_{off(max)}$. Provided this absolute maximum rating is not exceeded the on-time of MCT switches can be controlled between the Minimum On-Time $t_{on(min)}$ and infinity simply by the duration of the control signal.

Each switching module consists of a large number of MCT's which are connected in series and in parallel. The extremely fast and synchronous turn-on of all MCT'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-MCT 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. An optional synchronization input allows the parallel interconnection of up to 50 switching modules to multiply the turn-on peak current of a single module (Option 01B). The switches are controlled by a positive going signal of 3 to 10 volts amplitude. Due to the limited reverse voltage (Cf. data table, V_{rb} parameter) MCT switches always have to be operated with fast free-wheeling diodes if inductive loads are connected. 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 04). For detailed design recommendations please refer to the general instructions.

HTS 41-300-MCT — 4000 V / 3000 A (pk)
HTS 81-300-MCT — 8000 V / 3000 A (pk)
HTS 101-300-MCT — 10000 V / 3000 A (pk)

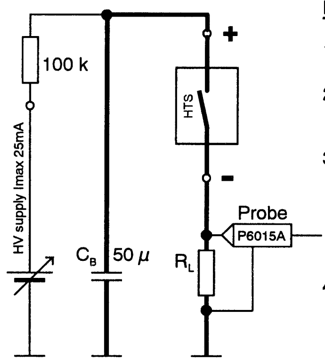


HTS 81-300-MCT
(Standard case)

MCT Technology
Low Conduction Loss
200A Turn-Off Capability

Patented

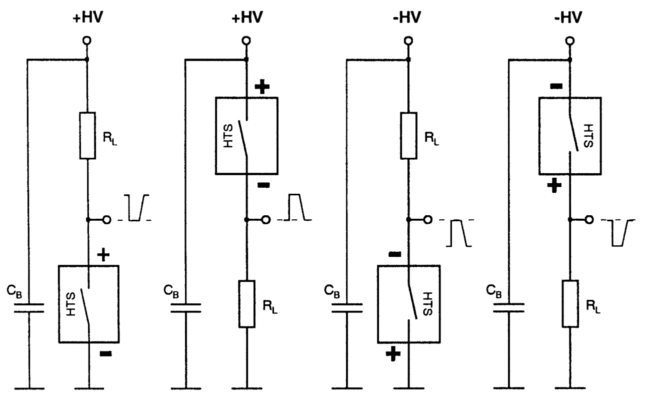
Test Circuit for $t_{r(on)}$



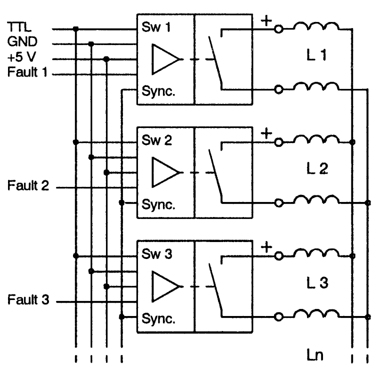
Notes:

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

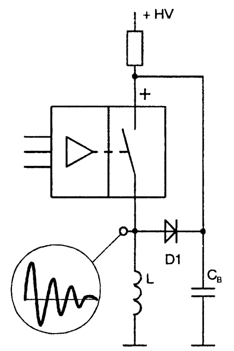


Parallel Connection



Note: Symetrical layout is recommended for good dynamic current sharing (Wiring inductance L1 to Ln shoud 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		41-300-MCT	81-300-MCT	101-300-MCT	Unit
Maximum Operating Voltage	$V_{O(max)}$	I_{off} < 300 µADC, T_{case} = 70°C		4500	8000	10000	VDC
Minimum Operating Voltage	$V_{O(min)}$				0		VDC
Typical Breakdown Voltage	V_{br}	I_{off} > 3 mADC, T_{case} = 70 °C		5000	9000	11000	VDC
Maximum Reverse Voltage	V_{rb}			25	45	55	VDC
Maximum Off-State Current	I_{off}	0.8 x $V_{O,}$ T_{case} = 25°C			250		µADC
Galvanic Isolation	V_I	HV side against control side		15000	20000	20000	VDC
Maximum Turn-On Peak Current	$I_{P(max)}$	T_{case}=25°C	t_p< 100 µs, duty cycle <1%		3000		
			t_p< 500 µs, duty cycle <1%		2000		
			t_p< 1 ms, duty cycle <1%		1000		ADC
Max. Non-repetive Peak Current	$I_{P(nr)}$	T_{case}=25°C	Half sine single pulse, tp<200µs		4000		
Max. Continuous Load Current	I_L	T_{case}=25°C	Standard plastic case	2.7	1.72	1.51	
		T_{fin} = 25°C	Opt. 04, cooling fins (air >4m/s)	17	16	16	ADC
Maximum Controllable Turn-Off Current (Cf. note 1)	$I_{off(max)}$	T_{case}=70°C	0.5 x $V_{O(max)}$		200		
			0.8 x $V_{O(max)}$		100		ADC
Typical On-State Voltage	V_{sat}	T_{case} = 25°C	0.01 x $I_{P(max)}$	5.5	9.9	12	
		t_p< 10µs, duty cycle <1%	0.1 x $I_{P(max)}$	7.5	14	17	
			1.0 x $I_{P(max)}$	18	32	39	VDC
Turn-On Delay Time	$t_{d(on)}$	@ $I_{P(max)}$, resistive load, 50-50%			550		ns
Typical Turn-On Rise Time	$t_{r(on)}$	Resistive load,	0.1 x $V_{O(max)}$, 0.1 x $I_{P(max)}$	260	260	270	
		10-80 %	0.8 x $V_{O(max)}$, 0.1 x $I_{P(max)}$	110	120	120	
			0.8 x $V_{O(max)}$, 1.0 x $I_{P(max)}$	180	200	200	ns
Typical Turn-Off Delay Time	$t_{d(off)}$	0.8x$V_{O(max)}$, @ $I_{off(max)}$, resistive load, 50-50%			2.1		µs
Typical Turn-Off Rise Time	$t_{r(off)}$	0.8x$V_{O(max)}$, @ $I_{off(max)}$, resistive load, 10/90%			1.5		µs
Critical Rate-of-Rise of Off-State Voltage	dv/dt	@ $V_{O(max)}$, exponential waveform		50	90	110	kV/µs
Minimum On-Time (Cf. note 1)	$t_{on(min)}$	Standard			1		
		Option 06, customized $t_{on(min)}$			1...1000		µs
Maximum On-Time	$t_{on(max)}$	Please note $P_{d(max)}$ limitations			∞		
Switch Recovery Time	t_{rc}	t_{rc} + $t_{on(min)}$ = minimum pulse spacing			2		µs
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,		8	5	4	kHz
Maximum Burst Frequency	$f_{b(max)}$	With option 01 only			330		kHz
Maximum Continuous Power Dissipation	$P_{d(max)}$	T_{case} = 25°C	Standard plastic case	12	14	15	
		T_{fin} = 25°C	Opt. 04, cooling fins (air >4m/s)	77	131	158	Watts
Linear Derating		Above 25°C	Standard plastic case	0.266	0.311	0.33	
		T_{case} / T_{fin}	Opt. 04, cooling fins (air >4m/s)	1.71	2.91	3.51	W/K
Temperature Range	T_O	Extended range on request			-40...70		°C
Coupling Capacitance	C_C	HV side against control side		12	13	15	pF
Auxiliary Supply Voltage	V_{aux}	Stabilized to ± 5%			5.0 (± 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		89x64x31	116x64x31	178x64x31	
		With option 04 (cooling fins)		89x64x66	116x64x66	178x64x66	mm^3
Weight		Standard case, reduced weight on request		340	470	620	
		With option 04 (cooling fins)		390	560	730	g

Note 1) MCT switches have a limited turn-off capability which is specified by $I_{off(max)}$. This parameter is an absolute maximum rating and must not be exceeded. In high peak current discharge applications the switch has to be kept actively in on-state until the discharge current drops safely below $I_{off(max)}$. Time constants longer than 1µs require option 06 (customized on-time extension, 1µs to 1 ms) for maximum switch protection.

Ordering Informations

HTS 41-300-MCT	Thyristor switch, 4000 VDC, 3000 A (pk)
HTS 81-300-MCT	Thyristor switch, 8000 VDC, 3000 A (pk)
HTS 101-300-MCT	Thyristor switch, 10000 VDC, 3000 A (pk)
Option 01 A	High frequency burst
Option 01 B	Synchronization input / output
Option 02	Flame retardend casting resin UL94-VO
Option 03	Increased thermal conductivity (plastic case only)
Option 04	Cooling fins (fins are on high voltage potential)
Option 06	Customized $t_{on(min)}$ from 1 to 1000 µs. Please refer to note 1)

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

101-300-MCT-01.00