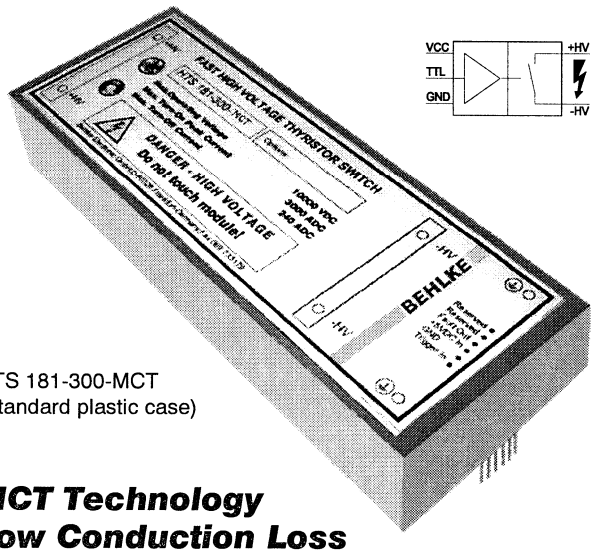
FAST HIGH VOLTAGE THYRISTOR SWITCHES

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 121-300-MCT 12000 V / 3000 A (pk)
HTS 151-300-MCT 15000 V / 3000 A (pk)
HTS 181-300-MCT 18000 V / 3000 A (pk)

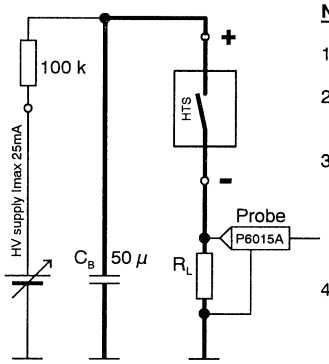


HTS 181-300-MCT
(Standard plastic case)

MCT Technology
Low Conduction Loss
200A Turn-Off Capability

Patented

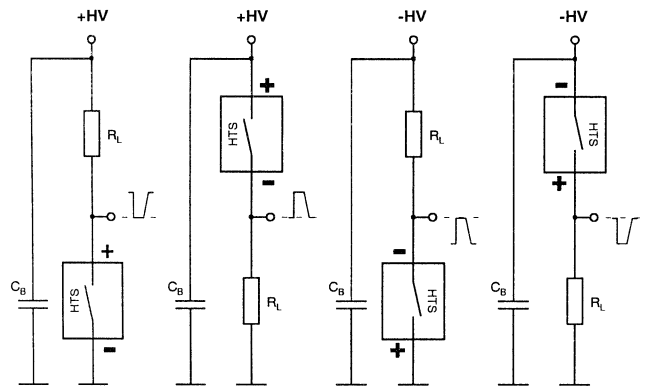
Test Circuit for $t_{r(on)}$



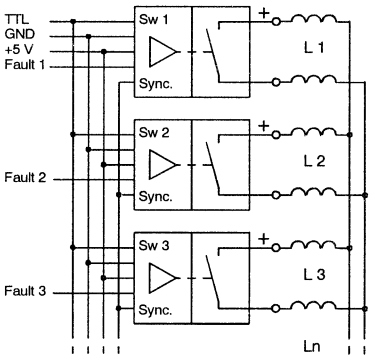
Notes:

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

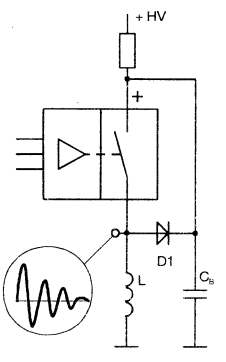


Parallel Connection



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)

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BEHLKE

TECHNICAL DATA

Specification	Symb.	Condition / Comment			121-300-MCT	151-300-MCT	181-300-MCT	Unit
Maximum Operating Voltage	$V_{O(max)}$	I_{off} < 300 µADC, T_{case} = 70°C			12000	15000	18000	VDC
Minimum Operating Voltage	$V_{O(min)}$					0		VDC
Typical Breakdown Voltage	V_{br}	I_{off} > 3 mADC, T_{case} = 70 °C			14000	17000	20000	VDC
Maximum Reverse Voltage	V_{rb}				70	85	100	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				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		1.14	1.18	1.1	
		T_{fin} = 25°C	Opt. 04, cooling fins (air >4m/s)		14	14	14	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 $I_{P(max)}$	15	19	22	
		t_p< 10µs, duty cycle <1%		0.1 x $I_{P(max)}$	25	31	36	
				1.0 x $I_{P(max)}$	49	60	70	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 $I_{P(max)}$		270	285	310	
		10-80 %	0.8 x $V_{O(max)}$, 0.1 x $I_{P(max)}$		110	140	150	
			0.8 x $V_{O(max)}$, 1.0 x $I_{P(max)}$		200	210	240	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			140	170	200	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,			3	2	1.5	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		16	20	22	
		T_{fin} = 25°C	Opt. 04, cooling fins (air >4m/s)		200	240	280	Watts
Linear Derating		Above 25°C	Standard plastic case		0.36	0.44	0.49	
		T_{case} / T_{fin}	Opt. 04, cooling fins (air >4m/s)		4.44	5.33	6.22	W/K
Temperature Range	T_O	Extended range on request				-40...70		°C
Coupling Capacitance	C_C	HV side against control side			16	20	35	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				178x64x31		
		With option 04 (cooling fins)				178x64x66		mm^3
Weight		Standard case, reduced weight on request			590	620	650	
		With option 04 (cooling fins)			740	790	850	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 121-300-MCT	Thyristor switch, 12000 VDC, 3000 A (pk)	**Option 02**	Flame retardend casting resin UL94-VO
HTS 151-300-MCT	Thyristor switch, 15000 VDC, 3000 A (pk)	**Option 03**	Increased thermal conductivity (plastic case only)
HTS 181-300-MCT	Thyristor switch, 18000 VDC, 3000 A (pk)	**Option 04**	Cooling fins (fins are on high voltage potential)
Option 01 A	High frequency burst	**Option 06**	Customized $t_{on(min)}$ from 1 to 1000 µs. Please refer to note 1)
Option 01 B	Synchronization input / output		

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