FAST HIGH VOLTAGE TRANSISTOR SWITCHES

This new generation of BEHLKE high voltage switching modules utilize an advanced MOSFET technology with very low on-resistance, the so called Trench FET technology. The switching speed of those modern FET is slightly slower than that of a classical power FET, but is still much faster than that of any IGBT, which is preferably used to achieve low turn-on losses. The new MOSFET switches of series HTS-B combine very low dynamic switching losses with moderate turn-on losses and are a serious alternative to IGBT switches. Another important advantage compared to the fault sensitive IGBT is the positive temperature coefficient of the on-resistance, which makes the switch short circuit proof within the thermal limits. Furthermore overvoltage transients as well as voltage reversal respectively current reversal is less dangerous to MOSFET's than to IGBT's. Insofar these switching modules are well suitable for applications with high demands on operational safety even under worst conditions.

The switching modules incorporate all features of the well known HTS switch family: Easy handling, high reliability, low jitter and reproducible switching behaviour.

The switch is turned on by a positive going signal of 3 to 6 volts amplitude, provided the auxiliary power supply is permanently connected to the +5.00 VDC input. The on-time may simply be varied between 250 ns and infinity by the input control pulse width. An interference-proof driver circuit provides signal conditioning, auxiliary voltage monitoring, frequency limitation and temperature protection. In case of any false operating condition the switches turn off immediately and a fault signal is generated (TTL level). The high frequency burst operation (>10 pulses/100µs) requires the option HFB (connection of external buffer capacitors at the driver). For operation at higher frequencies than specified under $f_{(max)}$ the option HFS must be used. In that case an internal DC/DC converter must be supported by an external supply of +180 VDC (± 5%, approx. 2-10 Watts depending on switching frequency).

Due to the high galvanic isolation the switches may simply be operated also in floating set-up's or in high-side circuits. Several housing options are available to meet individual constructional and power requirements. The standard plastic housing is used in low frequency applications with low average power dissipation. The plastic modules can additionally be fitted with non-isolated cooling fins (available as options CF, CF-X2 and CF-X3), which improves the max. Continuous Power Dissipation $P_{d(max)}$ by approx. factor 10 with forced air (>4m/s) or by factor 50, if the switching modules are immersed in isolating cooling liquids (e.g. GALDEN HT200, flow rate >0.1m/s, standard cooling fins). Another cooling method is given by the use of the grounded cooling flange (option GCF and GCF-X2). In conjunction with an optional water cooling plate or any other high performance heatsink, maximum power dissipations in the range of 1 to 3 kW are possible, with larger customized cooling flanges even up to 6 kW.

The modules can be installed on a printed circuit board, but if operated under air conditions, the use of option PT-HV (pigtails for HV connection) is recommended, in order to ensure a sufficient creepage distance according to industrial standards. For detailed design recommendations please refer to the general instructions for use.

HTS 81-12-B 8.4kV / 125 A
HTS 81-25-B 8.4 kV / 250 A

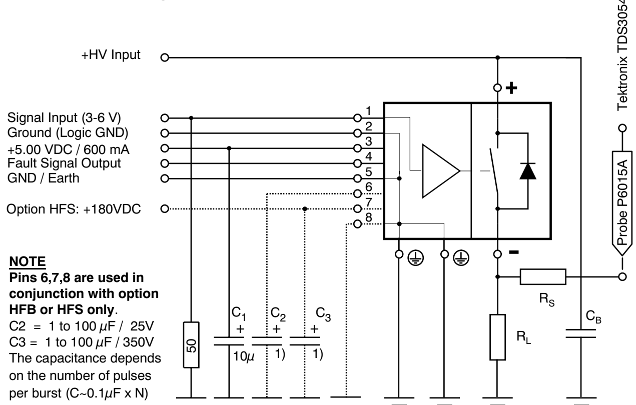
HTS 81-25-B
with option GCF

- Patented -
Made in Germany

MOSFET TECHNOLOGY

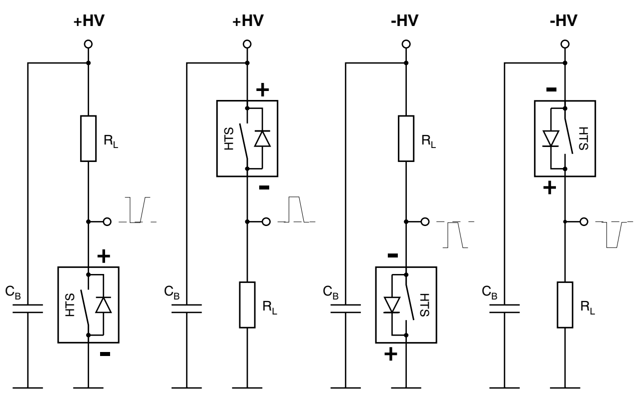
Variable On-Time
Very Low On-Resistance

Test Circuit (High-Side Switch)



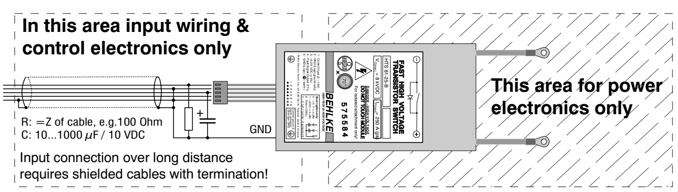
NOTE
Pins 6,7,8 are used in conjunction with option HFB or HFS only.
C2 = 1 to 100 µF / 25V
C3 = 1 to 100 µF / 350V
The capacitance depends on the number of pulses per burst (C~0.1µF x N)

Basic Circuits



Important EMC Design Hints

- Keep the wiring as short as possible and avoid large induction loop areas of the peak current carrying lines; the forward and return lines should be installed as closely as possible together. Control and power circuit must not be mixed. Always keep the transformer principle in mind!
- Use shielded leads at the control side to minimize noise induction. Low impedance drivers with 5 Volt output swing (into 50 Ohm) are required for driving long pulse transmission lines. Signal transmission lines must be terminated properly (e.g. by 50 Ohm). The auxiliary power supply must be well decoupled by a sufficient buffer capacitor.
- This high speed switching module can generate extreme di/dt's and dv/dt's. Therfore it is not useful to operate the switch and its peripheric components without a shielded housing. Other electronics including power supplies (!) may be disturbed. Please note your local EMC / EMI regulations. Please also see our option offers for possible EMC / EMI relevant modifications.



Behlke Electronic GmbH, 61476 Kronberg, Germany, **Tel.** +49 (0) 6173 9290 -20, **Fax** -30, **email** info@behlke.de

BEHLKE

TECHNICAL DATA

Specification	Symb.	Condition / Comment		HTS 81-12-B	HTS 81-25-B	Unit
Maximum Operating Voltage	$V_{O(max)}$	I_{off} < 100 σADC		8400		VDC
Minimum Operating Voltage	$V_{O(min)}$	Increased $t_{r(on)}$ and $t_{r(off)}$ below 0.1 x $V_{O(max)}$		0		VDC
Typical Breakdown Voltage	V_{br}	I_{off} > 1mADC, T_{case} = 70 °C		8800		VDC
Galvanic Isolation	V_I	Continuously	Standard housing	15		
			Option PT-HV	25		
			Option ISO-80	80		kVDC
Maximum Peak Current	$I_{P(max)}$	T_{case} = 25°C	t_p < 100 µs, duty cycle <1%	125	250	
		T_{fin} = 70°C*	t_p < 1 ms, duty cycle <10%	67	135	
		*measured at base	t_p < 10 ms, duty cycle <10%	52	104	ADC
Max. Continuous Load Current	I_L	T_{case} = 25°C	Standard plastic case	2.1	3.2	
		T_{flange} =25°C	Option CF, fins in air >4m/s	7.1	9.9	
		T_{fin} = 70°C*	Option CF, in Galden⊇ >0.1m/s	14.6	20.6	
		*measured at base	Opt. GCF, grounded cooling flange	20.3	28.7	ADC
Static On-Resistance	R_{stat}	T_{case} = 25°C	0.1 x $I_{P(max)}$	1.3	0.65	
			1.0 x $I_{P(max)}$	3.4	1.7	T
Maximum Off-State Current	I_{off}	0.8xV_O, T_{case}=70°C, <5σA leakage optionally available		50		σADC
Turn-On Delay Time	$t_{d(on)}$	@ $I_{P(max)}$		160	190	ns
Typical Turn-On Rise Time	$t_{r(on)}$	0.1 x V_O, 0.1 x $I_{P(max)}$		10	11	
		0.5 x V_O, 0.1 x $I_{P(max)}$		12	12	
		0.8 x V_O, 0.1 x $I_{P(max)}$		16	19	
		0.8 x V_O, 1.0 x $I_{P(max)}$		28	33	ns
Typical Turn-Off Rise Time	$t_{r(off)}$	0.8 x V_O, 0.1 x $I_{P(max)}$, resistive load, 10-90%		50		ns
Minimum On-Time	$t_{on(min)}$	Lower $t_{on(min)}$ on request		180		ns
Maximum On-Time	$t_{on(max)}$	Please note possible $P_{d(max)}$ limitations		∞		
Switch Recovery Time	t_{rc}	t_{rc} = minimum pulse spacing		500		ns
Typical Turn-On Jitter	$t_{j(on)}$	V_{aux} / V_{tr} = 5.0 VDC, fixed switching frequency		300		ps
Max. Switching Frequency	$f_{(max)}$	Pls. note possible	Standard	15	10	
		$P_{d(max)}$ limitations	Opt. HFS, please consult factory	100	60	kHz
Maximum Burst Frequency	$f_{b(max)}$	Use option HFB for >5 pulses within100 µs		2		MHz
Maximum Continuous Power Dissipation	$P_{d(max)}$	T_{case} = 25°C	Standard plastic case	18		
		T_{flange} =25°C	Option CF, fins in air >4m/s	168		
		T_{fin} = 70°C*	Option CF, in Galden⊇ >0.1m/s	722		
		*measured at base	Opt. GCF, grounded cooling flange	1400		Watts
Linear Derating		T_{case} = 25°C	Standard plastic case	0.4		
		T_{flange} =25°C	Option CF, fins in air >4m/s	3.73		
		T_{fin} = 70°C*	Option CF, in Galden⊇ >0.1m/s	16.04		
		*measured at base	Opt. GCF, grounded cooling flange	31.11		W/K
Operating Temperature Range	T_O	Extended temperature range on request		-40...70		°C
Storage Temperature Range	T_{ST}			-50...90		°C
Natural Capacitance	C_N	Capacitance between switch poles at $V_{O(max)}$		38	77	pF
Coupling Capacitance	C_C	HV side to GND	Standard devices	20		
		or control side	Opt. GCF, grounded cooling flange	132		pF
Diode Reverse Recovery Time	t_{rrc}	I_F= 10 A, T_{case} = 25°C	MOSFET parasitic diode	500		ns
Diode Forward Voltage Drop	V_F	I_F= 10 A, T_{case} = 25°C	MOSFET parasitic diode	11.2		VDC
Auxiliary Supply Voltage	V_{aux}	∂2% stability recommended, max. tolerance ∂5%		5.00		VDC
Auxiliary Supply Current	I_{aux}	@ f_{max}		600		mADC
Control Signal	V_{tr}	> 3VDC recommended		2...6		VDC
Fault Signal Output		TTL compatible, short circuit proof, L=Fault		H= 4 V, L= 0.5 V		VDC
Dimensions	LxWxH	Standard plastic case		135x64x28		
		Option FC, flat case		135x64x19		
		Option CF, non-isolated cooling fins, standard size		135x64x63		
		Option GCF, grounded cooling flange		192x100x35		mm^3
Weight		Standard plastic case		420		
		Option FC, flat case		320		
		Option CF, non-isolated cooling fins, standard size		630		
		Option GCF, grounded cooling flange		1450		g

Ordering Information

HTS 81-12-B Transistor switch, 8 kVDC, 125 Amps.
HTS 81-25-B Transistor switch, 8 kVDC, 250 Amps.
Option HFB High frequency burst
Option HFS High frequency switching
Option LP Low pass at control input (delay +50ns)
Option S-TT Soft transition time for simplified EMC design
Option PT-HV Pigtails for HV connection
Option ISO-40 Galvanic isolation increased to 40 kVDC
Option ISO-80 Galvanic isolation increased to 80 kVDC
Option PIN-C Soldering pins instead of pigtail/plug as control connection
Option FC Flat plastic case, module height reduced to 19 mm
Option UL-94 Flame-retardant casting resin according to UL94-V0
Option CF Non-isolated cooling fins, standard size, 35 mm height
Option GCF Grounded cooling flange, direct attachment to heat sink

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