

# FAST HIGH VOLTAGE TRANSISTOR SWITCHES

## DESCRIPTION

The ultra fast transistor switches of the UF series are distinguished above all by an extremely short rise time which remains constant over a wide range of operating voltage and load. BEHLKE solid-state switches are actively controlled devices (no avalanche technique) and have a highly reliable and reproducible switching behaviour regardless to temperature and load conditions. Compared to conventional high voltage switching elements, such as gas discharge tubes and spark gaps, BEHLKE switches do not show aging effects and achieve life times by several orders of magnitude higher than any other classical high voltage switch.

The switches are very easy to handle and only require a well stabilized +5.00 VDC auxiliary supply and a TTL-compatible trigger signal at the control side. The trigger can be any positive going pulse of at least 50 ns width and 3 to 10 volts amplitude. Due to the schmitt-trigger input characteristics and the very high signal amplification neither the switching behaviour nor the turn-on rise time will be influenced by the waveshape of the trigger pulse. After being triggered the switch turns on for about 100 nanoseconds. Shorter on-times respectively pulses of a few nanoseconds duration may simply be generated by means of the on-time options OT-5ns, OT-10ns and OT-20ns. Any other customized on-time above 20 ns is possible if the turn-off rise time is of secondary interest. Above 30 ns the on-time can also be adjusted by means of option OT-P (Programmable On-Time) within certain limits. The recovery time after a switching cycle is less than 1µs, making burst frequencies of up to 1MHz possible. Burst frequencies of up to 10 MHz can be realized on a custom design base.

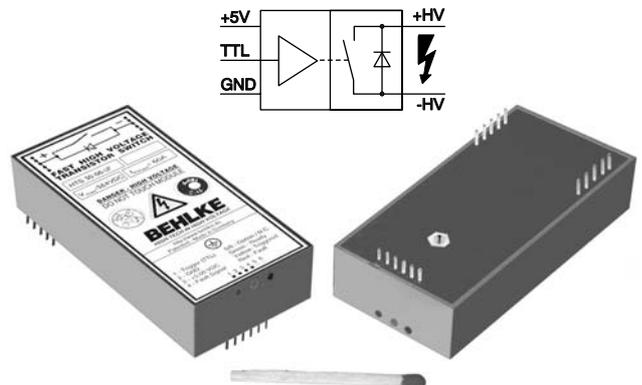
The internal driving circuit provides signal conditioning, auxiliary voltage monitoring, frequency limitation and temperature protection. The operating conditions are indicated by three built-in LEDs. In case of a fault (auxiliary voltage <4.75 VDC, frequency >f(max) and case temperature >75°C) the red LED will indicate the error and the switch is inhibited for at least 1 sec respectively for the duration of the fault condition. At the same time a TTL compatible fault signal is generated (Low=Fault). The reset time in case of over temperature can last some minutes depending on the ambient conditions. A green LED indicates "Ready for Operation" and a yellow one flashes if the switch has been triggered successfully.

The standard plastic housing is the cost efficient solution in low power / low frequency applications with up to 5 watts power dissipation. Above that the cooling option CF (non-isolated cooling fins) should be applied. Another cooling method is given by the grounded cooling flange, available as option GCF. The advantages are simplified heat removal by grounded heat sinks and less installation space, but the option GCF also implicates an increased coupling capacitance and consequently also slower rise times. Depending on circuitry,  $t_r$  may increase by approximately 10 to 50% when option GCF is used.

## CIRCUIT DESIGN RECOMMENDATIONS

In order to achieve the maximum turn-on rise time and the best HV pulse shape, all leads and circuit paths should be of lowest possible inductance. This can be achieved by means of very wide and short circuit tracks on the printed circuit board, if necessary in several layers (multi layer PCB). Part components such as  $R_s$ ,  $C_{BP}$  and  $C_B$  must be "inductance-free" and should only be connected with shortest possible wires / circuit tracks. Ground conducting tracks including the logic ground must be connected to a common ground point (star-type ground). Induction loop areas of dynamically current-carrying circuit paths should always be as small as possible. HV wiring and control circuitry should always be kept on distance. For further design recommendations please refer to the general instructions.

**HTS 30-08-UF** 3000 V / 80 A  
**HTS 30-06-UF** 3600 V / 60 A

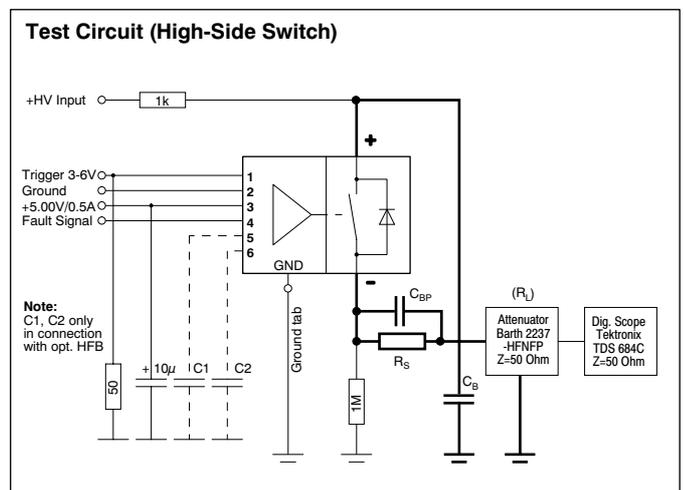
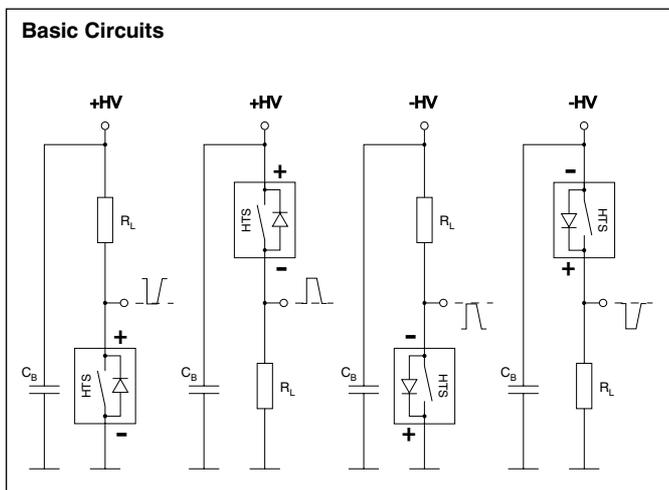
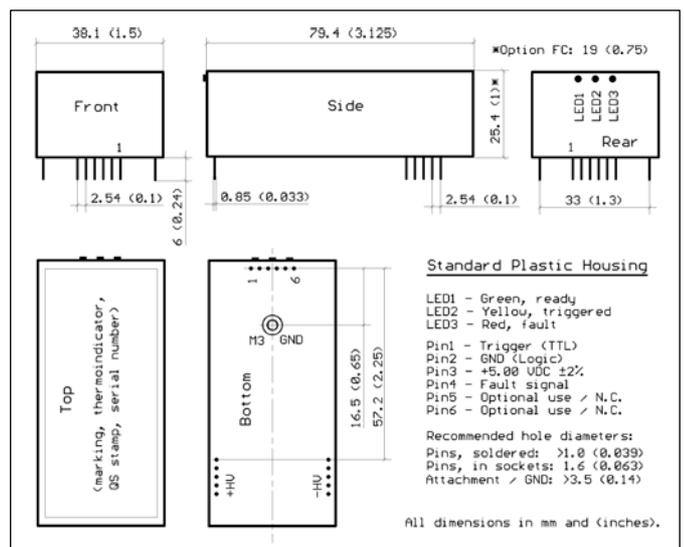


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# TECHNICAL DATA

Specification	Symbol	Condition / Comment	30-06-UF	30-08-UF	Unit
Max. Operating Voltage	$V_{O(max)}$	$I_{off} < 100 \mu ADC$	3600	3000	VDC
Lowest Useful Operating Voltage	$V_{O(min)}$	Use option 05 for lower voltages	Standard devices	100	VDC
			With OT Options	750	
Typical Breakdown Voltage	$V_{Br}$	$I_{off} > 1mADC, T_{case} = 70^\circ C$	3960	3300	VDC
Galvanic Isolation	$V_I$	HV side against control side	10000		VDC
Max. Peak Current	$I_{P(max)}$	$t_p < 50ns$	60	80	ADC
Static On-Resistance	$R_{stat}$	Current-dependent	$0.1 \times I_{P(max)}$	3.6	2.5
			@ $I_{P(max)}$	9.4	6.2
Max. Off-State Current	$I_{off}$	$0.8 \times V_O$	50		$\mu ADC$
Turn-On Delay Time	$t_{d(on)}$	@ $I_{P(max)}$	45		ns
Typical Turn-On Rise Time	$t_{r(on)}$	$0.8 \times V_O, R_L=50, R_S=33, 50\Omega$ BARTH attenuator $0.8 \times V_O, R_L=1k, C_L=7.5pF, HV$ probe PM 9100	1.9	1.6	ns
			0.7	0.6	
On-Time (Standard)	$t_{on}$	Voltage-dependent	@ $V_{O(max)}$	100	ns
			@ $V_{O(min)}$	120	
Min. Optional On-Time	$t_{on(min)}$	$\pm 20\%$ tolerance over the full voltage range	5		ns
Max. Optional On-Time	$t_{on(max)}$	Voltage-dependig	1		$\mu s$
Switch Recovery Time	$t_{rc}$	(Minimum pulse spacing)	1		$\mu s$
Typical Turn-On Jitter	$t_{j(on)}$	$V_{aux} / V_{tr} = 5.00$ VDC	100		ps
Max. Switching Frequency	$f_{(max)}$	Continuously, @ $V_{O(max)}$ , plastic case	5		kHz
Max. Burst Frequency	$f_{b(max)}$	Use „Burst Option“ for >10 pulses	1		MHz
Max. Power Dissipation	$P_{d(max)}$	Standard plastic case Option CF, cooling fins in air >4m/s With option GCF, grounded cooling flange	5		Watts
			60		
			300		
Linear Derating		Above 25°C Standard plastic case Option CF, cooling fins in air >4m/s With option GCF, grounded cooling flange	0.1		W/K
			1.2		
			6		
Temperature Range	$T_O$	Extended range on request	-40...75		°C
Natural Capacitance	$C_N$	@ $V_{O(max)}$	Standard devices	150	pF
			With OT options	50	
Coupling Capacitance	$C_C$	HV side against control side / GND	Standard device	7	pF
			Option GCF	31	
Diode Reverse Recovery	$t_{rrc}$	$0.2 \times I_{P(max)}$	1		$\mu s$
Auxiliary Supply Voltage	$V_{aux}$	Stabilized to $\pm 5\%$	5.0		VDC
Auxiliary Supply Current	$I_{aux}$	@ $f_{max}$	400		mADC
Trigger Signal	$V_{tr}$	> 3VDC recommended	2-10		VDC
Fault Signal Output		Short circuit proof, source/sink current max.10mADC. See product description.	Ready = High	>4.0	VDC
			Fault = Low	<0.8	
Fault Detection		By internal protection circuits. In case of fault the switch will be inhibited for approx. 1 sec respectively for the duration of fault. Reset time for thermal overload is ~5min	- Over temperature - Bad auxiliary voltage (<4.75 V) - Too high switching frequencies		
Operating Mode Indication		Built-in LEDs.	Green: Ready for trigger Yellow: Transistors triggered Red: Fault, switch is inhibited		
High Voltage Connection		Standard plastic case With option GCF, grounded cooling flange	Threated tabs at bottom for PCBs Threated tabs (metric M3) on top		
Control Connection		Standard plastic case With option GCF, grounded cooling flange	6 gold plated pins at bottom Pigtail with 5-pole miniature plug		
Dimensions		Standard plastic case Option FC, flat case Option CF, non-isolated cooling fins Opt. GCF, grounded cooling flange (overall dimension)	79 x 38 x 25		$mm^3$
			79 x 38 x 19		
			79 x 38 x 60		
			99 x 58 x 33		
Weight		Standard plastic case Option FC, flat case Option CF, non-isolated cooling fins Option GCF, grounded cooling flange	137		g
			116		
			185		
			420		

## Ordering Informations

**HTS 30-06-UF** Transistor switch, 3600 VDC, 60 Amps.  
**HTS 30-08-UF** Transistor switch, 3000 VDC, 80 Amps.  
**Option OT-5ns** On-time 5 ns  
**Option OT-10ns** On-time 10ns  
**Option OT-20ns** On-time 20ns  
**Option OT-C** Customized on-time, pls. indicate on-time  
**Option OT-P** Programmable on-time (only for  $t_p > 30$  ns)  
**Option ST** Stage tapping, pls. indicate tapping position

**Option UL** Flame retardend casting resin according to UL94-VO  
**Option CF** Non-isolated cooling fins,  $d=0.5$  mm, height 35 mm  
**Option GCF** Grounded cooling flange  
**Option GCF-W** Water cooler plate for the above cooling flange  
**Option FC** Flat case, 19 mm height  
**Option HFB** High frequency burst, for >10 pulses within <100  $\mu s$   
**Option IPC** Integrated part components (e.g. serial resistor or buffer capacitor) according to customers specification