FAST HIGH VOLTAGE TRANSISTOR SWITCHES

These MOSFET switches are designed for general high voltage switching applications such as deflection and acceleration grid drivers and electrical test equipment. The switching modules incorporate all features of the well known HTS switch family: Easy handling, high reliability, low jitter and reproducible switching behaviour. The HTS-LC2 series represents the second generation of Behlke low capacitance switches. The HV transient immunity of the HTS-LC2 series has been improved significantly and is now comparable with that of the standard HTS series.

The switch is turned-on by a positive going control signal of 3 to 6 Volts at the control input (pin1). The shielded control cable is terminated by an internal 100 Ohm resistor. The on-time may simply be controlled by the input control pulse width and can range from 200 ns to infinity. The control electronics of the switching module requires an auxiliary supply of +4.75 to +9.0 VDC (pin 3). To ensure a safe off-state of the switch, the auxiliary supply should be permanently present, especially in the case of possible voltage fluctuations or fast transients at the high voltage input.

An interference-proof driver and control circuit provides signal conditioning, auxiliary voltage monitoring, frequency limitation and temperature protection. Any false operating condition (under voltage, over frequency or over temperature) will result in immediate switch deactivation and a TTL compatible fault signal ("L") will be generated at pin 4 of the control plug. All operating conditions (pulse, on, off, fault) are indicated by LED's.

The high frequency burst operation (>100 pulses/100µs) requires the option "HFB" (High Frequency Burst) respectively "I-HFB" (Integrated High Frequency Burst), depending on the number of pulses to be generated. In case of option HFB, external buffer capacitors must be connected to the internal driver circuitry. A continuous high frequency operation above the specified maximum switching frequency requires the option "HFS" (High Frequency Switching). With the help of this option, two external supply voltages can be connected to increase the power capability of the internal switch driver for higher switching frequencies. Those external voltages are +15 V and +380-480 V, depending on switch model. The +5 V auxiliary supply is not required then.

Due to high galvanic isolation, the switches may also simply be operated in floating circuits or in high-side switching applications without any additional isolation transformer or optical coupler. Several housing and cooling options are available to meet individual design requirements. Please refer to product survey **"C3 Variable On-Time, Low Coupling Capacitance, MOSFET"** or consult BEHLKE for more details.

HTS 501-20-LC2 50 kV / 200 A
HTS 701-20-LC2 70 kV / 200 A
HTS 901-20-LC2 90 kV / 200 A

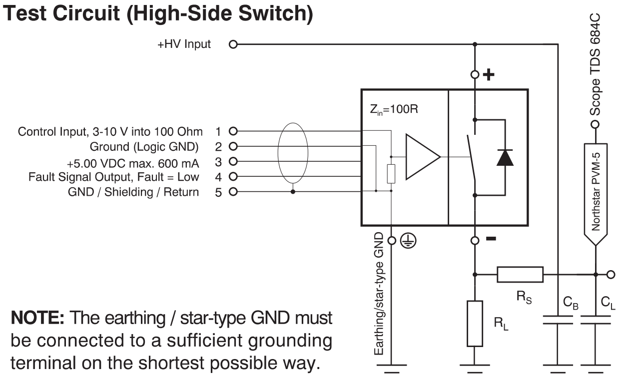
HTS 901-20-LC2
(standard model)

MOSFET TECHNOLOGY

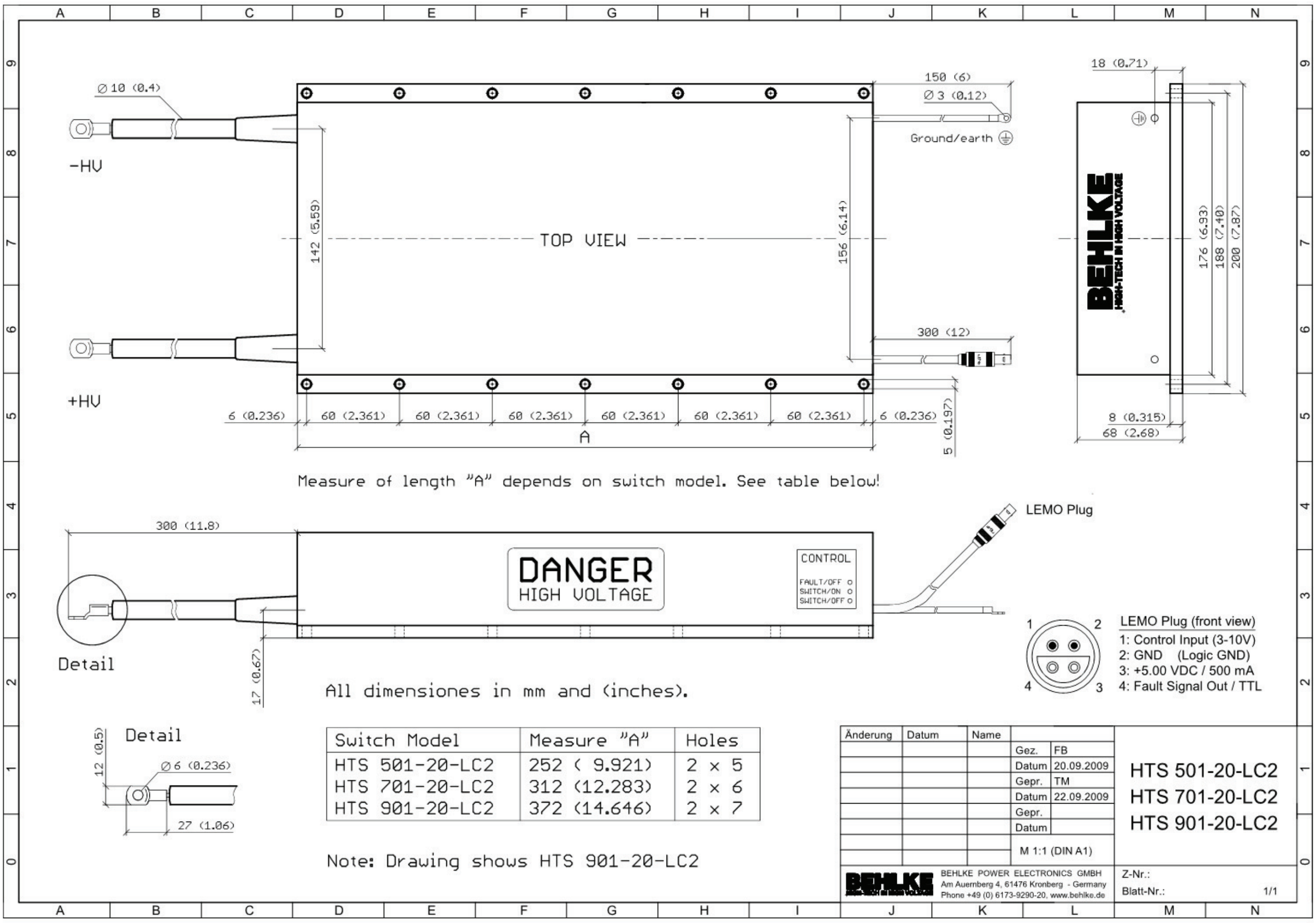
WWW.BEHLKE.DE

Made in Germany

Test Circuit (High-Side Switch)



NOTE: The earthing / star-type GND must be connected to a sufficient grounding terminal on the shortest possible way.



Switch Model	Measure "A"	Holes
HTS 501-20-LC2	252 (9.921)	2 x 5
HTS 701-20-LC2	312 (12.283)	2 x 6
HTS 901-20-LC2	372 (14.646)	2 x 7

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HIGH-TECH IN HIGH VOLTAGE

Technical Data

	Specification	Symb.	Condition / Comment		HTS 501-20-LC2	HTS 701-20-LC2	HTS 901-20-LC2	Unit
ABSOLUTE MAXIMUM RATINGS	Maximum Operating Voltage	$V_{O(max)}$	I_{off} < 50 µADC, T_{case} = 70°C		50	70	90	kVDC
	Maximum Isolation Voltage	V_I	Between HV switch and control input / GND		80	100	120	kVDC
	Max. Housing Insulation Voltage	V_{INS}	Between switch and housing surface, 3 minutes			150		kVDC
	Maximum Turn-On Peak Current	$I_{P(max)}$	T_{case} = 25°C	t_p< 200 µs, duty cycle <1%		200		
				t_p< 1 ms, duty cycle <1%		118		
				t_p< 10 ms, duty cycle <1%		72		
				t_p<100 ms, duty cycle <1%		54		ADC
	Maximum Continuous Load Current	I_L	T_{case} = 25°C	Standard model	1.26	1.26	1.26	
			T_{fluid} = 25°C	Option DLC - 2.0 / 2.8 / 3.6 [1]	9.5	9.5	9.5	
				Option DLC - 6.0 / 8.4 / 10 [1]	16.5	16.5	16.5	ADC
	Max. Continuous Power Dissipation	$P_{d(max)}$	T_{case} = 25°C	Standard model	35	49	63	
			T_{fluid} = 25°C	Option DLC - 2.0 / 2.8 / 3.6 [1]	2000	2800	3600	
				Option DLC - 6.0 / 8.4 / 10 [1]	6000	8400	10800	Watts
	Linear Derating		Above 25°C	Standard model	0.777	1.088	1.4	
				Option DLC - 2.0 / 2.8 / 3.6 [1]	44.44	62.22	80	
				Option DLC - 6.0 / 8.4 / 10 [1]	133.3	186.6	240	W/K
	Operating Temperature Range	T_O				-40…70		°C
	Storage Temperature Range	T_S				-40…90		°C
	Maximum Auxiliary Supply Voltage	$V_{aux(max)}$				9		VDC
ELECTRICAL CHARACTERISTICS	Permissible Operating Voltage Range	V_O			0…50	0…70	0…90	kVDC
	Typical Breakdown Voltage	V_{br}	**CAUTION:** V_{br} is a test parameter only for quality control purposes and is not applicable in normal operation!	I_{off} >500 µADC	53	74	95	kVDC
	Typical Off-State Current	I_{off}	0.8xV_O, T_{case} =25°C, lower leakage current on request			40		µADC
	Typical Static On-Resistance	R_{stat}	t_p< 1 µs, duty cycle <1%	0.1 x $I_{P(max)}$, T_{case} = 25°C	9	12.5	16	
				1.0 x $I_{P(max)}$, T_{case} = 25°C	10.5	15	19	
				1.0 x $I_{P(max)}$, T_{case} = 70°C	22	31	40	Ohm
	Typical Turn-On Delay Time	$t_{d(on)}$	Resistive load, 0.1 x $I_{P(max)}$, 0.8 x $V_{O(max)}$, 50-50%			250		ns
	Typical Turn-On Rise Time	$t_{r(on)}$	Resistive load, 10-90%	0.1 x $V_{O(max)}$, 0.1 x $I_{P(max)}$	12	14	15	
				0.8 x $V_{O(max)}$, 0.1 x $I_{P(max)}$	32	45	56	
				0.8 x $V_{O(max)}$, 1.0 x $I_{P(max)}$	35	50	62	ns
	Typical Turn-Off Rise Time	t_{off}, t_q	Resistive load, 10-90%	0.8 x $V_{O(max)}$, 0.1 x $I_{P(max)}$		30		
				0.8 x $V_{O(max)}$, 1.0 x $I_{P(max)}$		80		ns
	Maximum On-Time	$t_{on(max)}$				Infinitely		
	Minimum On-Time	$t_{on(min)}$	$t_{on(min)}$ can be customized. Please consult factory.			300		ns
	Maximum Off-Time	$t_{off(max)}$				Infinitely		
	Minimum Off-Time	$t_{off(min)}$	$t_{off(min)}$ can be customized. Please consult factory.			300		ns
	Typical Turn-On Jitter	$t_{j(on)}$	V_{aux} / V_{tr} = 5.00 VDC			3		ns
	Max. Continuous Switching Frequency	$f_{(max)}$	V_{aux} = 5.00 VDC, T_{case} = 25°C, switch will be turned off, if $f_{(max)}$ is exceeded	Standard	0.8	0.6	0.5	
				Option HFS		100		kHz
	Maximum Burst Frequency	$f_{b(max)}$	**CAUTION:** Applications with long lasting high frequency bursts may require special cooling measures to prevent MOSFET overheating. Please consult factory.			2		MHz
	Maximum Number of Pulses / Burst	N	@ $f_{b(max)}$ **NOTE:** Option HFB requires external buffer capacitors with a voltage rating of > 630 VDC and a capacitance of ≈ 100nF per additional pulse. The buffer capacitors are internally monitored.	Standard		>100		
				Option I-HFB		>1000		
				Option HFB		>10000		Pulses
	Coupling Capacitance	C_C	HV side against control side		33	46	60	pF
	Natural Capacitance	C_N	Between switch poles		54	40	30	pF
	Auxiliary Supply Voltage Range	V_{aux}	5.00 VDC recommended for best driver efficiency			4.75 – 5.25		VDC
	Intrinsic Diode Forward Voltage	V_F	T_{case} = 25°C, I_F =10 A		40	57	74	VDC
	Diode Reverse Recovery Time	t_{rrc}	**CAUTION:** Intrinsic diodes must not be used in normal operation. Inductive load requires fast free-wheeling diodes (series FDA) in parallel to the switch!	I_F =10A		<250		ns
	Auxiliary Supply Current	I_{aux}	V_{aux} = 5.00 VDC, T_{case} = 25°C	0.1 x $f_{(max)}$	250	350	450	
				@ $f_{(max)}$	800	800	800	mADC
	Control Voltage Range	V_{tr}	4 - 6 VDC recommended for best EMC			3 - 10		VDC
MECHANICAL / OPTIONS	Dimensions		Standard housing, without pigtails		252 x 200 x 68	312 x 200 x 68	372 x 200 x 68	mm^3
	Weight		Standard housing		3700	5200	6700	g

Recommended Options:

Option HFB	**High Frequency Burst:** Improved burst capability of driver by means of external buffer capacitors. Recommended for burst operation with >100 pulses within a burst of <100 µs duration.
Option I-HFB	**Integrated High Frequency Burst:** Improved burst capability by integrated buffer capacitors. For moderate burst requirements (10-100 pulses within a burst of <100 µs duration).
Option HFS	**High Frequency Switching:** Connector for additional auxiliary voltages (+12 VDC and +350 VDC to +450 VDC, model depending). Necessary for operation above standard $f_{(max)}$.
Option LP	**Low Pass:** Low pass filter at the control input. Propagation delay time will be increased by ~200 ns. Improved noise immunity and less critical wiring in high speed applications.
Option MIN-ON	**Minimum On-Time:** Individually increased "Minimum On-Time" to avoid unwanted triggering by input noise during this time. Please indicate the demanded $t_{on(min)}$ with order.
Option MIN-OFF	**Minimum Off-Time:** Individually increased "Minimum Off-Time" to avoid unwanted triggering by input noise during this time. Please indicate the demanded $t_{off(min)}$ with order.
Option DLC – X.X	**Direct Liquid Cooling**: Internal liquid channel in direct contact with the power semiconductors. Excellent cooling method for very high voltages. GALDEN® & non-conductive liquids only.
Option TH	**Tubular Housing:** Self-supporting axial housing. Attachment & HV connection by M12 bolts at the tube ends. Dimension ∅90x350, ∅90x450 or ∅90x550 mm (depending on switch model).
Option SEP-C	**Separate Control Unit:** Control unit (dimension 79x38x25 mm^3) separated from high-voltage switching unit. 1m connecting cable between switch and control (standard if option TH is ordered).

Note 1) Customized switching units with max. power dissipation of up to 15 kW are available on request. All data and specifications subject to change without notice! 901-20-LC2_09.09