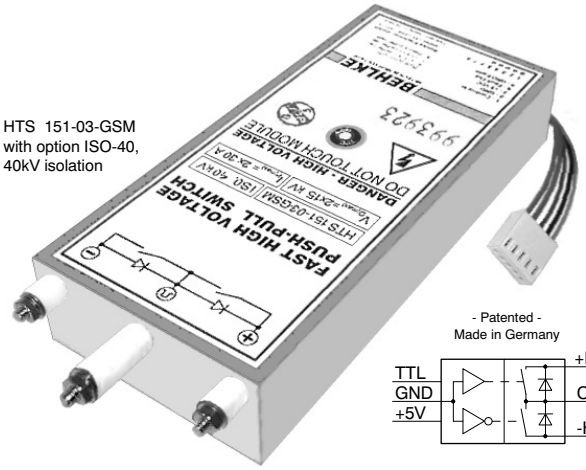
FAST HIGH VOLTAGE TRANSISTOR SWITCHES

The switching modules of the series HTS-GSM consist of two identical MOSFET switching paths that form a so-called half bridge circuit respectively push-pull circuit. Both switching paths are controlled by a common driver, which also provides a logic signal negation for one of the switches. The switches are mutually passively locked, so that a short in the bridge is excluded under all circumstances, including if the control input is disturbed by electromagnetic interferences (due to bad EMC design, for example). Especially in pulse generator applications with capacitive load, the push-pull principle has considerable advantages in comparision with the conventional circuitry using a single-switch with a working resistor. Push-pull circuits do not require large energy storage capacitors for a low pulse drop and, because there are no working resistor power losses, the efficiency of a push-pull pulser is excellent regardless of pulse width, frequency and duty cycle. The pulsers draw only currents for charging the connected load capacitance. Thanks to an extremely precise timing of the switches, there are also almost no cross currents in the bridge, except peak charging currents of the switch natural capacitances.

The switches are controlled by positive going signals of 3 to 10 Volts amplitude. Fault conditions as overfrequency, thermal overload (long-term overload) and incorrect auxilliary supply set the switching path A in off-state and the switching path B in on-state. Faults are indicated as an "L" signal at the fault signal output. Without 5VDC supply, both switching paths (A and B) are in off-state. That implies, without 5VDC the output potential could be undefined if the HV is still applied. To ensure a defined high voltage output potential in such cases, pull-up or pull-down resistors must be connected to the output. For further design recommendations, please refer to the general instructions.

HTS 81-06-GSM 2x 8 kV / 60A
HTS 151-03-GSM 2x15kV / 30A

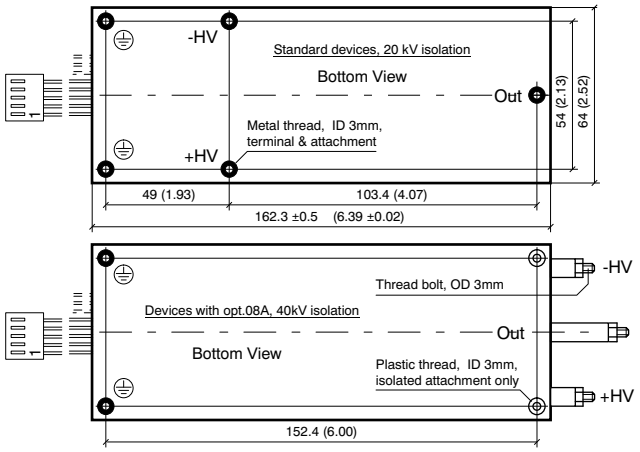


HTS 151-03-GSM with option ISO-40, 40kV isolation

- Patented - Made in Germany

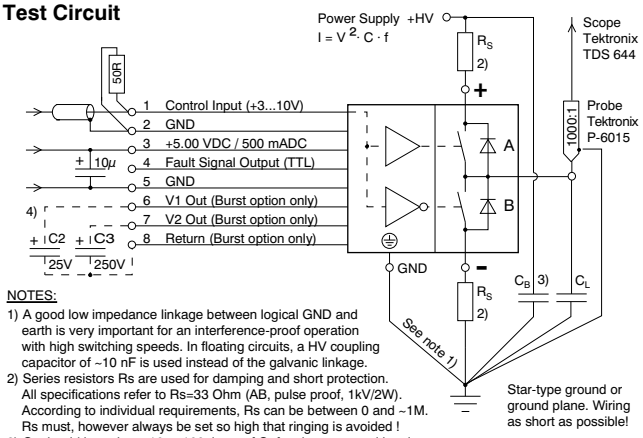
- Fast transition times, rise time and fall time ~15 ns
- Variable pulse width from 150 ns to infinity
- No pulse drop and very low ripple on the pulse top
- No working resistor power, small buffer capacitors

PUSH-PULL **MOSFET TECHNOLOGY**



All dimensions in mm and (inches). Metric screws are included in delivery. Customized cases on request.

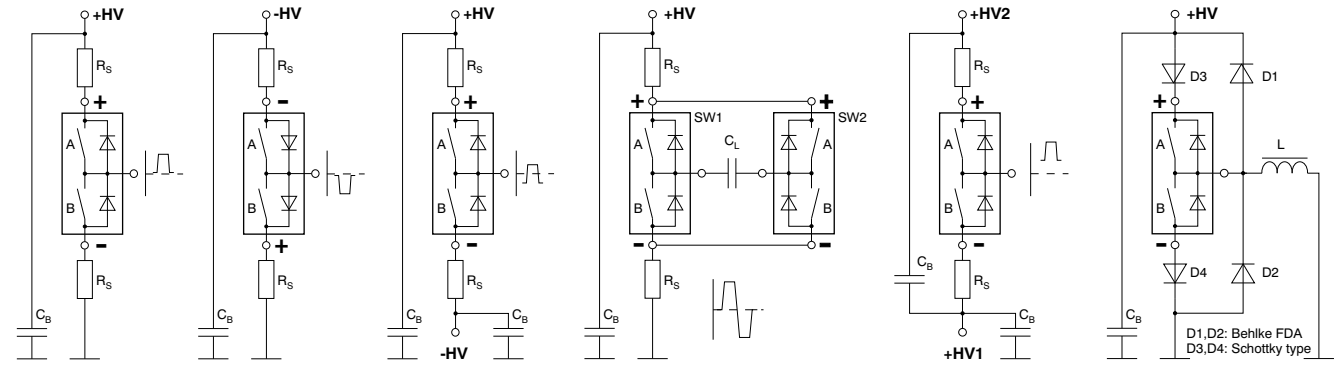
Test Circuit



NOTES:

1) A good low impedance linkage between logical GND and earth is very important for an interference-proof operation with high switching speeds. In floating circuits, a HV coupling capacitor of ~10 nF is used instead of the galvanic linkage.
2) Series resistors Rs are used for damping and short protection. All specifications refer to Rs=33 Ohm (AB, pulse proof, 1kV/2W). According to individual requirements, Rs can be between 0 and ~1M. Rs must, however always be set so high that ringing is avoided !
3) C_B should be at least 10 to 100 times of C_L for shortest transition times.
4) Burst option only. C= 0.1µF x number of pulses per burst. C2=25V, C3=250V.

Basic Circuits



Positive Pulses

Negative Pulses

Pos./Neg. Pulses
The sum of I+HVI and I-HVI must not exceed Vo(max).

Full Bridge Circuit
Control signal for SW2 is negated.

Floating Pulser (Pos.)
HV1 + HV2 must not exceed the Max. Isolation Voltage!

Inductive Load
External diodes must be used to avoid reverse currents through internal diodes!

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BEHLKE

TECHNICAL DATA

Specification	Symbol	Condition / Comment		81-06-GSM	151-03-GSM	Unit
Maximum Operating Voltage	$V_{O(max)}$	I_{off} < 10 µADC		2 x 8000	2 x 15000	VDC
Minimum Operating Voltage	$V_{O(min)}$	Increased transition times below 0.1 x $V_{O(max)}$		0		VDC
Typical Breakdown Voltage	V_{br}	Static voltage, I_{off} > 1 mADC, , T_{case} = 70 °C		2 x 9500	2 x 18000	VDC
Galvanic Isolation	V_I	Continuously	HV terminals at bottom (Standard)	20000		
			HV terminals at front (Opt.ISO-40)	40000		VDC
Max. Peak Current Capability	$I_{P(max)}$	T_{case} = 25°C	t_p<10 μs, duty cycle <1%	2 x 60	2 x 30	ADC
Max. Continuous Load Current	I_L	T_{case} = 25°C	Standard plastic case	2 x 0.91	2 x 0.41	
		T_{fin} = 25°C	Opt. ITC, incr. thermal conductivity	2 x 1.05	2 x 0.47	
			Opt. CF, cooling fins (air >4m/s)	2 x 2.89	2 x 1.29	ADC
Static On-Resistance	R_{stat}	T_{case} = 25°C	0.1 x $I_{P(max)}$	2 x 8	2 x 36	
			1.0 x $I_{P(max)}$	2 x 18	2 x 90	Ω
Maximum Off-State Current	I_{off}	0.8xV_O, T_{case}= 25...70°C, reduced I_{off} on request		10		µADC
Propagation Delay Time	t_d	Resistive Load		150		ns
Typical Output Transition Time (Rise Time & Fall Time)	t_r, t_f	0.8 x V_O	R_S = 33 Ω, C_L = 10 pF	7	14	
		10-90%	R_S = 33 Ω, C_L = 50 pF	9	18	
		Standard device	R_S = 33 Ω, C_L = 100 pF	12	26	
		(Bottom terminals)	R_S = 33 Ω, C_L = 200 pF	19	45	
			R_S = 22 Ω, C_L = 1000 pF	55	80	ns
Minimum Output Pulse Width	$t_{p(min)}$	Reduced output pulse width on request.		150		ns
Maximum Output Pulse Width	$t_{p(max)}$			No limitation, up to ∞		
Minimum Pulse Spacing	$t_{ps(min)}$	(Switch recovery time)		400		ns
Typical Output Pulse Jitter	t_j	V_{aux}=5.0 VDC	Fixed switching frequency, >2kHz	0.1		
		V_{tr} =5.0 VDC	Sweeped frequency, <2kHz	2		ns
Max. Continuous Switching Frequency	$f_{(max)}$	@ V_{aux} = 5.00 VDC Please note possible $P_{d(max)}$ limitations. Increased switching frequency on request.		10		kHz
Maximum Burst Frequency	$f_{b(max)}$	Use option HFB for >10 pulses per 20μs burst		2.5		MHz
Maximum Continuous Power Dissipation	$P_{d(max)}$	T_{case} = 25°C	Standard plastic case	2 x 15		
		T_{fin} = 25°C	Opt. ITC, incr. thermal conductivity	2 x 20		
			Opt. CF, cooling fins (air >4m/s)	2 x 150		Watts
Linear Derating		Above 25°C	Standard plastic case	2 x 0.33		
			Opt. ITC, incr. thermal conductivity	2 x 0.44		
			Opt. CF, cooling fins (air >4m/s)	2 x 3.33		W/K
Temperature Range	T_O			-40...70		°C
Typical Natural Capacitance	C_N	Capacitance between + and –	0.1 x $V_{O(max)}$	< 90		
		terminal of one switch path	0.8 x $V_{O(max)}$	< 30		pF
Typical Coupling Capacitance	C_C	Both switches against ground respectively control		< 30		pF
Reverse Recovery Time of the intrinsic diodes (Parasitic MOSFET Diodes)	t_{rrc}	**Note:** The internal diodes are too slow to be used periodically in forward direction (danger of bridge-short). Free-wheeling diode networks must be applied in case of inductive load or high stray inductance!	I_F =2A	500...1000		ns
Auxiliary Supply Voltage	V_{aux}	Stabilized to ± 5%		5.00		VDC
Auxiliary Supply Current	I_{aux}	V_{aux} = 5.00 VDC	@f <1kHz	<150		
		T_{case} = 25°C	@f_{max}	<1000		mADC
Control Signal	V_{tr}	>3VDC recommended for low jitter		3...10		VDC
Fault Signal Output		Short circuit proof, source/sink	Ready = High	≥4.0		
		current max. 10 mA	Fault = Low	≤0.8		VDC
Dimensions	LxWxH	Standard plastic case (Without connectors)		163x64x27		
		With option CF (cooling fins)		163x64x62		mm^3
Weight		Standard plastic case		460		
		With option CF (cooling fins)		650		g

Ordering Information

HTS 81-06-GSM	Push-pull transistor switch
HTS 151-03-GSM	Push-pull transistor switch
Option HFB	High frequency burst
Option ITC	Increased thermal conductivity
Option CF	Cooling fins, non isolated, for vertical air stream only
Option PIN-C	Control connection: Pins instead of pigtail & plug
Option ISO-40*	40kV isolation, HV front terminals
Option ISO-80*	80kV isolation, HV front terminals, enlarged case

* Not recommended for switching speeds <15ns