

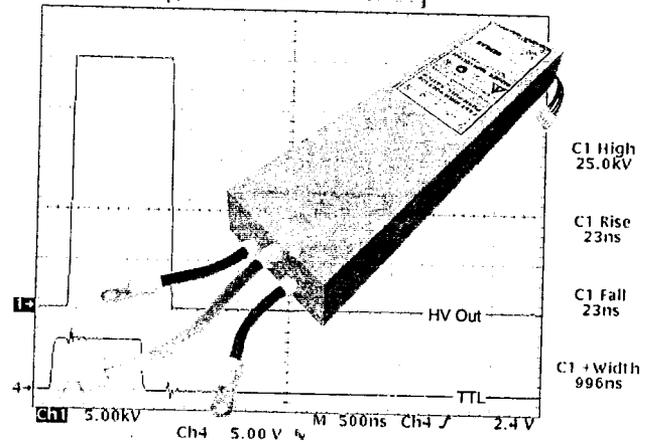
FAST HIGH VOLTAGE TRANSISTOR SWITCHES

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, even then, 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 comparison with the conventional circuitry using a single-switch with working resistor. Push-pull circuits do not require large energy storage capacitors for a low pulse droop and, because there are no working resistor power losses, the efficiency of a push-pull pulser is excellent regardless to 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 auxiliary supply set the switching path A in off-state and the switching path B in on-state. Faults are indicated as a "L" signal at the fault signal output. Without 5VDC supply both switching paths (A and B) are in off-state. That means, 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 161-06-GSM 2x16kV / 60A
HTS 301-03-GSM 2x30kV / 30A

Tek Run: 100MS/s Average

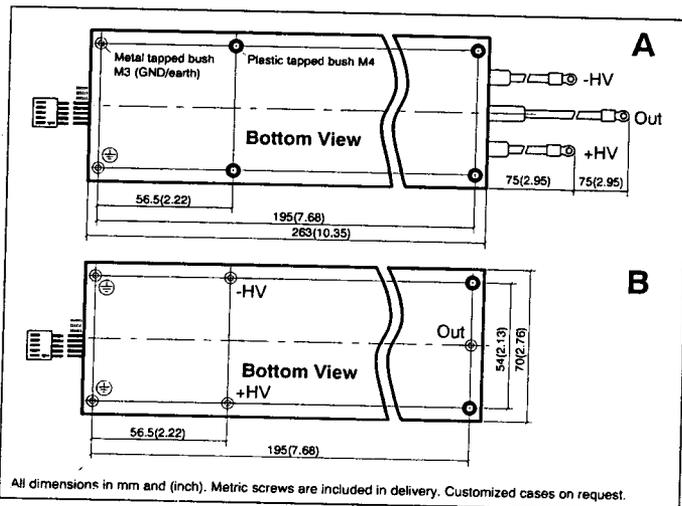


- Fast transition times, rise time and fall time ~20 ns
- Variable pulse width from 200 ns to infinity
- No pulse droop and very low ripple on the pulse top
- No working resistor power, small buffer capacitors

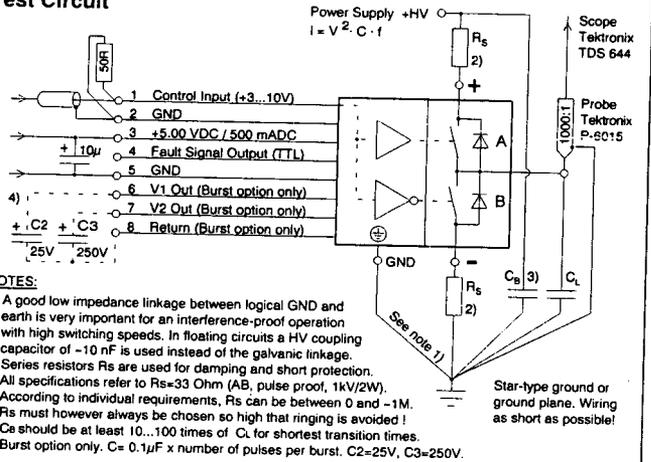
PUSH-PULL

Patented -
Made in Germany

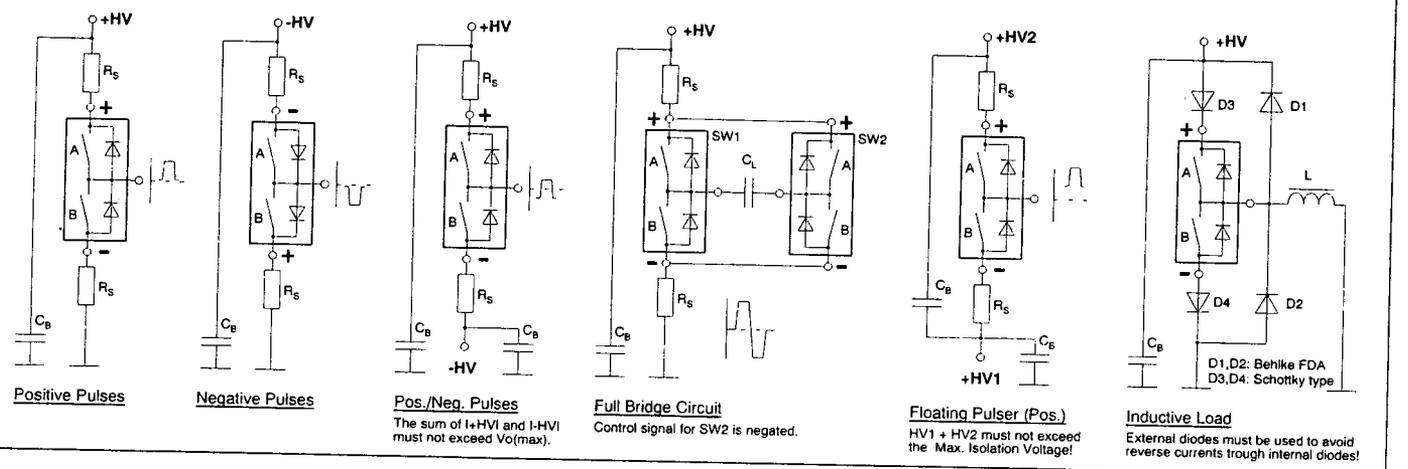
**MOSFET
TECHNOLOGY**



Test Circuit



Basic Circuits



TECHNICAL DATA

Specification	Symbol	Condition / Comment	161-06-GSM	301-03-GSM	Unit
Maximum Operating Voltage	$V_{O(max)}$	$I_{off} < 10 \mu ADC$	2 x 16	2 x 30	kVDC
Minimum Operating Voltage	$V_{O(min)}$	Increased transition times below $0.1 \times V_{O(max)}$	0		kVDC
Typical Breakdown Voltage	V_{br}	Static voltage, $I_{off} > 1 \text{ mADC}$, $T_{case} = 70^\circ C$	2 x 18	2 x 36	kVDC
Galvanic Isolation Voltage	V_i	Standard plastic case (see note 1) Option 08A (Pigtail version only, see drawing A) Option 08B (Pigtail version only, see drawing A)	25 40 80	40 - 80	kVDC
Maximum Peak Current	$I_{P(max)}$	$T_{case} = 25^\circ C$ $t_p < 10 \mu s$, duty cycle $< 1\%$	2 x 60	2 x 30	ADC
Max. Continuous Load Current	I_L	$T_{case} = 25^\circ C$ $T_{fin} = 25^\circ C$ Standard plastic case (see note 1) Opt.03, increased thermal conductivity Opt. 04, cooling fins (air $> 4\text{m/s}$)	2 x 0.7 2 x 0.86 2 x 2.2	2 x 0.33 2 x 0.41 2 x 1.05	ADC
Static On-Resistance	R_{stat}	$T_{case} = 25^\circ C$ $0.1 \times I_{P(max)}$ $1.0 \times I_{P(max)}$	2 x 18 2 x 40	2 x 72 2 x 180	Ω
Maximum Off-State Current	I_{off}	$0.8 \times V_{O}$, $T_{case} = 25 \dots 70^\circ C$, reduced I_{off} on request	10		μADC
Propagation Delay Time	t_d	Resistive Load	190		ns
Typical Output Transition Time (Rise Time & Fall Time)	t_r, t_f	$0.8 \times V_O$ 10-90% $R_S = 33 \Omega$, $C_L = 10\text{pF}$ $R_S = 33 \Omega$, $C_L = 50\text{pF}$ $R_S = 33 \Omega$, $C_L = 100\text{pF}$ $R_S = 33 \Omega$, $C_L = 200\text{pF}$ $R_S = 22 \Omega$, $C_L = 1000\text{pF}$	10 15 17 25 60	20 35 50 90 230	ns
Minimum Output Pulse Width	$t_{p(min)}$	Reduced output pulse width on request.	200		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	$V_{aux} = 5.0 \text{ VDC}$ $V_{tr} = 5.0 \text{ VDC}$ Fixed switching frequency, $> 2\text{kHz}$ Swept frequency, $< 2\text{kHz}$	0.1 5		ns
Max. Continuous Switching Frequency	$f_{(max)}$	Please note possible $P_{d(max)}$ limitations. Increased switching frequency on request.	2		kHz
Maximum Burst Frequency	$f_{b(max)}$	Use option 01 for > 10 pulses per $20\mu s$ burst	2.5		MHz
Maximum Continuous Power Dissipation	$P_{d(max)}$	$T_{case} = 25^\circ C$ $T_{fin} = 25^\circ C$ Standard plastic case (see note 1) Opt. 03, incr. thermal conductivity Opt. 04, air speed $> 4\text{m/s}$ (s. note 2)	2 x 20 2 x 30 2 x 200		Watts
Linear Derating		Above $25^\circ C$ Standard plastic case Opt.03, incr. thermal conductivity Opt. 04, air speed $> 4\text{m/s}$	2 x 0.44 2 x 0.66 2 x 4.44		W/K
Operating Temperature Range	T_O		-40...70		$^\circ C$
Typical Natural Capacitance	C_N	Capacitance between the terminals of <u>one</u> switch path $0.1 \times V_{O(max)}$ $0.8 \times V_{O(max)}$	< 90 < 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}	Important Note: Due to the high t_{rrc} of the parasitic diodes any current reversal must be avoided! Unclamped inductive load or high stray inductance of wiring may cause a short circuit in the bridge. Danger of irreparable damage! Use serial resistors, snubbers or fast free-wheeling diode networks to avoid any current reversal.	500...1000		ns
Auxiliary Supply Voltage	V_{aux}	Stabilized to $\pm 5\%$	5.00		VDC
Auxiliary Supply Current	I_{aux}	@ f_{max} , (Limitation of approx. 1 A recommended)	600		mADC
Control Signal	V_{tr}	$> 3\text{VDC}$ recommended for low jitter	3...10		VDC
Fault Signal Output		Short circuit proof, source/sink current max. 10 mA Ready = High Fault = Low	≥ 4.0 ≤ 0.8		VDC
Dimensions	LxWxH	Standard case (Without pigtails & opt. cooling fins)	263x70x35		mm ³
Weight		Standard plastic case With option 04 (cooling fins in standard size)	800 1450		g

Notes:

- The standard case is „A“ for the HTS 301-03-GSM and „B“ for the HTS 161-06-GSM. Please refer to the drawing overleaf. Version „B“ is optionally also available for the HTS 301-03-GSM (option 06) but only in connection with additional isolation measures (e.g. oil immersion) or in case of operating voltages less than 20 kVDC. The version „B“ for attachment on printed circuit boards is preferred in high speed circuits with transition times in the order of 10 to 20 ns or in case of critical EMC aspects.
- Cooling fins are not recommended if the HTS 301-03-GSM shall be operated in air above 20 kVDC. No limitations if operated in oil. Please consult factory for further oil cooling information.

Ordering Information

HTS 161-06-GSM	Push-pull transistor switch	Option 05	High power metal case (on request)
HTS 301-03-GSM	Push-pull transistor switch	Option 06	Printed circuit board version of HTS 301-03-GSM.
Option 01	High frequency burst	Option 08A	40kV isolation for HTS 161-06-GSM (pigtail version „A“ only)
Option 03	Increased thermal conductivity	Option 08B	80kV isolation (pigtail version „A“ only)
Option 04	Non-isolated cooling fins (oil immersion for $V_O > 20\text{ kV}$)		