HIGH VOLTAGE PUSH-PULL SWITCHING UNITS

The push-pull switching units of model series GHTS are ready-for-use pulsers and are especially designed for capacitive load elements such as pockels cells, deflection and acceleration grids, ion optics, piezo crystals, pulsed MCP's and SEV's. In combination with an external high voltage power supply and a control signal source true square wave pulses can be generated with amplitudes of 3.000 to 10.000 volts depending on type. The pulsers are galvanically isolated and can therefore be operated in both polarities as well as in different floating modes. The units contain two single switches which are alternately controlled to charge and discharge the capacitive load elements. Due to the absence of working resistors, currents from the H.V. power supply are only drawn to charge the capacitive load. The charge peak current can reach several ten amperes for a few nanoseconds but as soon as the load capacitance is fully charged the output current decreases almost to zero. This guarantees an excellent top flatness regardless to the pulse length. GHTS switching units are carefully optimized regarding all relevant high frequency / high power design aspects and show exceptional good switching characteristics.

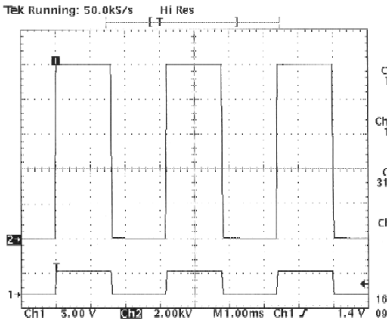
The devices consist of a DC/DC converter for the internal driver voltages, a control and protection circuit, a driver circuit and the switching module with the two alternately controlled switches. The switches are made of a large number of series and parallel connected MOSFET. Those MOSFET have intrinsic (parasitic) diodes which appear as parallel diodes at the switch paths. As a result of that the switch polarity is defined. That means when the polarity of input voltage changes the switch polarity must also be changed. This is simply be done by a plug change at the rear panel. Several ceramic capacitors are built-in to provide the necessary charge for fastest transitions and best pulse shape. Insofar a slower switching speed is demanded (e.g. for reduced EMI) or in case the output shall be safely protected against short circuits, the GHTS switching units can be equipped with output series resistors of 200 ohms (standard) or any other resistance value.

The control and protection circuit provides the precise timing of the high voltage switches under all operating conditions. Parameters such as switch temperature, switch control signal amplitude, switching frequency and output peak current are monitorred by the control circuit. Overheating, excessive switching frequency, over current (specific overload cases) and insufficient auxilliary power supply voltage will turn both switches off. Fault and switch condition are displayed by LED's. By means of a switchable inverter the control signal can be negated simply if necessary. A capacitively coupled monitoring output is provided to verify the high voltage pulses. Control input and trigger output are compatible to the TTL signal level (Z=50).

The GHTS switching units are built into small metal flange housings for ease of installation near the load element to be switched. This offers the advantage of a short pulse transmission cable with low capacitance which is the pre-condition for short transition times and low power losses at high switching frequencies. All connections are made by standard plug-in connectors. A complete set of plugs and adaptors is supplied with the unit. For operation at higher frequencies and higher capacitances an optional fan is available for some models (see data table overleaf).

GHTS 30	3000 VDC, 30-60 Amps
GHTS 60	6000 VDC, 15-60 Amps
GHTS 100	10000 VDC, 15-30 Amps

- True square wave pulses
- Nanoseconds rise time
- Low over and undershoot
- Highly stable pulse top
- No working resistor power
- Galvanic isolation
- Pulse monitor output
- Isolated trigger output
- Switchable signal inverter
- H.V. plug-in connectors



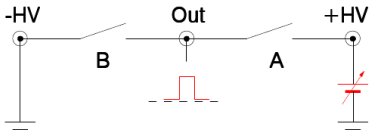
Wave Shape

The high voltage output signal (Ch 2) corresponds exactly to the input control signal (Ch 1). The pulse top flatness is determined by the accuracy and ripple of the externally connected H.V. power supply only.

CH2 vertical: 2 kV/div
Horizontal: 1ms/div.
Pure capacitive load

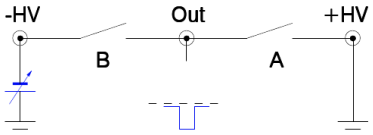
Positive Pulses

-HV is grounded and a positive voltage is applied to the +HV input.



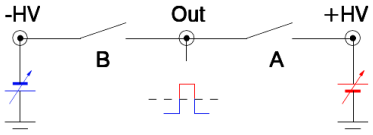
Negative Pulses

+HV is grounded and a negative voltage is applied to the -HV input.



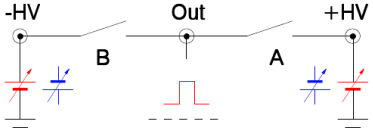
Alternating Pulse Polarity

The sum of |-HV| and |+HV| must not exceed the Max. Operating Voltage $V_{o(max)}$



Floating Output

-HV must always be more negativ than +HV. The sum of floating voltage and switching voltage must not exceed the isolation voltage.



Behlke Power Electronics GmbH, Phone +49 (0)6173-9290-20, Fax -30, www.behlke.com

BEHLKE
HIGH-TECH IN HIGH VOLTAGE

Specification	Symbol	Condition / Comment		30	30 A	60	60 A	60 B	100	100 A	Unit
Max. Operating Voltage Range(1)	$V_{O(max)}$			0-3000	0-3000	0-6000	0-6000	0-6000	0-10000	0-10000	VDC
Galvanic Isolation	V_I	Switches against GND (continuously)					>10000				VDC
Maximum Peak Current	$I_{P(max)}$	T_{case} = 25°C, t_p < 10 µs, duty cycle < 1%		30	60	15	30	60	15	30	ADC
Max. Continuous Load Current	$I_{L(max)}$	T_{case} = 25°C, Standard devices / (Opt. 01)					200 (100)				mADC
Static On-Resistance	R_{stat}	Standard devices at 0.1 x $I_{P(max)}$		50	50	75	50	50	90	75	Ω
Quiescent Current	I_{off}	Caused by internal safety discharge resistor		25	25	50	50	50	80	80	µADC
Pulse Delay Time	$t_{d(on)}$	C_L = 0 pF, 50-50 %		100	110	100	100	110	110	110	ns
Typical Transition Time	$t_{r(on)}$	0.5 x $V_{O(max)}$	C_L = 25 pF	12	10	15	12	10	15	14	
(Output Rise & Fall Time)		10-90 %	C_L = 100 pF	20	14	38	21	15	43	30	
			C_L = 500 pF	46	26	105	49	28	106	68	
			Opt. 01 (+200Ω), C_L = 100 pF	34	30	62	35	31	65	50	ns
Minimum Pulse Width	$t_{on(min)}$			100	150	100	100	150	100	150	ns
Maximum Pulse Width	$t_{on(max)}$						No limit, pulse width up to DC possible				
Switch Recovery Time	t_{rc}	t_{rc} = minimum pulse spacing		250	300	250	250	300	300	300	ns
Typical Turn-On Jitter	$t_{j(on)}$	V_{tr} = 5.0 VDC		100	300	100	100	300	300	300	ps
Maximum Switching Frequency	$f_{(max)}$	Please note possible $P_{d(max)}$ limitations (2)		20	15	20	20	15	15	15	kHz
Maximum Burst Frequency	$f_{b(max)}$			4	3.3	4	4	3.3	3.3	3.3	MHz
Burst Capability		At the minimum pulse spacing		>200	>100	>200	>150	>100	>150	>100	N-
(Number of pulses per burst)		Pulse spacing > 1µs		>1000	>500	>1000	>750	>500	>750	>500	Pulses
Max. Cont. Power Dissipation (2)	$P_{d(max)}$	T_{case} = 25°C, standard devices / (Opt. 02)		15	15	15	20 (40)	20 (40)	20 (40)	20 (40)	Watts
Linear Derating		Above 25°C, standard devices / (Opt. 02)		0.6	0.6	0.6	0.8 (1.6)	0.8 (1.6)	0.8 (1.6)	0.8 (1.6)	W/K
Temperature Range	T_O						-40...50				°C
Total Switch Capacitance	C_S	Natural & parasitic capacitances, see note (2)		75	110	75	100	140	100	140	pF
Diode Reverse Recovery Time (3)	t_{rrc}	I_F = 0.1 x $I_{P(max)}$					1				µs
Diode Forward Voltage Drop (3)	V_F	I_F = 0.1 x $I_{P(max)}$		4	3.5	4	6.5	6	6.5	6	VDC
Auxiliary Supply Voltage	V_{aux}	Supplied from plug-in mains adapter					12 (±10%)				VDC
Auxiliary Supply Current	I_{aux}	Standard devices / (Option 02 - fans)					300 (500)				mADC
Control Signal Voltage	V_{tr}	> 3VDC recommended					2-10				VDC
Trigger Output Voltage	$V_{tr(out)}$	Output isolated, short circuit proof, Z = 50Ω					4				VDC
Short-Circuit Strength and		An active basis protection	Standard devices	+++	++++	++	+++	++++	+	++	
Avalanche Strength of Switch		is provided for all models	With option 01	++++++	++++++	++++	+++++	++++++	++	++++	
Dimensions		LxWxH, Case body only		170 x 110 x 45			210 x 110 x 45				mm^3
Weight		Complete set		2.0			2.5				kg

(1) Floating and bipolar configurations: The sum of the absolute values |+HV| and |-HV| must not exceed $V_{o(max)}$.

(2) Capacitive power dissipation is determined by the equation $P_d = V_O^2 \cdot f \cdot (C_L + C_S)$ whereby Vo is the operating voltage, f the switching frequency, C_L the load capacitance and C_S the switch capacitance.

(3) Parasitic MOSFET diodes must not be operated dynamicly. Please consult factory in case of inductive load or current reversal.

Ordering Informations	
GHTS	Push-Pull Switching Unit
Option 01	Protective Series resistors
Option 02	Built-in miniature fans