	Specification	Symbol	Condition / Comment		401-20-GSM	501-20-GSM	651-20-GSM	Unit
ABSOLUTE MAXIMUM RATINGS	Maximum Operating Voltage	$V_{O(max)}$	I_{off} < 50 µADC, T_{case} = 70°C		± 40	± 50	± 65	kVDC
	Maximum Isolation Voltage	V_I	Between HV switch and control / GND, continuously			± 80		kVDC
	Max. Housing Insulation Voltage	V_{INS}	Between switch and housing surface, 3 minutes			± 100		kVDC
	Maximum Turn-On Peak Current	$I_{P(max)}$	T_{case} = 25°C	t_p< 200 µs, duty cycle <1% t_p< 1 ms, duty cycle <1% t_p< 10 ms, duty cycle <1% t_p< 100 ms, duty cycle <1%		200 118 72 54		ADC
	Maximum Continuous Load Current	$I_{L(max)}$	T_{case} = 25°C	Standard devices Devices with option DLC		1.5 8,25		ADC
	Max. Continuous Power Dissipation	$P_{d(max)}$	T_{case} = 25°C	Standard devices & FC, forced air 4 m/s Devices with option DLC	52 4800	64 6000	84 7800	Watt
	Linear Derating		Above 25°C	Standard devices & FC, forced air 4 m/s Devices with option DLC	1.172 106.66	1.422 133.32	1.848 173.32	W/K
	Operating Temperature Range	T_O	Standard devices & options ILC, DLC			-40...70 (60)		°C
	Storage Temperature Range	T_S	Switches with option ILC may require frost protection!			-40...90		°C
	Max. Permissible Magnetic Field	B	Homogeneous steady-field, surrounding the whole switch			25		mT
	Max. Auxilliary Voltage	V_{aux}	Built-in overvoltage limiter (replaceable)			5.5		VDC
ELECTRICAL CHARACTERISTICS	Permissible Operating Voltage Range	V_O	Unipolar operation (one switch pole grounded or floated) Bipolar operation (positive & negative voltage applied)		0... ± 40 0... ± 20	0... ± 50 0... ± 25	0... ± 65 0... ± 32	kVDC
	Typical Breakdown Voltage	V_{br}	**NOTE:** V_{br} is a test parameter for quality control purposes only. Not applicable in normal operation!	I_{off} > 0.5 mA	44	56	70	kVDC
	Typical Off-State Current	I_{off}	0.8xV_O, T_{case} =25...70°C, reduced I_{off} on request			< 40		µADC
	Typical Turn-On Resistance	R_{stat}	Each switching path t_p < 1µs, duty cycle < 1%	0.1 x $I_{P(max)}$, T_{case} =25°C 1.0 x $I_{P(max)}$, T_{case} =25°C 1.0 x $I_{P(max)}$, T_{case} =70°C	9 10.8 22.6	11 13.2 27.6	14 16.8 35.2	Ohm
	Typical Propagation Delay Time	$t_{d(on)}$	Resistive load, 0.1 x $I_{P(max)}$, 0.8 x $V_{O(max)}$, 50-50%			250		ns
	Typical Output Pulse Jitter	t_j	Impedance matched input, V_{aux} / V_{ctrl} = 5.00 VDC			3		ns
	Typical Ouput Transition Time (Rise Time & Fall Time)	t_r, t_f	Resistive load, 10-90%	0.1 x $V_{O(max)}$, I_L = 0.1 x $I_{p(max)}$ 0.8 x $V_{O(max)}$, I_L = 0.1 x $I_{p(max)}$ 0.8 x $V_{O(max)}$, I_L = 1.0 x $I_{p(max)}$	11 29 32	12 32 35	14 41 47	ns
	Maximum Turn-On Time	$t_{on(max)}$	No limitation			∞		ns
	Minimum Turn-On Time	$t_{on(min)}$	can be customized. Please consult factory			250		ns
	Max. Continuous Switching Frequency	$f_{(max)}$	@ V_{aux}= 5.00 V Sw. shutdown if $f_{(max)}$ is exceeded	Standard devices without HFS option Standard devices with HFS supply Opt. HFS + sufficient cooling option	1.4 100 200	1.2 100 200	0.6 100 200	kHz
	Maximum Burst Frequency	$f_{b(max)}$	Use option HFB for >10 pulses within 20µs or less			2		MHz
	Maximum Number of Pulses / Burst	$N_{(max)}$	f_b=1MHz (1µs spacing). Switch shutdown if $N_{(max)}$ is exceeded.			200	Use burst option HFB for >200 pulses	Pulses
	Coupling Capacitance	C_C	Switch against control side	Standard devices & options CF, DLC Devices with options GCF, ILC		<50 70 ... 200		pF
	Natural Capacitance	C_N	Between switch poles, @ 0.5 x $V_{O(max)}$		tbd.	tbd.	tbd.	pF
	Control Voltage Range	V_{ctrl}	The V_{ctrl} has no impact on the output pulse shape.			3 ... 10		VDC
	Auxiliary Supply Voltage Range	V_{aux}	The +5 V supply is not required in the HFS mode.			4.5 ... 5.5		VDC
	Typical Auxiliary Supply Current	I_{aux}	V_{aux} = 5.00 VDC, T_{case} = 25°C. Active current limitation above 1A.	0.01 x $f_{(max)}$ @ specified $f_{(max)}$	< 400 800	< 400 800	< 400 800	mADC
	Opt. HFS, Ext. Supply Voltage V1	$V_{HFS(V1)}$	Stability ±3%, current consumption <0.4 mA/kHz @ 25°C			15		VDC
	Opt. HFS, Ext. Supply Voltage V2	$V_{HFS(V2)}$	Stability ±3%, current consumption <0.5 mA/kHz @ 25°C		260	tbd.	359	VDC
	Intrinsic Diode Forward Voltage	V_F	T_{case} = 25°C, I_F = 0.3 x $I_{P(max)}$		32	40	52	VDC
	Diode Reverse Recovery Time	t_{rrc}	T_{case} = 25°C, I_F = 0.3 x $I_{P(max)}$, di/dt = 100 A/µs			<250ns		ns
HOUSING	Dimensions	LxWxH	Standard housing, without pigtails Devices with option ILC & DLC		350x150x68 400x200x90	400x150x68 425x200x90	375x300x70 400x325x130	mm^3
	Weight		Standard housing Devices with option ILC & DLC		5800 6700	6000 7000	11000 14700	g

FUNCTIONS	
Control Signal Input	**Pin 1** / Yellow (LS-C: Pin 1). TTL compatible (LS-C: With 100Ω termination). Schmitt-Trigger characteristics. Control voltage 2-10 V (3-5 V for low jitter).
Logic GND / 5V Return	**Pin 2** / Black (LS-C: Shielding). The ground pin is internally connected with the safety earthings terminals (threaded inserts) on bottom side.
5V Auxiliary Supply	**Pin 3** / Red (LS-C: Pin 4). The 5 V input is used for rep rates up to the specified max. frequency $f_{(max)}$. Higher rep rates require option HFS.
Fault Signal Output	**Pin 4** / Orange (LS-C: Pin 3). TTL output, short circuit proof. Indicating switch & driver over-heat, over-frequency, low auxiliary voltage. L = Fault.
Inhibit Signal Input	**Pin 5** / Green (LS-C: Pin 2). TTL compatible, Schmitt-Trigger characteristics for the connection of external safety circuits. L = Switch Inhibited.
LED Indicators	**GREEN**: "Auxiliary power good, switch OFF". **YELLOW**: "Control signal received, switch ON". **RED**: "Fault condition, switch OFF"
Temperature Protection	**A)** Standard switches and switches with opt. FC, CF , GCF: Thermo trigger 75°C, response time < 60 s @ 3xPd(max), ΔT=25K (50 to 75°C). Separate driver protection. **B)** Switches with option DLC: 65°C, response time < 3 s @ 3xPd(max), ΔT=25K (40 to 65°C), coolant flow > 3l / min. Separate driver protection.

ORDERING

HTS 401-20-GSM	Fast HV Push-Pull Switch, 40kV, 200 A
HTS 501-20-GSM	Fast HV Push-Pull Switch, 50kV, 200 A
HTS 651-20-GSM	Fast HV Push-Pull Switch, 65kV, 200 A

Option LP	Low Pass. Input filter for increased noise immunity.	**Option I-PC**	Integrated part components according to customer specification.
Option HFB	High Frequency Burst (improved capability by external capacitors)	**Option UL-94**	Flame retardant casting resin, UL94-V0
Option HFS	High Frequency Switching (two auxiliary supply inputs V1 & V2)	**Option I-FWD**	Integrated Free-Wheeling Diode. In connection with inductive load only.
Option I-HFS	Integrated High Frequency Burst	**Option I-FWDN**	Integrated Freewheeling Diode Network. In connection with inductive load.
Option S-TT	Soft Transition Time decrease the rise and fall time by 20%	**Option PT-C**	Pigtail for control connection: Flexible leads (l=75mm) with lemo connector.
Option Min-On	Individually increased "Min. On-Time" to avoid unwanted triggering	**Option SEP-C**	Separated control unit. Control unit with LED indicators in a separate housing.
Option Min-Off	Individually increased "Min. Off-Time" to avoid unwanted triggering	**Option TH**	Tubular Housing
Option PCC	Pulser Configuration. Switch combined with custom specific parts.	**Option CF**	Copper Cooling Fins. $P_{d(max)}$ can be increased by the factor 3 to 10.
Option ISO-80	80kV Isolation. Isolation Voltage increased to 80kV.	**Option GCF**	Grounded Cooling Flange. $P_{d(max)}$ can be increased by the factor 3 to 15.
Option ISO-120	120kV Isolation. Isolation Voltage increased to 120kV.	**Option ILC**	Indirect Liquid Cooling (for water). $P_{d(max)}$ can be increased by the factor 3 to 15.
Option ISO-160	160kV Isolation. Isolation Voltage increased to 160kV.	**Option DLC**	Direct Liquid Cooling. $P_{d(max)}$ can be increased by the factor 10 to 100.
Option ISO-200	200kV Isolation. Isolation Voltage increased to 200kV.	**FOR FURTHER PRODUCT OPTIONS PLEASE REFER TO THE OPTIONS PAGE.**	