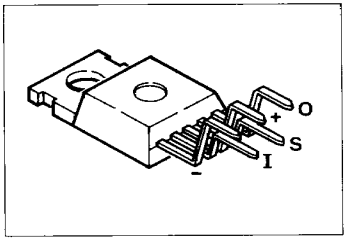
SIEMENS

PROFET **BTS 410 D/E/F/G**

Preliminary Data



- High-side switch
- Short-circuit protection
- Overtemperature protection
- Overload protection
- Load dump protection up to 80 V[1])
- Undervoltage and overvoltage shutdown with auto-restart and hysteresis
- Reverse battery protection[1])
- Input protection
- Inductive load generated negative voltage transient limit to typ. –10 V
- Broken inductive load protection[2])
- Open-load detection in on-condition
- Max. current internally limited
- Status output
- R_{on} constant versus V_{bb}
- Electrostatic discharge (**ESD**) protection
- Version E, G: Overtemperature shutdown with auto-restart
- Version G: Short-circuit protection by overtemperature protection

Type	Ordering code
BTS 410 D	C67078-S5305-A3
BTS 410 E	C67078-S5305-A4
BTS 410 F	C67078-S5305-A5
BTS 410 G	C67078-S5305-A6

Maximum Ratings

Parameter	Symbol	Values	Unit
Active overvoltage protection	$V_{bb(AZ)}$	>50	V
Short-circuit current	I_{SC}	self-limited	–
Max. power dissipation	P_{tot}	75	W
Operating and storage temperature range	T_j T_{stg}	–55 ... +150	°C
Thermal resistance Chip - case Chip – ambient	 $R_{th\ JC}$ $R_{th\ JA}$	 1.67 75	K/W

[1]) with 150 Ω resistor in GND connection
[2]) with 150 Ω resistor in GND connection or freewheel diode parallel to load.

Electrical Characteristics
at $T_j = 25$ °C, unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
On-state resistance (pin 3 to 5) $V_{bb} = 12$ V, $I_L = 1$ A	R_{on}	–	190	220	mΩ
Operating voltage (pin 3 to 1) $T_j = -40 \ldots +150$ °C	V_{bb}	4.9	–	42	V
Nominal current, calculated value (pin 5 to 1) ISO-proposal: $V_{bb}-V_{out} \leq 0.5$ V, $T_C = 85$ °C	I_L-ISO	–	–	1.6	A
Load current, theoretical value (pin 5 to 1) MOS-standard: $T_C = 25$ °C, $T_j = 150$ °C	I_L-MOS	–	–	13	
Load current limit (pin 5 to 1) active regulation starts BTS 410 D, E when $V_{bb}-V_{out} > 1$ V BTS 410 F, G	I_{LLim}	– –	15 5	– –	
Standby current (pin 3 to 1), $V_{bb} = 12$ V	I_R	–	10	50	µA
Short-circuit detection voltage, $V_{SC} = V_{bb} - V_{out}$	V_{SC}	–	8	–	V
Open-load detection current	I_{OL}	–	20	150	mA
Input voltage, (pin 2 to 1) $V_{bb} = 12$ V	$V_{in(off)}$ $V_{in(on)}$	– 0.5 2.4	– –	1.5 –	V
Max. input current at typ $V_{in(on)} = 6.0$ V	I_{in}	–	–	2	mA
Input current (pin 2 to 1) $V_{in(off)} = 0.4$ V $V_{in(on)} = 2.5$ V	 $I_{in(off)}$ $I_{in(on)}$	 1 10	 – –	 30 70	µA
Trip temperature automatic tripping when $T_j \geq 150$ °C	T_t	150	–	–	°C
Turn-on time Turn-off time $V_{bb} = 12$ V, 90 % V_{out}, $I_L = 1$ A, 10 % V_{out}	t_{on} t_{off}	15 5	– –	60 50	µs
Switching edge on Switching edge off $V_{bb} = 12$ V, 10 ... 30 % V_{out} $I_L = 1$ A, 70 ... 40 % V_{out}	dv/dt_{on} dv/dt_{off}	– –	– –	3 5	V/µs
Status (CMOS) BTS 410 D, $I_{St} = 50$ µA to GND. Status valid > 300 µs after switching edge	 $V_{St\ (high)}$ $V_{St\ (low)}$	 4.4 –	 – –	 6.5 0.4	V
Max. status current BTS 410 D, $I_{St} = 50$ µA to GND. Status valid > 300 µs after switching edge	I_{St}	–	–	5	mA

Electrical Characteristics (continued)
at $T_j = 25$ °C, unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Status (open drain) BTS 410 E/F/G, $I_{St} = 50$ µA to V_{bb}. Status valid > 300 µs after switching edge	$V_{St\ (high)}$ $V_{St\ (low)}$	5.0 –	– –	6.6 0.4	V
Max. status current BTS 410 E/F/G, $I_{St} = 50$ µA to V_{bb}. Status valid > 300 µs after switching edge	I_{St}	–	–	5	mA
Inductive load switch-off energy dissipation $T_j = 150$ °C	W_{ab}	–	–	0.4	J

Truth Table

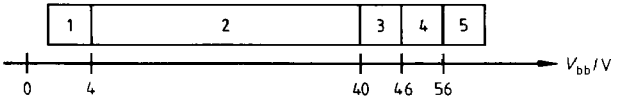
L = "Low" level H = "High" level	Input voltage	Status version D	Status version E, F	Status version G	Output voltage
Normal operation	L H	H H	H H	H H	L H
Open load	L H	H L	H L	H L	H[1]) H
Short-circuit	L H	H L	H L	H H	L L
Overtemperature	L H	L L	L L	L L	L L
Undervoltage	L H	L L	H H	H H	L L
Overvoltage	L H	L L	H H	H H	L L

Options Overview

	Version D	Version E	Version F	Version G
Load current limit	High level	High level	Low level	Low level
Status	CMOS	Open drain	Open drain	Open drain
Short-circuit protection	Switch off	Switch off	Switch off	By temp. protection
Overtemperature shutdown	Latch function[2])	Restart on cooling	Latch function[2])	Restart on cooling
Under- and overvoltage status feedback	Yes	No	No	No

[1]) Power transistor off
[2]) For type D and F: $V_{bb} > 9$ V

Operating Range (typ.)



1 Undervoltage sensor causes the device to switch off
2 Normal operation
3 Reduction of load current limit to reduce the short-circuit power dissipation of the switch
4 Overvoltage sensor causes the device to switch off
5 Increase of current between pin 3 and 1 from Zener diode to protect the circuit against overvoltage spikes

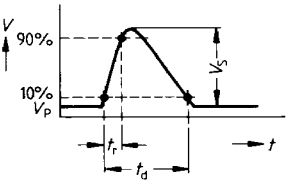
Interference Immunity[1)]
in acc. with DIN 40839, part 1 (12 V supply voltage)

Test pulse	Interference levels							
					with 150 Ω in GND connection			
	I	II	III	IV	I	II	III	IV
1	A	A	A	A	A	A	A	A
2	A	A	B	B	A	A	A	A
3 a	A	A	A	A	A	A	A	A
3 b	A	A	A	A	A	A	A	A
4	A	A	A	A	A	A	A	A
5	A	A	B	B	A	A	A	B

Class A: All functions of the device are performed as designed after exposure to disturbance.

Class B: One or more functions of the device are not performed as designed after exposure and cannot be returned to proper operation without replacing the device.

Test pulse 5: load dump



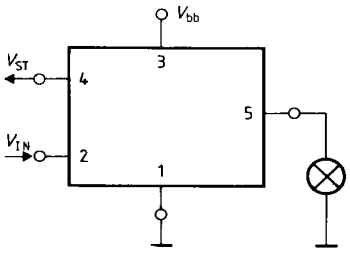
Parameters: V_S = 50 V (level 2)
V_p = 13.5 V
R_i = 0.5 ... 4 Ω
t_d = 40 ... 400 ms
t_r = 0.1 ... 10 ms
I_{Load} (Pin 5 to 1) = I_L-ISO (see page 135)
with 150 Ω in GND connection:
V_S = 80 V (level 3)

Note:
The conditions are related to each other in that the high setting values of V_S, R_i and t_d belong together as do respectively the low values.

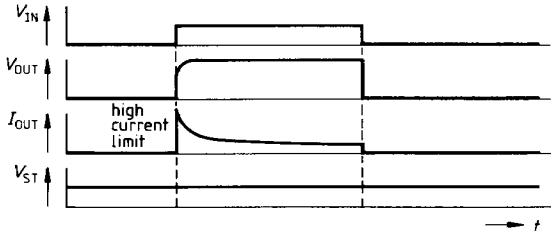
[1)] For detailed information refer to chapter Technical Information (DIN 40839: Electromagnetic compatibility (EMC) in motor vehicles; correlation with ISO-Technical Report 7637/0 and 7637/1).

Applications

Figure 1: Switching a lamp



Version D/E



Version F/G

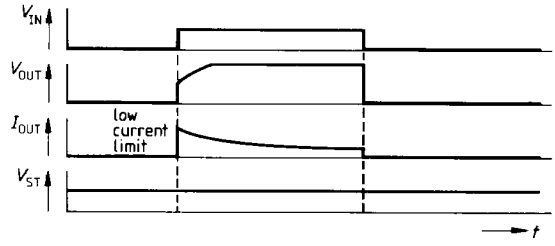


Figure 2: Switching a solenoid

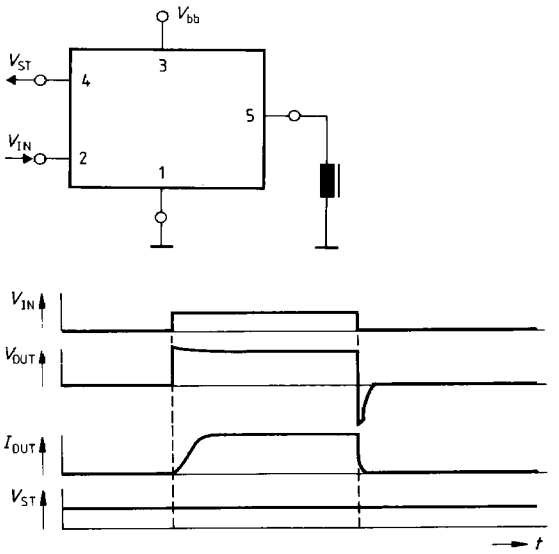


Figure 3: Operation with output short-circuited
Version D/E/F

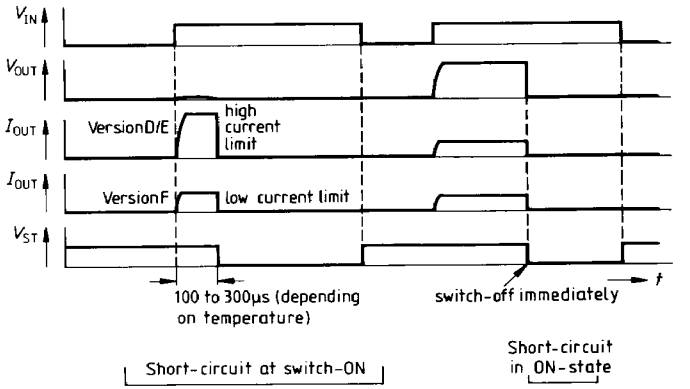


Figure 3: Operation with output short-circuited
Version G (short-circuit protection by overtemperature protection)

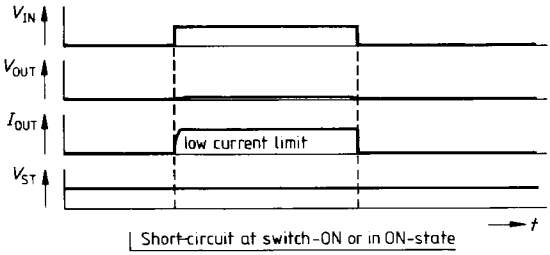


Figure 4: Operation with overload
Version D/F

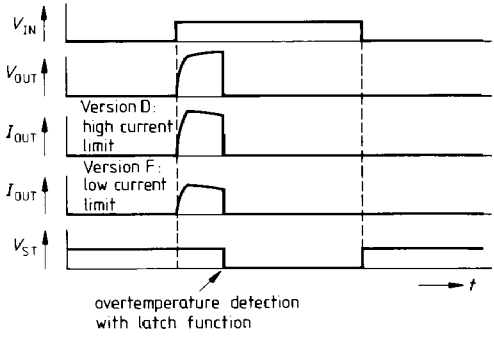


Figure 4: Operation with overload
Version E/G

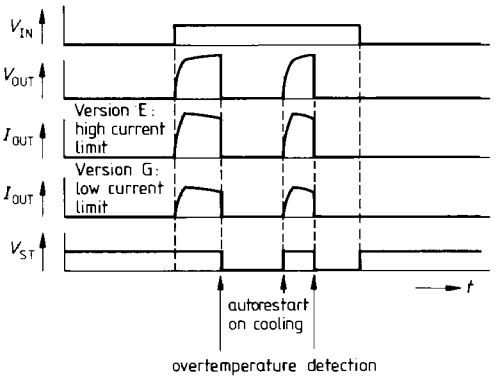


Figure 5: Operation with open load