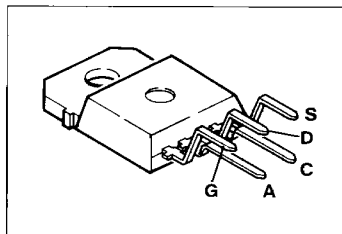


PROFET

Preliminary Data

BTS 432 D/E/F

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



Type	Ordering code
BTS 432 D	C67078-S5303-A3
BTS 432 E	C67078-S5303-A4
BTS 432 F	C67078-S5303-A5

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}	125	W
Operating and storage temperature range	T_j T_{stg}	- 55 ... + 150	°C
Thermal resistance			K/W
Chip - case	$R_{th JC}$	1.0	
Chip - ambient	$R_{th JA}$	75	

Electrical Characteristicsat $T_j = 25\text{ }^{\circ}\text{C}$, unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
On-state resistance (pin 3 to 5) $V_{bb} = 12\text{ V}$, $I_L = 2\text{ A}$	R_{on}	–	35	38	m Ω
Operating voltage (pin 3 to 1) $T_j = -40 \dots +150\text{ }^{\circ}\text{C}$	V_{bb}	4.9	–	42	V
Nominal current, calculated value (pin 5 to 1) ISO-proposal: $V_{bb} - V_{out} \leq 0.5\text{ V}$, $T_C = 85\text{ }^{\circ}\text{C}$	I_{L-ISO}	–	–	9	A
Load current, theoretical value (pin 5 to 1) MOS-standard: $T_C = 25\text{ }^{\circ}\text{C}$, $T_j = 150\text{ }^{\circ}\text{C}$	I_{L-MOS}	–	–	20	
Load current limit (pin 5 to 1) active regulation starts when $V_{bb} - V_{out} > 1\text{ V}$ BTS 432 D/E BTS 432 F	I_{LLim}	– –	40 7	– –	
Standby current (pin 3 to 1), $V_{bb} = 12\text{ V}$	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}	–	300	750	mA
Input voltage, (pin 2 to 1) $V_{bb} = 12\text{ V}$	$V_{in(off)}$	–0.5	–	1.5	V
Max. input current at typ $V_{in(on)} = 6.0\text{ V}$	$V_{in(on)}$	2.4	–	–	
Input current (pin 2 to 1) $V_{in(off)} = 0.4\text{ V}$ $V_{in(on)} = 2.5\text{ V}$	I_{in}	–	–	2	mA
Input current (pin 2 to 1) $V_{in(off)} = 0.4\text{ V}$ $V_{in(on)} = 2.5\text{ V}$	$I_{in(off)}$ $I_{in(on)}$	1 10	– –	30 70	μA
Trip temperature automatic tripping when $T_j \geq 150\text{ }^{\circ}\text{C}$	T_t	150	–	–	$^{\circ}\text{C}$
Turn-on time Turn-off time $V_{bb} = 12\text{ V}$, 90 % V_{out} , $I_L = 1\text{ A}$, 10 % V_{out}	t_{on} t_{off}	50 10	– –	300 60	μs
Switching edge on Switching edge off $V_{bb} = 12\text{ V}$, 10...30 % V_{out} $I_L = 1\text{ A}$, 70...40 % V_{out}	dv/dt_{on} dv/dt_{off}	– –	– –	2 4	V/ μs
Status (CMOS) BTS 432 D, $I_{St} = 50\text{ }\mu\text{A}$ 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 432 D, $I_{St} = 50\text{ }\mu\text{A}$ to GND. Status valid > 300 μs after switching edge	I_{St}	–	–	5.0	mA

Electrical Characteristicsat $T_j = 25\text{ °C}$, unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Status (open drain) BTS 432 E/F, $I_{St} = 50\text{ }\mu\text{A}$ to V_{bb} . Status valid $> 300\text{ }\mu\text{s}$ after switching edge	$V_{St\text{ (high)}}$ $V_{St\text{ (low)}}$	5.0 –	– –	6.6 0.4	V
Max. status current BTS 432 E/F, $I_{St} = 50\text{ }\mu\text{A}$ to V_{bb} . Status valid $> 300\text{ }\mu\text{s}$ after switching edge	I_{St}	–	–	5.0	mA
Inductive load switch-off energy dissipation $T_j = 150\text{ °C}$	W_{ab}	–	–	0.8	J
Reverse battery	$-V_{bb\text{max}}$	–	–	32	V

Truth Table

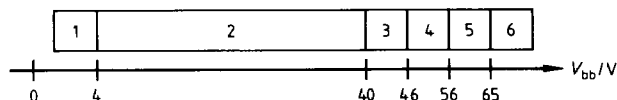
L = "Low" level H = "High" level	Input voltage	Status version D	Status version E, F	Output voltage
Normal operation	L H	H H	H H	L H
Open load	L H	H L	H L	H ¹⁾ H
Short-circuit	L H	H L	H L	L L
Overtemperature	L H	L L	L L	L L
Undervoltage	L H	L L	H H	L L
Overvoltage	L H	L L	H H	L L

Options Overview

	Version D	Version E	Version F
Load current limit	High level	High level	Low level
Status	CMOS	Open drain	Open drain
Overtemperature shutdown	Latch function ²⁾	Restart on cooling	Latch function ²⁾
Under- and overvoltage status feedback	Yes	No	No

¹⁾ Power transistor off²⁾ For $V_{bb} > 9\text{ V}$

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
- 6 Power transistor begins to turn on to protect itself against overvoltage spikes

Interference Immunity¹⁾

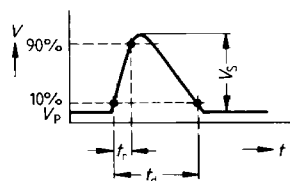
in acc. with DIN 40839, part 1 (12 V supply voltage)

Test pulse	Interference levels			
	I	II	III	IV
1	A	A	A	A
2	A	A	A	A
3 a	A	A	A	A
3 b	A	A	A	A
4	A	A	A	A
5	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: $V_S = 80 \text{ V}$ (level 3)
 $V_p = 13.5 \text{ V}$
 $R_i = 0.5 \dots 4 \ \Omega$
 $t_d = 40 \dots 400 \text{ ms}$
 $t_r = 0.1 \dots 10 \text{ ms}$

I_{Load} (Pin 5 to 1) = $I_{\text{L-ISO}}$ (see page 172)

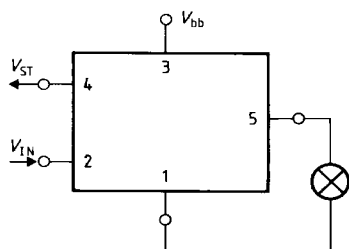
Note:

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.

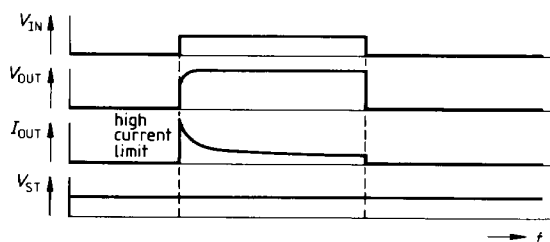
¹⁾ For detailed information refer to chapter Technical Information (DIN 40839: Electromagnetic compatibility (EMC) in motor vehicles; correlation with ISO-Technical Report 7637/0 and 7637/1).

Applications

Figure 1: Switching a lamp



Version D/E



Version F

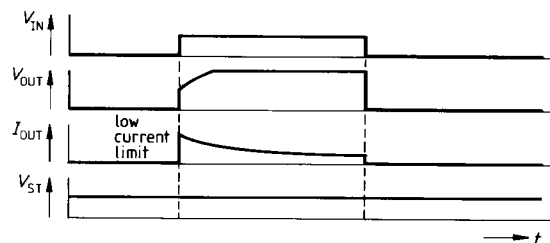


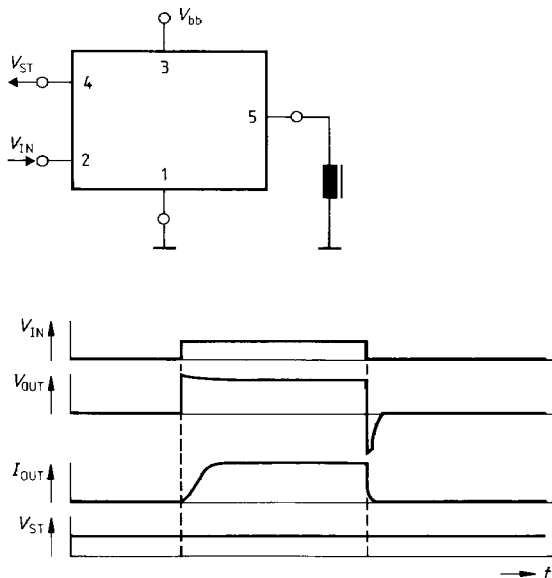
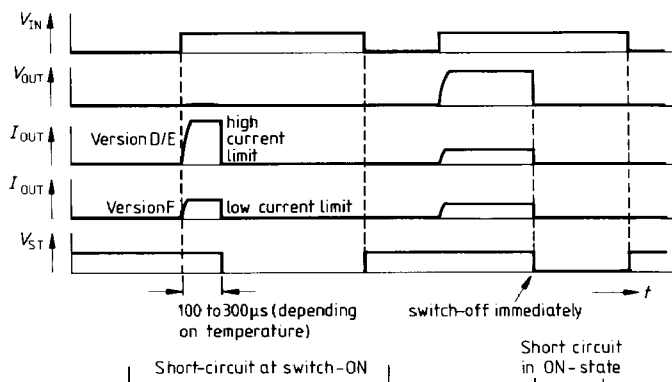
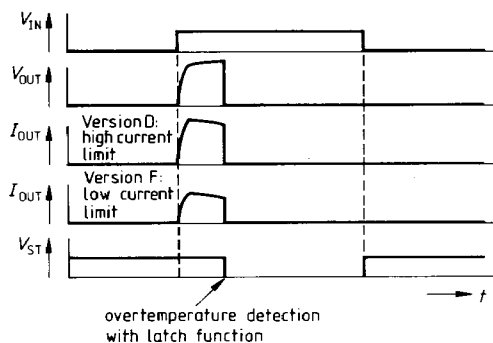
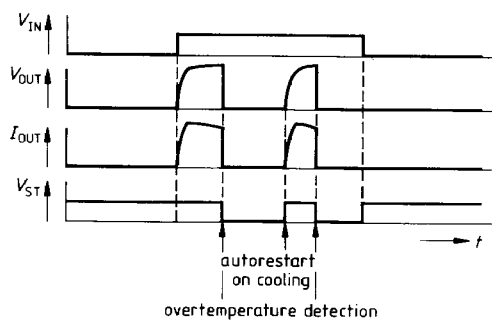
Figure 2: Switching a solenoid**Figure 3:** Operation with output short-circuited

Figure 4: Operation with overload

Version D/F



Version E

**Figure 5: Operation with open load**