SIEMENS

PROFET®

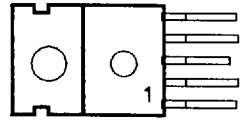
Preliminary data **BTS 409**

- High-side switch
- Overtemperature protection
- Overload protection
- Short circuit protection by overtemperature protection
- Overvoltage protection
- Input protection
- Clamp of negative output voltage with inductive loads
- Open load detection in ON-state
- Short to V_{bb} or open load detection in OFF-state
- Maximum current internally limited
- Protection against loss of ground
- Undervoltage shutdown with reset and hysteresis
- Overvoltage shutdown with reset and hysteresis
- Open drain status feedback
- Electrostatic discharge (ESD) protection

Description PROFET® an intelligent power switch with integrated protection against self-destruction

Application Power switch for all kinds of loads.

Case Plastic package, similar to TO 220 Pin 3 is shorted to the mounting flange



(OUT)	Output	(5)
(ST)	Status	(4)
(V_{bb})	Operating voltage	(3)
(IN)	Input	(2)
(GND)	Ground	(1)

pin configuration

TO220 / 5

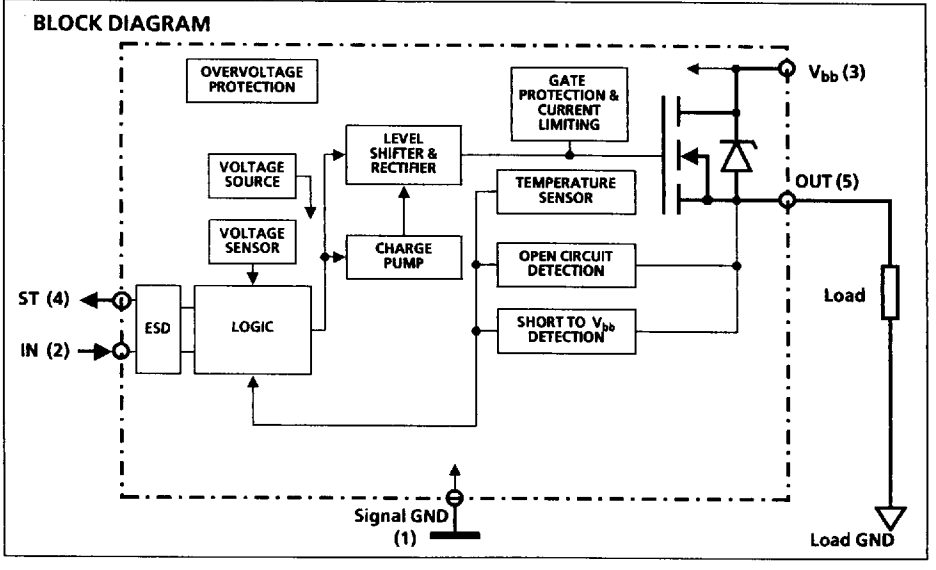
Type	Ordering code
BTS 409	C67078-S5311-A2

MAXIMUM RATINGS

DESCRIPTION	SYMBOL	RATINGS	UNIT	CONDITIONS
Breakdown voltage	$V_{bb(AZ)}$ [1]	>40	V	T_j = -40... + 150 °C, I_{bb} = 1mA
Short circuit current	I_{SC}	self-limited		
Max. power dissipation	P_D	30	W	T_C = 25 °C
Operating temperature range	T_j	-40...+150	°C	
Storage temperature range	T_{stg}	-55...+150	°C	
Status-pin current / Input	$I_{ST} \cdot I_{IN}$	5	mA	
Thermal resistance				
Chip - case	$R_{th\,JC}$	ca. 5	K / W	
Chip - ambient	$R_{th\,JA}$	75	K / W	

[1] Internal active clamp

BLOCK DIAGRAM



Electrical characteristics
(at T_j = 25 °C, unless otherwise specified)

Description	Symbol	Characteristics			Unit	Conditions
		min.	typ.	max.		
Drain-source on-state resistance (Pin 3 to 1)	$R_{DS(on)}$	-	170	200	mΩ	V_{bb} = 12 V, I_L = 2 A
Operating voltage (Pin 3 to 1)	V_{bb}	5.8	-	34	V	T_j = -40...+150 °C
Nominal current, (Pin 5 to GND)	I_L-ISO	1.6	-	-	A	ISO-proposal: V_{bb} - V_{out} ≤ 0.5V, T_C = 85 °C
Load current, theoretical value (Pin 5 to GND)	I_L-MOS	-	-	13	A	MOS-standard: T_C = 25°C T_j = 150°C
Load current limit (Pin 5 to GND)	I_{LLim}	-	11	-	A	
Standby current (Pin 3 to 1)	I_R	-	10	20	µA	V_{bb} = 12 V
Short to V_{bb} or open load detection level in OFF - state	V_{OC}	2	3	4	V	
Open load detection current in ON - state	I_{OL}	10	80	150	mA	
Input voltage (Pin 2 to 1)	$V_{in(off)}$ $V_{in(on)}$	-0.5 3.5	- -	1.5 20	V	V_{bb} = 12 V
Input current (Pin 2 to 1)	$I_{in(off)}$ $I_{in(on)}$	1 20	- 50	50 80	µA	$V_{in(off)}$ = 0.4 V $V_{in(on)}$ = 3.5 V
Trip temperature	T_t	150	-	-	°C	automatic shutdown
Slew rate	di/dt_{on} di/dt_{off}	0.01 0.01	- -	0.1 0.1	A/µs	V_{bb} = 12 V Resistive Load I_L = 2 A
Status (Open drain)	$V_{St\ (high)}$ $V_{St\ (low)}$	5 -	- -	7 0,4	V	I_{St} = 50 µA I_{St} = 1.6 mA T_j = -40...+ 150 °C
Output to ground internal impedance Pin 5 to 1(see circuits)	R_i	5	-	20	kΩ	V_{OUT} < 5V
Negative inductive clamp voltage	V_{ind}	-	33	-	V	V_{bb} = 12 V V_{ind} = $V_{bb(AZ)}$-Vbb $V_{bb(AZ)}$ = 45 V_{typ}
Reverse polarity (Pin 1 to 3) *	-V_{bb}	-	-	32	V	

*) Requires 150Ω resistor in GND connection. Reverse load current (through intrinsic drain-source diode) is normally limited by the connected load. Input and Status currents have to to be limited. It is recommend that 15kΩ resistors be inserted in series with IN and ST.

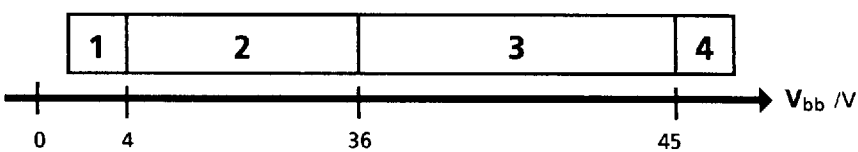
Truth table

	IN	OUT	ST
Normal operation	L H	L H	H H
Undervoltage / Overvoltage	X	L	H
Overtemperature	L H	L L	H L
Open Load	L H	Z H	H (L*) L
Output shorted to V_{bb}	L H	H H	L H (L**)

L = "Low" level X = "Don't care"
H = "High" level Z = Potential defined by external impedance

Status timing : see applications
(*) With an additional external resistor (see circuits)
(**) Low resistance detected by open load detection circuit

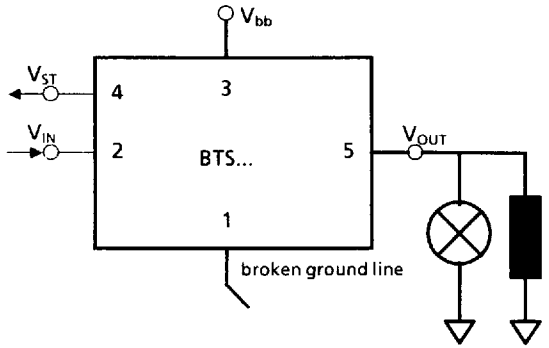
Operating range (typ. at T_j = 25 °C)



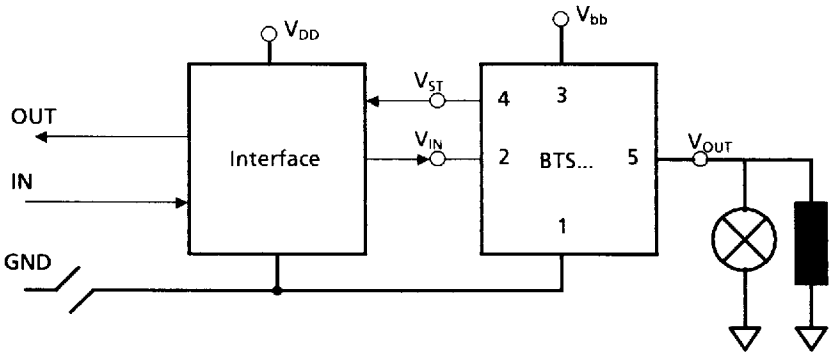
1: Undervoltage sensor causes the device to switch off
2: Normal operation
3: Overvoltage sensor causes the device to switch off
4: Increase of current between pin 3 and GND from Zener diode to protect the circuit against overvoltage spikes

This power switch is fully protected against loss of ground (see below).
By definition: no load current flows in the load despite loss of ground
(only the current through the internal impedance R_i between PIN 5 to 1 flows).

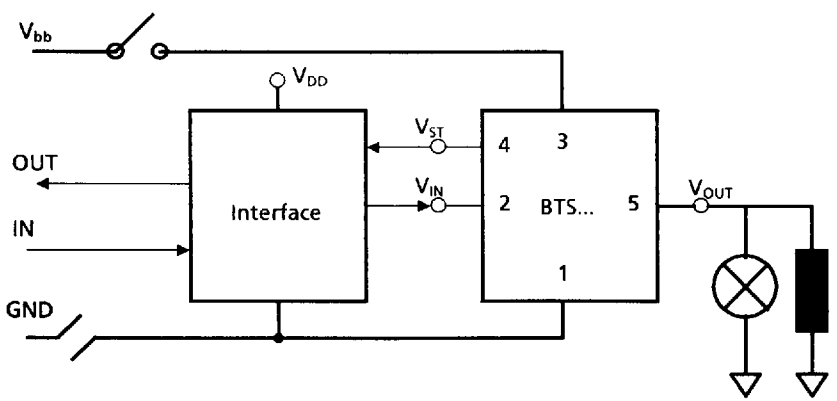
1: Broken ground line at the BTS...



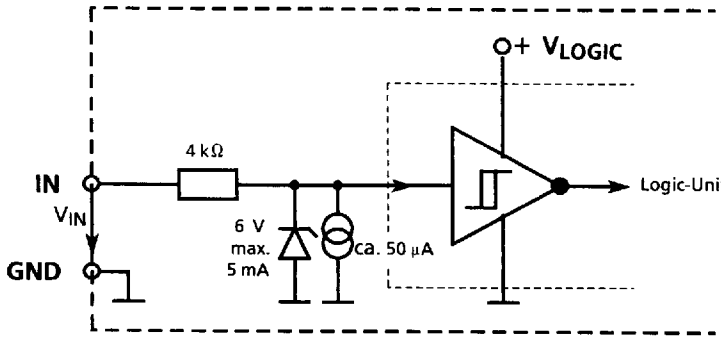
2: Broken ground line in the system, ground pulled high by Interface



3: Broken ground line in the system and interruption of V_{bb}

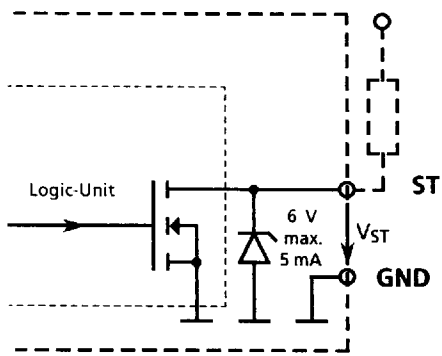


ESD Protected Logic-Input: IN (2)



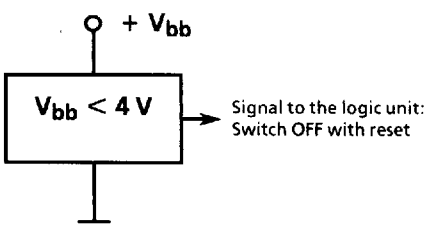
ESD Protected Status-Output: ST (4)

Open drain output with a typical output voltage of 6.0 V

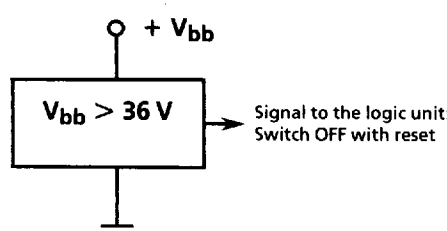


Voltage Sensor (typ. at $T_j = 25\,°C$) :

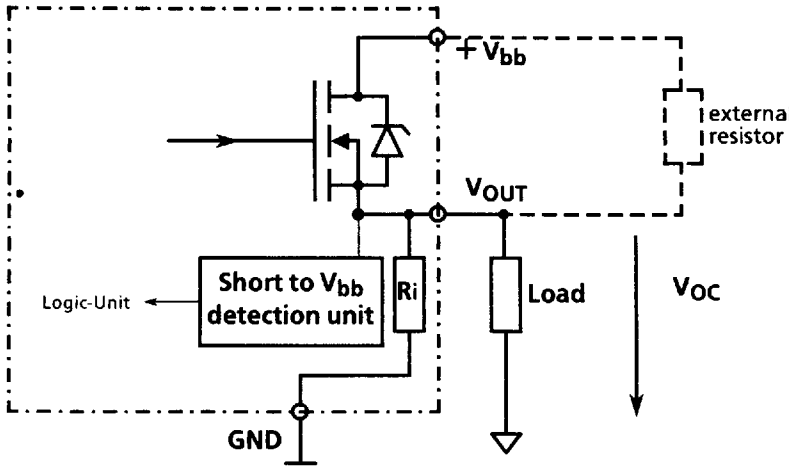
Undervoltage sensor



Overvoltage sensor

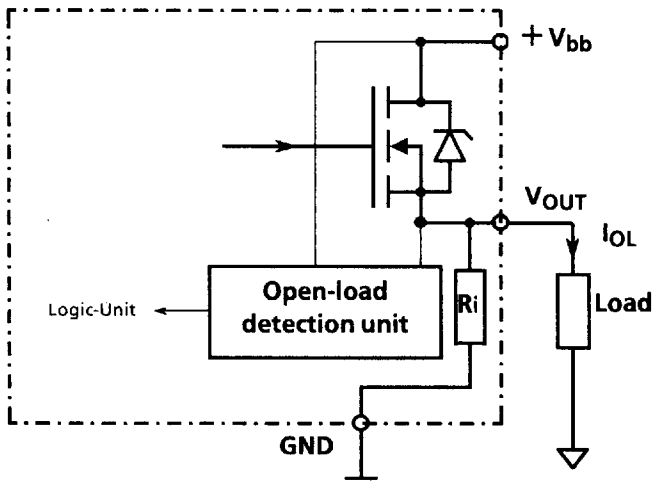


Short to V_{bb} or open load detection in OFF - state



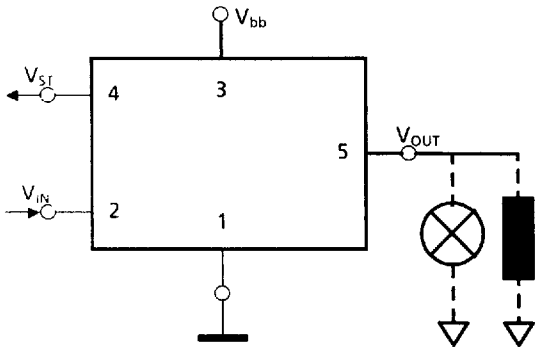
The "Short to V_{bb} detection" unit monitors the voltage between OUT and GND (additional external resistor between V_{bb} and OUT required for open load detection in the OFF - state)

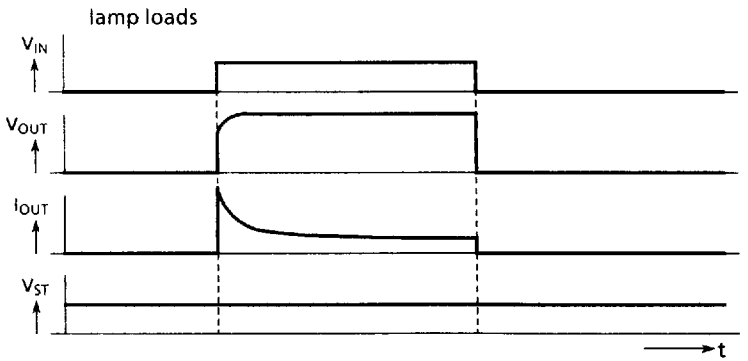
Open-load detection in ON - state

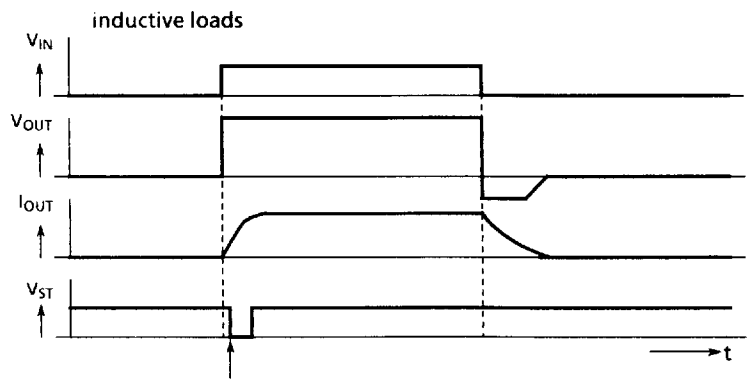


The *"Open-load detection" unit* monitors the voltage drop across the power transistor in the ON - state.

1: Switching a lamp or inductive loads

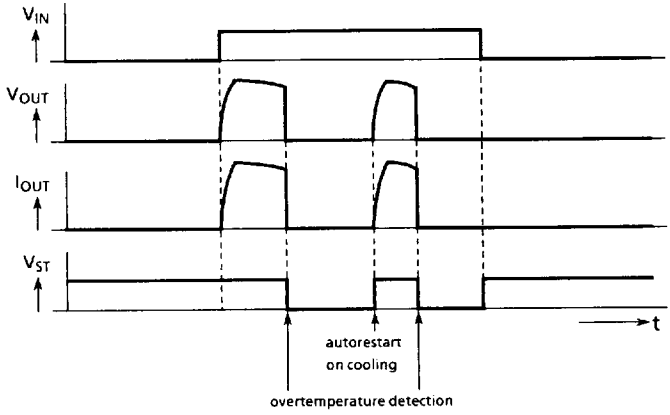




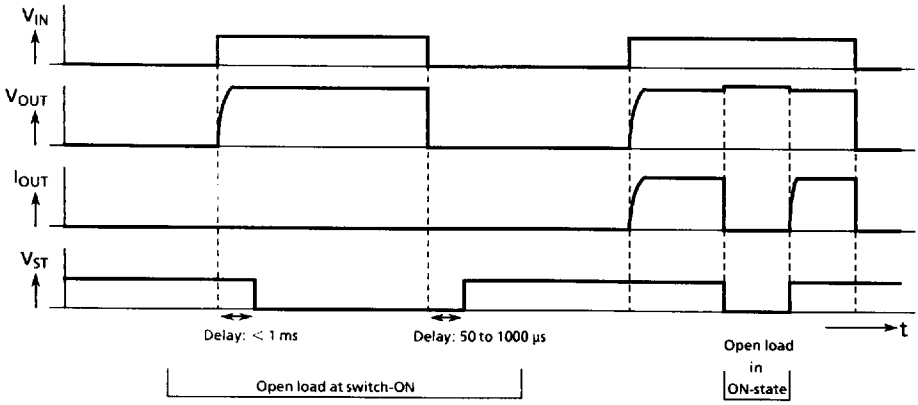


Open load detection at switch-on depending on value of inductor

2: Operation with overload / overtemperature



3: Operation with open load



4: Open load operation with additional external resistor between V_{bb} and OUT
5: Operation with output short-circuited to V_{bb}