

- 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



pin configuration

MAXIMUM RATINGS

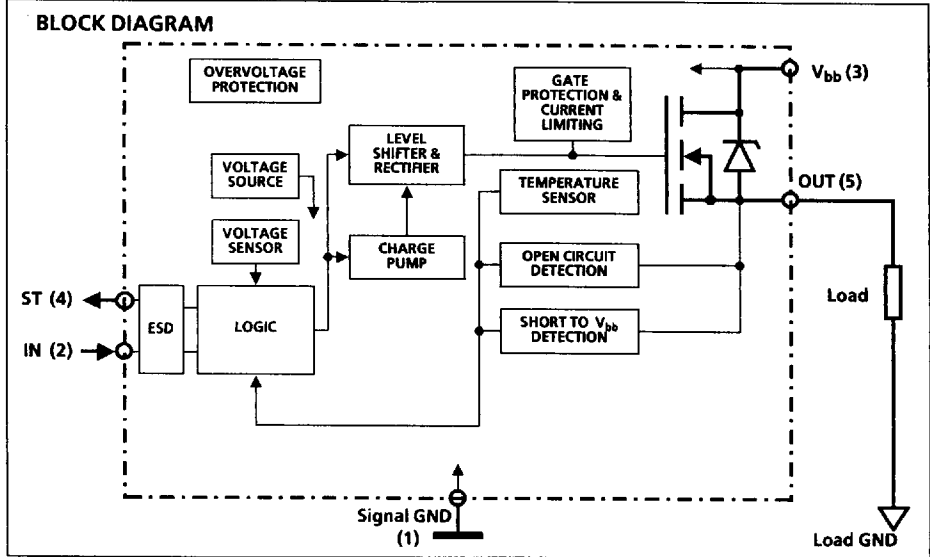
TO220 / 5

Type	Ordering code
BTS 409	C67078-S5311-A2

DESCRIPTION	SYMBOL	RATINGS	UNIT	CONDITIONS
Breakdown voltage	$V_{bb(A2)}^{1)}$	> 40	V	$T_j = -40...+150\text{ }^{\circ}\text{C}$, $I_{bb} = 1\text{ mA}$
Short circuit current	I_{SC}	self-limited		
Max. power dissipation	P_D	30	W	$T_C = 25\text{ }^{\circ}\text{C}$
Operating temperature range	T_j	-40...+150	$^{\circ}\text{C}$	
Storage temperature range	T_{stg}	-55...+150	$^{\circ}\text{C}$	
Status-pin current / Input	$I_{ST} \cdot I_{IN}$	5	mA	
Thermal resistance				
Chip - case	R_{thJC}	ca. 5	K / W	
Chip - ambient	R_{thJA}	75	K / W	

1) Internal active clamp

BLOCK DIAGRAM



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

*) Requires 150 Ω 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 be limited. It is recommend that 15k Ω 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"

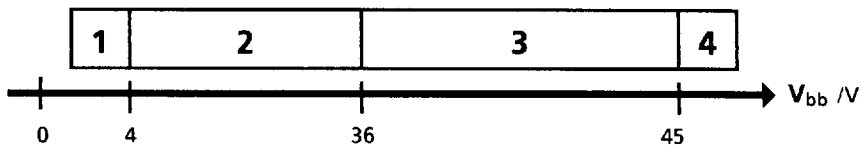
H = "High" level

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

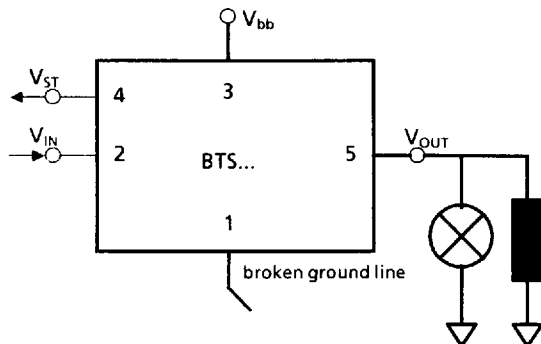
Operating range (typ. at $T_j = 25^\circ\text{C}$)

- 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

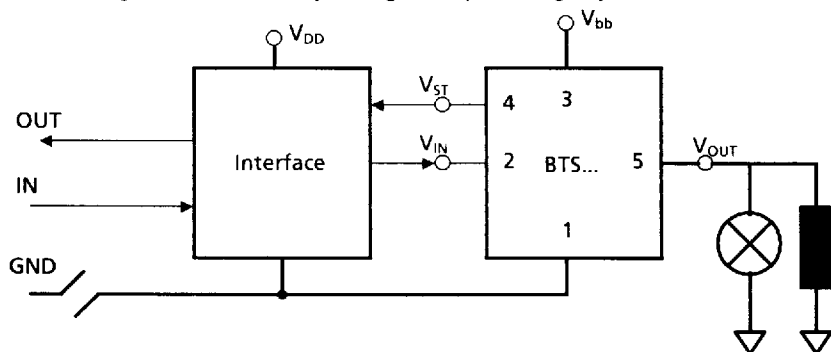
This power switch is fully protected against loss of ground (see below).

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).

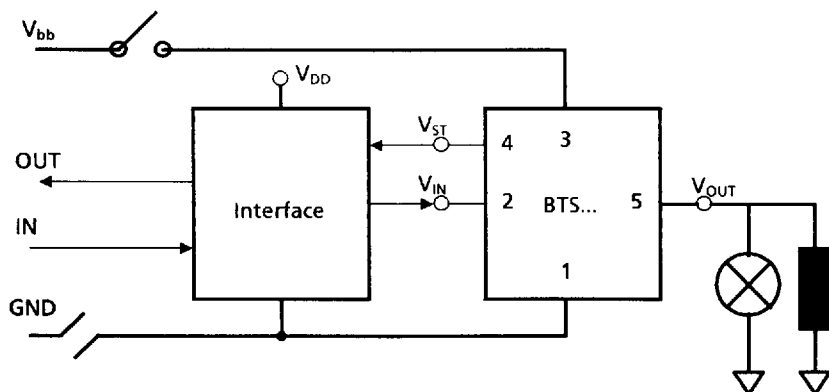
1: Broken ground line at the BTS...



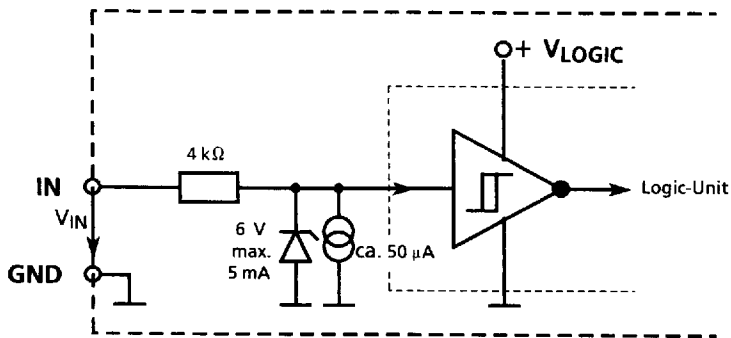
2: Broken ground line in the system, ground pulled high by Interface



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

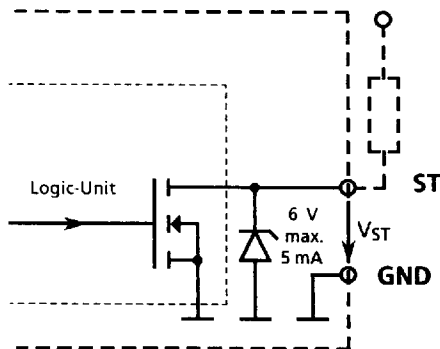


ESD Protected Logic-Input: IN (2)



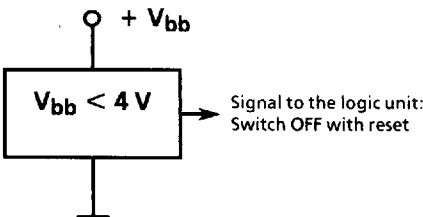
ESD Protected Status-Output: ST (4)

Open drain output with a typical output voltage of 6.0 V

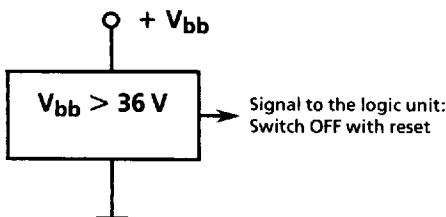


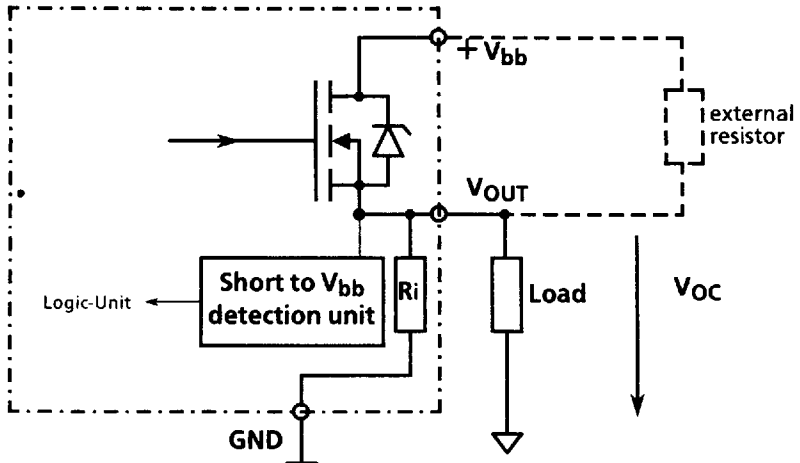
Voltage Sensor (typ. at T_j = 25 °C) :

Undervoltage sensor



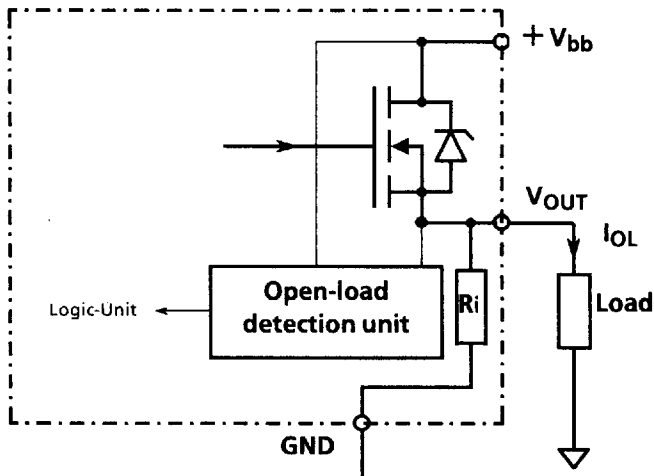
Overvoltage sensor



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

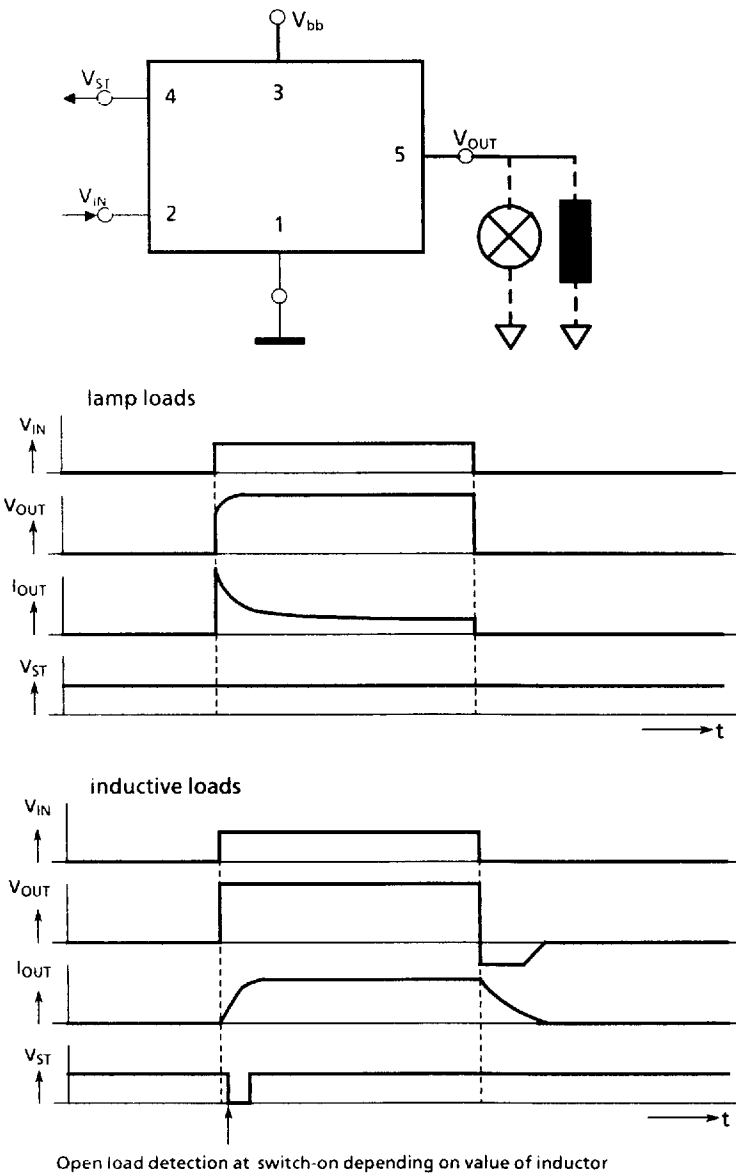
The "Short to V_{bb} detection" unit monitors the voltage between OUT and GND (additional external resistor between V_{bb} and OUT required for open load detection in the OFF - state)

Open-load detection in ON - state



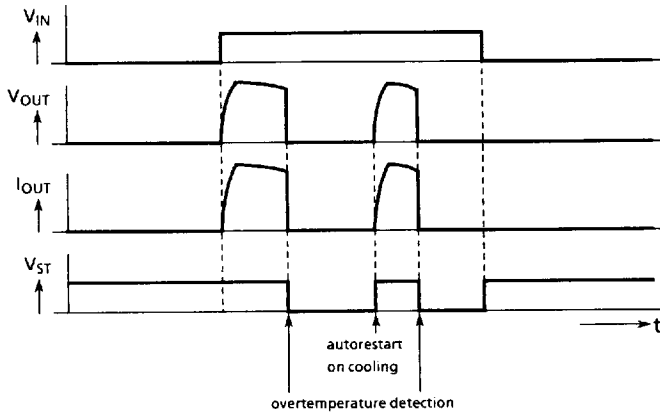
The "Open-load detection" unit monitors the voltage drop across the power transistor in the ON - state.

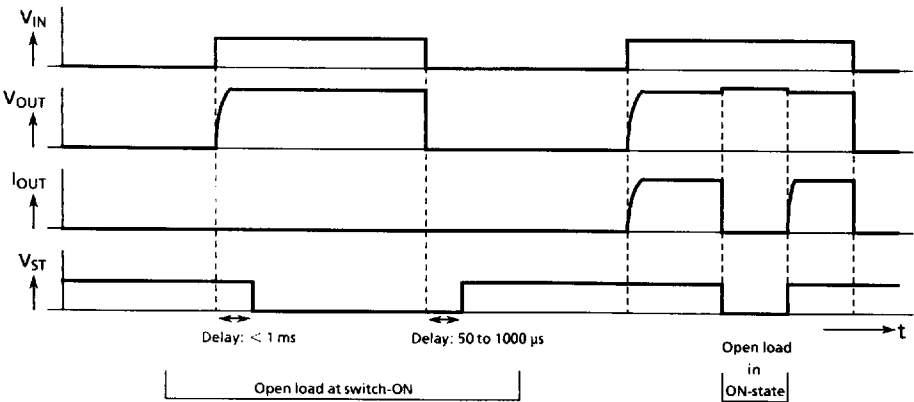
1: Switching a lamp or inductive loads



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

2: Operation with overload / overtemperature





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

