

Smart Power High-Side-Switch

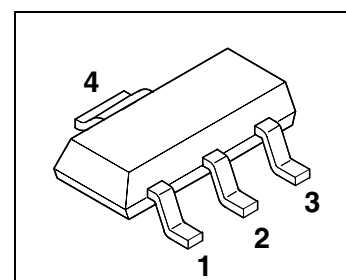
One Channel: 1 x 200mΩ

Features

- Short-circuit protection
- Current limitation
- Overload protection
- Overvoltage protection (including load dump)
- Undervoltage shutdown with autorestart and hysteresis
- Switching inductive loads
- Clamp of negative voltage at output with inductive loads
- Thermal shutdown with restart
- ESD - Protection
- Loss of GND and loss of V_{bb} protection
- Reverse battery protection with external resistor
- **Improved electromagnetic compatibility (EMC)**

Product Summary

		BSP 450	BTS 4141N	
Overvoltage protection	$V_{bb(AZ)}$	48	47	V
Operating voltage	$V_{bb(on)}$	12...40	12...45	V
On-state resistance	R_{ON}	200	200	mΩ



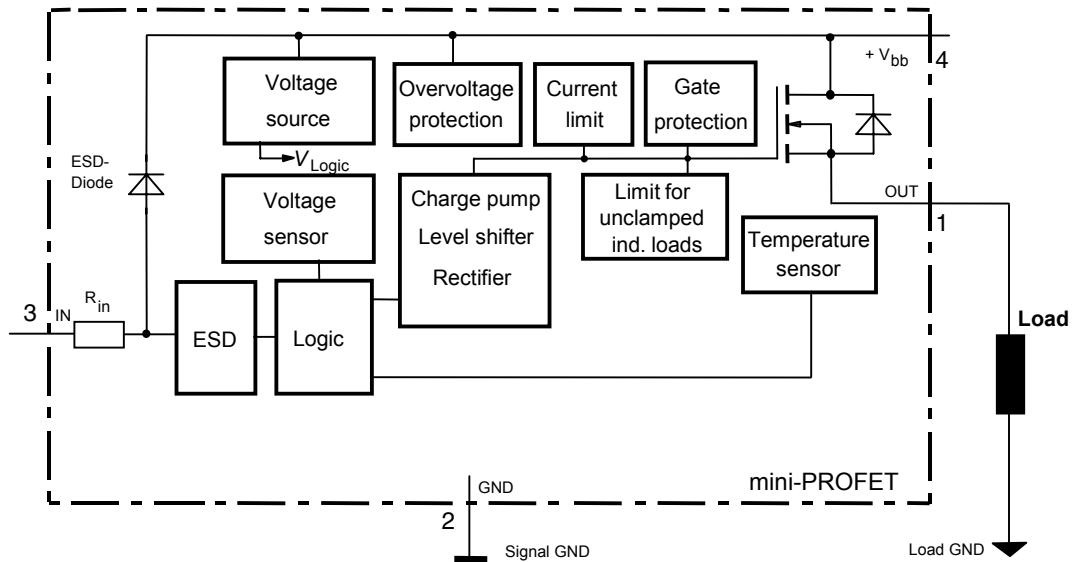
Application

- All types of resistive, inductive and capacitive loads
- Current controlled power switch for 12 V and 24 V DC applications
- Replaces electromechanical relays and discrete circuits

General Description

N channel vertical power MOSFET with charge pump ground referenced
CMOS compatible input, monolithically integrated in Smart SIPMOS technology.
Fully protected by embedded protection functions.

Block Diagram



Pin	Symbol	Function
1	OUT	Output to the load
2	GND	Logic ground
3	IN	Input, activates the power switch in case of logic high signal
4	Vbb	Positive power supply voltage

Maximum Ratings

BSP 450

BTS 4141N

Parameter	Symbol	Values	Values	Unit
at $T_j = 25^\circ\text{C}$, unless otherwise specified				
Supply voltage	V_{bb}	-0,3...48	-0,3...48	V
Load current (Short-circuit current, see page 5)	I_L	self limited	self limited	A
Continuous input voltage	V_{IN}	-5,0... V_{bb}	-10,0... V_{bb}	V
Maximum current through the input pin (DC)	I_{IN}	± 5	± 5	mA
Inductive load switch-off energy dissipation ¹⁾²⁾ single pulse	E_{AS}	0,5	0,7	J
Operating temperature range	T_j	-40 ...+ 125	-40 ...+ 125	$^\circ\text{C}$
Storage temperature range	T_{stg}	-55 ...+150	-55 ...+ 150	
Max. power dissipation (DC) ¹⁾	P_{tot}	1.4	1.4	W
Electrostatic discharge voltage (Human Body Model) according to ANSI EOS/ESD – S5.1 – 1993 ESD STM5.1 – 1998	E_{AS}			kV
Input pin		± 1	± 1	
All other pins		± 1	± 5	
Thermal resistance	junction – soldering point: junction - ambient: ¹⁾	R_{thJS} R_{thJA}	7 70	K/W

1) Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6 cm2 (one layer, 70µm thick) copper area for V_{bb} connection. PCB is vertical without blown air..

2) not subject to protection test, guaranteed by design

Electrical Characteristics

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Parameter and Conditions	Symbol	Values			Unit		
		Values			Values		
		min	typ	max	min	typ	max

Load Switching Capabilities and Characteristics

On-state resistance $T_j = 25^\circ\text{C}$, $I_L = 0,5\text{A}$ $T_j = 125^\circ\text{C}$	R_{ON}	--	0,16	0,2 0,38	--	0,15 0,27 0,32	Ω
Nominal load current Device on PCB ¹⁾	$I_{L(nom)}$	1,7 ²⁾	--	--	0,7	--	A
Turn-on time to 90% V_{OUT}	t_{on}	--	60	100	--	50	μs
Turn-off time to 10% V_{OUT}	t_{off}	--	90	150	--	75	μs
Slew rate on 10 to 30% V_{OUT}	dV/dt_{on}	--	2	4	--	1	V/ μs
Slew rate off 70 to 40% V_{OUT}	$-dV/dt_{off}$	--	2	4	--	1	V/ μs

1) Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6 cm2 (one layer, 70 μm thick) copper area for V_{bb} connection. PCB is vertical without blown air..

2) This value describes the maximum current of the MOSFET-part, but on this device the nominal load current is limited by the current limitation (see page 6)
 $I_{L(nom)}$ is limited by the current limitation.

Electrical Characteristics

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Parameter and Conditions	Symbol	Values			Values			Unit
		at $T_j = 25\text{ }^{\circ}\text{C}$, $V_{bb} = 24\text{ V}$			at $T_j = -40\dots125\text{ }^{\circ}\text{C}$, $V_{bb} = 15\dots30\text{ V}$			
		min	typ	max	min	typ	max	

Operating Parameters

Operating voltage	$V_{bb(on)}$	12	--	40	12	--	45	V
Undervoltage shutdown	$V_{bb(under)}$	7	--	10,5	7	--	10,5	V
Undervoltage restart	$V_{bb(u rst)}$	--	--	11	--	--	11	V
Undervoltage hysteresis	$\Delta V_{bb(under)}$	--	0,4	--	--	0,5	--	V
Standby current $T_j = -40\text{...}85\text{ °C}$ $T_j = 125\text{ °C}^{1)}$	$I_{bb(off)}$	--	10	25	--	10	25	μA
		--	--	50	--	--	50	
Operating current, $V_{IN} = \text{high}$	I_{GND}		1	1,6		1	1,6	mA
Leakage output current (included in $I_{bb(off)}$) $V_{IN} = 0\text{ V}$	$I_{L(off)}$	--	--	2	--	3,5	10	μA

¹⁾ higher current due temperature sensor

Electrical Characteristics

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Parameter and Conditions	Symbol	Values			Unit		
		Values			Values		
		min	typ	max	min	typ	max
		at $T_j = 25\text{ °C}$, $V_{bb} = 24\text{ V}$			at $T_j = -40\text{...}125\text{ °C}$, $V_{bb} = 15\text{...}30\text{ V}$		

Protection Functions

Initial peak short circuit current limit $T_j = -40\text{ °C}$ $T_j = 25\text{ °C}$ $T_j = 125\text{ °C}$	$I_{L(\text{lim})}$	-- -- 0,7	-- 1,5 --	2,4 -- --	-- -- 0,7	-- 1,4 --	2,1 -- --	A
Output clamp (inductive load switch off) at $V_{\text{out}} = V_{bb} - V_{\text{ON(CL)}}$	$V_{\text{ON(CL)}}$	--	72	--	62	68	--	V
Overvoltage protection	$V_{bb(\text{AZ})}$	48	--	--	47	--	--	V
Thermal overload trip temperature	T_{jt}	135	150	--	135	--	--	°C
Thermal hysteresis	ΔT_{jt}	--	10	--	--	10	--	K

Electrical Characteristics

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Parameter and Conditions	Symbol	Values			Unit		
		Values			Values		
		min	typ	max	min	typ	max

at $T_j = 25\text{ °C}$,
 $V_{bb} = 24\text{ V}$

at $T_j = -40\text{...}125\text{ °C}$,
 $V_{bb} = 15\text{...}30\text{ V}$

Input

Continuous input voltage	V_{IN}	-3,0	--	V_{bb}	-10 ¹⁾	--	V_{bb}	V
Input turn-on threshold voltage	$V_{IN(T+)}$	--	--	3,0	--	--	3,0	V
Input turn-off threshold voltage	$V_{IN(T-)}$	1,82	--	--	1,82	--	--	V
Input threshold hysteresis	$\Delta V_{IN(T)}$	--	0,1	--	--	0,2	--	V
Off state input current	$I_{IN(off)}$	20	--	--	20	--	--	μA
On state input current	$I_{IN(on)}$	--	--	110	--	--	110	μA
Input delay time at switch on V_{bb}	$t_{d(V_{bbon})}$	--	--	--	150	340	--	μs
Input resistance	R_i	1,5	2,8	3,5	1,5	3	5	$\text{k}\Omega$

Reverse Battery

Reverse battery ^{1) 2)}	$-V_{bb}$	--	--	30	--	--	45	V
Continuous reverse drain current	I_S	--	--	1	--	--	1	A
Drain source diode voltage	$-V_{ON}$	--	--	1,2	--	0,6	1,2	V

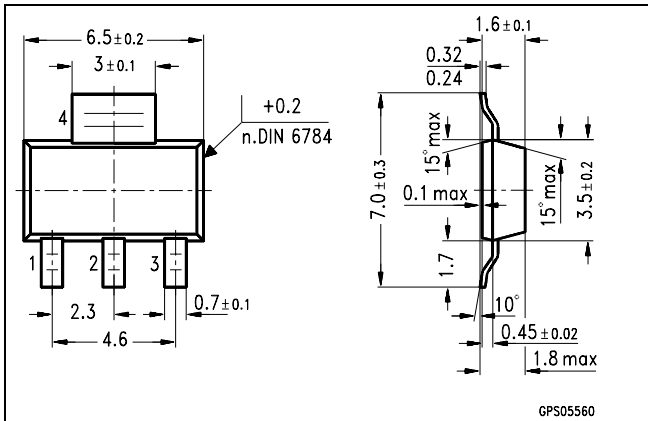
¹⁾ not subject to protection test, guaranteed by design

²⁾ Requires 150 Ω resistor in GND connection. Reverse load current (through intrinsic drain-source diode) is normally limited by the connected load.

Package:

all dimensions in mm.

SOT 223:



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