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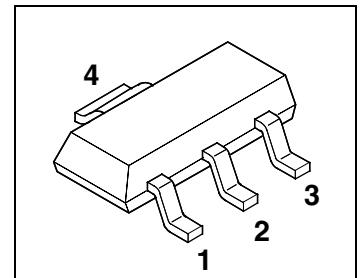
Application
- All types of resistive, inductive and capacitive loads
- Current controlled power switch for 12 V and 24 V DC applications
- Replaces electromechanical relays and discrete circuits

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.

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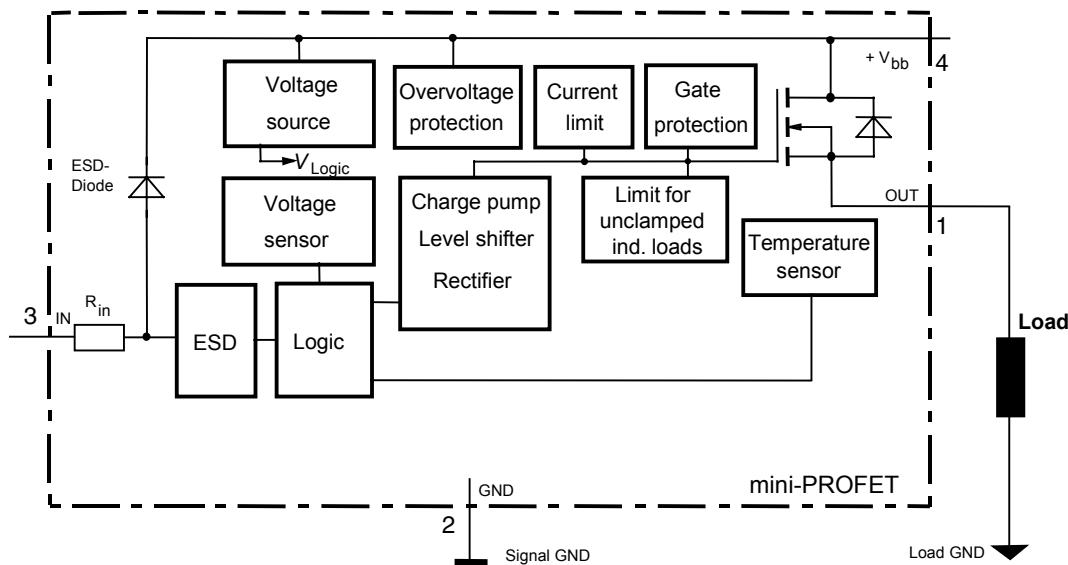
Pin	Symbol	Function
1	OUT	Output to the load
2	GND	Logic ground
3	IN	Input, activates the power switch in case of logic high signal
4	Vbb	Positive power supply voltage

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Maximum Ratings

at $T_j = 25°C$, unless otherwise specified

Parameter	Symbol	BSP 450 Values	BTS 4141N Values	Unit
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}	-5,0...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	tbd	J
Max. power dissipation (DC)[1] $T_A = 25 °C$	P_{tot}	1.4	1.4	W
Operating temperature range	T_j	-40 ...+ 125	-40 ...+ 125	°C
Storage temperature range	T_{stg}	-55 ...+150	-55 ...+ 150	
Electrostatic discharge voltage (Human Body Model) according to ANSI EOS/ESD – S5.1 – 1993	E_{AS}			kV
ESD STM5.1 – 1998				
Input pin		±1	±1	
All other pins		±1	**±5**	
Thermal resistance				K/W
junction – soldering point:	R_{thJS}	7	7	
junction - ambient:[1]	R_{thJA}	70	70	

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[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 tested, specified by design

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Electrical Characteristics

Parameter and Conditions

at T_j = 25 °C, V_{bb} = 24 V unless otherwise specified

Parameter	Symbol	BSP 450 Values			BTS 4141N Values			Unit
		min	typ	max	min	typ	max	
On-state resistance								
T_j = 25°C, I_L = 0,5A	R_{ON}	--	0,16	0,2	--	**0,15**	**0,2**	Ω
T_j = 125°C		--	--	0,38	--	**0,27**	**0,32**	
Load Switching Capabilities and Characteristics								
Nominal load current Device on PCB[1]	$I_{L(nom)}$	1,7[2]	--	--	**0,7**	--	--	A
Turn-on time T_j = -40...125°C to 90% V_{OUT}	t_{on}	--	60	100	--	**50**	100	µs
Turn-off time T_j = -40...125°C to 10% V_{OUT}	t_{off}	--	90	150	--	**75**	150	
Slew rate on 10 to 30% V_{OUT} T_j = -40...125°C	dV/dt_{on}	--	2	4	--	**1**	**2**	V/µs
Slew rate off 70 to 40% V_{OUT} T_j = -40...125°C	$-dV/dt_{off}$	--	2	4	--	**1**	**2**	V/µs

[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] 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.

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Electrical Characteristics

Parameter and Conditions

at T_j = 25 °C, V_{bb} = 24 V unless otherwise specified

Operating Parameters

Parameter and Conditions		Symbol	BSP 450 Values			BTS 4141N Values			Unit
			min	typ	max	min	typ	max	
Operating voltage	T_j = -40...125°C	$V_{bb(on)}$	12	--	40	12	--	**45**	V
Undervoltage shutdown	T_j = -40...125°C	$V_{bb(under)}$	7	--	10,5	7	--	10,5	V
Undervoltage restart	T_j = -40...125°C	$V_{bb(u\,rst)}$	--	--	11	--	--	11	V
Undervoltage hysteresis		$\Delta V_{bb(under)}$	--	0,4	--	--	**0,5**	--	V
Standby current		$I_{bb(off)}$							µA
T_j = -40...tbd°C			--	10	25	--	10	25	
T_j = 125°C[1]			--	--	50	--	--	50	
Operating current, V_{IN} = high	T_j = -40...125°C	I_{GND}	--	1	1,6	--	1	1,6	mA
Leakage output current (included in $I_{bb(off)}$) V_{IN} = 0 V	T_j = -40...125°C	$I_{L(off)}$	--	--	2	--	**tbd**	**10**	µA

[1] higher current due temperature sensor

Electrical Characteristics

BSP 450   BTS 4141N

Parameter and Conditions

at T_j = 25 °C, V_{bb} = 24 V unless otherwise specified

Parameter	Symbol	Values			Values			Unit
		min	typ	max	min	typ	max	
Initial peak short circuit current limit	$I_{L(lim)}$							A
T_j = -40°C		--	--	2,4	--	--	1,9	
T_j = 25°C		--	1,5	--	--	1,5	--	
T_j = 125°C		0,7	--	--	0,7	--	--	

Protection Functions

Parameter	Symbol	Values			Values			Unit
		min	typ	max	min	typ	max	
Output clamp (inductive load switch off) at $V_{out} = V_{bb} - V_{ON(CL)}$	$V_{ON(CL)}$	--	72	--	63	65	68	V
Overvoltage protection	$V_{bb(AZ)}$	48	--	--	47	--	--	V
Thermal overload trip temperature T_j=-40...+125°C	T_{jt}	135	150	--	135	--	--	°C
Thermal hysteresis	ΔT_{jt}	--	10	--	--	10	--	K

Electrical Characteristics

Parameter and Conditions

at T_j = 25 °C, V_{bb} = 24 V unless otherwise specified

Input

Parameter and Conditions	Symbol	BSP 450 Values min	typ	max	BTS 4141N Values min	typ	max	Unit
Continuous input voltage T_j = -40...125°C	V_{IN}	-3,0	--	V_{bb}	-3,0	--	V_{bb}	V
Input turn-on threshold voltage T_j = -40...125°C	$V_{IN(T+)}$	--	--	3,0	--	--	3,0	V
Input turn-off threshold voltage T_j = -40...125°C	$V_{IN(T-)}$	1,82	--	--	1,82	--	--	V
Input threshold hysteresis	$\Delta V_{IN(T)}$	--	0,1	--	--	0,3	--	V
Off state input current T_j = -40...125°C	$I_{IN(off)}$	20	--	--	--	20	--	µA
On state input current T_j = -40...125°C	$I_{IN(on)}$	--	--	110	--	--	110	µA
Input resistance	R_I	1,5	2,8	3,5	--	**3**	--	kΩ

Reverse Battery

Parameter and Conditions	Symbol	BSP 450 Values min	typ	max	BTS 4141N Values min	typ	max	Unit
Reverse battery[1]	$-V_{bb}$	--	--	30	--	--	**tbd**	V
Continious reverse drain current	I_S	--	--	1	--	--	**tbd**	A
Drain source diode voltage	$-V_{ON}$	--	--	1,2	--	**0,6**	--	V

[1] 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:
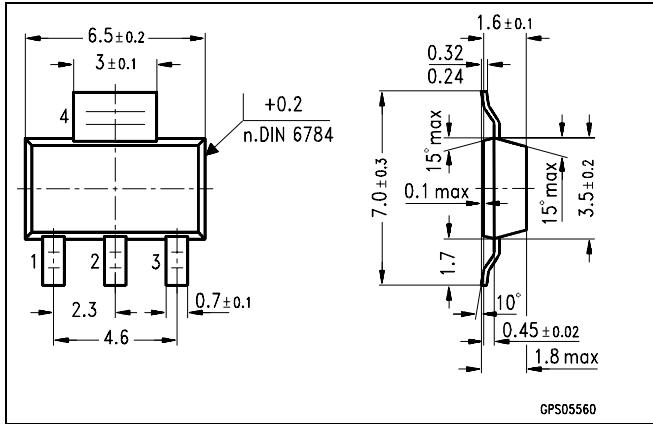
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