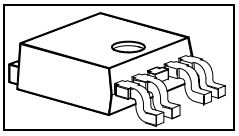
Smart Power High-Side-Switch
One Channel: 1 x 200mΩ

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		BTS 4501D	**BTS 4141D**	
Overvoltage protection	$V_{bb(AZ}$	47	47	V
Operating voltage	$V_{bb(on)}$	12...35	12...**45**	V
On-state resistance	R_{ON}	200	200	mΩ



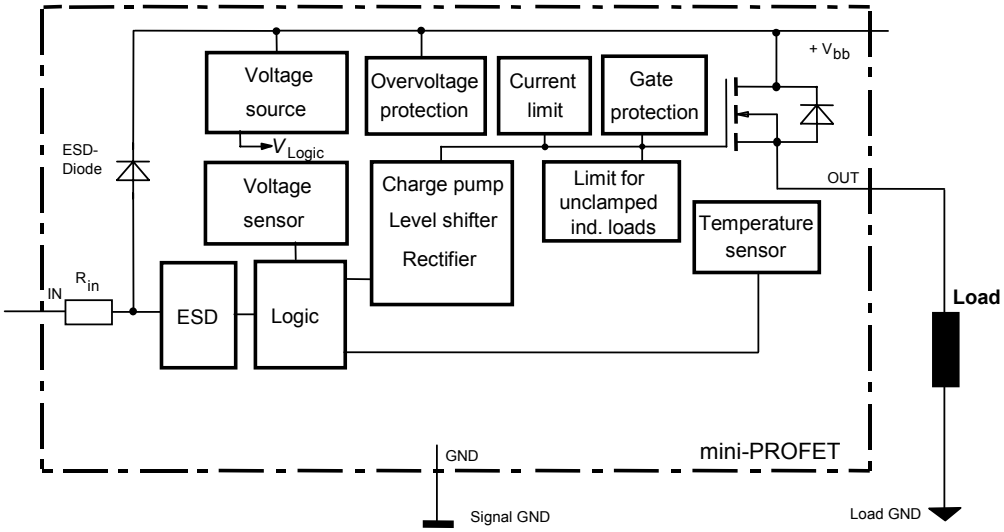
Application

- 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	NC	not connected
3	Vbb	connected with TAB
4	GND	Logic ground
5	IN	Input, activates the power switch in case of logic high signal
TAB	Vbb	Positive power supply voltage

Maximum Ratings

Parameter at T_j = 25°C, unless otherwise specified	Symbol	Values BTS4501D	Values **BTS 4141D**	Unit
Supply voltage	V_{bb}	-0,3...48	-0,3...48	V
Load current (Short-circuit current, see page 6)	I_L	self limited	self limited	A
Continuous input voltage	V_{IN}	-5,0... V_{bb}	**-10**... 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}	8	**12**	J
Operating temperature range Storage temperature range	T_j T_{stg}	-40 ...+ 125 -55 ...+150	-40 ...+ 125 -55 ...+ 150	°C
Max. power dissipation (DC)[1)] T_A = 25 °C	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 Input pin All other pins	E_{AS}	 ±1 ±1	 ±1 **±5**	kV
Thermal resistance junction – case: junction - ambient:[1)]	R_{thJC} R_{thJA}	3 60	3 60	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

Parameter and Conditions	Symbol	BTS 4501D Values at T_j = 25 °C, V_{bb} = 24 V			BTS 4141D Values at T_j = -40…125 °C, V_{bb} = 15…30 V			Unit
		min	typ	max	min	typ	max	
Load Switching Capabilities and Characteristics								
On-state resistance T_j = 25°C, I_L = 0,5A T_j = 125°C	R_{ON}	-- --	0,16 --	0,2 0,38	-- --	**0,15** **0,27**	0,2 **0,32**	Ω
Nominal load current Device on PCB[1)]	$I_{L(nom)}$	--	--	--	**0,7**	--	--	A
Turn-on time to 90% V_{OUT}	t_{on}	--	60	100	--	**50**	100	µs
Turn-off time to 10% V_{OUT}	t_{off}	--	90	150	--	**75**	150	
Slew rate on 10 to 30% V_{OUT}	dV/dt_{on}	--	2	4	--	**1**	**2**	V/µs
Slew rate off 70 to 40% V_{OUT}	$-dV/dt_{off}$	--	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..

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		min	typ	max	min	typ	max	
Operating Parameters								
Operating voltage	$V_{bb(on)}$	12	--	35	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	$I_{bb(off)}$							µA
T_j = -40...85°C		--	10	20	--	10	25	
T_j = 125°C[1)]		--	--	100	--	--	**50**	
Operating current, V_{IN} = high T_j = -40... 25°C	I_{GND}	0,5	1	1,5	--	1	**1,6**	mA
T_j = +125°C		0,4		1,2				
Leakage output current (included in $I_{bb(off)}$)	$I_{L(off)}$	--	--	2	--	**3,5**	**10**	µA
V_{IN} = 0 V								

[1)] higher current due temperature sensor

Electrical Characteristics

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		min	typ	max	min	typ	max	
Protection Functions								
Initial peak short circuit current limit	$I_{L(lim)}$							A
T_j = -40°C		--	--	1,8	--	--	**2,1**	
T_j = 25°C		--	1,4	--	--	1,4	--	
T_j = 125°C		0,7	--	--	0,7	--	--	
Output clamp (inductive load switch off) at $V_{out} = V_{bb} - V_{ON(CL)}$	$V_{ON(CL)}$	47	53	60	47	**52**	--	V
Overvoltage protection	$V_{bb(AZ)}$	47	--	--	47	--	--	V
Thermal overload trip temperature	T_{jt}	135	150	--	135	--	--	°C
Thermal hysteresis	ΔT_{jt}	--	10	--	--	10	--	K

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		min	typ	max	min	typ	max	
Input								
Continuous input voltage	V_{IN}	-3,0	--	V_{bb}	**-10**[1]	--	V_{bb}	V
Input turn-on threshold voltage	$V_{IN(T+)}$	--	--	2,6	--	--	**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}	$t_{d(Vbbon)}$	--	--	--	**150**	**340**	--	µs
Input resistance	R_I	--	--	--	1,5	**3**	**5**	kΩ
Reverse Battery								
Reverse battery[1) 2)]	$-V_{bb}$	--	--	--	--	--	**45**	V
Continious reverse drain current	I_S	--	--	1	--	--	1	A
Drain source diode voltage	$-V_{ON}$	--	--	1,2	--	**0,6**	1,2	V

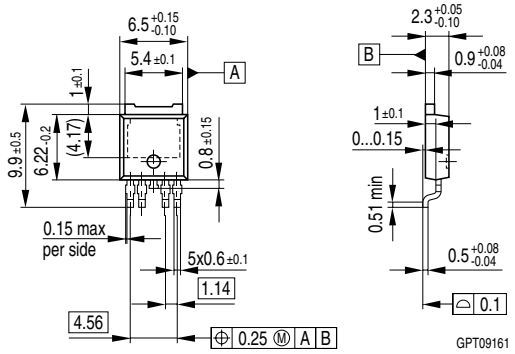
[1)] not subject to protection test, guaranteed by design

[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.

D-Pak:



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