

Low ON resistance USB high-side switch series

BD6510F / BD6512F / BD6513F

This series of high-side switching ICs have 2-channel MOSFET switches that have low ON resistances. These functions are useful for USB power control. Error signals can be conveyed via a built-in error detection circuit. Also included is a thermal shutdown circuit with a latch that can protect the output from unstable operation occurred by repeating the ON/OFF switch of the output protection circuit.

●Applications

USB hub, Notebook PC, Desk-top PC, Power switch

●Features

- 1) Dual D-MOS High-side switches.
- 2) Control logic Active-High (BD6510F / BD6512F)
Active-Low (BD6513F)
High level input > 2.5V , Low level input < 0.7V
- 3) Low on resistance Typ. = 100mΩ (VDD = 5V)
- 4) Continuous output load current Min. = 1A (BD6510F)
Min. = 0.6A (BD6512F / BD6513F)
- 5) Soft start circuit
- 6) Error detection circuit, Output protection circuit (Over current detector, Thermal shutdown, Under voltage lockout.)
- 7) Open-drain Error Flag output.

●Absolute maximum ratings (Ta=25°C)

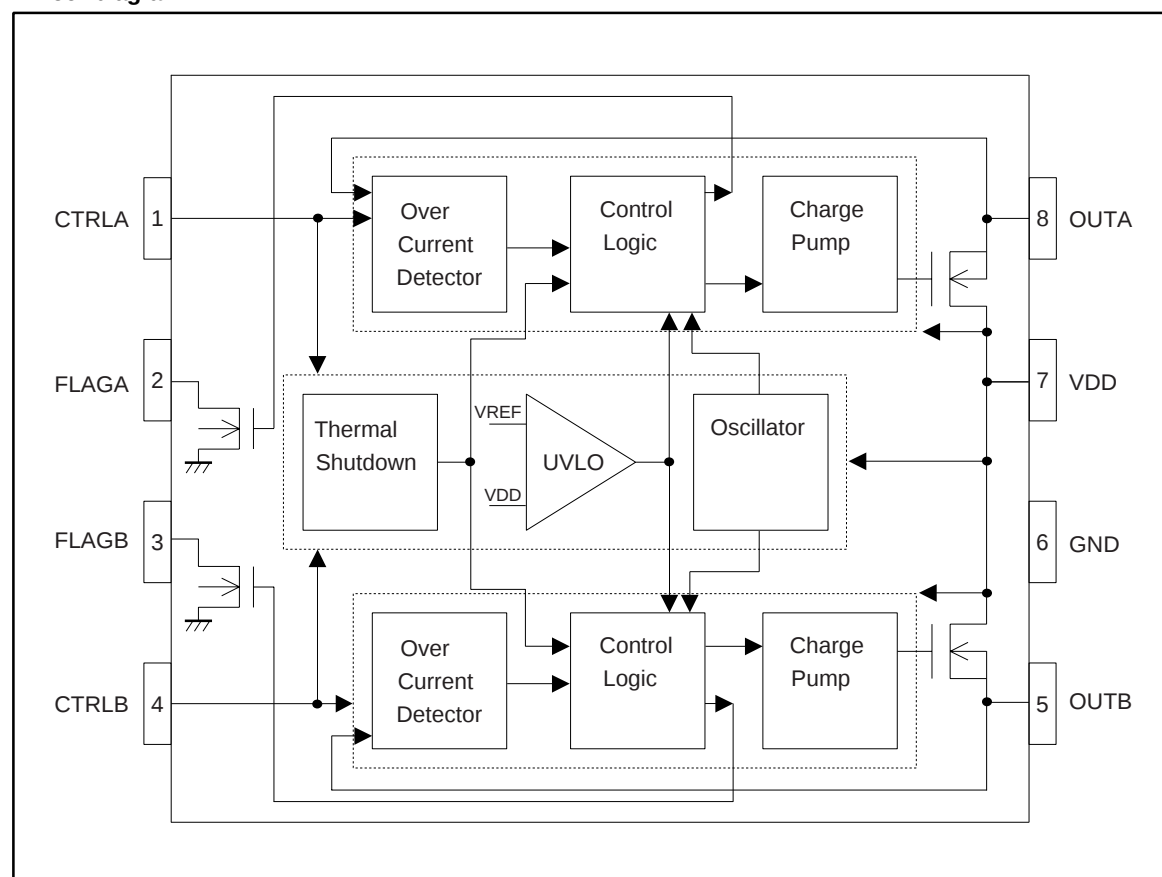
Parameter	Symbol	Limits	Unit
Supply voltage	V _{DD}	-0.3 to +6.0	V
Terminal Input	V _{IN}	-0.3 to V _{DD} +0.3	V
Storage Temperature	T _{STG}	-55 to +125	°C
Power dissipation *	P _d	450	mW

*This value decreases 4.5mW/°C above 25°C.
Resistance radiation design is not doing.

●Recommended operating conditions (Ta=25°C)

Parameter	Symbol	Limits	Unit
Supply voltage	V _{DD}	+3.0 to +5.5	V
Operating temperature	T _{OPR}	-25 to +85	°C

●Block diagram



●Pin description

Pin No.	Pin name	I / O	Pin description
1 4	CTRLA CTRLB	IN	Control input : High input >2.5V, Low input <0.7V
2 3	FLAGA FLAGB	OUT	Error flag output : Active-low, open-drain output.
5 8	OUTB OUTA	OUT	Switch output (Output D-MOS SW source)
6	V _{SS}	—	Ground
7	V _{DD}	—	Power supply (Output D-MOS SW drain)

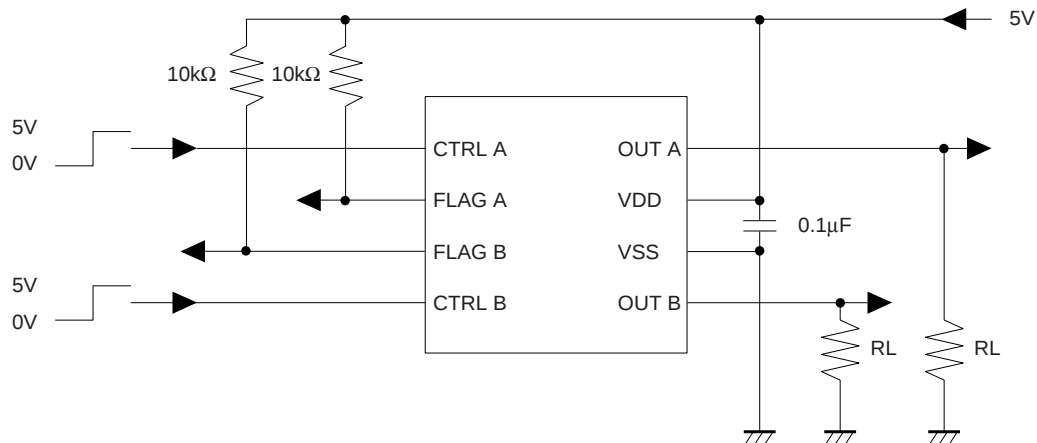
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●Internal circuit

Pin No.	Pin name	Equivalent circuit
1 4	CTRL A CTRL B	
2 3	FLAG A FLAG B	
8 5	OUT A OUT B	

●Electrical characteristics (Unless otherwise noted, VDD = 5V, Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Operating current	I _{DD}	—	85	120	μA	OUT=OPEN, VCTRL=5V(BD6510F/12F) VCTRL=0V(BD6513F)
		—	0.01	2	μA	OUT=OPEN, VCTRL=0V(BD6510F/12F) VCTRL=5V(BD6513F)
Control input voltage	V _{CTRL}	—	—	0.7	V	CTRL Low Level Input
		2.5	—	—	V	CTRL High Level Input
Control input current	I _{CTRL}	−1	0.01	1	μA	VCTRL=0V or 5V
On resistance	R _{ON}	—	100	130	mΩ	VDD=5V, IOUT=500mA
		—	120	160	mΩ	VDD=3.3V, IOUT=500mA
Turn on delay	T _{RD}	100	600	2000	μs	RL=10Ω "VCTRL=L→H"→VOUT=50% (BD6510F/12F) "VCTRL=H→L"→VOUT=50% (BD6513F)
Turn on rise time	T _R	200	1500	6000	μs	RL=10Ω VOUT=10%→90%
Turn off delay	T _{FD}	—	3	20	μs	RL=10Ω "VCTRL=H→L"→VOUT=50% (BD6510F/12F) "VCTRL=L→H"→VOUT=50% (BD6513F)
Turn off fall time	T _F	—	1	20	μs	RL=10Ω VOUT=90%→10%
UVLO threshold voltage	V _{UVLOH}	2.3	2.5	2.7	V	V _{DD} increasing
	V _{UVLOL}	2.1	2.3	2.5	V	V _{DD} decreasing
Thermal shutdown threshold	T _{TS}	—	135	—	°C	
Over current limit threshold level	I _{THLIM}	1	2	3	A	(BD6510F)
		1.25	1.65	2.20	A	(BD6512F/13F)
Over current limit level	I _{LIM}	0.6	1.1	1.6	A	(BD6512F/13F)
Flag output resistance	R _{FLAG}	—	16	40	Ω	IFLAG=5mA (BD6510F) IFLAG=10mA (BD6512F/13F)
Flag off current	I _{FLAG}	—	0.01	1	μA	

●Test circuit


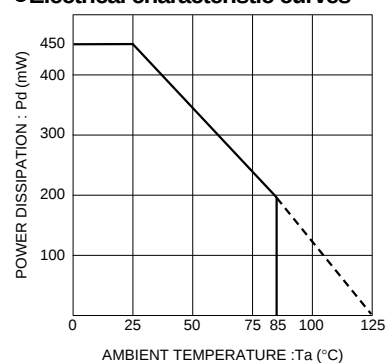
	BD6510F	BD6512F	BD6513F
Control logic	Hi-Active	Hi-Active	Lo-Active
Over current detector threshold level	1A to 2.0A(typ.) to 3A	1.25A to 1.65A(typ.) to 2.20A	
Over current limit level	—	0.6A to 1.1A(typ.) to 1.6A	
Switch current	1A(Min.)	0.6A(Min.)	

* Latch is released by forcing CTRL input SW OFF level or detecting UVLO.
Connect a bypass capacitor from V_{DD} to GND, located near the IC. Recommend over 1μF.
Connect a over 100kΩ pull-up resistor from FLAG to V_{DD}.

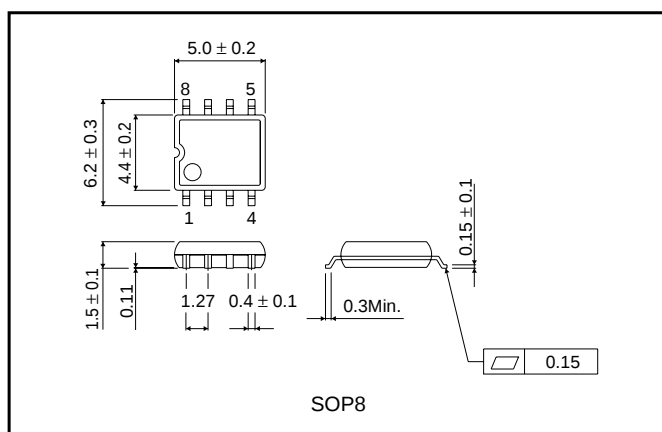
The diagram illustrates a USB-to-serial interface circuit. On the left, a USB connector provides 5V, D+, D-, and GND signals. The 5V line is connected to the IN pin of an IN Regulator, which outputs 3.3V. This 3.3V is connected to the VDD pin of a 3.3V USB Controller. The controller's GND is connected to the GND of the USB connector. The controller's CTRLA and FLAGA pins are connected to the CTRLB and FLAGB pins of a microcontroller, respectively. The microcontroller's VDD is connected to the 3.3V output of the IN Regulator. The microcontroller's GND is connected to the GND of the USB connector. The microcontroller's OUTA pin is connected to the D+ signal line of a second USB connector. The microcontroller's OUTB pin is connected to the D- signal line of the same USB connector. The second USB connector also provides 5V, D+, D-, and GND signals. The 5V line is connected to the VDD pin of a 5V Regulator, which outputs 5V. This 5V is connected to the VDD pin of the microcontroller. The microcontroller's GND is connected to the GND of the 5V Regulator. The microcontroller's OUTA pin is connected to the D+ signal line of the second USB connector. The microcontroller's OUTB pin is connected to the D- signal line of the second USB connector. The second USB connector also provides 5V, D+, D-, and GND signals. The 5V line is connected to the VDD pin of a 5V Regulator, which outputs 5V. This 5V is connected to the VDD pin of the microcontroller. The microcontroller's GND is connected to the GND of the 5V Regulator. The microcontroller's OUTA pin is connected to the D+ signal line of the second USB connector. The microcontroller's OUTB pin is connected to the D- signal line of the second USB connector. The second USB connector also provides 5V, D+, D-, and GND signals.

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●Electrical characteristic curves



●External dimensions (Unit : mm)



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