

STRUCTURE
PRODUCT SERIES

Silicon Monolithic Integrated Circuit
5-Channel Switching Regulator Controller for Digital Camera

TYPE

B D 9 7 3 3 K N

FEATURES

- Wide input voltage range (1.5 to 11)
- BD9733KN is a 5-channel controller that includes all of the circuits required constructing a switching regulator.
The circuits on the chip include a triangular-wave oscillator, a reference voltage circuit, a PWM comparator, a CMOS driver, and a short-circuit-protector.

○Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits	Units
Power Supply Voltage	VBAT,VCC, PVCC1,PVCC2	−0.3~12	V
Power Input Voltage	VIN1 (*1)	−0.3~17	V
	VIN2 (*2)	−0.3~12	V
	VIN3 (*3)	−9.0~VREGA	V
Power Dissipation	Pd	500(*4)	mW
		760(*5)	mW
Operating Temperature	Topr	−25~+85	°C
Storage Temperature	Tstg	−55~+125	°C

(*1) PG1 47pin (*2) PG2, 4, SWOUT46, 13,3pin (*3) PGd3 45pin

(*4) Without external heat sink, the power dissipation reduces by 5.0mW/°C over 25°C.

(*5) Reduced by 7.6mW/°C over 25°C, when mounted on a PCB (70.0mm×70.0mm×1.6mm).

○Recommended operating conditions

Parameter	Symbol	Spec.			Units
		Min.	Typ.	Max.	
Power Supply Voltage	VBAT	1.5	—	11	V
	VCC, PVCC1	2.5	—	11	V
	PVCC2	2.5	—	11	V
Oscillator Frequency	fosc	0.1	—	1	MHz
Driver Output Current	IOUT	—	—	30	mA
Driver Peak Current	Ipeak	—	—	200	mA
Timing Resistor	RT	10	—	30	kΩ
Timing Capacitor	CT	100	—	10000	pF
DELAY Time Set-up Resistor	RDELAY	100	—	400	kΩ
PG1 Sink Current	IPG1	—	—	1	mA
PG2, 4 Sink Current	IPG2,IPG4	—	—	800	μA
PG3 Source Current	IPG3	—	—	1	mA
SWOUT Sink Current	ISWOUT	—	—	300	μA

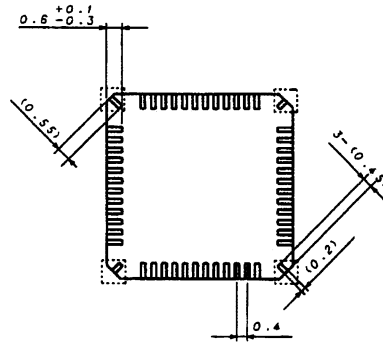
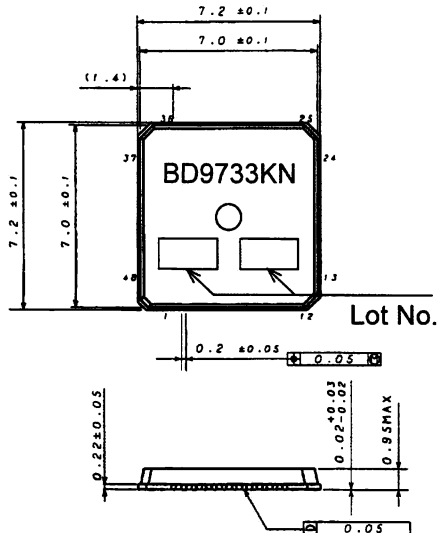
◎PVCC1 and Vcc should be the same voltage.

○Electrical characteristics (Ta=25°C, VBAT=3V, VCC=5V, RT=11kohm, CT=180pF, STB1~5=3V)

Parameter	Symbol	Spec.			Units	Conditions
		Min.	Typ.	Max.		
[Reference Voltage]						
Reference Voltage	Vref	0.99	1.0	1.01	V	Iref=1mA
Line Regulation	DVLI	—	4.0	12.5	mV	Vcc=3.0V ~9.5V
Load Regulation	DVLo	—	1.0	7.5	mV	Iref=0.1mA ~1mA
Short-Circuit Output Current	Ios	4	16	—	mA	Vref=0V
[Internal Regulator]						
REGA Output Voltage	VREGA	2.4	2.5	2.6	V	Ireg=1mA
[Low Voltage Input Prevented Operation Faults Circuit]						
Threshold Voltage 1	Vst1	2.3	2.4	2.5	V	VCC monitor
Hysteresis width 1	ΔVst1	—	200	—	mV	
Threshold Voltage 2	Vst2	—	2.0	—	V	VREGA monitor
Hysteresis width 2	ΔVst2	—	50	—	mV	
[Start up Circuit]						
Oscillator Frequency	Fstart	50	120	220	kHz	
Minimum VBAT Voltage	Vst1	—	1.1	1.5	V	VBAT monitor
[Slow Start]						
Slow Start Charge Current	Iss	1.1	2.2	3.3	μA	Vss=0V
[Protection Circuit]						
Timer Start Threshold Voltage	Vtc	2.1	2.2	2.3	V	FB monitor
SCP Output Current	Iscp	0.5	1.0	1.5	μA	VSCP=0.1V
SCP Threshold Voltage	Vtsc	0.45	0.50	0.55	V	
SCP Standby Voltage	Vssc	—	22	170	mV	
[Triangular wave oscillator]						
Oscillator Frequency	f osc1	450	500	550	kHz	RT=11kohm, CT=180pF
Frequency Stability (Vcc)	Df	—	1	5	%	VCC=3.0V ~9.5V
RT Output Voltage	VRT	0.78	1.00	1.22	V	
[Error Amp]						
Low-level Output Voltage	VOL	—	—	0.3	V	INV=2V
High-level Output Voltage	VOH	VREGA —0.3	—	—	V	INV=0V
Maximum Sink Current	IOI	200	700	—	μA	FB=1.0V, VINV=1.1V
Maximum Source Current	IOO	40	80	—	μA	FB=1.0V, VINV=0.9V
[PWM Comparator]						
Input Threshold Voltage	V10	—	1.49	—	V	V1:DUTY0%
	V100	—	1.95	—	V	V1:DUTY100%
MAX DUTY1,4,5	Dmax1	77	85	93	%	VINV=0.9V, VSCP=0V
MAXDUTY2 (step-up)	Dmax2	77	85	93	%	VINV=0.9V, VSCP=0V, UDSEL=0V
[Output circuit]						
High-level Output Voltage on Driving	VSATH	VCC —0.3	VCC —0.1	—	V	Ic=10mA
Low-level Output Voltage on Driving	VSATL	—	0.1	0.3	V	Ic=—10mA
[Start-up/down Selector]						
UDSEL2 Control Voltage	Step down	VUDDO	2.0	—	11	V
	Step up	VUDUP	—0.3	—	0.3	V
UDSEL2 Pull-down Resistor	RUDSE L2	250	400	700	kΩ	

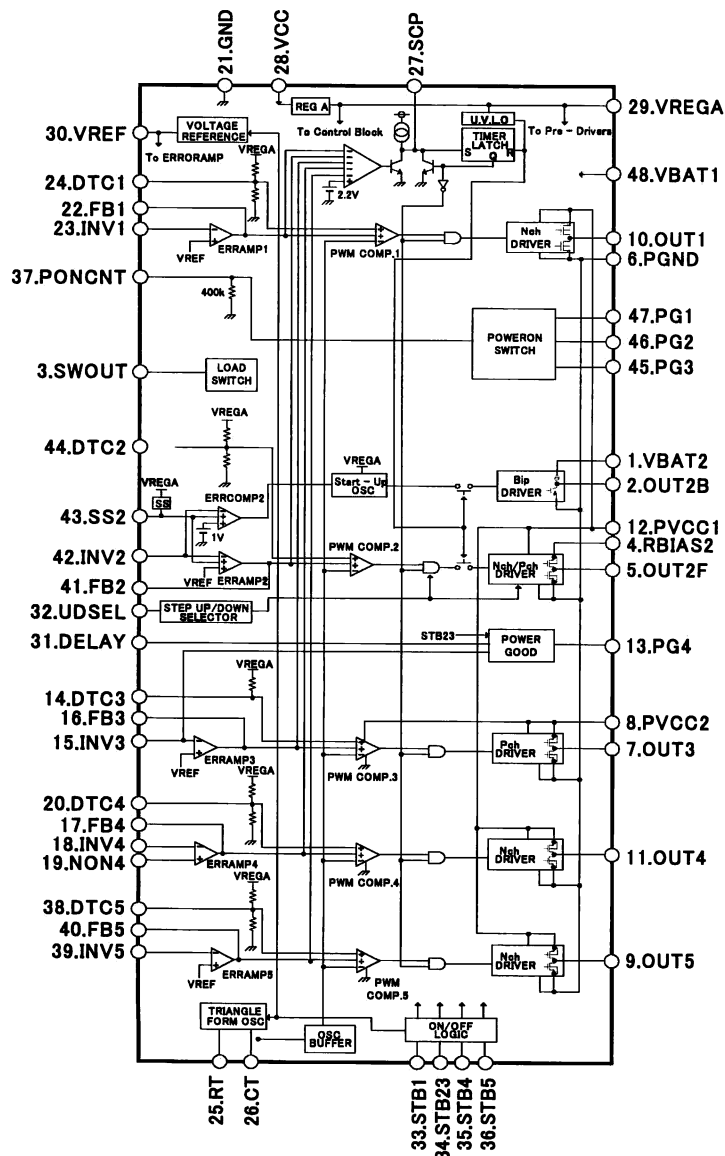
Parameter		Symbol	Spec.			Units	Conditions
			Min.	Typ.	Max.		
[Power Good, Power on Switch]							
PONCNT Control Voltage	ON	VPG ON	2.0	—	11	V	
	OFF	VPG OFF	−0.3	—	0.3	V	
PONCNT Pull-down Resistance		RCTRL	250	400	700	kΩ	
Input Threshold Voltage		VTH PG4	0.72	0.8	0.88	V	
Hysteresis width of Detector Cancellation		ΔVTL PG4	100	200	300	mV	
Threshold Voltage for Delay time		VTHDE	1.8	2.0	2.2	V	
Hysteresis width of Detector Cancellation		ΔVTH DE	100	200	300	mV	
P G 1	Output Voltage on driving	VSAT1	—	1.6	3.2	V	IO=500uA, PONCNT=3.0V
	Leak Current during Off Time	I LEAK1	—	0	5	μA	VPG=5V, PONCNT=0V
P G 2	Output Voltage on driving	VSAT2	—	0.1	0.3	V	IO=100uA, PONCNT=3.0V
	Leak Current during Off Time	I LEAK2	—	0	5	μA	VPG=5V, PONCNT=0V
P G 3	Output Voltage on driving	VSAT3	—	0.1	0.3	V	IO=100uA, PONCNT=3.0V
	Leak Current during Off Time	I LEAK3	—	0	5	μA	VPG=0V, PONCNT=0V
P G 4	Output Voltage on driving	VSAT4	—	0.1	0.3	V	Io=100uA, VINV3=1.1V
	Leak Current during Off Time	I LEAK4	—	0	5	μA	VPG=5.0V, STB23=0V
DELAY	Output Voltage on driving	VSATD	—	0.1	0.3	V	Io=100uA, INV3=0V
[Switch for Feedback Resistor]							
SW OUT	Output Voltage on driving	VSAT5	—	0.1	0.3	V	Iout=100uA, STB23=3.0V
	Leak Current during Off Time	I LEAK5	—	0	5	μA	Vsout=5.0V, STB23=0V
[STB1~5]							
STB Control Voltage 1	ON	VSTB H1	2.0	—	11	V	STB23
	OFF	VSTBL1	−0.3	—	0.3	V	
STB pull-down resistor2		RSTB1	250	400	700	kΩ	STB23
STB Control Voltage 2	ON	VSTBH2	2.0	—	11	V	STB1,4,5
	OFF	VSTBL2	−0.3	—	0.3	V	
STB pull-down resistor2		RSTB2	250	400	700	kΩ	STB1,4,5
[Circuit Current]							
Stand by Current		ISTB	—	—	5	μA	STB1~5=0V
Start up Current (VBAT 1.2 sink current)		IST	—	11	26	mA	VBAT=3V, VCC=0V
Circuit Current on Driving 1 (VBAT 1.2 sink current)		Icc1	—	130	400	μA	VFB=0V, VBAT=3V, VCC=5V
Circuit Current on Driving 2 (VCC, PVCC1,2 sink current)		Icc2	—	5	10	mA	VFB=0V, VBAT=3V, VCC=5V

○This product is not designed for normal operation within a radioactive environment.



Plastic mold
(UNIT : mm)

Block diagram



Pin No.	Pin Name
48	VBAT1
1	VBAT2
28	VCC
12	PVCC 1
8	PVCC 2
6	PGND
21	GND
29	VREGA
30	VREF
10,7,11,9	OUT 1,3,4,5
2	OUT2B
5	OUT2F
4	RBIA2
24,44,14,20,38	DTC1,2,3,4,5
22,41,16,17,40	FB1,2,3,4,5
23,42,15,18,39	INV1,2,3,4,5
19	NON4
43	SS2
25	RT
26	CT
27	SCP
37	PONCNT
47,46,45	PG 1,2,3
13	PG4
3	SWOUT
32	UDSEL2
33,34,35,36	STB 1,2,3,4,5
31	DELAY

○NOTE FOR USE

- (1) Absolute maximum rating
The device may be destroyed when applied voltage or operating temperature exceeds its absolute maximum rating. Because the source, such as short mode or open mode, cannot be identified if the device is destroyed, it is important to take physical safety measures (such as fusing) if a special mode in excess of absolute rating limits is to be implemented.
- (2) Supply line
Since the motor's reverse electromotive force gives rise to the return of regenerative current, measures should be taken to establish a channel for the current, such as adding a capacitor between the power supply and GND. In determining the approach to take, make sure that no problems will be posed by the various characteristics involved, such as capacitance loss at low temperatures with an electrolytic capacitor.
- (3) GND potential
Make sure the potential for the GND pin is always kept lower than the potentials of all other pins, regardless of the operating mode.
- (4) Thermal design
Be sure to factor in allowable power dissipation (Pd) in actual operation, and to build sufficient margin into the thermal design to accommodate this power loss.
- (5) Operation in strong magnetic fields
Use in strong electromagnetic fields may cause malfunctions. Exercise caution with respect to electromagnetic fields.
- (6) ASO
Set the parameters so that output Tr will not exceed the absolute maximum rating or ASO value when the IC is used.
- (7) Thermal shutdown circuit
This IC is provided with a built-in thermal shutdown (TSD) circuit, which is activated when the chip temperature reaches the threshold value listed below. When TSD is on, the device goes to high impedance mode. Note that the TSD circuit is provided for the exclusive purpose shutting down the IC in the presence of extreme heat, and is not designed to protect the IC per se or guarantee performance when or after extreme heat conditions occur. Therefore, do not operate the IC with the expectation of continued use or subsequent operation once the TSD is activated.
- (8) Mutual impedance
Use short and wide wiring tracks for the main supply and ground to keep the mutual impedance as small as possible. Use inductor and capacitor network to keep the ripple voltage minimum.
- (9) Voltage of STB pin
The threshold voltages of STB pin are 0.3V and 2.0V. STB state is set below 0.3V while action state is set beyond 2.0V.
The region between 0.3V and 2.0V is not recommended and may cause improper operation.
- (10) Setting Max Duty
Max duty limit might not work normally at high frequency. Consider adequate margin when operating circuit above the maximum allowable switching frequency.
- (11) Please use the same power supply of driver block as that of main block.
This IC can't be used on the application that arbitrary voltage is applied to driver block.

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