ROHM

STRUCTURE Silicon Monolithic Integrated Circuit
PRODUCT SERIES 7-Channel Switching Regulator Controller for Digital Camera

TYPE **BD9738KN**

FEATURES

- Wide input Voltage range (1.5 to 10V)
- Controls up to 7 switching regulators: Step-up converter (2 channels), Step-down converter (1channel), Configurable for step-up or step-down conversion (3 channels), Step-up converter for LED (1 channels)
- Synchronous rectifying action mode (4 channels) Built-in FET Transistor (3 channels)
- Positive-negative regulator with soft start for CCD supply

○Absolute maximum ratings (Ta=25℃)

Paramenter	Symbol	Limits	Units
Power Supply Voltage	VBAT1,2, VCC, PVCC	−0.3～12	V
	PVCCH, PVCCL	−0.3～15	V
Power Input Voltage	DRAIN1,2,3	−0.3～12	V
	OUT1B	−0.3～20	V
	OUT7B	−0.3～20	V
	VIN+	−0.3～20	V
	VIN−	−12～0.3	V
	SWOUT1,4, PGIN1	−0.3～12	V
	SWIN6,7	−0.3～20	V
Power Dissipation	Pd	610(*1)	mW
		1200(*2)	mW
Operating Temperature	Topr	−25～+85	℃
Storage Temperature	Tstg	−55～+125	℃

(*1) Without external heat sink, the power dissipation reduces by 6.1mW/℃ over25℃.
(*2) Reduced by 12.0mW/℃ over 25℃, when mounted on a PCB (70.0mm×70.0mm×1.6mm).

○Operating conditions (Ta = −25～+85℃)

Parameter	Symbol	Spec. Min.	Spec. Typ.	Spec. Max.	Units
Power Supply Voltage	VBAT	1.5	−	10	V
	VCC , PVCC	2.5	−	10	V
	PVCCL, PVCCH	4.0	−	14	V
VREF Pin Connect Capacitor	CVREF	1.0	−	4.7	μF
VREGA Pin Connect Capacitor	CVREGA	1.0	−	10	μF
SCP Pin Connect Capacitor	CSS1	0.001	−	2.2	μF
SS1 Pin Connect Capacitor	CSS23	0.005	−	10	μF
【Driver】					
DRAIN Pin Input Voltage	VDRAIN	−	−	8	V
Nch FET Output Current (CH2 Step down,CH3)	IoFET1	−	−	700	mA
Nch FET Output Current (CH1,CH2 Step up)	IoFET2	−	−	300	mA
Driver Output Current (CH4,5,6)	Iout	−	−	30	mA
Driver Peak Current	Ipeak	−	−	200	mA
Built-in NPN TR Sink Current(CH1)	INPNsink	−	−	500	mA

◎ It is storongly recommended that a capacitor connect to VREFF,VREGA pin to prevent oscillation.

Parameter	Symbol	Spec. Min.	Spec. Typ.	Spec. Max.	Units
【oscillator】					
Oscillator Frequency	fosc	0.1	−	1.2	MHz
OSC Timing Resistor	RT	4.7	−	30	kΩ
OSC Timing Capacitor	CT	100	−	10000	pF
【Positive-Negative Regulator】					
VIN+Pin Input Voltage	VVIN1	−	−	18	V
VIN−Pin Input Voltage	VVIN2	−10	−	−	V
Positive Regulator Output Current	IOREG1	−	−	50	mA
Negative Regulator Output Current	IOREG2	−	−	50	mA
Output Pin Capacitor	COREG	1.0	−	22	μF
SS2 Pin Connect Capacitor	CSS2	0.001	−	2.2	μF
【SW Circuit】					
DELAY Time Set-up Resistor	RDELAY	100	−	400	kΩ
SWOUT1 Sink Current	ISWOUT1	−	−	10	mA
PGOUT1 Source Current	IPGOUT1	−	−	100	mA
PG23Sink Current	IPG23	−	−	1	mA
SWOUT4 Sink Current	ISWOUT4	−	−	1	mA
SWOUT6 Sink Current	ISWOUT6	−	−	50	mA
SWOUT7 Sink Current	ISWOUT7	−	−	50	mA

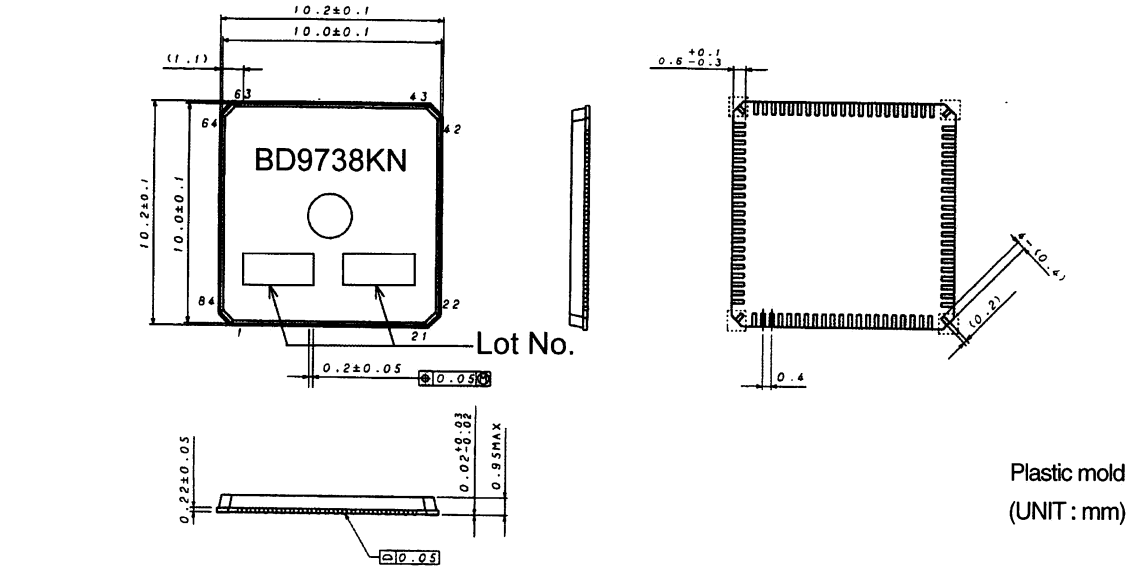
○Electrical characteristics (Ta=25℃, VBAT=3V, VCC=5V, RT=11kohm, CT=180pF, STB1～7=3V, unless otherwise specified)

Parameter	Symbol	Spec. Min.	Typ.	Max.	Units	Conditions
【Reference Voltage】						
Reference Voltage	Vref2	0.99	1.0	1.01	V	
Line Regulation	DVLi	–	4.0	12.5	mV	Vcc=3.0V～9.5V
Load Regulation	DVLo	–	1.0	7.5	mV	Iref=10μA ～100μA
Short-Circuit Output Current	Ios	0.2	1	–	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	Vstd1	3.45	3.6	3.75	V	PVCCL monitor
Hysteresis width 1	ΔVst1	–	300	–	mV	
Threshold Voltage 2	Vstd2	2.3	2.4	2.5	V	VCC monitor
Hysteresis width 2	ΔVst2	–	200	–	mV	
Threshold Voltage 3	Vstd3	–	2.0	–	V	VREGA monitor
Hysteresis width 3	ΔVst3	–	50	–	mV	
【Start up Circuit】						
Oscillator Frequency	Fstart	50	120	220	kHz	
Minimum VBAT Voltage	Vst1	2.5	-	-	V	VBAT monitor
Slow Start Charge Current	Iss1	1.1	2.2	3.3	μA	Vss1=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	Df	–	0.3	2	%	VCC=3.0V～9.5V
RT Output Voltage	VRT	0.78	1.00	1.22	V	
【Error Amp 1～6】						
Low-level Output Voltage	VOL	–	1.3	–	V	INV=2V
High-level Output Voltage	VOH	VREGA −0.3	–	–	V	INV=0V
Maximum Sink Current	IOI	36	72	-	μA	FB=1.7V,VINV=1.1V
Maximum Source Current	IOO	36	72	-	μA	FB=1.7V,VINV=0.9V
【Error Amp 7】						
Low -level Output Voltage	VOL	–	1.3	–	V	INV=2V
High -level Output Voltage	VOH	VREGA −0.3	–	–	V	INV=0V
Maximum Sink Current	IOI	36	72	–	μA	FB=1.7V,VINV=1.1V
Maximum Source Current	IOO	36	72	–	μA	FB=1.7V,VINV=0.9V
Non-inverting voltage reference	VNON7	–	0.2	–	V	
【Soft Start 23 】						
SS23 charge Current	Iss23	5	10	15	μA	Vss23=0V
【PWM Comparator 】						
Input Threshold Voltage 1, 2,3	Vt0	–	1.49	–	V	V1:DUTY0%
	Vt100	–	1.95	–	V	V1:DUTY100%
Input Threshold Voltage 4,5,6,7	Vt0	–	1.49	–	V	V1:DUTY0%
	Vt100	–	1.95	–	V	V1:DUTY100%
MAX DUTY1,6,7	Dmax1	77	85	93	%	VINV=0.9V, VSCP=0V
MAX DUTY2,4,5(step-up)	Dmax2	77	85	93	%	VINV=0.9V, VSCP =0V,UDSEL=0V,
【Output circuit】						
High-level Output Voltage on Driving	VSATH	VCC −1.6	VCC −0.8	–	V	Io=30mA
Low-level Output Voltage on Driving	VSATL	–	0.8	1.6	V	Io=-30mA
Hi-side Nch FET ON Resistor	Ron	–	270	500	mΩ	PVCCH=5V (Io=200mA)
Lo- side Nch FET ON Resistor	Ron	–	270	500	mΩ	PVCCL=5V (Io=200mA)
【Step-up/down Selector】						
UDSEL2,4,5 Control Voltage — Step down	VUDDO	VCC ×0.7	–	VCC	V	
UDSEL2,4,5 Control Voltage — Step up	VUDUP	0	–	VCC ×0.3	V	

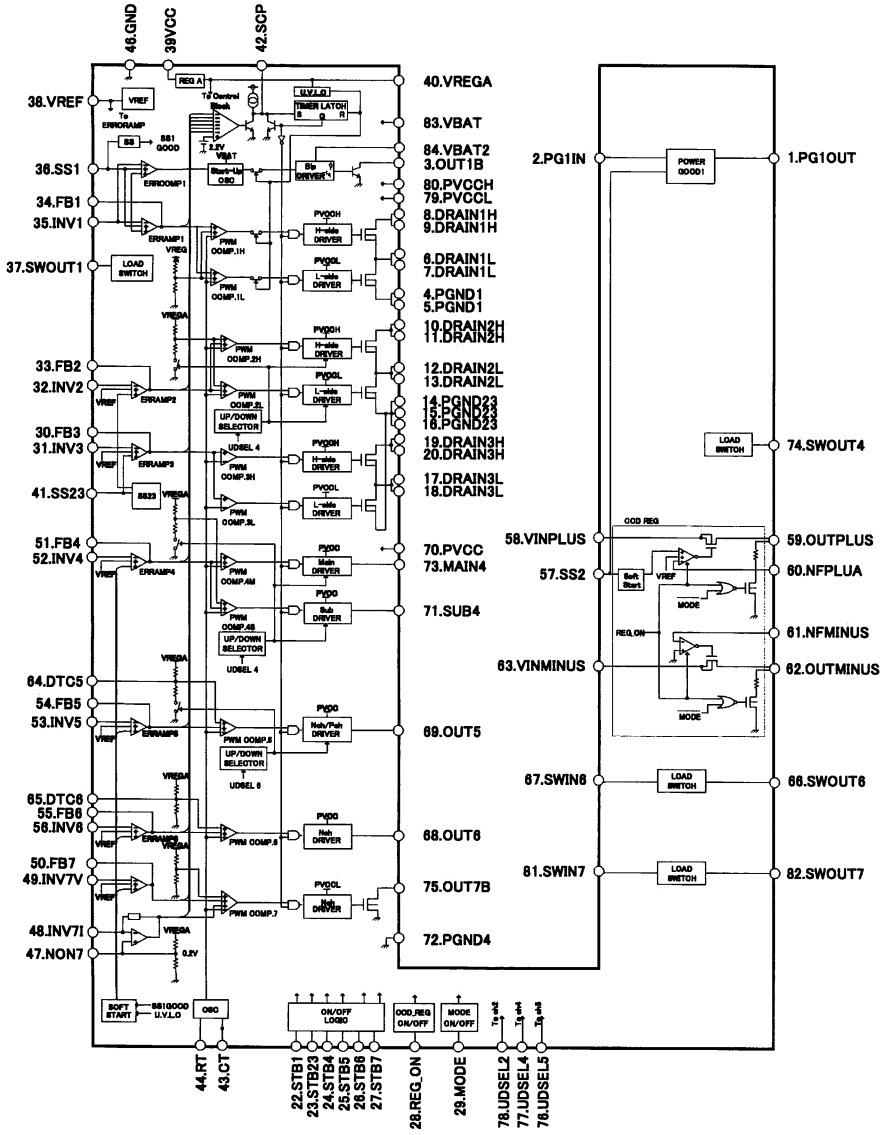
◎this product is not designed for normal operation within a radioactive environment.

Parameter		Symbol	Spec. Min.	Typ.	Max.	Units	Conditions
【Power Good】 (POWERGOOD1)							
POWERGOOD 1 Input Threshold Voltage		VTH PG1	0.63	0.7	0.77	V	VTH Low→High
Hysteresis width		ΔVTH PG1	100	200	300	mV	
PG1	Output Voltage on driving	VSAT	VPG 1IN −0.3	VPG 1IN −0.1	-	V	Io=80mA, VPG1IN=5V
	Leak Current during Off Time	ILEAK	–	0	5	μA	STB1=0V
Discharge Resistor		RDIS	82	165	330	Ω	
【Positive-Negative Regulator】							
Slow Start Charge Current		Iss2	1.0	2.0	3.0	μA	Vss2=0V
REG_ON Control Voltage	ON	Vthon	2.0	-	11	V	
	OFF	Vthoff	−0.3	-	0.3	V	
Control pin Pull-down Resistance		RCONT	250	400	700	kΩ	
●REG1 (VIN+=16V,R1A=700kΩ,R1B=50kΩ)							
Set-up value of Feedback Voltage1		VNF1	VREF −0.05	VREF	VREF +0.05	V	
Output Voltage 1		Vo1	-	15	-	V	Io=10mA
Maximum Output Current1		Imax1	-	50	-	mA	
Short -circuit Output Current1		Iscp1	-	50	-	mA	Vo=0V
Differential Voltage of input output1		ΔV1	-	80	160	mV	VIN+=14V,Io=10mA
Load stability1		Δvol1	-	10	50	mV	Io=0.1 ～10mA
Ripple Rejection1		RR1	-	40	-	dB	f=120Hz, VRR=-20dBV, Io=1mA
Discharge Resistor1		RDIS1	103	207	414	Ω	
●REG2 (VIN+=-8.5V,R2A=100kΩ,R2B=50kΩ)							
Set-up value of Feedback Voltage12		VNF2	−0.05	0	0.05	V	
Output Voltage		Vo2	-	-7.5	-	V	Io=10mA
Maximum Output Current2		Imax2	-	80	-	mA	
Differential Voltage of input output2		ΔV2	-	50	100	mV	VIN-=-6.5V, Io=10mA
Load stability2		Δvol2	-	10	50	mV	Io=0.1 ～10mA
Ripple Rejection2		RR2	-	50	-	dB	f=120Hz, VRR=-20dBV, Io=1mA
Discharge Resistor2		RDIS2	55	110	220	Ω	
【Power on Switch】							
SWOUT1	Output Voltage on driving	VSAT	–	0.1	0.3	V	Io=1mA
	Off Time Leak Current	ILEAK	–	0	5	μA	STB1=0V
SWOUT4	Output Voltage on driving	VSAT	–	0.1	0.3	V	Io=100μA
	Off Time Leak Current	ILEAK	–	0	5	μA	STB4=0V
SWOUT6	Output Voltage on driving	VSAT	VSW IN6 −0.3	VSW IN6 −0.1	–	V	Io=20mA VSWIN6=5V
	Off Time Leak Current	ILEAK	–	0	5	μA	STB6=0V
SWOUT7	Output Voltage on driving	VSAT	VSWI N7 −0.3	VSWI N7 −0.1	–	V	Io=10mA VSWIN7=10 V
	Off Time Leak Current	ILEAK	–	0	5	μA	STB7=0V
【STB1～7】							
S T B Control Voltage1	ON	VSTB H1	2.0	–	11	V	STB1
	OFF	VSTBL1	−0.3	–	0.3	V	
STB Pull-down Resistor 1		RSTB1	250	400	700	kΩ	STB1
S T B Control Voltage 2	ON	VSTB H2	2.0	–	11	V	STB23,4,5,6,7
	OFF	VSTBL2	−0.3	–	0.3	V	
STB Pull-down Resistor 2		RSTB2	250	400	700	kΩ	STB23,4,5,6,7
【Circuit Current】							
Stand by Current1 (VBAT sink current)		ISTB1	–	–	5	μA	STB1～7=0V
Stand by Current2 (VCC,PVCC sink current)		ISTB2	–	–	5	μA	STB1～7=0V
Start up Current (VBAT sink current)		IST	–	30	100	mA	CT=1.7V VCC=0V
Circuit Current on Driving1 (VBAT sink current)		Icc1	–	100	300	μA	CT=1.7V
Circuit Current on Driving 2 (VCC,PVCC sink current)		Icc2	–	5	15	mA	CT=1.7V INV=2.5V

○PACKAGE



○Block Diagram



Pin No.	Pin Name
83	VBAT1
84	VBAT2
39	VCC
70	PVCC
80	PVCCH
79	PVCCL
4,5,14,15,16,72	PGND1,23,4
46	GND
40	VREGA
69,68	OUT5,6
75	OUT7B
3	OUT1B
8,9,10,11,19,20	DRAIN1,2,3H
6,7,12,13,17,18	DRAIN1,2,3L
73	MAIN4
71	SUB4
38	VREF
64,65	DTC 5,6
34,33,30,51,54,55,50	FB 1~7
35,32,31,52,53,56	INV 1~6
48,49	INV7 I ,V
47	NON7
36,57	SS1,2
44	RT
43	CT
42	SCP
45	SYNC_DTC
78,77,76	UDSEL2,4,5
29	MODE
22,23,24,25,26,27	STB 1,23,4,5,6,7
41	SS23
28	REG_ON
58	VINPLUS
63	VINMINUS
2	PG1IN
67,81	SWIN6,7
1	PG1OUT
59	OUTPLUS
60	NFPLUS
62	OUTMINUS
61	NFMINUS
37,74,66,82	SWOUT1,4,6,7
21	N.C

○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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