STRUCTURE Silicon Monolithic Integrated Circuit

TYPE Step down DC/DC converter Controller for NOTE PC

PRODUCT SERIES **BD9533EKN**

FEATURES
- Built in H^3REG DC/DC controller
- Switching Frequency Variable (f=200kHz～600kHz)

○ ABSOLUTE MAXIMUM RATINGS (Ta=25℃)

Parameter	Symbol	Limit	Unit
Input Voltage 1	VCC	7 *1*2	V
Input Voltage 2	VDD	7 *1*2	V
Input Voltage 3	VIN	30 *1*2	V
BOOT Voltage	BOOT	35 *1*2	V
BOOT-SW Voltage	BOOT-SW	7 *1*2	V
HG-SW Voltage	HG-SW	7 *1*2	V
LG Voltage	LG	VDD	V
REF Voltage	REF	VCC	V
Output Voltage	VOUT/Is+/Is-	VCC	V
ILIM/SCP/SS/FS/SLLM Voltage	ILIM/SCP/SS/FS/SLLM	VCC	V
VREG Voltage	VREG	VCC	V
EN Input Voltage	EN	7 *1	V
Power Dissipation 1	Pd1	0.5 *3	W
Power Dissipation 2	Pd2	0.75 *4	W
Power Dissipation 3	Pd3	1.75 *5	W
Power Dissipation 4	Pd4	2.00 *6	W
Operating Temperature Range	Topr	-10～+100	℃
Storage Temperature Range	Tstg	-55～+150	℃
Maximum Junction Temperature	Tjmax	+150	℃

*1 Not to exceed Pd.
*2 Instantaneous surge voltage, back electromotive force and voltage under less than 10% duty cycle.
*3 Reduced by 4mW for each increase in Ta of 1℃ over 25℃ (when don't mounted on a heat radiation board)
*4 Reduced by 6mW for increase in Ta of 1℃ over 25℃. (when mounted on a board 70.0mm × 70mm × 1.6mm Glass-epoxy PCB.)
*5 Reduced by 14mW for increase in Ta of 1℃ over 25℃. (when mounted on a board 70.0mm × 70mm × 1.6mm Glass-epoxy PCB.)
*6 Reduced by 16mW for increase in Ta of 1℃ over 25℃. (when mounted on a board 70.0mm × 70mm × 1.6mm Glass-epoxy PCB.)

○ OPERATING CONDITIONS (Ta=25℃)

Parameter	Symbol	MIN	MAX	Unit
Input Voltage 1	VCC	4.5	5.5	V
Input Voltage 2	VDD	4.5	5.5	V
Input Voltage 3	VIN	4.5	28	V
BOOT Voltage	BOOT	4.5	33	V
SW Voltage	SW	-0.7	28	V
BOOT-SW Voltage	BOOT-SW	4.5	5.5	V
SLLM Input Voltage	SLLM	0	5.5	V
EN Input Voltage	EN	0	5.5	V
Output setting voltage	REF	0.7	2.0	V
Is Input Voltage	Is+/Is-	0.7	2.7	V
Minimum ON Time	Tonmin	-	200	nsec

★ This product is not designed for protection against radioactive rays.

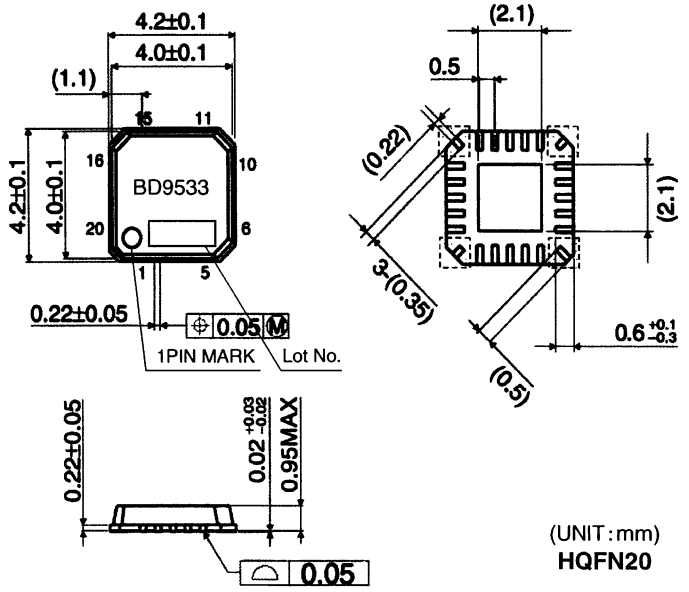
Status of this document
The Japanese version of this document is the official specification.
This translated version is intended only as a reference, to aid in understanding the official version.
If there are any differences between the original and translated versions of this document, the official Japanese language version takes priority.

OELECTRICAL CHARACTERISTICS

(unless otherwise noted, Ta=25℃ VCC=5V,VDD=5V,EN/SLLM=5V,VIN=12V,REF=1.8V,R_{FS}=68kΩ)

Parameter	Symbol	Standard Value			Unit	Condition
		MIN	TYP	MAX		
[Whole Device]						
VCC Bias Current	Icc	-	700	900	μA	
VIN Bias Current	Iin	-	100	200	μA	
VCC Standby Current	Iccstb	-	0	10	μA	EN=0V
VIN Standby Current	Iinstb	-	100	200	μA	EN=0V
EN Low Voltage	Enlow	GND	-	0.8	V	
EN HighVoltage	Enhigh	2.3	-	5.5	V	
EN Bias Current	Ien	-	7	10	μA	
VREG Voltage	Vreg	2.475	2.500	2.525	V	Ireg=100μA Ta=-10℃ to 100℃
[Under Voltage Locked Out]						
VCC threshold voltage	Vcc_UVLO	4.1	4.3	4.5	V	VCC:Sweep up
VCC hysteresis voltage	dVcc_UVLO	100	160	220	mV	VCC:Sweep down
VIN threshold voltage	Vin_UVLO	4.1	4.3	4.5	V	VIN:Sweep up
VIN hysteresis voltage	dVin_UVLO	100	160	220	mV	VIN:Sweep down
VREG threshold voltage	Vreg_UVLO	2.0	2.2	2.4	V	VREG:Sweep up
VREG hysteresis voltage	dVreg_UVLO	100	160	220	mV	VREG:Sweep down
[H^3REG]						
ON Time	Ton	400	500	600	nsec	
MAX ON Time	Tonmax	1	3	-	μsec	
MIN OFF Time	Toffmin	-	450	550	nsec	
[FET Driver]						
HG Higher side ON resistor	HGhon	-	3.0	6.0	Ω	
HG Lower side ON resistor	HGlon	-	2.0	4.0	Ω	
LG Higher side ON resistor	LGhon	-	2.0	4.0	Ω	
LG Lower side ON resistor	LGlon	-	0.5	1.0	Ω	
[SCP]						
SCP Detect Voltage	Vscp	REF×	REF×0.7	REF×	V	
SCP threshold voltage	Vscpth	1.2	1.25	1.3	V	
Charge current	Iscp	1.5	2	2.5	μA	
Standby voltage	Vscp_stb	-	-	50	mV	
[Soft start]						
Charge current	Iss	1.5	2	2.5	μA	
Standby voltage	Vss_stb	-	-	50	mV	
[Over Voltage Protection]						
OVP setting voltage	Vovp	REF×	REF×1.2	REF×	V	
[Over Current Protection Block]						
Current limit threshold1	Ilim1	43	50	57	mV	ILIM=0.5V Ta=-10℃ to 100℃
Current limit threshold2	Ilim2	160	200	240	mV	ILIM=2.0V
[VOUT setting]						
VOUT offset voltage	Voutoff	REF-7m	REF	REF+7m	V	Ta=-10℃ to 100℃
VOUT bias current	Ivout	-100	0	100	nA	
REF bias current	Iref	-100	0	100	nA	
Is+ Input current	Iis+	-1	0	1	μA	Is+=1.8V
Is- Input current	Iis-	-1	0	1	μA	Is-=1.8V
[SLLM]						
Continuous mode threshold	Vthcon	VCC-0.5	-	VCC	V	
SLLM threshold	VthSLLM	GND	-	0.5	V	

○ PHYSICAL DIMENSIONS



(UNIT:mm)
HQFN20

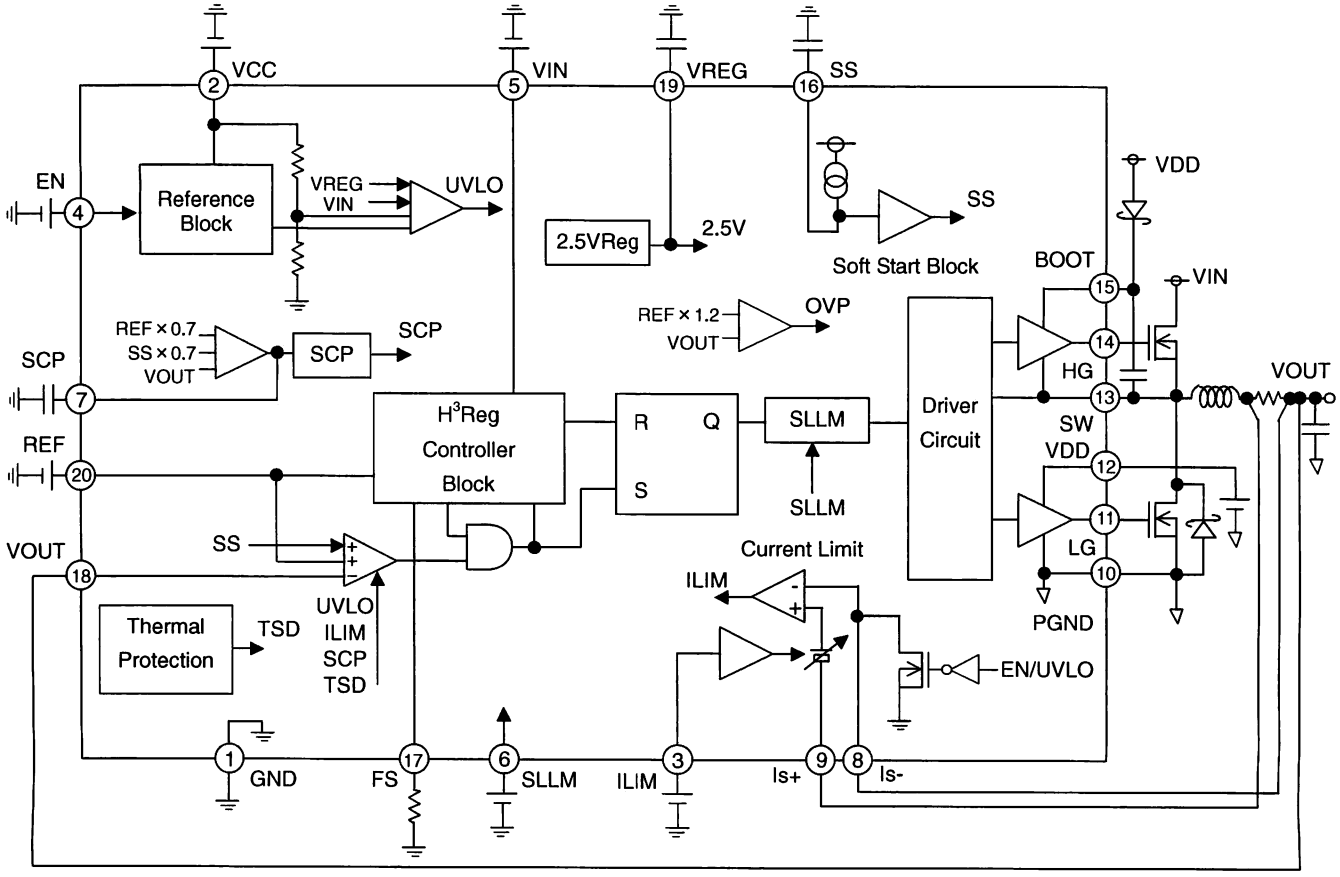
※ Mounting is not recommended to the dotted line part.

○ Pin Number Pin Name

Pin No.	Pin Name
1	GND
2	VCC
3	ILIM
4	EN
5	VIN
6	SLLM
7	SCP
8	IS-
9	IS+
10	PGND
11	LG
12	VDD
13	SW
14	HG
15	BOOT
16	SS
17	FS
18	VOUT
19	VREG
20	REF
-	FIN

Please short FIN to the 1PIN

○ BLOCK DIAGRAM



O 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.

TSD ON temperature [℃] (typ.)	Hysteresis temperature[℃] (typ.)
175	15

(8) Ground wiring pattern

When both a small-signal GND and high current GND are present, single-point grounding (at the set standard point) is recommended, in order to separate the small-signal and high current patterns, and to be sure the voltage change stemming from the wiring resistance and high current does not cause any voltage change in the small-signal GND. In the same way, care must be taken to avoid wiring pattern fluctuations in any connected external component GND.

(9) Heat sink (FIN)

Since the heat sink (FIN) is connected with the Sub, short it to the GND.

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