STRUCTURE Silicon Monolithic Integrated Circuit

PRODUCT NAME Dual output DC / DC Converter IC built in synchronous rectifier, with I^2C interface

TYPE **BD91362MUV**

FEATURES
- Output Voltage：8bit Adjustable Setting with I^2C interface (FB1=FB2=0.900～1.075V / 25mV step)
- Output Current：3.0A/1.0A
- High Efficiency and Fast Transient Response
- I^2C Compatible Interface(Device address '1100011')

○ABSOLUTE MAXIMUM RATING（Ta=25℃）

Parameter	Symbol	Limit	Unit
AVcc Voltage	VCC	-0.3～+7 *1	V
PVcc Voltage	PVCC	-0.3～+7 *1	V
VDVDD Voltage	DVDD	-0.3～+7 *1	V
BST Voltage	VBST	-0.3～+13	V
BST-SW Voltage	VBST-SW	-0.3～+7	V
EN・ SW・ITH Voltage	VEN	-0.3～+7	V
SCL・SDA Voltage	VSDA ,VSCL	-0.3～+7	V
Power Dissipation 1	Pd1	0.34 *2	W
Power Dissipation 2	Pd2	0.70 *3	W
Power Dissipation 3	Pd3	2.21 *4	W
Power Dissipation 4	Pd4	3.56 *5	W
Operating Temperature Range	Topr	-40～+105	℃
Storage Temperature Range	Tstg	-55～+150	℃
Operating Junction Temperature	Tjmax	+150	℃

*1 Pd, ASO, and Tj=150℃ should not be exceeded.
*2 IC only.
*3 1 layer, mounted on a board 74.2mm × 74.2mm × 1.6mm Glass-epoxy PCB (Copper foil area : 10.29mm^2)
*4 4 layers, mounted on a board 74.2mm × 74.2mm × 1.6mm Glass-epoxy PCB (1st ,4th Copper foil area :10.29mm^2 2nd ,3rd Copper foil area : 5505mm^2)
*5 4 layers, mounted on a board 74.2mm × 74.2mm × 1.6mm Glass-epoxy PCB (Copper foil area : 5505mm^2) , copper foil in each layers.

○OPERATING CONDITIONS（Ta=-40～+105℃）

Parameter	Symbol	Min.	Typ.	Max.	Unit
Vcc Voltage	VCC	2.7	5.0	5.5	V
PVcc Voltage	PVCC	2.7	5.0	5.5	V
VDVDD Voltage	DVDD *6	1.8	2.5	VCC	V
EN Voltage	VEN	0	-	VCC	V
SCL.SDA Voltage	VSDA ,VSCL	0	-	DVDD	V
Output Voltage range*7	VOUT	1.0	-	3.3*8	V
SW Average Output Current	ISW1	-	-	3.0*9	A
SW Average Output Current	ISW2	-	-	1.0*9	A

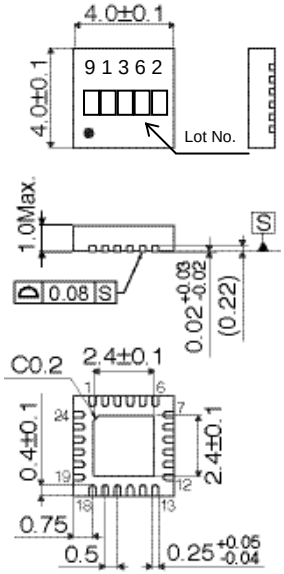
*6 VDVDD < VCC , PVCC
*7 Initial set of I2C interfece
*8 In case set output voltage 1.6V or more, VccMin.=VOUT+1.2V.
*9 Pd and ASO should not be exceeded.

This product is not designed for protection against radioactive rays.

○ELECTRICAL CHARACTERISTICS （Unless otherwise specified , Ta=25℃ VCC=PVCC=5.0V, DVDD =2.5V, EN=VCC）

Parameter	Symbol	Limit			Unit	Condition
		Min.	Typ.	Max.		
Standby Current	ISTB	-	0	20	μA	EN=0V
Bias Current	ICC	-	500	800	μA	
EN Low Voltage	VENL	-	GND	0.8	V	Standby Mode
EN High Voltage	VENH	2.0	Vcc	-	V	Active Mode
EN Input Current	IEN	-	2	10	μA	EN=2V
Oscillation Frequency	FOSC	0.8	1	1.2	MHz	
High-side FET ON Resistance	RONH1	-	60	90	mΩ	
	RONH2	-	170	255	mΩ	
Low-side FET ON Resistance	RONL1	-	55	83	mΩ	
	RONL2	-	130	195	mΩ	
FB Reference Voltage1	FB1	0.985	1.0	1.015	V	±1.5%
FB Reference Voltage2	FB2	0.985	1.0	1.015	V	±1.5%
ITH sink current 1	ITHSI1	10	18	-	μA	VFB1=1.2V
ITH source current 1	ITHSO1	10	18	-	μA	VFB1=0.8V
ITH sink current 2	ITHSI2	10	18	-	μA	VFB2=1.2V
ITH source current 2	ITHSO2	10	18	-	μA	VFB2=0.8V
UVLO Threshold Voltage	VUVLOL	2.4	2.5	2.6	V	VCC=5→0V
UVLO Release Voltage	VUVLOH	2.425	2.55	2.7	V	VCC=0→5V
Soft Start Time	TSS	0.5	1	2	ms	
Timer Latch Time	TLATCH	0.5	1	2	ms	SCP/TSD ON
Output Short circuit Threshold Voltage	VSCP1	-	0.5	0.7	V	FB1=1.0→0V(initial)
	VSCP2	-	0.5	0.7	V	FB2=1.0→0V(initial)
Digital I/O (SCL,SDA)						
INPUT Low Voltage	VIL	-	GND	0.2×DVDD	V	
INPUT High Voltage	VIH	0.8×DVDD	DVDD	-	V	
Inflow current	IIN	-	0	10	μA	SCL=SDA=2.5V
Data Output Low voltage	VOL	-	-	0.6	V	IOL=6mA

○PHYSICAL DIMENSION



VQFN024V4040 (Unit:mm)

○PIN No., PIN NAME

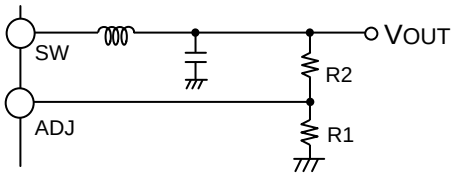
PIN No	PIN NAME	PIN No	PIN NAME
1	PVCC1	13	GND
2	BST	14	ITH2
3	SW1	15	FB2
4	SW1	16	ITH1
5	SW1	17	FB1
6	PGND1	18	VCC
7	PGND1	19	SCL
8	PGND1	20	SDA
9	PGND2	21	DVDD
10	SW2	22	N.C
11	PVCC2	23	PVCC1
12	EN	24	PVCC1

○FB Reference voltage

FB1,FB2	
0.900 V	
0.925 V	
0.950 V	
0.975 V	
1.000 V	(initial)
1.025 V	
1.050 V	
1.075 V	

*FB1,FB2 change after 10usec(max) pass from setting the voltage by I2C interface
*The time of 1step for FB1,FB2(25mV shift) take 5usec(max).
*The time that output voltage reaches the setting value is 0.06msec(max).

○SETTING THE OUTPUT VOLTAGE



The Output Voltage is set by the external resistor divider and is calculated as :

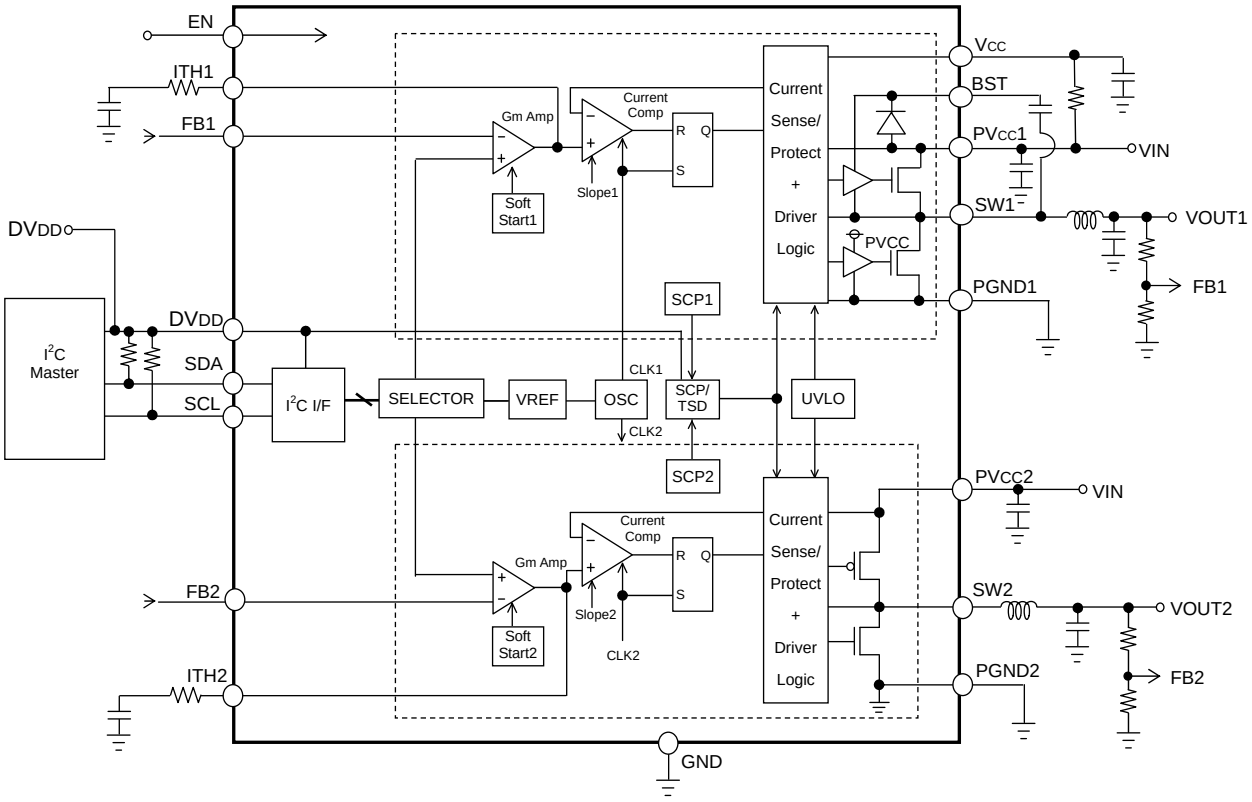
$$Vout=(R2/R1+1)\times V_{FB} \quad \cdots \quad ①$$

V_{FB} : FB pin feedback Voltage (1.0V typ)

It' s possible to adjust the output voltage by R1 and R2. (The Vout must be set from 1.0V to 3.3V. To control I^2C BUS,The Vout can be set 0.9～3.475V)

Resistance R1≒10kΩ is recommended. Please confirm the ripple voltage, if you can use the resistance more than 100kΩ.

OBLOCK DIAGRAM・APPLICATION CIRCUIT



OI2C - BUS control map

Byte	Bit7	Bit6	Bit5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	DEVICE ADDRESS[6:0]							R/W
2	FB1[2:0]			0	FB2[2:0]			0

Byte 1 is DEVICE ADDRESS:[1100011]

Byte 2 is DATA BIT, from Bit5 to Bit7 set FB2[2:0] , from Bit1 to Bit3 set FB1[2:0]. Bit0 and Bit4 input '0' .

The mode of this IC is WRITE MODE only.

REGSEL REGISTER (Write), initial value : 00h

REGISTRE	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
REGSEL	W	FB1[2:0]			0	FB2[2:0]			0
		0	0	0	0	0	0	0	0

Bit [7:5]: FB1[2:0] Set CH1 output voltage

"000": 1.000V(initial)

"001": 0.925V

"010": 0.950V

"011": 0.975V

"100": 0.900V

"101": 1.025V

"110": 1.050V

"111": 1.075V

Bit [3:1]: FB2[2:0] Set CH2 output voltage

"000": 1.000V(initial)

"001": 0.925V

"010": 0.950V

"011": 0.975V

"100": 0.900V

"101": 1.025V

"110": 1.050V

"111": 1.075V

ONOTES FOR USE

(1) Absolute Maximum Ratings

We are careful enough for quality control about this IC. So, there is no problem under normal operation, excluding that it exceeds the absolute maximum ratings. However, this IC might be destroyed when the absolute maximum ratings, such as impressed voltages or the operating temperature range, is exceeded, and whether the destruction is short circuit mode or open circuit mode cannot be specified. Take into consideration the physical countermeasures for safety, such as fusing, if a particular mode that exceeds the absolute maximum rating is assumed.

(2) GND Potential

Make setting of the potential of the GND terminal so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no terminals are at a potential lower than the GND voltage except for SW, PGND, GND terminals including an actual electric transient.

(3) Thermal design

Do not exceed the power dissipation (Pd) of the package specification rating under actual operation, and design enough temperature margins.

(4) Short circuit mode between terminals and wrong mounting

In order to mount the IC on a set PCB, pay thorough attention to the direction and offset of the ICs. Erroneous mounting can destroy the IC. Furthermore, if a short circuit occurs due to foreign matters entering between terminals or between the terminal and the power supply or the GND terminal, the IC can destroy

(5) Operation in Strong electromagnetic field

Be noted that using the IC in the strong electromagnetic radiation can cause operation failures.

(6) ASO(Area of Safety Operation.)

Do not exceed the maximum ASO and the absolute maximum ratings of the output driver.

(7) TSD(Thermal Shut-Down) circuit

The thermal shutdown circuit (TSD circuit) is built in this product. When IC chip temperature becomes higher, the thermal shutdown circuit operates and turns output off. The guarantee and protection of IC are not purpose. Therefore, do not use this IC after TSD circuit operates, nor use it for assumption that operates the TSD circuit.

(8) GND wiring pattern

Use separate ground lines for control signals and high current power driver outputs. Because these high current outputs that flows to the wire impedance changes the GND voltage for control signal. Therefore, each ground terminal of IC must be connected at the one point on the set circuit board. As for GND of external parts, it is similar to the above-mentioned.

(9) Operation in supply voltage range

Functional Circuit operation is guaranteed within operation ambient temperature, as long as it is within operation supply voltage range. The electrical characteristics standard value cannot be guaranteed.
However, there is no drastic variation in these values, as long as it is within operation supply voltage range.

(10) We are confident in recommending the above application circuit example, but we ask that you carefully check the characteristics of this circuit before using it. If using this circuit after modifying other external circuit constants, be careful to ensure adequate margins for variation between external devices and this IC, including not only static characteristics but also transient characteristics. If switching noise is high, insert the Low pass filter between Vcc pin and PVcc pin, insert the schottky barrier diodes between SW pin and PGND pin.

(11) Overcurrent protection circuit

The overcurrent protection circuit is built in the output. If the protection circuit operates more than for specific hours (when the load is short.), the output will be latched in OFF. The output returns when EN is turned on or UVLO is released again. These protection circuits are effective in the destruction prevention by broken accident. Do not use in continuous circuit operation.

(12) Selection of inductor

It is recommended to use an inductor with a series resistance element (DCR) 0.1Ω or less. Note that use of a high DCR inductor will cause an inductor loss, resulting in decreased output voltage. Should this condition continue for a specified period (soft start time + timer latch time), output short circuit protection will be activated and output will be latched OFF. When using an inductor over 0.1Ω, be careful to ensure adequate margins for variation between external devices and this IC, including transient as well as static characteristics.

(13) DV_{DD}

The operating voltage range for DV_{DD} is 1.8V~3.6V. The IC may not operate normally when the voltage is below than 1.8V. Therefore, a stabile power supply is required to ensure the supply voltage is within the DV_{DD} operating voltage range.
When I2C is not been used, DV_{DD} must be shorted to VCC.
Please be noticed that the output voltage from this IC can not be supplied to the DV_{DD}.

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