ROHM

STRUCTURE	Silicon Monolithic Integrated Circuit
TYPE	Multiple Voltage Regulator For Car Audio
PRODUCT SERIES	BD9400BFP
FEATURES	I^2C BUS Interface Built in LDO (250mA), Detector, Triangle Oscillator.

・ABSOLUTE MAXIMUM RATINGS (T_A=25℃)

PARAMETER	SYMBOL	LIMIT	UNIT
Supply Voltage	VCC	36 *1	V
INPUT Voltage	SDA, SCL, STBY,	7	V
Power Dissipation1	P_{D1}	0.85*2	W
Power Dissipation2	P_{D2}	1.45*3	W
Operation Temperature Range	T_{OPR}	−40～+85	℃
Storage Temperature Range	T_{STG}	+150	℃
Junction temperature range	T_{JMAX}	+150	℃

NOTE: *1 Do not exceed P_D
*2 P_D decreased at 6.8mW/℃ for temperatures above T_A=25℃ without heat sink.
*3 Pd decreased at 11.6mW/℃ for temperatures above T_A=25℃ with PCB (70×70×1.6mm^3)

・OPERATING CONDITIONS (T_A=-40～+85℃, Do not exceed P_D)

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage	VCC	7	26	V
Oscillator Frequency	FOSC	30	500	KHz

NOTE: This product is not designed for protection against radioactive rays.

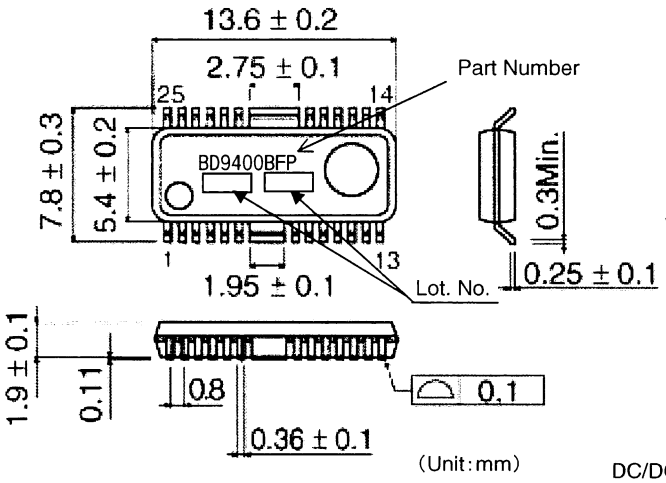
NOTE : The product described in this specification is a strategic product (and/or service) subject to COCOM regulations. It should not be exported without authorization from the appropriate government.

Status of this document
The English version of this document is the formal specification.
A customer may use this translation version only for a reference to help reading the formal version.
If there are any differences in translation version of this document, formal version takes priority.

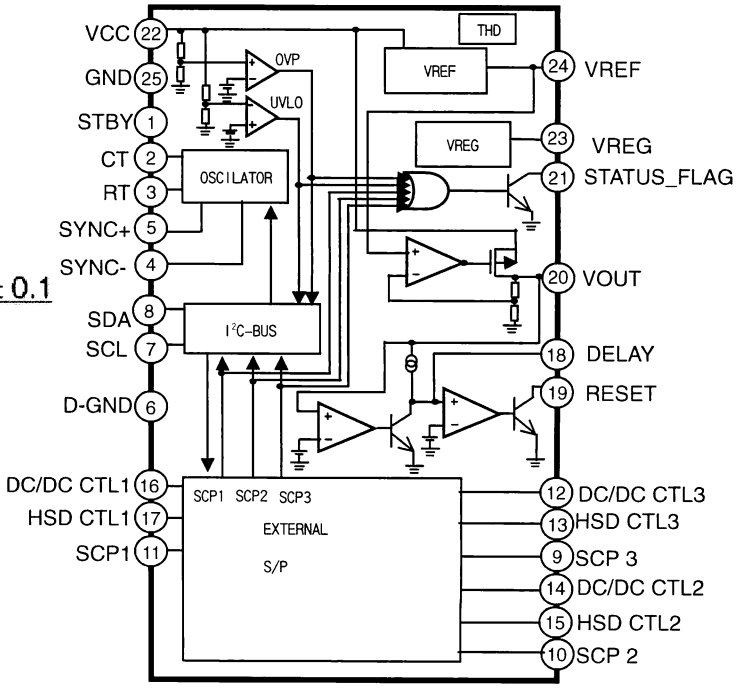
・ELECTRICAL CHARACTERISTIC (T_A=25℃, VCC=13.5V, STBY=3.3V unless otherwise specified.)

PARAMETER	SYMBOL	STANDARD VALUE			UNIT	CONDITIONS
		MIN.	TYP.	MAX.		
[OUTPUT: 3.3V, 250mA]						
Output Voltage	V_O	3.234	3.300	3.366	V	Io=10mA
Output Peak Current	I_{PEAK}	0.25	-	-	A	
Line Regulation	ΔV_{OL}	-	10	20	mV	VCC=9～26V, Io=10mA
Load Regulation	ΔV_{OR}	-	30	60	mV	Io=10～200mA
Ripple Rejection	RR	50	60	-	dB	f=100Hz, 0.5V_{p-p} , Io=10mA
[RESET]						
Detection Voltage	V_{DR}	2.66	2.80	2.94	V	
Hysteresis Voltage	ΔV_{DR}	-	90	-	mV	
Delay Time	T_{DR}	5	10	20	msec	C_{DELAY}=0.01uF
[Over Voltage Detection]						
Detection Voltage	V_{DO}	17.5	18.5	19.5	V	
Hysteresis Voltage	ΔV_{DO}	-	400	-	mV	
[Under Voltage Detection]						
Detection Voltage	V_{DU}	8.0	8.5	9.0	V	
Hysteresis Voltage	ΔV_{DU}	-	150	-	mV	
[STATUS_FLAG]						
Output Current	I_{STF}	1	-	-	mA	V_{STATUS_FLAG}=0.4V
[Triangle Oscillator]						
Oscillating Frequency	F_{OSC}	162	180	198	KHz	CT=100PF, RT=52KΩ
Frequency Tolerance	I_{ROSC}	-	-	2	%	
Frequency Shift 1	ΔF_{OSC1}	-	+10	-	%	In Compliance with I^2C Bus specification.
Frequency Shift 2	ΔF_{OSC2}	-	-10	-	%	In Compliance with IC Bus specification
Frequency Shift 3	ΔF_{OSC3}	-	+20	-	%	In Compliance with IC Bus specification
Frequency Shift 4	ΔF_{OSC4}	-	-20	-	%	In Compliance with IC Bus specification
[Reference Voltage]						
Output Voltage	V_{REF}	2.97	3.00	3.03	V	Io=1mA
Line Regulation	ΔV_{REFLI}	-	1	10	mV	VCC=8～26V, Io=0mA
Load Regulation	ΔV_{REFLO}	-	5	20	mV	Io=0～1mA
Short Output Current	I_{OVREF}	-	30	-	mA	
[VREG Voltage]						
Output Voltage	V_{REG}	4.5	5.0	5.5	V	Io=0mA
Output Current	I_{REG}	10	-	-	mA	
[Standby]						
Input High Level	V_{STAH}	2.3	-	3.3	V	
Input Low Level	V_{STAL}	0	-	1.0	V	
[All Devices]						
Consumption Current	I_{CC}	-	1.0	2.0	mA	V_{STB}=3.3V
Stand-by Current	I_{STBY}	-	60	100	μA	V_{STB}=0V

○Physical Dimensions



・○Block Diagram



・PIN FUNCTION

PIN No.	PIN NAME	FUNCTION
1	STBY	Circuit standby control
2	CT	Oscillator frequency adjustment pin connected capacitor
3	RT	Oscillator frequency adjustment pin connected resistor
4	SYNC-	Triangle Oscillator output alternative
5	SYNC+	Triangle Oscillator output non-alternative
6	DGND	Digital ground
7	SCL	Clock input terminal for I^2C BUS control
8	SDA	Data input terminal for I^2C BUS control
9	SCP3	Short circuit detection input from BD9401FM
10	SCP2	Short circuit detection input from BD9401FM
11	SCP1	Short circuit detection input from BD9401FM
12	DC/DC CTL3	DC/DC enable/disable control output to BD9401FM
13	HSD CTL3	High side switch enable/disable control output to BD9401FM
14	DC/DC CTL2	DC/DC enable/disable control output to BD9401FM
15	HSD CTL2	High side switch enable/disable control output to BD9401FM
16	DC/DC CTL1	DC/DC enable/disable control output to BD9401FM
17	HSD CTL1	High side switch enable/disable control output to BD9401FM
18	DELAY	RESET delay time adjustment pin connected capacitor
19	RESET	Reset output
20	VOUT	Regulator output for micro controller
21	STATUS_FLAG	OVP, UVLO, SCP1, SCP2 or SCP3 signal output
22	VCC	Main power supply pin
23	VREG	Reference voltage (5V) to BD9401FM
24	VREF	Reference voltage (3V) to BD9401FM
25	GND	Low-noise ground
FIN	FIN	It should be connected ground

O NOTE FOR USE

1. Absolute Maximum Range
   Absolute Maximum Ratings are values stated values, when any values in excess stated values may cause the deuce to be destroyed.
   We cannot be defined the failure mode, such as short mode or open mode.
   Therefore, physical devices for protection, such as fuses to be provided when a specific mode exceeds the Absolute.

2. Operating Supply Voltage Range
   Functional circuit operation is guaranteed within operation ambient temperature, as long as it is within operating supply voltage range. The electrical characteristics standard value can not be guaranteed. However, there is no drastic variation in these values, as long as it is within operating supply voltage range.

3. Grounding
   Connection of GND indicated in application circuit should be as short as possible to avoid electrical interference.

4. Power dissipation
   If IC is used on condition that the power loss is over the power dissipation, the reliability will become worse by heat up, such as reduced output current capability.
   Also, be sure to use this IC within a power dissipation range allowing enough of margin.

5. Oscillation Stopper of Output and Bypass Capacitor
   Please put capacitor of 10 μF, 10 μF and 0.1 μF on Vout, Vref and Vreg respectively to stop oscillation. It has a possibility of oscillation if capacitor value is changed due to temperature change. And it is recommended to use tantalum or electrolytic capacitor with low internal serial resistor (ESR). If extremely big capacitor (over 1000 μF) is used, it may have a case to occur oscillation of low frequency. And it is recommended to put bypass capacitor 1 μF into the nearest position between Input pin and GND.

6. Electrical characteristics described in these specifications may vary, depending on temperature, supply voltage, external circuits and other conditions. Therefore, be sure to check all relevant factors, including transient characteristics.

7. Overcurrent protection circuit
   The built-in overcurrent protection circuit is designed to respond to the output current and prevent destruction of the IC from load short circuits; however, it is only effective in protecting the IC from destruction in sudden overcurrent accidents.
   The protection circuit is not to be used continuously, or for transitions. In executing thermal design, bear in mind that overcurrent protection has negative characteristic according with the temperature.

8. Thermal shutdown circuit
   A built-in internal shutdown (TSD) circuit is provided to protect the IC from heat destruction. Operation has to be done within the allowable loss range, but in continuous use beyond the range, chip temperature Tj will increase to the threshold, activating the TSD circuit and turning the output power Tr OFF. Once the chip temperature Tj returns to the normal range, the circuit is automatically restored. Note that the TSD circuit is designed to operate over the maximum absolute rating. Therefore, make absolutely certain not to use the TSD function in set design.

9. Mounting Failures
   Mounting failure, such as misdirection or mismount, may cause a malfunction in the device.

10. Internal circuits or elements may be damaged when Vcc and pin voltage are reversed. For example, Vcc short circuit to GND while a external capacitor is charged. Output pin capacitor is recommended no larger than 1000μF. In addition, inserting a Vcc series countercurrent prevention diode, or a bypass diode between the various pins and the vcc, is recommended.

11. Electric Magnetic Field
    Mal-function may happen when the device is used in the strong electromagnetic field.

12. We recommend to put diode for protection purpose in case of output pin connected with large load of impedance or reverse current occurred during start up or output off timing.

13. Precautions for board inspection
    Connecting low-impedance capacitors to run inspections with the board may produce stress on the IC. Therefore, be certain to use proper discharge procedure before each process of the test operation. To prevent electrostatic accumulation and discharge in the assembly process, thoroughly ground yourself and any equipment that could sustain ESD damage, and continue observing ESD-prevention procedures in all handling, transfer and storage operations. Before attempting to connect components to the test setup, make certain that the power supply is OFF. Likewise, be sure the power supply is OFF before removing any component connected to the test setup.

14. GND 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 voltage fluctuations in any connected external component GND.

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