

STRUCTURE Silicon Monolithic Integrated Circuit
 TYPE Multiple Voltage Regulator For Car Audio
 PRODUCT SERIES **BD9400BFP**
 FEATURES I²C BUS Interface
 Built in LDO (250mA), Detector, Triangle Oscillator.

• ABSOLUTE MAXIMUM RATINGS (T_A=25°C)

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	°C
Storage Temperature Range	T _{STG}	+150	°C
Junction temperature range	T _{JMAX}	+150	°C

NOTE: *1 Do not exceed P_D

*2 P_D decreased at 6.8mW/°C for temperatures above T_A=25°C without heat sink.

*3 P_D decreased at 11.6mW/°C for temperatures above T_A=25°C with PCB (70×70×1.6mm³)

• OPERATING CONDITIONS (T_A=-40~+85°C, 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.

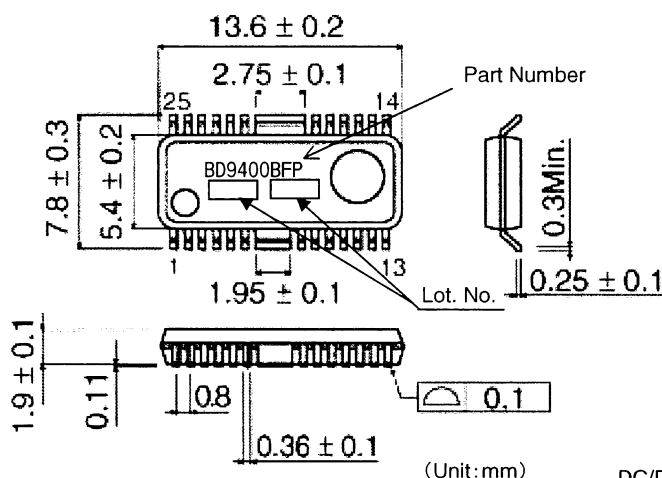
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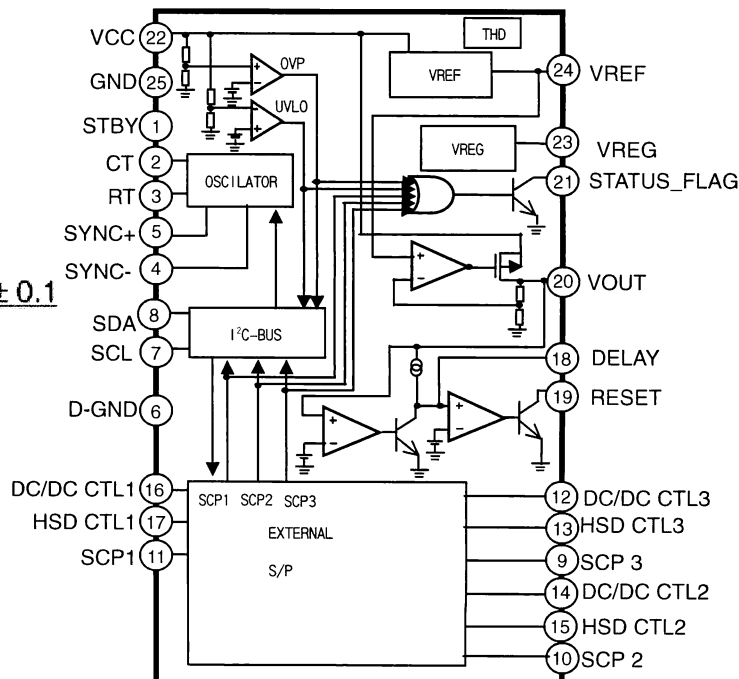
• ELECTRICAL CHARACTERISTIC (T_A=25°C, VCC=13.5V, STBY=3.3V unless otherwise specified.)

PARAMETER	SYMBOL	STANDARD VALUE			UNIT	CONDITIONS
		MIN.	TYP.	MAX.		
[OUTPUT: 3.3V, 250mA]						
Output Voltage	V _O	3.234	3.300	3.366	V	I _O =10mA
Output Peak Current	I _{PEAK}	0.25	–	–	A	
Line Regulation	ΔV _{OL}	–	10	20	mV	VCC=9~26V, I _O =10mA
Load Regulation	ΔV _{OR}	–	30	60	mV	I _O =10~200mA
Ripple Rejection	RR	50	60	–	dB	f=100Hz, 0.5V _{p-p} , I _O =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=52K Ω
Frequency Tolerance	I _{ROSC}	–	–	2	%	
Frequency Shift 1	ΔF _{OSC1}	–	+10	–	%	In Compliance with I ² C 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	I _O =1mA
Line Regulation	ΔV _{REFL1}	–	1	10	mV	VCC=8~26V, I _O =0mA
Load Regulation	ΔV _{REFLO}	–	5	20	mV	I _O =0~1mA
Short Output Current	I _{OVREF}	–	30	–	mA	
[VREG Voltage]						
Output Voltage	V _{REG}	4.5	5.0	5.5	V	I _O =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 I²C BUS control
8	SDA	Data input terminal for I²C 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

○ 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 $10\mu\text{F}$, $10\mu\text{F}$ and $0.1\mu\text{F}$ 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 $1000\mu\text{F}$) is used, it may have a case to occur oscillation of low frequency. And it is recommended to put bypass capacitor $1\mu\text{F}$ 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 T_j will increase to the threshold, activating the TSD circuit and turning the output power T_r OFF. Once the chip temperature T_j 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 $1000\mu\text{F}$. 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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Germany / Dusseldorf	TEL : +49(2154)9210	FAX : +49(2154)921400
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China / Hong Kong	TEL : +852(2)740-6262	FAX : +852(2)375-8971
Shanghai	TEL : +86(21)6279-2727	FAX : +86(21)6247-2066
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Beijing	TEL : +86(10)8525-2483	FAX : +86(10)8525-2489
Taiwan / Taipei	TEL : +866(2)2500-6956	FAX : +866(2)2503-2869
Korea / Seoul	TEL : +82(2)8182-700	FAX : +82(2)8182-715
Singapore	TEL : +65-6332-2322	FAX : +65-6332-5662
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Japan /
(Internal Sales)

Tokyo	2-1-1, Yaesu, Chuo-ku, Tokyo 104-0082	
	TEL : +81(3)5203-0321	FAX : +81(3)5203-0300
Yokohama	2-4-8, Shin Yokohama, Kohoku-ku, Yokohama, Kanagawa 222-8575	
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Nagoya	Dainagayo Building 9F 3-28-12, Meieki, Nakamura-ku, Nagoya, Aichi 450-0002	
	TEL : +81(52)581-8521	FAX : +81(52)561-2173
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	TEL : +81(75)311-2121	FAX : +81(75)314-6559

(Contact address for overseas customers in Japan)

Yokohama	TEL : +81(45)476-9270	FAX : +81(045)476-9271
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