1.2V to V$_{CC}$-1V, 2.5A 1ch
Ultra Low Dropout Linear Regulator

BD3506F

General Description

The BD3506F is an ultra-low dropout chipset linear regulator that can achieve ultra-low voltage output from an ultra-low voltage input. By using N-Channel MOSFET for built-in power transistor, the regulator can be used at ultra-low I/O voltage difference up to voltage difference generated by ON resistor (R$_{ON}$=120mΩ(Typ)). By reducing the I/O voltage difference, large current (I$_{OUTMAX}$=2.5A) output is achieved and conversion loss can be reduced making it comparable to switching power supply. BD3506F does not need any choke coil, diode for rectification and power transistors which are required for switching power supply. Consequently, total cost of the set can be reduced and compact size can be achieved for the set.   By using external resistors, output voltages from 0.65V to 2.5V can be set. In addition, since output voltage start-up time can be adjusted by using the NRCS terminal, it is possible to meet the power supply sequence of the set.
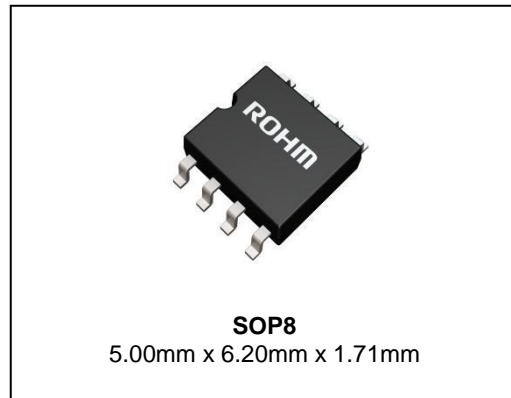
Features

- Built-in high-accuracy reference voltage circuit (0.65V±1%)
- Built-in VCC low input malfunction prevention circuit (V$_{CC}$ = 4.15V)
- Reduced rush current by NRCS
- Built-in ultra-low on-resistor N-Channel Power MOSFET
- Built-in current limiting circuit (2.5A min)
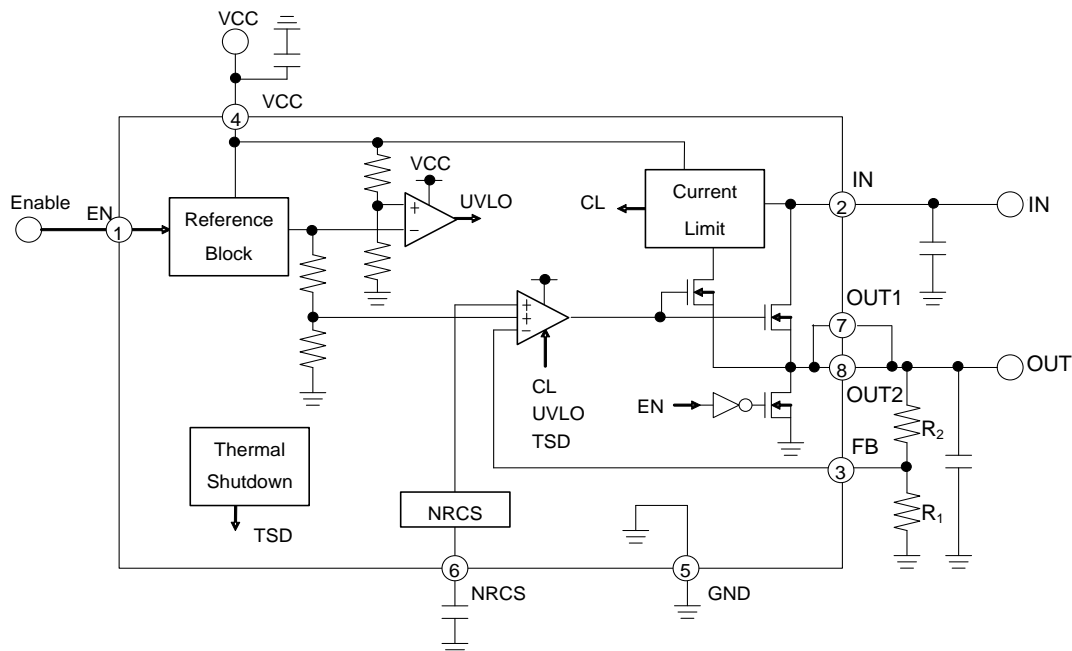- Built-in thermal shutdown circuit

Key Specifications

- IN Input Voltage Range: 1.2V to V$_{CC}$ -1V
- VCC Input Voltage Range: 4.3V to 5.5V
- Output Voltage Range: 0.65V to 2.5V
- Output Current: 2.5A (Max)
- ON-Resistance: 120mΩ(Typ)
- Standby Current: 0μA (Typ)
- Operating Temperature Range: -10°C to +100°C

Package
W(Typ) x D(Typ) x H(Max)

SOP8
5.00mm x 6.20mm x 1.71mm

Applications

Mobile PC, desktop PC, LCD-TV, DVD, digital home appliances

Typical Application Circuit and Block Diagram

○Product structure : Silicon monolithic integrated circuit   ○This product has no designed protection against radioactive rays

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Pin Configuration

TOP VIEW

EN	1		8	OUT2
IN	2		7	OUT1
FB	3		6	NRCS
VCC	4		5	GND
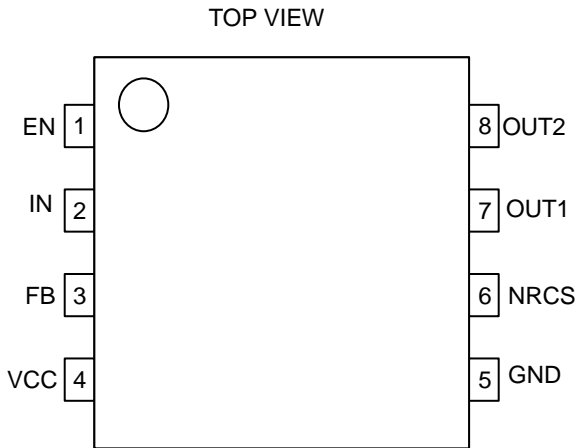
Pin Descriptions

Pin No.	Pin Name	Pin Function
1	EN	Enable pin
2	IN	Input voltage pin
3	FB	Output voltage feedback
4	VCC	Power source
5	GND	Ground pin
6	NRCS	NRCS(Non rush current on start up) time setup
7	OUT1	OUT1 Pin
8	OUT2	OUT2 Pin

Description of Blocks

1. AMP
   This is an error amplifier that compares the reference voltage (V_{REF}) with FB voltage to drive the output N-Channel FET. The frequency characteristics are optimized so that low ESR functional polymer capacitor can be used for the output capacitor and high-speed transient response can be achieved. The output voltage range of the AMP section is GND-VCC. When EN is OFF or at UVLO, the output goes LOW and the output N-Channel FET is turned OFF.

2. EN
   By the logic input pin, regulator ON/OFF is controlled. At the time of OFF, the circuit current is limited to 0 µA to reduce the standby current consumption of the apparatus. In addition, EN turns ON FET that can discharge NRCS and OUT and removes excess electric charge to prevent malfunction of IC on the load side. Since there is no electrical connection with the VCC terminal (as in the case where there is and ESD diode) , operation is independent on the input sequence.

3. UVLO
   To prevent malfunctions that can occur during sudden decrease in VCC, the UVLO circuit switches the output to OFF state, and (like the EN block) discharges NRCS and OUT. When the voltage exceeds the threshold voltage (TYP 4.15V), the output is restored.

4. Current Limit
   When the output is ON and the output current exceeds the set current limit threshold (2.5A or more) , the output voltage is attenuated to protect the IC on the load side. When current decreases, the output voltage is restored returns to the allowable value.

5. NRCS
   By connecting an external capacitor to NRCS pin and GND, soft start function is enabled. The output voltage startup time is determined by the time when the NRCS terminal reaches V_{FB} (0.65V). During start-up, the NRCS terminal serves as a constant current source of 20 µA (Typ), and charges the capacitor that is externally connected.

6. TSD (Thermal Shut down)
   In order to prevent thermal breakdown and thermal runaway of the IC, the output is turned OFF when chip temperature exceeds the threshold temperature. When the temperature decreases below the threshold temperature, the output is restored. While the TSD circuit is designed to protect the IC in the occurrence of extreme heat, thermal design should consider not to exceed Tj(max).

7. IN
   The IN line acts as the major current supply line, and is connected to the output N-Channel FET drain. Since there is no electrical connection with the VCC terminal, as in the case when an ESD diode is connected, its operation does not depend on the input sequence. However, because of the body diode of the output N-Channel FET, there is electrical connection (diode connection) between IN and OUT. Consequently, when the output is turned ON and OFF by IN, reverse current flows, in which case care must be taken.

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Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Input Voltage1	V_{CC}	7 (Note 1)	V
Input Voltage2	V_{IN}	7 (Note 1)	V
Enable Input Voltage	V_{EN}	7	V
Power Dissipation1	Pd1	0.56 (Note 2)	W
Power Dissipation2	Pd2	0.69 (Note 3)	W
Operating Temperature Range	Topr	-10 to+100	°C
Storage Temperature Range	Tstg	-55 to+125	°C
Maximum Junction Temperature	Tjmax	+150	°C

(Note 1) Provided Pd is not exceeded.
(Note 2) Derate by 4.48 mW/°C in the case of Ta ≥ 25°C (no heat radiation board),
(Note 3) Derate by 5.52 mW/°C in the case of Ta ≥ 25°C (when mounted on a 70mm x 70mm x 1.6mm glass epoxy substrate),
Caution: Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

Recommended Operating Conditions (Ta=25°C)

Parameter	Symbol	Rating		Unit
		Min	Max	
Input Voltage1	V_{CC}	4.3	5.5	V
Input Voltage2	V_{IN}	1.2	V_{CC} -1 (Note 4)	V
Output Voltage	V_{OUT}	V_{FB}	2.5	V
Enable Input Voltage	V_{EN}	-0.3	+5.5	V
Capacitor in NRCS pin	C_{NRCS}	0.001	1	µF

(Note 4) However, irrespective of charging order of VCC and IN.

Electrical Characteristics

(Unless otherwise noted, Ta=25°C V_{CC}=5V V_{EN}=3V V_{IN}=1.8V R_1=3.9kΩ R_2=3.3kΩ)

Parameter	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
Circuit Current	I_{CC}	-	0.7	1.4	mA	
Shut-Down Mode Current	I_{ST}	-	0	10	µA	V_{EN}=0V
Output Voltage	V_{OUT}	-	1.200	-	V	I_{OUT}=50mA
Maximum Output Current	I_{OUT}	2.5	-	-	A	
Maximum Short Current	I_{OST}	-	2.0	-	A	V_{OUT}=0V
Temperature Coefficient of Output Voltage	Tcvo	-	0.01	-	%/°C	
Feed Back Voltage 1	V_{FB1}	0.643	0.650	0.657	V	I_{OUT}=50mA
Feed Back Voltage 2	V_{FB2}	0.630	0.650	0.670	V	I_{OUT}=0 to 2A, Ta=-10°C to +100°C (Note 5)
Line Regulation 1	Reg.l1	-	0.1	0.5	%/V	V_{CC}=4.3V to 5.5V
Line Regulation 2	Reg.l2	-	0.1	0.5	%/V	V_{IN}=1.2V to 3.3V
Load Regulation	Reg.L	-	0.5	10	mV	I_{OUT}=0A to 2A
Dropout Voltage	dVo	-	120	200	mV	I_{OUT}=1A,V_{IN}=1.2V, Ta=-10°C to +100°C (Note 5)
Standby Discharge Current	I_{DEN}	150	-	-	mA	V_{EN}=0V, V_{OUT}=1V
[Enable]						
High Level Enable Input Voltage	V_{ENHI}	2	-	5.5	V	
Low Level Enable Input Voltage	V_{ENLOW}	-0.3	-	+0.8	V	
Enable Pin Input Current	I_{EN}	-	7	10	µA	V_{EN}=3V
[Voltage Feed Back]						
Feed Back Terminal Bias Current	I_{FB}	-100	0	+100	nA	

(Note 5) Not 100% tested

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Electrical Characteristics – continued

Parameter	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
[NRCS]						
NRCS Charge Current	I_{NRCS}	14	20	26	µA	V_{NRCS}=0.5V
NRCS Standby Voltage	V_{STB}	-	0	50	mV	V_{EN}=0V
[UVLO]						
VCC UVLO	V_{CCUVLO}	4.00	4.15	4.30	V	VCC: Sweep-up
VCC UVLO Hysteresis	V_{CCHYS}	100	160	220	mV	VCC: Sweep-down

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Typical Performance Curves
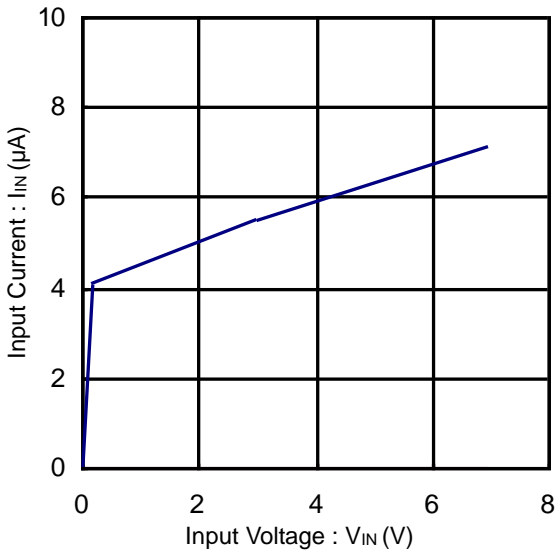
Figure 1. Input Current vs Input Voltage
(Ta=25°C)
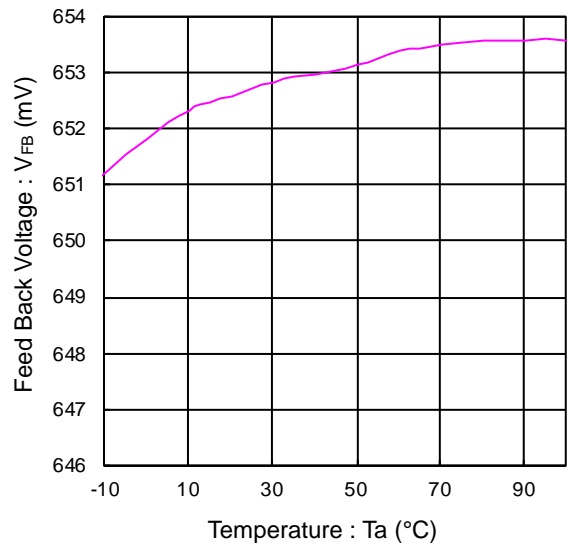
Figure 2. Feed Back Voltage vs Temperature
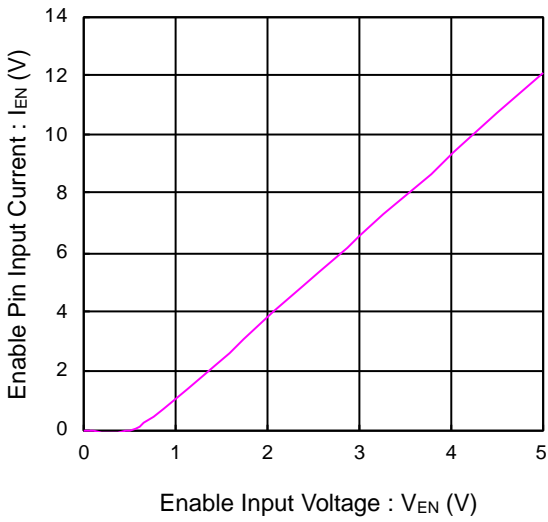
Figure 3. Enable Pin Input Current vs Enable Input
Voltage
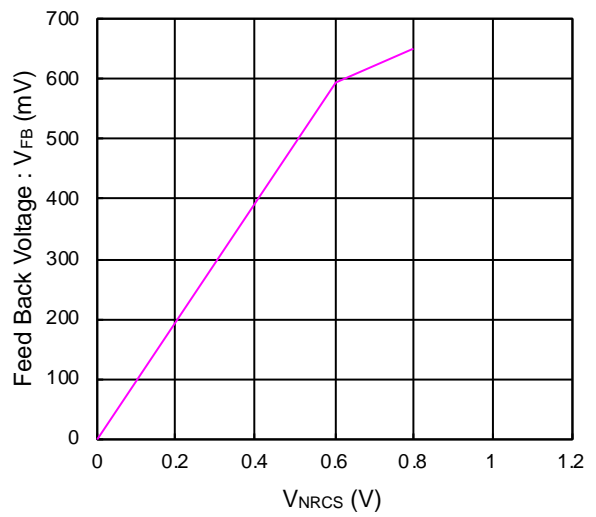
Figure 4. Feed Back Voltage vs V$_{NRCS}$

Typical Waveforms
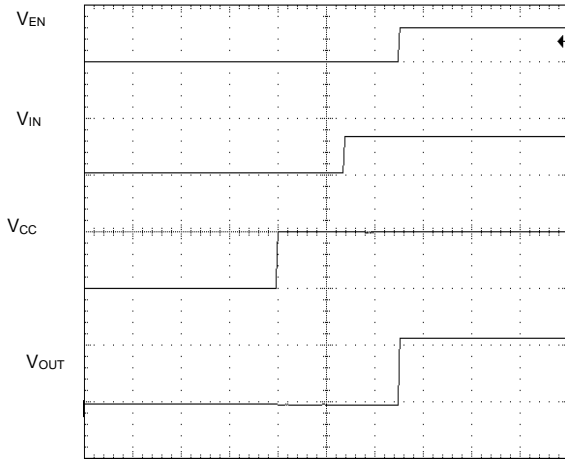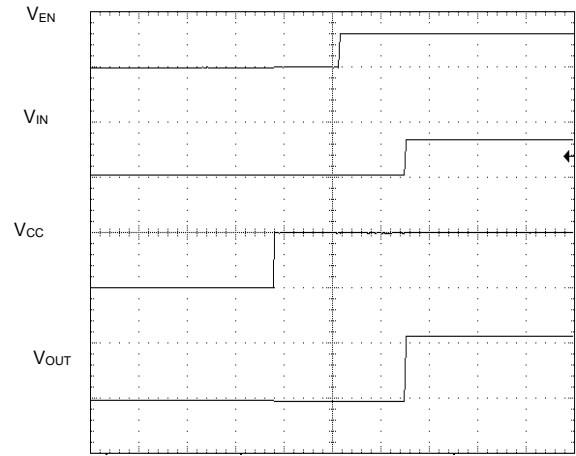

Figure 5. Input Voltage SequenceFinal Input Voltage EN
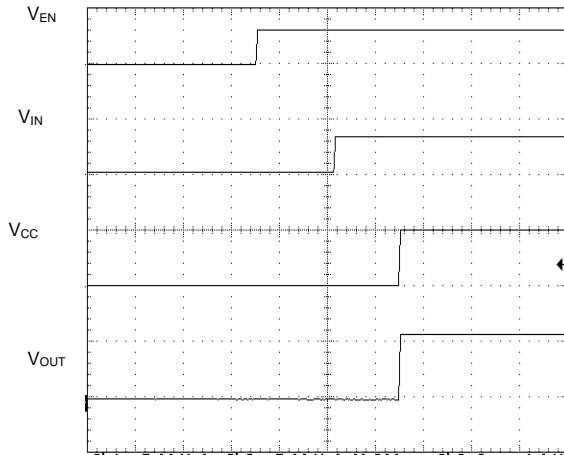

Figure 6. Input Voltage Sequence Final Input Voltage IN
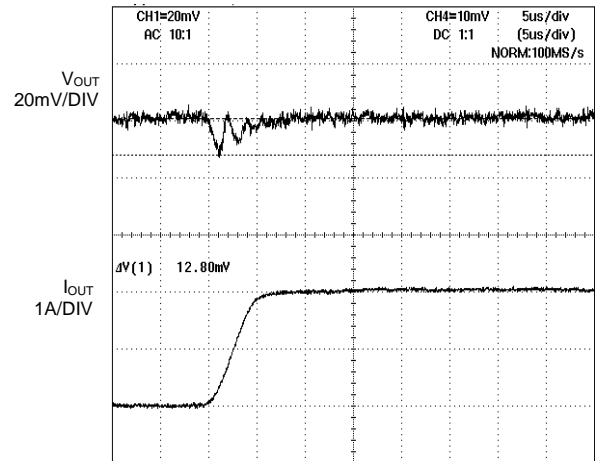

Figure 7. Input Voltage SequenceFinal Input Voltage VCC

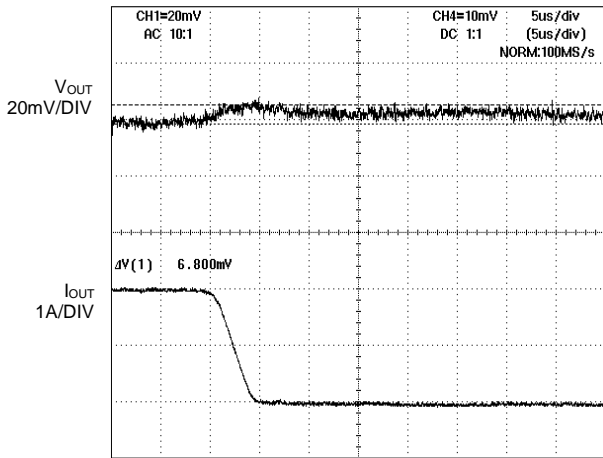

Figure 8. Transient Response (Rise) C$_{OUT}$=100µF

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Typical Waveforms – continued

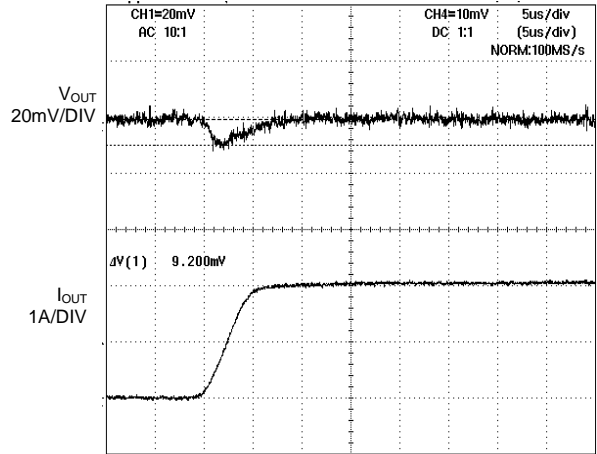Figure 9. Transient Response (Fall)
C_{OUT}=100µF

Figure 10. Transient Response (rise)
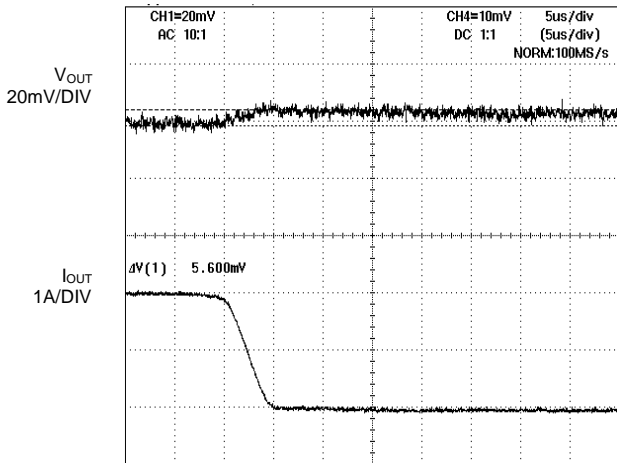C_{OUT}=220µF

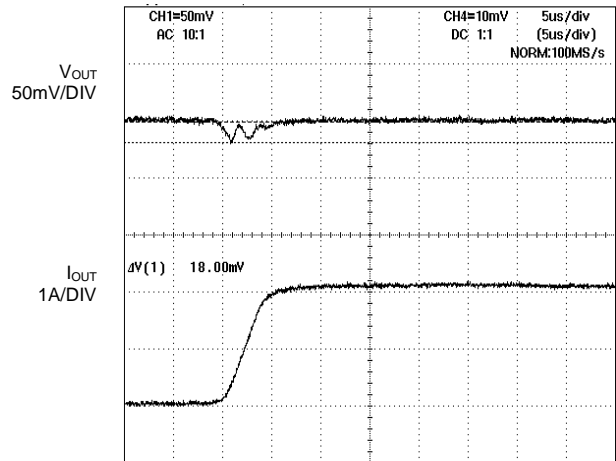Figure 11. Transient Response (Fall)
C_{OUT}=220µF

Figure 12. Transient Response (Rise)
47µ MLCC+30mΩ
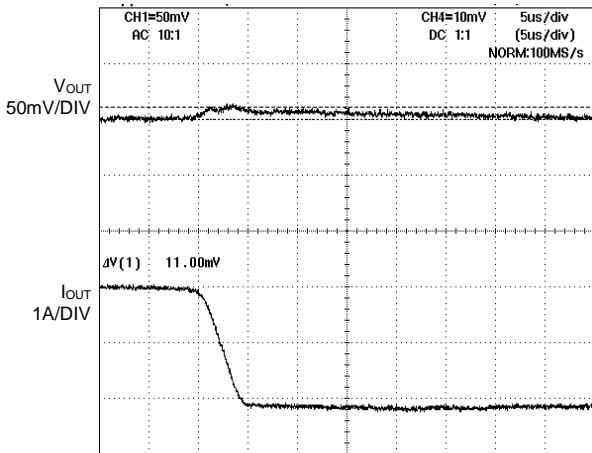
Typical Waveforms – continued

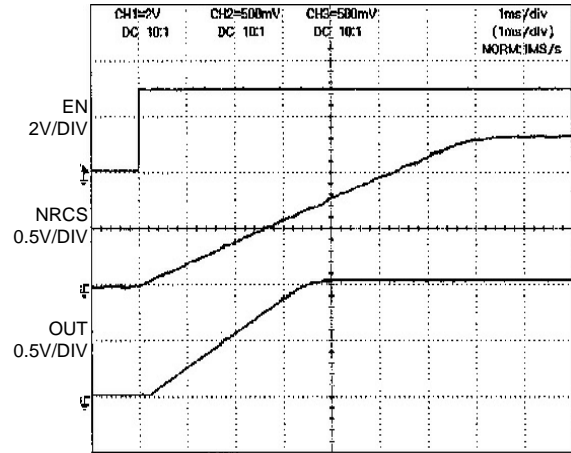
Figure 13. Transient Response (Fall)
47µ MLCC+30mΩ

Figure 14. Start up Wave Form
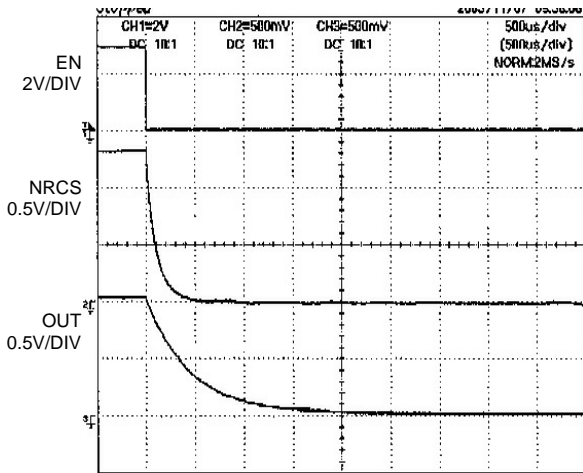
Figure 15. Shut down Wave Form

Timing Chart

EN   ON/OFF

IN

VCC

EN

NRCS

Start up Time

OUT

t

VCC   ON/OFF

IN

UVLO

VCC

hysteresis

EN

NRCS

Start up Time

OUT

t

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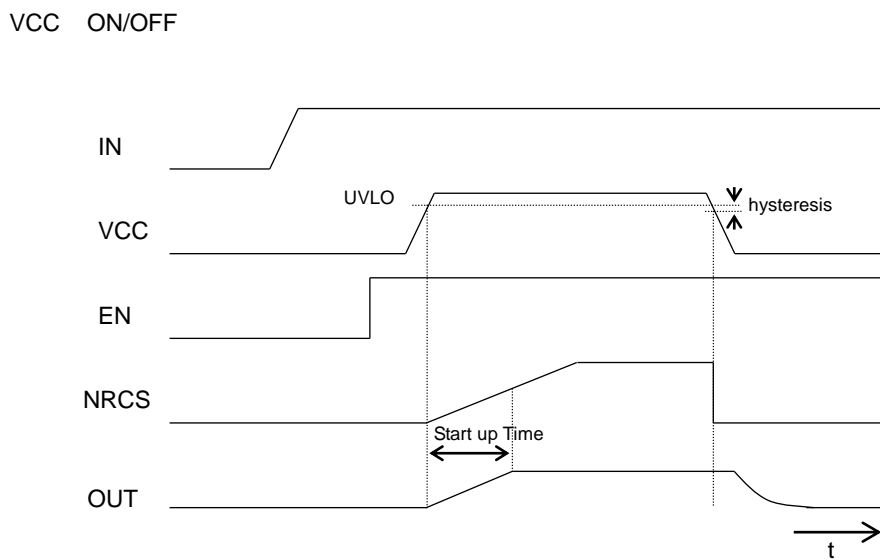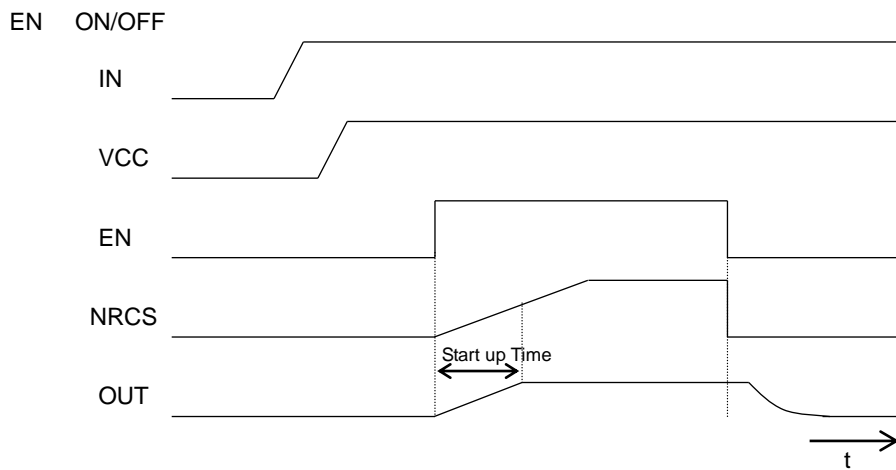
Application Information

1. Evaluation Board

■ BD3506F Evaluation Board Circuit
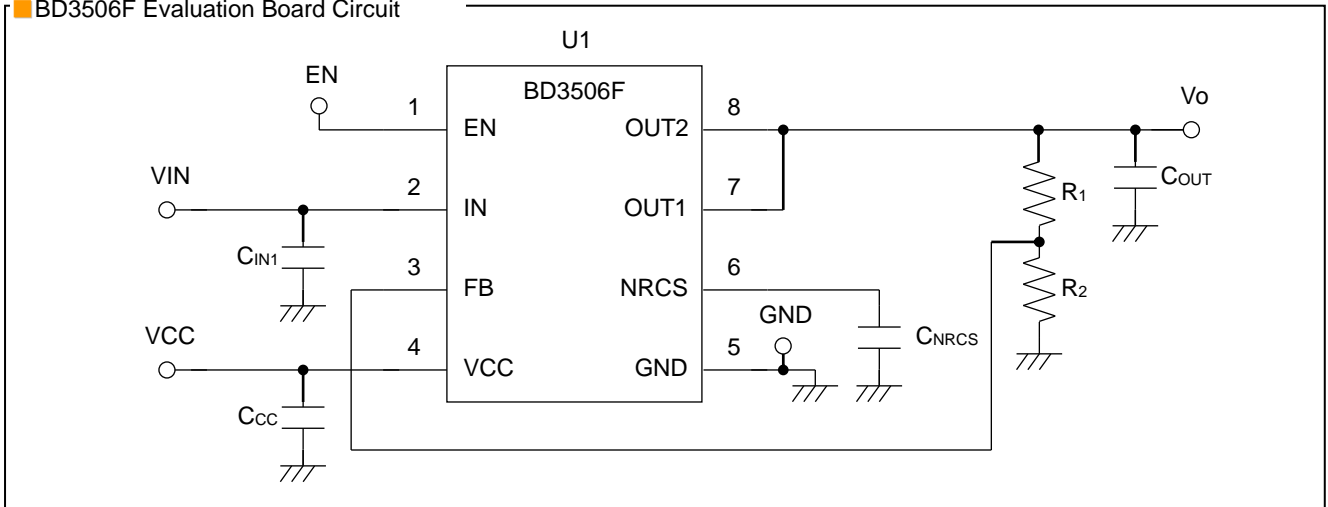
■ BD3506F Evaluation Board Application Components

Part No	Value	Company	Parts Name
U1	-	ROHM	BD3506F
R_1	3.3k	ROHM	MCR03Series
R_2	3.9k	ROHM	MCR03Series

Part No	Value	Company	Parts Name
C_{CC}	1µF	MURATA	GRM18 Series
C_{IN1}	10µF	MURATA	GRM21 Series
C_{OUT}	220µF	SANYO,etc	2R5TPE220MF
C_6	0.01µF	MURATA	GRM18 Series

■ BD3506F Evaluation Board Layout
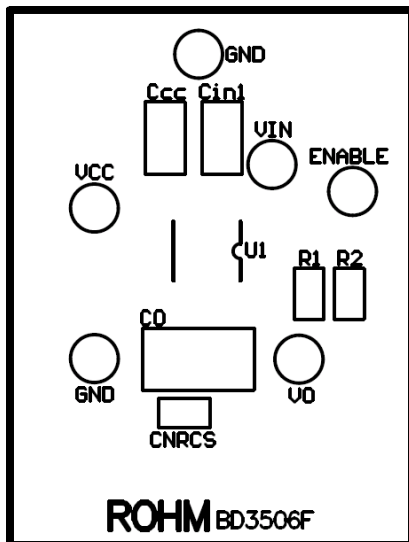
Silk Screen   TOP Layer   Bottom Layer
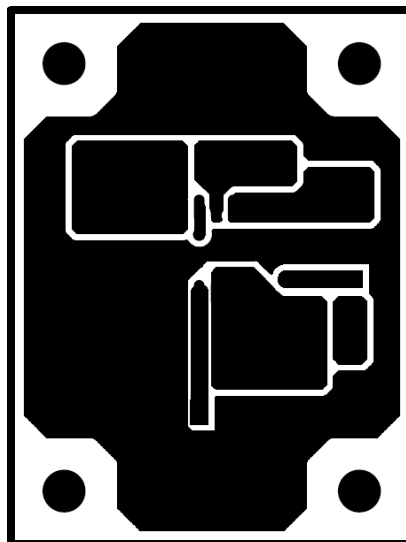
2. Recommended Circuits

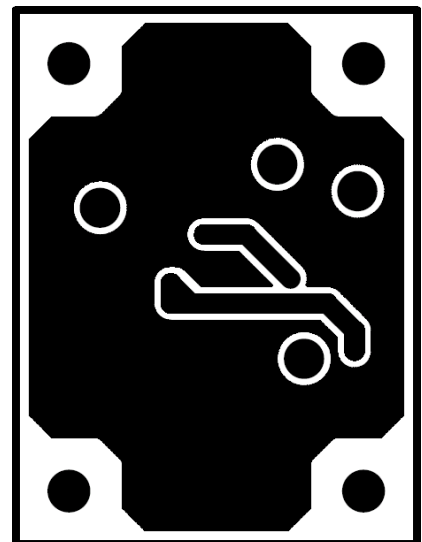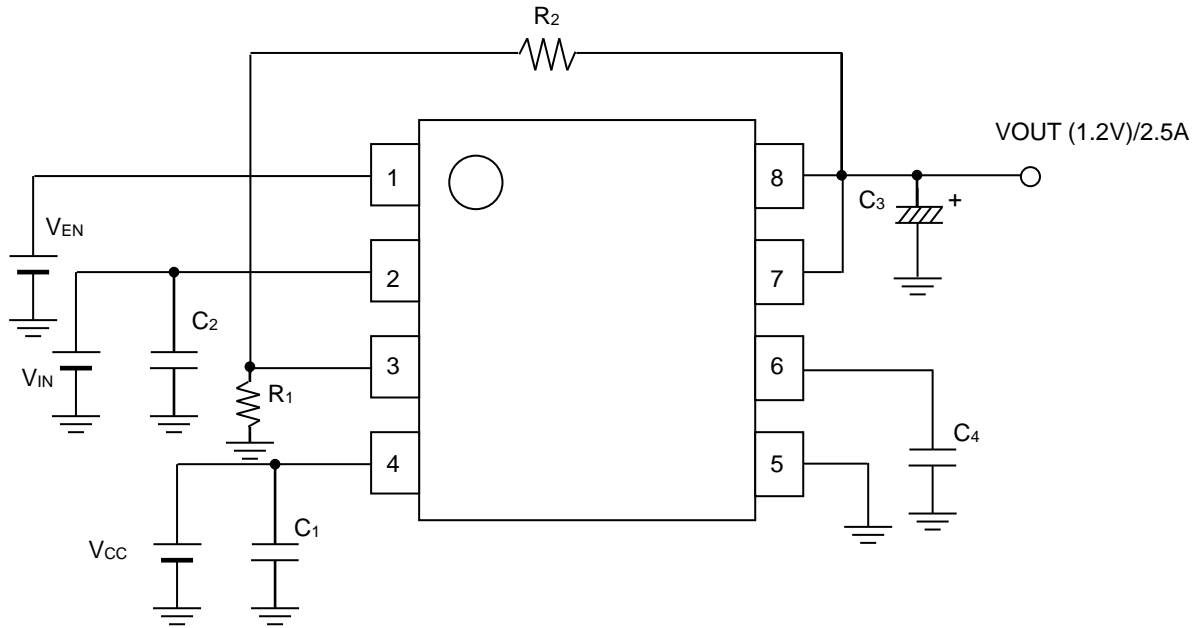| Part No	Value	Notes for use
R_1/R_2	6.5k/5.5k	The output voltage can be set by feedback voltage (V_{FB}) and value of output voltage setting resistors (R_1, R_2). Output voltage can be set by V_{FB} x (R_1+R_2) / R_1 but it is recommended to use at the resistance value (total: about 10 kΩ) which is not susceptible to feedback terminal bias current (±100 nA).
C_3	100µF	Connect the output capacitor between OUT1, OUT2 terminals and GND terminal without fail in order to stabilize output voltage. The output capacitor has a role to compensate for the phase of loop gain and to reduce output voltage fluctuation when load is rapidly changed. When there is an insufficient capacitor value, there is a possibility to cause oscillation, and when the equivalent serial resistance (ESR) of the capacitors is large, output voltage fluctuation is increased when load is rapidly changed. About 100-µF high-performance electrolytic capacitors are recommended but output capacitor greatly depends on temperature and load conditions. In addition, when only ceramic capacitors with low ESR are used, or various capacitors are connected in series, the total phase allowance of loop gain is insufficient, and oscillation may result. Thorough confirmation at application temperature and under load range conditions is requested.
C_1	1µF	The input capacitor plays a part to lower the output impedance of a power supply connected to input terminals (VCC). When output impedance of this power supply increases, the input voltage ($V_{CC,}$) become unstable and there is a possibility of giving rise to oscillation and degraded ripple rejection characteristics. The use of capacitors of about 1µF with low ESR, and which provide less capacitance value changes caused by temperature changes, is recommended. But since the input capacitor greatly depends on characteristics of the power supply used for input, substrate wiring pattern and thorough confirmation under the application temperature and load range, is requested.
C_2	10µF	The input capacitor plays a part to lower output impedance of a power supply connected to input terminals (IN). When output impedance of this power supply increases, the input voltages (V_{IN}) become unstable and there is a possibility of giving rise to oscillation and degraded ripple rejection characteristics. The use of capacitors of about 10µF with low ESR, and which provide less capacitance value changes caused by temperature changes, is recommended. But since input capacitor greatly depends on characteristics of the power supply used for input, substrate wiring pattern and thorough confirmation under the application temperature and load range, is requested.
C_4	0.1µF	In this IC, NRCS (Non Rush Current on Start-up) function prevents rush current from IN to load and output capacitor via OUT at the output voltage start-up. When the EN terminal is reset from High or UVLO, constant current is allowed to flow from the NRCS terminal. By this current, voltage generated at the NRCS terminal becomes the reference voltage and output voltage is started. In order to stabilize the NRCS set time, it is recommended to use a capacitor (B special) with less capacity value change caused by temperature change.

3. About Heat Loss

In thermal design, consider the temperature range wherein the IC is guaranteed to operate and apply appropriate margins. The temperature conditions that need to be considered are listed below:

(1) Ambient temperature Ta shall be not more than 100°C.
(2) Chip junction temperature Tj shall be not more than 150°C.

Chip junction temperature Tj can be considered under the following two cases.

①Chip junction temperature Tj is found from IC surface temperature TC under actual application conditions:

$$Tj = Tc + \theta j - c \times W$$

<Reference value>

    θj-c: SOP8 41.0°C/W

    Substrate size:70 x 70 x 1.6mm
    (Substrate surface capper
    foil area:less3%)

②Chip junction temperature Tj is found from ambient temperature Ta:

$$Tj = Ta + \theta j - a \times W$$

<Reference value>

θj-a: SOP8   222.0°C/W (IC only)
            181.0°C/W Single-layer substrate
                       (substrate surface copper foil area: less 3%)
                       Single-layer substrate

Substrate size 70 x 70 x 1.6mm^3 (thermal vias in the board.)

Most of heat loss in BD3506F occurs at the output N-Channel FET. The power loss is determined by multiplying the voltage between V_{IN} and V_{OUT} by the output current. Confirm voltage and output current conditions of IN and OUT used, and collate them with the thermal derating characteristics.

Power dissipation (W) = {Input voltage (V_{IN}) – Output voltage (V_{OUT})} x I_{OUT} (averaged)

Ex.)   If V_{IN} = 1.8V, V_{OUT}=1.2V, and I_{OUT} (averaged)= 1.5 A, the power dissipation is given by the following:

$$\text{Power dissipation} = (1.8V - 1.2V) \times 1.5 (A)$$
$$= 0.9W$$

Power Dissipation

SOP8
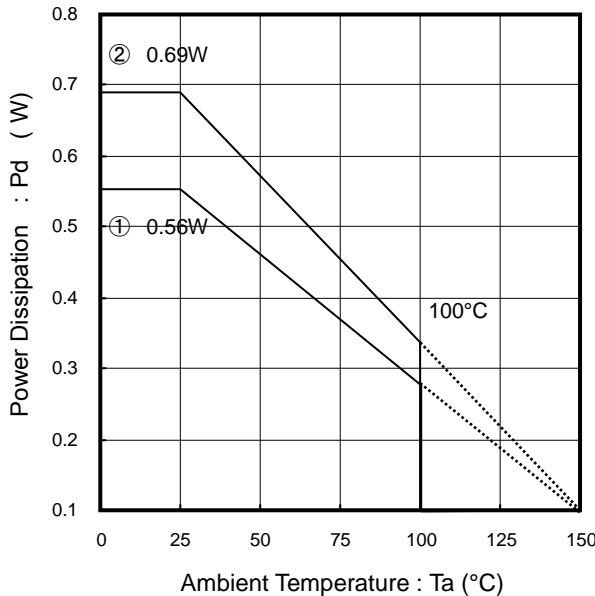
① IC only
    θj-a=222°C/W
② Mounted on board
    70mm x 70mm x 1.6mm Glass-epoxy PCB
    θj-a=181°C/W

I/O Equivalent Circuits

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Operational Notes

1. **Reverse Connection of Power Supply**
   Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. **Power Supply Lines**
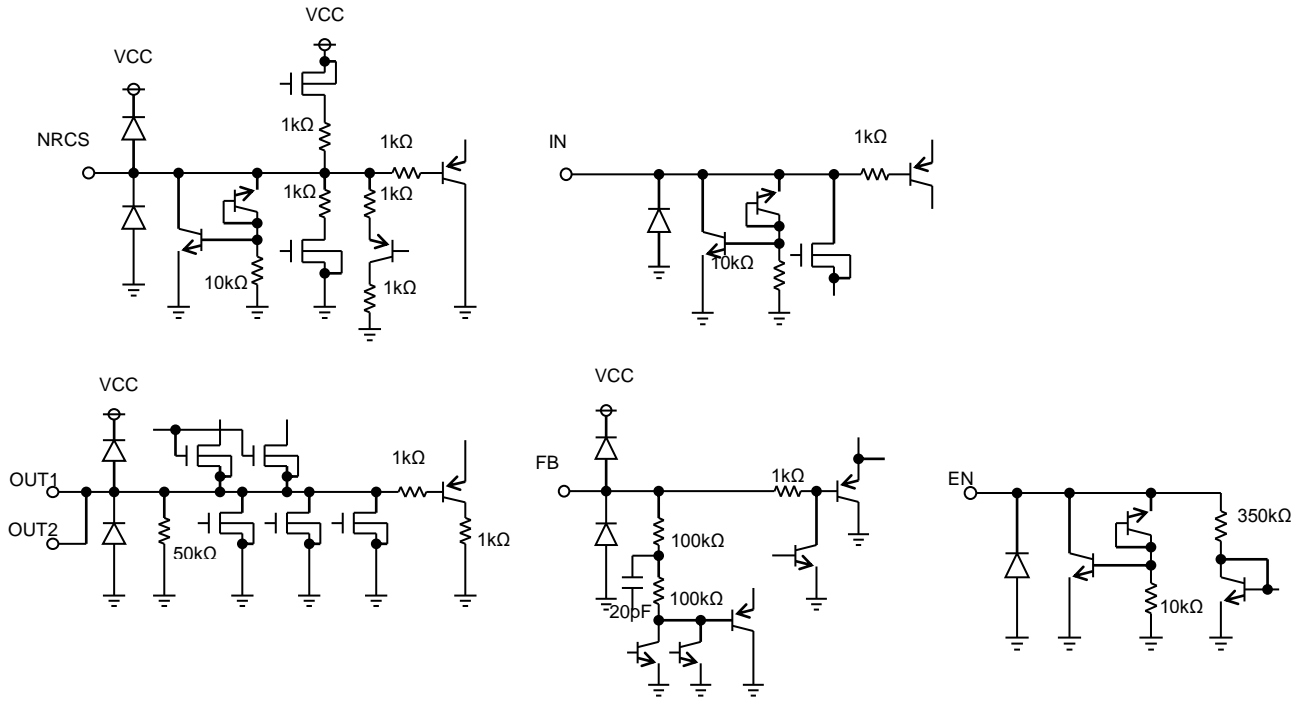   Design the PCB layout pattern to provide low impedance supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. **Ground Voltage**
   Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. **Ground Wiring Pattern**
   When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. **Thermal Consideration**
   Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the Pd rating.

6. **Recommended Operating Conditions**
   These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

7. **Inrush Current**
   When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

8. **Operation Under Strong Electromagnetic Field**
   Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

9. **Testing on Application Boards**
   When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

10. **Inter-pin Short and Mounting Errors**
    Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

11. **Unused Input Pins**
    Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

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Operational Notes – continued

12. **Regarding the Input Pin of the IC**
This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.
When GND > Pin B, the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.
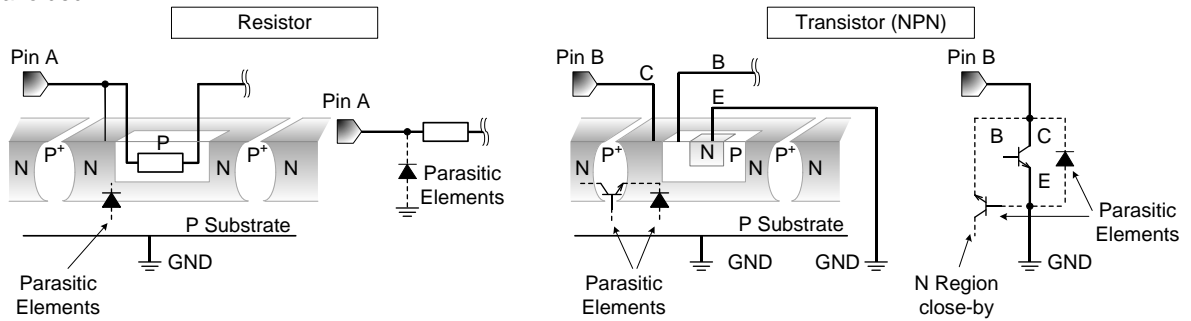

Figure 16. Example of monolithic IC structure

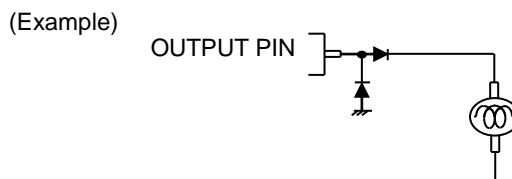13. **Thermal Shutdown Circuit(TSD)**
This IC has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's power dissipation rating. If however the rating is exceeded for a continued period, the junction temperature (Tj) will rise which will activate the TSD circuit that will turn OFF all output pins. When the Tj falls below the TSD threshold, the circuits are automatically restored to normal operation.
Note that the TSD circuit operates in a situation that exceeds the absolute maximum ratings and therefore, under no circumstances, should the TSD circuit be used in a set design or for any purpose other than protecting the IC from heat damage.

14. **Input Terminals (VCC,IN,EN)**
In the present IC, EN terminal, IN terminal, and VCC terminal have an independent construction. In addition, in order to prevent malfunction at the time of low input, the UVLO function is equipped with the VCC terminal. They begin to start output voltage when all the terminals reach threshold voltage without depending on the input order of input terminals.

15. In the event that load containing a large inductance component is connected to the output terminal, and generation of back-EMF at the start-up and when output is turned OFF is assumed, it is requested to insert a protection diode.

(Example)

Ordering Information

| B | D | 3 | 5 | 0 | 6 | F | | E | 2 | |

Part Number

Package
F : SOP8

Packaging and forming specification
E2: Embossed tape and reel

Marking Diagram

SOP8 (TOP VIEW)

D 3 5 0 6

Part Number Marking

LOT Number

1PIN MARK

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TSZ02201-0J2J0A601080-1-2
02.Nov.2015 Rev.001
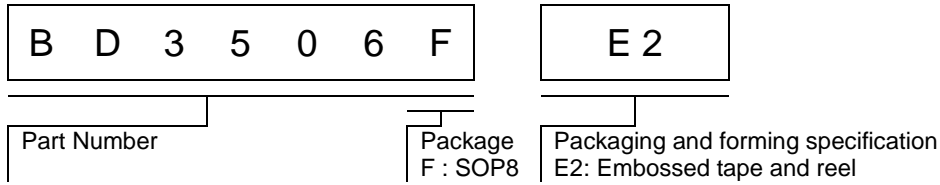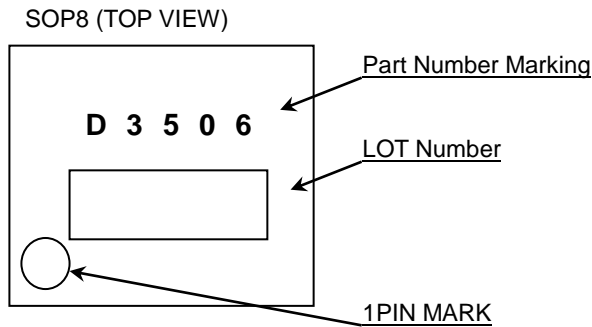
Physical Dimension, Tape and Reel Information

Package Name	SOP8

5. 0 ±0. 2
(Max 5.35 (include.BURR))

6. 2 ±0. 3
4. 4 ±0. 2

8 7 6 5

1 2 3 4

0. 595

4° +6° -4°

0. 9 ±0. 15

0. 3MIN

0. 17 +0. 1 -0. 05

S

1. 5 ±0. 1

0. 11

1. 27

0. 42 ±0. 1

0. 1 S
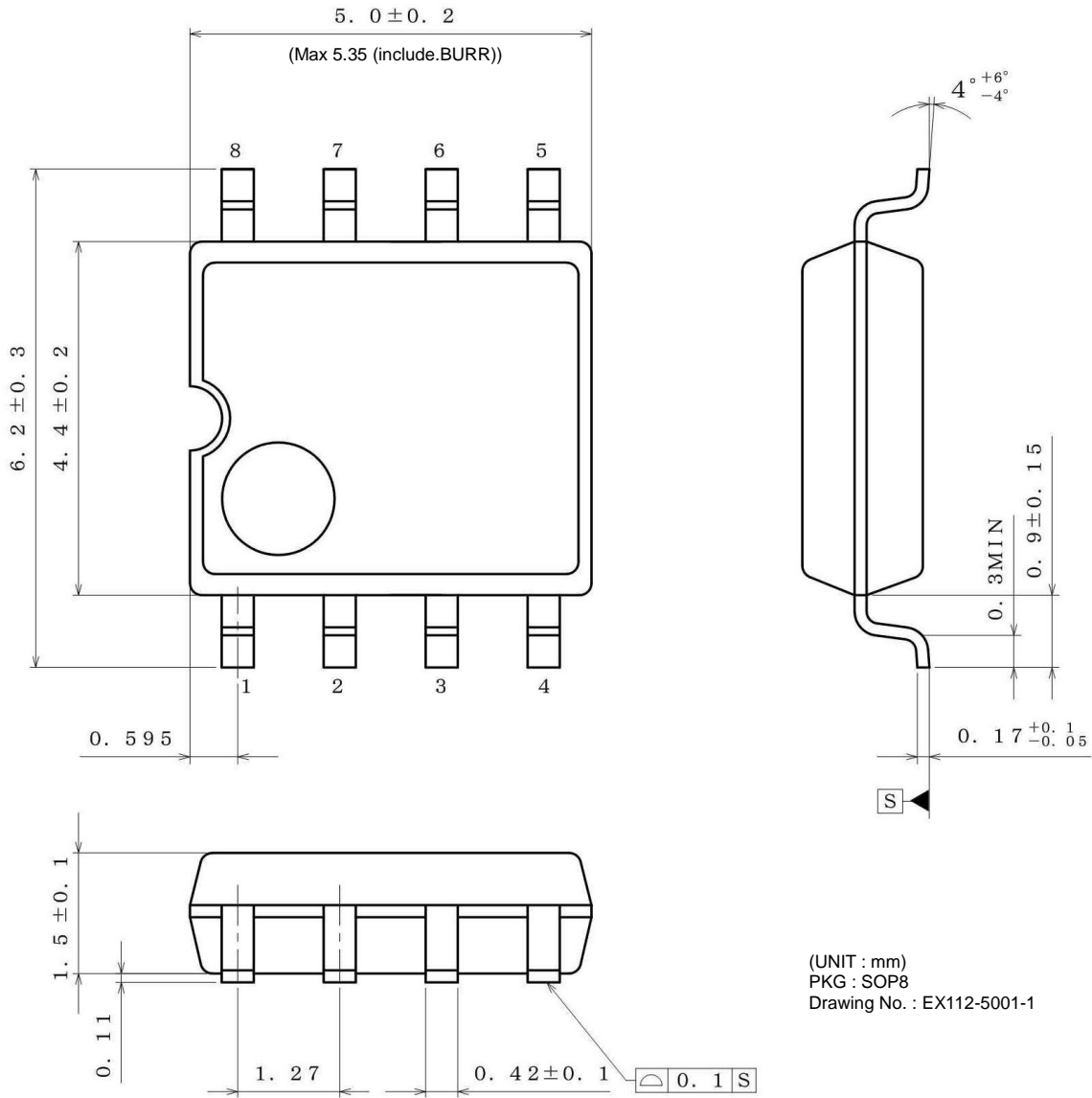
(UNIT : mm)
PKG : SOP8
Drawing No. : EX112-5001-1

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)

1pin

Reel

Direction of feed

＊Order quantity needs to be multiple of the minimum quantity.

Revision History

Date	Revision	Changes
02.Nov.2015	001	New Release

TSZ02201-0J2J0A601080-1-2
02.Nov.2015 Rev.001

Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment [(Note 1)], transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
    [a] Installation of protection circuits or other protective devices to improve system safety
    [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

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    [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
    [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
    [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
    [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
    [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
    [f] Sealing or coating our Products with resin or other coating materials
    [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
    [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits
1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic
This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation
1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
    [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
    [b] the temperature or humidity exceeds those recommended by ROHM
    [c] the Products are exposed to direct sunshine or condensation
    [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label
QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition
When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act
Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

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