

STRUCTURE Silicon Monolithic Integrated Circuit  
 TYPE Positive and Negative Variable Linear Regulator  
 PRODUCT SERIES **BD3988FV**

- FEATURES
1. Built-in positive (REG1) and negative (REG2) Linear Regulator for CCDs/ Variable output/ Low saturation voltage type.
  2. Built-in Discharge circuit. Negative output voltage (REG2) turns off immediately, after STB turns off.

○ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

| Parameter                    | Symbol | Limit    | Unit |
|------------------------------|--------|----------|------|
| Positive Supply Voltage      | VCC    | +18 ※1   | V    |
| Negative Supply Voltage      | VEE    | -18 ※1   | V    |
| Power Dissipation            | Pd     | 380 ※2   | mW   |
| Operating Temperature Range  | Topr   | -40~+85  | °C   |
| Storage Temperature Range    | Tstg   | -55~+125 | °C   |
| Maximum Junction Temperature | Tjmax  | 125      | °C   |

※1 Not to exceed Pd.

※2 Reduced by 3.8mW/°C over Ta=25°C ,during IC without heat sink operation.

○OPERATING CONDITIONS

| Parameter               | Symbol | Min   | Max   | Unit |
|-------------------------|--------|-------|-------|------|
| Positive Supply Voltage | VCC    | +15.0 | +18.0 | V    |
| Negative Supply Voltage | VEE    | -14.0 | -7.5  | V    |
| REG1 Output Voltage     | Vo1    | +14.0 | +16.0 | V    |
| REG2 Output Voltage     | Vo2    | -8.5  | -6.5  | V    |
| Output Current 1        | Io1    | —     | 25    | mA   |
| Output Current 2        | Io2    | —     | 50    | mA   |

※ Vdropout(Reg1) × Io(Reg1) + Vdropout(Reg2) × Io(Reg2) not to exceed Pd=380mW.

○ELECTRICAL CHARACTERISTICS(Unless otherwise specified, Ta=25°C, VCC=16.5V, VEE=-10V, Set REG1=15V, Set REG2=-7.5V)

| Parameter                                     | Symbol  | Limits |        |        | Unit | Conditions                  |
|---|---------|--------|--------|--------|------|-----------------------------|
|   |         | MIN    | Typ    | MAX    |      |                             |
| <b>【Bias current】</b>                         |         |        |        |        |      |                             |
| Bias Current (VCC)                            | ICC     | —      | 500    | 850    | μA   | Io1=0mA                     |
| Bias Current (VEE)                            | IEE     | —      | 200    | 300    | μA   | Io2=0mA                     |
| <b>【STB】</b>                                  |         |        |        |        |      |                             |
| STB OFF Voltage                               | STBOFF  | 0      | —      | 0.6    | V    | Io1, 2=0mA                  |
| STB ON Voltage                                | STBON   | 1.6    | —      | 3.5    | V    | Io1, 2=0mA                  |
| STB OFF Bias Current (VEE)                    | IOFF    | 0.7    | 1.6    | 2.5    | mA   | Io1, 2=0mA                  |
| STB ON Input Current                          | Iin     | 10     | 30     | 60     | μA   | VSTB=2V, Io1, 2=0mA         |
| <b>【Discharge block】</b>                      |         |        |        |        |      |                             |
| Discharge Current                             | Idis    | 1.5    | 3.5    | 6.0    | mA   |                             |
| <b>【REG1】</b>                                 |         |        |        |        |      |                             |
| CTL1 Voltage                                  | Vct11   | 1.372  | 1.400  | 1.428  | V    | Io1=10mA                    |
| Dropout Voltage 1                             | ΔVd1    | —      | 0.25   | 0.35   | V    | Vcc=14.2V, Io1=25mA         |
| Peak Output Current 1                         | Io1     | 25     | —      | —      | mA   |                             |
| Load Regulation 1                             | Vload1  | —      | 100    | —      | mV   | Io1=0~25mA                  |
| Short - Circuit Output Current 1              | Ishort1 | —      | 50     | —      | mA   | Vo1=0V                      |
| Ripple Rejection 1                            | R. R. 1 | —      | 50     | —      | dB   | f=120Hz, ein=1Vrms, Io1=2mA |
| Temperature Coefficient of Output Voltage 1 ※ | Tcvo1   | —      | ±0.02  | —      | %/°C | Io1=1mA, Tj=0~125°C         |
| <b>【REG2】</b>                                 |         |        |        |        |      |                             |
| CTL2 Voltage                                  | Vct11   | -1.275 | -1.250 | -1.225 | V    | Io2=10mA                    |
| Dropout Voltage2                              | ΔVd2    | —      | 0.35   | 0.45   | V    | VEE=-7.1V, Io2=50mA         |
| Peak Output Current2                          | Io2     | 50     | —      | —      | mA   |                             |
| Load Regulation2                              | Vload2  | —      | 100    | —      | mV   | Io2=0~50mA                  |
| Short - Circuit Output Current 2              | Ishort2 | —      | 120    | —      | mA   | Vo2=0V                      |
| Ripple Rejection2                             | R. R. 2 | —      | 50     | —      | dB   | f=120Hz, ein=1Vrms, Io2=2mA |
| Temperature Coefficient of Output Voltage 2 ※ | Tcvo2   | —      | ±0.02  | —      | %/°C | Io2=1mA, Tj=0~125°C         |

◎ Discharge time

$$t = (\text{Reg2} \times \text{Co}) / I_{\text{dis}} \text{ [s]}$$

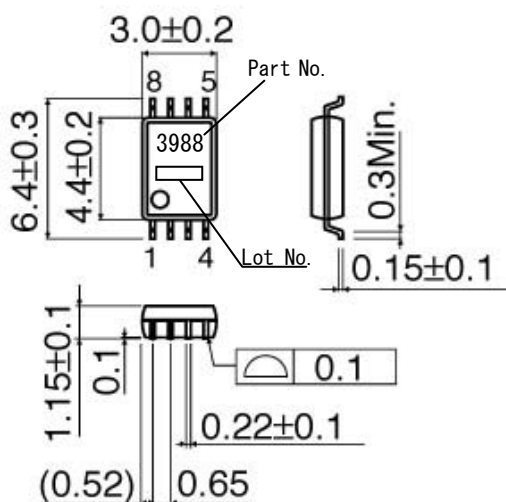
(VEE=-10V)

Co:Reg2 Output capacitor (μF)

※ Design Guarantee (Shipment inspection is not done on all products.)

This product is not designed for protection against radio active rays.

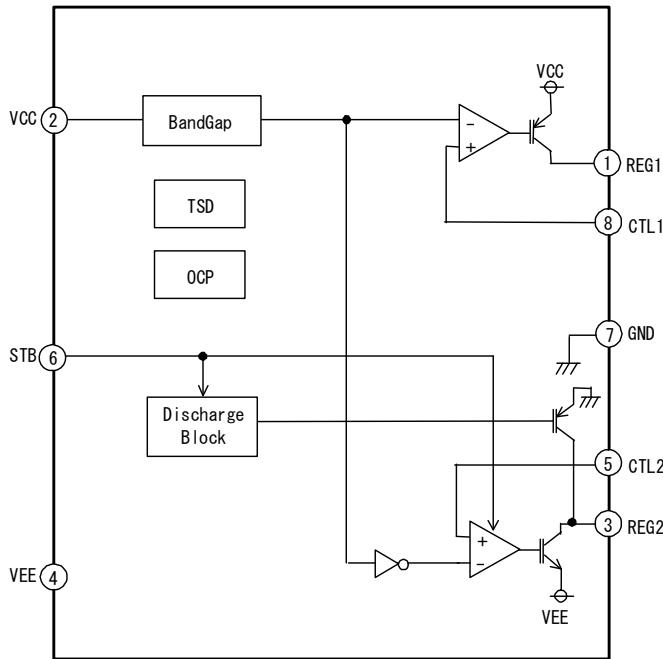
## ○PHYSICAL DIMENSIONS · MARKING



SSOP-B8 (UNIT : mm)

○BLOCK DIAGRAM

○PIN No. ・ PIN NAME



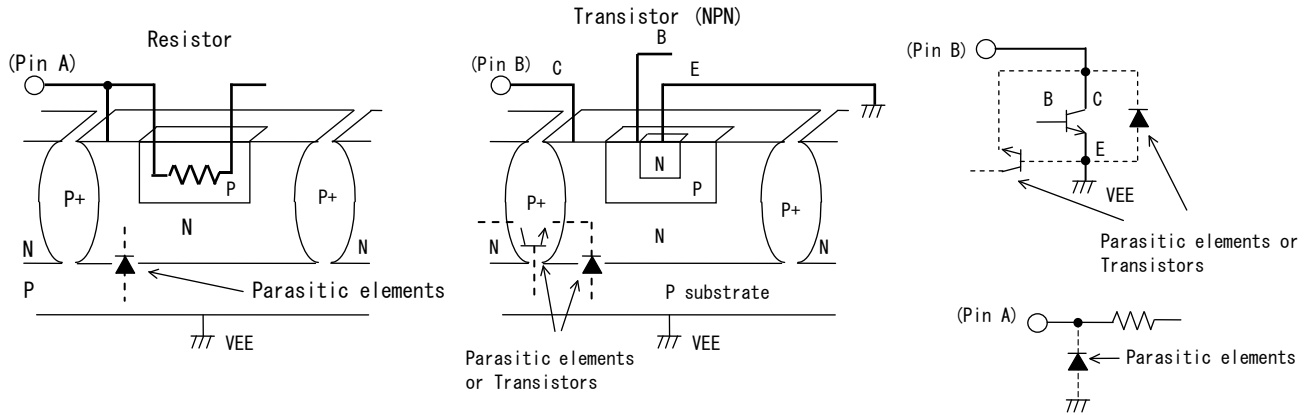
| Pin No. | Pin Name |
|---------|----------|
| 1       | REG1     |
| 2       | VCC      |
| 3       | REG2     |
| 4       | VEE      |
| 5       | CTL2     |
| 6       | STB      |
| 7       | GND      |
| 8       | CTL1     |

※Refer to the Technical Note about the details of the application.

○OPERATING NOTES

- 1) Absolute maximum ratings  
Use of the IC in excess of absolute maximum ratings such as the applied voltage or operating temperature range may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. A physical safety measure such as a fuse should be implemented when use of the IC in a special mode where the absolute maximum ratings may be exceeded is anticipated.
- 2) VEE potential  
Ensure a minimum VEE pin potential in all operating conditions.
- 3) Thermal design  
Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.
- 4) Pin short and mistake mounting  
Use caution when orienting and positioning the IC for mounting on printed circuit boards. Improper mounting may result in damage to the IC. Shorts between output pins and the power supply and GND pins caused by the presence of a foreign object may result in damage to the IC. Ensure a minimum GND pin potential in all operating conditions.
- 5) Actions in strong magnetic field  
Keep in mind that the IC may malfunction in strong magnetic fields.
- 6) Testing on application boards  
When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Always turn the IC's power supply off before connecting it to or removing it from a jig or fixture during the inspection process. Ground the IC during assembly steps as an antistatic measure, and use similar caution when transporting or storing the IC.
- 7) 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 these P layers with the N layers of other elements to create a variety of parasitic elements. For example, when the resistors and transistors are connected to the pins as shown in the following figure,
  - The P/N junction functions as a parasitic diode when  $VEE > \text{Pin A}$  for the resistor or  $VEE > \text{Pin B}$  for the transistor (NPN).
  - Similarly, when  $VEE > \text{Pin B}$  for the transistor (NPN), the parasitic diode described above combines with the N layer of other adjacent elements to operate as a parasitic NPN transistor.

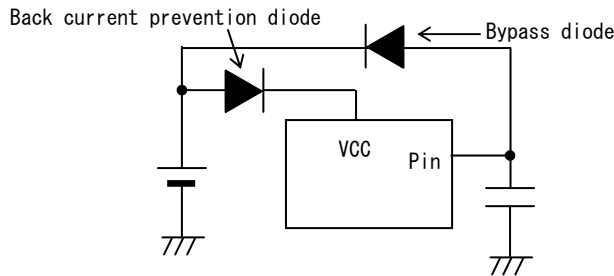
The formation of parasitic elements as a result of the relationships of the potentials of different pins is an inevitable result of the IC's architecture. The operation of parasitic elements can cause interference with circuit operation as well as IC malfunction and damage. For these reasons, it is necessary to use caution so that the IC is not used in a way that will trigger the operation of parasitic elements, such as by the application of voltages lower than the VEE (P substrate) voltage to input pins. Keep in mind that the IC may malfunction in strong magnetic fields.



8) Ground patterns

When using both small signal and large current GND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the application's reference point so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern of any external parts, either.

- 9) Applications or inspection processes where the potentials of the VCC pin and other pins may be reversed from their normal states may cause damage to the IC's internal circuitry or elements. Use an output pin capacitance of 1,000  $\mu$ F or lower in case VCC is shorted with the GND pin while the external capacitor is charged. It is recommended to insert a diode for preventing back current flow in series with VCC or bypass diodes between VCC and each pin.



10) Thermal shutdown circuit (TSD)

This IC incorporates a built-in TSD circuit for the protection from thermal destruction. The IC should be used within the specified power dissipation range. However, in the event that the IC continues to be operated in excess of its power dissipation limits, the attendant rise in the junction temperature ( $T_j$ ) will trigger the TSD circuit to turn off all output power elements. The circuit automatically resets once the junction temperature ( $T_j$ ) drops. Operation of the TSD circuit presumes that the IC's absolute maximum ratings have been exceeded. Application designs should never make use of the TSD circuit.

11) Overcurrent protection circuit (OCP)

The IC incorporates a built-in overcurrent protection circuit that operates according to the output current capacity. This circuit serves to protect the IC from damage when the load is shorted. The protection circuit is designed to limit current flow by not latching in the event of a large and instantaneous current flow originating from a large capacitor or other component. This protection circuits is effective in preventing damage due to sudden and unexpected accidents. However, the IC should not be used in applications characterized by the continuous operation or transitioning of the protection circuits. At the time of thermal designing, keep in mind that the current capacity has negative characteristics to temperatures.

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