

Secondary LDO Regulators for Local Power Supplies

18V Rated Voltage, 1A Secondary LDO Regulators

BA□□BC0, BD00BC0W Series



●Description

The BA□□BC0 are low-saturation regulators with an output current of 1.0 A and an output voltage accuracy of $\pm 2\%$. A broad output voltage range is offered, from 1.5V to 10V, and built-in overcurrent protection and thermal shutdown (TSD) circuits prevent damage due to short-circuiting and overloading, respectively.

●Features

- 1) Output current: 1 A (min.)
- 2) Output voltage accuracy: $\pm 2\%$
Broad output range available: 1.5 V - 10 V (BA□□BC0 series)
- 3) Low saturation-voltage type with PNP output
- 4) Built-in overcurrent protection circuit
- 5) Built-in thermal shutdown circuit
- 6) Integrated shutdown switch (BA□□BC0WT, BA□□BC0WT-5, or BA□□BC0WFP Series, BA00BC0WCP-V5)
- 7) Operating temperature range: -40°C to $+105^{\circ}\text{C}$

●Applications

All electronic devices that use microcontrollers and logic circuits

●Product Lineup

Part Number	1.5	1.8	2.5	3.0	3.3	5.0	6.0	7.0	8.0	9.0	10.0	Variable	Package
BA□□BC0WT	○	○	○	○	○	○	○	○	○	○	○	○	TO220FP-5
BA□□BC0WT-V5	○	○	○	—	○	○	—	—	—	○	—	○	TO220FP-5 (V5)
BA□□BC0WFP	○	○	○	○	○	○	○	○	○	○	○	○	TO252-5
BA□□BC0T	○	○	○	○	○	○	○	○	○	○	○	—	TO220FP-3
BA□□BC0FP	○	○	○	○	○	○	○	○	○	○	○	—	TO252-3
BA00BC0WCP-V5	—	—	—	—	—	—	—	—	—	—	—	○	TO220CP-V5

Part Number: BA□□BC0□ □
a b c

Symbol	Description			
a	Output voltage specification			
	□□	Output voltage (V)	□□	Output voltage (V)
	15	1.5 V typ	60	6.0 V typ
	18	1.8 V typ	70	7.0 V typ
	25	2.5 V typ	80	8.0 V typ
	30	3.0 V typ	90	9.0 V typ
	33	3.3 V typ	J0	10.0 V typ
	50	5.0 V typ	00	Variable
b	Existence of switch With W: A shutdown switch is provided. Without W: No shutdown switch is provided.			
c	Package T: TO20FP-5, TO220FP-5·V5, TO220FP-3 FP: TO252-5, TO252-3 CP: TO220CP-V5			

●Absolute Maximum Ratings (Ta = 25°C)

Parameter		Symbol	Limits	Unit
Power supply voltage		V _{CC}	18 ^{*1}	V
Power dissipation	TO252-3	P _d	1200 ^{*2}	mW
	TO252-5		1300 ^{*3}	
	TO220FP-3		2000 ^{*4}	
	TO220FP-5		2000 ^{*4}	
	TO220FP-5 (V5)		2000 ^{*4}	
	TO220CP-V5		2000 ^{*4}	
Operating temperature range		T _{opr}	−40 to +105	°C
Ambient storage temperature		T _{stg}	−55 to +150	°C
Maximum junction temperature		T _{jmax}	150	°C

*1 Must not exceed P_d.

*2 Derated at 9.6mW/°C at Ta>25°C when mounted on a glass epoxy board (70 mm × 70 mm × 1.6 mm).

*3 Derated at 10.4mW/°C at Ta>25°C when mounted on a glass epoxy board (70 mm × 70 mm × 1.6 mm).

*4 Derated at 16mW/°C at Ta> 25°C

●Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit
Input power supply voltage	V _{CC} ^{*5}	3.0	16.0	V
Input power supply voltage	V _{CC} ^{*6}	V _o +1.0	16.0	V
Output current	I _o	—	1	A
Variable output voltage setting value	V _o	1.5	12	V

*5 When output voltage is 1.5 V, 1.8 V, or 2.5 V.

*6 When output voltage is 3.0 V or higher.

●Electrical Characteristics

BA□□BC0FP/T/WFP/WT (−V5)

(Unless otherwise specified, Ta = 25°C; V_{CTL} = 3 V; V_{CCDC}^{*7})

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Output voltage	V _o	V _o (T) × 0.98	V _o (T)	V _o (T) × 1.02	V	I _o = 200mA
Shutdown circuit current	I _{sd}	—	0	10	μA	V _{CTL} = 0 V while in off mode
Minimum I/O voltage difference ^{*8}	ΔV _d	—	0.3	0.5	V	I _o = 200 mA, V _{CC} = 0.95 × V _o
Output current capacity	I _o	1	—	—	A	
Input stability ^{*9}	Reg.I	—	15	35	mV	V _{CC} = V _o +1.0V→16V, I _o = 200mA
Load stability	Reg.L	—	35	75	mV	I _o = 0 mA → 1 A
Temperature coefficient of output voltage ^{*10}	T _{cvo}	—	±0.02	—	%/°C	I _o = 5 mA, T _j = 0°C to 125°C

V_o (T): Set output voltage

*7 V_o = 1.5 V, 1.8 V, 2.5 V : V_{CC} = 3.3 V, V_o = 3.0 V, 3.3 V : V_{CC} = 5 V,
V_o = 5.0 V : V_{CC} = 8 V, V_o = 6.0 V : V_{CC} = 9 V, V_o = 8.0 V : V_{CC} = 11 V,
V_o = 9.0 V : V_{CC} = 12 V, V_o = 10.0 V : V_{CC} = 13 V

*8 V_o ≥ 3.3 V

*9 Change V_{CC} from 3.0 V to 6 V if 1.5 V ≤ V_o ≤ 2.5 V.

*10 Operation guaranteed

BA00BC0WFP/WT (−V5)/CP-V5

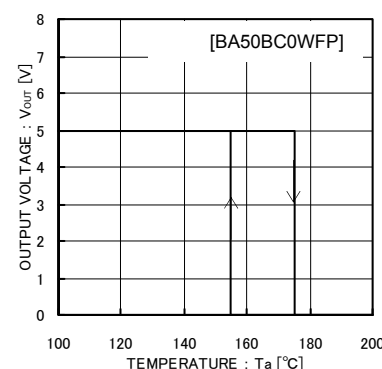
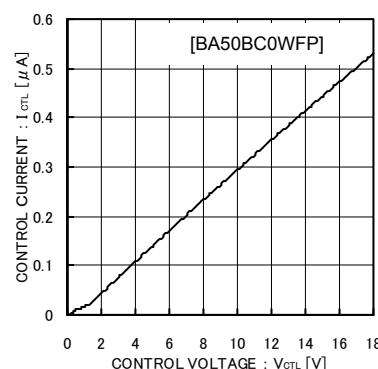
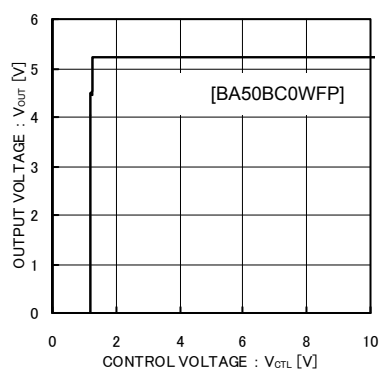
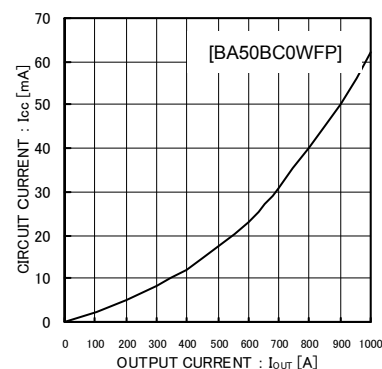
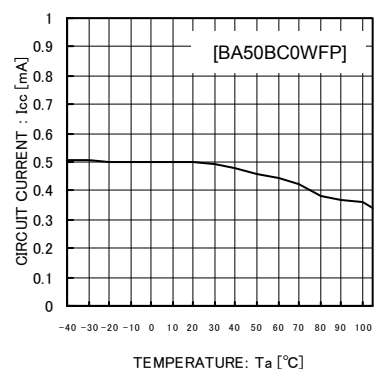
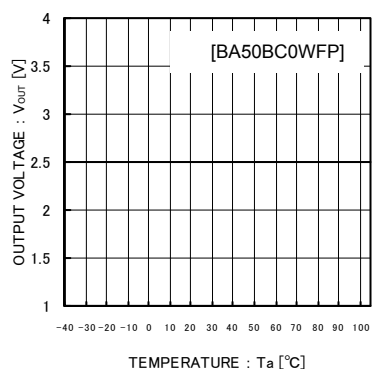
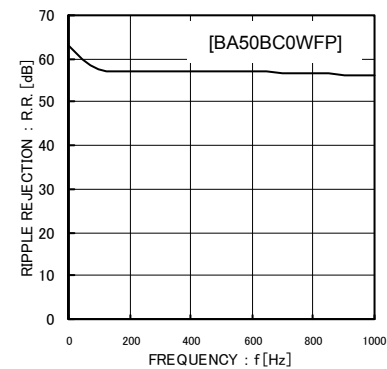
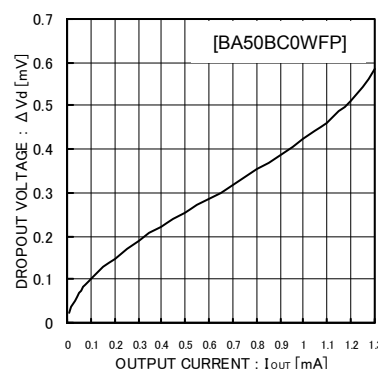
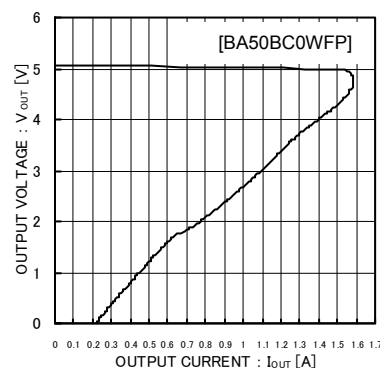
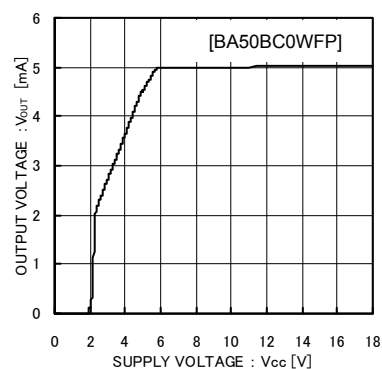
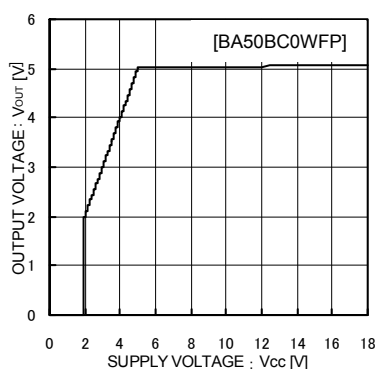
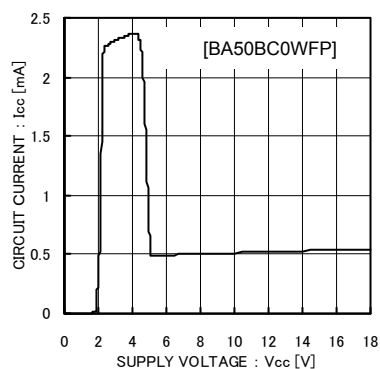
(Unless otherwise specified, Ta = 25°C, V_{CC} = 3.3 V, V_{CTL} = 3 V, R1 = 30 kΩ, R2 = 30 kΩ^{*11})

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Shutdown circuit current	I _{sd}	—	0	10	μA	V _{CTL} = 0 V while in OFF mode
Reference voltage	V _c	1.225	1.250	1.275	V	I _o = 50 mA
Minimum I/O voltage difference	ΔV _d	—	0.3	0.5	V	I _o = 500 mA, V _{CC} = 2.5V
Output current capacity	I _o	1	—	—	A	
Input stability	Reg.I	—	15	30	mV	V _{CC} = V _o + 1.0 V → 16V, I _o = 200 mA
Load stability	Reg.L	—	35	75	mV	I _o = 0 mA → 1A
Temperature coefficient of output voltage ^{*12}	T _{cvo}	—	±0.02	—	%/°C	I _o = 5mA, T _j =0°C to 125°C

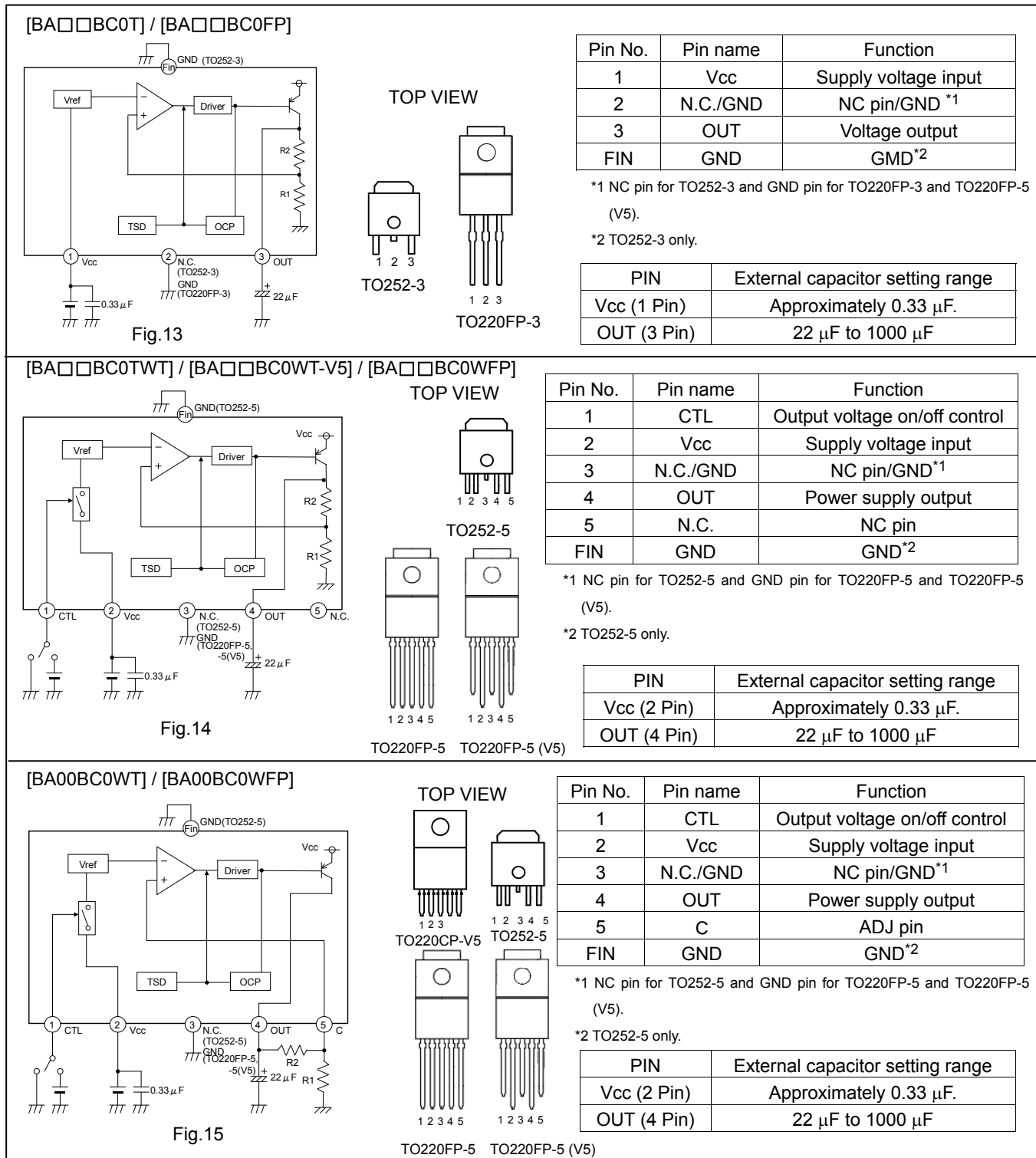
*11 V_{OUT} = V_c × (R1 + R2) / R1 (V)

*12 Operation guaranteed

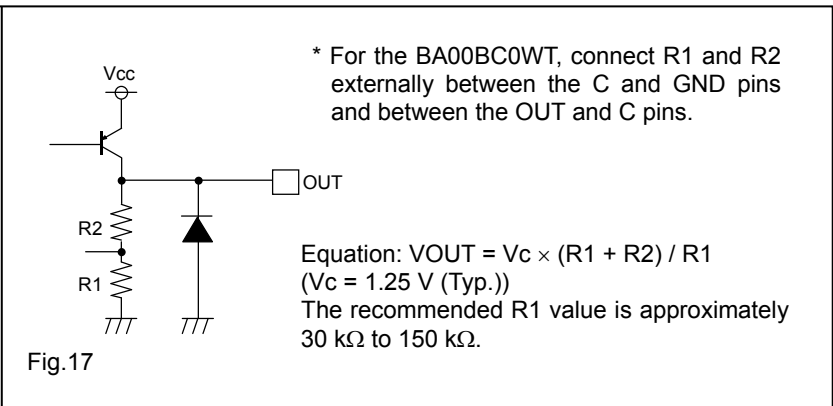
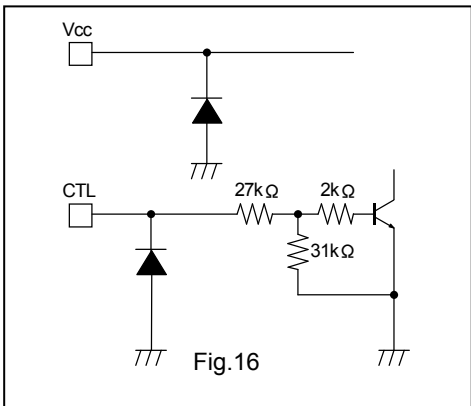
●Electrical Characteristics Curves (Unless otherwise specified, $T_a = 25^\circ\text{C}$, $V_{cc} = 8\text{ V}$, $V_{CTL} = 2\text{ V}$, $I_o = 0\text{ mA}$)



● Block Diagrams / Standard Example Application Circuits



● Input / Output Equivalent Circuit Diagrams



● Thermal Derating Curves

● TO220FP-3/TO220FP-5/TO220FP-5-V5)

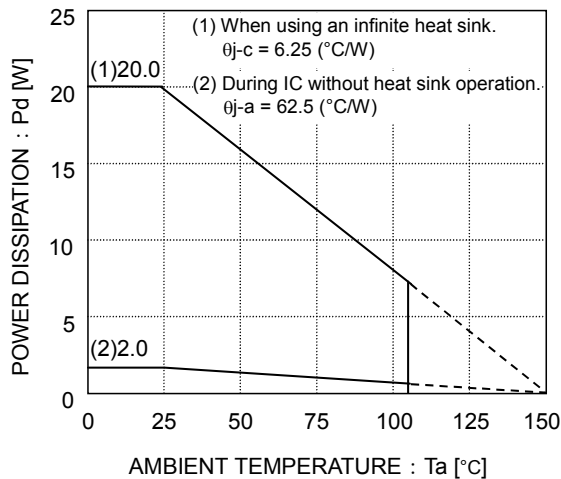


Fig.18

The characteristics of the IC are greatly influenced by the operating temperature. If the temperature exceeds the maximum junction temperature T_{jmax} , deterioration or damage may occur. Implement proper thermal designs to ensure that power dissipation is within the permissible range in order to prevent instantaneous damage resulting from heat and maintain the reliability of the IC for long-term operation.

The following method is used to calculate the power consumption P_c (W).

$$P_c = (V_{cc} - V_o) \times I_o + V_{cc} \times I_{cca}$$

$$\text{Power dissipation } P_d \geq P_c$$

The load current I_o is calculated:

$$I_o \leq \frac{P_d - V_{cc} \times I_{cca}}{V_{cc} - V_o}$$

Calculation Example:

$V_{cc} = 6.0$ V and $V_o = 5.0$ V at $T_a = 85^\circ\text{C}$

$$\frac{0.676 - 6.0 \times I_{cca}}{6.0 - 5.0}$$

$$I_o \leq 550 \text{ mA } (I_{cca} \approx 20 \text{ mA})$$

Refer to the above and implement proper thermal designs so that the IC will not be used under excessive power dissipation conditions under the entire operating temperature range.

The power consumption P_c of the IC in the event of shorting (i.e. the V_o and GND pins are shorted) can be obtained from the following equation:

$$P_c = V_{cc} \times (I_{cca} + I_{short}) \quad (I_{short}: \text{short current}).$$

● TO252-3/TO252-5

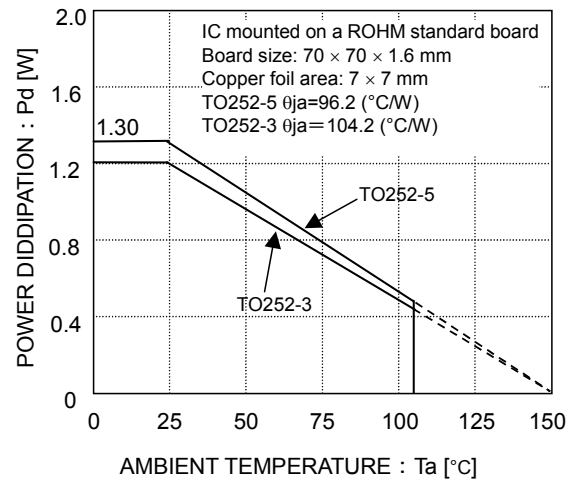


Fig.19

V_{cc} : Input voltage
 V_o : Output current
 I_o : Load current
 I_{cca} : Circuit current

$$\left(\begin{array}{l} \theta_{ja} = 96.2^\circ\text{C/W} \rightarrow -10.4 \text{ mW}/^\circ\text{C} \\ 25^\circ\text{C} = 1300 \text{ mW} \rightarrow 85^\circ\text{C} = 676 \text{ mW} \end{array} \right)$$

● Operation Notes

● Vcc pin

Insert a capacitor (0.33 μF approx.) between VCC and GND.

The capacitance will vary depending on the application. Use a suitable capacitance and implement designs with sufficient margins.

● GND pin

Verify that there is no potential difference between the ground of the application board and the IC.

If there is a potential difference, the set voltage will not be output accurately, resulting in unstable IC operation.

Therefore, lower the impedance by designing the ground pattern as wide and as short as possible.

● CTL pin

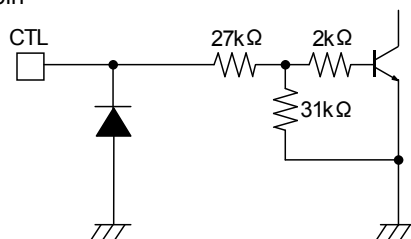


Fig.20 Input Equivalent Circuit

The CTL pin turns on at an operating power supply voltage of 2.0 V or higher and turns off at 0.8 V or lower. There is no particular order when turning the power supply and CTL pins on or off.

●Vo pin

Insert a capacitor between the Vo and GND pins in order to prevent output oscillation.

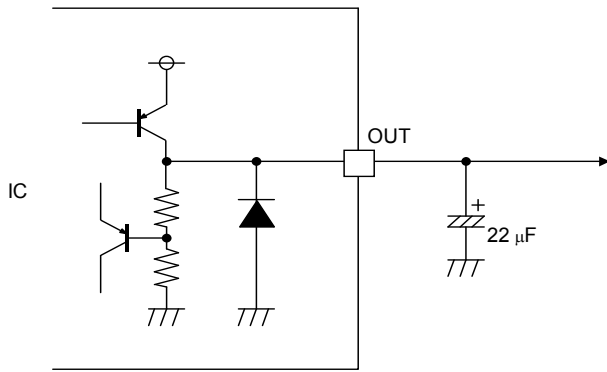


Fig.21 Output Equivalent Circuit

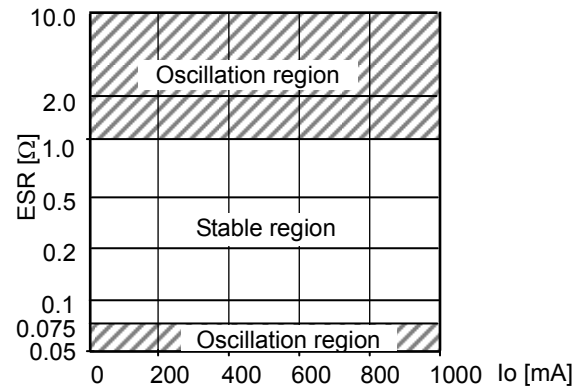


Fig.22 ESR vs IO(22 μ F)

The capacitance may vary greatly with temperature changes, thus making it impossible to completely prevent oscillation. Therefore, use a tantalum aluminum electrolytic capacitor with a low ESR (Equivalent Serial Resistance). The output will oscillate if the ESR is too high or too low, so refer to the ESR characteristics in Fig. 20 and operate the IC within the stable region. Use a capacitor within a capacitance between 22 μ F and 1,000 μ F.

Below figure, it is ESR-to-IO stability Area characteristics, measured by 22 μ F-ceramic-capacitor and resistor connected in series.

This characteristics is not equal value perfectly to 22 μ F-aluminum electrolytic capacitor in order to measurement method. Note, however, that the stable range suggested in the figure depends on the IC and the resistance load involved, and can vary with the board's wiring impedance, input impedance, and/or load impedance. Therefore, be certain to ascertain the final status of these items for actual use.

Keep capacitor capacitance within a range of 22 μ F~1000 μ F. It is also recommended that a 0.33 μ F bypass capacitor be connected as close to the input pin-GND as location possible. However, in situations such as rapid fluctuation of the input voltage or the load, please check the operation in real application to determine proper capacitance.

●Precautions

1. Absolute maximum ratings

An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.

2. GND voltage

The potential of GND pin must be minimum 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. Inter-pin shorts and mounting errors

Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if pins are shorted together.

5. Actions in strong electromagnetic field

Use caution when using the IC in the presence of a strong electromagnetic field as doing so may cause the IC to malfunction.

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. Use similar precaution when transporting or storing the IC.

7. Regarding 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 these P layers with the N layers of other elements, creating a parasitic diode or transistor. For example, the relation between each potential is as follows:

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 can occur inevitable in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Accordingly, methods by which parasitic diodes operate, such as applying a voltage that is lower than the GND (P substrate) voltage to an input pin, should not be used.

8. Ground Wiring Pattern

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 ground potential of application 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 components, either.

9. Thermal shutdown circuit

The IC incorporates a built-in thermal shutdown circuit (TSD circuit). The thermal shutdown circuit (TSD circuit) is designed only to shut the IC off to prevent thermal runaway. It is not designed to protect the IC or guarantee its operation. Do not continue to use the IC after operating this circuit or use the IC in an environment where the operation of this circuit is assumed.

10. Overcurrent Protection Circuit

An overcurrent protection circuit is incorporated in order to prevention destruction due to short-time overload currents. Continued use of the protection circuits should be avoided. Please note that the current increases negatively impact the temperature.

11. Damage to the internal circuit or element may occur when the polarity of the Vcc pin is opposite to that of the other pins in applications. (I.e. Vcc is shorted with the GND pin while an external capacitor is charged.) Use a maximum capacitance of 1000μF for the output pins. Inserting a diode to prevent back-current flow in series with Vcc or bypass diodes between Vcc and each pin is recommended.

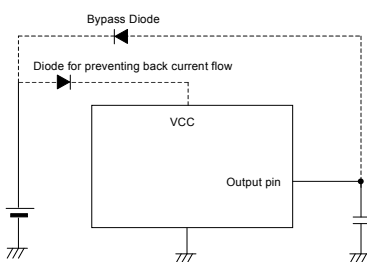


Fig.23 Bypass Diode

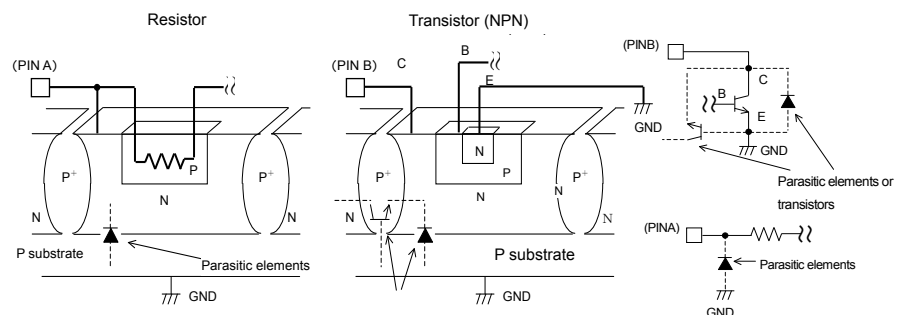


Fig.24 Example of Simple Bipolar IC Architecture

●Part Number Explanation

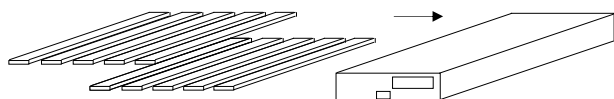
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ROHM Part Number		Output voltage 00: Variable Others: Fixed		Current Capacity BC0: 1.0 A			Shutdown switch W: A switch is provided. No: No switch is provided.	Package FP: TO252-3, 5 T: TO220FP-3, 5 CP : TO220CP-V5		Packaging specifications E2: Emboss taping (TO252-3,5, TO220CP-V5) No: Tube container V5: Foaming (V5) only		

<p>TO220FP-3</p> <p>(Unit:mm)</p>	<p>TO220FP-5</p> <p>(Unit:mm)</p>	<p>TO220FP-5(V5)</p> <p>(Unit:mm)</p>
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<p>TO252-3</p> <p>(Unit:mm)</p>	<p>TO252-5</p> <p>(Unit:mm)</p>	<p>TO220CP-V5</p> <p>(Unit:mm)</p>
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<Package Specification>

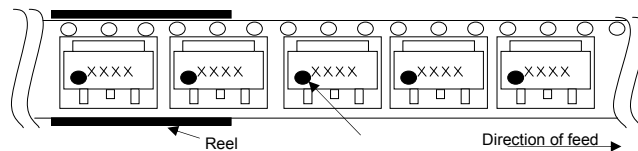
Package Form	Container tube
Package Quantity	500pcs
Package Orientation	Direction of products is fixed in a container tube.



*Orders are available in complete units only.

<Tape and Reel information >

Tape	Embossed taping
Quantity	2000pcs
Direction of feed	E2 (When the reek is held with the left hand and the tape is drawn out with the right hand, the No.1 pin of the product faces the lower left direction.)



*Orders are available in complete units only.

- The contents described herein are correct as of September, 2008
- The contents described herein are subject to change without notice. For updates of the latest information, please contact and confirm with ROHM CO.,LTD.
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- The products described herein utilize silicon as the main material.
- The products described herein are not designed to be X ray proof.

The products listed in this catalog are designed to be used with ordinary electronic equipment or devices (such as audio visual equipment, office-automation equipment, communications devices, electrical appliances and electronic toys). Should you intend to use these products with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers and other safety devices), please be sure to consult with our sales representative in advance.

Contact us for further information about the products.

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ROHM CO., LTD.

21 Saiin Mizosaki-cho, Ukyo-ku, Kyoto
615-8585, Japan
TEL: +81-75-311-2121 FAX: +81-75-315-0172
URL <http://www.rohm.com>

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San Diego	TEL: +1-858-625-3630	FAX: +1-858-625-3670	Tianjin	TEL: +86-22-23029181	FAX: +86-22-23029183
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United Kingdom	TEL: +44-1-908-306700	FAX: +44-1-908-235788	Xiamen	TEL: +86-592-238-5705	FAX: +86-592-239-8380
Denmark	TEL: +45-3694-4739	FAX: +45-3694-4789	Zhuhai	TEL: +86-756-3232-480	FAX: +86-756-3232-460
Espoo	TEL: +358-9725-54491	FAX: +358-9-7255-4499	Hong Kong	TEL: +852-2-740-6262	FAX: +852-2-375-8971
Salo	TEL: +358-2-7332234	FAX: +358-2-7332237	Taipei	TEL: +886-2-2500-6956	FAX: +886-2-2503-2869
Oulu	TEL: +358-8-5372930	FAX: +358-8-5372931	Kaohsiung	TEL: +886-7-237-0881	FAX: +886-7-238-7332
Barcelona	TEL: +34-9375-24320	FAX: +34-9375-24410	Singapore	TEL: +65-6332-2322	FAX: +65-6332-5662
Hungary	TEL: +36-1-4719338	FAX: +36-1-4719339	Philippines	TEL: +63-2-807-6872	FAX: +63-2-809-1422
Poland	TEL: +48-22-5757213	FAX: +48-22-5757001	Thailand	TEL: +66-2-254-4890	FAX: +66-2-256-6334
Russia	TEL: +7-495-739-41-74	FAX: +7-495-739-41-74	Kuala Lumpur	TEL: +60-3-7958-8355	FAX: +60-3-7958-8377
Seoul	TEL: +82-2-8182-700	FAX: +82-2-8182-715	Penang	TEL: +60-4-2286453	FAX: +60-4-2286452
Masan	TEL: +82-55-240-6234	FAX: +82-55-240-6236	Kyoto	TEL: +81-75-365-1218	FAX: +81-75-365-1228
Dalian	TEL: +86-411-8230-8549	FAX: +86-411-8230-8537	Yokohama	TEL: +81-45-476-2290	FAX: +81-45-476-2295
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www.rohm.com

Contact us : webmaster@rohm.co.jp