Secondary LDO Regulators for Local Power Sources

Fixed/Fixed Dual-output Secondary LDO Regulator

BA3258HFP, BA33D□□ Series

●Description

The BA3258HFP and BA33D□□ are fixed 2-output low-saturation regulators with a voltage accuracy at both outputs of ±2%. These series incorporate both overcurrent protection and thermal shutdown (TSD) circuits in order to prevent damage due to output short-circuiting and overloading, respectively.

●Features

1) Output voltage accuracy: ±2%.
2) Output current capacity: 1A (BA3258HFP), 0.5A (BA33D□□ Series)
3) A ceramic capacitor can be used to prevent output oscillation (BA3258HFP).
4) High Ripple Rejection (BA33D□□ Series)
5) Built-in thermal shutdown circuit
6) Built-in overcurrent protection circuit

●Applications

FPDs, TVs, PCs, DSPs in DVDs and CDs

●Product Lineup

Part Number	Output voltage Vo1	Output voltage Vo2	Current capability Io1	Current capability Io2	Package
BA3258HFP	3.3 V	1.5 V	1 A	1 A	HRP-5
BA33D15HFP	3.3 V	1.5 V	0.5 A	0.5 A	HRP-5
BA33D18HFP	3.3 V	1.8 V	0.5 A	0.5 A	HRP-5

●Absolute Maximum Ratings

BA3258HFP

Parameter	Symbol	Limits	Units
Applied voltage	V_{CC}	15*1	V
Power dissipation	Pd	2300*2	mW
Operating temperature range	T_{opr}	−30 to 85	°C
Ambient storage temperature	T_{stg}	−55 to 150	°C
Maximum junction temperature	T_{jmax}	150	°C

BA33D□□ Series

Parameter	Symbol	Limits	Units
Applied voltage	V_{CC}	18*1	V
Power dissipation	Pd	2300*2	mW
Operating temperature range	T_{opr}	−25 to 105	°C
Ambient storage temperature	T_{stg}	−55 to 150	°C
Maximum junction temperature	T_{jmax}	150	°C

*1 Must not exceed Pd
*2. Derated at 18.4 mW/°C at Ta>25°C when mounted on a glass epoxy board (70 mm × 70 mm × 1.6 mm)

Oct.2007

●Recommended Operating Conditions

BA3258HFP

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input power supply voltage	Vcc	4.75	—	14.0	V
3.3 V output current	Io1	—	—	1	A
1.5 V output current	Io2	—	—	1	A

BA33D□□Series

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input power supply voltage	Vcc	4.1	—	16.0	V
3.3 V output current	Io1	—	—	0.5	A
1.5 V output current	Io2	—	—	0.5	A
1.8 V output current	Io2	—	—	0.5	A

●Electrical Characteristics

BA3258HFP (Unless otherwise specified, Ta = 25°C, Vcc = 5 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Bias current	IB	—	3	5	mA	Io1 = 0 mA, Io2 = 0 mA
[3.3 V Output Block]						
Output voltage1	Vo1	3.234	3.300	3.366	V	Io1 = 50 mA
Minimum output voltage difference 1	ΔVd1	—	1.1	1.3	V	Io1 = 1 A, Vcc = 3.8 V
Output current capacity 1	Io1	1.0	—	—	A	
Ripple rejection 1	R.R.1	46	52	—	dB	f = 120 Hz, ein = 0.5 Vp-p, Io1 = 5 mA
Input stability 1	Reg.I1	—	5	15	mV	Vcc = 4.75 → 14 V, Io1 = 5 mA
Load stability 1	Reg.L1	—	5	20	mV	Io1 = 5 mA → 1 A
Temperature coefficient of output voltage 1[*3]	Tcvo1	—	±0.01	—	%/°C	Io1 = 5 mA, Tj = 0°C to 85°C
[1.5 V Output Block]						
Output voltage 2	Vo2	1.470	1.500	1.530	V	Io2 = 50 mA
Output current capacity 2	Io2	1.0	—	—	A	
Ripple rejection 2	R.R.2	46	52	—	dB	f = 120 Hz, ein = 0.5 Vp-p, Io2 = 5 mA
Input stability 2	Reg.I2	—	5	15	mV	Vcc = 4.1 → 14 V, Io2 = 5 mA
Load stability 2	Reg.L2	—	5	20	mV	Io2 = 5 mA → 1 A
Temperature coefficient of output voltage 2[*3]	Tcvo2	—	±0.01	—	%/°C	Io2 = 5 mA, Tj = 0°C to 125°C

*3: Design is guaranteed within these parameters. (No total shipment inspection is made.)

BA33D□□ Series (Unless otherwise specified, Ta = 25°C, Vcc = 5 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Bias current	Ib	—	0.7	1.6	mA	Io1 = 0 mA, Io2 = 0 mA
[3.3 V Output Block]						
Output voltage 1	Vo1	3.234	3.300	3.366	V	Io1 = 250 mA
Minimum output voltage difference 1	ΔVd1	–	0.25	0.50	V	Io1 = 250 mA, Vcc = 3.135 V
Output current capacity 1	Io1	0.5	—	—	A	
Ripple rejection 1	R.R.1	—	68	—	dB	f = 120 Hz, ein = 1 Vp-p, Io1 = 100 mA
Input stability 1	Reg.I1	—	5	30	mV	Vcc = 4.1 V →16 V, Io1 = 250 mA
Load stability 1	Reg.L1	—	30	75	mV	Io1= 0 mA → 0.5 A
Temperature coefficient of output voltage 1[*3]	Tcvo1	—	±0.01	—	%/°C	Io1 = 5 mA, Tj = 0℃ to 125℃

BA33D15HFP Vo2 output

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
[1.5 V Output Block]						
Output voltage 2	Vo2	1.470	1.500	1.530	V	Io2 = 250 mA
Output current capacity 2	Io2	0.5	—	—	A	
Ripple rejection 2	R.R.2	—	74	—	dB	f = 120 Hz, ein = 1 Vp-p, Io2 = 100 mA
Input stability 2	Reg.I2	—	5	30	mV	Vcc = 4.1 V → 16 V, Io2 = 250 mA
Load stability 2	Reg.L2	—	30	75	mV	Io2 = 0 mA → 0.5 A
Temperature coefficient of output voltage 2[*3]	Tcvo2	—	±0.01	—	%/℃	Io2 = 5 mA, Tj = 0℃ to 125℃

BA33D18HFP Vo2 output

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
[1.8 V Output Block]						
Output voltage 2	Vo2	1.764	1.800	1.836	V	Io2 = 250 mA
Output current capacity 2	Io2	0.5	—	—	A	
Ripple rejection 2	R.R.2	—	72	—	dB	f = 120 Hz, ein = 1 Vp-p, Io2 = 100 mA
Input stability 2	Reg.I2	—	5	30	mV	Vcc = 4.1 V → 16 V, Io2 = 250 mA
Load stability 2	Reg.L2	—	30	75	mV	Io2 = 0 mA → 0.5 A
Temperature coefficient of output voltage 2[*3]	Tcvo2	—	±0.01	—	%/℃	Io2 = 5 mA, Tj = 0℃ to 125℃

*3: Design is guaranteed within these parameters. (No total shipment inspection is made.)

●BA3258HFP Electrical Characteristics Curves (Unless otherwise specified, Ta = 25°C, Vcc = 5V)

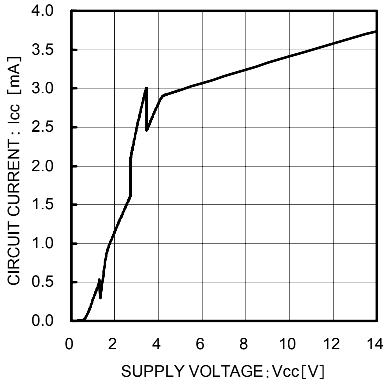


Fig.1 Circuit Current (with no load)

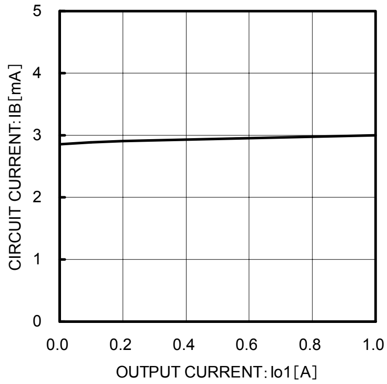


Fig. 2 Circuit Current vs Load Current Io2 (Io1 = 0 →1 A)

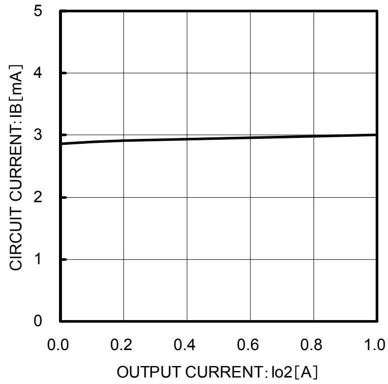


Fig. 3 Circuit Current vs Load Current Io2 (Io2 = 0 → 1 A)

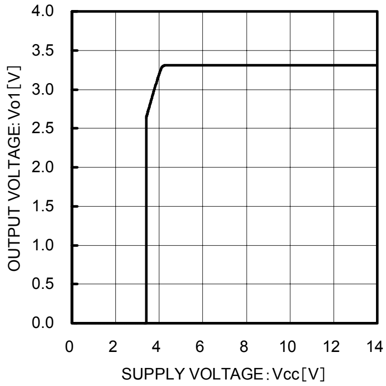


Fig. 4 Input Stability (3.3 V output with no load)

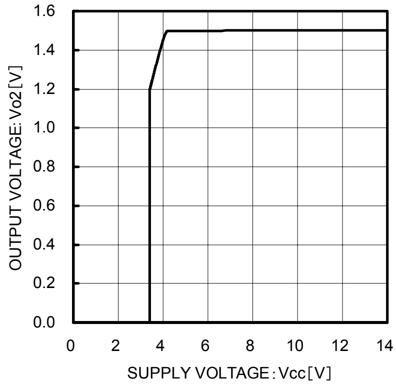


Fig. 5 Input Stability (1.5 V output with no load)

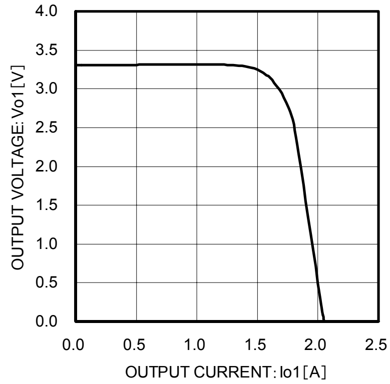


Fig. 6 Load Stability (3.3 V output)

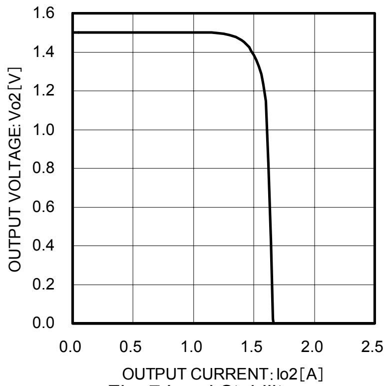


Fig. 7 Load Stability

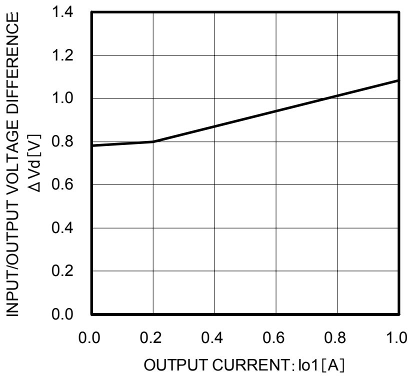


Fig. 8 I/O Voltage Difference (3.3 V output) (Vcc = 3.8 V, Io1 = 0 → 1 A)

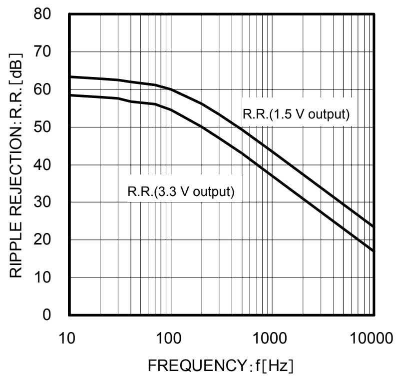


Fig. 9 R.R. Characteristics (ein = 0.5 Vp-p, Io = 5 mA)

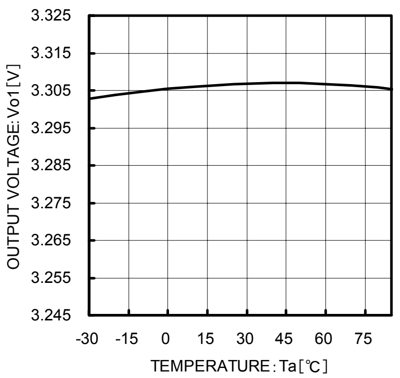


Fig. 10 Output Voltage vs Temperature (3.3 V output)

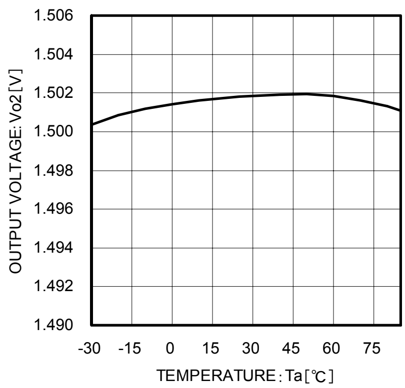


Fig. 11 Output Voltage vs Temperature (1.5 V output)

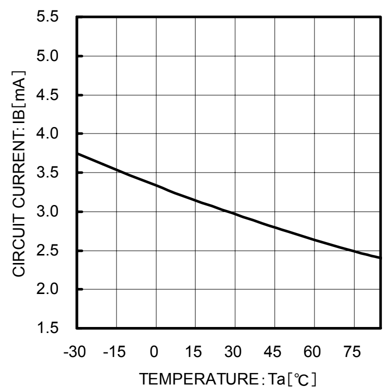


Fig. 12 Circuit Current vs Temperature (Io = 0 mA)

●BA33D15HFP Electrical Characteristics Curves (Unless otherwise specified, Ta = 25°C, Vcc = 5V)

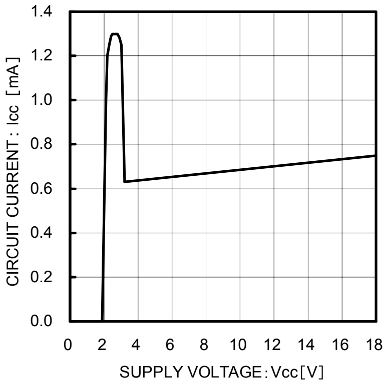


Fig. 13 Circuit Current (with no load)

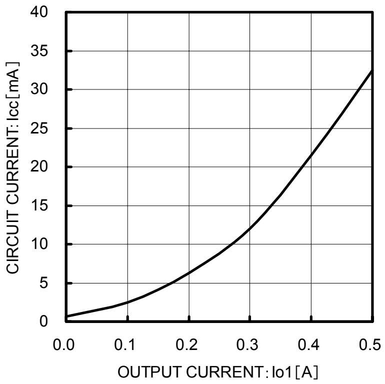


Fig. 14 Circuit Current vs Load Current Io1 (Io1 = 0 → 500 mA)

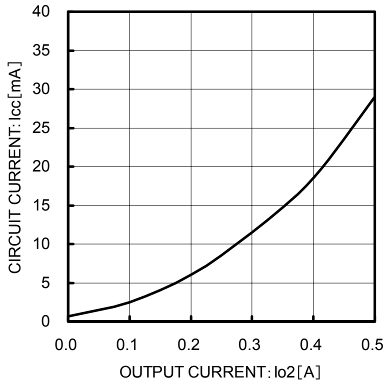


Fig. 15 Circuit Current vs Load Current Io2 (Io2 = 0 → 500 mA)

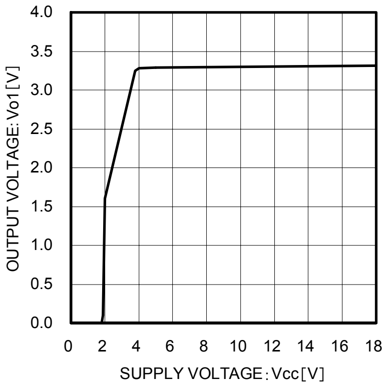


Fig. 16 Input Stability (3.3 V output, Io1 = 250 mA)

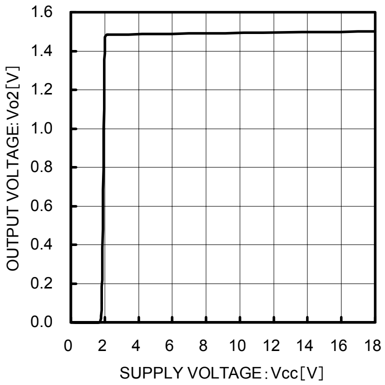


Fig. 17 Input Stability (1.5 V output, Io2 = 250 mA)

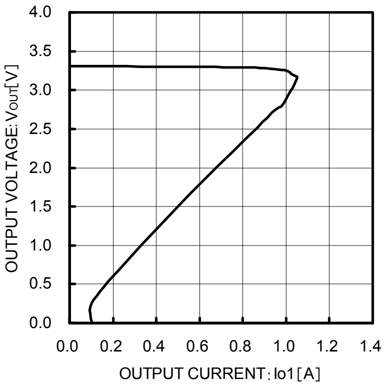


Fig. 18 Load Stability (3.3 V output)

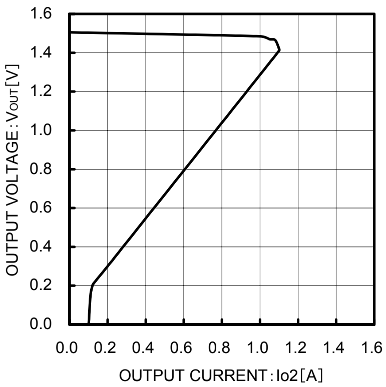


Fig. 19 Load Stability (1.5 V output)

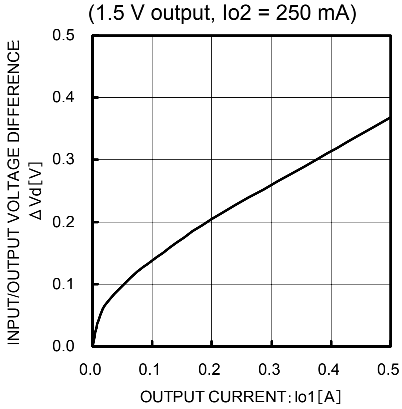


Fig. 20 I/O Voltage Difference (Vcc = 3.135 V, 3.3 V output)

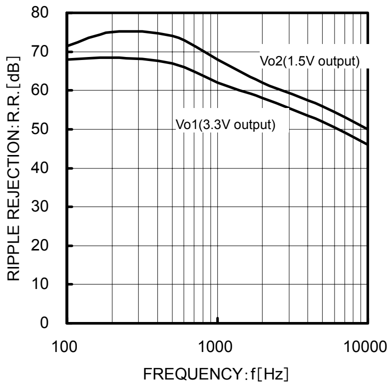


Fig. 21 R.R. Characteristics (ein = 1 Vp-p, Io = 100 mA)

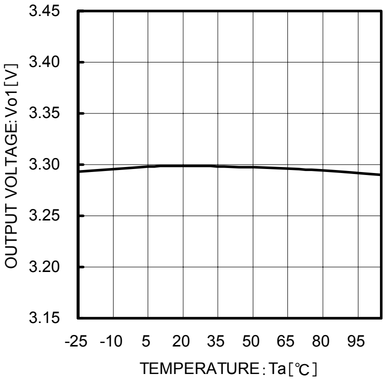


Fig. 22 Output Voltage vs Temperature (3.3 V output)

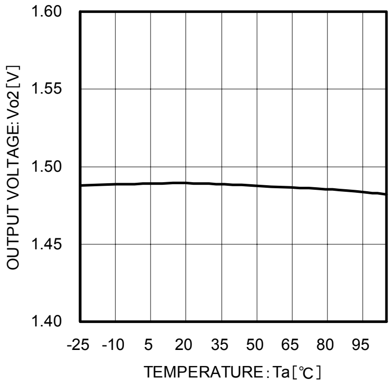


Fig. 23 Output Voltage vs Temperature (1.5 V output)

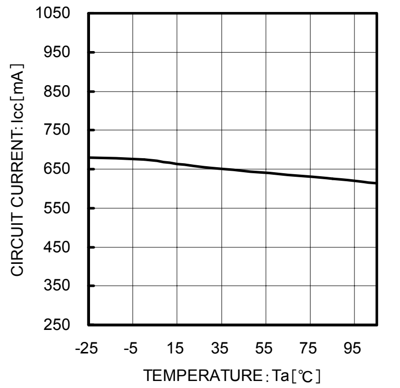


Fig. 24 Circuit Current vs Temperature (Io = 0 mA)

●Block Diagrams / Standard Example Application Circuits

BA3258HFP

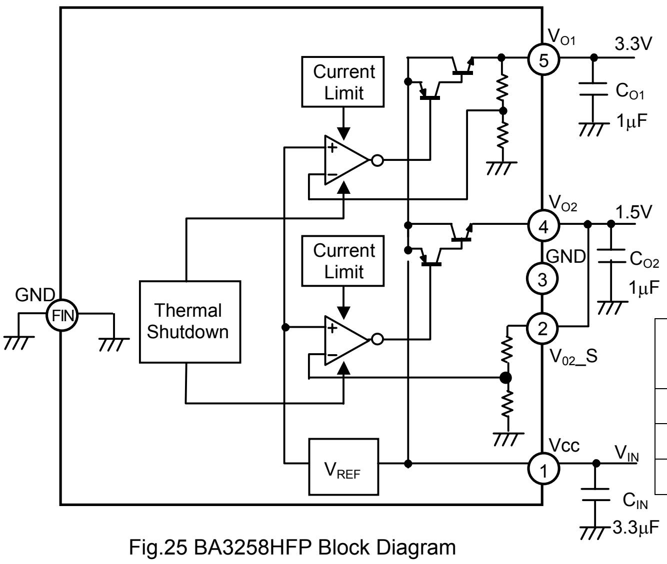
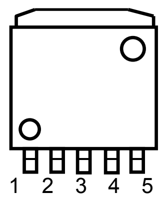


Fig.25 BA3258HFP Block Diagram

Pin No.	Pin name	Function
1	Vcc	Power supply pin
2	V02_S	Output voltage monitor pin
3	GND	GND pin
4	Vo2	1.5 V output pin
5	Vo1	3.3 V output pin
FIN	GND	GND pin

PIN	External capacitor setting range
Vcc (1 Pin)	Approximately 3.3 μF
Vo1 (5 Pin)	1 μF to 1000 μF
Vo2 (4 Pin)	1 μF to 1000 μF

TOP VIEW



HRP5

BA33D□□ Series

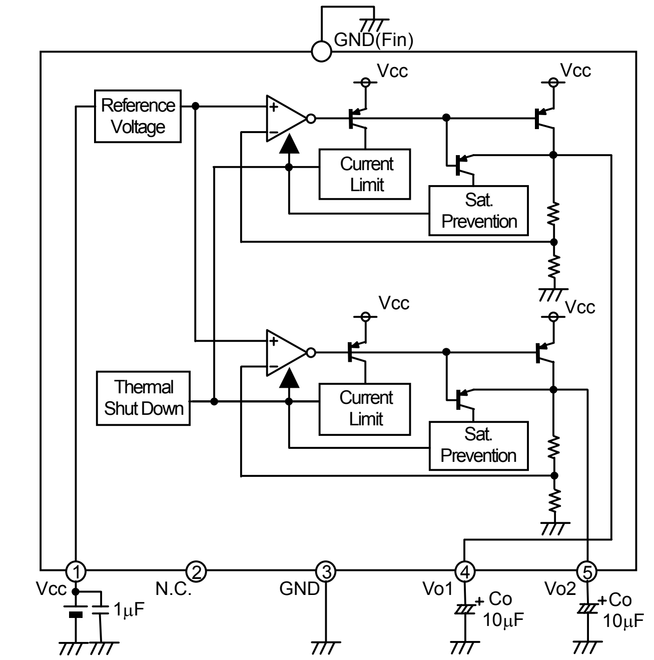


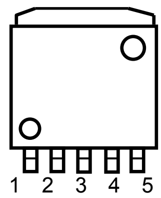
Fig.26 BA33D□□ Series Block Diagram

Pin No.	Pin name	Function
1	Vcc	Power supply pin
2	N.C.	N.C. pin
3	GND	GND pin
4	Vo1	3.3 V output pin
5	Vo2	1.5 V/1.8 V output pin
FIN	GND	GND pin

*The N.C. pin is not electrically connected internally

TOP VIEW

PIN	External capacitor setting range
Vcc (1 Pin)	Approximately 3.3 μF
Vo1 (4 Pin)	10 μF to 1000 μF
Vo2 (5 Pin)	10 μF to 1000 μF



HRP5

●Input / Output Equivalent Circuits

BA3258HFP

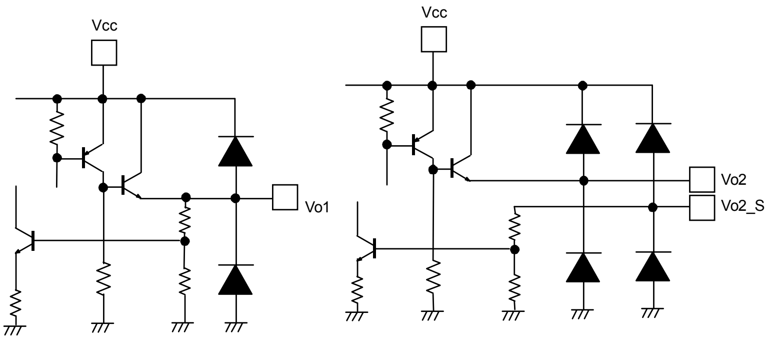


Fig. 27 BA3258HFP Input / Output Equivalent Circuit

BA33D□□ Series

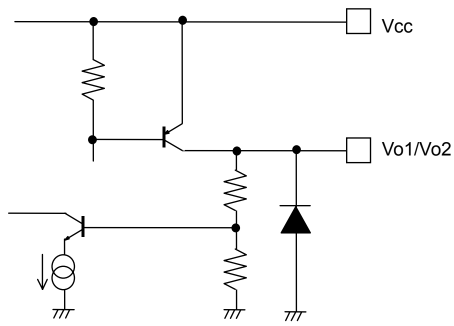
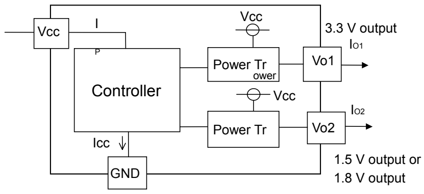


Fig. 28 BA33D□□ Series Equivalent Circuit Diagrams

●Thermal Design

If the IC is used under excessive power dissipation conditions, the chip temperature will rise, which will have an adverse effect on the electrical characteristics of the IC, such as a reduction in current capability. Furthermore, if the temperature exceeds Tjmax, element deterioration or damage may occur. Implement proper thermal designs to ensure that the power dissipation is within the permissible range in order to prevent instantaneous IC damage resulting from heat and maintain the reliability of the IC for long-term operation. Refer to the power derating characteristics curves in Fig. 29.

- Power Consumption (Pc) Calculation Method



*Vcc: Applied voltage
Io1: Load current on Vo1 side
Io2: Load current on Vo2 side
Icc: Circuit current
* The Icc (circuit current) varies with the load.
(See reference data in Figs. 2, 3, 14, and 15.)

- Power consumption of 3.3V power transistor:
  $Pc1 = (Vcc - 3.3) \times Io1$
- Power consumption of Vo2 power transistor:
  $Pc2 = (Vcc - Vo2) \times Io2$
- Power consumption due to circuit current:
  $Pc3 = Vcc \times Icc$

$\rightarrow Pc = Pc1 + Pc2 + Pc3$

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.

- Calculation example (BA33D15HFP)

Example: Vcc = 5V, Io1 = 200mA, and Io2 = 100mA

- Power consumption of 3.3V power transistor: $Pc1 = (Vcc - 3.3) \times Io1 = (5 - 3.3) \times 0.2 = 0.34W$
- Power consumption of 1.5V power transistor: $Pc2 = (Vcc - 1.5) \times Io2 = (5 - 1.5) \times 0.2 = 0.35W$
- Power consumption due to circuit current: $Pc3 = Vcc \times Icc = 5 \times 0.0085 = 0.0425$ (W) (See Figs. 14 and 15)

Implement proper thermal designs taking into consideration the dissipation at full power consumption (i.e., Pc1 + Pc2 + Pc3 = 0.34 + 0.35 + 0.0425 = 0.7325W).

●Explanation of External Components

- BA3258HFP

1) Pin 1 (Vcc pin)
   Connecting a ceramic capacitor with a capacitance of approximately 3.3μF between Vcc and GND as close to the pins as possible is recommended.
2) Pins 4 and 5 (Vo pins)
   Insert a capacitor between the Vo and GND pins in order to prevent output oscillation. The capacitor may oscillate if the capacitance changes as a result of temperature fluctuations. Therefore, it is recommended that a ceramic capacitor with a temperature coefficient of X5R or above and a maximum capacitance change (resulting from temperature fluctuations) of ±10% be used. The capacitance should be between 1μF and 1,000 μF. (Refer to Fig. 30)

- BA33D□□ Series

1) Pin 1 (Vcc pin)
   Insert a 1μF capacitor between Vcc and GND. The capacitance will vary depending on the application. Check the capacitance with the application set and implement designing with a sufficient margin.
2) Pins 4 and 5 (Vo pins)
   Insert a capacitor between the Vo and GND pins in order to prevent oscillation. 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 characteristcs in Fig. 31 and operate the IC within the stable operating region. If there is a sudden load change, use a capacitor with higher capacitance. A capacitance between 10μF and 1,000μF is recommended.

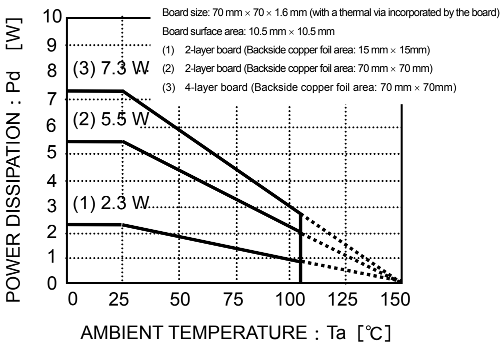


Fig. 29 Thermal Derating Curves

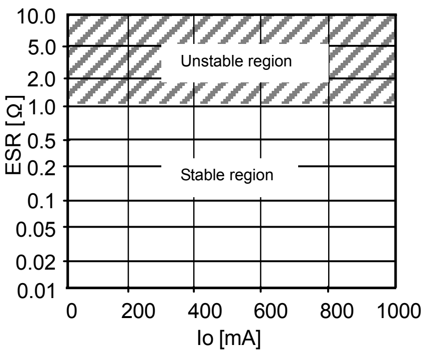


Fig. 30 BA3258HFP ESR characteristics

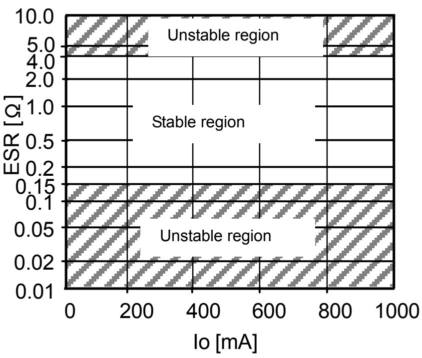


Fig. 31 BA33D□□ Series ESR

● Operation Notes

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.

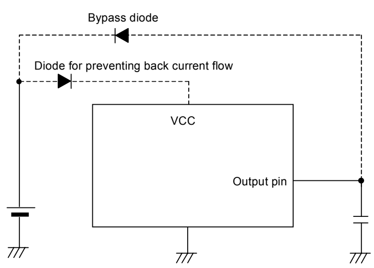
7) Regarding input pin of the IC
This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated.
P-N junctions are formed at the intersection of these P layers with the N layers of other elements, creating a parasitic diode or transistor. For 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 (TSD)
This IC incorporates a built-in thermal shutdown circuit for protection against thermal destruction. Should the junction temperature (Tj) reach the thermal shutdown ON temperature threshold, the TSD will be activated, turning off all output power elements. The circuit will automatically reset once the chip's temperature Tj drops below the threshold temperature. Operation of the thermal shutdown circuit presumes that the IC's absolute maximum ratings have been exceeded. Application designs should never make use of the thermal shutdown circuit.

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 1000 mF 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.



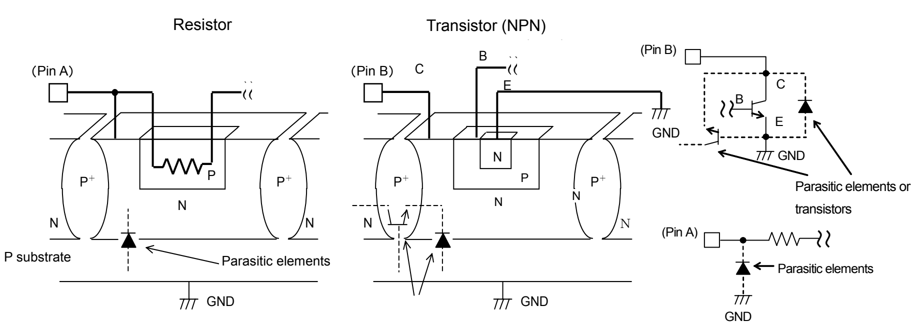


Fig32 Bypass diode

Fig. 33 Example of Simple Bipolar IC Architecture

●Part Number Explanation

B	A		3	2	5	8		H	F	P	–	T	R

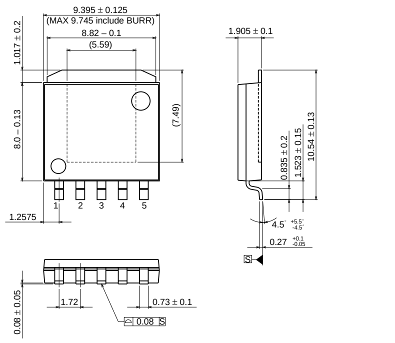
- BA: ROHM Part Number
- HFP: Package, HFP: HRP5
- TR: Packaging specifications, TR: Embossed taping

B	A		3	3	D		1	5		H	F	P	–	T	R

- BA: ROHM Part Number
- 15: Output voltage, 1.5 V output: 15, 3.0 V output: 18
- HFP: Package, HFP: HRP5
- TR: Packaging specifications, TR: Embossed taping

HRP5

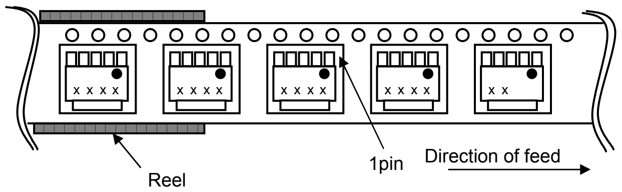
<Dimension>



(Unit:mm)

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	TR (The direction is the 1pin of product is at the upper light when you hold reel on the left hand and you pull out the tape on the right hand)



※When you order , please order in times the amount of package quantity.

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