Low saturation voltage type 3-terminal regulator

BA○○T/FP Series

The BA○○FP Series are fixed output low drop-out type, 3-pin voltage regulators with positive output. These regulators are used to provide a stabilized output voltage from a fluctuating DC input voltage.
There are 10 fixed output voltages, as follows : 3V, 3.3V, 5V, 6V*, 7V, 8V, 9V, 10V, 12V and 15V*. The maximum current capacity is 1A for each of the above voltages. (Items marked with an asterisk are under development.)

●Applications
Constant voltage power supply

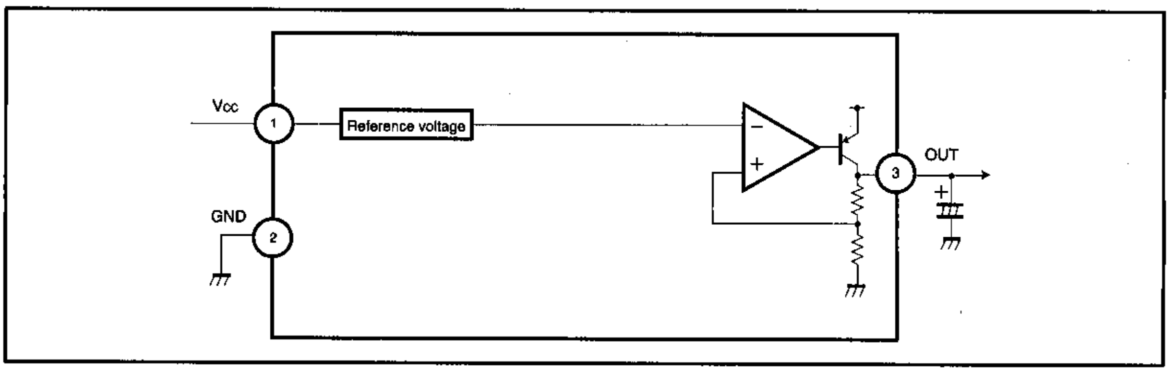
●Features
1) Built-in overvoltage protection circuit, overcurrent protection circuit and thermal shutdown circuit.
2) TO220FP and TO252-3 packages are available to cover a wide range of applications.
3) Compatible with the BA178○○ series.
4) Richly diverse lineup.
5) Low dropout voltage differential.

●Product codes

Output Voltage (V)	Product No.	Output Voltage (V)	Product No.
3.0	BA03T / FP	8.0	BA08T / FP
3.3	BA033T / FP	9.0	BA09T / FP
5.0	BA05T / FP	10.0	BA10T / FP
6.0	BA06T* / FP*	12.0	BA12T / FP
7.0	BA07T / FP	15.0	BA15T* / FP*

* : Under development.

●Block diagram



●Absolute maximum ratings (Ta=25℃)

Parameter		Symbol	Limits	Unit
Power supply voltage		Vcc	35	V
Power dissipation	TO220FP	Pd	2000 *1	mW
	TO252 - 3		1000 *2	
Operating temperature		Topr	−40~85	℃
Storage temperature		Tstg	−55~150	℃
Applied surge voltage		Vsurge	50 *3	V

*1 Reduce 16 mW for each 1°C when using the product at Ta=25°C or higher. (TO 220FP)
*2 Reduce 8 mW for each 1°C when using the product at Ta=25°C or higher. (TO 252 - 3)
*3 Voltage application time : 200 msec. or less

●Recommended operating conditions

BA03T/FP

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vin	4	—	25	V
Output current	Io	—	—	1	A

BA033T/FP

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vin	4.3	—	25	V
Output current	Io	—	—	1	A

BA05T/FP

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vin	6	—	25	V
Output current	Io	—	—	1	A

BA06T/FP (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vin	7	—	25	V
Output current	Io	—	—	1	A

BA07T/FP

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vin	8	—	25	V
Output current	Io	—	—	1	A

BA08T/FP

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vin	9	—	25	V
Output current	Io	—	—	1	A

BA09T/FP

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vin	10	—	25	V
Output current	Io	—	—	1	A

BA10T/FP

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vin	11	—	25	V
Output current	Io	—	—	1	A

BA12T/FP

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vin	13	—	27	V
Output current	Io	—	—	1	A

BA15T/FP (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vin	16	—	25	V
Output current	Io	—	—	1	A

●Electrical characteristics

BA03T/FP (unless otherwise noted, Ta=25℃, Vcc=8V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	Vo1	2.85	3.0	3.15	V		Fig.1
Line regulation	Reg.I	—	20	100	mV	Vcc=4→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	ein=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	—	±0.02	—	%/℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	—	0.3	0.5	V	Vcc=2.85V	Fig.3
Bias current	Ib	—	2.5	5.0	mA	Io=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	—	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	—	0.4	—	A	Vcc=25V	Fig.5

BA033T/FP (unless otherwise noted, Ta=25℃, Vcc=8V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	Vo1	3.15	3.3	3.45	V		Fig.1
Line regulation	Reg.I	—	20	100	mV	Vcc=4.3→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	ein=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	—	±0.02	—	%/℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	—	0.3	0.5	V	Vcc=3.15V	Fig.3
Bias current	Ib	—	2.5	5.0	mA	Io=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	—	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	—	0.4	—	A	Vcc=25V	Fig.5

BA05T/FP (unless otherwise noted, Ta=25℃, Vcc=10V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	Vo1	4.75	5.0	5.25	V		Fig.1
Line regulation	Reg.I	—	20	100	mV	Vcc=6→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	ein=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	—	±0.02	—	%/℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	—	0.3	0.5	V	Vcc=4.75V	Fig.3
Bias current	Ib	—	2.5	5.0	mA	Io=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	—	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	—	0.4	—	A	Vcc=25V	Fig.5

BA06T/FP (unless otherwise noted, Ta=25℃, Vcc=11V, Io=500mA) (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	Vo1	5.7	6.0	6.3	V		Fig.1
Line regulation	Reg.I	–	20	100	mV	Vcc=7→25V	Fig.1
Ripple rejection	R.R.	45	55	–	dB	ein=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	–	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	–	±0.02	–	%/℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	–	0.3	0.5	V	Vcc=5.7V	Fig.3
Bias current	Ib	–	2.5	5.0	mA	Io=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	–	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	–	0.4	–	A	Vcc=25V	Fig.5

BA07T/FP (unless otherwise noted, Ta=25℃, Vcc=12V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	Vo1	6.65	7.0	7.35	V		Fig.1
Line regulation	Reg.I	–	20	100	mV	Vcc=8→25V	Fig.1
Ripple rejection	R.R.	45	55	–	dB	ein=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	–	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	–	±0.02	–	%/℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	–	0.3	0.5	V	Vcc=6.65V	Fig.3
Bias current	Ib	–	2.5	5.0	mA	Io=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	–	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	–	0.4	–	A	Vcc=25V	Fig.5

BA08T/FP (unless otherwise noted, Ta=25℃, Vcc=13V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	Vo1	7.6	8.0	8.4	V		Fig.1
Line regulation	Reg.I	–	20	100	mV	Vcc=9→25V	Fig.1
Ripple rejection	R.R.	45	55	–	dB	ein=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	–	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	–	±0.02	–	%/℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	–	0.3	0.5	V	Vcc=7.6V	Fig.3
Bias current	Ib	–	2.5	5.0	mA	Io=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	–	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	–	0.4	–	A	Vcc=25V	Fig.5

●Electrical characteristics

BA09T/FP (unless otherwise noted, Ta=25℃, Vcc=14V, Io=500mA) (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	Vo1	8.45	9.0	9.55	V		Fig.1
Line regulation	Reg.I	−	20	100	mV	Vcc=10→25V	Fig.1
Ripple rejection	R.R.	45	55	−	dB	ein=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	−	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	−	±0.02	−	%/℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	−	0.3	0.5	V	Vcc=8.45V	Fig.3
Bias current	Ib	−	2.5	5.0	mA	Io=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	−	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	−	0.4	−	A	Vcc=25V	Fig.5

BA10T/FP (unless otherwise noted, Ta=25℃, Vcc=15V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	Vo1	9.5	10	10.5	V		Fig.1
Line regulation	Reg.I	−	20	100	mV	Vcc=11→25V	Fig.1
Ripple rejection	R.R.	45	55	−	dB	ein=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	−	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	−	±0.02	−	%/℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	−	0.3	0.5	V	Vcc=9.5V	Fig.3
Bias current	Ib	−	2.5	5.0	mA	Io=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	−	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	−	0.4	−	A	Vcc=25V	Fig.5

BA12T/FP (unless otherwise noted, Ta=25℃, Vcc=17V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	Vo1	11.4	12	12.6	V		Fig.1
Line regulation	Reg.I	−	20	100	mV	Vcc=13.5→27V	Fig.1
Ripple rejection	R.R.	45	55	−	dB	ein=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	−	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	−	±0.02	−	%/℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	−	0.3	0.5	V	Vcc=11.4V	Fig.3
Bias current	Ib	−	2.5	5.0	mA	Io=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	−	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	−	0.4	−	A	Vcc=27V	Fig.5

BA15T/FP (unless otherwise noted, Ta=25℃, Vcc=20V, Io=500mA) (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	Vo1	14.25	15	15.75	V		Fig.1
Line regulation	Reg.I	–	20	100	mV	Vcc=17→30V	Fig.1
Ripple rejection	R.R.	45	55	–	dB	ein=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	–	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	–	±0.02	–	% / ℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	–	0.3	0.5	V	Vcc=14.25V	Fig.3
Bias current	Ib	–	2.5	5.0	mA	Io=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	–	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	–	0.4	–	A	Vcc=30V	Fig.5

●Measurement circuits

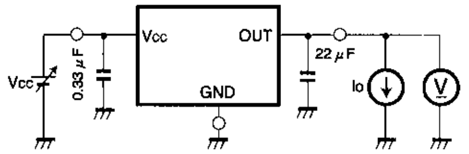
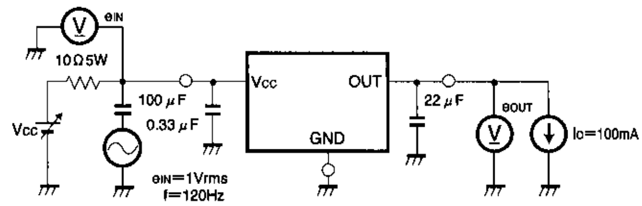


Fig. 1 Measurement circuit for output voltage, line regulation, load regulation, temperature coefficient of output voltage



Ripple rejection ratio R.R. = 20 log$\left(\frac{|e_{IN}|}{|e_{OUT}|}\right)$

Fig. 2 Measurement circuit for ripple rejection ratio

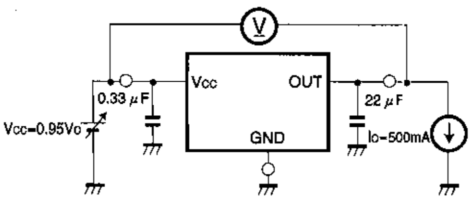


Fig. 3 Measurement circuit for dropout voltage

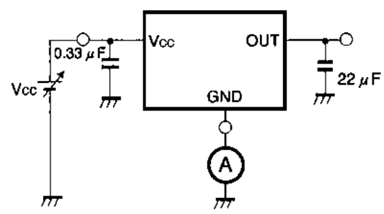


Fig. 4 Measurement circuit for bias current

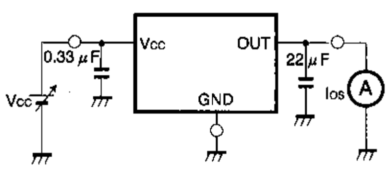


Fig. 5 Measurement circuit for short-circuit output current

●Precautions for use

1. Although the circuit examples included in this handbook are highly recommended for general use, you should thoroughly familiarize yourself with the circuit characteristics as they relate to your own conditions. If you intend to change the number of external circuits, leave an ample margin, taking into account discrepancies in both static and dynamic characteristics of external components and Rohm ICs.
   Please be advised that Rohm cannot provide complete assurance regarding patent rights.
2. Operating power supply voltage
   When operating within the normal voltage range and within the ambient operating temperature range, most circuit functions are guaranteed.
   The rated values cannot be guaranteed for the electrical characteristics, but there are no sudden changes of the characteristics within these ranges.
3. Power dissipation Pd
   Heat attenuation characteristics are noted on a separate page and can be used as a guide in judging power dissipation.
   If these ICs are used in such a way that the allowable power dissipation level is exceeded, an increase in the chip temperature could cause a reduction in the current capability or could otherwise adversely affect the performance of the IC. Make sure a sufficient margin is allowed so that the allowable power dissipation value is not exceeded.
4. Preventing oscillation in output and using bypass capacitors
   Always use a capacitor (with a capacitance of 10 μF or greater) between the output pins and the GND to prevent oscillation.
   Changes in the temperature and other factors can cause the capacitance of the capacitor to change, which may cause oscillation. To prevent this, we recommend using a tantalum electrolytic capacitor.
   Also, we recommend adding a bypass capacitor of about 0.33 μF between the input pin and the GND, as close to the pin as possible.
5. Overcurrent protection circuit
   An overcurrent protection circuit is built into the outputs, to prevent destruction of the IC in the even the load is shorted.
   This protection circuit limits the current in the shape of a '7'. This circuit is designed with a high margin, so that that current is restricted and latching is prevented, even if a high-capacitance capacitator causes a large amount of current to temporary flow through the IC.
   However, these protection circuits are only good for preventing damage from sudden accidents and should not be used for continuous protection (for instance, clamping at an output of 1Vf or greater; below 1Vf, the short mode circuit operates). Note that the capacitor has negative temperature characteristics, and the design should take this into consideration.
6. Thermal overload circuit
   A built-in thermal overload circuit prevents damage from overheating. When the thermal circuit is activated, the outputs are turned OFF. When the temperature drops back to a constant level, the circuit is restored.
7. Internal circuits could be damaged if there are modes in which the electric potential of the application's input (V_{CC}) and GND are the opposite of the electric potential normally used by each of the outputs. Use of a diode or other such bypass path is recommended.
8. Although the manufacture of this product includes rigorous quality assurance procedures, the product may be damaged if absolute maximum ratings for voltage or operating temperature are exceeded. If damage has occurred, special modes (such as short circuit mode or open circuit mode) cannot be specified. If it is possible that such special modes may be needed, please consider using a fuse or some other mechanical safety measure.
9. When used within a strong magnetic field, be aware that the possibility of malfunction exists.

●Electrical characteristic curves

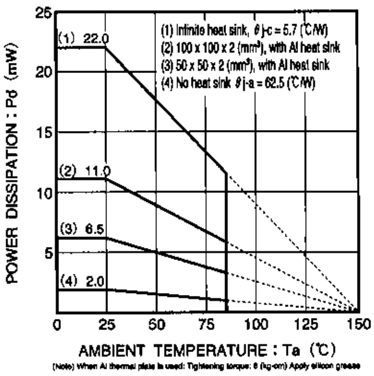


Fig.6 Ta - power dissipation characteristic (TO220FP)

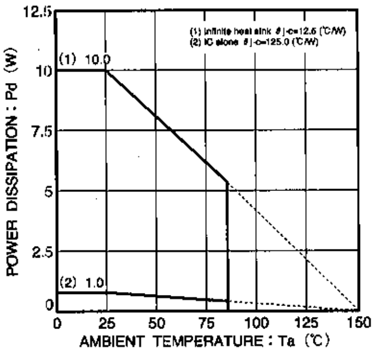


Fig. 7 Ta - power dissipation characteristic (TO 252-3)

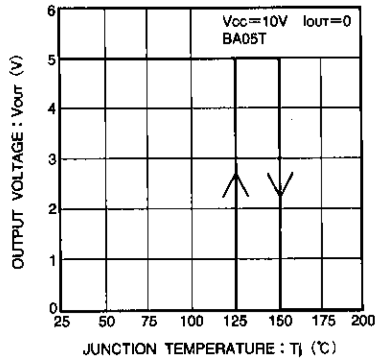


Fig. 8 Thermal cutoff circuit characteristic

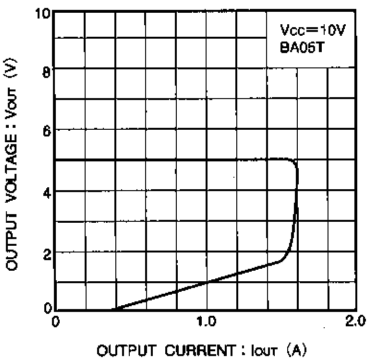


Fig. 9 Current limit characteristic

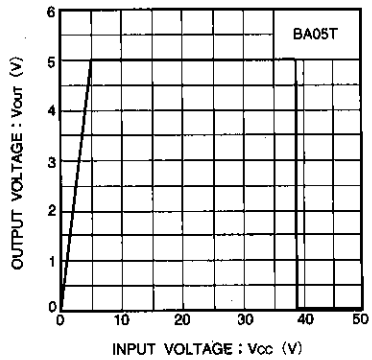
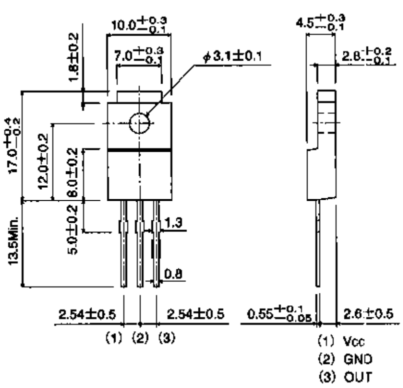


Fig. 10 Over voltage protection characteristic

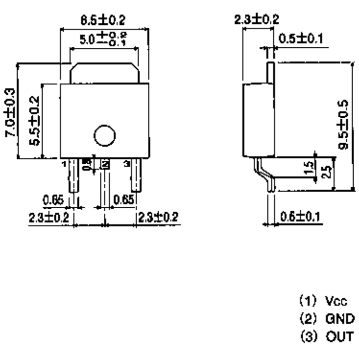
●External dimensions (Units: mm)

BA○○T Series



TO220FP

BA○○FP Series



TO252-3

ROHM

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