

# Low saturation voltage type regulator with ON / OFF switch

## BA○○ST series

The BA○○ST series are variable, fixed output low drop-out type voltage regulators with an ON / OFF switch. These regulators are used to provide a stabilized output voltage from a fluctuating DC input voltage.

Fixed output voltages are 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-5 package can be used in wide range of applications.
- 3) 0μA (design value) circuit current when switch is off.
- 4) Richly diverse lineup.
- 5) Low minimum I / O voltage differential.

### ●Product codes

Output voltage (V)	Product No.	Output voltage (V)	Product No.
Variable	BA00ST*	8.0	BA08ST
3.0	BA03ST *	9.0	BA09ST
3.3	BA033ST	10.0	BA10ST
5.0	BA05ST	12.0	BA12ST
6.0	BA06ST *	15.0	BA15ST *
7.0	BA07ST		

\* Under development.

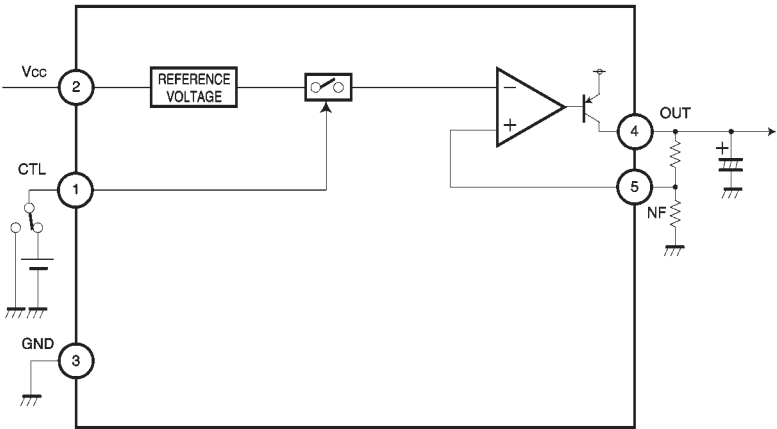
### ●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V <sub>CC</sub>	35	V
Power dissipation	P <sub>d</sub>	2000* <sup>1</sup>	mW
Operating temperature	T <sub>opr</sub>	−40~+85	°C
Storage temperature	T <sub>stg</sub>	−55~+150	°C
Peak applied voltage	V <sub>surge</sub>	50* <sup>2</sup>	V

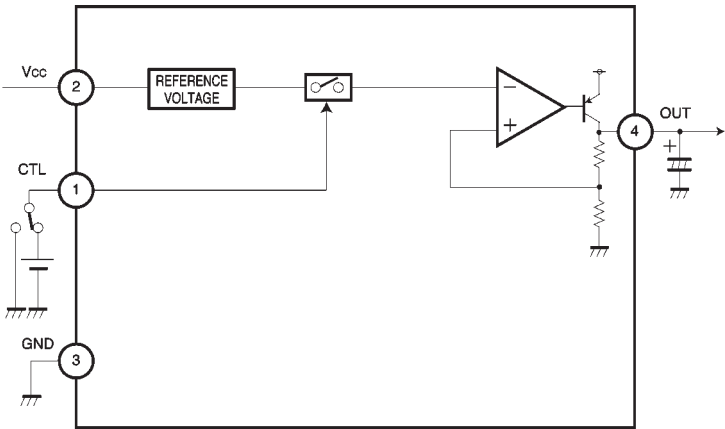
\*1 Reduced by 16mW for each increase 10To of 1°C over 25°C.

\*2 Voltage application time : 200 msec. or less

●Block diagram



Variable output type (BA00AST)



Fixed output type

## ● Pin descriptions

Pin No.	Pin name	Function
1	CTL	Output ON/OFF
2	V <sub>CC</sub>	Power supply input
3	GND	Ground
4	OUT	Output
5	C	Reference power supply pin for setting voltage with the BA00ST.
	N.C.	In the BA○○ST Series, these are NC pins, except for the BA00ST.

## ● Recommended operating conditions

## BA00ST

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	4	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## BA03ST (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	4	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## BA033ST

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	4.3	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## BA05ST

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	6	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## BA06ST (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	7	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## BA07ST

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	8	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## BA08ST

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	9	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## BA09ST

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	10	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## BA10ST

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	11	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## BA12ST

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	13	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## BA15ST (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V <sub>CC</sub>	16	—	25	V
Output current	I <sub>O</sub>	—	—	1	A

## ● Electrical characteristics

BA00ST (unless otherwise noted, Ta = 25°C, Vcc = 10V, Io = 500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Reference voltage	V <sub>ref</sub>	1.200	1.225	1.250	V		Fig.1
Power save current	I <sub>st</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>o</sub>	—	5.0	—	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>cc</sub> =6→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	θ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>o</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>o</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>cvo</sub>	—	±0.01	—	% / °C	I <sub>o</sub> =5mA, T <sub>j</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>cc</sub> =0.95V <sub>o</sub>	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>o</sub> =0mA	Fig.4
Peak output current	I <sub>o-P</sub>	1.0	1.5	—	A	T <sub>j</sub> =25°C	Fig.1
Output short-circuit current	I <sub>os</sub>	—	0.4	—	A	V <sub>cc</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>o</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>o</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>o</sub> =0mA	Fig.6

BA03ST (unless otherwise noted, Ta = 25°C, Vcc = 8V, Io = 500mA) (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Power save current	I <sub>st</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>O1</sub>	2.85	3.0	3.15	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>cc</sub> =4→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	θ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>o</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>o</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>cvo</sub>	—	±0.02	—	% / °C	I <sub>o</sub> =5mA, T <sub>j</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>cc</sub> =0.95V <sub>o</sub>	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>o</sub> =0mA	Fig.4
Peak output current	I <sub>o-P</sub>	1.0	1.5	—	A	T <sub>j</sub> =25°C	Fig.1
Output short-circuit current	I <sub>os</sub>	—	0.4	—	A	V <sub>cc</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>o</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>o</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>o</sub> =0mA	Fig.6

BA033ST (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 8V, I<sub>o</sub> = 500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Power save current	I <sub>ST</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>O1</sub>	3.13	3.3	3.47	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>CC</sub> =4.3→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	Θ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>o</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>o</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>CVO</sub>	—	±0.02	—	% / °C	I <sub>o</sub> =5mA, T <sub>j</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>CC</sub> =0.95V <sub>o</sub>	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>o</sub> =0mA	Fig.4
Peak output current	I <sub>o-p</sub>	1.0	1.5	—	A	T <sub>j</sub> =25°C	Fig.1
Output short-circuit current	I <sub>os</sub>	—	0.4	—	A	V <sub>CC</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>o</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>o</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>o</sub> =0mA	Fig.6

BA05ST (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 10V, I<sub>o</sub> = 500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Masurement circuit
Power save current	I <sub>ST</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>O1</sub>	4.75	5.0	5.25	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>CC</sub> =6→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	Θ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>o</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>o</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>CVO</sub>	—	±0.02	—	% / °C	I <sub>o</sub> =5mA, T <sub>j</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>CC</sub> =4.75V	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>o</sub> =0mA	Fig.4
Peak output current	I <sub>o-p</sub>	1.0	1.5	—	A	T <sub>j</sub> =25°C	Fig.1
Output short-circuit current	I <sub>os</sub>	—	0.4	—	A	V <sub>CC</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>o</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>o</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>o</sub> =0mA	Fig.6

BA06ST ( unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 11V, I<sub>o</sub> = 500mA) (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Power save current	I <sub>ST</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>O1</sub>	5.7	6.0	6.3	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>CC</sub> =7→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	Θ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>o</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>o</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>CV0</sub>	—	±0.02	—	% / °C	I <sub>o</sub> =5mA, T <sub>j</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>CC</sub> =5.7V	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>o</sub> =0mA	Fig.4
Peak output current	I <sub>o-P</sub>	1.0	1.5	—	A	T <sub>j</sub> =25°C	Fig.1
Output short-circuit current	I <sub>os</sub>	—	0.4	—	A	V <sub>CC</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>o</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>o</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>o</sub> =0mA	Fig.6

BA07ST (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 12V, I<sub>o</sub> = 500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Power save current	I <sub>ST</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>O1</sub>	6.65	7.0	7.35	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>CC</sub> =8→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	Θ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>o</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>o</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>CV0</sub>	—	±0.02	—	% / °C	I <sub>o</sub> =5mA, T <sub>j</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>CC</sub> =6.65V	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>o</sub> =0mA	Fig.4
Peak output current	I <sub>o-P</sub>	1.0	1.5	—	A	T <sub>j</sub> =25°C	Fig.1
Output short-circuit current	I <sub>os</sub>	—	0.4	—	A	V <sub>CC</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>o</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>o</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>o</sub> =0mA	Fig.6

BA08ST (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 13V, I<sub>O</sub> = 500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Power save current	I <sub>ST</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>O1</sub>	7.6	8.0	8.4	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>CC</sub> =9→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	Θ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>O</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>O</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>CV0</sub>	—	±0.02	—	% / °C	I <sub>O</sub> =5mA, T <sub>J</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>CC</sub> =0.95V <sub>O</sub>	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>O</sub> =0mA	Fig.4
Peak output current	I <sub>O-P</sub>	1.0	1.5	—	A	T <sub>J</sub> =25°C	Fig.1
Output short-circuit current	I <sub>OS</sub>	—	0.4	—	A	V <sub>CC</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>O</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>O</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>O</sub> =0mA	Fig.6

BA09ST (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 14V, I<sub>O</sub> = 500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Power save current	I <sub>ST</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>O1</sub>	8.55	9.0	9.45	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>CC</sub> =10→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	Θ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>O</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>O</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>CV0</sub>	—	±0.02	—	% / °C	I <sub>O</sub> =5mA, T <sub>J</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>CC</sub> =0.95V <sub>O</sub>	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>O</sub> =0mA	Fig.4
Peak output current	I <sub>O-P</sub>	1.0	1.5	—	A	T <sub>J</sub> =25°C	Fig.1
Output short-circuit current	I <sub>OS</sub>	—	0.4	—	A	V <sub>CC</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>O</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>O</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>O</sub> =0mA	Fig.6

BA10ST (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 15V, I<sub>o</sub> = 500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Power save current	I <sub>ST</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>O1</sub>	9.5	10	10.5	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>CC</sub> =11→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	ϕ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>o</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>o</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>CV0</sub>	—	±0.02	—	% / °C	I <sub>o</sub> =5mA, T <sub>j</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>CC</sub> =0.95V <sub>o</sub>	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>o</sub> =0mA	Fig.4
Peak output current	I <sub>o-P</sub>	1.0	1.5	—	A	T <sub>j</sub> =25°C	Fig.1
Output short-circuit current	I <sub>os</sub>	—	0.4	—	A	V <sub>CC</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>o</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>o</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>o</sub> =0mA	Fig.6

BA12ST (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 17V, I<sub>o</sub> = 500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Power save current	I <sub>ST</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>O1</sub>	11.4	12	12.6	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>CC</sub> =13→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	ϕ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>o</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>o</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>CV0</sub>	—	±0.02	—	% / °C	I <sub>o</sub> =5mA, T <sub>j</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>CC</sub> =0.95V <sub>o</sub>	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>o</sub> =0mA	Fig.4
Peak output current	I <sub>o-P</sub>	1.0	1.5	—	A	T <sub>j</sub> =25°C	Fig.1
Output short-circuit current	I <sub>os</sub>	—	0.4	—	A	V <sub>CC</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>o</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>o</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>o</sub> =0mA	Fig.6



BA15ST (unless otherwise noted, Ta = 25°C, Vcc = 20V, Io = 500mA) (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Power save current	I <sub>ST</sub>	—	0	10	μA	OFF mode	Fig.4
Output voltage	V <sub>O1</sub>	14.25	15	15.75	V		Fig.1
Input stability	Reg.I	—	20	100	mV	V <sub>CC</sub> =16→25V	Fig.1
Ripple rejection ratio	R.R.	45	55	—	dB	θ <sub>IN</sub> =1V <sub>rms</sub> , f=120Hz, I <sub>o</sub> =100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I <sub>o</sub> =5mA→1A	Fig.1
Temperature coefficient of output voltage	T <sub>cvo</sub>	—	±0.02	—	% / °C	I <sub>o</sub> =5mA, T <sub>j</sub> =0~125°C	Fig.1
Minimum I/O voltage differential	V <sub>d</sub>	—	0.3	0.5	V	V <sub>CC</sub> =0.95V <sub>o</sub>	Fig.3
Bias current	I <sub>b</sub>	—	2.5	5.0	mA	I <sub>o</sub> =0mA	Fig.4
Peak output current	I <sub>o-P</sub>	1.0	1.5	—	A	T <sub>j</sub> =25°C	Fig.1
Output short-circuit current	I <sub>os</sub>	—	0.4	—	A	V <sub>CC</sub> =25V	Fig.5
ON mode voltage	V <sub>th1</sub>	2.0	—	—	V	Output Active mode, I <sub>o</sub> =0mA	Fig.6
OFF mode voltage	V <sub>th2</sub>	—	—	0.8	V	Output OFF mode, I <sub>o</sub> =0mA	Fig.6
Input high level current	I <sub>IN</sub>	100	200	300	μA	CTL=5V, I <sub>o</sub> =0mA	Fig.6

### ● Measurement circuits

(The C pin only exists on the BA00AST, For the BA00AST, place a 6.8 kΩ resistor between the OUT and C pins, and a 2.2 kΩ resistor between the C and GND pins.)

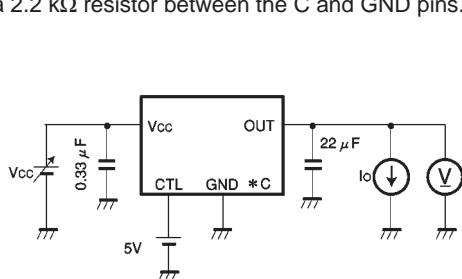


Fig.1 Measurement circuit for output voltage, input stability, load regulation, and temperature coefficient of output voltage

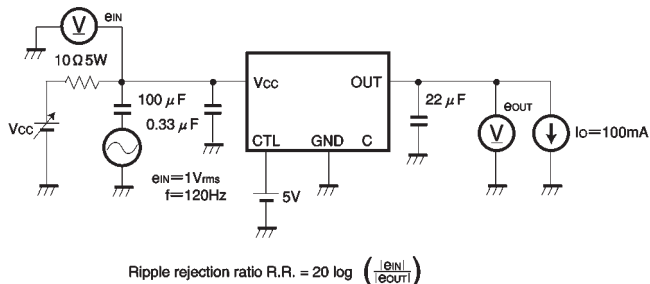


Fig.2 Measurement circuit for ripple rejection ratio

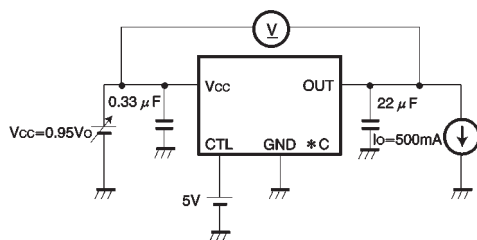


Fig.3 Measurement circuit for minimum I/O voltage differential

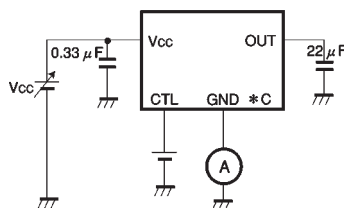


Fig.4 Measurement circuit for bias current, power save current measurement circuit

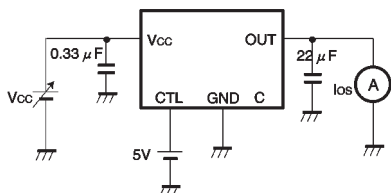


Fig.5 Measurement circuit for output short-circuit current

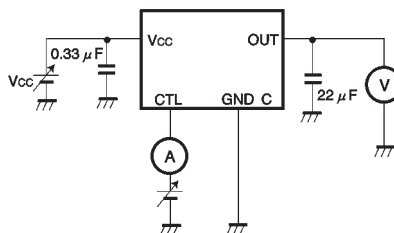


Fig.6 Measurement circuit for ON/OFF mode voltage, input high level current

## ● Operation notes

## (1) 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.

## (2) Power dissipation

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.

## (3) Output oscillation prevention and bypass capacitor

Be sure to connect a capacitor between the output pin and GND to prevent oscillation. Since fluctuations in the value of the capacitor due to temperature changes may cause oscillations, a tantalum electrolytic capacitor with a small internal series resistance (ESR) is recommended.

A 22 $\mu$ F capacitor is recommended; however, be aware that if an extremely large capacitance is used (1000 $\mu$ F or greater), then oscillations may occur at low frequencies. Therefore, be sure to perform the appropriate verifications before selecting the capacitor.

Also, we recommend connecting a 0.33 $\mu$ F bypass capacitor as close as possible between the input pin and GND.

## (4) Current overload protection circuit

A current overload protection circuit is built into the out-

puts, to prevent IC destruction if the load is shorted.

This protection circuit limits the current in the shape of a '7'. It is designed with a high margin, so that even if a large current suddenly flows through the large capacitor in the IC, the current is restricted and latching is prevented.

However, these protection circuits are only good for preventing damage from sudden accidents. The design should take this into consideration, so that the protection circuit is not made to operate continuously (for instance, clamping at an output of 1V<sub>F</sub> or greater; below 1V<sub>F</sub>, the short mode circuit operates). Note that the capacitor has negative temperature characteristics, and the design should take this into consideration.

## (5) Thermal overload circuit

A built-in thermal overload circuit prevents damage from overheating. When the thermal circuit is activated, the various outputs are in the OFF state. When the temperature drops back to a constant level, the circuit is restored.

(6) Internal circuits could be damaged if there are modes in which the electric potential of the application's input (V<sub>CC</sub>) and GND are the opposite of the electric potential of the various outputs. Use of a diode or other such bypass path is recommended.

(7) 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.

(8) When used within a strong magnetic field, be aware that there is a slight possibility of malfunction.

The graph shows the relationship between power dissipation and ambient temperature for four different heat sink configurations. The y-axis represents power dissipation in Watts (W), ranging from 0 to 25. The x-axis represents ambient temperature in degrees Celsius (°C), ranging from 0 to 150. Four curves are plotted, each corresponding to a different configuration:

- (1) Infinite heat sink: A solid line starting at 22.0 W at 25°C and decreasing linearly to 0 W at 150°C.
- (2) Alumina PCB, 100×100×2 mm<sup>2</sup>: A solid line starting at 11.0 W at 25°C and decreasing linearly to 0 W at 150°C.
- (3) Alumina PCB, 50×50×2 mm<sup>2</sup>: A solid line starting at 6.5 W at 25°C and decreasing linearly to 0 W at 150°C.
- (4) IC alone: A solid line starting at 2.0 W at 25°C and decreasing linearly to 0 W at 150°C.

Dashed lines extend from the solid lines to the right, indicating the theoretical maximum power dissipation for each configuration at higher temperatures.

Figure 10 is a graph showing Load Regulation. The Y-axis is labeled "OUTPUT VOLTAGE :  $V_{out}$  (V)" and ranges from 0 to 6. The X-axis is labeled "JUNCTION TEMPERATURE :  $T_j$  (°C)" and ranges from 25 to 200. The graph shows a constant output voltage of 5V across the temperature range. The test conditions are  $V_{cc} = 10V$ ,  $I_{out} = 0$ , and the device is BA05ST.

Figure 10 is a line graph titled "Load Regulation Graph". The y-axis is labeled "OUTPUT VOLTAGE :  $V_{out}$  (V)" and ranges from 0 to 10 with major grid lines every 2 units. The x-axis is labeled "OUTPUT CURRENT :  $I_{out}$  (A)" and ranges from 0 to 2.0 with major grid lines every 1.0 unit. The graph shows a constant output voltage of approximately 5.0V from 0A to 1.5A, followed by a sharp drop to 0V at 1.6A. The graph is labeled with  $V_{cc}=10V$  and BA05ST.

The graph shows the typical transfer characteristics of the BA05ST relay. The y-axis represents the output voltage  $V_{out}$  in Volts, ranging from 0 to 6V. The x-axis represents the input voltage  $V_{cc}$  in Volts, ranging from 0 to 50V. The curve indicates that the relay is normally closed (0V output) for input voltages up to approximately 38V. At this point, the output voltage switches sharply to 5V, which is the nominal coil voltage, and remains constant for higher input voltages up to 50V.

The drawing shows the mechanical specifications of the TO220FP-5 package. The front view (left) includes dimensions for the overall height (13.5 Min.), mounting tab height (17.0 ± 0.4), and various widths and spacings for the pins and body. The side view (right) shows the package thickness (2.85) and mounting tab thickness (0.5 ± 0.1). A pin 1 indicator is shown on the front view.

Dimensions (mm):

- Overall height: 13.5 Min.
- Mounting tab height: 17.0 ± 0.4
- Mounting tab thickness: 0.5 ± 0.1
- Pin 1 indicator: 1
- Pin 2: 2
- Pin 3: 3
- Pin 4: 4
- Pin 5: 5
- Pin spacing: 1.2
- Pin width: 0.8
- Pin pitch: 1.778
- Mounting tab width: 4.5 ± 0.3
- Mounting tab thickness: 2.85
- Mounting tab hole diameter: 3.2 ± 0.1
- Mounting tab hole position: 7.0 ± 0.3
- Mounting tab hole diameter: 4.5 ± 0.3
- Mounting tab hole position: 2.8 ± 0.2
- Mounting tab hole diameter: 0.85 ± 0.2
- Mounting tab hole position: 8.0 ± 0.2
- Mounting tab hole position: 12.0 ± 0.2
- Mounting tab hole position: 1.8 ± 0.2
- Mounting tab hole position: 10.0 ± 0.3