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) 0 μA (design value) circuit current when switch is off.
4) Richly diverse lineup of products.
5) Low dropout voltage.

●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		

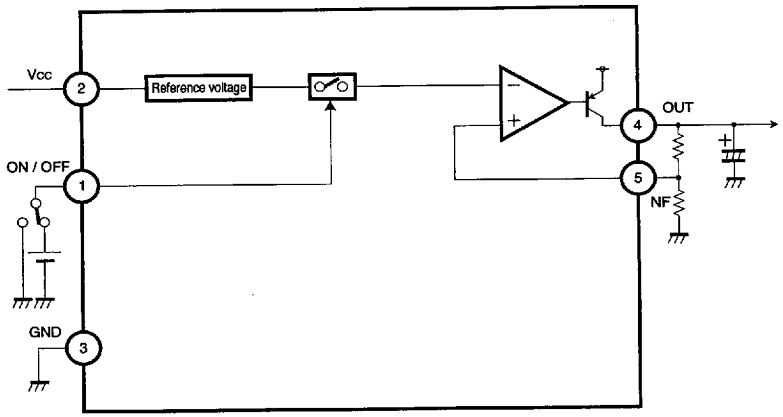
* : Under development.

●Absolute maximum ratings (Ta=25℃)

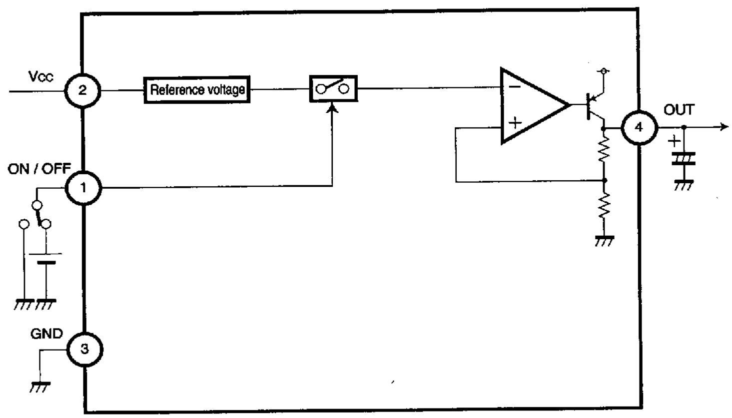
Parameter	Symbol	Limits	Unit
Power supply voltage	Vcc	35	V
Power dissipation	Pd	2000*1	mW
Operating temperature	Topr	−40~85	℃
Storage temperature	Tstg	−55~150	℃
Applied surge voltage	Vsurge	50*2	V

*1 Reduce 16 mW for each 1°C when using the regulator at Ta=25°C or higher.
*2 Voltage application time : 200 msec. or less

●Block diagram



Variable output type (BA○○ST)



Fixed output type

●Pin descriptions

Pin No.	Pin Name	Function
1	ON / OFF	Output ON/OFF pin
2	Vcc	Power supply input pin
3	GND	Ground pin
4	OUT	Output pin
5	NF	Reference power supply pin for setting voltage with the BA00ST.
	NC	In the BA00ST Series, these are NC pins, except for the BA○○ST.

●Recommended operating conditions

BA00ST (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vcc	4	—	33	V
Output current	Io	—	—	1	A

BA03ST (under development)

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

BA033ST

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

BA05ST

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

BA06ST (under development)

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

BA07ST

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

BA08ST

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

BA09ST

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

BA10ST

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

BA12ST

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

BA15ST (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	Vcc	16	—	30	V
Output current	Io	—	—	1	A

● Electrical characteristics

BA00ST (unless otherwise noted, Ta=25℃, V_{CC}=10V, Vo=5V, Io=500mA) (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Reference voltage	Vref	1.21	1.27	1.33	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=6→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	T_{CVO}	—	±0.02	—	% / ℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	—	0.3	0.5	V		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	I_{OS}	—	0.3	1.0	A	V_{CC}=25V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when"H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

BA03ST (unless otherwise noted, Ta=25℃, V_{CC}=8V, Io=500mA) (under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	V_{O1}	2.85	3.0	3.15	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=4→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	T_{CVO}	—	±0.02	—	% / ℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	—	0.3	0.5	V	V_{CC}=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	I_{OS}	—	0.3	1.0	A	V_{CC}=25V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when"H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

BA033ST (unless otherwise noted, Ta=25℃, V_{CC}=8V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	V_{O1}	3.15	3.3	3.45	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=4.3→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=1Vrms, f=120Hz, Io=100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	Io=5mA→1A	Fig.1
Temperature coefficient of output voltage	T_{CVO}	—	±0.02	—	% / ℃	Io=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	—	0.3	0.5	V	V_{CC}=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	I_{OS}	—	0.3	1.0	A	V_{CC}=25V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when"H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

BA05ST (unless otherwise noted, Ta=25℃, V_{CC}=10V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Masurement Circuit
Output voltage	V_{O1}	4.75	5.0	5.25	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=6→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=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	V_{CC}=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	—	0.3	1.0	A	V_{CC}=25V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when"H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

BA06ST (unless otherwise noted, Ta=25℃, V_{CC}=11V, Io=500mA)　(under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	V_{O1}	5.7	6.0	6.3	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=7→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=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	V_{CC}=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	—	0.3	1.0	A	V_{CC}=25V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when"H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

BA07ST (unless otherwise noted, Ta=25℃, V_{CC}=12V, Io=500mA)　(under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	V_{O1}	6.65	7.0	7.35	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=8→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=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	V_{CC}=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	—	0.3	1.0	A	V_{CC}=25V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when "H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

●Electrical characteristics

BA08ST (unless otherwise noted, Ta=25℃, V_{CC}=13V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	V_{O1}	7.6	8.0	8.4	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=9→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=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	V_{CC}=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	—	0.3	1.0	A	V_{CC}=25V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when "H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

BA09ST (unless otherwise noted, Ta=25℃, V_{CC}=14V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	V_{O1}	8.45	9.0	9.55	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=10→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=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	V_{CC}=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	—	0.3	1.0	A	V_{CC}=25V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when "H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

BA10ST (unless otherwise noted, Ta=25℃, V_{CC}=15V, Io=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	V_{O1}	9.5	10	10.5	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=11→25V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=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	V_{CC}=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	—	0.3	1.0	A	V_{CC}=25V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when "H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

BA12ST (unless otherwise noted, Ta=25℃, V_{CC}=17V, I_O=500mA)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	V_{O1}	11.4	12	12.6	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=13.5→27V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=1Vrms, f=120Hz, I_O=100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I_O=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	—	±0.02	—	% / ℃	I_O=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	—	0.3	0.5	V	V_{CC}=11.4V	Fig.3
Bias current	Ib	—	2.5	5.0	mA	I_O=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	—	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	—	0.3	1.0	A	V_{CC}=27V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when "H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

BA15ST (unless otherwise noted, Ta=25℃, V_{CC}=20V, I_O=500mA)　(Under development)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output voltage	V_{O1}	14.25	15	15.75	V		Fig.1
Input regulation	Reg.I	—	20	100	mV	V_{CC}=17→30V	Fig.1
Ripple rejection	R.R.	45	55	—	dB	e_{IN}=1Vrms, f=120Hz, I_O=100mA	Fig.2
Load regulation	Reg.L	—	50	150	mV	I_O=5mA→1A	Fig.1
Temperature coefficient of output voltage	Tcvo	—	±0.02	—	% / ℃	I_O=5mA, Tj=0→125℃	Fig.1
Dropout voltage	Vd	—	0.3	0.5	V	V_{CC}=14.25V	Fig.3
Bias current	Ib	—	2.5	5.0	mA	I_O=0mA	Fig.4
Peak output current	Io-p	1.0	1.5	—	A	Tj=25℃	Fig.1
Short-circuit output current	Ios	—	0.3	1.0	A	V_{CC}=30V	Fig.5
ON mode voltage	Vth1	2.0	—	—	V	Output Active mode	Fig.6
OFF mode voltage	Vth2	—	—	0.8	V	Output OFF mode	Fig.6
Input current when "H"	I_{IN}	—	150	—	μA	CTL=5V	Fig.6

●Measurement circuits

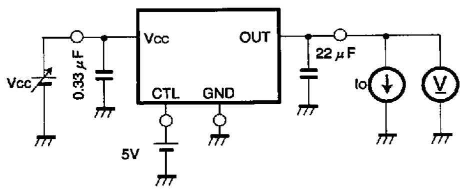
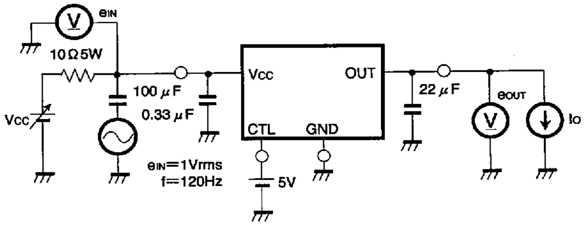


Fig.1 Measurement circuit for output voltage, input regulation, load regulation, and temperature coefficient of output voltage



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

Fig.2 Measurement circuit for ripple rejection ratio

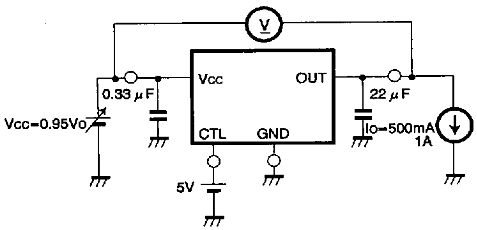


Fig.3 Measurement circuit for dropout voltage

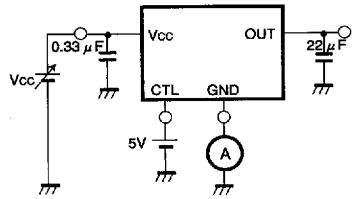


Fig.4 Measurement circuit for bias current

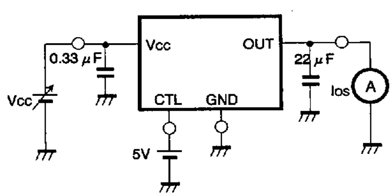


Fig.5 Measurement circuit for short-circuit output current

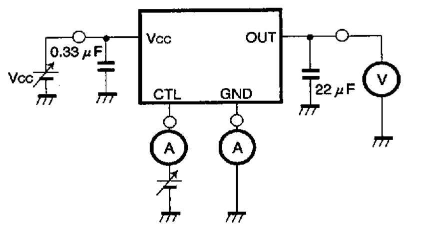


Fig.6 Measurement circuit for ON/OFF mode voltage, input current when “ H”

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●Operation notes

1. Although the circuit examples included in this handbook are highly recommendable for general use, you should be thoroughly familiar with circuit characteristics as they relate to your own use 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 parts and Rohm ICs. In addition, 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 bias capacitors
   Always use a capacitor between the output pins and the GND to prevent fluctuation in the output and to prevent oscillation between the output pins and the GND. (A capacitor greater than 10 μF for all temperature ranges should be used.)
   Changes in the temperature and other factors can cause the capacitance of the capacitor to change, and this can cause oscillation. To prevent this, we recommend using a tantalum capacitor which has minimal changes in nominal capacitance.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. Current overload protection circuit
   A current overload protection circuit is built into the outputs, 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 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 various outputs are in the OFF state. 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 of the various outputs. Use of a diode or other such bypass path is recommended.
8. Although the manufacture of this product includes rigorous quality assurance procedures, it may be damaged if absolute maximum ratings for voltage or operating temperature are exceeded. When 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 there is a slight possibility of malfunction.

●Electrical characteristic curves

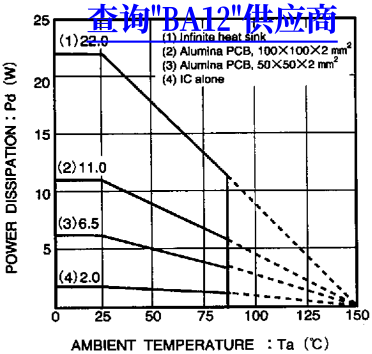

Fig. 7 Ambient temperature - power dissipation characteristic

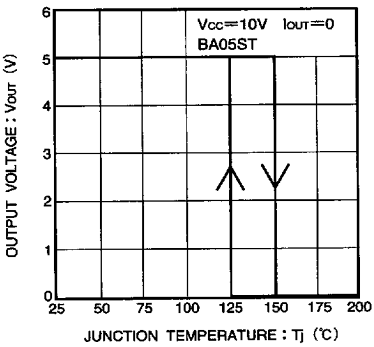

Fig. 8 Thermal cutoff circuit characteristic

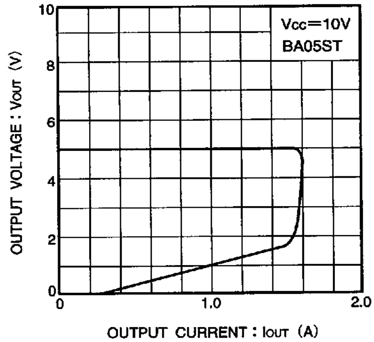

Fig. 9 Current limit characteristic

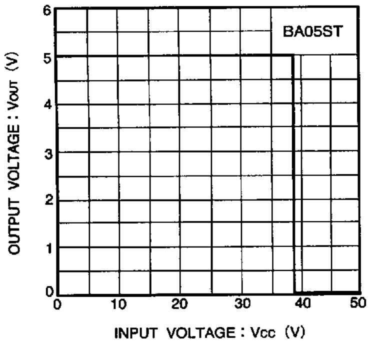

Fig. 10 Over voltage protection characteristic

●External dimensions (Units: mm)