

# Step-down type switching power supply

## BA9771T

**under  
development**

The BA9771T step-down type switching power supply accepts a maximum input voltage of 46V, and can output a maximum current of 1.5A. The output voltage can be set from 5 to 40V using external resistors.

### ●Applications

Printers and car stereos

### ●Features

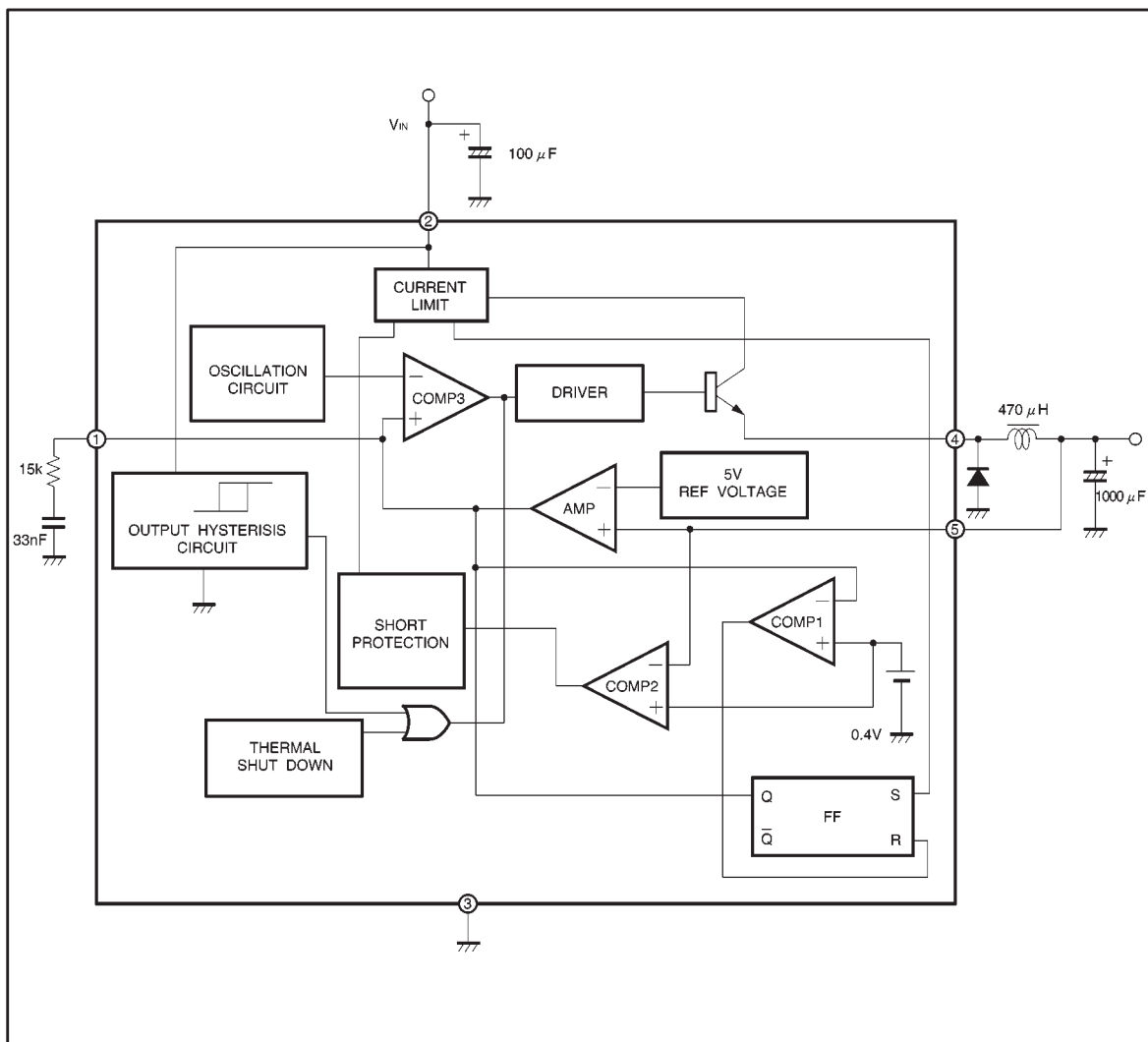
- 1) Output voltage can be set from 5V (Vref) to 40V.
- 2) Output current capacity is 1.5A.
- 3) Output current limiter circuit on the chip prevents the chip from destruction in the case of a short circuit in the output.
- 4) A temperature protection circuit protects the IC from destruction due to heat generated by excessive loads.
- 5) Ideal as a power supply for printers.
- 6) TO220FP-5 package is perfect for compact designs.

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

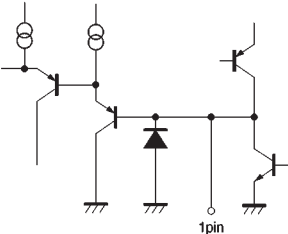
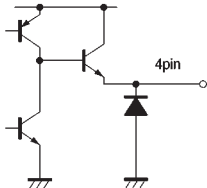
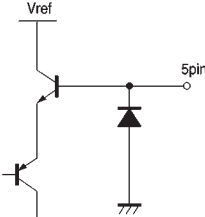
Parameter	Symbol	Limits	Unit
Supply voltage	V <sub>CC</sub>	50	V
Power dissipation	P <sub>d</sub>	2000*	mW
Operating temperature	T <sub>opr</sub>	-30~+85	°C
Storage temperature	T <sub>stg</sub>	-55~+150	°C
Pin 1 and pin 5 voltages	V1, V5	5.5	V

\*Reduced by 16mW for each increase in Ta of 1°C over 25°C  
(in the case that a heatsink is not used) .

## ● Block diagram



●Input / output circuits

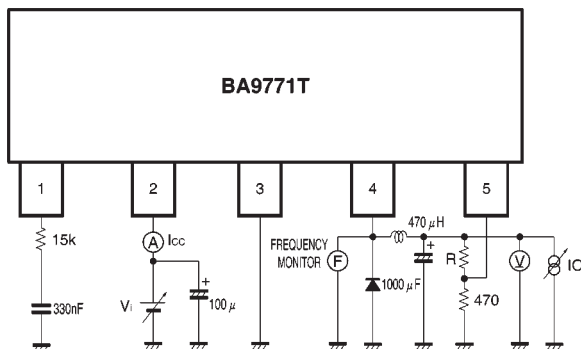
Pin No.	Pin name	Pin Descriptions	Equivalent I/O circuit
1	FC (FREQUENCY COMPENSATION)	By connecting a series RC circuit between the FC pin and GND, the frequency characteristics can be stabilized.	
2	INPUT	Power supply pin	—
3	GND	Ground pin	—
4	OUTPUT	Output pin	
5	FEEDBACK	Regulator feedback pin. 5V output can be obtained when this is directly connected to pin 4. Using a resistor divider, the output voltage can be set between 5V and 40V.	

●Electrical characteristics (unless otherwise noted, Ta = 25°C, Vi = 35V, Vo = Vref)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Coniditions	Measurement circuit
Output voltage	Vo	Vref	—	40	V	Vi=46V, Io=1A	Fig.1
Input voltage range	Vi	9	—	46	V	Vo=Vref~40V	Fig.1
Circuit current	Iq	—	9	14	mA	Duty 0%, Vi=46V, Io=0A	Fig.1
Voltage stability	$\Delta V_{oi}$	—	15	50	mV	Vi=9~46V, Io=1A	Fig.1
Load stability	$\Delta V_{ol}$	—	15	45	mV	Io=0.2~1.5A	Fig.1
Reference voltage	Vref	4.75	5	5.25	V	Io=1A	Fig.1
Thermal characteristics*1	$\Delta V_{ref} / \Delta T$	—	+0.5	—	mV / °C	Tj=0~125°C, Io=10mA	Fig.1
Minimum I / O voltage difference	$\Delta V_o$	—	1.5	2	V	Io=1.5A	Fig.2
Maximum output current	Iom	1.5	2.5	—	A	Vi=9~46V, Vo=Vref~40V	Fig.1
Output short circuit current	I <sub>s</sub>	—	0.5	1.0	A	Vi=46V	Fig.3
Efficiency	$\eta$	—	70	—	%	Io=1.0A	Fig.1
Ripple rejection	RR	50	56	—	dB	$\Delta V_i=2V_{rms}$ , f=100Hz Io=1A	Fig.4
Frequency voltage dependence	$\Delta f / \Delta V_i$	—	+0.02	—	% / V	Vi=9~46V	Fig.1
Frequency temperature dependence*1	$\Delta f / \Delta T_j$	—	−0.28	—	% / °C	Tj=0~125°C	Fig.1
Frequency range	f	75	100	130	kHz		Fig.1
Output leak current	I <sub>l</sub>	—	—	1	mA		Fig.5

\*1 Design guaranteed (not calculated for all values).

## ● Measurement circuits



Caution) If  $R=0$ ,  $V_o=V_{ref}$ ;  $V_o = \frac{470+R}{470} \times V_{ref}$

Fig.1

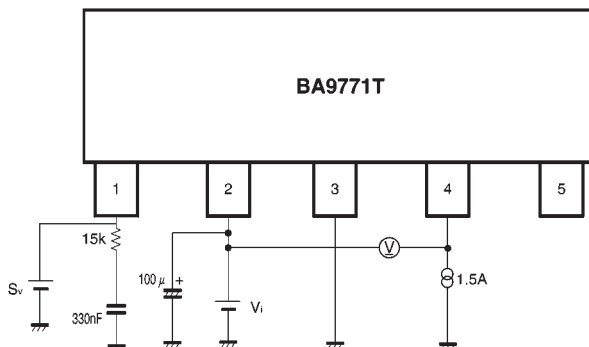
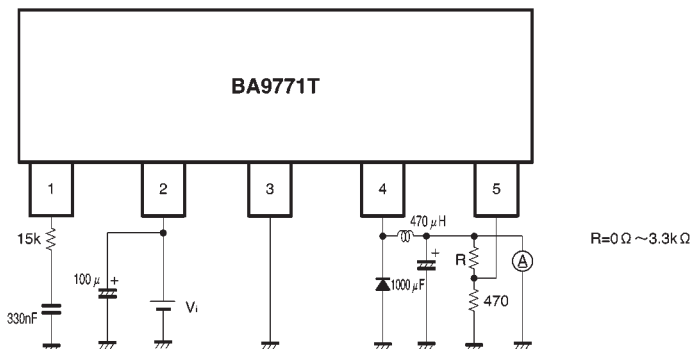


Fig.2 Min input-output voltage difference



Caution) Short-circuit current is measured by average current at output

Fig.3 Output short current

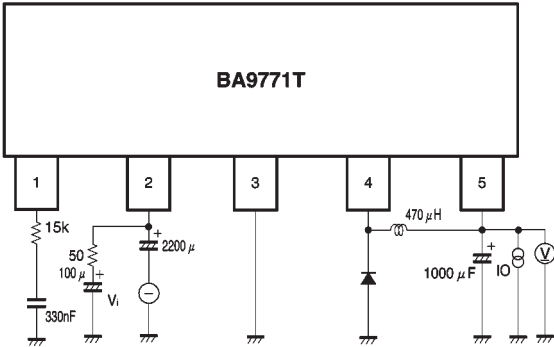


Fig.4 Ripple rejection

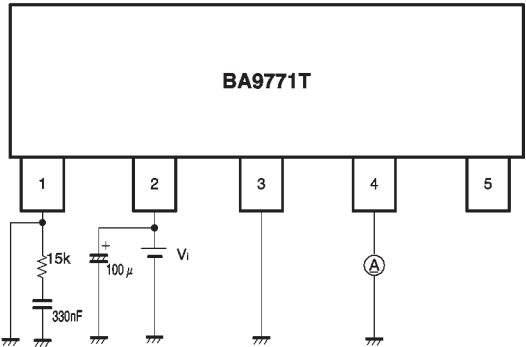
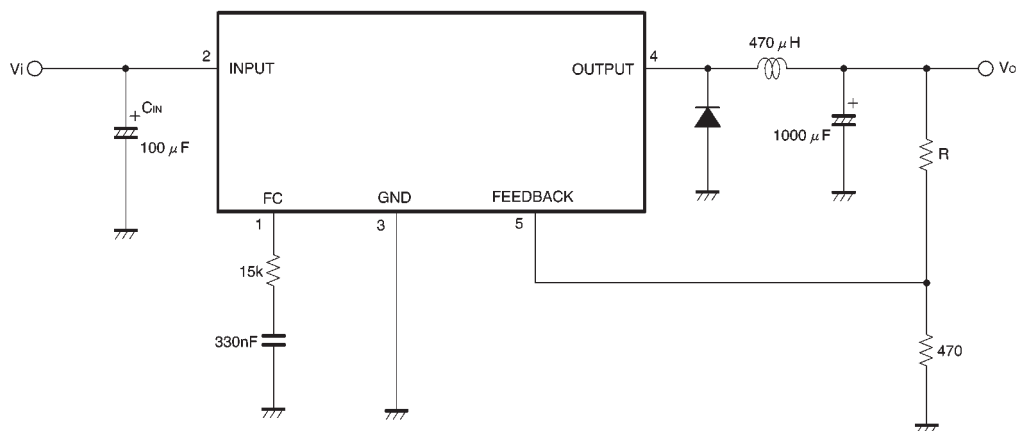


Fig.5 Output leak current

## ●Application example



$$V_o = \frac{470 + R}{470} \times V_{ref} \text{ (V)}$$

Fig.6

### ● Operation notes

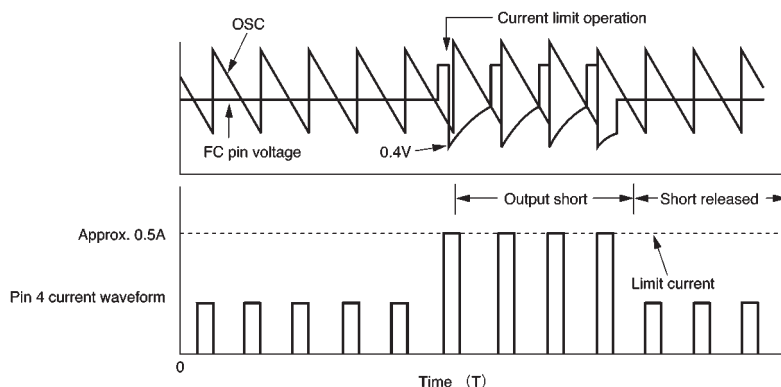
(1) The over-current protection circuit and short circuit protection limit the current to a maximum of 2.5A (Typ.). When the pin 5 voltage is clamped to a voltage above 0.4V, the 2.5A current is internally set to a duty cycle about 10% to protect the IC. However, in this case, it is normal for the coil current to be 2.5A, so even if it is possible to clamp the pin 5 voltage to a voltage above 0.4V, you should confirm that there are no problems with the overall set.

In addition to the above operation, if you lower the pin 5 voltage to below 0.4V, the circuit will interpret this as an output short circuit, and in addition to applying a current limit of 0.5A (Typ.), the pin 4 output will be switched on and off repeatedly with a duty cycle about 10% in the same way as for when the pin 5 voltage was over 0.4V (see the diagram below).

However, to ensure that the short circuit protection operates correctly, we recommend that you connect a 15k $\Omega$  resistor and 330nF capacitor in series with the FC pin (pin 1), as shown in Fig. 6.

If there is no problem with the basic circuit operation, the resistor connected to pin 1 can be made lower than 15k $\Omega$ , but if it is made larger than 15k $\Omega$ , the short circuit current will become larger than 1A, so care is required.

For the capacitor, if a component with a value larger than 330nF is not used, the short circuit current may become greater than 1A.



### (2) Rising and falling characteristics

The output voltage has hysteresis, and begins to rise when the power supply voltage is 8V, and fall when the power supply voltage is 3V. The hysteresis is determined by a resistor and a diode, and has a temperature derating of  $-30\text{mV} / ^\circ\text{C}$ .

## ●Electrical characteristics curves

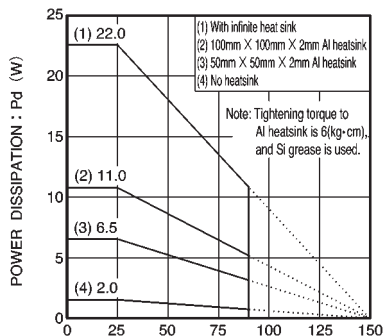
AMBIENT TEMPERATURE :  $T_a$  (°C)

Fig.7 Thermal dissipation curve

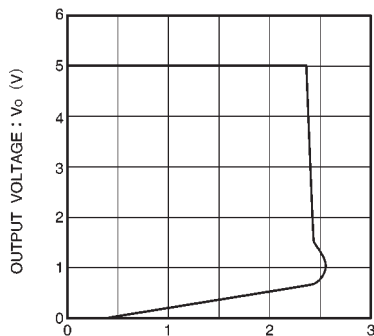
OUTPUT CURRENT :  $I_o$  (A)

Fig.8 Output voltage vs. output current

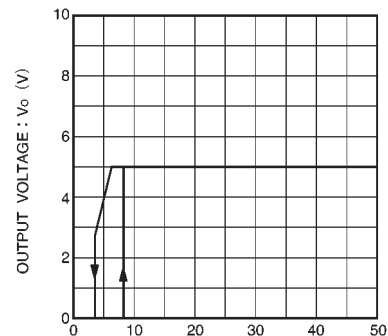
INPUT VOLTAGE :  $V_i$  (V)

Fig.9 Output voltage vs. input current

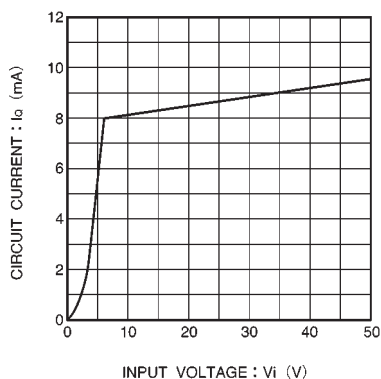
INPUT VOLTAGE :  $V_i$  (V)

Fig.10 Circuit current vs. input voltage

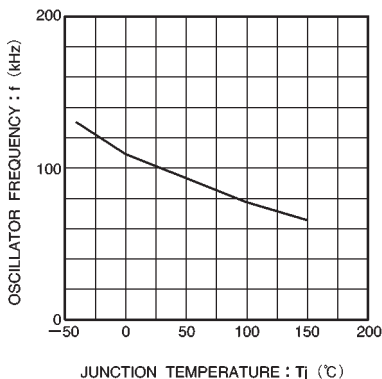
JUNCTION TEMPERATURE :  $T_j$  (°C)

Fig.11 Oscillator frequency vs. junction temperature

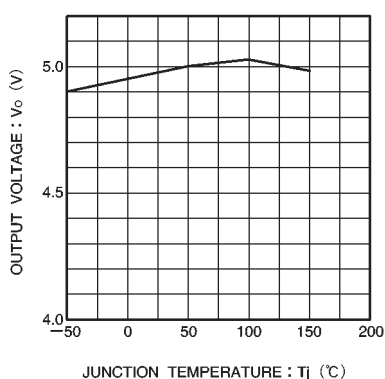
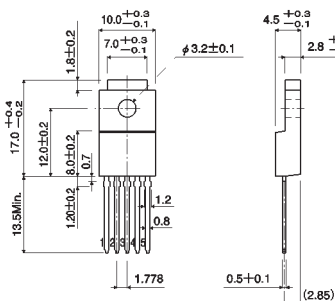
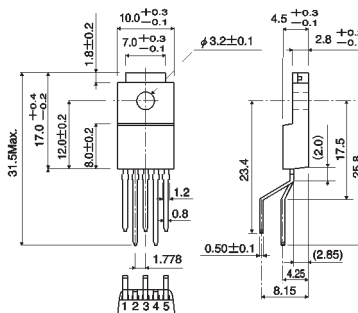
JUNCTION TEMPERATURE :  $T_j$  (°C)

Fig.12 Output voltage vs. junction temperature

## ●External dimensions (Units: mm)



TO220FP-5



TO220FP-5(V5)