

## ■ Description

The FA7610CP(N), 7612CP(N) and 7617CP(N) are bipolar ICs containing basic circuits necessary for PWM-type switching power supply control. To minimize the number of external discrete components, the FA7610CP(N) is provided for a flyback or step-up power-supply circuit, the FA7612CP(N) for a step-down power-supply circuit and FA7617CP(N) for a flyback power supply circuit.

## ■ Features

### FA7610CP(N)

- For flyback transformer-type or step-up power-supply circuit (maximum output duty = 64% typical)
- Totem-pole predriver
- PWM-type switching power supply control
- Low-voltage operation ( $V_{CC} = 3.6$  to  $22V$ )
- Latch-mode short-circuit protection function (no malfunction by noise)
- Soft-start function
- Undervoltage lockout function
- One capacitor shared for short circuit protection and for soft-start to minimize the number of external discrete components

### FA7612CP(N)

- For step-down power-supply circuit (maximum output duty = up to 100%)
- Open collector output
- PWM-type switching power supply control
- Low-voltage operation ( $V_{CC} = 3.6$  to  $22V$ )
- Latch-mode short-circuit protection function (no malfunction by noise)
- Soft-start function
- Undervoltage lockout function
- One capacitor shared for short circuit protection and for soft-start to minimize the number of external discrete components

### FA7617CP(N)

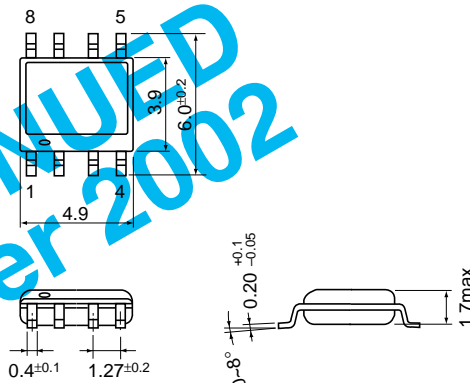
- For flyback transformer-type power-supply circuit (maximum output duty = 67% typical)
- Open collector output
- PWM-type switching power supply control
- Low-voltage operation ( $V_{CC} = 3.6$  to  $22V$ )
- Latch-mode short-circuit protection function (no malfunction by noise)
- Soft-start function
- Undervoltage lockout function
- One capacitor shared for short circuit protection and for soft-start to minimize the number of external discrete components

## ■ Applications

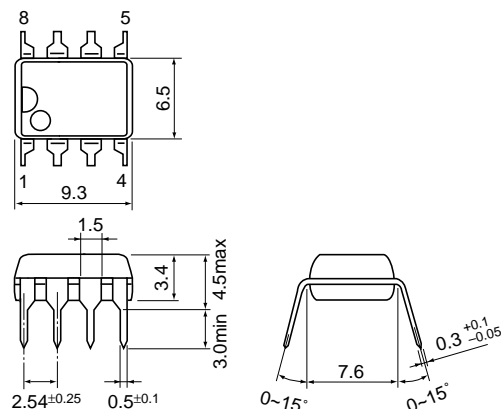
- Battery power supply for portable equipment

## ■ Dimensions, mm

### • SOP-8

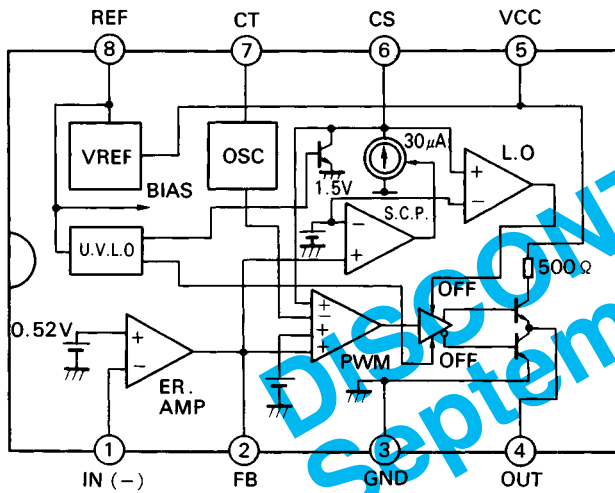


### • DIP-8



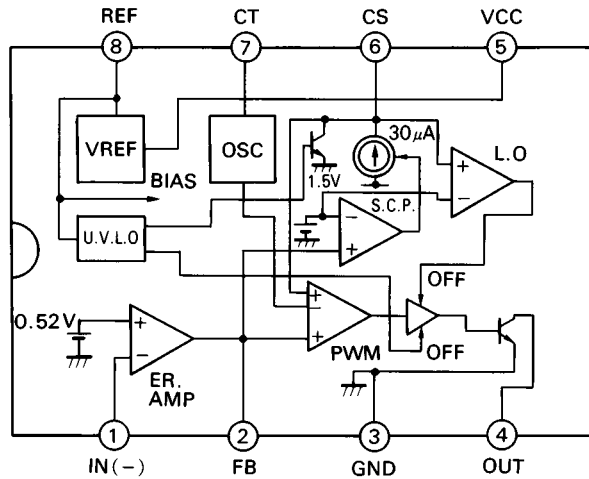
# ■ Block diagram

## ● FA7610CP(N)



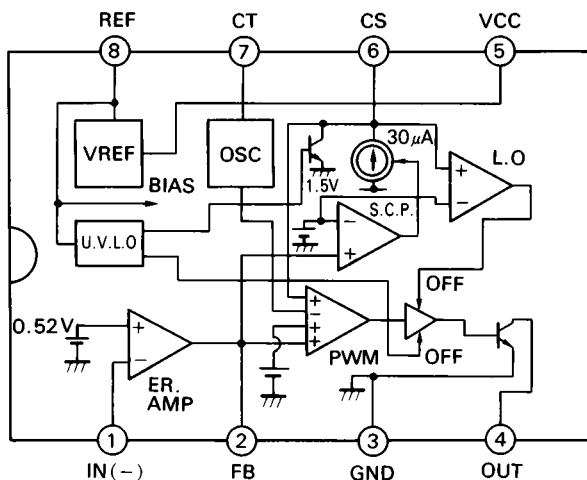
Pin No.	Pin symbol	Description
1	IN (-)	Inverting input to error amplifier
2	FB	Error amplifier output
3	GND	Ground
4	OUT	Output
5	VCC	Power supply
6	CS	Capacitor for soft-start, short-circuit protection and delay
7	CT	Oscillator timing capacitor
8	REF	Reference voltage output (2.5V)

## ● FA7612CP(N)



Pin No.	Pin symbol	Description
1	IN (-)	Inverting input to error amplifier
2	FB	Error amplifier output
3	GND	Ground
4	OUT	Output
5	VCC	Power supply
6	CS	Capacitor for soft-start, short-circuit protection and delay
7	CT	Oscillator timing capacitor
8	REF	Reference voltage output (2.5V)

## ● FA7617CP(N)



Pin No.	Pin symbol	Description
1	IN (-)	Inverting input to error amplifier
2	FB	Error amplifier output
3	GND	Ground
4	OUT	Output
5	VCC	Power supply
6	CS	Capacitor for soft-start, short-circuit protection and delay
7	CT	Oscillator timing capacitor
8	REF	Reference voltage output (2.5V)

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

Item	Symbol	Rating		Unit
		FA7610C	FA7612C/17C	
Supply voltage	V <sub>CC</sub>	22	22	V
Reference voltage output current	I <sub>OR</sub>	5	5	mA
Output current	I <sub>O</sub>	±50	80	mA
Total power dissipation	P <sub>d</sub>	400	400	mW
Operating temperature	T <sub>opr</sub>	−20 to +85	−20 to +85	°C
Storage temperature	T <sub>stg</sub>	−40 to +150	−40 to +150	°C

## ■ Recommended operating conditions

Item	Symbol	FA7610C		FA7612/17C		Unit
		Min.	Max.	Min.	Max.	
Supply voltage	V <sub>CC</sub>	3.6	20	3.6	20	V
Feedback resistance	R <sub>NF</sub>	100		100		kΩ
Oscillator timing capacitor	C <sub>T</sub>	220	22,000	220	22,000	pF
Oscillator timing resistance	R <sub>T</sub>	10	100	10	100	kΩ
Oscillation frequency	f <sub>osc</sub>	5	200	5	500	kHz

■ Electrical characteristics (Ta = 25°C, V<sub>CC</sub> = 6V, R<sub>T</sub> = 33kΩ, C<sub>T</sub> = 1000pF)

## Reference voltage section Common to FA7610C/12C/17C

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Output voltage	V <sub>REF</sub>	I <sub>OR</sub> = 1mA	2.528	2.580	2.632	V
Line regulation	LINE	V <sub>CC</sub> = 3.6 to 20V, I <sub>OR</sub> = 1mA		4	12	mV
Load regulation	LOAD	I <sub>OR</sub> = 0.1 to 1mA		1	6	mV
Output voltage variation due to temperature change	V <sub>TC1</sub>	Ta = −20 to +25°C	−1		1	%
	V <sub>TC2</sub>	Ta = +25 to +85°C	−1		1	%

## Oscillator section Common to FA7610C/12C/17C

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Oscillation frequency	f <sub>osc</sub>	C <sub>T</sub> = 1000pF, R <sub>T</sub> = 33kΩ	100	111	122	kHz
Frequency variation 1 (due to supply voltage change)	f <sub>dV</sub>	V <sub>CC</sub> = 3.6 to 20V		1		%
Frequency variation 2 (due to temperature change)	f <sub>dT</sub>	Ta = −20 to +85°C		5		%

## Error amplifier section Common to FA7610C/12C/17C

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Reference voltage	V <sub>B</sub>		0.515	0.525	0.535	V
Input bias current	I <sub>B</sub>			5	100	nA
Open-loop voltage gain	A <sub>V</sub>		70			dB
Unity-gain bandwidth	G <sub>B</sub>			0.6		MHz
Maximum output voltage (Pin 2)	V <sub>OM+</sub>	R <sub>NF</sub> = 100kΩ	V <sub>REF</sub> − 0.2			V
	V <sub>OM−</sub>	R <sub>NF</sub> = 100kΩ			200	mV
Output source current (Pin 2)	I <sub>OM+</sub>	V <sub>OM</sub> = 1V	40	85	200	μA

## PWM comparator section

Item	Symbol	Test condition	FA7610C			FA7612C			FA7617C			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Input threshold voltage (pin 2)	V <sub>TH0</sub>	Duty cycle = 0%		0.85	0.95		0.85	0.95		0.85	0.95	V
Input threshold voltage (pin 2)	V <sub>TH50</sub>	Duty cycle = 50%		1.1			1.1			1.1		V
Maximum duty cycle	α <sub>M</sub>	(Pin 2 = 1.2V)	58	64	75		100		63	67	71	%

**Soft-start circuit section** Common to FA7610C/12C/17C

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input bias current (Pin 6)	IBCS			80	300	nA
Input threshold voltage (Pin 6)	V <sub>TH CS0</sub>	Duty cycle = 0%		0.22	0.32	V
Input threshold voltage (Pin 6)	V <sub>TH CS50</sub>	Duty cycle = 50%		0.46		V

**Short-circuit protection circuit section** Common to FA7610C/12C/17C

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input threshold voltage (Pin 2)	V <sub>TH PC</sub>		1.20	1.50	1.80	V
Charge current (Pin 6)	I <sub>CHG</sub>	Pin 6 = 0V, Pin 2 = 2V	20	30	40	μA
Latch-mode threshold voltage (Pin 6)	V <sub>TH LA</sub>		1.20	1.50	1.80	V

**Undervoltage lockout circuit section** Common to FA7610C/12C/17C

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
OFF-to-ON threshold voltage	V <sub>TH ON</sub>			2.70		V
ON-to-OFF threshold voltage	V <sub>TH OFF</sub>			2.52		V
Voltage hysteresis	V <sub>HYS</sub>		60	180		mV

**Output section**

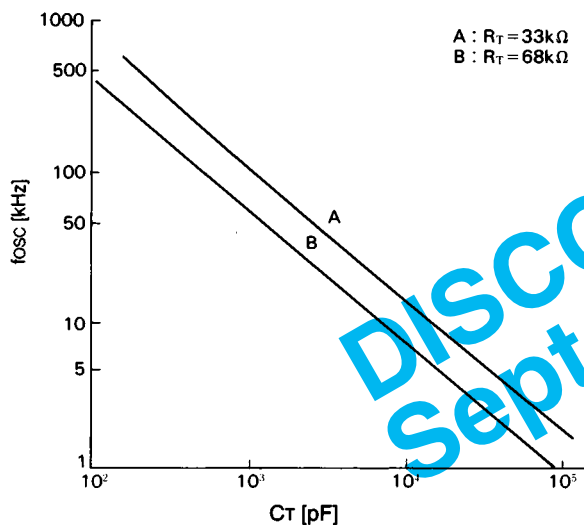
Item	Symbol	Test condition	FA7610C			FA7612C/17C			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
H-level output voltage (Pin 4)	V <sub>OH</sub>	R <sub>L</sub> = 10kΩ	3.5	4.0		—	—	—	V
L-level output voltage (Pin 4)	V <sub>OL</sub>	Output sink current = 20mA		0.25	0.65		0.9	1.5	V
Output source current (Pin 4)	I <sub>SOURCE</sub>	Pin 4 = 0V	8	11	14	—	—	—	mA

**Overall device**

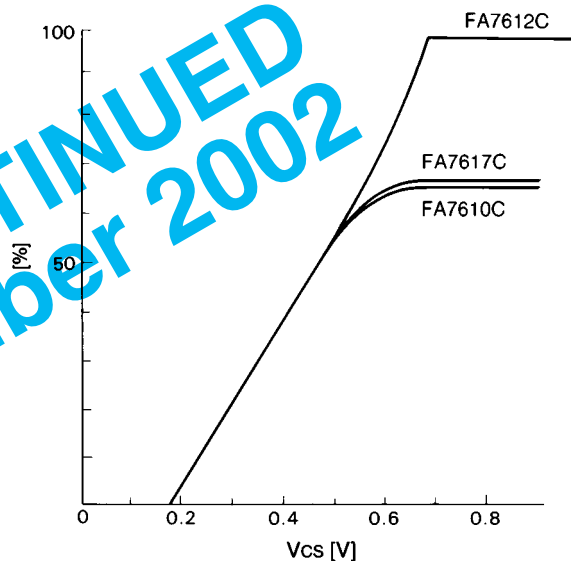
Item	Symbol	Test condition	FA7610C			FA7612C/17C			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Supply current	I <sub>CC LA</sub>	Latch mode		1.6	2.2		1.5	2.2	mA
Operating-state supply current	I <sub>CC AV</sub>	R <sub>L</sub> = ∞ Duty cycle = 50%		2.6	3.8		1.8	3.0	mA

■ Characteristic curves ( $T_a = 25^\circ\text{C}$ )

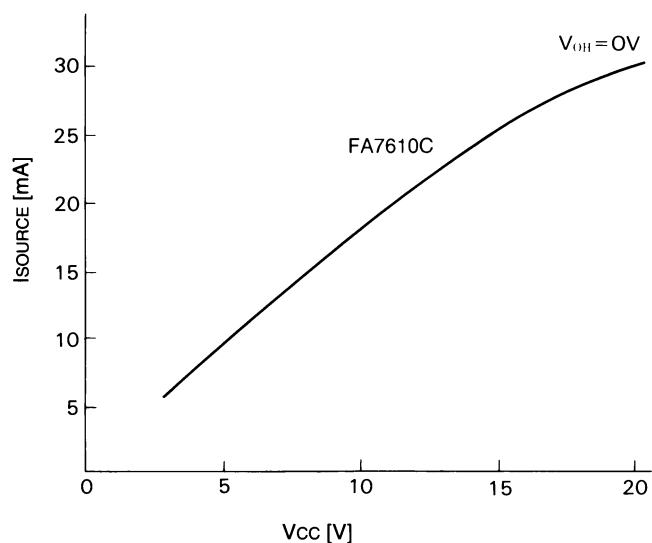
Oscillation frequency( $f_{osc}$ ) vs. timing capacitor capacitance( $C_T$ )



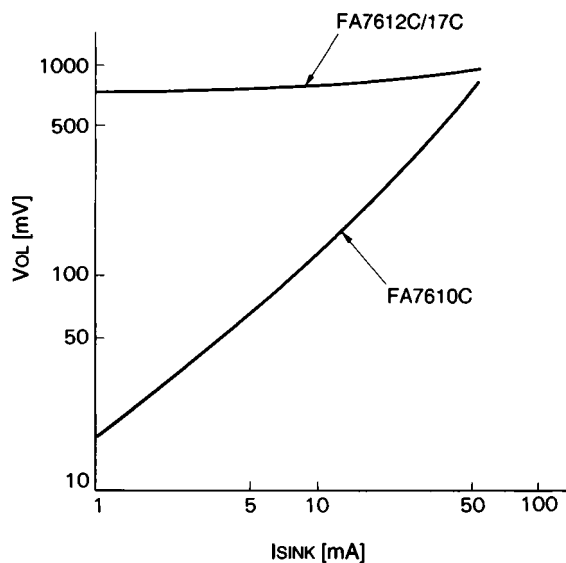
Output duty cycle vs. CS terminal voltage( $V_{cs}$ )



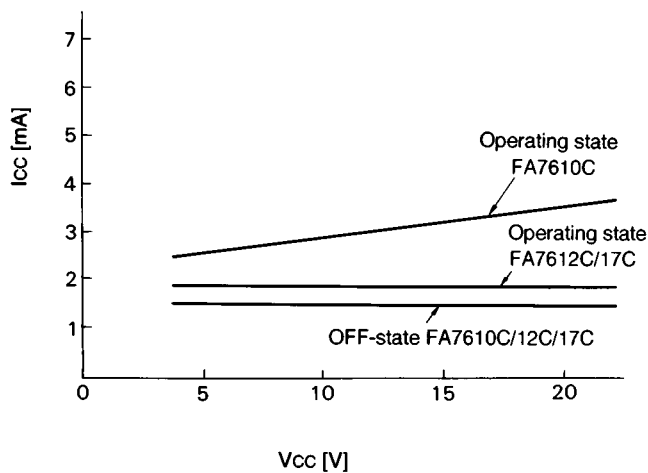
Output source current ( $I_{source}$ ) vs. supply voltage( $V_{cc}$ )



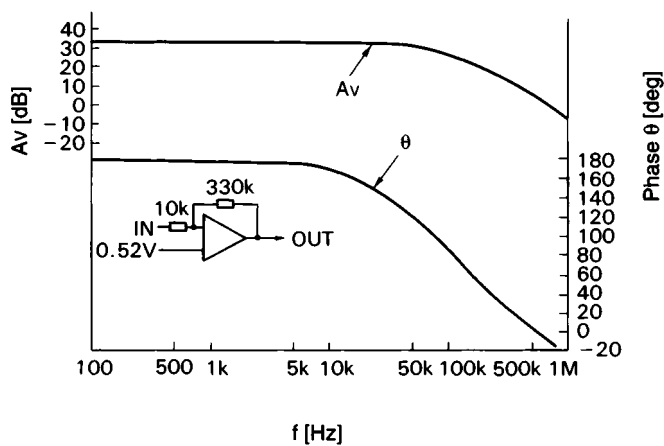
L-level output voltage( $V_{OL}$ ) vs. output sink current ( $I_{sink}$ )



Supply current( $I_{cc}$ ) vs. supply voltage( $V_{cc}$ )



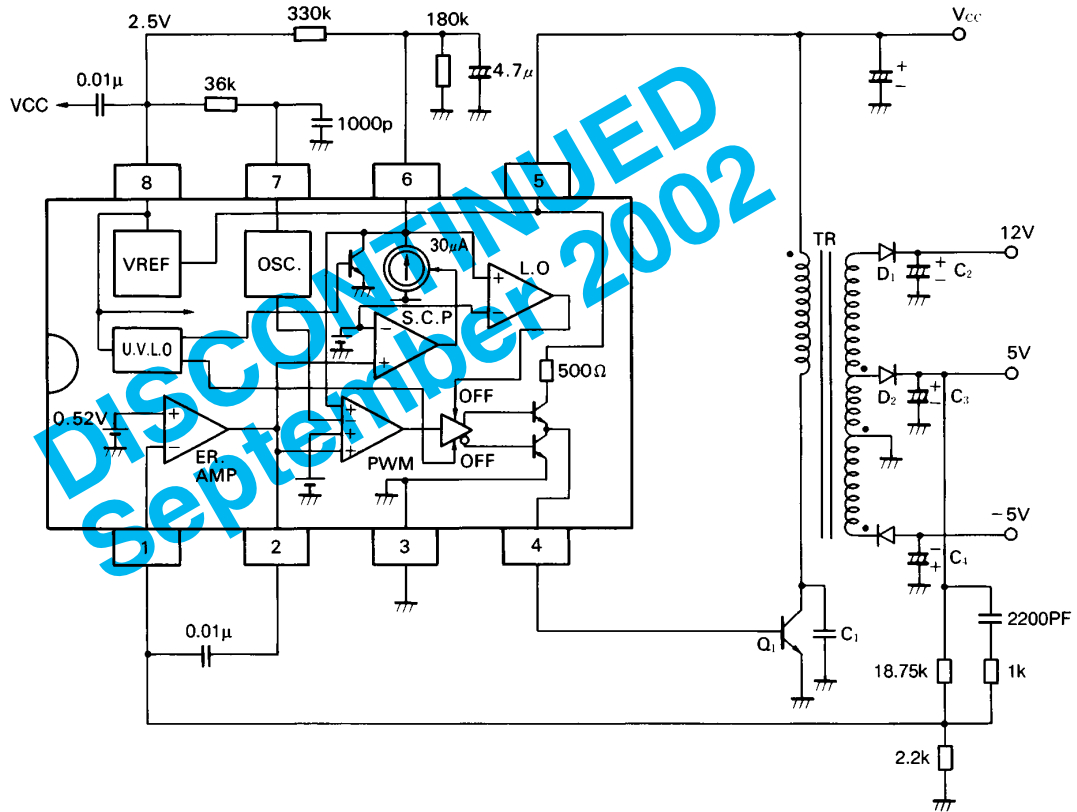
Error amplifier frequency( $f$ ) vs. voltage gain( $A_V$ ) / phase ( $\theta$ )



## ■ Application circuit

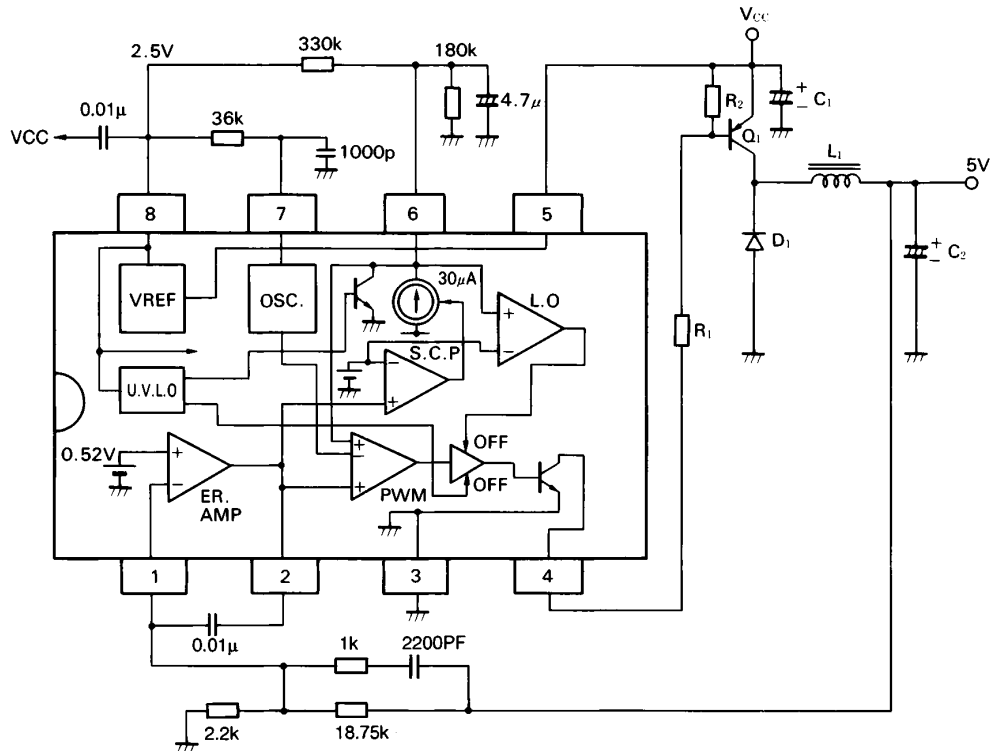
### ● FA7610CP(N)

#### Flyback-transformer type converter circuit



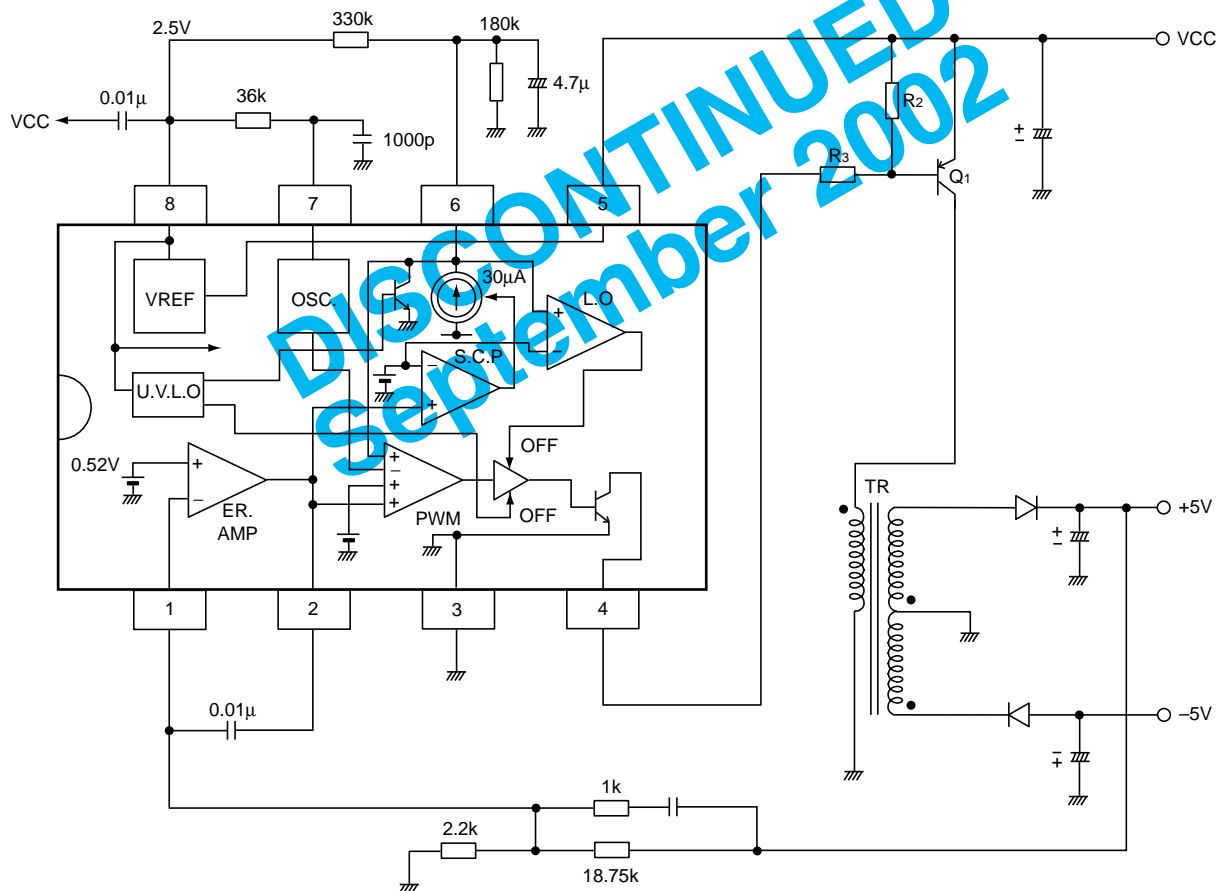
### ● FA7612CP(N)

#### Chopper type buck converter circuit



• FA7617CP(N)

Flyback-transformer type converter circuit



Parts tolerances characteristics are not defined in the circuit design sample shown above. When designing an actual circuit for a product, you must determine parts tolerances and characteristics for safe and economical operation.

Please connect a capacitor, which the value is about  $0.01\mu\text{F}$  to  $0.1\mu\text{F}$ , between VCC and REF terminals in order to prevent from irregular output pulse at start up.

## WARNING

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