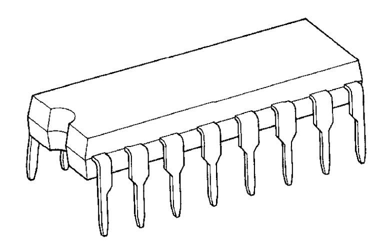
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA7715P

FREQUENCY TO VOLTAGE CONVERTER

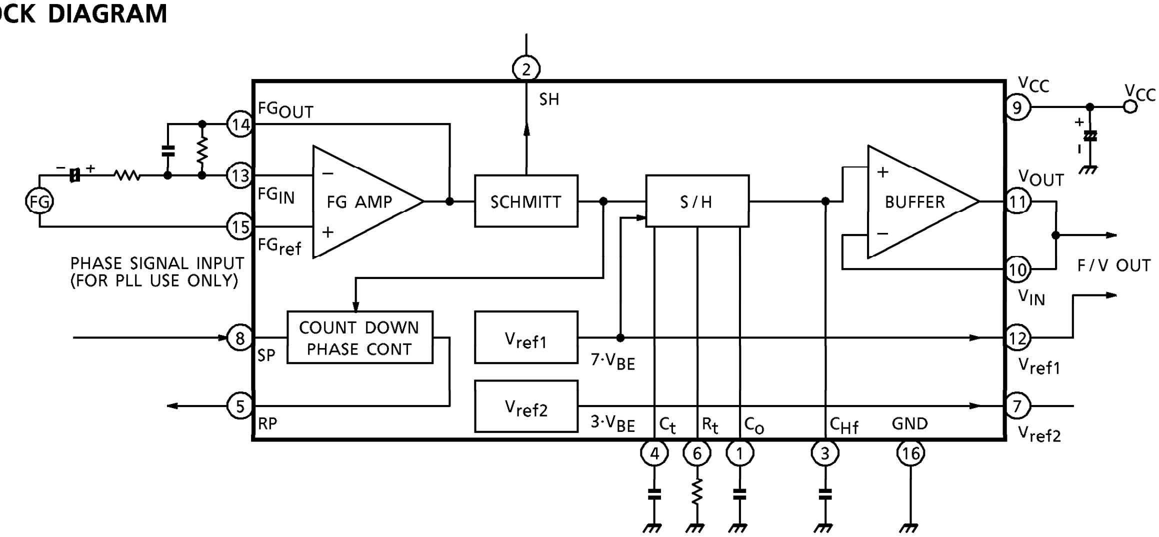
The TA7715P is a general purpose F-V converter designed for FDD, VTR, ATR and player F-servo system use.
It contains High Gain Input Amplifier, Hysteresis Amplifier (for wave form shapping), and Sample-and-Hold type F-V conversion amplifier.



DIP16-P-300-2.54A

Weight : 1.11g (Typ.)

BLOCK DIAGRAM



PIN FUNCTION

PIN No.	SYMBOL	FUNCTIONAL DESCRIPTION
1	C_o	Capacitor connection terminal for setting time constans (for F / V Amp.)
2	SH	Schmitt Amp. output terminal
3	C_{Hf}	Capacitor connection terminal forgetting time constants (for F / V buffer Amp.)
4	C_t	Capacitor connection terminal for setting time constants
5	RP	Phase control signal output terminal
6	R_t	Resistor connection terminal for setting time constants
7	V_{ref2}	Internal reference voltage output terminal
8	SP	Phase control signal input terminal
9	V_{CC}	Power supply input terminal
10	V_{IN}	Buffer Amp. negative input terminal
11	V_{OUT}	Buffer Amp. output terminal
12	V_{ref1}	F / V Amp. reference voltage output terminal
13	FG_{IN}	FG Amp. negative-side input terminal
14	FG_{OUT}	FG Amp. output terminal
15	FG_{ref}	FG Amp. positive-side input terminal
16	GND	GND terminal

OPERATION

TA7715P outputs control signals (F / V conversion output) generated by the sample and hold (S / H) circuit for each cycle of the frequency signal output.
Consequently, TA7715P offers a superior response to methods counting the monostable multivibrator cycles or the input signal cycles to drive a D / A converter and output a latched result.
Fig.1 shows the input FG amp circuit, which amplifies the weak FG signal.
The Schmitt circuit in the next stage has the required hysteresis for wave-shaping and generates the signals needed for S / H.
S / H operations are based on the waveform-shaped FG output from the SH terminal (pin②). That is, the time constant capacitor C_t (pin④) is momentarily charged to the internal reference voltage $10 \cdot V_{BE}$ when the SH pulse (pin②) falls.
The hold pulse and reset pulse required for the S / H operation are generated by the voltage of this capacitor. The hold pulse is output until the voltage falls to $9 \cdot V_{BE}$. The reset pulse is output while the voltage is falling between $9 \cdot V_{BE}$ and $5 \cdot V_{BE}$.
The voltage of the C_t is discharged by the constant current (I_{O2}), which is determined by resistor R_t connected to the R_t terminal (pin⑥).
The S / H operation is based on the hold and reset pulses generated by the changes in the C_t voltage.
First, capacitor C_o, which is connected to the C_o terminal (pin①), is momentarily charged to $10 \cdot V_{BE}$ by the reset pulse and discharged by the constant current (I_{O3}), which is determined by R_t. F / V conversion is performed by designating the discharge time as the time from the reset pulse fall to the hold pulse rise.

In other words, the F / V conversion output is performed by retaining the C_o terminal output with the hold pulse. (Fig.3)
The C_o output is transferred to C_{Hf} in the circuit and output through the buffer amp. The buffer amp output (V_{OUT} pin, pin⑪) changes to $\pm 3 \cdot V_{BE}$ with $7 \cdot V_{BE}$ as the center, that is, within the range of $4 \cdot V_{BE} \sim 10 \cdot V_{BE}$, according to the input frequency. Thus, the F / V conversion output is obtained by the output differential with the potential of the V_{ref1} terminal (pin⑫), which has a reference voltage of $7 \cdot V_{BE}$.
In addition, the conversion output can be amplified by the buffer amp using direct current. The gain in the Fig.2 example is a multiple of ((Ra + Rb) / Rb).
Although unlike C_o, C_t, and R_t, the C_{Hf} value does not need to be precise, too large a value causes deterioration in response characteristics.
Too small a value causes F / V conversion error due to leakage.
If the FG frequency is in the range of 500~1kHz, use the values indicated in the application circuits.

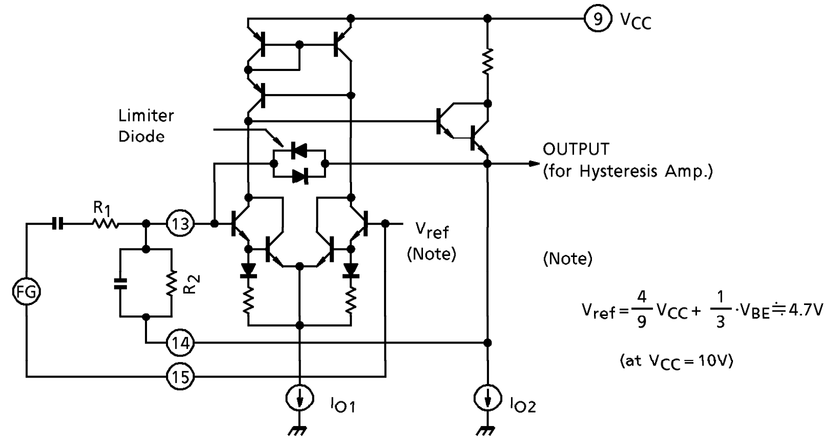


Fig.1 FG Amp.

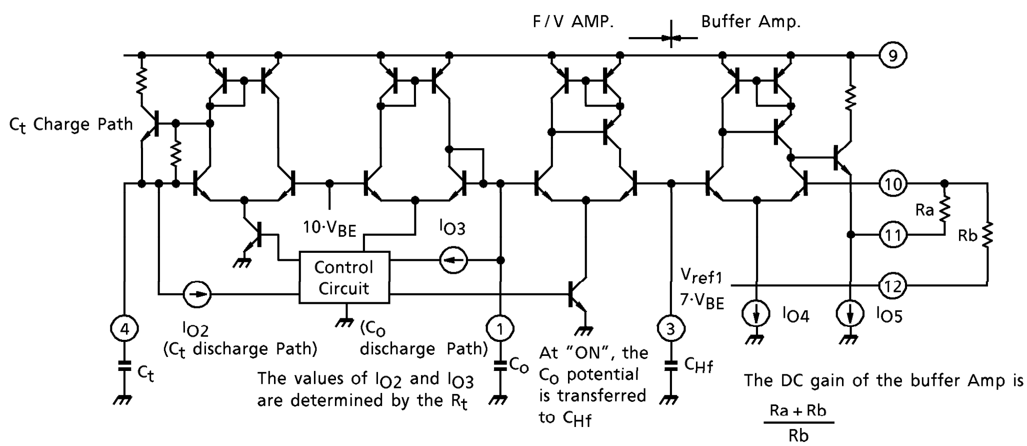


Fig.2 S / H, buffer Amp.

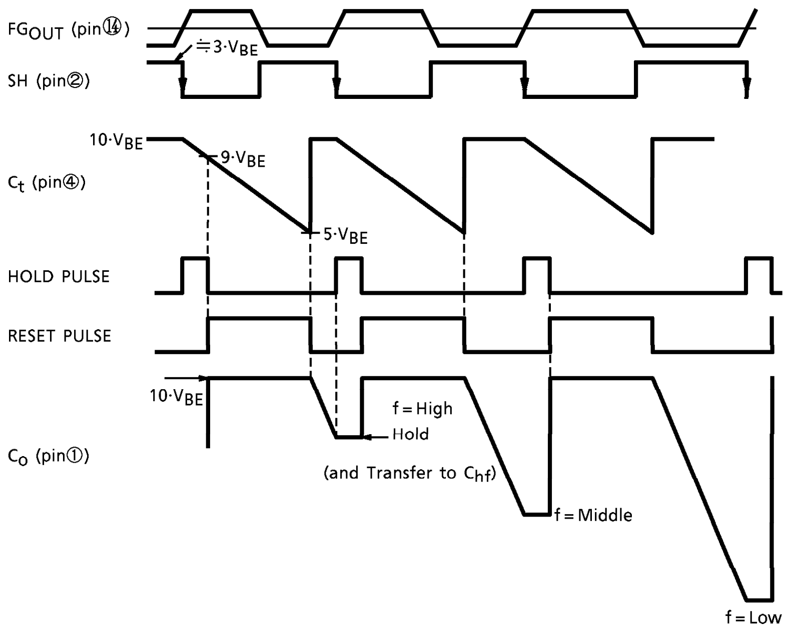


Fig.3 Timing chart

MAXIMUM RATINGS (Ta = 25°C)

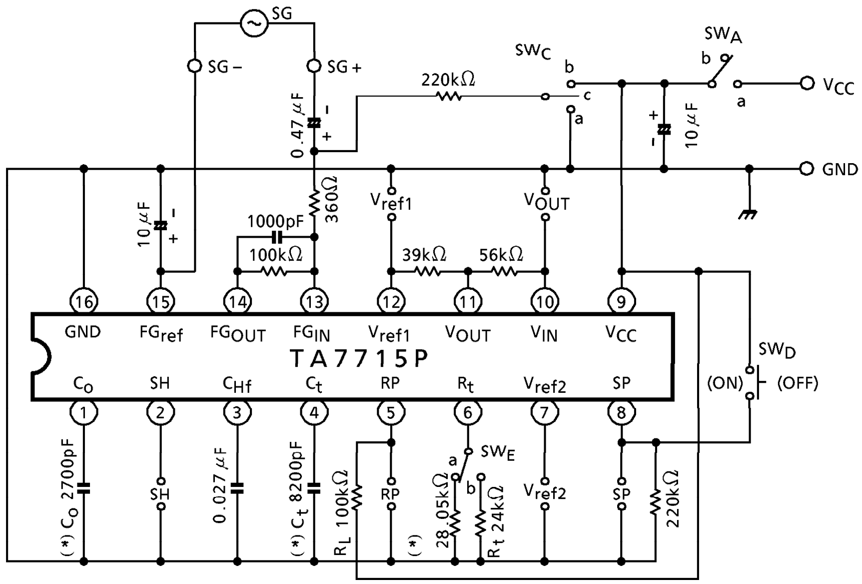
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	15	V
Power Dissipation (Note)	P_D	750	mW
Operating Temperature	T_{opr}	−25~75	°C
Storage Temperature	T_{stg}	−55~150	°C

(Note) Derated above Ta = 25°C in the proportion of 6mW / °C.

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{CC} = 10V, Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage Range	$V_{CC\,(opr)}$	—	e_i = 2mV$_{rms}$, f = 726Hz	9	10	12	V
Supply Current	I_{CC}			2.5	—	10	mA
Input Sensing Voltage	V_{IN}	—	f = 726Hz	0.35	—	2.5	mV$_{rms}$
Reference Voltage	V_{ref1}	—	—	4.0	5.0	6.0	V
	V_{ref2}			1.5	2.0	2.5	
F / V Converter Output Voltage	V_{OUT}	—	e_i = 2mV$_{rms}$, f = 726Hz R_f = 27.6kΩ	−0.5	0	0.5	V
F / V Converter Output Noise Voltage	V_{NF}	—	e_i = 2mV$_{rms}$, f = 726Hz	—	—	5	mV$_{rms}$
Max. Output Voltage	V_{FH}	—	e_i = 2mV$_{rms}$, f = 900 ± 10Hz	2.5	—	—	V
	V_{FL}		e_i = 2mV$_{rms}$, f = 580 ± 10Hz	—	—	−2.2	
RP Saturation Voltage	$V_{RP\,(sat)}$	—	R_L = 100kΩ	—	—	0.3	V

TEST CIRCUIT



(*) ±1% ACCURACY IS REQUIRED

MEASURING METHOD

(1) Operating voltage range

F / V conversion must be performed when V_{CC} is set between 9~12V with $e_i = 2mV_{rms}$ and f = 726Hz. At this time, SW_A is set to a, SW_C to OFF, SW_D to OFF, and SW_E to a.

(2) Power supply current

In state (1), read power supply current.

(3) Input operating voltage

In state (1), read the input level when the input level is gradually increased and the SH terminal is in operating mode (confirm square wave output of f = 726Hz with amplitude of about 3V).

(4) Reference voltage 1

In state (1), read the DC voltage of V_{ref1} terminal.

(5) Reference voltage 2

In state (1), read the DC voltage of V_{ref2} terminal.

(6) F / V conversion output voltage

In state (1), read the voltage between terminal V_{ref1}-V_{OUT}. Set $R_t = 27.6k\Omega$.

(7) F / V conversion output noise voltage

In state (1), read the AC voltage of pin⑩.

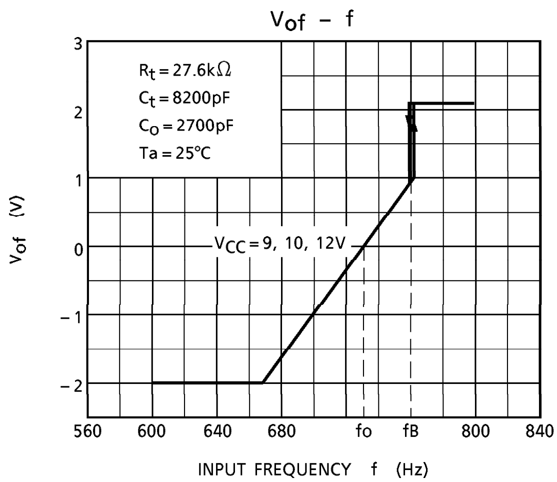
(8) Maximum output voltage

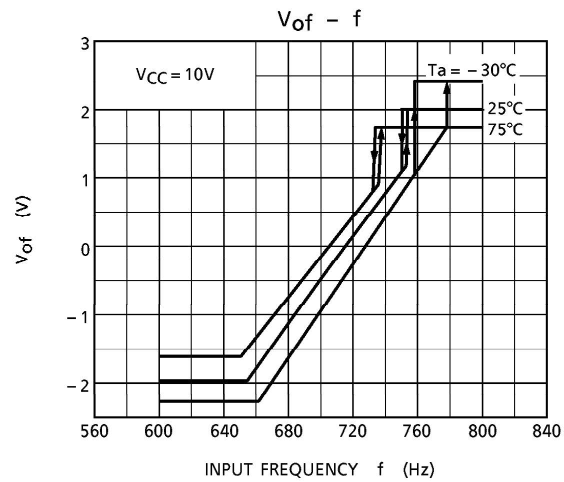
In state (1), set the input frequency to the specified value and read the voltage between terminal V_{ref1}-V_{OUT}.

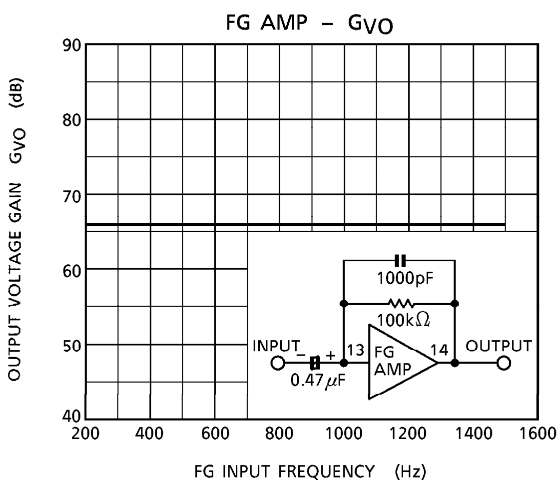
(9) RP saturation voltage

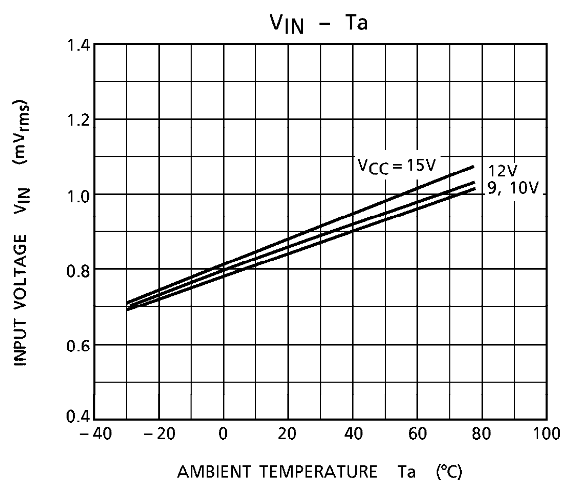
In state (8), set the SP terminal to "OPEN" and read the DC voltage when the RP terminal is set to "ON".

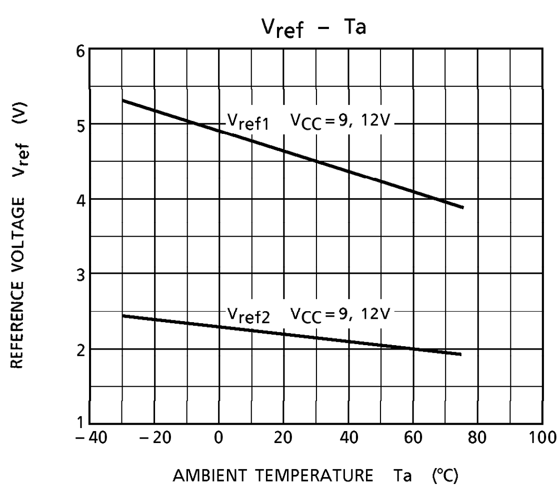
Load resistor R_L should have the specified value and be connected directly to the V_{CC} terminal. If the RP terminal is "OFF", set the SW_D to "ON" and measure the RP saturation voltage.


Vof – f
Rt = 27.6kΩ
Ct = 8200pF
Co = 2700pF
Ta = 25°C
VCC = 9, 10, 12V
Vof (V)
INPUT FREQUENCY f (Hz)
560 600 640 680 fo fB 800 840
3 2 1 0 –1 –2

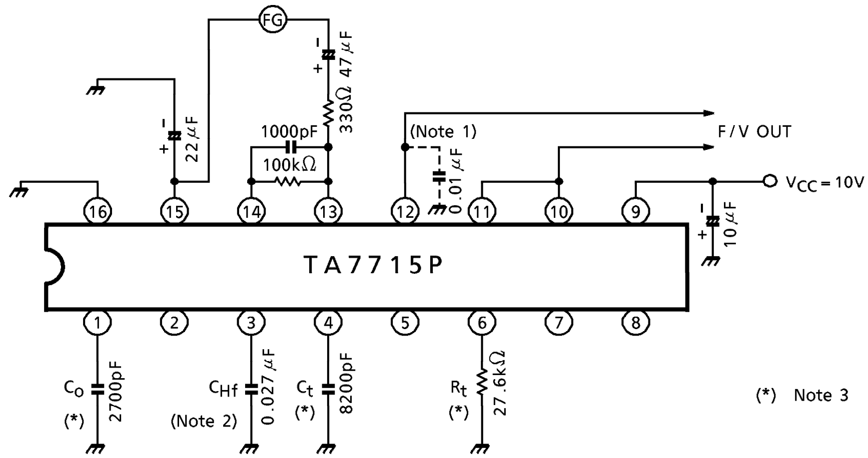

Vof – f
VCC = 10V
Ta = –30°C
25°C
75°C
Vof (V)
INPUT FREQUENCY f (Hz)
560 600 640 680 720 760 800 840
3 2 1 0 –1 –2


FG AMP – GVO
OUTPUT VOLTAGE GAIN GVO (dB)
FG INPUT FREQUENCY (Hz)
200 400 600 800 1000 1200 1400 1600
90 80 70 60 50 40
1000pF
100kΩ
INPUT
0.47μF
13
FG AMP
14
OUTPUT


VIN – Ta
VCC = 15V
12V
9, 10V
INPUT VOLTAGE VIN (mVrms)
AMBIENT TEMPERATURE Ta (°C)
–40 –20 0 20 40 60 80 100
1.4 1.2 1.0 0.8 0.6 0.4


Vref – Ta
Vref1 VCC = 9, 12V
Vref2 VCC = 9, 12V
REFERENCE VOLTAGE Vref (V)
AMBIENT TEMPERATURE Ta (°C)
–40 –20 0 20 40 60 80 100
6 5 4 3 2 1

APPLICATION CIRCUIT 1



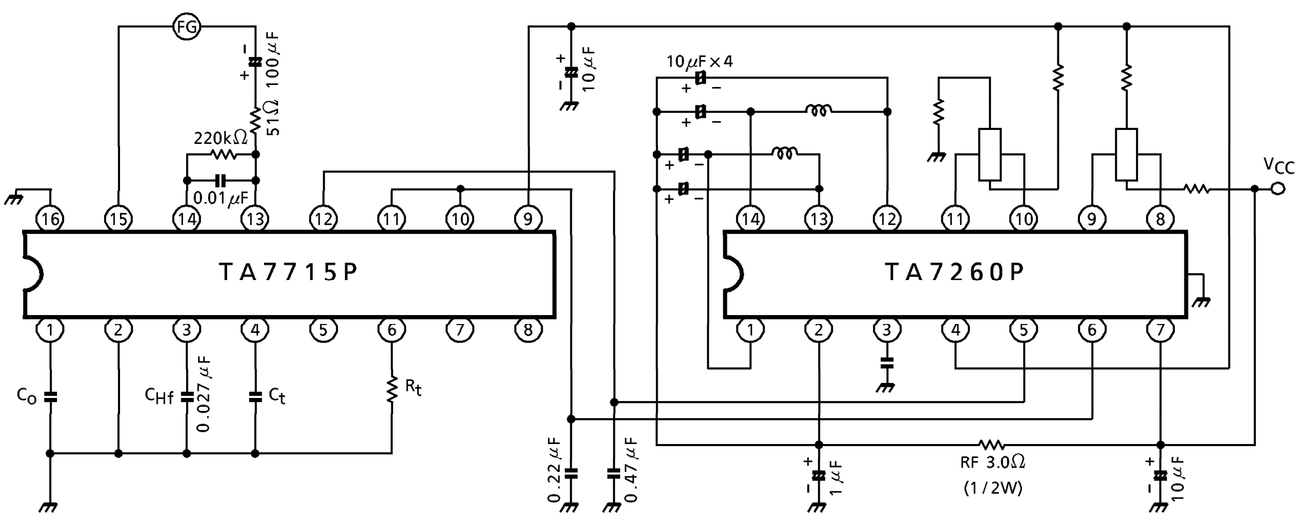
(Note 1) Connect if required.
(Note 2) C_{Hf} value is depend on Input Frequency and internal Bias Current (Base current). Recommended value is 0.027μF at Input Frequency range of 300 to 1kHz.
(Note 3) Center Frequency and Jump Up Frequency are calculated by following equations.

$$f_o = \frac{1}{R_t\ (5 \cdot C_t + 3 \cdot C_o)}\ (\text{Hz})$$

$$f_B = 0.187\ \frac{(5 \cdot C_t + 3 \cdot C_o)}{C_t} \cdot f_o\ (\text{Hz})$$

(Note 4) Recommended to use low leakage capacitance for C_{Hf}, C_o, C_t.

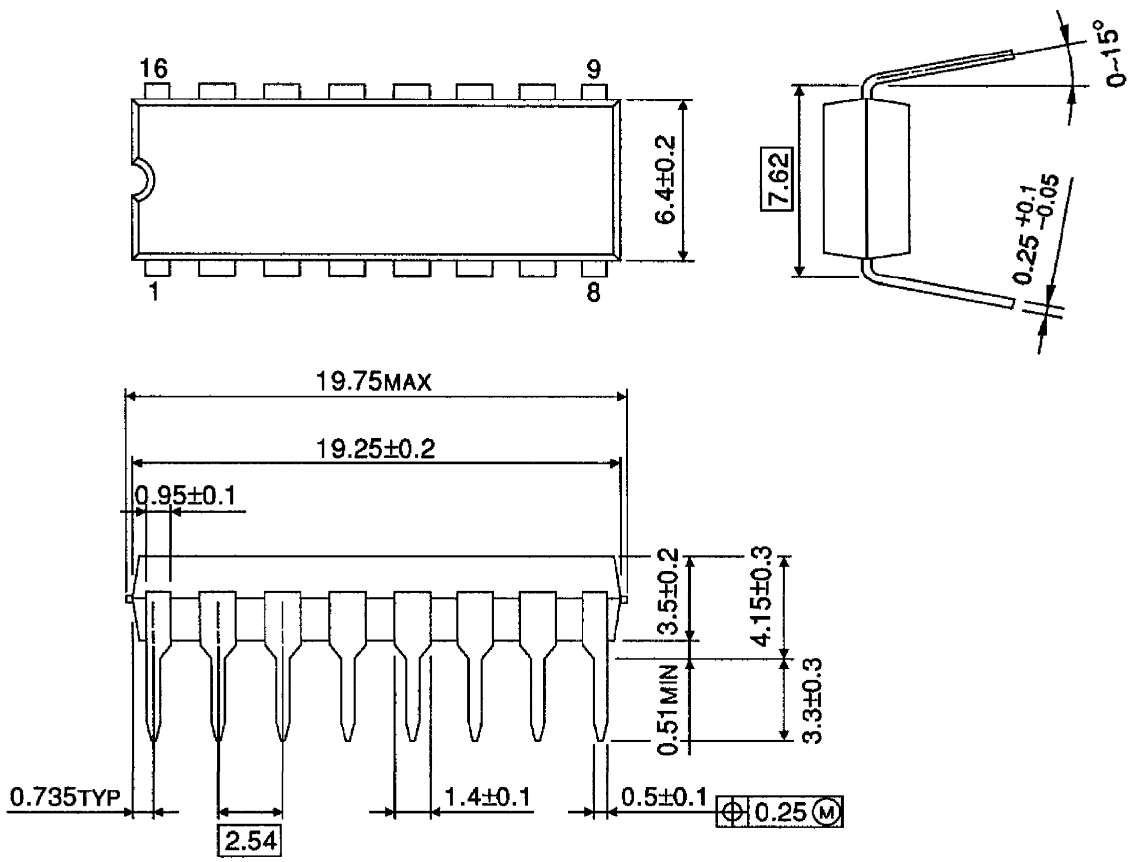
APPLICATION CIRCUIT 2



OUTLINE DRAWING

DIP16-P-300-2.54A

Unit : mm



Weight : 1.11g (Typ.)