TA7372P

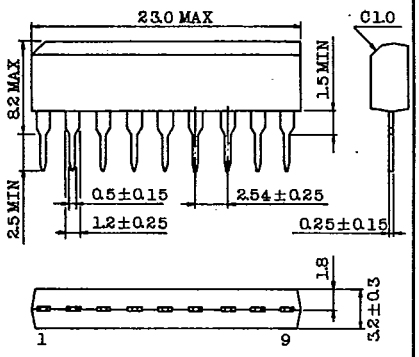
T-77-21

FM DIVERSITY

TA7372P is FM Diversity IC to detect the change of noise volume of receiver and to select either good one of the two antennas.

- Simple construction.
- Effectively operates against multipath distortion and skip noise.
- FM diversity is made possible by adding this IC and two PIN diodes to the Conventional FM car radio.
- Built-in AGC circuit makes possible the noise detection in a wide range.
- By fixing to one antenna during low input time, abnormal noise produced during the transfer at low input time can be prevented.
- Operating supply voltage range
  : V_{opr}=7~15V (Ta=25°C)

Unit in mm



Lead pitch is 2.54 and tolerance is ±0.25 against theoretical center of each lead that is obtained on the basis of No.1 lead.

JEDEC	—
TOSHIBA	S9A-P

Weight : 0.92g (Typ.)

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	16	V
⑦, ⑧ pin Output Current	I_7, I_8	15	mA
Power Dissipation	P_D	600	mW
Operating Temperature	Topr	-30~85	°C
Storage Temperature	Tstg	-55~150	°C

Note: Derated above 25°C in the proportion of 4.8mW/°C.

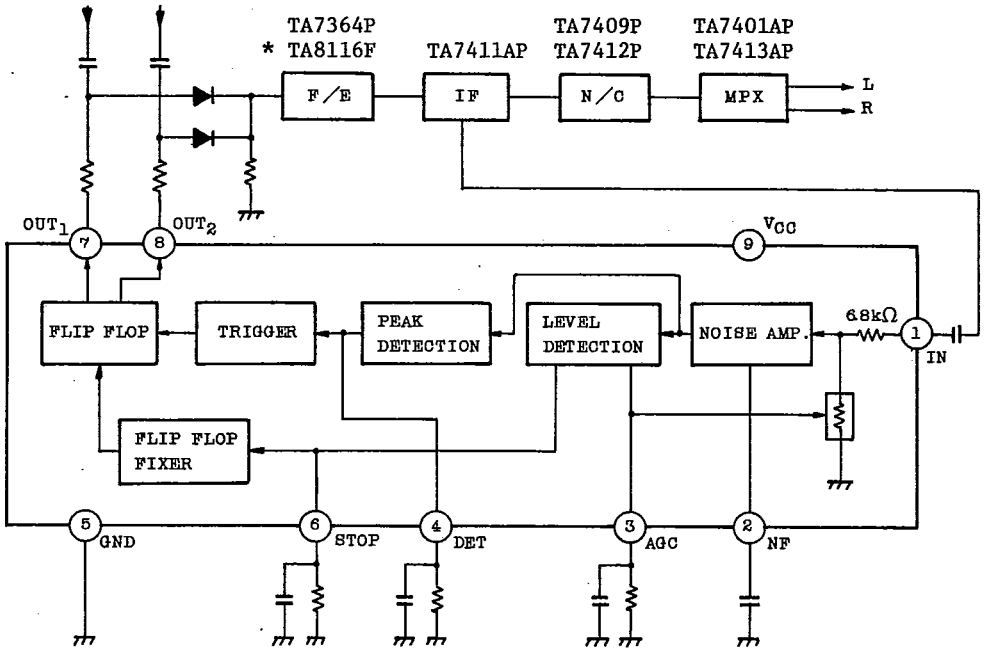
ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{CC}=8.5V, f=200kHz, Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{CCQ}	-	Excluding I_7 and I_8	3.5	4.8	6.5	mA
Detected Noise Sensitivity	V_{S1}	-	Refer to measuring method	18	24	30	mV_{rms}
AGC Width	W_{AGC}	-	Refer to measuring method	24	26	27	dB
Flip Flop Fixed Input	V_{S2}	-	SW_1=SW_2=SW_3=off Input for making ⑦ pin "H"	-	170	-	mV_{rms}

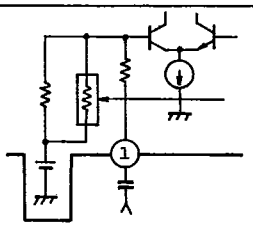
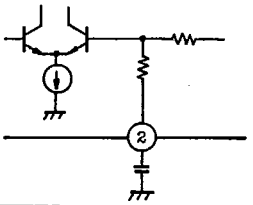
TA7372P

BLOCK DIAGRAM

(* means under development)

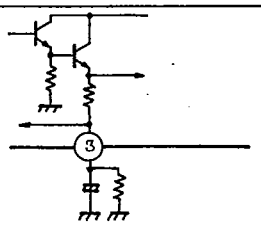
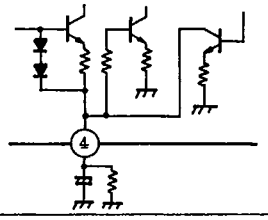
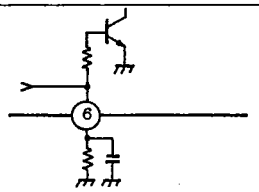
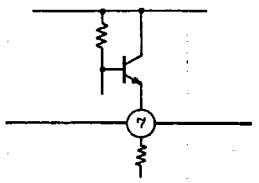
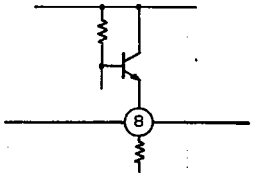


DESCRIPTION OF TERMINALS

PIN No.	TERMINAL	DESCRIPTION	INTERNAL EQUIVALENT CIRCUIT	TERMINAL VOLTAGE (V) (Note)
1	IN	Noise input terminal		1.4
2	NF	Noise amp NF terminal		1.4

TA7372P

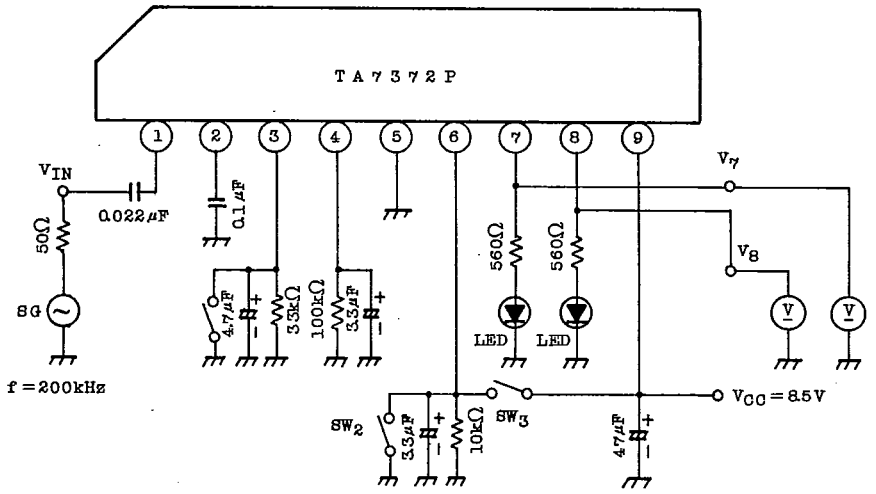
DESCRIPTION OF TERMINAL

PIN No.	TERMINAL	DESCRIPTION	INTERNAL EQUIVALENT CIRCUIT	TERMINAL VOLTAGE (V) (Note)
3	AGC	AGC time constant setting terminal		0
4	DET	Peak detection time constant setting terminal		0
5	GND	GND		0
6	STOP	Flip Flop Fixation sensitivity setting terminal		0
7	OUT1	Flip Flop output terminal 1.		6.4 (0)
8	OUT2	Flip Flop output terminal 2.		0 (6.4)
9	V_{CC}	Power supply		8.5

Note: Terminal voltage at no signal.
(Typical value at the test circuit V_{CC}=8.5V, Ta=25°C)

TA7372P

TEST CIRCUIT



MEASURING PROCEDURE

1. Noise Detection Sensitivity V_{S1}
   (1) Ground ③ pin with SW1.
   (2) Connect ⑥ pin once to V_{CC} with SW3 and open SW3.
   (At this time, V7="H" and V8="L".)
   (3) Gradually increase the input voltage Vi till V7="L" (V8="H"), and determine Vi at this time as V_{S1}.
   Note) Keep SW2 always open.

2. AGC Width WAGC
   (1) Open SW1.
   (2) Connect ⑥ pin once to V_{CC} with SW3 and open SW3.
   (At this time, V7="H" and V8="L".)
   (3) Ground ⑥ pin with SW2. (In this case, the priority function of V7="H" at the heavy noise input is lost.)
   (4) Gradually increase the input voltage Vi till V7="L" (V8="H") and determine Vi at this time as V_L.
   (5) AGC width is expressed as follows.

$$WAGC(dB) = 20\log \frac{V_L}{V_{S1}}$$

TA7372P

* OUTLINE OF OPERATION

TA7372P adopts the diversity system which detects an increase of noise of receiver and changes over the antenna.

Let us suppose that there are two antennas A and B, and receiving is now being made by A antenna.

If the electric field strength E_A of A antenna changes from 30dBμ to 20dBμ and noise volume increases, the noise amplified by the amplifier of the block diagram is changed to D.C. by level Det, and operates trigger circuit.

As a result, F/F is inversed and antenna is changed over from A to B. The process of this operation is made as follows by the electric field strength E_B of B antenna.

1) $E_B > 25\sim30dB\mu$

   F/F connects B antenna with only one inversion.

2) $20dB\mu < E_B < 25B\mu$

   F/F connects B antenna with several times (odd Number) of inversion.

   ex. A→B→A→B

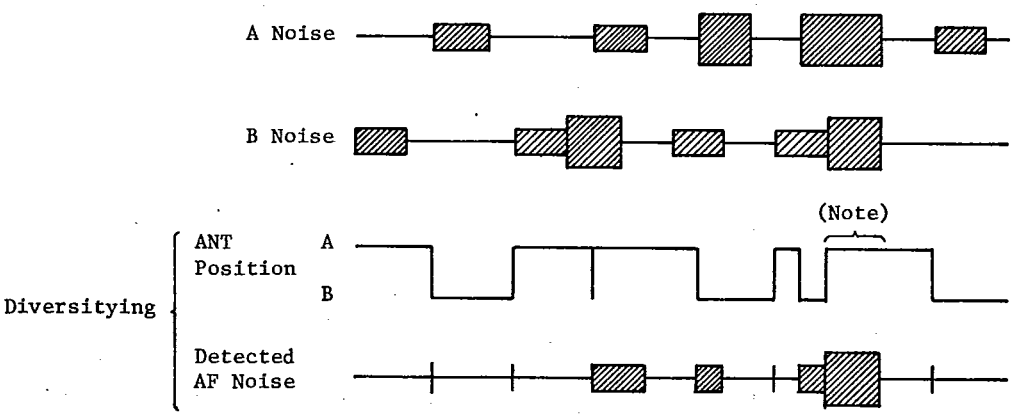
3) $E_B < 20dB\mu$

   F/F connects A antenna with several times (even Number) of inversion.

   ex. A→B→A→B→A

The figure indicates sequential change of noise when A,B antennas are connected and change of noise when A,B antennas are changed over by TA7372P.

However, the noise volume is expressed with three values of big, medium and small, for the purpose of simplification.



Note: State flip flop fixed.

TA7372P

CAUTIONS FOR APPLICATION

1. Noise AMP. and AGC (Fig.1)

As shown in Fig.1, the gain of the noise AMP. due to the differential AMP. is set to 40dB, however, when AGC is not applied, due to the loss caused by the resistance of the noise AMP. input terminal, the gain becomes about 37dB, (The max. resistance value of the electronic volume is 22kΩ.)

When AGC is applied, since the resistance value of the electronic volume decreases, the input resistance value viewed from 1 pin decreases. Therefore, when the output resistance R of the external AMP. to be connected to 1 pin is extremely larger than the input resistance of 1 pin, the noise detection operation is sometimes not performed when connected to TA7372P even if the single unit gain of the external AMP. is large.

Take care for the external AMP. gain and the output resistance for application.

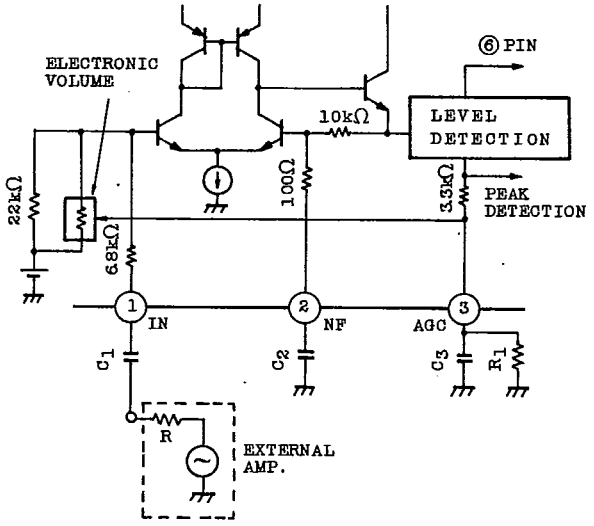


Fig. 1 NOISE AMP. AND AGC

2. Time Constant of AGC (Fig.1)

By R1 and C3 to be connected to AGC terminal of 3 pin, the response time of AGC is determined.

The rise time is determined by the product of the internal output resistance 3.3kΩ of the level detection section multiplied by the external capacitor C3, and the fall time is determined by the product of R1 multiplied by C3.

In case the time constant is small, since the response time of AGC becomes short, AGC is applied also even when the high frequency noise is input, and the signal is not transferred to the peak detection section of the next stage.

Therefore, unless a remarkably large noise is input, the antenna is not changed over.

On the other hand, in case the time constant is large, since the response time of AGC becomes long, the antenna becomes to be changed over even when the high frequency noise is small.

3.3μ~100μF are appropriate for the value of C3, and about 33kΩ for the value of R1.

Since the values vary according to IF detection IC, determine the value after investigation.

3. Peak Detection and Trigger (Fig.2 and Fig.3)

The peak value of the half-wave rectified noise transferred from the above mentioned level detection section is detected at the peak detection section. At this time, by C4 connected to 4 pin, the charging time is determined and the discharging time by C4 and R2.

The noise peak value detected at the peak detection section is transferred to the trigger section of the next stage. The threshold value is determined so that the flip flop is inverted when 4 pin peak value becomes about 1V.

The noise detected at the peak detection section is charged in C4 as the charge, and in this state, the antenna can not be changed over in high speed.

Therefore, for the measure against this condition, the instantaneous discharging circuit is provided.

In the noise AMP. the changeover sensitiviny is about 24mVrms (f=200kHz) in the state AGC is not applied.

On the contrary, in the state the input noise amplitude is constant and AGC is applied, the changeover input voltage ratio is set at about 10dB (f=200kHz).

0.47μF is appropriate as C4 value and 100kΩ as R2 value. However, when C4 is made excessively large, the changeover of the antenna becomes difficult to perform and the skip noise grows large.

Determine the value after investigation.

TA7372P

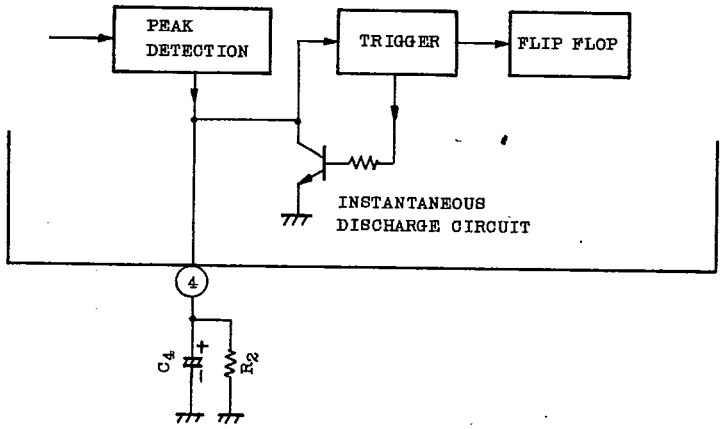
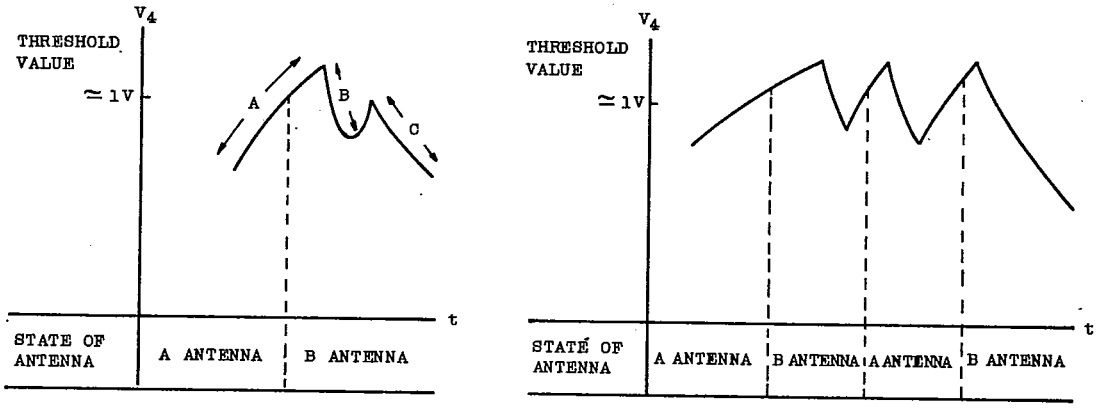


Fig. 2 PEAK DETECTION AND TRIGGER



A: Charging period with C_4

B: Instantaneous discharging period

C: Discharging period with R_2

Fig.3 OPERATION WAVEFORM PEAK DETECTION AND TRIGGER

TA7372P

4. Fixing Function of Flip Flop (Fig.4)

During the weak input, when the pulse-like noise is increased in the audio or when the white noise which can not be treated with AGC amount of TA7372P is increased, the high-speed changeover operation of antenna begins.

However, in this state, because of the weak input, the tuner limitter is often not applied and the offensive changeover noise is generated in the audio output at the antenna changeover.

In TA7372P, this problem is solved by means of connecting only the antenna connected to 7 pin side without changing over the antenna during the weak input as shown in Fig.4.

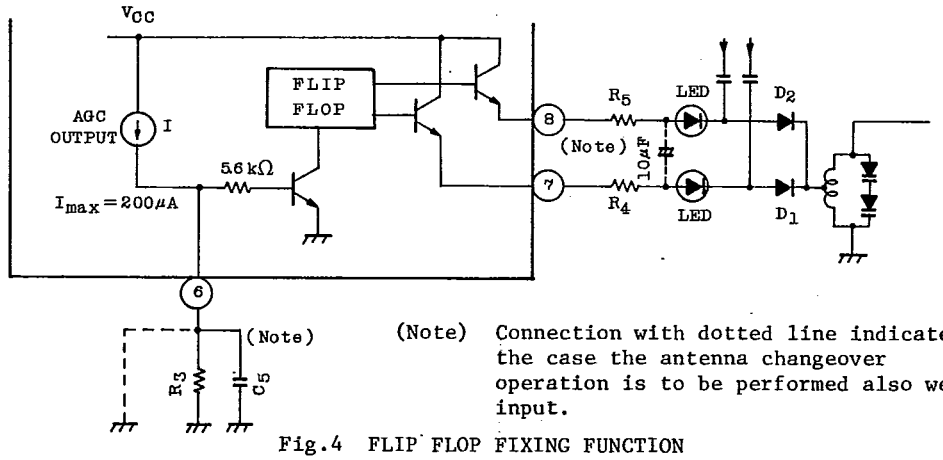
At weak input, when the noise to be input to 1 pin increases and AGC begins to be applied, the current I proportional to AGC amount is output from 6 pin. (Set at I nearly equals to 200μA at max. of AGC).

On the other hand, since the threshold value of flip-flop fixed section is about 0.7V, the sensitivity at flip-flop fixed period (antenna changeover stop) can be set.

Therefore, when R3 becomes large, the sensitivity boosts up and the antenna electric field density is fixed at rather high point. (It is contrary when R3 becomes small.)

Also at the weak input, for changing over the antenna, ground 6 pin and in order to prevent the noise at the high-speed changeover, connect the resistance of about 10μF at the anode side of LED.

For the detail, refer to the application circuit example 2.



(Note) Connection with dotted line indicates the case the antenna changeover operation is to be performed also weak input.

Fig.4 FLIP FLOP FIXING FUNCTION

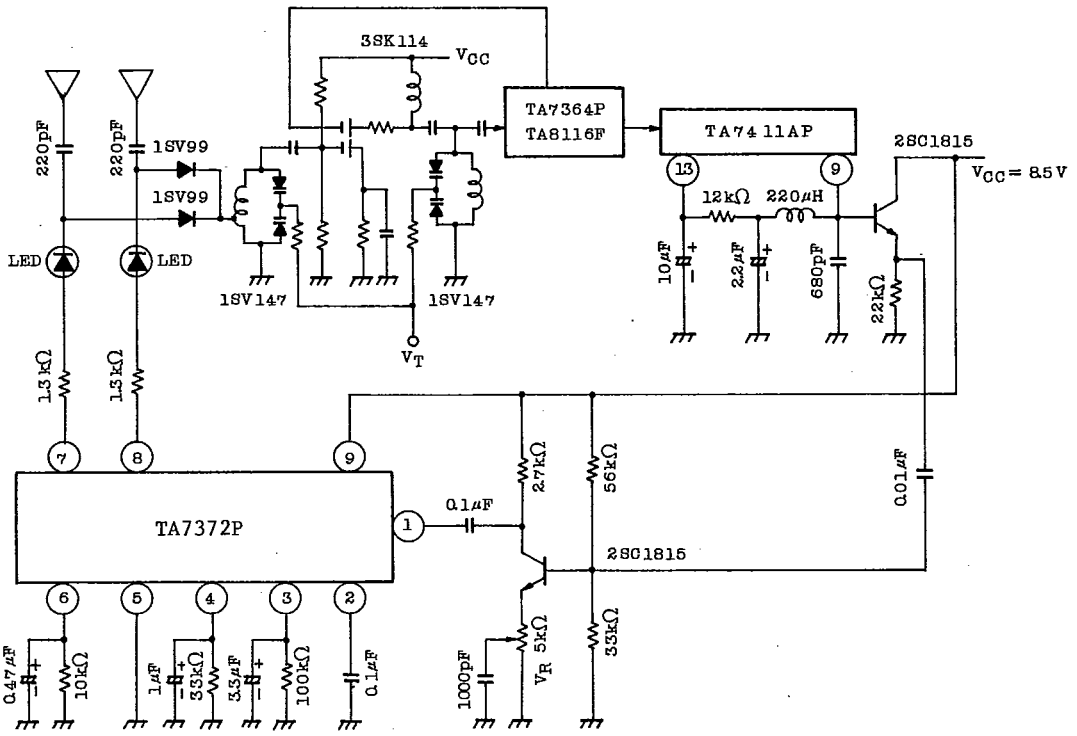
TA7372P

5. Flip Flop Output (Fig.4)

As shown in Fig.4, the voltage output is of the emitter follower type, and the current flowing in the pin diode D1 or D2 is set by the external R4 or R5 at each "H" mode.

The voltage at the time when ⑦ pin or ⑧ pin becomes "H" is set at 6.4V.

APPLICATION CIRCUIT EXAMPLE 1 (Antenna changeover stop at weak input)

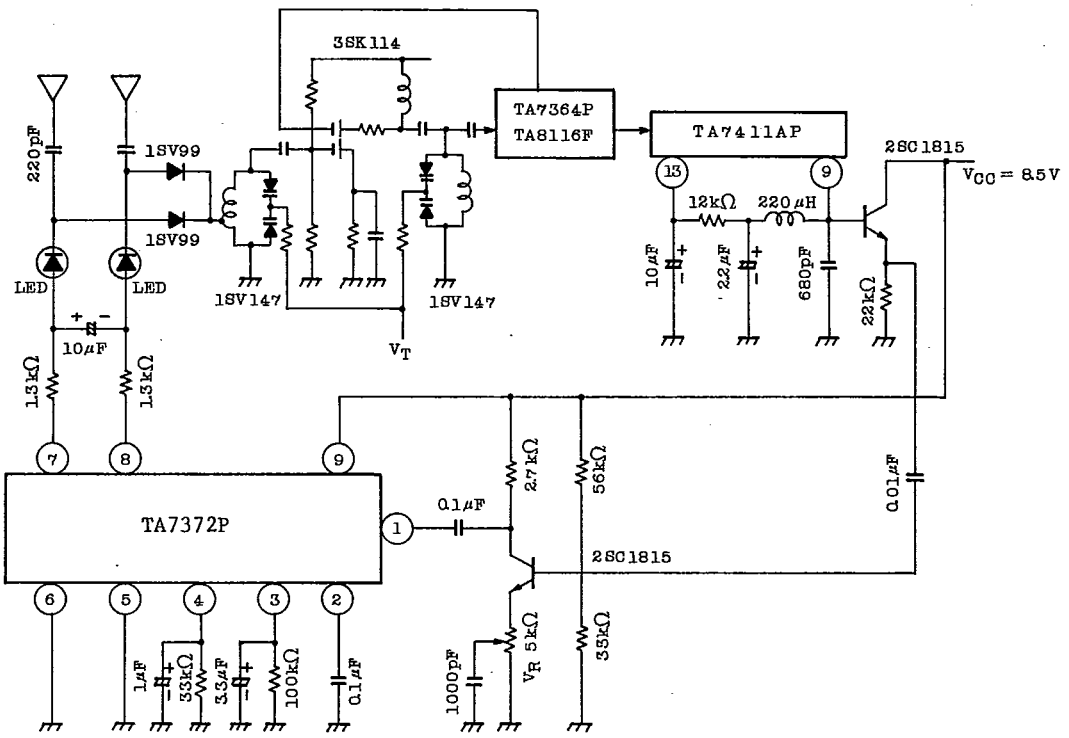


Adjusting Method

(1) Send a signal around practical sensitivity to ⑦ pin side antenna.
(2) Ground ⑥ pin, and slowly turn VR from the minimum gain to the position at which two LED light simultaniously.
(3) Release the grounding of ⑥ pin.

TA7372P

APPLICATION CIRCUIT EXAMPLE 2 (Antenna changeover operation at weak input)

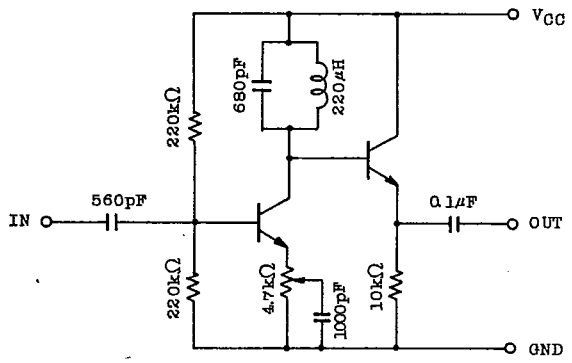


Adjusting Procedure

(1) To either of the two antennas, input the desired signal of near the practical sensitivity.

(2) Gradually turn VR from minimum point to the point at which two LEDs light at the same time.

TA7372P



CAUTIONS:

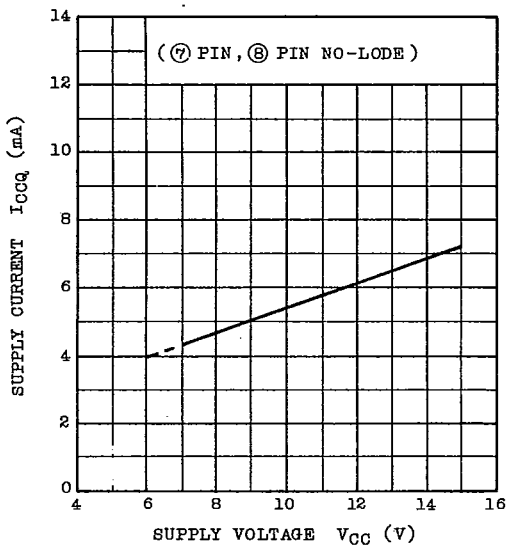
The optimum point varies according to F/E or IF detection. Therefore, it is sometimes better to change the desired signal level of (1) to the easiest adjustable level.

The noise components of over 100kHz necessary for TA7372P can be obtained from the high-pass AMP. output of the noise canceller. In many cases, IF detection IC carries out the muting operation such as the soft muting, and sometimes the noise components of the weak input becomes less than those of the medium input. This is an example of fetching the noise components from AFC output terminal of TA7611AP in which the noise amount does not vary even if the muting operation is carried out, by means of using LC resonance circuit. (Both application circuits of ex.1 and ex.2.)

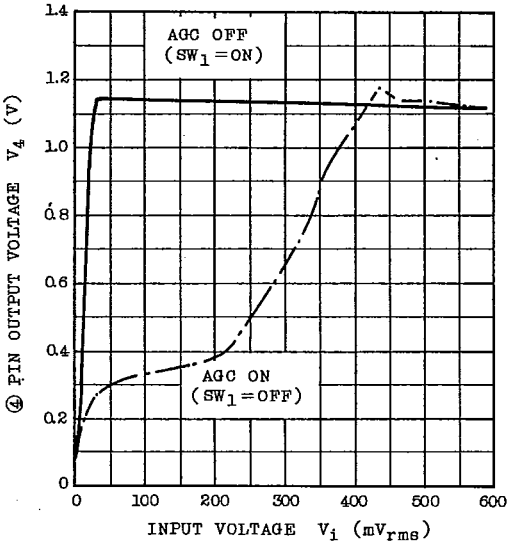
In the set without the functions of muting and noise canceller, it is useful to fetch the noise output from IF detection output by means of applying the circuit shown in the above figure.

TA7372P

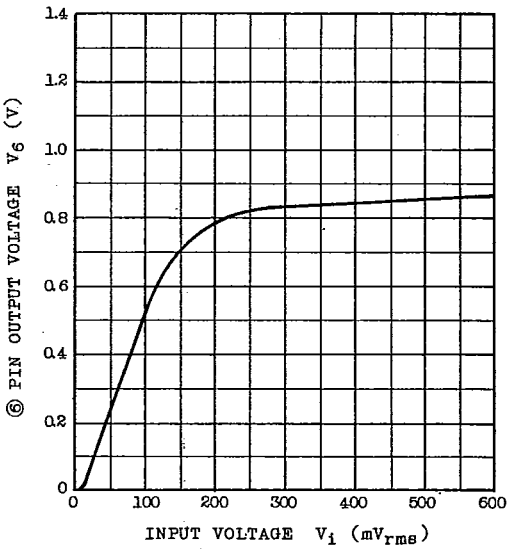
I_{CCQ} – V_{CC}



V_4 – V_i

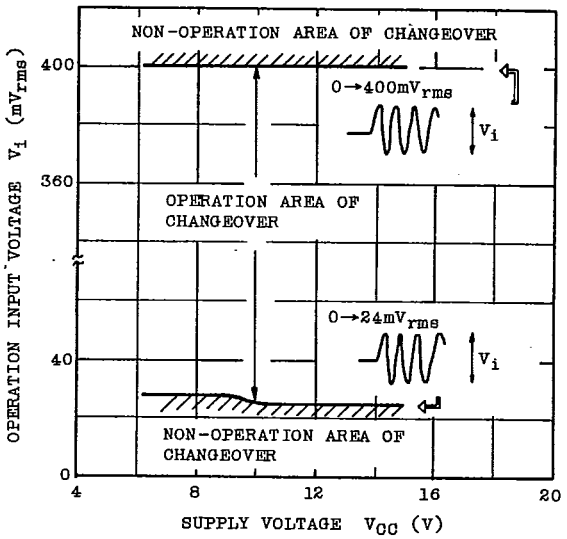


V_6 – V_i



TA7372P

V_i – V_{CC} (TONE-BURST)



NOISE DETECTION SENSITIVITY ACCORDING TO NOISE INPUT VOLTAGE DIFFERENCE