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AN ADVANCED LOW POWER RADIO 1 CHIP IC

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ABSTRACT

We've developed the single chip FM/AM radio IC capable of achieving low power consumption to extend a radio's battery life. Consequently the operating time is 4 or 5 times the conventional radio's one. [1]

INTRODUCTION

The newly developed IC is a low power AM/FM 2 band radio IC in order to make operating time long when it operates by small batteries, without degrading the characteristic.

The several problems caused by lower power operation are,

- a) a decrease of the gain-bandwidth product
- b) an increase of noise from an active device
- c) a degradation of interference characteristics (inter modulation, blocking, pull-in)
- d) an increase of a distortion

Unless these problems are solved to make a consumption power low, the characteristics of this system are degraded. We've decreased a consumption current using new circuit techniques.

THE PROBLEM CAUSED BY LOW POWER

There are some higher power circuit blocks to avoid degradation of radio characteristics.

1) At a high frequency amplifier, as a current is decreased, an amplifier gain falls by degradation of a high frequency characteristic of transistors, and a dynamic range becomes worse, degradation of the Noise Figure caused by noise increase arise. Therefore the current cannot be so small, this circuit block consumes relatively high power.

2) At a local oscillator circuit, As an oscillation level is low with current decrease, oscillator signal pull-in and oscillation level decrease, caused by an

external interference signal, arise. And then the oscillator will become unstable or stop, so an oscillation level cannot be so small.

3) Intermediate Frequency (IF) amplifier is the most high gain amplifier in a radio. And front-end gain can be low if the IF amplifier's Noise Figure is low. It is effective to decrease a current. The first amplifier must be low noise and high gain in order to make a total Noise Figure of IF amplifiers low.

So the problem is decreasing the current of these higher power circuit blocks.

HOW TO SOLVE THESE PROBLEMS AND NEW CIRCUITS

As shown in Fig.1, the circuit block that needs a stable voltage by a regulator is connected in series with the large current circuit block that needs no stable voltage. So the same circuit bias current flow through both circuit blocks. Then the consumption current can be decreased. For example, at FM receiving mode an FM RF amplifier is connected in series with an FM local oscillator, referring to Fig.2. At AM receiving mode an AM IF amplifier is connected in series with an AM RF amplifier and an AM local oscillator.

As an FM IF amplifier a new circuit configuration is adopted. As shown in Fig. 3, the first amplifier is connected in series with the following parallel amplifiers. So a same direct bias current flow through both amplifiers. And the circuits work as an multistage amplifier, so an alternating current flows from the 1st amp to the 5th amp. The consumption current of this circuit consists of only the first amplifier's current, so a low-power, low-noise, high-gain amplifier can be achieved. A practical configuration of this circuit is shown in Fig. 4.

CONCLUSION

Using these power saving circuits, an FM/AM radio IC, which consumption current is 1.4mA at FM mode, 0.8mA at AM mode, can be realized. This consumption current is 1/4 or 1/5 times a conventional IC's current. Therefore a radio's battery life extend 4 or 5 times as long as a conventional one's. And this IC is 24 pins small outline package as shown in Fig.5.

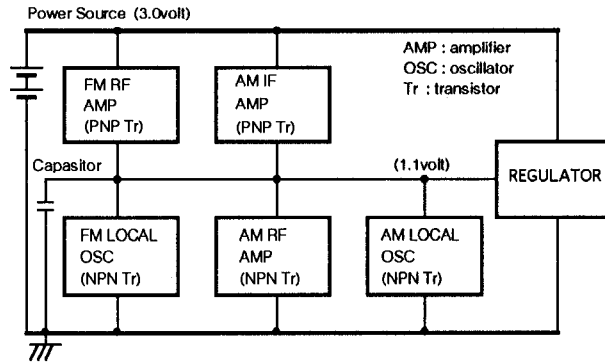


Fig.1 A configuration of large current circuit blocks

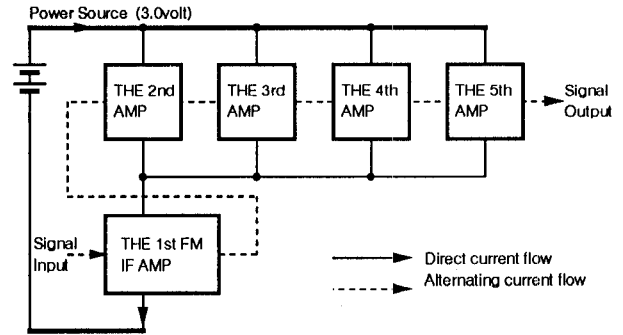


Fig.3 FM IF amplifier

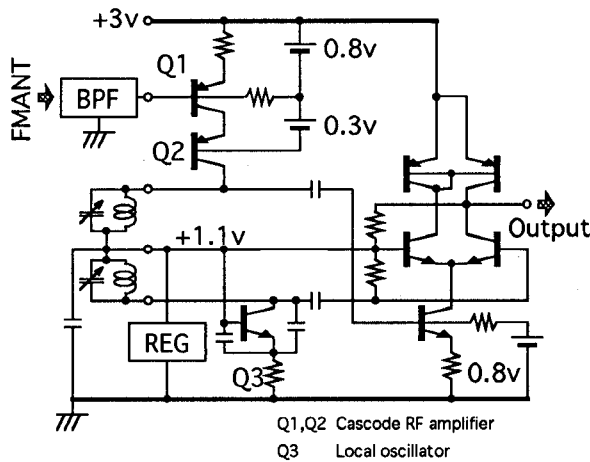


Fig.2 FM RF amplifier and FM local oscillator

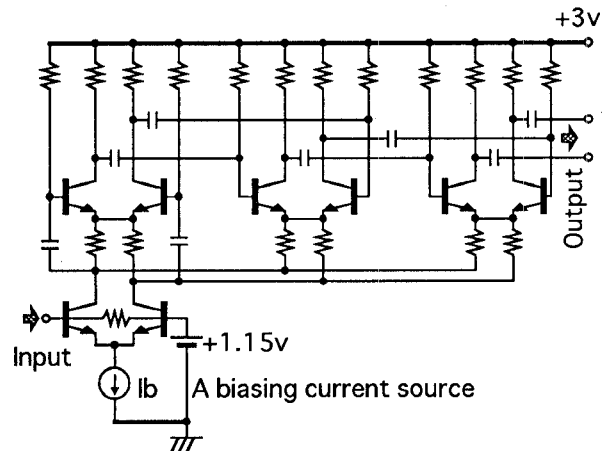


Fig.4 A practical configuration of FM IF amplifier

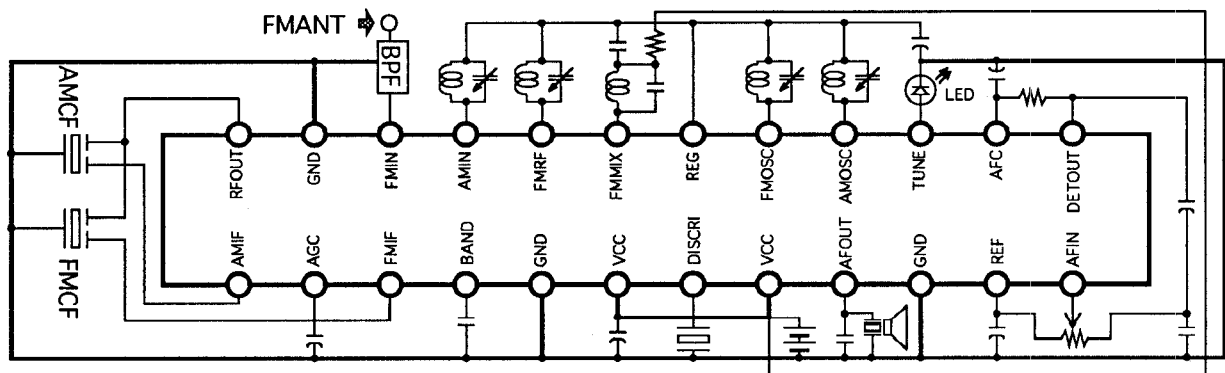


Fig.5 Peripheral components of the low power radio 1 chip IC

REFERENCE

- [1] T. Okanobu, T. Tsuchiya, K. Abe and Y. Ueki, "A complete single chip AM/FM radio integrated circuit," IEEE Trans. Consumer Electronics, vol. CE-28, pp. 652-664, Dec. 1983.