## BA1404 BA1404F

## FM stereo transmitter

The BA1404 and BA1404F monolithic ICs are stereo transmitters

Each IC consists of a stereo modulator that creates stereo composite signals, an FM modulator that creates FM signals, and an RF amplifier. The stereo modulator develops composite signals made up of a MAIN (L+R) signal, a SUB (L-R) signal and a pilot (19 kHz) signal using 38 kHz crystal oscillators.

The FM modulator has carriers on the FM broadcast band (75  $\sim 108$  MHz)

The RF amplifier transmits the stereo encoded FM signals and is also a buffer for the FM modulator.

The stereo transmitter is equipped with a constant voltage pin for a variable capacitor that is used to finely adjust the FM frequency.

#### **Features**

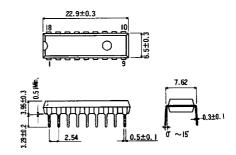
- available in DIP18 and SOP18 packages
- low operating voltage range (1.0 V ~ 2.0 V)
- low power consumption, typically 3 mA
- · requires few external components

## **Applications**

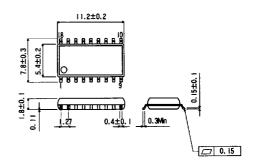
- FM stereo transmitters
- Wireless microphones

### **Dimensions (Units: mm)**

### **BA1404 (DIP18)**



#### BA1404F (SOP18)



## **Block diagram**

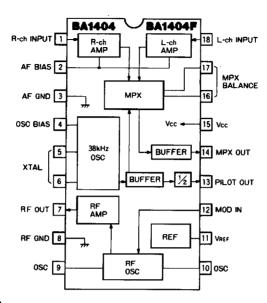


Table 1 Pin description

Pin no.	Pin name	Description				
1	R-ch audio input	Connects to the pre-emphasis circuit				
2	Input amplifier bypass	Connects to the bypass capacitor				
3	GND	Low frequencies				
4	38 kHz oscillator bypass	Connects to bypass capacitor				
5	38 kHz oscillator	Connects to 38 kHz crystal oscillators				
6	38 kHz OSC	Connects to load capacitor of crystal oscillator				
7	RF output	Connects to LC resonator				
8	GND	High frequency				
9	RF oscillator	Connects to bypass capacitor				
10	RF oscillator	Connects to capacitor and LC resonator				
11	Voltage supply	Connects to variable capacitor				
12	Modulation signal input	Connects to bypass capacitor and modulated signal source				
13	Pilot signal output	Connects to RC mixer circuit				
14	Multiplexer signal output	Connects to RC mixer circuit				
15	V <sub>CC</sub>	Power supply				
16	Multiplexer modulator balance	Connects to trimpot resistor				
17	Multiplexer modulator balance	Connects to trimpot resistor				
18	L-ch audio input	Connects to pre-emphasis circuit				

## Absolute maximum ratings ( $T_a = 25$ °C)

Parameter Power supply voltage		Symbol	Limits 2.5	Unit	Conditions	
		V <sub>CC</sub>		V		
Power dissipation	BA1404	Б	1200		Reduce power by 12.0 mW for each degree above 25°C.	
	BA1404F	_ P <sub>d</sub>	450	- mW	Reduce power by 4.5 mW for each degree above 25°C.	
Operating temperature		T <sub>opr</sub>	<b>−25 ~ +75</b>	°C		
Storage temperature		T <sub>stg</sub>	<b>−50 ~ +125</b>	°C		

## Recommended operating conditions $(T_a = 25^{\circ}C)$

Parameter	Symbol	Min	Typical	Max	Unit
Power supply voltage	V <sub>CC</sub>	1	1.25	2	٧

# Electrical characteristics ( $T_a = 25^{\circ}C$ , $V_{CC} = 1.25 V$ )

Parameter	Symbol	Min	Typical	Max	Unit	Conditions
Quiescent current	ΙQ	0.5	3	5	mA	
Input impedance	Z <sub>IN</sub>	360	540	720	Ω	f <sub>iN</sub> = 1 kHz
Input/output gain	G <sub>V</sub>	30	37		dB	V <sub>IN</sub> = 0.5 mV
Channel balance	СВ			2	dB	$V_{IN} = 0.5 \text{ mV}$
Multiplexer output voltage	V <sub>OM</sub>	200			mV <sub>pk-pk</sub>	THD ≤ 3%
Multiplexer 38 kHz leakage	V <sub>OO</sub>		1		m∨	No signal
Pilot output voltage	V <sub>OP</sub>	460	580		mV <sub>pk-pk</sub>	No load
Channel separation	Sep	25	45		dB	With a standard demodulator
Input conversion noise voltage	V <sub>NIN</sub>		1		μV <sub>rms</sub>	IHF-A when 38 kHz is terminated
RF output voltage	Vosc	350	600		mV <sub>rms</sub>	

Figure 1 Test circuit

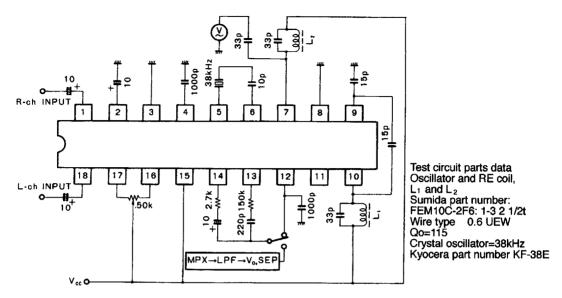
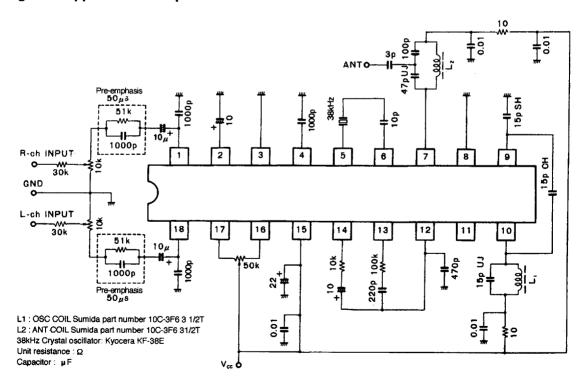


Figure 2 Application example



### **Circuit operation**

#### Stereo modulator

The R-channel audio is input from pin 1 and the L-channel from pin 18. Each audio signal is amplified about 37 dB by independent amplifiers and output to the multiplexer.

The 38 kHz crystal oscillator, connected between pin 5 and pin 6, creates a 38 kHz subcarrier and a 19 kHz pilot signal with the same phase but delayed by a 1/2 cycle.

The audio signals and the 38 kHz subcarrier are balanced and modulated in the multiplexer. The L + R signal and the 38 kHz subcarrier, which are a DSB-modulated signal at L-R, are added to create the main carrier, which is output from pin 14.

The potentiometer between pins 16 and 17 can be used to lessen the subcarrier leakage due to unbalance in the multiplexer.

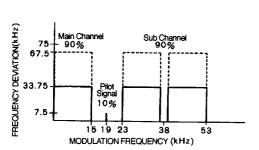


Figure 3 Modulation spectrum of pilot tone

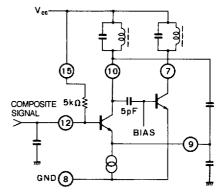


Figure 4 FM modulator

## FM modulator

The high-frequency oscillator is a collector tuning-type or Collpits oscillator as shown in Figure 4. The composite signal is input from pin 12 to the base of the transistor. By adding the audio signal to the base, the reactance of the transistor changes. By changing the time constant of the tuning circuit in the oscillator, the frequency is modulated.

The oscillation frequency is determined by the LC resonator that is connected between pin 10 and the  $V_{CC}$ . Because this oscillator does not compensate for  $V_{CC}$  fluctuation and temperature changes, the frequency changes are large, and, when the receiver is part of a synthesizer (digital tuning) system, tuning should be separated from  $V_{CC}$ .

It is suggested that you use a variable capacitor (AFC) system, or an external FM modulator when frequency stability is required.

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