

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 ~ 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

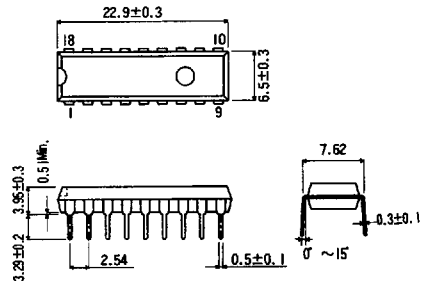
- available in DIP18 and SOP18 packages
- low operating voltage range (1.0 V ~ 2.0 V)
- low power consumption, typically 3 mA
- requires few external components

Applications

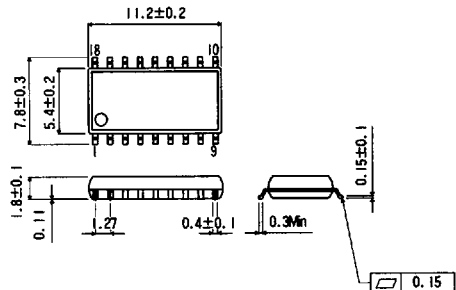
- FM stereo transmitters
- Wireless microphones

Dimensions (Units : mm)

BA1404 (DIP18)



BA1404F (SOP18)



Block diagram

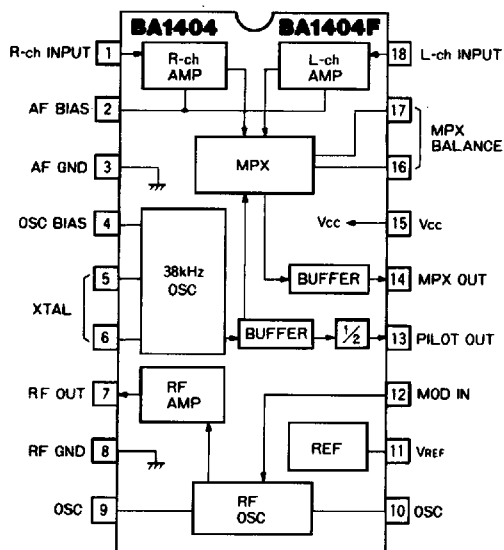


Table 1 Pin description

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 _{CC}	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 ($T_a = 25^\circ\text{C}$)

Parameter		Symbol	Limits	Unit	Conditions
Power supply voltage		V_{CC}	2.5	V	
Power dissipation	BA1404	P_d	1200	mW	Reduce power by 12.0 mW for each degree above 25°C .
	BA1404F		450		Reduce power by 4.5 mW for each degree above 25°C .
Operating temperature		T_{opr}	$-25 \sim +75$	$^\circ\text{C}$	
Storage temperature		T_{stg}	$-50 \sim +125$	$^\circ\text{C}$	

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

Parameter	Symbol	Min	Typical	Max	Unit
Power supply voltage	V_{CC}	1	1.25	2	V

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

Parameter	Symbol	Min	Typical	Max	Unit	Conditions
Quiescent current	I_Q	0.5	3	5	mA	
Input impedance	Z_{IN}	360	540	720	Ω	$f_{IN} = 1\text{ kHz}$
Input/output gain	G_V	30	37		dB	$V_{IN} = 0.5\text{ mV}$
Channel balance	CB			2	dB	$V_{IN} = 0.5\text{ mV}$
Multiplexer output voltage	V_{OM}	200			mV_{pk-pk}	THD $\leq 3\%$
Multiplexer 38 kHz leakage	V_{OO}		1		mV	No signal
Pilot output voltage	V_{OP}	460	580		mV_{pk-pk}	No load
Channel separation	Sep	25	45		dB	With a standard demodulator
Input conversion noise voltage	V_{NIN}		1		μV_{rms}	IHF-A when 38 kHz is terminated
RF output voltage	V_{OSC}	350	600		mV_{rms}	

Figure 1 Test circuit

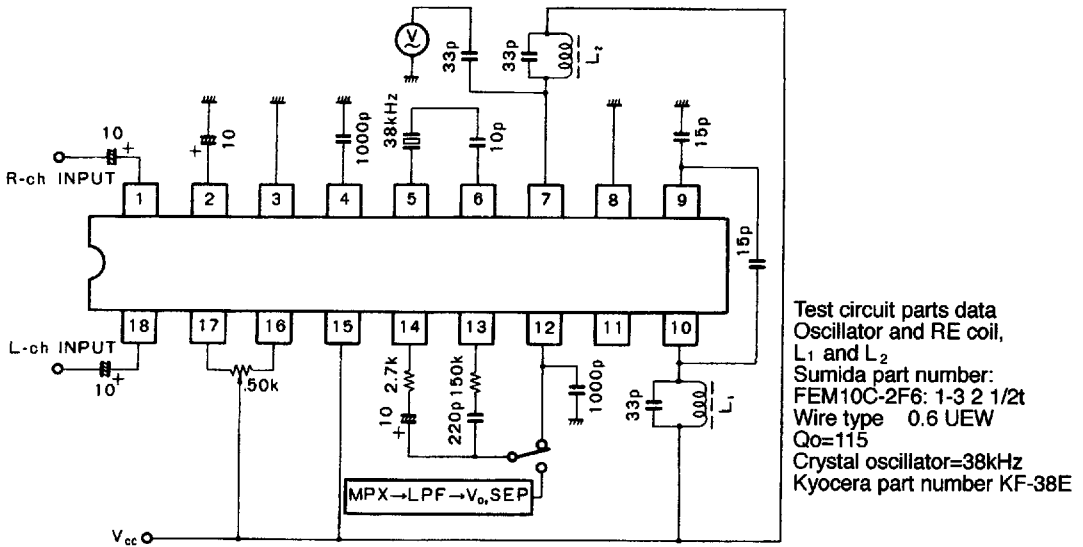
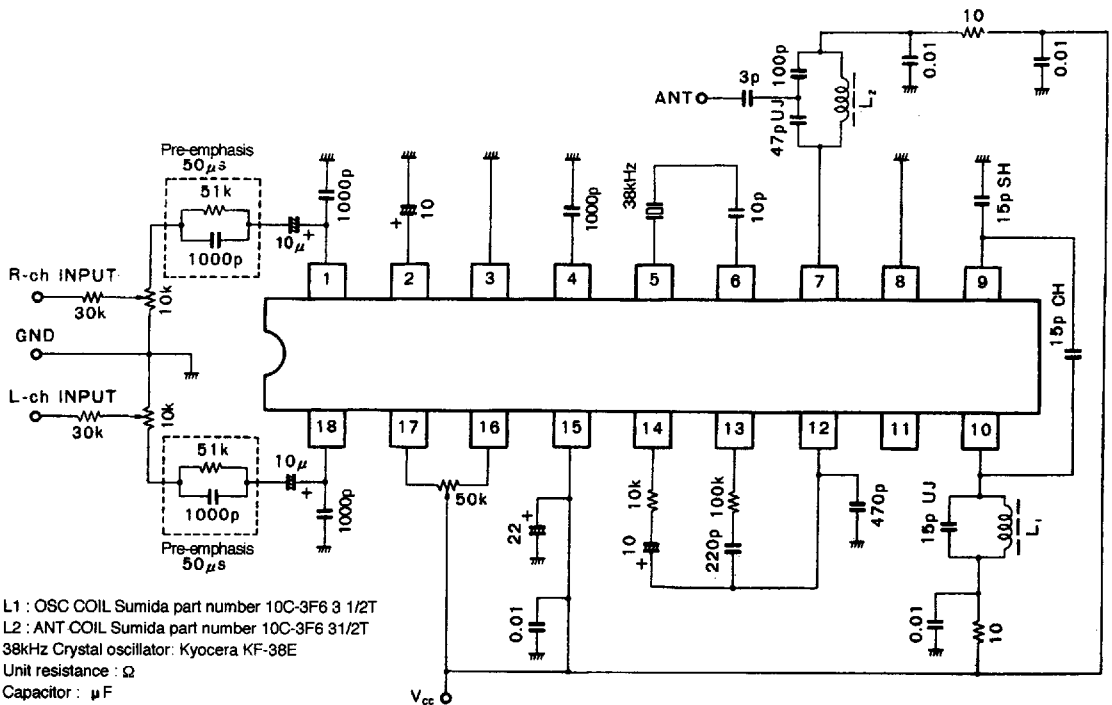


Figure 2 Application example



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.

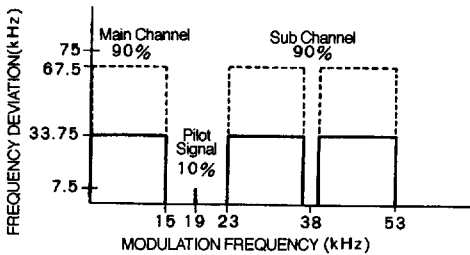


Figure 3 Modulation spectrum of pilot tone

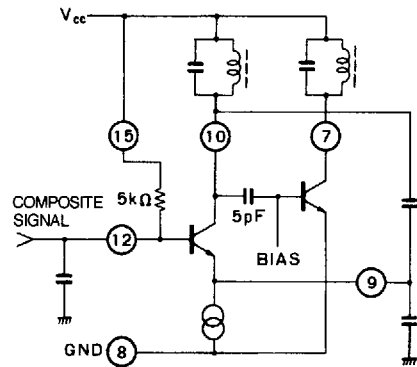


Figure 4 FM modulator

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.