

FM front end

BA4412

The BA4412 is a monolithic IC for use as an FM front end.

It consists of an RF amplifier, mixer circuit, oscillator circuit, input buffer circuit, IF amplifier circuit, and a variable capacitor-diode for AFC.

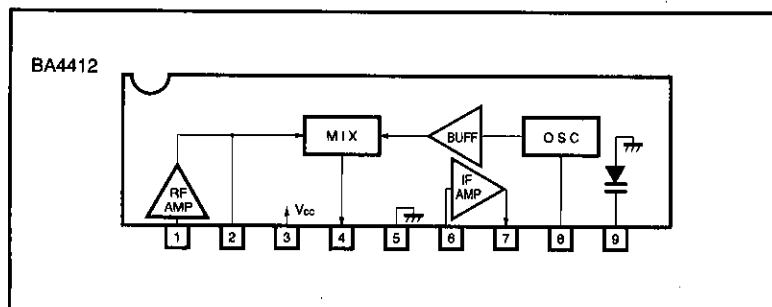
●Applications

FM radios
Radio cassette players
Home stereos

●Features

- 1) Wide operating voltage range : 2 to 8V.
- 2) An RF amplifier, mixer, oscillator, oscillator input buffer, IF amplifier, and AFC variable capacitor-diode are all housed in a 9-pin SIP package. Convenient pin arrangement for mounting.
- 3) Input/output impedance of IF amplifier is matched with ceramic filter impedance at 330 Ω .
- 4) Mixer output can also be used with resistive load.
- 5) Bypass capacitor for RF amplifier is included on-chip.
- 6) Feedback capacitor for oscillator is included on-chip.
- 7) Uses a double balance mixer circuit. A buffer at the oscillator input and a diode limiter at the mixer output minimize oscillator leakage for good response to strong input.

●Block diagram



● Absolute maximum ratings ($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Limits	Unit
Supply voltage	$V_{CC \text{ Max.}}$	9.0	V
Power dissipation	P_d	500*	mW
Operating temperature	T_{opr}	$-25 \sim 75$	$^\circ\text{C}$
Storage temperature	T_{stg}	$-55 \sim 125$	$^\circ\text{C}$
AFC voltage	V_{AFC}	3.0	V

* At temperatures above $T_a = 25^\circ\text{C}$, decreases 5.0 mW per degree.

● Recommended operating conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	2.0	4.0	8.0	V

● Electrical characteristics (unless otherwise indicated, $T_a = 25^\circ\text{C}$ and $V_{CC} = 3\text{V}$)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Quiescent current	I_o	5.5	8.0	10.5	mA	—	Fig.1
IF output voltage	V_{OUT}	20	35	50	mV _{rms}	$f_{IN}=100\text{MHz}$, 80dB μV	Fig.1
IF input/output impedance	Z_{IF}	—	330	—	Ω	—	Fig.1
Oscillator voltage	V_{OSC}	200	300	400	mV	$f_{OSC}=110.7\text{MHz}$	Fig.1
Diode capacitance	C_{AFC}	—	9	—	pF	$V_i=2\text{V}$	Fig.1

● Measurement circuit

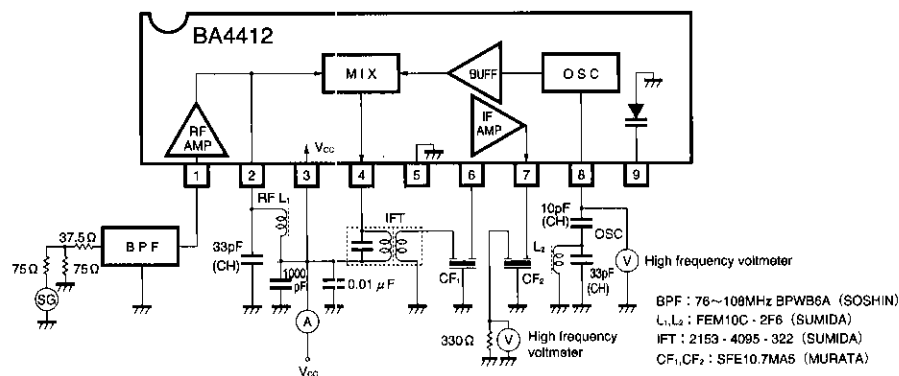


Fig. 1

●Application example

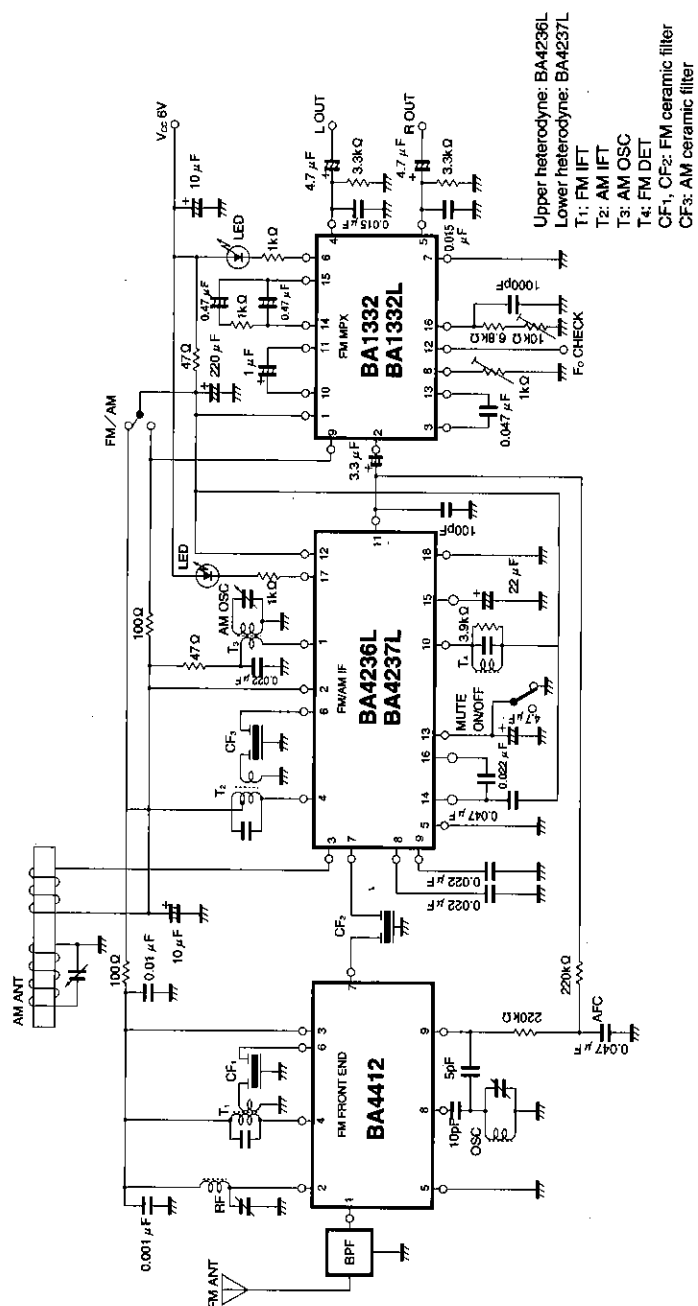


Fig. 2 (a) Schematic of total application circuit

●Application example

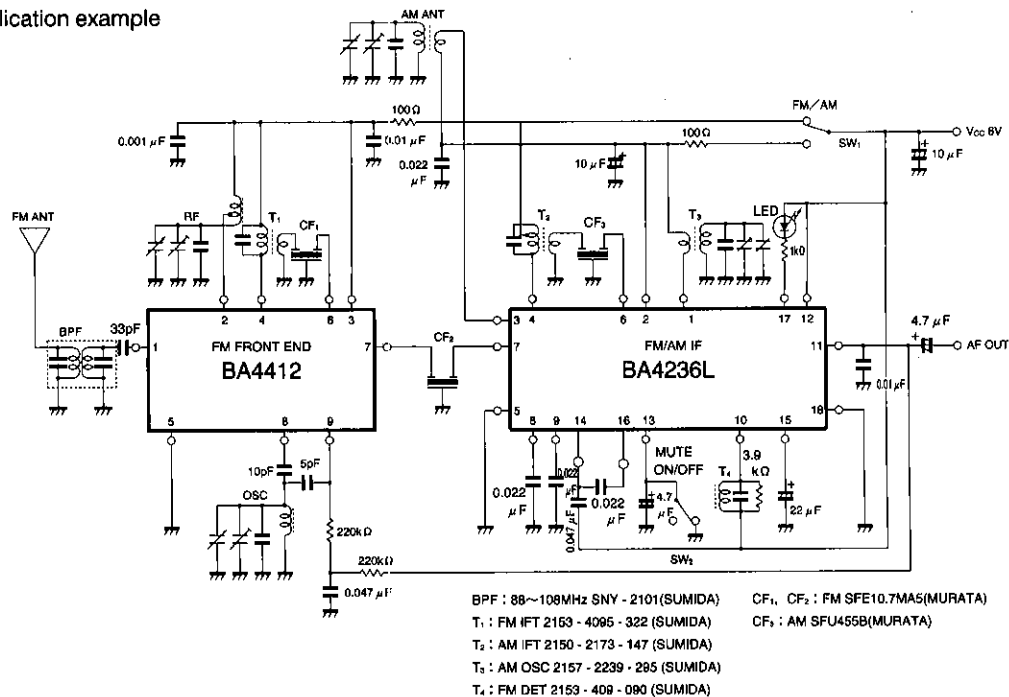


Fig. 2 (b) Schematic of application board circuit (BA4412+BA4236L)

● Circuit operation

(1) RD amplifier circuit

The RF amplifier consists of a common base transistor and a bypass capacitor.

The antenna circuit uses a band pass filter (BPS), and as the RF amplifier has a grounded base, the BPS must have an output impedance of $75\ \Omega$. If a BPF without DC cutoff is used, a coupling capacitor will be necessary.

An LC tuning circuit is connected to form the output load of the RF amplifier. A coil with tap or a coil with secondary winding can be used to reduce spurious ratios such as image ratios. A coupling capacitor for the mixer circuit is included on-chip.

(2) Mixer circuit

The mixer circuit is a double balance type based on a differential amplifier. It has minimal OSC leakage and little spurious interference.

The mixer output includes a diode limiter for improved response to strong input signals.

In addition to an IFT, a resistive load can also be used for the mixer output load. However, take care in this case as the gain will fall.

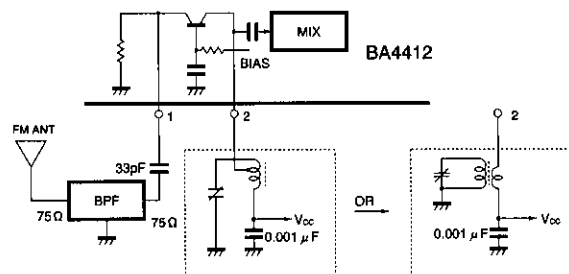


Fig. 3

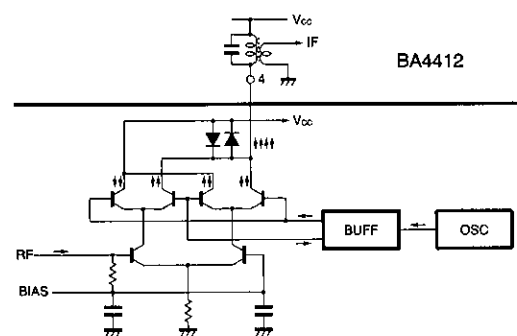


Fig. 4

(3) Oscillation circuit

The oscillation circuit is a Colpitts circuit with grounded collector. The capacitor between the base and emitter and the capacitor between the collector and emitter which form the oscillation circuit are included on the IC.

A buffer has been added for input to the mixer circuit to stabilize the circuit when strong input is present.

(4) IF amplifier

The IF amplifier circuit consists of a differential amplifier and an emitter-follower. The input/output impedance is set with resistors in the IC to 330Ω , and it can be directly connected to a ceramic filter.

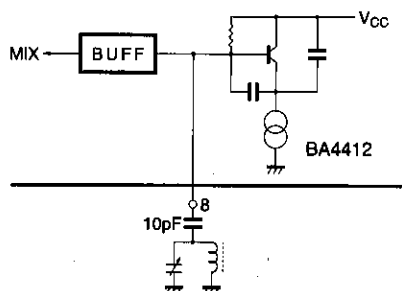


Fig. 5

● Coil specifications

- 1) T_1 : FM IFT (10.7MHz) 2153-4095-322

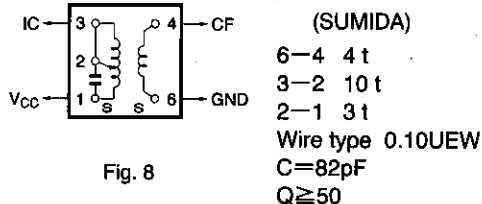


Fig. 8

- 3) T_3 : AM OSC 2157-2239-295 (SUMIDA)

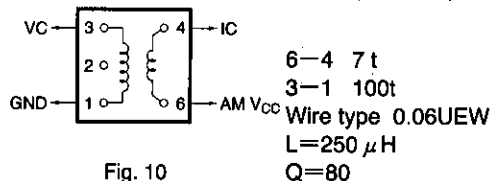


Fig. 10

- 5) BPF: FM BPF (76MHz~108MHz) SNY-2102 (SUMIDA)

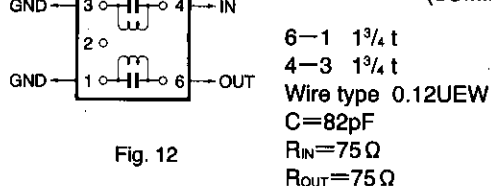


Fig. 12

(5) Variable capacitor-diode for AFC

A variable capacitor-diode is included on the IC for AFC using the FM detection output S curve. The anode is connected to ground.

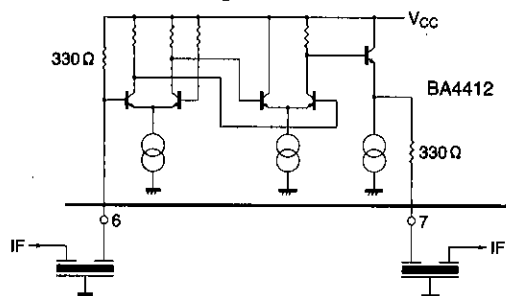


Fig. 6

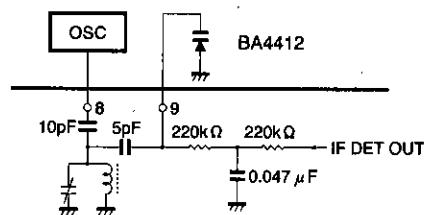


Fig. 7

- 2) T_2 : AM IFT (455kHz) 2150-2173-147

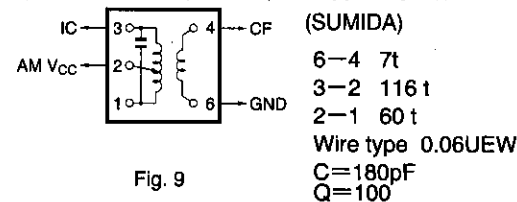


Fig. 9

- 4) T_4 : FM DET (10.7 MHz) 2153-409-090

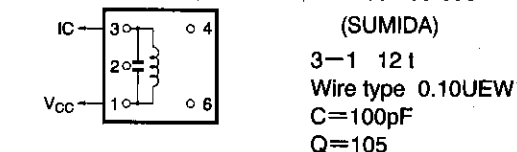


Fig. 11

● Electrical characteristic curves

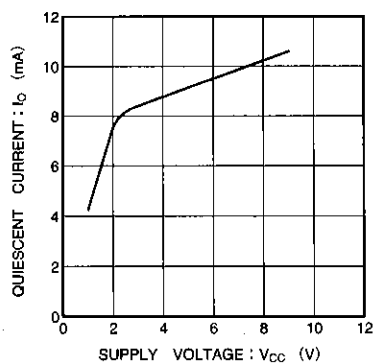


Fig. 13 Quiescent current vs. supply voltage

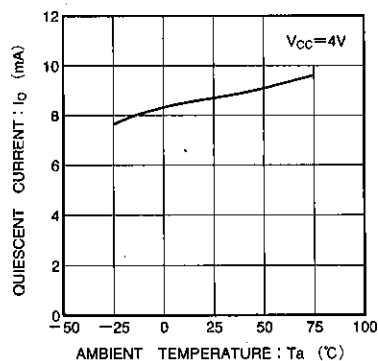


Fig. 14 Quiescent current vs. ambient temperature

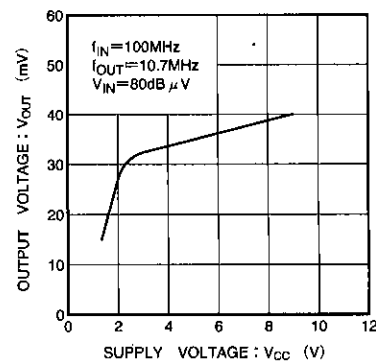


Fig. 15 Output voltage vs. supply voltage

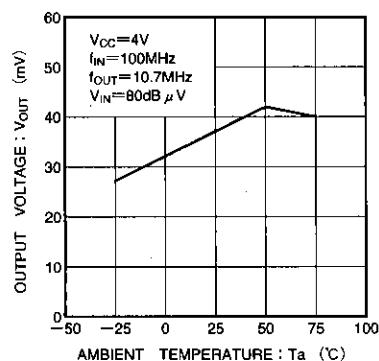


Fig. 16 Output voltage vs. ambient temperature

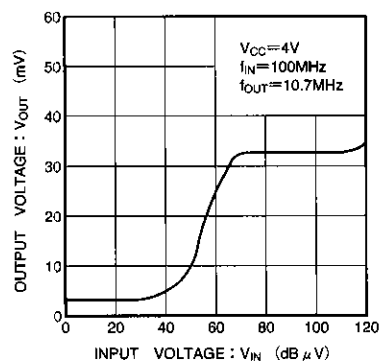


Fig. 17 Output voltage vs. input voltage

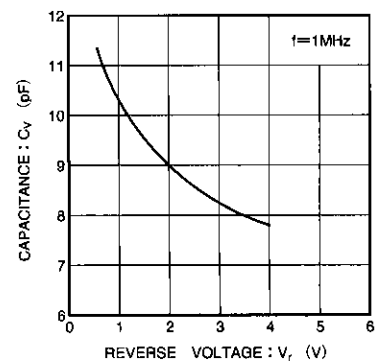


Fig. 18 AFC capacitor capacitance vs. applied voltage

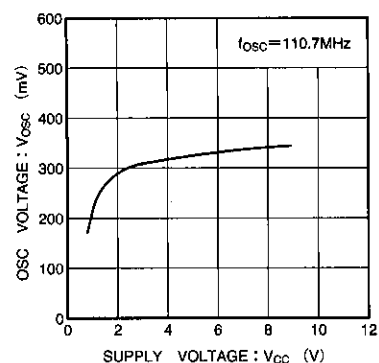


Fig. 19 Oscillator voltage vs. supply voltage

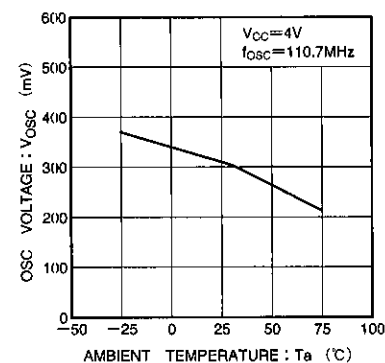


Fig. 20 Oscillator voltage vs. ambient temperature

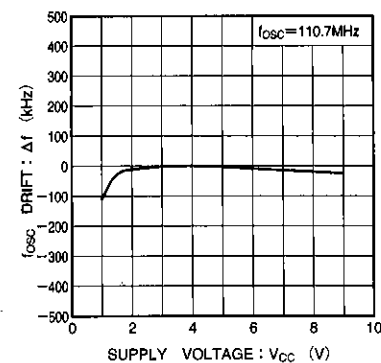


Fig. 21 Oscillation frequency vs. supply voltage

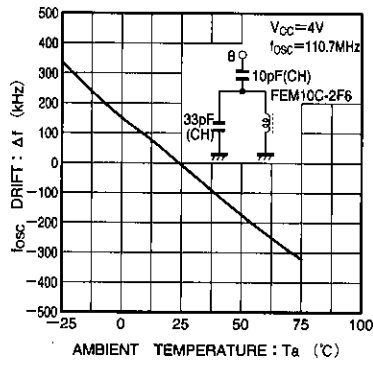


Fig. 22 Oscillation frequency vs. ambient temperature

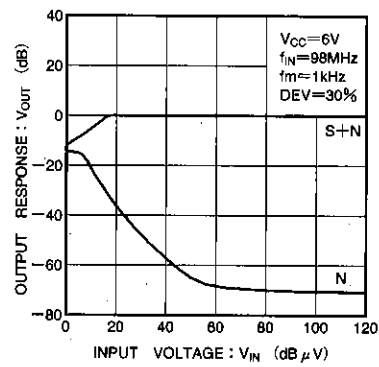
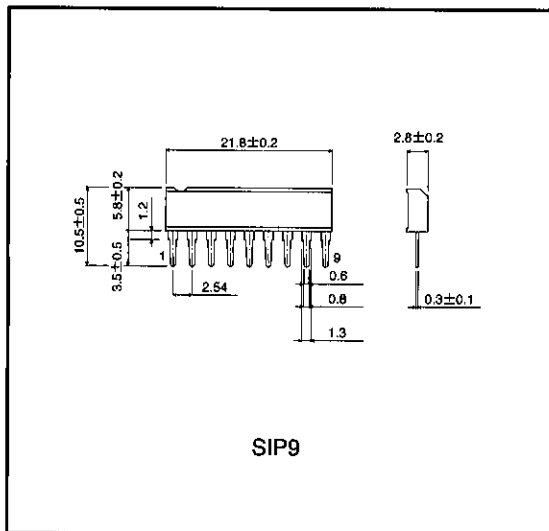


Fig. 23 Overall input/output characteristics (BA4412+BA4236L, Fig2[(b)])

● External dimensions (Unit: mm)



Front end

High-frequency signal processors

Notes

- The contents described in this catalogue are correct as of March 1997.
- No unauthorized transmission or reproduction of this book, either in whole or in part, is permitted.
- The contents of this book are subject to change without notice. Always verify before use that the contents are the latest specifications. If, by any chance, a defect should arise in the equipment as a result of use without verification of the specifications, ROHM CO., LTD., can bear no responsibility whatsoever.
- Application circuit diagrams and circuit constants contained in this data book are shown as examples of standard use and operation. When designing for mass production, please pay careful attention to peripheral conditions.
- Any and all data, including, but not limited to application circuit diagrams, information, and various data, described in this catalogue are intended only as illustrations of such devices and not as the specifications for such devices. ROHM CO., LTD., disclaims any warranty that any use of such device shall be free from infringement of any third party's intellectual property rights or other proprietary rights, and further, assumes absolutely no liability in the event of any such infringement, or arising from or connected with or related to the use of such devices.
- Upon the sale of any such devices; other than for the buyer's right to use such devices itself, resell or otherwise dispose of the same; no express or implied right or license to practice or commercially exploit any intellectual property rights or other proprietary rights owned or controlled by ROHM CO., LTD., is granted to any such buyer.
- The products in this manual are manufactured with silicon as the main material.
- The products in this manual are not of radiation resistant design.

The products listed in this catalogue are designed to be used with ordinary electronic equipment or devices (such as audio-visual equipment, office-automation equipment, communications devices, electrical appliances, and electronic toys). Should you intend to use these products with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers, or other safety devices) please be sure to consult with our sales representatives in advance.

- Notes when exporting
 - It is essential to obtain export permission when exporting any of the above products when it falls under the category of strategic material (or labor) as determined by foreign exchange or foreign trade control laws.
 - Please be sure to consult with our sales representatives to ascertain whether any product is classified as a strategic material.