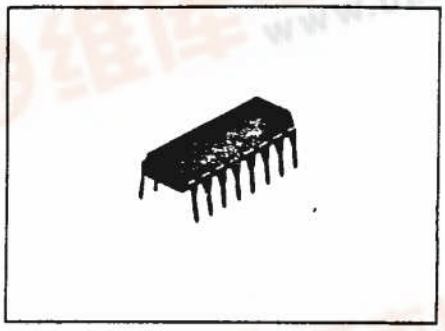
# BA4210



The BA4210 is a monolithic integrated circuit consisting of two FM IF amplifiers, an AM mixer and an IF amplifier for use in low-voltage FM/AM radios and cassette recorders with built-in radios.

## Features

1. Operates stably over a wide range of supply voltages and has excellent characteristics at low voltages ($V_{CC}$=2.5~6.0V).
2. High-gain FM section IF amplifier circuit.
3. The AM section includes a mixer, local oscillator, IF amplifier, and AGC circuit, and has excellent AGC and distortion characteristics.

## Applications

AM/FM Radios
Radio cassette recorders

## Dimensions (Unit: mm)

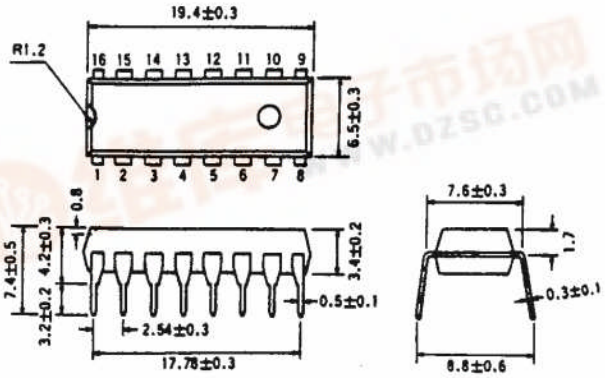



Fig. 1

## Block Diagram

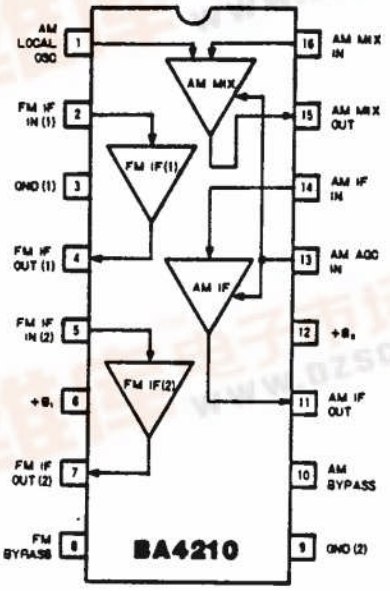



Fig. 2

## Absolute Maximum Ratings (Ta=25°C)

| Parameter | Symbol | Limits | Unit |
|---|---|---|---|
| Supply voltage | Vcc | 9 | V |
| Power dissipation | Pd | 550* | mW |
| Operating temperature range | Topr | −25~75 | °C |
| Storage temperature range | Tstg | −40~125 | °C |

* Derating is done at 5.5mW/°C for operation above Ta=25°C

## Recommended Operating Conditions (Ta=25°C)

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Supply voltage | Vcc | 2.5 | 4.0 | 6.0 | V |

## Electrical Characteristics (Ta=25°C, $V_{CC}$=4.0V)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Conditions | Test circuit |
|---|---|---|---|---|---|---|---|
| Quiescent current (AM) | $I_Q$ (AM) | 4.5 | 8.0 | 11.5 | mA | — | Fig. 3-1 |
| Voltage gain (MIX) | $A_U$ (MIF) | 7.5 | 11.5 | 15.5 | dB | f=1MHz, R=50Ω, $R_L$=1kΩ (AM) | Fig. 3 |
| Voltage gain (IF) | $A_U$ (IF) | 44.0 | 50.0 | 56.0 | dB | f=455kHz, $R_G$=50Ω, $R_L$=330Ω (AM) | Fig. 3 |
| Circuit current (FM) | $I_Q$ (FM) | 5.0 | 9.0 | 13.0 | mA | — | Fig. 3-2 |
| Voltage gain ($IF_1$) | $A_U$ ($IF_1$) | 38.0 | 42.0 | 46.0 | dB | f=10.7MHz, $R_G$=50Ω, $R_L$=1kΩ (FM) | Fig. 3 |
| Voltage gain ($IF_2$) | $A_U$ ($IF_2$) | 27.0 | 33.0 | 39.0 | dB | f=10.7MHz, $R_G$=50Ω, $R_L$=330Ω (FM) | Fig. 3 |

## Test Circuits

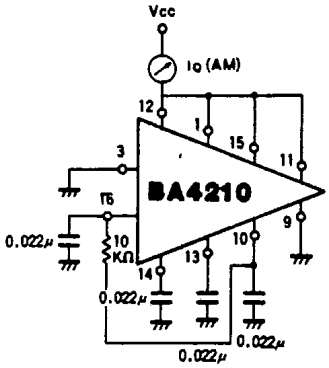



Fig. 3-1

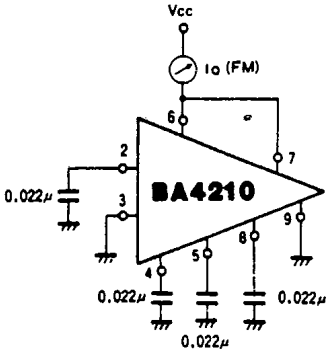



Fig. 3-2

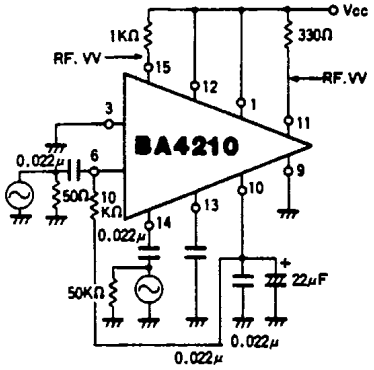



Fig. 3-3

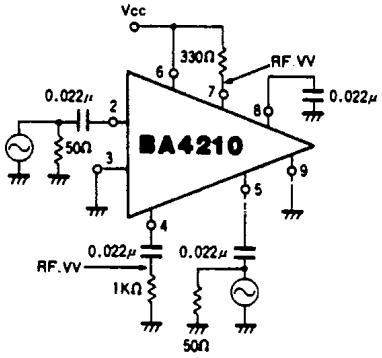



Fig. 3-4

## Application Example

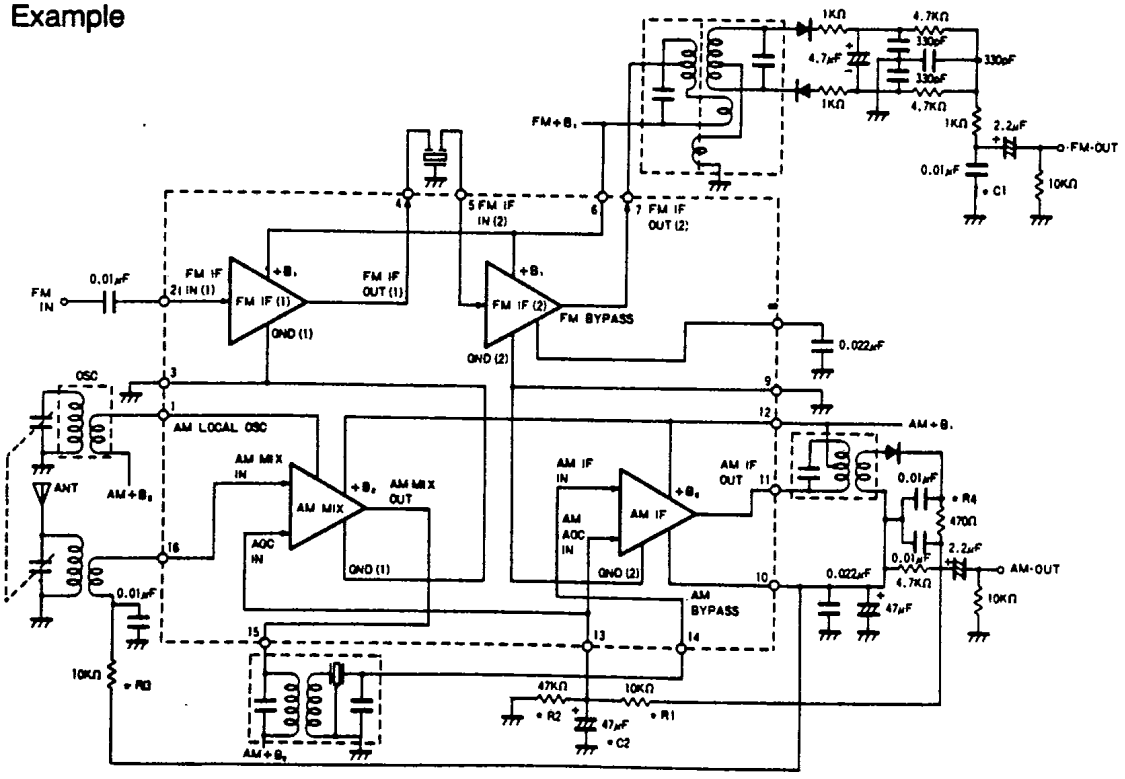



Fig. 4

## Circuit Description

1. FM Section

In the application example shown, the output of the ratio detector after limiting is 180mVrms for 1kHz modulation input and ±75kHz dviation. When connecting a ceramic filter to the first IF section stage, if the filter characteristics are not the same as the ceramic filter connected between pin 4 and pin 5, non-coincidence of the passbands of the two filters may result in deterioration of distortion characteristics. Also, it is possible to replace the ceramic filter between pin 4 and pin 5 with a ceramic capacitor.

When connecting a stereo demultiplexer IC (MPX IC) to the last stage, capacitor $C_1$ should be removed.

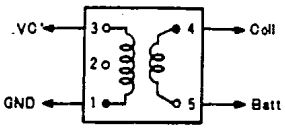
2. AM Section

In the application example shown, for direct input to the 50Ω input at pin 16, 60mVrms output is obtainable with 60dBμV modulation of 30% at 1kHz frequency.

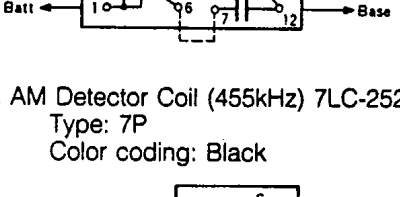
By adjusting the ratio of $R_1$ and $R_2$, the input level at which AGC begins to take effect can be selected. $R_1$ and $C_2$ form a filter so that the value of $R_1$ should be chosen to be approximately 10kΩ. Note that the $C_2$ 47μF, if made a value approximately 10μF, will cause filter characteristics to deteriorate, resulting in increased distortion in the low and high frequency ranges. $C_2$ should be kept in the range 33~47μF.

## Coil Specifications

1. AM Oscillator Coil (MW) 7BR-4398X (TOKO)
   Type: 7P 1-3 65T
   Color coding: Black 4-6 11T

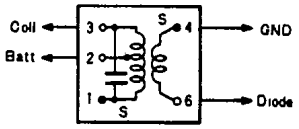



2. AM Interstage Coil CFZ-455C (TOKO) L=150μH (±6%) $Q_u$>80 (f=1.4MHz)




Bandwidth: 6kHz (min.)
Selectivity: 20dB (min.) or better (at ±10kHz detuning)

3. AM Detector Coil (455kHz) 7LC-252222 No. (TOKO)
   Type: 7P
   Color coding: Black
   1-3 146T
   2-3 37T
   4-6 33T




Internal capacitor C=180pF
$Q_u$=70±20%

4. FM Detector Transformer (10.7MHz) (TOKO)

| | | Internal C | | | |
|---|---|---|---|---|---|
| Primary | 119AC-470085L$_8$ | (Gray) 47pF | 4-2 5½T | 2-3 8T | 1-5 5½T |
| Secondary | 119FC-560061N$_6$ | (Blue) 56pF | 1-2 6T | 2-3 6T | 4-6 1T |

Type 7P

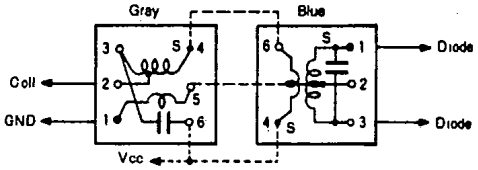



Fig. 5 Coil used in the application example

## Electrical Characteristic Curves

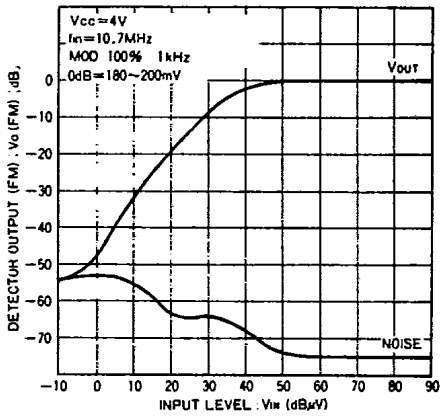



Fig. 6 FM input/output characteristics

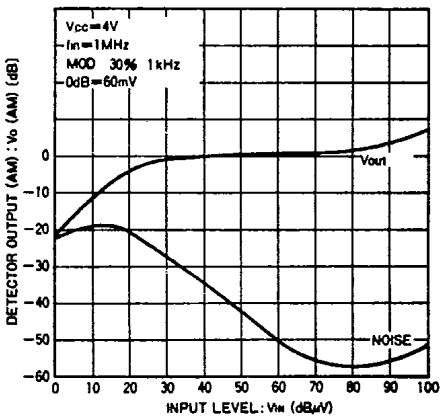



Fig. 7 AM input/output characteristics

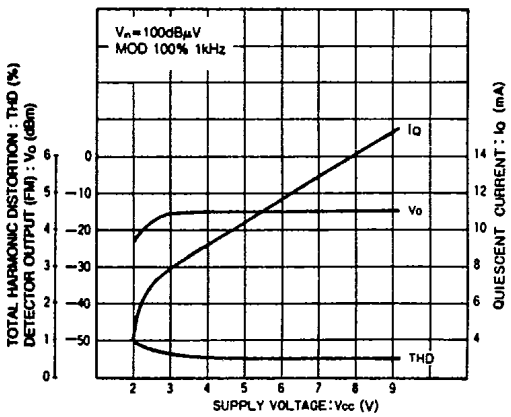



Fig. 8 FM low-voltage performance

## Electrical Characteristic Curves

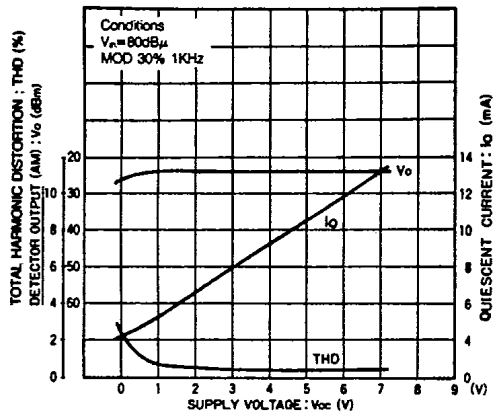



Fig. 9 AM low-voltage performance

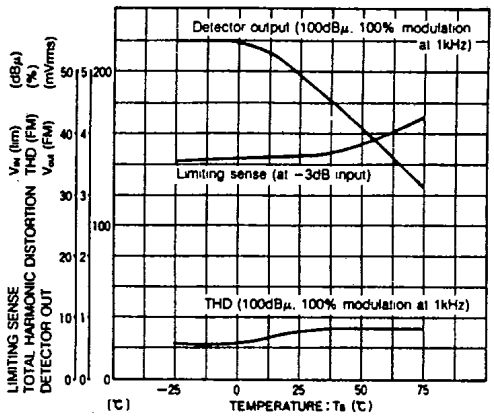



Fig. 10 FM temperature characteristics

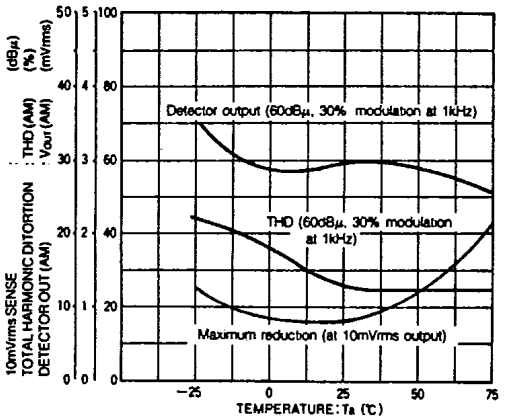



Fig. 11 AM temperature characteristics

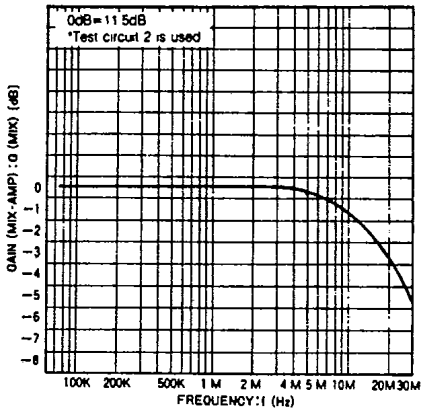



Fig. 12 AM-Mixer stage frequency characteristics

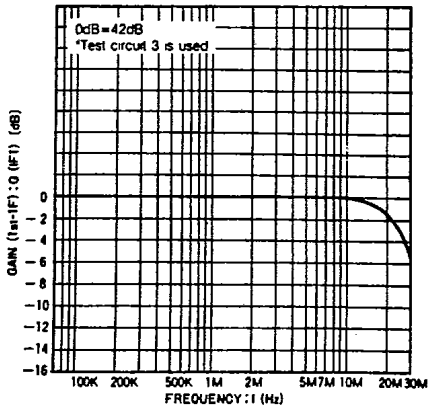



Fig. 13 1st FM IF stage frequency characteristics

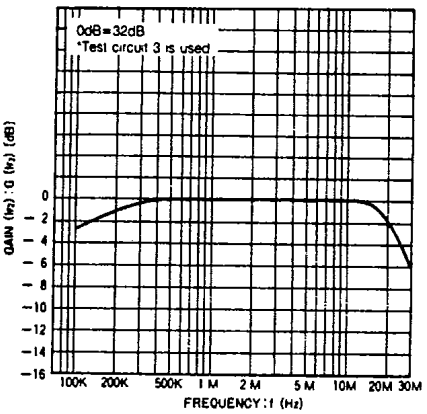
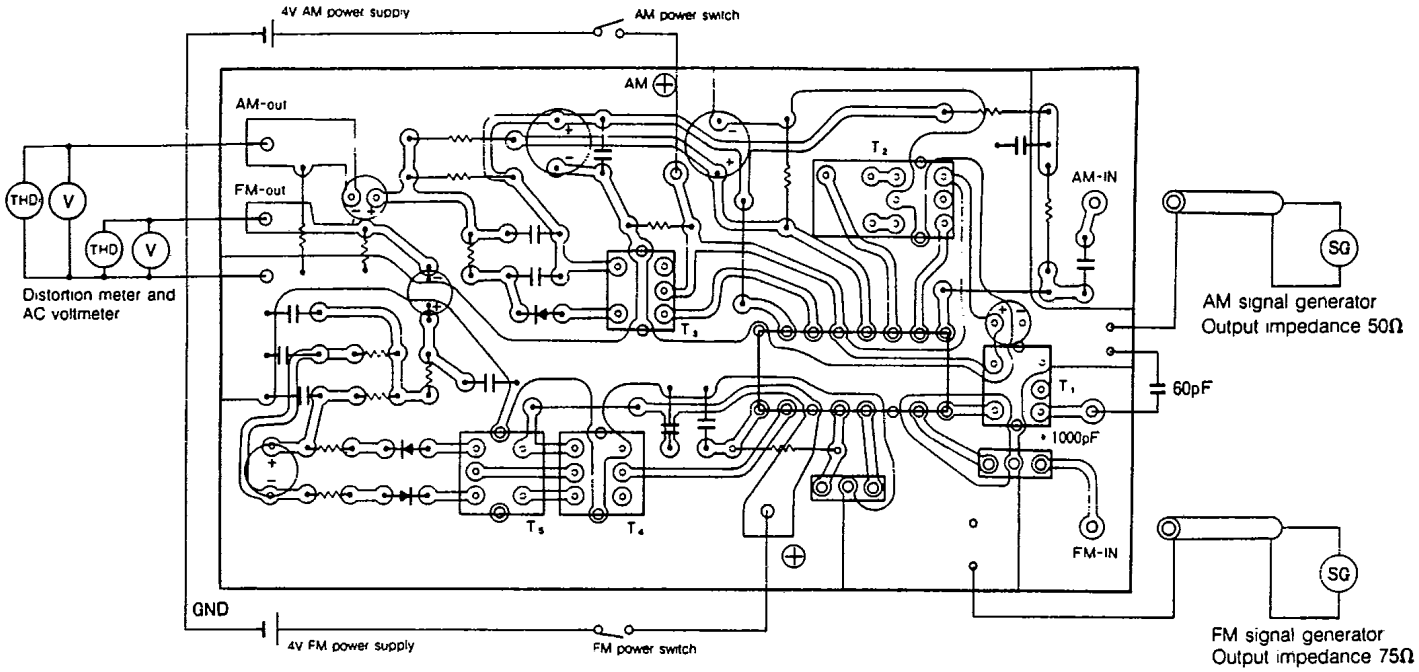
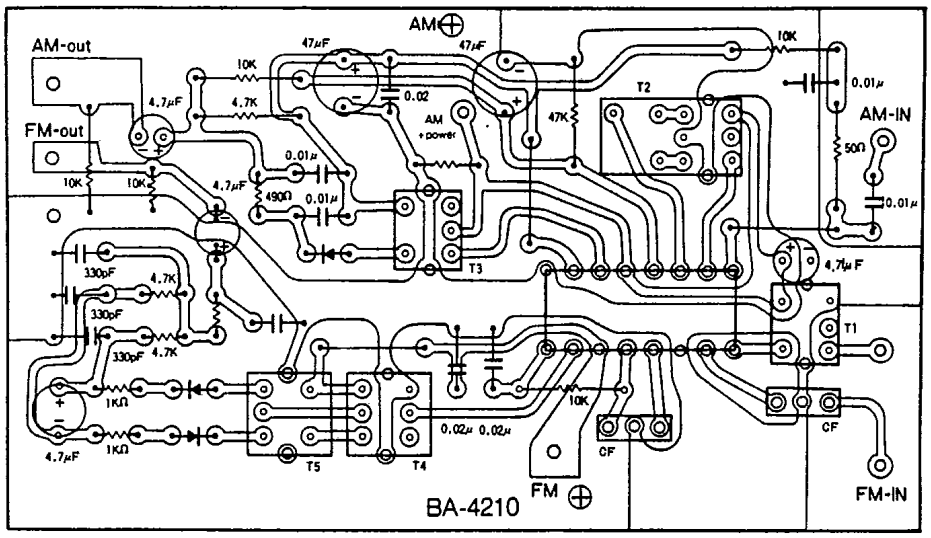



Fig. 14 2nd FM IF stage frequency characteristics




AM: $T_1$ is adjusted for oscillation at approximately 1.5MHz.
$T_2$ and $T_3$ are adjusted using a sweeper marker generator for maximum waveform amplitude at 1MHz.
FM: $T_4$ and $T_5$ are adjusted using a sweeper marker generation for best S-curve slope and linearity.

Fig. 15 Test circuit setup




$T_1$: AM oscillator coil (MW band) 7BR-4398X
$T_2$: AM interstage coil CFZ-455C
$T_3$: AM detector coil 7LC-25222
$T_4$: FM detector coil (primary) 119AC-470085$L_8$
$T_5$: FM detector coil (secondary) 119FC-560061$N_6$

Fig. 16 Application example board layout