

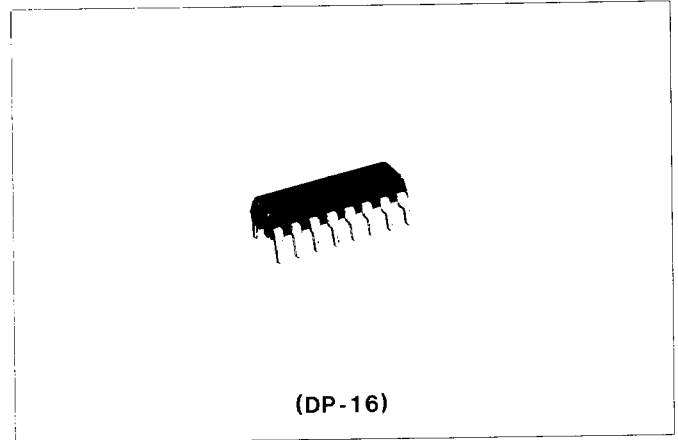
HA12413

FM/AM IF SYSTEM

The HITACHI HA12413 is an IC for FM/AM IF system. Typical applications include cassette radios and modular stereos, functioning and featuring as follows.

FUNCTIONS

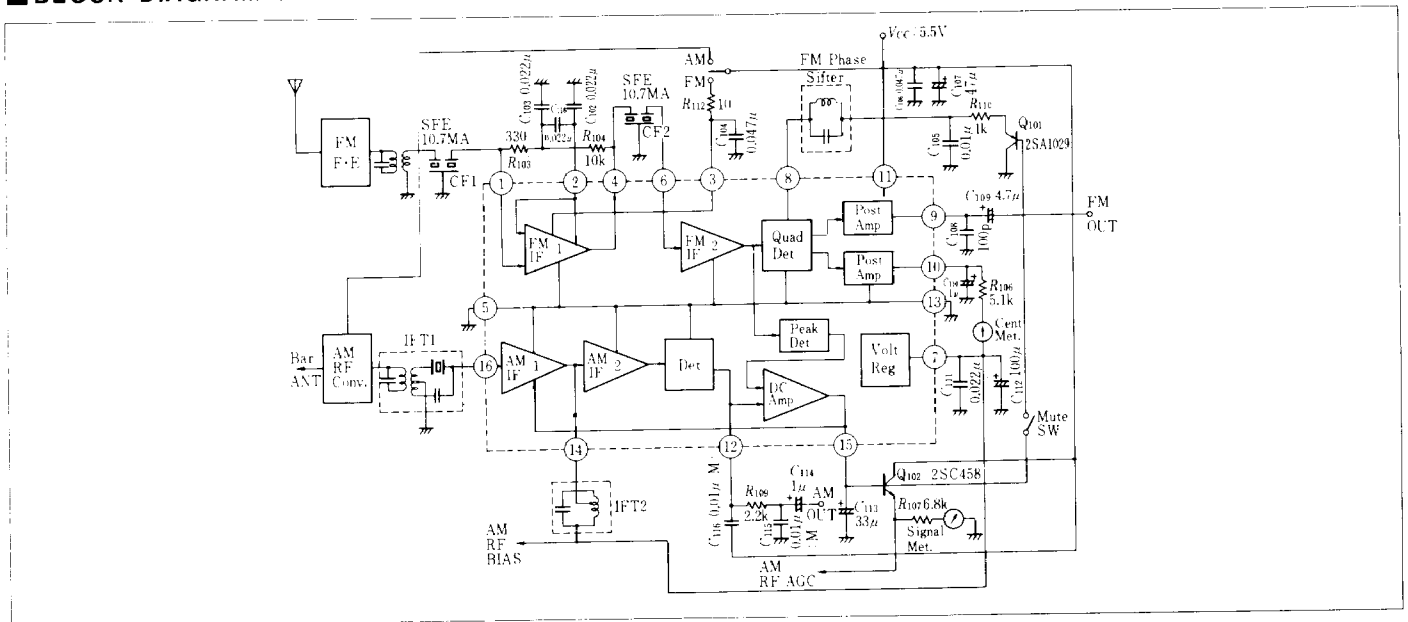
- FM**
- IF Amplifier (With C.F. is inserted between the stages)
 - Audio Amplifier
 - Quadrature Detector
 - Signal Meter (One external NPN transistor required. Used also for AM)
 - Center Meter
- AM**
- IF Amplifier (With AGC)
 - Detector
 - Signal Meter (Same pin with FM)



FEATURES

- FM**
- High Limiting Sensitivity, and High Stability (33dB μ)
 - Low Residual Noise (-45dB at Vin=-10dB μ)
 - Small Side Peak of Detuned Output Voltage (Peak Level is approx. +2dB in comparison with that of Center Frequency)
 - Muting Available at lower input level (One external PNP transistor required)
- AM**
- Voltage Regulator for RF external Circuit
 - High AGC Figure of merit
- FM/AM**
- Low Operating Current (FM: 11mA, AM:8mA)
 - Wide Range of Operating Supply Voltage (3V~16V)
 - Low External Parts count

BLOCK DIAGRAM & TYPICAL APPLICATION CIRCUIT



ABSOLUTE MAXIMUM RATINGS (Ta=25°C, unless otherwise specified)

| Item | Symbol | Rating | Unit |
|-----------------------------|------------------|-------------|------|
| Supply Voltage | V _{CC} | 16 | V |
| Power Dissipation | P _T * | 350 | mW |
| Operating Temperature Range | T _{OP} | -20 to +70 | °C |
| Storage Temperature Range | T _{STG} | -55 to +125 | °C |

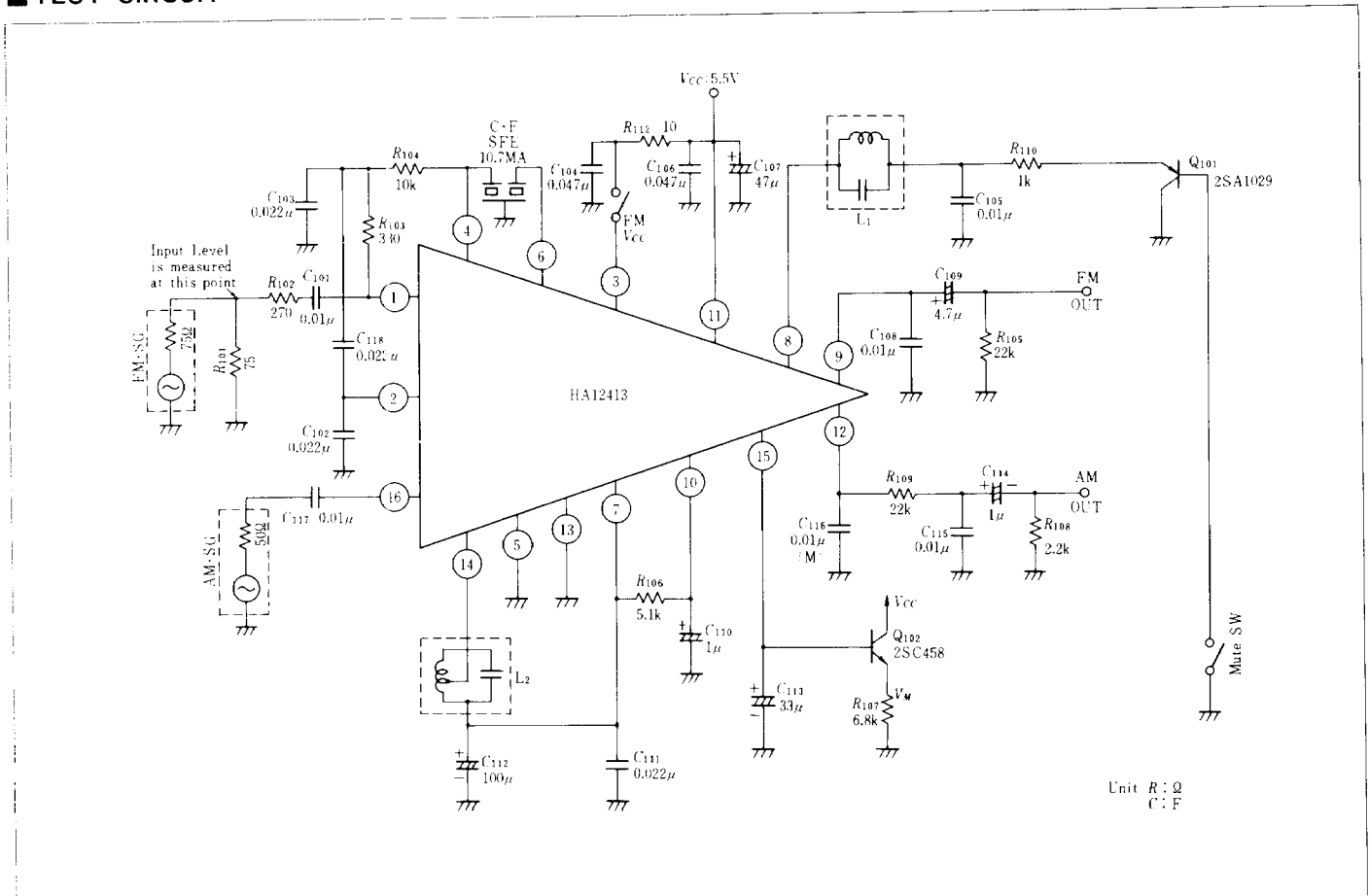
*Value at Ta=70°C

(at $T_a=25^\circ\text{C}$ unless otherwise specified, the test conditions are:
 FM: $V_{CC}=5.5\text{V}$, $f_c=10.7\text{MHz}$, $f_m=1\text{kHz}$, $\Delta f=75\text{kHz}$
 AM: $V_{CC}=5.5\text{V}$, $f_c=455\text{kHz}$, $f_m=1\text{kHz}$, $m=30\%$)

■ ELECTRICAL CHARACTERISTICS

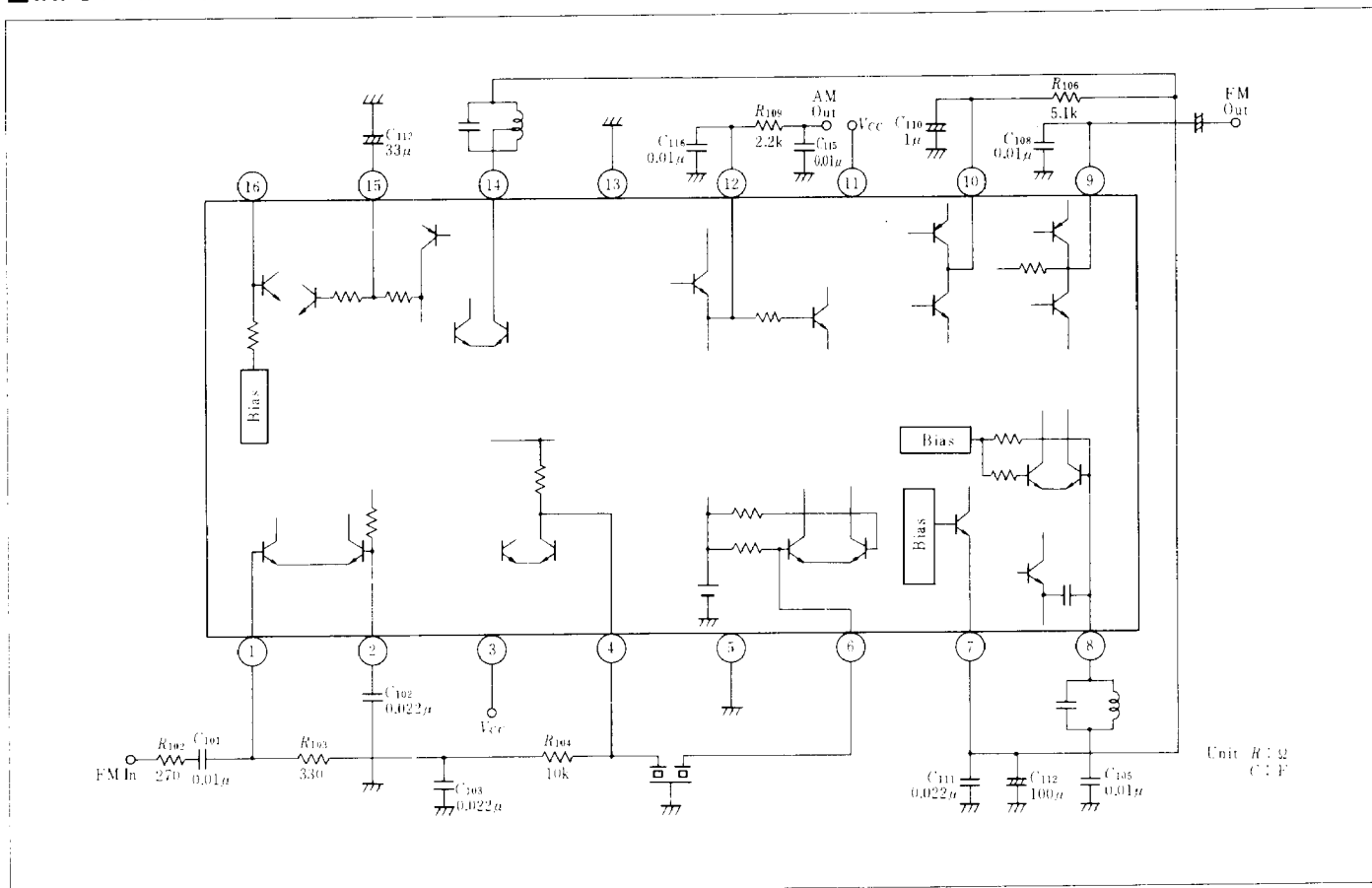
| | Item | Symbol | Test Conditions | min. | typ. | max. | Unit |
|----|-----------------------------|----------------|---|------|------|------|------------|
| FM | Operating Current | I_{CC} | $V_{CC}=5.5\text{V}$, No Input | 7 | 11 | 16.5 | mA |
| | Audio Output Voltage | $V_{O,AF}$ | $V_{in}=100\text{dB}\mu$ | 180 | 245 | 310 | mV |
| | Total Harmonic Distortion | $T.H.D.$ | $V_{in}=100\text{dB}\mu$ | — | 0.3 | 1.0 | % |
| | Limiting Sensitivity | $V_{in,lim}$ | the value of input to make output lower by 3dB | — | 33 | 38 | dB μ |
| | Signal-to-Noise Ratio | S/N | $V_{in}=100\text{dB}\mu$ | 72 | 83 | — | dB |
| | AM Rejection Ratio | AMR | $V_{in}=100\text{dB}\mu$, AM Modulation: $f_m=1\text{kHz}$, $m=30\%$ | 50 | 60 | — | dB |
| | Signal Meter Output Voltage | V_M | $V_{in}=100\text{dB}\mu$ | 1.05 | 1.5 | 2.05 | V |
| | Residual Noise | V_N | Noise level with $V_{in}=-10\text{dB}\mu$ to Audio Output Voltage with $V_{in}=100\text{dB}\mu$ | — | 45 | — | dB |
| AM | Muting Attenuation | $Mute_{(ATT)}$ | $V_{in}=37\text{dB}\mu$, Mute SW: ON | — | 35 | — | dB |
| | Total Harmonic Distortion | $T.H.D.(1)$ | $V_{in}=74\text{dB}\mu$ | — | 0.3 | 2.0 | % |
| | Total Harmonic Distortion | $T.H.D.(2)$ | $V_{in}=100\text{dB}\mu$ | — | 0.7 | 3.5 | % |
| | Signal-to-Noise Ratio | S/N | $V_{in}=74\text{dB}\mu$ | 45 | 55 | — | dB |
| | Maximum Sensitivity | S_{IF} | the value of input to make $V_{O,AF}=10\text{mV}$ | — | 29 | — | dB μ |
| | Signal Meter Output Voltage | V_M | $V_{in}=100\text{dB}\mu$ | 1.2 | 1.4 | 1.6 | V |
| | Audio Output Voltage | $V_{O,AF}$ | $V_{in}=74\text{dB}\mu$ | 45 | 65 | 85 | mV |
| | Input Impedance at 16 pin | $Z_{in,16}$ | DC measurement | 1.45 | 2.12 | 2.8 | k Ω |

■ TEST CIRCUIT



Unit R: Ω
 C: F

INPUT AND OUTPUT CIRCUIT OF EACH PIN



EXTERNAL COMPONENTS

1. Resistor

| Part No. | Recommended Value | Function | Influence | | Note |
|------------------|-------------------|---|--------------------------------------|--|-----------------------------|
| | | | Less than Recommended Value | More than Recommended Value | |
| R ₁₀₁ | 75Ω | SG Impedance Matching | — | — | Only for test circuit |
| R ₁₀₂ | 270Ω | Input Impedance Matching | — | — | Only for test circuit |
| R ₁₀₃ | 330Ω | Impedance Matching to Intermediate Frequency Filter | — | — | — |
| R ₁₀₄ | 10kΩ | IF Amp. DC Feedback | Offset of Defferential Voltage: High | Offset of Defferential Voltage: High | — |
| R ₁₀₅ | 22kΩ | Load Resistor for FM Detective Output | Detective Output: Low | Detective Output: High | Only for test circuit |
| R ₁₀₆ | 5.1kΩ | Load Resistor for AFC Voltage | AFC Voltage: Low | AFC Voltage: High | — |
| R ₁₀₇ | 6.8kΩ | Meter Operating Current Limiting | Meter Swing: Large | Meter Swing Small | Decided by the Meter Rating |
| R ₁₀₈ | 22kΩ | Load Resistor for AM Detective Output | Detective Output: Low | — | Only for test circuit |
| R ₁₀₉ | 2.2kΩ | L. P. F. Forming (With C ₁₁₅) | Carrier Leak: Large | Frequency Characteristics of Detective Output: Deteriorate | — |
| R ₁₁₀ | 1kΩ | Mute-ON-Current Limiting | IC Breakdown | Mute Attenuation: Deteriorate | — |
| R ₁₁₂ | 10Ω | Decoupling (With C ₁₁₆) | Unstabilizing | Voltage-Abating Characteristics: Deteriorate | — |

2. Condensor

| Part No. | Recommended Value | Functions | Influence | | Note |
|------------------|-------------------|---|--|--|---|
| | | | Less than the Recommended Value | More than the Recommended Value | |
| C ₁₀₁ | 0.01 μ | Input DC Cut | Deterioration of Sensitivity | — | — |
| C ₁₀₂ | 0.022 μ | Input Decoupling | Unstabilizing | — | — |
| C ₁₀₃ | 0.022 μ | Input Decoupling | Unstabilizing | — | — |
| C ₁₀₄ | 0.047 μ | FM V _{cc} Supply Decoupling | Unstabilizing | — | — |
| C ₁₀₅ | 0.01 μ | Detector Decoupling | Unstabilizing | — | — |
| C ₁₀₆ | 0.047 μ | Power Supply Decoupling | Unstabilizing | — | — |
| C ₁₀₇ | 47 μ | Power Supply Decoupling | Superposing of Low Frequency Signal | — | — |
| C ₁₀₈ | 0.01 μ | De-emphasis (With 9pin Output Impedance) | Deterioration of De-emphasis Characteristics | Deterioration of De-emphasis Characteristics | C ₁₀₈ = 100 pF, for Stereo Use |
| C ₁₀₉ | 4.7 μ | FM Output DC Cut | Separation Deteriorating in Low Frequency Range | — | — |
| C ₁₁₀ | 1 μ | AFC Output Decoupling | Low Frequency Signal Superposing on AFC Controlling Line | Long time is required for AFC operation to start | — |
| C ₁₁₁ | 0.022 μ | Voltage Regulator Decoupling | Unstabilizing | — | — |
| C ₁₁₂ | 100 μ | FM \rightleftharpoons AM Crosstalk Decreasing | Large Crosstalk | — | — |
| C ₁₁₃ | 33 μ | AGC Decoupling | THD Deterioration at AM Low Frequency Range | Long time is required for AGC operation to start | — |
| C ₁₁₄ | 1 μ | AM Output DC Cut | Deterioration of Frequency Characteristic in Low Frequency Range | — | — |
| C ₁₁₅ | 0.01 μ | LPF Forming (With R 109) | Large Carrier Leak | Deterioration of Frequency Characteristic of Recovered Audio Voltage | — |
| C ₁₁₆ | 0.01 μ | AM Detecting | | — | Use Polyester Film Capacitor |
| C ₁₁₇ | 0.01 μ | AM Input DC Cut | Deterioration of Sensitivity | — | — |
| C ₁₁₈ | 0.022 μ | Input Decoupling | Unstabilizing | — | — |

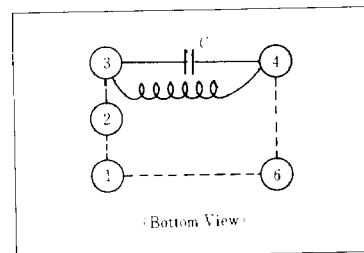
3. Semiconductor

- *Q₁₀₁ : 2SA1029 (Transistor for Muting)
 - *Q₁₀₂ : 2SC458 $\text{\textcircled{B}}$ (Transistor for Signal Meter Drive)
- Note) V_{BE} at Q₁₀₂ 2SC458 $\text{\textcircled{B}}$ (When 100 μ A emitter current supplied) : 606 mV typ.

4. Coil/Filter

- 1) Ceramic Filter Murata SFE 10.7MA
- 2) Coil

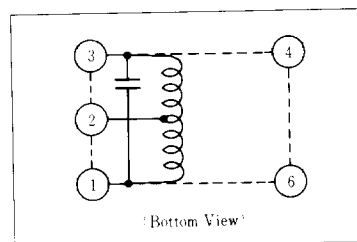
L2 (FM Det Coil) Mitsumi No.MB-90438



Number of : 14.5T Turns

C: 100pF
Qu: 60 typ

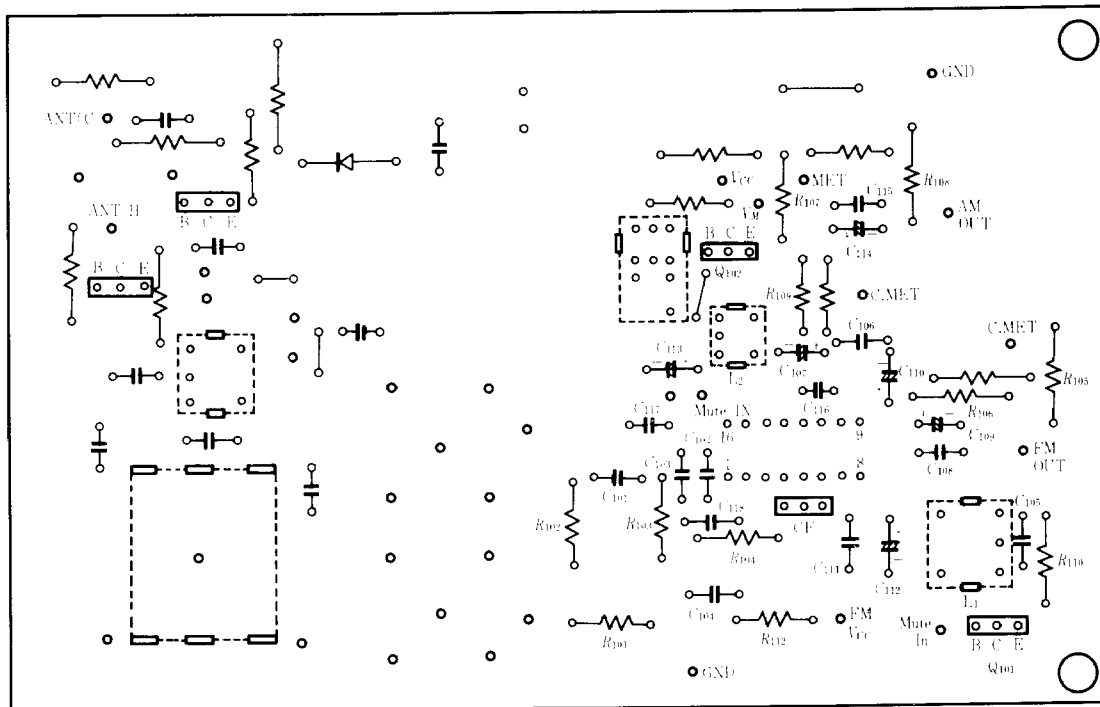
L2 (AM IFT Coil) Mitsumi No.MB-90439



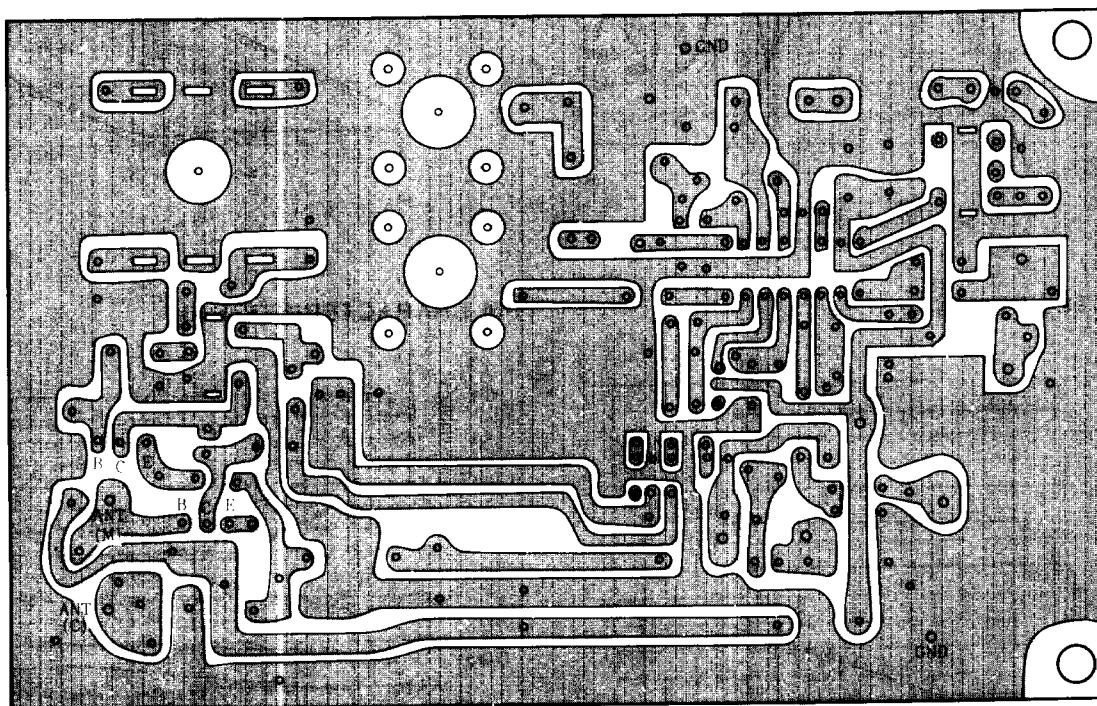
Number of: ①-②: 52T Turns
②-③: 94T

C: 180pF
Qu: 125 typ

PC-BOARD LAYOUT PATTERN

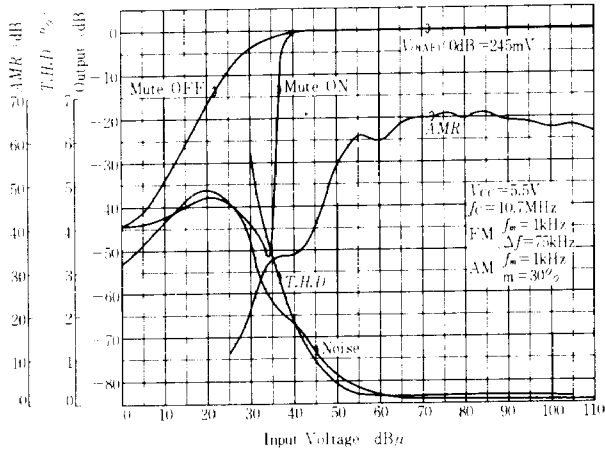


(Top View)

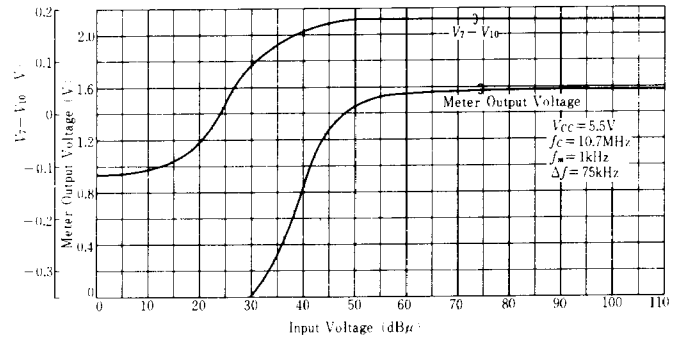


(Bottom View)

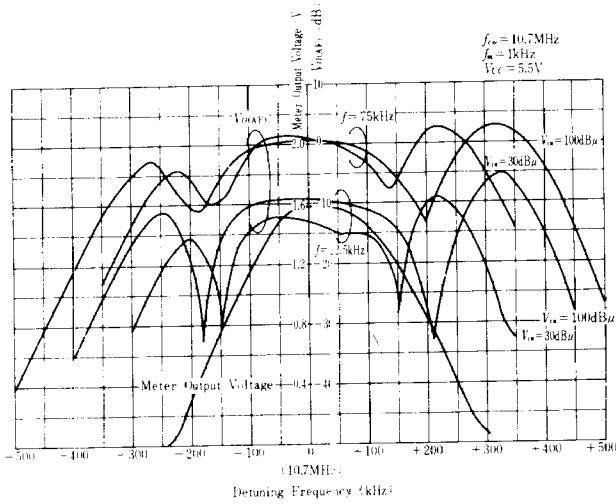
FM CHARACTERISTICS (1)



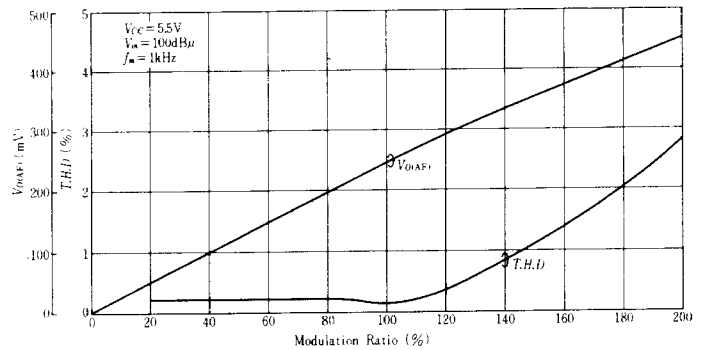
FM CHARACTERISTICS (2)



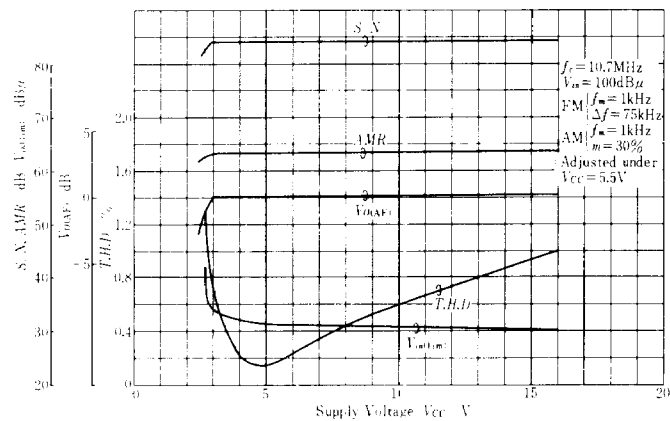
FM CHARACTERISTICS (3)



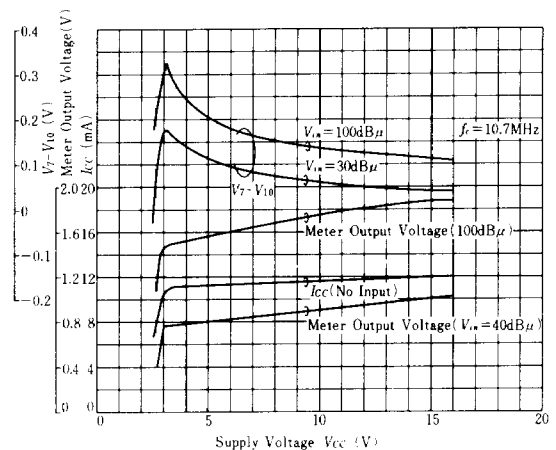
FM CHARACTERISTICS (4)



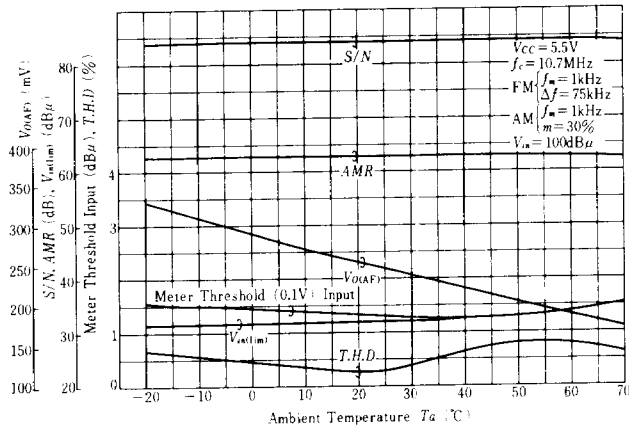
FM CHARACTERISTICS (5)



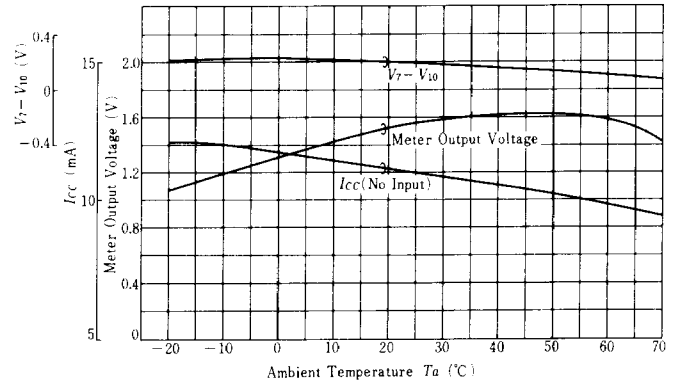
FM CHARACTERISTICS (6)



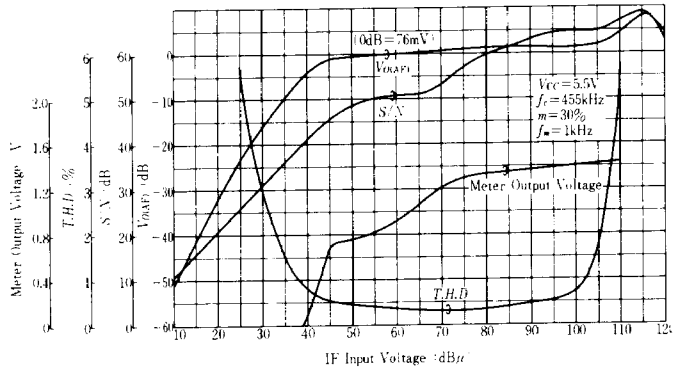
FM CHARACTERISTICS (7)



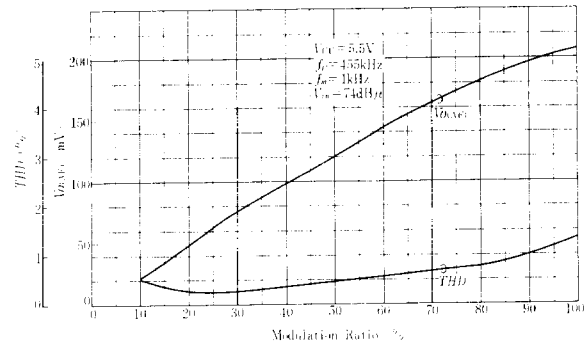
FM CHARACTERISTICS (8)



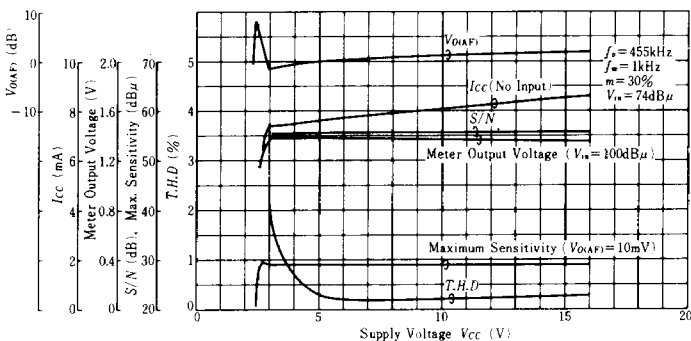
AM CHARACTERISTICS (1)



AM CHARACTERISTICS (2)



AM CHARACTERISTICS (3)



AM CHARACTERISTICS (4)

