

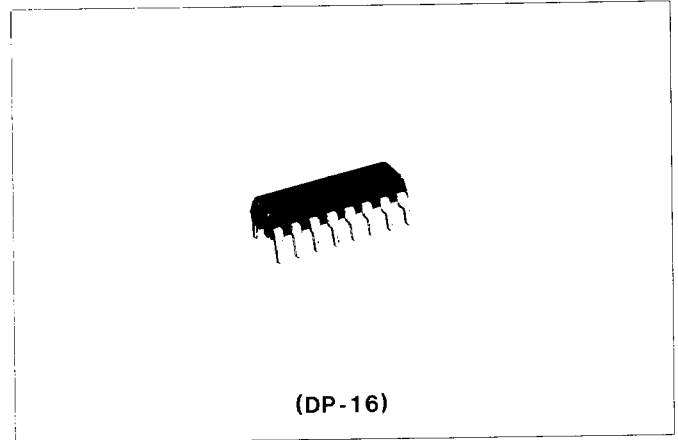
HA12413

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

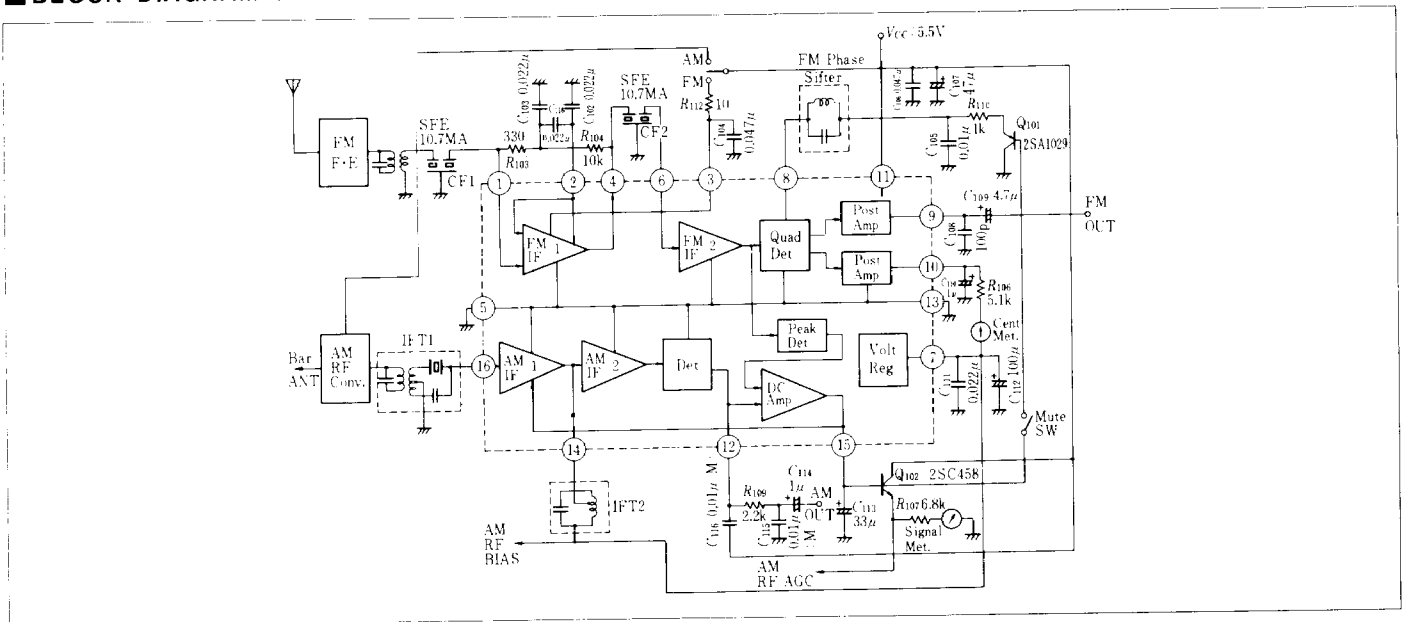
- FM**
- IF Amplifier (With C.F. is inserted between the stages)
 - Audio Amplifier
 - Quadrature Detector
 - Signal Meter (One external NPN transistor required. Used also for AM)
 - Center Meter
- AM**
- IF Amplifier (With AGC)
 - Detector
 - Signal Meter (Same pin with FM)



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 |

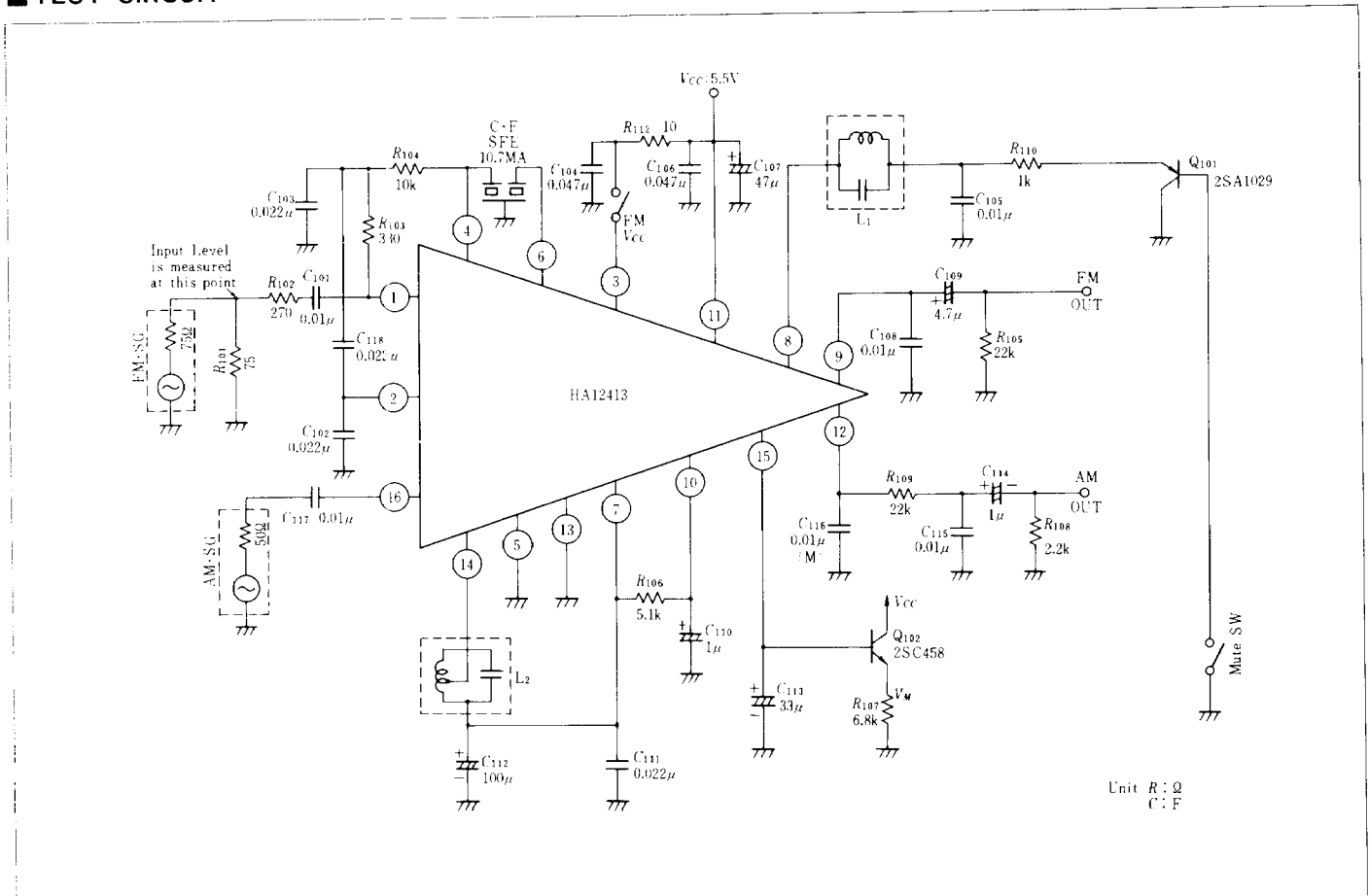
*Value at Ta=70°C

(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 : $V_{CC}=5.5\text{V}$, $f_c=455\text{kHz}$, $f_m=1\text{kHz}$, $m=30\%$)

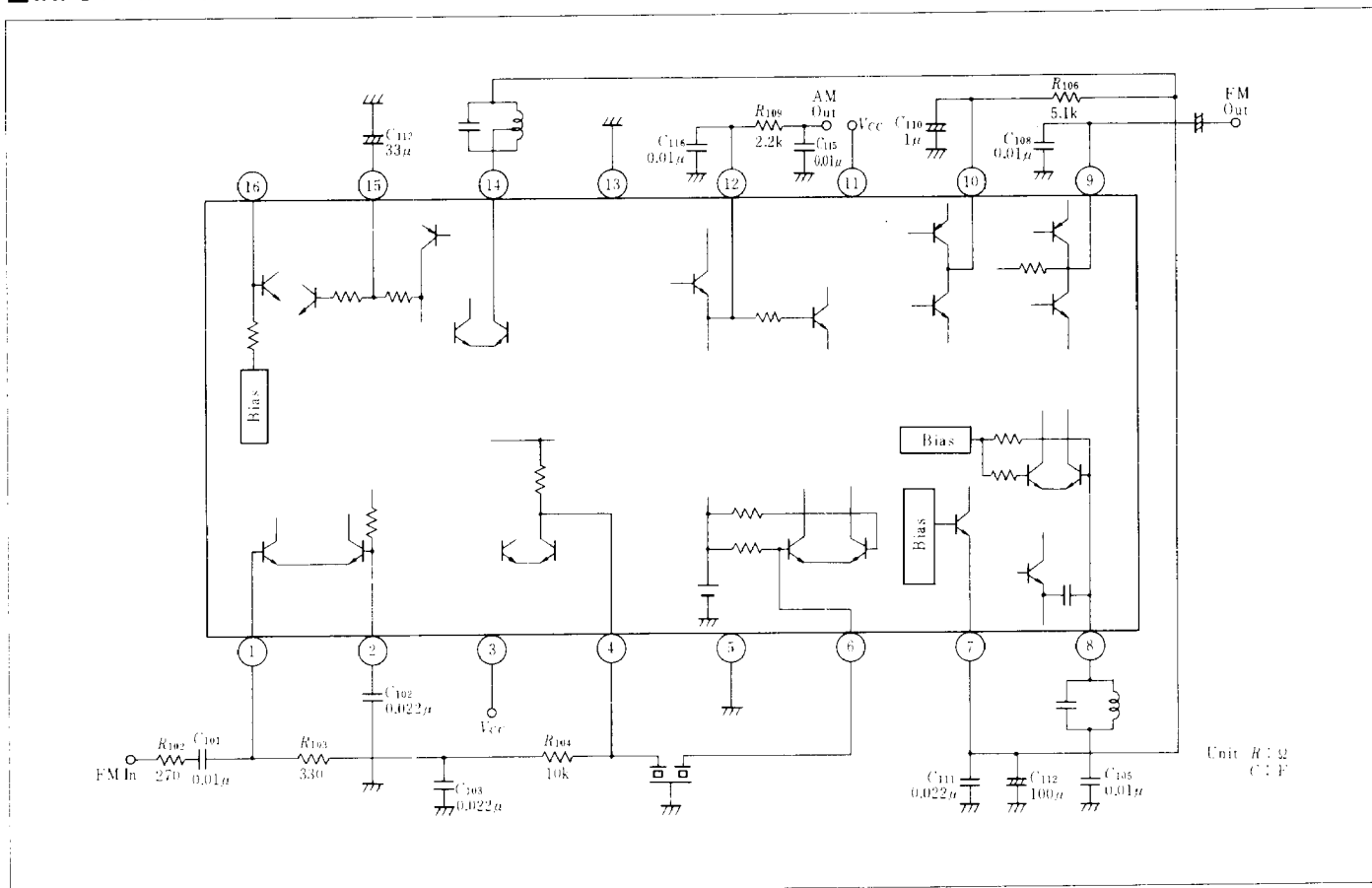
■ ELECTRICAL CHARACTERISTICS

| | 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 | $\text{dB}\mu$ |
| | 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 | — | $\text{dB}\mu$ |
| | 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



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 \leftrightarrow 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 | — | — |

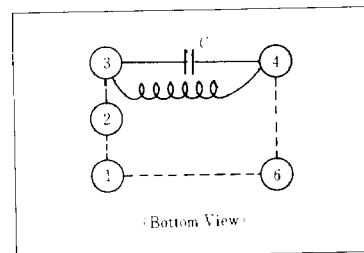
3. Semiconductor

- *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

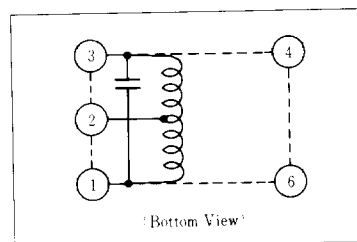
L2 (FM Det Coil) Mitsumi No.MB-90438



Number of : 14.5T Turns

C: 100pF
Qu: 60 typ

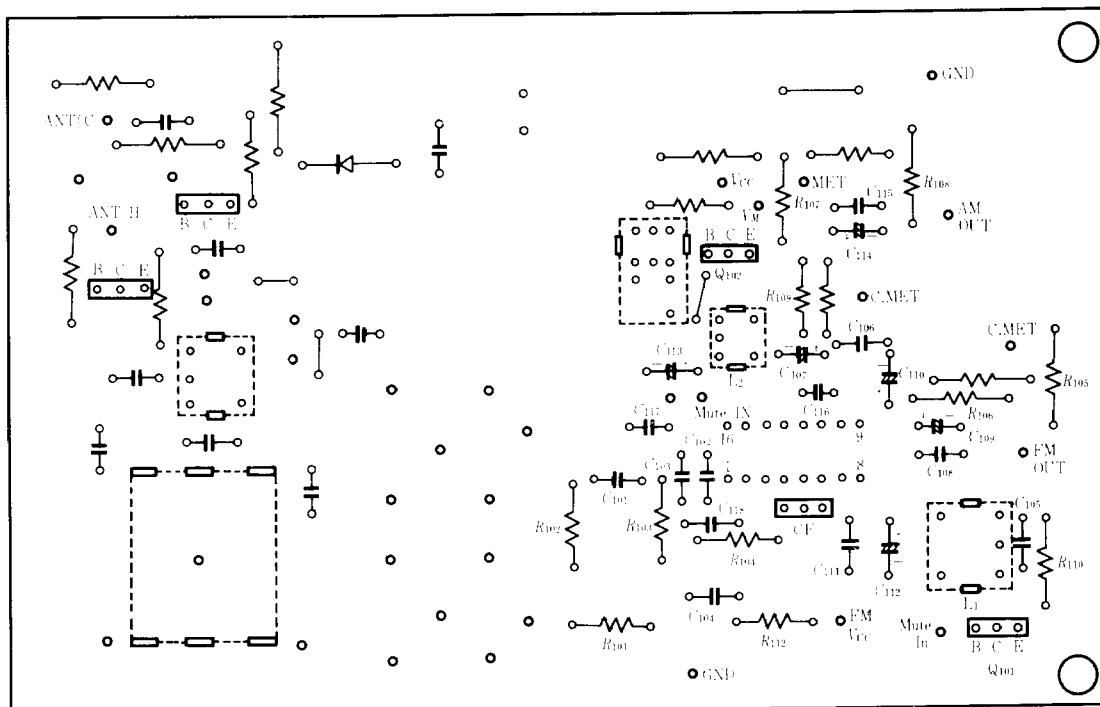
L2 (AM IFT Coil) Mitsumi No.MB-90439



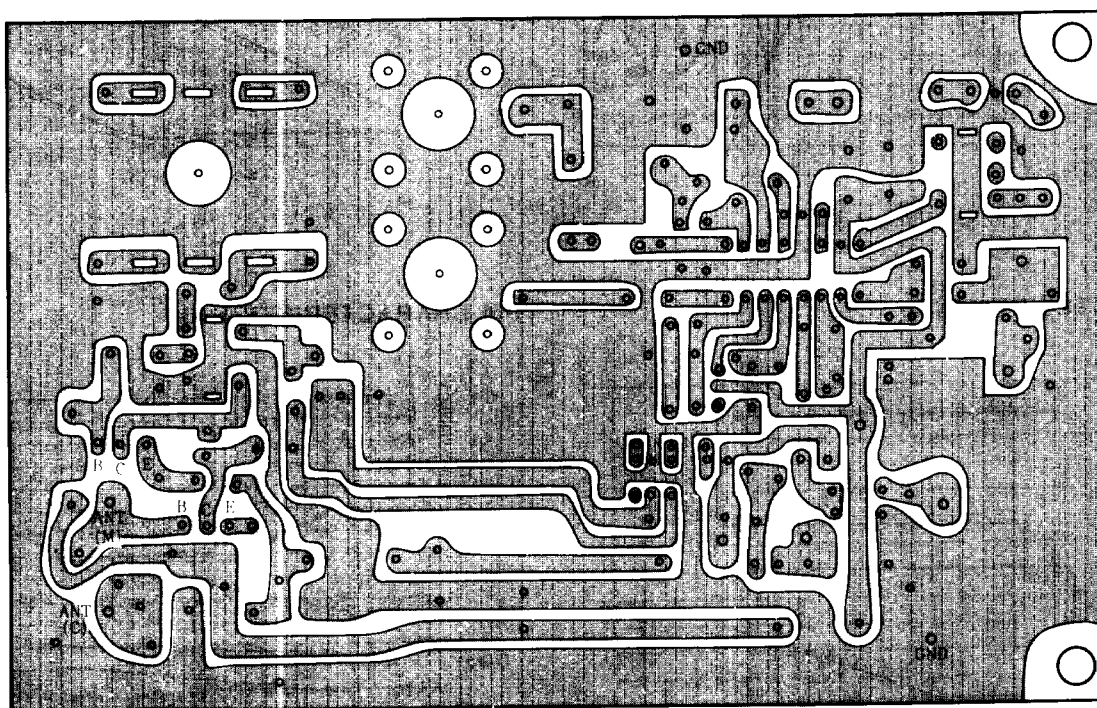
Number of: ①-②: 52T Turns
②-③: 94T

C: 180pF
Qu: 125 typ

PC-BOARD LAYOUT PATTERN

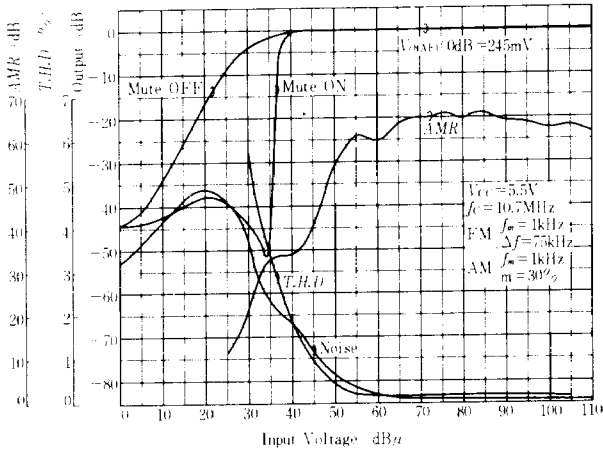


(Top View)

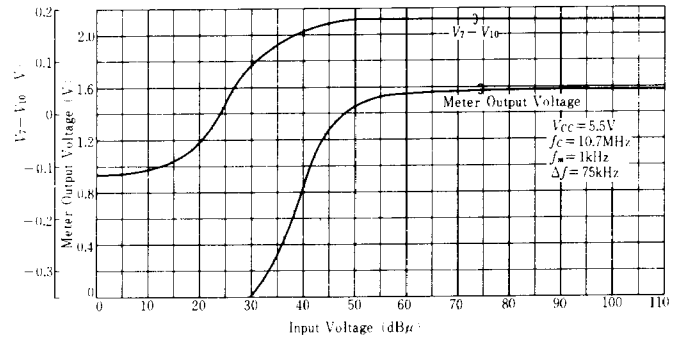


(Bottom View)

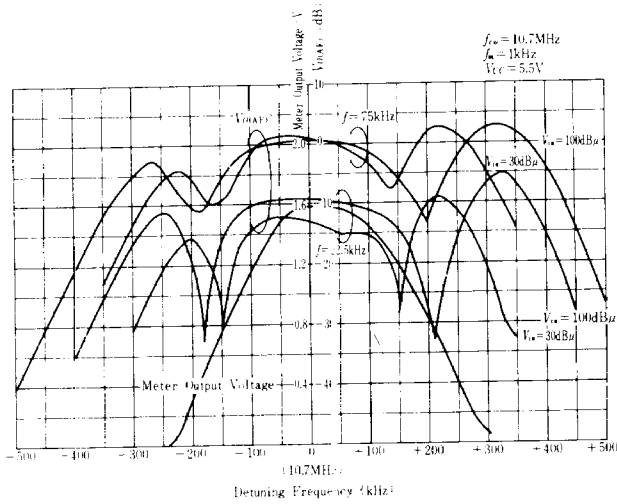
FM CHARACTERISTICS (1)



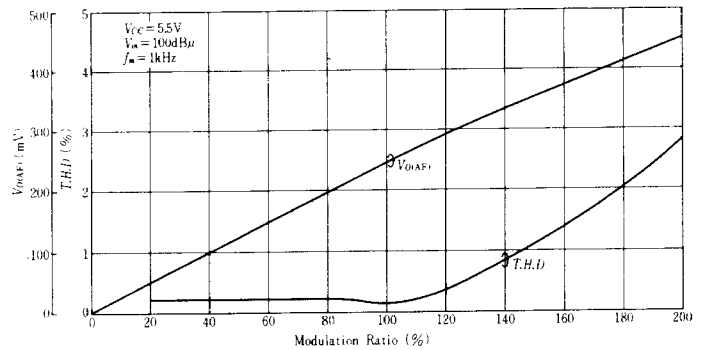
FM CHARACTERISTICS (2)



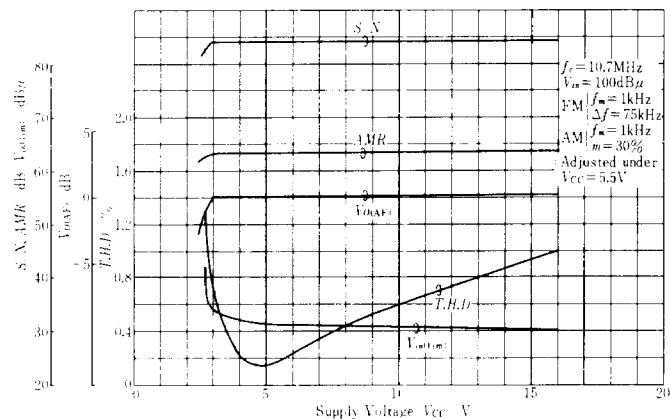
FM CHARACTERISTICS (3)



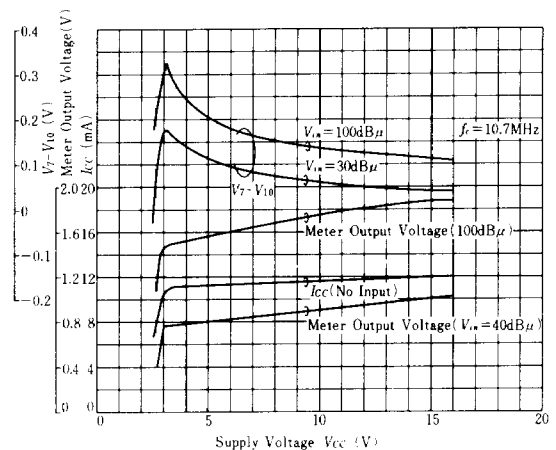
FM CHARACTERISTICS (4)



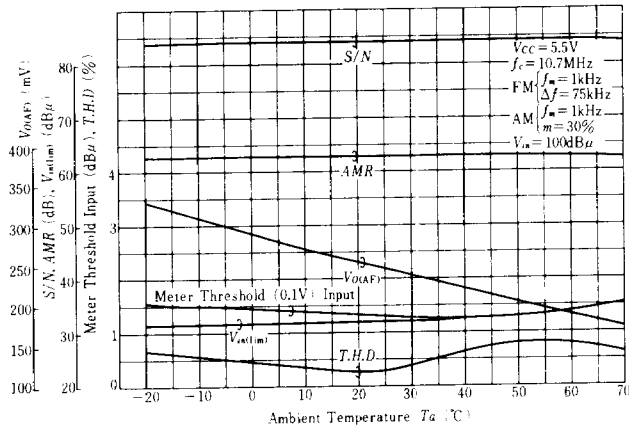
FM CHARACTERISTICS (5)



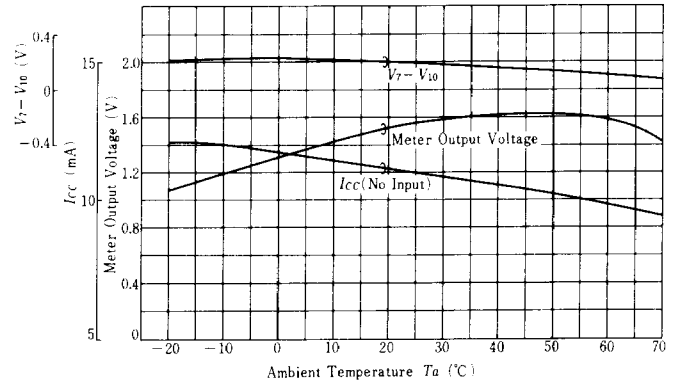
FM CHARACTERISTICS (6)



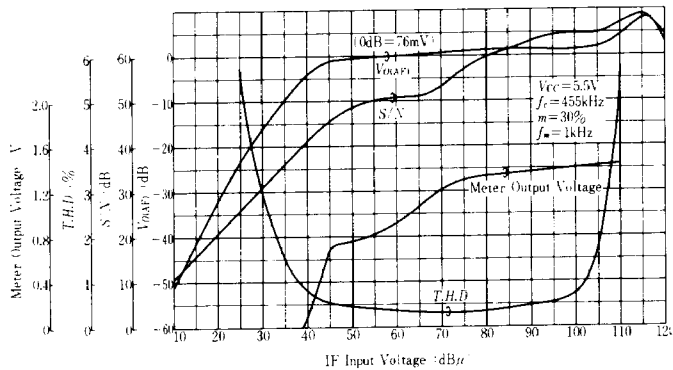
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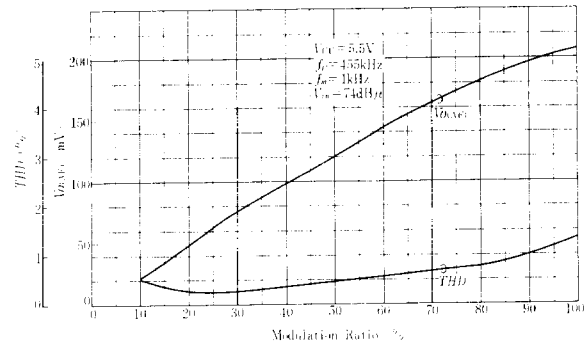
FM CHARACTERISTICS (8)



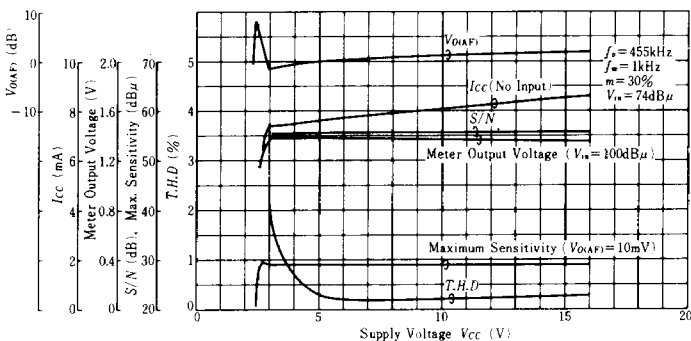
AM CHARACTERISTICS (1)



AM CHARACTERISTICS (2)



AM CHARACTERISTICS (3)



AM CHARACTERISTICS (4)

