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.

(DP-16)

■ FUNCTIONS

FM
- IF Amplilfier
  (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)

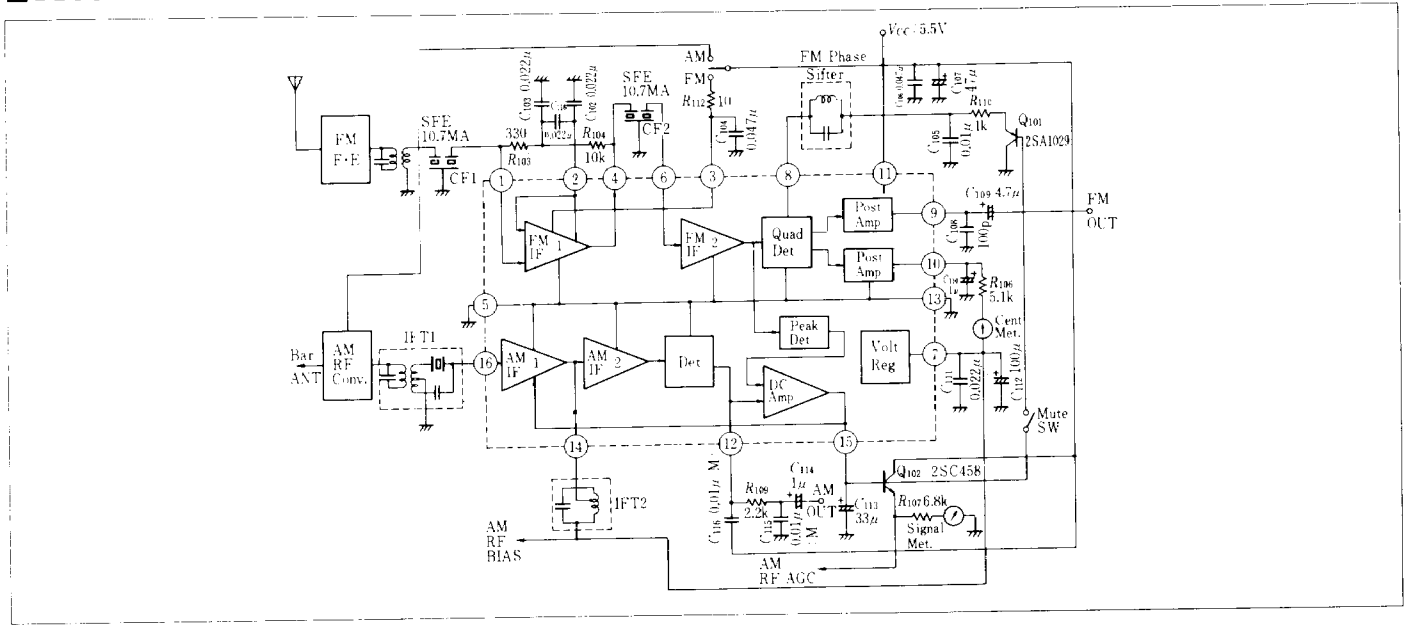
■ FEATURES

FM
- High Limiting Sensitivity, and High Stability (33dBμ)
- Low Residual Noise (−45dB at Vin=−10dBμ)
- 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℃, unless otherwise specified)

Item	Symbol	Rating	Unit
Supply Voltage	V_{CC}	16	V
Power Dissipation	P_T*	350	mW
Operating Temperature Range	T_{opr}	−20 to +70	℃
Storage Temperature Range	T_{stg}	−55 to +125	℃

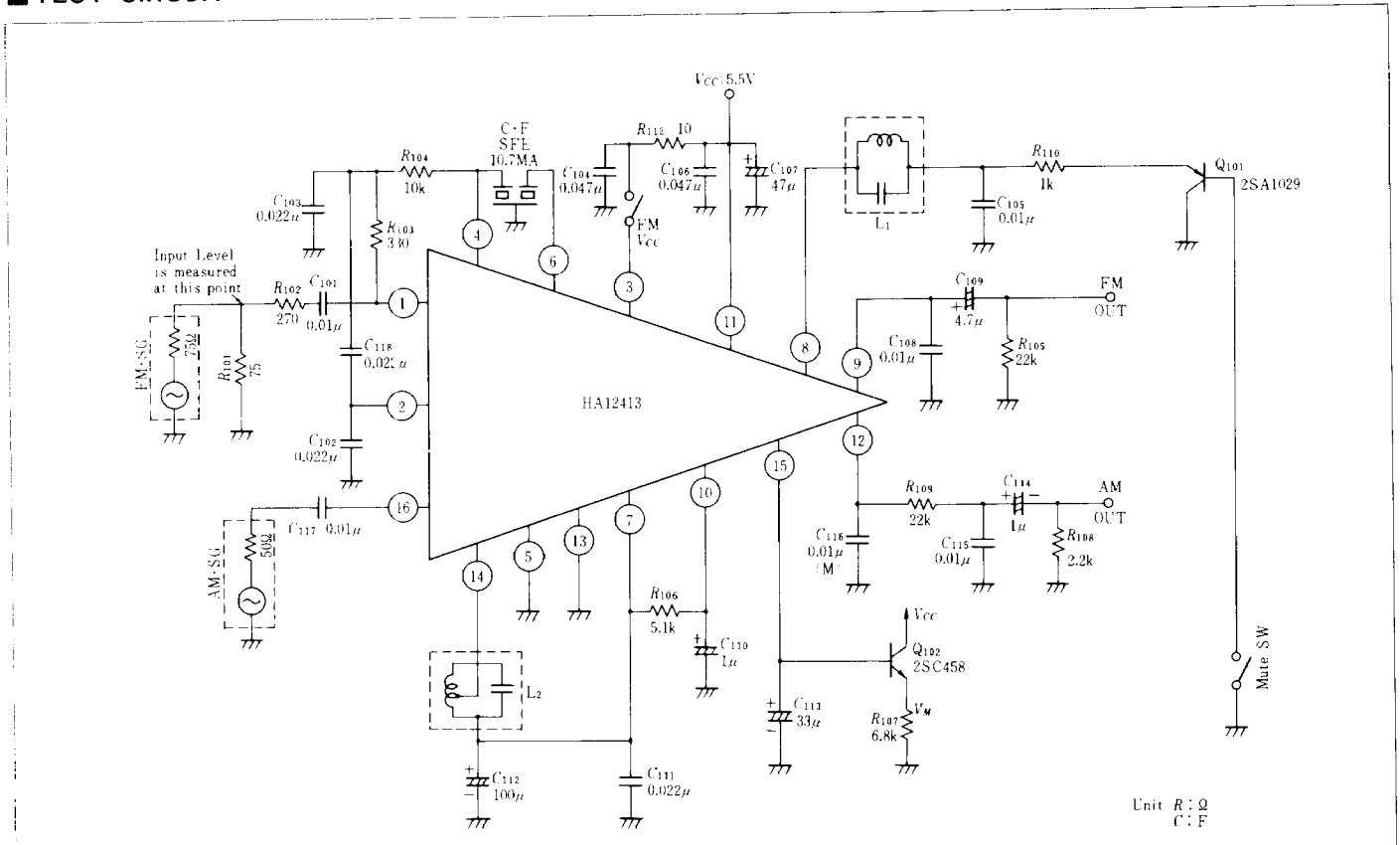
*Value at Ta=70℃

■ELECTRICAL CHARACTERISTICS

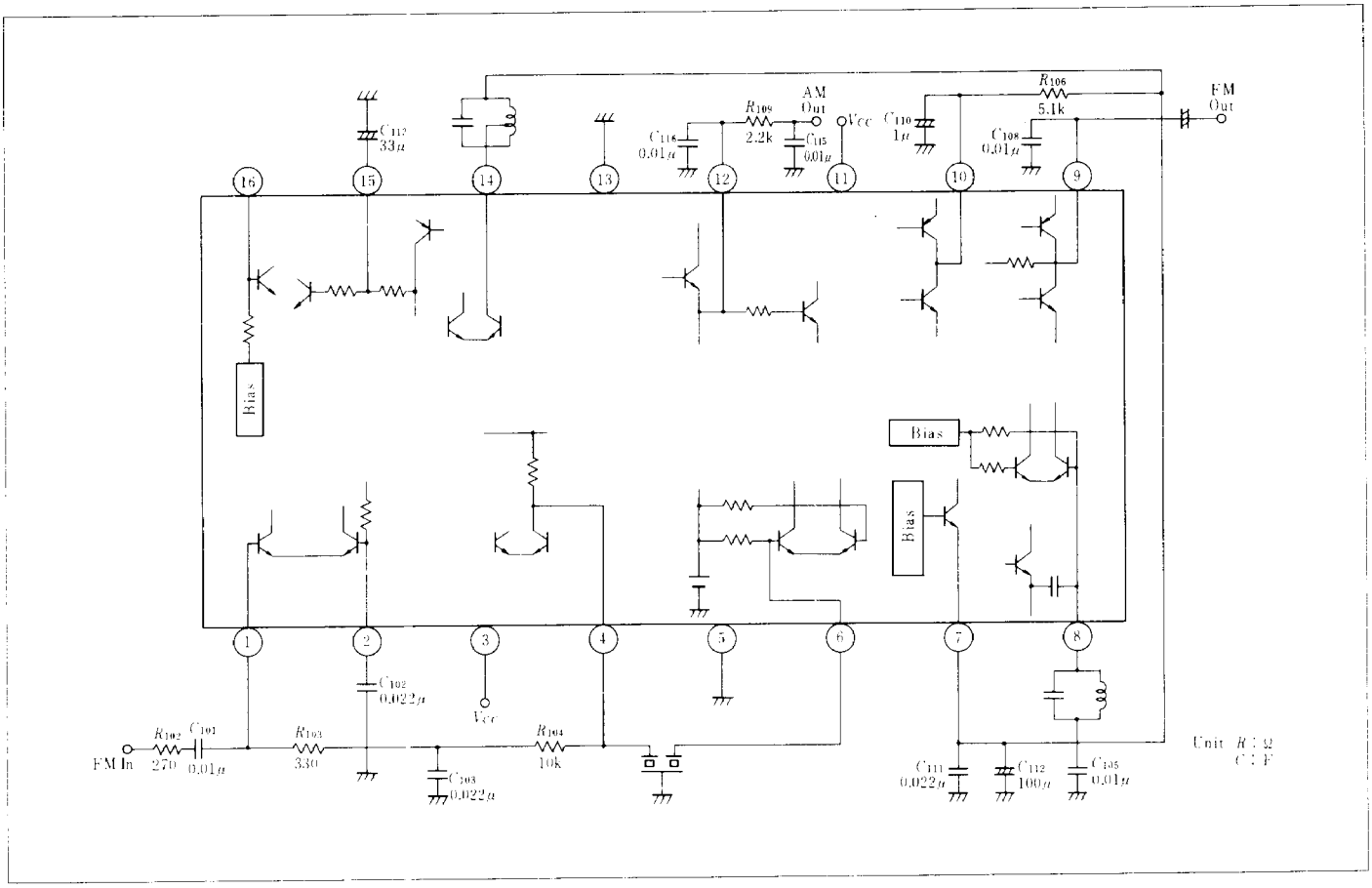
(at Ta=25℃ unless otherwise specified, the test conditions are:
FM : V_{CC}=5.5V, f_C=10.7MHz, f_m=1 kHz, $\triangle f$=75kHz
AM : V_{CC}=5.5V, f_C=455kHz, f_m=1 kHz, m=30%)

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

■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 Defferencial Voltage: High	Offset of Defferencial 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_{104})	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}	0.01μ	Input DC Cut	Deterioration of Sensitivity	—	—
C_{102}	0.022μ	Input Decoupling	Unstabilizing	—	—
C_{103}	0.022μ	Input Decoupling	Unstabilizing	—	—
C_{104}	0.047μ	FM V_{CC} Supply Decoupling	Unstabilizing	—	—
C_{105}	0.01μ	Detector Decoupling	Unstabilizing	—	—
C_{106}	0.047μ	Power Supply Decoupling	Unstabilizing	—	—
C_{107}	47μ	Power Supply Decoupling	Superposing of Low Frequency Signal	—	—
C_{108}	0.01μ	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}	4.7μ	FM Output DC Cut	Separation Deteriorating in Low Frequency Range	—	—
C_{110}	1μ	AFC Output Decoupling	Low Frequency Signal Superposing on AFC Controlling Line	Long time is required for AFC operation to start	—
C_{111}	0.022μ	Voltage Regulator Decoupling	Unstabilizing	—	—
C_{112}	100μ	FM⇄AM Crosstalk Decreasing	Large Crosstalk	—	—
C_{113}	33μ	AGC Decoupling	THD Deterioration at AM Low Frequency Range	Long time is required for AGC operation to start	—
C_{114}	1μ	AM Output DC Cut	Deterioration of Frequency Characteristic in Low Frequency Range	—	—
C_{115}	0.01μ	LPF Forming (With R 109)	Large Carrier Leak	Deterioration of Frequency Characteristic of Recovered Audio Voltage	—
C_{116}	0.01μ	AM Detecting		—	Use Polyester Film Capacitor
C_{117}	0.01μ	AM Input DC Cut	Deterioration of Sensitivity	—	—
C_{118}	0.022μ	Input Decoupling	Unstabilizing	—	—

3. Semiconductor

* Q_{101} : 2SA1029 (Transistor for Muting)
* Q_{102} : 2SC458Ⓑ (Transistor for Signal Meter Drive)

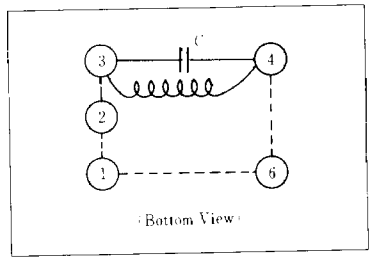
Note) V_{BE} at Q_{102} 2SC458Ⓑ (When 100μA emitter current supplied) : 606 mV typ.

4. Coil/Filter

1) Ceramic Filter Murata SFE 10.7MA

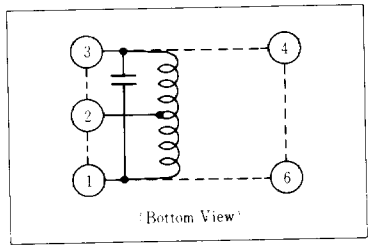
2) Coil

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



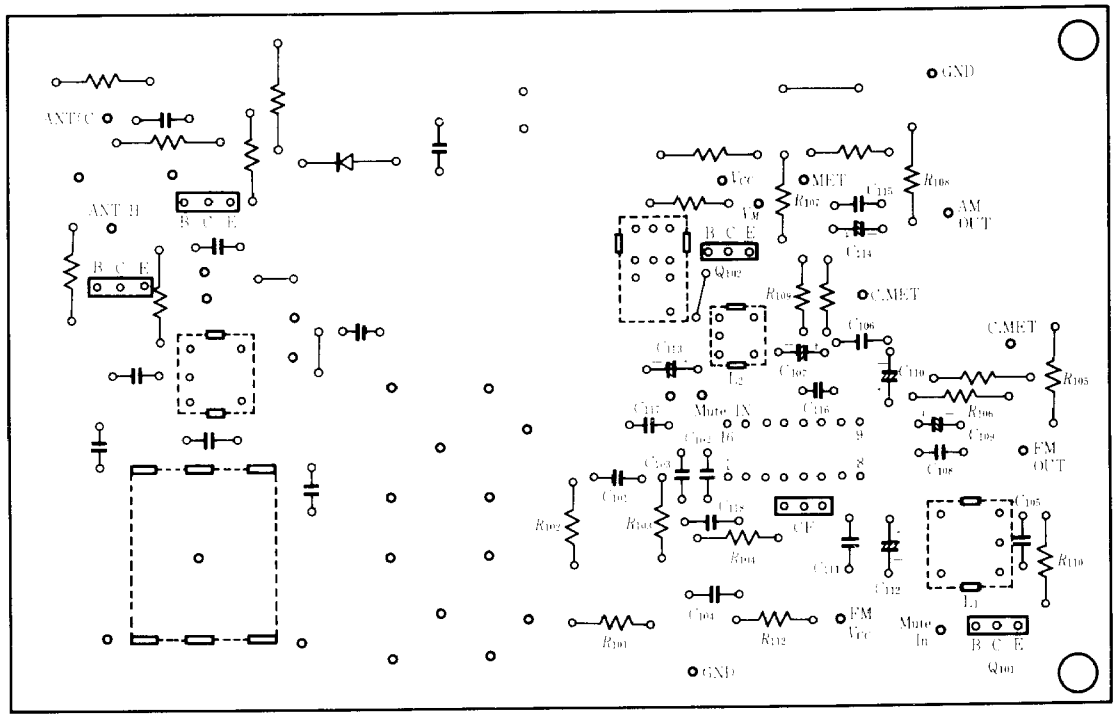
Number of : 14.5T Turns
C: 100pF
Qu: 60 typ

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

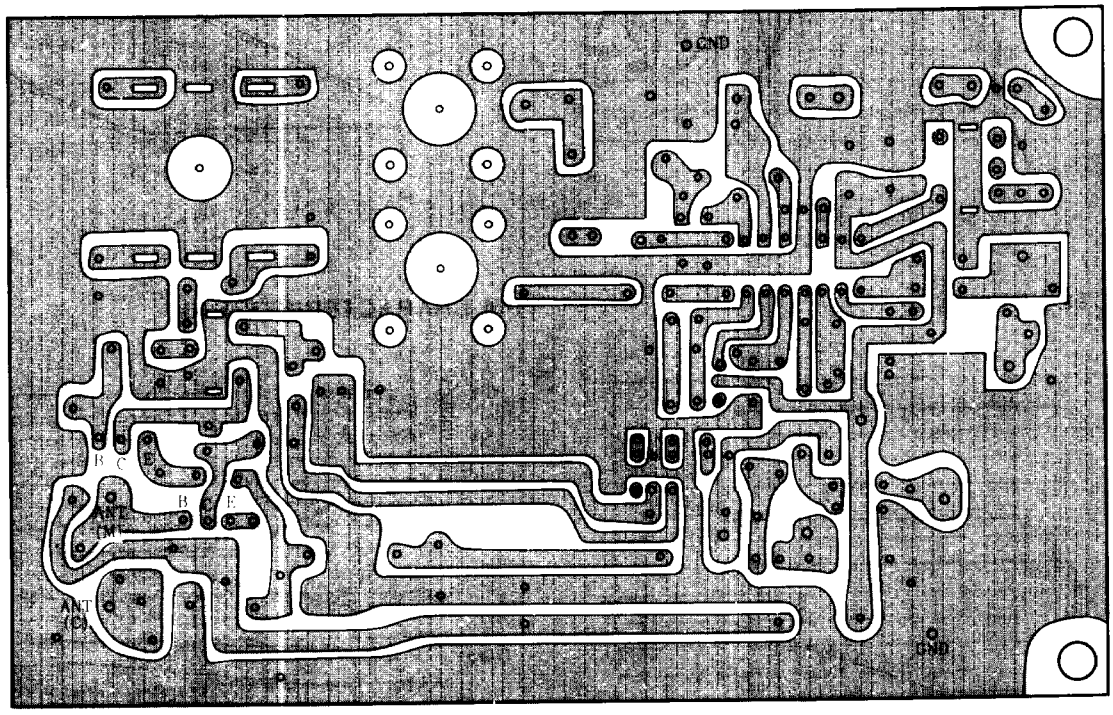


Number of: ①-②: 52T Turns ②-③: 94T
C: 180pF
Qu: 125 typ

■PC-BOARD LAYOUT PATTERN

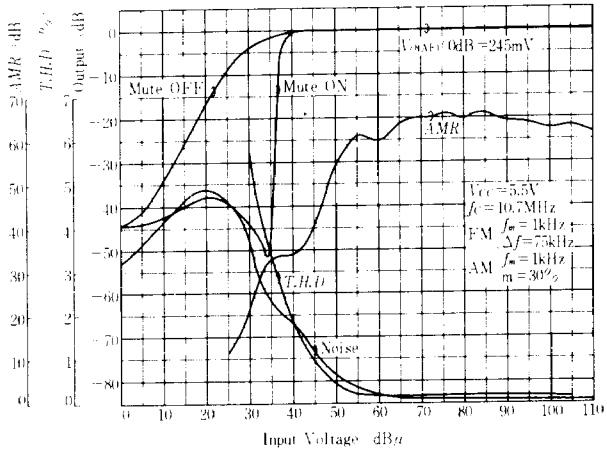


(Top View)

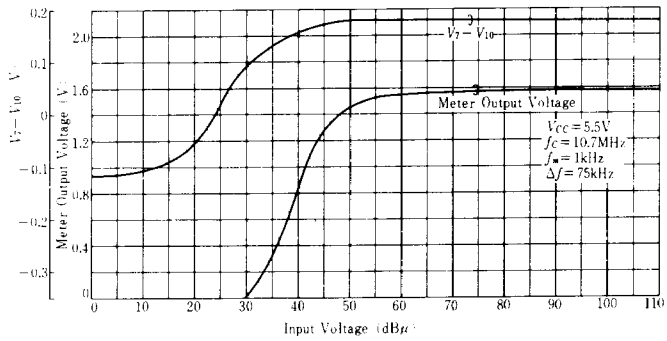


(Bottom View)

FM CHARACTERISTICS (1)



FM CHARACTERISTICS (2)



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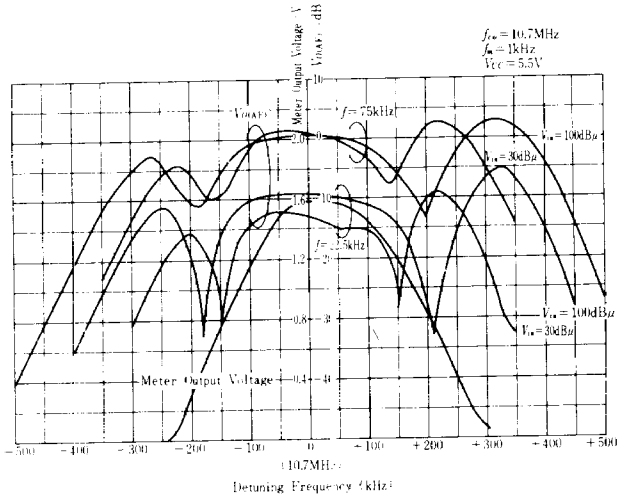

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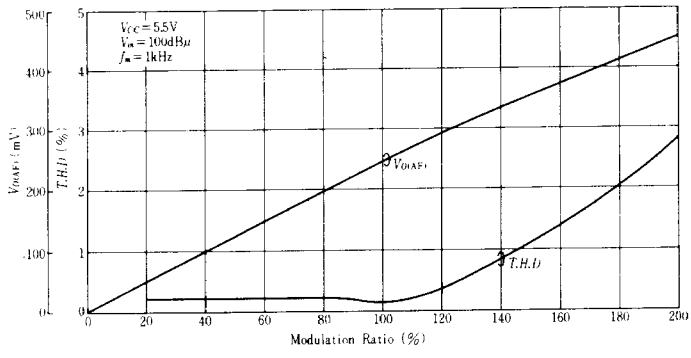

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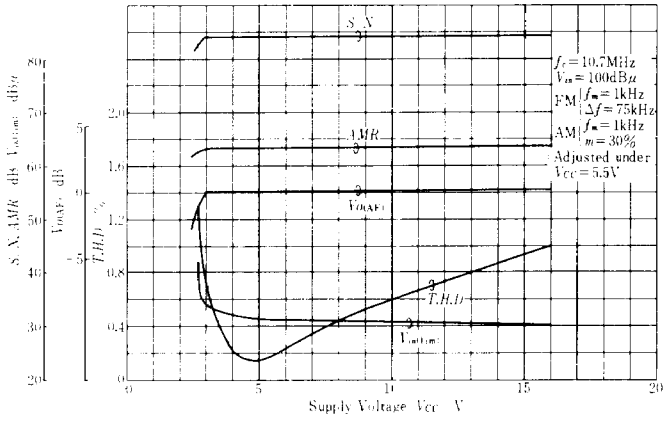

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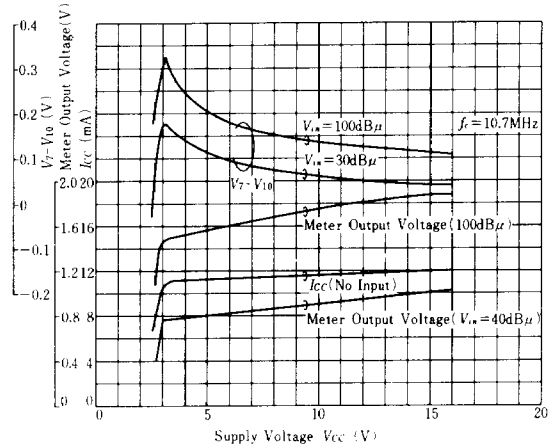

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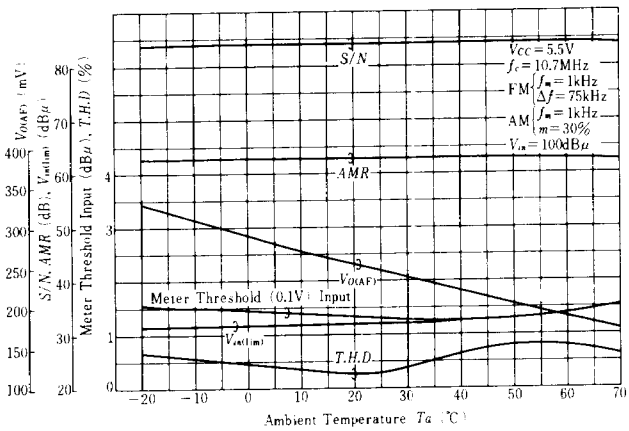

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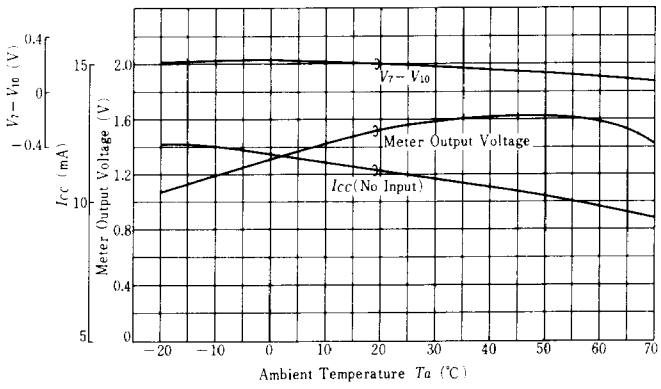

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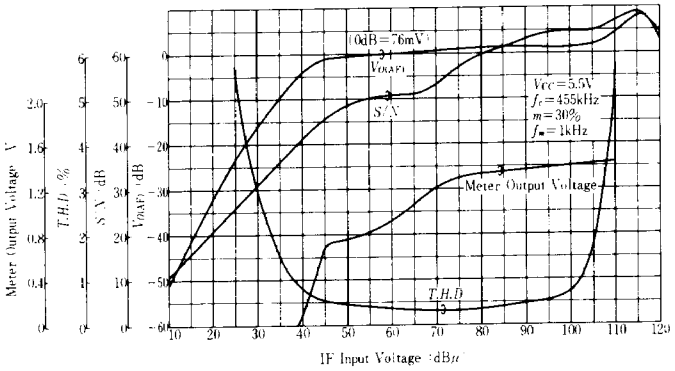

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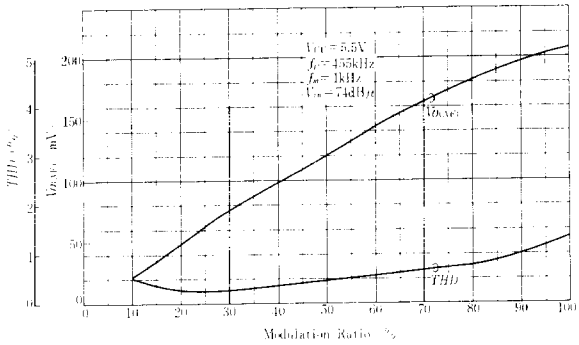

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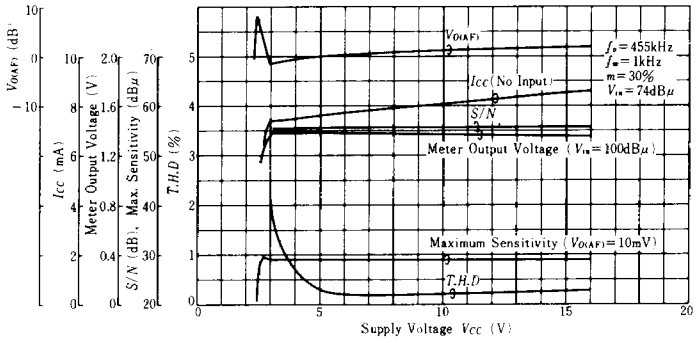
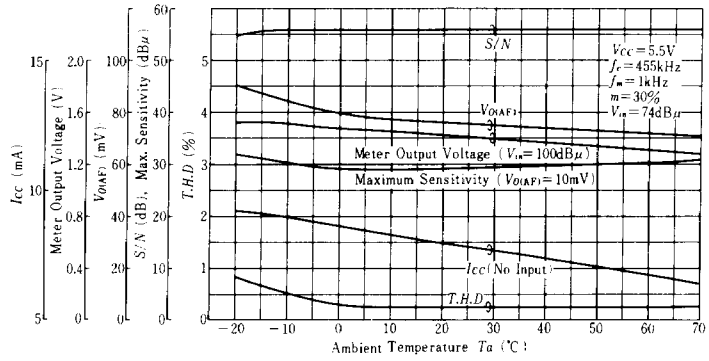
AM CHARACTERISTICS (4)