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)

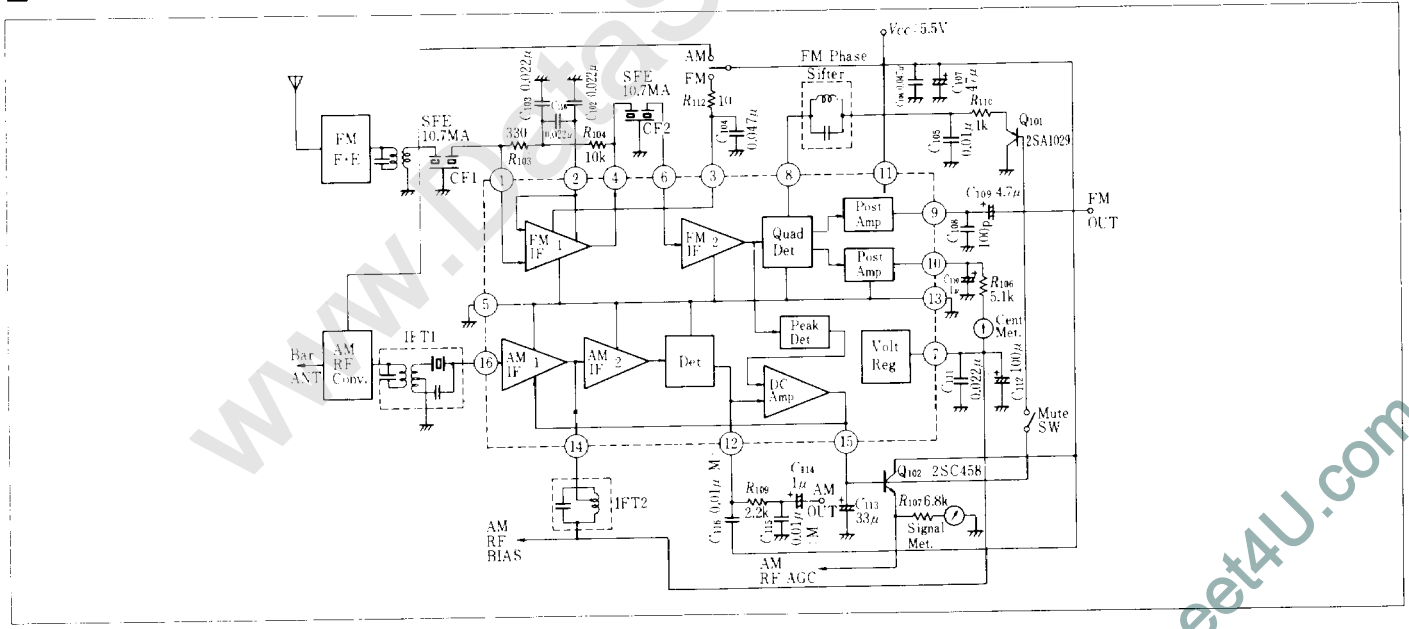
■ FEATURES

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	℃

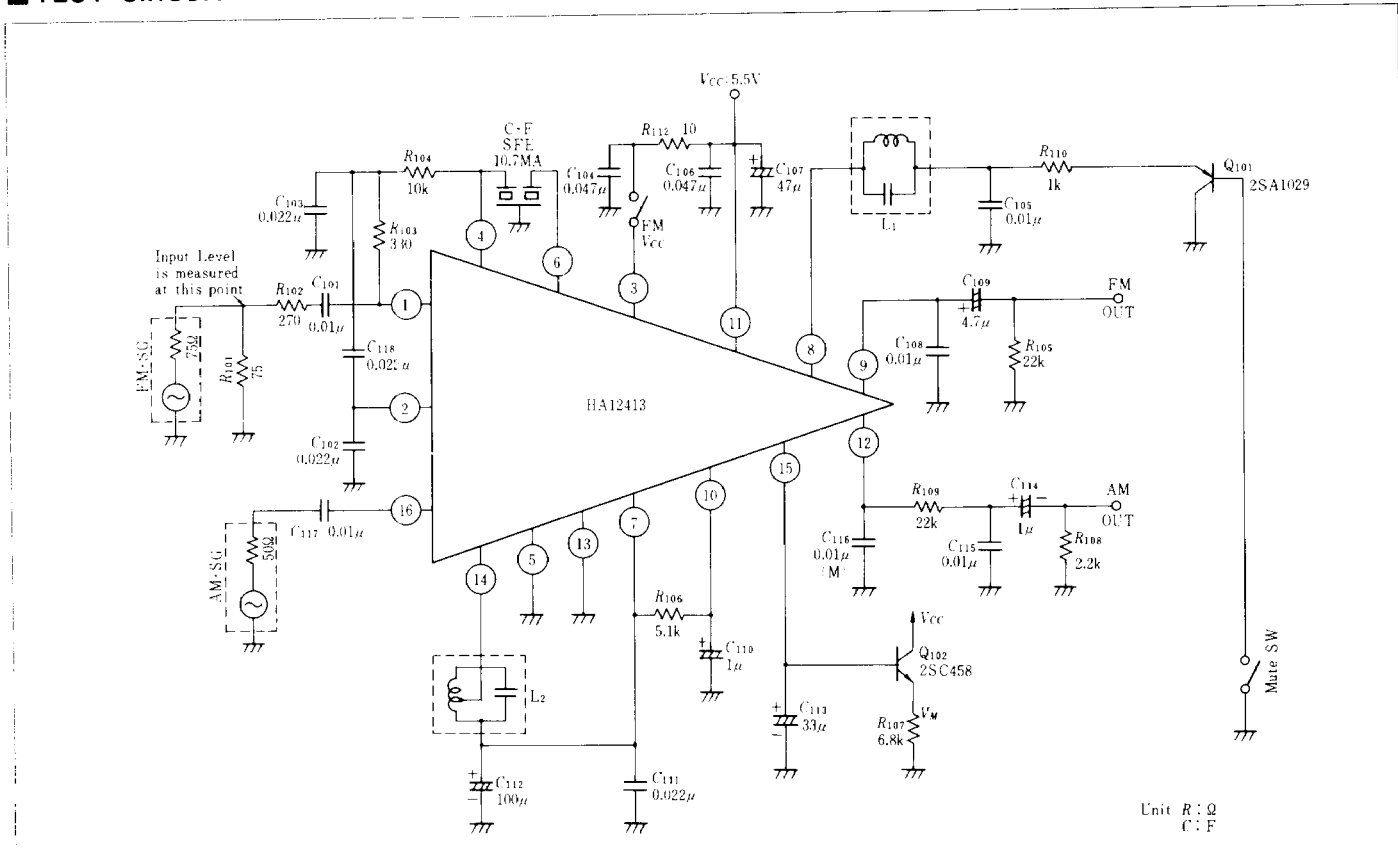
*Value at Ta=70℃

■ELECTRICAL CHARACTERISTICS

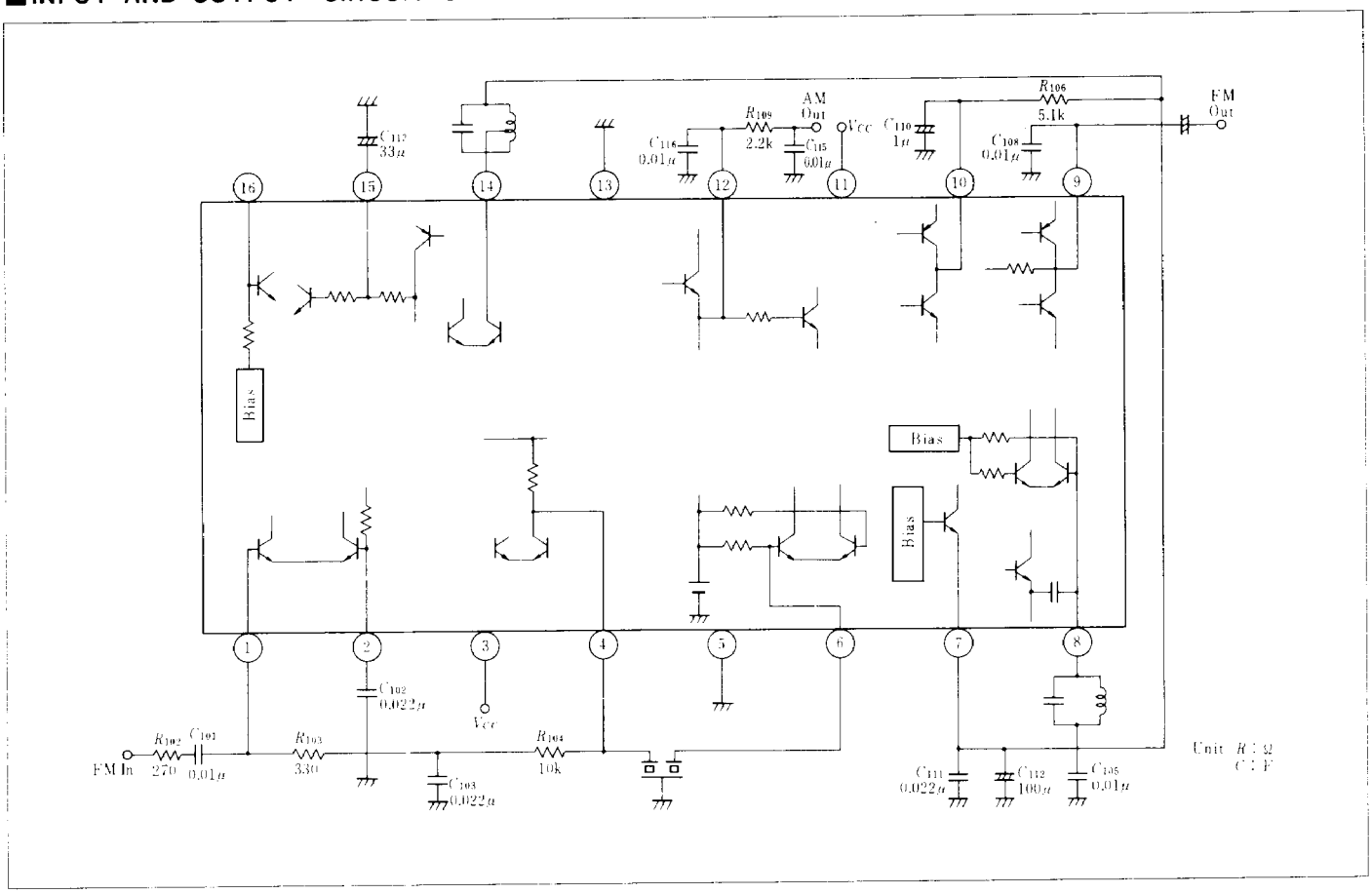
(at Ta=25℃ unless otherwise specified, the test conditions are:
FM : V_{CC}=5.5V, f_C=10.7MHz, f_m=1 kHz, $\triangle f$=75kHz
AM : V_{CC}=5.5V, f_C=455kHz, f_m=1 kHz, m=30%)

	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)

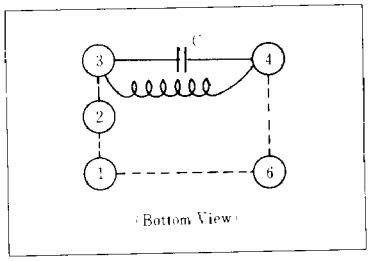
Note) V_{BE} at Q_{102} 2SC458Ⓑ (When 100μA emitter current supplied) : 606 mV typ.

4. Coil/Filter

1) Ceramic Filter Murata SFE 10.7MA

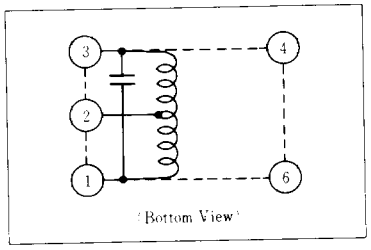
2) Coil

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



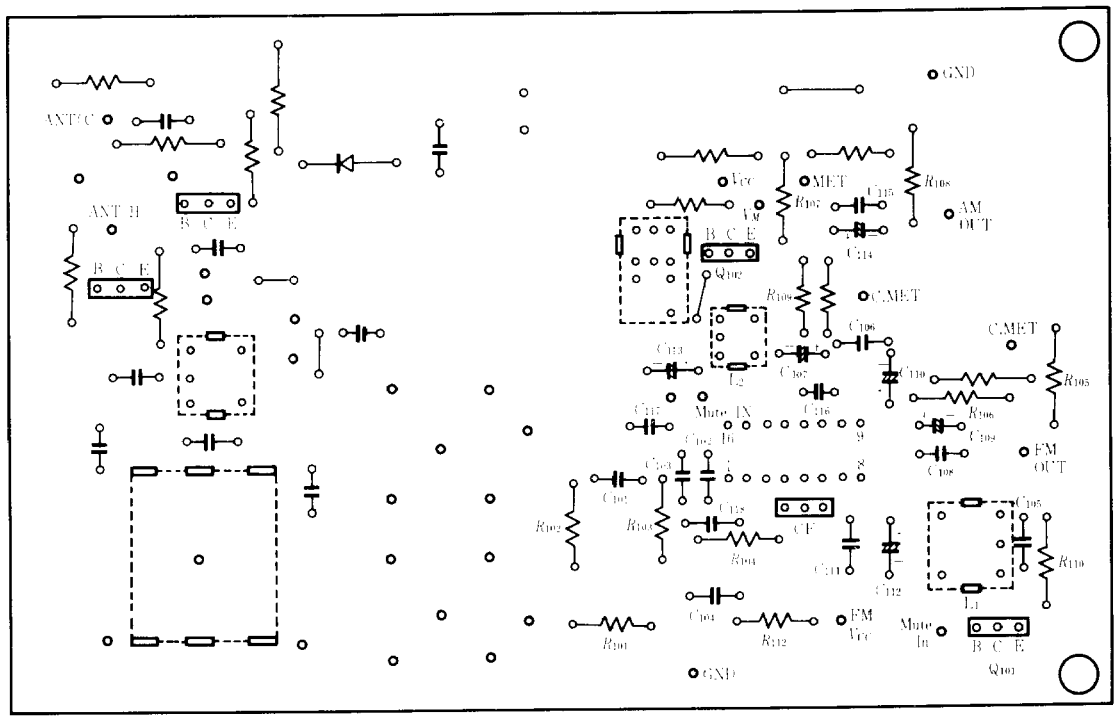
Number of : 14.5T Turns
C: 100pF
Qu: 60 typ

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

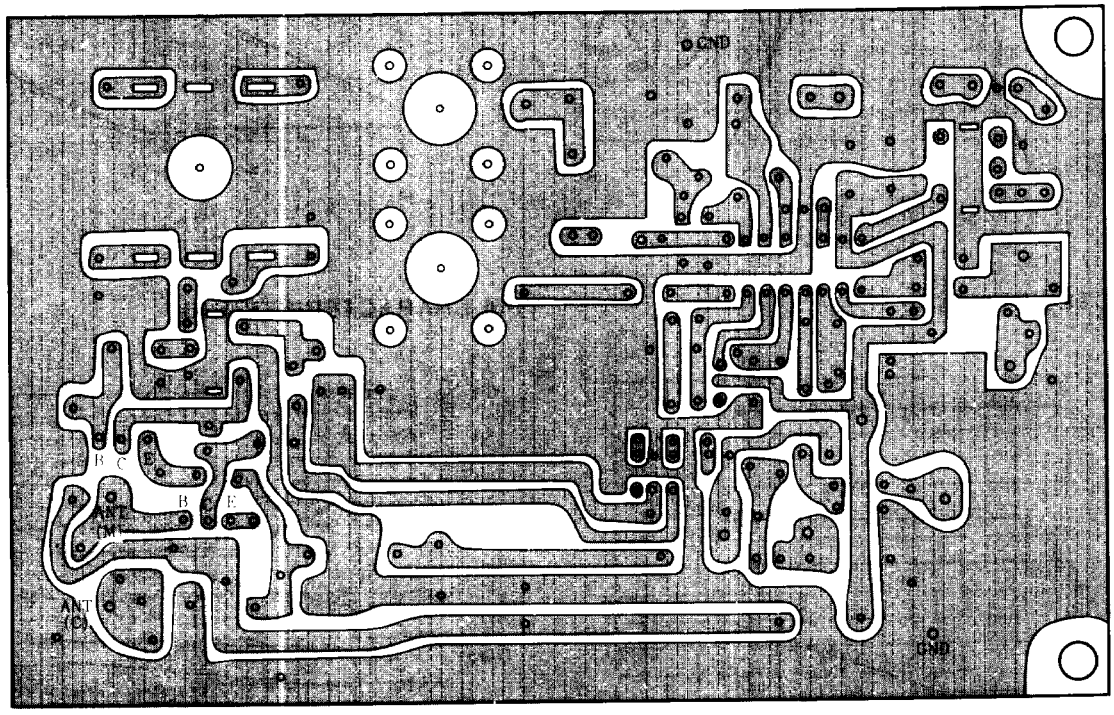


Number of: ①-②: 52T Turns ②-③: 94T
C: 180pF
Qu: 125 typ

■PC-BOARD LAYOUT PATTERN

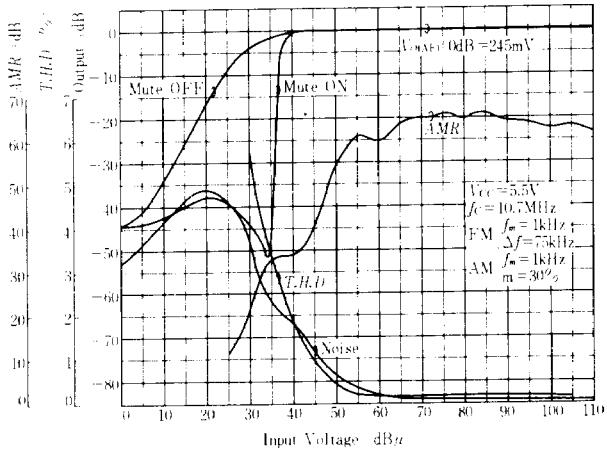


(Top View)

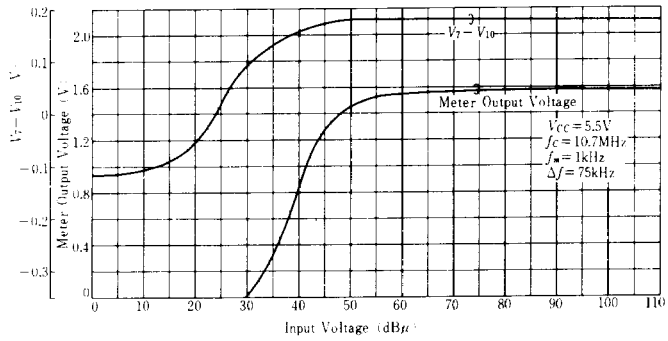


(Bottom View)

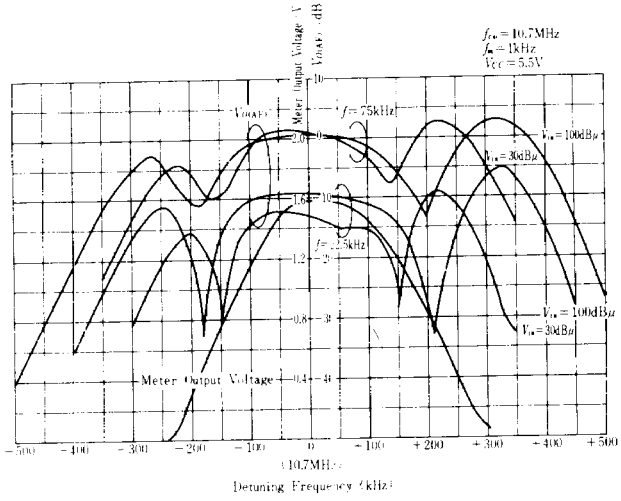
FM CHARACTERISTICS (1)



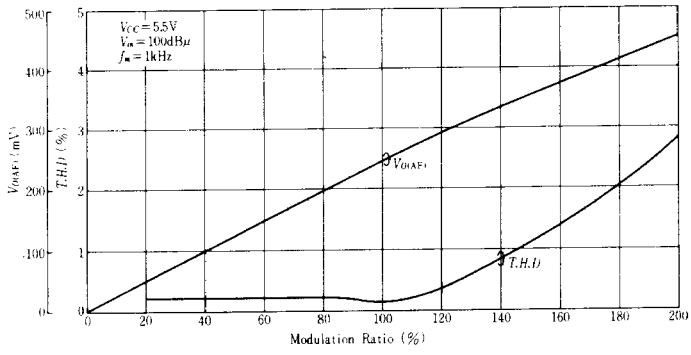
FM CHARACTERISTICS (2)



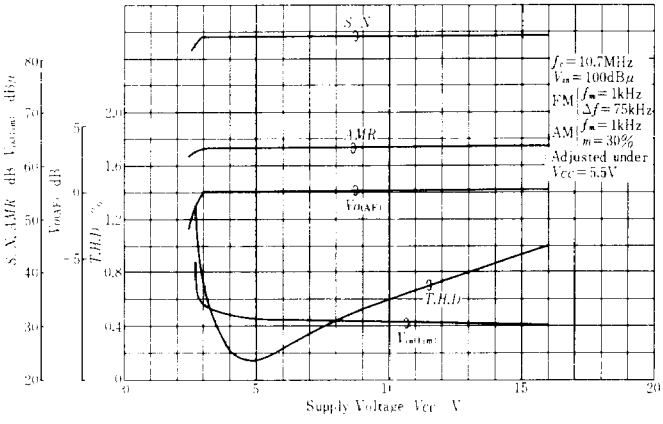
FM CHARACTERISTICS (3)



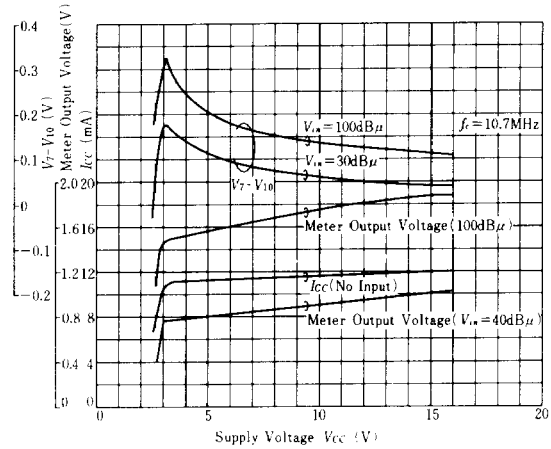
FM CHARACTERISTICS (4)



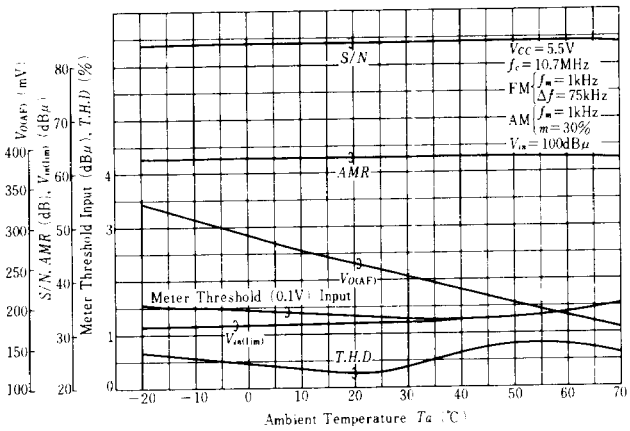
FM CHARACTERISTICS (5)



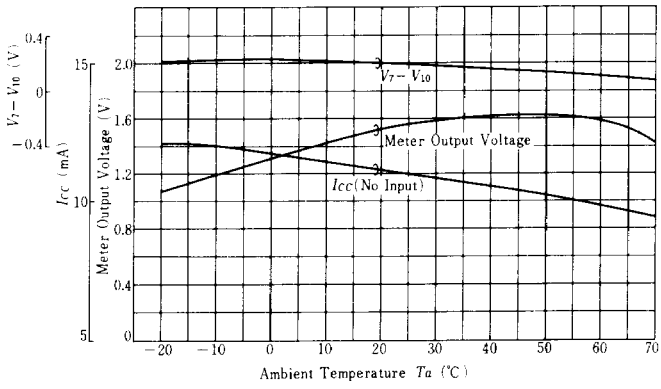
FM CHARACTERISTICS (6)



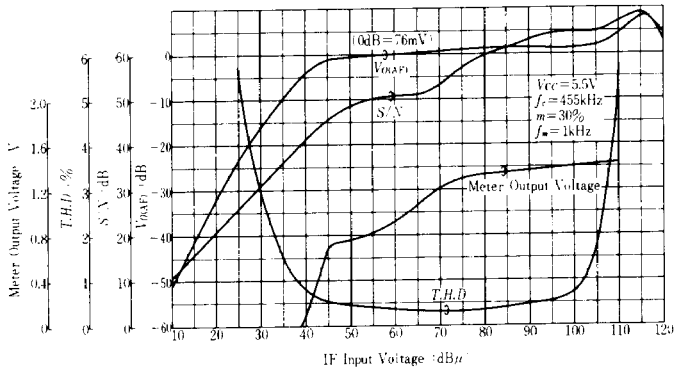
FM CHARACTERISTICS (7)



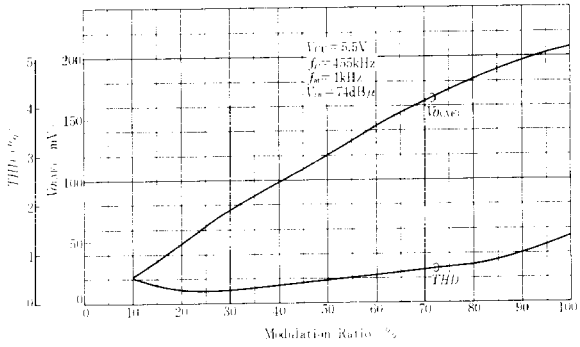
FM CHARACTERISTICS (8)



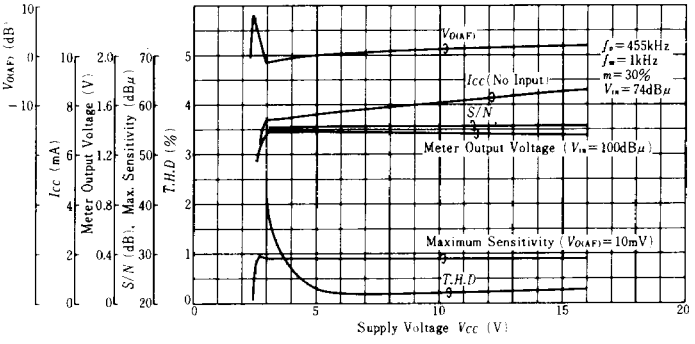
AM CHARACTERISTICS (1)



AM CHARACTERISTICS (2)



AM CHARACTERISTICS (3)



AM CHARACTERISTICS (4)