No.1304B

SANYO

LA1247

Monolithic Linear IC

AM Electronic Tuner

The LA1247 is a high-performance IC developed for AM electronic tuning systems. It performs all the functions needed for AM tuner systems and also provides auto search stop signal, local oscillation buffer output, low-level local oscillation. Moreover, the local oscillation is stable from LW to SW, facilitating multiband applications.

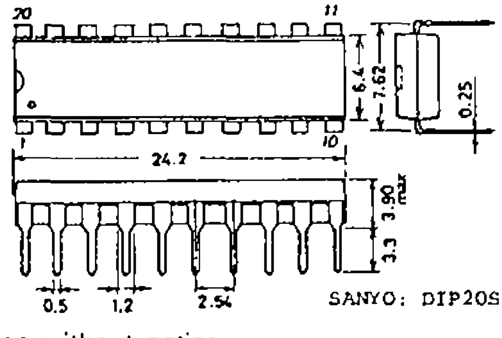
Functions

- RF amplification
- OSC (with ALC)
- Detection
- Signal meter drive output (also used as auto search stop signal)
- Others
- MIX
- IF amplification
- AGC
- Local oscillation buffer output

Features

1. Narrow-band signal meter: Usable as auto search stop signal (possible to make wide-band) Signal meter output 1/2 frequency ±1.5 kHz typ.
2. Local oscillation buffer output: Easy to design electronic tuning frequency display
3. LSC (with ALC): Stabilized oscillation output for varactor diode and improved tracking error
4. RF amplification: Excellent usable sensitivity (45 dB/m typ.) due to low noise transistor cascode connection
5. MIX: Highly resistant to spurious interference, IF interference due to double balanced type differential MIX (IF interference = 85 dB typ.)
6. Low noise: Good S/N (57 dB typ.) for medium input
7. V_{CC} variation compensation: Little variation in gain, distortion, etc. (8 to 16 V)
8. Pop noise reduction: Possible to reduce pop noise at the time of V_{CC}-on, mode-on by selecting AGC time constant
9. Meeting AM stereo requirements: Subchannel S/N is more improved as compared with the LA1245.

Case Outline 3021B-D20SIC (unit:mm)



Specifications and information herein are subject to change without notice.

SANYO Electric Co.,Ltd. Semiconductor Overseas Marketing Div.
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Maximum Ratings at T_a = 25°C

				unit
Supply voltage	V_{CC} max	Pin 8, 14	16	V
Output voltage	V_O	Pin 5, 7	24	V
Input voltage	V_I	Pin 3	5.6	V
Supply current	I_{CC} max	Pin 5 + 7 + 8 + 14	32	mA
Output high drive current	I_{18}	Pin 18	5	mA
	I_{20}	Pin 20	2	mA
Allowable power dissipation	P_d max	See Fig. 2	700	mW
Operating temperature	T_{opg}		−20 ~ +70	°C
Storage temperature	T_{stg}		−40 ~ +125	°C

Recommended Operating Condition at T_a = 25°C

			unit
Recommended supply voltage	V_{CC}	12	V
Operating voltage range	V_{CC}	8 ~ 16	V

Operating Characteristics at T_a = 25°C, V_{CC} = 12 V, f_r = 1 MHz, f_m = 400 Hz, at specified test circuit (based on application circuit).

			min	typ	max	unit
Current dissipation	I_{CC} (1)	quiescent	16.0	25.0	35.0	mA
	I_{CC} (2)	with 107 dBμ input	19.0	29.0	40.0	mA
Detection output	V_O (1)	with 23 dBμ input, mod. 30 %	−27.5	−23.0	−18.5	dBm
	V_O (2)	with 80 dBμ input, mod. 30 %	−15.5	−12.5	−9.5	dBm
Signal to noise ratio	S/N (1)	with 23 dBμ input, mod. 30 %	16	20		dB
	S/N (2)	with 80 dBμ input, mod. 30 %	52	57		dB
Total harmonic distortion	THD (1)	with 80 dBμ input, mod. 30 %		0.4	1.0	%
	THD (2)	with 107 dBμ input, mod. 30 %		0.3	1.0	%
Signal meter output	V_{SM} (1)	quiescent		0	0.5	V
	V_{SM} (3)	with 107 dBμ input	3.5	5.0	7.0	V
Input at signal meter output = 1 V	V_{IN} (1)	V_{SM} output 1V	20.0	26.0	32.0	dBμ
Local oscillation-buffer output	V_{osc}		380	530		mVrms

Reference Characteristics

			typ	unit
Signal meter output	V_{SM} (2)	with 40 dBμ input	2.5	V
Total harmonic distortion	THD (3)	with 112 dBμ input, mod. 30	2	%
Local oscillation fluctuation within a band	ΔV_{osc}	from V_{oscL} (522 kHz) to V_{oscH} (1647 kHz)	10	mVrms
Signal meter band width*	V_{SM-BW1}	with 80 dBμ input, 1/2 output frequency	±1.5	kHz
	V_{SM-BW2}	with 80 dBμ input, 1/10 output frequency	−4.5/+7	kHz
Selectivity		±10 kHz at 30 % mod.	45	dB
IF Interference		f_r = 600 kHz	85	dB
Image frequency interference ratio		f_r = 1400 kHz	40	dB
AM stereo subchannel	S/N	Subchannel S (See Subchannel S/N test circuit on page 6.)	50	dB

* BFB450C4 N (MURATA, JAPAN) was used as a narrow band filter.
(note) 0 dBm = 775 mV, 0 dBμ = 1 μV.

Using the automatic search-stop signal

Signal Meter-driving output is equivalent to Fig.1, signal meter driving output (abbreviated as V_{SM}) is narrowed in band width and can be used as an automatic search-stop signal when a narrow band series resonator is connected to pin 15. V_{SM} can be adjusted with R_{208} and R_{211} both in wide band and narrow band since R_{208} is inversely proportional to V_{SM}, while R_{211} is proportional to V_{SM}. R_{208} is related to the Q of narrow band signal meter. When the resistance of R_{208} is increased, the Q will be damped and the band width increased. On the other hand, R_{211} used as the output impedance of V_{SM} and affects the cut-off frequency and time constant of low pass filter for V_{SM} and the meter drive impedance. The time constant and the cut-off frequency fc can be expressed as follows:

$$\tau = (C_{114} + C_{115} + C_S) \times (R_{211} // R_{in})$$

$$f_c = \frac{1}{2\pi\tau}$$

A semi-fixed resistor is recommended to be used as R_{211} to allow the fluctuation of V_{SM}. Refer to Fig. 3 for the value of the semi-fixed resistor since this depends upon V_{SM} and R_{208}. Fig. 3 shows the lowest limit of the semi-fixed resistor in relation to R_{208} with the parameter of V_{SM} set point the value of the semi-fixed resistor will be equal to or greater then that shown in Fig. 3. For example, when V_{SM} = 5 V and R_{208} = 240 ohm, R_{211} becomes 28 kohm. Thus, the value of the semi-fixed resistor is determined to be about 30 kohm. When the value of V_{SM} is too large, it is limited and saturated to the source voltage so it is recommended to follow the condition of $V_{SM} \leq V_{CC} - 2$ (V). When a narrow band serial resonator is used, include the resonant impedance to determine the value of R_{208}.

Fig. 1 Signal Meter Detector Circuit

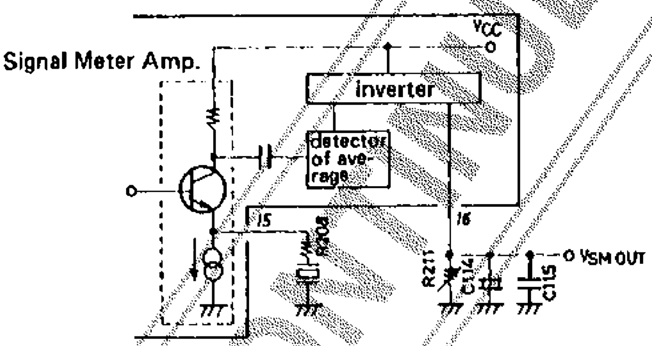


Fig. 2 Pd max − T_a

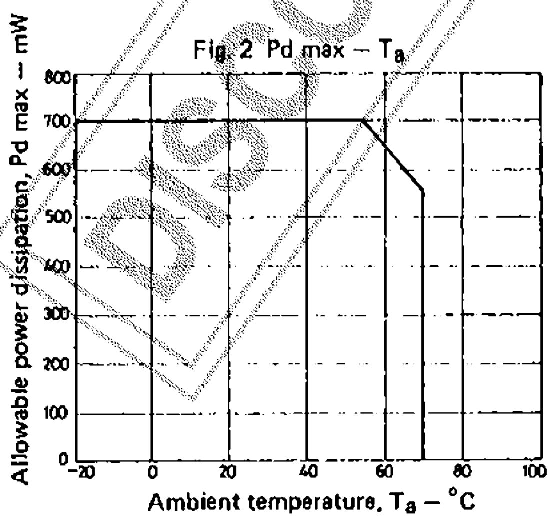
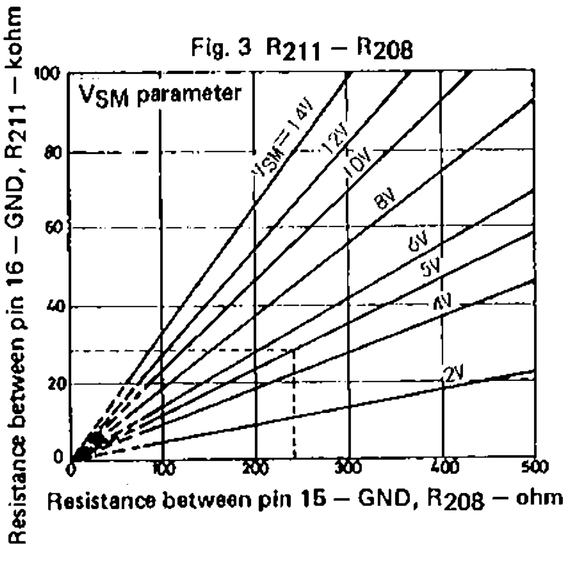


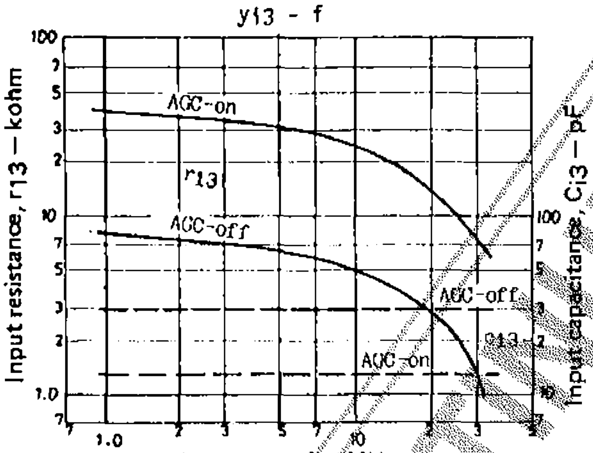
Fig. 3 R_{211} − R_{208}



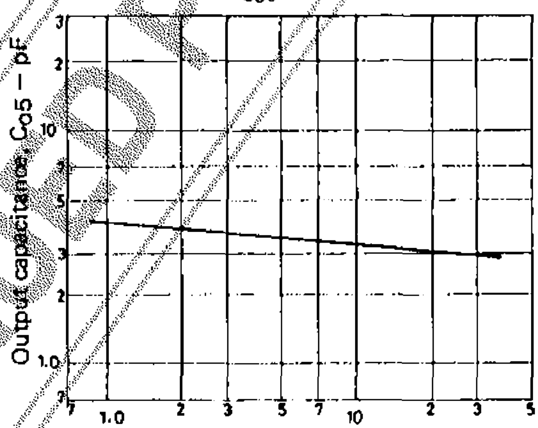
Input/Output Admittance

—	parameter	frequency	—	AGC-off	AGC-on
RF	yi3	1 MHz	r_i c_i	8 kΩ 30 pF	40 kΩ 13 pF
	yo5	1 MHz	r_o c_o	– 4 pF	– –
MIX	yi6	1 MHz	r_i c_i	10 kΩ 2.6 pF	– –
	yo7	500 kHz	r_o c_o	– 2 pF	– –
1st IF	yi9	500 kHz	r_i c_i	3 kΩ 7 pF	3.2 kΩ 3 pF
	yo10	500 kHz	r_o c_o	45 Ω 20 pF	42 Ω 20 pF
2nd IF	yi11	500 kHz	r_i c_i	80 Ω –150 pF	– –

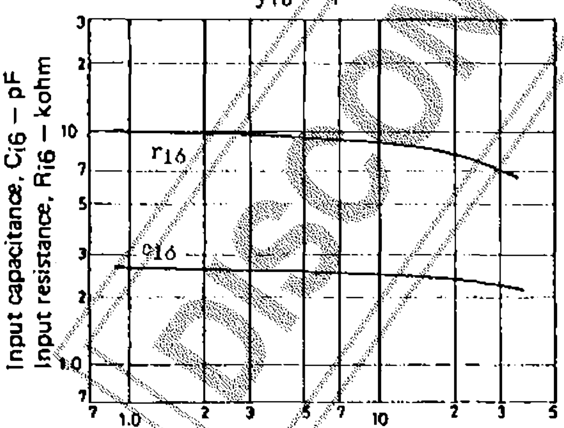
yi3 - f



co5 - f



yi6 - f



Notes on LA1247 usage

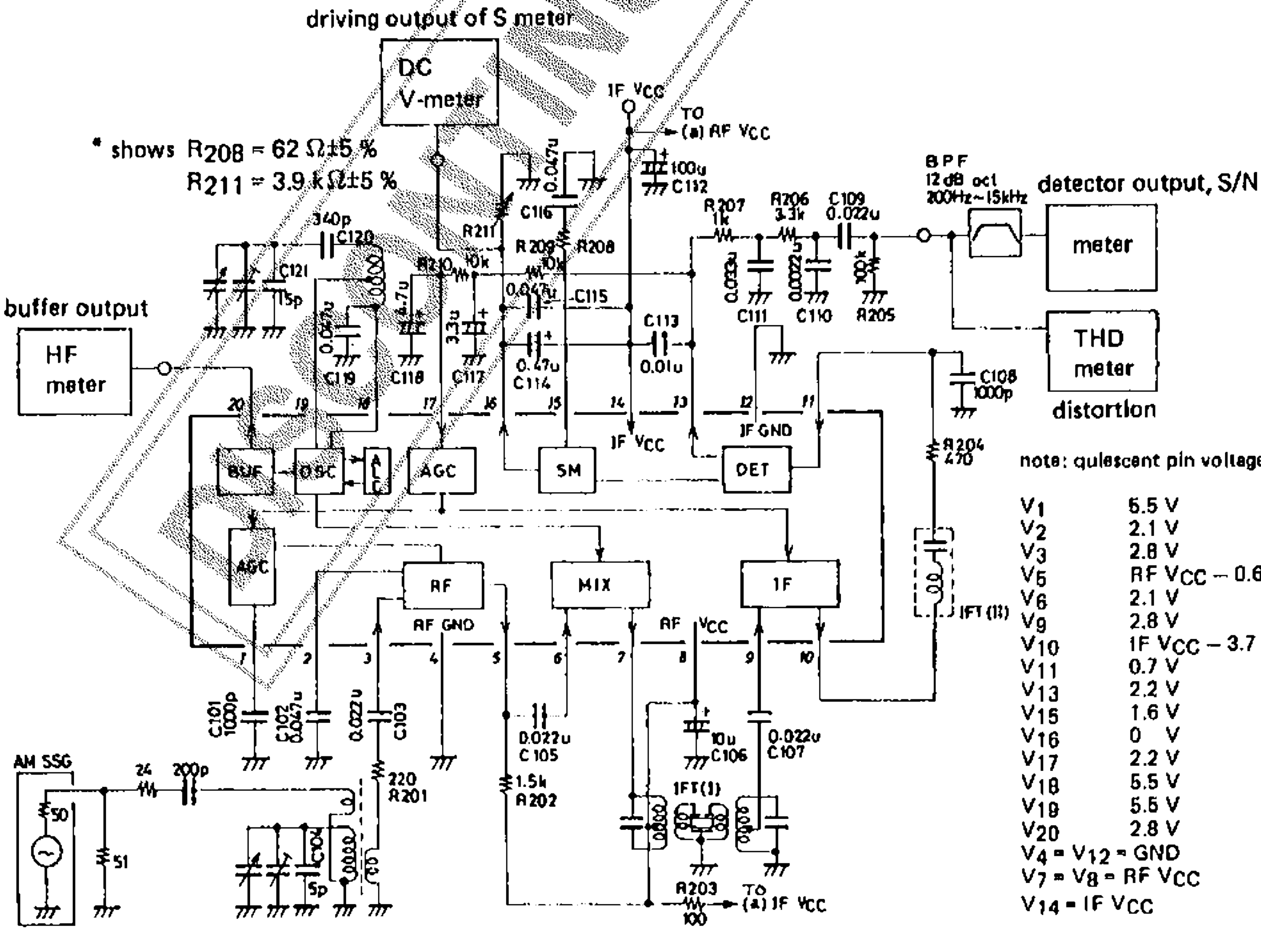
1. When suddenly tuned to a broadcasting station of intermediate or high field strength, a large current of high frequency flows into the signal meter circuit, causing the local oscillator malfunctions and abnormal noises.
   To eliminate this:
   - Use $R_{208} \gtrsim 240$ ohm for manual tuning type.
   - Use $R_{208} \geq 82$ ohm, and use the local oscillation coil at the 1/3 tap (except SW for electronic tuning type (which uses a narrow band filter).

2. Use the bias on the condition RF $V_{CC} \leqq$ IF V_{CC}, since abnormal noise levels might be caused when detuning a strong input on the condition RF $V_{CC} \geqq$ IF V_{CC}
3. Use the signal meter driving output (V_{SM}) at $V_{SM} \leqq V_{CC} - 2$ (V) to avoid saturation caused by V_{CC}.
4. Use 1/2 or more tap of LW and MW oscillation coil to improve S/N and the detuning characteristics of the distortion ratio.
5. Use the full-tap of SW oscillation coil, to allow the sag in oscillation power by the decreasing of Q.
6. Avoid the coupling of the antenna tuning circuit and the local oscillating circuit so as not to leak the local oscillation into the antenna tuning circuit.
7. Connect the detection capacitor C_{113} between pin 13 (output) and pin 14 (V_{CC}) to avoid the leakage of the IF signal into the GND line. Connection between pin 13 and pin 12 (GND) increases the tweet interference and deteriorates the usable sensitivity.
   Moreover, depending on the positions of C_{113} and the bar antenna, higher harmonics having twice or three times the frequency of the IF signal may pass into the antenna and cause tweet interference in extreme cases oscillation might be caused. To prevent this:
   - Traim lead wires and connect them near 13 and 14 pins.
   - Place C_{113} far from the antenna.
8. When a cable or something similar is connected to a local oscillation buffer (pin 20), which is equivalent to connecting a capacitor of about 20 pF, the output from the buffer will be of sawtooth waves, causing the level low at the short wave band. To prevent this, connect a resistor between pin 20 and GND, which will increase the operating current of the buffer amplifier. Since the maximum current obtained from pin 20 is 2 mA, the suitable resistance between pin 20 and GND is 1.5 kohm.
9. Use a semi-fixed resistor for R_{211} to allow the fluctuation of V_{SM}.
10. When changing an IFT or using an RF tuner, select a filter and related circuits according to the following conditions. The input levels of each terminal where 30 % modulated detection output of – 25 dB is obtained are as follows:

Pin 11 input	when Rg = 520 ohm (470 ohm + 50 ohm)	75 dBμ
Pin 9 input	when Rg = 50 ohm	53 dBμ
Pin 6 input	when Rg = 50 ohm	48 dBμ
Pin 3 input	when Rg = 50 ohm	22 dBμ

Slight change in IFT, however, will be covered by changing the constant of resistors R_{202} and R_{204}.

■ **Application 1**

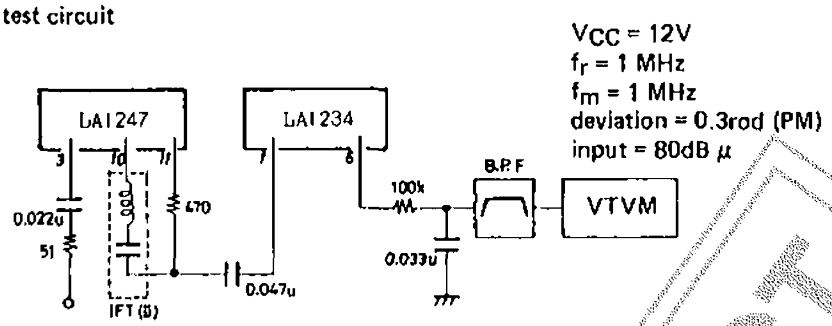


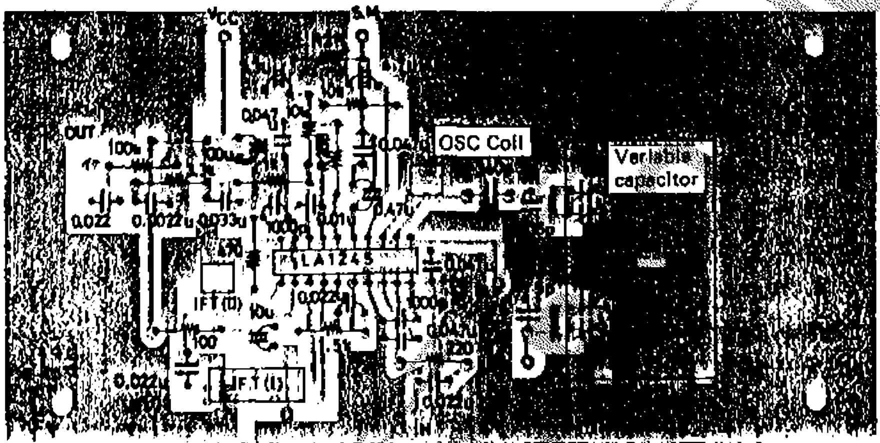
note: quiescent pin voltage

V_1	5.5 V
V_2	2.1 V
V_3	2.8 V
V_5	RF V_{CC} – 0.6 V
V_6	2.1 V
V_9	2.8 V
V_{10}	IF V_{CC} – 3.7 V
V_{11}	0.7 V
V_{13}	2.2 V
V_{15}	1.6 V
V_{16}	0 V
V_{17}	2.2 V
V_{18}	5.5 V
V_{19}	5.5 V
V_{20}	2.8 V

$V_4 = V_{12} =$ GND
$V_7 = V_8 =$ RF V_{CC}
$V_{14} =$ IF V_{CC}

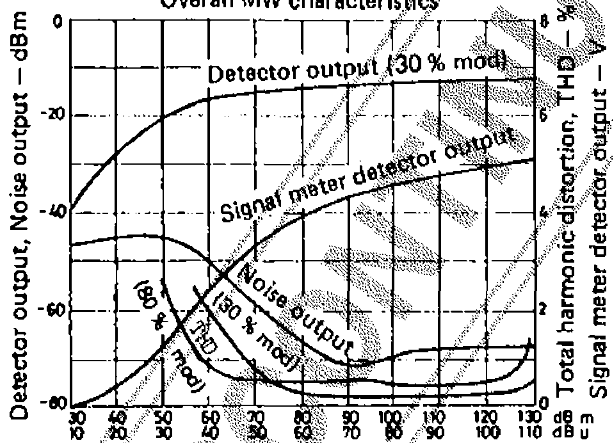
□ Subchannel S/N test circuit



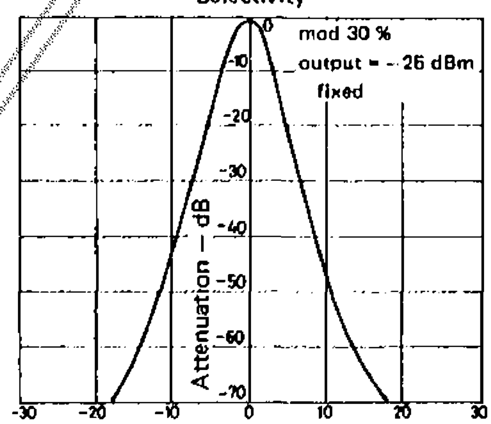


An Example of Printed Pattern (Cu-foild area) (150 x 72 mm^2)

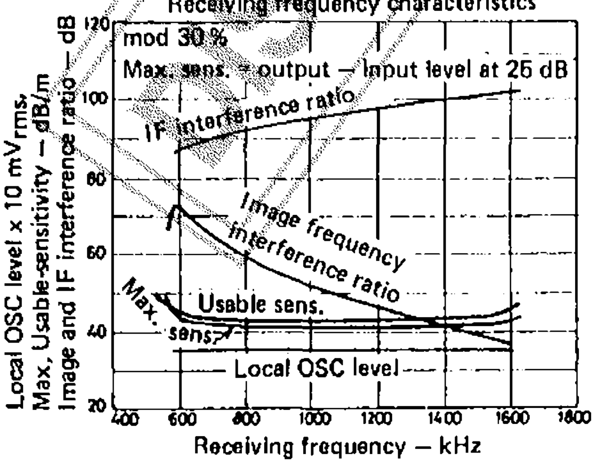
Overall MW characteristics



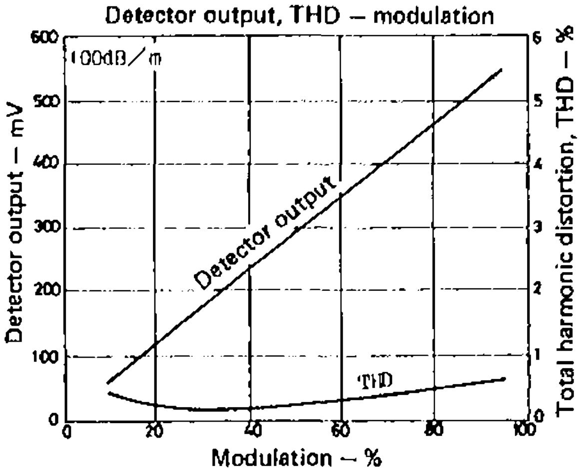
Selectivity



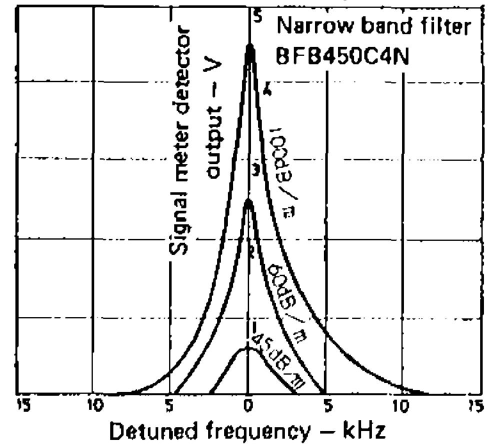
Receiving frequency characteristics



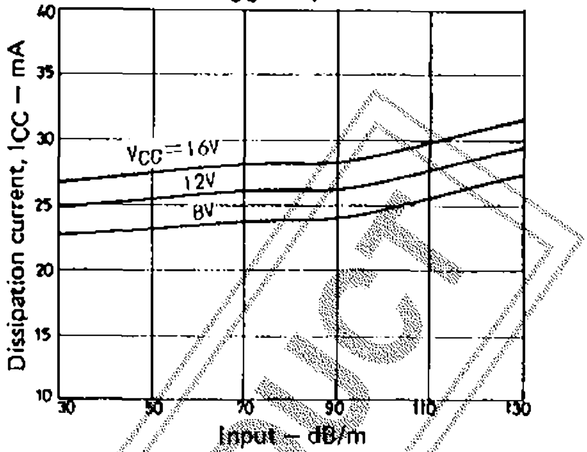
Detector output, THD – modulation



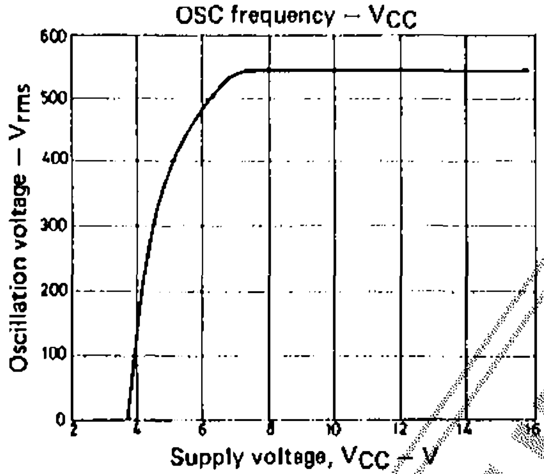
Detuned characteristic of signal meter



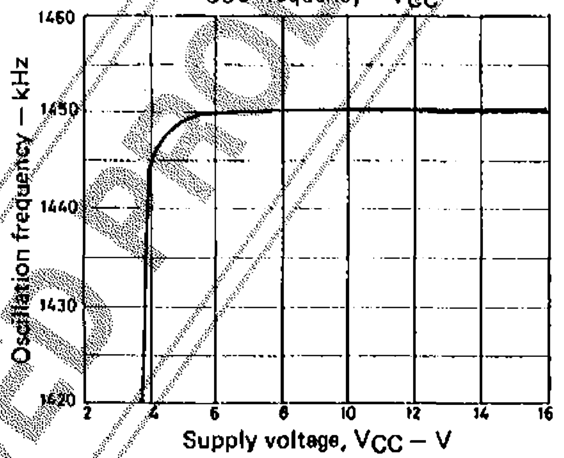
ICC – input



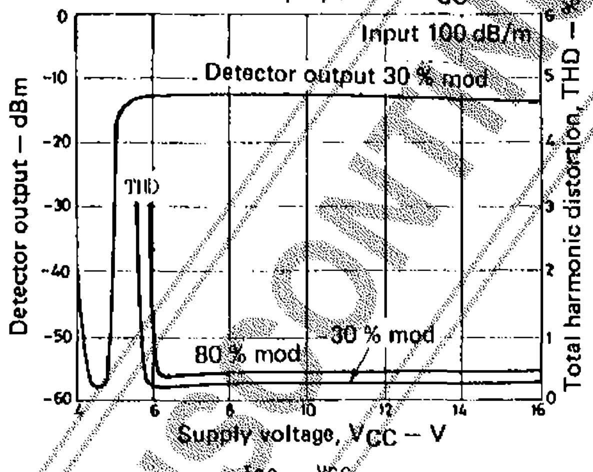
OSC frequency – VCC



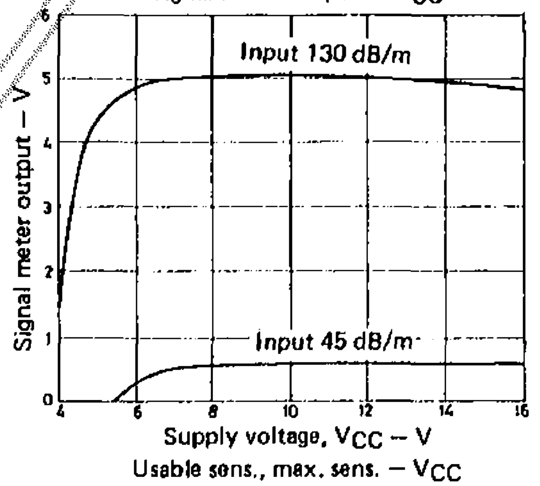
OSC frequency –VCC



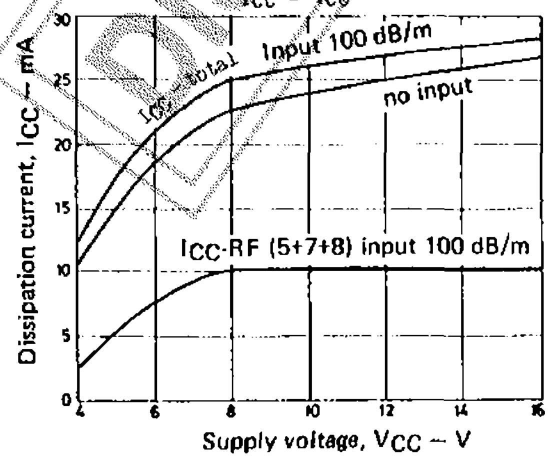
Detector output, THD – VCC



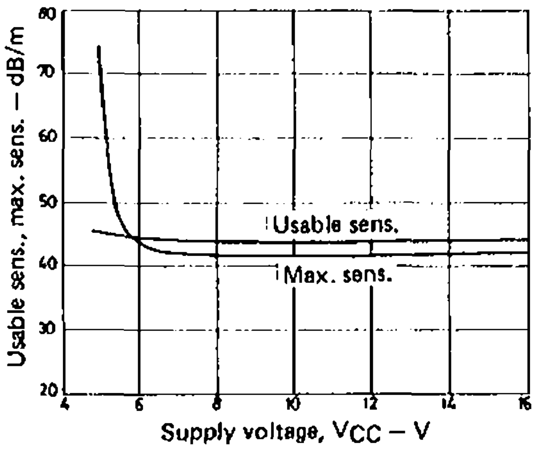
Signal meter output – VCC



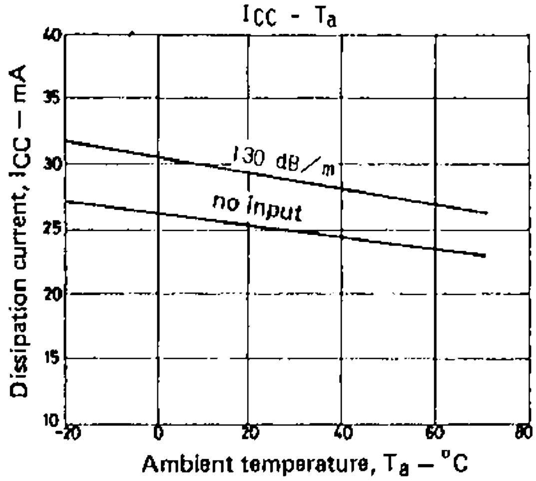
ICC – VCC



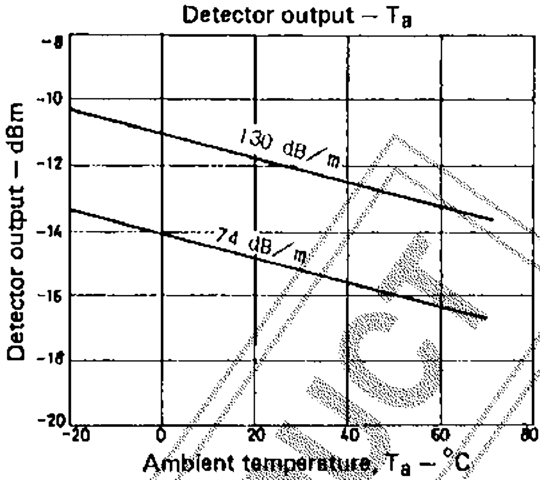
Usable sens., max. sens. – VCC



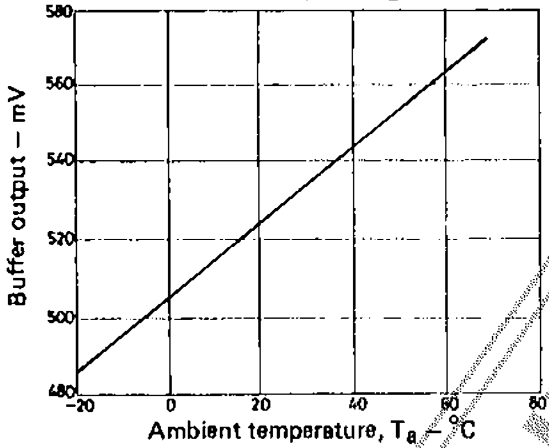
I_{CC} – T_a



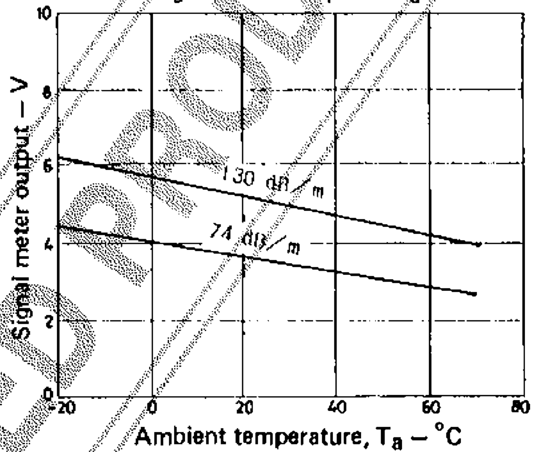
Detector output – T_a



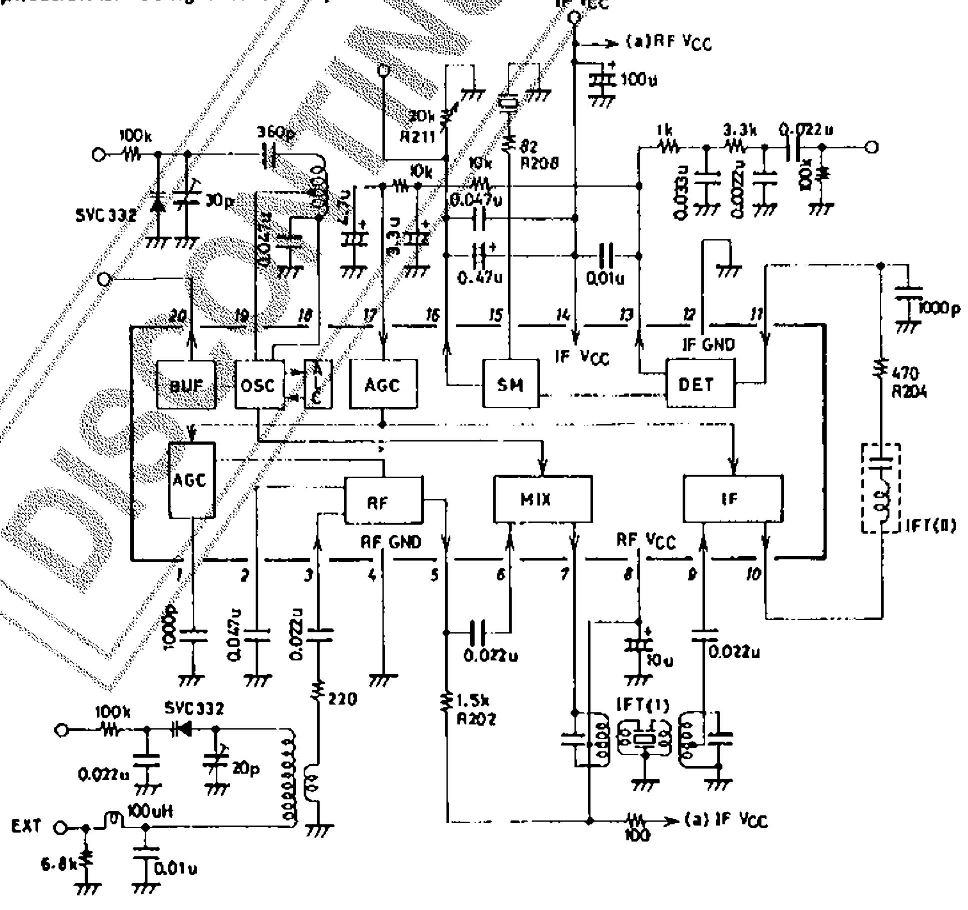
Buffer output – T_a

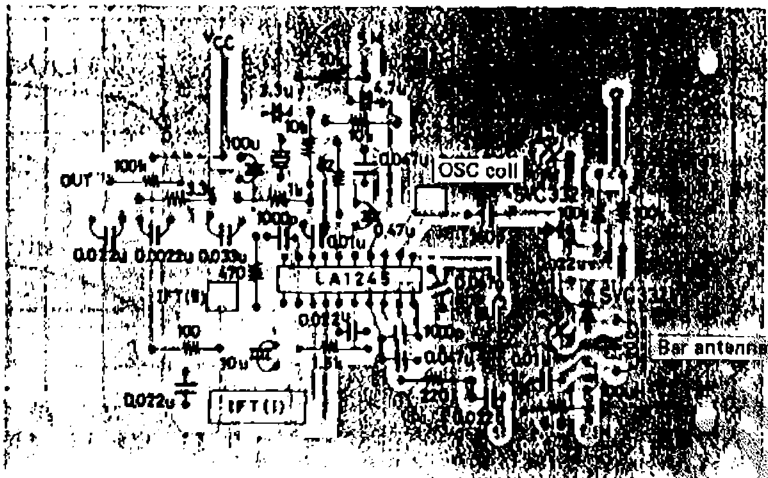


Signal meter output – T_a



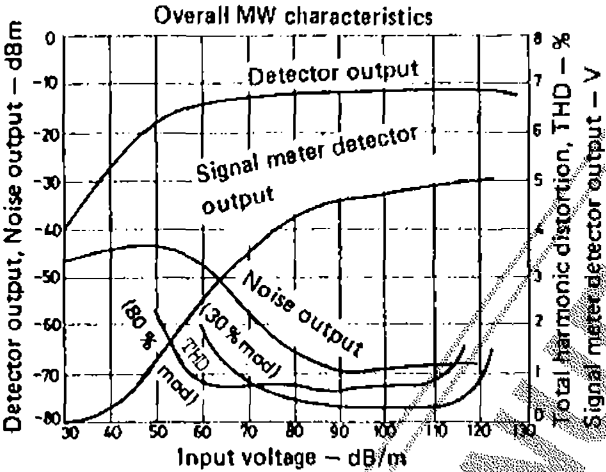
- **Application 2:** Using Variable Capacitance Diodes





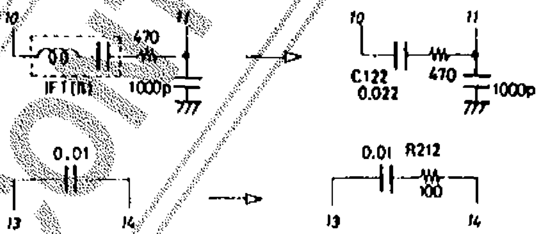
An Example of Printed Pattern (Cu-foild area) (130 x 80 mm²)

Overall MW characteristics



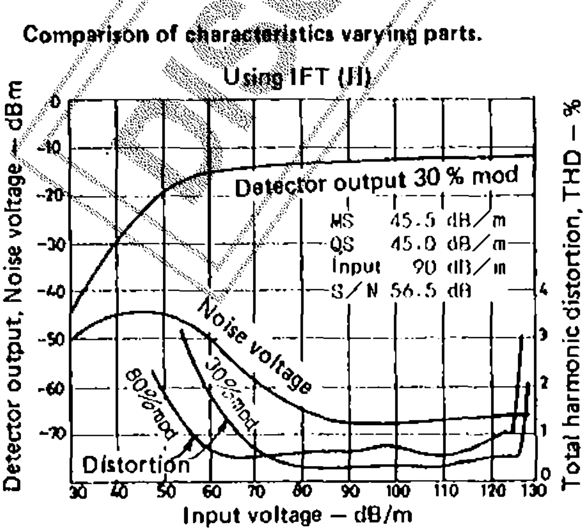
- **Application 3: Rejecting IFT (II)**

Following 2 changes are recommended as C-coupling without IFT (II).



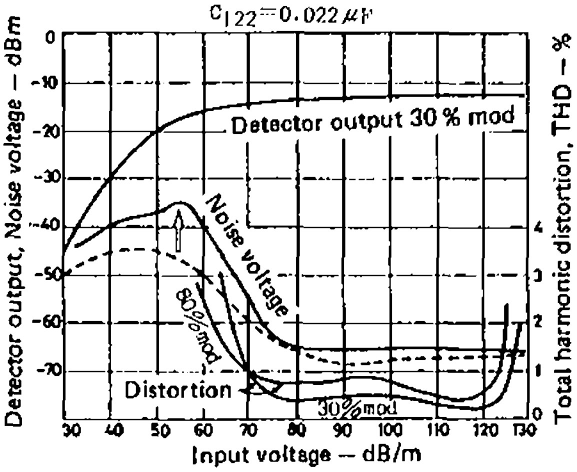
Comparison of characteristics varying parts.

Using IFT (II)



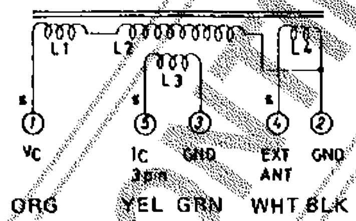
Without IFT (II), C-coupled

C_{122}=0.022μF



Peripheral Parts

(1) Bar Antenna (34H-052-869 Sumida Co.,)



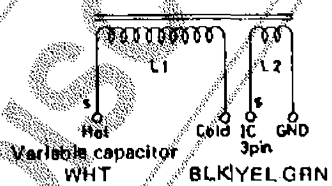
For use of general variable capacitor

L (between pin 1, 2) = 270 μH

$Q \geqq 180$

L1:	solenoid	43 t.
L2:	space	42 t.
L3:	solenoid	7 t.
L4:	solenoid	4 t.

(2) Bar Antenna (C-4898 Coil Snake Co.,)



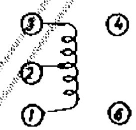
For use of variable capacitor diode

L (between pin 1, 2) = 250 μH

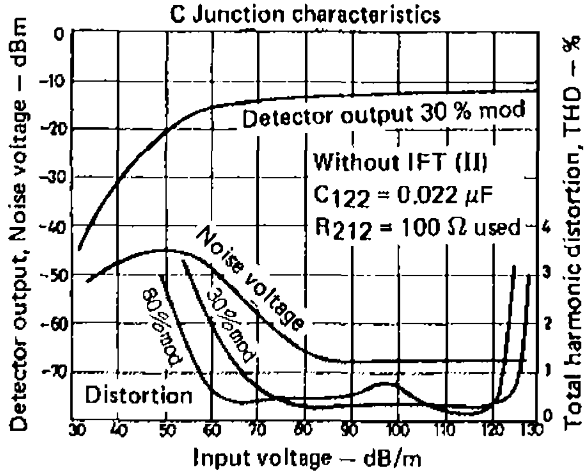
$Q \geqq 250$

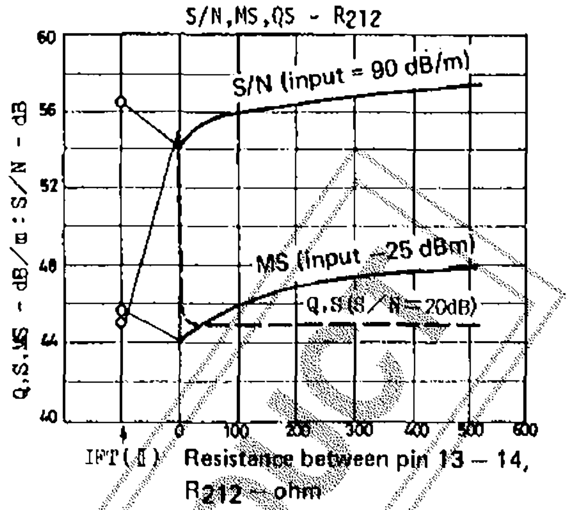
L1:	solenoid	55 t.
L2:	solenoid	5 t.

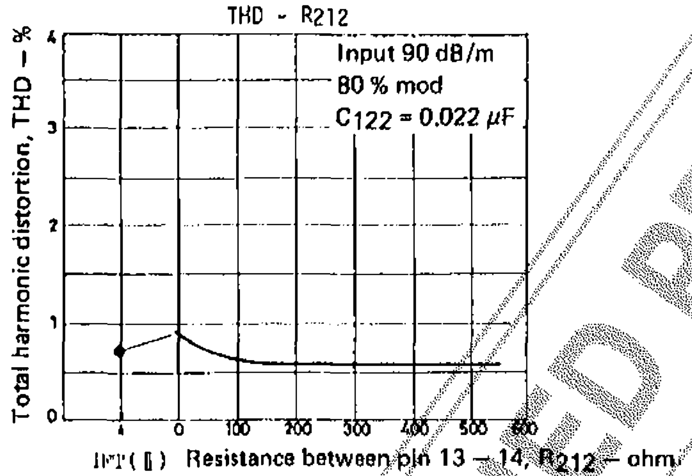
(3) Osc coil



2157-223-072 Sumida	2157-223-082 Sumida	7BR-6654Y Toko
L (between pin 1 and 3) = 147 μH	L (between pin 1 and 3) = 147 μH	L (between pin 1 and 3) = 147 μH
$Q \geqq 85$	$Q \geqq 85$	$Q \geqq 90$
3 – 2 39 t.	3 – 2 26 t.	3 – 2 31 t.
2 – 1 39 t.	2 – 1 52 t.	2 – 1 31 t.


C Junction characteristics
Detector output, Noise voltage – dBm
Total harmonic distortion, THD – %
Input voltage – dB/m
Detector output 30 % mod
Without IFT (II)
C122 = 0.022 μF
R212 = 100 Ω used
Noise voltage
80% mod
30% mod
Distortion


S/N,MS,QS - R212
Q,S,MS - dB/m : S/N - dB
S/N (input = 90 dB/m)
MS (input -25 dBm)
Q.S(S/N=20dB)
IFT(II) Resistance between pin 13 – 14, R212 – ohm

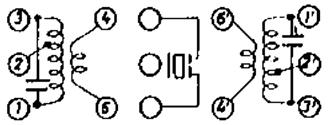

THD - R212
Total harmonic distortion, THD – %
Input 90 dB/m
80 % mod
C122 = 0.022 μF
IFT(II) Resistance between pin 13 – 14, R212 – ohm

(4) Variable Capacitor (C123A Alps Co.,)

c max	326.8 pF
c min	6.7 pF

(5) Variable Capacitor Diode (SVC332 Sanyo)

(6) IFT (I) (CMFQ-021A Toko Co.,)



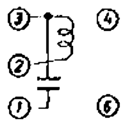
(7LC-6283N) yellow: input

(7MC-6284N) blue: output

CFMQ-021A

3 – 2	58 t.	3 – 2	18 t.
2 – 1	98 t.	2 – 1	130 t.
6 – 4	16 t.	6 – 4	16 t.
Cent. Freq. 450 kHz		Cent. Freq. 450 kHz	
Qu = 70 + 20 %		Qu = 110	
Tuned Cap. 180 pF		Tuned Cap. 180 pF	

(7) IFT (II)



2150-208-033 Sumida Co.,
Cent. Freq. 455 kHz
Q ≧ 95
between 2 and 3 170 t.
Tuned Cap. 180 pF
2150-208-033 Sumida Co.,

7LC-4751B Toko Co.,
Cent. Freq. 455 kHz
Q ≧ 75
between 2 and 3 146 t.
Tuned Cap. 180 pF
7LC-4751B Toko Co.,

(8) Narrow Band Resonator (BFB450C4 N Murata Co.,)