Monolithic Linear IC

LA1245

SANYO

AM Electronic Tuner

Overview

LA1245 is a high performance IC to be used as an AM electronic tuner. It provides an automatic search-stop signal, local oscillator buffer-output, and the low level local oscillation, as well as providing all other functions required of an AM tuner. Moreover, the stable local oscillation from LW to SW facilitates the use of many band.
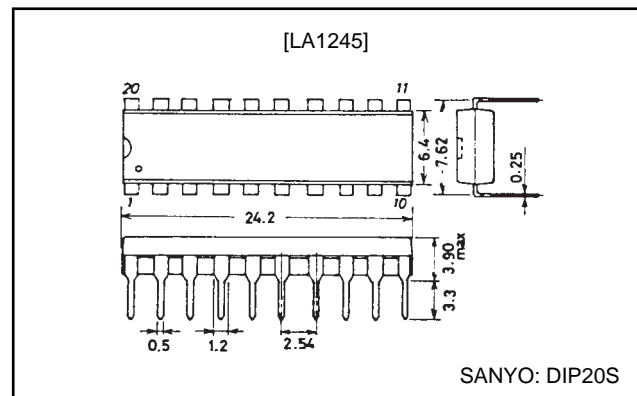
Functions

- RF amplifier   • MIX   • OSC (with ALC)   • Detection
- IF amplifier   • AGC   • Local oscillation buffer-output
- Signal meter driving output (also used as an automatic search stop-signal)
- etc.

Package Dimensions

unit : mm

3021B-DIP20S

[LA1245]

SANYO: DIP20S

Features

• Narrow-band signal meter	: Available as an automatic search-stop signal (also available as a wide-band signal meter). Signal meter output=1/2 frequency ±1.5kHz typ.
• Local oscillation buffer-output	: Facilitates the design of electronic tuning systems and frequency representation.
• OSC (with ALC)	: The oscillation output is stabilized at a low level (350 mVrms) for a varactor diode, and tracking error is minimized.
• RF amplifier	: Excellent in usable sensitivity by incorporating low-noise transistors in cascode circuit (45dB/m typ).
• MIX	: Double balanced differential MIX prevents the influence of spurious radiation and IF interferences (IF interference = 85dB typ).
• Low noise	: Excellent in S/N for intermediate input (57dB typ).
• Compensation for V_{CC} fluctuation	: Allows little gain fluctuation and little distoriton fluctuation (8 to 16 V).
• Low shock noise	: Able to decrease the shock noise by selecting AGC time constant when changing V_{CC}-on and/or switching the mode.

Specifications
Maximum Ratings at Ta=25°C

Parameter	Symbol	Conditions	Ratings	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	Pd max	See Figure 2	700	mA
Operating temperature	Topr		−20 to +70	°C
Storage temperature	Tstg		−40 to +125	°C

Recommended Operating Conditions at Ta=25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		12	V

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

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain	I_{CC}1	quiescent	16.0	25.0	35.0	mA
	I_{CC}2	107 dBμ input	19.0	29.0	40.0	mA
Detection output	V_O1	23 dBμ input, mod. 30%	−27.5	−23.0	−18.5	dBm
	V_O2	80 dBμ input, mod. 30%	−15.5	−12.5	−9.5	dBm
Signal to noise ratio	S/N1	23 dBμ input, mod. 30%	16	20		dB
	S/N2	80 dBμ input, mod. 30%	52	57		dB
Total harmonic distortion	THD1	80 dBμ input, mod. 30%		0.4	1.0	%
	THD2	107 dBμ input, mod. 30%		0.3	1.0	%
Signal meter output	V_{SM}1	quiescent		0	0.5	V
	V_{SM}3	107 dBμ input	3.0	4.5	7.0	V
Input at signal meter output=1V	V_{IN}1	V_{SM} output=1V	19.0	25.0	31.0	dBμ
Local oscillation-buffer output	V_{osc}		250	350		mVrms

Reference Characteristics

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Signal meter output	V_{SM}2	40 dBμ input		2.5		V
Total harmonic distortion	THD3	112 dBμ input, mod.30%		2		%
Local oscillation fluctuation within a band	ΔV_{osc}	V_{osc}L (522kHz) to V_{osc}H (1647kHz)		10		mVrms
Signal meter band width*	V_{SM-BW1}	80 dBμ input, 1/2 output frequency		±1.5		kHz
	V_{SM-BW2}	80 dBμ input, 1/10 output frequency		−4.5/+7		kHz
Selectivity		±10kHz at 30% mod.		45		dB
IF interference		f_r=600kHz		85		dB
Image frequency interference ratio		f_r=1400kHz		40		dB

* BFB450C4 N (Murata, Co.,) was used as a narrow band filter.

(Note) 0 dBm=775mV, 0 dBu=1μV.

Using the automatic search-stop signal

Signal Meter-driving output circuit is equivalent to Figure. 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 impeadance 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 τ and the cut-off frequency fc can be expressed as follows :

$$\left\{ \begin{array}{l} \tau = (C_{114}+C_{115}+C_S)\ (R_{211}//R_{in}) \\ f_c = \frac{1}{2\pi\tau} \end{array} \right.$$

A semi-fixed resistor is recommended to be used as R_{211} to cope with the fluctuation of V_{SM}. Refer to Figure. 3 for the value of the semi-fixed resistor since this depends upon V_{SM} and R_{208}. Figure. 3 shows the lowest limit of the semi-fixed resistor in relation to R_{208} with the parameter of V_{SM} set point, and the value of the semi-fixed resistor will be equal to or greater than that shown in Figure. 3. For example, when $V_{SM}=5V$ and $R_{208}=240\Omega$, R_{211} becomes $28k\Omega$. Thus, the value of the semi-fixed resistor is determined to be about $30k\Omega$. 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 $V_{SM} \le V_{CC}-2(V)$. When a narrow band serial resonator is used, include the resonant impedance to determine the value of R_{208}.

Figure. 1 Signal Meter Detector Circuit

Figure. 2 P_d max - T_a

Figure. 3 R_{211} - R_{208}
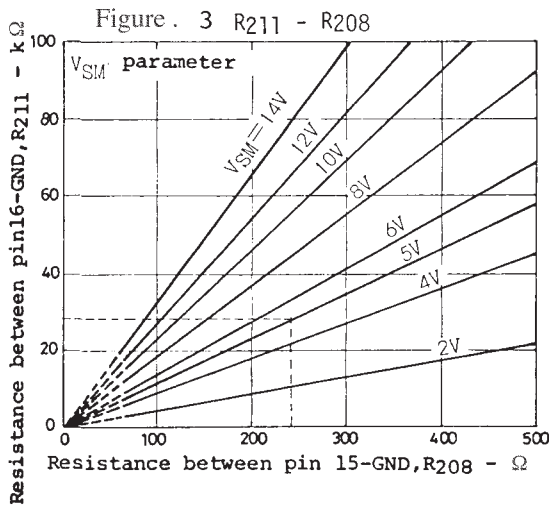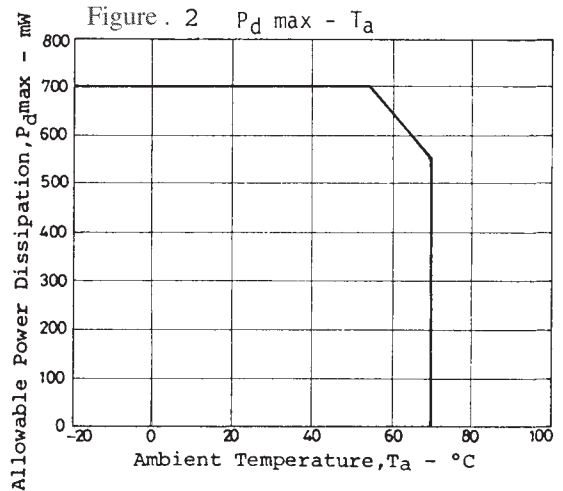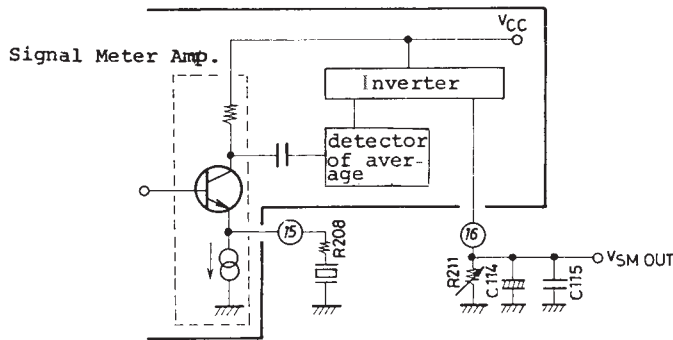
Input/Output Admittance

—	Parameter	Frequency	—	AGC-off	AGC-on
RF	y_{i3}	1 MHz	r_i	8 kΩ	40 kΩ
			c_i	30 pF	13 pF
	y_{o5}	1 MHz	r_o	—	—
			c_o	4 pF	—
MIX	y_{i6}	1 MHz	r_i	10 kΩ	—
			c_i	2.6 pF	—
	y_{o7}	500 kHz	r_o	— kΩ	—
			c_o	2 pF	—
1st IF	y_{i9}	500 kHz	r_i	3 kΩ	3.2 kΩ
			c_i	7 pF	3 pF
	y_{o10}	500 kHz	r_o	45 Ω	42 Ω
			c_o	20 pF	20 pF
2nd IF	y_{i11}	500 kHz	r_i	80 Ω	—
			c_i	—150 pF	—

$y_{i3} - f$

$c_{o5} - f$

$y_{i6} - f$

Notes on LA1245 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 $R_{208} \geq 240\Omega$ for manual tuning type.
   · Use $R_{208} \geq 82\Omega$, 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 $V_{CC} \leq$ IF V_{CC}, since abnormal noise levels might be caused when detuning a strong input on the codition RF $V_{CC} >$ IF V_{CC}.

3. Use the signal meter driving output (V_{SM}) at $V_{SM} \leq V_{CC} - 2$ (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, and in extreme cases oscillation might be cause. To prevent this :
   · Shorter 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 20pF, 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 2mA, the suitable resistance between pin 20 and GND is 1.5kΩ.

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 –25dBm is obtained are as follows :

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

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

11. When the coupling coefficient of the local oscillation coil is small and an anti-resonance point of about 100MHz is present or the stray capacitance between pin 19 and pin 20 is large, the buffer output (pin 20) may be subject to parasitic oscillation of about 100MHz. In this case, connect a capacitor of about 30pF between pin 20 and GND. To observe parasitic oscillation, connect a capacitor of 5pF in series with the probe. If the probe is connected direct to pin 20, the input capacitance of the probe causes parasitic oscillation to stop, which makes it impossible to observe.

Sample Application Circuit 1
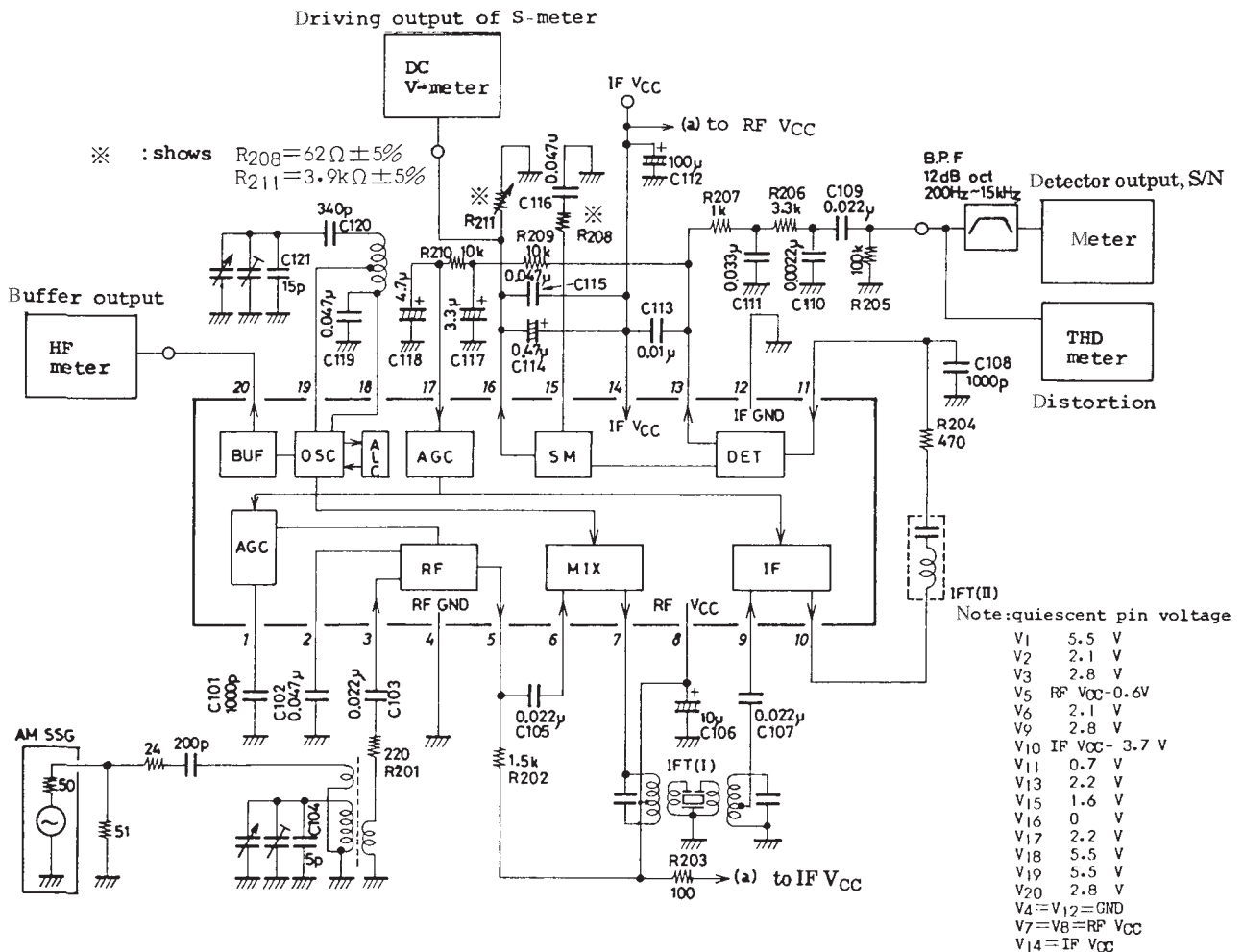
Unit (resistance : Ω, capacitance : F)
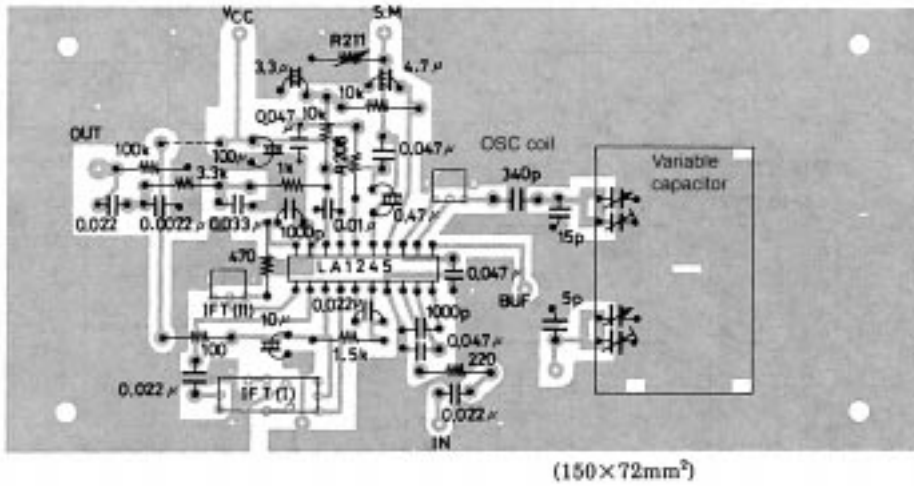
An Example of Printed Pattern (150x72mm², bottom view)

Unit (resistance: Ω, capacitance: F)
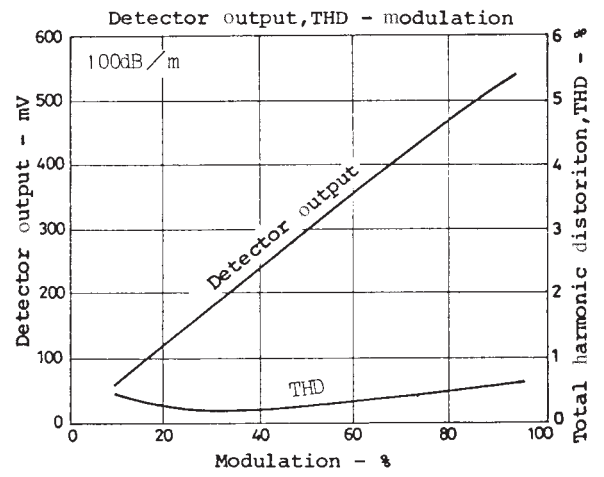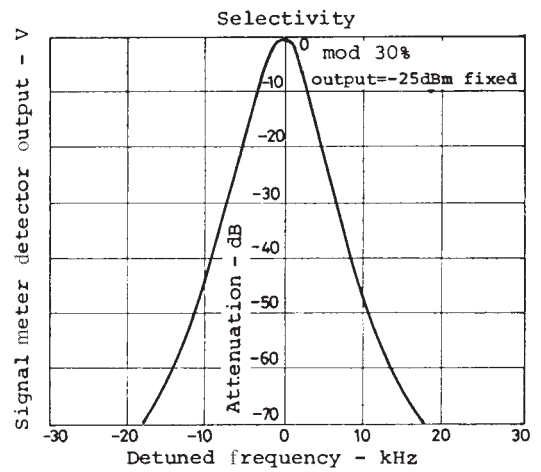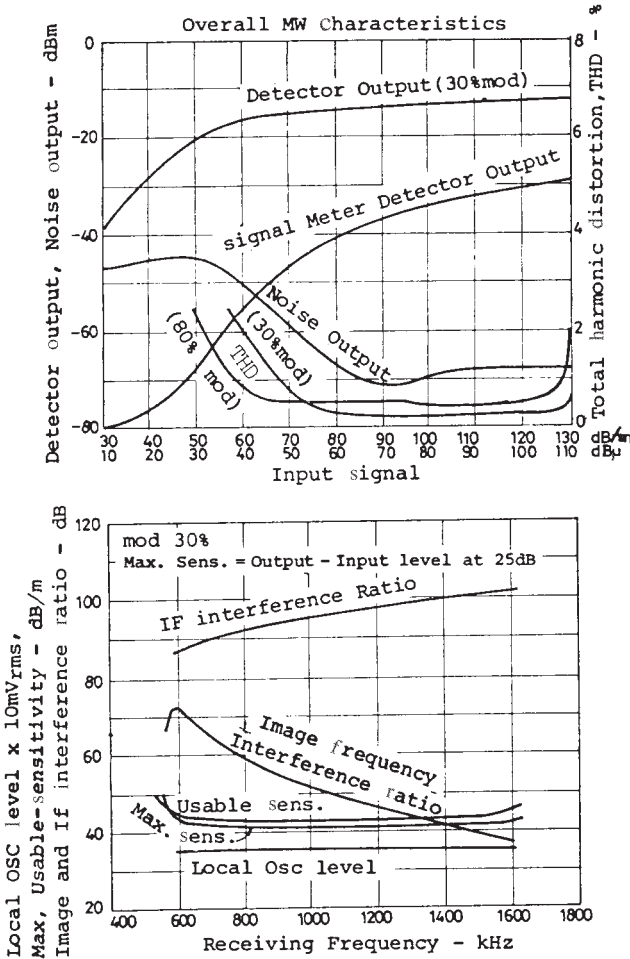
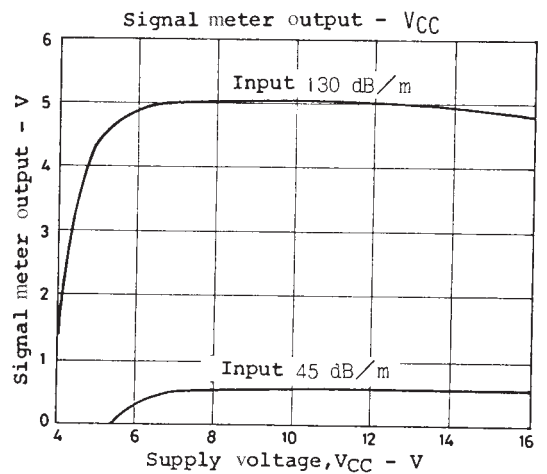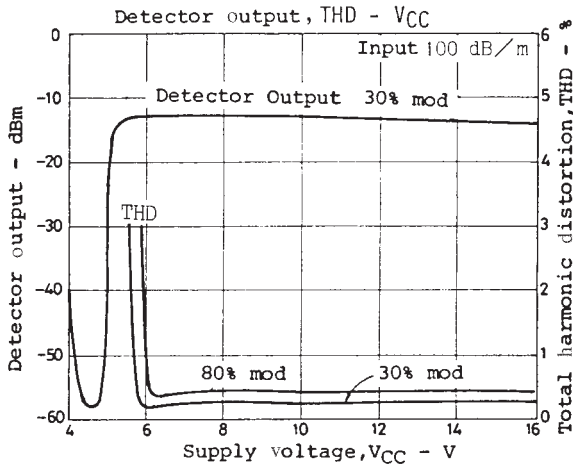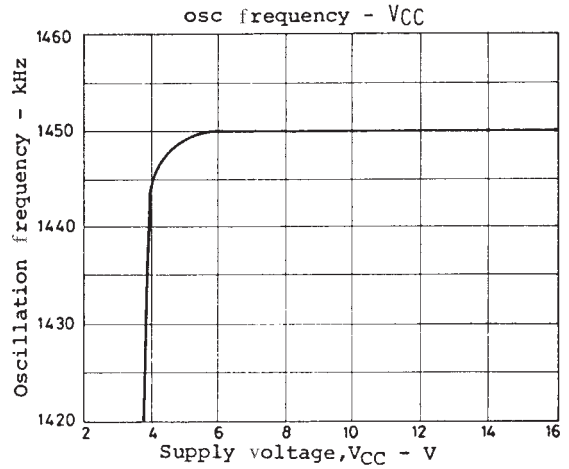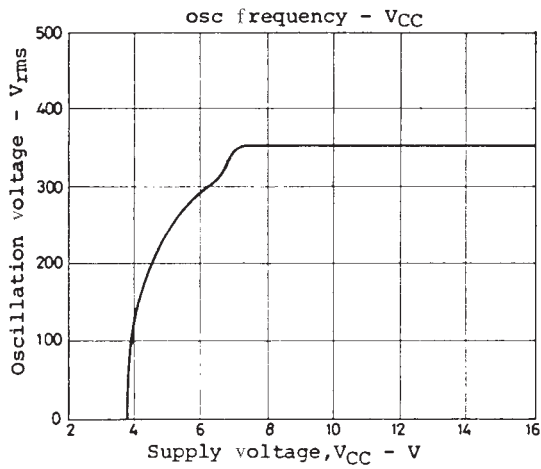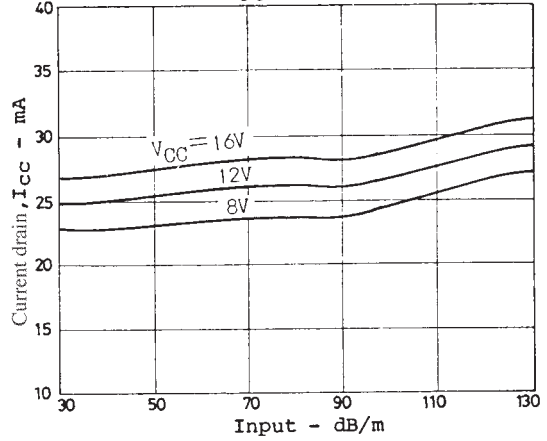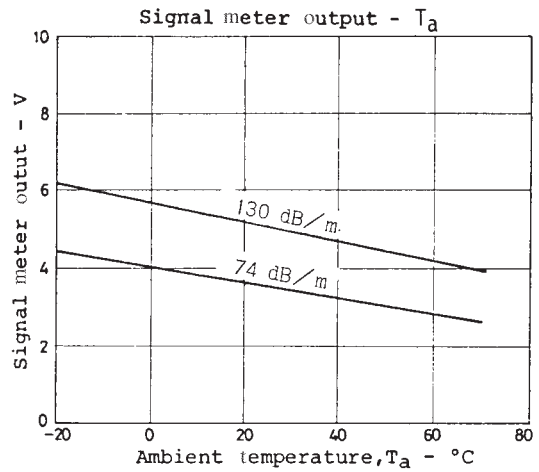## Detuned characteristic of signal meter

narrow band filter
BFB 450C4

Signal Meter Detector Output – V

100dB/m

60dB/m

45dB/m

Detuned frequency – kHz

I_{CC} – Input

Current drain, I_{CC} – mA

V_{CC} = 16V

12V

8V

Input – dB/m

osc frequency – V_{CC}

Oscillation voltage – V_{rms}

Supply voltage, V_{CC} – V

osc frequency – V_{CC}

Oscillation frequency – kHz

Supply voltage, V_{CC} – V

Detector output, THD – V_{CC}

Detector output – dBm

Total harmonic distortion, THD – %

Input 100 dB/m

Detector Output 30% mod

THD

80% mod   30% mod

Supply voltage, V_{CC} – V

Signal meter output – V_{CC}

Signal meter output – V

Input 130 dB/m

Input 45 dB/m

Supply voltage, V_{CC} – V

I_{CC} – V_{CC}

Current drain, I_{CC} – mA

Input 100dB/m

I_{CC}-total

no input

I_{CC}-RF (5+7+8) input 100dB/m

Supply voltage, V_{CC} – V

Usable sens., Max. sens. – V_{CC}

Usable sens., Max. sens. – dB/m

Usable sens.

Max. sens.

Supply voltage, V_{CC} – V

$I_{CC} - T_a$

Current drain , I_{CC} – mA vs Ambient temperature, T_a – °C

130 dB/m

no input

Detector output – T_a

Detector output – dBm vs Ambient temperature, T_a – °C

130 dB/m

74 dB/m

Buffer output – T_a

Buffer output – mV vs Ambient temperature, T_a – °C

Signal meter output – T_a

Signal meter outut – V vs Ambient temperature, T_a – °C

130 dB/m

74 dB/m

Sample Application Circuit 2 : Using variable capacitance diodes

IF V_{CC}

(a) to RF V_{CC}

100µ

100k 360p

20k R211 82 R208

1k 3.3k 0.022µ

SVC 332 30p

10k 10k

0.047µ

0.047µ

4.7µ

3.3µ

0.47µ

0.01µ

0.033µ

0.0022µ

100k

IF V_{CC}

IF GND

1000p

470 R204

IFT(II)

| 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 |

BUF OSC A L C AGC SM DET

AGC RF MIX IF

RF GND RF V_{CC}

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

1000p 0.047µ 0.022µ 0.022µ 10µ 0.022µ

100k SVC 332

0.022µ 20p

220 1.5k R202

IFT(1)

EXT 100uH

6.8k 0.01µ

100 (a) to RF V_{CC}
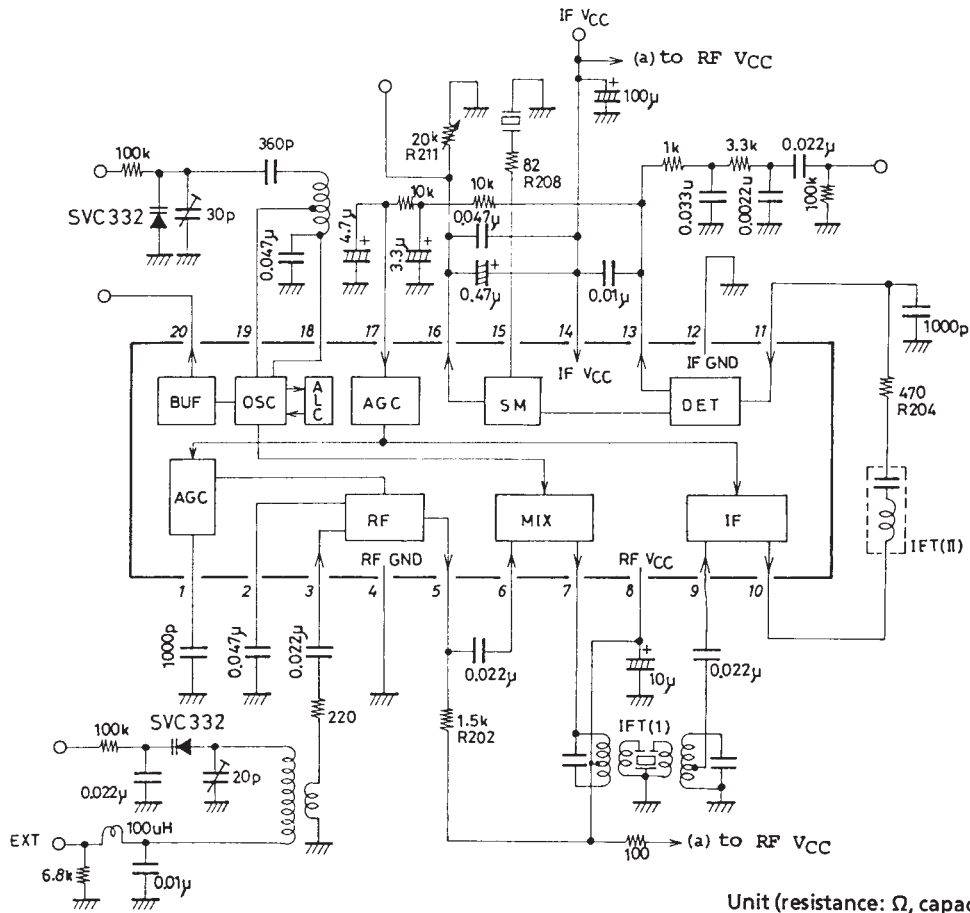
Unit (resistance: Ω, capacitance: F)
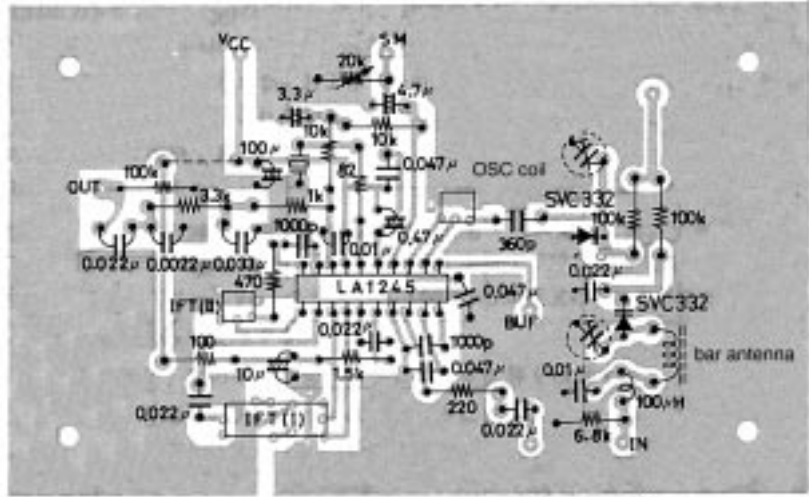
An Example of Printed Pattern (130x80mm², bottom view)

Unit (resistance: Ω, capacitance: F)

Overall MW characteristics
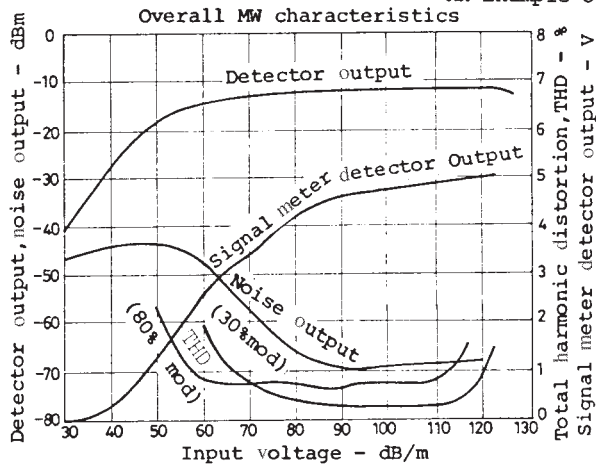
Sample Application Circuit 3 : Rejecting IFT (II)

Following 2 changes are recommended as C-conpling without IFT (II)
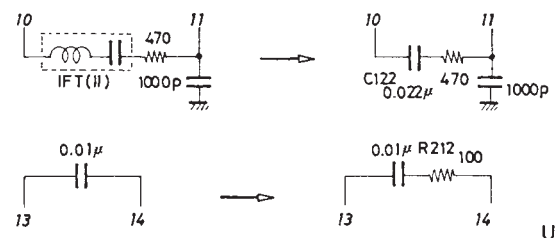
Unit (resistance: Ω, capacitance: F)

Comparison of characteristics varying parts.

S/N.MS.QS - R212
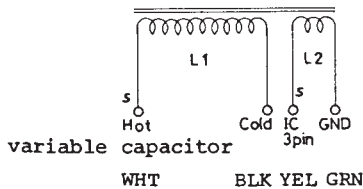

THD - R212
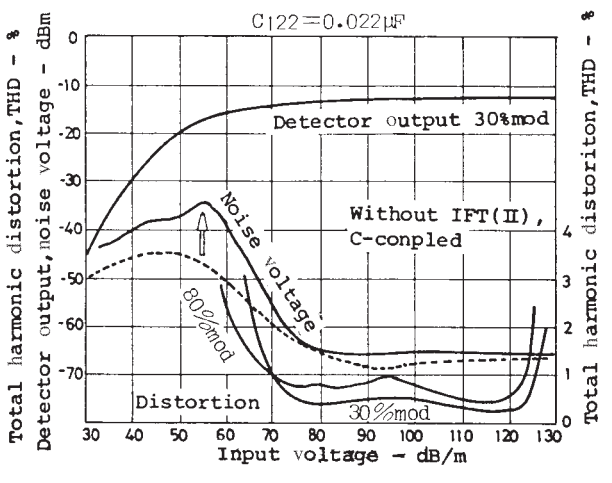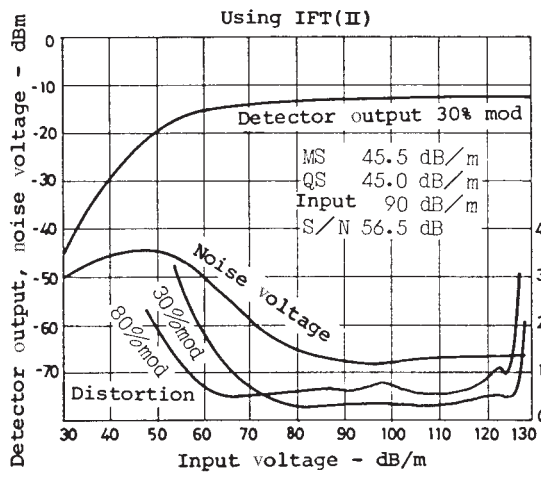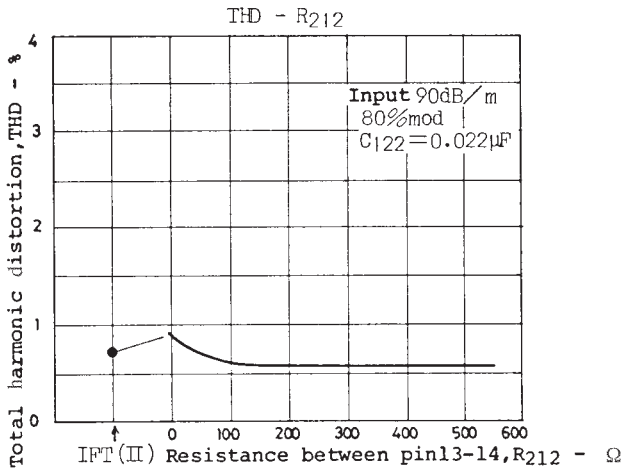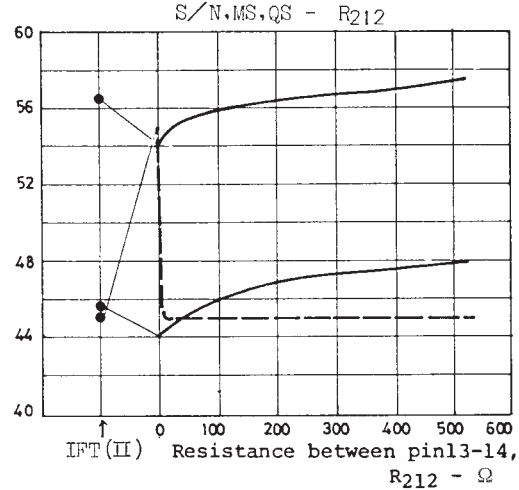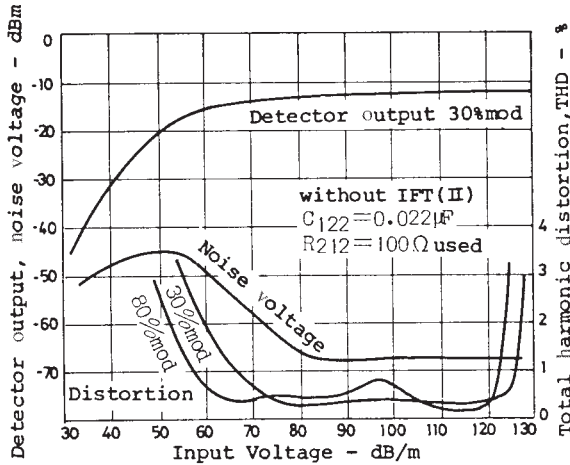
Peripheral Parts

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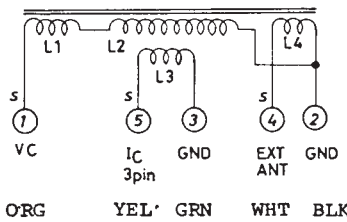

```
For use of general variable capacitor

L(between pins 1,2)=270μH
Q≧180
L1 : solenoid        43 t.
L2 : space           42 t.
L3 : solenoid         7 t.
L4 : solenoid         4 t.
```

(2) Bar Antenna (C-4698 Coil Snake Co.,)


```
For use of variable capacitor diode

L(between pins 1,2)=250μH
Q≧250
L1 : solenoid        55 t.
L2 : solenoid         5 t.
```

(3) Osc coil

2157-223-072 **Sumida**   2157-223-082 **Sumida**   7BR-6654Y **Toko**
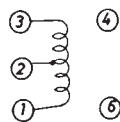
	2157-223-072 Sumida		2157-223-082 Sumida		7BR-6654Y Toko	
L(between pins 1 and 3)	=147μH		147μH		=147μH	
	Q≧85		Q≧85		Q≧90	
	③-②	39 t.	③-②	26t.	③-②	31 t.
	②-①	39 t.	②-①	52t.	②-①	31 t.

(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.,)
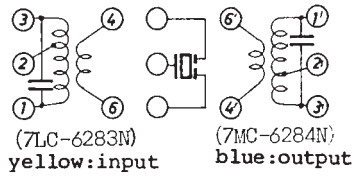
CFMQ-021A

③-② 58t.   ③-② 18t.
②-① 98t.   ②-① 130t.
⑥-④ 16t.   ⑥-④ 16t

(7LC-6283N) (7MC-6284N)
yellow:input   blue:output

Cent. Freq.450kHz   Cent. Freq.450kHz
Qu=70+20%   Qu=110
Tuned Cap. 180pF   Tuned Cap. 180pF

(7) IFT (II)
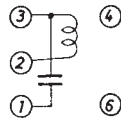
2150-208-033 Sumida Co.,   7LC-4751B Toko Co.,
Cent. Freq. 455kHz   Cent Freq. 455kHz
Q≧95   Q≧75
between 2 and 3 170t.   between 2 and 3 146t.
Tuned Cap. 180pF   Tuned Cap. 180pF

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

This catalog provides information as of June, 1997. Specifications and information herein are subject to change without notice.