Ordering number : EN737F

Monolithic Linear IC

LA1245

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.

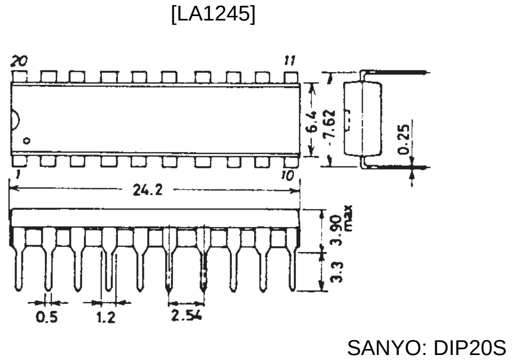
Functions

- 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



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*	$V_{SM\text{-}BW1}$	80 dBμ input, 1/2 output frequency		±1.5		kHz
	$V_{SM\text{-}BW2}$	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 :

$$\begin{cases} \tau = (C_{114}+C_{115}+C_S)\ (R_{211}//R_{in}) \\ f_C = \dfrac{1}{2\pi\tau} \end{cases}$$

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}=240Ω, R_{211} becomes 28kΩ. Thus, the value of the semi-fixed resistor is determined to be about 30kΩ. 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}.

Figure . 1 Signal Meter Detector Circuit

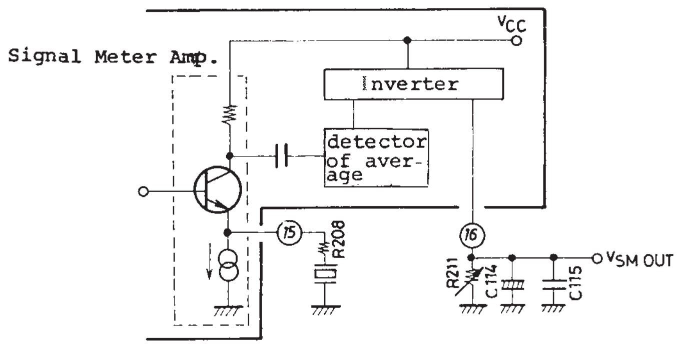


Figure . 2 Pd max - Ta

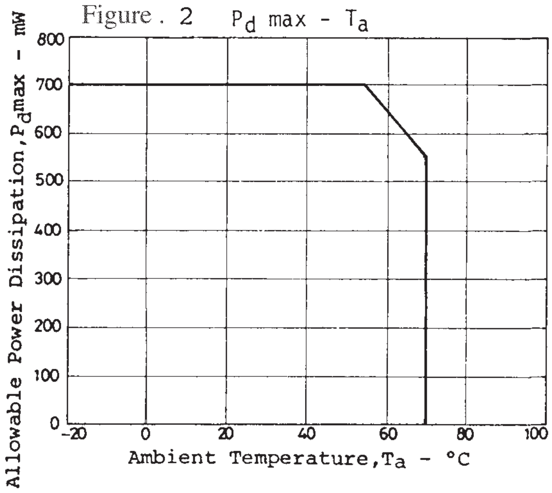
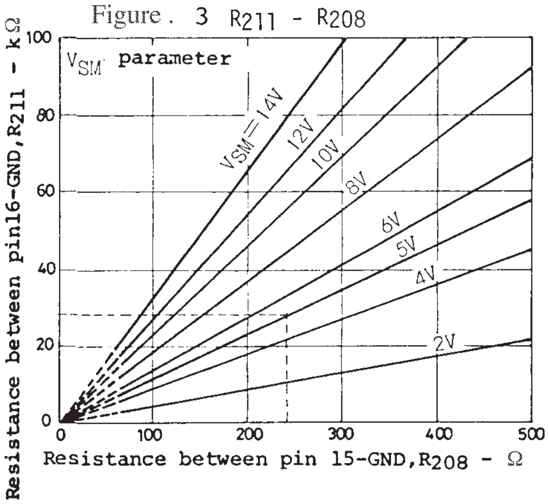
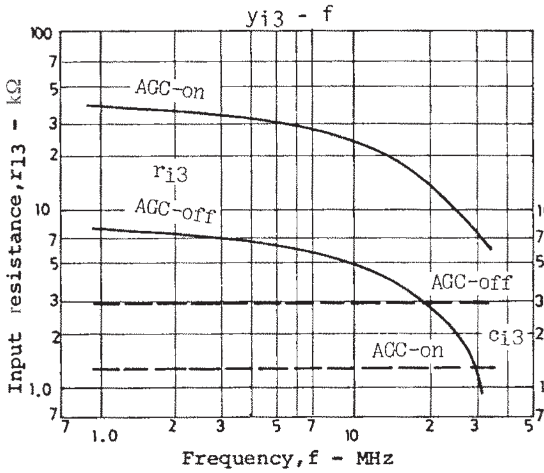


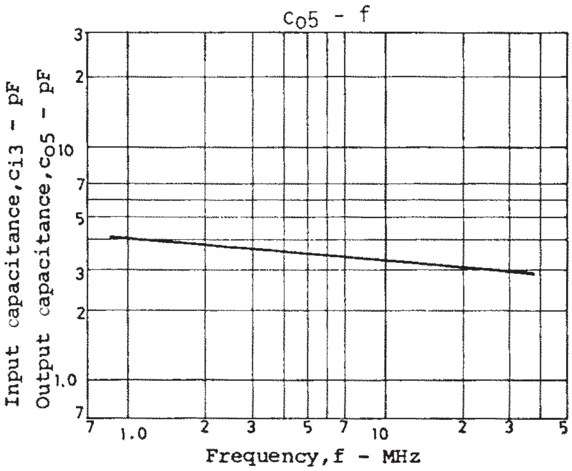
Figure . 3 R211 - R208

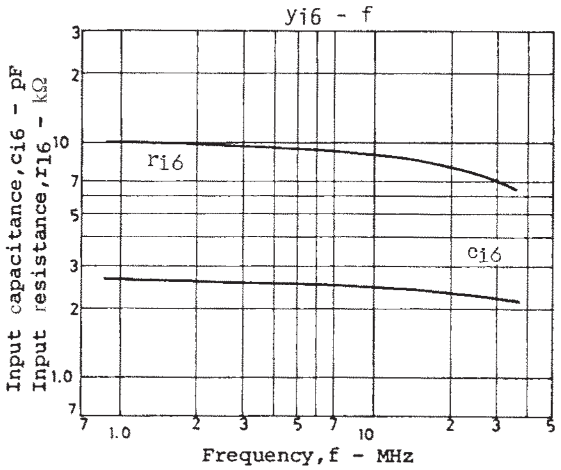


Input/Output Admittance

—	Parameter	Frequency	—	AGC-off	AGC-on
RF	yi3	1 MHz	ri	8 kΩ	40 kΩ
			ci	30 pF	13 pF
	yo5	1 MHz	ro	—	—
			co	4 pF	—
MIX	yi6	1 MHz	ri	10 kΩ	—
			ci	2.6 pF	—
	yo7	500 kHz	ro	— kΩ	—
			co	2 pF	—
1st IF	yi9	500 kHz	ri	3 kΩ	3.2 kΩ
			ci	7 pF	3 pF
	yo10	500 kHz	ro	45 Ω	42 Ω
			co	20 pF	20 pF
2nd IF	yi11	500 kHz	ri	80 Ω	—
			ci	−150 pF	—







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}≥240Ω for manual tuning type.
   · Use R_{208}≥82Ω, 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}≤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}≤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.

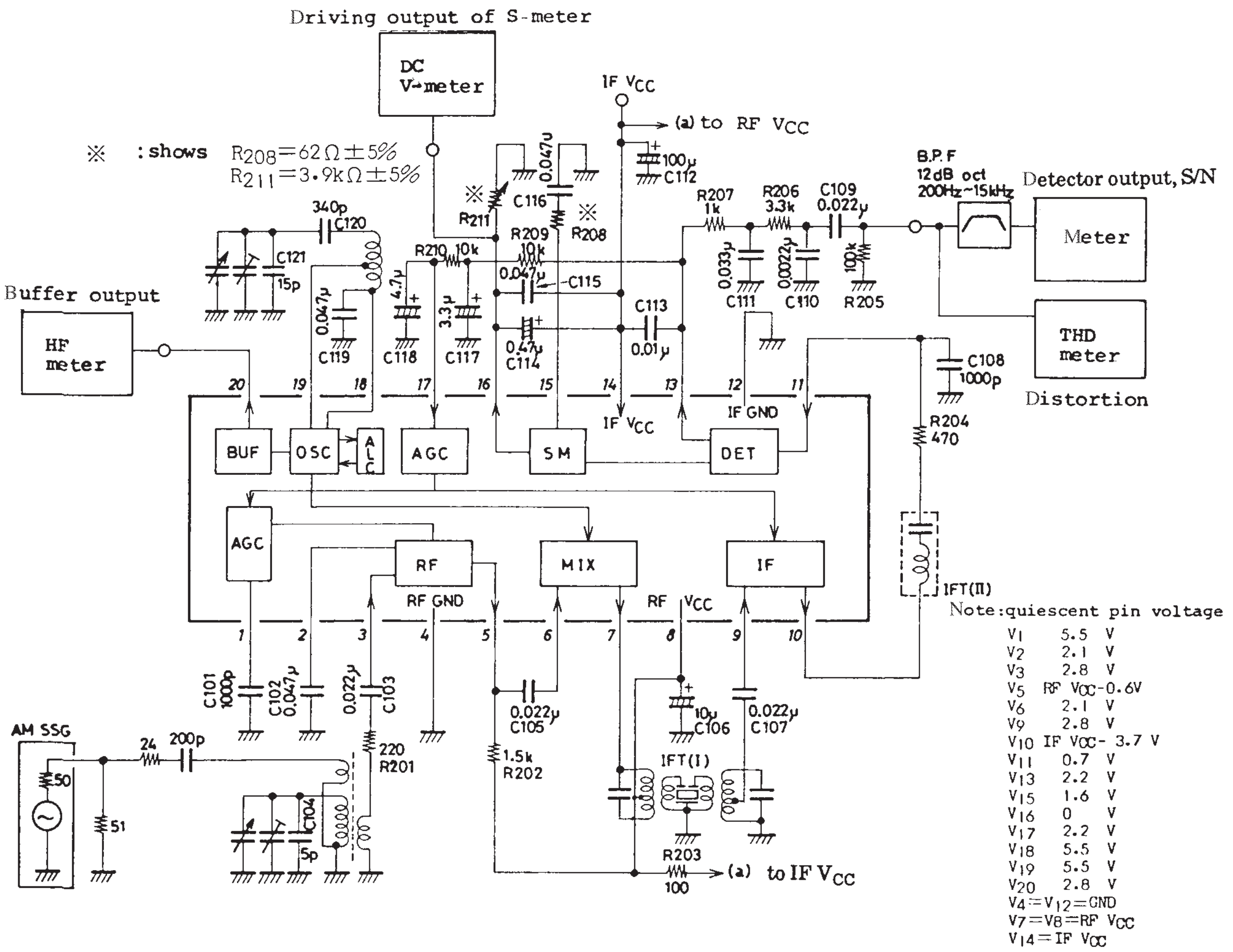
8. When a cable or something similar is connected to a local oscillation buffer (pin 20), which is equivalent to connecting a capacitor of about 20pF, the output from the buffer will be of sawtooth waves, causing the level low at the short wave band. To prevent this, connect a resistor between pin 20 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

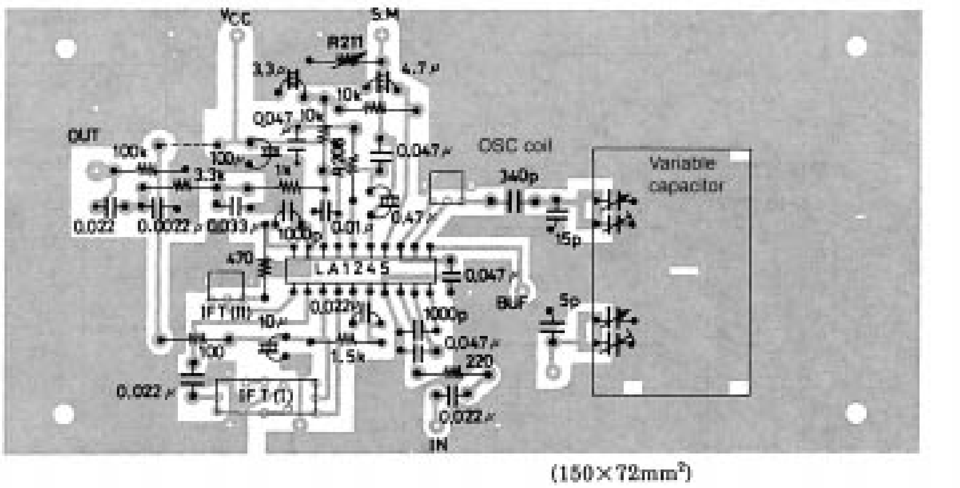
Slight change in IFT, however, will be covered by changing the constant of resistors R_{202} and R_{204}.

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

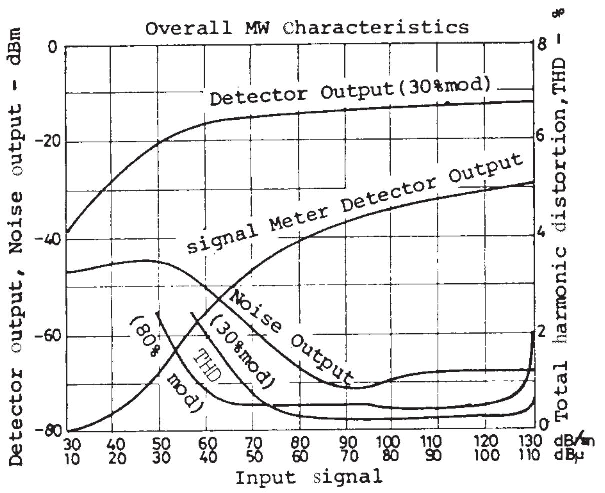


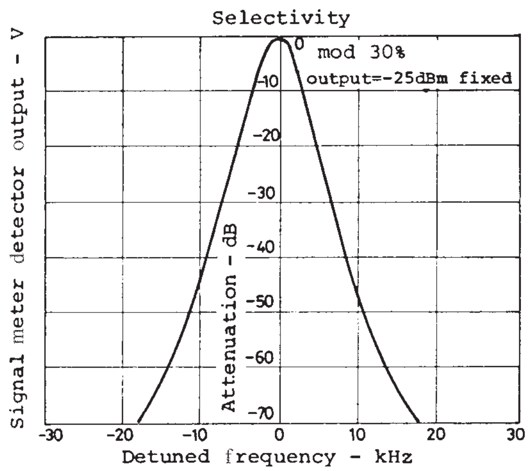
Unit (resistance : Ω, capacitance : F)

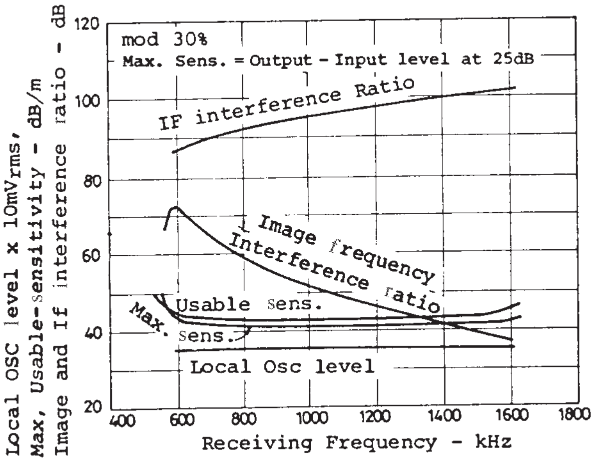


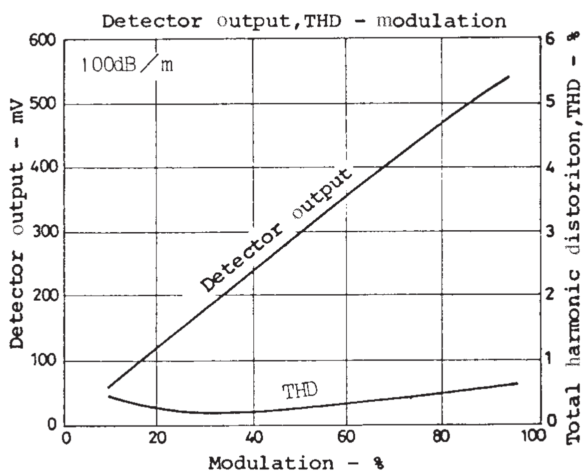
An Example of Printed Pattern (150x72mm², bottom view)

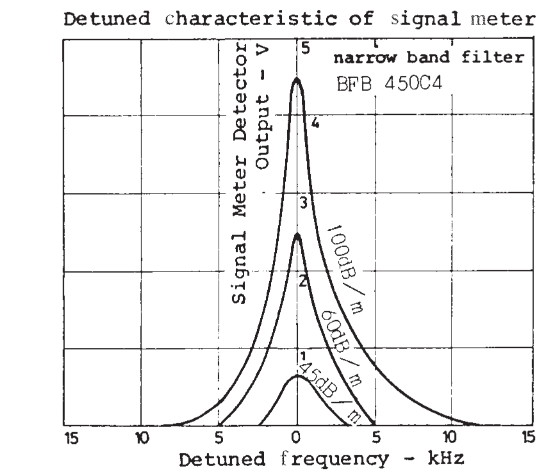
Unit (resistance: Ω, capacitance: F)

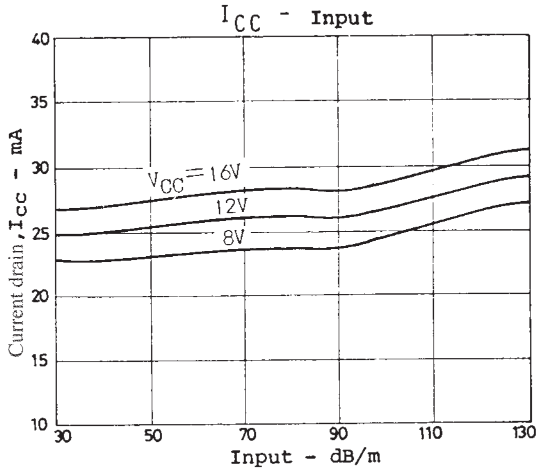


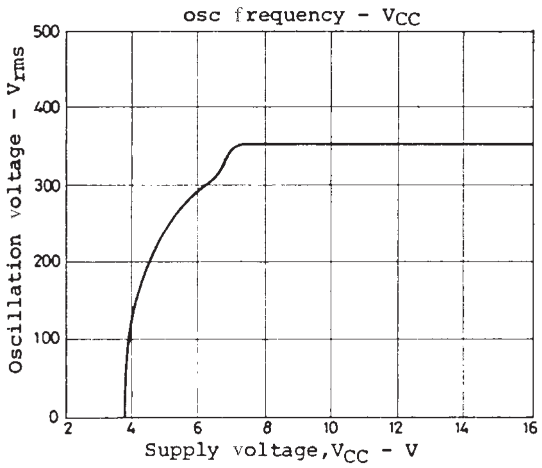


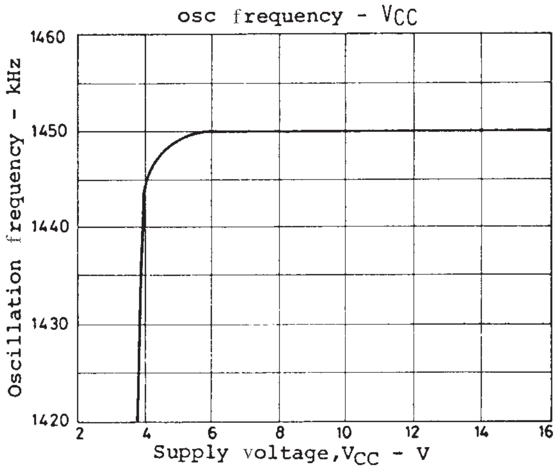


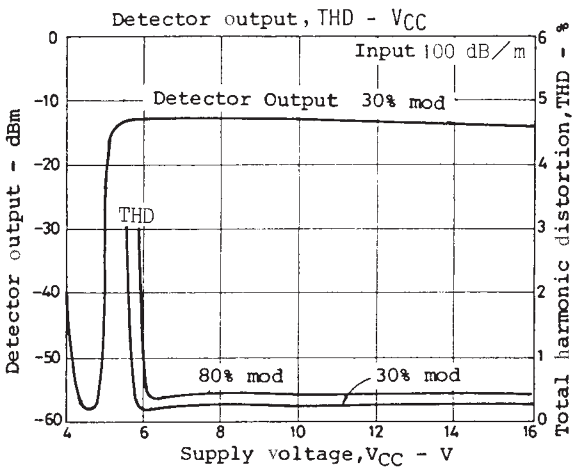


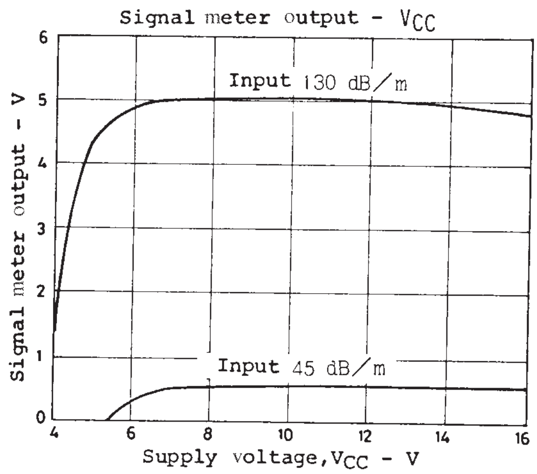

Detuned characteristic of signal meter
Signal Meter Detector Output - V
narrow band filter
BFB 450C4
100dB/m
60dB/m
45dB/m
Detuned frequency - kHz

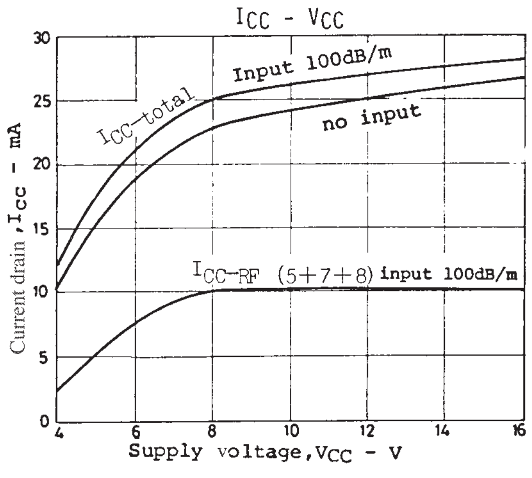

I_{CC} - Input
Current drain, I_{CC} - mA
V_{CC}=16V
12V
8V
Input - dB/m

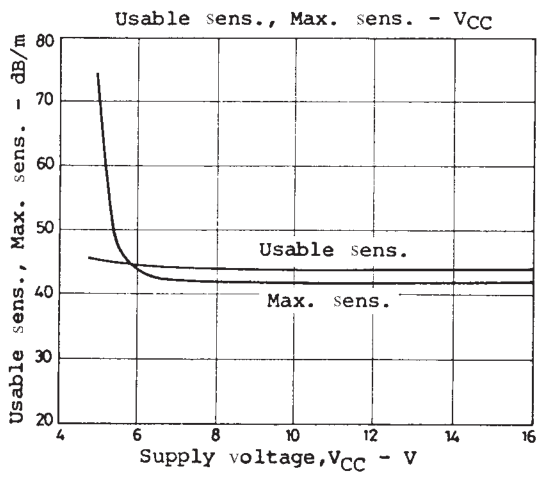

osc frequency - V_{CC}
Oscillation voltage - V_{rms}
Supply voltage, V_{CC} - V

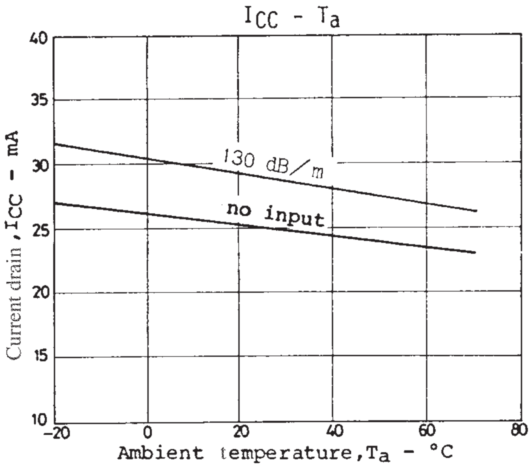

osc frequency - V_{CC}
Oscillation frequency - kHz
Supply voltage, V_{CC} - V

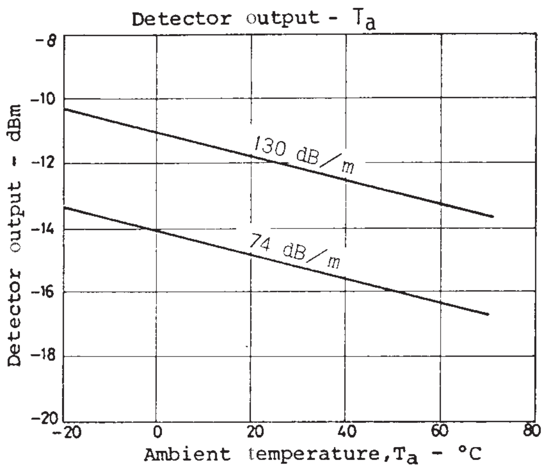

Detector output, THD - V_{CC}
Input 100 dB/m
Detector Output 30% mod
THD
80% mod
30% mod
Detector output - dBm
Total harmonic distortion, THD - %
Supply voltage, V_{CC} - V

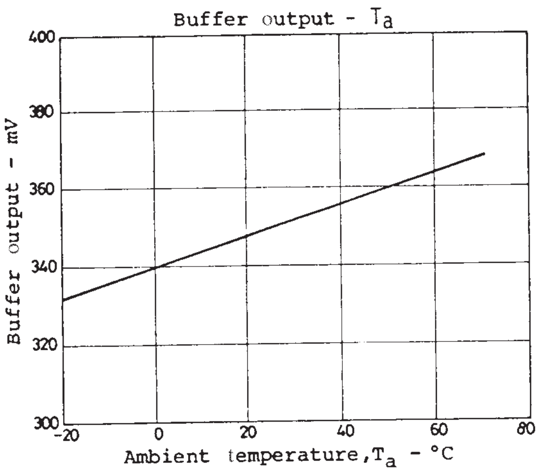

Signal meter output - V_{CC}
Input 130 dB/m
Input 45 dB/m
Signal meter output - V
Supply voltage, V_{CC} - V

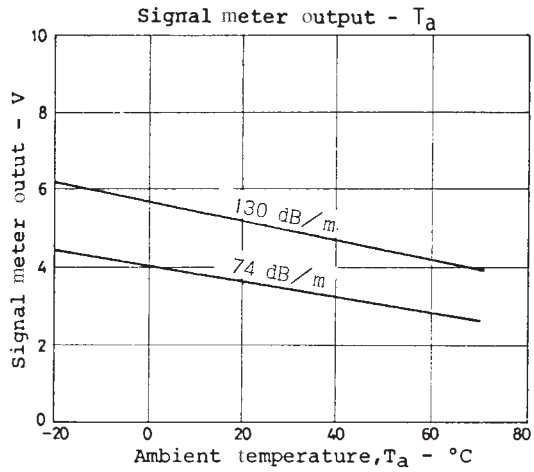

I_{CC} - V_{CC}
Input 100dB/m
I_{CC}-total
no input
I_{CC}-RF (5+7+8) input 100dB/m
Current drain, I_{CC} - mA
Supply voltage, V_{CC} - V


Usable sens., Max. sens. - V_{CC}
Usable sens.
Max. sens.
Usable sens., Max. sens. - dB/m
Supply voltage, V_{CC} - V

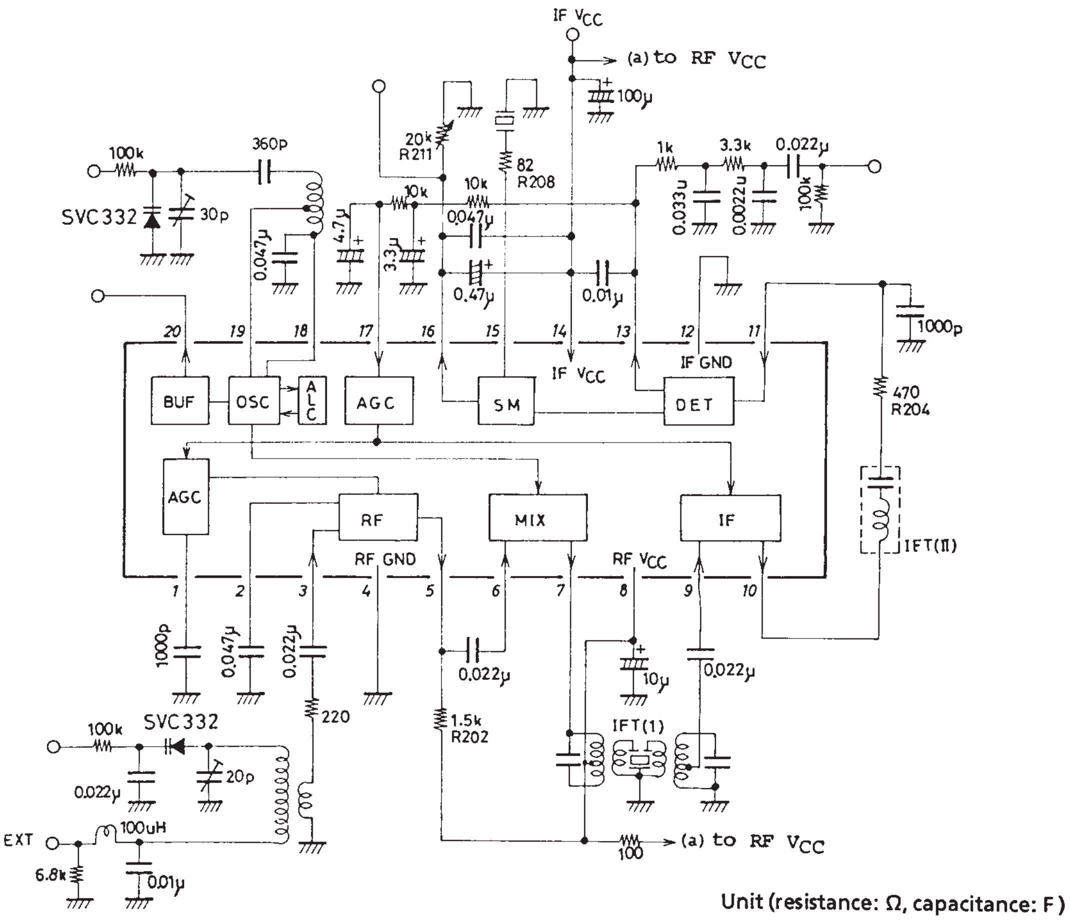




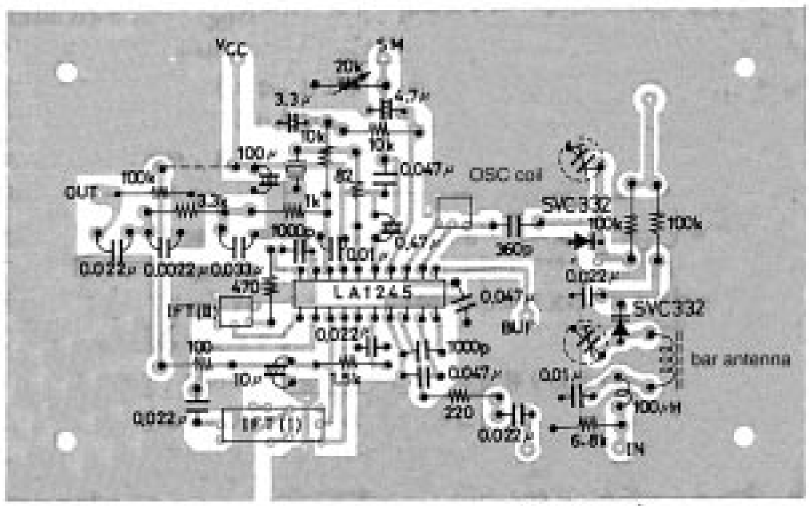




Sample Application Circuit 2 : Using variable capacitance diodes



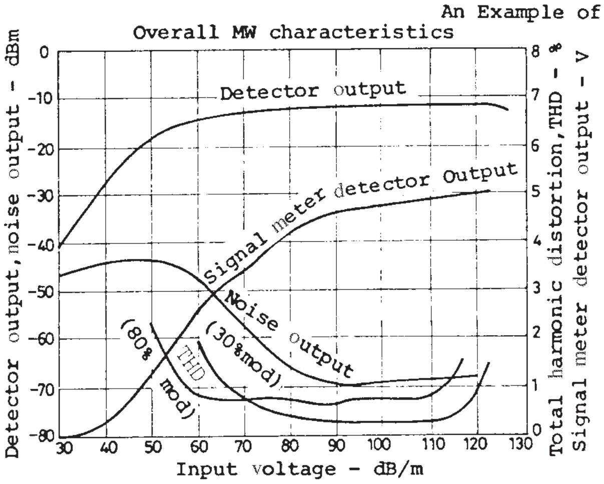
Unit (resistance: Ω, capacitance: F)



130×80mm²

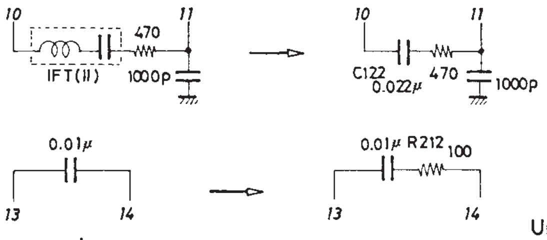
An Example of Printed Pattern (130x80mm², bottom view)

Unit (resistance: Ω, capacitance: F)



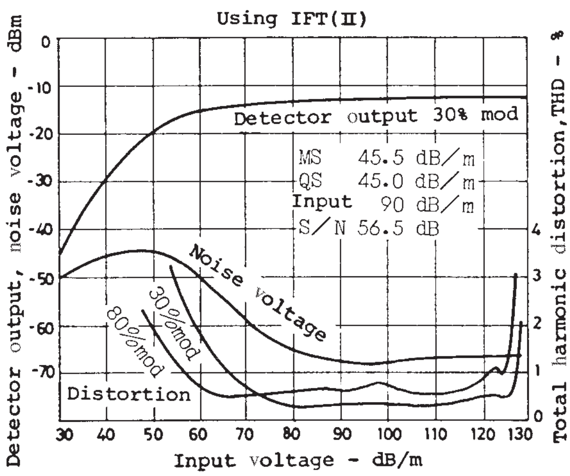
Sample Application Circuit 3 : Rejecting IFT (II)

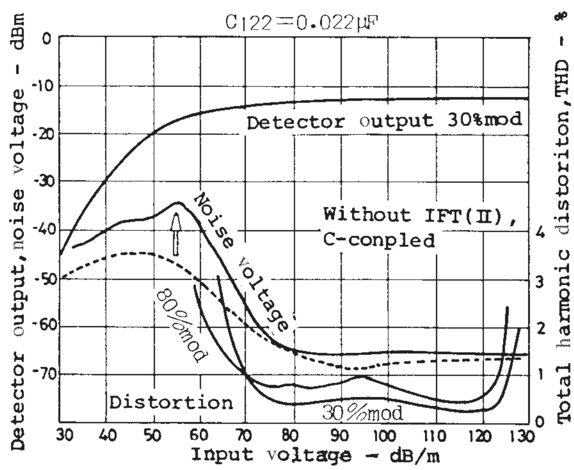
Following 2 changes are recommended as C-conpling without IFT (II)

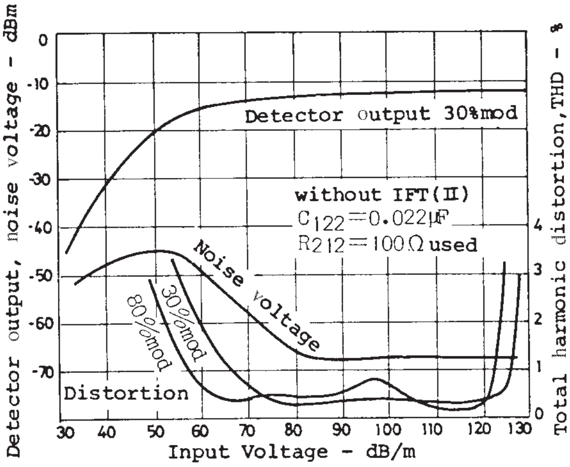


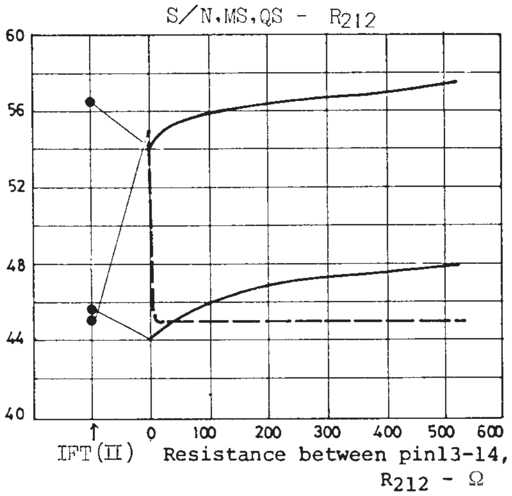
Unit (resistance: Ω, capacitance: F)

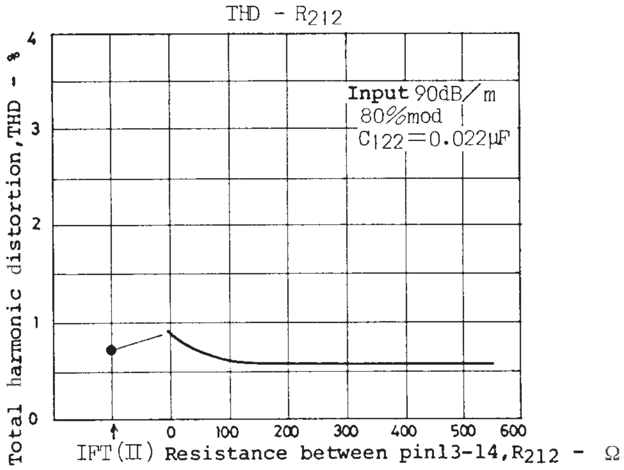
Comparison of characteristics varying parts.





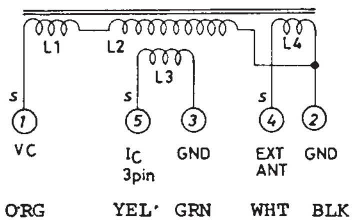






Peripheral Parts

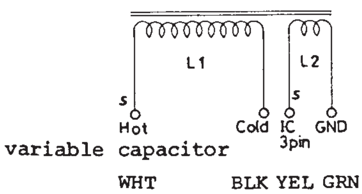
(1) Bar Antenna (34H-052-869 Sumida Co.,)



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.

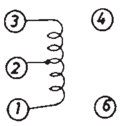
(2) Bar Antenna (C-4698 Coil Snake Co.,)



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



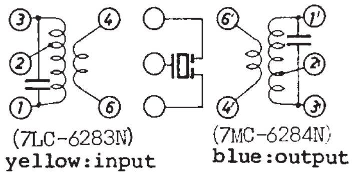
2157-223-072 Sumida		2157-223-082 Sumida		7BR-6654Y Toko	
L(between pins 1 and 3)=147μH		L(between pins 1 and 3) 147μH		L(between pins 1 and 3)=147μH	
Q≧85		Q≧85		Q≧90	
③-②	39 t.	③-②	26t.	③-②	31 t.
②-①	39 t.	②-①	52t.	②-①	31 t.

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

c max	326.8 pF
c min	6.7 pF

(5) Variable Capacitor Diode (SVC332 Sanyo)

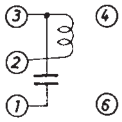
(6) IFT (I) (CMFQ-021A Toko Co.,)



CFMQ-021A

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