Ordering number : EN2276B

Monolithic Linear IC

LA1175, 1175M

FM Front End For Car Radio, Home Stereo Applications

Functions

- Double-balanced type MIX, PIN diode drive AGC output, MOS FET gate drive AGC output, keyed AGC, differential IF amplifier, buffer amplifier for oscillation, local oscillation.

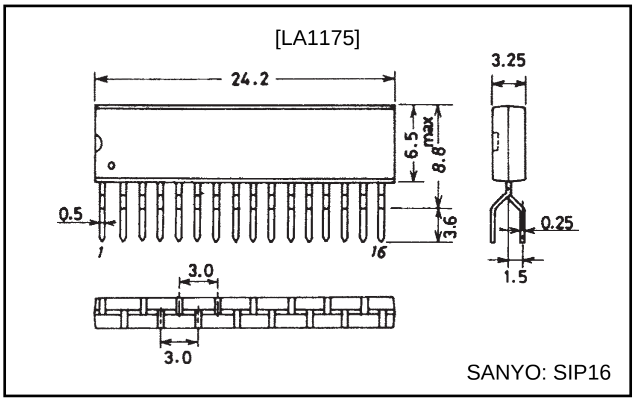
Features

- By using the keyed AGC system, which is effective in improving the sensitivity suppression characteristic, in combination with the antenna damping AGC (PIN diode driver on chip) and MOS FET 2nd gate drive AGC, the intermodulation characteristic for a large undesired signal is greatly improved. It is also possible to use the keyed AGC system in combination with the antenna damping AGC or MOS FET 2nd gate drive AGC.
- The temperature characteristic and noise figure are improved. The same supply voltage makes it easy to use the LA1175, 1175M.

Package Dimensions

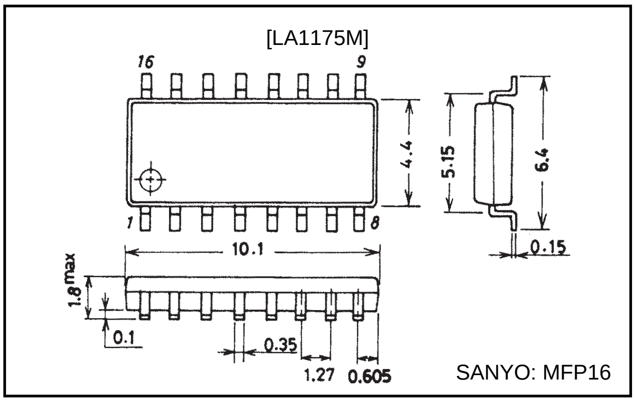
unit: mm

3020A-SIP16



unit: mm

3035A-MFP16



Specifications

Maximum Ratings at Ta=25°C

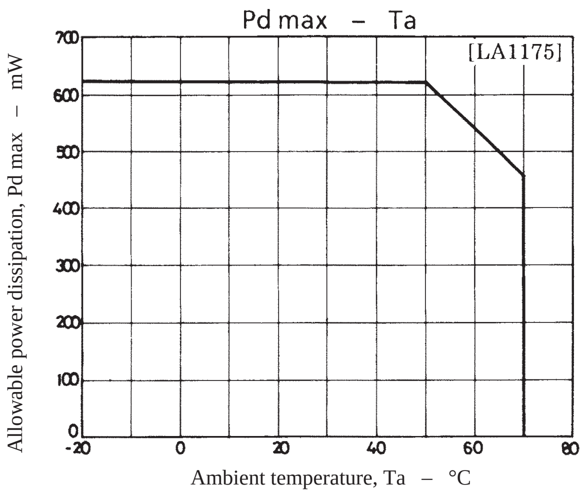
Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max	Pins 4, 14	9.5	V
		Pins 8, 9	15	V
Allowable power dissipation	Pd max	LA1175 : Ta≤70°C	460	mW
		LA1175M : Ta≤70°C Mounted on PCB (bakelite) of 40mm×48mm×1.8mm²	435	mW
Operating temperature	Topr		–20 to +70	°C
Storage temperature	Tstg		–40 to +125	°C

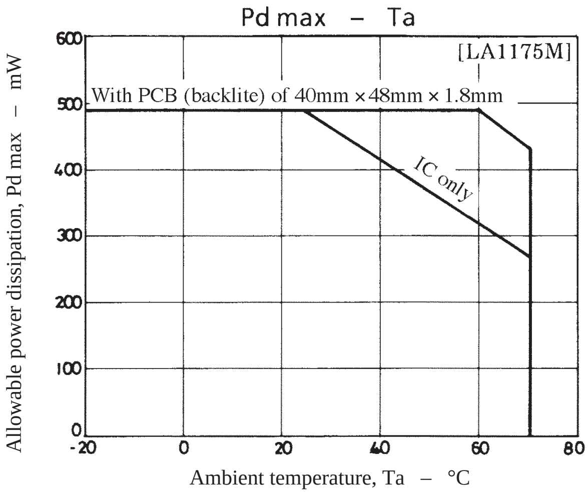
Operating Conditions at Ta=25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}	Pin 4, 8, 9, 14	8	V
Operating voltagerange	V_{CC} op		8 to 9	V

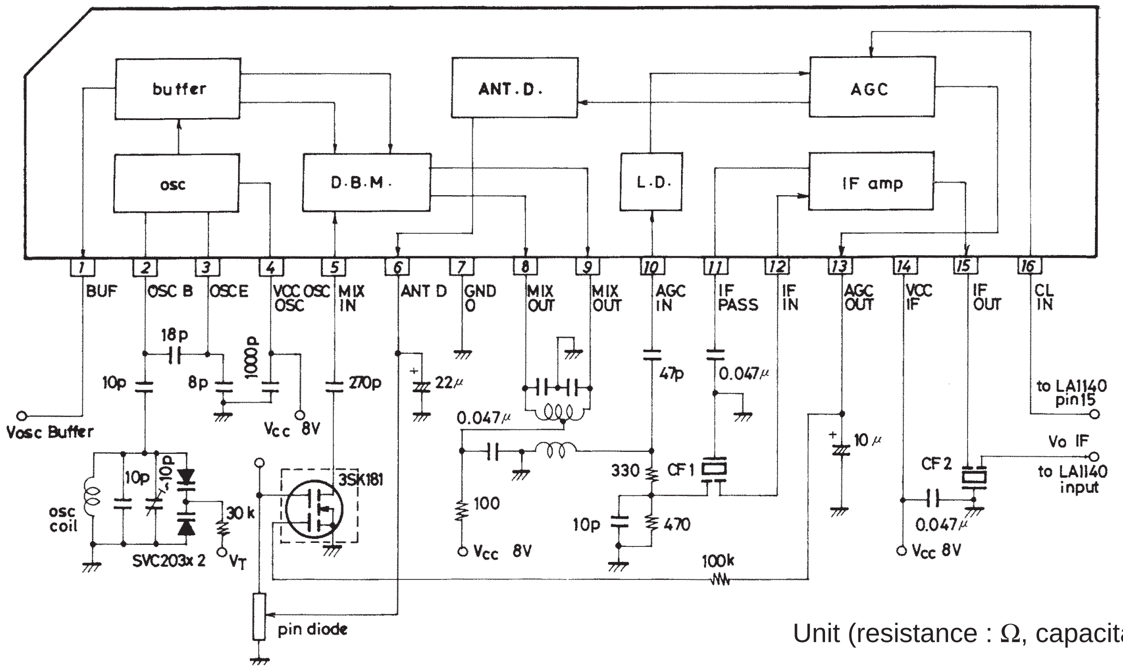
Electrical Characteristics at Ta=25°C, V_{CC}=8V, See specified Test Circuit.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain	I_{CC}	Pins 4, 8, 9, 14 : no input	23.0	28.0	33.0	mA
AGC high-level voltage	V_{AGCH}	V_{IN}=0dBμ, V_{CL}=4V	7.6	7.9		V
AGC low-level voltage	V_{AGCL}	V_{IN}=100dBμ, V_{CL}=4V		0.2	0.7	V
IF input resistance	R_{IN}		260	330	400	Ω
AGC control input	$V_{CL}7$	V_{IN}=100dBμ, V_{AGC}=7V		0.25	0.5	V
	$V_{CL}2$	V_{IN}=100dBμ, V_{AGC}=2V	1.1	1.6	2.1	V
Voltage gain	A_V	LA1175 : V_{IN}=75dBμ	99	102	105	dBμ
		LA1175M : V_{IN}=75dBμ	97	100	103	dBμ
Input limiting voltage	V_{INlim}	LA1175 : Referenced to V_{IN}=110dBμ	81	88	95	dBμ
		LA1175M : Referenced to V_{IN}=110dBμ	80	87	94	dBμ
AGC input voltage	V_{iAGC}	V_{AGC}=2V	67	74	81	dBμ
Saturation output voltage	V_{OUT}	LA1175 : V_{IN}=110dBμ	110	114		dBμ
		LA1175M : V_{IN}=110dBμ	100	113		dBμ
OSC BUFF output	V_{OSC} BUFF	1kΩ load	105	109		dBμ
ANT damping drive current	I_{ANT-D}	V_{IN}=100dBμ	4.5	6.0	8.0	mA

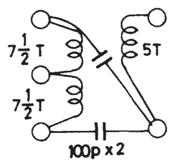




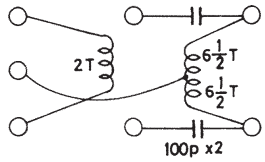
Equivalent Circuit Block Diagram and Peripheral Circuit : LA1175



Unit (resistance : Ω, capacitance : F)

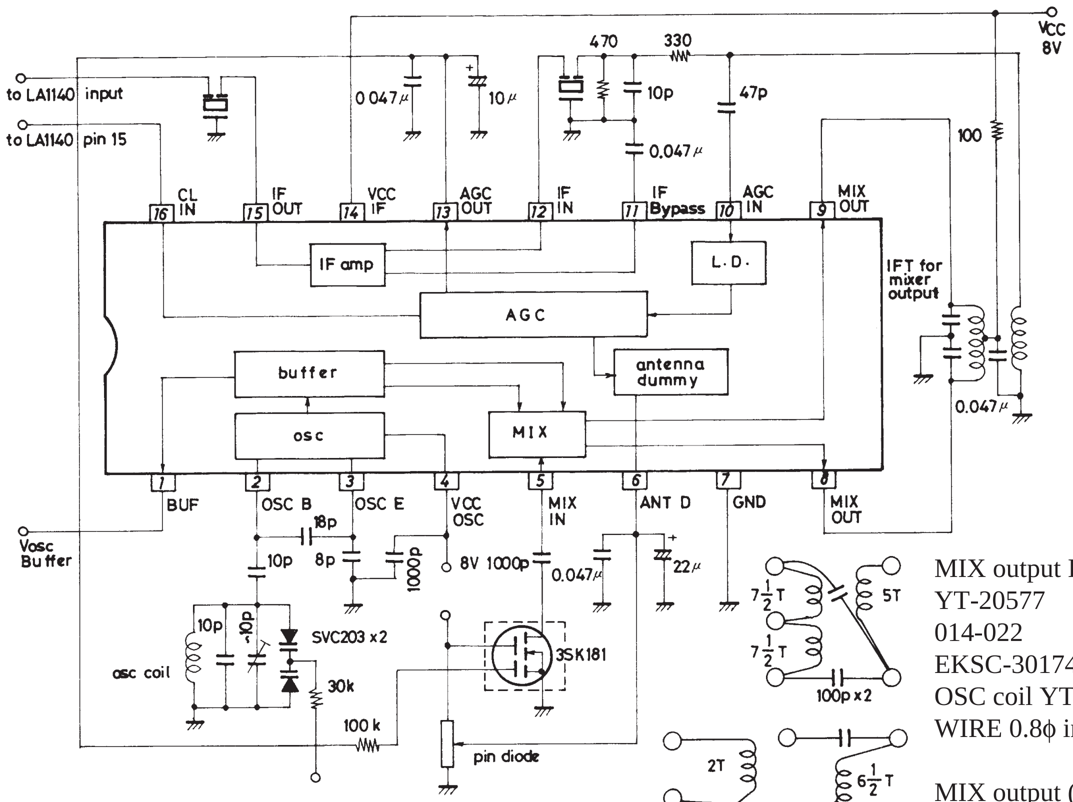


MIX output IFT 10mm□
YT-20577 (Mitsumi)
014-022 (Sumida)
EKSC-30174FCU (Toko)
OSC coil YT-30013 (Mitsumi)
WIRE 0.8ϕ inside dia. 6mmϕ 4T air core

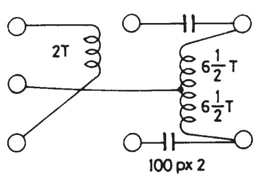


MIX output (small-sized)
47K-074-124 (Sumida)

Equivalent Circuit Block Diagram and Peripheral Circuit : LA1175M



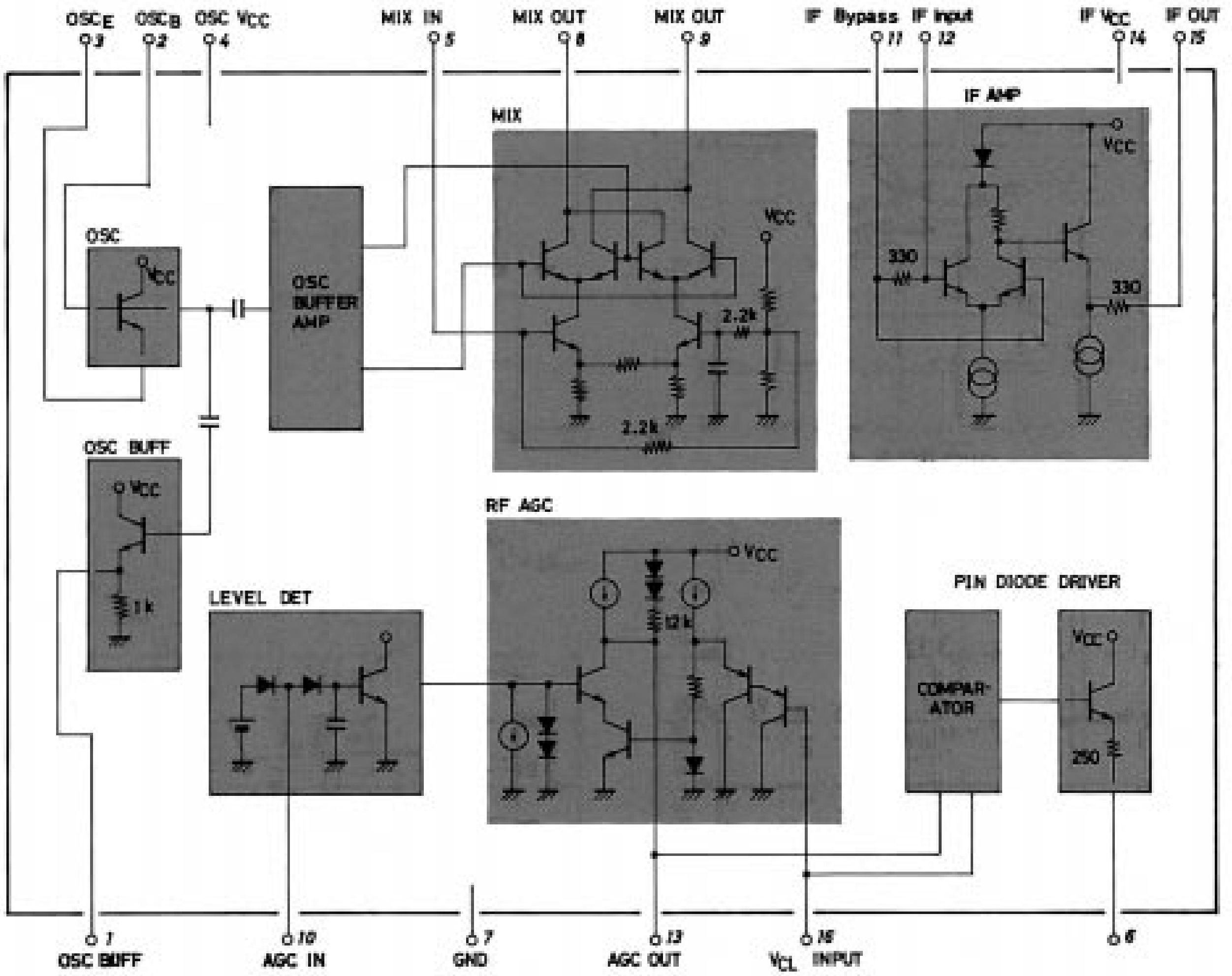
MIX output IFT 10mm□
YT-20577 (Mitsumi)
014-022 (Sumida)
EKSC-30174FCU (Toko)
OSC coil YT-30013 (Mitsumi)
WIRE 0.8ϕ inside dia. 6mmϕ 4T air core



MIX output (small-sized)
47K-074-124 (Sumida)

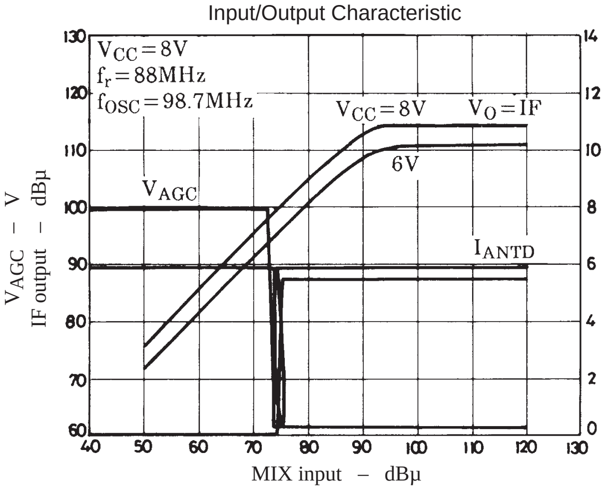
Unit (resistance : Ω, capacitance : F)

Internal Connection Diagram : LA1175

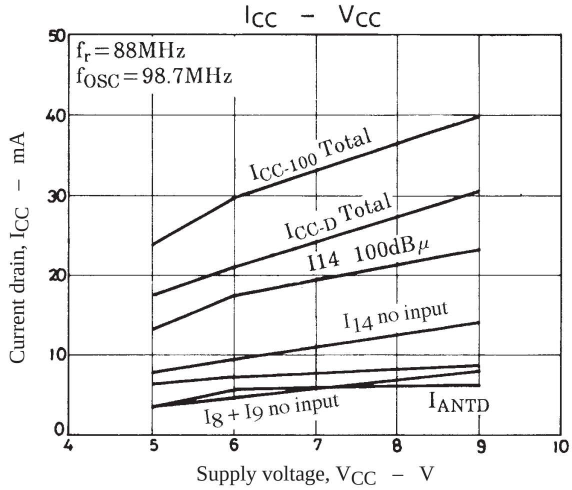


Unit (resistance : Ω, capacitance : F)

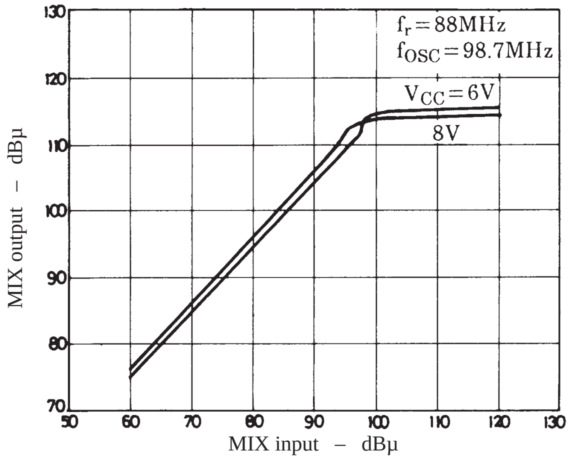
Input/Output Characteristic

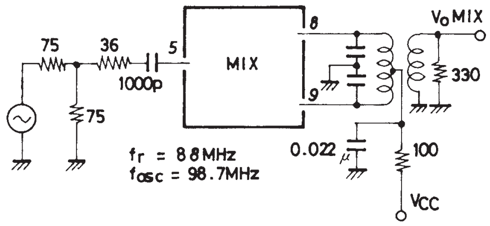


ICC – VCC



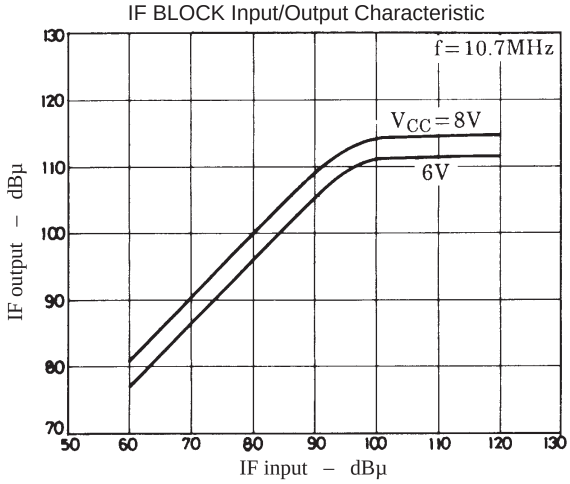
MIX BLOCK Input/Output Characteristic

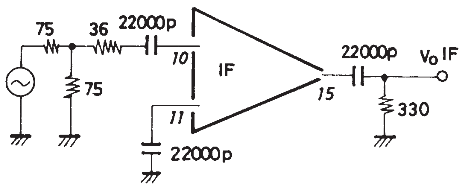




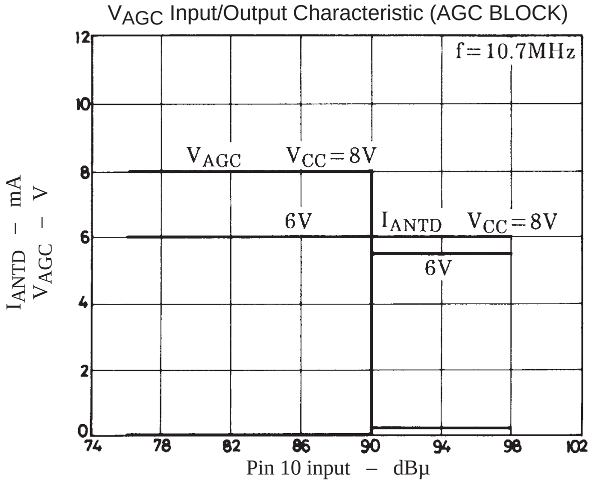
Unit (resistance : Ω, capacitance : F)

IF BLOCK Input/Output Characteristic

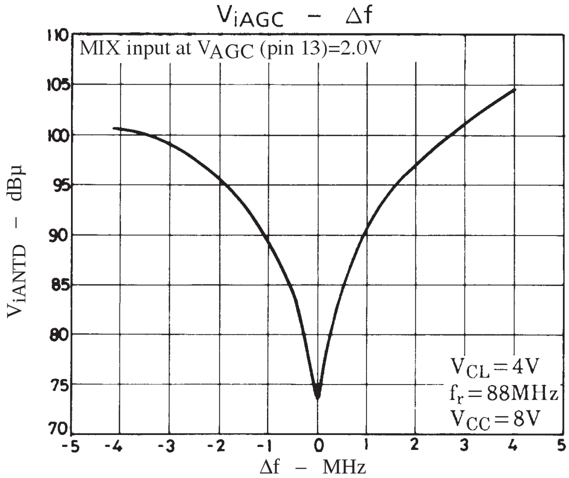




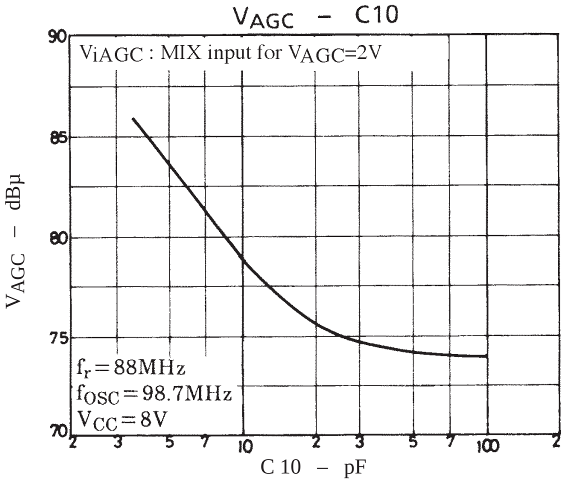
V_{AGC} Input/Output Characteristic (AGC BLOCK)

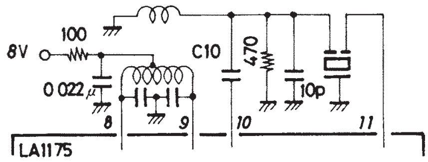


V_{iAGC} – Δf



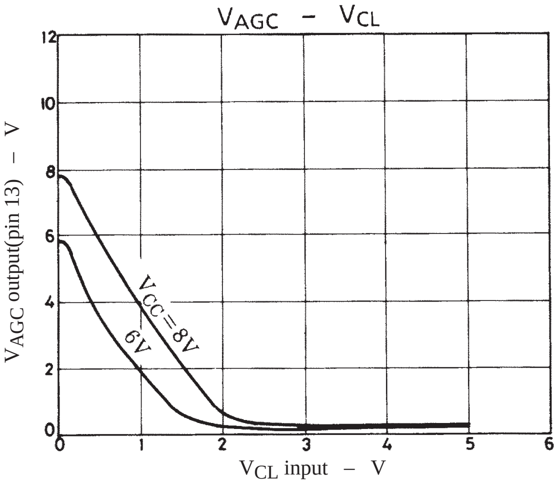
V_{AGC} – C10



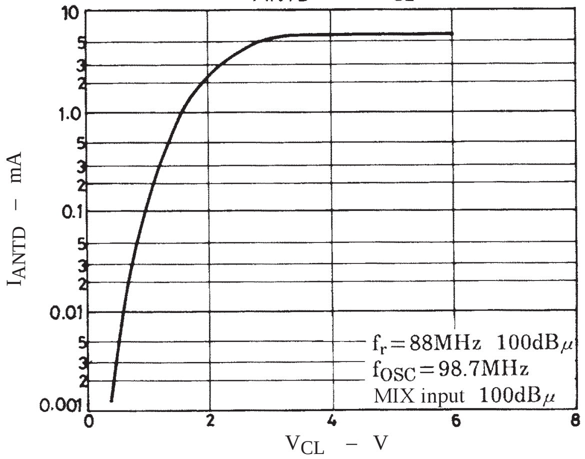


Unit (resistance : Ω, capacitance : F)

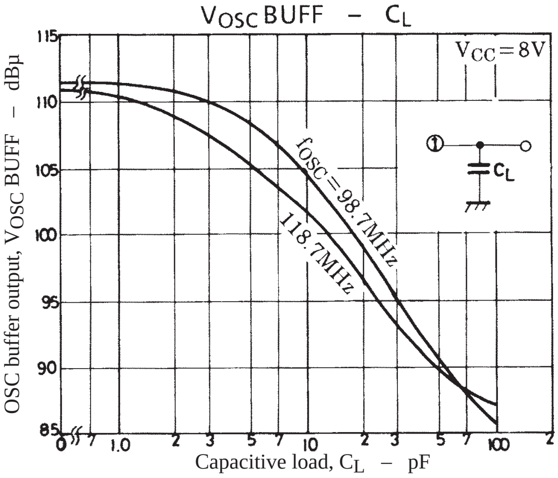
VAGC – VCL



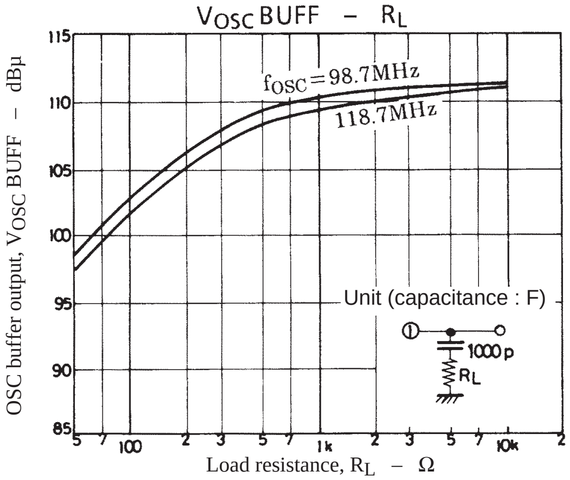
IANTD – VCL



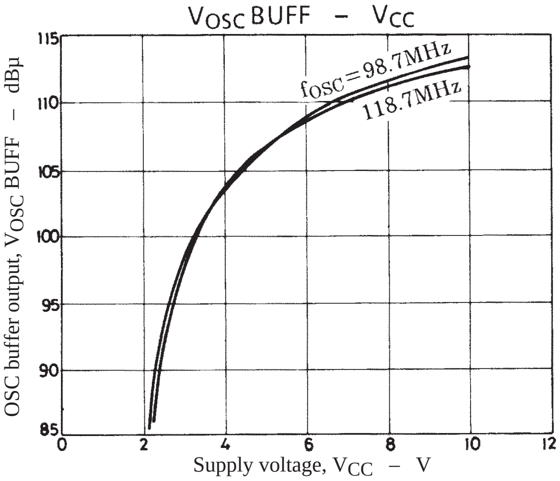
VOSC BUFF – CL



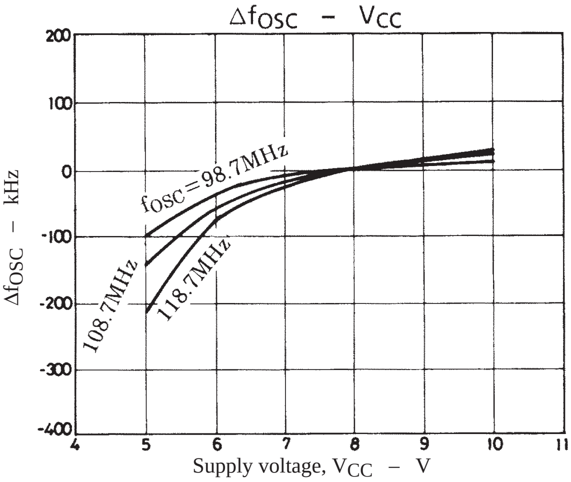
VOSC BUFF – RL



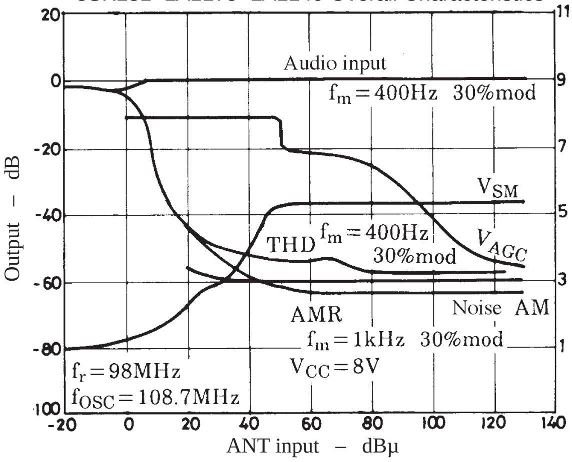
VOSC BUFF – VCC



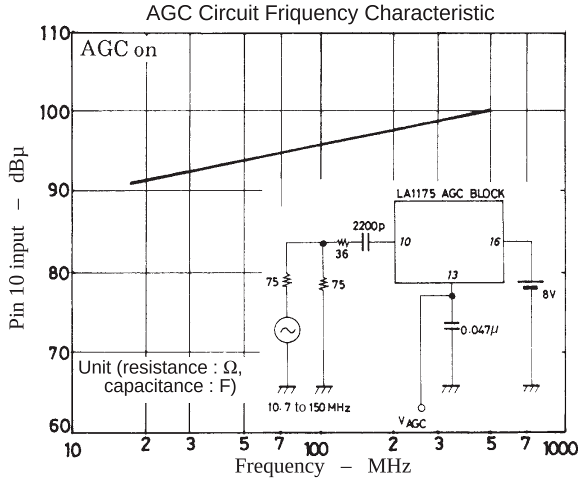
ΔfOSC – VCC



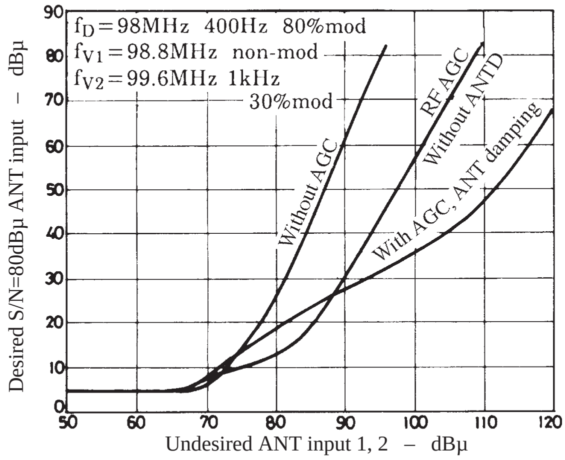
3SK181+LA1175+LA1140 Overall Characteristics



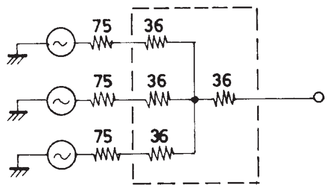
AGC Circuit Friquency Characteristic



Intermodulation Characteristic

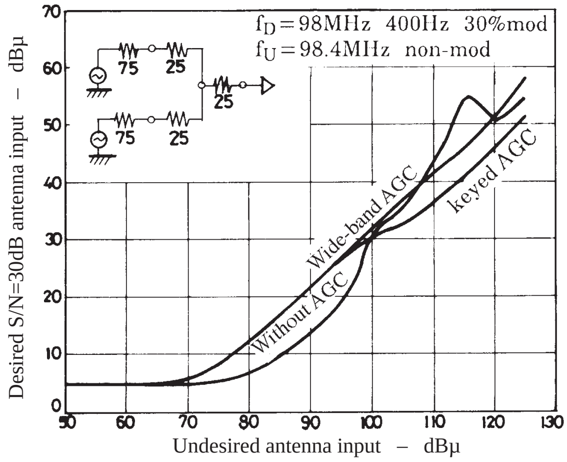


Intermodulation dummy used

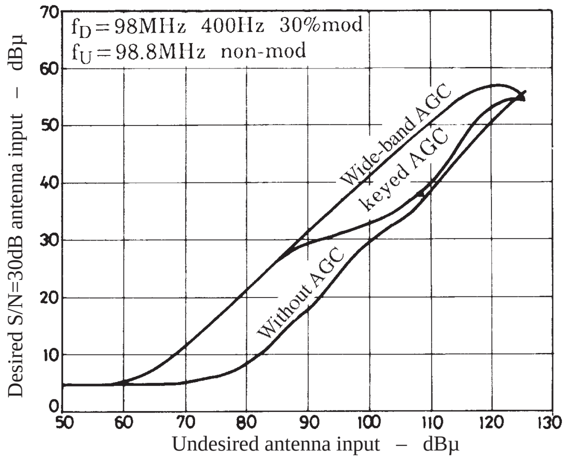


Unit (resistance : Ω)

Cross Modulation Characteristic



Intermodulation Characteristic



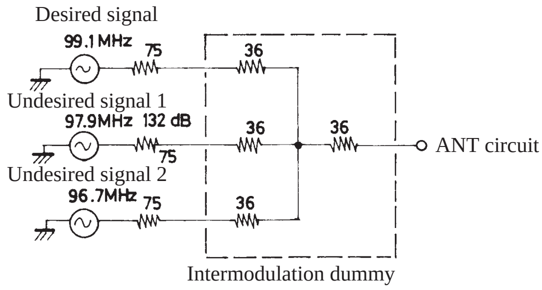
Improvement of IM characteristic in strong undesired input signal mode when ANT damping AGC is used (LA1174).

Test conditions

f_D : 99.1MHz, f_m=400Hz 100% mod

f_{U1} : 97.9MHz non-mod SG open 132dBμ

f_{U2} : 96.7MHz f_m=1kHz 100% mod



Unit (resistance : Ω)

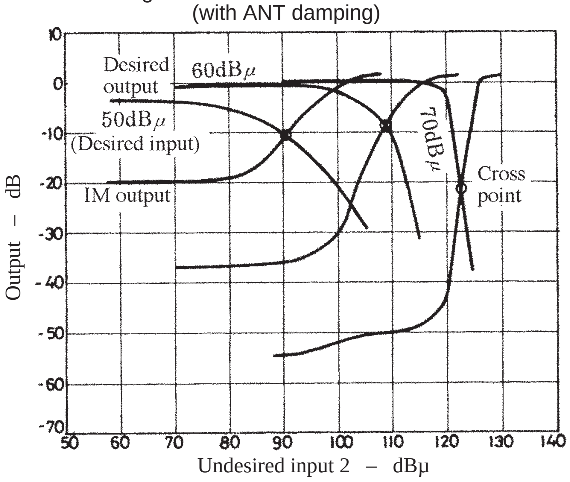
Cross point

The open input level of undesired signal 2 at which the IM output and desired signal output are at the same level.

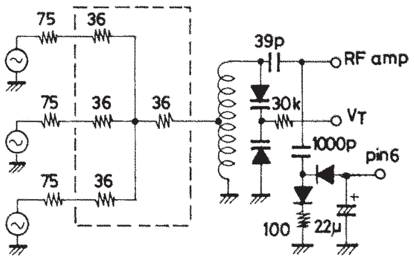
IM output	• Desired signal	: Non-mod at each specified input
	• Undesired signal 1	: Non-mod at input 132dBμ (SG open)
	• Undesired signal 2	: 100% mod with input variable
Desired signal output	• Desired signal	: 100% at each specified input
	• Undesired signal 1	: Non-mod at input 132dBμ (SG open)
	• Undesired signal 2	: Non-mod with input variable

Desired input level		50dBμ	60dBμ	70dBμ	80dBμ	
Cross point	With ANT damping RF AGC and ANTD AGC	90.5dBμ	109dBμ	123dBμ	Test impossible	Refer to Fig. A.
	Without ANT damping RF AGC only	59.5dBμ	72dBμ	89dBμ	98dBμ	Refer to Fig. B.
Improvement		31dB	37dB	34dB		

Fig. A Intermodulation Characteristic
(with ANT damping)

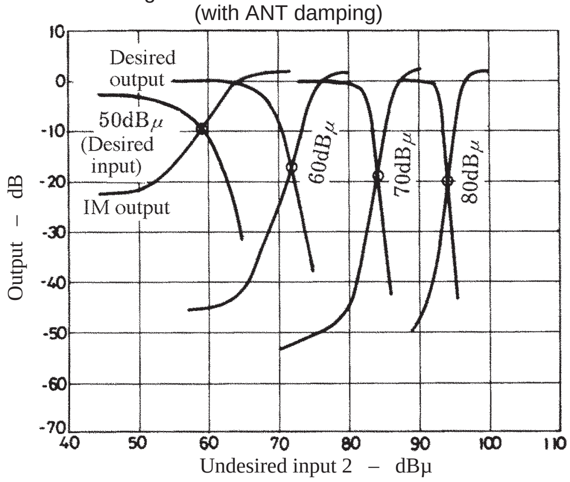


Solid line f_D = 99.1MHz f_m = 400Hz 700% mod
f_{U1} = 97.9MHz non-nod
132dBμ (SG open)
f_{U2} = 96.7MHz non-mod
Broken line f_D = 99.1MHz non-mod
f_{U1} = 97.9MHz non-mod
132dBμ (SG open)
f_{U2} = 96.7MHz 1kHz 100% mod

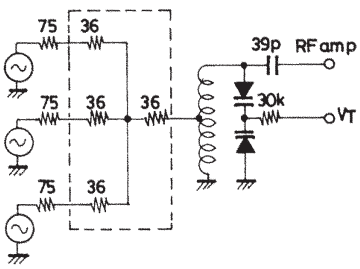


Intermodulation dummy

Fig. B Intermodulation Characteristic
(with ANT damping)



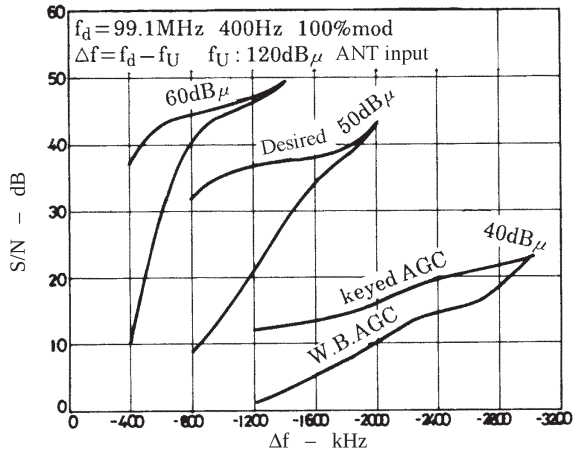
Solid line f_D = 99.1MHz f_m = 400Hz 700% mod
f_{U1} = 97.9MHz non-nod
132dBμ (SG open)
f_{U2} = 96.7MHz non-mod
Broken line f_D = 99.1MHz non-mod
f_{U1} = 97.9MHz non-mod
132dBμ (SG open)
f_{U2} = 96.7MHz 1kHz 100% mod

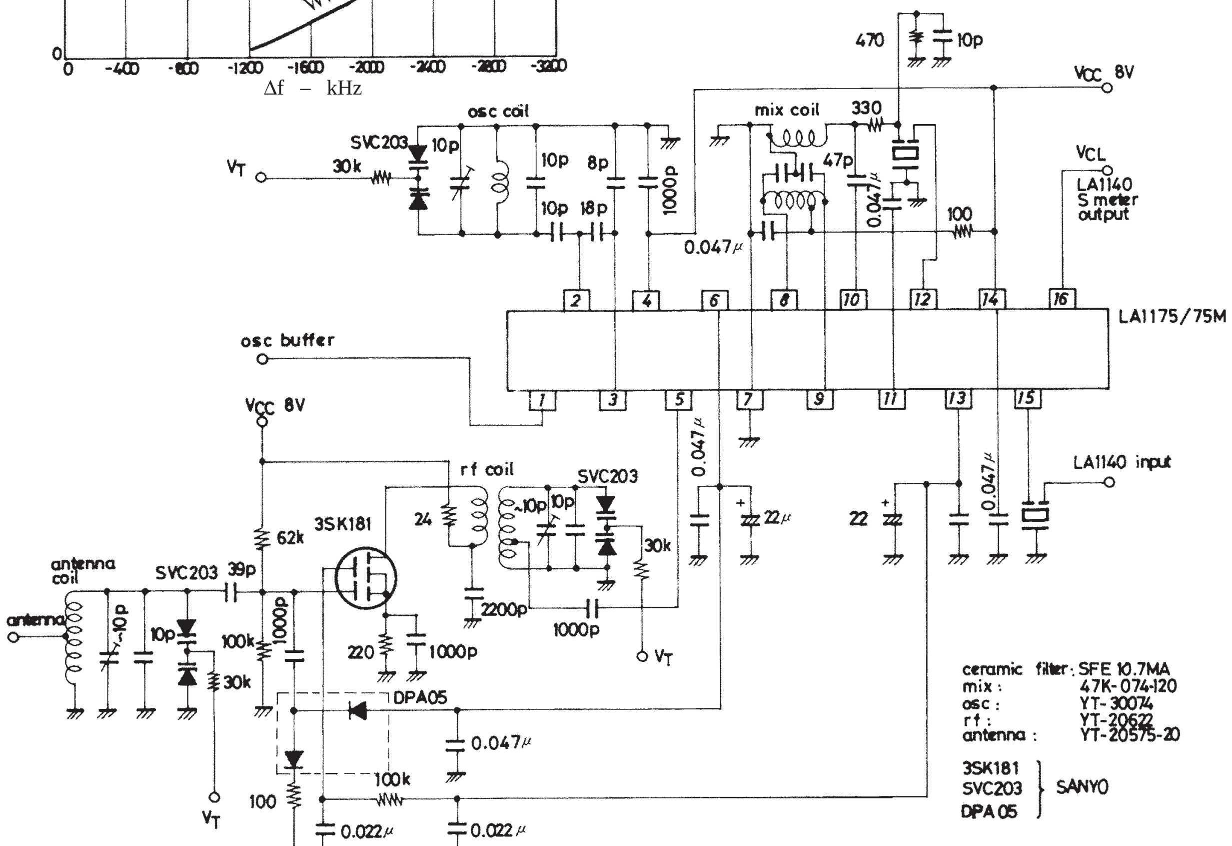


Intermodulation dummy

Unit (resistance : Ω, capacitance F)

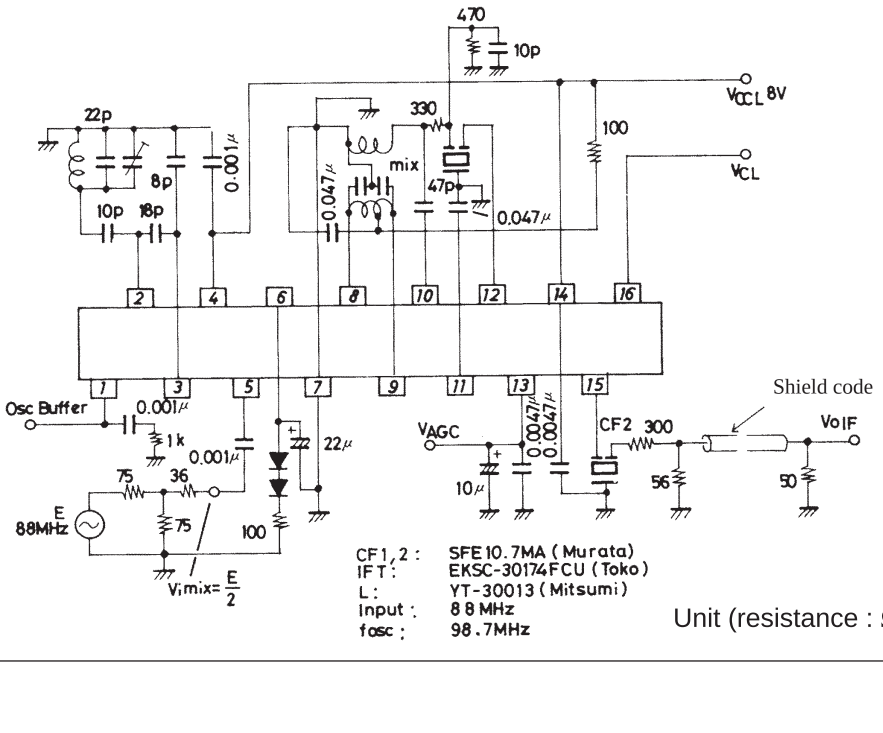
3SK181+LA1175+LA1140 Cross Modulation Characteristic
(Sensitivity Suppression Characteristic in strong undesired input signal mode





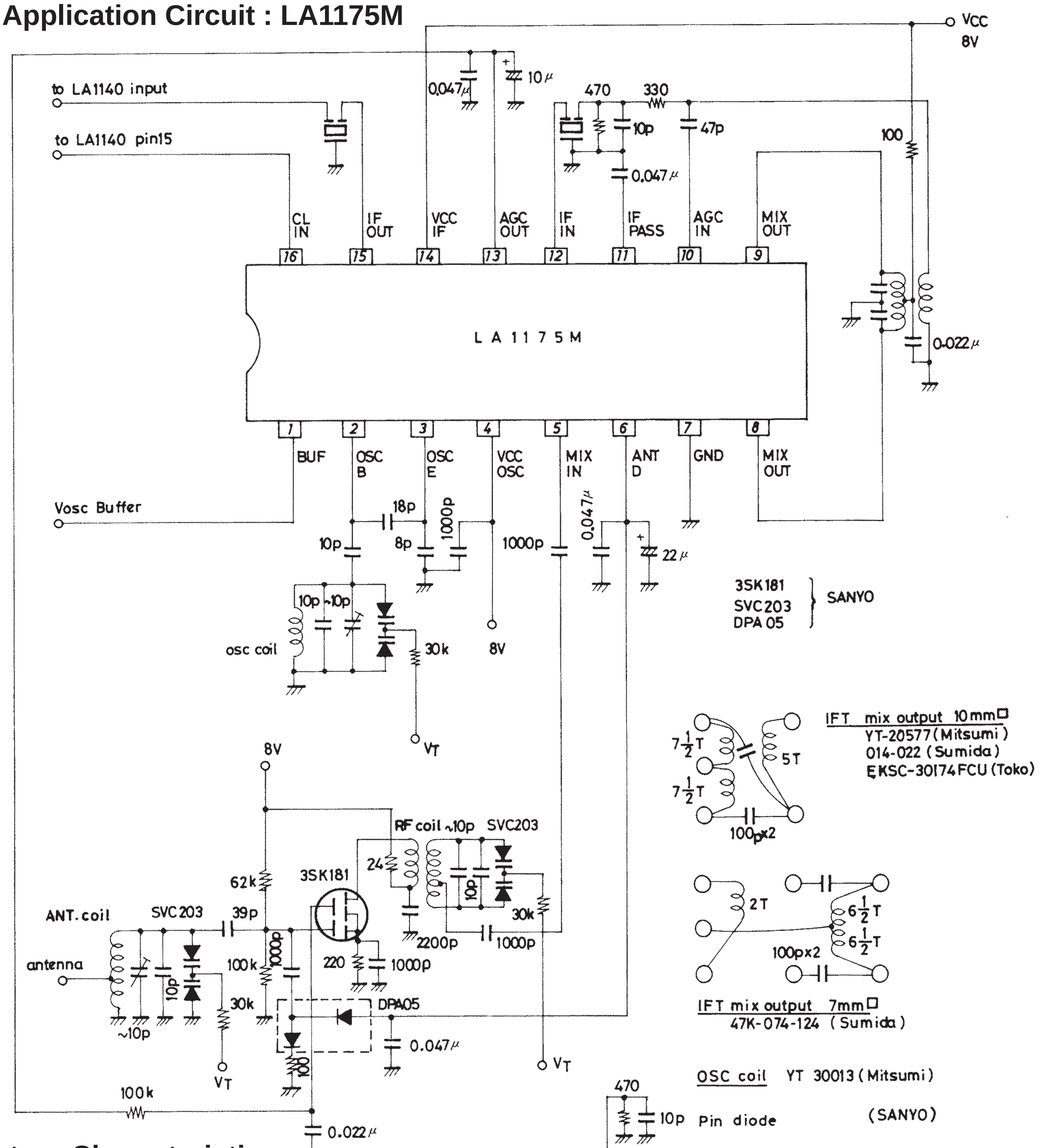
Unit (resistance : Ω, capacitance : F)

Test Circuit



Unit (resistance : Ω, capacitance : F)

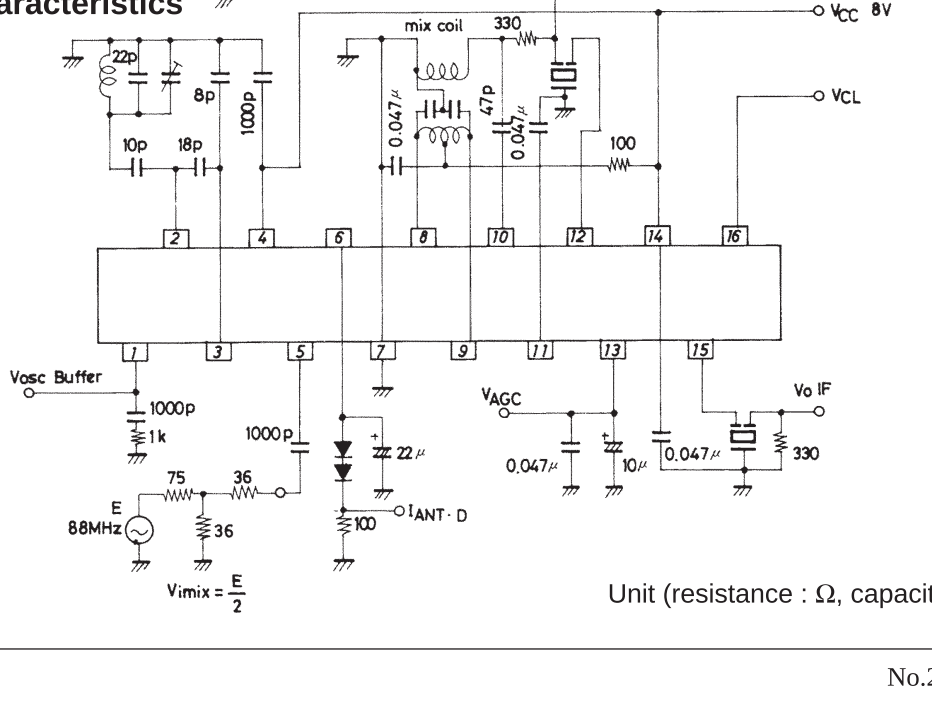
Sample Application Circuit : LA1175M



Temperature Characteristics

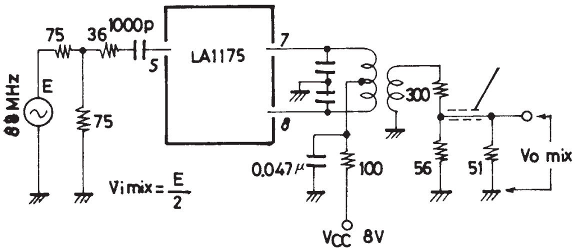
(1), (2), (3)

Test Circuit

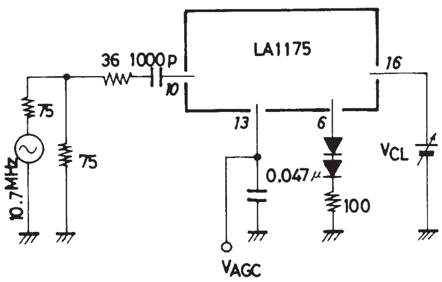


Unit (resistance : Ω, capacitance : F)

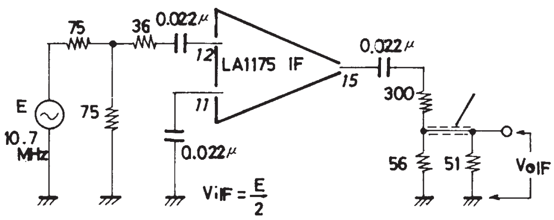
Temperature Characteristics (4)



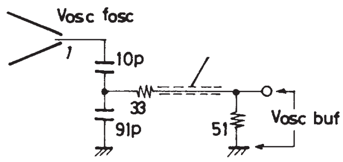
Temperature Characteristics (5)



Temperature Characteristics (6)

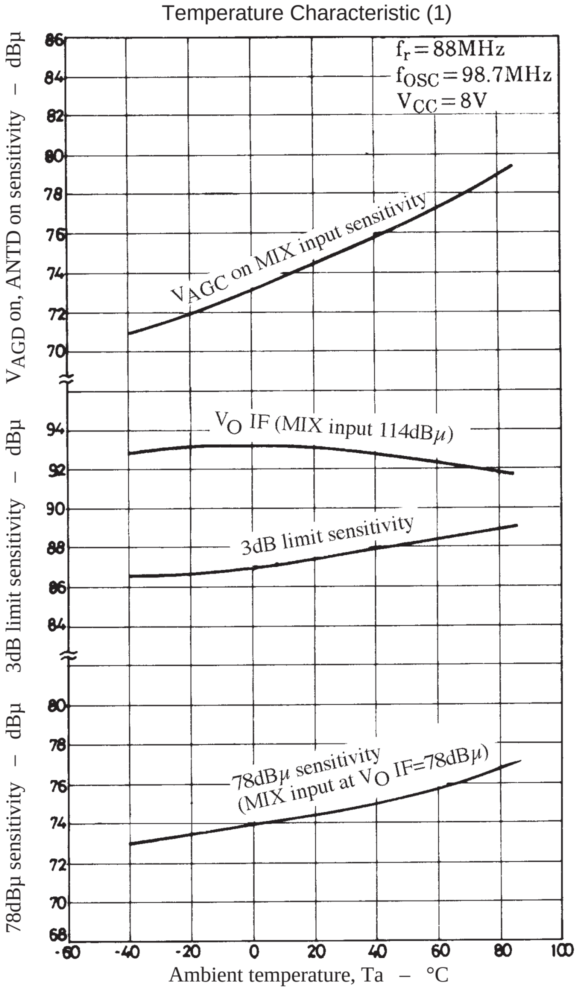


Temperature Characteristics (7)

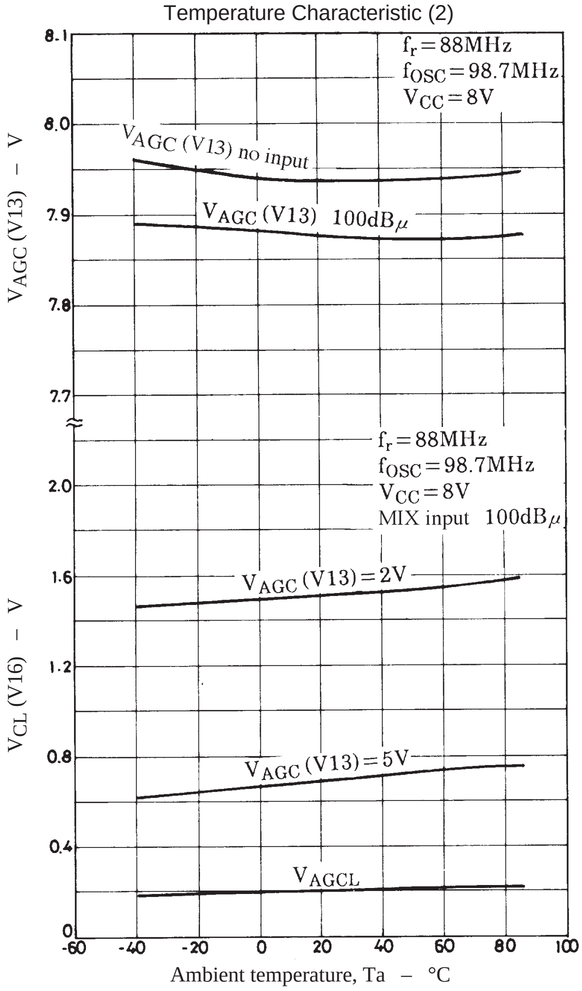


Unit (resistance : Ω, capacitance : F)

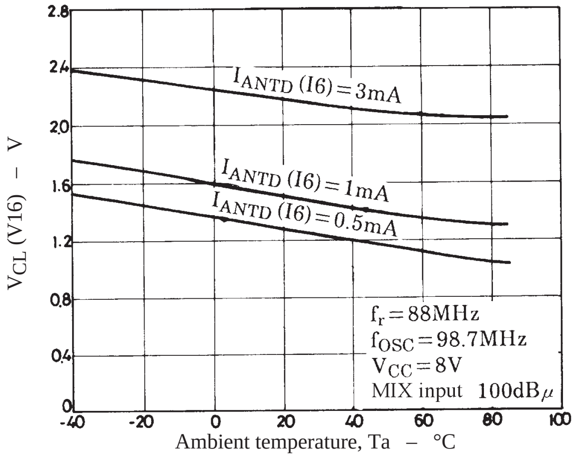
Temperature Characteristic (1)



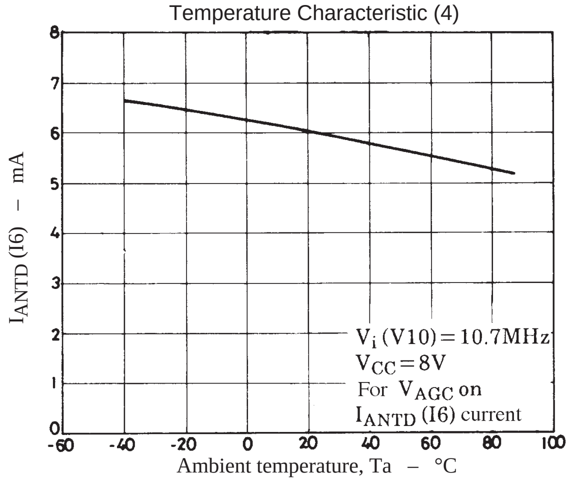
Temperature Characteristic (2)



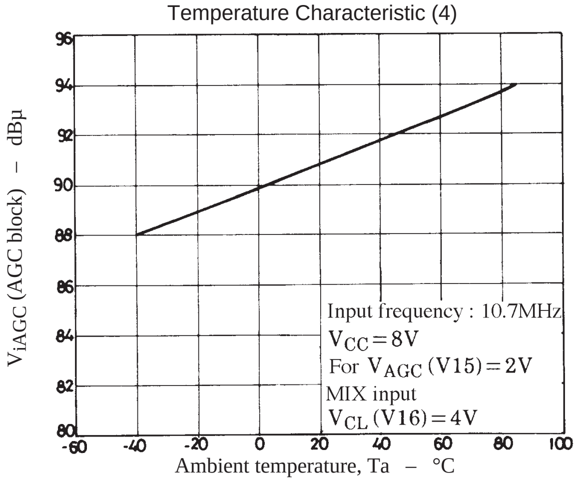
Temperature Characteristic (3)



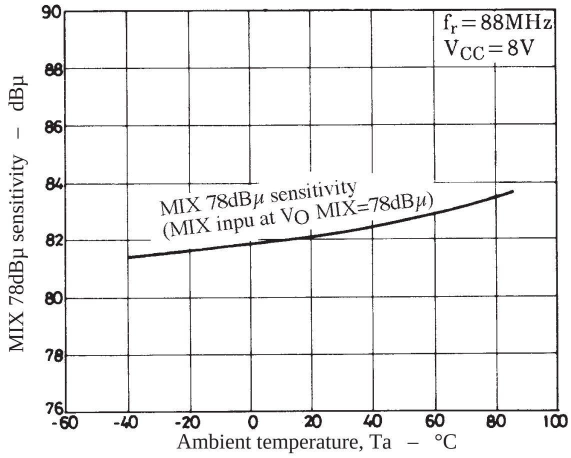
Temperature Characteristic (4)



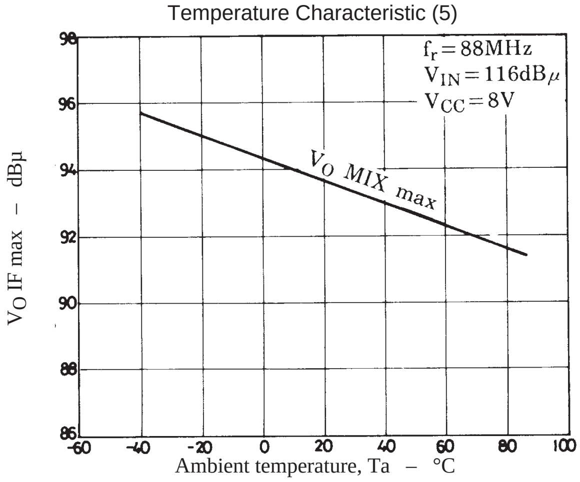
Temperature Characteristic (4)



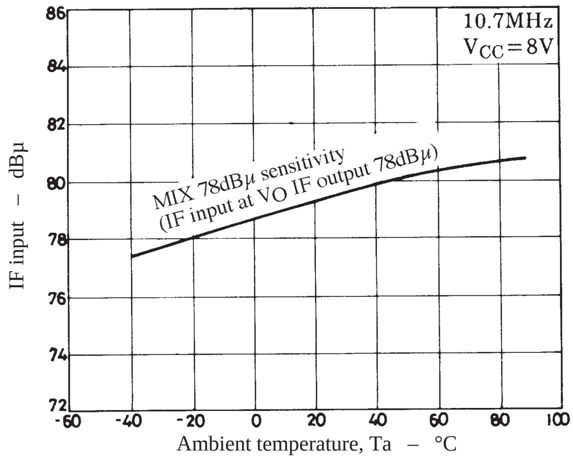
Temperature Characteristic (5)



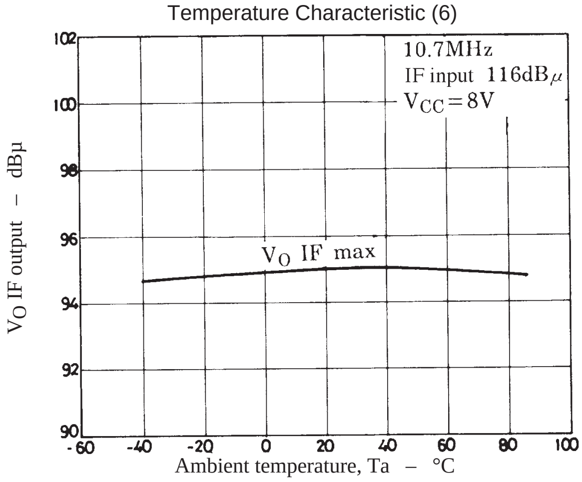
Temperature Characteristic (5)



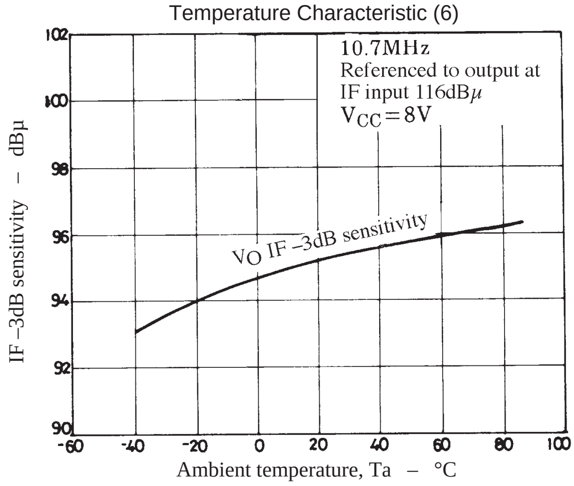
Temperature Characteristic (6)



Temperature Characteristic (6)



Temperature Characteristic (6)



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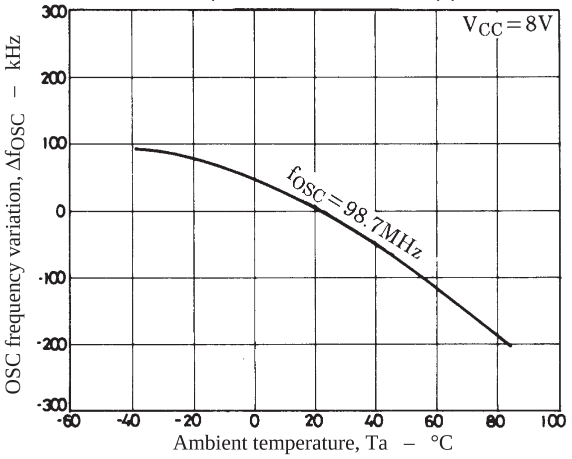

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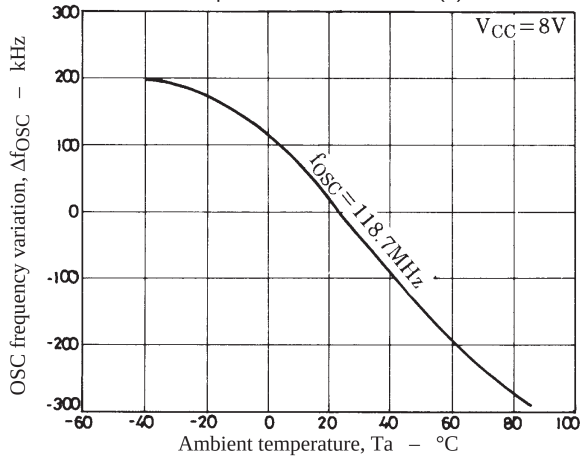

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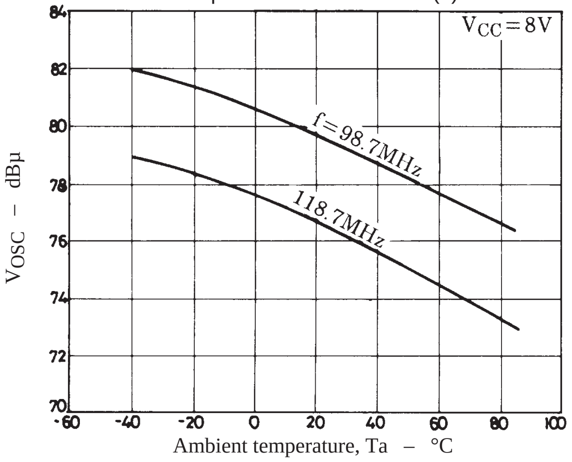


Description of AGC circuit in the LA1175, 1175M

The LA1175, 1175M are designed so that AGC is operated in the order shown below.

ANT damping (PIN diode) → MOS FET 2nd gate voltage control

(Attenuation)20dB (Attenuation)60dB

The following are the reasons why AGC is operated in this order.

(1) When a signal of 110dBμ or greater is applied to the varactor in the ANT circuit, intermodulation may occur. In this case, if AGC is operated in the order of MOS FET 2nd gate control AGC → ANT damping (PIN diode), the input to the varactor in the ANT circuit is not restricted unless a strong signal with AGC attenuation 60dB or greater is given. Therefore, AGC should be operated in the order shown above.

(2) If the two AGC loops (AGC loop (ANT damping) and AGC loop (MOS FET 2nd gate control)) are operated simultaneously, the transient response of AGC loses stability. Therefore, the order shown below is impracticable.

MOS FET 2nd gate control → ANT damping → MOS FET 2nd gate control.

Relation between keyed AGC and two AGC loops

For the LA1170, keyed AGC provides AGC attenuation control (RF MOS FET 2nd gate). For the LA1175, 1175M, however, there are two AGC loops as shown above. Therefore, keyed AGC must be applied to both of the two AGC loops. The LA1175, 1175M contain the ANT damping circuit to improve intermodulation in a strong field, but the prevention of intermodulation in a strong field and the improvement of the sensitivity suppression characteristic by keyed AGC are mutually exclusive as mentioned below.

Conditions	Desired signal	Weak field
	Undesired signals 1, 2	Strong field (Field strength in which the ANT circuit may cause intermodulation to occur)

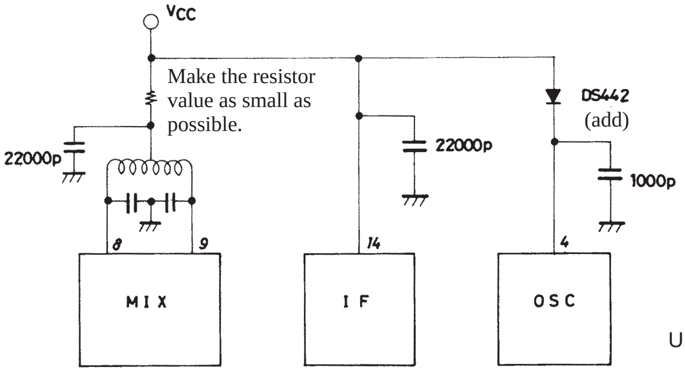
If keyed AGC is operated to cause AGC-OFF mode to be entered when a desired signal is received, the varactor in the ANT circuit may be distorted and intermodulation may occur, which means that it is meaningless for the LA1175, 1175M to contain the ANT damping circuit because it produces no effect. Therefore, the effect of the keyed AGC circuit in the LA1175, 1175M on the ANT damping circuit is made less than that in the LA1170 so that the above-mentioned problem does not arise. However, if the LA1175, 1175M are used under the same conditions as for the LA1170 (no ANT damping, pin 6 open), keyed AGC is operated in the same manner as for the LA1170.

Application circuit used in a very strong field

Since the LA1175, 1175M are designed to be operated from single supply, the dynamic range of the MIX output becomes narrower as compared with the dual-supply type (V_{CC} MIX=12V, other=8V) heretofore in use. IF an adjacent interference channel signal is very strong, the intermodulation characteristic at Δf=400kHz is deteriorated, because the dynamic range of the MIX output exceeds the limit, which causes a distortion to occur.

The following three countermeasures are available.

1. Q of the MIX coil is made higher to provide a higher selectivity.
   (Must be balanced with the detection band of the wide-band AGC)
2. The LA1175, 1175M are operated from dual supplies (Most ideal).
3. The application circuit shown below is used.



Unit (capacitance : F)

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