



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.

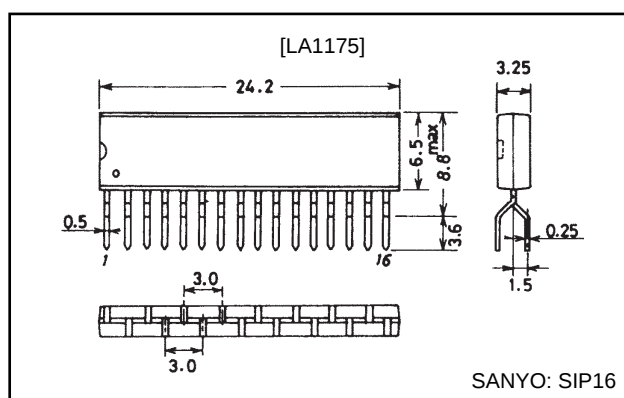
Features

- 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

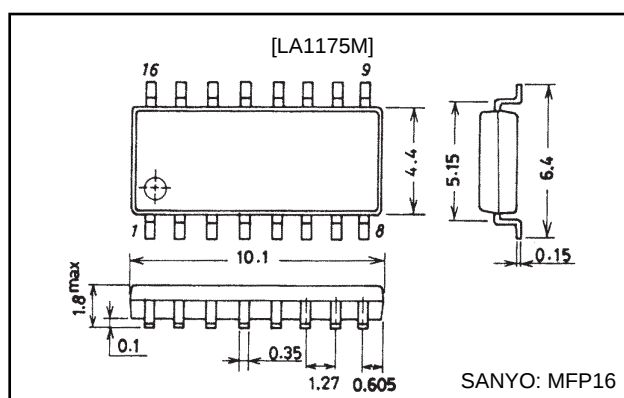
unit: mm

3020A-SIP16



unit: mm

3035A-MFP16



Specifications

Maximum Ratings at $T_a=25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC \text{ max}}$	Pins 4, 14	9.5	V
		Pins 8, 9	15	V
Allowable power dissipation	$P_d \text{ max}$	LA1175 : $T_a \leq 70^\circ\text{C}$	460	mW
		LA1175M : $T_a \leq 70^\circ\text{C}$ Mounted on PCB (bakelite) of $40\text{mm} \times 48\text{mm} \times 1.8\text{mm}^2$	435	mW
Operating temperature	T_{opr}		-20 to +70	$^\circ\text{C}$
Storage temperature	T_{stg}		-40 to +125	$^\circ\text{C}$

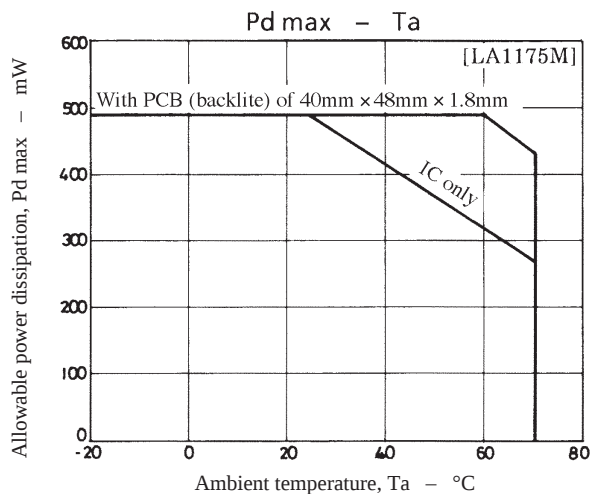
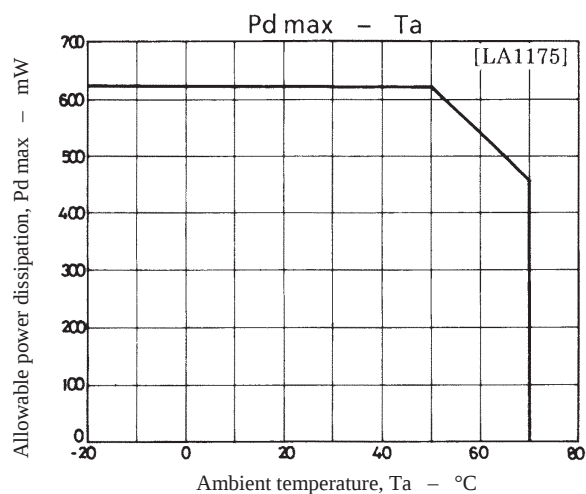
LA1175, 1175M

Operating Conditions at Ta=25°C

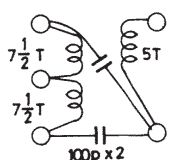
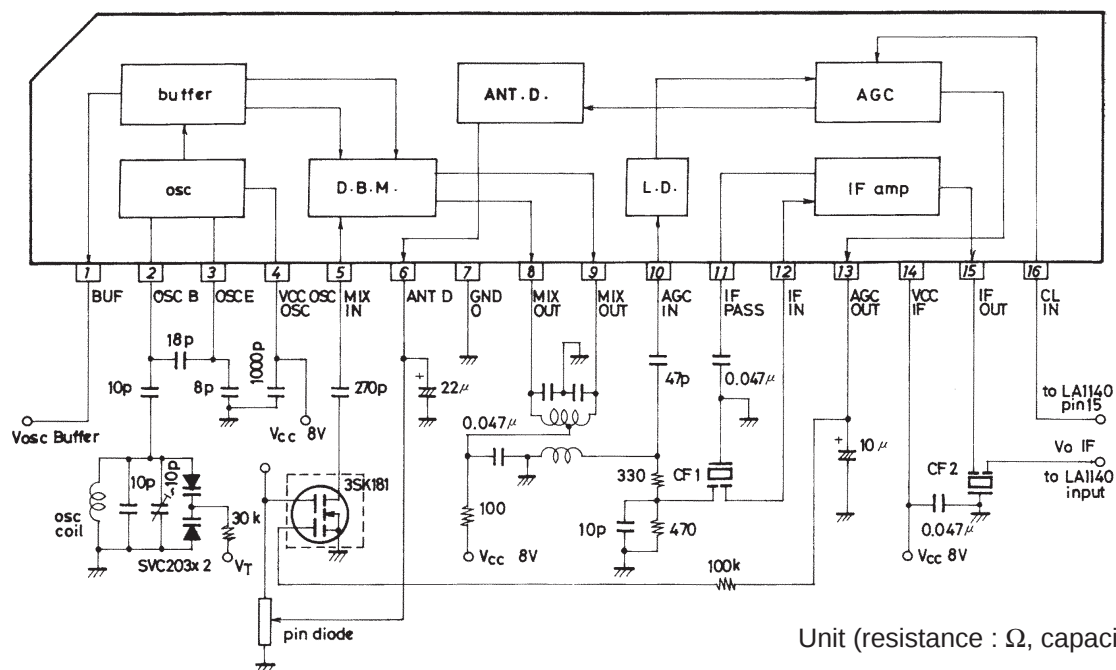
Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V _{CC}	Pin 4, 8, 9, 14	8	V
Operating voltage range	V _{CC} op		8 to 9	V

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

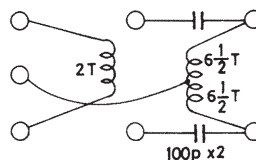
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain	I _{CC}	Pins 4, 8, 9, 14 : no input	23.0	28.0	33.0	mA
AGC high-level voltage	V _{AGCH}	V _{IN} =0dBμ, V _{CL} =4V	7.6	7.9		V
AGC low-level voltage	V _{AGCL}	V _{IN} =100dBμ, V _{CL} =4V		0.2	0.7	V
IF input resistance	R _{IN}		260	330	400	Ω
AGC control input	V _{CL7}	V _{IN} =100dBμ, V _{AGC} =7V		0.25	0.5	V
	V _{CL2}	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

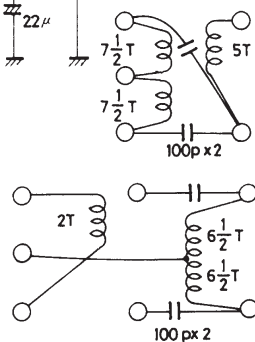
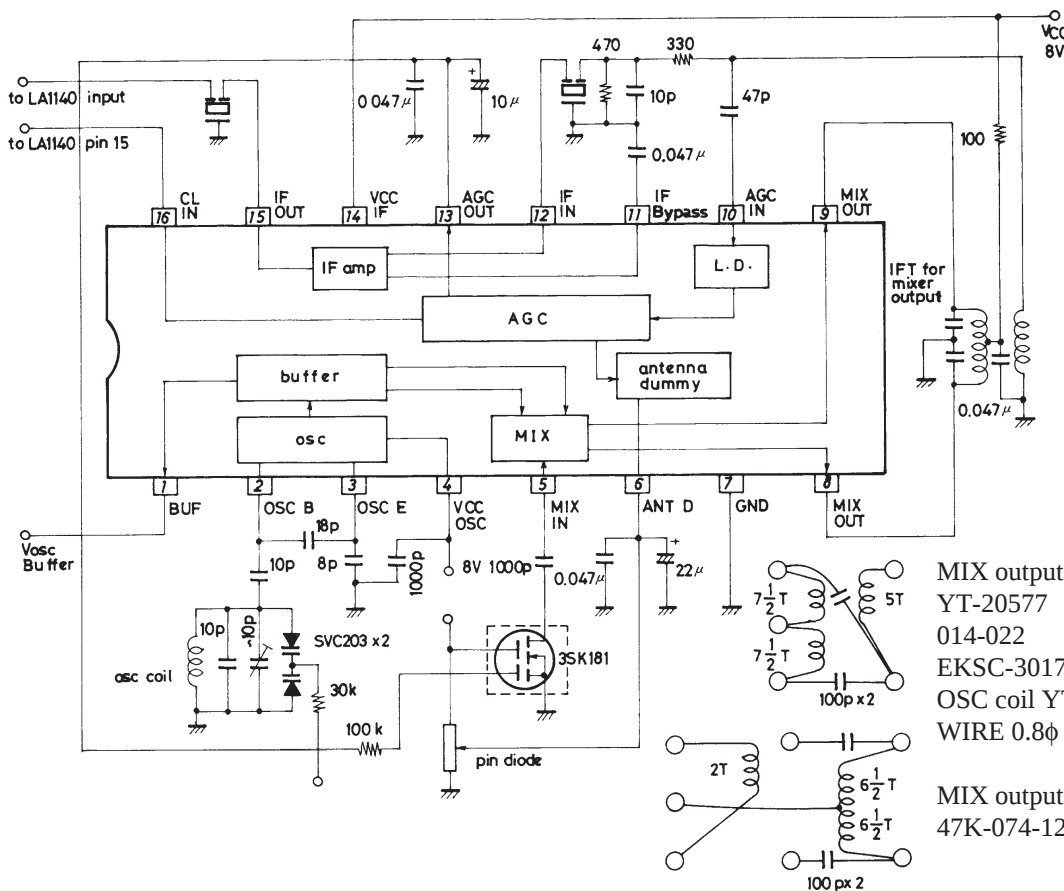


MIX output IFT 10mm □
 YT-20577 (Mitsumi)
 014-022 (Sumida)
 EKSC-30174FCU (Toko)
 OSC coil YT-30013 (Mitsumi)
 WIRE 0.8φ inside dia. 6mmφ 4T air core

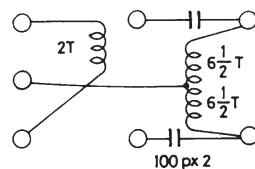


MIX output (small-sized)
 47K-074-124 (Sumida)

Equivalent Circuit Block Diagram and Peripheral Circuit : LA1175M

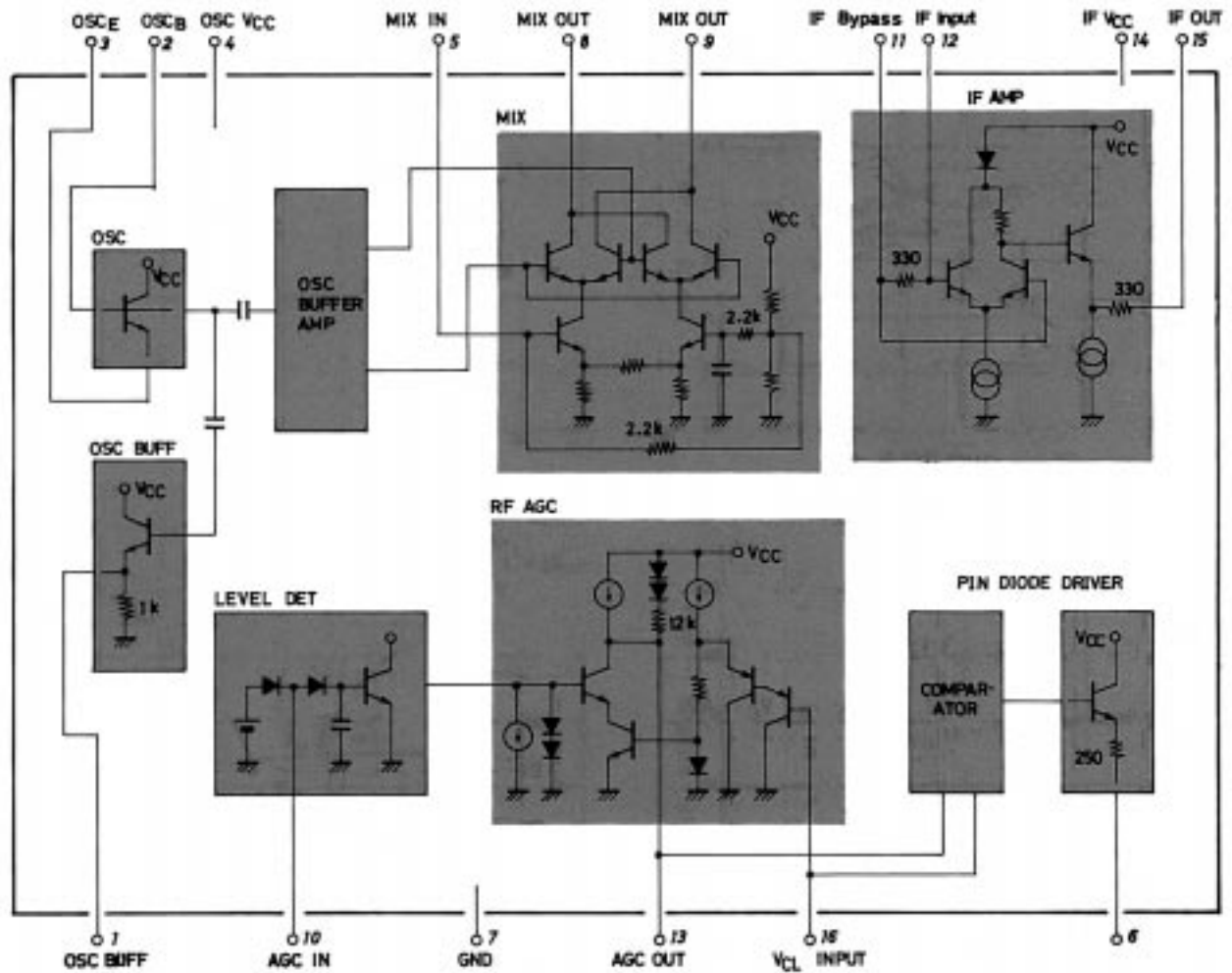


MIX output IFT 10mm □
 YT-20577 (Mitsumi)
 014-022 (Sumida)
 EKSC-30174FCU (Toko)
 OSC coil YT-30013 (Mitsumi)
 WIRE 0.8φ inside dia. 6mmφ 4T air core

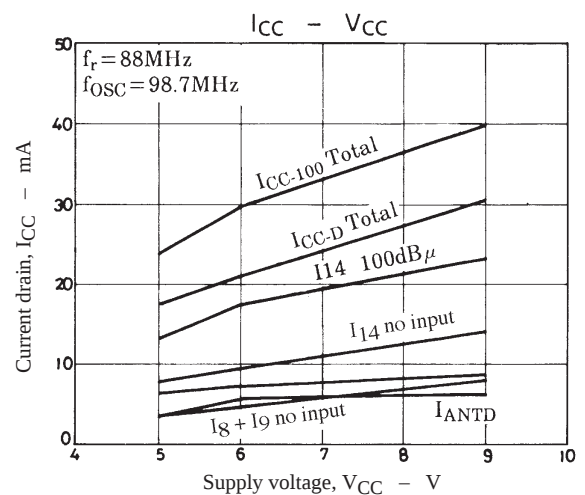
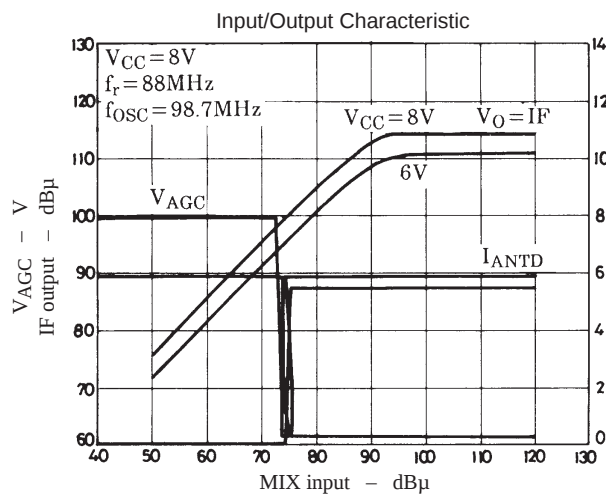


MIX output (small-sized)
 47K-074-124 (Sumida)

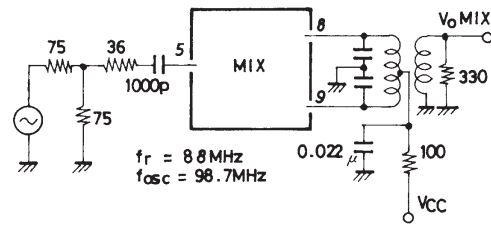
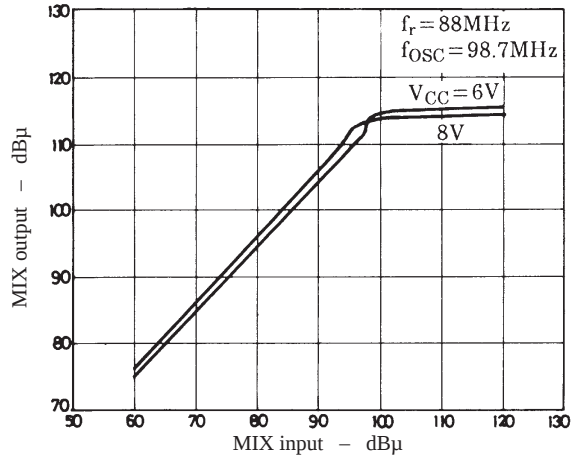
Internal Connection Diagram : LA1175



Unit (resistance : Ω , capacitance : F)

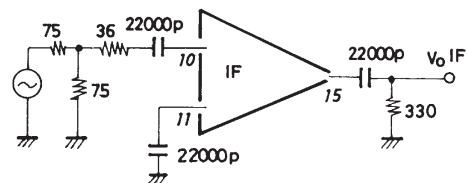
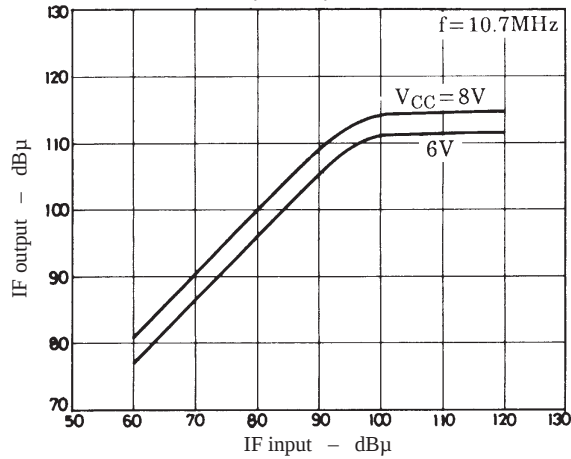


MIX BLOCK Input/Output Characteristic

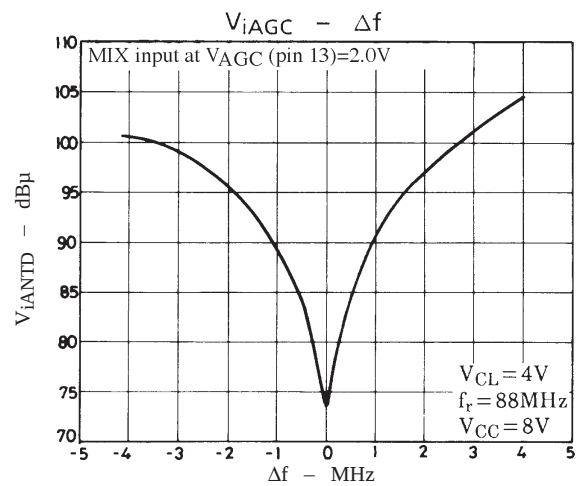
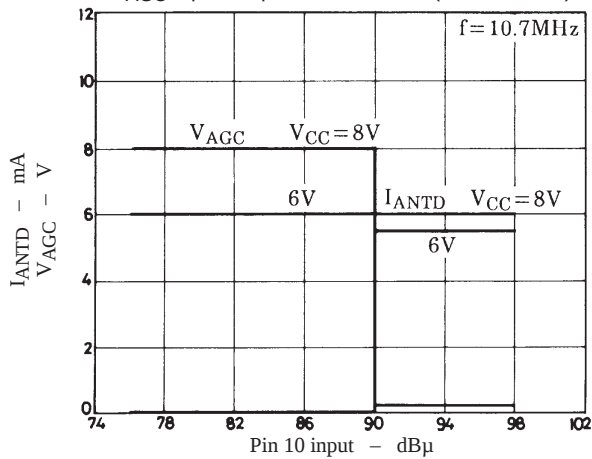


Unit (resistance : Ω, capacitance : F)

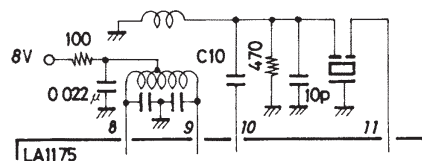
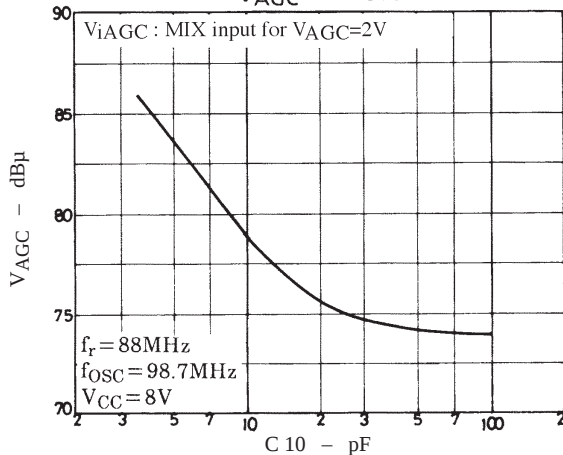
IF BLOCK Input/Output Characteristic



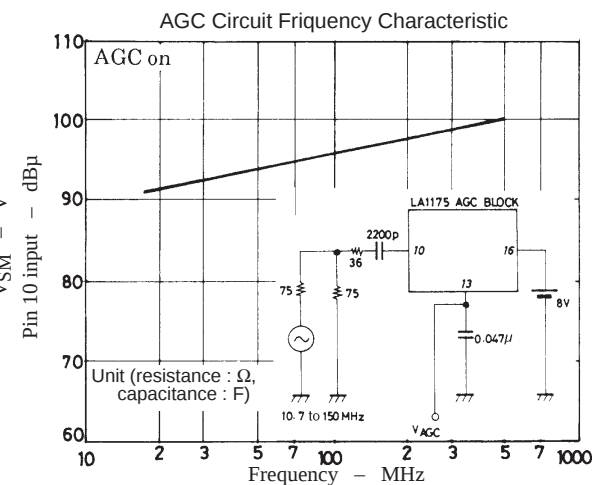
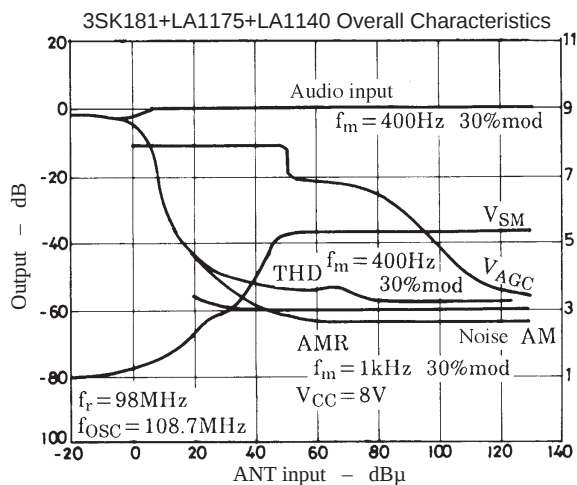
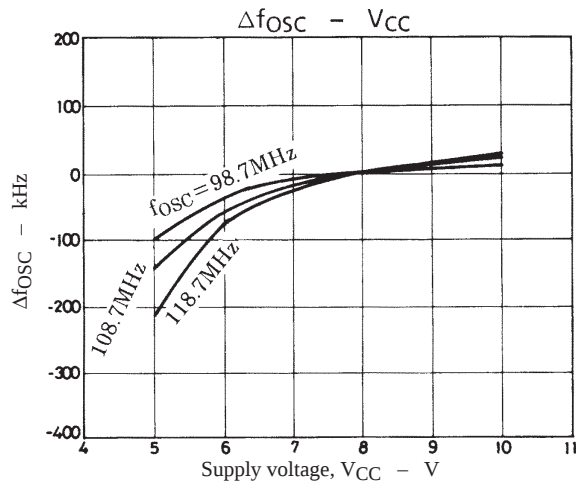
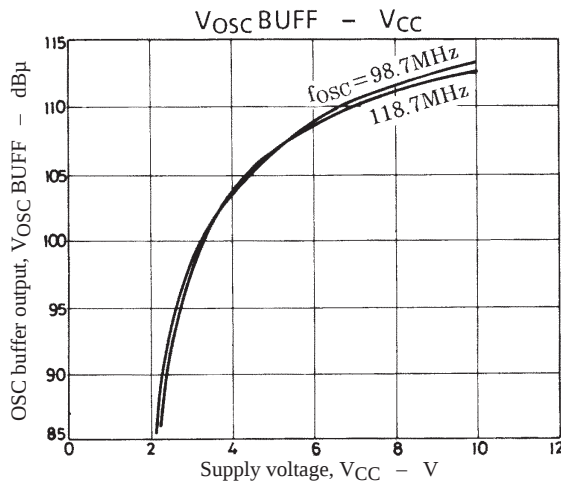
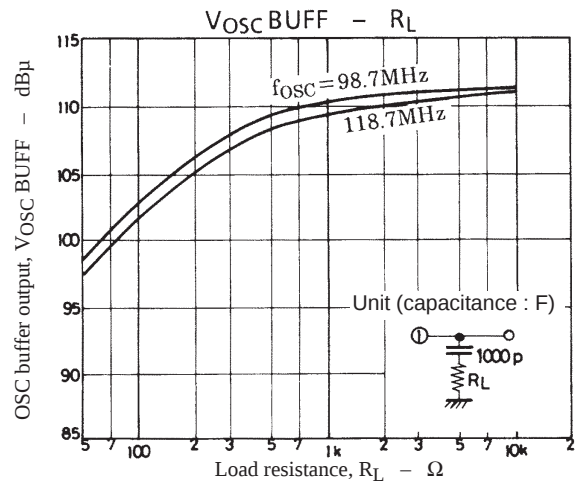
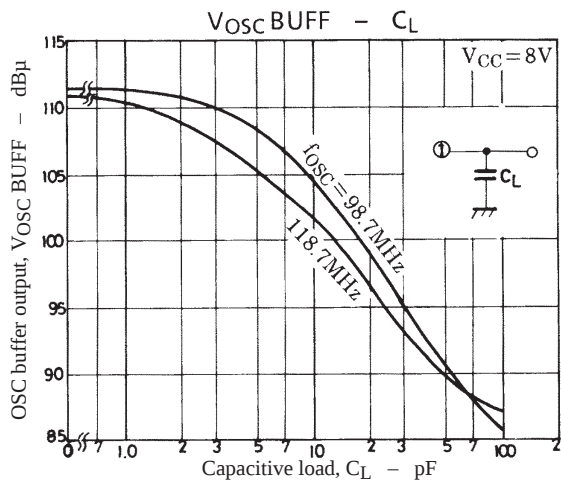
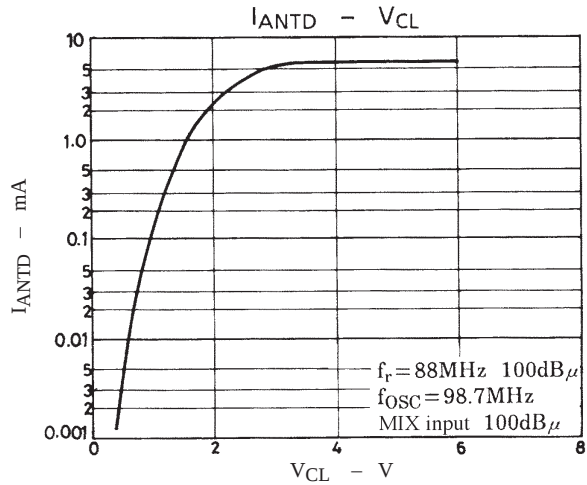
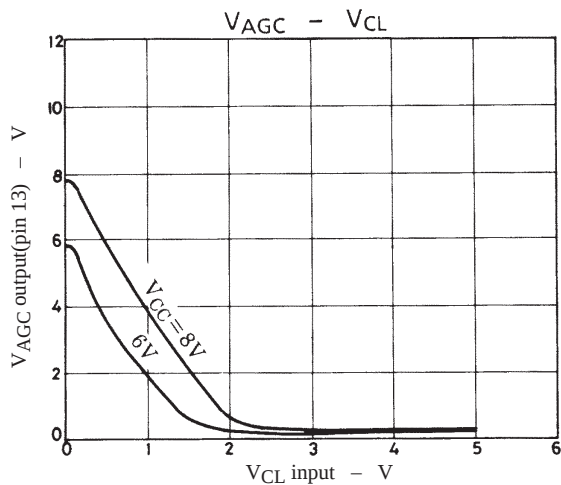
V_{AGC} Input/Output Characteristic (AGC BLOCK)

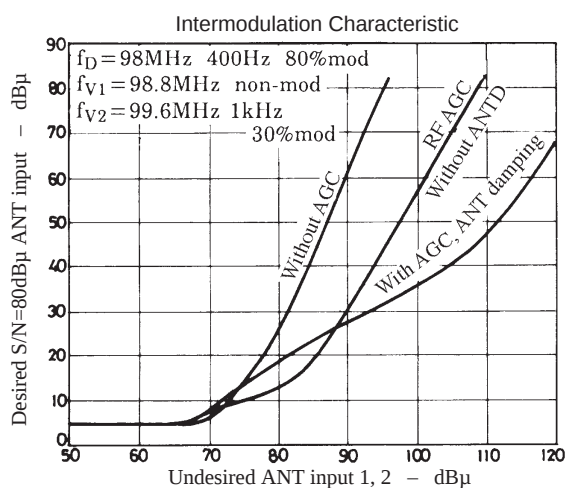


V_{AGC} - C10

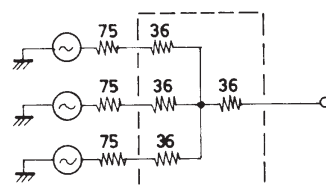


Unit (resistance : Ω, capacitance : F)

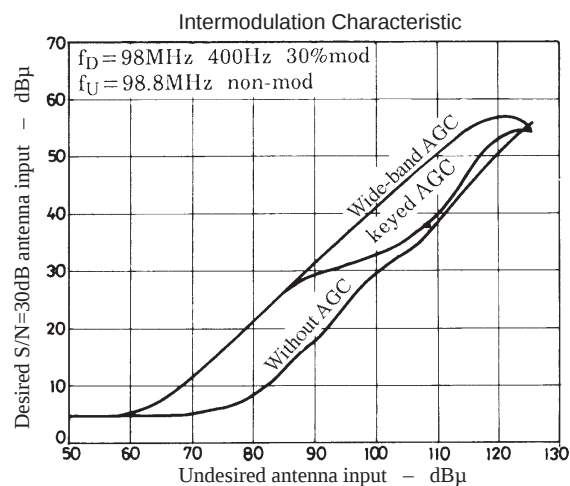
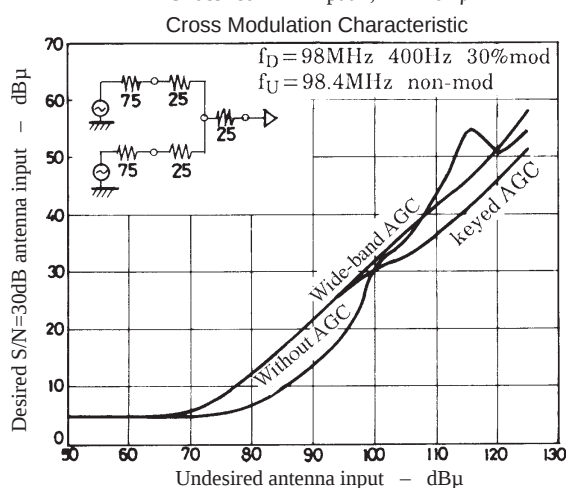




Intermodulation dummy used



Unit (resistance : Ω)



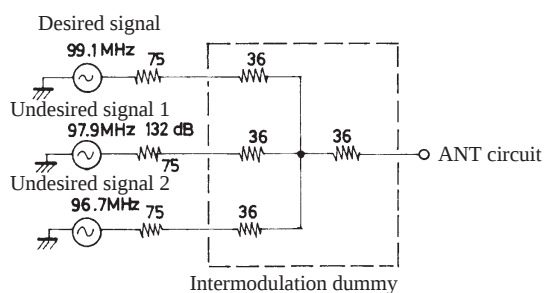
Improvement of IM characteristic in strong undesired input signal mode when ANT damping AGC is used (LA1174).

Test conditions

f_D : 99.1MHz, $f_m=400\text{Hz}$ 100% mod

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

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



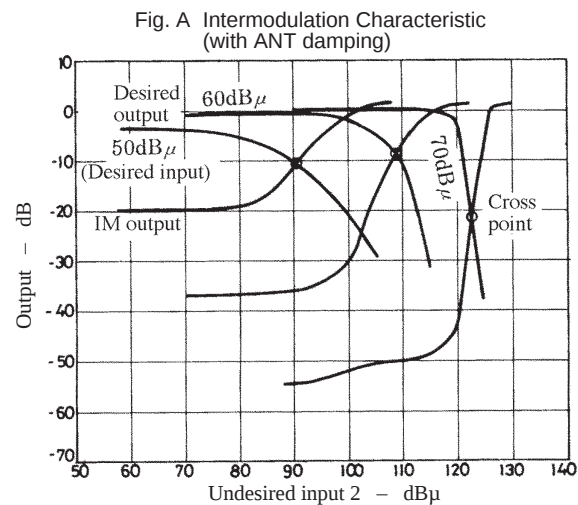
Unit (resistance : Ω)

Cross point

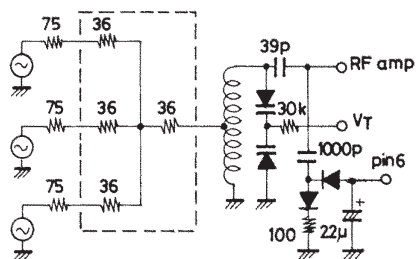
The open input level of undesired signal 2 at which the IM output and desired signal output are at the same level.

IM output	Desired signal	: Non-mod at each specified input
	Undesired signal 1	: Non-mod at input 132dB μ (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 132dB μ (SG open)
	Undesired signal 2	: Non-mod with input variable

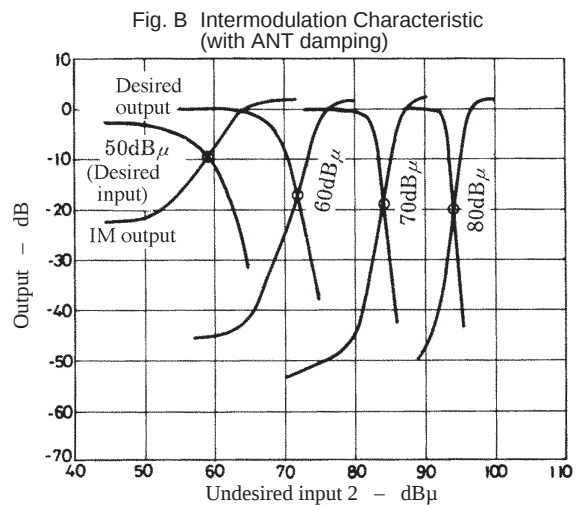
Desired input level		50dB μ	60dB μ	70dB μ	80dB μ	
Cross point	With ANT damping RF AGC and ANTD AGC	90.5dB μ	109dB μ	123dB μ	Test impossible	Refer to Fig. A.
	Without ANT damping RF AGC only	59.5dB μ	72dB μ	89dB μ	98dB μ	Refer to Fig. B.
Improvement		31dB	37dB	34dB		



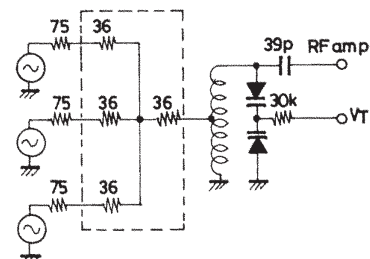
Solid line $f_D = 99.1\text{MHz}$ $f_m = 400\text{Hz}$ 700% mod
 $f_{U1} = 97.9\text{MHz}$ non-mod
132dB μ (SG open)
 $f_{U2} = 96.7\text{MHz}$ non-mod
Broken line $f_D = 99.1\text{MHz}$ non-mod
 $f_{U1} = 97.9\text{MHz}$ non-mod
132dB μ (SG open)
 $f_{U2} = 96.7\text{MHz}$ 1kHz 100% mod



Intermodulation dummy



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

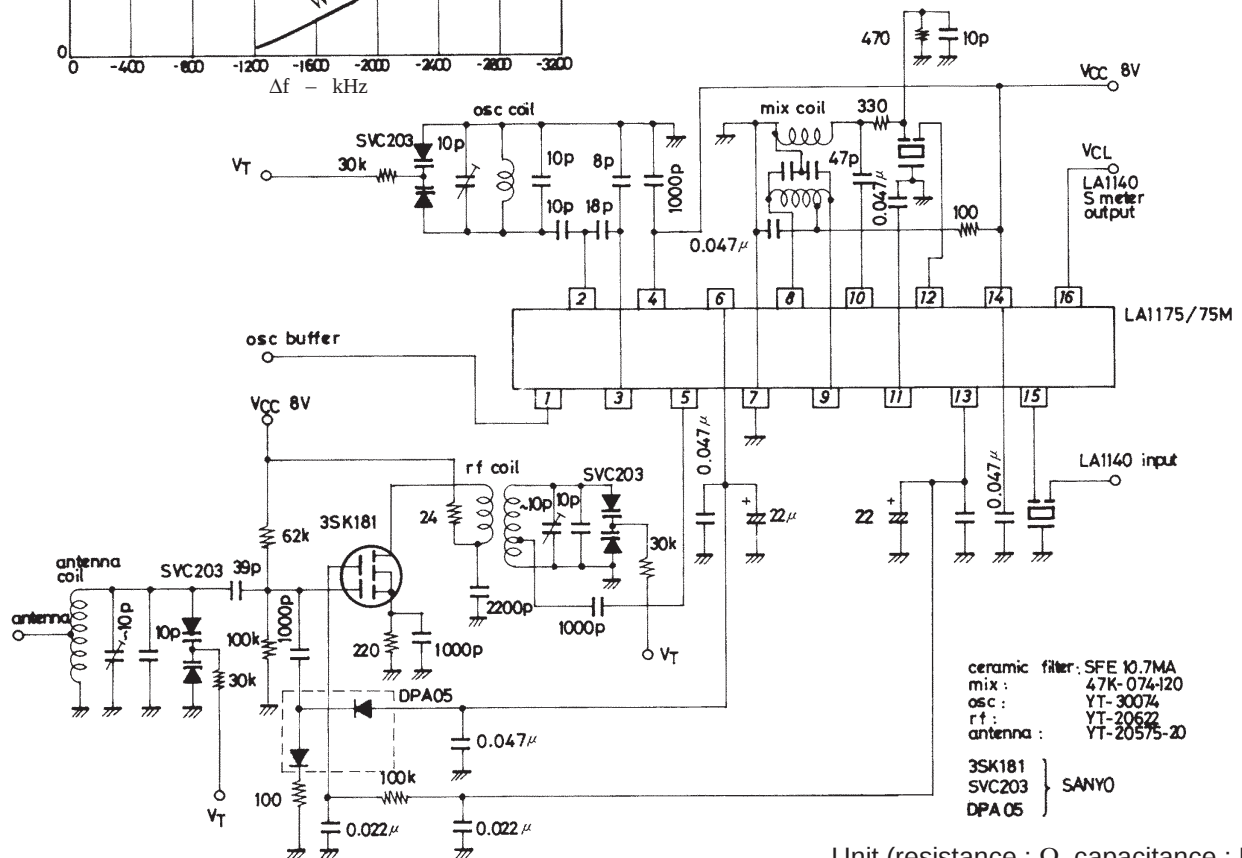
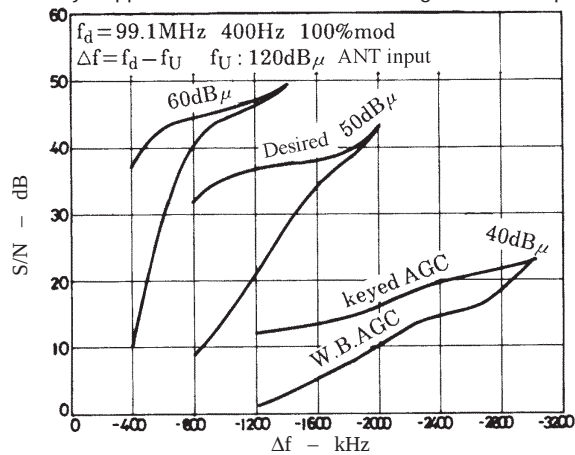


Intermodulation dummy

Unit (resistance : Ω , capacitance F)

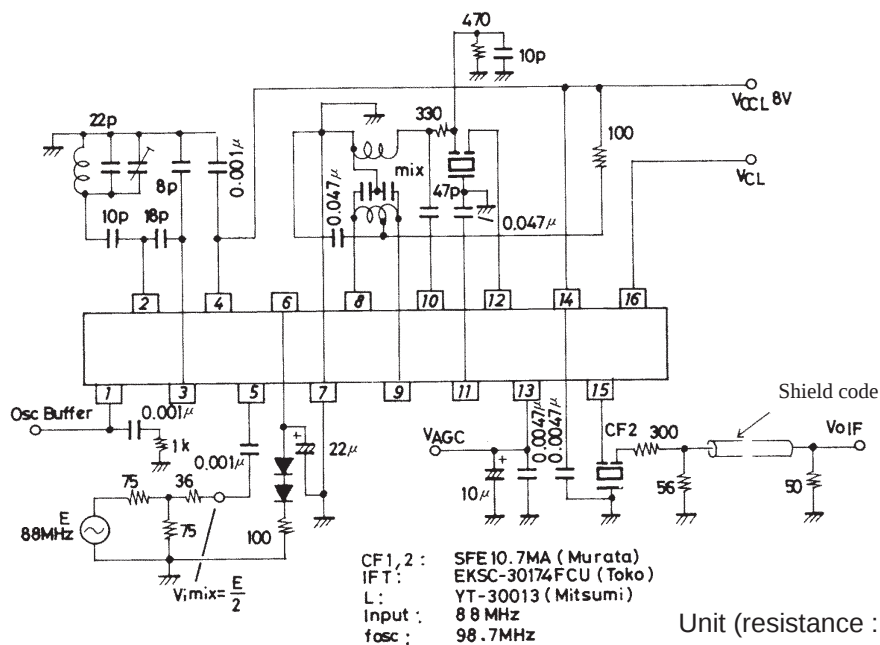
LA1175, 1175M

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



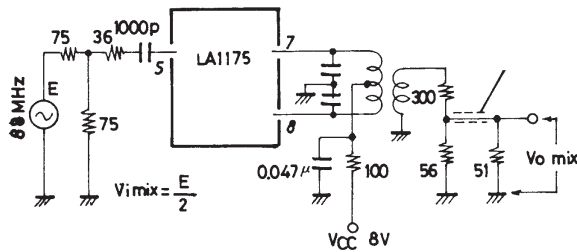
Unit (resistance : Ω , capacitance : F)

Test Circuit

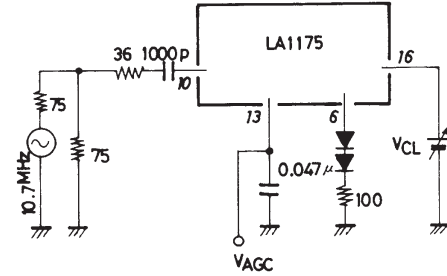


Unit (resistance : Ω , capacitance : F)

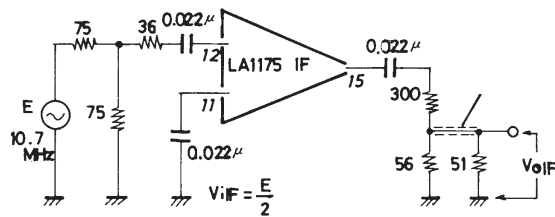
Temperature Characteristics (4)



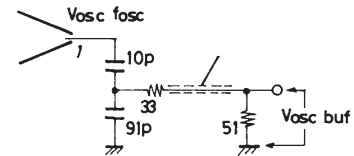
Temperature Characteristics (5)



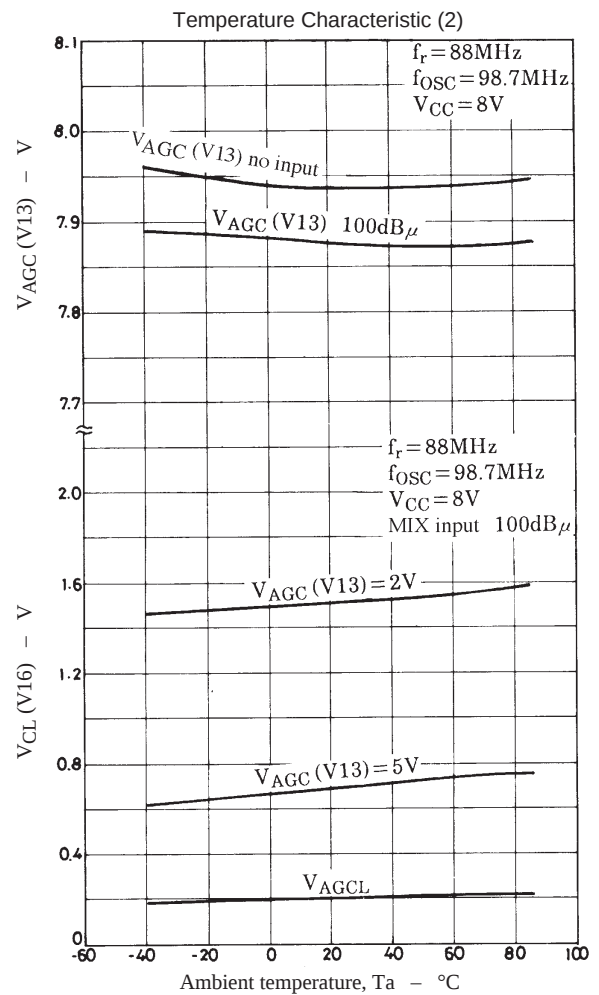
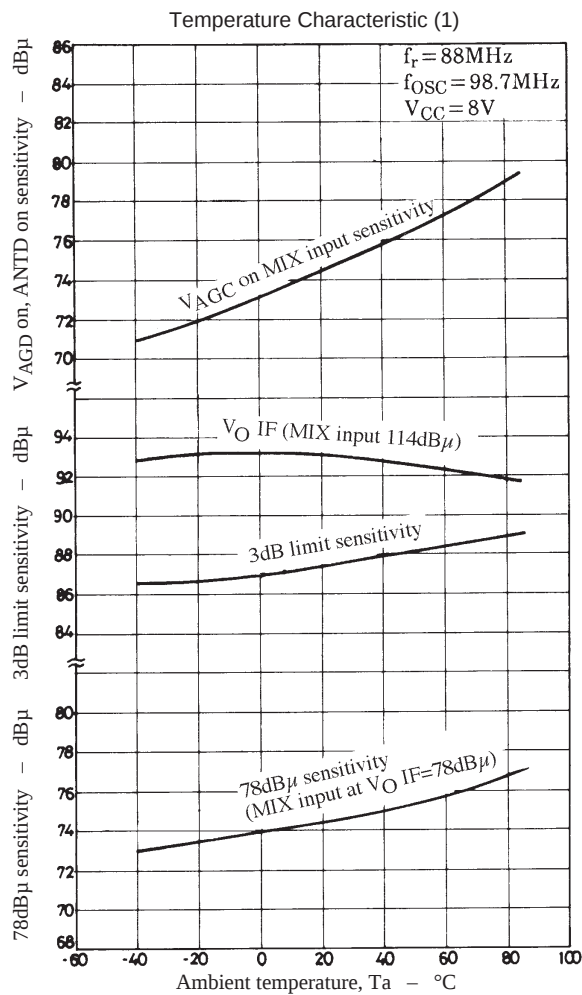
Temperature Characteristics (6)

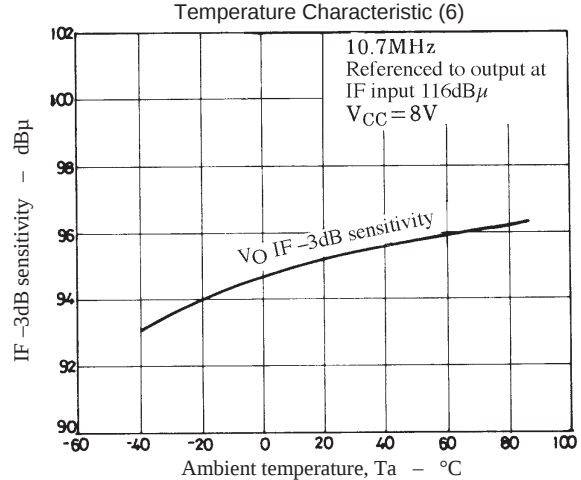
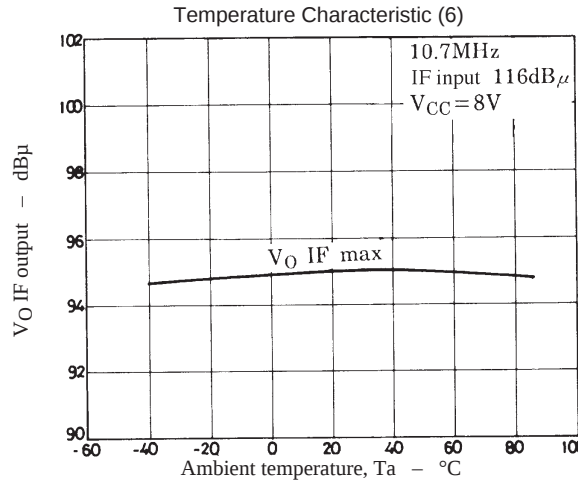
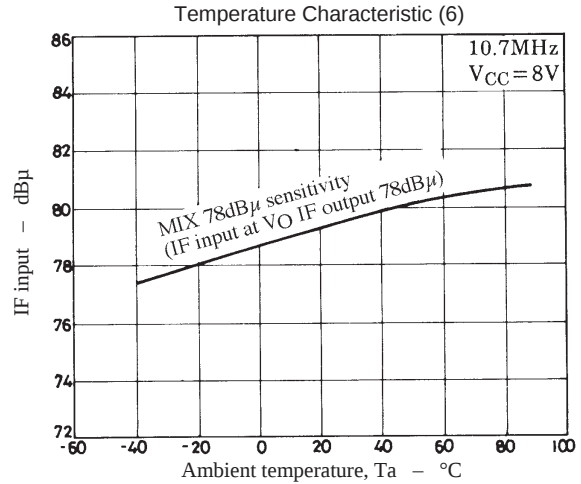
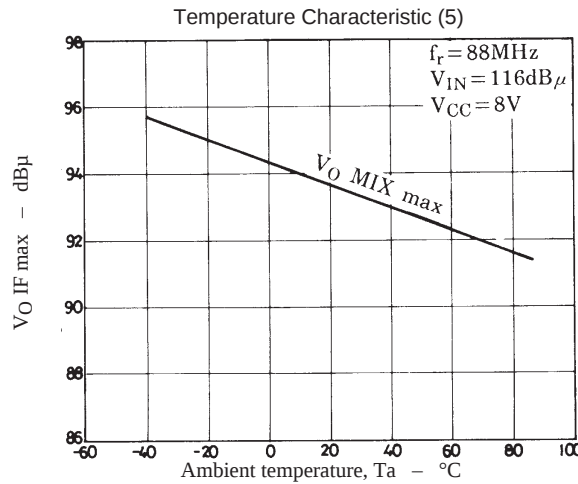
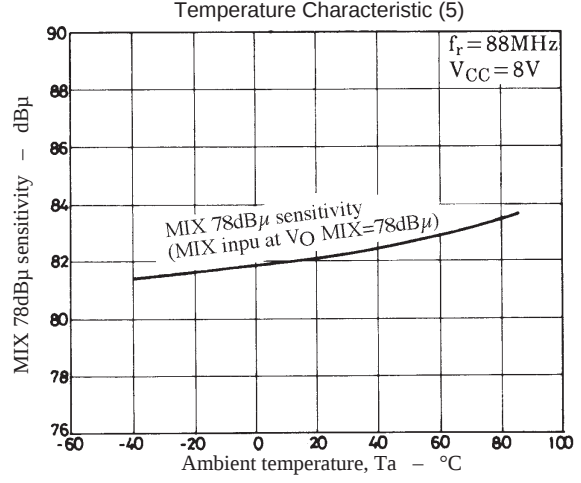
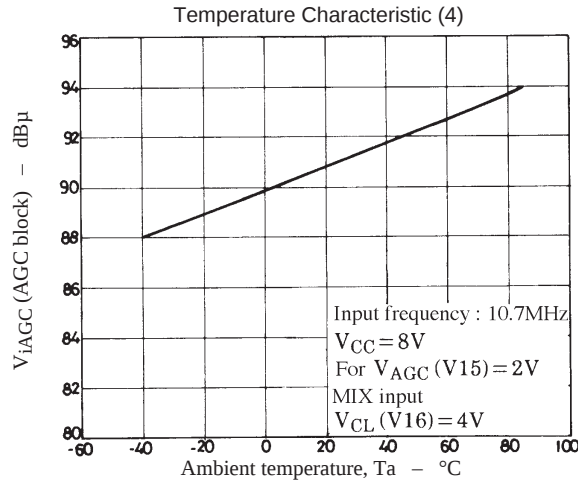
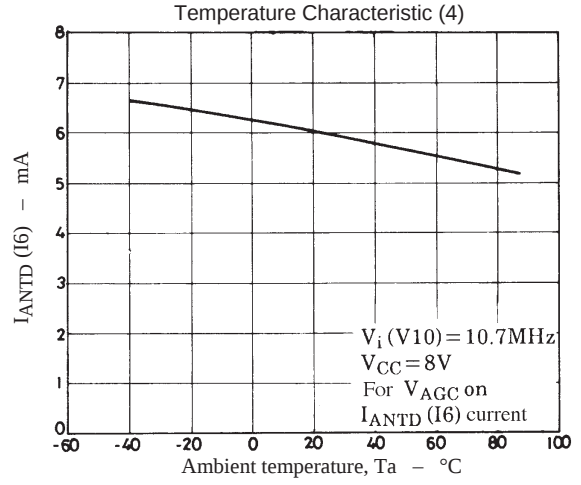
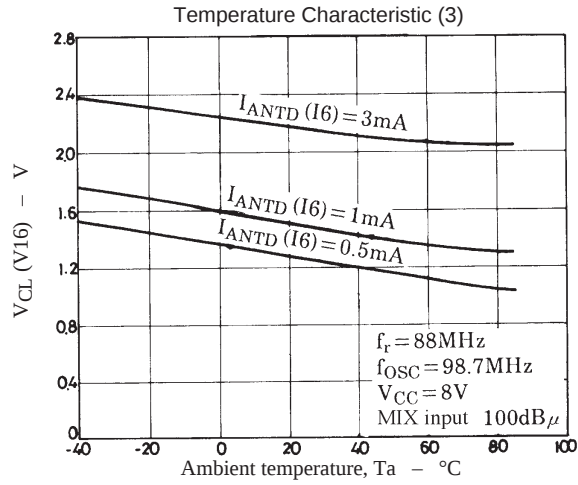


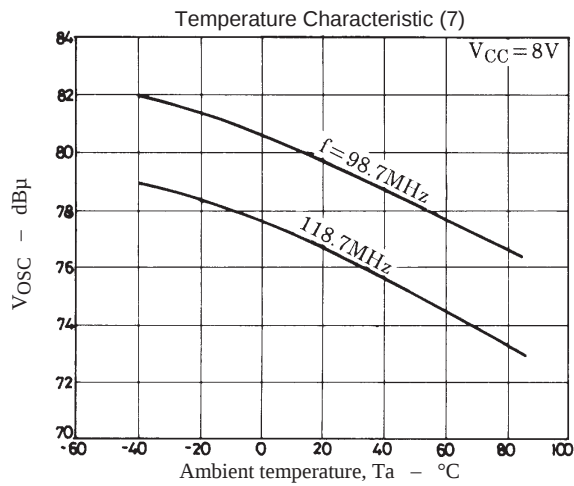
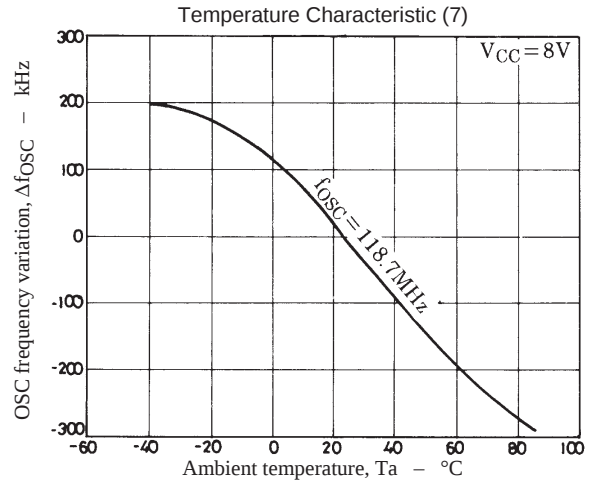
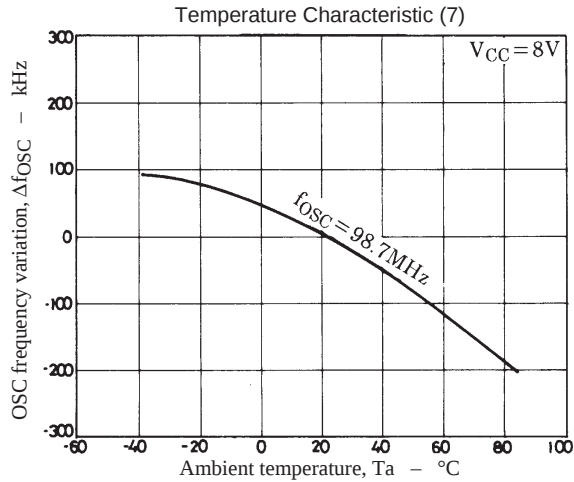
Temperature Characteristics (7)



Unit (resistance : Ω, capacitance : F)







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 110dB μ 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)

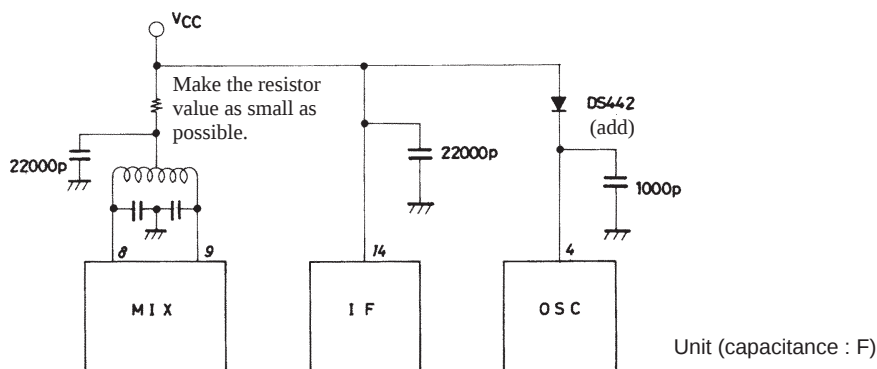
If keyed AGC is operated to cause AGC-OFF mode to be entered when a desired signal is received, the varactor in the ANT circuit may be distorted and intermodulation may occur, which means that it is meaningless for the LA1175, 1175M to contain the ANT damping circuit because it produces no effect. Therefore, 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 $\Delta f=400\text{kHz}$ 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.



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