No.1273C

LA 1170

Monolithic Linear IC

FM FRONT END FOR CAR RADIOS, HOME STEREOS

The LA1170 is an FM front end IC for use in car radio, home stereo applications. It contains an AGC driver (keyed AGC) being effective in improving the interference characteristic, thereby offering such great advantages as improving the interference characteristic without a sacrifice of usable sensitivity and eliminating the need to use the conventional DX-LOCAL select switch. The oscillator and oscillation buffer on chip facilitate designing of electronic tuning sets.

Functions and Features

- Double-balanced type MIX (Improved spurious characteristic)
- Keyed AGC (Improved intermodulation, cross modulation characteristic)
- Differential IF amplification (Improved limiting characteristic)
- Oscillator and buffer amplifier local oscillation (Electronic tuning set applications)

Maximum Ratings at Ta=25°C

				unit
Maximum Supply Voltage	V_{CCL} max	Pins(4),(14)	10	V
	V_{CCH} max	Pins(8),(9)	16	V
Allowable Power Dissipation	Pd max	Ta≦70°C	460	mW
Operating Temperature	Topg		-20 to +70	°C
Storage Temperature	Tstg		-40 to +125	°C

Operating Conditions at Ta=25°C

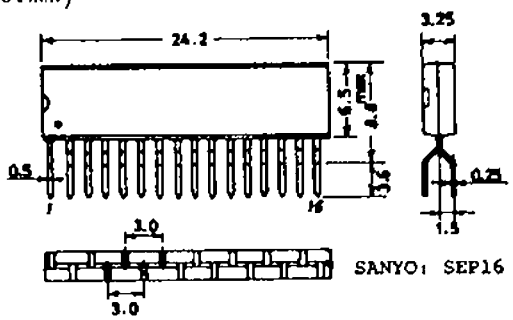
				unit
Recommended Supply Voltage	V_{CCL}	Pins(4),(14)	8	V
	V_{CCH}	Pins(8),(9)	12	V
Operating Voltage Range	V_{CCH} op		10 to 14	V

Operating Characteristics at Ta=25°C, V_{CCL}=8V, V_{CCH}=12V, See specified Test Circuit.

			min	typ	max	unit
Current Dissipation	I_{CCL}	Pins(4),(14)	11	17	23	mA
	I_{CCH}	Pins(8),(9)	3.5	6	9	mA
MIX Input Offset	ΔV_{IN} MIX		-20	0	20	mV
MIX Output Offset	ΔI_{OUT} MIX		-500	0	500	uA
High Level AGC Output	VAGCH	V_i=0dBu, V_{CL}=4V	7.6	7.9		V
Low Level AGC Output	VAGCL	V_i=100dBu, V_{CL}=4V		0.3	0.7	V

Continued on next page.

Case Outline 3020A-S16IC
(unit:mm)



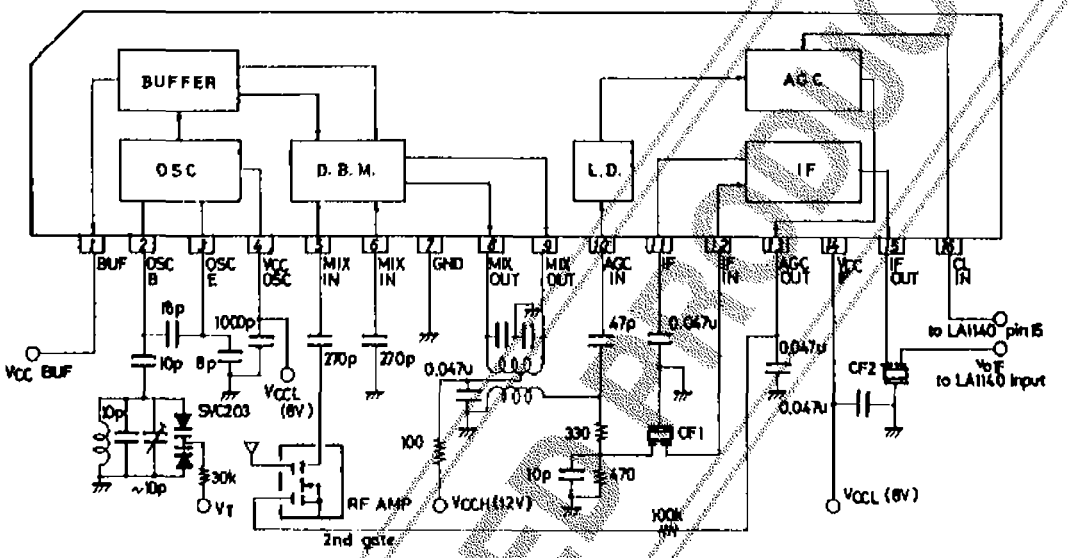
Specifications and information herein are subject to change without notice.

SANYO Electric Co.,Ltd. Semiconductor Overseas Marketing Div.
Natsume Bldg., 18-6, 2-chome, Yushima, Bunkyo-ku, TOKYO 113 JAPAN

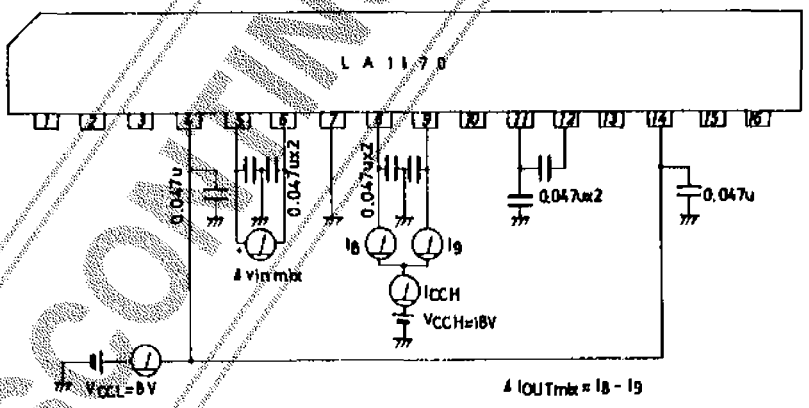
Continued from preceding page.

			min	typ	max	unit
IF Input Resistance	R_{IN}		260	330	400	ohm
AGC Control Input	V_{CL7}	Vi=100dBu, V_{AGC}=7V		0.25	0.5	V
	V_{CL2}	Vi=100dBu, V_{AGC}=2V	1.1	1.6	2.1	V
Voltage Gain	Av	Vi=77dBu	96	100	104	dBu
Input Limiting Voltage	Vi lim	Referenced to Vi=110dB	80	87	94	dBu
AGC Input Voltage	Vi AGC	V_{AGC}=2V	65	72	79	dBu
Saturation Output Voltage	V_{OUT}	Vi=110dBu	107	111		dBu
OSC Buffer Output	$V_{OSC\ BUFF}$	1kohm load	107	111		dBu

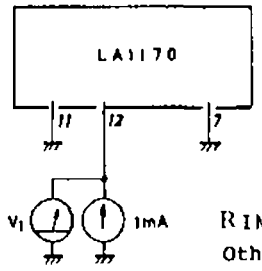
Equivalent Circuit Block Diagram and Peripheral Circuit



Test Circuit 1



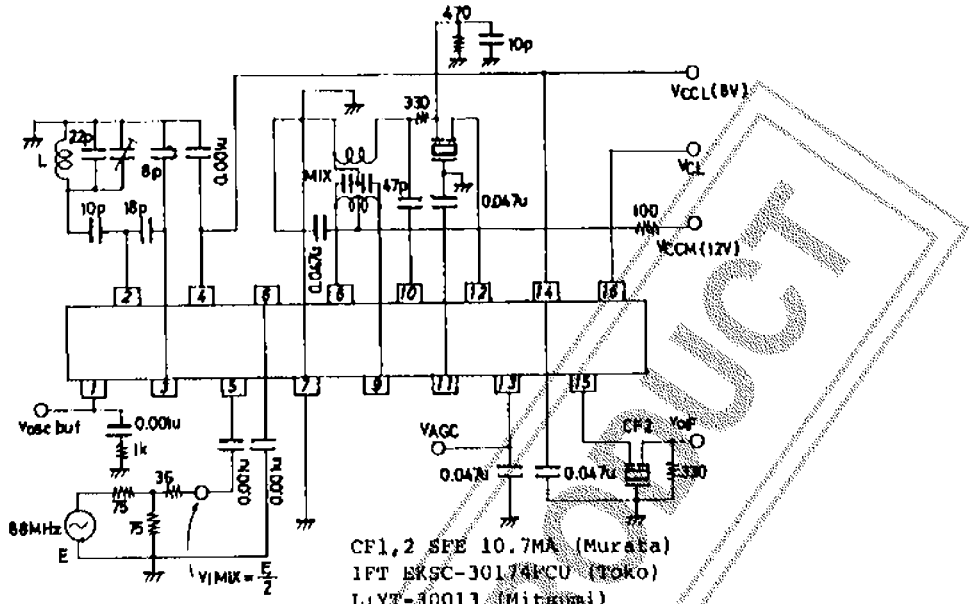
Test Circuit 2



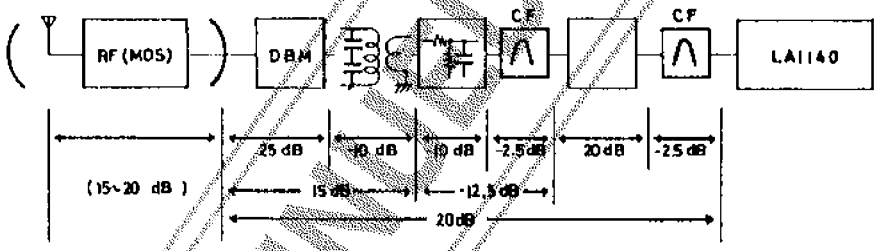
$R_{IN} = V_I \times 10^3$

Other pins: Open

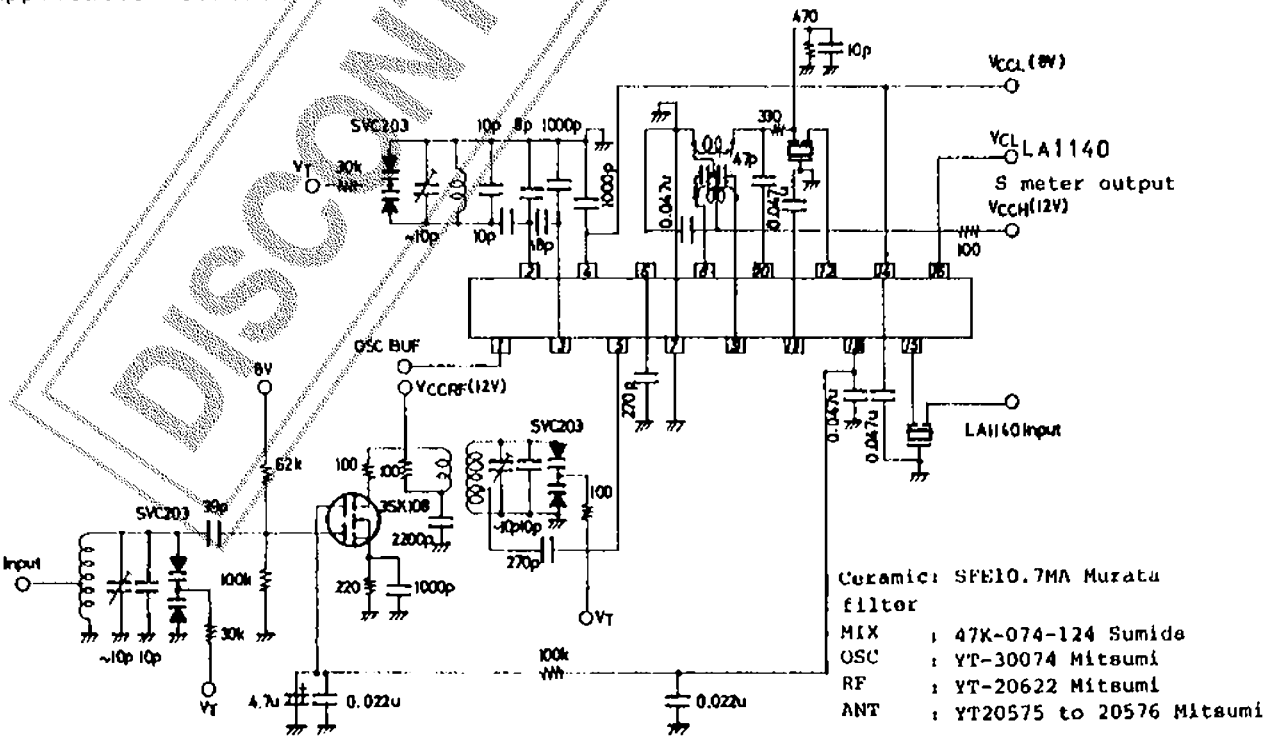
Test Circuit 3

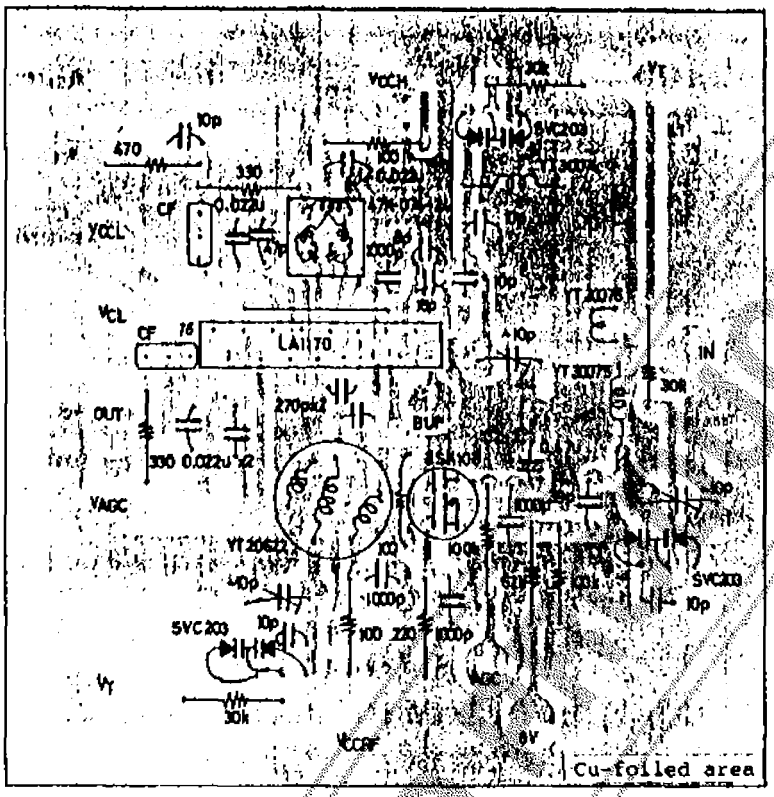


Gain Distribution at Each Stage

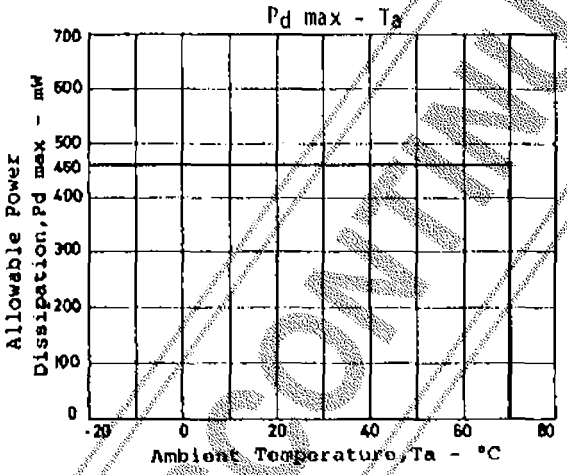


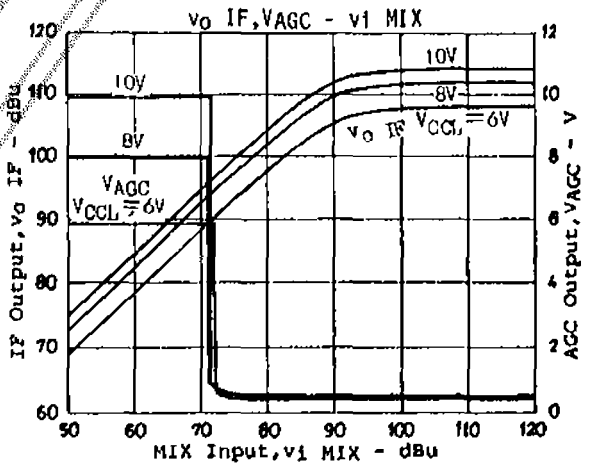
Application Circuit

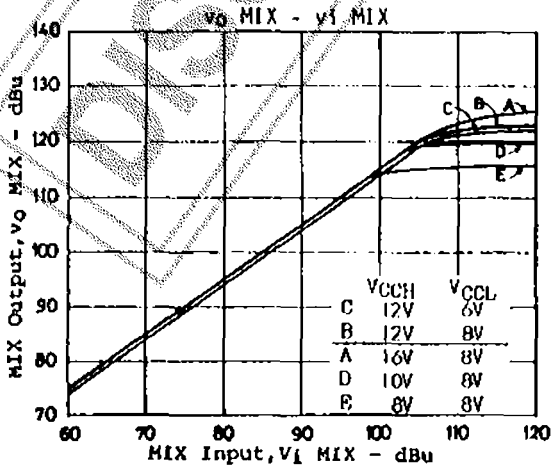


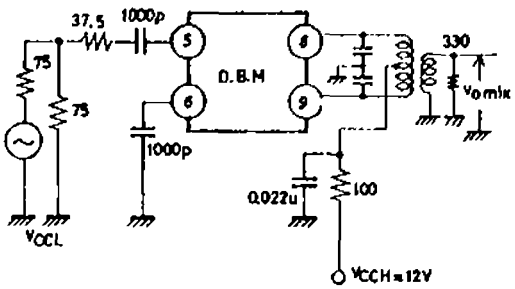


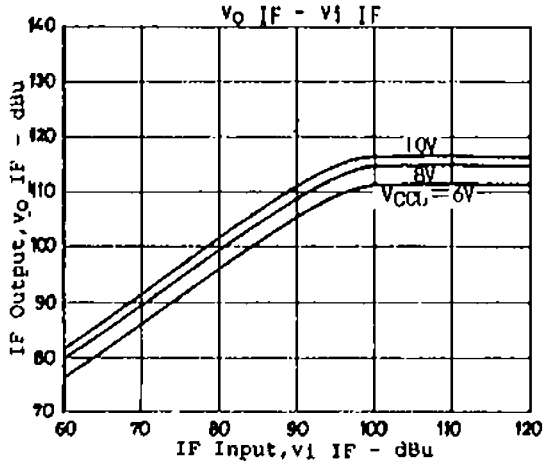
Sample Printed Circuit Pattern 80 x 63mm²

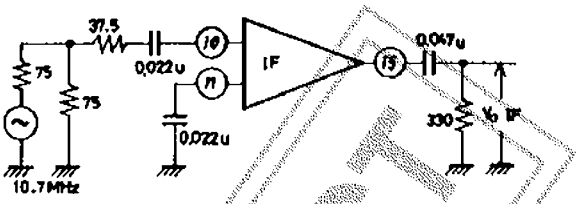


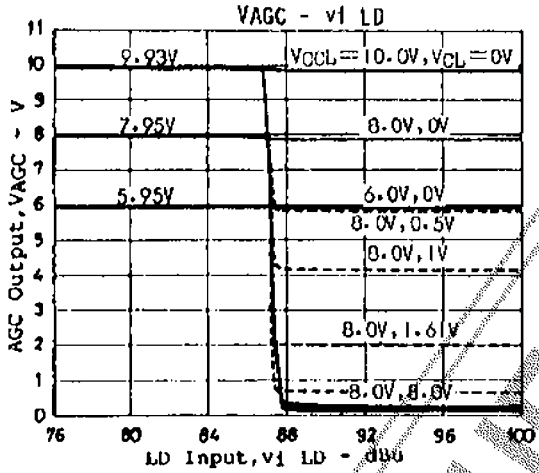


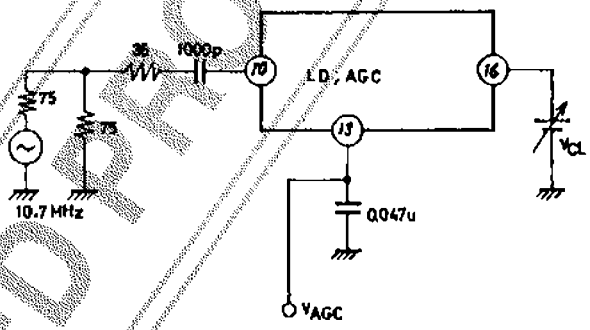


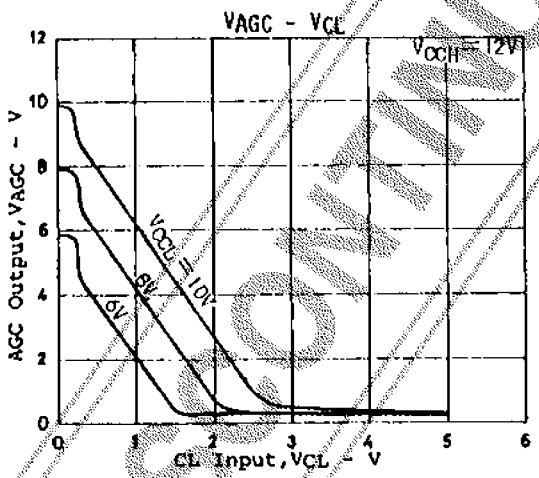


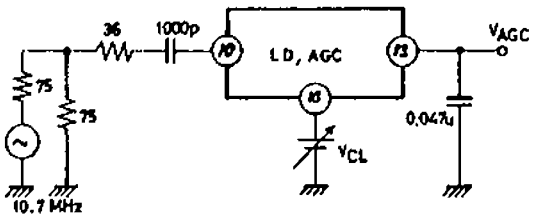


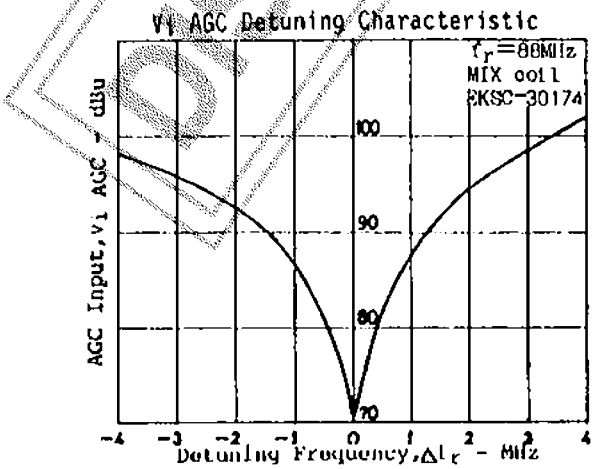


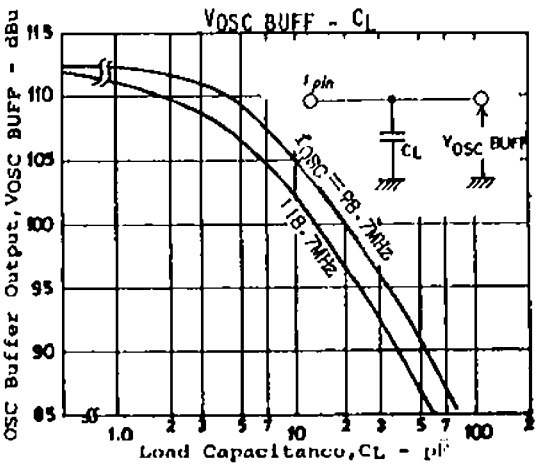


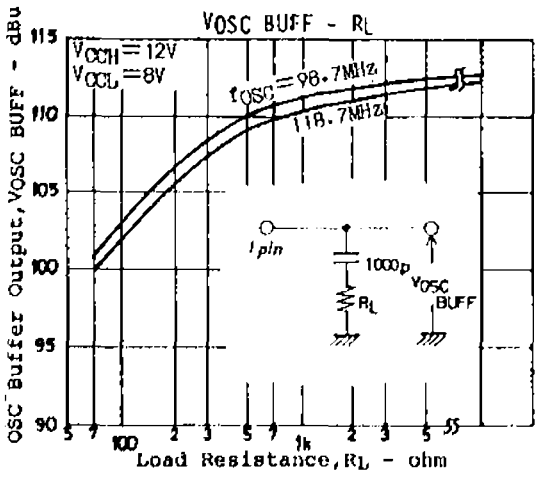


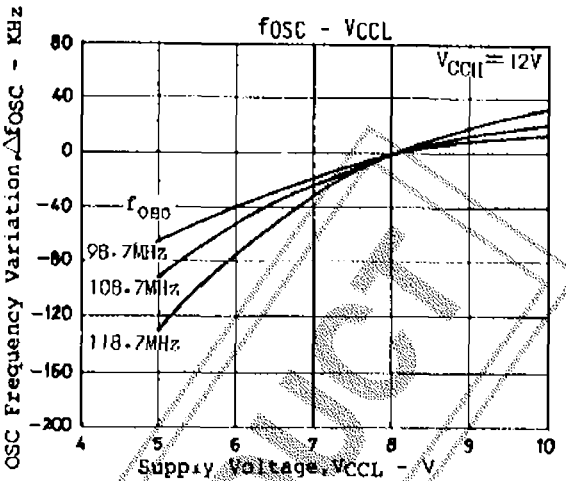


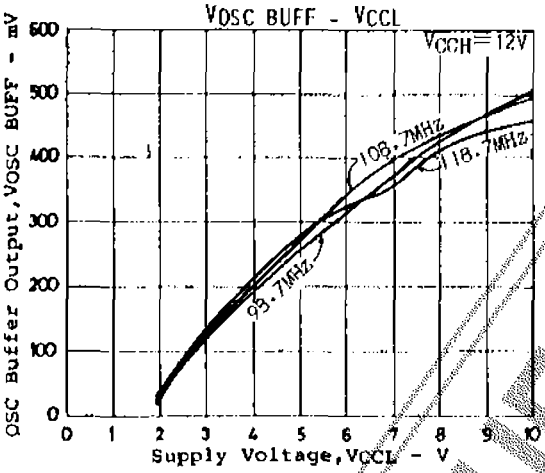


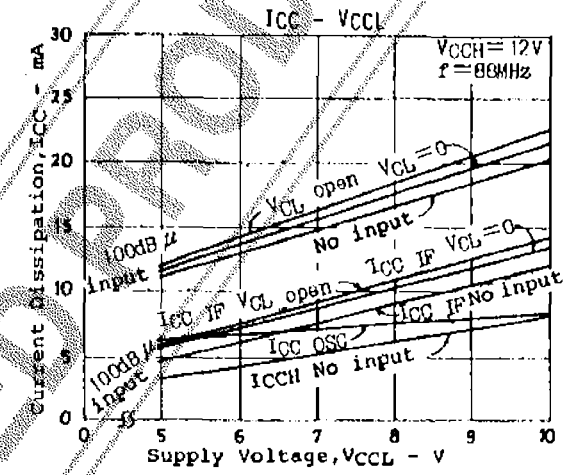


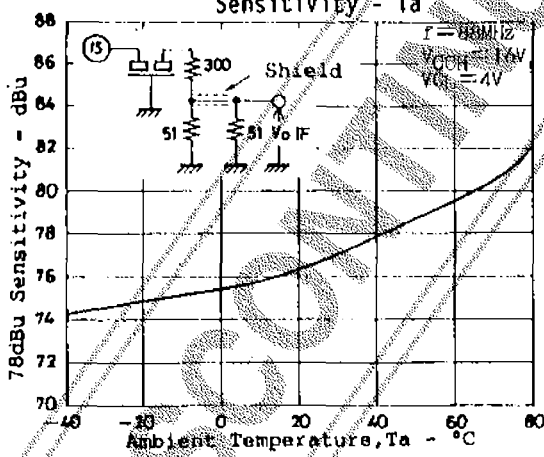


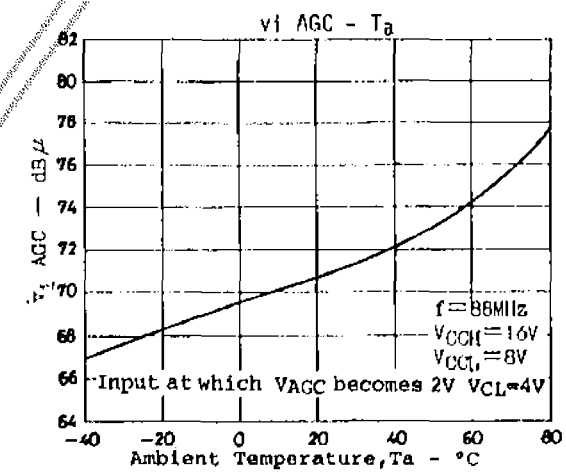


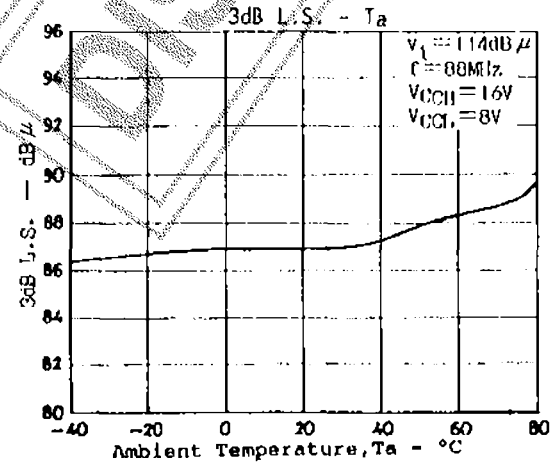


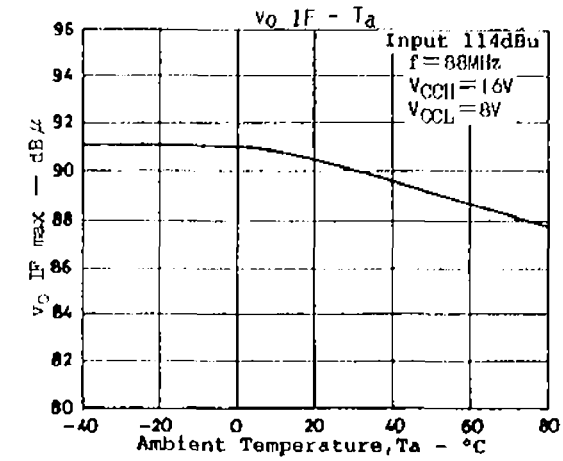


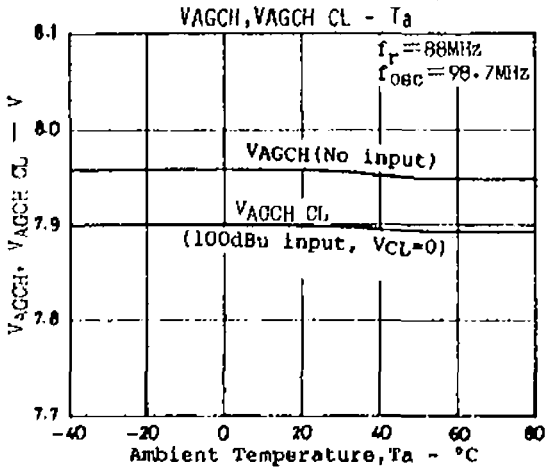


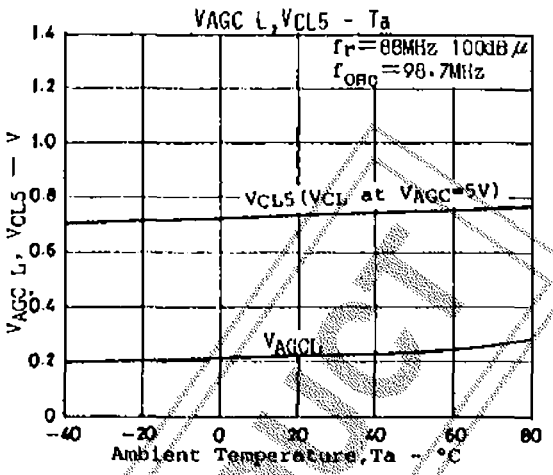


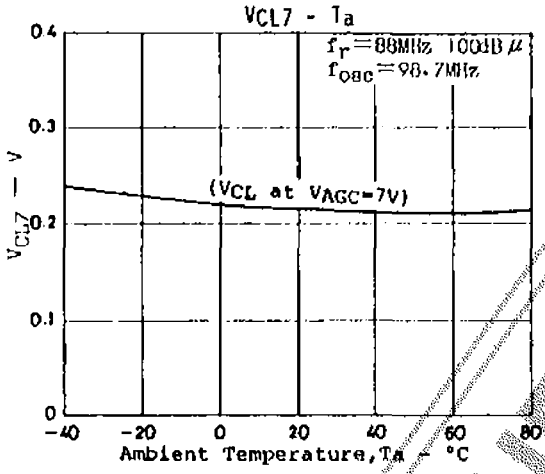


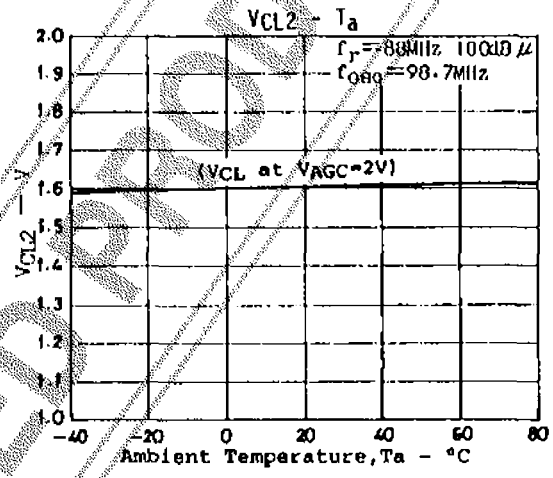


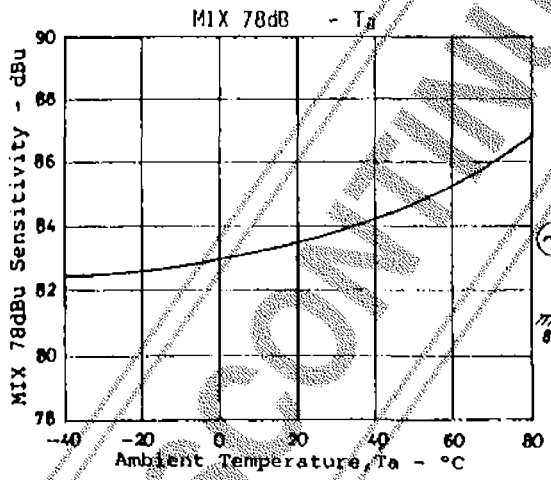


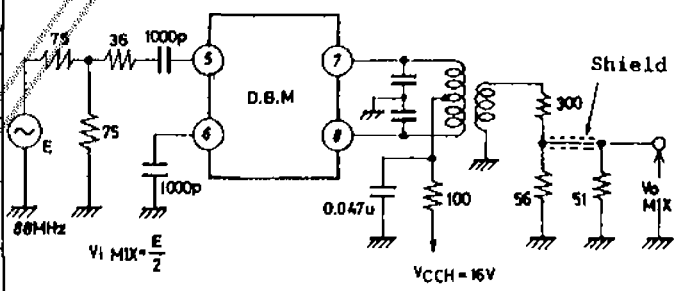


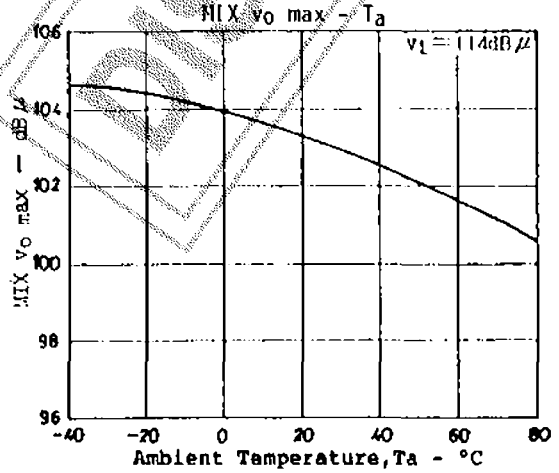


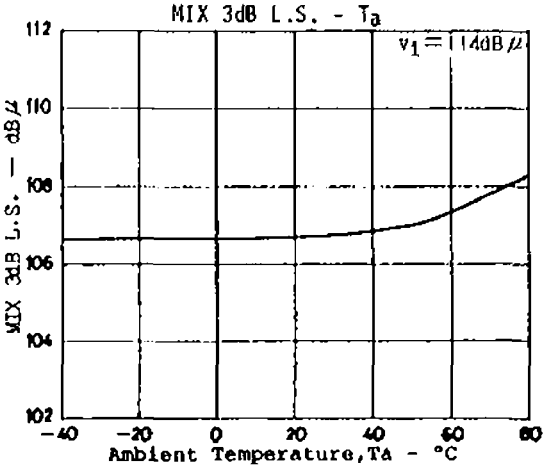


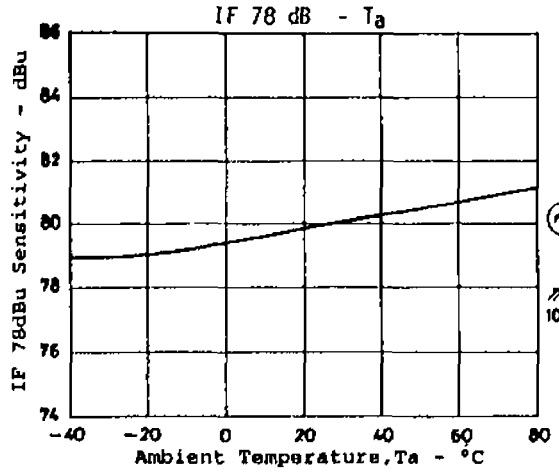


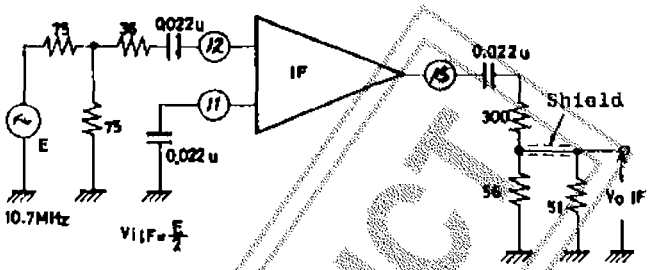


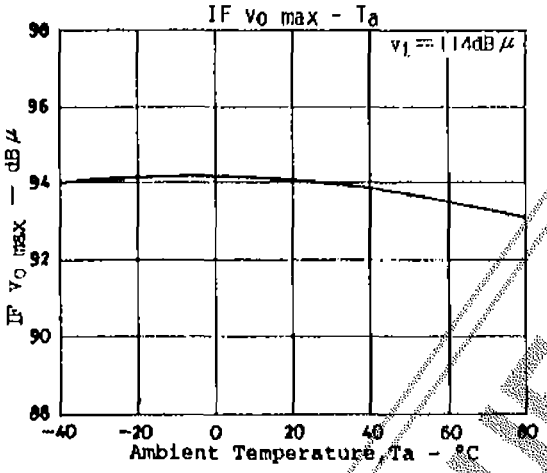


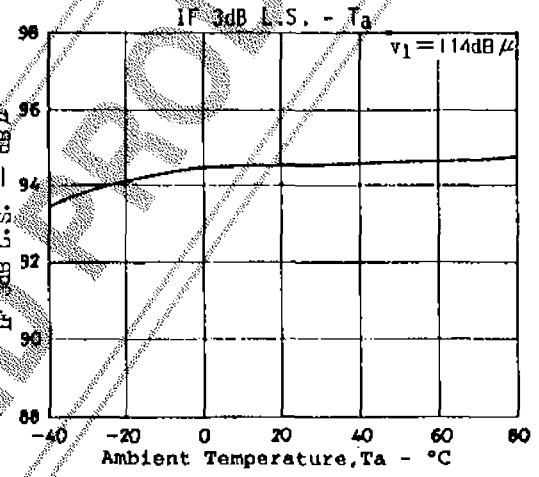


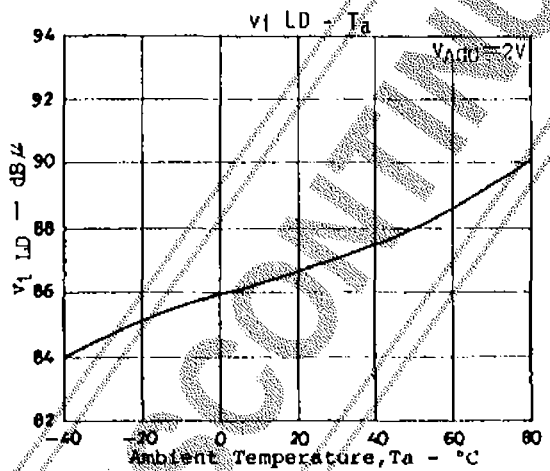


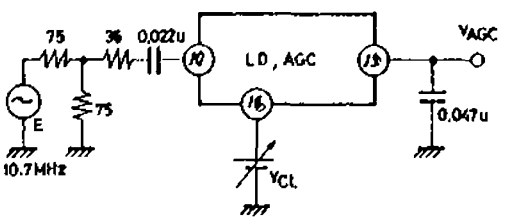


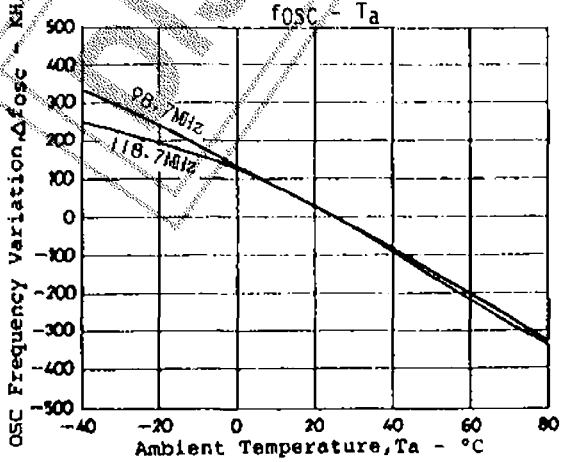


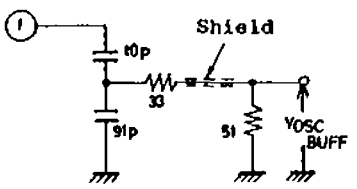


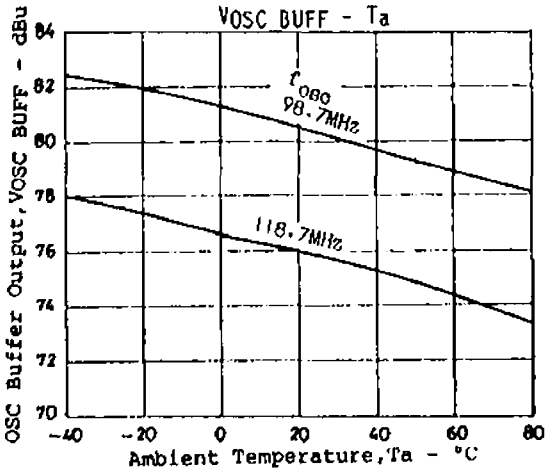


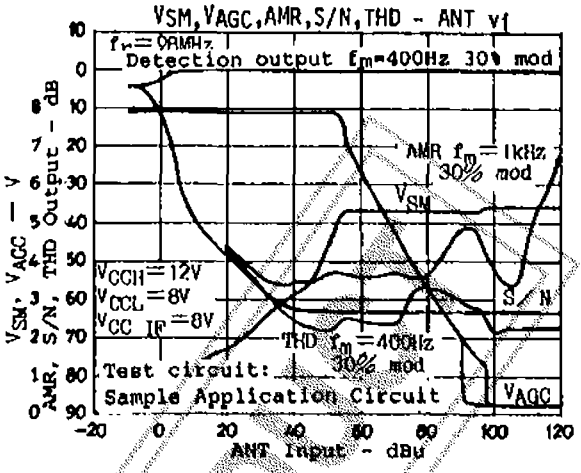


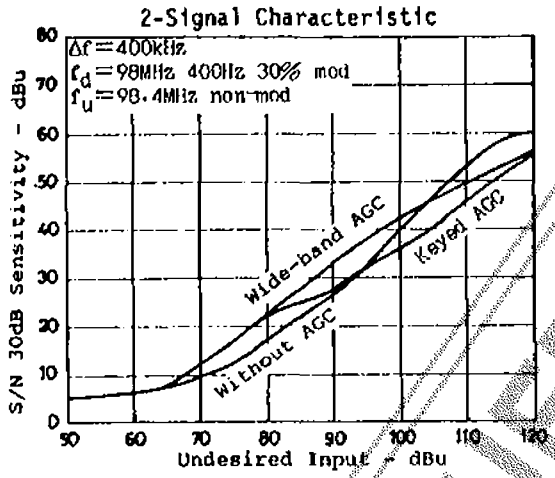


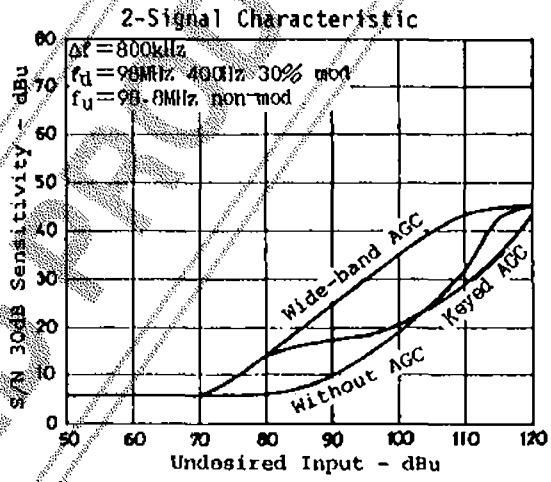




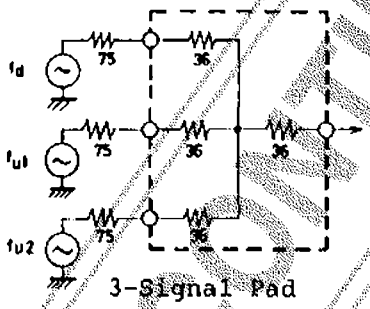




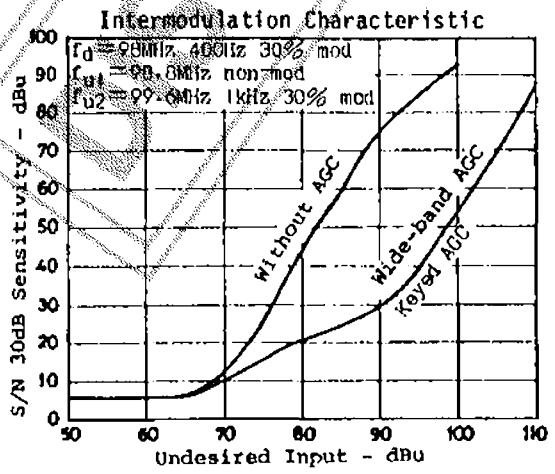




Intermodulation Characteristic Test Method



fd Desired signal 98MHz 400Hz 30%mod
ful Undesired signal 98.8MHz
fu2 Undesired signal 99.6MHz 1kHz 30%mod
Input level of desired channel signal at which S/N of detection output (LA1140) becomes 30dB



The following methods have been adopted as measures against saturation at the MIX stage.

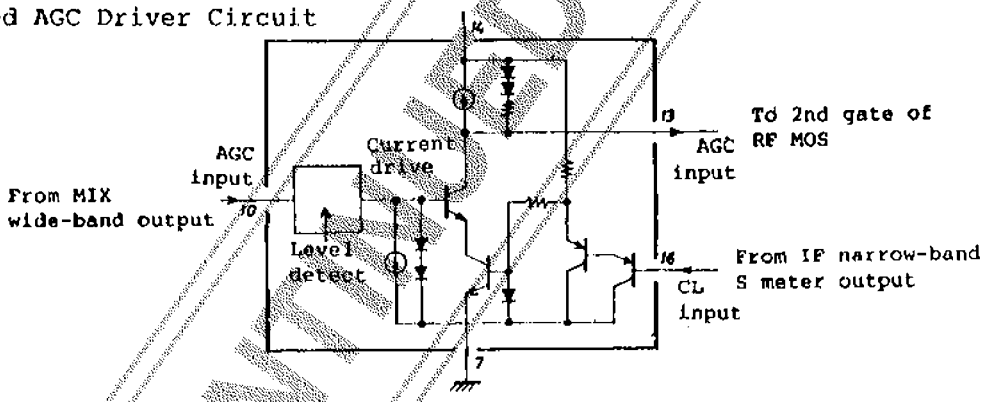
Method	Operation	Problem
Narrow-band AGC I AGC starts working when input is relatively low.	RF amp gain is reduced according to ON channel signal strength.	Max. S/N is not extended when input signal is medium to storng. (Especially stereo S/N)
Narrow-band AGC II (Delay type)		When desired channel signal is weak, operation is the same as when no AGC is applied.
Wide-band AGC	RF amp gain is reduced so that MIX stage is not saturated with adjacent channel signal included.	Sensitivity suppression attributable to AGC applied even in the absence of desired channel signal

Optimum AGC depends on input conditions (relative strength of desired channel signal, adjacent channel signal and the like). Conventional methods have not been satisfactory enough to achieve optimum AGC.

Keyed AGC System of LA1170

The keyed AGC system of the LA1170 is configured as a driver circuit shown below. This AGC system is the same as conventional wide-band AGC system in that AGC starts working when the wide-band input signal at pin 10 exceeds a certain value, but has an important feature that the output signal at pin (13) which is related to AGC amount is proportional to the narrow-band input signal at pin (16). Therefore, there is no such case that AGC applied to excess causes desired channel signal also to disappear as is often the case with conventional AGC system. In the absence of a strong signal in the neighborhood, the system enters narrow-band AGC II operation mode; and in the presence of a strong signal in the neighborhood, the system approaches narrow-band AGC I operation mode.

Keyed AGC Driver Circuit



The AGC signal is made up by both detecting (pin 10) whether the MIX stage is saturated with adjacent channel signals included and detecting (pin 16) the strength of a desired channel signal. Thus, decision of the input conditions which has been made one-dimensionally is now made two-dimensionally. As a result, optimum AGC meeting each input condition can be applied. This is an ideal AGC system.

Characteristics of LA1170-Used FM Car Radio

Shown below are the characteristics related to AGC of the LA1170-used FM car radio. Less sensitivity caused by IM interference and sensitivity suppression caused by AGC applied to excess when in the 2-signal mode have been mutually exclusive. However, the LA1170 is free from these disadvantages.

	IM Interference	Sensitivity Suppression
AGC of LA1170	○	○
Conventional wide-band AGC	○	×
Without AGC	×	○

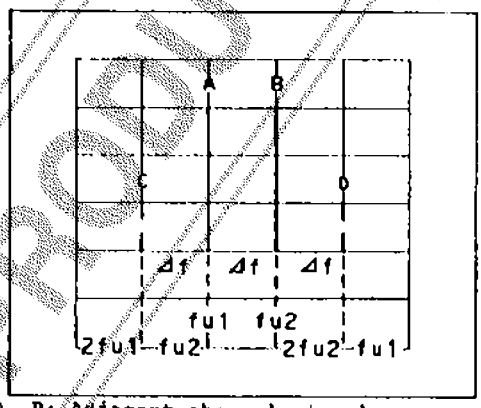
The keyed AGC system of the LA1170 meets the new FTZ standard. The LA1170 features that the interference characteristic can be greatly improved with other characteristics (usable sensitivity, S/N, etc.) unaffected.

IM Interference

Of interference characteristics of FM receivers, IM(intermodulation) interference characteristic is an important consideration. IM interference occurs when a strong adjacent channel signal causes the MIX stage to be saturated. Generally speaking, this becomes a problem in urban areas. When strong Ach, Bch signals cause the MIX stage to be saturated, interference signals are generated on Cch, Dch and Cch, Dch reception is made impossible under some circumstances. If the gain at the RF stage is reduced and the MIX input is limited to prevent the MIX from being saturated, less IM interference can be achieved (but the usable sensitivity, S/N are worsened). A lot of sets are equipped with the Local/DX select SW as a measure against IM interference. However, when the SW is placed in the Local position, the S/N is worsened (as compared with when placed in the DX position). So, the SW position must be selected for optimum reception according to the input conditions. In car radio applications, the input conditions are not constant and it is troublesome for the listener (=driver) to change the SW position often according to the input conditions.

*: Saturation at the RF stage is an important consideration, but saturation at the MIX stage is a more important consideration.

Mechanism of IM Interference



A, B: Adjacent channel signal
C, D: Interference signal generated by A, B

Special Parts

	Mitsumi	Sumida	Toko
ANT coil	YT-30075	0708-673	-
	YT-30076	0708-671	
OSC coil	YT-30074	0708-672	-
MIX coil	YT-20577	014-022	EKSC-30174FCU
		47K-074-124	
RF coil	YT-20622	0264-319	

RF AMP 3SK108 Sanyo
Varactor diode SVC203 Sanyo
C.F. SFE 10.7MA Murata

Proper Cares in Using IC

1. Since the LA1170 has no voltage regulator internally, V_{CC}+8V must be regulated before being applied to pins (4), (14).
2. It is recommended that the voltage used to bias pins (8), (9) should be as high as possible to make the dynamic range of MIX output wider.
3. It is recommended that the MIX load should be of balanced type to match with the balanced type MIX.
4. The RF AMP using an enhancement DD MOS is capable of direct driving the AGC system.