

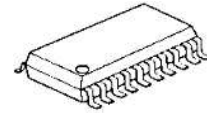
## 100MHz INPUT MIXER AND 450kHz FM/AM IF DEMODULATOR IC

### ■ GENERAL DESCRIPTION

The **NJM2552** is a FM IF demodulator IC with 450kHz (standard) IF input, which operates from 2.2V to 9.0V supply. It includes an oscillator, mixer, limiting amplifier, FM/AM detectors, and RSSI circuit.

The **NJM2552** is suitable for FM /AM receivers for data / voice radio systems.

### ■ PACKAGE OUTLINE

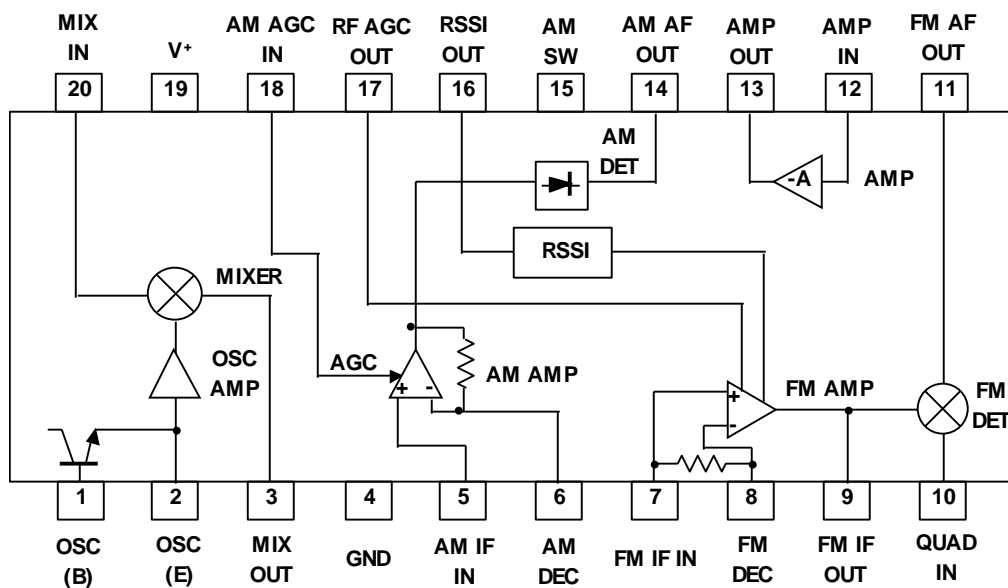


NJM2552V

### ■ FEATURES

- Wide Operating Voltage 2.2V to 9.0V
- Low Operating Current FM: 2.5mA at  $V^+ = 2.7V$ , AM SW = LOW  
AM and FM: 5mA at  $V^+ = 2.7V$ , AM SW = HIGH
- Maximum Mixer Input Frequency 100MHz (reference value)
- IF Frequency 450kHz (standard)
- AM/FM detector circuits selectable  
AM SW= HIGH Simultaneous operation of AM/FM sections  
AM SW= LOW FM section only
- Built-in AGC circuit in AM section
- Wide Range RSSI (Received Signal Strength Indication)
- Bipolar Technology
- Package Outline SSOP20

### ■ BLOCK DIAGRAM



**■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)**

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V <sup>+</sup>	12	V
Power Dissipation	P <sub>d</sub>	300	mW
Operating Temperature	T <sub>opr</sub>	-40 to +85	°C
Storage Temperature	T <sub>stg</sub>	- 50 to +125	°C

**■ RECOMMENDED OPERATING CONDITION (Ta=25°C)**

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V <sup>+</sup>		2.2	2.7	9.0	V

**■ ELECTRICAL CHARACTERISTICS**

Ta=25°C, V<sup>+</sup>=2.7V, f<sub>MIX</sub>=10.7MHz, f<sub>LO</sub>=10.25MHz, f<sub>IF</sub>=450kHz,

**FM:** f<sub>dev</sub>=±3kHz, f<sub>mod</sub>=1kHz, AM SW=LOW

**AM:** AM=30%, f<sub>mod</sub>=1kHz, AM SW=HIGH, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Current Consumption	I <sub>ccq1</sub>	No signal, Circuit 1 AM SW=HIGH	-	5	6.6	mA
Current Consumption	I <sub>ccq2</sub>	No signal, Circuit 1 AM SW=LOW	-	2.5	3.1	mA
Mixer Conversion Gain	G <sub>mix</sub>	V <sub>inMIX</sub> =40dBuV, Pin3 with ceramic filter and 1.8kΩ terminated. Circuit5	18	22	26	dB
Mixer 3rd Order Intercept	IIP3	Circuit5	-	95	-	dBuV
Mixer Input Resistance	R <sub>inM</sub>		-	3.6	-	kΩ
Mixer Input Capacitance	C <sub>inM</sub>		-	3.2	-	pF
Mixer Output Resistance	R <sub>oM</sub>		-	1.8	-	kΩ
<b>[FM IF Section]</b>						
SINAD 12dB	SINAD	Mixer input, Circuit 2	-	5	-	dBuV
Demodulated Output Level 1	V <sub>od1</sub>	f <sub>IF</sub> input, Circuit 4 V <sub>inIF</sub> =80dBuV	55	80	105	mVrms
Total Harmonic Distortion 1	THD1	f <sub>IF</sub> input, Circuit4 V <sub>inIF</sub> =80dBuV	-	1	2	%
Signal to Noise Ratio 1	S/N1	f <sub>IF</sub> input, Circuit4 V <sub>inIF</sub> =80dBuV	43	60	-	dB
AM Rejection Ratio	AMR	f <sub>IF</sub> input, Circuit4 V <sub>inIF</sub> =80dBuV, AM=30%	30	40	-	dB

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
FM IF Amp. Input Impedance	RinFMIF	DC value	1.2	1.8	2.4	kΩ
RSSI Output Voltage 1	Vrssi1	fIF input, Circuit4 No input signal	-	0.1	0.4	V
RSSI Output Voltage 2	Vrssi2	fIF input, Circuit4 VinIF=60dBuV	0.8	1.1	1.4	V
RSSI Output Voltage 3	Vrssi3	fIF input, Circuit4 VinIF=100dBuV	1.8	2.1	2.4	V
FM IF Amplifier	FMIFGV	fIF input, Circuit4	-	120	-	dB
RF AGC Output Voltage	VAGC	fIF input, Circuit4 VinIF =80dBuV	0.75	1.05	1.35	V
<b>[AM IF Section]</b>						
Demodulated Output Level 2	Vod2	fIF input, Circuit4 VinIF =80dBuV AGC On	42	60	85	mVrms
Total Harmonic Distortion 2	THD2	fIF input, Circuit4 VinIF =60dBuV AGC On	-	1	3	%
Total Harmonic Distortion 3	THD3	fIF input, Circuit4 VinIF =60dBuV,AM80% AGC On	-	2	4	%
Signal to Noise Ratio 2	S/N2	fIF input, Circuit4 VinIF =80dBuV AGC On	40	44	-	dB
Demodulated Output Deviation	DVod	fIF input, Circuit4 VinIF =80 to 90dBuV AGC On		±1.5		dB
AM IF Amplifier Input Impedance	RinAMIF	DC value	8	10	12	kΩ
<b>[AMP Section]</b>						
Amplifier Gain	G v	31kHz, Circuit 3	-	47	-	dB

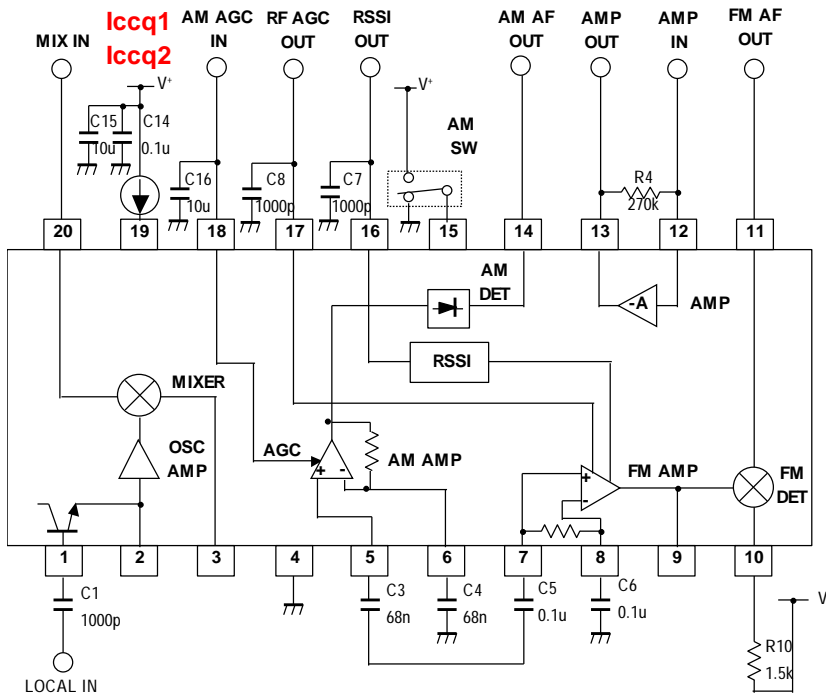
■ **AM SW pin select mode**

Control Voltage	FM section	AM section	Other sections
0V to 0.3V(Low)	On	Off	On
0.8V to V <sup>+</sup> (HIGH)	On	On	On

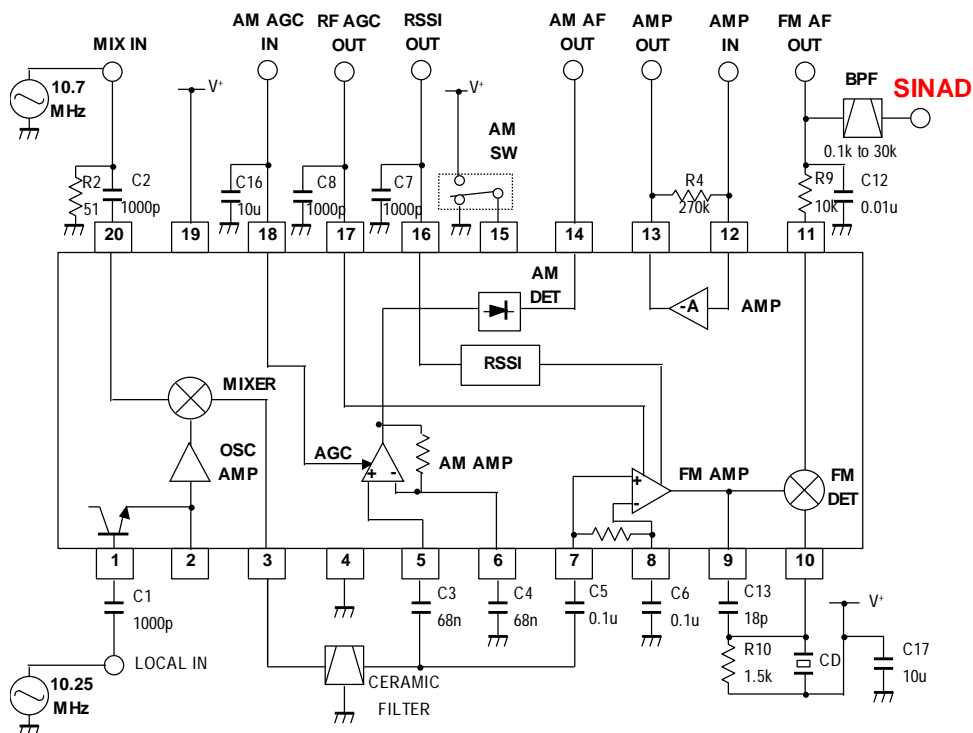
■ TEST CIRCUIT

This test circuit allows the measurement of all parameters described in "ELECTRICAL CHARACTERISTICS". This test circuit includes some electrical switches that should be in the suitable position for the measurement of each parameter.

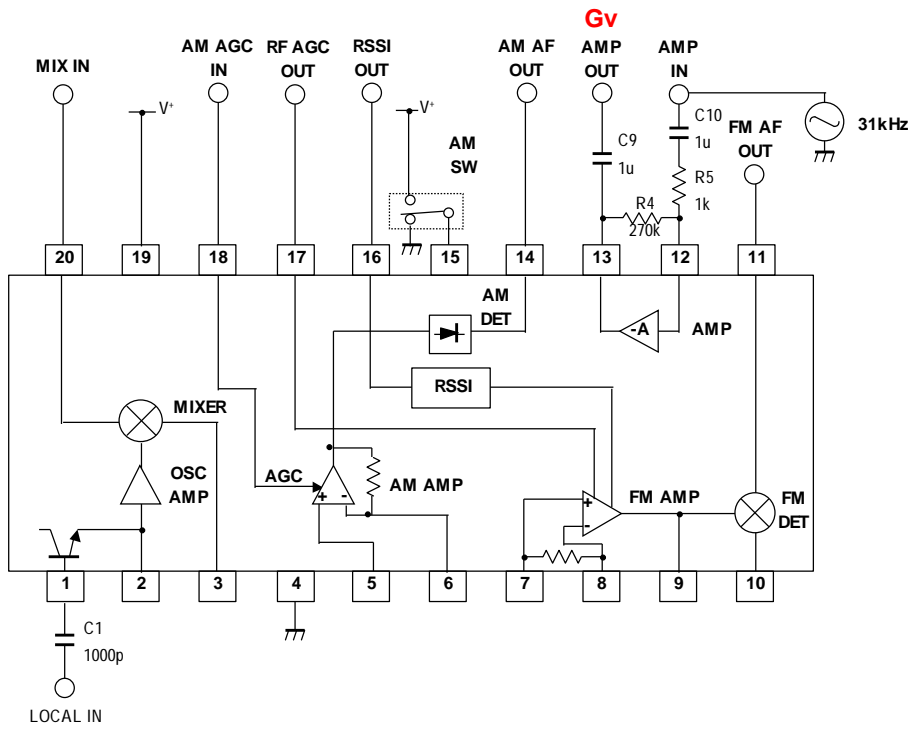
● Circuit 1 (Iccq1, Iccq2)



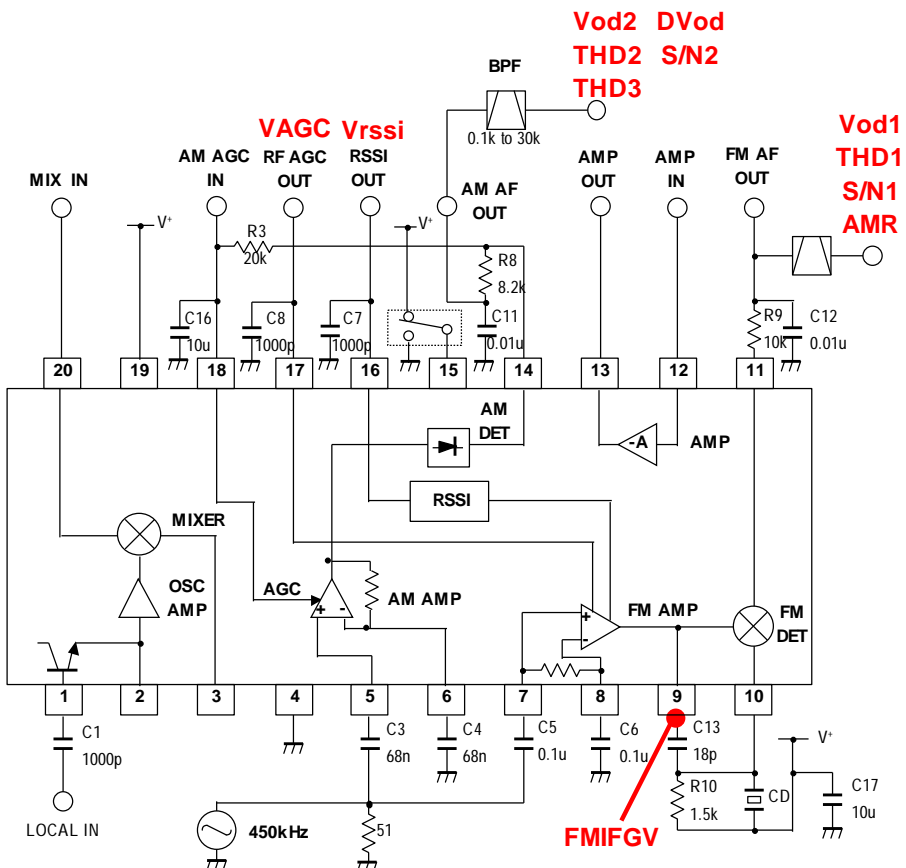
● Circuit 2 (SINAD)



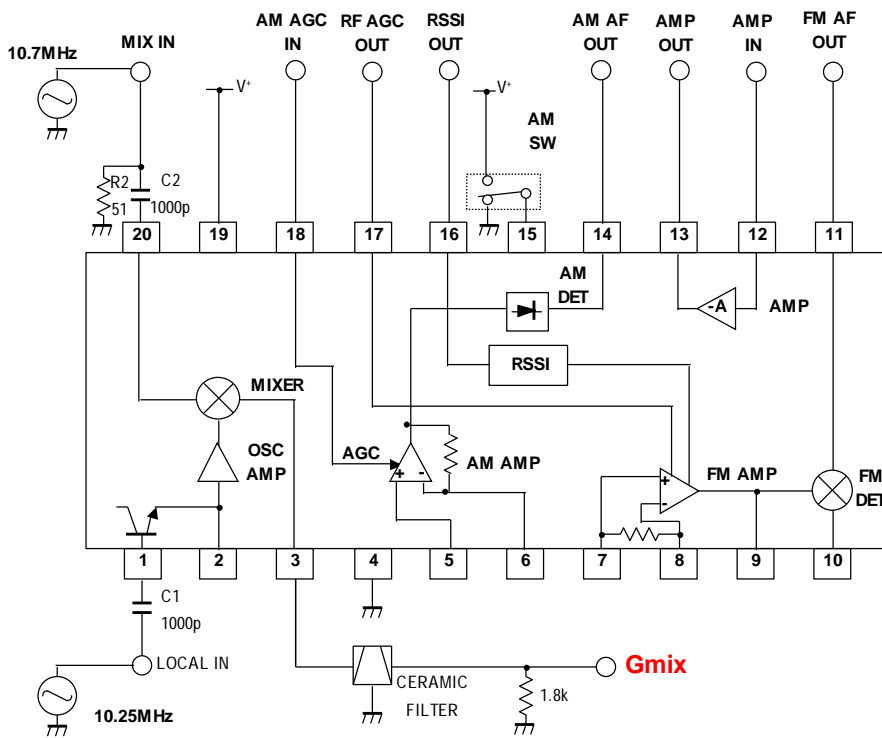
● Circuit 3 (Gv)



● Circuit 4 (Vod1/2, THD1/2/3, SN1/2, AMR, Vrssi1/2/3, FMIFGV, VAGC, DVod)



● Circuit 5 (Gmix)



■ **TERMINAL FUNCTION** ( $T_a=25^\circ\text{C}$ ,  $V^+=2.7\text{V}$ , circuit 1)

Pin No.	SYMBOL	EQUIVALENT CIRCUIT	VOLTAGE	FUNCTION
1	OSC (B)		2.66V	<b>Oscillator Base / Oscillator Emitter</b> Colpitts - type oscillator is formed with an external oscillator element of crystal unit or SAW resonator. Output of an external oscillator circuit can also input to pin1 or pin2.
2	OSC (E)		1.95V	
3	MIX OUT		1.75V	<b>Mixer Output</b> An external 450kHz ceramic filter is connected. The typical output impedance is 1.8kΩ.
4	GND	-	--	<b>Ground</b>
5	AM IF IN		1.35V	<b>AM IF Input</b> This is an AM IF signal input to AGC amplifier. The typical input impedance is 10kΩ.
6	AM DEC		1.35V	<b>AM IF Decoupling</b> This is an AM IF decoupling terminal for AGC amplifier. An external decoupling capacitor is connected to enhance stability.
7	FM IF IN		2.66V	<b>IF Limiter Amplifier Input</b> This is an input to the IF amplifier after passing through 450kHz ceramic filter. The typical input impedance is 1.8kΩ.
8	FM DEC		2.66V	<b>IF Decoupling</b> An external decoupling capacitor is connected to enhance stability.

Pin No.	SYMBOL	EQUIVARENT CIRCUIT	VOLTAGE	FUNCTION
9	FM IF OUT		1.80V	<p><b>FM IF Output</b> This is an output of FM IF signal passing through the internal FM amplifier. An external phase - shifting capacitor is connected between pin9 and pin10.</p>
10	QUAD IN		2.70V	<p><b>Quadrature Detector Input</b> An external phase - shifting coil or ceramic discriminator is connected.</p>
11	FMAF OUT		0.96V	<p><b>FM Demodulated Signal Output</b> An external 3rd order multiple feed -back filter (RC filter) is connected.</p>
12	AMP IN		0.66V	<p><b>Input of Amplifier for Low Pass Filter</b> External RC components form a low pass filter between pin12 and pin13. This terminal is biased from pin 11 through an external RC filter.</p>
13	AMP OUT		0.71V	<p><b>Output of Amplifier for Low Pass Filter</b></p>



Pin No.	SYMBOL	EQUIVALENT CIRCUIT	VOLTAGE	FUNCTION
14	AM AF OUT		1.46V	<b>AM Demodulated Signal Output</b> An external RC filter may be connected to reduce undesired signal.
15	AM SW		--	<b>AM Section ON/OFF Switch</b> Both of AM and FM section are in action during AM SW=HIGH. When AM SW=LOW, AM section keeps a state of not working.
16	RSSI OUT		0.17V	<b>Received Signal Strength Indicator Output</b> Pin 16 outputs DC level proportional to the log of input signal level to pin7.
17	RF AGC OUT		0.08V	<b>Output of RF AGC circuit</b> Pin 17 outputs DC voltage to control the gain of external RF amplifier.

Pin No.	SYMBOL	EQUIVALENT CIRCUIT	VOLTAGE	FUNCTION
18	AMAGC IN		1.46V	<b>Gain Control of AGC Circuit for AM Signal</b> Pin 18 is connected with pin 14 through the external ripple filter of R and C.
19	V <sup>+</sup>	-	-	Supply Voltage
20	MIX IN		0.94V	<b>Mixer Input</b> The mixer is designed to work up to 100MHz with the typical input impedance of $R_{inM} = 3.6k\Omega$ and $C_{inM} = 3.2pF$ (at 10.7MHz).

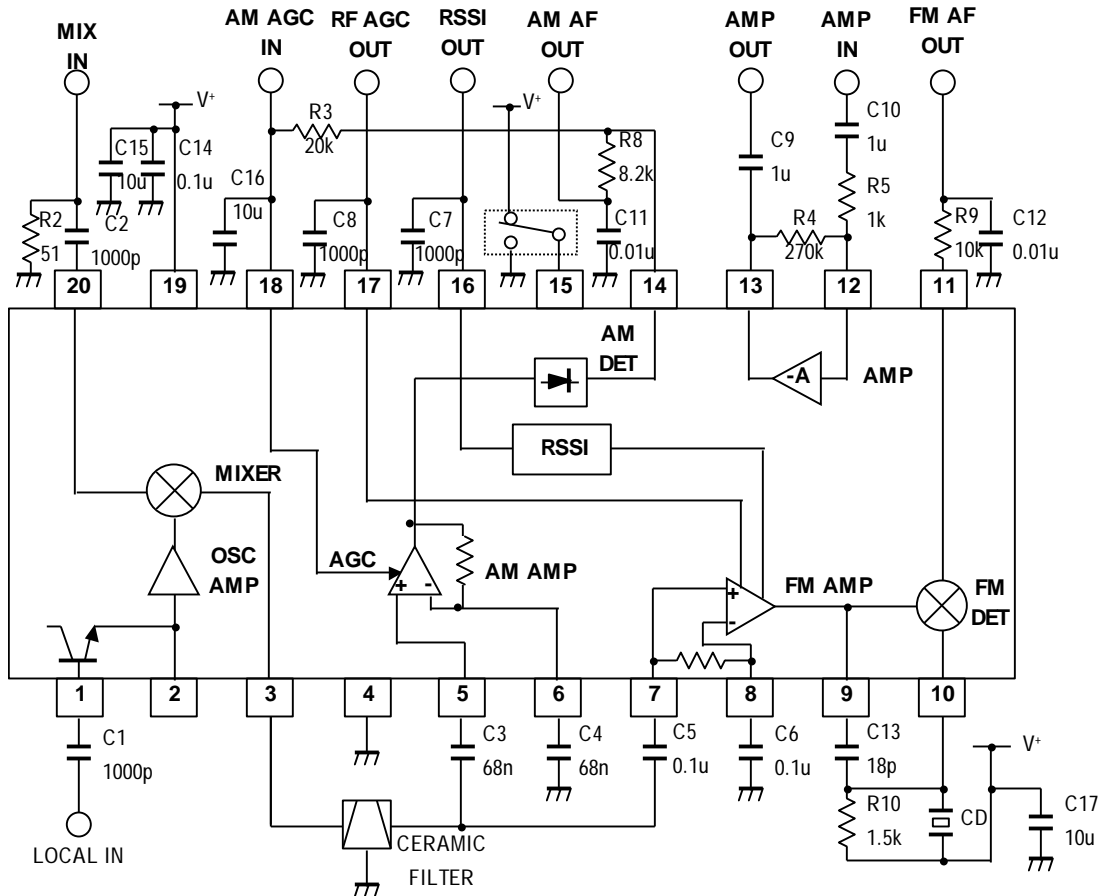
**Note :**

- ESD protection diodes exist between each of the following pins and V<sup>+</sup>.  
Pin 1,2,3,5,6,7,8,9,10,11,12,13,14,16,17,18,20
- ESD protection diodes also exist between each of the following pins and ground.  
Pin 1,2,3,5,6,7,8,9,10,11,12,13,14,15,16,17,18,20

■ EVALUATION PC BOARD

The evaluation board is useful for your design and to have more understanding of the usage and performance of this device. This circuit is the same as TEST CIRCUIT. Note that this board is not prepared to show the recommendation of pattern and parts layout.

● Circuit Diagram



Note:

1. External Components

R1=R6=R7=0Ω R2=51Ω R3=20kΩ R4=270kΩ R5=1kΩ R8=8.2kΩ R9=10kΩ R10=1.5kΩ

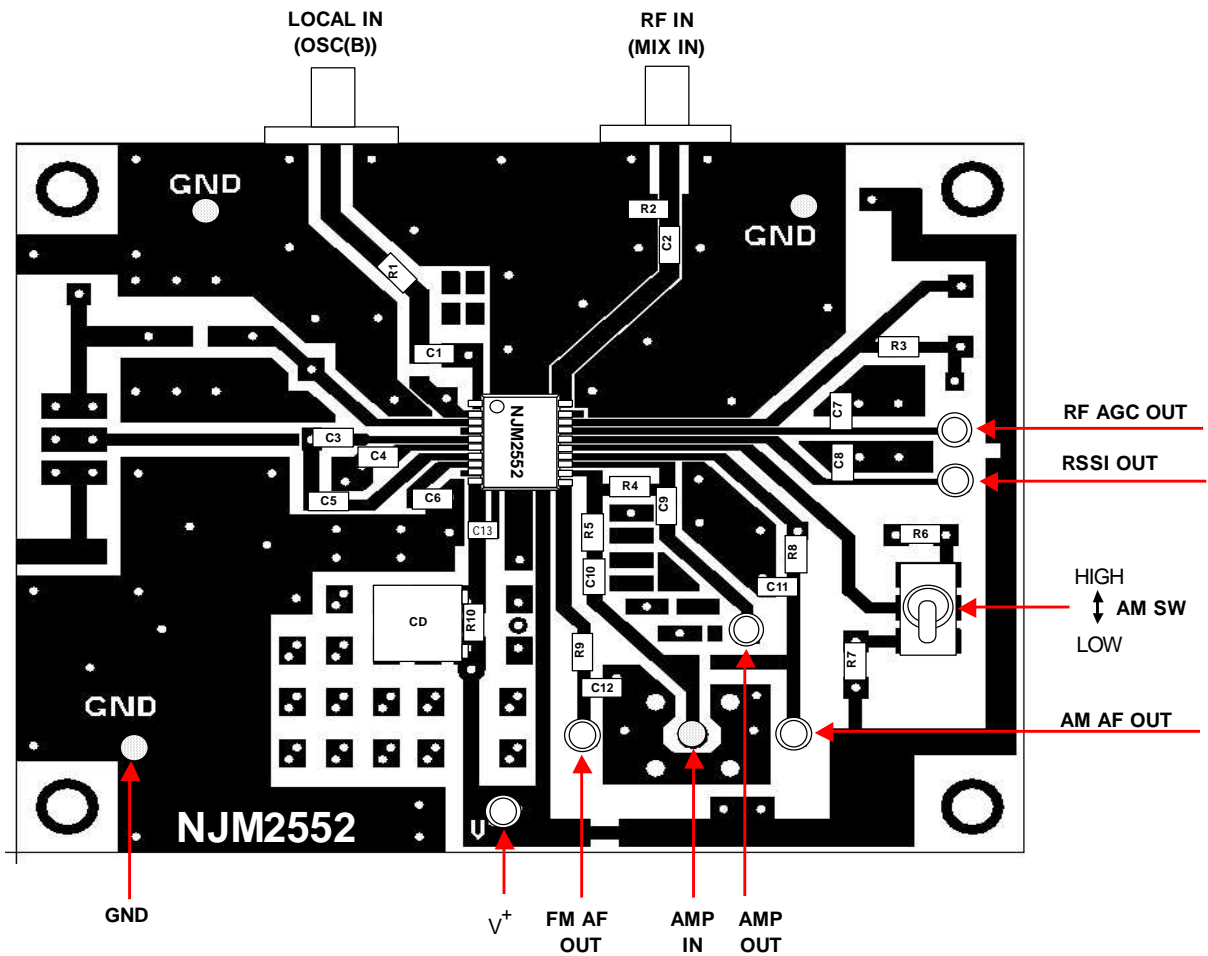
C1=C2=C7=1000pF C3=C4=68nF C5=C6=C14=0.1uF C9=C10=1uF

C11=C12=0.01uF C13=18pF C15=C16=C17=10uF

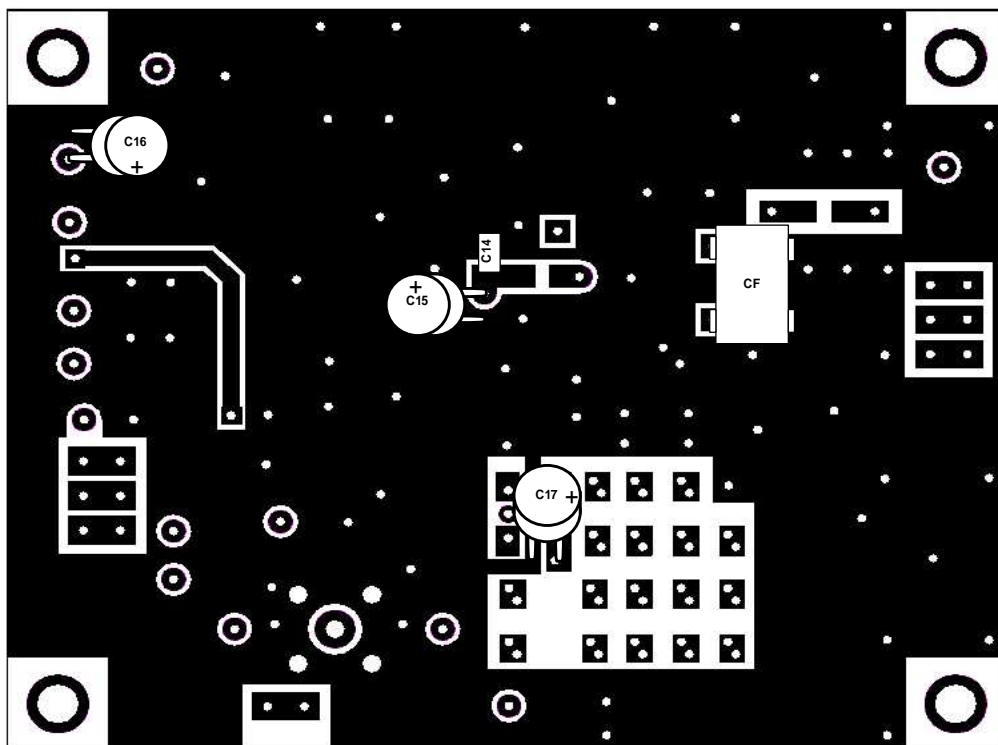
CD : Ceramic Discriminator, 450kHz

CERAMIC FILTER : CF, 450kHz

● Circuit Side View



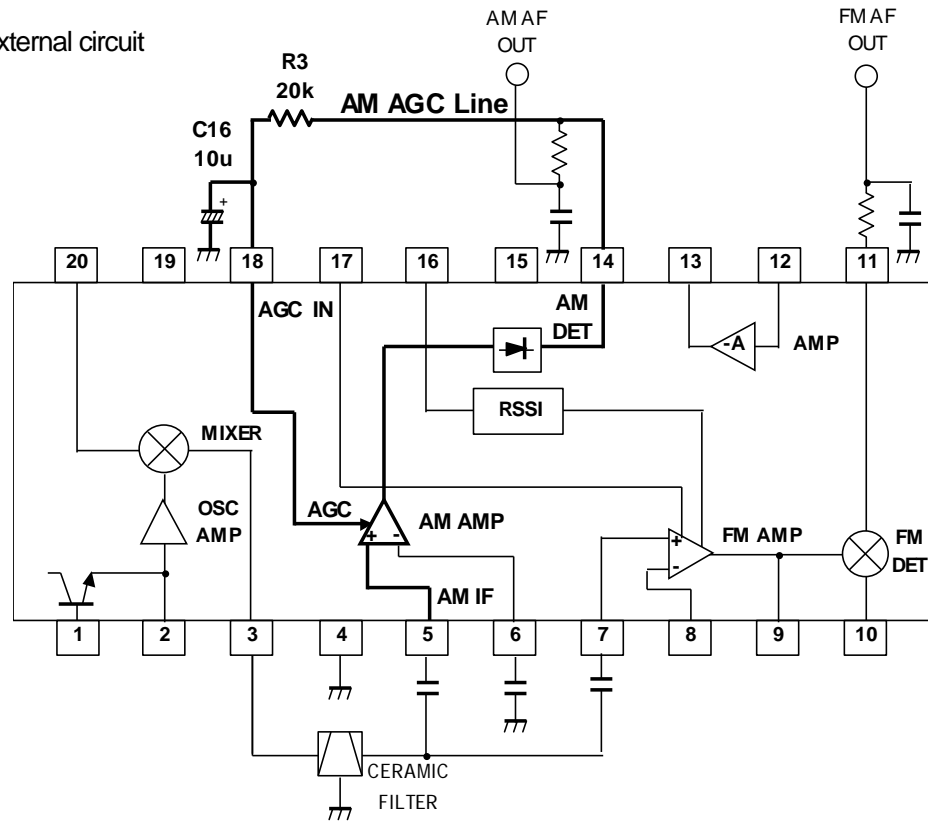
● Ground Side View



■ Description

● AM AGC Line

1. Example of external circuit

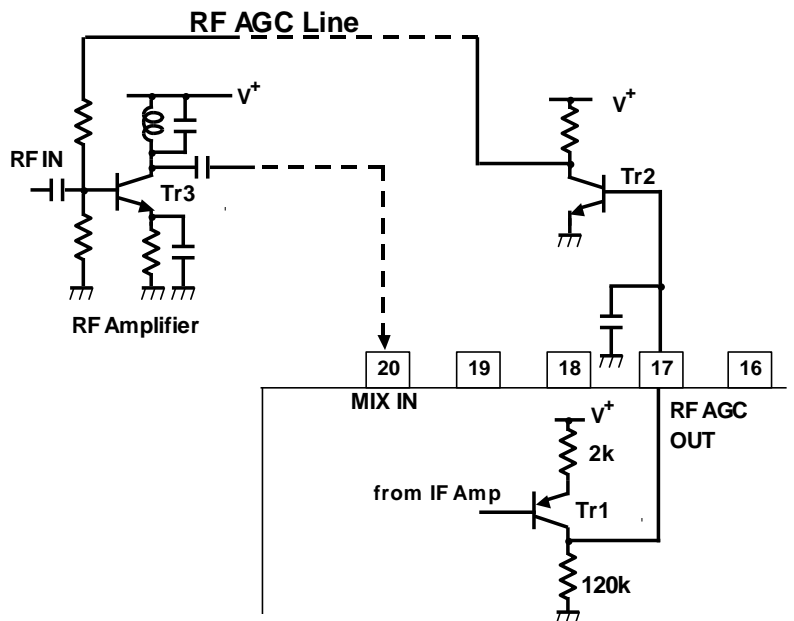


2. Explanation

AM AGC IN terminal (pin18) is usually connected with the AM DET terminal (pin 14) through the ripple filter of R3 and C16. This filter has the time constant of  $R3 \times C16$  and this value of time constant is generally selected to be 5 to 10 times larger than the lowest cycle of the AM modulation signal (, not AM demodulated signal). AGC IN terminal (pin 18) can also be controlled by an external DC source instead of DC output of AM DET terminal.

● RF AGC Line

1. Example of external circuit



2. Explanation

RF AGC OUT terminal (pin17) can be connected to the bias circuit of the external RF amplifier to control its gain. RF AGC characteristics are shown on following page.

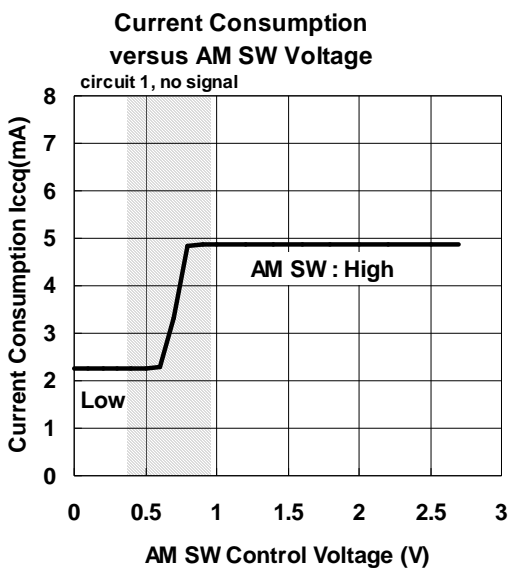
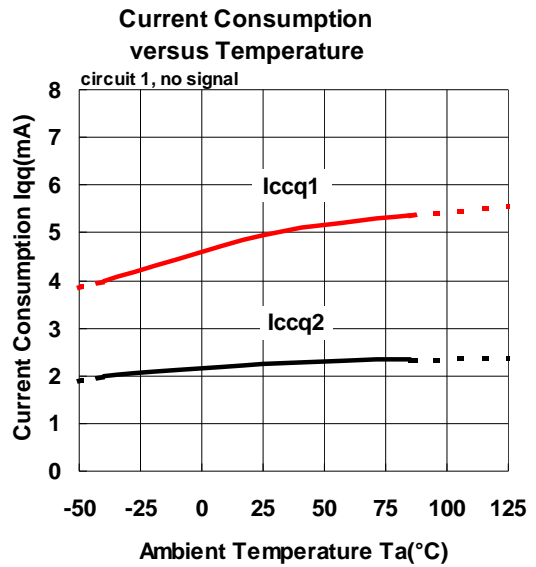
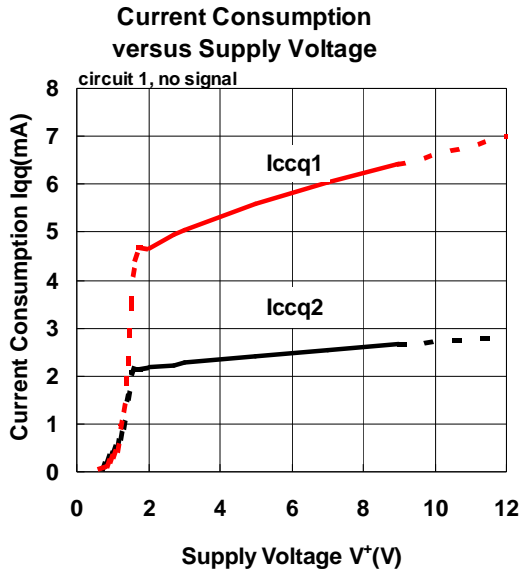
## ■ TYPICAL CHARACTERISTICS

Ta=25°C, V<sup>+</sup>=2.7V, fMIX=10.7MHz, fLO=10.25MHz, fIF=450kHz

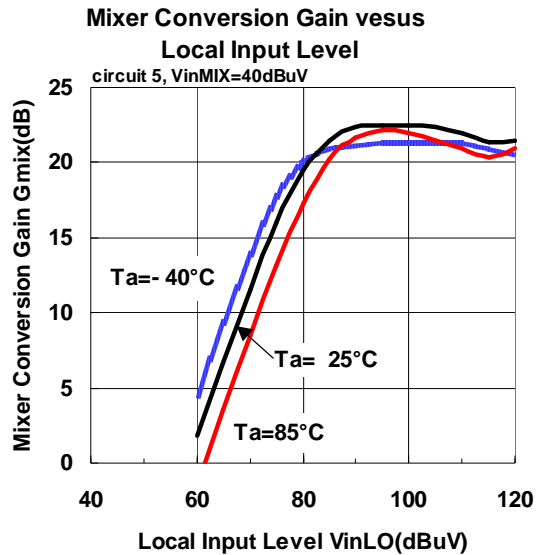
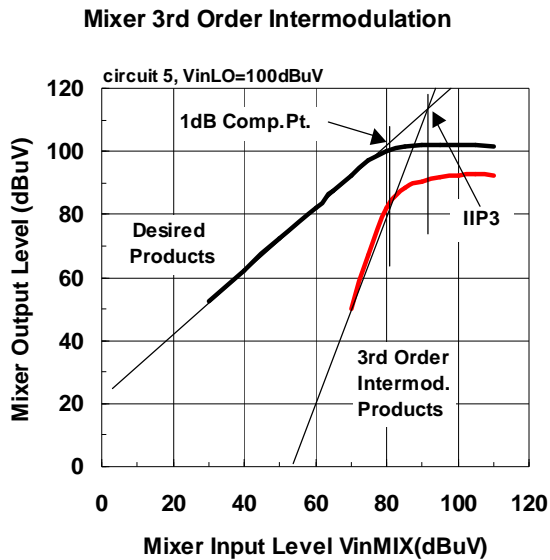
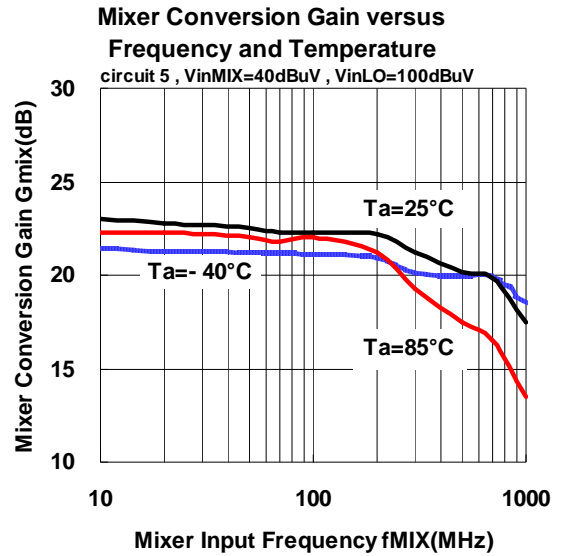
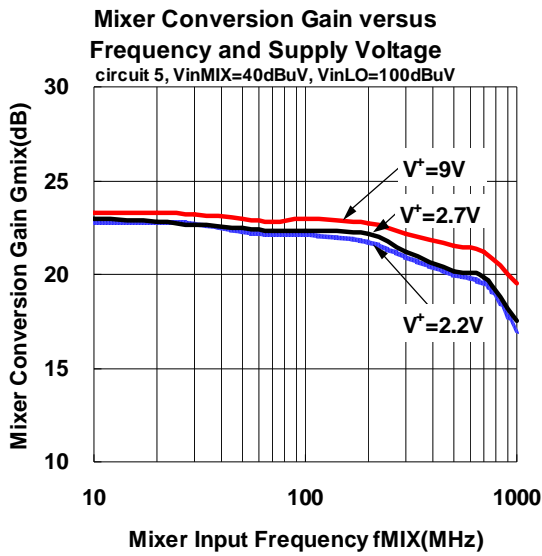
FM: fdev=±3kHz, fmod=1kHz, AM SW=LOW

AM: AM=30%, fmod=1kHz, AM SW=HIGH, unless otherwise noted.

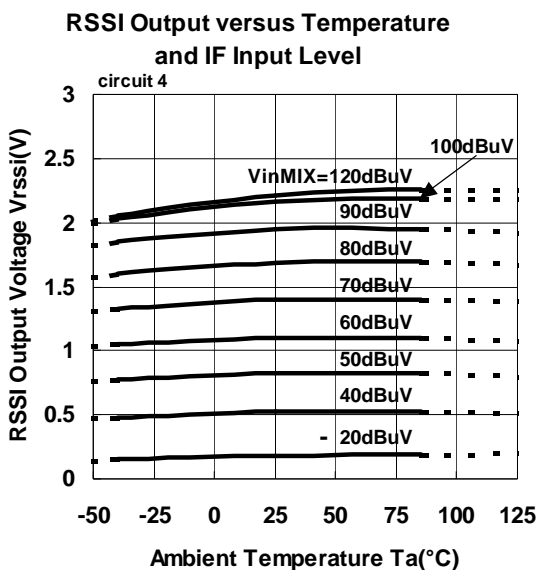
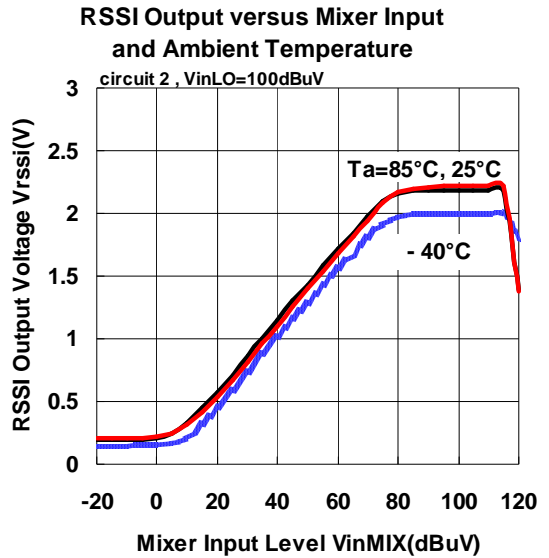
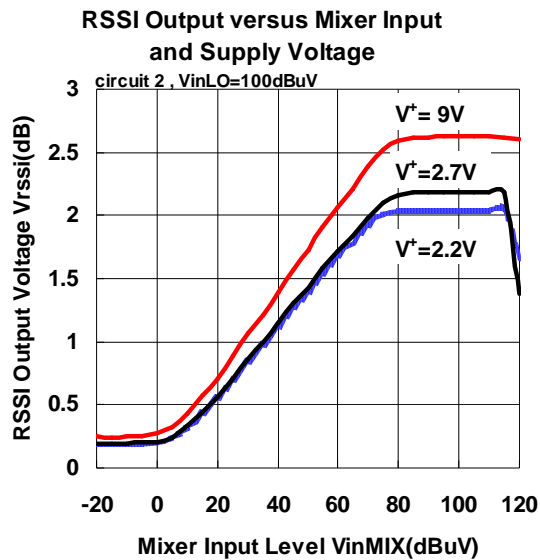
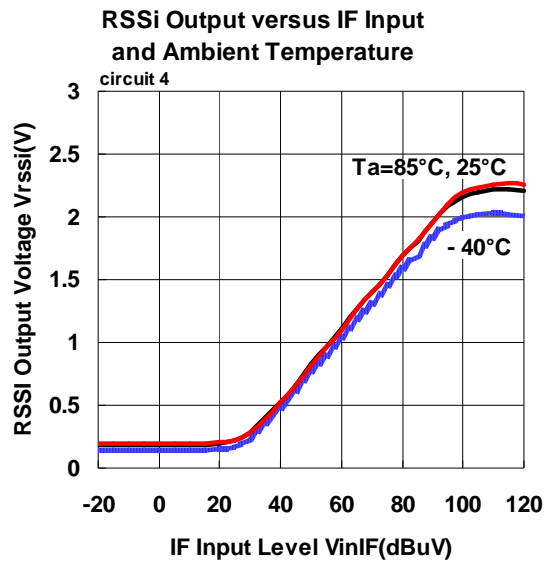
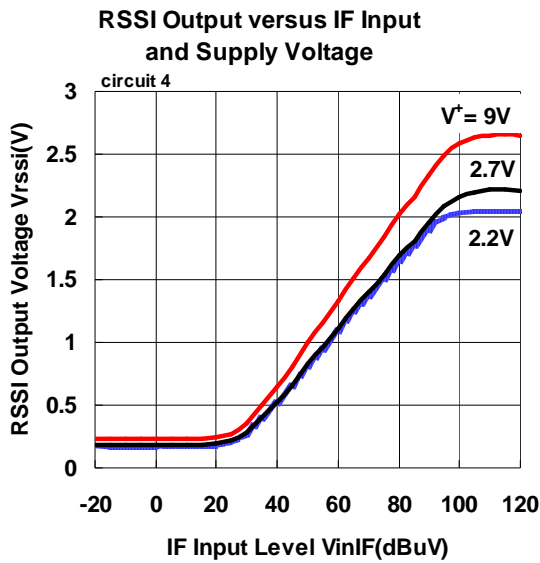
### [DC Characteristics]



[Mixer Characteristics]

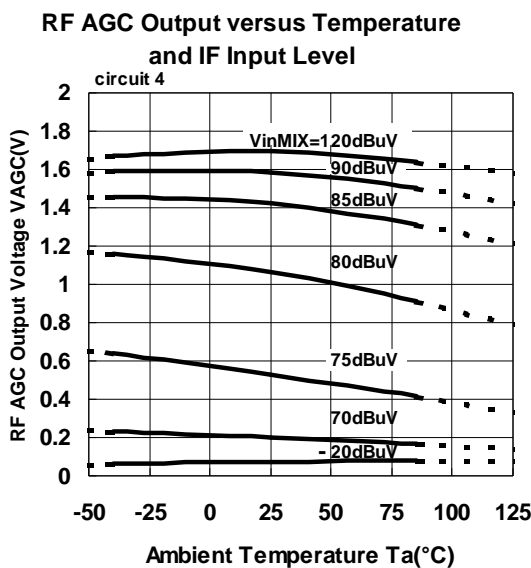
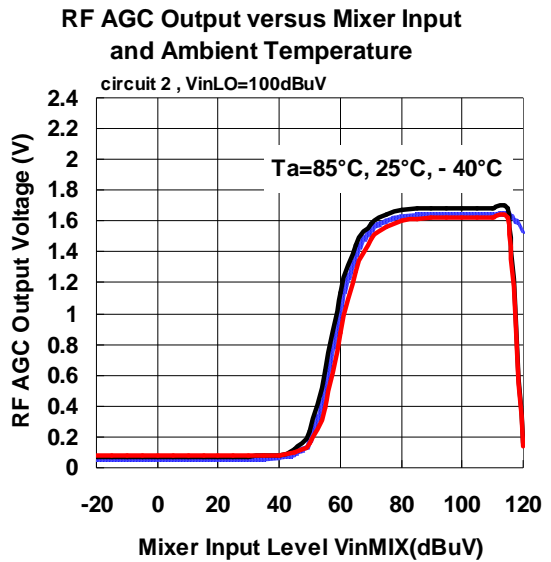
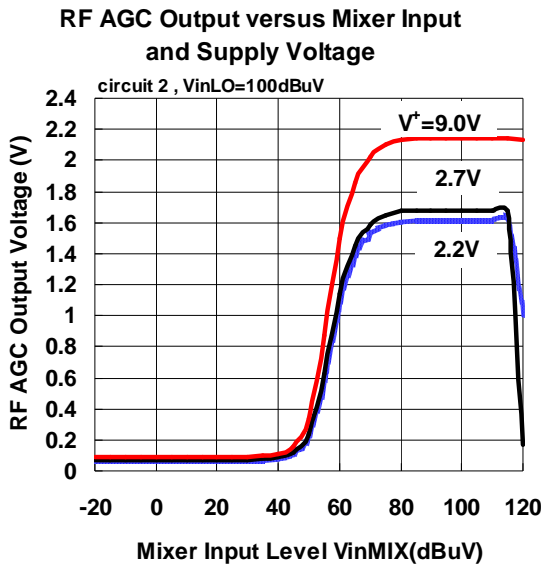
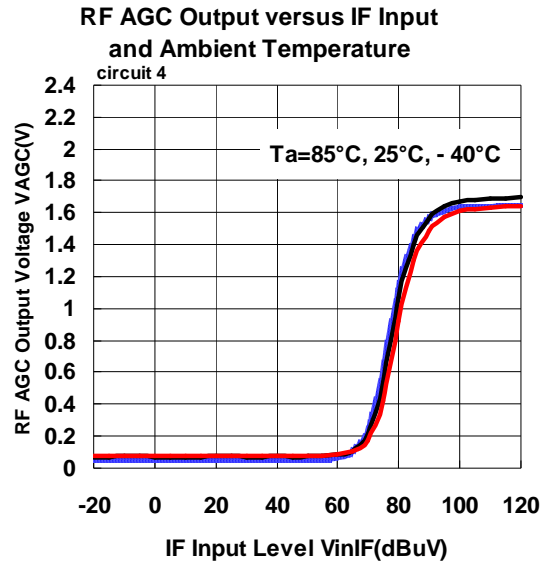
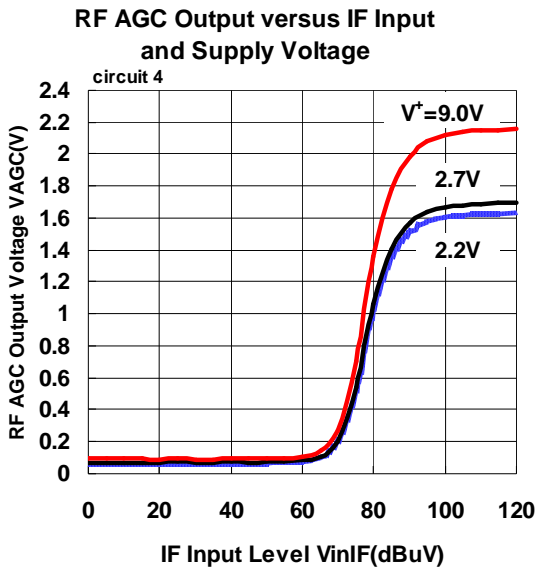


[RSSI Characteristics]

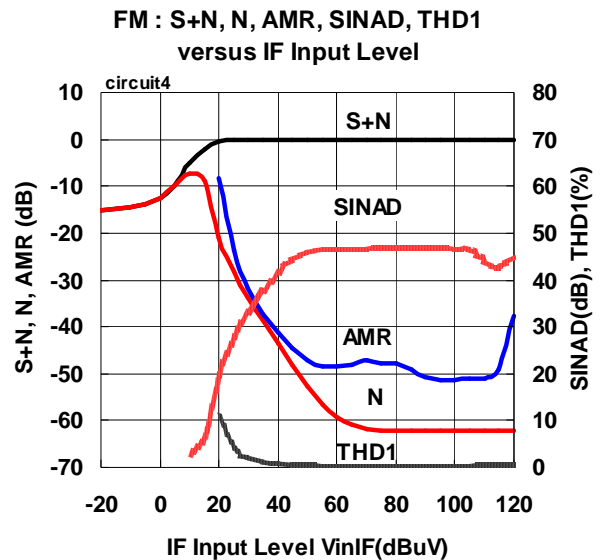
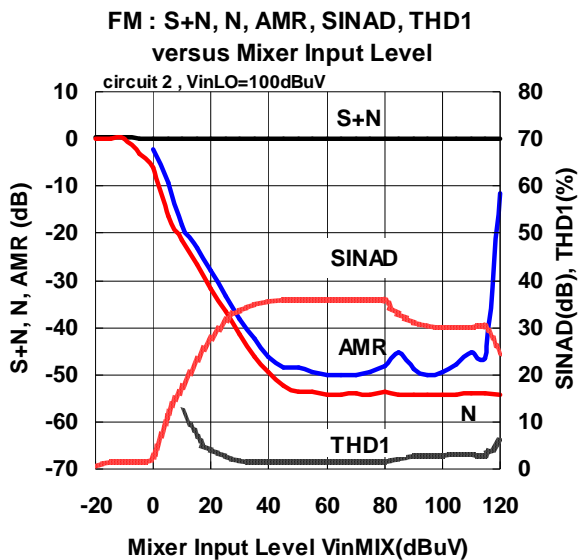
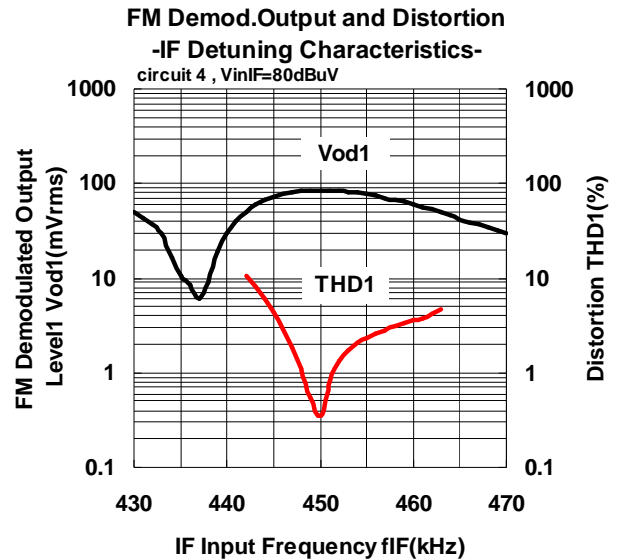
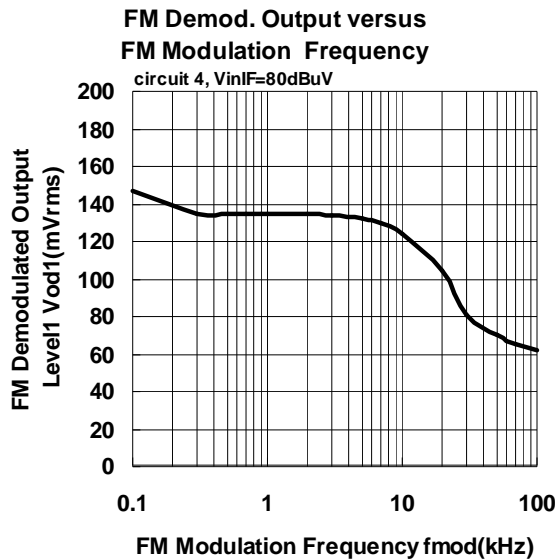
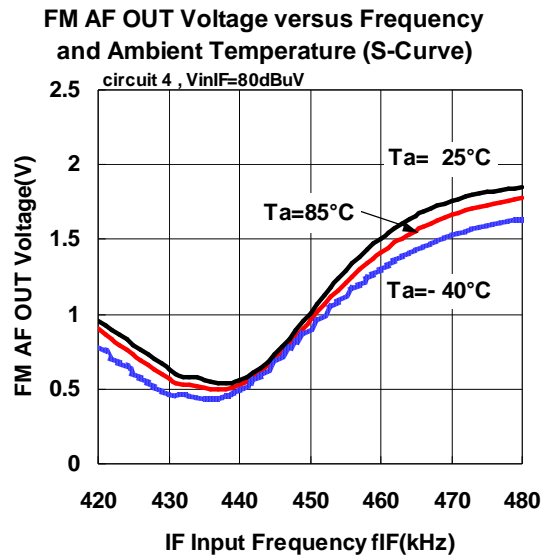
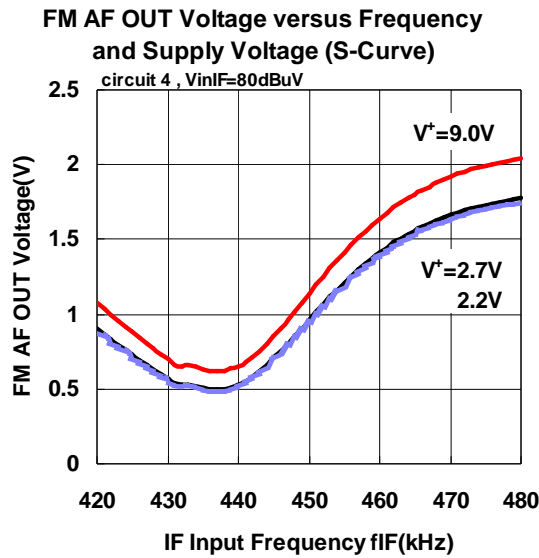




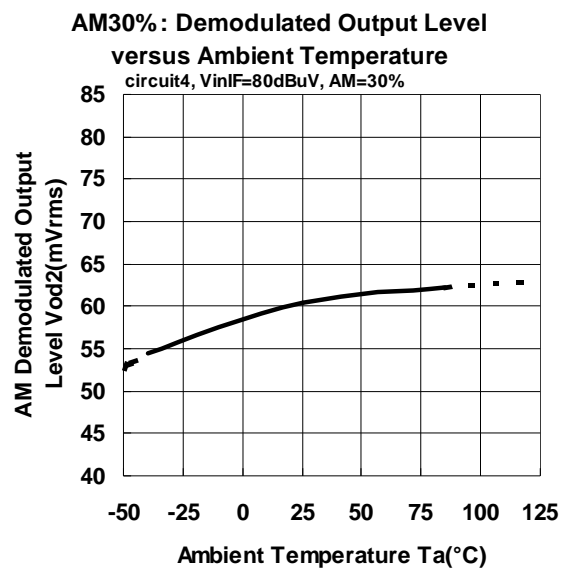
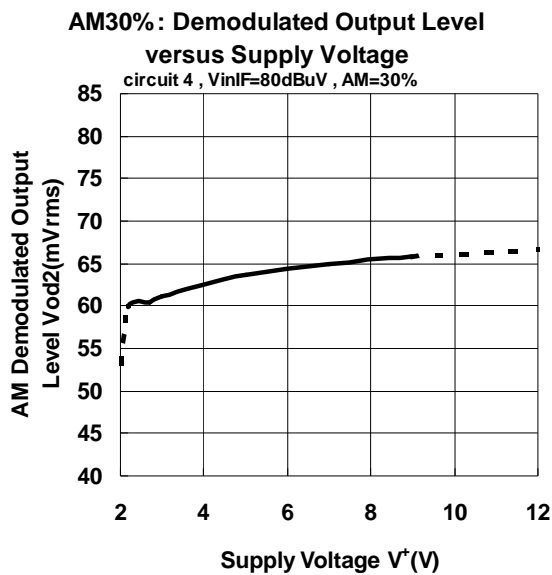
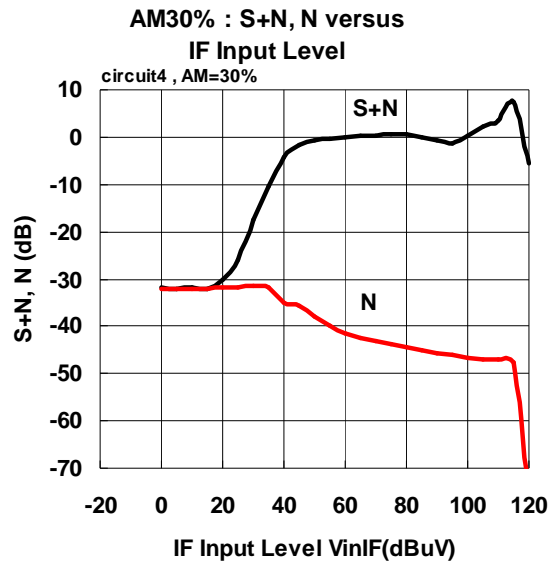
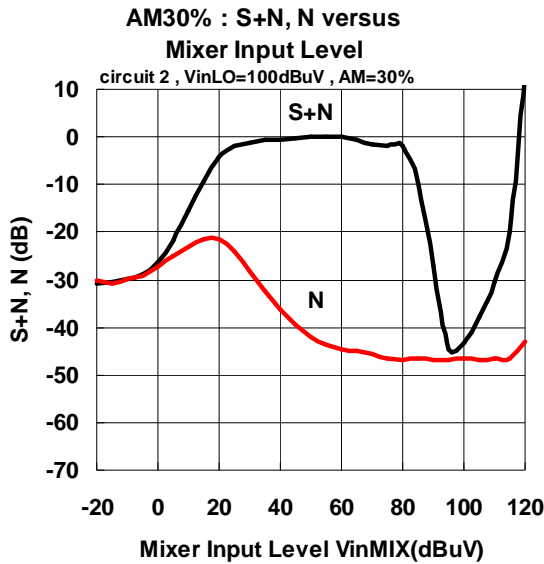
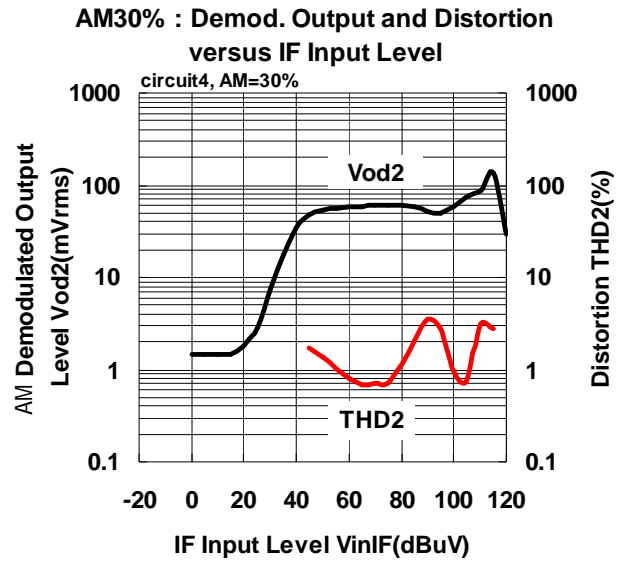
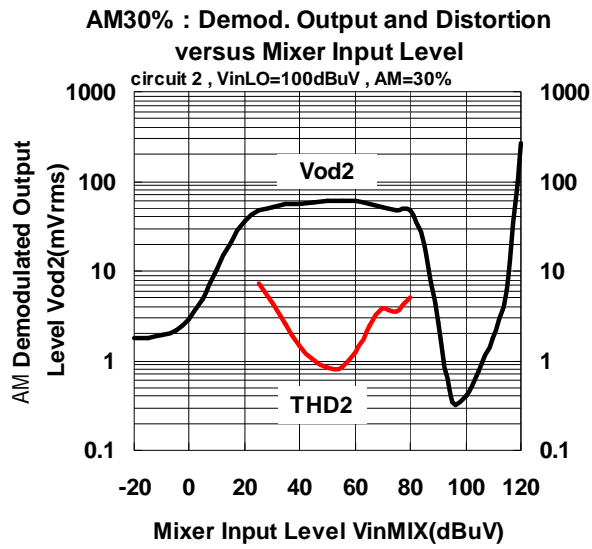
[RF AGC Characteristics]

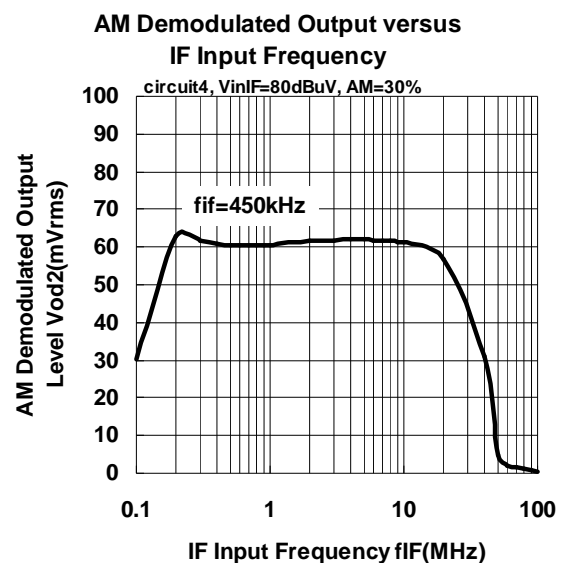
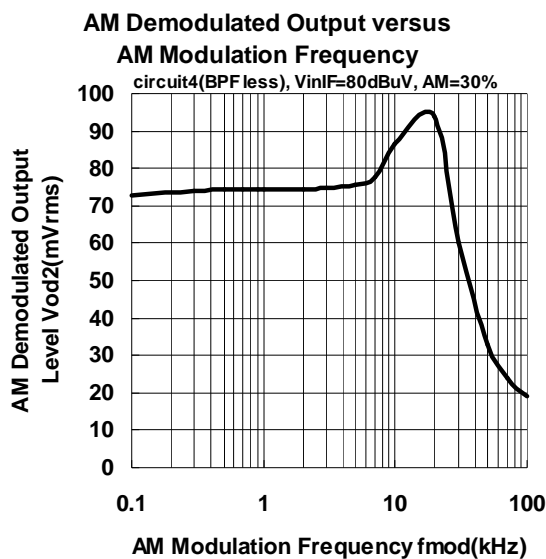
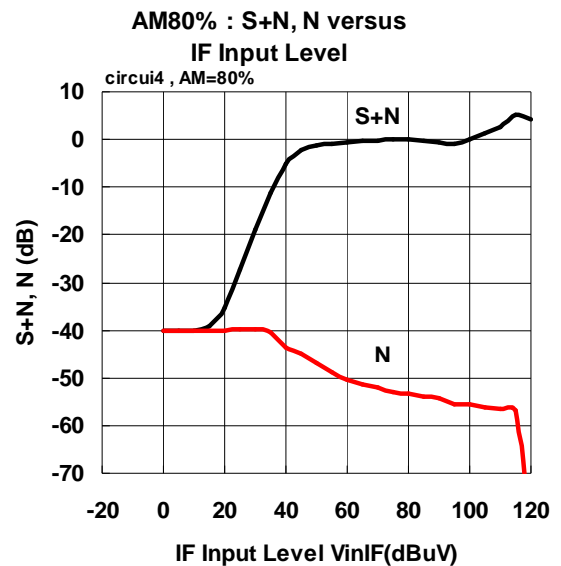
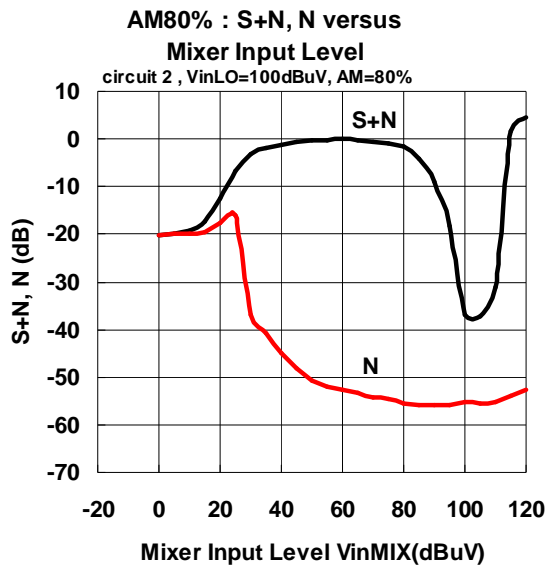
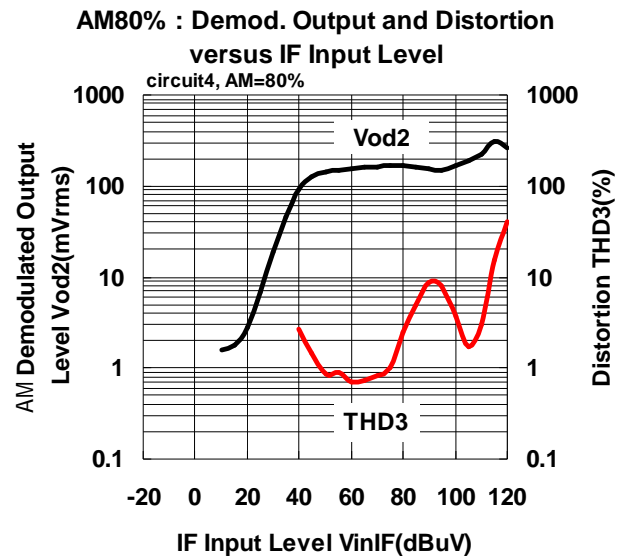
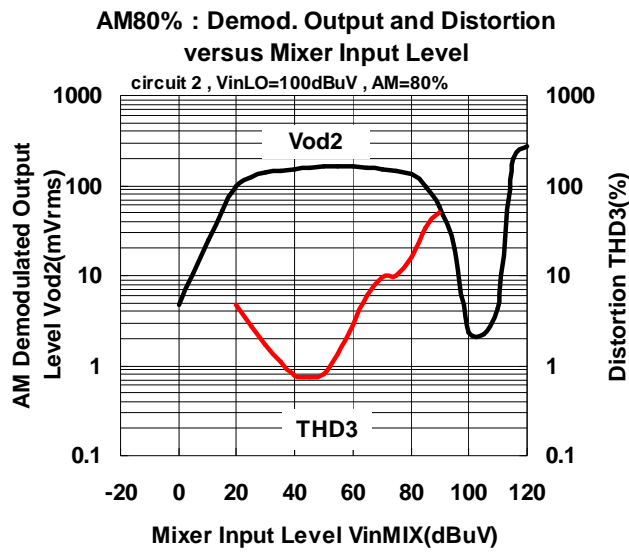


[FM Demodulation Characteristics]



[AM Demodulation Characteristics]





**[CAUTION]**

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