

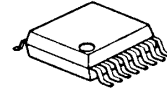
100MHz INPUT 450kHz FM IF DEMODULATOR IC FOR VOICE

■ GENERAL DESCRIPTION

The **NJM2591** is a wide - operating voltage, low – current FM IF demodulator IC for voice application. It includes an oscillator, mixer, limiting amplifier, quadrature detector, and active filter.

The **NJM2591** also has a noise detector and noise comparator with hysteresis range.

■ PACKAGE OUTLINE

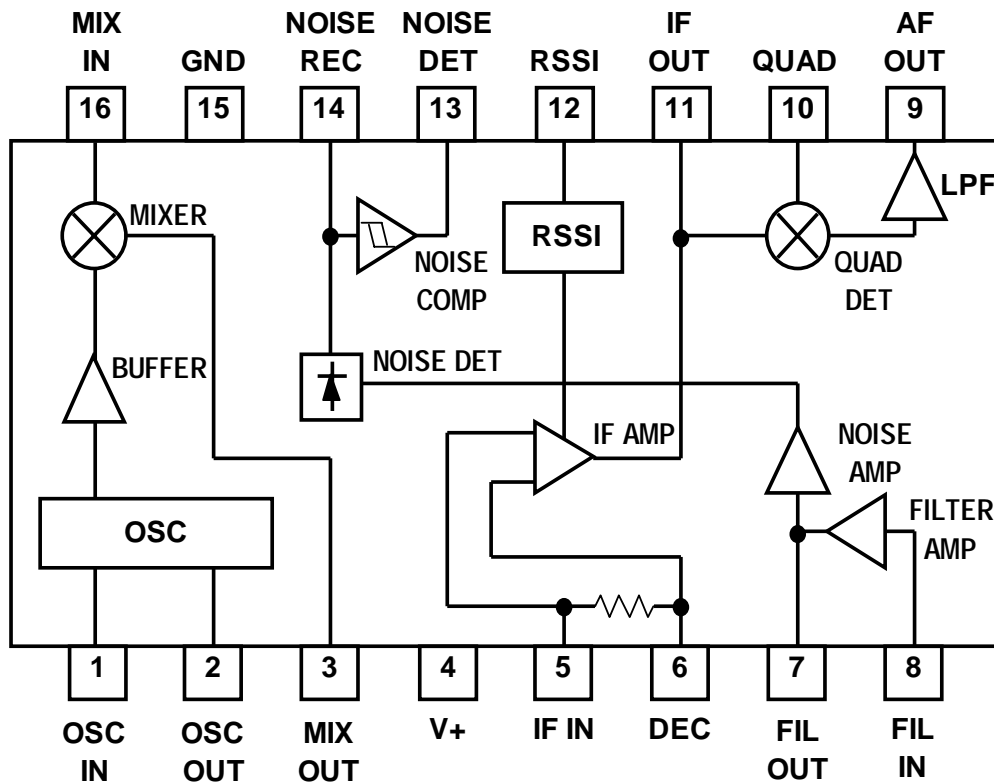


NJM2591V

■ FEATURES

- Wide Operating Voltage 1.8V to 9.0V
- Low Operating Current 2.5mA type. at $V^+ = 2.0V$
- Maximum Input Frequency 100MHz (reference value)
- IF Frequency 450kHz (standard)
- Bipolar Technology
- Package Outline SSOP16

■ BLOCK DIAGRAM



NJM2591

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V ⁺	10.0	V
Power Dissipation	P _D	300	mW
Operating Temperature	T _{opr}	- 30 to +85	°C
Storage Temperature	T _{stg}	- 40 to +125	°C

■ RECOMMENDED OPERATING CONDITION

(Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V ⁺		1.8	2.5	9.0	V

■ ELECTRICAL CHARACTERISTICS

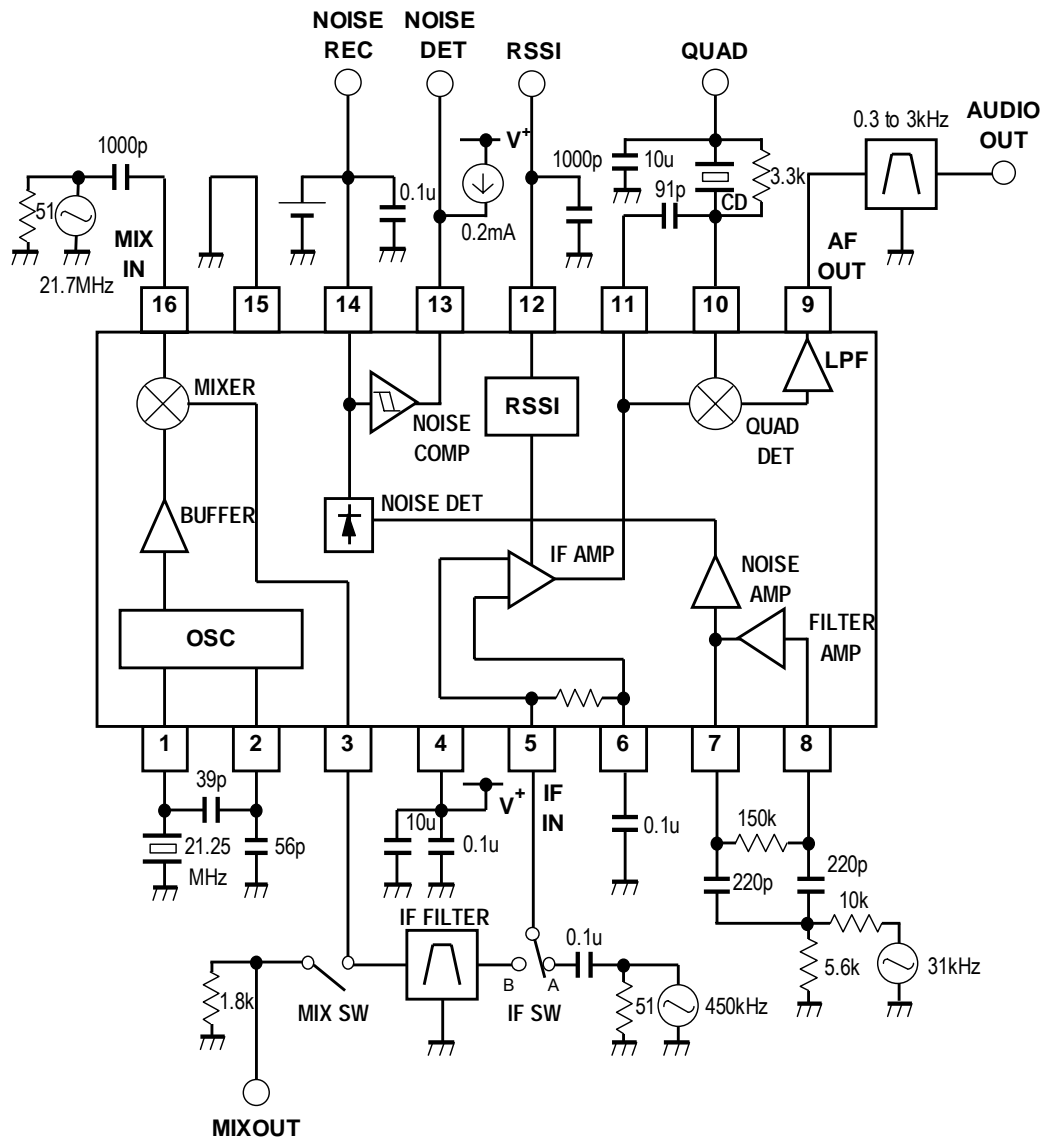
(Ta=25°C, V⁺=2.0V, f_{mix}=21.7MHz, f_{lo}=21.25MHz, f_{if}=450kHz, f_{mod}=1kHz, f_{dev}=±1.5kHz, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Current Consumption	I _{ccq}	No Signal	-	2.5	-	mA
Mixer Conversion Gain	G _{mix}	Without filter, VinMIX=46dBuVEMF, Pin3 is terminated with 1.8kΩ	21	24	27	dB
Mixer 3rd Order Intercept	IP3		-	96	-	dBuVEMF
Mixer Input Resistance	R _{inM}		-	(10)	-	kΩ
Mixer Input Capacitance	C _{inM}		-	(3.2)	-	pF
Mixer Output Resistance	R _{oM}		1.2	1.8	2.4	kΩ
12 dB S/N	12dB S/N		-	11	-	dBuV
Audio Output Voltage	V _{od}	IF input VinIF=80dBuVEMF	70	100	130	mVrms
Signal to Noise Ratio	S/N	IF input VinIF=80dBuVEMF	43	65	-	dB
AM Rejection Ratio	AMR	IF input, AM=30% VinIF=80dBuVEMF	-	40	-	dB
IF Amplifier Input Resistance	R _{inIF}		1.2	1.8	2.4	kΩ
RSSI Output Voltage 1	V _{rssi1}	V ⁺ =3.0V, IF input VinIF=30dBuVEMF	0.2	0.36	0.52	V
RSSI Output Voltage 2	V _{rssi2}	V ⁺ =3.0V, IF input VinIF=100dBuVEMF	1.4	2.0	2.6	V
Noise Detector Output Voltage	V _{nedt}	I _{sink} =0.2mA	-	0.1	0.5	V
Noise Detector Output Leak Current	I _{leak}	V _{nrec} =0.6V, V _{nedt} =2V	-	0	5	μA
Noise Detector Level "High"	V _{th-h}		-	0.5	0.7	V
Noise Detector Level "Low"	V _{th-l}		0.3	0.4	-	V

The values shown in parenthesis are reference values.

■ 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.



IF FILTER: CFWCA450KGFA (Murata Manufacturing Co., Ltd., JAPAN)

Ceramic discriminator CD: CDBLA450KCAY24 (Murata Manufacturing Co., Ltd., JAPAN)

■ CERAMIC DISCRIMINATOR (especially designed for NJM2591)

To optimize some important performance, the following ceramic discriminator is available. For more information on this CD and 455KHz CD, please contact the CD supplier.

CDBC450KCAY70 (Murata Manufacturing Co., Ltd., JAPAN)

with the external capacitance Cd of 33pF (instead of 91pF)

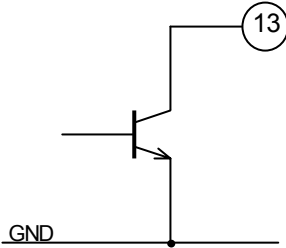
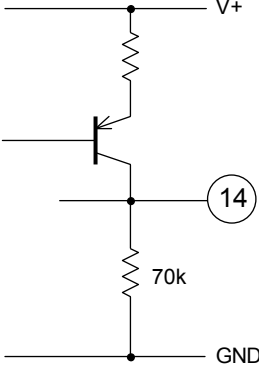
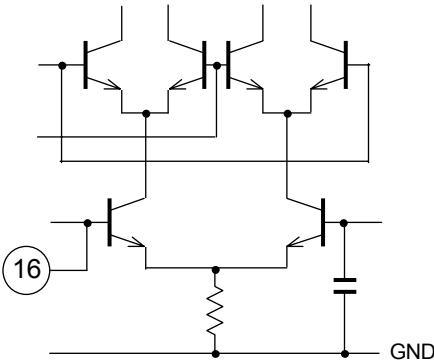
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■ TERMINAL FUNCTION (Ta=25°C, V+=2.0V)

Pin No.	SYMBOL	EQUIVARENT CIRCUIT	VOLTAGE	FUNCTION
1	OSC IN		1.97V	Local Oscillator Input and Output. Adding an external oscillator element of crystal unit or SAW resonator forms Colpitts - type oscillator. Output of an external oscillator circuit can also input to pin1 or pin2.
2	OSC OUT		1.27V	
3	MIX OUT		558mV	Mixer Output. Typical input impedance is 1.8kΩ.
4	V+		-	Supply Voltage.
5	IF IN		1.98V	IF Limiter Amplifier Input. Typical input impedance is 1.8kΩ.
6	DEC		1.98V	IF Decoupling. An external decoupling Capacitor is connected.
7	FIL OUT		691mV	Amplifier Output and Input. External RC components form a band pass filter.
8	FIL IN		662mV	

Pin No.	SYMBOL	EQUIVALENT CIRCUIT	VOLTAGE	FUNCTION
9	AF OUT		780mV	Demodulated Signal Output.
10	QUAD		2.0V	Quadrature Detector Input. Adding a 90 degree-phase shifter forms a quadrature detector circuit. A 90 degree-phase shifter mainly consists of a discriminator and a resistor.
11	IF OUT		1.18V	IF Output. Output of IF Amplifier
12	RSSI		71.8mV	Received Signal Strength Indicator (RSSI) Output. The output signal level is in logarithmic proportion to the IF limiter amplifier input signal of pin5.

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Pin No.	SYMBOL	EQUIVARENT CIRCUIT	VOLTAGE	FUNCTION
13	NOISE DET		--	Noise Comparator Output. The result of noise comparator is output by comparing the output voltage of pin14 with internal reference.
14	NOISE REC		67.3mV	Noise Detector Output. The output of filter amplifier is rectified to direct current by external capacitor.
15	GND	--	--	Ground.
16	MIX IN		1.0V	Mixer Input. Doubly balanced to reduce spurious radiation.

● Note

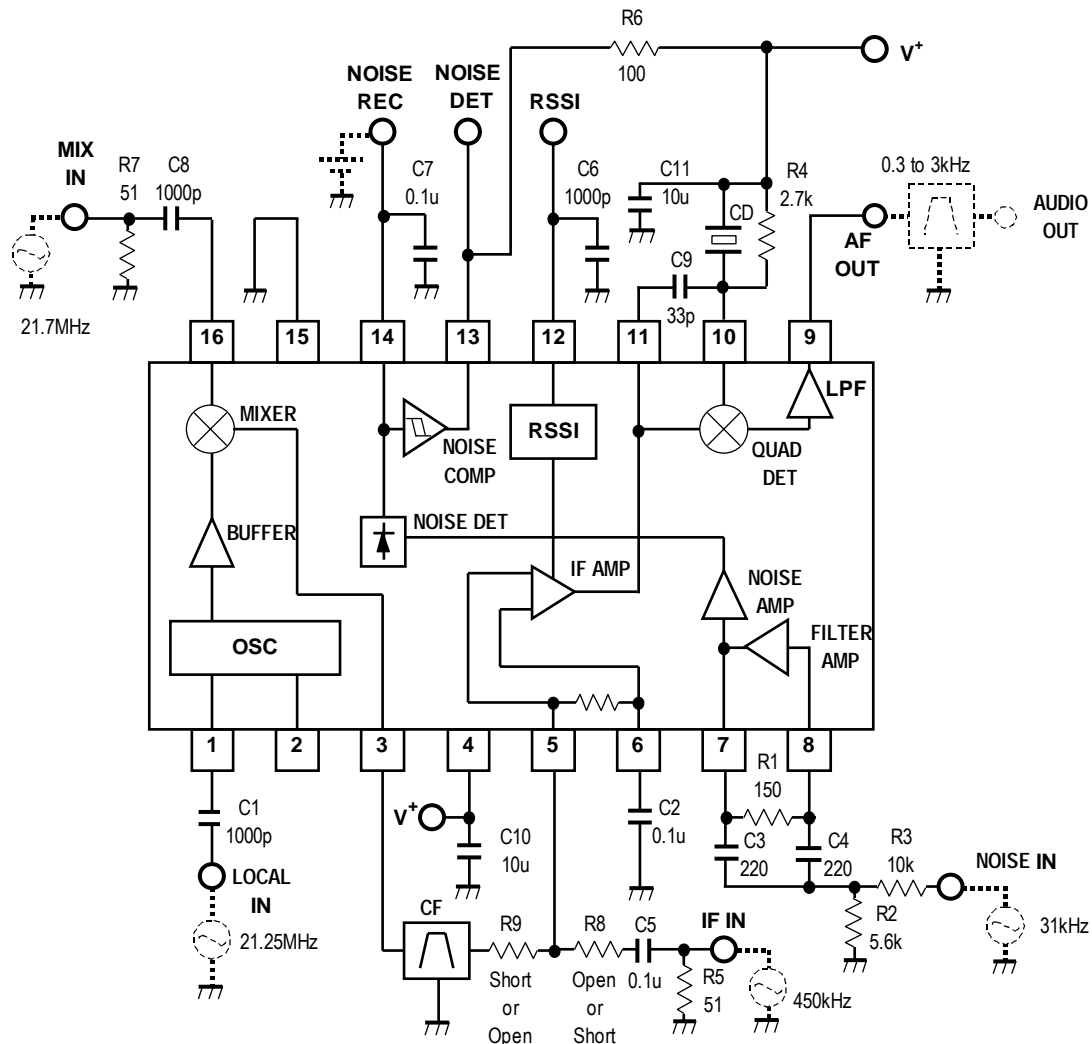
1. ESD protection diodes exist between each of all terminals and V⁺.
2. ESD protection diodes also exist between each terminal and ground.

■ EVALUATION BOARD

The evaluation PC board is useful for your design and is intended to have more understanding of the usage and performance of this device. The circuit of this board is the same as TEST CIRCUIT. For other electrical conditions, it should be necessary to reconsider each value of external components.

Note that this board is not prepared to show the recommendation of pattern and parts layout.

● Circuit Diagram

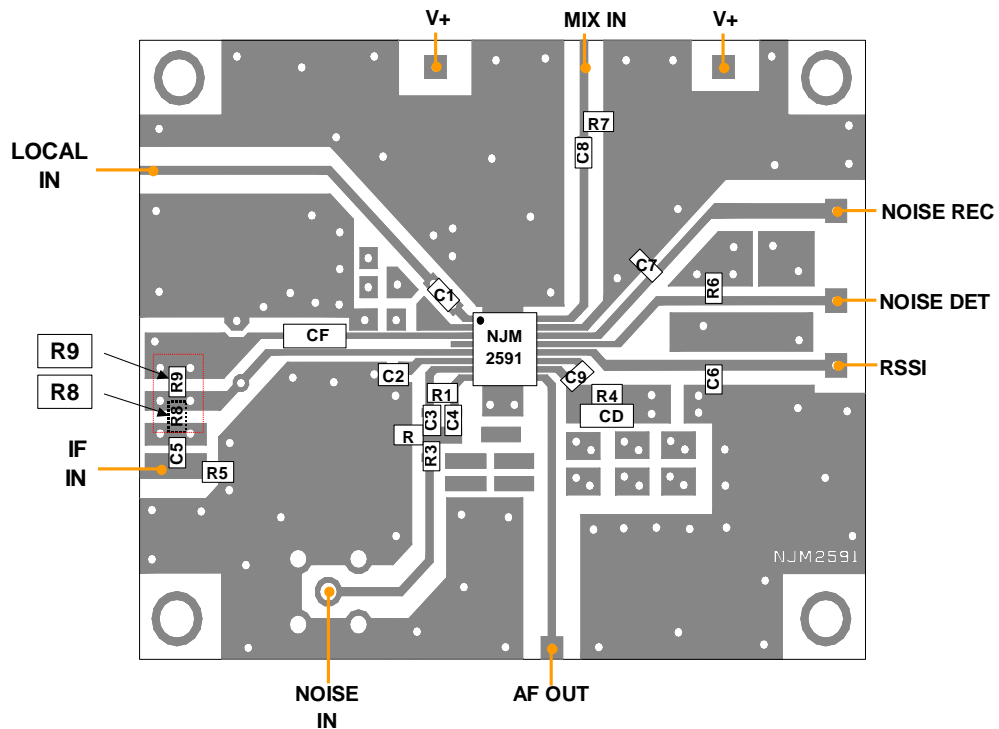


● Note

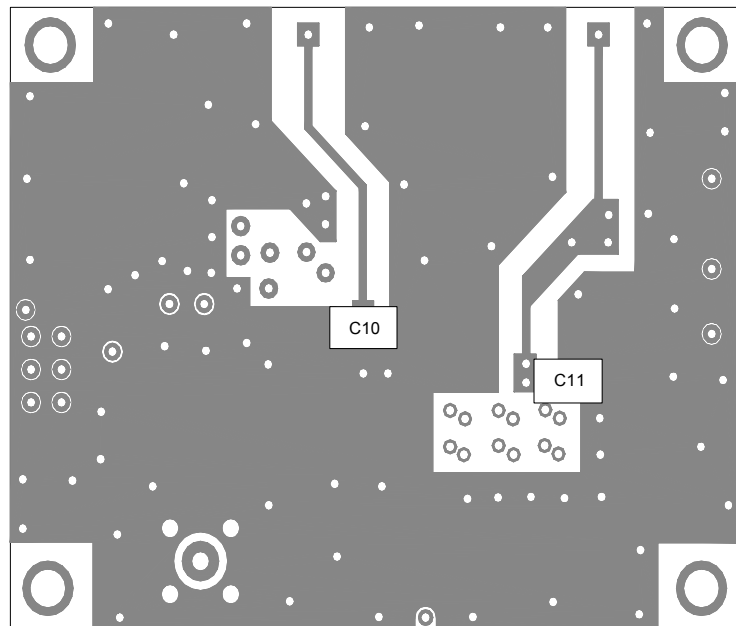
- This board is designed for mixer-input type and R9 / R8 are factory-configured as follows :
 R8 : open
 R9 : chip resistor of 0Ω
 For the case of IF-input type, please change the position of the chip resistor of 0Ω as follows ;
 R8 : chip resistor of 0Ω
 R9 : open
- External components
 CF=CFWCA450KGFA-R0 (Murata)
 CD=CDBC450KCAY70-R0 (Murata)

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- Circuit Side View



- Ground Side View



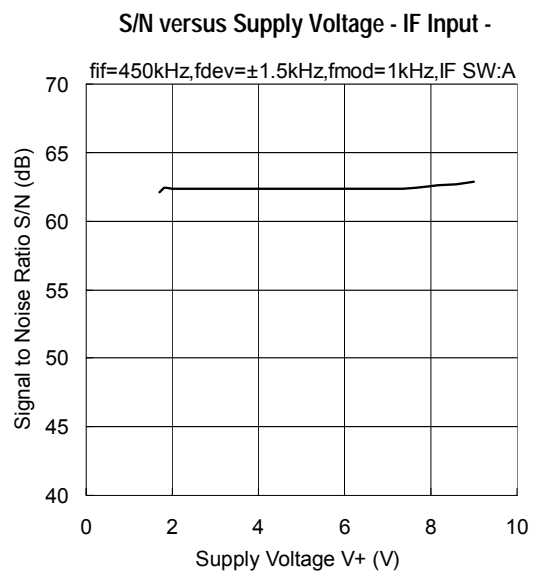
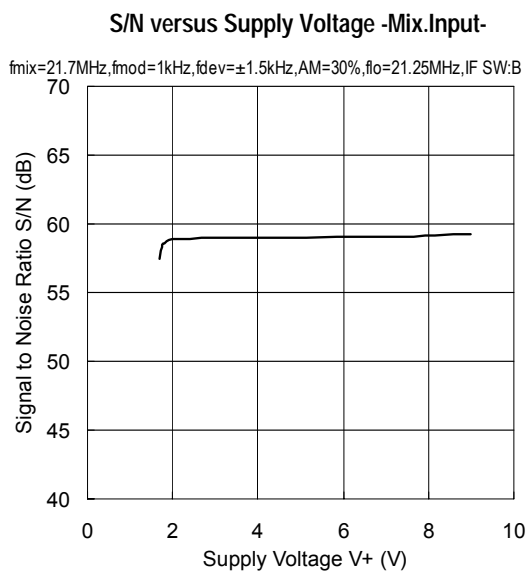
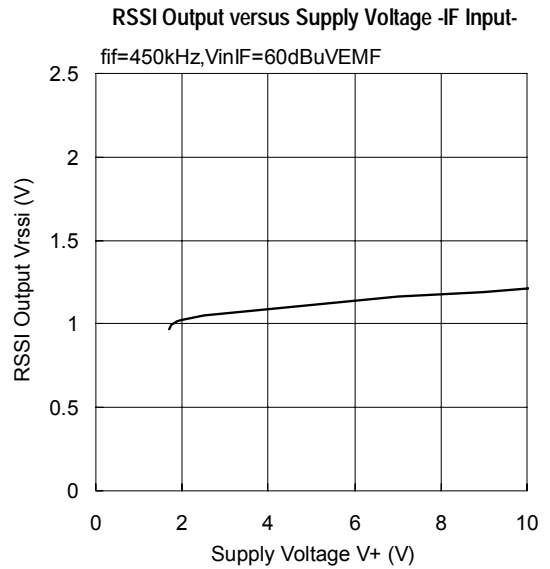
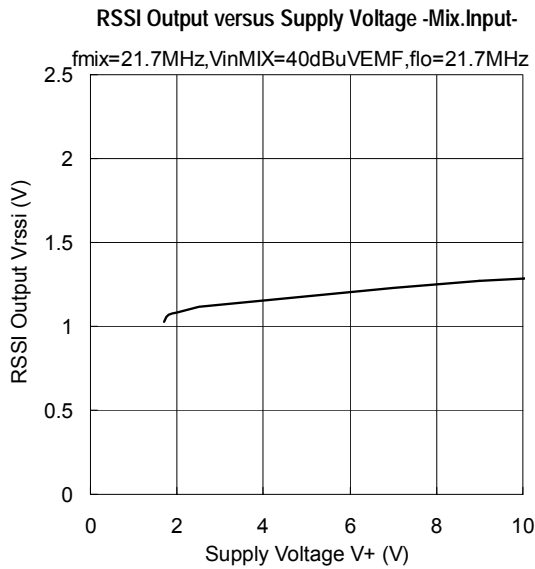
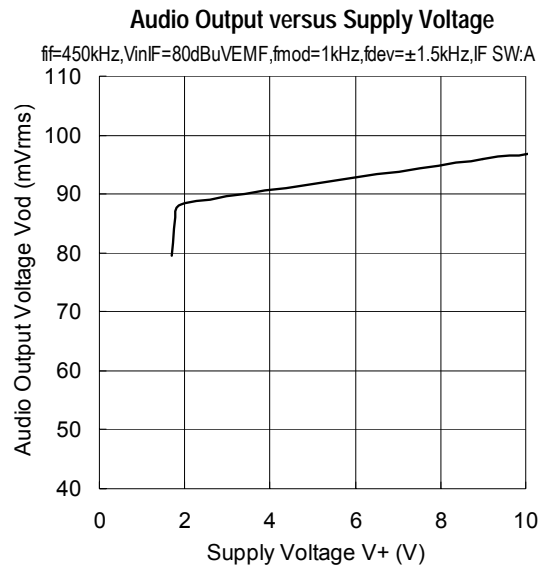
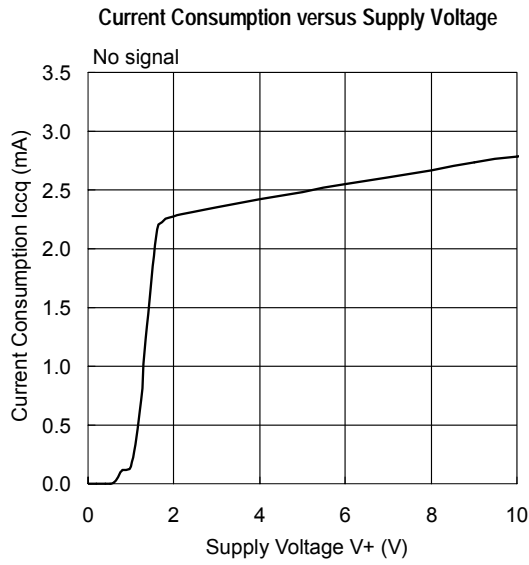
- Note

1. External Components

$C1, C1, C6, C8=1000\text{pF}$ $C2, C7, C5=0.1\mu\text{F}$ $C3, C4=220\text{pF}$ $C9=33\text{pF}$
 $R1=150\text{k}\Omega$ $R2=5.6\text{k}\Omega$ $R3=10\text{k}\Omega$ $R4=2.7\text{k}\Omega$ $R5, R7=51\Omega$ $R6=100\text{k}\Omega$ $R9=0\Omega$ $R8=\text{open}$
 $C10, C11=10\mu\text{F}$
 $CF=\text{CFWCA450KGFA-R0(Murata)}$
 $CD=\text{CDBC450KCAY70-R0(Murata)}$

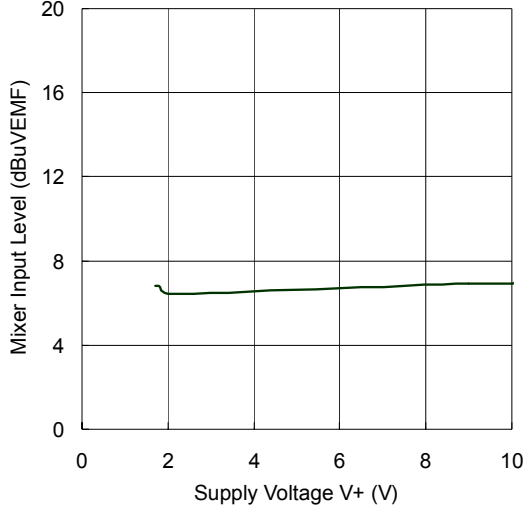
2. There are two terminals for V+. For proper operation, both of these terminals are necessary for power supply.

■ **TYPICAL CHARACTERISTICS (Ta=25°C, V+=2.0V, unless otherwise noted)**



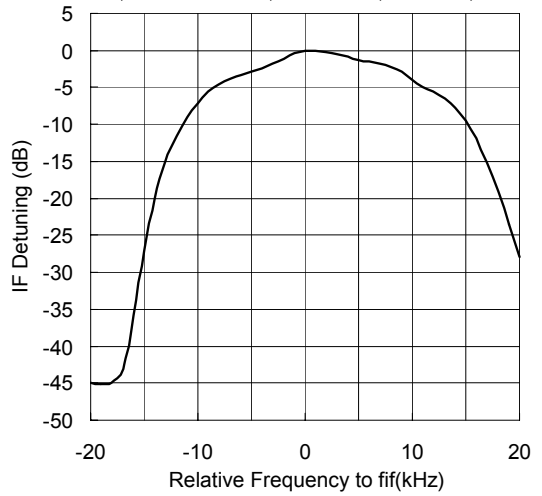
Audio Out 12dB S/N Sensitivity versus Supply Voltage

f_{mix}=21.7MHz, f_{mod}=1kHz, f_{dev}=±1.5kHz, f_o=21.25MHz, 100dBuV, IF SW:B



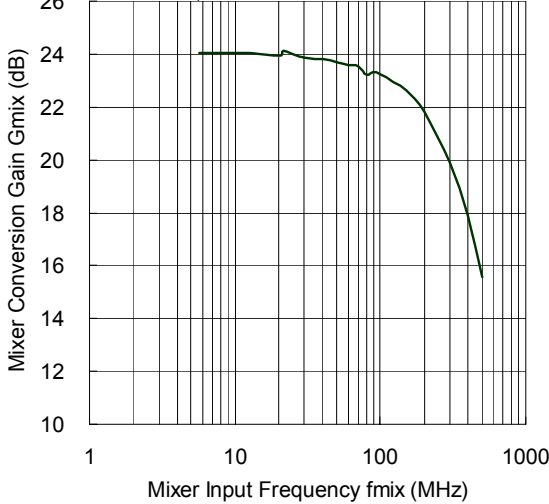
IF Detuning characteristics

f_{if}=450kHz, VinIF=80dBuVEMF, f_{dev}=±1.5kHz, f_{mod}=1kHz, IF SW:A



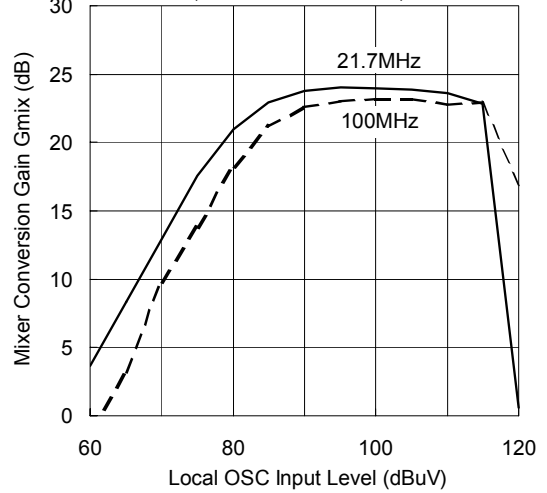
Mixer Conversion Gain versus Frequency

f_{if}=450kHz, MIX OUT: 1.8kΩ term.



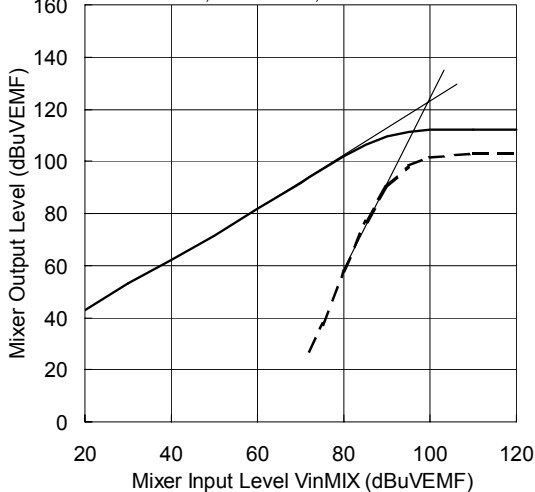
Mixer Conversion Gain versus OSC Input

f_{if}=450kHz, MIX OUT: 1.8kΩ term., V+ = 2.0V



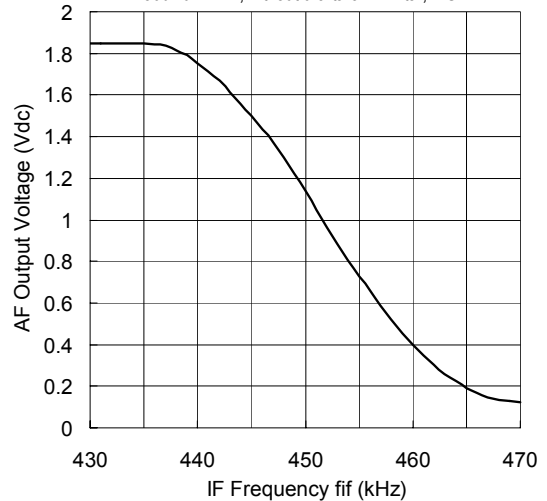
Mixer 3rd Order Intercept

f_{mix}=21.7MHz, f_o=21.25MHz, MIX OUT: 1.8kΩ term.

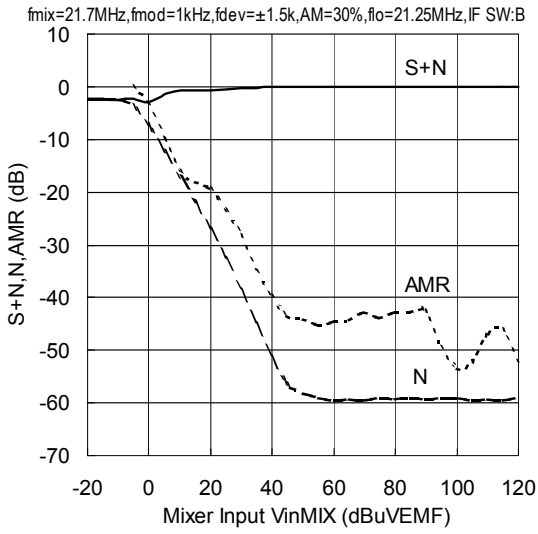


AF Output versus Frequency : S-Curve

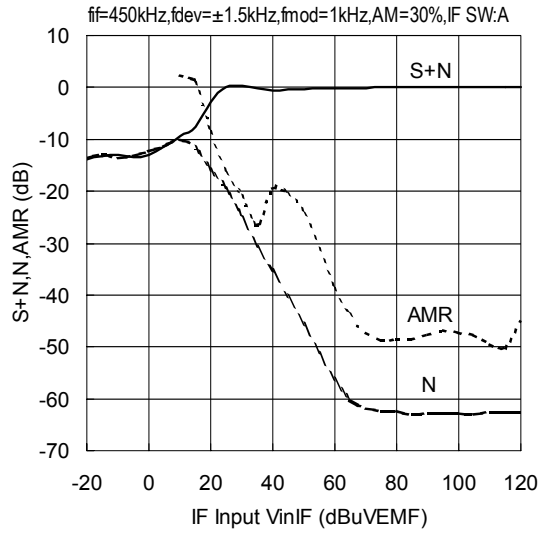
VinIF=80dBuVEMF, Without 0.3-to-3kHz filter, IF SW:A



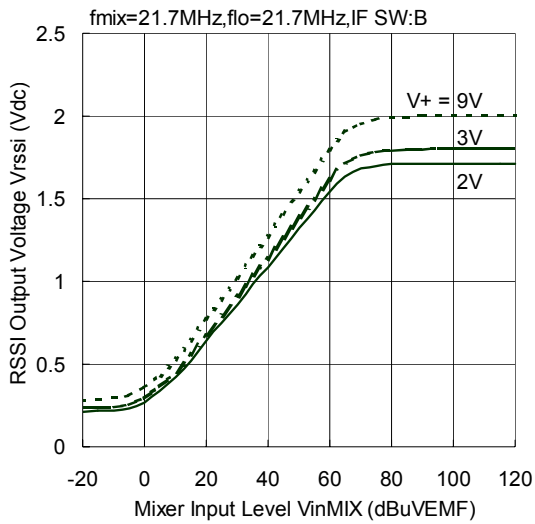
S+N,N,AMR versus Mixer Input



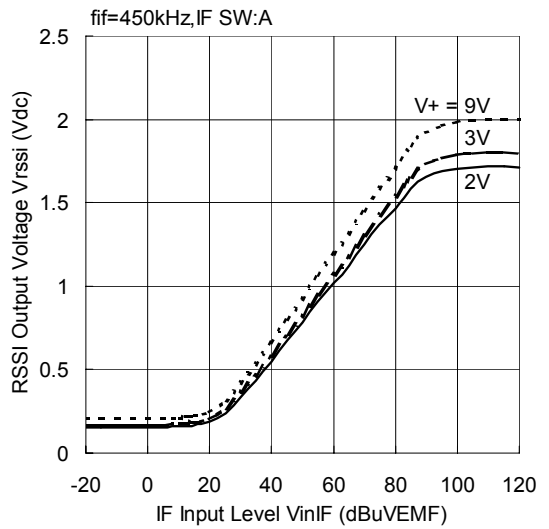
S+N,N,AMR versus IF Input



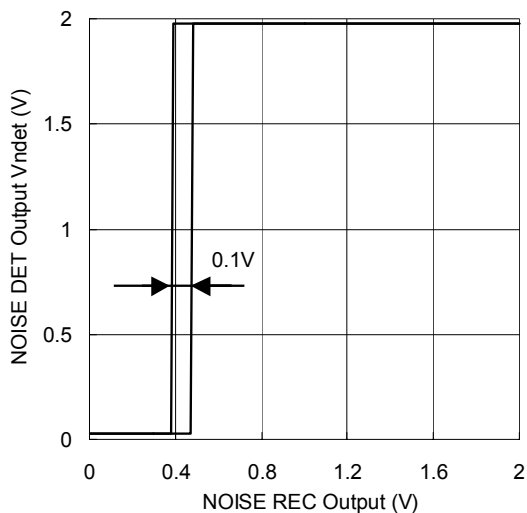
RSSI Output Voltage versus Mixer Input



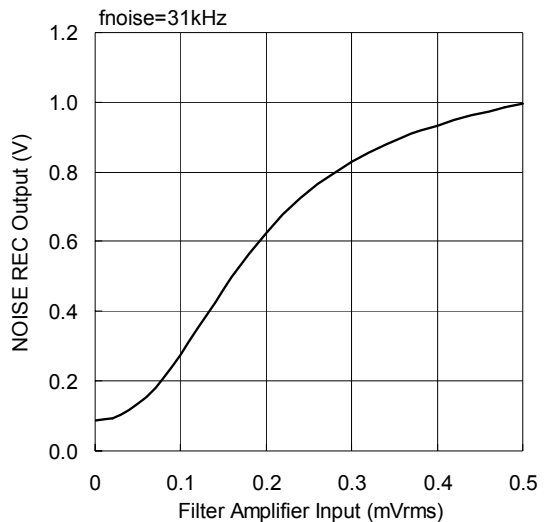
RSSI Output Voltage versus IF Input



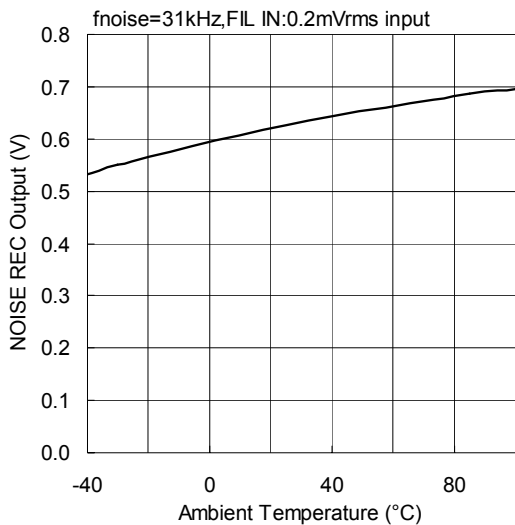
Noise Comparator Characteristics



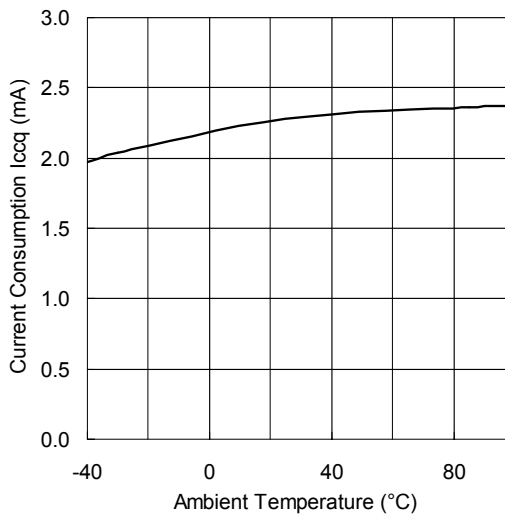
Noise Detector Characteristics



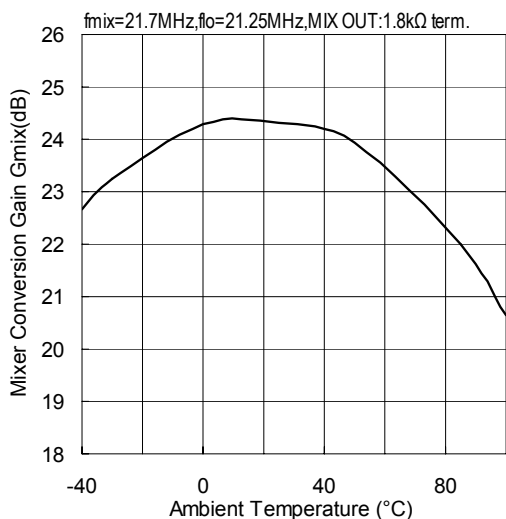
NOISE REC Output versus Temperature



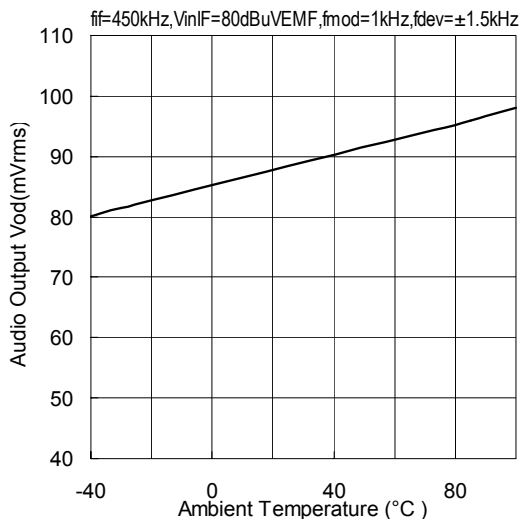
Current Consumption versus Temperature



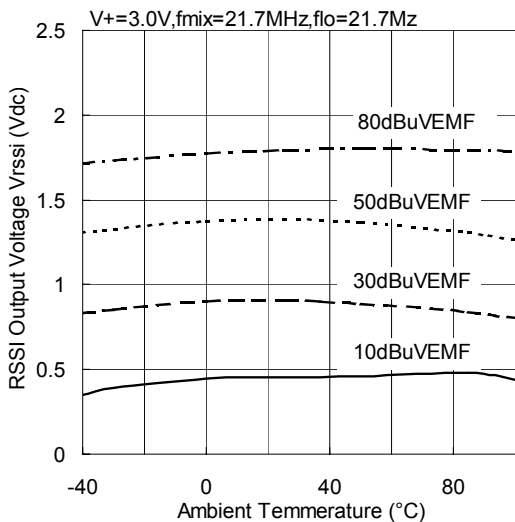
Mixer Conversion Gain versus Temperature



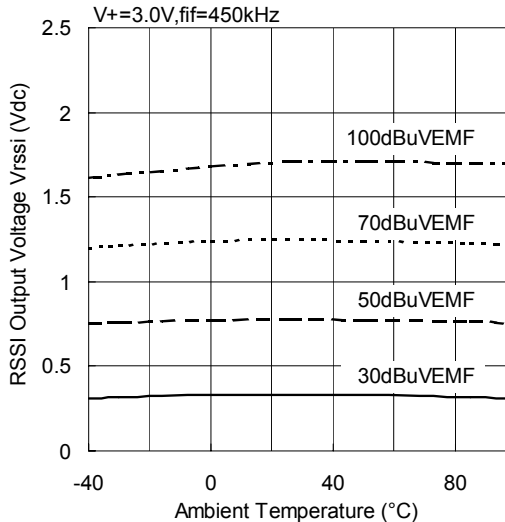
Audio Output versus Temperature



RSSI Output versus Temperature -Mix.Input-



RSSI Output versus Temperature -IF Input-



[CAUTION]

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