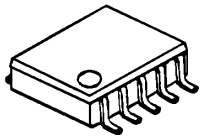
WIDE BAND FM IF DEMODULATOR

■ GENERAL DESCRIPTION

The **NJM2549** is a wide band IF IC with a maximum IF input frequency of 15 MHz.
It includes an IF Amplifier, Quadrature Detector, RSSI and IF Balanced Output.

■ PACKAGE OUTLINE



NJM2549RB2

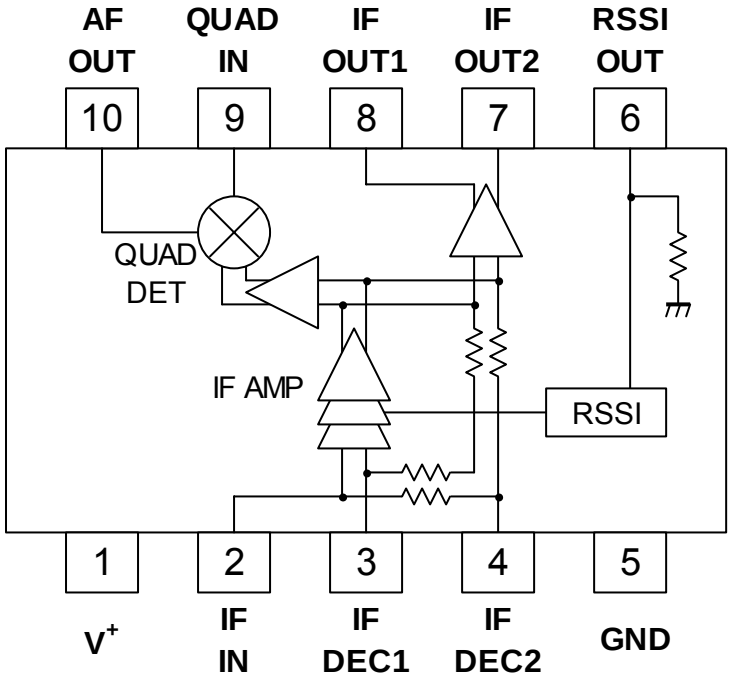
■ MAIN APPLICATIONS

- RF ID
- Radar detector
- Wireless Infrared Communication System
- Voice Transmission System
- A few MHz band Signal Detector

■ FEATURES

● Wide Range Operating Voltage	2.7V to 9V (recommended supply voltage)
● Low Operating Current	3mA (standard)
● Wide Range IF Input Frequency	10.7MHz (standard) 100kHz to 15MHz (reference value)
● Wide Band FM Detector Range	DC to 1MHz (reference value)
● RSSI Quick Response	
● High FM Detection Sensitivity	22dBuV (- 3dB Limiting Sensitivity)
● IF Amplifier with Balanced Output	
● Bipolar Technology	
● Package Outline	TVSP10

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	10	V
Power Dissipation	P_D	300	mW
Operating Temperature	T o p r	- 40 to + 85	°C
Storage Temperature	T s t g	- 50 to + 125	°C

■ RECOMMENDED OPERATIONAL CONDITION (Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V^+		2.7	3	9	V

■ ELECTRICAL CHARACTERISTICS

(Ta = 25°C, V^+ = 3V, IF IN = 10.7MHz / 80dBuV, fdev = ± 10kHz, fmod = 1kHz, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Current Consumption	Iccq	No Signal, Test Circuit 1	-	3	3.7	mA
IF						
IF Input / Output Gain	G_{IF}	IF IN = 20dBuV , Test Circuit 4	70	75	80	dB
IF Output Gain Frequency Characteristics	$f_{IF}1$	The ratio from the gain at 10.7MHz to the gain at 1MHz, Test Circuit 4	-3	0	3	dB
	$f_{IF}2$	The ratio from the gain at 10.7MHz to the gain at 15MHz, Test Circuit 4	-4	-1	2	
IF Amplifier Input Resistance	$R_{I\,IF}$	2 - 4 pin Resistance, Test Circuit 3	8.5	10	11.5	kΩ
IF Output Level	$V_{O\,IF}$	RL = 15kΩ, No Modulation, Test Circuit 4	350	425	500	mVpp
Duty Ratio of Wave IF Output	DR_{IF}	RL = 15kΩ, No Modulation, Test Circuit 4	44	50	58	%
IF Output Current	I_{OIF}	No Signal, Test Circuit 4	230	290	350	uA

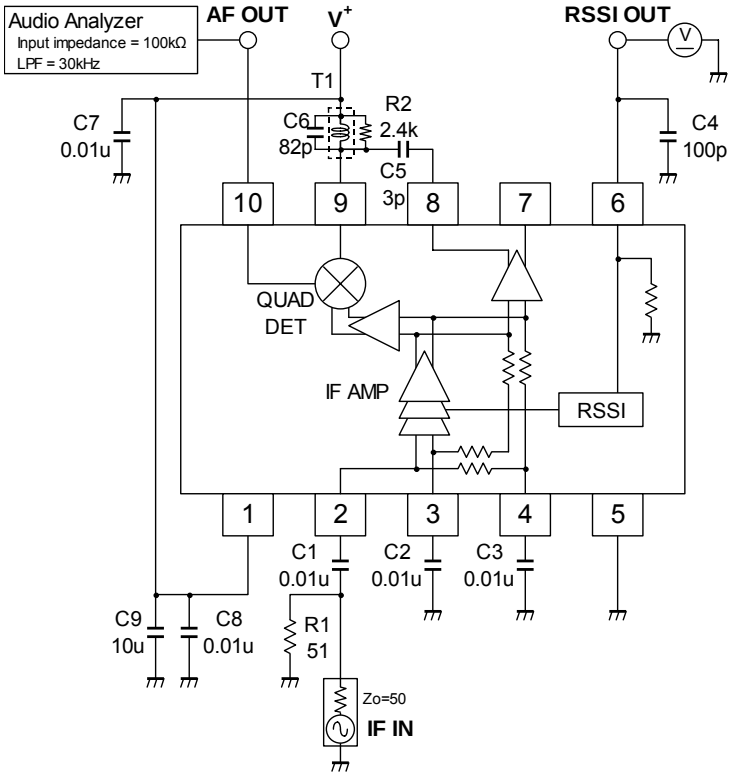
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
DETECTION						
Demodulated DC Level	$V_{O\,DC}1$	IF IN = 10.62MHz, No Modulation, Test Circuit 1	-	0.1	0.3	V
	$V_{O\,DC}2$	IF IN = 10.7MHz, No Modulation, Test Circuit 1	0.8	1.1	1.4	
	$V_{O\,DC}3$	IF IN = 10.83MHz, No Modulation, Test Circuit 1	2.7	2.9	-	
Demodulated Signal Level	$V_{O\,AC}1$	Test Circuit 1	120	150	180	mVrms
Demodulated Signal Level of IF/3	$V_{O\,AC}2$	IF IN = 3.56667MHz, 100dBuV, Test Circuit 1	100	130	160	
12dB SINAD Sensitivity	12dBS/N	Test Circuit 1	-	33	-	dBuV
- 3dB Limiting Sensitivity	$P_{I\,LIM}$	Measured at -3dB, Test Circuit 1	-	22	-	
Signal to Noise Ratio	S/N	Ratio of S+N and N, Test Circuit 1	-	45	-	dB
AM Rejection Ratio	AMR	AM = 30%, Test Circuit 1	-	45	-	
Total Harmonic Distortion	THD	fdev = ± 30kHz, Test Circuit 1	-	0.5	-	%
AF Output pin Bias Current	$I_{O\,AF}$	No Signal, Test Circuit 4	160	205	250	uA
Demodulated Signal Frequency Characteristics	f_{DET}	fdev = ±100kHz, fmod = 1kHz to 1MHz, Gain deflection, Test Circuit 6	-	-2	-	dB
RSSI						
RSSI Output Voltage	$V_{RSSI}1$	No Signal, Test Circuit 1	-	10	50	mV
	$V_{RSSI}2$	IF IN = 45dBuV, Test Circuit 1	350	550	750	
	$V_{RSSI}3$	IF IN = 80dBuV, Test Circuit 1	1.5	1.7	1.85	V
	$V_{RSSI}4$	IF IN = 100dBuV, Test Circuit 1	1.8	2	2.1	
RSSI Output Resistance	$R_{O\,RSSI}$	5 - 6 pin Resistance, Test Circuit 3	12	15	18	KΩ
RSSI Dynamic Range	D_{RSSI}	$X = (V_{RSSI}3 - V_{RSSI}2) / 35$, $D1 = 45 - (V_{RSSI}2 - V_{RSSI}1) / X$, $D2 = 80 + (V_{RSSI}4 - V_{RSSI}3) / X$, $D_{RSSI} = D2 - D1$	-	60	-	dB
RSSI Response	T_{RI}	Time taken for RSSI Output to change from 10% to 90% after IF signal turns on. Test Circuit 7	-	4	-	usec
	T_{FI}	Time taken for RSSI Output to change from 90% to 10% after IF signal turns off. Test Circuit 7	-	4	-	

The values shown in parenthesis are reference values.

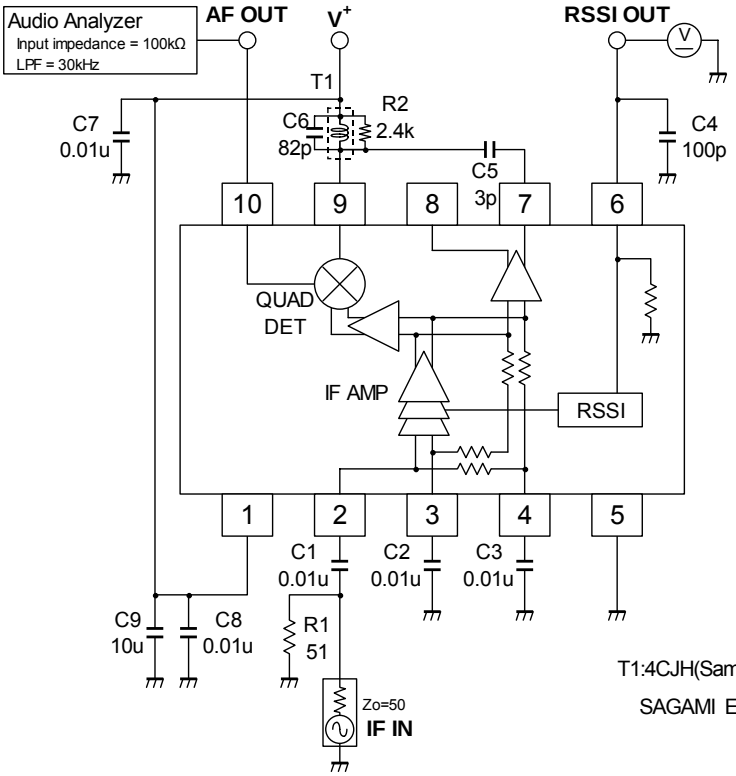
■ TEST CIRCUIT

This test circuit allows the measurement of all parameters described in “ELECTRICAL CHARACTERISTICS”.

● **Test Circuit 1** (Detected Output: S-Curve)

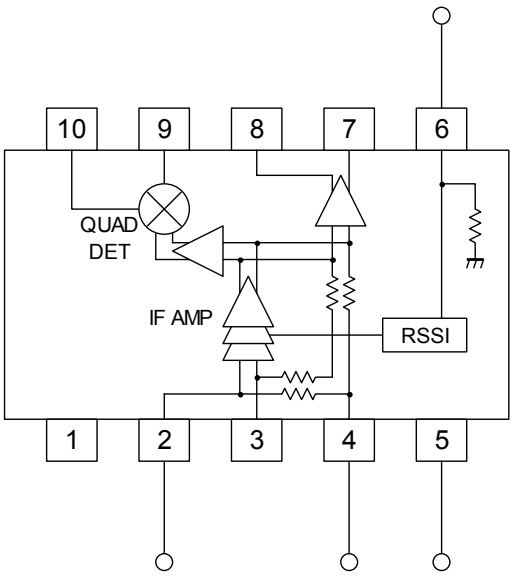


● **Test Circuit 2** (Detected Output: N-Curve, the Detected Output is reversed)

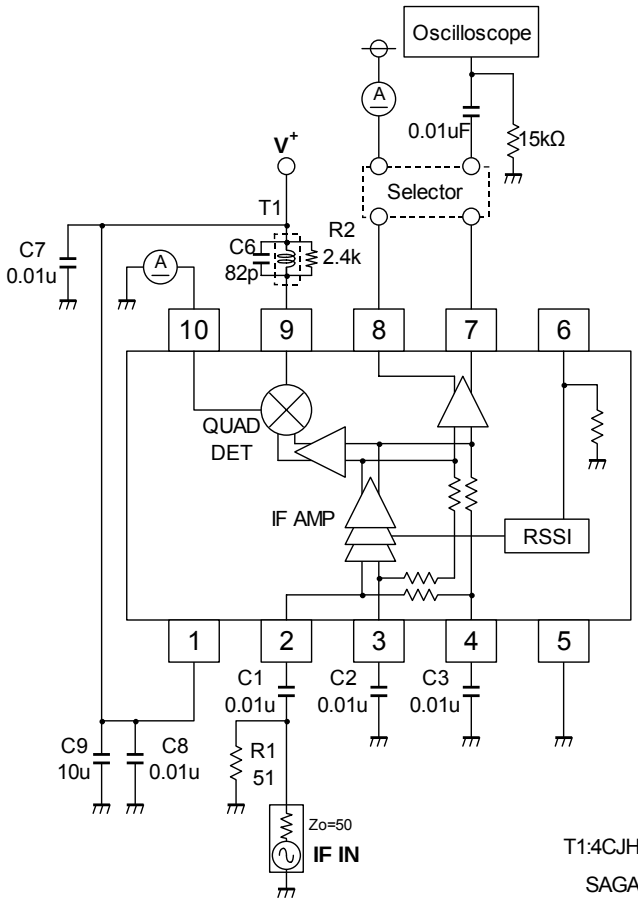


T1:4CJH(Sample No.:080293006)
SAGAMI ELEC CO., LTD. (Japan)

● **Test Circuit 3** for Terminal Resistance

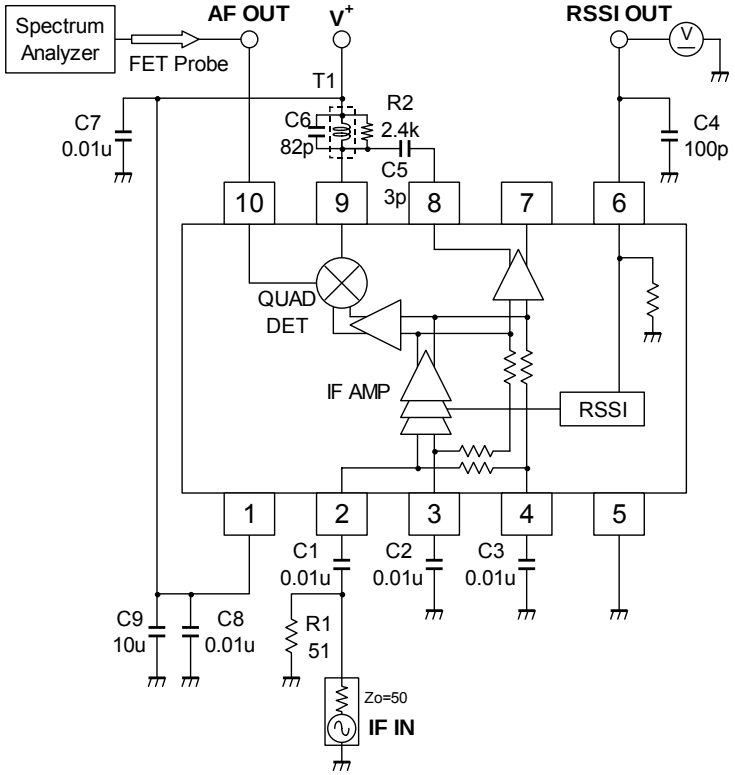


● **Test Circuit 4** for IF Amplifier

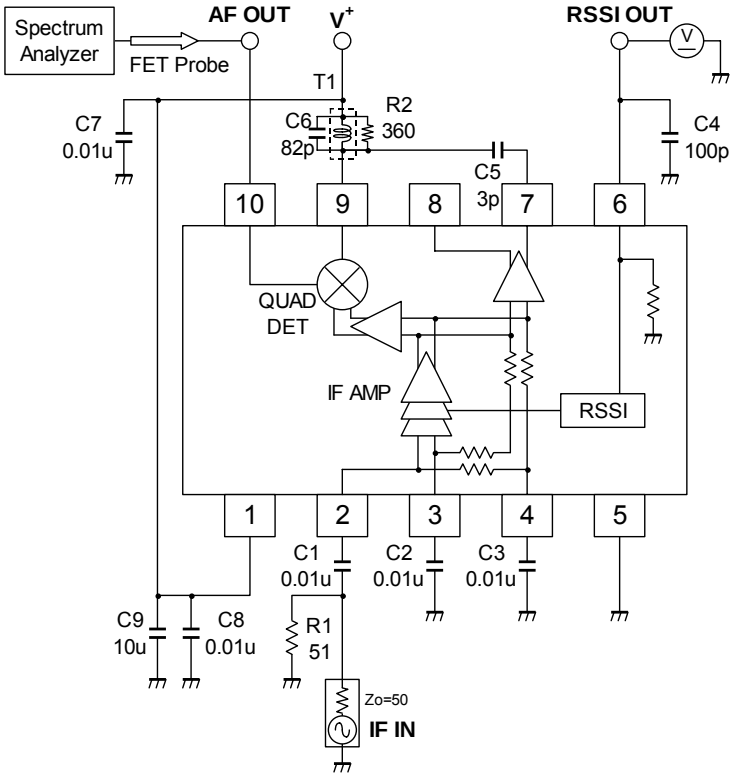


T1:4CJH(Sample No.:080293006)
SAGAMI ELEC CO., LTD. (Japan)

● **Test Circuit 5** for Demodulated Signal Frequency Characteristics (Detected Output: S-Curve)

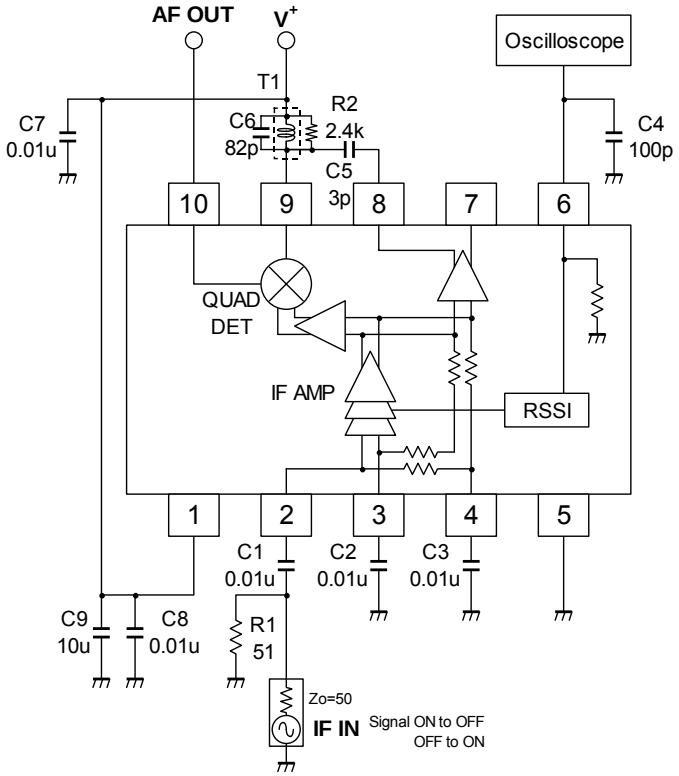


● **Test Circuit 6** for Demodulated Signal Frequency Characteristics (Detected Output: N-Curve)

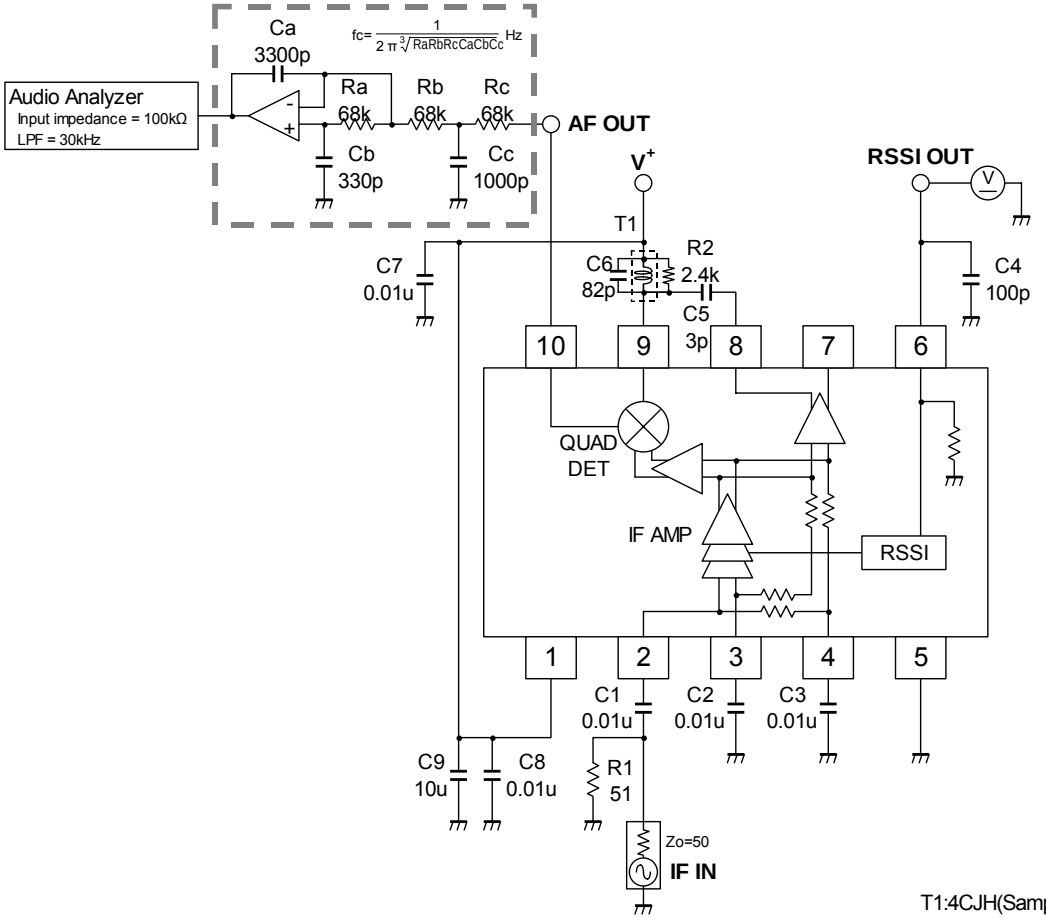


T1:4CJH(Sample No.:080293006)
SAGAMI ELEC CO., LTD. (Japan)

● **Test Circuit 7** for RSSI Response



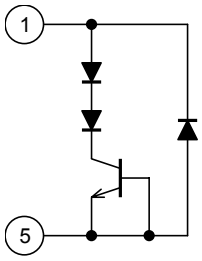
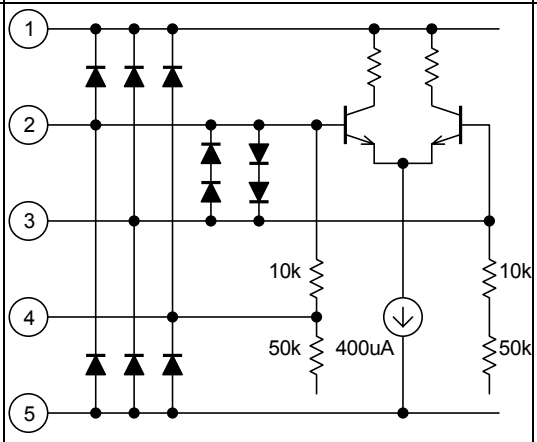
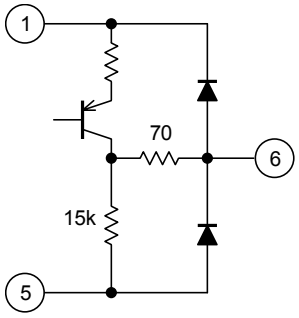
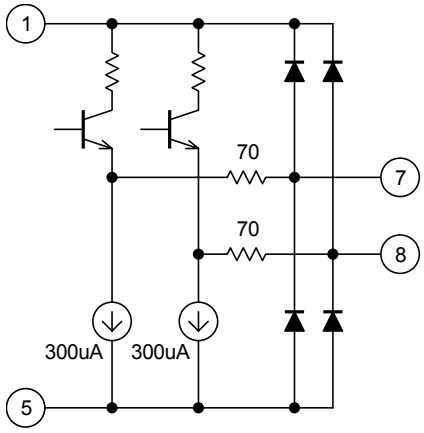
● **Test Circuit 8** for Demodulated signal (LPF is connected)

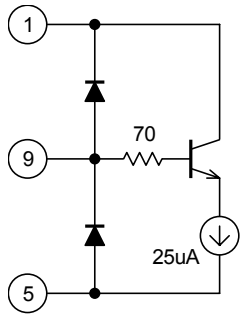
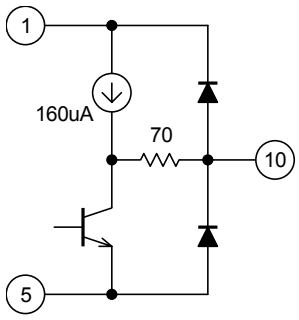


T1:4CJH(Sample No.:080293006)
SAGAMI ELEC CO., LTD. (Japan)

■ TERMINAL FUNCTION

(Ta = 25°C , V^+ = 3V , No signal)

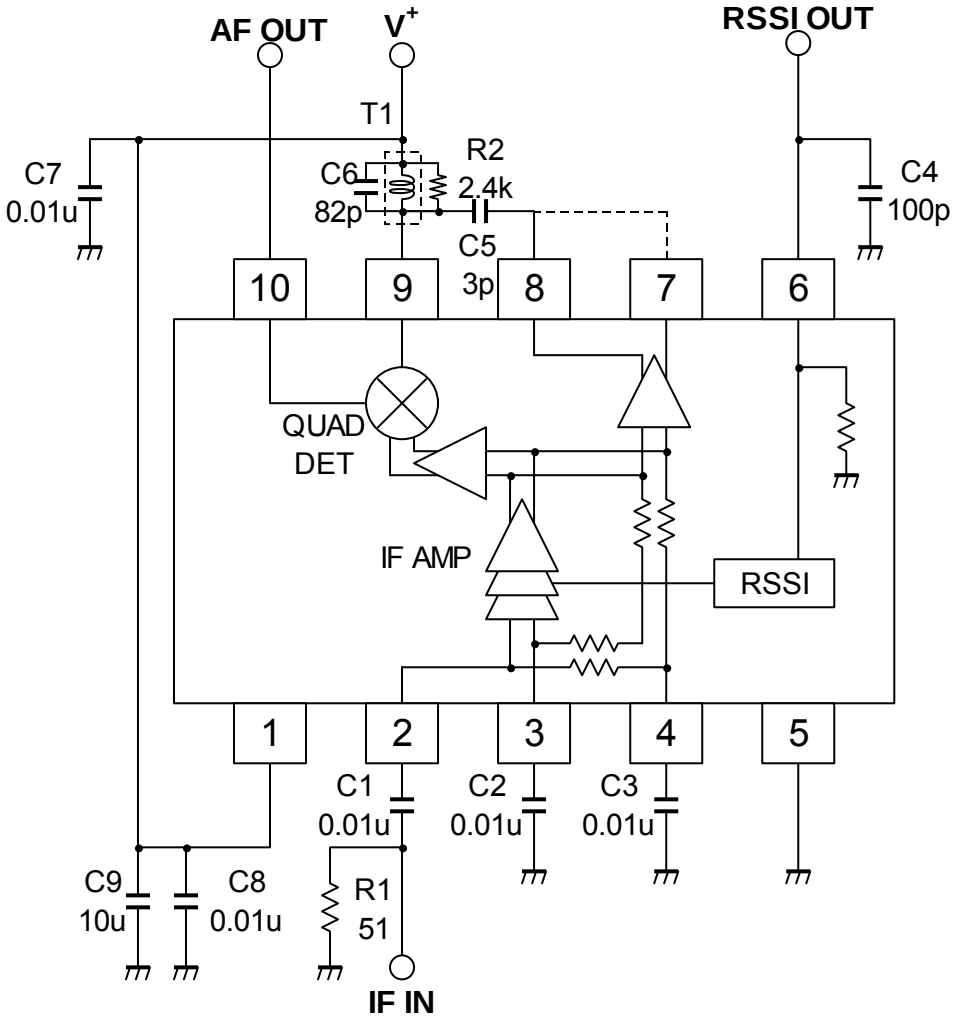
Pin No.	SYMBOL	EQUIVARENT CIRCUIT	VOLTAGE	FUNCTION
1	V^+		--	**Supply Voltage**
2 3 4	IF IN IF DEC1 IF DEC2		1.95V	**2pin: IF Amplifier Input** **3,4pin: IF Decoupling** An external decoupling capacitor is connected to enhance stability. The bandwidth of IF Amplifier can be adjusted. Large capacity: narrow IF Small capacity: wide IF
6	RSSI		--	**Received Signal Strength Indicator Output** Pin6 outputs DC level proportional to the log of pin2 input signal level.
7 8	IF OUT2 IF OUT1		1.25V	**FM IF Output** This is a balanced output, and the capacitor for the phase-shifter is connected between QUAD IN and either of IF OUTs. The joining terminal changes the inclination. 7pin:N-Corve 8pin:S-Corve

Pin No.	SYMBOL	EQUIVARENT CIRCUIT	VOLTAGE	FUNCTION
9	QUAD IN		--	**Quadrature Detector Input** An external phase-shifting coil or discriminator is connected between IF OUT and pin9. Note that supply voltage should be the same as the voltage supplied to pin1.
10	AF OUT		1.05V	**Demodulated Signal Output** Can output the wide range between ground level and supply voltage level.

■ EVALUATION 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



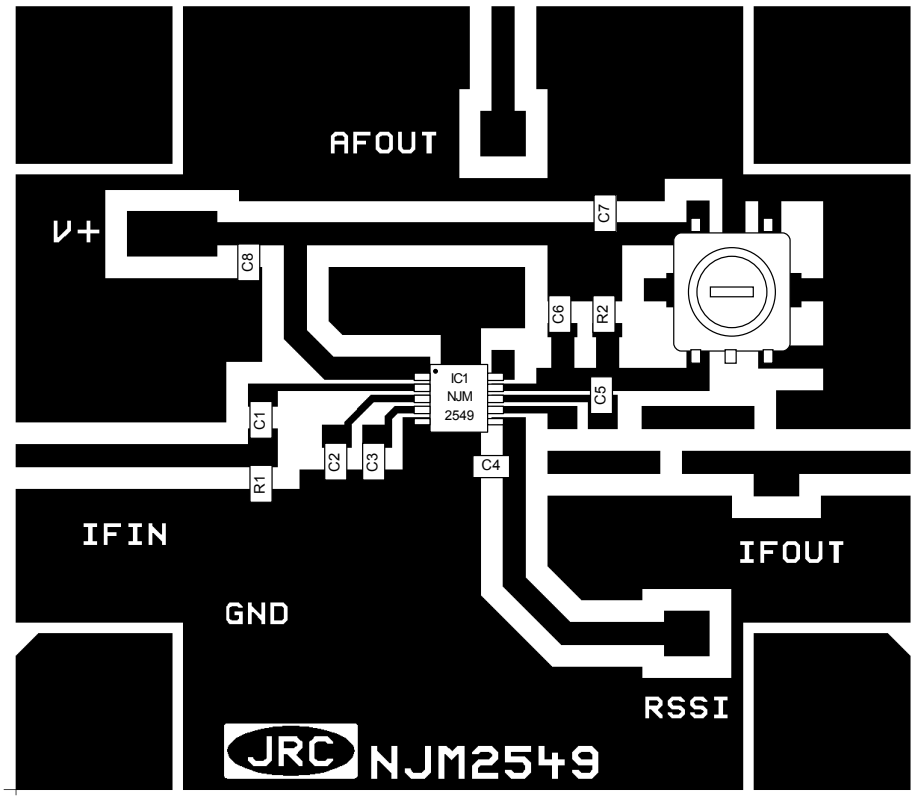
● List of Component

Items	Designation	Value	Items	Designation	Value
Capacitor	C1	0.01uF	Resistor	R1	51Ω
Capacitor	C2	0.01uF	Resistor	R2	2.4kΩ
Capacitor	C3	0.01uF			
Capacitor	C4	100pF	Transformer	T1	4CJH
Capacitor	C5	3pF			
Capacitor	C6	82pF	IC	IC1	NJM2549
Capacitor	C7	0.01uF			
Capacitor	C8	0.01uF			
Capacitor	C9	10uF			

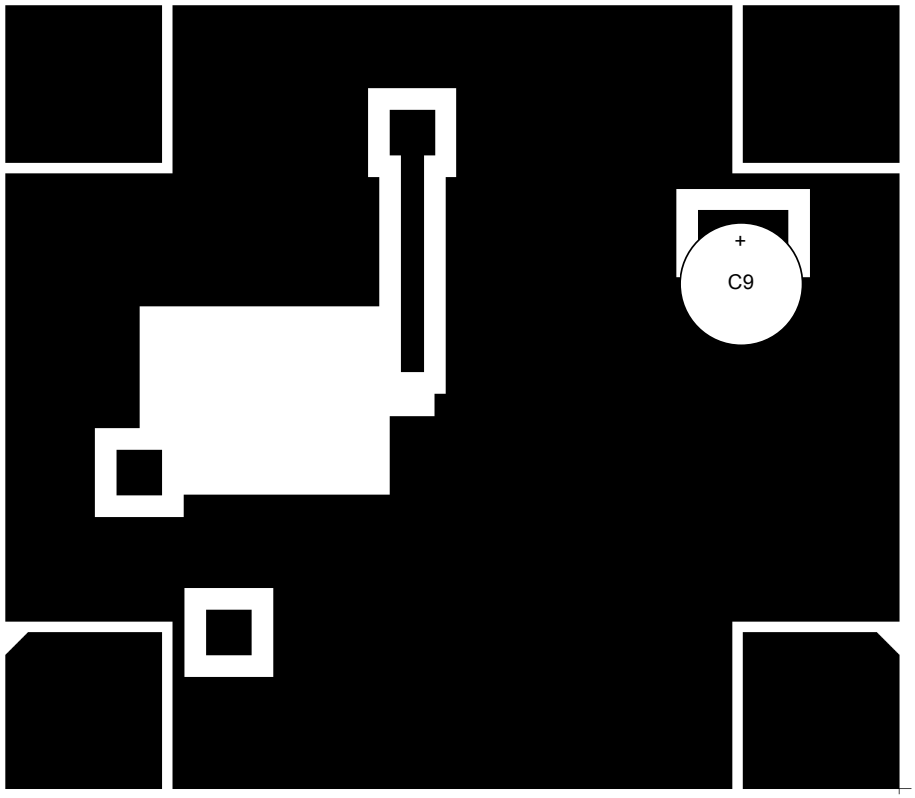
Note: IF transformer for detection, 4CJH(Sample No.:080293006) SAGAMI ELEC CO., LTD. (Japan)

● PRINTED CIRCUIT BOARD

Circuit Side View



Ground Side View

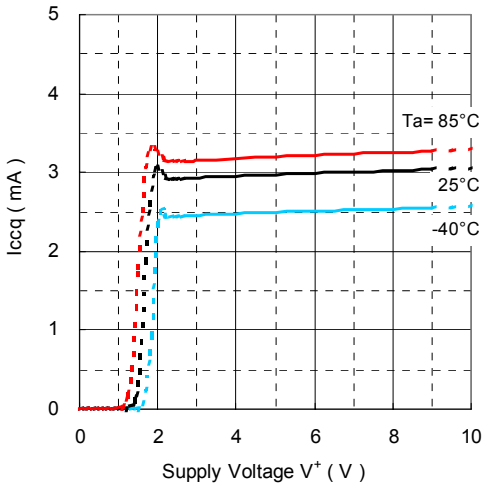


■ TYPICAL CHARACTERISTICS

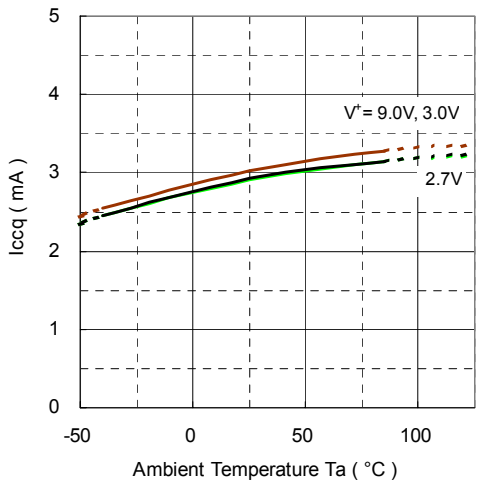
[DC CHARACTERISTICS]

(Test Circuit 1, Ta = 25°C, V^+ = 3V, No Signal, unless otherwise noted)

Current Consumption versus Supply Voltage and Ambient Temperature



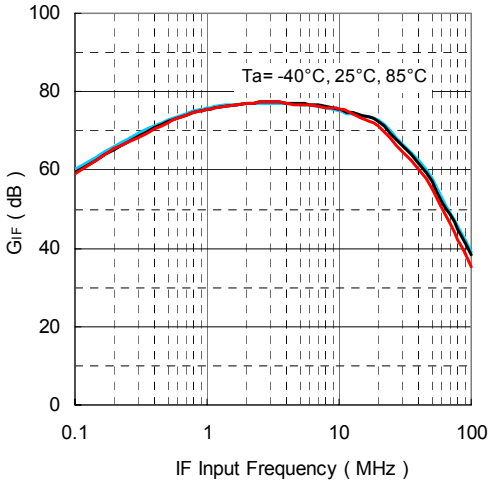
Current Consumption versus Temperature and Supply Voltage



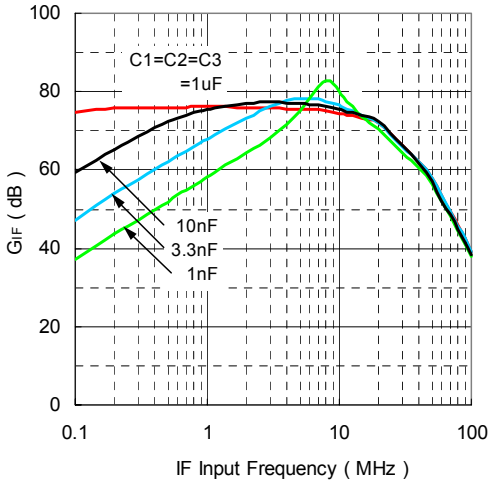
[IF AMP CHARACTERISTICS]

(Test Circuit 4, Ta = 25°C, V^+ = 3V, IF IN = 10.7MHz / 20dBuV, No Modulation, unless otherwise noted)

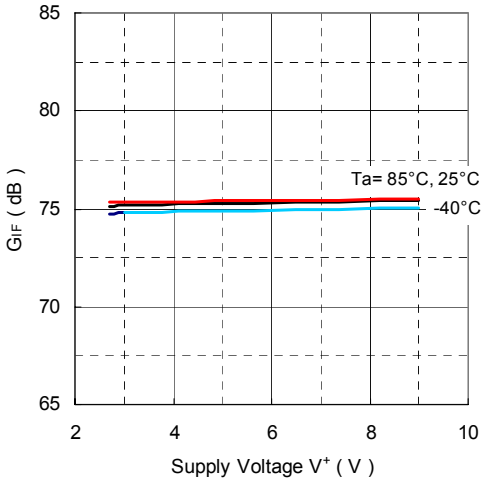
IF AMP Gain versus IF Frequency (Standard Circuit)



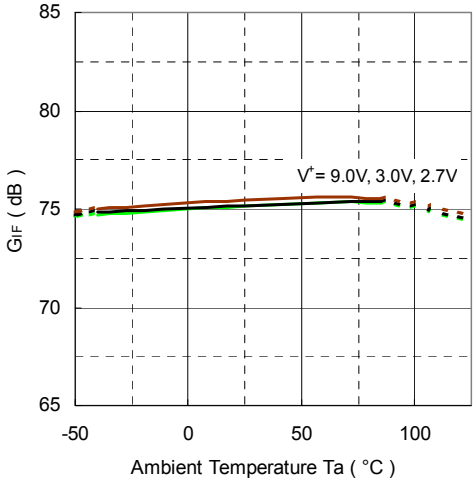
IF AMP Gain versus IF Frequency and Terminal Capacitance



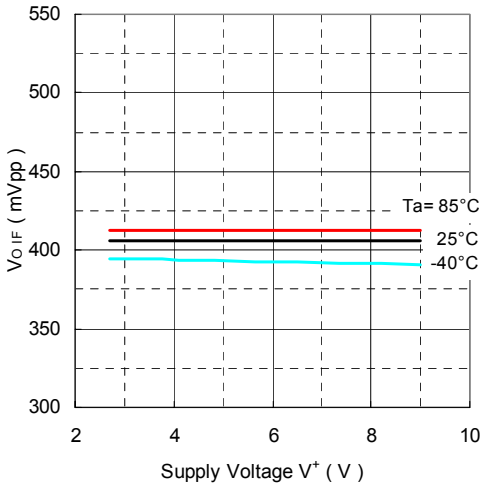
IF AMP Gain versus Supply Voltage and Ambient Temperature



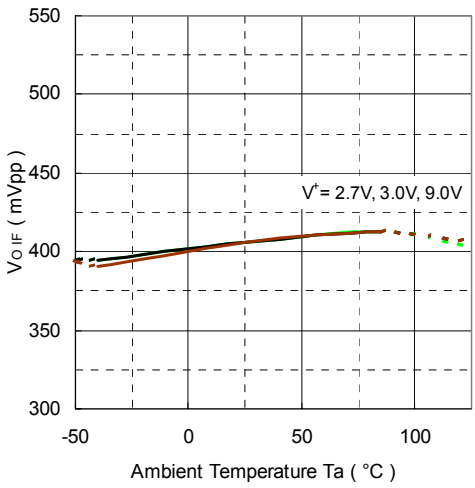
IF AMP Gain versus Temperature and Supply Voltage



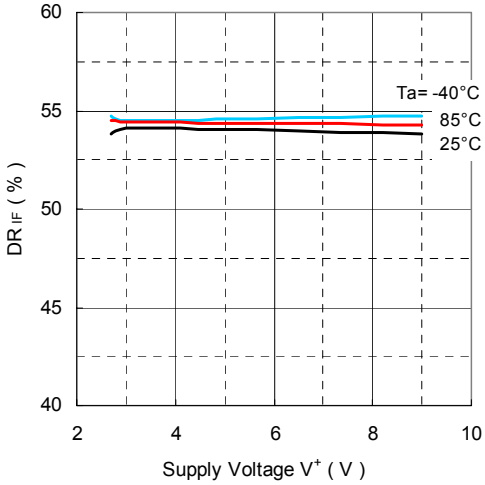
IF Output Level versus Supply Voltage and Ambient Temperature



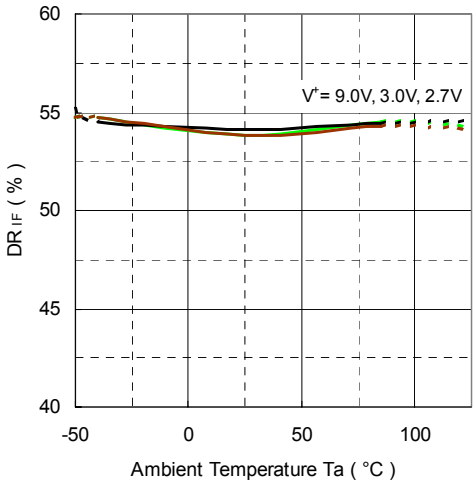
IF Output Level versus Temperature and Supply Voltage



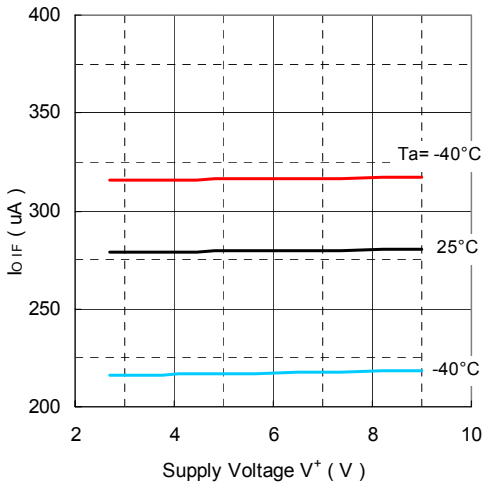
IF Output Duty Ratio versus Supply Voltage and Ambient Temperature



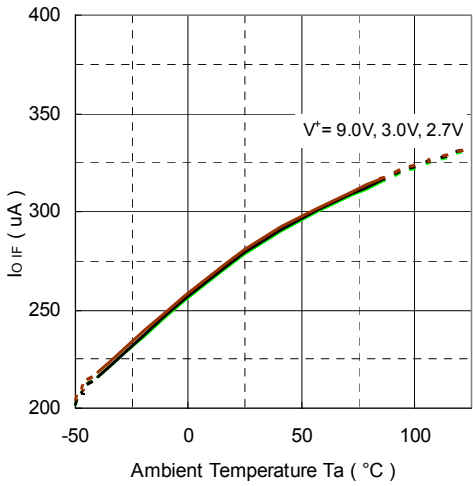
IF Output Duty Ratio versus Temperature and Supply Voltage



IF Output Current versus Supply Voltage and Ambient Temperature



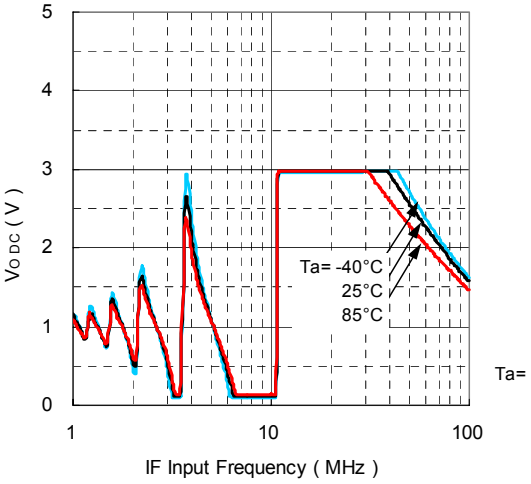
IF Output Current versus Temperature and Supply Voltage



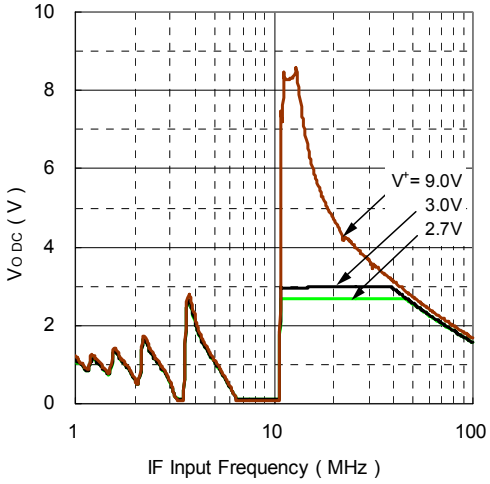
[DEMODULATED CHARACTERISTICS (S- Curve)]

(Test Circuit 1, Ta = 25°C, V^+ = 3V, IF IN = 10.7MHz / 20dBuV, No Modulation, unless otherwise noted)

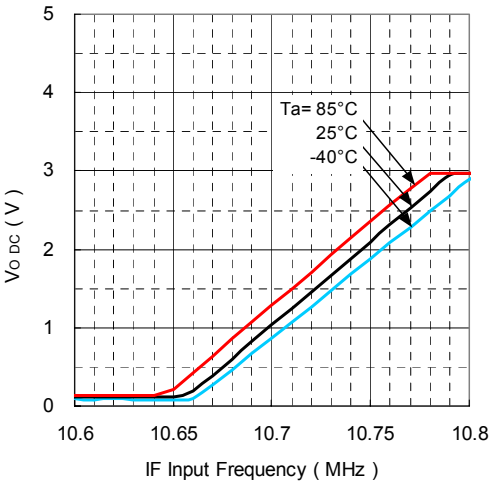
Demodulated DC Level versus Frequency
(S-curve, BW:99MHz, Ambient Temperature)



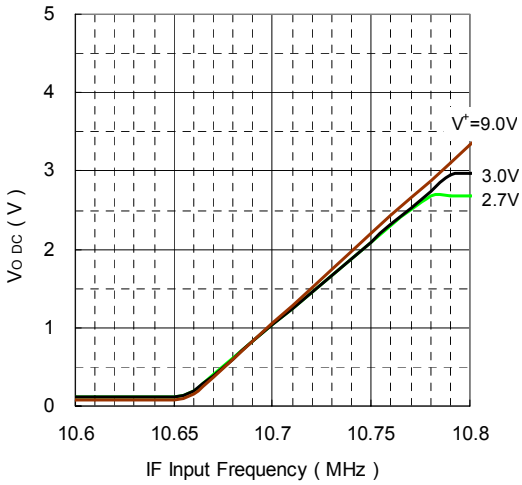
Demodulated DC Level versus Frequency
(S-curve, BW:99MHz, Supply Voltage)



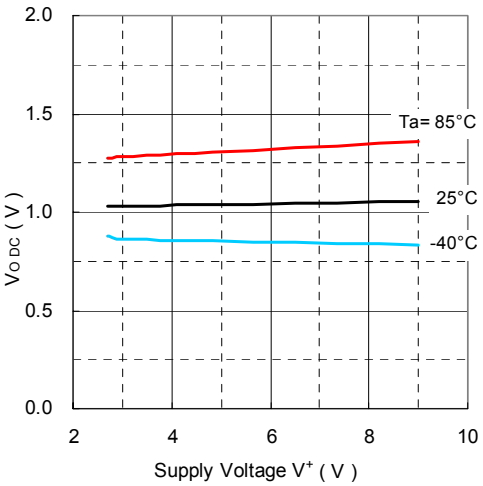
Demodulated DC Level versus Frequency
(S-curve, BW:200kHz, Ambient Temperature)



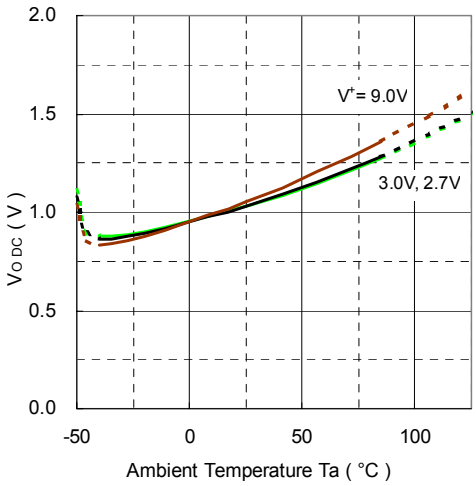
Demodulated DC Level versus Frequency
(S-curve, BW:200kHz, Supply Voltage)



Demodulated DC Level versus Supply Voltage
(S-curve, Ambient Temperature)



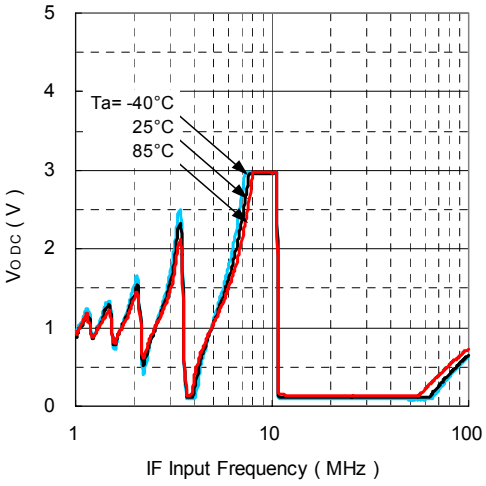
Demodulated DC Level versus Temperature
(S-curve, Supply Voltage)



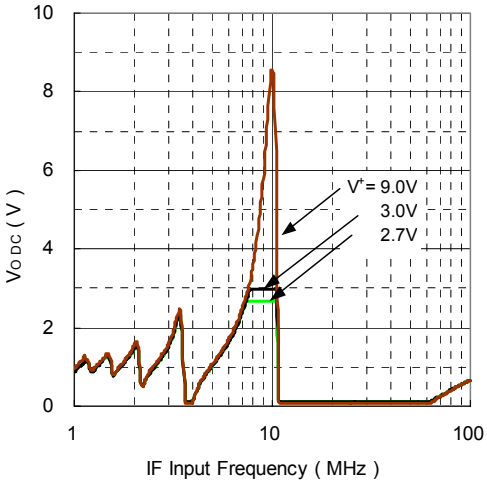
[DEMODULATED CHARACTERISTICS (N- Curve)]

(Test Circuit 2, Ta = 25°C, V^+ = 3V, IF IN = 10.7MHz / 20dBuV, No Modulation, unless otherwise noted)

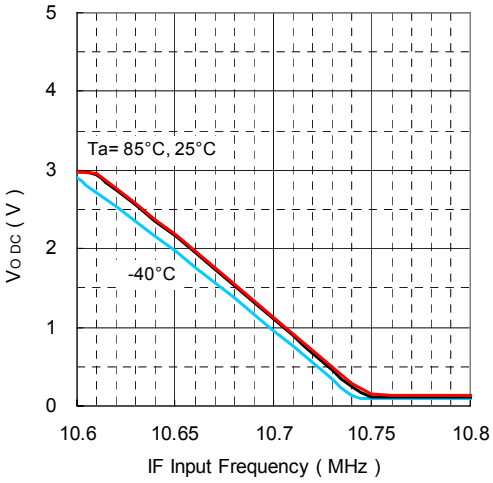
Demodulated DC Level versus Frequency
(N-curve, BW:99MHz, Ambient Temperature)



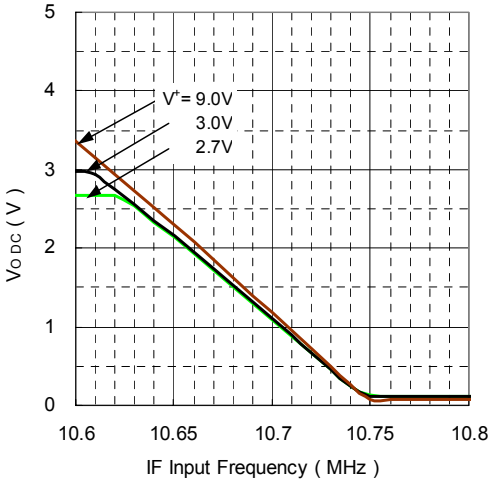
Demodulated DC Level versus Frequency
(N-curve, BW:99MHz, Supply Voltage)



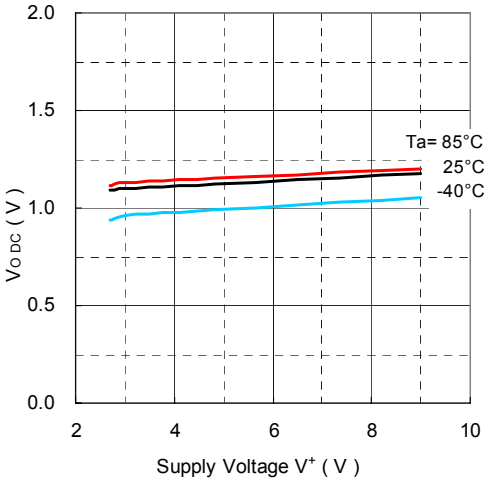
Demodulated DC Level versus Frequency
(N-curve, BW:200kHz, Ambient Temperature)



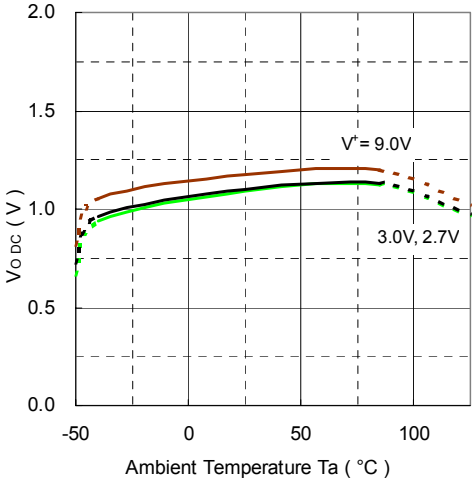
Demodulated DC Level versus Frequency
(N-curve, BW:200kHz, Supply Voltage)



Demodulated DC Level versus Supply Voltage
(N-curve, Ambient Temperature)



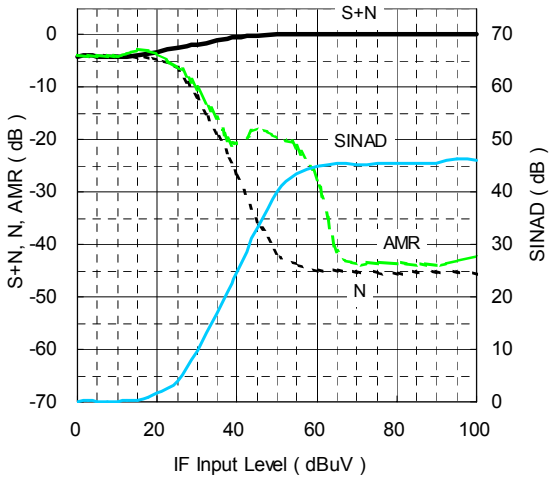
Demodulated DC Level versus Temperature
(N-curve, Supply Voltage)



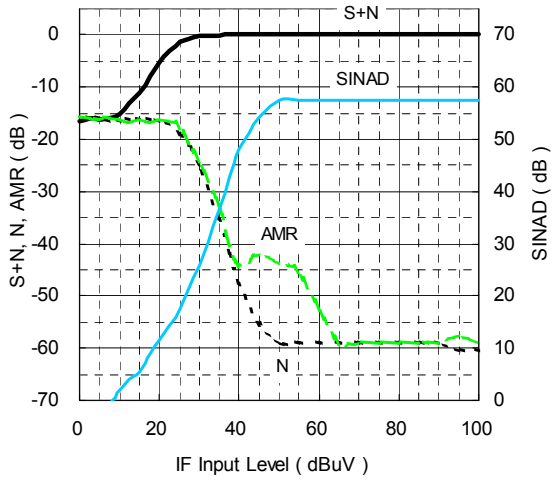
[DEMODULATED CHARACTERISTICS (AC Level)]

(Test Circuit 1, Ta = 25°C, V^+ = 3V, IF IN = 10.7MHz / 80dBuV, fdev = ± 10kHz, fmod = 1kHz, unless otherwise noted)

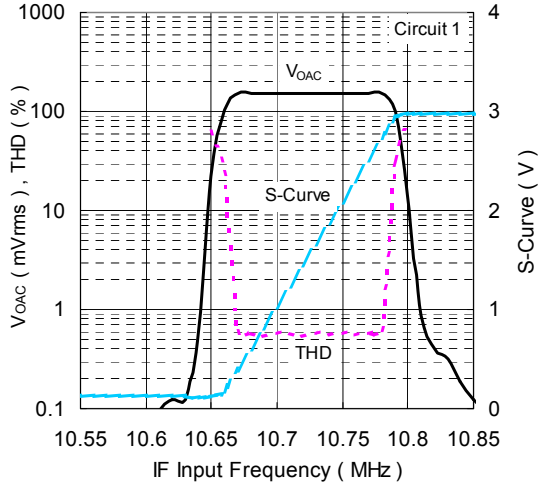
S+N, N, AMR, SINAD versus IF Input Level
(Test Circuit 1)



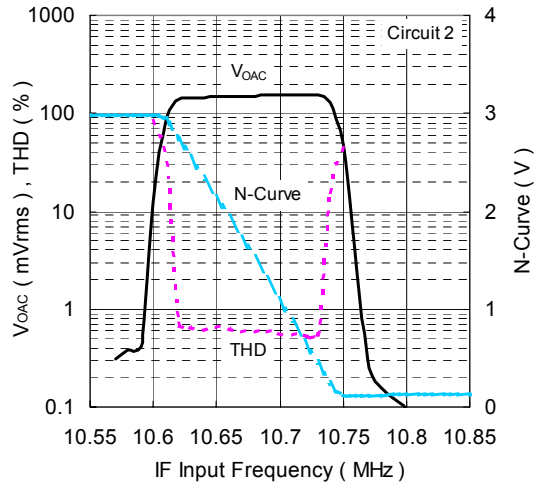
S+N, N , AMR , SINAD versus IF Input Level
(Test Circuit 8)



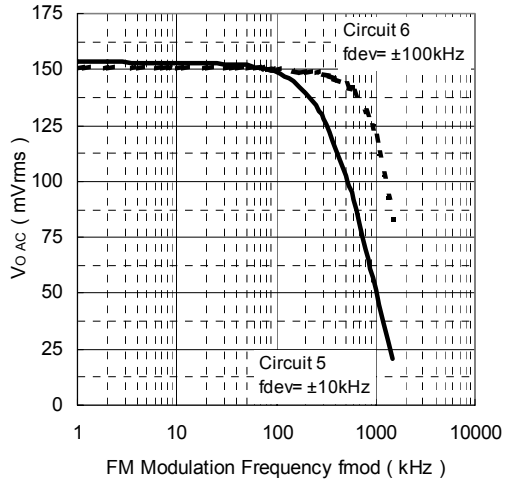
Detuning Characteristic
(V_{OAC}, THD, S-Curve)



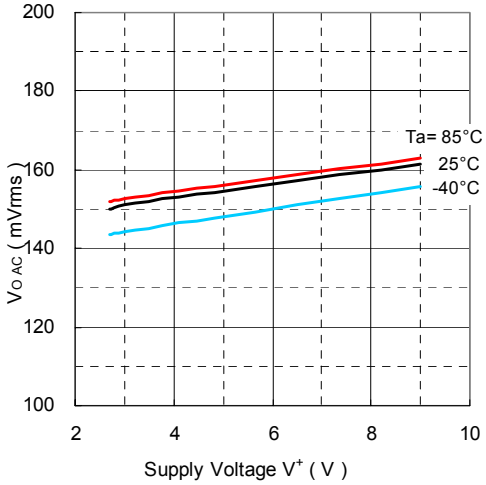
Detuning Characteristic
(V_{OAC}, THD, N-Curve)



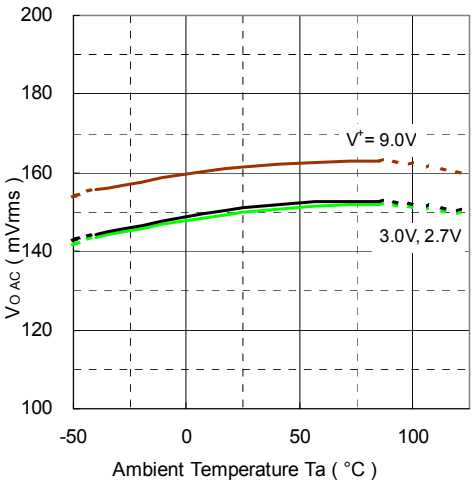
Demodulated Signal Level versus
FM Modulation Frequency



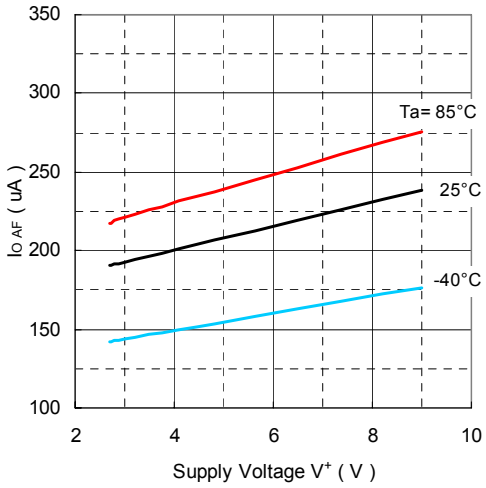
Demodulated Signal Level versus
Supply Voltage and Ambient Temperature



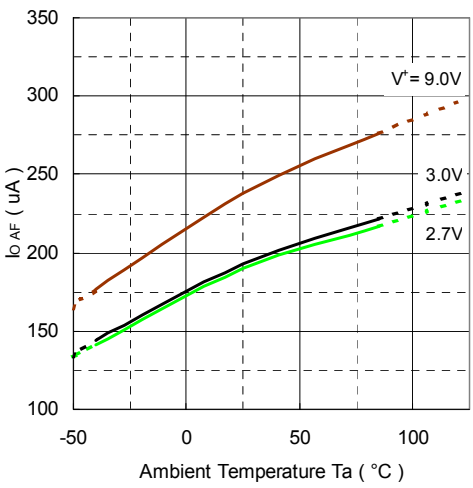
Demodulated Signal Level versus
Temperature and Supply Voltage



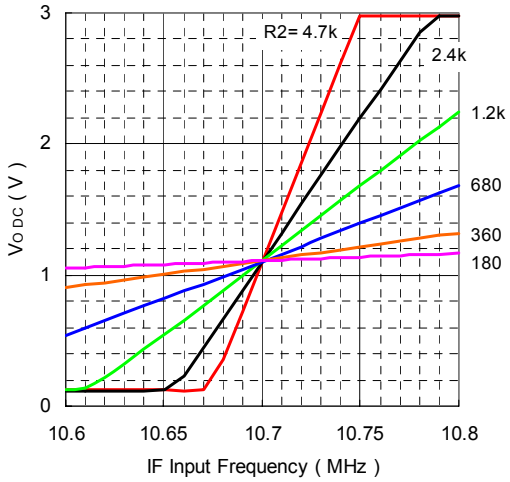
AF Output pin Bias Current versus
Supply Voltage and Ambient Temperature



AF Output pin Bias Current versus
Temperature and Supply Voltage



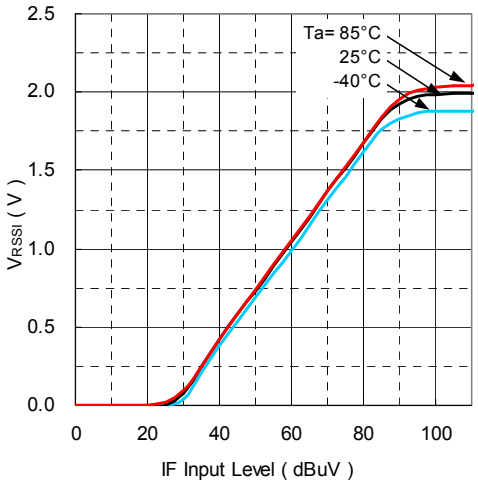
Demodulated DC Level versus Frequency
and R2



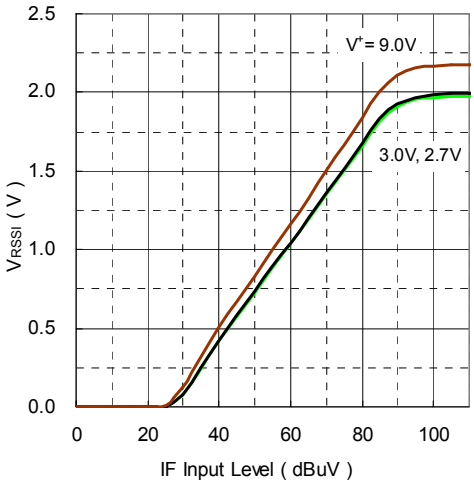
[RSSI CHARACTERISTICS]

(Test Circuit 1, Ta = 25°C, V^+ = 3V, IF IN = 10.7MHz / 80dBuV, fdev = ± 10kHz, fmod = 1kHz, unless otherwise noted)

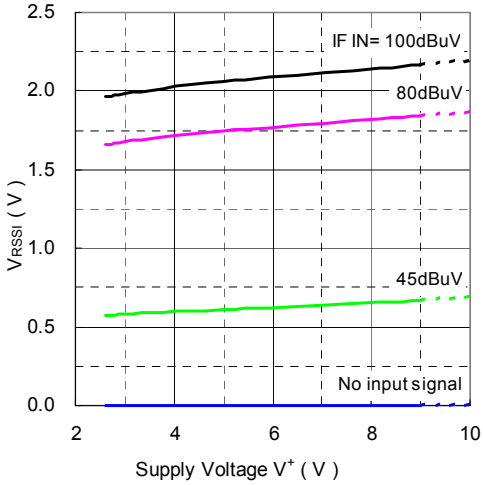
RSSI Output versus IF Input Level and Ambient Temperature



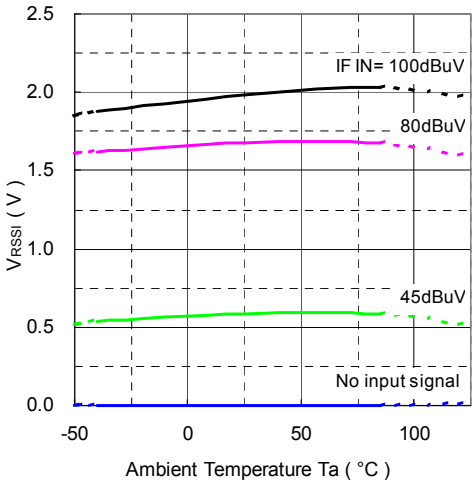
RSSI Output versus IF Input Level and Supply Voltage



RSSI Output versus Supply Voltage and IF Input Level



RSSI Output versus Temperature and IF Input Level



RSSI Output versus Supply Voltage Frequency and IF Input Level