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2nd mixer and IF amplifier IC for digital cellular

BH4138FV

The BH4138FV is an IC developed for use with digital cellular phones. This IC contains a 2nd mixer and IF amplifier.

●Applications

Digital cellular phones

●Features

- 1) Mixer circuit, IF amplifier, and RSSI circuit are built-in.
- 2) Mixer input frequency response 10MHz to 200MHz.
- 3) The recommended IF amplifier frequencies are 450kHz and 455kHz.
- 4) High gain IF amplifier (100dB).
- 5) Battery saving function.
- 6) Buffer amplifier for RSSI.
- 7) Low voltage operation (2.3V to 5.5V).

●Absolute maximum ratings (Ta = 25°C)

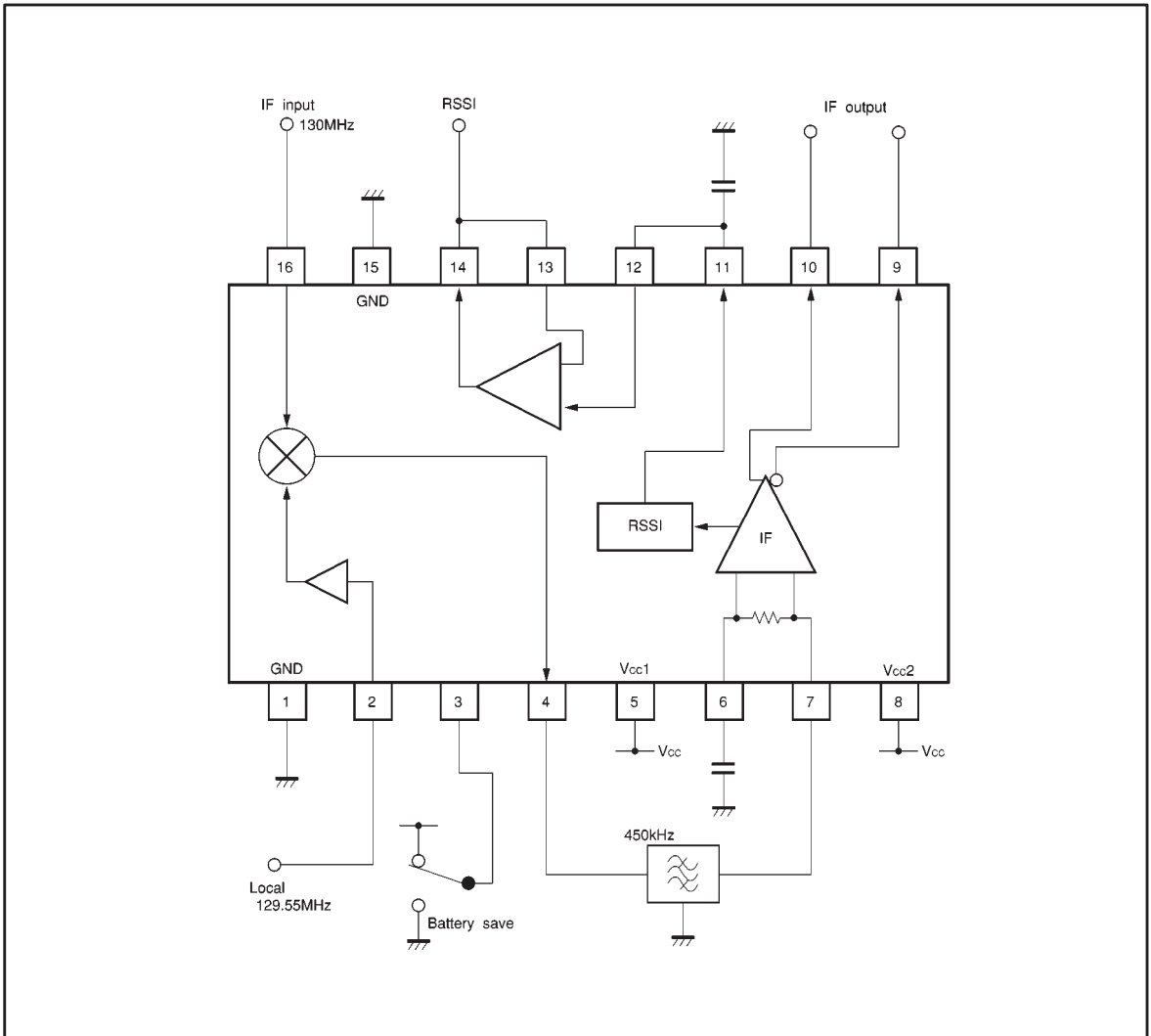
Parameter	Symbol	Limits	Unit
Power supply voltage	V _{CC}	7.0	V
Power dissipation	P _d	350*1	mW
Storage temperature	T _{sig}	-55~+125	°C

*1 Reduced by 3.5mW for each increase in Ta of 1°C over 25°C.

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Limits	Unit	Conditions
Operating power supply voltage	V _{CC}	2.3~5.5	V	—
Operating temperature	T _{opr}	-40~+85	°C	—
Mixer input frequency	f _{MIX IN}	10~200	MHz	pin 16
Mixer output frequency	f _{MIX OUT}	350~500	kHz	pin 4
IF input frequency	f _{IF IN}	350~500	kHz	pin 7
Mixer input level	V _{MIX IN}	10~95	dB μV	pin 16
Local input level	V _{LO IN}	95~105	dB μV	pin 2
IF input level	V _{IF IN}	15~100	dB μV	pin 7
Battery saving input voltage	V _{TH-H}	2~V _{CC}	V	Active
	V _{TH-L}	-0.3~+0.2	V	Battery saving

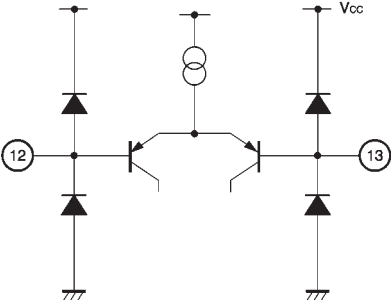
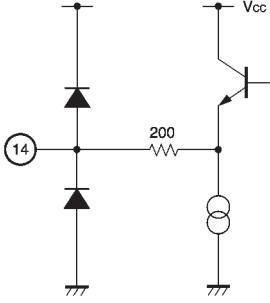
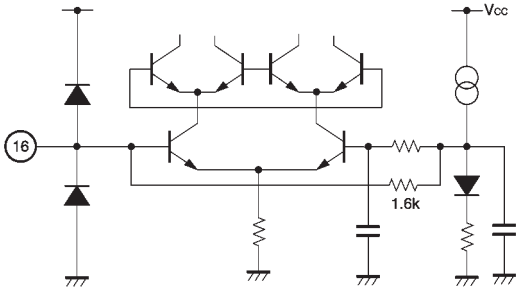
● Block diagram



● Pin descriptions

Pin No.	Function	Equivalent circuit	DC voltage (V)
1	GND	GND	GND
2	Local oscillation input pin Input from the external oscillator.		—
3	Battery saving pin $V_{p3} \leq 0.2V$: battery saving $2V \leq V_{p3} \leq V_{cc}$: active (V_{p3} : voltage at pin 3)		—
4	Mixer output pin Connect to ceramic filter. Output impedance is $2k\Omega$		$V_{cc}-1.6$
5	Power supply pin	The power supply for mixer stage and front of the IF amplifier.	V_{cc}

Pin No.	Function	Equivalent circuit	DC voltage (V)
6	IF amplifier output pin Connect a capacitor.		$V_{CC}-0.6$
7	IF amplifier input pin Connect a ceramic filter. Input impedance is $2k\Omega$		$V_{CC}-0.6$
8	Power supply pin 2	The power supply for the IF rear stage.	V_{CC}
9,10	IF amplifier output pin Pins 9 and 10 output opposite phase.		$V_{CC}-1.2$
11	RSSI output pin Connect a capacitor.		0.15

Pin No.	Function	Equivalent circuit	DC voltage (V)
12	Non-inverting input pin of the buffer amplifier		—
13	Inverting input pin of the buffer amplifier		
14	Output pin of the buffer amplifier		—
15	GND	GND	GND
16	Mixer input pin Input 1st IF signal by DC cut.		1.2

- Electrical characteristics (unless otherwise noted, $T_a = 25^\circ\text{C}$, $V_{CC} = 3.0\text{V}$, SG1 $f_{\text{IN(MIX)}} = 130\text{MHz}$, SG2 $f_{\text{IN(LO)}} = 129.55\text{MHz}$, $100\text{dB}\mu\text{V}$, SG3 $f_{\text{IN(IF)}} = 450\text{kHz}$)

Alternating level to be indicated by termination.

*Items marked with an asterisk are reference values

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current	I_o	—	3.0	3.9	mA	$V_{\text{IN(LO)}}=100\text{dB}\mu\text{V}$ $\text{SW1}=1$
Quiescent current during battery saving	$I_{o(\text{BS})}$	—	0	5	μA	$V_{\text{IN(LO)}}=100\text{dB}\mu\text{V}$ $\text{SW1}=2$
〈MIX—local oscillator stage〉						
Mixer conversion gain	G_{vc}	8.5	12.5	16.5	dB	$V_{\text{IN(MIX)}}=60\text{dB}\mu\text{V}$ $\text{SW2}=1$ ($R_L=2\text{k}\Omega$)
1dB gain compression level*	V_{OM}	96	101	—	dB μV	—
3rd order intercept point*	IP_3	110	115	—	dB μV	$f_1=130.05\text{MHz}$, $f_2=130.10\text{MHz}$
Noise figure*	NF	—	8.5	12.5	dB	Matched impedance input
Mixer input admittance*	$Y_{\text{IN(MIX)}}$	0.38+j2.75			ms	$f=130\text{MHz}$ $G+jB$
Mixer output resistance*	$R_{\text{O(MIX)}}$	1.6	2	2.4	k Ω	—
Local oscillator input admittance*	$Y_{\text{IN(LO)}}$	0.25+j3.65			ms	$f=130\text{MHz}$ $G+jB$
〈IF stage〉						
IF gain*	G_{v}	95	100	105	dB	—
Input resistance*	$R_{\text{IN(IF)}}$	1.6	2	2.4	k Ω	—
Output level	V_{OIF}	0.7	1	1.3	$V_{\text{P-P}}$	$V_{\text{IN(IF)}}=80\text{dB}\mu\text{V}$ $\text{SW2}=2$
Output duty ratio	DR	45	50	55	%	$V_{\text{IN(IF)}}=80\text{dB}\mu\text{V}$, $C_L=10\text{pF}$ $\text{SW2}=2$
Phase delay*	$\Delta\Phi$	—	3	15	deg	$V_{\text{IN(IF)}}=30\text{dB}\mu\text{V}\sim 105\text{dB}\mu\text{V}$

- Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{CC} = 3.0V, SG1 f_{IN(MIX)} = 130MHz, SG2 f_{IN(LO)} = 129.55MHz, 100dBμV, SG3 f_{IN(IF)} = 450kHz)

Alternating level to be indicated by termination.

*Items marked with an asterisk are reference values

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
〈RSSI stage〉						
Output voltage 1	V _{RSSI1}	—	0.15	0.4	V	No input SW2=2
Output voltage 2	V _{RSSI2}	1.0	1.2	1.4	V	V _{IN(IF)} =65dB μV SW2=2
Output voltage 3	V _{RSSI3}	1.9	2.0	2.2	V	V _{IN(IF)} =100dB μV SW2=2
Output voltage 4	V _{RSSI4}	0.5	0.7	0.9	V	V _{IN(IF)} =40dB μV SW2=2
Output voltage 5	V _{RSSI5}	1.4	1.6	1.8	V	V _{IN(IF)} =80dB μV SW2=2
Dynamic range*	D _R	80	85	—	dB	—
Linearity*	L _R	—	—	±2.5	dB	It computes in the regression from V _{IN(MIX)} =10dB μV to 90dB μV
Slope*	S _R	1.91	21.3	23.4	mV/dB	It computes in the regression from V _{IN(MIX)} =10dB μV to 90dB μV
Output resistance*	R _{O(RSSI)}	40	50	60	kΩ	—
Power supply ON rise time*	T _{ON}	—	270	405	μs	C _L =100pF SW ₁ =2→1 V _{IN(MIX)} =35~100dB μV
Power supply OFF fall time*	T _{OFF}	—	130	195	μs	C _L =1000pF SW ₁ =1→2 V _{IN(MIX)} =35~100dB μV
RSSI rise time*	T _R	—	150	225	μs	C _L =1000pF SG1=OFF→V _{IN(MIX)} V _{IN(MIX)} =35~100dB μV
RSSI fall time*	T _F	—	410	615	μs	C _L =1000pF SG1=V _{IN(MIX)} →OFF V _{IN(MIX)} =35~100dB μV

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● Measurement circuit

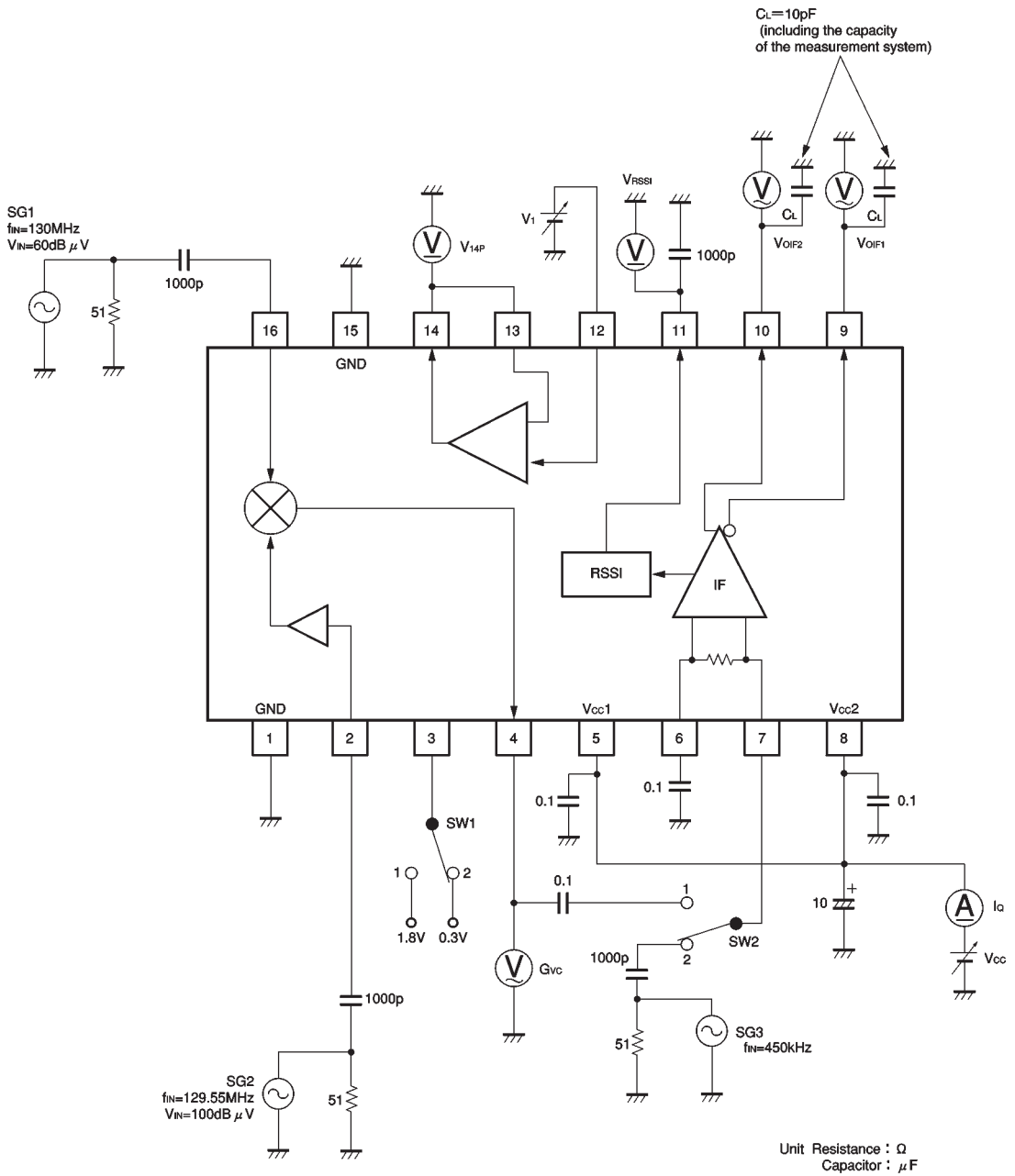


Fig.1

●Application example

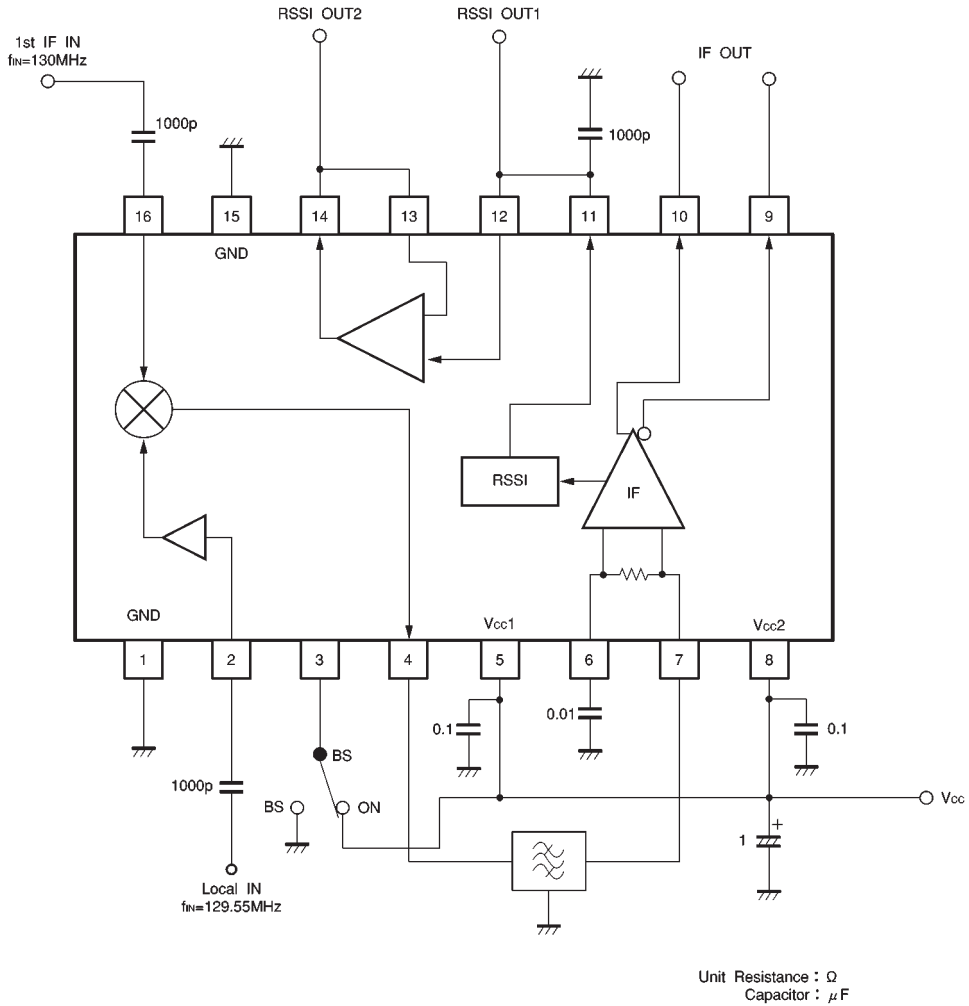
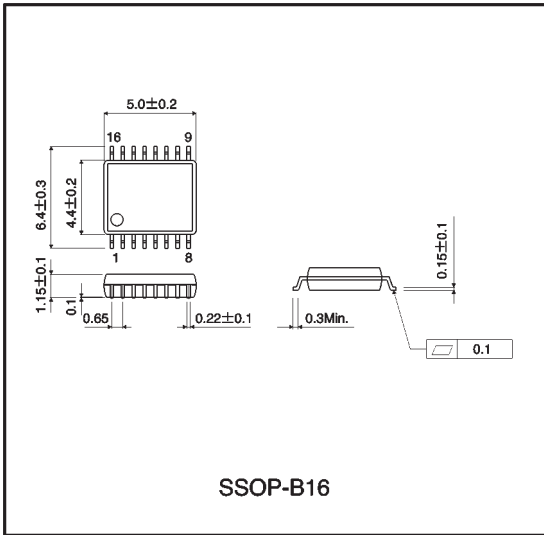


Fig.2

● External dimensions (Units: mm)



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