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)

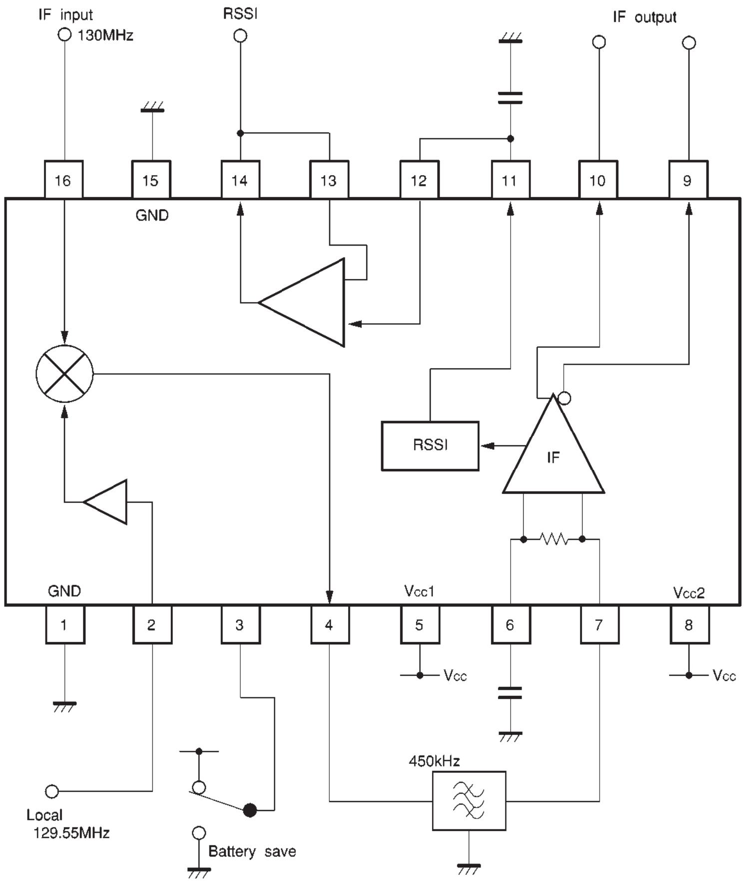
Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	7.0	V
Power dissipation	Pd	350*1	mW
Storage temperature	Tsig	−55～+125	℃

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

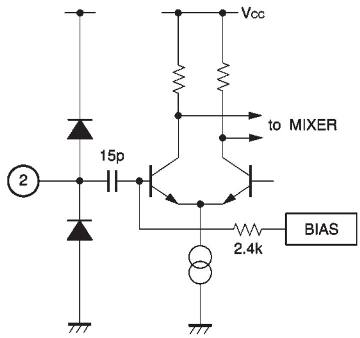
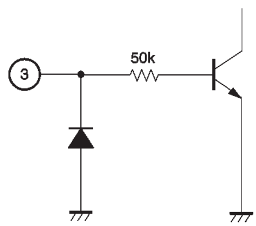
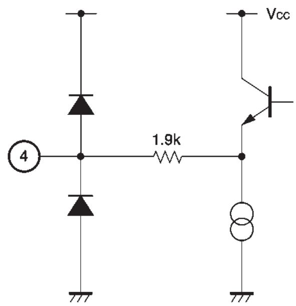
●Recommended operating conditions (Ta = 25°C)

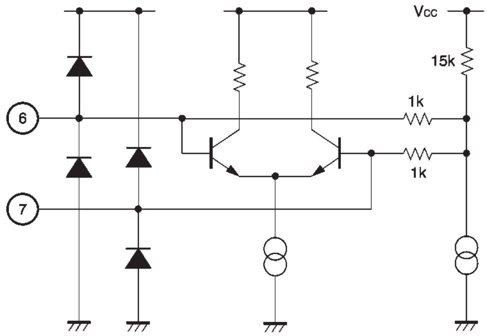
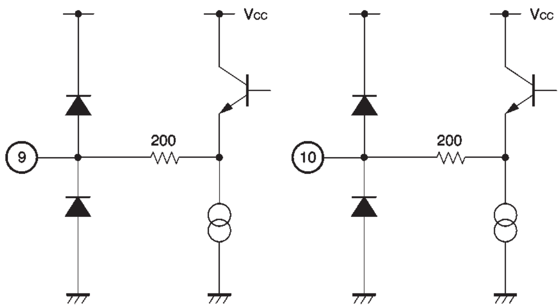
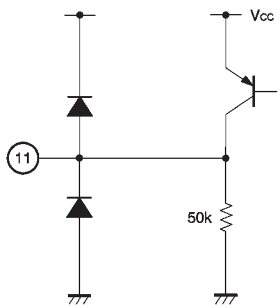
Parameter	Symbol	Limits	Unit	Conditions
Operating power supply voltage	V_{CC}	2.3～5.5	V	−
Operating temperature	Topr	−40～+85	℃	−
Mixer input frequency	$f_{MIX\ IN}$	10～200	MHz	pin 16
Mixer output frequency	$f_{MIX\ OUT}$	350～500	kHz	pin 4
IF input frequency	$f_{IF\ IN}$	350～500	kHz	pin 7
Mixer input level	$V_{MIX\ IN}$	10～95	dBμV	pin 16
Local input level	$V_{LO\ IN}$	95～105	dBμV	pin 2
IF input level	$V_{IF\ IN}$	15～100	dBμV	pin 7
Battery saving input voltage	V_{TH-H}	2～V_{CC}	V	Active
	V_{TH-L}	−0.3～+0.2	V	Battery saving

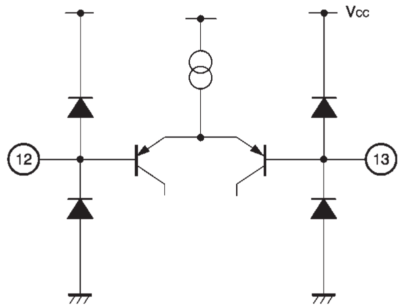
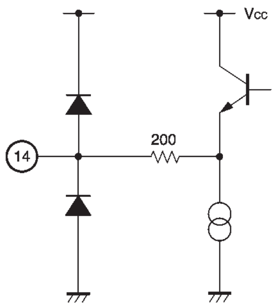
●Block diagram

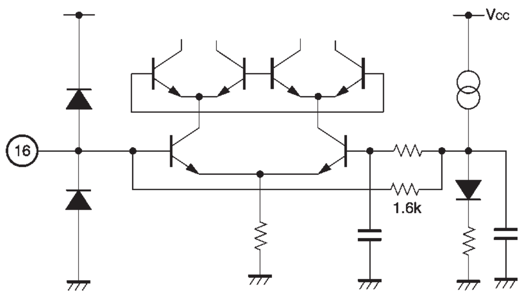


●Pin descriptions

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 $V_{p3} \leqq 0.2V$: battery saving $2V \leqq V_{p3} \leqq V_{CC}$: active （V_{p3} : voltage at pin 3）		—
4	Mixer output pin Connect to ceramic filter. Output impedance is 2kΩ		$V_{CC}-1.6$
5	Power supply pin	The power supply for mixer stage and front of the IF amplifier.	V_{CC}

<table>
<tr><th>Pin No.</th><th>Function</th><th>Equivalent circuit</th><th>DC voltage（V）</th></tr>
<tr><td>6</td><td>IF amplifier output pin
Connect a capacitor.</td><td rowspan="2">
</td><td>Vcc−0.6</td></tr>
<tr><td>7</td><td>IF amplifier input pin
Connect a ceramic filter.
Input impedance is 2kΩ</td><td>Vcc−0.6</td></tr>
<tr><td>8</td><td>Power supply pin 2</td><td>The power supply for the IF rear stage.</td><td>Vcc</td></tr>
<tr><td>9,10</td><td>IF amplifier output pin
Pins 9 and 10 output opposite phase.</td><td>
</td><td>Vcc−1.2</td></tr>
<tr><td>11</td><td>RSSI output pin
Connect a capacitor.</td><td>
</td><td>0.15</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Function</th><th>Equivalent circuit</th><th>DC voltage (V)</th></tr>
<tr><td>12</td><td>Non-inverting input pin of the buffer amplifier</td><td rowspan="2">
</td><td rowspan="2">—</td></tr>
<tr><td>13</td><td>Inverting input pin of the buffer amplifier</td></tr>
<tr><td>14</td><td>Output pin of the buffer amplifier</td><td>
</td><td>—</td></tr>
<tr><td>15</td><td>GND</td><td>GND</td><td>GND</td></tr>
<tr><td>16</td><td>Mixer input pin

Input 1st IF signal by DC cut.</td><td>
</td><td>1.2</td></tr>
</table>

●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
Quiescent current	I_O	—	3.0	3.9	mA	$V_{IN(LO)}$=100dBμV SW1=1
Quiescent current during battery saving	$I_{O(BS)}$	—	0	5	μA	$V_{IN(LO)}$=100dBμV SW1=2
〈MIX−local oscillator stage〉						
Mixer conversion gain	G_{VC}	8.5	12.5	16.5	dB	$V_{IN(MIX)}$=60dBμV SW2=1 (R_L=2kΩ)
1dB gain compression level*	V_{OM}	96	101	—	dBμV	—
3rd order intercept point*	IP_3	110	115	—	dBμV	f_1=130.05MHz, f_2=130.10MHz
Noise figure*	NF	—	8.5	12.5	dB	Matched impedance input
Mixer input admittance*	$Y_{IN(MIX)}$		0.38+j2.75		ms	f=130MHz G+jB
Mixer output resistance*	$R_{O(MIX)}$	1.6	2	2.4	kΩ	—
Local oscillator input admittance*	$Y_{IN(LO)}$		0.25+j3.65		ms	f=130MHz G+jB
〈IF stage〉						
IF gain*	G_V	95	100	105	dB	—
Input resistance*	$R_{IN(IF)}$	1.6	2	2.4	kΩ	—
Output level	V_{OIF}	0.7	1	1.3	V_{P-P}	$V_{IN(IF)}$=80dBμV SW2=2
Output duty ratio	DR	45	50	55	%	$V_{IN(IF)}$=80dBμV, C_L=10pF SW2=2
Phase delay*	ΔΦ	—	3	15	deg	$V_{IN(IF)}$=30dBμV～105dBμV

●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	$V_{IN(IF)}$=65dBμV SW2=2
Output voltage 3	V_{RSSI3}	1.9	2.0	2.2	V	$V_{IN(IF)}$=100dBμV SW2=2
Output voltage 4	V_{RSSI4}	0.5	0.7	0.9	V	$V_{IN(IF)}$=40dBμV SW2=2
Output voltage 5	V_{RSSI5}	1.4	1.6	1.8	V	$V_{IN(IF)}$=80dBμV SW2=2
Dynamic range*	D_R	80	85	—	dB	—
Linearity*	L_R	—	—	±2.5	dB	It computes in the regression from $V_{IN(MIX)}$=10dBμV to 90dBμV
Slope*	S_R	1.91	21.3	23.4	mV/dB	It computes in the regression from $V_{IN(MIX)}$=10dBμV to 90dBμV
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 $V_{IN(MIX)}$=35~100dBμV
Power supply OFF fall time*	T_{OFF}	—	130	195	μs	C_L=1000pF SW_1=1→2 $V_{IN(MIX)}$=35~100dBμV
RSSI rise time*	T_R	—	150	225	μs	C_L=1000pF SG1=OFF→$V_{IN(MIX)}$ $V_{IN(MIX)}$=35~100dBμV
RSSI fall time*	T_F	—	410	615	μs	C_L=1000pF SG1=$V_{IN(MIX)}$→OFF $V_{IN(MIX)}$=35~100dBμV

◎Not designed for radiation resistance.

●Measurement circuit

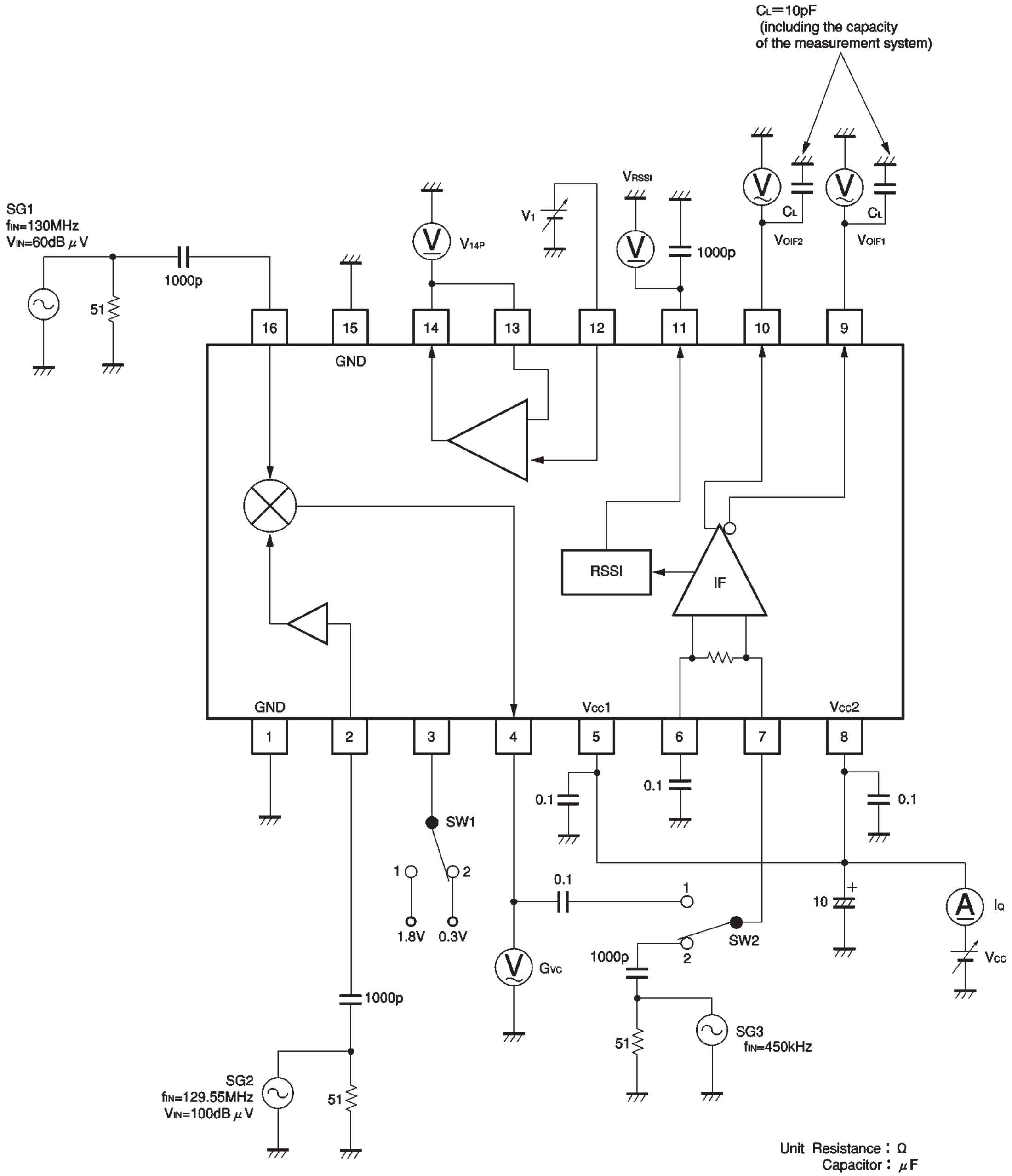


Fig.1

●Application example

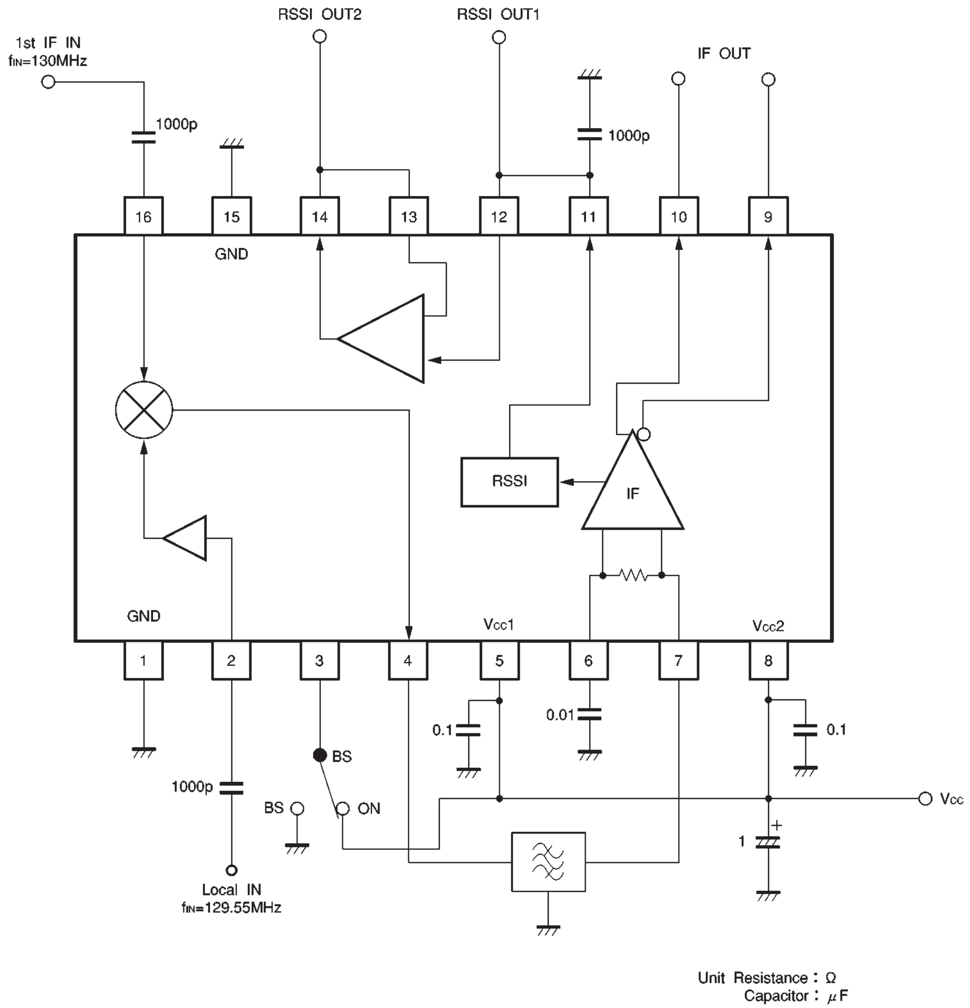
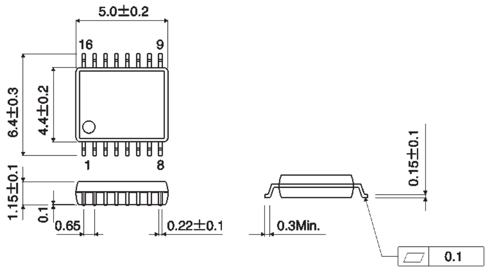


Fig.2

●External dimensions (Units: mm)



SSOP-B16