

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)

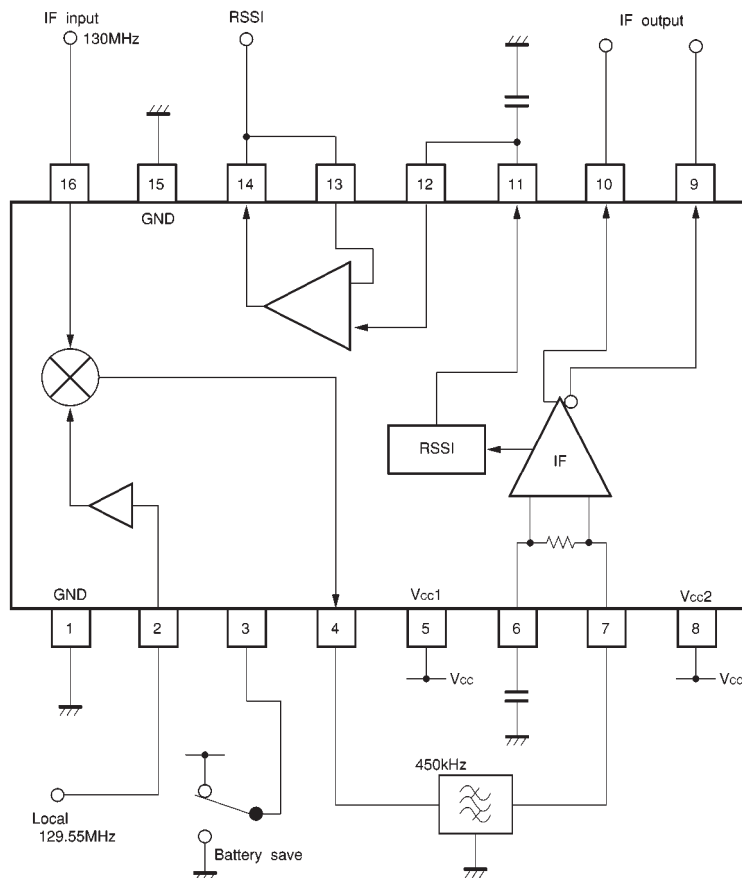
Parameter	Symbol	Limits	Unit
Power supply voltage	V _{CC}	7.0	V
Power dissipation	P _d	350*1	mW
Storage temperature	T _{sig}	−55~+125	°C

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

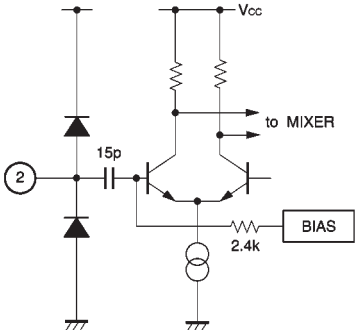
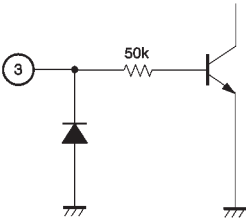
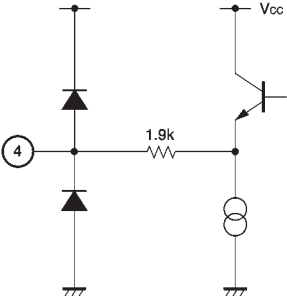
●Recommended operating conditions (Ta = 25°C)

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 μ V	pin 16
Local input level	V _{LO IN}	95~105	dB μ V	pin 2
IF input level	V _{IF IN}	15~100	dB μ V	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 2kΩ		$V_{cc}-1.6$
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 $f_{IN(MIX)} = 130\text{MHz}$, SG2 $f_{IN(LO)} = 129.55\text{MHz}$, $100\text{dB}\mu\text{V}$, SG3 $f_{IN(IF)} = 450\text{kHz}$)

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 _{IN(LO)} =100dB μ V SW1=1
Quiescent current during battery saving	I _{o(BS)}	—	0	5	μ A	V _{IN(LO)} =100dB μ V SW1=2
〈MIX—local oscillator stage〉						
Mixer conversion gain	G _{vc}	8.5	12.5	16.5	dB	V _{IN(MIX)} =60dB μ V SW2=1 (R _L =2k Ω)
1dB gain compression level*	V _{OM}	96	101	—	dB μ V	—
3rd order intercept point*	IP ₃	110	115	—	dB μ V	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)} =80dB μ V SW2=2
Output duty ratio	DR	45	50	55	%	V _{IN(IF)} =80dB μ V, C _L =10pF SW2=2
Phase delay*	Δ Φ	—	3	15	deg	V _{IN(IF)} =30dB μ V~105dB μ 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

◎Not designed for radiation resistance.

SG1
 $f_{IN}=130\text{MHz}$
 $V_{IN}=60\text{dB } \mu\text{V}$

1000p

51

GND

16 15 14 13 12 11 10 9

V_{14P}

V₁

V_{RSSI}

1000p

C_L=10pF
 (including the capacity
 of the measurement system)

V_{0IF2}

V_{0IF1}

GND

1 2 3 4 5 6 7 8

V_{CC1}

V_{CC2}

SW1

1.8V

0.3V

0.1

0.1

0.1

1000p

51

SG2
 $f_{IN}=129.55\text{MHz}$
 $V_{IN}=100\text{dB } \mu\text{V}$

51

SG3
 $f_{IN}=450\text{kHz}$

51

10

V_{CC}

I_a

Unit Resistance : Ω
 Capacitor : μF

Fig.1

●Application example

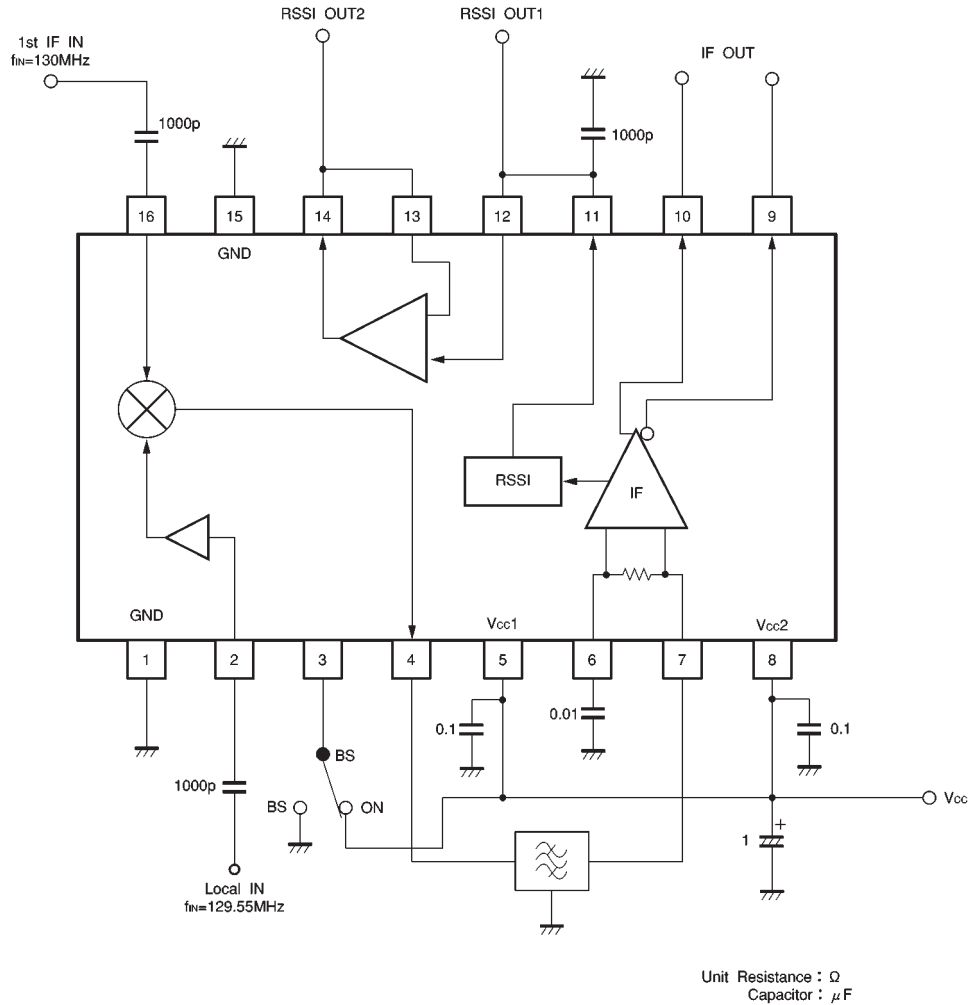


Fig.2

●External dimensions (Units: mm)

