Amplifier with band-pass filter

SPECIFICATION

1 FEATURE

- UMC CMOS 0.18 um
- Low consumption
- Wide gain adjustment range
- Differential input and output
- Digital code gain adjustment
- Independent setting for upper and lower band-pass filter cut-off frequency
- Portable to other technologies (upon request)

2 APPLICATION

- IF filtration and amplification

3 OVERVIE

Band-pass filter (BPF) include LPF and two stages amplifier. All stages input DC decoupled and compensated. LPF is based on Chebyshev 4th stage filter. BPF has constant gain 20 dB. Two stage amplifier gain is changed by digital code from 0 to 60 dB.

4 STRUCTURE

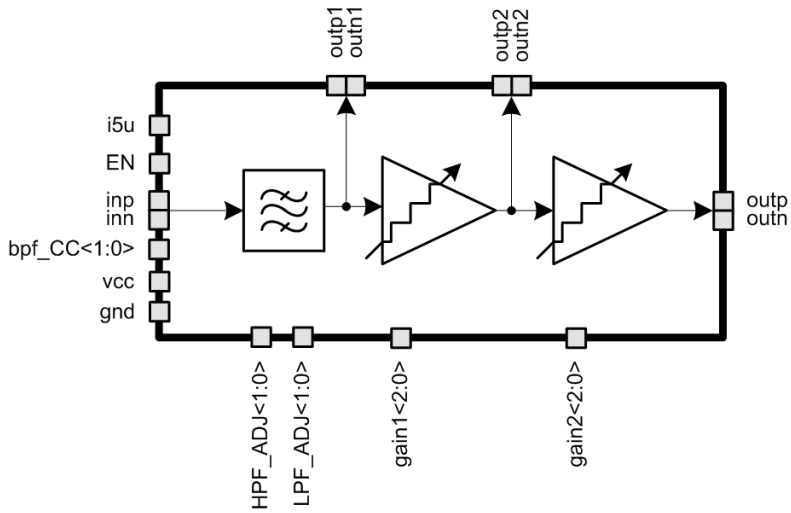

Figure 1: Amplifier with band-pass filter structure

5 PIN DESCRIPTION

Name	Direction	Description
i5u	I	Reference current (5 uA)
inp	I	Differential input
inn	I	
EN	I	BPF enable/disable
bpf_CC<1:0>	I	Amplifier current control
HPF_ADJ<1:0>	I	BPF upper cut-off frequency control
LPF_ADJ<1:0>	I	BPF lower cut-off frequency control
gain1<2:0>	I	1st stage amplifier gain control
gain2<2:0>	I	2nd stage amplifier gain control
outp	O	Differential output
outn	O	
outp1	O	Differential output after LPF
outn1	O	
outp2	O	Differential output after 1st stage amplifier
outn2	O	
vcc	IO	Supply voltage
gnd	IO	Ground

6 LAYOUT DESCRIPTION

The block dimensions are given in the table 1.

Table 1: Block dimensions

Dimension	Value	Unit
Height	570	um
Width	430	um

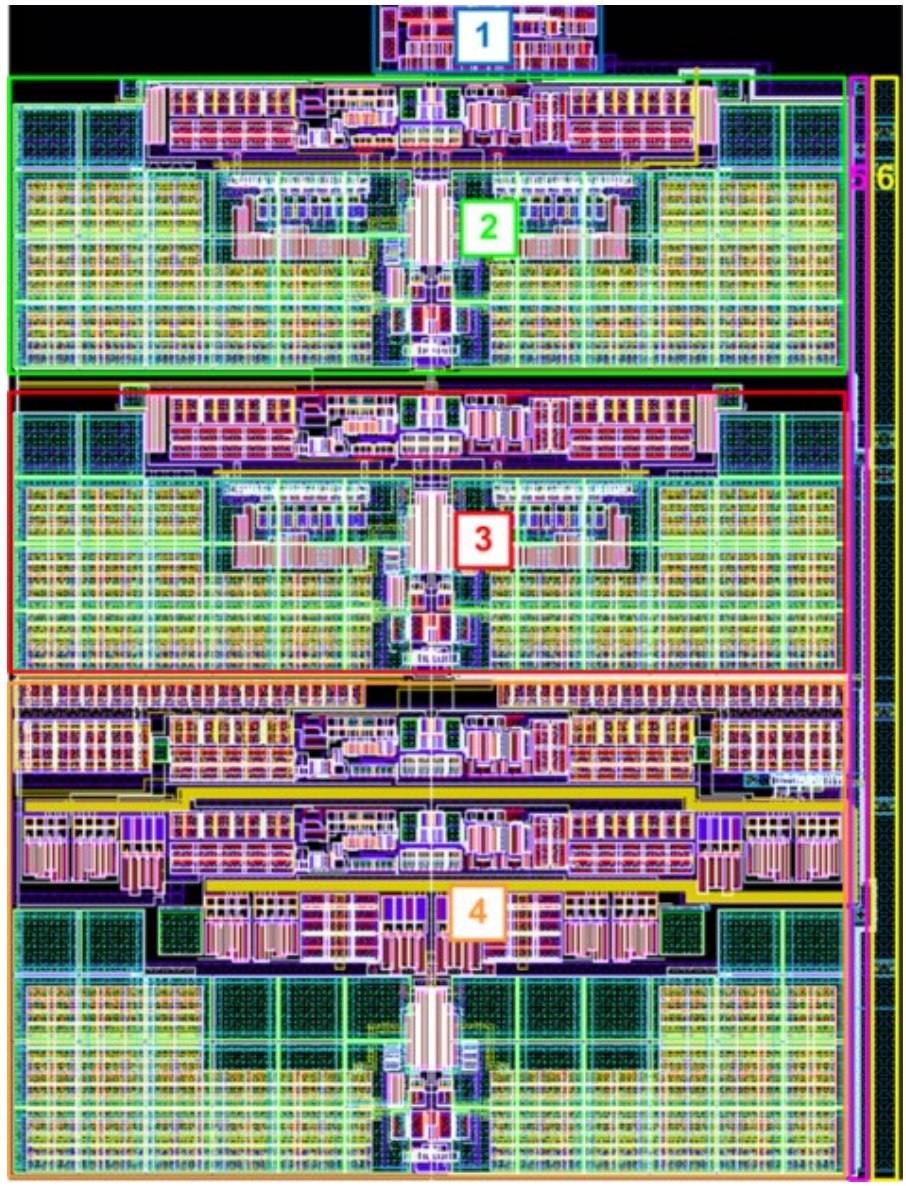

Figure 2: Amplifier with band-pass filter layout

1. Current source
2. 2nd stage amplifier
3. 1st stage amplifier LPF
4. LPF
5. Supply voltage bas
6. Ground bas

7 OPERATING CHARACTERISTICS

7.1 TECHNICAL CHARACTERISTICS

Technology UMC CMOS 0.18 um
Status silicon proven
Area 0.25 mm^2

7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for V_{dd} = 2.7 ÷ 3.3 V and T = -45 ÷ +100°C. Typical values are at V_{dd} = 2.8 V, T = +27°C, unless otherwise specified.

Parameter	Symbol	Condition	Value			Unit
			min	typ.	max	
Supply voltage	V_{dd}	-	2.7	2.8	3.3	V
Operating temperature range	T	-	-45	+27	100	°C
LPF attenuation per octave	A_{cut_LPF}	-	33	36	38	dB
HPF attenuation per octave	A_{cut_HPF}	-	-	17.9	-	dB
LPF cut-off frequency	f_{c_LPF}	LPF_ADJ<1:0>=0	1.7	2.78	4.5	MHz
		LPF_ADJ<1:0>=1	1.4	2.2	3.7	
		LPF_ADJ<1:0>=2	0.95	1.45	2.37	
		LPF_ADJ<1:0>=3	0.7	1.1	1.76	
HPF cut-off frequency	f_{c_HPF}	HPF_ADJ<1:0>=0	195	285	360	kHz
		HPF_ADJ<1:0>=1	94	160	240	
		HPF_ADJ<1:0>=2	60	100	160	
		HPF_ADJ<1:0>=3	8	15	27	
Maximum gain	G_{max}	-	76.9	79.7	83.6	dB
Minimum gain	G_{min}	-	21.5	22.4	23.1	dB
Gain adjustment step	ΔG	-	3	4	5	dB
Current consumption in an active mode	I_{cc}	BPF_CC<1:0>=0	-	0.3	0.41	mA
		BPF_CC<1:0>=1	-	0.6	0.81	
		BPF_CC<1:0>=2	-	1.47	2.0	
		BPF_CC<1:0>=3	-	1.73	2.4	
Current consumption in a standby mode	I_{stb}	-	-	-	0.01	uA
Input logic-high level	V_{IH}	For digital input	$0.7V_{dd}$	-	V_{dd}+0.25	V
Input logic-low level	V_{IL}		-0.25	-	$0.3V_{dd}$	V

8 TYPICAL CHARACTERISTICS

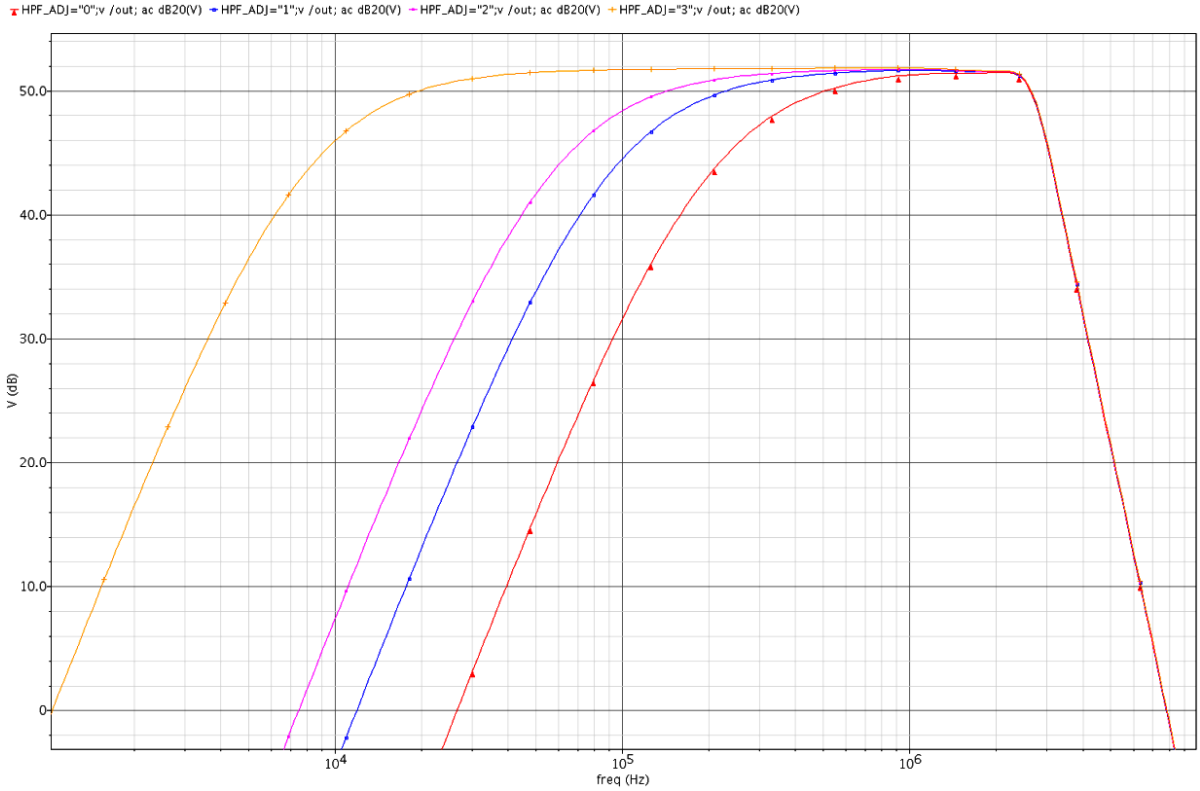

Figure 3: HPF cut-off frequency vs control code

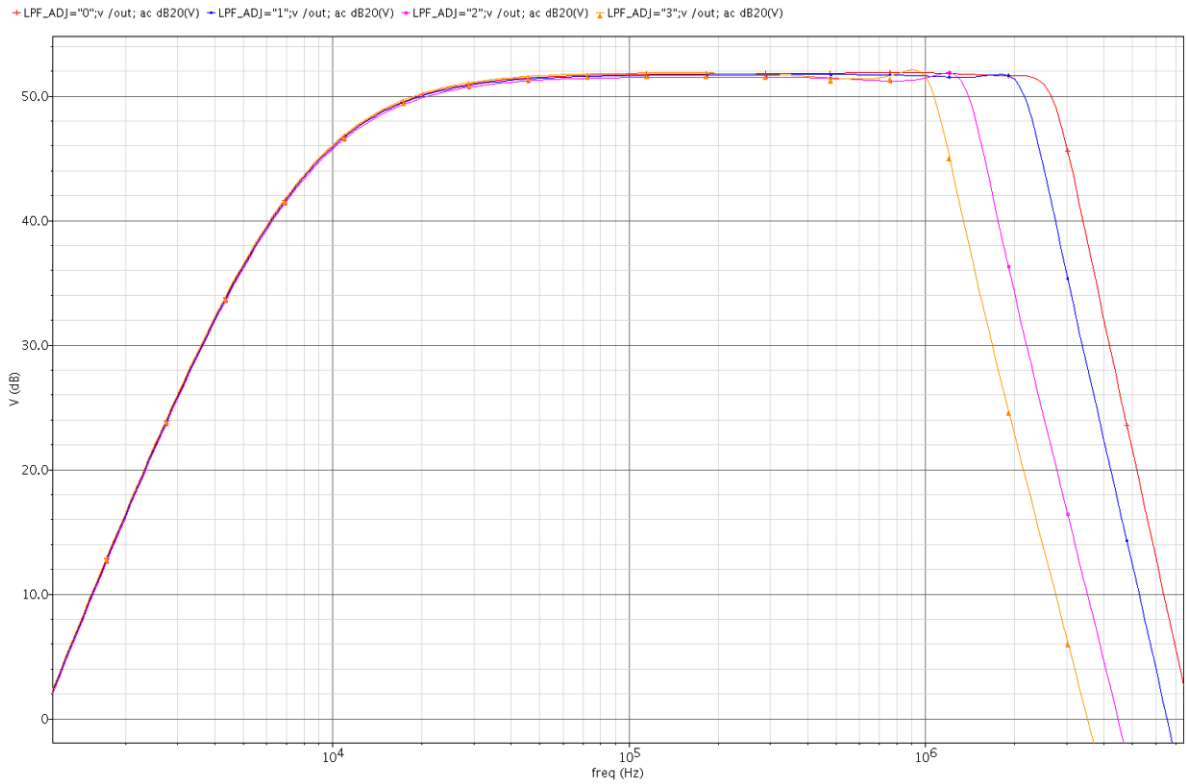

Figure 4: LPF cut-off frequency vs control code

9 DELIVERABLES

Depending on license type IP may include:

- Schematic or NetList
- Abstract view (.lef and .lib files)
- Layout (optional)
- Verilog behavior model
- Extracted view (optional)
- GDSII
- DRC, LVS, antenna report
- Test bench with saved configurations (optional)
- Documentation