

# Low pass filter

## SPECIFICATION

### 1 FEATURES

- AMS BiCMOS 0.35  $\mu\text{m}$
- Low noise figure
- High linearity
- Low pass filter cut-off frequency adjustment system (LPF CFAS)
- Very low amplitude ripple
- Supported foundries: TSMC, UMC, Global Foundries, SMIC, iHP, AMS, Vanguard, SilTerra

### 2 APPLICATION

- Receivers

### 3 OVERVIEW

The IP1\_LPF\_01R5 is the 4<sup>th</sup> order Butterworth low pass filter with cut-off frequency adjustment. High third-order input intercept point is reached due to using a pseudodifferential circuit and Sallen-Key circuit. There are two modes for cut-off frequency programming: manually and automatically. The generator is used to adjust filter cut-off (CO) frequency in automatic mode. Also CO frequency can be set by the digital code CFAS\_Code<6:0>. The block is fabricated on AMS BiCMOS 0.35  $\mu\text{m}$  technology.

### 4 STRUCTURE

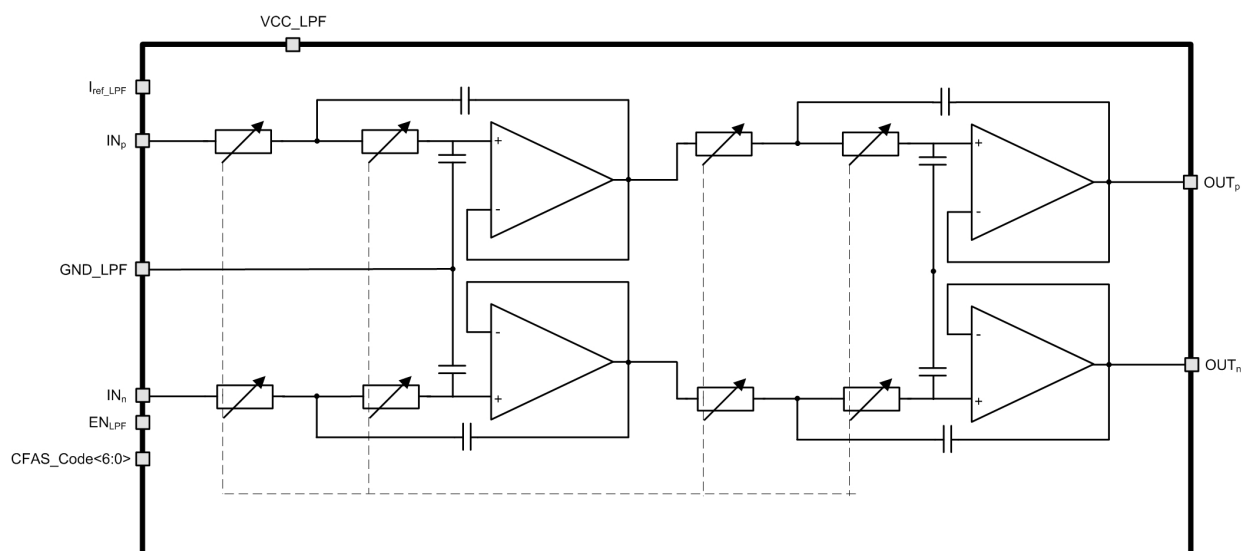


Figure 1: Low pass filter structure.

## 5 PIN DESCRIPTION

Name	Direction	Description
I <sub>ref_LPF</sub>	IO	Reference current 60 $\mu$ A
IN <sub>p</sub>	I	Differential input
IN <sub>n</sub>	I	
CFAS_Code<6:0>	I	Digital code of LPF cut-off frequency adjustment system
EN	I	LPF enable/disable
EN <sub>CFAS</sub>	I	LPF cut-off frequency adjustment system enable/disable
OUT <sub>p</sub>	O	LPF differential output
OUT <sub>n</sub>	O	
VCC_LPF	IO	LPF supply voltage
GND_LPF	IO	LPF ground

## 6 LAYOUT DESCRIPTION

Low pass filter dimensions are given in the table 1.

Table 1: Block dimensions.

Dimension	Value	Unit
Height	410	$\mu\text{m}$
Width	645	$\mu\text{m}$

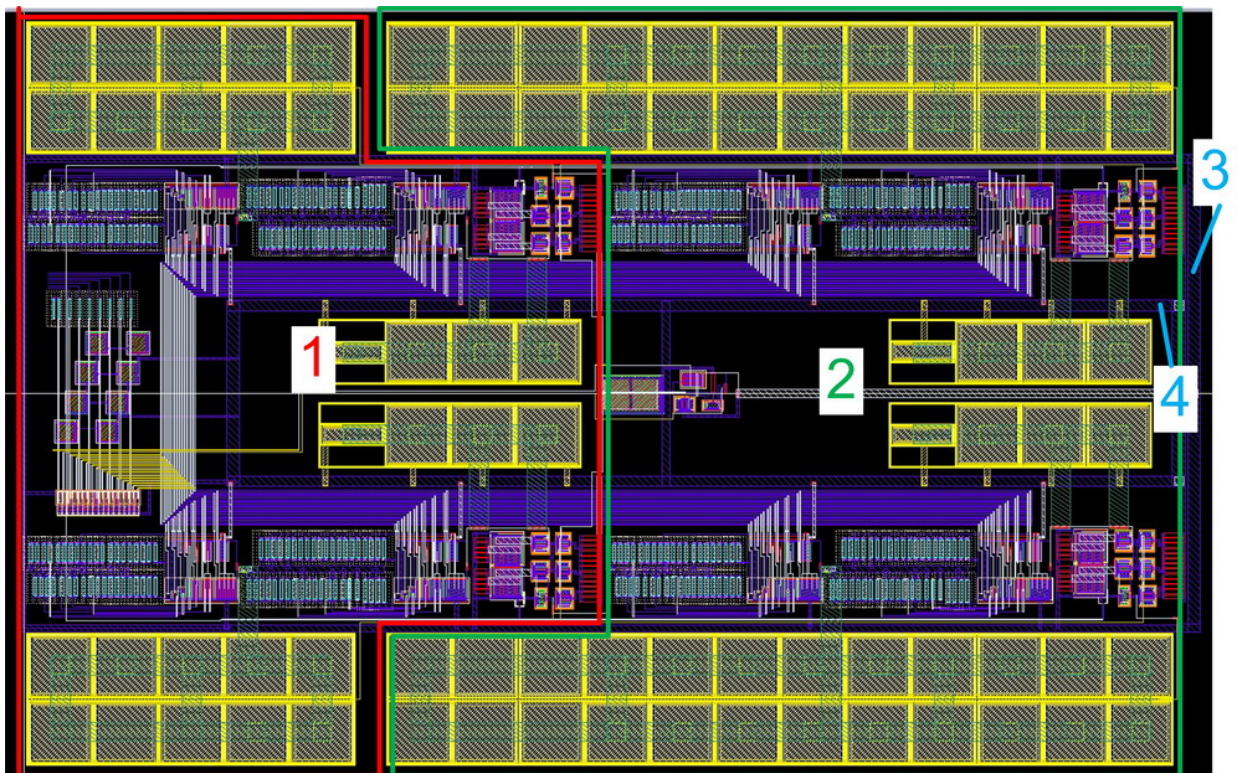


Figure 2: Low pass filter layout view.

1. The 1<sup>st</sup> pseudodifferential stage
2. The 2<sup>nd</sup> pseudodifferential stage
3. Supply voltage bus
4. Ground bus

## 7 OPERATING CHARACTERISTICS

### 7.1 TECHNICAL CHARACTERISTICS

Technology \_\_\_\_\_ AMS BiCMOS 0.35 $\mu$ m  
 Status \_\_\_\_\_ silicon proven  
 Area \_\_\_\_\_ 0.27 mm<sup>2</sup>

### 7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for  $V_{cc} = 2.75 \div 3.2$  V and  $T = -45 \div +85^{\circ}\text{C}$ . Typical values are at  $V_{cc} = 3.0$  V,  $T = +27^{\circ}\text{C}$ , unless otherwise specified.

Parameter	Symbol	Condition	Value			Unit
			min	typ.	max	
Supply voltage	$V_{cc}$	-	2.75	3.0	3.2	V
Operating temperature range	T	-	-45	+27	+85	$^{\circ}\text{C}$
Filter order	$O_f$	-	-	4	-	-
Insertion loss	G	In passband	-0.5	-1.4	-2.3	dB
Filter bandwidth	F	-1 dB	21.8	23	23.9	MHz
		-4 dB	-	30	-	MHz
		-17 dB	-	50	-	MHz
Group delay ripple	$t_{del}$	2.5...18.5 MHz	-	4.7	5.3	ns
		4.5...22.5 MHz		5.4	5.6	
Input referred noise	RN	Differential input 100 $\Omega$	-	14.5	21.5	$\frac{\text{nV}}{\sqrt{\text{Hz}}}$
1 dB compression point	$P_{1dB}$	1 dB	7.8	10.5	-	dBm
3 <sup>rd</sup> order input intercept point	IP3	Differential input	-	26	-	dBm
Input impedance	R	Differential input	78	102	131	$\Omega$
Supply current	$I_{cc}$	-	-	3.4	3.5	mA
Stand-by current	$I_{stb}$	-	-	0.01	0.1	$\mu\text{A}$
Input logic-level low	$V_{IL}$	For digital inputs	-0.25	-	0.3	V
Input logic-level high	$V_{IH}$		$0.7V_{cc}$	-	$V_{cc} + 0.25$	V

## 8 DELIVERABLES

IP contents:

- Schematic or NetList
- Layout or blackbox
- Extracted view (optional)
- GDSII
- DRC, LVS, antenna report
- Test bench with saved configurations (optional)
- Documentation