

Low - pass filter with frequency adjustment system

SPECIFICATION

1 FEATURES

- SMIC CMOS 0.18 μ m
- Wide cut-off frequency adjustment range (1MHz...200MHz)
- Low group delay time ripple vs. frequency (3.5ns)
- Low pass filter cut-off frequency adjustment system (LPF CFAS)
- There are 4 operation modes
- No external components required
- Portable to other technologies (upon request)

2 APPLICATION

- Intermediate frequency signal processing
- Navigation systems including multisystems

3 OVERVIEW

The cell is based on 3rd order Butterworth low-pass filter (LPF) with cut-of frequency adjustment in a wide range. There are 2 modes for cut-off frequency programming: manual and automatically. The generator is used to control filter cut-off frequency in an automatic mode. Oscillator oscillation frequency correlates with cut-off frequency which can be fixed by digital code LPF_ctrl<6:0>.

There are 4 operation modes with different rated signal level under the same value of distortion. Greater level of signal corresponds to a higher current consumption.

It is possible to use several LPF with one generator for multichannel systems.

The block is fabricated on SMIC CMOS 0.18 μ m technology.

4 STRUCTURE

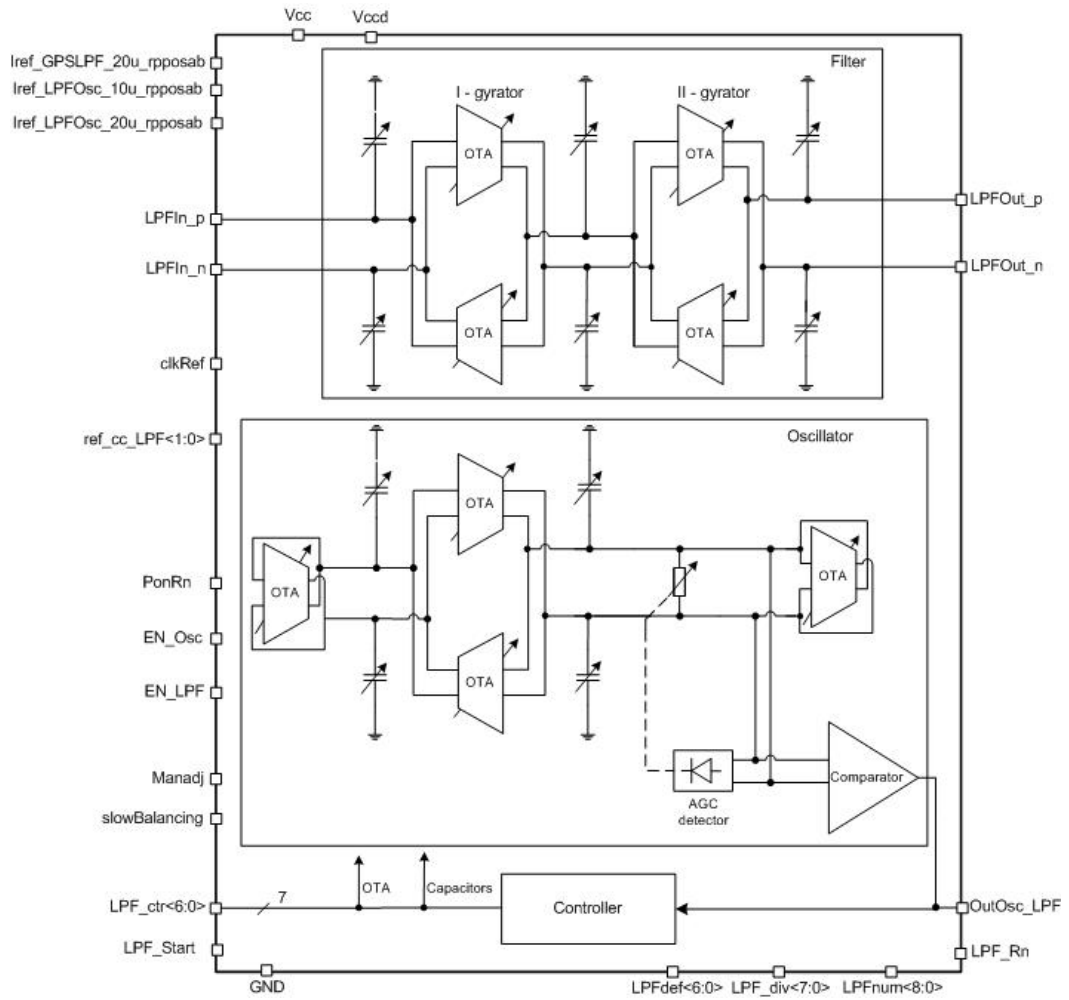


Figure 1: Low-pass filter with frequency adjustment system structure.

5 PIN DESCRIPTION

| Name | Direction | Description |
|-------------------------|-----------|--|
| LPFIn_p | I | Analog differential input |
| LPFIn_n | I | |
| LPF_ctr<6:0> | O | Digital code controlling a central frequency |
| LPFdef<6:0> | I | Digital input of LPF cut-off frequency adjustment system |
| LPF_div<7:0> | I | Digital code forming coefficient for frequency adjustment system |
| LPF_num<8:0> | I | Pulse number for internal LPF adjustment |
| clkRef | I | Reference frequency (3.105 MHz) |
| ref_cc_LPF<1:0> | I | Reference voltage control |
| slowBalancing | I | Oscillator setting time control |
| Iref_GPSLPF_20uA_rposab | I | Reference current (20 μ A) |
| Iref_LPFOsc_10uA_rposab | I | Reference current (10 μ A) |
| Iref_LPFOsc_20uA_rposab | I | Oscillator reference current (20 μ A) |
| Manadj | I | Manual mode enable for cut-off frequency adjustment enable |
| PonRn | I | Reset of defaults |
| EN_Osc | I | Oscillator enable/disable |
| EN_LPF | I | LPF enable/disable |
| LPF_Start | I | Filter automatic frequency adjustment system enable |
| LPFOut_p | O | Analog differential output |
| LPFOut_n | O | |
| OutOsc_LPF | O | Oscillator digital output |
| LPF_Rn | O | Automatic adjustment system status |
| Vccd | IO | Digital supply voltage |
| 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 | 441.54 | μm |
| Width | 384.45 | μm |

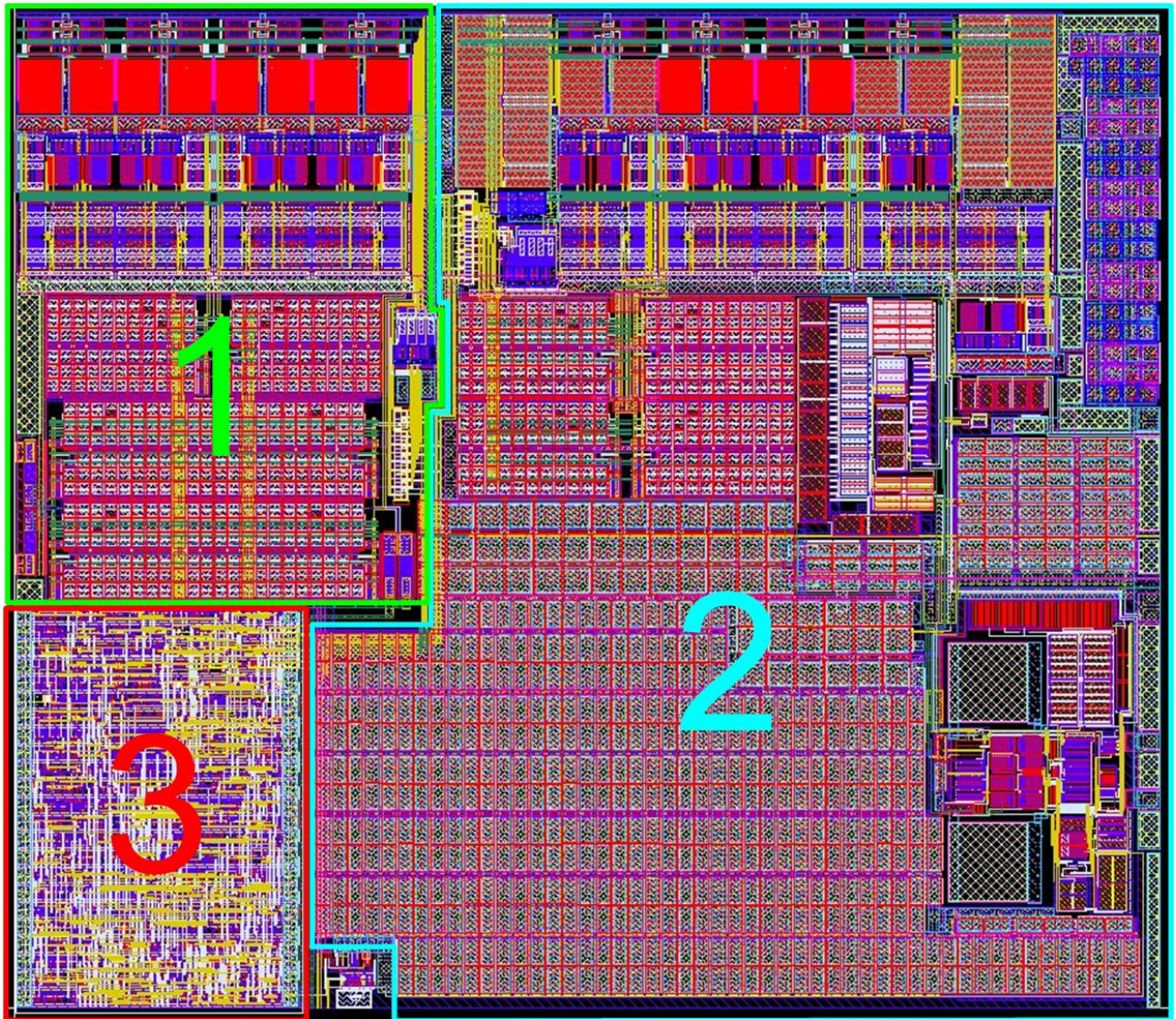


Figure 2: Device layout view.

1. LPF
2. Oscillator
3. Controller

7 OPERATING CHARACTERISTICS

7.1 TECHNICAL CHARACTERISTICS

Technology _____ SMIC CMOS 0.18 μ m
 Status _____ silicon proven
 Area _____ 0.17mm²

7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for $V_{cc} = 1.7 \div 1.9$ V , $V_{dd} = 2.7 \div 3.6$ V and $T = -45 \div +90$ °C. Typical values are at $V_{cc} = 1.8$ V, $V_{dd} = 3.15$ V and $T = +27^{\circ}$ C , unless otherwise specified.

| Parameter | Symbol | Condition | Value | | | Unit |
|---------------------------------------|-------------|------------------------|--------------|--------|--------|------------|
| | | | min | typ | max | |
| Supply voltage | V_{cc} | - | 1.7 | 1.8 | 1.9 | V |
| Digital supply voltage | V_{dd} | - | 2.7 | 3.15 | 3.6 | V |
| Operating temperature range | T | - | -45 | 27 | 90 | °C |
| Filter order | k | - | - | 3 | - | - |
| Insertion loss | G | - | - | -0.3 | - | dB |
| Input signal bandwidth | F | - | - | 18.07 | - | MHz |
| Attenuation factor | α | At 25MHz | - | 8.05 | - | dB |
| | | At 50MHz | - | 24.08 | - | |
| | | At 100MHz | - | 41.73 | - | |
| Group delay time ripple | t_{del} | - | - | 2.48 | - | ns |
| Noise figure | NF | - | - | 16.18 | - | dB |
| Input 1dB compression point | P_{1dB} | - | - | -21.26 | -21.54 | dBm |
| Input impedance | R_{in} | At differential input | - | 2 | - | k Ω |
| Output impedance | R_{out} | At differential output | - | 2 | - | k Ω |
| Oscillator start time | t_{start} | - | - | - | 1.5 | ms |
| Peak-to-peak oscillator analog signal | A | - | - | 120 | - | mV |
| Oscillation frequency range | F | - | 7 | - | 150 | MHz |
| LPF offset error | δ | - | - | - | 5 | % |
| Current consumption | I_{cc} | - | - | 1.3 | 1.5 | mA |
| Current consumption in a standby mode | I_{stb} | - | - | - | 1.1 | μ A |
| Input logic-high level | V_{IH} | For digital inputs | 0.7 V_{cc} | - | 3.6 | V |
| Input logic-low level | V_{IL} | | -0.25 | - | 0.3 | 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