

# Fifth-order passive LPF

## SPECIFICATION

### 1 FEATURES

- TSMC CMOS 0.065  $\mu\text{m}$
- Differential inputs, outputs
- Fixed cut-off frequency: 25MHz, 50MHz, 100MHz
- High linearity
- Low noise figure
- Portable to other technologies (upon request)

### 2 APPLICATION

- IF signal processing

### 3 OVERVIEW

The 5<sup>th</sup> order passive differential low-pass filter (LPF) with fixed cut-off frequency presets. LPF is implemented using integrated inductors. Cut-off frequency switching is performed by switched-capacitor circuit.

### 4 STRUCTURE

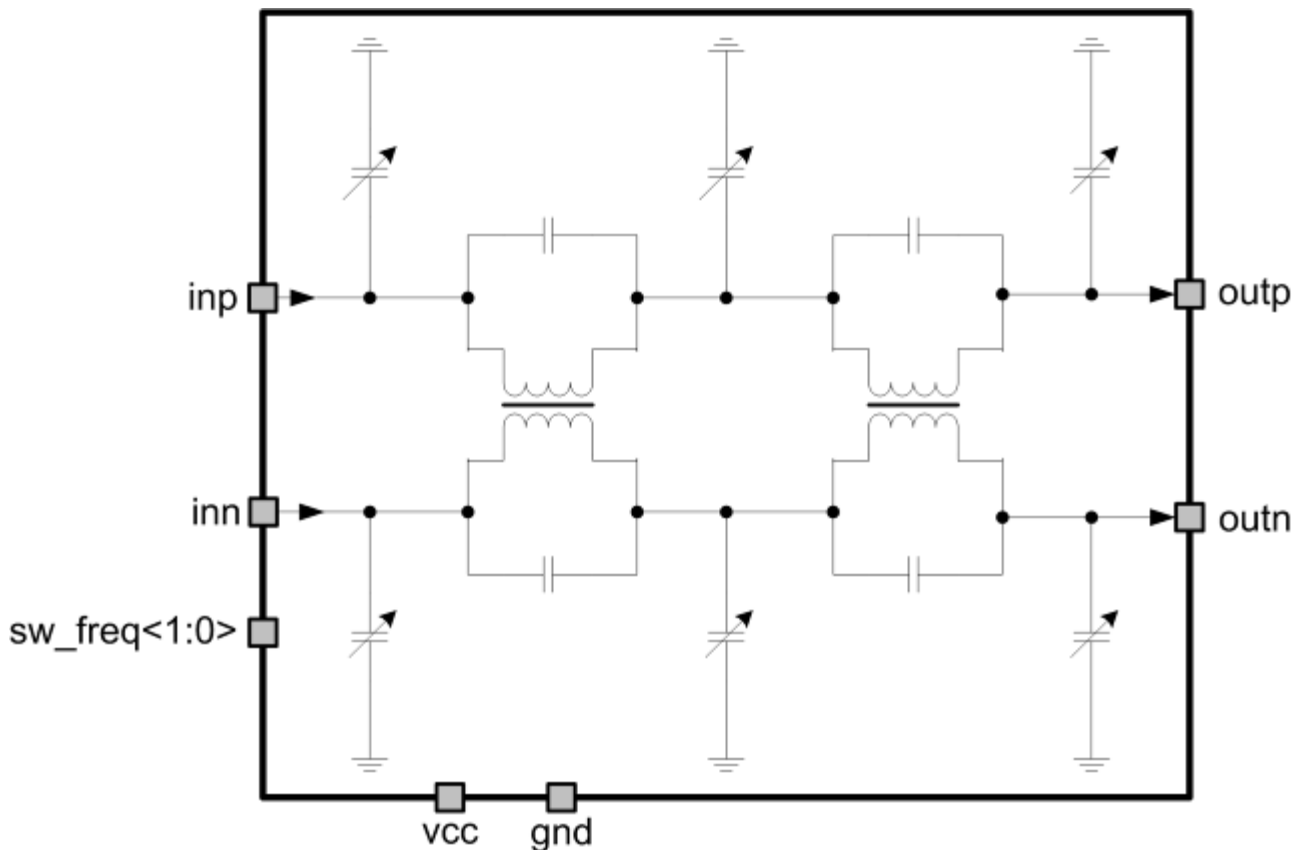


Figure 1: Fifth-order passive LPF structure.

## 5 PIN DESCRIPTION

Name	Direction	Description
sw_freq<1:0>	I	LPF cut-off frequency control code
inp	I	LPF differential input
inn	I	
outp	O	LPF differential output
outn	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	1355	$\mu\text{m}$
Width	1740	$\mu\text{m}$

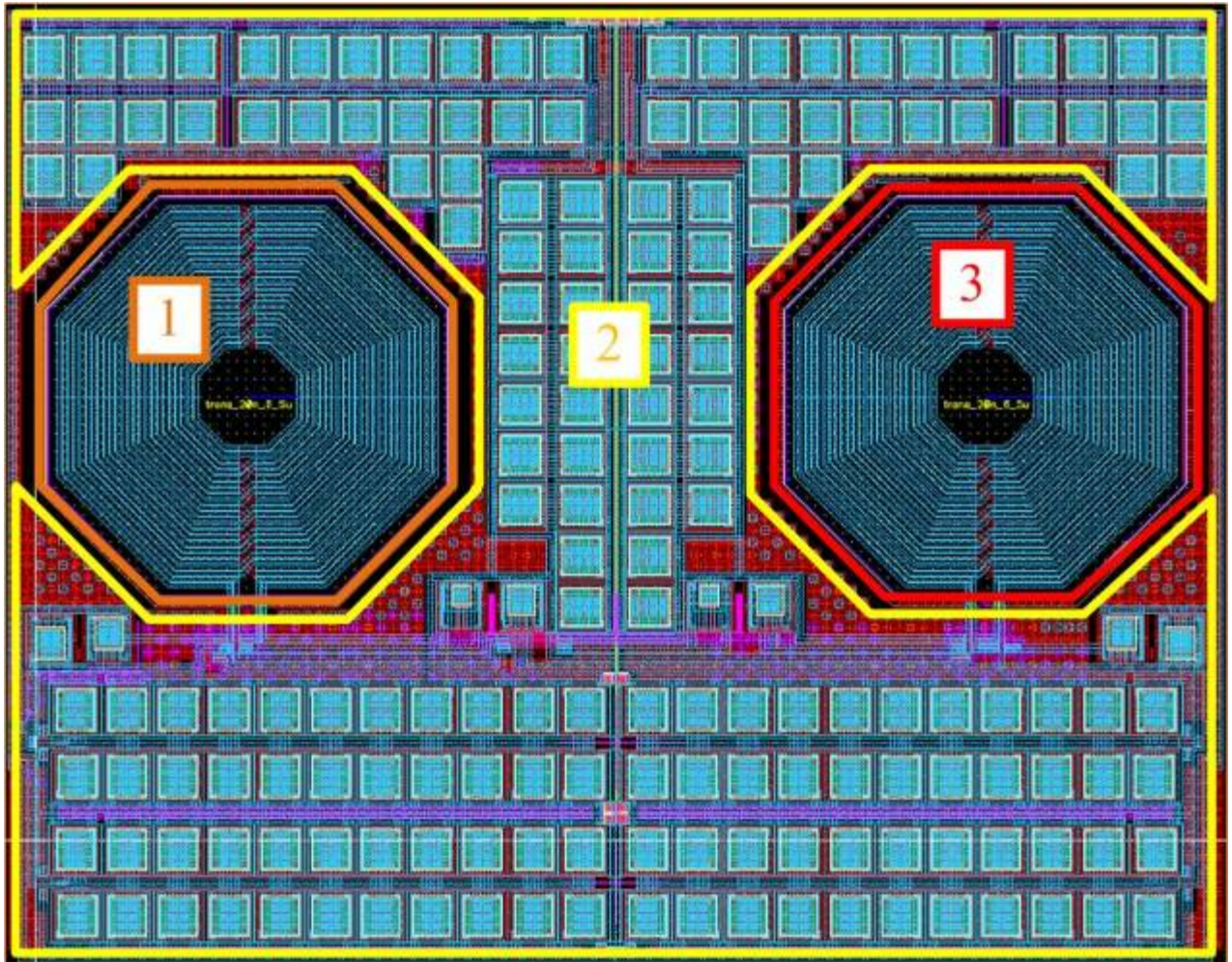


Figure 2: Device layout view.

1. Transformer №1
2. Switched capacitors
3. Transformer №2

## 7 OPERATING CHARACTERISTICS

### 7.1 TECHNICAL CHARACTERISTICS

Technology \_\_\_\_\_ TSMC CMOS CRN65LP  
 Status \_\_\_\_\_ silicon proven  
 Area \_\_\_\_\_ 2.36mm<sup>2</sup>

### 7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for  $V_{cc} = 2.375 \div 2.625$  V and  $T = -40 \div +125^{\circ}\text{C}$ . Typical values are at  $V_{cc} = 2.5\text{V}$ ,  $T = +85^{\circ}\text{C}$ , unless otherwise specified.

Parameter	Symbol	Condition	Value			Unit
			min	typ	max	
Supply voltage	$V_{cc}$	-	2.375	2.5	2.625	V
Temperature range	T	-	-40	85	125	$^{\circ}\text{C}$
Filter order	k	-	-	5	-	-
Insertion loss	G	-	-	-3.7	-	dB
Input signal bandwidth	$F_C$	Preset 1	-	25	-	MHz
		Preset 2	-	50	-	
		Preset 3	-	100	-	
Attenuation >400MHz	$G_A$	$F_C = 100$ MHz	48	50	51	dB
		$F_C = 50$ MHz	61	64	68	
		$F_C = 25$ MHz	69	73	78	
Amplitude ripple	$\Delta A$	$F_C = 100$ MHz	0.7	1.1	1.7	dB
		$F_C = 50$ MHz	1.5	2.4	3	
		$F_C = 25$ MHz	2	3	3.9	
Noise figure	NF	-	-	8	8.1	dB
1 dB compression point	$P_{1dB}$	-	14	14	-	dBm
Input/output impedance	R	Differential	-	50	-	$\Omega$
Current consumption	$I_{cc}$	-	-	-	1	$\mu\text{A}$
Input logic-high level	$V_{IH}$	For digital input	0.85 $V_{dd}$	-	1.15 $V_{dd}$	V
Input logic-low level	$V_{IL}$		-0.2	-	+0.2	V

## 8 TYPICAL CHARACTERISTICS

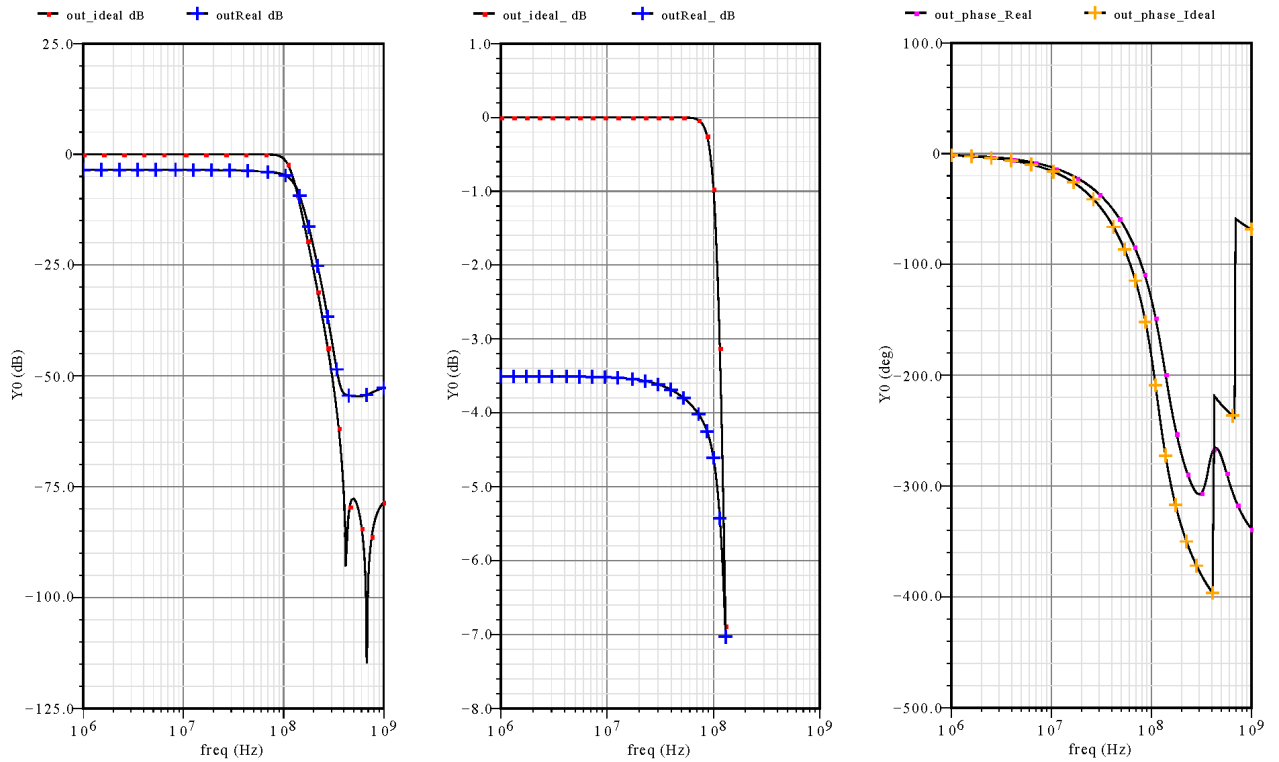


Figure 3: Amplitude frequency characteristics and phase frequency variation for band pass 100MHz.

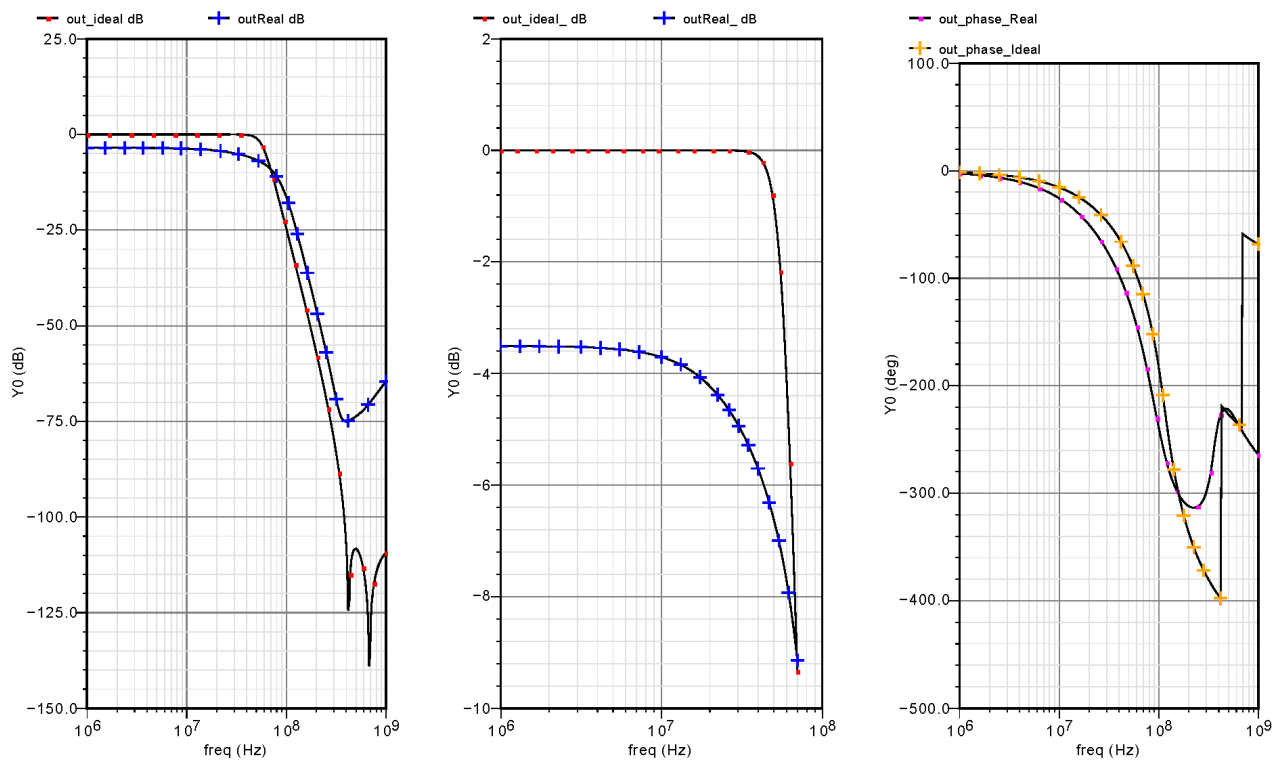


Figure 4: Amplitude frequency characteristics and phase frequency variation for band pass 50MHz.

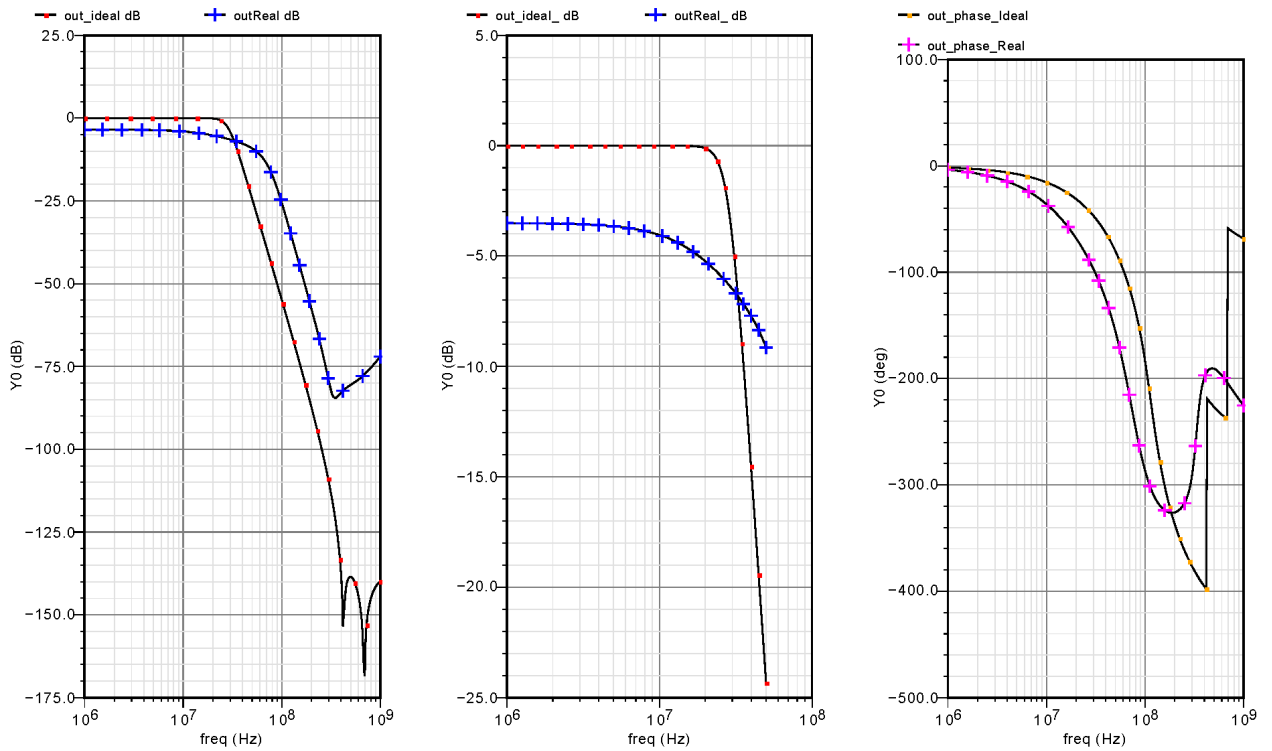


Figure 5: Amplitude frequency characteristics and phase frequency variation for band pass 25MHz.

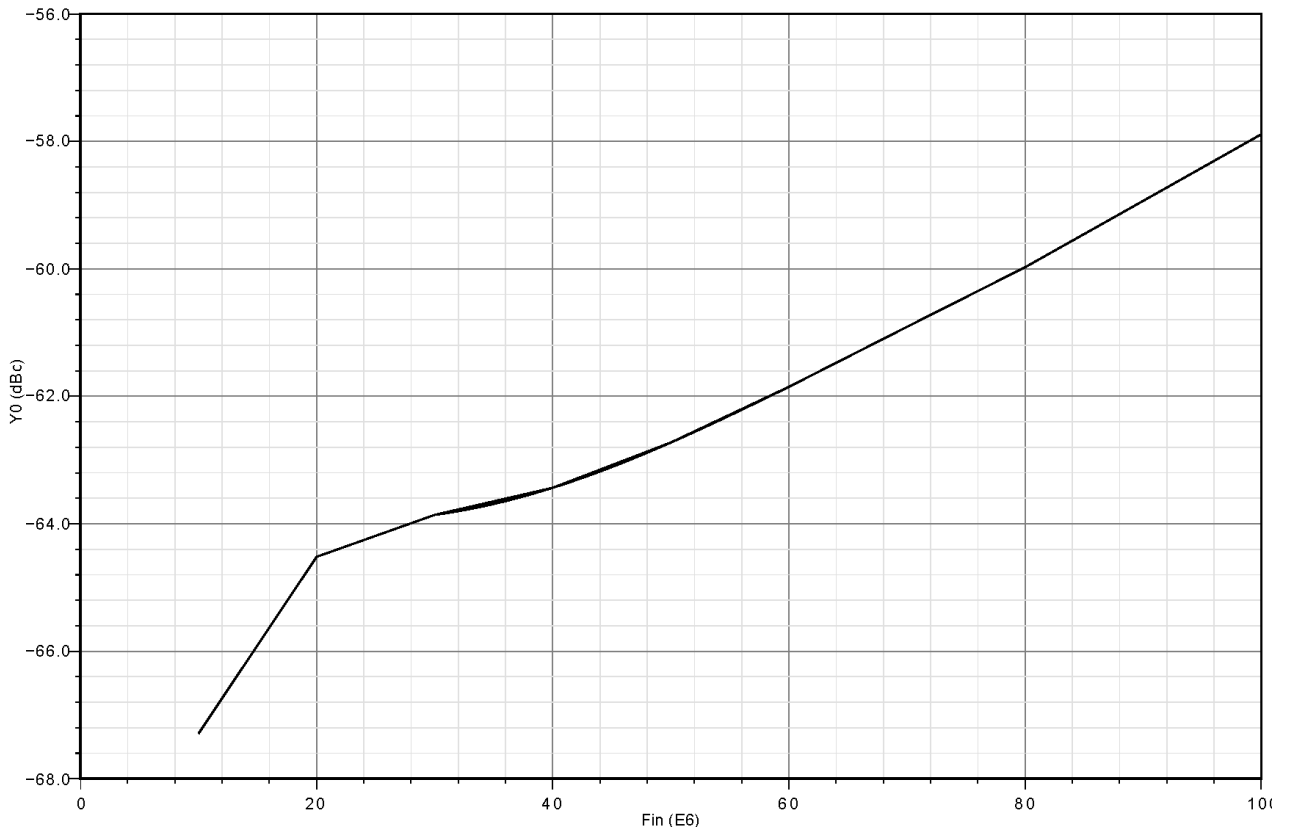


Figure 6: IM3,  $V_{out}=2V$  (peak-peak).

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## 9 DELIVERABLES

IP contents:

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