An 80-400 MHz 74 dB-DR Gm-C Low-Pass Filter With a Unique Auto-Tuning System

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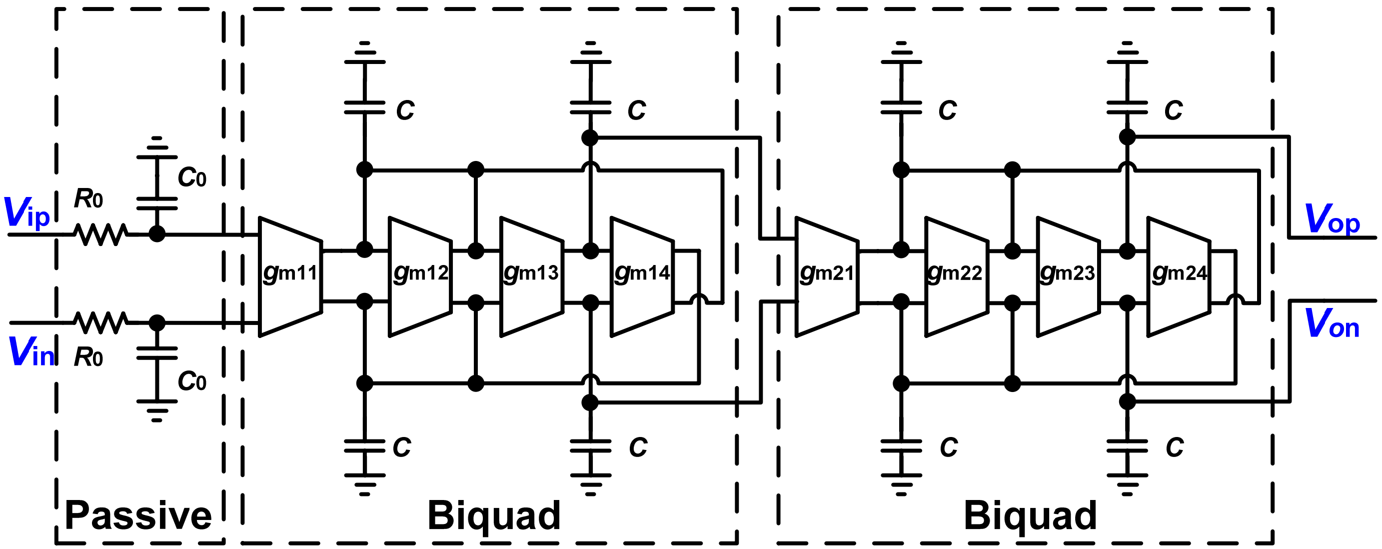
Outline

- **Design Specifications**
- **Filter Architecture**
- **Tuning Technique**
- **Measurement Results and Comparisons**

Design Specifications

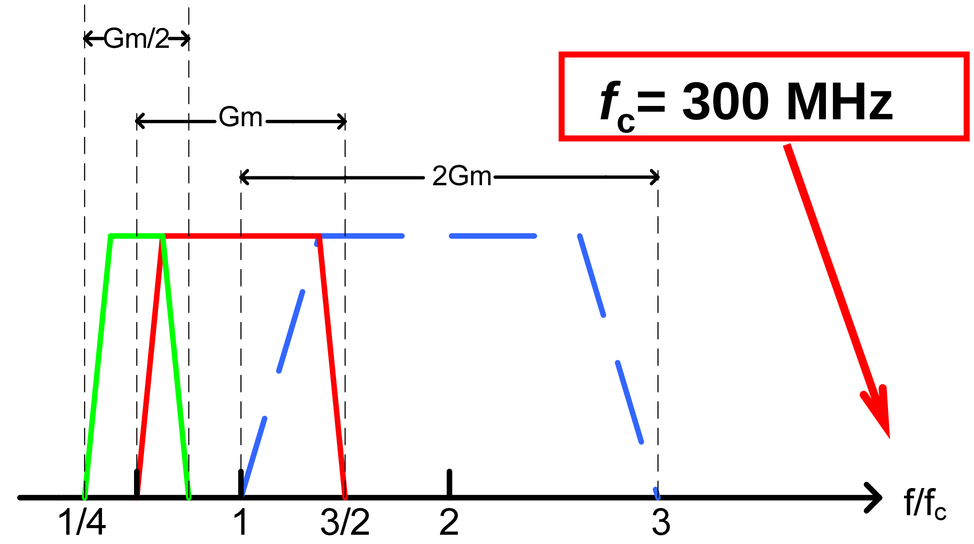
- Filter Type: 5th Order Chebyshev
- Ripple:< 1 dB
- Attenuation: >45 dB @ 2.3* f_c
- Voltage Gain: 0-30 dB



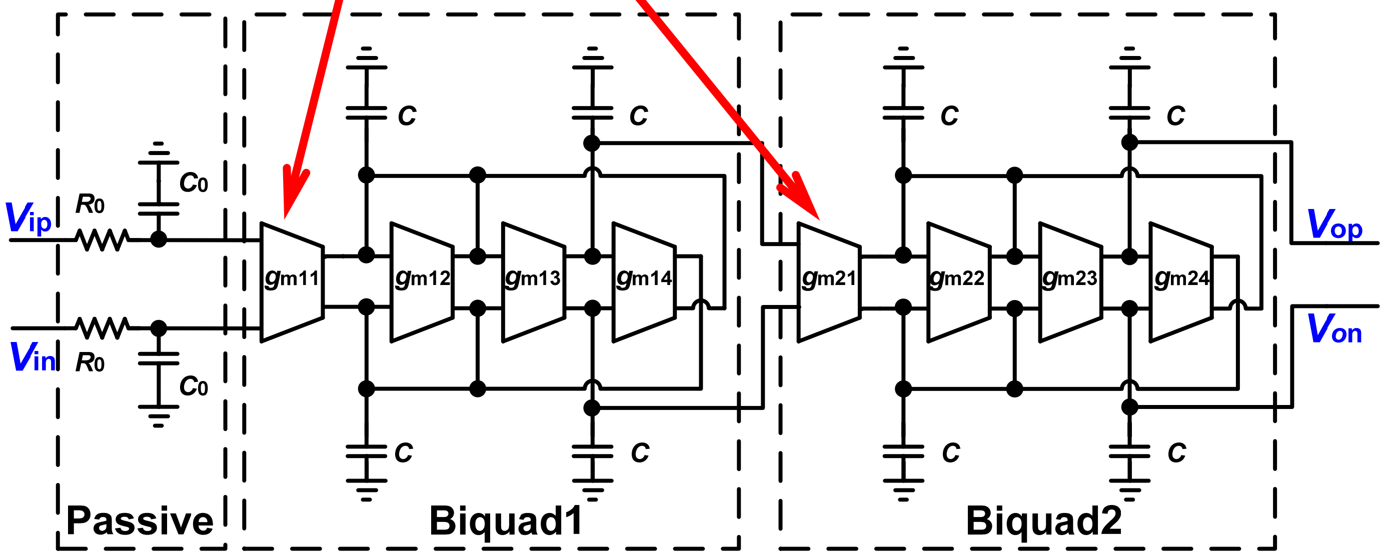
Q=0.5 **Q=0.94** **Q=3.28**

Programmable Gm-C filter Architecture

- 1 bit Gm Cell
- 5 bit DCCA



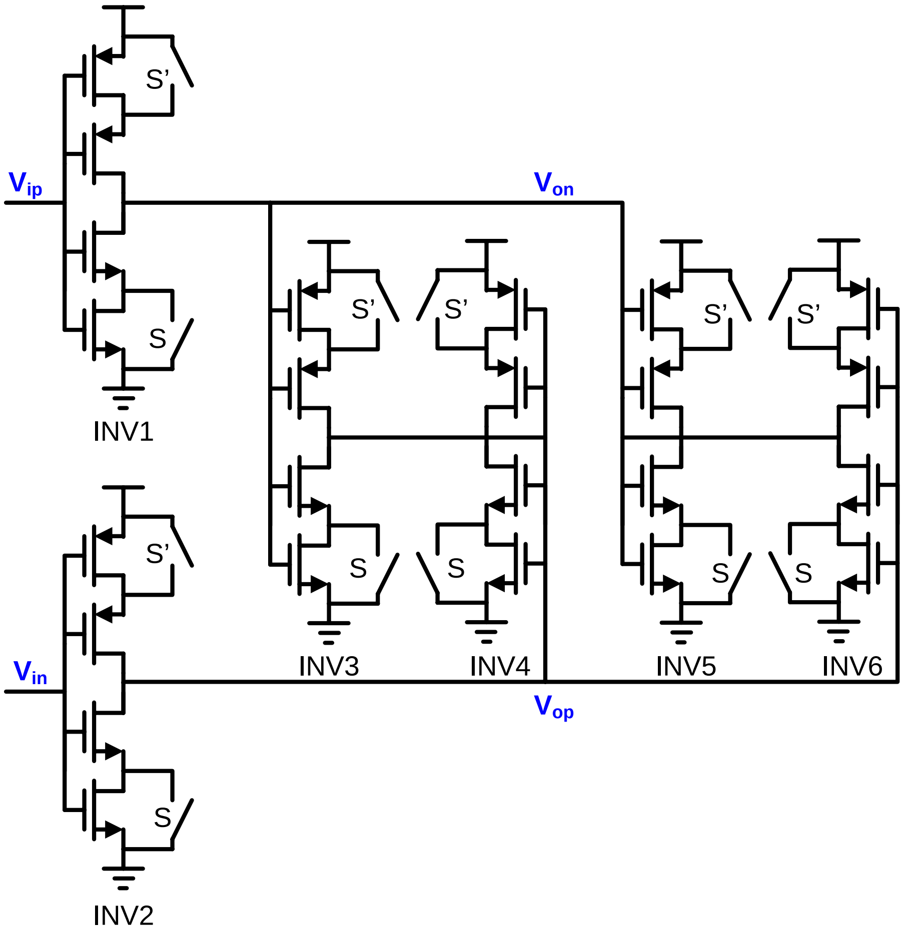
Programmable Gm



Transconductor Structure

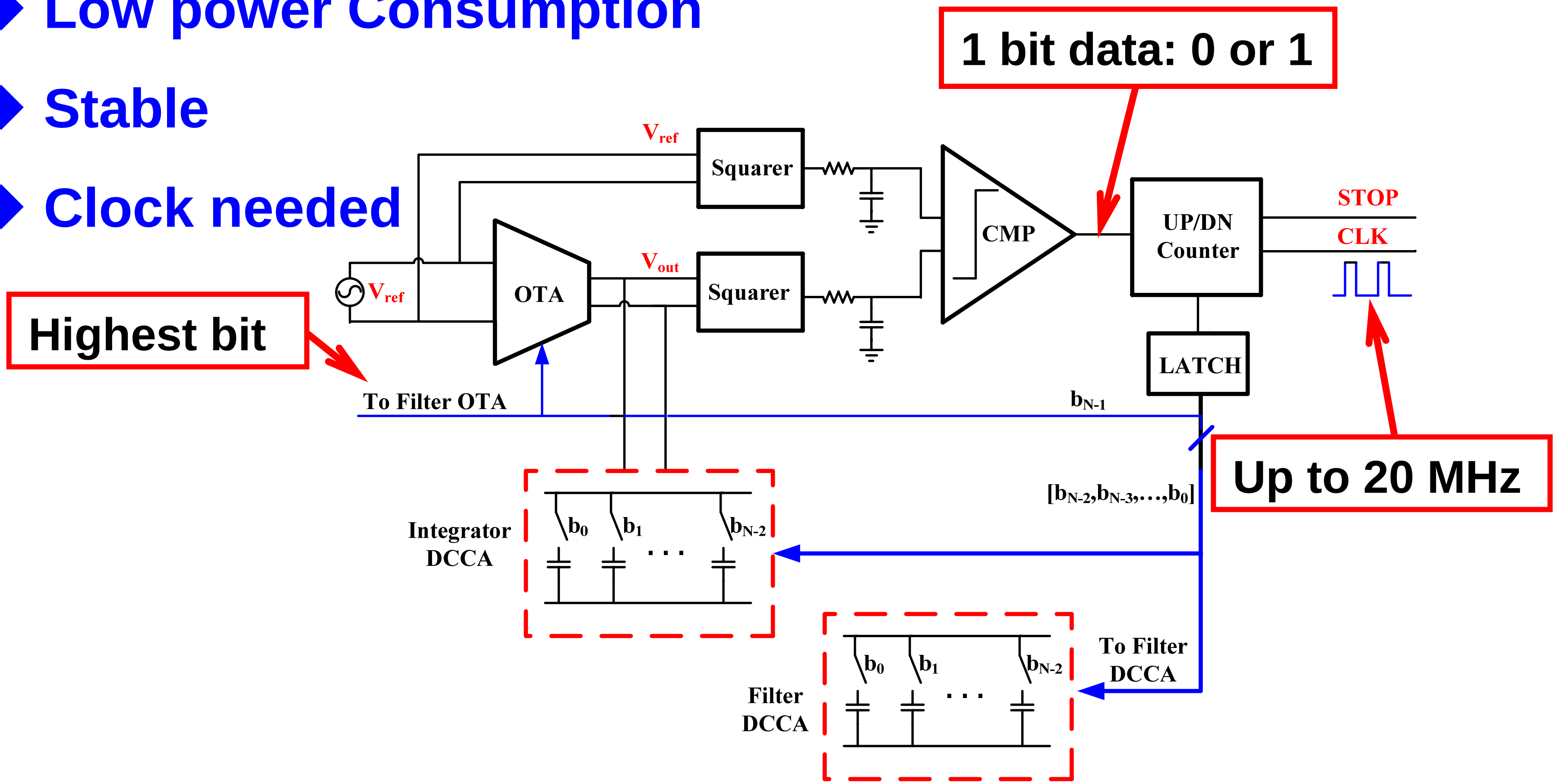
1bit Gm Cell

- Modified Nauta structure
- Six Inverters
- Controlled by 'S'
- Transconductance can be switched between 'g_m' and '$g_m/2$'

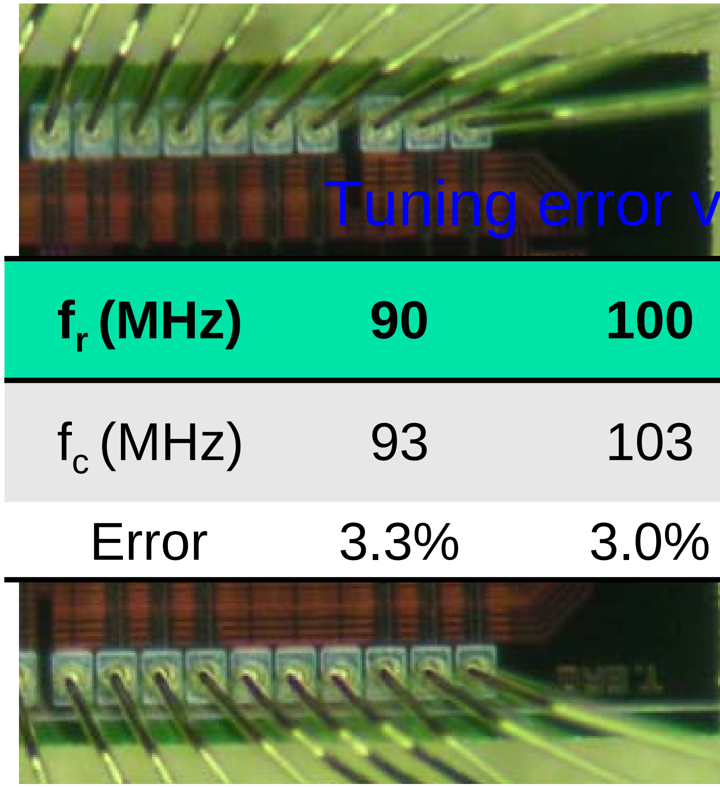


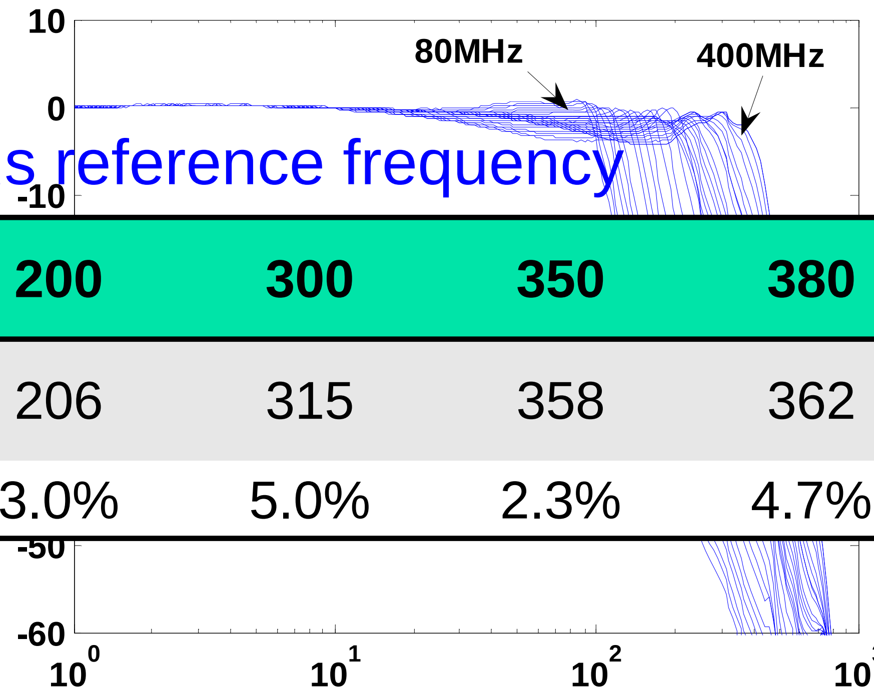
Discrete Auto Tuning Technique

- Wide tuning range
- Low power Consumption
- Stable
- Clock needed



Chip Photograph and Measurement





Tuning error versus reference frequency

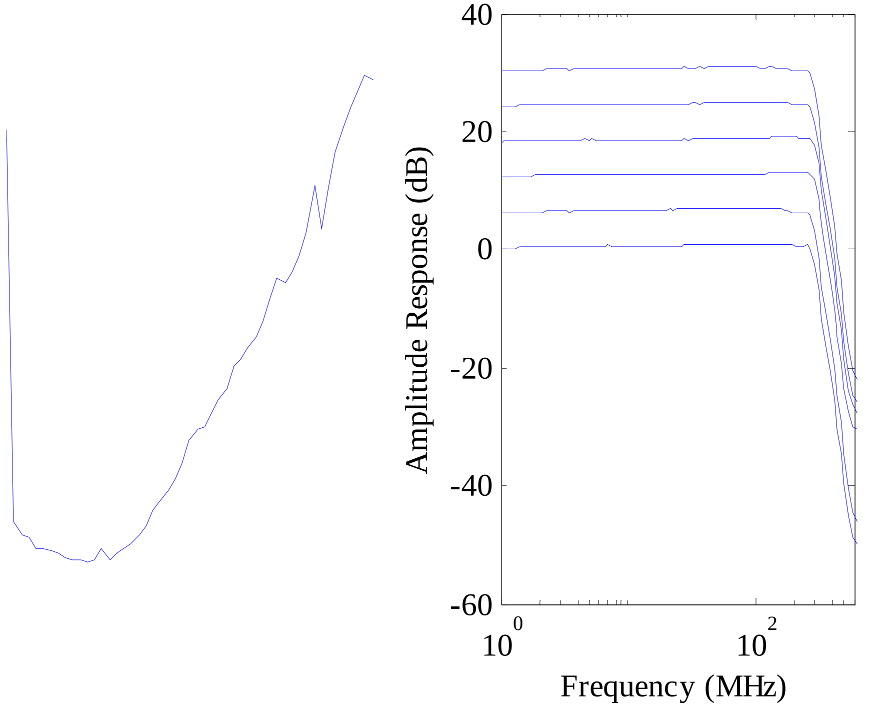
f_r (MHz)	90	100	200	300	350	380
f_c (MHz)	93	103	206	315	358	362
Error	3.3%	3.0%	3.0%	5.0%	2.3%	4.7%

Active area: 0.13 mm^2

Tuning Range: 80 MHz- 400 MHz

Measurement Results

Measured @ 250 MHz Cut-off frequency

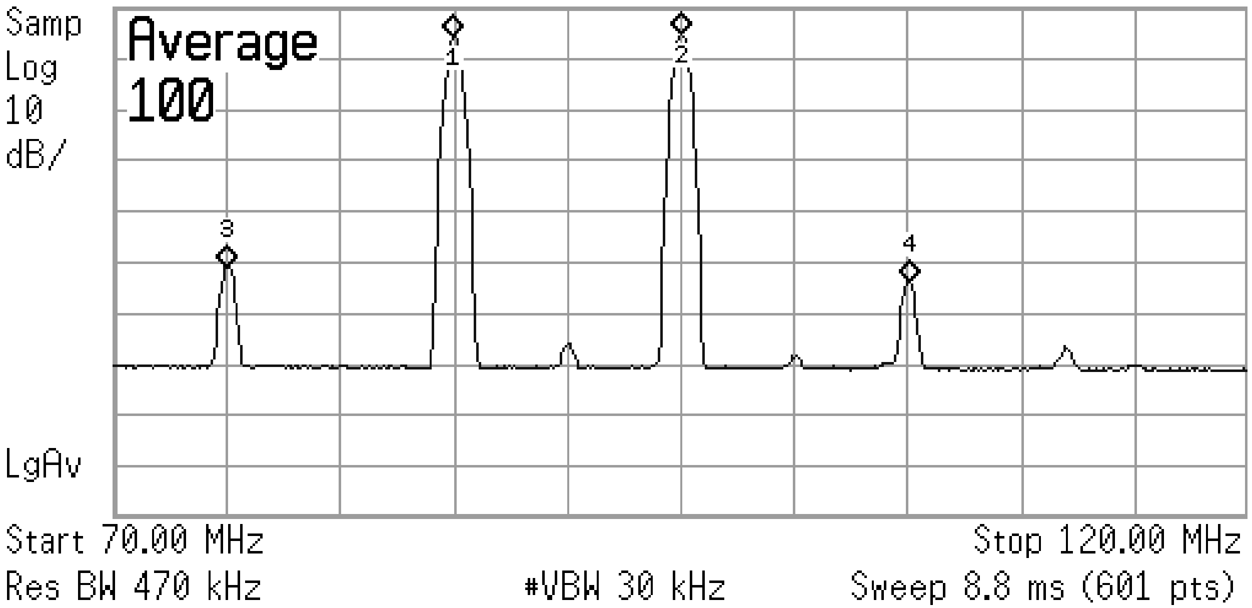


- Noise Figure: 14-18 dB
- Voltage Gain: 0-30 dB

Measured NF and Voltage Gain

Measurement Results

Two tone test @ 100 MHz



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	84.92 MHz	-5.89 dBm
2	(1)	Freq	95.00 MHz	-5.31 dBm
3	(1)	Freq	75.00 MHz	-50.74 dBm
4	(1)	Freq	105.08 MHz	-53.70 dBm

- Cut-off frequency: 250 MHz
- IIP3=17.4 dBm

Comparisons

	JSSC 2010[1]	Electronic Letter 2010[2]	This Work
Technology (um)	0.13	0.13	0.13
Supply Voltage(V)	1.2	1.5	1.2
Power (mW)	20.8	21	9
Bandwidth (MHz)	200	70-280	80-400
Active area (mm^2)	0.28	0.12	0.13
Gain (dB)	0	0	0-30
DR	54.5	53	74/60
FoM	NaN	13.3	2.8

$$FoM = \frac{Power}{pQ_{\mathrm{max}} f_{\mathrm{c}} DR^2}$$

[1] M. Mobarak etal, JSSC 2010, 351-367

[2] W. Li etal, Electronics Letter 2010, Vol 46, No. 17

The End

Q&A?