

Th1A-3

# A Novel Filter Architecture with Five Reconfigurable Filtering Functions

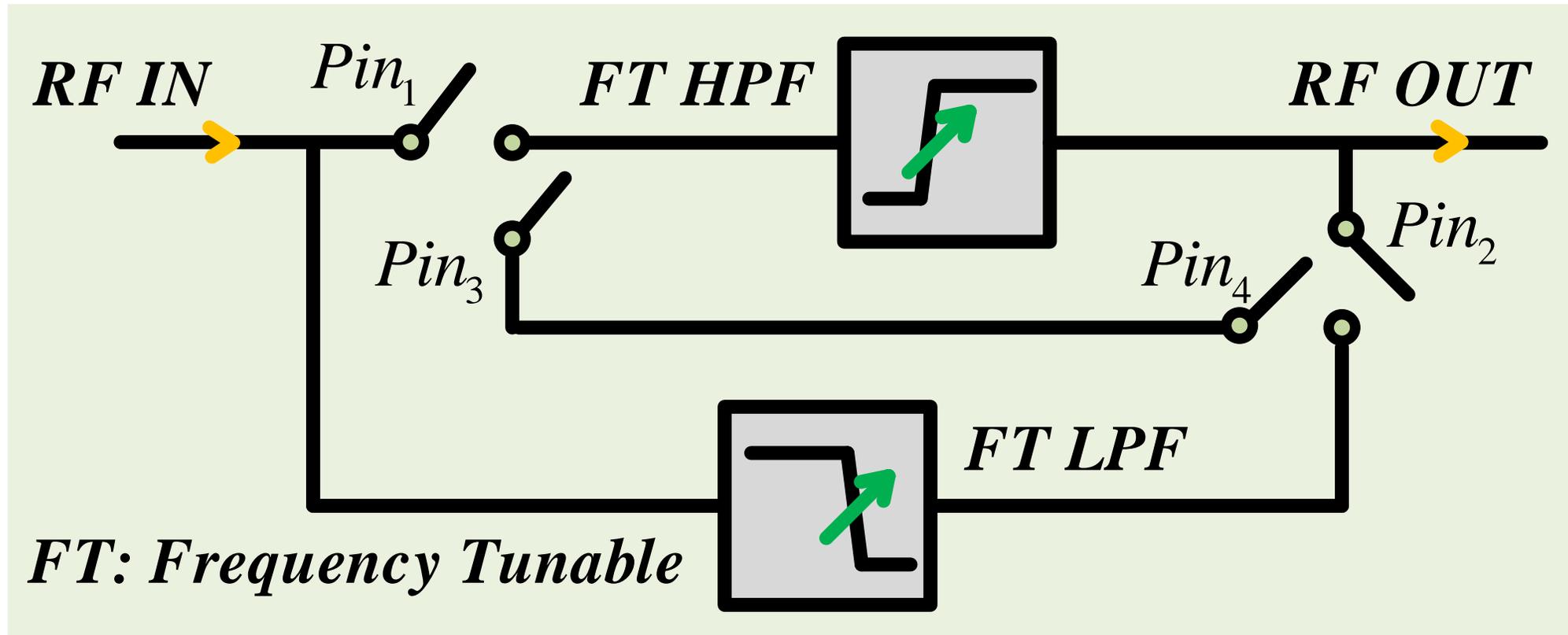
Yuhang Ning<sup>1</sup>, Zhihua Wei<sup>1</sup>, Pei-Ling Chi<sup>2</sup>, and Tao Yang<sup>1</sup>

<sup>1</sup>University of Electronic Science and Technology of China, Chengdu, China

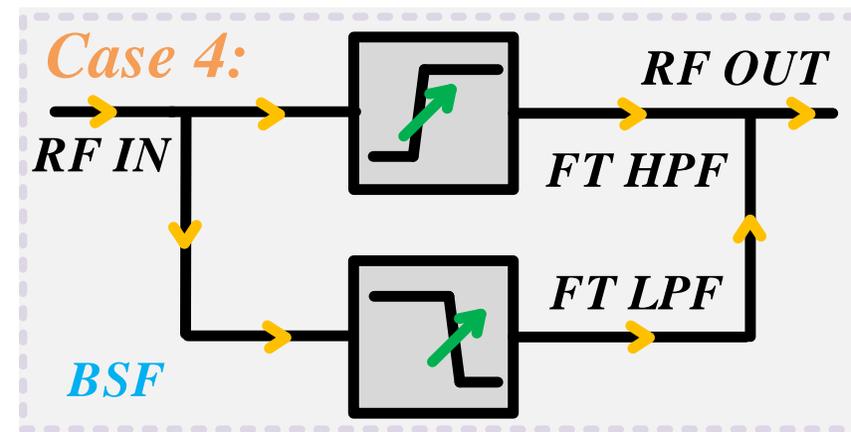
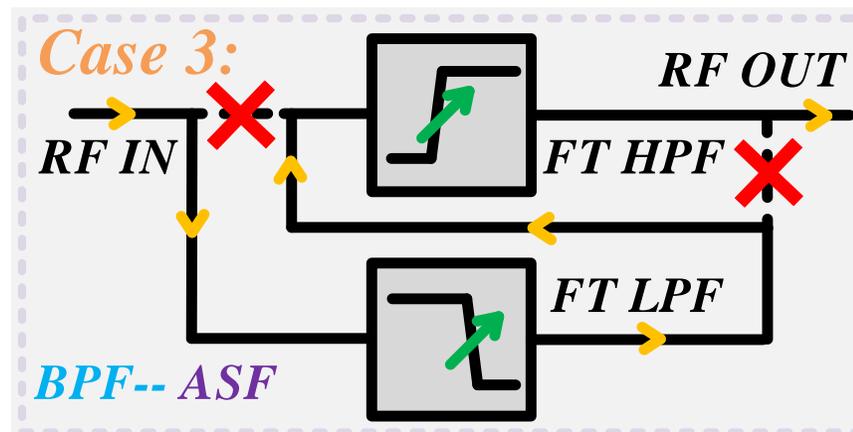
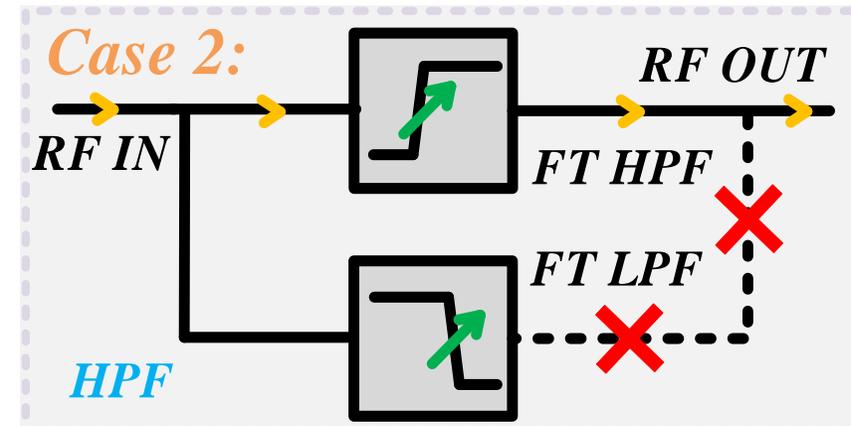
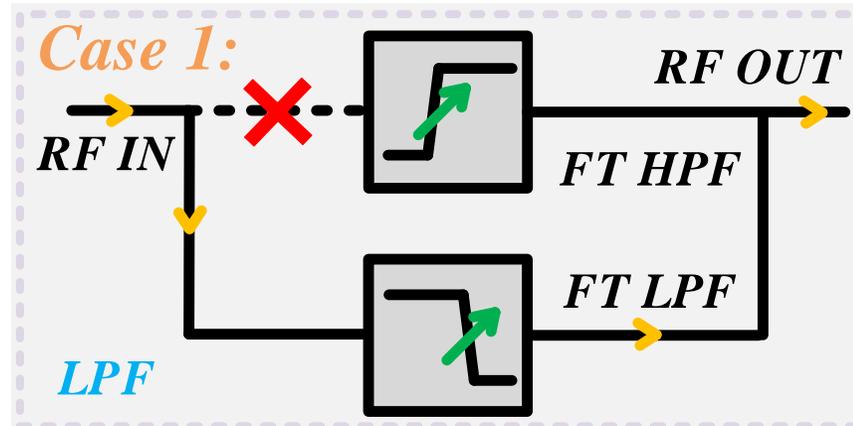
<sup>2</sup>National Chiao Tung University, Hsinchu, Taiwan, China

- **Introduction**
- **Design**
- **Results**
- **Conclusion**

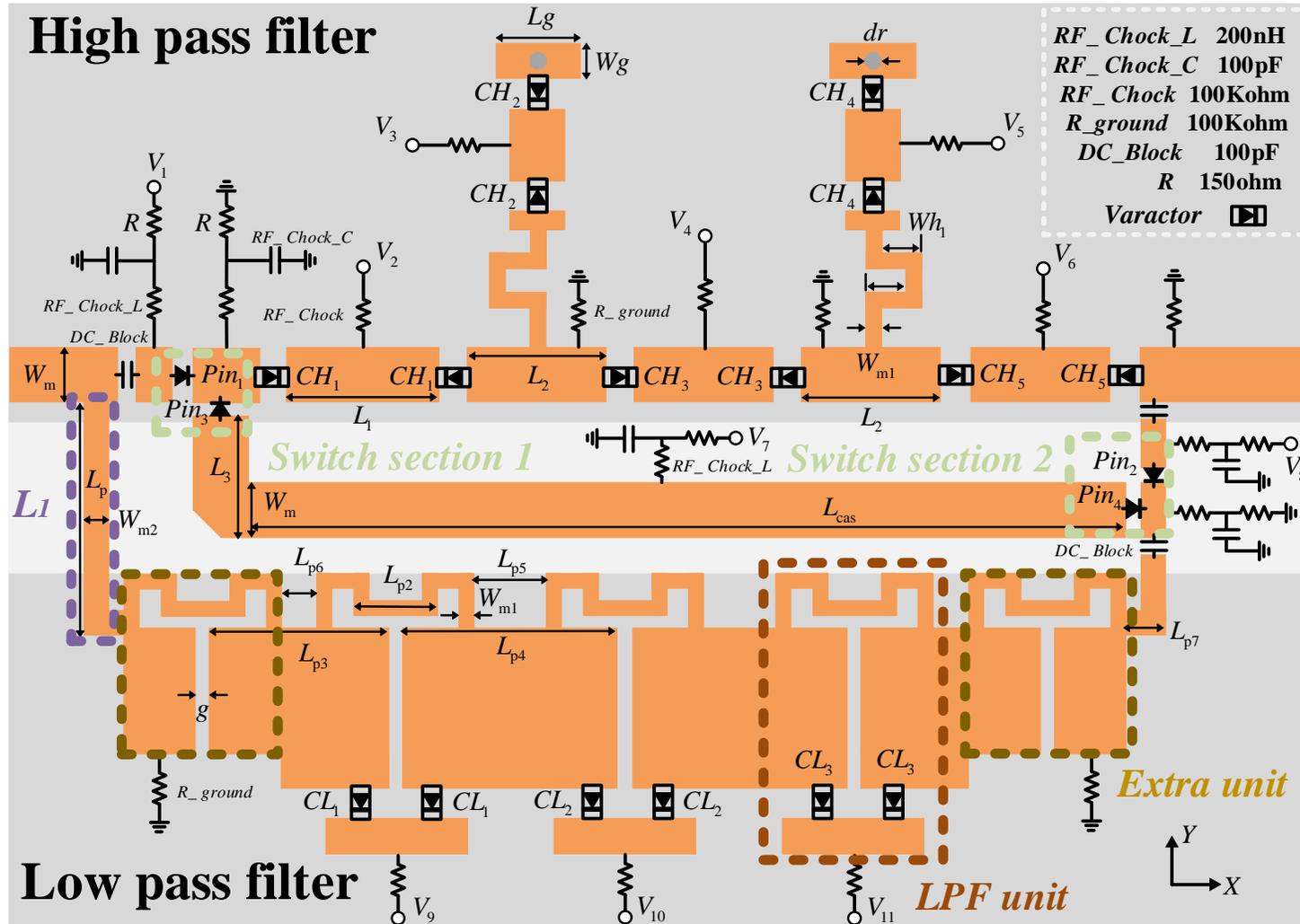
- Reconfigurable Filter With **Four** Pin-diodes



The proposed filter Architecture

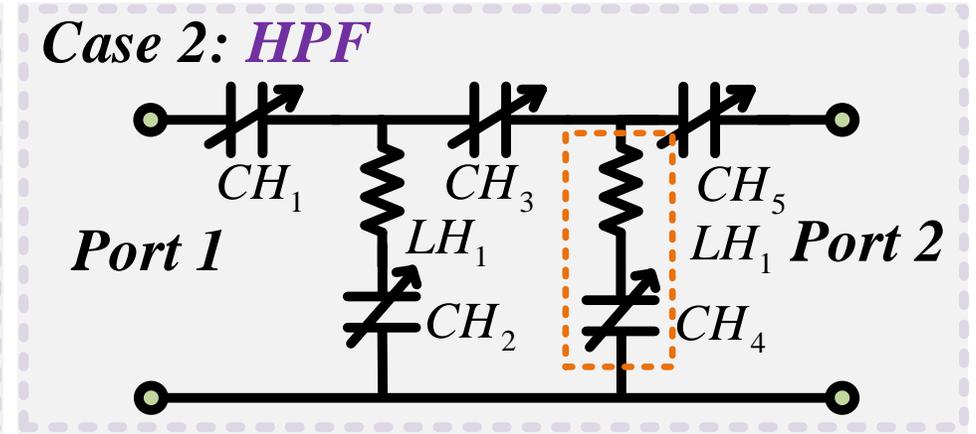
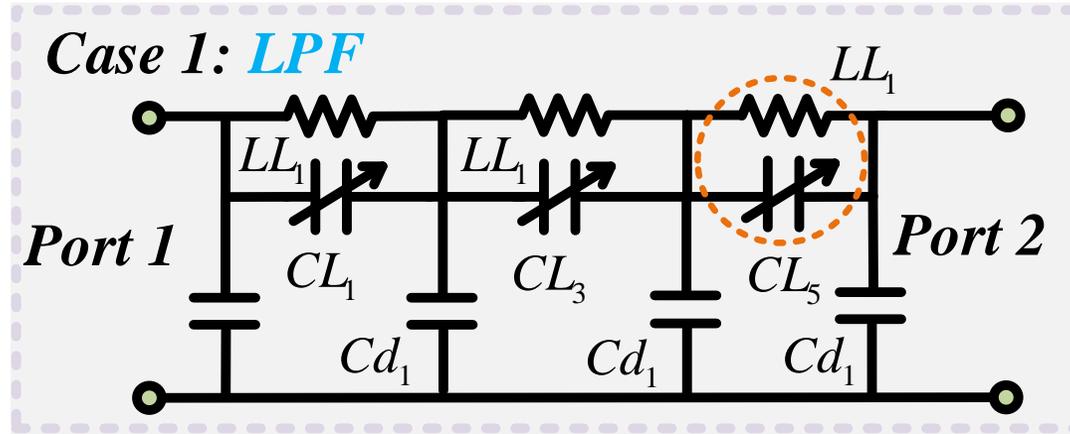


- **Five** Filtering Functions: Low Pass (LPF), High Pass (HPF), Bandpass (BPF), Bandstop (BSF), and All Stop (ASF).

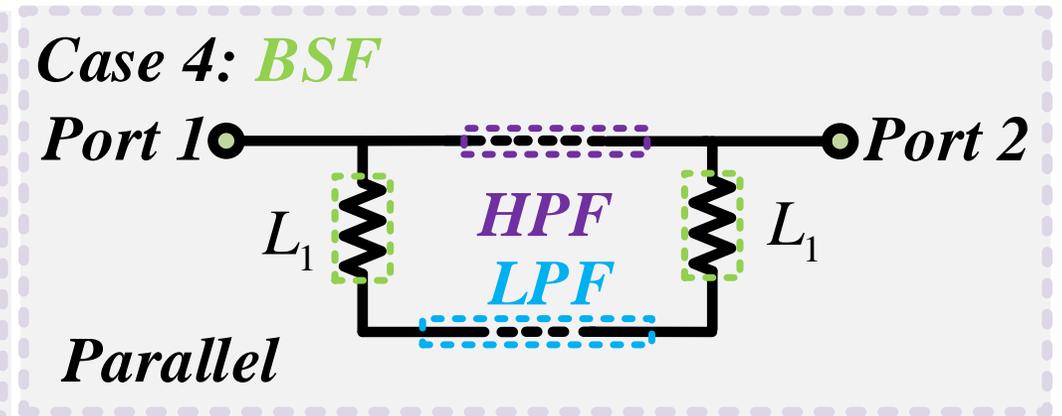
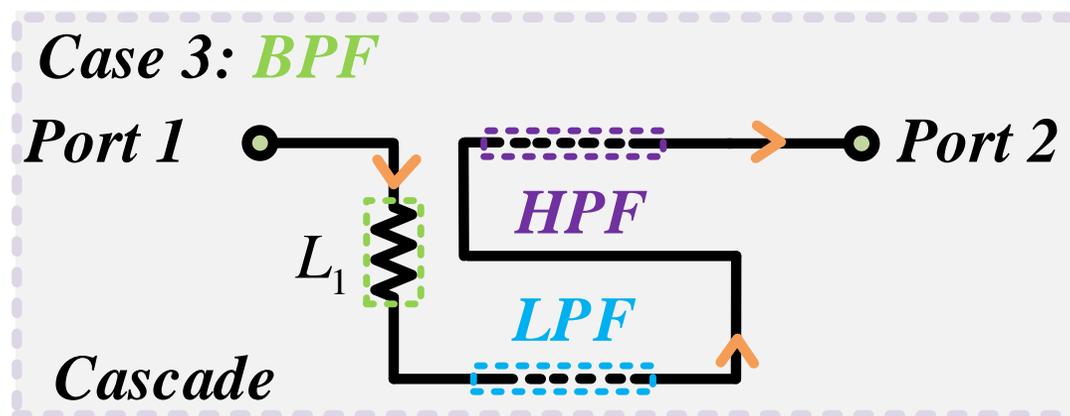


Physical layout of the proposed filter

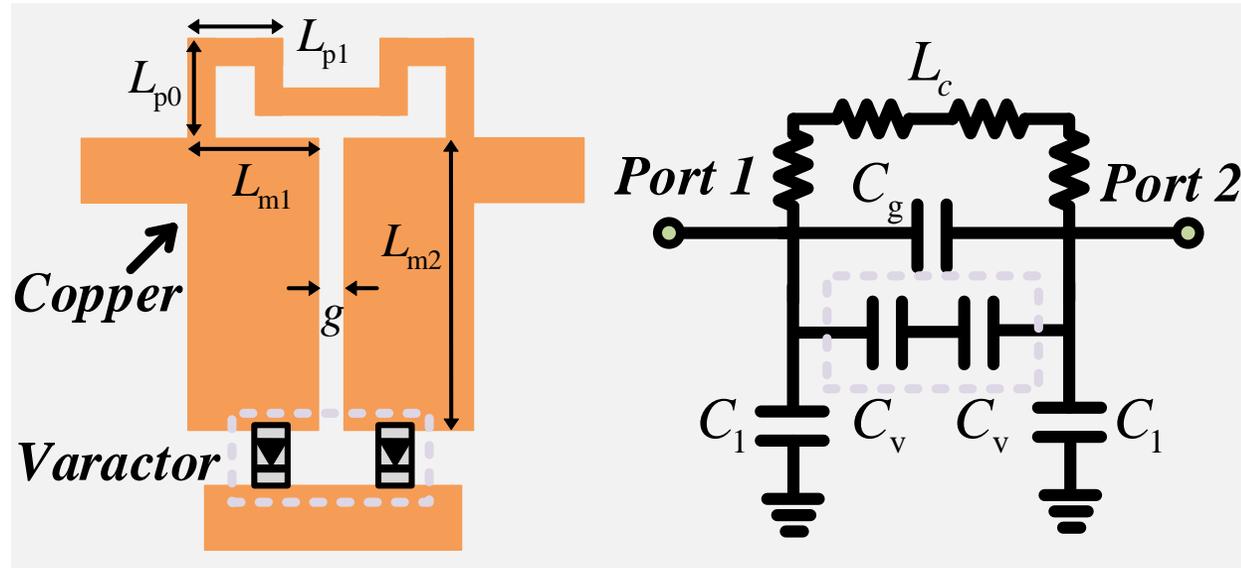
- Lumped element equivalent circuit.



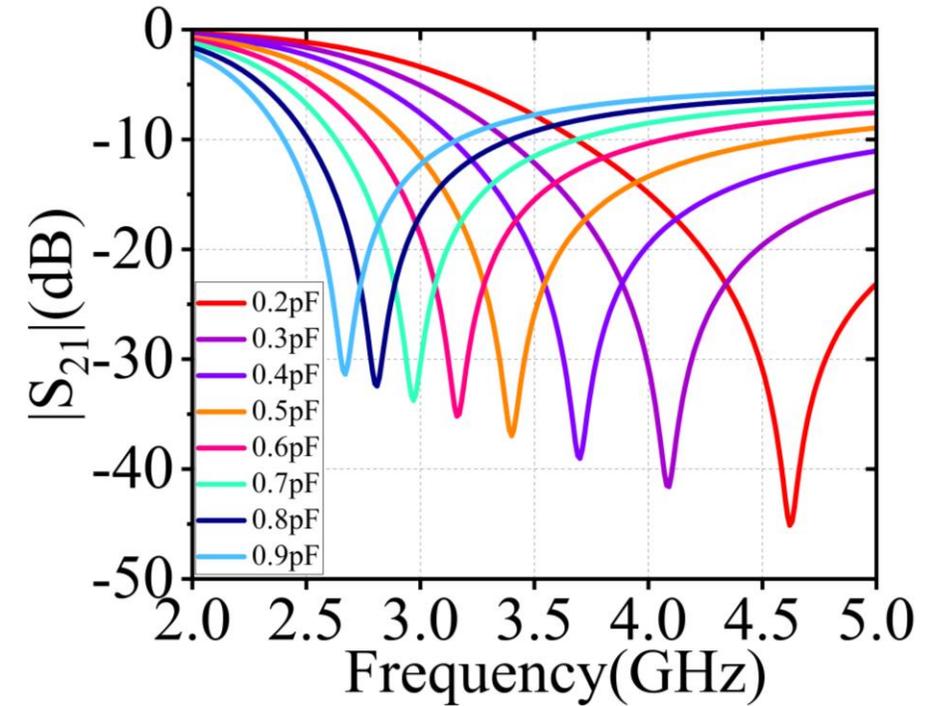
- Simplified equivalent circuit.



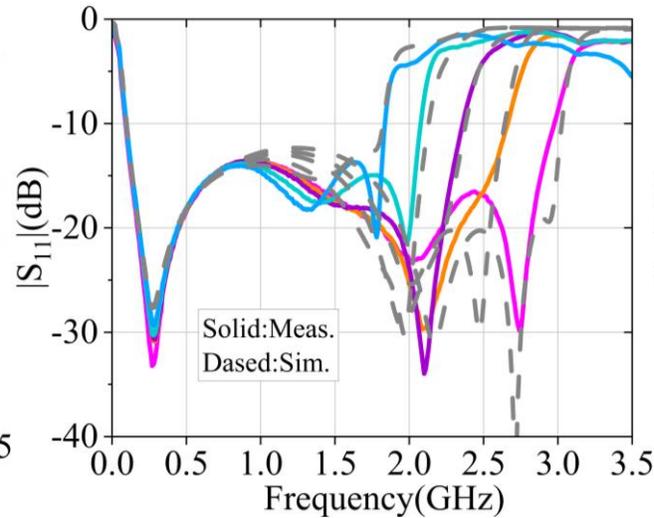
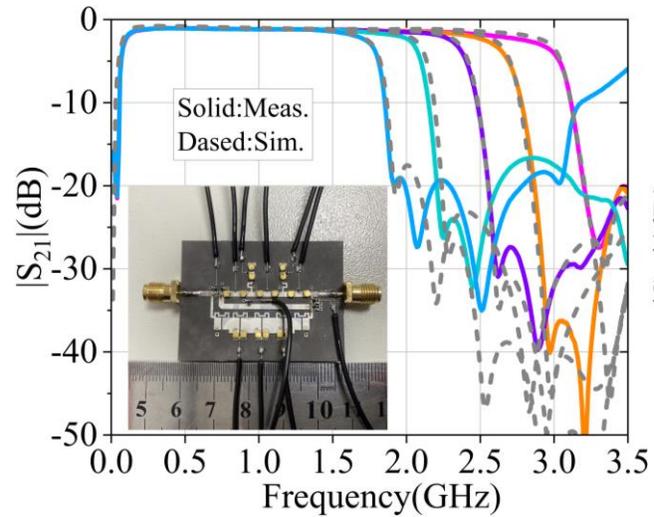
- **Lowpass Filter Unit.**



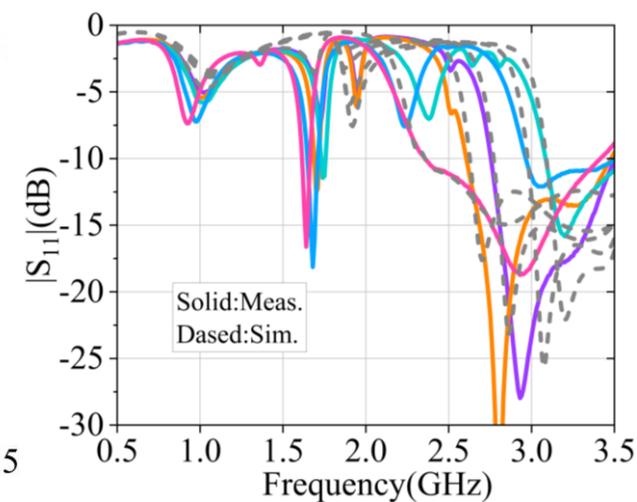
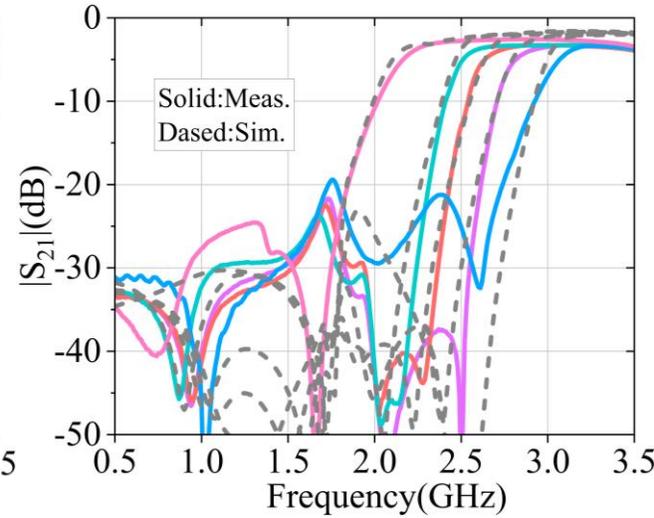
- **Frequency tunable.**



## ● LPF Mode



## ● HPF Mode

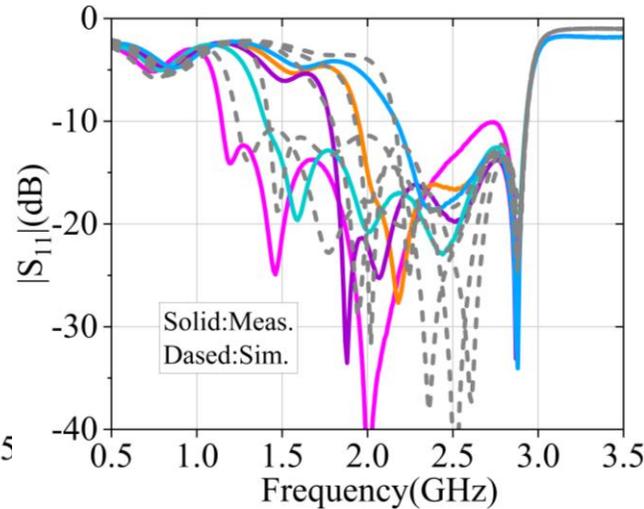
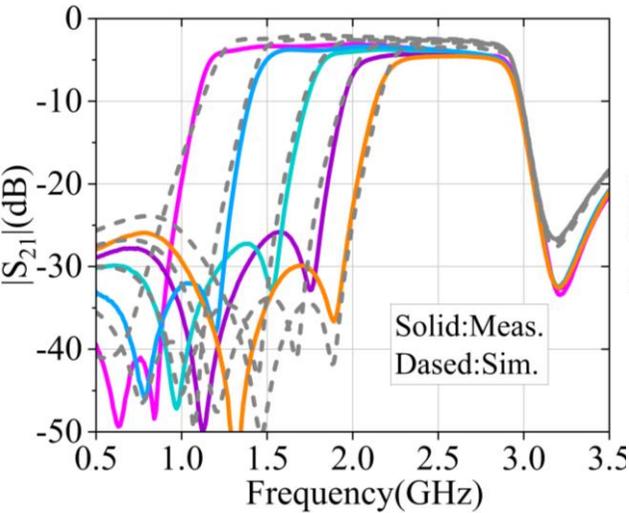


## ● Performance

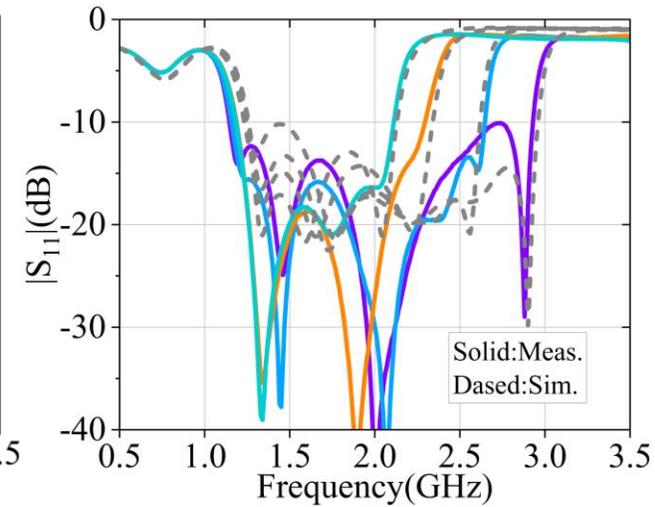
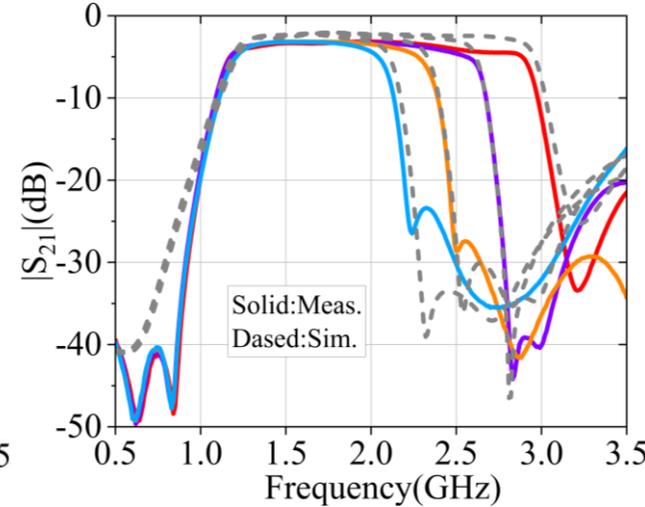
Filtering Mode	Frequency	Insertion Loss	Return Loss
LPF	1.8 – 3 GHz	1.1 – 1.24 dB	>13.5 dB
HPF	2.1 – 3.1 GHz	3.3 – 3.8 dB	>10 dB

## ● BPF Mode: Four tuning modes

### ● Mode I



### ● Mode II

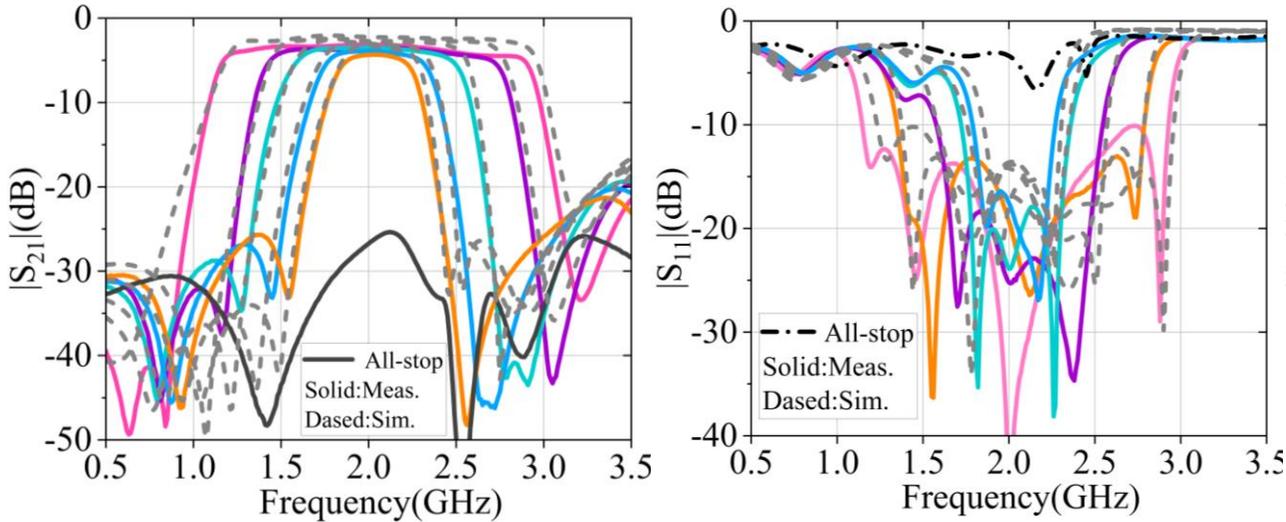


## ● Performance

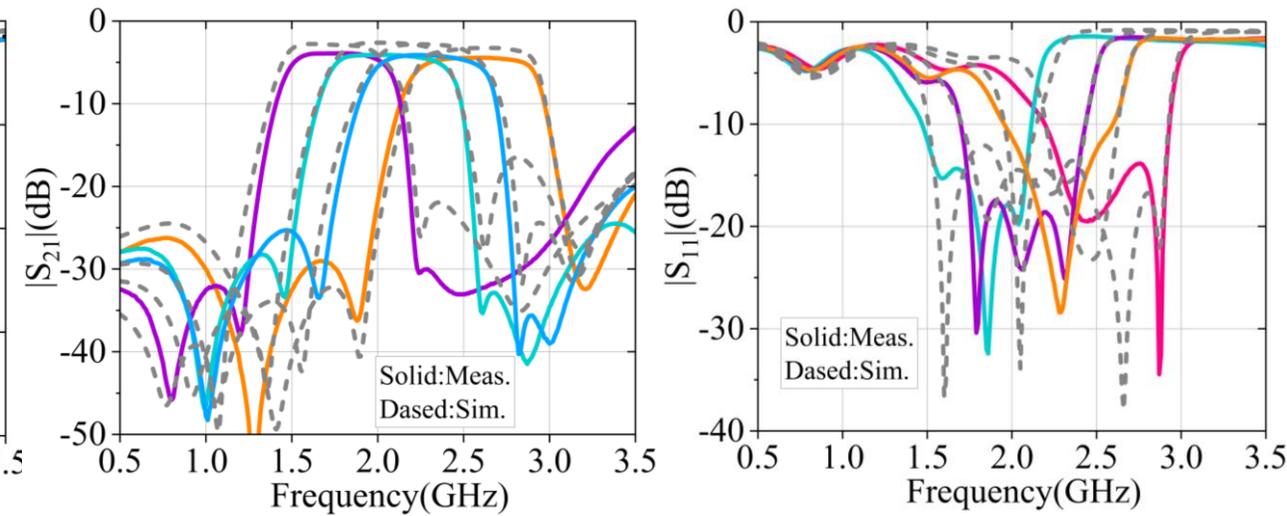
BPF (Mode)	Frequency	Bandwidth	Insertion Loss	Return Loss
Mode I	1.12 – 2.18 GHz	Tunable	4.5 dB	> 10 dB
Mode II	2.08 – 2.93 GHz	Tunable	4.6 dB	> 10 dB

- **BPF Mode: Four tuning modes**

- **Mode III (ASF: IS > 25dB)**



- **Mode IV**

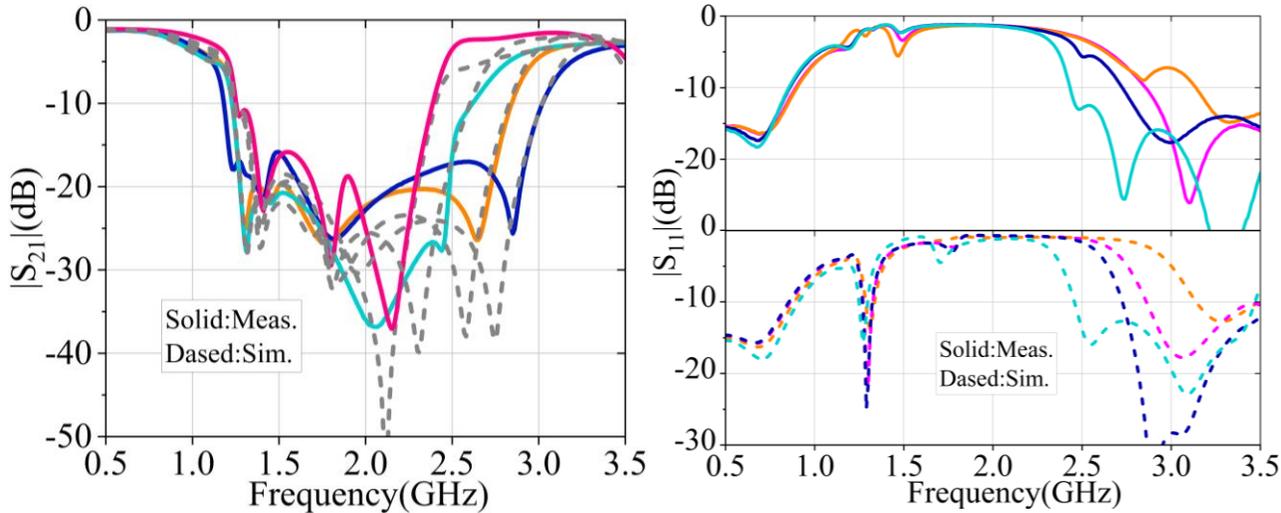


- **Performance**

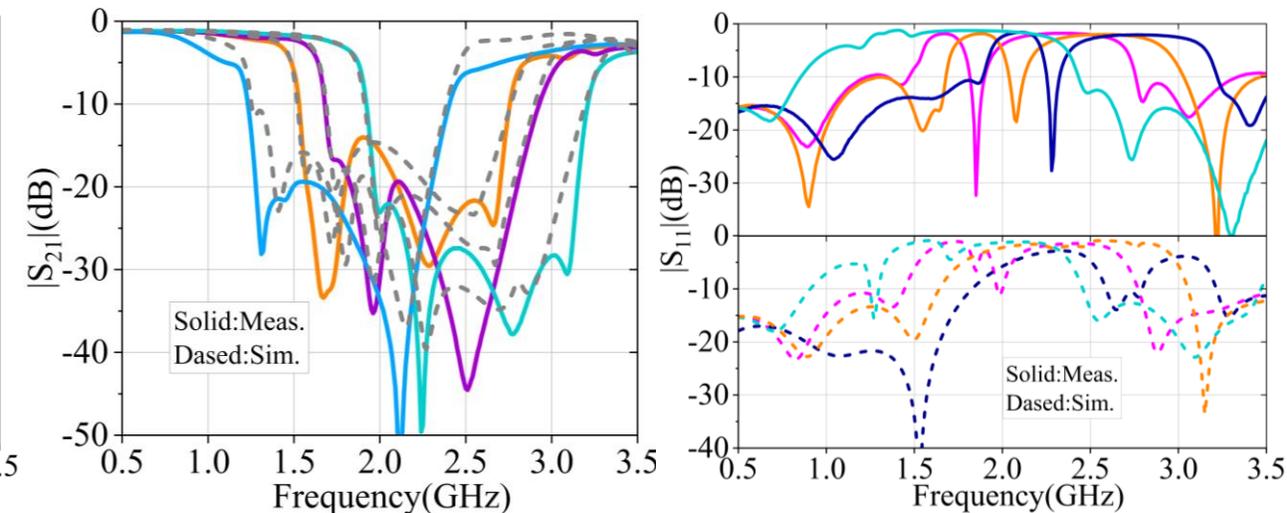
BPF (Mode)	Frequency	Bandwidth	Insertion Loss	Return Loss
Mode III	Fixed at 2 GHz	22.8% – 87.8%	3.1 – 4.3 dB	> 10 dB
Mode IV	1.4 – 2.9 GHz	650MHz	4 – 4.6 dB	> 10 dB

## ● BSF Mode: Four tuning modes

### ● Mode I



### ● Mode II



## ● Performance

BSF (Mode)	Frequency	Bandwidth	Insertion Loss	Return Loss
Mode I	2.48 – 3.12 GHz	Tunable	1.2 – 3.5 dB	> 16 dB
Mode II	1.8 – 2.55 GHz	1.3 GHz	1.3 – 4.3 dB	> 10 dB

## ● COMPARISON

Ref.	Tuning element and number	Filtering mode	CF tunability	BW tunability
[2]	Varactor diode	BPF	✓	✓
[4]	6 pin-diodes	BSF & Narrow-BPF & Wide-BPF	✗	✗
[5]	6 pin-diodes	BSF & BPF & Dual-BPF	✗	✗
[6]	6 RF diodes	BSF & BPF & Quadrature coupler	✗	✗
[7]	3 MEMS switches	BSF & BPF & All pass filter	✓	✗
<b>This Work</b>	<b>4 pin-diodes &amp; Varactor diode</b>	<b>LPF &amp; HPF &amp; BPF &amp; BSF &amp; ASF</b>	<b>✓</b>	<b>✓</b>

Reference:

[1] M. Sanchez-Renedo, R. Gomez-Garcia, J. I. Alonso and C. Briso-Rodriguez, "Tunable combline filter with continuous control of center frequency and bandwidth," *IEEE Trans. Microw. Theory Tech.*, vol. 53, pp. 191-199, Jan. 2005.

[2] H. Joshi, H. H. Sigmarsson, S. Moon, D. Peroulis and W. J. Chappell, "High-Q Fully Reconfigurable Tunable Bandpass Filters," *IEEE Trans. Microw. Theory Tech.*, vol. 57, pp. 3525-3533, Dec. 2009.

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- (i.e., **LPF**, **HPF**, **BPF**, **BSF** and **ASF**) have been successfully achieved by using **four** pin-diodes and varactor diode.
  - 1. A novel filter architecture with five reconfigurable filtering functions is proposed.**
  - 2. For each filter function, the proposed filter possesses continuous tunability in terms of both CF and BW.**
  - 3. Four flexible CF and BW tuning modes is achieved in BPF and BSF state.**

***Thanks For Listening !***