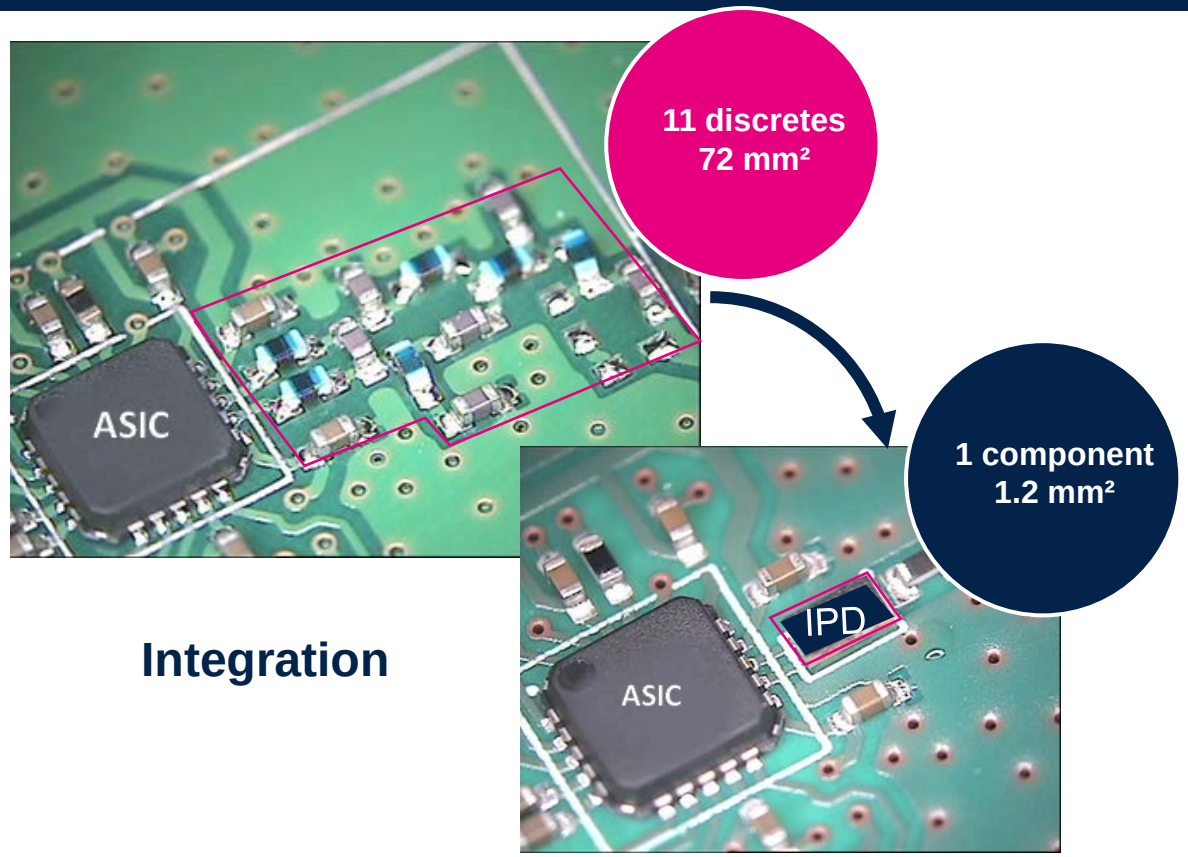
Integrated passive devices (IPD) for RF applications

Discrete & Filters Division (DFD)

Automotive & Discrete Group (ADG)

Integrated passive devices (IPD) for RF applications

ST integrated passive devices offer a competitive cost structure, a small form factor, and reduced power losses

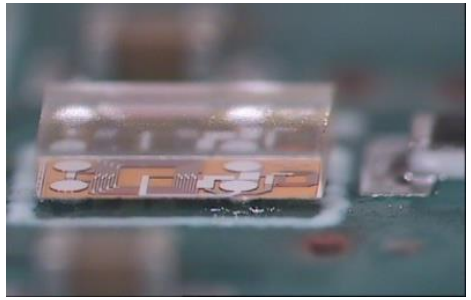


Integration

Covering all RF applications with a frequency range from 168 MHz and above including Sub-1 GHz, WLAN, Bluetooth, ZigBee, WiMax, UWB, UMTS, LTE and more.

Summary of key benefits

- Design **simplification**
- Same **performance** across components, tolerances, and temperature
- System **integration**
- **Reliability** improvement
- BOM **reduction**
- Successful **development** story



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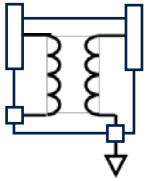
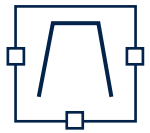
Example of RF connectivity

High quality baluns, RF couplers, combiners, filters, diplexers, triplexers, & impedance matching ICs in various design configurations

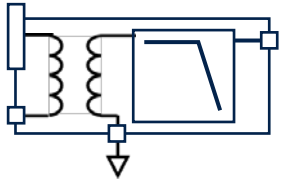
Balun



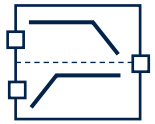
Filter



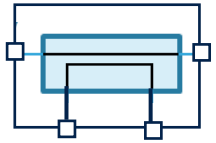
Balun + filter



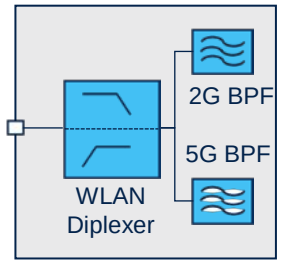
Diplexer



Coupler



All in one
Diplexer + 2G BPF + 5G BPF



Able to integrate high-quality passive elements (resistors, inductors, and capacitors) on glass-sand high-resistivity silicon substrates and in various design configurations.

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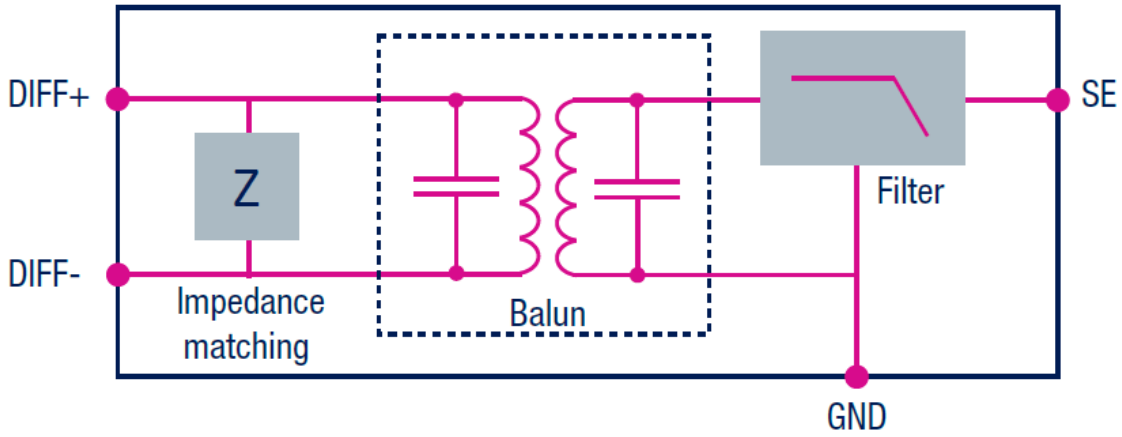
Tuned for high RF integration

ST RF IPD baluns improve system performance & simplify RFIC to antenna matching network complexity

Designed with integrated harmonic filters, they facilitate compliance with major EMC regulations: CCC, FCC, ETSI, ARIB



ST baluns integrate the following functions:

- Impedance matching
- 50 Ω nominal input impedance
- Harmonic filter

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Balun portfolio

Tailored for the main RF standards

Our solutions are tailored for:

- Bluetooth® Low Energy 2.4 GHz radios
- IEEE 802.15.4-based specification including Zigbee
- Sub-1GHz RF transceivers
- Sigfox wireless connectivity
- LoRa wireless connectivity

Significantly helping to reduce RF complexity and provide an optimized link budget, our wide range of integrated baluns includes companion-chips to today's latest transceivers from manufacturers including:

- STMicroelectronics
- Atmel
- Texas Instruments
- Nordic Semi

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Sub-1 GHz, Bluetooth Low Energy, Wi-Fi, UWB portfolio

Sub-1 GHz

- ST SPIRIT
- ST S2-LP
- ST STM32WL

sigfox

BLE ZigBee

- ST BlueNRG
- TI
- Nordic Semi
- ATMEL
- ST STM32WB

STM32

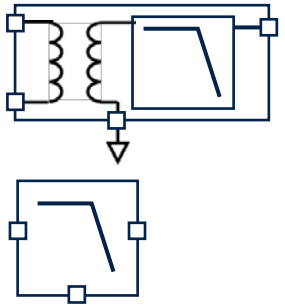
WiFi

- ATMEL

UWB

- 3 to 8 GHz DECAWAVE

- Balun
- Filter



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Balun/STM32WL correspondence matrix

Power frequency	22 dBm 864-928 MHz		15 dBm 864-928 MHz	
#PCB layers	4	2	4	2
STM32WL BGA	BALFHB-WL-01D3		BALFHB-WL-04D3	
STM32WL QFN	BALFHB-WL-02D3	BALFHB-WL-03D3	BALFHB-WL-05D3	BALFHB-WL-06D3

Power frequency	17 dBm 470-530 MHz	
#PCB layers	4	2
STM32WL BGA	BALFLB-WL-07D3	
STM32WL QFN	BALFLB-WL-08D3	BALFLB-WL-09D3

STM32WL BGA	STM32WL5xJxIx STM32WLExJxIx
STM32WL QFN	STM32WL5xCxUx STM32WLExCxUx

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Low pass filter/STM32WB correspondence matrix

Power frequency	10 dBm 2.45 GHz	
#PCB layers	2	2
STM32WB55Cx STM32WB55Rx STM32WB35xxx STM32WB50xxx STM32WB30xxx STM32WB1xx	MLPF-WB-01D3 MLPF-WB-01E3 MLPF-WB55-01E3	
STM32WB55Vxx STM32WB1x		MLPF-WB55-02E3
STM32WB5x STM32WB1x		MLPF-WB-02D3

STM32WB QFN	STM32WB55Cx STM32WB55Rx STM32WB35xxx STM32WB50xxx STM32WB30xxx STM32WB1xx
STM32WB BGA	STM32WB55Vxx STM32WB1x
STM32WB BGA	STM32WB5x STM32WB1x

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Low pass filter/BlueNRG correspondence matrix

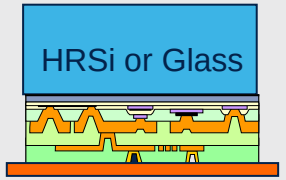
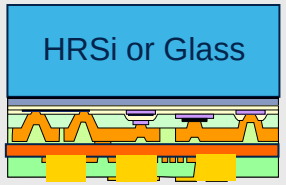
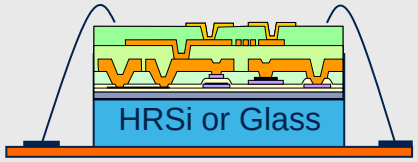
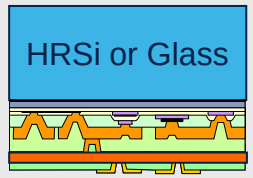
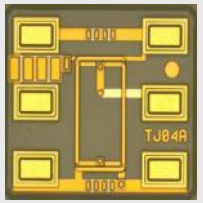
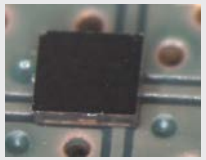
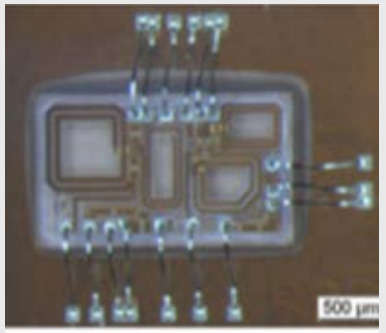
Power frequency	10 dBm 2.45 GHz
#PCB layers	2
BlueNRG-LP & BlueNRG-LPS QFN & BGA	BALUN
BLUENRG-3x5Vx BLUENRG-3x5Ax BLUENRG-3x5Mx BLUENRG-332xx	BALF-NRG-01D3

Power frequency	10 dBm 2.45 GHz
#PCB layers	2
BlueNRG-1 (QFP32 and CSP34) BlueNRG-2 (QFN32 and CSP34)	BALF-NRG-02D3

Balun/SPIRIT correspondence matrix

Power frequency	868-915 MHz		433 MHz	
#PCB layers	3	4	3	4
SPIRIT1		BALF-SPI-01D3		BALF-SPI-02D3
S2-LP	BALF-SPI2-01D3		BALF-SPI2-02D3	

ST RF IPD packages

CSPG	CSPG w/o bumps	Wire bonding	CSP Microbumping
			
	 		
350 µm Thickness	**125 µm Thickness**	**125 µm Thickness**	**250 µm Thickness**

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IPD benefits versus LTCC

	IPD	LTCC	Discretes
Thickness	Very Good	Good	Medium
Integration	Very Good	Good	Bad
Flexibility	Very Good	Low	Very Good
Complexity simplification	Very Good	Good	Low
Space/area	Good	Medium	Bad
Performances (losses, …)	Very Good	Good	Low
Standardity	Medium	Very Good	Very Good
Integrated matching	Very Good	Good	Low
Summary	★★★	★★	★

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Technologies & roadmap

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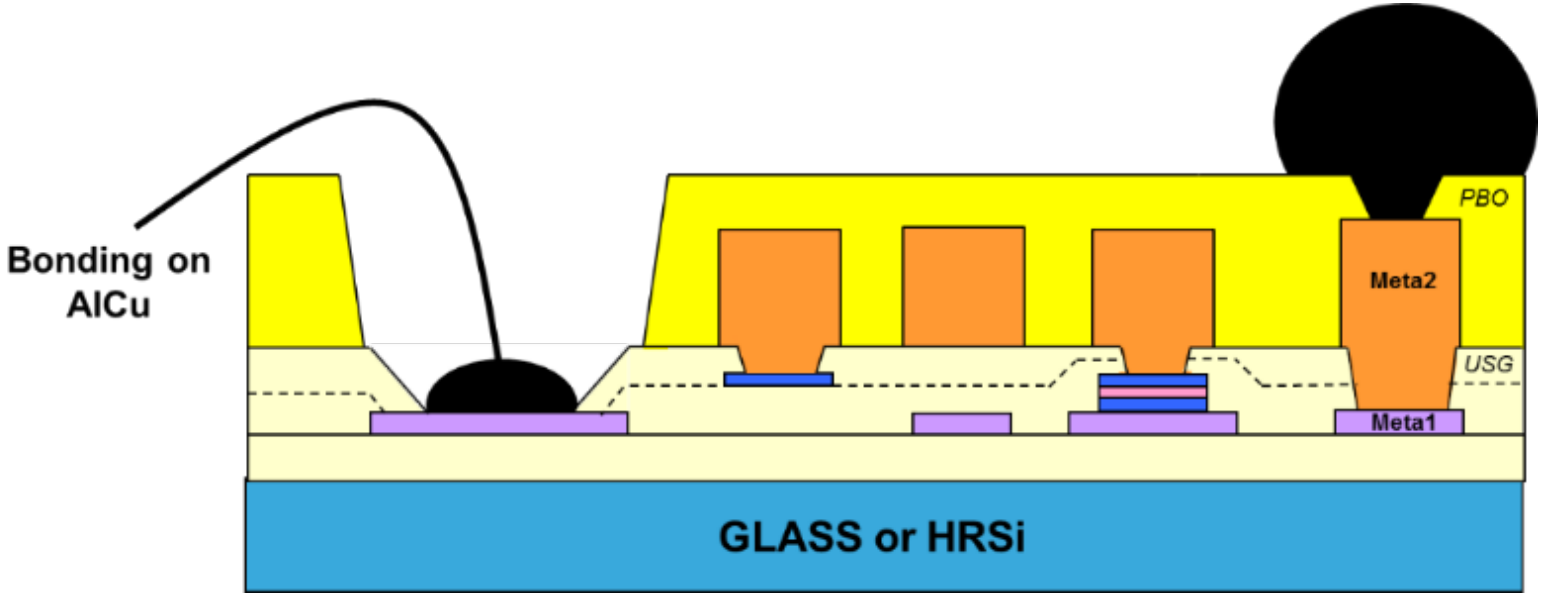
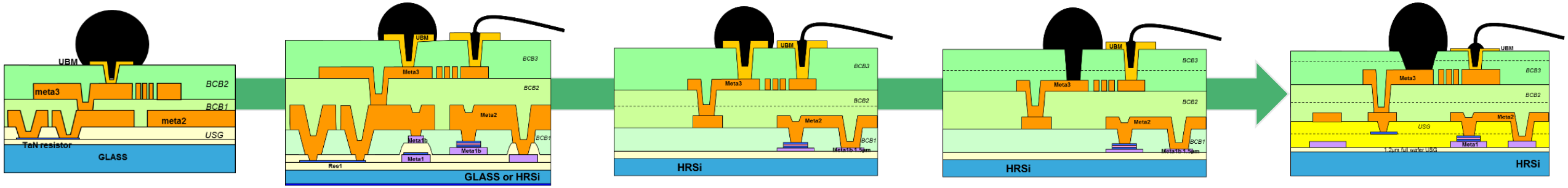
RLC07 copper layer technology

Performance on a budget



L01 and RLC06X copper layer technologies

Improved integration and performance with thicker copper layer and new high-Q material



L01
Copper: 3 + 3 µm
+ resistor

RLC06A
Copper: 6 + **3** µm
Resistor
Low density caps/high density cap

RLC06B
Copper: 6 + **6** µm
High density cap

RLC06C
Copper: 6 + **10** µm
High density cap with
High-Q dielectric resistor

RLC06E
Copper: 6 + **10** µm
High density cap with
High-Q dielectric resistor
Low density cap/high precision

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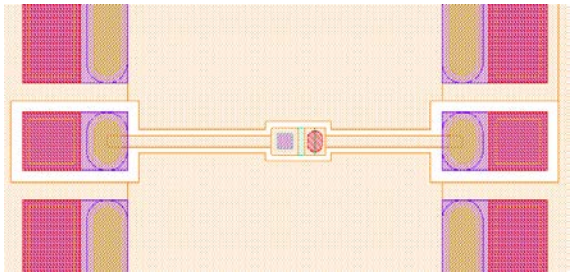
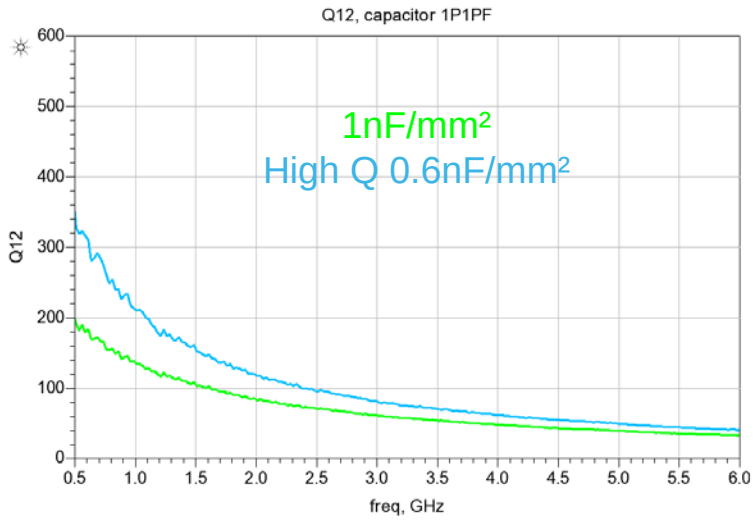
RLC06E technology with high-Q capacitor

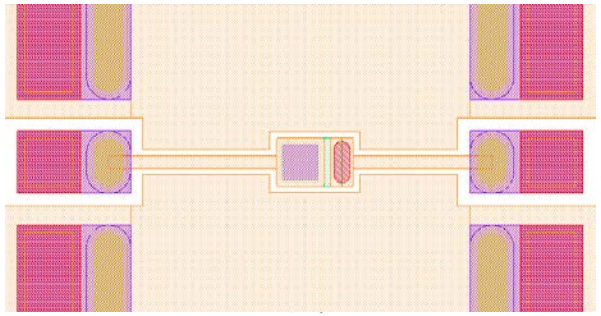
Improvement of the Q factor at low frequencies with the High-Q dielectric resonators

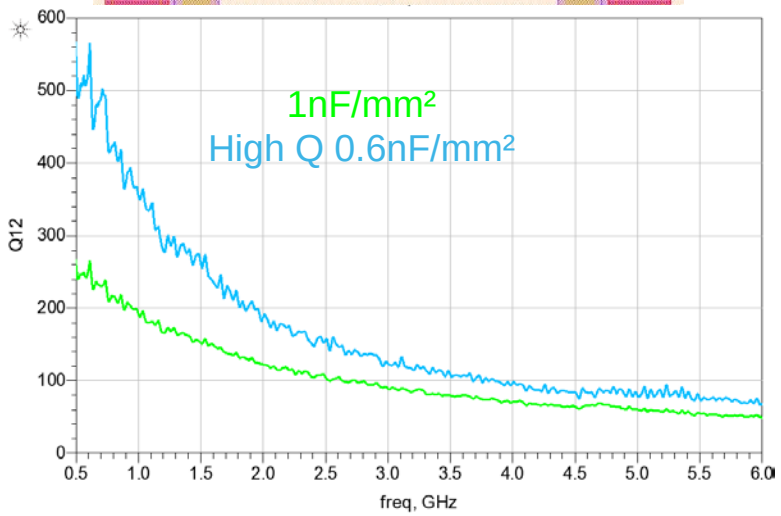
Capacitor 1.1 pF





Capacitor 4 pF





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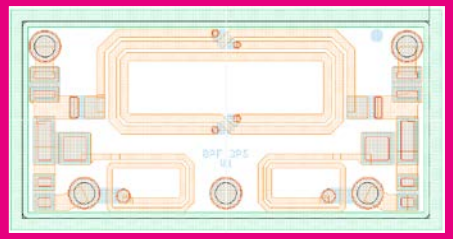
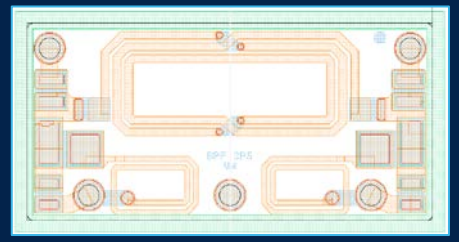
RLC06E technology with high-Q capacitor

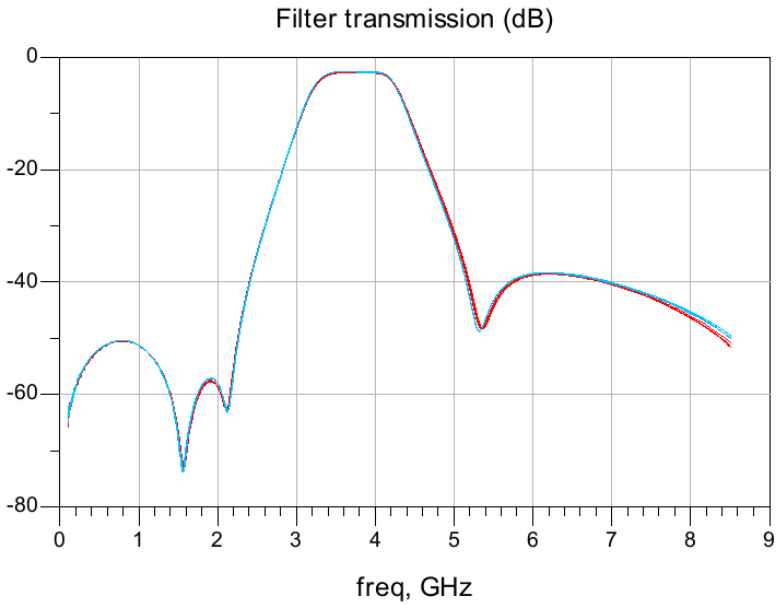
Impact on BPF performance

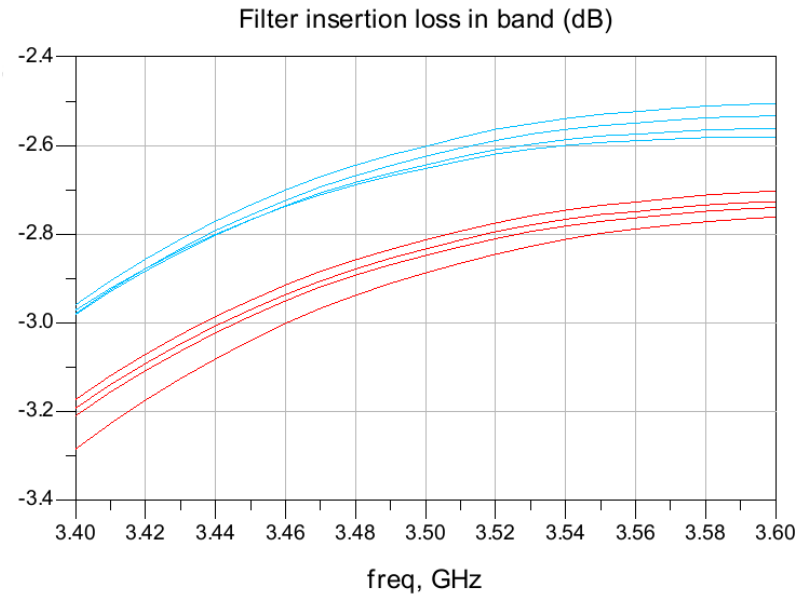


Design with
“standard dielectric”



Design with new
high-Q material





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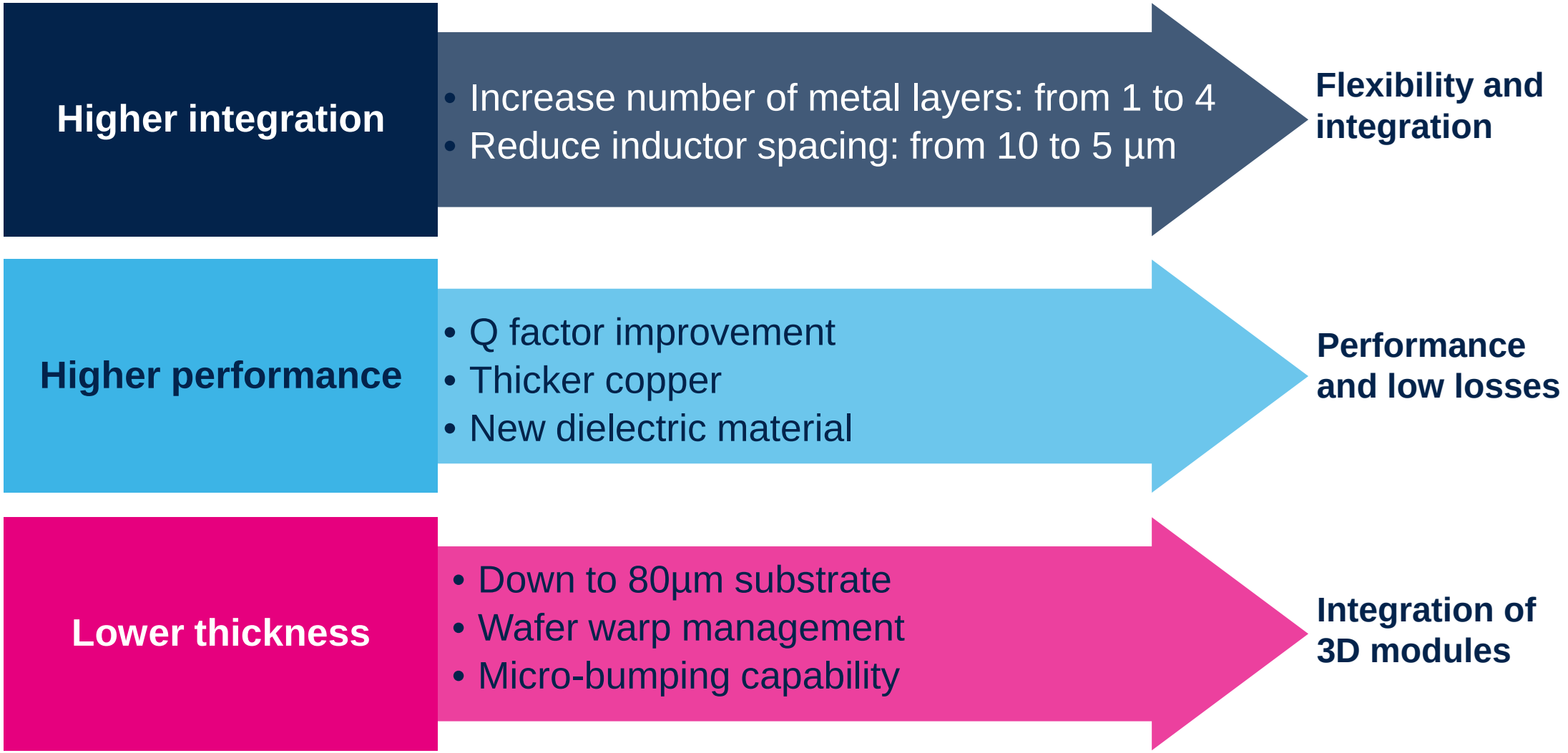
ST RF-IPD roadmap



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Our technology starts with You

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