# Integrated passive devices (IPD) for RF applications

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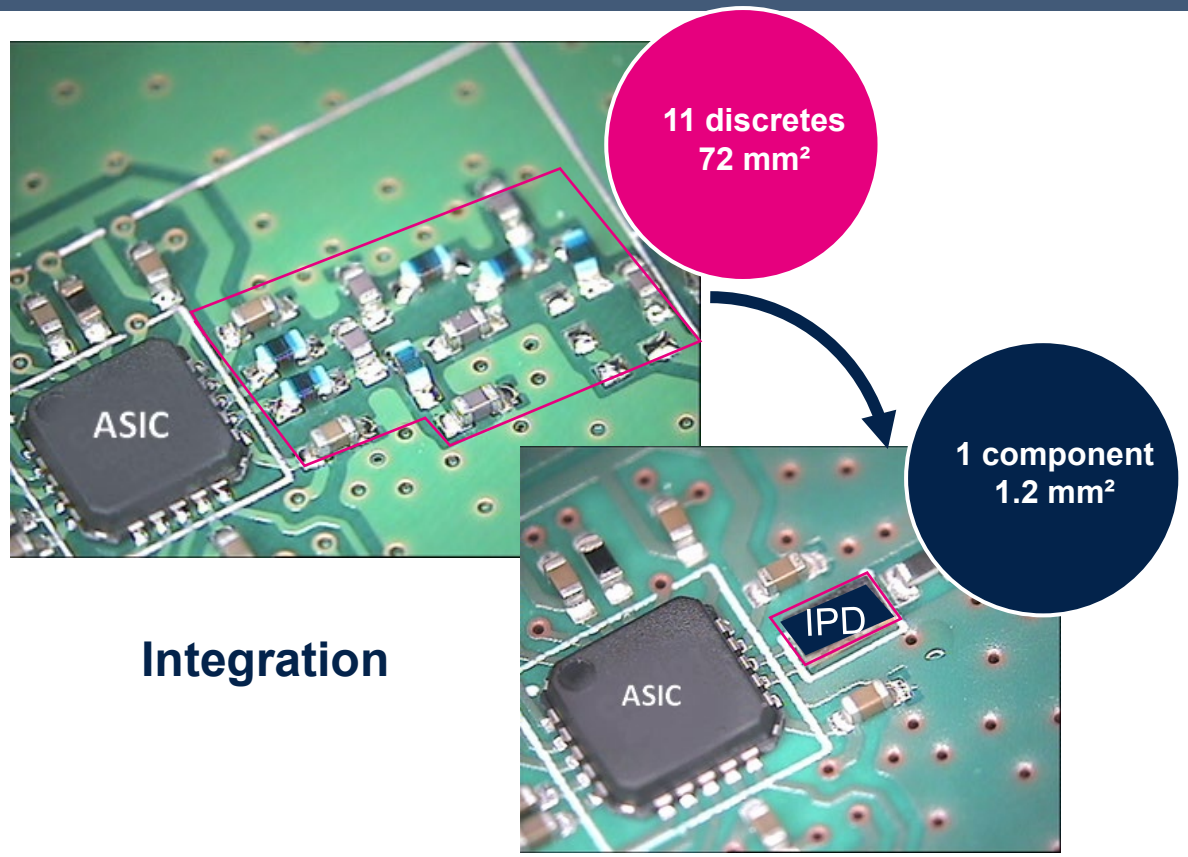
# Integrated passive devices (IPD) for RF applications

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

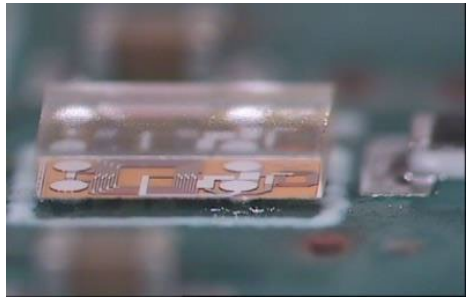



**Integration**

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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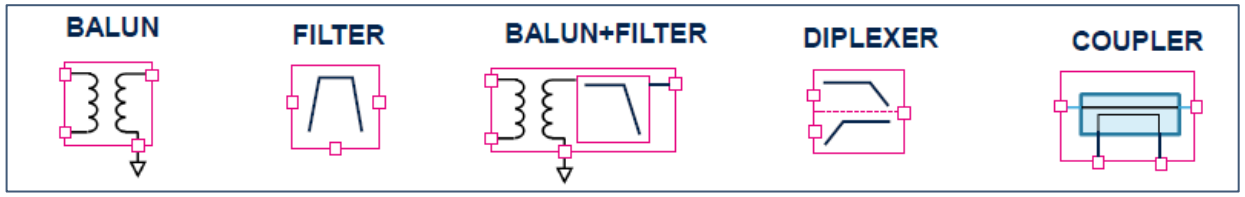
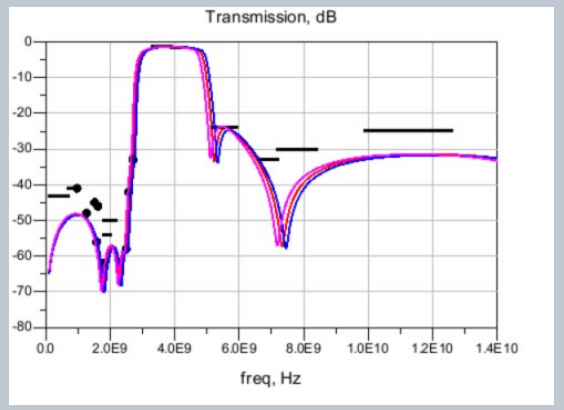
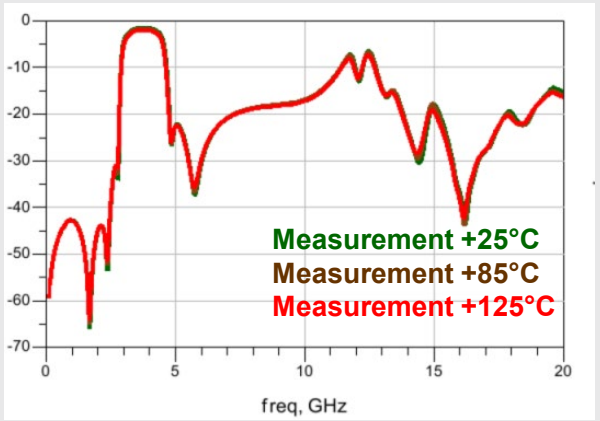
# What are RF integrated passive devices?

**The technology is dedicated to design RF products on glass or high resistivity substrate**




**Process variation: low impact**




**Temperature: low impact**

- Design simplification & performance optimization
- System integration & reliability improvement
- BOM reduction
- Easier and successful development process
- Lower thickness than LTCC
- Low process variation versus discreet/LTCC
- Low temperature impact versus discreet/LTCC

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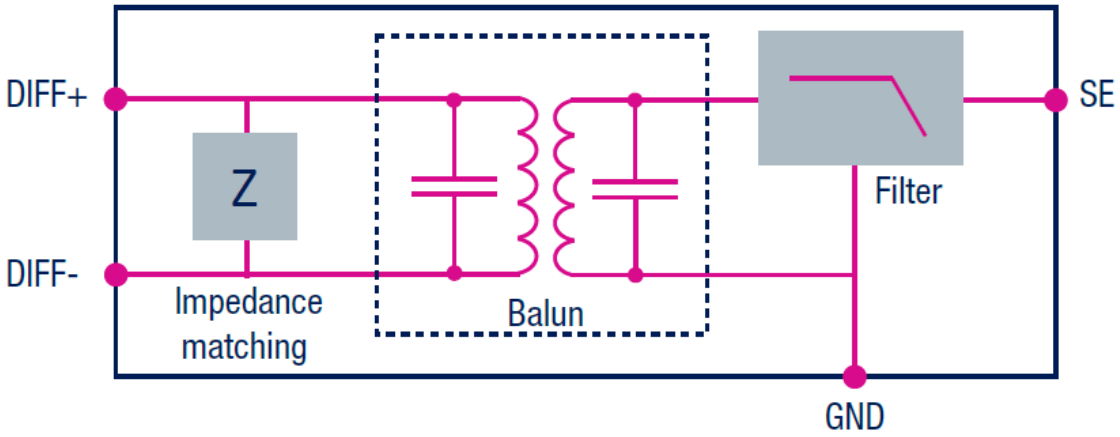
# Tuned for high RF integration

## 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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# 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, etc.) | Very good | Good | Low |
| Standardness | Medium | Very good | Very good |
| Integrated matching | Very good | Good | Low |
| **Summary** | ★★★ | ★★ | ★ |

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# RF IPD products for STM32WL5, STM32WL3, SPIRIT1, and S2-LP long rang wireless ICs

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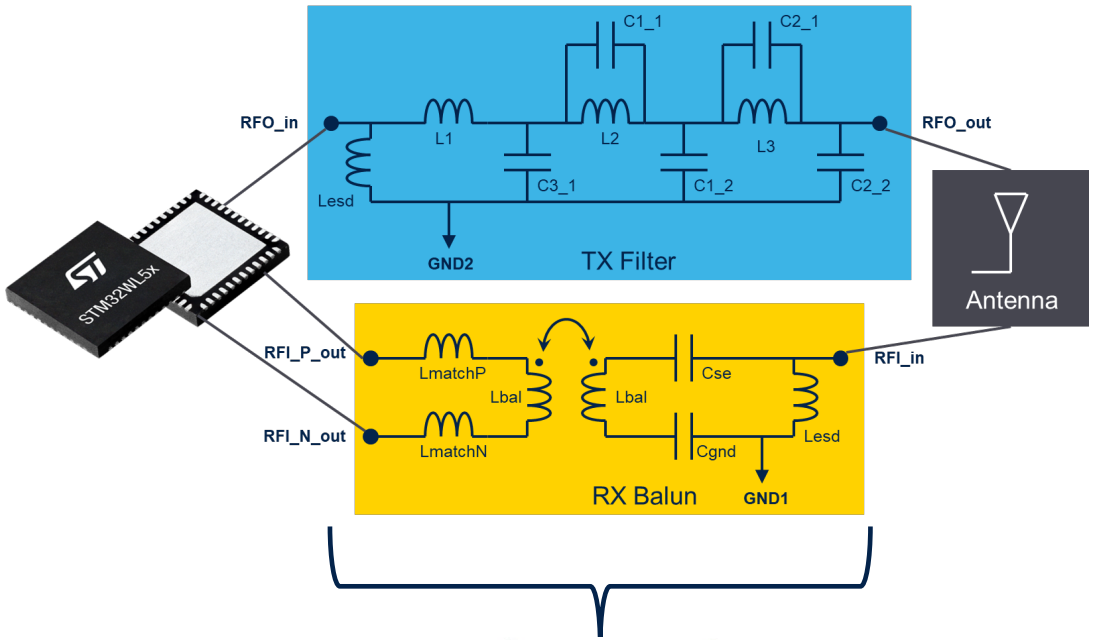
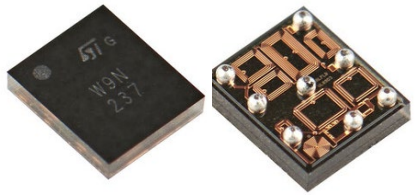
# RF IPD companion chips for STM32WL5

## IPD die replaces 14 discreet L&C components and one balun



**IPD for STM32WL**
**1.8 x 2.13 mm²**

- 9 IPD products
  - Developed to match each STM32WL configuration
  - Pin to pin compatible
- IPD die contain:
  - Tx matching networks
  - Rx matching networks
  - Balun
  - Harmonics filter
  - ESD shunt inductor

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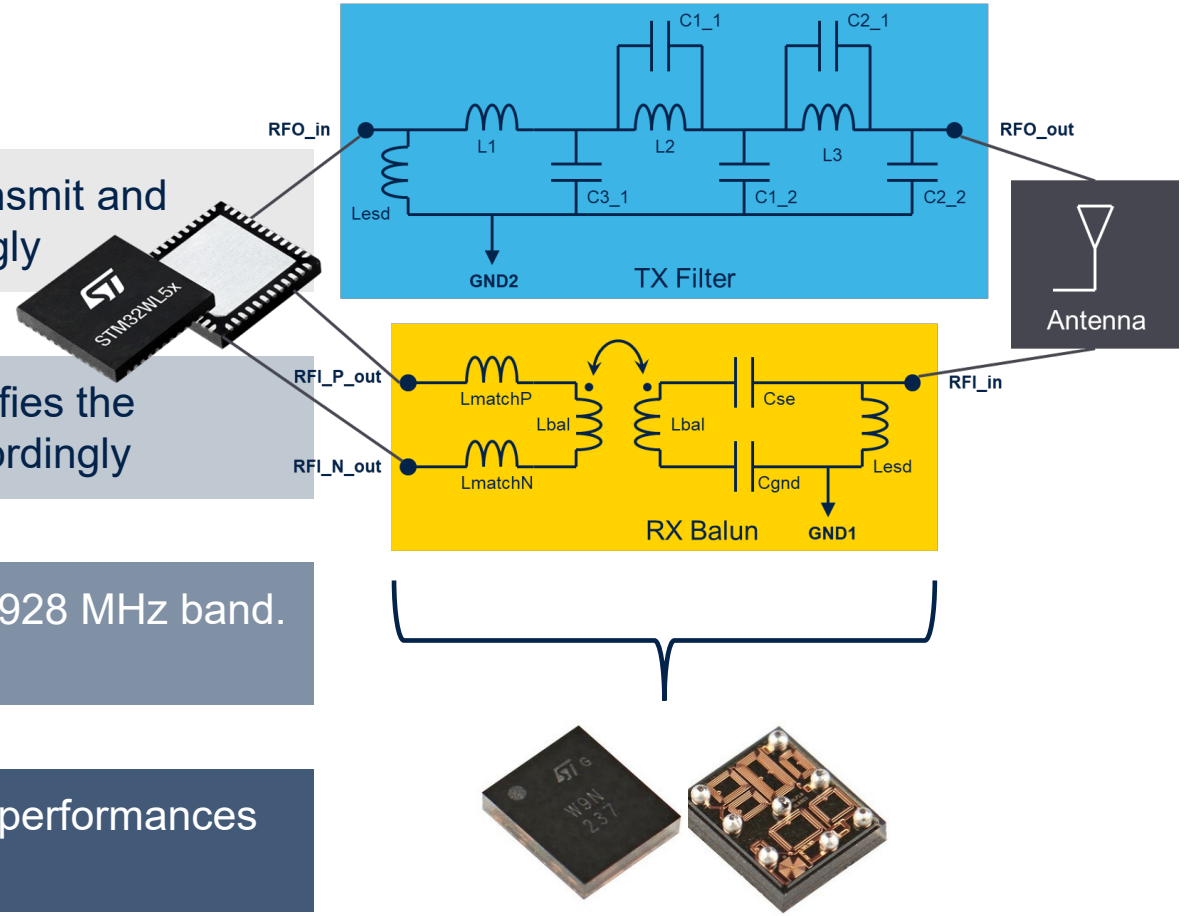
# RF IPD companion chips for STM32WL5
# The reason for 9 products

**STM32WL package**: the STM32WL package has an impact on the transmit and receive impedances. L&C values in IPD die must be modified accordingly

**STM32WL power level**: increasing or decreasing the power level modifies the impedance of STM32WL. L&C values in IPD die must be modified accordingly

**Frequency band**: STM32WL can work at 470-530 MHz band and 862-928 MHz band. Different products for each band

**Customer PCB (number of layers)**: the number of layers impacts RF performances and impedance levels






**IPD for STM32WL**
**1.8 x 2.13 mm²**

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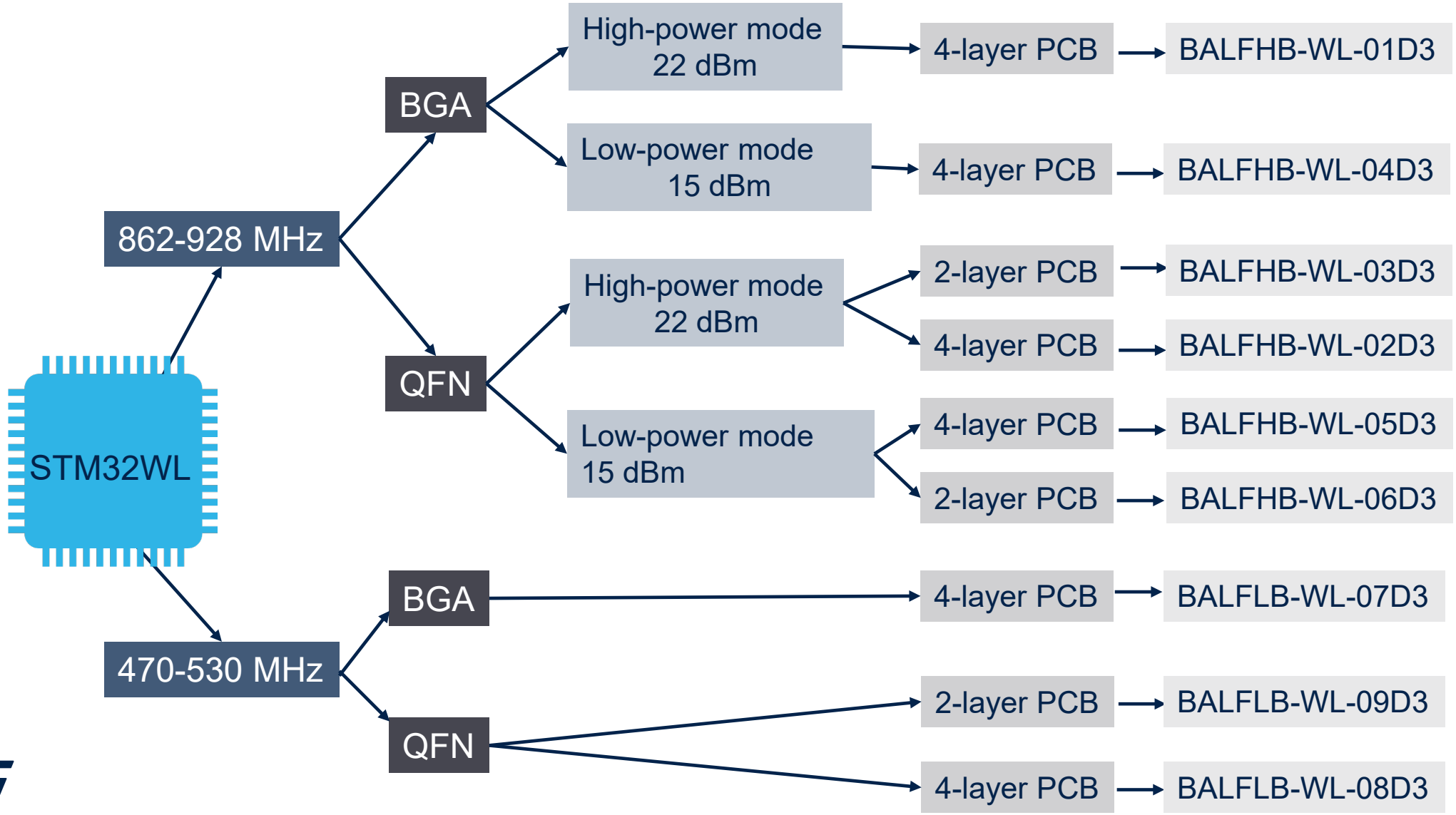
# Choosing the RF IPD companion chip for STM32WL5

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# Choosing the RF IPD companion chip for STM32WL5

**All the products are qualified EPL and are part of the ST 10-year longevity program**

| Power frequency | High power mode 862-928 MHz | | Low power mode 862-928 MHz | |
|---|---|---|---|---|
| # PCB layers | 4 layers | 2 layers | 4 layers | 2 layers |
| STM32WL5 high band BGA | BALFHB-WL-01D3 | | BALFHB-WL-04D3 | |
| STM32WL5 high band QFN | BALFHB-WL-02D3 | BALFHB-WL-03D3 | BALFHB-WL-05D3 | BALFHB-WL-06D3 |
| power frequency | High power mode 470-510 MHz | | | |
| # PCB layers | 4 layers | 2 layers | | |
| STM32WL5 low band BGA | BALFHB-WL-07D3 | | | |
| STM32WL5 low band QFN | BALFHB-WL-08D3 | BALFHB-WL-09D3 | | |

1. 868, 915, and 490 MHz most common frequencies
2. 15, 17, or 22 dBm power level
3. BGA or QFN package
4. 2- or 4-layer PCB

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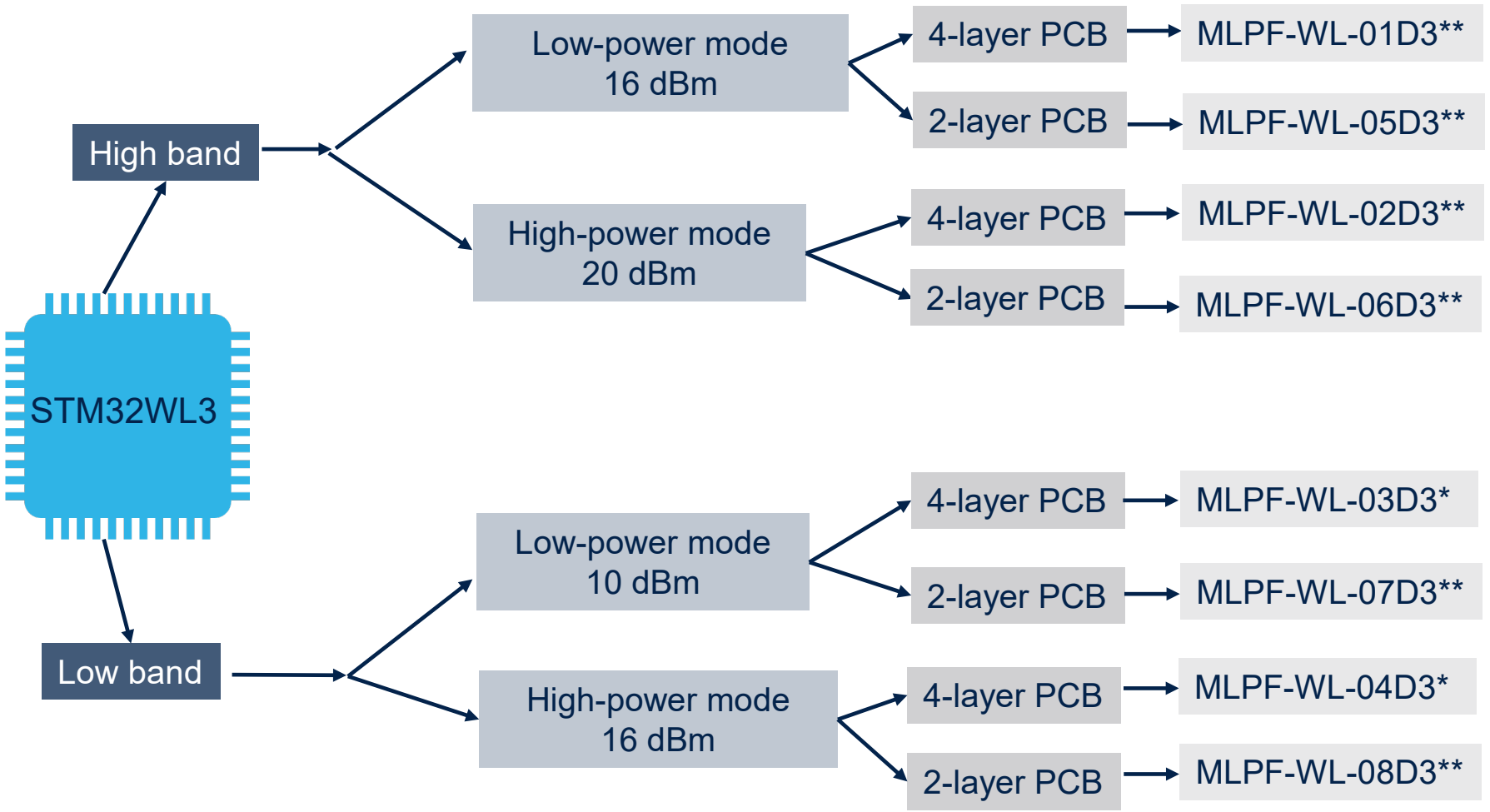
# RF IPDs products companion chip to STM32WL3
## how to pick up the right one




* Qualification Q2 2024 ** Qualification Q4 2024

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# Choosing the RF IPD companion chip for SPIRIT1 and S2-LP

**All the products are qualified EPL and are part of the ST 10-year longevity program**

| | High-power mode High-frequency band | | Low-power mode Low-frequency band | |
|---|---|---|---|---|
| | 4 layers | 2 layers | 4 layers | 2 layers |
| SPIRIT1 | BALF-SPI-01D3 | | BALF-SPI-02D3 | |
| S2-LP | BALF-SPI2-01D3 | BALF-SPI2-03D3* | BALF-SPI2-02D3 | |

1. 868, 915, 433, or 490 MHz most common frequencies
2. 14 or 16 dBm power level
3. 2- or 4-layer PCB

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# RF IPD products for STM32WB and BlueNRG Bluetooth® Low Energy chips

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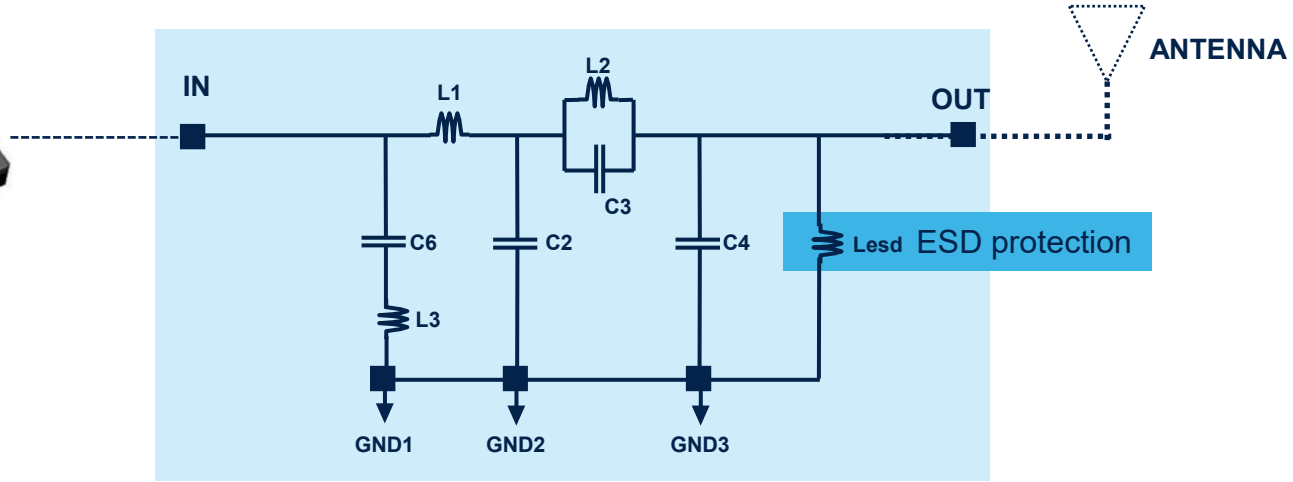
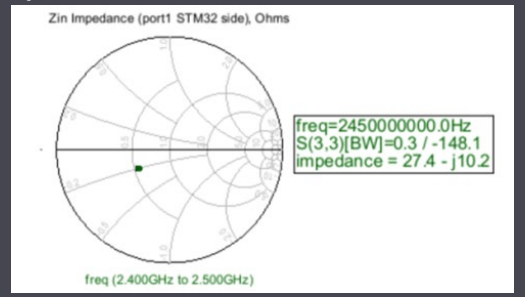
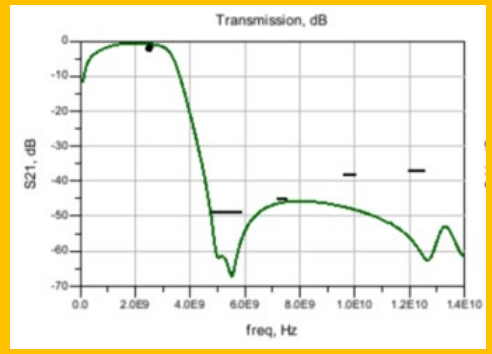
# RF IPD companion chip to STM32WB

**Harmonics filtering, impedance matching, and ESD protection in one die**


Direct match of STM32WB impedance




Deep attenuation to answer system requirements

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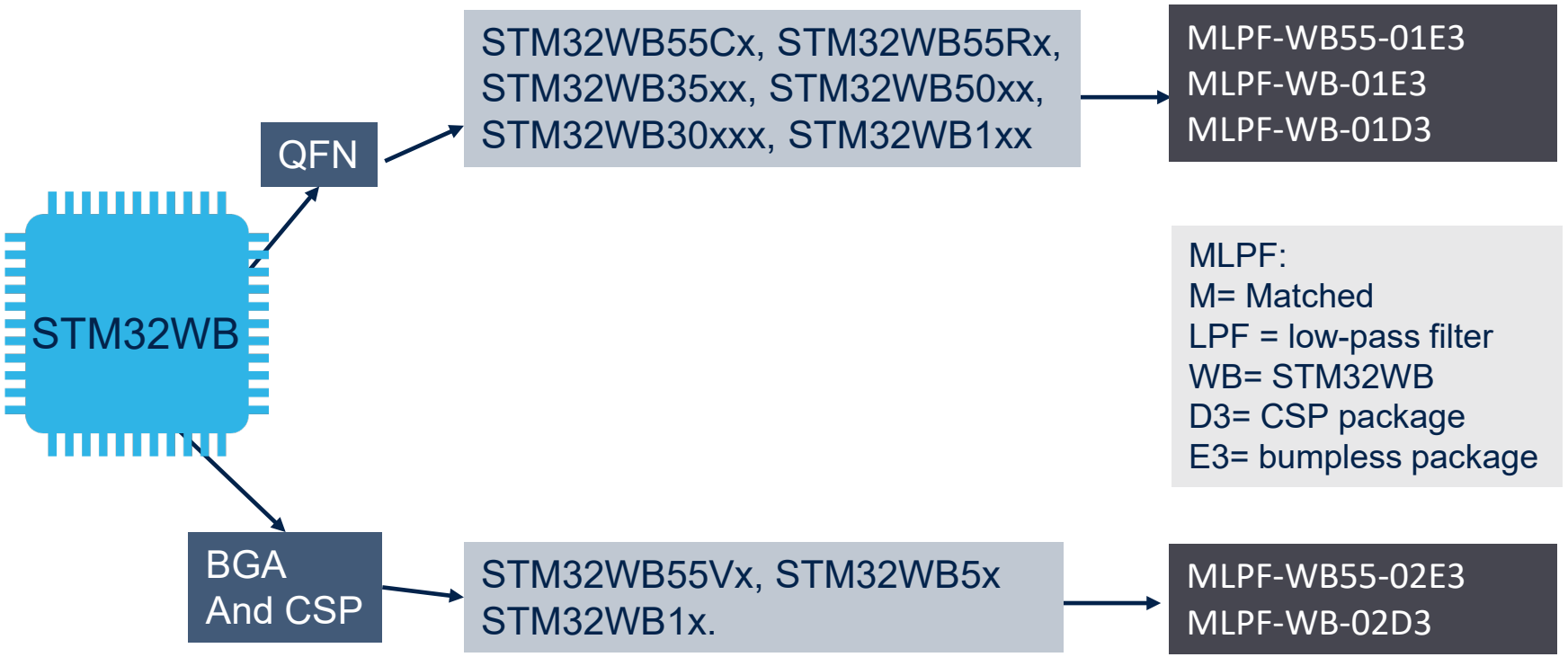
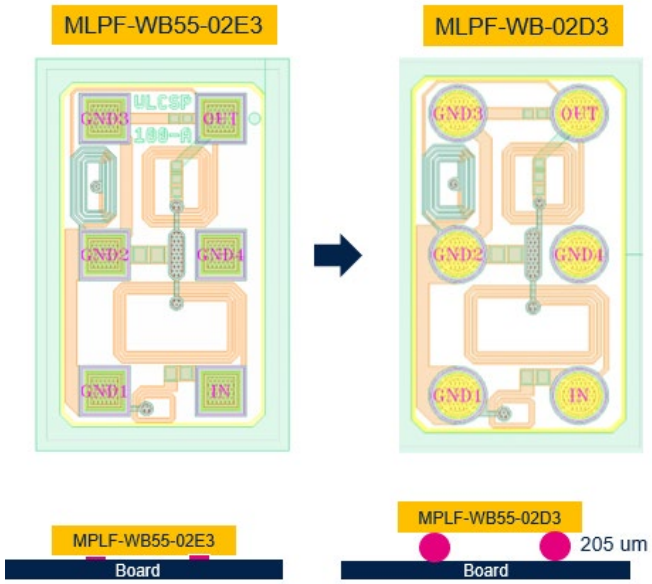
# RF IPD companion chip to STM32WB 5 Products

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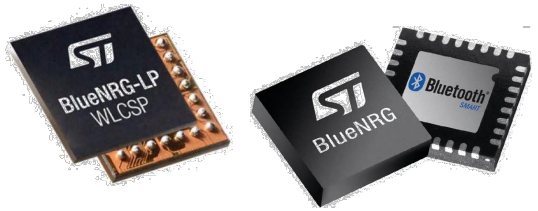
# RF IPD companion chips for STM32WB

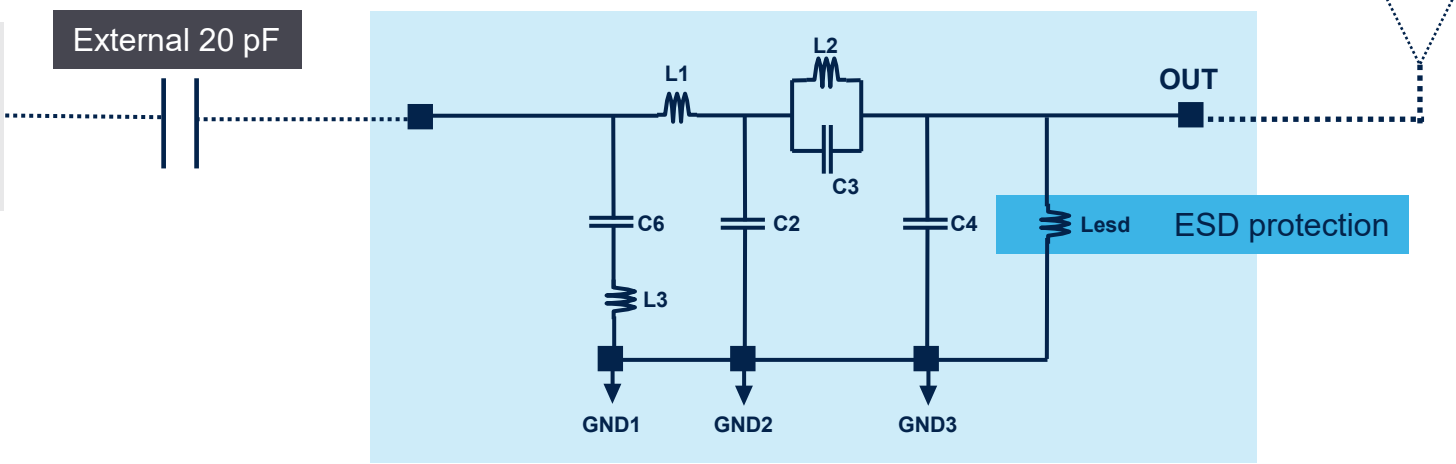
| STM32 part number | STM32 package | RF IPD part number |
|---|---|---|
| STM32WB55Cx, STM32WB55Rx, STM32WB35xx, STM32WB50xx, STM32WB30xxx, STM32WB1xx | QFN | MLPF-WB-01D3 |
| STM32WB55Cx, STM32WB55Rx, STM32WB35xx, STM32WB50xx, STM32WB30xxx, STM32WB1xx | QFN | MLPF-WB-01E3 |
| STM32WB55Cx, STM32WB55Rx, STM32WB35xx, STM32WB50xx, STM32WB30xxx, STM32WB1xx | QFN | MLPF-WB55-01E3 |
| STM32WB5x and STM32WB1x, STM32WB55Vx | BGA/CSP | MLPF-WB-02D3 |
| STM32WB5x and STM32WB1x, STM32WB55Vx | BGA/CSP | MLPF-WB55-02E3 |

# RF IPD companion chip for BlueNRG LP/LPS

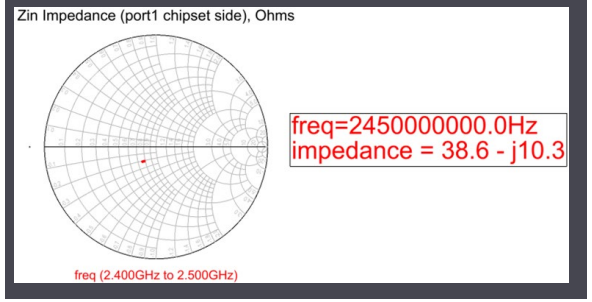
## Harmonics filtering, impedance matching, and ESD protection in one die

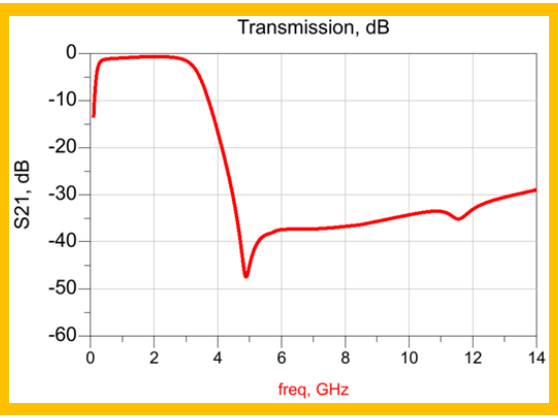
**BLUENRG-3x5Vx**
**BLUENRG-3x5Ax**
**BLUENRG-332xx**
**QFN32 & CSP packages**
**40 Ω**




### Direct match of BlueNRG-LP impedance




Deep attenuation to answer system requirements

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# MLPF-NRG-01D3 RF IPD companion chip for BlueNRG-LP/LPS

## One product compatible with all the following ICs

| IC | Package | Part number |
|---|---|---|
| BLUERNG-LP | QFN32 | BLUENRG-345AC<br>BLUENRG-355AC<br>BLUENRG-345AT<br>BLUENRG-355AT |
| | QFN48 | BLUENRG-345MC<br>BLUENRG-355MC<br>BLUENRG-345MT<br>BLUENRG-355MT |
| | WLCSP | BLUENRG-345VC<br>BLUENRG-355VC<br>BLUENRG-345VT<br>BLUENRG-355VT |
| BLUENRG-LPS | QFN32 | BLUENRG-332AC<br>BLUENRG-332AT |
| | WLCSP | BLUENRG-332VT |

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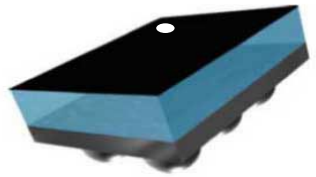
# MLPF-WB-04D3 RF IPD companion chip for STM32WBA

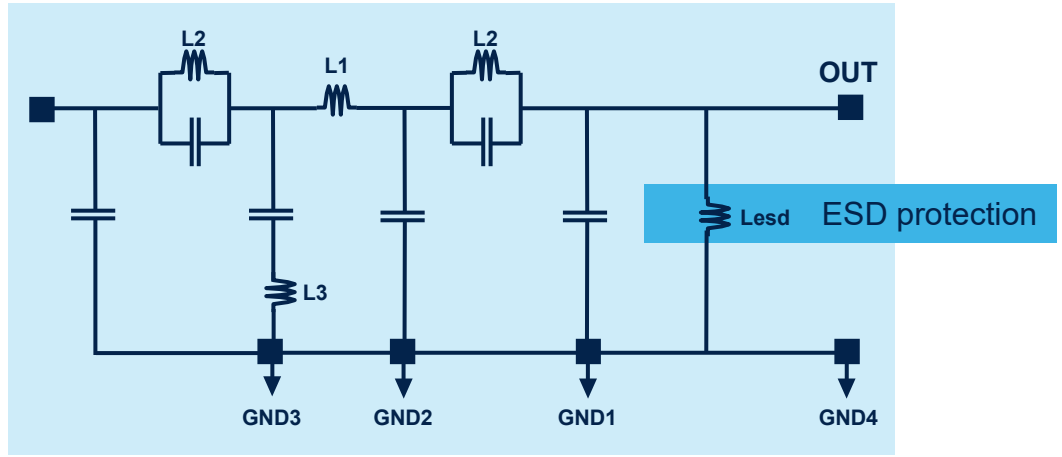
## Harmonics filtering, impedance matching, and ESD protection in one die

- Designed to simplify the RF path between STM32WBA and antenna
- Optimizes performance, BOM, and reliability
- System integration: small die size 1.6 x 1 mm²

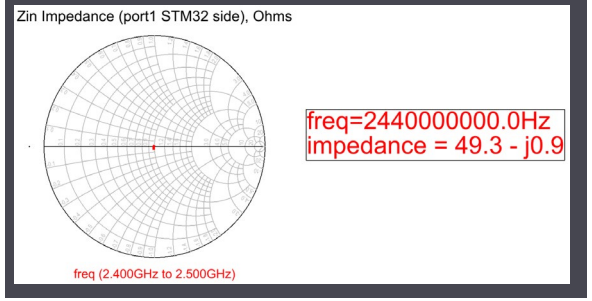
MLPF-WB-04D3 1.6 x 1 mm²

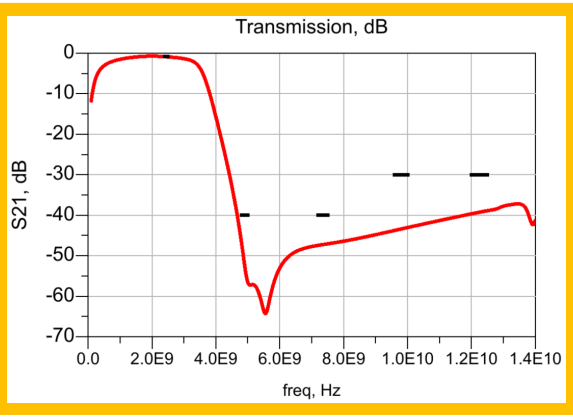


Chip scale package on glass 6 bumps




### Direct match of STM32WBA impedance

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