



# RF front-end solutions for mobile applications

## Selection guide



[www.infineon.com/rf](http://www.infineon.com/rf)





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# Introduction

Infineon has been a leading semiconductor player in Mobile Communication since the days of Siemens AG, its parent company. Not only are we the world's largest LNA supplier, but also the ones who identified the need for – and created the first – LTE LNAs back in 2014. Furthermore, we're pioneers in LTE RF front-end and antenna tuning excellence, providing customers with new architecture proposals and highly qualified on-site support. Looking to the future, we're already a leading company in upcoming 5G applications such as mmW. As demonstrated by our tailor-made in-house technology development and in-house multi-site manufacturing to ensure a secure supply, we're highly committed to becoming the No. 1 player in radio frequency.

## We support you by being the first to provide what applications truly need

- › The world's first LTE LNA supplier with the highest market share to date worldwide
- › Fastest market share growth in RF switches in 2015
- › Fastest market share growth in antenna tuners in 2015

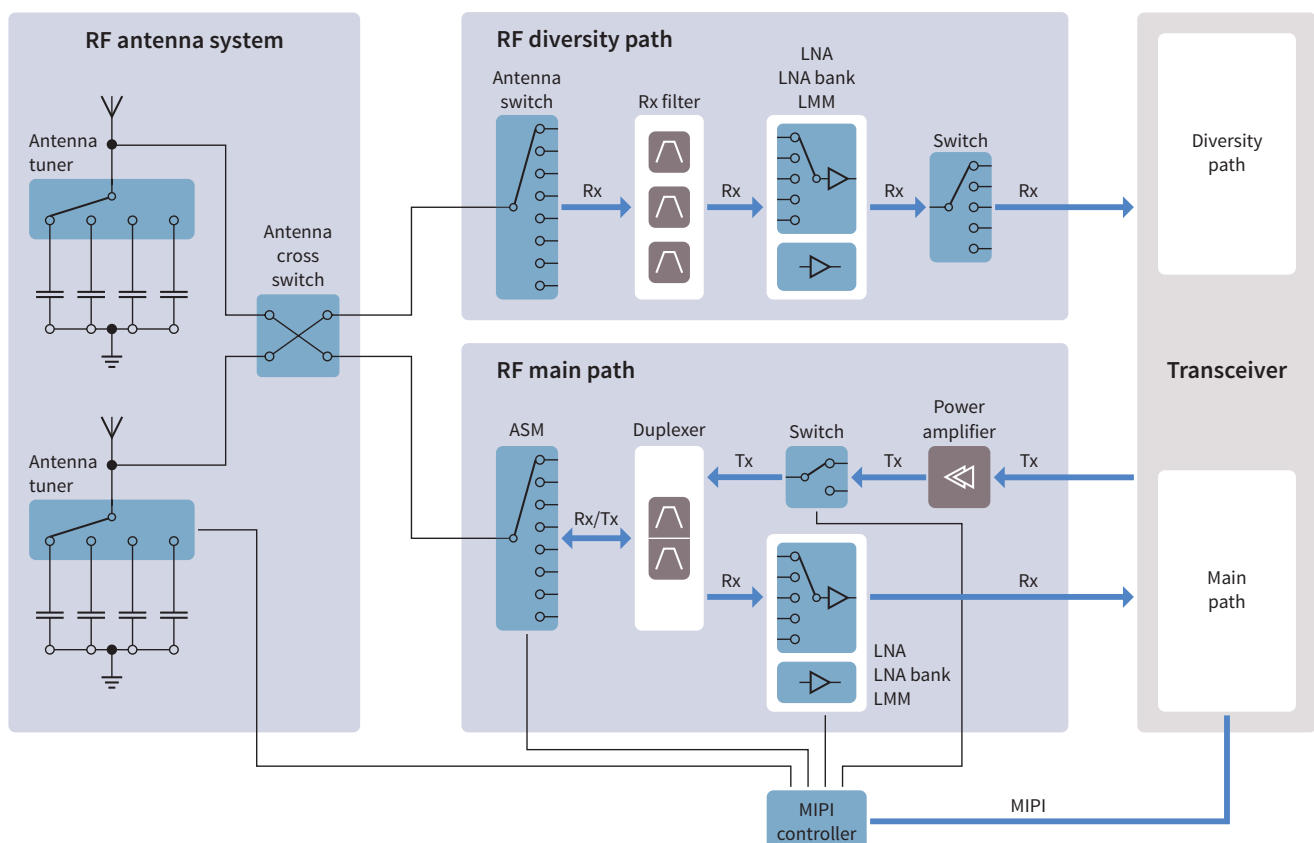
## We support you with technological innovations dedicated to RF applications

- › World's best SiGe:C technology enabling LNAs with the lowest NF, highest linearity and lowest power consumption
- › In-house 130 nm RFCMOS technology enabling switches for complex technology with the smallest size and lowest insertion loss
- › 2-layer leadframe package for complex systems and flexibility in design
- › Continuous investment in future technologies, leading in mmW application

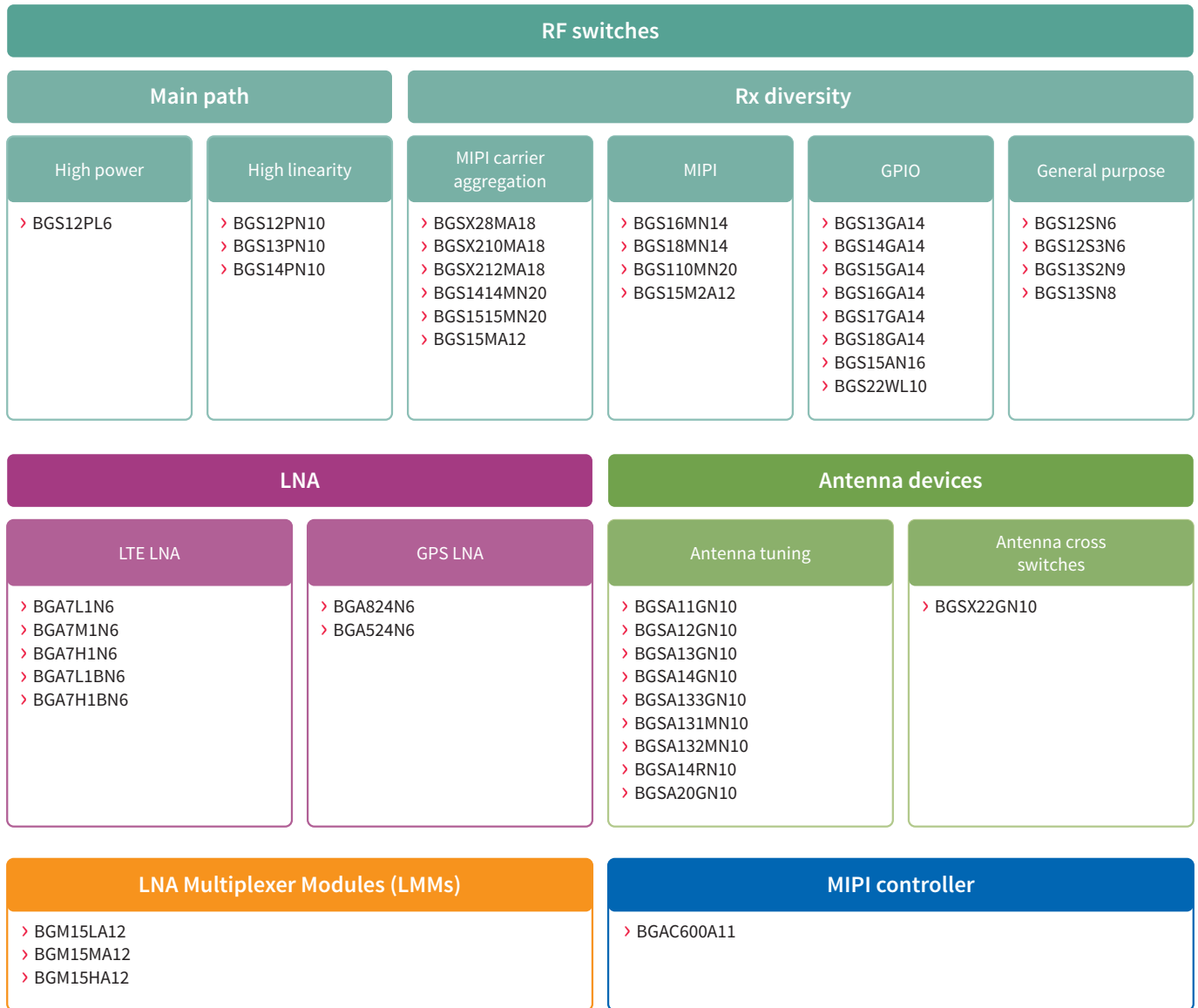
## We support you with system know-how and technical support

- › In-house system expert team with a background in smartphone design
- › In-house system simulation capability
- › Antenna expertise

## Infineon's RF front-end system solutions



## Overview of Infineon's RF front-end products







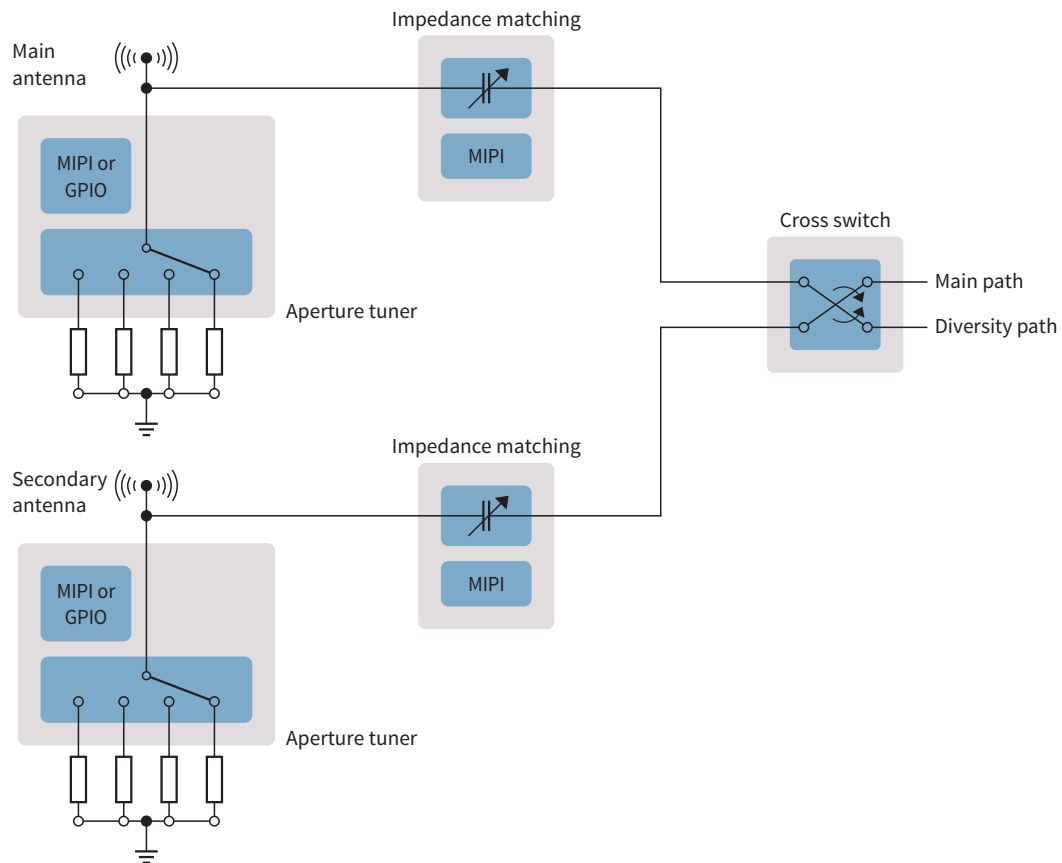
# Antenna systems

RF antenna system – for improved signal quality and a longer battery life

A high-efficiency RF antenna needs space – something in short supply in today's smartphones. Outstanding signal quality and a long battery life go hand in hand with a good antenna. With Infineon by your side, you can overcome the challenges associated with antenna systems to create designs in tune with the needs of today.

## Customer benefits

- > A twenty-fold improvement in antenna radiation efficiency means
- > Several hours of more talk time
- > Several hours of more data browsing
- > 5-bar signal strength wherever you go



### Infiniteon switches for antenna tuning

| Product family | Type    | $R_{on}$<br>[ $\Omega$ ] | $C_{off}$<br>[pF] | $V_{RF}$ (max.)<br>[V] | Ctrl            |
|----------------|---------|--------------------------|-------------------|------------------------|-----------------|
| BGSA11GN10     | 2x SPST | 0.38                     | 0.25              | 36                     | GPIO (4 states) |
| BGSA12GN10     | SP2T    | 1.60                     | 0.12              | 48                     | GPIO (2 states) |
| BGSA13GN10     | SP3T    | 0.8/1.4/1.6              | 0.30/0.16/0.12    | 48                     | GPIO (4 states) |
| BGSA14GN10     | SP4T    | 1.60                     | 0.12              | 48                     | GPIO (4 states) |
| BGSA133GN10    | SP3T    | 0.5/1.0/1.0              | 0.6/0.3/0.3       | 44                     | GPIO (4 states) |
| BGSA131MN10    | SP3T    | 0.5/1.0/1.0              | 0.6/0.3/0.3       | 44                     | MIPI (8 states) |
| BGSA132MN10    | SP3T    | 0.5/1.0/1.0              | 0.6/0.3/0.3       | 44                     | MIPI (8 states) |
| BGSA14RN10     | SP4T    | 0.95                     | 0.30              | 44                     | GPIO (8 states) |
| BGSA20GN10     | 2x SPST | 2.30                     | C1+C2             | 90                     | GPIO (4 states) |

### Infiniteon cross switches for antenna routing

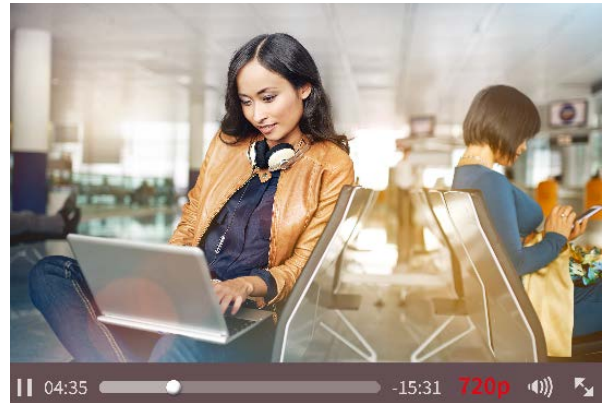
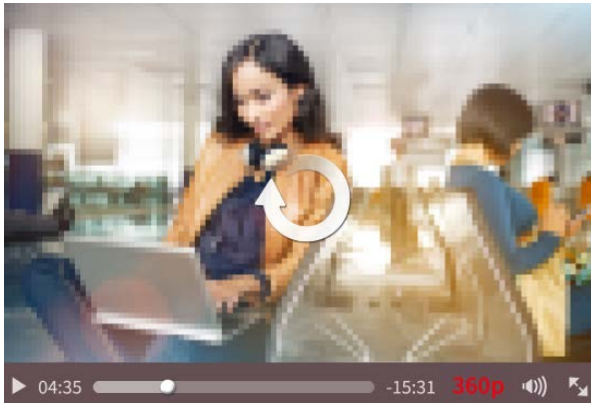
| Product family | Type  | $P_{max}$<br>[dBm] | $I_L$<br>[dB] | Frequency<br>[MHz] | Ctrl |
|----------------|-------|--------------------|---------------|--------------------|------|
| BGSX22GN10     | DPDXT | 36                 | 0.3–0.6       | 100–3800           | GPIO |

# Diversity path

Enhanced RF diversity signals for a better user experience

One of the biggest frustrations of modern life is having to constantly wait for videos, maps etc. to load on our smartphone

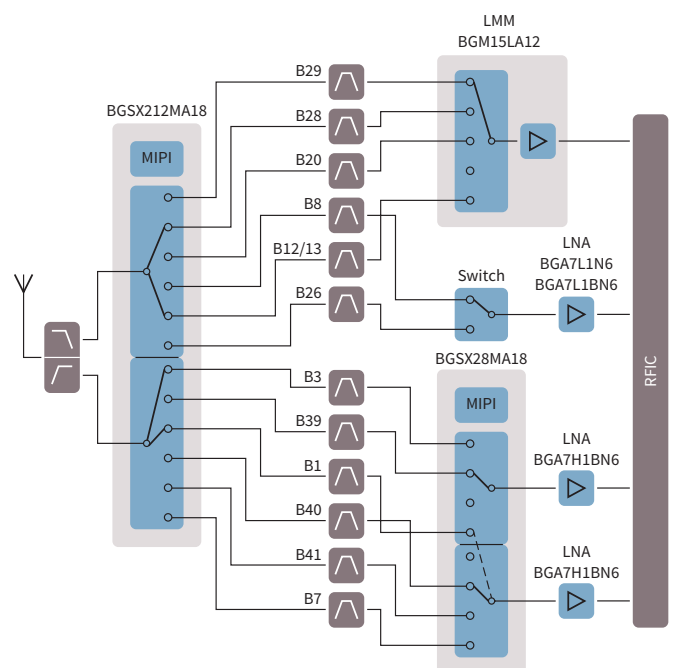
A satisfying user experience depends on the instant, smooth and reliable availability of data



Adding a diversity path coupled with the following technologies could help to achieve the desired satisfying user experience.

## Carrier aggregation

- Carrier aggregation increases system bandwidth but requires hardware support
- Up to 4x downlink carrier aggregation-capable chipsets and handsets are available on the market today
- Thanks to their direct mapping and cross ports capability, Infineon's **BGSX2xxMA18** MIPI-controlled switches support up to 4CA and many different band combinations
- Infineon's **BGS15MA12** with direct mapping can support up to 5CA



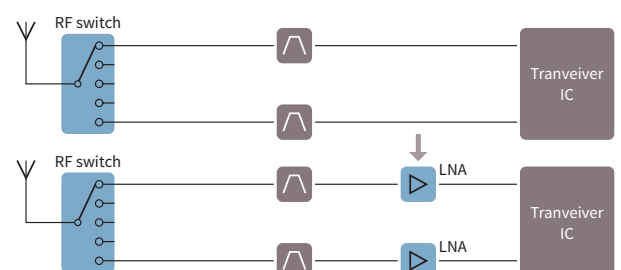
## LNA (Low Noise Amplifier)

With more than 2 billion LTE LNAs shipped to date, Infineon is the world's first and foremost LTE LNA supplier. Infineon currently manufactures two LNA series:

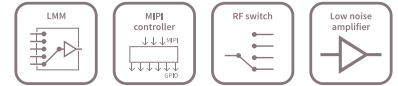
| LTE LNA without bypass                              |          |          | LTE LNA with bypass                                 |           |
|---|----------|----------|---|-----------|
| BGA7L1N6  | BGA7M1N6 | BGA7H1N6 | BGA7L1BN6   | BGA7H1BN6 |
| Up to 0.5 dB better NF <sup>1)</sup>                |          |          | Up to 0.3 dB better NF <sup>1)</sup>                |           |
| > 10 percent less current consumption <sup>1)</sup> |          |          | > 15 percent less current consumption <sup>1)</sup> |           |

1) Compared to competitors

Adding a low-noise amplifier could typically increase system SNR by 3 dB, thereby increasing the data rate by up to 80 percent.







## Infineon switches with MIPI for carrier aggregation

| Product family | Type   | Size [mm] | Frequency (max.) [GHz] | dBm |
|----------------|--------|-----------|------------------------|-----|
| BGSX28MA18     | DPX8T  | 2.0 x 2.4 | 3.8                    | 27  |
| BGSX210MA18    | DPX10T | 2.0 x 2.4 | 3.8                    | 27  |
| BGSX212MA18    | DPX12T | 2.0 x 2.4 | 3.8                    | 27  |
| BGS15MA12      | SP5T   | 1.1 x 1.9 | 3.0                    | 27  |
| BGS1414MN20    | DP8T   | 2.3 x 2.3 | 3.0                    | 32  |
| BGS1515MN20    | DP10T  | 2.3 x 2.3 | 3.0                    | 32  |

## Infineon switches with MIPI

| Product family | Type  | Size [mm] | Frequency (max.) [GHz] | dBm |
|----------------|-------|-----------|------------------------|-----|
| BGS110MN20     | SP10T | 2.3 x 2.3 | 3.0                    | 32  |
| BGS18MN14      | SP8T  | 2.0 x 2.0 | 3.0                    | 32  |
| BGS16MN14      | SP6T  | 2.0 x 2.0 | 3.0                    | 32  |
| BGS15M2A12     | SP5T  | 1.1 x 1.9 | 3.0                    | 32  |

## Infineon switches with GPIO

| Product family | Type | Size [mm]   | Frequency (max.) [GHz] | dBm |
|----------------|------|-------------|------------------------|-----|
| BGS13GA14      | SP3T | 2.0 x 2.0   | 6.0                    | 28  |
| BGS14GA14      | SP4T | 2.0 x 2.0   | 6.0                    | 28  |
| BGS15GA14      | SP5T | 2.0 x 2.0   | 6.0                    | 28  |
| BGS16GA14      | SP6T | 2.0 x 2.0   | 6.0                    | 28  |
| BGS17GA14      | SP7T | 2.0 x 2.0   | 6.0                    | 28  |
| BGS18GA14      | SP8T | 2.0 x 2.0   | 6.0                    | 28  |
| BGS15AN16      | SP5T | 2.3 x 2.3   | 3.0                    | 32  |
| BGS22WL10      | DPDT | 1.15 x 1.55 | 3.8                    | 30  |

## LNA Multiplexer Modules (LMMs) with MIPI

| Product family | Type | Band      | Gain [dB] | NF [dB] | Frequency [GHz] |
|----------------|------|-----------|-----------|---------|-----------------|
| BGM15LA12      | SP5T | Low band  | 17.5      | 1.10    | 0.7–1.0         |
| BGM15MA12      | SP5T | Mid band  | 16.7      | 1.15    | 1.7–2.2         |
| BGM15HA12      | SP5T | High band | 16.3      | 1.20    | 2.3–2.7         |

## LTE LNA

| Product family | Band            | Size [mm] | Gain [dB] | NF [dB] | Frequency [GHz] |
|----------------|-----------------|-----------|-----------|---------|-----------------|
| BGA7L1N6       | Low band        | 1.1 x 0.7 | 13.0      | 0.6     | 0.7–1.0         |
| BGA7M1N6       | Mid band        | 1.1 x 0.7 | 13.0      | 0.6     | 1.7–2.2         |
| BGA7H1N6       | High band       | 1.1 x 0.7 | 13.0      | 0.6     | 2.3–2.7         |
| BGA7L1BN6      | Low band        | 1.1 x 0.7 | 16.1      | 0.6     | 0.7–1.0         |
| BGA7H1BN6      | Mid + High band | 1.1 x 0.7 | 15.7      | 0.8     | 1.8–2.7         |

# Main path

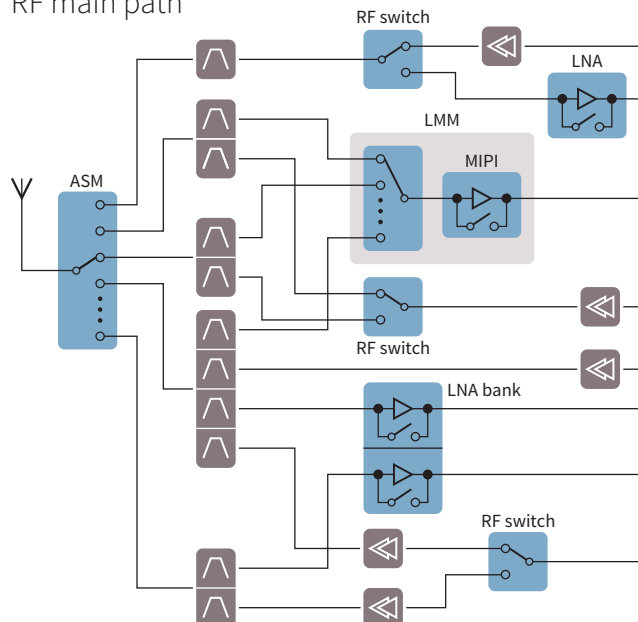
Added value and increased performance with Infineon components

The RF main path simultaneously transmits and receives RF signals. However, the introduction of carrier aggregation – for both transmitting and receiving signals – is making RF designs more complex. RF components have to:

- › Handle high-power signals
- › Deliver best performance and
- › Help to save valuable battery energy

All our LNA and Switch solutions are designed to do just this

RF main path

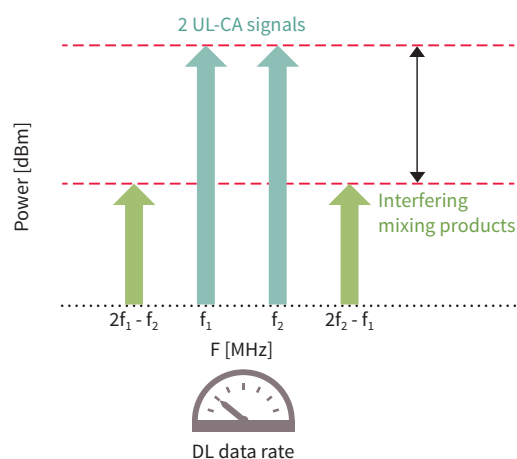


## Main path switches

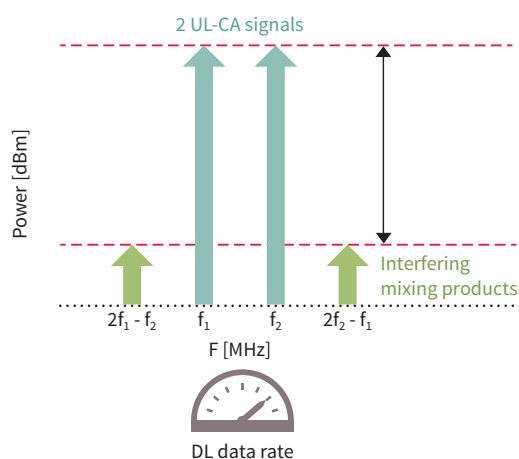
Our high-power switch family can handle very high transmitting signal levels of up to 38 dBm, while at the same time exhibiting low losses to conserve battery power. These switches feature proprietary RF CMOS technology and com-

bine low loss characteristics with high linearity for uplink carrier aggregation, where two signals are transmitted simultaneously by a mobile device.

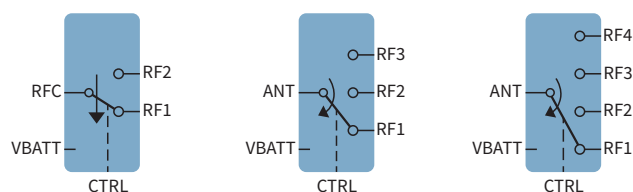
## Low linearity component



## High linearity component



The product family is designed to provide maximum flexibility in RF-front-end design.



## Main path modules

The Low-noise amplifier Multiplex Module (LMM) simplifies the RF-front-end design and helps to

- › Reduce size
- › Optimize costs
- › Improve system performance
- › Reduce time-to-market

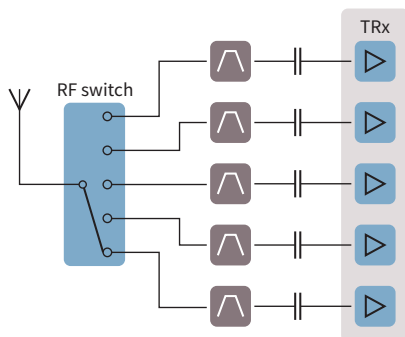
The LMM components combine the advantages of discrete RF-components and Front-End Modules (FEM) – the

ideal choice for Downlink-Carrier Aggregation (DL-CA) and Uplink Carrier-Aggregation (UL-CA).

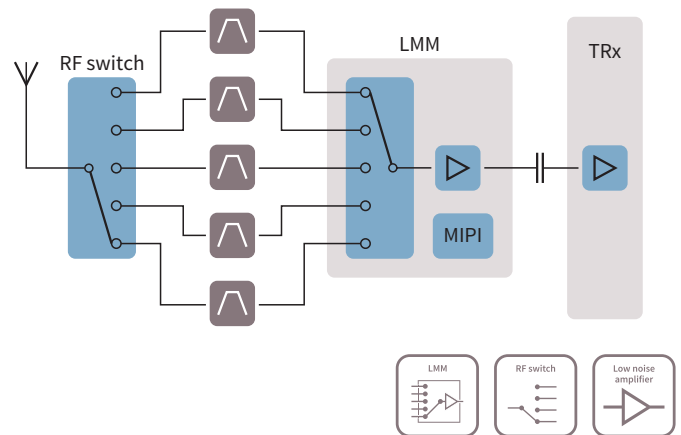
Added value of an integrated LNA + switch

- › Up to 80 percent less number of routing lines + MIPI-controlled
- › Up to 50 percent smaller
- › Up to 60 percent BOM cost savings

### Discrete RF front-end design



### LMM RF front-end design



### Infinion switches for high power/linearity

| Product family | Type | Size [mm] | Frequency (max.) [GHz] | Power (max.) [dBm] |
|----------------|------|-----------|------------------------|--------------------|
| BGS12PL6       | SPDT | 0.7 x 1.1 | 3                      | 35                 |
| BGS12PN10      | SPDT | 1.5 x 1.1 | 4                      | 38                 |
| BGS13PN10      | SP3T | 1.5 x 1.1 | 4                      | 38                 |
| BGS14PN10      | SP4T | 1.5 x 1.1 | 4                      | 38                 |

### Infinion general-purpose switches SPDT/SP3T

| Product family | Type | Size [mm]   | Frequency (max.) [GHz] | Power (max.) [dBm] |
|----------------|------|-------------|------------------------|--------------------|
| BGS13S2N9      | SP3T | 1.15 x 1.15 | 2.7                    | 30                 |
| BGS13SN8       | SP3T | 1.15 x 1.15 | 6.0                    | 30                 |
| BGS12SN6       | SPDT | 0.7 x 1.1   | 6.0                    | 30                 |
| BGS12S3N6      | SPDT | 0.65 x 0.98 | 6.0                    | 30                 |

### LTE LNA for main path

| Product family | Type        | Size [mm] | Gain [dB] | NF [dB] | Frequency [GHz] |
|----------------|-------------|-----------|-----------|---------|-----------------|
| BGA7L1N6       | w/o bypass  | 1.1 x 0.7 | 13.0      | 0.6     | 0.7–1.0         |
| BGA7M1N6       | w/o bypass  | 1.1 x 0.7 | 13.0      | 0.6     | 1.7–2.2         |
| BGA7H1N6       | w/o bypass  | 1.1 x 0.7 | 13.0      | 0.6     | 2.3–2.7         |
| BGA7L1BN6      | with bypass | 1.1 x 0.7 | 16.1      | 0.6     | 0.7–1.0         |
| BGA7H1BN6      | with bypass | 1.1 x 0.7 | 15.7      | 0.8     | 1.8–2.7         |

### LNA Multiplexer Modules (LMMs) with MIPI

| Product family | Type       | Size [mm] | Gain [dB] | NF [dB] | Frequency [GHz] |
|----------------|------------|-----------|-----------|---------|-----------------|
| BGM15LA12      | SP5T + LNA | 1.9 x 1.1 | 17.5      | 1.10    | 0.7–1.0         |
| BGM15MA12      | SP5T + LNA | 1.9 x 1.1 | 16.7      | 1.15    | 1.7–2.2         |
| BGM15HA12      | SP5T + LNA | 1.9 x 1.1 | 16.3      | 1.20    | 2.3–2.7         |



# Complementary wireless

## Enhanced connectivity in mobile devices

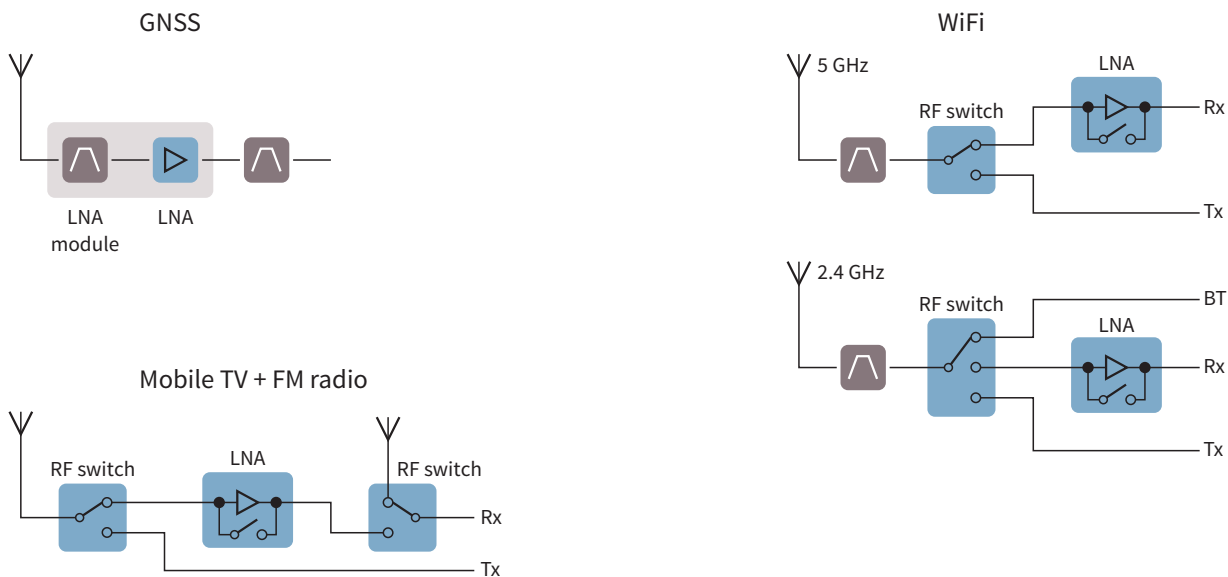
Today's smartphones are veritable all-rounders. After all, they come equipped with a host of complementary wireless applications from WiFi and Bluetooth to GNSS and mobile TV. For today's designers, however, ensuring high-quality signals over larger coverage areas is proving a real challenge. This is something that can be overcome by improving system sensitivity in wireless applications.

Infineon's broad portfolio of solutions includes dedicated Low-Noise Amplifiers (LNA) and various switch solutions for specific wireless applications. Our LNA solutions and switches enable you to create designs with the lowest NF/IL, low current consumption, high linearity and fast switching times – all of which result in the highest possible system sensitivity.

Our end-to-end portfolio also provides the ultimate in design flexibility, offering compact footprints and high levels of integration. Explore our range of wireless applications and find the right solution for your specifications.

### Customer benefits

- › Improved Time to First Fix (TTFF) for navigation applications – even under the most extreme environmental conditions (urban and mountain environments)
- › Better mobile TV reception – even in subways
- › Fast WiFi connectivity in 2.4 GHz and 5 GHz frequency bands



### GNSS LNA

| Product family | Size [mm] | Gain [dB] | Current [mA] | NF [dB] |
|----------------|-----------|-----------|--------------|---------|
| BGA824N6       | 1.1 x 0.7 | 17.1      | 3.9          | < 0.55  |
| BGA524N6       | 1.1 x 0.7 | 20.0      | 2.5          | < 0.55  |

### Mobile TV LNA

| Product family | Size [mm] | Ctrl | Gain modes [dB]   | Supply voltage [V] | Frequency [MHz] |
|----------------|-----------|------|-------------------|--------------------|-----------------|
| BGA729N6       | 1.1 x 0.7 | GPIO | 16.3 / -4.0 / -20 | 1.5 to 3.3         | 70–1000         |





# LTE-U/LAA

Taking data rates to the next level with 5–6 GHz unlicensed band

## Motivation

Bandwidth is the most scarce resource in mobile communication. It's hard to get and the costs associated with a successful bid run into billions. Going for the unlicensed 5–6 GHz is a natural choice:

1. It's free.
2. It offers a very broad bandwidth.



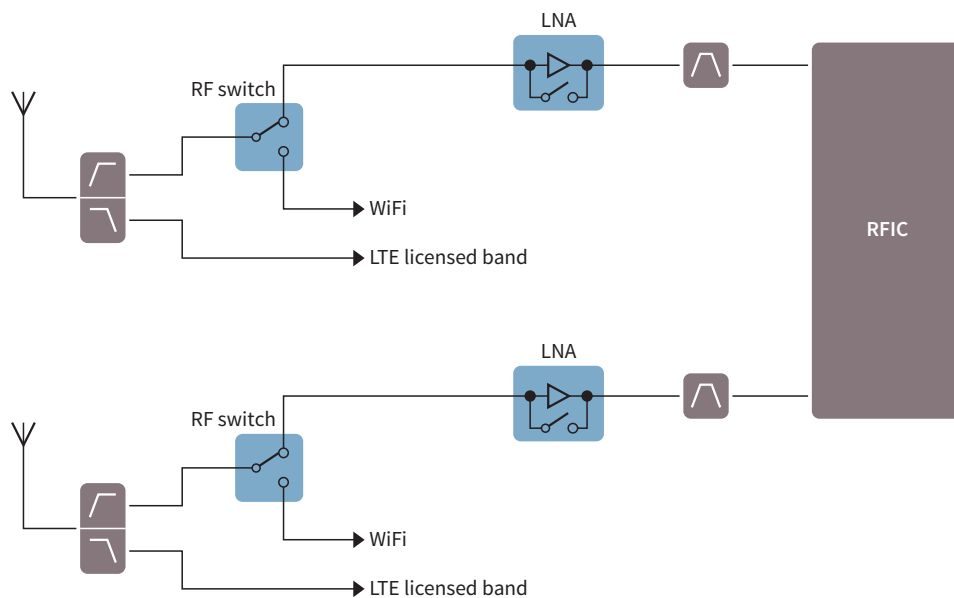
## Challenge

Operating at a higher frequency presents RF design with a new challenge: the insertion loss associated with PCB trace, and the fact that the noise levels of the RFIC's internal LNA increase significantly (7 dB vs. 4 dB at high band). As a result, a lower SNR leads to a reduced data rate, which compromises the desired effect of LTE-U.

## Solution

Adding an LNA to the circuit and placing it as close to the antenna as possible can help improve the SNR by 3 dB and help double the data rate.

In some customers' applications a low insertion loss switch is also required.



Infiniteon switches for application at up to 6 GHz

| Product name | Type | Size [mm] | Frequency (max.) [GHz] | Power (max.) [dBm] |
|--------------|------|-----------|------------------------|--------------------|
| BGS12SN6     | SPDT | 0.7 x 1.1 | 6                      | 30                 |
| BGS13GA14    | SP3T | 2.0 x 2.0 | 6                      | 28                 |
| BGS14GA14    | SP4T | 2.0 x 2.0 | 6                      | 28                 |







# Support material

More detailed information on RF devices



[www.infineon.com/mobile](http://www.infineon.com/mobile)



[www.infineon.com/mobiledevices](http://www.infineon.com/mobiledevices)

Datasheets/Application notes/Technical documents



[www.infineon.com/rf](http://www.infineon.com/rf)

Component libraries for RF devices

Infineon Technologies provides Component Libraries for part of its product portfolio. This ensures convenient customer access to the latest model versions and a seamless integration into our customer's circuit and system simulators.



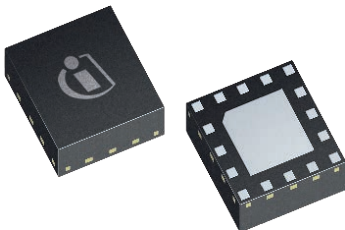
[www.infineon.com/rfcomponentlibraries](http://www.infineon.com/rfcomponentlibraries)


Evaluation boards



[www.infineon.com/rfevalboards](http://www.infineon.com/rfevalboards)

# Package information

| ATSLP-12-1,-4, -5   |                   | ATSLP-14  |                    | ATSLP-18-2,-3,-4  |                   |
|---|-------------------|---|--------------------|---|-------------------|
| 12  | 1.9 x 1.1 x 0.6   | 14  | 2.0 x 2.0 x 0.6    | 18  | 2.0 x 2.4 x 0.6   |
|    |                   |    |                    |    |                   |
| 7:1   |                   | 7:1   |                    | 7:1   |                   |
| TSLP-6-4  |                   | TSLP-10-1   |                    | TSNP-6-2  |                   |
| 6   | 1.1 x 0.7 x 0.31  | 10  | 1.55 x 1.15 x 0.39 | 6   | 1.1 x 0.7 x 0.375 |
|   |                   |   |                    |   |                   |
| 7:1   |                   | 7:1   |                    | 7:1   |                   |
| TSNP-9-3  |                   | TSNP-10-1   |                    | TSNP-14-3   |                   |
| 9   | 1.1 x 1.1 x 0.375 | 10  | 1.5 x 1.1 x 0.375  | 14  | 2.0 x 2.0 x 0.77  |
|  |                   |  |                    |  |                   |
| 7:1   |                   | 7:1   |                    | 7:1   |                   |
| TSNP-16-6   |                   | TSNP-20-1   |                    | Package (JEITA-code)  |                   |
| 16  | 2.3 x 2.3 x 0.73  | 20  | 2.3 x 2.3 x 0.73   | X   | L x W x H         |
|  |                   |  |                    |  |                   |
| 7:1   |                   | 7:1   |                    | All dimensions in mm  |                   |

 **RoHS** All products are available in green (RoHS compliant).

Footprints are recommendations only.

For detailed information please refer to our datasheets or [www.infineon.com/packages](http://www.infineon.com/packages).





# Where to buy

Infineon distribution partners and sales offices:

[www.infineon.com/WhereToBuy](http://www.infineon.com/WhereToBuy)

## Service hotline

Infineon offers its toll-free 0800/4001 service hotline as one central number, available 24/7 in English, Mandarin and German.

- › Germany ..... 0800 951 951 951 (German/English)
- › China, mainland ..... 4001 200 951 (Mandarin/English)
- › India ..... 000 800 4402 951 (English)
- › USA ..... 1-866 951 9519 (English/German)
- › Other countries ..... 00\* 800 951 951 951 (English/German)
- › Direct access ..... +49 89 234-0 (interconnection fee, German/English)

\* Please note: Some countries may require you to dial a code other than "00" to access this international number.  
Please visit [www.infineon.com/service](http://www.infineon.com/service) for your country!



Mobile product catalog

Mobile app for iOS and Android.

[www.infineon.com](http://www.infineon.com)

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### Additional information

For further information on technologies, our products, the application of our products, delivery terms and conditions and/or prices, please contact your nearest Infineon Technologies office ([www.infineon.com](http://www.infineon.com)).

### Warnings

Due to technical requirements, our products may contain dangerous substances. For information on the types in question, please contact your nearest Infineon Technologies office.

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# Mouser Electronics

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[BGSA14RN10E6327XTSA1](#) [BGSA20GN10E6327XTSA1](#)