

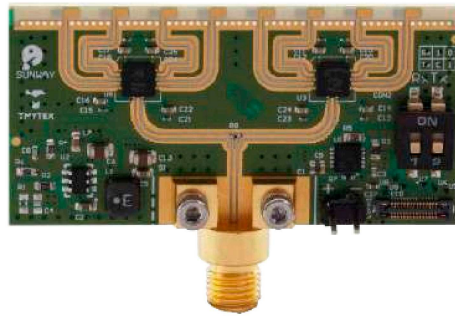
## Antenna-in-Package (AiP)

### Overview

The 5G era is coming soon. Massive deployment is expected in 2021 worldwide. It is time to start testing hybrid beamforming on small cells in various situations and conditions. We will need a phased array AiPs to do this. This is where TMYTEK come into the picture. We have been helping our customers designing and manufacturing AiP for 5G communication applications for the past years. We currently offer two types of AiP– one is standard AiP and the other is scalable AiP.

Our standard AiP module includes 1x8 array and 4x4 array both operating at the n261 NR frequency band. The other FR2 bands will be available soon. Our scalable AiPs are designed with flexibility in mind. Its size is scalable ranging from 8x8 array up to 4K array. This design is used to fit customers' various needs for different setup scenarios and applications.

To meet the 5G market, we have developed the technology to build up/down converter into the AiP. This makes our module IF ready and it also saves the cost of high-frequency connectors and cables. Our AiP is made ready to help users to prepare, design, test and deploy beamforming solutions for small cells and 5G research. More details are outlined below.



### Highlights

#### Scalability & Large Array

To form a large phased array is a very challenging task. This highly integrated packaging would ramp up issues like heat management, yield rate, hard-to-repair, mechanical alignment and so on. The reasonable approach is to divide-and-conquer. A unit module with 8x8 patches makes more sense to 5G small cell and CPE in terms of EIRP. By arranging multiple unit cells in one large motherboard, we can form a larger array. In some application, 4K even 8K array is possible. This all can be addressed by our technology.

#### IF Ready

In modern communication, converting RF to IF is essential for signal processing purpose. The highest benefit of using IF is to reduce the cost of the connectors on the AiP modules. This is very critical for massive deployment. TMYTEK designs our own mixer and local oscillator (LO) and makes the up/down conversion as a built-in feature.

#### Customizable

TMYTEK is familiar with almost all beamforming chips on the market. Customizing the AiP with specific array size, optimized for different frequency band, or single or dual polarization, are all possible.



## UE vs. gNB (Base station)

UE (User Equipment) typically uses a small size array. Our standard 1x8 AiP was built to emulate a mobile device like a tablet. Smartphone chip makers mostly adopt 1x4 or 2x4 array size to reduce the footprint of the module. On the other hand, gNB, the 5G base station, would need a larger array to meet the EIRP requirement. Array such as 8x8, 64x64, or even bigger is possible. TMYTEK is ready to build all kinds of AiP to fulfill the market.

## Specification

### Fixed Size AiP

Part Number	NR Frequency Band	RF (GHz)	Tx EIRP (dBm)	Tx Total Gain (dBi)	Rx Total Gain (dBi)	Phase Shifter Range (°)	Attenuator Range (dB)	Package (mm)
AIP-JF-28-4x4	n261	27.5 - 28.35	41	49	35	360	15	40 x 27 x 3
AIP-JF-28-1x8	n261	27.5 - 28.35	21.5	40	24	360	15	50 x 20 x 3

### Unit Module AiP

Part Number	NR Frequency Band	RF (GHz)	IF (GHz)	Tx EIRP (dBm)	Tx Total Gain (dBi)	Phase Shifter Range (°)	Attenuator Range (dB)	Package (mm)
MAIP-JF-28-8x8	n261	27.5 - 28.35	0.01 - 6	53	53	360	15	61 x 40 x 1

## Customization Requirement

If you require any customized AiP, please contact us for more details. We also offer 39 GHz and sub-6 GHz solutions.