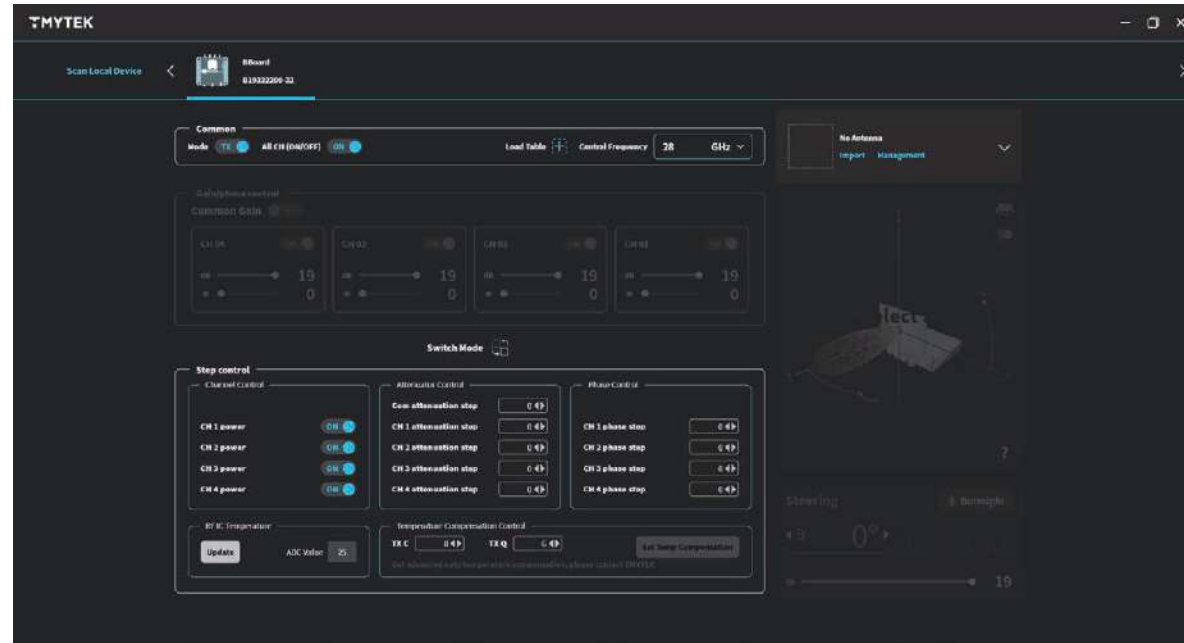## Hardware Package and TMXLAB Kit (TLK)

TMYTEK's intuitive GUI, TMXLAB Kit (TLK), connects to the BBoard via the LAN port to control the phase and amplitude of each RF port to form the beams. An API is included and it is compatible with LabVIEW, MATLAB, Python, C#, C++, and other programming languages.

TMXLAB Kit (TLK)

COCO Antenna
27-29 GHz. 7 dBi gain.

Amplifier
20-40 GHz. 15 dB gain.

Array Antenna
n257. 15 dBi gain.

BBoard
n257 beamformer.

RF Cables
Up to 40 GHz.

Power Detector
0.1-40 GHz.
35 dB Dynamic Range.

Signal Source PLO
26.5-29.5 GHz. 8 steps.

Power Combiner/Splitter
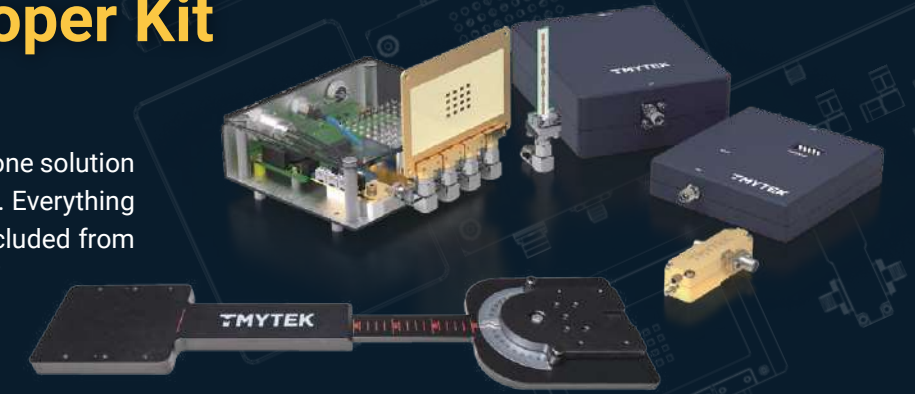10-40 GHz. 1.2 dB loss.

Learn More ▾   Visit TMYTEK ▾

5G mmWave Developer Kit
For Academic and R&D

TMYTEK 5G mmWave Developer Kit is an all-in-one solution package that integrates hardware and software. Everything you need to start the mmWave innovation is included from 5G FR2 beamformer to 40 GHz RF cables.

Unleash your creativity for future wireless technology.

The labsheet leads Professors an easy life in courseware preparation, and the engineering students will learn the fundamentals of beamforming and mmWave propagation. The well designed hardware and software enables R&D's prototype in antenna design and protocol development.
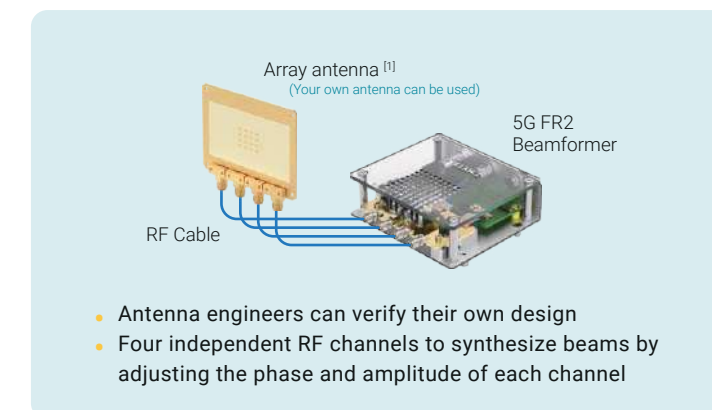
Recommended for

- Engineering professors
- Engineering students
- RF engineers
- Antenna designers
- Protocol developers
- Algorithm developers

| Your Benefits	Features
Millimeter-wave all-in-one	Beamformer, array antenna, signal source, power detector, power combiner/splitter, RF cables, amplifier, and more
Ready-to-use Beamformer	A 5G FR2 beamformer with 1x4 RF ports, array antenna and COCO antenna
Save Time	A lab sheet to save Professor's time in courseware preparation
Affordable	More than eight pieces of high frequency components with affordable price
Flexible	2.92 mm connectors and 40 GHz RF cables make the connection between components

Antenna Verification

Array antenna [1]
(Your own antenna can be used)
5G FR2 Beamformer
RF Cable

- Antenna engineers can verify their own design
- Four independent RF channels to synthesize beams by adjusting the phase and amplitude of each channel

Communication System Prototyping

SDR
UD Box [2]
5G FR2 Beamformer

- Compatible with most SDRs: NI USRP
- Beam tracking algorithm development
- Beam management implementation

[1] Array antenna: antenna designers' own antenna can be attached with 5G FR2 beamformer.
[2] Optional ultra broadband frequency converter, contact sales@tmytek.com
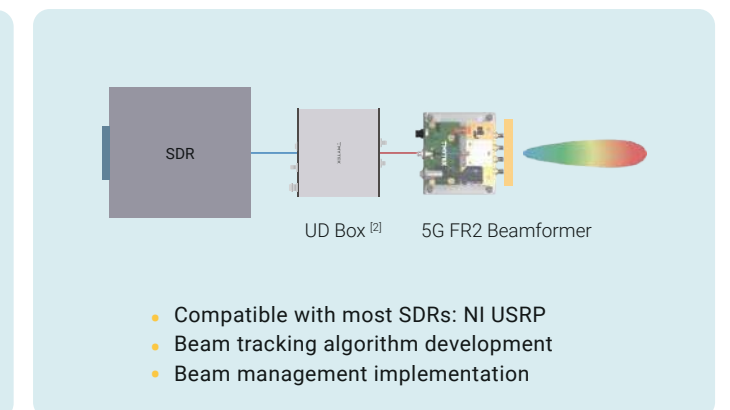
Courseware

The TMYTEK 5G mmWave Developer Kit includes signal source, array antenna, beamformer, amplifier, power detector, and RF cables to allow engineering students to set up a 5G communication system and observe beamforming results on instruments, conduct creative and innovative research on antenna design or protocol validation.

TMYTEK created a versatile 5G mmWave courseware and Labsheet to teach the principles behind beamforming and experiments to understand the propagation property of mmWave signals. The courseware introduces the sessions and offers the following benefits to students:

- Familiarize with millimeter-wave RF front-end
- Understand the link budget
- Understand constructive and destructive interference
- Verify the theory about phased array
- Hands-on experiment beamforming and beam control
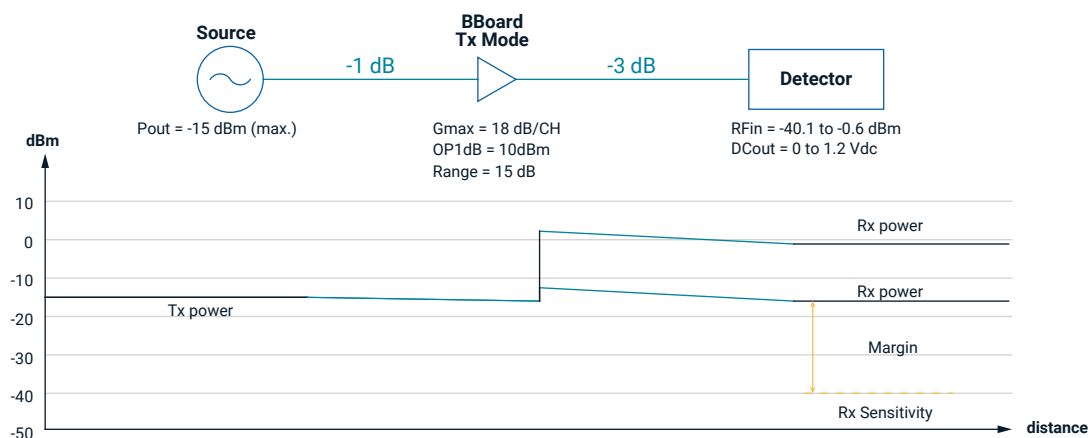- Beam pattern measurement
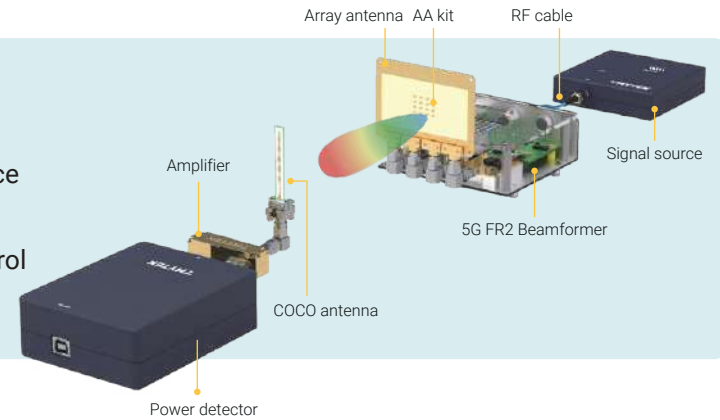
Lab Sheets

To educate next generation RF engineers, the Developer Kit provides not only a comprehensive mmWave hardware, but also a set of labsheets. Save professors' time in courseware preparation.

Lab 1. What is the link budget?	Lab 5. How is the beam steered?
Lab 2. What is channel gain?	Lab 6. How is the beam pattern measured?
Lab 3. What is constructive/destructive interference in conduction?	Lab 7. How to measure the channel gain at the receiver?
Lab 4. What is constructive/destructive interference in radiation?	Lab 8. How to implement the in-phase at the receiver?

Lab Highlight
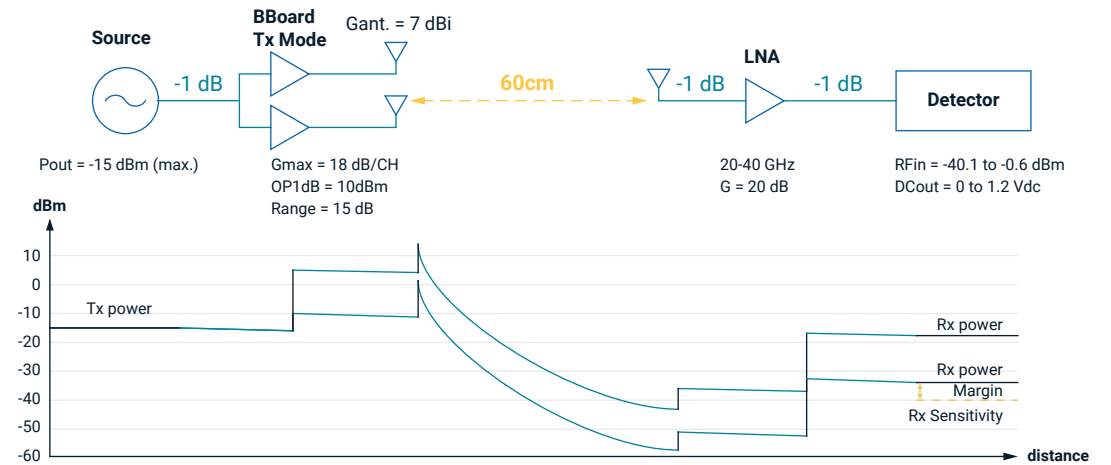
▮ Link budget and gain control

Understand the link budget in a mmWave system and control the gain of each channel on BBoard

### ▮ Constructive and destructive interferences

Learn the principles of beamforming: constructive vs destructive interferences
Radiative: Taking into account the path loss in the air

▮ Beam steering and beam pattern measure

Learn to steer the beam to the expected angle and experience from the operation, and to steer quickly at different angles to cover a designated area. In addition, simulate and measure the mmWave antenna in CATR, then replace the CATR with a Developer Kit fixture that includes a ruler and a protractor to sketch the beam pattern using Microsoft Excel or similar software.
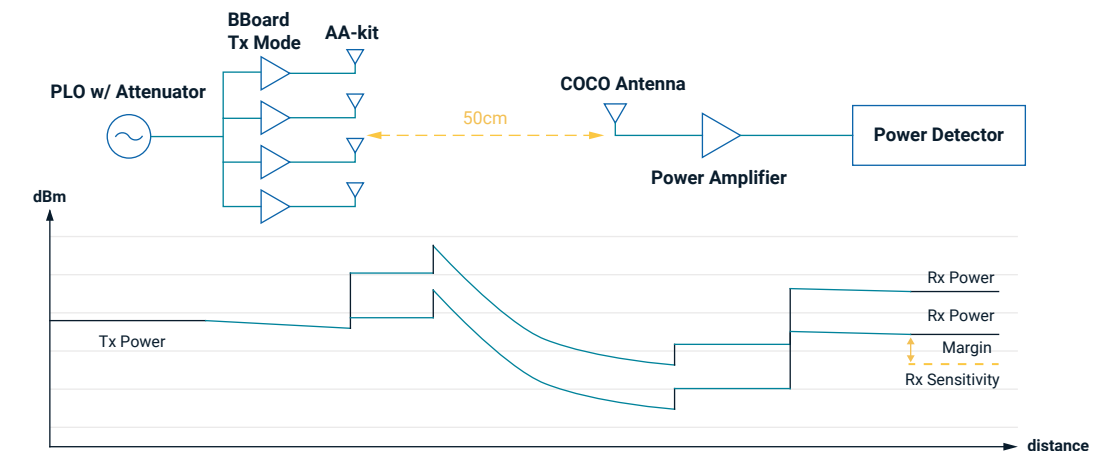
▮ 5G mmWave Developer Kit Fixture

The fixture can be used to conduct an over-the-air experiment, allowing the TX and RX to be positioned at precise distances and angles.

(Source: Analog Devices 2020. Phased Array Antenna Patterns— Part 1: Linear Array Beam Characteristics and Array Factor)