TMYTEK

User Manual

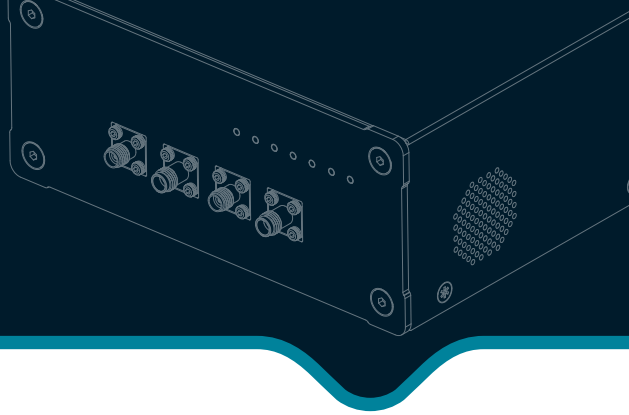
UD Box 5G Series

UDB-D-G

UDB-S-G

TMY Technology Inc.

TMYTEK.com



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Legal Considerations

This device, UD Box 5G Series, is neither designed to generate and use locally RF energy for industrial or scientific purpose nor designed to be used by the general public in any residential environment. Every country has different laws governing the transmission and reception of radio signals. Users are solely responsible for using TMYTEK mmWave bundle systems in compliance with all applicable laws and regulations.

Before you attempt to transmit and/or receive on any frequency or operation environment, TMYTEK recommends that you determine what licenses may be required and what restrictions may apply. TMYTEK does not accept any responsibility for the user's use of our products. The user is solely responsible for complying with local laws and regulations.

TMYTEK

Important Safety Information

- This manual is intended for the following personnel :
  - Engineers responsible for installation, wiring, and maintenance of the equipment
  - Personnel responsible for normal daily operation of the equipment.
- In order to protect the system controlled by the product and the product itself and ensure safe operation, observe the safety precautions described in this user's manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- If this instrument is used in a manner not specified in this user's manual, the protection provided by this instrument may be impaired.
- If any protection or safety circuit is required for the system controlled by the product or for the product itself, prepare it separately.
- Modification of the product is strictly prohibited.

Symbol Glossary

	"ON"/"OFF" (push button)
	Warning & Caution
	Notice
	Warning, possibility of electric shock
	“In” position of a bi-stable push control
	“Out” position of a bi-stable push control

Maintenance and Service Information

- All services must be carried out by authorized TMYTEK designated centers. See product return and service address below.
- Any defective or malfunctioned parts must be returned to a designed TMYTEK service center for repair or replacement.
- If the product is returned for repair, please put the device back into the crash box provided by the original factory, and then pack the crash box and send it back.

Product Return and Service Address:

- **Address :**
  Rm. E, 3F., No. 3, Yuandong Rd., Banqiao Dist., New Taipei City 220, Taiwan (R.O.C.)
- **Phone:**
  +886-2-8226-9168
- **A copy of this User Manual can be accessed and downloaded from:**
  tmytek.com

Product Warnings, Cautions, and Notices

Warnings

- This unit is not an explosion-proof type. Do not use it in a place with explosive gasses to prevent explosion, fire or other serious accidents. The recommended environment shall be indoor and avoid water.
- **Risk of injury due to disregarding safety information**
  Observe the information on appropriate operating conditions provided in the data sheet to prevent personal injury or damage to the instrument. Read and observe the basic safety instructions provided with the instrument, in addition to the safety instructions in the following sections. In particular: **Do not open the instrument casing.**
- **Risk of electric shock**

  If moisture enters the casing, for example if you clean the instrument using a moist cloth, contact with the instrument can lead to electric shock.

  Before cleaning the instrument other than with a dry cloth, make sure that the instrument is switched off and disconnected from all power supplies.

Cautions

- Ensure the UD Box 5G Series product is securely placed on a stable horizontal surface. Be sure to wind up redundant wires and into neat loops that are secured and fixed so as not to pose a tripping hazard or risk for dislodging connection.
- Wiring work must be performed with the main power set to OFF to prevent electric shocks.
- Wires should be the proper one meeting the ratings of this instrument. If using a wire which cannot endure the ratings, a fire may occur.
- Be sure to use a power supply of the correct rating. Connection of power supply of incorrect rating may cause fire.
- Replacement parts such as a maintenance part should be disposed of as incombustibles. For details, follow the local ordinance.

Notices

- **Risk of instrument (UD Box 5G Series) damage due to inappropriate operating conditions**
  An unsuitable operating site or test setup can damage the instrument itself and connected devices. Before switching on the instrument, observe the information on appropriate operating conditions provided in the data sheet. In particular, ensure the following:
  - All fan openings are unobstructed and the airflow perforations are unimpeded. A minimum distance of 10 cm to other objects is recommended.
  - The instrument is dry and shows no sign of condensation.
  - The ambient temperature does not exceed the range specified in the data sheet.
  - Signal level from all connectors does not exceed the spec value.

- **Instrument damage caused by electrostatic discharge**
  Electrostatic discharge (ESD) can damage the electronic components of the instrument and the device under test (DUT). Electrostatic discharge is most likely to occur when you connect or disconnect the instrument to other parts of the fixture or the equipments' port. To pre-vent electrostatic discharge, use a wrist strap and cord and connect yourself to the ground, or use a conductive floor mat and heel strap combination.

- **Risk of instrument damage due to insufficient airflow in a rack**
  If you mount several instruments in a rack, you need an efficient ventilation concept to ensure that the instruments do not overheat. Insufficient airflow for a longer period can disturb the operation and even cause damage.

- **Maximum input levels**
  The maximum input levels at all ports according to the front panel labeling or the data sheet must not be exceeded.

- **High Signal Power**

  When dealing with external signal amplification, make sure that:

  - the signals fed to the instructment are within the allowed range
  - during calibration the calibration standards meet the requirements in terms of their power handling capacity

  Attenuator pads can be used to adapt the power levels.

- **Risk of instrument damage due to obstructed fans**

  If the instrument is operated in dusty areas, the fans become obstructed by dust or other particles over time. Check and clean the fans regularly to ensure that they always operate properly. If the instrument is run with obstructed fans for a longer period, the instrument overheats, which can disturb the operation and even cause damage.

- **Instrument damage caused by cleaning agents**

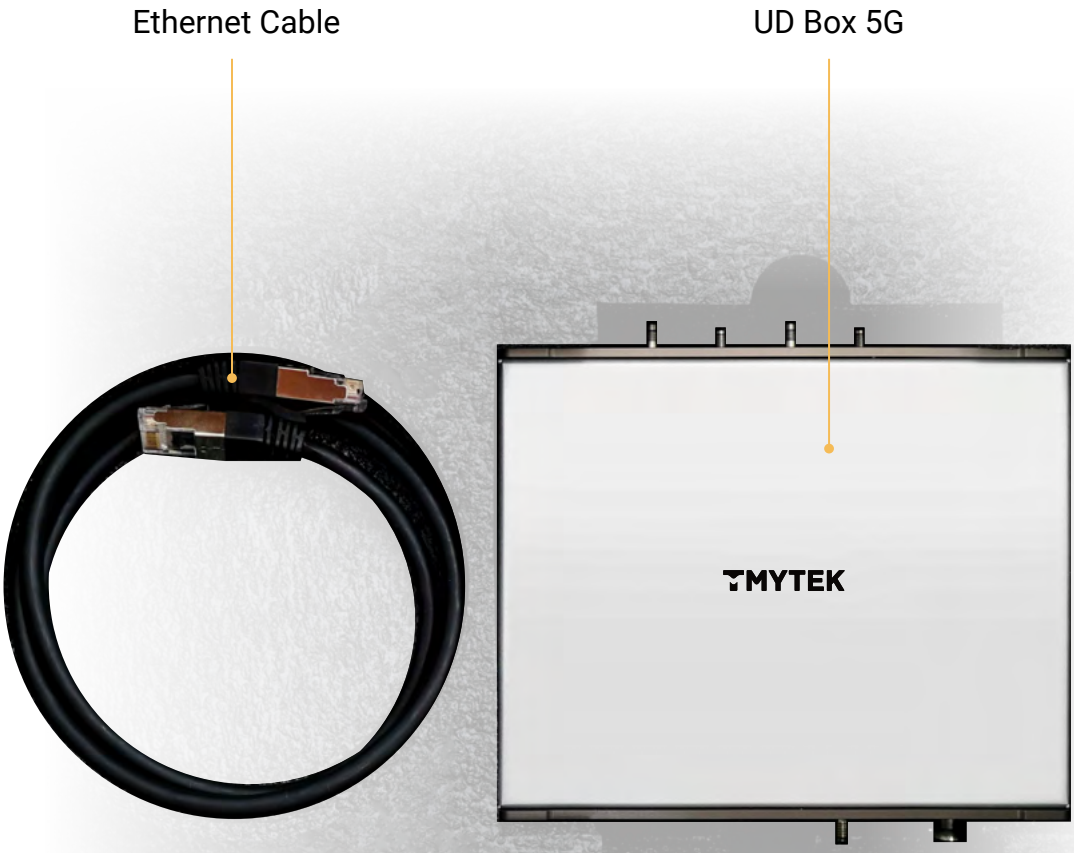
  Cleaning agents contain substances such as solvents (thinners, acetone, etc.), acids, bases, or other substances. Solvents can damage the front panel labeling, plastic parts, or screens, for example.

  Never use cleaning agents to clean the outside of the instrument. Use a soft, dry, lint-free dust cloth instead.

Check the Products Upon Delivery

It is recommended that the customer perform the following confirmation items after receiving the product delivered.

- Confirm that the contents of the product are complete
- Confirm the product serial number is correct
- Confirm whether the appearance is normal without damage
- Confirm that the instrument is operational and functional



After-Sales Warranty

Warranty Time

With one year of repair coverage, TMYTEK restores the functionality of your device and performs firmware updates in adherence to TMYTEK specifications.

How to Contact Warranty Service

Users can contact TMYTEK's global distributors or directly contact TMYTEK sales window for maintenance service procedures.

How to send it back for repair

The warranty window will directly assign a shipping company to the client for delivery services, and the user only needs to pre-pack the repair items.

Warranty Policy

1. TMYTEK warrants against defects in materials and workmanship for a period of one year from the date the hardware product is shipped to the customer. This warranty is void if the product's failure has resulted from accident, abuse, misapplication, modification, improper calibration by the customer, use of improper hardware or software, or unauthorized maintenance or repair. Hazards such as lightning, flood, exceeding voltage specifications, or customer abuse are not covered under warranty.

2. The customer may return a hardware product for repair that is not covered by a repair program. A standard repair fee, specific to the product, is charged for any product that is repaired outside of the covered period.

3. All repairs carry a 90-day warranty, which begins the day the repaired item is shipped back to the customer. The product will continue to be covered by any existing repair program or by the 90-day repair warranty, whichever is longer.

4. TMYTEK contacts the customer for hardware covered under a repair program that cannot be repaired and offers an equivalent replacement product, if available. For hardware that is not covered under a repair program, TMYTEK offers customers the following options:
   - The customer may upgrade to a newer, functionally equivalent product at the normal list price.
   - TMYTEK can return the product to the customer. There is a nominal testing and handling fee for this option.
   - The customer can request that TMYTEK appropriately dispose of the product at no charge.

UD Box 5G Series Introduction and Overview

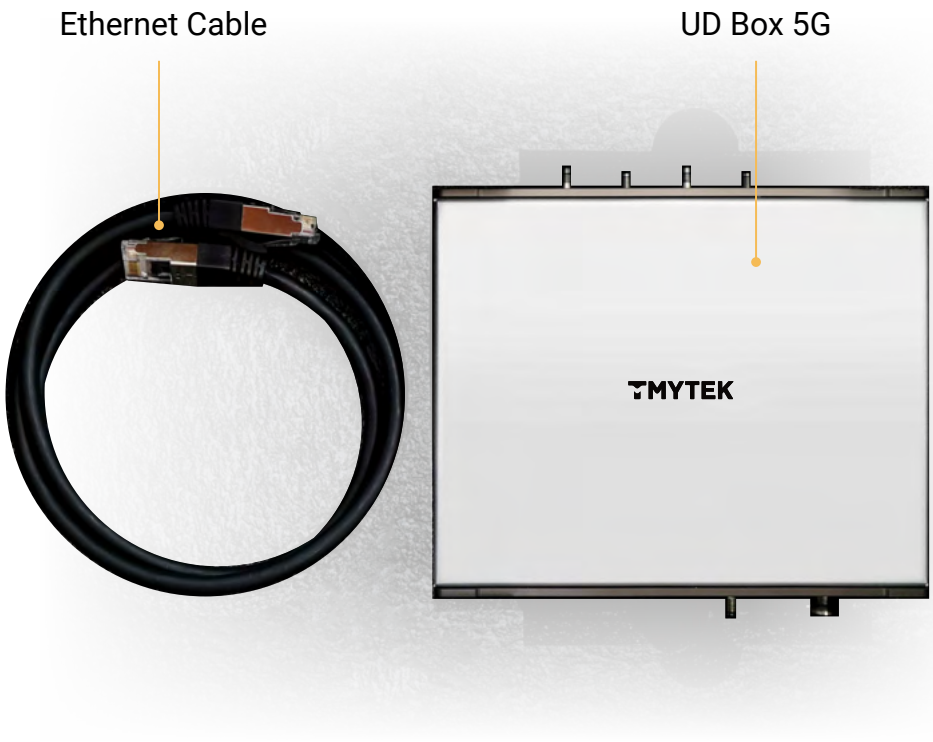
Overview

The UD Box 5G Series could be generally used in mmWave radar research and development, frequency extension with fundamental RF instrument/equipment (i.e., wireless tester, signal generator, signal analyzer, network analyzer, etc), and communication system development. The UD Box 5G Series offers signal and dual channels, with each channel including IF and RF ports. Furthermore, each channel plays both roles of up and down conversions because of the bi-directional characteristic of UD Box 5G Series.

UD Box 5G Series provides a 10 MHz and a 100 MHz reference clock output to synchronized other devices; these clock sources are generated by a precise OCXO clock. On the other hand, UD Box 5G Series can be synchronized by the 100 MHz clock as well.

The RF operating frequency of UD Box 5G Series is 24 GHz to 44 GHz and IF operating frequency is 10 MHz to 14 GHz. The phase-locked oscillator (PLO) is embedded inside, and frequency control range of PLO is 24 GHz to 44 GHz. The hardware control interface of UD Box 5G is Ethernet, UD Box 5G Series could be controlled by TMXLAB Kit and API.

Name and description of main units:



UD Box 5G Series comprises the following components:

Component Name	Speciation/ Description
UD Box 5G Dual Front panel  Back panel  UD Box 5G Single Front panel  Back panel 	**Front panel:** 1. Two RF ports (single will be one) 2. Two IF ports (single will be one) 3. LED indicators for different status. **Rear panel:** 1. LAN port for control. 2. Power button for power on/off. 3. DC IN port for DC power supply. 4. 100 MHz In/Out port for 100 MHz reference synchronization. 5. 10 MHz Out for 10 MHz reference synchronization. 6. +5V/+9V for 5-V and 9-V DC output.
Ethernet Cable 	The Ethernet cable could be connected between the device and control host.

Power adapter

Component Name	Speciation/ Description
Product ID	APD065T-A20
USB Type-C P.D. 65 Watt 	The adapter for power supply of UD Box 5G Series. • 100-240 VAC Universal Input • USB Type-C P.D. 65 Watt

UD Box 5G Series LED indicators and regarding status:

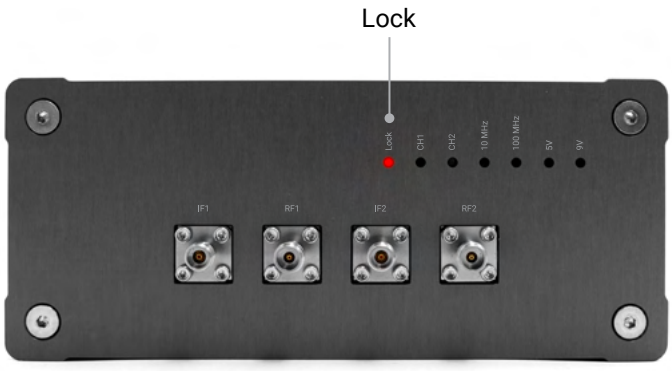
UD Box 5G Dual:

LED indicators

Lock	CH1	CH2	10 MHz	100 MHz	5V	9V
Lock/Unlock	ON/OFF	ON/OFF	ON/OFF	OFF/IN/OUT	ON/OFF	ON/OFF

Lock:

UD Box 5G device boots up successfully when the Lock indicator turn red. Please re-press the power button to reboot the device again if the indicator doesn't turn red, shown as below.



CH1 & CH2 :

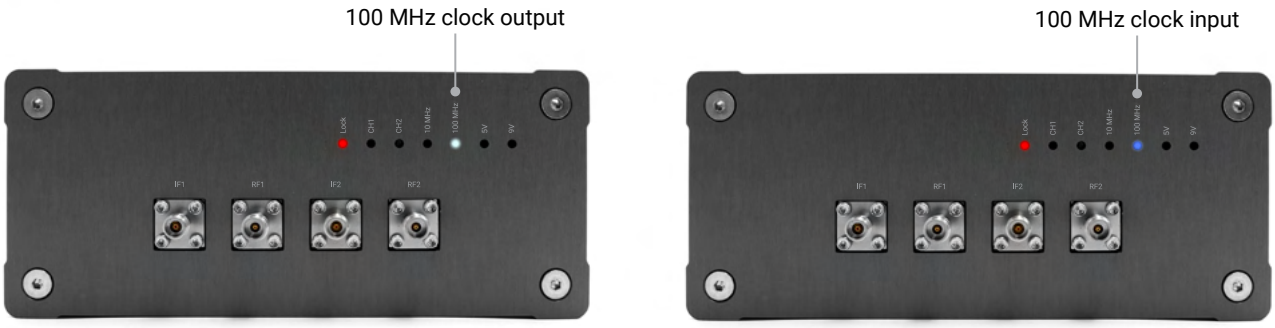
Two Channels is controlled by a custom control software TMXLAB Kit GUI. When CH1/CH2 is on, the indicator turns white, otherwise, the indicator is off, shown as below.

10 MHz (Out) :

When the white light is on, UD Box 5G transmit a 10 MHz reference source which is available for synchronizing with clock source of other device, shown as below.

100 MHz (In/Out) :

UD Box 5G can transmit or receive 100 MHz clock. The output signal of 100 MHz that comes out of UD Box 5G is available to be synchronized with other devices. The 100MHz indicator lights up in white when device transmit 100MHz reference source. Reversely, when device receive an input signal of 100MHz, 100MHz indicator lights in blue, shown as below.



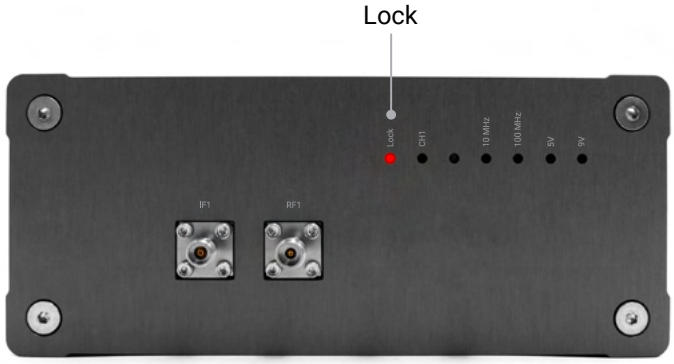
UD Box 5G Single:

LED indicators

Lock	CH1		10 MHz	100 MHz	5V	9V
Lock/Unlock	ON/OFF	N/A	ON/OFF	OFF/IN/OUT	ON/OFF	ON/OFF

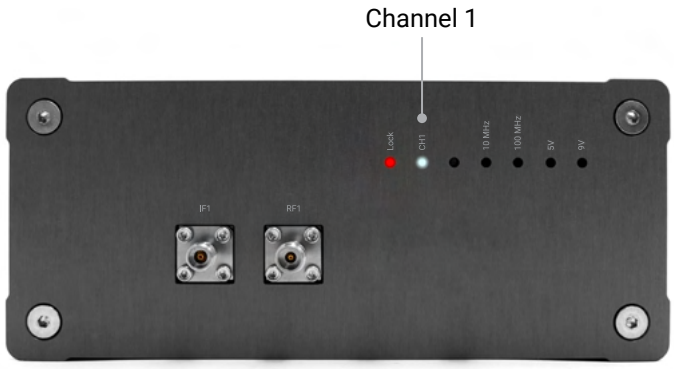
Lock:

UD Box 5G device boots up successfully when the Lock indicator turn red. Please re-press the power button to reboot the device again if the indicator doesn't turn red, shown as below.



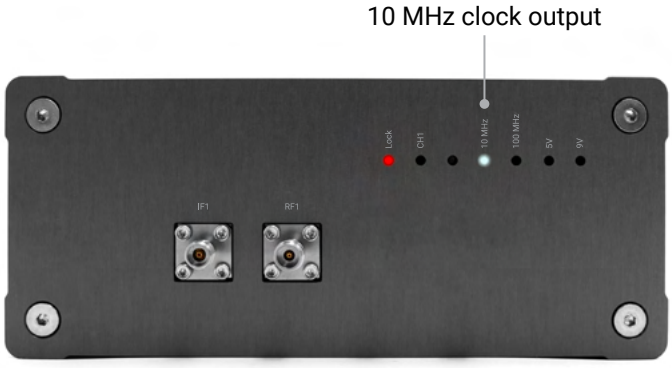
CH1:

The channel is controlled by a custom control software TMXLAB Kit GUI. When the CH1 is on, the indicator turns white, otherwise, the indicator is off, shown as below.



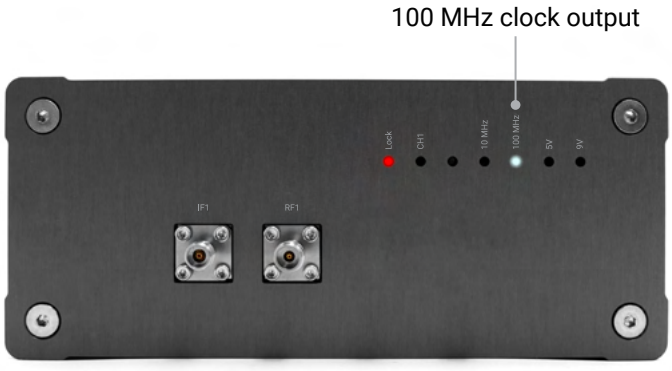
10 MHz (Out) :

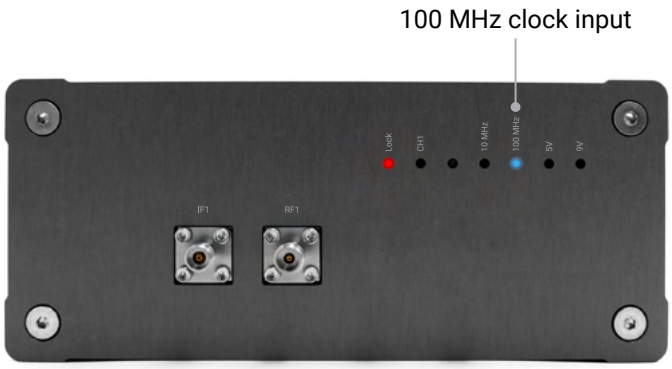
When the white light is on, UD Box 5G transmit a 10 MHz reference source which is available for synchronizing with clock source of other device, shown as below.



100 MHz (In/Out) :

UD Box 5G can transmit or receive 100 MHz clock. The output signal of 100 MHz that comes out of UD Box 5G is available to be synchronized with other devices. The 100MHz indicator lights up in white when device transmit 100MHz reference source. Reversely, when device receive an input signal of 100MHz, 100MHz indicator lights in blue, shown as below.





Setup UD Box 5G Series Platform

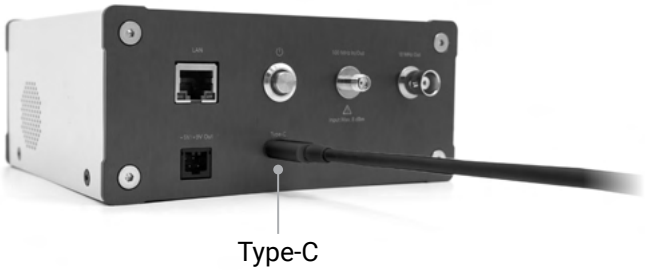
How to connect UD Box 5G Series

Step 1

Connect the power adapter and power cable.

Step 2

Connect the cable to DC in.

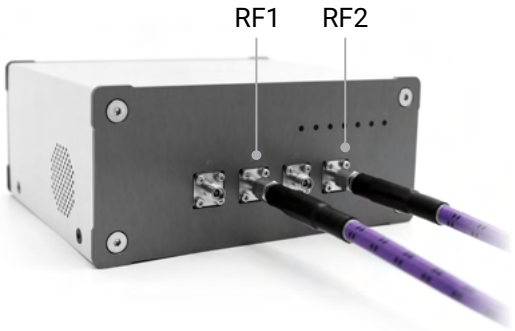


Step 3

Connect the power cable to the wall plug.

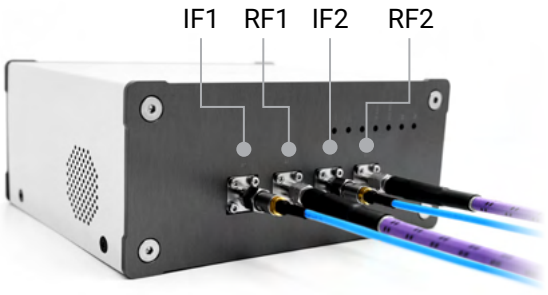
Step 4

Connect the RF port(s) with another device (i.e., DUT or equipment or terminator) via standard RF 2.4 mm coaxial cable/adapter.



Step 5

Connect the IF port(s) with another device (i.e., DUT or equipment or terminator) via standard 2.92 mm coaxial cable/adapter.

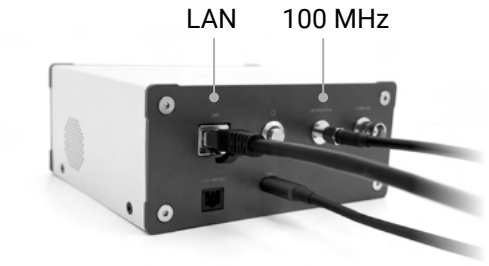


Step 6

Connect the LAN port to your controlling system or PC via Ethernet cable to control the UD Box 5G Series.

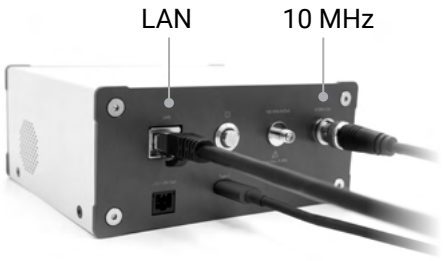
Step 7 (optional)

Connect 100 MHz in/out port to another UD Box 100 MHz in/out port via SMA cable if you need to synchronize two UD Box 5G Series.



Step 8 (optional)

Connect the 10 MHz output port to another equipment's 10 MHz input port via BNC cable if you need to synchronize with other equipment.



Operating Instruction for UD Box 5G Series

Turn on the power of UD Box 5G Series by pressing the ON/OFF button on the rear panel. If the power is turned on, the power switch light will blue light on, and the LEDs of Lock, CH1, CH2 on the front panel will also light on.

Turn on the power of UD Box 5G with “In” position of a the ON/OFF button.

Turn off the power of UD Box 5G with “Out” position of ON/OFF button.

The power switch lights on when the power is turned on.

Please refer to Software User Guide for using TMXLAB Kit to control UD Box 5G Dual.

TMXLAB KIT Software Operating Instructions

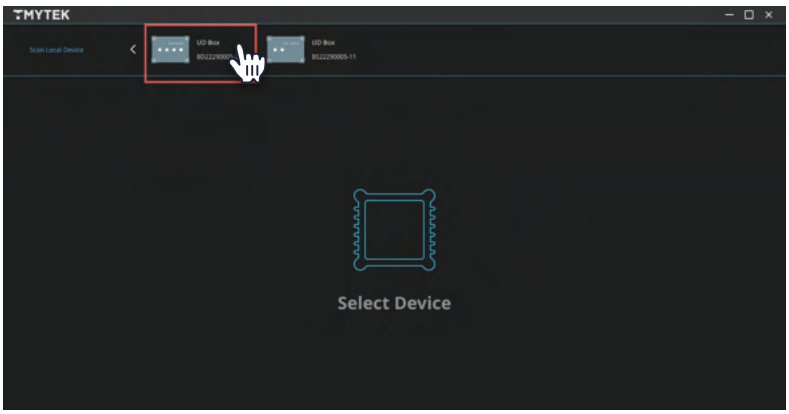
Step 1

Download the latest version of TMXLAB Kit GUI from TMYTEK official website and install.

https://tmytek.com/resources/downloads/tmxlab-kit

Step 2

Connect UD Box 5G Dual and PC with Ethernet, and turn on the power of UD Box 5G Dual. Then open TMXLAB Kit. After scanning is completed, click the device icon above (red block)



*If the device cannot be recognized normally, please confirm the network environment settings. domain must be set to 192.168.100.xxx. (If the IP address of the device and PC is assigned by DHCP, this step can be skipped.)

Device Controller via TMXLAB Kit Software

The "Device Controller" is designed to enter the expected frequencies of IF and RF ,and further control the built-in local oscillator frequency.

Step 1

"Current Value" displays the current relative frequency setting of connected device.

Step 2

Choose the desired value of bandwidth in the drop-down list,TMXLAB Kit will follow up by calculating the harmonic based on the selected value.

Step 3

- In the Frequency Setting, the LO frequency can be set.
- After inputting RF, click “Enter” or move the arrow below to the IF setting field.
- After inputting IF, click “Enter” or move the arrow below to the LO setting field.
- Selecting the LSI or HSI frequency for the LO.
- Click “Save” to configure the UD Box 5G.
- Click “Reset” to clear all input values and return to the RF setting field.

Step 4

If the input frequency falls within the band of harmonics, the current Value will show in yellow. The Harmonic indicator in the upper right corner will also show yellow to warn the user.

NOTE: UD Box will still apply this setting even if the yellow warning is shown.

Step 5

Users can click the toggle switch to switch each item on and off.

Step 6

You can choose either internal source or external source in the Ref Source section.

You can download a more detailed operation manual at the following website https://tmytek.com/resources/downloads/tmxlab-kit

Cleaning and Maintenance

This section describes how to clean the UD Box 5G Series.

- To protect yourself, be sure to unplug the power cable from the outlet before cleaning the UD Box 5G Series.
- Never clean the internal components of the UD Box 5G Series.
- For normal cleaning, rub the surface gently with a dry, soft cloth.
- Always keep the connectors free from stains and dust.

Frequently Asked Questions and Answers

Q1: Can UD Box 5G Series utilize an external reference clock?

UD Box 5G is already integrated with an internal reference clock (OCXO). It can be synchronized between UD Box 5G Series and baseband instrumentation. UD Box 5G provides 10/100 MHz reference clock output and 100 reference clock input function.

Q2: Can UD Box 5G dual Series operate in up/down conversion simultaneously?

Yes, the TMYTEK UD Box 5G Series is bi-directional and is not limited to any single direction.

Q3: What is the LO coverage?

24-44 GHz.

Q4: I cannot see any filter in the RF port for image rejection in the schematic. Is the image from the IF conversion rejected by the filter in the UD Box 5G Series?

UD Box 5G Series is a broadband device so the image rejection filter is not built-in. We can design specific filters to fulfill the band you are Interested in.

Q5: UD Box 5G Series doesn't have amplifiers, does TMYTEK provide a Power Amplifier as an accessory?

Yes, we have PA that covers 20 to 40 GHz and UD Box 5G Series has external power supply to feed and drive the PA.

Q6: Can the UD Box 5G Series be controlled with an API?

Yes, the UD Box 5G Series API is available on github. Users can connect and control the UD Box 5G Series via the Ethernet connection.
https://github.com/tmytek/ud-api

Q7: Does UD Box 5G Series's performance vary under the different temperatures?

The reference clock of the UD Box 5G Series will vary slightly at different temperatures, so we recommend that customers warm up for 30 minutes to allow the UD Box 5G Series to reach a temperature equilibrium state before using it.

Q8: How do you suppress the image when converting up to mmWave?

You can utilize a suitable BPF at the RF path on the UD Box 5G Series.

Specification

UD Box 5G Single and Dual Comparison

Model	UD Box 5G Single	UD Box 5G Dual
IF Channel	1 channel	2 channels
RF Channel	1 channel	2 channels
RF Frequency	24 - 44 GHz	
IF Frequency	0.01 - 14 GHz	
LO Frequency	24 - 44 GHz	
Conversion Loss	13 dB	
Tx Output P1dB	0 dBm	
Rx Input P1dB	10 dBm	
DC Power Consumption	20W	
DC Input	15V	

System RF Specifications

Parameter	Conditions	Unit	Min.	Typ.	Max.
RF Frequency	---	GHz	24	---	44
IF Frequency	---	GHz	0.01	---	14
LO Frequency	---	GHz	24	---	44
LO Frequency Resolution	---	MHz	---	0.01	---
Reference Clock Stability	-30 - +70 degree	ppb	-50	---	50
Conversion Loss	Full band	dB	---	13	---
IF to RF Isolation	With filter / No filter	dB	70*[1] / 12	---	---
RF to IF Isolation	With filter / No filter	dB	46*[1] / 18	---	---
Lo to RF Leakage	Full band	dBm	-22	---	---
Lo to IF Leakage	Full band	dBm	-22	---	---
Tx Output P1dB	RF = 28/39 GHz Tested at RF1 and RF2 port	dBm	0	---	---
Rx Input P1dB	RF = 28/39 GHz Tested at RF1 and RF2 port	dBm	10	---	---
Rx Noise Figure	28/39 GHz	dB	---	13.8	---
RF Return Loss	Full band	dB	6	10	---
IF Return Loss	Full band	dB	8	10	---
Warm Up Time	---	min.	---	30*[2]	---

*[1] With optional n257 filter

*[2] Suggested warm up time

Clock Output Characteristics

Parameter	Conditions	Unit	Min.	Typ.	Max.
100 MHz Output Power	---	dBm	-3	---	---
100 MHz Phase Noise	@1 kHz carrier offset	dBc/Hz	---	-120	---
	@10 kHz carrier offset	dBc/Hz	---	-125	---
	@100 kHz carrier offset	dBc/Hz	---	-130	---
	@1 MHz carrier offset	dBc/Hz	---	-135	---
10 MHz Output Power	---	dBm	-5	---	---
10 MHz Phase Noise	@1 kHz carrier offset	dBc/Hz	---	-120	---
	@10 kHz carrier offset	dBc/Hz	---	-125	---
	@100 kHz carrier offset	dBc/Hz	---	-128	---
	@1 MHz carrier offset	dBc/Hz	---	-130	---

DC Characteristics

Parameter	Conditions	Unit	Min.	Typ.	Max.
DC Power Consumption	---	W	---	20	24
DC Input	---	V	---	15	---
Accessories DC Power Supply	---	V	---	5/9	---
		mA	---	250/400	---

AC Specifications

Parameter	Conditions	Unit	Min.	Typ.	Max.
Adapter Input Voltage	---	Vac	100	---	240
Adapater Input Current Consumption	---	A	---	---	1.6

Software Specifications

Parameter	Conditions	Unit	Min.	Typ.	Max.
Switch time	---	ms	---	100	---
PC OS	Windows 7/8/10				
API Support Language	C#, C/C++, Python, LabVIEW, MATLAB				
Control Interface	Ethernet				

Connector Information

Parameter	Conditions	Location	Type and Function
RF	Single Channel	Front Panel	Single 2.4 mm connector
	Dual Channel	Front Panel	Dual 2.4 mm connectors
IF	Single Channel	Front Panel	Single 2.92 mm connector
	Dual Channel	Front Panel	Dual 2.92 mm connectors
Power DC IN		Rear Panel	Input DC power
LAN		Rear Panel	Ethernet Port LO frequency control
ON/OFF Button		Rear Panel	Power ON/OFF switch
Reference Clock Port	10 MHz	Rear Panel	BNC connector
	100 MHz	Rear Panel	SMA connector
DC Power Output Port		Rear Panel	Output 5V and 9V DC power

Package Details

TMYTEK's connectorized packaging:

Parameter	Condition	Unit	Main body	Connector included
Dimension	Length	mm	120.6	142.8
	Width	mm	152	152
	Height	mm	65	65
Weight	unit	g	---	900
Material	Aluminum	---	---	---

Troubleshooting

UD Box 5G can not power on

Symptom:

Pressing the power button of the UD Box 5G does not respond and does not light up.

Solution:

Complete the following steps.

- Verify that the device is connected to the power supply.
- Verify that the power supply is functional.
- Verify that the power button is engaged.

UD Box 5G can not operate normally

Symptom:

When the LOCK light of the UD BOX 5G does not light up and does not work normally.

Solution:

Please try off and on UD Box 5G again or unplug the power supply and power on again, until the Lock light is on and it works normally.

The external 100 MHz of UD Box 5G synchronization cannot work

Symptom:

When the UD Box 5G uses an external 100MHz clock signal to synchronize, the UD Box 5G can not up or down converter normally.

Solution:

When the UD Box 5G uses an external 100MHz clock signal to synchronize, the UD Box 5G can not up or down converter normally.

- Verify that there is a signal output when the external 100MHz sync
- Verify that the UD Box 5G is switched to the external sync clock state and the blue light is on
- Verify that CH1/2 are turned on

UD Box 5G can not be found through the TMXLAB Kit

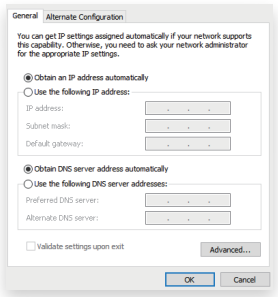
Symptom:

When you connect the UD Box 5G and open the TMXLAB Kit, the UD Box 5G device cannot be found.

Solution:

Complete the following steps.

If you control UD Box 5G through an Ethernet Switch, there are 2 types of network topology for setting of multiple devices. If DHCP is enabled, please set your control host to “obtain IP address automatically”. The IP address shall be assigned automatically



If no DHCP function supported, the static IP needs to be configured manually. Please set the control terminal IP to 192.168.100.xxx.

Then avoid other device with the same IP as the UD Box 5G.(Please only connect the UD Box 5G and then use the TMXLAB kit to click the gear in the upper right corner to confirm.)

* If you want to control multiple UD Box 5G devices at the same time, you can use a LAN switch with DHCP function to connect all UD Box 5G devices, or you must configure them with individual IP addresses to avoid IP Confilct.
* Following configuration, the UD Box 5G must be rebooted and rescanned.

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Address (UK) : Measurement House, London Rd, Newbury RG14 2PZ