



TMYTEK UD Box 5G with thinkRF RTSA R5500\*

(\* This application note applies to R5550)

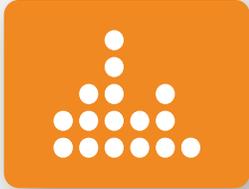
# Extend Your T&M to mmWave Bands



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## OVERVIEW



**THIS APPLICATION NOTE** describes the integration of TMYTEK UD Box 5G up/down-converter with the thinkRF R5500 real-time spectrum analyzer, which will demonstrate the ability, to use existing sub-6 GHz spectrum analyzer to analyze 5G mmWave (FR2) signals.

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## Overview

Today's high-band signal standards are using higher frequencies and wider bandwidths than ever before. Mobile operators and system integrators can retain existing field, lab, and manufacturing test equipment, extend the life of their investment, and reduce time to market and costs when measuring 5G signals in a variety of deployment scenarios and applications.

This application note describes the integration of TMYTEK UD Box 5G up/down-converter with the thinkRF R5500 real-time spectrum analyzer, which will demonstrate the ability, to use existing sub-6 GHz spectrum analyzer to analyze 5G mmWave (FR2) signals.

The test setup includes a 28 GHz mmWave signal generator source, which illustrates down-conversion in 2 different ways:

LO < RF and LO > RF (LO- Local Oscillator, RF- Radio Frequency), producing IF - 3 GHz and IF - 5 GHz respectively. The IF signal spectrum was displayed with the real-time spectrum analyzer.

### Solution Highlights

- Extend existing sub-6 GHz instruments to 5G mmWave economically
- Reduce costs and time while upgrading to 5G mmWave
- Up and down convert 5G mmWave with ease



## UD Box 5G - Key Features

- RF I/O: 24 - 44 GHz; IF I/O: 0.01 - 14 GHz
- Integrated LO with precise OCXO
- Controllable LO frequency: 24 - 44 GHz
- LO frequency resolution: 10 KHz
- Real-time bandwidth: 800 MHz
- Single/dual channels
- Compact(143 x 152 x 65 mm), light (0.9 Kg)
- Low power consumption: < 24 W

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## Overview

TMYTEK and thinkRF joined forces to introduce an Ultra-wideband Real-Time Spectrum Analyzer solution covering 5G FR1 and FR2 bands. thinkRF RTSA 5500 is a wideband, compact, and remote deployable spectrum analyzer. TMYTEK UD Box 5G is ultra-broadband 5G up/down converter comprising of mixer(s), internal LO built by excellent phase noise PLO and optional filters. It comes in 2 choices of single or dual channels.

Remote spectrum monitoring is widely deployed for wireless spectrum resource management. Wireless industry needs to address 5G mmWave spectral efficiencies economically and verify the beam tracking

The TMYTEK and thinkRF spectrum analyzer solution supports:

- Wireless telecom carriers and OEMs in extending the life of their investment, reducing time to market and costs
- Universities and labs in retaining existing field, lab, and manufacturing test equipment

algorithm and protocols with ease.

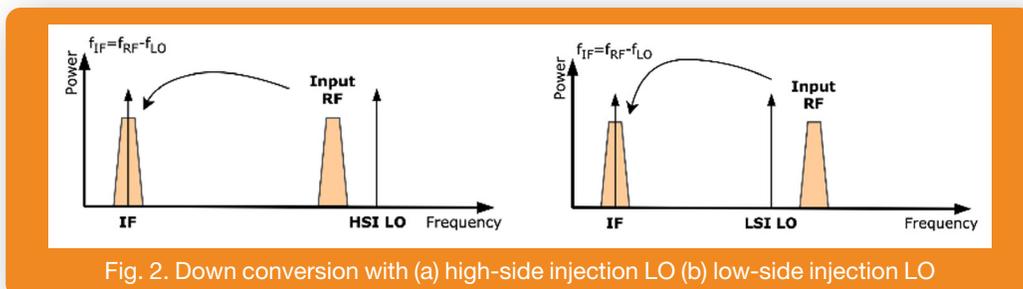
thinkRF R5500 and TMYTEK UD Box 5G together provide a compact, flexible, and cost-effective spectrum monitor solution as seen in Fig. 1.



## Down-convert RF to IF

RF signal at FR2 (24 - 44 GHz) is down-converted to be monitored in the spectrum analyzer. Frequency can be converted by two different sides - low-side injection ( $LO < RF$ )

and high-side injection ( $LO > RF$ ), as shown in Fig. 2. Both these can convert RF to desired IF frequency.



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## Frequency Extension Equipment Setup

To address the frequency extension of spectrum analyzer to 24 - 44 GHz, the measurement setup in Fig. 3 has a frequency converter – TMYTEK UD Box 5G, spectrum/signal analyzer – thinkRF R5500 and RF signal source - Keysight M9384B.

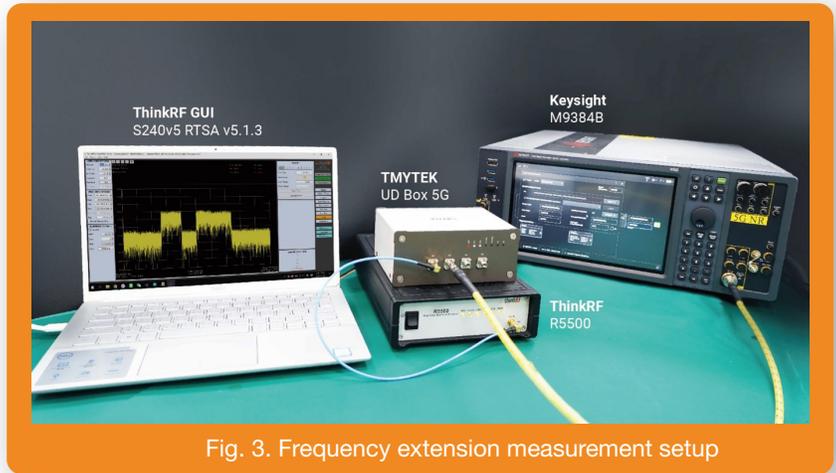


Fig. 3. Frequency extension measurement setup

## IF Signal Spectrum Measurement

The frequency conversion with RF= 28 GHz is shown here. RF from signal generator is down converted by UD Box 5G in 2 different ways  
 (a) LSI LO= 25 GHz

(b) HSI LO= 33 GHz.  
 This IF signal is shown on R5500. Input RF in both cases is 28 GHz. The frequency spectrum is shown in Fig. 4.

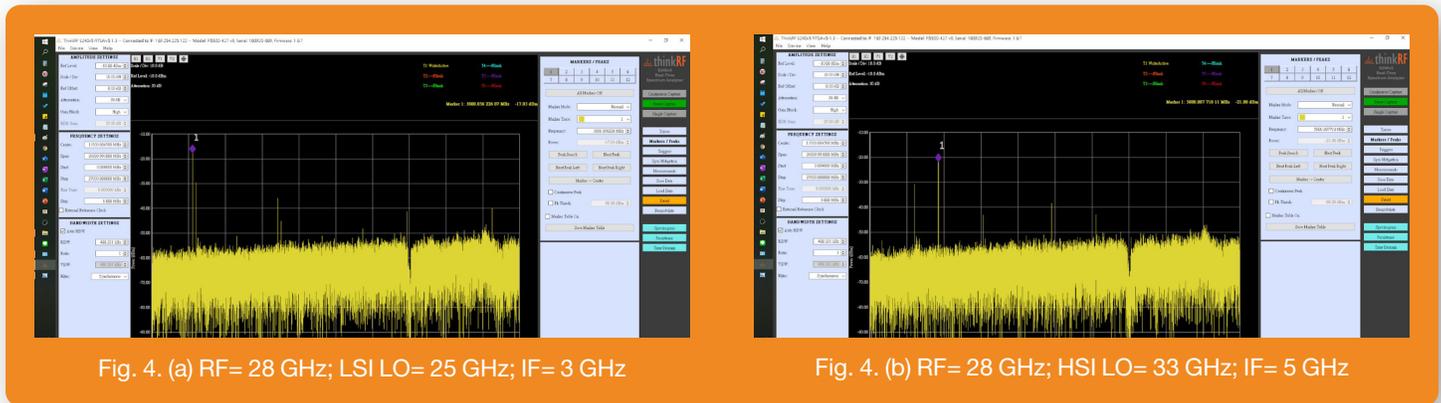


Fig. 4. (a) RF= 28 GHz; LSI LO= 25 GHz; IF= 3 GHz

Fig. 4. (b) RF= 28 GHz; HSI LO= 33 GHz; IF= 5 GHz

## IF Output Power Levels

The measured IF powers are shown in Table. 1.

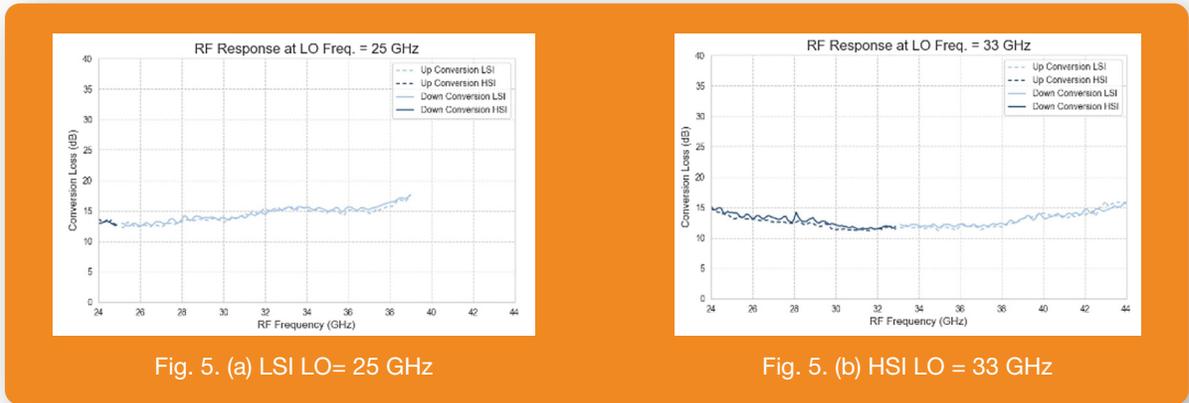
LO Frequency	IF frequency	RF Input Power	IF Output power
LSI LO= 25 GHz	RF-LO= 3 GHz	0 dBm	-17.03 dBm
HSI LO= 33 GHz	RF-LO= 5 GHz	0 dBm	-21.00 dBm

Table 1. Measured power in spectrum analyzer with RF= 28 GHz

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## Conversion Loss Performance

The measured UD Box 5G conversion loss across 5G FR2 is shown in Fig. 5.



The conversion loss of UD Box 5G is about 12 dB, resulting in good spectral efficiencies.

## Measurement Considerations

UD Box 5G performance/testing is measured within 24 - 44 GHz.

## Summary

The application note demonstrated the ability to extend existing sub-6 GHz equipment to include 5G mmWave capabilities.

The existing spectrum analyzer (R5500) can analyze and detect signals up to a maximum frequency of 27 GHz. But, by integrating it with TMYTEK UD Box 5G, it has been shown that spectrum analysis of 5G mmWave up to 44 GHz can be achieved.

R5500 integrated with UD Box 5G is an economical and time-saving spectrum analyzer solution that extends spectrum analysis capabilities to 44 GHz, thereby, maximizing the life of existing equipment.

## References

Related documents:

- Refer to [R5500/R5550 Real Time Spectrum Analyzer](#): thinkRF Support for R5500 datasheet, user guide and functionality.
- Refer to [UD Box 5G | Up/down converter, frequency converter | Up to 44 GHz | TMYTEK for TMYTEK UD Box 5G features, capabilities, and more details](#)

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TMYTEK UD Box 5G with thinkRF RTSA R5500



## ABOUT thinkRF

thinkRF is the leader in software-defined spectrum analysis platforms that monitor, detect and analyze complex waveforms in today's rapidly evolving wireless landscape. By providing more flexibility, greater coverage, increased functionality and better ROI, thinkRF solutions are ideal for regulatory and intelligence monitoring, telecom deployment optimization and RF application development. With open APIs and proven integrations, thinkRF offers the only compact and networkable spectrum analyzer that can be deployed without a PC and the best price to performance on the market.

Aerospace and defense companies, spectrum regulators and wireless communications providers use the remotely deployable, PC-driven and easily-upgraded platform to replace traditional lab equipment for wireless spectrum analysis.

For more information, visit [www.thinkrf.com](http://www.thinkrf.com).



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