The 5G era has dawned. Massive deployments are expected in 2021 worldwide. IMT-2020 defines eMBB, URLLC, and mMTC, which are keys to successful 5G communications. TMYTEK has developed a scalable and flexible system consisting of BBox (a ready-to-use beamformer) and UD Box (an up/down converter) to help our customers move onto 5G beamforming developments and tests with ease.

Our broadband UD Box comprises the mixer(s), internal LO built by our excellent phase noise PLO and optional filters. More details are below.

Features

- RF: 24 to 44 GHz
- IF: 0.01 to 14 GHz
- Adjustable LO frequency: 16 to 32 GHz
- Conversion Loss: 14 dB (typical)
- Integrated with internal LO source
- Choices of single or dual channels
- Up and down conversion in the same box
- Easy-to-use
- Ideal for 5G communication application
- RoHS Compliant

Figure 1. UD Box

Function Block Diagram

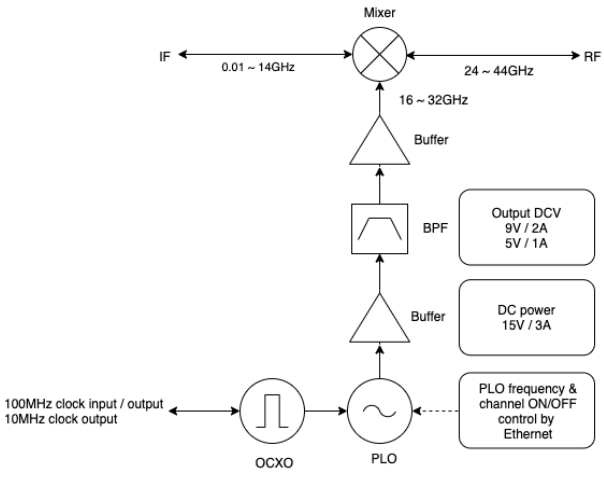

Figure 2. UD Box Single Channel Block Diagram

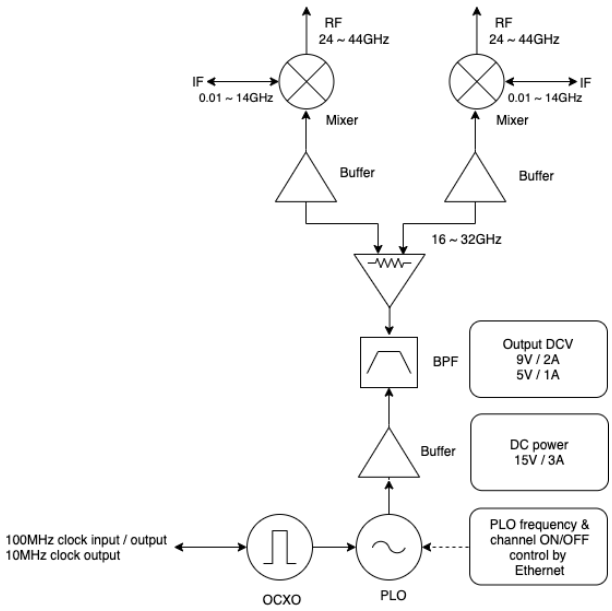

Figure 3. UD Box Dual Channel Block Diagram

RF Specifications

Parameter	Conditions	Unit	Min.	Typ.	Max.
RF Frequency	---	GHz	24	---	44
IF Frequency	---	GHz	0.01	---	14
LO Frequency	---	GHz	16	---	32
LO Frequency Resolution	---	MHz	---	0.01	---
Reference Clock Stability	-30 ~ +70 degree	ppb	-50	---	50
Conversion Loss	Full band	dB	---	14	---
IF to RF Isolation	With filter / No filter	dB	70 / 13*[1]	---	---
RF to IF Isolation	With filter / No filter	dB	54 / 15*[1]	---	---
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	8	---
IF Return Loss	Full band	dB	6	8	---
Warm Up Time	---	minutes	---	30*[2]	---

*[1] With optional n257 filter
*[2] Suggested warm up time

DC and Clock Specifications

Parameter	Conditions	Unit	Min.	Typ.	Max.
DC Power Consumption	---	W	---	13.5	18
Supply Voltage	---	V	---	15	---
Accessories DC Power Supply	Single Channel	V	---	5/9	---
		mA	---	250/400	---
	Dual Channel	V	---	5/9	---
		mA	---	250/400	---
Reference Clock	Out	MHz	---	10	---
	In / Out	MHz	---	100	---

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				
Control Interface	Ethernet				

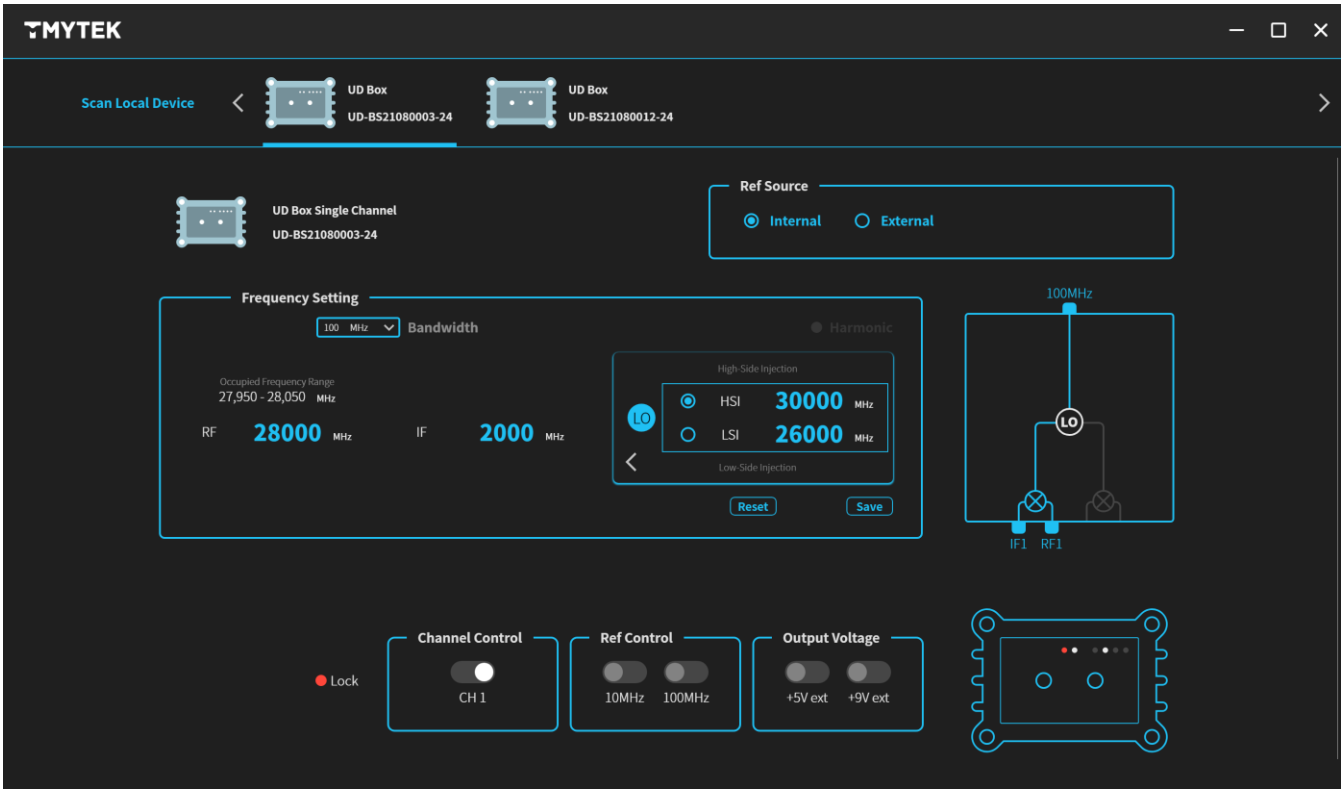

Figure 4. Controlling UD Box using TMXLAB Kit

Connector Specifications

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

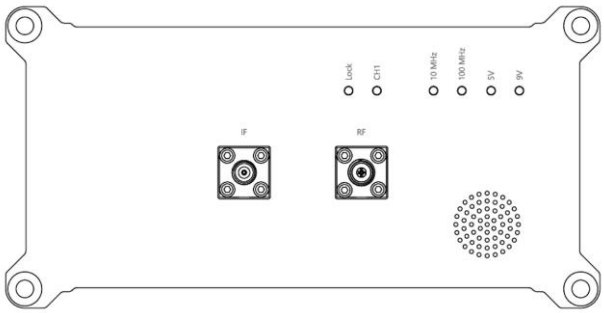

Figure 5. UD Box Front Panel — Single Channel

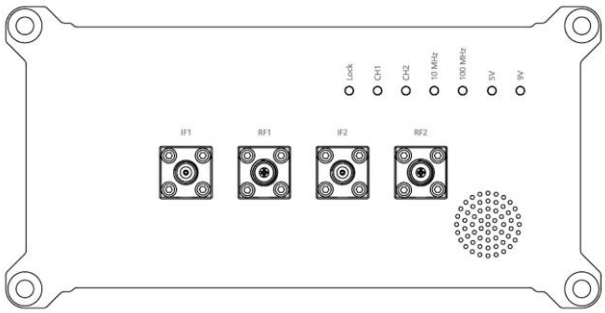

Figure 6. UD Box Front Panel — Dual Channel

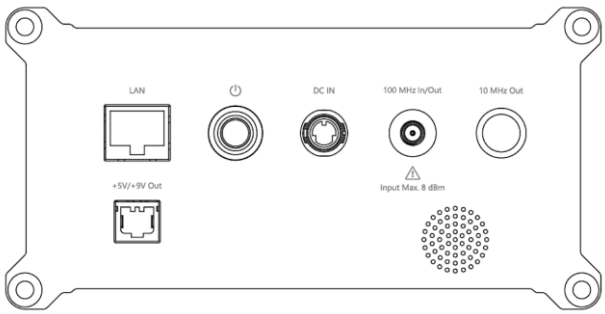

Figure 7. UD Box Back Panel

Package Details

TMYTEK's connectorized packaging:

Parameter	Condition	Unit	Main body	Connector included
Dimension	Length	mm	120.7	142.8
	Width	mm	152	152
	Height	mm	77	77
Weight	unit	g	---	1243
Material	Aluminum	---	---	---

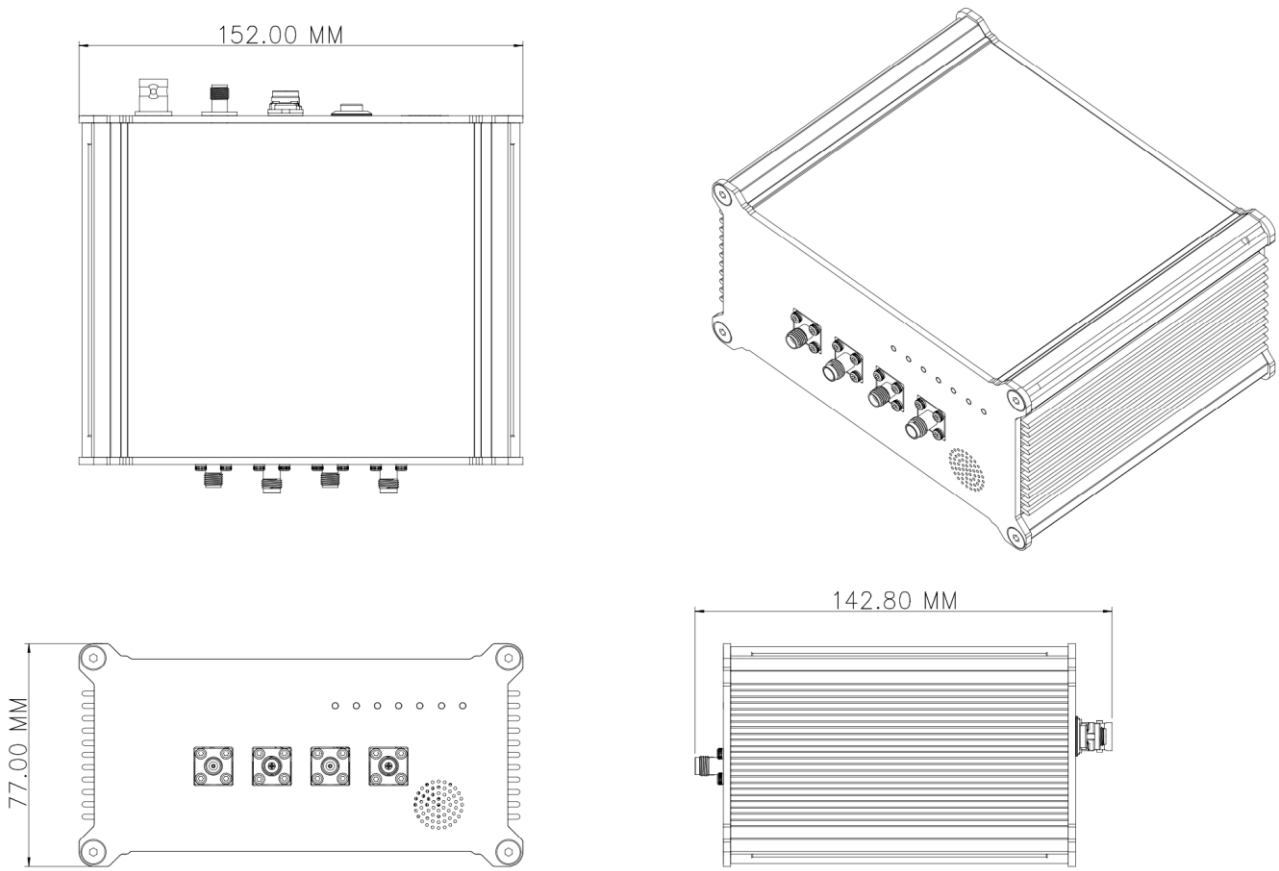

Figure 8. UD Box Mechanical Drawing

Accessories Specifications

The following accessories are developed by TMYTEK for use with UD Box under different applications (with emphasis on the 5G application). Please consult us for detailed accessories' specifications.

Item Type	3GPP Band	Units	Operating Frequency
RF Filter	n257	GHz	26.5 - 29.5
	n260	GHz	37 - 40
	n261	GHz	27.5 - 28.5
IF Filter	---	GHz	0 - 6
	---	GHz	0 - 15
Amplifier	---	GHz	20 - 40

Typical Performances

Conversion Loss

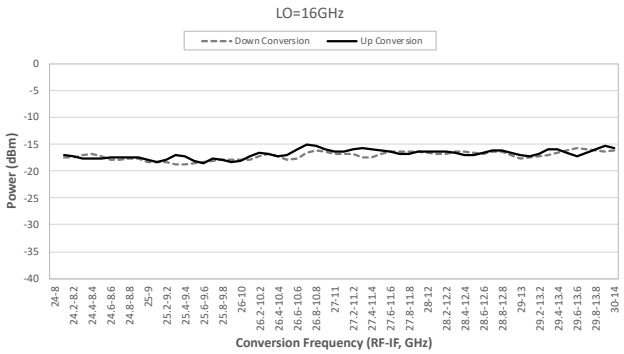

Figure 9. Conversion loss at different RF-IF pairs – LO at 16 GHz

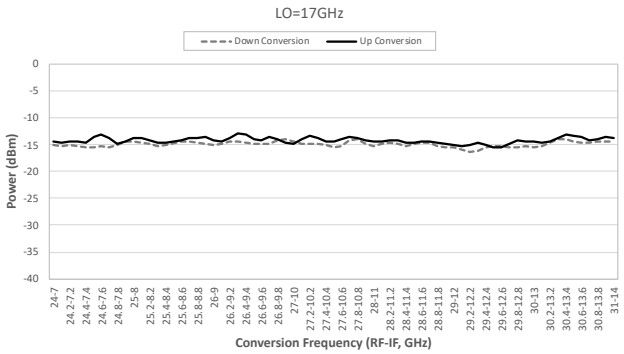

Figure 10. Conversion loss at different RF-IF pairs – LO at 17 GHz

Conversion Loss (continued)

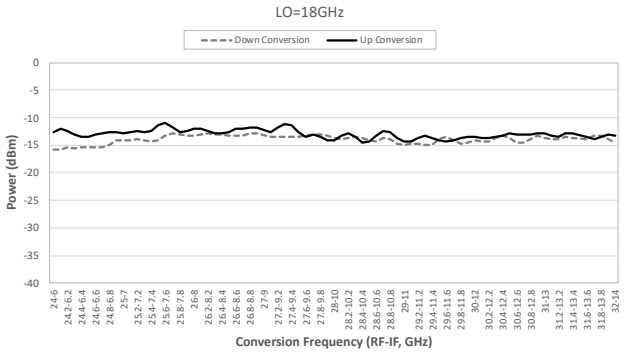

Figure 11. Conversion loss at different RF-IF pairs – LO at 18 GHz

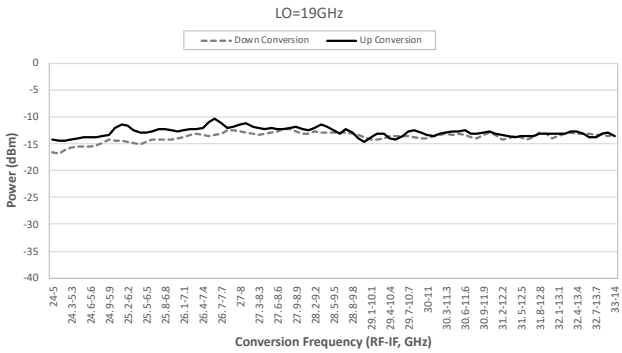

Figure 12. Conversion loss at different RF-IF pairs – LO at 19 GHz

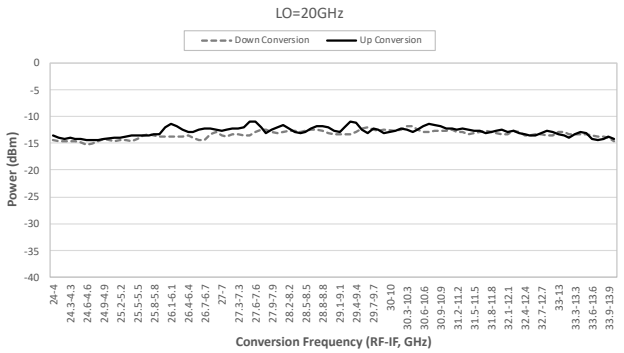

Figure 13. Conversion loss at different RF-IF pairs – LO at 20 GHz

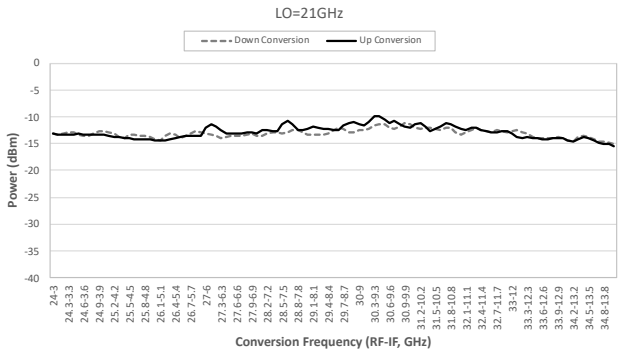

Figure 14. Conversion loss at different RF-IF pairs – LO at 21 GHz

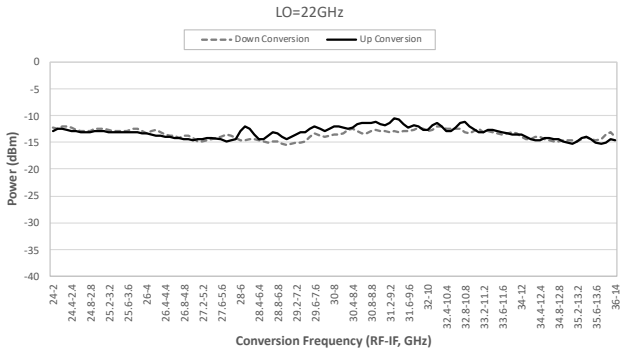

Figure 15. Conversion loss at different RF-IF pairs – LO at 22 GHz

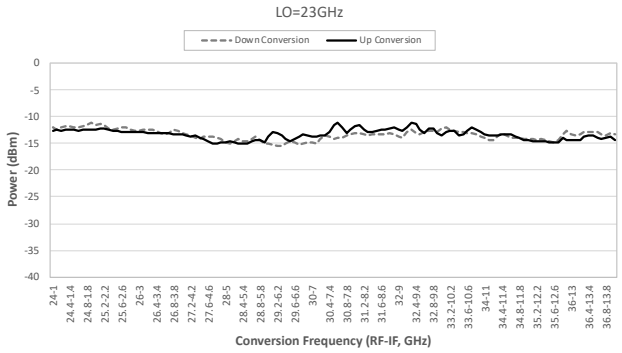

Figure 16. Conversion loss at different RF-IF pairs – LO at 23 GHz

Conversion Loss (continued)

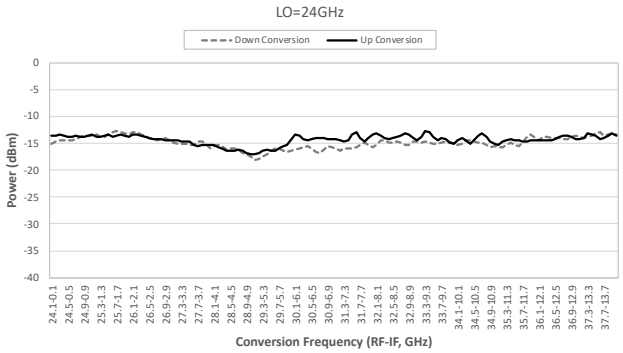

Figure 17. Conversion loss at different RF-IF pairs – LO at 24 GHz

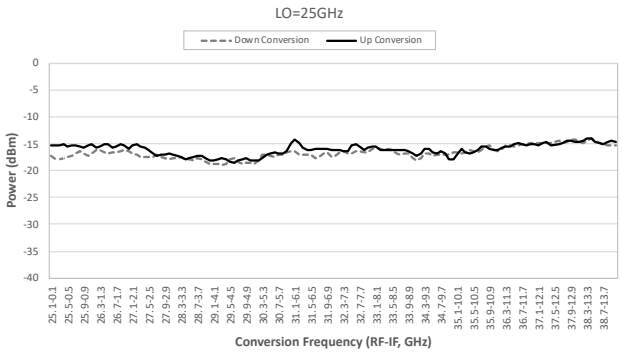

Figure 18. Conversion loss at different RF-IF pairs – LO at 25 GHz

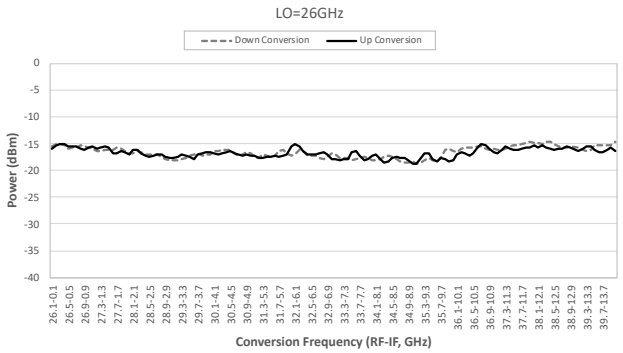

Figure 19. Conversion loss at different RF-IF pairs – LO at 26 GHz

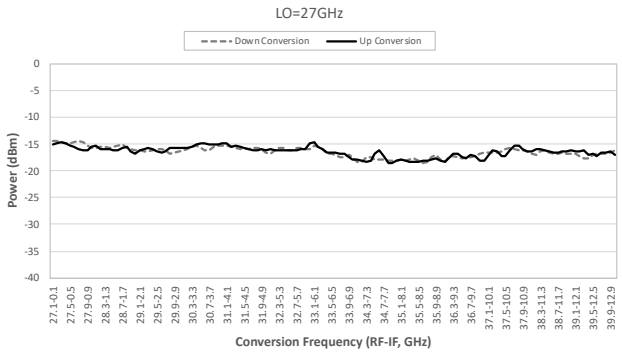

Figure 20. Conversion loss at different RF-IF pairs – LO at 27 GHz

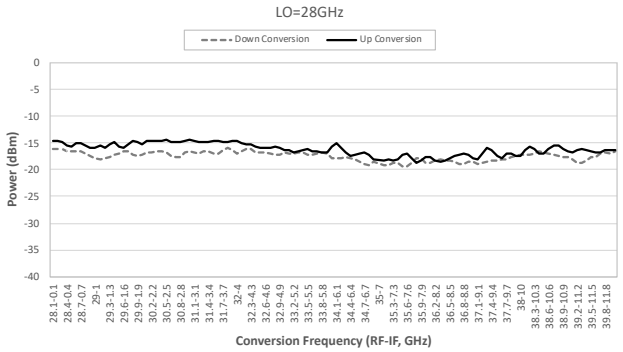

Figure 21. Conversion loss at different RF-IF pairs – LO at 28 GHz

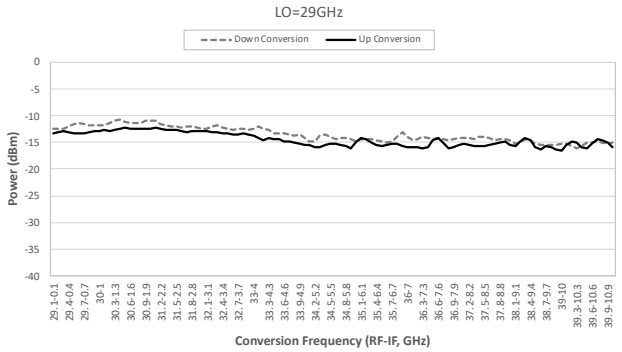

Figure 22. Conversion loss at different RF-IF pairs – LO at 29 GHz

Conversion Loss (continued)

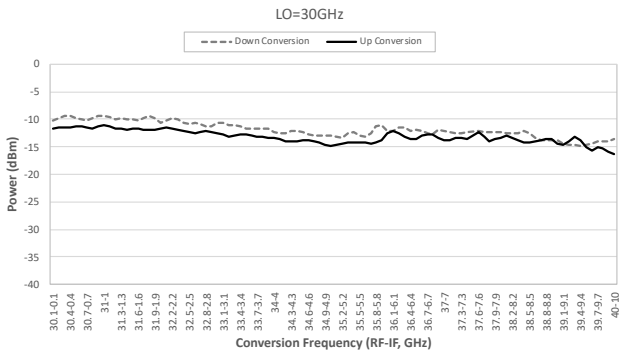

Figure 23. Conversion loss at different RF-IF pairs – LO at 30 GHz

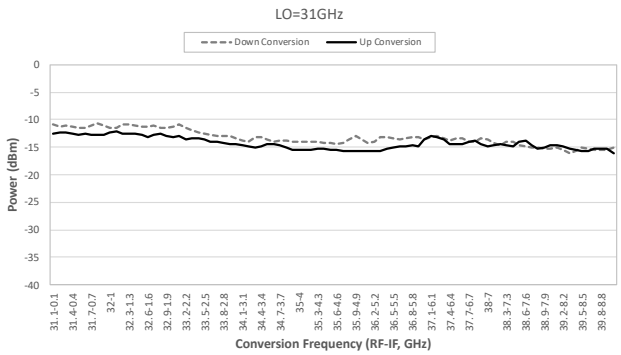

Figure 24. Conversion loss at different RF-IF pairs – LO at 31 GHz

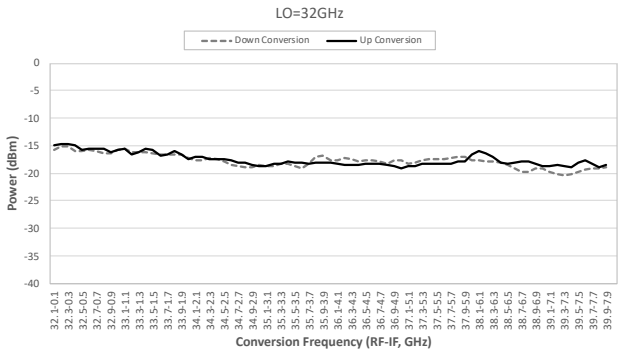

Figure 25. Conversion loss at different RF-IF pairs – LO at 32 GHz

Power at 1 dB Compression

Test Condition: LO 26 GHz | IF 2 GHz | RF 28 GHz

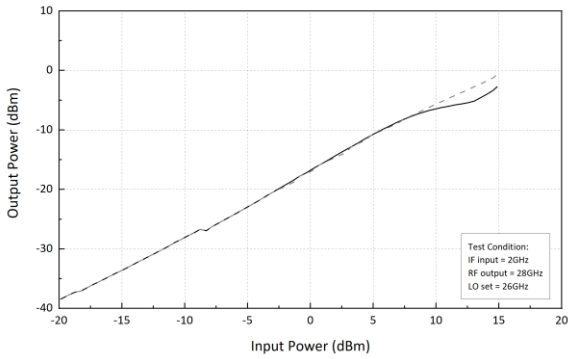

Figure 26. OP1dB for Up Conversion

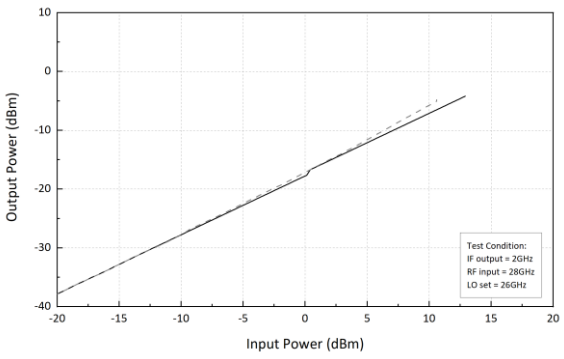

Figure 27. IP1dB for Down Conversion

Return Loss

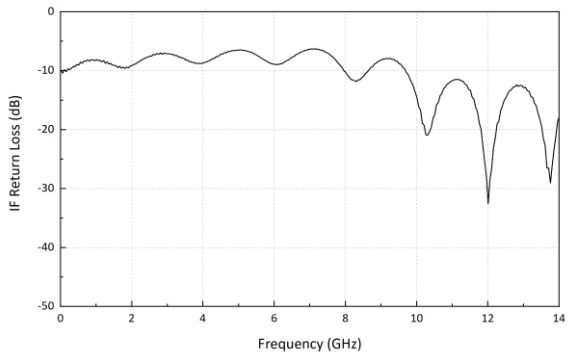

Figure 28. Return Loss at IF port

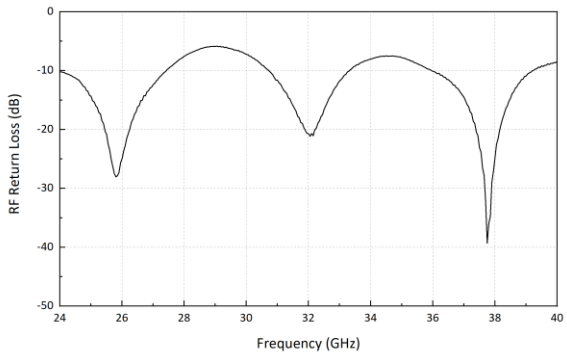

Figure 29. Return Loss at RF port

