BBox Lite 5G 28 GHz

BB-LITE-BPB0B-28

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 small and compact development tool to help our customers in moving onto 5G beamforming developments and tests with ease. We call it the BBox™ Lite. Our BBox™ Lite is the lighter version of our BBox™ series. It consists of 4 channel RF control, standard antenna kit and API software control through ethernet interface.

Similar to our BBox™ series products, our Lite version governs the phase and amplitude control of 4 channels. It is most suitable for manufacturing tests, OTA chamber development, or for educational purposes. Please find more details below.

Features

- Operating Frequency: 26.5 to 29.5 GHz
- Designed for 5G n257 band (including n261 band)
- Up to 4 controllable RF channels with patch antenna
- Each channel provides:
  - 360˚ phase shifter coverage with 5˚ per step
  - RMS phase error: 4˚ (typical)
  - 15 dB attenuation range with 0.5 dB per step
  - RMS attenuation error: 0.35 dB (typical)
- T/R half duplex operation
- 2 ms T/R mode switching time (typical)
- 2 ms beam steering time (typical) *[1]
- PC software control via RJ-45 Ethernet interface

Figure 1. BBox™ Lite 5G 28 GHz

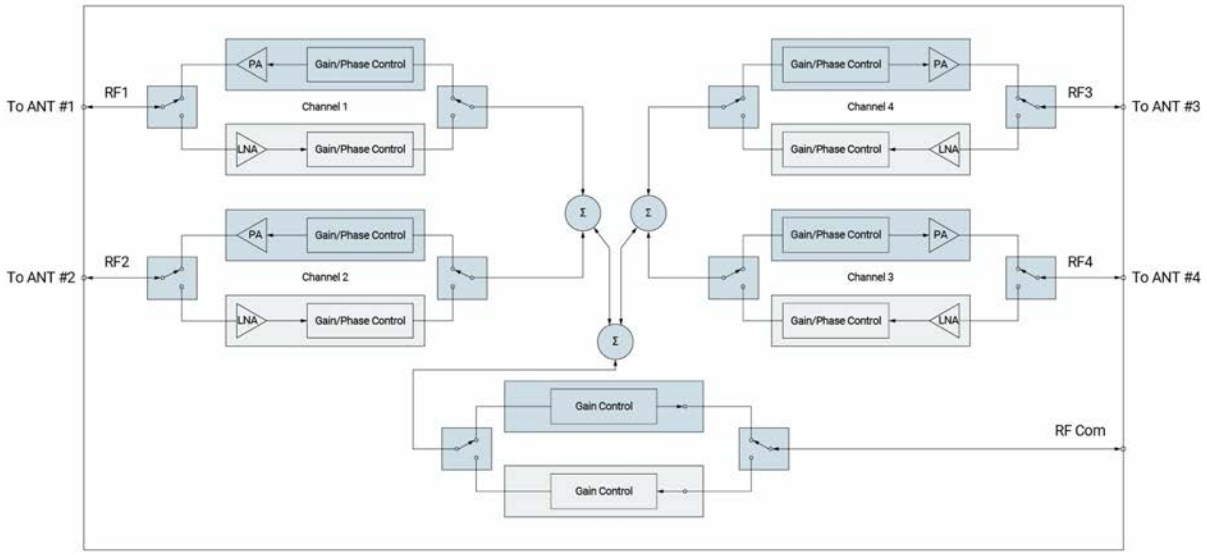

Figure 2. 5G Beamformer System Diagram (4 channels)

*[1] Beam steering time is the time it takes for all 4 channels' gain and phase to change to reflect the new beamforming angle. The time here is dependent on the CPU speed of the PC in which the control interface (UI or API) is running on.

Single Channel RF Specifications

Tested conditions: 4 channels, f_{RF} = 28 GHz, Z_{Sys} = 50 Ω and T_{AMB} = 25℃

Parameter	Conditions	Unit	Min.	Typ.	Max.
Operating Frequency Range	Without antenna	GHz	26.5	28	29.5
Maximum Gain	Tx Mode	dB	16	18	---
	Rx Mode	dB	12	14	---
Noise Figure	Rx Mode	dB	---	14	16
OP1dB	Tx Mode	dBm	9	10.5	12
IP1dB	Rx Mode	dBm	-22.5	-21	-19.5
Phase Shifting Range		deg	---	360	---
Phase Shifting Step		deg	---	5	---
RMS Phase Error		deg	---	4	---
Attenuator Range	Common Gain + Channel gain	dB	---	15	---
	Common Gain	dB	6.5	7.5	8
	Channel Gain	dB	6.5	7.5	8
Attenuator Step		dB	---	0.5	---
RMS Attenuation Error		dB	---	0.35	---
Return Loss	RF Port (Tx)	dB	7	10	---
	RF Port (Rx)	dB	7	10	---
	COM Port	dB	---	7	---
Channel-to-Channel Isolation	Maximum gain setting-Tx	dB	---	25	---
	Maximum gain setting-Rx	dB	---	30	---

System RF Specifications

Parameter	Conditions	Unit	Min.	Typ.	Max.
Operating Frequency Range	With AA-Kit, compliant with n257 and n261 band	GHz	26.5		29.5
Number of Controllable Channels			---	4	---
Antenna Array Gain		dB	14	15	---
Transmitter Maximum Gain		dB	34	37	---
Transmitter EIRP		dBm	26	29	---
Maximum Input Power	Tx Mode	dBm	---	-8	---
Receiver Maximum Gain		dB	30	33	---
Beam Steering Range	Vertical	deg	---	Fixed	---
	Horizontal	deg	---	±45	---
3dB Beamwidth	Broadside	deg	---	25	30

DC and Control Specifications

Parameter	Conditions	Unit	Min.	Typ.	Max.
Power Consumption	Tx Mode	W	---	---	4.5
	Rx Mode	W	---	---	3
Supply Voltage		Vdc	---	5	---
T/R Switching Time	Between Tx and Rx modes	ms	---	2	---
Beam Steering Time*[1]	Dependent on CPU speed	ms	---	2	---
Channel ON/OFF Time		ms	---	2	---

AC Specifications

Parameter	Conditions	Unit	Min.	Typ.	Max.
Adapter Input Voltage		Vac	100	---	240
Adapter Input Current Consumption		A			0.7

Software Control Interface

The BBox™ Lite software interface offers both UI and API control which are completely designed in house by our software team. Our patented software algorithm offers better accuracy and easier control on the beam angles. The module can be controlled by RJ-45 ethernet cable. Both the UI and API are available for our customers to access and download from the Web. Our developed user interface is called TMXLAB Kit, which is also the same UI for controlling our BBox™ One and UD Box. The BBox™ Lite interface shows the 4-channel amplitude and phase control as depicted below. To control the parameters, users can drag the Common Gain, dB, or Φ slide bars on the desired channel to make the changes. The righthand portion of the interface shows the beam steering angle as well as the total module gain. This function can be used together with our standard antenna kit to control the steering angle.

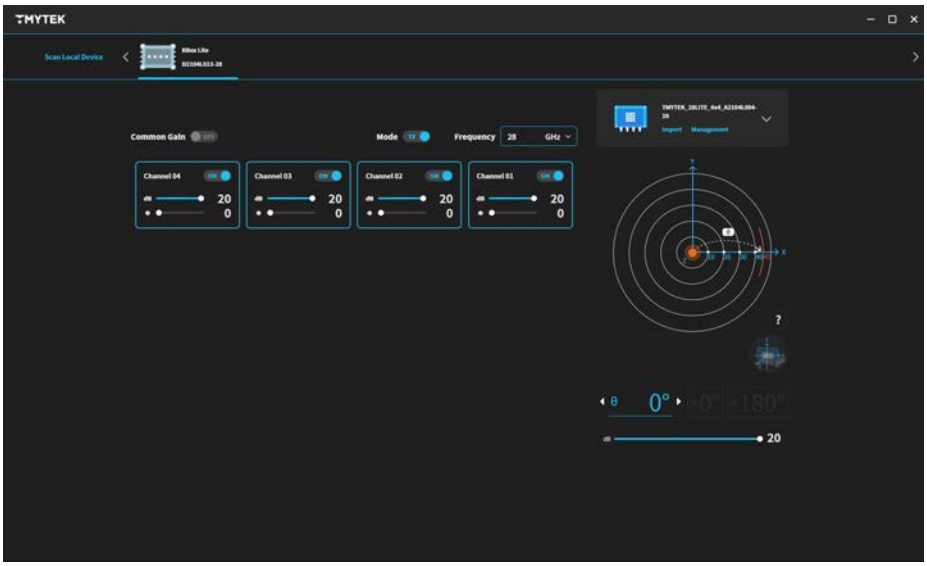

Figure 3. TMXLAB Kit – Software GUI for controlling BBox™ Lite

Connector Specifications

Parameter	Location	Type and Function
RF1, RF2, RF3, RF4	Front Panel	4 channel RF ports with 2.92 mm (K) Jack connectors
RJ-45 Ethernet	Back Panel	Control port (including UI and API control)
DC IN	Back Panel	Type-C DC input (DC 5V/3A max. adapter included)
RF COM	Back Panel	RF common port with 2.92 mm (K) Jack connector
Switch Button	Back Panel	ON/OFF Switch
SPI Connector	Back Panel	Option Mode : Register Base Direct Control

Package

TMYTEK's compact connectorized packaging:

Parameter	Condition	Unit	Min	Typ	Max
Dimension	Length	mm	117.4	119.4	121.4
	Width	mm	100.0	102.0	104.0
	Height	mm	99.2	101.2	103.2
Weight	Aluminum	g	---	470	---

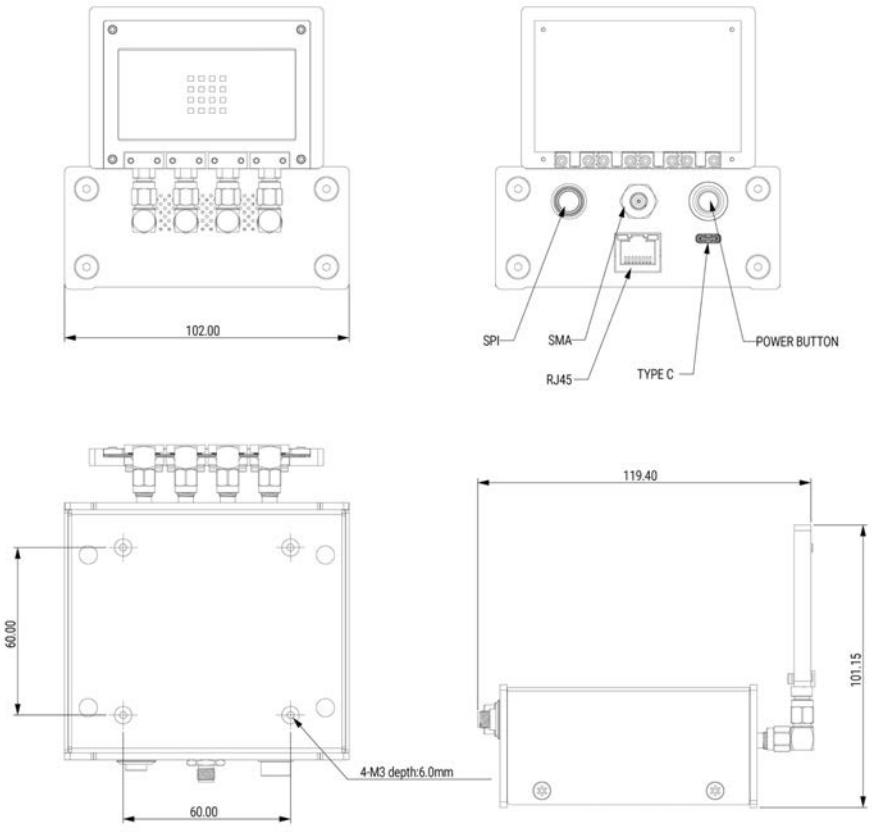

Figure 4. BBox™ Lite Dimension Drawing

Typical Performances

TX Mode

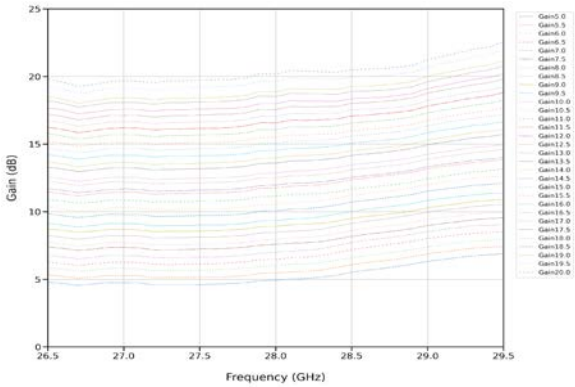

Figure 5. Tx Gain vs Frequency for RF 1

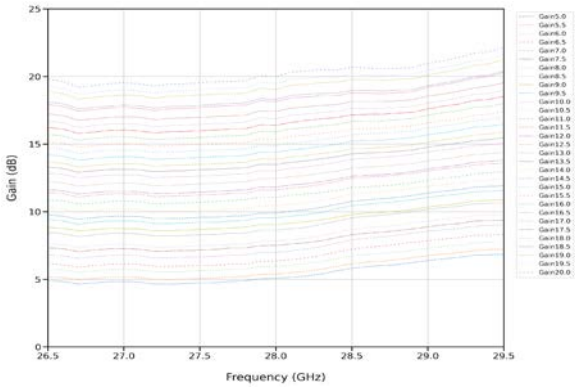

Figure 6. Tx Gain vs Frequency for RF 2

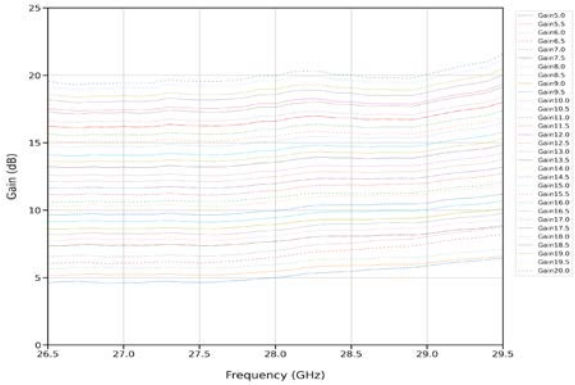

Figure 7. Tx Gain vs Frequency for RF 3

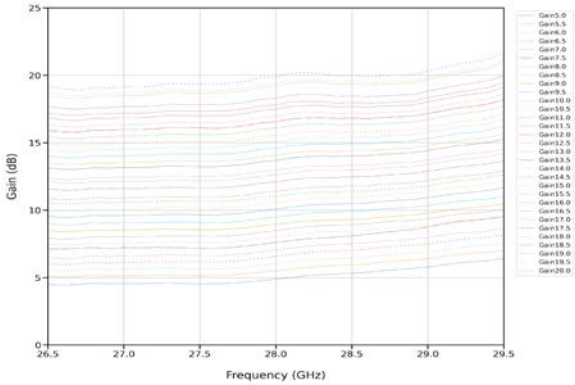

Figure 8. Tx Gain vs Frequency for RF 4

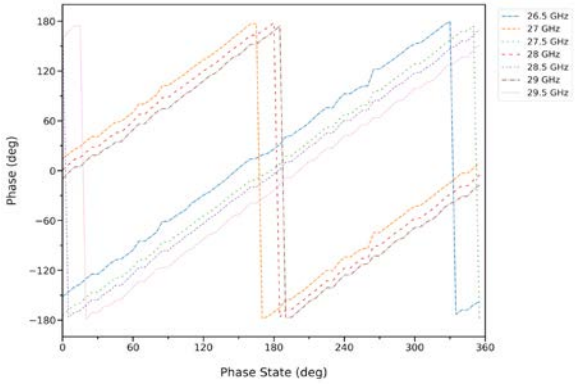

Figure 9. Tx Phase vs Phase States for RF 1

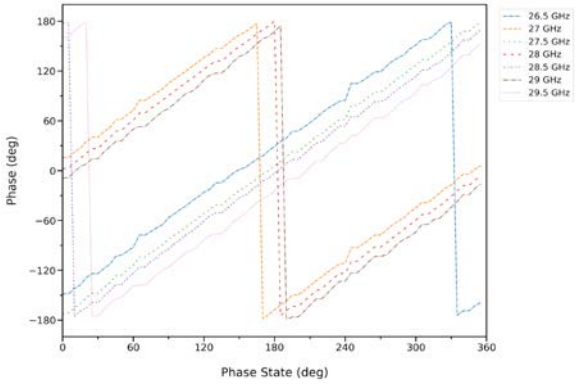

Figure 10. Tx Phase vs Phase States for RF 2

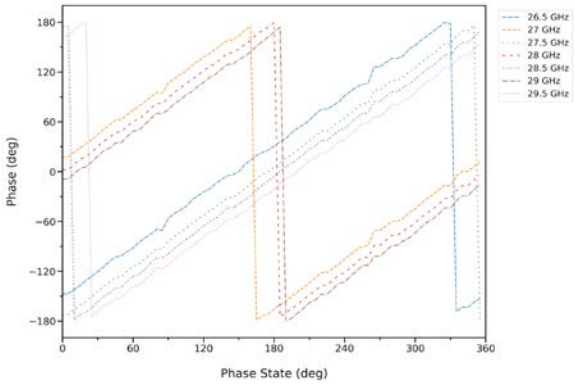

Figure 11. Tx Phase vs Phase States for RF 3

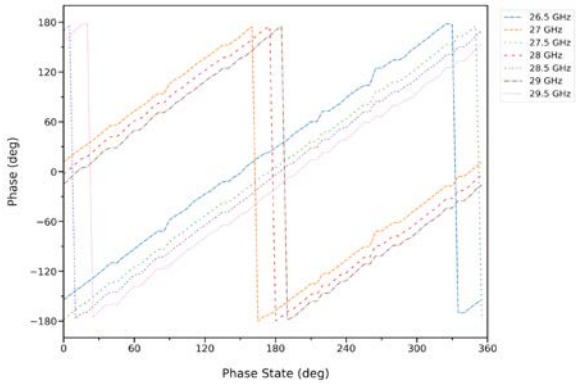

Figure 12. Tx Phase vs Phase States for RF 4

RX Mode

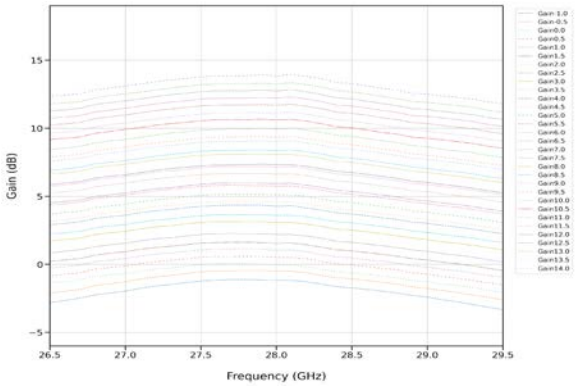

Figure 13. Rx Gain vs Frequency for RF 1

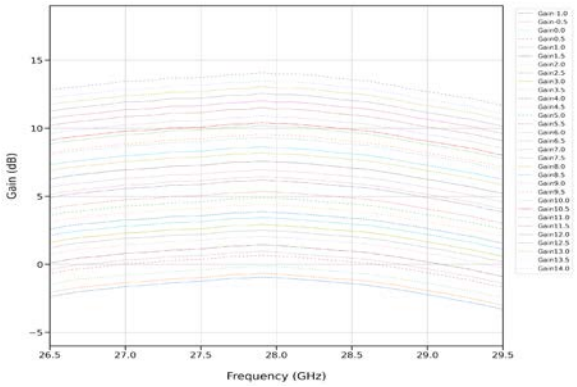

Figure 14. Rx Gain vs Frequency for RF 2

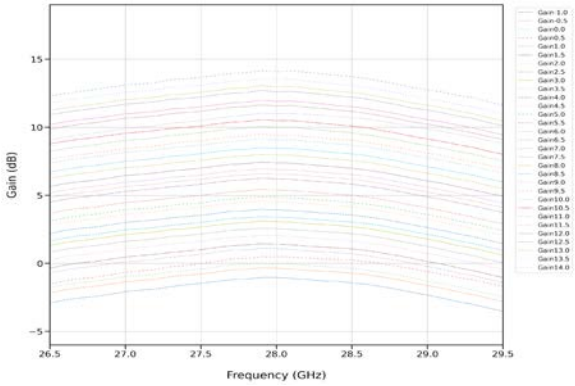

Figure 15. Rx Gain vs Frequency for RF 3

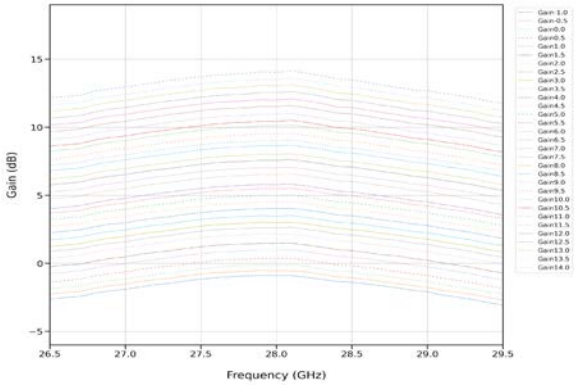

Figure 16. Rx Gain vs Frequency for RF 4

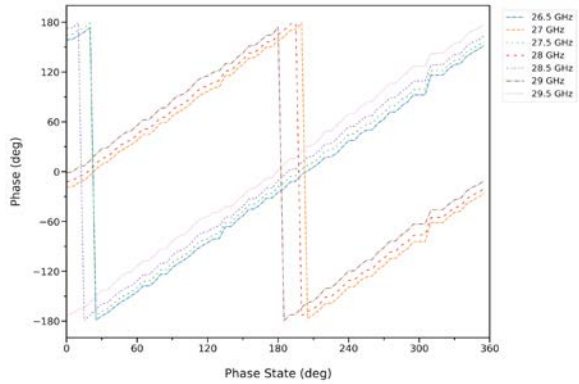

Figure 17. Rx Phase vs Phase States for RF 1

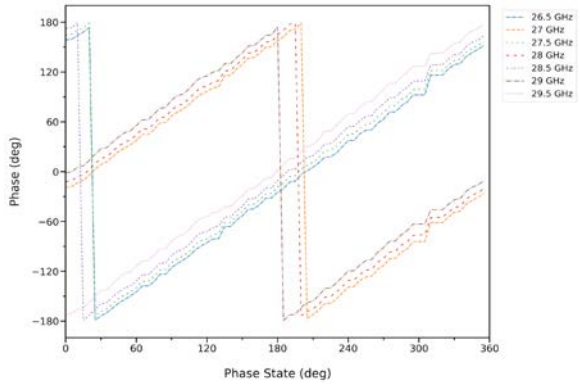

Figure 18. Rx Phase vs Phase States for RF 2

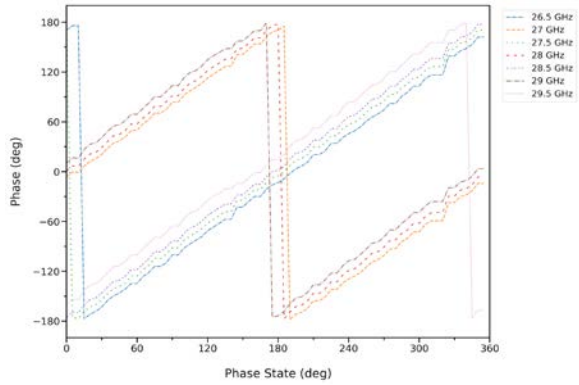

Figure 19. Rx Phase vs Phase States for RF 3

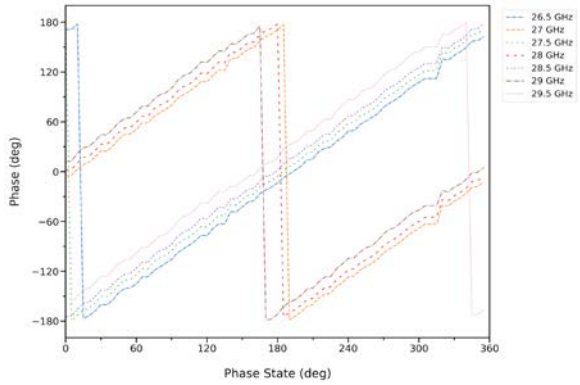

Figure 20. Rx Phase vs Phase States for RF 4

Return Loss

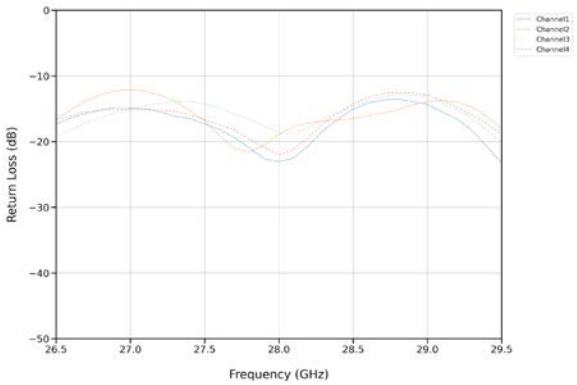

Figure 21. RF Port Return Loss of Tx mode