Datasheet

BBox One 5G 39 GHz

BB-ONE-BP00B-394A

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™ One. It consists of 16 channel RF control, standard antenna kit and API software control through ethernet interface.

Our BBox™ One is the most critical module in the whole BBox™ building blocks and that is because it is where the main mmWave functions happen. BBox™ One provides the ability to do phase and amplitude control through ethernet connection. It comprises of RF components such as T/R switch, LNA/PA and phase shifters as well as our standard antenna for 5G beam steering. More details are outlined below.

Features

- Operating Frequency: 37 to 40 GHz
- Designed for 5G n260 band
- Up to16 controllable RF channels with the choice of 4x4 or 8x8 series 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
- Typical T/R mode switching time: 2 ms (Ethernet)/ 10ns (GPIO)[1]
- Typical beam steering time: 2 ms (Ethernet)/ 140 ns (SPI)[2]
- PC software control via RJ-45 Ethernet interface
- FPGA/ SDR control via SPI interface

Figure 1. BBox™ One 5G 39 GHz

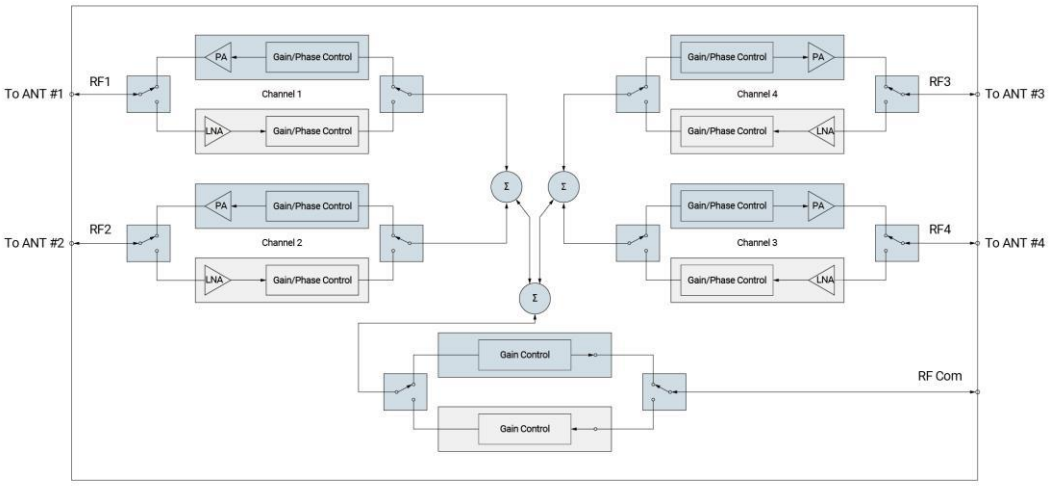

Figure 1. 5G Beamformer System Diagram (4 channels)

[1]Depends on host GPIO
[2]Under beam table pre-config, the minimum beam steering latency is approximately 140 ns via 100MHz SPI interface.

Single Channel RF Specifications

Tested conditions: 4 channels, f_{RF} = 39 GHz, Z_{Sys} = 50 Ω and T_{AMB} = 25℃

Parameter	Conditions	Unit	Min.	Typ.	Max.
Operating Frequency Range	Without antenna	GHz	37	39	40
Maximum Gain	Tx Mode	dB	1	3	5
	Rx Mode	dB	-1	1	3
Noise Figure	Rx Mode	dB	---	23	25
OP1dB	Tx Mode	dBm	8	10	12
IP1dB	Rx Mode	dBm	-20	-18	-16
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	0.4
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.
Antenna Array Size			---	4x4	---
Operating Frequency Range	With antenna	GHz	37	---	38
Number of Controllable Channels			---	16	---
Antenna Array Gain		dB	13	14	---
Transmitter Maximum Gain		dBi	27	29	---
Transmitter EIRP		dBm	35	36	---
Maximum Input Power	Tx Mode	dBm	---	7	---
Receiver Maximum Gain		dB	24	26	---
Beam Steering Range	Vertical	deg	---	±40	---
	Horizontal	deg	---	±40	---
3dB Beamwidth	Broadside, Vertical	deg	---	25	30
	Broadside, Horizontal	deg	---	25	30

DC and Control Specifications

Parameter	Conditions	Unit	Min.	Typ.	Max.
Power Consumption	Tx Mode	W	---	---	16
	Rx Mode	W	---	---	12
Supply Voltage		Vdc	---	15	---
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™ One 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 either by RJ-45 ethernet cable or USB cable. Both the UI and API are available for our customers to access and download from the Web. The user interface shows the 16-channel phase and amplitude control block diagram as depicted below. To control the parameters, please drag the dB and Φ slide bars on the desired channel to make the changes. The left portion of the interface shows the beam steering angle. This can be used together with our standard antenna kit to control the steering angle.

Figure 2. TMXLAB Kit – Software GUI for controlling BBox™ One

Connector Specifications

Parameter	Location	Type and Function
RF1, RF2, …, RF16	Front Panel	16 channel RF ports with SMPM connectors
RJ-45 Ethernet	Back Panel	Control port (including UI and API control)
DC IN	Back Panel	Type-C DC input (DC 15V/2A max. adapter included)
RF COM	Back Panel	RF common port with 2.92 mm (K) Jack connectors
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	Length	Width	Height
Dimension	With AA-Kit	mm	153	82	82
Weight	Aluminum	g	---	650	---

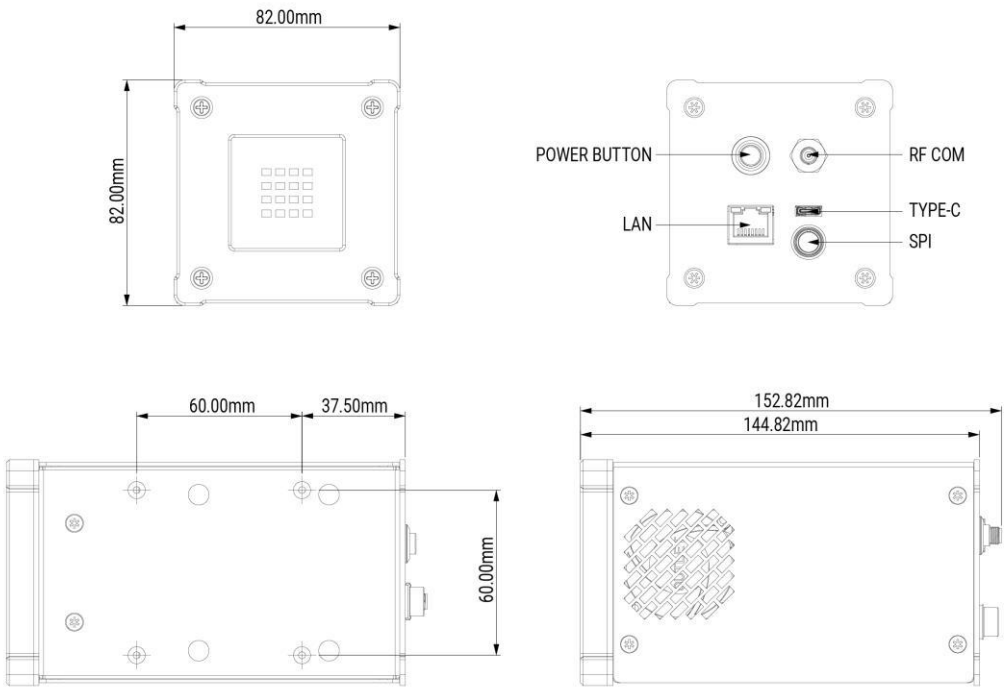

Figure 4. BBox™ One Dimension Drawing

