vBlu

Hardware spec

Revision 1

Vayyar Imaging Ltd.

Web: https://vayyar.com

Add:Suzhou Industrial Park, Suzhou City, Jiangsu Province Building 24, Block A, Times Square

Notice

Revision History

Revision	Date	Author	Description
1	December 2019	Yuval Mekamel	
1.3	July 2020	Yuval Mekamel	Updated mechanical and TX power and frequency data
1.4	February 2022	Noam Reuveni	Updated frequency data

Table of Contents

List of Figures

List of Tables

Chapter 1
Introduction

This guide provides basic technical information on the Vayyar vBlu board. vBlu board allows to build a three-dimensional, RF-based sensor.

1.1 Audience

This document is targeted at the following audiences:

- Engineering and technical marketing personnel who are interested in evaluating Vayyar 3D imaging capabilities and are considering integrating Vayyar solutions into their products.

1.2 Release Information

This is a first Hardware version for demonstration of system capabilities. Both algorithmic capabilities and features are under continuous development and improvement.

1.3 Glossary

Table 1: Glossary

Term	Definition
AC	Alternating Current
API	Application Programming Interface
DC	Direct Current
DLL	Dynamic Link Library
GUI	Graphical User Interface
IP	Internet Protocol. An IP address is a numerical identifier assigned to a computing device or node in a TCP/IP network. The address is used to locate and identify the node in communications with other nodes on the network.
MCU	Micro-Controller Unit
PCB	Printed Circuit Board
RF	Radio Frequency
SoC	System-on-chip

Chapter 2
System Overview

The vBlu system is designed to be operated as a 3D imaging non-contact RF sensor, which enables to identify multiple objects (“targets”) in a defined space (“arena”).

2.1 System Architecture

The vBlu system architecture and connectivity scheme is illustrated in the figure below.

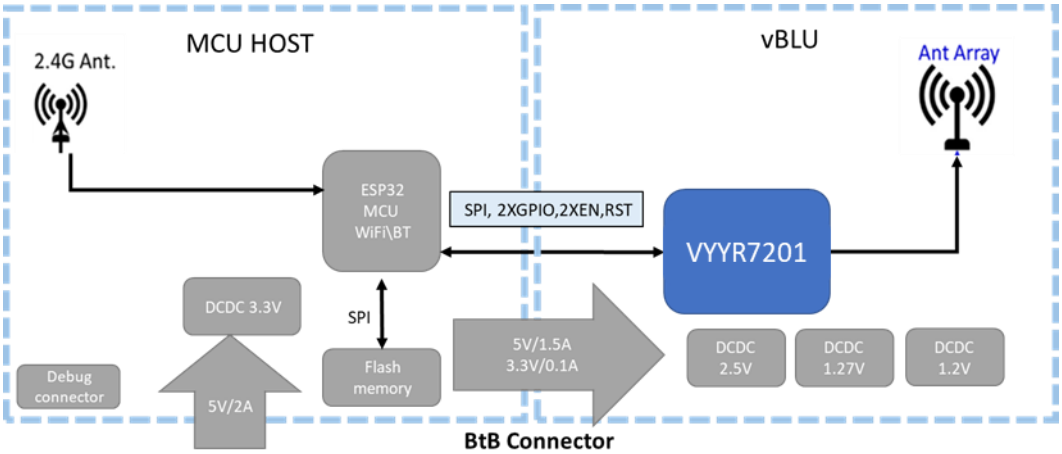


Figure 1: vBlu System Architecture

The vBlu system is comprised of the following components:

- The vBlu RF Sensor Unit (DSP included inside the VYYR7201 chip)
  - The interface between boards is SPI
  - Local power supply devices (2.5V, 1.27V, 1.2V)
- MCU and wireless connectivity module
  - Local power supply devices (3.3V …)
  - Flash memory

2.2 Hardware

The figure below presents a high-level block diagram of a vBlu based system:

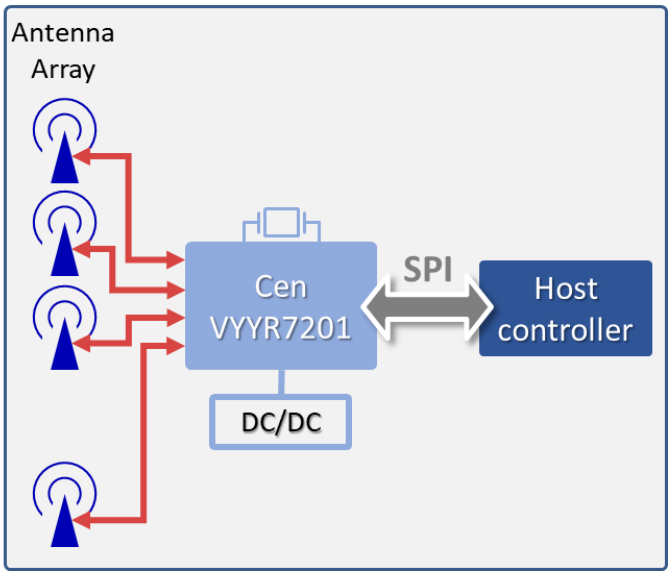


Figure 2: High-Level Block Diagram

The following components are embedded in the sensor unit PCB:

- Vayyar VYYR7201-B2 system-on-chip (SoC).
- 46 embedded Tx/Rx linear polarized PCB embedded, wide-band antennas.
- DC modules
- 40 MHz Crystal is used as a clocking source for the VYYR7201 SoC.
- Digital interface for SPI protocol via 30-pin connector (2BBDVM-53-615G718A01). Refer to section 2.2.2.

2.2.1 Sensor Unit Specification

Table 2: Sensor Unit Specification

Parameter	Specification	Notes
Transceivers	24TX/22RX	
Frequency Band (Japan)	60.01-60.49 GHz	
Frequency Band (Rest of World)	61.01-61.49 GHz	
Field of View (FoV)	Refer to section 2.2.5 Antenna and RF Characteristics	
Range Resolution	$\frac{C}{2BW} = \frac{3e^8}{2 \cdot 1.1e^9} = 13.6\text{cm}$	Depends on the configured BW
Range Accuracy	< < Range Resolution	Depends on the target strength and shape
Angular Resolution	$\Delta\theta \approx \frac{\lambda}{D} \approx \frac{3e^8}{64e^9 \cdot 0.046} \approx 0.102rad \approx 6deg$	λ – Wavelength [@62.5GHz] D – Length of the array [0.046m]
Angular Accuracy	<< Angular Resolution	Depends on the target strength and shape
Dimensions	Without case: 45 mm x 45 mm	Dimensions refer to vBlu board

2.2.2 Digital Interface

The on-board connector requires the following inputs – both for input and DC:

- 5V DC supply
- SPI interface
- DC enable signals
- Reset signal
- GPIO signals

30-pin connector –2BBDVM-53-615G718A01 (Most Well):

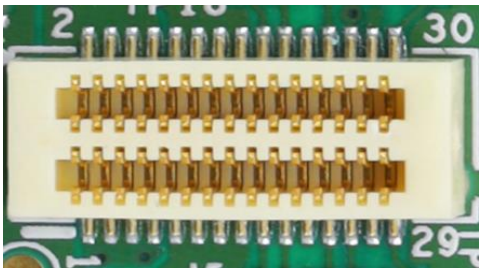


Figure 3: 30-pin Connector

The following table describes the connectivity of the 30-pin connector:

Table 3: 30-pin Connector's Pins Description

Pin #	Signal Name	Direction	Description
1	5Vin	Supply	5V Supply Input
2	5Vin		
3	5Vin		
4	5Vin		
5	5Vin		
6	5Vin		
7	5Vin		
8	5Vin		
9	GND	GND	GND
10	GND		
11	GND		
12	GND		
13	GND		
14	GND		
15	GND		
16	GND		
17	SPI-SS	In	SPI Chip Select
18	SPI-SCLK	In	SPI Clock
19	SPI-SI	In	SPI Data In
20	SPI-SO	Out	SPI Data Out
21	GND	GND	GND
22	GND		
23	GP1	In/Out	Optional GPIO for future use
24	En-DIG	In	Enable for 3.3V and 1.2V regulators
25	GP0	In/Out	Optional GPIO for future use
26	En-RF	In	Enable for 2.5V and 1.27V regulators
27	GND	GND	GND
28	GND		
29	3v3 (VIO)	Supply	3.3V Supply Input
30	reset_n	In	Reset to VYYR7202 chip

2.2.3 RF Interface - Antennas

The array of 46 antennas serves to connect the sensor unit with the environment. The antennas are embedded in the PCB, as depicted in the figure below.

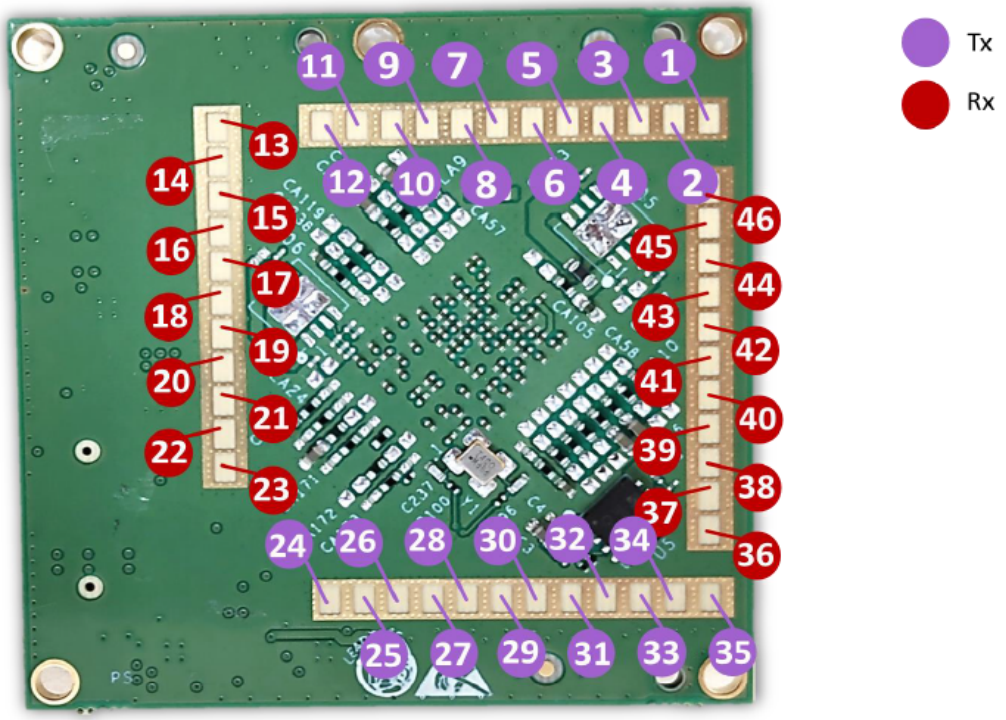


Figure 4: Antenna Positions and Numbering

For each transmitting (TX) antenna, there are multiple receiving (RX) antennas for collecting and recording the received RF signals. Each RX antenna and its associated TX antenna serve as an antenna pair.

2.2.4 Electrical Specifications

The following electrical specifications are for the sensor unit. The host DC board should provide the main 5V and the I/O of 3.3V/1.8V. The current consumption specifications are based on lab measurements performed by Vayyar boards, and a preliminary estimation of expected performance for the module.

Table 4: Sensor Unit Electrical Specification

Supply voltage	Min Voltage	Max Voltage	Max current consumption (profile dependent)	Average current consumption (Duty cycle dependent)
5V	4.5V	5.5V	1.5A	0.7A
3.3V	3V	3.5V	0.1A	0.05A

2.2.5 Antenna and RF Characteristics

The following are antenna and RF characteristics, based on the simulation of a single antenna over an infinite ground plane:

Table 5: Antenna and RF Characteristics

Parameter	Value	Comment
Gain	5 dBi @61 GHz	At 0˚ Elevation, 0˚ Azimuth
Antenna -3 db Beamwidth	150 deg. @61 GHz (E-plane) 85 deg. @61 GHz (H-plane)	
Polarization	Linear	
Max Tx Power	Up to -20 dBm	Aggregated peak conducted power

The figure below depicts an antenna and its E and H planes:

- E-plane – plane XZ (green)
- H-plane – plane YZ (red)

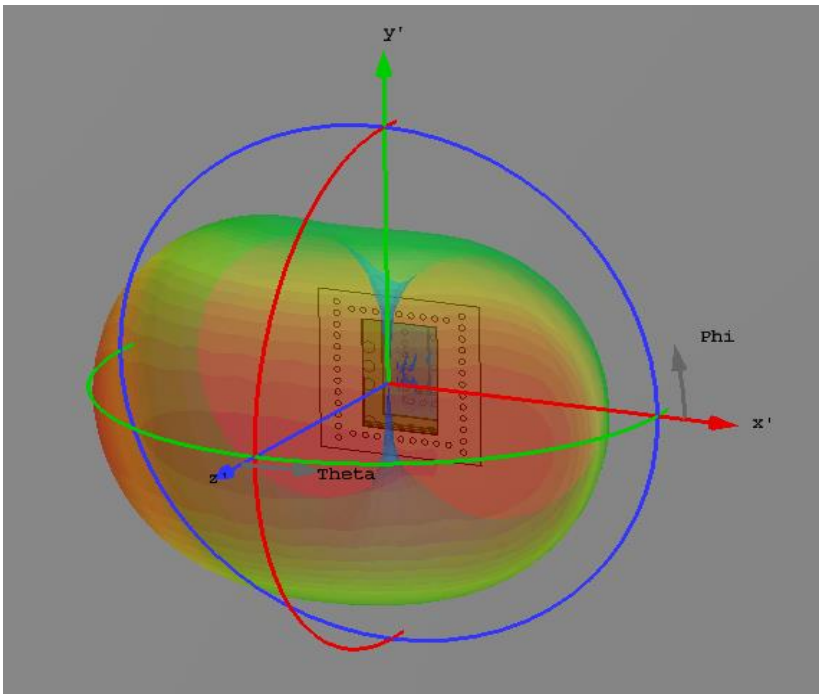


Figure 5: vBlu Antenna Pattern

2.2.6 Mechanical Guidelines

- Material: standard ABS/PC-ABS or other polymers (assuming Ɛr = 2.9@62GHz)
- Thickness: $1.4mm \pm 0.05mm$ (~ half wavelength in the material)
- Distance from PCB: $2.4mm \pm 0.1mm$
- Painting: non-conductive paints (Zero DC-conductivity is required)
- Metal nuts: try to keep out of the senor's field of view
- Product level EM simulation is recommended

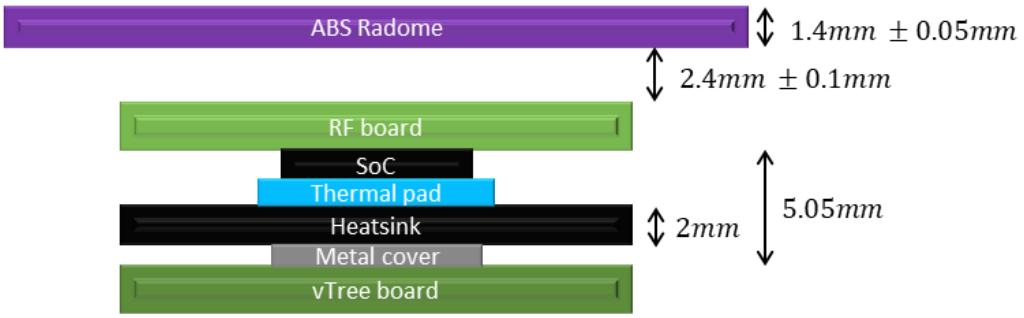
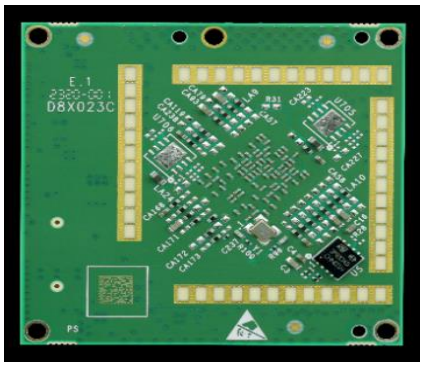


Figure 6: Mechanical Guidelines

NOTE

For wall installation, verify the board is installed rotated by 45°.

Figure 7: vBlu - wall installation



2.3 Software

The vBLU system DSP performs signal processing and generation of the arena image. The SPI I\F will be used for both boot-loading the VYYR7201 FW, and for retrieving either points-list or targets-list (position, state and SNR).

The exact API shall be discussed and concluded with the partner, and provided in the API spec.

The following diagram describes the processing flow of the software.

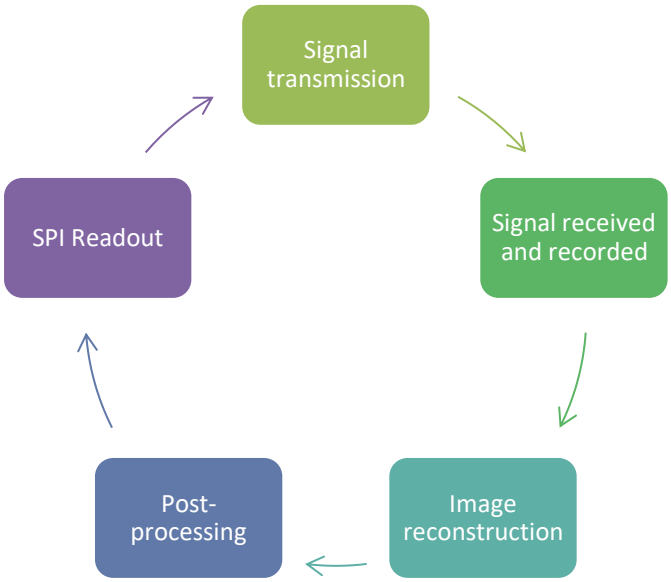


Figure 8: Processing Flow

END OF DOCUMENT