# WALABOT - Technical Brief
Technical Specs (subject to change)

1.   Introduction

Walabot is a programmable 3D sensor that looks into objects using radio frequency technology that breaks through known barriers, bringing highly sophisticated sensing capabilities to your fingertips. Walabot uses an antenna array to illuminate the area in front of it, and sense the returning signals. The signals are produced and recorded by VYYR2401 A3 System-on-Chip integrated circuit. The data is communicated to a host device using a USB interface, which is implemented using Cypress controller.
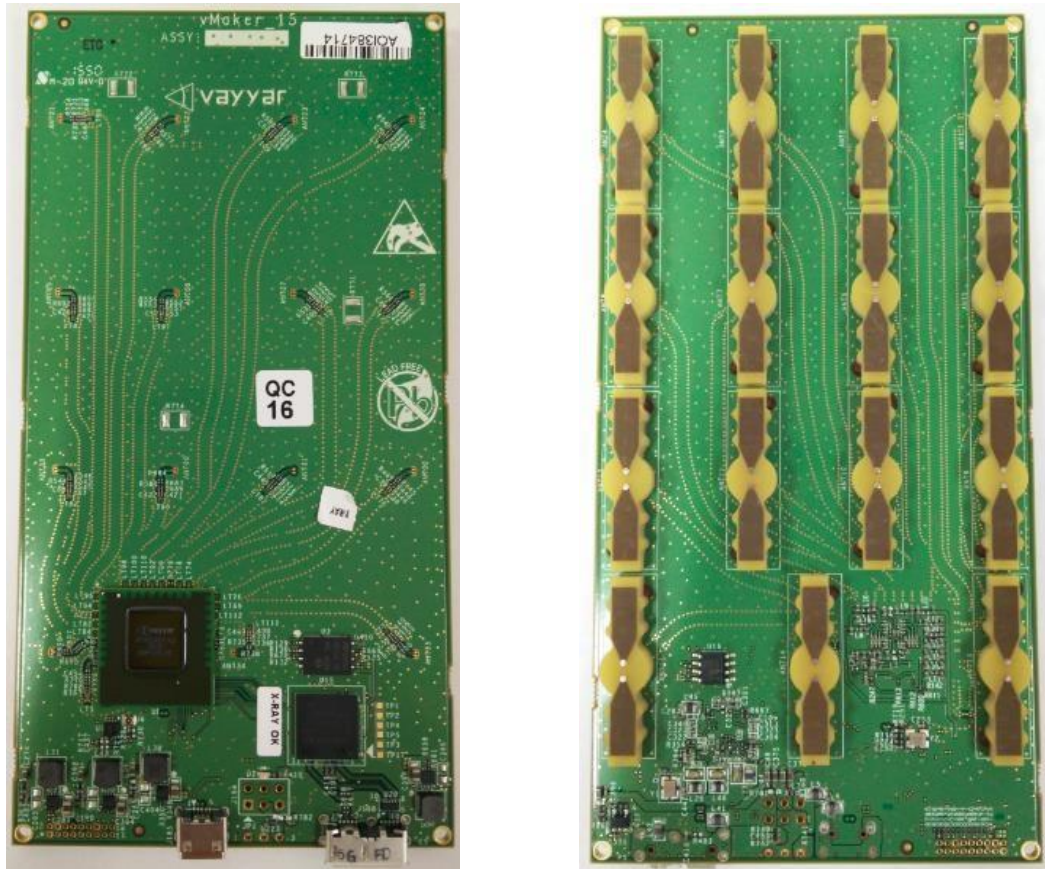
The left picture shows the backside of the board, with the VYYR2401 chip, the USB controller and the micro-USB connectors. The right picture shows the antenna array. This side should be directed towards the objects you want to sense.

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2.   Features

Three-dimensional radio-frequency based sensor

Uses an array of linearly polarized broadband antennas

Frequency range:

Developer
  o   3.3-10 GHz (US/FCC model)
  o   6.3-8 GHz (EU/CE model)

Starter
  o   6.3-8 GHz

Based on VYYR2401 A3 System-on-Chip for signal production and recording

Cypress FX3 controller for USB communication and data pre-processing

Walabot interface connectors:
  o   Micro-USB 2.0 for high-rate data communication. Option to provide supply from USB.
 o   Single supply voltage 4.5-5.5v input for non-USB power applications.

2.1   Feature summary of Starter, Creator and Developer models

Capability \ Model	Walabot Starter	Walabot Creator	Walabot Developer
Physical			
Number of antennas	3	15	18
Board size	72 mm * 48 mm	72 mm * 140 mm	72 mm * 140 mm
External powering option	No	Yes	Yes
Software API capabilities			
Basic API functions	Yes	Yes	Yes
2D acquisition	Yes	Yes	Yes
3D acquisition	No	Yes	Yes
Multiport recorder (raw data)	No	No	Yes
Software application capabilities			
Breathing detection	Yes	Yes	Yes
Object detection	Yes	Yes	Yes
Short range imaging	No	No	Yes

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3.   Functionality

3.1   Overview

Walabot senses the environment by transmitting, receiving and recording signals from multiple antennas. The broadband recordings from multiple transmit-receive antenna pairs are analyzed to reconstruct a three dimensional image of the environment. Analysis of sequences of images allows detecting changes in the environment. Walabot is capable of short-range imaging into dielectric environments, such as drywall and concrete.
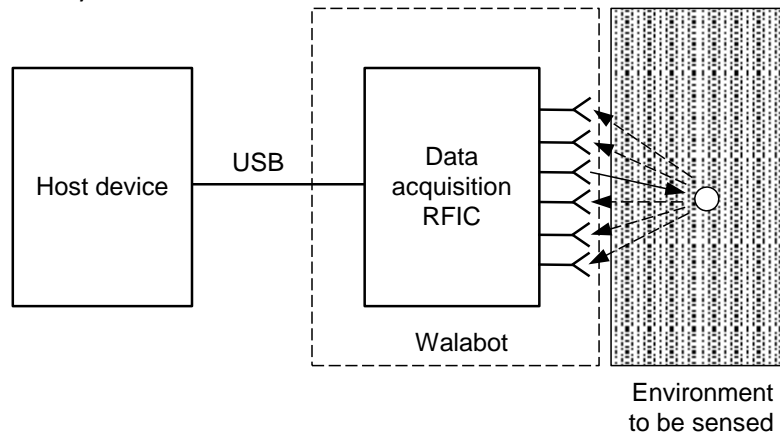
This opens the possibility to use Walabot for numerous use-cases:

    In-room Imaging
    In-wall imaging
    Object detection, location and tracking
    Change detection
    Speed measurement
    Motion sensing, such as breathing detection
    Sensing of dielectric properties of materials

Some of these capabilities are provided within the software API of Walabot.

3.2   Software API

Walabot SDK provides shared libraries with a defined API. In addition, binding code is provided for java and C# (JNI & pInvoke interfaces). Development of an application for Walabot can be done either for Windows/Linux or for Android. Programming languages can be:

    C#/VB/C++ for windows
    C++ for Linux (future release)
    Java/C++ for Android (future release)

The API functions can be grouped into following categories (subject to change):

    General Initialization and configuration – common for all use-cases

Single Target Location
Respiration and heartbeat monitoring
General Doppler speed measurement
RF Imaging
People presence monitoring

The API allows writing powerful and flexible applications easily. For example, high-level flow to get RF image from the device is as follows:

Initialize the device
Set the input parameters – the arena dimension, resolution and medium dielectric constant.
Perform recording.
Get the resulting 3D image.

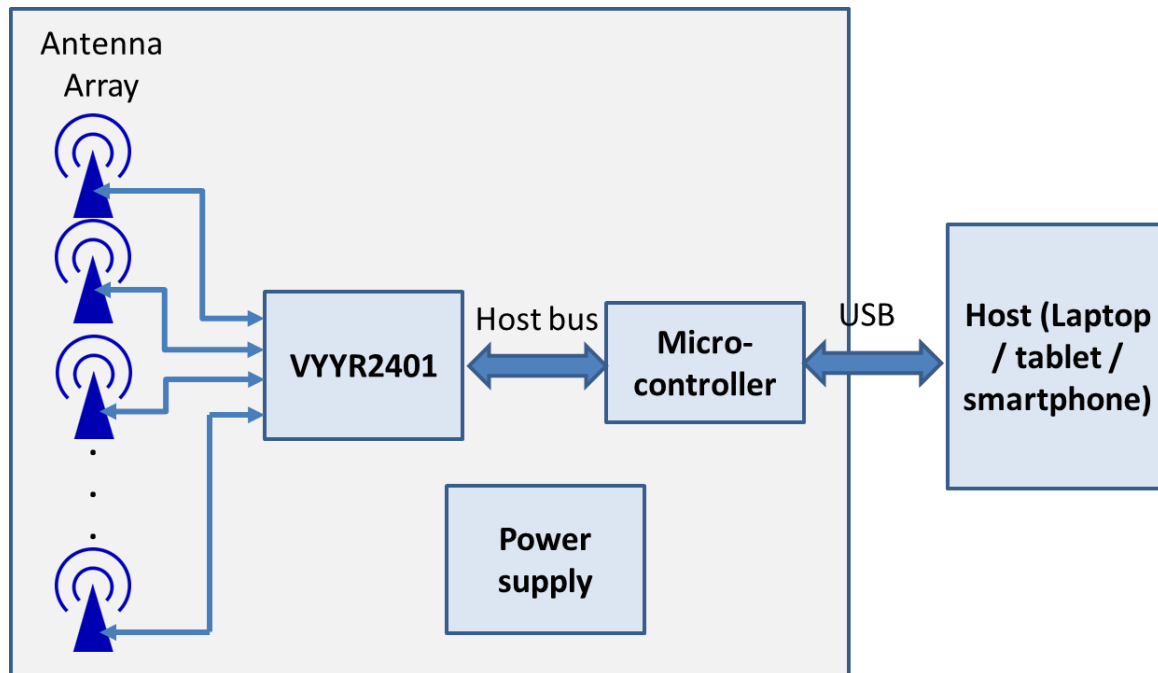For additional information regarding API and sample code examples please refer to http://api.walabot.com/

We also have a beta version.
For additional information regarding our beta API and sample code examples please refer to http://api.beta.walabot.com/

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4.   Block Diagram

Figure 2 presents a high level block diagram of the Walabot platform.


5.   Interfaces

The module main interface is USB for communication and configuration.

5.1   USB Interface

The onboard µUSB 2.0 connector supports USB 2.0 in High-Speed mode (480Mbit) and USB 3.0 in Super-Speed mode.

5.2   Powering options

The Walabot Developer and Creator have two µUSB connectors – one is used for data transfer and possibly powering the Walabot, and the other USB connector is for power only. Select your power source for Walabot using the jumper on the back side of Walabot board. In the figures below you can see the jumper position for powering through the main (blue) or the auxiliary (green) USB port.

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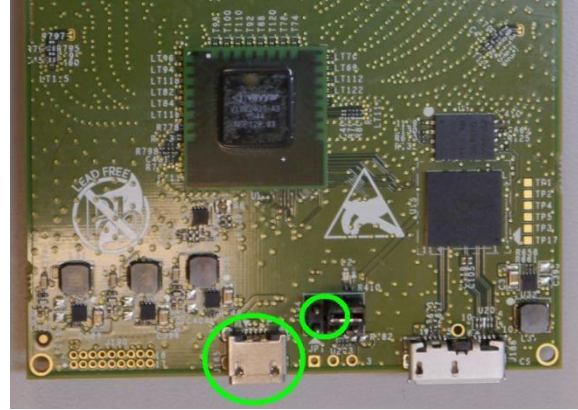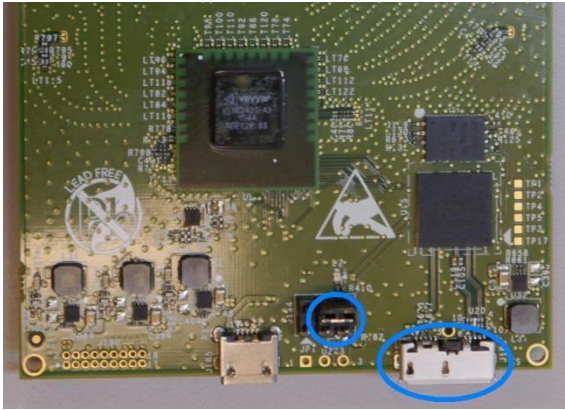
When you are at the point in your project where you would like to place the board in a case, you will need to experiment with the powering option and place the jumper accordingly.   By default, the board is configured to provide power using the main USB port.

The external powering requires a 5 Volt (+/- 10%) supply. Walabot consumes 0.4-0.9 Ampere current, depending on application and operation profile.

6.   Software Installation

Walabot software installation depends on the platform. You'll have to follow instructions specific to your OS. Check on the Walabot site (http://api.walabot.com/_install.html) for the latest instructions and documentation.

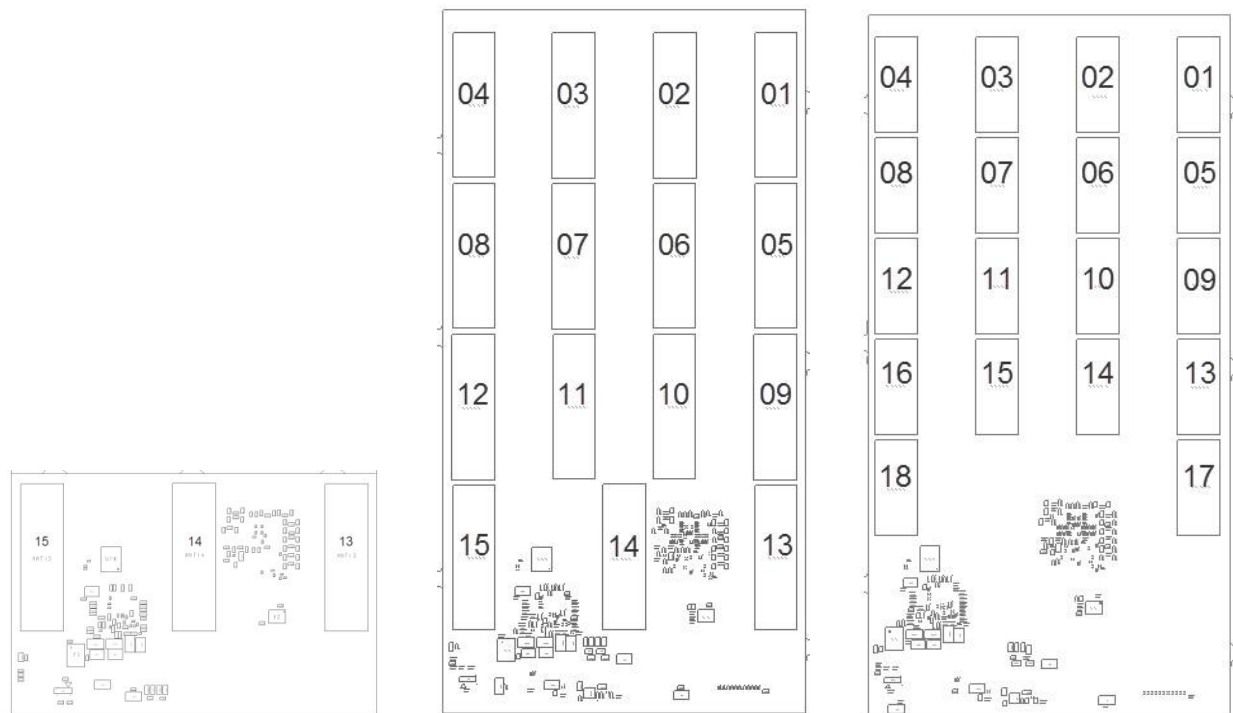WALABOT

7. Antennas and RF characteristics

7.1 Antenna Characteristics

The antennas have broadband performance covering the 3-10 GHz frequency range. Representative simulated gain patterns at low/medium/high frequency of the Creator model are shown below:
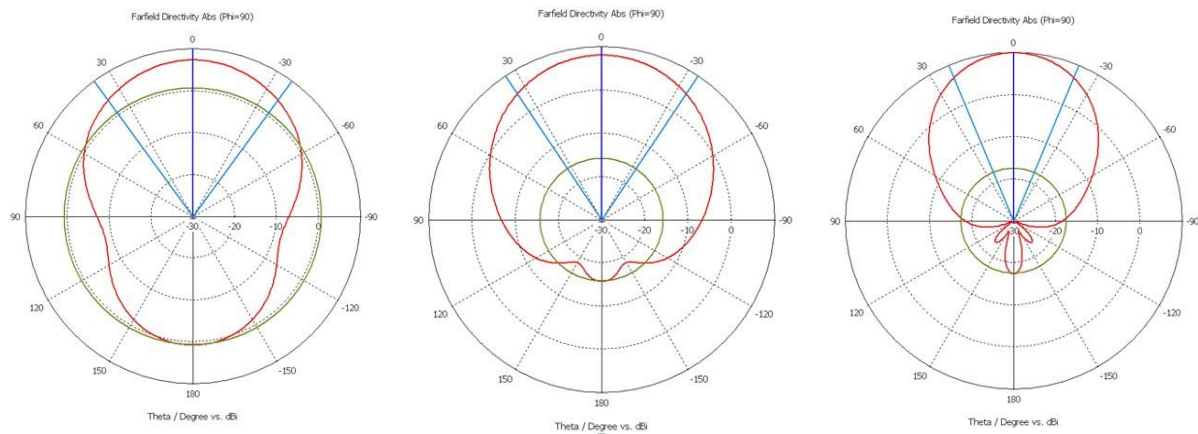
7.2 Antenna numbering

In scenarios where you want to relate the data from specific antenna pairs to antennas' locations, you may refer to the figure below, for numbering of antennas in the Starter, Creator, and Developer models.

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7.3   RF Characteristics

Walabot operates over an ultrawideband (UWB) range of frequencies corresponding to the regulatory domain of the model. The US/FCC models of Walabot Developer can operate over 3.3-10 GHz range. The European/CE models can operate over 6.3-8 GHz range. Walabot starter operates between 6.3-8 GHz range. The average transmit power of both models is below -41dBm/MHz. These power levels do not have any health issues whatsoever. The range of frequencies is predetermined for each regulatory domain.

7.3.1   Operating Walabot in conjunction with other wireless devices

In some cases your projects may contain both Walabot module and an additional wireless device for communications in proximity to each other. It is best to configure the devices such that their frequencies of operation do not overlap. For example, if the FCC model of Walabot is used in conjunction with a WiFi module, it is the safest to configure WiFi to operate in the 2.4 GHz band, rather than in the 5 GHz band. If you configure Walabot to use 3.3-4.8 GHz subband or the 6.3-8 GHz subband (as in CE models), both 2.4 and 5 GHz bands of WiFi are safe to use. Bluetooth, Zigbee and cellular bands are all below 3 GHz and should pose no mutual interference challenges. We recommend locating the modules furthest away from each other.

8.   Mechanical data

Eventually, as your Walabot board becomes part of your project, you'll want to secure it in a safe and convenient place. Several options are possible.

We supply an optional protective case, which can be used to host the Walabot board. This case comprises a magnetic mount on its back, which enables it to attach to iron surfaces. We supply a stick-on metallic ring which can be placed on your cellphone, or your robot, or the wall of your lab, so that you can attach and detach Walabot easily. Make sure that the front side (the side without the logo) is facing towards the area of interest.

You can fix Walabot to the surface of your project, or to its cover. Make sure that the front cover is nonmetallic (e.g. plastic) and preferably thin (not exceeding 2 mm). Make sure that the front side with the antennas is facing outwards.

In the case of temporary use of bare board, be sure to lay it on a non-conducting surface, to prevent an electric short. Avoid repeated strain on USB connectors.

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8.1   Starter model

Back View   **Front View**

8.2   Creator and Developer models
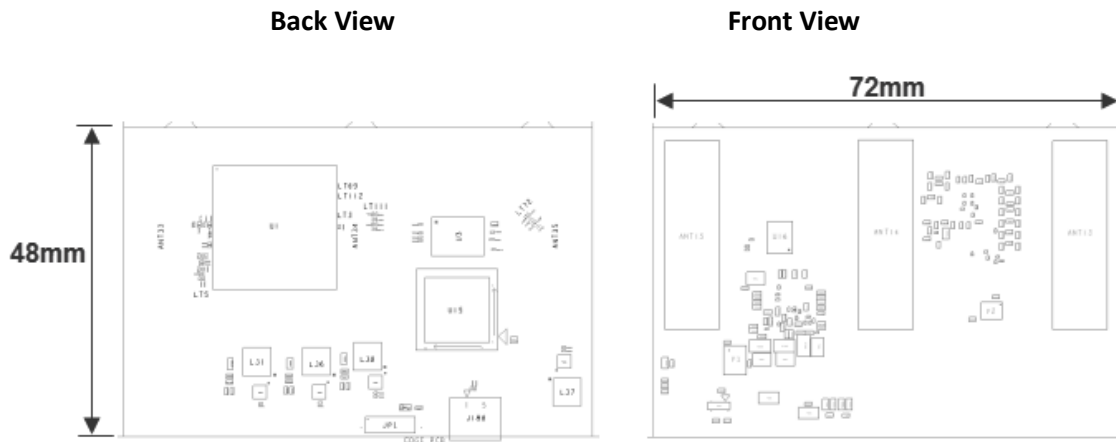
Back View   **Front View**
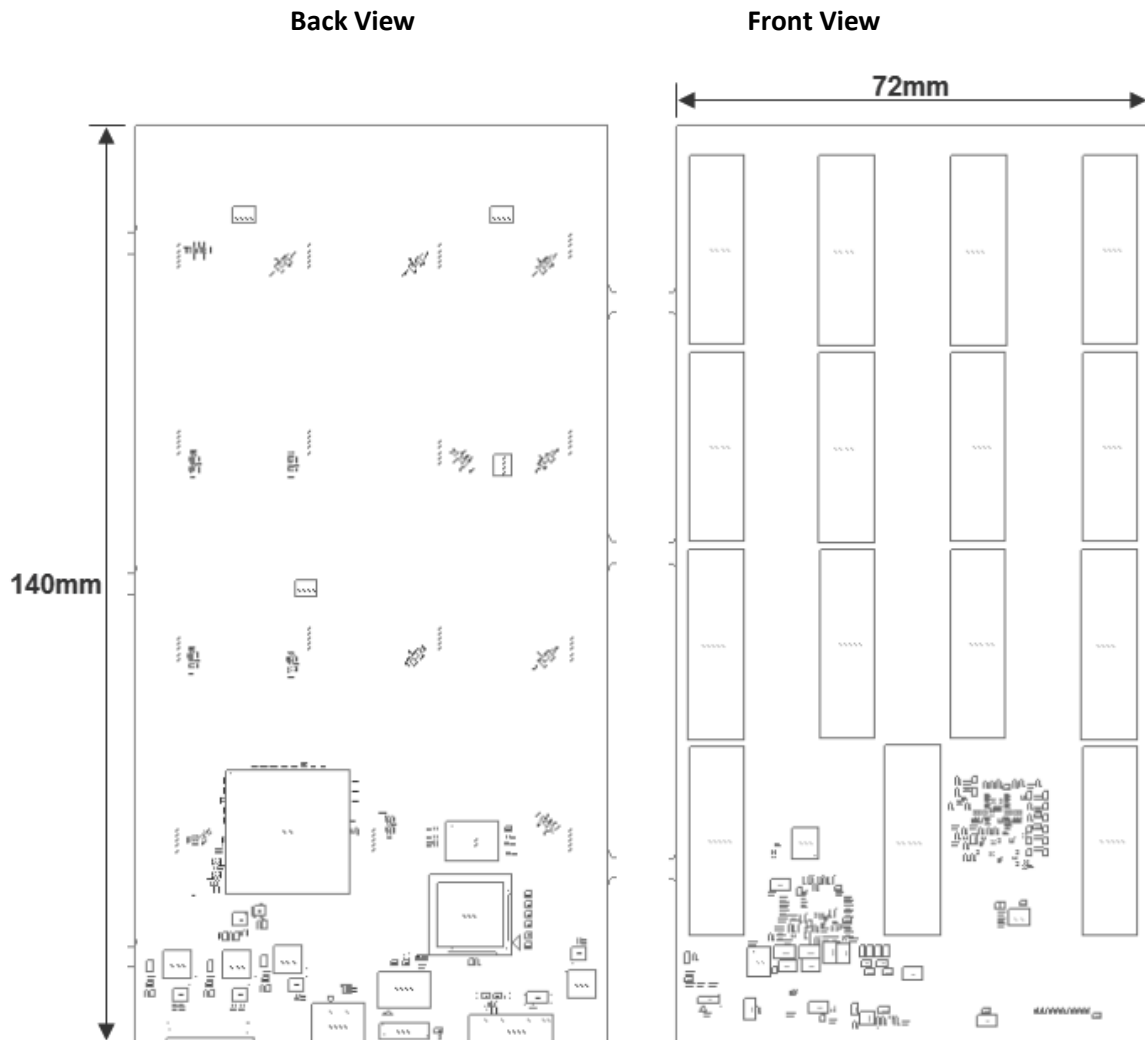
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8.3   Optional case

Back View   **Front View**

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9.   Regulatory Information

9.1   Regulatory Conformance

The Walabot device has been designed to be in compliance with the FCC regulations governing UWB hand-held systems (Part 15.519) also known as "battery powered devices" or "mobile devices." This means that the device can be incorporated in a wide variety of products including educational robots, pipe locators, breathing monitors, etc. Note that there are other applications which are specifically forbidden, such as use of the devices in toys. See FCC Parts 15.519 and 15.521 for more details.

Certain models of the Walabot device have been designed and tested to be in compliance with CE requirements, and in particular to conform to ETSI standards EN 302 065-1, EN 301 489-33 and EN 301 489-1. In particular, the CE compliant devices are restricted to operation in the 6-8.5 GHz band. **Make sure that if you design to use the device outside US, that you have the appropriate model number.**

9.2   FCC regulatory statements

This device complies with 47 CFR Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The user is cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device may not be employed for the operation of toys. Operation onboard an aircraft, a ship or a satellite is prohibited.

The use of this device mounted on outdoor structures, e.g., on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited.

Moreover, the following statements apply:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.

9.3   FCC ID Labels

The Walabot products have a FCC ID of **2AHIS-VMAKER**. The FCC ID marking is found on the right lower front side of the printed circuit board.

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