ARIA™ Sensing by Cover Sistemi

LT103OEM UWB Radar Module

Rev.2.1

Data: 27/01/2021

Author: Technical Office

POC: info@ariasensing.com

LT103OEM UWB Radar Module

Rev.2.1

1 Summary

LT103OEM is a high-precision, compact and lightweight SMT Ultra-Wide Band Radar module for indoor applications. LT103OEM integrates high-end antennas, the signal processing unit and the communication interface. It is designed to comply with EU EN 302 065 (EU), ARIB STD-T91 Ver. 2.0 2015 (Japan), FCC CFR 47 Part 15 (USA), RS220 03/2009 (Canada), KCC (South Korea) UWB Regulations.

General Specifications

- Maximum detection range: 10 meters
- Power consumption: 150mW @ 1.8V
- Operating frequency: 7.3GHz to 8.5GHz
- Power supply: Typical 1.8Vdc to 3.3Vdc
- Operating temperature: -40°C to +85°C
- Embedded antenna aperture: ±60° (azimuth) by ±60° (elevation)
- Communication interface: UART
- Dimensions: 15mm x 30mm

The device is typically installed into a wall-mounted product to detect people and gesture in rooms, offices, corridors, etc. Other use cases may require the device installed in cavities inside furnishings or switch-plates.

The device emits the UWB pulses only in the “inside” of a building.

Typical applications:

- Presence detection
- Position tracking
- Breath detection and monitoring
- Gesture recognition

Table of contents

1 Summary 1
2 Features 2
3 Operating principle 2
4 Electrical specifications 4
5 Radar Diagram 5
6 Pin-out description 8
7 Firmware 9
8 Typical Schematic 10
9 Suggested layout 10
10 Communication Interface 12
11 Drawings 12

2 Features

The LT103OEM is a high configurable UWB radar. This module combines a full UWB transceiver and an on board MCU.
The module is targeted for application like presence detection, position tracking, breath detection and analysis. The communication is achieved with a **U**niversal **A**synchronous **R**eceiver-**T**ransmitter interface.

3 Operating principle

The operating principle of the system is based on the direct readout of the backscattered pulse

- The transmitter emits pulses (Fig. 1a) which travels into space and hits the targets that are into active area of the radar

- The targets reflect part of the incoming energy (echoes) backward to the radar module (Fig. 1b).
- The receiver converts the incoming signal to digital data, these data are provided to the MCU and processed according to the application.

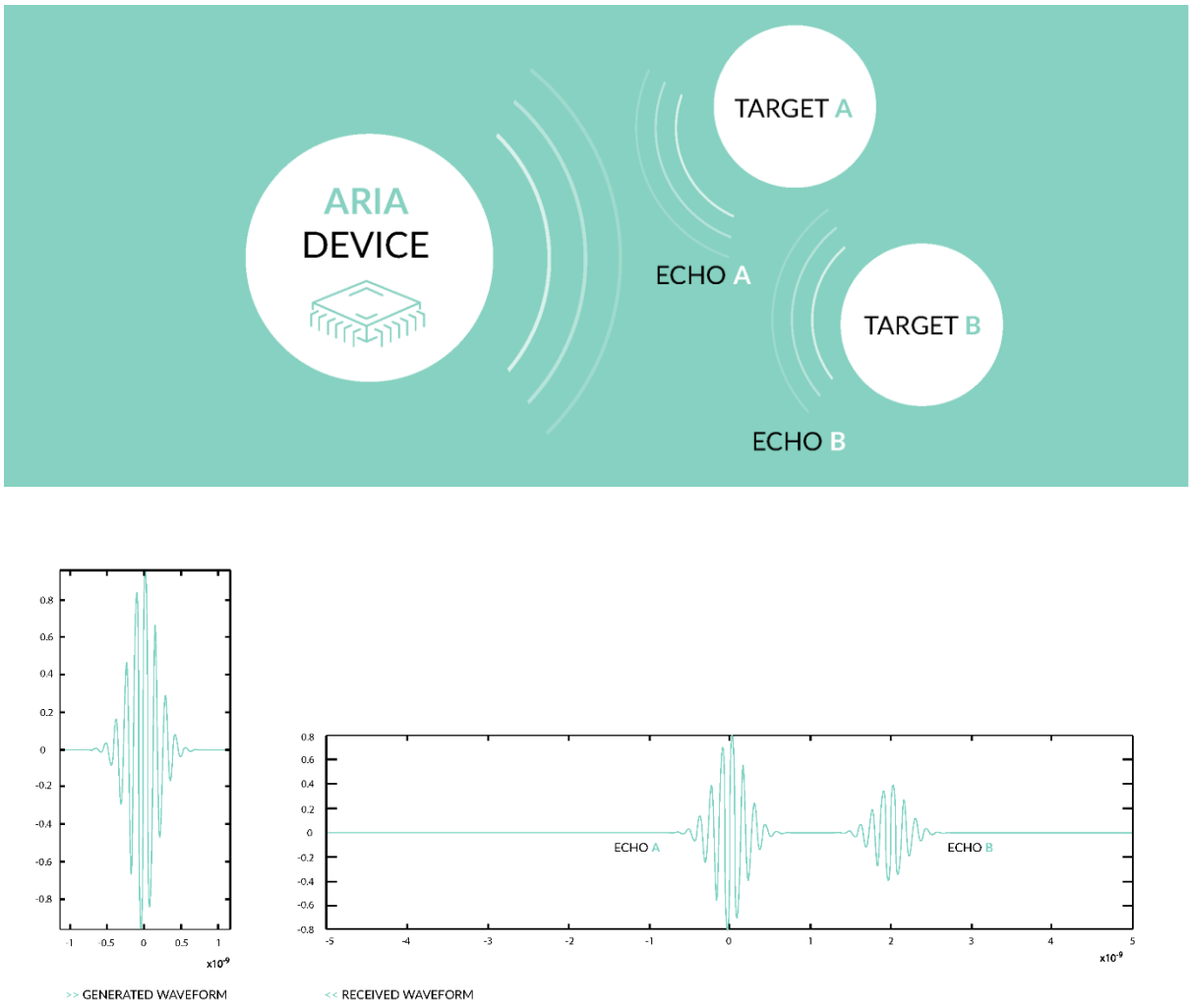


Fig. 1: The basic principle and the waveforms: a) generated pulse at transmitter (left) and b) generated echoes from targets (right)

4 Electrical specifications

	Min	Typ	Max
Operating frequency	7.3GHz	7.9GHz	8.5GHz
Mean e.i.r.p. density			-41.3dBm/MHz
Peak e.i.r.p. density			0dBm/50MHz
Temperature range	-40°C		+85°C
Supply voltage (Vdd_{RF})	1.72V	3.3V	3.6V
Supply voltage (Vdd_{DIG})	1.72V	3.3V	3.6V
Supply current (Idd_{RF}+Idd_{DIG})			100 mA
Range resolution		7 mm	
V_{IL}	0		$0.3 \cdot Vdd_{DIG}$
V_{IH}	$0.7 \cdot Vdd_{DIG}$		Vdd_{DIG}
V_{OL} (I_{OL}=0 mA)	0.0		
V_{OH} (I_{OH}=0 mA)			Vdd_{DIG}
R_{series} IO (protection resistors, UART, SWDIO and SWDCLK)		220 Ohm	

Table 1: LT103OEM electrical specifications

5 Radar Diagram

The LT103OEM emitted power is radiated mainly in the radar front side, along the so called **downrange direction** where the radiated power is at maximum.

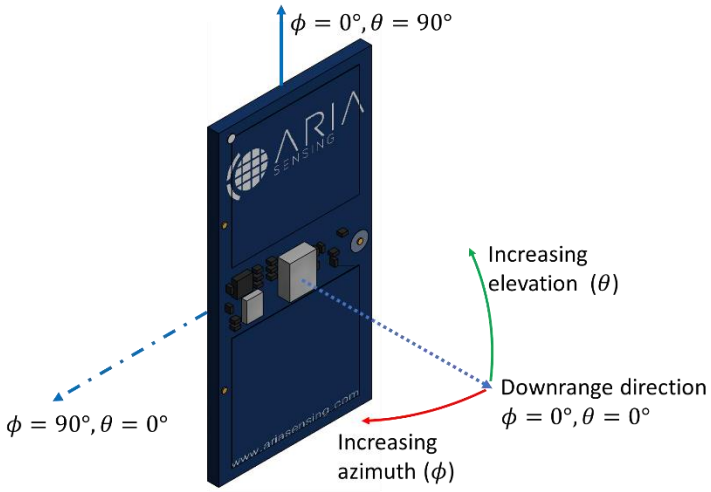


Fig. 2 Radar refence axes

Moving from the downrange direction, the emitted and received power decay. Thus, the same target placed at the same distance but at different azimuth and elevation angles will generate different echo's amplitudes (and lower when compared to the downrange direction).

The received power is shown in the next pictures. In Fig. 3, the power (dB scale) is taken over the "horizontal" (i.e. over θ=0°cut-plane). The power is normalized to the power received from the same target placed along the down-range direction.

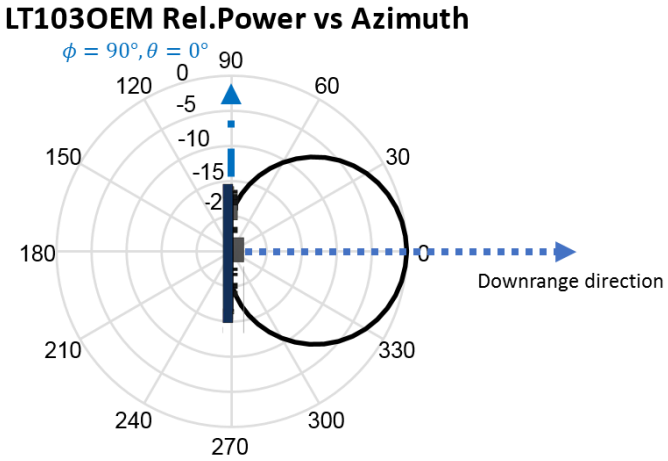


Fig. 3 Relative power (dB) over $\theta = 0°$ cut-plane relative to the downrange axis

In Fig. 4, the power (dB scale) is taken over the “vertical” (i.e. over φ=0˚cut-plane). The power is normalized to the power received from the same target placed along the down-range direction.

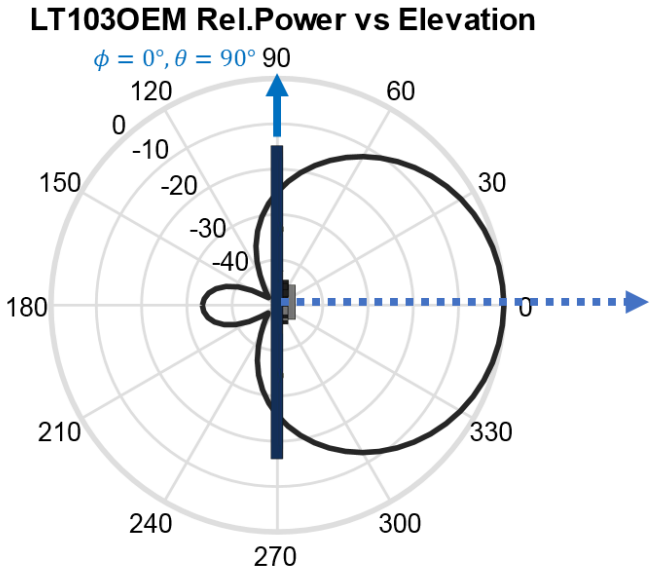
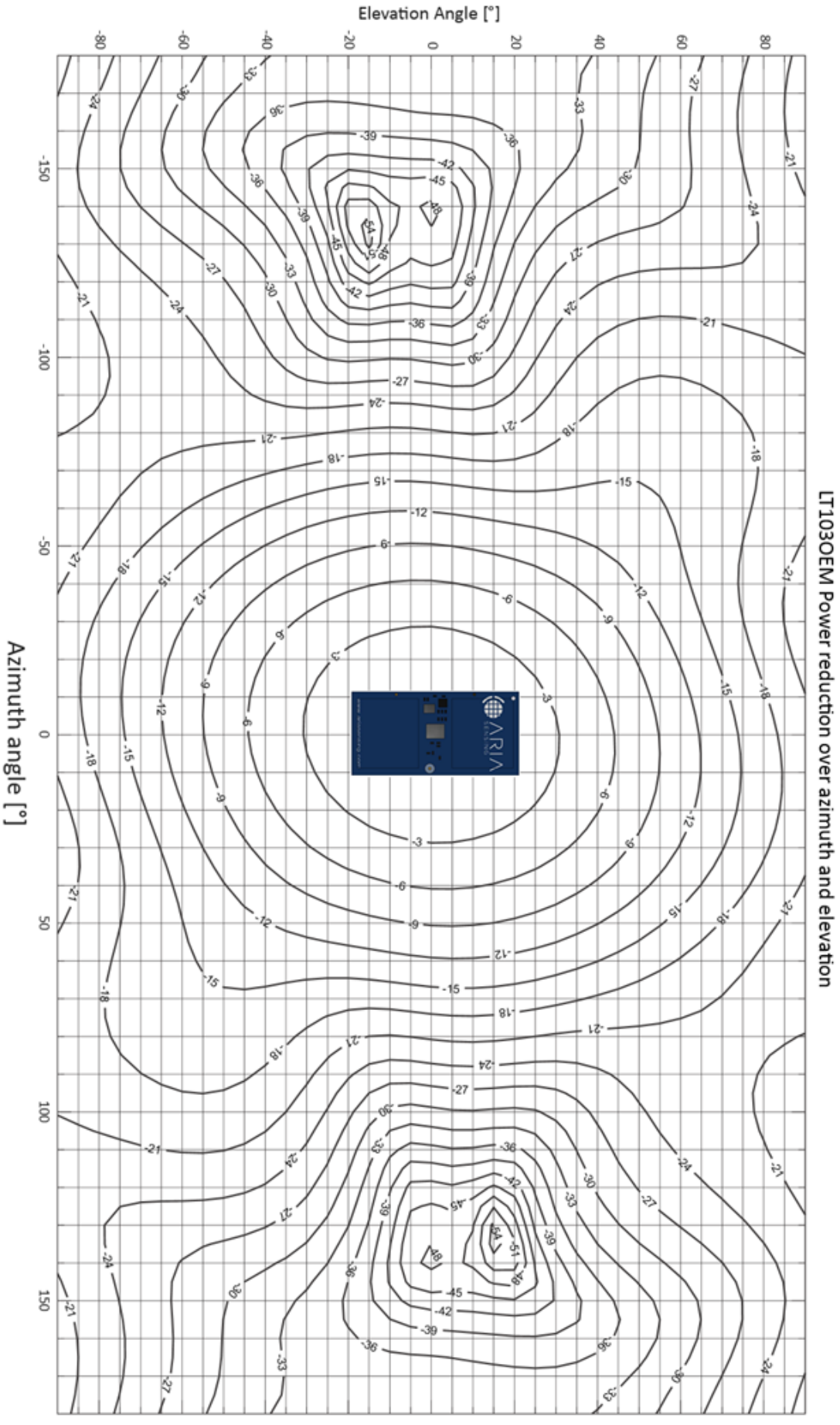


Fig. 4 Relative power (dB) over $\phi = 0°$ cut-plane relative to the downrange axis.

In the next picture a full representation of the entire volume is reported. The received power is normalized to the power along down-range direction. The ratio is reported in *dB*.



LT103OEM Power reduction over azimuth and elevation

6 Pin-out description

The LT103OEM pin-out reference drawing and functionality is described in Fig. 2 and Table 2 respectively.

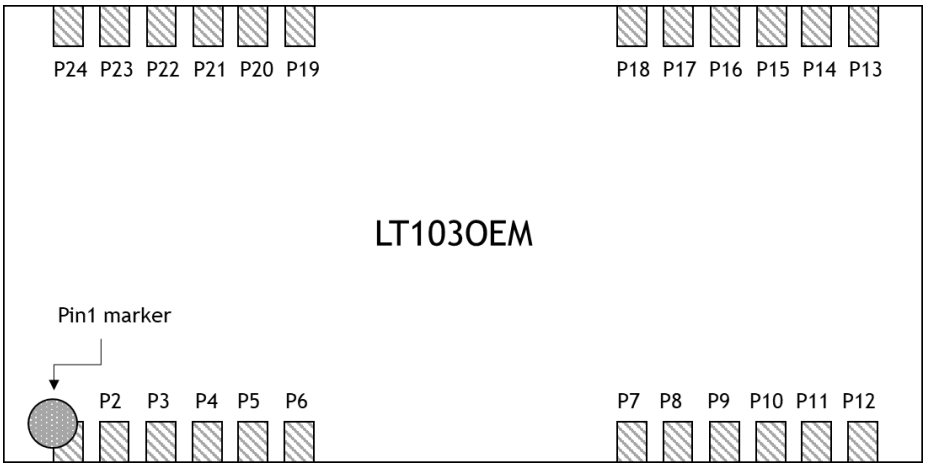


Fig. 5: Reference Drawing for Pin Out (top-side, top-view)

Pin	Description
1	Ground
2	CKIO_P <In/Out> LVDS Synchronization Clock Pos (multi-module)
3	CKIO_N<In/Out> LVDS Synchronization Clock Neg (multi-module)
4	Ground
5	Vdd_{RF}: RF Power Supply Voltage (may be shorted to P19)
6	Ground
7	Ground
8	SYSRST: system reset (active low)
9	SWDCLK: Debugger Clock
10	SWDIO: Debugger I/O
11	Ground
12	Ground
13	Ground
14	Ground
15	Ground
16	UART_RX: UART Receiver Pin

17	UART_TX: UART Transmitter Pin
18	Ground
19	Vdd_{DIG}: Digital Power Supply Voltage (may be shorted to P5)
20	Ground
21	Ground
22	TRX_SYNC: Synchronization Signal (Multi-module)
23	Ground
24	Ground

Table 2: LT103OEM pins description

7 Firmware

LT103OEM module is provided with a pre-programmed FW, this FW provides:

- Direct access to the data processing section: raw data or partially processed data
- Moving target detection algorithm
- Front-end control and parametrization

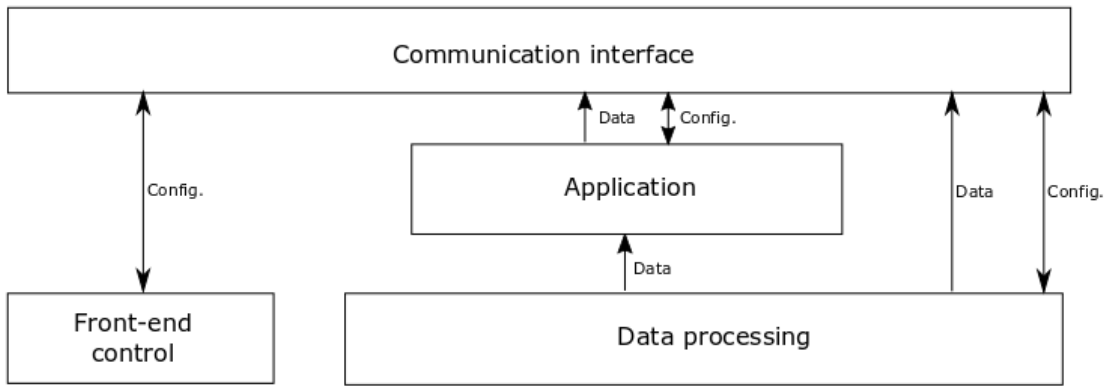


Fig. 6: FW structure

The figure shows the basic structure of the FW. Currently only one application is provided, but the module can run multiple application according to the user needs (ex. Presence detection, breath analysis, etc.). See documentation for details about communication protocol and algorithms.

Bootloader (optional)

The module may be provided with a bootloader application. This feature enables the on-field reprogramming of the module but require an additional start-up sequence in order to run the application FW (see protocol documentation).

This feature is provided on demand.

8 Typical Schematic

The typical schematic for LT103OEM is reported in Fig. 4.

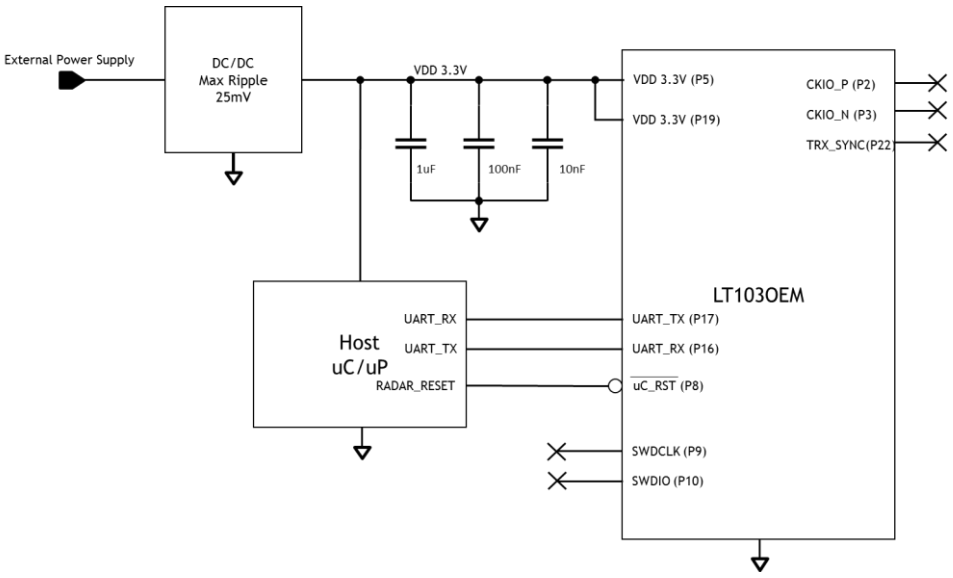


Fig. 7 Typical Schematic

A LDO may be used instead of DC/DC converter. The maximum ripple for the DC/DC output is 25mV.

9 Suggested layout

It is strongly recommended to follow the following layout for your board carrying the LT103OEM. Different layouts may result in slight reductions in performances. Reference layout files in Gerber format for host board is available on demand.

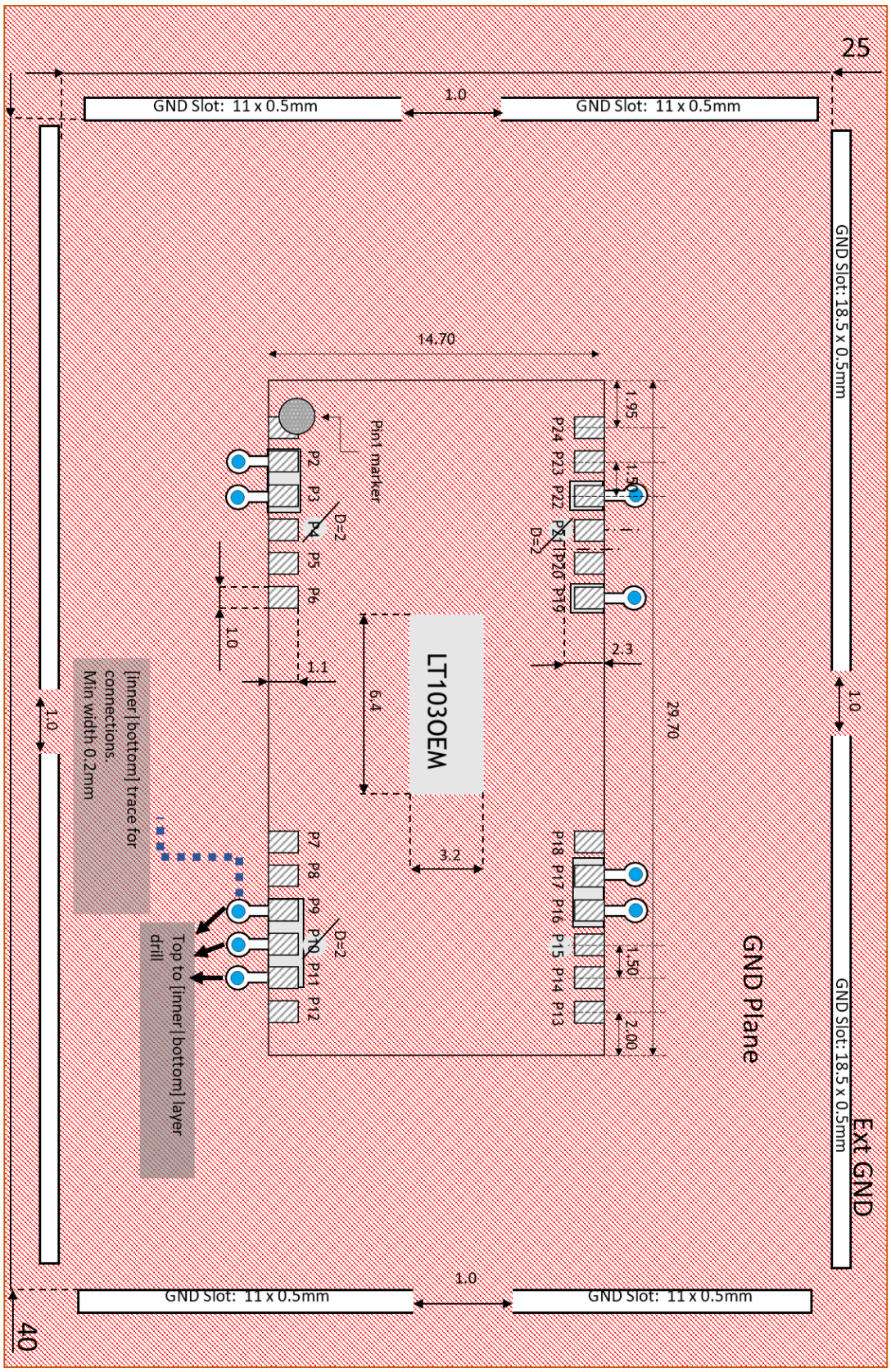


Fig. 8 Suggested Layout for any board adopting LT103OEM

10 Communication Interface

The communication to/from the LT103OEM device is performed through a UART interface. The details and specifications of the communication protocol are provided in "*LT102 and LT103OEM COM Protocol*" document.

11 Drawings

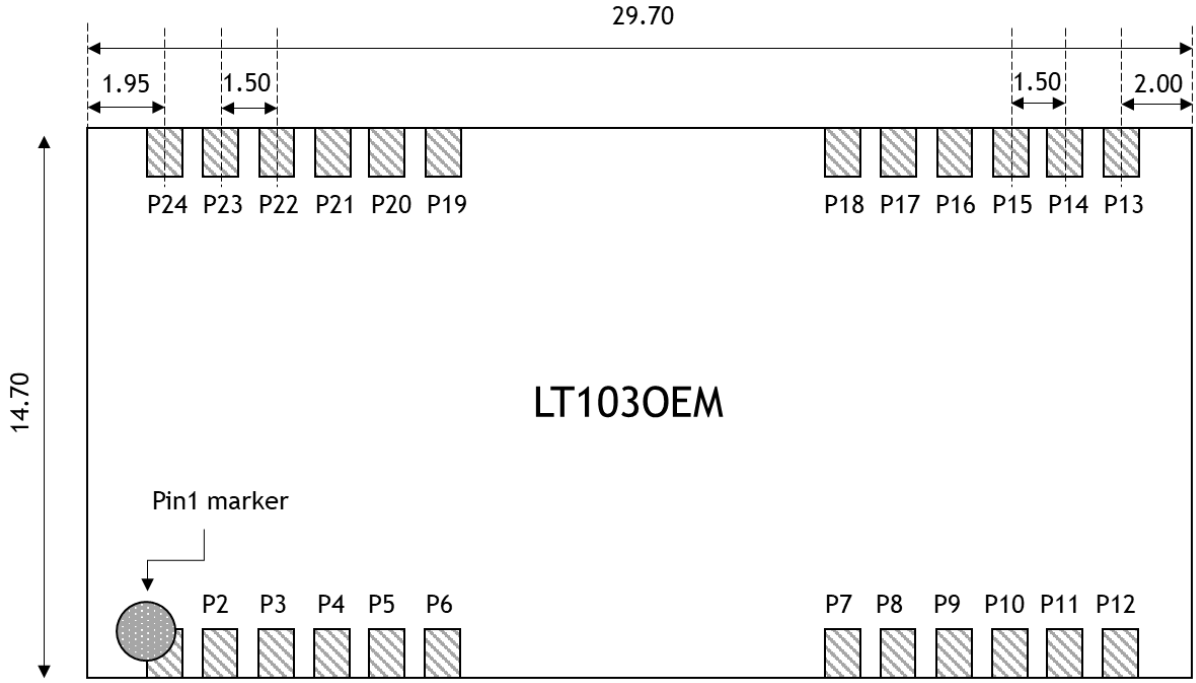


Fig. 9: LT103OEM drawings (15mm x 30mm). Top side (top view)

12 Restriction

- In accordance with Commission Decision 2000/299/CE of 6 April 2000, the device is classified as Class I, Subclass 57e "Equipment using Ultra-Wideband Technology (Location tracking systems)"
- The LT103OEM is a Class I, Subclass 57e device. It is intended for indoor use only.
- The LT103OEM is sensitive to direct sun and visible/IR light. It is recommended to shield it.
- To guarantee the maximum detection distance (10m) the LT103OEM must be kept at least 2m away from a 5GHz WiFi device.

- If the maximum range is less or equal than 5m, there is no minimum distance to 5GHz WiFi devices
- Refer to Paragraph 9. for the layout of the host board.

13 Regulatory Information USA

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
This device complies with 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.
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.

13.1 RF exposure safety

It is designed not to exceed the emission limits for exposure to radio frequency (RF) energy set by the Federal Communications Commission.

13.2 Labelling Requirements for the Host Device

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in

the host device, otherwise, the host device must be labelled to display the FCC ID of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

FCC ID: 2AXYT-LT103OEM

UWB devices may not be employed for the operation of toys. Operation on-board an aircraft, a ship or a satellite is prohibited.

Warning: indoor use only is allowed."

13.3 Compliance of Host Devices

The module has been evaluated in portable stand-alone conditions. For different operational conditions from a stand-alone modular transmitter in a host (multiple, simultaneously transmitting modules or other transmitters in a host), additional testing may be required (collocation, retesting…).

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed. The end product with an embedded module may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized per FCC Part 15.