

Toxic-Detection-PCB – Product Brief

Revision

Revision	Date	Author	Comment
v4.0	Oct 16	Paul Capgras	First draft

1. Motivation

This project aims to design a new PCB to interface with **2 sets of 4 chemical sensors** used to detect toxic gases in the air.

The previous electronic interface, **TELLUS Network Sensor Solutions (rev. 3.2)**, is now limited because it provides only one interface for the sensor AFE, thus supporting only four sensors instead of eight. The current workaround uses **two TELLUS boards** connected in a controller/target architecture.

In parallel, the first AI models have been developed and deployed on an **STM32** to perform real-time toxic gas detection. These algorithms were tested on an STM32 development board but **cannot be embedded** in the current TELLUS board, as the onboard **ESP32** MCU is not powerful enough to run this new software.

A new revision of the TELLUS board is therefore required, with two main goals:

- Support **2 sets of 4 chemical sensors** by providing two AFE interfaces.
 - Integrate a **computing chip powerful enough** to handle the new software requirements.
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2. Functional Description

The device will interface with **two sets of four chemical sensors** and **one temperature sensor**.

- Every **10 seconds**, a measurement of the eight sensors is performed.
- Every **minute**, a Wi-Fi communication occurs to push data to:
 - **Mode 1:** the cloud database, or
 - **Mode 2:** a local computer connected via Wi-Fi.

Data processing can also be enabled and performed on the onboard MCU before transmission via Wi-Fi.

The device will be **powered through a USB-C connector**. The external power source (transformer or battery) is **out of scope** for this project.

The device will include a **computing chip powerful enough to run small AI models**, such as the **STM32H755**. It will be **reprogrammable** as many times as the user desires.

Additional features:

- Provide **power for a ventilator**.
- Optionally support a **LoRa connection**.

3. Electrical Specifications

- **Input power:** 5 V via USB-C connector
 - **Maximum power consumption:** TBD
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4. Mechanical and Form Factor

- **Board dimensions:** Must fit within the predefined box (TBD).
 - **Mounting holes:** Yes (4 total, size TBD).
 - **Connector placement constraints:** None.
 - **Other mechanical constraints:** None.
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5. Interface & Connectivity

- 2 interfaces for 4-sensor AFEs
 - 1 interface to power a ventilator
 - 1 LoRa interface (optional)
 - 1 USB-C connector for power
 - Programming/debug interfaces
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6. System Block Diagram

TBD

7. Design Constraints

- **PCB layers:** Up to 4
 - **EMI/EMC requirements:** None
 - **Safety certifications:** None
 - **Standard certifications:** None
 - **ESD protection:** Yes, where required
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8. Power Architecture

No specific requirements at this stage.

9. Firmware / Software Considerations

- Existing projects were developed using **ESP32-WROOM** and **STM32H755**.
 - The Wi-Fi stack uses **MQTT** protocol.
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10. Testing & Validation

- All signals should be accessible for probing.
- All power lines should be easily accessible.
- The debug bus should be clearly exposed for observation.

11. Deliverables

- Component selection
- Schematic
- Schematic design notes
- PCB layout
- Layout design notes
- Bill of Materials (BOM)
- Gerber files

12. Manufacturing & Assembly

- **Manufacturing:** External
- **Assembly:** TBD (to decide whether in-lab or outsourced)

13. Questions

The **TELLUS Network Sensor Solutions board** includes more features than required for this project (see [Motivation](#)). Unless stated otherwise, these will **not be retained**.

Feature	Keep?
Microphone	No
Temperature & humidity sensor	No
PM sensor connector (MOLEX-53261-0871)	No
User button	No
Thermal probe	No
eSIM interface	No
GNSS antenna	No
Main antenna	No
BG77 module	No
GPS module	No
GPS antenna	No

Additional open points:

- Should we include a **microSD card connector**?

- Will the PCB be **assembled in the lab** or externally?
 - What is the confidentiality level of the project? Once finished, can it be open-source?
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Appendix

Why a measurement every 10 seconds?

Because real-time operation is required for many applications, and the evolution of air composition is slow enough to justify a sampling frequency of **0.1 Hz**.

Why can't we process the data in the cloud?

Because the project targets applications that may **not have cloud connectivity** and might require **immediate, local alerts** (e.g., alarms, warning lights).