

TP-2 Compact Power Sensor

System Design Description

Abstract

This document describes the TP-2 Compact Motor Power Sensor implementation, providing electrical measurement data such as voltage, current, and power for the AI ore handling control and optimization system. The implementation is designed for reliable measurement, calibration, and Arrowhead-based interoperability.

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1 Overview

This document describes the **TP-2 Compact Motor Power Sensor** system, which provides electrical measurement data such as voltage, current, and power for the AI ore handling control and optimization system.

This implementation is designed to measure power reliably, stay properly calibrated, and work with other Arrowhead-based systems [1].

In Section 2, we describe implementation details of the system.

2 Implementation

This implementation is based on the **PowerSensor.SysD** design document [2] and follows Arrowhead documentation conventions [1].

2.1 Implementation language and tools

- **Programming Language:** Python 3.11
- **Tools / IDE:** Visual Studio Code; Papyrus for SysML modeling [3]
- **Libraries:** HTTP client library for data transmission; JSON for data serialization
- **Database:** MySQL (temporary local storage of measurement data)
- **System State:** Stateful (retains calibration and configuration parameters)

2.2 Functional properties implementation

- **Resources:** Analog-to-digital converter (ADC) for current and voltage sampling.
- **Data handled:** Voltage, current, and power readings.
- **Data handled and eventually stored by the system:**
 - **Used database:** MySQL
 - **Database structure:** Temporary table storing recent readings for calibration and diagnostics.
 - **Data models:** Measurement data structure compliant with **PowerMeasurement.IDD**.
- **Result provided as:** Power measurement data returned through the produced PowerMeasurement service.

Operations implemented:

- **MeasurePower(): PowerMeasurement.IDD** — Captures current power data and returns it through the PowerMeasurement service.
- **CalibrateSensor(referenceValue: Float): Boolean** — Calibrates internal measurement constants against a known reference.
- **DiagnosticSelfTest(): Boolean** — Executes a built-in test to verify hardware functionality and sensor integrity.

2.3 Non functional properties implementation

2.3.1 Security

All communication between this system and external consumers is secured via HTTP over TLS (HTTPS) using Arrowhead TOKEN-based authentication [1, 4].

2.3.2 Power management

Low power operational mode is supported during idle state to minimize energy consumption.

2.3.3 Internal monitoring

Self-test and calibration data are logged for diagnostics and reliability tracking.

2.3.4 Configuration

Configuration data is accepted via secure HTTP requests. Typical parameters include calibration constants, sampling interval, and measurement scaling factors.

3 Services

The implementation services are based on the following SD and IDD documents:

- SysD: *PowerSensor_SysD* [2]
- SD: *PowerMeasurement_SD* [5]
- IDD: *PowerMeasurement_IDD* [6]

Table 1: References to documentation for services produced and consumed.

Services produced	SysD ref	SD ref	IDD ref
PowerMeasurement	PowerSensor_SysD	PowerMeasurement_SD	PowerMeasurement_IDD
Services consumed	SysD ref	SD ref	IDD ref
None	–	–	–

4 References

- [1] “Eclipse arrowhead framework documentation,” Eclipse Arrowhead Project, 2024, <https://eclipse-arrowhead.github.io/>.
- [2] ricbli 7, “Powersensor.sysd – system description,” 2025, course project document (D7560E Embedded Intelligence, LTU).
- [3] “Eclipse papyrus,” Eclipse Foundation, 2025, <https://www.eclipse.org/papyrus/>.
- [4] M. Jones, J. Bradley, and N. Sakimura, “Json web token (jwt),” RFC 7519, 2015, <https://www.rfc-editor.org/rfc/rfc7519>.
- [5] ricbli 7, “Powermeasurement.sd – service description,” 2025, course project document (D7560E Embedded Intelligence, LTU).
- [6] —, “Powermeasurement.idd – interface design description,” 2025, course project document (D7560E Embedded Intelligence, LTU).

5 Revision History

5.1 Amendments

No.	Date	Version	Subject of Amendments	Author
1	2025-10-16	1.0	Initial version of TP-2 Compact Motor Power Sensor SysDD.	ricbli-7

5.2 Quality Assurance

No.	Date	Version	Approved by
1	2025-10-16	1.0	—