PowerSensor

System Description

Abstract
The PowerSensor_SysD describes the power measurement subsystem within the AI ore handling control and optimization architecture. The system acquires electrical parameters (voltage, current, power), supports calibration and diagnostics, and exposes measurements via Arrowhead services.

Contents

1 Overview

The **PowerSensor_SysD** defines the system-level design of the power measurement subsystem within the AI ore handling control and optimization architecture. It provides measurement capabilities for electrical parameters (voltage, current, and power) and interfaces with higher-level control and optimization components through Arrowhead services [1].

The PowerSensor_SysD is responsible for acquiring accurate power data, performing self-diagnostics, and maintaining calibration over time to ensure reliable operation.

The rest of this document is organized as follows. In Section 1.1, we reference major prior art capabilities of the system. In Section 1.2, we describe intended usage of the system. In Section 1.3, we describe fundamental properties provided by the system. In Section 1.4, we describe important delimitations of the system. In Section 2, we describe the services consumed or produced by the system. In Section 3, we describe the security capabilities of the system.

1.1 Significant Prior Art

This subsystem builds upon industrial energy monitoring solutions used in automation and process control. It extends these concepts by integrating the Arrowhead Framework to enable secure, interoperable, and distributed service communication between intelligent devices and optimization layers [1].

1.2 How This System Is Meant to Be Used

The **PowerSensor_SysD** operates as a distributed sensor node that continuously monitors electrical performance. The data supports AI control loops and optimization layers that regulate energy usage and detect anomalies.

Typical usage includes:

- Real-time measurement of electrical power.
- Calibration using known reference values.
- Periodic self testing for diagnostics and fault detection.

1.3 System functionalities and properties

1.3.1 Functional properties of the system

The following core operations are provided by the PowerSensor system:

- **MeasurePower(): PowerMeasurement_IDD** — Performs live measurement of voltage, current, and power, returning structured results based on the PowerMeasurement_IDD data model.
- **CalibrateSensor(referenceValue: Float): EBoolean** — Calibrates the sensor against a known reference input and returns true if successful.
- **DiagnosticSelfTest(): EBoolean** — Executes a built-in diagnostic procedure to confirm operational health and connectivity.

1.3.2 Configuration of system properties

The PowerSensor stores configuration parameters such as calibration constants, measurement intervals, and device-specific identification within its local MySQL database.

1.3.3 Data stored by the system

The subsystem temporarily stores measurement samples for diagnostics and calibration verification. Processed and aggregated data is transferred through the PowerMeasurement_SD service.

1.3.4 Non functional properties

- **Security:** Token-based authentication, Transport Layer Security (TLS) [1, 2].
- **Safety:** Self test routines detect operational faults.
- **Energy Efficiency:** Supports low power idle modes.
- **Latency:** Real-time response suitable for control integration.

1.3.5 Stateful or stateless

The system is **stateful**, retaining calibration parameters and diagnostic results between operational cycles.

1.4 Important Delimitations

The PowerSensor_SysD is limited to measuring and reporting electrical parameters. It does not control actuators or perform optimization directly. Instead, it provides accurate, real-time measurement data to higher-level supervisory and AI components.

2 Services

This section describes consumed and produced services. Each subsection names a produced or consumed service indicating the different capabilities and associated interfaces. References to the appropriate SD and IDD documents should be provided.

2.1 Produced service

with references to SD and IDD documents

- **PowerMeasurement_SD** — Provides real-time electrical power measurement data.
  - Implements: **PowerMeasurement_IDD**
  - Exposed Operation: `GetPowerMeasurement()`
  - Protocol: HTTP 1.1
  - Encoding: JSON
  - Security: TOKEN (Arrowhead Token) [1, 2]

2.2 Consumed services

with references to SD and IDD documents

The PowerSensor_SysD does not directly consume external services. It provides services used for external optimization, which may in turn alter consumed services.

3 Security

The PowerSensor_SysD operates exclusively in **secure Arrowhead mode** [1]. All communication is encrypted and authenticated, ensuring data integrity and trust within the distributed control system.

3.1 Security model

Property	Value
Protocol	HTTP 1.1
Data Encryption	TLS 1.3
Authentication	Arrowhead Token
Authorization	Arrowhead Authorization System
Certificate Type	X.509 (ApplicationSystem level)
Crypto Algorithm	RSA

For Arrowhead certificate profile and security guidance, see Arrowhead documentation [1].

4 References

[1] “Eclipse arrowhead framework documentation,” Eclipse Arrowhead Project, 2024, https://eclipse-arrowhead.github.io/.

[2] M. Jones, J. Bradley, and N. Sakimura, “Json web token (jwt),” RFC 7519, 2015, https://www.rfc-editor.org/rfc/rfc7519.

5 Revision History

5.1 Amendments

No.	Date	Version	Subject of Amendments	Author
1	2025-10-15	1.0	Initial PowerSensor SysD document based on Arrowhead framework template.	ricbli-7

5.2 Quality Assurance

No.	Date	Version	Approved by
1	2025-10-15	1.0	–