IDTA 02029-1

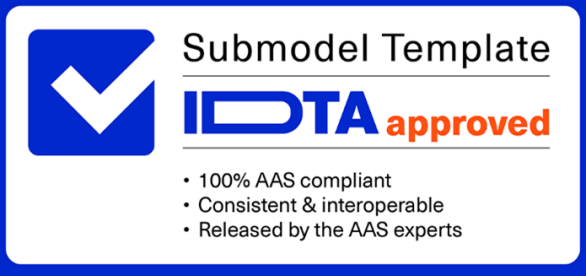
Submodel Sensor 4.0

Part 1: Measurement Value

Version 1.0 - Dec 2025

SPECIFICATION

Submodel Template of the
Asset Administration Shell



Part 1: Measurement Value

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Version history

Date	Version	Comment
11.12.2025	1.0	Release of the official Submodel template published by IDTA

General

About this document

This document is a part of a specification series. Each part specifies the contents of a submodel template for the Asset Administration Shell (AAS). The AAS is described in [1], [2], [3] and [6]. First exemplary submodel contents were described in [4], while the actual format of this document was derived by the "Administration Shell in Practice" [5]. The format aims to be very concise, giving only minimal necessary information for applying a submodel template, while leaving deeper descriptions and specification of concepts, structures and mapping to the respective documents [1] to [6].

The target group of the specification are developers and editors of technical documentation and manufacturer information, which are describing assets in smart manufacturing by means of the Asset Administration Shell (AAS) and therefore need to create a submodel instance with a hierarchy of SubmodelElements. This document especially details on the question, which SubmodelElements with which semantic identification shall be used for this purpose.

This document is a part of the specification series IDTA 02029 describing sensor devices. This series consist of the following Submodel templates, of which some may still be under development (further specifications are possible):

Part 1: Measurement Value

Part 2: Sensor Parameter

Scope of the Submodel

The idea of Submodel Sensor 4.0 is to provide a common representation of all data around industrial sensors, including data that is generated by sensors as well as data that describes the sensor itself and its integration. Submodel Sensor 4.0 is intended as a series of Submodel templates for different aspects of sensor usage. This document as part 1 of the Submodel Sensor 4.0 series is named “Measurement Value” because it focusses on the operation of sensors as data generating devices. It provides a data model for a generic access to sensor data completely independent from the sensor’s functional and interface technology.

In a part 2 of Submodel Sensor 4.0 it is planned to cover the parameter of sensor devices. More parts are to be defined

By using the Submodel “Measurement Value” the AAS is intended to be the translating instance between the physical sensor and any data processing system. The sensor provides its measurement values and additional data describing the measurements into the Submodel.

Measurement values are instance related data and they are usually highly dynamic while other data is static (like the unit of the values that usually does not change in the entire lifetime of the sensor) or can be seen as “quasi-static” (like the measurement reference which may change only in rather long intervals).

Relevant standards for the Submodel template

Table 1. : Relevant standards for the Submodel template

Standard	Title	Description / Focus
IEC 60947-5-2	Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches	Specifies characteristics of proximity switches, including sensing distances, operating principles, and electrical interfaces — relevant for describing physical and functional properties of sensors.
IEC 60947-5-7	Low-voltage switchgear and controlgear – Part 5-7: Control circuit devices and switching elements – Proximity switches with analogue output	Extends IEC 60947-5-2 by specifying analog signal behavior, such as voltage/current ranges and linearity. Supports detailed property modeling in analog-output sensors.
ISO/IEC/IEEE 24748	Systems and Software Engineering – Life Cycle Management	Provides standardized terminology and models for life-cycle processes. Supports consistent modeling of sensor states and transitions across design, deployment, use, and disposal.
IEC 61406-1:2022	Identification Link - Part 1: General requirements	Specifies minimum requirements for a globally unique identification of physical objects which also constitutes a link to its related digital information. This identification is designated hereinafter as "Identification Link" (IL), with the encoded data.
IEC 61406-2:2024	Identification Link - Part 2: Types/models, lots/batches, items and characteristics	Complements IEC 61406-1 by providing additional requirements for those cases where data elements are encoded within the Structured Identification Link string with standardized syntax and semantics.
ECLASS (Advanced)	Standardized Product Classification and Description System	Provides semantic, machine-readable classification and property definitions for industrial components, including sensors. Supports the use of globally standardized property IDs in submodel elements.
IEC CDD (Common Data Dictionary)	IEC 61360-based Semantic Dictionary for Electrical and Automation Components	Offers globally harmonized property definitions and value domains. Enables interoperable, semantically consistent modeling of sensor characteristics in digital systems like AAS.

Use cases, requirements and design decisions

To identify relevant use cases for sensor components it is useful to have a look on their lifecycle according ISO/IEC/IEEE 24748:

1. Concept: Initial idea and feasibility studies.
2. Development: Design and development of the product
    1. Engineering of sensor device
3. Production: Manufacturing and deployment.
    1. Manufacturing of sensor device
    2. Configuration
    3. Calibration
4. Planning and Procurement (in addition to ISO/IEC/IEEE 24748 definition)
    1. Planning of sensors into processes and machines
    2. Procurement

5. Utilization: Operation and use of the product.
    1. Integration
    2. Parametrization
    3. Operation
6. Support: Maintenance and support activities.
    1. Replacement
    2. Maintenance
    3. Service
7. Retirement: Decommissioning and disposal.
    1. Decommissioning

Several sensor-related use cases are already covered by existing or coming submodels.

Such an example is the engineering use case in the planning and procurement phase. It is strongly recommended to use the Submodel Template “Generic Frame for Technical Data for Industrial Equipment in Manufacturing” and to import structures from dictionaries like ECLASS or IEC-CDD into the Submodel Template “Generic Frame for Technical Data for Industrial Equipment in Manufacturing”. Other use cases are not specific for sensor devices and will be or are already covered by more generic approaches like configuration, parametrization or quality documentation.

This specification focusses on the use case operation of industrial sensors and on a generic approach to access measurement values generated by the sensors, which is located in the utilization phase of the lifecycle. The idea is to define a data model which contains all necessary data about sensor measurement values in a technology- and interface-agnostic way. By using the measurement value submodel, developers of IT systems should be able to use sensor data without any deeper knowledge of the sensors themselves.

Other use cases than sensor operation may be covered by future releases or activities of the Sensor 4.0 working group.

Information structures and attributes

Approach of the Submodel

A sensor hardware converts a physical value into an electrical signal, e.g a temperature into an electric current or a distance into an electric voltage. Finally a digital value is generated. To cover the wide variety of sensors the submodel template defines a generic structure to describe measurement values.

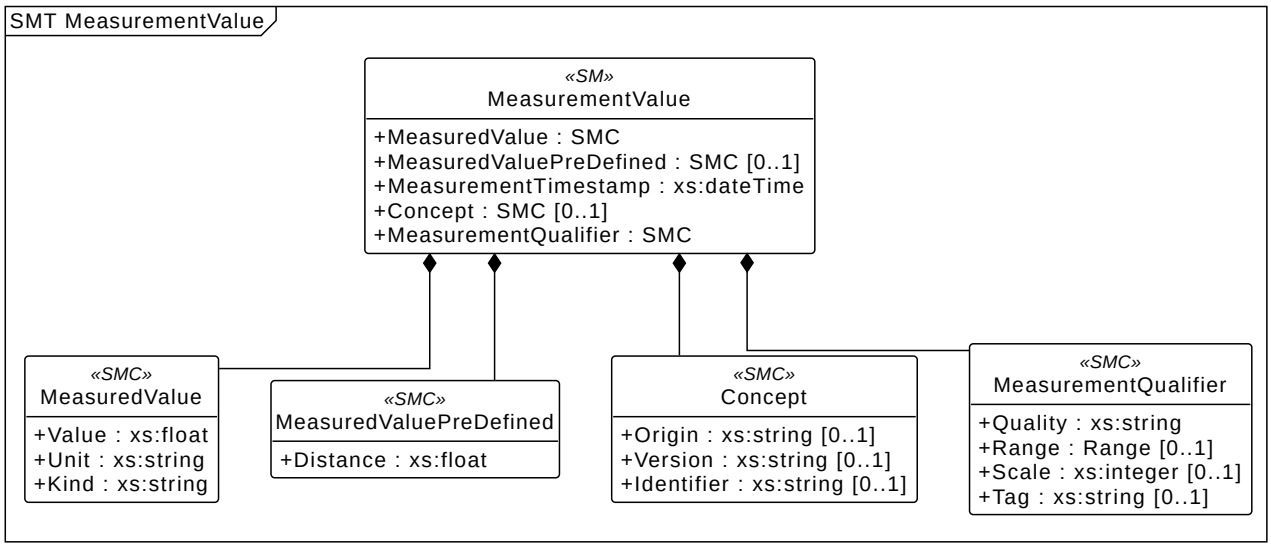

Figure 1. UML diagram for the overall Submodel

The SubmodelElements for this first level are described as follows (see Table for the overall Submodel). The table convention is explained in Annex A.2.

Table 2. Table for the overall Submodel

idShort:	**MeasurementValue**		
Class:	Submodel		
semanticId:	https://admin-shell.io/idta/SubmodelTemplate/measurementValue/1/0		
Parent:	MeasurementValueAAS		
Explanation:	The Submodel Template for Measurement Value		
Element details:	-		
[SME type] idShort	semanticId Description@en	[valueType] example	card.
[SMC] MeasuredValue	https://admin-shell.io/idta/measurementvalue/measuredvalue/1/0 This is the measured value of the sensor output	[] 3 elements	1

[SMC] MeasuredValuePreDefined	https://admin-shell.io/idta/measurementvalue/measuredvaluepredefined/1/0 The predefined measured value of the sensor	[] 1 elements	0..1
[Prop] MeasurementTimestamp	0112/2///61360_7#CBA007 supplementalSemanticId: 0112/2///61360_7#CBA008 Date and time when the measurement was taken.	[DateTime] 2024-09-29 09:05:00.000	1
[SMC] Concept	https://admin-shell.io/idta/measurementvalue/concept/1/0 This collection defines which semantic definition is used for measuredvalue	[] 3 elements	0..1
[SMC] Measurement Qualifier	https://admin-shell.io/idta/measurementvalue/measurementqualifier/1/0 The Qualifier of the measurement	[] 4 elements	1

SMC MeasuredValue

A sensor hardware converts a physical value into an electrical signal, e.g a temperature into an electric current or a distance into an electric voltage. Finally a digital value is generated. To cover the wide variety of sensors the submodel template defines a generic structure to describe measurement values.

The SubmodelElements for this first level are described as follows (see Table for the overall Submodel). The table convention is explained in Annex A.2.

Table 3. Table for the overall Submodel

idShort:	**MeasuredValue**		
Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/measurementvalue/measuredvalue/1/0		
Parent:	MeasurementValue		
Explanation:	This is the measured value of the sensor output		
Element details:	-		
[SME type] idShort	semanticId Description@en	[valueType] example	card.
[Prop] Value	https://admin-shell.io/idta/measurementvalue/value/1/0 The value of the of measured sensor output	[Float] 17.356	1

[Prop] Unit	0112/2///62720#UBA000 The unit of the measured value	[String] m	1
[Prop] Kind	0112/2///62683#ACI144 supplementalSemanticId: 0112/2///62683#ACI144 Kind of measured value	[String] Distance	1

SMC Measured Value PreDefined

A sensor hardware converts a physical value into an electrical signal, e.g a temperature into an electric current or a distance into an electric voltage. Finally a digital value is generated. To cover the wide variety of sensors the submodel template defines a generic structure to describe measurement values.

The SubmodelElements for this first level are described as follows (see Table for the overall Submodel). The table convention is explained in Annex A.2.

When using a property from a dictionary (e.g., IEC CDD, ECLASS) or an IoT-platform, attributes such as unit, format, definition, etc. are predefined. By using the semanticID of this property, the value can be automatically interpreted by the target system with these attributes. Suitable properties can be selected, for example, from the IEC CDD dictionary from block 0112/2///61987#ABN682 "Continuous measurement variables".

The property used in SMC MeasuredValuePredefined must not conflict with the property Kind in SMC MeasuredValue.

Table 4. Table for the overall Submodel

idShort:	**MeasuredValuePreDefined**		
Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/measurementvalue/measuredvaluepredefined/1/0		
Parent:	MeasurementValue		
Explanation:	The predefined measured value of the sensor		
Element details:	-		
[SME type] idShort	semanticId Description@en	[valueType] example	card.
[Prop] Distance	0112/2///61987#ABN718#001 The measured length between two points.	[Float] 17.356	1

SMC Concept

A sensor hardware converts a physical value into an electrical signal, e.g a temperature into an electric current or a distance into an electric voltage. Finally a digital value is generated. To cover the wide variety of

sensors the submodel template defines a generic structure to describe measurement values.

The SubmodelElements for this first level are described as follows (see Table for the overall Submodel). The table convention is explained in Annex A.2.

Table 5. Table for the overall Submodel

idShort:	**Concept**		
Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/measurementvalue/concept/1/0		
Parent:	MeasurementValue		
Explanation:	This collection defines which semantic definition is used for measuredvalue		
Element details:	-		
[SME type] idShort	semanticId Description@en	[valueType] example	card.
[Prop] Origin	https://admin-shell.io/idta/measurementvalue/origin/1/0 The origin of the semantic description	[String] IEC-CDD / ECLASS / Other	0..1
[Prop] Version	https://admin-shell.io/idta/measurementvalue/version/1/0 The version of the semantic defintion used	[String] 001	0..1
[Prop] Identifier	https://admin-shell.io/idta/measurementvalue/identifier/1/0 The identifier of the semantic definition used	[String] iec:62683:ACH695:Distance	0..1

SMC Measurement Qualifier

A sensor hardware converts a physical value into an electrical signal, e.g a temperature into an electric current or a distance into an electric voltage. Finally a digital value is generated. To cover the wide variety of sensors the submodel template defines a generic structure to describe measurement values.

The SubmodelElements for this first level are described as follows (see Table for the overall Submodel). The table convention is explained in Annex A.2.

Table 6. Table for the overall Submodel

idShort:	**MeasurementQualifier**
Class:	SubmodelElementCollection
semanticId:	https://admin-shell.io/idta/measurementvalue/measurementqualifier/1/0
Parent:	MeasurementValue
Explanation:	The Qualifier of the measurement

Element details:	-		
[SME type] idShort	semanticId Description@en	[valueType] example	card.
[Prop] Quality	0112/2///61360_7#CBA006 Quality of the measured value (e.g., Good, Bad, Uncertain and others like out of range).	[String] good	1
[Range] Range	https://admin-shell.io/idta/meaurementvalue/range/1/0 Allowed minimum and maximum measurement limits.	[] -10.00 .. 100.00	0..1
[Prop] Scale	https://admin-shell.io/idta/measurementvalue/scale/1/0 Factor used to convert or adjust the measured value.	[Integer] 1	0..1
[Prop] Tag	0112/2///61987#ABB271 Identifier linking the measurement to its source or device.	[String] Device @ Station 1	0..1

Annex A. Explanations on used table formats

1. General

The used tables in this document try to outline information as concise as possible. They do not convey all information on Submodels and SubmodelElements. For this purpose, the definitive definitions are given by a separate file in form of an AASX file of the Submodel template and its elements.

2. Tables on Submodels and SubmodelElements

For clarity and brevity, a set of rules is used for the tables for describing Submodels and SubmodelElements.

- The tables follow in principle the same conventions as in [5].
- The table heads abbreviate 'cardinality' with 'card'.
- The tables often place two informations in different rows of the same table cell. In this case, the first information is marked out by sharp brackets [] form the second information. A special case are the semanticIds, which are marked out by the format: (type)(local)[idType]value.
- The types of SubmodelElements are abbreviated:

SME type	SubmodelElement type
Property	Property
MLP	MultiLanguageProperty
Range	Range
File	File
Blob	Blob
Ref	ReferenceElement
Rel	RelationshipElement
SMC	SubmodelElementCollection
SML	SubmodelElementList

- If an idShort ends with '__00__', this indicates a suffix of the respective length (here: 2) of decimal digits, in order to make the idShort unique. A different idShort might be choosen, as long as it is unique in the parent's context.
- The Keys of semanticId in the main section feature only idType and value, such as: https://admin-shell.io/vdi/2770/1/0/DocumentId/Id. The attribute "type" (typically "ConceptDescription" and "(local)" or "GlobalReference") need to be set accordingly; see [6].
- If a table does not contain a column with "parent" heading, all represented attributes share the same parent. This parent is denoted in the head of the table.
- Multi-language strings are represented by the text value, followed by '@'-character and the ISO 639 language code: example@EN.
- The [valueType] is only given for Properties.

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