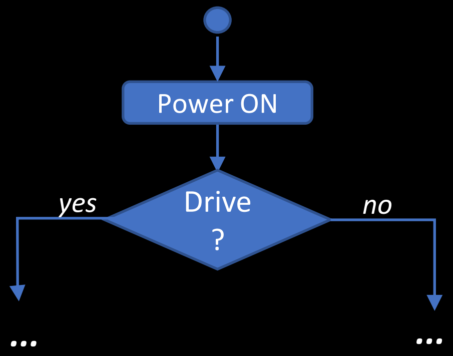
VISION:EER

Requirements
In the Loop (RIL)
Tests



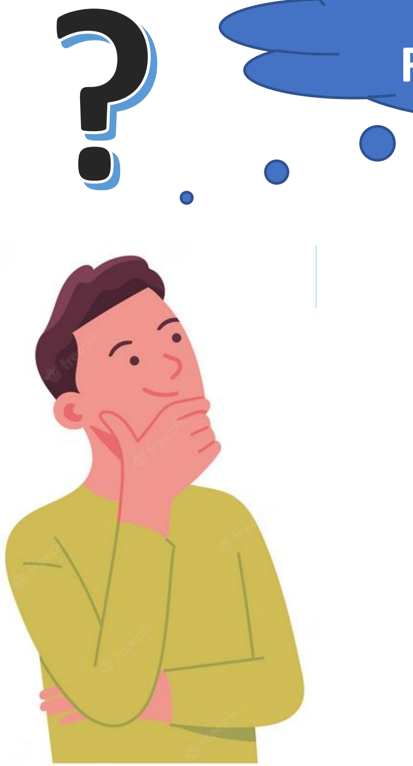
Contents

1. Problem to be solved
2. Solution
3. Visioneer RE Process
4. Visioneer-Tool Functions

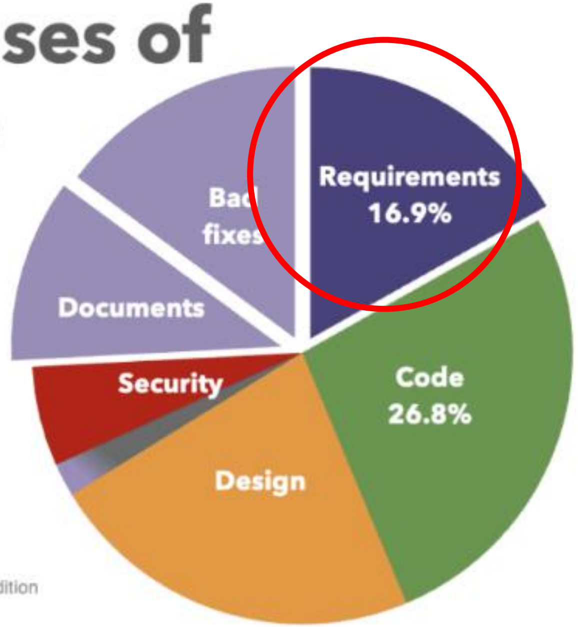
Problem to be solved

Bad Requirement-Specifications are causing enormous costs:

How to avoid bad Requirement-Specifications ?



Root Causes of Software Defects



1,000 FP Application
Source: Capers Jones
Applied Software Measurement, third edition

Expected Characteristics:

- Necessary
- Traceable
- Correct
- Feasible
- Testable

Tool support available

- Complete
- Consistent
- Unambiguous
- Conforming
- Unique

No sufficient tool support *

**** Only 50% of the req-characteristcs verifications can be performed with common metric-tools!***

Idea

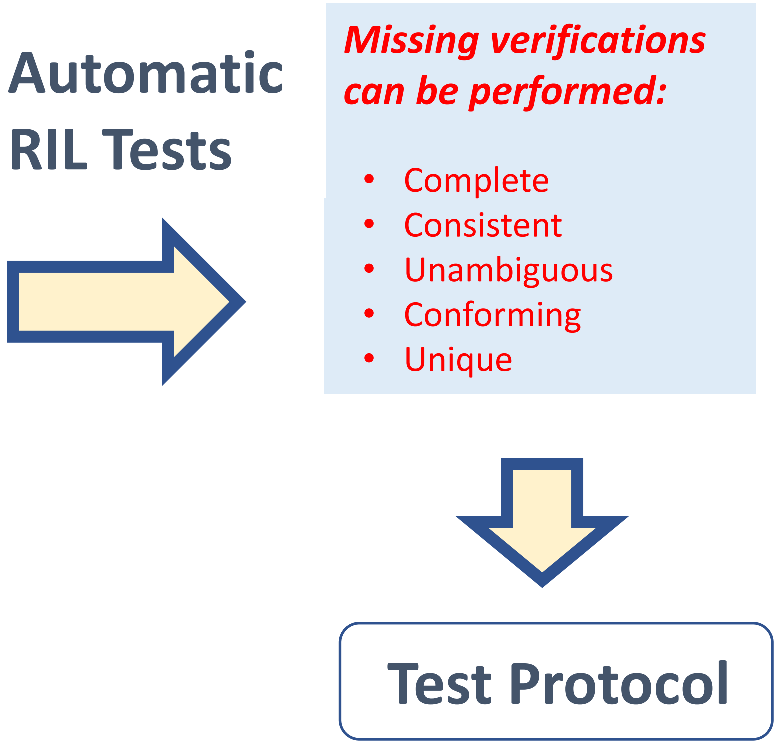
“ Through a smart <u>standardizations</u> of <u>textual</u> requirement-specifications elements

→ *All expected characteristics can be automatically verified “*

<u>Standardization-Measures:</u>

- **<u>Standardization</u> of specifications contents and requirements syntax**
- **<u>Classification</u> of functional requirements**

  e.g. structure or behavior req, goal,..
- **<u>Reuse</u> of specification-elements through template-classes**
  - **Specification-Structures** and **Reqs** can be <u>inherited</u>
  - **Classes** can be <u>derived</u> (specialized) or <u>instantiated</u> (copied)



Automatic RIL Tests

Missing verifications can be performed:

- Complete
- Consistent
- Unambiguous
- Conforming
- Unique

Test Protocol

Solution

Visioneer provides the following services/products:

1. RE Consulting services for pilot projects

- Visioneer provides a **method** consisting of ap. **70 generic RIL test,** a method how to **handle reqs with classes** and about reusable **50 generic req template-classes** → shall be applied and customized in a pilot project
- **Goal** of the RE consulting is to set up an **RE process** together with the customer and defining various criteria, the measures and evidences how to secure all of the required reqs characteristics

The RE Consulting services performed together with our consulting partners:

- **Engineering People GmbH (EU)**
  Status: The 1. pilot project (Cariad) will be closed in May 23 → the 2. pilot will start in June 23
- **SMSTT (USA/Asia)**
  Status: ??

2. Visioneer-Tool to perform the missing RIL tests

- Visioneer provides a **SW Tool** (AddOn for Codebeamer/Doors) that can **handle reqs** with **classes,** perform the missing 50% of the **req-characteristcs verifications** and create RIL **test protocols**

Status: 1. version available 26. Apr 23

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Visioneer RE Process

Visioneer RE method:

1. Using the described Standardization-Measures
2. Describing reusable reqs or reqs-structures in Classes
3. Definition of an applied RE Process
   - Definition of the criteria to fulfil each of the expected reqs characteristics
   - Definition of the measures that required to fulfil each criteria
   - Creation of automated verifications that generate evidences for each measure

Example RE Process

For each of the req characteristics:
the **criteria**, the **measures** and the **evidences** shall be defined
e.g for completeness

Completeness criteria	Measures	Evidence
Functional completeness	- Each stakeholder req must be linked with a system req - …	CB Metric
Logical completeness	- All logical input signal combinations must have clear defined output values	VISIONEER Tool
……		

The VISIONEER Tool is providing the missing 50% of RIL tests

Missing RIL Tests

No **evidences** can be created with common tools for the following **criteria and measures** :

Completeness	
Criteria	**Measures**
Logical completeness	All logical input signal combinations must have clear defined output values →it shall be verified if all pot. combinations are ´defined
Detail completeness	All necessary details shall be defined →it shall be verified if all mandatory templates items are reused
Complete error handling and supplement functions description	Each of the funct. entities (*e.g. signal*) shall be described according to an item-template containing the entity specific (*e.g. signal-specific*) error handling and supplement functions →it shall be verified if the spec contains only reqs-structures which are derived from its entity specific template (*System Kit*)

Missing RIL Tests for el. Systems

No **evidences** can be created with common tools for the following **criteria and measures** :

Conforming	
Criteria	**Measures**
The req specication structure shall be conforming to the system architecture elements	The req specification structure must contain all functional entities of the system architecture and its IF (Interfaces) → It shall be verified, if the req specification structure and its IF is synchronized with the sys. arch. elements (MBSE) *e.g. K-Matrix*

Missing RIL Tests for el. Systems

Unambiguity Criteria

It shall be clear what library-elements are mandatory or optional or proposals and what can be overwritten or deleted

Uniqueness Criteria

Each of the reqs shall be handled according to the single-source-of-truth

Consistency Criteria

Each member of a functional entity shall all be described with the same spec-structure items

Measures

The Reuse of templates shall be handled with **object-oriented methods** (classes)

→ it shall be verified if the inheritance rules are followed

Visioneer Tool Functions

Version 1 (for Codebeamer) → available 26. Apr 23

- Reqs templates class handling and verification of inheritance rules

Version 2 (for Codebeamer) → planned Sept 23

- Performance of all missing RIL Tests and Test Protocol creation

Version 2 (for Doors) → planned Dec 23

- Same functions as v2.0 for CB

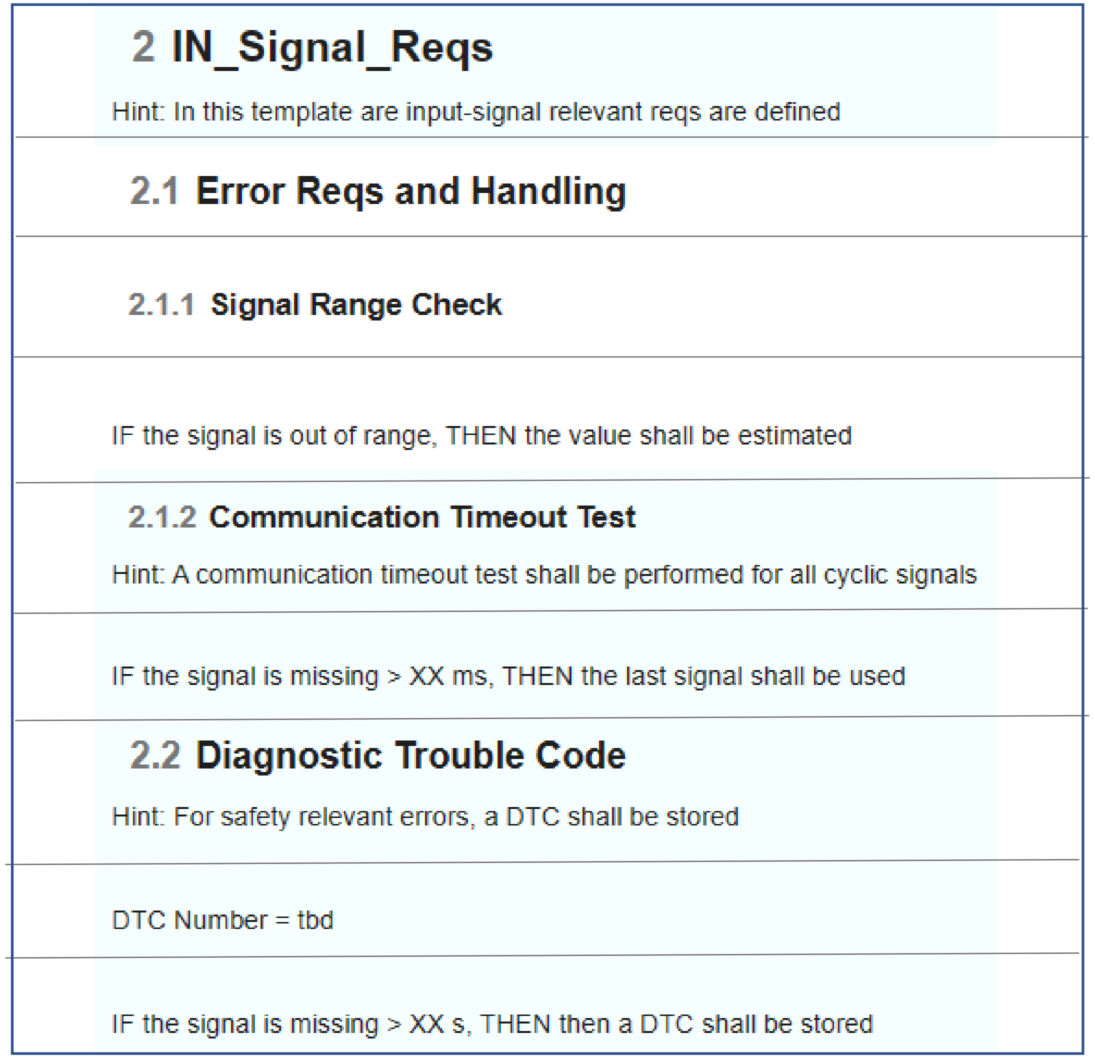
Version 3 (for Doors and CB) → planned Mar 24

- Implementation of MBSE interfaces

Visioneer Tool Version 1:

Handling of Requirement Template Classes

Current Req Templates



2 IN_Signal_Reqs

Hint: In this template are input-signal relevant reqs are defined

2.1 Error Reqs and Handling

2.1.1 Signal Range Check

IF the signal is out of range, THEN the value shall be estimated

2.1.2 Communication Timeout Test

Hint: A communication timeout test shall be performed for all cyclic signals

IF the signal is missing > XX ms, THEN the last signal shall be used

2.2 Diagnostic Trouble Code

Hint: For safety relevant errors, a DTC shall be stored

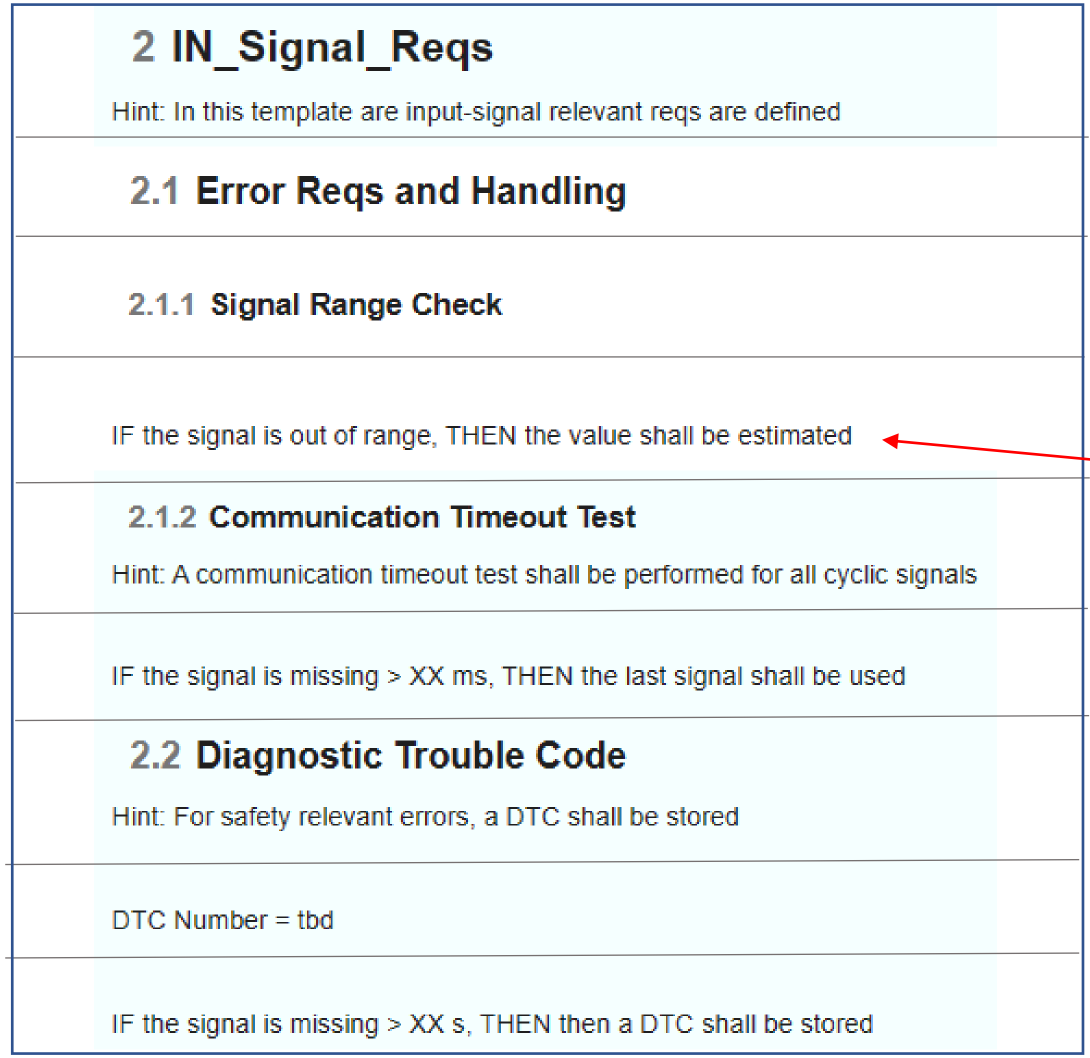
DTC Number = tbd

IF the signal is missing > XX s, THEN then a DTC shall be stored

In this (simplified) example-template generic requirements are defined

- which are **relevant** for **any signal**
- and shall be **reused** for the **signal-reqs** of each signal

Current Req Templates



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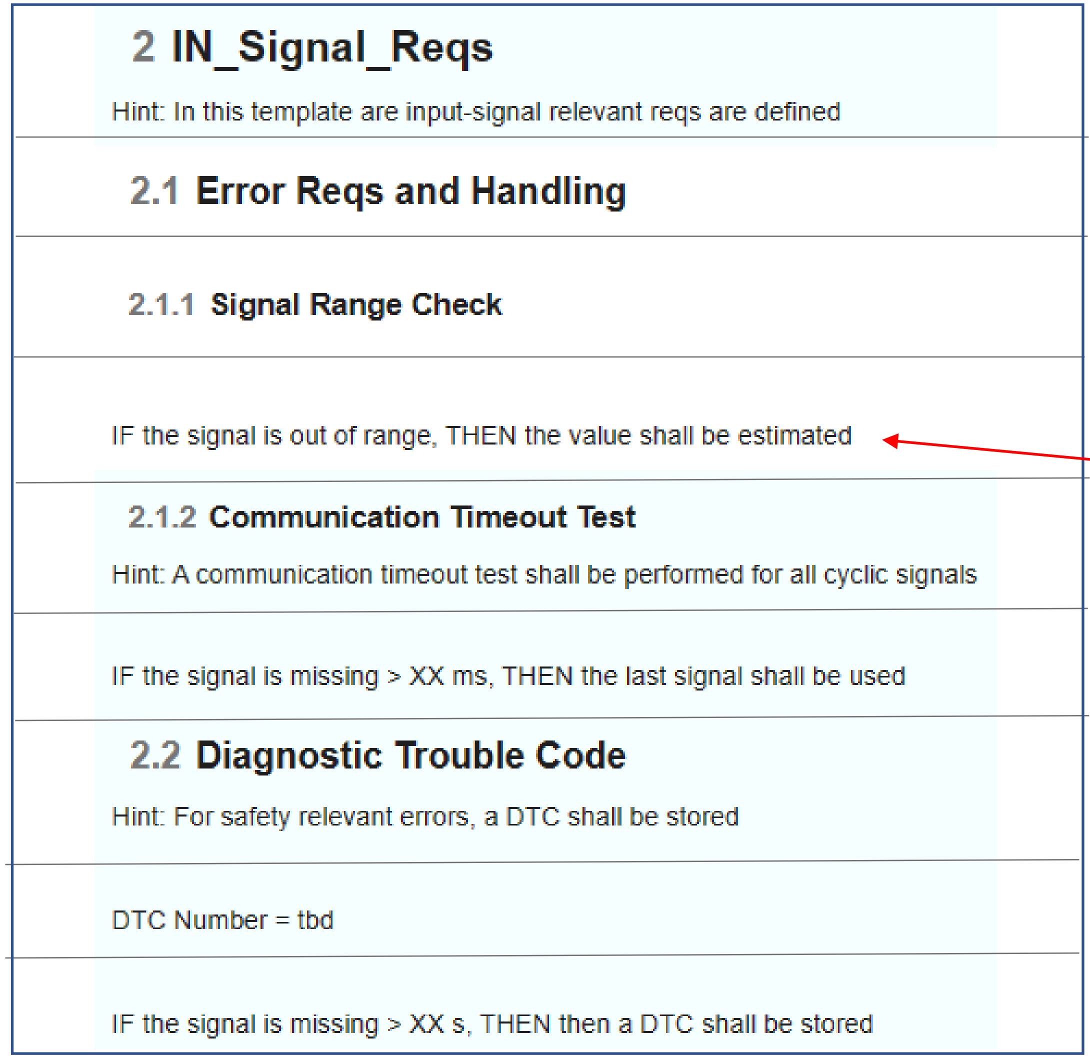
→ **General Reuse-Problems:**

- Some reqs are **vague** and thus **not testable**
- It is unclear, what reqs are **mandatory** and what are **proposals**
- It is unclear what req is **relevant** (common) for which **specific entity** (e.g. for all CAN signals)
- It is **not verified automatically** if the reused templates contain all **mandatory items**

Current Req Templates



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→ **General Reuse-Problems:**

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- It is **not verified automatically** if the reused templates contain all **mandatory items**

→ High review-efforts
→ A risk for false or missing reqs

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Solution Requirement Template-Classes

With Template-Classes textual reqs can be inherited with **object-oriented methods:**

- It is defined (via field), if a req is **mandatory** a **proposal** or if it can be **overwritten** or **deleted**
- The reqs are **classified** into **different types** (*e.g. behavior reqs, goals*) to be handled (verified) separately
- Only **case-spefic reqs** are **inherited** (*through simple syntax rules*)
- Derived-classes contain all common reqs of the **parent-** (*e.g. Signals*) and **children-entities** (e.g. *CAN_Signals*)
- Class-instances are reused to define the reqs of each single entity-member (*e.g. for each Input-Signal*)
- **Cardinalities** *(e.g. 1..*)* for the allowed multiplicities of **req-items** can be defined
- **Without tool change** (AddOn for Codebeamer) → no synchronization with MBSE tool needed

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Solution Requirement Template-Classes

By reusing Template-Classes it is automatically verified,

if all derived-classes and class-instances follow the

inheritance rules of its parents (by the Visioneer-Tool)

Example Template-Class

	Type	Classification	Protection
1 IN_Signal_Reqs Hint: In this template are input-signal relevant reqs are defined	Class	-	-
1.1 Error Reqs and Handling	Folder	-	Mandatory
1.1.1 Signal Range Check	Folder	-	Mandatory
IF the signal is out of range, THEN the value shall be estimated	Functional Req	Functional Goal	Proposal
1.1.2 Communication Timeout Test [yes / no] Hint: A communication timeout test shall be performed for all cyclic signals	Folder	-	Mandatory
[case yes] IF the signal is missing > XX ms, THEN the last signal shall be used	Functional Req	Cond. Beh. Req.	Mandatory
1.2 Diagnostic Trouble Code [yes, no] Hint: For safety relevant errors, a DTC shall be stored	Folder	-	Mandatory
[case yes] DTC Number = tbd	Information	-	Mandatory
[case yes] IF the signal is missing > XX s, THEN then a DTC shall be stored	Functional Req	Cond. Beh. Req.	Mandatory

Example Template-Class

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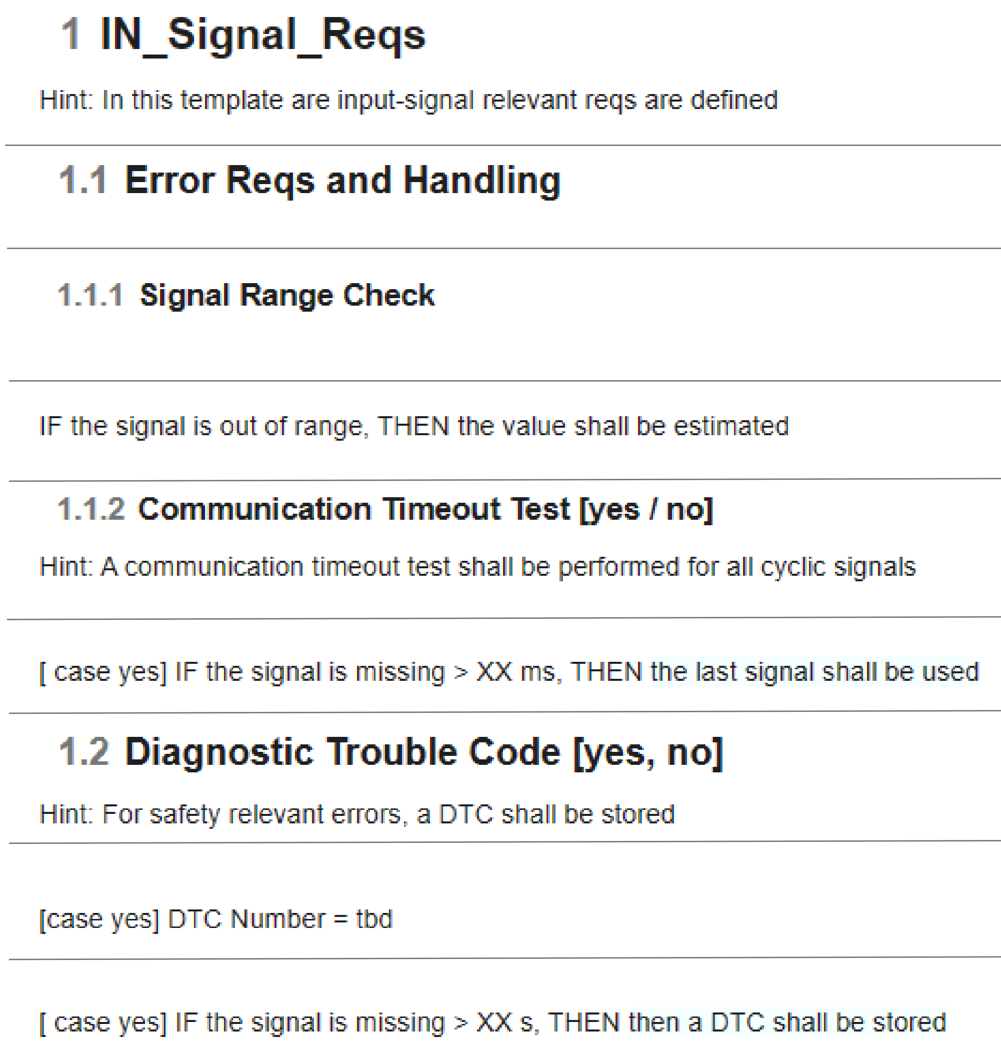
[case yes] DTC Number = tbd	Information	-	Mandatory
[case yes] IF the signal is missing > XX s, THEN then a DTC shall be stored	Functional Req	Cond. Beh. Req.	Mandatory

Item may not be deleted in child

Example Template-Class



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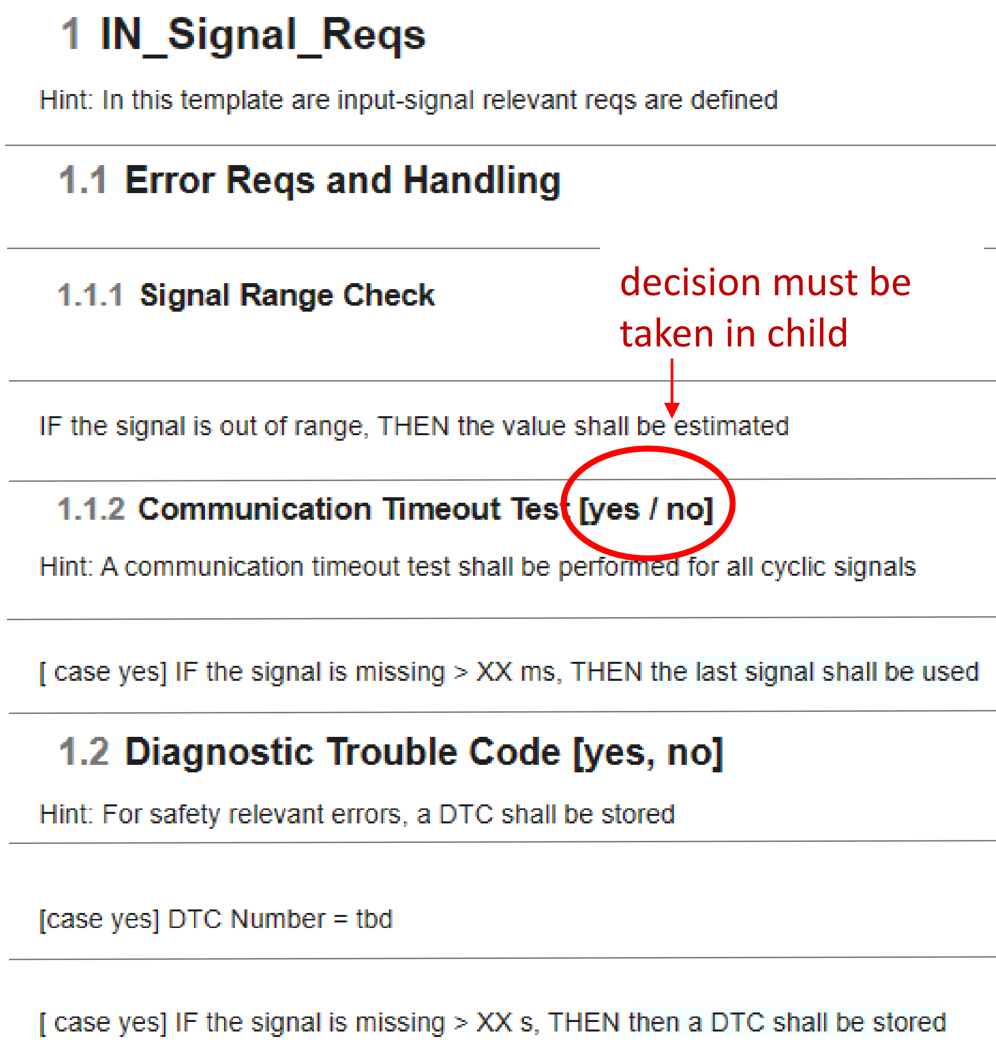
[case yes] DTC Number = tbd	Information	-	Mandatory
[case yes] IF the signal is missing > XX s, THEN then a DTC shall be stored	Functional Req	Cond. Beh. Req.	Mandatory

Not testable, child must be linked with details

Example Template-Class



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[case yes] DTC Number = tbd	Information	-	Mandatory
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decision must be taken in child

Example Template-Class

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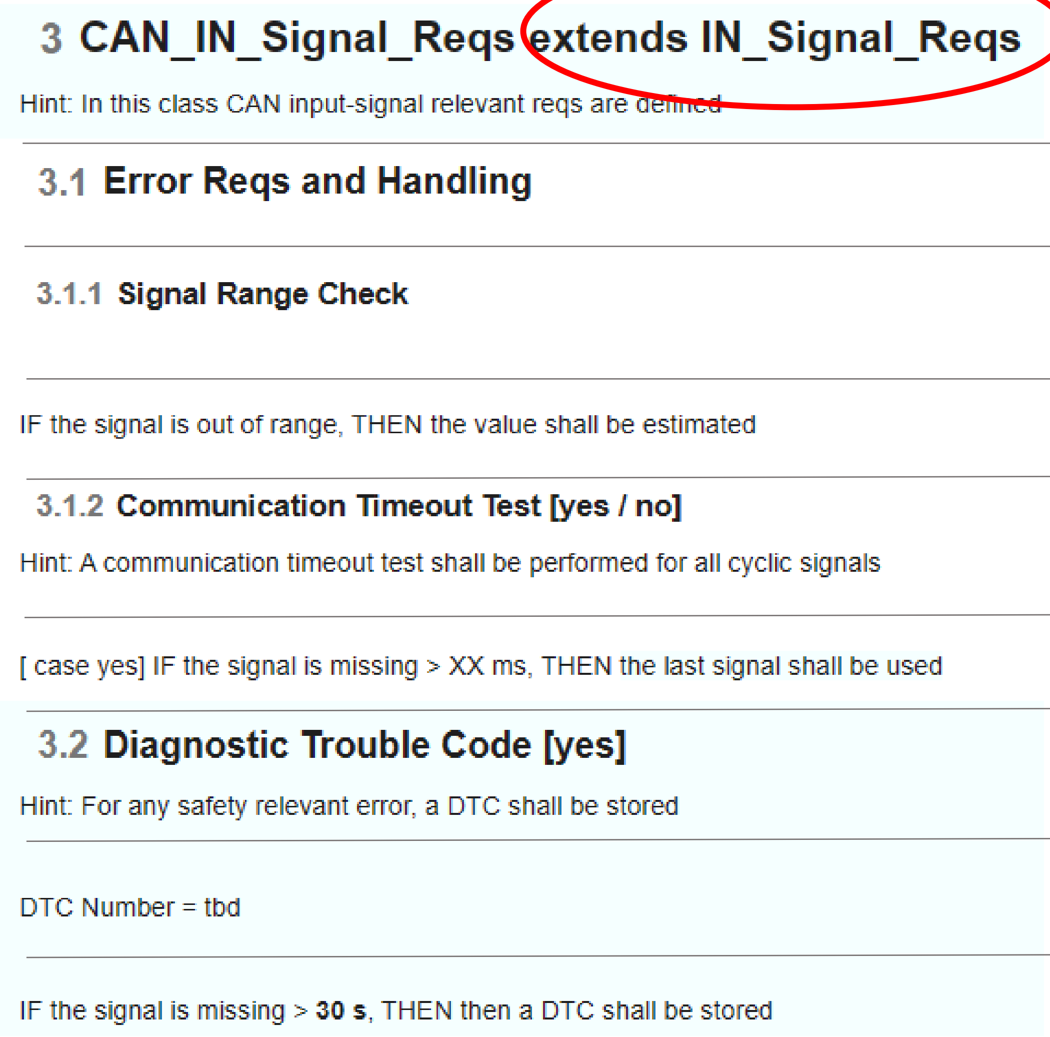
[case yes] IF the signal is missing > XX s, THEN then a DTC shall be stored	Functional Req	Cond. Beh. Req.	Mandatory

detail must be defined in child

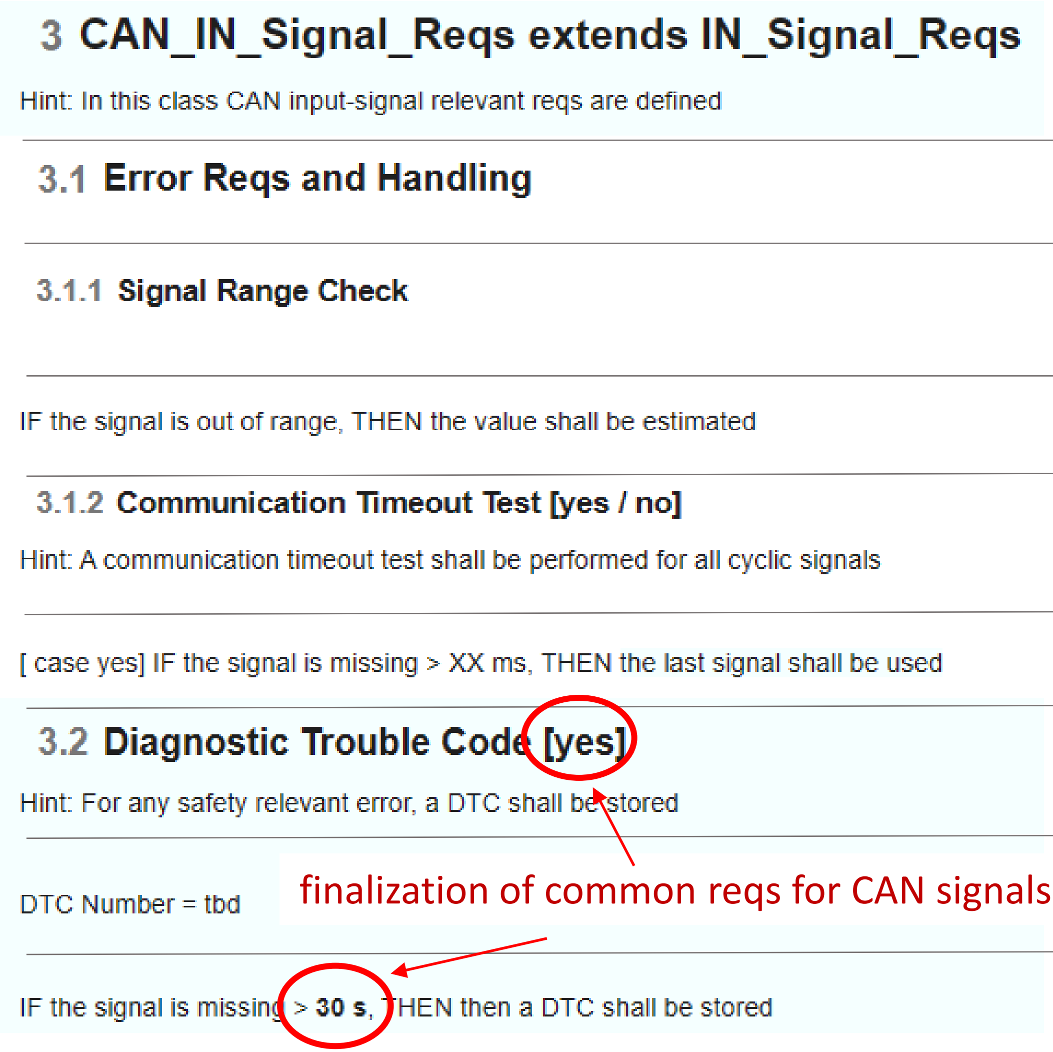
Example Derived-Class

parent-class relation



	Type	Classification	Protection
3 CAN_IN_Signal_Reqs extends IN_Signal_Reqs Hint: In this class CAN input-signal relevant reqs are defined	Class	-	-
3.1 Error Reqs and Handling	Folder	-	Mandatory
3.1.1 Signal Range Check	Folder	-	Mandatory
IF the signal is out of range, THEN the value shall be estimated	Functional Req	Functional Goal	Proposal
3.1.2 Communication Timeout Test [yes / no] Hint: A communication timeout test shall be performed for all cyclic signals	Folder	-	Mandatory
[case yes] IF the signal is missing > XX ms, THEN the last signal shall be used	Functional Req	Cond. Beh. Req.	Mandatory
3.2 Diagnostic Trouble Code [yes] Hint: For any safety relevant error, a DTC shall be stored	Folder	-	Mandatory
DTC Number = tbd	Information	-	Mandatory
IF the signal is missing > **30 s**, THEN then a DTC shall be stored	Functional Req	Cond. Beh. Req.	Mandatory

Example Derived-Class



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DTC Number = tbd	nformation	-	Mandatory
IF the signal is missing > **30 s**, THEN then a DTC shall be stored	Functional Req	Cond. Beh. Req.	Mandatory

finalization of common reqs for CAN signals

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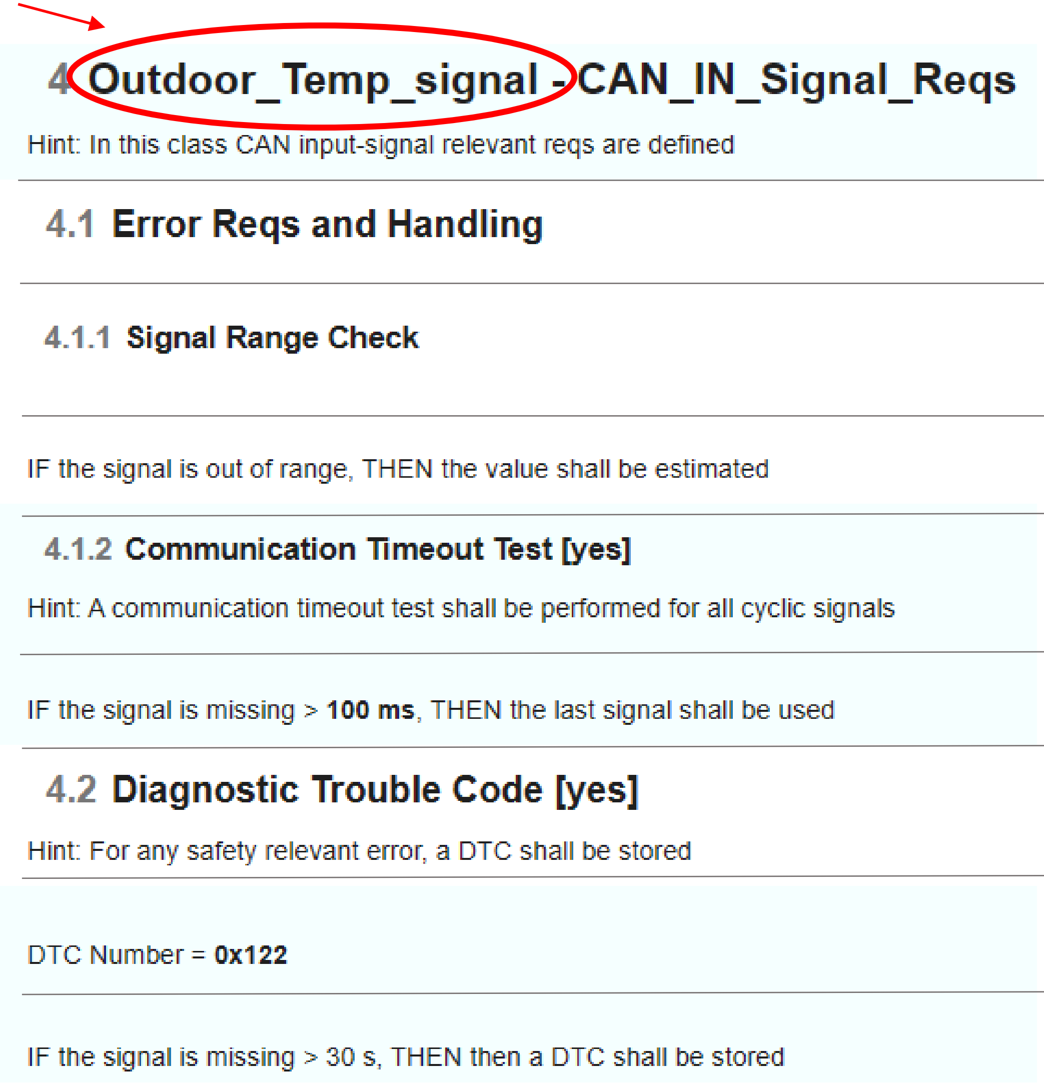
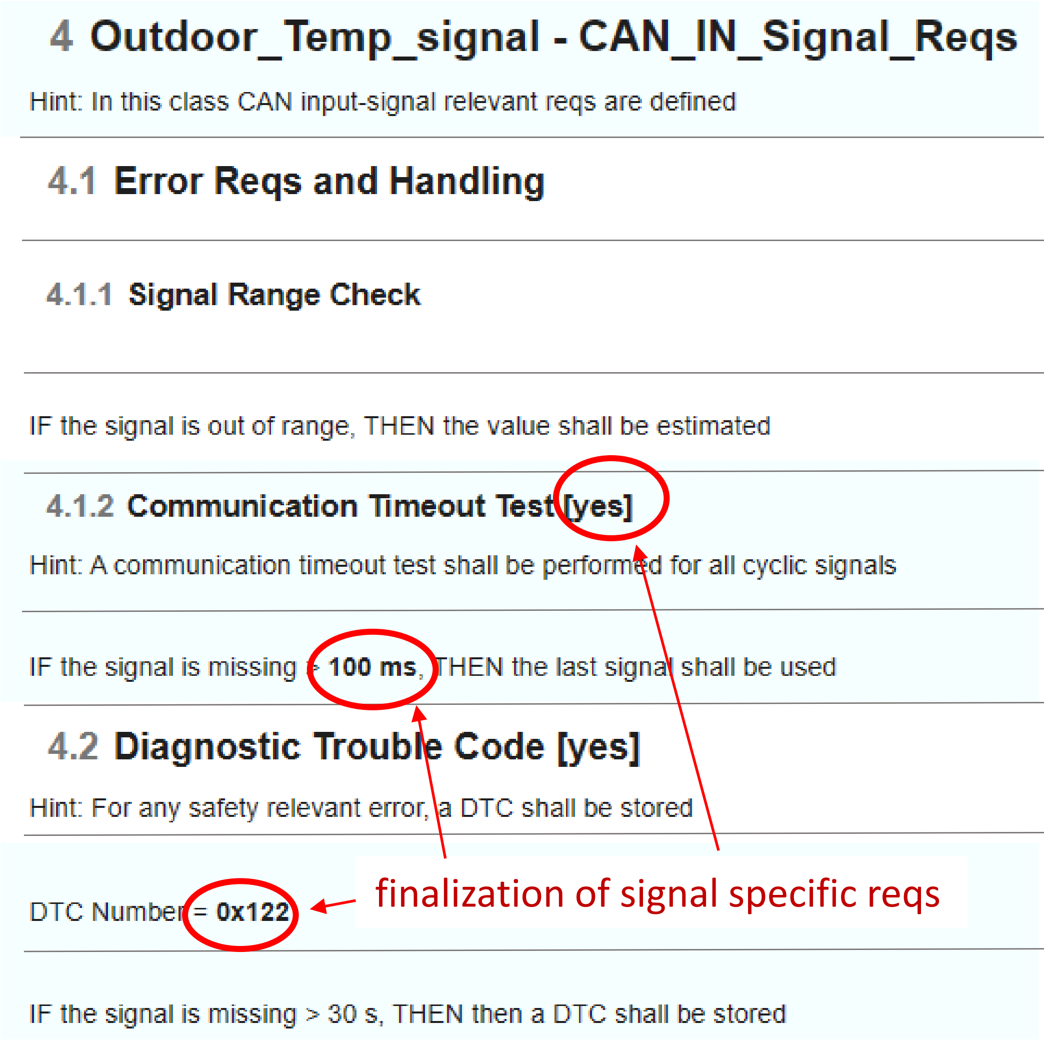
Example Class-Instance

signal name = instance



	Type	Classification	Protection
4 Outdoor_Temp_signal - CAN_IN_Signal_Reqs Hint: In this class CAN input-signal relevant reqs are defined	Class	-	-
4.1 Error Reqs and Handling	Folder	-	Mandatory
4.1.1 Signal Range Check	Folder	-	Mandatory
IF the signal is out of range, THEN the value shall be estimated	Functional Req	Functional Goal	Proposal
4.1.2 Communication Timeout Test [yes] Hint: A communication timeout test shall be performed for all cyclic signals	Folder	-	Mandatory
IF the signal is missing > **100 ms**, THEN the last signal shall be used	Functional Req	Cond. Beh. Req.	Mandatory
4.2 Diagnostic Trouble Code [yes] Hint: For any safety relevant error, a DTC shall be stored	Folder	-	Mandatory
DTC Number = **0x122**	Information	-	Mandatory
IF the signal is missing > 30 s, THEN then a DTC shall be stored	Functional Req	Cond. Beh. Req.	Mandatory

Example Class-Instance



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IF the signal is missing > 30 s, THEN then a DTC shall be stored	Functional Req	Cond. Beh. Req.	Mandatory

finalization of signal specific reqs

Visioneer Tool Requirements

The 1. version of the Visioneer-Tool:

- *is an Add-On for Codebeamer*

Tool Requirements:

1. **Rules for the class-inheritance**
2. **Process for the creation of derived classes**
3. **Process for class instantiation**
4. **Observing the class rules and error handling**

1. Rules for class-inheritance

Derived-classes and class-instances shall inherit from its parents:

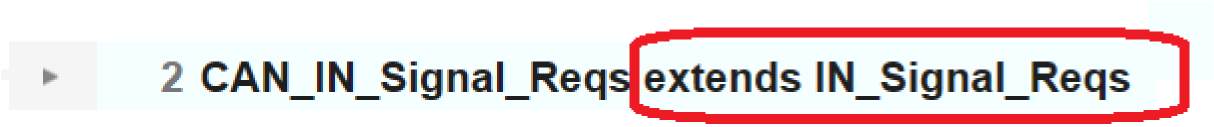
- all items
- all fields
- all field values, except

Tags, *Associations*, *Downstream References*, *Attachments/Comments*, *Spent Effort*, *Status values* are not copied from the template (by CB)

2. Process for the creation of derived classes

- Derived-classes can only be created in the *items template* tracker.

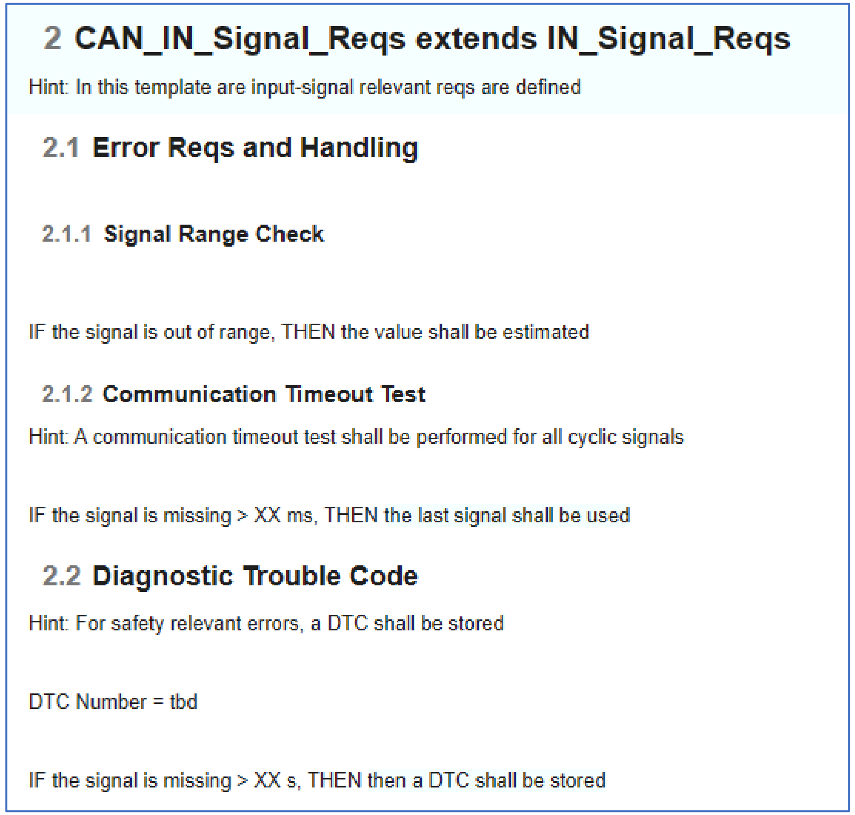
- To create a derived class, a folder shall be created with the following syntax:



2 CAN_IN_Signal_Reqs extends IN_Signal_Reqs

- After pressing the synchronization-button, the parent-class is copied, according to its inheritance rules

- All common reqs for CAN signals can then be finalized in the derived class



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2.2 Diagnostic Trouble Code

Hint: For safety relevant errors, a DTC shall be stored

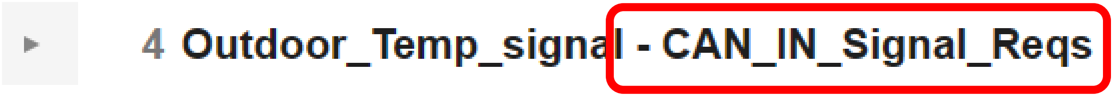
DTC Number = tbd

IF the signal is missing > XX s, THEN then a DTC shall be stored

3. Process for the creation of class-instances

- Class-Instances may not be created in the *items template* tracker, but in any specification

- To create a Class-Instances, a folder shall be created with the following syntax:

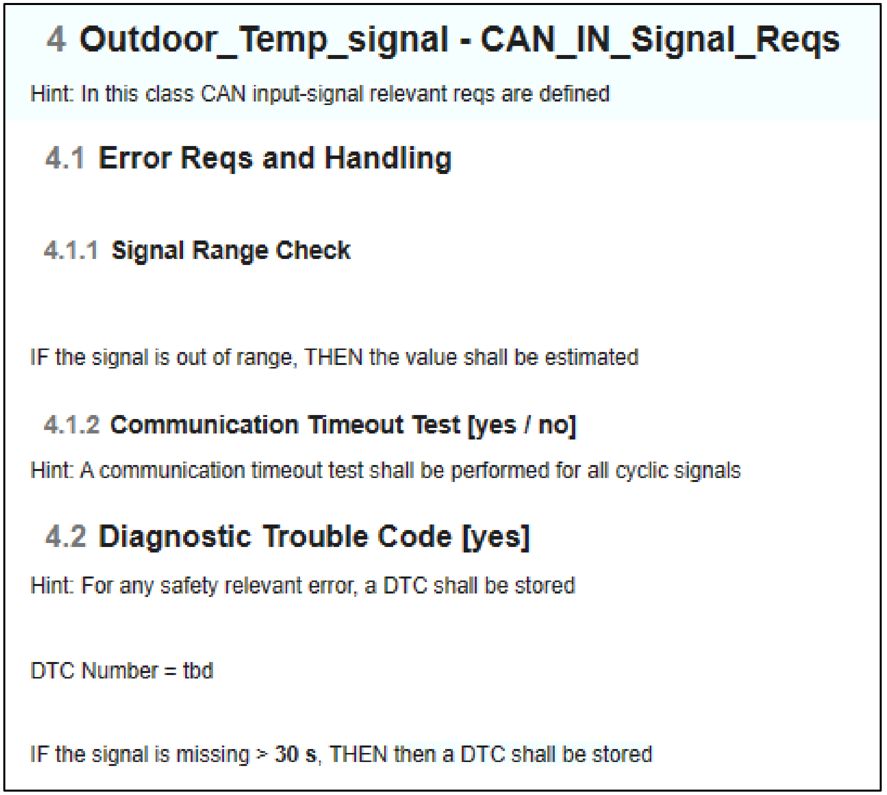


▸ 4 Outdoor_Temp_signal - CAN_IN_Signal_Reqs

- After pressing the synchronization-button, the parent-class is copied, according to its inheritance rules:

- Case relevant reqs are only inherited, if the decision is taken

- All signal specific reqs can then be finalized in the instance



4 Outdoor_Temp_signal - CAN_IN_Signal_Reqs

Hint: In this class CAN input-signal relevant reqs are defined

4.1 Error Reqs and Handling

4.1.1 Signal Range Check

IF the signal is out of range, THEN the value shall be estimated

4.1.2 Communication Timeout Test [yes / no]

Hint: A communication timeout test shall be performed for all cyclic signals

4.2 Diagnostic Trouble Code [yes]

Hint: For any safety relevant error, a DTC shall be stored

DTC Number = tbd

IF the signal is missing > **30 s**, THEN then a DTC shall be stored

4. Observing the class rules and error handling

After pressing the synch. button, each **derived-class** and each **class-instances** shall be verified, if it follows the inheritance rules of its parents:

- If any **mandatory** item is **deleted**
- If text that may **not be overwritten** is overwritten
- Only allowed **case-relevant-decision** are taken if if the right **case-relevant req** is inherited
- If the number of **multiplicities** are within the range of its **cardinalities**
- If all items contain a req as child in **class-instances**
- If all open details are defined in **class-instances**

→ If any error is detected, it shall be notified in the error-field (mandatory-field)

→ If the error is corrected, the error-field shall be cleared

Thank you for your attention!

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