



Item Definition

Wiper&Washer

Version 2.0

Index

1	History notes	3
2	Introduction	5
3	Overview	5
3.1	Vehicle communication architecture	5
3.2	Vehicle's relevant information	6



3.3	Vehicle State Machine	6
3.4	Item Expected Operation	6
3.5	Law specifications and homologation criteria	7
3.6	Quality constraints	7
4	Item Description	7
4.1	Item Architecture	7
4.2	Block Diagram	8
4.3	Item Components	9
4.3.1	Components	9
4.3.1.1	NVO	9
4.3.1.2	NBC	9
4.3.1.3	WSM	9
4.3.1.4	Washer pump	10
4.3.1.5	Wiper motors	10
4.3.1.6	RLS	10
4.3.1.7	NQS	10
4.4	Item Functions	10
4.5	Open Points	13
5	Proven in use candidate	13
6	SEooC development	13
7	Component Reuse	14
8	Preliminary Failure modes and potential effects	14
9	Parameters	14
10	Abbreviations and references	15
10.1	Abbreviations	15
10.2	References	15

General content

The primary purpose of this document is to define and describe the item, its functionality, dependencies on, interaction with, the driver, the environment and other items at the vehicle level and to support an adequate understanding of the item so that the activities in subsequent phases can be performed.

Terms and definitions

For the purposes of this document, the following terms and definitions apply. In *curative*-style the definitions already detailed



in ISO 26262-1 (see [1]), reported only for readability, to which the reader shall refer to find the valid definitions.

Fault, abnormal condition that can cause an element or an item to fail

Failure, termination of the ability of an element or an item to perform a function as required (there is a difference between “to perform a function as required” – stronger definition, use-oriented – and “to perform a function as specified”, so a failure can result from an incorrect specification)

Harm, physical injury or damage to the health of people

Hazard, potential source of harm

E/E system, system that consists of electrical and/or electronic elements, including programmable electronic elements (including power supplies, sensors and other input devices, data highways and other communication paths, actuators and other output devices)

System, set of elements, at least sensor, controller, and actuator, in relation with each other in accordance with a design (An element of a system can be another system at the same time)

Item, system or array of systems or a function to which ISO 26262 is applied

1 History notes

Date	Version	Description	Author
14/06/2022	0.1 draft	First edition	Valentina Piscopo
14/07/2022	0.2R	Reviewed by Ceccati	Michele Pinto
30/11/2022	0.3	F244 adaptation. New template.	B. Mirandola
29/05/2023	0.4	Removed the bonnet status since the bonnet will be non-openable. Rear washer pump not present.	B. Mirandola
06/06/2023	0.5	<ul style="list-style-type: none">Updated F244 network ArchitectureUpdated ID block diagrams	T. De Nigris
09/06/2023	0.6	Added comments as review of the version 0.5.	B. Mirandola
17/07/2023	0.7	<ul style="list-style-type: none">Updated document resolving review commentsRemoved rear wiper/washer as not present in F244Added additional information shared by WSM supplierAdded parameters as work itemsAdded vehicle state machine information	T. De Nigris



F244_FuSa

F244_WiperWasher_ID

07/08/2023	1.0	Updated document resolving review comments	T. De Nigris
13/05/2024	2.0	Updated document due to: <ul style="list-style-type: none">• F244-RMF 108 (vertical wiper configuration)	T. De Nigris



2 Introduction

The item definition contains the functions and purposes of the system in question, to identify its functionality and act as a starting point for subsequent analyzes. There is information on the operating environment, intended use, general requirements and constraints. At the end the main functionalities and the state analysis will be identified.

The aim of this document is:

- to support an adequate analysis to understand the safety relevance of the item;
- to define and describe the item, its dependencies on and interaction with the environment and other items;
- to support an adequate understanding of the item so that the activities in subsequent phases can be performed.

3 Overview

3.1 Vehicle communication architecture

The architecture proposed for the F244 project is called "Domain architecture"; this architecture is an evolution of the "Segregated" architecture with the main difference the introduction of the domain ECUs and CAN FD. The Segregate HS architecture was removed from the project F250 (where a "Distributed" architecture has been adopted), so the F244 project will be the first project to introduce the SGW and by consequence the network segregation.

The domain architecture is able to implement every car configuration and power train of the Ferrari range: GT/Sport and ICE/xHEV/EV powertrains.

The network architecture of the F244 is presented below:

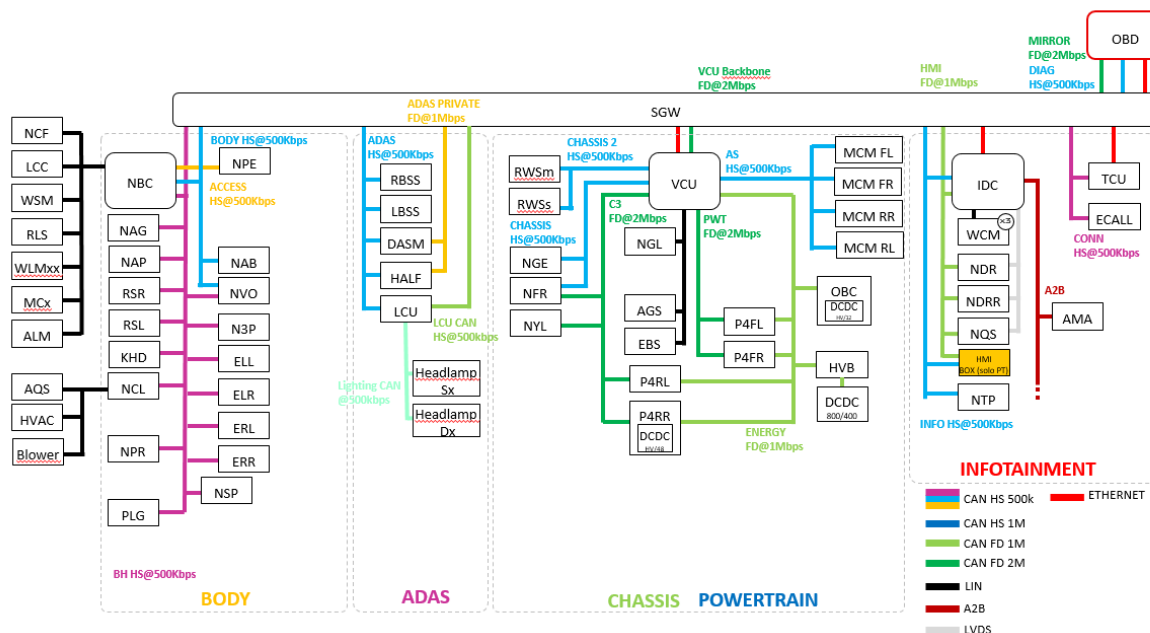


Figure 1 : F244 Network Architecture



3.2 Vehicle's relevant information

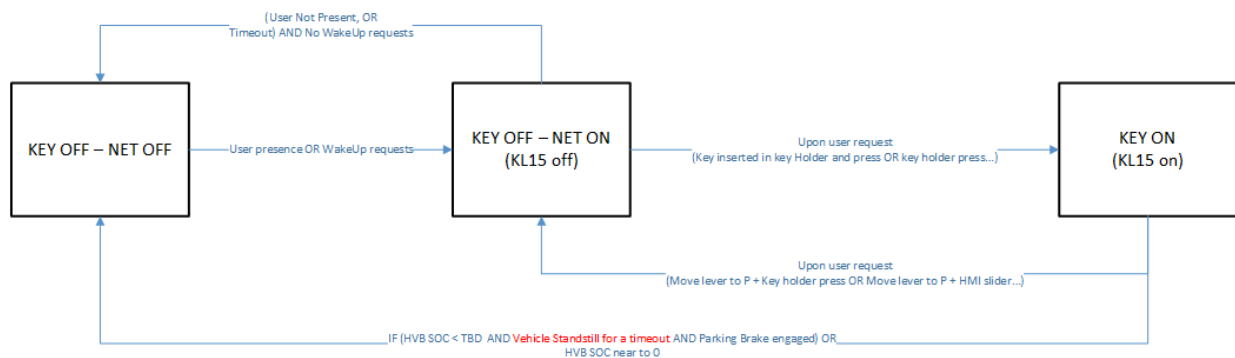
The F244 will be the first electrical vehicle equipped with four electric motors P4: 2x inverters 800V on the front axle and 2x inverters 800V on the rear axle.

It is foreseen to have two different batteries: one low voltage battery (12V) and one high voltage battery (800V).

The F244 will be a 4 doors vehicle with 4/5 seats.

3.3 Vehicle State Machine

The state machine below shows the main states of the item; the transition between the different states is based on driver request or vehicle's internal logics



- KeyOff -Net Off: The vehicle is in sleep conditions. No vehicle network communications; the ECUs are running in low consumption mode , waiting for awake requests;
- KeyOff - NetOn: The vehicle network is awake after recognition of the user presence; since the KL15 is OFF, only some ECUs are working and some functionalities and diagnosis are not available;
- KeyOn (KL15 ON): Vehicle fully operative: just some PWT functions may be not available (e.g. torque).

3.4 Item Expected Operation

The item has the scope to manage the front windscreen wiper and washer so that the driver may always have the best possible road visibility.

The driver interacts with the system using the commands located on the NVO (steering wheel):

- a rotary switch (with 4 stable position)
- one unstable button for the activation of washer/antipanic functions

By using these commands, the user can request the activation of wipers (at different speeds), and the activation of washer functionality in order to spray a controlled amount of washer fluid onto the windshield, aiding in the removal of dirt, debris, and other obstructions that may impede visibility.

Aside of NVO, the system also includes the windscreen washer pump, the NBC node and the WSM node (which controls the wiper motors by adjusting their speed or frequency based on inputs acquired from user requests or from the RLS node).



The main functionalities of the system are:

- *To activate the front wiper motor* – The front wiper can work in different modalities:
 - *OFF*
 - *AUTO*
 - *First speed*
 - *Second speed*
- *To activate the Antipanic function* – Through a pull and consecutive release of the button within 9-2 - T Antipanic Wash Button on the steering wheel, the NBC shall activate the wiping system
- *To activate the washer* – Through a pull of the button for a time $t > 9-2 - T Antipanic Wash Button$ on the NVO, the NBC activates the pump for the washer; the washer request activates also the related wiper
- *To deactivate the front wiper system* - The driver can manually request, by setting the rotary switch in the OFF position, to deactivate the wiping system
- *To activate the Service Position Strategy* - The service position shall allow user to change wiper blades and to protect the wiper blades in snow and/or ice conditions (only when the vehicle is stopped and switched off)

The physical drive of the windscreen wiper is done by NBC node which manages to acquire wiping commands from the NVO.

3.5 Law specifications and homologation criteria

-

3.6 Quality constraints

-

4 Item Description

This chapter provides the description of the item and its component, sensors or actuators. Can be used graphical elements to support the description.

4.1 Item Architecture

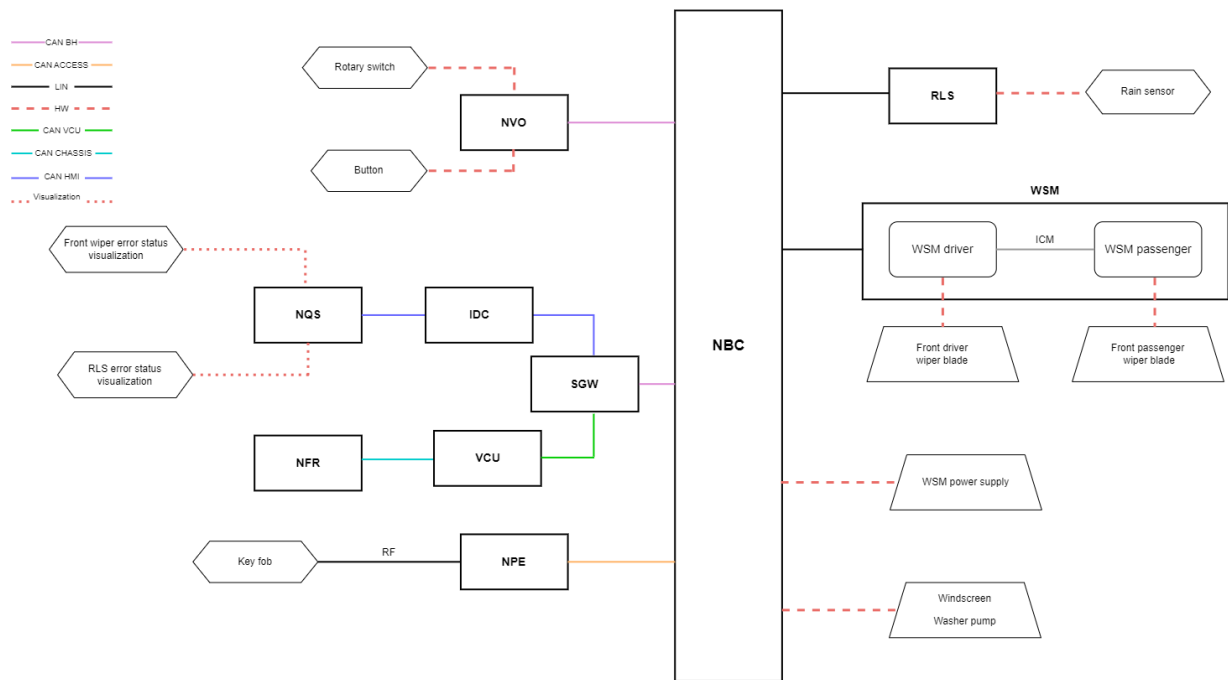


Figure 2 System Architecture

4.2 Block Diagram

The pictures below represents the layout of the item in terms of information exchanged between the components.

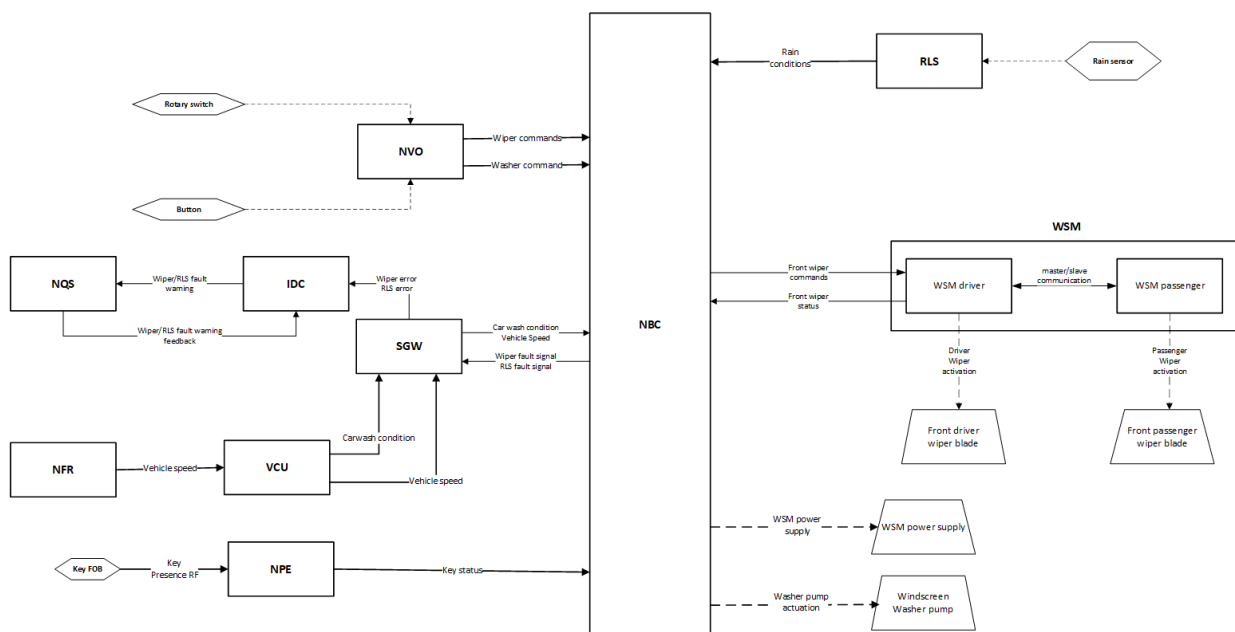


Figure 3 Wiper system block diagram

F



4.3 Item Components

This chapter provides an overview of the item and its constituent components.

4.3.1 Components

4.3.1.1 NVO

- It is equipped with a rotary switch (to select and activate the related wiper function) and an unstable button for single activation of the front wiper or to activate the windshield washer pump (if the button is pressed and held).
- The NVO acquires the user request and sends on CAN networks the command status. There is also a HW connection between NVO and NBC which is used for actuating a recovery strategy in case NBC detects a fault on wipers.
- It acquires the windscreen wiper and washer pump activation command

4.3.1.2 NBC

- It is the master of the functionality since it receives all the relevant inputs (i.e. vehicle speed, key status, weather conditions, user request,...)
- It manages to acquire wiping and washing commands from CAN network and to manage the wiper system by sending the request to WSM
- It sends to the WSM all the relevant information that it needs to properly work and receives from it the information about his working conditions and the eventual problems/errors.
- It shall drive physical power supply in Key On and in Key Off conditions, as long as the internal signal SBMT_Status = "Active", for power supply the WSM.
- It commands via HW the Windscreen washer pump and via LIN the WSM.
- It sends to NQS information about status and faults of the functionality

4.3.1.3 WSM

- It commands the two front wiper actuators and sends back to NBC information about the wiper status.
- The two front wiper actuators (driver actuator and passenger actuator) are in charge of the motion of the associated wiper blade, creating a pattern that resembles the flapping of a butterfly's wings.
- The WSM driver actuator is connected to the NBC through LIN, and the WSM passenger actuator communicates with the WSM driver actuator using the InterMotorCommunication (IMC) protocol.
- The WSM actuators have a blade's collision avoidance mechanism, and in case any master/slave communication defect is detected, the passenger's wiper blade parks, while the driver's wiper blade wipes alone providing the driver with the necessary visibility.
- The two WSM actuators (for driver and passenger side) are ASIL A compliant, and they consist of two identical motors and ECUs in a Master/Slave configuration



4.3.1.4 Washer pump

- It is commanded by NBC and it is the actuator of the washer functionality.

4.3.1.5 Wiper motors

- They control the movement of the wiper blades.
- The front motors are controlled by WSM which consists of two different control units responsible for the movement of the related wiper blades (driver's and passenger's blade).

4.3.1.6 RLS

- The rain light sensor detects weather conditions and sends information to NBC about the best wiping mode and wiping speed for those conditions, in case the wipers are in AUTO mode.
- It is linked via LIN to the NBC

4.3.1.7 NQS

- It acquires the front windscreen wiper error state and displays it
- It acquires the RLS error state and car wash activation error and manages the related icons

4.4 Item Functions

ID	F244_WiperWasher_F1
Name	Front wiper activation
Description	<p>Through the commands on the NVO node, the driver can request the activation of the front wiper. It can work in different modalities:</p> <ul style="list-style-type: none">• AUTO: The wiper is commanded according to the information received from RLS about the outdoor rain status. The possible working modes are an intermittent wiping at first speed, continuous wiping at first speed and continuous wiping at second speed• First/Second speed: The wipers are activated at different rotation speed <p>If the vehicle is standstill and the front wiper is in AUTO mode, then some limitations to the nominal behavior are introduced in order to guarantee the integrity of the windscreen and the comfort of the driver:</p> <ul style="list-style-type: none">• If the AUTO mode is selected before the KeyOff->KeyON transition ,then the front wiper can be activated only if the vehicle speed is above the <u>9-1 - V_AutoActivation</u> .• If in KeyON and the internal signal of external temperature is below <u>9-3 -</u>



	<p><u>Low_Temp_inhibition_ON</u> and the driver selects AUTO mode then the front wiper is inhibited. But if the driver overrides then the functionality is activated.</p> <ul style="list-style-type: none">• If the driver performs a Key On and the vehicle is in standstill with the neutral gear engaged and the wiper is not working for <u>9-4 - T_Auto_N_Inhibition</u> then the auto mode is inhibited <p>The front wiper functionality is stopped if:</p> <ul style="list-style-type: none">• A car wash situation is detected, OR• A KeyOn -> KeyOff transition is detected.
Working conditions	The front wiper can be actuated only in KeyOn conditions (except for service mode).
Operating mode	The front wiper may works both in manual and automatic mode; in automatic mode, the wiper is commanded by RLS
Preconditions for functionality	<ul style="list-style-type: none">• KeyOn, AND• Wiper requested, AND• No car wash conditions

ID	F244_WiperWasher_F2
Name	Antipanic activation
Description	<p>Through a pull and consecutive release of the button within time $\leq T_Antipanic_Wash_Button$ on the steering wheel, the driver can request the activation of "Antipanic" function.</p> <ul style="list-style-type: none">• Antipanic: When antipanic is request by NVO button, the wiping system shall perform one cycle at high speed (plus eventually the fraction of cycle before reaching the first reversing point at the time when the "antipanic" is activate until the first inversion). The antipanic function overrides any other mode running prior to the request.
Working conditions	The Antipanic can be actuated only in KeyOn conditions.
Operating mode	Only manual mode
Preconditions for functionality	Antipanic request



ID	F244_WiperWasher_F3
Name	Washer activation
Description	<p>Through a long press of the button on the NVO, the NBC activates the pump for the washer; the washer request activates also the related wiper and both are ON as long as the button is pressed. The wiper remains ON for a number of wiping cycles (probably 3) after the washer pump has been deactivated.</p> <p>The washer functionality is stopped if:</p> <ul style="list-style-type: none">• A car wash situation is detected, OR• A KeyOn -> KeyOff transition is detected <p>After 60s, if the washer request is still active, the NBC aborts the function and stops the washer pump and the front wiper.</p>
Working conditions	The washer can be actuated only in KeyOn conditions. In case of KeyOn -> KeyOff transition, the movement is stopped.
Operating mode	Only manual mode
Preconditions for functionality	Washer request

ID	F244_WiperWasher_F4
Name	Wiper deactivation
Description	<p>Through the commands on the NVO node, the driver can request the deactivation of the front wiper. Infact It can work in:</p> <ul style="list-style-type: none">• OFF: The wiper system is OFF
Working conditions	The wiper can be deactivated only in KeyOn conditions.
Operating mode	Only manual mode
Preconditions for functionality	Deactivation request

ID	F244_WiperWasher_F5
Name	Service Position Strategy Activation



Description	<p>The front wiper may also be activated in order to reach the service position (the service position shall allow user to change wiper blades and to protect the wiper blades in snow and/or ice conditions): pushing the washer button for a time longer than T_Service_User_Activation (3sec), within T_Service_Activation (30sec) from the KeyOn -> KeyOff transition, the wiper is commanded to reach the service position.</p> <p>The system exits from the service position if:</p> <ul style="list-style-type: none">• KeyOn, AND• (Wiper requested, OR• Washer requested, OR• VehicleSpeed >= 9-1 - V_AutoActivation <p>Once the service position is deactivated, the wiper system shall follow the inputs from NVO.</p>
Working conditions	Key On --> Key Off condition
Operating mode	Only manual mode
Preconditions for functionality	<p>NBC, from transition KeyOn to KeyOff condition, shall start a timer T_Service_Activation.</p> <p>IF NBC at Key Off condition, inside this timer, read:</p> <ul style="list-style-type: none">• NVO_INFO.FrontWindshieldWasherSwitchSts = "Active" for time => T_Service_User_Activation (RDI) parameter <p>shall set NBCtoWSM.Stop_Pos_Req = "STOP IN SERVICE".</p>

4.5 Open Points

-

5 Proven in use candidate

Not Applicable

6 SEooC development

Not Applicable



7 Component Reuse

Most of the components involved in the item are a carry over in terms of HW design; it is possible that SW modifications will be requested but just to align the previous contents to F244 peculiarities.

List of components already used in previous projects:

- NBC - ASIL B capable
- NPE - ASIL QM capable
- RLS - ASIL QM capable

The list above will not be developed from the scratch for the F244 project: some modifications will be performed but just in terms of SW logics.

Front wiper implements a new wiping motion by creating a pattern that resembles the flapping of a butterfly's wings. This motion pattern is achieved by using two different ECUs that manage the related wiper blade (driver's and passenger's blade)

8 Preliminary Failure modes and potential effects

PRELIMINARY FAILURE MODES	POTENTIAL PRELIMINARY EFFECTS
Wiper stopped while the vehicle is moving	Bad visibility for the driver
Wiper does not start when requested	Bad visibility for the driver
Washer does not start when requested	Front screen can not guarantee a good visibility

9 Parameters

V_AutoActivation

Description Parameter	Minimum vehicle speed to activate front wipers
Unit	[km/h]
Value	4

T_Antipanic_Wash_Button

Description Parameter	Minimum time to activate the pump for the washer
Unit	[ms]
Value	500

Low_Temp_inhibition_ON

--	--



Description Parameter	Minimum external temperature to inhibit the wiper AUTO mode
Unit	[C]
Value	4

T_Auto_N_Inhibition

Description Parameter	Mimimum time to inhibit the wiper AUTO mode
Unit	[s]
Value	4

10 Abbreviations and references

10.1 Abbreviations

ASIL	Automotive Safety Integrity Level
CAN	Connected Area Network
LIN	Local Interconnect Network
E/E	Electric/Electronic
NBC	Nodo Body Computer
VCU	Vehicle Control Unit
WSM	Wiper System Module
IDC	Infotainment Domain Controller
NQS	Nodo Quadro Strumenti
NVO	Nodo Volante
NPE	Nodo Passive Entry
RLS	Rain Light Sensor
IMC	InterMotorCommunication

Table z – List of abbreviations

10.2 References

Ref [1]	International Standard, ISO 26262, second edition 2018, https://www.iso.org/ Table k - List of references
---------	---