TCD Technical Customer Documentation

Preliminary

This **preliminary TCD** documents the present status of the agreed specifications. It will be confirmed when all validation has been completed with positive results.

Product designation:	TCU2
Version:	3.9
Date:	2024-04-30

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1 PRODUCT IDENTIFICATION

Product designation:	Paccar TCU2
Product part number:	7620.000.275, 7620.000.276, 7620.000.305, 7620.000.345, 7620.002.015, 7620.002.016
Type designation:	TCU2 EU IP30 (7620.000.276, 7620.000.345, 7260.000.331) TCU2 NA IP30 (7620.000.275, 7620.002.015) TCU2 NA IP67 (7620.000.305, 7620.002.016)
RB TCD Number	
(Development) Part number:	7620.000.275-0X, 7620.000.276-0X, 7620.000.305-0X
Offer drawing number:	-
Name of customer:	Paccar Inc.
Customer specification:	
Number:	TRS Q98-5016E0040
Edition/version	TRS Telematics Control Unit (TCU) NA Phase 2 V1.1
Date:	25.08.2020
Title:	PACCAR_Central_Requirements_Tool.xlsm
Application:	Truck Connectivity
Further applicable documents:	
TCU-2.1_V2_Requirement_Spec.doc	

The product has been developed, validated, and released exclusively for use in these applications and contexts as described in this TCD.

The product is designed and released for civil applications.

Note: whenever in this TCD the term “CUSTOMER” is mentioned, it shall mean “PACCAR Inc.”.

2 GENERAL PRODUCT DESCRIPTION

2.1 MAIN FUNCTIONS AND CHARACTERISTICS OF THE PRODUCT

The Bosch Telematics Control Unit 2 (“TCU2”) is a series of automotive connectivity devices, which is designed to connect trucks to the outside world using various wired and wireless interfaces.
TCU2 can communicate with the vehicle using CAN-Bus, Ethernet and various Inputs and Outputs and thereby allows collection and processing of vehicle data (“Remote Measurements”), diagnosing faults (“Remote Diagnostics”) as well as updating the whole vehicle (“Remote Update”).
On the other hand, TCU2 features 4G Cellular Connectivity to connect to cloud services, Bluetooth & WLAN to connect to end-customer devices (like Tablets, Smart Phones), as well as GNSS, to determine the position of the vehicle.
TCU2 can manage all kinds of data transfer (for example, Vehicle Data to Cloud, 4G to WLAN Hotspot, Vehicle Data to end-customer tablet) and is prepared that applications can be deployed by 3rd parties.
Additionally, Electronic Horizon functionalities, as used in the European regulation of the intelligent speed assist (GSR ISA), can be hosted on TCU2.
The series consists of three different devices, which differ mainly in their operational regions (North America, Europe), as well as in their IP Rating Class (IP30 and IP67).
During this document the term “TCU2” refers to all three variants (IP30 NA, EU IP30, NA IP67). If any section is only valid for one or two of the three variants, this is highlighted in that section.

The main characteristics of the product are:

Wireless Interfaces:

- 4G LTE Cellular Interface
  - SIM Card support: Internal embedded SIM and removable plastic SIM with 4FF Nano SIM formfactor (IP 30 variants)
- GNSS: GPS, GLONASS, BeiDou, Galileo, QZSS (For NA-Variants: only GPS, Galileo)
- WLAN b/g/n/ac (Remark: Variant EU IP 30 with WLAN deactivated and not certified with SW 23.03.S.004)
- Bluetooth 5.0 and BLE

Wired Interfaces:

- 3x CAN-FD Bus (compatible to CAN 2.0)
- 1x Automotive Ethernet 100Base-T1
- 4x Digital Inputs
- 2x Low-side switch Outputs
- 1x USB 2.0 (EU-Variant Only)

Power and Processing

- Voltage range: from 9V to 32V
- LTE Cellular module with integrated application processor and memory
- Coprocessor for vehicle communication

The Paccar TCU2 consists of three different variants derived from the same platform with following main features and differences:

Feature	NA IP 30 Variant (TCU2-NA-IP30)	NA IP 67 Variant (TCU2-NA-IP67)	EU IP 30 Variant (TCU2-EU-IP30)
Operat. Voltage	9VDC ... 32 VDC		
CPU	Dual Core ARM A53 @ 1.5Ghz inside WNC NAD		
... DMIPS	7000		
... RAM	1GB		
... NAND	1GB		
Utility Controller	Aurix TC377TP		
... Program Flash	6MB		
... NOR Flash	4MB		
Sensors	Temperature: Onboard NTCs 6D-IMU (Accelerometer + Gyro): Bosch SMI230		
RTC	Including coin cell battery		
HSM	TPM SLI9670		
GNSS	U-Blox M9		
Housing	IP 30	IP 67	IP 30
eMMC	16GB	16GB	32GB
Backup Battery	Yes	Yes	No

Feature	NA IP 30 Variant (TCU2-NA-IP30)	NA IP 67 Variant (TCU2-NA-IP67)	EU IP 30 Variant (TCU2-EU-IP30)
Cellular (See Chapter 4.3.3)	4G LTE Cat. 6 NA	4G LTE Cat. 6 NA	4G LTE Cat. 6 EU
75V Load Dump	Yes	Yes	No
BT/WLAN	WLAN b/g/n/ac, BT5.0		
USB 2.0	No		Yes, only MSG
CAN(-FD)	2 CANs on board, 1 used after SOP	2 CANs on board, 1 used after SOP	3 CANs on board, 2 used after SOP
Eth. 100Base-T1	1		
Digital Input	4		
Low Side Output	2		
Container Apps.	✓	✓	✓
Vehicle Mgmt. App (Bosch VMS)	✓	✓	✓
Remote Diagnostic (Bosch Grade-X)	✓	✓	✓
Electronic Horizon	–	–	✓
… GSR ISA	–	–	✓
… PCC	–	–	✓
Remote Tacho	–	–	✓
IDS	H-IDS	H-IDS	H-IDS Prepared

The selected CPU configuration (Dual Core A53, 7000 DMIPS) is the maximum possible configuration for the current 4G NAD Platform. The alternative Single-Core 4G Platform (3500 DMIPS) will not be considered for this project.

The following table shows the mapping of part numbers to variants

Part number	Variant	Comment
7620.000.275	TCU2 NA IP30	Production SW: Dolphin SP2.1
7620.002.015	TCU2 NA IP30	Production SW: Dolphin SP3
7620.000.305	TCU2 NA IP67	Production SW: Dolphin SP2.1
7620.002.016	TCU2 NA IP67	Production SW: Dolphin SP3
7620.000.276	TCU2 EU IP30	Production SW: LEO SP2.1
7620.000.345	TCU2 EU IP30	Production SW: CASSIOPEIA
7620.000.331	TCU2 EU IP30	Production SW: Cassiopeia SP1

2.2 INTENDED USE

Target Markets

The product is intended based on the regulatory requirements directly applicable to the product at the time of TCD creation in the following target market(s):

Note: Availability of released country homologations will be announced separately.

TCU2 EU IP30:

Variant	Country	Country code
EU	Austria	AT
EU	Belgium	BE
EU	Bosnia Herzegovina	BA
EU	Bulgaria	BG
EU	Croatia	HR
EU	Cyprus	CY
EU	Czechia	CZ
EU	Denmark	DK
EU	Estonia	EE
EU	Finland	FI
EU	France	FR
EU	Germany	DE
EU	Gibraltar	GI
EU	Greece	GR
EU	Guadeloupe	GP
EU	Hungary	HU
EU	Iceland	IS
EU	Ireland	IE
EU	Isle of Man	IM
EU	Israel	IL
EU	Italy	IT
EU	Jersey	JE
EU	Latvia	LV
EU	Liechtenstein	LI
EU	Lithuania	LT
EU	Luxembourg	LU
EU	Malta	MT
EU	Martinique	MQ
EU	Mauritius	MU
EU	Monaco	MC

Variant	Country	Country code
EU	Montenegro	ME
EU	Netherlands	NL
EU	North Macedonia	MK
EU	Norway	NO
EU	Poland	PL
EU	Portugal	PT
EU	Reunion	RE
EU	Romania	RO
EU	San Marino	SM
EU	Serbia	RS
EU	Singapore	SG
EU	Slovakia	SK
EU	Slovenia	SI
EU	Spain incl. Gran Canaria (Canary Islands) and Tenerife (Canary Islands)	ES
EU	Sweden	SE
EU	Switzerland	CH
EU	United Kingdom	GB

TCU2 NA IP30 and TCU2 NA IP67:

Variant	Country	Country code
NA	Canada	CA
NA	Mexico	MX
NA	United States of America	US

The product can be used in a released target market in the applications set out in chapter 1, subject to the limits, conditions and other specifications described in this TCD ("Intended Use").

In the case that CUSTOMER wants to use the product outside the Intended Use, CUSTOMER shall

(1) on its own responsibility evaluate and comply with any regulatory requirements resulting there from for the product and evaluate and ensure the usability of the product for the area of application intended by the customer or

(2) obtain a new, extending Bosch release, which shall be ordered separately from Bosch (e.g. by means of a change request).

Deliveries and services (fulfilment of contract) shall be subject to the provision that there are no obstacles to performance due to national or international (re-)export control regulation, in particular embargoes or other sanctions.

Market Conditions

The product will meet the requirements and specifications agreed between Bosch and CUSTOMER and documented in the Technical Offer Package [1] accompanying our offer. With regard to the use and intended purpose of the product, however, only market conditions, standards relevant to the industry, and other (industrial) standards existing or known at the time of the first SOP (Start Of Production), hereinafter collectively referred to as “market conditions”, shall be taken into account. These particularly include the frequency bands, signal strength, data transmission (especially transmission frequency, data format, and quantity of data) and the storage of data (especially the duration, format, and location). It cannot be ruled out that one or more of the market conditions may change after the SOP, which might have undesirable or unintended effects on the product, and which might also impair or exclude the usability of the product. These effects do not constitute a defect

of product. Any necessary product modifications that take the changed market conditions into account shall be agreed and reordered on a case-by-case basis by means of a change request. The same applies if a change in legislation will influence the product as described above or will require a change to the product.

WLAN frequency regulations

The compliance with country regulations regarding the operation of WLAN bands is handled by the software of the TCU2. The software retrieves the current country the TCU2 is located in, e. g. by information of cellular base stations, and restricts the WLAN output power and allowed frequencies. Additionally, it takes into account that BT&WLAN is deactivated in countries where no type approval is given for the device.
Since the country regulations can evolve over time, it would be preferable to have a hyperlink e. g. in the user manual which points to online pages allowing the user to look up the WLAN regulatory status of relevant countries.

Field data acquisition and active field observation

Software modules are available for our control units for the acquisition and statistical classification used in the design/testing of relevant field loads. Knowing the actual field data (e.g.: voltage, temperature, software resets) makes it possible to avoid overdesign and overtesting by using assumptions that are too conservative and could potentially result in higher cost than necessary. Quality problems due to incorrectly estimated field loads and damage mechanisms can also be reduced or detected earlier. Of course, no personalized data is collected/transmitted, and the data cannot be manipulated. Our scalable concepts enable us to optimize risk management. Please do not hesitate to contact our experts at any time for further technical information and design that complies with data protection legislation.

2.3 PRODUCT SAFETY

2.3.1 FUNCTIONAL SAFETY

PRODUCT without ASIL rating

Bosch points out that the TCU2 series has been developed according to QM and does not implement any ASIL-classified requirements (in the sense of ISO 26262). It is therefore not approved by Bosch for applications in which one or more requirements with an ASIL classification (above QM) are assigned to the Bosch scope of supply.
The customer has to ensure that the TCU2 is suitable to be used within the overall system regarding any functional safety requirements assigned to the TCU2 in the overall system.

2.3.2 DATA PROTECTION, CYBER SECURITY AND OVER-THE-AIR ASPECTS

Product IT Security

To ensure product IT security, external interfaces are removed, deactivated, or protected against unauthorized access within the product software or during volume production. These security mechanisms can impede or limit the analysis conducted by Bosch or its suppliers. The security concept of the product defines how the product IT security and the analysis options are aligned in coordination with Paccar Inc. This can include the acceptance of certain limitations in analyzability or necessary adjustments to the security mechanisms – also with respect to customer service measures.

2.3.3 SAFETY AND WARNING NOTES

This paragraph contains important safety and warning notes for handling and operating the device in series applications.

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE is used to address practices not related to physical injury.

Safety instructions (or equivalent) signs indicate specific safety-related instructions or procedures.

WARNING

- The product is provided and approved for a rated voltages from 9V to 32V. Short circuits must be securely prevented, even in the event of a fault. Creeping short-circuits in particular lead to high arc energies that cannot be switched off by conventional melting fuses. If other rated voltages are present in the vehicle (e.g. 48 V for example in hybrid vehicles, or 400/800 V in electric vehicles) we recommend that safety precautions are taken in the vehicle itself (e.g. additional insulation of high voltage lines and the use of edge protectors when passing through sharp-edged areas, in order to prevent short circuits to inputs/outputs of our device, e. g. to loudspeaker lines).

CAUTION

- The product is intended, and has been approved, for installation and operation in vehicles class MX + NX with a rated voltage of 12 or 24 volts. It may be necessary to adapt the product's factory-set state to suit the specific country. See also the offer drawing 7620000275.
- Only connecting cables and external devices that are appropriate for the device in question may be used (e.g.: proper current carrying capability, proper EMC shielding, flammability verified with appropriate certificates). Compliance with the applicable standards can no longer be guaranteed if the device – including the software – is modified without the agreement of Bosch
- Bosch assumes no responsibility for damage as a result of incorrect indicators/displays. These may arise if the device has not been connected or has been incorrectly connected, or if the device receives false or erroneous signals from the system.

NOTICE

- Formation of condensation on the device must be avoided. In case of condensation formation, you must allow an acclimatization time of up to two hours to pass.
- If housing sealed (e.g. IPx7): formation of condensation when the plug is not inserted is to be avoided.
- Do not cover ventilation openings and heat sinks. Otherwise, a build-up of heat that could lead to malfunction may occur in the device.
- The housing/surface of the TCU2 may be very hot when the device is operational. Please exercise caution and use appropriate protective equipment (PPE).
- Do not insert foreign bodies into the insertion slots or openings of the device. Injury, or damage to the device, may occur otherwise.
- The device must not come into contact with hot or burning objects (e.g. cigarettes).
- To clean the device, never use hard or sharp objects that could damage the protective pane or housing. Do not use aggressive cleaning agents such as thinners, gasoline, abrasive cleaners, spray cleaners, acidic or alkaline solutions, or wax. Do not spray any liquids onto the device. To clean the housing and protective pane / display, moisten a soft cloth with tepid water and wipe off the dirt. Make sure that no liquid enters the inside of the display. Afterwards, wipe the cleaned surface with a clean, dry cloth.
- If the device is to be cleaned before installation in the vehicle, you must make sure the openings (in particular the connector contact points) are kept sealed so that no liquid can enter the device.
- Any media compatibility test (such as a single wetting with gasoline) that may be referred to in Chapter 4.5 (Chemical Characteristics) does not represent an extension to the permitted cleaning agents.
- The WLAN antennas must be installed inside the vehicle cabin, because the WLAN 5.1 GHz band (channels 36-48) are not allowed outside the cabin in some countries. In case the WLAN antennas shall be placed outside the vehicle, a change in the software is needed to disable the WLAN 5.1 GHz band (channels 36-48). A recertification will be necessary.
- The customer must ensure that GNSS functionalities are configured according to regulations of different target markets, e.g. US (e.g. GLONASS requires licensing), RUS (GLONASS), China (e.g. encryption of positioning information required). Bosch sets the devices end-of-line to “GPS+Galileo enabled” (for NA variants) and “All enabled” (for EU variant)

2.3.4 Safety and Warning Notes for the Battery Pack

The following Safety and Warning Notes for the Battery Pack are relevant for TCU2 NA IP30 and TCU2 NA IP67 devices.

⚠ DANGER!

- Failure to carefully observe the following procedures and precautions can result in leakage of battery fluid (electrolyte), heat generation, explosion, fire and serious personal injury!
  - Never dispose of Sealed Nickel-Metal Hydride Rechargeable batteries in a fire of heat them.
  - Do not connect the (+) positive and (-) negative terminals of Sealed Nickel-Metal Hydride Rechargeable batteries together with electrically conductive materials, including lead wires. Do not transport or store Sealed Nickel-Metal Hydride Rechargeable batteries with their uncovered terminals or connected with a metal necklace or other electrically conductive material. When carrying or storing batteries, use a special case.
  - Only charge Sealed Nickel-Metal Hydride Rechargeable batteries using those specific chargers that satisfy ´s specifications. Only charge batteries under the specified conditions.
  - The (+) positive and (-) negative terminals of Sealed Nickel-Metal Hydride Rechargeable batteries are predetermined. Do not force the terminal to connect to a charger or an equipment. If the terminals cannot be easily connected to the charger or the equipment, check if the (+) and (-) terminal are incorrectly positioned.
  - Do not directly connect Sealed Nickel-Metal Hydride Rechargeable batteries to a direct power source or the cigarette lighter socket in a car.
  - Do not use Sealed Nickel-Metal Hydride Rechargeable batteries in any equipment other than those specified.
- Sealed Nickel-Metal Hydride Rechargeable batteries contain a strong colorless alkaline solution (electrolyte). The alkaline solution is extremely corrosive and will cause skin damage. If any fluid from Sealed Nickel-Metal Hydride Rechargeable batteries comes in contact with user´s eyes, they should immediately flush their eyes and wash them thoroughly with clean water from the tap or another source and consult a doctor urgently. The strong alkaline solution can damage eyes and lead to permanent loss of eyesight.

⚠ WARNING!

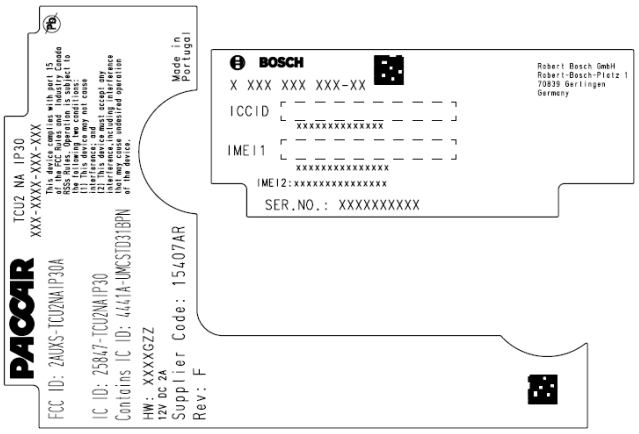
- Do not apply water, seawater or other oxidizing reagents to Sealed Nickel-Metal Hydride Rechargeable batteries, as this can cause rust and heat generation. If battery becomes rusted, the gas release vent may no longer operate, and can result in explosion.
- Don not over-charge Sealed Nickel-Metal Hydride Rechargeable batteries by exceeding the predetermined charging period specified by the battery charge´s instructions or indicator. If Sealed Nickel-Metal Hydride Rechargeable batteries are not fully charged after the battery charger´s predetermined charging period has elapsed, stop the charging process. Prolonged charging may cause leakage of battery fluid, heat generation.
- Sealed Nickel-Metal Hydride Rechargeable batteries contain a strong colorless alkaline solution (electrolyte). If the skin or clothing come in contact with fluid from Sealed Nickel-Metal Hydride Rechargeable battery, thoroughly wash the area immediately with clean water from the tap or another source. Battery fluid can irritate the skin.
- Do not connect equal to or more than 2 Sealed Nickel-Metal Hydride Rechargeable batteries in series, as this may cause electrical shocks, leakage of battery fluid and heat generation.
- Do not remove the outer tube from a battery or damage it. Doing so will expose the battery to the risk of a short circuit, and may cause leakage of battery fluid, heat generation explosion and fire.
- If Sealed Nickel-Metal Hydride Rechargeable batteries leak fluid, change color, change shape, or change in any other way, do not use them, otherwise they may cause heat generation, explosion and fire.
- Keep Sealed Nickel-Metal Hydride Rechargeable batteries and the equipment using them out of the reach of babies and small children, in order to avoid accidental swallowing of the batteries. In the event the batteries are swallowed, consult a doctor immediately.

⚠ CAUTION

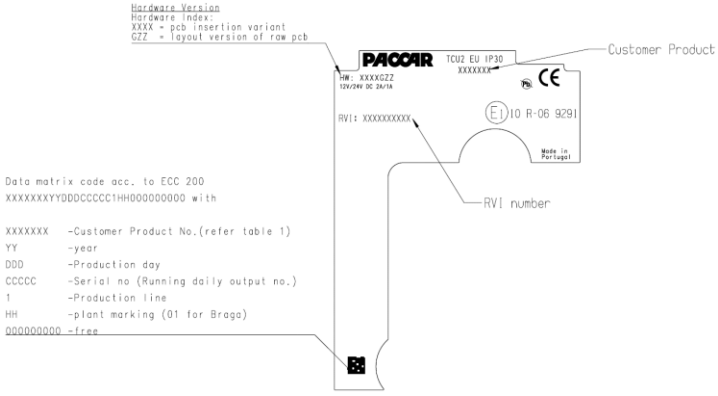
- Do not strike or drop Sealed Nickel-Metal Hydride Rechargeable batteries.
- Store Sealed Nickel-Metal Hydride Rechargeable batteries out of the reach of babies and small children. When charging or using a battery, do not let babies or small children remove the battery from the charger or the equipment being used.
- Be sure to use the recommended charging method for Sealed Nickel-Metal Hydride Rechargeable batteries, read the battery charger´s instruction manual carefully.
- Do not use or store battery at high temperature, such as in strong direct sunlight, in cars during hot weather, or directly inf front of a heater. This may cause a leakage of battery fluid. It could also impair performance an shorten operating life of Sealed Nickel-Metal Hydride Rechargeable batteries.
- Be sure to turn off the equipment after use of Sealed Nickel-Metal Hydride Rechargeable batteries, otherwise, may result in leakage of battery fluid.
- After removed from equipment, Sealed Nickel-Metal Hydride Rechargeable batteries in dry place and within the recommended storage temperature range. This will help preserve the batteries performance and durability and minimize the possibility of leakage of battery fluid or corrosion. (The battery manufacturer recommends the storage temperature range from -20 to +30 deg. C for long service life).
- To use batteries for the first time after purchase or having not used them for a long period of time, be sure to charge them.
- After long term storage, there is a possibility that the battery could not be fully charged. In order to fully charge it, please charge and discharge the battery for a few times.
- Do not use old and new batteries mixed together, or batteries at different charge levels. Do not use the Sealed Nickel-Metal Hydride Rechargeable batteries mixed together with a dry cell or other batteries of different capacity, type, or brand name. This may cause leakage of battery fluid and heat generation.
- If the Sealed Nickel-Metal Hydride Rechargeable battery terminals become dirty, clean up them with a soft dry cloth prior to use. Dirt on the terminals can result in poor contact with the equipment, loss of power, or inability to charge.
- Batteries have a limited lifetime. Even in the same equipment, the battery life varies depending on the ambient temperature during operation and number of charge/discharge cycles. Therefore, if the operation time of Sealed Nickel-Metal Hydride Rechargeable battery becomes much shorter than its initial operating time, even after recharging, it is most likely near the end of its lifetime and should be replaced with a new battery. Please do not dispose together with trash since used Sealed Nickel-Metal Hydride Rechargeable batteries is a valuable resource. Apply tapes to either battery terminals or connection code, insulate them, and please perform the recycle action.

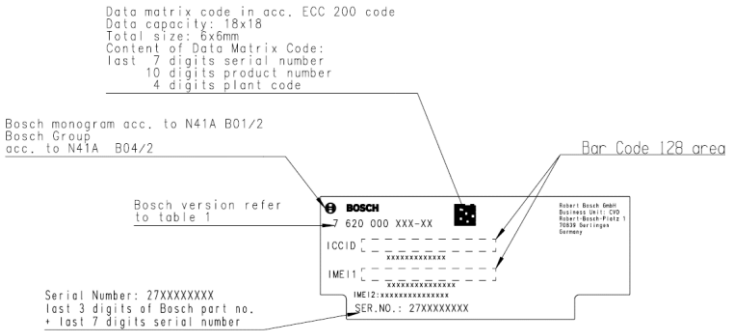
2.4 LABELING OF THE PRODUCT

TCU2 NA IP30 device:

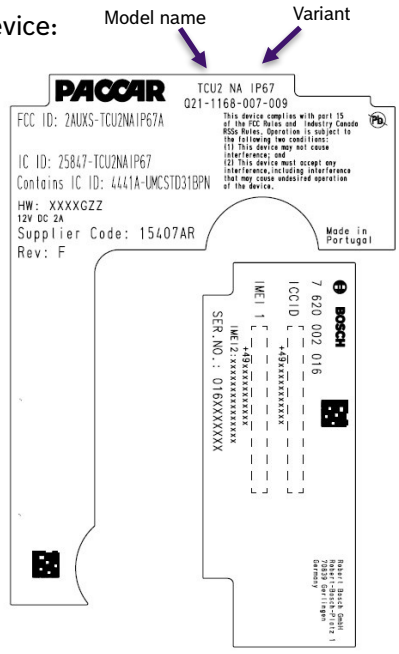


TCU2 EU IP30 device:





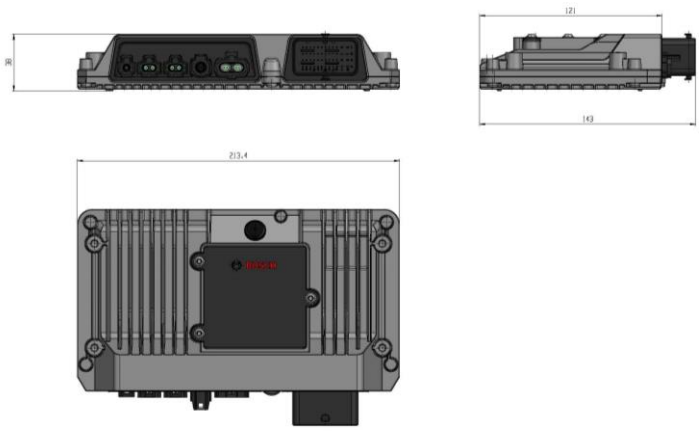
TCU2 NA IP67 device:



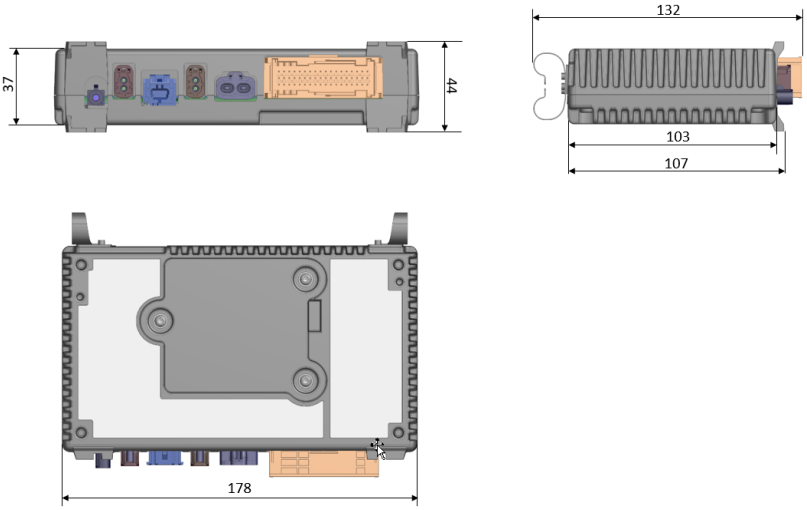
2.5 DIMENSIONS AND WEIGHTS

	IP 30 Variant	IP 67 Variant
Height	37 mm	38 mm
Width	103 mm	121 mm
Length	178 mm	213 mm
Weight (without backup battery)	~ 726 g	~826 g

Dimensions of IP 67 variant (pictures are for illustration purpose only):



Dimensions of IP 30 variant (pictures are for illustration purpose only):



The backup battery weighs approximately 116 g.

2.6 POWER CONSUMPTION / POWER OUTPUT

Nominal supply voltage:	12V/24V
Operational voltage range:	9V... 32V
Quiescent current:	1,3mA at 12V 0,6mA at 24V
Ambient temperature range:	-40°C . . . +60°C/+65°C full operational +60°C/+65°C . . . +85°C limited operational ○ temperature increase over 65°C => change from full operation to limited operation ○ temperature decrease below 60°C => change from limited operation to full operation ○ Remark: EU IP30 full operation temperature limited to 37°C for first certification with SW: 23.03.S.004 ○ Remark: EU IP30 full operation temperature limited to 55°C for second certification with SW: 23.04.S.013
Max. current consumption:	2A at 12V 1A at 24V

KL.30:
• Reverse Polarity Protection max. 40V

Load Dump Protection:
• Pulse A +75V for 12V nominal voltage (only for NA variant)
• Pulse B +58V for 24V nominal voltage

2.7 GENERAL REMARKS ON SERVICE, REPAIR, AND MAINTENANCE

Repair of the product is not possible.
An exchange of the backup battery is possible but may only be performed by authorized personnel. The exchange battery must be aligned with Bosch. The battery type is described in chapter Power Supply.

The TCU2 EU IP30 variant is not allowed to be operated with an internal backup battery.

2.8 INFORMATION ON DISPOSAL AND RECYCLING

Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.
Please contact your local authority for further details of your nearest designated collection point. Penalties may be applicable for incorrect disposal of this waste, in accordance with your national legislation.

Disposal in Countries Inside of the European Union (acc. to end-of live vehicles Directive 2000/53/EG)
Electrical appliances, batteries and packaging should be supplied to an environmental friendly recycling. Do not dispose electrical appliances in the domestic waste. According to the European directive 2000/53/EG defective products must be collected and recycled.

The tightness of the product will be affected by opening the housing.

Within the European Union any non-functional product can be disposed at all public collection points for electric old products. The unit, accessories and packaging should be sorted for environmental friendly recycling. Do not dispose of the product into household waste!

Disposal in Countries Outside of the European Union
For disposal in countries outside of the European Union, please find out about the legal disposal guidelines and directives applying in this country. If you wish to discard this product please contact your local authorities or dealer and ask for the correct method of disposal.

2.9 CERTIFICATION NOTICES AND REGULATORY VERBIAGE

2.9.1 TCU2 EU IP30

The OEM shall include the following regulatory statements in his user guide/manual.

Product Designation: Paccar TCU2

Model Name: TCU2
Variant Name: EU IP30

Certificate Holder: Robert Bosch GmbH
Address: Robert-Bosch-Platz 1
70839 Gerlingen
Germany

This equipment shall be installed and operated according to the above defined installation requirements including the minimum distance between the TCU2 EU IP30 external antenna and the nearest interior Class-A surface of 200 mm.

2.9.1.1 INFORMATION FOR REGIONS GOVERNED BY CE

Robert Bosch GmbH declares that the radio Equipment TCU2 EU IP30 is in compliance with Directive 2014/53/EU.

			RED - Directive / technical rule	Text RED simplified EU DoC
Austria	AT	DE	2014/53/EU	Hiermit erklärt Robert Bosch GmbH, dass der Funkanlagentyp TCU2 EU IP30 der Richtlinie 2014/53/EU entspricht. Der vollständige Text der EU-Konformitätserklärung ist unter der folgenden Internetadresse verfügbar: https://eu-doc.bosch.com/
Belgium	BE	FR	2014/53/UE	Le soussigné, Robert Bosch GmbH, déclare que l'équipement radioélectrique du type TCU2 EU IP30 est conforme à la directive 2014/53/UE. Le texte complet de la déclaration UE de conformité est disponible à l'adresse internet suivante: https://eu-doc.bosch.com/
Bulgaria	BG	BG	2014/53/EC	С настоящото Robert Bosch GmbH декларира, че този тип радиосъоръжение TCU2 EU IP30 е в съответствие с Директива 2014/53/ЕС. Цялостният текст на ЕС декларацията за съответствие може да се намери на следния интернет адрес: https://eu-doc.bosch.com/
Cyprus	CY	EL	2014/53/EE	Με την παρούσα ο/η Robert Bosch GmbH, δηλώνει ότι ο ραδιοεξοπλισμός TCU2 EU IP30 πληροί την οδηγία 2014/53/ΕΕ. Το πλήρες κείμενο της δήλωσης συμμόρφωσης ΕΕ διατίθεται στην ακόλουθη ιστοσελίδα στο διαδίκτυο: https://eu-doc.bosch.com/
Czech Republic	CZ	CS	2014/53/EU	Tímto Robert Bosch GmbH prohlašuje, že typ rádiového zařízení TCU2 EU IP30 je v souladu se směrnicí 2014/53/EU. Úplné znění EU prohlášení o shodě je k dispozici na této internetové adrese: https://eu-doc.bosch.com/
Germany	DE	DE	2014/53/EU	Hiermit erklärt Robert Bosch GmbH, dass der Funkanlagentyp TCU2 EU IP30 der Richtlinie 2014/53/EU entspricht. Der vollständige Text der EU-Konformitätserklärung ist unter der folgenden Internetadresse verfügbar: https://eu-doc.bosch.com/
Denmark	DK	DA	2014/53/EU	Hermed erklærer Robert Bosch GmbH, at radioudstyrstypen TCU2 EU IP30 er i overensstemmelse med direktiv 2014/53/EU. EU-overensstemmelseserklæringens fulde tekst kan findes på følgende internetadresse: https://eu-doc.bosch.com/
Estonia	EE	ET	2014/53/EL	Käesolevaga deklareerib Robert Bosch GmbH, et käesolev raadioseadme tüüp TCU2 EU IP30 vastab direktiivi 2014/53/EL nõuetele.

				ELi vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil: https://eu-doc.bosch.com/
Spain	ES	ES	2014/53/UE	Por la presente, Robert Bosch GmbH declara que el tipo de equipo radioeléctrico TCU2 EU IP30 es conforme con la Directiva 2014/53/UE. El texto completo de la declaración UE de conformidad está disponible en la dirección Internet siguiente: https://eu-doc.bosch.com/
Finland	FI	FI	2014/53/EU	Robert Bosch GmbH vakuuttaa, että radiolaitetyyppi TCU2 EU IP30 on direktiivin 2014/53/EU mukainen. EU-vaatimustenmukaisuusvakuutuksen täysimittainen teksti on saatavilla seuraavassa internetosoitteessa: https://eu-doc.bosch.com/
France	FR	FR	2014/53/UE	Le soussigné, Robert Bosch GmbH, déclare que l'équipement radioélectrique du type TCU2 EU IP30 est conforme à la directive 2014/53/UE. Le texte complet de la déclaration UE de conformité est disponible à l'adresse internet suivante: https://eu-doc.bosch.com/
Greece	GR	EL	2014/53/EE	Με την παρούσα ο/η Robert Bosch GmbH, δηλώνει ότι ο ραδιοεξοπλισμός TCU2 EU IP30 πληροί την οδηγία 2014/53/ΕΕ. Το πλήρες κείμενο της δήλωσης συμμόρφωσης ΕΕ διατίθεται στην ακόλουθη ιστοσελίδα στο διαδίκτυο: https://eu-doc.bosch.com/
Croatia	HR	HR	2014/53/EU	Robert Bosch GmbH ovime izjavljuje da je radijska oprema tipa TCU2 EU IP30 u skladu s Direktivom 2014/53/EU. Cjeloviti tekst EU izjave o sukladnosti dostupan je na sljedećoj internetskoj adresi: https://eu-doc.bosch.com/
Hungary	HU	HU	2014/53/EU	Robert Bosch GmbH igazolja, hogy a TCU2 EU IP30 típusú rádióberendezés megfelel a 2014/53/EU irányelvnek. Az EU-megfelelőségi nyilatkozat teljes szövege elérhető a következő internetes címen: https://eu-doc.bosch.com/
Ireland	IE	EN	2014/53/EU	Hereby, Robert Bosch GmbH declares that the radio equipment type TCU2 EU IP30 is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: https://eu-doc.bosch.com/
Italy	IT	IT	2014/53/UE	Il fabbricante, Robert Bosch GmbH, dichiara che il tipo di apparecchiatura radio TCU2 EU IP30 è conforme alla direttiva 2014/53/UE. Il testo completo della dichiarazione di conformità UE è

				disponibile al seguente indirizzo Internet: https://eu-doc.bosch.com/
Lithuania	LT	LT	2014/53/ES	Aš, Robert Bosch GmbH, patvirtinu, kad radijo įrenginių tipas TCU2 EU IP30 atitinka Direktyvą 2014/53/ES. Visas ES atitikties deklaracijos tekstas prieinamas šiuo interneto adresu: https://eu-doc.bosch.com/
Luxembourg	LU	FR	2014/53/UE	Le soussigné, Robert Bosch GmbH, déclare que l'équipement radioélectrique du type TCU2 EU IP30 est conforme à la directive 2014/53/UE. Le texte complet de la déclaration UE de conformité est disponible à l'adresse internet suivante: https://eu-doc.bosch.com/
Latvia	LV	LV	2014/53/ES	Ar šo Robert Bosch GmbH deklarē, ka radioiekārta TCU2 EU IP30 atbilst Direktīvai 2014/53/ES. Pilns ES atbilstības deklarācijas teksts ir pieejams šādā interneta vietnē: https://eu-doc.bosch.com/
Malta	MT	MT	2014/53/UE	B'dan, Robert Bosch GmbH , niddikjara li dan it-tip ta' tagħmir tar-radju TCU2 EU IP30 huwa konformi mad-Direttiva 2014/53/UE. It-test kollu tad-dikjarazzjoni ta' konformità tal-UE huwa disponibbli f'dan l-indirizz tal-Internet li ġej: https://eu-doc.bosch.com/
Netherlands	NL	NL	2014/53/EU	Hierbij verklaar ik, Robert Bosch GmbH, dat het type radioapparatuur TCU2 EU IP30 conform is met Richtlijn 2014/53/EU. De volledige tekst van de EU-conformiteitsverklaring kan worden geraadpleegd op het volgende internetadres: https://eu-doc.bosch.com/
Poland	PL	PL	2014/53/UE	Robert Bosch GmbH niniejszym oświadcza, że typ urządzenia radiowego TCU2 EU IP30 jest zgodny z dyrektywą 2014/53/UE. Pełny tekst deklaracji zgodności UE jest dostępny pod następującym adresem internetowym: https://eu-doc.bosch.com/
Portugal	PT	PT	2014/53/UE	O(a) abaixo assinado(a) Robert Bosch GmbH declara que o presente tipo de equipamento de rádio TCU2 EU IP30 está em conformidade com a Diretiva 2014/53/UE. O texto integral da declaração de conformidade está disponível no seguinte endereço de Internet: https://eu-doc.bosch.com/
Romania	RO	RO	2014/53/UE	Prin prezenta, Robert Bosch GmbH declară că tipul de echipamente radio TCU2 EU IP30 este în conformitate cu Directiva 2014/53/UE.

				Textul integral al declarației UE de conformitate este disponibil la următoarea adresă internet: https://eu-doc.bosch.com/
Sweden	SE	SV	2014/53/EU	Härmed försäkrar Robert Bosch GmbH att denna typ av radioutrustning TCU2 EU IP30 överensstämmer med direktiv 2014/53/EU. Den fullständiga texten till EU-försäkran om överensstämmelse finns på följande webbadress: https://eu-doc.bosch.com/
Slovenia	SI	SL	2014/53/EU	Robert Bosch GmbH potrjuje, da je tip radijske opreme TCU2 EU IP30 skladen z Direktivo 2014/53/EU. Celotno besedilo izjave EU o skladnosti je na voljo na naslednjem spletnem naslovu: https://eu-doc.bosch.com/
Slovakia	SK	SK	2014/53/EÚ	Robert Bosch GmbH týmto vyhlasuje, že rádiové zariadenie typu TCU2 EU IP30 je v súlade so smernicou 2014/53/EÚ. Úplné EÚ vyhlásenie o zhode je k dispozícii na tejto internetovej adrese: https://eu-doc.bosch.com/
Moldovia	MD	RO	Punerea la dispoziție pe piață a echipamentelor radio	Prin prezenta, Robert Bosch GmbH declară că tipul de echipamente radio TCU2 EU IP30 este în conformitate cu Reglementarea tehnică „Punerea la dispoziție pe piață a echipamentelor radio”. Textul integral al declarației de conformitate este disponibil la următoarea adresă de Internet: https://eu-doc.bosch.com/
Turkey	TK	TR	2014/53/AB	İşbu belge; Robert Bosch GmbH telsiz ekipmanı tipinin TCU2 EU IP30 2014/53/AB sayılı Direktif'e uygun olduğunu beyan eder. AB uygunluk beyanının tam metni aşağıdaki internet adresinde mevcuttur: https://eu-doc.bosch.com/

2.9.1.2 ADDITIONAL COUNTRY SPECIFIC REQUIREMENTS

2.9.1.2.1 LICHTENSTEIN AND SWITZERLAND

This device restricts the transmission of WLAN when the target is located in Serbia.

Declaration of WLAN Transmission Power 2014/53/EU for Lichtenstein and Switzerland:
WLAN 2412 – 2462 MHz <20 dBm
WLAN 5180 – 5240 MHz <14 dBm
WLAN 5745 – 5825 MHZ <14 dBm

2.9.1.2.2 SERBIA

This device does not transmit WLAN on 5 GHz frequencies 5170 – 5250 MHz when the target is located in Serbia.

Declaration of WLAN Transmission Power 2014/53/EU for Serbia:
WLAN 2412 – 2462 MHz <20 dBm
WLAN 5745 – 5825 MHZ <14 dBm

2.9.1.2.3 ISRAEL

2.9.1.2.4 MAURITIUS

2.9.1.2.5 SINGAPORE

2.9.2 TCU2 NA IP30 and TCU2 NA IP67

The OEM shall include the following regulatory statements in his user guide/manual

Model Name: TCU2 NA IP 30
TCU2 NA IP 67

2.9.2.1 USA

FCC ID: 2AUXS-TCU2NAIP30A
2AUXS-TCU2NAIP67A

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
To comply with FCC Exposure requirements the OEM is instructed by the Grantee to assure a minimum separation distance of 20 cm between the antennas and any human body as documented in the filing.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

2.9.2.2 CANADA

IC: 25847-TCU2NAIP30
25847-TCU2NAIP67

Contains IC: 4441A-UMCSTD31BPN

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:
(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

RF Exposure Information:
This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Déclaration d'exposition aux radiations:
Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

2.9.2.3 MEXICO

La operación de este equipo está sujeta a las siguientes dos condiciones:
(1) es posible que este equipo o dispositivo no cause interferencia perjudicial y
(2) este equipo o dispositivo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada.

2.10 Certified Countries

2.10.1 Certified Countries TCU2 EU IP30

country	ISO A2	CE	Bosch Part number
Germany	DE	yes	7620.000.276 7620.000.345 7620.000.311
France	FR	yes	7620.000.276 7620.000.345 7620.000.311
Italy	IT	yes	7620.000.276 7620.000.345 7620.000.311
Netherlands	NL	yes	7620.000.276 7620.000.345 7620.000.311
Sweden	SE	yes	7620.000.276 7620.000.345 7620.000.311
Belgium	BE	yes	7620.000.276 7620.000.345 7620.000.311
Hungary	HU	yes	7620.000.276 7620.000.345 7620.000.311
Czech Republic	CZ	yes	7620.000.276 7620.000.345 7620.000.311
Spain	ES	yes	7620.000.276 7620.000.345 7620.000.311
United Kingdom	UK	yes	7620.000.276 7620.000.345 7620.000.311
Austria	AT	yes	7620.000.276 7620.000.345 7620.000.311
Luxembourg	LU	yes	7620.000.276 7620.000.345 7620.000.311
Switzerland	CH	yes	7620.000.276 7620.000.345 7620.000.311
Norway	NO	yes	7620.000.276 7620.000.345 7620.000.311
Finland	FI	yes	7620.000.276 7620.000.345 7620.000.311
Denmark	DK	yes	7620.000.276 7620.000.345 7620.000.311
Romania	RO	yes	7620.000.276 7620.000.345 7620.000.311

country	ISO A2	CE	Bosch Part number
Poland	PL	yes	7620.000.276 7620.000.345 7620.000.311
Portugal	PT	yes	7620.000.276 7620.000.345 7620.000.311
Greece	GR	yes	7620.000.276 7620.000.345 7620.000.311
Ireland	IR	yes	7620.000.276 7620.000.345 7620.000.311
Crotia	HR	yes	7620.000.276 7620.000.345 7620.000.311
Slovenia	SI	yes	7620.000.276 7620.000.345 7620.000.311
Slovakia	SK	yes	7620.000.276 7620.000.345 7620.000.311
Estonia	EE	yes	7620.000.276 7620.000.345 7620.000.311
Bosnia and Herzegovina	BA	yes	7620.000.276 7620.000.345 7620.000.311
Latvia	LV	yes	7620.000.276 7620.000.345 7620.000.311
Lithuania	LT	yes	7620.000.276 7620.000.345 7620.000.311
North Macedonia	MK	yes	7620.000.276 7620.000.345 7620.000.311
Cyprus	CY	yes	7620.000.276 7620.000.345 7620.000.311
Malta	MT	yes	7620.000.276 7620.000.345 7620.000.311
Montenegro	ME	yes	7620.000.276 7620.000.345 7620.000.311
San Marino	SM	yes	7620.000.276 7620.000.345 7620.000.311
Gibralty	GI	yes	7620.000.276 7620.000.345 7620.000.311
Gran Canaria (Canary Islands)	-	yes	7620.000.276 7620.000.345 7620.000.311
Guadeloupe	GP	yes	7620.000.276 7620.000.345 7620.000.311

country	ISO A2	CE	Bosch Part number
Iceland	IS	yes	7620.000.276 7620.000.345 7620.000.311
Isle of Man (part of UK)	IM	yes	7620.000.276 7620.000.345 7620.000.311
Jersey (part of UK)	JE	yes	7620.000.276 7620.000.345 7620.000.311
Liechtenstein	LI	yes	7620.000.276 7620.000.345 7620.000.311
Martinique	MQ	yes	7620.000.276 7620.000.345 7620.000.311
Monaco	MC	yes	7620.000.276 7620.000.345 7620.000.311
Reunion	RE	yes	7620.000.276 7620.000.345 7620.000.311
Tenerife (Canary Islands)	-	yes	7620.000.276 7620.000.345 7620.000.311

2.10.2 Certified Countries TCU2 NA

Country	Certification	Comment	Bosch Part Number
USA	FCC (IP 30: 2AUXS-TCU2NAIP30A IP67: 2AUXS-TCU2NAIP67A Contains FCC: NKRUMC-STD31BPN)	Only for Sharkfin antenna constellation >4.7m	7620.000.275; 7620.000.305
Canada	IP30: 25847-TCU2NAIP30 IP67: 25847-TCU2NAIP67 Contains IC: 4441A-UMCSTD31BPN	Only for Sharkfin antenna constellation >4.7m	7620.000.275; 7620.000.305

2.11 Development Devices

1. Conditions about the Development Devices:

- Development Devices are intended to be used solely for testing in-depth functionality of a release.
- Development Devices will be produced with Customer Release SW installed. These devices have separate part numbers, in comparison to Production Devices.
- Secure boot is not available in Development Devices, therefore an operator can install both Customer Release SW and Customer Development SW using RAUC update method.
- Not all the data generated by the components (e.g. container applications) will be deleted after an update automatically.

2. Precautions and appropriate technical and organizational measures:

- Install Customer Development SW before the initial use.
- Sanitize the data on the device before handing it over to another entity or department (i.e. sanitize the data before the development device leaves your trust boundary).
- Store the data before sanitization, if it is needed later.
- Update the device before handing it over to another entity or department (i.e. hand over the Development Device with a freshly installed image before it leaves your trust boundary)
- Share the credentials and the data only on need-to-know basis.

3 SYSTEM DESCRIPTION

3.1 SYSTEM OF INTEREST (SOI)

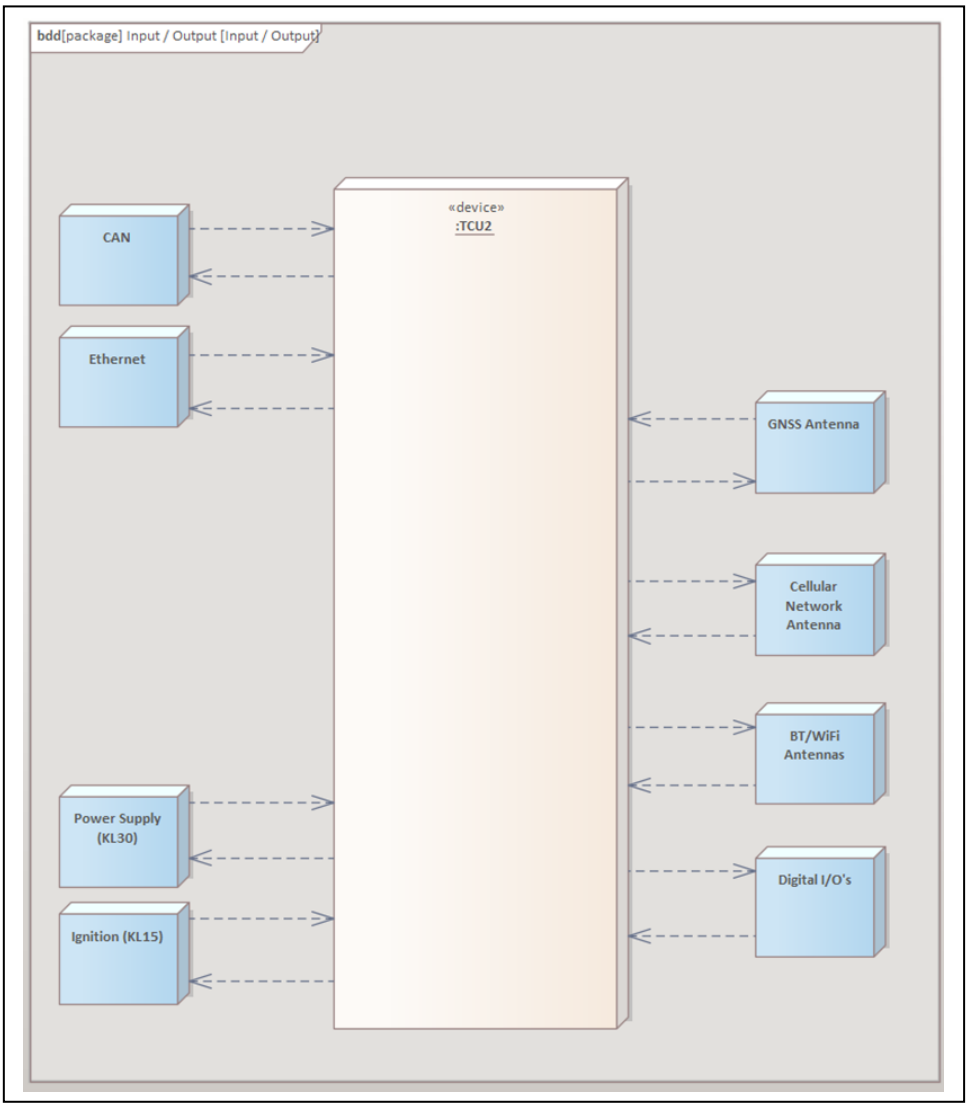


Figure 1: TCU2 in the system context

3.2 AUXILLARY EQUIPMENT – ANTENNAS & CABLING

The TCU2 device did undergo homologation & testing with cable and antenna specification provided by PACCAR and DAF. Several device parameters (f.ex. Bluetooth/WLAN Sending Power) are set according to the provided technical datasheets and Bosch Measurements. If auxillary equipment is changed in field, it cannot be guaranteed that legal limits are kept. For example, if a cable (like Bluetooth / WLAN Antennna Cable) is shortened, the radiated power at the antenna might be too high. This would require a change in the output power and thus re-homologation.

The customer is responsible for only using cables and/or antennas that ensure that limits with regards to minimum health and safety requirements regarding the exposure of workers to the risks from electromagnetic fields are fulfilled (directives 2004/40/EU and 2013/35/EU).

The requirements in this chapter are deemed to be fulfilled, when the product successfully has passed the release tests (see e.g. the EMC test specification).
The isolation between each frequency band (cellular, BT/WLAN and GNSS) of the antenna system needs to be as high as possible in order to avoid interference and intermodulation during co-existence test. This is important to pass legal EMC requirements. This isolation does also ensure proper operating performance and provide co-existence operation of the different systems cellular, BT/WLAN and GNSS.

3.2.1 TCU2 EU IP30 Equipment

3.2.1.1 ANTENNAS

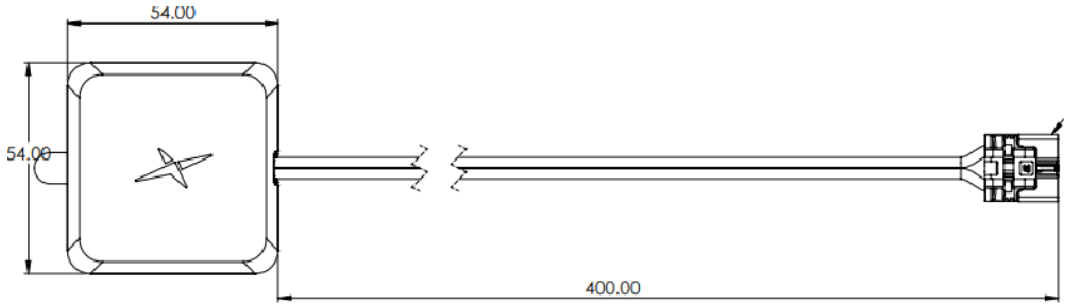
The TCU2 EU IP30 was homologated with the following antennas:

- **Main Antenna:**
  - Variant #1: DAF Duplex Antenna (GNSS+Cellular #1), Nr. 2243195, manufactured by Hirschmann, Nr. 920-693-001
    Provided Datasheet: “Test_Report_DAF_Duplex_B2-Samples_23.09.2019-signed.pdf”

  - Variant #2: Leyland Combi Antenna (GNSS+Cellular+AM/FM/DAB+BT/WLAN), Volvo 23311779, manufactured by Hirschmann, Nr. 920-447-011,
    Provided datasheet “Leyland_4G_Antenna_Spec.pdf”.
    Note: AM/FM/DAB and BT/WLAN are NOT used. BT/WLAN is only homologated with the separate BT/WLAN antenna.

- **Cellular Patch Antenna:**
    - DAF Adhesive Mount Cellular Antenna (Cellular #2), 2277168, manufactured by Hirschmann, Nr. 920-714-001
      Provided datasheet: “Measurement_Report_DAF_Adhesive_Mount_4G_Antenna_C-Samples_29.01.2021.pdf”

- **Bluetooth / WLAN Antenna:**
    - Taoglas PP407096
      Provided datasheet “PP407096_Specification_BT_preliminary.pdf”



*Variant: EU IP 30: WLAN deactivated and not certified with SW S.004

3.2.1.2 CABLING

The TCU2 EU IP30 is homologated with the following antenna cable and cable lengths:

- Used antenna cable: LEONI Dacar 462-Koax-50-1
- Cable lengths TCU2 EU IP30:

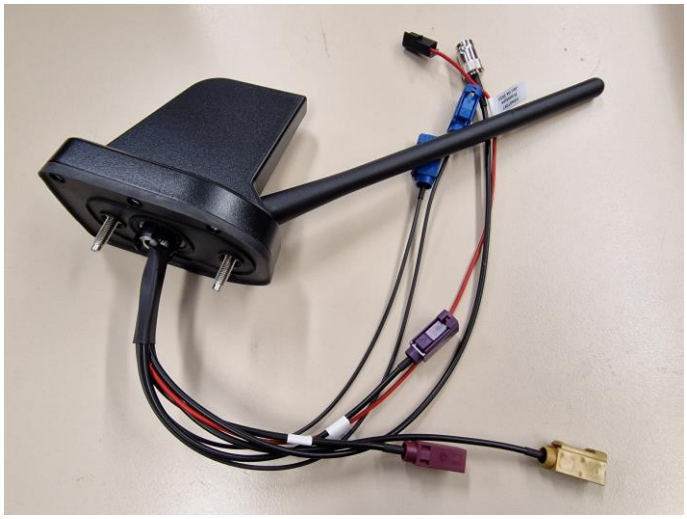
RF Module	Antenna Cable lengths (Min)	Antenna Cable lengths (Max)
Cellular Ant1	4,6m	4,90
Cellular Ant2	0,98m	1,90m
GNSS	4,84m	5m
BT/WLAN	0,4m	0,4m

3.2.2 TCU2 NA IP30 & TCU2 NA IP67 Equipment

3.2.2.1 ANTENNAS

The TCU2 NA IP30 & IP67 were homologated with the following antennas:

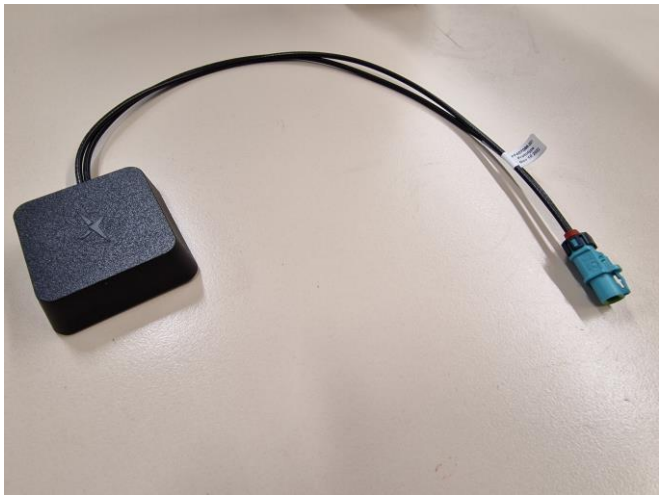
- **Main Antenna:**
  - Variant #1: Taoglas Supercombo Permanent Mount 6-in-1 Antenna (2* GNSS, 2* Cellular, 1* SiriusXM & 1* AM/FM), Part No: PP407097
    Provided Datasheet: “PP407097_specification_Sharkfin.pdf”



  - Variant #2: Taoglas Colosseum (2* Cellular, 2* Wi-Fi, 1* GNSS), Part No: PP407100
    Provided Datasheet: “PP407100_Specification_Puck_MA850.pdf”

- Variant #3: Taoglas MA240 Genesis – Candy Bar (2* Cellular, 1* GNSS), Part No: PP407093
  Provided Datasheet: “Candy Bar - PP407093.pdf”

- **Bluetooth / WLAN Antenna:**
  - Taoglas PP407096
    Provided datasheet “PP407096_Specification_BT.pdf”



3.2.2.2 CABLING

The TCU2 NA IP30 & IP67 were homologated with the following antenna cable and cable lengths:

- Used antenna cable: LEONI Dacar 462-Koax-50-1
- Cable lengths TCU2 NA IP30:

RF Module	Antenna Cable lengths (Min)	Antenna Cable lengths (Max)
Cellular	0,3 m	7,75m
GNSS	0,3m	7,75m
BT/WLAN	0,4m	0,4m

- Cable lengths TCU2 NA IP67:

RF Module	Antenna Cable lengths (Min)	Antenna Cable lengths (Max)
Cellular	0,3m	6,9m
GNSS	0,25m	8,25m
BT/WLAN	0,4m	0,4m

The distance between the human body and the antennas has to be 20 cm.

3.3 SOFTWARE

3.3.1 SW ARCHITECTURE OVERVIEW

The SW Architecture overview depicts a broad overview about the PACCAR/DAF Project from SW side, consisting of the TCU (on-board) scope, as well as the ETAS PANTARIS Cloud (off-board) scope. This TCD mainly handles the local Bosch XC components (Hardware + Middleware + PCC, ISA). The Device SW Stack of PANTARIS Cloud Services from ETAS/VCS and Bosch AA is described in its own TCD.

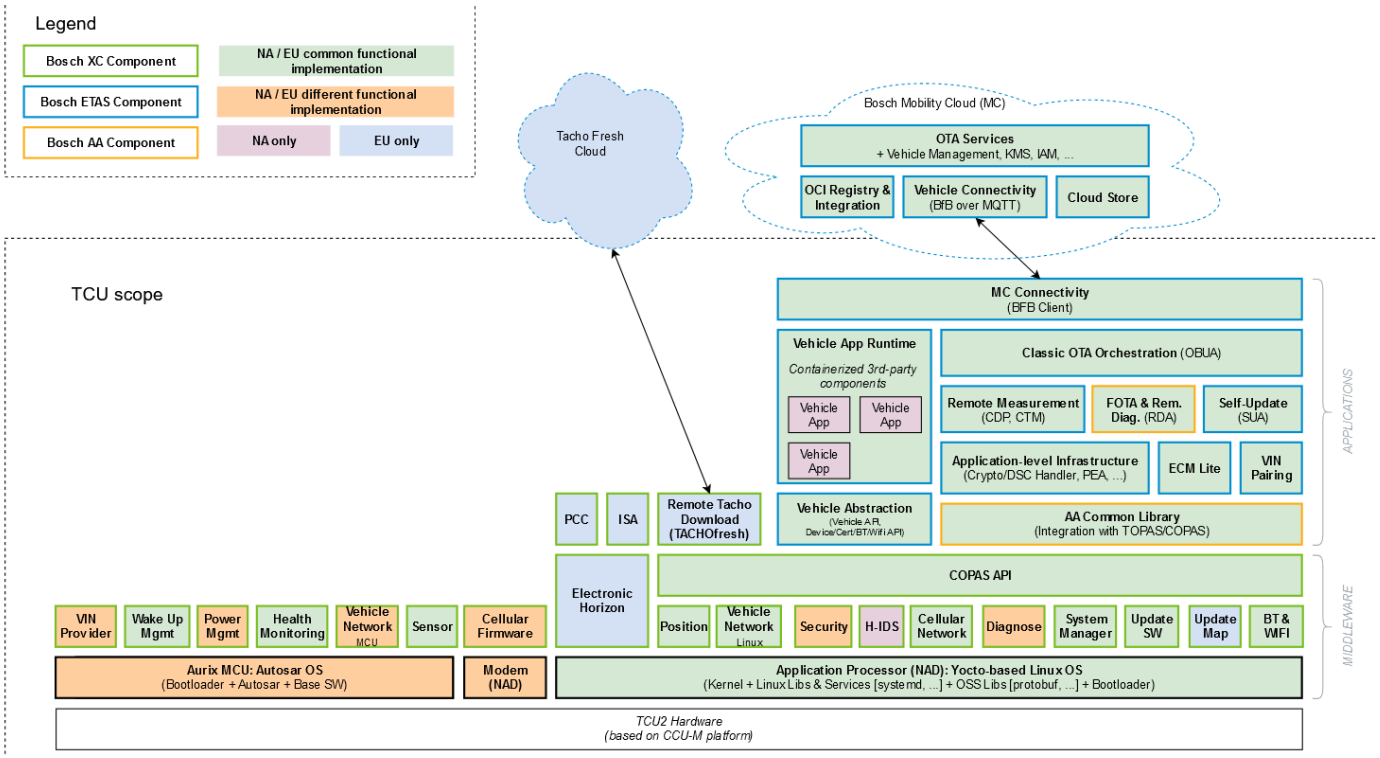


Figure 2: SW Architecture Overview NA+EU

3.3.2 SOFTWARE – HARDWARE COMPATIBILITY

To make sure that only unchanged and correct software runs on productive trucks, Bosch uses a signature process for the software which runs on the TCU2. To achieve so, the TCU2 hardware is e-fused in Bosch-Factory to a specific key, which limits the hardware to only run correctly signed software. A special development-hardware (“unsecured HW”) has no key and can thus run any available software.
Please keep in mind that only EU-Software can run on EU-Samples and only NA-Software can run on NA-Samples.

How are the fuses set on which hardware?
Which SW Build can run on Hardware with Fuses set to “No”, “DEV” or “PROD”?

		NAD Secure Boot Key (eFuses)		
		No Key (unsecured)	DEV Key (secured)	PROD Key (secured)
Hardware	TCU2 EU IP30	C1 Samples: → 7620000276-03 C2 Samples Development: → 7620000276-05 D Samples Development: → 7620000278	C2 Samples Release: → 7620000276-04	D Samples Release: → 7620000276 → 7620000345 → 7620000331 →7620000251
	TCU2 NA IP30	C1 Samples: → 7620000275-06 C2 Samples Development: → 7620000275-08 C3 Samples Development: → 7620000275-11 D Samples Development: →7620005006	C2 Samples Release: → 7620000275-07 C2.1 Samples Release: → 7620000275-09	C3 Samples Release: → 7620000275-10 C4 Samples Release: → 7620000275-12 D Samples Release: → 7620000275 →7620002015
	TCU2 NA IP67	C1 Samples: → 7620.000.305-04 C2 Samples Development: → 7620.000.305-05 C3 Samples Development: → 7620.000.305-07 D Samples Development: →7620005007	C2 Samples Release: → 7620.000.305-03	C3 Samples Release: → 7620.000.305-06 D Samples Release: →7620002016
Software	Customer Release PROD Key	compatible	Not compatible	compatible
	Customer Release DEV Key	compatible	compatible	Not compatible
	Customer Development No Key	compatible	Not compatible	Not compatible

3.3.3 DELIVERY STATE OF SAMPLES

3.3.3.1 EU VARIANT

D-Samples

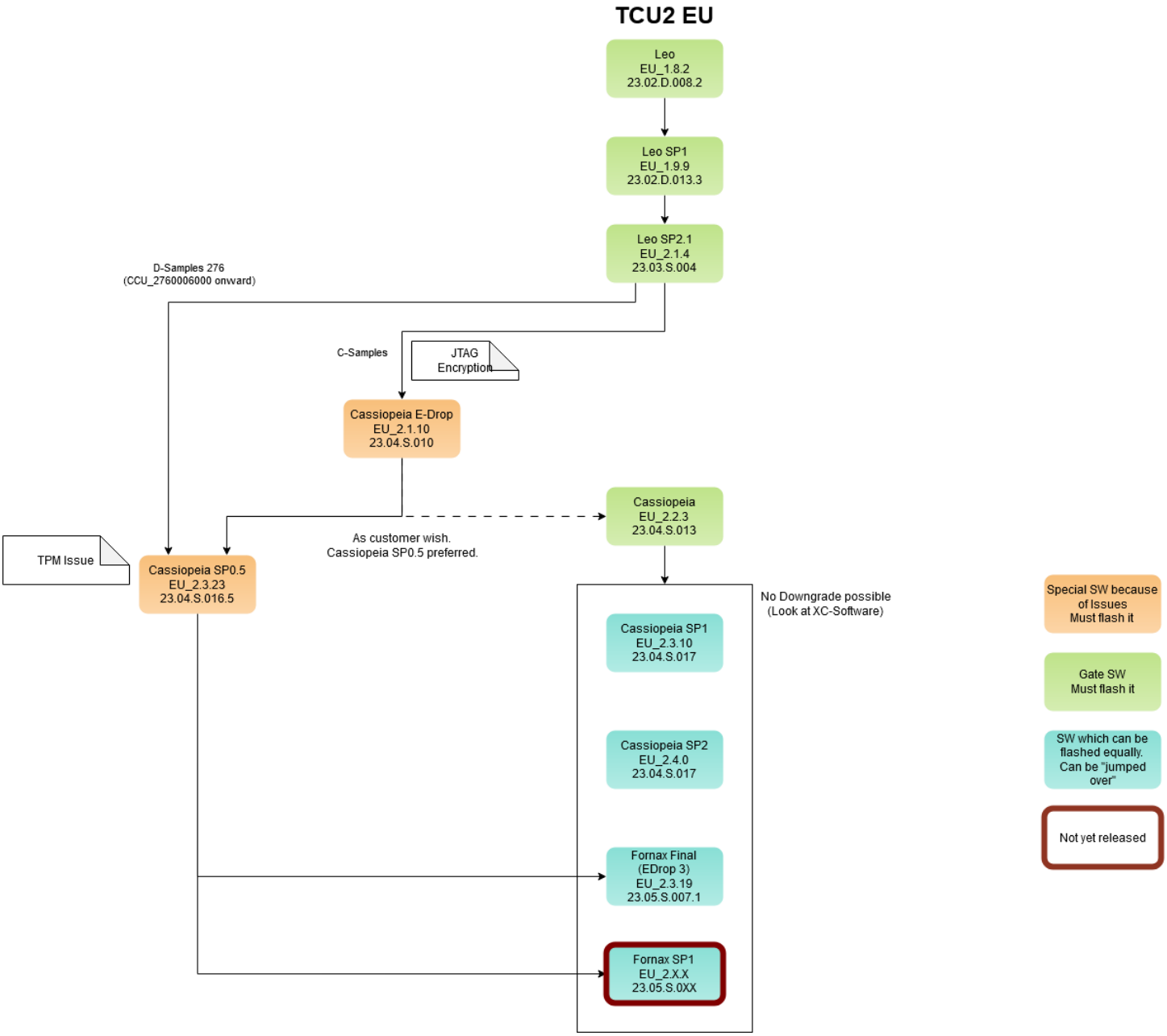
- 762 0000 276: Leo SP2.1 EU_2.1.4 Customer-Release
    - In Backend: CCU_2760006000 onward
- 762 0000 345: Cassiopeia EU_2.2.3 Customer-Release
    - In Backend: CCU_345XXXXXXX
- 762 0000 331: Cassiopeia SP1 EU_2.3.10 Customer-Release
    - In Backend: CCU_331XXXXXXX
- 762 0000 278: TBC
    - In Backend: CCU_278XXXXXXX

C-Samples

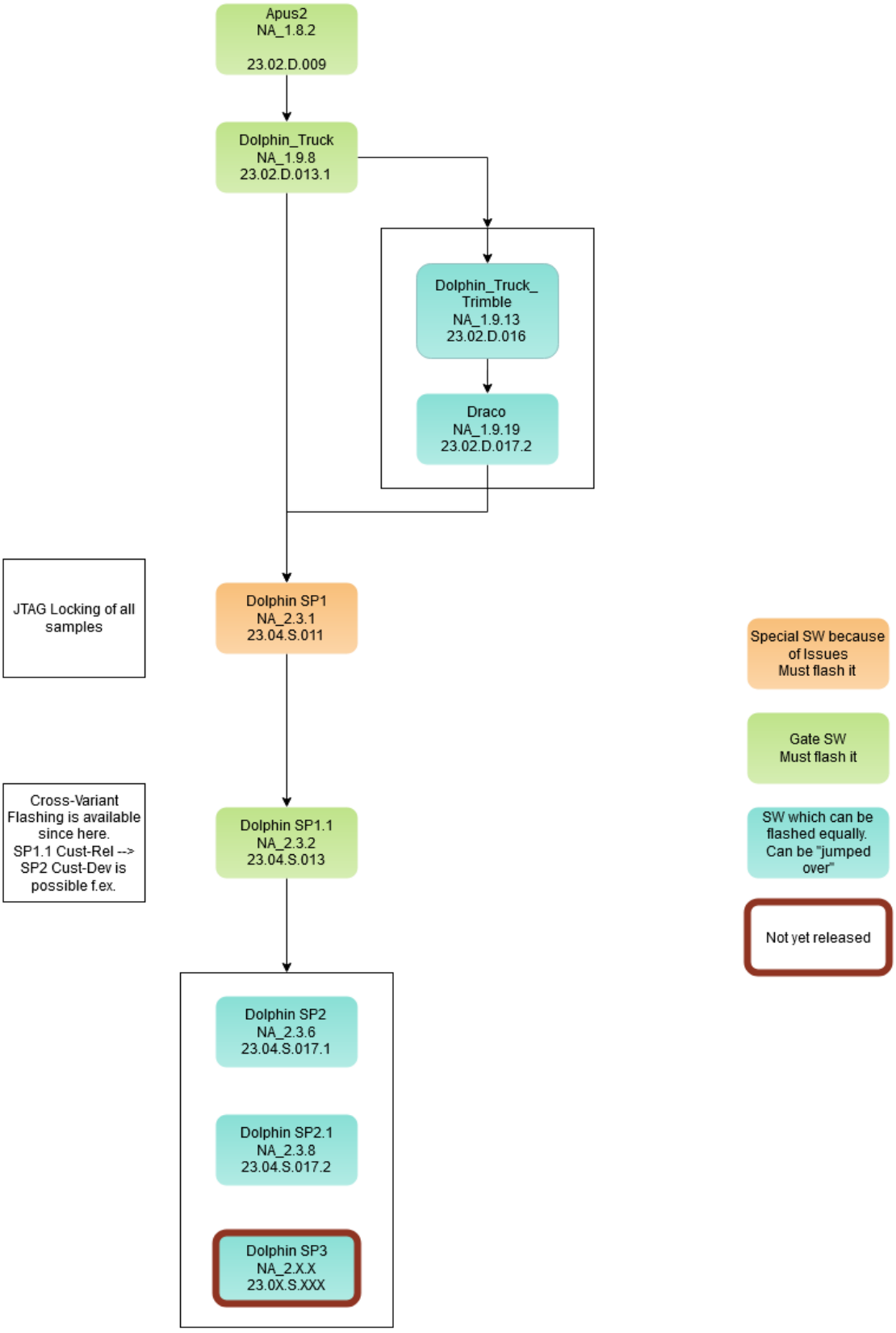
- 762 0000 276-05: Leo EU_1.8.2 Customer-Release
    - In Backend: CCU2760005999 and below
- 762 0000 276-04: Leo EU_1.8.2 Customer-Release
    - In Backend: CCU2760005999 and below
- 762 0000 276-03: Leo EU_1.8.2 Customer-Release
    - In Backend: CCU2760005999 and below

3.3.4 SOFTWARE UPDATE CASCADE

The TCU2 must undergo a controlled update cascade between Leo SP2.1, Cassiopeia, Cassiopeia SP1 and Fornax (for EU Builds) as well as during Dolphin NA Builds. Not keeping the update chain will either result in failing updates (f.ex. jumping over EU_2.2.3 or EU_2.3.YY will result in Signature Verification Errors) or might even lead to failing devices (installing EU_2.2.3 or EU_2.3.10 on devices which were initially shipped with EU_2.1.4 will lead to the TPM Counter Issue, which means devices can fail after several days of operation). Thus, the following cascade must be followed:
TCU2 EU:



TCU2 NA:



Bosch Internal Link: https://inside-docupedia.bosch.com/confluence/display/PACCARConnectedTruck/Customer+SW+Update+Overview

3.3.5 DEVELOPMENT SOFTWARE

Since the software release Cassiopeia SP1 (EU), development samples (without Secure Boot Key) can be updated to a customer-development software. In the customer-development software, the filesystems of the TCU2 are writeable and additional user permissions are granted. Additionally, in the future, a hotfix mechanism will be integrated which allows easy user permission changes for devices.
The customer-development variant can be installed using the normal OTA or SSH update flow. It is possible to update cross-variant on the same software (e.g. Cassiopeia SP1 Customer-Release to Cassiopeia SP1 Customer-Development and vice versa), as well as directly combining update and variant change (e.g. Cassiopeia SP1 Customer-Release to Fornax Customer-Development) in one step.

3.3.6 SYSTEM RESOURCES

<table>
<tr><th>Feature</th><th>CPU</th><th>RAM</th><th>Flash Memory</th></tr>
<tr><td>NAD Modem (DSP core)</td><td>0 % (DSP core)</td><td>100 MByte</td><td>192 MByte</td></tr>
<tr><td>Linux + MTK/WNC Middleware
Cellular Data Transfer (Routing)</td><td>2,9 % (200 DMIPS)
14,3 % (1.000 DMIPS)</td><td>100 MByte</td><td>182 MByte</td></tr>
<tr><td>Bosch Copas Middleware
incl. Self Update</td><td rowspan="2">35,7% (2.500 DMIPS)</td><td>130 MByte</td><td>512 MByte</td></tr>
<tr><td>Bosch Applications
OTA Update</td><td>165 MByte</td><td>400 Mbyte (eMMC)
2 GByte (eMMC)</td></tr>
<tr><td>Horizon Software incl. PCC, ISA</td><td>28,6% (2.000 DMIPS)</td><td>256 MByte</td><td>8 GByte *1 (eMMC)</td></tr>
<tr><td>Container Framework and
Container Applications</td><td>11,4% (800 DMIPS)</td><td>256 MByte</td><td>4 GByte (eMMC)</td></tr>
<tr><td>Sum</td><td>92,9% (6.500 DMIPS)</td><td>1.007 MByte</td><td>14,4 GByte + 886 MByte</td></tr>
<tr><td>Available</td><td>100% (7.000 DMIPS)</td><td>1.024 MByte</td><td>16 GByte *2 + 1.024 MByte</td></tr>
</table>

3.3.7 IVD IMPLEMENTATION (UN-ECE R156, RFEC 048)

The SW inside the TCU2 device is integrity protected. The TCU2 reports an IVD for the whole system with Diagnostic ID F150. The output consists of two concatenated IVDs:

- <Number of IVDs – for TCU2: 0x02> <System IVD> <Map IVD>

[09:38:33] - Tx	IVD Data for electronic parts Read
[09:38:33]	PACCAR_TCU
[09:38:33] - Rx	Positive response:
IVD Data	0x02 0xDB 0x76 0x72 0x53 0x29 0x6C 0x47 0xD7 0xA2 0x07 0x55 0xA5 0x7C 0x57 0xA5 0x8F 0xC7 0x... 0xEE 0x31 0x76 0x1C 0xF8 0x07 0x22 0x4A 0x88 0x94 0x5F 0xBE 0x0E 0x4D 0x03 0x7A 0x28 0x09 0xE... 0x7C 0x24 0x64 0x00 0x10 0xED 0x28 0x8C 0x86 - 02 DB 76 72 53 29 6C 47 D7 A2 07 55 A5 7C 57 A5 8... DD E0 EE 31 76 1C F8 07 22 4A 88 94 5F BE 0E 4D 03 7A 28 09 EB C8 7C 24 64 00 10 ED 28 8C 86
IVD - System partition	0xDB 0x76 0x72 0x53 0x29 0x6C 0x47 0xD7 0xA2 0x07 0x55 0xA5 0x7C 0x57 0xA5 0x8F 0xC7 0xDD 0... 0x31 0x76 0x1C 0xF8 0x07 0x22 0x4A 0x88 0x94 0x5F 0xBE 0x0E - DB 76 72 53 29 6C 47 D7 A2 07 55 A... 57 A5 8F C7 DD E0 EE 31 76 1C F8 07 22 4A 88 94 5F BE 0E
IVD - Map data	0x4D 0x03 0x7A 0x28 0x09 0xEB 0xC8 0x7C 0x24 0x64 0x00 0x10 0xED 0x28 0x8C 0x86 - 4D 03 7A 28... EB C8 7C 24 64 00 10 ED 28 8C 86

Please take into account that the System IVD and Map IVD do have different lengths. No separator is inserted between both (as specified in RfeC 048). The IVD is only available after Linux Boot, not in early diagnostics.

3.3.7.1 SYSTEM IVD

The System IVD returns the Roothash of the Verified Boot Chain of the currently running linux / overall software. This makes the IVD available right from the start (no need to check all files), as verification is done on-access / on-runtime. As the control unit uses integrity protected file systems, any modification of files would lead to another hash and would cause the system to restart.
As the Linux Roothash checks the whole filesystem, this IVD is representative for the combination of Base Linux (XC), Application Software (ETAS) and thus for all other type-approval relevant functionalities (Horizon Functionality, ISA, PCC, BEV R13).

3.3.7.2 MAP IVD

The Map IVD is a checksum for the currently active map used by the TCU2 Horizon. The map is independent on the TCU2 Software. As the map is big (>6GB) and CPU Usage and Read Data Rate of the TCU2 memory limited, checking of the whole map is not possible in a short time. Thus, two mechanisms are implemented for Map IVD:

1. During production, the map data is placed on the device. The reference IVD (taken from the official release notes) is injected to the device database. An End-Of-Line-Check verifies Bosch Map Part Number, DAF Map Part number and Reference Map are correct.
   This makes sure that the IVD is available right after production and causes a short “Takt Time” in DAF production.
2. During runtime, the map-update component will, on every boot, start to check the map files, calculate the IVD and store it in the device database. This makes sure that the IVD is always fresh and reduces CPU load (no on-access check needed, IVD calculation can run with lower priority in the background)

3.3.8 Local device access

The TCU2 devices do offer the possibility to connect using SSH and SCP tooling. Putty or Windows SSH can be used for command execution, WinSCP or Windows SCP can be used for data transfer.
The kind of access depends on the software build variant (customer release, customer development), the software version (pre-Cassiopeia, Cassiopeia onward), as well as the ECU Type (Europe or North America).
EU Variant:

	Access via USB	Access via Automotive Ethernet
<= Leo Software, customer-release	Possible, using **pre**-SOP credentials	Possible, using **pre**-SOP credentials
>= Cassiopeia Software, customer-release	Not possible	Possible, using **post**-SOP credentials
>= Cassiopeia SP 1, customer-development	Possible, using **pre**-SOP credentials	Possible, using **pre**-SOP credentials

NA Variant:

	Access via USB	**Access via Automotive Ethernet**
<= Dolphin Trimble, customer-release	Not possible	Possible, using **pre**-SOP credentials
>= Dolphin SP1, customer-release	Not possible	Possible, using **post**-SOP credentials
>= Dolphin SP X , customer-development	Not possible	Possible, using **pre**-SOP credentials

Remarks:

- Pre SOP credentials: „paccar_rsa" / "paccar_ppk": Link
- Post SOP credentials: "paccar-cust-rel_rsa" / "paccar-cust-rel_ppk": Link
- Access via USB:
    - Turn on TCU2 EU and connect a Mini-USB Cable to the TCU2.
    - Open Windows Device Manager, go to "Network Adapters"
    - If "Remote NDIS Compatible Device" is not detected automatically, install the driver manually.
        - Select the device with yellow exclamation mark.
        - Right click → Update Driver → Select manually from the list → Microsoft Corporation → Remote NDIS compatible device
    - Set up the new Remote NDIS network adapter in Control Panel with IP Address as
        - PC IP: 192.168.42.9
        - Subnet Mask: 255.255.255.0
    - TCU2 EU can then be accessed using the Login in Putty/WinSCP: paccar@192.168.42.1
- Access via Ethernet
    - Turn on TCU2 EU and connect the TCU2 with the Automotive Ethernet Port, which is closer to the Bluetooth Antenna (Brown Plug) to a media converter for Automotive Ethernet. Connect the other side of the Media Converter to an Ethernet plug on your PC.
    - Set up the new network adapter in Control Panel with IP Address as
        - PC IP: 192.168.205.9
        - Subnet Mask: 255.255.255.0
        - VLAN ID: 2
    - TCU2 can then be accessed using the Login in Putty/WinSCP: paccar@192.168.205.10

4 TECHNICAL DATA WITH MEASURED VARIABLES AND MEASURING CONDITIONS

4.1 FUNCTIONS, FUNCTION STATES (MODES OF OPERATION), FUNCTIONAL CHARACTERISTICS AND BOUNDARY CONDITIONS

The product supports the following power modes:

1. OFF mode: Paccar TCU2 is disconnected from vehicle battery and internal backup battery (only applicable for NA-variants) is discharged

All processors are OFF

All functions are not running

2. STANDBY mode: Paccar TCU2 is connected to vehicle battery or supplied by internal backup battery (only applicable for NA-variants).

The main processor is OFF

Partial functions (Wakeup related) are enabled

3. NORMAL mode: Paccar TCU2 is connected to vehicle or supplied by internal backup battery (only applicable for NA-variants) and the device is turned on

All processors are on

All functions are enabled

4. Vehicle Tracking Mode: Paccar TCU2 is connected to vehicle or supplied by internal backup battery (only applicable for NA-variants).

All processors are on

Partial functions (tracking related) are enabled

Possible wakeup sources: CAN (only in EU Variant), KL15 (Ignition).

4.1.1 DTC – DIAGNOSTIC TROUBLE CODES

DTC	Error Text	Enabling	Disabling	Mask (NA)	Mask (EU)
0xA80003	Supply voltage - Critical high	Voltage > 34.5V	Voltage < 34.V	Byte 2, Bit 0	Byte 2, Bit 0
0xA80004	Supply voltage - Critical low	Voltage < 7.5V and no BuB	Voltage > 8.0V	Byte 3, Bit 7	Byte 3, Bit 7
0x61F2EC	Back-up battery non-recoverable failure	• Iout Pin > Iout_ocp • Vset / CHM_TMR / Iset pin short / open • Timer expiration for Li+ charging • Vout < Vrechg after timer expiration for NiMH charging	An input supply or CE pin toggle is required to restart operation	Byte 0, Bit 2	Byte 0, Bit 2
0x61F2EB	Back-up battery recoverable failure	Battery Charger reports recoverable failure. This will be caused by: • Vin Pin > Vin_ovp • Vout Pin > Vout_ovp • Thermal Hot • Thermal Cold • Thermal Shutdown • disconnect Backup Battery	Battery Charger does not report recoverable failure for 3 measurement cycles (30ms).	Byte 2, Bit 4	Byte 2, Bit 4
0x64F2E0	System temperature - Critical High	Temperature > 65°C	Temperature < 60°C	Byte 3, Bit 6	Byte 3, Bit 6
0x64F2E1	System temperature - Critical Low	Temperature < -40°C	Temperature > -40°C	Byte 3, Bit 5	Byte 3, Bit 5
0xAD210C	NAD Secure Boot Failure	unsigned SW image detected on a signed device	install of a signed SW image	Byte 3, Bit 4	Byte 3, Bit 4
0x8C1E05	GNSS Antenna - Open circuit	Antenna not connected/broken	plugin/repair antenna	Byte 1, Bit 1	Byte 1, Bit 1
0x8C1E06	GNSS Antenna - Short to GND	Antenna shorted (Signal Pin to GND)	repair/remove short circuit	Byte 1, Bit 0	Byte 1, Bit 0
0x09F1EC	GNSS Module error	no communication between NAD and GNSS module	after reboot, communication is possible	Byte 2, Bit 7	Byte 2, Bit 7
0x0CF1EC	GNSS Jamming Detected	• no correct GNSS signal received • will also detected for a short time if the GNSS antenna will be disconnected/removed	provide interference-free GNSS signal	Byte 3, Bit 3	Byte 3, Bit 3
0x8E1E05	Cellular Network Antenna 1 - Open Circuit	Antenna not connected/broken	plugin/repair antenna	Byte 0, Bit 0	Byte 0, Bit 0
0x8E1E06	Cellular Network Antenna 1 - Short to GND	Antenna shorted	repair/remove short circuit	Byte 1, Bit 7	Byte 1, Bit 7

DTC	Error Text	Enabling	Disabling	Mask (NA)	Mask (EU)
0x6DF1E5	Cellular Network Antenna 2 - Open Circuit	Antenna not connected/broken	plugin/repair antenna	Byte 1, Bit 6	Byte 1, Bit 6
0x6DF1E6	Cellular Network Antenna 2 - Short to GND	Antenna shorted	repair/remove short circuit	Byte 1, Bit 5	Byte 1, Bit 5
0x6DF2EC	Modem Module error	flashed wrong modem image	flash correct modem image	Byte 2, Bit 5	Byte 2, Bit 5
0x6DF3EC	SIM Card cannot be used	• Switch to "External SIM" • unplug SIM Card,	plug in SIM and a reboot needed	Byte 2, Bit 1	Byte 0, Bit 2
0xD1F0E5	BT/WLAN Antenna 1 - Open circuit	Antenna not connected/broken	plugin/repair antenna	Byte 0, Bit 7	Byte 0, Bit 7
0xD1F0E6	BT/WLAN Antenna 1 - Short to GND	Antenna shorted	repair/remove short circuit	Byte 0, Bit 6	Byte 0, Bit 6
0xD1F1E5	WLAN Antenna 2 - Open circuit	Antenna not connected/broken	plugin/repair antenna	Byte 0, Bit 5	Byte 0, Bit 5
0xD1F1E6	WLAN Antenna 2 - Short to GND	Antenna shorted	repair/remove short circuit	Byte 0, Bit 4	Byte 0, Bit 4
0xD1F2EC	BT/WLAN Module error	no communication between NAD and BT/WLAN module	after reboot, communication is possible	Byte 0, Bit 3	Byte 0, Bit 3
0x7C2013	ETH PHY - Cable error	Cable diagnostic failed/detected a short or open	Cable Diag is OK	Byte 1, Bit 4	Byte 1, Bit 4
0x99F3F3	ETH Port - Link down	• Link is down • At the instant of transceiver link state down	• Link is up • At the instant of transceiver link up	Byte 1, Bit 3	Byte 1, Bit 3
0x99F4EC	ETH - Switch error	Switch initialization exceeds retry counter	Success of switch initialization	Byte 1, Bit 2	Byte 1, Bit 2
0x7F0209	CAN1 BusOff	CAN bus off occurs (wrong Baud rate) or short CANH and CANL	when CAN bus off recovers, Upon occurrence of bus off end	Byte 0, Bit 1	Byte 0, Bit 1
0xCF0409	CAN2 BusOff	CAN bus off occurs (wrong Baud rate) or short CANH and CANL	when CAN bus off recovers, Upon occurrence of bus off end	Byte 3, Bit 0	Byte 3, Bit 0
0xD30409	CAN3 BusOff	CAN bus off occurs (wrong Baud rate) or short CANH and CANL	when CAN bus off recovers, Upon occurrence of bus off end	Byte 3, Bit 1	Byte 3, Bit 1
0x63F2EC	IMU Error	Accelerator (X<1g, Y<1g, Z<0.5g) && Gyroscope "true" on "Ready" and "OK"	after reboot	Byte 2, Bit 6	Byte 2, Bit 6
0xFDF1E2	SW Update - General failure	Wrong update package file path	After successful install of update package	Byte 2, Bit 3	Byte 2, Bit 3

DTC	Error Text	Enabling	Disabling	Mask (NA)	Mask (EU)
0xFDF2E2	SW Update - Signature verification failure	• with wrong signature • incomplete • corrupt content	After successful install of update package	Byte 2, Bit 2	Byte 2, Bit 2
0xED0002	VIN Mismatch detected	• new CAN_VIN was detected which is not equal with PAIRED_VIN • CAN_VIN and PAIRED_VIN are not equal with DEFAULT_VIN and/or RESET_VIN	TESTER_VIN set back to RESET_VIN	Byte 3, Bit 2	Byte 3, Bit 2
0xD1F0EC	USB Error	USB Pins short to BAT or short to GND		Byte 4, Bit 7	Byte 4, Bit 7
DTC	DTC is active				
DTC	DTC is not active				

Table 1 DTC's part 1

4.2 MECHANICAL CHARACTERISTICS

The device is intended to be mounted in a decoupled cab in a commercial vehicle. For the performed release test, see the reliability test specification, which is attached as an appendix.

Insufficient cable harness fixation can cause premature failures. The device is validated with the cable harness fixation that is listed in the reliability test specification, which is attached as an appendix.

For mechanical shock/drop tests, see the reliability test specification, which is attached as an appendix. Performing such tests does not imply that this is a permitted handling. Do not throw or drop the unit. Dropping the unit may result in a malfunction that may only become evident at a later point in time. Such units will have to be scrapped or sent to Bosch for inspection and repair.

4.2.1 CONNECTORS

IP 30 Device	IP 67 Device
Main: Tyco MQS Header, 54 poles	Main: Molex CMC Header, 48 poles
GNSS: Rosenberger Fakra-HF	GNSS: Rosenberger Fakra-HFM
CN: Rosenberger Fakra-HFM, vertical dual connector	CN: Rosenberger Fakra-HFM, horizontal dual connector
Bluetooth/WLAN: Rosenberger Fakra-HFM, vertical dual connector	Bluetooth/WLAN: Rosenberger Fakra-HFM, horizontal dual connector
ETH: Rosenberger H-MTD	ETH: Rosenberger H-MTD
USB: Molex USCAR-Header, Type Mini-B	

Note: Bosch is only responsible for the compliance of the product side plug (interface) with the agreed upon customer specification. Since the plug system is used per customer request, Bosch is not responsible and does not warrant for the connection assembly as a whole, especially not for its electrical function, durability and sealing.

4.2.2 MATERIAL

a) Material: GD-AlSi9Cu3 – DIN 1706 or ADC12 lead free
b) Colour: Aluminium grey, dull finish

4.2.3 INGRESS PROTECTION

Non-Ingress Protection Code Device: IP30
Ingress Protection Code Device: IP67

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 POWER SUPPLY

The power supply of the TCU is designed for 12V and 24V system (operating voltage: 9V…32V).
The device complies with the following standards:

ISO 16750-1:2006 Road vehicles – Environmental conditions and testing for electrical and electronic equipment, part 1: General, 2006-08-01

ISO 16750-2:2012 Road vehicles - Environmental conditions and testing for electrical and electronic equipment, part 2: Electrical loads, 2012-11-01

For TCU2-NA-IP30 and TCU2-NA-IP67 variants, there is the option for a back-up battery considered for the use-case of vehicle tracking. The goal is to be able to wake-up 3.3 days once per hour and send GNSS position to a back-end. The backup battery consists of 4 cells.

- Backup battery cell-type: FDK HR-AAULT
- Backup battery pack: FDK 4HR-AAULT-BOE
- Nominal voltage: 4.8V
- Nominal capacity: 1050mAh
- Charging: 100mA x 16h
- Self-Discharging: 650 days at 20°C (~ 22 month)

The real time clock is powered with a coin cell of the type: BR-1225A.

4.3.2 HARDWARE BLOCK DIAGRAM

The hardware block diagram shows both, the EU- and NA-Variants. Light blue are components which differ for both variants:

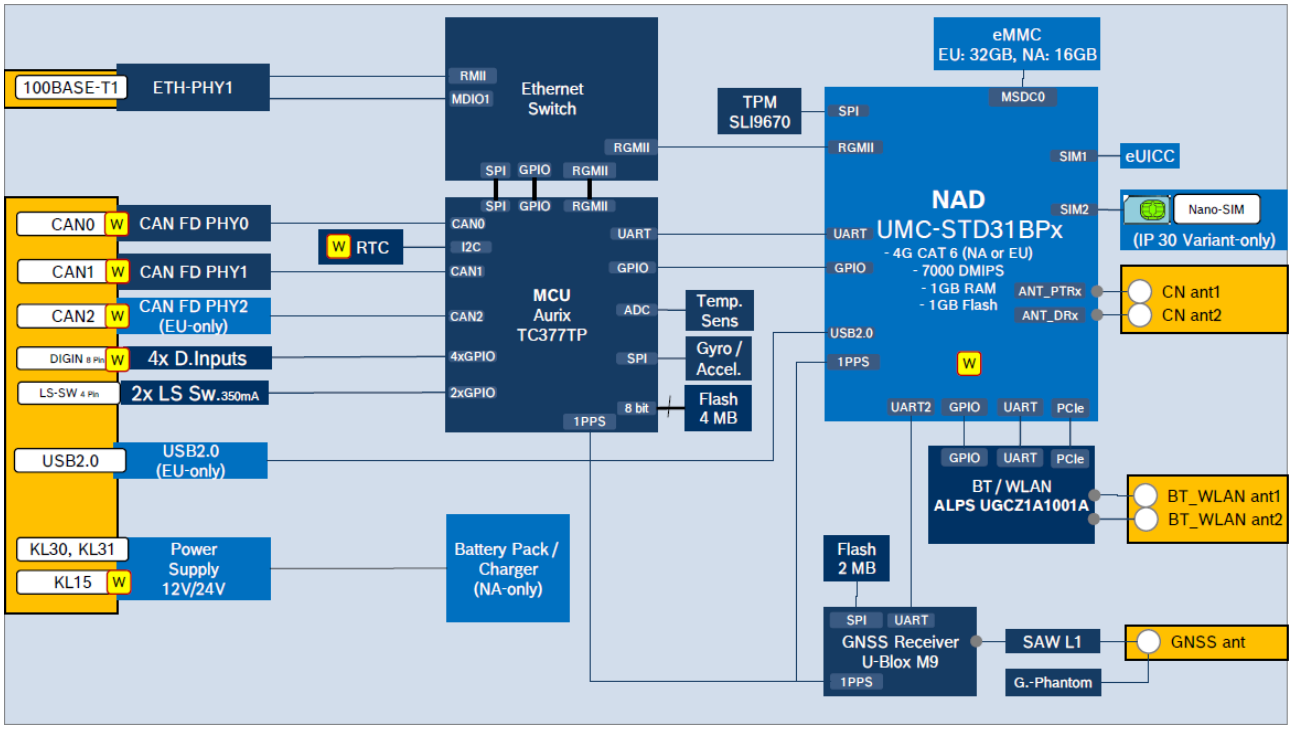


Figure 3: Schematics showing main components and hardware interfaces of the TCU2 for EU and NA.

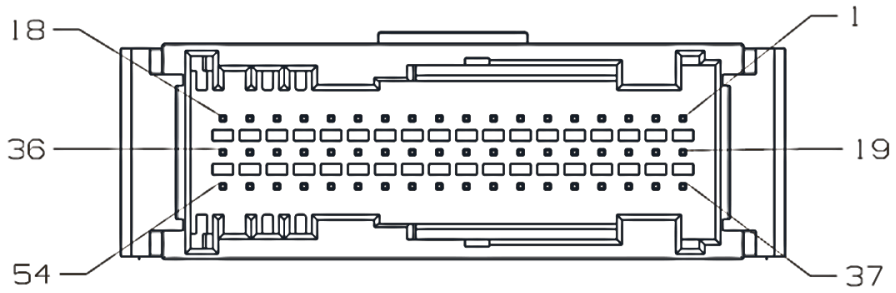
There is no dedicated main processor. The Linux and all main applications will run on the NAD module which has compute power of 7000 DMIPS.

4.3.3 PIN ASSIGNMENT

Electrical Characteristics, Protection, Diagnosis Functions: See “PACCAR TCU2 Customer Pin Characteristic.xlsx” on PACCAR Sharepoint → TCU → 05_TCU2_EU → 03_Design_Documents_Bosch → 06_Hardware

4.3.3.1 MAIN CONNECTOR

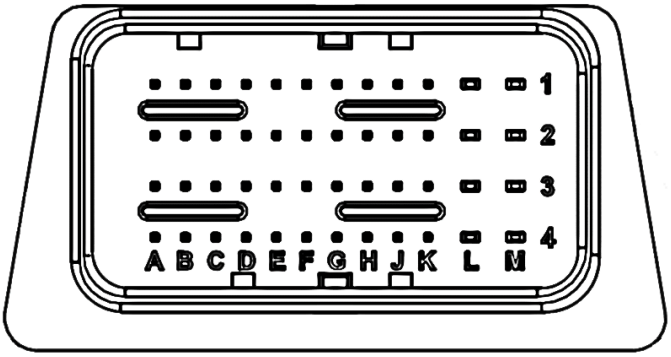
IP 30 Device



Pin	Function	Input / Output (I/O)
1	KL.30 (UBAT)	I
2	KL.30 (UBAT)	I
3	CAN3_GND	GND
4	CAN3_L	I/O
5	KL.15 (IGNITION)	I
6	CAN1_GND	GND
7	CAN1_GND	GND
8	DIGITAL_IN4_GND	GND
9	DIGITAL_IN3	I
10	CAN1_TR	I/O
11	Not connected	N/A
12	CAN2_L DaisyChain	I/O
13	CAN2_H DaisyChain	I/O
14	Not connected	N/A
15	Not connected	N/A
16	Not connected	N/A
17	LS_SWITCH_1_GND	GND
18	LS_SWITCH_1	O
19	KL.31 (GND_Z)	GND
20	KL.31 (GND_Z)	GND
21	CAN3_H	I/O
22	CAN2_GND	GND
23	CAN2_GND	GND
24	CAN1_H	I/O
25	Not connected	N/A

26	DIGITAL_IN4	I
27	DIGITAL_IN2_GND	GND
28	DIGITAL_IN1	I
29	Not connected	N/A
30	Not connected	N/A
31	Not connected	N/A
32	Not connected	N/A
33	Not connected	N/A
34	Not connected	N/A
35	LS_SWITCH_2_GND	GND
36	LS_SWITCH_2	O
37	KL.31 (GND_Z)	GND
38	KL.31 (GND_z)	GND
39	CAN3_GND	GND
40	CAN2_H Main	I/O
41	CAN2_L Main	I/O
42	CAN1_L	I/O
43	Not connected	N/A
44	DIGITAL_IN3_GND	GND
45	DIGITAL_IN2	I
46	DIGITAL_IN1_GND	GND
47	Not connected	N/A
48	Not connected	N/A
49	Not connected	N/A
50	Not connected	N/A
51	Not connected	N/A
52	Not connected	N/A
53	Not connected	N/A
54	Not connected	N/A

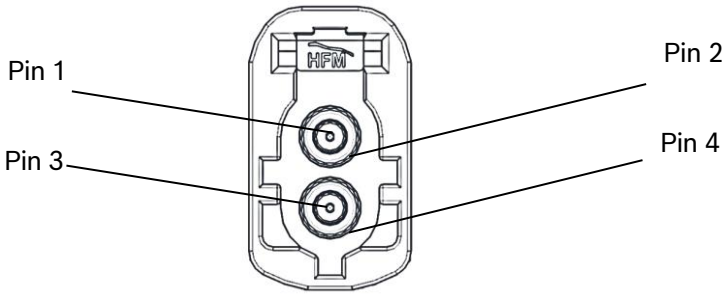
IP67 Device (IP67)



	A	B		C	D	E	F	G	H	J	K	L	M
1	CAN1_TR	CAN1_H		CAN1_L	CAN1_GND	CAN2_H	CAN2_L	CAN2_GND	NC	NC	NC	KL30	KL30
2	LSS1_CON	GND		NC	CAN1_GND	NC	NC	CAN2_GND	GND	DIG_IN3	NC	NC	GND
3	LSS2_CON	GND		NC	GND	NC	NC	GND	DIG_IN4	GND	IGN	NC	GND
4	NC	NC		NC	DIG_IN1	NC	NC	DIG_IN2	NC	NC	NC	NC	NC

4.3.3.2 CELLULAR RADIO CONNECTORS

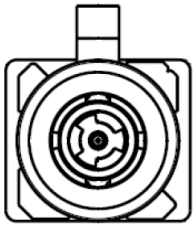
Pin	Function
1	GSM / LTE Antenna 1
2	Ground Antenna 1
3	GSM / LTE Antenna 2
4	Ground Antenna 2



The isolation between both antennas has to be as high as possible and the correlation between the 3D radiation patterns of the two antennas has to be as low as possible. The isolation should be more than 15 dB and the correlation should be less than 0,4.

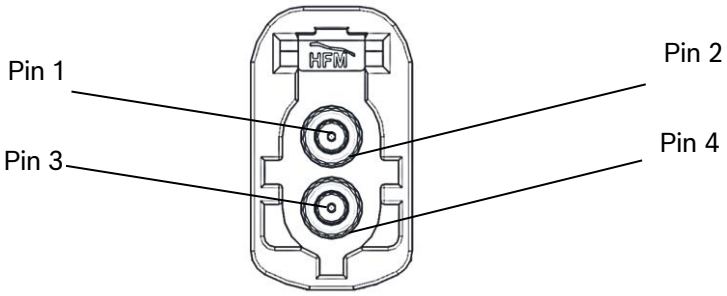
4.3.3.3 GNSS IP 30 CONNECTOR

Pin	Function
1	GNSS Antenna Input
	Ground



4.3.3.4 BT/WLAN IP 30 CONNECTOR

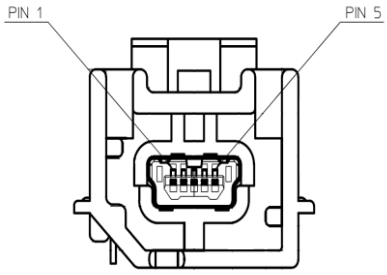
Pin	Function
1	BT and WLAN Antenna 1
2	Ground of Antenna 1
3	WLAN Antenna 2
4	Ground of Antenna 2



The isolation between both antennas has to be as high as possible.

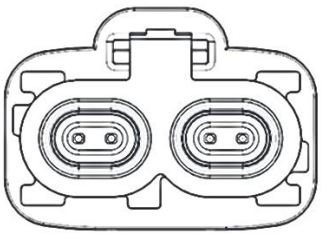
4.3.3.5 USB-CONNECTOR IP 30 EU DEVICE

Pin	Function	Input / Output (I/O)
1	USB1_VBUS	I/O
2	USB1_DM	I/O
3	USB1_DP	I/O
4	USB1_ID	I
5	USB_GND	GND



4.3.3.6 ETH CONNECTOR IP 30 DEVICE

Pin	Function	Input / Output (I/O)
1-1	ETH1: 100BASE-T1 Automotive Ethernet, Data+	I/O
1-2	ETH1: 100BASE-T1 Automotive Ethernet, Data-	I/O
2-1	ETH2: 100BASE-T1 Automotive Ethernet, Data+	I/O
2-2	ETH2: 100BASE-T1 Automotive Ethernet, Data-	I/O



4.3.4 CELLULAR

- A cellular network (CN) feature is implemented with a 4G Cat6 modem with fallback for 2G (only enabled for EU variant).
- The CN module with valid SIM card enable and provide the connection to cellular infrastructure and network for data upstream/downstream for telematics application. There are 2 types of SIM card available:
  - Internal/embedded SIM chip (onboard)
  - External SIM card (insertion via SIM card connector)
- The different variants of the TCU2 differ in the CN modem and the capabilities for cellular connections. That's why the TCU2 can only be used in the regions from chapter 2.2 INTENDED USE.

For full functionality of the cellular system, the device is dependent on the availability of an IPv4 network provided by the MNO for all respective countries.

4.3.4.1 CELLULAR CHARACTERISTICS

- TCU2 NA IP30 and TCU2 NA IP67:

2G	Band Support	GSM850MHz
		DCS1900MHz
	Power Class	GSM/GPRS (GMSK) Power Class
		• Class 4 (33 dBm) +/-2dBm for GSM/E-GSM band
		• Class 1 (30 dBm) +/2dBm for DCS/PCS band
		EDGE (8-PSK) Power Class
		• Class E2 (27 dBm) +/-3dBm for GSM/E-GSM band
		• Class E2 (26 dBm) +/-3dBm for DCS/PCS band
	Data rate	GPRS - multi-slot class 12, CS1-CS4, up to 85.6 kb/s DL/UL
		EDGE - multi-slot class 12, MCS1-MCS9, up to 236.8 kb/s DL/UL
LTE	Band Support	Band 7 (2600 MHz)
		Band 12(17) (700 MHz)
		Band 25(2) (1900 MHz)
		Band 26(5) (850 MHz)
		Band 66(4) (1700 MHz)
		Band 71 (600 MHz)
	Power Class	Class 3 (23 dBm) Tolerance +2/-2dBm
	Data rate	LTE category 6 - up to 300 Mb/s DL, 50 Mb/s UL

- TCU2 EU IP30:

2G	Band Support	E-GSM900MHz
		DCS1800MHz
	Power Class	GSM/GPRS (GMSK) Power Class
		• Class 4 (33 dBm) +/-2dBm for GSM/E-GSM band
		• Class 1 (30 dBm) +/-2dBm for DCS/PCS band
		EDGE (8-PSK) Power Class
		• Class E2 (27 dBm) +/-3dBm for GSM/E-GSM band
		• Class E2 (26 dBm) +/-3dBm for DCS/PCS band
	Data rate	GPRS - multi-slot class 12, CS1-CS4, up to 85.6 kb/s DL/UL
		EDGE - multi-slot class 12, MCS1-MCS9, up to 236.8 kb/s DL/UL
LTE	Band Support	Band 1 (2100 MHz)
		Band 3 (1800 MHz)
		Band 7 (2600 MHz)
		Band 8 (900 MHz)
		Band 20 (800 MHz)
		Band 28 (700 MHz)
	Power Class	Class 3 (23 dBm) Tolerance +2/-2dBm
	Data rate	LTE category 6 - up to 300 Mb/s DL, 50 Mb/s UL

4.3.5 GNSS (Geolocation)

Supported Satellites:
- GPS, GLONASS, BeiDou, Galileo, QZSS
- Limitation for TCU2 NA variants: only GPS and Galileo

Operating Frequency:
- GPS: L1C/A (1575.42 MHz)
- Galileo: E1-B/C (1575.42 MHz)
- BeiDou: B1I (1561.098 MHz)
- GLONASS: L1OF (1592.9525 MHz to 1610.485 MHz)
- QZSS: L1 C/A/S (1575.42 MHz)

4.3.6 BT/WLAN CHARACTERISTICS

The device operates with two Antennas (both external).
Bluetooth and WLAN can work together. Bluetooth signals are sent over one external Antenna, whereas WLAN signals are sent over both external Antennas.

Bluetooth Specification

- Bluetooth Standard: Bluetooth 5.0
- Operation Mode: Bluetooth Classic and Bluetooth Low Energy.
- Output power: Class 2 (<4 dBm EIRP)

WLAN Specification

Possible WLAN Modes:

- Access Point Mode (AP)
  - Limitation: DFS channels are not used
- Station Mode (STA)
  - Device can connect to external AP on DFS Channels

4.3.6.1 BT/WLAN TCU2 IP 30 EU

Mode	Operating Frequency [Mhz]	Output power, EIRP				Sensitivity	Maximum Input level	Losses from Module to TCU HF connector
		EU General	CH, LIE	Serbia	Israel			
1Mbps, Bluetooth, Average Power	2402 to 2480	≤ +4dBm				-70dBm	-20dBm	< 1.5 dB (typical, measured @2.45GHz from module to HF connector)
1Mbps, Bluetooth, Low Energy, Average Power	2402 to 2480	≤ +4dBm				-70dBm	-10dBm	
802.11b/g/n	2412 to 2742	≤ 20dBm				-76dBm	-10dBm	
802.11n/ac	5150 to 5250	≤16dBm	≤14dBm	N/A	N/A	-82dBm	-30dBm	
802.11n/ac	5250 to 5350	N/A	N/A	N/A	N/A	-82dBm	-30dBm	
802.11n/ac	5470 to 5725	N/A	N/A	N/A	N/A	-82dBm	-30dBm	
802.11n/ac	5725 to 5875	≤16dBm	≤16dBm	≤16dBm	N/A	-82dBm	-30dBm	

CH… Switzerland
LIE… Liechtenstein.
N/A means that the specific bands are disabled.

TCU2 IP30 EU – European Union: SW restricted Output power (from “Cassiopeia SP1” XC SW: 23.04.S.013)

4.3.6.2 BT/WLAN TCU2 NA IP 30 AND TCU2 NA IP 67

Mode	Operating Frequency [Mhz]	Output power EIRP	Sensitivity	Maximum Input level	Losses from Module to TCU HF connector
1Mbps, BLUETOOTH, Average Power	2402 to 2480	≤ +4dBm	-70dBm	-20dBm	< 1.5 dB (typical, measured @2.45GHz from module to HF connector)
1Mbps, BLUETOOTH Low Energy, Average Power	2402 to 2480	≤ +4dBm	-70dBm	-10dBm	
802.11b/g/n	2412 to 2742	≤ 30 dBm	-76dBm	-10dBm	
802.11n/ac	5150 to 5250	≤17 dBm	-82dBm	-30dBm	
802.11n/ac	5250 to 5350	≤17 dBm	-82dBm	-30dBm	
802.11n/ac	5470 to 5725	≤17 dBm	-82dBm	-30dBm	
802.11n/ac	5725 to 5875	≤17 dBm	-82dBm	-30dBm	

Note:

- For the frequencies 5250 ... 5350 MHz and 5470 ... 5725 MHz WLAN client mode is supported only.

4.3.6.3 BLUETOOTH REAL-WORLD TESTS

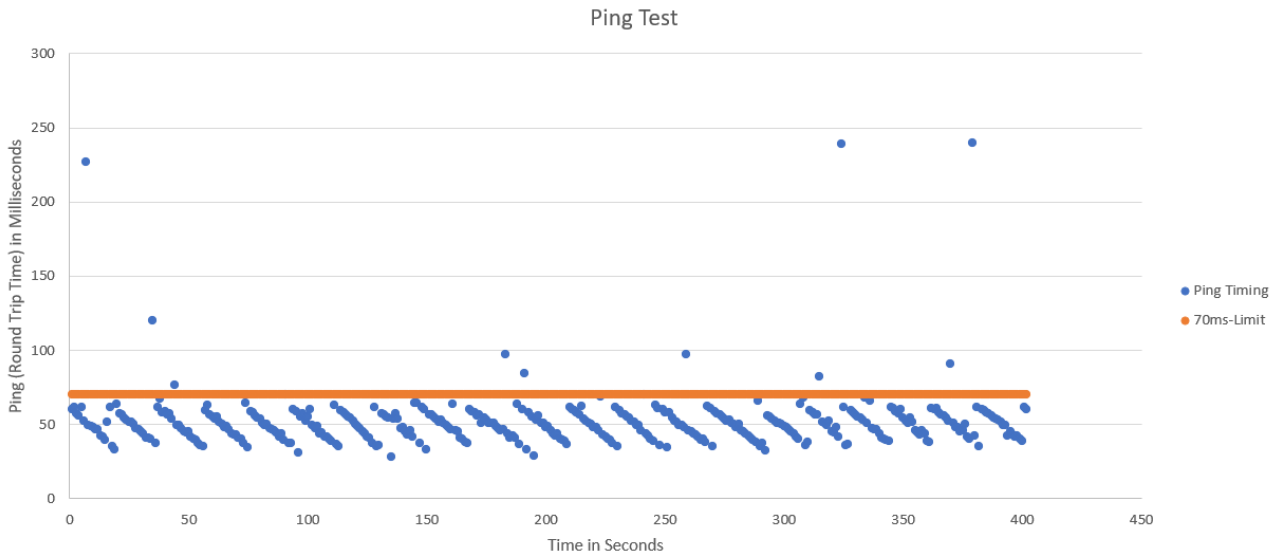
Bluetooth-Chipset is connected to the main processor with a 2 MBit/s UART interface since “Cassiopeia SP1” XC SW: 23.04.S.013). in the software versions before the Bluetooth-Chipset is connected to the main processor with a 115.200bit/s UART interface, which means that the maximum throughput is limited to around 90kbit/s.

In 2023/CW34, a workshop between DAF and Bosch showed the Bluetooth Performance under real world conditions. The testing conditions were as follows:

- TCU2 EU C2-Sample Unsecured (762 0000 276 – 05) with Leo SP2.1 (a.k.a. EU_2.1.4 / XC 23.03.S.004) in the Bosch Development Variant
- Taoglas (PACCAR NA & EU) BT/WLAN Antenna
- Nokia X10 as End-Device
    - Bluetooth Meter, version 1.1.4. This app displays the RSSI which is received during the discovery process.
    - Ping Tools, version 1.64 Free. This app contains the iPerf client.

Results:

- All tested use cases (including In-Truck & 10m Distance In-Lab) had full data-throughput (limited by the 115kBaud UART Interface between Processor and BT Chipset)
- In-Truck & Low-Range In-Lab Use Case showed good RSSI values, High Range (10m) Use Case in Lab had lower RSSI → Still enough to get full throughput.
- Checking the retransmission rate (indirectly, by assessing the ping-round-trip-times) showed only ~3% transmissions taking more time / being retransmitted.
- The DAF Tablet hat ~8-10dbm higher RSSI (better/larger antenna than the Nokia X10 phone) but was not 100% usable due to company IT policies (→ PAN Data Connection / Hotspot Functionality was blocked). So, all tests were conducted using the Nokia X10 Phone.



4.4 CLIMATIC CHARACTERISTICS

Storage temp.: -40°C to 85°C

Operating temp.: -40°C to +60°C/+65°C (full operation)

Operating temp.: +60°C/+65°C to 85°C (limited operation)

- temperature increase over 65°C => change from full operation to limited operation
- temperature decrease below 60°C => change from limited operation to full operation

Remark: EU IP30 full operation temperature limited to 37°C for first certification with SW: S.004

IP30 devices with backup battery are not ADR compliant.

IP30 devices without backup battery are ADR compliant in case of all below conditions are met:

- Installation space with pollution degree 1 and 2
- Devices are installed behind an ADR master switch
- Devices are installed inside the cabin (ADR Zone 2).

4.5 CHEMICAL CHARACTERISTICS

Chemical characteristics can be found in the reliability test plan.

4.7 TRANSPORT, ASSEMBLY, START AND END OF OPERATION, STORAGE

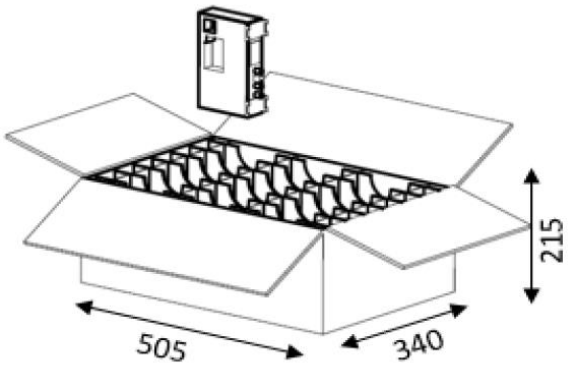
Please pay special attention to the safety and warning notes!

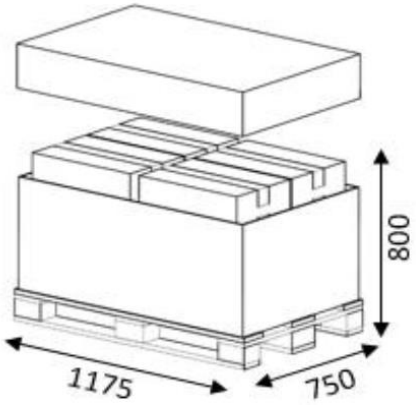
Transport

Do not throw or drop the unit. Dropping the unit may result in a malfunction that may only become evident at a later point in time. Such units will have to be scrapped or sent to Bosch for inspection and repair.

Packaging concept for the Paccar TCU Phase 2 are as shown below:

Pallet Dimension	1175 x 750 x 800 (mm)
Box dimension	505 X 340 x 215 (mm)





Assembly

The product's operating safety is only ensured if the permissible conditions are maintained. Voltage supply and grounding: Make sure that the loudspeaker cables do not have any contact to ground (earth, negative terminal of the vehicle battery). Observe the correct sequence when connecting to /disconnecting from the vehicle's electrical system.

Start and End of operation

If the device is connected incorrectly, it may draw the full operating current even when switched off. In this case, without any further deactivation on the vehicle side, there is a risk of battery depletion. No liability is assumed for any damage occurring because of this.

Storage

Furthermore, do not throw or drop the unit. Dropping the unit may result in a malfunction that may only become evident at a later point in time. Such units will have to be scrapped or sent to Bosch for inspection and repair.

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5 TESTING

5.1 TESTING BY BOSCH

- EMC component test
- Electrical performance measurements (FEP)
- System tests
- Reliability tests
- Flammability test*

5.2 TESTING BY THE CUSTOMER

- System tests
- Integration tests on vehicle level

6 ASSESSMENT OF PRODUCTS RETURNED FROM 0-MILEAGE AND FROM THE FIELD

Returned products are considered good if they fulfil the specifications / test data for 0-mileage and field listed in the TCD.

7 APPENDICES AND REFERENCES

8 HISTORY

Release	Date	Edited by	Release description
0.9	21.04.2022	M. Fiedler J. Krost	Creation of initial version.
1.0	28.04.2022	M. Fiedler J. Krost Y. Suman	First Release Version
1.1	25.05.2022	J. Krost	Minor updates
1.2	23.06.2022	M. Fiedler A. Sonnenberg	Correct Name for Pin8 on IP30 connector
1.3	25.07.2022	J. Krost A. Sonnenberg	USB pins for IP67 updated
1.4	25.08.2022	D. Höchemer	Updated feature overview (EU, NA)
1.5	19.09.2022	D. Höchemer	Included the EU-changes regarding BT/WLAN, USB, CAN

Release	Date	Edited by	Release description
			Added SW Architecture Overview
1.6	30.09.2022	D. Höchemer	Consolidated the HW BDD, Added Information about maximum possible CPU ressources, Added NA Arch. Overview
1.7	09.01.2023	D. Höchemer	Updated Pinning (CAN2, CAN3) Updated Variant Table Updated SoI Diagram Updated SW Arch. Overview
1.8	23.01.2023	D. Höchemer A. Sonnenberg J. Krost	Updated Backup Battery Updated Block Diagram
1.9	13.02.2023	D. Höchemer C. Kwong	Added USB to EU Updated EU Country List, Block Diagram & SW Arch. Updated Mechanic Labels Overview (TachoFresh Cloud)
1.10	24.02.2023	J. Krost	Added IPv4 premisses for MNO network in chapter “Cellular”
1.11	14.03.2023	D. Höchemer	Updated Blockdiagram (SIM1 / SIM2 switched)
2.2	05.04.2023	D. Höchemer	Updated Blockdiagram (Micro→Nano SIM)
2.3	19.04.2023	D. Höchemer	Updated Pin Description of BT/WLAN Antenna
2.4	12. May 2023	M. Fiedler	Add chapter “4.1.1 DTC – DIAGNOSTIC TROUBLE CODES”
2.5	7. July 2023	J. Krost	Updated GNSS disclaimer and WLAN antenna limitation in chapter 2.3.3
2.6	07.Aug. 2023	M. Charles	Correct the country in the chapter “2.2 INTENDED USE” based on the information from Feb. 2023
2.7	18. Aug. 2023	D. Höchemer C. Kwong	Updated Drawings (E1-Numbers) Updated Variant Overview (H-IDS Prepared for EU)
2.8	22. Aug 2023	M. Fiedler	Correct the country in the chapter “2.2 INTENDED USE” based on the information from Feb. 2023
2.9	28. Aug 2023	D. Höchemer	Added Chapters for IVD (3.2.2) and added more details for Bluetooth (4.3.7)
2.10	14. Sep 2023	Höchemer, Fiedler, Krost, Sonnenberg	Incorporated review findings
2.11	25. Sep 2023	M. Fiedler	update in chapter 2.1. the line "Sensors" in the table
2.12	02. Nov 2023	D. Höchemer	Added information regarding antennas for EU
2.12	08. Nov 2023	A. Sonnenberg	Technical characteristics for radio modules added
2.12	08. Nov 2023	M. Fiedler	Added chapter CERTIFICATION NOTICES AND REGULATORY VERBIAGE
2.12	08. Nov.2023	M. Charles	Add safety hint.

Release	Date	Edited by	Release description
2.12	09. Nov 2023	A. Sonnenberg	Antenna information for NA variant added
2.13	14.Nov 2023	E. Stilke	Formal changes. Adaption of safety and certification notes. Adding Remarks regarding temperature for S.004
2.13	15. Nov 2023	A. Sonnenberg, M. Fiedler, J. Krost, D. Höchemer	Antenna information for EU variant added Review
2.13	15. Nov 2023	E. Stilke	SW restricted output power Wi-Fi for IP30 EU added
2.14	17. Nov 2023	C. Thein	Publisher updated
2.15	20. Nov 2023	D. Höchemer	Added Temperature Hysteresis (60-65°C) for full operational. Added note regarding intended use
3.0	27. Nov 2023	D. Höchemer, C. Thein M. Fiedler J. Krost	Switchover to new template. Final version for PN 7620.000.276 (IP30 EU w/ SW LEO SP2.1)
3.1	30. Nov 2023	M. Fiedler D. Höchemer	Update DTC overview Added Information regarding SSH Access
3.2	8. Jan 2024	M. Fiedler D. Höchemer J. Krost	Added comments from QMM-VR2 and customer
3.3	11. Jan 2024	M. Fiedler T. Dargel	Adapt chapter 2.9
3.4	18. Jan 2024	M. Fiedler	Adapt chapter "4.1.1 DTC – DIAGNOSTIC TROUBLE CODES"
3.5	1. Feb 2024	M. Fiedler D. Höchemer	Added chapter "2.10.1. Certified Countries TCU2 EU IP30", Added “Self-discharging” of Backup Batterie in chapter “4.3.1 Power Supply” Added chapter “3.3.2 Software – Hardware Compatibility”, “3.3.3” and “3.3.4” Rework in BT/WLAN Chapter
3.6.	8. Feb 2024	M. Fiedler U. Yesilmen	Added chapter “2.11 Development Devices”
3.7	9. Feb 2024	M. Fiedler	Added chapter “2.3.4 Safety and Warning Notes for the Battery Pack”
3.8	8. Mar 2024	M. Fiedler A. Sebastian D. Höchemer	Update chapters “2.6. POWER CONSUMPTION / POWER OUTPUT”, “4.4 CLIMATIC CHARACTERISTICS” and “3.2.2.1 ANTENNAS” Update of chapter “3.3.2 Software – Hardware Compatibility” & “3.3.4 Software Update Cascade”
3.9	29.April 2024	E. Stilke	New p/n 7620.002.015, New p/n 7620.002.016 and partially New p/n 7620.000331 added Updated antenna lengths in Chapter 3.2.2.2 Updated label in Chapter 2.4

Release	Date	Edited by	Release description
			Updated FCC ID in Chapter 2.9.2.1 Added Chapter 2.10.2 “Certified Countries TCU2 NA”

9 CONTACT PERSON

Robert Bosch GmbH, XC-CT/EPM, Elita Stilke, elita.stilke@de.bosch.com

Robert Bosch GmbH
XC-CT/EPM
Contact person: Elita Stilke

MM-620.07-001 Generic TCD Template HW EN
Owner: see Mobility Template
Version: 2023-07-10