

ISOBUS: Technical Fundamentals and Communication (3)

Franz Höpfinger

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1. Wiki 3: ISOBUS Technology & Machine Systems

1.1 Master Craftsman Schools at Munich East Station

1.1.1 This is in the curriculum (Framework Curriculum 2025)

Here you will find all the technical requirements of the new Master Craftsman Examination Regulations 2025 (LandBauMechMstrV of September 9, 2024, effective August 1, 2025), clearly structured by modules and fields of activity.

-  [This is in the curriculum – Technical Curriculum Overview 2025](#)
-

1.1.2 Technical Focus Areas (Content Pages)

1.  [Hydraulics & Electrohydraulics](#) (LS Pumps, Proportional Valves, PWM, ISO 1219)
 2.  [Pneumatics & Compressed Air Brake Systems](#) (2-Line Systems, ALB, ABS/EBS)
 3.  [Internal Combustion Engines & Exhaust Aftertreatment](#) (Common Rail, VTG, SCR/AdBlue, DPF, Stage V)
 4.  [High-Voltage Technology \(HV\) & E-Mobility](#) (DGUV 209-093, Activation, Li-Ion/BMS, 48V)
 5.  [Transmission Technology, Chassis & Steering Systems](#) (CVT/Vario, Power Shift, Articulated/All-Wheel Steering)
 6.  [Machine Safety, Standards & Testing](#) (UVV/DGUV 70/73, SP, CE Conformity, ISO 12100)
-

Useful Links:

-  [Main Menu](#)
 -  [Super Search \(All Wikis\)](#)
 -  [Download PDF Handbook](#)
-

 [Main Menu](#) |  [Super Search \(All Wikis\)](#) | [Quick Search \(IEC 61499\)](#)

1.1.3 Related Topic Subpages on ms-muc-docs.de

-  [The PWM Signal & Infographic on ms-muc-docs.de](#)

2. AEF ISOBUS CHECK Tool

<https://www.aef-isobus-database.org/isobusdb/internal/download/isobuscheck.jsf>

3. Flow Structures

https://de.wikibooks.org/wiki/C-Programmierung:_Kontrollstrukturen

3.1 if statement

(also called WENN-Funktion or <https://excelhero.de/funktionen/excel-wenn-funktion/> in the Microsoft-heavy German education system) Example: <https://onlinegdb.com/wWii98Jv3>

3.1.1 else statement

The else statement is optional.

Example: <https://onlinegdb.com/CFbDfaSX4>

Example: <https://onlinegdb.com/CnSm1M4fn>

3.2 switch statement

Example: https://onlinegdb.com/5_n5GjAkT

3.3 Conditional Expression

Example: https://www.onlinegdb.com/KURn4fl_M

In this example you will see:

```
``{code-block} C :caption: C-Code
printf(" w = %s", w ? "Wahr" : "Falsch"); This means:
If w is true, the text "True" is displayed, and vice versa.
```

In the example https://github.com/Meisterschulen-am-Ostbahnhof-Munchen/cc_i_EasyExample/blob/master/EasyExample/components/AppIso/App_VTClientLev2.c, you will see the following expression in line [https://github.com/Meisterschulen-am-Ostbahnhof-Munchen/cc_i_EasyExample/blob/master/EasyExample/components/AppIso/App_VTClientLev2.c#:text=IsoVtcCmd_NumericValue\(u8Instance%2C%20ObjectPointer_](https://github.com/Meisterschulen-am-Ostbahnhof-Munchen/cc_i_EasyExample/blob/master/EasyExample/components/AppIso/App_VTClientLev2.c#:text=IsoVtcCmd_NumericValue(u8Instance%2C%20ObjectPointer_)

```
``{code-block} C :caption: C-Code
```

```
IsoVtcCmd_NumericValue(u8Instance, ObjectPointer_Tagesziel, Tageszaehler >= Tagesziel ?
OutputString_ZielErreicht : ID_NULL); Here, the green box with the text "Target Achieved" is shown or
hidden.
```

3.4 For Loop

Example: https://onlinegdb.com/_zCm5ZHsK

Example: https://onlinegdb.com/_jcCRpYe3

3.5 While Loop

Example: <https://onlinegdb.com/AnrnomF39G>

3.6 Do-While Loop

Example: <https://onlinegdb.com/LQIBQwXest>

4. Busmaster

<http://rbei-etas.github.io/busmaster/>

5. C programming

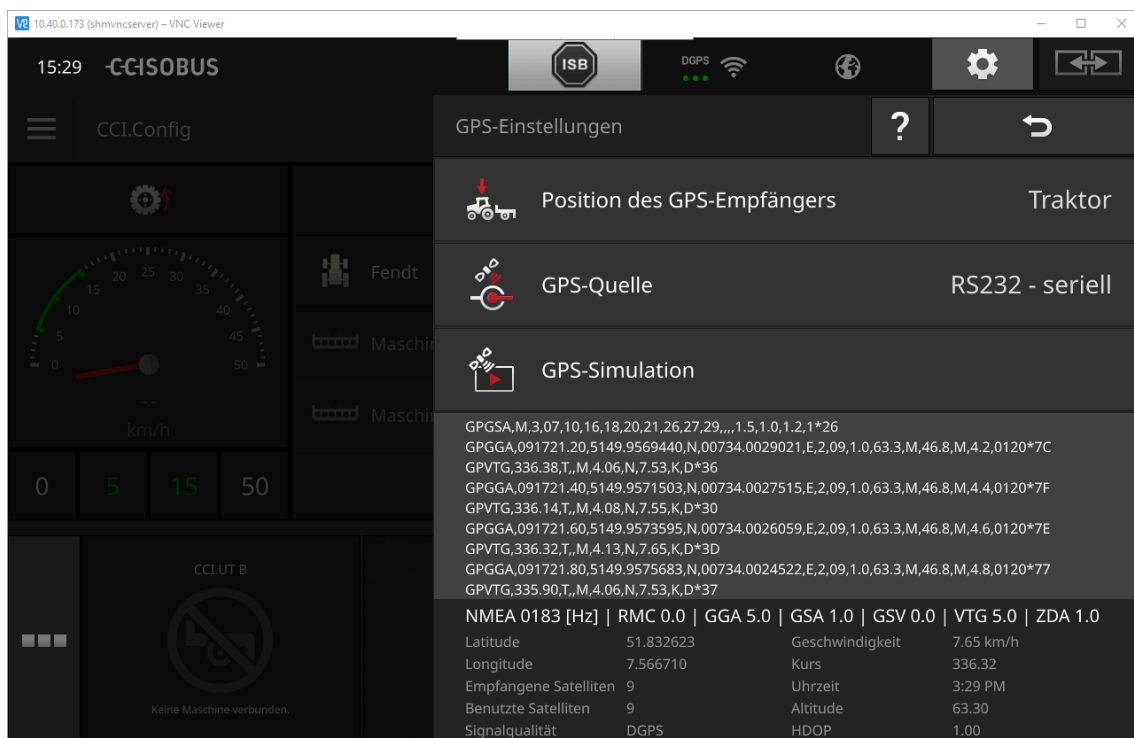
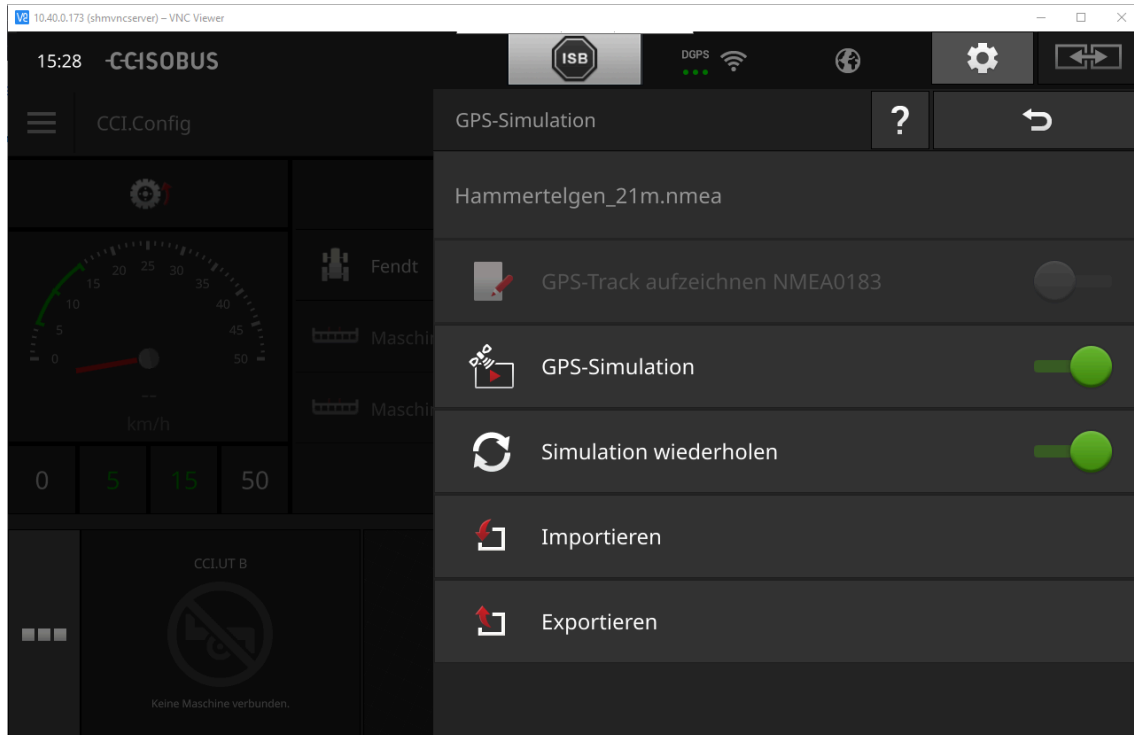
6. CCI Displays

TODO:

- Load field outlines
- Load application map
- WiFi
- Ethernet
- Teams (Homeschooling)
- Projector

7. GPS Simulation on the Display

Simply go to the terminal and navigate to: CCI.Config => GPS => GPS simulation => Import, select the desired option, and press the back button. Then start the simulation (password required!) and enable repeat. The simulation will now run. Load a suitable field boundary so the simulation looks realistic.





8. GPS Simulation via PC (avangardo)

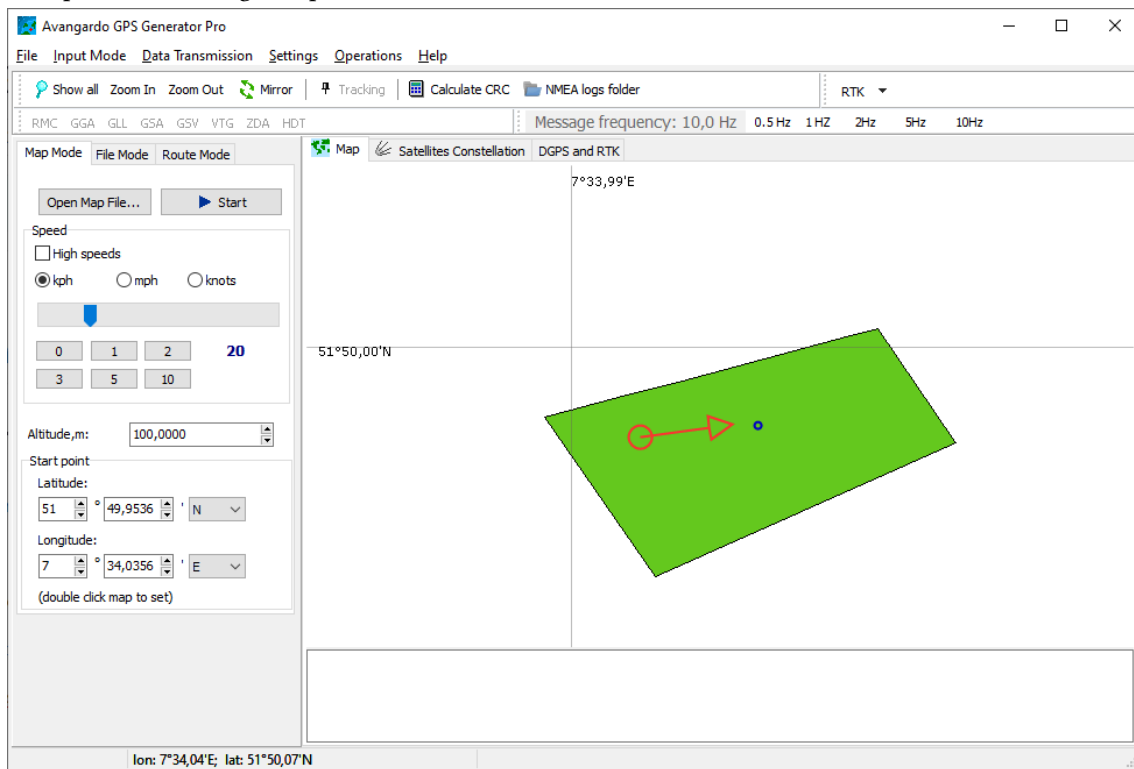
8.1 Hardware

8.2 Software

Unfortunately, avangardo is no longer available! Unzip av_gps_generator_pro.zip, run setup.exe, GPS Generator PRO v.4.2.2 is probably the current version.

Start the program,

Import Hammertelgen.shp:



Important settings:

Packet Data Transmission Options

Data packet period, sec:

0,20

+ Add Packet

✕ Del Packet

+ Add Message

▼

✕ Del Message

⌵ Packet #1

GGA

VTG

GSA

Use Drag&Drop operations to order data packets and messages in them. Mesages in one packet will be sent all at one time. Packets will be sent in specified order.

OK

Cancel

NMEA options ✕

NMEA Version: NMEA 0183 v.3.0 ▼

Lat and Lon precision, decimal digits: 8 ▲▼

Speed precision, decimal digits: 0 ▲▼

Course precision, decimal digits: 0 ▲▼

HDOP, PDOP and VDOP precision, decimal digits: 0 ▲▼

Altitude and geoidal separation precision: 0 ▲▼

Talker ID (two-letter code): GP

☐ Generate random CRC error in protocol (5%)

OK Cancel

The screenshot shows a Windows-style dialog box titled "Output Settings" with a close button (X) in the top right corner. It has three tabs: "NMEA log files", "Serial port" (which is selected), and "UDP".

Under the "Serial port" tab, there are three main options:

- ☒ Output NMEA messages to serial port
- ☒ Use COM port:
 - Port name*:
- ☐ Create COM port to Bluetooth device:
 -

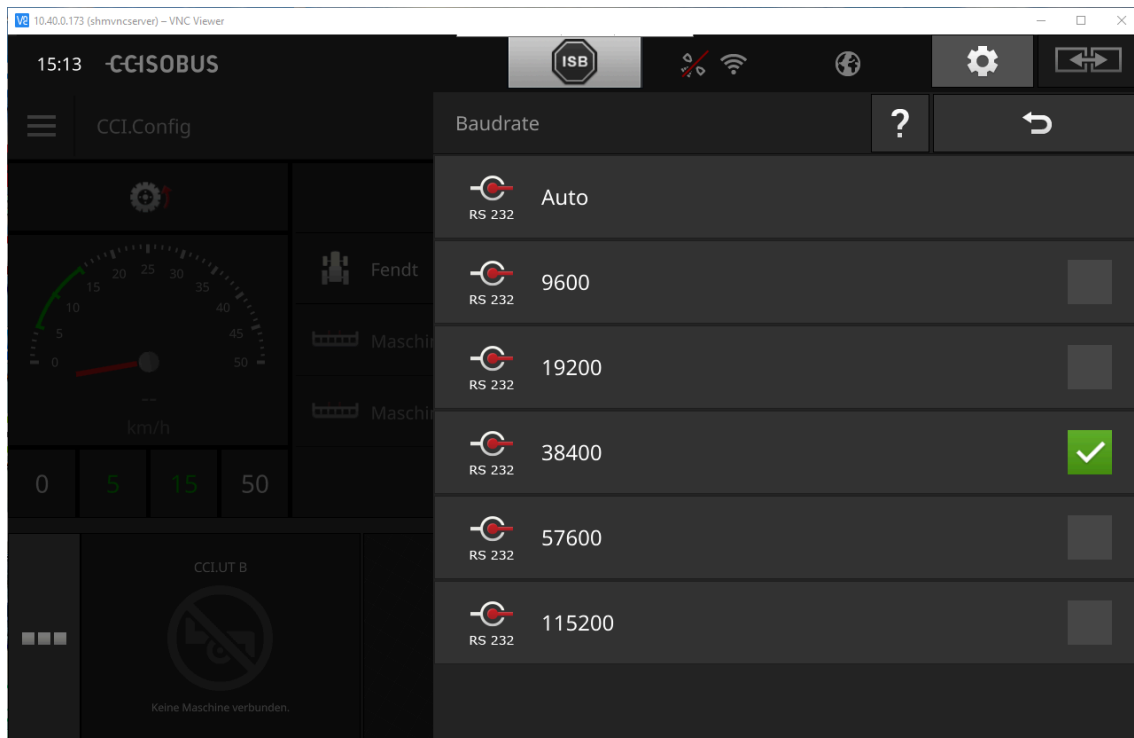
Below these options is a section titled "Port Settings" with five rows of controls:

- Speed, bps:
- Data bits:
- Parity:
- Stop bits:
- Flow control:

At the bottom of the dialog, there is a blue italicized note: "* For virtual COM port it`s name may be like this: //./COM".

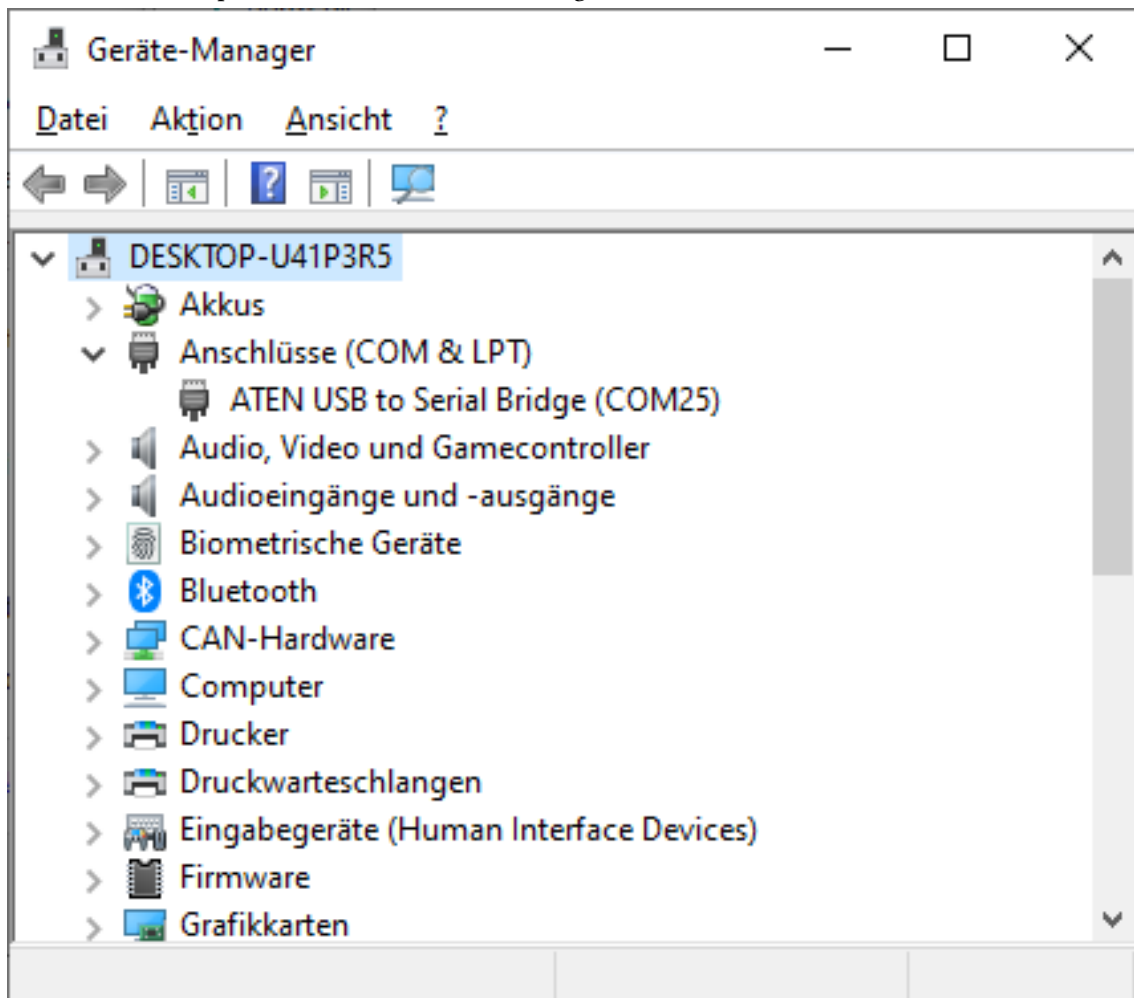
At the very bottom are two buttons: "OK" and "Cancel".

The baud rate here must match the baud rate on the CCI1200.
CCI.Config => GPS => Baud Rate



For the port name, you usually enter

You can find the port number in the Device Manager of the Control Panel:



References:

<https://web.archive.org/web/20211028015532/http://www.avangardo.com/how-to/>
(Original page no longer available)

9. Basic Operational Combinations

<https://www.xplore-dna.net/course/view.php?id=15> AND Operation OR Operation XOR Operation
Negating Binary Values (NOT Operation)

10. Home

10.1 Podcast

- [logiBUS®: Revolutionizing Agricultural IT – How ISOBUS Becomes a Smart Home for Farmers

11. IEC programming according to IEC 61131-3

https://de.wikipedia.org/wiki/International_Electrotechnical_Commission https://de.wikipedia.org/wiki/EN_61131 <https://github.com/Meisterschulen-am-Ostbahnhof-Muenchen/PlcLib> PLC Lib with IEC 61131 alike functions. Very much inspired by OSCAT: <http://www.oscat.de/> and CoDeSys: <https://www.helpme-codesys.com/>
<https://github.com/Meisterschulen-am-Ostbahnhof-Muenchen/TimeDelay>
<https://www.xplore-dna.net/course/view.php?id=15>
<https://www.xplore-dna.net/mod/page/view.php?id=153>

11.1 Basic Interconnections

https://de.wikipedia.org/wiki/Boolesche_Algebra

11.1.1 AND

<https://www.xplore-dna.net/mod/page/view.php?id=155>
https://content.helpme-codesys.com/de/CODESYS%20Development%20System/_cds_operator_and.html

11.1.2 OR

https://content.helpme-codesys.com/de/CODESYS%20Development%20System/_cds_operator_or.html

11.1.3 NOT

<https://www.xplore-dna.net/mod/page/view.php?id=157>
https://content.helpme-codesys.com/de/CODESYS%20Development%20System/_cds_operator_not.html

11.1.4 Exclusive OR

<https://www.xplore-dna.net/mod/page/view.php?id=154>
https://content.helpme-codesys.com/de/CODESYS%20Development%20System/_cds_operator_xor.html

11.2 Memory Components

<https://de.wikipedia.org/wiki/Flipflop>

11.2.1 SR Flip-Flop

<https://www.xplore-dna.net/mod/page/view.php?id=173>
<https://content.helpme-codesys.com/de/libs/Standard/Current/Bistable-Function-Blocks/SR.html>
https://content.helpme-codesys.com/de/CODESYS%20Safety%20for%20EtherCAT%20Safety%20Module/el6900_fb_sr.html

11.2.2 RS Flip-Flop

<https://www.xplore-dna.net/mod/page/view.php?id=1038>
<https://content.helpme-codesys.com/de/libs/Standard/Current/Bistable-Function-Blocks/RS.html>

https://content.helpme-codesys.com/de/CODESYS%20Safety%20for%20EtherCAT%20Safety%20Module/el6900_fb_rs.html

11.2.3 TOGGLE (Impulse Switch)

http://www.oscat.de/oscat_basic333_de.pdf Page 280; Item 17.16. TOGGLE

11.3 Time-based functions

11.3.1 TON: On-delay

This function block delays a signal from the on-time by a specified duration.

<https://www.xplore-dna.net/mod/page/view.php?id=167>

<https://content.helpme-codesys.com/en/libs/Standard/Current/Timer/TON.html>

11.3.2 TOF: Off-delay

This function block extends a signal from the off-time by a specified duration.

<https://www.xplore-dna.net/mod/page/view.php?id=168>

<https://content.helpme-codesys.com/en/libs/Standard/Current/Timer/TOF.html>

11.3.3 TONOF: On/Off Delay

http://oscat.de/images/OSCATBasic/oscat_basic333_de.pdf Page 215

11.3.4 TP: Pulse Generation

<https://www.xplore-dna.net/mod/page/view.php?id=166>

<https://content.helpme-codesys.com/en/libs/Standard/Current/Timer/TP.html>

11.4 Querying Signal Edges of an Operand

Edge Detection

<https://www.xplore-dna.net/mod/page/view.php?id=158>

11.4.1 R_TRIG

https://content.helpme-codesys.com/de/libs/Standard/Current/Trigger/R_TRIG.html

<https://www.plcademy.com/function-block-diagram-programming/>

-> at R_TRIG Function Block

Source: <https://www.plcademy.com/function-block-diagram-programming/>

11.4.2 F_TRIG

https://content.helpme-codesys.com/de/libs/Standard/Current/Trigger/F_TRIG.html

-> at F_TRIG Function Block

12. ISO/OSI Layer Model

12.1 General Information

The ISO/OSI reference model (also called the OSI model) is a theoretical model that describes communication between different computers and networks. It was developed by the International Organization for Standardization (ISO) and is specified in the standard ISO 7498-1. The OSI model consists of seven layers, each with specific tasks in the communication process:

- Physical layer: Transmission of bits over the physical medium (cable, radio, fiber optic, etc.)

- Data link layer: Error detection and correction, device addressing (MAC address)

- Network layer: Routing of packets between different networks

- Transport layer: Division of data into packets, ensuring reliability and complete transmission

- Session layer: Establishment, maintenance, and termination of sessions between applications

- Presentation layer: Conversion of data into a format understandable by the application

- Application layer: Interface between applications and the network, e.g., email, web browser, or file transfer

The OSI model serves as a reference for the development of network protocols and architectures. It enables the integration and standardization of various network technologies, allowing devices from different manufacturers to communicate with each other.

12.2 ISO/OSI Reference Model and SAE J1939

SAE J1939 is a protocol specifically designed for use in commercial vehicles and machinery. It is based on the CAN bus standard and uses the ISO/OSI reference model as the foundation for its layered architecture.

The SAE J1939 protocol architecture consists of five layers:

- Application Layer: This layer defines the specific application data exchanged between devices on the network.

- Transport or Service Layer: This layer is responsible for dividing the data into smaller packets and ensuring the reliability of data transmission.

- Network Layer: This layer manages addressing and the exchange of packets between different networks.

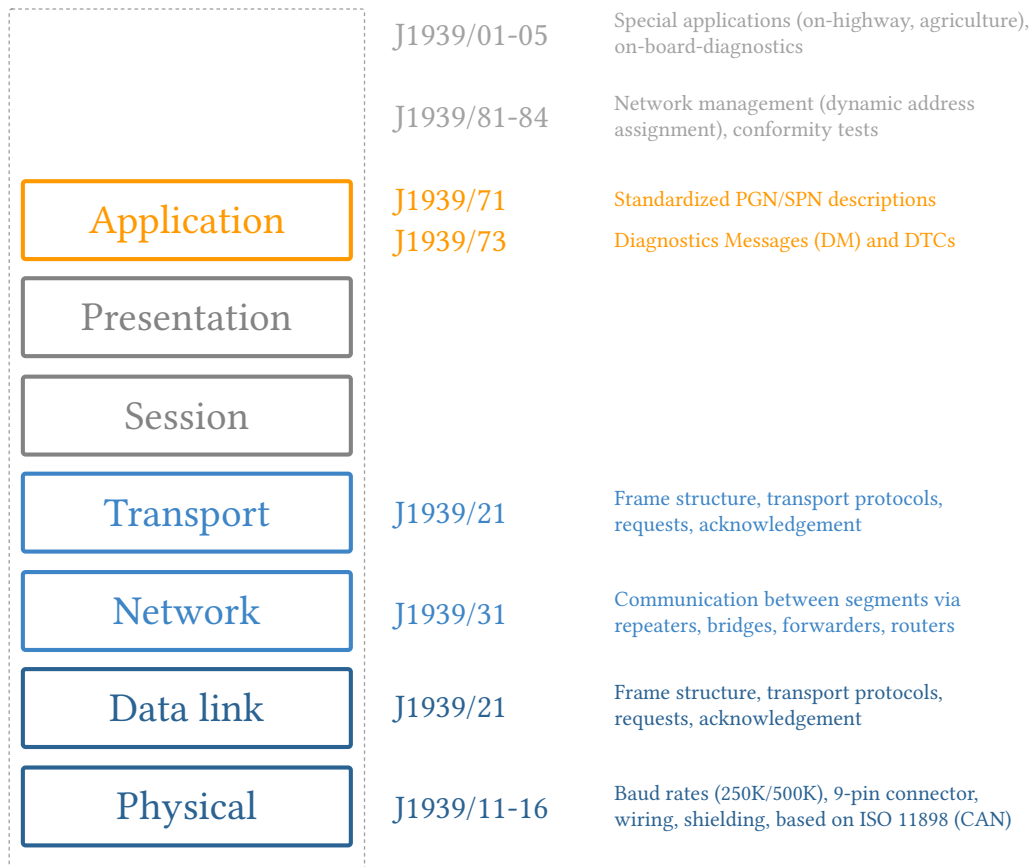
- Data Link Layer: This layer provides error detection and correction, as well as access to the medium (CAN bus).

- Physical Layer: This layer handles the electrical and physical transmission of data over the medium (CAN bus).

Like the OSI model, the layered architecture of SAE J1939 enables the interoperability and integration of various devices from different manufacturers into a network. This facilitates the development and implementation of applications for commercial vehicles and machinery based on SAE J1939.

<https://www.csselectronics.com/pages/j1939-explained-simple-intro-tutorial>

7 layer OSI model | J1939 standards



12.3 ISO/OSI Reference Model and ISO 11783

<https://www.csselectronics.com/pages/isobus-introduction-tutorial-iso-11783>

7 layer OSI model | **ISOBUS (ISO 11783)**

Application	ISO 11783-7/8/9/10/12/13/14
Presentation	ISO 11783-6/7/11
Session	ISO 11783-6/7/10/14
Transport	ISO 11783-3/5
Network	ISO 11783-4/5
Data link	ISO 11783-3 (ISO 11898-1)
Physical	ISO 11783-2 (ISO 11898-2)

13. Calibration Methods: Two-Point and Multi-Point Calibration

13.1 Why calibrate at all?

No sensor delivers exactly the physical value you actually want to measure straight out of the box. A raw signal (for example a voltage, a current, or a digitized number 0...4095 from an analog-to-digital converter) is only indirectly related to the desired physical quantity - the steering angle, the fill level, or the oil pressure, say. Two sources of error practically always show up together:

- a **zero-point error** (offset): the raw signal is not itself zero at the true physical zero, but shifted by a constant amount, and
- a **slope error** (gain or span error): a change in the physical quantity does not produce exactly the expected change in the raw signal, but one that deviates from it, more or less.

Calibrating means: at at least two known, physically reached reference points (for example “full lock left” and “full lock right”), relate the raw signal measured there to the physical target value that actually applies at that point - so that a conversion rule for all values in between falls out of it.

13.2 The classic method: zero point, then slope

The traditional approach, inherited from instrumentation engineering, corresponds exactly to setting up a line equation $y = m \cdot x + b$ from school math - only carried out as two separate, sequential physical actions:

1. **Zero-point adjustment:** Move to the lower reference (for example the left-hand stop), enter the desired target value, and trigger the zero-point trim. Internally this computes an offset b , so that the reading is correct at exactly this one point.
2. **Slope adjustment:** Move to the upper reference (for example the right-hand stop), enter the second target value, and trigger the span trim. This computes the slope m - using the offset already determined in the first step.

The method works, but it has a built-in trap: the second step **strictly requires** the first step to have already been carried out, because the slope calculation continues to work with the intermediate result remembered during the zero-point adjustment. If, by mistake, the span is adjusted first with no zero point ever set (or the order is swapped), the system computes using a value that has not yet been meaningfully set - often a technical default or a leftover from a previous calibration - and the result is a silently wrong calibration that looks plausible at first glance. In practice this is guarded against technically: the span adjustment simply cannot be triggered until the zero point has been set at least once. That reliably protects against the operating mistake, but it costs extra effort - a sequencing safeguard that is only needed in the first place because the calculation method itself forces an order.

13.3 The smarter method: independent reference points

The more modern approach solves exactly this problem by separating the calculation step from the calibration action:

- When a reference position is reached, **only** the raw signal measured there is stored, unchanged - a pure snapshot operation, with no calculation and no reference to any other calibration point.
- The actual conversion (the line through the stored points) is **not** computed during calibration, but freshly, every single time a new measurement actually needs to be displayed or processed further.

This removes the dependency on a particular order between the two calibration steps: each step on its own only records an independent number, so the reference points can be set in any order, repeated as often as needed, and - particularly relevant in practice - recalibrated individually, for example when only

one of the two end stops needs readjusting in the field, without the other one having to be redone. Order-independence is not the same thing as completeness, though: the conversion itself is of course only available once both required reference points have actually been set - before that, the line is simply still missing its second support point. The difference from the classic method is not that a point may be missing, but that it no longer matters *which* of the two is set first.

sequenceDiagram

```

    participant Operator
    participant Calibration
    participant MeasurementProcessing

```

```

    Operator->>Calibration: Set reference point
    Calibration->>Calibration: Store raw signal
    Operator->>Calibration: Set other reference point
    Calibration->>Calibration: Store raw signal
    MeasurementProcessing->>Calibration: New measurement
    Calibration-->>MeasurementProcessing: Compute line from both points

```

The principle extends directly to three (or more) reference points. Whenever a sensor has a distinguished center position in addition to its two end stops - the classic case being a steering angle sensor with the three references “full lock left”, “straight ahead”, and “full lock right” - a single line equation is no longer enough, because mechanical tolerances can make the characteristic curve run at a different slope to the left of center than to the right. Each of the three points then independently stores its own measured raw value, and the points are afterwards connected piecewise-linearly - one slope between the left stop and center, a separate, independent slope between center and the right stop. Here too, the same rule holds unchanged: because each of the three points only independently stores a raw value, and the interpolation only happens at read-time, there is no enforceable order between the three calibration steps at all - each point can be set on its own, and readjusted later on its own. And once again the same caveat applies: as long as not all three points have actually been set, the conversion is missing one of its support points - freedom of order does not remove the need to eventually have visited every required point.

flowchart LR

```

    L[Left stop] --> RL[Store raw signal]
    M[Center position] --> RM[Store raw signal]
    R[Right stop] --> RR[Store raw signal]
    RL --> I[Piecewise linear interpolation]
    RM --> I
    RR --> I
    I --> V[Convert measurement]

```

13.4 The general lesson behind it

The difference between the two methods is not, in the end, a special case unique to sensor calibration - it is a general design principle that remains valid far beyond it: whenever several independent pieces of information need to be captured, it is worth asking whether they must be folded into a running intermediate result immediately as they are captured - or whether it would be simpler and more robust to first store each piece of information on its own, unchanged, and only compute the actual result later, on demand, from all the individual values taken together.

The first variant saves a little computation at the moment of capture itself, but pays for it with a hidden ordering dependency between the capture steps - with all the consequences that has for operation, error safety, and maintainability: an extra sequencing check becomes necessary, a single step can no longer be repeated on its own without risk, and the actual reason for the required order is often not visible from the outside at all, only understandable from the internal calculation rule. The second variant is marginally more work at the moment of capture itself - the raw value simply has to be kept separately instead of being folded in right away - but gains robustness in return: every capture step is, on its own, completely independent, repeatable as often as needed, and executable in any order, because it needs no knowledge of the other steps at all.

This trade-off - “fold it in immediately and accept a dependency” versus “just record it for now, and dissolve the dependency by pushing it to the end” - comes up again and again in control and measurement engineering, far beyond the calibration of individual sensors. It is worth deliberately checking, for every multi-step capture or setup procedure, which of the two variants is actually at play - and whether an apparently “logical” order is really justified by the underlying problem, or merely a side effect of how the calculation happened to be built.

13.5 Implementations in Function Block Libraries

The calibration procedures described above are available as ready-to-use function blocks in the **4diac Library Reference** and the **OSCAT Basic Library**:

13.5.1 Two-Point Calibration (Offset & Scale)

- [CALIBRATE \(4diac Library Reference\)](#): Classic Boolean-triggered two-point calibration ($Y = (X + \text{OFFSET}) * \text{SCALE}$).
- [E_CALIBRATE \(4diac Library Reference\)](#): Event-driven two-point calibration (EIC0/EICS).
- [AR_CALIBRATE \(4diac Library Reference\)](#): Adapter-based two-point calibration for IEC 61499.

13.5.2 Three-Point Calibration (Min, Mid, Max)

- [CALIBRATE_3P \(4diac Library Reference\)](#): Boolean-triggered three-point calibration with center-offset compensation (e.g. joysticks).
- [E_CALIBRATE_3P \(4diac Library Reference\)](#): Event-driven three-point calibration (EI_MIN/EI_MID/EI_MAX).
- [AR_CALIBRATE_3P \(4diac Library Reference\)](#): Adapter-based three-point calibration for IEC 61499.

13.5.3 OSCAT Documentation (Structured Text)

- [CALIBRATE \(OSCAT Basic Docs\)](#): Documentation of the original OSCAT ST implementation.

14. Literature on C Programming

C Programming on Wikibooks – The Free Library <https://de.wikibooks.org/wiki/C-Programmierung>
https://de.wikipedia.org/wiki/International_Electrotechnical_Commission Note: The links go to Amazon.
This is done for clarity only and does NOT constitute a purchase recommendation.

15. Literature - CAN Bus

[https://de.wikipedia.org/wiki/International_Electrotechnical_Commission/wiki/International_Electrotechnical_Commission)

<https://de.wikipedia.org/>

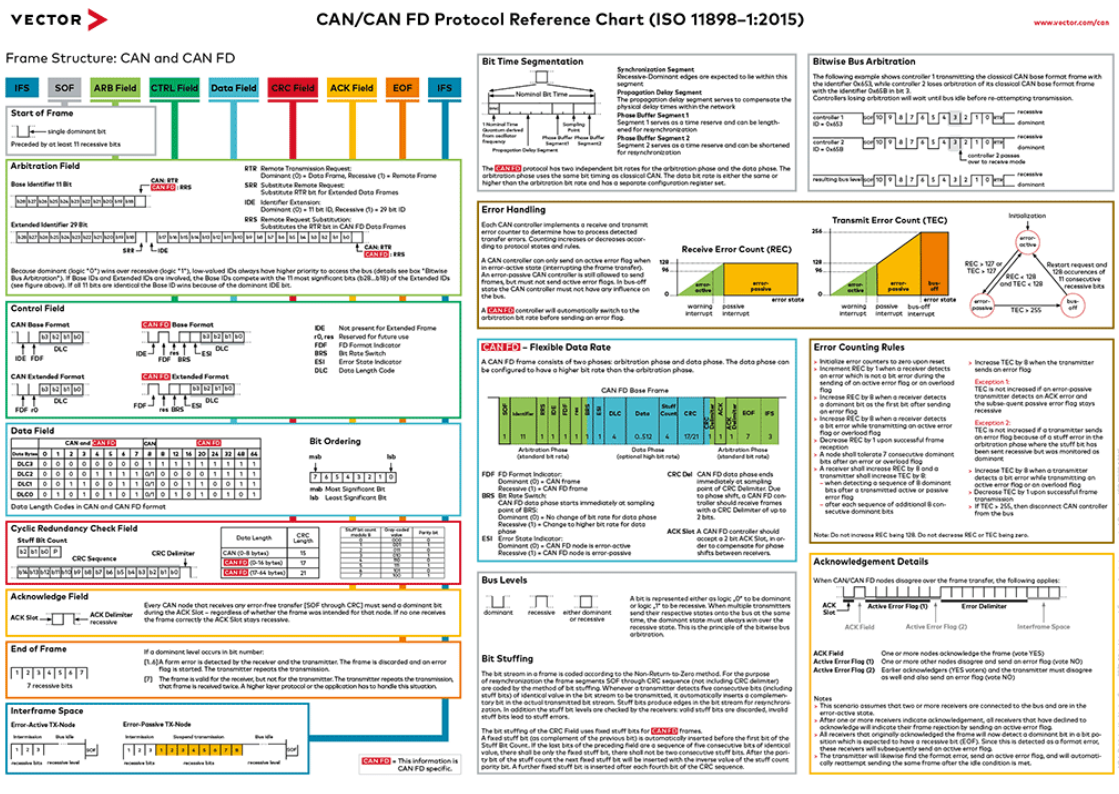
https://de.wikipedia.org/wiki/Controller_Area_Network

<https://elearning.vector.com/>

Learning Module: Introduction to CAN (38 slides)

<https://elearning.vector.com/mod/page/view.php?id=111>

Poster:



16. ESP32 Literature

16.1 Related topic subpages on ms-muc-docs.de

-  [ESP32 & ESP32-S3 DevKit on ms-muc-docs.de](#)

17. ISOBUS Standards Literature

M:\Agricultural Machinery Mechanics\Instruction\SL\DLG\pconvert\progs\database\norm\pdf\ This folder contains some older versions; the latest versions are listed below with a link to the Beuth website. These can also be obtained directly from ISO. <https://www.isobus.net/isobus/> -> Much of the content is available here free of charge. Searchable.

17.1 ISO 11783-1:2017-12

17.1.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 1: General standard for mobile data communication

English Title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 1: General standard for mobile data communication

Publication Date

2017-12

Original Languages

English <https://www.iso.org/standard/57556.html>

<https://www.beuth.de/de/norm/iso-11783-1/284007429>

M:\Landmaschinenmechanik\Unterricht\SL\DLG\pconvert\progs\database\norm\pdf\11783-02.pdf

17.2 ISO 11783-2:2019-04

17.2.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 2: Physical Layer

English Title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 2: Physical layer

Publication Date

2019-04

Original Languages

English <https://www.beuth.de/de/norm/iso-11783-2/306884456>

M:\Landmaschinenmechanik\Unterricht\SL\DLG\pconvert\progs\database\norm\pdf\11783-03.pdf

17.3 ISO 11783-3:2018-11

17.3.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 3: Data link layer

English Title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 3: Data link layer

Publication date

2018-11

Original languages

English <https://www.beuth.de/de/norm/iso-11783-3/298364278>

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17.4 ISO 11783-4:2011-12

17.4.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 4: Network layer

English title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 4: Network Layer

Publication Date

2011-12

Original Languages

English <https://www.beuth.de/de/norm/iso-11783-4/148454849>

M:\Landmaschinenmechanik\Unterricht\SL\DLG\pconvert\progs\database\norm\pdf\11783-05.pdf

17.5 ISO 11783-5:2019-06

17.5.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 5: Network management

English Title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 5: Network Management

Publication Date

2019-06

Original Languages

English <https://www.beuth.de/de/norm/iso-11783-5/310726359>

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Machinery

Mechanics/Instruction\SL\DLG\pconvert\progs\database\norm\pdf\11783-06.pdf

17.6 ISO 11783-6:2018-06

17.6.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 6: Virtual terminal

English Title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 6: Virtual Terminal

Publication Date

2018-06

Original Languages

English <https://www.beuth.de/de/norm/iso-11783-6/291680983>

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17.7 ISO 11783-7:2015-03

17.7.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 7: Implement messages application layer

English Title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 7: Implement messages application Layer

Publication Date

2015-03

Original Languages

English <https://www.beuth.de/de/norm/iso-11783-7/233938000>

M:\Landmaschinenmechanik\Unterricht\SL\DLG\pconvert\progs\database\norm\pdf\11783-08.pdf

17.8 ISO 11783-8:2006-02

17.8.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 8: Powertrain

English Title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 8: Powertrain Messages

Publication Date

2006-02

Original Languages

English <https://www.beuth.de/de/norm/iso-11783-8/88817735>

M:\Landmaschinenmechanik\Unterricht\SL\DLG\pconvert\progs\database\norm\pdf\11783-09.pdf

17.9 ISO 11783-9:2012-02

17.9.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 9: Tractor ECU

English Title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 9: Tractor ECU

Publication Date

2012-02

Original Languages

English <https://www.beuth.de/de/norm/iso-11783-9/150733683>

M:\Landmaschinenmechanik\Unterricht\SL\DLG\pconvert\progs\database\norm\pdf\11783-10.pdf

17.10 ISO 11783-10:2015-09

17.10.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 10: Task controller and management information system data

English Title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 10: Task controller and management information system data Interchange

Publication Date

2015-09

Original Languages

English <https://www.beuth.de/de/norm/iso-11783-10/242296016>

M:\Landmaschinenmechanik\Unterricht\SL\DLG\pconvert\progs\database\norm\pdf\11783-11.pdf

17.11 ISO 11783-11:2011-07

17.11.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 11: Mobile data element

English Title

Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 11: Mobile data element dictionary

Publication date

2011-07

Original languages

English
<https://www.beuth.de/de/norm/iso-11783-11/144157071>

M:\Landmaschinenmechanik\Unterricht\SL\DLG\pconvert\progs\database\norm\pdf\11783-12.pdf

17.12 ISO 11783-12:2019-01

17.12.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 12: Diagnostics

English title
Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 12: Diagnostics Services
Publication Date
2019-01
Original Languages
English <https://www.beuth.de/de/norm/iso-11783-12/302431051>

M:\Landmaschinenmechanik\Unterricht\SL\DLG\pconvert\progs\database\norm\pdf\11783-13.pdf

17.13 ISO 11783-13:2011-04

17.13.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 13: File server

English Title
Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 13: File server
Publication Date
2011-04
Original Languages
English <https://www.beuth.de/de/norm/iso-11783-13/141530744>

M:\Landmaschinenmechanik\Unterricht\SL\DLG\pconvert\progs\database\norm\pdf\11783-14.pdf

17.14 ISO 11783-14:2013-09

17.14.1 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 14: Sequence control

English Title
Tractors and machinery for agriculture and forestry - Serial control and communications data network
- Part 14: Sequence control
Publication Date
2013-09
Original Languages
English <https://www.beuth.de/de/norm/iso-11783-14/194148107>

18. ISOBUS Literature

Telegram group about ISOBUS: [https://t.me/+V_7QkEUfnYjFlJo0 https://t.me/+V_7QkEUfnYjFlJo0)
[<https://t.me/joinchat/B1-SThBCW-w6klLwK3zLjw> <https://t.me/joinchat/B1-SThBCW-w6klLwK3zLjw>)

Telegram group about CCI: https://t.me/joinchat/8_KHdpS2ynVjOTUy

LinkedIn:

<https://www.linkedin.com/groups/102887/>

TUM:

The most comprehensive agricultural engineering library I know of:

[<https://mediatum.ub.tum.de/> <https://mediatum.ub.tum.de/>)

among others:

<https://mediatum.ub.tum.de/1615119>

ISOBUS Literature

<https://de.wikipedia.org/wiki/ISOBUS> -> quite high-level.

<https://obstwein-technik.eu/Core?aktiveNavigationsID=879&fachbetrageID=209>

<https://mediatum.ub.tum.de/?id=709486>

AEF Training:

<https://www.aef-online.org/about-us/isobus.html>

[https://www.aef-online.org/fileadmin/user_upload/Content/pdfs/AEF_handfan_EN.pdf https://www.aef-online.org/fileadmin/user_upload/Content/pdfs/AEF_handfan_EN.pdf)

[https://www.aef-online.org/fileadmin/user_upload/Content/pdfs/AEF_handfan_DE.pdf https://www.aef-online.org/fileadmin/user_upload/Content/pdfs/AEF_handfan_DE.pdf)

[<https://www.aef-online.org/news/downloads.html> <https://www.aef-online.org/news/downloads.html>]

<https://www.aef-isobus-database.org/isobusdb/internal/wbt/isobus.jsf>

<https://www.aef-isobus-database.org/isobusdb/internal/wbt/database.jsf>

<https://www.aef-isobus-database.org/isobusdb/internal/wbt/checktool.jsf>

Further AEF training courses:

at: M:\Agricultural Machinery Mechanics\Lessons\SL\AEF

--

<https://www.isobus.net/isobus/>

--

Distek Blog:

The entire blog is interesting, but only this one page provides truly technical information.

<https://www.distek.com/blog/isobus-plugfest-2014-saw/>

--

<https://www.aef-isobus-database.org/> -> We'll look at this separately in an hour.

--

<http://sharepoint.aef-online.org/> -> We don't have access to this yet; MS first needs to become an AEF member.

--

CCI: I'll inquire about what documentation is available there.

I'll find somewhere to put the display manuals.

--

<https://youtu.be/wP8J4lJ0Qk> ISOBUS Prototype and Test Development with CANoe .ISO11783

--

<https://staging.cc-isobus.com/tutorials/>

<https://www.cc-isobus.com/training/>

19. Literature SAE-J1939

https://de.wikipedia.org/wiki/SAE_J1939

Learning Module J1939 <https://elearning.vector.com/mod/page/view.php?id=253>

Poster

https://assets.vector.com/cms/_processed_/3/0/csm_SAE-J1939-Poster_Protocol_Overview_1920x1356_2ebcc3f011.png

! [SAE J1939 Protocol Overview - Topics: Specification Documents | Physical Layer | Frame Structure | Transport Protocols | Request Handling | Diagnostics | Network Management https://assets.vector.com/cms/_processed_/3/0/csm_SAE-J1939-Poster_Protocol_Overview_1920x1356_2ebcc3f011.png]

20. Literature

20.1 Podcast

- [Max Eyth: Engineer, Visionary, Bridge Builder – His Legacy in Technology, Agriculture, and Literature

21. Operators

Applies to: Mathematics Applies to: C Programming

Operators have a priority:

[List_of_Operators_by_Priority](#) Popular example: Multiplication and division before addition and subtraction

Examples:

Easy to test here:

https://www.onlinegdb.com/online_c_compiler

<https://www.xplore-dna.net/course/view.php?id=15>

<https://www.xplore-dna.net/mod/page/view.php?id=155>

<https://www.xplore-dna.net/mod/page/view.php?id=153>

22. PEAK adapter cable

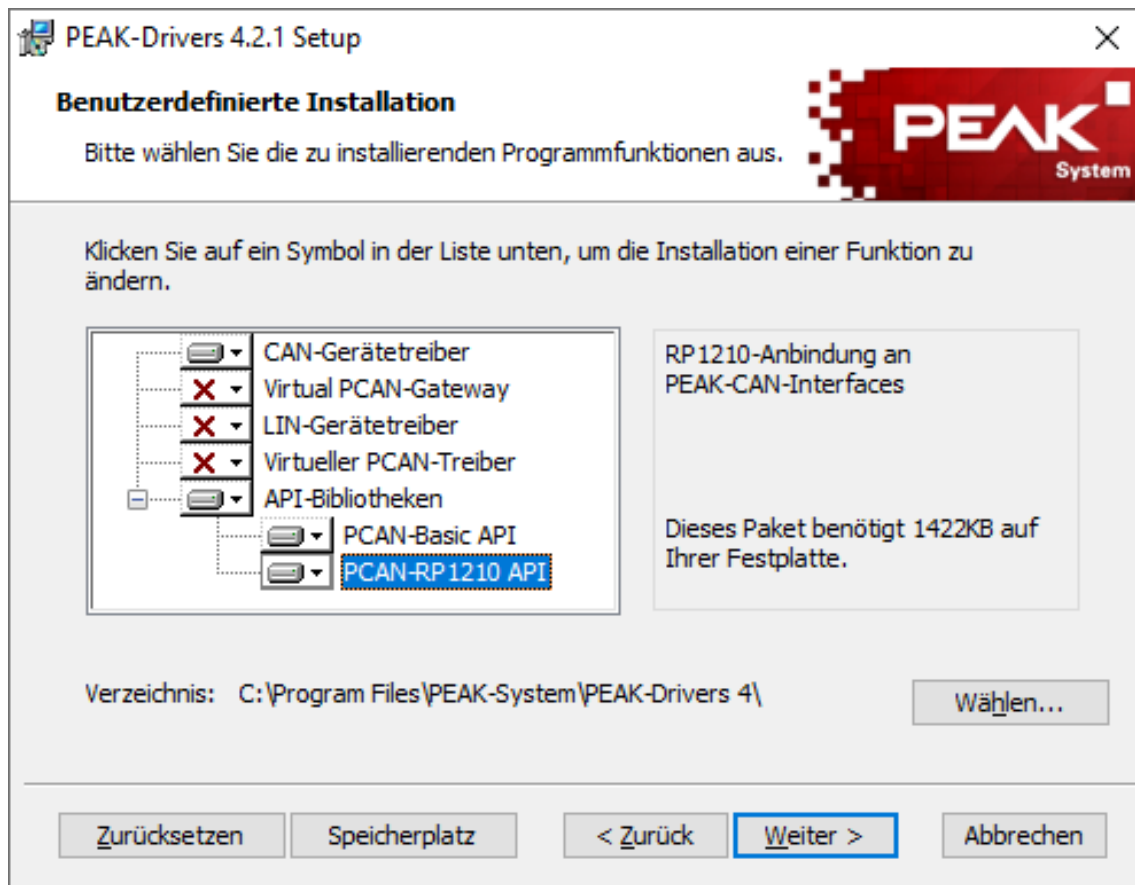
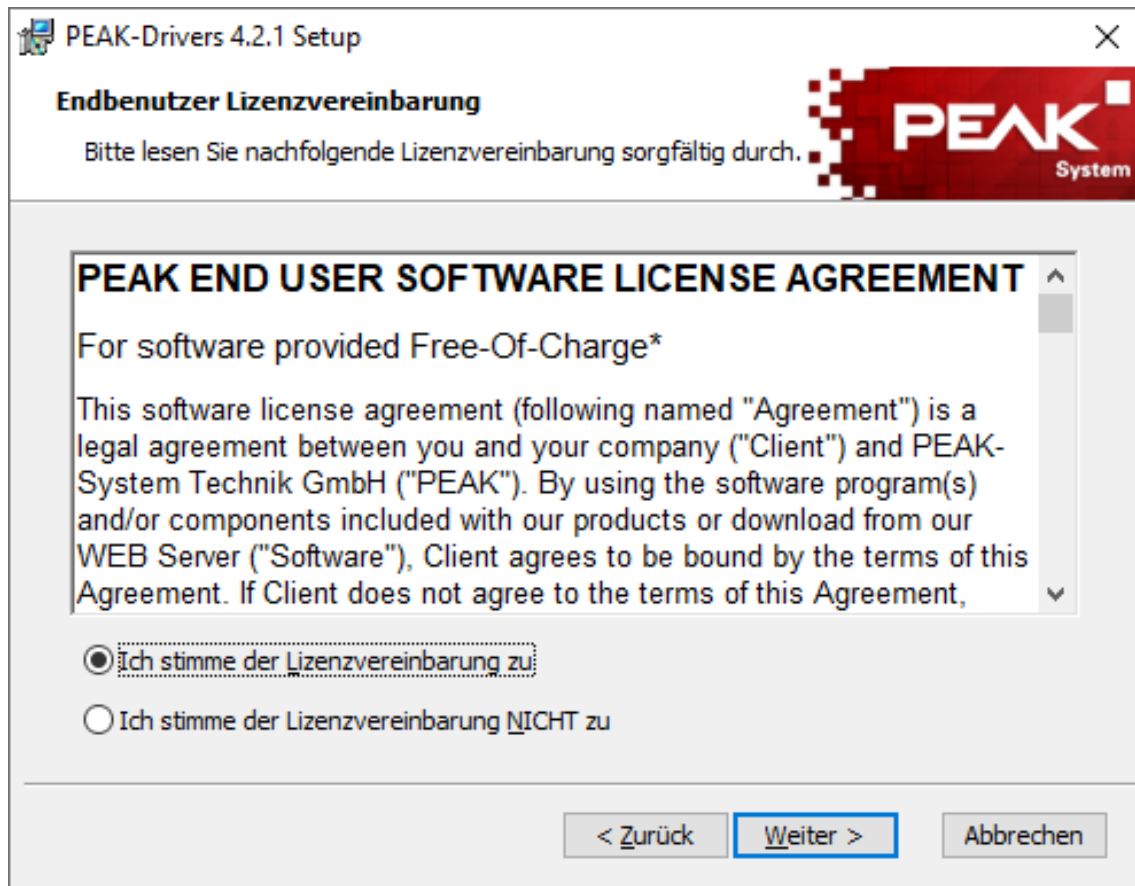
<https://agro-center.de/programmier-und-diagnosekabel-2xsub-d-9-polig-agwxxx200838.html>

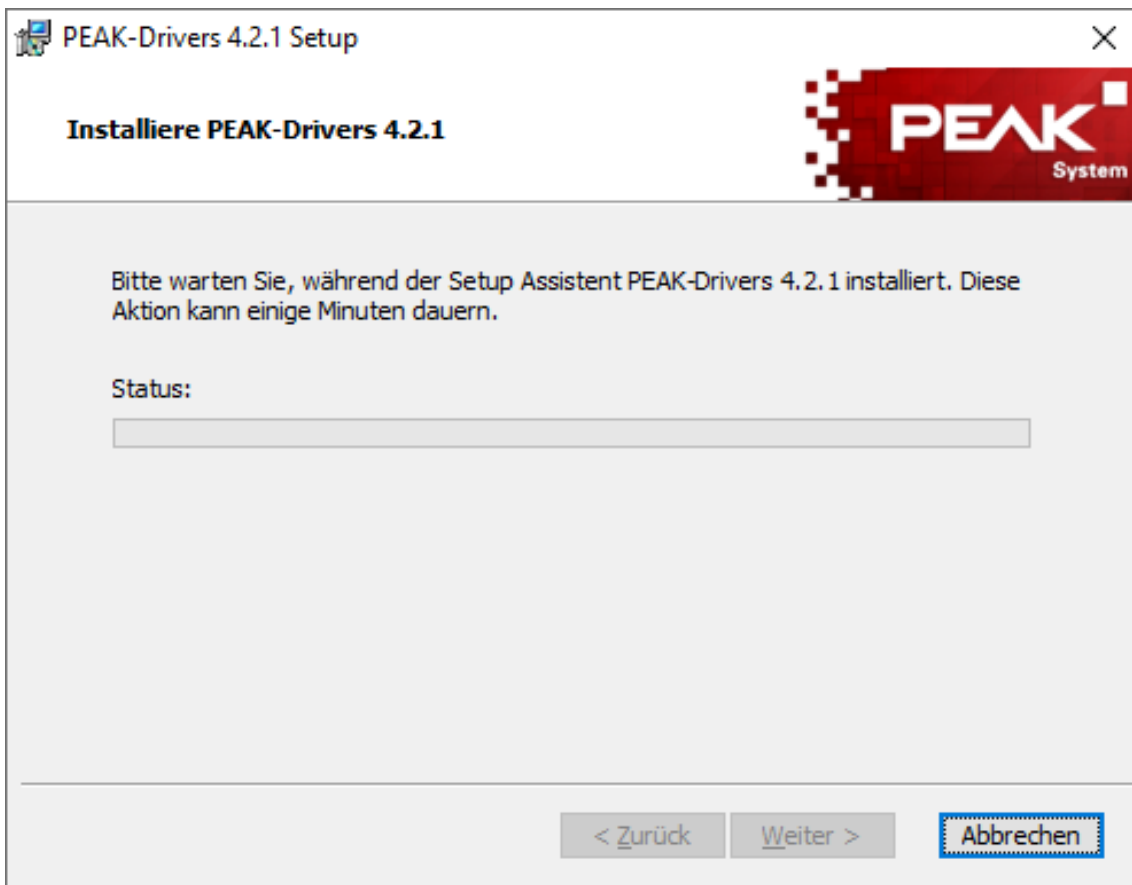


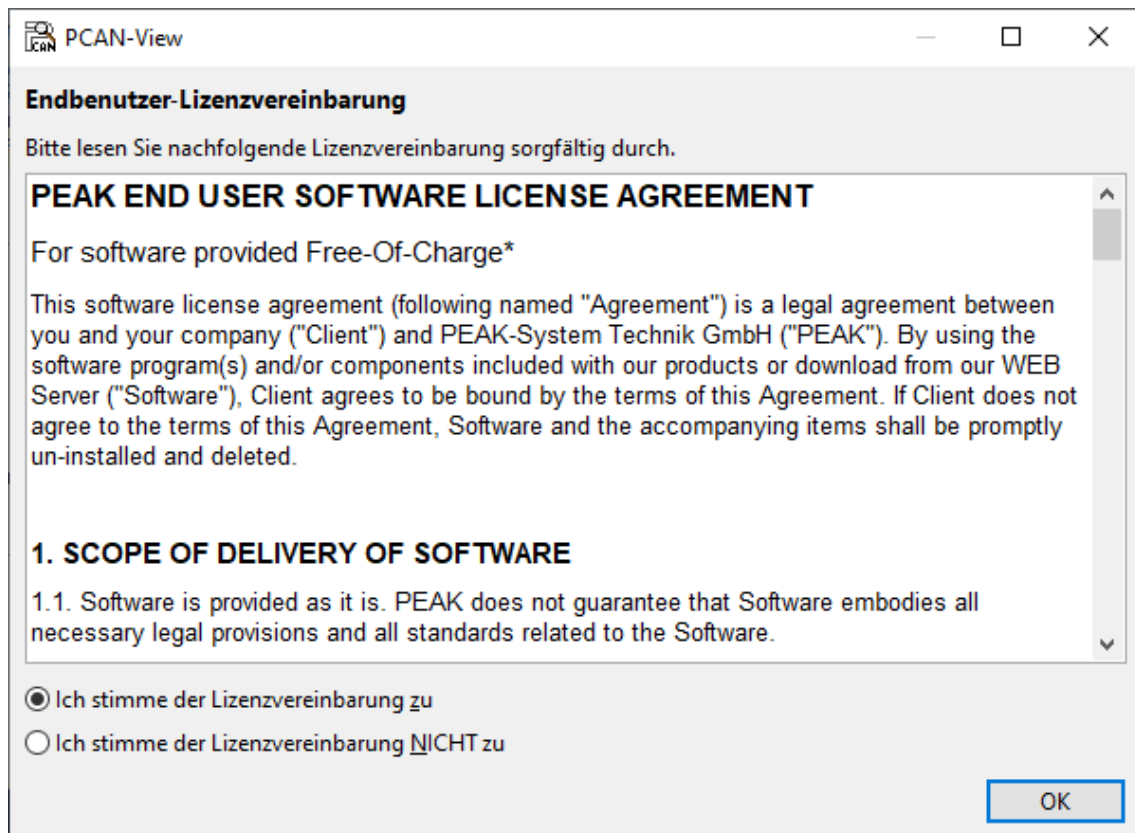
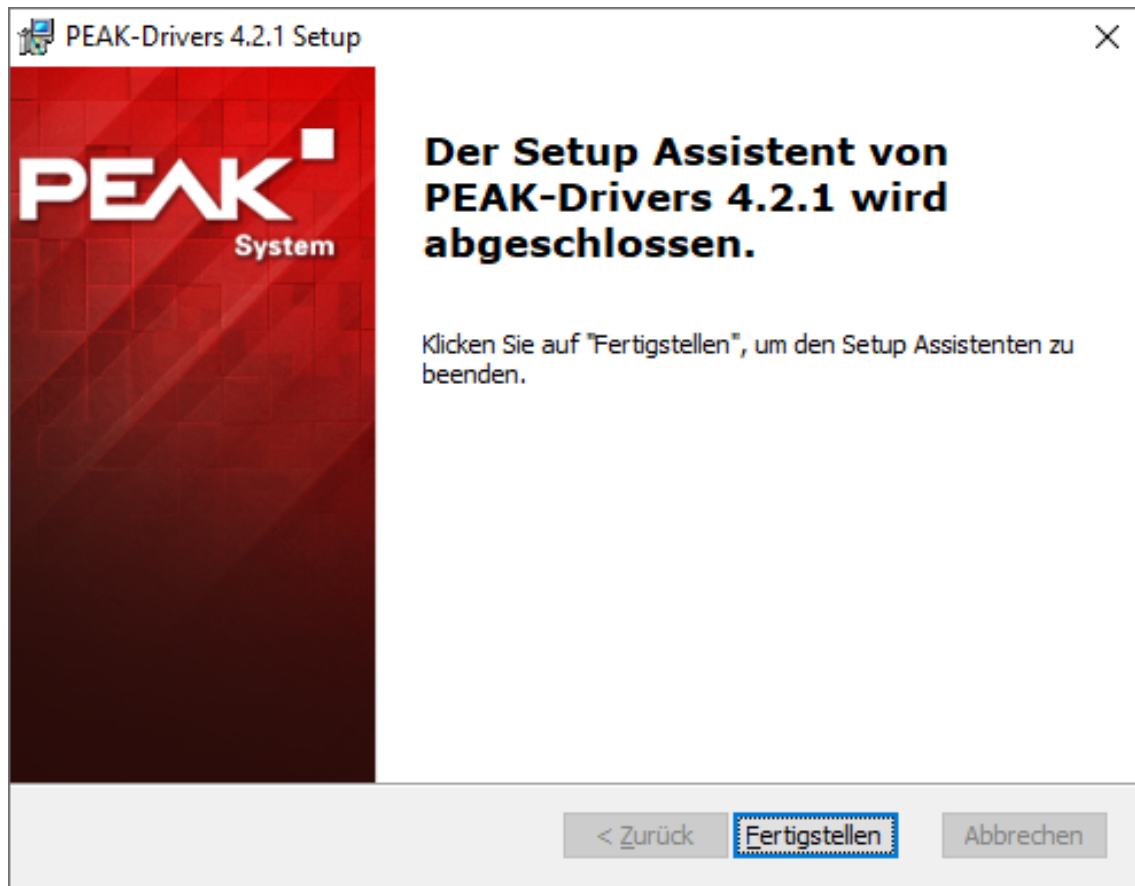
23. PEAK driver

PeakOemDrv.exe









PCAN-View

DateiCANBearbeitenSendenAnsichtTraceFensterHilfe



Senden / Empfangen

Trace

CAN-ID

<Leer>

Typ

Länge

Daten

Zykluszeit

Anzahl

Empfangen

CAN-ID

<Leer>

Typ

Länge

Daten

Zykluszeit

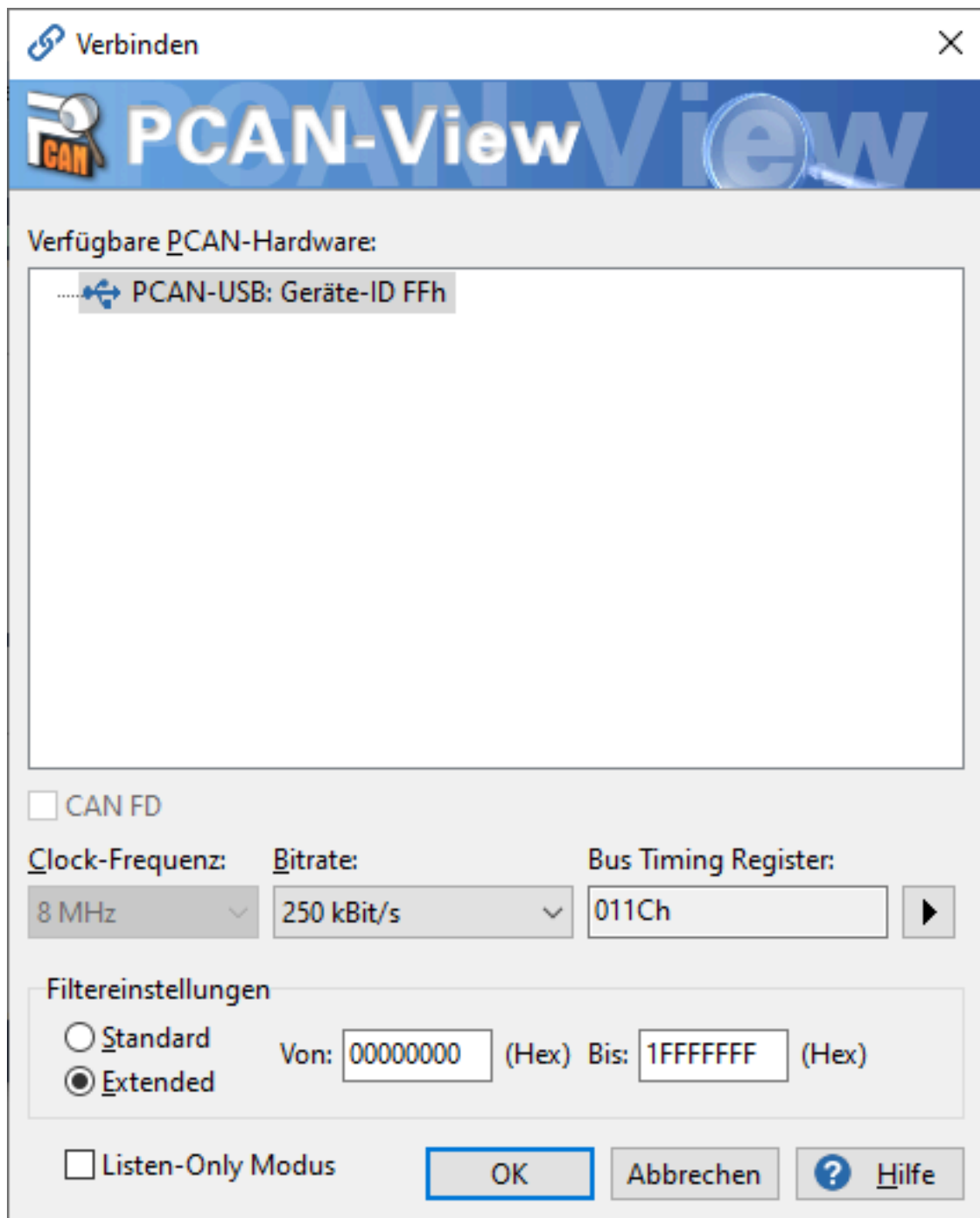
Anzahl

Trigger

Kommentar

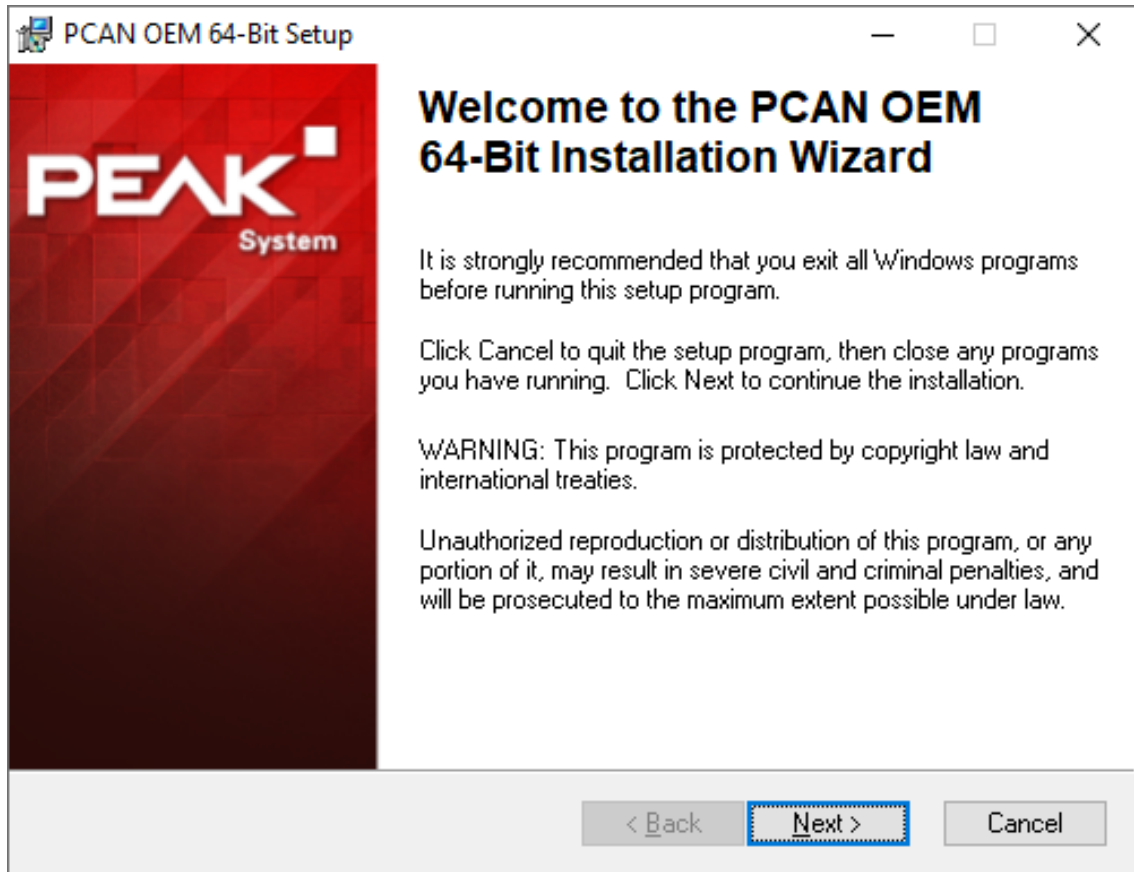
Senden

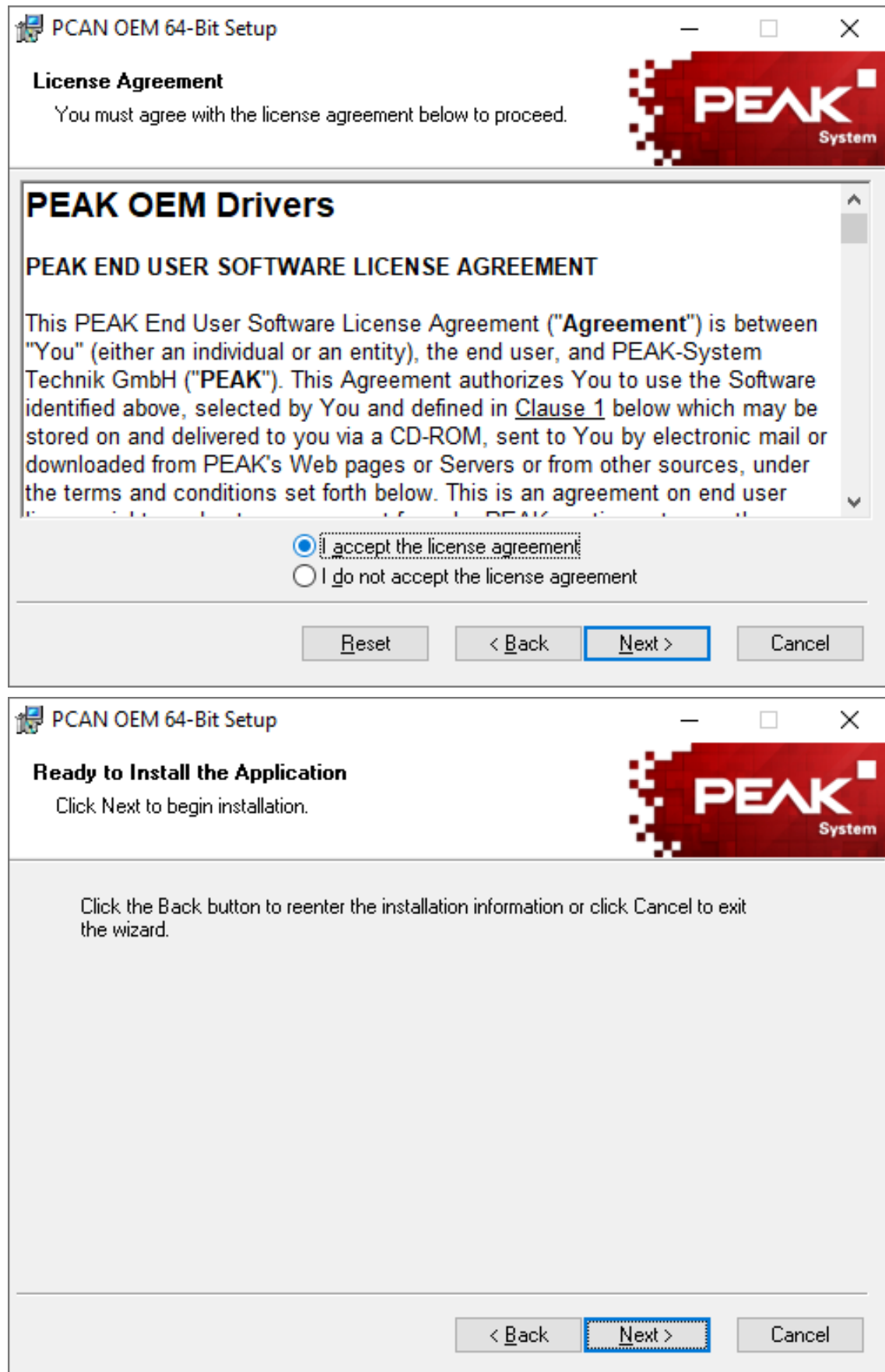
Nicht verbunden

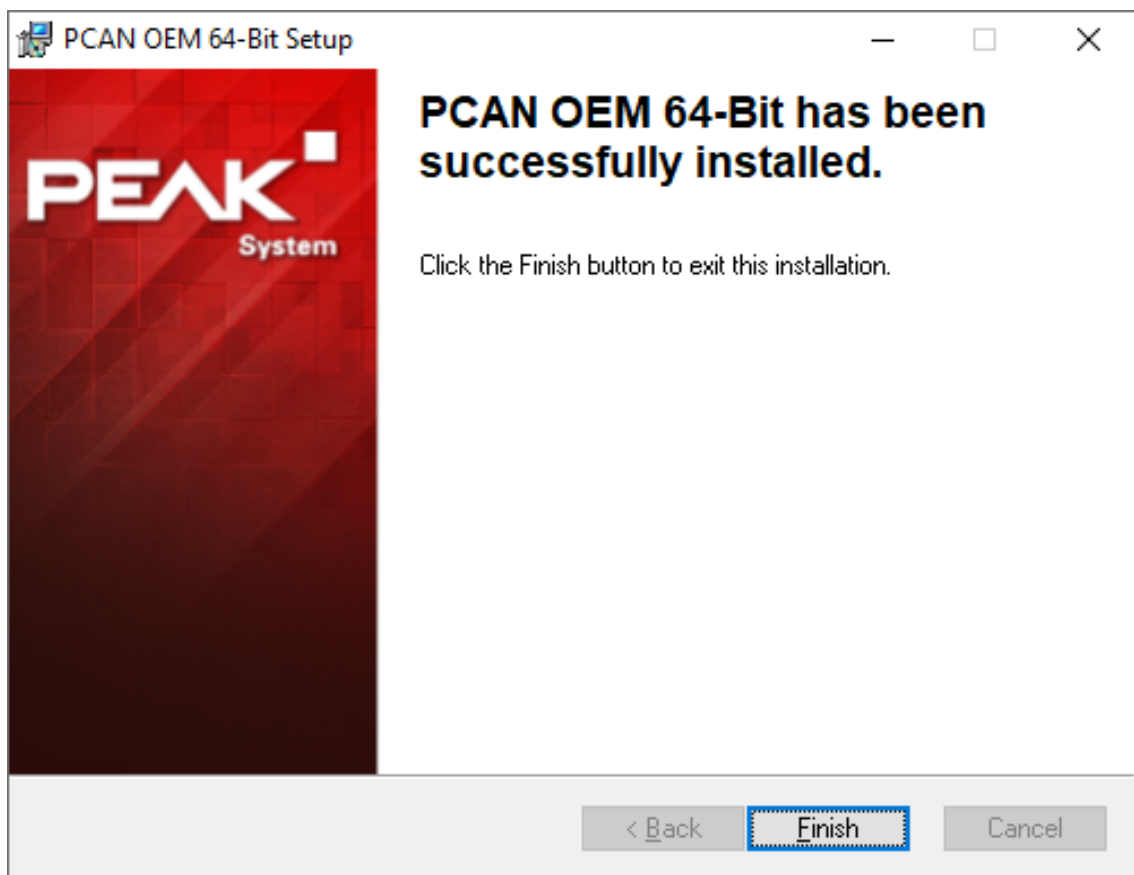
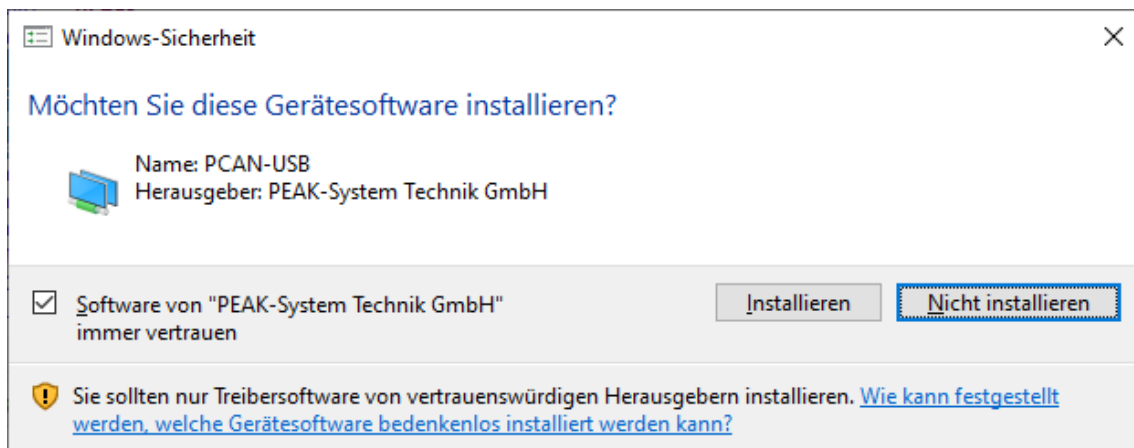


24. PEAK driver2

DLG\pconvert\progs\can\CANdriver\peak\OEM\Redistributable PcanOemSetup.exe







25. PEAK

26. Pconvert Teaching Materials

The following materials are of interest: Path: M:\Agricultural Machinery Mechanics\Teaching\SL\DLG\pconvert\ppt

- ISOBUS_DLG_D01.ppt / ISOBUS_DLG_D01.pdf /
- ISOBUS in the DLG Test Experiences and State of Development

One of the few GERMAN publications on the topic of ISOBUS.

- ainfo01.pdf and others (02, 03...)
- Extremely simple description of ISOBUS, too simple for master craftsman training, but perhaps @Josef Heller <mailto:josef.heller@ms-muc.de> for vocational school?
- Including pinout diagrams

M:\Agricultural Machinery Mechanics\Instruction\SL\DLG\pconvert\pconvert\appl\xml\pict_HwTest

Various wiring diagrams for common ISOBUS tests can be found here.

M:\Agricultural Machinery Mechanics\Instruction\SL\DLG\pconvert\xml\pict_CERT

Numerous machine photos can be found here.

Numerous machine photos can be found here. M:\Agricultural Machinery Mechanics\Instruction\SL\DLG\pconvert\xml\pict_HLP

Various photos of test setups, etc.

M:\Agricultural Machinery Mechanics\Instruction\SL\DLG\pconvert\xml\pict_igs

Incredible...

Old DLG certificates... now replaced by AEF.

--

M:\Agricultural Machinery Mechanics\Instruction\SL\DLG\pconvert\progs\database\norm\pdf

ISOBUS standards. Quite up-to-date!

M:\Agricultural Machinery Mechanics\Instruction\SL\DLG\pconvert\progs\database\norm\bild\VT

This contains, for example, an overview of the VT colors: Maske01.pdf

27. UT-VT-AUX

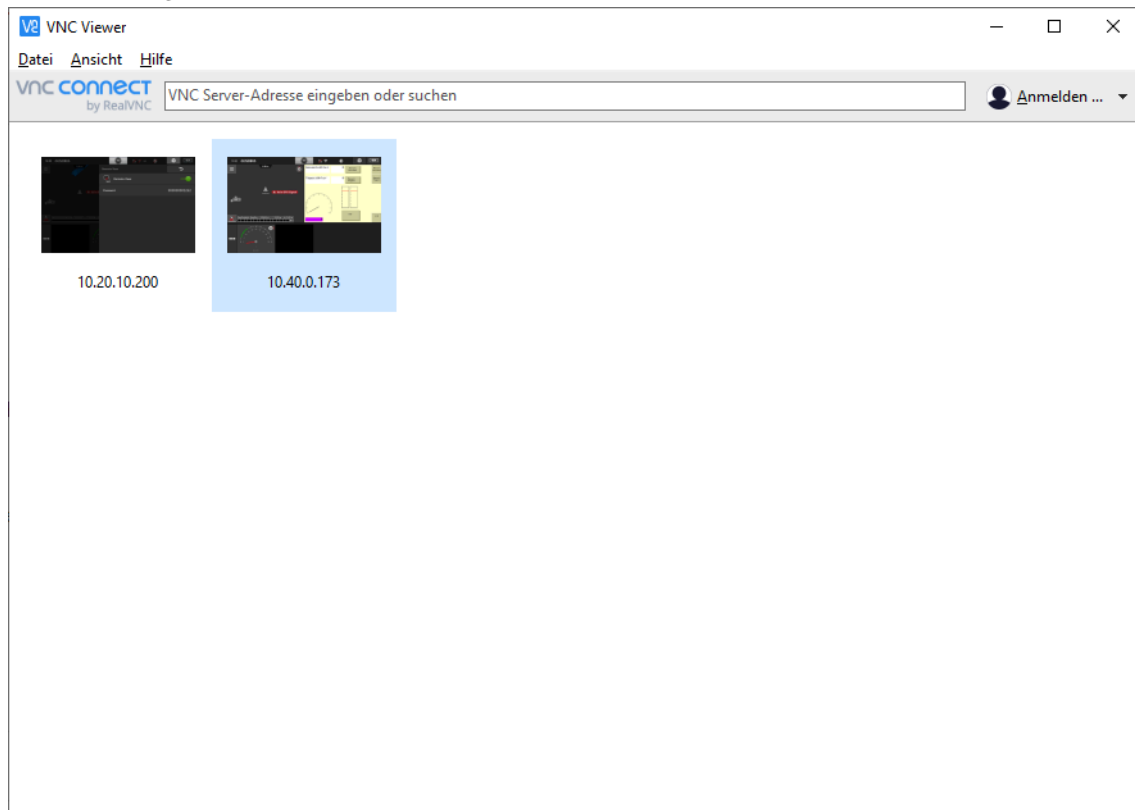
ISO 11783-6	AEF	AUX
VT 1		
VT 2	UT 1	AUX-O
VT 3	UT 2	AUX-N
VT 4		
VT 5		
VT 6		

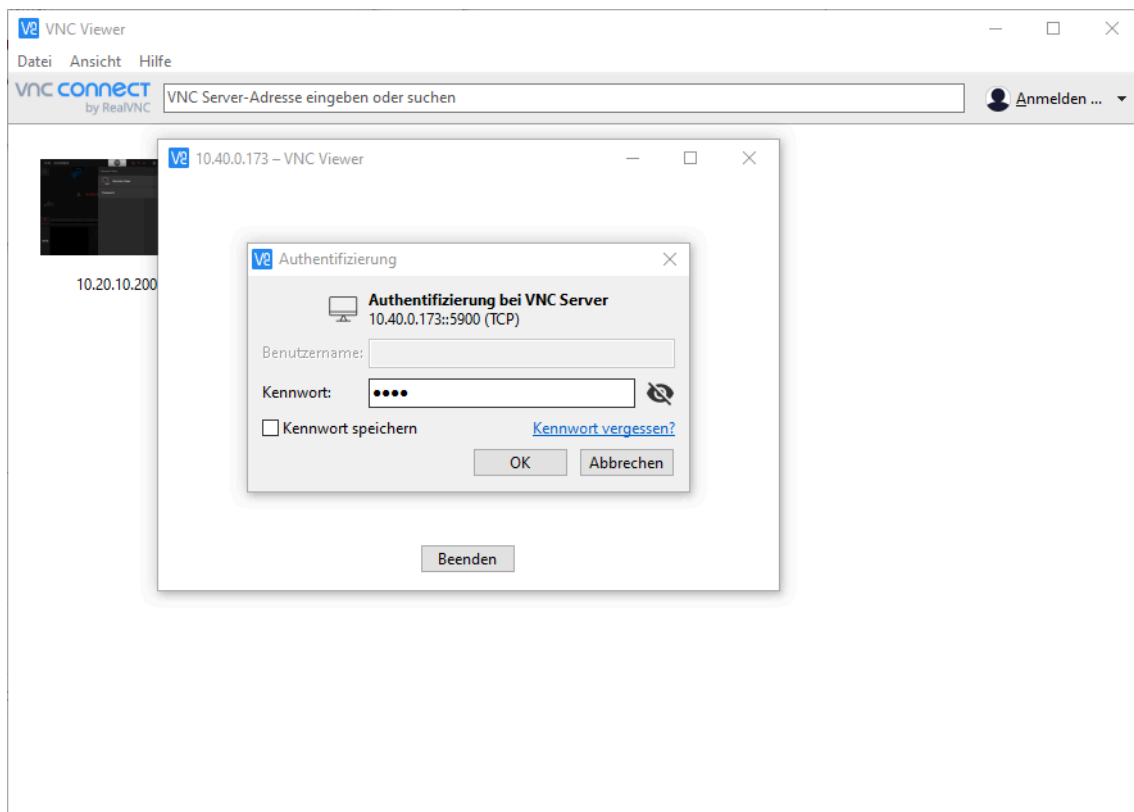
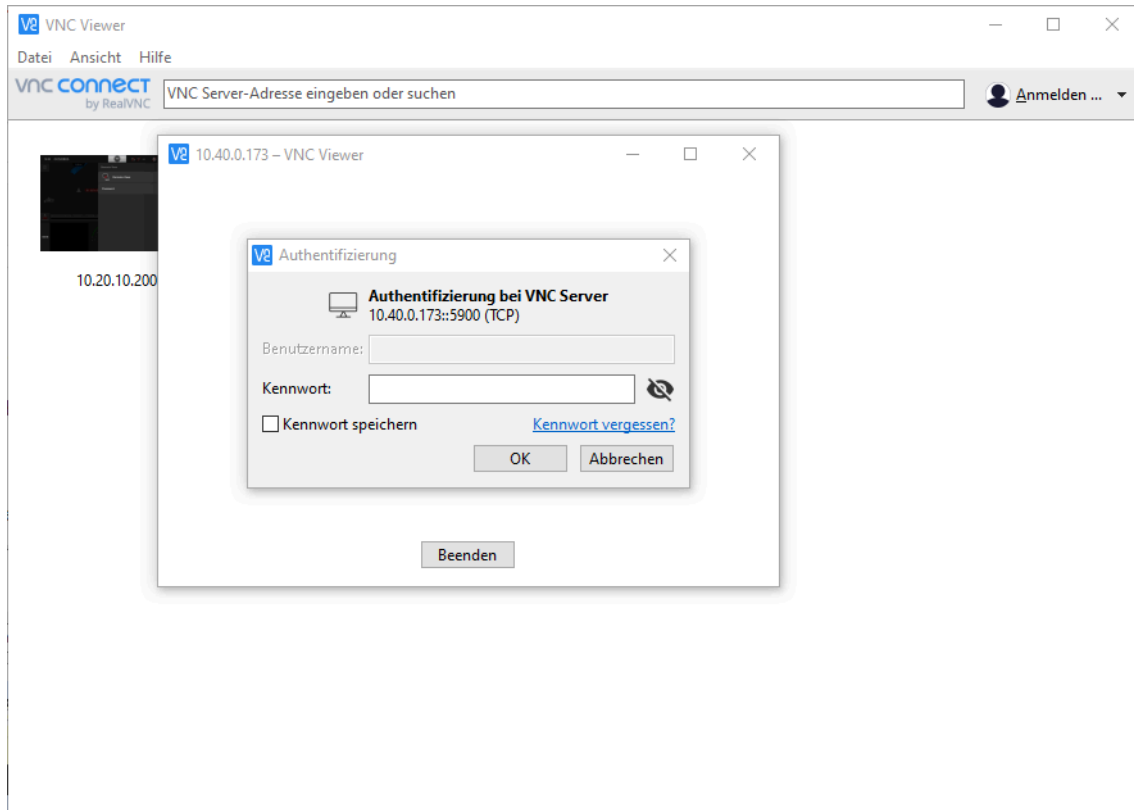
28. VNC Mirroring

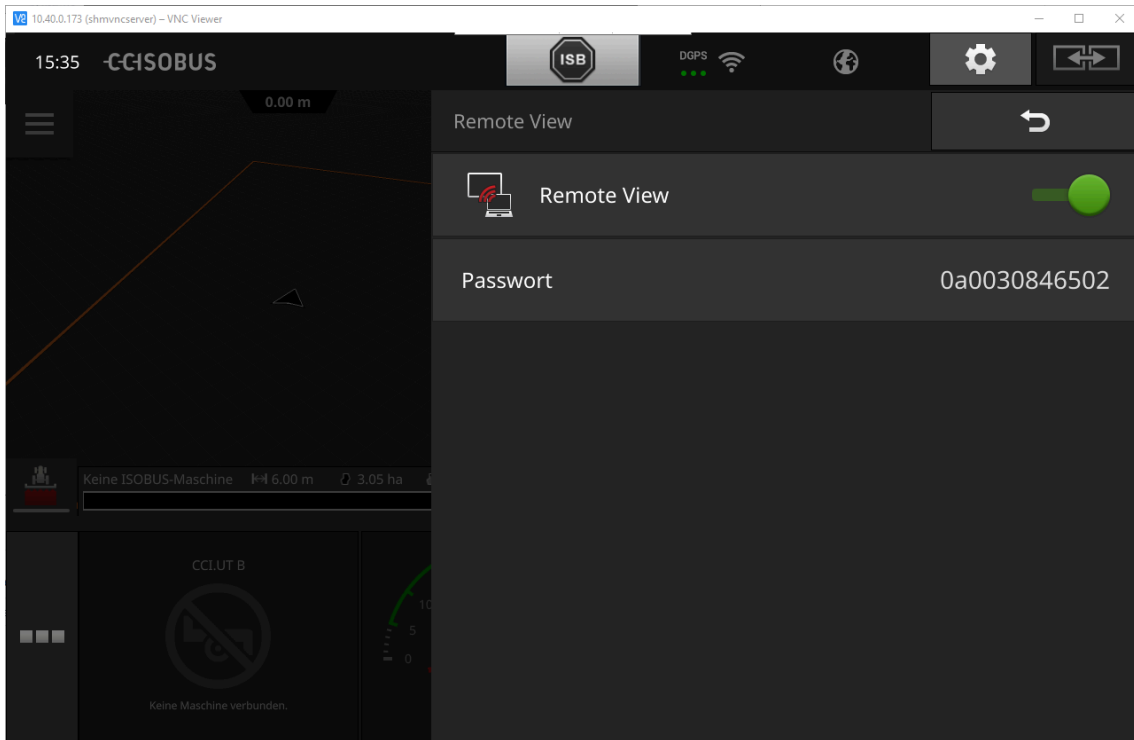
<https://www.realvnc.com/de/connect/download/viewer/windows/>

VNC-Viewer-6.20.529-Win-

dows-64bit.exe Start. Remote View must be enabled. Enter the IP address of the display, or select it by double-clicking:







29. This is what the curriculum says: Technical focus areas (Framework Curriculum 2025)

 **Source & Legal Basis:** **Source:** *Framework Curriculum for Preparation for the Master Craftsman Examination in Agricultural and Construction Machinery Mechatronics* **Publisher:** German Association of Agricultural and Construction Machinery Technicians V., Alfredstraße 102, 45131 Essen (Status: February 25, 2025) **Regulation:** *Master Craftsman Examination Regulation (LandBauMechMstrV)* of September 9, 2024 (Federal Law Gazette 2024 I No. 277, effective August 1, 2025)

Legal Basis: Master Craftsman Examination Regulation in the Agricultural and Construction Machinery Mechatronics Trade (LandBauMechMstrV of September 9, 2024, Federal Law Gazette 2024 I No. 277, effective August 1, 2025).

29.1 Overview of Technical Requirements

The revised 2025 curriculum requires prospective master craftsmen and women to possess comprehensive skills in the diagnosis, repair, system integration, and maintenance of complex agricultural and construction machinery.

In addition to networked electronics and software (ISOBUS/CAN bus), the training covers the following **core technical areas**:

29.2 Technical Areas & Content Pages

29.2.1 1. Hydraulics & Electrohydraulics

- **Curriculum Reference:** Part I LE 2.4 | Part II LE 1.1 & LE 1.3
- **Focus Areas:** Constant and variable displacement pumps, load sensing (LS), proportional valve technology, PWM control, pressure and flow sensors, ISO 1219 circuit diagrams, bio-hydraulic oils.

29.2.2 2. Pneumatics & Compressed Air Brake Systems

- **Curriculum Reference:** Part I LE 2.4 | Part II LE 1.1
- **Focus Areas:** Compressed air generation and treatment, single- and dual-line trailer brake systems, automatic load-dependent brake force control (ALB), ABS/EBS systems for agricultural and construction machinery.

29.2.3 3. Internal Combustion Engines & Exhaust Aftertreatment (Stage V)

- **Curriculum Reference:** Part I LE 2.3 | Part II LE 1.1 & LE 1.3
- **Focus Areas:** Common-rail injection systems, variable turbine geometry (VTG) turbochargers, Stage V emissions standard, SCR/AdBlue, DPF regeneration, EGR systems, sensors (NOx, soot, exhaust gas temperature).

29.2.4 4. High-voltage (HV) technology & e-mobility

- **Curriculum Reference:** Part I LE 2.3 | Part II LE 1.1 & LE 1.3

- **Focus Areas:** Voltage disconnection & intrinsic safety according to DGUV 209-093 / DGUV 200-005, lithium-ion battery systems & BMS, 48V electrical systems, electric motors & power electronics (inverters).

29.2.5 5. Transmission Technology, Chassis & Steering Systems

- **Curriculum Reference:** Part I LE 2.3 | Part II LE 1.1
- **Focus Areas:** Continuously Variable Transmissions (CVT/Vario), Power Shift Transmissions, Power Split, All-Wheel Drive & PTO Control, Hydro-Pneumatic Suspensions, All-Wheel Drive & Articulated Steering.

29.2.6 6. Machine Safety, Standards & Inspections (UVV/SP/CE)

- **Curriculum Reference:** Part I LE 1.3 & LE 2.5 | Part II LE 1.2 & LE 2.2
- **Focus Areas:** Accident prevention inspections according to DGUV Regulation 70/73, safety inspections (SP), emissions testing (AU), CE conformity & risk assessment (ISO 12100), EU type approval 167/2013 / StVZO.

29.3 Hour allocation of the technical modules in the framework curriculum

Module / Field of activity	Total duration	Technical focus areas
Part I – Field of activity 1: Extensions	160 teaching units	Assembly, wiring, sensor/actuator integration, hydraulic adjustment
Part I – Field of activity 2: Diagnosis & Repair	220 teaching units	Motors, high-voltage systems, hydraulics, pneumatics, chassis, bus systems
Part II – Area of Expertise 1: Customer Requirements & Technology	380 hours	Mechanical Engineering (160h), Maintenance (40h), Diagnostics (100h), Drawings (40h)

29.3.1 Relevant subpages on ms-muc-docs.de

-  Eclipse 4diac IDE & Color Reference on ms-muc-docs.de
-  The PWM Signal & Infographic on ms-muc-docs.de

29.4 Main Portal & Direct Links to the 6 Wikis

Wiki	Topic / Description	Link
Wiki 0	Master Schools Wiki General information, Curriculum 2025 & Main Wiki.	 Open
Wiki 1	C Programming in ISOBUS Fundamentals of C programming and the ISOBUS environment.	 Open
Wiki 2	ISOBUS Virtual Terminal User interfaces, ISO Designer & VT objects.	 Open
Wiki 3	ISOBUS Technology & Machine Systems Hydraulics, pneumatics, motors, high-voltage technology, gearboxes & machine safety.	 Open
Wiki 4	Visual Programming Languages Low-code development, IEC 61499 & 4diac IDE (main curriculum topic).	 Open

Wiki 4.1	4diac Library Reference Function block & adapter reference for the 4diac libraries.	 Open
Wiki 4.2	4diac Exercises: Training Solutions Exercises and sample solutions for training with 4diac.	 Open
Wiki 5	Electronic Tools & Measuring Instruments Handbook for crimping technology, soldering stations, oscilloscopes & microscopes.	 Open

29.4.1 PDF Downloads for All Wikis

Wiki	PDF (DE)	PDF (EN)
Wiki 0 – Main Wiki	 DE	 EN
Wiki 1 – C Programming in ISOBUS	 DE	 EN
Wiki 2 – ISOBUS Virtual Terminal	 DE	 EN
Wiki 3 – ISOBUS Technology & Machine Systems	 DE	 EN
Wiki 4 – Visual Programming Languages	 DE	 EN
Wiki 4.1 – 4diac Library Reference	 DE	 EN
Wiki 4.2 – 4diac Exercises	 DE	 EN
Wiki 5 – Electronic Tools	 DE	 EN

 **Central Portal of the Munich Master Schools:** Visit the main platform: www.ms-muc-docs.de |  [Interactive Curriculum Framework 2025](#) |  [Wiki Overview](#) |  [PDF Downloads](#)

]

30. nx_farm_display

Unfortunately, nx9 is no longer available!! <https://www.reuters.com/markets/deals/cnh-industrial-buys-software-house-nx9-bolster-agriculture-business-2021-12-02/>

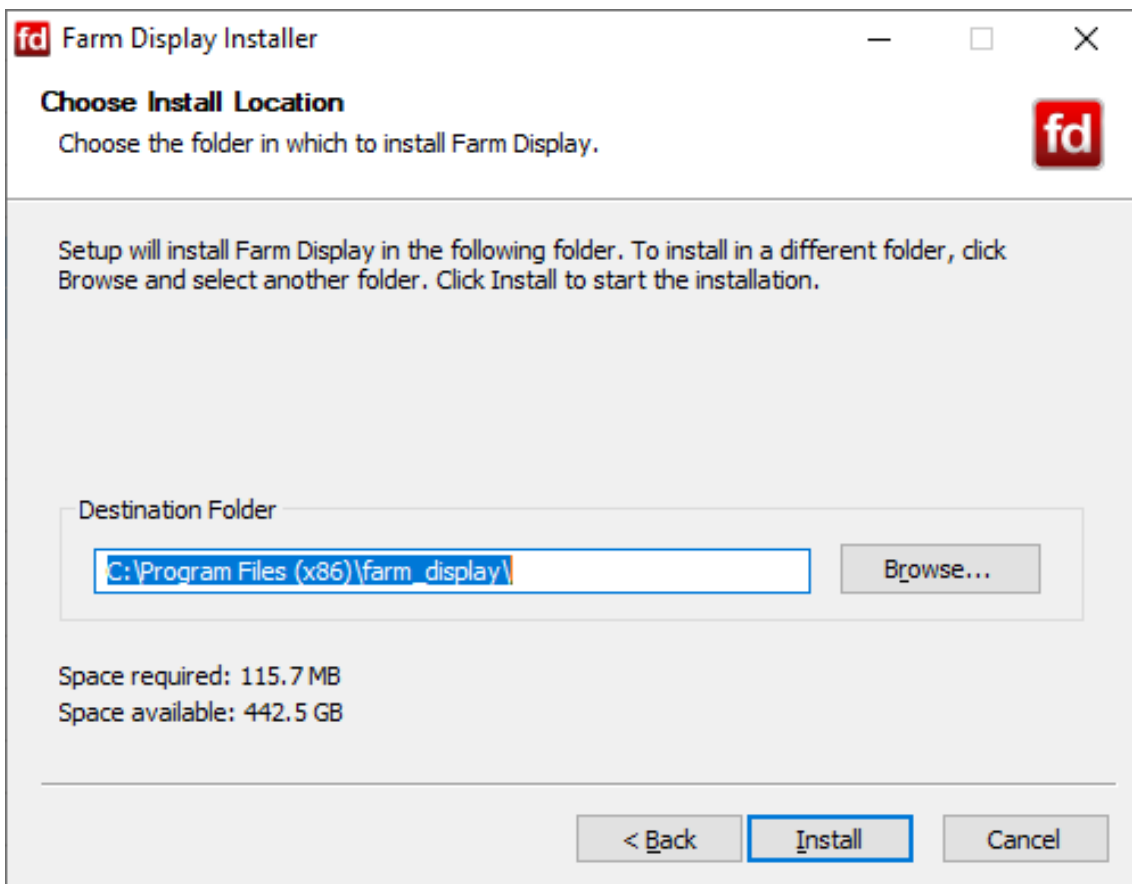
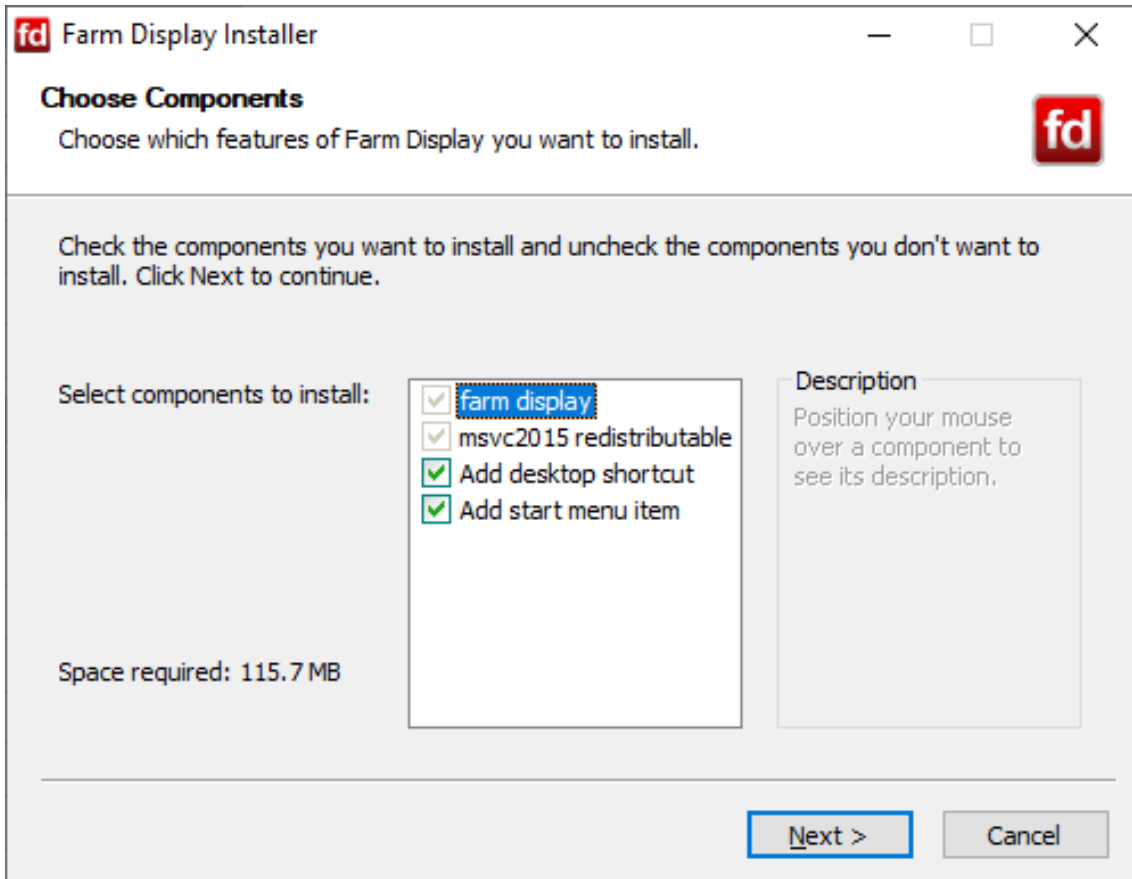
Der Computer wurde durch Windows geschützt

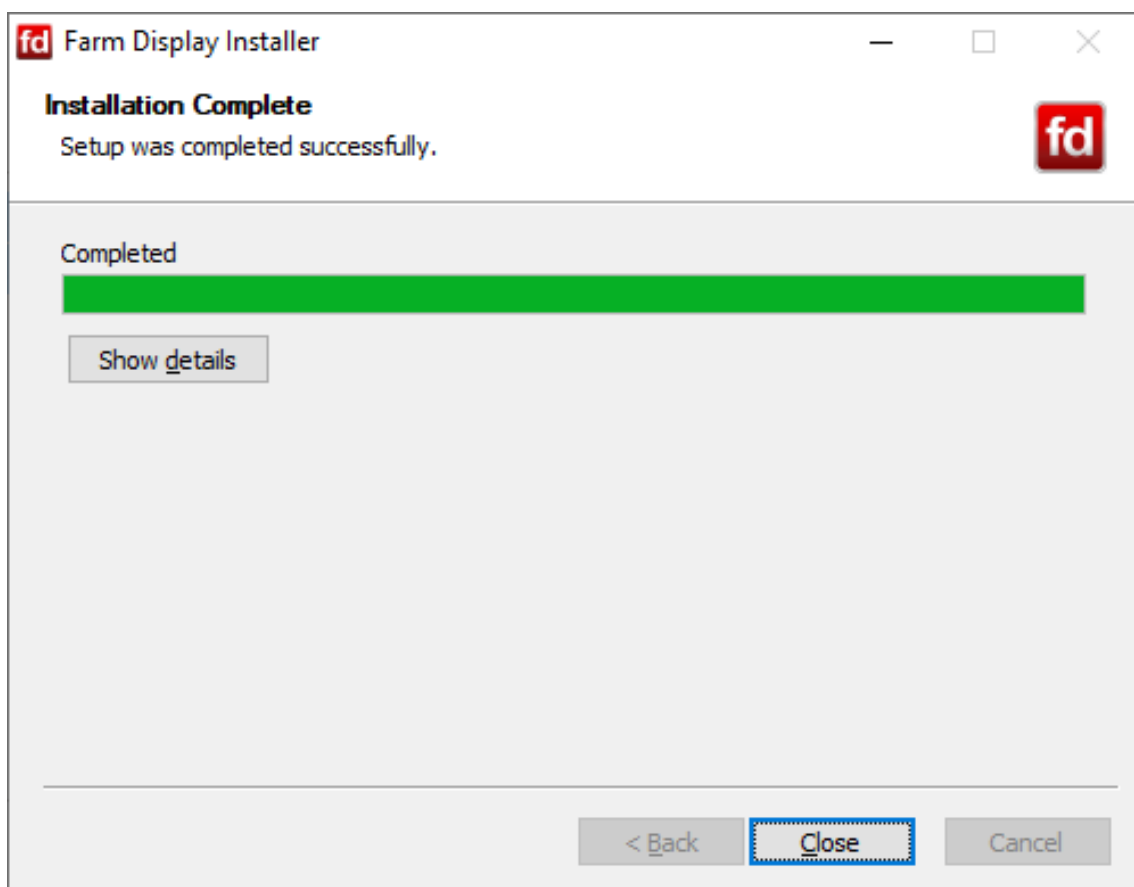
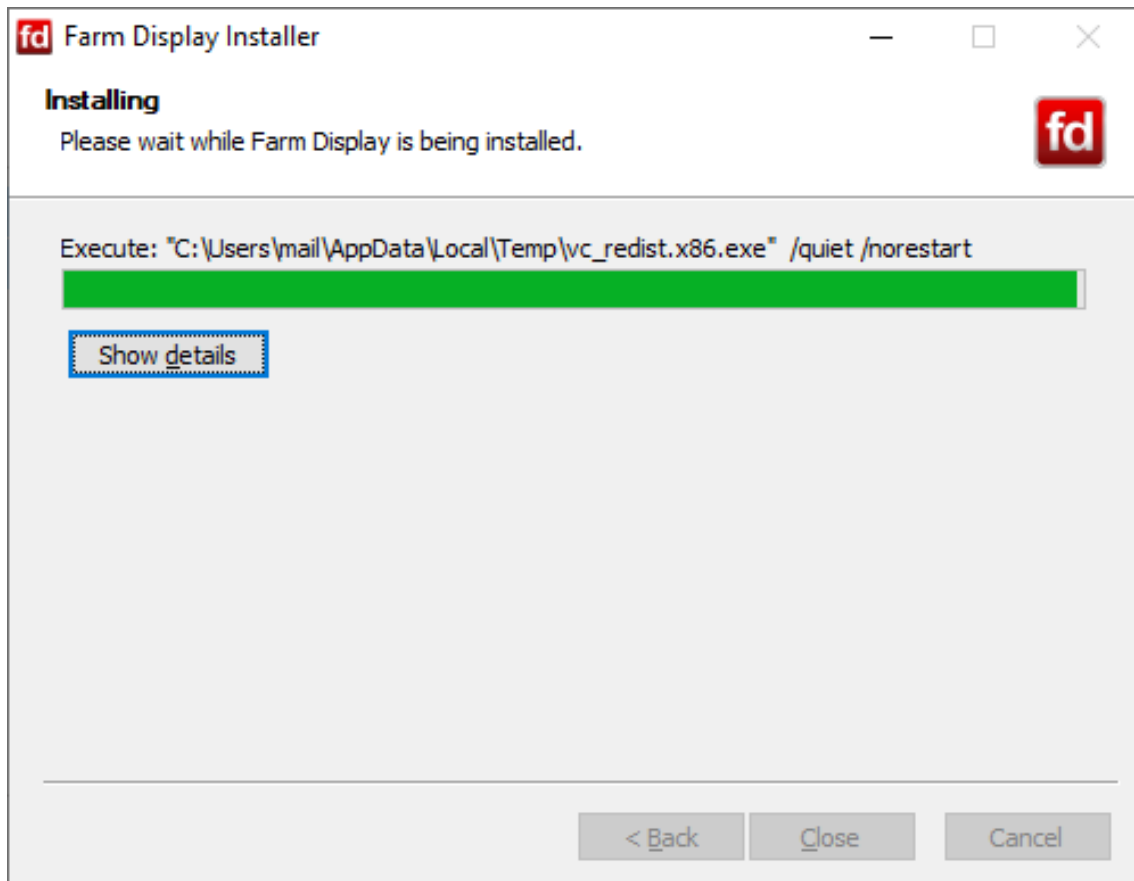
Von Microsoft Defender SmartScreen wurde der Start einer unbekannten App verhindert. Die Ausführung dieser App stellt u. U. ein Risiko für den PC dar.

[Weitere Informationen](#)

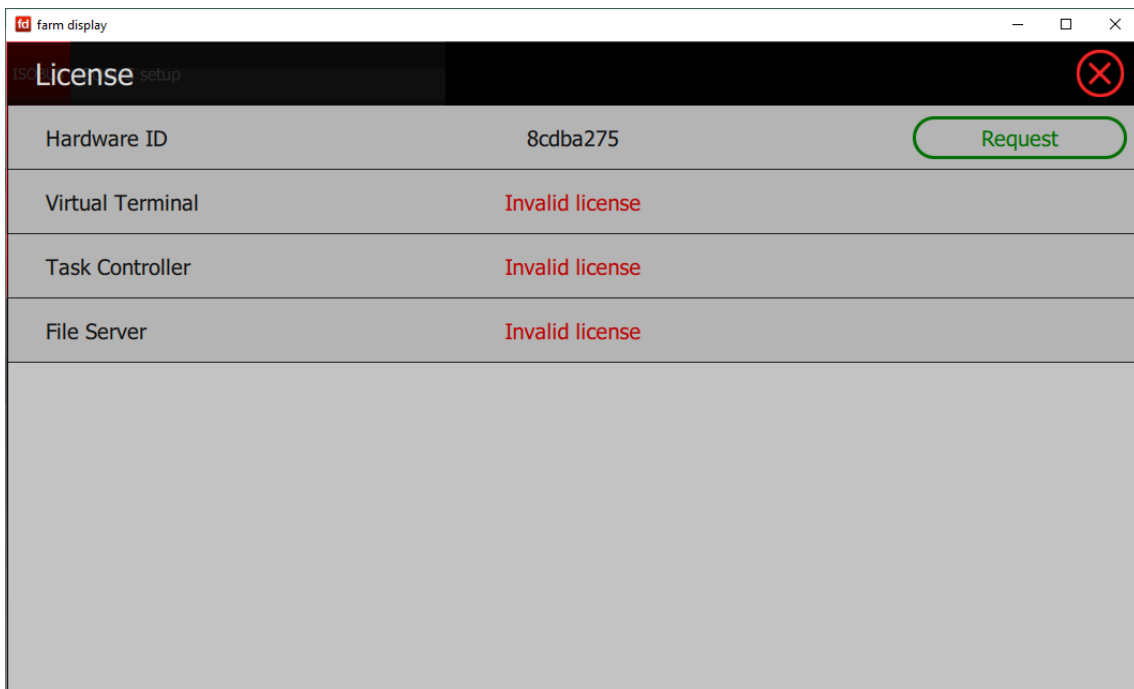
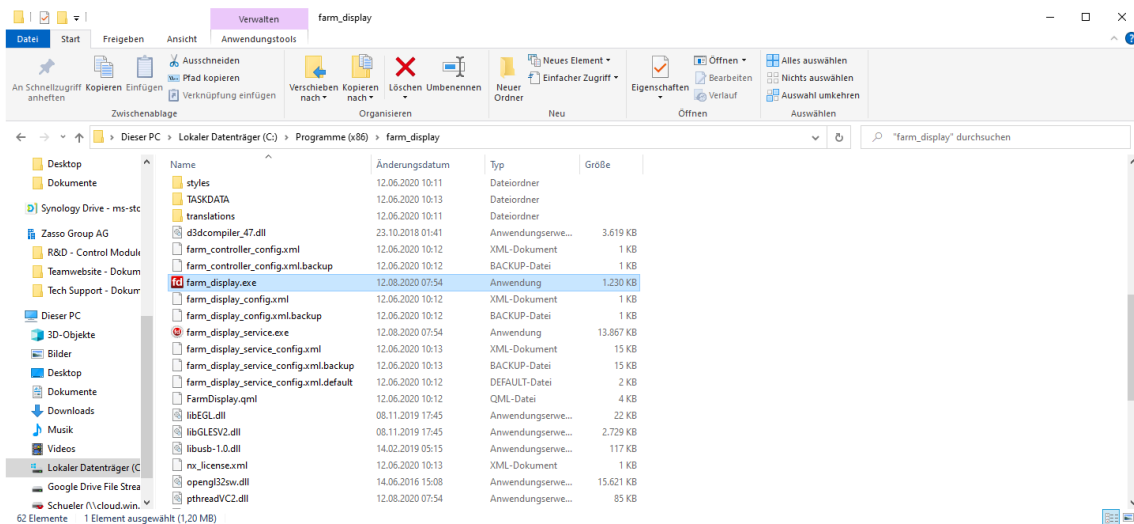
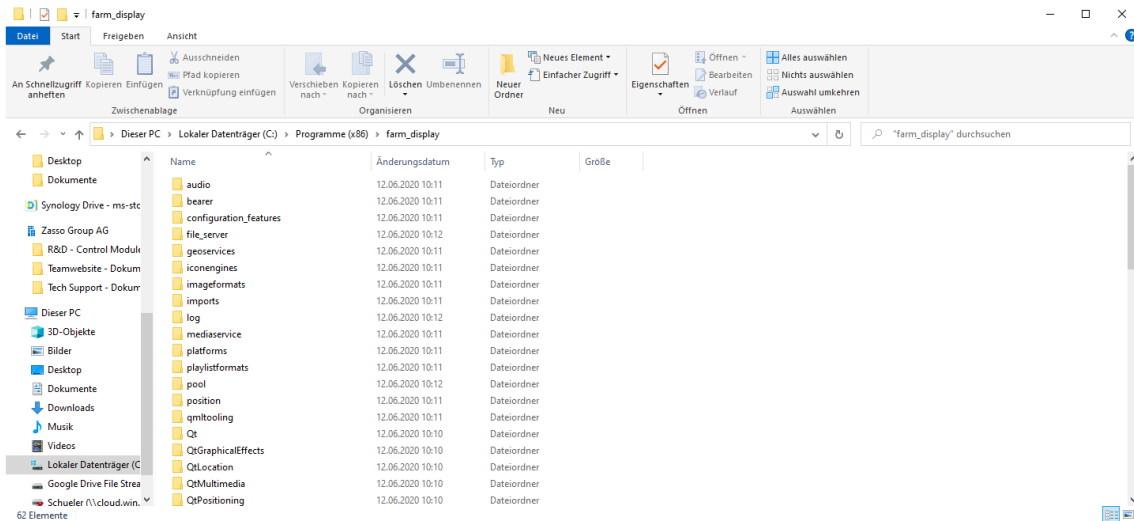
Nicht ausführen

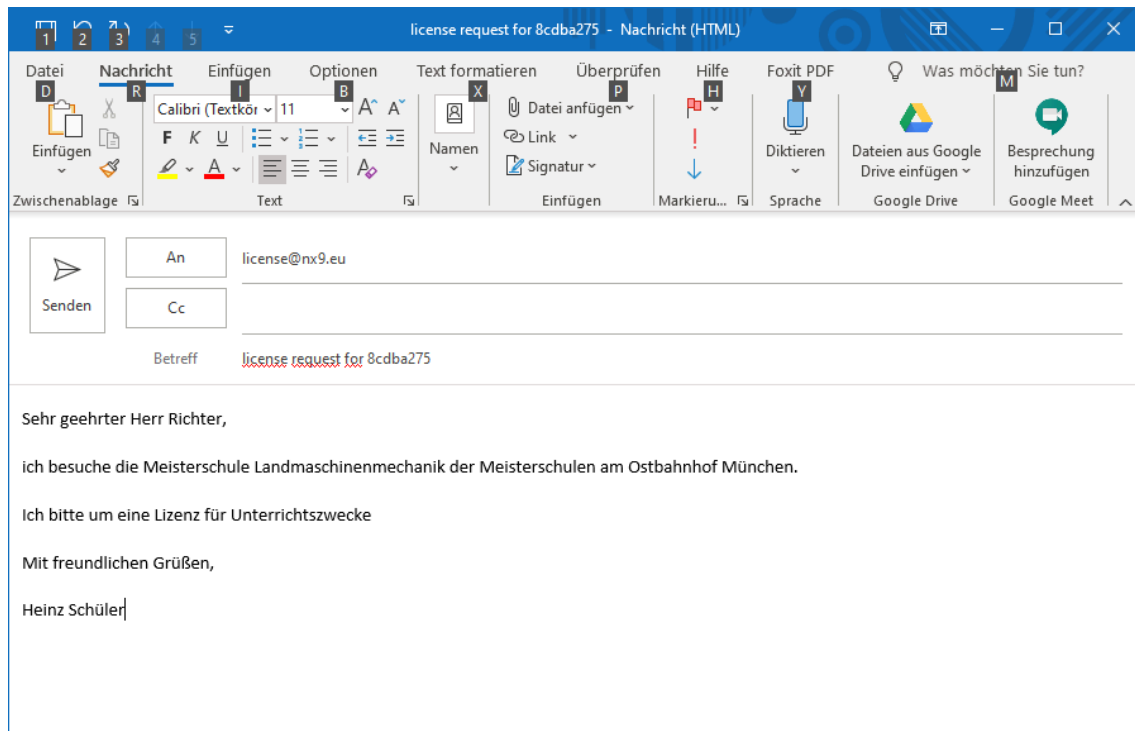






C:\Program Files (x86)\farm_display





31. pconvert

Located here: M:\Agricultural Machinery Mechanics\Instruction\SL\DLG\pconvert It is started with pconvert.exe Due to the slow Wi-Fi connection, it is advisable to copy it to your own PC beforehand. Here are two more points:

Licensing:

We received the following information from the DLG (www.DLG.org) DLG TestService GmbH, (https://de.wikipedia.org/wiki/Deutsche_Landwirtschafts-Gesellschaft)

As discussed by phone, the buyer is additionally authorized to copy the software for teaching purposes at the master craftsman school. The software may only be used at the master craftsman school and not for commercial purposes.

I would like to point out that this software is not technically protected (license key, dongle). YOU are therefore responsible for NOT making any copies of the software for commercial purposes. If you wish to use the software commercially, you must purchase a license from the DLG for €1995.

If you practice with the software at home after the lesson next week or in preparation, I consider that part of the learning process.

If a customer comes to you and you repair their machine with it, and you issue an invoice, that's clearly commercial.

So,

I'll describe this using the PEAK USB adapter, <https://www.peak-system.com/PCAN-USB.199.0.html>.

Other adapters are also supported:

See the list at the very end of this email.

First, we need the basic PEAK driver:

Download the device driver setup for Windows from the website mentioned above.

In the options, select at least PCAN Basic and Device Driver.

Now you should check if the PEAK is working using PCAN-View.

Other adapters are also supported:

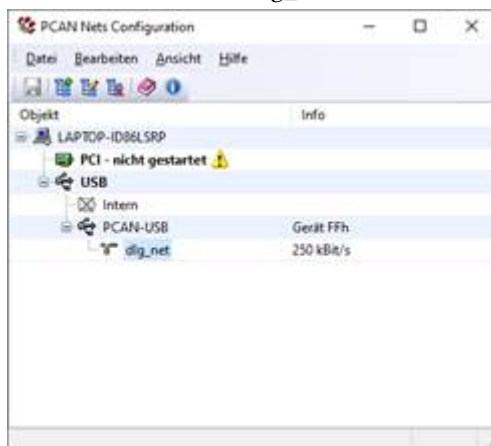
See the list at the very end of this email. Now, install the extended driver (Pconvert works without it, but the extended driver is better if you plan to use PCAN-View or Busmaster with Pconvert later).

M:\Landmaschinenmechanik\Unterricht\SL_**\DLG\pconvert\progs\can\CANdriver\peak\OEM\Redis-tributable

Then create a network in NetCFG32:

M:\Landmaschinenmechanik\Unterricht\SL_**\DLG\pconvert\progs\can\CANdriver\peak

Name this network dlg_net

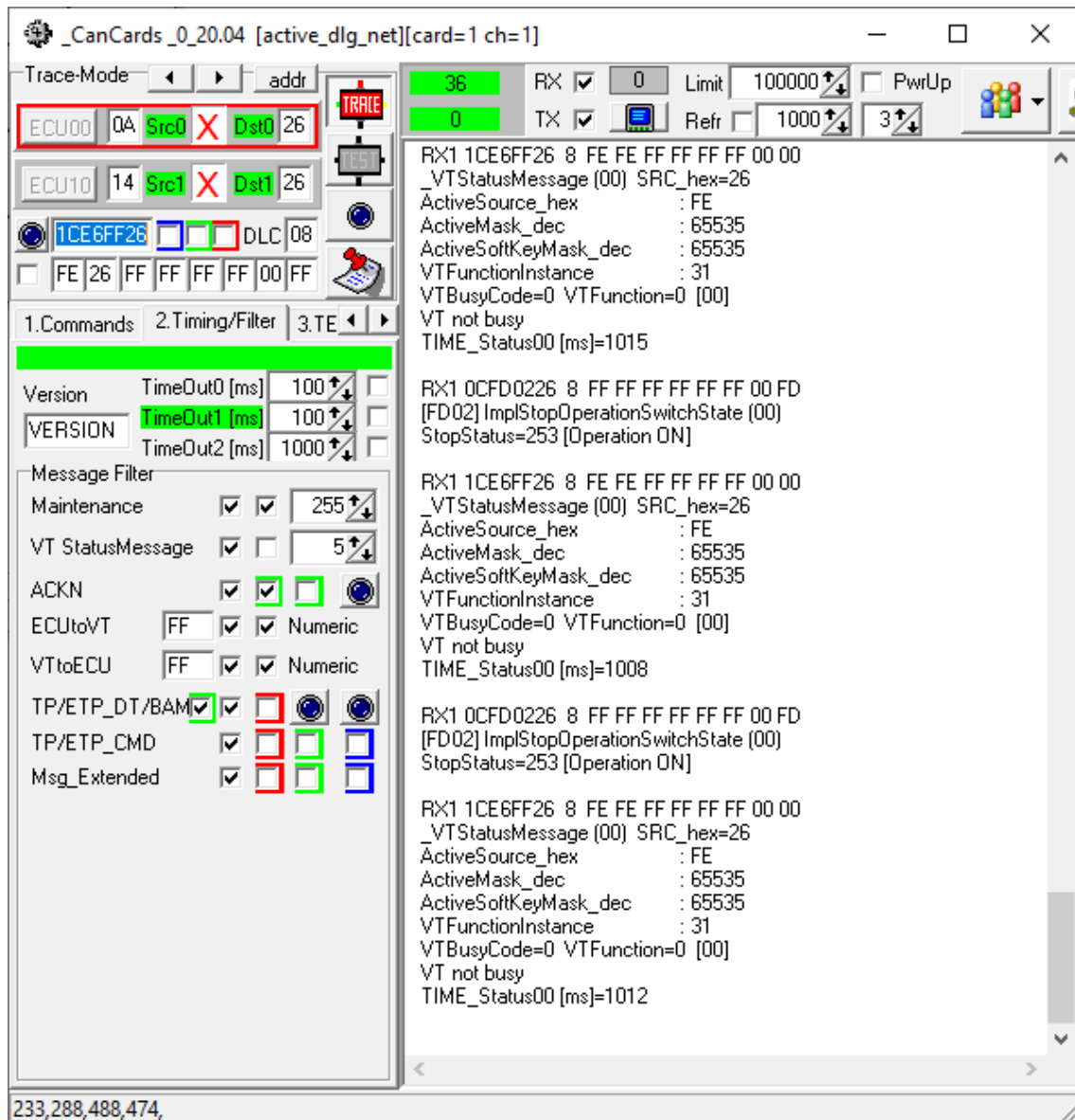


Now start pconvert:

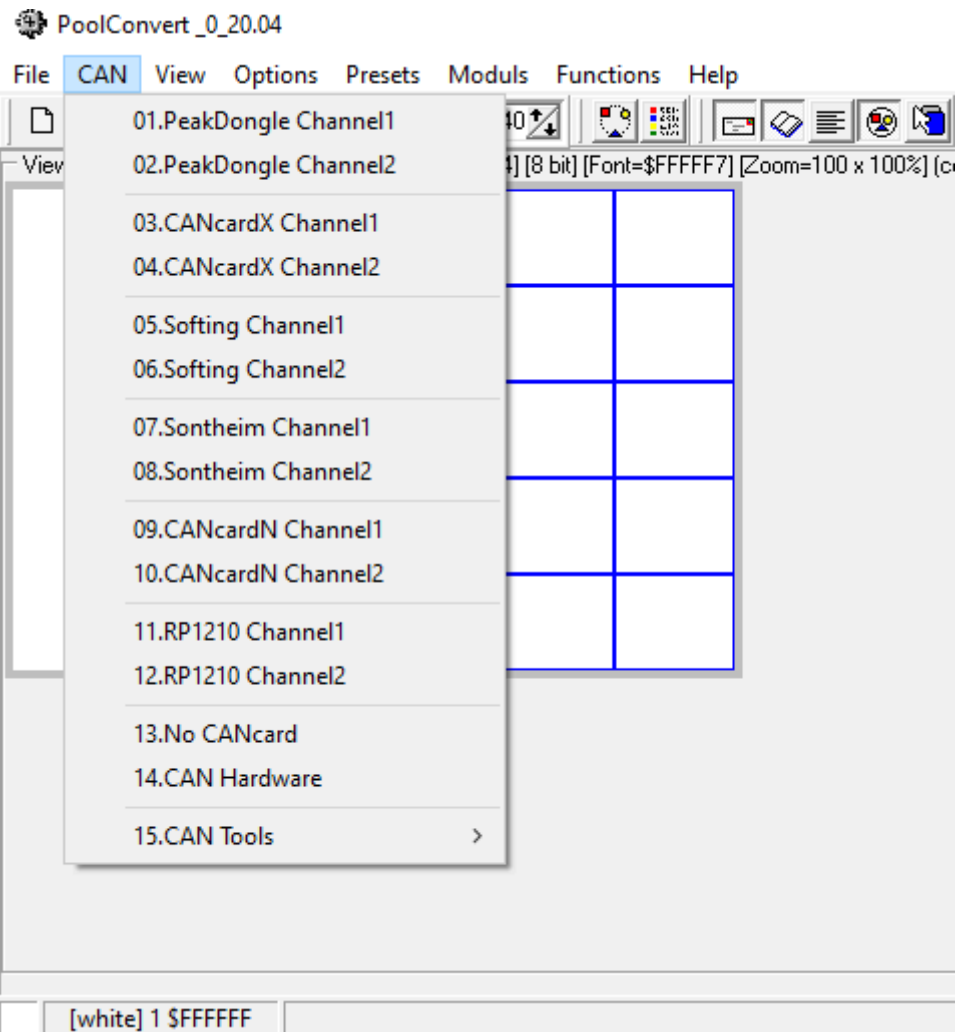
M:\Landmaschinenmechanik\Unterricht\SL_**\DLG\pconvert Run pconvert.exe

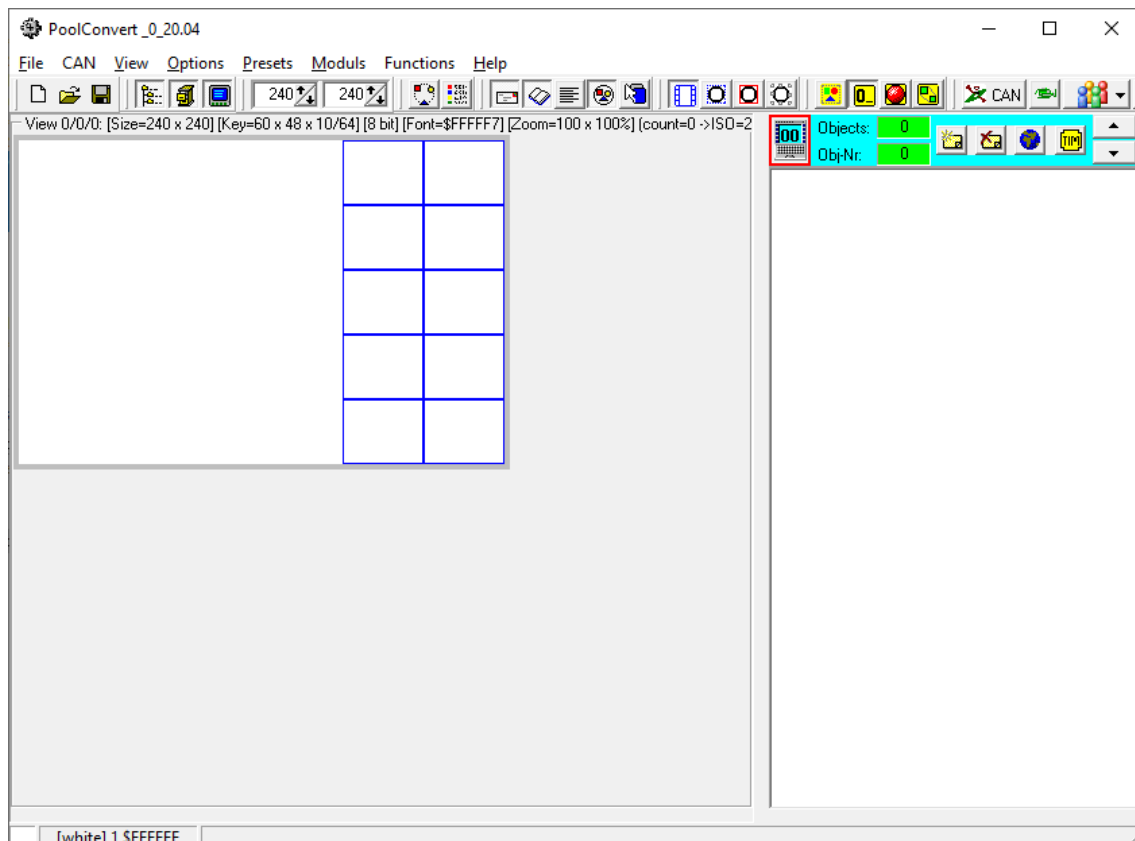
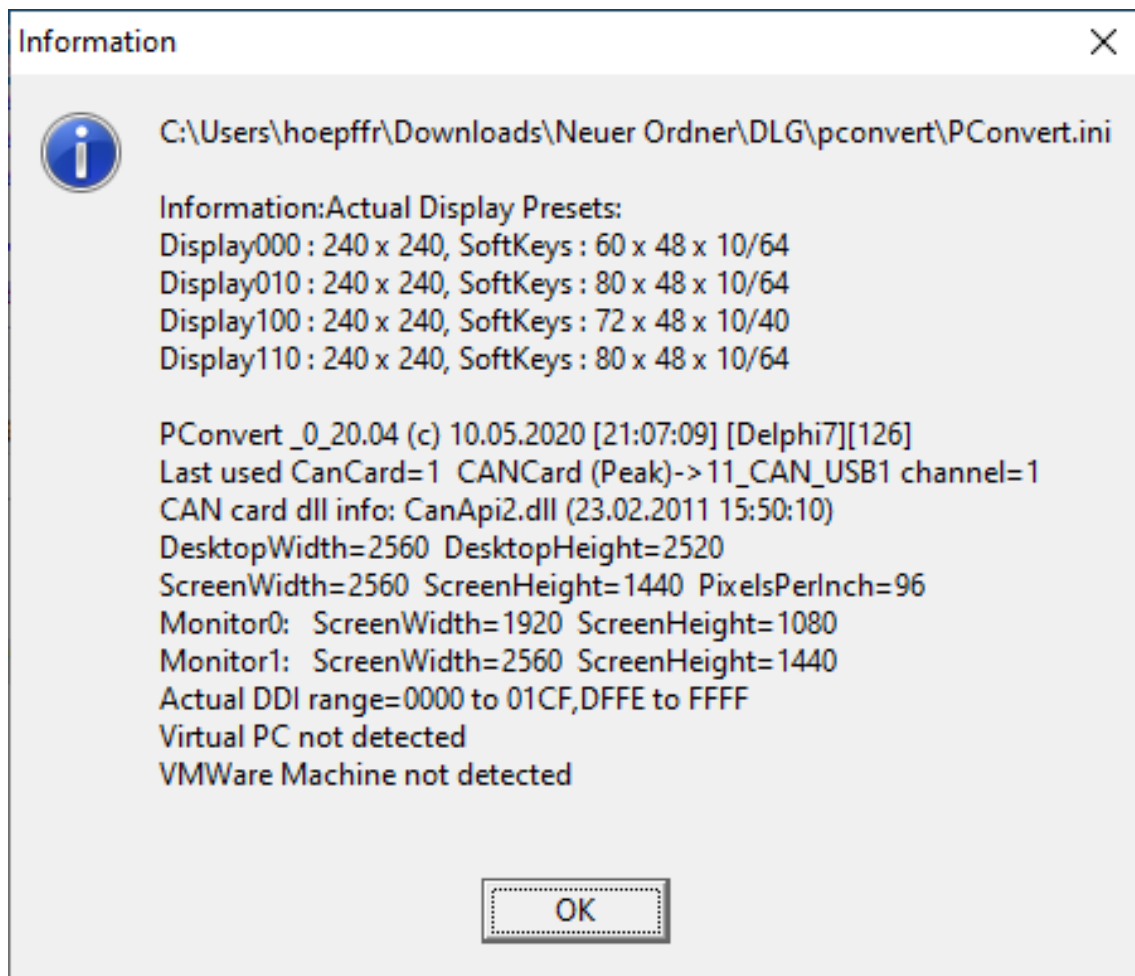
Then select CAN – CAN Tools – Net Client Check the box for Mode

In the window that appears, select “TRACE,” and it will show what's happening on the bus:



If this doesn't work, select CAN – CAN Tools – Net Client Table – Close and Set Net Client again.
This is especially important if the network isn't named DLG_net. **





_CanCards_0_20.04 [active_dlg_net][card=1 ch=1]

Trace-Mode: addr: 522 RX: 0 Limit: 100000 PwrUp: 0 TX: 1000 Refr: 3

ECU00: 0A Src0 X Dst0 26
ECU10: 14 Src1 X Dst1 26
1CE6FF26 DLC 08
FE 26 FF FF FF FF 00 FF

1.Commands 2.Timing/Filter 3.TE

Version: TimeOut0 [ms] 100
VERSION: TimeOut1 [ms] 100
TimeOut2 [ms] 1000

Message Filter:
Maintenance: ☒ ☒ 255
VT StatusMessage: ☒ ☐ 5
ACKN: ☒ ☒ ☐ ☐
ECUtoVT: FF ☒ ☒ Numeric
VTtoECU: FF ☒ ☒ Numeric
TP/ETP_DT/BAM: ☒ ☒ ☐ ☐
TP/ETP_CMD: ☒ ☐ ☐ ☐
Msg_Extended: ☒ ☐ ☐ ☐

ActiveMask_dec: 65535
ActiveSoftKeyMask_dec: 65535
VTFunctionInstance: 0
VTBusyCode=16 VTFunction=0 [00]
busy parsing ObjectPool=00
TIME_Status00 [ms]=624

RX1 1CE60026 8 D1 FF FF FF FF 00 FF FF
LoadVersionResponse
ErrorCode_hex[00E600D1]=00

RX1 1CE72600 8 C0 FF 1E 00 00 00 FF FF
GetMemory MemoryByte=30

RX1 1CE60026 8 C0 03 00 FF FF FF FF FF
GetMemoryResponse =3.0
ISO_Version : 3
MemoryStatus : 0

RX1 1CEC2600 8 10 15 00 03 03 00 E7 00
[TP_CM_RTS_E700_00_0] Size=21 Packets=3
ECUtoVT_PGN

RX1 1CEC0026 8 11 03 01 FF FF 00 E7 00
[TP_CM_CTS_E700_00_0] Packets=3 Next=1
ECUtoVT_PGN

RX1 1CEB2600 8 01 11 00 00 00 BB 01 E8
RX1 1CEB2600 8 02 03 01 00 02 F9 2A 00
RX1 1CEB2600 8 03 00 29 00 65 6E 64 65
RX1 1CEC0026 8 13 15 00 03 FF 00 E7 00
[TP_CM_EQMA_E700_00_0] Size=21 Packets=3
ECUtoVT_PGN

RX1 1CE72600 8 12 FF FF FF FF FF FF FF
EndOfObjectPool

RX1 1CE60026 8 12 01 00 00 F9 2A 01 FF
x_EndOfObjectPoolResponse
Error_ParentObjID=0
Error_ObjID=11001
ObjectPoolErrorCode_hex=01
Method/Attribute not supported
ErrorCode_hex=01
Error in ObjectPool

RX1 1CE6FF26 8 FE FE FF FF FF FF 00 00
_VTStatusMessage(00) SRC_hex=26
ActiveSource_hex : FE
ActiveMask_dec : 65535
ActiveSoftKeyMask_dec : 65535

233,288,488,474,

32. PGN

32.1 Chapter: What is a PGN (Parameter Group Number)?

32.1.1 Introduction

In the world of mobile machinery, especially in agricultural and construction engineering, communication between different electronic control units (ECUs) plays a central role. To make this communication efficient and standardized, the **ISOBUS protocol** was developed, which is based on the **CAN bus (Controller Area Network)**. A key element of this protocol is the **Parameter Group Number (PGN)**, which enables the unique identification of messages. This chapter explains what a PGN is, how it is structured, and what role it plays in ISOBUS communication

32.1.2 Definition of a PGN

A **Parameter Group Number (PGN)** is a 24-bit number that identifies a specific message or data set within the ISOBUS network. Each PGN represents a logical grouping of data that is transmitted together. This data can contain information such as the speed of a machine, the status of an attachment, or control commands for a hydraulic system.

32.1.3 Structure of a PGN

A PGN consists of three main components:

1. **Extended Data Page (EDP):** 1 bit
 - Indicates whether the PGN is located on the Extended Data Page.
 - Value: 0 (default) or 1 (extended).
1. **Data Page (DP):** 1 bit
 - Helps distinguish between different message types.
 - Value: 0 (default) or 1 (alternative).
1. **PF (Parameter Group Format) and PS (Parameter Group Specific):**
 - **PF (8 bits):** Defines the format of the PGN.
 - If $PF < 240$, then the PGN is a **peer-to-peer message** (targeted).
 - If $PF \geq 240$, then the PGN is a **broadcast message** (directed to all devices).
 - **PS (8 bits):**
 - If $PF < 240$: PS specifies the destination address.
 - If $PF \geq 240$: PS is used to further specify the PGN.

The complete PGN is formed by combining EDP, DP, PF, and PS and is represented as a 24-bit value.

32.1.4 Example of a PGN

Let's take PGN 65096 (**Wheel-based Speed and Distance – WBSD**) as an example:

- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 72
- **PGN:** 0x00FE48 (hexadecimal) or 65096 (decimal).

This PGN identifies a message containing information about a machine's wheel-based speed and distance.

32.1.5 Role of PGNs in ISOBUS Communication

1. Message Identification:

Each PGN uniquely identifies a specific message or data record. This allows ECUs to know what type of data they are receiving or sending.

1. Standardization:

Using PGNs standardizes communication between devices from different manufacturers. This enables interoperability between tractors, implements, and other machinery.

1. Efficient Data Transmission:

PGNs group related data into a single message, increasing data transmission efficiency and reducing network traffic.

1. Flexibility:

PGNs can represent both targeted (peer-to-peer) and general (broadcast) messages, increasing communication flexibility.

32.1.6 Types of PGNs

1. Broadcast PGNs:

- Sent to all devices on the network.
- Examples: speed, RPM, operating hours.

1. Peer-to-Peer PGNs:

- Sent to a specific device.
- Examples: control commands for a specific implement.

1. Proprietary PGNs:

- Defined by manufacturers for specific applications.
 - Are not part of the ISOBUS standard.
-

32.1.7 Summary

A **Parameter Group Number (PGN)** is a central element of ISOBUS communication. It uniquely identifies a message or data record, thus enabling the standardized and efficient transfer of data between different electronic control units. The use of PGNs ensures interoperability between devices from different manufacturers, which is particularly important in agricultural and construction engineering.

32.2 PGN List

32.3 COG & SOG, Rapid Update (PGN 129026) in the NMEA 2000 Standard

32.3.1 Introduction

The NMEA 2000 standard is a widely used standard in the maritime industry for communication between various navigation and ship systems. A key component of this standard is Parameter Group Number (PGN) 129026, known as “COG & SOG, Rapid Update.” This message transmits critical navigation data in real time and plays a central role in the safety and efficiency of shipping.

32.3.2 Meaning of COG and SOG

COG (Course Over Ground) and SOG (Speed Over Ground) are two of the most fundamental navigation parameters:

- **COG** indicates the actual direction of travel of the vessel over ground, measured in radians or degrees.
- **SOG** represents the speed of the vessel over ground, typically in meters per second or knots.

These values are essential for:

- Collision avoidance systems
- Autopilots
- Navigation displays
- Logbook entries
- Maneuvering assistance

32.3.3 Technical Specification of PGN 129026

The technical description from the file shows the structure of this message:

```
enum E_cogReference(0="True", 1="Magnetic", 2="Error")
[PGN_129026_cogSogRapidUpdate] ID=19F802FEh
```

32.3.3.1 Key Fields

32.3.4 SOG (Speed Over Ground)

- 16-bit unsigned value
- Unit: m/s
- Scaling factor: 0.01 (value 100 = 1.00 m/s)

32.3.5 COG (Course Over Ground)

- 16-bit unsigned value
- Unit: Radians
- Scaling factor: 0.0001 (high precision)

32.3.6 COG Reference

- 2-bit enumeration (0=True, 1=Magnetic, 2=Error)
- Indicates whether the course is relative to True North or Magnetic North

32.3.7 SID (Sequence Identifier)

- 8-bit identifier for message tracking

32.3.8 Special Features of "Rapid Update"

The term "Rapid Update" indicates several important characteristics:

- **High Update Rate:** This message is typically sent at a higher frequency than Standard COG/SOG messages.
- **Reduced latency:** Important for real-time applications such as collision avoidance.
- **Compact size:** With a data length of only 8 bytes (DLC=8), the message is efficiently transmitted.

32.3.9 Application examples

1. **Collision avoidance systems:** Radar anti-collision systems (RAS) use fast COG/SOG updates to detect collision risks early.
2. **Autopilot control:** Modern autopilots adjust the course based on real-time COG data to compensate for drift caused by currents.
3. **AIS transponders:** Use this data to accurately display the movements of other vessels.
4. **Navigation software:** Displays current movement data for route planning.

32.3.10 Significance for Maritime Safety

The rapid and precise transmission of COG and SOG is crucial for:

- Avoiding navigational errors
- Precise maneuver calculation

- Real-time monitoring of vessel movement
- Integration with other safety systems

32.3.11 Conclusion

PGN 129026 “COG & SOG, Rapid Update” is a fundamental component of the NMEA 2000 standard, enabling the rapid and precise transmission of essential navigation data. Its efficient structure and high update rate make it indispensable for modern maritime navigation and safety systems. The standardized definition of this message, as shown in the specification, ensures interoperability between devices from different manufacturers, thus contributing to safety and efficiency in shipping.

32.3.12 SPN

Yes, in the NMEA 2000 standard, the values from PGN 129026 (“COG & SOG, Rapid Update”) have assigned **SPN numbers (Suspect Parameter Numbers)**, which serve to uniquely identify the individual parameters.

32.3.12.1 SPN Assignment for PGN 129026

Here are the relevant SPNs for the most important fields of the message:

1. SOG (Speed Over Ground)

- **SPN 1284**
- Description: Speed over ground
- Unit: **m/s** (Scale: 0.01)
- Range: 0 – 655.34 m/s (theoretical, practically typically < 50 m/s ≈ 97.2 kn)

1. COG (Course Over Ground)

- **SPN 1285**
- Description: Course over ground
- Unit: **Radian (rad)** (Scale: 0.0001)
- Range: 0 – 6.2832 rad (corresponds to 0–360°)

1. COG Reference (Course reference direction)

- **SPN 1286**
- Description: Reference for COG (True/Magnetic)
- Encoding:
- 0 = True (Geographic North)
- 1 = Magnetic (Magnetic North)
- 2 = Error (Error state)

1. SID (Sequence Identifier)

- **SPN 1287**
- Description: Sequence identifier for message tracking
- Range: 0–255

32.3.12.2 Important Notes

- The **reserved fields** (e.g., reserved6, reserved) do not have an SPN assignment because they are not intended for user data.
- SPNs are used in diagnostic systems (e.g., for fault codes) and in documentation to uniquely reference parameters.
- Scaling factors (e.g., 0.01 for SOG) are important for converting raw values into physical units.

32.3.12.3 Example

A SOG value of 1850 (raw value) would mean:

$$[1850 \times 0.01 = 18.50 \text{ m/s} \approx 36 \text{ kn}]$$

If you are looking for an official reference, these SPNs are defined in the **NMEA 2000 database** or in documents such as “**NMEA 2000® Standard PGNs**” (ISO 11783-3).

Do you need more details about a specific SPN?

32.4 PGN 61444

32.4.1 PGN

Parameter Group Number (PGN) 61444, also known as **Electronic Engine Controller 1 (EEC1)**, is one of the most important J1939 messages and is typically sent on the ISOBUS implement bus of tractors. It contains basic engine parameters such as speed, torque, and operating mode. **Parameter Group Number (PGN) 61444**, also known as **Electronic Engine Controller 1 (EEC1)**, is one of the most important J1939 messages and is typically sent on the ISOBUS implement bus of tractors. It contains basic engine parameters such as speed, torque, and operating mode.

32.4.1.1 PGN 61444 – Electronic Engine Controller 1 (EEC1)

- **PG Label:** Electronic Engine Controller 1
- **PG Acronym:** EEC1
- **PG Notes:**
 - J1939 message, but typically also sent via ISOBUS
 - Contains engine speed, torque, and operating mode
 - Sent by the engine ECU
 - Important for implement control and power calculation
- **EDP:** 0
- **DP:** 0
- **PF:** 240
- **PS:** 3
- **Multipacket:** No
- **Transmission Rate:** 10 ms (engine running) / 1 s (engine stopped)
- **PG Data Length:** 8 Bytes
- **Default Priority:** 3
- **PG Reference:** J1939DA

32.4.1.2 Technical Details

- **PG Document:** J1939DA

32.4.1.3 Use Case

This message is used for:

- Engine speed monitoring
- Power calculation (RPM x Torque)
- Automatic implementation adjustment to engine load
- Speed control and limiting
- Diagnostics and fault detection

32.4.2 SPNs in PGN 61444 – Electronic Engine Controller 1 (EEC1)

32.4.3 SPN 899 – Engine Torque Mode

- **SP Position:** Bits 1.1-1.4
- **SP Length:** 4 bits
- **Scaling:** 16 states per 4 bits
- **Range:** 0 to 15
- **Unit:** bit
- **Description:** Current engine torque mode (e.g., 0 = No demand, 1 = Accelerator pedal, 2 = Cruise control, etc.)

32.4.4 SPN 4154 – Actual Engine - Percent Torque (Fractional)

- **SP Position:** Bits 1.5-1.8
- **SP Length:** 4 Bits
- **Scaling:** 0.125%/Bit

- **Offset:** 0
- **Range:** 0 to 1.875%
- **Unit:** %
- **Description:** Fractional portion of the actual torque (supplements SPN 513)

32.4.5 SPN 512 – Driver’s Demand Engine - Percent Torque

- **SP Position:** Byte 2
- **SP Length:** 8 Bits
- **Scaling:** 1%/Bit
- **Offset:** –125
- **Range:** –125 to 125%
- **Unit:** %
- **Description:** Torque requested by the driver (e.g., accelerator pedal)

32.4.6 SPN 513 – Actual Engine - Percent Torque

- **SP Position:** Byte 3
- **SP Length:** 8 Bits
- **Scaling:** 1%/Bit
- **Offset:** –125
- **Range:** –125 to 125%
- **Unit:** %
- **Description:** Current engine torque (integer part)

32.4.7 SPN 190 – Engine Speed

- **SP Position:** Bytes 4-5
- **SP Length:** 16 Bits
- **Scaling:** 0.125 rpm/Bit
- **Offset:** 0
- **Range:** 0 to 8,031.875 rpm
- **Unit:** rpm
- **Description:** Current engine speed

32.4.8 SPN 1483 – Source Address of Controlling Device for Engine Control

- **SP Position:** Byte 6
- **SP Length:** 8 bits
- **Scaling:** 1 per bit
- **Offset:** 0
- **Range:** 0 to 255
- **Unit:**
- **Description:** Address of the control unit that controls the engine

32.4.9 SPN 1675 – Engine Starter Mode

- **SP Position:** Bits 7.1-7.4
- **SP Length:** 4 bits
- **Scaling:** 16 states per 4 bits
- **Range:** 0 to 15
- **Unit:** bit
- **Description:** Starter mode (e.g., 0 = starter inactive, 1 = starter active, etc.)

32.4.10 SPN 2432 – Engine Demand – Percent Torque

- **SP Position:** Byte 8
- **SP Length:** 8 bits
- **Scaling:** 1 %/Bit
- **Offset:** –125

- **Range:** –125 to 125%
 - **Unit:** %
 - **Description:** Torque requested by the engine control unit
-

32.4.10.1 Summary

- PGN 61444 contains 8 SPNs for engine control and monitoring.
- Main parameters: Engine Speed (SPN 190) and Actual Engine Torque (SPN 513).
- Although a J1939 message, it is typically also sent via ISOBUS.
- The message is sent at a rate of 10 ms (with the engine running).
- For complete details, see J1939DA.

32.5 PGN 61474

32.5.1 PGN

Parameter Group Number (PGN) 61474, also known as **Machine Selected Speed (MSS)**, transmits the operator-selected target speed and associated parameters. This message conforms to the ISOBUS standard ISO 11783.

32.5.1.1 PGN 61474 – Machine Selected Speed

- **PG Label:** Machine Selected Speed
- **PG Acronym:** MSS
- **PG Notes:**
 - Used for speed control systems
 - Supports precision farming applications
 - Typically sent by the tractor ECU
- **EDP:** 0
- **DP:** 0
- **PF:** 240
- **PS:** 34
- **Multipacket:** No
- **Transmission Rate:** 100 ms
- **PG Data Length:** 8 Bytes
- **Default Priority:** 3
- **PG Reference:** ISO 11783-7

32.5.1.2 Technical Details

- **SP Start Bit:** See SPN definitions
- **PG Document:** ISO 11783-7

32.5.1.3 Application Use

Enables precise speed control for:

- Automatic steering systems
 - Section control
 - Precision farming operations
-

32.5.2 SPNs in PGN 61474 – Machine Selected Speed

32.5.3 SPN 4305 – Machine Selected Speed

- **SP Position:** Bits 1-2
- **SP Length:** 16 bits
- **Scaling:**
 - Bits 1-8: 0.256 m/s per bit
 - Bits 9-16: 0.001 m/s per bit
- **Range:** 0-64.255 m/s

- **Description:** Selected target speed

32.5.4 SPN 4306 – Machine Selected Distance

- **SP Position:** Bits 3-6
- **SP Length:** 32 bits
- **Scaling:** 0.001 m per bit
- **Range:** 0-4211081.215 m
- **Description:** Distance traveled at selected speed

32.5.5 SPN 5818 – Machine selected speed exit/reason code

- **SP Position:** Bits 7.1-7.6
- **SP Length:** 6 bits
- **States:** 64 possible status codes
- **Description:** Reason for speed change

32.5.6 SPN 4309 – Machine selected direction

- **SP Position:** Bits 8.1-8.2
- **SP Length:** 2 bits
- **States:**
 - 00: Forward
 - 01: Reverse
 - 10: Neutral
 - 11: Invalid

32.5.7 SPN 4308 – Machine selected speed source

- **SP Position:** Bits 8.3-8.5
- **SP Length:** 3 bits
- **States:** 8 possible sources
- **Description:** Origin of speed selection

32.5.8 SPN 4307 – Machine-selected speed limit status

- **SP Position:** Bits 8.6-8.8
- **SP Length:** 3 bits
- **States:** 8 possible limiting states
- **Description:** Speed limiting status

32.5.8.1 Summary

- Contains 6 specific parameters for speed control
- Provides detailed information on speed selection
- Important for automated control systems
- Full 8-byte message utilization

32.6 PGN 64770

32.6.1 PGN

Parameter Group Number (PGN) 64770, also known as **All implements stop operations switch state (AISO)**, is an important ISO 11783-7 message for the emergency shutdown of all implements. This message is sent by the tractor to immediately stop all connected implements. **Parameter Group Number (PGN) 64770 ...**, also known as **All implements stop operations switch state (AISO)**,** is an important ISO 11783-7 message for the emergency shutdown of all implements.** This message is sent by the tractor to immediately stop all connected implements. **Parameter Group Number (PGN) 64770** **Parameter Group Number (PGN) 64770** **Parameter Group Number (PGN) 647

32.6.1.1 PGN 64770 – All implements stop operations switch state (AISO)

- **PG Label:** All implements stop operations switch state
- **PG Acronym:** AISO
- **PG Notes:**
 - Emergency shutdown for all implements
 - Sent by the tractor
 - 1-second transmission interval and on state change
 - Important for safety applications
- **EDP:** 0
- **DP:** 0
- **PF:** 253
- **PS:** 2
- **Multipacket:** No
- **Transmission Rate:** 1 s and on change of state
- **PG Data Length:** 8 Bytes
- **Default Priority:** 3
- **PG Reference:** ISO 11783-7

32.6.1.2 Technical Details

- **PG Document:** ISO 11783-7

32.6.1.3 Use Case

This message is used For:

- Emergency shutdown of all attachments
- Safety functions (e.g., emergency stop)
- Centralized control of implement operations
- Operator and machine protection

32.6.2 SPNs in PGN 64770 – All implements stop operations switch state (AISO)

32.6.3 SPN 7443 – Stop All Implement Operations Transition Number

- **SP Position:** Byte 7
- **SP Length:** 8 bits
- **Scaling:** 256 states per 8 bits
- **Range:** 0 to 255
- **Unit:** bit
- **Description:** Transition number for the stop operation (for sequencing)

32.6.4 SPN 5140 – Stop all implement operations

- **SP Position:** Bits 8.1-8.2
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:**
 - 00: Off (Normal operation)
 - 01: On (Stop all attachments)
 - 10: Error
 - 11: Not available
- **Description:** Switch for emergency shutdown of all attachments

32.6.4.1 Summary

- The PGN 64770 contains 2 SPNs for emergency shutdown.
- Main function: Stop all implement operations (SPN 5140).
- Sent at 1-second intervals or upon state change.
- Essential for safety applications in ISOBUS.

32.7 PGN 65040 - Auxiliary Valve 0 Estimated Flow

32.7.1 PGN

Parameter Group Number (PGN) 65040, also known as **Auxiliary valve 0 estimated flow (AV00EF)**, provides the estimated oil flow and valve status for auxiliary valve 0. This message is sent by the tractor and is important for the hydraulic control of implements. **

32.7.1.1 PGN 65040 – Auxiliary valve 0 estimated flow (AV00EF)

- **PG Label:** Auxiliary valve 0 estimated flow
 - **PG Acronym:** AV00EF
 - **PG Notes:**
 - Contains estimated oil flow for extend and retract ports
 - Valve status and fail-safe mode
 - High-resolution flow value
 - Sent by the tractor ECU
 - **EDP:** 0
 - **DP:** 0
 - **PF:** 254
 - **PS:** 16
 - **Multipacket:** No
 - **Transmission Rate:** 100 ms
 - **PG Data Length:** 8 Bytes
 - **Default Priority:** 3
 - **PG Reference:** ISO 11783-7
-

32.7.2 SPNs in PGN 65040 – Auxiliary valve 0 estimated flow (AV00EF)

32.7.3 SPN 1901 – Auxiliary valve 0 extend port estimated flow

- **SP Position:** Byte 1
- **SP Length:** 8 bits
- **Scaling:** 1%/bit
- **Offset:** -125
- **Range:** -125 to 125%
- **Unit:** %
- **Description:** Estimated oil flow at the extend port (extend)

32.7.4 SPN 1902 – Auxiliary valve 0 retract port estimated flow

- **SP Position:** Byte 2
- **SP Length:** 8 bits
- **Scaling:** 1%/bit
- **Offset:** -125
- **Range:** -125 to 125%
- **Unit:** %
- **Description:** Estimated oil flow on Retract Port

32.7.5 SPN 1903 – Auxiliary valve number 0 valve state

- **SP Position:** Bits 3.1-3.4
- **SP Length:** 4 bits
- **Scaling:** 16 states per 4 bits
- **Range:** 0 to 15
- **Unit:** bit
- **Description:** Current valve state (16 different states)

32.7.6 SPN 1910 – Auxiliary valve 0 fail safe mode

- **SP Position:** Bits 3.7-3.8
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:**
 - 00: Off
 - 01: On
 - 10: Error
 - 11: Not available
- **Description:** Fail-safe mode of the valve

32.7.7 SPN 5161 – Auxiliary valve number 0 estimated flow limit status

- **SP Position:** Bits 4.6-4.8
- **SP Length:** 3 bits
- **Scaling:** 8 states per 3 bits
- **Range:** 0 to 7
- **Unit:** bit
- **Description:** Flow limitation status

32.7.8 SPN 5800 – Auxiliary valve 0 exit/reason code

- **SP Position:** Bits 5.1-5.6
- **SP Length:** 6 bits
- **Scaling:** 64 states per 6 bits
- **Range:** 0 to 63
- **Unit:** bit
- **Description:** Exit/Reason Code for the valve

32.7.9 SPN 9732 – Auxiliary valve 0 estimated flow (high resolution)

- **SP Position:** Bytes 7-8
 - **SP Length:** 16 Bits
 - **Scaling:** 0.004%/Bit
 - **Offset:** -125
 - **Range:** -125 to 132.02%
 - **Unit:** %
 - **Description:** High-resolution estimated oil flow
-

32.7.9.1 Summary

- The PGN 65040 contains 7 SPNs for valve 0.
- Estimated flows for the extend and retract ports.
- High-resolution value for more precise control.
- Analogous PGNs exist for valves 1-15 (PGN 65041-65055).

32.8 PGN 65056 - Auxiliary Valve 0 Measured Flow

32.8.1 PGN

Parameter Group Number (PGN) 65056, also known as **Auxiliary valve 0 measured flow (AV00MF)**, provides the measured oil flow and pressure for auxiliary valve 0. This message is sent by the tractor and contains actual values for the hydraulic control system. **

32.8.1.1 PGN 65056 – Auxiliary valve 0 measured flow (AV00MF)

- **PG Label:** Auxiliary valve 0 measured flow
- **PG Acronym:** AV00MF
- **PG Notes:**

- Contains measured oil flows for the extend and retract ports
 - Pressure values for the extend, retract, and return ports
 - Flow limit status
 - Sent by the tractor ECU
 - EDP: 0
 - DP: 0
 - PF: 254
 - PS: 32
 - Multipacket: No
 - Transmission Rate: 100 ms
 - PG Data Length: 8 Bytes
 - Default Priority: 3
 - PG Reference: ISO 11783-7
-

32.8.2 SPNs in PGN 65056 – Auxiliary valve 0 measured flow (AV00MF)

32.8.3 SPN 1899 – Auxiliary valve number 0 extends port measured flow

- **SP Position:** Byte 1
- **SP Length:** 8 bits
- **Scaling:** 1%/bit
- **Offset:** -125
- **Range:** -125 to 125%
- **Unit:** %
- **Description:** Measured oil flow at the extend port (extend)

32.8.4 SPN 1900 – Auxiliary valve number 0 retract port measured flow

- **SP Position:** Byte 2
- **SP Length:** 8 bits
- **Scaling:** 1%/bit
- **Offset:** -125
- **Range:** -125 to 125%
- **Unit:** %
- **Description:** Measured oil flow on Retract port

32.8.5 SPN 1904 – Auxiliary valve number 0 extends port pressure

- **SP Position:** Bytes 3-4
- **SP Length:** 16 bits
- **Scaling:** 5 kPa/bit
- **Offset:** 0
- **Range:** 0 to 321,275 kPa
- **Unit:** kPa
- **Description:** Printing on the extend port

32.8.6 SPN 1905 – Auxiliary valve number 0 retract port pressure

- **SP Position:** Bytes 5-6
- **SP Length:** 16 bits
- **Scaling:** 5 kPa/bit
- **Offset:** 0
- **Range:** 0 to 321,275 kPa
- **Unit:** kPa
- **Description:** Pressure on the retract port

32.8.7 SPN 1906 – Auxiliary valve number 0 return port pressure

- **SP Position:** Byte 7

- **SP Length:** 8 Bits
- **Scaling:** 16 kPa/Bit
- **Offset:** 0
- **Range:** 0 to 4000 kPa
- **Unit:** kPa
- **Description:** Pressure at the return port

32.8.8 SPN 5160 – Auxiliary valve number 0 measured flow limit status

- **SP Position:** Bits 8.6-8.8
- **SP Length:** 3 Bits
- **Scaling:** 8 states per 3 bits
- **Range:** 0 to 7
- **Unit:** bit
- **Description:** Flow limit status

32.8.8.1 Summary

- The PGN 65056 contains 6 SPNs for valve 0.
- Measured flow rates and pressures for all ports.
- Analogous PGNs exist for valves 1-15 (PGN 65057-65071).
- Supplements the Estimated Flow message (PGN 65040) with actual values.

32.9 PGN 65088

32.9.1 PGN

Parameter Group Number (PGN) 65088, also known as **Lighting Data (LD)**, transmits the status of all lighting and illumination functions of a tractor and connected implements. This message conforms to the ISOBUS standard ISO 11783.

32.9.1.1 PGN 65088 – Lighting Data (LD)

- **PG Label:** Lighting Data
- **PG Acronym:** LD
- **PG Notes:**
 - Sent as requested
 - Contains the on/off status of all vehicle lights
 - Each light is represented by 2 bits (4 states)
 - Important for controlling accessories and lighting management
- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 64
- **Multipacket:** No
- **Transmission Rate:** As requested
- **PG Data Length:** 8 Bytes
- **Default Priority:** 6
- **PG Reference:** ISO 11783-7

32.9.1.2 Technical Details

- **SP Start Bit:** See SPN Definitions
- **PG Document:** ISO 11783-7

32.9.1.3 Use Case

This message is used for:

- Monitoring and control of vehicle lighting
- Synchronization of implement lighting with tractor lighting

- Automatic lighting control systems
 - Diagnostics and fault detection in lighting systems
-

32.9.2 SPNs in PGN 65088 – Lighting Data (LD)

32.9.3 SPN 2404 – Daytime running lights

- **SP Position:** Bits 1.1-1.2
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:**
 - 00: Off
 - 01: On
 - 10: Error
 - 11: Not available
- **Description:** Daytime running lights

32.9.4 SPN 2352 – Alternate headlights

- **SP Position:** Bits 1.3-1.4
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Alternate headlights

32.9.5 SPN 2350 – Low-beam headlights

- **SP Position:** Bits 1.5-1.6
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Low beam

32.9.6 SPN 2348 – High-beam headlights

- **SP Position:** Bits 1.7-1.8
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** High beam

32.9.7 SPN 2388 – Tractor front fog lights

- **SP Position:** Bits 2.1-2.2
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** Same as SPN 2404
- **Description:** Tractor front fog lights

32.9.8 SPN 2386 – Rotating beacon light

- **SP Position:** Bits 2.3-2.4
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** Same as SPN 2404
- **Description:** Rotating beacon

32.9.9 SPN 2370 – Right-turn signal lights

- **SP Position:** Bits 2.5-2.6
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Right turn signal

32.9.10 SPN 2368 – Left-turn signal lights

- **SP Position:** Bits 2.7-2.8
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Left turn signal

32.9.11 SPN 2392 – Back-up lights and alarm horn

- **SP Position:** Bits 3.1-3.2
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Reversing light and horn

32.9.12 SPN 2376 – Center stop lights

- **SP Position:** Bits 3.3-3.4
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Center brake lights

32.9.13 SPN 2374 – Right brake lights

- **SP Position:** Bits 3.5-3.6
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Right brake lights

32.9.14 SPN 2372 – Left brake lights

- **SP Position:** Bits 3.7-3.8
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Left brake lights Brake Lights

32.9.15 SPN 2384 – Implement Clearance Lights

- **SP Position:** Bits 4.1-4.2
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Implement clearance lights

32.9.16 SPN 2382 – Tractor Clearance Lights

- **SP Position:** Bits 4.3-4.4
- **SP Length:** 2 Bits

- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Tractor clearance lights

32.9.17 SPN 2380 – Implement Marker (Position) Lights

- **SP Position:** Bits 4.5-4.6
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Implement position lights

32.9.18 SPN 2378 – Tractor marker (position) lights

- **SP Position:** Bits 4.7-4.8
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Tractor position lights

32.9.19 SPN 2390 – Rear fog lights

- **SP Position:** Bits 5.1-5.2
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Rear fog lights

32.9.20 SPN 2358 – Tractor underside-mounted work lights

- **SP Position:** Bits 5.3-5.4
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Tractor work lights, low-mounted

32.9.21 SPN 2360 – Tractor rear low-mounted work lights

- **SP Position:** Bits 5.5-5.6
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Tractor rear work lights, low-mounted

32.9.22 SPN 2362 – Tractor rear high-mounted work lights

- **SP Position:** Bits 5.7-5.8
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Tractor side work lights, high-mounted

32.9.23 SPN 2364 – Tractor side low-mounted work lights

- **SP Position:** Bits 6.1-6.2
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:** Same as SPN 2404
- **Description:** Tractor side work lights, low-mounted

32.9.24 SPN 2366 – Tractor side high-mounted work lights

- **SP Position:** Bits 6.3-6.4
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:** Same as SPN 2404
- **Description:** Tractor side work lights, high-mounted

32.9.25 SPN 2354 – Tractor front low-mounted work lights

- **SP Position:** Bits 6.5-6.6
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Tractor front work lights, low-mounted

32.9.26 SPN 2356 – Tractor front high-mounted work lights

- **SP Position:** Bits 6.7-6.8
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Tractor front work lights, high-mounted

32.9.27 SPN 2398 – Implement OEM option 2 light

- **SP Position:** Bits 7.1-7.2
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Add-on device OEM Option 2 light

32.9.28 SPN 2396 – Implement OEM option 1 light

- **SP Position:** Bits 7.3-7.4
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Add-on device OEM Option 1 light

32.9.29 SPN 2407 – Implement right forward work lights

- **SP Position:** Bits 7.5-7.6
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Add-on device for right-facing work lights

32.9.30 SPN 2598 – Implement left-facing work lights

- **SP Position:** Bits 7.7-7.8
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Add-on device for left-facing work lights

32.9.31 SPN 2402 – Implement right-facing work lights

- **SP Position:** Bits 8.3-8.4
- **SP Length:** 2 Bits

- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Add-on device for right-facing work lights

32.9.32 SPN 2400 – Implement left-facing work lights

- **SP Position:** Bits 8.5-8.6
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 2404
- **Description:** Implement for left-facing work lights

32.9.33 SPN 2394 – Implement rear work lights

- **SP Position:** Bits 8.7-8.8
 - **SP Length:** 2 bits
 - **Scaling:** 4 states per 2 bits
 - **States:** As SPN 2404
 - **Description:** Implement for rear work lights
-

32.9.33.1 Summary

- The PGN 65088 contains 31 SPNs that represent the status of various lighting functions.
- Each SPN uses 2 bits with 4 possible states (Off, On, Error, Not available).
- The message is sent on request and has a data length of 8 bytes.
- This PGN is essential for coordinating lighting systems between the tractor and implements.

32.10 PGN 65091

32.10.1 PGN

Parameter Group Number (PGN) 65091, also known as **Primary or Rear Power Take-Off (RPTO)**, is used for transmitting data to the rear power take-off (PTO) in agricultural machinery. This message conforms to the ISOBUS standard ISO 11783.

32.10.1.1 PGN 65091 – Primary or Rear Power Take-Off (PTO)

- **PG Label:** Primary or Rear Power Take-Off
- **PG Acronym:** RPTO
- **PG Notes:**
 - Used for controlling the rear power take-off (PTO)
 - Contains speeds, operating modes, and status information
 - Critical for PTO-driven implements
- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 67
- **Multipacket:** No
- **Transmission Rate:** 100 ms when engaged, otherwise on request
- **PG Data Length:** 8 Bytes
- **Default Priority:** 3
- **PG Reference:** ISO 11783-7

32.10.1.2 Technical Details

- **SP Start Bit:** See SPN Definitions
- **PG Document:** ISO 11783-7

32.10.1.3 Application Case

Enables precise control of:

- Rear PTO-driven implements
 - Speed control
 - Operating mode control
-

32.10.2 SPNs in PGN 65091 – Primary or Rear Power Take-Off

32.10.3 SPN 1883 – Rear PTO output shaft speed

- **SP Position:** Bits 1-2
- **SP Length:** 16 Bits
- **Scaling:** 0.125 rpm per bit
- **Range:** 0-8031.875 rpm
- **Description:** Current speed of the rear PTO

32.10.4 SPN 1885 – Rear PTO Output Shaft Speed Set Point

- **SP Position:** Bits 3-4
- **SP Length:** 16 Bits
- **Scaling:** 0.125 rpm per bit
- **Description:** Target speed of the rear PTO shaft

32.10.5 SPN 5156 – Rear PTO engagement request status

- **SP Position:** Bits 5.1-5.2
- **SP Length:** 2 bits
- **States:**
- 00: Off
- 01: On
- 10: Pending
- 11: Error

32.10.6 SPN 1892 – Rear Power Take Off Economy Mode

- **SP Position:** Bits 5.3-5.4
- **SP Length:** 2 bits
- **States:**
- 00: Normal
- 01: Economy
- 10: Reserved
- 11: Invalid

32.10.7 SPN 1890 – Rear Power Take Off Mode

- **SP Position:** Bits 5.5-5.6
- **SP Length:** 2 bits
- **States:**
- 00: Ground speed
- 01: Engine speed
- 10: Mixed
- 11: Invalid

32.10.8 SPN 2408 – Rear Power Take Off Engagement

- **SP Position:** Bits 5.7-5.8
- **SP Length:** 2 Bits
- **States:**
- 00: Disengaged
- 01: Engaged
- 10: Transition

- 11: Fault

32.10.9 SPN 5159 – Rear PTO shaft speed limit status

- **SP Position:** Bits 6.2-6.4
- **SP Length:** 3 Bits
- **States:** 8 possible limit statuses
- **Description:** Speed limit status

32.10.10 SPN 5158 – Rear PTO Economy mode request status

- **SP Position:** Bits 6.5-6.6
- **SP Length:** 2 Bits
- **States:** 4 possible request statuses

32.10.11 SPN 5157 – Rear PTO mode request status

- **SP Position:** Bits 6.7-6.8
- **SP Length:** 2 bits
- **States:** 4 possible mode requests

32.10.12 SPN 5820 – Rear PTO exit/reason code

- **SP Position:** Bits 7.1-7.6
 - **SP Length:** 6 bits
 - **States:** 64 possible status codes
 - **Description:** Reason for state change
-

32.10.12.1 Summary

- Contains 10 specific parameters for rear PTO control
- Provides comprehensive control over speeds and operating modes
- Important for modern tractor control systems
- Full 8-byte message utilization

32.11 PGN 65092

32.11.1 PGN

Parameter Group Number (PGN) 65092, also known as **Secondary or Front Power Take-Off Output Shaft (FPTO)**, transmits data to the front power take-off (PTO) shaft in modern tractors. This message conforms to the ISOBUS standard ISO 11783.

32.11.1.1 PGN 65092 – Secondary or Front Power Take-Off Output Shaft (FPTO)

- **PG Label:** Secondary or Front Power Take-Off Output Shaft
- **PG Acronym:** FPTO
- **PG Notes:**
 - Used for controlling the front PTO
 - Contains speeds, operating modes, and status information
 - Critical for front-mounted PTO devices
 - Complementary to PGN 65091 (Rear PTO)
- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 68
- **Multipacket:** No
- **Transmission Rate:** 100 ms when engaged, otherwise on request
- **PG Data Length:** 8 Bytes
- **Default Priority:** 3

- **PG Reference:** ISO 11783-7

32.11.1.2 Technical Details

- **SP Start Bit:** See SPN definitions
- **PG Document:** ISO 11783-7

32.11.1.3 Application Case

Enables precise control of:

- Front PTO-driven implements
 - Speed control for front-mounted implements
 - Automatic operating mode switching
-

32.11.2 SPNs in PGN 65092 – Secondary or Front Power Take-Off Output Shaft

32.11.3 SPN 1882 – Front PTO output shaft speed

- **SP Position:** Bits 1-2
- **SP Length:** 16 bits
- **Scaling:** 0.125 rpm per bit
- **Range:** 0-8031.875 rpm
- **Accuracy:** ± 0.125 rpm
- **Description:** Current speed of the Front PTO

32.11.4 SPN 1884 – Front PTO Output Shaft Speed Set Point

- **SP Position:** Bits 3-4
- **SP Length:** 16 Bits
- **Scaling:** 0.125 rpm per bit
- **Description:** Target speed of the front PTO

32.11.5 SPN 5152 – Front PTO Engagement Request Status

- **SP Position:** Bits 5.1-5.2
- **SP Length:** 2 Bits
- **States:**
 - 00: Off
 - 01: On
 - 10: Pending
 - 11: Error

32.11.6 SPN 1891 – Front Power Take Off Economy Mode

- **SP Position:** Bits 5.3-5.4
- **SP Length:** 2 Bits
- **States:**
 - 00: Normal Mode
 - 01: Economy Mode
 - 10: Reserved
 - 11: Invalid

32.11.7 SPN 1889 – Front Power Take Off Mode

- **SP Position:** Bits 5.5-5.6
- **SP Length:** 2 Bits
- **States:**
 - 00: Ground speed mode
 - 1: Engine speed mode
 - 10: Mixed mode

- 11: Invalid

32.11.8 SPN 1888 – Front Power Take Off Engagement

- **SP Position:** Bits 5.7-5.8
- **SP Length:** 2 Bits
- **States:**
 - 00: Disengaged
 - 01: Engaged
 - 10: Transition
 - 11: Fault

32.11.9 SPN 5155 – Front PTO shaft speed limit status

- **SP Position:** Bits 6.2-6.4
- **SP Length:** 3 bits
- **States:** 8 possible limiting states
- **Description:** Speed limiting status

32.11.10 SPN 5154 – Front PTO Economy mode request status

- **SP Position:** Bits 6.5-6.6
- **SP Length:** 2 bits
- **States:** 4 possible request states

32.11.11 SPN 5153 – Front PTO mode request status

- **SP Position:** Bits 6.7-6.8
- **SP Length:** 2 bits
- **States:** 4 possible mode requests

32.11.12 SPN 5817 – Front PTO exit/reason code

- **SP Position:** Bits 7.1-7.6
 - **SP Length:** 6 bits
 - **States:** 64 possible status codes
 - **Description:** Reason for State Change
-

32.11.12.1 Summary

- Includes 10 specific parameters for front PTO control
- Provides comprehensive control over speeds and operating modes
- Essential for modern front-mounted implements
- Structurally similar to PGN 65091 (Rear PTO), but for front-mounted applications
- Full 8-byte message utilization
- Standard update rate: 100 ms

32.12 PGN 65093

32.12.1 PGN

Parameter Group Number (PGN) 65093, also known as **Primary or Rear Hitch Status (RHS)**, transmits status information for the rear three-point linkage of tractors. This message conforms to the ISOBUS standard ISO 11783.

32.12.1.1 PGN 65093 – Primary or Rear Hitch Status

- **PG Label:** Primary or Rear Hitch Status
- **PG Acronym:** RHS
- **PG Notes:**

- Used for monitoring the rear hitch
- Contains position, force, and status data
- Important for automatic depth control systems
- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 69
- **Multipacket:** No
- **Transmission Rate:** 100 ms
- **PG Data Length:** 8 Bytes
- **Default Priority:** 3
- **PG Reference:** ISO 11783-7

32.12.1.2 Technical Details

- **SP Start Bit:** See SPN definitions
- **PG Document:** ISO 11783-7

32.12.1.3 Application Case

Enables monitoring and control of:

- Rear hitch position
 - Traction force measurement
 - Automatic depth control systems
-

32.12.2 SPNs in PGN 65093 – Primary or Rear Hitch Status

32.12.3 SPN 1873 – Rear Hitch Position

- **SP Position:** Byte 1
- **SP Length:** 8 bits
- **Scaling:** 0.4% per bit
- **Range:** 0-100%
- **Description:** Current rear hitch position

32.12.4 SPN 5151 – Rear Hitch Position Limit Status

- **SP Position:** 2.4-2.6 bits
- **SP Length:** 3 bits
- **States:** 8 possible limit statuses
- **Description:** Position limit status

32.12.5 SPN 1877 – Rear Hitch In-work Indication

- **SP Position:** Bits 2.7-2.8
- **SP Length:** 2 bits
- **States:**
 - 00: Not in work
 - 01: In work
 - 10: Transition
 - 11: Error

32.12.6 SPN 1881 – Rear Nominal Lower Link Force

- **SP Position:** Byte 3
- **SP Length:** 8 bits
- **Scaling:** 0.8% per bit
- **Offset:** -100%
- **Range:** -100% to +100%
- **Description:** Standardized pulling force

32.12.7 SPN 1879 – Rear Draft

- **SP Position:** Bytes 4-5
- **SP Length:** 16 bits
- **Scaling:** 10N per bit
- **Offset:** –320,000 N
- **Range:** –320,000 to +322,550 N
- **Description:** Measured tractive force

32.12.8 SPN 5819 – Rear hitch exit/reason code

- **SP Position:** Bits 6.1-6.6
 - **SP Length:** 6 bits
 - **States:** 64 possible status codes
 - **Description:** Reason for state change
-

32.12.8.1 Summary

- Contains 6 specific parameters for rear hitch monitoring
- Provides comprehensive information on position and forces
- Important for automatic control systems
- Typical update rate: 100 ms

32.13 PGN 65094

32.13.1 PGN

Parameter Group Number (PGN) 65094, also known as **Secondary or Front Hitch Status (FHS)**, transmits status information for the front three-point linkage of tractors. This message complies with the ISOBUS standard ISO 11783.

32.13.1.1 PGN 65094 – Secondary or Front Hitch Status

- **PG Label:** Secondary or Front Hitch Status
- **PG Acronym:** FHS
- **PG Notes:**
 - Used for monitoring the front hydraulics
 - Contains position, force, and status data
 - Important for front-mounted implements
 - Complementary to PGN 65093 (Rear Hitch Status)
- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 70
- **Multipacket:** No
- **Transmission Rate:** 100 ms
- **PG Data Length:** 8 Bytes
- **Default Priority:** 3
- **PG Reference:** ISO 11783-7

32.13.1.2 Technical Details

- **SP Start Bit:** See SPN definitions
- **PG Document:** ISO 11783-7

32.13.1.3 Application Case

Enables monitoring and control of:

- Front hydraulic position
- Traction measurement for front implements

- Automatic control systems for front-mounted implements
-

32.13.2 SPNs in PGN 65094 – Secondary or Front Hitch Status

32.13.3 SPN 1872 – Front Hitch Position

- **SP Position:** Byte 1
- **SP Length:** 8 bits
- **Scaling:** 0.4% per bit
- **Range:** 0-100%
- **Description:** Current position of the front hitch

32.13.4 SPN 5150 – Front Hitch Position Limit status

- **SP Position:** 2.4-2.6 bits
- **SP Length:** 3 bits
- **States:** 8 Possible Limiting States
- **Description:** Front Hitch Position Limiting State

32.13.5 SPN 1876 – Front Hitch In-work Indication

- **SP Position:** Bits 2.7-2.8
- **SP Length:** 2 Bits
- **States:**
- 00: Not in work
- 01: In work
- 10: Transition
- 11: Error

32.13.6 SPN 1880 – Front Nominal Lower Link Force

- **SP Position:** Byte 3
- **SP Length:** 8 Bits
- **Scaling:** 0.8% per bit
- **Offset:** -100%
- **Range:** -100% to +100%
- **Description:** Normalized front hitch force

32.13.7 SPN 1878 – Front Draft

- **SP Position:** Bytes 4-5
- **SP Length:** 16 Bits
- **Scaling:** 10 N per Bit
- **Offset:** -320.000 N
- **Range:** -320.000 to +322.550 N
- **Description:** Measured tractive force at the front hitch

32.13.8 SPN 5816 – Front hitch exit/reason code

- **SP Position:** Bits 6.1-6.6
 - **SP Length:** 6 Bits
 - **States:** 64 possible status codes
 - **Description:** Reason for front hitch state change
-

32.13.8.1 Summary

- Contains 6 specific parameters for front hydraulic monitoring
- Provides comprehensive information on position and forces
- Important for automatic control of front implements

- Structurally similar to PGN 65093 (rear suspension), but for front application
- Typical update rate: 100ms

32.14 PGN 65095

32.14.1 PGN

Parameter Group Number (PGN) 65095, also known as **Maintain Power (MP)**, controls the power supply to implements and ECUs after the ignition is switched off. This message is sent by the implement to inform the tractor whether and for how long the power supply should be maintained. **Note:** This message is sent by the implement, not the tractor. It is used to control the power supply. **Parameter Group Number (PGN) 65095**

32.14.1.1 PGN 65095 – Maintain Power (MP)

- **PG Label:** Maintain Power
- **PG Acronym:** MP
- **PG Notes:**
 - Sent when the ignition switches from ON to OFF
 - Or when parameters change
 - 6 SPNs, each with 2 bits (4 states)
 - This is an implement-to-tractor message
- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 71
- **Multipacket:** No
- **Transmission Rate:** As required after receiving the message indicating that the ignition switch has changed from the ON state to the OFF state, or on a change of parameter state
- **PG Data Length:** 8 Bytes
- **Default Priority:** 6
- **PG Reference:** ISO 11783-7

32.14.1.2 Technical Details

- **PG Document:** ISO 11783-7

32.14.1.3 Use Case

This message is used for:

- Safe shutdown of implements
- Maintaining power supply after ignition is switched off
- Status message of implement states (Transport, Park, Ready, In Progress)
- Coordination between tractor and implement during shutdown

32.14.2 SPNs in PGN 65095 – Maintain Power (MP)

32.14.3 SPN 1867 – Maintain ECU Power

- **SP Position:** Bits 1.7-1.8
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:**
 - 00: Off
 - 01: On
 - 10: Error
 - 11: Not available
- **Description:** Requests maintenance of ECU Power Supply On

32.14.4 SPN 1868 – Maintain Actuator Power

- **SP Position:** Bits 1.5-1.6
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** Same as SPN 1867
- **Description:** Requests continued actuator power supply

32.14.5 SPN 1869 – Implement Transport State

- **SP Position:** Bits 2.7-2.8
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** Same as SPN 1867
- **Description:** Implement is in transport state

32.14.6 SPN 1870 – Implement Park State

- **SP Position:** Bits 2.5-2.6
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 1867
- **Description:** Attachment is in parked state

32.14.7 SPN 1871 – Implement ready-to-work state

- **SP Position:** Bits 2.3-2.4
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 1867
- **Description:** Attachment is ready for work

32.14.8 SPN 7447 – Implement in-work state

- **SP Position:** Bits 2.1-2.2
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **States:** As SPN 1867
- **Description:** Attachment is in operation

32.14.8.1 Summary

- The PGN 65095 contains 6 SPNs for power supply and status management.
- All SPNs use 2 bits with 4 states.
- This message is sent from the implement to the tractor.
- Essential for safely shutting down implements.

32.15 PGN 65096

32.15.1 PGN

Parameter Group Number (PGN) 65096, which is referred to as **Wheel-based Speed and Distance (WBSD)**. This message is typically sent by a tractor ECU (Electronic Control Unit) on the implement bus in agricultural and construction machinery. It contains important data such as the measured wheel-based speed, a free-running odometer reading, the direction of travel, and the start/stop switch status. Here is a summary of the key details:

32.15.1.1 PGN 65096 – Wheel-based Speed and Distance (WBSD)

- **PG Label:** Wheel-based Speed and Distance

- **PG Acronym:** WBSD
- **PG Notes:**
 - The message is sent by the tractor ECU on the implement bus.
 - Contains wheel-based speed, odometer reading, direction of travel, and start/stop status.
 - With the ignition off, ECU_PWR and PWR must be held for an additional 2 seconds to send the message (except during engine start).
 - The accuracy of wheel-based and ground-based data may decrease at low speeds.
 - At low speeds, wheel-based information may not update at 100 ms intervals. ... - **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 72
- **Multipacket:** No
- **Transmission Rate:** 100 ms
- **PG Data Length:** 8 Bytes
- **Default Priority:** 3
- **PG Reference:** ISO 11783-7

32.15.1.2 Technical Details

- **SP Start Bit:** 8.7
- **PG Document:** ISO 11783-7 (Standard for agricultural and forestry machinery)

32.15.1.3 Use Case

This message is used to provide information about speed and distance traveled to systems connected to the tractor (e.g., implements). This is particularly important for precise control and regulation tasks in agricultural engineering.

32.15.2 SPNs in PGN 65096 – Wheel-based Speed and Distance (WBSD)

The information you provided relates to the **Suspect Parameter Numbers (SPNs)** contained in **PGN 65096 (Wheel-based Speed and Distance – WBSD)**. Each SPN represents a specific parameter within the message. Here is a detailed breakdown of the SPNs:

32.15.3 SPN 1862 – Wheel-based machine speed

- **SP Position in PG:** Bits 1-2
- **SP Length:** 16 Bits
- **Scaling:** 0.001 m/s per bit
- **Offset:** 0
- **Description:** Specifies the wheel-based speed of the machine in meters per second (m/s).

32.15.4 SPN 1863 – Wheel-based machine distance

- **SP Position in PG:** Bits 3-6
- **SP Length:** 32 Bits
- **Scaling:** 0.001 m per bit
- **Offset:** 0
- **Description:** A free-running distance counter that indicates the distance traveled in meters (m).

32.15.5 SPN 1866 – Maximum Time of Tractor Power

- **SP Position in PG:** Bit 7
- **SP Length:** 8 Bits

- **Scaling:** 1 minute per bit
- **Offset:** 0
- **Description:** Indicates the maximum time for which tractor power is maintained (in minutes).

32.15.6 SPN 1864 – Wheel-based machine direction

- **SP Position in PG:** Bits 8.1-8.2
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Offset:** 0
- **Description:** Indicates the direction of travel of the machine. The 4 possible states are:
 - 00: Forward
 - 01: Reverse
 - 10: Neutral
 - 11: Invalid

32.15.7 SPN 1865 – Key switch state

- **SP Position in PG:** Bits 8.3-8.4
- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Offset:** 0
- **Description:** Indicates the state of the ignition switch. The 4 possible states are:
 - 00: Off
 - 01: On
 - 10: Start
 - 11: Invalid

32.15.8 SPN 5203 – Implement Start/Stop operations

- **SP Position in PG:** Bits 8.5-8.6
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **Offset:** 0
- **Description:** Specifies the state of the start/stop operations for implements. The 4 possible states are:
 - 00: Stop
 - 01: Start
 - 10: Pause
 - 11: Invalid

32.15.9 SPN 5244 – Operator direction reversed

- **SP Position in PG:** Bits 8.7-8.8
- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **Offset:** 0
- **Description:** Indicates whether the operator direction is reversed. The 4 possible states are:
 - 00: Normal
 - 01: Reversed
 - 10: Neutral
 - 11: Invalid

32.15.9.1 Summary

- The PGN 65096 contains 7 SPNs that describe various parameters such as speed, distance, direction of travel, ignition switch state, and start/stop operations.
- Each SPN has a fixed position, length, and scale within the 8-byte message.
- The SPNs partially use 2-bit fields to represent 4 states.

32.16 PGN 65097

32.16.1 PGN

Parameter Group Number (PGN) 65097, also known as **Ground-based Speed and Distance (GBSD)**, transmits ground-based speed and distance data from agricultural machinery. This message is part of the ISOBUS standard according to ISO 11783.

32.16.1.1 PGN 65097 – Ground-based Speed and Distance (GBSD)

- **PG Label:** Ground-based Speed and Distance
- **PG Acronym:** GBSD
- **PG Notes:**
 - Sent by the tractor ECU
 - Provides independent speed measurement (not wheel-based)
 - Especially important in slip conditions
 - Alternative to PGN 65096 (WBSD)
- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 73
- **Multipacket:** No
- **Transmission Rate:** 100 ms
- **PG Data Length:** 8 Bytes
- **Default Priority:** 3
- **PG Reference:** ISO 11783-7

32.16.1.2 Technical Details

- **SP Start Bit:** Varies depending on the SPN
- **PG Document:** ISO 11783-7

32.16.1.3 Application Case

This message is used for:

- Precise speed measurement independent of wheel slip
 - Precision agricultural applications
 - Automatic steering systems
 - Section control
-

32.16.2 SPNs in PGN 65097 – Ground-based Speed and Distance

32.16.3 SPN 1859 – Ground-based machine speed

- **SP Position:** Bits 1-2
- **SP Length:** 16 bits
- **Scaling:** 0.001 m/s per bit
- **Range:** 0-65.535 m/s ($\approx$ 236 km/h)
- **Accuracy:** $\pm$ 0.001 m/s
- **Description:** Ground speed (independent of wheel slip)

32.16.4 SPN 1860 – Ground-based machine distance

- **SP Position:** Bits 3-6
- **SP Length:** 32 Bits
- **Scaling:** 0.001 m per bit
- **Range:** 0-4,294,967,295 m
- **Description:** Ground-based distance measurement

32.16.5 SPN 1861 – Ground-based machine direction

- **SP Position:** Bits 8.1-8.2
 - **SP Length:** 2 Bits
 - **States:**
 - 00: Forward
 - 01: Reverse
 - 10: Stationary
 - 11: Invalid
 - **Description:** Direction of travel based on ground movement
-

32.16.5.1 Summary

- Contains 3 essential parameters for ground-based motion detection
- Critical for precise agricultural applications
- Independent of wheel slip (unlike WBSD)
- Standard update rate: 100 ms
- Typically combined with GPS or radar sensors

Important: This PGN is specific to ground-based measurements and complementary to wheel-based measurements (PGN 65096).

32.17 PGN 65254

32.17.1 PGN

Parameter Group Number (PGN) 65254, also known as **Time/Date (TD)**, transmits current time and date information in the ISOBUS network. This message is important for time synchronization, logging, and timestamping in agricultural machinery. **

32.17.1.1 PGN 65254 – Time/Date (TD)

- **PG Label:** Time/Date
- **PG Acronym:** TD
- **PG Notes:**
 - Sent on request
 - Contains UTC time and local time zone offsets
 - Typically provided by the tractor ECU
 - Year offset from 1985 (value 0 = 1985)
- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 230
- **Multipacket:** No
- **Transmission Rate:** On request
- **PG Data Length:** 8 Bytes
- **Default Priority:** 6
- **PG Reference:** ISO 11783-7

32.17.1.2 Technical Details

- **PG Document:** ISO 11783-7

32.17.1.3 Use Case

This message is used for:

- Time synchronization between ECUs
 - Timestamps for process data logging
 - Documentation of working hours
 - Correct time information in the task controller and FMIS
-

32.17.2 SPNs in PGN 65254 – Time/Date (TD)

32.17.3 SPN 959 – Seconds

- **SP Position:** Byte 1
- **SP Length:** 8 bits
- **Scaling:** 0.25 s per bit
- **Offset:** 0 s
- **Range:** 0 to 59.75 s
- **Unit:** s
- **Description:** Seconds (0-59)

32.17.4 SPN 960 – Minutes

- **SP Position:** Byte 2
- **SP Length:** 8 bits
- **Scaling:** 1 minute per bit
- **Offset:** 0 min
- **Range:** 0 to 59 min
- **Unit:** min
- **Description:** Minutes (0-59)

32.17.5 SPN 961 – Hours

- **SP Position:** Byte 3
- **SP Length:** 8 Bits
- **Scaling:** 1 h per bit
- **Offset:** 0 h
- **Range:** 0 to 23 h
- **Unit:** h
- **Description:** Hours (0-23)

32.17.6 SPN 963 – Month

- **SP Position:** Byte 4
- **SP Length:** 8 Bits
- **Scaling:** 1 month per bit
- **Offset:** 0 month
- **Range:** 1 to 12 months
- **Unit:** month
- **Description:** Month (1-12)

32.17.7 SPN 962 – Day

- **SP Position:** Byte 5
- **SP Length:** 8 Bits
- **Scaling:** 0.25 days per bit
- **Offset:** 0 days
- **Range:** 0.25 to 31.75 days
- **Unit:** days
- **Description:** Day (0.25 steps, 1-31)

32.17.8 SPN 964 – Year

- **SP Position:** Byte 6
- **SP Length:** 8 Bits
- **Scaling:** 1 year per bit
- **Offset:** 1985 year
- **Range:** 1985 to 2235
- **Unit:** year

- **Description:** Year (Offset 1985, Value 0 = 1985)

32.17.9 SPN 1601 – Local minute offset

- **SP Position:** Byte 7
- **SP Length:** 8 bits
- **Scaling:** 1 minute per bit
- **Offset:** –125 minutes
- **Range:** –59 to 59 minutes
- **Unit:** minutes
- **Description:** Local time offset in minutes (for time zone)

32.17.10 SPN 1602 – Local hour offset

- **SP Position:** Byte 8
 - **SP Length:** 8 bits
 - **Scaling:** 1 hour per bit
 - **Offset:** –125 hours
 - **Range:** –23 to 23 hours
 - **Unit:** hours
 - **Description:** Local time offset in hours (for time zone)
-

32.17.10.1 Summary

- PGN 65254 contains 8 SPNs for complete time/date information.
- Time zone is specified by the local minute/hour offset.
- The year has an offset of 1985.
- Important for logging and synchronization in the ISOBUS network.

32.18 PGN 65255

32.18.1 PGN

Parameter Group Number (PGN) 65255, also known as **Vehicle Hours (VH)**, contains operating hour information for the vehicle and the power take-off (PTO). This information is important for maintenance and performance analysis.

32.18.1.1 PGN 65255 – Vehicle Hours (VH)

- **PG Label:** Vehicle Hours
- **PG Acronym:** VH
- **PG Notes:**
 - Contains total vehicle operating hours
 - Contains power take-off (PTO) operating hours
 - Important for maintenance intervals
 - J1939 message, typically also sent via ISOBUS
- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 231
- **Multipacket:** No
- **Transmission Rate:** On request
- **PG Data Length:** 8 Bytes
- **Default Priority:** 6
- **PG Reference:** J1939DA

32.18.1.2 Technical Details

- **PG Document:** J1939DA

32.18.1.3 Use Case

This message is used for:

- Maintenance Interval Monitoring
 - Performance Analysis and Logging
 - Operating Hour Recording for Attachments
 - Documentation in Task Controller and FMIS
-

32.18.2 SPNs in PGN 65255 – Vehicle Hours (VH)

32.18.3 SPN 246 – Total Vehicle Hours

- **SP Position:** Bytes 1-4
- **SP Length:** 32 Bits
- **Scaling:** 0.05 h/Bit
- **Offset:** 0
- **Range:** 0 to 210,554,060.75 h
- **Unit:** h
- **Description:** Total operating hours of the vehicle

32.18.4 SPN 248 – Total Power Takeoff Hours

- **SP Position:** Bytes 5-8
 - **SP Length:** 32 Bits
 - **Scaling:** 0.05 h/Bit
 - **Offset:** 0
 - **Range:** 0 to 210,554,060.75 h
 - **Unit:** h
 - **Description:** Total Power Take-Off (PTO) operating hours
-

32.18.4.1 Summary

- PGN 65255 contains 2 SPNs for operating hours.
- Important for maintenance and documentation.
- Although a J1939 message, it is typically also sent via ISOBUS.
- The message is sent on request.
- For complete details, see J1939DA.

32.19 Vehicle Direction/Speed (VDS) – PGN 65256 (0x18FEE8FE) in the J1939 Protocol

32.19.1 Introduction

The **Vehicle Direction/Speed (VDS) – Parameter Group Number (PGN) 65256 (0x18FEE8FE)** is a message in the **SAE J1939 protocol** used in commercial vehicle and off-highway communication. It provides important information about the **vehicle's movement**, including **altitude, inclination, speed, and compass direction**. This data is particularly relevant for **vehicle navigation systems, telematics, and driver assistance systems**.

32.19.2 Technical Specification of PGN 65256

The technical description in the file shows the structure of this message: [VDS] ID=18FEE8FEh

32.19.3 Structure of the VDS Message

The VDS message has a **Data Length (DLC) of 8 bytes** and is typically transmitted at **1-second intervals** (**CycleTime = 1000 ms**). It contains four main parameters:

32.19.3.1 1. SPN-580 - Altitude (height above sea level)

- **Position:** 48 bits (6 bytes), 16-bit resolution
- **Unit:** Meters (m)
- **Factor:** 0.125
- **Offset:** -2500
- **Range:** -2500 m to +5531.875 m
- **SPN (Suspect Parameter Number):** 580

The altitude refers to **sea level under standard atmospheric conditions** (ISO 2533). The -2500 m offset allows for the representation of low-lying areas (e.g., below sea level).

32.19.3.2 2. SPN-583 - Pitch (Angle of Inclination)

- **Position:** 32 bits (4 bytes), 16-bit resolution
- **Unit:** Degrees (°)
- **Factor:** 0.0078125 (1/128)
- **Offset:** -200
- **Range:** -200° to +301.9921875°
- **SPN:** 583

The **pitch angle** describes the **rotation around the transverse axis (Y-axis)** of the vehicle. A positive value indicates **ascent (going uphill)**, a negative value **decline (going downhill)**. The definition follows a **Z-down coordinate system**, which is common in aviation and navigation.

32.19.3.3 3. SPN-517 - Navigation-Based Vehicle Speed

- **Position:** 16 bits (2 bytes), 16-bit resolution
- **Unit:** km/h
- **Factor:** 0.00390625 (1/256)
- **Range:** 0 to 250.99609375 km/h
- **SPN:** 517

This speed is determined **not via wheel sensors**, but via **navigation systems such as GPS**. It is particularly useful when the wheel speed is inaccurate (e.g., due to wheel slippage or tire pressure loss).

32.19.3.4 4. SPN-165 - Compass Bearing (Compass Direction)

- **Position:** 0 bits (first byte), 16-bit resolution
- **Unit:** Degrees (°)
- **Factor:** 0.0078125 (1/128)
- **Range:** 0° to 501.9921875° (modulo 360° for true compass values)
- **SPN:** 165

The **compass direction** indicates the **current direction of travel** of the vehicle (0° = north, 90° = east, etc.). The value can exceed 360° but is typically normalized to 0°–360°.

Compass direction indicates the **current direction of travel** of the vehicle (0° = north, 90° = east, etc.). The value can exceed 360° but is typically normalized to 0°–360°.**

32.19.4 Areas of Application

The VDS message is used in various systems, including:

- **Telematics Systems** (e.g., Fleet Management)
- **Advanced Driver Assistance Systems (ADAS)**
- **Off-Road and Construction Equipment Control**
- **Autonomous Vehicles & Precision Farming**

Since speed and direction are **GPS-based**, this message is particularly suitable for applications where **wheel encoders would be inaccurate** (e.g., on slippery surfaces).

32.19.5 Summary

The **VDS-PGN 65256 (0x18FEE8FE)** is an important J1939 message that provides the **altitude, pitch, speed, and direction** of a vehicle. Due to its GPS-based speed measurement and precise angle infor-

mation, it is particularly valuable for **navigation and automation systems**. The defined SPNs enable easy integration into existing J1939 networks, making them a central element of modern vehicle communication.

32.20 PGN 65265

32.20.1 PGN

Parameter Group Number (PGN) 65265, also known as **Cruise Control/Vehicle Speed 1 (CCVS1)**, is an important J1939 message containing information about vehicle speed, cruise control, and various switch states. It is also typically transmitted on the ISOBUS implement bus of tractors. **Parameter Group Number (PGN) 65265**, also known as **Cruise Control/Vehicle Speed 1 (CCVS1)**, is an important J1939 message containing information about vehicle speed, cruise control, and various switch states.** It is also typically transmitted on the ISOBUS implement bus of tractors. **Parameter Group Number (PGN) 65265**

32.20.1.1 PGN 65265 – Cruise Control/Vehicle Speed 1 (CCVS1)

- **PG Label:** Cruise Control/Vehicle Speed 1
- **PG Acronym:** CCVS1
- **PG Notes:**
 - J1939 message, but is also typically sent via ISOBUS
 - Contains Wheel-Based Vehicle Speed
 - Cruise control switch and states
 - Brake, clutch, and parking brake switches
 - Sent by the tractor ECU
- **EDP:** 0
- **DP:** 0
- **PF:** 240
- **PS:** 4
- **Multipacket:** No
- **Transmission Rate:** 100 ms
- **PG Data Length:** 8 Bytes
- **Default Priority:** 3
- **PG Reference:** J1939DA

32.20.1.2 Technical Details

- **PG Document:** J1939DA

32.20.1.3 Use Case

This message is used for:

- Vehicle speed monitoring
- Cruise control functions
- Brake and clutch status detection
- Parking brake switch evaluation
- Speed control of attachments

32.20.2 SPNs in PGN 65265 – Cruise Control/Vehicle Speed 1 (CCVS1)

32.20.3 SPN 69 – Two-Speed Axle Switch

- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **Description:** Two-speed axle switch

32.20.4 SPN 70 – Parking Brake Switch

- **SP Length:** 2 bits

- **Scaling:** 4 states per 2 bits
- **Description:** Parking brake switch

32.20.5 SPN 1633 – Cruise Control Pause Switch

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Description:** Cruise control pause switch

32.20.6 SPN 3807 – Park Brake Release Inhibit Request

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Description:** Request to lock parking brake release

32.20.7 SPN 84 – Wheel-Based Vehicle Speed

- **SP Length:** 16 Bits
- **Scaling:** 1/256 km/h per bit
- **Offset:** 0
- **Range:** 0 to 250.996 km/h
- **Unit:** km/h
- **Description:** Wheel-based vehicle speed

32.20.8 SPN 595 – Cruise Control Active

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits 2 Bits
- **Description:** Cruise control enabled

32.20.9 SPN 596 – Cruise Control Enable Switch

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Description:** Cruise control enable switch

32.20.10 SPN 597 – Brake Switch

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Description:** Brake switch

32.20.11 SPN 598 – Clutch Switch

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Description:** Clutch switch

32.20.12 SPN 599 – Cruise Control Set Switch

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Description:** Cruise control set switch

32.20.13 SPN 600 – Cruise Control Coast (Decelerate) Switch

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Description:** Cruise control decelerate switch

32.20.14 SPN 601 – Cruise Control Resume Switch

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Description:** Cruise control resume switch

32.20.15 SPN 602 – Cruise Control Accelerate Switch

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Description:** Cruise control accelerate switch

32.20.16 SPN 86 – Cruise Control Set Speed

- **SP Length:** 8 Bits
- **Scaling:** 1 km/h per bit
- **Offset:** 0
- **Range:** 0 to 250 km/h
- **Unit:** km/h
- **Description:** Cruise control set speed

32.20.17 SPN 976 – PTO Governor State

- **SP Length:** 5 bits
- **Scaling:** 32 states per 5 bits
- **Description:** PTO governor state

32.20.18 SPN 527 – Cruise Control States

- **SP Length:** 3 bits
- **Scaling:** 8 states per 3 bits
- **Description:** Cruise control state

32.20.19 SPN 968 – Engine Idle Increment Switch

- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **Description:** Idle increment switch

32.20.20 SPN 967 – Engine Idle Decrement Switch

- **SP Length:** 2 bits
- **Scaling:** 4 states per 2 bits
- **Description:** Idle Speed Reduction Switch

32.20.21 SPN 966 – Engine Diagnostic Test Mode Switch

- **SP Length:** 2 Bits
- **Scaling:** 4 states per 2 bits
- **Description:** Engine Diagnostic Test Mode Switch

32.20.22 SPN 1237 – Engine Shutdown Override Switch

- **SP Length:** 2 Bits
 - **Scaling:** 4 states per 2 bits
 - **Description:** Engine Shutdown Override Switch
-

32.20.22.1 Summary

- PGN 65265 contains 21 SPNs for vehicle speed and cruise control.

- Key parameters: Wheel-Based Vehicle Speed (SPN 84) and Cruise Control Set Speed (SPN 86).
- Although a J1939 message, it is typically also sent via ISOBUS.
- The message is sent at a rate of 100 ms.
- For complete details, see J1939DA.

32.21 PGN 65267

32.21.1 PGN

Parameter Group Number (PGN) 65267, also known as **Vehicle Position 1 (VP1)**, transmits basic vehicle position data. This message is part of the SAE J1939 standard. **Parameter Group Number (PGN) 65267**, also known as **Vehicle Position 1 (VP1)**, transmits basic vehicle position data.** This message is part of the SAE J1939 standard. **Parameter Group Number (PGN) 65267**

32.21.1.1 PGN 65267 – Vehicle Position 1 (VP1)

- **PG Label:** Vehicle Position 1
- **PG Acronym:** VP1
- **PG Notes:**
 - Typically sent by GPS modules
 - Contains basic geographic coordinates
 - Important for positioning and navigation
 - Often combined with other navigation PGNs
- **EDP:** 0
- **DP:** 0
- **PF:** 254
- **PS:** 243
- **Multipacket:** No
- **Transmission Rate:** 100-1000 ms
- **PG Data Length:** 8 Bytes
- **Default Priority:** 6
- **PG Reference:** SAE J1939-71

32.21.1.2 Technical Details

- **SP Start Bit:** See SPN definitions
- **PG Document:** SAE J1939-71

32.21.1.3 Use Case

Enables the transmission of:

- Latitude
- Longitude
- Used for basic positioning

32.21.2 SPNs in PGN 65267 – Vehicle Position 1

32.21.3 SPN 584 – Latitude

- **SP Position:** Bits 1-4
- **SP Length:** 32 bits
- **Scaling:** 1e-7 degrees per bit
- **Range:** $\pm 90^\circ$ (North/South)
- **Accuracy:** 0.0000001°
- **Description:** Latitude in decimal degrees

32.21.4 SPN 585 – Longitude

- **SP Position:** Bits 5-8
- **SP Length:** 32 bits

- **Scaling:** 1e-7 Deg per bit
 - **Range:** $\pm 180^\circ$ (East/West)
 - **Accuracy:** 0.0000001°
 - **Description:** Geographic longitude in decimal degrees
-

32.21.4.1 Summary

- Includes 2 basic position parameters
- High-precision positioning (up to 1.1 cm accuracy)
- Often combined with PGN 65256 (VDS)
- Typical update rate: 100-1000 ms
- Important for precision agriculture and navigation

33. Technik

33.1 Transmission Technology, Chassis & Steering Systems

 **Source & Legal Basis:** **Source:** *Framework Curriculum for the Preparation for the Master Craftsman Examination in Agricultural and Construction Machinery Mechatronics* **Publisher:** German Association of Agricultural and Construction Machinery Mechatronics Technicians (LandBauTechnik-Bundesverband e. V.), Alfredstraße 102, 45131 Essen (as of February 25, 2025) **Regulation:** *Master Craftsman Examination Regulation (LandBauMechMstrV)* of September 9, 2024 (Federal Law Gazette 2024 I No. 277, effective August 1, 2025)

Framework Curriculum Category: Part I LE 2.3 | Part II LE 1.1

Relevance: Mechanical, hydraulic, and electronic systems for power transmission and chassis guidance.

33.1.1 1. Transmission Technology & Power Splitting

33.1.1.1 Continuously Variable Transmissions (CVT / Vario)

- **Principle:** Hydrostatic-mechanical power splitting.
- **Components:** Planetary gear set, variable displacement pump, and variable displacement motor.
- **Advantage:** Continuously variable adjustment of the gear ratio at the optimal engine speed.

33.1.1.2 Power Shift Transmissions

- **Function:** Shifting under load without interruption of traction using wet multi-plate clutches and solenoid valves.
 - **Calibration:** Learning the clutch filling times and pressures using a diagnostic tester.
-

33.1.2 2. Chassis & Hydro-Pneumatic Suspension

33.1.2.1 Suspension Systems

- **Hydro-Pneumatic Suspension:** Nitrogen accumulators as the spring element, hydraulic oil as the transmission medium.
 - **Level Control:** Position sensors detect the axle spacing; Solenoid valves adjust the oil volume in the suspension cylinder.
-

33.1.3 3. Steering Systems & Assistance

33.1.3.1 Hydrostatic & Electro-hydraulic Steering

- **Orbitrol (Hydraulic Steering):** Uninterrupted mechanical-hydraulic emergency steering capability.
- **All-Wheel & Articulated Steering:** Electronic control of multiple steering modes (front-wheel steering, all-wheel steering, crab steering) with steering angle sensors.
- ...

33.2 High-Voltage (HV) Technology & E-Mobility in Commercial Vehicles

 **Source & Legal Basis:** **Source:** *Framework Curriculum for the Preparation for the Master Craftsman Examination in Agricultural and Construction Machinery Mechatronics* **Publisher:** German Association of Agricultural and Construction Machinery Mechatronics Technicians (LandBauTechnik-Bundesverband e. V.), Alfredstraße 102, 45131 Essen (as of February 25, 2025) **Regulation:** *Master Craftsman Examination Regulation (LandBauMechMstrV)* of September 9, 2024 (Federal Law Gazette 2024 I No. 277, effective August 1, 2025)

Framework Curriculum Category: Part I LE 2.3 | Part II LE 1.1 & LE 1.3 **Relevance:** Safety and maintenance regulations for electric and hybrid agricultural and construction machinery.

33.2.1 1. Safety Rules & DGUV Regulations

33.2.1.1 Legal Basis & Qualification

- **DGUV Information 209-093 / DGUV 200-005:** Qualification for work on vehicles with high-voltage systems (HV levels 1, 2, and 3).
- **Voltage Limits:** AC voltage > 30 ext{V AC}\$ or DC voltage > 60 ext{V DC}\$ is considered high voltage.

33.2.1.2 5 Safety Rules for De-energizing

1. Disconnect (pull the HV service disconnecter / main switch).
 2. Secure against reconnection (padlock / warning sign).
 3. Verify absence of voltage (two-pole test adapter / measurement at test points +, –, PE).
 4. Grounding and short-circuiting (from 1,000 ext{V}\$).
 5. Cover or barricade adjacent live parts.
-

33.2.2 2. Battery Technology & Power Electronics

33.2.2.1 Lithium-Ion Batteries & BMS

- **Cell Chemistry:** NMC (Nickel-Manganese-Cobalt), LFP (Lithium Iron Phosphate).
- **BMS (Battery Management System):** Cell balancing, monitoring of cell voltage, temperature, and insulation resistance (ISO monitor).

33.2.2.2 Inverters & Electric Motors

- **Inverters:** Conversion of DC battery voltage to 3-phase AC for the drive system.
- **Motor Types:** Permanent Magnet Synchronous Motors (PSM), Induction Motors (ASM) with regenerative braking capability.

33.3 Hydraulics & Electrohydraulics in Agricultural and Construction Machinery

 **Source & Legal Basis:** **Source:** *Framework Curriculum for the Preparation for the Master Craftsman Examination in Agricultural and Construction Machinery Mechatronics* **Publisher:** German Association of Agricultural and Construction Machinery Mechatronics Engineers (LandBauTechnik-Bundesverband e. V.), Alfredstraße 102, 45131 Essen (as of February 25, 2025) **Regulation:** *Master Craftsman Examination Regulation (LandBauMechMstrV)* of September 9, 2024 (Federal Law Gazette 2024 I No. 277, effective August 1, 2025)

Framework Curriculum Category: Part I LE 2.4 | Part II LE 1.1 & LE 1.3

Relevance: Core technology for working functions, power transmission, and steering systems.

33.3.1 1. Hydraulic Systems & Variable Displacement Pumps

33.3.1.1 Pump Types & Efficiencies

- **Constant Displacement Pumps:** Gear pumps, piston pumps (used in simple hydraulic circuits).
- **Variable Displacement Pumps:** Axial piston pumps with swashplate design (used in load-sensing systems).
- **Efficiencies:** Volumetric and mechanical-hydraulic efficiency, minimizing power loss.

33.3.1.2 Load-Sensing (LS) Control Principle

- **Function:** The pump delivers only the pressure ($p_{LS} + \Delta p$) and flow rate required by the most active consumer.
 - **LS Signal Line:** Transmits the highest load pressure of all active consumers to the pump controller.
 - **Advantages:** High energy efficiency, low oil heating, simultaneous operation of multiple consumers regardless of the load.
-

33.3.2 2. Electrohydraulics & Proportional Valve Technology

33.3.2.1 Valve Types & Control

- **Proportional Directional Control Valves:** Stepless control of oil flow and direction of movement.
- **PWM Control:** Pulse-width modulated signals (typically 100–300 Hz) to reduce hysteresis and friction at the solenoid coils.
- **Slider Position Feedback:** Hall sensors / LVDT sensors for precise slide monitoring in a closed-loop control system.

33.3.2.2 CAN Bus-Controlled Valve Blocks

- Decentralized valve control units with integrated CAN bus node (ISOBUS / J1939 communication).
 - Fault diagnosis: Short circuit, open circuit, coil overheating, slide jamming.
-

33.3.3 3. Hydraulic Media & Circuit Diagram Reading (ISO 1219)

33.3.3.1 Oils & Environmental Protection

- **Mineral Oils:** HLP, HVLP (Viscosity Classes ISO VG 32, 46, 68).
- **Bio-Oils:** HEES (Synthetic Esters), Biodegradability, Compatibility with Sealing Materials (FKM, NBR).

33.3.3.2 Standards & Symbols

- Reading of complex ISO 1219-1 circuit diagrams: Pressure relief valves, flow control valves, hydraulic accumulators, logic valves (cartridge technology).
-

33.3.3.3 Related topic subpages on ms-muc-docs.de

- [ The PWM Signal & Infographic on ms-muc-docs.de]

33.4 Machine Safety, Standards & Inspections (UVV / SP / CE)

 **Source & Legal Basis:** **Source:** *Framework Curriculum for Preparation for the Master Craftsman Examination in Agricultural and Construction Machinery Mechatronics* **Publisher:** German Association of Agricultural and Construction Machinery Mechatronics Engineers (LandBauTechnik-Bundesverband e. V.), Alfredstraße 102, 45131 Essen (as of February 25, 2025) **Regulation:** *Master Craftsman Examination Regulation (LandBauMechMstrV)* of September 9, 2024 (Federal Law Gazette 2024 I No. 277, effective August 1, 2025)

Framework Curriculum Category: Part I LE 1.3 & LE 2.5 | Part II LE 1.2 & LE 2.2 **Relevance:** Legal responsibility and documentation obligations of the master craftsman.

33.4.1 1. Statutory Inspections in the Agricultural and Construction Machinery Industry

33.4.1.1 DGUV Regulations & Accident Prevention Regulations

- **DGUV Regulation 70/73 (Accident Prevention Regulations):** Regular inspection of vehicles and winches, lifting and pulling equipment by qualified personnel.
- **Inspection Reports:** Legally compliant recording, documentation of defects, and inspection sticker.

33.4.1.2 Safety Inspection (SP) & Emissions Test (AU)

- **SP according to § 29 StVZO:** Recurring inspection of the chassis, suspension, steering, braking system, and wheels of high-speed tractors (> 40 km/h) and construction machinery.
 - **Emissions & Exhaust Gas Test:** Verification of compliance with opacity limits or particle number (PN measurement from Stage V).
-

33.4.2 2. Machine Safety & CE Conformity

33.4.2.1 Machinery Directive 2006/42/EC & Regulation (EU) 2023/1230

- **Risk assessment according to EN ISO 12100:** Identification of hazards, design safeguards, technical safeguards, user information.
- **Safety-related parts of control systems:** EN ISO 13849-1 (Performance Level PL a to PL e) and AgPL (Agricultural Performance Level).

33.4.2.2 Type Approval EU 167/2013 (Tractor Mother Regulation)

- Harmonised design and testing regulations for agricultural and forestry vehicles in the EU (brakes, occupant protection, lighting).

33.5 Internal Combustion Engines & Exhaust Aftertreatment (EU Stage V)

 **Source & Legal Basis:** **Source:** Framework Curriculum for the Preparation for the Master Craftsman Examination in Agricultural and Construction Machinery Mechatronics **Publisher:** German Association of Agricultural and Construction Machinery Mechatronics Engineers (LandBauTechnik-Bundesverband e. V.), Alfredstraße 102, 45131 Essen (as of February 25, 2025) **Regulation:** Master Craftsman Examination Regulation (LandBauMechMstrV) of September 9, 2024 (Federal Law Gazette 2024 I No. 277, effective August 1, 2025)

Framework Curriculum Category: Part I LE 2.3 | Part II LE 1.1 & LE 1.3

Relevance: Drive and emission control systems of modern agricultural and construction machinery.

33.5.1 1. Common Rail Injection & Turbocharging

33.5.1.1 Common Rail Systems

- **High-Pressure Generation:** Pressures up to 2,500 bar using radial piston pumps.
- **Injectors:** Piezo and solenoid injectors with multiple injection (piston, main, and post-injection).
- **Fault Diagnosis:** Return flow measurement, high-pressure sensors, zero-quantity calibration.

33.5.1.2 Turbochargers & Boost Pressure Control

- **VTG / VGT (Variable Turbine Geometry):** Adjustable guide vanes for optimizing boost pressure at low engine speeds.
- **Intercooler:** Increased air density for efficient combustion.

33.5.2 2. Exhaust Aftertreatment according to EU Stage V

33.5.2.1 Exhaust Gas Purification Components

1. **DOC (Diesel Oxidation Catalyst):** Conversion of CO and hydrocarbons (HC) to CO₂ and H₂O, oxidation of NO to NO₂.
2. **DPF (Diesel Particulate Filter):** Physical filtration of soot particles; passive and active regeneration through late injection.
3. **SCR (Selective Catalytic Reduction):** Injection of AdBlue (32.5% urea solution) to reduce nitrogen oxides (NO_x) to nitrogen (N₂) and water (H₂O).
4. **EGR (Exhaust Gas Recirculation):** Cooled recirculation of exhaust gas to reduce the combustion temperature.

33.5.2.2 Sensors & Diagnostics

- NO_x sensors (before and after the SCR catalyst), differential pressure sensor (DPF soot load), exhaust gas temperature sensors (EGTS).
- Derate conditions (reduction in power and speed due to AdBlue shortage or exhaust gas faults).

33.6 Pneumatics & Compressed Air Brake Systems

 **Source & Legal Basis:** **Source:** *Framework Curriculum for the Preparation for the Master Craftsman Examination in Agricultural and Construction Machinery Mechatronics* **Publisher:** German Association of Agricultural and Construction Machinery Mechatronics Engineers (LandBauTechnik-Bundesverband e. V.), Alfredstraße 102, 45131 Essen (as of February 25, 2025) **Regulation:** *Master Craftsman Examination Regulation (LandBauMechMstrV)* of September 9, 2024 (Federal Law Gazette 2024 I No. 277, effective August 1, 2025)

Framework Curriculum Category: Part I LE 2.4 | Part II LE 1.1 **Relevance:** Safety-relevant systems for brakes and auxiliary functions in tractors, trailers, and construction machinery.

33.6.1 1. Compressed Air Generation & Treatment

33.6.1.1 Compressor & Pressure Regulation

- **Piston Compressors:** Single- and two-stage compression.
- **Pressure Regulators:** Controls the cut-in and cut-out pressure (e.g., 8.1 bar / 10.0 bar).
- **Air Drying Systems:** Single- and dual-chamber air dryers with cartridge and automatic regeneration phase.

33.6.1.2 Multi-Circuit Protection Valves

- Protection of individual brake circuits (service brake circuits 1 & 2, parking brake, auxiliary consumers).
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33.6.2 2. Trailer Brake Systems (1- & 2-Line Systems)

33.6.2.1 2-Line Compressed Air Brake System (Standard according to EU 167/2013)

- **Supply Line (Red):** Constant supply pressure from the tractor unit to the trailer (approx. 7.0–8.5 bar).
- **Control Line (Yellow):** Transmits the brake pressure-dependent control pressure when the foot brake is applied (0–7.5 bar).
- **Trailer Brake Valve:** Controls the pressure supply from the trailer reservoir to the brake cylinders.

33.6.2.2 ALB (Automatic Load-Dependent Brake Force Control)

- Mechanical linkage on the trailer axle or pneumatic actuation with air suspension.

- Adjusts the brake pressure to the load condition (empty, partial, and full load) to prevent overbraking/wheel lockup.

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33.6.3 3. ABS / EBS Systems in Agricultural and Construction Machinery

- **Electronic Braking System (EBS):** Senses wheel speeds (inductive/Hall sensors) and electronically modulates the brake pressures.
- **Circular Connector:** ISO 7638 connector for power supply and CAN data transmission of the EBS between the tractor unit and trailer.