

THE MEASURABLE DIFFERENCE.



DEWETRON

▼

OXYGEN Training CAN CAN-FD FlexRay



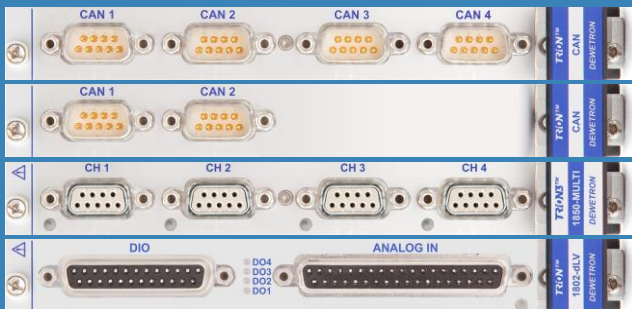


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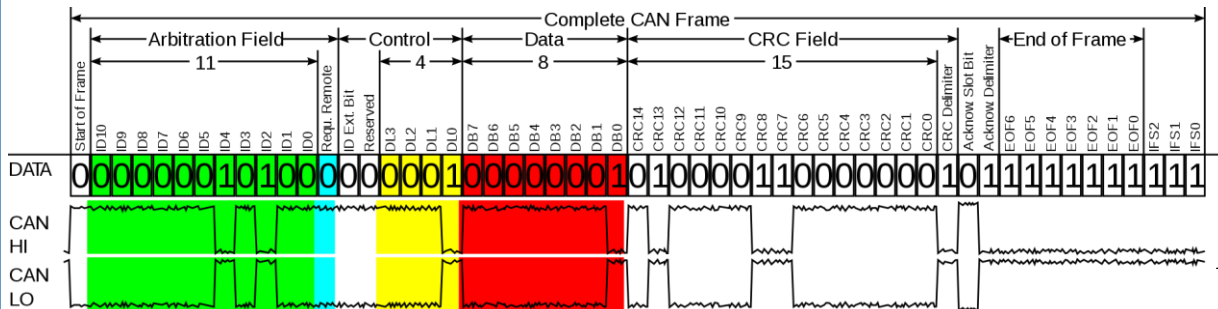
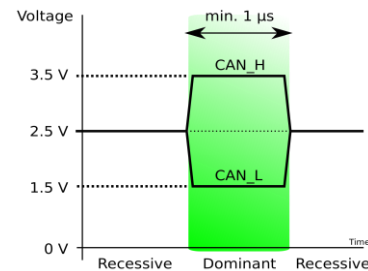
CAN

CAN port available on

- > TRION-CAN (2/4 port)
- > TRION-2402-MULTI (1 port)
- > TRION-1802/1600-dLV (1 port)
- > TRION-1820-MULTI (1 port)
- > TRION(3)-18x0-MULTI (1 port)



- > CAN (Control Area Network) is a serial bus system and was initiated 1983 by BOSCH and is mainly used in the automotive industries
- > Differential data transmission, CAN-High, CAN-Low ref. to CAN-GND
- > High Speed CAN (1 Mbaud) for short distances and much data vs. Low Speed CAN (125 kBaud) for long distances and reduced data
- > Data: 0-8 times 8-bit



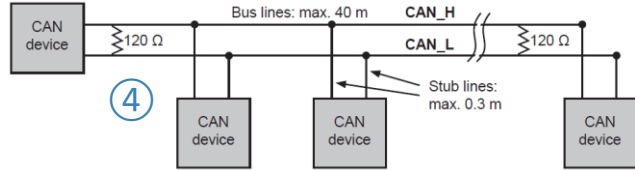


CAN – CAN Port Configuration

- ① Go to the CAN port configuration
- ② Select the proper Baud rate of the CAN bus
- ③ Not applicable for CAN receive
- ④ Optionally apply a 120 Ohm resistor to the CAN bus
- ⑤ Not applicable for CAN receive
- ⑥ Sets the time base on which the CAN signals are aligned
- ⑦ If all settings are applied correctly, the frame preview will show the received messages
- ⑧ If CPAD are used, the a decoder can be added to decode the signals without a dbc-file

The screenshot shows the DEWETRON software interface. On the left, a tree view shows the 'LocalNode' containing 'DEWE3-A4' and 'USB-Cameras'. Under 'DEWE3-A4', there is a 'TRION-CAN-4' folder with four sub-items: 'CAN 1/1 Sim', 'CAN 1/2 Sim', 'CAN 1/3 Sim', and 'CAN 1/4 Sim'. The 'PORT CONFIG' panel on the right shows settings for 'CAN 1/1' (SN:1234567890) on 'TRION-CAN-4'. The settings are: Baud rate (50000 Baud), Listen only (False), Termination (False), Autonomous Resend (False), Timestamp (AD Sample Rate), and CPAD (Add decoder). Below this is a 'FRAME PREVIEW' section showing a message ID of '0xae' and a bitstream table. At the bottom, a list of AI channels is shown, with 'AI 1/1@TRIONet_RL' selected and 'used as CAN' checked.

When using the CAN port of a TRION(3)-18x0-MULTI or a TRION-2402—MULTI board, the CAN port is available on AI 1 of these boards. For accessing and using these CAN ports, you have to set the Input mode of AI 1 to CAN first and activate the dedicated CAN port second





CAN – CAN Data Decoding dbc- and arxml-files

- ① Press *Load DBC...* for dbc-decoding or *Load ARXML...* for arxml decoding
- ② A channel picker dialog will open to select the messages and signals to be decoded. Press *Ok* when finished
- ③ The option *Show only active messages* performs a scan on the CAN bus to check which CAN messages are available on the CAN bus and filters the channel picker accordingly
- ④ If one or several messages available on the CAN bus should not be defined in the selected dbc- or arxml-file you can manually add them by pressing *Add message channel* and defining the correct settings in the CAN message setup
- ⑤ After pressing *Ok* you will find the selected messages and signals in the channel list

Message ID: 0xabc	7	6	5	4	3	2	1	0
0	0	7	0	0	5	0	0	0
1	0	15	0	14	11	10	11	9
2	0	23	0	21	20	18	17	16
3	0	31	0	29	28	27	26	25
4	0	39	0	37	36	35	34	33
5	0	47	0	45	44	43	42	41
6	0	55	0	53	52	51	50	49
7	0	63	0	61	60	59	58	57

ARXML file decoding is supported in OXYGEN R5.6 or higher ARXML file version 4.1 or high is required

It is also possible to add and decode other CAN channels from a dbc- or arxml file during the data analysis (CAN offline decoding). To do so, the steps above have to be repeated within the loaded data file.

- TRION-CAN-4
 - CAN 1/1 Sim
 - BAP_ACC (CAN MESSAGE) - highlighted with 5
 - BAP_Data_ACC (CAN SIGNAL)
 - Airbag_03 (CAN MESSAGE)
 - AB_MKB_Safing (CAN SIGNAL)
 - AB_MKB_guelting (CAN SIGNAL)



CAN – CAN Message Setup

- ① The CAN message setup can be accessed if certain settings of the CAN message shall be changed
- ② Protocol type *CAN*, *J1939* or *CAN-FD*
- ③ Message ID from 0x0 to 0x7ff
- ④ Message type *Standard* or *Extended*
- ⑤ The DLC can be set from 0 ... 8 (...64 for CAN-FD)
- ⑥ The message can be swapped between receiving or transmitting CAN data
- ⑦ If the CAN message includes one additional signal which is not loaded from the dbc-or arxml-file or available within the dbc-file, a new signal can be added

Counter | CAN | Video | Search... | Channel | Color | Setup

- LocalNode
 - DEWE3-A4
 - TRION-CAN-4
 - CAN 1/1 Sim (CAN 1/1) TRION-CAN-4
 - BAP_ACC** (CAN MESSAGE) 1
 - BAP_Data_ACC (CAN SIGNAL)
 - Airbag_03 (CAN MESSAGE)
 - AB_MKB_Safing (CAN SIGNAL)
 - AB_MKB_gueltig (CAN SIGNAL)
 - CAN 1/2 Sim (CAN 1/2) TRION-CAN-4
 - CAN 1/3 Sim (CAN 1/3) TRION-CAN-4
 - CAN 1/4 Sim (CAN 1/4) TRION-CAN-4

USB-Cameras

CAN MESSAGE | BAP_ACC

MESSAGE SETUP

Protocol: CAN 2

Message ID: 0x674 3

Type: STANDARD 4

DLC: 8 5

Mode: Receive 6

Add signal channel 7

FRAME PREVIEW

	7	6	5	4	3	2	1	0
0	7	6	5	4	3	2	1	0
1	15	14	13	12	11	10	9	8
2	23	22	21	20	19	18	17	16
3	31	30	29	28	27	26	25	24
4	39	38	37	36	35	34	33	32
5	47	46	45	44	43	42	41	40
6	55	54	53	52	51	50	49	48
7	63	62	61	60	59	58	57	56



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CAN – CAN Signal Setup

- 1 The CAN signal setup can be accessed by pressing the gear button of the respective CAN signal in the Channel List
- 2 Data format: *Intel* or *Motorola*
- 3 Data type: *Double*, *Float*, *Signed Integer* or *Unsigned Integer*
- 4 Start bit: Define the start bit of the signal within its message
- 5 Length: Define the length of the signal within its message
- 6 Signal Type: *Regular*, *Multiplexed* or *Multiplexor*
- 7 DBC Scaling: Change the scaling of the signal
- 8 The preview shows the past 10 seconds of the signal to check if proper settings have been applied to the signal

The screenshot shows the DEWETRON software interface for configuring a CAN signal. The main window is titled "CAN SIGNAL" and displays the configuration for the "BAP_Data_ACC" signal. The interface is divided into several sections:

- Channel List:** Located on the left, it shows a tree view of channels. The "BAP_Data_ACC" signal is selected, and its gear icon is circled with a blue "1".
- MESSAGE SETUP:** This section contains fields for Protocol (CAN), Message ID (0x674), Type (STANDARD), DLC (8), and Mode (Receive). An "Add signal channel" button is at the bottom.
- CHANNEL SETUP:** This section is divided into two sub-sections:
 - GENERAL:** Contains fields for Data format (INTEL, circled with a blue "2"), Data type (UNSIGNED_INTEGER, circled with a blue "3"), Start bit (0, circled with a blue "4"), Length (16, circled with a blue "5"), and Signal type (REGULAR, circled with a blue "6").
 - DBC SCALING:** Contains fields for Scale (k factor) (1), Offset (0), and Unit.
- FRAME PREVIEW:** A table showing the bit positions (0-7) and their corresponding values for the selected message. A blue circle "8" highlights the bit positions.
- PREVIEW:** A graph showing the signal waveform over time. The y-axis ranges from 0 to 65535, and the x-axis shows time intervals. A blue circle "8" highlights the graph area.

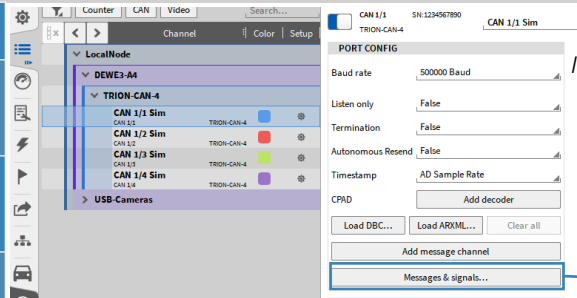


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CAN – CAN Editor

The CAN Editor can be used to

- ① Manually add or delete CAN messages and signals
- ② Rename the currently selected CAN message and signal
- ③ Add comments to messages and signals
- ④ Edit CAN messages
- ⑤ Edit CAN signals
- ⑥ Set the CAN Message mode to Receive for acquiring data or transmit for outputting OXYGEN data over CAN
- ⑦ Providing a preview of the past 10 seconds
- ⑧ Option to automatically detect new CAN messages occurring on the bus



Instead of using dbc- or arxml-files for data decoding it is also possible to add CAN messages and signals manually.

OXYGEN provides a CAN editor for this purpose which can be opened by pressing the Messages & signals... button the CAN port configuration

Id	Name	Color	Active	Scaled Value
0x0	CAN Message 1		<input type="checkbox"/>	
0x0	CAN Signal 1		<input type="checkbox"/>	NaN
0x0	CAN Signal 2		<input type="checkbox"/>	NaN
0x0	CAN Message 2		<input type="checkbox"/>	
0x0	CAN Message 3		<input type="checkbox"/>	
0x0	CAN Signal 3		<input type="checkbox"/>	NaN
0x0	CAN Signal 4		<input checked="" type="checkbox"/>	NaN

The CAN editor and the related CAN message / signal setup is also available for CAN-FD streams



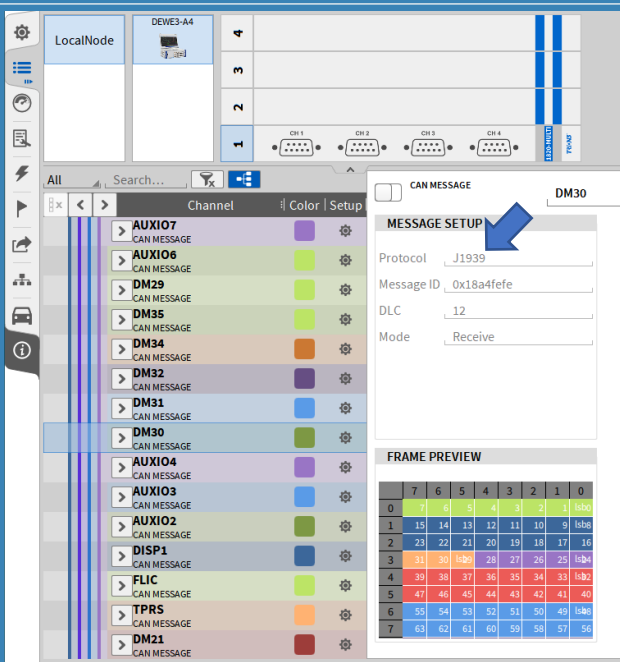
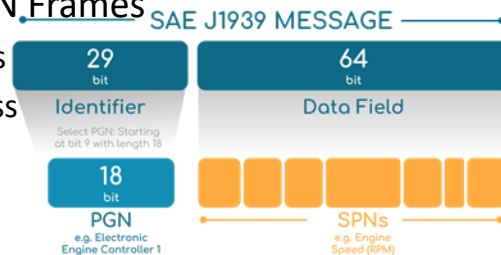
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CAN – SAE J1939

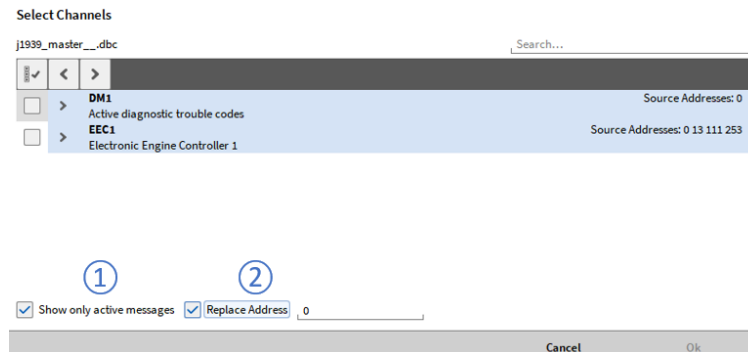
- > Create DBC-File, adapt Message IDs to specify source address if necessary
- > Load DBC-File in Oxygen
- > Check Messages for right PGN and Source Address

- > J1939 is a protocol overlay of CAN-Bus used in heavy duty vehicles
- > Message IDs have standardized pattern
- > Oxygen CAN is able to decode J1939 CAN Frames
- > Loading of DBC-files with J1939 Messages
- > Showing PGN Number and Source Address
- > Decoding of Multi-frame messages
- > No special setting necessary



*Replace Source Address:
If a dbc- or arxml file is loaded that contains J1939 messages, the source Address will be displayed when Show only active messages is activated.*

By Selecting Replace Address it is possible to replace the current source address of the dedicated message by a user defined one.



- > Cyclic output of measurement data via TRION-CAN
- > Compatible with all TRION-Based CAN interfaces and Vector VN-series CAN interfaces
- > Selectable transmission rate (0.1 Hz to 100 Hz) for each CAN-Message
- > Selectable delay for tuning the signal quality
- > Receive/Transmit setting for each message
- > Messages and signals must be predefined within a .dbc or can be defined by using the CAN Editor
- > **Usecase:** Testbed Integration, Automotive Testbed environment for electrical Powertrain testing



CAN OUT – SOFTWARE SETUP

- ① To transmit OXYGEN data over CAN, the CAN message Mode must be set to Transmit
- ② Output rate can be defined from 0.1 ... 100 Hz
- ③ Output delay can be set from 1 ... 500 ms
- ④ Drop the channel or type its name into the Transmission Settings - Channel

If one element of an array channel shall be output, the element's index can be directly defined here

The Autonomous Resend option provides the following functionality for CAN buses which transmit data:

False (Default): The transceiver only sends the data once no matter if the receiver send an acknowledgement or not and sends the next message right afterwards. This makes the CAN data transmission more deterministic on a correctly terminated CAN bus. But there is a remaining risk that a messages gets lost.

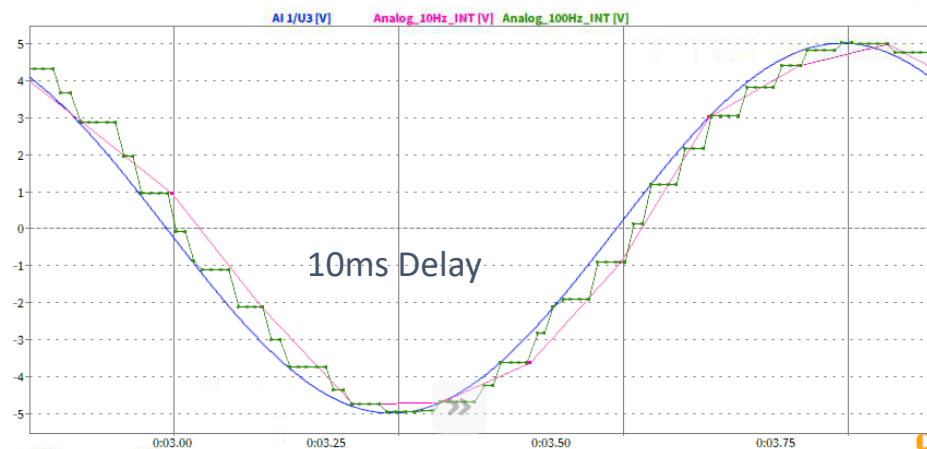
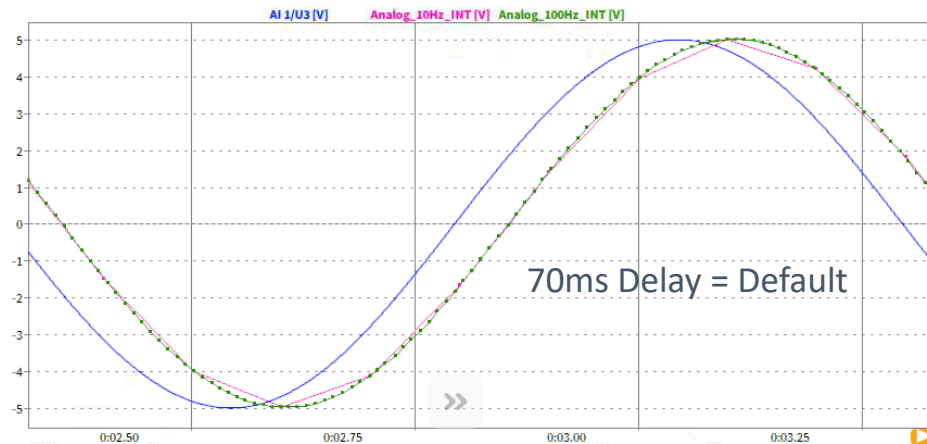
True: The risk of losing messages during transmission is low as message is resend in case no acknowledgement is sent by the receiver. But the risk of colliding messages of several transceivers is higher.

Please note that the preview will not show the currently transmitted data but has no functionality when the message mode is Transmit



CAN OUT – INFLUENCE OF DELAY

- > Due to signal path delays in some parts in the software, realtime processing is not possible
- > With the selectable output delay, the user can choose between smoothness or fast reaction





CAN-FD - GENERAL

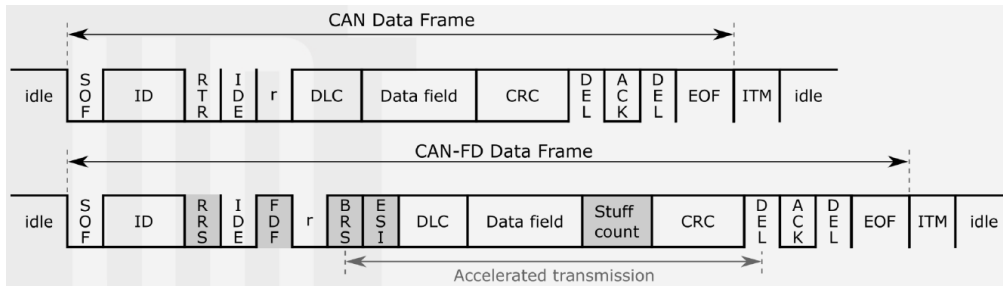
CAN-FD support with

- > Vector VN 1610
- > Vector VN 1630
- > Vector VN 1640
- > NEXDAQ



- > Connection via USB
- > Theoretically, the whole VN family with CAN-FD support should work
- > Multiple Adapter support
- > Synchronized to Analog Data with Delay lower than 50 μs
- > Can be used as CAN device as well

- CAN has reached practical limits in current applications
- CAN buses exceed recommended busloads (>50 %)
 - High overhead for sending CAN messages (≥50 % overhead) → Only around 40-50 % of the bandwidth is used for actual data
 - CAN bus speeds are limited to 1-Mbit/s
- CAN-FD is based on the CAN 2.0 specification
 - Physical layer not changed
 - Support for variable bitrates (*FD* → *Flexible Data*) for the two main message segments:
 - Arbitration phase –same as standard CAN
 - Data phase –bitrates >1-Mbit/s possible (up to ~8-Mbit/s)
 - Support for larger data payloads – up to 64 bytes/message



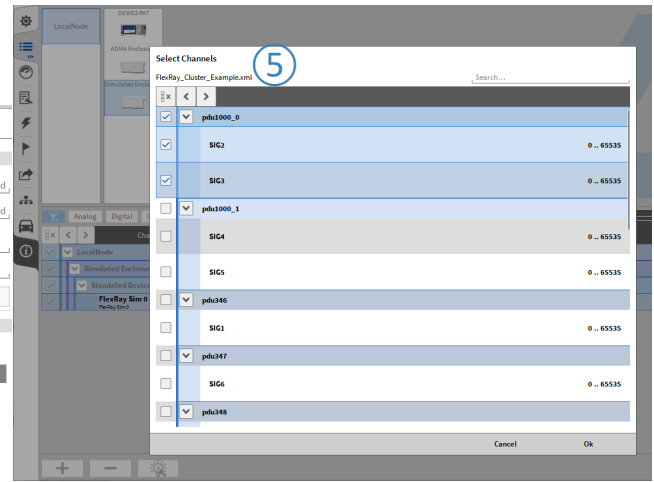
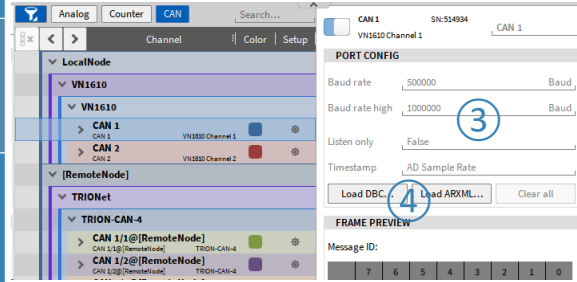
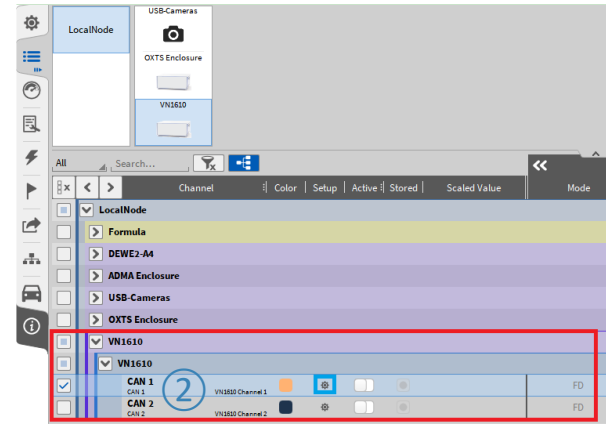
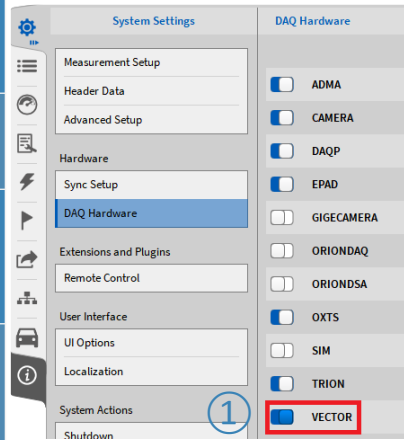


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CAN-FD – SOFTWARE SETUP via Vector Hardware

- Latest *Vector driver setup* needs to be installed
- ① Enable *Vector* hardware in DAQ hardware setup
- ② When hardware is connected, it will be recognized automatically and listed in the Channel List
- ③ Only difference to conventional CAN setup is *Baud rate high* which describes data transmission speed of the data segment
- ④ Load the proper dbc- or arxml-file
- ⑤ A channel selection dialog will open
Select either all channels or only certain channels to be decoded and recorded





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CAN-FD – SOFTWARE SETUP via NEXDAQ

- The NEXDAQ supports CAN-FD natively.
- ① Enable one or two CAN-Channels
- ② Setup the Baud rate high and Baud rate low.

The screenshot shows the NEXDAQ software interface. At the top, there's a hardware connection diagram with various ports labeled CNT 1-4, CH 1-8, and CAN 1-2. Below this, the 'PORT CONFIG' window for 'CANFD 1/1' is open. A red circle '1' highlights the 'CANFD 1/1' checkbox, and another red circle '2' highlights the 'Baud rate' field, which is set to 500000. Other settings include 'Sample point' at 70%, 'Baud rate high' at 4000000, and 'Listen only' set to False.

This screenshot shows the 'MESSAGE SETUP' window for 'CAN Message 1'. The 'Protocol' is set to 'CAN', 'Message ID' is 11939, 'Type' is 'CAN_FD', and 'DLC' is 8. Below this is a 'FRAME PREVIEW' table showing data bytes for CAN FD frames.

	7	6	5	4	3	2	1	0
9	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0



FLEXRAY - GENERAL

Flexray support with

- > Vector VN 7610



- > Connection via USB

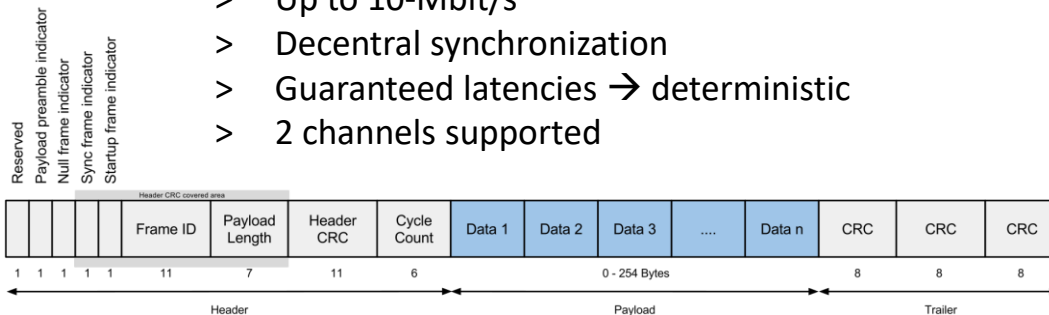
- > Compatible with Fibex 2.0 to 4.1.2 Standard for description file (ASAM MCD-2 NET)

- > Multiple Adapter support
- > Synchronized to Analog Data with Delay lower than 50 μ s

- > Development initiated by BMW, Daimler, Motorola and Philips in 2000
- > First car with Flexray was BMW X5 in 2006
- > Flexray was developed to compensate CAN disadvantages, like
 - > Higher data rates
 - > Realtime capability
 - > Reliability

> Characteristics

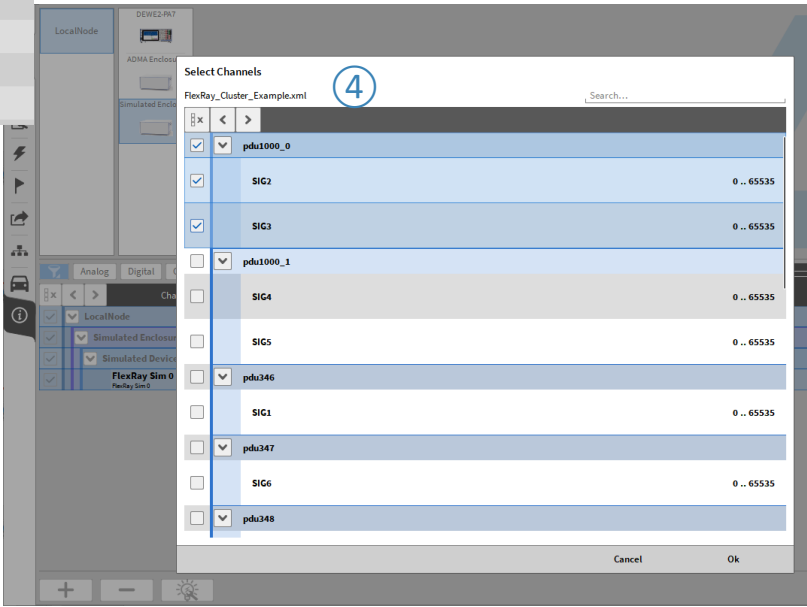
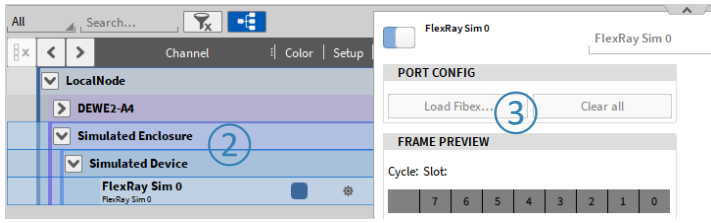
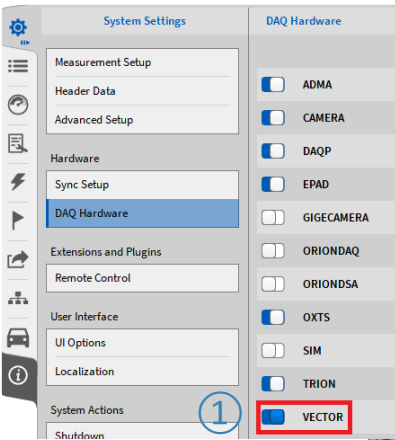
- > Up to 10-Mbit/s
- > Decentral synchronization
- > Guaranteed latencies \rightarrow deterministic
- > 2 channels supported





FLEXRAY – SOFTWARE SETUP

- Latest *Vector driver setup* needs to be installed
- ① Enable *Vector* hardware in DAQ hardware setup
- ② When hardware is connected, it will be recognized automatically and listed in the Channel List
- ③ Click „Load Fibex“ and select the Fibex file
- ④ Select the signals from the Fibex file to be created in OXYGEN
OFFLINE DECODING SUPPORTED TOO



- Limitations:
- > No support of ARXML (AUTOSAR XML) description files
 - > No support of multiplexed frames
 - > No bus settings possible – auto detection enabled
 - > No support of STRING channels
 - > No support of different scaling types of one signal depending on range



ENUM SCALING

- > Convert numerical data into text
- > Supported for CAN, IMU (ADMA & OXTS), Ethernet Receiver and GPS channels
- > Can be configured via dedicated *Enum label editor* in Channel Setup (1)
- > Use i.e. Digital Meter or *Data Label* option in Recorder for visualization (2)

