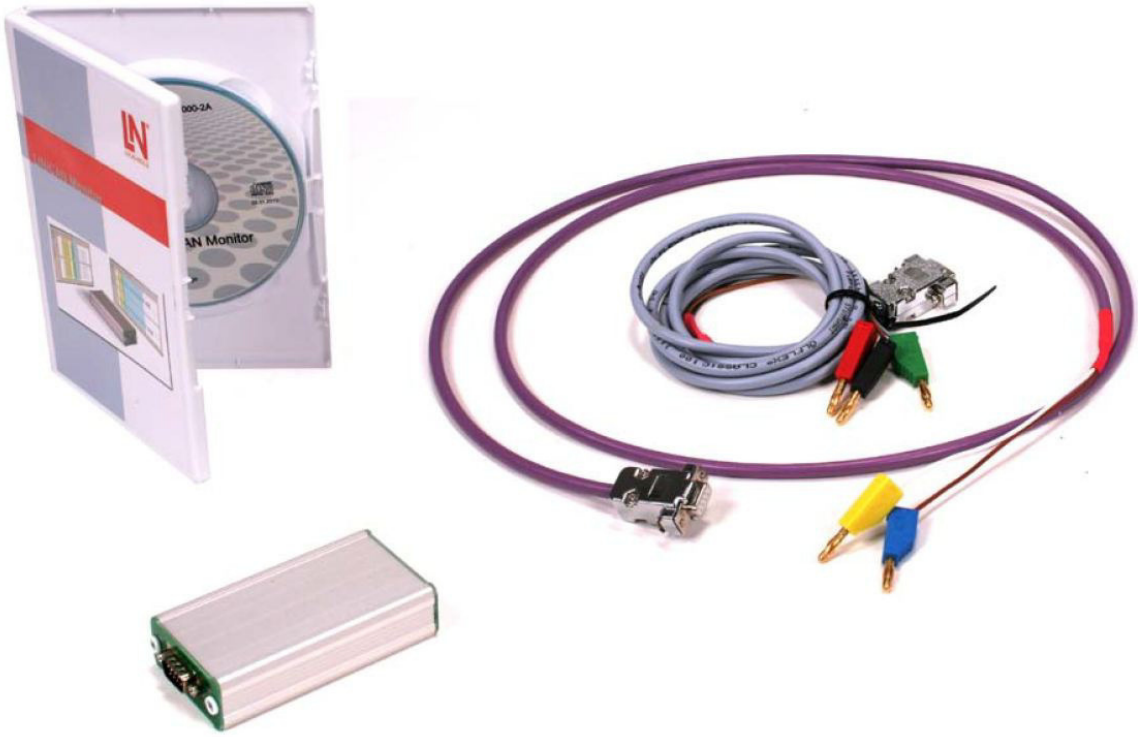
LUCAS-NÜLLE

User manual
CAN/LIN Monitor SO2000-2A

CAN/LIN Monitor



User manual
CAN/LIN Monitor SO2000-2A

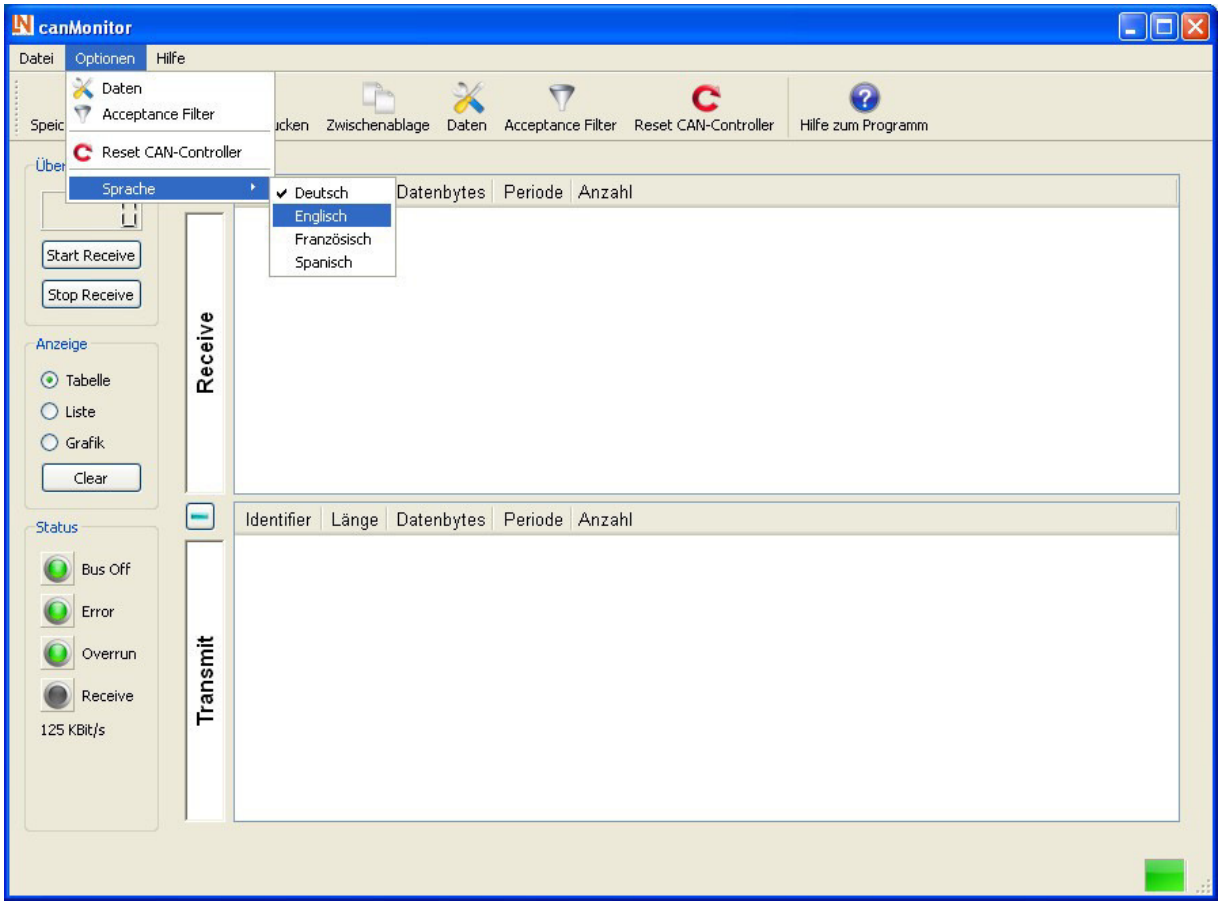
Table of contents

1. Language Selection

The first time the program is started, it will start in German.

To change the language, go to “Optionen” then “Sprache” and select English. Now shut down the program by clicking the X on the top right corner.

Please note: The program must be restarted before a newly selected language can be used.



2. About CAN bus

A CAN bus involves a two-wire bus connection between various control devices connected to the bus.

A complete bus packet consists of an identifier, a length indicator and payload bytes.

The CAN transceiver needs a two-wire connection to the CAN bus. This means using a two-wire cable to connect the USB adapter to the system being investigated.

For more information, see the Lucas-Nuelle Automotive L@Bsoft course: “The CAN bus”

The Lucas-Nuelle CAN/LIN adapter

The CAN/LIN adapter has two transceivers, one for a LIN bus and one for a CAN bus. The LIN bus driver is also used to record data from a K-line bus.

Optocouplers galvanically isolate the transceivers from the CAN/LIN adapter's microcontroller and therefore also from the USB bus.

CAN-BUS packets are processed by a CAN controller are passed from there along the parallel data line to the microcontroller

The microcontroller in the USB adapter possesses Flash memory, which can be programmed via the USB port of the microcontroller.

Technical data:

TJA1020 LIN transceiver

TJA1050 CAN transceiver

SJA1000 CAN controller

Atmel 89C5131 microcontroller with USB port clocked at 24 MHz

Transceivers are galvanically isolated via optocouplers

Power is supplied via the USB bus so that no dedicated power supply is required

Pin assignments for 9-pin SUB-D plug.

Pin 1 = Spare
Pin 2 = CAN_L
Pin 3 = GND
Pin 4 = LIN/K line
Pin 5 = +12
Pin 6 = Spare
Pin 7 = CAN_H
Pin 8 = Spare
Pin 9 = Spare

Restrictions

The CAN/LIN adapter software can run under 32-bit versions of WINDOWS XP and WINDOWS 7.

It should be noted that Windows is not a real-time operating system.

This means that it cannot be definitively guaranteed that all CAN packets recorded by the CAN/LIN adapter can always be displayed under any circumstances. The CAN packets are read via the USB link in sequence. If the CAN Monitor program is unable to read data, it may be that such data will be lost, as later messages could overwrite that information before it has been displayed.

This situation can occur if a lot of mouse movement is being carried out or if a large number of programs are all open at once and making intensive use of the USB bus or of the computer's processing capacity.

3. Connecting the CAN/LIN adapter

Measurements on a CAN data bus

In order to make measurements on a CAN bus, you use the two-wire cable:

Connect the data leads to the CAN/LIN adapter and the measurement terminals to the data bus.

Yellow plug: CAN High
Blue plug: CAN Low

4. Getting started

Make sure you follow the correct sequence when switching on.

1. Test that the CAN bus is working

2. Connect up the CAN/LIN adapter and run the “CanMonitor” software

3. Check the connection between PC and hardware. The display at the bottom right of the CAN/LIN Monitor window will be “GREEN” when the connection is established. Beforehand it will be “YELLOW” and it shows “RED” if there is a fault. Further information can be found below in the “Indicator field” section.

4. You can use the Data button to set an appropriate baud rate for the connected system.

Indicator field

The CAN Monitor program allows you to view the individual CAN packets sent along a CAN bus system. The CAN/LIN adapter does the job of writing packets to the CAN bus and also records them for transmission via a USB link so that they can be viewed on a PC.

In order to display the data, the program needs a driver so that it can access the USB bus. This driver must be installed before you try to use CAN Monitor. At the bottom right of the status bar there is a colour-coded indicator field, which displays the status of the USB connection.

Indicator field red:

The USB driver could not be run.

The program will need to be restarted after the USB driver has been re-installed so that the USB driver can be detected when the program starts.

Indicator field yellow:

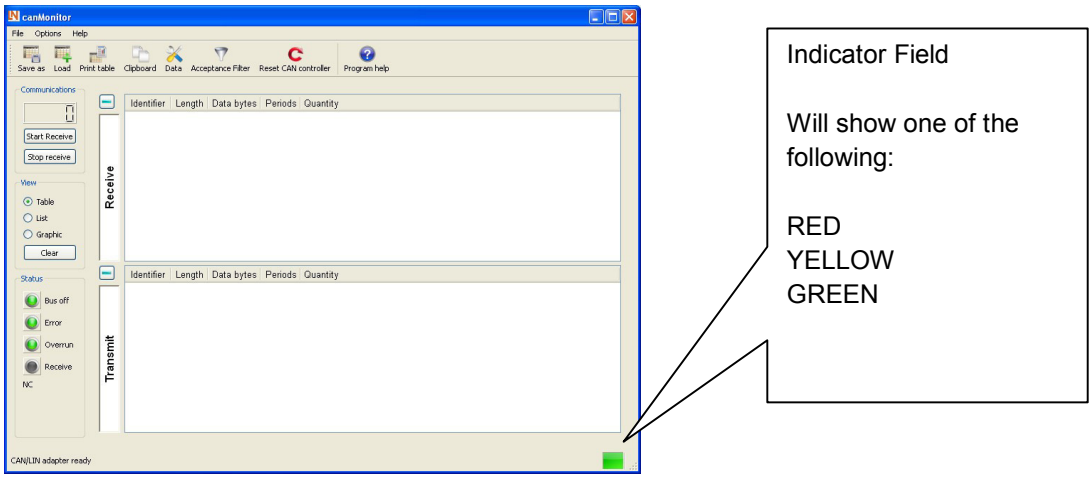
The USB driver is running but the CAN/LIN adapter has not yet been detected.

Once the CAN adapter is connected, it should be detected automatically and the indicator field should then display a green signal.

Indicator field green:

The USB driver is running, the CAN/LIN adapter has been detected and is ready to record data.

When the CAN adapter is disconnected, the indicator field will change to yellow.



5. Display of the program

Most of the program window is occupied by a panel for displaying data. The left-hand side features tool icons for selecting the display format for CAN packets that have been recorded.

1. The counter field displays the number of CAN packets received. When using the Table view format, this represents the number of different packets. In the List view, it represents the number of entries in the list. In Graphic mode, the number of different packets is shown, as in the Table view. While transmission is taking place, the counter field is shown in green.
2. Press <Start Receive> to initiate transmission of messages.
3. <Stop Receive> halts the transmission of data.
4. The <Clear> button deletes the contents of the table, list or graphic being displayed. In each case, it is only the memory for the view currently being displayed that is deleted. Other views remain unaffected.
5. Shows current view selected. Click on the word to change view.

Each of the view formats has its own memory. Switching from one view to another means that it is necessary to make a new recording of CAN packets till the memory is full. Switching to another view mode does not delete this memory. On switching back to the earlier view, the same data as before will be shown.

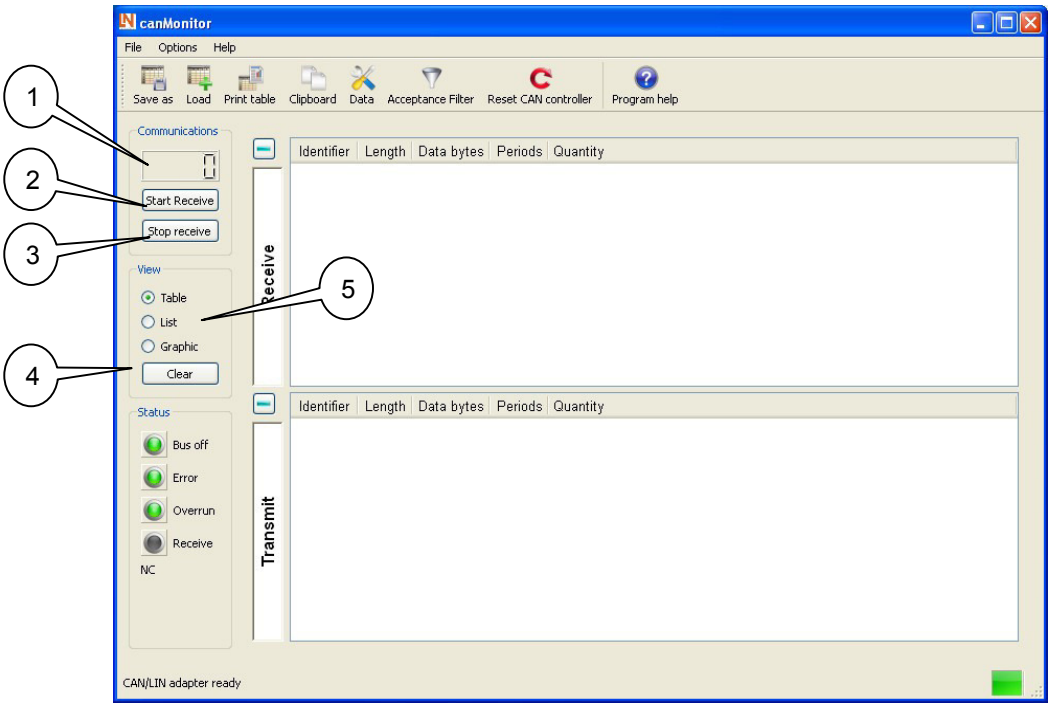
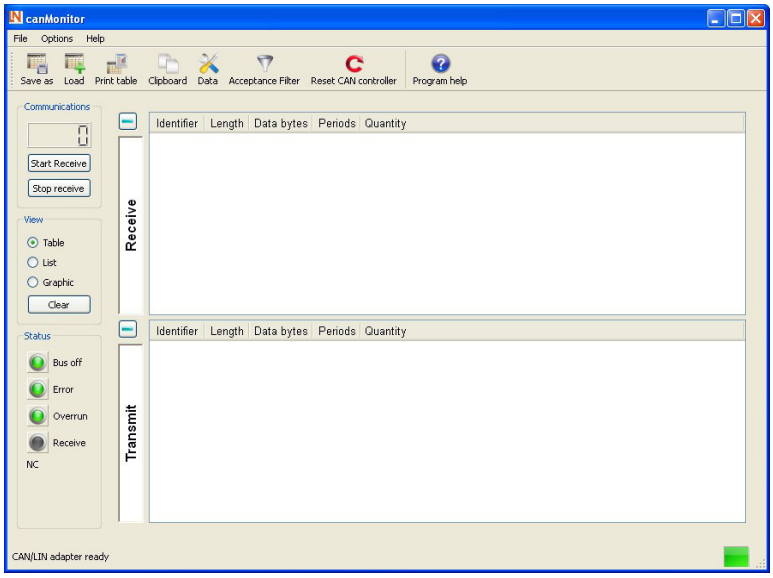


Table view



With this option CAN packets are displayed in a table, which is divided into Receive and Transmit sections.

The Receive table contains all the CAN packets which have been received. Any packet received which has an ID identical to one already in the table will overwrite the previous table entry for that ID. The number of table rows is equal to the number of different CAN packets received.

The Identifier field contains the identifier for the CAN packet.

The Length field indicates the number of bytes in the CAN packet.

The Data bytes field contains the number of payload bytes in the CAN packet.

The Period field indicates the time interval between individual CAN packets. The interval arises during transmission of CAN packets from the CAN controller to the microcontroller. The Period field shows the time between the receipt of one Identifier and the next.

The Quantity field is the total number of packets, incremented as they are received.

The settings window opened from the menu under Option->Data allows you to specify the format in which data bytes are displayed in the Receive table. You can choose binary, decimal or hexadecimal format.

Any packets received thereafter will be displayed in the format that has been set.

Edit Receive Table

A packet can be selected by clicking on it. In order to cancel the selection, click the tool button with the blue bar in the top left corner of the Receive table. Clicking on the Receive table with the right mouse button opens a menu with an option to copy a selected message.

Edit Transmit Table

Clicking the right mouse button on the Transmit table opens a menu with various options for creating or modifying CAN packets.

- New: A new packet can be entered into an editor window
- Edit: A selected packet is shown in the editor window where it can be modified.
- Insert: A packet previously received and copied from the Receive table is inserted into the Transmit table
- Delete: A selected packet is deleted from the Transmit table.
- Clear All: All packets are deleted from the Transmit table.

A packet can be selected by clicking on it. To cancel the selection, click the tool button with the blue bar in the top left corner of the Receive table

The message selected in the Transmit table can be transmitted by pressing the space bar.

New Transmit Packet

An entry window for modifying or creating packets to be transmitted can be opened from the menu invoked by right-clicking on the Transmit table.

The entry window allows you to specify a transmit packet. The identifier and data are to be entered in hexadecimal format.

You can create packets with both standard and extended identifiers.

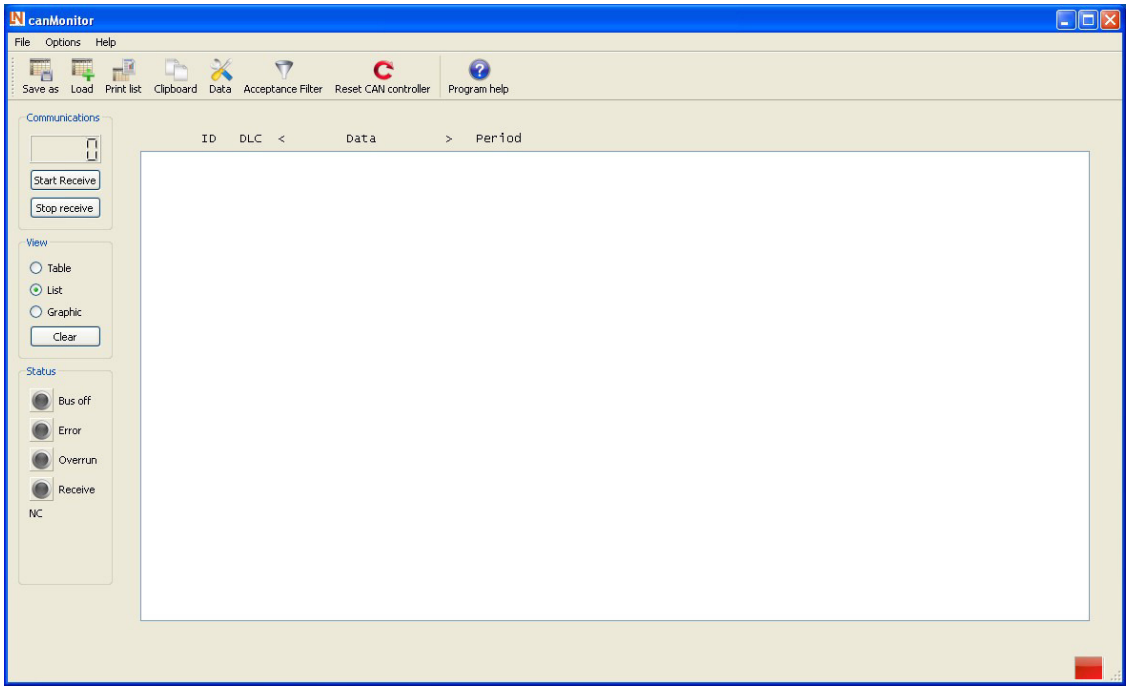
Please not that a remote request packet has no data, meaning that the length field should be set to zero when such a packet is created.

If a remote request packet is created with a length entry of anything other than zero, there will still be no transmission of data but the incorrect length will still be sent as specified.

If a number other than zero is entered into the field for the period, the packet will be automatically sent in accordance with the specified period.

For manual transmissions, the Period field must contain zero. Transmission is then initiated by pressing the space key, in which case the selected packet will then be sent. Up to twenty packets can be created for automatic transmission.

List view



CAN messages are displayed in a list format. Each packet is displayed in a list entry on a separate line.

A settings window invoked from the menu under Options->Data allows you to select how many CAN packets are to be included in the list. The maximum number of entries is 10 000.

In the same window, you can also set the format in which the data bytes are to be displayed in the list. You can choose between binary, decimal and hexadecimal.

Newly received packets will then be displayed in the format you have selected.

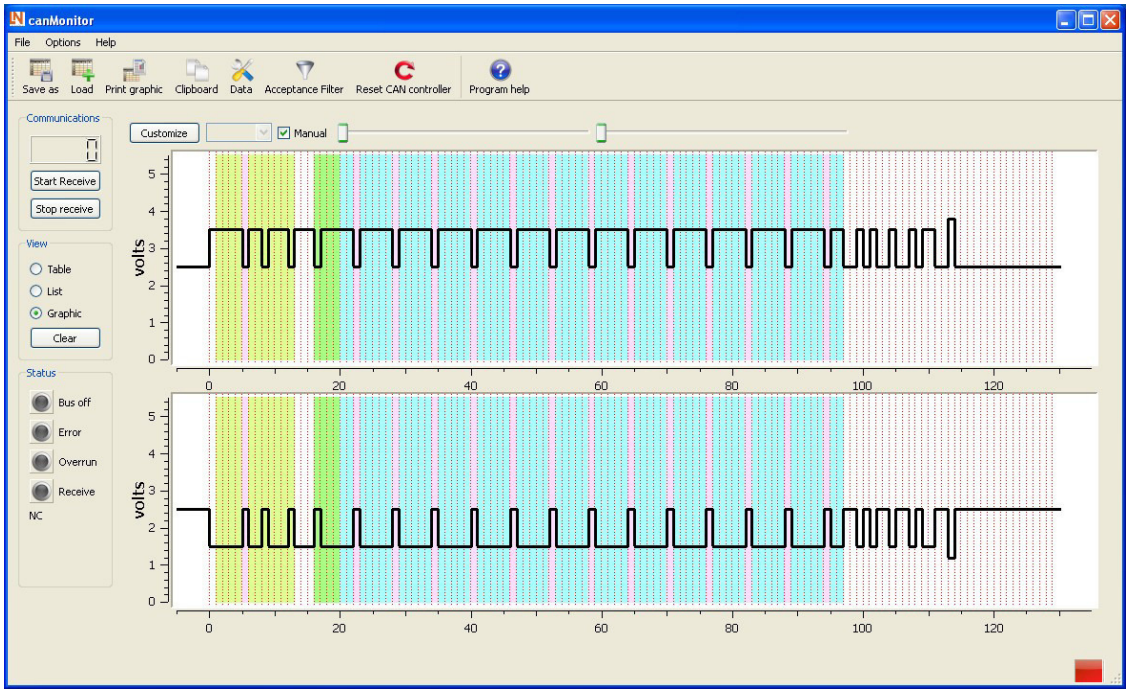
You can also change the font size for the entries in the list.

Settings for data format and font size also apply to the Table view.

Right clicking the List view opens a pop-up menu. Beforehand, selected list entries can also be prepared by dragging them with the left mouse button held down.

The pop-up menu provides options for deleting selected entries or changing the format of the data fields. The fields may be displayed in numeric form or as ASCII code.

Graphic view



The graphic window allows for the display of up to three signals.

The change in voltage against time is displayed as in an oscilloscope trace.

The number of data bytes is traced along the x-axis.

The selection field above the graphic itself contains all the packet identifiers and any of them may be selected.

Every time a packet with the selected identifier is received, the graphic is redrawn.

Alternatively, a previously entered packet can be displayed by manual intervention simply by clicking the Manual field.

Above the graphic there are two sliders. The right-hand one zooms in or out of the graphic while the left-hand one shifts the position of the displayed packet in the view window.

The Customize button opens a settings window with a large number of options for modifying the graphic display of CAN messages.

Customize options

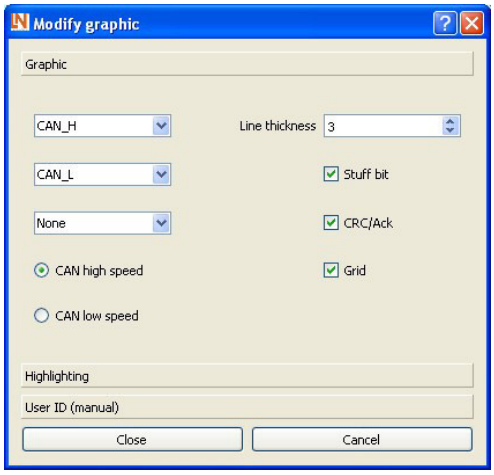
The <Graphic Settings> window is divided into three sections, each accessed by clicking on the corresponding header.

The graphic settings section is selected by default when you open the window.

All settings take effect only after you click the <Close> button to close the window.

Graphic

This panel allows you to select the graphic to be displayed. There are three selections possible.



The top selection allows you to select the voltage signal on the CAN_H line, the voltage for the CAN_L or neither.

The centre one offers the same possibilities.

The bottom selection allows you to see the voltage difference between CAN H and CAN L.
V diff = V (CAN H) – V (CAN L), or remove it all together.

The CAN High Speed and CAN Low Speed fields modify how the voltage over time for the various CAN messages is displayed.

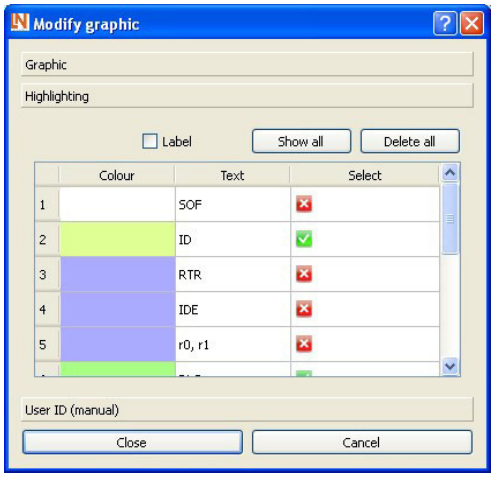
The line thickness for the voltage curves can be set to any value from 1 to 6.

If the stuff bit option is deactivated, the packets are displayed without any stuff bits (non-data bits for padding out a byte to 8 bits).

The CRC / Ack field allows the display to include or omit the CRC field and / or acknowledge bit.

The Grid field adds a background to the graphic with a reference line following each bit in the packet.

Highlighting



The graphic representations of the voltage signal can be colour coded according to the logical content of the packets.

The fields to be coloured and the colours themselves can be individually selected.

The choice can be made by modifying a displayed table.

The colour with which a specific field in a packet is to be highlighted is selected from the left-hand column.

Clicking the colour panel opens a selection dialog box from which the colours can be specified.

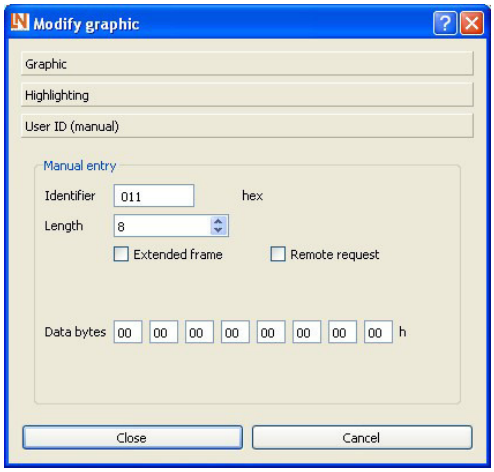
The centre field contains the corresponding label text.

The text not only labels the corresponding field in the CAN packet but is also displayed on the graphic when the <Label> option field is selected.

In the right-hand column of the table, you can specify whether a specific area of the CAN packet is to be colour coded. This simply involves clicking the relevant field in the column.

The two buttons labelled <Show All> and <Delete All> apply to all option fields in the right-hand column of the table.

User ID (Manual)



This entry field allows you to assemble a packet to be displayed in a graphic when the User ID (Manual) button in the graphic window is pressed.

Data bytes are to be entered in hexdecimal format.

The entries containing the data will be saved when the program exits and will be available once again next time the program is started.

6. Menu options and program functions

Across the top of the program window is a selection of functions and options. They are:

1. Save as
2. Load
3. Print list
4. Clipboard
5. Data
6. Acceptance Filter
7. Reset CAN controller
8. Program help

1. Save As

Displayed CAN packets can be stored in a file with the ending .dat when a filename and directory are specified.

The display view is saved as well and will be restored automatically whenever the file is loaded again.

2. Load

Previously saved CAN packets can be read from a file.

A check is made to ensure that the file is in a valid data format.

When loading saved CAN messages, the data memory from which the data was saved will be overwritten from the file.

In addition, the view is automatically set to that which was in use when the data was saved.

3. Print

CAN messages from the table or list currently being displayed can be printed out.

It is also possible to print out a selected section of the table or list.

CAN messages can be printed out in table or list format depending on the settings.

It is also possible to print out a graphic view. Graphic print-outs automatically use the full page-width available.

All print-outs have a specified header. The text for this header can be selected in the Print Header field under <Options -> Data>.

4. Clipboard

Clicking this button copies the currently displayed table, list or graphic to the Windows clipboard.

This useful function makes it easy to transfer CAN Monitor content to a word processing program or a PowerPoint presentation.

5. Data

This allows you to select the general settings for communications and display.

Communications: The baud rate can be set to any of the recommended settings.

If it should be necessary to configure a baud rate not included on the list, the USER option can be selected and the data for the baud rate timing register on the SJA1000 chip can then be entered directly into the fields provided there. It needs to be noted that the CAN/LIN adapter itself is clocked at 24 MHz.

To simplify configuration, the baud rate calculator can be invoked.

Packet count: in the List view, a set number of CAN packets can be read in.

Transmission is automatically stopped once the set number of packets is reached.

The setting can be anything up to a maximum of 10 000 list entries.

Display: CAN messages can be displayed in binary, decimal or hexadecimal formats.

Font sizes: Here it is also possible to select the font sizes for Table, List and Graphic view from here.

Print header for pages: whatever is input into the field provided here will be printed at the top of all printed pages.

6. Acceptance filters

The SJA1000 CAN Controller used by the CAN/LIN adapter provides two independent acceptance filters.

A packet is displayed if it has passed either Filter 1 or Filter 2.

Entering 000h in the Acceptance Code and Acceptance Mask fields means that no messages can get through at all.

The acceptance filters can be returned to their default state by pressing Reset.

7. Reset CAN controller

Clicking this button resets the registers in the SJA100 CAN controller in the same way as unplugging and reconnecting the USB leads to the CAN/LIN adapter.

8. Program help

This icon allows you to gain access to the help file for the program.

7. LIN monitor

About LIN bus

A LIN bus is a single-wire bus connection between a master control unit and the slave controllers connected to it.

A complete LIN packet consists of a packet header and a packet response.

The LIN transceiver needs to be connected to the on-board power supply, electrical earth and to the single LIN bus line itself. It is therefore necessary to use a three-wire cable to link the CAN/LIN adapter to the system being investigated.

For more information, please refer to the Lucas-Nuelle L@Bsoft course “LIN bus”.

8. Connecting the CAN/LIN adapter

Measurements on a LIN data bus

In order to make measurements on a LIN bus, you use the three-wire cable:

Connect the data leads to the CAN/LIN adapter and the measurement terminals to the data bus.

Red plug: 12V DC positive
Black plug: Negative
Green plug: LIN measurement lead

9. Getting started

Make sure you follow the correct sequence when switching on.

1. Test that the LIN bus is working

2. Connect up the CAN/LIN adapter and run the “LIN Monitor” software

3. Check the connection between PC and hardware. The display at the bottom right of the CAN/LIN Monitor window will be “GREEN” when the connection is established. Beforehand it will be “YELLOW” and it shows “RED” if there is a fault. Further information can be found above in the “Indicator field” section.

4. You can use the Data button to set an appropriate baud rate for the connected system.

10. Display

Most of the program window is occupied by a panel for displaying data. The left-hand side features tool icons for selecting the display format for LIN packets that have been recorded.

1. The counter field displays the number of LIN packets received. When using the Table view format, this represents the number of different packets. In the List view, it represents the number of entries in the list. In Graphic mode, the number of different packets is shown, as in the Table view.
2. Press <Start> to initiate transmission of messages.
3. <Stop> halts the transmission of data.
4. The <Clear> button deletes the contents of the table, list or graphic being displayed.
5. While transmission is taking place, the counter field is shown in green.

In each case, it is only the memory for the view currently being displayed that is deleted. Other views remain unaffected.

Each of the view formats has its own memory. Switching from one view to another means that it is necessary to make a new recording of LIN packets till the memory is full. Switching to another view mode does not delete this memory. On switching back to the earlier view, the same data as before will be shown.

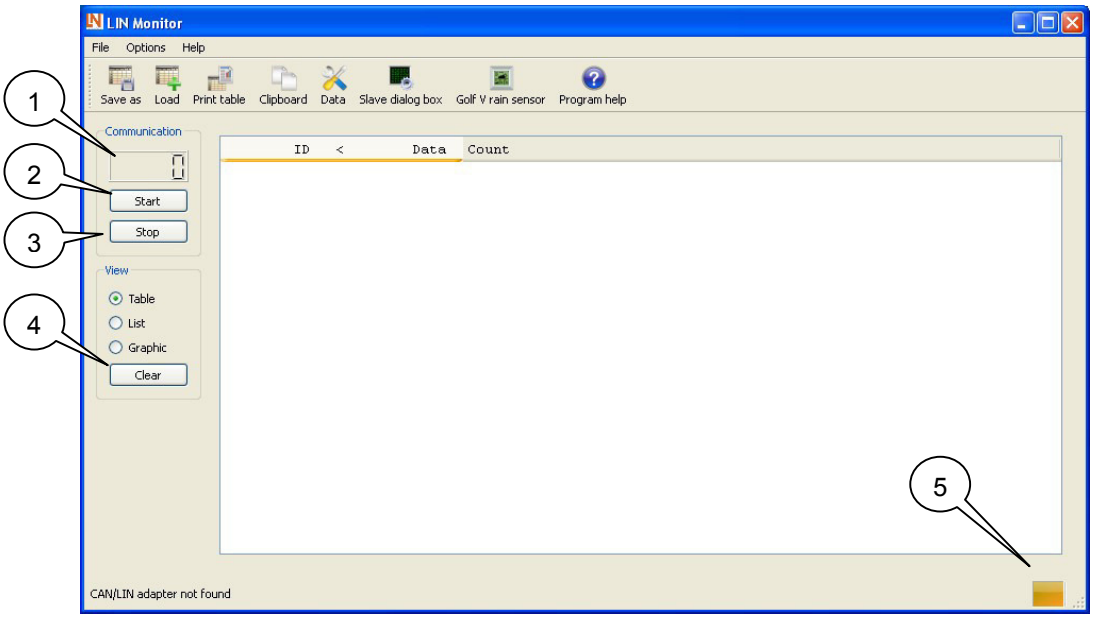
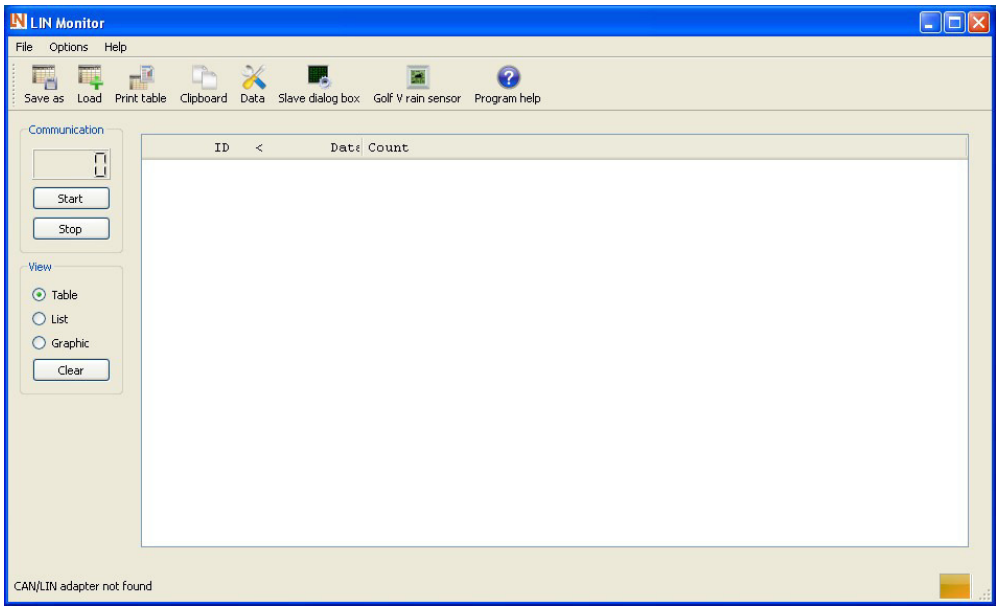


Table view

With this option LIN packets are displayed in a table.



Any packet received which has an ID identical to one already in the table will overwrite the previous table entry for that ID. The number of table rows is equal to the number of different LIN packets received.

On each row, a zero will be displayed in the Sync Break field to clarify that a synchronisation break has been identified. This in fact consists of thirteen null bits.

The Synch Field entry shows 55h, which is used in the header to synchronise the baud rate.

The ID field contains the identifier for the CAN packet. A settings window can be opened from the menu under Options->Data from which it is possible to select whether the ID is to be shown with or without parity bits.

The Data bytes field contains the number of payload bytes in the CAN packet.

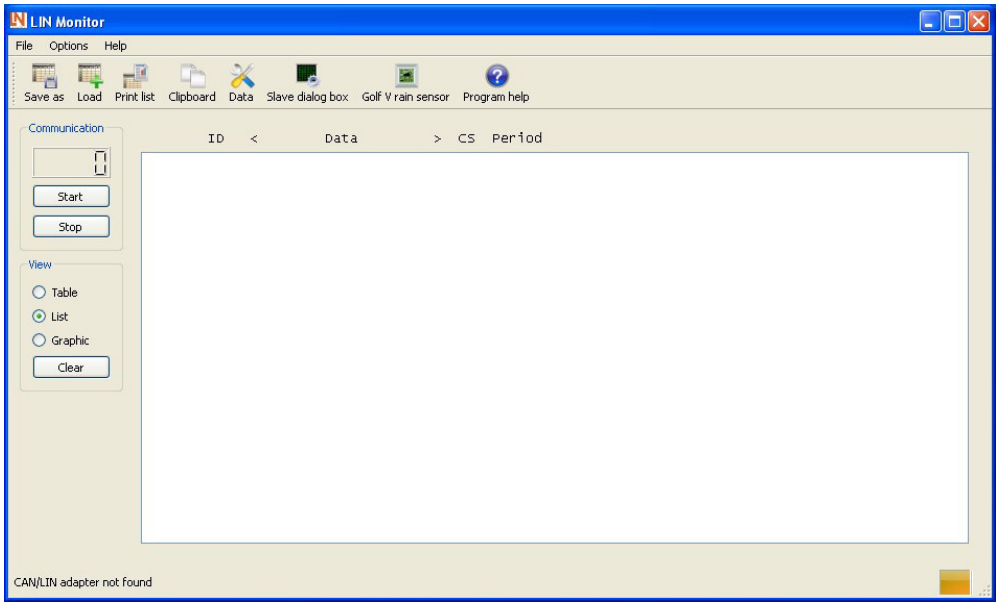
The Check field shows the check sum for the LIN packet.

The Period field indicates the time interval between individual CAN packets. The interval is counted from the start of the synchronisation break. The Period field shows the time in milliseconds between one synchronisation break and the next.

The Quantity field is the total number of packets, incremented as they are received.

List

LIN messages are displayed in a list format. Each packet is displayed in a list entry on a separate line.



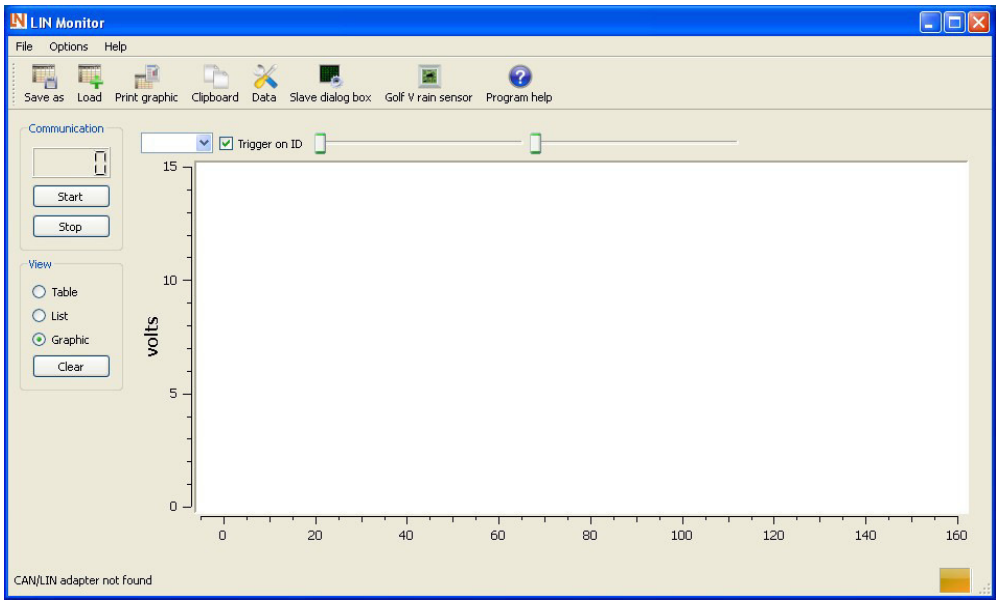
The number of LIN packets to be included in the list can be set from the menu under Options->Data. The maximum number of entries is 10 000.

Right clicking the List view opens a pop-up menu. Beforehand, selected list entries can also be prepared by dragging them with the left mouse button held down.

The pop-up menu provides options for deleting selected entries or changing the format of the data fields. The fields may be displayed in numeric form or as ASCII code.

Graphic view

When LIN packets are received, their PIDs are stored in a list.



Any such PID can be selected from the combo box above the graphic.

Any time a packet containing this PID is received, the graphic of the voltage signal will be redrawn, i.e. redrawing is effectively triggered from the PID itself.

If the option <Trigger on ID> is deselected, drawing is no longer triggered by specific PIDs and every incoming LIN packet will be displayed.

The slider on the right above the graphic can be used to change the scale for the x-axis. The left-hand slider is used to shift the displayed segment right or left along the axis.

A settings window invoked from the menu under <Options->Data> allows you to select the format for the graphic.

The thickness of the line used for the curves can be configured to any of four settings from 1 to 4.

The graphic can also be enhanced with colour-coded highlighting and label text.

Any colours can be selected by clicking the colour indicator fields in the colour dialog box that opens.

The settings window accessed under <Options->Data> also allows you to add a grid to the graphic, which provides clear separation between the individual data bits in the LIN packet.

11. Menu options and program functions

Across the top of the program window is a selection of functions and options. They are:

1. Save as
2. Load
3. Print
4. Clipboard
5. Data
6. Slave dialog box
7. Golf V Rain Sensor
8. Program help

1. Save as

Displayed LIN packets can be stored in a file with the ending .dat when a filename and directory are specified.

The display view is saved as well and will be restored automatically whenever the file is loaded again.

2. Load

Previously saved LIN packets can be read from a file.

A check is made to ensure that the file is in a valid data format.

When loading saved LIN messages, the data memory from which the data was saved will be overwritten from the file.

In addition, the view is automatically set to that which was in use when the data was saved.

3. Print

LIN messages from the table, list or graphic currently being displayed can be printed out. LIN messages can be printed out in table, list or graphic format depending on the settings.

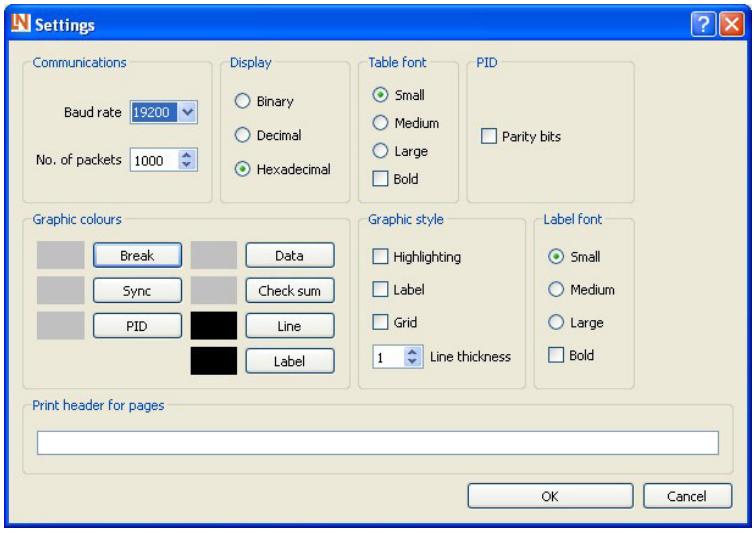
It is also possible to print out a selected section of the table or list.

4. Clipboard

Clicking this button copies the currently displayed table, list or graphic to the Windows clipboard.

This useful function makes it easy to transfer LIN Monitor content to a word processing program or a PowerPoint presentation.

5. Data



The Data icon allows for the following settings of communications and display to be changed.

Communications:

Baud rate: The baud rate can be set to any of the recommended settings.

Packet count: In the List view, a set number of LIN packets can be read in.

Transmission is automatically stopped once the set number of packets is reached.

The setting can be anything up to a maximum of 10 000 list entries.

Display: LIN messages can be displayed in binary, decimal or hexadecimal formats.

Table font: It is also possible to select the font sizes for Table or List views from here.

PID: The LIN identifier can be displayed with or without parity bits. When the option is selected, the parity bits are shown.

Graphic colours: Specific areas of a LIN packet can be highlighted in different colours. Clicking the relevant button opens a colour selection dialog box from which the colour for the highlighting can be selected.

The <Line> and <Label> buttons are exceptions in that they set the colour for the voltage signal and the displayed text.

The colours currently set in each are displayed to the left of the buttons.

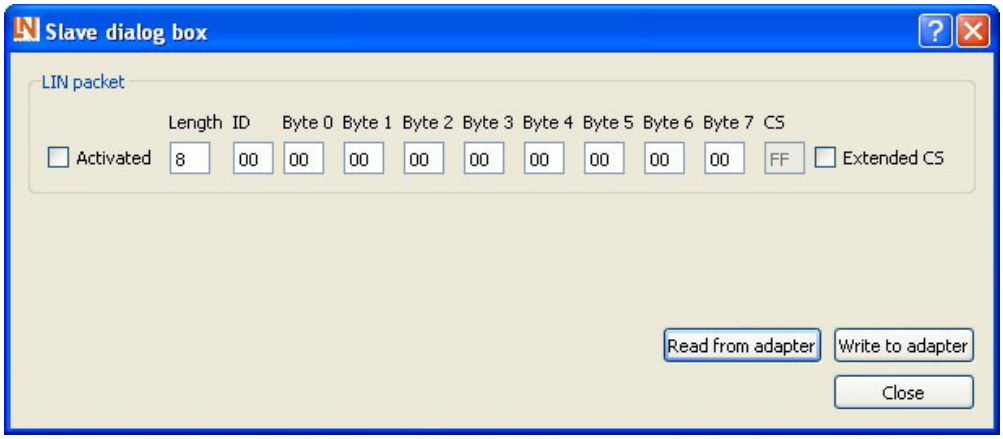
Graphic style: Using the <Show highlighting> and <Show labels> buttons, you can determine whether the colour-coded highlights and the corresponding text are to be displayed or not.

It is also possible to set the line thickness for the voltage signal to any of four settings.

Label font: Allows you to set the font size for the displayed text (labels)

Print header for pages: whatever is input into the field provided here will be printed at the top of all printed pages.

6. Slave dialog box



The Slave dialog box allows you to enter a LIN packet. This packet forms the response to any LIN header with the specified ID received from the adapter.

The LIN header in question can, of course, only be furnished with the right data section from the LIN packet, if no other slave is writing data for this header.

Click <Read from adapter> to read out the most recent settings from the CAN/LIN adapter. This will overwrite any data currently being input.

All subsequent settings are only activated after selecting <Write to adapter>.

Activated: If this option is selected, the packet defined in the dialog box will be output in the form of a LIN response. If not, the output of LIN responses will be disabled.

Length: Number of data bytes.

ID: The LIN identifier must be entered in full, including parity bits.

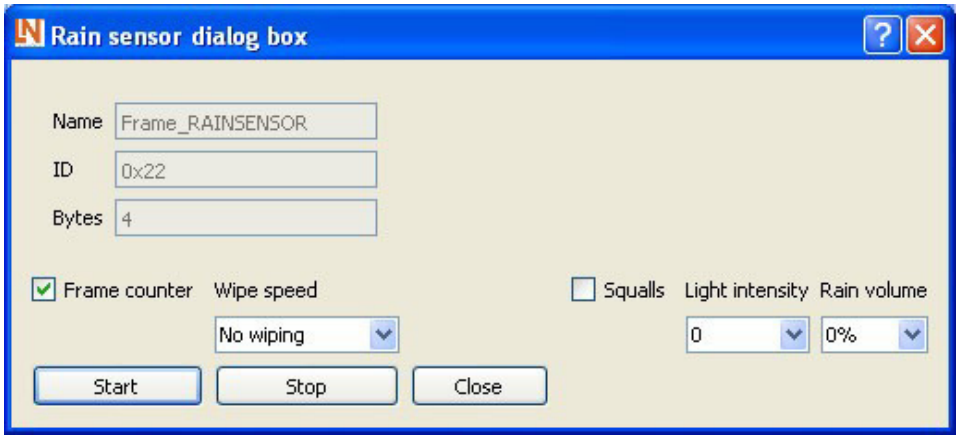
Bytes 0 to 8:

Data bytes will be outputted in the form of a LIN response.

CS: Check sum derived from the input values

Extended CS: If this option is selected, an extended check sum conforming to LIN 2.0 will be calculated.

7. Golf V rain sensor



It is possible to generate data for packets intended for a rain sensor specific to Volkswagen Golf V models.

This is also practical when a vehicle has no rain sensor and a packet with the header 0x22 is sent by the on-board controller to the wiper motor via the LIN bus, since in the absence of a rain sensor, a packet with this header would elicit no response. LIN Monitor makes it possible to generate a response to this message so that the actions arising from that response can immediately be seen.

Frame counter: To ensure security of the data, the rain sensor transmits a continually incremented count in a specific field of each data packet it transmits. Such a frame counter can, of course, be generated by the CAN/LIN adapter as well, although the function can also be switched off for test purposes in order to simulate a fault.

Wipe speed: The choice of wipe speed applies to all the data generated and therefore defines the speed of the wipers.

Squalls, light intensity and rain volume: These are transmitted in addition to data generated by the rain sensor and included by the on-board controller in its messages to control the wipers.

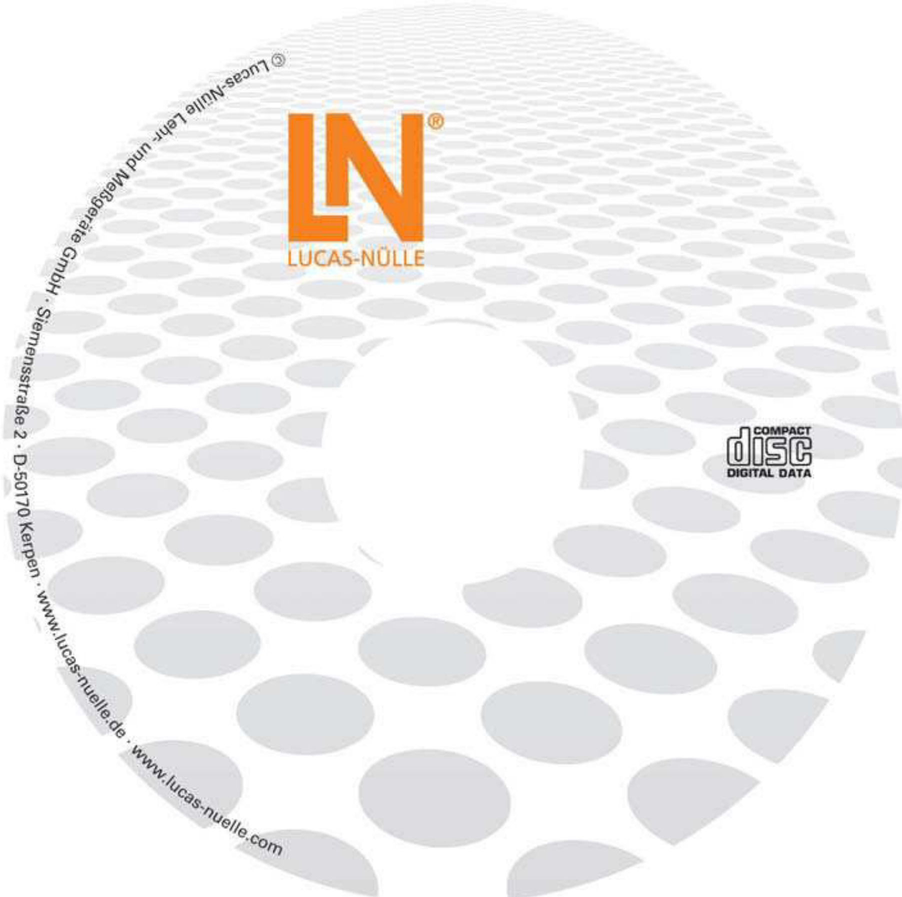
Light intensity is counted in Lux.

Rain sensor packets are generated within the CAN/LIN adapter when <Start> is pressed and can be halted by pressing <Stop>.Once generation of rain-sensor packets has been initiated, they will continue even after the dialog box has been exited by pressing <Close>.

8. Program help

This icon allows you to gain access to the help file for the program

12. Notes



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