LIPOWSKY
INDUSTRIE-ELEKTRONIK

CAN-Spy®

Operating Manual

Version 1.65

Documentation History

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Current product information as well as the status of software and documentation versions are available at http://www.lipowsky.de and http://www.dgeinc.net.

SAFETY REFERENCE!!!

Before operating the CAN-Spy tool, it is important to read all parts of this manual.

When using CAN- Spy with systems such as machines, vehicles, modules, etc., the user is in the position to affect these systems in such a way as to cause a situation to be created in which danger to people and material damage is possible.

The CAN-Spy should only be used with those configurations that will not negatively affect the system.

1 INTRODUCTION

CAN-Spy is a universal device for simulating and diagnosing issues on the CAN bus. It allows CAN communications to be read on the message level. It also scales and displays the data from the messages in plain text with engineering units and names.

This system is therefore suitable for analysing communication processes (used for the development and commissioning of new CAN systems) and for visualizing data contents (for example in service areas and maintenance of automotive modules or machines).

Special features, such as the Analog Echo (i.e. Analog Out), allow the application of traditional analog measuring and recording methods at the digital CAN bus level. Thus, these features permit an extended and enhanced use of the device's existing capabilities.

2 ITEMS SUPPLIED

CAN-Spy tool, AC adapter, terminator and manual.

3 OPERATING ELEMENTS AND OPERATION OF CAN-SPY

The CAN-Spy is operated exclusively by means of the control knob and the integrated push buttons. In any active screen or menu, a function can be selected by turning the knob and activated by pushing the knob. The selected item will be displayed in white characters against a dark background.

Adjusting parameters, texts, etc. works the same way. The parameter to be adjusted is selected with the control knob. A small sub-menu is displayed when the knob is pushed. Here, different options, ciphers, or characters can be selected. Again, an item is selected by turning the knob and activated by pushing the knob.

CAN-Spy makes extensive use of multiple layers of menus and sub-menus. Some sub-menus require navigation through several different screens to reach it. Sub-menus generally have an END or RETURN option that takes the user back to the previous screen.

The "ESC" key functions like the RETURN option. It allows the user to return to a higher menu level in any of the following menus: "Filter, Trigger, Terminal/Setup, Instrument/Setup, Sender/Setup, Quelle/Scroll, and AnalogEcho/Setup".

In some cases, not all menu items can be seen immediately on the display. Depending on the type of menu, a horizontal arrow (< or >) or a vertical arrow(? or ?) indicates the direction of more menu selections.

The "F1" key on the front of the unit has not been allocated a function.

4 START-UP

Before boot up, the connections to the CAN-Bus and the power outlet have to be present. Use the 9-pin D-Sub connector for the CAN-Bus connection. If the CAN-Spy is the last device on the bus, the Terminator has to be connected to the second 9-pin D-Sub connector. The AC Adapter connects the tool to the power outlet (110V). Pressing the control knob turns the tool on.

Alternatively, the B12 and later models of the CAN-Spy device can be supplied with power via pin 9 of the CAN-Bus interface. See the label on the back of the CAN-Spy for the device's model number and Section 6.2.1 of this manual for more information regarding pin allocation.

If it is desired to delete the device settings at start up, press and hold the "ESC" button and then press and hold the control knob to turn the device on. A menu for deleting the device settings and replacing them with default values or to cancel the process appears on the display.

After start up, the device indicates the firmware version, the set CAN parameters, and if applicable the installed options (if this is not the case, please refer to the hint below). If the control knob is pressed before or during the display of the firmware version, the process will be cancelled.

```
CAN-Spy              V.1.40

CAN ID:              11-BIT
CAN baud rate:       STD-500KB


OPTIONS:             NONE
```

After a few seconds, the monitor mode will be displayed with the main menu items in the bottom line. If the device is set up to automatically detect the baud rate, the system will try to identify the baud rate. The baud rate cannot be detected automatically if there is only one device using the bus besides the CAN-Spy or if no messages matching the specified length of the identifier (11 bit or 29 bit depending on the CAN-Spy settings) are being exchanged. In this case, the detection mode has to be stopped by pushing the control knob. Thereafter, automatic detection of the baud rate may be switched off in the SETUP menu (see Section 5.8.1). The correct baud rate may be entered manually. If there is only one other user connected to the CAN bus in addition to the CAN-Spy, make sure that the LISTEN ONLY mode has been switched off in the SETUP menu.

```
S 1FEEFFEE AB 0A CD 00 EE FF DD 1B 01411
S 1FEEFFEE AB                      00021
  1FEEFFEE AB 0A CD 00 EE FF DD 1B 00531
  1FEEFFEE AB 0A CD 00             03764
  1FEEFFEE AB 0A CD 00 EE FF DD 1B 00008
  1FEEFFEE AB 0A CD 00 EE FF DD 1B 05300
R ********                         00239
MONITOR TERMINAL INSTRUMENT SENDER     >
```

The desired function may be selected from the main menu at the bottom of the screen. An arrow on the right- and/or left-hand side indicates further possible selection items. The currently selected device function is displayed

inversely in front of a dark background (i.e. as “MONITOR” shows above). The selected menu item can be changed by turning the control knob to the right or left.

Hints:

The bootstrap mode is activated if the CAN-Spy is turned on or reset while connected to a PC on which a terminal application is running. In this case, the CAN-Spy can only be started up by quitting the terminal application or by disconnecting the PC and rebooting.

If the user wants to keep the data in receive buffer valid after a power off / power on cycle (setup option: DELETE RECEIVE BUFFER – NO), the CAN-Spy needs to be turned off by selecting TURN OFF from the main menu. Just cutting off power might lead to loss of data.

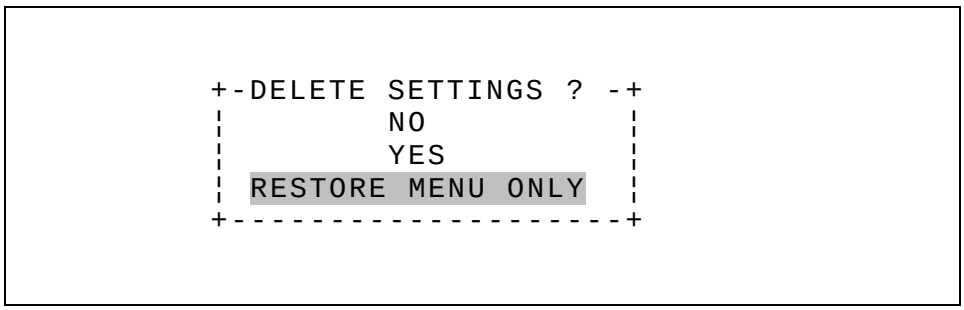
Since software version V.1.40 the menu buttons (MONITOR, TERMINAL, INSTRUMENT,....) can be deactivated or reactivated by the user. This is done in the SETUP section available from the main menu. So it might happen, that you will not see all menu buttons shown in this manual, because they had been disabled on your device.

In case of a disabled SETUP button, a special power-on procedure must be executed, to regain access to the SETUP menu.

1. Press and hold ESC-Key with device switched off

2. Press and hold control knob, (ESC-Key is still pressed), this will power on the device

After approximately 2 seconds a selection menu appears:



Selection NO will continue without any action.

Selection YES will reset all CAN-Spy parameter to factory defaults.

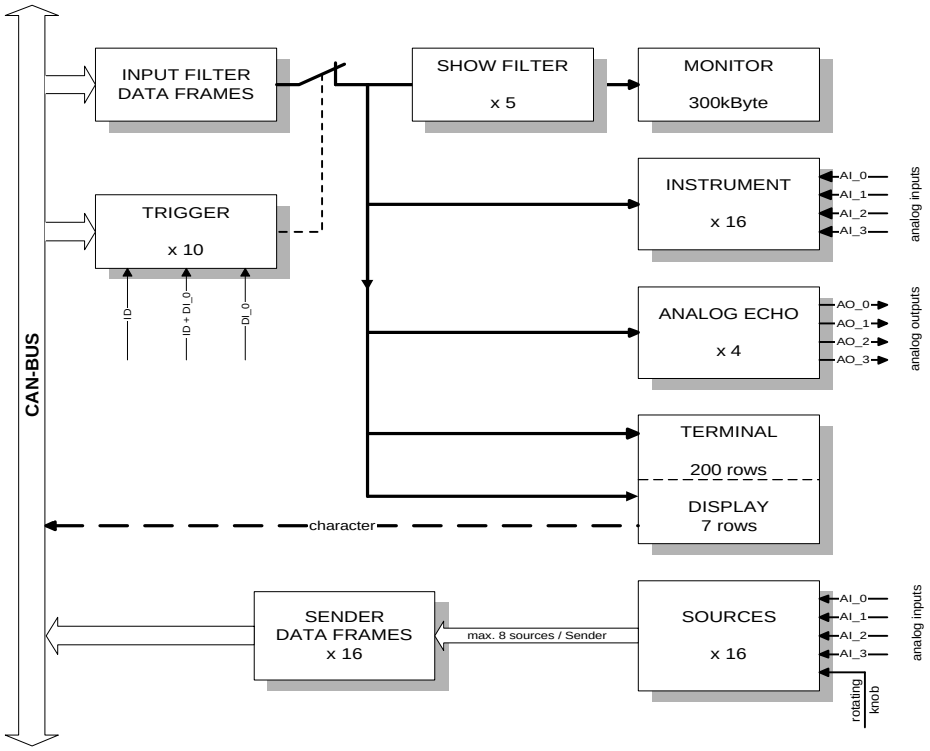
Selection RESTORE MENU ONLY will reactivate all MENU buttons.

5 CAN-SPY OPERATING STRUCTURE

The following functions may be accessed from the main menu:

- MONITOR
- TERMINAL
- INSTRUMENT
- SENDER
- SOURCE
- ANALOG ECHO
- COMMUNICATION
- SETUP
- USER DEFINITION
- TURN OFF

The following figure shows the structure and the essential functions of the CAN-Spy.



CAN-Spy System Overview

Two essential characteristics of the device become clear from the system overview.

The input and show filter, as well as the trigger function in the Monitor menu influence other functions in the tool also.

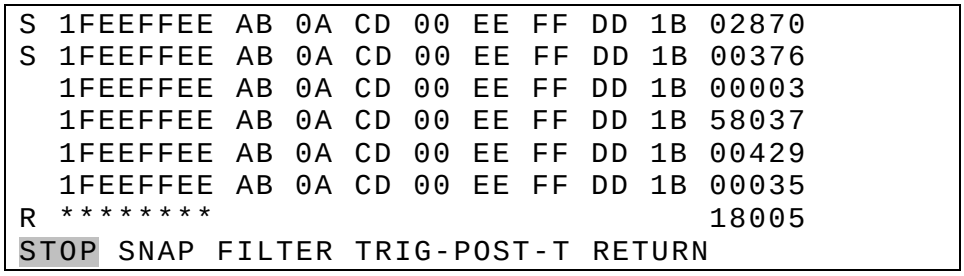
For example, an active and defined input filter for a specific identifier not only affects the display of messages in the Monitor menu, but also the Instrument, AnalogEcho, and Terminal functions (if they are set up for messages of the specific identifier).

Trigger events that occur stop, possibly with a delay, the recording of data. Only a trigger reset will allow the recording to continue.

5.1 MONITOR

This operating mode allows analysis of the messages transmitted on the CAN bus. Either all messages or certain messages can be detected and displayed. The delta time between messages is displayed to allow verification of protocols and device properties.

Triggering allows certain communication events to be recorded for later analysis. Filtering allows the display of high volume of data to be reduced to just the messages of interest.



MONITOR

While the device is in monitor mode, CAN data will be displayed immediately if messages are being received from the bus and accepted by the reception filters. The monitor permanently displays the last seven messages that have been written into memory. Whenever a trigger is activated and the memory capacity is filled after a trigger event, the recording will stop.

The data is displayed in the following format:

- TYPE (R = REMOTE FRAME, S = SELF SENT, T = TRIGGER, ´ ´ = RECEIVED, E = BUS ERROR)
- IDENTIFIER OF THE CAN BUS MESSAGE (11 OR 29 BITS LONG)
- CAN DATA (0 TO 8 BYTES)
- RELATIVE TIME BETWEEN ADJACENT MESSAGES IN MS

Different Errors can occur on te CAN-Bus.

The CAN Spy reports to different error classes: transmission errors and receive errors.

1. Receive Errors: This are all erros reported by the can-controller during the reception of a CAN-frame.
    a. Stuff error: more than 5 consecutive bits with the same level are detected
    b. Form error: according to the CAN-specification, specific bits must have specific expected values.

c. CRC error: the checksum (CRC) of the received frame is wrong.

2. Transmission Errors: This errors are recognized during the transmission of a CAN-frame.
   a. Bit1 error : CAN controller put a recessive bit on the bus, but a dominant level was read back.
   b. Bit0 error: CAN controller put a dominant bit on the bus, but a recessive level was read back.
   c. ACK error: No ACK(nowledge) was received .

The error are represented in the monitor window with „E TRANSMITT“ in case of a transmission error and „E RECEIVE“ in case of a receive error.

The menu in the bottom line displays the sub-functions that are available while in the Monitor mode:

- STOP
- SNAP
- FILTER
- TRIGGER
- RETURN

A menu item can be selected by turning the control knob. The selected sub-function (displayed inversely) is activated by pushing the control knob.

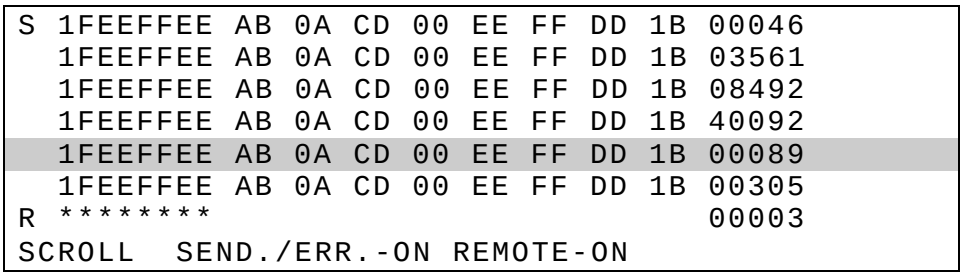
5.1.1 MONITOR-STOP

The STOP function in Monitor freezes the current memory state. The STOP function corresponds to an actuated MID trigger, so half of the memory will be filled with data transmitted before the monitoring was stopped.

If a PRE trigger has already been activated when the monitor has been stopped, data will cease being stored in the memory as soon as the memory is filled.

The user can scroll through all messages that have been recorded up to that particular moment.

While scrolling, bus traffic continues to be recorded in the background until the available memory has been filled.



MONITOR-STOP-SCROLL

Pushing the knob will display a menu that allows the SCROLL mode to be terminated.

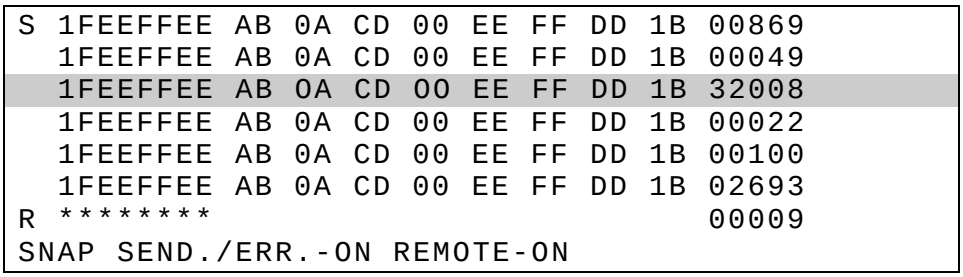
1. Exit the scroll mode and return to the back to the main menu by selecting “Menu” and pressing the control knob.

2. "Menu & CLR screen" deletes recorded CAN messages and takes the user back to the main menu.
3. "Go to…" allows the user to chose the newest message, the oldest message, or last released trigger.
4. "Send/Error" toggles the visibility of the SEND/ERROR CAN messages.
5. "Remote" toggles the visibility of the REMOTE CAN messages

While exiting the scroll mode, it is possible to reset the released trigger. If the trigger is not reset, the recorded data will not be overwritten and can be displayed with different settings in the various show filters. If the trigger is reset, the recording continues.

5.1.2 MONITOR-SNAP

Activating the SNAP function in Monitor freezes the last 32 messages. The user can scroll through these messages. Bus traffic continues to be recorded in the background. Unlike the STOP function, the SNAP function does not affect the triggering of the device. Here, a short snapshot (SNAP) of the data is available while the actual recording and triggering runs simultaneously in the background.



MONITOR-SNAP

Pushing the knob will display a menu that allows the SNAP mode to be terminated.

5.1.3 MONITOR-FILTER

The filters allow the user to restrict the recording and display of data to certain bus messages. Selection is performed using the Message ID. It is possible to define up to five filters. A filter is defined by specifying two criteria, the MASK and the STATE. The mask indicates the bits of the Message ID that have to be considered in the comparison. The STATE indicates the values of the bits that have to match in the comparison, taking the mask into account. These values are indicated in hexadecimal format.

Examples:

MASK 00000003 STATE 00000001

All identifiers with bit 0 = 1 and bit 1 = 0 satisfy the filter condition.

MASK 000000FF STATE 00000031

All identifiers (Message IDs) that have lower 8 bits equal to 00110001 satisfy the filter condition.

CAN-Spy filters are divided into two groups: input filters and show filters. An input filter is a pass-filter that allows the user to reduce the recorded amount of data. Only the CAN messages that pass through this filter are processed by the CAN-Spy (Monitor, Terminal, AnalogEcho, Etc.).

Show filters may be defined as pass filters or blocking filters. They only work when displayed under STOP and SNAP modes. Pass filters only allow those messages that match the filter's criteria to be view. With blocking filters, only those messages that do not match the filter are displayed.

Example:

If only the messages with the identifier 11223344 are to be recorded, a pass filter has to be defined with the MASK set to FFFFFFFF and the STATE set to 11223344.

The first level of the FILTER menu is displayed when the filter is activated.

```
RETURN
INPUT FILTER MASK       00000000
INPUT FILTER STATUS     00000000
SHOW FILTER TYPE        PASS FILTER
SHOW FILTER USAGE        YES
SHOW FILTER DEFINITION
RETURN
STOP SNAP FILTER TRIG-POST-R RETURN
```

MONITOR-FILTER (First Level)

Turning the control knob allows the user to cycle through the menu items.

5.1.4 MONITOR-FILTER Menu (First Level)

- RETURN Returns to Monitor mode.
- INPUT FILTER MASK Assigns a mask for the input filter.
- INPUT FILTER STATUS Assigns the input filter bits state.
- SHOW FILTER TYPE Defines filter as pass or blocking filter (PASS / BLOCKING FILTER).
- SHOW FILTER USAGE Activates the filter function (YES/NO).
- SHOW FILTER DEFINITION Branch in the menu (second level) for input of the single filter definitions.

When the control knob is pushed, the highlighted parameter can be edited.

5.1.5 MONITOR-FILTER Definition (Second Level)

This sub-menu allows the definition of different filter conditions. Single filter conditions are related by "or". This means that all messages will go through a pass filter which matches one or another filter condition.

```
 MASK   STATE  NAME      ACTIVE
1FFFFFFF 00CF0000 XXXXXXX     YES
1FFFFFFF 00CF0004 XXXXXXX     YES
NEW LINE
END


STOP SNAP FILTER TRIG-POST-R RETURN
```

MONITOR-FILTER (Second Level)

- NEW LINE Produces another empty filter.
- END Returns to the first level of the filter menu.

The list displays all defined filters. If the user pushes the control knob while one of the filters is selected, its parameters can be edited.

When editing the filter, the user can select one of two additional menu items, END and DELETE. END will terminate the editing mode. DELETE will delete the filter.

- MASK Compares the bits that have a value of '1' with the identifier.
- STATE Determines bit conditions for comparison with the identifier.
- NAME Indicates the name of the filter.
- ACTIVE Activates/deactivates the use of the respective filter line (YES / NO).
- END Terminates the editing mode.
- DELETE Deletes a filter.

```
 MASK   STATE  NAME       ACTIVE
1FFFFFFF 00CF0000 XXXXXXX     YES
1FFFFFFF 00CF0004 XXXXXXX     YES          >
NEW LINE
END


STOP SNAP FILTER TRIG-POST-R RETURN
```

MONITOR-FILTER (Second Level)

5.1.6 MONITOR-TRIGGER

The Trigger feature in Monitor allows the user to interrupt the recording of messages when an event or message matches a certain criteria. Possible trigger conditions include: a specific message identifier, the rise or falling edge (i.e. flank) on digital I/O *DIN0*, or a specific message identifier (taking into account the level on digital I/O *DIN0*). See Appendix. Up to 10 triggers can be defined.

The reaction to actuating the trigger depends on the type of trigger selected. The trigger type can be switched to PRE, MID, or POST trigger. In the case of PRE triggers, the memory will be completely filled after a trigger event. With MID triggers the memory will be half-rewritten and then stopped. Thus, data is retained in the memory before and after the trigger event. With POST triggers, immediately following the occurrence of the trigger event a stop occurs. In this case, the memory contains the maximum possible amount of data before the event occurred.

The type and state of the triggers are displayed in the bottom line of the screen. The trigger may have three states:

- R - Reset (a trigger event has not yet occurred)
- T - Triggered (a trigger event has occurred, and memory will be filled with data depending on the trigger type)
- S - Stop (recording of further messages has been stopped completely)

A trigger reset has to be actuated in order to continue recording messages.

```
RETURN
TRIGGER RESET
TRIGGER TYPE     PRE
TRIGGER SOURCE   NONE
TRIGGER EXT.     RISING EDGE/HIGH
TRIGGER DEFINITION
RETURN
STOP SNAP FILTER TRIG-POST-R RETURN
```

MONITOR-TRIGGER

5.1.7 MONITOR-TRIGGER Menu (First Level)

- RETURN — Returns to Monitor mode.
- TRIGGER RESET — Resets the trigger logic and resumes recording.

- TRIGGER TYPE Defines the trigger as a POST, MID or PRE trigger. In other word, it defines whether the trigger event is the last, middle, or first item in memory (POST / MID / PRE).
- TRIGGER SOURCE Defines trigger events. Defines if the trigger is actuated by the identifier of a message, a flank (i.e. edge) on *DIN0* or by identifier of message taking into account the state on *DIN0* (NO / IDENTIFIER / EXTERNAL / EXTERNAL + IDENTIFIER).
- TRIGGER EXT. Defines flank (i.e. edge) or state of digital input as a condition for actuating trigger.
- TRIGGER DEFINITION Opens the second level of the Trigger menu.

5.1.8 MONITOR-TRIGGER Definition (Second Level)

When the menu item TRIGGER DEF. is selected, all defined trigger events are listed.

```
MASK     STATUS   NAME     ACTIVE
1FFFF0FF 00CF0000 XXXXXXX    YES
10FFFFFF 00CF0004 XXXXXXX    YES
NEW ROW
END


STOP SNAP FILTER TRIG-POST-R RETURN
```

MONITOR-TRIGGER (Second Level List)

- NEW ROW Displays a new, empty trigger.
- END Returns to the first level of the Trigger menu.

A trigger is defined using MASK and STATUS. MASK selects the bits of the identifier that are to be considered in the comparison. STATUS defines whether the masked bits have to be 1or 0 in order to match the condition. The values are quoted in hexadecimal format (e.g.: $F_{hex} = 1111_{bin}$; $3_{hex} = 0011_{bin}$) .

Examples:

MASK 00000010 STATUS 00000010

All message IDs where the fourth bit is a 1 will act as a trigger.

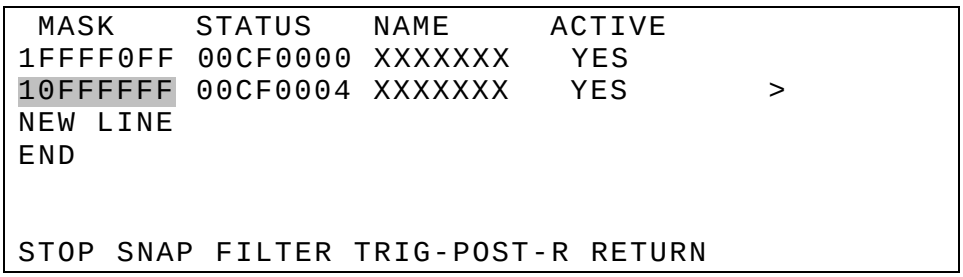
MASK 000000FF STATUS 00000031

All message IDs where the lower eight bits equal 00110001 will act as a trigger.

For example, in order to use a message with the message ID 11223344 as a trigger, the following three steps must be completed. First, the TRIGGER SOURCE must be set to IDENTIFIER. Second, the MASK must be set to FFFFFFFF. Third, the STATUS must be set to 11223344. Additionally, a name may be entered for this trigger in the NAME field.

The ACTIVE switch allows individual triggers to be switched off without deleting them.

Triggers can be selected by turning the control knob until the desired trigger is highlighted. The selected trigger can then be edited by pushing the control knob. When editing a trigger in the reference line, there are two additional menu items, END and DELETE. Choose END to stop the editing process or DELETE to delete the trigger.



MONITOR-TRIGGER (Second Level Editor)

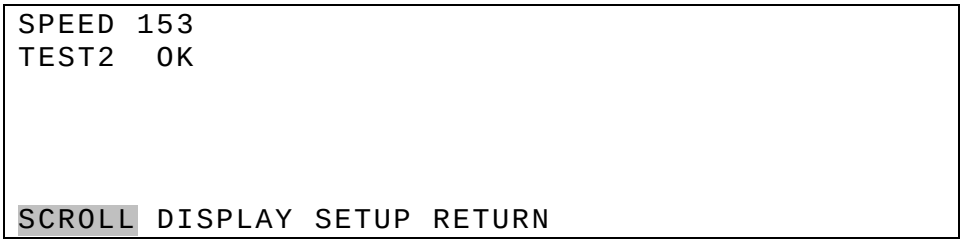
- MASK — Compares bits with the value of '1' to the identifier (i.e. message ID).
- STATUS — Determines the bit conditions for comparison with the identifier.
- NAME — Indicates the descriptive name of the trigger.
- ACTIVE — Activates or deactivates the use of a single trigger (YES / NO).
- END — Terminates editing mode.
- DELETE — Deletes entry.

5.2 TERMINAL

This function, available from the main menu, allows the installation of a terminal channel on a freely programmable identifier. The data bytes of a CAN message with this identifier will then be interpreted as ASCII characters and displayed as plain text. For example, by reserving a certain identifier, that is an output channel, the Terminal mode can be used to debug messages when developing software.

ASCII characters below 20h will not be displayed. The characters LF (0Ah) and CR (0Dh) are supported.

Three sub-functions are available from the Terminal menu: SCROLL (for scrolling the text display), SETUP (for entering the desired terminal identifier), and DISPLAY.

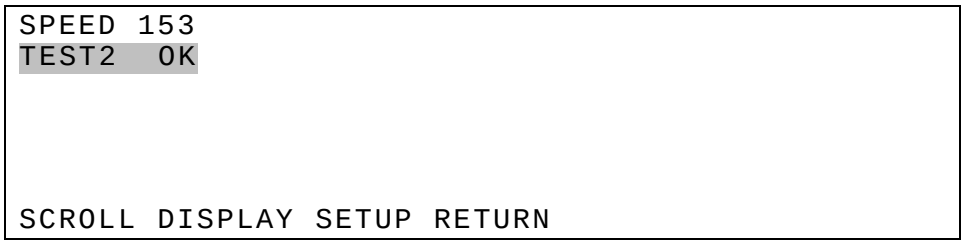


TERMINAL

- SCROLL — Allows the texts to be scrolled.
- DISPLAY — 7-line constant text display.
- SETUP — Adjusts the identifier for text messages.
- RETURN — Returns to the main menu.

5.2.1 TERMINAL-SCROLL

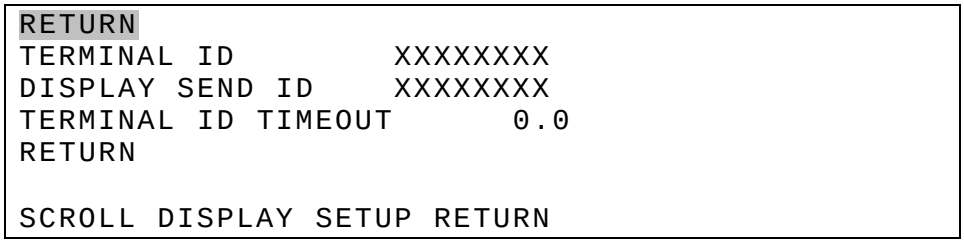
Selecting this function allows in Terminal the text to be scrolled through. Push the knob to terminate the SCROLL mode.



TERMINAL-SCROLL

5.2.2 TERMINAL-SETUP

Use the SETUP screen to enter identifiers (i.e. message IDs) for the terminal function, where they will be available as ASCII strings for easy interpretation and display. Identifiers can also be set up from this screen, so characters can be sent to the display function (see Section 5.2.3).



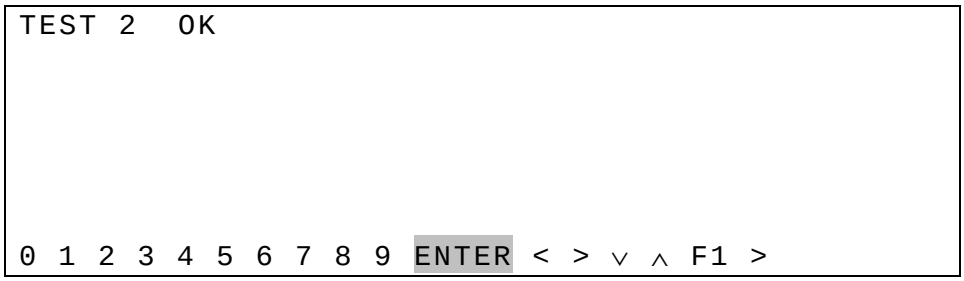
TERMINAL-SETUP

- RETURN — Returns to the Terminal menu.
- TERMINAL ID — Indicates the identifier for text messages.
- DISPLAY SEND ID — Indicates the identifier for sending the display data.
- TERMINAL ID TIMEOUT — Time in seconds.

If no CAN message is present after this time, the note "OFFLINE" appears in the display window. The value 0.0 indicates that the control is turned off.

5.2.3 TERMINAL-DISPLAY

In the DISPLAY mode, control characters can be used to achieve a permanent display on the CAN-Spy. Additionally, characters can be sent from the CAN-Spy that can be used for communication with other bus participants.



TERMINAL-DISPLAY

This function only works in connection with other bus participants. By pushing the knob, the selected character in the lower line menu will be transmitted as an ASCII value.

Supported Control Characters (Upon Receipt):

ASCII	Description
0X12	Cursor position is followed by two bytes. Byte 1:Number of line, BYTE 2: Number of column.
0X09	Cursor forwards
0X08	Cursor backwards
0X06	Cursor on
0X05	Delete display
0X07	Cursor off
0X0A	Cursor to next line
0X0D	Cursor to beginning of line

Menu Terminal Display (Transmittable Characters):

Menu key	ASCII Value Sent
0	0X30
1	0X31
2	0X32
3	0X33
4	0X34
5	0X35
6	0X36
7	0X37
8	0X38
9	0X39

Menu Key	ASCII Value Sent
ENTER	0X0D
<	0X46
>	0X47
^	0X48
v	0X49
F1	0X41
F2	0X42
F3	0X43
F4	0X44
RETURN	Returns to Terminal menu

When “DISPLAY” is selected, 0x4B will be sent.

When “ RETURN ” is selected, 0x45 will be sent.

5.3 INSTRUMENT

This function allows CAN-Spy instruments to be defined. A CAN-Spy instrument takes the data content of a given message, converts it into familiar engineering units, and displays it for easy review.

Furthermore, the device allows multiplexed data with 8- or 16-Bit multiplexor to be displayed. Byte 1 of the CAN message is used for the 8-Bit multiplexor. For the 16-Bit multiplexor, byte 1 of the CAN message is the low-byte and byte 2 is the high-byte. (CAN data bytes are counted 1…8)

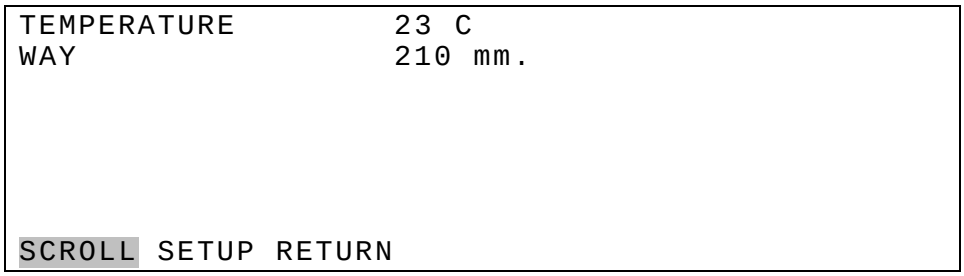
Since software version V.1.33 the position of the mulitplexor is not longer fixed to data bytes 1 resp. 1 and 2, but it now can be programmed to any position within the can data bytes by the parameter MULTIPLEXOR POSITION (see 5.3.3). In case of a 16-bit multiplexor this parameter defines the location of the low byte, the multiplexor high byte is located in the consecutive data byte.

Conversion factors, the display format, the units of measurement, plain text names, identifiers, and the position of the data within the CAN message can be individually adjusted for each instrument. The CAN-Spy instrument function allows complex data to be read quickly and easily. A maximum of 16 CAN-Spy instruments can be defined.

Since software version V.1.33 an overflow control had been included. If the result of the scaling function will be to large to be represented by an signed long 32 bit number, instead of displaying digits, there will be displayed a asterik (*) for every digit of this value.

Displaying MIN/Max Values

Since software version V.1.70 an instrument can defined to show the maximum or minimum of the received values. If you define an instrument to show minimum or maximum value, it is helpful to name the instrument MIN-,,, resp. MAX-… so you will remember that the value shown in the display is not the actual one.

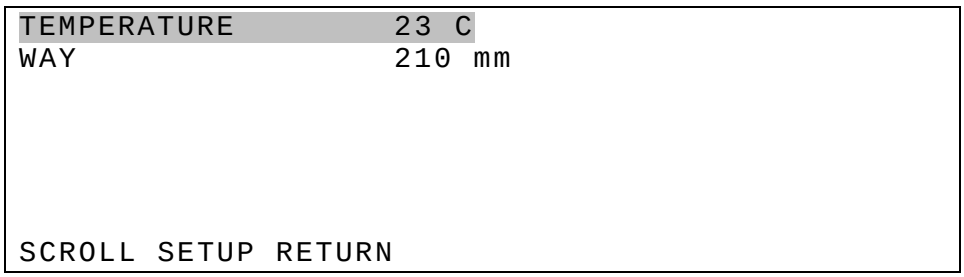


INSTRUMENT

- SCROLL — Scrolls through the instruments.
- SETUP — Set up of the instruments.
- RETURN — Returns to the main menu.

5.3.1 INSTRUMENT-SCROLL

Use the SCROLL function on the Instrument screen to scroll through a list of the active instruments.

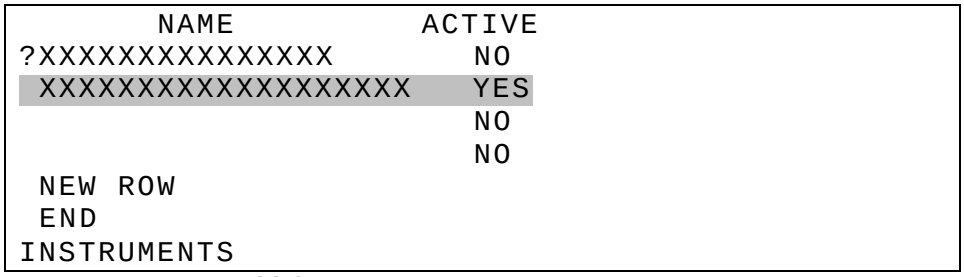


INSTRUMENT-SCROLL

Push the knob when scrolling through the instruments to activate a menu that will allow you to return to the main Instrument menu or to reset the minmal resp. maximal values of such instruments, which are defined to show minimal or maximal values.

5.3.2 INSTRUMENT-SETUP

While viewing the main Instrument screen, select SETUP by pushing the knob to go to the SETUP screen. All instruments are listed on this screen.



INSTRUMENT-SETUP (List)

To edit an instrument's parameters, select it, press the knob, select DETAILS, and press the knob again. This will take you to the DETAILS screen. See Section 5.3.3 for more information.

When an activated instrument is selected, three further selections will appear: DETAILS, END, and DELETE. At first only the DETAILS option is displayed. Turning the knob to the right, as indicated by the arrow, will reveal the END and DELETE options.

```
       NAME            ACTIVE
 XXXXXXXXXXXXXXX         NO
 XXXXXXXXXXXXXXXXXXX     YES    DETAILS     >
                         NO
                         NO
 NEW ROW
 END
INSTRUMENTS
```

INSTRUMENT-SETUP (Editor)

- NAME — Indicates the name of the instrument.
- ACTIVE — Activates display of the respective instrument (YES / NO).
- DETAILS — Screen where the instrument's parameters can be adjusted.
- END — Returns to the instrument list.
- DELETE — Deletes entry.

5.3.3 INSTRUMENT-SETUP-DETAILS (Second Level)

In the second level of the SETUP menu in Instrument, the parameters of a defined instrument can be adjusted.

```
RETURN
UNIT                        mm.
IDENTIFIER                153F8600
FORMAT LENTH                    10
DECIMAL PLACES                   0
SCALING FACTOR                   1
SCALING DIVISOR                  1
INSTRUMENTS
```

INSTRUMENT-SETUP-DETAILS (Second Level)

- RETURN — Returns to the INSTRUMENT-SETUP screen (first level).
- UNIT — Alters the unit of measurement for the instrument.
- IDENTIFIER — Alters the message ID used by instrument.
- LENGTH FORMAT — Defines the number of figures for the display value. (A decimal point allocates one figure. Too small of a value produces false values to be displayed).
- DECIMAL PLACES — Number of figures after the decimal point when displayed as a decimal fraction. (Also affects the displayed value).
- SCALING FACTOR — Number to be multiplied with the received value before display.
- SCALING DIVISOR — Number to divide the received value by before display.
- SCALING OFFSET — Number to be added to the received value before display.
- CONTROL VALUE BY — Defines the value based on Message, AIN1, AIN2, AIN3, or AIN4
- MULTIPLEXED DATA — Permits the use of an 8- or 16-Bit multiplexor.

- MULTIPLEX KEY — This is the value of the multiplexor (8 or 16 Bit), which must be found in the data bytes located at <MULTIPLEXOR POSITION>. If the value found there, matchs with the MULTIPLEX KEY defined here, the instrument will be updated.
  In case of a 8 Bit multiplexor, the two digits from the left must be defined to zero.
- MULTIPLEXOR POSITION — This parameter defines the position, where the multiplexor byte(s) are located.
  If a 8 Bit multiplexor is used, this parameter gives the data byte number (1…8) where the mulitplexor is located in the can message.
  If a 16 Bit multiplexor is used, this parameter gives the data byte number (1…8) where the mulitplexor low byte is located in the can message, the multiplexor high byte is then found in the consecutive data byte.
  (available since software version V.1.33)
- VALUE SIZE — Defines whether the instrument is 32-bit, 16-bit, or 8-bit.
- VIEW FORM — (DEZ/HEX/BIN) this parameter allows for selection of the way how the value is displayed. The value can be displayed in decimal, hexadecimal or binary format.
- VIEWED VALUED — Defines whether the instrumnent shows the actual value (CURRENT) or the minimum (MIN) or the maxiumum (MAX) value, which was received form the bus. if MIN or MAX is selected, the stored minimum resp. maximum values will be reset, when the instrument setup menu is called and during setu parameter download. The minimum resp. maximum values can also be reset manually in the instrument scroll window (see 5.3.1)
- DATA SOURCE — Displays the third level of the SETUP series of screens, this screen indicates the correlation of the CAN data bytes to the displayed value.

The value displayed on the instrument is calculated as follows:

$V1 = V0 * FACTOR / DIVISOR$ (1)

$\text{Display value} = (V1 + OFFSET) * 10^{-(\text{DECIMAL PLACES})}$ (2)

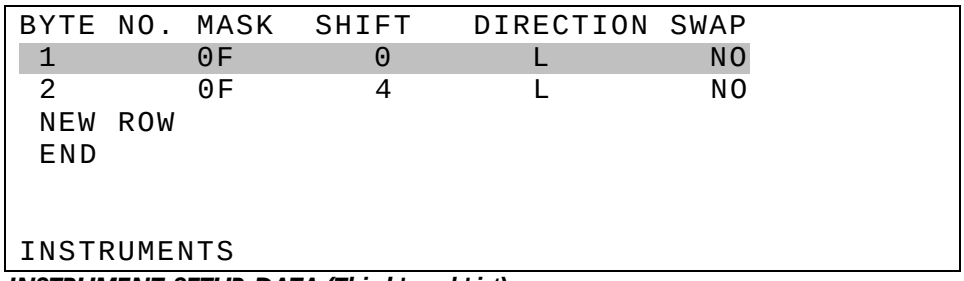
(1) : V0 is the value taken from a CAN message (correlation at DATA SOURCE).

(2) : DECIMAL PLACES affects not only the display format but also the display value.

For an example, see Section 5.3.5.

5.3.4 INSTRUMENT-SETUP-DATA (Third Level)

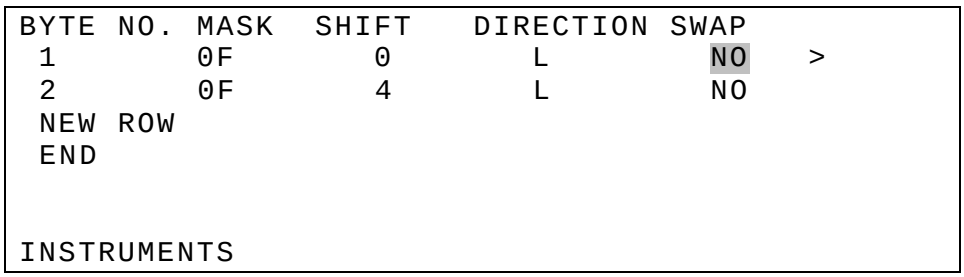
From this screen, particular bytes of a message can be selected and grouped to enable the display of a particular value for the instrument. Note that for all instruments a maximum of 24 lines are available for assigning CAN data bytes to their display values.



INSTRUMENT-SETUP-DATA (Third Level List)

- NEW LINE — Produces an empty line for editing data bytes.
- END — Terminates the editing mode.

Push the control knob while a line is highlighted to activate an editing mode where the parameters for the selected byte can be adjusted. In the editing mode, two additional menu items will appear, END and DELETE. Select END to leave the editing mode. Use DELETE to delete the selected line.

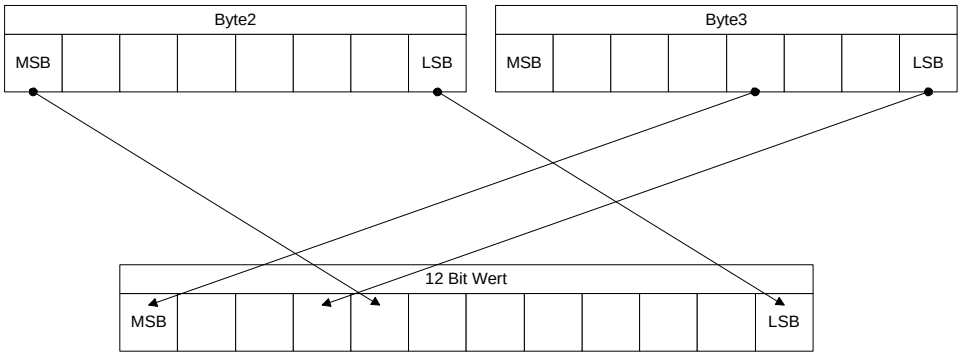


INSTRUMENT-SETUP-DATA (Third Level List)

- BYTE NO. — Indicates the number of data bytes in a message.
- MASK — Bytes labelled '1' are grouped to form one value (a maximum of 32 bits).
- SHIFT — Indicates the number of bits that the masked bits need to be shifted in order for the resulting number to be correct.
- DIRECTION — Indicates the direction (to the left or to the right) that the masked bits need to be shifted (L / R).
- SWAP — Indicates whether the respective data byte will be reverted (turned around) bit-wise before masking (YES / NO).
- END — Terminates the editing mode.
- DELETE — Deletes the selected line.

5.3.5 Example: Data Source in INSTRUMENT-SETUP-DATA

A 12-bit value with the data byte2 and the lower nibble of data byte3 will be formed according to the following illustration.



For this purpose, the parameters in the DATA menu (third level) have to be adjusted as follows:

BYTE-NO.	MASK	SHIFT	DIRECT.	REVERSE
2	FF	0	L	NO
3	0F	8	L	NO

The value displayed on the instrument is calculated as follows:

V1 = 12 bit value * FACTOR

V2 = V1 / DIVISOR

Display Value = (V2 + OFFSET) * $10^{-(\text{DECIMAL PLACES})}$ (1)

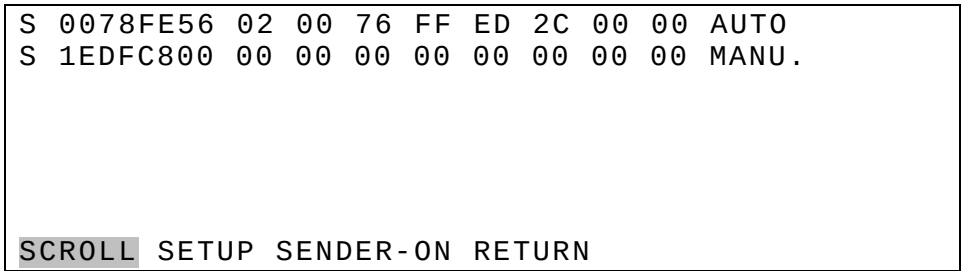
The values for FACTOR, DIVISOR and OFFSET have to be adjusted in the DETAILS menu (second level). See Section 5.3.3.

(1) : DECIMAL PLACES are also adjusted in the second level of the SETUP menu. The adjusted value affects both the display format and the display value. The effect of this value can be adjusted by selecting the respective SCALE FACTOR.

5.4 SENDER

The SENDER feature allows manual or periodical transmission of messages with fixed data. The data content of a sender can also be coupled with a source. The source allows dynamic contribution of data as scaled number values. The transmitted value can be changed with the control knob, or an analog input can be entered as a source. With this function, CAN bus devices (with variable data content) can be simulated.

The SENDER-ON/OFF menu item, at the bottom of the screen, indicates whether or not CAN messages can be sent from this screen. If SENDER-ON is displayed, then messages can be sent from this screen. If SENDER-OFF is displayed, then sending messages from this screen is forbidden. By selecting this item and pressing the knob, the user can toggle between these two states.

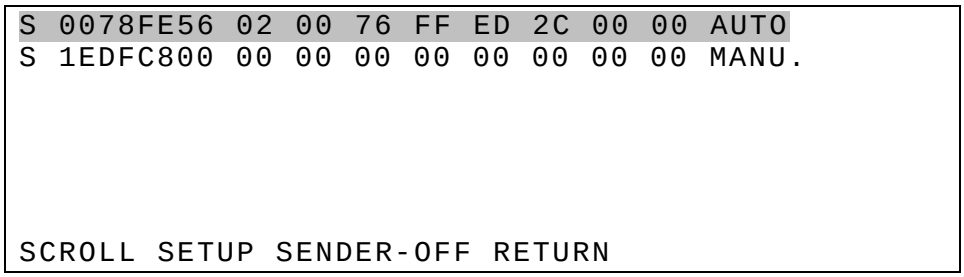


SENDER

- SCROLL — Scrolls through the senders.
- SETUP — Defines the senders.
- SENDER ON/OFF — Turns the Sender on or off.
- RETURN — Returns to the main menu.

5.4.1 SENDER-SCROLL

The Scroll mode allows the user to scroll through the senders. Pushing the knob while a given sender is selected, will activate a menu allowing the user to either transmit the message or return to the Sender menu. A message can be manually transmitted for each sender this way. Therefore, a sender that normally transmits periodically would send its message premature.

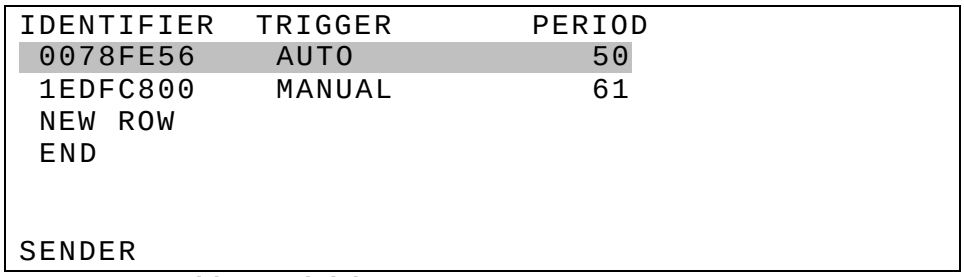


SENDER-SCROLL

5.4.2

5.4.3 SENDER-SETUP

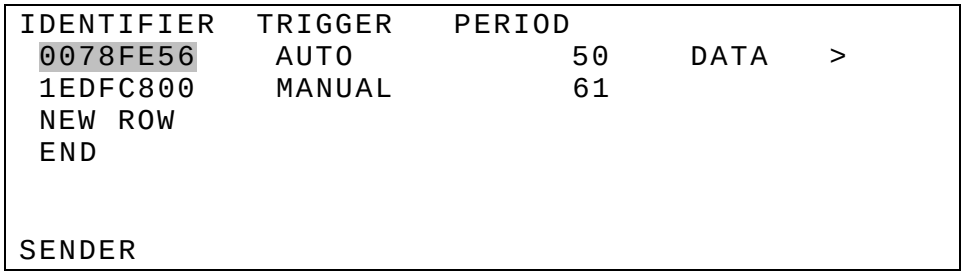
This screen shows all of the defined senders. Pushing the knob, while a specific sender is highlighted, opens the SENDER-SETUP menu. The user can then adjust the properties of the selected sender.



SENDER-SETUP (First Level List)

- NEW ROW — Create a new line for defining a new sender.
- END — Returns to the sender menu.

A maximum of 16 senders can be defined.



SENDER-SETUP (First Level Editor)

- IDENTIFIER — Indicates the message ID of the message to be transmitted.
- TRIGGER — Indicates the triggering frequency, or in other words whether the sender is inactive, automatically sent, or manually sent (INACTIVE / AUTO / MANUAL). Since software version V.1.40 two additional selections are available: REM.-AUTO and REM.MANU. Both are used to define a remote frame sender. REM.-AUTO will cause a remote frame beeing sent periodically, REM.-MANU sets a remote frame sender, which will send on manual request. In case of REM.-AUTO the value given as PERIOD should be longer than the expected reponse time of the device which will repsond to this remote frame.
- PERIOD — Indicates the duration of the trigger event in ms. Note: this feature can only be used with AUTO trigger.
- DATA — Activates a menu from which the number and the value of the sender message can be adjusted (see Section 5.4.4). In case of a remote frame sender only the data length definition will be necessary.
- SOURCE — Activates a menu where the source of the sender can be modified (see Section 5.4.5).
- END — Returns to the list of defined senders.
- DELETE — Deletes the respective sender.

5.4.4 SENDER-SETUP-DATA

The length and the constant value of the Sender message can be modified from this screen. Depending on the device settings, these constant sender data bytes might eventually be completely or partly rewritten by defined and sender-correlated sources.

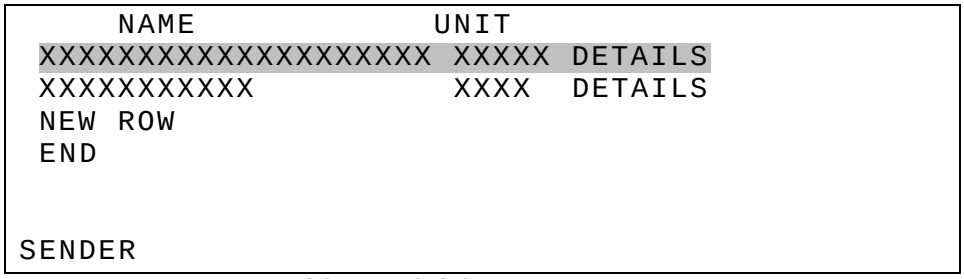
```
RETURN
DATA LENGTH              8
DATA BYTE 0             70
DATA BYTE 1             5F
DATA BYTE 2             00
DATA BYTE 3             78
DATA BYTE 4             FF
SENDER
```

SENDER-SETUP-DATA

- RETURN — Returns to the SENDER-SETUP menu (second level).
- DATA LENGTH — Indicates the number of bytes in the sender message.
- DATA BYTE X — Indicates the value for data byte [X].

5.4.5 SENDER-SETUP-SOURCE

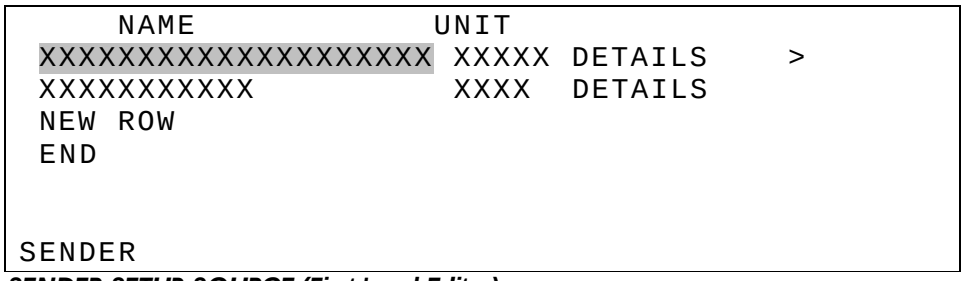
All sources that correlate with a specific sender are listed on this screen. Pushing the control knob while a given source is selected opens an editor where the values for that source can be modified. Up to 8 sources can be assigned to a single sender. It is important to note that there is a maximum of 16 sources that can be assigned to the total number of senders.



SENDER-SETUP-SOURCE (First Level List)

- NEW ROW — Generates a new empty source.
- END — Returns to the SENDER-SOURCE menu.

The names and units of the sources (text) can be defined in the editor. Selecting DETAILS leads to the menu for adjusting the parameters of a source.



SENDER-SETUP-SOURCE (First Level Editor)

- NAME — Indicates the name of the source (text, max. 20 characters).
- UNIT — Indicates the unit of the source value (text, max. 5 characters).
- DETAILS — Activates the SENDER-SETUP-SOURCE menu (second level) for adjusting the parameters of a source.
- END — Returns to SENDER-SETUP-SOURCE menu.
- DELETE — Deletes the selected source.

5.4.6 SENDER-SETUP-SOURCE-DETAILS (Second Level)

On this screen, the source's parameters can be adjusted. These parameters include format and scaling for the source's value.

```
RETURN
FORMAT LENGTH                5
DECIMAL PLACES               0
SCALING FACTOR               1
SCALING DIVISOR              1
SCALING OFFSET               0
MAXIMUM VALUE            65535
SENDER
```

SENDER-SETUP-SOURCE-DETAILS (Second Level)

- RETURN — Returns to the editor of SENDER-SETUP-SOURCE.
- FORMAT LENGTH — Defines the total number of figures for the value display in the menu source.
- DECIMAL PLACES — The number of figures after the decimal point when displayed as a decimal fraction (also affects display value).
- SCALING FACTOR — The number by which the source value is multiplied.
- SCALING DIVISOR — The number by which the source value is divided.
- SCALING OFFSET — The number that is added to the source value.
- MAXIMUM VALUE — Indicates the maximum adjustable number (only at the control knob).
- MAXIMUM VALUE — Indicates the minimal adjustable number (only at the control knob).
- INCREMENT — Changes the speed of the value change (at control knob).
- DEFAULT VALUE — Indicates the value of the defined source at start up of the device.
- CONTROL VALUE BY — Allows selection of one of the five sources for value input: the control knob or analog inputs AI1 through AI4.
- DATA DESTINATION — Activates the third level of the SENDER-SETUP-SOURCE menu in which the correlation of the 32-bit value to the data bytes of the sender message (data target) is defined.

The value of a source (analog input or control knob) is converted to a 32-bit value as follows:

32-bit value = (source value + offset) * factor/divisor

This 32-bit value that results from the scaling is correlated in the third level of the SENDER-SETUP-SOURCE menu (DATA TARGET) with the data bytes of the sender message (See Section 5.4.7 and Section 5.4.8)

Important Note!!!

In the SOURCE menu, the display value of the defined source is not affected by the scaling. It is affected by the decimal places. The pure value of the source always is a whole number value. Depending on decimal places, a decimal point is placed within the displayed value.

Display value = source value * 10 $^{-(\text{DECIMAL PLACES})}$

= (32 bit value * DIVISOR/FACTOR – Offset) * 10 $^{-(\text{DECIMAL PLACES})}$

5.4.7 SENDER-SETUP-SOURCE-DATA (Third Level)

This menu allows the user to display and adjust how the scaled value of the source (signed 32-bit value) is converted to single bytes. It also allows the user to select how these bytes are to be inserted into the data bytes of the sender message.

Constant data, which may have been associated with a sender, is rewritten by the allocation of sources (though only by the bits that are masked here and inserted into the sender data).

Please note that for all sources a maximum of 32 lines are available for allocating CAN data bytes.

```
BYTE NO. MASK  SHIFT   DIRECTION SWAP
 1        0F       0        L        N
 2        0F       4        R        N
 NEW ROW
 END


SENDER
```

SENDER-SETUP-SOURCE-DATA (Third Level List)

- NEW ROW — Generates a new empty line for data byte editing.
- END — Returns to the second level of the SENDER-SOURCE menu.

Pushing the control knob while a line is selected activates an editing mode. The properties for a byte may be adjusted while in this mode. Two additional menu items are also available in the editing mode. The first is for exiting the editing mode, and the second for deleting the entry.

```
BYTE NO. MASK  SHIFT   DIRECTION SWAP
 1        0F       0        L        N      >
 2        0F       4        R        N
 NEW ROW
 END


SENDER
```

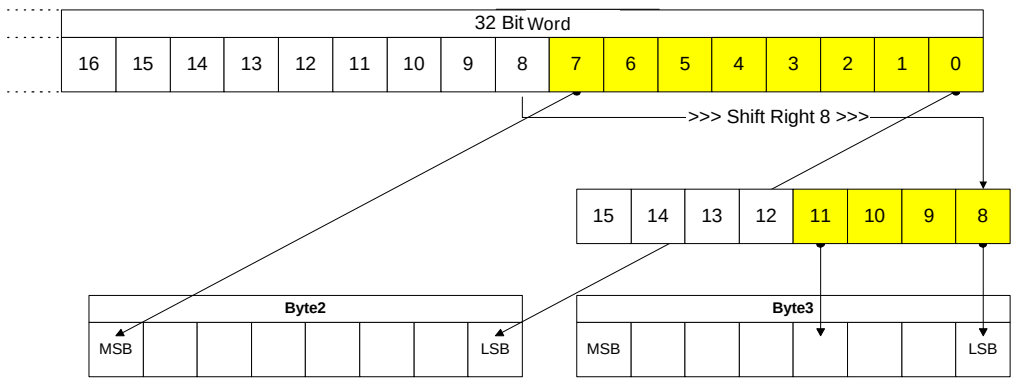
SENDER-SETUP-SOURCE-DATA (Third Level Editor)

- BYTE NO. — Indicates the number of data bytes in the send message.
- MASK — The bits with a value of '1' are inserted into the respective byte.

- SHIFT — Indicates the number of bits that the masked bits need to be shifted in order for the resulting number to be correct.
- DIRECTION — Indicates the direction, to the left or to the right, that the masked bits need to be shifted (L / R).
- SWAP — Indicates whether or not the respective data byte must be reversed bit-wise before masking.
- END — Terminates the editing mode.
- DELETE — Deletes the entry.

5.4.8 Example: SOURCE DATA TARGET

The lower 12 bits of the 32-bit value (scaled source value) are correlated with the bytes 2 and 3 of the Sender message as a 12-bit value according to the following illustration:



For this purpose, the parameters of the third level of the SENDER-SETUP-SOURCE screen must be adjusted as follows:

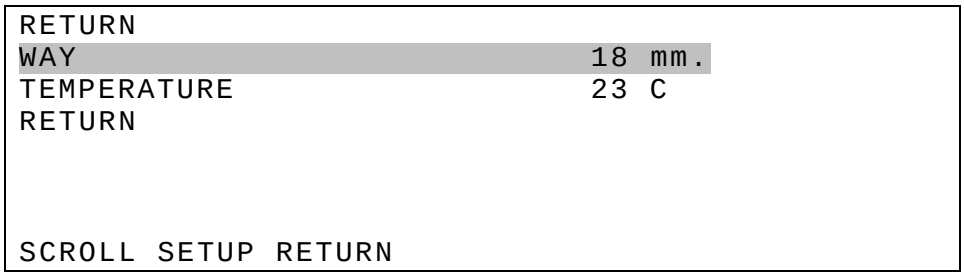
BYTE-NO.	MASK	SHIFT	DIRECTION	SWAP
2	FF	0	L	NO
3	0F	8	R	NO

5.5 SOURCE

This function displays all defined sources. Not all sources have values that are editable. Those that derive their values from analog inputs are not editable.

5.5.1 SOURCE-SCROLL

All defined sources can be scrolled through via the SOURCE-SCROLL screen.



SOURCE- SCROLL

- RETURN Returns to the SOURCE menu.

Pushing the knob can modify a selected source. If the source is editable, a menu will appear where its value can be modified. Note, if the source's value is derived from an analog input, its value cannot be modified.

Use the SENDER-SETUP menu to define and adjust source parameters (See Section 5.4.3).

5.6 ANALOG ECHO (OUT)

The Analog Echo or Analog Out function is similar to the Instrument function. By using it, the data contents of certain CAN messages can be recorded, converted into familiar units of measure, and displayed with the analog output. It also allows the display of multiplexed data with 8-Bit multiplexor for which data byte 1 of the CAN message is used. (data byte counting form 1 to 8)

Since software version V.1.33 the multiplexor used is not fixed to data byte 1, but can be selected by the parameter MULTIPLEXOR POSITION (see 5.6.2) ist.

At the same time these values are output to one of four possible analog outputs. The digital data of a CAN bus message is converted to another signal that can be channelled to existing analog measuring or recording devices. A maximum of four analog channels can be installed.

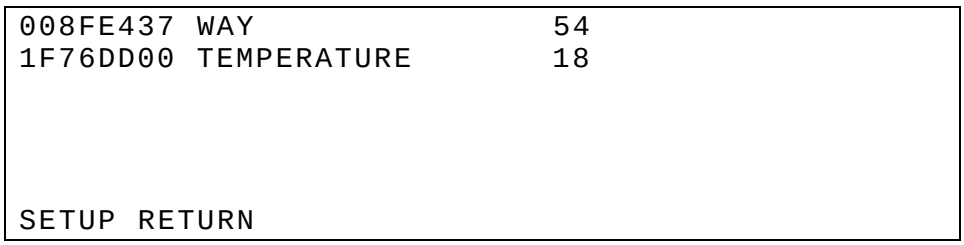
Frequency Output

Since software version 1.50 analog echo channel 0 offers an additional frequency output on digital output 0.

On the Analog Echo display, the 11-Bit value appears that is used to generate the analog signal. To create this 11-Bit value, "Offset", "Factor", and "Divisor" is applied to received data of the CAN message. Even though "Offset" can be entered as a 32-Bit value, only the lower 16-bit value will be used. This means the user will get meaningful results between –32769 and +32767. Only the lowest 11-bit value of the 16-bit result is used to generate the analog output signals.

Since software version V.1.33 the range of the scaled values are checked. All negative values are clipped to 0V output voltage and all values greater than a 11 bit integer number will be clipped to a display of 0x7FF corresponding to a 10 Volt output voltage.

The output value of the installed analog echoes (i.e. analog outputs) can be controlled from the display. The value in the display are always given in hexadecimal representation.

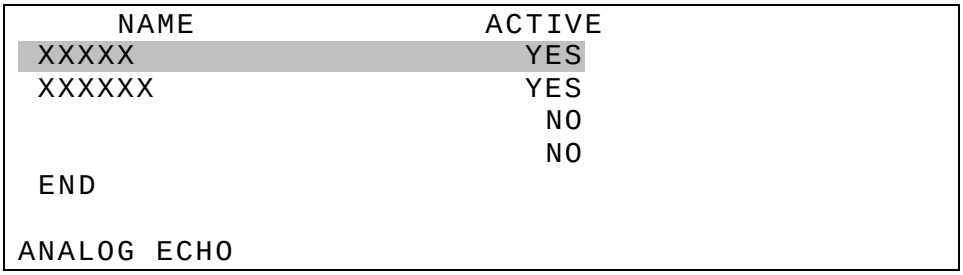


ANALOG ECHO

- SETUP — Defines and adjusts analog echoes (analog outs).
- RETURN — Returns to the main menu.

5.6.1 ANALOG ECHO (Out) SETUP

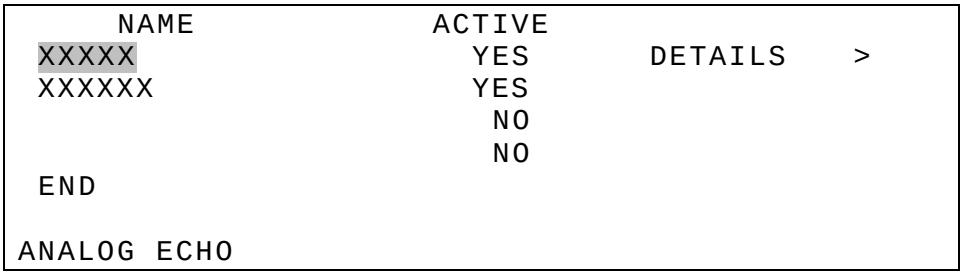
All four definable analog echoes (output) are displayed when the ANALOG ECHO-SETUP is selected. The correlation of an analog echo with the matching analog output is defined by its position in the list (from top to bottom: AO0...AO3). Each analog echo installed can be deactivated without deleting it.



ANALOG ECHO-SETUP (List)

- END — Returns to the analog echo menu.

Push the knob to edit the name and state of the highlighted Analog Echo.



ANALOG ECHO-SETUP (Editor)

- NAME — Name of the analog echo (10 character limit).
- ACTIVE — Analog echo activated (YES) or deactivated (NO).
- DETAILS — Activates the ANALOG ECHO-SETUP (second level) in which the parameters of the analog echo can be adjusted.
- END — Returns to the list of analog echoes.

5.6.2 ANALOG ECHO-SETUP-DETAILS (Second Level)

ANALOG ECHO (OUT)

The properties of a given Analog Echo can be adjusted from the Analog Echo Setup screen.

```
RETURN
UNIT                              mm.
IDENTIFIER                    0263FE00
FORMAT LENGTH                       12
DECIMAL PLACES                       3
SCALING FACTOR                       1
SCALING DIVISOR                      1
ANALOG ECHO
```

ANALOG ECHO-SETUP-DETAILS (second level)

- RETURN — Returns to the Analog Echo menu (second level).
- UNIT — Enters the unit of the analog echo value (text, 5 characters).
- IDENTIFIER — Defines the identifier of a message with data for analog echo.
- FORMAT LENGTH — Indicates the number of digits for value display.
- DECIMAL PLACES — Indicates the number of figures after the point when displayed as a decimal fraction.
- SCALING FACTOR — Indicates the number that the received value is multiplied by before display.
- SCALING DIVISOR — Indicates the number that the received value is divided by before display.
- SCALING OFFSET — Indicates the number that is added to the received value before display.
- MULTIPLEXED DATA — Permits the use of 8-bit multiplexors.
- MULTIPLEX KEY — If the content of data-byte 1 is the same as the value, the analog echo will be updated. (CAN data bytes counted from 1 to 8)
- MULTIPLEXOR POSITION — since software version V.1.33 the multiplexor is not fixed to data byte position 1, but can be defined by this parameter.
- DATA SOURCE — Opens a sub-menu where the data bytes of the CAN bus message can be correlated with the value to be displayed.
- RETURN — Returns to the ANALOG ECHO-SETUP screen (first level).

For a further explanation of scaling, see Section 5.3.3 INSTRUMENT-SETUP-DETAILS.

5.6.3 ANALOG ECHO-SETUP-DATA (Third Level)

From this screen, the user can adjust the data bytes of the CAN bus message in order to create a signed 16 bit value. A maximum of 16 data sets (lines) are available for the correlation of the CAN data bytes with the displayed values.

```
 BYTE NO. MASK  SHIFT   DIRECT.   REVERSE
 1        FF       0       L         N
 2        FF       8       L         N
 NEW ROW
 END


ANALOG ECHO
```

ANALOG ECHO- SETUP-DATA (Third Level List)

- NEW LINE — Generates a new empty line for editing data bytes.
- END — Returns to the third level of the ANALOG ECHO menu.

To edit a value, select its line and push the knob.

```
BYTE NO. MASK  SHIFT   DIRECT.   REVERSE
 1        FF       0       L         N
 2        FF       8       L         N    >
 NEW ROW
 END


ANALOG ECHO
```

ANALOG ECHO-SETUP-DATA (Third Level Editor)

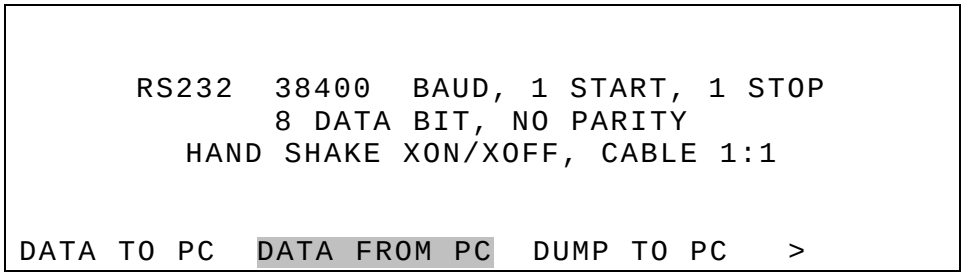
- BYTE NO. — Indicates the number of data bytes in the message.
- MASK — The bytes labelled '1' are grouped to form a 16-bit number.
- SHIFT — Indicates the number of bits that the masked bits need to be shifted in order for the resulting number to be correct.
- DIRECT. — Indicates the direction to the left or to the right that the masked bits need to be shifted (L / R).
- SWAP — Indicates whether or not the respective data byte has to be reversed bit-wise before masking.
- END — Terminates the editing mode.
- DELETE — Deletes an entry.

See Section 5.3.5 for an example of the correlation of the sender message with the value to be displayed or output.

5.7 COMMUNICATION

CAN-Spy can be connected to a PC via a RS232 interface (1:1 cable, fixed baud rate, 38400 baud). Adjustments made on the CAN-Spy device can thus be transferred to the PC and vice versa. Adjustments for different applications can be saved in the PC and reloaded to the device as required. Alternatively, the device adjustments can be copied (via a PC) to another device. Moreover, the current messages on the bus, converted to ASCII characters, can be transmitted to the PC.

However, CAN-Spy will not record messages from the bus at the same time that it is uploading the converted messages to the PC. The format of the device adjustments to be transmitted is explained in the appendix (See Section 6.3.2, page 49).



- DATA TO PC — Sends current device settings to the PC.
- DATA FROM PC — Receives and saves device settings.
- DUMP TO PC — Diverts the messages on the bus as ASCII characters to the PC.
- RETURN — Returns to the main menu.

5.8 SETUP

CAN-Spy's settings can be adjusted and customized to the CAN bus from the SETUP screen. For example, the length of the INDENTIFIER for recorded messages can be adjusted so that only messages of the specified length are recorded.

The LISTEN ONLY mode prevents a CAN bus from taking over the device. It should be noted that it is not possible to transmit or answer received messages while in this mode.

For safety reasons, the CAN bus connection should be disconnected before SET DEFAULT VALUES is selected. The adjustable default values are listed in the Appendix (Section 6.3.1, page 48). Defined filters, triggers, senders, etc. are deleted when default values are restored.

Note: The CAN interface is compatible with CAN-C only. Fault tolerant CAN-B requires an optional transceiver to convert levels.

```
RETURN
DISPLAY-CONTRAST                34
IDENTIFIER                      29-BIT
CAN-TIMING
DIALOG-LANGUAGE                 ENGLISH
LISTEN ONLY                     NO
SET DEFAULT VALUES
<SOURCE ANALOG ECHO COMMUNICATION SETUP >
```

SETUP Menu (First Level)

- RETURN — Returns to the main menu.
- DISPLAY CONTRAST — Controls the display contrast.
- IDENTIFIER — Indicates whether 11-bit or 29-bit message identifiers are recognized (11-bit / 29-bit).
- CAN-TIMING — Activates the second level of the SETUP menu where time constants can be adjusted.
- DIALOG LANGUAGE — Displays texts in a selected language.
- LISTEN ONLY — Prohibits or permits CAN bus detection (transmission) of the device (YES / NO).
- SET DEFAULT VALUES — Resets all device settings to their original factory settings.
- DELETE RECEIVE BUFFER — (Yes/No) With "No" the receive buffer will not be cleared on power-on. To keep the data in the receive buffer uncorrupted, the device must be switched off by the menu function TURN OFF. Simply cutting off the power supply, might lead to data corruption.
- MENUE CONFIGURATION — Opens a sub-menu where the menu functions TERMINAL, INSTRUMENT, SENDER, SOURCE, ANALOG ECHO, SETUP and USER DEF. can disabled and enabled. How to renable a disabled setup menu, can be found at the end of chapter 4. (Since software version 1.40)
- AUTO-ACK (HW-OPTION) — (Yes/No). If the unit is equipped with an Auto Ack hardware option, the AUTO-ACK feature can be turned on resp. off here. With AUTO-ACK turned on, a second CAN-Controller is activated to acknowledge the frames send by the CAN-

SPY. This will allow for sending CAN-frames without any other CAN-node on the bus. (Since software version 1.40)

- CONFIRM POWER ON (Yes/No). If Yes is selected, the device will request for a power-on confirmation with key F1. If this will not be given within severall seconds, the device will power off automatically. (Since software version V.1.40).
- SELF TEST Tests the RS232 interface, digital and analog I/O (special plugs required).

5.8.1 SETUP-CAN TIMING (Second Level)

The automatic baud rate identification can only function reliably if two conditions are met. First, there must be at least two bus participants on the CAN bus besides the CAN-Spy. Second, the identifier length of the messages must match that which has been specified on the device (11- or 29-bit).

The baud rate cannot be identified automatically if there is only one bus participant in addition to the CAN-Spy or if there are no messages that match the specified identifier length. In this case, the user must manually enter the correct BAUD RATE.

```
RETURN
AUTODETECT(POWER ON)          NO
BAUDRATE                      STD-250KB
BAUDRATE AUTOSET
BAUDRATE ADJUST
RETURN

<SOURCE ANALOG ECHO COMMUNICATION SETUP >
```

SETUP-CAN TIMING (Second Level)

- RETURN Returns to the second level of the SETUP menu.
- AUTODETECT Indicates whether the automatic baud rate adjustment is activated when device is switched on (YES / NO).
- BAUDRATE Displays the adjusted baud rate. Also allows the selection of a baud rate from a list of standard baud rates.
- BAUDRATE AUTOSET Activates automatic baud rate adjustment.
- BAUDRATE ADJUST Activates the third level of the SETUP menu for adjusting user-defined time constants for the CAN controller.

Hint: The CAN-Transmitter automatically uses the high-speed modus for a baud rate of 500kB/s or higher. There is no slope angle (slope-control) restriction anymore. At a baud rate of 500kB or higher, it is recommended to use a shielded CAN cable to avoid HF interference.

5.8.2 SETUP-TIME CONSTANTS (Third Level)

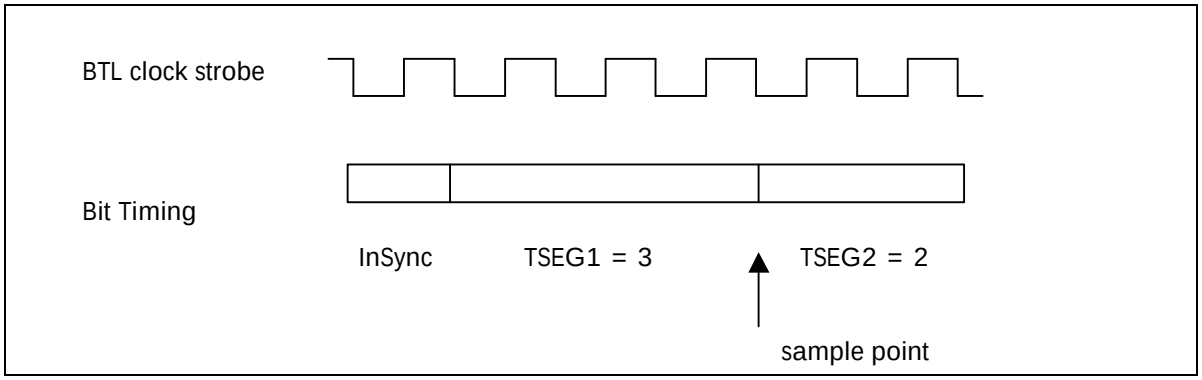
Time constants for the CAN controller can be entered and changed in this screen. If a baud rate is selected from one of the available standard baud rates, these time constants are adjusted automatically into plausible values. These values are saved internally and are not accessible.

If time parameters are entered or altered here, the baud rate will be adapted accordingly. An adjusted standard baud rate is changed automatically to a USER-defined baud rate. The baud rate value that results from the adjustments will be displayed after leaving the third level of the SETUP menu.

The parameters that are programmed on this screen are related to the synchronization behavior and the position of the sample point within the bit time.

The BTL (Bit Timing Logic) beat is an auxiliary strobe for scanning the bus signal that results from the oscillator strobe pulse of the CAN chip.

*BTL frequency = oscillator frequency / (2 * (BAUD RATE PRESCALER + 1))*



A CAN bit consists of three segments: the InSYNC cycle and two time segments. InSYNC has a constant length of one BTL clock strobe. The position of the sample point within a bit time is adjusted by defining the time segments.

There are (TSEG1 + 1) BTL beats before the sample point and (TSEG2 + 1) BTL beats after the sample point.

The sum of the three time segments per bit has to correspond with the bit time *(bit time = BTL-beat length *(3+ TSEG1 + TSEG2))*. The bit time results from the selected or necessary baud rate *(bit time = 1 / baud rate)*.

The SYNCHRONIZATION JUMP WIDTH is for resynchronization of the CAN controller. If the flank (i.e. edge) of the bit, that is expected in the InSYNC segment, occurs a few BTL beats sooner or later, the controller can shorten or lengthen the main segments of its bit time by a certain amount. The SYNCHRONIZATION JUMP WIDTH is the amount by which the segment may be shortened or lengthened.

```
RETURN
TSEG1                11
TSEG2                 6
SYNCHR. JUMP WIDTH    3
BAUD RATE PRESCALER   1
RETURN

<SOURCE ANALOG ECHO COMMUNICATION SETUP >
```

SETUP (Third Level)

- RETURN Returns to the SETUP menu (second level).
- TSEG1 Indicates the length time (in BTL beats) before the sample point for segment1 (2...15).
- TSEG2 Indicates the length of time (in BTL beats) after the sample point for segment2 (1...7).
- SYNCHR. JUMP WIDTH Number of BTL beats for resynchronization.
- BAUD RATE PRESCALER Generates the BTL beat from the CPU beat.

5.8.3 SETUP-SELF TEST

Special plug connectors for the RS232 interface and the Multi I/O interface are required to perform the self-test of the device. For a self-test, it is recommended to interrupt the CAN bus connection, because testing of the analog I/Os might affect the sender data. When activating the menu item SELF TEST, the serial interface and the digital outputs and inputs are tested automatically. If the self- test is not performed successfully due to an error in the device or because the required test plugs are not connected, the test process can be terminated by pushing the knob. After pressing the knob, the SELF TEST menu will appear. If the test was successful, the menu will appear automatically after the test is complete.

```
RETURN
RS232 TEST OK
DIGITAL I/O TEST OK
ANALOG OUTPUT1                    0
ANALOG OUTPUT2                    0
ANALOG OUTPUT3                    0
ANALOG OUTPUT4                    0
<SETUP USER DEF. SWITCH OFF
```

SETUP-SELF TEST

- RETURN Returns to the main menu.
- RS232 Indicates the test result for the RS232.
- DIGITAL I/O Indicates the test result for the digital I/O.
- ANALOG OUTPUT 1...4 Indicates the analog outputs with adjustable output value.
- ANALOG INPUT 1...4 Indicates the analog inputs with input value.

From the SELF TEST menu, the analog outputs and inputs can be tested as long as the required test plugs are present. When an output is selected, an output value can be adjusted with the control knob. The value is accepted and displayed when the editing mode is terminated (by pushing the knob). Now a value should be displayed at the respective input that approximately corresponds to half the output value. The outputs have a data width of 11 bits. The inputs, however, should have a value of only 10 bits. This allows representation of a voltage of 0 to 10 volts each (10 V equals 2047 at the output, 1023 at the input).

The output voltages may also be adjusted manually for other purposes, such as using the CAN-Spy as a voltage source. However, it would provide only a small amount of power, and that amount would be inaccurate and somewhat unstable.

The outputs can also be switched to the inputs by using the test plug. These can be used as manually adjustable sources for the senders.

5.9 SWITCHING OFF

Selecting this menu item and pushing the control knob switches the device off.

5.10 ERROR MESSAGES

ERROR EEPROM DATA

Data in the EEPROM cannot be read. This can occur if a new software version was programmed into the device that is not compatible with the data of the previous software. In the "SETUP" menu, set default values, then define and save new device settings.

Appears at start-up.

DEFAULT XXXXXXXXXXX DUE TO ERROR

Part of the device settings is out of the admissible value range. Instead of the read values, default values are used. In the "SETUP" menu, set default values, then define and save new device settings.

Appears in the main menu window where the XXXXXXXXX data is used.

Examples:

DEFAULT INSTR. DATA DUE TO ERROR appears in the "INSTRUMENT" window.

DEFAULT SENDER DATA DUE TO ERROR appears in the "SENDER" window.

TRAP: XXXXXXXXXXXXXXXXX

CPU error. If this error occurs, please notify the manufacturer or your distributor with the exact Trap message and information regarding the circumstances of your test. Turn on the tool anew.

Appears in every currently active window.

DATA WITHOUT VERSION NUMBER

Line with version number is missing in the device settings file, received from the PC, or is not present on the first line.

Appears in the COMMUNICATION window.

TOO MANY ROWS OF THIS TYPE

This indicates that more lines with the same name are received by the device settings file than are allowed. Use the stated line number to determine which line (line name) it is. It is possible to determine which line is unnecessary by using the data in the lines with the same line name. This problem might occur after the file was manually edited.

Appears in the COMMUNICATION window.

ERROR FORMAT ASCII

A string in the device settings file, received from the PC is too long.

Appears in the COMMUNICATION window.

ERROR FORMAT NUMBER

An error occurred while translating ASCII data from the device settings file into numbers. Possible cause: the translated number is too large.

Appears in the COMMUNICATION window.

DATA DESTROYED

CAN messages to be displayed in the STOP or SNAP window are overwritten by newly recorded messages.

Appears in the STOP and SNAP window.

NO DATA There are no recorded CAN messages.

Appears in the STOP and SNAP window.

CAN MESSAGE LOST At least one CAN message was lost due to extended CAN data processing time. Possible cause: many analog echoes (outs) with the same identifier or many data sources per analog echo (out).

Appears in the currently active window of the main menu.

6 APPENDIX

6.1 Technical Data

Weight:	1.6 kg
Dimensions (L x W x D):	155 mm x 230 mm x 56 mm without handle
	205 mm x 270 mm x 56 mm with handle
Current consumption:	Approx. 330 mA at 12 V with activated display background illumination
Memory:	512 Kb RAM

6.2 Interfaces

- Two CAN bus interfaces (D-Sub 9 plug). However, only one is usable without the optional module. The maximum baud rate is 1 Mbit/s. The CAN bus has to be terminated in the plug if necessary.
- One RS232 interface (D-Sub 9 socket). Currently the RS232 interface is usable for software updates, configuration and CAN data up- and download. It has a maximum baud rate of 38,400 baud.
- One Multi I/O interface (D-Sub 25 socket).
  - 2 digital optically uncoupled inputs (5 V-24 V input voltage)
  - 2 digital optically uncoupled outputs (maximum 500 mA output current, short-circuit proof). The supply voltage for the digital outputs has to be fed externally (12 V-24 V)!
  - 4 analog inputs (0 – 10 V, 10 bit resolution)
  - 4 analog outputs (0 – 10 V, 11 bit resolution)

6.2.1 Pin Allocation

CAN bus interface (D-SUB 9, plug)

2	CANL
3,6	GND
7	CANH
9	+Vpower supply in/out.

While B12 and later models of the CAN-Spy device can be supplied with power with the included AC adapter, they can also be powered via pin 9 of the CAN bus interface using a 9 to 36V DC external power source. Pin 9 can also be used as a power source for the CAN-High/Low Speed (CAN B to CAN C) adapter.

However, if the CAN-Spy is being powered via pin 9, then the original power supply must not be used at the same time. See the label on the back of the CAN-Spy for the device's model number.

RS232 interface (D-SUB 9, socket)

2	TXD
3	RXD
5	GND
7	HSHI
8	HSHO

Multi I/O interface (D-SUB 25, socket)

1	GND
2	AI3 (analog input)
3	AI1 (analog input)
4	GND
5	DIN0+ (digital input)
6	DIN0- (digital input)
7	+Vin1 (supply voltage for digital output)
8	DOUT0 (digital output)
9	DOUT1 (digital output)
10	GNDIN1 (GND for digital output)
11	GND
12	AO1 (analog output)
13	AO3 (analog output)
14	GND
15	AI2 (analog input)
16	AI0 (analog input)
17	GND
18	DIN1+
19	DIN1-
20	+Vin1 (supply voltage for digital output)
21	NC.
22	GNDIN1 (GND for digital output)
23	GND
24	AO0 (analog output)
25	AO2 (analog output)

6.3 Device Adjustments

6.3.1 Default Values

User-made adjustments to properties and values listed below revert to default values when the CAN-Spy is reset. If the DEFAULT VALUES setting is selected from the SETUP menu, all user-defined filters, triggers, instruments, senders, sources, and analog echoes will be deleted. The unit should be disconnected from the CAN bus before the unit is reset.

Setup:

DISPLAY CONTRAST:	25
IDENTIFIER:	11
DIALOG LANGUAGE:	ENGLISH
LISTEN ONLY:	NO

CAN Timing:

AUTODETECT:	NO
BAUDRATE:	STD-250KB

Setup Time Constants:

TSEG1:	0
TSEG2:	0
SYNCHR. JUMP WIDTH:	0
BAUD RATE PRESCALER:	0

Terminal IDs:

TERMINAL ID:	18FF1930
DISPLAY SEND ID:	18FF1931

6.3.2 Data Format

The data entries used for adjusting settings are exchanged between CAN-Spy and the PC in ASCII code. These entries are described in the following. The entries occurring *with an example* are underlined. These lines can occur once or several times depending on how many filters, triggers, senders, etc. have been defined. The single positions from 1 to n of an entry are listed and explained below.

Versions No. *VS00 =00000000*

Input Filter *FL00 =0x01|0x01 |0x00000000|0x00000000*

1. SHOW FILTER TYPE — 0- BLOCKING FILTER, 1- PASS FILTER
2. SHOW FILTER USAGE — 0- NO, 1- YES
3. INPUT FILTER MASK
4. INPUT FILTER STATE

Data for Single Filter (FD00-FD04) *FD00 =0x1FFFFFFF|0x18FEAE30| |0x01|0x01*

1. MASK
2. IDENTIFIER (Message ID)
3. NAME (up to 7 characters)
4. Filter is active — 0- NO, 1- YES
5. Data for single filter are used — 0- NO, 1- YES

Trigger *TR00 =0x00|0x00|0x00*

1. TRIGGER TYPE — 0-PRETRIGGER, 1-MIDTRIGGER, 2-POSTTRIGGER
2. TRIGGER SOURCE — 0- NONE, 1- IDENTIFIER, 2- EXTERN, 3- IDENTIFIER+EXTERN
3. TRIGGER EXTERN if 2. == 2 — 0- Triggering at rising flank (i.e. edge), 1- at descending
   if 2. == 3 — 0- Triggering at HIGH on DIN0, 1- LOW on DIN0

Data for Single Trigger (TD00-TD09) *TD00 =0x00000000|0x00000000| |0x00|0x00|0x00*

1. MASK
2. IDENTIFIER (Message ID)
3. NAME (up to 7 characters)
4. Trigger is active — 0- NO, 1- YES
5. Number of digital input — Currently Always 0
6. Data for single trigger is used — 0- NO, 1- YES

Data for Terminal *TL00 =0x18FF1930|0x18FF1931|0x00*

1. TERMINAL ID
2. DISPLAY SEND ID
3. TERMINAL ID TIMEOUT

Data for Single Instrument (IT00-IT15)

IT00 =PRESSURE /0x18FEAE30/0x0008/0x0001/0/0x01/0x0C/0x02/0x00/0x00 /0x00/0x00/0x0000|0x00|0x00|0x00

1. NAME (up to 20 characters)
2. UNIT (text up to 5 characters)
3. IDENTIFIER (Message ID) of CAN message with data for this instrument
4. SCALING FACTOR
5. SCALING DIVISOR
6. SCALING OFFSET
7. Instrument is ACTIVE — 0- NO, 1- YES
8. FORMAT LENGTH
9. DECIMAL PLACES
10. VIEW IM SETUP WINDOW
11. CONTROL VALUE BY — 0 – MESSAGE, 1..4 – analog Inputs 1..4
12. VALUE SIZE — 0-32-BIT, 1-16-BIT, 2-8-BIT
13. MULTIPLEXED DATA — 0-NEIN, 1-16-BIT, 2-8-BIT
14. MULTIPLEX KEY
15. MULTIPLEXOR POSITION — 0..7
16. DARSTELLUNG — 0-DEZ., 1-HEX., 2-BIN.
17. ANGEZEIGTER WERT — 0-AKTUELLE, 1-MINIMUM, 2-MAXIMUM

Data Source Line for Instrument (ID0-ID23) *ID00 =0xFF|0x00|0x05|0xFF|0x00|0x00|0x00|0x01*

1. Set service information to 0xFF
2. Number of instrument that this line belongs to — (0xFF: to none)
3. Number of BYTES in CAN message
4. MASK
5. SHIFT factor
6. Shift DIRECTION — 0- to the left, 1- to the right

7. SWAP Byte bit-wise 0- NO, 1- YES
8. Line of data is used 0- NO, 1- YES

Data for single sender (SR00-SR15)

SR00 =0x18F0010B|0x08|0x01|0x00|0x00|0x00|0x00|0x00|0x00|0x00|0x00|0x0000060E|0x01

1. IDENTIFIER (message ID) of sender message
2. Number of bytes in sender message
3. TRIGGER of sender 0 - sender INACTIVE, 1 - send PERIODICALLY, 2- send MANUALLY
4. Content of BYTE 0 in CAN message
5. Content of BYTE 1 in CAN message
6. Content of BYTE 2 in CAN message
7. Content of BYTE 3 in CAN message
8. Content of BYTE 4 in CAN message
9. Content of BYTE 5 in CAN message
10. Content of BYTE 6 in CAN message
11. Content of BYTE 7 in CAN message
12. SEND PERIOD in ms (only relevant if the trigger = 1)
13. Sender message data is used 0- NO, 1- YES

Data for Single Source (QL00-QL15)

*QL00 =BREAK PEDAL POSITION|% |0x01|0x00|0x0C|0x01|0x0001|0x0004| 0|0x00000480| 0|0x0001| 0|0x*00

1. NAME of source (up to 20 characters)
2. UNIT (up to 5 characters)
3. Data of source is used 0- NO, 1- YES
4. Number of the sender that this source belongs to (0xFF: to none)
5. FORMAT LENGTH
6. DECIMAL PLACES
7. SCALING FACTOR
8. SCALING DIVISOR
9. SCALING OFFSET
10. MAX. VALUE for source value
11. MIN. VALUE for source value
12. INCREMENT (relative value that determines how fast the entry value will change on turning the knob)

13. DEFAULT VALUE for source value
14. GIVEN VALUE, source of source value 0- control knob, 1- AIN1, 2- AIN2, 3- AIN3, 4- AIN4

Data Targets for Sources (QD00-QD31) *QD00 =0x20|0x00|0x01|0xFF|0x00|0x00|0x00|0x01*

1. Set service data to 0x00
2. Number of source that this data target belongs to (0xFF: to none)
3. Number of BYTES of CAN message in which the data get
4. MASK (only positions labeled 1 are used)
5. SHIFT factor
6. Shift DIRECTION 0- to the left, 1- to the right
7. SWAP byte bit-wise 0- NO, 1- YES
8. Data of line is used 0- NO, 1- YES

Data for Single Analog Echo (AE00-AE03)

AE00 = | |0x00000000|0x0001|0x0001| 0|0x00|0x0C|0x00|0x00|0x00|0x00

1. NAME of analog echo (text up to 10 characters)
2. UNIT (text up to 5 characters)
3. IDENTIFIER (Message ID)
4. SCALING FACTOR
5. SCALING DIVISOR
6. SCALING OFFSET
7. Analog echo is used 0- NO, 1- YES
8. FORMAT LENGTH
9. DECIMAL PLACES
10. MULTIPLEXED DATA 0-NEIN, 1-JA
11. MULTIPLEX KEY
12. MULTIPLEXOR POSITION 0..7

Data Source for Analog Echo (AD00-AD15)

AD00 =0xFF|0x02|0x00|0x00|0x00|0x01|0x00|0x01

1. Service data (set to 0xFF)
2. Number of analog echo to which this data source belongs (0xFF to none)
3. Number of BYTES with data in CAN message

4. MASK (only positions labelled 1 are read)
5. SHIFT factor
6. Shift DIRECTION 0- left hand, 1- right hand
7. SWAP byte bit-wise 0- NO, 1- YES
8. Line of data is used 0- NO, 1- YES

Data for Setup

ST00 =0x0000FFA9|0x01|0x00|0x01|0x00|0x01|0x0000|0x0000|0x0000|0x0000|0x00

1. Value in register for CONTRAST voltage
2. The length of IDENTIFIER LENGTH that works 0- 11Bit, 1- 29Bit
3. DIALOG LANGUAGE 0- ENGLISH
4. Use the default baud rate after switching on the device 0- NO, 1- YES
5. Default BAUD RATE 0-STD-125K, 1-STD-250K, 2-STD-500K, 3-STD-1M, 4-USERDEFINIED
6. LISTEN ONLY 0- YES, 1- NO
7. Value for TSEG1
8. Value for TSEG2
9. SYNCHRONIZATION JUMP WIDTH
10. BAUD RATE PRESCALER
11. SENDER ON/OFF 0-OFF, 1-ON

6.4 Restrictions with High Baud Rate and Bus Load

In order to avoid loss of data at a baud rate of 1Mbit/s and 100% bus load, it is suggested that the user define no more than two analog echos with no more than two data sources each.

If the user does not follow the suggestion above, it is possible that at a baud rate of 1Mbit/s and 100% bus load the remote frame will be displayed before the data frame (consisting of only one identifier). This situation also occurs if the remote frame was received after the data frame.

If a loss of data occurs, a message will be displayed on the screen. Pressing the control knob once will delete this message.

6.5 Hints

1. There are only two bus users and at the attempt to send a message both are getting stuck.

The device can only be used again when the connection is interrupted, yet the CAN-Spy displays false data in the window. The device is set for LISTEN ONLY or another bus user does not send an ACK (acknowledgement) back.

2. The display remains empty and dark after start up.

CAN-Spy is connected to the PC with a serial interface where a terminal application is running. In this case, the bootstrap mode will be activated after switching on or resetting. The CAN-Spy can only be rebooted by terminating the terminal application or interrupting the PC connection and switching it on again.

3. The MONITOR window is full of error messages after start up.

It is necessary to test if the correct baud rate is selected, if other bus users are present while sending periodic CAN messages, or if another CAN node sends ACK.

3. No CAN messages are present in the MONITOR window after start up.

If the right baud rate is selected, the CAN bus is connected, and CAN messages seem to be on the bus, it needs to be verified if the correct identifier type (11- or 29-Bit) is selected.

4. The display is full with send messages. The device reacts very slowly to user manipulations.

There might be too many periodic senders defined.

5. None of the defined send messages are being sent.

It needs to be verified that sending of messages is allowed (SENDER menu then SENDER-ON).

6. After start up, an "ERROR EEPROM DATA" error message appears.

This can occur if a new software version was programmed into the device that is not compatible with the data of the previous software. Save old device settings in the PC before a software update and then to set the default device settings in the SETUP menu. Now the saved device settings in the PC can be loaded into the CAN-Spy.

7. Reset device settings.

If it is desired to delete device settings at start up, press and hold the "ESC" button and then press and hold the control knob to turn the device on. A menu for deleting the device settings and replacing them with default values or cancelling the process appears on the display.

After start up, the device indicates the firmware version, the set CAN parameters, and, if applicable, the installed options (if this is not the case, please refer to the hint on page 5 of this manual). If the control knob is pressed before or during the display of the firmware version, the process will be cancelled.

Lipowsky Industrie-Elektronik GmbH

Römerstraße 57, D-64291 Darmstadt, Germany
Quality Management

EG-Konformitätserklärung
Declaration of conformity

Wir Lipowsky Industrie-Elektronik GmbH
We Römerstr. 57
D-64219 Darmstadt, Germany

erklären in alleiniger Verantwortung, daß das Produkt
declare under our sole responsibility that the product

CAN-Spy®

auf das sich diese Erklärung bezieht, mit folgenden Normen übereinstimmt:
to which this declaration relates, is in conformity with the following standards:

EN 50082-2:1995
EN 55022 Klasse B:1998
EN 61000-4-2:1995
EN 61000-4-3:1996
EN 61000-4-4:1995
EN 61000-4-5:1995
EN 61000-4-6:1996

entsprechend den Bestimmungen der Richtlinien 89/336/EWG und 93/68/EWG.
following the provisions of directives 89/336/EEC and 93/68/EEC.

Darmstadt, 1999-11-24

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Dipl.-Ing. Andreas Lipowsky
(Geschäftsführer / *Managing Director*)