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User Manual

CANalarm®

User Manual

CANalarm®

Version: 1.1

Date: 09/29/2015

Version Overview

Date	Revision	Change(s)
06/10/2015	0	First version
09/29/2015	1	Description for the new user interface of the message trigger Error correction

Note:

Use of the CANalarm® device and proper understanding of this manual require general knowledge of the CAN-Bus, CANopen, DeviceNet and/or SAE J1939 fieldbus systems.

Table of Contents

1 Introduction

Thank you for purchasing the CANalarm®. You have acquired a tool supporting you in the start-up, analysis, monitoring and servicing/maintenance of your CAN bus system.

Thanks to its wide range of applications, its high data transfer rate and above all through its high tolerance against interference in the field of plant automation, the CAN bus has been well established for the last few years. Nonetheless, even when starting up new plants, but also during operation, a large number of problems occur, resulting quickly in undesired and often expensive failures.

The CANalarm® in the form of a 9-pin D-Sub field bus connector is designed for the logical monitoring of CAN bus systems and is integrated via plug&play into an existing and running system. As a passive bus node, it detects without interaction and continuously typical characteristics of a CAN communication and compares it with user settable trigger criteria:

- Bus traffic load
- Number of error frames
- ID and content of the transmitted telegrams

As soon as at least one of the trigger criteria is met, this condition is indicated by a status LED and by a potential-free switching output. The switching output is also integrable in the system control, so that an independent monitoring system can be realized in a simple way.

2 Start-up

2.1 Receiving inspection

Carefully unpack and check the device and completeness of the delivery immediately after receipt. If transport damage is suspected, inform the delivery agent within 72 hours and keep the packaging for inspection. The device must only be transported in its original or equivalent packaging.

2.2 Handling

Always handle the CANalarm® with the required care. Its display is made of glass and thus may break if the device falls on a hard surface or is subjected to hard impact. Before turning on the CANalarm®, allow the device to warm up to room temperature. When operating the device, it is imperative to observe the general accident prevention regulations relating to the use of measuring instruments. The device must only be used in dry rooms.

3 Overview of the CANalarm®

3.1 Connections
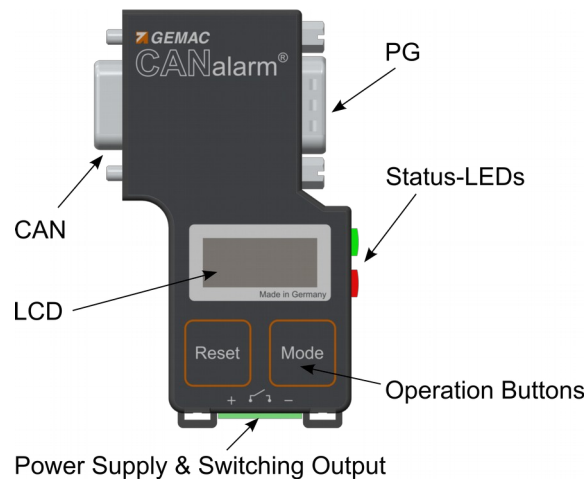
3.1.1 Connection to the CAN bus

The CANalarm® is connected to the CAN bus system by way of a 9-pin D-Sub connector. The connector pin assignment complies with CiA DS-102.

Pin	Signal	Connector Pin Assignment
1	-	-
2	CAN_L	CAN_L bus line
3	CAN_GND	-
4	-	-
5	CAN_SHLD	Shield
6	CAN_V- / GND	GND / 0 V / V-
7	CAN_H	CAN_H bus line
8	-	-
9	CAN_V+	Optional external supply voltage (+24 V)

Table 1: Connector pin assignment

3.1.2 Power supply

The CANalarm® is power supplied via either its CAN connector or its 4-pin connector (Table 2).

Pin	Signal	Connector Pin Assignment
1	Vcc	External supply voltage
2 + 3	SWITCH	Potential-free switching output
4	GND	Ground of the external supply voltage

Table 2: Pin assignment of the 4-pin connector

3.1.3   Switching output

Additionally, a potential-free switching output is led through at this 4-pin connector (Table 2). It is used as signal output, which displays the incidence of a trigger event according to its configuration. A triggered switching output can be reset automatically by the device or manually by shortly pushing the RESET-button (Chapter 5 „Configuration").

3.2   Buttons

For its operation, the CANalarm® is equipped with two push buttons (RESET and MODE). Their functionality is described in the according chapters of this user manual.

3.3   Operation modes

The CANalarm® can be used in three operation modes:

- **Normal Mode:**

  As a passive bus node, the CANalarm® analyzes the data traffic of the CAN bus and shows the results via its display and its status LEDs.

  You can switch forward the displayed values by pushing the MODE button shortly. The CANalarm® is re-started if you keep the RESET button pressed for at least 3 seconds.

- **Config Mode:**

  The CANalarm® is also a passive bus node and can be configured via its operation buttons (Chapter 5.1 „Configuration at the device"). You can switch between *Config* and *Normal Mode* by keeping the RESET and the MODE buttons pressed for one second simultaneously.

- **Remote Mode:**

  The CANalarm® is an active bus node and can be configured by the CAN bus via the PC software "CDS Configuration Tool" (Chapter 5.2 Remote configuration"). You can switch into this mode by using the PC program.

3.4   Status LEDs

Dependently from the operation mode of the CANalarm®, the LEDs show the recent status of the bus or of the device (Table 3)

	Normal / Config		Remote	
green	*off:* *flashing:* *on:* *blinking:*	no power supply automatic baud rate scan is in process baud rate detected, but no bus activity recognized bus activity recognized	*off:* *flickering:* *on:*	no power supply automatic baud rate scan is in process standard operation mode
red	*off:* *on:*	switching output opened switching output connected through	*off:* *simple flash:* *on:*	device is running without errors passive-error-mode active-error-mode

Table 3: Modes of the state LEDs

4   Diagnosis Functions

4.1   Bus traffic load

Problems in the planning, diagnosis and alarm messages as well as bad transmission characteristics with resulting sporadic repetitions of telegrams may increase the bus traffic load. A permanent measurement of the bus traffic load may uncover such problems.

To ensure a correct measurement, merely the correct baud rate of the CAN bus segment has to be set and the CANalarm® must be connected to the CAN bus system. Then, the device measures the bus traffic load continuously for a second. In case the bus traffic load exceeds a settable threshold, a trigger signal is sent.

4.2   Faulty telegrams

Error Frames are a component of the error management in the Data-Link-Layer, which is implemented in all CAN controllers. It is able to recognize the following error types:

- Bit errors
- Bit-Stuffing errors
- CRC errors
- Format errors
- Acknowledgment errors

Each error, which is recognized by the error management, is transmitted to all nodes by an Error Frame. This procedure is achieved with a deliberate coding violation. Then, all CAN controllers will discard the telegram, which has been destroyed by an Error Frame and the sending CAN controller repeats the transmission.

The counter for error telegrams and the monitoring of the bus traffic load are a real-time monitoring function. This measurement is based on the test of the protocols of all transmitted telegrams on the bus system. If an active or a passive Error Frame is recognized, the relevant counter is increased. In general, this counter should display the value „0". However, if errors occur occasionally or often, problems in the physical layer of the bus and from these resulting transmission errors are most likely the reason. These can be detected by a more detailed analysis of the CAN bus with appropriate diagnosis devices (e.g. CAN-Bus Tester 2 or CAN-touch®).

The counter of error telegrams of the CANalarm® counts up to maximum 99,999,999 errors and identifies the number of error frames per second, additionally. For its correct operation, it is essential to set the appropriate baud rate of the CAN bus segment. If a wrong baud rate is set, the faulty detection of telegrams can cause the increase of the counter of error telegrams in case of each data transmission.

Maximum values for the absolute and in time standardized error frames can be determined. As soon as these values are exceeded, the CANalarm® activates a trigger.

4.3 Monitoring of malfunctions

Some fields of application require a continuous monitoring of the status of all CAN nodes to respond to a malfunction and to set the complete system in a defined status. A simple way is to let all CAN nodes sending a message with a particular CAN-ID cyclically (refer to „Heartbeat"-telegrams in CANopen). If one bus node stops transmitting this message while the system is running, you could expect a malfunction of this bus node.

The CANalarm® offers the opportunity to analyze the CAN-IDs of all telegrams transmitted on the bus. If one ID has not been received within a defined time (Timeout), the CANalarm® can activate a trigger and transmits the error to a superior control via its switching output.

License note:

Triggering to a timeout of up to 32 CAN-IDs is only possible, if the appropriate license is active in the CANalarm® (see Section 6„License Management„). You can check the available licenses for your device in the PC software „CDS Configuration Tool".

4.4 Message trigger

It is also possible that a reaction of the bus system control is necessary sometimes, if a telegram with a particular ID, and/or a specific DLC and/or data content is transmitted on the bus.

In addition to the analysis of the IDs, the CANalarm® is able to check the count and the content of the data bytes in all telegrams received on the bus according to a specification. In case of a compliance, a trigger is activated.

License note:

Triggering to a particular CAN-ID or group of IDs or to a specific data content is only possible, if the appropriate license is active in the CANalarm® (see Section 6 „License Management"). You can check the available licenses for your device in the PC software „CDS Configuration Tool".

5 Configuration

The CANalarm® can be configured either at the device itself or easily via its CAN interface with the PC pro-gram „*CDS Configuration Tool*".

5.1 Configuration at the device

For changing the settings of the CANalarm® at the device, the operation mode „*Config Mode*" has to be acti-vated by pressing and holding the RESET and the MODE button simultaneously for a second. The following settings can be made with the buttons:

- ■ `BUSLOAD`   Threshold value of bus traffic load
  (*off* – deactivated)
- ■ `ERRORS Σ`   Threshold value of number of error frames
  (*off* – deactivated)
- ■ `ERROR/s`   Threshold value of error frames per second
  (*off* – deactivated)
- ■ `FAIL-MON`   Monitoring of malfunctions
  (*off* – deactivated
   active – activated)
- ■ `MSG-TRIG`   Message trigger
  (*off* – deactivated
   active – activated)
- ■ `BAUDRATE`   Baud rate of the CANalarm®
  (*auto* – automatic baud rate detection)
- ■ `CONTRAST`   Vernier adjustment of the LCD contrast

Additionally, the menu items `SET-ID` and `REPLY-ID` show the CAN-IDs, which enable the device to com-municate with the configuration software „*CDS Configuration Tool*".

The menu of the *Config Mode* is navigated via the buttons:

- ■ **MODE:**   press shortly → go one menu item further
  press for 1 sec → go one menu layer below
- ■ **RESET:**   press shortly → go one menu layer above
  press for 3 sec → CANalarm® is restarted

The selected settings are permanently saved in the CANalarm® while switching into normal mode. For switching into normal mode, the RESET and the MODE buttons must be pressed and held for one second at the same time.

5.2 Remote configuration

For simple and complete setup of the device, it is recommended to use the PC software „*CDS Configura-tion Tool*". It is available free of charge under www.gemac-chemnitz.de and enables the user to easily set up the CANalarm® via its CAN interface and a PC CAN interface (e.g. CAN-Bus Tester 2).

5.2.1 Connection of the device

Figure 1 shows the user interface of the program. Before a connection to the connected CANalarm® can be established, the appropriate CAN interface has to be selected in the list and its correct baud rate has to be allocated. If the automatic baud rate detection is active in the CANalarm®, any baud rate can be selected. Additionally, the telegram IDs for the communication of the program with the CANalarm® must be indicated. The default setting for the transmitting direction is 0x7A0. The default setting for the receiving direction is 0x7A1. In case these IDs have been changed but are unknown now, they can be shown on the display of the device while it is in „Config Mode". To read out these IDs, use the menu items SET-ID and REPLY-ID (see Section 5.1„Configuration at the device").

The software starts searching for a connected CANalarm® with the chosen parameters by clicking "Connect". Pay attention that not more than one node, which reacts to the selected communication IDs, may be connected to the CAN bus at any time.
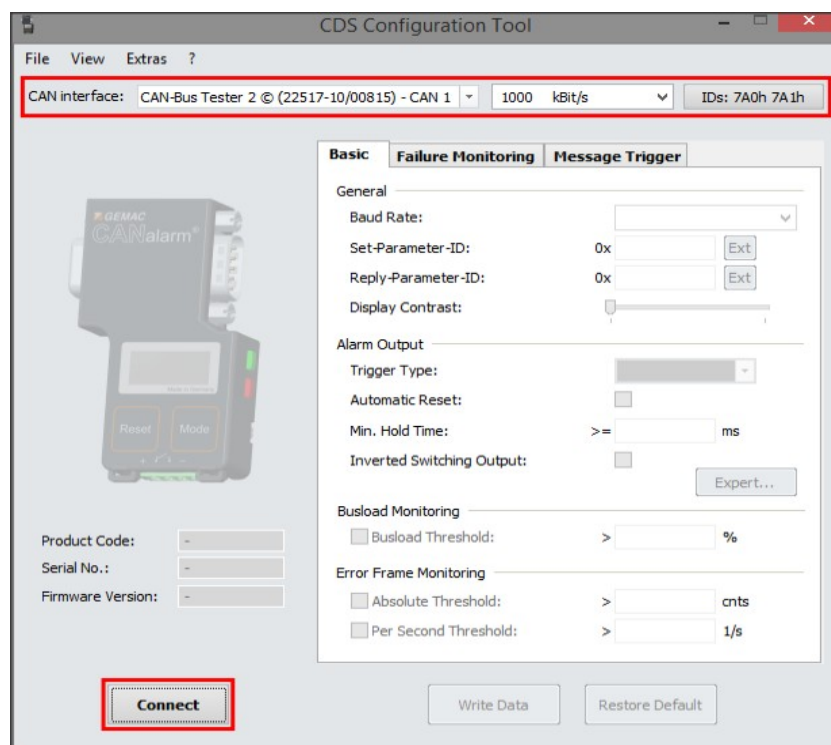

Figure 1: Establishment of the CAN connection

If the connection has been successfully established, the CANalarm® switches into *Remote Mode* and the program shows the product code, the serial number and the firmware version of the connected device (Figure 2). The user will be asked to upgrade the firmware version of his CANalarm®, if the version on the device is too old for the CDS Configuration Tool.

Furthermore, the entry masks for the various settings are activated and the software licenses available for this device are shown in form of symbols 📋 or 🔒 (see Section 6 „License Management").
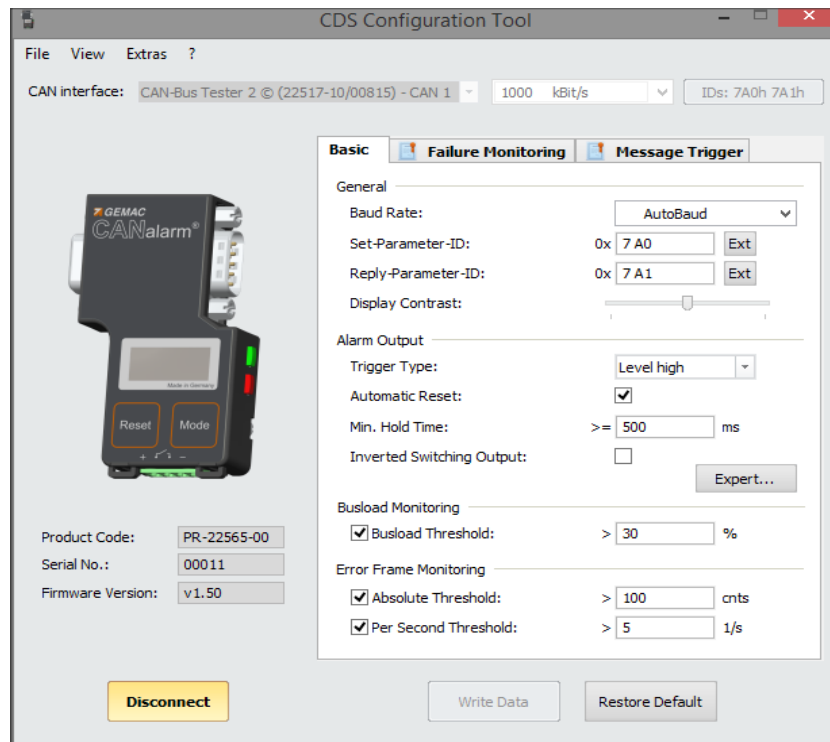
Figure 2: Device information and configuration of the basic diagnosis

5.2.2   Establishment of the basic diagnosis functions

- **Baud Rate:** CAN baud rate, which the CANalarm® is participating with at the bus traffic. If „Auto baud" is selected, the device detects the current baud rate at the bus automatically.

- **Set and Reply-Parameter-ID:** Telegram IDs, which enable the communication between PC program and the CANalarm®. The IDs 0x7A0 and 0x7A1 are set by default. If these IDs are already used by other nodes on the CAN bus to be monitored, it is highly recommended to choose alternative IDs.

- **Display Contrast:** Vernier adjustment of the LCD contrast to increase the readability of the display.

- **Bus Load Threshold:** Trigger threshold for the bus traffic load. If this check box is deselected, this trigger condition is not active.

- **Absolute Threshold:** Trigger threshold for the total number of detected error frames. This condition is inactive, if the check box is deselected.

- **Per Second Threshold:** Trigger threshold for the number of detected error frames within one second. This condition can be deactivated via the check box as well.

Due to its numerous settings, the switching output is described more detailed in the following paragraphs. The figures 3 and 4 show a basic circuit and an example of an appropriate signal sequence at the switching output. This overview can be opened by a click on the button "Expert" in the slider "Basic" of the PC software.

The point of origin are the results of the diagnosis functions of the device, meaning the bus traffic load, the monitoring of the error frames and malfunctions as well as the telegram trigger. These are consolidated to a „Trigger Signal" and transmitted to a multiplexer. This multiplexer determines which condition of the trigger

signal or which change of the trigger condition causes the triggering of the switching output. This means in detail:

- **Trigger condition:** *Whilst* the trigger signal has the according edge (High/Low), the switching output is still triggered.
- **Change of a trigger condition:** *As soon as* the trigger signal changes its condition (falling / rising edge), the switching output is triggered.

Whether a triggered switching output shall be reset automatically or by the user, can be decided via the switch described in the following schema. If „automatic Reset" is selected, a retriggerable monoflop is controlled. This monoflop turns off the switching output after a preset hold time (10...60000 ms), which has been determined by the user. For the alternative manual reset, the RESET button activates the reset input of a RS flipflop with set priority.

Finally, the polarity of the switching output can be switched to „Non inverted" or to „Inverted" by the second switch.
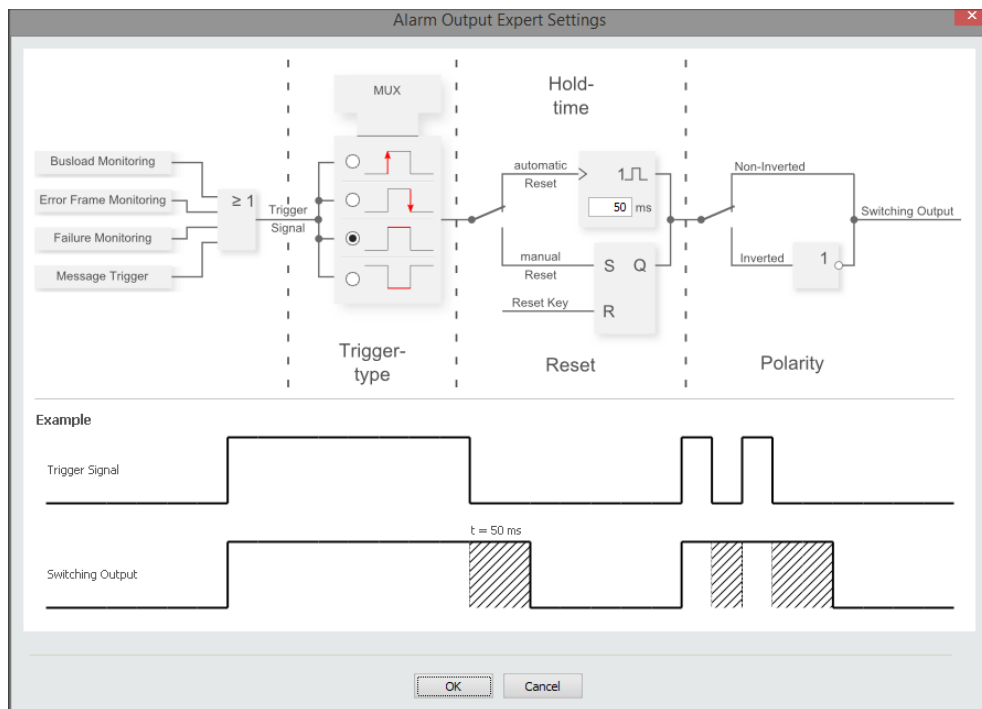

Figure 3: Configuration of the switching output – Example 1

The example in figure 3 results in the following mode of operation: Whilst one of the monitorings activates a trigger (high edge of the trigger signal), the switching output stays turned on. As soon as the monitorings activate no trigger (low edge), the output stays turned on for another 50 ms. Then, the output turns off automatically, unless, a monitoring triggers another alarm within this time.

A possible szenario is a signal transducer (e.g. a horn or a signal light) connected to the switching output, which displays the point of time when the permitted bus traffic load is exceeded.

The configuration described in figure 4 results in another mode of operation. As soon as one of the monitorings results in triggering (rising edge of the trigger signal), the switching output is turned on and then automatically turned off after a period of 750 ms. If one of the monitorings activates another trigger within this time, the switching output stays turned on for a longer time correspondingly. Additionally, the switching polarity is inverted, so that the output is opened in case of an error.

This configuration would be suitable for an automatic restart of the CAN bus system via the switching output in case of a node malfunction caused by turning off and following turning on the the bus operation voltage.
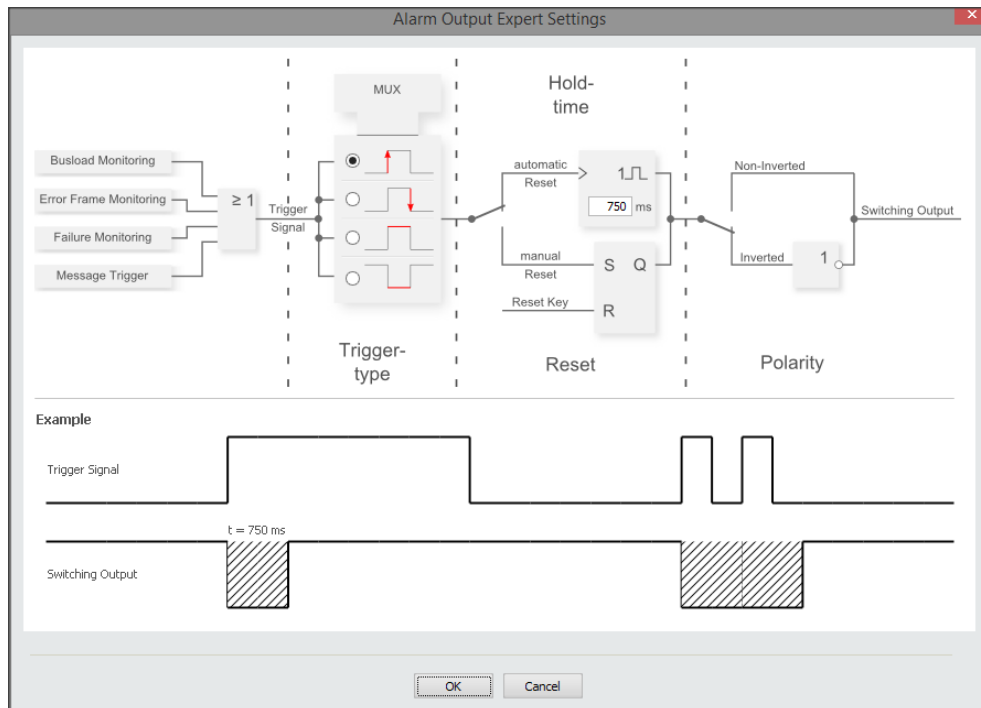

Figure 4: Configuration of the switching output – Example 2

5.2.3   Establishment of the monitoring of malfunctions and the message trigger

If the appropriate licenses are active on the device (see Section 6„License Management"), the enhanced diagnosis functions can be established via the sliders „Failure Monitoring" and „Message Trigger".
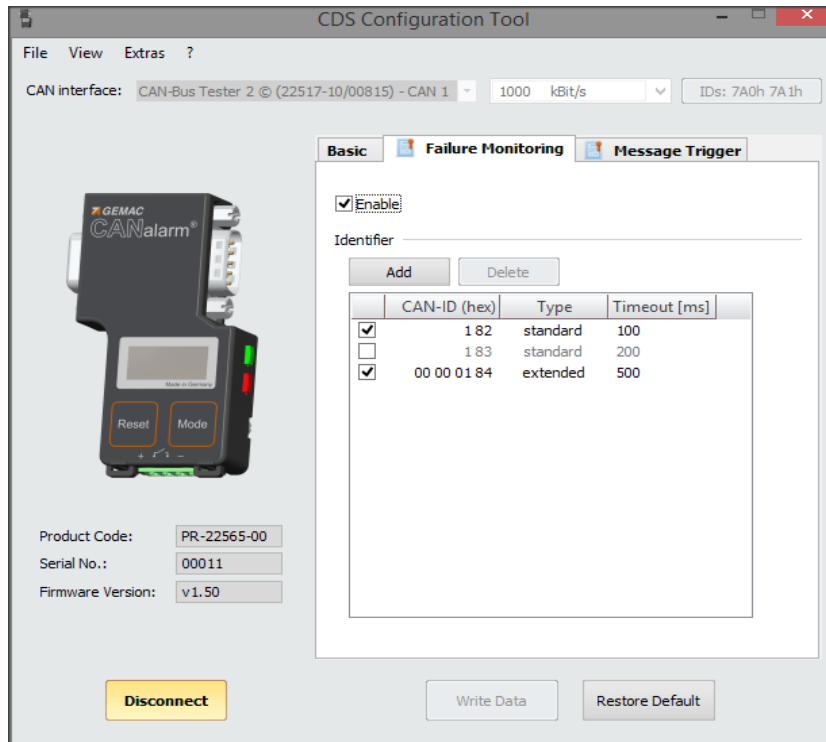
Figure 5: Configuration of the failure monitoring

Figure 5 Shows the entry mask to establish the failure monitoring.

- **Enable:** Activates/Deactivates the failure monitoring.
- **Identifier:** List of the monitored CAN IDs. Up to 32 IDs can be added to this list via the "Add" button. To handle a list entry, double-click to the particular feature of the entry. To stop the monitoring of an ID without deleting its settings, use the check box at the beginning of the line of this list entry. To delete a configuration durably, it has to be selected and deleted via the button "Delete".

The message trigger can be configured in the third slider „Message Trigger" (Figure 6):

- **Enable:** Activates/Deactivates the message trigger.
- **Identifier:** Displays the relevant CAN ID or ID group. Each bit in the identifier can be assigned to one of the following values:
    - X – Bit is not relevant
    - 0 – Bit is relevant and must be '0'
    - 1 – Bit is relevant and must be '1'

  The selection can be performed either using the appropriate buttons or by entering the appropriate hexadecimal values for mask and value. The field „Mask" shows the meaning of the bit value: The bit value '1' means that this bit is relevant and the bit value '0' means this bit must not be drawn on for filtering. The field „Value" displays the bit value, which must be adopted by the relevant bits in the field „Mask" to be accepted by the filter.
- **Data:** Definition of the filter for the data length and content. A particular byte or group of bytes can be specified for each byte of the data frames of a CAN message. The input via the bit buttons or the fields „Mask" and „Value" occurs in the same way as the input of the CAN ID. Additionally it can be determined whether the Data Length Code of the message has to be relevant ('0' ... '8') or not

('any'). If the CANalarm® receives a telegram fulfilling all those data specifications, a trigger is acti-
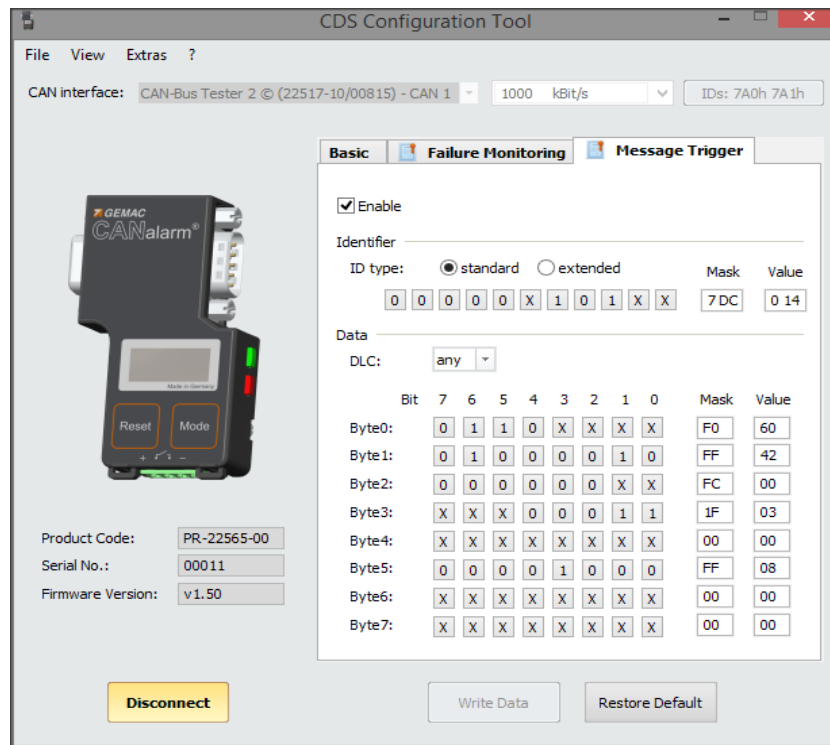vated and, according to the configuration, the switching output is active.

Figure 6: Configuration of the message trigger

5.2.4   Saving the selected settings

To save the selected settings on the device permanently, click „Write Data". Press the button "Restore De-
fault" to restore the default settings of the CANalarm®.

The connection to the device is disconnected via the button „Disconnect". Then, the device switches into
Normal Mode and starts immediately its analysis of the data traffic on the CAN bus with the determined set-
tings. This function enables the CANalarm® to be implemented in an already existing bus system. To ensure
the correct operation of the device, the CAN IDs for the communication between the CANalarm® and the PC
program (default: 0x7A0 and 0x7A1) may not be used by other bus nodes.

6 License Management

The basic set of the CANalarm® contains the **basic** diagnosis functions. These are:

- Measurement and evaluation of the bus traffic load
- Analysis of all CAN telegrams on the bus regarding error frames

The optional diagnosis functions **failure monitoring** and **message trigger** can be enabled as required by purchasing additional licenses.

After having purchased licenses for additional software modules, a license file (*.cdslic) is made available to you. This license file is uploaded to the connected CANalarm® via the PC software „CDS Configuration Tool" in the menu item „License File" under „Extras" (Figure 7). The license is valid for one device with a particular serial number and can be uploaded to this device only.
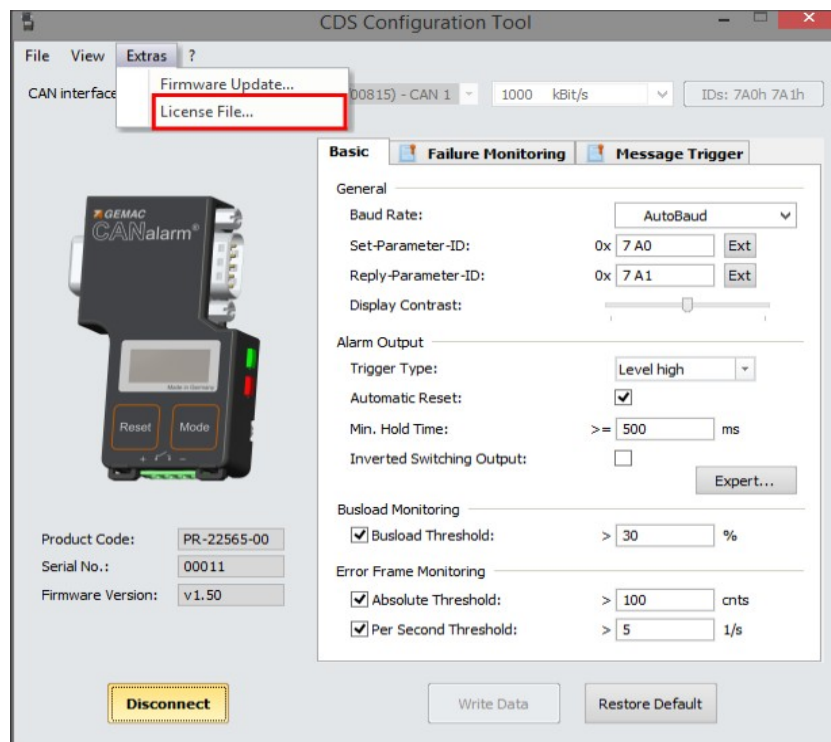

Figure 7: Device license

7   Technical Specifications

Electrical parameters	
Supply voltage	+ 9 … 32 VDC
Supply current	16 mA @ 24 V
Mechanical parameters	
Temperature range	0 °C to 50 °C
Degree of protection of the housing	IP20
CAN	
Protocol	CAN 2.0 A and B according to ISO 11898-2
Supported baud rates	10k, 20k, 50k, 100k, 125k, 250k, 500k, 800k, 1 MBit/s Additionally user-defined: 33.3, 62.5, 83.3 kBit/s Automatic detection
Connections	CAN 9-pin D-Sub connector PG Potential-free switch (60 V/1.25 A AC/DC)

Table 4: Technical data

8   Ordering Information

Product	Description	Article number
CANalarm® - Basic set		
CANalarm® - Basic set	CANalarm® incl. short manual	PR-22565-00
Licenses for optional Software Modules		
License „Failure Monitoring"	License key for failure monitoring of can nodes	SW-22565-10
License „Message Trigger"	License key for analyzing of CAN messages	SW-22565-11

Table 5: Ordering Information

9 Notes