Telemotive AG

blue PiraT

User's Manual

**License
Complex Trigger**

Version: 1.1

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1 Introduction

1.1 Overview

The function is called as a trigger, when a defined event will cause a certain, singular action.
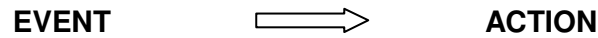
EVENT $\Longrightarrow$ **ACTION**

The different events and actions can be combined without any restriction.
The user's manual describes the configuration and the overall functionality of the remote control monitor function.

1.2 System Requirements

The complex trigger function works on any blue PiraT system with a remote control and a recent software. However, it is necessary to purchase a special license for this function. Please read the manual "blue PiraT - How to manage licenses" for more information about handling licenses.

This manual refers to the following software versions:

- Data logger firmware V6.0.1
- Client 3.5.1

Software updates are frequently available in the blue PiraT Service Center. Please make sure to have a current software installed.

1.3 Trigger Function

1.3.1 Trigger Event

Following event functions are available:

1. Actuate a function key (F1…F10) on the Remote Control
   The following conditions are available:

   - Key pressed
   - Key released

2. Digital input signal on the blue PiraT datalogger with a defined signal level
   The following conditions are available:

   - Signal level = active
   - Signal level = inactive

3. CAN-signals meets a configurable condition
   The following inequalities are available:

   - less than (<)
   - less than or equal (<=)
   - greater than (>)
   - greater than or equal (>=)
   - equal (=)
   - not equal (!=)

It is possible to combine different events with logical operations (complex event). There is no limit in the number of combined events.
The following logical operations are available:

- AND   (&)
- OR   (|)
- NOT   (!)

Example for a complex event:

    ((CAN2.signal1 <= 10) & (CAN1.signal2 = 30)) | (RC.F1 = PRESSED)

1.3.2 Trigger Action

The following trigger actions are available:

- Set marker
- Send CAN message
- Append info entry to data overview
- Display message in the Remote Control
- Set digital output #1 active
- Set digital output #1 inactive
- Display Remote Control Monitor

2 Configuration

2.1 Configuration menu

The configuration application must be started to configure the complex trigger function. If the license has been installed correctly, the selection tree on the left hand side shows the entry 'Trigger'. The trigger configuration exist on three parts, trigger name, trigger event and triiger action.

With the selection of the "New Trigger.." button, it is possible to configure up to 50 different triggers (see Figure 1).
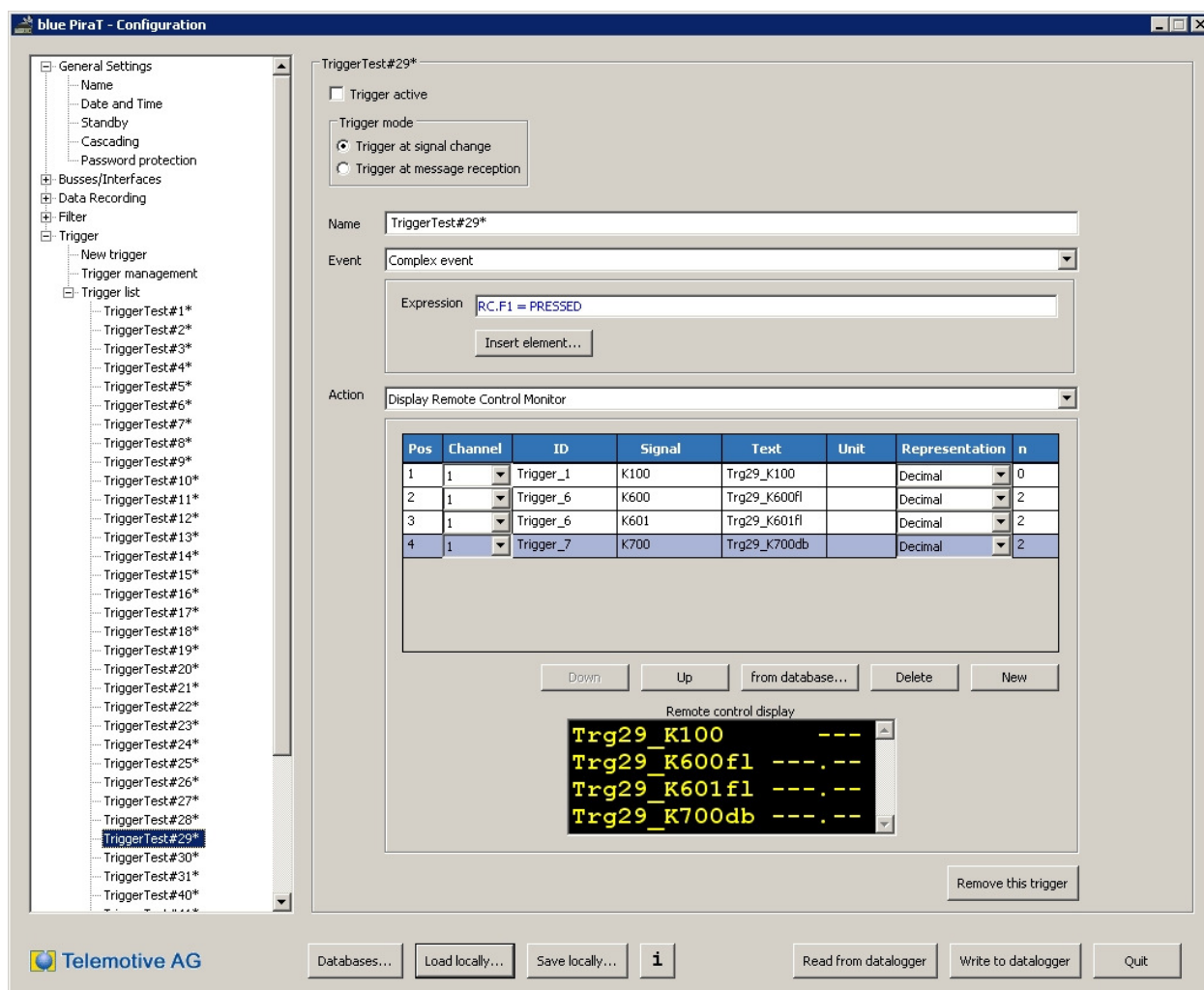

Figure 1: trigger configuration

The complete data logger configuration can be managed by following buttons:

„Databases…":	Opens the dialog to configure the location of DBC databases.
„Load locally…":	Loads data from a locally stored configuration file
„Store locally…":	Saves configuration data to a local file
„i":	Opens a dialog with program information
„Read from datalogger":	Loads the configuration data from the connected datalogger and displays it in the dialog
„Write to datalogger":	Sends the configuration data to the connected datalogger. The configuration is applied immediately
„Quit":	The quit button closes the configuration application

2.2 Trigger configuration

After selecting the option „New trigger", a panel for configuration of the trigger appears. The different options are described in the following chapters (see Figure 2).

Figure 2: Configuration „New trigger"

2.2.1 Trigger state

Each trigger can be configured to be active or inactive. If a trigger is inactive, its parameters are still kept in the configuration, but the data logger does not execute the trigger.

2.2.2 Trigger mode

Each trigger has two different modes of evaluation of the trigger condition:

Trigger at signal change: The trigger occurs only if there is a change in the signal value and the event conditions are met. This trigger condition mode is applicable for periodic signals (i.e. CAN signals), where only one trigger is required for the first time the event condition is true. (default trigger mode)

Trigger at message reception: The trigger occurs every time a signal message was received and the event conditions will be met. This trigger mode is applicable if every reception of a message should cause a new trigger.

2.2.3 Trigger name

The name of the trigger can changed by the user. The new trigger name is be displayed in the selection tree on the left hand side. The number of characters for the trigger name is limited to 50 characters.

2.2.4 Trigger event and action

The trigger function is defined by an event and a consecutive action. Events and actions can be defined and changed by the user in any sequence.

2.2.5 Removing the trigger

The button "Remote this trigger" deletes the entire trigger configuration.

2.3 Configuration of the events

2.3.1 Event - Remote Control function key

The event remote control function key is completely defined by selecting the function key F1 to F10 and the key status "key pressed" or "key released" (see Figure 3). These parameters have to be selected by the user.

Figure 3: Event – remote control function key

The related action is executed once when the event condition "key pressed" or "key released" changes into the status "true".
A connected blue PiraT remote control is required for this event.

2.3.2 Event – digital Input

The event digital input is completely defined by selecting the signal status "active" or "inactive" (see Figure 4). This parameter has to be selected by the user.
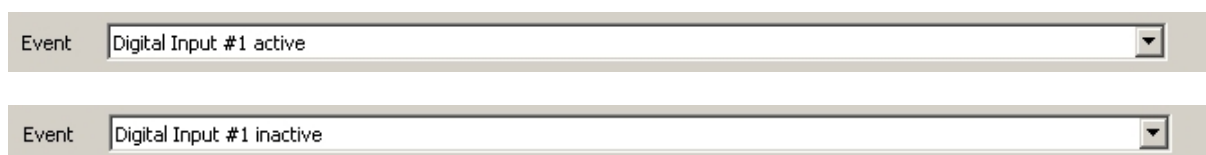

Figure 4: event – digital Input

The condition „digital input #1 active" ist true, when the voltage level of the digital input comply to the chassis ground (KL31).
The condition „digital input #1 inactive" ist true, when the voltage level of the digital input comply to the battery voltage (KL30).

The related action is executed once when the event condition „digital input #1 active" or „digital input #1 inactive" change into the status "true".
There is only a single digital input port available in the actual blue PiraT hardware. The pin assignment is listed in the Appendix A.

2.3.3 Complex event

The trigger functionality offers the possibility to combine different single events to a logical expression, a so called "complex event". A "complex event" can start only one action. Different complex events can configured to different actions.
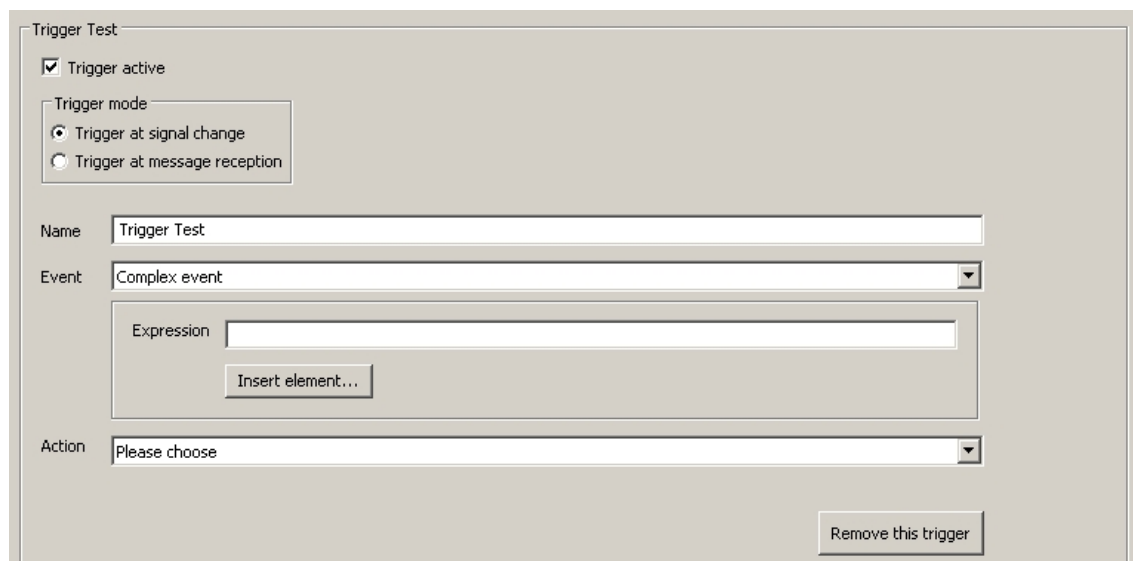

Figure 5: complex event

The user has to select the "complex event" in the first configuration step. After that, the empty input field "Expression" appears. The user can now insert different event conditions by the "Insert element" button. It is also possible to generate only one event condition for a complex event.

2.3.3.1 Event selection

The different basic events are selected with the "Insert element" button (see Figure 6).
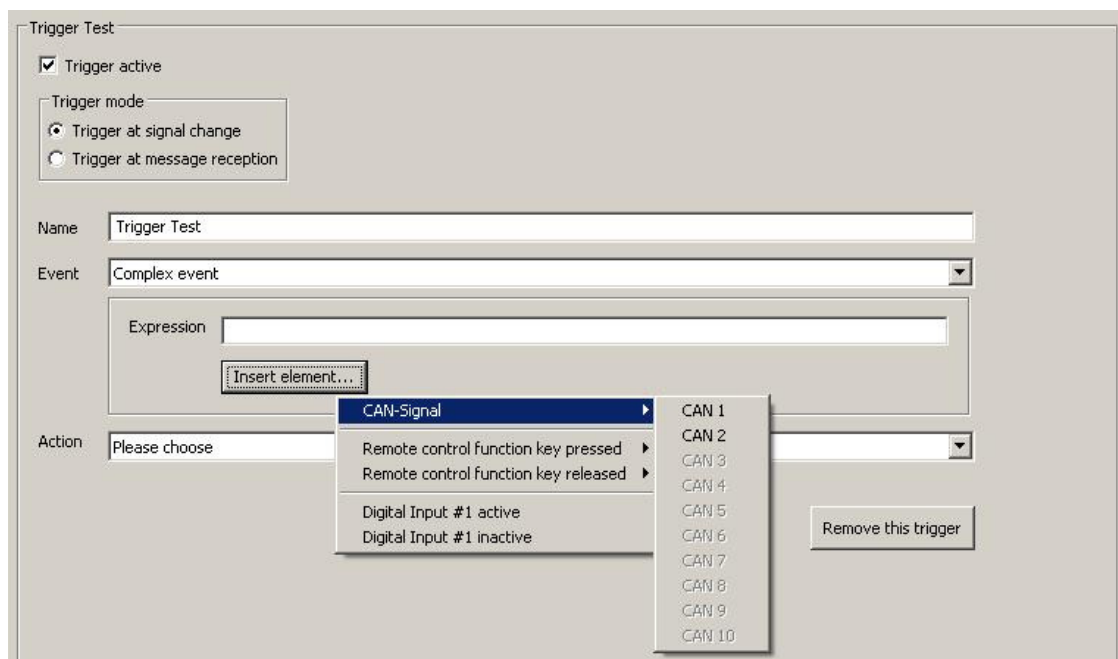

Figure 6. insert an event

The selected event is inserted on the current cursor position. Inserted events are displayed in a blue text color. Error and warning messages are displayed in a red text color. Once an event has been inserted, it can be deleted but not modified by the user (see Figure 7).
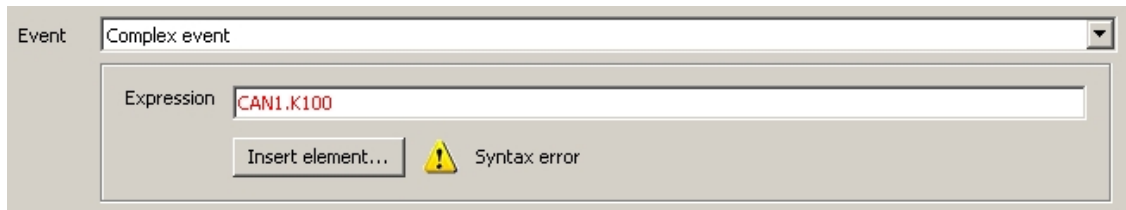
Figure 7: Selected event

2.3.3.2 CAN-Signal

CAN-signals are selected in the dialog „Signal selection from CAN database" (see Figure 8).
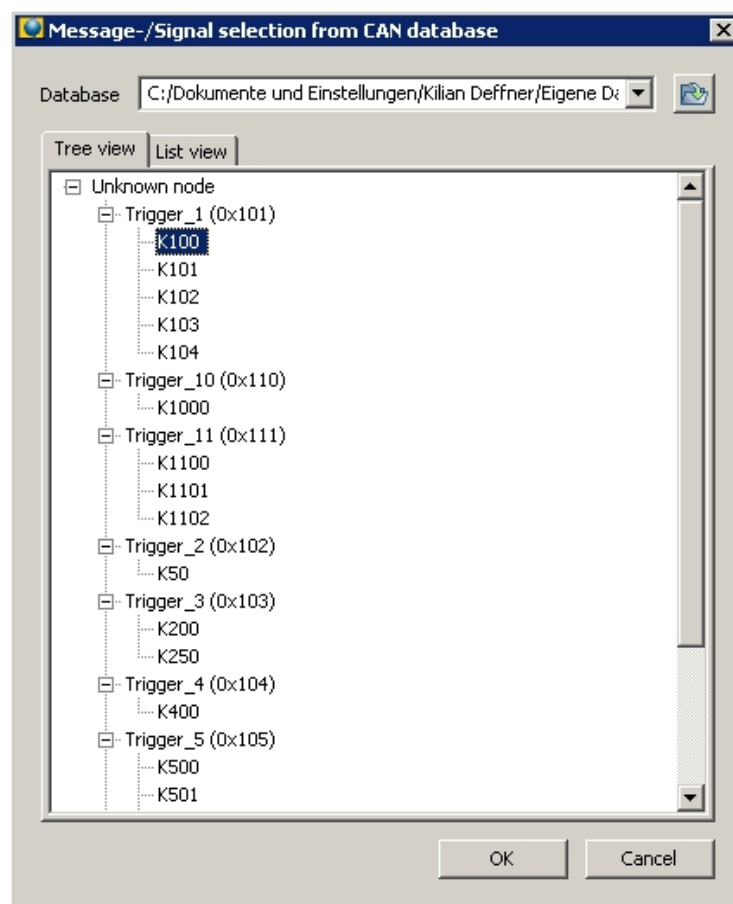
Figure 8. CAN signal selection

After the CAN signal selection, the CAN signal in the expression field is displayed in the following format

                    CAN<channel number>.<signal name>

It is not possible to edit the signal name or channel number.

To complete the event condition, the user has to insert an operator and behind a reference value (i.e., a scaled decimal value) by the PC keyboard (see Figure 9). It is not possible to change this order.

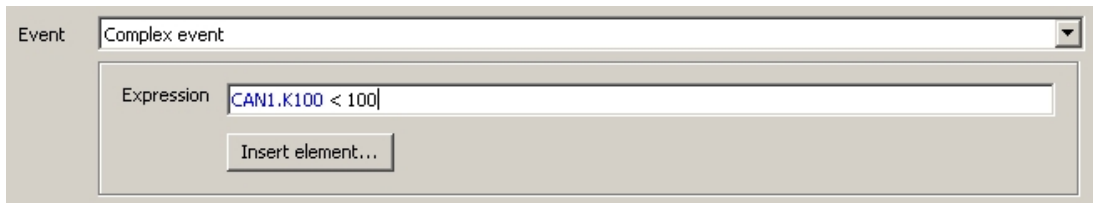**Figure 9: Event condition - CAN-signal**

2.3.3.3 Digital Input

Two options are available for the digital input signals (see Figure 10).

- "Digital Input #1 active"
- "Digital Input #1 inactive"

The event conditions are automatically generated and displayed in the expression field. There is no additional user input required.

The event conditions are displayed in the expression field as followed:

```
DIGIN#<channel number> = 1
DIGIN#<channel number> = 0
```
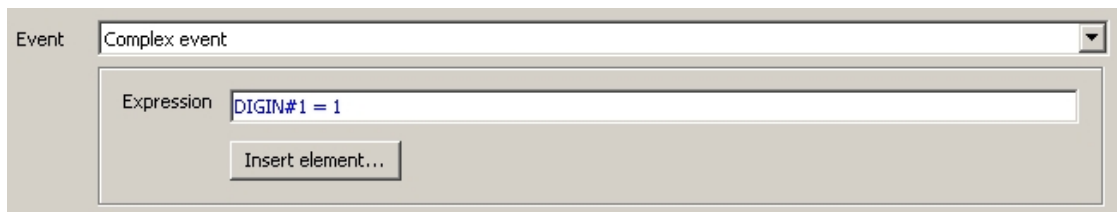

Figure 10: Event condition – digital input

There is only one digital input port available in the current blue PiraT hardware. The event condition digital input corresponds to the description in chapter 2.3.2.

DIGIN#1 = 0	⇔	Digital Input #1 active
DIGIN#1 = 1	⇔	Digital Input #1 inactive

It is not possible to edit the digital input event in the expression field after it has been added.

2.3.3.4 Remote control function key

The user has to select two parameters to define the function key event.

- Function key F1 to F10
- Button „pressed" or „released"

The event conditions are displayed in the expression field as followed:

```
RC.F<channel number>   = PRESSED
RC.F<channel number>   = RELEASED
```


Figure 11: Event condition – RC function keys

It is not possible to edit the remote control function key event in the expression field after it has been added.

2.3.3.5 Auswahl der Operatoren

The following compare operations, logical operations, and numerical characters are available to combine different single events to a valid complex event expression:

logical operations:
        &   logical AND combination
        | logical OR combination
        !   negation of events expressions

compare operations / inequalities:
        <   less than
        <=   less than or equal
        >   greater than
        >=   greater than or equal
        =   equal
        !=   not equal

alpanumerical characters:
        0 to 9   compare value

characters:
        (and) brackets for event expressions
        . und , dot and comma for floating point expressions

                dot- and comma-character will be processed equivalent. The presentation depends on the language settings choosen during the Client installation.

The user has to select and insert the compare operators, logical operators and characters by the PC keyboard in the expression field. The configuration can be changed any time by the user.

Notice! – *It is not possible for the user to insert a space-character. Space-character are inserted automatically to improve the readability.*

The single event conditions inside of a complex event expression is processed by a defined priority list:

operation	description	priority	
( )	bracket open / close	1	(high)
!	NOT	2	
<, <=, >, >=, =, !=	compare	3	
&		logical AND, OR	4	(low)

Example:
event condition: 1   2   3

Expression | (CAN1.K100 <= 10) & !((CAN1.K50 = 100) | (RC.F1 = PRESSED))

Process order:
1. identify the results of the bracket term of event expression 1,2 and 3
2. the results of event expression 2 and 3 are combined with logical OR; this result are than negated
3. A logical AND is applied to the result of point 2 and the result of event condition 1

The NOT operator always applies to the subsequent bracket expression.

2.3.3.6 Input parameter verification

The complex event expression is validated immediately after each user input. Error and warning messages, if applicable, are displayed in red color.
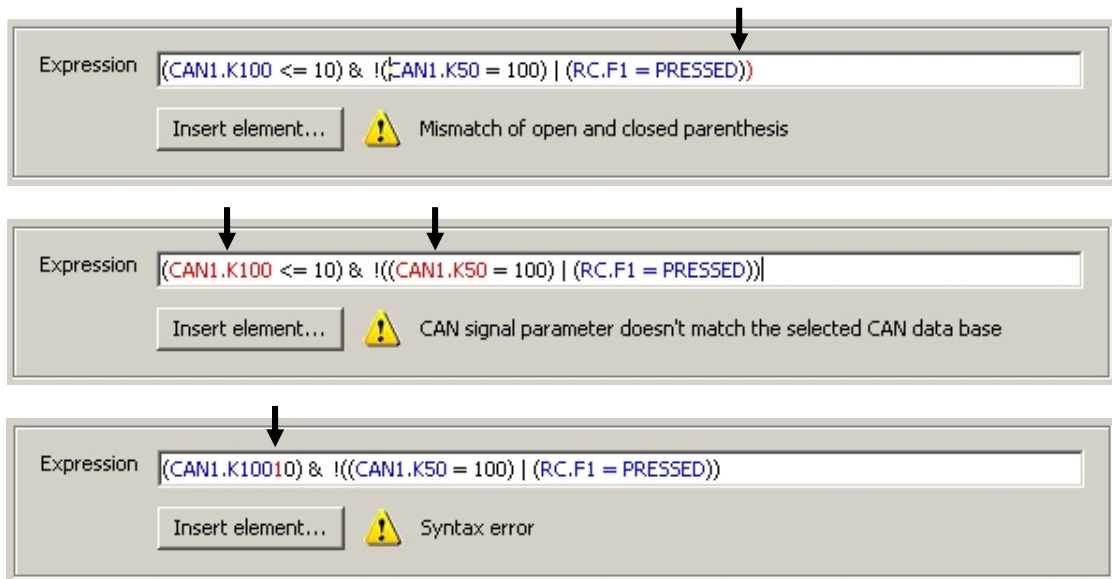

Figure 12. Error and warning messages for the expression field

The following error and warning messages are displayed:

- Mismatch of open and closed closed parenthesis:

    The number of opened parenthesis are not equal to the number of closed parenthesis

- CAN signal parameter doesn't CAN signal is match the selected

    After the CAN database has been changed, the selected CAN signal is not available in the new database :

- Syntax error.

    Compare operators or logical operators are missing or event conditions are used not correctly

2.3.3.7 Cursor position

The cursor can be moved by the user either with the arrow keys of the PC keyboard or with the PC mouse. Inserted elements are skipped by the cursor because they can't be edited (see Figure 1).

Figure 13: Cursor position

The cursor can also be placed with the left mouse button. The cursor is placed right next to the selected element.

2.3.3.8 Deletion of events, characters and operations

Events, characters and operators can be marked and/or deleted as followed:

- ▪ backspace button the event, character or operator on the left hand side of the cursor is marked and/or deleted
- ▪ delete button the event, character or operator on the right hand side of the cursor is marked and/or deleted
- ▪ PC mouse events, characters or operations are marked with the pressed left pc mouse button

Expression `CAN1.K100 <= 100 & CAN1.K50 = 100`

Figure 14: marking of elements

All elements of a complex event expression can be marked and deleted individually or altogether. The single event CAN signal, function key and digital input can be deleted only at once.

2.3.3.9 Changing of CAN databases

Is there any change of a CAN database before loading the configuration or during configuration of the trigger parameter, the display in the expression field is updated automatically. The signal name of the new CAN database is displayed. The old signal name are kept in case the CAN signal is not listed in the new CAN database or the CAN database was deactivated. In this case, the CAN signal is displayed in red color. (see Figure 12).

Example:
1. The expression field contains "CAN1.clampstatus = 3". It is a CAN signal from the database with the CAN-ID 0x480, data bit 0-7, which was used during CAN signal configuration
2. The user switches to a new CAN database
3. In the new database the CAN signal with the CAN-ID 0x480 and the data bit 0-7 is named "clampstatus_new".
4. In the expression field the new signal name is automatically updated to "CAN1.clampstatus_new = 3".
5. Now, the user deactivates the CAN database in the configurator
6. In the expression field the signal name changes to "CAN1.clampstatus_new = 3"

2.4 Configuration of the trigger action

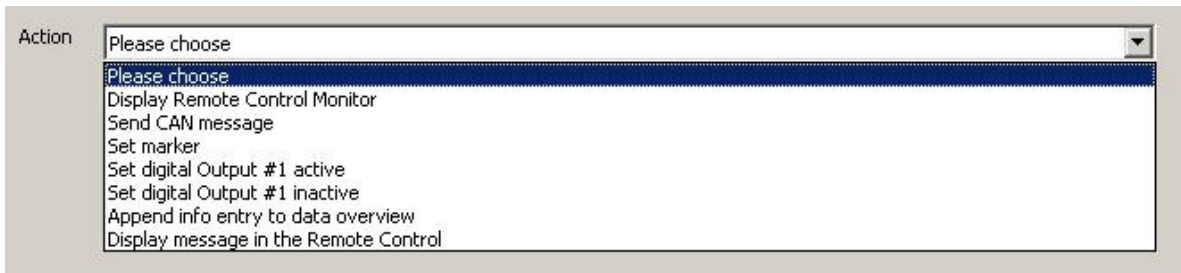After the configuration of the trigger event, the selection of the trigger action is required.

Figure 15: Configuration of the trigger action

The required trigger action can be selected in the check-box "action". The following trigger actions are available:

- Display Remote Control Monitor (extra license required)
- Send CAN message
- Set marker
- Set digital Output #1 active
- Set digital Output #1 inactive
- Append info entry to data overview
- Display message in the Remote Control

2.4.1 Set marker

The behavior of the action 'Set marker' is identical to the behavior when the user triggers a marker by the front panel button or by the remote control marker button.

Figure 16: Action – Set marker

There is no additional user input required for his action.

The following steps are done by setting a marker:

- recording the time stamp and the marker counter as trace data
- Increase the marker counter by one
- Optical and acoustic feedback in the remote control
- Write marker info to the data overview
- Switch the front panel marker LED on

2.4.2 Send CAN message

After the selection of the trigger action „Send CAN message" additional parameters have to be set by the user.
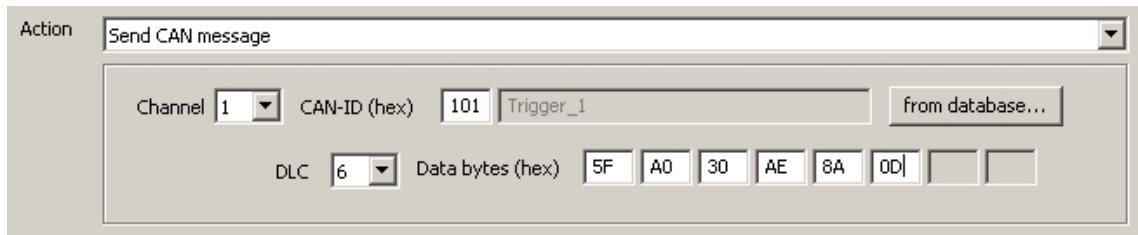

Figure 17. Aktion - CAN-Nachricht senden

The CAN message parameters can be selected manually or automatically by using the CAN database (see marker configuration in the blue PiraT user's manual).

Warning – using this function can influence the vehicle's network significantly. By using this function one must be aware of the consequences of sending the specified CAN message.

2.4.3 Append info entry to the data overview

For the action ‚append info entry to the data overview', it is possible to configure free text and CAN signals. The info entry is limited to a maximum of 75 characters.
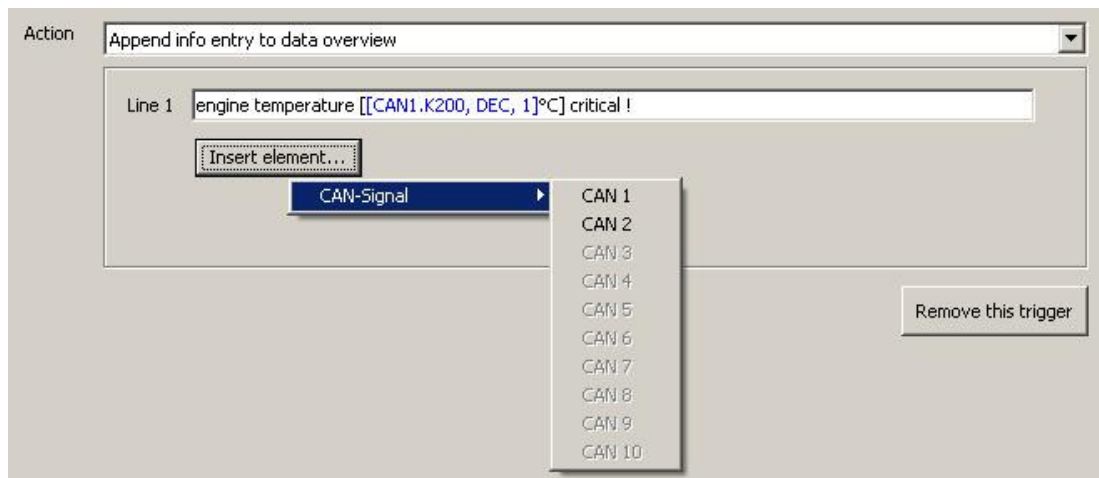
Figure 18: action – append info entry to the data overview

The info entry is displayed in the event overview during the download or format conversion process of the trace data.

Figure 19. append info entry to the data overview

2.4.4 Info display to the remote control

For the action ‚info display to the remote control' it is possible to configure free text and CAN signals. For the info display there are 20 characters per line and total 4 lines.
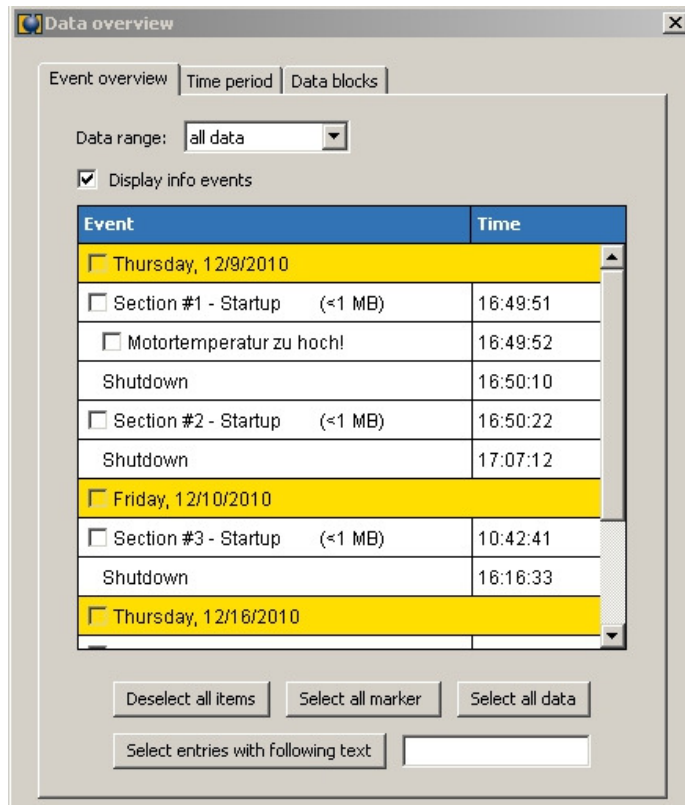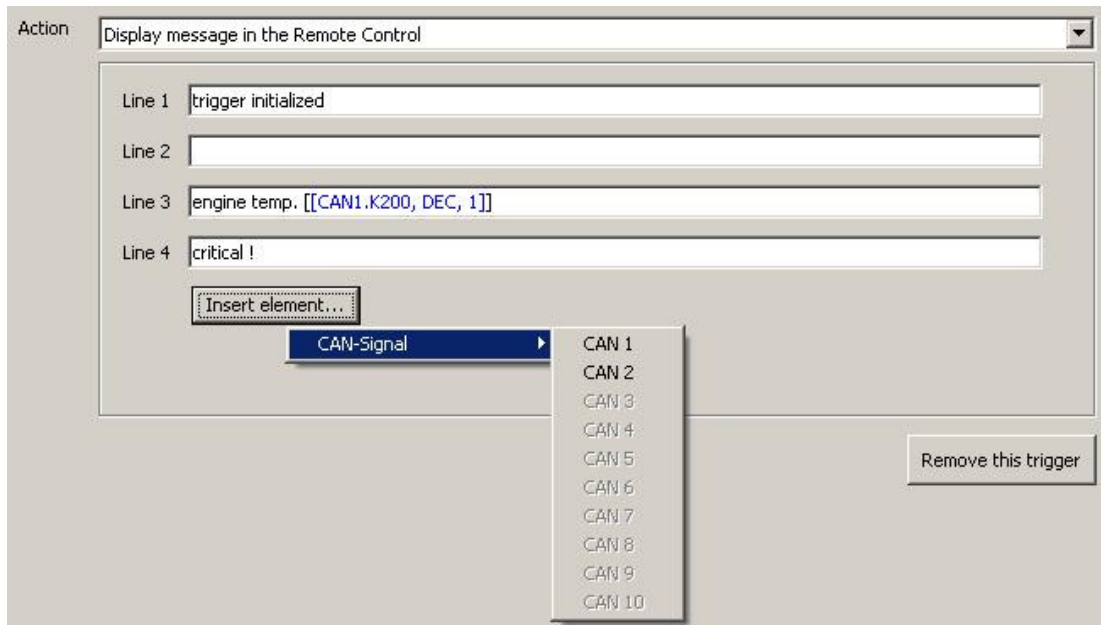

Figure 20: action – display info to the remote control

Figure 21: example – display info to the remote control

The message is displayed for 4 seconds. The previous remote control screen is displayed after this time has passed. If an additional complex trigger or a marker is executed during this, the current message is overwritten by the new one.

2.4.5 Digital output active / inactive

It is possible to switch on the digital output signal with the action "digital output #1 active". The level of the output signal then corresponds to the power supply level (KL30). The digital output has a maximal load of 100mA.

Figure 22: action – digital output active

It is possible to switch off the digital output signal with the action "digital output #1 inactive". The off level of the output signal is 0V (KL31).

Figure 23: action – digital output inactive

There is no additional user configuration required for this trigger action. A single digital output is available on current actual blue PiraT hardware. The pinout is listed in the appendix.

2.4.6 Remote Control Monitor

Selected CAN signals can be displayed online in the remote control with the trigger action "Remote Control Monitor".
This trigger action is only available if the License "Remote Control Monitor" is installed. The document "User's Manual Remote Control Monitor" describes the configuration and the functionality of this license.

2.5 Trigger management

There is an option 'trigger management' in the configuration menu. Selecting this option, a list of all triggers and possible management functions appears.
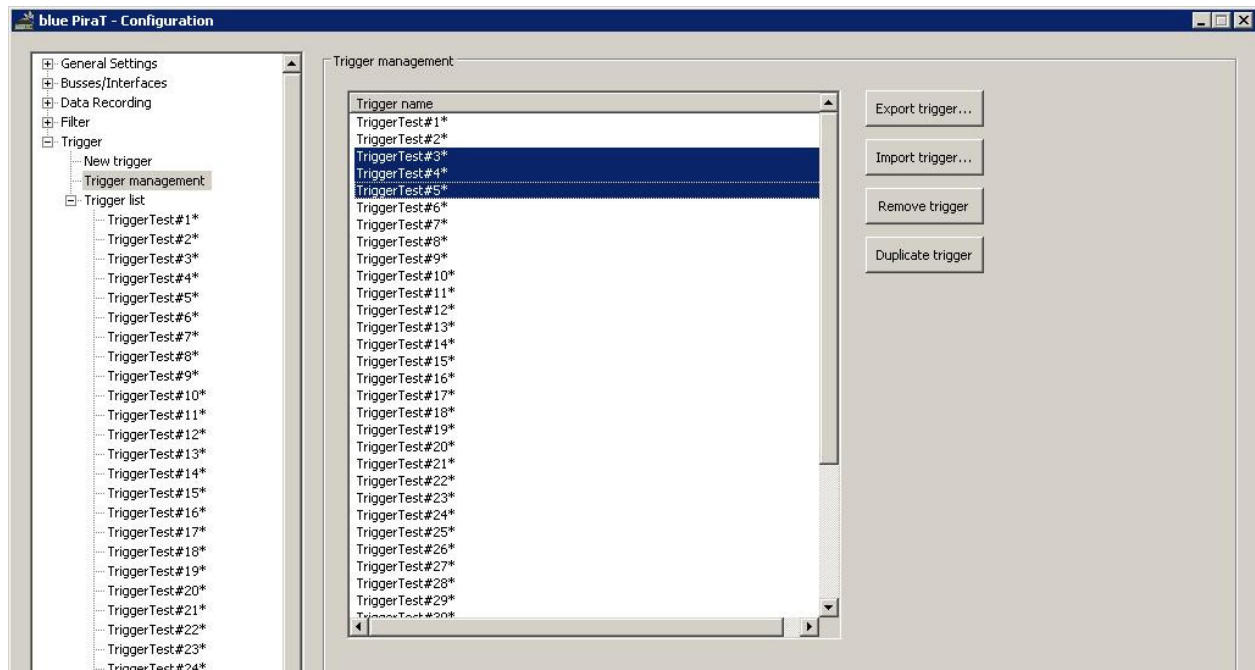
Figure 24: Trigger management

It is possible to select one or more triggers from the list. The selected triggers can be managed by the function buttons on the right side.

The following management functions are available:

"Export trigger…"   Selected trigger configurations are stored in an external trigger file (.tri)

"Import trigger…"   Trigger configurations are loaded from an external trigger file and added to the existing trigger list.

"Remove trigger…"   Selected trigger configurations are removed from the list.

"Dublicate trigger…"   Selected trigger configurations are duplicated and added to the existing trigger list. The duplicated trigger are prefixed with the extension "Copy_". The trigger name can be changed by the user.

3 Limits of the trigger functionality

The following points should be considered with regard to the trigger function execution:

- The trigger function is only available after the data logger startup is complete (10 sec.)
- In certain disadvantageous cases, it is possible that there is a maximum time delay of 200 msec between event and action, caused by a high bus- and system-load.

The user can configure up to 50 independent trigger events and trigger actions. Such a configuration can cause a high trigger performance in the bluePiraT system. This could result in a data processing problem and possibly in partially lost of the data recording. To avoid this situation, a trigger debouncing mechanism is implemented. The trigger debouncing is able to handle temporary a high trigger load inside of a time limit with the condition "number of triggers within the defined time". The trigger debouncing condition is different for each trigger action and is not changeable.

action:	debouncing conditions (max. values)
▪ Set marker	1 marker per 2 seconds (as previously) *
▪ Display message in the Remote Control	1 display message per 500 millisecond
▪ Append info entry to data overview	100 entries per 10 minutes
▪ Send CAN message	1 CAN-signal per 100 millisecond
▪ Set digital Output active / inactive	10 switching operations per 1 minute
▪ Display Remote Control Monitor	update of the CAN signal values in 250 msec.

* During the trigger "set marker" the automatically combined actions "Append info entry to data overview" and "display message in the remote control" are not limited.

Triggers are eliminated if the number of triggers exceeds the debouncing level inside the measurement time. In this case a warning message is appended to the data overview. The warning messages are created in an interval of 60 seconds. The warning message contains the name of the causing trigger action and the number of the missing triggers.

Example warning message in the data overview:

Warning: **'trigger action name'** *trigger action skipped* **n** *times*

Trigger action name :
- Set marker
- Display message in the Remote Control
- Append info entry to data overview
- Send CAN message
- Set digital Output active / inactive
- Display Remote Control Monitor

n :   number of the skipped trigger actions

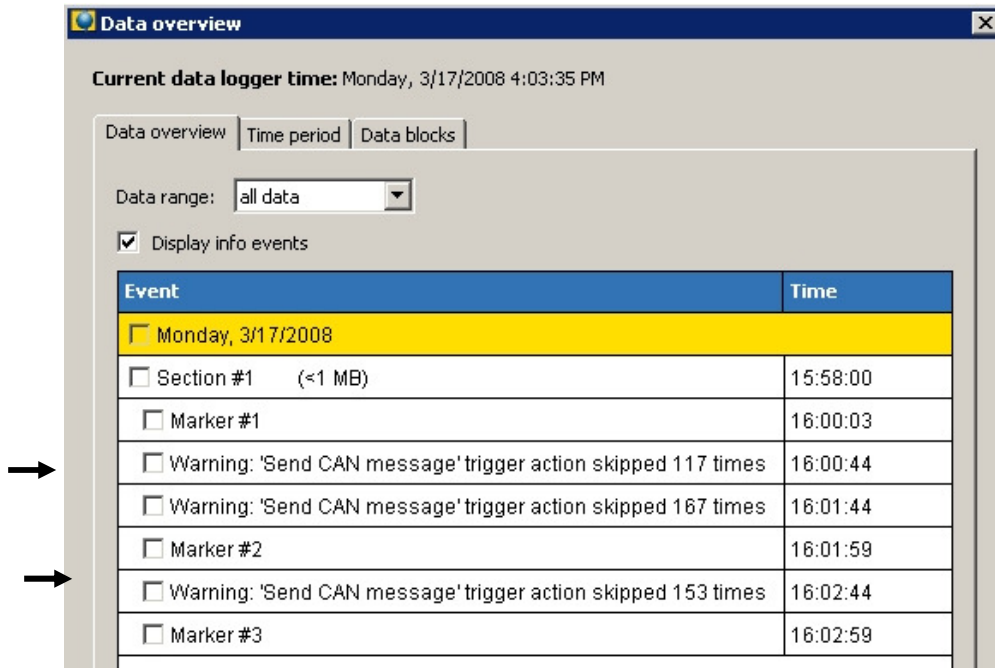The counter for missing triggers is reset to zero after each startup of the data logger.

Figure 25. Trigger Debouncing

Appendix A: Pinout of digital inputs and outputs

blue PiraT datalogger: Multifunctional connector, 54 pins

pin	function	pin	funktion
1	reserved	28	highspeed CAN1_H
2	digital ground for complex trigger input	29	lowspeed CAN3_H
3	reserved	30	highspeed CAN2_H
4	reserved	31	lowspeed CAN2_H
5	reserved	32	RS232 #1 Tx
6	reserved	33	RS232 #2 Tx
7	digital signal input for complex trigger	34	RS232 #4 Tx
8	reserved	35	KL 30
9	external marker button	36	ground clock in/out
10	highspeed CAN1_L	37	reserved
11	highspeed CAN3_L	38	reserved
12	highspeed CAN2_L	39	reserved
13	lowspeed CAN2_L	40	reserved
14	RS232 #1 Rx	41	reserved
15	RS232 #2 Rx	42	reserved
16	RS232 #4 Rx	43	reserved
17	RS232 #2/#4 ground	44	reserved
18	clock out	45	lowspeed CAN1_L
19	reserved	46	lowspeed CAN1_H
20	reserved	47	ground CAN1
21	reserved	48	ground CAN2
22	reserved	49	ground CAN3
23	reserved	50	RS232 #1/#3 ground
24	reserved	51	RS232 #3 Rx
25	reserved	52	RS232 #3 Tx
26	digital signal output for complex trigger	53	KL 31
27	digital ground for complex trigger input and marker	54	clock in

Table 1: Pinout of the multifunctional connector (Mainboard V1.1, V1.2)

pin	function	pin	function
1	reserved	28	highspeed CAN1_H
2	digital ground for complex trigger input	29	lowspeed Aux-CAN_H
3	reserved	30	highspeed CAN2_H
4	reserved	31	lowspeed CAN2_H
5	RS422 #1 Rx+	32	RS232 #1 Tx
6	RS422 #2 Rx+	33	RS232 #2 Tx
7	RS422 #4 Rx+	34	RS232 #4 Tx
8	RS422 #3/#4 GND	35	KL 30
9	external marker button	36	ground clock in/out
10	highspeed CAN1_L	37	reserved
11	lowspeed Aux-CAN3_L	38	reserved
12	highspeed CAN2_L	39	reserved
13	lowspeed CAN2_L	40	reserved
14	RS232 #1 Rx	41	RS422 #1/#2 GND
15	RS232 #2 Rx	42	RS422 #3 Rx+
16	RS232 #4 Rx	43	RS422 #3 Rx-
17	RS232 #2/#4 GND	44	digital signal input for complex trigger
18	clock out	45	lowspeed CAN1_L
19	reserved	46	lowspeed CAN1_H
20	reserved	47	ground CAN1
21	reserved	48	ground CAN2
22	reserved	49	ground Aux-CAN
23	RS422 #1 Rx-	50	RS232 #1/#3 Masse
24	RS422 #2 Rx-	51	RS232 #3 Rx
25	RS422 #4 Rx-	52	RS232 #3 Tx
26	digital signal output for complex trigger	53	KL 31
27	digital ground for complex trigger input and marker	54	clock in

Table 2: Pinout of the multifunctional connector (Mainboard >V1.5)

Appendix B: License Shortcut

Die License "shortcut" is supported by the firmware V5.2.2 and higher. The shortcut functionality is completely replaced by the license "complex trigger". Figure 26 shows how to connect an external button to the digital input of a complex trigger.
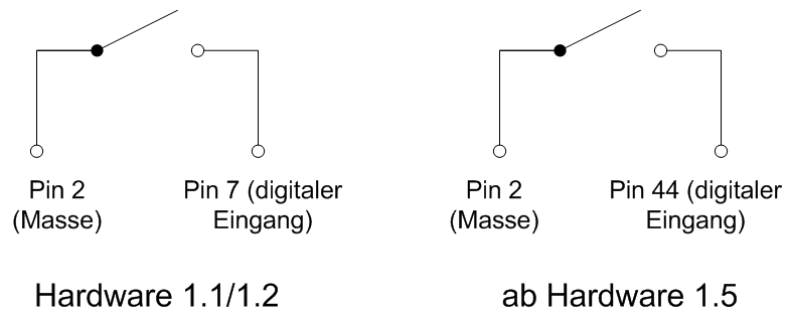
UPDATE SCREENSHOT TO ENGLISH!

Pin 2   Pin 7 (digitaler   Pin 2   Pin 44 (digitaler
(Masse)   Eingang)   (Masse)   Eingang)

Hardware 1.1/1.2   ab Hardware 1.5

Figure 26: Connection of an external button

Appendix C: Abbreviation

blue PiraT   **P**rocessing **I**nformation **R**ecording **A**nalysing **T**ool
RC   **R**emote **C**ontrol
CAN   **C**ontroller **A**rea **N**etwork
MB   **M**ain**b**oard