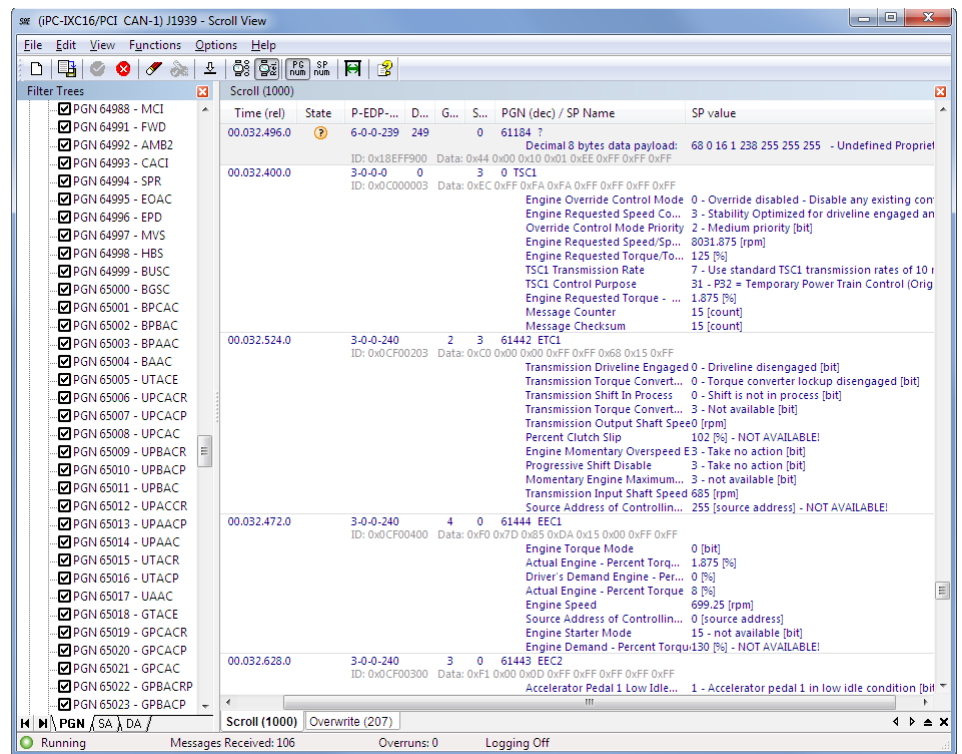# J1939-Module

canAnalyser3 Module
for SAE J1939 Protocol Interpretation

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Document number: 4.02.0149.20000
Version: 1.4

Contents

Chapter 1

Overview

The J1939-Module (Fig. 1.1) is an add-on module for the canAnalyser3 and provides the display of received layer-2 messages in J1939 notation. The messages are displayed in accordance with the SAE J1939 standard (see Appendix A.2). In addition, it is possible to display the corresponding layer-2 messages of the protocol specific interpretation.
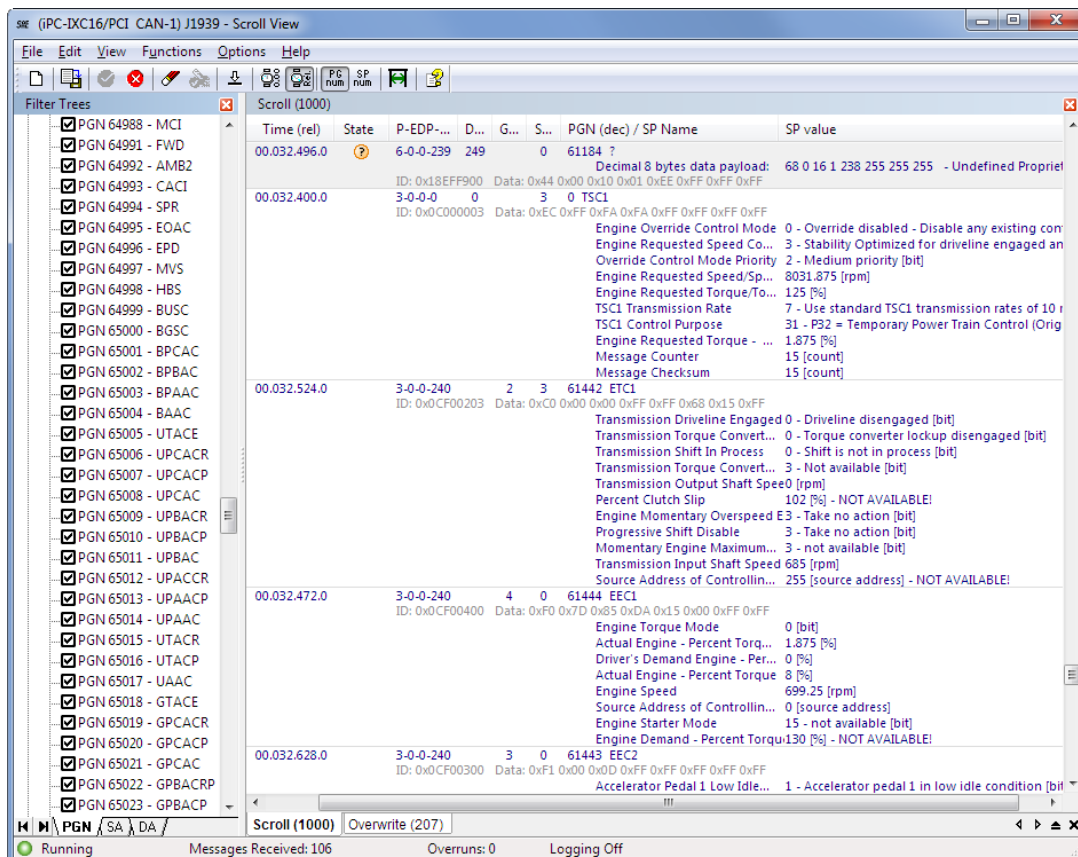
Figure 1.1: J1939-module

Chapter 2

Installation and start-up

2.1 System requirements

The condition for installation of the J1939-Module is an installed, working canAnalyser3.

2.2 Installation

To install the J1939-Module, insert the provided program CD into the drive of your computer and run the file "J1939Module30.exe".
Follow the instructions of the installation program.
The installation includes a special edition of the IXXAT J1939 Designer which allows for the creation, editing and generation of user defined J1939 message databases.
For a detailed description of the J1939 Designer's operation please refer its manual.

2.3 Starting the J1939-Module

In order to start the J1939-Module, the canAnalyser3 must first be called. The J1939-Module now appears in the **Modules Window** of the Control Panel (Fig. 2.1). From here the module can be dragged to a CAN bus. If the analysis configuration is saved, the canAnalyser3 starts the J1939-Module automatically by loading this analysis configuration the next time.
For more information see the canAnalyser3 user's manual.

Figure 2.1: Control Panel

Chapter 3

Usage of the J1939-Module

3.1 Scope of functions

The J1939-Module enables received CAN messages to be interpreted in accordance with the SAE J1939 standard. It is suitable for troubleshooting and analysis of J1939 networks and systems.

The J1939-Module provides the following analysis functions:

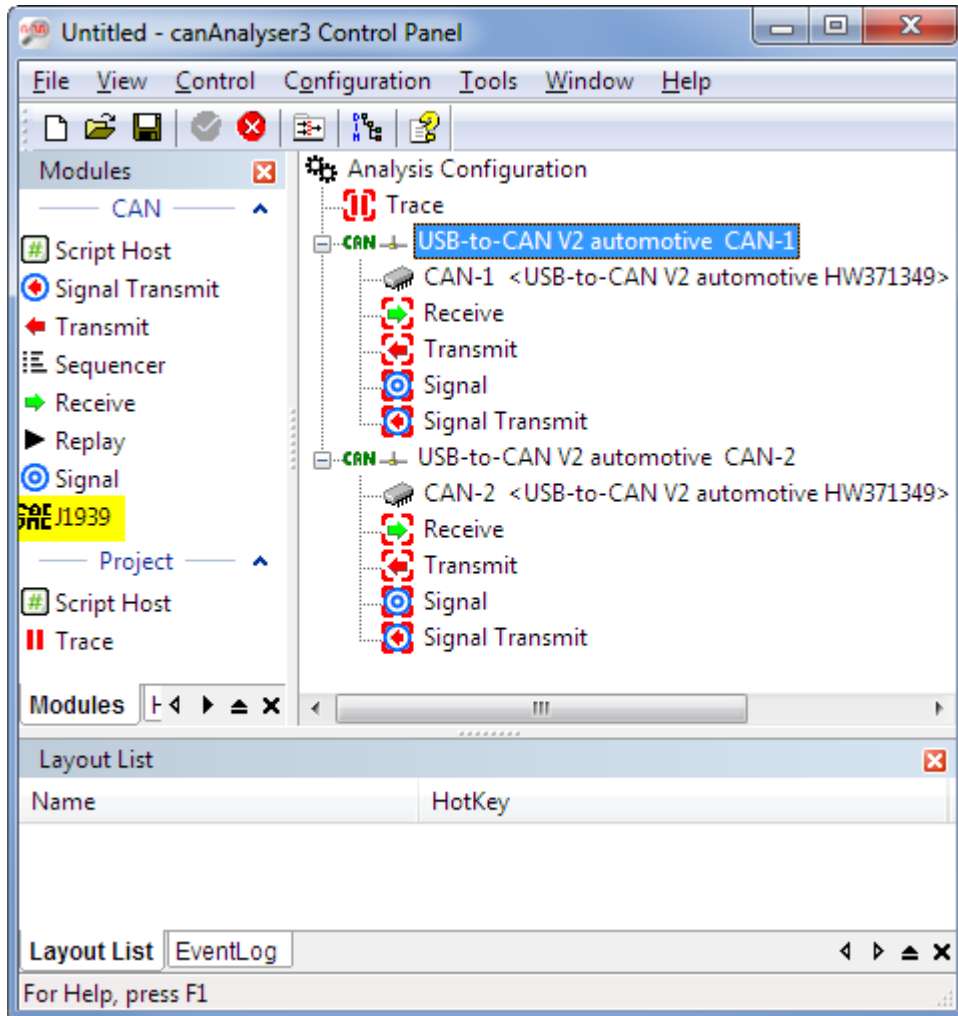- Interpretation of extended CAN messages (29-bit Identifier) and extraction of Priority, Parameter Group Number, Extended Data Page, Data Page, Protocol Data Unit Format, Protocol Data Unit Specific (Destination Address or Group Extension) and Source Address

- Interpretation of standard CAN messages (11-bit Identifier) and extraction of Priority and Source Address (scroll view only)

- Interpretation of application messages:

    - Interpretation of application messages defined by SAE
    - Interpretation of application messages defined by the user according to a loaded user-specific database
    - For each parameter the SPN, SP name, value, unit and specific indicator (if available) is displayed

- Interpretation of diagnostic messages

- Processing and interpretation of the Transport Protocol:

    - Verification of Transport Protocol and display of J1939 message with interpreted application data
    - Display of connection management messages at message reception to verify Transport Protocol (Single Fragment Mode)

- Processing of the NMEA2000 Fast-Packet Protocol

- Display of interpreted J1939 messages in order of time of reception (scroll view)

- Display of interpreted J1939 messages sorted according to PGNs (overwrite view)

- Display of the corresponding layer-2 messages

- Display of bus errors and error frames

- Display of total number of interpreted J1939 messages (scroll view) and number of interpreted messages per PGN (overwrite view)

- Change detection for parameter values of received messages with same PGN (overwrite view)

- Change detection for Source Address of received messages with same PGN (overwrite view)

- Filtering by Parameter Group Numbers, Destination and Source Addresses

- Export and import of the module configuration and filter settings

- Export of received messages in CSV format to file resp clipboard

- Message recording to a CSV file

- Interpretation of layer-2 trace files

As different instances of the J1939-Module can be started from the Control Panel (not with canAnalyser3 lite), it is possible to configure each J1939-Module with individual filtering settings, loaded user-defined database, etc.

3.2 Message display

Interpreted J1939 messages can be displayed one by one in the order of their reception, or cumulated sorted by PGN in ascending order.
The one by one display is referred to as Scroll View and can be found on the **Scroll** tab, whereas the cumulated view is displayed on the **Overwrite** tab. Use hotkey `Ctrl-TAB` to switch between the views.
For each of the views, the following display options can be set:

- Various interpreted values can be displayed in hexadecimal or decimal format. The display format for the individual columns is selected via the menu **View** or by right mouse click on the corresponding column header.

- A J1939 message can be displayed over several lines if the window is not wide enough to display all information. For this, the menu item **View** | **Word wrap lines** is enabled. Separating lines can be shown between the interpreted J1939 messages by activating menu item **View** | **Draw Guides**.

- To display the corresponding layer-2 message(s) below a J1939 message, the menu item **View** | **Show Layer 2 message** has to be enabled.

- The Parameter Group can be displayed as number or as name. For switching between the two different views menu item **View** | **Show PGN** is used, and there is also a corresponding toolbar button.

- The Suspect Parameter can be displayed as number or as name. The displaying format is be changed using the menu item **View** | **Show SPN**, and there is also a corresponding toolbar button.

- Extended CAN messages that contain PGNs which are not specified in the loaded databases are displayed only if the menu item **View** | **Show unknown Messages** is enabled.

Note: Changing the menu item **View** | **Show unknown Messages** only affects the J1939 messages received after the setting change but not the messages already received.
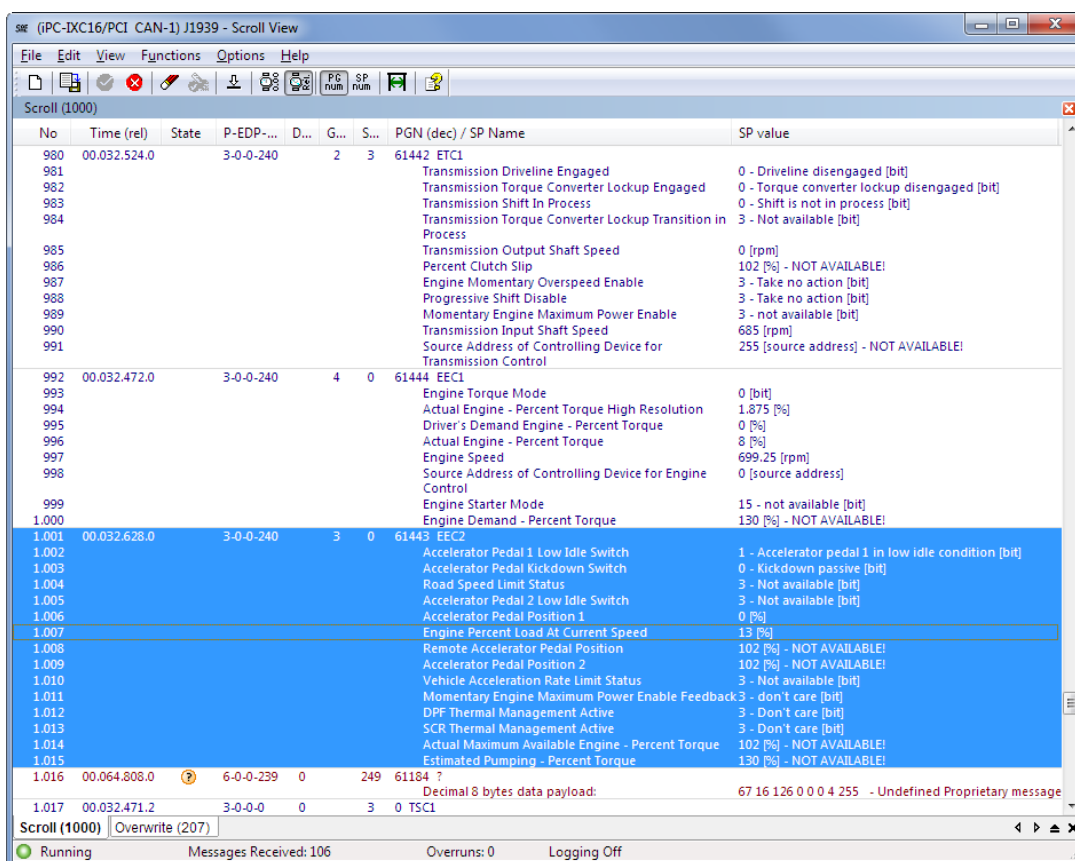
Figure 3.1: J1939-Module: Scroll view

3.2.1 Scroll view

In this view the J1939 messages are listed in order of their reception with the following information (Fig. 3.1):

Column	Meaning
No	Consecutive row number (not related to the layer-2 message nor the PG)
Time (rel/abs)	Time stamp of the J1939 message reception, optionally absolute in UTC time format or relative to the previously received message; the display of hours can be switched on and off by right-clicking on the column heading
State	Reception status
P-EDP-DP-PF	Priority - Extended Data Page - Data Page - Protocol Data Unit format (hex/dec)
DA (dec/hex)	Protocol Data Unit Specific: Destination Address
GE (dec/hex)	Protocol Data Unit Specific: Group Extension
SA (dec/hex)	Source Address
PGN/PG Name / SPN/SP Name	Parameter Group Number (hex/dec) or Parameter Group Name and indented Suspect Parameter Number (hex/dec) or Name of the Suspect Parameter
SP value	Value of the Suspect Parameter (dec/hex)

Visualization of the reception status

The column **State** visualizes the reception status by various icons:

| Status	Meaning
	RTR: Remote CAN frame was received
	Standard message: Standard CAN frame was received
	Error frame: An error frame was received
	Unknown message: A message with a PGN that is not specified at the loaded databases was received
	Transport Protocol: A Fragmented message, transmitted by Transport Protocol, was aborted
	Message overflow: Messages were lost
	Interpretation error: Unexpected data has disrupted the interpretation process
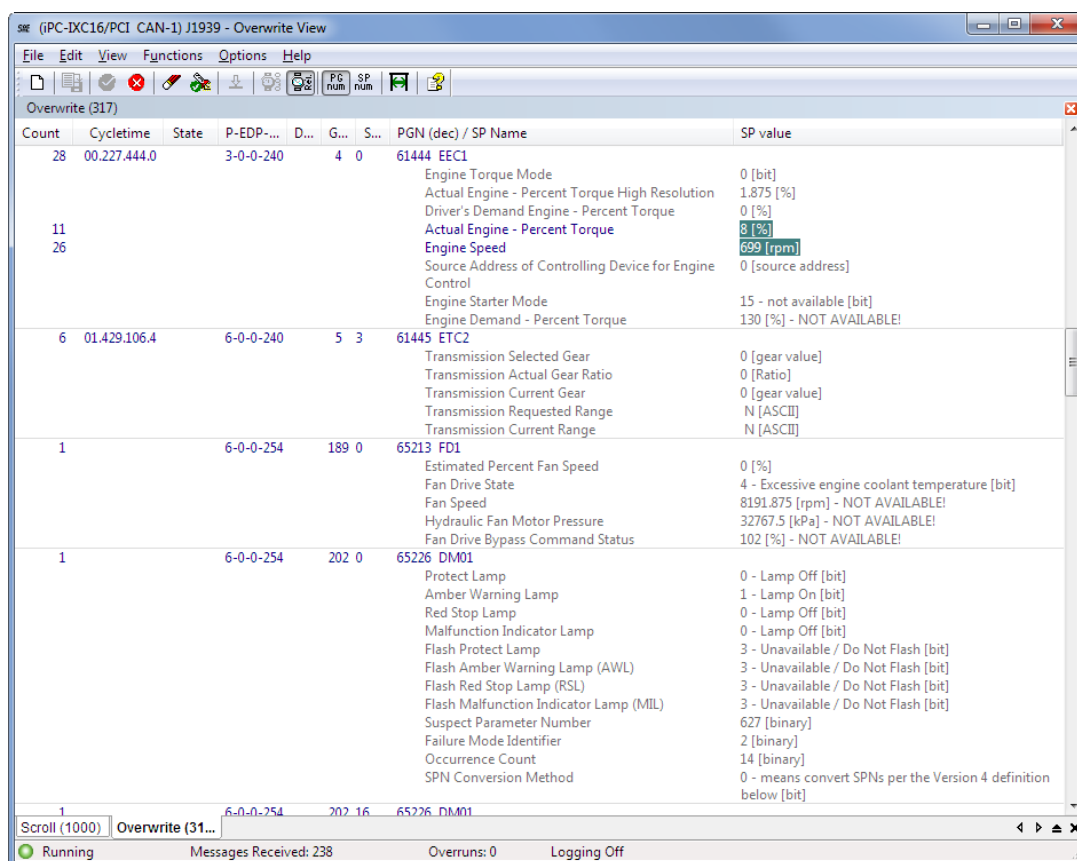
Figure 3.2: J1939-Module: Overwrite view

3.2.2 Overwrite view

In the overwrite view the J1939 messages are sorted according to the PGNs (Fig. 3.2). The information of the last PG received is always shown in each case. When Data Change Detection 3.2.2 is switched on, changed data are highlighted in color.
The following information is displayed:

Column	Meaning
Count	Number of received J1939 messages with the same PGN resp Number of SPN data changes
Cycletime / Time (abs)	Optionally last cycle time of the message or absolute time stamp of the last reception in relation to the start time of the configuration; by right clicking on the column heading, the display of hours and minutes can be switched on or off
State	Reception status
P-EDP-DP-PF	Priority - Extended Data Page - Data Page - Protocol Data Unit format (hex/dec)
DA (dec/hex)	Protocol Data Unit Specific: Destination Address
GE (dec/hex)	Protocol Data Unit Specific: Group Extension
SA (dec/hex)	Source Address; If change monitoring is enabled, the SA which have been changed once are highlighted in color
PGN/PG Name / SPN/SP Name	Parameter Group Number (hex/dec) or Parameter Group Name and indented Suspect Parameter Number (hex/dec) or Name of the Suspect Parameter
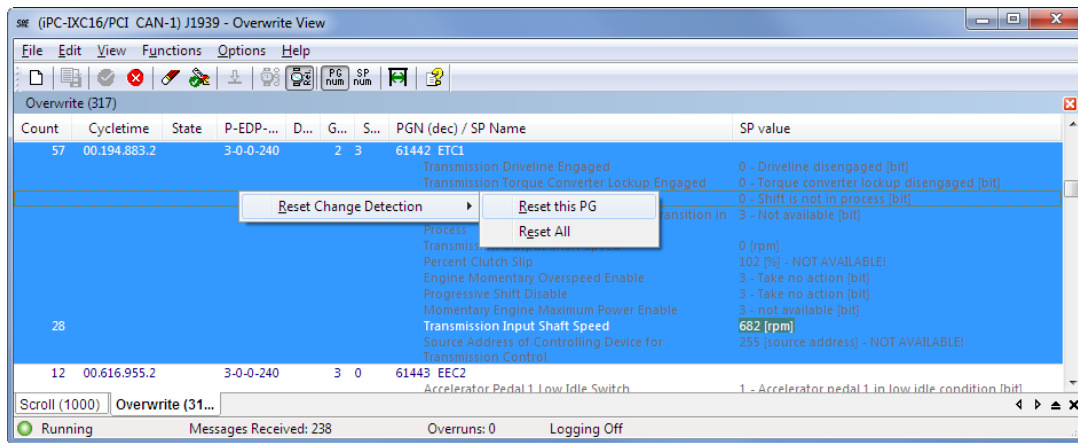
Figure 3.3: Context menu for Overwrite view

SP value	Value of the Suspect Parameter; if change monitoring is enabled, the value which have been changed once are highlighted in color

Data change detection

The data change detection occurs in the Overwrite View of the J1939-Module and can be enabled and disabled via menu item **Options** | **Data Change Detection**.

With the first complete reception of a PG, a new J1939 message is added in the overwrite view. Its SPs are colored gray. Starting with the second reception of the same PG, the changed values of the Parameters and Source Address compared with the first reception are highlighted, provided that Data Change Detection is switched On, and the regular coloring applies.

The data display of changed data can be reset via the context menu of the display area (Fig. 3.3) or via the menu item **Functions** | **Reset Change Detection All**.

Visualization of the reception status

The column **Status** visualizes the reception status by various icons:

Status	Meaning
	Uncertain value: Messages have been lost and displayed data may therefore be false
	Uncertain counter: Messages have been lost. The number displayed in the column Count may therefore be too small

3.3 Message interpretation

J1939-Module interprets standard and extended CAN frames according to the SAE specification. The interpretation of data transmitted in CAN messages is based on a database. The standard database is loaded automatically at module startup and contains Parameter Groups and Parameters specified in SAE J1939-71, J1939-73, J1939-74 and J1939-75 (see Appendix A.2).
In addition, a database that contains user-defined proprietary Parameter Groups and Parameters as well as Configurable Parameter Groups (J1939-74) can be created by the user and loaded into the J1939-Module. Parameter Groups having the Data Page bit or the Extended Data Page bit set are also supported in user defined databases.
For a description of the database structure see chapter **3.12** . A special edition of the IXXAT J1939 Designer is included in the scope of delivery. With this tool, user-defined databases can be created, edited and generated easily in a visual manner.

3.3.1 Standard CAN messages (11-bit identifier)

The SAE standard specifies only the structure of the identifier for standard CAN frames, the content of the data field is not specified. The J1939-Module displays the following information for standard messages:

- Priority

- Source address

- Data bytes (SP value column)

Standard CAN messages are displayed in black text color.

3.3.2 Extended CAN messages (29-bit identifier)

Note: To be able to receive extended CAN messages the canAnalyser3 Control Panel has to be configured accordingly. See chapter **Configuration tree - CAN settings** of the canAnalyser3 manual for details.

At the default configuration of the module all Parameter Groups and Parameters defined by SAE will be interpreted. Furthermore one additional user-defined database with proprietary Parameter Groups and Suspect Parameters (J1939-21) and configurable Parameter Groups (J1939-74) can be loaded. Messages, which are not defined in a databases, cannot be interpreted. Displaying these unknown messages can be turned on and off via menu item **View** | **Show unknown Messages**

Following information is extracted from extended CAN messages:

Application and diagnostics layer messages

- Parameter Group Number

- Name of Parameter Group

- For each Parameter the following information is interpreted:

  - Suspect Parameter Number

– Name of SPN

– Value

– Unit

– "Not available or not request", "Error" indicator or "Parameter Specific Indicator" (specified in J1939-71, see Appendix A.2)

Application and diagnostics layer messages are displayed in blue text color. Further differentiation is given by the shade of blue:

- **Navy** indicates standardized application and diagnostics PGNs.

- **Blue** indicates user defined PGNs.

- **Iron blue** indicates PGNs with Data Page bit set.

Data link and network layers messages (J1939-21 and J1939-81)

- Request message

    – Requested Parameter Group Number

- Request2 message

    – Requested Parameter Group Number

    – Special Instructions

- Acknowledgement message

    – Control Byte (Acknowledgement type)

    – Group Function Value (if available)

    – Parameter Group Number of requested information

- Address claimed/Cannot Claim message

    – NAME of controller application

- Commanded Address message

    – NAME of controller application

    – New Source Address

- Group Function message

    These messages have to be specified by the user. Description of the Parameters Groups and Suspect Parameters has to be at the user-defined database if these messages should be interpreted.

Data link and network layers messages are displayed in brown text color.

Following information is extracted from the NAME:

- Identity Number (except Transfer message)

- Manufacturer Code (except Transfer message)

- Function Instance

- ECU instance

- Function

- Vehicle System

- Industry Group

- Vehicle System Instance

- Arbitrary Address Capable

Transport Protocol

For the interpretation of the Transport Protocol there are two modes:

- If the menu item **Options** | **Single Fragment Mode** is active, the following interpretation
  is performed: Each CAN message is interpreted immediately after reception without con-
  sideration of the Transport Protocol context. The transmitted data are displayed byte-wise.

- If the menu item **Options** | **Single Fragment Mode** is inactive, the following interpretation
  is performed: The Transport Protocol is checked and interpreted. If the transmission was
  correct, the transmitted application data are interpreted and displayed. Protocol overhead
  is not shown. If an error occurs the Transport Protocol is aborted and the error is displayed.

Interpretation and visualization of all non-fragmented messages is equal in both modes.
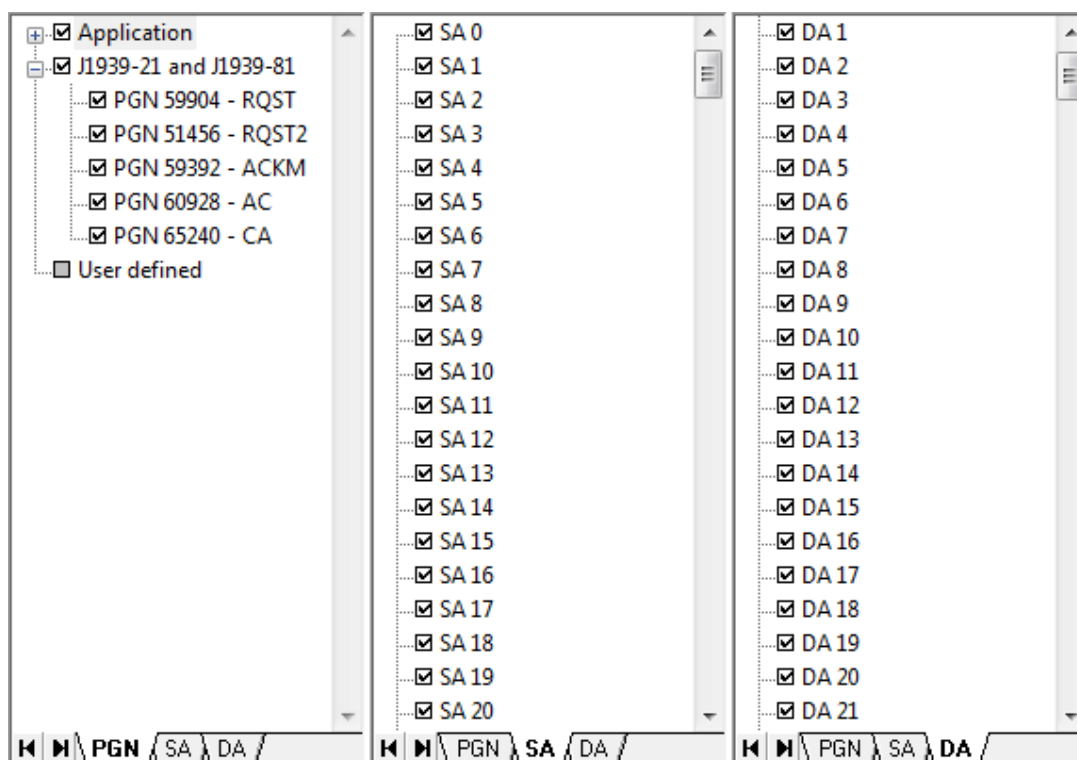
Figure 3.4: J1939 filters

3.4 Message filtering

The J1939-Module has an integrated filter on the left side of the window. The filter offers three views (Fig. 3.4), that are used for configuration and to display the current filter settings.
Filtering comprises all specified PGNs and all possible Source and Destination Addresses. For simple configuration of the filter, it provides three views, which can be selected via tabsheets. The individual elements of the filter are enabled or disabled via check boxes. In addition, the complete filter can be opened or closed via a pop-up menu.
The filter criterions are joined by AND operator, e.g. a J1939 message is only displayed if it passes the PGN filter, the DA filter and the SA filter.
Standard CAN messages and J1939 messages with PDU 2 format do not contain a Destination Address field. Therefore for these messages the DA filter setting is ignored.

The following filter views are available:

- Filtering by Parameter Group Numbers

  All PGNs are displayed in a tree structure (Fig. 3.4). PGNs are subdivided into four branches: "Application" PGNs, "Diagnostics" PGNs, "J1939-21 and J1939-81" and "User defined" PGNs. The PGNs are arranged hierarchically according to PG number within each branch. In this tree for each individual PGN, it is possible to define whether the message is to be displayed or filtered out.

- Filtering by Source Addresses

  All SAs are listed in a tree structure (Fig. 3.4). Any SA can be displayed or filtered out.

- Filtering by Destination Addresses

  All DAs are listed in a tree structure (Fig. 3.4). Any DA can be displayed or filtered out.
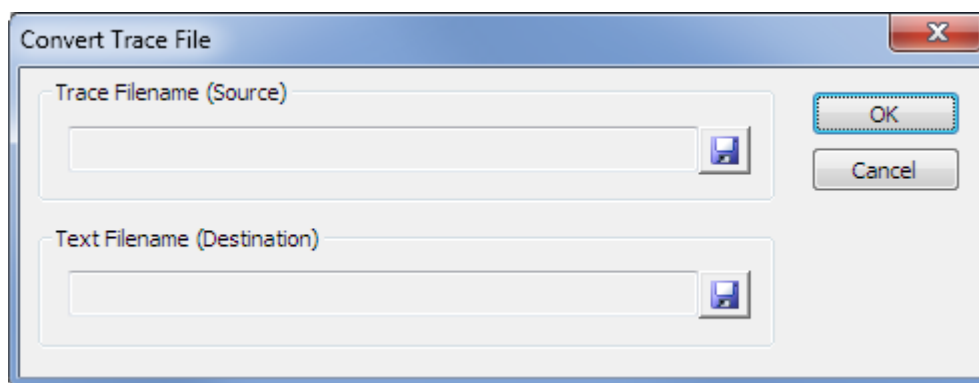
Figure 3.5: Conversion of a trace

Note: Changing the filter settings only affects the messages received after the setting change but not the messages already received before that.

3.5 Message recording (Online logging)

Message recording enables received and interpreted messages to be written directly into file. The J1939 messages are saved in ASCII format as a CSV (comma separated value) file and can be imported for analysis and further processing in standard tools such as Microsoft Excel. At the beginning of logging, it is enquired to which file the messages are to be written. The display formats and the interpretation mode are adopted at the beginning of logging. Changing the format during logging has no influence on the format in the file. Changes in filter settings, on the other hand, take immediate effect.
Online logging can be stopped by user at any time or it will be stopped automatically when free disk space is less than 25 MiB. The size of one trace file is limited to 1 GiB, then a following trace file will be created.

3.6 Interpretation of a trace

A binary trace generated via the canAnalyser3's **Trace-module** can be interpreted by the J1939-Module and saved to a CSV file. To start conversion, the menu item **File | Convert Trace File...** is selected. This opens the dialog (Fig. 3.5), in which the trace file to be interpreted and the name of the CSV file to be generated is defined. After acknowledging the dialog with the OK button, the interpretation is started.

Attention: During the interpretation of traces, message reception of the J1939-Module is stopped.

3.7   Menu reference

3.7.1   File menu

Menu item	Function
New	Creates a new configuration with default settings: Message display and filter settings are reset; user-defined database is removed
Load Database...	Loads a user-defined database. Only one user-defined database can be loaded at one time and Loading removes any previously loaded user-defined data base.
Import Options...	Imports previously exported settings such as font, window layout, filter settings, etc. from a file
Export Options...	Exports the current settings such as font, window layout, filter settings, etc. to a file
Export Messages...	Saves all the messages in the internal display buffers to an ASCII file
Convert Trace File...	Converts a trace and writes the result to an ASCII file
Exit	Ends the J1939-Module

Explanations for exporting and importing solely settings you will find in chapter **The term analysis configuration** of the canAnalyser3 user manual.

3.7.2   Edit menu

Menu item	Function
Copy CSV	Copies marked lines CSV formatted to clipboard
Toggle Marker *	Sets or Removes a Marker for selected message
Previous Marker *	Jumps to previous Marker (no wraparound)
Next Marker *	Jumps to next Marker (no wraparound)
Set/Release Time Reference *	Sets Timestamp Zero for selected message / Releases previously set Timestamp Zero
Jump to Time Reference *	Jumps to previously set Timestamp Zero message

* Only available in Scroll View

3.7.3 View menu

Menu item	Function
Time relative	Display of the time stamp absolute or relative to the previously displayed J1939 message
PF hex	Display of the PDU format in decimal or hexadecimal notation
DA hex	Display of the Destination Address in decimal or hexadecimal notation
GE hex	Display of the Group Extension in decimal or hexadecimal notation
SA hex	Display of the Source Address in decimal or hexadecimal notation
SP value hex	Display of the interpreted SP value in decimal or hexadecimal notation
Show PGN	Display of the PG as name or as number
PGN hex	Display of the PGN in decimal or hexadecimal notation
Show SPN	Display of the SP as name or as number
SPN hex	Display of the SPN in decimal or hexadecimal notation
Show Layer 2 Message	Display of the corresponding layer-2 messages below a J1939 message
ID hex	Display of the layer-2 message identifier in decimal or hexadecimal notation (only available if layer-2 messages are displayed)
Data hex	Display of the layer-2 message data field in decimal or hexadecimal notation (only available if layer-2 messages are displayed)
Show unknown Messages	Display of messages that are not specified at the loaded databases
Draw Guides	Draws additional horizontal guides between the lines in grey
Word wrap lines	Displays the interpreted SPs over several lines if the specified column width is not sufficient for the display of the complete interpretation
Show recent Frames	Display of the latest messages in the Scroll View
Filter Trees	Shows/Hides the filter trees pane
Scroll View	Switches to resp hides the scroll view
Overwrite View	Switches to resp hides the overwrite view
Toolbar	Shows/Hides the toolbar
Status Bar	Shows/Hides status bar

3.7.4 Functions menu

Menu item	Function
Start	Starts message reception of the J1939-Module
Stop	Stops message reception
Reset Change Detection All	Resets data change detection of all messages
Online Logging...	Writes the interpreted messages to an ASCII file in parallel with their displaying in the views
Clear All	Clears the display and resets the reception counters
Autosize Columns	Regulates ideal column widths

3.7.5 Options menu

Menu item	Function
Data Change Detection	Activates/deactivates data change detection
Data Change Detection Color...	Opens a dialog to select the color in which changed data is to be marked
Single Fragment Mode	Toggle single fragment mode/complete message mode
Fonts...	Opens a dialog to select the font in which the messages are to be displayed

3.7.6 Help menu

Menu item	Function
Help Topics	Opens the online help of the J1939-Module
About...	Displays the version information of the J1939-Module
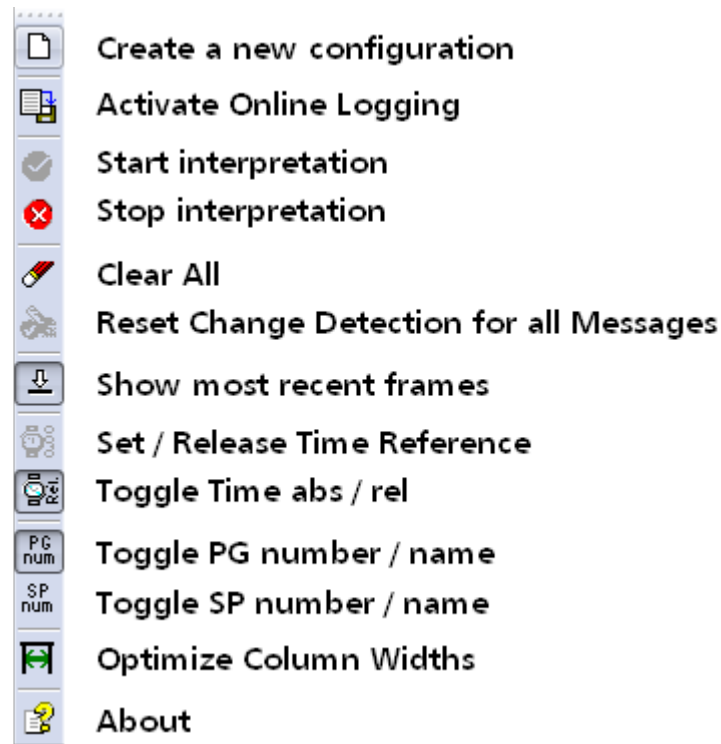
Figure 3.6: Toolbar of the J1939-Module

3.8 Toolbar

The main functions of the J1939-Module can also be called via the toolbar (Fig. 3.6).

3.9 Status bar

The status bar contains an LED icon that displays the status of the Control Panel or of the J1939-Module:

LED color	Meaning
Green	Control Panel and J1939-Module are started
Flashing red	Control Panel is stopped
Red	J1939-Module is stopped

3.10 Hotkeys

TAB	Switch between filter trees and message views
Ctrl+TAB	Switch between Scroll view and Overwrite view
F1	Online-Help
F2	Go to Next Marker in Scroll view
Shift+F2	Go to Previous Marker in Scroll view
Ctrl+F2	Toggle Marker in Scroll view
F5	Start message reception
Shift+F5	Stop message reception
F6	Enable/disable inline logging
F8	Clear View
F11	Show/hide filter trees
Ctrl+C	Copy marked lines CSV formatted to clipboard
Ctrl+D	Load a user-defined database
Ctrl+E	Export the received messages to a file
Ctrl+N	Create a new configuration
Ctrl+O	Load application settings from file
Ctrl+S	Save application settings from file
Ctrl+W	Close application window
PageDown	Scroll one page ahead in current View
PageUp	Scroll one page backward in current View
Ctrl+PageDown	Scroll 1000 messages ahead in current View
Ctrl+PageUp	Scroll 1000 messages backward in current View
Ctrl+0	Jump to Time Reference message
Ctrl+1..9	Jump to 10%..90% of current View
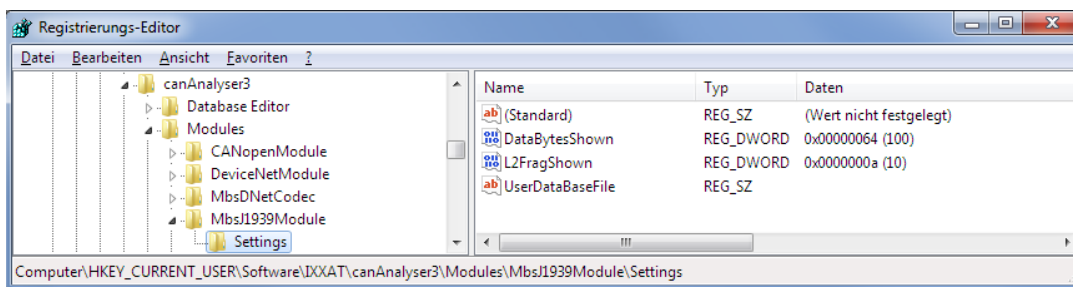
Figure 3.7: Registry settings of the J1939-Module

3.11 Windows Registry

A few additional display settings can be done in the Windows Registry at

`HKCU\Software\IXXAT\canAnalyser3\Modules\MbsJ1939Module\Settings`

(Fig. 3.7):

- **L2FragShown** is a DWORD key setting the maximum number of lines to be shown when layer-2 messages are displayed (see also (View | Show Layer 2 message 3.2)). Default value is 10.

- **DataBytesShown** is a DWORD key setting the maximum number of databytes displayed for unknown or proprietary PGNs. Default value is 100.

If a mentioned registry key is not existing, it can be created with the context menu of the registry editor via command **New** | **DWORD-value (32bit)**

3.12 J1939 database structure

A J1939 database is a XML file conforming the structure specified in this chapter. Differences between the specified format and the database will lead to failures during import or interpretation.

J1939 database begins with XML declaration, which specifies the version of XML being used: **<xml version="1.0" encoding="ISO-8859-1">**. Remaining part of the file is the database's body. It is marked by **<J1939-PROJECT>** tag and contains three parts:

- Database description

- Suspect Parameter description

- Parameter Group description

First part is marked by **<PRJ-DATA>** tag and contains description of the database file:

- Database name

- Customer

- User

- Date of the creation/editing

- Version

- Some comments

Example:

```
<PRJ-DATA>
   <PRJ-NAME>SAE J1939 Suspect Parameters and
                 Parameters Groups</PRJ-NAME>
   <PRJ-CUSTOMER></PRJ-CUSTOMER>
   <PRJ-USER></PRJ-USER>
   <PRJ-DATE></PRJ-DATE>
   <PRJ-VERSION>1.5</PRJ-VERSION>
   <PRJ-COMMENT>Application layer and
                 Application Layer-Diagnostics</PRJ-COMMENT>
</PRJ-DATA>
```

The second part contains the specification of all Suspect Parameters. Definition of each parameter is marked by **<SUSPECTPARAMETER>** tag and contains parameter attributes:

- Number of the parameter: Numerical value

- Name of the parameter: String

- Length of the parameter in bits: Numerical value (if parameter has a variable length tag has to be empty)

- Resolution (unit/bit): Numerical value

- Offset: numerical value

- Minimal value: Numerical value

- Maximal value: Numerical value

- Standard parameter: TRUE or FALSE

- Unit of the parameter: String

- (Data) type: "float", "integer", "BitField", "ASCII" or "binary"

- Parameter type: "Scale", "State", "ASCII", "NUMERIC_ASCII" or "Bit Field"

Example:

```
<SUSPECTPARAMETER>
   <SP-SPN>52</SP-SPN>
   <SP-NAME>Engine Intercooler Temperature</SP-NAME>
   <SP-LENGTHBIT>8</SP-LENGTHBIT>
   <SP-RESOLUTION>1</SP-RESOLUTION>
   <SP-OFFSET>-40</SP-OFFSET>
   <SP-DATAMIN>-40</SP-DATAMIN>
   <SP-DATAMAX>210</SP-DATAMAX>
   <SP-STANDARD>TRUE</SP-STANDARD>
   <SP-UNIT>deg C</SP-UNIT>
   <SP-TYPE>integer</SP-TYPE>
   <SP-PARTYPE>Scale</SP-PARTYPE>
</SUSPECTPARAMETER>
```

If a Suspect Parameter has a Specific Indicator or some states the tag **<STATE>** is used to describe each state value. It contains following sub tags:

- Corresponding numerical value of the parameter

- Meaning: String

Example:

```
<SUSPECTPARAMETER>
   <SP-SPN>69</SP-SPN>
   <SP-NAME>Two Speed Axle Switch</SP-NAME>
   <SP-LENGTHBIT>2</SP-LENGTHBIT>
   <SP-RESOLUTION>1</SP-RESOLUTION>
   <SP-OFFSET>0</SP-OFFSET>
   <SP-DATAMIN>0</SP-DATAMIN>
   <SP-DATAMAX>3</SP-DATAMAX>
   <SP-STANDARD>TRUE</SP-STANDARD>
   <SP-UNIT>bit</SP-UNIT>
   <SP-TYPE>BitField</SP-TYPE>
   <SP-PARTYPE>State</SP-PARTYPE>
   <STATE>
        <STATE-VALUE>00</STATE-VALUE>
```

```
            <STATE-NAME>Low speed range</STATE-NAME>
        </STATE>
        <STATE>
            <STATE-VALUE>01</STATE-VALUE>
            <STATE-NAME>High speed range</STATE-NAME>
        </STATE>
    </SUSPECTPARAMETER>
```

Note: If some attributes are not specified for current parameter corresponding tags have to be included as empty tags to the database file.

Parameters of the "Bit field" type contain list of the flags. Each flag is specified by:

- Name of the flag: String

- Number of the bit (from beginning of Suspect Parameter data field)

- List of the flag values:

    - Value of the flag
    - Meaning

Example:

```
<FLAG>
    <FLAG-NAME>Misfire monitoring support</FLAG-NAME>
    <FLAG-BIT-NUMBER>1</FLAG-BIT-NUMBER>
    <VALUE>
        <VAL-NUMBER>0</VAL-NUMBER>
        <VAL-MEANING>test not supported by this
                    controller</VAL-MEANING>
    </VALUE>
    <VALUE>
        <VAL-NUMBER>1</VAL-NUMBER>
        <VAL-MEANING>test supported by this
                    controller</VAL-MEANING>
    </VALUE>
</FLAG>
```

The third part of the database body contains specification of all Parameters Groups. Definition of each parameter group is marked by the **<PARAMETERGROUP>** tag and contains group attributes and lists of the parameters:

- Number of the Parameters Group: Numerical value

- Name of the Parameters Group: String

- Acronym of the Parameters Group: String

- Length of the Parameters Group at the bytes: Numerical value (if parameter group has a variable length tag has to be empty)

- Transmission Repetition Rate: String

- Diagnosis message coding: True or False

- First Parameter:

  - Number of the Suspect Parameter specified at the SAE J1939-71: Numeric value
  - Start bit of the parameter at the Group data field: Numeric value

- Second Parameter:

  - Number of the Suspect Parameter specified at the SAE J1939-71: Numeric value
  - Start bit of the parameter at the Group data field: Numeric value

- ...

Example:

```
<PARAMETERGROUP>
  <PG-PGN>65155</PG-PGN>
  <PG-NAME>Ignition Timing 2 - IT2 -</PG-NAME>
  <PG-ACRONYM>IT2</PG-ACRONYM>
  <PG-LENGTH>8</PG-LENGTH>
  <PG-TRANSRATE>On request</PG-TRANSRATE>
  <PG-DM>False</PG-DM>
  <PG-SP>
      <SP-NUMBER>1417</SP-NUMBER>
      <SP-STARTBIT>1</SP-STARTBIT>
  </PG-SP>
  <PG-SP>
      <SP-NUMBER>1418</SP-NUMBER>
      <SP-STARTBIT>17</SP-STARTBIT>
  </PG-SP>
  <PG-SP>
      <SP-NUMBER>1419</SP-NUMBER>
      <SP-STARTBIT>33</SP-STARTBIT>
  </PG-SP>
  <PG-SP>
      <SP-NUMBER>1420</SP-NUMBER>
      <SP-STARTBIT>49</SP-STARTBIT>
  </PG-SP>
</PARAMETERGROUP>
```

Note: String of the Parameters Group's name contains full name and optional acronym and must have following format: **<Parameters Group Name>-<acronym>-**. If an acronym is not specified the string contains name and empty acronym field: **<Parameter Group Name>- -**.
If Parameter Group contains recurred group of the parameters the **<FRAME>** tag is used to define it. It contains following attributes:

- Repeat counter: If the tag is empty it means that frame repeats until the end of the data field. A numeric value specifies the number of repetitions. Further the value of a transmitted parameter can specify the repeat counter, using the format: **N<Suspect Parameter Number>**

- Length of the frame: If the tag is empty the length is variable and depends on the included parameters length. A numeric value specifies the length. Further the value of a transmitted parameter can specify the frame length, using the format: **N<parameter number>**

- List of the included parameter (same as PG list)

Example:

```
<PARAMETERGROUP>
  <PG-PGN>65168</PG-PGN>
  <PG-NAME>Engine Torque History - ETH -</PG-NAME>
  <PG-ACRONYM>ETH</PG-ACRONYM>
  <PG-LENGTH>N/A</PG-LENGTH>
  <PG-TRANSRATE>N/A</PG-TRANSRATE>
  <PG-DM>False</PG-DM>
  <PG-SP>
    <SP-NUMBER>1246</SP-NUMBER>
    <SP-STARTBIT>1</SP-STARTBIT>
  </PG-SP>
  <FRAME>
    <FR-REPEATECOUNT>N1246</FR-REPEATECOUNT>
    <FR-LENGTH>32</FR-LENGTH>
    <PG-SP>
        <SP-NUMBER>1247</SP-NUMBER>
        <SP-STARTBIT>9</SP-STARTBIT>
    </PG-SP>
    <PG-SP>
        <SP-NUMBER>1248</SP-NUMBER>
        <SP-STARTBIT>25</SP-STARTBIT>
    </PG-SP>
    <PG-SP>
        <SP-NUMBER>1249</SP-NUMBER>
        <SP-STARTBIT>41</SP-STARTBIT>
    </PG-SP>
    [...]
  </FRAME>
</PARAMETERGROUP>
```

Note: Some frames can contain several repeat counters. In this case this tag has to be included several times. The result value of the counter will be calculated as sum of all numerical values or values of the parameters.

Appendix A

Registers

A.1 Definitions, acronyms, abbreviations for J1939

Data Page (DP)   One bit in the Identifier portion of the CAN Arbitration Field is used to select one of two pages of Parameter Group Numbers. It is one of the fields used to determine the Parameter Group Number. It became generally accepted to reserve the second page, i.e. Data Page = 1 for NMEA2000 usage.

Destination Address (DA)   This is a Protocol Data Unit specific field in the 29 bit CAN identifier used to indicate the address of the ECU intended to receive the J1939 message.

Electronic Control Unit (ECU)   A computer based electronic assembly from which J1939 messages may be sent or received.

Extended Data Page (EDP)   In addition to the Data Page (DP) bit, another bit in the Identifier portion of the CAN Arbitration Field is used to select one of two extended pages of Parameter Group Numbers. This bit was formerly reserved.

Extended Frame   A CAN data frame using a 29 bit identifier as defined in the CAN 2.0b specification.

Group Extension (GE)   This is a Protocol Data Unit specific field in the 29 bit CAN identifier that is used as part of the information necessary to determine the Parameter Group Number.

NAME   An 8 byte value which uniquely identifies the primary function of an ECU and its instance on the network. A device's NAME must be unique, no two devices may share the same NAME value on a given vehicle network.

Parameter Group (PG)   A collection of parameters that are conveyed in a J1939 message. The PG identifies the data in a message, regardless of whether it is a single packet or multipacket message. Parameter Groups are not dependent on the source address field thus allowing any source to send any Parameter Group.

Parameter Group Number (PGN) A three byte, 24 bit, representation of the (Extended) Data Page bits, PDU Format, and GE fields. The Parameter Group Number uniquely identifies a particular Parameter Group.

PDU Format (PF) An 8 bit field in the 29 bit CAN identifier that identifies the PDU format and is used in whole or in part to provide a label for a Parameter Group. It also is one of the fields used to determine the Parameter Group Number.

PDU Specific (PS) An 8-bit field in the 29 bit identifier whose definition depends upon the value of the PDU Format field. It can be either a destination address (DA) or Group Extension (GE). It also is one of the fields used to determine the Parameter Group Number.

Priority A 3-bit field in an identifier that establishes the arbitration priority of the information communicated. The highest priority is zero and the lowest priority is seven.

Protocol Data Unit (PDU) A PDU is the J1939 specific term of a CAN 2.0b Data Frame.

Source Address (SA) An 8-bit field in the 29 bit identifier which allows for the unique identification of the source of a message. The SA field contains the address of the ECU that is sending the message.

Standard Frame A CAN data frame using an 11 bit identifier as defined in the CAN 2.0a/2.0b specification.

Suspect Parameter Number (SPN) A 19 bit number used to identify a particular element, component, or parameter associated with an ECU.

A.2 Specifications

[1] SAE J1939 STANDARD COLLECTION
J1939-21 Data Link Layer
December 2010
Society of Automotive Engineers, Inc. (SAE)

[2] SAE J1939 STANDARD COLLECTION
J1939-71 Vehicle Application Layer
April 2014
Society of Automotive Engineers, Inc. (SAE)

[3] SAE J1939 STANDARD COLLECTION
J1939-73 Application Layer Diagnostics
July 2013
Society of Automotive Engineers, Inc. (SAE)

[4] SAE J1939 STANDARD COLLECTION
J1939-74 Application - Configurable Messaging
November 2010
Society of Automotive Engineers, Inc. (SAE)

[5]   SAE J1939 STANDARD COLLECTION
J1939-75 Application Layer - Generator Sets and Industrial
May 2011
Society of Automotive Engineers, Inc. (SAE)

[6]   SAE J1939 STANDARD COLLECTION
J1939-81 Network Management
June 2011
Society of Automotive Engineers, Inc. (SAE)