MANUAL

CANStudio v3

SOFTWARE TOOL FOR CAN COMMUNICATION

SOFTWARE IS OPERATING WITH CRUSB CAN/USB CONVERETER

ATTENTION!
Using CANStudio software You can influence on CAN bus communication, which can be dangerous for control system and human health or live.
DIGA is not responsible for not proper use or result of CANStudio use.

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Information in this document can be little different form real CANStudio functions depends from CANStudio version.
DIGA programmer team try to up-date this document as often as is possible. This document can be changed without any prior informed.

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1. INTRODUCTION

CANStudio is advanced software tool for designers, integrators and service man for devices and network based on CAN technology. It is cooperating with CAN/USB CRUSB converter. It allows to configure devices with CAN interface and specially CANopen® protocol, and also based on LSS service. It allows to build multi nodes network and save it on disk. Monitoring the network is very easy when using view windows for incoming CAN frames, numeric display and graph. User can influence for CAN network using generators and predefined control commands according to CANopen® specification.

Controller Area Network (CAN) *is serial data transfer system developed by Robert Bosch GmbH. Currently is described by ISO 11898-1 standard.*

CAN in Automation (CiA®) *is international group of users and manufacturers founded in 1992, which promotes CAN bus and support high layer protocol based on CAN specification (www.can-CiA.org).*

CANopen® *is the specification family which describe CAN network. Application layer and communication profile (CiA® 301) are standardized by EN 50325-4 norm.*

Layer Setting Service (LSS) *in CANopen® protocol defines communication service for example for NODE-ID setting and baudrate for CAN bus node.*

Basic software functions:

- automatic CAN baudrate detection
- automatic CANopen® node search
- setting non typical CAN baudrates (SJA1000/16MHz) and bit timing parameters (CRUSB v1.x)
- listen mode operation
- CAN frame generating
- SYNC frame generating
- sending list of CAN frames from file or defined list
- displaying CAN telegrams in the table or chronological.
- file storing (logging)
- receive and transmit CAN frame filter
- CANopen® and J1939 frames interpretation
- trend graphical values presentation
- numeric gauge value presentation
- visualisation system for data from CAN frames.
- saving graph trends in BMP or JPG files
- EDS and DCF files saving
- CANopen® network project building
- LSS support
- NMT and SDO frames manage
- updating CANStudio via website
- supported languages :Polish, English and German
- possibilities to define user language
- creating user scripts in CANStudio TOOLS
- supporting two independent CAN channels (2 x CRSUB v1.x)

2. INSTALING CANStudio

!!! *To proper operation CANStudio with CRUSB v1/ or v2 interface it is necessary to install USB drivers. How to install USB drivers is described in CRUSB converter manual.*

Driver is provided on CD-ROM together with converter and CANStudio application. Current version is available on website www.diga.biz.pl part “download”. After inserting CD-ROM to CD drive then the following starter window will appear:

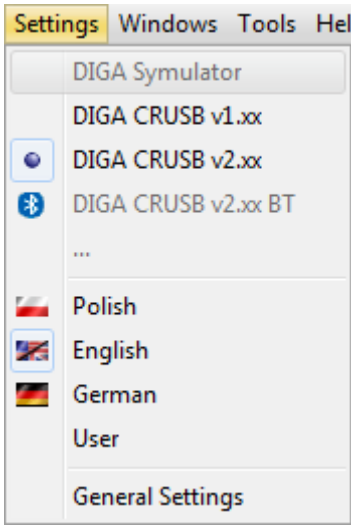
If PC is not supported autostart then start *Loader.exe* file.

Installing is allowed after clicking on button (Read me)

In this file there is also described the installation process

Installing as follows:

- Install USB driver for CRUSB (do as manual states).
- Connect CRUSB to PC (System should install device automatic).
- Install CANStudio
- install BOOTDRIVER (allows to updated CRUSB for new firmware via USB).
- Start CANStudio from desktop icon or from main menu of Windows
- From menu CANStudio → Settings select DIGA CRUSB v1.xx.



Next click on green icon CAN to

CAN connect . CAN disconnection is done by clicking on red CAN icon.

After above CANStudui is ready to operate.

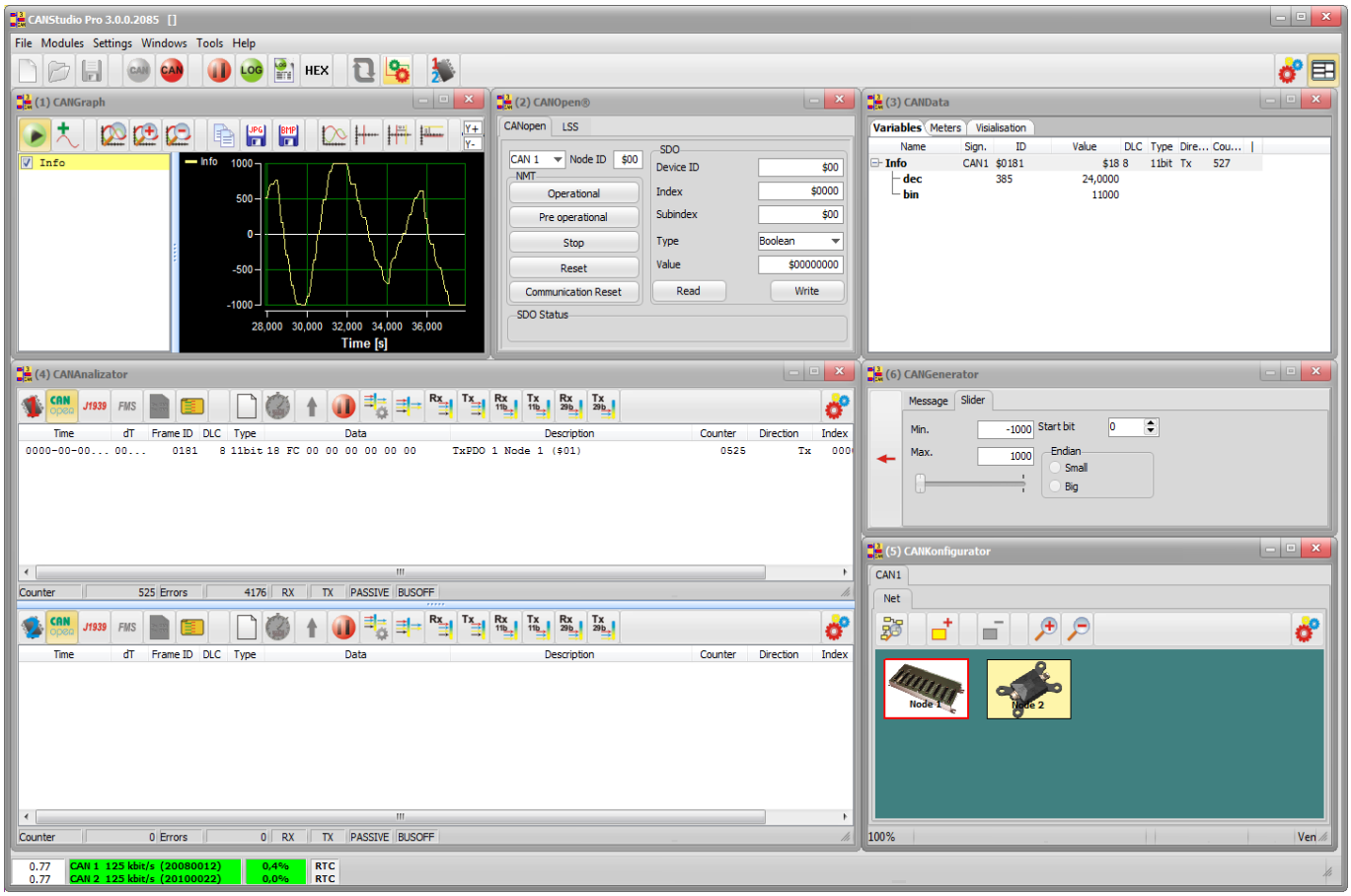
!!! Starting CANStudio is available after accepting yellow message.

!!! CRUSB converter has not to be necessary connected to PC before CANStudio starts.

Appearing CRUSB in system allows to activate CAN communication (green CAN press button).

3. MAIN CANStudio WINDOW

In the main CANStudio window there are different modules , which if they are ON, then are able to see in main window. Module windows are equipped with magnetic function which help to resize the window directly to the edge. Windows positions are store in the project files.

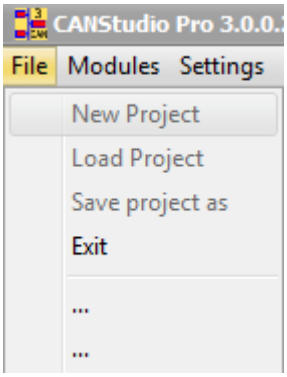


3.1. Main menu

In the main menu there are basic functions and settings for CANStudio.

3.1.1. File tab

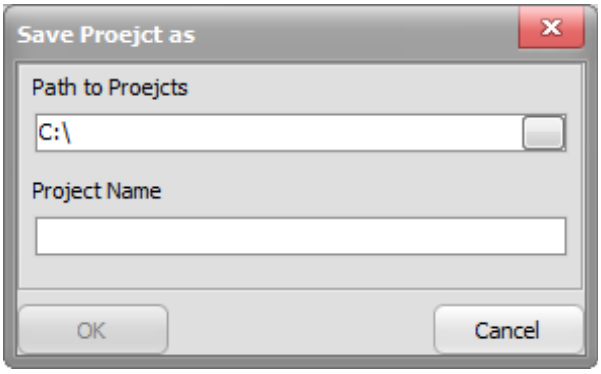
In this tab user can create, save and load project.



New project	Create new project, empty project, to store the project must be saved.
Open project	Open project from file.
Save project	Save project to file.
Exit	Close CANStudio.

Project file is saved with file extension .cs3

Project is stored in separate folder project named, which user enter during first saving on disk.



In the project there are stored information about windows position, configuration and CAN network parameters. EDS files which were changed by CANStudio are stored in such a form in the current project, as well as values set in Object Dictionary. It allows to store full configuration of the network and export values set by user in object Dictionary into DCF file.

Project folder consist of:

[project_name].cs3 – main project file.

Folders: LOG, NODES, PIC.

Electronic Data sheet (EDS) *this is a file which describe device functions according to standard schematics. Including Object Dictionary and parameters default values.*

Device configuration file (DCF) *this is a text file based on EDS. Additional there is a elements describing configured device (user configuration).*

Object Dictionary *it is a heart of each CANopen® device. Provide access to all types of data provided in the device, communication parameters, process data and configuration parameters.*

3.1.2. Modules tab

Allows to switch ON module windows. Closing module window is possible by closing the window (not unselect in tab).

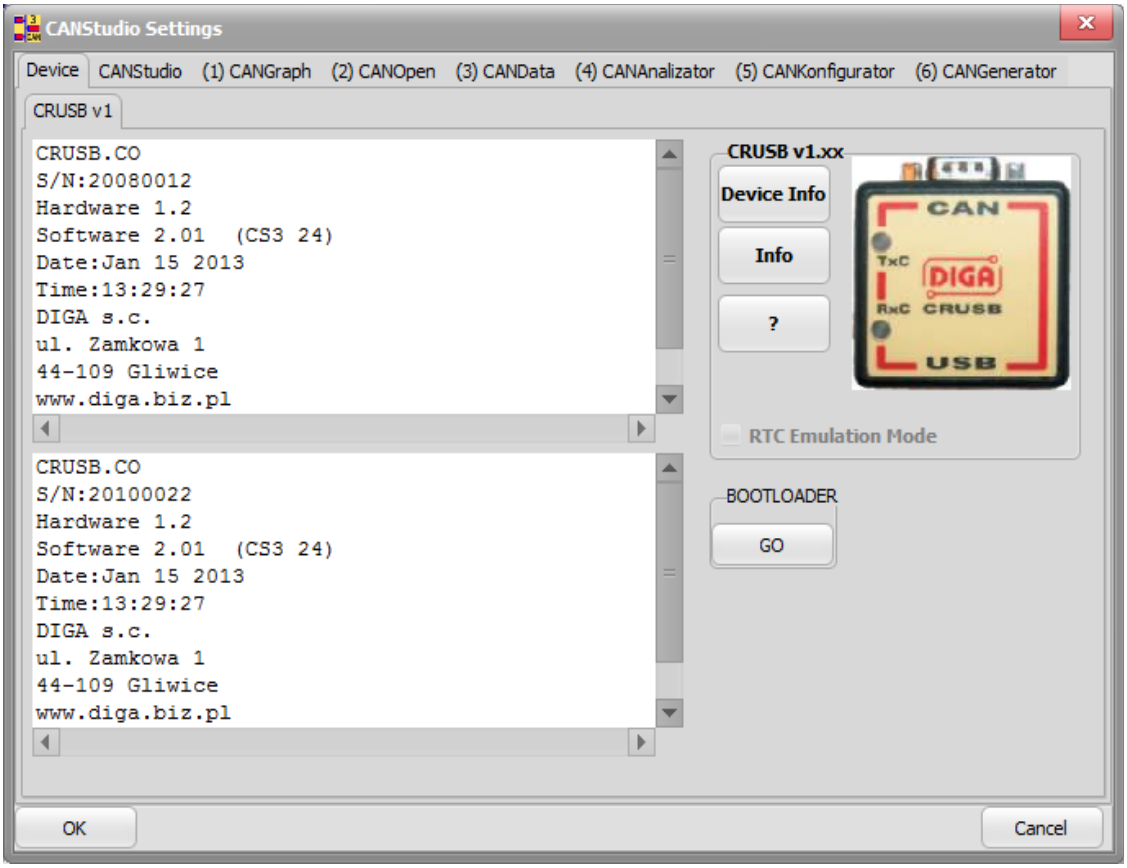
3.1.3. Settings tab

In this tab user can change language version of CANStudio. Available language versions: Polish, English, German. There is possible to create user language version (user). It is possible by modifying text files in the lang folder → user which is located in the main folder of installed CANStudio.

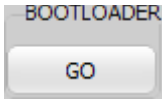
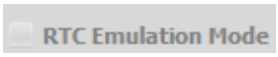
General settings of CANStudio allows to read interface parameters, application parameters settings, and also to set CRUSB into the firmware update mode.

3.1.3.1 Device tab

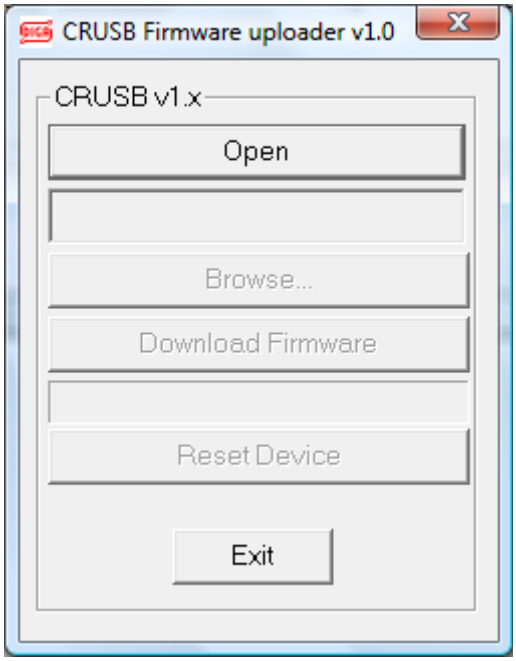
General settings window for CRSUB v1



Device Info	DIGA CRUSB v1.xx SN : 20100022 VID: 10C4 PID: 8372 Information from USB controller about connected CRUSB device
Info	Information about installed CRUSB device. CRUSB.CO S/N:20100022 Hardware 1.2 Software 2.01 (CS3 24) Date:Jan 15 2013 Time:13:29:27 DIGA s.c. ul. Zamkowa 1 44-109 Gliwice www.diga.biz.pl
?	Display command list of CRUSB.

	Press button to change CRUSB into firmware update (BOOTLOADER mode), which allows to upload new firmware to CRUSB device.
	Option only for CRUSB v1.xx and firmware 2.xx for CRUSB v1.xx. Allows to turn-on real time clock emulation, which allows to display current date and time in CAN messages in CANAnalizator window and LOG file.

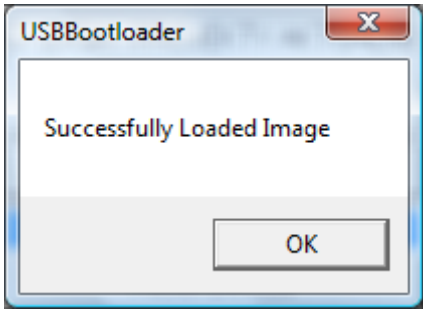
After starting BOOTLOADER mode then automatic start Uploader application. .



Firmware update is done as follows:

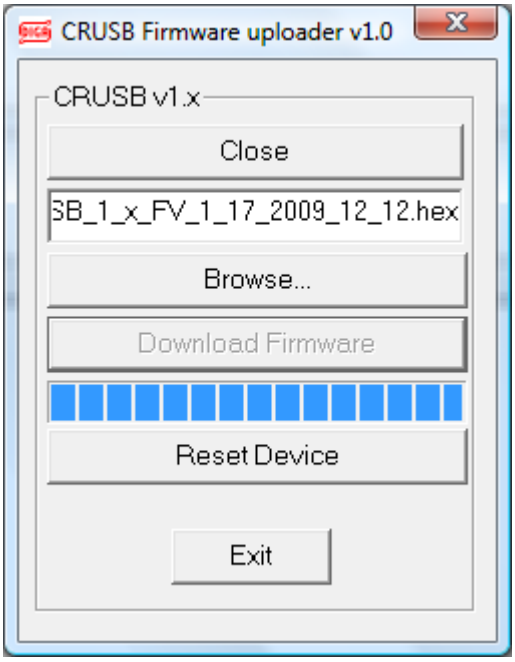
1. click on press button *Open* – application will connect to CTUSB
2. select new firmware file by clicking on *Browse* press button
3. Press *Download Firmware* and wait until new firmware will be uploaded.

   After successful updating the following message will appear :

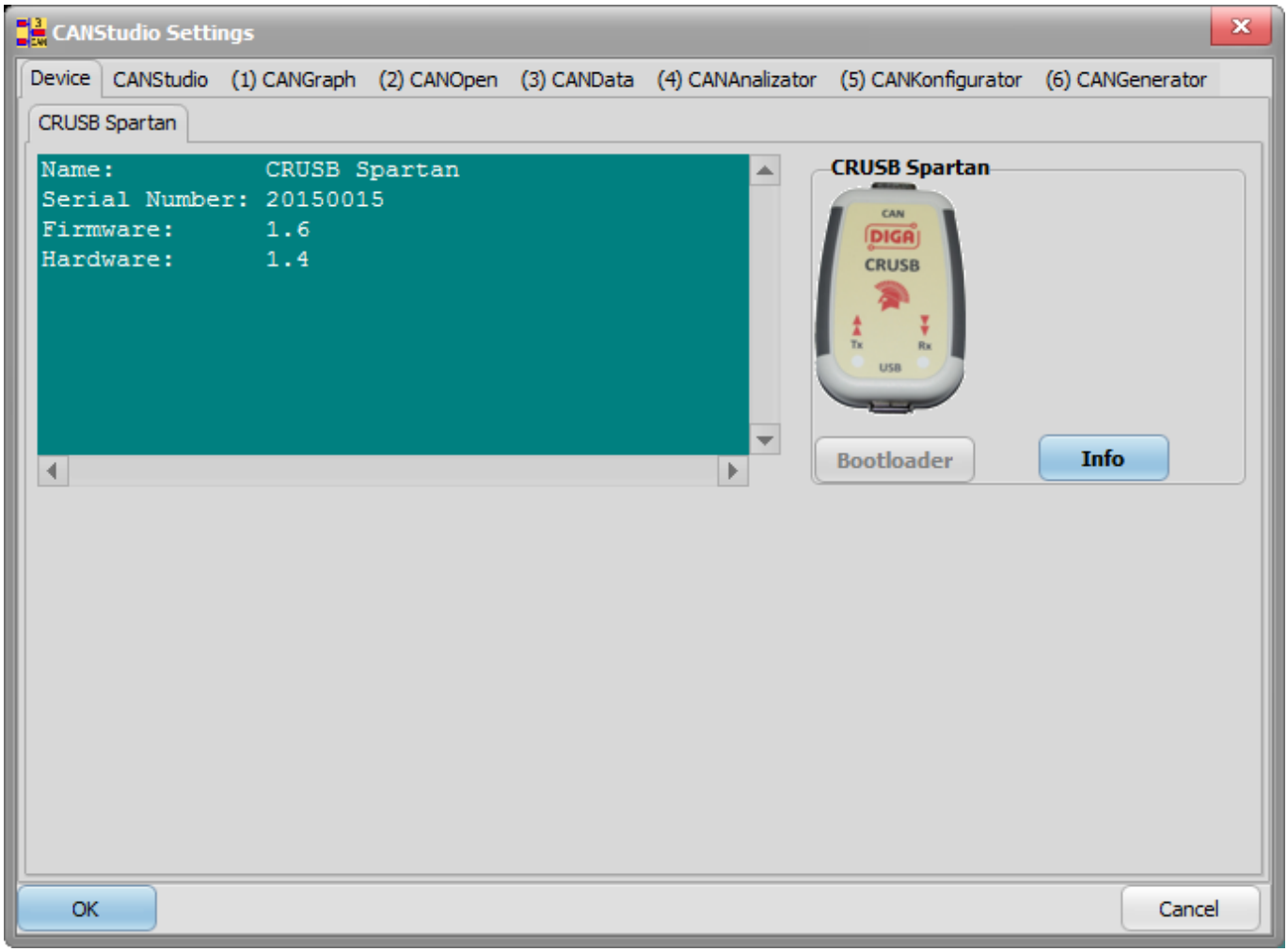


4. press *Reset Device*

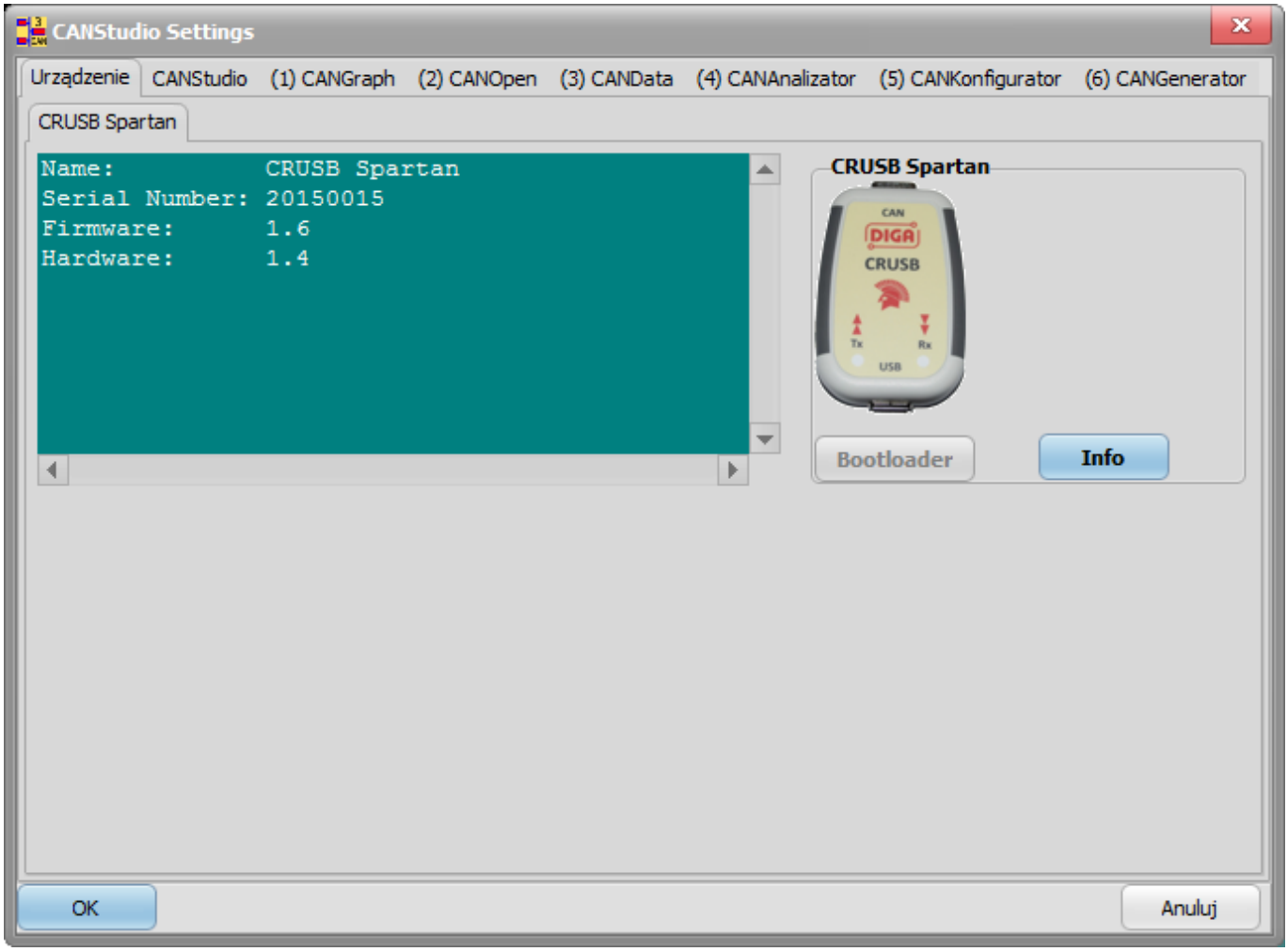
5. close Uploader application by clicking on *Exit*

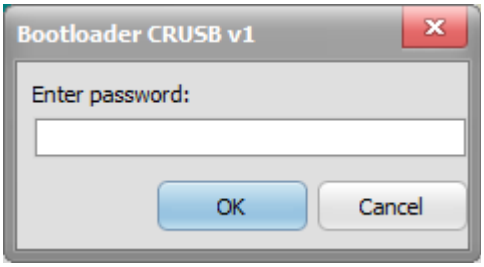


!!! During firmware updating it is necessary to be careful. Interpreting updating process can damage internal software in CRUSB and then it is necessary to upload internal software by manufacturer (DIGA).



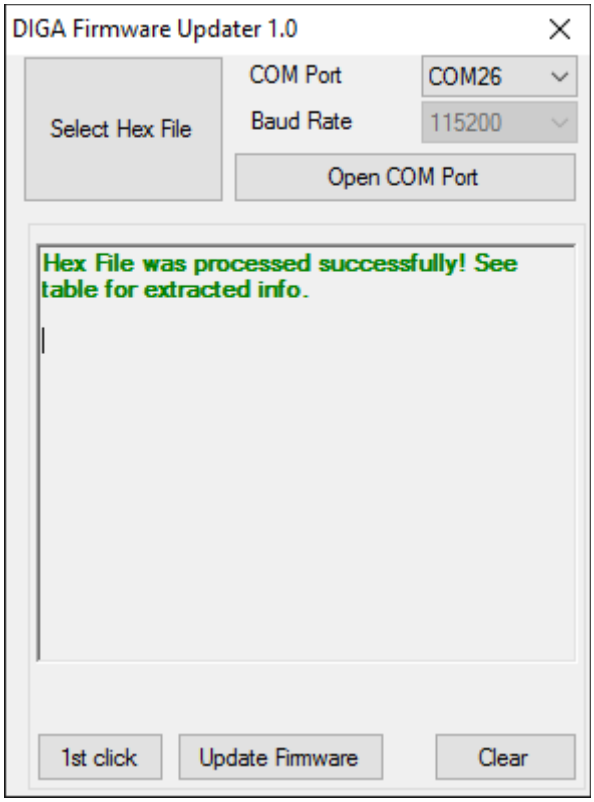
General settings window for CRSUB Spartan



Info	Information about CRUSB Spartan device .
Bootloader	Button which set CRUSB Spartan into BOOTLOADER mode, which allows to update new firmware in CRUSB Spartan.It is necessary to type the passowrd which is the serial number of the device.  After click OK on the device should blue LEDs ON.

After BOOTLOADER mode settings it is necessary to start updater application.

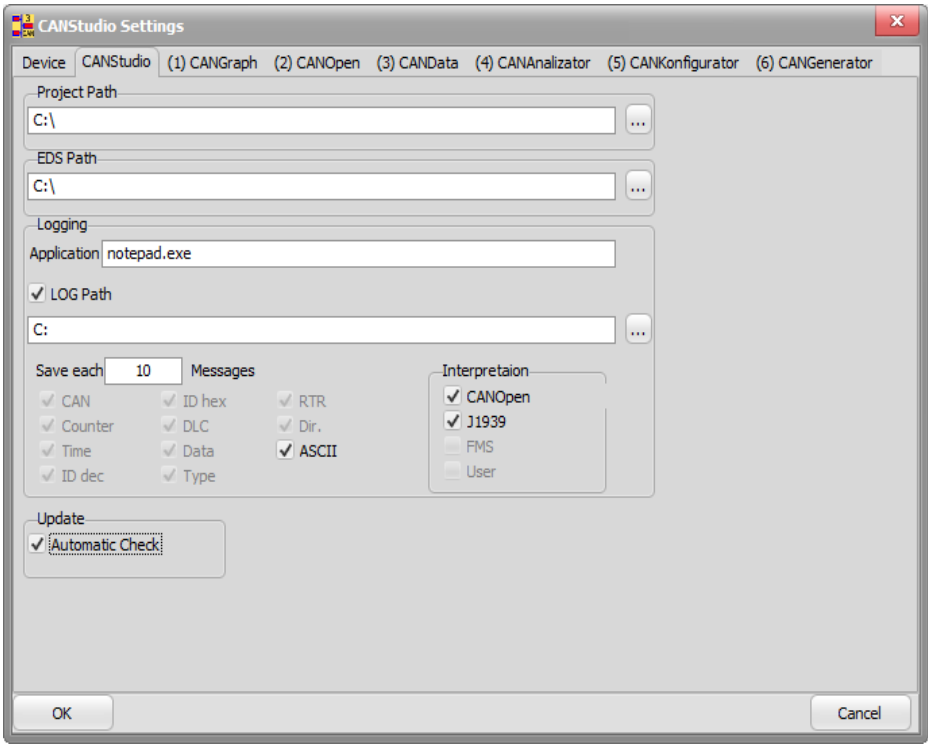
c:\Program Files(x86) \DIGA\CANstudio_v3_Pro\Tools\BL_CRUSB_Spartan\DIGA_updater.exe



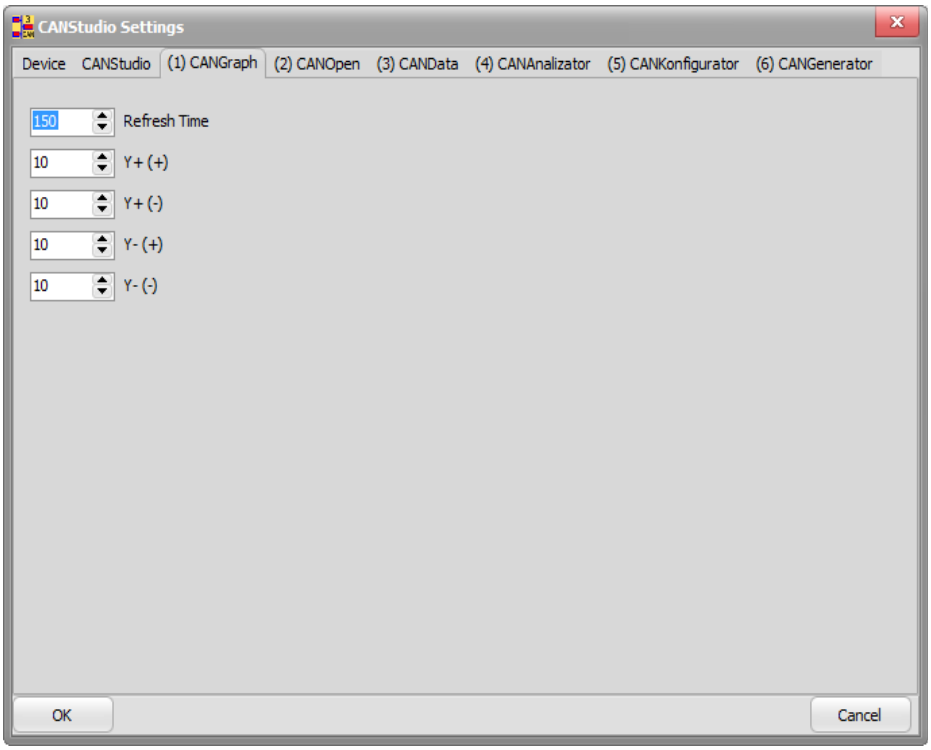
1. Select proper COM
2. Click on ***Select Hex File*** and load the firmware hex file
3. Click on ***Open COM port***
4. Click on ***1st click***
5. Click on ***Update Firmware***
6. After finishing the update procedure on device should green LEDs ON.

!!! During firmware updating it is necessary to be careful. Interpreting updating process can damage internal software in CRUSB Spartan and then it is necessary to upload internal software by manufacturer (DIGA).

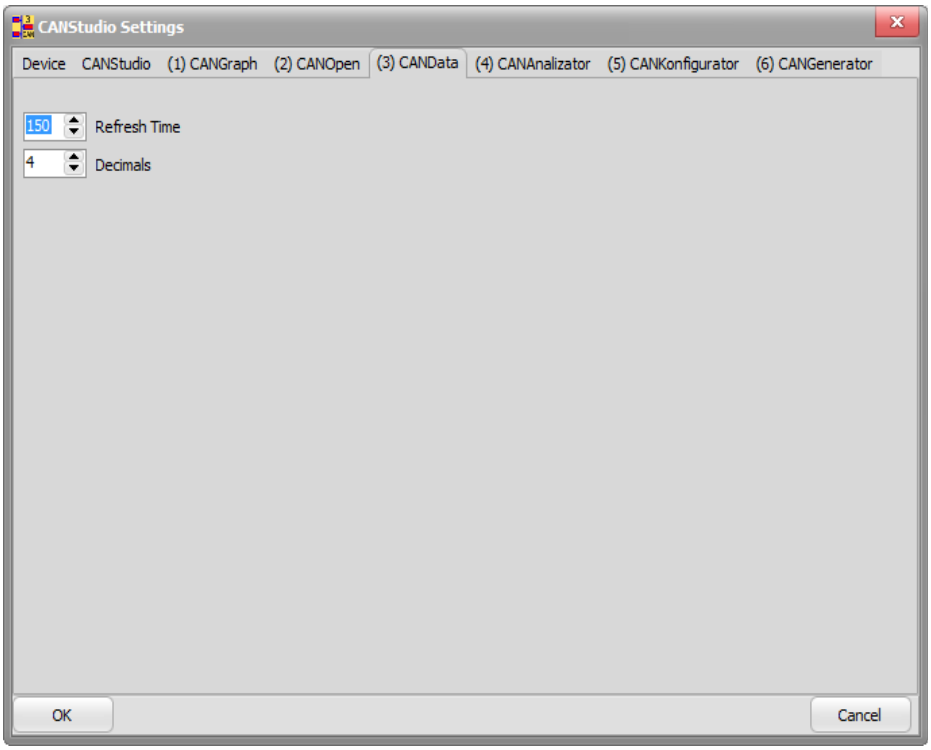
3.1.3.2 CANStudio tab.



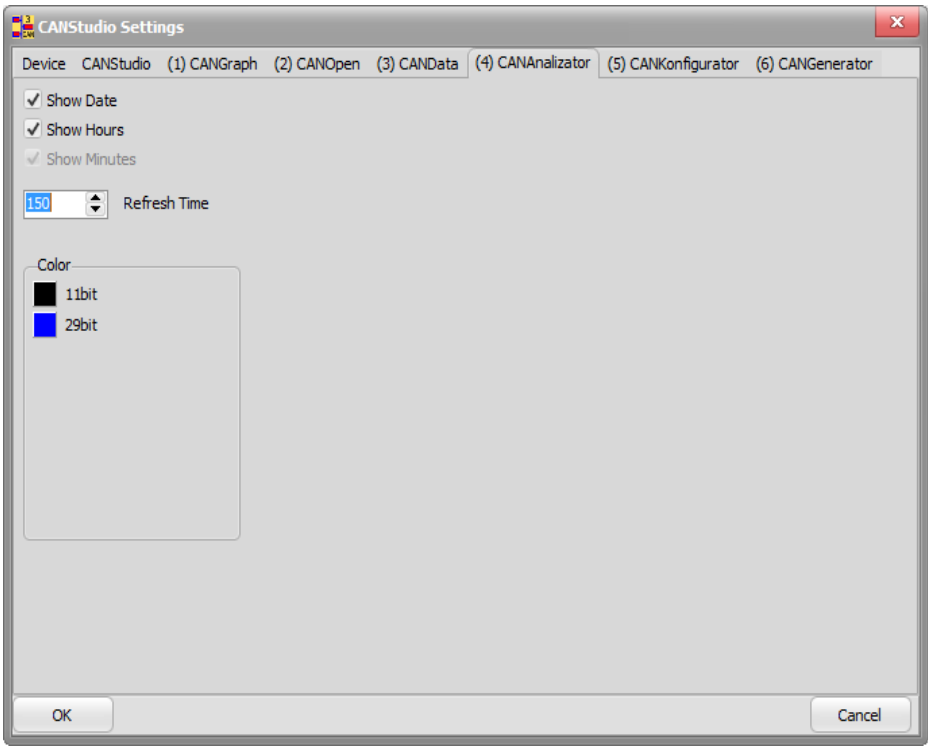
3.1.3.3 CANGraf tab



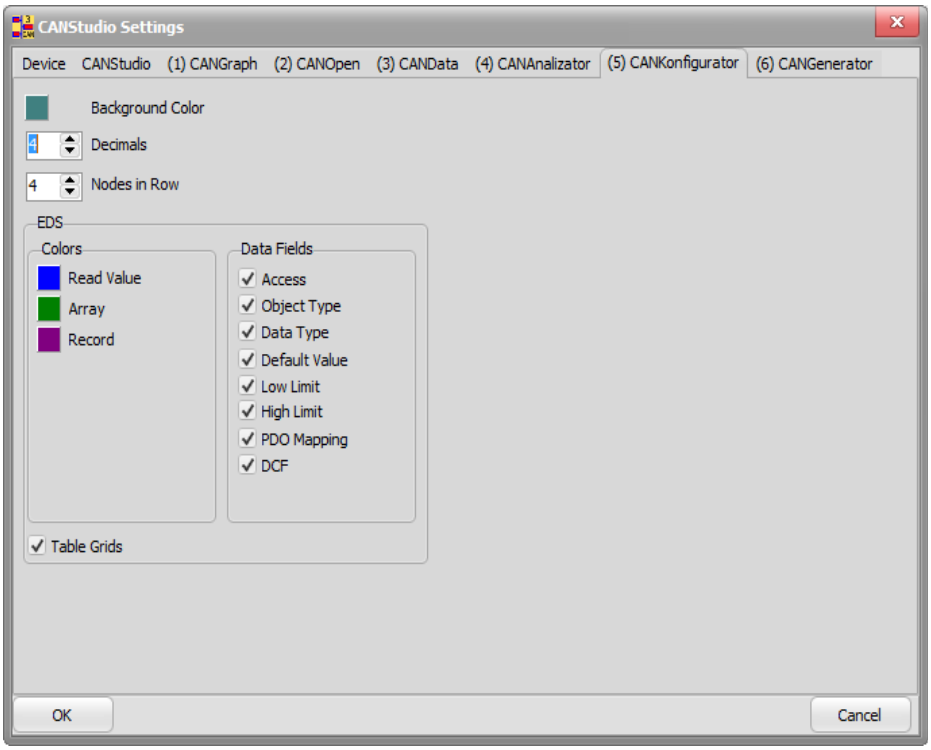
3.1.3.4 CANData tab



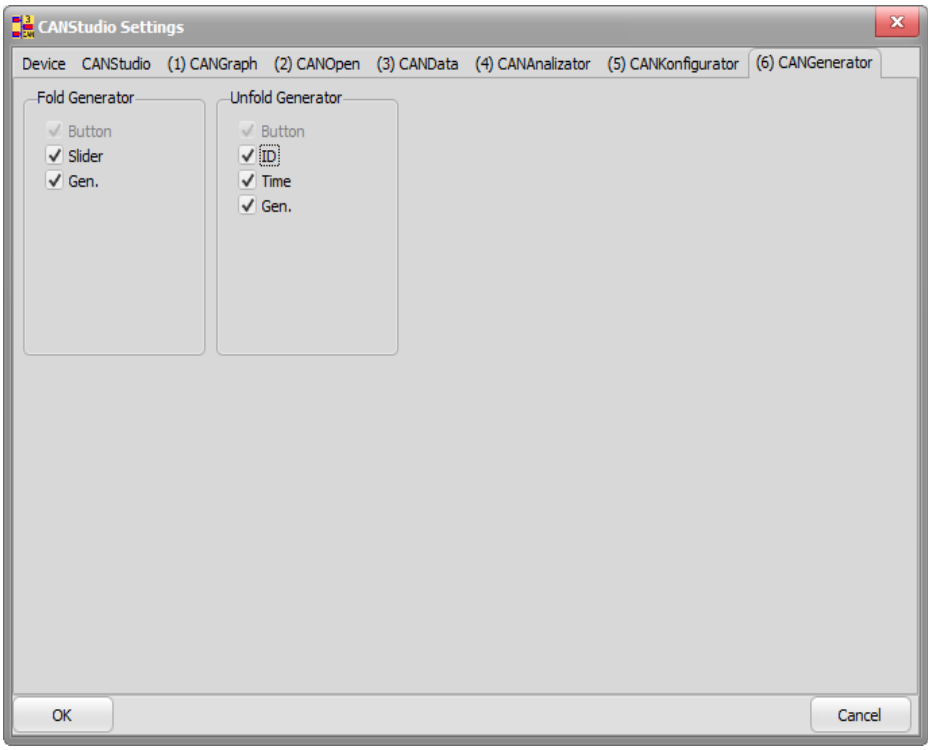
3.1.3.5 CANAnalizator tab



3.1.3.6 CANKonfigurator tab



3.1.3.7 CANGenerator tab

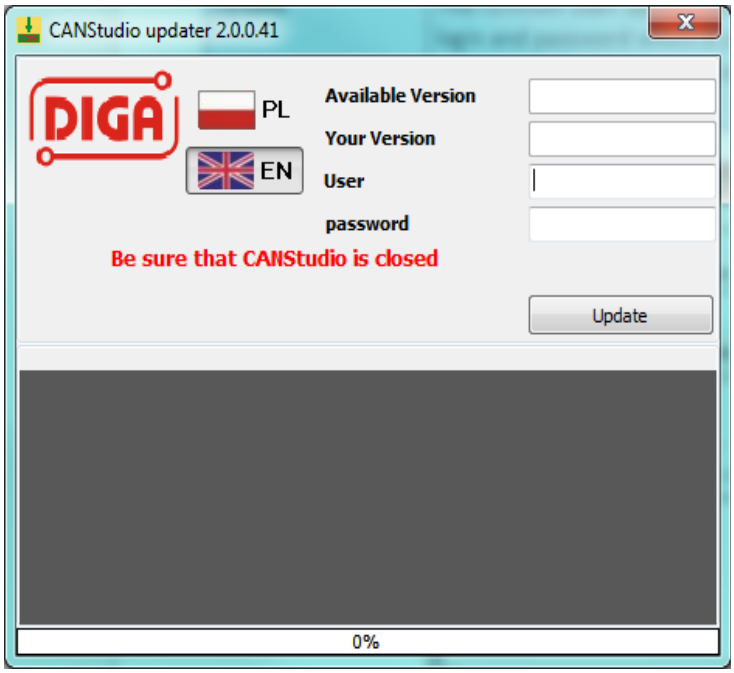


3.1.4. Windows tab

In this tab by using *Default*, user can set default positions for windows.

3.1.5. Help tab, update CANStudio

Help	Open help file for CANStudio in pdf version
About	Display CANStudio information window. There is a CANStudio version information ,software licence, CRUSB interface number and manufacturer address information.
Update	This function start update window for internet update. It it necessary to have login and password which is provided together with purchased software. In the case of no internet connection then please contact DIGA to get new install version of CANStudio.



Updating procedure:

- enter user and password
- Press *Update* button
- Update will automatic be downloaded and installed in the system.

3.2. Toolbar

Toolbar has got basic function for managing the project in CANStudio, and selected control elements and configuration for CANStudio.

	New project. Details information for working on project see item 3.1.1
	Open existing project. Details information for working on project see item 3.1.1
	Save project. Details information for working on project see item 3.1.1
	Connect to CAN.
	Disconnect from CAN.
	Pause.
	LOG storing ON/OFF Details information for logging see item 3.2.2.
	Open current logging file.
 	Type of displaying values in CANStudio. HEX – hexadecimal, $number DEC - decimal
	Start “Simulator” function, allows to send messages between CAN and CAN 2 channels. After turning-on this function, messages are not send to CRUSB v1 aor CRUSB v2 interfaces.
	Strating CANStudio TOOLS application. This tool allows manage user scripts. Allows to send and receive CAN messages of both CAN channels. Additional it is equipped with serial port terminal function also with scripting support. Detail information about functions available in CANStudio TOOLS is available in CANStudio TOOLS help file.
	Allows to configure both CAN channels boudrate.
	Settings CANStudio parameters window.

	Update. If this window will appear on the toolbar means that new CANStudio version is available via internet update. Updates are available for registers users with valid update subscription. Automatic update check function is ON/OFF in *main menu → Settings → General Settings → CANStudio [TAB] → Automatic Check.*
	Windows arrange. Switching ON this function makes windows stick to edges and are still stick also during scaling main CANStudio window.

3.2.1. Mange project functions

Details information of working with project see item 3.1.1. (File tab).

	Open new project, empty project. To store new project it is necessary to save it. This function is also available in File tab → New project.
	Open existing project previously saved. This function is also available in File tab → Open project.
	Save current project in the file. This function is also available in File tab → Savbe project.

3.2.2. Storing in file (LogFile)

n order to store frames from canbus in file, it is necessary to click LOG button which is located on toolbar. From now all frames received and transmitted will be stored in log file which is stored in current

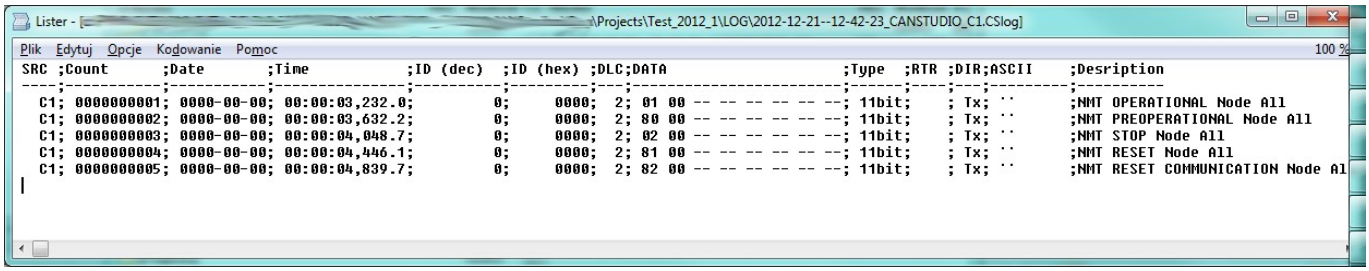
project folder.

!!! In the Windows Vista™, project in the default CANStudio folder can be stored in virtual folder which is not real existing in the CANStudio folder. To find real localisation of the project and stored files can be difficult. It is recommended to save project in the real folder which is not protected by system when Virtual Store is activated. Example path:
C:\Users\ROMEK\AppData\Local\VirtualStore\Program Files\DIGA\CANstudioEnt\Projects

In the file name there is a date and time of creating the file and CANStudio name. File is text file with file extension .CSlog

Example of file name::2012-12-21--12-42-23_CANSTUDIO_C1.CSlog

File is save in convention of:



For each frame is provide the following information:

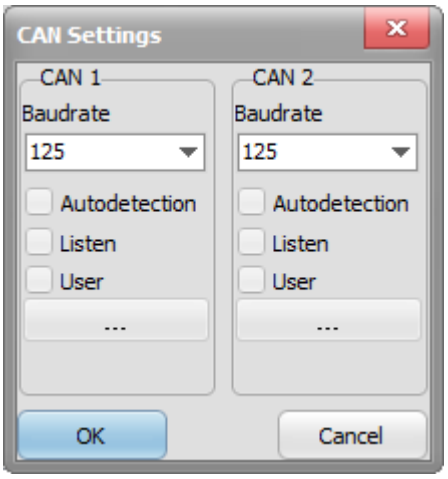
SRC	Data source C1- CAN 1, C2 – CAN 2
Count	Next frame counter.
Date	Date of income data frame as a yyyy-mm-dd
Time	Time of income data frame in [ms]
ID (dec)	Frame ID in decimal.
ID (hex)	Frame ID in hexadecimal.
DLC	Number of data bytes.
DATA	Data in LSB...MSB
Type	Frame type 11-bit or 29-bit
RTR	RTR frame
DIR	Direction : Tx - transmitted, Rx – received.
ASCII	ASCII interpretation
Description	Description according to selected interpretation;

Log file can be generated into canbus in the CANopen® module in the tab LOG (generator field).

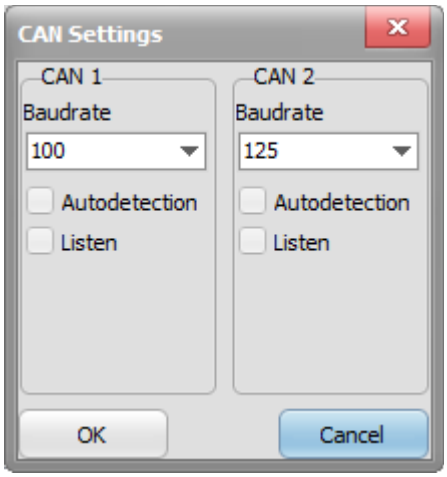
3.2.3. CAN bus boudrate settings.

Allows to set CAN bus boudrate, boudrate auto-detection and listen mode.

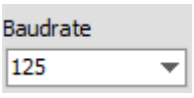
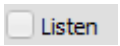
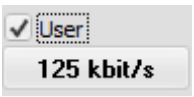
CRUSB v1



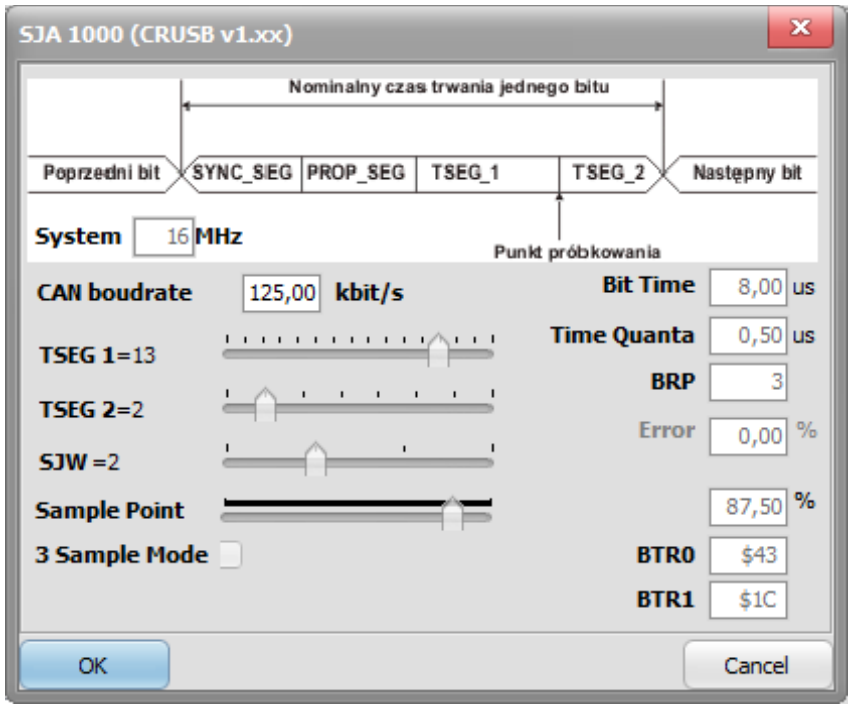
CRUSB v2



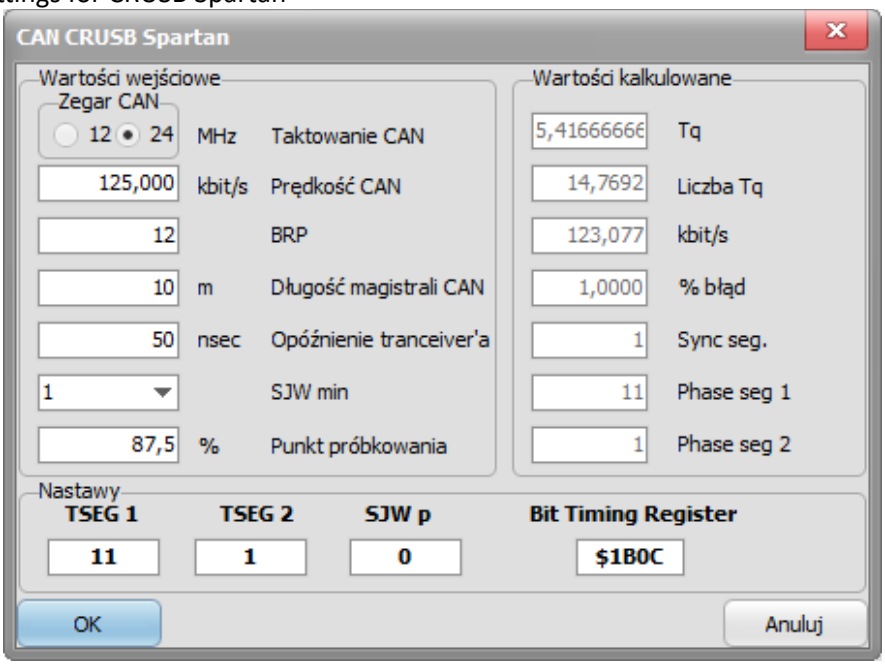
This filed allows to set CAN bus baudrate for both CAN channels.

	baudrate settings for CAN bus. Pre-definde baudrates according to CANopen®: **10, 20, 50, 100, 125, 250, 500, 800, 1000 kbit/s** Selected boudrte will be set after next CAN connection. Changing the baudrate is possible after disconnecting the network and once again CAN connection. Current CAN baudrate is signalling in the CANStudio main window status bar.
	Checking this check-box makes that after CAN connecting there will be auto-detection CAN bus baudrate. There are available only CANopen® baudrates given in above.
	Checking this field makes that in the CAN bus connection in the listen mode. In this case there is no possible to send any CAN frame and only receive CAN frames. This operation mode is signalling in CANStudio main window status bar as a *Listen.*
	This field allows to select user CANbus baudrate. Limitation is only by the CRUSB physical settings. Correct settings are shown in 'hint' after typed desired settings. Using this function it is possible to set non typical baudrates from CANopen® point of view but used in automotive industry.

There is also possible to change bit parameters. Settings according to CAN SJA1000 controller (NXP) .

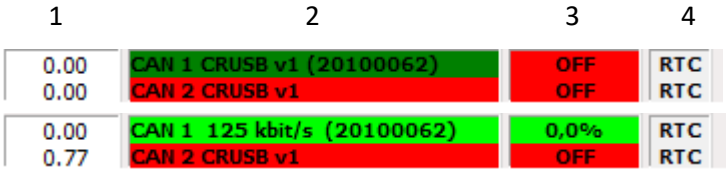


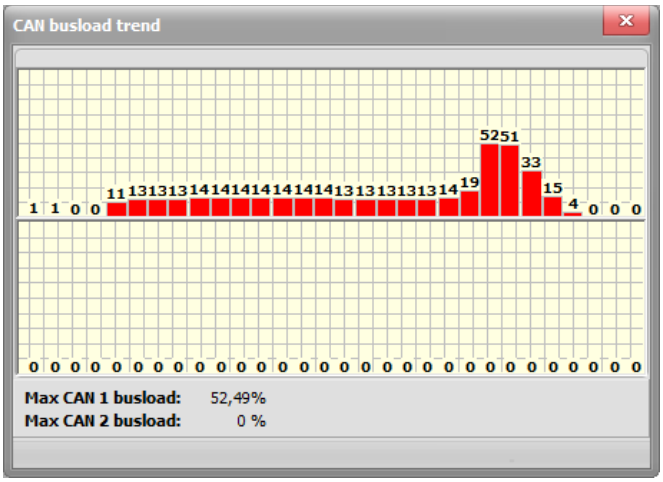
Settings for CRUSB Spartan



3.3. Status bar

Status bar has got information about status and mode of CANStudio operation.

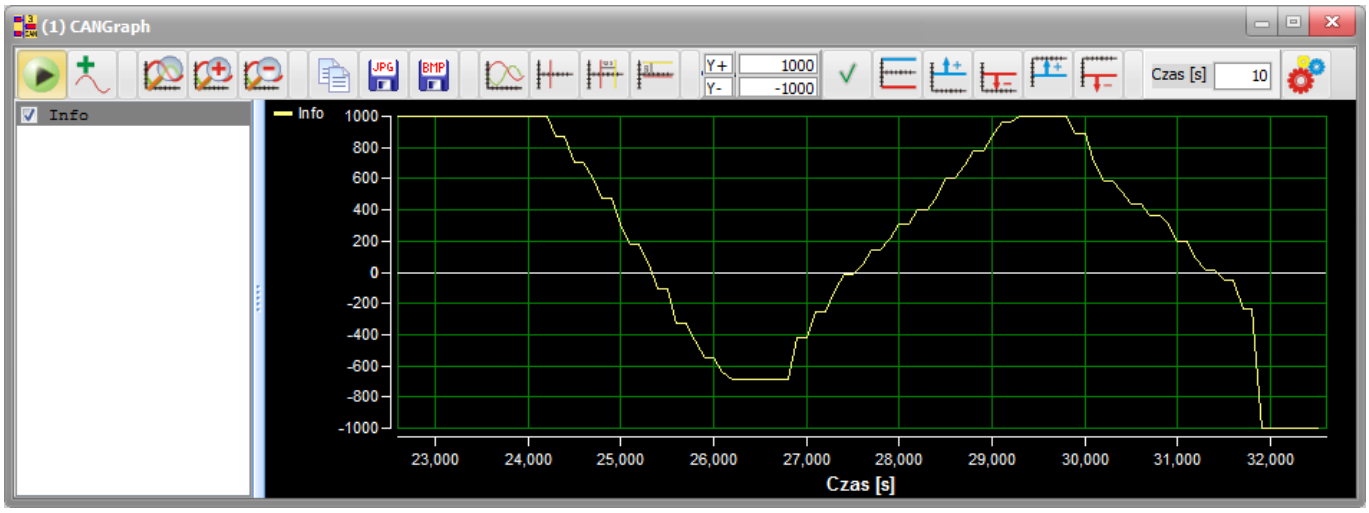


1	Buffer bar for incoming data in percentage (0 – 100%). In the case of high load on canbus and not enough PC power, it can happen that buffer can be overloaded and lost some frames. This bar allows to watch out and take what to do for user if overload is coming.
2	CAN bus connection status CAN 1 CRUSB v1 CAN 2 CRUSB v1 Red field means that no CRUSB device is connected. CAN 1 CRUSB v1 (20100062) CAN 2 CRUSB v1 CRUSB v1 serial number 20100062 is connected for CAN 1 channel. CAN 1 125 kbit/s (20100062) CAN 2 CRUSB v1 When CAN communcation will be ON then field will change color to lime and current CAN bus boudrate will be shown.
3	BUS load of CAN bus. OFF OFF There is no connection in both CAN channels. 0,0% OFF CAN 1 i connected and bus load is 0,0%. Klikając dwukrotnie lewym przyciskiem myszy mamy dostęp do okna wizualizacji obciążenia magistrali CAN 
4	RTC RTC Information about RTC (Real Time Clock) mode ON/OFF. This option is available only for CRUSB v1 interface and firmware 2.xx and for CRUSB v2. In order to turn ON this option it is necessary to as: CRUSB v1: *main menu → Settings → General Settings → CRUSB v1 [TAB] → RTC Emulation Mode.*

	CRUSB v2: function is integrated.

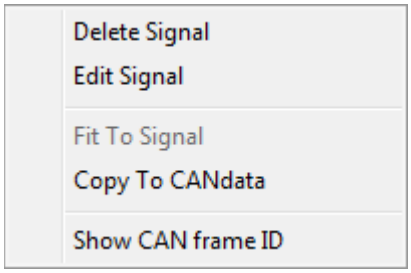
4. CANGraph Window (1)

CANGraf module allows trend graphical presentation of data receiving from CAN bus. There is possible to present multi trends for other data



4.1. Signal pop-up menu

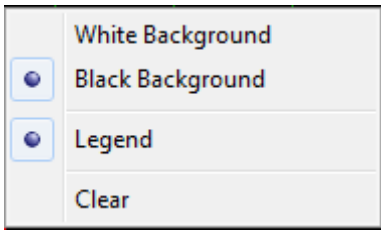
After right mouse button click on the variable field then we have access to variable add, edit and delete functions.



Delete Signal	Delete selected signal.
Edit Signal	Edit parameters of selected signal. Function opens window CANGraph (1.1). This window is identical as window for add new signal.
Fit To Signal	Function not available.
Copy To CANdata	Function copy current selected signal configuration to CANData, without additional variables settings.
Show CAN frame ID	ON/OFF CAN frame ID display near name of the signal.

4.2. Graph pop-up menu

After right mouse button click on the graphical area then we have access to some configuration.



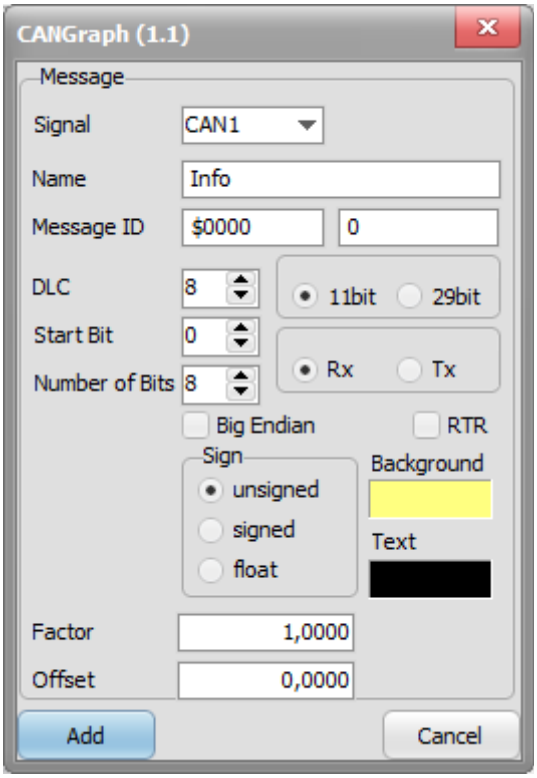
White Background	Sets White color background.
Black Background	Sets Black color background.
Legend	ON/OFF legend for graphical area.
Clear	Clear graphical area.

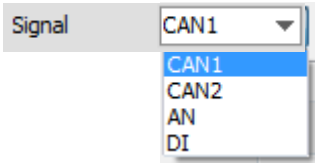
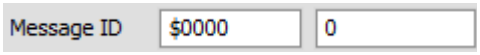
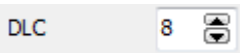
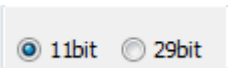
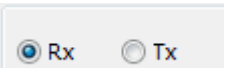
Black background is mainly to see graph on the display, and white background is useful for printing and put into documents. *Legend* function shows line colour for trends.

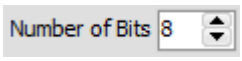
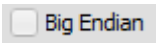
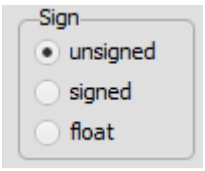
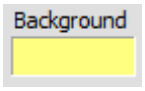
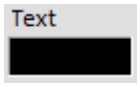
4.3. Add new signal.

Clicking on button then user can add new signal to graphical observation.

This function opens CANGarph (1.1) window for add signal.

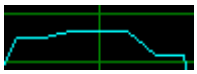
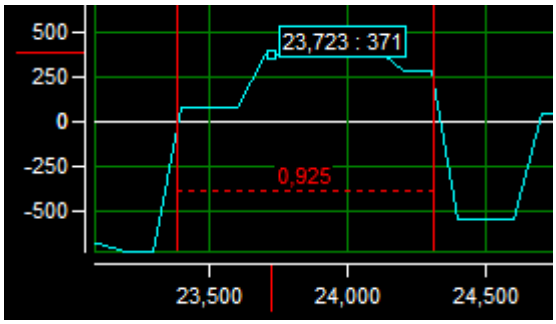
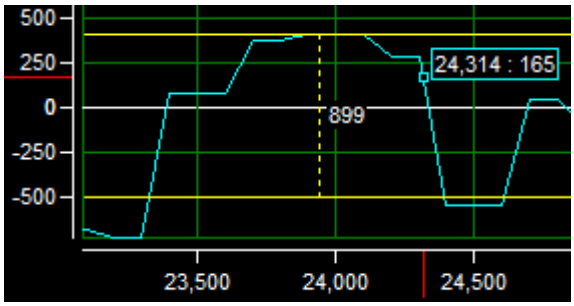
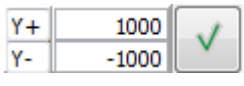


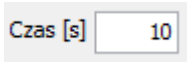
	Signal source. CAN 1 - CAN 1 channel CAN 2 - CAN 2 channel AN - Analogue input DI - Digital input
	Name given by user.
	Frame ID in hexadecimal and decimal format . When user type in one filed then automatic second filed will be calculated.
	DLC for CAN frame
	Type of CAN frame
	Rx – received CAN frame by CANStudio Tx – transmitted CAN frame by CANStudio
	Indicate from which bit variable are consider It is possible to increment by 1 bit.

	Number of bits for variable It is possible to increment by 1 bit.
	Setting direction of data bytes. Check means Big Endian, uncheck means Little Endian.
	Type of the sign for variable.
	Clciking on this fields opens color selector window for current variable. Using this function user can change color for variable and and for trend.
	Setting font color for variable.
	Read value is multiple by this value. It allows to rescale the value for example “to move” delimiter.
	Value from this field is added to variable.
	Add message to the list or accept changes after variable edit operation.
	Cancel operation.

On toolbar there are functions, which allow set display parameters.

	Switch ON/OFF local pause for CANGraph window Stop displaying in this window This pause can be ON/OFF by main pause button on CANStudio toolbar.
	Add new signal to graph.
	Show all trends. This function scale the trends to basic values to fit the scope.
	Zoom in the scale This function make more width for vertical axle.
	Zoom out the scale This function make less width for vertical axle.
	Copy to clipboard. This function copy the actual display trends into the system clipboard.

	Save actual displayed trends as JPG file This file is stored in the project folder.
	Save actual displayed trends as BMP file This file is stored in the project folder.
	Points ON/OFF. ON/OFF of displaying the points on the trends in the place of measurement (samples) 
	ON/OFF Marker for Y (vertical) values. ON/OFF marker on displayed trends. It is possible to move marker via mouse which allows to read Y value for selected position.
	ON/OFF Marker for distance in X axle (time). ON/OFF double marker on the trends. Markers are possible to move on the trends using mouse which allows to read distance between markers (time between markers). 
	ON/OFF vertical markers. ON/OFF double marker on the trends. Markers are possible to move on the trends using mouse which allows to read distance between markers. 
	Setting the value and acceptance the vertical range. Clicking on acceptance press button then accept the desired of the range.
	Set zero. It sets zero level on the middle of the vertical scale.
	Increase upper range.

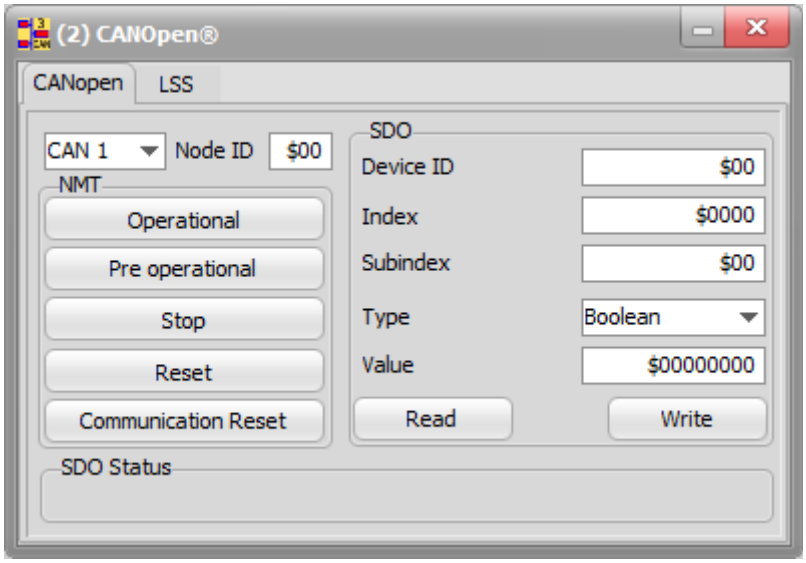
	Decrease upper range.
	Decrease lower range.
	Increase lower range.
	Setting the time scale on the trend. Time in seconds in the range of 1 to 36000.
	Open CANGraph Settings window.

Part of the graph can zoomed in by selecting the area by left mouse button press. It Is possible to back to default setting of zoom using function *Show all graphs*

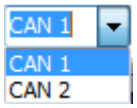
5. CANopen® window (2)

CANopen® module allows to manage network according to CANopen®. Allows to send NMT messages and also make LSS configuration process of CANopen® node.

5.1. CANopen® tab



5.1.1. *NMT (Network Management)* field.

	Selecting CAN channel for NMT operation.
	Node ID for NMT operation. ID=$00 means NMT for all slave nodes (CANopen®).

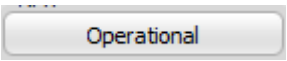
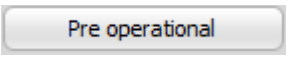
CANStudio can manage the CANopen® network as NMT master, sends NMT commands to slave nodes. In the text window type a ID for node which will be operated ($00 means all nodes).

NMT (Network Management) *– CANopen® service which allows to manage the CAN network.*

NMT Master *– device which manage the CAN network by sending NMT frames. Using this frames can control the state of all NMT slave nodes.*

NMT Slave *– device which receive NMT commands base on it it set its operation status.*

Frame ID 0x0000 is reserved For NMT (highest priority on the network).

	Sends *Operational* command to CAN network. This command is also available in other places by O press button.
	Sends *Pre operational* command to CAN network. This command is also available in other places by PO press button.
	Sends *Stop* command to CAN network. This command is also available in other places by S press button.

Reset	Sends *Reset* command to CAN network. This command is also available in other places by R press button.
Communication Reset	Sends *Reset Communication* command to CAN network. This command is also available in other places by RC press button.

5.3. *SDO* (*Service Data Object*) field – reading device CANopen® object dictionary

SDO filed allows to configure and sends any SDO CAN frame. In the *SDO Status* field can appear information about error when SDO read/write operation was not successful.

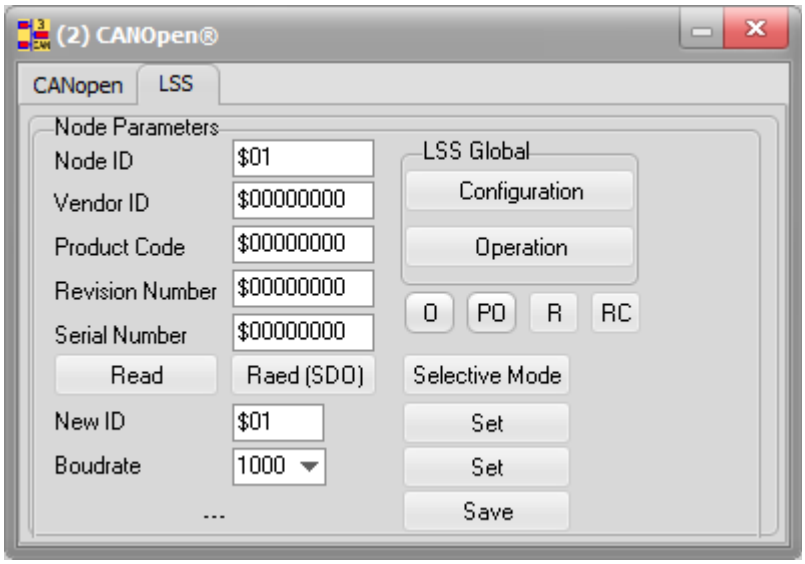
Access to Object Dictionary is also available via *CANeds* window and list of Objects in the device EDS file (main configuration method).

SDO (Service Data Object) *is a CANopen® service which gives access to all elements of Object Dictionary. SDO use to CAN frames with different COB-ID – one is a device request and second is device replay. It also allows to write block of data in the device.*

On SDO request with COB-ID 0x600+ID then device should replay using COB-ID 0x580+ID with proper data on data fields.

Device ID $00	Node ID, which will be manage via SDO.
Index $0000	Object Dictionary Index, which will be used.
Subindex $00	Object Dictionary Sub Index, which will be used.
Type Boolean	Data type: **boolean**: boolean variable **U8** : unsigned 8-bit variable **U16** : unsigned 16-bit variable **U32** : unsigned 32-bit variable **S8** : signed 8-bit variable **S16** : signed 16-bit variable **S32** : signed 32-bit variable
Value $00000000	Value for write or read to/from selected Object Dictionary.
Read	Sends configured SDO read.
Write	Sends configured SDO write.
SDO Status	SDO operation status. In the case of not successful operation then error description is displayed.

5.2. LSS tab

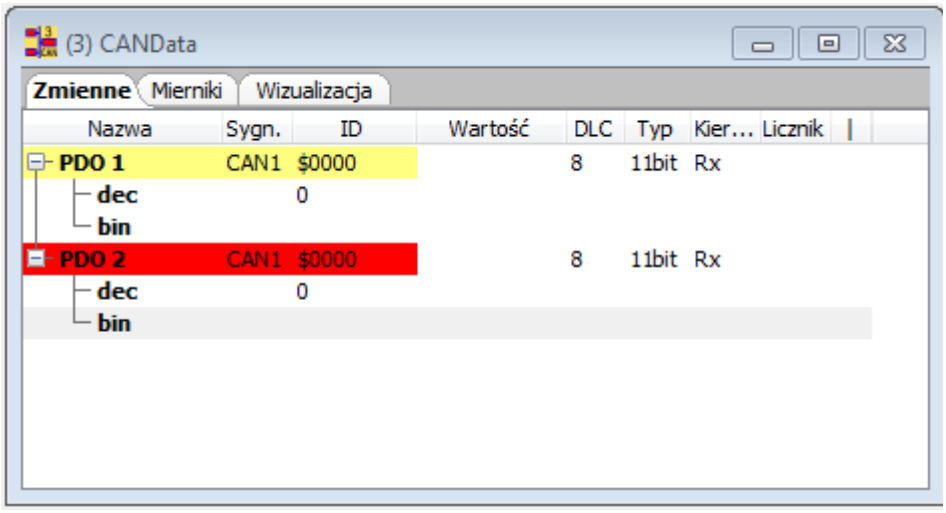

(2) CANOpen®
CANopen
LSS
Node Parameters
Node ID
$01
Vendor ID
$00000000
Product Code
$00000000
Revision Number
$00000000
Serial Number
$00000000
Read
Raed (SDO)
New ID
$01
Boudrate
1000
...
LSS Global
Configuration
Operation
0
PO
R
RC
Selective Mode
Set
Set
Save

6. CANData window (3)

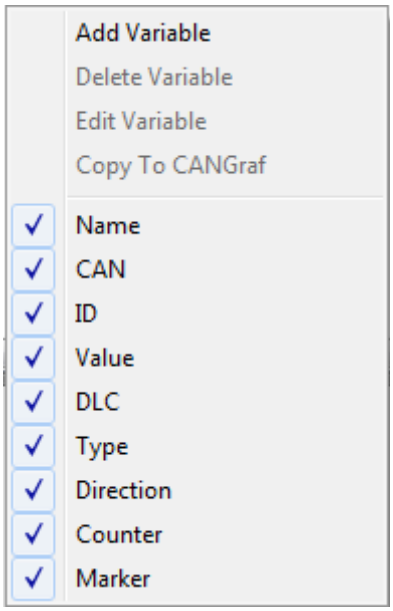
CANData module allows to observe data in selected CAN frames as a interpretation variables U8,U16,U32,S8,S16,S32, Real and binary. It means that data in the data field (for example with process data sends from transducer) can be displayed as values according to type of variable. This data can also be displayed as gauges in the meters.

6.1. Variables – configuration variable for view.

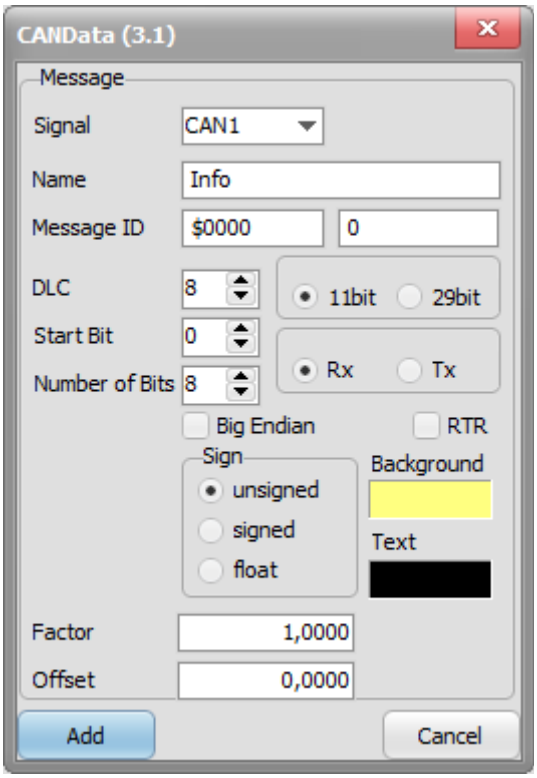
In this window it is possible to configure displaying values from CAN frames. They are presented as decimal, hexadecimal and binary values. In the last column there is a marker which indicates that frames are coming and values are updating.



Left mouse button click on the table filed on *Values* Tab then we have access to the following pop-up

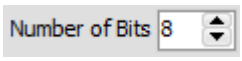
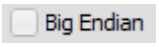
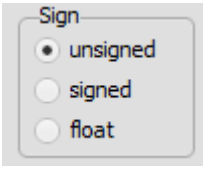
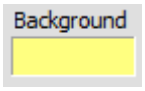
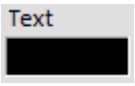


Add Variable function and Edit variable open configuration window.

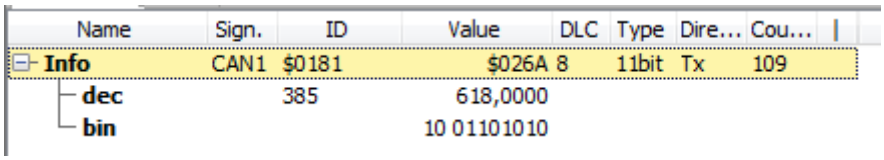


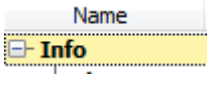
Add signal function as well as *Edit signal* opens dialogue window. In order to edit variable it is possible by selecting *Edit signal* or double left mouse button on the name of variable in the table.
Copy to CANGraph function copy settings of the selected signal to CANGraph without additional parameters configuration.

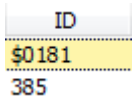
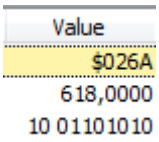
Signal CAN1 (CAN1, CAN2, AN, DI)	Signal source. CAN 1 - CAN 1 channel CAN 2 - CAN 2 channel AN - Analogue input DI - Digital input
Name Info	Name given by user.
Message ID $0000 0	Frame ID in hexadecimal and decimal format . When user type in one filed then automatic second filed will be calculated.
DLC 8	DLC for CAN frame
11bit 29bit	Type of CAN frame
Rx Tx	Rx – received CAN frame by CANStudio Tx – transmitted CAN frame by CANStudio
Start Bit 0	Indicate from which bit variable are consider It is possible to increment by 1 bit.

	Number of bits for variable It is possible to increment by 1 bit.
	Setting direction of data bytes. Check means Big Endian, uncheck means Little Endian.
	Type of the sign for variable.
	Clciking on this fields opens color selector window for current variable. Using this function user can change color for variable and and for trend.
	Setting font color for variable.
	Read value is multiple by this value. It allows to rescale the value for example “to move” delimiter.
	Value from this field is added to variable.
	Add message to the list or accept changes after variable edit operation.
	Cancel operation.

Variables in CANData are displayed as followes:

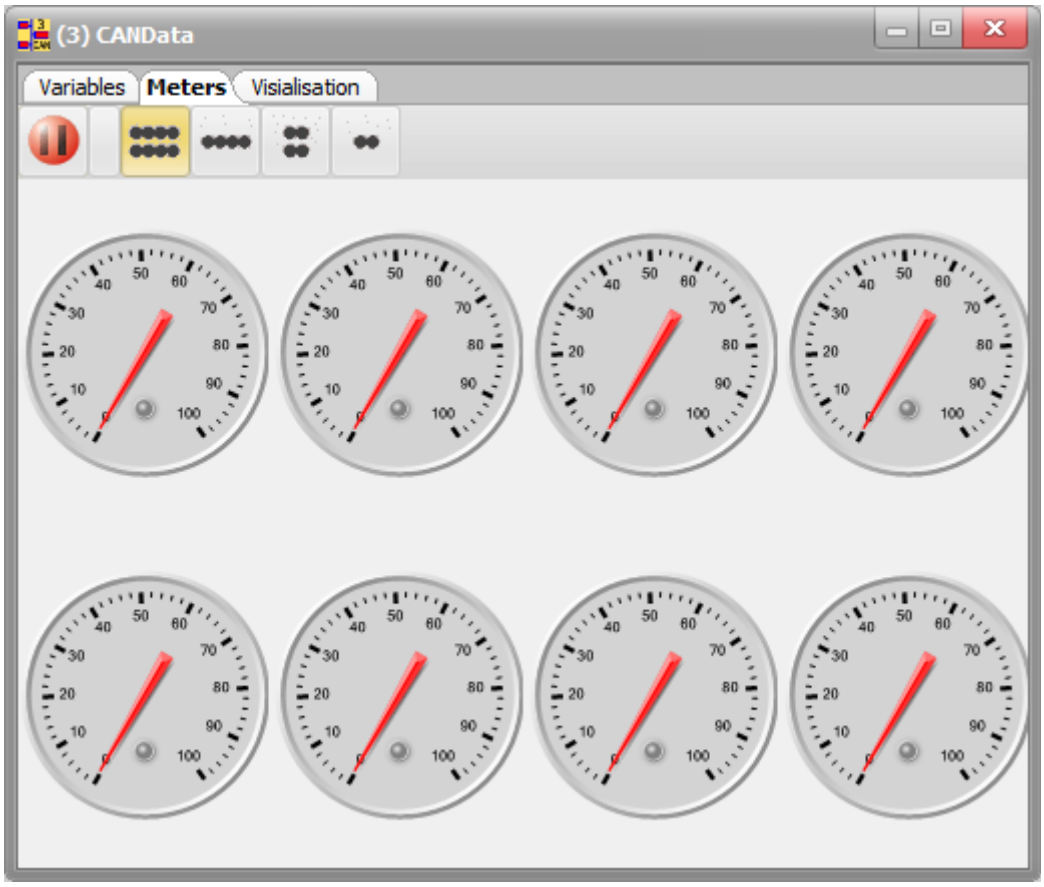


	Name of displayed variable.
	Data source

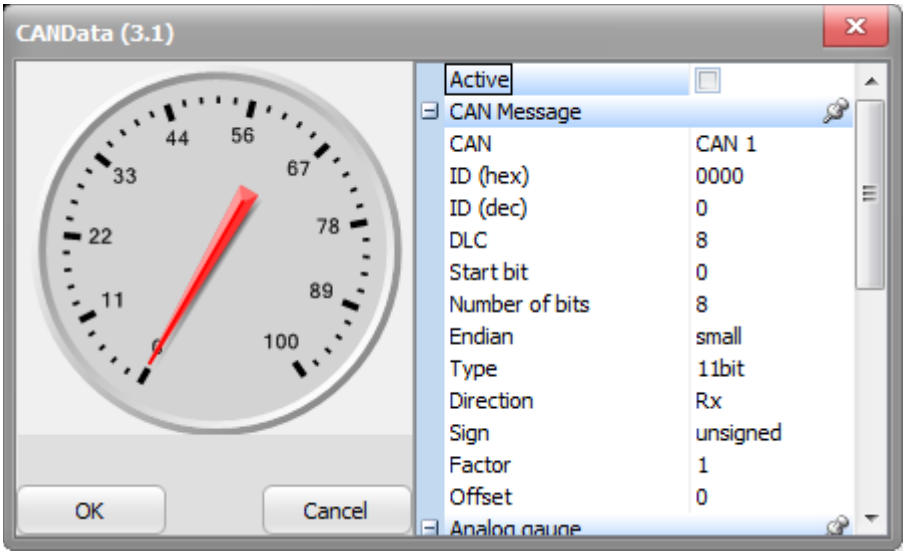
	Frame ID presented as Hex or Dec.
	Variable value presented in decimal, hexadecimal or binary code.
	DLC of CAN frame.
	CAN frame type (11-bit, 29-bit)
	Direction of variable flow Rx – received frame Tx – transmitted frame
	Received frame counter.
	Variable marker refresh. In this field in each CAN frame (refresh variable) the marker is changing (-, \, |, /) what if cicling data are coming it looks as animation.

6.2. Meters – configure variable to observe in meter

Meters are used for visualisation the variable value from the CAN frame.



Double click on selected meter open configuration dialogue window. This is also possible to open this window by clicking right mouse button on the selected meter and select *Edit.*



Configuration window allows to set parameters of the received variable and gauge display parameters.

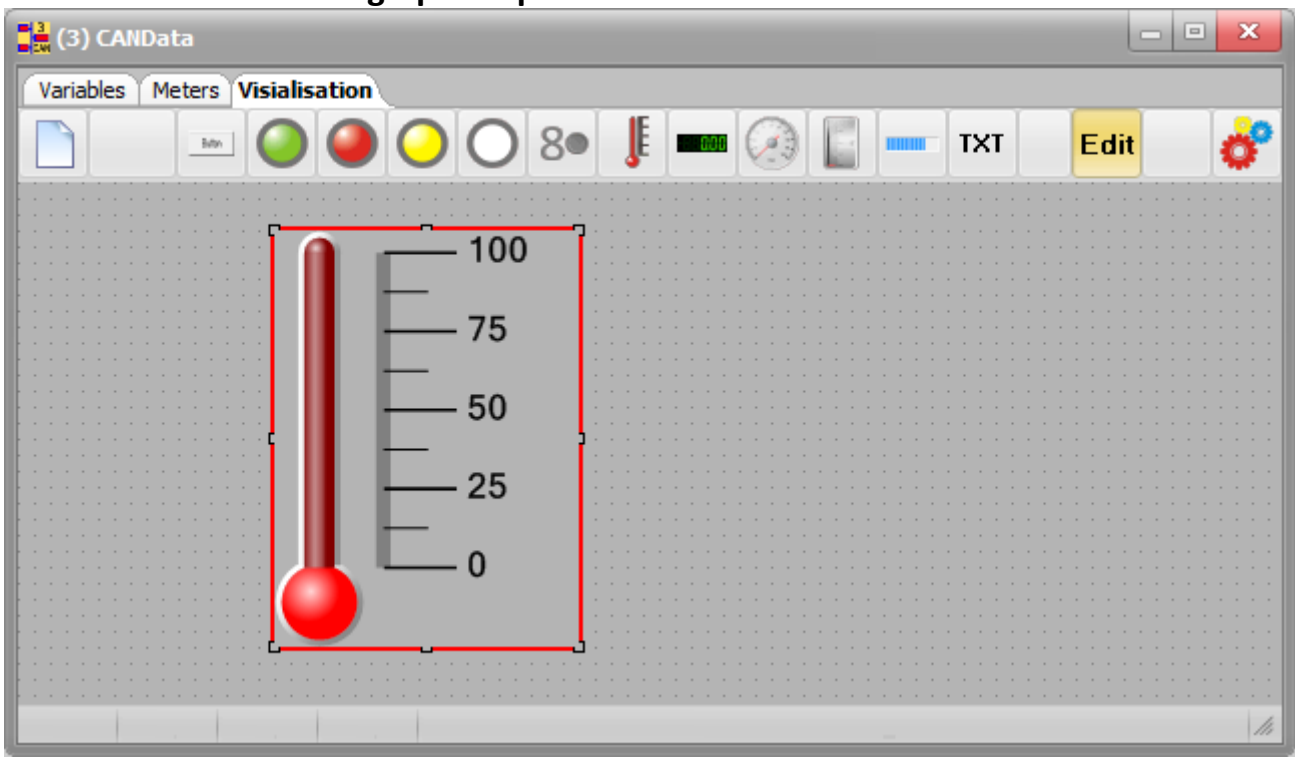
Active		
CAN message		CAN communication parameters
	CAN	CAN channel selecting

	ID (hex)	CAN frmae ID in hexadecimal.
	ID (dec)	CAN frame ID in decimal.
	Start bit	Start bit of the variable.
	Number of bits	Selectable evry 1bit.
	Endian	Setting direction of data bytes in variable.
	Type	Frame type 11bit: 11 bit CAN frame (standard) 29bit: 29 bit CAN frame (extended)
	Direction	Data direction Rx – received CAN frame. Tx – transmitted AN frame.
	Sign	Unsigned, signed or real value.
	Factor	Value is multiple by this value. It allows to rescale the value.
	Offset	This value is add to variable.
Analogue gauge		
	Name	User name.
	Color	Background gauge color.
	Hand color	Gauge hand color.
Picture		
	Image folder	Setting picture for background gauge.
	file	Background file as bmp.
Scale		
	Range min.	Minimal range value for scale.
	Range max.	Maximal range value for scale.
	Decimals	Precision for displayed value. This value means how many decimals is displayed.
	Position min.	Position of minimal scale in 360^0.
	Position max.	Position of maximal scale in 360^0.
	Major ticks	Major tick number.
	Minor ticks.	Minor tick number.

On toolbar there are function which allows to set display parameters.

	ON/OF local pause for CANGraph window. Pause the display in this window. Pause can be ON/OFF by main pause push button in main toolbar of CANStudio.
	Set panel only for two gauges.
	Panel for four gauges settled in two rows.
	Panel for fours gauges settled horizontal in one row.
	Panel for eight gauges settled horizontal in two rows.

6.3. Visualisation – graphical presentation



This tab allows to set different kind of gauges, displays, bargraphs, texts and LEDs. Allows to build visualisation system for received and transmitted data in CANStudio. To put object on the board it is necessary left mouse button click on selected object on toolbar and then also left mouse button click on the graphical board. User can set size of each object by catching the corner and adjust size. Double click on object allows to set individual parameters for the object.

Changing the size of the object as well as parameters is only possible in Edit mode.

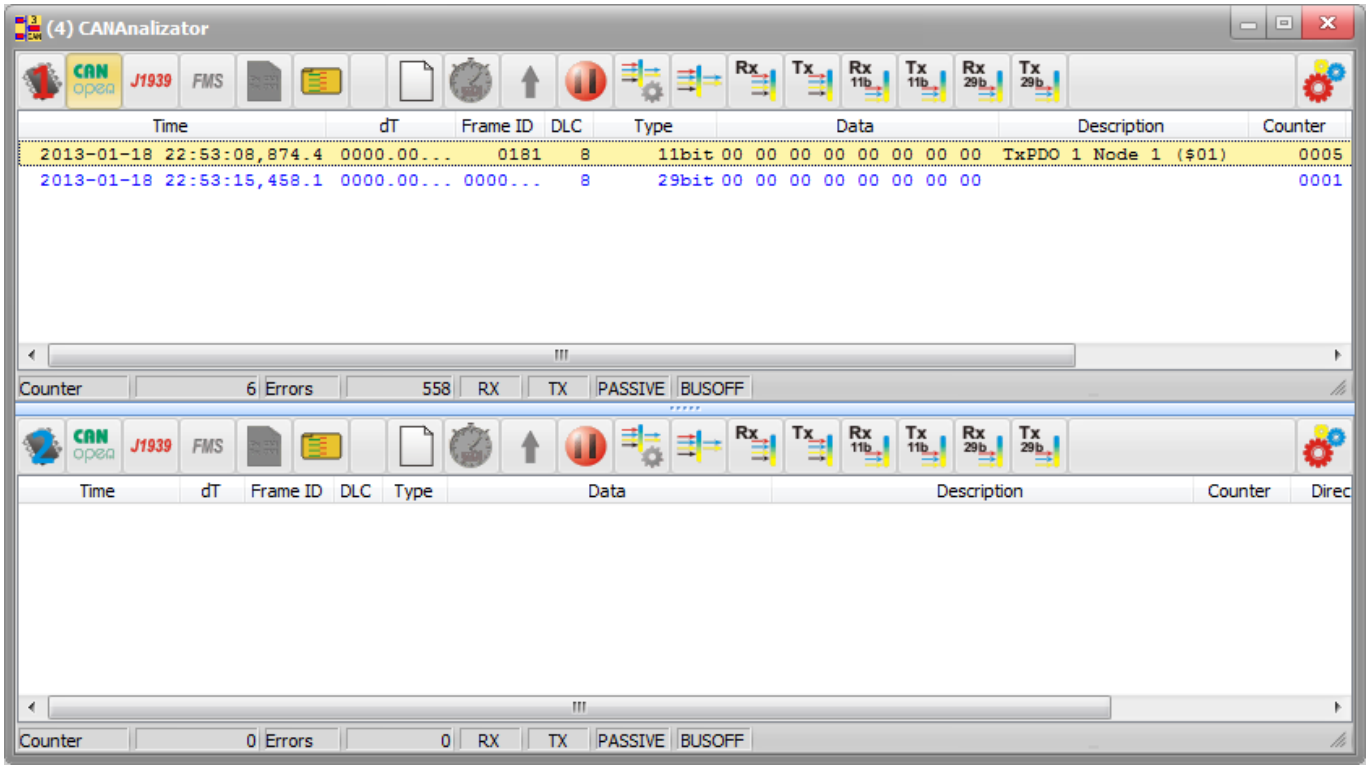
On toolbar there are as follows:

	New visualisation.
	Push button for send CAN frame to CAN bus.
	Predefined color LEDs.
	Thermometer.
	Segment display.
	Analogue gauge.
	Level gauge.

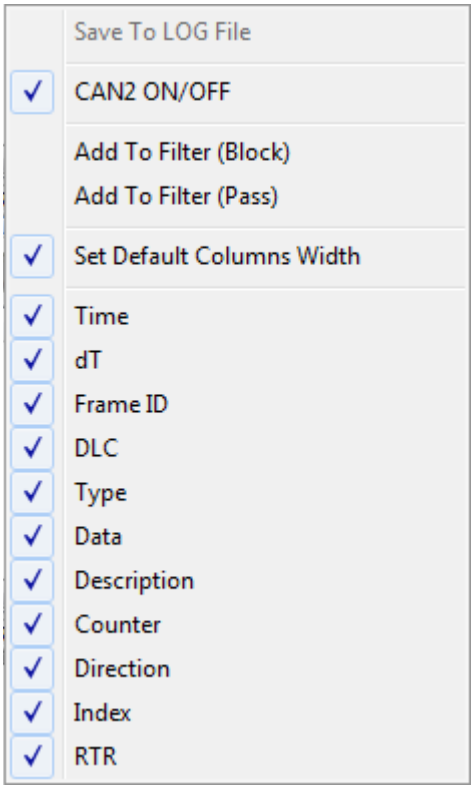
	Bar-graph.
	Description text.
	Changing edit mode to operation mode and back.
	Open CANData parameters settings window.

6. CANAnalizator window (4)

CANAnalizator module allows to display all CAN frames from CANbus in tabelar or chronological mode. There is also interpretation modules and filter module.



Clicking right mouse button on main field window we open pop-up menu:



Save To LOG File	Allows to save displayed frames in LOG file. This function is active only in chronological mode.
✓ CAN2 ON/OFF ✓ CAN1 ON/OFF	Allows to show or hide one of the CAN channel window.
Add To Filter (Block) Add To Filter (Pass)	Add selected frame to block or pass filter. This function is only availabe in tabelar mode.
Set Default Columns Width	Allows to set default columns width for CANAnaliztor window.

Toolbar of CANAnalizator:

	CAN channel identification.
	ON/OFF CANopen® interpretation. Turning ON this function display interpretation of CANopen® messages in description column.
	ON/OFF J1939 interpretation. Turning ON this function display interpretation of J1939 messages in description column.
	This function is not available.
	Hide/Show detailed interpretation window.
	Clear tables it is possible to do any time.
	Allows to to change display mode as a chronological or tabelar. Tabelar mode displays CAN frames in rows and increment counter. In chronological frames are add behind or before last frame. It depends about direction of display. It is nor permitted to change display mode during runtime.
	Setting direction of adding next CAN frame. This function is only available in chronological mode.
	ON/OF local pause for CANAnalizator window. Pause the display in this window. Pause can be ON/OFF by main pause push button in main toolbar of CANStudio.
	Filter configuration. Open filter configuration window.

	Filter ON/OFF. ON/OFF CAN frames filter in CANAnalizator window.
	ON/OFF Filter RX ON/OFF. Filtering display of all received CAN frames.
	ON/OFF Filter TX ON/OFF. Filtering displayd of all transmitted CAN frames.
	ON/OFF Filter 11 bit RX. Filtering (blocking) display of all received 11bit CAN frames.
	ON/OFF Filter 11 bit TX. Filtering (blocking) display of all transmitted 11bit CAN frames.
	ON/OFF Filter 29 bit RX. Filtering (blocking) display of all received 29bit CAN frames.
	Filter 29 bit RX. Filtering (blocking) display of all received 29bit CAN frames.
	Function not available.
	Open CANAnalizator parameters settings window.

6.1. Tabelar display mode.

In tabelar display mode, received messages are sorted according to ID. Each message with ID and proper DLC is assigned to its own row in the table when last messages in received. Messages with the same ID but different DLC are displayed in separated rows.

In the table there shown:

Time – date and time of received CAN frame of message;

time is get from CRUSB v1 or V2 (for CRUSB v1 date is only available when RTC in ON)

dT – time between last two CAN messages and the same ID

ID – CAN frame ID

DLC – number of data bytes.

Type – CAN frame type; 11b: 11 bit CAN frame (standard) 29b: 29 bit CAMN frame (extended)

Data – data bytes as LSB...MSB

Description – Interpretation description if it is ON.

Counter – CAN frames counter; shows how many CAN frames was collected with the same ID

Direction – describes if it is received or transmitted CAN frame.

Rx – received CAN frame Tx – transmitted CAN frame from CANStudio.

Index - number assigned by CANStudio, this number is assigned as a next of received new CAN frame.

6.2. Chronological display mode.

In chronological display mode CAN messages are displayed next by next. All list of CAN messages are displayed according to time. Echa CAN frames get new row in the table.

In the table there shown:

Time – date and time of received CAN frame of message;

time is get from CRUSB v1 or V2 (for CRUSB v1 date is only available when RTC in ON)

dT – time between last two CAN messages and the same ID

ID – CAN frame ID

DLC – number of data bytes.

Type – CAN frame type; 11b: 11 bit CAN frame (standard) 29b: 29 bit CAMN frame (extended)

Data – data bytes as LSB...MSB

Description – Interpretation description if it is ON.

Counter – CAN frames counter; shows how many CAN frames was collected with the same ID

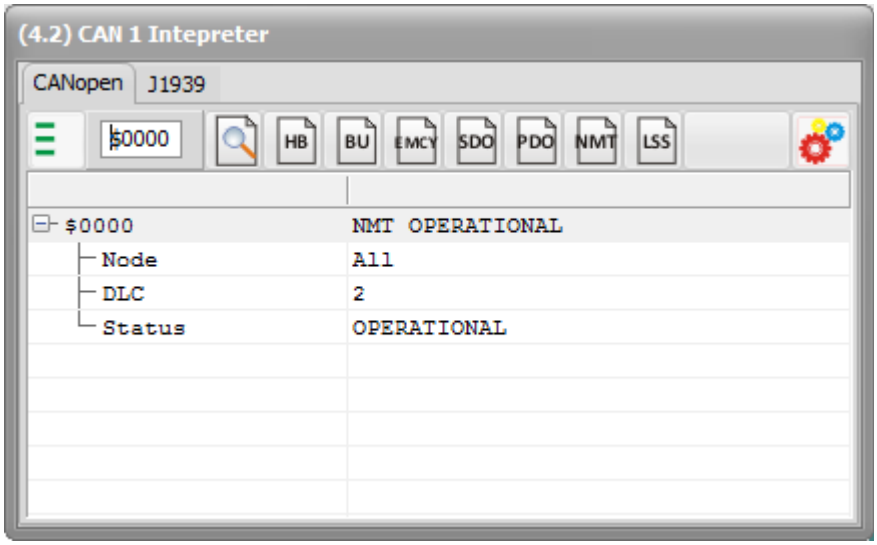
Direction – describes if it is received or transmitted CAN frame.

6.3. Status bar

In the CANAnalizator status bar there are presented information about current CAN bus status and statistics such as current CAN bus load, CAN frames counter and error frames counter.

Licznik 0	Counter all CAN frames from CAN connection moment (both kind received and transmitted).
Błędne 0	CAN error frames counter which appear on the CAN bus.
RX	Signalizing problems of receiving CAN frames from CAN bus. Error is signalized by changing field to red color. Most reasons of this error is different CAN boudrate on CAN bus against to CRUSB device.
TX	Signalizing problems of transmitting CAN frames to CAN bus. Error is signalized by changing field to red color. Most reasons of this error is different CAN boudrate on CAN bus against to CRUSB device. Then sent CAN frames is not acknowledged by any other CAN node which means error.
BUSOFF	Signalizing serious CAN bus problems. Error is signalized by changing colour to red. BUS OFF means that CRUSB is cut off from CAN bus, because to many CAN error frames.
PASSIVE	Signalizing reaching passive error level.

6.4. CAN messages detail interpretation window.



This window presents detailed interpretation of CANopen®, J1939 CAN frames. User can filtering some messages so displayed will be only these important.

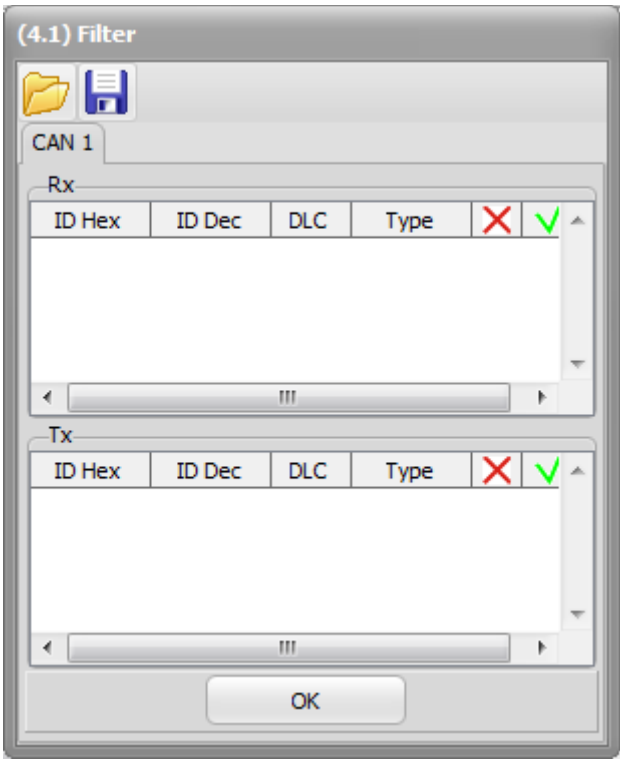
Interpreter window Toolbar(4.2):

CANopen	CANopen® protocol tab.
	Fold/Unfold CANopen® frames.
$0000	Searching CANopen® ID frame.
	Search CANopen® ID push button.
HB	ON/OFF filtering **Heartbeat** messages.
BU	ON/OFF filtering **Bootup** messages.
EMCY	ON/OFF filtering **EMCY** messages.
SDO	ON/OFF filtering **SDO** messages.
PDO	ON/OFF filtering P**DO** messages.
NMT	ON/OFF filtering **NMT** messages.

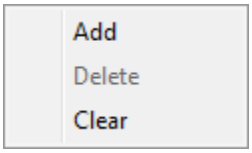
	ON/OFF filtering **LSS** messages.

6.5. CAN frame Filter

CAN frame filter allows to select messages which must be blocking or passed to be displaed in CANAnaliztor window.



Clicking right mouse button on table field Rx or Tx we get pop-up menu:



user can add, delete selected CAN frame and clear all values.

	Shows filter settings window.
	ON/OFF filter operation.

According to selecting elements or for selected CAN frame will be blocked of passed.

!!! In order to pass only selected CAN frames it is necessary to switch ON blocking Tx and Rx frames.

Filter definitions are saved in the project.

It is possible to load or save defined filter configuration in any place in the hard drive using function under push buttons:

Filter configuration window is divided into two parts:

1. Filetr TX

   This function allows to set CAN frames which are transmitted to be blocked or pass in CANanalizator.

   Procedure how to add CAN frame to filter:

   - in the configuration field type CAN frame ID, DLC and frame type.

   - using press button *Add* new frame appear in the list (depends form Rx, Tx settings)

   Add CAN frame to filter is also possible by *Add to Rx/Tx filter* function by click right mouse button and select this function from pop-up menu.

2. Filter RX

   This function allows to set CAN frames which are received to be blocked or pass in CANanalizator.

   Procedure how to add CAN frame to filter:

   - in the configuration field type CAN frame ID, DLC and frame type.

   - using press button *Add* new frame appear in the list (depends form Rx, Tx settings)

   Add CAN frame to filter is also possible by *Add to Rx/Tx filter* function by click right mouse button and select this function from pop-up menu.

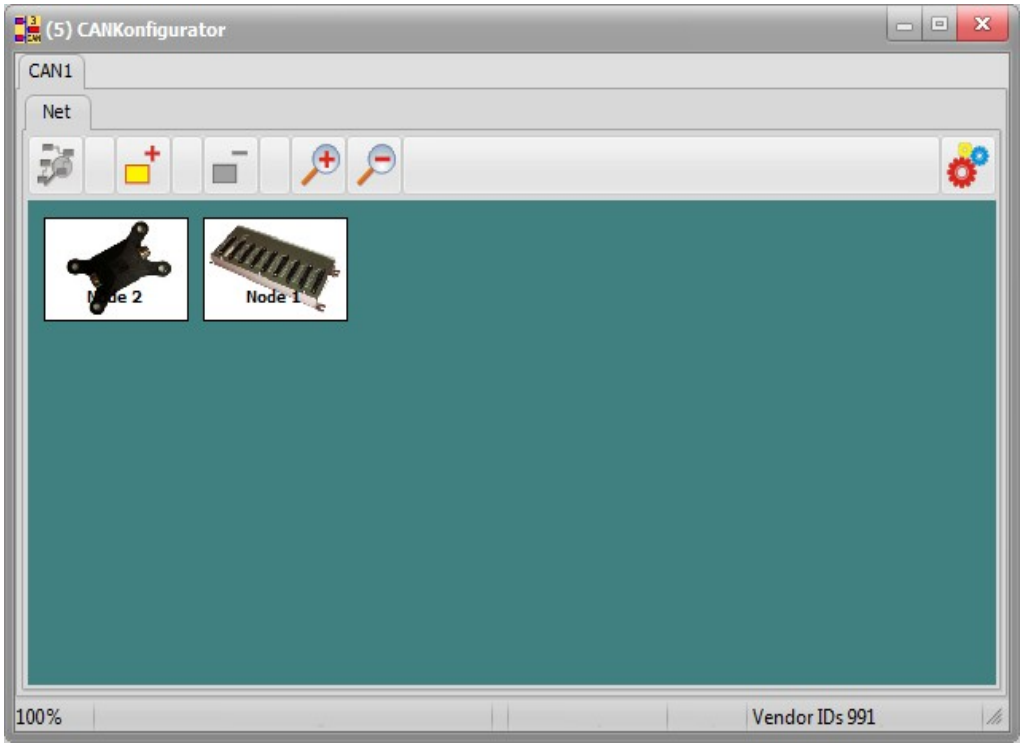
7. CANKonfigurator window (5)

CANKonfigurator allows to create CANopen® network configuration. Configuration is done by inserting on graphical board nodes. To each nodes it it is possible to link ID number, EDS file or DCF file and bitmap and description. Loaded EDS file for selected node is stored in t he project together with values and modification for selected. Double mouse clicking on the node shows **Node** tab where user can work on EDS or DCF files. For devices supporting LSS is prepared module for simple node configuration.

Operating with CANopen® devices is based mainly on its configuration with access using EDS or DCF file. EDS file should be provided by CANopen® device manufacturer. CANStudio is equipped with advanced module for EDS file workout, allows its modification in the project via adding or deleting data. There is also module for check file correct during file loading. In the window on status there display parameters for selected element of Object Dictionary. Elements are displayed as a tree style of Object Dictionaries Indexes.

User can modify parameters stored in the node/device and read or write all of indexes including sub-indexes of Object Dictionaries in the Node/Device.

7.1. Network tab

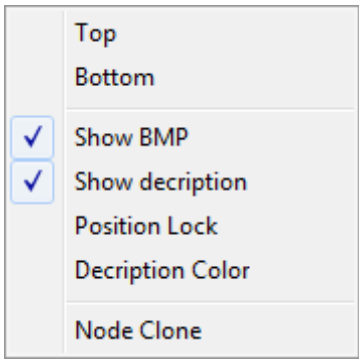


Toolbar for Net tab:

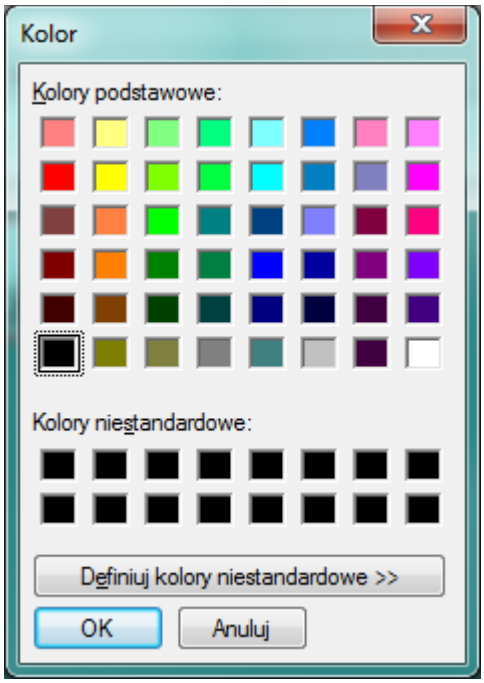
	Allows automatic detect CANopen® nodes. It is recommend to switch all nodes into pre-operational state.
	Adding new CANopen® network node. In order to add new node it is necessary to click on this push button and then new node will be added to board. User have to configure this node.
	Deleting selected node from project.

	Zoom in elements in the work area.
	Zoom out elements in the work area.
	Open CANKonfigurator parameters settings window.

Clicking right mouse button on selected node we get pop-up menu:

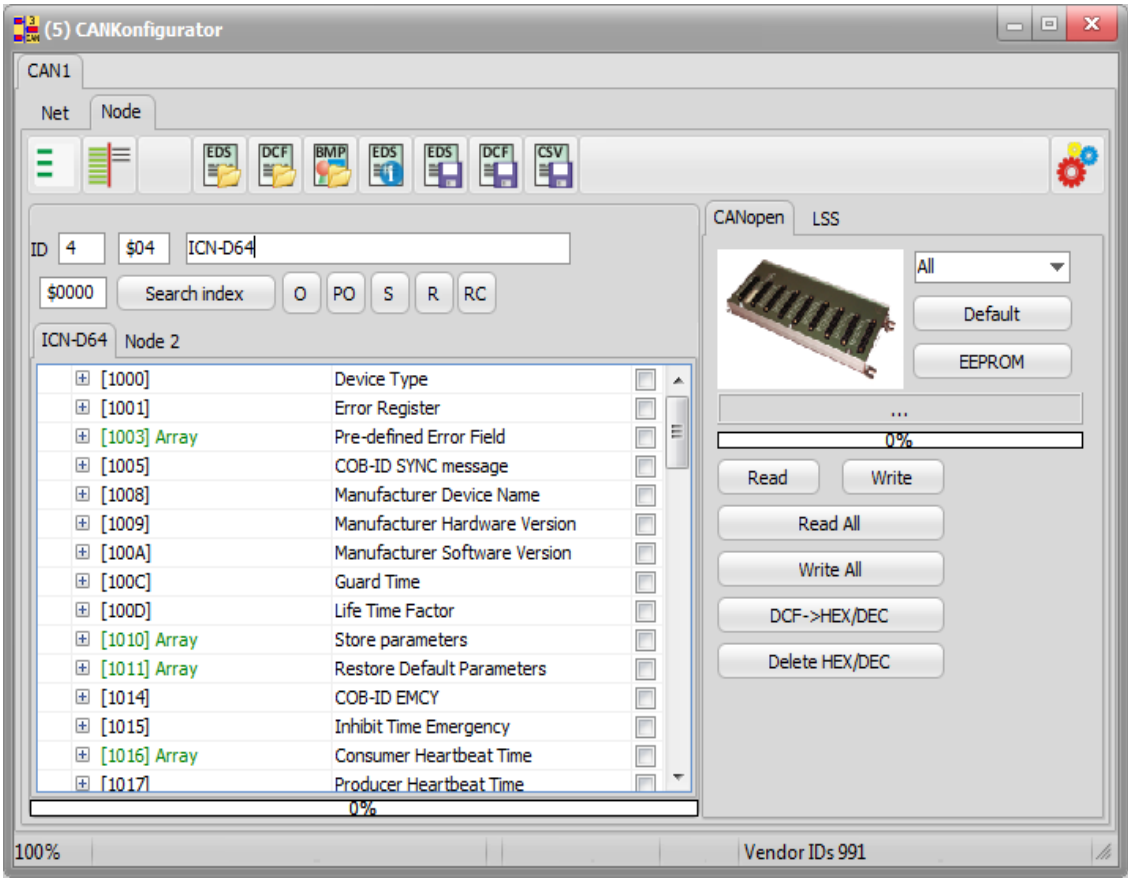


Top	This function allows to move node on the top of board
Bottom	This function allows to move node on the bottom of board
Show BMP	ON/OFF node bitmap
Show decription	ON/OFF node description
Position Lock	ON/OFF node fix on the board
Decription Color	This function allows to select description font color

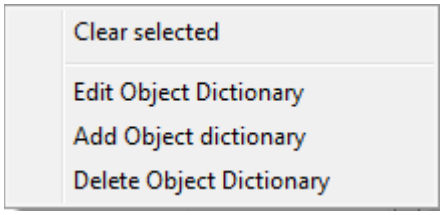
	
Node Clone	This function allows to clone node.

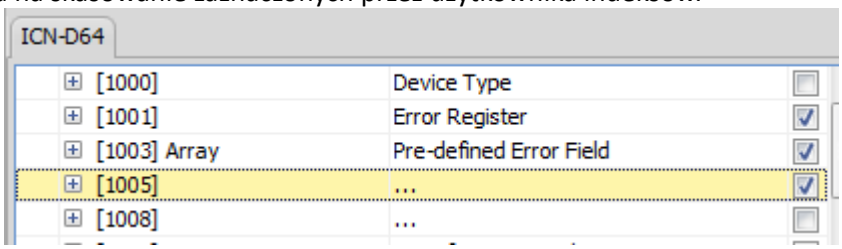
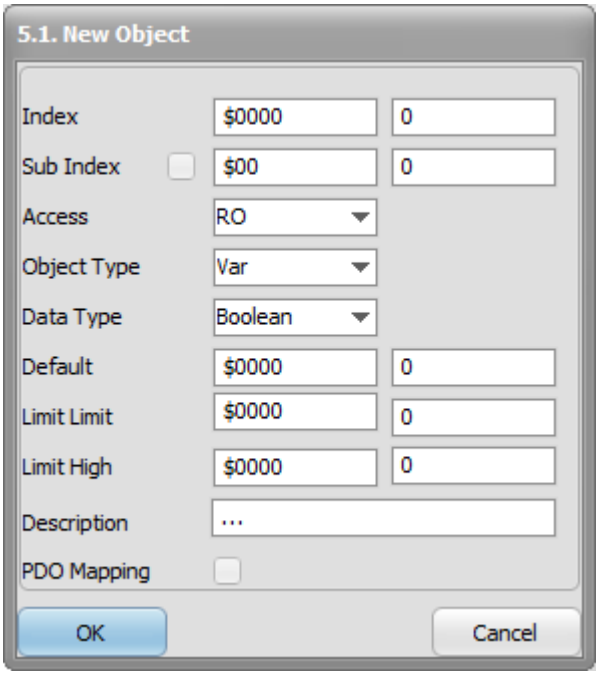
7.2. Node tab

Double click left mouse button on selected node will show node tab for node editing as follows:

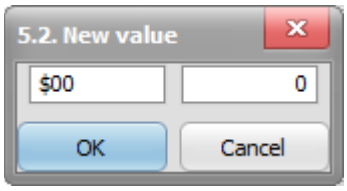


Click right mouse button on the tree will show pop-up menu:



Clear selected	Allows Pozwala na skasowanie zaznaczonych przez użytkownika indeksów. 
Edit Object Dictionary	Function allows to change parameters selected *Object Dictionary.*
Add Object dictionary	This function allows to add new *Object Dictionary* index.  In this window user have to set new object. Information about structure of Object Dictionary is available in *CAN in Automation (CiA® Draft Standard 301) specifications.* Information about EDS structure is avaliable in *CAN in Automation (CiA® Draft Standard 306)* specifications.
Delete Object Dictionary	This function remove selected *Object Dictionary.*

Double left miuse button click on the *Hex* or *Dec* allows to modify value.



!!! Once again EDS is loaded for selected node then modified values will be lost.

Access type description according to DS 301:

RW – read and write *access*

WO – *write only access*

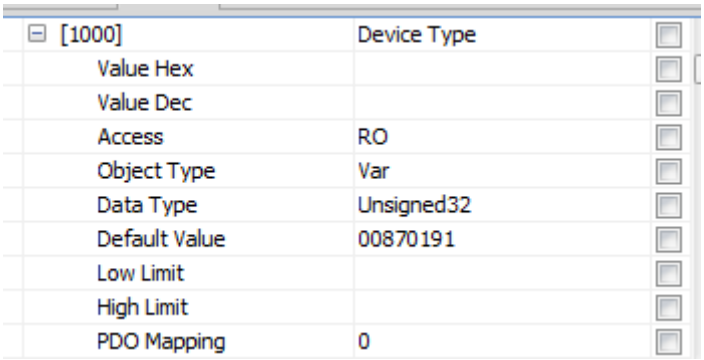
RO – *read only access*

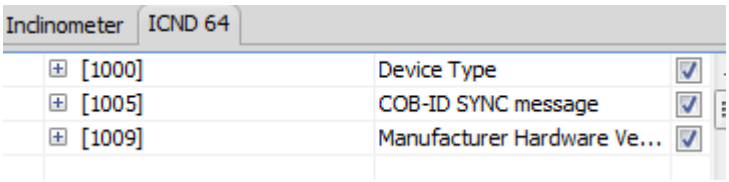
CONST – *read only access, value is constant*

General object type according to DS 301:

Index	**Variable type**
0001	BOOLEAN
0002	INTEGER8
0003	INTEGER16
0004	INTEGER32
0005	UNSIGNED8
0006	UNSIGNED16
0007	UNSIGNED32
0008	REAL32
0009	VISIBLE_STRING

Toolbar for node tab:

	This function allows to fold or unfold EDS tree objects. 
	This function allows to filter selected EDS objects. In order to this it is necessary to select objects by check box

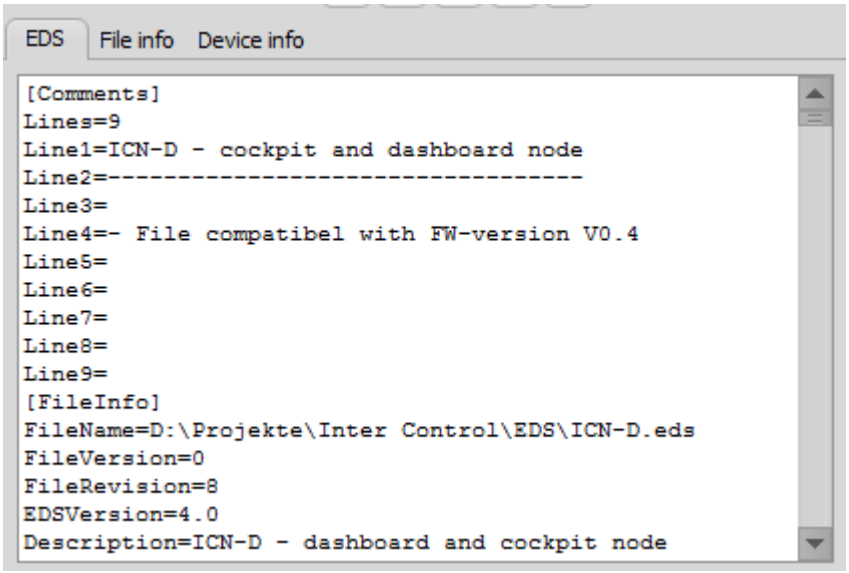


Open EDS file for selected node.

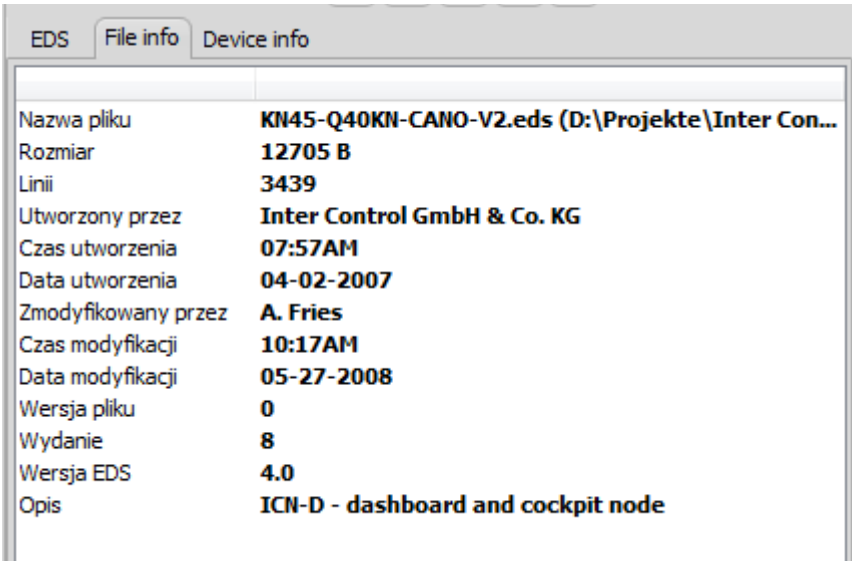
Open DCF file for selected node.

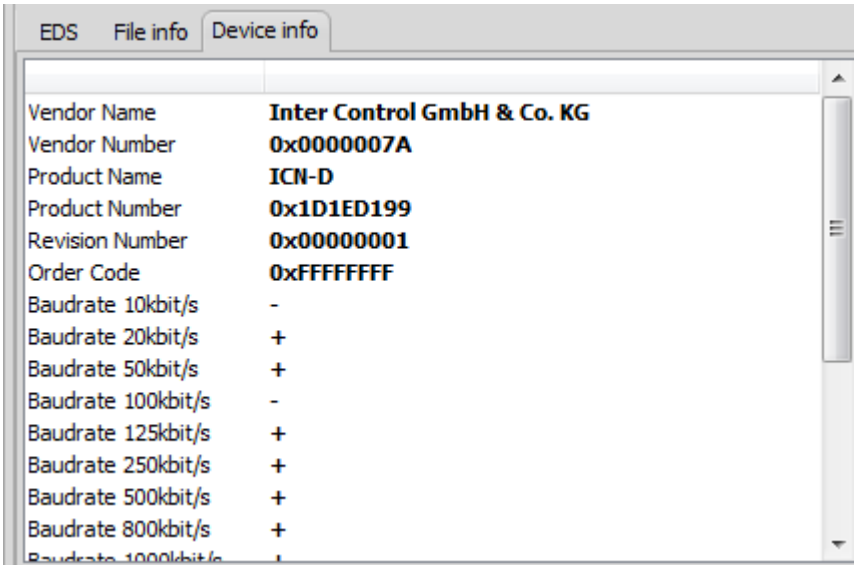
Open BMP file for selected node.

This function displays inforamtion about loaded EDS file.
- displaying EDS file with editing possibility.



- displaying EDS file information.



	- Display device information existing in EDS file. 
	This function allows to save EDS file.
	This function allows to save DCF file.
	This function allows to save CSV text file.

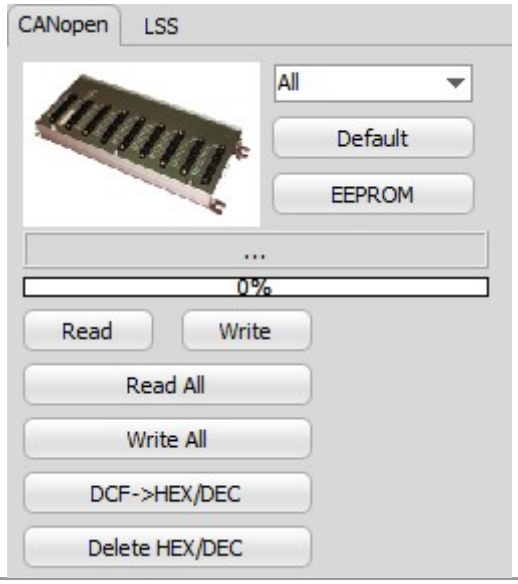
Status bar:

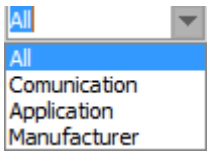
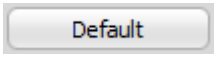
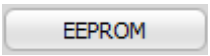
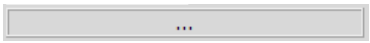
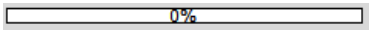
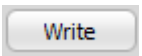
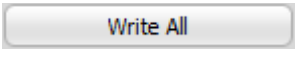
100%	Current scale view for board.
ID=4 ($04) ICND 64	Info bar for selected node.
Vendor IDs 979	Information about VENDOR ID numbers.

Additional functions for node/device:

ID 4 $04	Node ID
ICN-D64	User name for node
$0000 Search index	This function allows to search selected index of Object Dictionary.
O PO S R RC	NMT messages: O – operational PO – pre-operational R – reset RC – communication reset **!!! NMT messages concern selected Node ID**
0%	Load EDS progress.

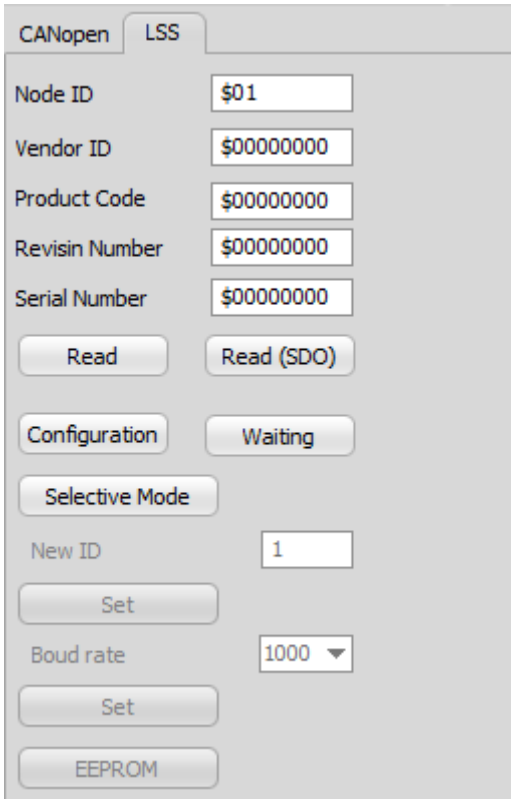
7.2.1. CANopen® manage



	Choose range of parameters. *Select range the parameters which will be used for read or write into device using press button Default and EEPROM.*
	Loading default manufacturer settings. Sends CAN frame which order to load default values into Object Dictionary, provided by manufacturer. Range of parameters is selected in the selection field as above. Reading is done by operation on Object Dictionary 0x1011 according to CiA® DS-301.
	Storing data in device. Sends CAN frame which order to store values into Object Dictionary. Range of parameters is selected in the selection field as above. Storing is done by operation on Object Dictionary 0x1010 according to CiA® DS-301.
	Text information about read and write SDO operation.
	Progress of reading or writing *Object Dictionary* via SDO.
	Read selected *Object Dictionary*
	Write selected *Object Dictionary*
	Read all elements from Object Dictionary. After reading , all values are displayed in the HEX/DEC.
	Write all elements from from Object Dictionary. For writing data are taken from Column *HEX /DEC,* if there is empty field then this Object Dictionary is skipped.
	Rewrites values from *DCF* field to *DEC/HEX* fields. Allows to write values in the device because for writing, data are taken from

	HEX/DEC fields.
Delete HEX/DEC	Deletes values in *HEX/DEC* fileds

7.2.2. LSS manage



This tab allows to read device information via LSS and also configure ID and CAN baudrate for for device which support LSS protocol.

!!! only some of devices has got LSS implementation.

Layer Setting Service (LSS) in CANopen® protocol defines communication service for setting ID and CAN baudrate.

In the filed *Node* ID type current Node-ID (device).

Using press button *Read (SDO)* is possible to read device parameters from Object Dictionary 0x1018.

Next it is necessary to set device into Global State by *Global Mode – Configuration*. In this mode, device is ready to receive CAN frames with new settings.

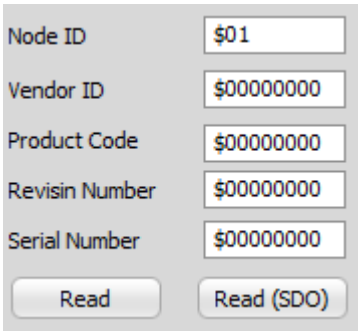
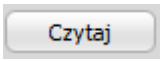
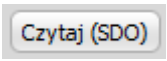
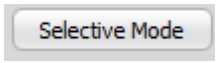
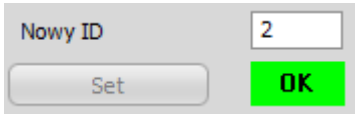
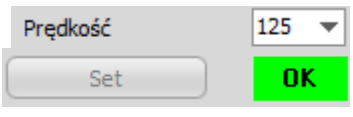
It is possible to call Switch State Selective to set device into configuration state (press button *Selective Mode*). After click left mouse button on it then CAN frames are sent based on data previously read from device.

!!! To use function *Selective Mode* it is necessary to read node parameters.

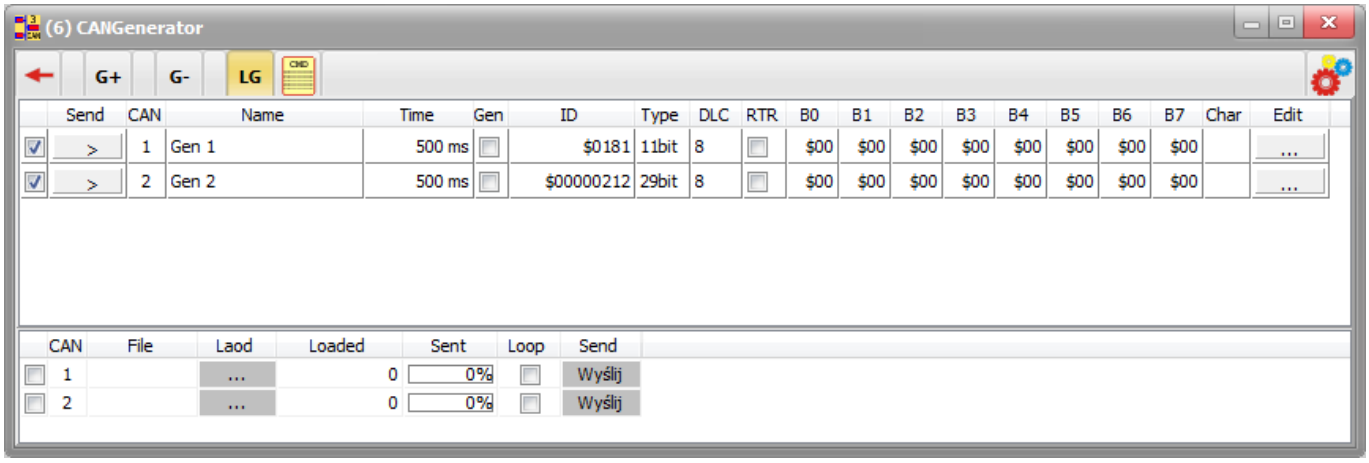
After setting, all data should be stored in device by store command generated by click left mouse button on *EEPROM.*

Example configuration:

1. Device with ID 02h in the pre-operational state.
2. In the filed *Node Id* type 02.
3. Switch device into LSS configuration mode: Global *Mode - > Configuration*.
4. Using *Read* press button, read parameters from device (information).
5. In the filed *New Node ID*, type new Node ID. Using press button *Set* then new ID is send to device. Correct operation will be confirmed by showing green OK text behind the S*et* press button.
6. In the filed *Baudrate*, type new CAN baudrate. Using press button *Set* then new CAN baudrate is send to device. Correct operation will be confirmed by showing green OK text behind the S*et* press button.
7. Save settings by pressing *STORE in EEPROM.*
8. After reset device will start with new settings.

	Node ID - in this filed type current Node ID Vendor ID - read manufacturer Vendor ID Product Code - read product code Revision Number - read revision number Serial Number - read serial number  - read above information via LSS  - read above information via SDO
	Switch device into LSS mode: Configuration - LSS configuration mode (7E5h / 04h 01h 00h 00h 00h 00h 00h 00h) Waiting – LSS waiting mode (7E5h / 04h 00h 00h 00h 00h 00h 00h 00h)
	After pressing this press button then sequence Switch State Selective CAN frames with above node parameters is send.
	Setting new Node ID. Correct device response is confirmed green icon on the right side New Node ID will be used after device reset if EEOPROM store was done.
	Setting new baudrate for node. Correct device response is confirmed green icon on the right side New baudrate will be used after device reset if EEOPROM store was done.
	Store parameters into EEPROM. Correct device response is confirmed green icon on the right side Send CAN frame (7E5h / 04h 01h 00h 00h 00h 00h 00h 00h)
	This filed below *STORE in EEPROM* press button interprets device response.

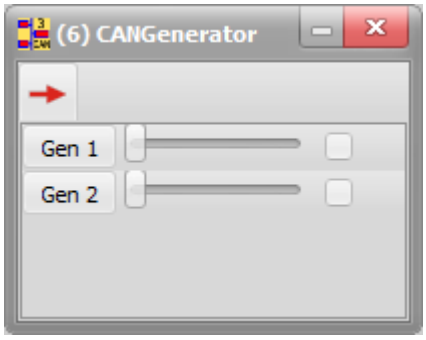
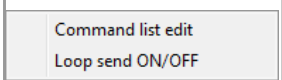
8. CANGenerator window (6)

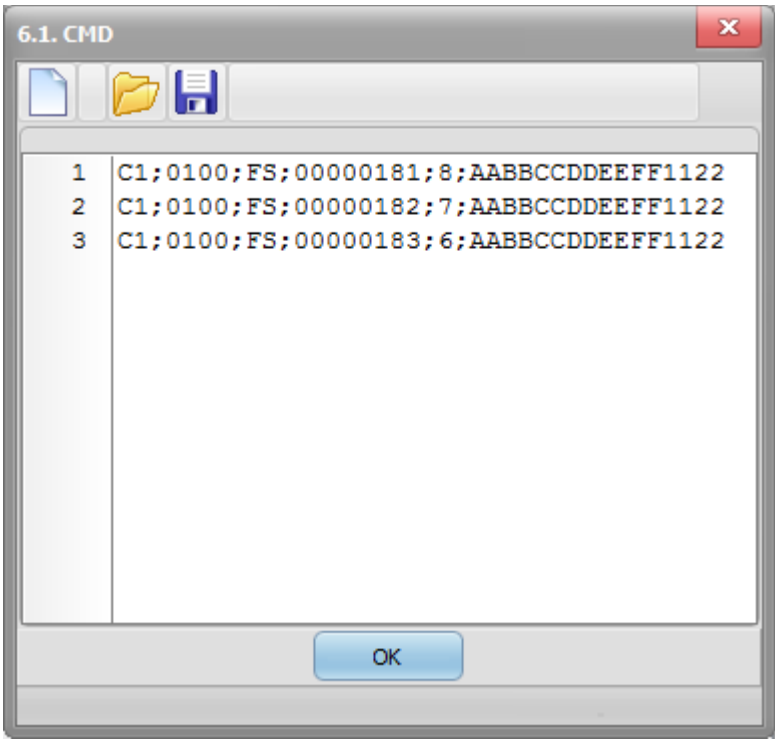


This module allows user to add generator list and send data to CAN bus from CANStudio. Allows to send package frames from LOG file.

8.1. Frame generator

Toolbar:

	Go into panel view.  In order to return to tabelar view it is necessary to click on
	Add new generator.
	Delete selected geneartor.
	ON/OFF LOG generator window.
   	Click right mouse button on this icon user gets access to *Command list edit* function, which allows to define sequence of CAN frames for send and save in text file. Loop ON/OFF allows to send defined sequence of CAN frames in loop.



Loop Send ON/OFF allows to send cyclically defined CAN frames.
After deinined or load list of commands. Click left mouse button on CMD push button then list of CAN frames is send do CAN bus according to time intervals.

Row structure:
CHANNEL <semicolon> CZAS <semicolon> COMMAND <semicolon> ID <semicolon> DLC < semicolon DATA

CHANNEL:
C1 – CAN 1
C2 – CAN 2

COMMAND:
FS - 11bit frame
RS - 11b RTR frame
FE - 29b frame
RE - 29b RTR frame

Example of definition:
Sending 11bit CAN frame in 100ms interval, ID0x181, DLC =8, data 0xAA 0xBB 0xCC 0xDD 0xEE 0xFF 0x11 0x22

C1;0100;FS;00000181;8;AABBCCDDEEFF1122
C1;0100;FS;00000181;8;AABBCCDDEEFF1122
C1;0100;FS;00000181;8;AABBCCDDEEFF1122

Clear CMD window.

Loading command list from file.

Saving command list in the file.

Configured list of command is stored in CANStudio project.

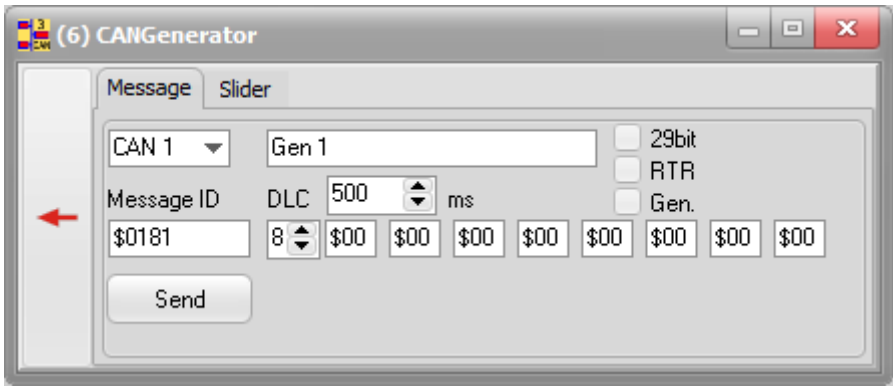
	Attention! **Clicking left mouse button on this icon sends loaded commands list to CAN bus. To avoid casual command list send after click left mouse button on CMD icon it is necessary to clear the command list.** **Attention!** **On last row there must not be any space or ENTER character.** **If ENTER is on end then *Sentence error* message will appear.**
	Open parameters settings window.

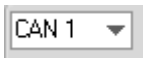
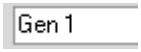
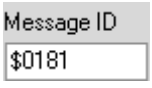
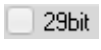
8.1.1. Generator configuration

Double click left mouse button on generator name user go to generator configuration tabs.

8.1.2. Messages tab

This tab allows to set parameters for CAN frame.

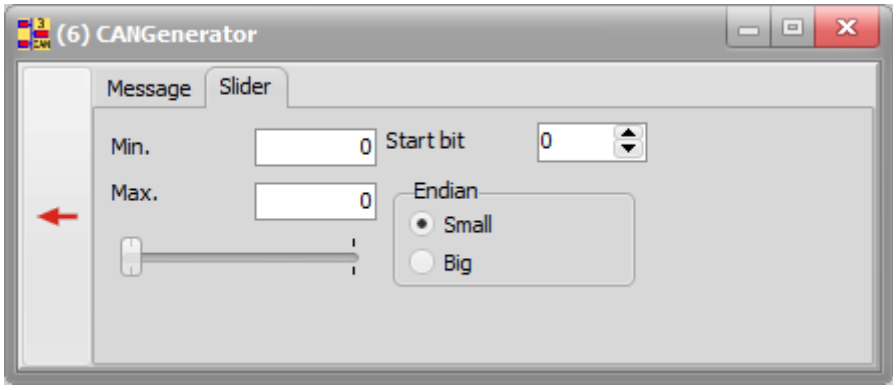


	Return to tabelar view.
	Select CAN channel for send CAN frame.
	Generator name given by user.
	CAN frame ID.
	Number of data bytes.
	Time interval for cycling send.
	Checking this box set 29bit frame identification (extended). If this box in not checked then Can frame is 11bit (standard)

RTR	Setting type of CAN frame as *Remote Frame*. RTR bit in arbitrage field is set to recessive. ***Remote frame it*** *is frame which data transition request from selected device. Include Node ID, DLC set as DLC for requested frame and no data. Currently this type of communication is not recommended to use in CAN network and often not supported by devices.*
Gen.	ON/OFF for cyclic CAN frame generating according to time duration settings.
$00 $00 $00 $00 $00 $00 $00 $00	Data fields.
Send	Left mouse button click sends once CAN frame to CAN bus.

8.1.3.Slider tab

In this tab user can set parameters for interactive slider for send CAN frame.

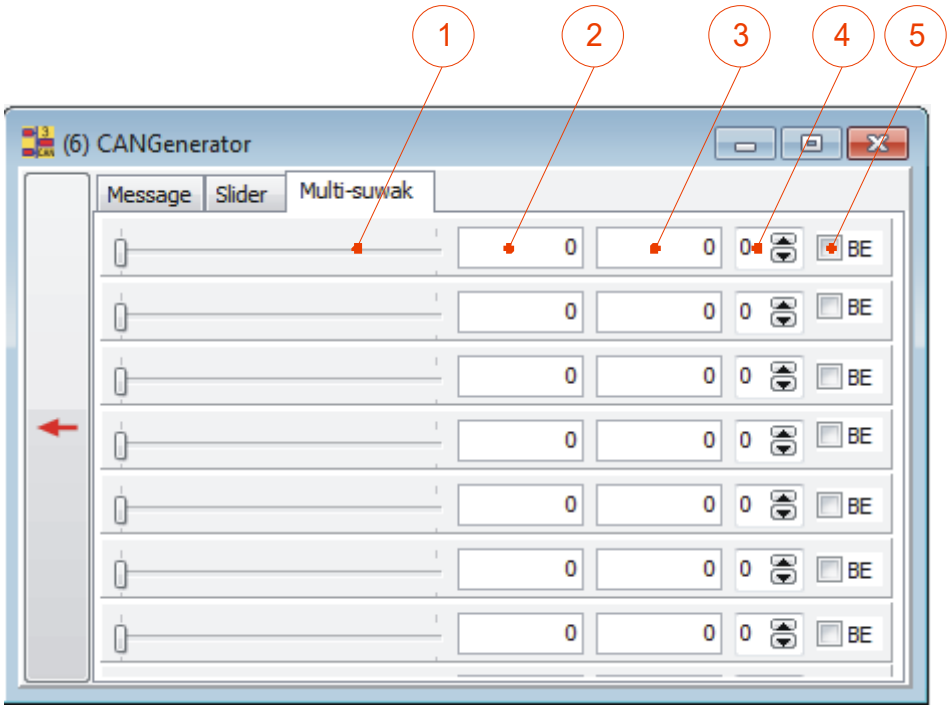


	Return to tabelar view.
Min. 0	Minimal value for variable.
Max. 0	Maximal value for variable.
Start bit 0	Start bit for data which will be send to CAN bus. Value is chcnge with 8 bit step.
Endian Small Big	Direction of data bytes in the variable.
	Slider which allows to send interactively data from range Min to Max.

!!! Number of bytes is depend of Max. value.

8.1.4. Multi-slider tab

This tab allows to set parameters of sliders for send CAN frame.
Allows to set all bytes in one CAN massage.

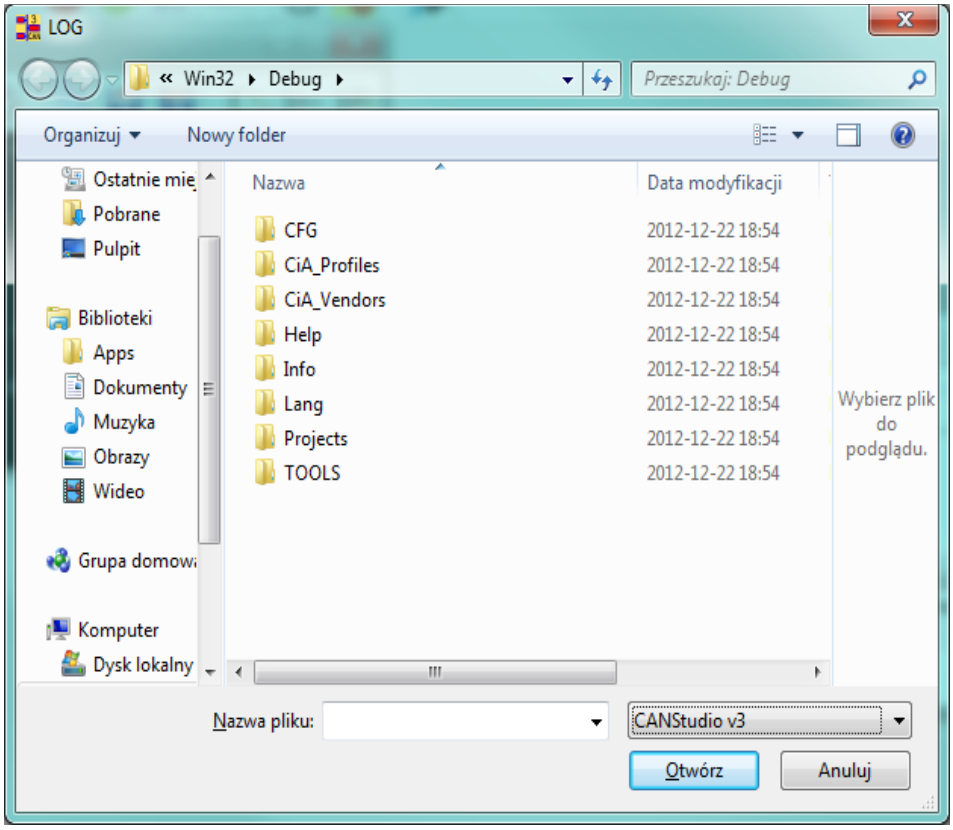


1	Slider
2	Minimum value
3	Maximum value
4	Start bit
5	Checked – Big Endian, unchecked Small Endian

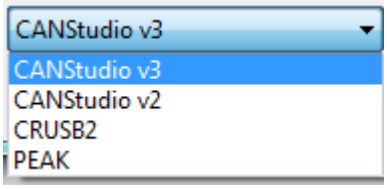
8.2. LOG Generator – send CAN frames from LOG file

This function allows to generate CAN frames according to real logged CAN frames in file. Push button LG allows to show or hide of table for both CAN channels.

User can load LOG file by clicking on push button ...

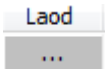
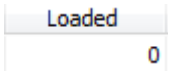
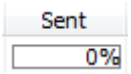
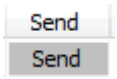


Module allows to load the following file types:

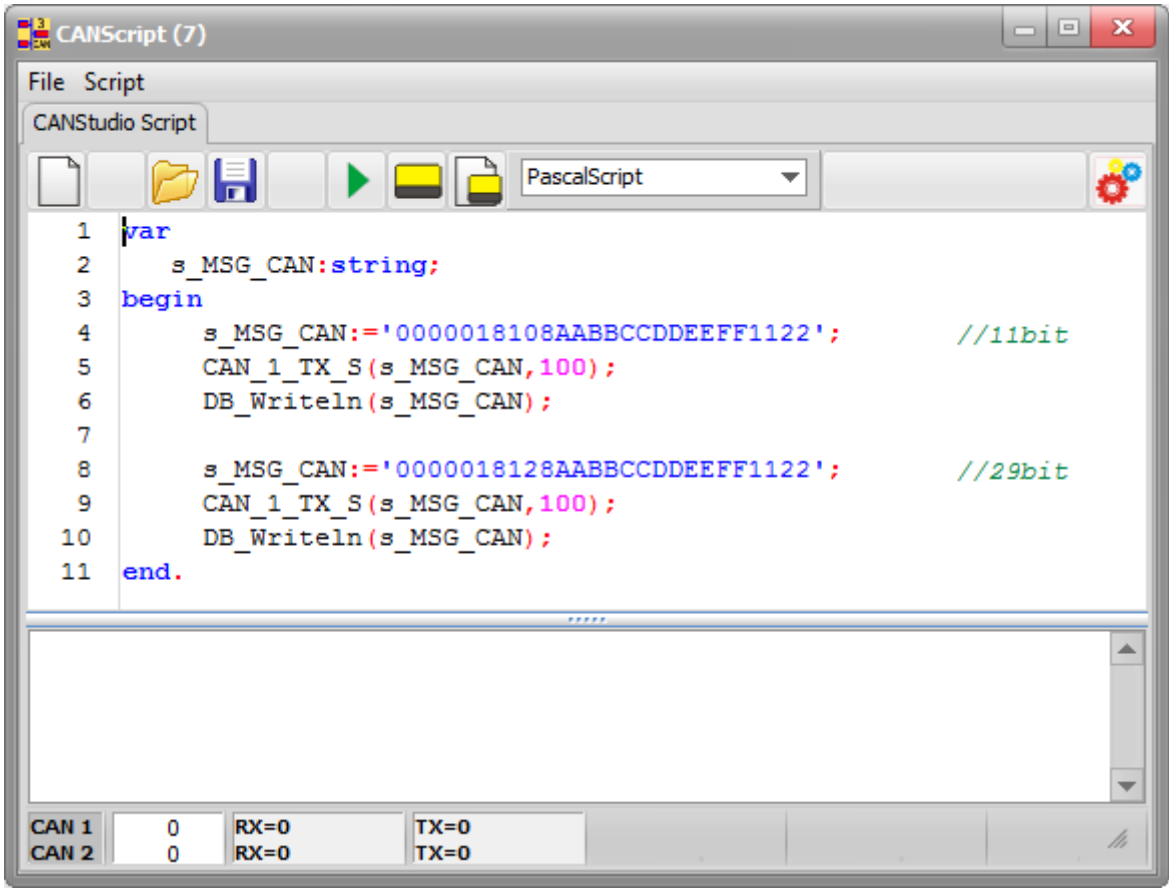


CANStudio v3	LOG file stored in CANStudio 3
CANStudio v2	LOG file stored in CANStudio 2
CRUSB2	LOG file stored on CRUSB v2 SD card (DIGA product)
PEAK	LOG file stored on PCAN-USB (PEAK)

Table column description:

	Check this box means that push button for the generator will be displayed on panel mode/view. (see 8.1)
	LOG, CSLOG file path
	Push button to load LOG file.
	Information about loaded CAN frames from LOG file.
	Information about progress of send CAN frames to CAN bus.
	Check this box means that after sending last CAN frame them start sending Can frames from first CAN frame.
	This push button start sending CAN frames to CAN bus.

9. CANScript (7)



Script system allows user to write his own scripts which make more flexible work with CAN.

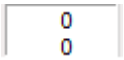
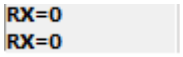
The following languages are available:

- Pascal
- C++
- Java
- Basic

	New script
	Load scrip
	Save script
	Run script
	Debugger window ON/OFF

	Clear Debugger window
	Language selector
	Settings

9.1. Status bar

	CAN status information
	Number of CAN messages counted in Rx FIFO for eacg CAN channel
	Number of CAN frames received by selected CAN channel
	Number of CAN frames sent by selected CAN channel

9.2. List of native commands

Terminal commands	
DB_Writeln	*procedure ST_Writeln(const s: string);* Send strinf to debugger window
DB_Readln	*function ST_Readln(const question: string): string;* Get string from debugger window
DB_Clear	*ST_Clear;* Clear debugger window

<table>
<tr><td colspan="2">Komendy CAN:</td></tr>
<tr><td>SC_CANout</td><td>procedure SC_CANout(u32_ID: longword; u8_DLC: byte; au8_DATA: array of byte;u8_RTR: byte; u8_Type: byte; u8_DIR: byte; CAN_CH: byte);

Procedure to send CAN frame to selected channel</td></tr>
<tr><td>CAN_1_TX_S
CAN_2_TX_S</td><td>procedure CAN_1_TX_S(str: string;u16_Time:word);
Procedure to send CAN frame to selected channel as string (hex)

Przykład wysłania ramki 11bit:
CAN_1_TX_S('0000018108AABBCCDDEEFF1122',100); //ramka 11bit
CAN_2_TX_S('0000018108AABBCCDDEEFF1122',100); //ramka 11bit
<table>
<tr><td>00000181</td><td>CAN frame ID
CAN frame ID</td></tr>
<tr><td>0</td><td>0 – 11bit
2 - 29bit</td></tr>
<tr><td>8</td><td>
DLC datai 0 do 8</td></tr>
<tr><td>AABBCCDDEEFF1122</td><td>Data bytes</td></tr>
<tr><td>100</td><td>Time interval for delay (not implemented)</td></tr>
</table>
</td></tr>
<tr><td>CAN_1_RX_S
CAN_2_RX_S</td><td>function CAN_1_RX_S:string;
function CAN_2_RX_S:string;

Function to get CAN frame form FIFO for selected CAN channel as string.</td></tr>
<tr><td>CAN_1_RX_CLEAR
CAN_2_RX_CLEAR</td><td>CAN_1_RX_CLEAR;
CAN_2_RX_CLEAR;

Clear all CAN frames from selected CAN channel FIFO</td></tr>
</table>

File commands	
TEXT_FILE_OPEN_W	*procedure* TEXT_FILE_OPEN_W(S_FILE:STRING); Procedure to open text file for write S_FILE: full name and path for file
TEXT_FILE_OPEN_R	*procedure* TEXT_FILE_OPEN_R(S_FILE:STRING); Procedure to open text file for read S_FILE: full name and path for file
TEXT_FILE_CLOSE	*procedure* TEXT_FILE_CLOSE; Procedure to close text file
TEXT_FILE_WRITE_S	*procedure* TEXT_FILE_WRITE_S(STR:STRING); Procedure to write string to tet file included CR char on end.
TEXT_FILE_READ_S	*function* TEXT_FILE_READ_S:STRING; Function to read string from fileF.