TSMaster User Manual

Chapter 1 TSMaster User Interface

1.1 User Interface Introduction

TSMaster is an open environment for monitoring, simulation of automotive network communications. The main interface of TSMaster is shown as below.

1.1.1 Main Interface

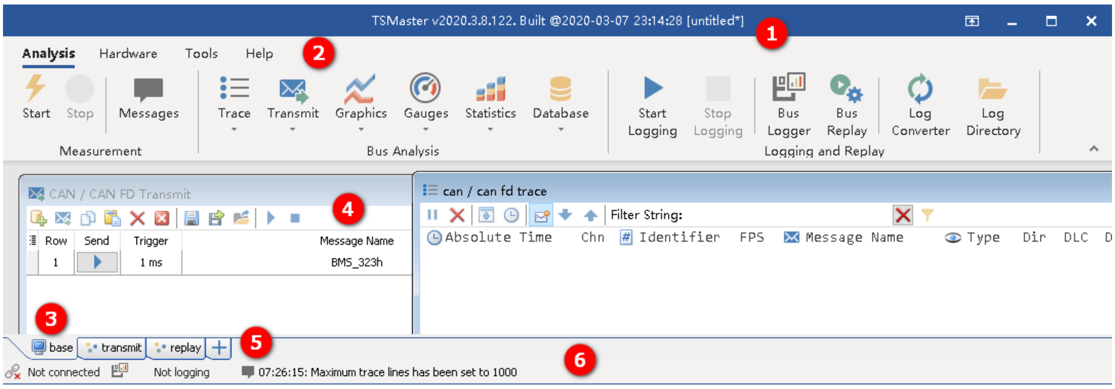


Fig 1 TSMaster main interface

1. Application title bar. The application name, build time and loaded configuration is shown in this title bar.
2. Ribbon toolbar. The main functions are accessed from this ribbon toolbar.
3. Page tabs. Each tab contains a set of windows for measurement and simulation. User can add or delete window inside the current tab.
4. Application forms. Each window is a function performing specific tasks.
5. Add page button. User can add new page by clicking this button. If user want to delete a page, just right-click on the current page and select “delete tab” command.
6. Status bar. The connection status of application, logging information and write information are shown in the status bar.

1.1.2 Ribbon Functions

There are four tabs in ribbon: Analysis, Hardware, Tools and Help.

1.1.2.1 Analysis Tab

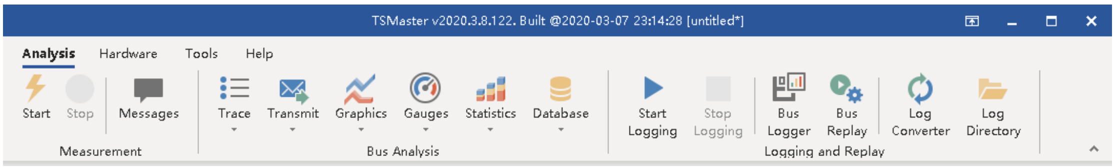


Fig 2 Analysis tab in Ribbon

Start: Start application. This operation will connect all the logical channels with hardware channels, the data from hardware will be shown in the application interface.

After application is started, the following functions are not available:

- Bus Replay. Bus replay is only allowed when application is disconnected.
- Channel Selection. Channel selection is only available before application connection.
- Channel Mapping. Channel mapping information is required before application is connectd.
- Network Hardware. Hardware parameters are only allowed to configure before application is started.

Stop: Stop application. This operation will disconnect all the logical channels with hardware channels. The logging operation is also stopped if already running.

After application is stopped, the following functions are now available:

- Bus Replay. User can load logged files and analyze them in the application forms.
- Channel Selection. User can map channels freely when application is not connected.
- Channel Mapping. User can manage application and channels in the channel mapping form.
- Network Hardware. User can alter hardware configuration when application is not connected.

Messages: Show message window.

Trace: This is a drop-down button as shown below:

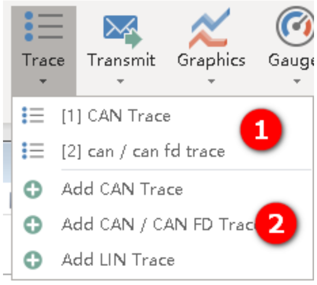


Fig 3 Trace drop-down button

1. Trace windows that already exist in the system, click to show one of them.
2. Add new trace window in the system. The default location is the current tab.

Transmit: Show or add transmit windows for bus message transmission.

Graphics: Show or add graphics windows for signal curve display.

Gauges: Show or add gauge windows for signal value display.

Statistics: Show bus statistics window.

Database: Show bus database window, CAN (*.dbc) and LIN (*.ldf) files are supported.

Start Logging: Start logging of bus events.

Stop Logging: Stop logging of bus events.

Bus Logger: Show bus logging configuration window.

Bus Replay: Show bus replay window.

Log Converter: Show log file converter application which converts blf file format to asc file format and vice versa.

Log Directory: Show the current log file directory in Windows explorer.

1.1.2.2 Hardware Tab

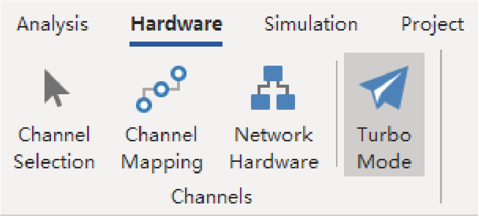


Fig 4 Hardware tab in ribbon

Channel Selection: Open channel selection window for logical channel mapping with hardware channels.

Channel Mapping: Open channel mapping configuration window to manage application logical channels and mapping.

Network Hardware: Open hardware configuration window to configure individual hardware channel parameters.

Turbo Mode: Checking this option will minimize all hardware channel latencies at the expense of consuming more CPU usage. Users who concern very much for hardware performance are recommended to check this option.

1.1.2.3 Project Tab

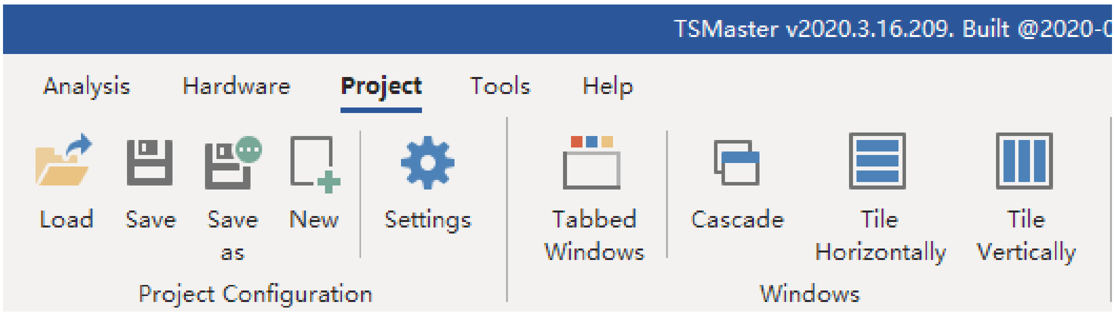
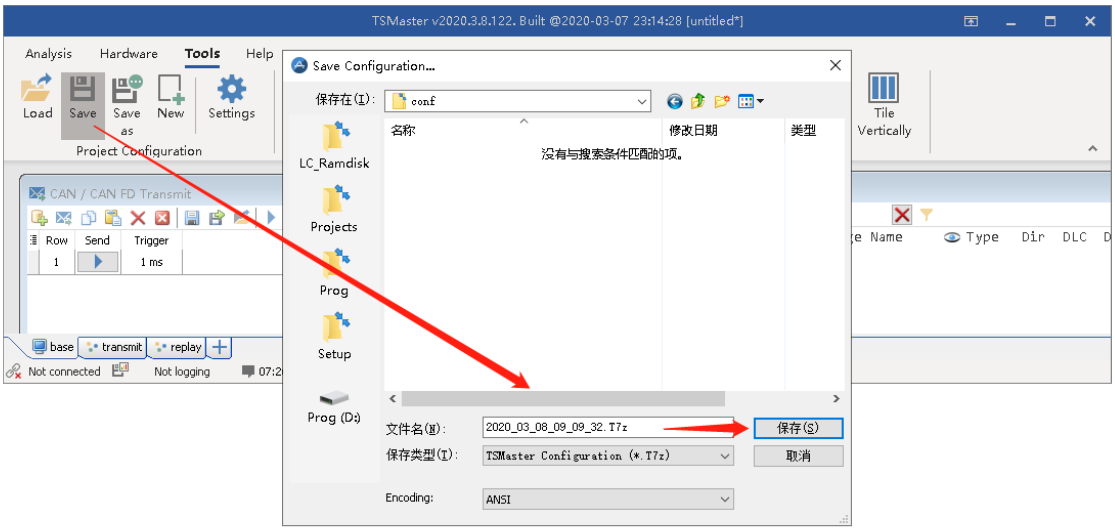


Fig 5 TSMaster Project Tab

Load: Load TSMaster configuration file, this operation will overwrite all the current settings.

Save: Save TSMaster configuration file to a location. If the destination configuration is specified, the following save command will update the destination configuration file.

The first time when the button is clicked, a save as dialog will be prompt for user to select a destination configuration file:



TSMaster v2020.3.8.122. Built @2020-03-07 23:14:28 [untitled*]

Save Configuration...

保存在(I): conf

没有与搜索条件匹配的项。

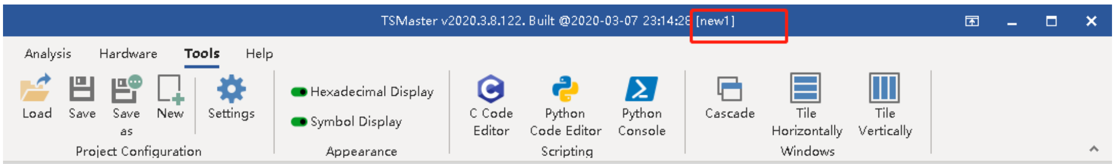
文件名(N): 2020_03_08_09_09_32.T7z

保存类型(T): TSMaster Configuration (*.T7z)

Encoding: ANSI

Fig 6 Save configuration for the first time

Just specify a location and file name for the configuration file, and click "Save" button. The application title will display the destination configuration file name after the configuration file is saved:



TSMaster v2020.3.8.122. Built @2020-03-07 23:14:28 [new1]

Fig 7 Configuration file name shown in the title bar

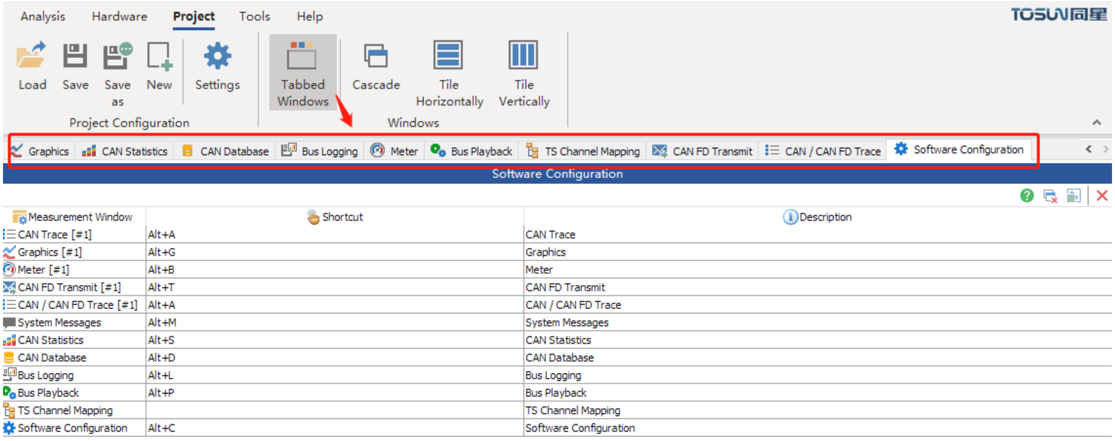
After the configuration file is saved, each successive save command will update this file continuously.

Save as: This command will popup a save as dialog for the user to change the configuration file to another location.

New: This command will erase all the current configuration and create a new environment for analysis. Note: please save all your work into a configuration file before applying this command.

Settings: Opens a software configuration window showing all the opened windows. User can show/hide/delete the application forms in this window. The title of each application form can also be modified here.

Tabbed Windows: This checkbox displays all windows in tabs or vice versa:



Software Configuration

Measurement Window	Shortcut	Description
CAN Trace [#1]	Alt+A	CAN Trace
Graphics [#1]	Alt+G	Graphics
Meter [#1]	Alt+B	Meter
CAN FD Transmit [#1]	Alt+T	CAN FD Transmit
CAN / CAN FD Trace [#1]	Alt+A	CAN / CAN FD Trace
System Messages	Alt+M	System Messages
CAN Statistics	Alt+S	CAN Statistics
CAN Database	Alt+D	CAN Database
Bus Logging	Alt+L	Bus Logging
Bus Playback	Alt+P	Bus Playback
TS Channel Mapping		TS Channel Mapping
Software Configuration	Alt+C	Software Configuration

Fig 8 Tabbed Windows

Note: When this checkbox is checked, the lower tab group disappears because all the sub forms are displayed in the above tabs.

If this checkbox is unchecked, the lower tab group will be visible again and each tab group controls a series of sub mdi forms.

Cascade: Cascade application forms in the current tab group.

Tile Horizontally: Tile all the application forms in the current tab horizontally.

Tile Vertically: Tile all the application forms in the current tab vertically.

Note: This above features “Cascade, Tile Horizontally and Tile Vertically” are only available when “Tabbed Windows” feature is unchecked.

1.1.2.4 Tools Tab

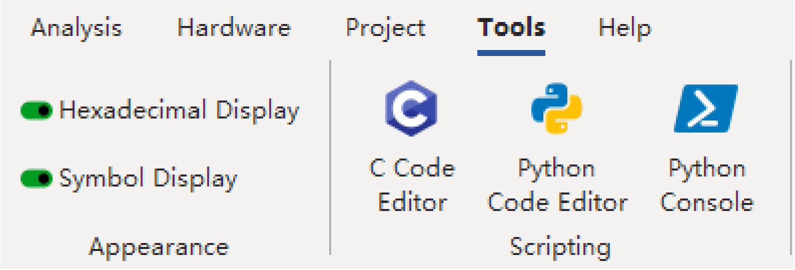


Fig 9 Tools tab in ribbon

Hexadecimal Display: This command toggles display between hexadecimal and decimal.

Symbol Display: This command toggles display between symbol description and value of a signal in database.

C Code Editor: This command opens TSMaster C Code Editor for editing C scripts.

Python Code Editor: This command opens TSMaster Python Code Editor for editing Python scripts.

Python Console: This will open python console window for interacting with internal python engine shipped with TSMaster.

1.1.3 Help Tab

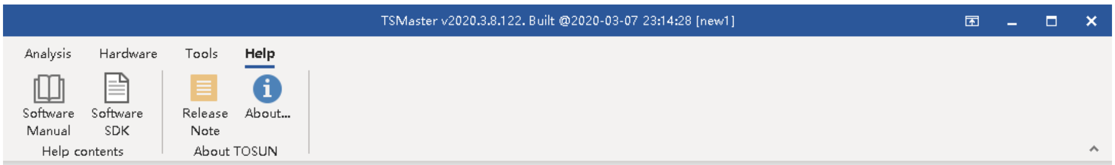


Fig 10 Help tab in ribbon

Software Manual: This software manual will be shown.

Software SDK: TSMaster API description manual will be shown.

Release Note: This will open release note for the current version of TSMaster.

About...: This will show about dialog of TOSUN company.

1.1.4 Application Shortcuts

- Ctrl + O: Open project
- Ctrl + N: Create new project
- Ctrl + S: Save the current project
- Ctrl + TAB: move to next tab in Tabbed windows mode
- Ctrl + Shift + TAB: move to previous tab in Tabbed windows mode
- Ctrl + W: close the current active window or tab

1.1.5 Univeral Drag and Drop

TSMaster support many different automotive bus database types to be dragged and droped into TSMaster application main interface.

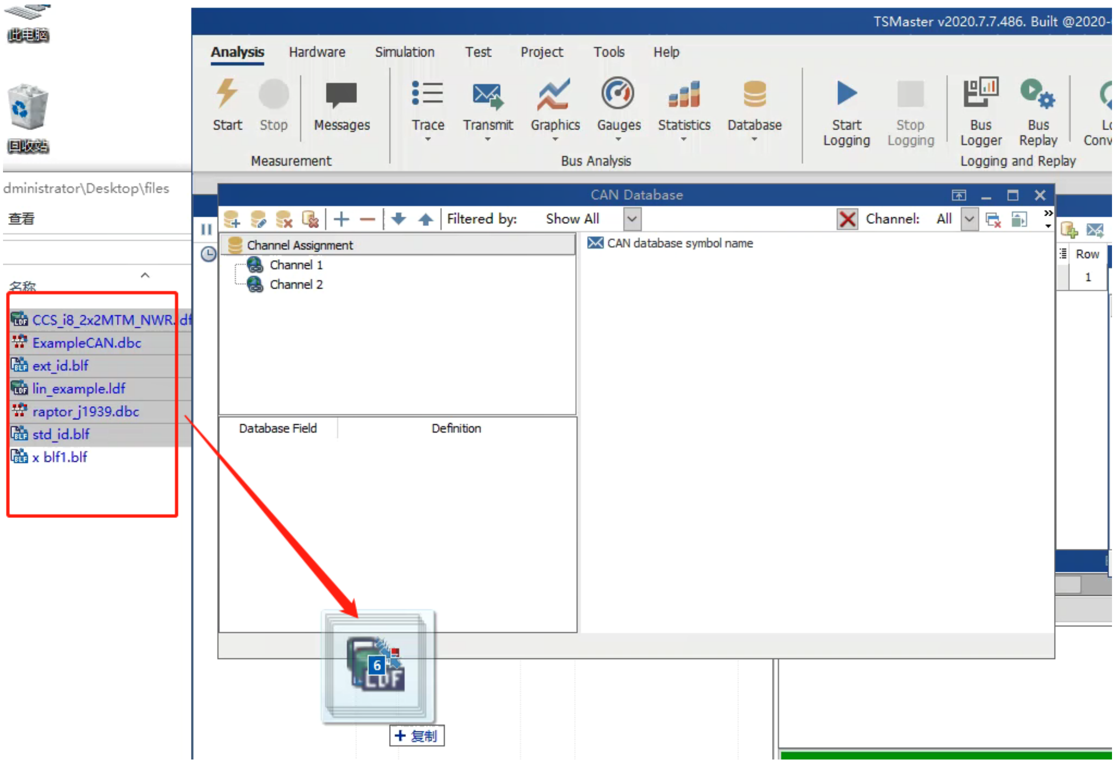


Fig 11 Universal drag ang drop in TSMaster

The supported suffixes of file types are listed below:

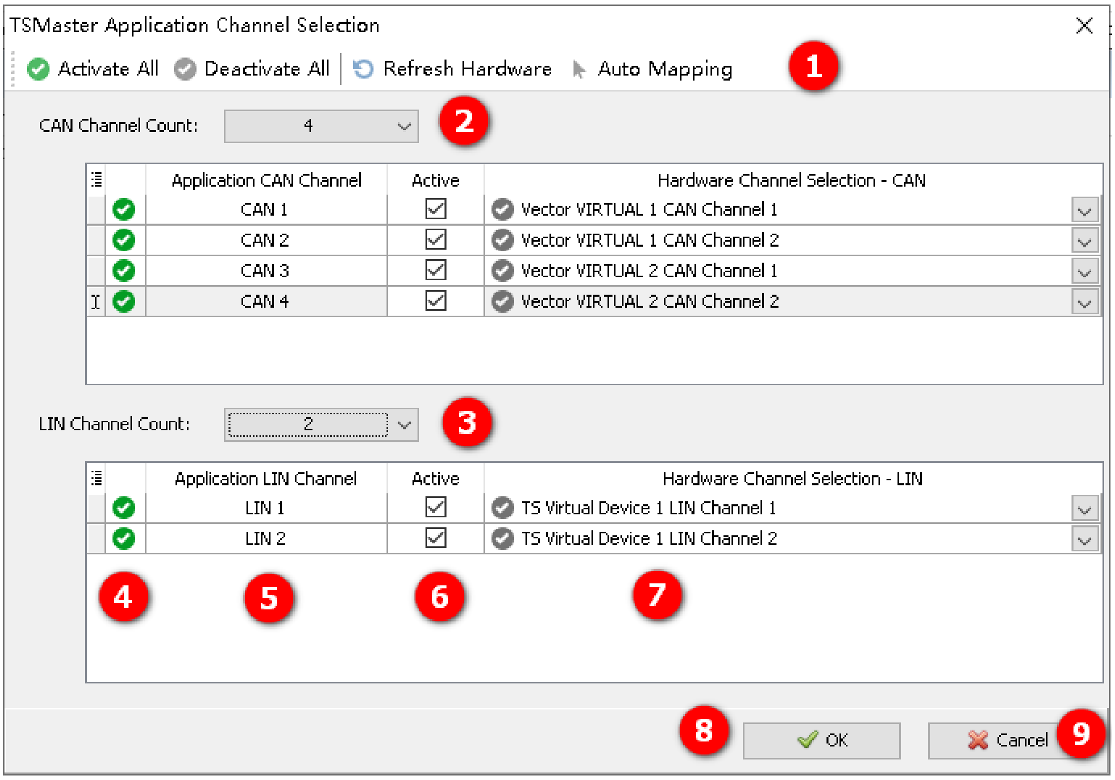
Table 1 File formats that support drag and drop

File extension	Associated Vendor	File Description
blf	Vector	Binary logging format of different bus systems
dbc	Vector	CANdb network file
ldf	ISO	LIN description file
mpc	TOSUN	TSMaster mini program source file extension
t7z	TOSUN	TSMaster project file
mp	TOSUN	TSMaster mini program compiled binary file
arxml	AutoSAR	AutoSAR system description file
dbf	ETAS	Bus Master file format
sym	PEAK	PEAK PCAN CAN description file
mat	Mathworks	MATLAB file format used in TOSUN calibration module

mp4	MPEG-4 Part 14	ISO/IEC 14496-12(MPEG-4 Part 12 ISO base media file format), used in Video Replay
avi	Microsoft	Audio Video Interleave, a widely used video file format created by Microsoft in 1992, used in Video Replay
wmv	Microsoft	A video file based on the Microsoft Advanced Systems Format (ASF) container format, used in Video Replay
mpeg	ISO and IEC	Moving Picture Experts Group (MPEG), used in Video Replay, used in Video Replay
mpg	ISO and IEC	Moving Picture Experts Group (MPEG), used in Video Replay, used in Video Replay
m4v	Apple	A video container format developed by Apple and is very similar to the MP4 format, used in Video Replay
mov	Apple	A movie file saved in the QuickTime File Format (QTFF), which is a multimedia container file format, used in Video Replay
asf	Microsoft	The container format for Windows Media Audio and Windows Media Video-based content, used in Video Replay
flv	Adobe	A file format used by Adobe Flash Player and Adobe AIR to store and deliver synchronized audio and video streams over the Internet, used in Video Replay
f4v	Apple	A Flash MP4 Video file, sometimes called an MPEG-4 Video file, used in Video Replay
rmvb	RealNetworks	RealMedia Variable Bitrate (RMVB) is a variable bitrate extension of the RealMedia multimedia

		digital container format, used in Video Replay
rm	RealNetworks	RealMedia is a proprietary multimedia container format created by RealNetworks. Its extension is ". rm", used in Video Replay
3gp	3rd Generation Partnership Project	A 3GP file is a multimedia file saved in an audio and video container format, used in Video Replay
vob	DVD Forum	A movie data file from a DVD disc, typically stored in the VIDEO_TS folder at the root of the DVD, used in Video Replay

1.2 Channel Selection



CAN Channel Count: 4

	Application CAN Channel	Active	Hardware Channel Selection - CAN
✓	CAN 1	☑	Vector VIRTUAL 1 CAN Channel 1
✓	CAN 2	☑	Vector VIRTUAL 1 CAN Channel 2
✓	CAN 3	☑	Vector VIRTUAL 2 CAN Channel 1
✓	CAN 4	☑	Vector VIRTUAL 2 CAN Channel 2

LIN Channel Count: 2

	Application LIN Channel	Active	Hardware Channel Selection - LIN
✓	LIN 1	☑	TS Virtual Device 1 LIN Channel 1
✓	LIN 2	☑	TS Virtual Device 1 LIN Channel 2

Fig 12 Channel Selection dialog

Channel selection dialog is used to quick configure application channel mapping before application is running.

1. Toolbar buttons described below:

   Activate All: Activate all the application channels

   Deactivate All: Deactivate all the application channels

   Refresh Hardware: Refresh hardware channel list after USB devices are plugged in or out

   Auto Mapping: Automatically search hardware channels and map each application channel with available hardware channel in the order of discovery.

2. **Application CAN channel count**: Displays the current CAN channel count of TSMaster, the user can change it using drop-down button, the modification takes effect immediately.

3. **Application LIN channel count**: Displays the current LIN channel count of TSMaster, the user can change it using drop-down button, the modification takes effect immediately.

4. **Availability**: Indicates the availability of the current application channel. The color of the icon has the following meaning:

   ✅ This application channel mapping is valid. The corresponding application is fully functional during measurement.

   ✔ This application channel is disabled. The corresponding application channel is not available during measurement.

   ❌ This application channel is invalid, the user must resolve the mapping problem, otherwise the application cannot start.

5. **Application channel**: Application logical channel specified by user. Each application channel number has an ascending order starting from 1. The available application channels are from 1 to CAN channel count.

6. **Active Selection**: This checkbox controls the availability of the current application channel. Default selection is checked. If user wants to disable the current application channel, the selection can be unchecked. After that, the mapping of this application channel will not be available during measurement.

7. **Hardware channel selection drop-down box**: This drop-down box lists all the available hardare channels that can be mapped with the current application channel. The color of each item listed has the following meaning:

✅ This hardware channel is not mapped with other application channels, it is free for user to select.

✔ This hardware channel is already mapped with one application channel. Multiple application channels mapping to the same hardware channel is not allowed.

❌ This application channel is not mapped with any hardware channel, the user must ensure the mapping of the application channel before measurement starts.

Note: If TSMaster is opened for the first time, when user tries to connect application without opening this dialog, a default configuration is automatically applied, which performs the following operations:

[1] search for available CAN and LIN hardware channels excluding TS virtual channels

[2] set application CAN and LIN channels according to the first found hardware channels

[3] start application for the measurement

1.3 System Messages Window

System messages window displays all the software related messages, the message color has the following meaning:

⬛ Default: Normal message

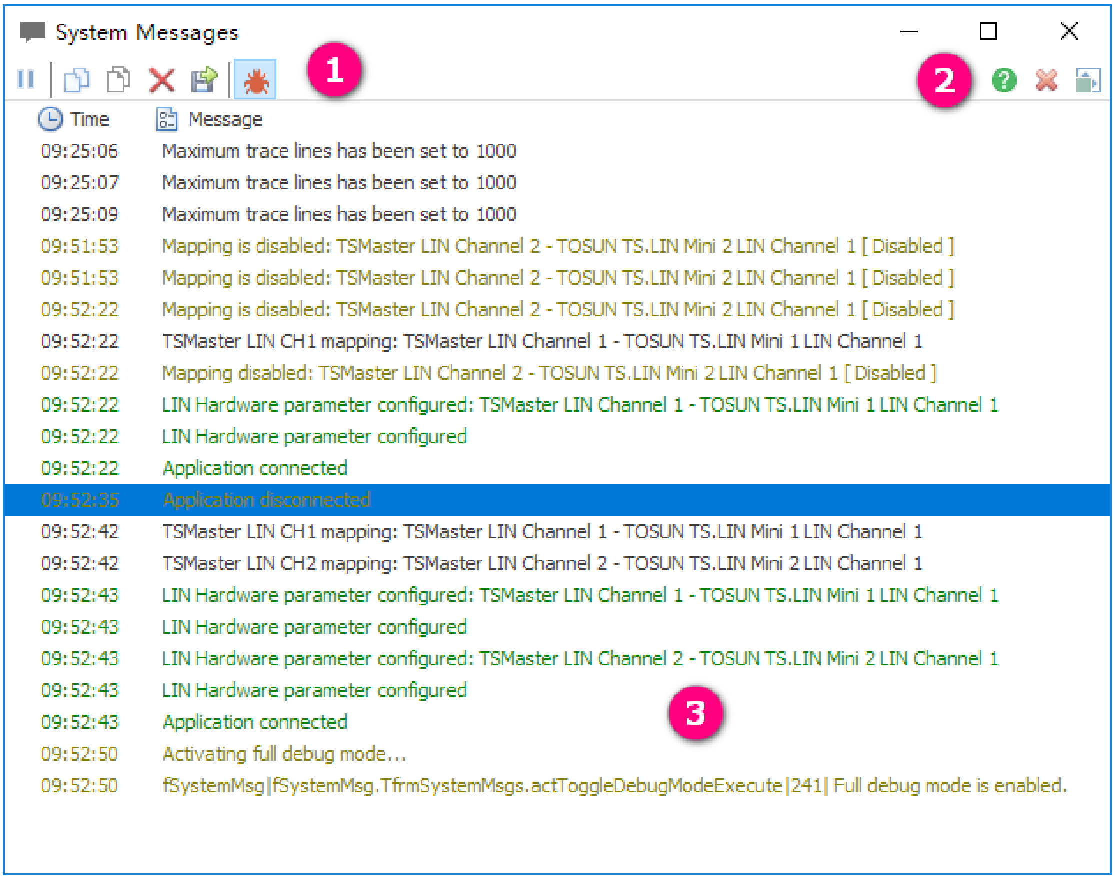
◼ Verbose: Message of minor importance

🟫 Hint: Message that should to come into notice

🟩 OK: Message that indicates the current operation is successful

🟥 Error: The current operation encounters an error

The description of system message window is shown below:



```
09:25:06   Maximum trace lines has been set to 1000
09:25:07   Maximum trace lines has been set to 1000
09:25:09   Maximum trace lines has been set to 1000
09:51:53   Mapping is disabled: TSMaster LIN Channel 2 - TOSUN TS.LIN Mini 2 LIN Channel 1 [ Disabled ]
09:51:53   Mapping is disabled: TSMaster LIN Channel 2 - TOSUN TS.LIN Mini 2 LIN Channel 1 [ Disabled ]
09:52:22   Mapping is disabled: TSMaster LIN Channel 2 - TOSUN TS.LIN Mini 2 LIN Channel 1 [ Disabled ]
09:52:22   TSMaster LIN CH1 mapping: TSMaster LIN Channel 1 - TOSUN TS.LIN Mini 1 LIN Channel 1
09:52:22   Mapping disabled: TSMaster LIN Channel 2 - TOSUN TS.LIN Mini 2 LIN Channel 1 [ Disabled ]
09:52:22   LIN Hardware parameter configured: TSMaster LIN Channel 1 - TOSUN TS.LIN Mini 1 LIN Channel 1
09:52:22   LIN Hardware parameter configured
09:52:22   Application connected
09:52:35   Application disconnected
09:52:42   TSMaster LIN CH1 mapping: TSMaster LIN Channel 1 - TOSUN TS.LIN Mini 1 LIN Channel 1
09:52:42   TSMaster LIN CH2 mapping: TSMaster LIN Channel 2 - TOSUN TS.LIN Mini 2 LIN Channel 1
09:52:43   LIN Hardware parameter configured: TSMaster LIN Channel 1 - TOSUN TS.LIN Mini 1 LIN Channel 1
09:52:43   LIN Hardware parameter configured
09:52:43   LIN Hardware parameter configured: TSMaster LIN Channel 2 - TOSUN TS.LIN Mini 2 LIN Channel 1
09:52:43   LIN Hardware parameter configured
09:52:43   Application connected
09:52:50   Activating full debug mode...
09:52:50   fSystemMsg|fSystemMsg.TfrmSystemMsgs.actToggleDebugModeExecute|241| Full debug mode is enabled.
```

Fig 13 System Message Window

1. **Toolbar buttons**

❚❚ Pause checkbox, check to suppress the display of incoming messages

⧉ Copy the selected logs into clipboard

🗐 Copy all the logs into clipboard

✕ Clear the display of the current window, this will delete all the logs

💾 Save the log to a file on the disk

🐞 Debugging mode switch, check to open debug mode, each log message will then contain stack trace info.

2. **Common window buttons**

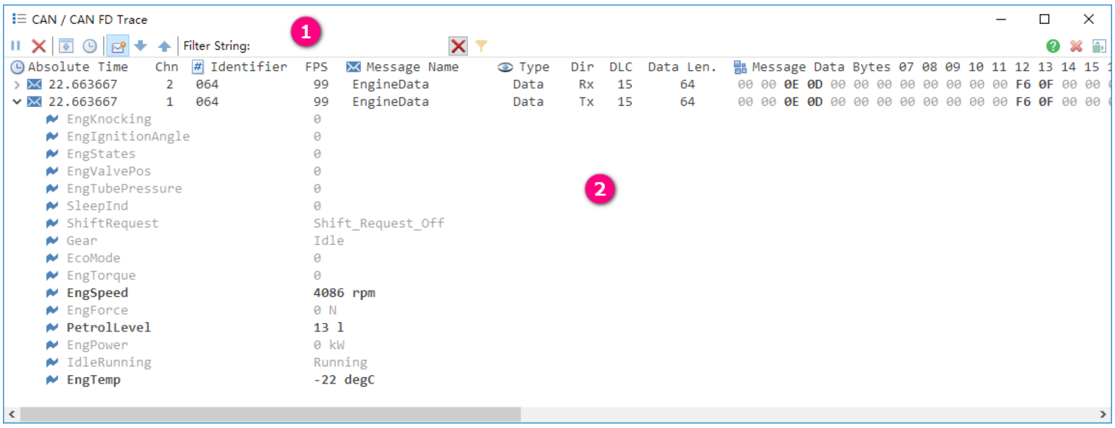
? Opens help document for the current window

✖ Delete or hide the current window, if the user selects “Delete”, the window will be destroyed and will not appear in any of the application tabs; if the user selects “Hide”, the window will be hidden in the current tab, but may be displayed in other tabs. Note: the default operation of closing a window by clicking on the right-top red button of a window – □ × is to hide it.

3. **Logging area**: The time and description of events are displayed here.

1.4 CAN / CAN FD Trace

CAN / CAN FD Trace window display events from CAN / CAN FD networks.



```
Absolute Time   Chn  Identifier   FPS   Message Name     Type   Dir  DLC  Data Len.   Message Data Bytes 07 08 09 10 11 12 13 14 15
> 22.663667      2   064          99    EngineData       Data   Rx   15      64       00 00 0E 0D 00 00 00 00 00 00 00 00 F6 0F 00 00
v 22.663667      1   064          99    EngineData       Data   Tx   15      64       00 00 0E 0D 00 00 00 00 00 00 00 00 F6 0F 00 00
     EngKnocking                  0
     EngIgnitionAngle             0
     EngStates                    0
     EngValvePos                  0
     EngTubePressure              0
     SleepInd                     0
     ShiftRequest                 Shift_Request_Off
     Gear                         Idle
     EcoMode                      0
     EngTorque                    0
     EngSpeed                     4086 rpm
     EngForce                     0 N
     PetrolLevel                  13 l
     EngPower                     0 kW
     IdleRunning                  Running
     EngTemp                      -22 degC
```

Fig 14 CAN / CAN FD Trace Window

1.4.1 Trace toolbar

⏸ Pause display button, when checked, the “Pause” button will switch to “Continue” ▶ and incoming events will not be refreshed on the screen. The incoming events will be visible again when the “Continue” button is clicked.

✕ Clear the display of the current trace window.

⇩ This checkbox sets trace window in chronological view mode. In this mode every incoming new message will be display as one trace line.

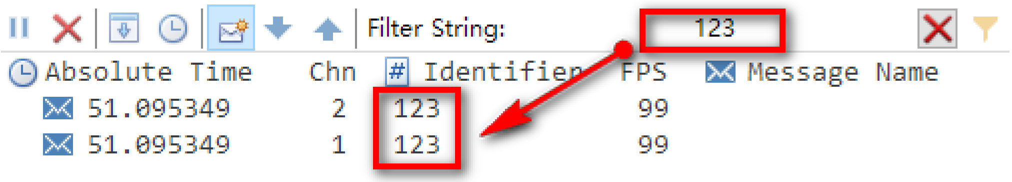
🕒 This checkbox sets trace window in relative time mode.

This checkbox ensures the trace list always scroll to the latest message.

Expand all message nodes to view their signal values.

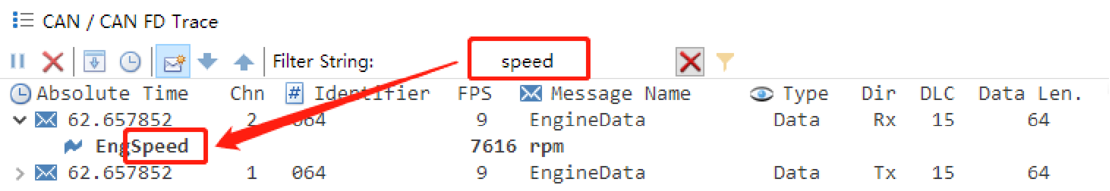
Collapse all message nodes so signals are hidden.

Filter String: speed ☒ Filter trace list with specified string, the filter string can be the following types:


Filter String: 123

Absolute Time	Chn	Identifier	FPS	Message Name
51.095349	2	123	99	
51.095349	1	123	99	

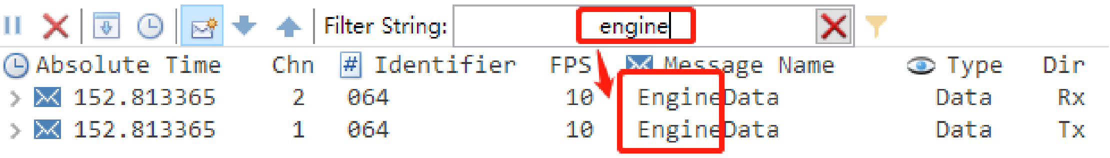
Fig 15 Filter by identifier


CAN / CAN FD Trace

Filter String: speed

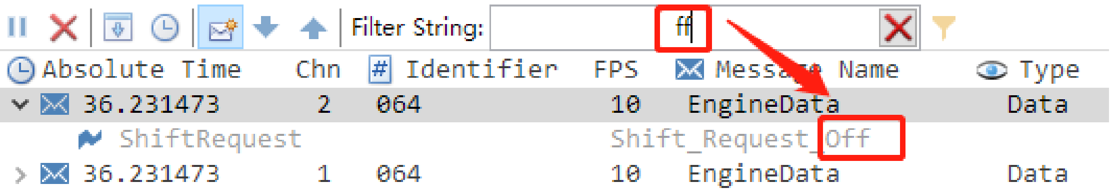
Absolute Time	Chn	Identifier	FPS	Message Name	Type	Dir	DLC	Data Len.
62.657852	2	064	9	EngineData	Data	Rx	15	64
EngSpeed			7616 rpm					
62.657852	1	064	9	EngineData	Data	Tx	15	64

Fig 16 Filter by signal name


Filter String: engine

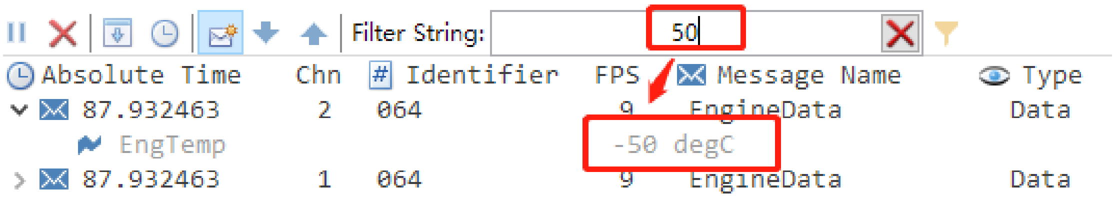
Absolute Time	Chn	Identifier	FPS	Message Name	Type	Dir
152.813365	2	064	10	EngineData	Data	Rx
152.813365	1	064	10	EngineData	Data	Tx

Fig 17 Filter by message name


Filter String: ff

Absolute Time	Chn	Identifier	FPS	Message Name	Type
36.231473	2	064	10	EngineData	Data
ShiftRequest			Shift_Request_Off		
36.231473	1	064	10	EngineData	Data

Fig 18 Filter by signal symbol value



Filter String: 50

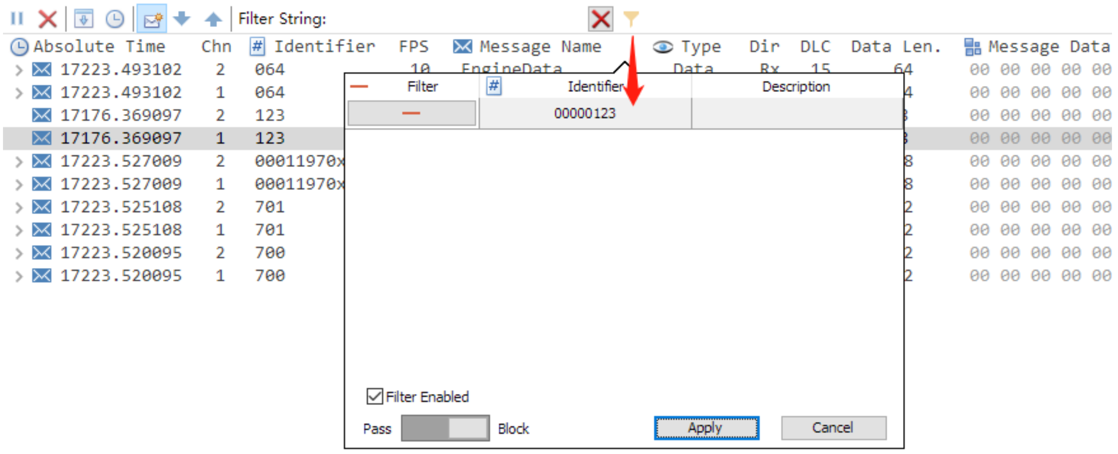
```
Absolute Time   Chn  Identifier   FPS  Message Name    Type
87.932463       2    064          9    EngineData      Data
    EngTemp                       -50 degC
87.932463       1    064          9    EngineData      Data
```

Fig 19 Filter by signal numeric value

☒ Clear filter value, the trace list will then display all the trace lines.

▼ Message filter tool, which allows specific message identifiers to display in the trace, and meanwhile blocks other message identifiers. User can use this message filter to hide some irrelevant messages, or just monitor certain messages.

1.4.2 Trace message identifier filter



Filter String:

```
Absolute Time     Chn  Identifier  FPS  Message Name  Type  Dir  DLC  Data Len.  Message Data
17223.493102      2    064         10   EngineData    Data  Rx   15   64         00 00 00 00 00
17223.493102      1    064                                             4          00 00 00 00 00
17176.369097      2    123                                                        00 00 00 00 00
17176.369097      1    123                                                        00 00 00 00 00
17223.527009      2    00011970x                                       8          00 00 00 00 00
17223.527009      1    00011970x                                       8          00 00 00 00 00
17223.525108      2    701                                             2          00 00 00 00 00
17223.525108      1    701                                             2          00 00 00 00 00
17223.520095      2    700                                             2          00 00 00 00 00
17223.520095      1    700                                             2          00 00 00 00 00
```

Filter	Identifier	Description
—	00000123	

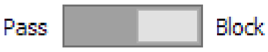
☑ Filter Enabled

Pass Block

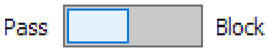
Apply Cancel

Fig 20 Trace message identifier filter

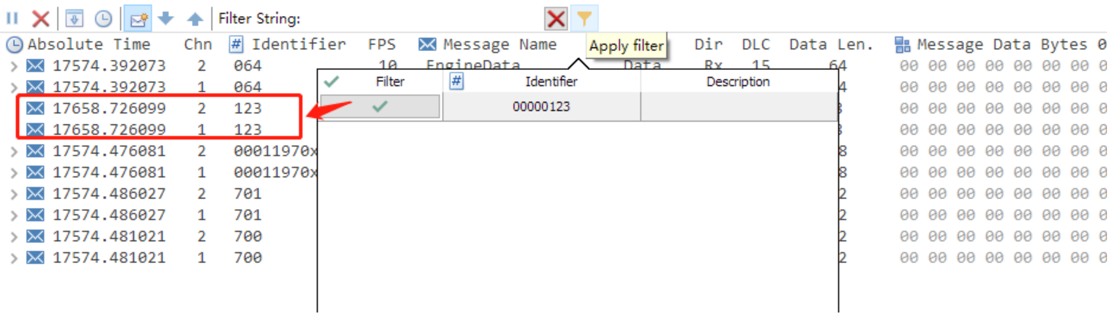
The trace message identifier filter works under either of the two conditions:

1. Block mode 

The message identifier in the list will be blocked, and other message will pass the fiter. In the above picture, only 0x123 will be blocked, while other message identifiers will be displayed in the trace window.

2. Pass mode 

The message identifier in the list will be passed, and other message will be blocked. In the following picture, only 0x123 will be refreshed in the trace list:

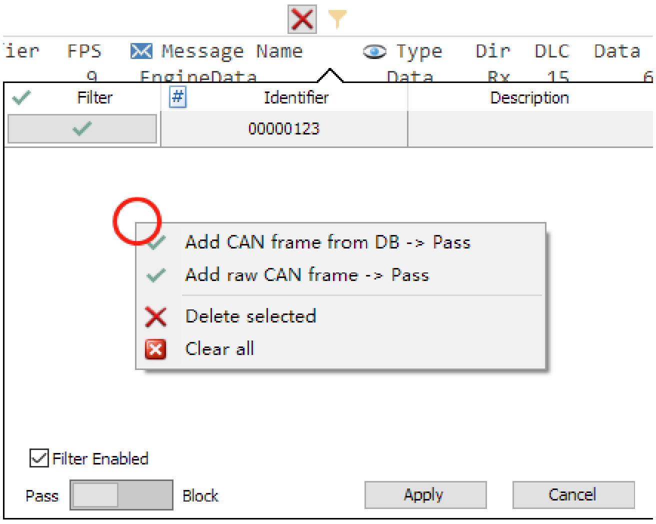


Absolute Time	Chn	Identifier	Message Data Bytes
17574.392073	2	064	00 00 00 00 00 00 00 0
17574.392073	1	064	00 00 00 00 00 00 00 0
17658.726099	2	123	00 00 00 00 00 00 00 0
17658.726099	1	123	00 00 00 00 00 00 00 0
17574.476081	2	00011970x	00 00 00 00 00 00 00 0
17574.476081	1	00011970x	00 00 00 00 00 00 00 0
17574.486027	2	701	00 00 00 00 00 00 00 0
17574.486027	1	701	00 00 00 00 00 00 00 0
17574.481021	2	700	00 00 00 00 00 00 00 0
17574.481021	1	700	00 00 00 00 00 00 00 0

Filter	Identifier	Description
✓	00000123	

Fig 21 Message identifier filter working in pass mode

To add or delete message identifiers in the list, just right-click on the empty area of the list, you will see the following popup menu items:

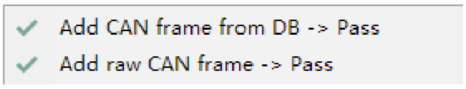


Filter	Identifier	Description
✓	00000123	

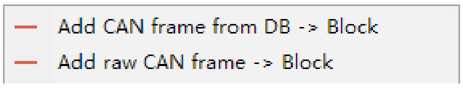
☑ Filter Enabled

Pass Block

Fig 22 Add or delete message identifiers in the list



Add CAN frame identifiers from database or on the fly. These added message identifiers will be passed to the trace list. These menu items will be shown when the filter is in pass mode.



Add CAN frame identifiers from database or on the fly. These added message identifiers will be blocked and will not be displayed in the trace list. These menu items will be shown when the filiter is in block mode.

This operation will remove the selected message identifier from the filter list.

This operation clears all the message identifier items from the filter list.

This checkbox controls whether the message identifier filter is enabled or not.

1.4.3 Trace list columns

Absolute Time: Absolute measurement time in seconds, this is the default time display format. The absolute time or message will be displayed in this column.

Relative Time: The relative time indicates the time in relation to the preceding message. In chronological mode this is the message received directly before the current message, whereas in fixed position mode the relative time is displayed in relation to the previous message of the same type.

Chn: The channel number of the message.

Identifier: CAN message identifier, extended identifier format will add a “x” symbol to the identifier value.

FPS: Frames per second, this column displays the frame rate of specific identifier.

Message Name: The name of the message defined in the database.

Type: CAN message type will be displayed here including the following:

- Data: Classical CAN data frame
- Remote: Classical CAN remote frame
- FD: CAN FD frame

Dir: Direction of the CAN message, can be Tx (transmit) or Rx (receive)

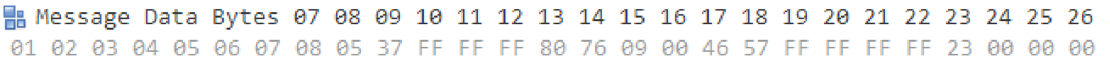
DLC: Data length code from CAN messages, in CAN FD frame the DLC has the following relationships with the length of data bytes:

DLC	Data length
0~8	Same as DLC
9	12
10	16

11	20
12	24
13	32
14	48
15	64

Data Len: The length of data bytes.

Message Data Bytes: Each data byte of the message. In CAN FD frame, the data byte can be larger than 8 bytes, each data byte with index starting from 0 is shown:

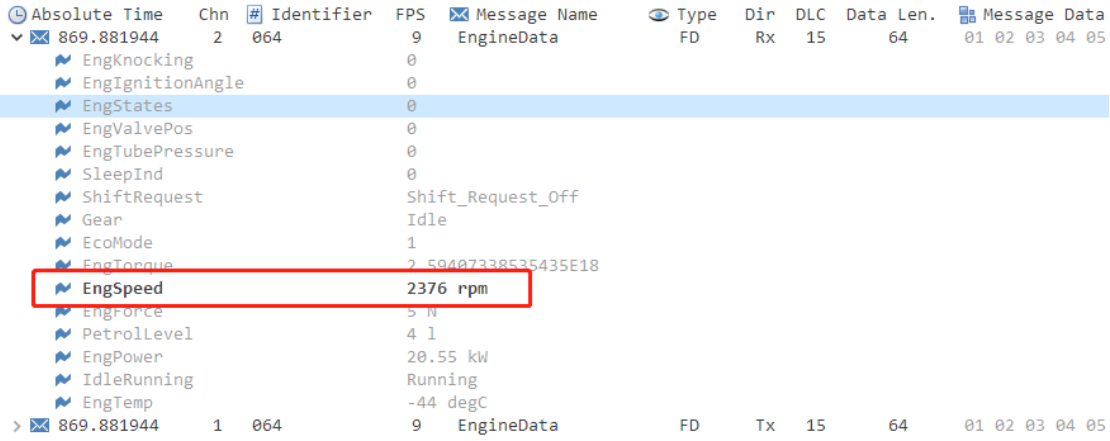


```
Message Data Bytes 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
 01 02 03 04 05 06 07 08 05 37 FF FF FF 80 76 09 00 46 57 FF FF FF FF 23 00 00 00
```

Fig 23 Message data bytes with index starting from 0

1.4.4 Trace Signals Display

Trace signals can be expanded if a message is defined in the loaded CAN database:

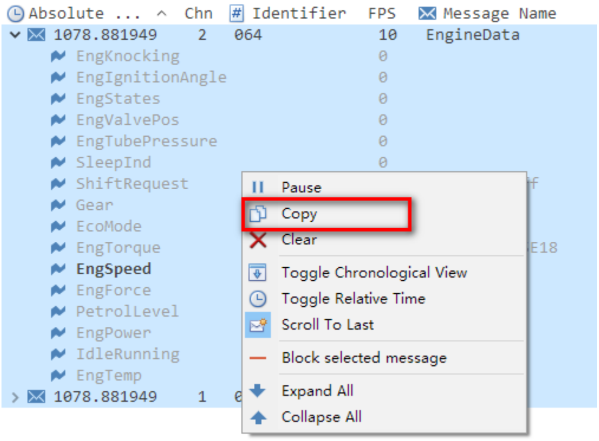


```
Absolute Time   Chn  Identifier  FPS  Message Name      Type  Dir  DLC  Data Len.  Message Data
v 869.881944    2    064         9    EngineData        FD    Rx   15   64         01 02 03 04 05
    EngKnocking                  0
    EngIgnitionAngle             0
    EngStates                    0
    EngValvePos                  0
    EngTubePressure              0
    SleepInd                     0
    ShiftRequest                 Shift_Request_Off
    Gear                         Idle
    EcoMode                      1
    EngTorque                    2.59407338535435E18
    EngSpeed                     2376 rpm
    EngForce                     5 N
    PetrolLevel                  4 l
    EngPower                     20.55 kW
    IdleRunning                  Running
    EngTemp                      -44 degC
> 869.881944    1    064         9    EngineData        FD    Tx   15   64         01 02 03 04 05
```

Fig 24 Signals with updated values highlighted

1.4.5 Popup Menus

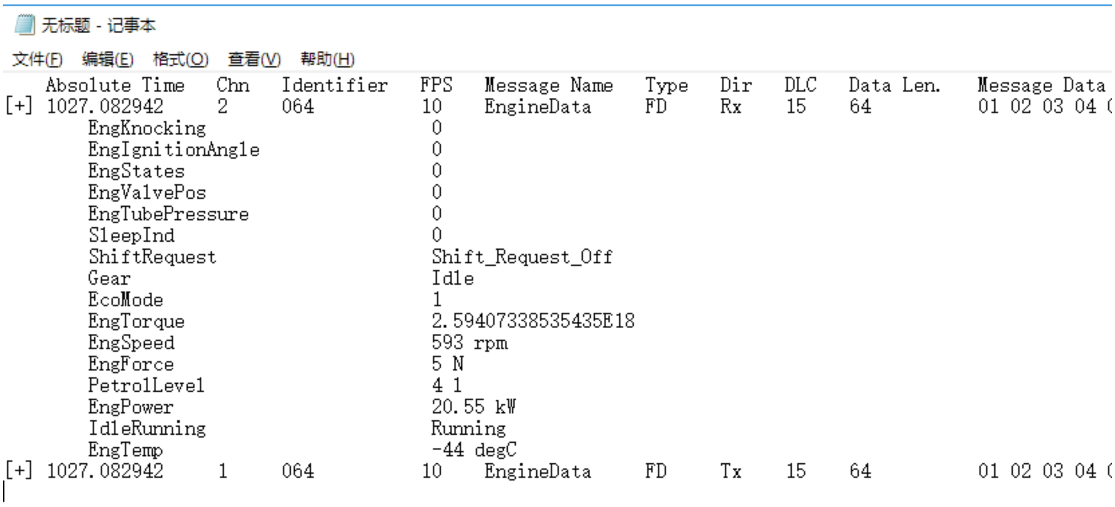
Most of trace popup menu items can be found in trace toolbar except “Copy” and “Block selected message”:



```
Absolute ...  ^  Chn   Identifier   FPS   Message Name
v 1078.881949    2     064          10    EngineData
    EngKnocking                     0
    EngIgnitionAngle                0
    EngStates                       0
    EngValvePos                     0
    EngTubePressure                 0
    SleepInd                        0
    ShiftRequest
    Gear
    EcoMode
    EngTorque
    EngSpeed
    EngForce
    PetrolLevel
    EngPower
    IdleRunning
    EngTemp
> 1078.881949    1
```

Fig 25 Trace popup menu

To copy the trace lines, the user has to select certain trace lines and then click the “Copy” item. The selected text has the same layout as trace display:

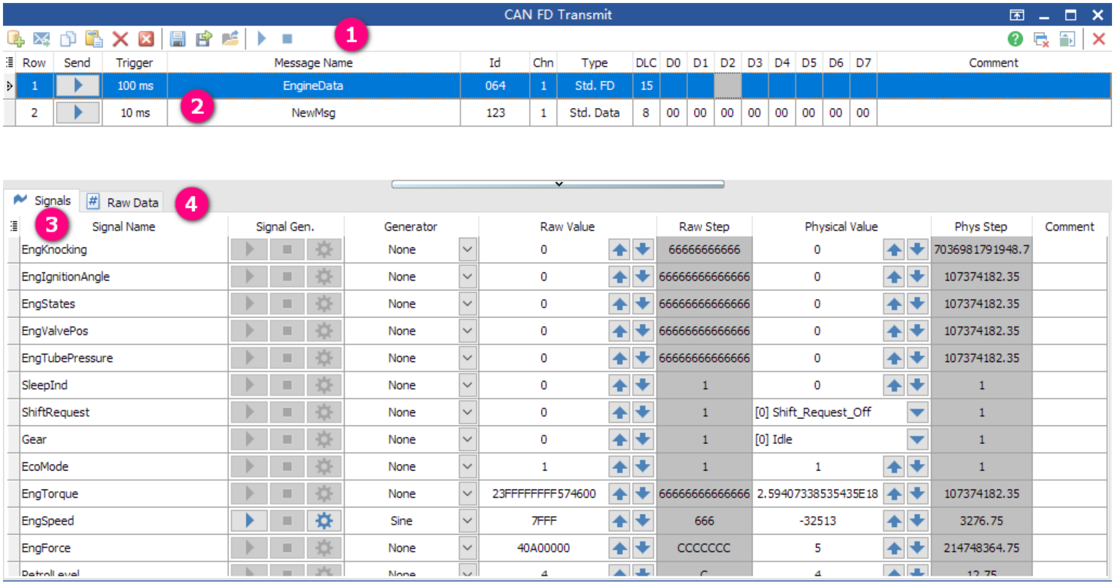


```
    Absolute Time    Chn    Identifier    FPS    Message Name    Type    Dir    DLC    Data Len.    Message Data
[+] 1027.082942      2      064           10     EngineData      FD      Rx     15     64           01 02 03 04 (
        EngKnocking                        0
        EngIgnitionAngle                   0
        EngStates                          0
        EngValvePos                        0
        EngTubePressure                    0
        SleepInd                           0
        ShiftRequest                       Shift_Request_Off
        Gear                               Idle
        EcoMode                            1
        EngTorque                          2.59407338535435E18
        EngSpeed                           593 rpm
        EngForce                           5 N
        PetrolLevel                        4 l
        EngPower                           20.55 kW
        IdleRunning                        Running
        EngTemp                            -44 degC
[+] 1027.082942      1      064           10     EngineData      FD      Tx     15     64           01 02 03 04 (
```

Fig 26 Selected trace lines in text

1.5 CAN / CAN FD Transmit Window

CAN / CAN FD frames can be transmitted manually or periodically by CAN / CAN FD transmit window:



Row	Send	Trigger	Message Name	Id	Chn	Type	DLC	D0	D1	D2	D3	D4	D5	D6	D7	Comment
1	▶	100 ms	EngineData	064	1	Std. FD	15									
2	▶	10 ms	NewMsg	123	1	Std. Data	8	00	00	00	00	00	00	00	00	

Signal Name	Signal Gen.	Generator	Raw Value	Raw Step	Physical Value	Phys Step	Comment
EngKnocking	▶ ■ ⚙	None	0	66666666666	0	7036981791948.7	
EngIgnitionAngle	▶ ■ ⚙	None	0	66666666666666	0	107374182.35	
EngStates	▶ ■ ⚙	None	0	66666666666666	0	107374182.35	
EngValvePos	▶ ■ ⚙	None	0	66666666666666	0	107374182.35	
EngTubePressure	▶ ■ ⚙	None	0	66666666666666	0	107374182.35	
SleepInd	▶ ■ ⚙	None	0	1	0	1	
ShiftRequest	▶ ■ ⚙	None	0	1	[0] Shift_Request_Off	1	
Gear	▶ ■ ⚙	None	0	1	[0] Idle	1	
EcoMode	▶ ■ ⚙	None	1	1	1	1	
EngTorque	▶ ■ ⚙	None	23FFFFFFFF574600	66666666666666	2.59407338535435E18	107374182.35	
EngSpeed	▶ ■ ⚙	Sine	7FFF	666	-32513	3276.75	
EngForce	▶ ■ ⚙	None	40A00000	CCCCCCC	5	214748364.75	
PetrolLevel	▶ ■ ⚙	None	4	C	4	12.75	

Fig 27 CAN / CAN FD Transmit Window

1.5.1 Transmit toolbar

Add a CAN message from database.

Add a raw CAN message directly into transmit list, which can be freely modified.

Copy selected CAN messages into clipboard, which can be pasted into current transmit list.

Paste the copied CAN message from clipboard into the current transmit list.

Delete the selected CAN messages from current list

Remove all the CAN messages from current list.

Save the current transmit list to an external file. For the first time a save dialog box appears for the user to specify destination file. The following save operations will overwrite this file.

Export the current transmit list to an external file.

Load transmit list from external file, this operation will overwrite all the existing transmit list.

▶ Start the transmission of the current transmit list. Note: this operation will send all the frames inside the transmit list, for manual transmit messages, only one frame is sent per message; for cyclic transmit messages, all of them are scheduled to be sent periodically.

■ Stop all the periodically transmitted messages. Note: this operation will be executed everytime when application disconnects.

1.5.2 Transmit list

The transmit list contains messages to be edited, each message has the following properties:

Row: The number of each transmit message in ascending order, this field is read-only and cannot be edited.

Send: This is a button controlling the current message transmission. The style of this button depends on the trigger type of the current message:

- Manal transmit message: Each click on this button will trigger one CAN message transmission.
- Periodic transmit message: The first click on this button will start the cyclic transmission of this message. The transmit button will then switch to a "Stop" button: ■ The next click on this stop button will stop the cyclic transmission of the current message.

Trigger: Message transmission type:

- Manual: One click on the "Send" button will trigger one CAN message transmission
- Periodic: Periodic transmission type has the following properties:

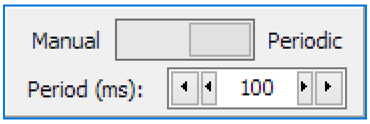

Manual Periodic
Period (ms): 100

Fig 28 Periodic transmission type configuration

The period can be within range from 1ms to 1000000000ms.

Message Name: The name of the message, if this message is added from CAN database, then the message name is defined by CAN database and cannot be modified by user; if this message is added manually, then the name of the message can be freely altered by user.

Id: Identifier of CAN message.

Chn: The channel number of CAN message.

Type: CAN frame type, can be the one of the following 6 types:

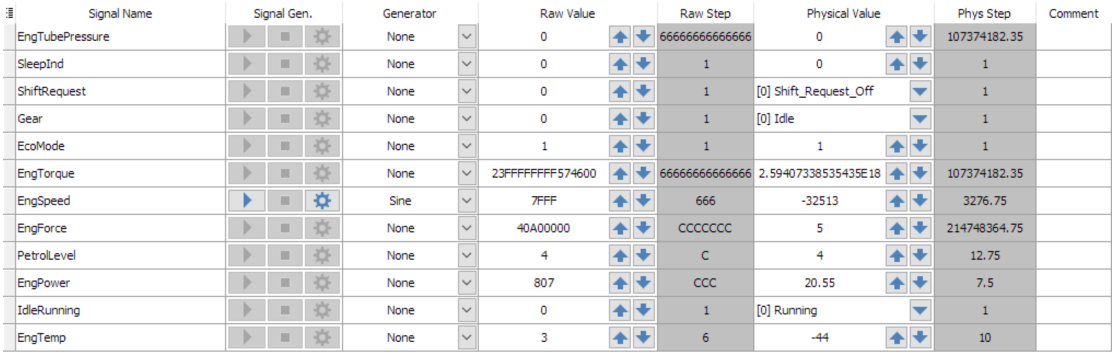
- Std. Data: Classical CAN data frame with standard identifier
- Std. Remote: Classical CAN remote frame with standard identifer
- Std. FD: FD frame with standard identifier
- Ext. Data: Classical CAN data frame with extended identifier
- Ext. Remote: Classical CAN remote frame with extended identifier
- Ext. FD: FD frame with extended identifier

DLC: Data length code of the CAN message, which can be within range 0~15.

D0~D7: Classical CAN data frame data byte editors. Note: In FD CAN frame, these editors are unavailable and replaced by “Raw Data” editors located on the bottom panel.

1.5.3 Signals list

Signals list displays editors for modifying signal properties of the selected CAN message defined in CAN database. The raw CAN messages do not have signals list editors.



Signal Name	Signal Gen.	Generator	Raw Value	Raw Step	Physical Value	Phys Step	Comment
EngTubePressure		None	0	66666666666666	0	107374182.35	
SleepInd		None	0	1	0	1	
ShiftRequest		None	0	1	[0] Shift_Request_Off	1	
Gear		None	0	1	[0] Idle	1	
EcoMode		None	1	1	1	1	
EngTorque		None	23FFFFFFFF574600	66666666666666	2.59407338535435E18	107374182.35	
EngSpeed		Sine	7FFF	666	-32513	3276.75	
EngForce		None	40A00000	CCCCCCC	5	214748364.75	
PetrolLevel		None	4	C	4	12.75	
EngPower		None	807	CCC	20.55	7.5	
IdleRunning		None	0	1	[0] Running	1	
EngTemp		None	3	6	-44	10	

Fig 29 Signals list of the selected CAN message

1.5.3.1 Signal Name

The signal name defined in the CAN database.

1.5.3.2 Signal Gen.

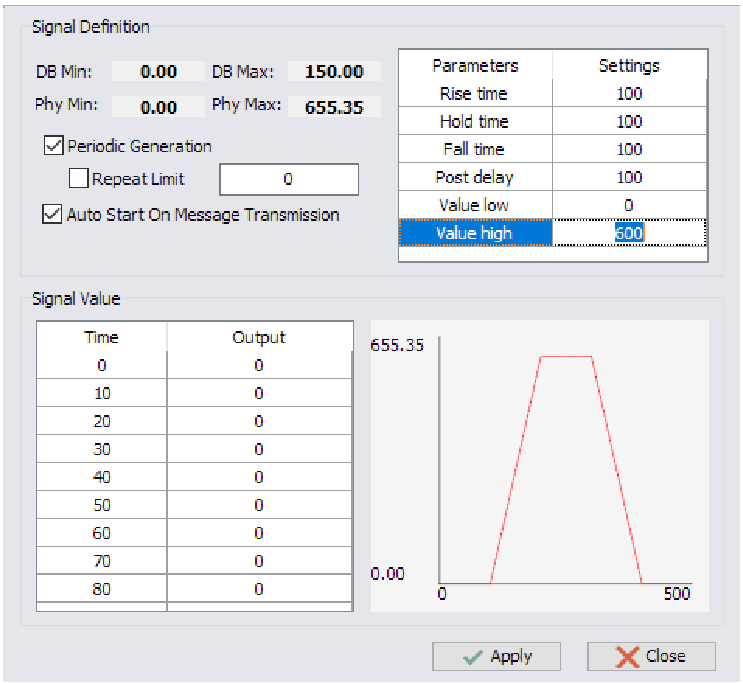
The signal value generator feature, which has three buttons for sending and configuring the value changing behavior of each CAN signal:

- ▶ Start generating of the current signal. Once this button is clicked, the button changes to “Pause” button shown below.
- ⏸ Pause button, once this button is clicked, the current CAN signal generator pauses, the button then changes back to “Send” button shown above.
- ■ Stop button, a click on this button stop the operation of the current CAN signal generator.

1.5.3.3 Generator

This combobox specifies the generator type of the current CAN signal, which has the following choices:

- None: No CAN signal generator is available, the signal value in the sent CAN message depends on the physical value set on the “Physical Value” on the right side.
- Ramps and Pulses:



Signal Definition

DB Min: 0.00 DB Max: 150.00

Phy Min: 0.00 Phy Max: 655.35

☑ Periodic Generation

□ Repeat Limit 0

☑ Auto Start On Message Transmission

Parameters	Settings
Rise time	100
Hold time	100
Fall time	100
Post delay	100
Value low	0
Value high	500

Signal Value

Time	Output
0	0
10	0
20	0
30	0
40	0
50	0
60	0
70	0
80	0

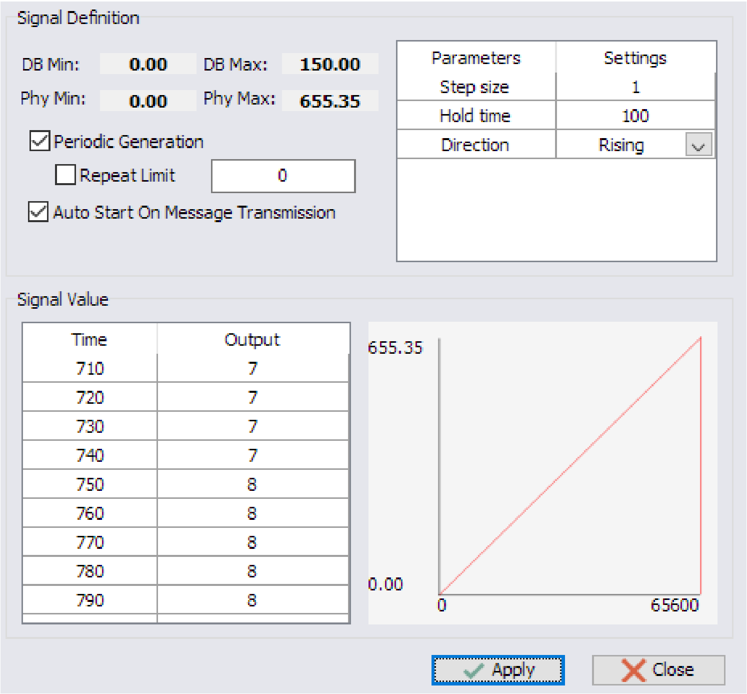
Fig 30 Ramps and Pulses signal generator

The selected CAN signal will be generated in the time series of Rise-Hold-Fall-Delay. The high value, low value and each time segment can be modified.

- DB Min and Max: The minimum and maximum value defined in the database.
- Phy Min and Max: The physical minimum and maximum value that the signal can reach.
- Periodic Generation: The signal generator can restart itself when a period of value has been generated.
- Repeat Limit: The restart count of periodic generation, if not specified, the restart count of periodic generation is unlimited. This limit number depends on the activation status of “Periodic Generation”.
- Auto Start On Message Transmission: The signal generator will automatically start when the parent message is scheduled to be transmitted periodically.
- Signal Value table: The signal value table defines each signal physical value against time in milliscends. The table is read-only except custom signal generator.
- Parameter list: The signal waveform depends the parameters defined in this table.

- Signal waveform preview: The signal value being generated by this generator can be previewed in a time-value view here.

- Value Range



Signal Definition

DB Min: 0.00 DB Max: 150.00

Phy Min: 0.00 Phy Max: 655.35

☑ Periodic Generation

□ Repeat Limit 0

☑ Auto Start On Message Transmission

Parameters	Settings
Step size	1
Hold time	100
Direction	Rising

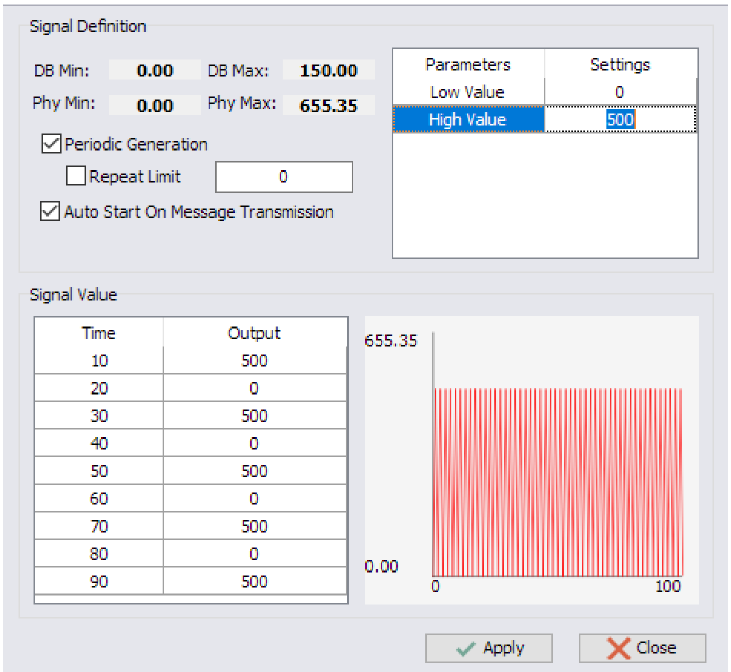
Signal Value

Time	Output
710	7
720	7
730	7
740	7
750	8
760	8
770	8
780	8
790	8

Fig 31 Value range signal generator

The value range generator traverses the signal value in “Rising”, “Falling” and “Alternate” methods.

- Toggle



Signal Definition

DB Min: 0.00 DB Max: 150.00

Phy Min: 0.00 Phy Max: 655.35

☑ Periodic Generation

□ Repeat Limit 0

☑ Auto Start On Message Transmission

Parameters	Settings
Low Value	0
High Value	500

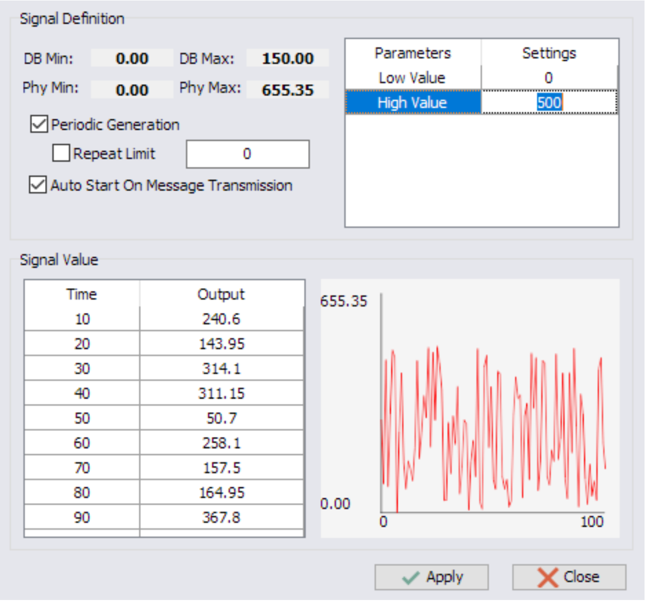
Signal Value

Time	Output
10	500
20	0
30	500
40	0
50	500
60	0
70	500
80	0
90	500

Fig 32 Toggle signal generator

The toggle signal generator changes the signal value between low and high. The low and high value can be specified by the user.

- Random



Signal Definition

DB Min: 0.00 DB Max: 150.00

Phy Min: 0.00 Phy Max: 655.35

☑ Periodic Generation

□ Repeat Limit 0

☑ Auto Start On Message Transmission

Parameters	Settings
Low Value	0
High Value	500

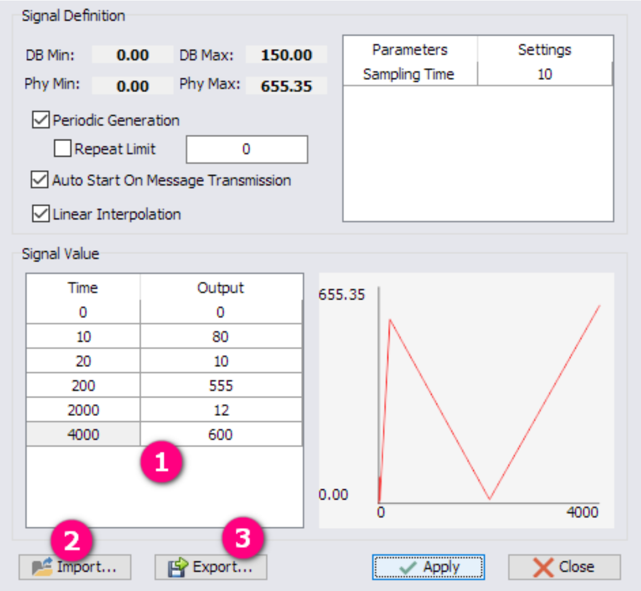
Signal Value

Time	Output
10	240.6
20	143.95
30	314.1
40	311.15
50	50.7
60	258.1
70	157.5
80	164.95
90	367.8

Fig 33 Random signal generator

The random signal generator outputs random signal values. The low value and high value of the random range can be specified.

- User Defined



Signal Definition

DB Min: 0.00 DB Max: 150.00

Phy Min: 0.00 Phy Max: 655.35

☑ Periodic Generation

☐ Repeat Limit 0

☑ Auto Start On Message Transmission

☑ Linear Interpolation

Parameters	Settings
Sampling Time	10

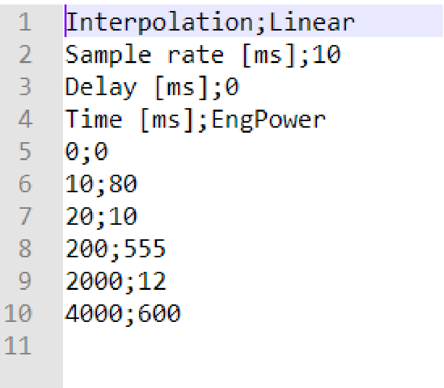
Signal Value

Time	Output
0	0
10	80
20	10
200	555
2000	12
4000	600

Fig 34 User defined signal generator

User defined signal generator provides an interface for the user to interact with the signal values. The user can make the waveform from external software such as excel, and then import the waveform data into the transmission value table.

1. **Signal Value table**: To append a new value into the table, press “Down” key. To insert a new value before the selected value in the table, press “Insert” key. Note: the time series in the table must be in ascending order, otherwise the generator will stop on the incorrect time.
2. **Import button**: The user can import signal waveform defined externally. The waveform data file should have the extension of “*.sig” and should have the following format:



```
Interpolation;Linear
Sample rate [ms];10
Delay [ms];0
Time [ms];EngPower
0;0
10;80
20;10
200;555
2000;12
4000;600

```

Fig 35 User defined signal generator import file format

Line 1: Interpolation method, only Linear is supported currently.

Line 2: Sample rate in milliseconds. Note: the charactor “;” is the separator between the key and value in the “key - value” pair.

Line 3: Delay time in milliseconds.

Line 4: Table description of the following “key - value” pair.

Line 5 and the following: Table data defined in “key - value” pair which are separated by “;” character.

3. **Export button**: The export feature of the signal generator, which will export the current table value into a “*.sig” file.

1.5.3.4 Raw Value

Raw value editor of the current selected signal. To modify a signal’s raw value without touching its physical value, use this editor.

⬆⬇ Increment and decrement button of the raw value. Clicking on the corresponding button increments or decrements the raw value by the step defined on the “Raw Step” field.

1.5.3.5 Raw Step

The increment or decrement step of the “Raw Value” field.

1.5.3.6 Physical Value

Physical value editor of the current selected signal. To modify a signal’s physical value without touching its raw value, use this editor.

⬆⬇ Increment and decrement button of the physical value. Clicking on the corresponding button increments or decrements the physical value by the step defined on the “Phys Step” field.

1.5.3.7 Phys Step

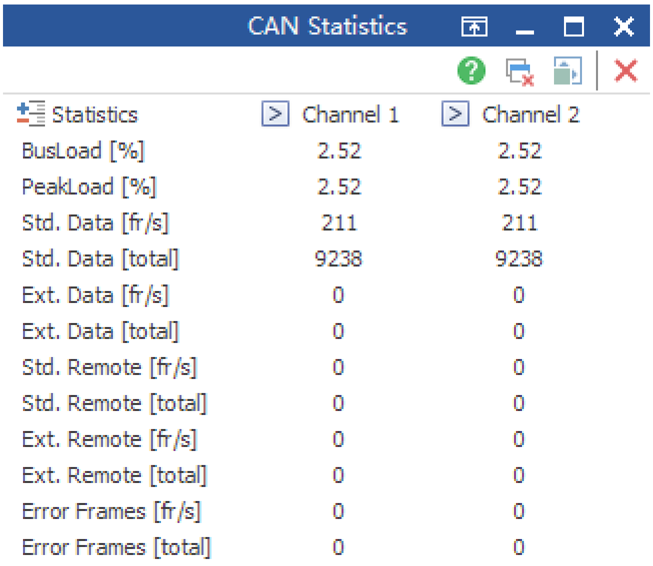
The increment or decrement step of the “Physical Value” field.

1.5.3.8 Comment

User comment on the specified signal.

1.6 CAN Statistics

1.6.1 CAN Statistics list



Statistics	Channel 1	Channel 2
BusLoad [%]	2.52	2.52
PeakLoad [%]	2.52	2.52
Std. Data [fr/s]	211	211
Std. Data [total]	9238	9238
Ext. Data [fr/s]	0	0
Ext. Data [total]	0	0
Std. Remote [fr/s]	0	0
Std. Remote [total]	0	0
Ext. Remote [fr/s]	0	0
Ext. Remote [total]	0	0
Error Frames [fr/s]	0	0
Error Frames [total]	0	0

Fig 36 CAN Statistics

CAN Statistics window displays bus load and frame rate of each CAN channel. The following value can be monitored:

Bus Load: CAN bus load in percentage.

Peak Load: CAN bus peak load from the start of measurement in percentage.

Std. Data [fr / s]: Standard classical CAN data frame rate per second.

Std. Data [total]: Total number of classical standard CAN data frame.

Ext. Data [fr / s]: Extended classical CAN data frame rate per second.

Ext. Data [total]: Total number of classical extended CAN data frame.

Std. Remote [fr / s]: Standard classical CAN remote frame rate per second.

Std. Remote [total]: Total number of remote classical CAN remote frame.

Ext. Remote [fr / s]: Extended classical CAN remote frame rate per second.

Ext. Remote [total]: Total number of extended classical CAN remote frame.

Error frames [fr / s]: CAN error frame rate per second.

Error frames [total]: Total number of CAN error frames.

1.6.2 CAN statistics popup menu

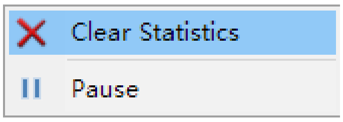


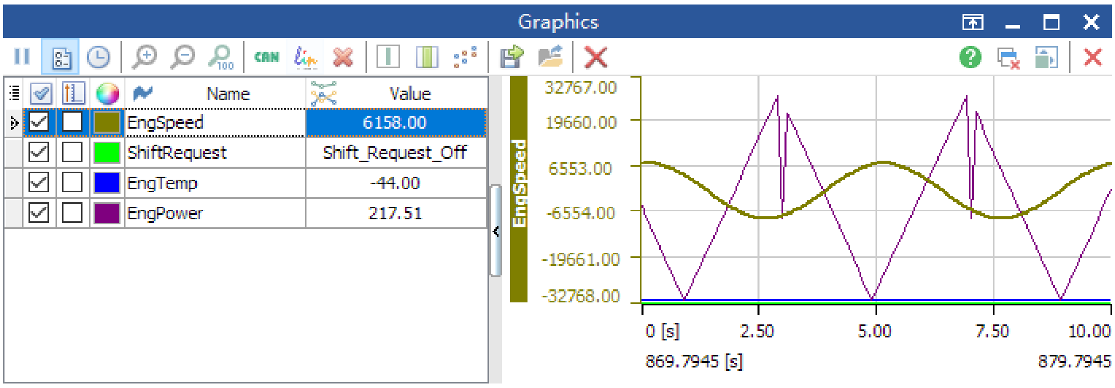
Fig 37 CAN statistics popup menu

Clear Statistics: Clear all the statistics data immediately.

Pause: Pause the display of current CAN statistics data.

1.7 Graphics

Graphics window displays signals from CAN, CAN FD and LIN messages.



			Name	Value
☑	□	🟫	EngSpeed	6158.00
☑	□	🟩	ShiftRequest	Shift_Request_Off
☑	□	🟦	EngTemp	-44.00
☑	□	🟪	EngPower	217.51

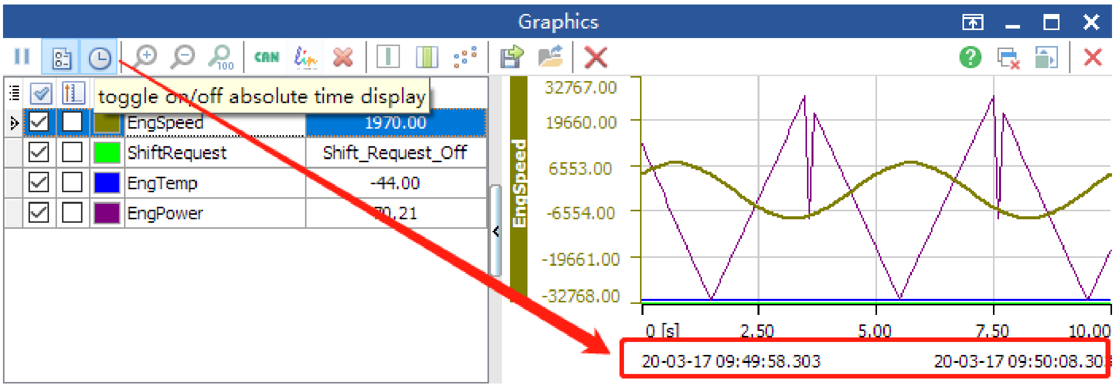
Fig 38 Graphics

1.7.1 Graphics toolbar

⏸ Pause the display of graphics, the next click on this button will resume the display of graphics.

▤ This checkbox controls the display of left signal list panel.

Absolute time and relative time switch box, when enabled, the time axis in the graphics will switch to a formatted date time display:



☑	□	🟫	EngSpeed	1970.00
☑	□	🟩	ShiftRequest	Shift_Request_Off
☑	□	🟦	EngTemp	-44.00
☑	□	🟪	EngPower	?0.21

Fig 39 Formatted date time display of time axis

When disabled, the time axis will display relative time relative to the beginning of measurement.

Zoom in button, click to zoom in the graphic display in time.

Zoom out button, click to zoom out the graphic display in time.

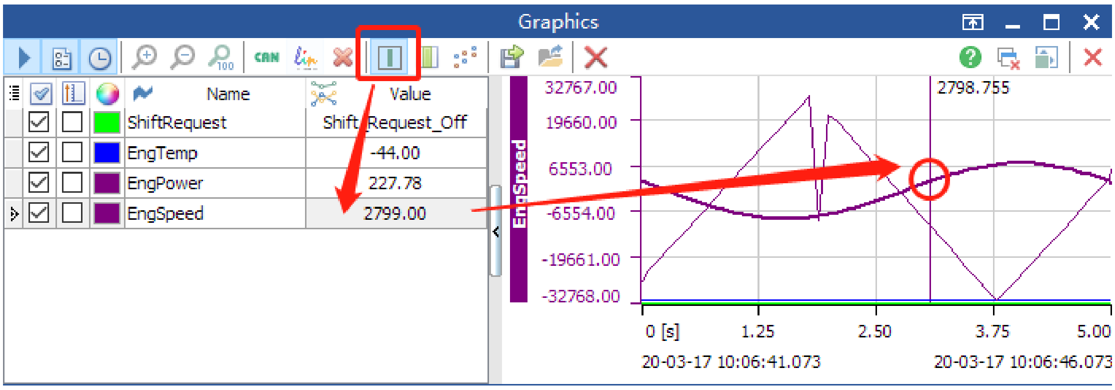
Zoom reset button, click to set the graphics display to original zoom factor.

Add a CAN signal from database.

Add a LIN signal from database.

Delete the selected signal in the list.

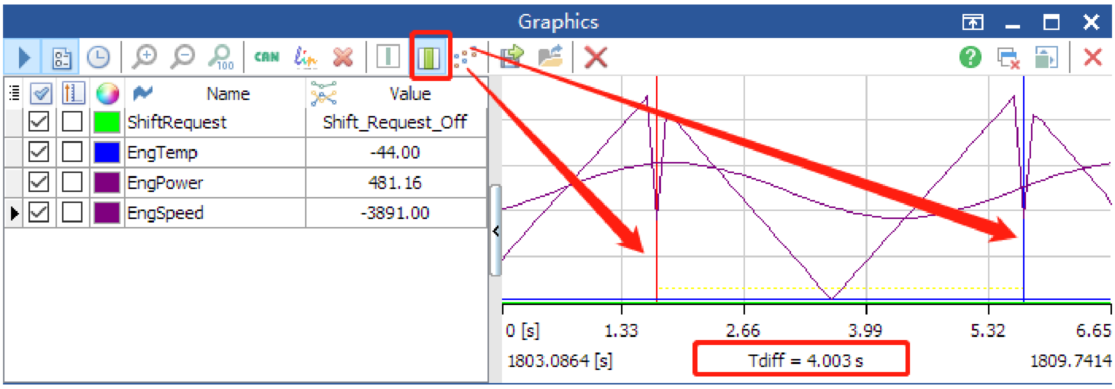
This checkbox displays or hides the measurement cursor. When this checkbox is checked, a measurement cursor will be displayed on the graphics window, which displays the selected signal value according to the measurement time. Move the cursor across the graphic area, you will see the value displayed in the measurement cursor being continuously updated. Uncheck this checkbox hids the measurement cursor.



			Name	Value
☑	□	🟩	ShiftRequest	Shift_Request_Off
☑	□	🟦	EngTemp	-44.00
☑	□	🟪	EngPower	227.78
☑	□	🟪	EngSpeed	2799.00

Fig 40 Graphics measurement cursor

Time measurement cursor checkbox. This checkbox shows or hides the time measurement cursor pair.

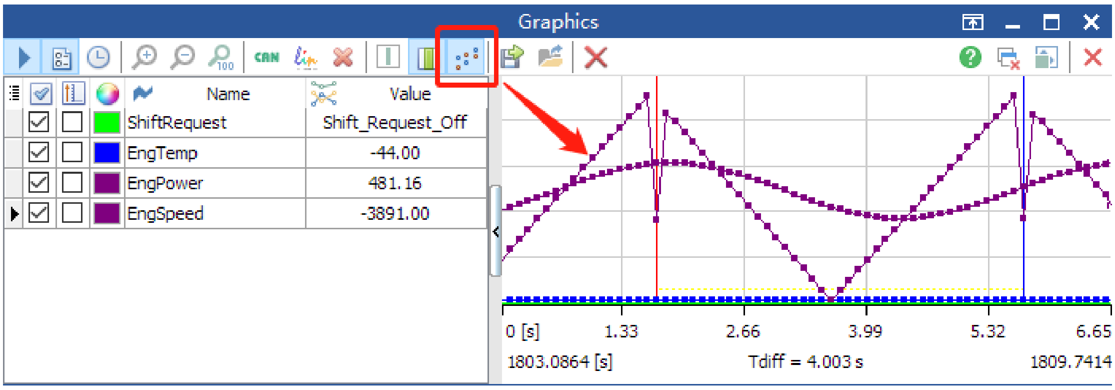


			Name	Value
☑	□	🟩	ShiftRequest	Shift_Request_Off
☑	□	🟦	EngTemp	-44.00
☑	□	🟪	EngPower	481.16
☑	□	🟪	EngSpeed	-3891.00

Fig 41 Time measurement cursor checkbox

When the time measurement cursor is enabled, the user can define a time range between blue cursor and red cursor. “Left click” on the graphics window drops a blue cursor to the location of the click point, and “Right click” on the graphics window drops a red cursor to the location of the click point. The delta time between blue cursor and red cursor will then be displayed on the bottem area of time axis in the graphics window.

Sample point display. When this checkbox is checked, each sample point will be displayed in the graphics window, it is easy for the user to detect frame loss situation with the help of the samle point display.



☑				Name	Value
☑	□	🟩	ShiftRequest		Shift_Request_Off
☑	□	🟦	EngTemp		-44.00
☑	□	🟪	EngPower		481.16
☑	□	🟪	EngSpeed		-3891.00

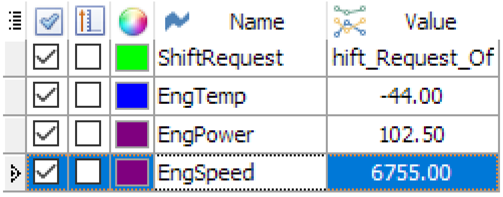
Fig 42 Sample point display

Export graphics data to an external location. Note: this button is only enabled when application disconnects.

Import graphics data from an external location. Note: this button is only enabled when application disconnects.

✕ Clears all the data in the graphics.

1.7.2 Graphics signal list

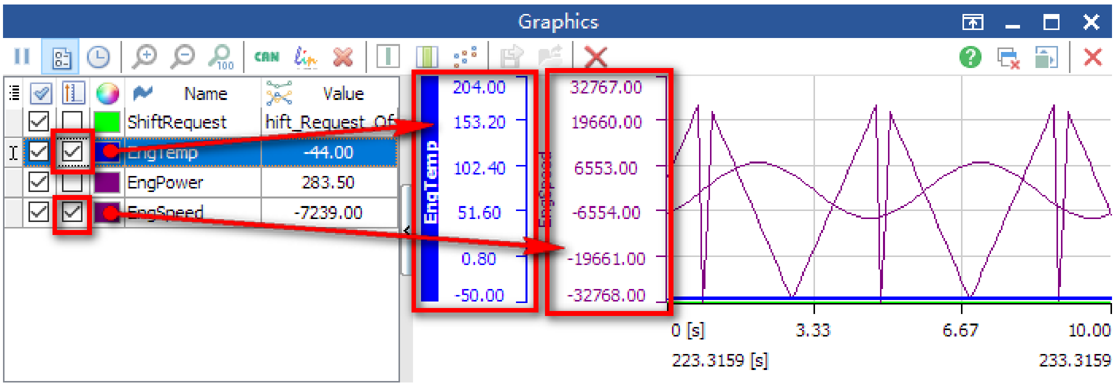


☑				Name	Value
☑	□	🟩	ShiftRequest		hift_Request_Of
☑	□	🟦	EngTemp		-44.00
☑	□	🟪	EngPower		102.50
☑	□	🟪	EngSpeed		6755.00

Fig 43 Graphics signal list

☑ Signal visibility checkbox, the signal will be set to hidden when this checkbox is unchecked.

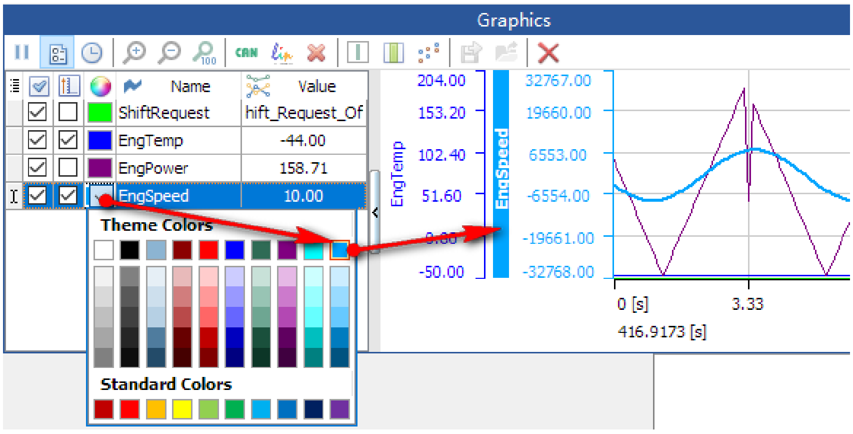
Always show value axis checkbox, if the checkbox is checked, the value axis of the specified signal will be displayed in the graphics window permanently.



			Name	Value
☑	□	🟩	ShiftRequest	hift_Request_Of
☑	☑	🟦	EngTemp	-44.00
☑	□	🟪	EngPower	283.50
☑	☑	🟪	EngSpeed	-7239.00

Fig 44 Signal axis display

Color picker. Clicking on this button will popup a dialogbox for the user to pick a color for the specified signal:



			Name	Value
☑	□	🟩	ShiftRequest	hift_Request_Of
☑	☑	🟦	EngTemp	-44.00
☑	□	🟪	EngPower	158.71
☑	☑		EngSpeed	10.00

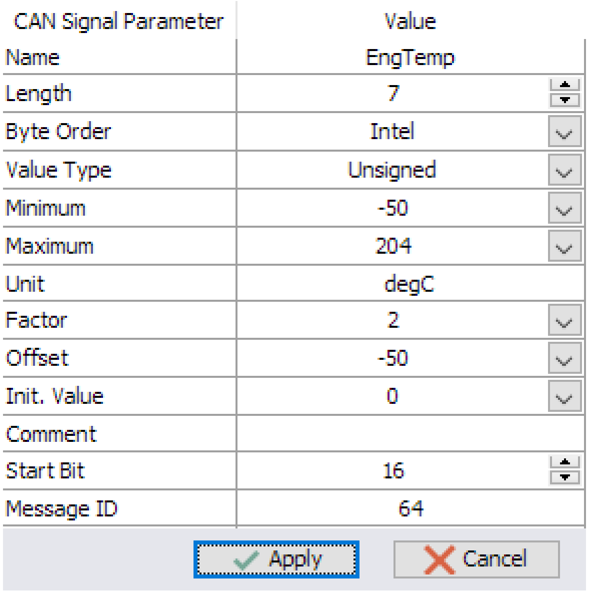
Fig 45 Color picker of graphic signals

Signal name field, this field displays signal name according to the database definition.

Signal value field, this field display real-time signal physical value.

1.7.3 Signal property inspector

Signal property inspector will be popuped when the signal in the list is double-clicked, or the “Edit Signal...” menu item is clicked. Take “CAN signal property inspector” as an example:



CAN Signal Parameter	Value
Name	EngTemp
Length	7
Byte Order	Intel
Value Type	Unsigned
Minimum	-50
Maximum	204
Unit	degC
Factor	2
Offset	-50
Init. Value	0
Comment	
Start Bit	16
Message ID	64

Fig 46 Signal properties inspector

The following properties can be displayed or modified by user freely:

Name: the signal name

Length: the bit count of the signal

Byte Order: Intel or Motorola byte order switch of the signal

Value Type: the value type can be Unsigned, Signed, 32-bit float or 64-bit float

Minimum: the minimum physical value of the signal, this value also adjusts the lower range of graphics display

Maximum: the maximum physical value of the signal, this value also adjusts the higher range of graphics display

Unit: the unit of the signal

Factor: enlarge factor of the signal

Offset: offset value of the signal

Init. Value: initialize value of the signal

Comment: the user can add comments on the specified signal

Start Bit: the signal start bit in the message which contains it

Message ID: the identifier of the message which contains it

Channel Number: the CAN channel number of the signal

1.7.4 Signal Popup menu

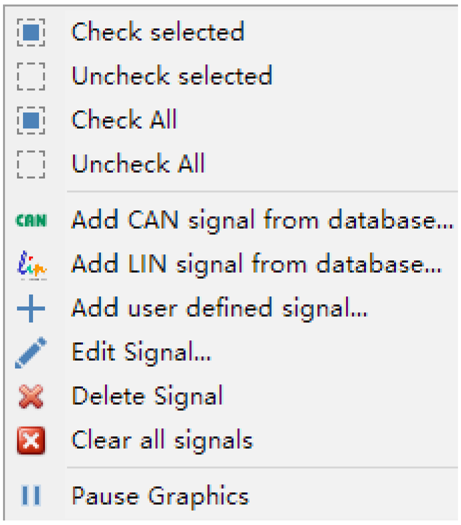


Fig 47 Graphics signal popup menu

Check selected: Make all the selected signals visible in the graphics.

Uncheck selected: Make all the selected signals invisible in the graphics.

Check All: Make all the signals visible in the graphics.

Uncheck All: Make all the signals invisible in the graphics.

Add CAN signal from database...: This button popup a CAN database signal selector for the user to select CAN signals to monitor.

Add LIN signal from database...: This button popup a LIN database signal selector for the user to select LIN signals to monitor.

Add user defined signal...: This button adds a custom signal in the list, which can be modified later.

Edit Signal...: Popups the “Signal property inspector” as described above.

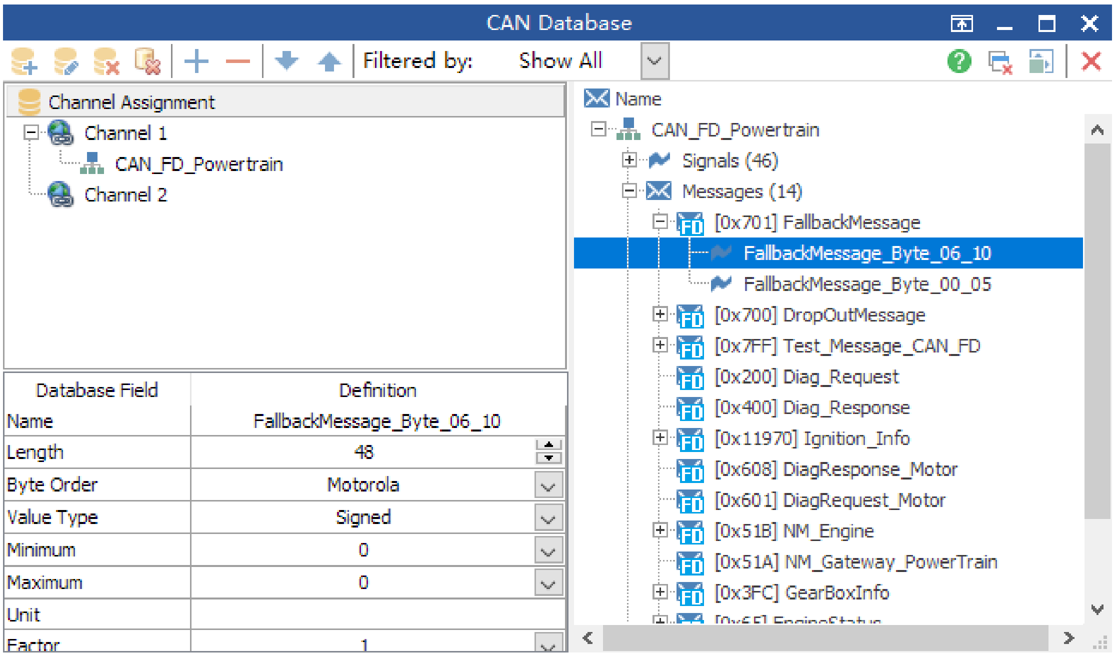
Delete Signal: This buttonj deletes all the selected signals from the list.

Clear All Signals: This button deletes all the signals from the list.

Pause Graphics: This button pauses the display of the current graphics window, a click on this button again will resume the display of the current graphics window.

1.8 CAN Database

CAN database viewer can be used to load/unload CAN database, select CAN messages or CAN signals in the TSMaster application.



Channel Assignment
- Channel 1
  - CAN_FD_Powertrain
- Channel 2

Database Field	Definition
Name	FallbackMessage_Byte_06_10
Length	48
Byte Order	Motorola
Value Type	Signed
Minimum	0
Maximum	0
Unit	
Factor	1

Name
- CAN_FD_Powertrain
  - Signals (46)
  - Messages (14)
    - [0x701] FallbackMessage
      - FallbackMessage_Byte_06_10
      - FallbackMessage_Byte_00_05
    - [0x700] DropOutMessage
    - [0x7FF] Test_Message_CAN_FD
    - [0x200] Diag_Request
    - [0x400] Diag_Response
    - [0x11970] Ignition_Info
    - [0x608] DiagResponse_Motor
    - [0x601] DiagRequest_Motor
    - [0x51B] NM_Engine
    - [0x51A] NM_Gateway_PowerTrain
    - [0x3FC] GearBoxInfo
    - [0x6F1] EngineStatus

Fig 48 CAN Database

1.8.1 CAN database toolbar

Add a CAN database from external *.dbc file

Edit the current selected database (*.dbc file) using default editor on this computer

Delete the current selected database from the database list

Delete all the database links from the database list

Increase a channel resource for database file mapping

Decrease a channel resource for database file mapping

Expand all nodes in the database treeview

Collapse all nodes in the database treeview

Filter by: database element filter, can be the following for user to select in database element selector mode:

- Show All: all the database elements will be displayed in the treeview
- CAN Signal: Only CAN signals are displayed

- CAN Message: Only CAN messages are displayed
- CAN Node: Only CAN nodes are displayed
- Envrionment Variable: Only environment variables are displayed

1.8.2 CAN database channel assignment

CAN database channel assignment enables the user to associate the selected database with specific CAN channels. A CAN database can support only one CAN channel, or multiple channels.

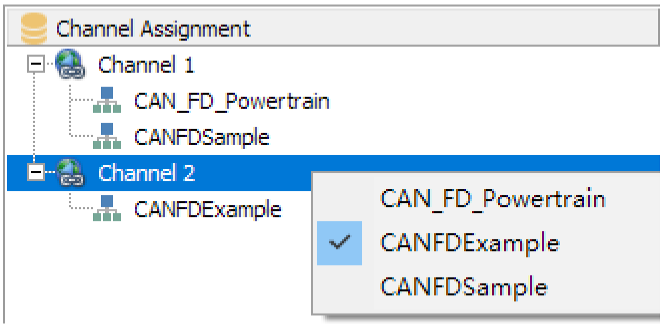
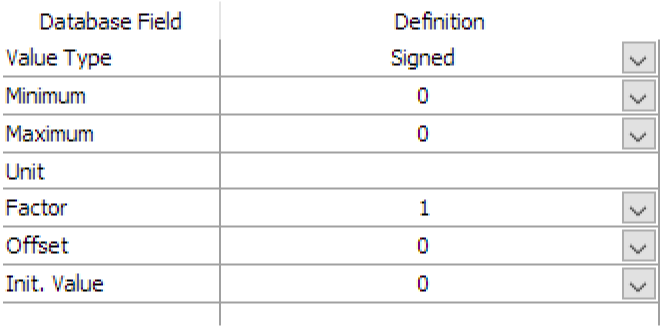


Fig 49 Channel assignment

When there are multiple database files loaded, the user may right-click on the specific CAN channel, which popups a list of available CAN databases. The user can associate / deassociate the database with the currently selected CAN channel by clicking on the database item in the popup menu.

1.8.3 CAN Database field viewer



Database Field	Definition
Value Type	Signed
Minimum	0
Maximum	0
Unit	
Factor	1
Offset	0
Init. Value	0

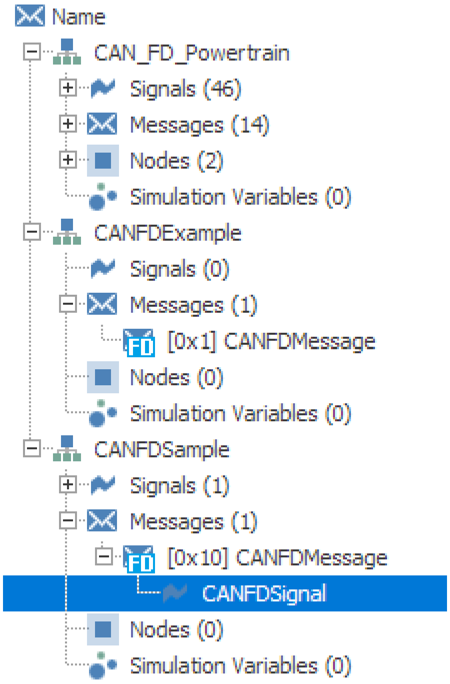
Fig 50 CAN database field viewer

The CAN database field viewer is used to display properties of the selected element, which can be CAN signal, CAN message, CAN node, environment variable or

CAN network.

Note: the CAN database field viewer currently not supports editing of CAN elements.

1.8.4 CAN element treeview



```
Name
CAN_FD_Powertrain
    Signals (46)
    Messages (14)
    Nodes (2)
    Simulation Variables (0)
CANFDExample
    Signals (0)
    Messages (1)
        [0x1] CANFDMessage
    Nodes (0)
    Simulation Variables (0)
CANFDSample
    Signals (1)
    Messages (1)
        [0x10] CANFDMessage
            CANFDSignal
    Nodes (0)
    Simulation Variables (0)
```

Fig 51 CAN element treeview

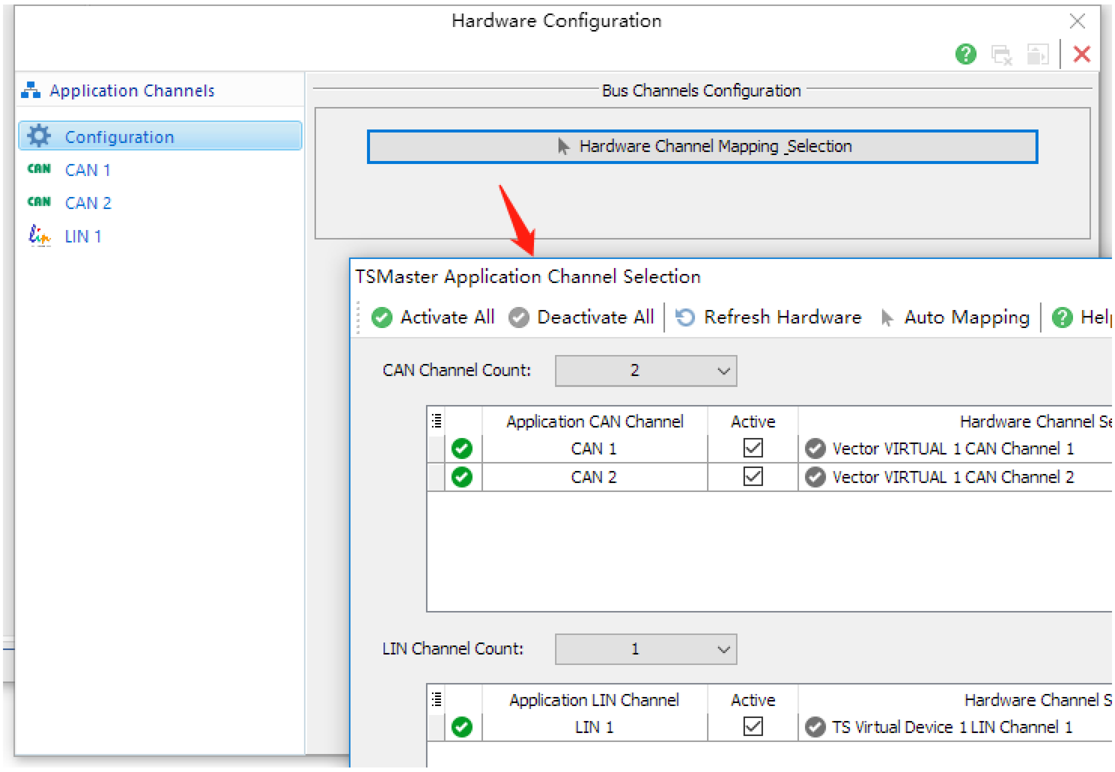
The CAN element treeview displays all the loaded CAN database information including CAN network, CAN signals, CAN messages, CAN nodes and Environment variables.

1.9 Hardware Configuration

The hardware configuration window is used to set hardware parameters before measurement starts.

1.9.1 Configuration Page

The configuration page contains all the application channels specified by user. There is a button which opens channel selection dialog mentioned above.



CAN Channel Count: 2

	Application CAN Channel	Active	Hardware Channel Se
✓	CAN 1	☑	Vector VIRTUAL 1 CAN Channel 1
✓	CAN 2	☑	Vector VIRTUAL 1 CAN Channel 2

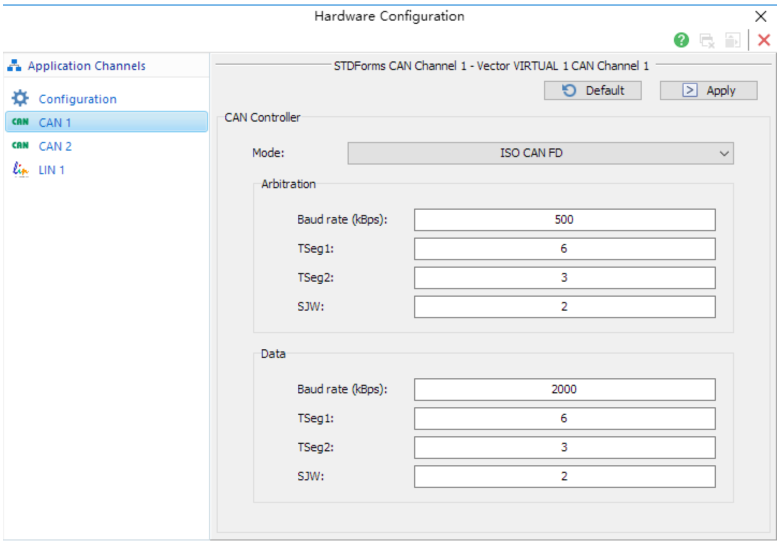
LIN Channel Count: 1

	Application LIN Channel	Active	Hardware Channel S
✓	LIN 1	☑	TS Virtual Device 1 LIN Channel 1

Fig 52 Hardware Configuration page

1.9.2 Channel configuration page

The channel configuration page differs when different application channel is selected. The user must check the hardware settings in each channel before starting the measurement.



CAN Controller

Mode: ISO CAN FD

Arbitration

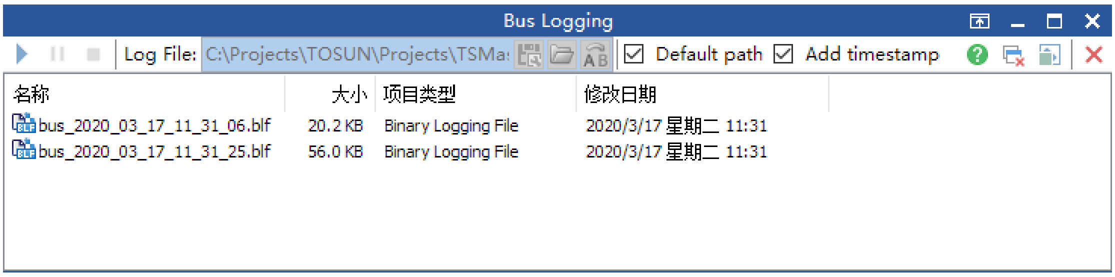
Baud rate (kBps): 500
TSeg1: 6
TSeg2: 3
SJW: 2

Data

Baud rate (kBps): 2000
TSeg1: 6
TSeg2: 3
SJW: 2

Fig 53 Hardware channel settings

1.10 Bus Logging



Bus Logging

Log File: C:\Projects\TOSUN\Projects\TSMa: ☑ Default path ☑ Add timestamp

名称	大小	项目类型	修改日期
bus_2020_03_17_11_31_06.blf	20.2 KB	Binary Logging File	2020/3/17 星期二 11:31
bus_2020_03_17_11_31_25.blf	56.0 KB	Binary Logging File	2020/3/17 星期二 11:31

Fig 54 Bus logging

1.10.1 Bus logging toolbar

▶ Start logging, this button is disabled when logging engine is working.

❚❚ Pause logging, this button is enabled when logging engine is working.

■ Stop logging, this button is enabled when logging engine is working.

Log File: C:\Projects\TOSUN\Projects\TSMa: Log file destination editor.

Select log file location.

Opens folder of log file destination.

Starts TS log file converter to convert log files to another format.

□ Default path Default path checkbox, if this checkbox is checked, the log file destination folder will be set to relative folder to TSMaster configuration file.

☑ Add timestamp Auto add timestamp to every log file name.

1.10.2 Bus logging popup menu

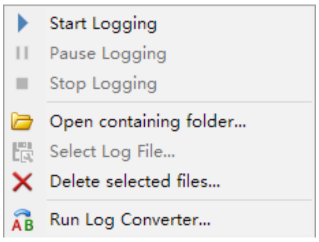
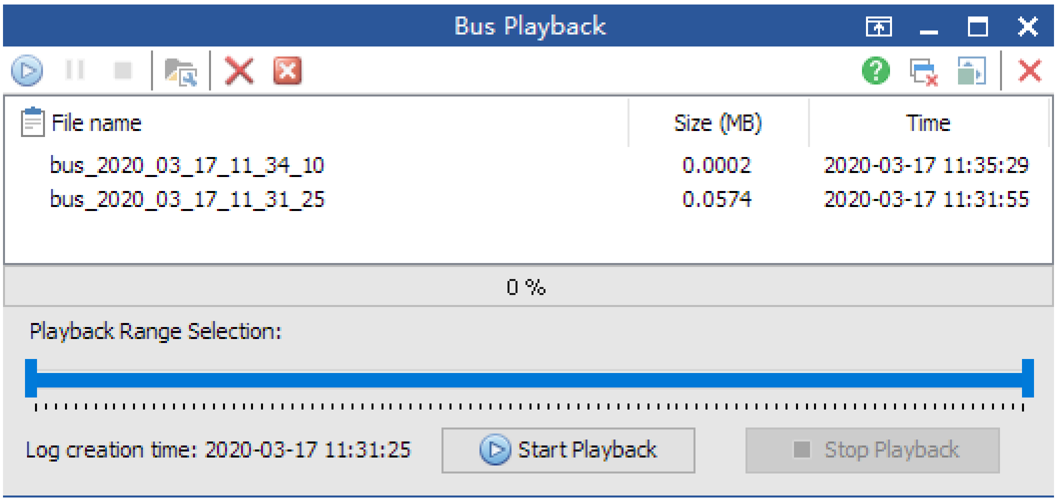


Fig 55 Bus logging popup menu

The popup menu will popups when user right-click on the log file list. All the menu items are described in the above chapter.

1.11 Bus Playback

Bus playback window replays CAN, CAN FD and LIN messages from external log files when the application is not connected.



File name	Size (MB)	Time
bus_2020_03_17_11_34_10	0.0002	2020-03-17 11:35:29
bus_2020_03_17_11_31_25	0.0574	2020-03-17 11:31:55

0 %

Playback Range Selection:

Log creation time: 2020-03-17 11:31:25

Fig 56 Bus playback

1.11.1 Bus playback toolbar

Starts playback. This button is not enabled when application is connected.

Pause playback. This button is enabled when playback starts.

Stop playback. This button is enabled when playback starts.

Add playback files to the log file list.

Remove the selected log files from the list.

Remove all the log files from the list.

1.11.2 Bus playback popup menu

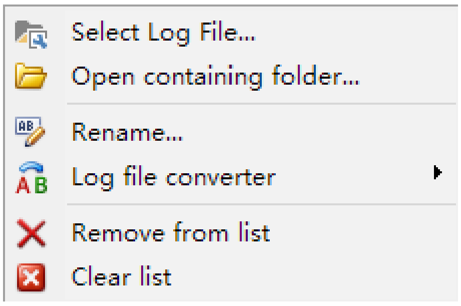


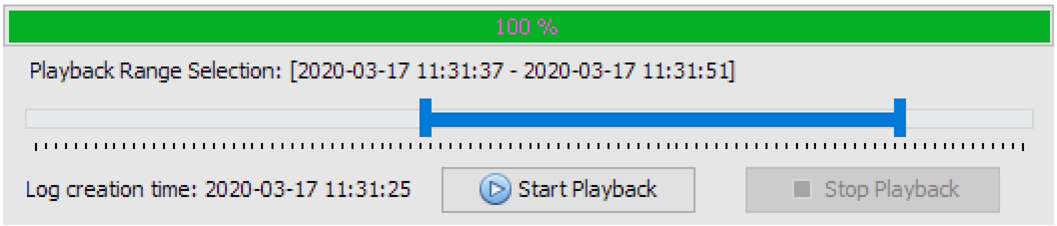
Fig 57 Bus playback popup menu

The menu items are described in the above chapter except:

Open containing folder…: Open the folder which contains the selected log file.

Rename…: Popups a rename dialog box for the user to rename the selected log file.

1.11.3 Playback control



Playback Range Selection: [2020-03-17 11:31:37 - 2020-03-17 11:31:51]

Log creation time: 2020-03-17 11:31:25

Fig 58 Bus playback control

🟩 Playback progress indication.

├─┤ Playback range selection.

1.12 Meter

Meter displays CAN or LIN signals defined in CAN or LIN databases.

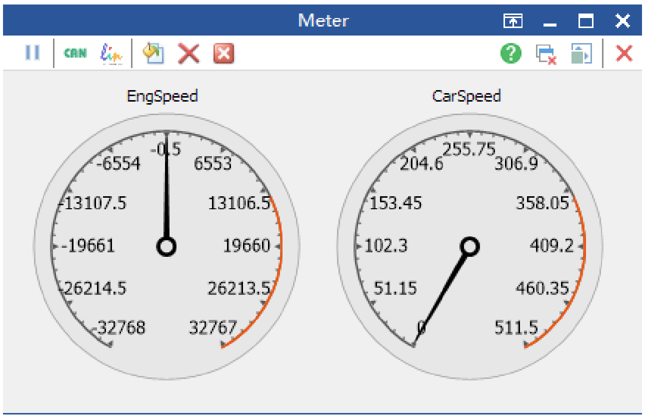


Fig 59 Meter

1.12.1 Meter toolbar

II Pause display of meter signals, when checked, all the meter signals refresh tasks are paused.

CAN Add a CAN signal from database.

Add a LIN signal from database.

Enable customization of the layout of meters.

Select meter display style.

✕ Delete the selected meter signals.

☒ Delete all the signals in meter window.

1.12.2 Meter Layout Control

You can simply click customization button to control each meter layout:

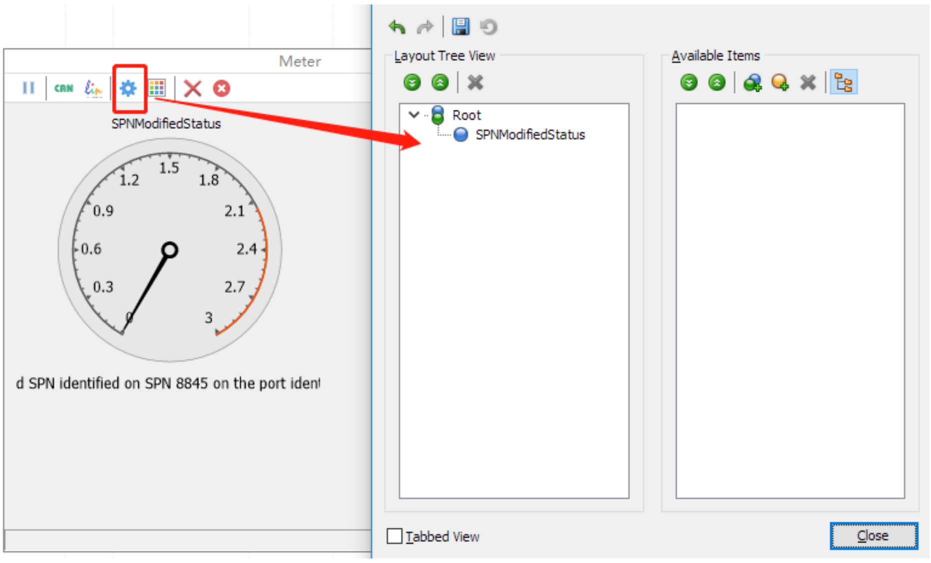


Fig 60 Meter Control customization

Then you can directly drag and drop each meter to your desired location:

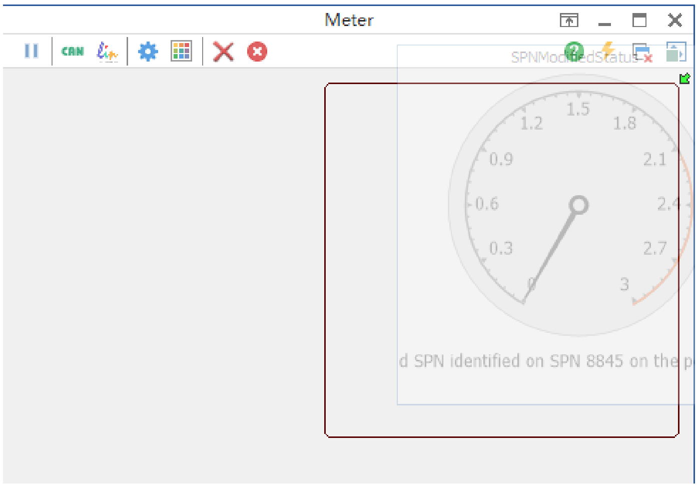
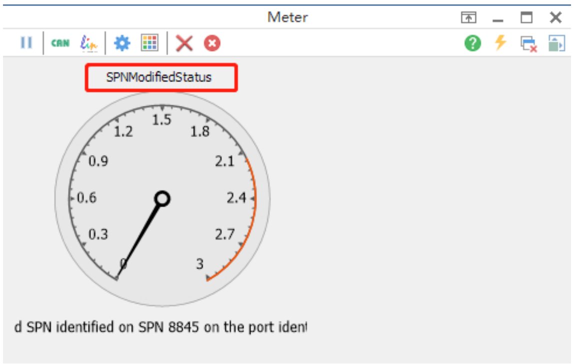


Fig 61 Meter Control drag and drop

After the customization window is closed, you are leaving the customization mode.

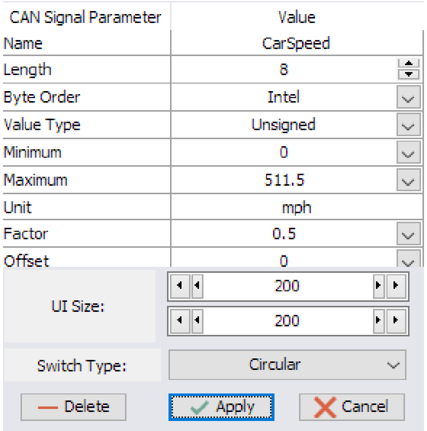
Another way to quick customize the meter is to directly drag the caption area of each meter to align it:



d SPN identified on SPN 8845 on the port iden

Fig 62 Drag caption area to align it

1.12.3 Meter signal editor



CAN Signal Parameter	Value
Name	CarSpeed
Length	8
Byte Order	Intel
Value Type	Unsigned
Minimum	0
Maximum	511.5
Unit	mph
Factor	0.5
Offset	0

UI Size: 200 200

Switch Type: Circular

Fig 63 Meter signal editor

Name: the name of the signal to be displayed.

Length: signal bit count.

Byte Order: can be Intel or Motorola.

Value Type: can be Unsigned, Signed, 32-bit float or 64-bit float.

Minimum: the minimum physical value of the signal, this setting also affects the graphical minimum range.

Maximum: the maximum physical value of the signal, this setting also affects the graphical maximum range.

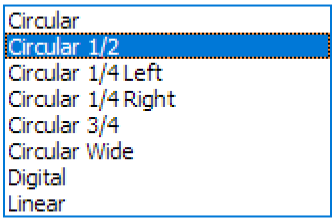
Unit: the unit of signal physical value.

Factor: the enlarge factor of the physical value of signal.

Offset: the offset value of the physical value of the signal.

UI Size in width and height: user can adjust the size of the meter by modifying these parameters.

Switch Type: the following types are supported:



Circular
Circular 1/2
Circular 1/4 Left
Circular 1/4 Right
Circular 3/4
Circular Wide
Digital
Linear

Fig 64 The type of meter display

1.13 LIN Trace

1.13.1 Trace toolbar

⏸ Pause display button, when checked, the "Pause" button will switch to "Continue" ▶ and incoming events will not be refreshed on the screen. The incoming events will be visible again when the "Continue" button is clicked.

✕ Clear the display of the current trace window.

This checkbox sets trace window in chronological view mode. In this mode every incoming new message will be display as one trace line.

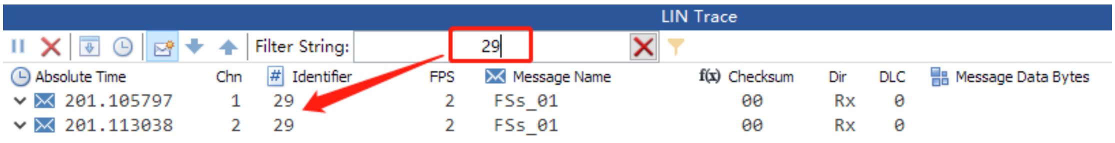
🕒 This checkbox sets trace window in relative time mode.

This checkbox ensures the trace list always scroll to the latest message.

⬇ Expand all message nodes to view their signal values.

⬆ Collapse all message nodes so signals are hidden.

Filter String: speed ☒ Filter trace list with specified string, the filter string can be the following types:

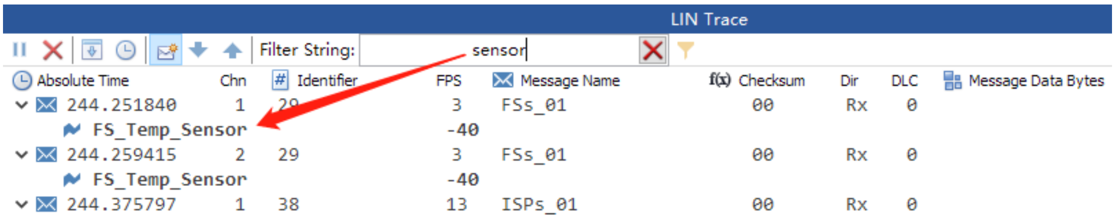


LIN Trace

Filter String: 29

Absolute Time	Chn	Identifier	FPS	Message Name	Checksum	Dir	DLC	Message Data Bytes
201.105797	1	29	2	FSs_01	00	Rx	0	
201.113038	2	29	2	FSs_01	00	Rx	0	

Fig 65 Filter by identifier

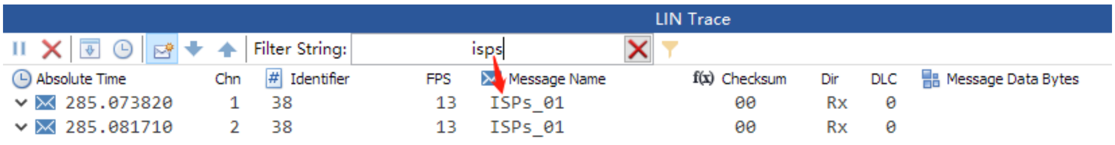


LIN Trace

Filter String: sensor

Absolute Time	Chn	Identifier	FPS	Message Name	Checksum	Dir	DLC	Message Data Bytes
244.251840	1	29	3	FSs_01	00	Rx	0	
FS_Temp_Sensor			-40					
244.259415	2	29	3	FSs_01	00	Rx	0	
FS_Temp_Sensor			-40					
244.375797	1	38	13	ISPs_01	00	Rx	0	

Fig 66 Filter by signal name

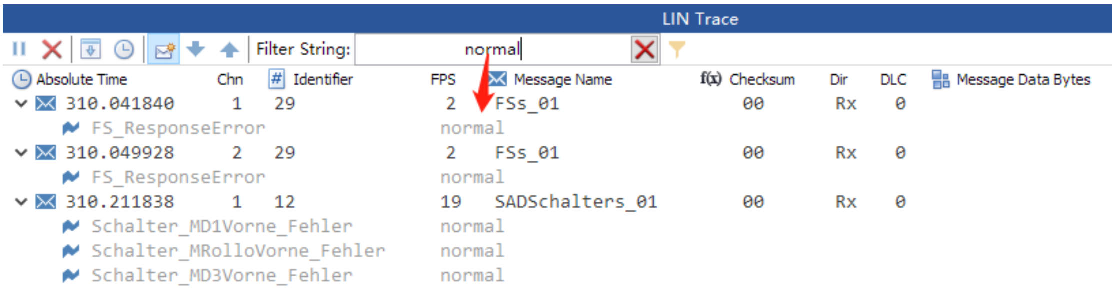


LIN Trace

Filter String: isps

Absolute Time	Chn	Identifier	FPS	Message Name	Checksum	Dir	DLC	Message Data Bytes
285.073820	1	38	13	ISPs_01	00	Rx	0	
285.081710	2	38	13	ISPs_01	00	Rx	0	

Fig 67 Filter by message name

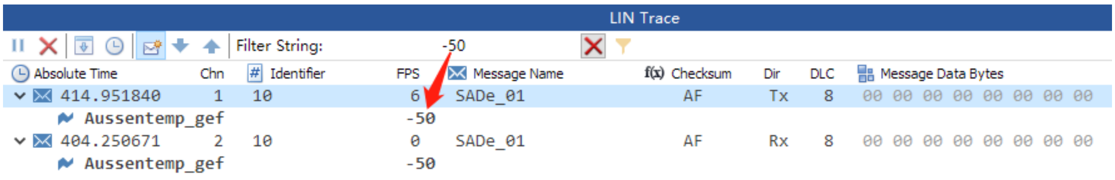


LIN Trace

Filter String: normal

Absolute Time	Chn	Identifier	FPS	Message Name	Checksum	Dir	DLC	Message Data Bytes
310.041840	1	29	2	FSs_01	00	Rx	0	
FS_ResponseError			normal					
310.049928	2	29	2	FSs_01	00	Rx	0	
FS_ResponseError			normal					
310.211838	1	12	19	SADSchalters_01	00	Rx	0	
Schalter_MD1Vorne_Fehler			normal					
Schalter_MRolloVorne_Fehler			normal					
Schalter_MD3Vorne_Fehler			normal					

Fig 68 Filter by signal symbol value



LIN Trace

Filter String: -50

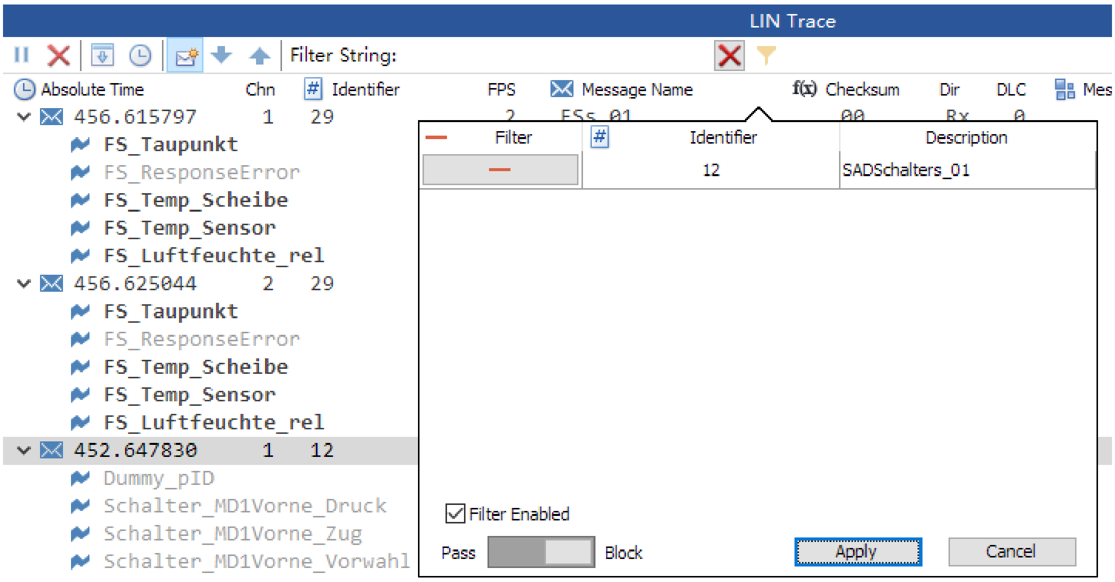
Absolute Time	Chn	Identifier	FPS	Message Name	Checksum	Dir	DLC	Message Data Bytes
414.951840	1	10	6	SADe_01	AF	Tx	8	00 00 00 00 00 00 00 00
Aussentemp_gef			-50					
404.250671	2	10	0	SADe_01	AF	Rx	8	00 00 00 00 00 00 00 00
Aussentemp_gef			-50					

Fig 69 Filter by signal numeric value

☒ Clear filter value, the trace list will then display all the trace lines.

▼ Message filter tool, which allows specific message identifiers to display in the trace, and meanwhile blocks other message identifiers. User can use this message filter to hide some irrelevant messages, or just monitor certain messages.

1.13.2 Trace message identifier filter



```
456.615797   1   29
    FS_Taupunkt
    FS_ResponseError
    FS_Temp_Scheibe
    FS_Temp_Sensor
    FS_Luftfeuchte_rel
456.625044   2   29
    FS_Taupunkt
    FS_ResponseError
    FS_Temp_Scheibe
    FS_Temp_Sensor
    FS_Luftfeuchte_rel
452.647830   1   12
    Dummy_pID
    Schalter_MD1Vorne_Druck
    Schalter_MD1Vorne_Zug
    Schalter_MD1Vorne_Vorwahl
```

Filter	Identifier	Description
—	12	SADSchalters_01

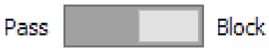
☑ Filter Enabled

Pass ▨□ Block

Fig 70 Trace message identifier filter

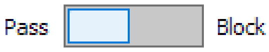
The trace message identifier filter works under either of the two conditions:

3. Block mode

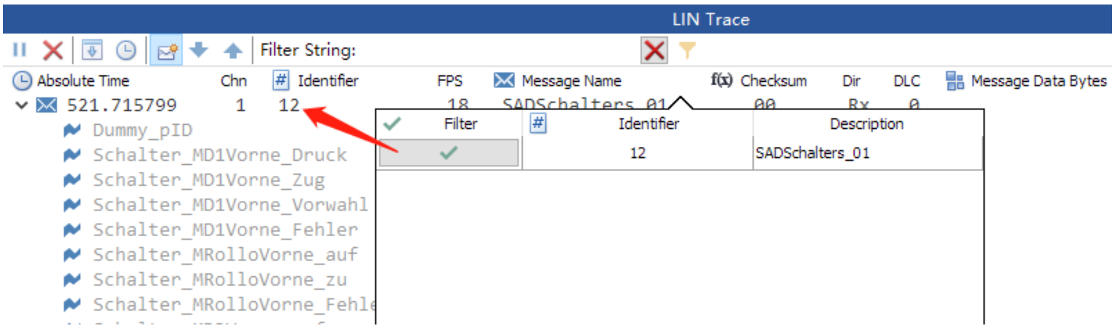


The message identifier in the list will be blocked, and other message will pass the fiter. In the above picture, only 0x12 will be blocked, while other message identifiers will be displayed in the trace window.

4. Pass mode



The message identifier in the list will be passed, and other message will be blocked. In the following picture, only 0x12 will be refreshed in the trace list:

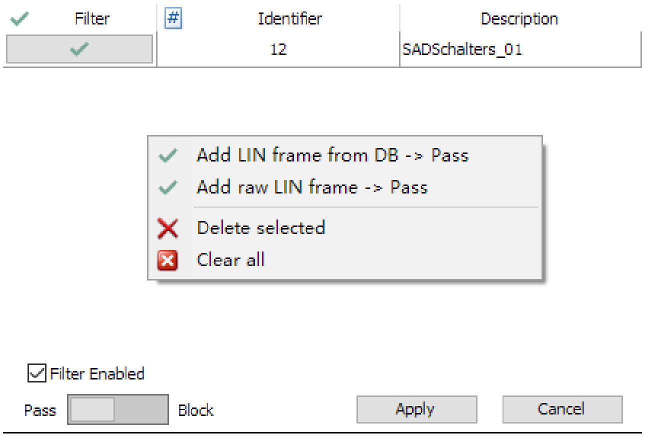


```
521.715799   1   12
    Dummy_pID
    Schalter_MD1Vorne_Druck
    Schalter_MD1Vorne_Zug
    Schalter_MD1Vorne_Vorwahl
    Schalter_MD1Vorne_Fehler
    Schalter_MRolloVorne_auf
    Schalter_MRolloVorne_zu
    Schalter_MRolloVorne_Fehle
```

Filter	Identifier	Description
✓	12	SADSchalters_01

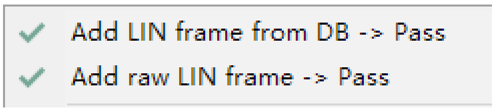
Fig 71 Message identifier filter working in pass mode

To add or delete message identifiers in the list, just right-click on the empty area of the list, you will see the following popup menu items:

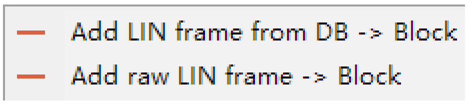


✓ Filter	#	Identifier	Description
✓		12	SADSchalters_01

Fig 72 Add or delete message identifiers in the list



Add LIN frame identifiers from database or on the fly. These added message identifiers will be passed to the trace list. These menu items will be shown when the filter is in pass mode.



Add LIN frame identifiers from database or on the fly. These added message identifiers will be blocked and will not be displayed in the trace list. These menu items will be shown when the filiter is in block mode.

This operation will remove the selected message identifier from the filter list.

This operation clears all the message identifier items from the filter list.

This checkbox controls whether the message identifier filter is enabled or not.

1.13.3 Trace list columns

Absolute Time: Absolute measurement time in seconds, this is the default time display format. The absolute time or message will be displayed in this column.

Relative Time: The relative time indicates the time in relation to the preceding message. In chronological mode this is the message received directly before the current message, whereas in fixed position mode the relative time is displayed in relation to the previous message of the same type.

Chn: The channel number of the message.

Identifier: LIN message identifier.

FPS: Frames per second, this column displays the frame rate of specific identifier.

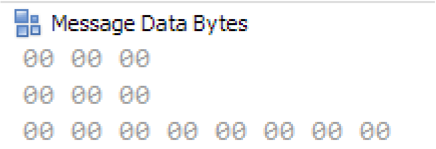
Message Name: The name of the message defined in the database.

Checksum: LIN frame checksum value read by tool.

Dir: Direction of the LIN message, can be Tx (transmit) or Rx (receive)

DLC: Data length code from LIN messages.

Message Data Bytes: Each data byte of the message.

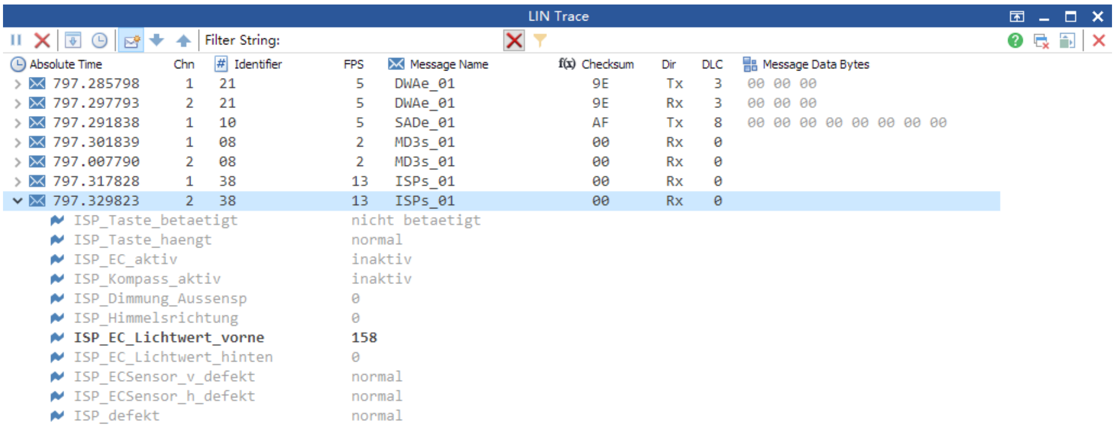


Message Data Bytes
00 00 00
00 00 00
00 00 00 00 00 00 00 00

Fig 73 Message data bytes with index starting from 0

1.13.4 Trace Signals Display

Trace signals can be expanded if a message is defined in the loaded LIN database:



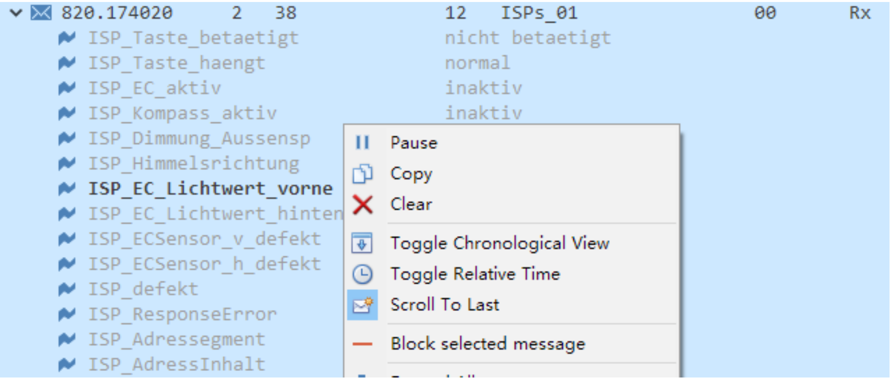
Absolute Time	Chn	Identifier	FPS	Message Name	Checksum	Dir	DLC	Message Data Bytes
797.285798	1	21	5	DWAe_01	9E	Tx	3	00 00 00
797.297793	2	21	5	DWAe_01	9E	Rx	3	00 00 00
797.291838	1	10	5	SADe_01	AF	Tx	8	00 00 00 00 00 00 00 00
797.301839	1	08	2	MD3s_01	00	Rx	0	
797.007790	2	08	2	MD3s_01	00	Rx	0	
797.317828	1	38	13	ISPs_01	00	Rx	0	
797.329823	2	38	13	ISPs_01	00	Rx	0	
ISP_Taste_betaetigt			nicht betaetigt					
ISP_Taste_haengt			normal					
ISP_EC_aktiv			inaktiv					
ISP_Kompass_aktiv			inaktiv					
ISP_Dimmung_Aussensp			0					
ISP_Himmelsrichtung			0					
ISP_EC_Lichtwert_vorne			**158**					
ISP_EC_Lichtwert_hinten			0					
ISP_ECSensor_v_defekt			normal					
ISP_ECSensor_h_defekt			normal					
ISP_defekt			normal					

Fig 74 Signals with updated values highlighted

1.13.5 Popup Menus

Most of trace popup menu items can be found in trace toolbar except “Copy” and

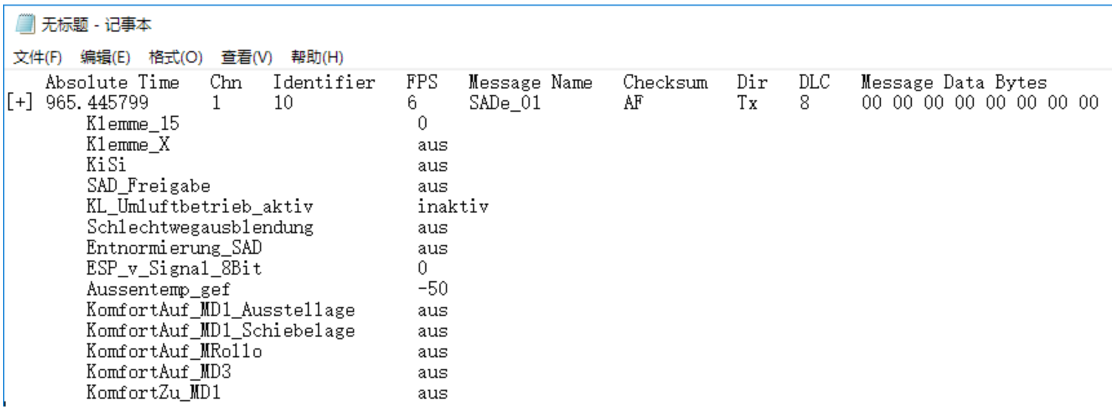
"Block selected message":



```
820.174020    2   38          12   ISPs_01          00      Rx
    ISP_Taste_betaetigt       nicht betaetigt
    ISP_Taste_haengt          normal
    ISP_EC_aktiv              inaktiv
    ISP_Kompass_aktiv         inaktiv
    ISP_Dimmung_Aussensp
    ISP_Himmelsrichtung
    ISP_EC_Lichtwert_vorne
    ISP_EC_Lichtwert_hinten
    ISP_ECSensor_v_defekt
    ISP_ECSensor_h_defekt
    ISP_defekt
    ISP_ResponseError
    ISP_Adressegment
    ISP_AdressInhalt
```

Fig 75 Trace popup menu

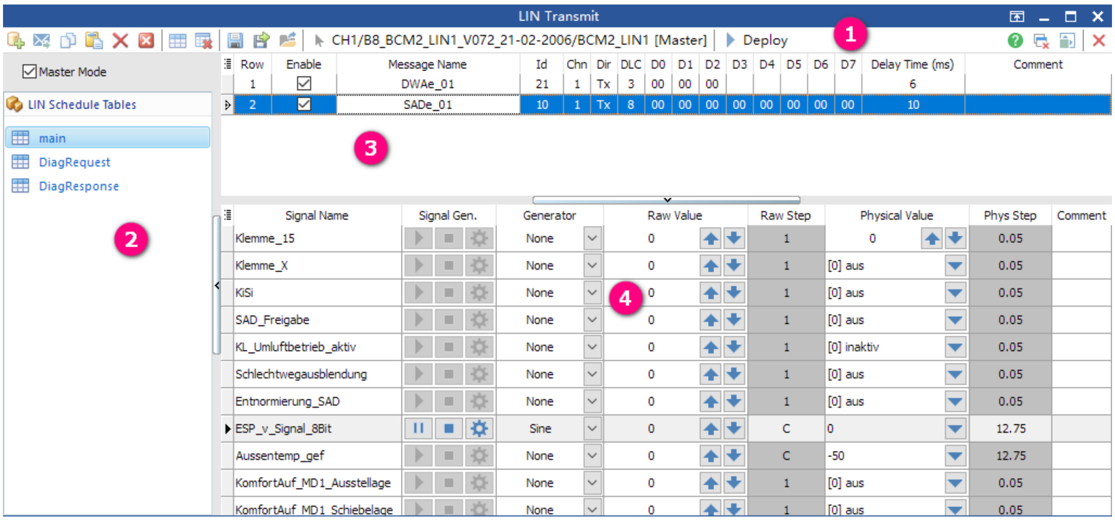
To copy the trace lines, the user has to select certain trace lines and then click the "Copy" item. The selected text has the same layout as trace display:



```
    Absolute Time  Chn  Identifier  FPS  Message Name  Checksum  Dir  DLC  Message Data Bytes
[+] 965.445799     1    10          6    SADe_01       AF        Tx   8    00 00 00 00 00 00 00 00
        Klemme_15                    0
        Klemme_X                     aus
        KiSi                         aus
        SAD_Freigabe                 aus
        KL_Umluftbetrieb_aktiv       inaktiv
        Schlechtwegausblendung       aus
        Entnormierung_SAD            aus
        ESP_v_Signal_8Bit            0
        Aussentemp_gef               -50
        KomfortAuf_MD1_Ausstellage   aus
        KomfortAuf_MD1_Schiebelage   aus
        KomfortAuf_MRollo            aus
        KomfortAuf_MD3               aus
        KomfortZu_MD1                aus
```

Fig 76 Selected trace lines in text

1.14 LIN Transmit



Row	Enable	Message Name	Id	Chn	Dir	DLC	D0	D1	D2	D3	D4	D5	D6	D7	Delay Time (ms)	Comment
1	☑	DWAe_01	21	1	Tx	3	00	00	00						6	
2	☑	SADe_01	10	1	Tx	8	00	00	00	00	00	00	00	00	10	

Signal Name	Signal Gen.	Generator	Raw Value	Raw Step	Physical Value	Phys Step	Comment
Klemme_15		None	0	1	0	0.05	
Klemme_X		None	0	1	[0] aus	0.05	
KiSi		None	0	1	[0] aus	0.05	
SAD_Freigabe		None	0	1	[0] aus	0.05	
KL_Umluftbetrieb_aktiv		None	0	1	[0] inaktiv	0.05	
Schlechtwegausblendung		None	0	1	[0] aus	0.05	
Entnormierung_SAD		None	0	1	[0] aus	0.05	
ESP_v_Signal_8Bit		Sine	0	C	0	12.75	
Aussentemp_gef		None	0	C	-50	12.75	
KomfortAuf_MD1_Ausstellage		None	0	1	[0] aus	0.05	
KomfortAuf_MD1_Schiebelage		None	0	1	[0] aus	0.05	

Fig 77 LIN Transmit

1.14.1 Transmit toolbar

Add a LIN message from database.

Add a raw LIN message directly into transmit list, which can be freely modified.

Copy selected LIN messages into clipboard, which can be pasted into current transmit list.

Paste the copied LIN message from clipboard into the current transmit list.

Delete the selected LIN messages from current list

Remove all the LIN messages from current list.

Add a new schedule table.

Delete the selected schedule table including its messages and signals.

Save the current transmit list to an external file. For the first time a save dialog box appears for the user to specify destination file. The following save operations will overwrite this file.

Export the current transmit list to an external file.

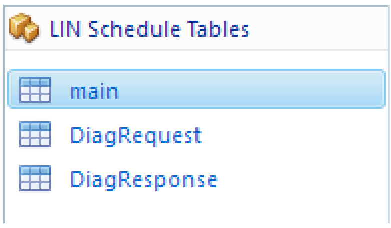
Load transmit list from external file, this operation will overwrite all the existing transmit list.

Select LIN node, this will popup a LIN database window for the user to choose LIN node. After a LIN node is selected, the message list and schedule tables are associated with this node for simulation.

▶ Deploy the schedule table into the hardware. The LIN hardware will automatically perform LIN message transmission.

■ Undeploy all LIN messages. When this button is clicked, the scheduled LIN frames in the hardware are stopped.

1.14.2 LIN schedule table list



LIN Schedule Tables

- main
- DiagRequest
- DiagResponse

Fig 78 LIN schedule tables

The LIN schedule table list displays all the schedule tables of the current master node. If the current LIN node is not LIN master, this page is automatically hidden. Select one item in the list will display all the frame list on the message list.

1.14.3 Transmit list

The transmit list contains messages to be edited, each message has the following properties:

Row: The number of each transmit message in ascending order, this field is read-only and cannot be edited.

Enable: Activate or deactivate the current LIN frame.

Message Name: The name of the message, if this message is added from LIN database, then the message name is defined by LIN database and cannot be modified by user; if this message is added manually, then the name of the message can be freely altered by user.

Id: Identifier of LIN message.

Chn: The channel number of LIN message.

DLC: Data length code of the LIN message, which can be within range 0~8.

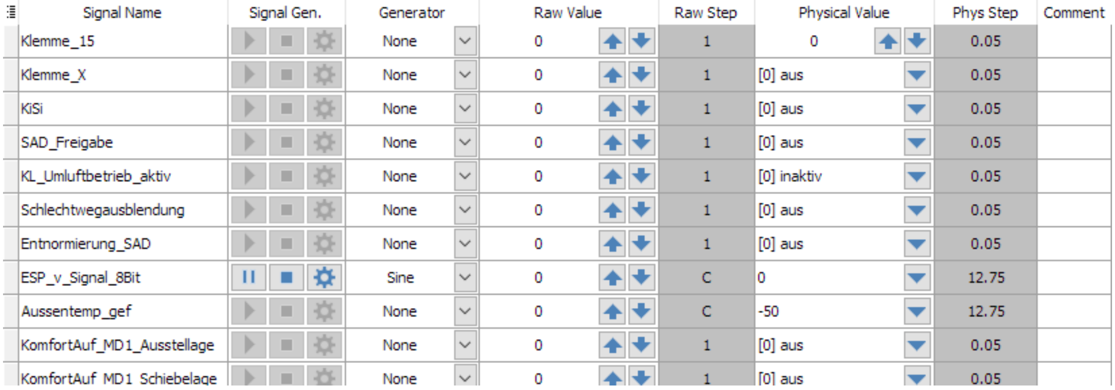
D0~D7: LIN data frame data byte editors.

Delay Time (ms): LIN frame transmit delay time in milliseonds.

Comment: User can edit the comment of each LIN frame.

1.14.4 Signals list

Signals list displays editors for modifying signal properties of the selected LIN message defined in LIN database. The raw LIN messages do not have signals list editors.



Signal Name	Signal Gen.	Generator	Raw Value	Raw Step	Physical Value	Phys Step	Comment
Klemme_15	▶ ■ ⚙	None	0	1	0	0.05	
Klemme_X	▶ ■ ⚙	None	0	1	[0] aus	0.05	
KiSi	▶ ■ ⚙	None	0	1	[0] aus	0.05	
SAD_Freigabe	▶ ■ ⚙	None	0	1	[0] aus	0.05	
KL_Umluftbetrieb_aktiv	▶ ■ ⚙	None	0	1	[0] inaktiv	0.05	
Schlechtwegausblendung	▶ ■ ⚙	None	0	1	[0] aus	0.05	
Entnormierung_SAD	▶ ■ ⚙	None	0	1	[0] aus	0.05	
ESP_v_Signal_8Bit	❚❚ ■ ⚙	Sine	0	C	0	12.75	
Aussentemp_gef	▶ ■ ⚙	None	0	C	-50	12.75	
KomfortAuf_MD1_Ausstellage	▶ ■ ⚙	None	0	1	[0] aus	0.05	
KomfortAuf_MD1_Schiebelage	▶ ■ ⚙	None	0	1	[0] aus	0.05	

Fig 79 Signals list of the selected LIN message

1.14.4.1 Signal Name

The signal name defined in the LIN database.

1.14.4.2 Signal Gen.

The signal value generator feature, which has three buttons for sending and configuring the value changing behavior of each LIN signal:

- ▶ Start generating of the current signal. Once this button is clicked, the button changes to “Pause” button shown below.

- ⏸ Pause button, once this button is clicked, the current LIN signal generator pauses, the button then changes back to "Send" button shown above.
- ■ Stop button, a click on this button stop the operation of the current LIN signal generator.

1.14.4.3 Generator

This combobox specifies the generator type of the current LIN signal, which is described in "CAN Transmit Window".

1.14.4.4 Raw Value

Raw value editor of the current selected signal. To modify a signal's raw value without touching its physical value, use this editor.

⬆⬇ Increment and decrement button of the raw value. Clicking on the corresponding button increments or decrements the raw value by the step defined on the "Raw Step" field.

1.14.4.5 Raw Step

The increment or decrement step of the "Raw Value" field.

1.14.4.6 Physical Value

Physical value editor of the current selected signal. To modify a signal's physical value without touching its raw value, use this editor.

⬆⬇ Increment and decrement button of the physical value. Clicking on the corresponding button increments or decrements the physical value by the step defined on the "Phys Step" field.

1.14.4.7 Phys Step

The increment or decrement step of the “Physical Value” field.

1.14.4.8 Comment

User comment on the specified signal.

1.15 LIN Database

LIN database viewer can be used to load/unload LIN database, select LIN messages or LIN signals in the TSMaster application.

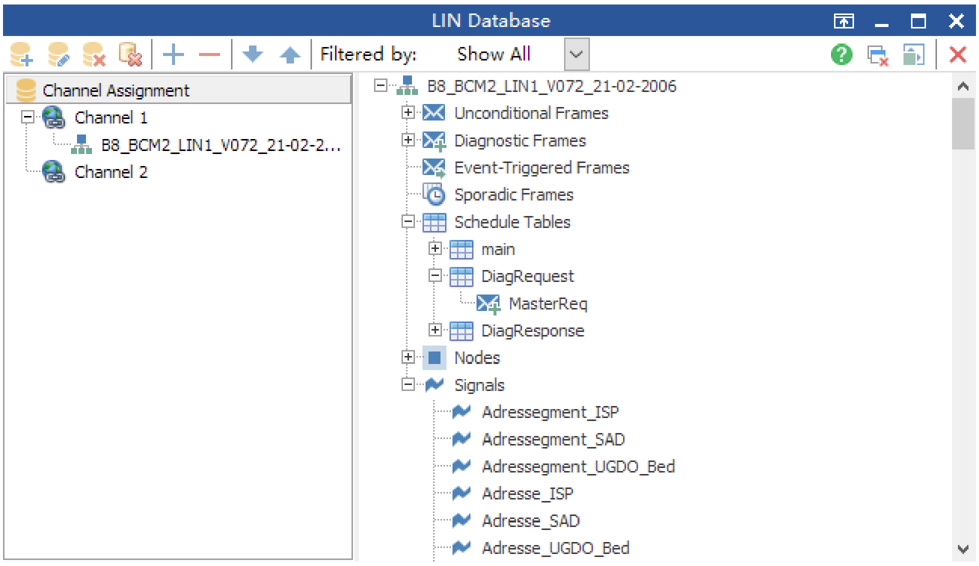


Fig 80 LIN Database

1.15.1 LIN database toolbar

Add a LIN database from external *.ldf file

Edit the current selected database (*.ldf file) using default editor on this computer

Delete the current selected database from the database list

Delete all the database links from the database list

Increase a channel resource for database file mapping

— Decrease a channel resource for database file mapping

🡇 Expand all nodes in the database treeview

🡅 Collapse all nodes in the database treeview

Filter by: database element filter, can be the following for user to select in database element selector mode:

- Show All: all the database elements will be displayed in the treeview
- LIN Signal: Only LIN signals are displayed
- LIN Message: Only LIN messages are displayed
- LIN Node: Only LIN nodes are displayed
- Envrionment Variable: Only environment variables are displayed

1.15.2 LIN database channel assignment

LIN database channel assignment enables the user to associate the selected database with specific LIN channels. A LIN database can support only one LIN channel, or multiple channels.

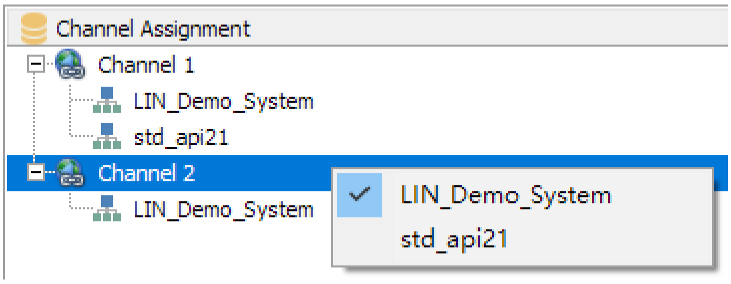
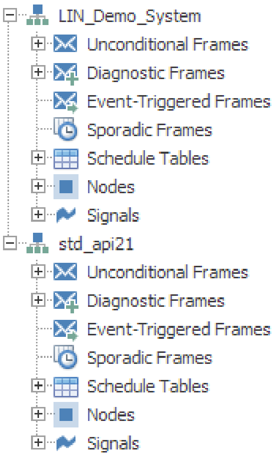


Fig 81 Channel assignment

When there are multiple database files loaded, the user may right-click on the specific LIN channel, which popups a list of available LIN databases. The user can associate / deassociate the database with the currently selected LIN channel by clicking on the database item in the popup menu.

1.15.3 LIN element treeview



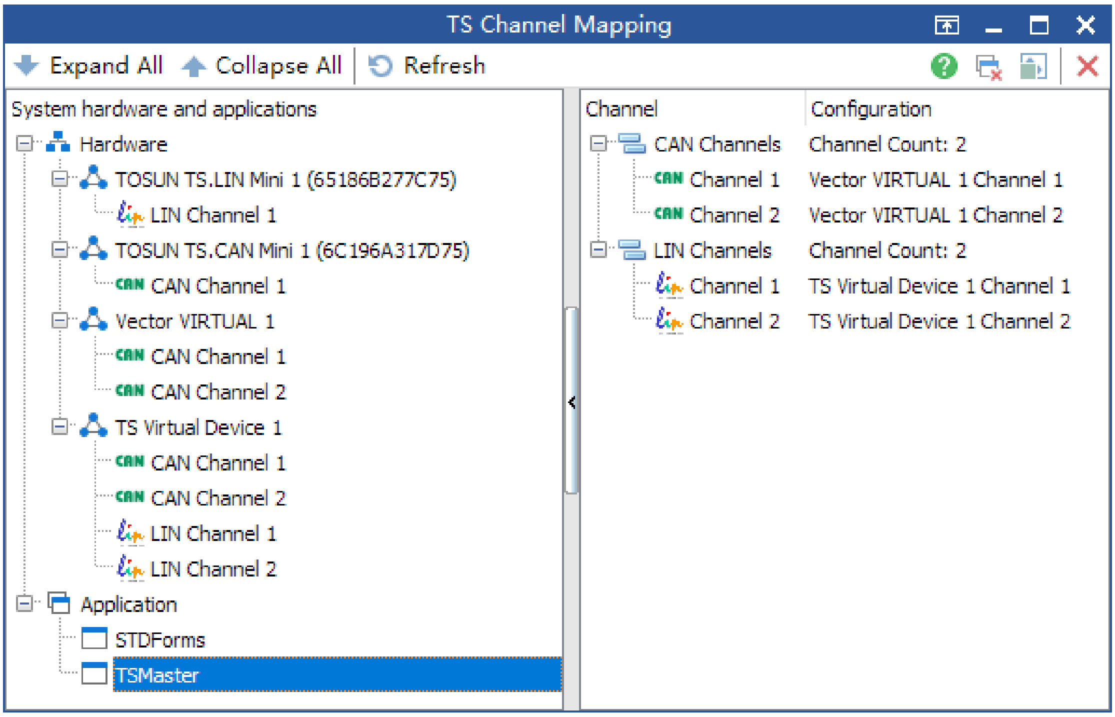
- LIN_Demo_System
  - Unconditional Frames
  - Diagnostic Frames
  - Event-Triggered Frames
  - Sporadic Frames
  - Schedule Tables
  - Nodes
  - Signals
- std_api21
  - Unconditional Frames
  - Diagnostic Frames
  - Event-Triggered Frames
  - Sporadic Frames
  - Schedule Tables
  - Nodes
  - Signals

Fig 82 LIN element treeview

The LIN element treeview displays all the loaded LIN database information including LIN network, LIN signals, LIN messages, LIN nodes, LIN schedule tables and Environment variables.

1.16 TS Channel Mapping

TS channel mapping window is a tool for the management of hardware and logical channel mappings.



System hardware and applications

- Hardware
  - TOSUN TS.LIN Mini 1 (65186B277C75)
    - LIN Channel 1
  - TOSUN TS.CAN Mini 1 (6C196A317D75)
    - CAN Channel 1
  - Vector VIRTUAL 1
    - CAN Channel 1
    - CAN Channel 2
  - TS Virtual Device 1
    - CAN Channel 1
    - CAN Channel 2
    - LIN Channel 1
    - LIN Channel 2
- Application
  - STDForms
  - TSMaster

Channel	Configuration
CAN Channels	Channel Count: 2
Channel 1	Vector VIRTUAL 1 Channel 1
Channel 2	Vector VIRTUAL 1 Channel 2
LIN Channels	Channel Count: 2
Channel 1	TS Virtual Device 1 Channel 1
Channel 2	TS Virtual Device 1 Channel 2

Fig 83 TS Channel Mapping

1.16.1 TS Channel Mapping toolbar

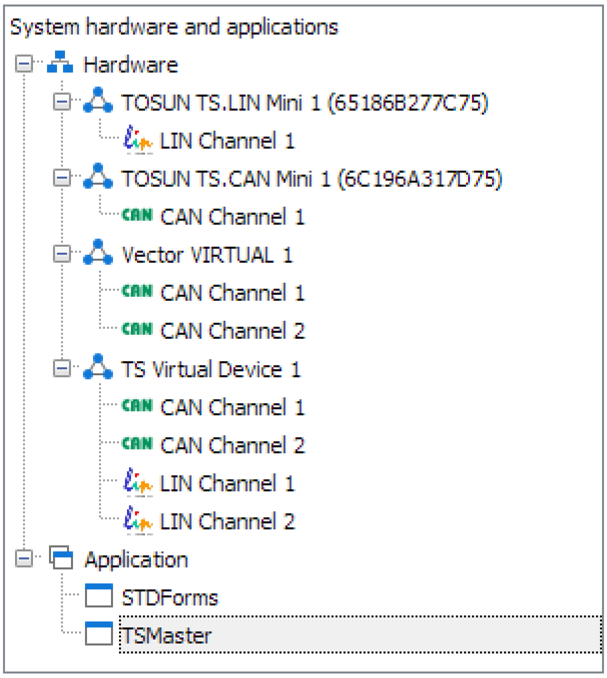
⬇ Expand all the tree nodes of hardware list.

⬆ Collapse all the tree nodes of hardware list.

⟲ Refresh hardware channel and logical channel lists.

1.16.2 Hardware channel and application list

The list has two main groups: hardware channels and applications:



System hardware and applications

- Hardware
  - TOSUN TS.LIN Mini 1 (65186B277C75)
    - LIN Channel 1
  - TOSUN TS.CAN Mini 1 (6C196A317D75)
    - CAN Channel 1
  - Vector VIRTUAL 1
    - CAN Channel 1
    - CAN Channel 2
  - TS Virtual Device 1
    - CAN Channel 1
    - CAN Channel 2
    - LIN Channel 1
    - LIN Channel 2
- Application
  - STDForms
  - TSMaster

Fig 84 Hardware channels and applications

The hardware list displays each hardware devices and available channels inside the device.

The application list displays all the applications that requires mapping.

1.16.3 Map a hardware channel with a logical application channel

There are several ways for a user to map.

- Right click on the hardware channel

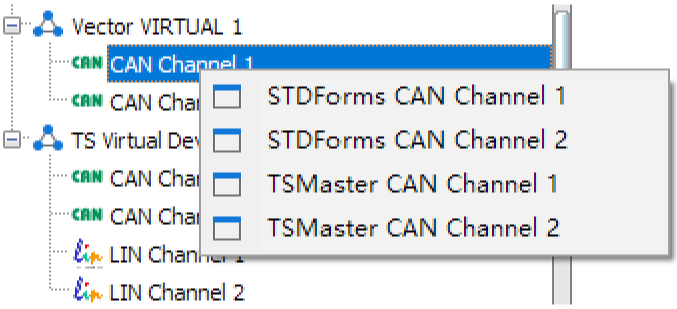


Fig 85 Right click on the hardware channel

- Right click on the application logical channel

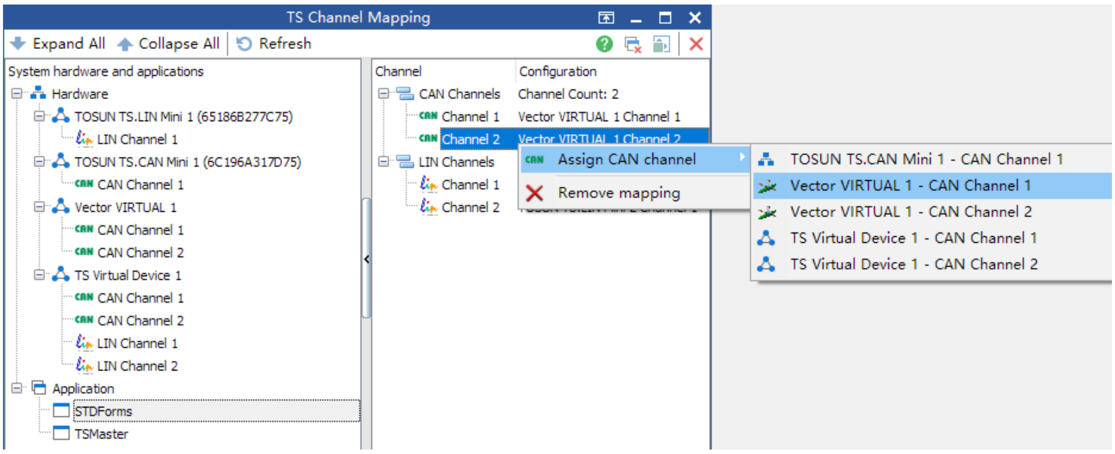


Fig 86 Right click on the logical channel

1.16.4 Add or delete an application

To add a new application, right-click on the “Application” group and select “Add application…” menu item.

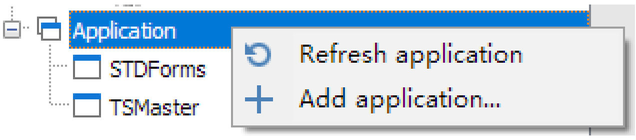


Fig 87 Add a new application

To delete an existing application, right-click on the specified application, and select “Delete application…” menu item.

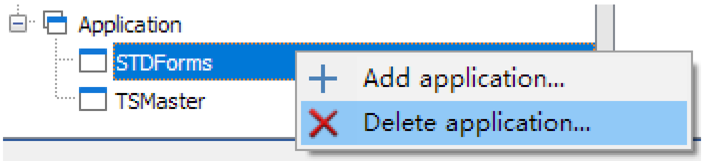
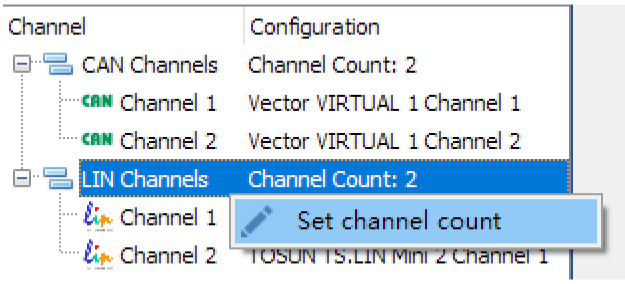


Fig 88 Delete application

1.16.5 Set channel count of a bus type

To set the channel count of a bus type such as LIN bus, right-click on the “LIN channels” group and select “Set channel count” menu item:

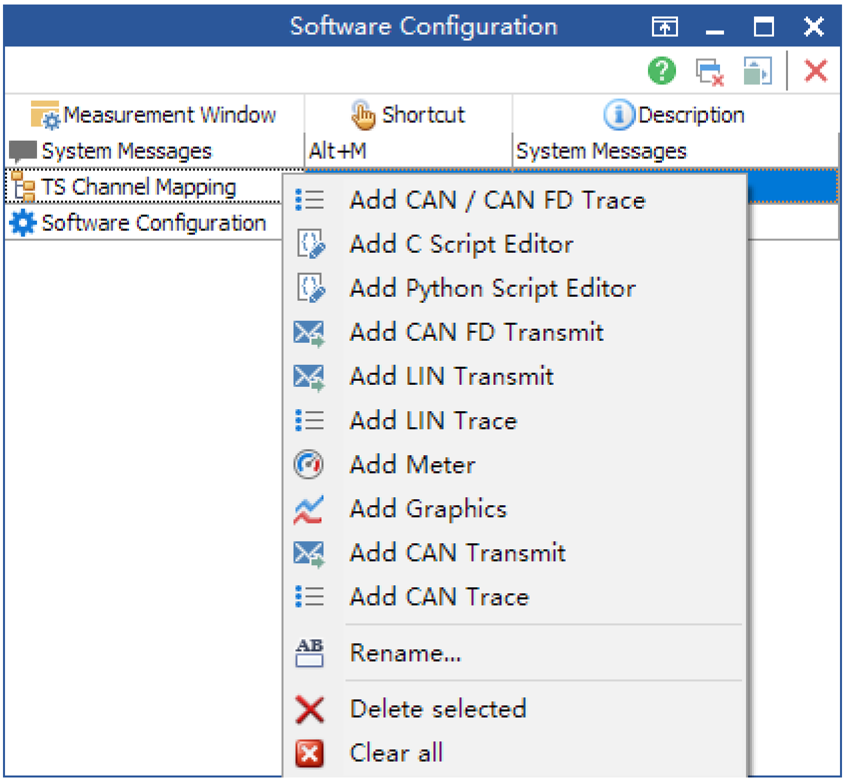


Channel	Configuration
CAN Channels	Channel Count: 2
CAN Channel 1	Vector VIRTUAL 1 Channel 1
CAN Channel 2	Vector VIRTUAL 1 Channel 2
LIN Channels	Channel Count: 2
Channel 1	
Channel 2	TOSUN TS.LIN Mini 2 Channel 1

Fig 89 Set application channel count

1.17 Software Configuration

The software configuration controls each application form’s status:



Measurement Window	Shortcut	Description
System Messages	Alt+M	System Messages
TS Channel Mapping		
Software Configuration		

Fig 90 Software configuration

The list contains all the opened application windows. With the help of its pop-up menu, the user can delete the selected window, rename the selected window and also create new window to perform specific tasks.

1.18 TS Log Converter

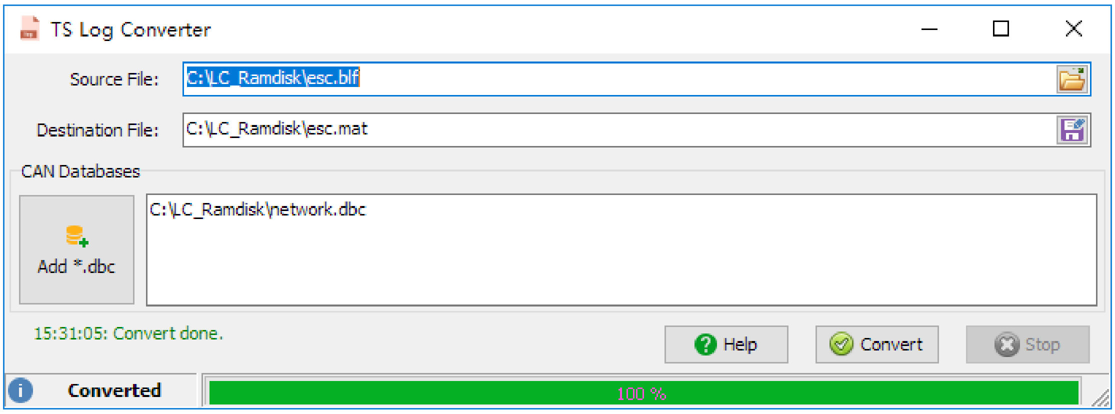
1.18.1 Log file types

TS log file converter can be started in “Analysis – Log Converter”, which converts log files from one format to another format. The following formats are supported:

Table 2 TS Log Converter capabilities

Source format	Destination format	Support	Comments
asc	blf	●	
asc	mat	●	dbc required
blf	asc	●	
blf	mat	●	dbc required
mat	asc	○	
mat	blf	○	

1.18.2 Log converter interface



Source File: C:\LC_Ramdisk\esc.blf

Destination File: C:\LC_Ramdisk\esc.mat

C:\LC_Ramdisk\network.dbc

15:31:05: Convert done.

Fig 91 Log converter interface

Source File: the source log file to be converted, acceptable file types can be “*.asc” and “*.blf”.

Destination File: the destination log file for the conversion result, acceptable file types can be “*.asc”, “*.blf” and “*.mat”.

CAN Databases: the additional CAN database file list for user to load “*.dbc” file. Note: only “*.mat” output file requires this section.

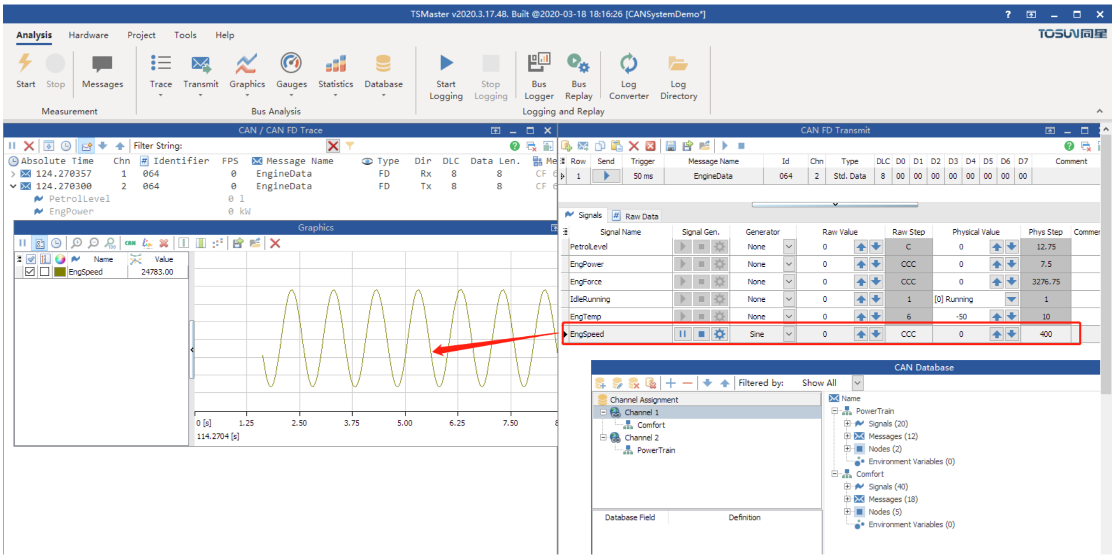
Help: opens this help file.

Convert: starts convertion based on the specified source and destination file.

Stop: stop conversion.

1.18.3 Mat File Example

Load sample dbc “Powertrain.dbc” and “Comfort.dbc” into TSMaster. Stimulate the “EngSpeed” signal with signal generator in the transmit window.



Absolute Time	Chn	Identifier	FPS	Message Name	Type	Dir	DLC	Data Len.
124.270357	1	064	0	EngineData	FD	Rx	8	8
124.270300	2	064	0	EngineData	FD	Tx	8	8
PetrolLevel			0 l					
EngPower			0 kW					

Name	Value
☑ □ EngSpeed	24783.00

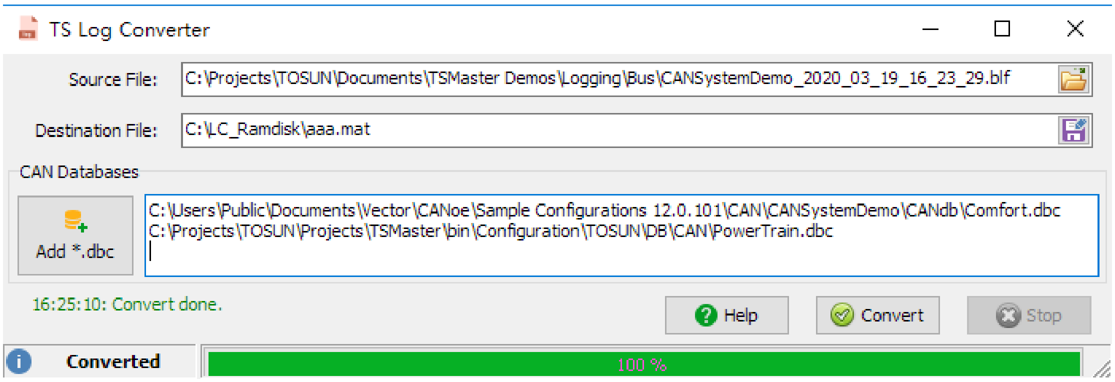
Row	Send	Trigger	Message Name	Id	Chn	Type	DLC	D0	D1	D2	D3	D4	D5	D6	D7	Comment
1	▶	50 ms	EngineData	064	2	Std. Data	8	00	00	00	00	00	00	00	00	

Signal Name	Signal Gen.	Generator	Raw Value	Raw Step	Physical Value	Phys Step	Comment
PetrolLevel		None	0	C	0	12.75	
EngPower		None	0	CCC	0	7.5	
EngForce		None	0	CCC	0	3276.75	
IdleRunning		None	0	1	[0] Running	1	
EngTemp		None	0	6	-50	10	
EngSpeed		Sine	0	CCC	0	400	

Fig 92 Load dbc and stimulate EngSpeed signal

Start logging of blf file and after some while stop logging.

After blf file is created, load the blf file in TS log converter and associate dbc files:



Source File: C:\Projects\TOSUN\Documents\TSMaster Demos\Logging\Bus\CANSystemDemo_2020_03_19_16_23_29.blf

Destination File: C:\LC_Ramdisk\aaa.mat

CAN Databases

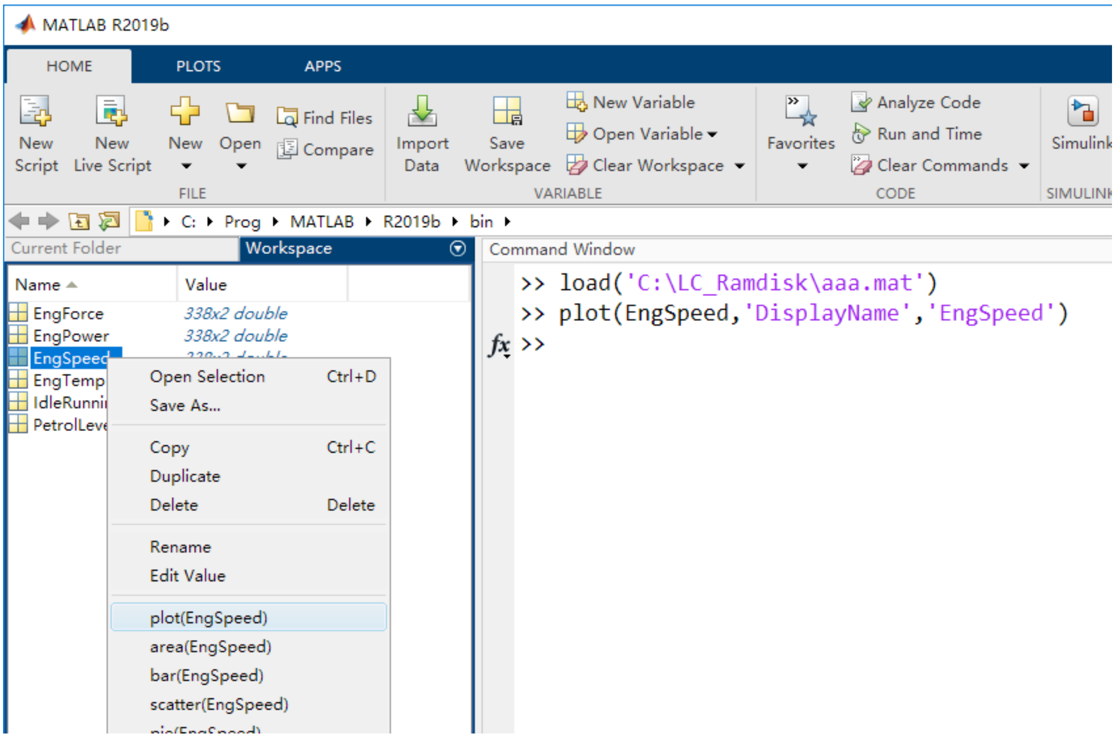
C:\Users\Public\Documents\Vector\CANoe\Sample Configurations 12.0.101\CAN\CANSystemDemo\CANdb\Comfort.dbc
C:\Projects\TOSUN\Projects\TSMaster\bin\Configuration\TOSUN\DB\CAN\PowerTrain.dbc

16:25:10: Convert done.

Converted 100 %

Fig 93 Specify log files and database files

After the log file has been converted, drag the mat file into MATLAB, find the signal “EngSpeed” in the workspace, and plot it by clicking “plot” in the popup menu, you will see the signal trace.



Name	Value
EngForce	338x2 double
EngPower	338x2 double
EngSpeed	
EngTemp	
IdleRunni	
PetrolLeve	

```
>> load('C:\LC_Ramdisk\aaa.mat')
>> plot(EngSpeed,'DisplayName','EngSpeed')
fx >>
```

Fig 94 Find signal "EngSpeed" and plot it

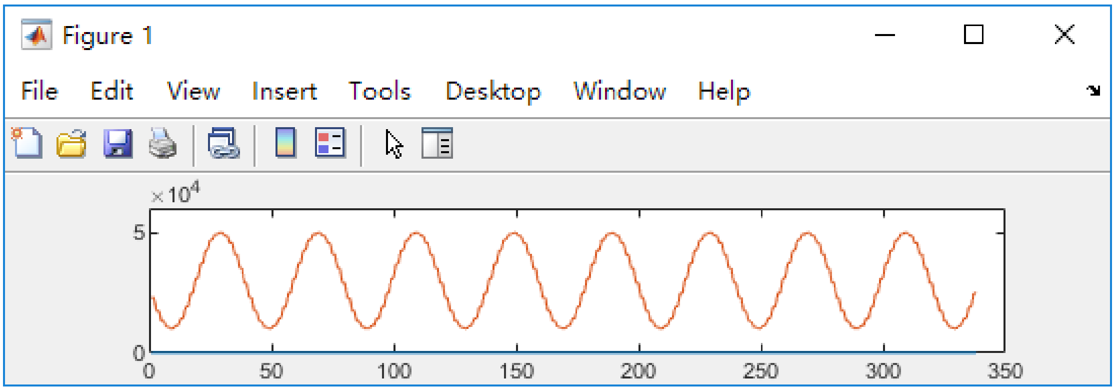


Fig 95 EngSpeed signal has been plotted

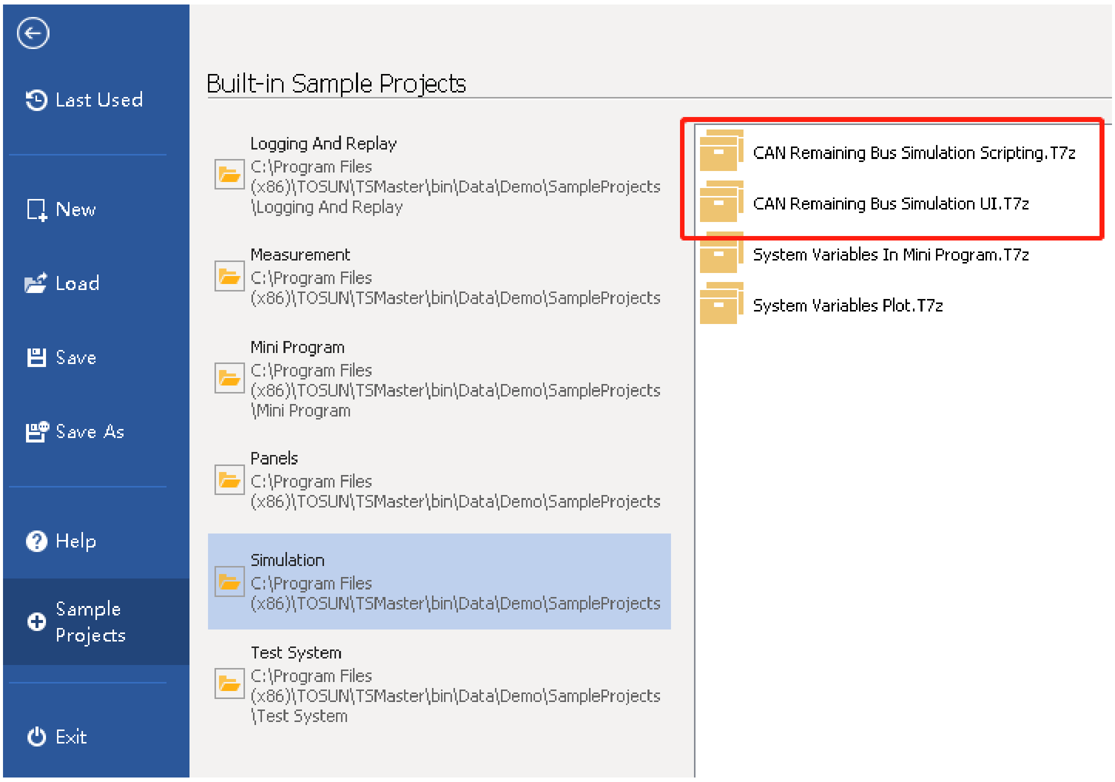
1.19 CAN Remaining Bus Simulation

CAN Remaining Bus Simulation (CAN RBS) is a software module performing CAN Bus simulation that sending background messages of network nodes defined in the CAN databases.

Please refer to the following examples to use CAN RBS simulation on UI, or with scripts:

“CAN Remaining Bus Simulation UI.T7z”

“CAN Remaining Bus Simulation Scripting.T7z”



Built-in Sample Projects

Logging And Replay
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Logging And Replay

Measurement
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Mini Program
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Mini Program

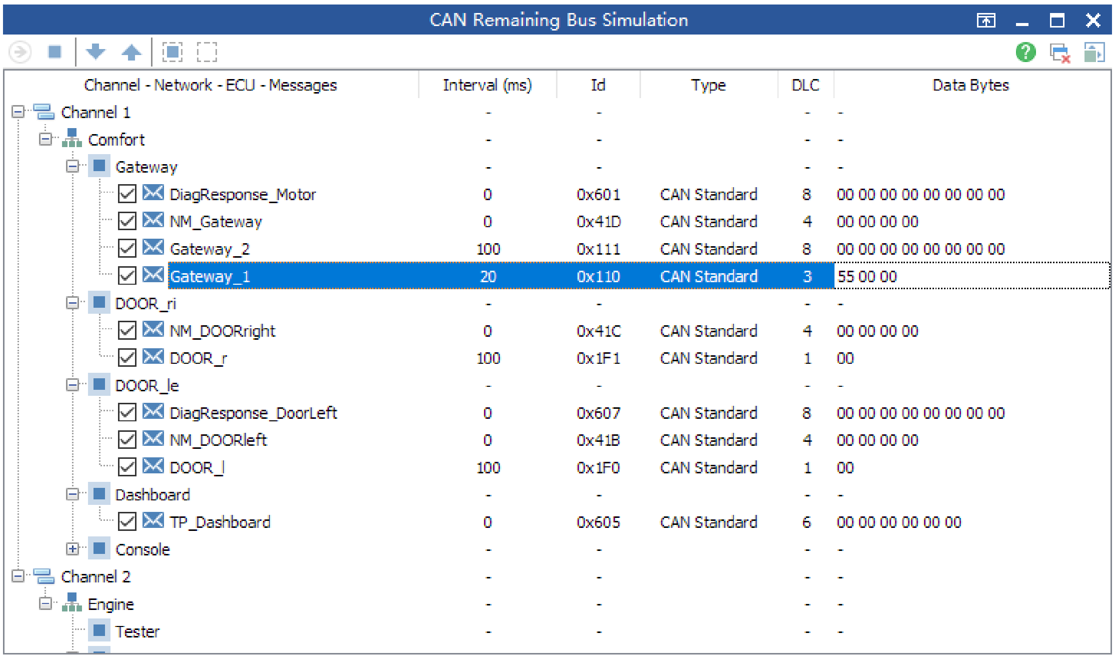
Panels
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Simulation
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Test System
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Test System

CAN Remaining Bus Simulation Scripting.T7z
CAN Remaining Bus Simulation UI.T7z
System Variables In Mini Program.T7z
System Variables Plot.T7z

Fig 96 CAN Remaining Bus Simulation Examples



Channel - Network - ECU - Messages	Interval (ms)	Id	Type	DLC	Data Bytes
Channel 1	-	-		-	-
Comfort	-	-		-	-
Gateway	-	-		-	-
☑ DiagResponse_Motor	0	0x601	CAN Standard	8	00 00 00 00 00 00 00 00
☑ NM_Gateway	0	0x41D	CAN Standard	4	00 00 00 00
☑ Gateway_2	100	0x111	CAN Standard	8	00 00 00 00 00 00 00 00
☑ Gateway_1	20	0x110	CAN Standard	3	55 00 00
DOOR_ri	-	-		-	-
☑ NM_DOORright	0	0x41C	CAN Standard	4	00 00 00 00
☑ DOOR_r	100	0x1F1	CAN Standard	1	00
DOOR_le	-	-		-	-
☑ DiagResponse_DoorLeft	0	0x607	CAN Standard	8	00 00 00 00 00 00 00 00
☑ NM_DOORleft	0	0x41B	CAN Standard	4	00 00 00 00
☑ DOOR_l	100	0x1F0	CAN Standard	1	00
Dashboard	-	-		-	-
☑ TP_Dashboard	0	0x605	CAN Standard	6	00 00 00 00 00 00
Console	-	-		-	-
Channel 2	-	-		-	-
Engine	-	-		-	-
Tester	-	-		-	-

Fig 97 CAN Remaining Bus Simulation

1.19.1 CAN RBS toolbar

➲ Start simulation, the activated message in the list will be scheduled in the transmission engine.

■ Stop simulation, all the message transmissions are halted.

⬇ Expand all nodes to view their transmission messages.

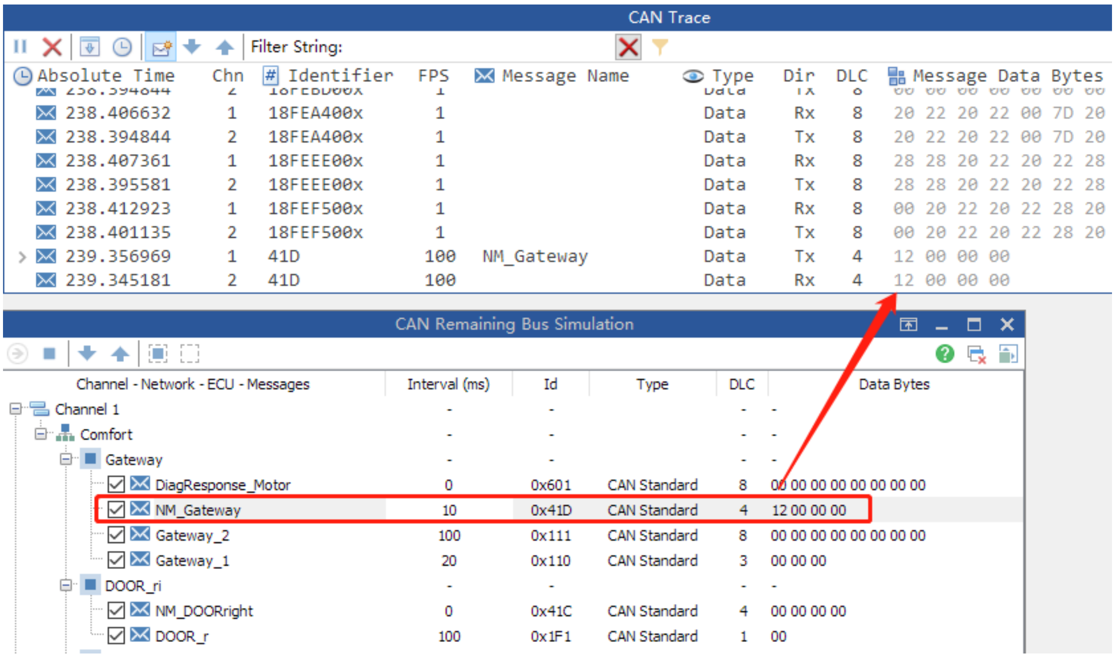
⬆ Collapse all nodes so messages are hidden.

▣ Select all messages in the list.

⬚ Deselect all messages in the list.

1.19.2 CAN RBS message list

The CAN RBS message list displays all the information and properties of each node’s transmit message. User can modify message properties while the simulation is running.



CAN Trace

Absolute Time	Chn	Identifier	FPS	Message Name	Type	Dir	DLC	Message Data Bytes
238.406632	1	18FEA400x	1		Data	Rx	8	20 22 20 22 00 7D 20
238.394844	2	18FEA400x	1		Data	Tx	8	20 22 20 22 00 7D 20
238.407361	1	18FEEE00x	1		Data	Rx	8	28 28 20 22 20 22 28
238.395581	2	18FEEE00x	1		Data	Tx	8	28 28 20 22 20 22 28
238.412923	1	18FEF500x	1		Data	Rx	8	00 20 22 20 22 28 20
238.401135	2	18FEF500x	1		Data	Tx	8	00 20 22 20 22 28 20
239.356969	1	41D	100	NM_Gateway	Data	Tx	4	12 00 00 00
239.345181	2	41D	100		Data	Rx	4	12 00 00 00

CAN Remaining Bus Simulation

Channel - Network - ECU - Messages	Interval (ms)	Id	Type	DLC	Data Bytes
Channel 1	-	-		-	-
Comfort	-	-		-	-
Gateway	-	-		-	-
☑ DiagResponse_Motor	0	0x601	CAN Standard	8	00 00 00 00 00 00 00 00
☑ NM_Gateway	10	0x41D	CAN Standard	4	12 00 00 00
☑ Gateway_2	100	0x111	CAN Standard	8	00 00 00 00 00 00 00 00
☑ Gateway_1	20	0x110	CAN Standard	3	00 00 00
DOOR_ri	-	-		-	-
☑ NM_DOORright	0	0x41C	CAN Standard	4	00 00 00 00
☑ DOOR_r	100	0x1F1	CAN Standard	1	00

Fig 98 CAN RBS list

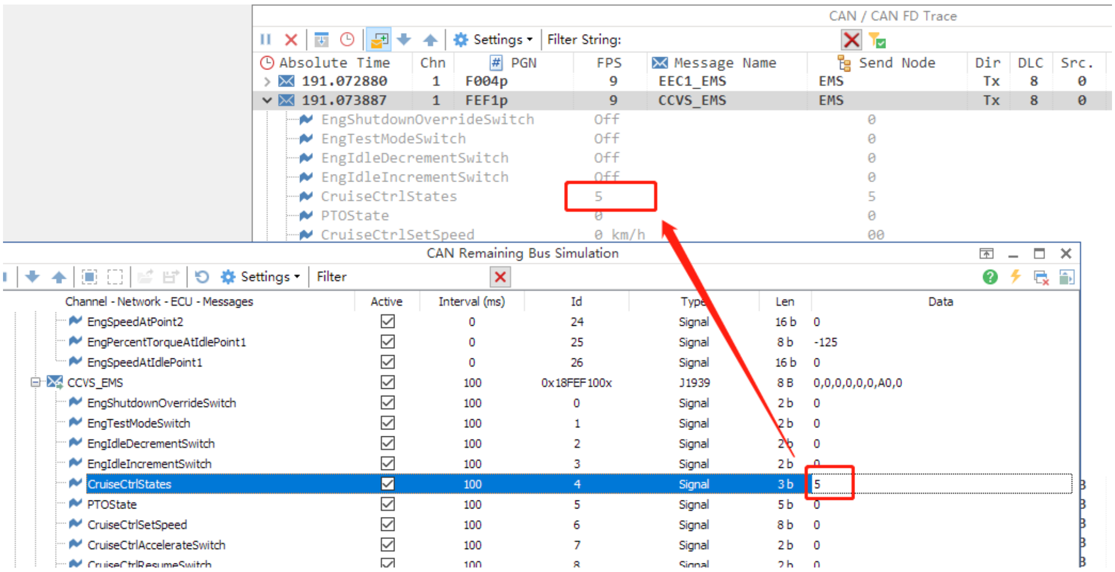
The fields that support dynamic assignment are:

- Message interval (ms)
- Message identifier

- Message DLC
- Message data bytes

1.19.3 Modify Signal In CAN RBS

You can expand the message to directly modify its signal value, which will take effect immediately:



CAN / CAN FD Trace

Absolute Time	Chn	PGN	FPS	Message Name	Send Node	Dir	DLC	Src.
191.072880	1	F004p	9	EEC1_EMS	EMS	Tx	8	0
191.073887	1	FEF1p	9	CCVS_EMS	EMS	Tx	8	0
EngShutdownOverrideSwitch			Off		0			
EngTestModeSwitch			Off		0			
EngIdleDecrementSwitch			Off		0			
EngIdleIncrementSwitch			Off		0			
CruiseCtrlStates			5		5			
PTOState			0		0			
CruiseCtrlSetSpeed			0 km/h		00			

CAN Remaining Bus Simulation

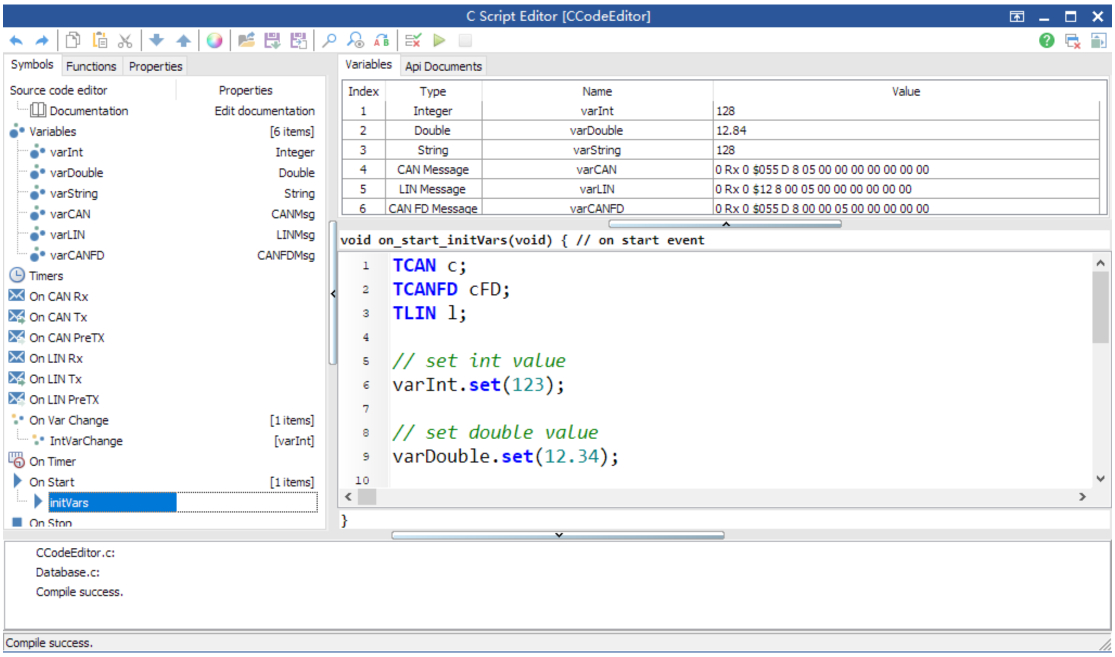
Channel - Network - ECU - Messages	Active	Interval (ms)	Id	Type	Len	Data
EngSpeedAtPoint2	☑	0	24	Signal	16 b	0
EngPercentTorqueAtIdlePoint1	☑	0	25	Signal	8 b	-125
EngSpeedAtIdlePoint1	☑	0	26	Signal	16 b	0
CCVS_EMS	☑	100	0x18FEF100x	J1939	8 B	0,0,0,0,0,0,A0,0
EngShutdownOverrideSwitch	☑	100	0	Signal	2 b	0
EngTestModeSwitch	☑	100	1	Signal	2 b	0
EngIdleDecrementSwitch	☑	100	2	Signal	2 b	0
EngIdleIncrementSwitch	☑	100	3	Signal	2 b	0
CruiseCtrlStates	☑	100	4	Signal	3 b	5
PTOState	☑	100	5	Signal	5 b	0
CruiseCtrlSetSpeed	☑	100	6	Signal	8 b	0
CruiseCtrlAccelerateSwitch	☑	100	7	Signal	2 b	0
CruiseCtrlResumeSwitch	☑	100	8	Signal	2 b	0

Fig 99 Modify signal value in RBS in UI

You can also modify signals in scripts, please refer to example: *"CAN Remaining Bus Simulation Scripting.T7z"*

1.20 C Script Editor

C Script editor is a C implementation of TS Mini Program. TSMaster C script enables the user to utilize maximum abilities of TSMaster main application.



Source code editor	Properties
Documentation	Edit documentation
Variables	[6 items]
varInt	Integer
varDouble	Double
varString	String
varCAN	CANMsg
varLIN	LINMsg
varCANFD	CANFDMsg
Timers	
On CAN Rx	
On CAN Tx	
On CAN PreTX	
On LIN Rx	
On LIN Tx	
On LIN PreTX	
On Var Change	[1 items]
IntVarChange	[varInt]
On Timer	
On Start	[1 items]
initVars	
On Stop	

Index	Type	Name	Value
1	Integer	varInt	128
2	Double	varDouble	12.84
3	String	varString	128
4	CAN Message	varCAN	0 Rx 0 $055 D 8 05 00 00 00 00 00 00 00
5	LIN Message	varLIN	0 Rx 0 $12 8 00 05 00 00 00 00 00 00
6	CAN FD Message	varCANFD	0 Rx 0 $055 D 8 00 00 05 00 00 00 00 00

```
void on_start_initVars(void) { // on start event
TCAN c;
TCANFD cFD;
TLIN l;

// set int value
varInt.set(123);

// set double value
varDouble.set(12.34);

}
```

```
CCodeEditor.c:
Database.c:
Compile success.
```

Compile success.

Fig 100 C Code Editor user interface

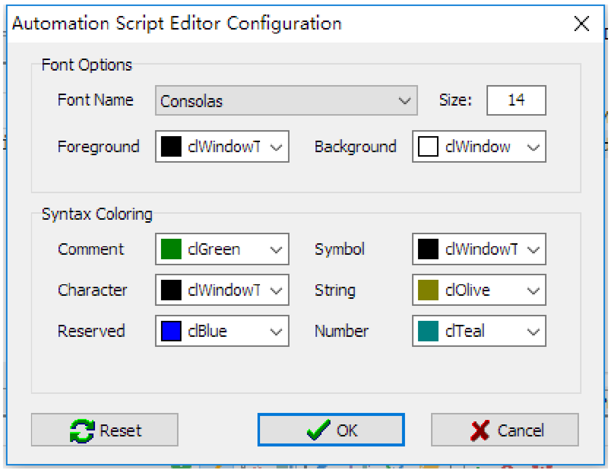
1.20.1 C Script Editor toolbar

Undo and Redo the modification you made in the script.

Copy, Paste and Cut the selected text in the script editor.

Expand or collapse the left symbol tree or function tree.

Editor color configuration, which brings up a syntax color editor for you to choose styles:



Font Options

Font Name: Consolas Size: 14

Foreground: ■ clWindowT Background: □ clWindow

Syntax Coloring

Comment	🟩 clGreen	Symbol	■ clWindowT
Character	■ clWindowT	String	■ clOlive
Reserved	🟦 clBlue	Number	■ clTeal

Fig 101 Color editor

Import an external mpc file into this code editor.

Save the current mpc file, the system will automatically save this file when application configuration is saved.

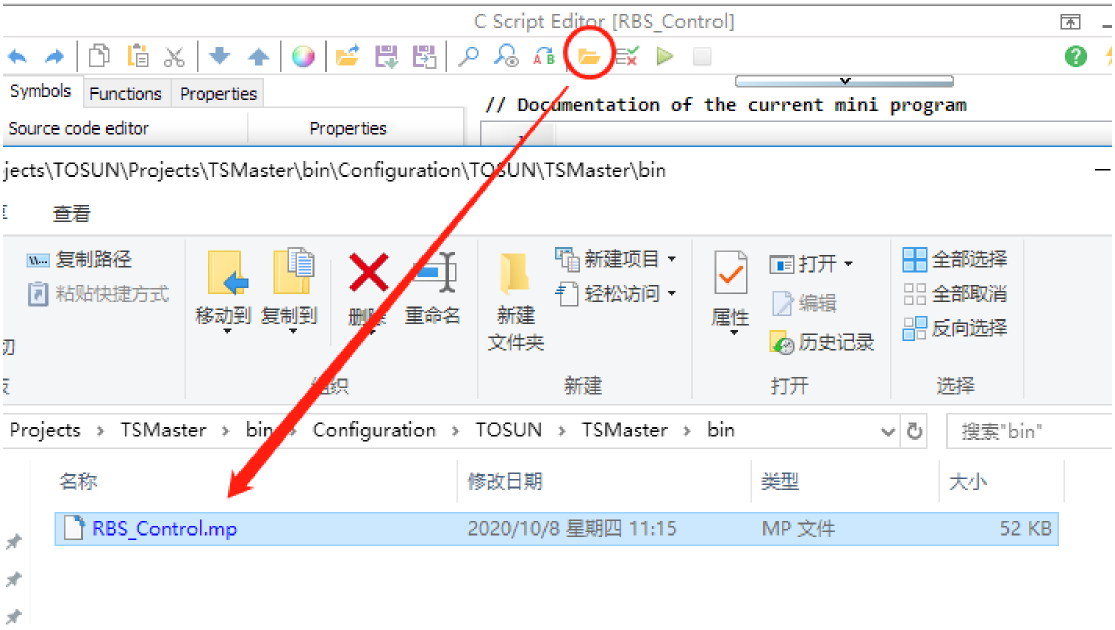
Export the current mpc file to another location. Note: the script location you are editing won’t be changed. This is just an export operation.

Search a text sequence.

Search next, this feature has a shortcut “F3”, which is really useful when you want to jump to the location of the same text sequence currently selected.

Replace a text sequence.

Opens the directory containing the compiled script, after successful compilation, you will find a “.mp” file inside this directory, drag this file into TSMaster will cause TSMaster treats this file as a mini program library:



```
// Documentation of the current mini program
```

jects\TOSUN\Projects\TSMaster\bin\Configuration\TOSUN\TSMaster\bin

名称	修改日期	类型	大小
RBS_Control.mp	2020/10/8 星期四 11:15	MP 文件	52 KB

Fig 102 Compiled mini program location

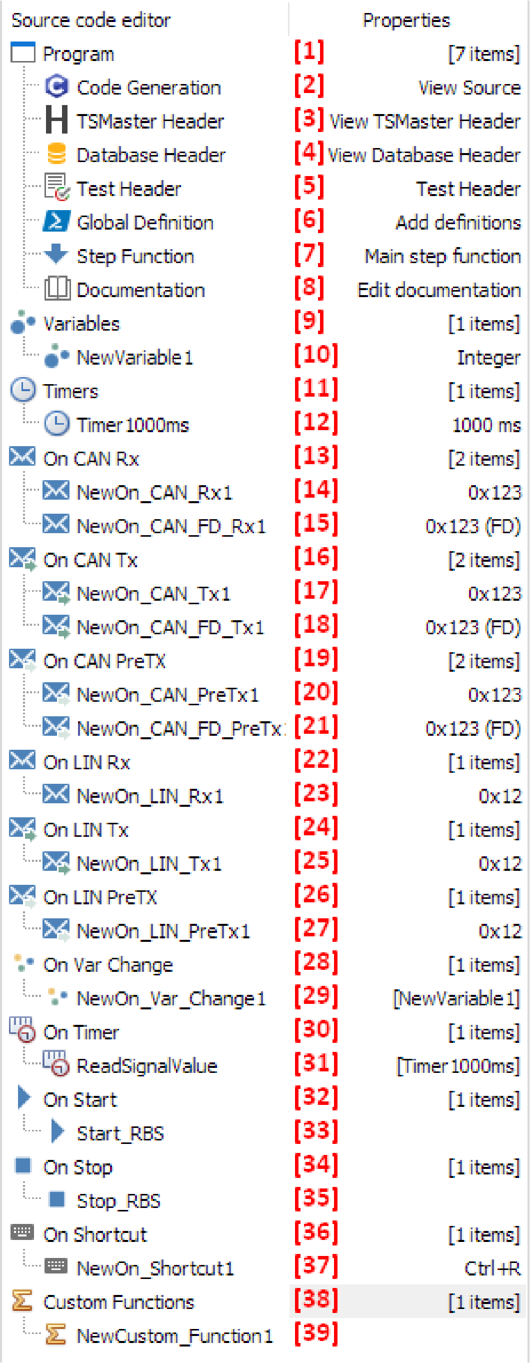
Compile the current mini program. Error information will popup if your syntax is incorrect.

Run the current mini program, if the source file is changed, the mini program is firstly compiled then executed by the TSMaster.

🟩 Stop the execution of the current mini program.

1.20.2 Symbol Tree

The symbol tree items are described as below:



Source code editor		Properties
Program	[1]	[7 items]
Code Generation	[2]	View Source
TSMaster Header	[3]	View TSMaster Header
Database Header	[4]	View Database Header
Test Header	[5]	Test Header
Global Definition	[6]	Add definitions
Step Function	[7]	Main step function
Documentation	[8]	Edit documentation
Variables	[9]	[1 items]
NewVariable1	[10]	Integer
Timers	[11]	[1 items]
Timer1000ms	[12]	1000 ms
On CAN Rx	[13]	[2 items]
NewOn_CAN_Rx1	[14]	0x123
NewOn_CAN_FD_Rx1	[15]	0x123 (FD)
On CAN Tx	[16]	[2 items]
NewOn_CAN_Tx1	[17]	0x123
NewOn_CAN_FD_Tx1	[18]	0x123 (FD)
On CAN PreTX	[19]	[2 items]
NewOn_CAN_PreTx1	[20]	0x123
NewOn_CAN_FD_PreTx	[21]	0x123 (FD)
On LIN Rx	[22]	[1 items]
NewOn_LIN_Rx1	[23]	0x12
On LIN Tx	[24]	[1 items]
NewOn_LIN_Tx1	[25]	0x12
On LIN PreTX	[26]	[1 items]
NewOn_LIN_PreTx1	[27]	0x12
On Var Change	[28]	[1 items]
NewOn_Var_Change1	[29]	[NewVariable1]
On Timer	[30]	[1 items]
ReadSignalValue	[31]	[Timer1000ms]
On Start	[32]	[1 items]
Start_RBS	[33]	
On Stop	[34]	[1 items]
Stop_RBS	[35]	
On Shortcut	[36]	[1 items]
NewOn_Shortcut1	[37]	Ctrl+R
Custom Functions	[38]	[1 items]
NewCustom_Function1	[39]	

Fig 103 Symbol tree items

1.20.2.1 Program group

Program

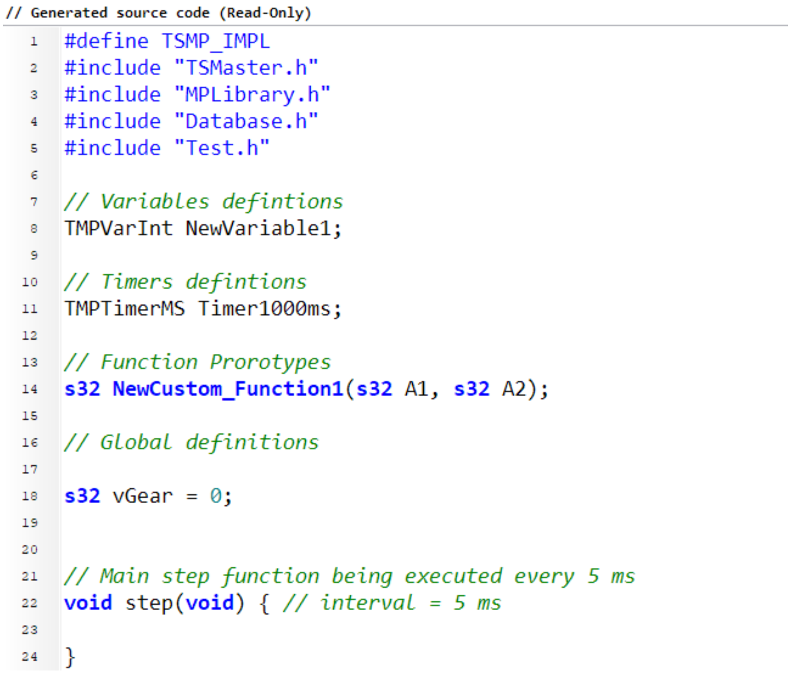
The program group contains mini program related headers, sources and documentation.

1.20.2.2 Code Generation

Code Generation

This section contains all generated source code of this mini program.

This source code is read-only, to solve problems of your code during compile, you should first goto error line to identify problems, and then navigate to the associated code section to correct problems.



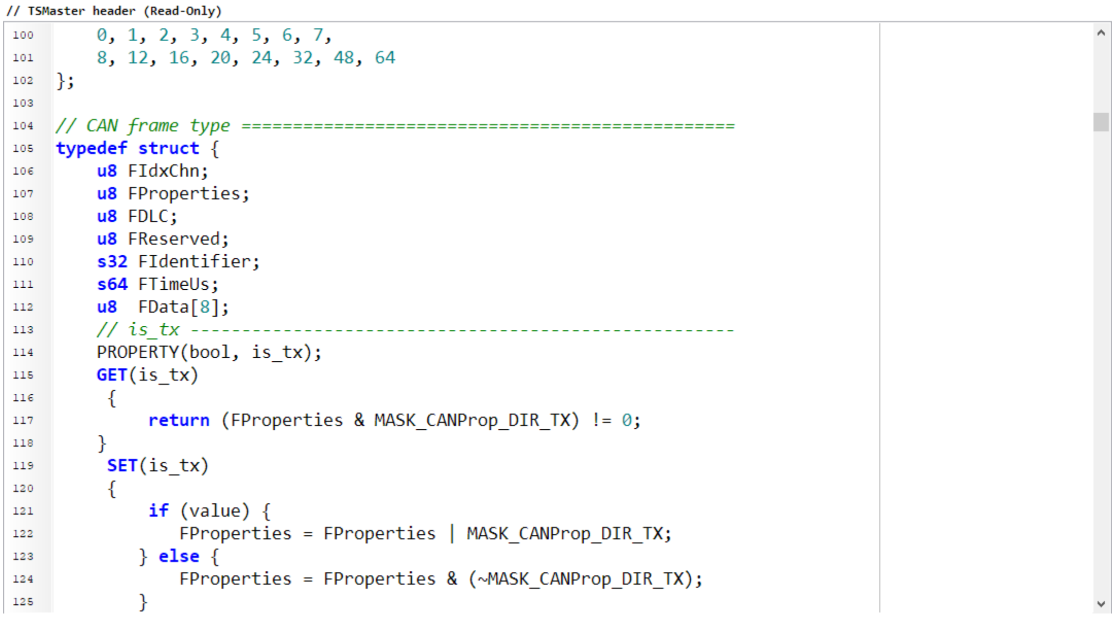
```
// Generated source code (Read-Only)
#define TSMP_IMPL
#include "TSMaster.h"
#include "MPLibrary.h"
#include "Database.h"
#include "Test.h"

// Variables defintions
TMPVarInt NewVariable1;

// Timers defintions
TMPTimerMS Timer1000ms;

// Function Prorotypes
s32 NewCustom_Function1(s32 A1, s32 A2);

// Global definitions

s32 vGear = 0;


// Main step function being executed every 5 ms
void step(void) { // interval = 5 ms

}
```

Fig 104 Code generation page

1.20.2.3 TSMaster Header

TSMaster Header

This section contains all interface definitions of TSMaster mini program, to find out record, typedef of TSMaster mini program symbols such as "TCAN", "PCAN", Please refer to this section.



// TSMaster header (Read-Only)

```
    0, 1, 2, 3, 4, 5, 6, 7,
    8, 12, 16, 20, 24, 32, 48, 64
};

// CAN frame type ================================================
typedef struct {
    u8 FIdxChn;
    u8 FProperties;
    u8 FDLC;
    u8 FReserved;
    s32 FIdentifier;
    s64 FTimeUs;
    u8  FData[8];
    // is_tx -----------------------------------------------------
    PROPERTY(bool, is_tx);
    GET(is_tx)
     {
         return (FProperties & MASK_CANProp_DIR_TX) != 0;
    }
     SET(is_tx)
     {
         if (value) {
            FProperties = FProperties | MASK_CANProp_DIR_TX;
        } else {
            FProperties = FProperties & (~MASK_CANProp_DIR_TX);
        }
```

Fig 105 TSMaster header

1.20.2.4 Database Header

Database Header

This sections contains all message and signal definitions from any loaded dbc/ldf databases.

To manipulate a CAN signal for example, you should:

[1] Load specific dbc file into TSMaster

[2] Switch to this section, you will see all the extracted database symbols

[3] Navigate to "Functions" tab on the right, you will see messages in this tree

[4] Right-click on one of the messages such as "Configure_1", and select "Insert into script"

This will insert the definition of "Configure" message on Channel 1 into the current script, such as:

```
TConfigure_1 Configure_1;
Configure_1.init();
```

[5] the last inserted line "Configure_1.init();" is initialization method of message "Configure_1"

you should cut this line to place before any code which access "Configure_1"

[6] then you can get or set its signals freely:

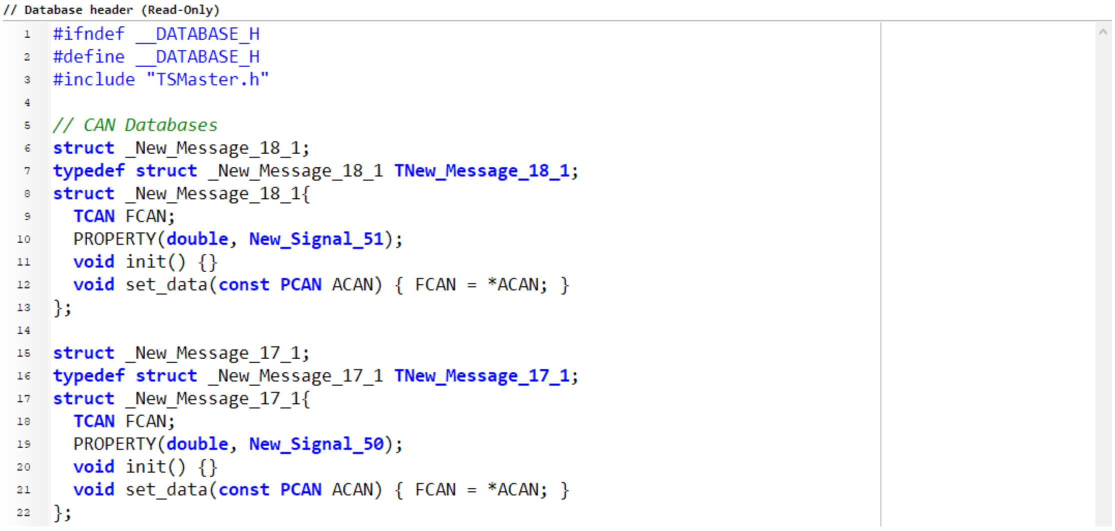
To get signal value "FL_Speed": result = Wheel_Speed_1.FL_Speed;

To set signal value "FL_Speed": Wheel_Speed_1.FL_Speed = 12.3;

[7] To send this message out, just use the following code:

com.transmit_can_async(&Wheel_Speed_1.FCAN);

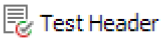
where "FCAN" is its internal CAN message object, which contains all raw data bytes of tihs messageNote: Compile will fail if databases are loaded with same message names in the same channel.



```
// Database header (Read-Only)
#ifndef __DATABASE_H
#define __DATABASE_H
#include "TSMaster.h"

// CAN Databases
struct _New_Message_18_1;
typedef struct _New_Message_18_1 TNew_Message_18_1;
struct _New_Message_18_1{
  TCAN FCAN;
  PROPERTY(double, New_Signal_51);
  void init() {}
  void set_data(const PCAN ACAN) { FCAN = *ACAN; }
};

struct _New_Message_17_1;
typedef struct _New_Message_17_1 TNew_Message_17_1;
struct _New_Message_17_1{
  TCAN FCAN;
  PROPERTY(double, New_Signal_50);
  void init() {}
  void set_data(const PCAN ACAN) { FCAN = *ACAN; }
};
```

Fig 106 Database Header

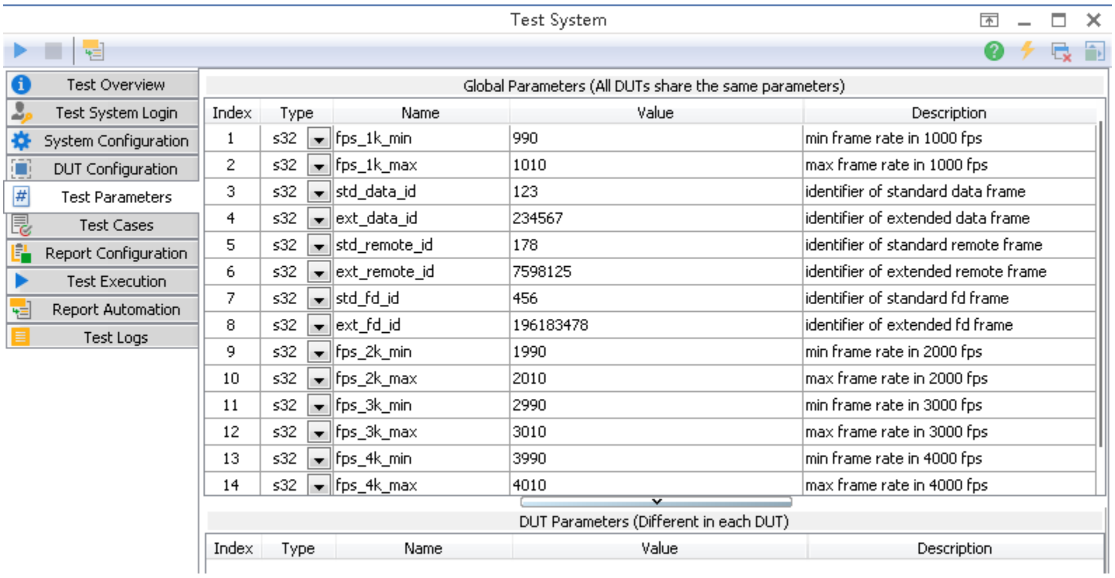
1.20.2.5 Test Header



This section contains all parameter definitions of the test system that uses this mini program as test case.

You can locate any parameter you previously defined in test system.

After parameters are defined, the “Test Header” section will reflect all the parameter definitions using C code.



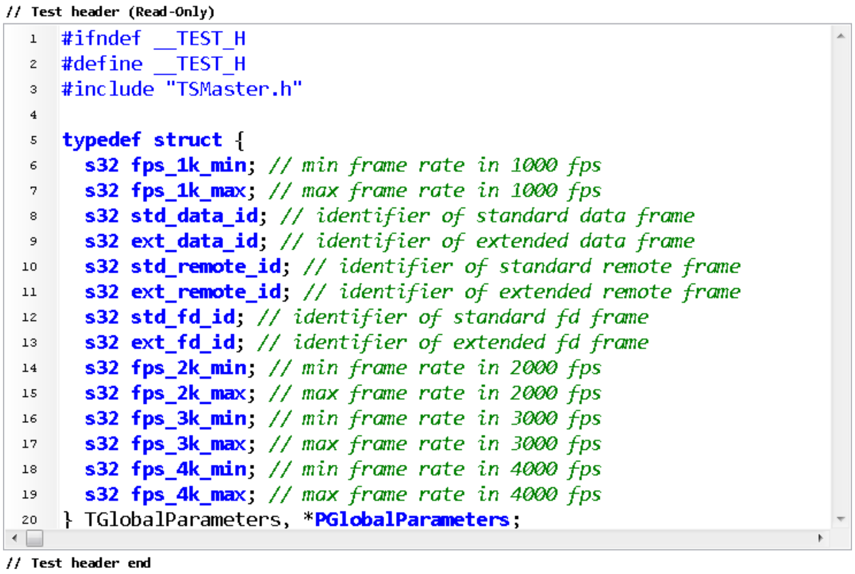
Global Parameters (All DUTs share the same parameters)

Index	Type	Name	Value	Description
1	s32	fps_1k_min	990	min frame rate in 1000 fps
2	s32	fps_1k_max	1010	max frame rate in 1000 fps
3	s32	std_data_id	123	identifier of standard data frame
4	s32	ext_data_id	234567	identifier of extended data frame
5	s32	std_remote_id	178	identifier of standard remote frame
6	s32	ext_remote_id	7598125	identifier of extended remote frame
7	s32	std_fd_id	456	identifier of standard fd frame
8	s32	ext_fd_id	196183478	identifier of extended fd frame
9	s32	fps_2k_min	1990	min frame rate in 2000 fps
10	s32	fps_2k_max	2010	max frame rate in 2000 fps
11	s32	fps_3k_min	2990	min frame rate in 3000 fps
12	s32	fps_3k_max	3010	max frame rate in 3000 fps
13	s32	fps_4k_min	3990	min frame rate in 4000 fps
14	s32	fps_4k_max	4010	max frame rate in 4000 fps

DUT Parameters (Different in each DUT)

Index	Type	Name	Value	Description

Fig 107 Parameters defined in test system



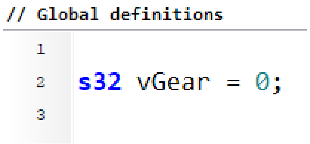
```
// Test header (Read-Only)
#ifndef __TEST_H
#define __TEST_H
#include "TSMaster.h"

typedef struct {
  s32 fps_1k_min; // min frame rate in 1000 fps
  s32 fps_1k_max; // max frame rate in 1000 fps
  s32 std_data_id; // identifier of standard data frame
  s32 ext_data_id; // identifier of extended data frame
  s32 std_remote_id; // identifier of standard remote frame
  s32 ext_remote_id; // identifier of extended remote frame
  s32 std_fd_id; // identifier of standard fd frame
  s32 ext_fd_id; // identifier of extended fd frame
  s32 fps_2k_min; // min frame rate in 2000 fps
  s32 fps_2k_max; // max frame rate in 2000 fps
  s32 fps_3k_min; // min frame rate in 3000 fps
  s32 fps_3k_max; // max frame rate in 3000 fps
  s32 fps_4k_min; // min frame rate in 4000 fps
  s32 fps_4k_max; // max frame rate in 4000 fps
} TGlobalParameters, *PGlobalParameters;
// Test header end
```

Fig 108 Test Header

1.20.2.6 Global definition

Global Definition

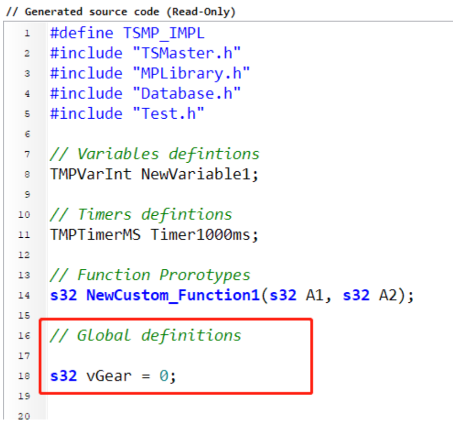
This section contains all your global definitions, which will be placed before all event functions such as "#include <xxx>", or "s32 vVar1;", etc.



```
// Global definitions

s32 vGear = 0;

```

Fig 109 Global definitions

When you define global variables in the source, they will be generated on top of the source in “Code Generation”:



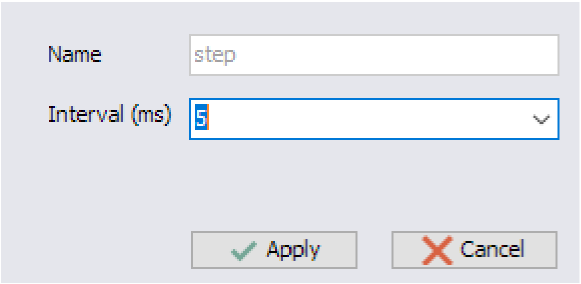
```
// Generated source code (Read-Only)
#define TSMP_IMPL
#include "TSMaster.h"
#include "MPLibrary.h"
#include "Database.h"
#include "Test.h"

// Variables defintions
TMPVarInt NewVariable1;

// Timers defintions
TMPTimerMS Timer1000ms;

// Function Prorotypes
s32 NewCustom_Function1(s32 A1, s32 A2);

// Global definitions

s32 vGear = 0;


```

Fig 110 Globally defined variables in "Code Generation"

1.20.2.7 Step Function

The function in this section will be automatically executed periodically, such as step function of ECU tasks, or any periodic task.

Double click on this section will popup property editor, in which you can specify period in milliseconds.



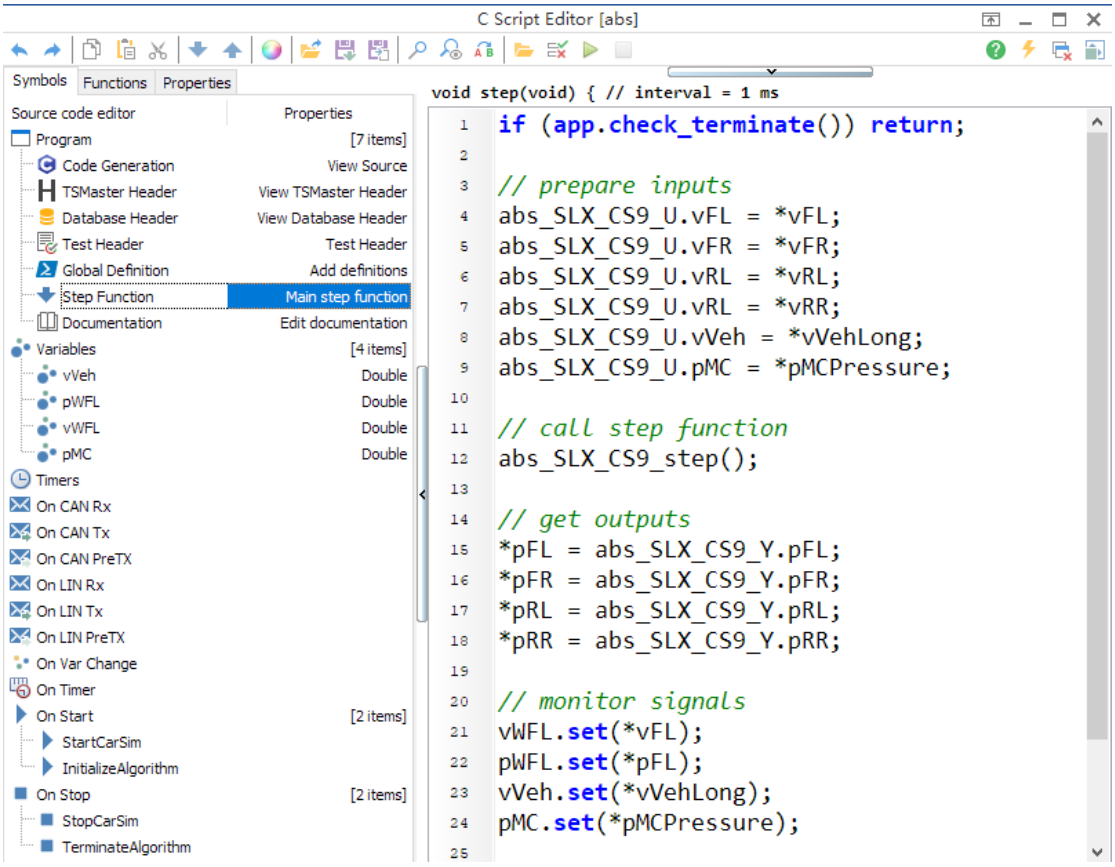
Name: step

Interval (ms): 5

Fig 111 Step function configuration

In the example of TSMaster – CarSim cosimulation example, you can see the algorithm of ABS function is invoked in the step function every 5ms.

You can first prepare function inputs before “abs_SLX_CS9_step” is called, and retrieve function outputs after “abs_SLX_CS9_step” is called. You can then plot the important signals in Graphics, panels and so on. You can even plot internal, or temp. variables, too.



```
void step(void) { // interval = 1 ms
if (app.check_terminate()) return;

// prepare inputs
abs_SLX_CS9_U.vFL = *vFL;
abs_SLX_CS9_U.vFR = *vFR;
abs_SLX_CS9_U.vRL = *vRL;
abs_SLX_CS9_U.vRL = *vRR;
abs_SLX_CS9_U.vVeh = *vVehLong;
abs_SLX_CS9_U.pMC = *pMCPressure;

// call step function
abs_SLX_CS9_step();

// get outputs
*pFL = abs_SLX_CS9_Y.pFL;
*pFR = abs_SLX_CS9_Y.pFR;
*pRL = abs_SLX_CS9_Y.pRL;
*pRR = abs_SLX_CS9_Y.pRR;

// monitor signals
vWFL.set(*vFL);
pWFL.set(*pFL);
vVeh.set(*vVehLong);
pMC.set(*pMCPressure);
```

Fig 112 Step function of ABS SIL test

1.20.2.8 Documentation

Documentation

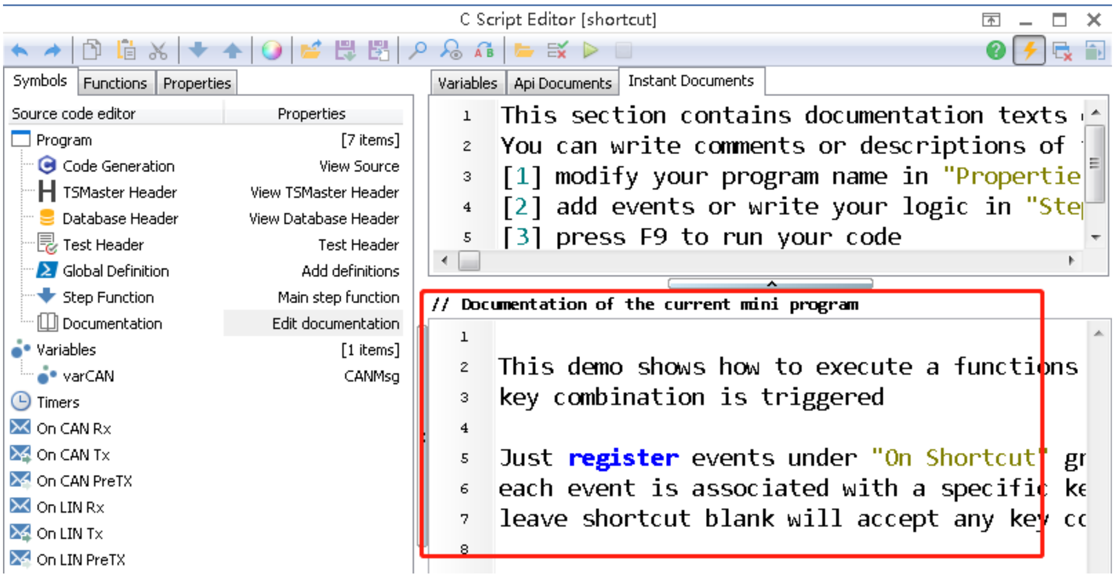
This section contains documentation texts of this mini program.

You can write comments or descriptions of this mini program here, steps to create mini program:

[1] modify your program name in "Properties" - "Program Settings" - "Program Name"

[2] add events or write your logic in "Step Function"

[3] press F9 to run your code



```
This section contains documentation texts
You can write comments or descriptions of
[1] modify your program name in "Propertie
[2] add events or write your logic in "Ste
[3] press F9 to run your code
```

```
// Documentation of the current mini program

This demo shows how to execute a functions
key combination is triggered

Just register events under "On Shortcut" gr
each event is associated with a specific ke
leave shortcut blank will accept any key cc
```

Fig 113 Documentation of mini program

1.20.2.9 Variables Group

Variables group contains globally defined variables in the current mini program.

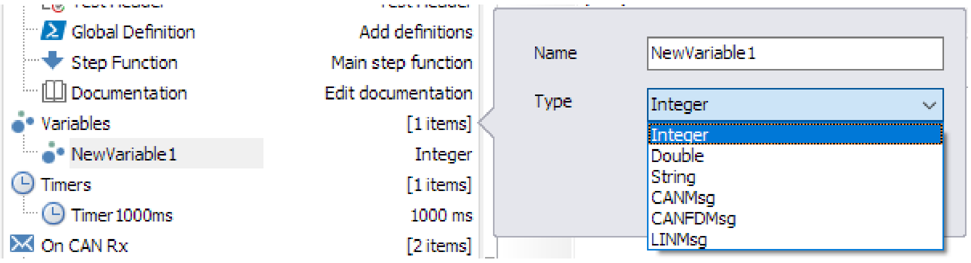
If you define variable here, such as "v1" of double type, you should use it with the following method:

[1] read this variable: double d = v1.get();

[2] write this variable: v1.set(12.34);

[3] watch this variable in realtime: just run your mini program, you will see this variable value in "Variables" page.

1.20.2.10 Variable



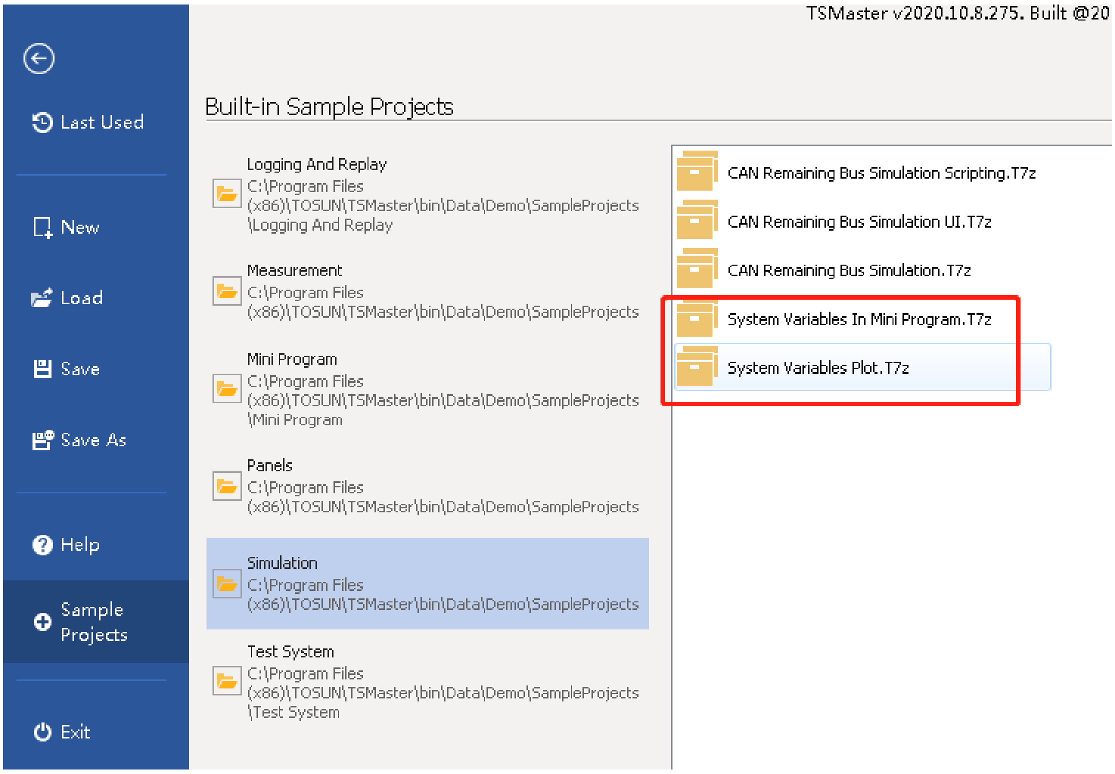
Name NewVariable1

Type Integer

Fig 114 Variable in mini program

When you double click a variable in the group, you will see a popup appears, in which you can modify the variable name, and type.

Note: each variable you defined in the “Variables Group” will become an internal system variable in TSMaster when this script is being executed, that is, you can monitor this variable in real-time in Graphics, Panels or even in your other mini programs. Please refer to TSMaster example “System Variables in Mini Program” for details:



TSMaster v2020.10.8.275. Built @20

Built-in Sample Projects

Logging And Replay
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Logging And Replay

Measurement
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Mini Program
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Mini Program

Panels
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Simulation
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Test System
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Test System

CAN Remaining Bus Simulation Scripting.T7z
CAN Remaining Bus Simulation UI.T7z
CAN Remaining Bus Simulation.T7z
System Variables In Mini Program.T7z
System Variables Plot.T7z

Fig 115 Variables will become System variables

1.20.2.11 Timers Group

Timer group contains every timer you defined. To use timer, you should for example:

[1] define a timer in this group such as "tim1"

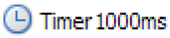
[2] set the period(ms) of this timer such as 10ms

[3] define a on timer callback "OnTim1" in "On Timer" group and associate the callback with this timer

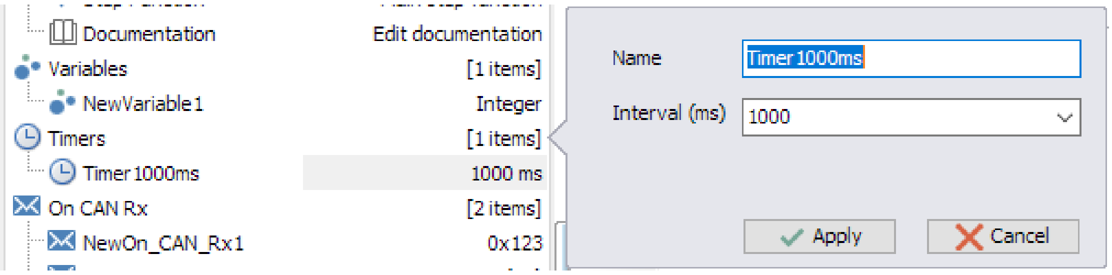
[4] start the timer using "tim1.start();"

[5] now in callback "OnTim1", your code of this function will be executed every 10ms

1.20.2.12 Timer


Timer 1000ms

When you double click on a timer, you will see a popup showing the properties of the current selected timer. You can modify the name, and interval in milliseconds.



Documentation	Edit documentation
Variables	[1 items]
NewVariable1	Integer
Timers	[1 items]
Timer1000ms	1000 ms
On CAN Rx	[2 items]
NewOn_CAN_Rx1	0x123

Name: Timer1000ms

Interval (ms): 1000

Fig 116 Timer defintion

1.20.2.13 On CAN Receive Event Group

On CAN Rx

CAN receive event group contains every CAN / CAN FD reception callback you defined. To use a reception callback, you should for example:

[1] define a callback named "OnRx123" with an identifier "0x123", this means message with id = 0x123 will fire this event

If you want to trigger ANY Rx frame, just leave the identifier text box blank

[2] you will get parameter "ACAN" in this event to operate with

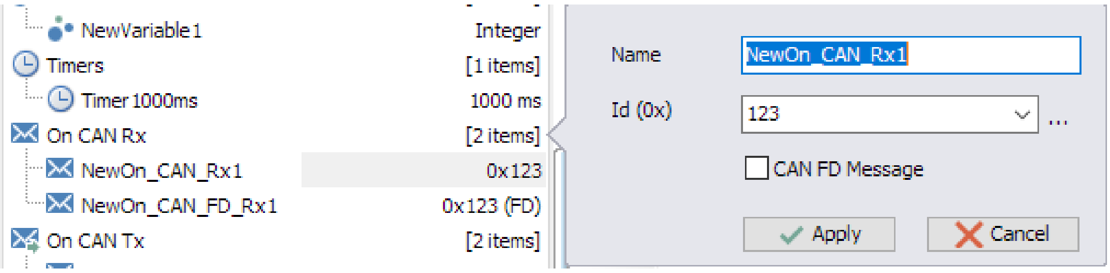
Such as: ACAN->FData[0] to access the first data byte of this received message

Please see "TSMaster Header" section on the left tree to find out data type and elements of "TCAN"

1.20.2.14 On CAN Receive Event

NewOn_CAN_Rx1

When you double click on the event, you will see a popup showing the properties of this event. You can modify the name, identifier of this event. Switch on or off “CAN FD Message” will change the event type to be “CAN FD” event or “Classical CAN” event.

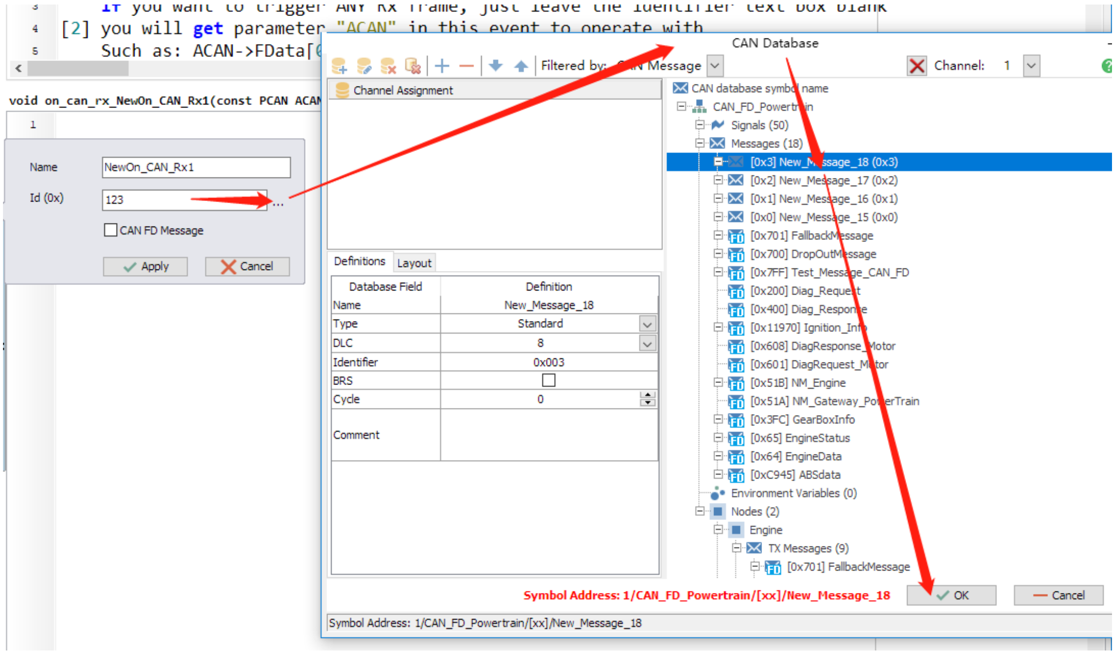


NewVariable1 Integer
Timers [1 items]
Timer1000ms 1000 ms
On CAN Rx [2 items]
NewOn_CAN_Rx1 0x123
NewOn_CAN_FD_Rx1 0x123 (FD)
On CAN Tx [2 items]

Name NewOn_CAN_Rx1
Id (0x) 123
□ CAN FD Message

Fig 117 On CAN Rx Event

When a database is assigned, you can pick any CAN message from the database by clicking “…” button on the right side of the “Id” input box.



```
    If you want to trigger ANY Rx frame, just leave the identifier text box blank
[2] you will get parameter "ACAN" in this event to operate with
    Such as: ACAN->FData[(
```

```
void on_can_rx_NewOn_CAN_Rx1(const PCAN ACAN
```

Name: NewOn_CAN_Rx1

Id (0x): 123 ...

□ CAN FD Message

CAN Database — Filtered by: CAN Message — Channel: 1

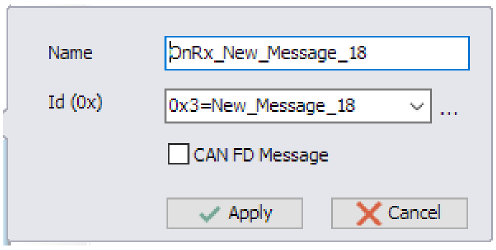
Database Field	Definition
Name	New_Message_18
Type	Standard
DLC	8
Identifier	0x003
BRS	□
Cycle	0
Comment	

Symbol Address: 1/CAN_FD_Powertrain/[xx]/New_Message_18

Symbol Address: 1/CAN_FD_Powertrain/[xx]/New_Message_18

Fig 118 CAN message selector for On Rx event

After the message is selected, you can see the information is automatically inserted into the input box:



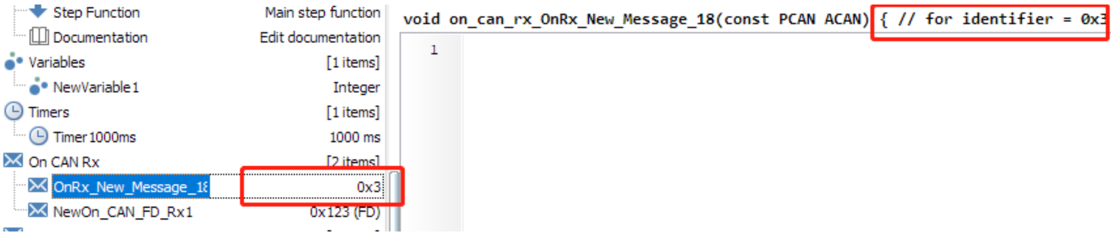
Name: OnRx_New_Message_18

Id (0x): 0x3=New_Message_18 ...

□ CAN FD Message

Fig 119 CAN message information automatically inserted

After you click “Apply” or press enter key, you can see the information is recognized by the script editor:



Step Function	Main step function
Documentation	Edit documentation
Variables	[1 items]
NewVariable1	Integer
Timers	[1 items]
Timer1000ms	1000 ms
On CAN Rx	[2 items]
OnRx_New_Message_18	0x3
NewOn_CAN_FD_Rx1	0x123 (FD)

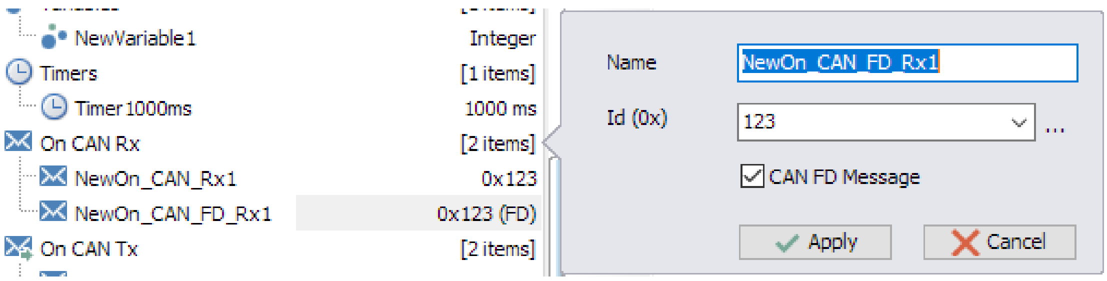
```
void on_can_rx_OnRx_New_Message_18(const PCAN ACAN) { // for identifier = 0x3
```

Fig 120 On message information recognized by the editor

1.20.2.15 On CAN FD Receive Event

NewOn_CAN_FD_Rx1

When you double click on the event, you will see a popup showing the properties of this event. You can modify the name, identifier of this event. Switch on or off “CAN FD Message” will change the event type to be “CAN FD” event or “Classical CAN” event.


NewVariable1	Integer
Timers	[1 items]
Timer1000ms	1000 ms
On CAN Rx	[2 items]
NewOn_CAN_Rx1	0x123
NewOn_CAN_FD_Rx1	0x123 (FD)
On CAN Tx	[2 items]

Name: NewOn_CAN_FD_Rx1

Id (0x): 123

☑ CAN FD Message

Fig 121 On CAN FD Rx Event

1.20.2.16 On CAN Transmit Event Group

On CAN Tx

CAN transmit event group contains every CAN / CAN FD transmit callback you defined.

Note: only transmitted frame (ACKed by other node) fires transmit callback. TOSUN, Vector and IntrepidCS hardware have ability to get correct timestamp of transmitted frame

To use a transmit callback, you should for example:

[1] define a callback named "OnRx123" with an identifier "0x123", this means message with id = 0x123 will fire this event

If you want to trigger ANY Tx frame, just leave the identifier text box blank

[2] you will get parameter "ACAN" in this event to operate with

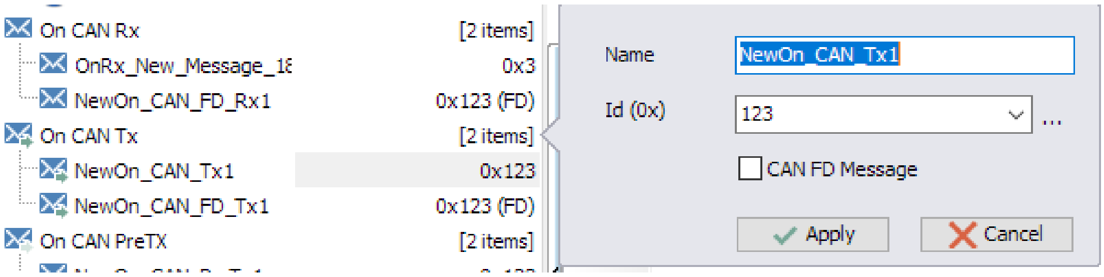
Such as: ACAN->FData[0] to access the first data byte of this received message

Please see "TSMaster Header" section on the left tree to find out data type and elements of "TCAN"

1.20.2.17 On CAN Transmit Event

NewOn_CAN_Tx1

When you double click on the event, you may see the properties popup showing, which is similar to "On CAN Receive Event":



On CAN Rx [2 items]
OnRx_New_Message_18 0x3
NewOn_CAN_FD_Rx1 0x123 (FD)
On CAN Tx [2 items]
NewOn_CAN_Tx1 0x123
NewOn_CAN_FD_Tx1 0x123 (FD)
On CAN PreTX [2 items]

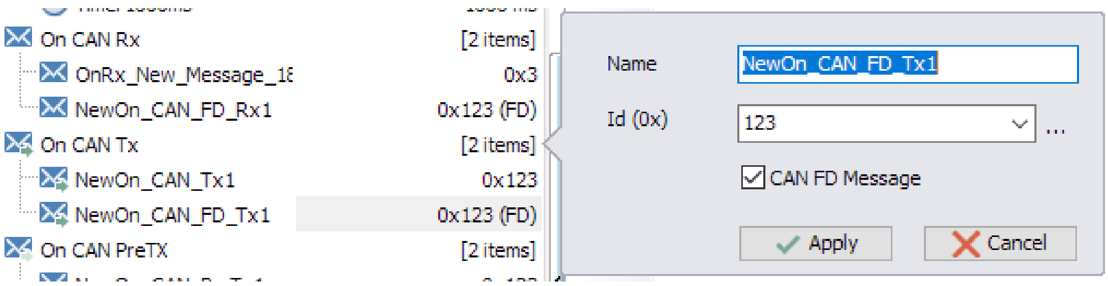
Name: NewOn_CAN_Tx1
Id (0x): 123
□ CAN FD Message

Fig 122 On CAN Transmit event

1.20.2.18 On CAN FD Transmit Event

NewOn_CAN_FD_Tx1

When you double click on the event, you may see the properties popup showing, which is similar to "On CAN Receive Event":



On CAN Rx [2 items]
OnRx_New_Message_18 0x3
NewOn_CAN_FD_Rx1 0x123 (FD)
On CAN Tx [2 items]
NewOn_CAN_Tx1 0x123
NewOn_CAN_FD_Tx1 0x123 (FD)
On CAN PreTX [2 items]

Name: NewOn_CAN_FD_Tx1
Id (0x): 123
☑ CAN FD Message

Fig 123 On CAN FD Transmit event

1.20.2.19 On CAN Pre-Transmit Event Group

On CAN PreTX

CAN pre-Tx event group contains every CAN pre-Tx callback you defined.

Note: This feature is introduced by TOSUN for users to interact with >>> EACH <<< frame being transmitted

This is really useful when you want to modify frame content, or frame type before this frame is sent

Use this feature with care

To use a pre-Tx callback, you should for example:

[1] define a callback named "OnPreTx123" with an identifier "0x123", this means message with id = 0x123 will fire this event

If you want to trigger ANY pre-Tx frame, just leave the identifier text box blank

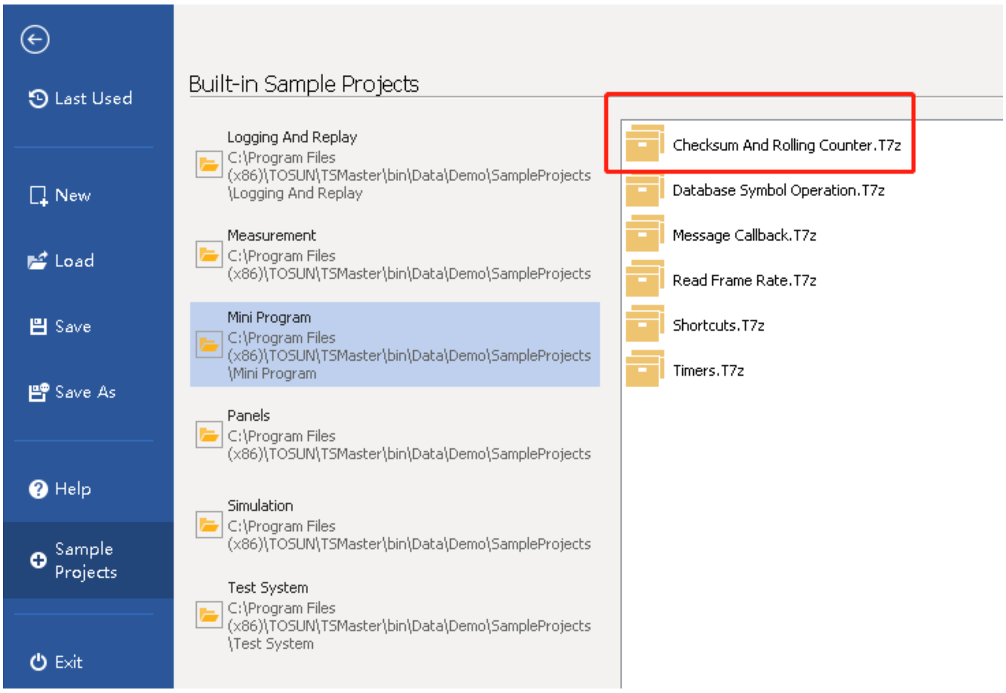
[2] you will get parameter "ACAN" in this event to operate with

Such as: ACAN->FData[0] to access the first data byte of this received message

If you want to force the first byte to 0, write this code: "ACAN->FData[0] = 0;"

Please see "TSMaster Header" section on the left tree to find out data type and elements of "TCAN"

Please also refer to the example “Checksum And Rolling Counter” to maximize the ability of “Pre-Tx” event:



Built-in Sample Projects

Logging And Replay
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Logging And Replay

Measurement
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Mini Program
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Mini Program

Panels
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Simulation
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Test System
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Test System

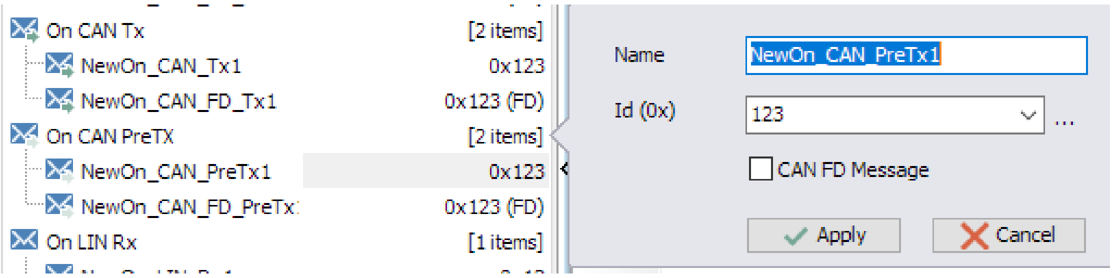
Checksum And Rolling Counter.T7z
Database Symbol Operation.T7z
Message Callback.T7z
Read Frame Rate.T7z
Shortcuts.T7z
Timers.T7z

Fig 124 Checksum and Rolling Counter example based on Pre-Tx event

1.20.2.20 On CAN Pre-Transmit Event

NewOn_CAN_PreTx1

When you double click on the event, you may see the properties popup showing, which is similar to “On CAN Receive Event”:



On CAN Tx [2 items]
NewOn_CAN_Tx1 0x123
NewOn_CAN_FD_Tx1 0x123 (FD)
On CAN PreTX [2 items]
NewOn_CAN_PreTx1 0x123
NewOn_CAN_FD_PreTx: 0x123 (FD)
On LIN Rx [1 items]

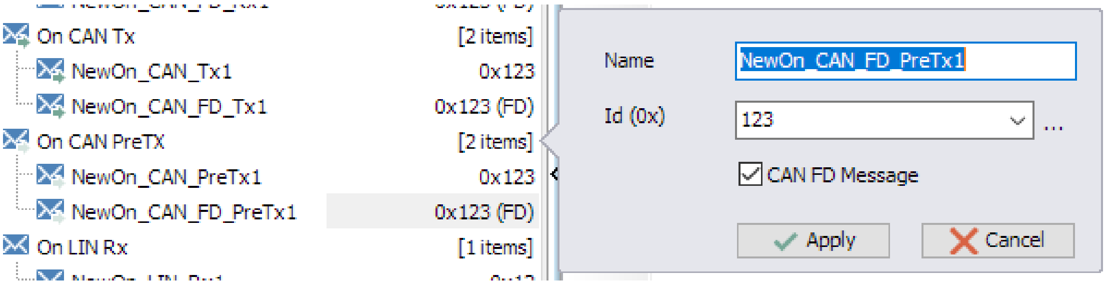
Name: NewOn_CAN_PreTx1
Id (0x): 123
□ CAN FD Message

Fig 125 On CAN Pre-Transmit event

1.20.2.21 On CAN FD Pre-Transmit Event

NewOn_CAN_FD_PreTx1

When you double click on the event, you may see the properties popup showing, which is similar to “On CAN Receive Event”:



On CAN Tx [2 items]
NewOn_CAN_Tx1 0x123
NewOn_CAN_FD_Tx1 0x123 (FD)
On CAN PreTX [2 items]
NewOn_CAN_PreTx1 0x123
NewOn_CAN_FD_PreTx1 0x123 (FD)
On LIN Rx [1 items]

Name: NewOn_CAN_FD_PreTx1
Id (0x): 123
☑ CAN FD Message

Fig 126 On CAN FD Pre-Transmit event

1.20.2.22 On LIN Receive Event Group

On LIN Rx

LIN receive event group contains every LIN reception callback you defined. To use a reception callback, you should for example:

[1] define a callback named "OnRx12" with an identifier "0x12", this means message with id = 0x12 will fire this event

If you want to trigger ANY Rx frame, just leave the identifier text box blank

[2] you will get parameter "ALIN" in this event to operate with

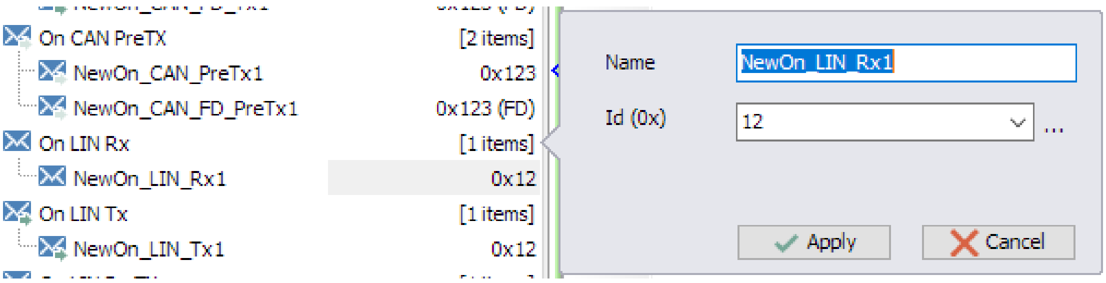
Such as: ALIN->FData[0] to access the first data byte of this received message

Please see "TSMaster Header" section on the left tree to find out data type and elements of "TLIN"

1.20.2.23 On LIN Receive Event

NewOn_LIN_Rx1

When you double click on the event, you may see the properties popup showing, which is similar to “On CAN Receive Event”:



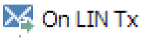
On CAN PreTX [2 items]
NewOn_CAN_PreTx1 0x123
NewOn_CAN_FD_PreTx1 0x123 (FD)
On LIN Rx [1 items]
NewOn_LIN_Rx1 0x12
On LIN Tx [1 items]
NewOn_LIN_Tx1 0x12

Name: NewOn_LIN_Rx1

Id (0x): 12

Fig 127 On LIN Receive Event

1.20.2.24 On LIN Transmit Event Group



On LIN Tx

LIN transmit event group contains every LIN transmit callback you defined.

Note: only transmitted frame fires transmit callback

TOSUN, Vector and IntrepidCS hardware have ability to get correct timestamp of transmitted frame

To use a transmit callback, you should for example:

[1] define a callback named "OnRx12" with an identifier "0x12", this means message with id = 0x12 will fire this event

If you want to trigger ANY Tx frame, just leave the identifier text box blank

[2] you will get parameter "ALIN" in this event to operate with

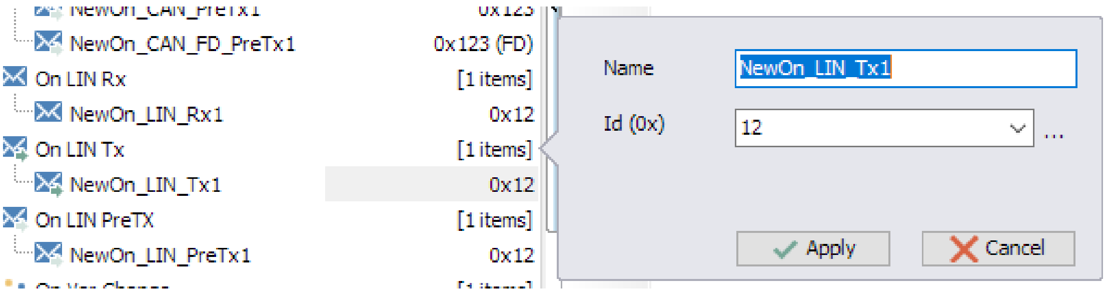
Such as: ALIN->FData[0] to access the first data byte of this received message

Please see "TSMaster Header" section on the left tree to find out data type and elements of "TLIN".

1.20.2.25 On LIN Transmit Event

NewOn_LIN_Tx1

When you double click on the event, you may see the properties popup showing, which is similar to “On CAN Receive Event”:



NewOn_CAN_FD_PreTx1	0x123 (FD)
On LIN Rx	[1 items]
NewOn_LIN_Rx1	0x12
On LIN Tx	[1 items]
NewOn_LIN_Tx1	0x12
On LIN PreTX	[1 items]
NewOn_LIN_PreTx1	0x12

Name: NewOn_LIN_Tx1

Id (0x): 12

Fig 128 On LIN Receive Event

1.20.2.26 On LIN Pre-Transmit Event Group

On LIN PreTX

LIN pre-Tx event group contains every LIN pre-Tx callback you defined.

Note: This feature is introduced by TOSUN for users to interact with >>> EACH <<< frame being transmitted

This is really useful when you want to modify frame content, or frame type before this frame is sent

Use this feature with care

To use pre-Tx callback, you should for example:

[1] define a callback named "OnPreTx12" with an identifier "0x12", this means message with id = 0x12 will fire this event

If you want to trigger ANY pre-Tx frame, just leave the identifier text box blank

[2] you will get parameter "ALIN" in this event to operate with

Such as: ALIN->FData[0] to access the first data byte of this received message

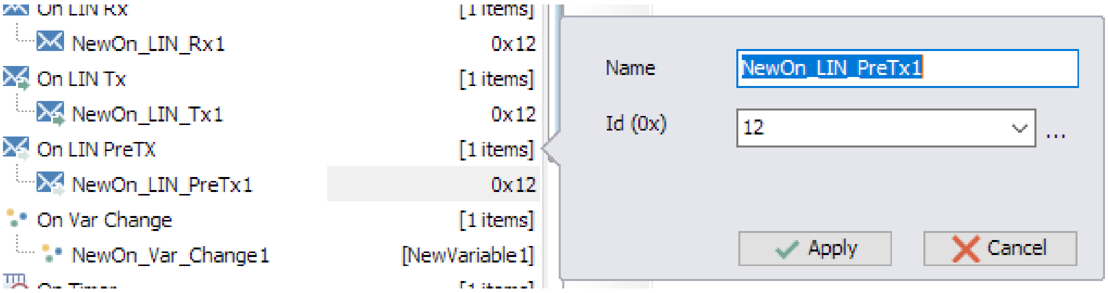
If you want to force the first byte to 0, write this code: "ALIN->FData[0] = 0;"

Please see "TSMaster Header" section on the left tree to find out data type and elements of "TLIN"

1.20.2.27 On LIN Pre-Transmit Event

NewOn_LIN_PreTx1

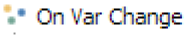
When you double click on the event, you may see the properties popup showing, which is similar to “On CAN Receive Event”:


On LIN Rx [1 items]
NewOn_LIN_Rx1 0x12
On LIN Tx [1 items]
NewOn_LIN_Tx1 0x12
On LIN PreTX [1 items]
NewOn_LIN_PreTx1 0x12
On Var Change [1 items]
NewOn_Var_Change1 [NewVariable1]
On Timer

Name: NewOn_LIN_PreTx1
Id (0x): 12

Fig 129 On LIN Pre-Transmit Event

1.20.2.28 On Var Change Event Group


On Var Change

On Var Change group contains every global variable event you defined.

For example a variable named "v1" is changed using "v1.set()" method,

it will immediately trigger its associated on change event

To use on var change callback, you should for example:

[1] define a variable named "v1" in "Variables" section on the left tree

[2] define a "on var change" event in this section

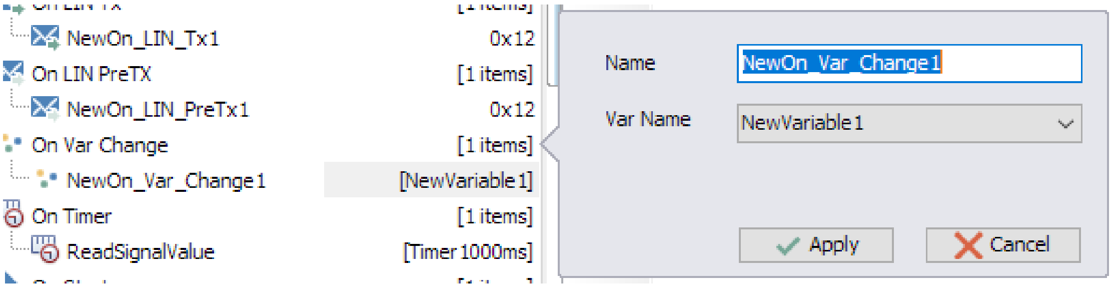
[3] associate its "Variable" property with "v1" in the drop down list

[4] write your code in this event to deal with event of "v1" change

1.20.2.29 On Var Change Event

NewOn_Var_Change1

When you double click on the event handler of variable change, you can see a popup showing the properties of this event, you can assign the variable when this event.



NewOn_LIN_Tx1	0x12
On LIN PreTX	[1 items]
NewOn_LIN_PreTx1	0x12
On Var Change	[1 items]
NewOn_Var_Change1	[NewVariable1]
On Timer	[1 items]
ReadSignalValue	[Timer 1000ms]

Name: NewOn_Var_Change1

Var Name: NewVariable1

Fig 130 On Var Change Event

1.20.2.30 On Timer Event Group

On Timer

On Timer group contains every timer event you defined. To use timer event, you should for example:

[1] define a timer in group "Timers" such as "tim1"

[2] set the period(ms) of this timer such as 10ms

[3] define a on timer callback "OnTim1" in this group and associate the callback with this timer

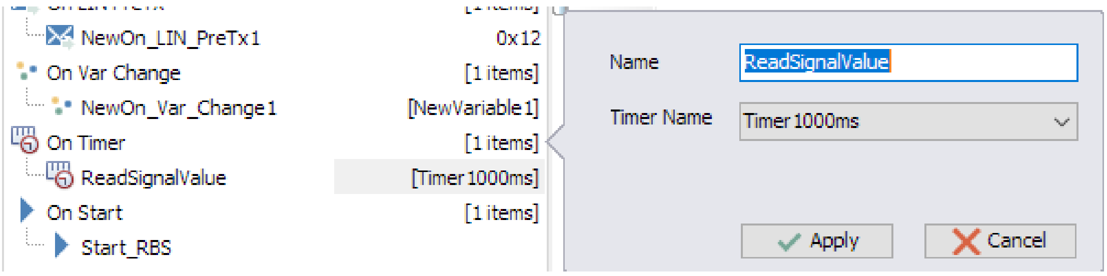
[4] start the timer using "tim1.start();"

[5] now in callback "OnTim1", your code of this function will be executed every 10ms

1.20.2.31 On Timer Event

ReadSignalValue

When you double click on a timer event, you can see a popup dialog showing the properties of this event. You can assign a timer to this event. So when the timer overflows, this event will be triggered.



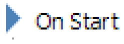
NewOn_LIN_PreTx1 0x12
On Var Change [1 items]
NewOn_Var_Change1 [NewVariable1]
On Timer [1 items]
ReadSignalValue [Timer1000ms]
On Start [1 items]
Start_RBS

Name: ReadSignalValue

Timer Name: Timer1000ms

Fig 131 On Timer Event

1.20.2.32 On Start Event Group



On Start

On Starts group contains every on start event you defined.

If you define more than one on start event, each event will be executed one by one when this script starts.

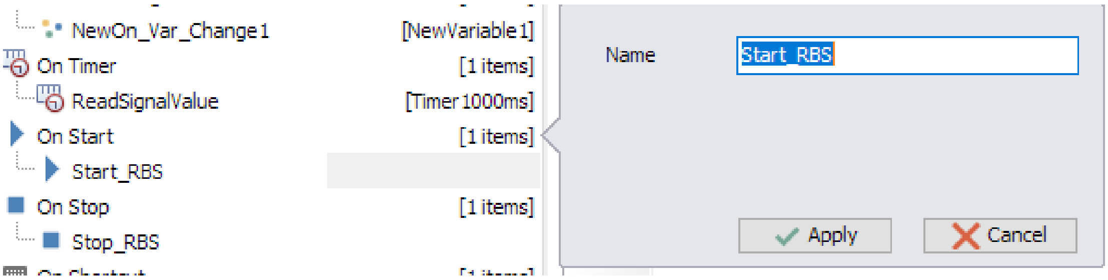
Note: No timer, receive or transmit events will be triggered in on start callback.

If you want to perform automated test with event support, move your test logic into step function.

1.20.2.33 On Start Event

Start_RBS

When you double click on the event, you can see a popup dialog showing the properties of this event. You can modify the name of this event.



NewOn_Var_Change1 [NewVariable1]
On Timer [1 items]
ReadSignalValue [Timer1000ms]
On Start [1 items]
Start_RBS
On Stop [1 items]
Stop_RBS

Name: Start_RBS

Fig 132 On Start Event

1.20.2.34 On Stop Event Group

On Stop

On Stops group contains every on stop event you defined.

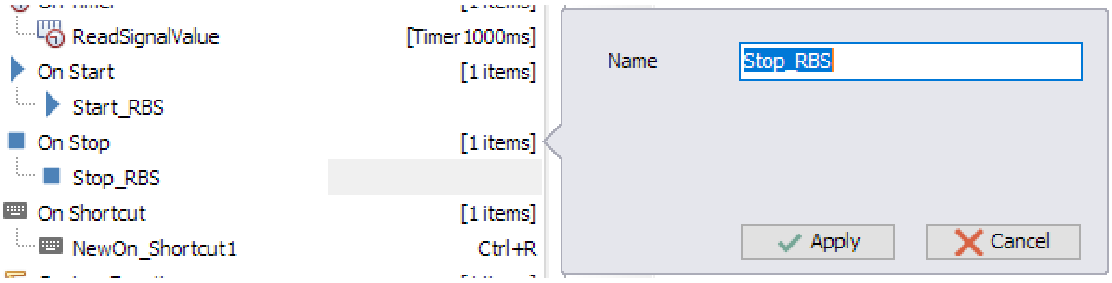
If you define more than one on stop event, each event will be executed one by one when this script stops.

Note: No timer, receive or transmit events will be triggered in on stop callback.

1.20.2.35 On Stop Event

Stop_RBS

When you double click on the event, you can see a popup dialog showing the properties of this event. You can modify the name of this event.

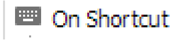


```
ReadSignalValue     [Timer 1000ms]
On Start            [1 items]
  Start_RBS
On Stop             [1 items]
  Stop_RBS
On Shortcut         [1 items]
  NewOn_Shortcut1   Ctrl+R
```

Name: Stop_RBS

Fig 133 On Stop Event

1.20.2.36 On Shortcut Event Group



On Shortcut

On shortcuts group contains every shortcut associated event you defined.

To use on shortcut event, you should for example:

[1] define an on shortcut event named "OnKeyA" if you want to use keyboard A key to trigger

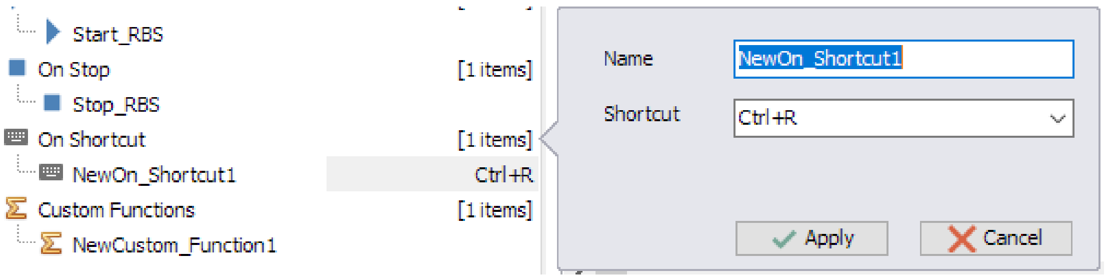
[2] In shortcut field, just press "A" key of your keyboard, so key A is associated with this event

[3] Write your code in this event content, so the code will be executed when this mini program starts and key A is pressed

1.20.2.37 On Shortcut Event

NewOn_Shortcut1

When you double click on the event, you can see a popup dialog showing the properties of this event. You can modify the name and associated shortcut of this event.



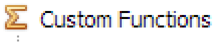
Start_RBS
On Stop [1 items]
Stop_RBS
On Shortcut [1 items]
NewOn_Shortcut1 Ctrl+R
Custom Functions [1 items]
NewCustom_Function1

Name: NewOn_Shortcut1
Shortcut: Ctrl+R

Fig 134 On Shortcut Event

Please refer to TSMaster example “Shortcuts.T7z” for detailed usage of shortcut events.

1.20.2.38 Custom Functions Group



Custom Functions

Custom Functions group contains every function you defined.

To use custom funtions, you should for example:

[1] define a custom function in this group and name it "func1"

[2] specify its parameters such as "const s32 A, const s32 B" if you want two parameters

[3] write algorithm in this function such as "return A + B;"

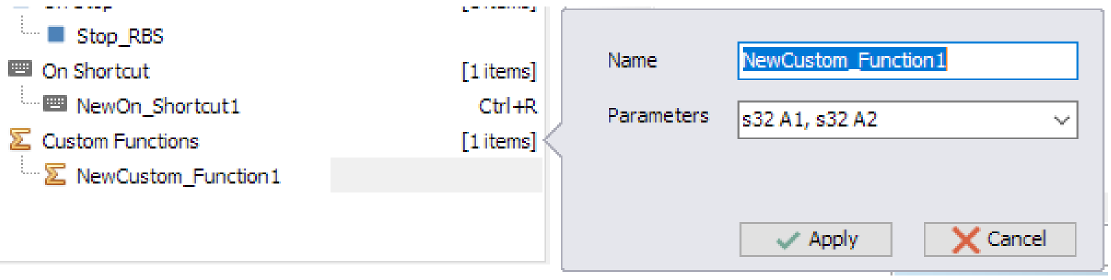
[4] in other place of this mini program, just call "r = func1(3, 5);" which will get result of 3 + 5 into variable r

Note: you can publish your custom function as mini program library to be invoked by other mini programs.

1.20.2.39 Custom Function

NewCustom_Function1

When you double click on the function, you can edit the name, and the parameters of this function.



Stop_RBS	
On Shortcut	[1 items]
NewOn_Shortcut1	Ctrl+R
Custom Functions	[1 items]
NewCustom_Function1	

Name: NewCustom_Function1

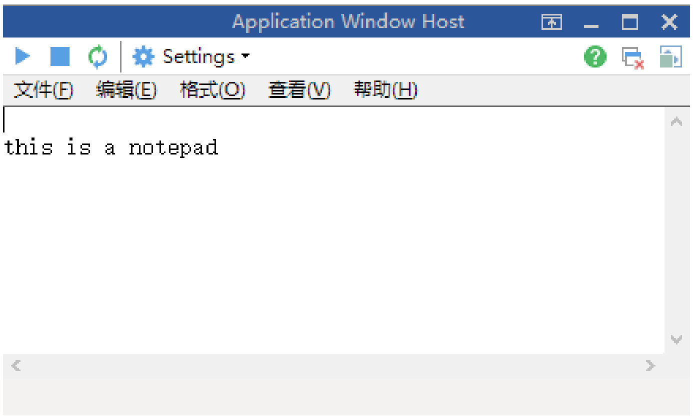
Parameters: s32 A1, s32 A2

Fig 135 Custom Function

Please refer to TSMaster example “Checksum And Rolling Counter.T7z” for detailed usage of custom function, in this example, a CRC-8 checksum algorithm is implemented in custom function.

1.21 Application Window Host

TS application window host enables external application to be hosted in TSMaster window. External application can be any type of program with main form for user interaction. It is very useful for user to manage multiple applications just within TSMaster user interface.



```
this is a notepad
```

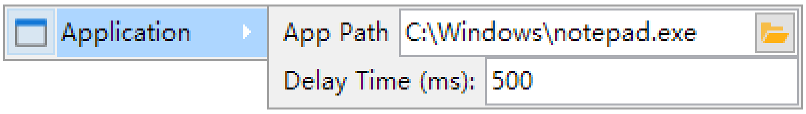
Fig 136 Application window host

▶ Start external application in current form

■ Stop external application

↻ Restart external application

Settings ▾ Application configuration, which contains the following items:



Application ▸

App Path: C:\Windows\notepad.exe

Delay Time (ms): 500

Fig 137 Application settings

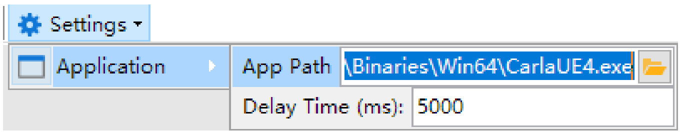
App Path: Specify full path of external application.

Delay Time (ms): Delay a certain time (ms) before the external application is hosted into current form.

Usage example steps for Carla integration:

[1] Find Carla application full path, fill it into “App Path”

[2] Set a certain delay time before this application is hosted, if application takes longer to start, set this value larger. In this example, the delay time is 5s



Settings ▾

Application ▸

App Path: \Binaries\Win64\CarlaUE4.exe

Delay Time (ms): 5000

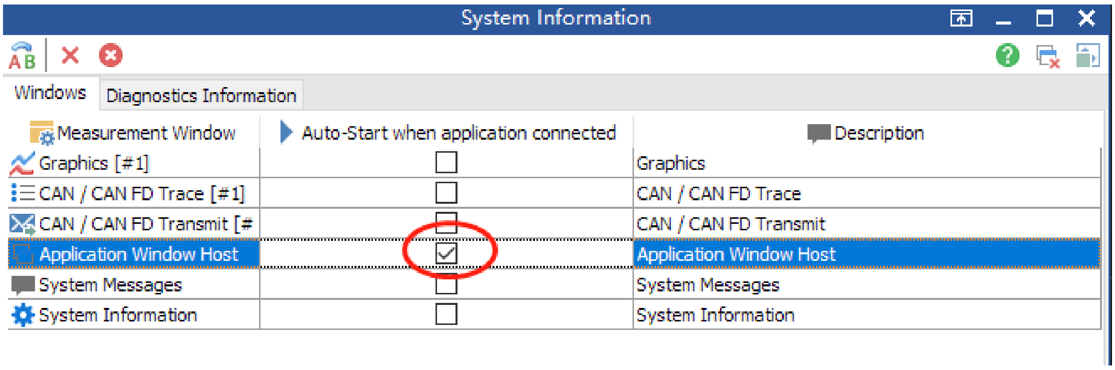
Fig 138 Carla Integration

[3] Click start button ▶ to run external application: Carla

[4] You will see Carla application is hosted into this form

[5] Click stop button ■ to terminate Carla application.

[6] You can set “Auto-start” of this window so that Carla is automatically created when application is connected, and automatically destroyed when application is disconnected.



System Information

Windows | Diagnostics Information

Measurement Window	Auto-Start when application connected	Description
Graphics [#1]	□	Graphics
CAN / CAN FD Trace [#1]	□	CAN / CAN FD Trace
CAN / CAN FD Transmit [#	□	CAN / CAN FD Transmit
Application Window Host	☑	Application Window Host
System Messages	□	System Messages
System Information	□	System Information

Fig 139 Auto start and stop Carla

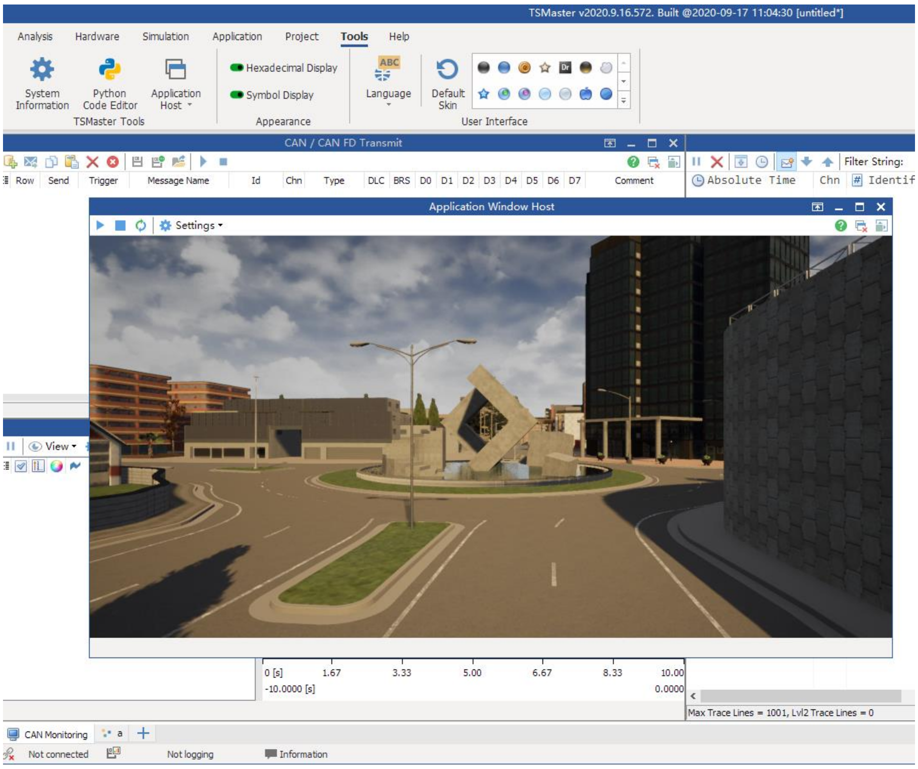
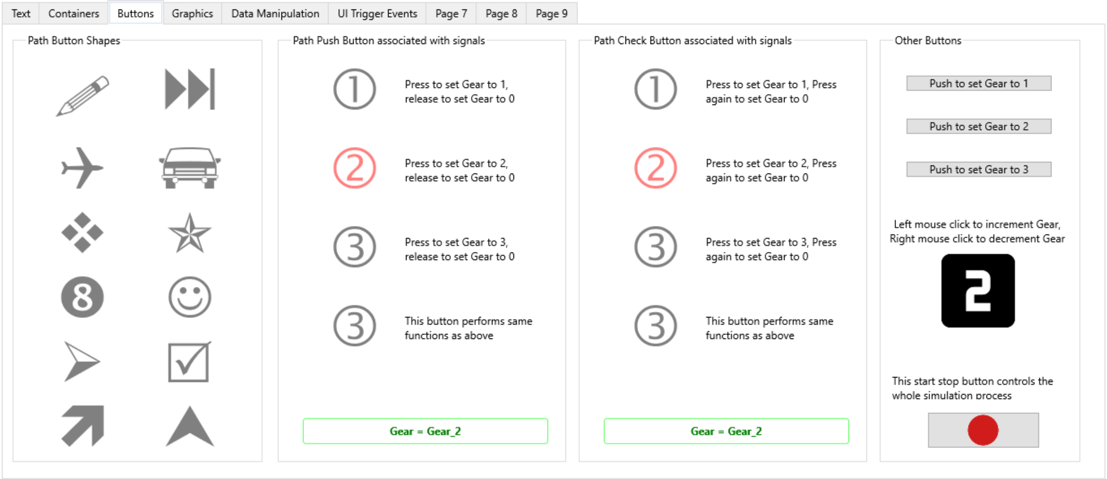


Fig 140 Carla Integration Result

1.22 Panel

TSMaster panel allows users to create their own application interface to send messages, receive messages, signals and doing various operations based on TSMaster's sophisticated control architecture.

Please refer to TSMaster example "Panel Basics.T7z" to understand the abilities of TSMaster panel component.



Path Button Shapes

Path Push Button associated with signals

Press to set Gear to 1, release to set Gear to 0

Press to set Gear to 2, release to set Gear to 0

Press to set Gear to 3, release to set Gear to 0

This button performs same functions as above

Path Check Button associated with signals

Press to set Gear to 1, Press again to set Gear to 0

Press to set Gear to 2, Press again to set Gear to 0

Press to set Gear to 3, Press again to set Gear to 0

This button performs same functions as above

Other Buttons

Left mouse click to increment Gear, Right mouse click to decrement Gear

This start stop button controls the whole simulation process

Fig 141 TSMaster Panel Interface

1.22.1 Panel Toolbar

Edit mode selector, this selector controls the visibility of TSMaster internal panel editor. It has the following three states:

1) Pressed state: means the panel is now in editor mode, you can modify the controls on panel freely.

2) Unpressed state: means the panel is now in test mode, this mode shows how the panel will look like when application is started, you can view the panel control layout and make adjustment to its internal controls by click on this button again to activate edit mode.

3) Disabled mode: means the TSMaster application is connected, the panel is now in running mode, no editor features available. If you want to edit the panel again, please first disconnect application.

Basic Copy, Paste, Cut and Delete function of panel controls, Note: you must first select one or multiple panel controls before performing these operations.

Bring to front, and Send to back function of panel controls.

Align Alignment adjustment of panel controls, which has the following sub items for multiple selected items:

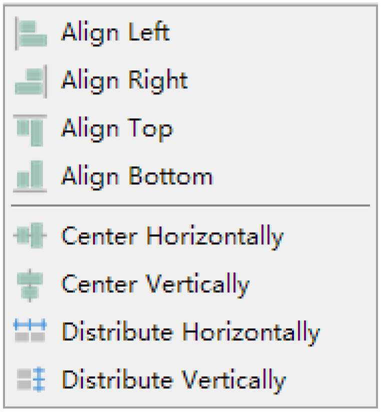


Fig 142 Alignment of panel controls

- Align Left: move all selected controls to left align
- Align Right: move all selected controls to right align
- Align Top: move all selected controls to top align
- Align Bottom: move all selected controls to bottom align
- Center Horizontally: move all selected controls to the same Y coordinates
- Center Vertically: move all selected controls to the same X coordinates
- Distribute Horizontally: move all selected controls so each has the same X gap with its nearest sibling
- Distribute Vertically: move all selected controls so each has the same Y gap with its nearest sibling

Create a new panel, this will delete all the controls on the current panel

Import a panel from external panel files, this will delete all the controls on the current panel

Export the current panel to external files

Settings ▾ Panel settings, which has the following sub menus:

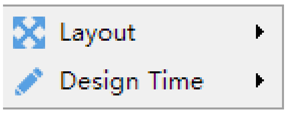


Fig 143 Panel settings sub menu

1.22.1.1 Panel Layout Settings

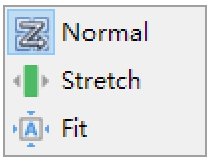


Fig 144 Panel layout settings

Normal: all panel controls will be displayed as is:

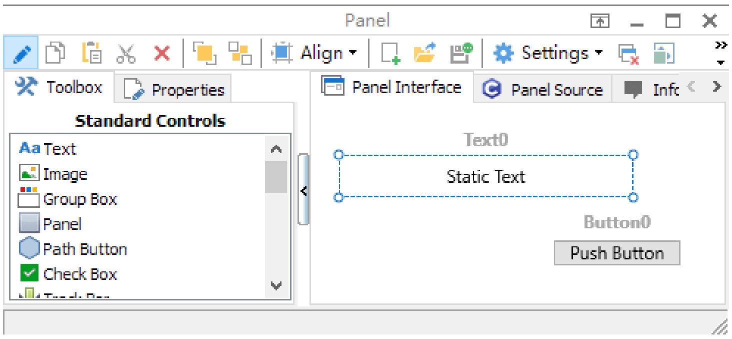


Fig 145 Normal panel layout settings

Stretch: all panel controls will be stretched to fill the display area:

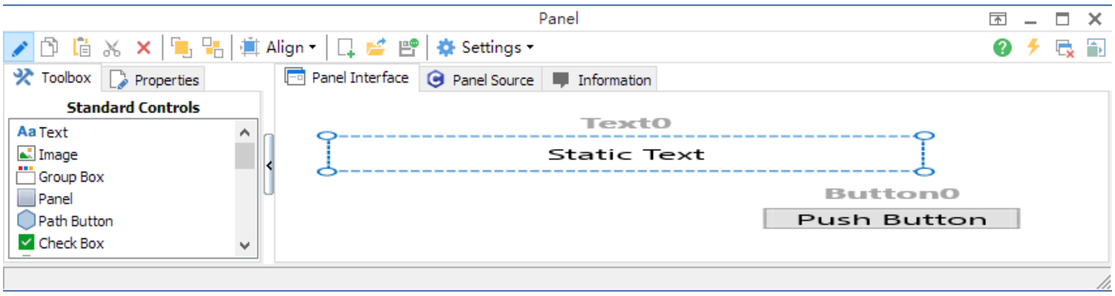


Fig 146 Stretch panel layout settings

Fit: all panel controls will be adjusted to fit the display area, while keeping their x and y ratio fixed:

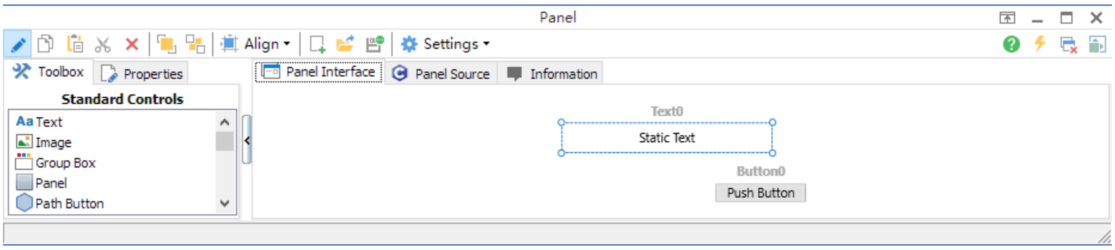


Fig 147 Fit panel layout settings

1.22.1.2 Panel Design Time Settings

Panel design time settings supports displaying panel variable link on bottom of each control:

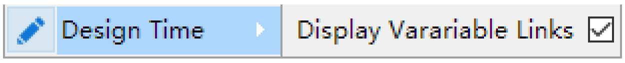


Fig 148 Panel design time settings

If this option is switched on, you will see a complete variable database address text displayed on bottom:

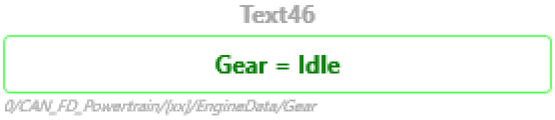


Fig 149 Panel variable address display

1.22.2 Panel Controls

Please see the following picture demonstrating each TSMaster panel control:

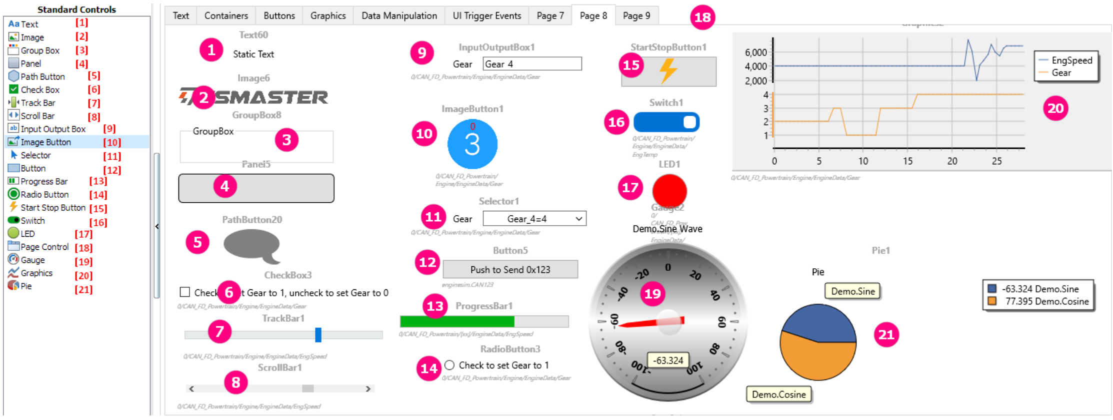
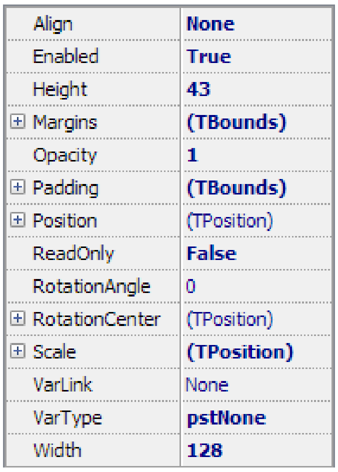


Fig 150 TSMaster panel control overview

1.22.2.1 Panel Common Properties

This section describes all common properties of panel controls:



Align	None
Enabled	True
Height	43
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
VarLink	None
VarType	pstNone
Width	128

Fig 151 TSMaster Panel control common properties

1.22.2.1.1 Align

Align controls docking feature of each panel control, the type of which is picked from the following list:

Value	Meaning
Bottom	The control moves and pins to the bottom of its parent and resizes to fill the width of its parent. The height of the control is not affected. If another most side-pinned control already occupies part of the parent area, the control resizes to fill the remaining width of its parent. The anchors are set to [akLeft,akBottom,akRight].
Center	The control moves to the center of the parent area. The control's size is not affected. If another side-pinned control already occupies part of the parent area, the control moves to the center of the remaining parent area. The control is not anchored to its parent.
Client	The control resizes to fill the client area of its parent. If another side-pinned control already occupies part of the parent area, the control resizes to fit within the remaining parent area. The anchors are set to [akLeft,akTop,akRight,akBottom]
Contents	The control resizes to fill the entire bounds of its parent, overlapping it. The anchors are set to [akLeft,akTop,akRight,akBottom].

Fit	The control resizes to fit the parent area, preserving its aspect ratio. The control moves to the center of the parent area. The anchors are set to [akLeft,akTop,akRight,akBottom].
FitLeft	The control resizes to fit the parent area, preserving its aspect ratio. The control moves to and pins to the left side of the parent. The anchors are set to [akLeft,akTop,akRight,akBottom].
FitRight	The control resizes to fit the parent area, preserving its aspect ratio. The control moves to and pins to the right side of the parent. The anchors are set to [akLeft,akTop,akRight,akBottom].
Horizontal	The control resizes to fill the height of its parent. The width of the control is not affected. If another side-pinned control already occupies part of the parent area, the control resizes to fill the remaining height of its parent. The anchors are set to [akLeft,akRight].
HorzCenter	The control is centered horizontally within the client area of the parent and resizes to fill the height of its parent. The width of the control is not affected. If another side-pinned control already occupies part of the parent area, the control resizes to fill the remaining height of its parent. The anchors are set to [akTop,akBottom].
Left	The control moves and pins to the left side of its parent and resizes to fill the height of its parent. The width of the control is not affected. If another side-pinned control already occupies part of the parent area, the control resizes to fill the remaining height of its parent. The anchors are set to [akLeft,akTop,akBottom].
MostBottom	The control moves and pins to the bottom of its parent, set to be the bottommost, and resizes to fill the width of its parent. The height of the control is not affected. The anchors are set to [akLeft,akRight,akBottom].
MostLeft	The control moves and pins to the left side of its parent, set to be the leftmost, and resizes to fill the height of its parent. The width of the control is not affected. If

	another most side-pinned control already occupies part of the parent area, the control resizes to fill the remaining height of its parent. The anchors are set to [akLeft,akTop,akBottom].
MostRight	The control moves and pins to the right side of its parent, set to be the rightmost, and resizes to fill the height of its parent. The width of the control is not affected. If another most side-pinned control already occupies part of the parent area, the control resizes to fill the remaining height of its parent. The anchors are set to [akTop,akRight,akBottom].
MostTop	The control moves and pins to the top of its parent, set to be the topmost, and resizes to fill the width of its parent. The height of the control is not affected. The anchors are set to [akLeft,akTop,akRight].
None	The control remains where it was placed. This is the default value. No automatic positioning and sizing are performed. The anchors are set to [akLeft,akTop].
Right	The control moves and pins to the right side of its parent and resizes to fill the height of its parent. The width of the control is not affected. If another side-pinned control already occupies part of the parent area, the control resizes to fill the remaining height of its parent. The anchors are set to [akRight,akTop,akBottom].
Scale	The control resizes and moves to maintain the relative position and size as its container resizes. The anchors are set to [akLeft,akTop,akRight,akBottom].
Top	The control moves and pins to the top of its parent and resizes to fill the width of its parent. The height of the control is not affected. If another most side-pinned control already occupies part of the parent area, the control resizes to fill the remaining width of its parent. The anchors are set to [akLeft,akTop,akRight].
VertCenter	The control is centered vertically within the client area of the parent and resizes to fill the width of its parent. The height of the control is not affected. If another side-

	pinned control already occupies part of the parent area, the control resizes to fill the remaining width of its parent. The anchors are set to [akLeft,akRight].
Vertical	The control resizes to fill the width of its parent. The height of the control is not affected. If another side-pinned control already occupies part of the parent area, the control resizes to fill the remaining width of its parent. The anchors are set to [akTop,akRight].

1.22.2.1.2 Enabled

Controls whether the control responds to mouse, keyboard, and timer events.

Use Enabled to change the availability of the control to the user. To disable a control, set Enabled to False. Some disabled controls appear dimmed (for example: buttons, check boxes, labels), while others (container controls) simply lose their functionality without changing their appearance. If Enabled is set to False, the control ignores mouse, keyboard, and timer events.

To re-enable a control, set Enabled to True.

1.22.2.1.3 Height

Specifies the vertical size of the control (in pixels).

Use the Height property to read or change the height of the control.

1.22.2.1.4 Margins

Specifies the control's margins.

The Margins of a control are the distances (in pixels) from each edge (top, left, bottom, right) to another control within the same Parent or to the edge of its Parent. Margins adds space to the outer side of the control.

If a margin is not 0, no other control will come closer to the control than the specified distance. If the distance from a Parent edge to the corresponding control edge is smaller than the specified Margins for that edge, the control is repositioned and resized, if necessary, to maintain the specified distance.

The following image shows how Padding and Margins properties affect alignment, position, and size of controls.

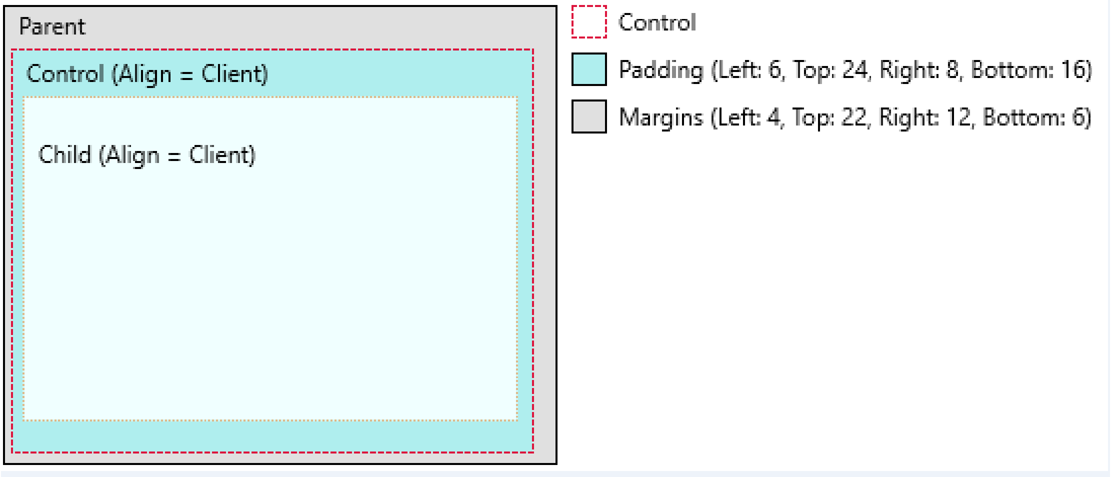

Parent
Control (Align = Client)
Child (Align = Client)
Control
Padding (Left: 6, Top: 24, Right: 8, Bottom: 16)
Margins (Left: 4, Top: 22, Right: 12, Bottom: 6)

Fig 152 Margins description

1.22.2.1.5 Opacity

Specifies the control opacity.

Set Opacity to customize the transparency of the current control.

Opacity takes values between 0 and 1. If Opacity is 1, the control is completely opaque; if it is 0, the control is completely transparent. The values over 1 are treated as 1, and the ones under 0 are treated as 0.

Opacity applies to the control's children.

1.22.2.1.6 Padding

Specifies the control's padding.

The Padding of a control specifies how close, in pixels, the control's children can come to each of its edges (top, left, bottom, right). Padding adds space to the inner side of the control.

The control's children are repositioned and resized, if necessary, to maintain the Padding.

The above image in “Margins” section shows how Padding and Margins properties affect alignment, position, and size of controls.

1.22.2.1.7 Position

Specifies the upper-left corner of the current control, relative to its parent.

Position can be affected by the Padding of its parent and the Margins of the control.

1.22.2.1.8 ReadOnly

Determines whether you can change the text of this edit control.

To prevent the contents of the edit control from being edited, set the ReadOnly property to True. Set ReadOnly to False to allow the contents of the edit control to be edited.

Setting ReadOnly to True ensures that the text is not altered, while still allowing you to select text. The selected text can then be manipulated by the application, or copied to the Clipboard.

1.22.2.1.9 RotationAngle

Specifies the amount (in degrees) by which the control is rotated from the x-axis.

Positive angles correspond to clockwise rotation. For counterclockwise rotation, use negative values.

To set the rotation center, use RotationCenter as described below.

1.22.2.1.10 RotationCenter

Specifies the position of the pivot point of the control.

The coordinates of the rotation center take values in the range from 0 through 1. The point with the coordinates (0,0) corresponds to the upper-left corner of the control, the point with the coordinates (1,1) corresponds to the lower-right corner of the control. The default center of rotation is (0.5, 0.5).

Values outside of [0,0] and [1,1] can be clipped in some descendant classes.

To set the rotation angle, use RotationAngle as described above.

1.22.2.1.11 Scale

Specifies the scale of the control.

Set the Scale coordinates to specify the scale on each axis.

The initial scale rate is 1 on each axis.

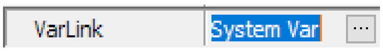
Note: Controls that have the Align or Anchors properties set can use a scale that is different from the default (1,1), so that controls align together even when they have a custom scale.

1.22.2.1.12 VarLink

The associated variable in TSMaster, which can be:

- CAN signal
- LIN signal
- System Variable

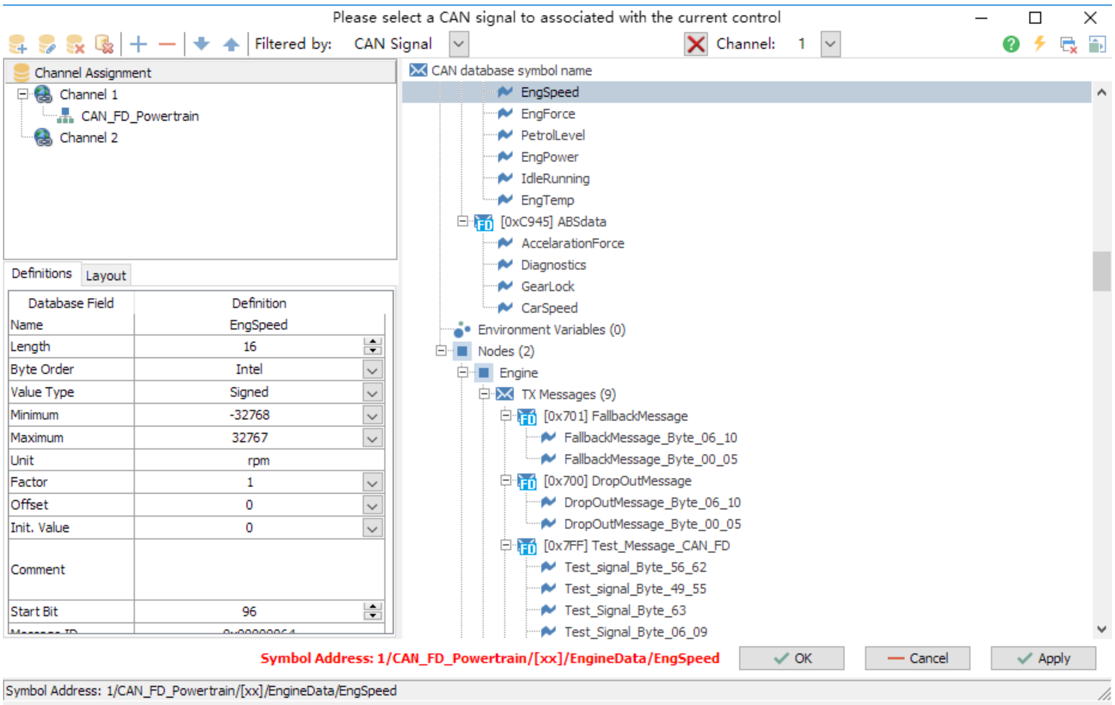
Normally you can double click on a control to change its associated variable, or just click the "…" button on the right side of property editor:



VarLink System Var

Fig 153 VarLink Editor

If your current control is associated with a CAN signal, then the popup dialog will prompt you to select a CAN signal from database:



Please select a CAN signal to associated with the current control

Filtered by: CAN Signal   Channel: 1

Channel Assignment
- Channel 1
  - CAN_FD_Powertrain
- Channel 2

Definitions | Layout

Database Field	Definition
Name	EngSpeed
Length	16
Byte Order	Intel
Value Type	Signed
Minimum	-32768
Maximum	32767
Unit	rpm
Factor	1
Offset	0
Init. Value	0
Comment	
Start Bit	96

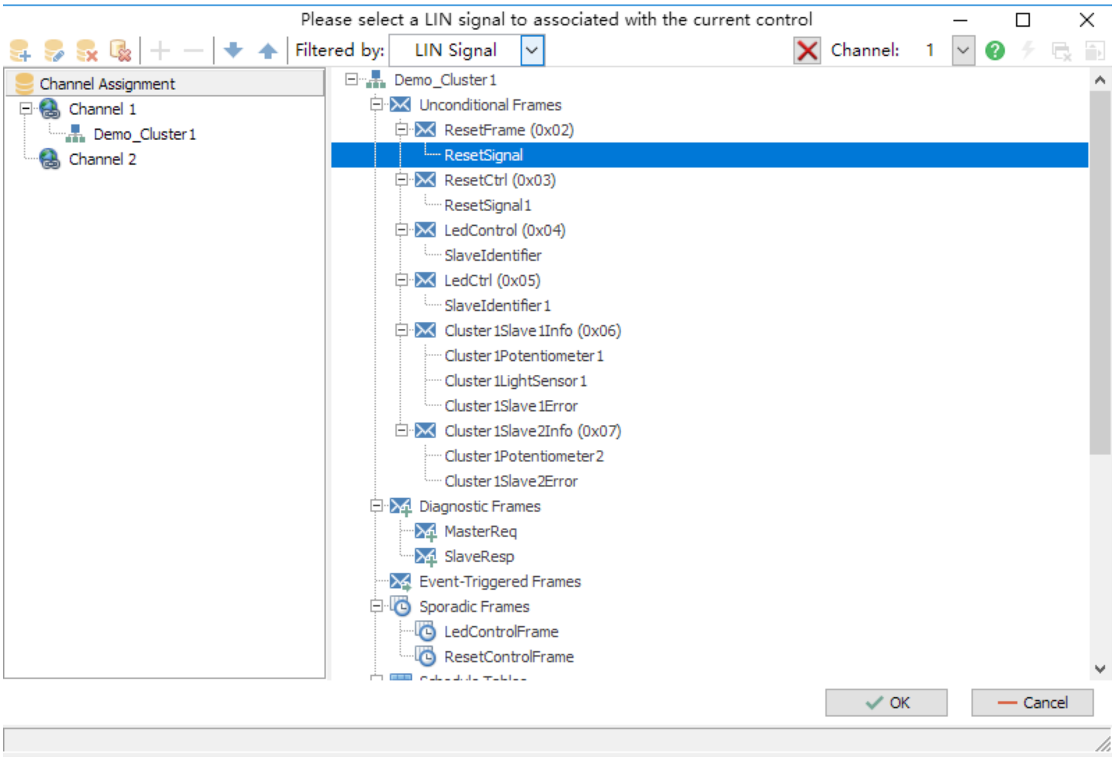
CAN database symbol name
- EngSpeed
- EngForce
- PetrolLevel
- EngPower
- IdleRunning
- EngTemp
- [0xC945] ABSdata
  - AccelarationForce
  - Diagnostics
  - GearLock
  - CarSpeed
- Environment Variables (0)
- Nodes (2)
  - Engine
    - TX Messages (9)
      - [0x701] FallbackMessage
        - FallbackMessage_Byte_06_10
        - FallbackMessage_Byte_00_05
      - [0x700] DropOutMessage
        - DropOutMessage_Byte_06_10
        - DropOutMessage_Byte_00_05
      - [0x7FF] Test_Message_CAN_FD
        - Test_signal_Byte_56_62
        - Test_signal_Byte_49_55
        - Test_Signal_Byte_63
        - Test_Signal_Byte_06_09

Symbol Address: 1/CAN_FD_Powertrain/[xx]/EngineData/EngSpeed

Symbol Address: 1/CAN_FD_Powertrain/[xx]/EngineData/EngSpeed

Fig 154 CAN signal selector

If your current control is associated with a LIN signal, then the popup dialog will prompt you to select a LIN signal from database:



Please select a LIN signal to associated with the current control

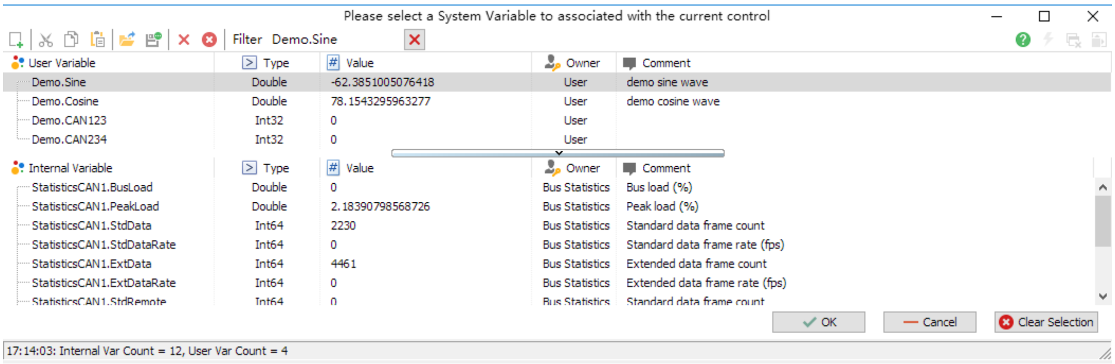
Filtered by: LIN Signal   Channel: 1

Channel Assignment
- Channel 1
  - Demo_Cluster1
- Channel 2

- Demo_Cluster1
  - Unconditional Frames
    - ResetFrame (0x02)
      - ResetSignal
    - ResetCtrl (0x03)
      - ResetSignal1
    - LedControl (0x04)
      - SlaveIdentifier
    - LedCtrl (0x05)
      - SlaveIdentifier1
    - Cluster1Slave1Info (0x06)
      - Cluster1Potentiometer1
      - Cluster1LightSensor1
      - Cluster1Slave1Error
    - Cluster1Slave2Info (0x07)
      - Cluster1Potentiometer2
      - Cluster1Slave2Error
  - Diagnostic Frames
    - MasterReq
    - SlaveResp
  - Event-Triggered Frames
  - Sporadic Frames
    - LedControlFrame
    - ResetControlFrame

Fig 155 LIN signal selector

If your current control is associated with a system variable, then the popup dialog will prompt you to select a system variable from the system variable manager:



Please select a System Variable to associated with the current control

Filter Demo.Sine

User Variable	Type	Value	Owner	Comment
Demo.Sine	Double	-62.3851005076418	User	demo sine wave
Demo.Cosine	Double	78.1543295963277	User	demo cosine wave
Demo.CAN123	Int32	0	User	
Demo.CAN234	Int32	0	User	

Internal Variable	Type	Value	Owner	Comment
StatisticsCAN1.BusLoad	Double	0	Bus Statistics	Bus load (%)
StatisticsCAN1.PeakLoad	Double	2.18390798568726	Bus Statistics	Peak load (%)
StatisticsCAN1.StdData	Int64	2230	Bus Statistics	Standard data frame count
StatisticsCAN1.StdDataRate	Int64	0	Bus Statistics	Standard data frame rate (fps)
StatisticsCAN1.ExtData	Int64	4461	Bus Statistics	Extended data frame count
StatisticsCAN1.ExtDataRate	Int64	0	Bus Statistics	Extended data frame rate (fps)
StatisticsCAN1.StdRemote	Int64	0	Bus Statistics	Standard data frame count

17:14:03: Internal Var Count = 12, User Var Count = 4

Fig 156 System variable selector

Note: Some controls do not support associating with variables, such as groupbox, start-stop button and so on. In this case, the VarLink is not available.

Note: Default VarLink type is set to "None", that is nothing is associated with the current control. If you want to assign this control with either CAN, LIN or system variable, please first modify the "VarType" property below.

1.22.2.1.13 VarType

Variable type of the current associated signal, which can be:

- None
- CAN signal
- LIN signal
- System variable

The default variable type of each control is "None", you can switch type among the above types, by selecting the down arrow, or just double click the editor.

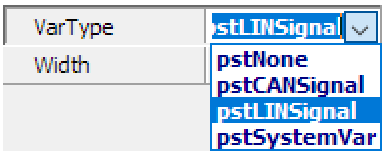


Fig 157 Switch signal type

1.22.2.1.14 Width

Specifies the horizontal size of the control (in pixels).

Use the Width property to read or change the width of the control.

1.22.2.1.15 TextSettings

Some text controls have this property, which provide all styled text representation properties and methods to manage them.

The styled text representation properties are FontColor, TextAlign, VertTextAlign, Trimming, WordWrap, and Font (TFont.Family, TFont.Size, and TFont.Style).

- **FontColor**

Specifies the font color of the text in this TTextControl control.

Use the FontColor property to read or change the font color of the text in this TTextControl control. The default value of the FontColor property is TAlphaColorRec.Black.

- **TextAlign**

Specifies how the text will be displayed in terms of horizontal alignment.

The TextAlign property specifies how the TTextControl object will display the text in terms of horizontal alignment. TextAlign can have one of the following values (defined in TTextAlign):

Center (default)--aligns the text on a horizontal axis, at the middle of the TTextControl object.

Leading--aligns the text on a horizontal axis, at the leftmost position inside the TTextControl object.

Trailing--aligns the text on a horizontal axis, at the rightmost position inside the TTextControl object.

- **VertTextAlign**

Specifies how the text will be displayed in terms of vertical alignment.

The VertTextAlign property specifies how the TTextControl control displays the text in terms of vertical alignment. VertTextAlign can have one of the following values (defined in TTextAlign):

Center (default)--aligns the text on a vertical axis, at the middle of the

TTextControl object.

Leading--aligns the text on a vertical axis, at the topmost position inside the TTextControl object.

Trailing--aligns the text on a vertical axis, at the bottommost position inside the TTextControl object.

- **Trimming**

Specifies the behavior of the text, when it overflows the area for drawing the text.

Trimming may take the following values defined in the TTextTrimming type: None, Character, and Word.

If the value of this property is not None and the text does not fit in the drawing area, then it is trimmed to fit the area and an ellipsis sign is printed after the trimmed text.

- **WordWrap**

Specifies whether the text inside the TTextControl object wraps when it is longer than the width of the control.

Set WordWrap to True to allow the TTextControl control to display multiple lines of text. When WordWrap is True, text that is too long for the TTextControl object wraps at the right margin and continues in additional lines.

Set WordWrap to False for the text to span onto a single line of the TTextControl. However, in this case, the text that is too long for TTextControl appears truncated.

The default value for the WordWrap property is False.

- **Font.Family**

Identifies the typeface of the font.

Use Family to specify the typeface of the font.

- **Font.Size**

The height of the font in points.

Use Size to specify the size of text. The size includes the ascent, above the baseline and the descent, below the baseline.

For example, suppose the font's Size is 24. On Windows, 24 DIPs is 24/96 or 1/4 inches tall. 1/4-inch on a screen at 96 DPI is 24 pixels.

Text sized in points on Windows will appear larger at the same numeric value. For example, 24 points at 96 DPI is 32 pixels tall.

- **Font.Style**

Determines whether the font is normal, italic, underlined, and so on.

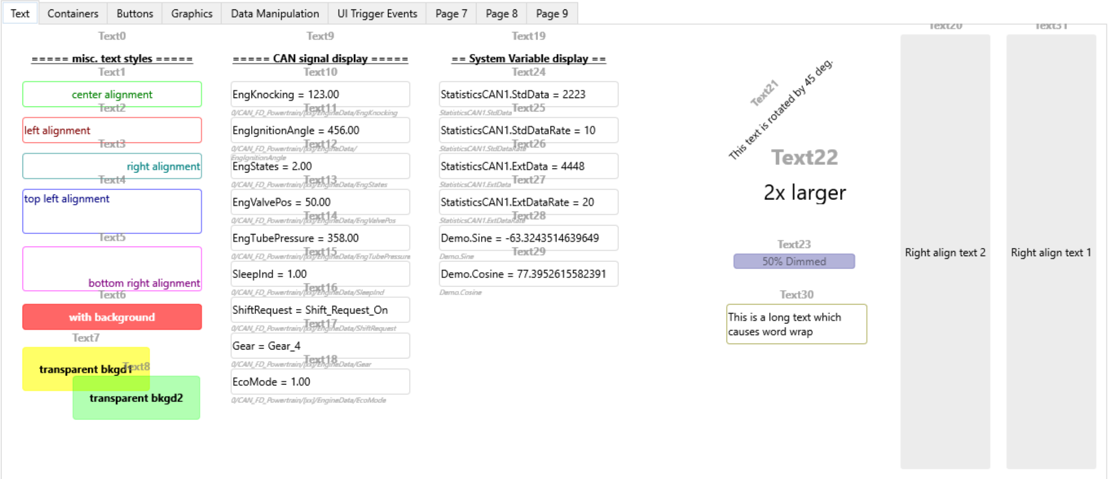
Use Style to add special characteristics to characters that use the font. Style is a set containing zero or more values from the following:

Table 3 Font style

Value	Meaning
fsBold	The font is bold.
fsItalic	The font is italic.
fsUnderline	The font is underlined.
fsStrikeOut	The font is displayed with a horizontal line through it.

1.22.2.2 Text

A text is used to display static text, or a signal real-time value (CAN, LIN, system variable). Text control has various properties, by modifying its properties, you can get sophisticated display effects as shown below:



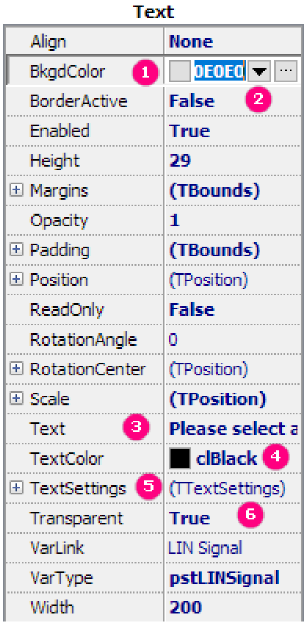
EngKnocking = 123.00
0/CAN_FD_Powertrain/[xx]/EngineData/EngKnocking
EngIgnitionAngle = 456.00
0/CAN_FD_Powertrain/[xx]/EngineData/EngIgnitionAngle
EngStates = 2.00
0/CAN_FD_Powertrain/[xx]/EngineData/EngStates
EngValvePos = 50.00
0/CAN_FD_Powertrain/[xx]/EngineData/EngValvePos
EngTubePressure = 358.00
0/CAN_FD_Powertrain/[xx]/EngineData/EngTubePressure
SleepInd = 1.00
0/CAN_FD_Powertrain/[xx]/EngineData/SleepInd
ShiftRequest = Shift_Request_On
0/CAN_FD_Powertrain/[xx]/EngineData/ShiftRequest
Gear = Gear_4
0/CAN_FD_Powertrain/[xx]/EngineData/Gear
EcoMode = 1.00
0/CAN_FD_Powertrain/[xx]/EngineData/EcoMode

StatisticsCAN1.StdData = 2223
StatisticsCAN1.StdData
StatisticsCAN1.StdDataRate = 10
StatisticsCAN1.StdDataRate
StatisticsCAN1.ExtData = 4448
StatisticsCAN1.ExtData
StatisticsCAN1.ExtDataRate = 20
StatisticsCAN1.ExtDataRate
Demo.Sine = -63.3243514639649
Demo.Sine
Demo.Cosine = 77.3952615582391
Demo.Cosine

Fig 158 Text control

Apart from the common properties described above, a text control has additional

6 properties:



Text

Align	None
BkgdColor	0E0E0
BorderActive	False
Enabled	True
Height	29
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
Text	Please select a
TextColor	■ clBlack
⊞ TextSettings	(TTextSettings)
Transparent	True
VarLink	LIN Signal
VarType	pstLINSignal
Width	200

Fig 159 Text additional properties

BkgdColor: the background color of a text. If the text is set to “Transparent”, this property does not have any effect.

Border Active: True: the border of the text is visible; False: the border of the text is invisible.

Text: the static text display for the end user. If “VarType” of the text is set to any signal besides “None”, the text control will display the signal value, and this text property does not have any effect.

TextColor: the color of the text.

TextSettings: Keeps the values of styled text representation properties that are set in the Object Inspector or programmatically.

TextSettings references a TTextSettings type object that handles values of styled text representation properties that are set in the Object Inspector or programmatically. TextSettings references a TTextSettings type object, which handles styled text representation properties to be used for drawing texts in this control.

TTextSettings type objects provide all styled text representation properties and methods to manage them.

The styled text representation properties are FontColor, TextAlign, VertTextAlign, Trimming, WordWrap, and Font (TFont.Family, TFont.Size, and TFont.Style).

Please refer to "TextSettings" section above to view detailed description.

1.22.2.3 Image

Image control displays static images for the end user. The most popular image types (png, jpg, bmp, gif, tif, tiff, ico) are all supported by the image control:

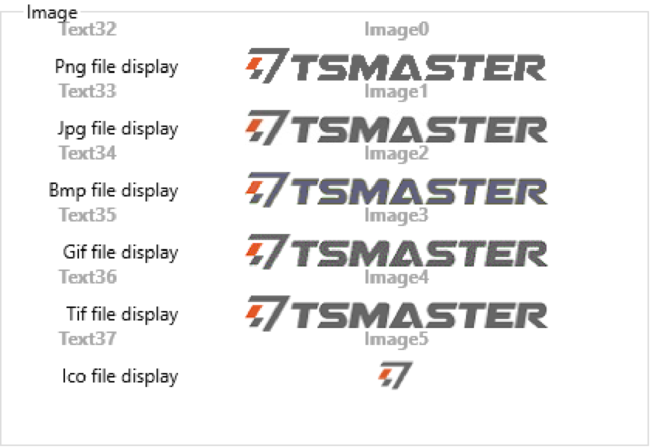


Fig 160 Image types supported

To change an image, just double click on the image control, you will see a picture selector popup dialog appears, from which you can load, save pictures to the image control:

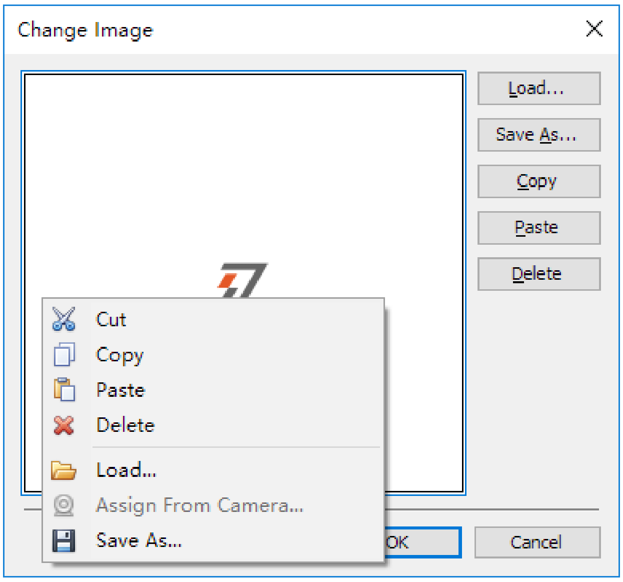
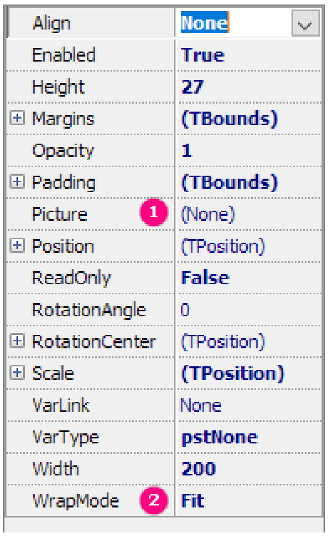


Fig 161 Picture selector

The image control has two additional properties as shown below:



Align	None
Enabled	True
Height	27
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
Picture	(None)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
VarLink	None
VarType	pstNone
Width	200
WrapMode	Fit

Fig 162 Image properties

- **Picture**

You can change the static image display by double-clicking the image, or by clicking the “…” button on the right side of this property.

- **WrapMode**

Specifies whether and how to resize, replicate, and position the bitmap image for rendering the TImage surface.

The WrapMode property should be one of the constants defined in the TImageWrapMode type:

Original displays the image with its original dimensions.

Fit provides the best fit, keeping image proportions (the ratio between the width and height) for the TImage rectangle. If needed, the image is scaled down or stretched to best fit the rectangle area. This is the default option.

Stretch stretches the image to fill the entire rectangle of the TImage component.

Tile tiles the TImage image to cover the entire rectangle of the TImage component.

Center centers the image to the rectangle of the TImage component. The image is never resized, regardless the size of the rectangle of the TImage component.

Place fits the image into the TImage rectangle. If the width or height of the image is greater than the corresponding dimension of the TImage rectangle, then the image is scaled down keeping image proportions (the ratio between the width and height) to fit in the TImage rectangle. The obtained image is centered in the TImage rectangle. Place only makes images smaller, never larger.

1.22.2.4 Group Box

Represents a graphical control used to arrange multiple related graphical controls on the surface of a form.

Use GroupBox whenever you need to arrange multiple related controls on a form (for instance, multiple radio buttons or check boxes). The most commonly grouped controls are radio buttons. After placing a group box on a FireMonkey form, select components from the Toolbox and place them in the group box. The Text property contains text that labels the group box at run time.

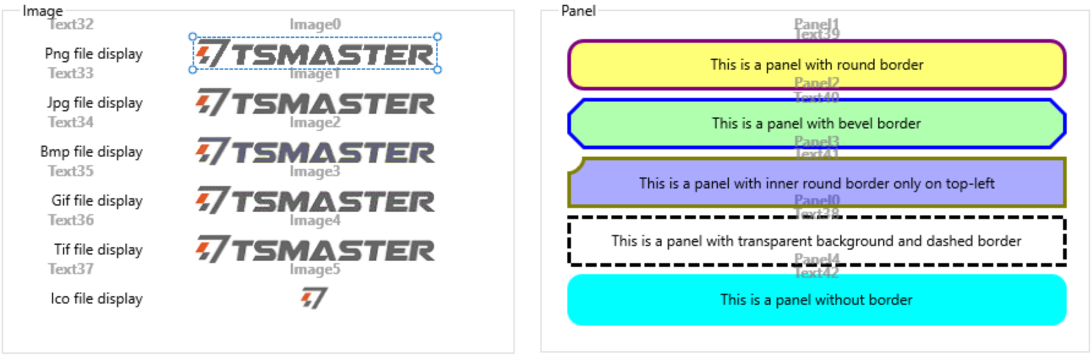
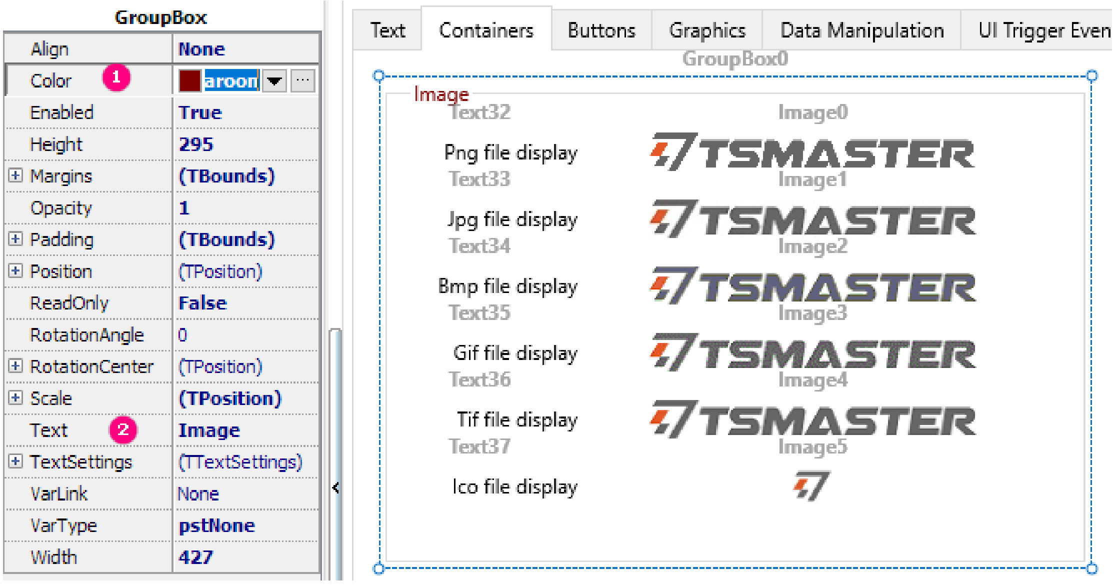


Fig 163 Group Box for grouped dislay of controls

Group box has two additional properties:



GroupBox

Align	None
Color 1	🟥 aroon
Enabled	True
Height	295
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
Text 2	Image
⊞ TextSettings	(TTextSettings)
VarLink	None
VarType	pstNone
Width	427

Fig 164 Group Box properties

- **Color**

The text color of group box.

- **Text**

The text display of group box.

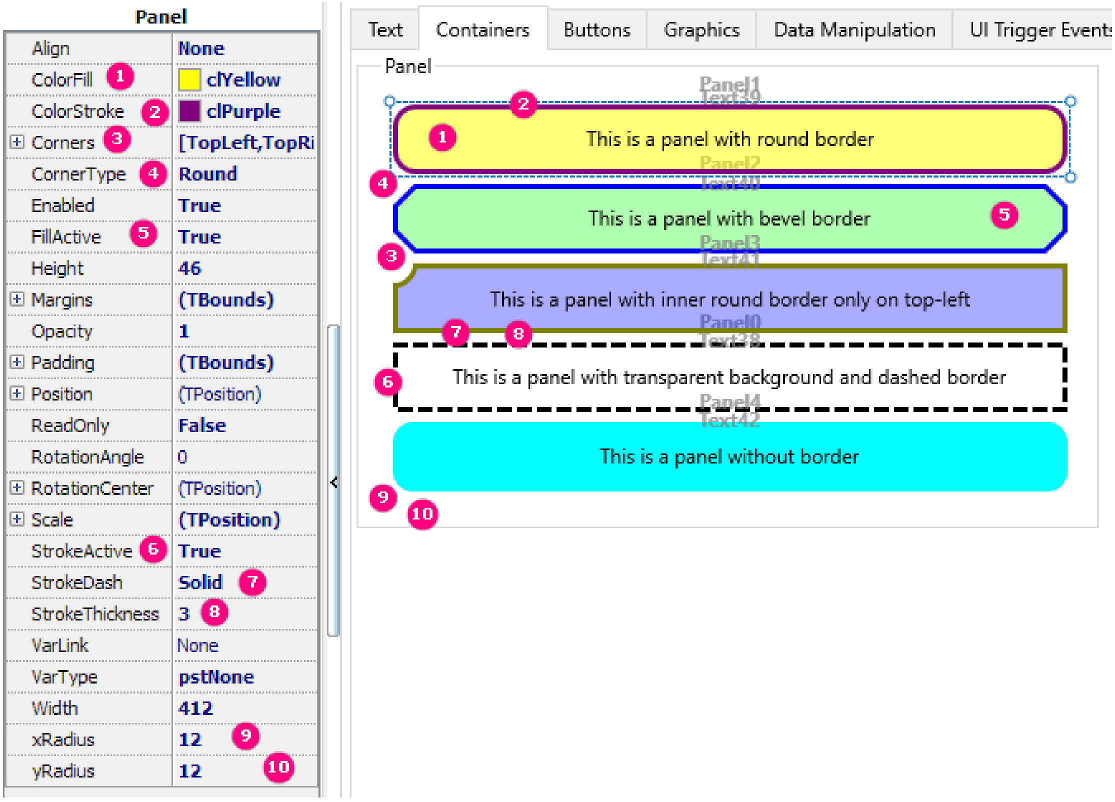
1.22.2.5 Panel

Represents a generic general-purpose panel used to hold multiple controls for organizing purposes.

Use TPanel components when you need to provide the user with a way of placing multiple graphical components on a surface for organizing purposes.

Panels have methods to help manage the placement of child controls embedded in the panel. You can also use panels to group controls together, similarly to the way you can use a group box. Panels are typically used for groups of controls within a single form. Panels with no borders are useful as docking sites when writing applications that use drag-and-dock.

Panel has 12 additional properties compared with common properties of a standard control:



Panel

Align	None
ColorFill	clYellow
ColorStroke	clPurple
⊞ Corners	[TopLeft,TopRi
CornerType	Round
Enabled	True
FillActive	True
Height	46
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
StrokeActive	True
StrokeDash	Solid
StrokeThickness	3
VarLink	None
VarType	pstNone
Width	412
xRadius	12
yRadius	12

This is a panel with round border

This is a panel with bevel border

This is a panel with inner round border only on top-left

This is a panel with transparent background and dashed border

This is a panel without border

Fig 165 Panel additional properties

[1] **ColorFill**: Determines the color used to fill the shape background.

[2] **ColorStroke**: Determines the color of the drawing pen used to draw lines and shape contours of the graphical primitives.

[3] **Corners**: Specifies shapes of which corners in the TRectangle rectangle object are customized according to the CornerType, XRadius, and YRadius properties.

By default, all four corners are customized.

Corners can contain a set of constants defined in the TCorner type: TopLeft, TopRight, BottomLeft, and BottomRight. Use the AllCorners constant to select all corners.

If Corners is an empty set or any of the XRadius and YRadius properties is zero, then no corner shape customization is used.

[4] **CornerType**: Specifies the type of the corner shape's customization in the rectangle.

Values of CornerType are defined in TCornerType. These Round, Bevel, InnerRound, and InnerLine values define the following types of corner shape customizations:

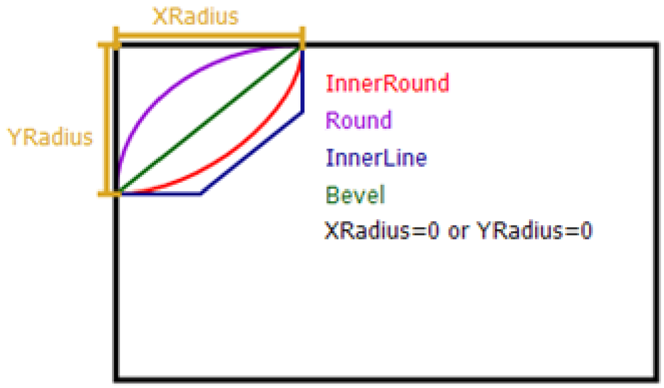


Fig 166 CornerType defintion

CornerType applies to corners specified in the Corners set.

XRadius and YRadius specify the distance from a corner to the start point of the corner shape customization, on the horizontal and vertical sides.

Note: If Corners is an empty set or any of the XRadius and YRadius properties is zero, then no corner shape customization is used.

[5] **FillActive**: Whether the current panel has fill property, if set to false, all properties related to fill have no effects.

[6] **StrokeActive**: Whether the current panel has stroke property, if set to false, all properties related to stroke have no effects.

[7] **StrokeDash**: Specifies the dash-dot style of lines or of contours.

A shape contour or a line can contain several segments (dash-dot groups) with different lengths and spaces between segments.

The possible values of Dash are Solid, Dash, Dot, DashDot, DashDotDot, and Custom defined in the TStrokeDash type.

The default is Solid--a single solid line.

Notice that if Dash is not Solid, Cap affects the ends of each line segment of the contour.

[8] **StrokeThickness**: Specifies the width, in pixels, of the stroke outline to draw a line or a contour.

[9] **xRadius**: Specifies the distance from a corner to the start point of the corner shape customization, on the horizontal sides of TRectangle.

During design time, the maximum possible value of XRadius is limited by the half of the smallest side.

If XRadius=0, then no corner shape customization is used.

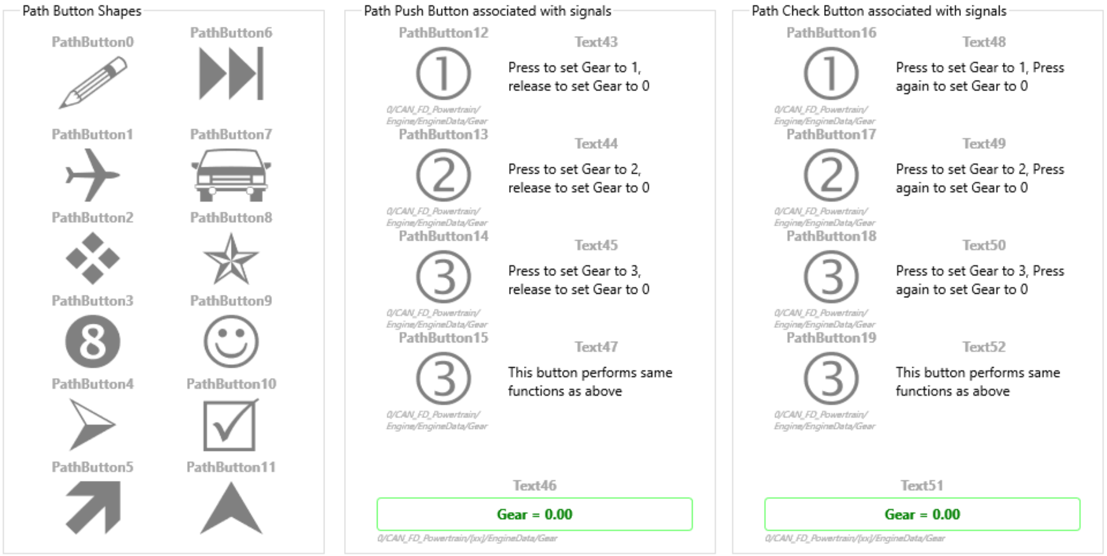
[10] **yRadius**: Specifies the distance from a corner to the start point of the corner shape customization, on the vertical sides of TRectangle.

During design time, the maximum possible value of YRadius is limited by the half of the smallest side.

If YRadius=0, then no corner shape customization is used.

1.22.2.6 Path Button

Path button is a push or checked button display complex images using vector graphic technology. You can pick a shape for a path button, and assign signals to it.


Path Button Shapes
PathButton0
PathButton6
PathButton1
PathButton7
PathButton2
PathButton8
PathButton3
PathButton9
PathButton4
PathButton10
PathButton5
PathButton11
Path Push Button associated with signals
PathButton12
Text43
0/CAN_FD_Powertrain/Engine/EngineData/Gear
PathButton13
Text44
0/CAN_FD_Powertrain/Engine/EngineData/Gear
PathButton14
Text45
0/CAN_FD_Powertrain/Engine/EngineData/Gear
PathButton15
Text47
0/CAN_FD_Powertrain/Engine/EngineData/Gear
Text46
Gear = 0.00
0/CAN_FD_Powertrain/[xx]/EngineData/Gear
Path Check Button associated with signals
PathButton16
Text48
0/CAN_FD_Powertrain/Engine/EngineData/Gear
PathButton17
Text49
0/CAN_FD_Powertrain/Engine/EngineData/Gear
PathButton18
Text50
0/CAN_FD_Powertrain/Engine/EngineData/Gear
PathButton19
Text52
0/CAN_FD_Powertrain/Engine/EngineData/Gear
Text51
Gear = 0.00
0/CAN_FD_Powertrain/[xx]/EngineData/Gear

Press to set Gear to 1, release to set Gear to 0

Press to set Gear to 2, release to set Gear to 0

Press to set Gear to 3, release to set Gear to 0

This button performs same functions as above

Press to set Gear to 1, Press again to set Gear to 0

Press to set Gear to 2, Press again to set Gear to 0

Press to set Gear to 3, Press again to set Gear to 0

This button performs same functions as above

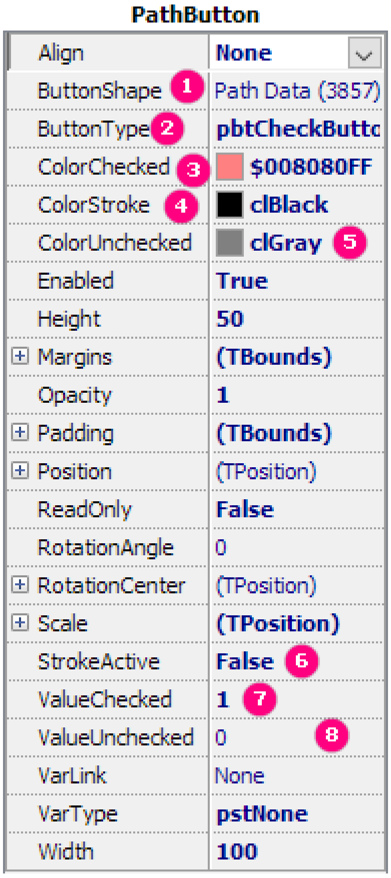
Fig 167 Path button

A path button also displays the state of the current signal. For example, we set the button's "ValueChecked" is 3, and "ValueUnchecked" is 2. Then the following behavior will be monitored:

- Associated signal is 3: the button will be displayed "Checked"
- Associated signal is 2: the button will be displayed "Unchecked"

- Associated signal is 1, or other value except 2 or 3: the button will be displayed "Unchecked"

A path button has additional 8 properties:



PathButton

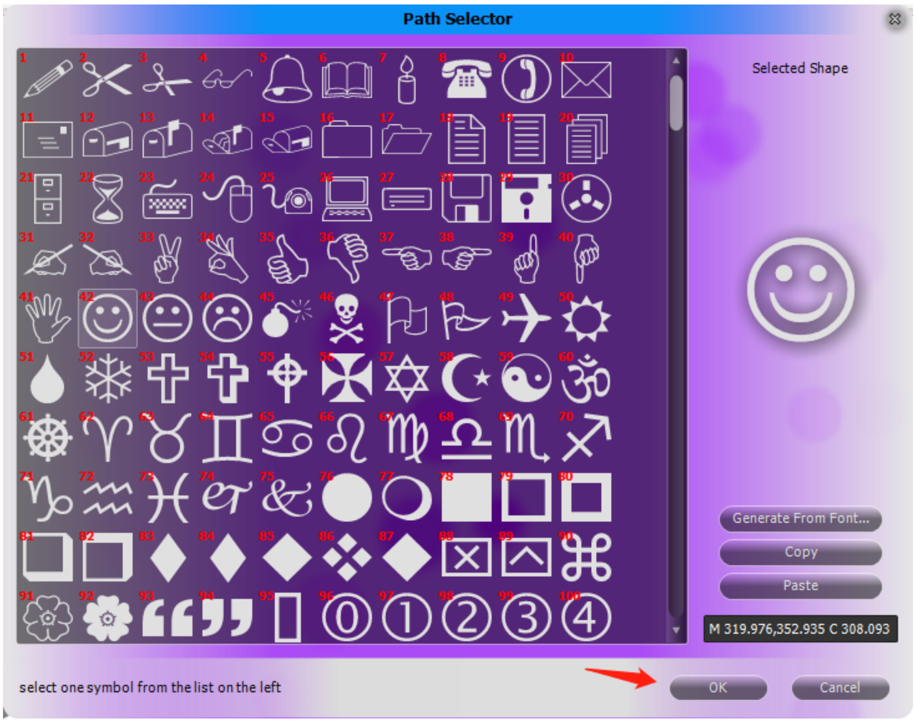
Align	None
ButtonShape	Path Data (3857)
ButtonType	pbtCheckButtc
ColorChecked	🟥 $008080FF
ColorStroke	⬛ clBlack
ColorUnchecked	▨ clGray
Enabled	True
Height	50
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
StrokeActive	False
ValueChecked	1
ValueUnchecked	0
VarLink	None
VarType	pstNone
Width	100

Fig 168 Path button properties

[1] Button Shape

The button shape is the data of its path, which represents a series of connected curves and lines. You can use the internal path selector to build the shape of the button, by clicking on the "…" button on the right side of the property.

There are in total 867 different paths in the list for you to choose from. If these shapes are not enough, you can add your own paths by clicking on the "Generate from Font…" button, to generate more paths from external font files:



Path Selector

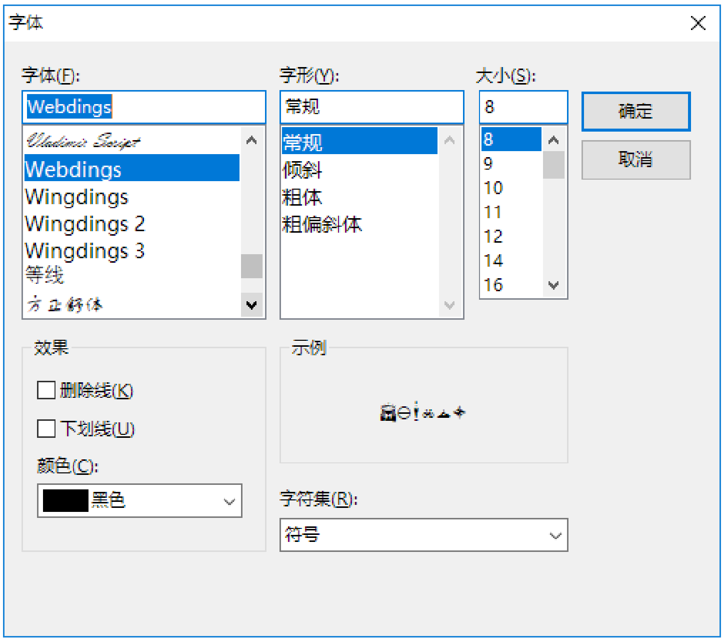
Selected Shape

M 319.976,352.935 C 308.093

select one symbol from the list on the left

Fig 169 Pick a path and select OK

Normally you can find more shapes in “Wingdings” or “Webdings” because they contain graphical symbols more than other font files:



字体

字体(F): Webdings

Vladimir Script
Webdings
Wingdings
Wingdings 2
Wingdings 3
等线
方正舒体

字形(Y): 常规

常规
倾斜
粗体
粗偏斜体

大小(S): 8

8
9
10
11
12
14
16

效果

□ 删除线(K)

□ 下划线(U)

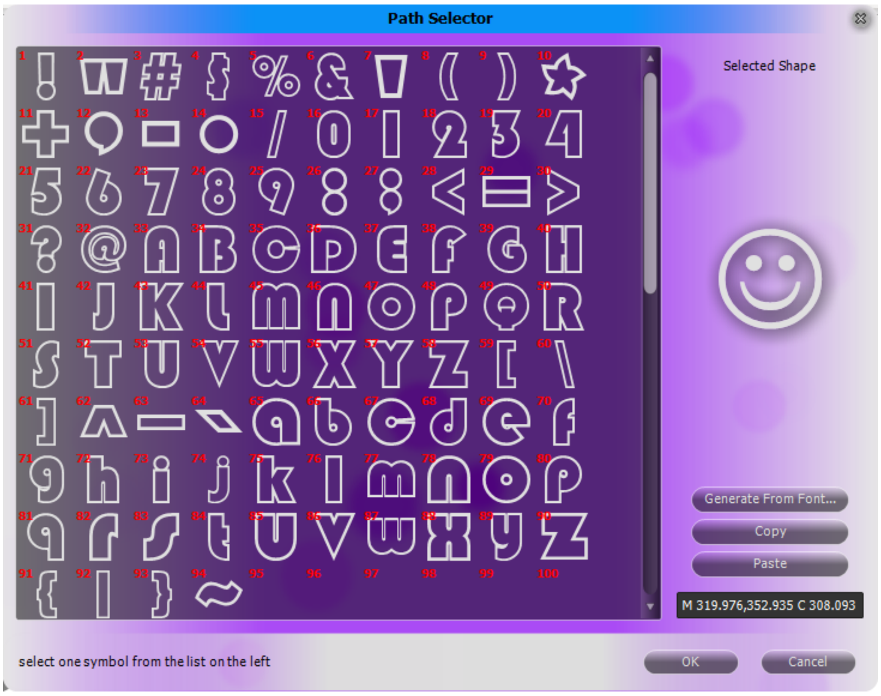
颜色(C): 黑色

示例

字符集(R): 符号

Fig 170 Recommended font files for generating paths

After selecting proper font files, you can get more paths to select from:



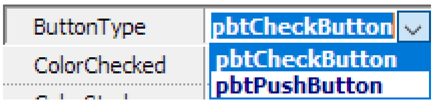
M 319.976,352.935 C 308.093

select one symbol from the list on the left

Fig 171 External paths from font files

[2] Button Type

A button type can be “Push button” or “Check button”:



ButtonType pbtCheckButton

ColorChecked

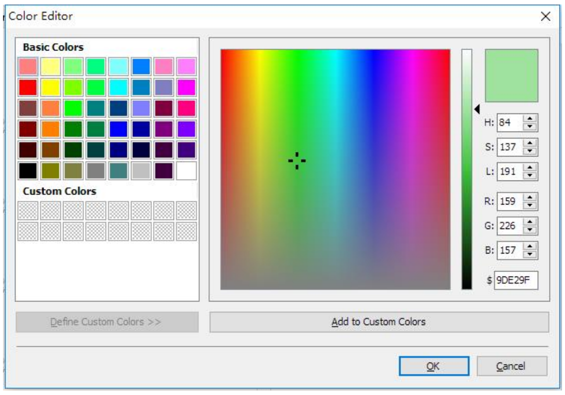
Fig 172 Path Button type

Push Button: This button type has only one stable state “Unpushed State”. If you push this button down, it will enter “Pushed State”, and the signal associated with it will be changed to “ValueChecked”, but after you release your mouse, this button will revert back to “Unpushed State”, and the signal will be changed back to “ValueUnchecked”.

Check Button: This button type has two stable state “Unpushed State” and “Pushed State”. If you push this button, it will enter “Pushed State” and remain in this state even if you release your mouse. And if you push it again, it will switch back to “Unpushed State” and remain in this state.

[3] ColorChecked

The path button will change its fill color to this color when the button is in “Pushed State”. Please use the color selector to assign a color to it:



H: 84
S: 137
L: 191
R: 159
G: 226
B: 157
$ 9DE29F

Fig 173 Color Selector

[4] ColorStroke

Determines the color of the drawing pen used to draw lines and shape contours of the graphical primitives.

[5] ColorUnchecked

The path button will change its fill color to this color when the button is in “Unpushed State”. Please use the color selector to assign a color to it.

[6] StrokeActive

Whether the current button has stroke property, if set to false, all properties related to stroke have no effects

[7] ValueChecked

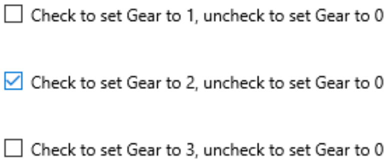
If the button is in “Pushed State”, its related signal will be changed to this value.

[8] ValueUnchecked

If the button is in “Unpushed State”, its related signal will be changed to this value.

1.22.2.7 Check Box

A check box is a value selector, which can be either ON(selected) or OFF(cleared).



□ Check to set Gear to 1, uncheck to set Gear to 0

☑ Check to set Gear to 2, uncheck to set Gear to 0

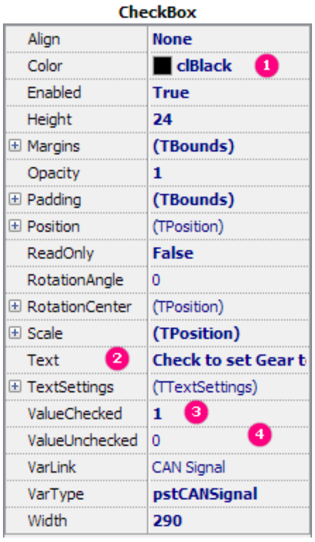
□ Check to set Gear to 3, uncheck to set Gear to 0

Fig 174 Check Box

A check box also displays the state of the current signal. For example, we set the check box’s “ValueChecked” is 3, and “ValueUnchecked” is 2. Then the following behavior will be observed:

- Associated signal is 3: the check box will be automatically checked
- Associated signal is 2: the check box will be automatically unchecked
- Associated signal is 1, or other value except 2 or 3: the check box will be automatically unchecked

A check box has 4 additional properties:



CheckBox

Align	None
Color	■ clBlack
Enabled	True
Height	24
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
Text	Check to set Gear t
⊞ TextSettings	(TTextSettings)
ValueChecked	1
ValueUnchecked	0
VarLink	CAN Signal
VarType	pstCANSignal
Width	290

Fig 175 Check box additional properties

[1] Color

The text color of check box can be set here.

[2] Text

The displayed text on the check box.

[3] ValueChecked

If the check box is checked, the associated signal will be changed to this value.

[4] ValueUnchecked

If the check box is unchecked, the associated signal will be changed to this value.

1.22.2.7.1 Track Bar

Track bar represents a general-purpose value changer for use in applications where tracking is required.

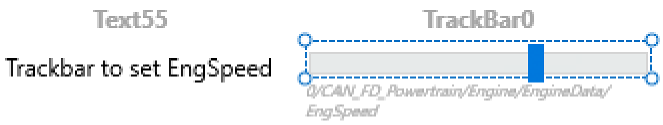
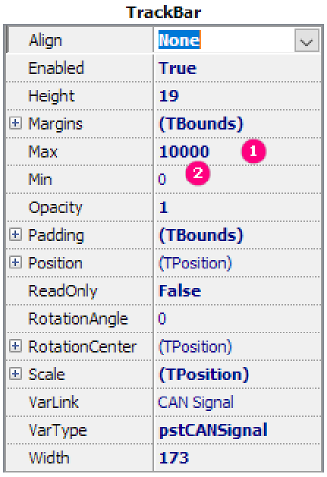


Fig 176 Track Bar

A track bar also displays its associated signal value in real-time within its supported range. If its signal has a value that is out of the track bar's max range, then the track bar will display this signal value at its maximum range.

A track bar has 2 additional properties as shown below:



TrackBar

Align	None
Enabled	True
Height	19
⊞ Margins	(TBounds)
Max	10000
Min	0
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
VarLink	CAN Signal
VarType	pstCANSignal
Width	173

Fig 177 Track bar additional properties

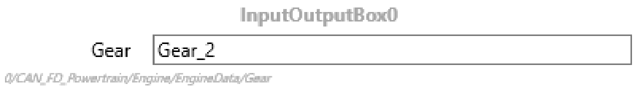
The min and max properties specifies its associated signal's physical range.

1.22.2.8 Scroll Bar

A scroll bar Represents a standard value changer that is used to scroll the value range of a signal. Its performs completely same as "Track Bar" described above.

1.22.2.9 Input Output Box

An input output box is a text box to display or set signal value.



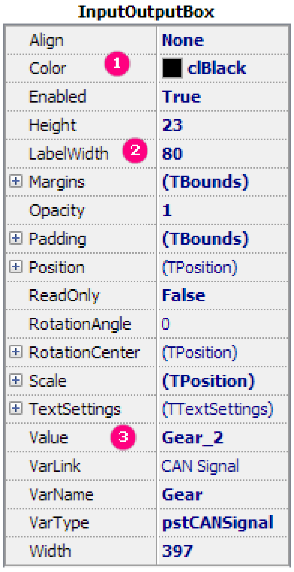
InputOutputBox0

Gear Gear_2

0/CAN_FD_Powertrain/Engine/EngineData/Gear

Fig 178 Input Output Box

An input output box has 3 additional properties:



InputOutputBox

Align	None
Color	■ clBlack
Enabled	True
Height	23
LabelWidth	80
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
⊞ TextSettings	(TTextSettings)
Value	Gear_2
VarLink	CAN Signal
VarName	Gear
VarType	pstCANSignal
Width	397

Fig 179 Input Output Box additional properties

[1] Color

The text color of the text box.

[2] LabelWidth

The width of its label in pixels.

[3] Value

The signal's real-time value can be displayed or set here.

Note: The display of signal value supports symbol display. But setting value does not, because it is not easy sometimes for human to write complete symbol value for a signal without mistake, use physical value instead. Or if you want to set symbol value, please use "Value Selector".

1.22.2.10 Image Button

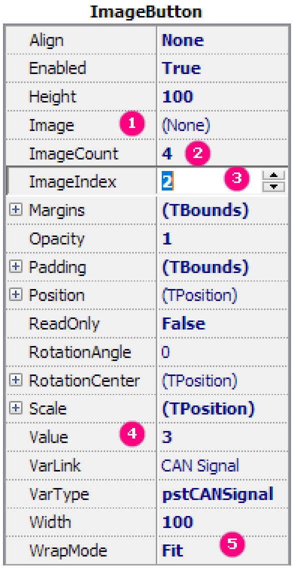
Image button displays a series of images depending on the real-time value of its associated signal. For example of the following value mapping:

Table 4 Image Button Value Mapping

Signal Value	Image
0	
1	
2	
3	

If its associated signal value is within [0, 1, 2, 3], this button will display the mapped image on the right side of the table. This image button will remain unchanged if its associated signal's value is out of scope of the value table [0, 1, 2, 3].

An image button has 5 additional properties as shown below:



ImageButton

Align	None
Enabled	True
Height	100
Image	(None)
ImageCount	4
ImageIndex	2
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
Value	3
VarLink	CAN Signal
VarType	pstCANSignal
Width	100
WrapMode	Fit

Fig 180 Image button additional properties

[1] Image

The picture at the current "ImageIndex", click the "…" button on the right side of the property to change the current image.

[2] ImageCount

The “Value - Image” pair count. Please set this count to a value between [1..100].

[3] ImageIndex

The current editing image index from 0 to “ImageCount” - 1. If you want to set the first image, set this value to 0 and then modify “Image” property; If you want to set the last image (for example image count is 5 in total), set this value to 4 and then modify the “Image” property.

[4] Value

The physical value of the current image index in “Value - Image” pair.

[5] WrapMode

Specifies whether and how to resize, replicate, and position the bitmap image for rendering the TImage surface.

The WrapMode property should be one of the constants defined in the TImageWrapMode type:

Original displays the image with its original dimensions.

Fit provides the best fit, keeping image proportions (the ratio between the width and height) for the TImage rectangle. If needed, the image is scaled down or stretched to best fit the rectangle area. This is the default option.

Stretch stretches the image to fill the entire rectangle of the TImage component.

Tile tiles the TImage image to cover the entire rectangle of the TImage component.

Center centers the image to the rectangle of the TImage component. The image is never resized, regardless the size of the rectangle of the TImage component.

Place fits the image into the TImage rectangle. If the width or height of the image is greater than the corresponding dimension of the TImage rectangle, then the image is scaled down keeping image proportions (the ratio between the width and height) to fit in the TImage rectangle. The obtained image is centered in the TImage rectangle. Place only makes images smaller, never larger.

1.22.2.11 Selector

A selector is a “Text – Value” list, which represents a combo box, which is a button with a list box attached to it.

Click the button to display the list. You can select an item from the list and it will appear as the button's text. You can type text directly into the combo box button. For example, if you select “Gear_2=2” in the list below, you will see the signal value associated to this selector changed to 2, You can also set “2” directly in the text area to force change the signal’s physical value to 2:

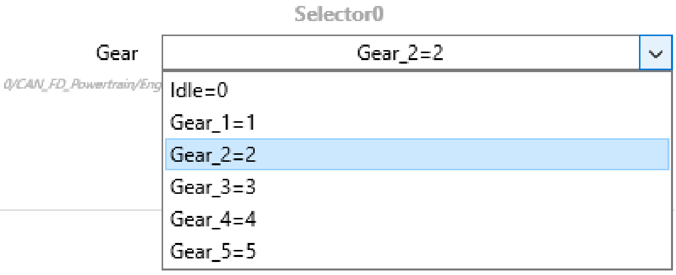
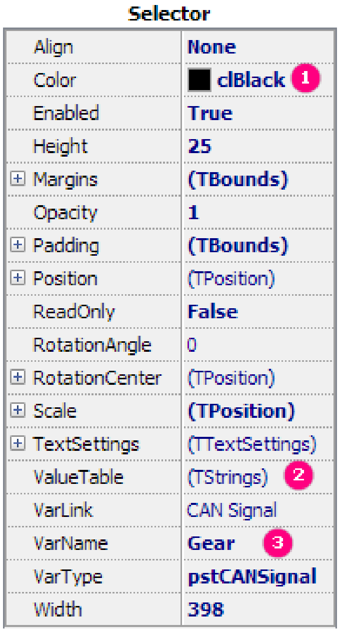


Fig 181 Selector

A selector has additional 3 properties as shown below:



Selector

Align	None
Color	■ clBlack 1
Enabled	True
Height	25
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
⊞ TextSettings	(TTextSettings)
ValueTable	(TStrings) 2
VarLink	CAN Signal
VarName	Gear 3
VarType	pstCANSignal
Width	398

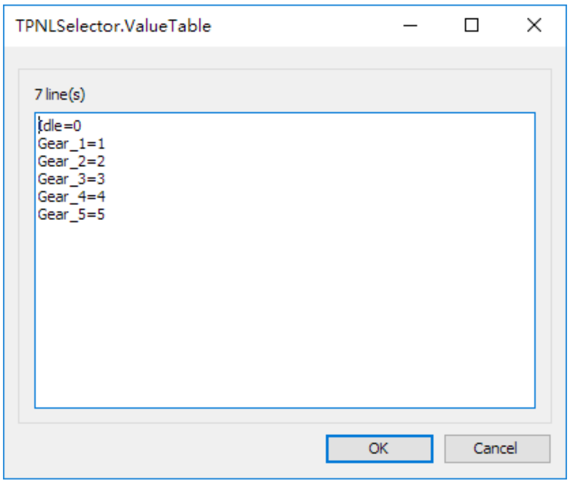
Fig 182 Selector

[1] Color

The text color of the selector.

[2] Value Table

Value Table is a list of “Name - Value” pairs. By clicking on the “…” button, you can edit the pairs:



7 line(s)

```
Idle=0
Gear_1=1
Gear_2=2
Gear_3=3
Gear_4=4
Gear_5=5
```

Fig 183 Value Table editor

Please be sure to follow the rules “Name=Value” while editing the value table.

[3] VarName

The display name on the left side of the selector, which is automatically set by the signal selector when this control is associated with a signal, you can also modify this display name, too.

1.22.2.12 Button

A button is a push button setting its associated signal when its state is “Pushed”, and never revert value when its state is “Unpushed”. It has only one trigger value:

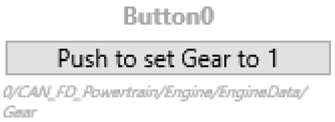


Fig 184 Button

Please refer to “Path Button” with “Push Button” mode for details.

1.22.2.13 Progress Bar

A progress bar represents an animated progress indicator for general progress indication. It is a display only control for signal physical value or system variable value monitoring.

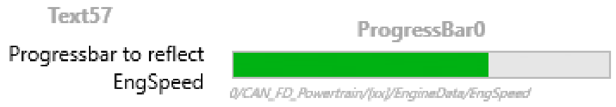
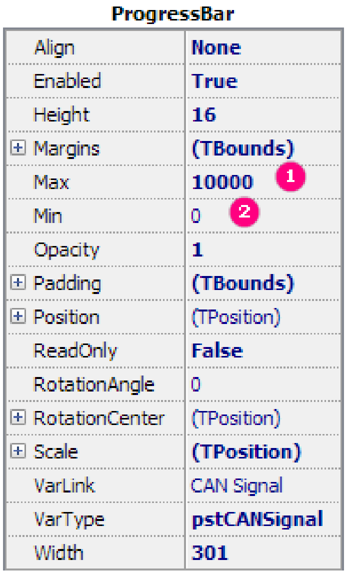

Text57
Progressbar to reflect EngSpeed
ProgressBar0
0/CAN_FD_Powertrain/[xx]/EngineData/EngSpeed

Fig 185 Progress Bar

A progress bar has 2 additional properties:



ProgressBar

Align	None
Enabled	True
Height	16
⊞ Margins	(TBounds)
Max	10000 ❶
Min	0 ❷
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
VarLink	CAN Signal
VarType	pstCANSignal
Width	301

Fig 186 Progress Bar additional properties

Min and Max specifiy the signal value range to display. In the above picture, the Min value is 0 and Max value is 10000. If the signal's actual value is 15000, the progress bar will remain display 100% value range.

1.22.2.14 Radio Button

RadioButton, also called option button, presents a set of mutually exclusive choices. You can create individual radio buttons or use a group to automatically arrange radio buttons into groups. You can group radio buttons to let the user select one from a limited set of choices.

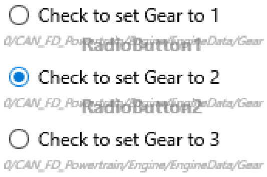
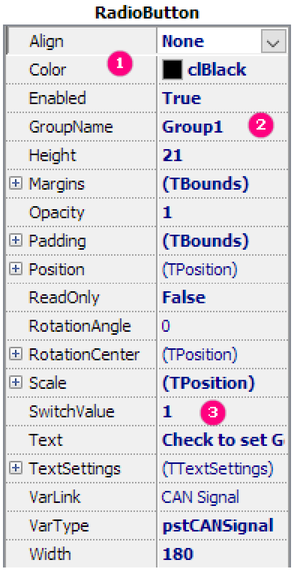

○ Check to set Gear to 1
0/CAN_FD_Powertrain/Engine/EngineData/Gear
RadioButton1
● Check to set Gear to 2
0/CAN_FD_Powertrain/Engine/EngineData/Gear
RadioButton2
○ Check to set Gear to 3
0/CAN_FD_Powertrain/Engine/EngineData/Gear

Fig 187 Radio Button

Radio button also displays the signal real-time value if the value matches its “ON state value”.

A radio button has 3 additional properties as shown below:



RadioButton

Align	None
Color	■ clBlack
Enabled	True
GroupName	Group1
Height	21
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
SwitchValue	1
Text	Check to set G
⊞ TextSettings	(TTextSettings)
VarLink	CAN Signal
VarType	pstCANSignal
Width	180

Fig 188 Radio Button additional properties

[1] Color

The text color of radio button.

[2] GroupName

Specifies the name of the group this radio button is part of.

Set the GroupName property to the name of the group this radio button belongs to. If multiple radio buttons are part of the same group, that is, all of them have the same GroupName, when you click one of them, it becomes selected, while the others in this group become cleared.

[3] SwitchValue

The SwitchValue will be written to the associated signal if the current radio button is checked. Besides, if the associated signal has been changed externally, this radio button will also show a “checked” state.

1.22.2.15 Start Stop Button

Start stop button controls whether the current application should be connected or disconnected. There are no additional properties assigned with start stop button.

In editor mode, you can select this button and modify its common properties, as shown below:

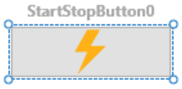


Fig 189 Start Stop button in editor mode

If you switch the panel into test mode while the application is disconnected, you can see the selection border of this button disappears, that means you can click this button to bring the application into connected state.

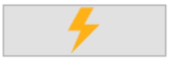


Fig 190 Start Stop button in test mode

And after this button is clicked in test mode, you can see the application is connected, and this button switches to a “stop button” indicating that if you click this button again, the application will be disconnected.

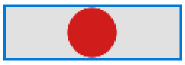


Fig 191 Start Stop button in application connected state

1.22.2.16 Switch

Switch represents a two-way on-off switch for use in applications.

Use a Switch whenever you need to provide the user with a two-way on-off switch.

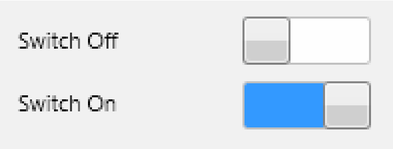
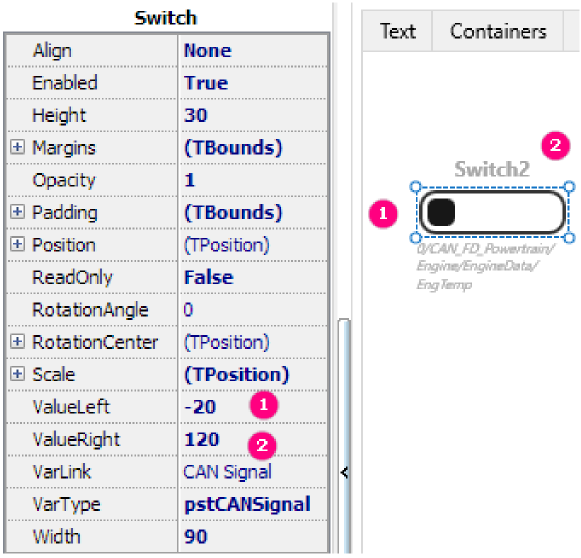


Fig 192 Switch

A switch also displays its associated signal’s real-time value if the value matches its “ValueLeft” or “ValueRight” properties.

A switch has 2 additional properties as shown below.



Switch

Align	None
Enabled	True
Height	30
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
ValueLeft	-20
ValueRight	120
VarLink	CAN Signal
VarType	pstCANSignal
Width	90

Fig 193 Switch additional properties

[1] ValueLeft

This value will be written to its associated signal if you switch this control from right to left.

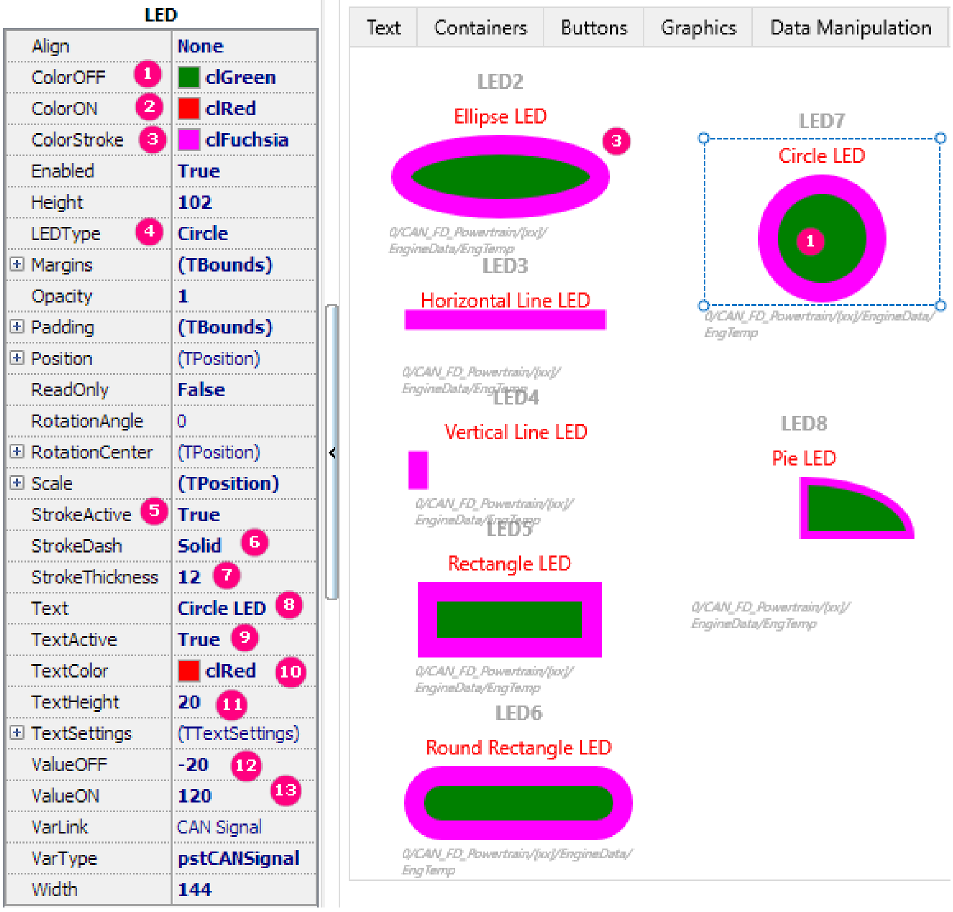
[2] ValueRight

This value will be written to its associated signal if you switch this control from left to right.

1.22.2.17 LED

LED is a display only control to show Boolean value of a signal.

A led has 13 additional properties as shown below:



LED

Align	None
ColorOFF	🟩 clGreen
ColorON	🟥 clRed
ColorStroke	🟪 clFuchsia
Enabled	True
Height	102
LEDType	Circle
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
StrokeActive	True
StrokeDash	Solid
StrokeThickness	12
Text	Circle LED
TextActive	True
TextColor	🟥 clRed
TextHeight	20
⊞ TextSettings	(TTextSettings)
ValueOFF	-20
ValueON	120
VarLink	CAN Signal
VarType	pstCANSignal
Width	144

1
2
3
4
5
6
7
8
9
10
11
12
13
Text
Containers
Buttons
Graphics
Data Manipulation
LED2
Ellipse LED
3
0/CAN_FD_Powertrain/[xx]/EngineData/EngTemp
LED7
Circle LED
1
0/CAN_FD_Powertrain/[xx]/EngineData/EngTemp
LED3
Horizontal Line LED
0/CAN_FD_Powertrain/[xx]/EngineData/EngTemp
LED4
Vertical Line LED
0/CAN_FD_Powertrain/[xx]/EngineData/EngTemp
LED8
Pie LED
LED5
Rectangle LED
0/CAN_FD_Powertrain/[xx]/EngineData/EngTemp
0/CAN_FD_Powertrain/[xx]/EngineData/EngTemp
LED6
Round Rectangle LED
0/CAN_FD_Powertrain/[xx]/EngineData/EngTemp

Fig 194 LED additional properties

[1] ColorOFF

The LED’s fill color will be changed to this value if its associated signal’s value is lower or equal than “ValueOFF”.

[2] ColorON

The LED’s fill color will be changed to this value if its associated signal’s value is larger or equal than “ValueON”.

[3] ColorStroke

The stroke color of the LED shape.

[4] LEDType

LED shape type, can be: Circle, Ellipse, Horizontal Line, Vertical Line, Rectangle, Round Rectangle, Pie

[5] StrokeActive

This property will control whether stroke related properties is activated.

[6] StrokeDash

Specifies the dash-dot style of lines or of contours.

A shape contour or a line can contain several segments (dash-dot groups) with different lengths and spaces between segments.

The possible values of Dash are Solid, Dash, Dot, DashDot, DashDotDot, and Custom defined in the TStrokeDash type.

The default is Solid--a single solid line.

[7] StrokeThickness

Specifies the width, in pixels, of the stroke outline to draw a line or a contour.

[8] Text

The display text on top of this LED.

[9] TextActive

This property controls the visibility of the display text.

[10] TextColor

The color of the display text.

[11] TextHeight

The height of the display text in pixels.

[12] ValueOFF

The LED's color will be switched to "ColorOFF" if its associated signal's value has been changed to this value.

[13] ValueON

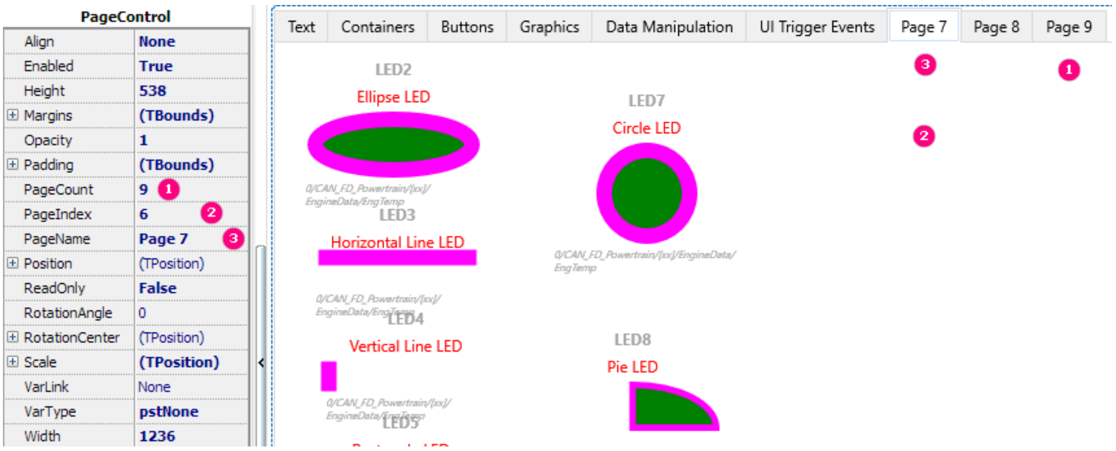
The LED's color will be switched to "ColorON" if its associated signal's value hass been changed to this value.

1.22.2.18 Page Control

1.22.2.18.1 Page Control Properties

Page control is a tab set that has the appearance of notebook dividers.

A page control has 3 additional properties as shown below:



PageControl

Align	None
Enabled	True
Height	538
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
PageCount	9
PageIndex	6
PageName	Page 7
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
VarLink	None
VarType	pstNone
Width	1236

Fig 195 Page Control

[1] PageCount

Specifies how many pages this page control holds. You must set a value between 1 and 100.

[2] PageIndex

This property will show the current page index starting from 0. If you want to edit the name of page 3, you must set "PageIndex" to 2 and then modify the "PageName" property.

[3] PageName

The name of the current page. If you want to modify the name of another page say the last page (5 pages in total), you must first set "PageIndex" to 2 and then modify this property.

1.22.2.18.2 Delete a page in Page Control

Steps to delete a page in page control:

[1] Firstly, navigate to the page to be deleted, and delete all the controls in this page

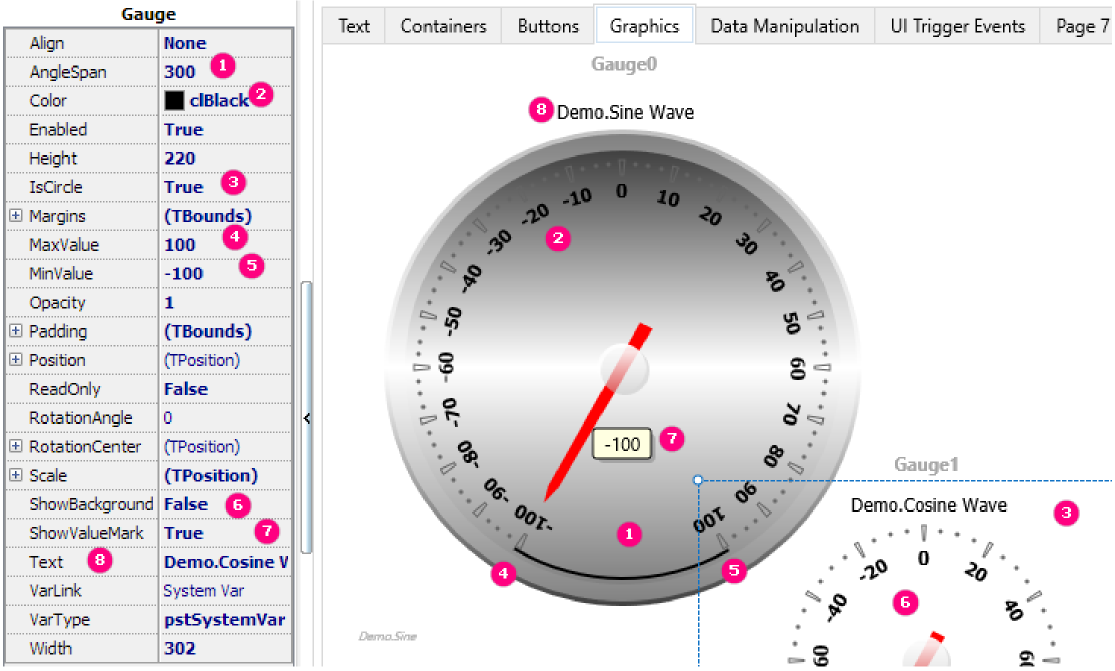
[2] Move the page to be deleted to the last page by setting "SetIndex" of the current page to the last index, if the count is 9, then the last index is 8

[3] Decrement page count by 1

1.22.2.19 Gauge

Gauge displays a meter interface for monitoring signals or system variables. It is a display only control.

A gauge has 8 additional properties as shown below:



Gauge

Align	None
AngleSpan	300
Color	■ clBlack
Enabled	True
Height	220
IsCircle	True
⊞ Margins	(TBounds)
MaxValue	100
MinValue	-100
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
ShowBackground	False
ShowValueMark	True
Text	Demo.Cosine V
VarLink	System Var
VarType	pstSystemVar
Width	302

Fig 196 Gauge additional properties

[1] AngleSpan

The display area of this gauge from 0 ~ 360 degree:

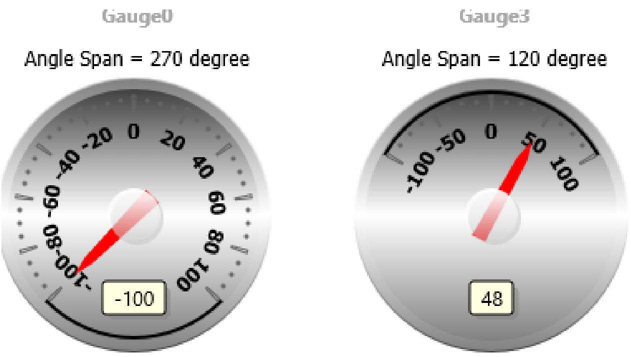


Fig 197 Gauges with different angle spans

[2] Color

The text color of this gauge is controlled by this property.

[3] IsCircle

If this property is true, the gauge will be a circle, otherwise an ellipse.

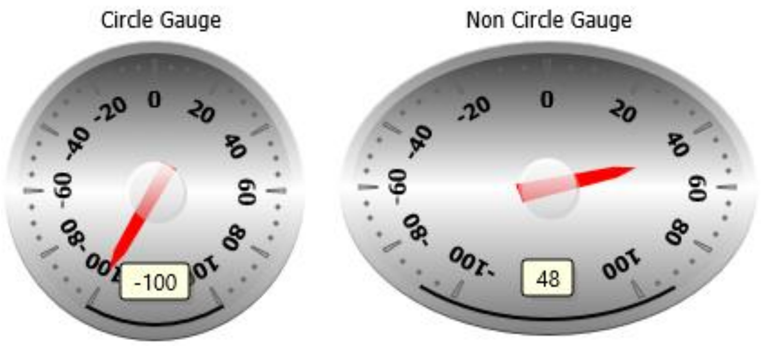


Fig 198 Gauges with IsCircle set to true and false

[4] MaxValue

The maximum physical value of its associated signal.

[5] MinValue

The minimum physical value of its associated signal.

[6] ShowBackground

This property controls if a gauge’s background color is visible.

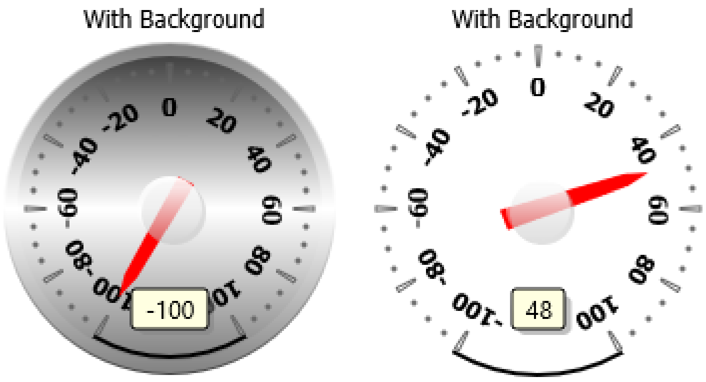


Fig 199 Gauge with/without background

[7] ShowValueMark

This property controls if a gauge’s value mark is visible.

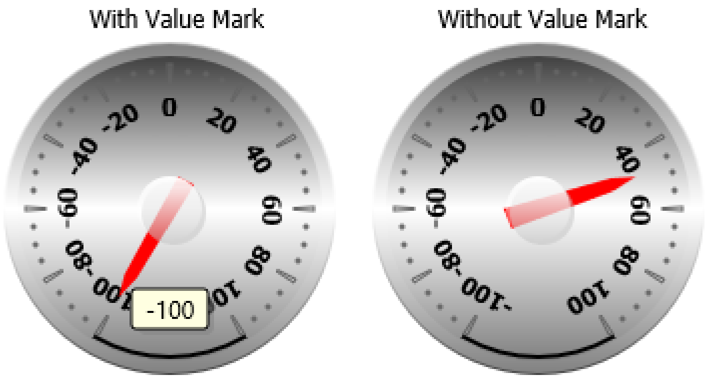


Fig 200 Gauge with/without value mark

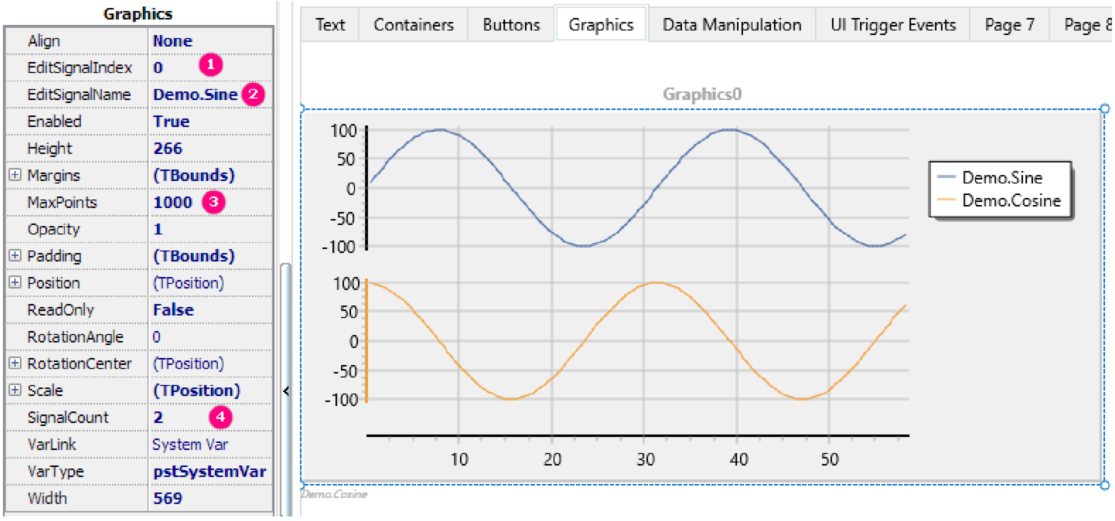
[8] Text

The display text on top of the gauge.

1.22.2.20 Graphics

Graphics is a curve container for multiple signals physical value display. You can add up to 100 signals into one graphics control. Graphics is a display only control.

A graphics control has 4 additional properties as shown below:



Graphics

Align	None
EditSignalIndex	0 ①
EditSignalName	Demo.Sine ②
Enabled	True
Height	266
⊞ Margins	(TBounds)
MaxPoints	1000 ③
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
SignalCount	2 ④
VarLink	System Var
VarType	pstSystemVar
Width	569

Fig 201 Graphics additional properties

[1] EditSignalIndex

This property determines which signal is currently being edited. If you want to modify the second signal’s display name and database address, you should first set this property to 1 and then modify “VarLink” and “EditSignalName” properties.

[2] EditSignalName

Editing this property will update signal display name in “Lengend” area on the right side of the graphics control.

[3] MaxPoints

The maximum data points of each signal displayed in graphics control. The default point count is 1000.

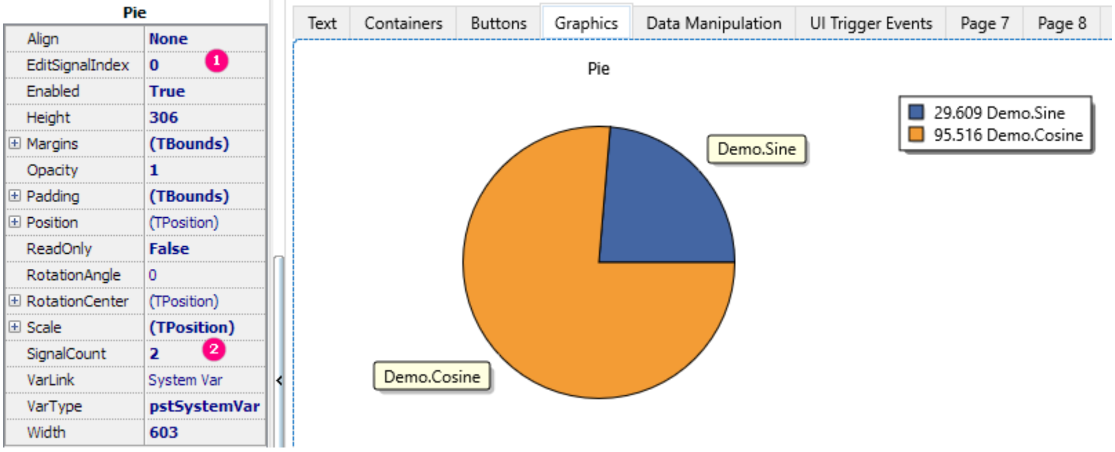
[4] SignalCount

This property specifies the signal count inside this graphics control. If you want to add 5 signals into this control to display them, first set this property to 5, and then set “EditSignalIndex” from 0 to 4, during this process you can modify each signal’s property.

1.22.2.21 Pie

Pie control displays relationship of multiple signals. It is a display only control.

A pie control has 2 additional properties as shown below:



Pie

Align	None
EditSignalIndex	0
Enabled	True
Height	306
⊞ Margins	(TBounds)
Opacity	1
⊞ Padding	(TBounds)
⊞ Position	(TPosition)
ReadOnly	False
RotationAngle	0
⊞ RotationCenter	(TPosition)
⊞ Scale	(TPosition)
SignalCount	2
VarLink	System Var
VarType	pstSystemVar
Width	603

Fig 202 Pie additional properties

[1] EditSignalIndex

This property determines which signal is currently being edited. If you want to modify the second signal’s database address, you should first set this property to 1 and then modify “VarLink” properties.

[2] SignalCount

This property specifies the signal count inside this pie control. If you want to add 5 signals into this control to display them, first set this property to 5, and then set

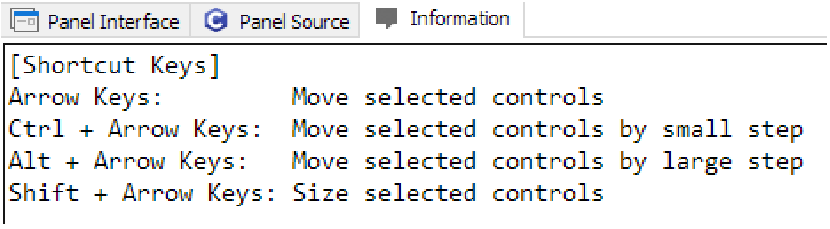
"EditSignalIndex" from 0 to 4, during this process you can modify each signal's property.

1.22.3 Panel Design Recommendations

1.22.3.1 Using Shortcuts

You can find shortcuts description in "Information" page of each Panel form.

Note: You must first select one or more panel controls and then press shortcuts, so that these shortcuts may affect the controls you selected.



```
[Shortcut Keys]
Arrow Keys:         Move selected controls
Ctrl + Arrow Keys:  Move selected controls by small step
Alt + Arrow Keys:   Move selected controls by large step
Shift + Arrow Keys: Size selected controls
```

Fig 203 Panel shortcuts

1.22.3.2 Remaining Bus Simulation

If any panel signal is associated with CAN or LIN signal, the CAN RBS or LIN RBS is forced to be started if it is not configured to be automatically run when application is started. This is because panel bus signals rely on "Remaining Bus Simulation" functionality.

1.23 Test System

TSMaster test system provides a complete solution for general purpose test automation requirements, which covers every aspect of automated tests.

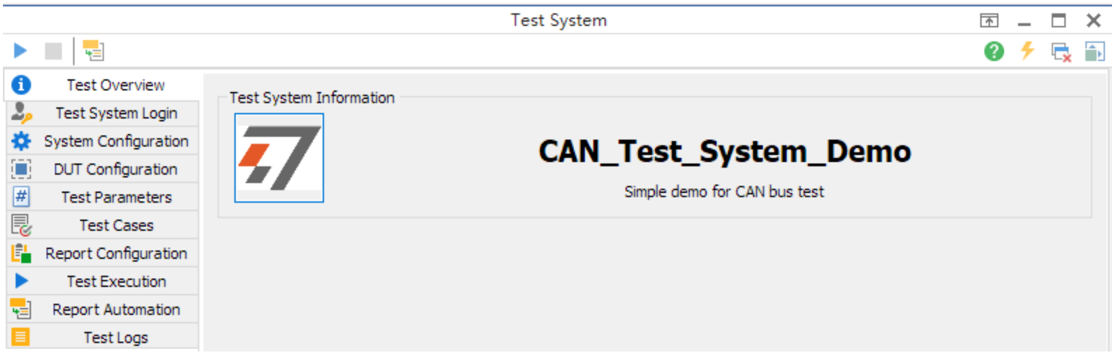


Fig 204 TSMaster Test System

Please refer to TSMaster example "CAN Test Demo.T7z" to see the ability of Test System:

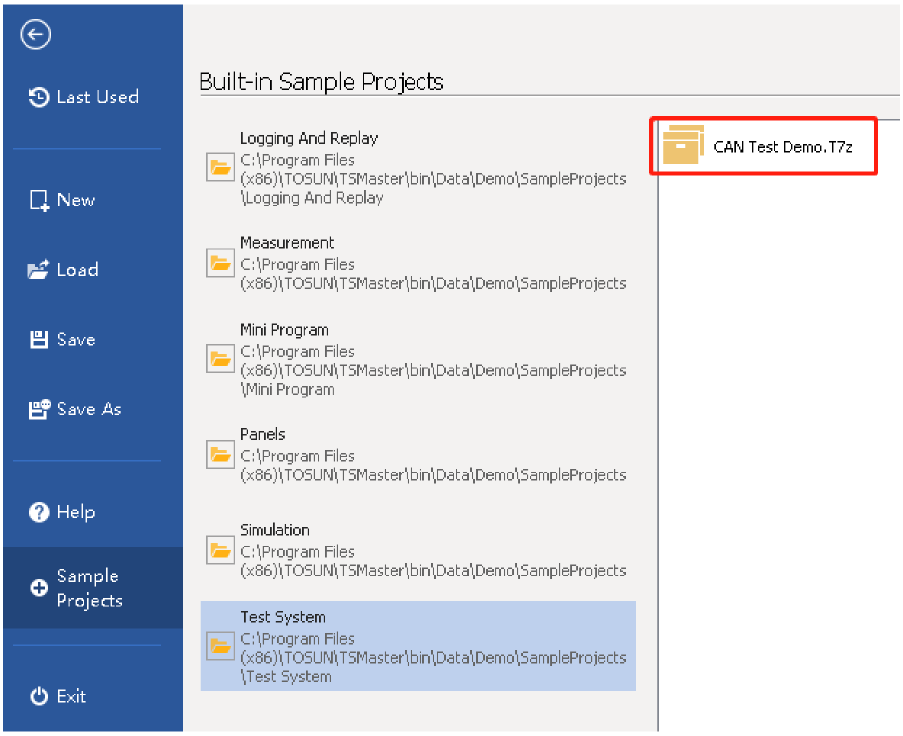

Last Used
New
Load
Save
Save As
Help
Sample Projects
Exit
Built-in Sample Projects
Logging And Replay
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Logging And Replay
Measurement
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects
Mini Program
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Mini Program
Panels
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects
Simulation
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects
Test System
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Test System
CAN Test Demo.T7z

Fig 205 CAN Test Demo Example

1.23.1 Test System Toolbar

Test system toolbar provides one-key start feature of all test cases and report generation, which greatly improves test efficiency.

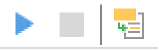


Fig 206 Test System Toolbar

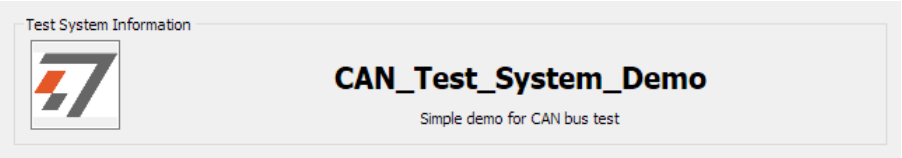
▶ Start all test cases required based on the test system configuration.

■ Stop the test system.

📋 Start auto generation of test report.

1.23.2 Test System Overview

Test system overview displays the test system name, icon and descriptions of the current test system. You can create or open one test system at a time.


Test System Information

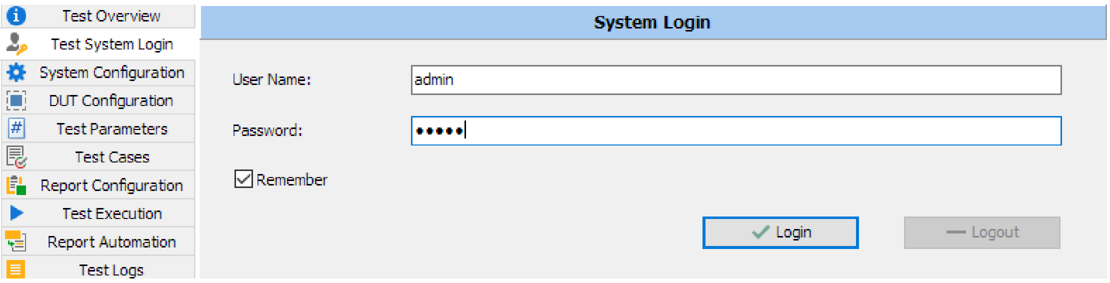
CAN_Test_System_Demo

Simple demo for CAN bus test

Fig 207 Test system overview

1.23.3 Test System Login

You must first login into the test system before any operation in the test system. The system will grant you abilities based on your current privileges. Note: the default user name and password for a new test system are all “admin”, please type in the user name and password correctly in order to login. You can also tick “Remember” so that you do not need to type user name and password again the next time you use test system.



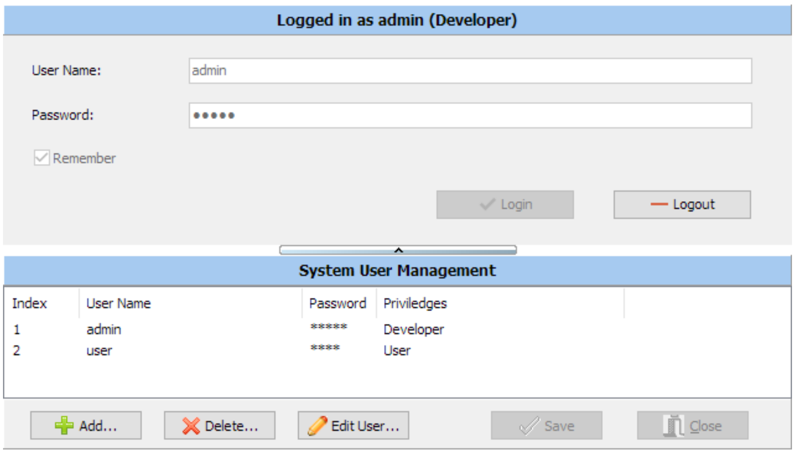
User Name: admin

Password: •••••

☑ Remember

Fig 208 Test System Login

After successful login, you can see “System user management” under “System Login” panel if your privilege is “Developer”:



Logged in as admin (Developer)

User Name: admin

Password: •••••

☑ Remember

System User Management

Index	User Name	Password	Priviledges
1	admin	*****	Developer
2	user	****	User

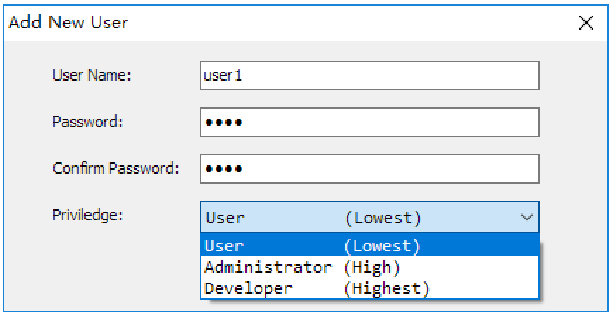
Fig 209 System User Management

There are 3 user privileges as described below:

- User: Can only perform tests, user cannot edit test cases.
- Administrator: Can edit the whole test system except user list.
- Developer: Can edit every aspect of test system.

There are 5 buttons on bottom of the user management panel:

- **Add Button**: To add new user into the test system.



Add New User

User Name: user1

Password: ••••

Confirm Password: ••••

Priviledge: User (Lowest)

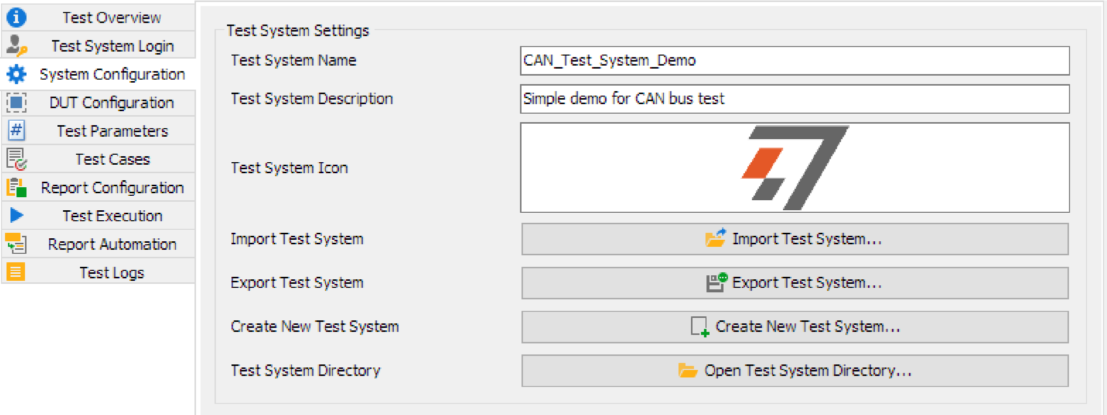
Fig 210 Add new user

- **Delete Button**: To delete the selected user from the list. Note: If you delete all users from the list, you may not be able to login to the system next time. Please contact TOSUN if you are in this situation.
- **Edit User Button**: To open the edit user dialog box, the user name, password and user privilege can be modified.
- **Save Button**: Save the current list after modification.
- **Close Button**: Close the current panel after modification.

1.23.4 System Configuration

You can configure the test system, import or export the whole test system with its test cases and parameters from an external config file.

Note: users with “User” privilege are not able to edit the system configuration.



Test System Name: CAN_Test_System_Demo
Test System Description: Simple demo for CAN bus test
Test System Icon
Import Test System
Export Test System
Create New Test System
Test System Directory

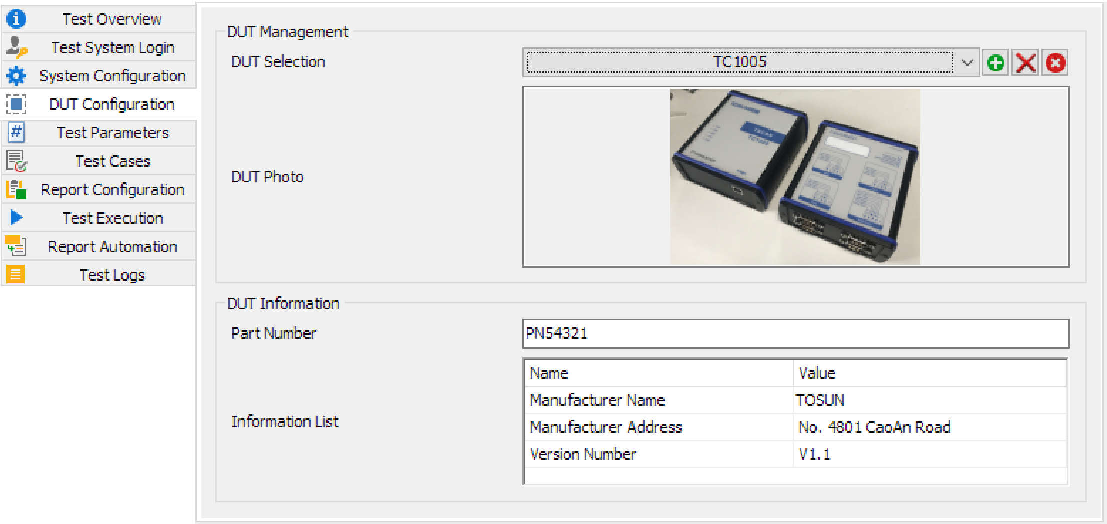
Fig 211 System Configuration

- **Test System Name**: the name of the current test system, which will appear in the test report.
- **Test System Description**: Enter the description of the current test system.
- **Test System Icon**: You can change the icon of the test system. All major image file types are supported.
- **Import Test System**: You can load the test system from an externl file.
- **Export Test System**: You can export the whole test system to an external file.
- **Create New Test System**: This will delete everything in the current test system and create an empty one for you to configure.
- **Test System Directory**: You can open the test system directory.

1.23.5 DUT Configuration

You can create, edit or delete DUTs (Device Under Test) in the test system, assign photos to DUT, assign part number if DUT is a device in EOL test, add any information to the DUT which will be represented in test reports.

Note: users with “User” privilege can only modify “Part Number” in the DUT configuration.



DUT Selection: TC1005

Part Number: PN54321

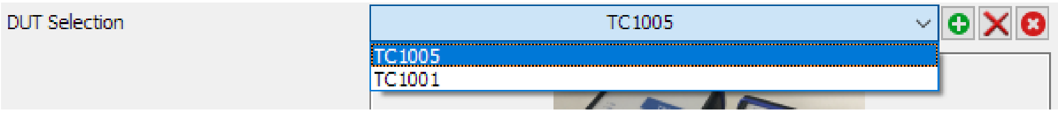
Information List:

Name	Value
Manufacturer Name	TOSUN
Manufacturer Address	No. 4801 CaoAn Road
Version Number	V1.1

Fig 212 DUT Configuration

- **DUT Selector**

You can select the DUT you want to test in the list.



DUT Selection: TC1005

TC1005
TC1001

Fig 213 DUT selector

If you want to add new DUT into the list, please click the add button ⊕ and assign a name to the new DUT.

If you want to delete the current DUT from the list, please click the delete button ✕ so that the current DUT information will be removed.

If you want to clear all DUTs from the list, please click the delete all button ⊗.

- **Part Number**

You can assign a part number to the current DUT, this result in the auto generated test result folder has a name suffix for you to identify, such as:

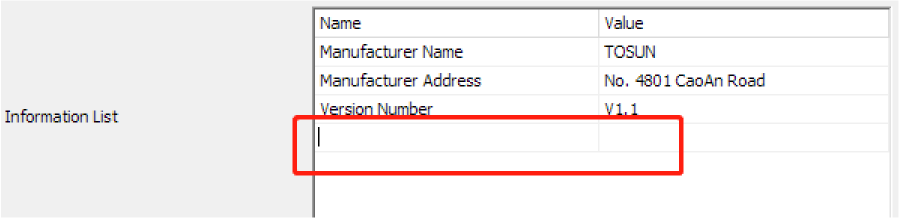
\TestResults\CAN_Test_System_Demo\TC1005_PN54321

Part Number: PN54321

Fig 214 DUT part number

Information List

You can add, delete, insert information into the information list. Press “Down” key on the bottom line of the list to add a new item.

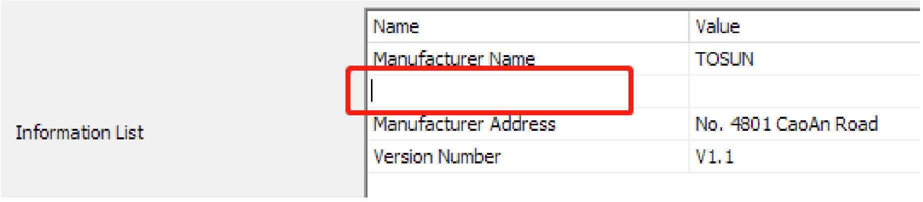


Information List

Name	Value
Manufacturer Name	TOSUN
Manufacturer Address	No. 4801 CaoAn Road
Version Number	V1.1
|	

Fig 215 Append a new item into the list

Or you can press “Insert” key on one of the line in the list to insert a new item before the selected line.



Information List

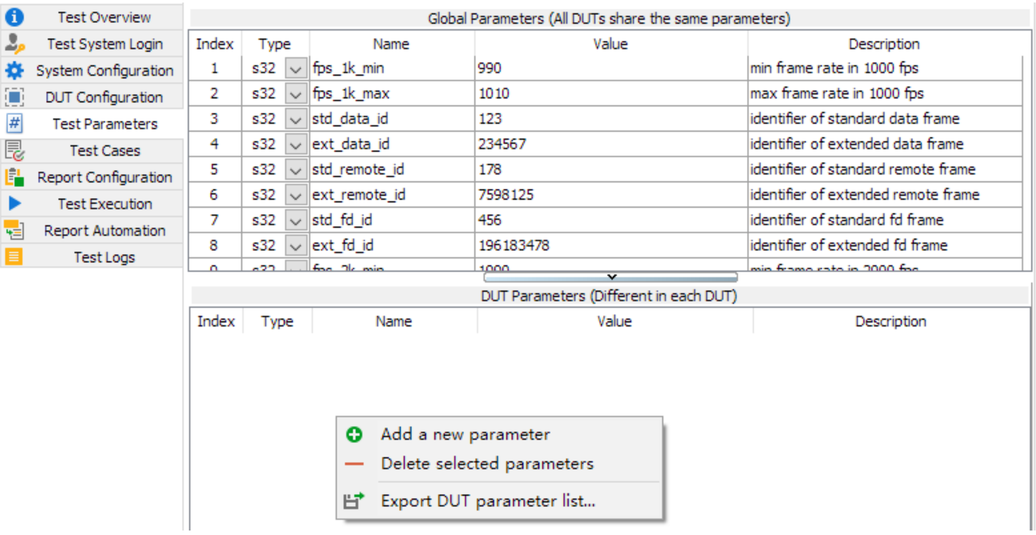
Name	Value
Manufacturer Name	TOSUN
|	
Manufacturer Address	No. 4801 CaoAn Road
Version Number	V1.1

Fig 216 Insert a new item

Or you can delete everything in a line to delete this information line.

1.23.6 Test Parameters

You can perform parameterised test in the test system by adding global parameters or DUT specific parameters in the “Test Parameters” list:



Global Parameters (All DUTs share the same parameters)

Index	Type	Name	Value	Description
1	s32	fps_1k_min	990	min frame rate in 1000 fps
2	s32	fps_1k_max	1010	max frame rate in 1000 fps
3	s32	std_data_id	123	identifier of standard data frame
4	s32	ext_data_id	234567	identifier of extended data frame
5	s32	std_remote_id	178	identifier of standard remote frame
6	s32	ext_remote_id	7598125	identifier of extended remote frame
7	s32	std_fd_id	456	identifier of standard fd frame
8	s32	ext_fd_id	196183478	identifier of extended fd frame
9	s32	fps_2k_min	1990	min frame rate in 2000 fps

DUT Parameters (Different in each DUT)

Index	Type	Name	Value	Description

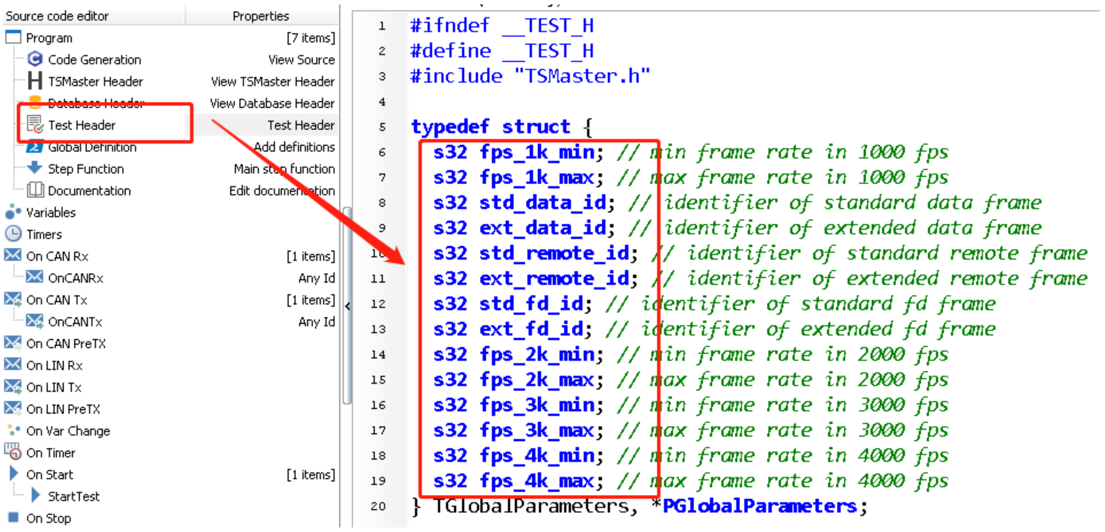
Fig 217 Test Parameters

A parameter supports the following data types:

- u8: unsigned char, 8 bits
- s8: signed char, 8 bits
- u16: unsigned word, 16 bits
- s16: signed word, 16 bits
- u32: unsigned integer, 32 bits
- s32: signed integer, 32 bits
- u64: unsigned long integer, 64 bits
- s64: signed long integer, 64 bits
- float: IEEE float, 32 bits
- double: IEEE float, 64 bits
- string: char array with terminator char “\0”
- TCAN: CAN data structure defined in mini program in “TSMaster.h”
- TCANFD: CAN FD data structure defined in mini program in “TSMaster.h”
- TLIN: LIN data structure defined in mini program in “TSMaster.h”

Please fill “Name”, “Value” and “Description” value after a new parameter is defined, as they may appear in the generated test code. The “Name” should strictly follow any C identifier’s rule.

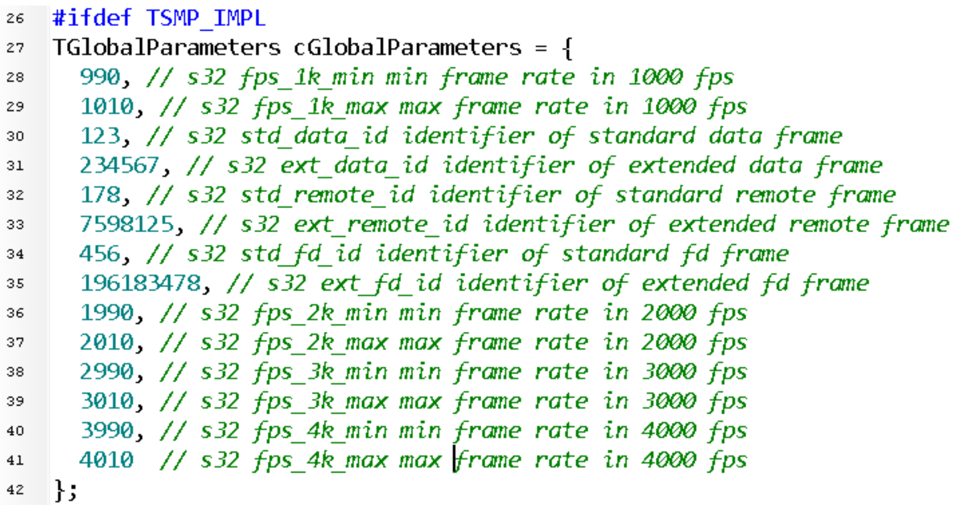
After you open any of the test cases in test system, you can find the parameters you previously defined in the “Test Header”. For example, if you define a couple of test parameters in “Global Parameters”, all these parameters are visible and are the same in all DUTs:



```
#ifndef __TEST_H
#define __TEST_H
#include "TSMaster.h"

typedef struct {
  s32 fps_1k_min; // min frame rate in 1000 fps
  s32 fps_1k_max; // max frame rate in 1000 fps
  s32 std_data_id; // identifier of standard data frame
  s32 ext_data_id; // identifier of extended data frame
  s32 std_remote_id; // identifier of standard remote frame
  s32 ext_remote_id; // identifier of extended remote frame
  s32 std_fd_id; // identifier of standard fd frame
  s32 ext_fd_id; // identifier of extended fd frame
  s32 fps_2k_min; // min frame rate in 2000 fps
  s32 fps_2k_max; // max frame rate in 2000 fps
  s32 fps_3k_min; // min frame rate in 3000 fps
  s32 fps_3k_max; // max frame rate in 3000 fps
  s32 fps_4k_min; // min frame rate in 4000 fps
  s32 fps_4k_max; // max frame rate in 4000 fps
} TGlobalParameters, *PGlobalParameters;
```

Fig 218 Auto generated parameter definitions

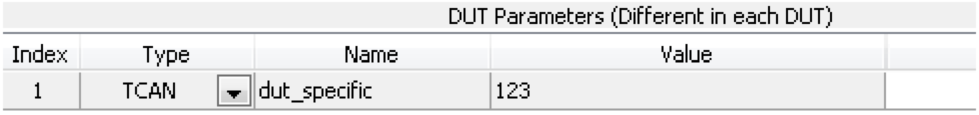
And you can also find the constant values of the parameters after the record definition:



```
#ifdef TSMP_IMPL
TGlobalParameters cGlobalParameters = {
  990, // s32 fps_1k_min min frame rate in 1000 fps
  1010, // s32 fps_1k_max max frame rate in 1000 fps
  123, // s32 std_data_id identifier of standard data frame
  234567, // s32 ext_data_id identifier of extended data frame
  178, // s32 std_remote_id identifier of standard remote frame
  7598125, // s32 ext_remote_id identifier of extended remote frame
  456, // s32 std_fd_id identifier of standard fd frame
  196183478, // s32 ext_fd_id identifier of extended fd frame
  1990, // s32 fps_2k_min min frame rate in 2000 fps
  2010, // s32 fps_2k_max max frame rate in 2000 fps
  2990, // s32 fps_3k_min min frame rate in 3000 fps
  3010, // s32 fps_3k_max max frame rate in 3000 fps
  3990, // s32 fps_4k_min min frame rate in 4000 fps
  4010  // s32 fps_4k_max max frame rate in 4000 fps
};
```

Fig 219 Auto generated parameter value

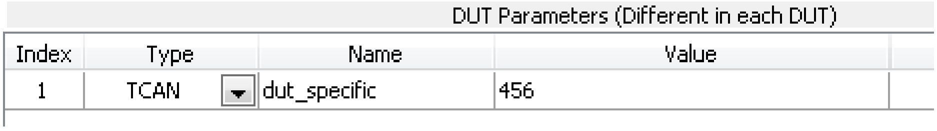
And If you specify a parameter in “DUT Parameters”, you can configure different values of such parameter in different DUT by switching “DUT Configuration”:



DUT Parameters (Different in each DUT)

Index	Type	Name	Value
1	TCAN	dut_specific	123

Fig 220 Parameter in DUT TC1001

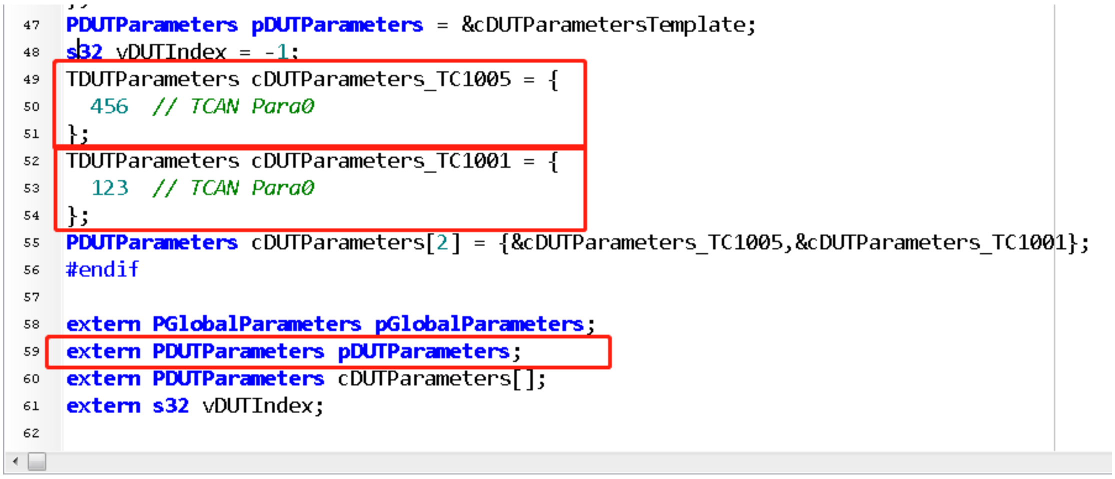


DUT Parameters (Different in each DUT)

Index	Type	Name	Value
1	TCAN	dut_specific	456

Fig 221 Parameter in DUT TC1005

After you re-open the test case in test system, you can find all the DUT specific parameters are defined with different value specified:



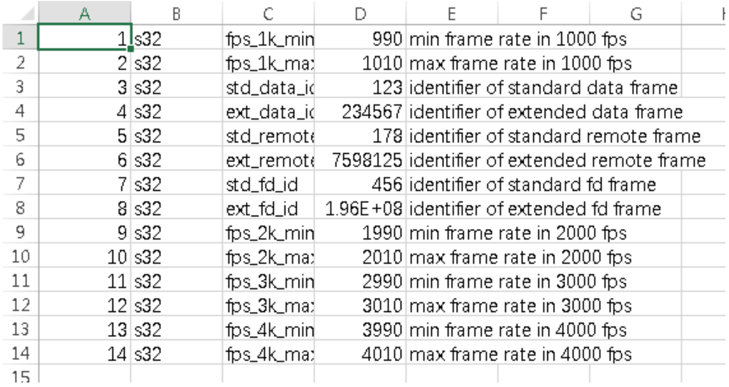
```
PDUTParameters pDUTParameters = &cDUTParametersTemplate;
s32 vDUTIndex = -1;
TDUTParameters cDUTParameters_TC1005 = {
  456  // TCAN Para0
};
TDUTParameters cDUTParameters_TC1001 = {
  123  // TCAN Para0
};
PDUTParameters cDUTParameters[2] = {&cDUTParameters_TC1005,&cDUTParameters_TC1001};
#endif

extern PGlobalParameters pGlobalParameters;
extern PDUTParameters pDUTParameters;
extern PDUTParameters cDUTParameters[];
extern s32 vDUTIndex;
```

Fig 222 DUT specific parameters definition

If you want to access “DUT global parameters” in mini program, just use the struct pointer “pGlobalParameters”

If you want to access “DUT specific parameters” in mini program, just use the struct pointer “pDUTParameters”

You can export the definitions of parameters into an external csv file:



	A	B	C	D	E	F	G	H
1	1	s32	fps_1k_min	990	min frame rate in 1000 fps			
2	2	s32	fps_1k_ma:	1010	max frame rate in 1000 fps			
3	3	s32	std_data_ic	123	identifier of standard data frame			
4	4	s32	ext_data_ic	234567	identifier of extended data frame			
5	5	s32	std_remote	178	identifier of standard remote frame			
6	6	s32	ext_remote	7598125	identifier of extended remote frame			
7	7	s32	std_fd_id	456	identifier of standard fd frame			
8	8	s32	ext_fd_id	1.96E+08	identifier of extended fd frame			
9	9	s32	fps_2k_min	1990	min frame rate in 2000 fps			
10	10	s32	fps_2k_ma:	2010	max frame rate in 2000 fps			
11	11	s32	fps_3k_min	2990	min frame rate in 3000 fps			
12	12	s32	fps_3k_ma:	3010	max frame rate in 3000 fps			
13	13	s32	fps_4k_min	3990	min frame rate in 4000 fps			
14	14	s32	fps_4k_ma:	4010	max frame rate in 4000 fps			
15								

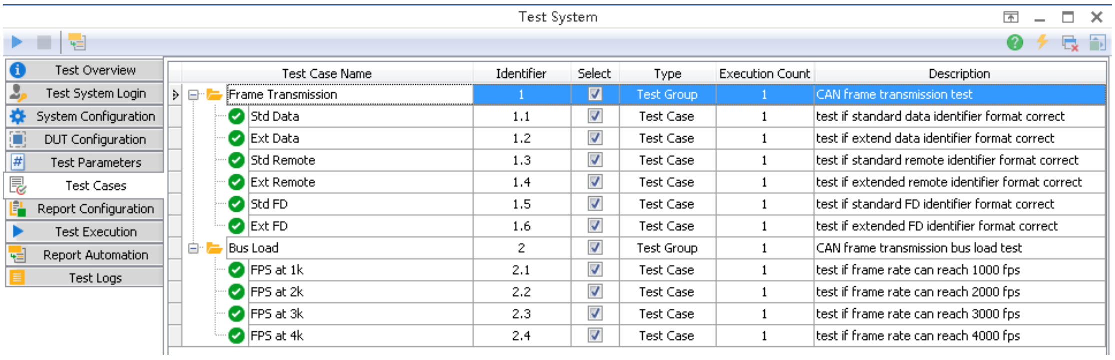
Fig 223 Exported parameters in csv file

1.23.7 Test Cases

1.23.7.1 Test Cases Interface

Test cases are listed in this interface, which also shows last results of each test case execution. “OK” results are marked green color and “NOK” results are marked red color.

You can add, edit, delete unlimited number of test cases in the “Test Cases” page:



Test Case Name	Identifier	Select	Type	Execution Count	Description
Frame Transmission	1	☑	Test Group	1	CAN frame transmission test
✓ Std Data	1.1	☑	Test Case	1	test if standard data identifier format correct
✓ Ext Data	1.2	☑	Test Case	1	test if extend data identifier format correct
✓ Std Remote	1.3	☑	Test Case	1	test if standard remote identifier format correct
✓ Ext Remote	1.4	☑	Test Case	1	test if extended remote identifier format correct
✓ Std FD	1.5	☑	Test Case	1	test if standard FD identifier format correct
✓ Ext FD	1.6	☑	Test Case	1	test if extended FD identifier format correct
Bus Load	2	☑	Test Group	1	CAN frame transmission bus load test
✓ FPS at 1k	2.1	☑	Test Case	1	test if frame rate can reach 1000 fps
✓ FPS at 2k	2.2	☑	Test Case	1	test if frame rate can reach 2000 fps
✓ FPS at 3k	2.3	☑	Test Case	1	test if frame rate can reach 3000 fps
✓ FPS at 4k	2.4	☑	Test Case	1	test if frame rate can reach 4000 fps

Fig 224 Test Cases

You can do any operation in the popup menu by right clicking on the test case list area.

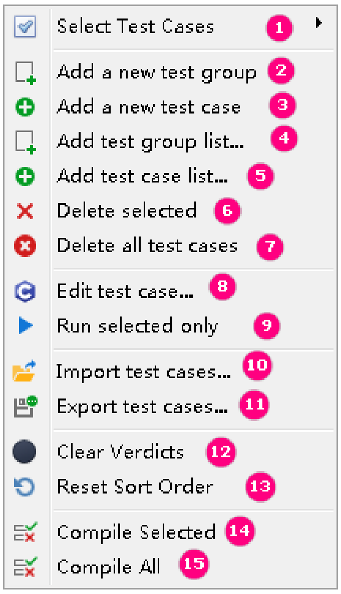


Fig 225 Test case popup menu

1. Select Test Cases

Select test cases popup menu item has a sub menu as shown below:

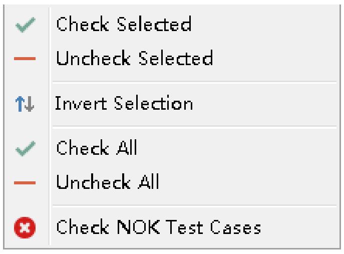


Fig 226 Select Test Cases sub menu

- **Check Selected**: Check all selected test cases that can be batched run in the test execution.
- **Uncheck Selected**: Uncheck all selected test cases that will not be run in the test execution.
- **Invert Selection**: Invert the checked states of test cases so that the previously checked test cases will not be executed but previously unchecked test cases will be executed.
- **Check All**: Check all test cases that can be batched run in the test execution.
- **Uncheck All**: Uncheck all test cases so that no test cases can be performed. If there are many test cases, you can uncheck all and then check the items you want to execute in some cases.

- **Check NOK Test Cases**: Check the test cases that are marked as “NOK”, this is useful for you to perform tests on failed items.

2. Add a new test group

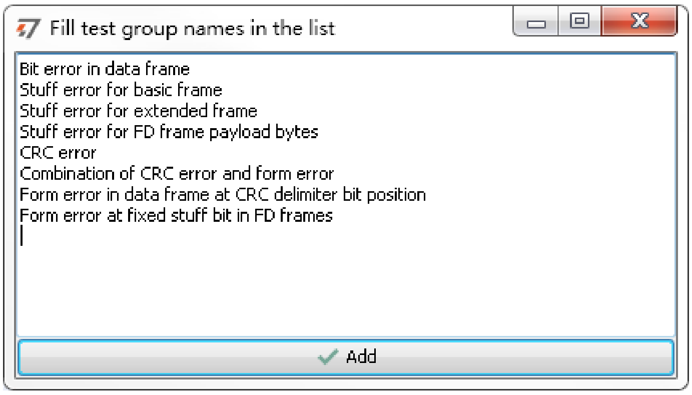
You can add an empty test group in the list, which may contain other test groups and test cases.

3. Add a new test case

You can add a new test case under any test group, but you cannot add it directly under another test case.

4. Add test group list…

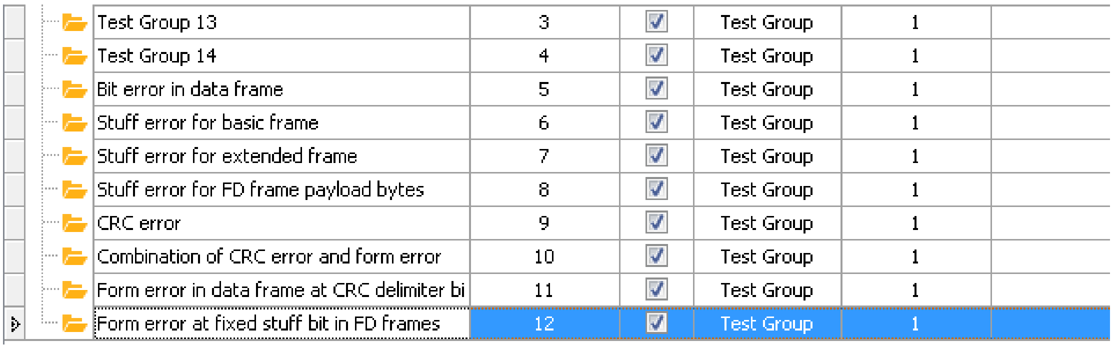
You can add a list of test groups with just one command:



Bit error in data frame
Stuff error for basic frame
Stuff error for extended frame
Stuff error for FD frame payload bytes
CRC error
Combination of CRC error and form error
Form error in data frame at CRC delimiter bit position
Form error at fixed stuff bit in FD frames

Fig 227 Add a list of test groups

Then you can add test cases into these newly added test groups:

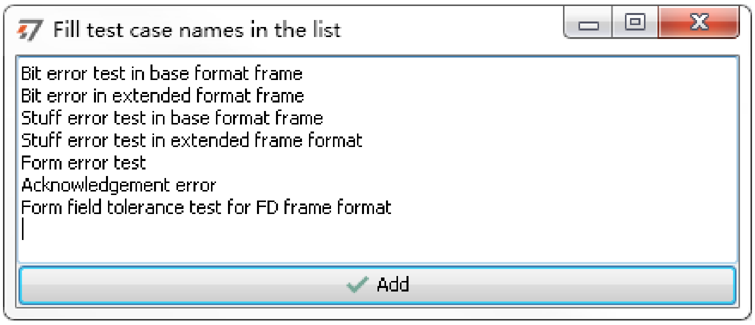


Test Group 13	3	☑	Test Group	1	
Test Group 14	4	☑	Test Group	1	
Bit error in data frame	5	☑	Test Group	1	
Stuff error for basic frame	6	☑	Test Group	1	
Stuff error for extended frame	7	☑	Test Group	1	
Stuff error for FD frame payload bytes	8	☑	Test Group	1	
CRC error	9	☑	Test Group	1	
Combination of CRC error and form error	10	☑	Test Group	1	
Form error in data frame at CRC delimiter bi	11	☑	Test Group	1	
Form error at fixed stuff bit in FD frames	12	☑	Test Group	1	

Fig 228 Added test groups

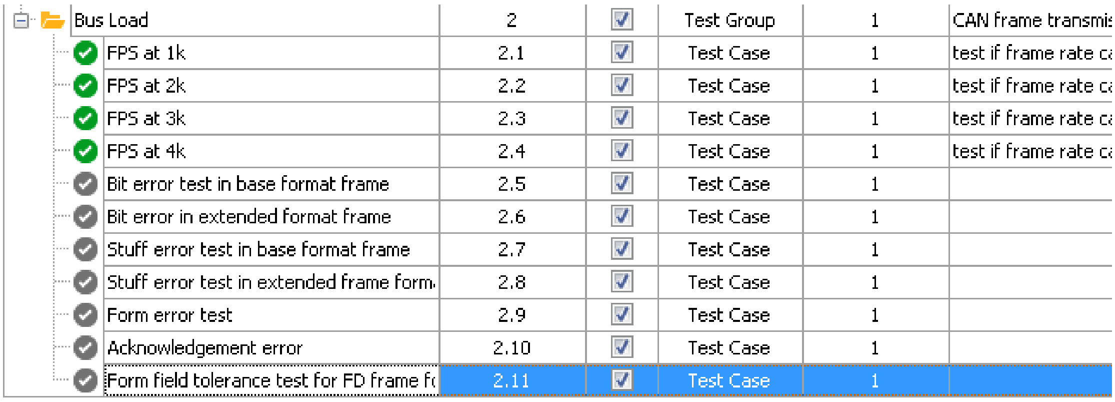
5. Add test case list…

You can add a list of test cases in the selected test group, or directly on the root:



Bit error test in base format frame
Bit error in extended format frame
Stuff error test in base format frame
Stuff error test in extended frame format
Form error test
Acknowledgement error
Form field tolerance test for FD frame format

Fig 229 Add a list of test cases



Bus Load	2	☑	Test Group	1	CAN frame transmis
FPS at 1k	2.1	☑	Test Case	1	test if frame rate ca
FPS at 2k	2.2	☑	Test Case	1	test if frame rate ca
FPS at 3k	2.3	☑	Test Case	1	test if frame rate ca
FPS at 4k	2.4	☑	Test Case	1	test if frame rate ca
Bit error test in base format frame	2.5	☑	Test Case	1	
Bit error in extended format frame	2.6	☑	Test Case	1	
Stuff error test in base format frame	2.7	☑	Test Case	1	
Stuff error test in extended frame form	2.8	☑	Test Case	1	
Form error test	2.9	☑	Test Case	1	
Acknowledgement error	2.10	☑	Test Case	1	
Form field tolerance test for FD frame fo	2.11	☑	Test Case	1	

Fig 230 Test cases added under the selected group

6. Delete Selected

Delete the selected test cases

7. Delete all test cases

Delete all the test cases in the list

8. Edit test case…

Open C code editor to edit the logic of the current selected test case

9. Run Selected Only

Run only the selected test case, this is useful if you do not want to execute other test cases.

10. Import test cases…

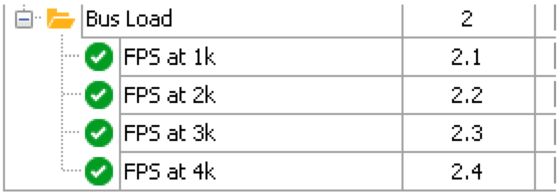
Import test cases from external configuration file.

11. Export test cases…

Export the current test case list to an external configuration file, which can be loaded by test system from another TSMaster.

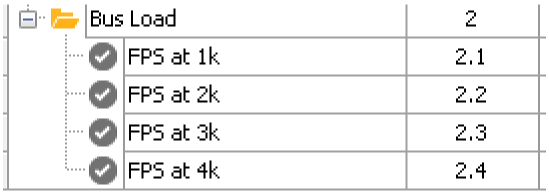
12. Clear Verdicts

To clear the test result verdicts:



Bus Load	2
✓ FPS at 1k	2.1
✓ FPS at 2k	2.2
✓ FPS at 3k	2.3
✓ FPS at 4k	2.4

Fig 231 Before verdicts are cleared



Bus Load	2
✓ FPS at 1k	2.1
✓ FPS at 2k	2.2
✓ FPS at 3k	2.3
✓ FPS at 4k	2.4

Fig 232 After verdicts are cleared

13. Reset sort order

To reset the ordering of test cases to initial state.

14. Compile Selected

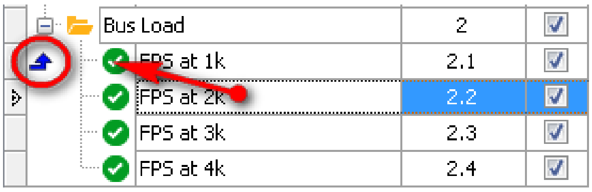
Compile the selected test cases. TSMaster mini programs (*.mp) files are generated, one test case one mp file. The test system will run on compiled mp files.

15. Compile All

Compile all test cases.

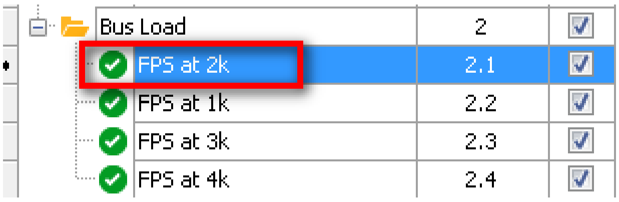
1.23.7.2 Ordering of test cases

You can use mouse to drag drop test cases or test groups to perform any ordering requirements.



Bus Load	2	☑
✓ FPS at 1k	2.1	☑
✓ FPS at 2k	2.2	☑
✓ FPS at 3k	2.3	☑
✓ FPS at 4k	2.4	☑

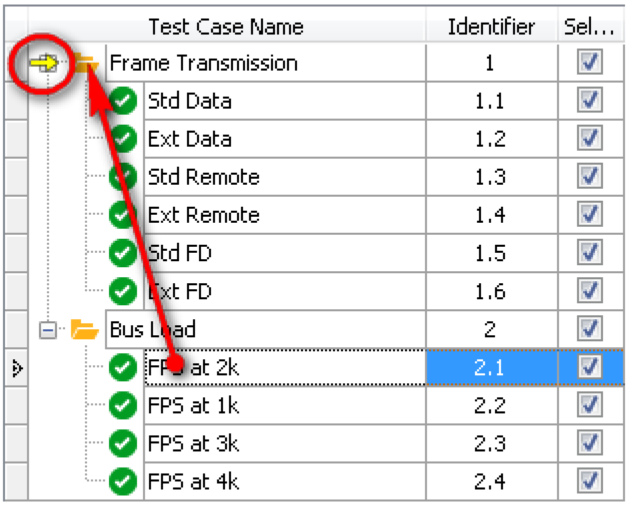
Fig 233 Before drop: drag an item "2.2" before "2.1"



Bus Load	2	☑
FPS at 2k	2.1	☑
FPS at 1k	2.2	☑
FPS at 3k	2.3	☑
FPS at 4k	2.4	☑

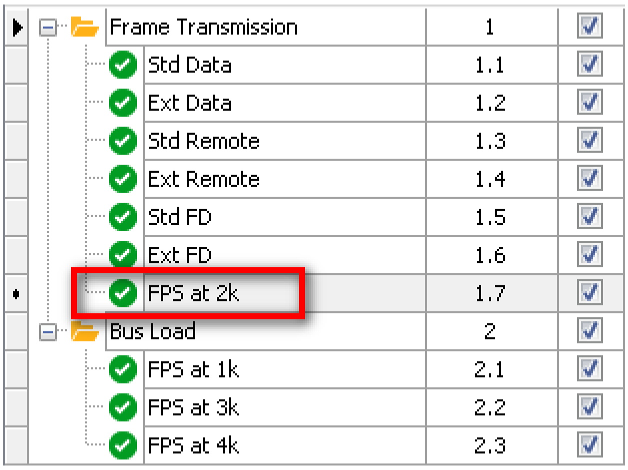
Fig 234 After drop: drag an item "2.2" before "2.1"

You can also drag a test case from one group and drop it in another group to append it at last.



Test Case Name	Identifier	Sel...
Frame Transmission	1	☑
Std Data	1.1	☑
Ext Data	1.2	☑
Std Remote	1.3	☑
Ext Remote	1.4	☑
Std FD	1.5	☑
Ext FD	1.6	☑
Bus Load	2	☑
FPS at 2k	2.1	☑
FPS at 1k	2.2	☑
FPS at 3k	2.3	☑
FPS at 4k	2.4	☑

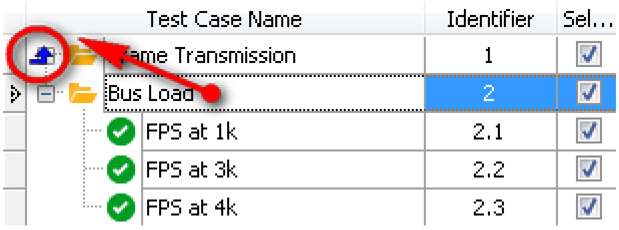
Fig 235 Drag a test case to another group: before append



Frame Transmission	1	☑
Std Data	1.1	☑
Ext Data	1.2	☑
Std Remote	1.3	☑
Ext Remote	1.4	☑
Std FD	1.5	☑
Ext FD	1.6	☑
FPS at 2k	1.7	☑
Bus Load	2	☑
FPS at 1k	2.1	☑
FPS at 3k	2.2	☑
FPS at 4k	2.3	☑

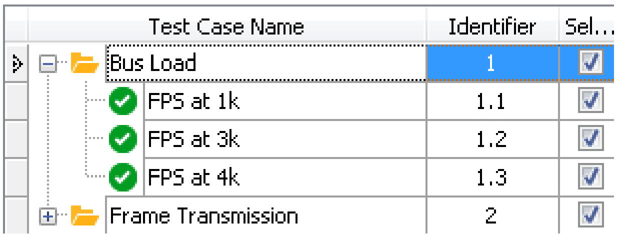
Fig 236 Drag a test case to another group: after append

If you want to move a group or a test case to the end, please move up the end node:



Test Case Name	Identifier	Sel...
ame Transmission	1	☑
Bus Load	2	☑
FPS at 1k	2.1	☑
FPS at 3k	2.2	☑
FPS at 4k	2.3	☑

Fig 237 To move "Frame Transmission" to end, you should move “Bus Load” upwards



Test Case Name	Identifier	Sel...
Bus Load	1	☑
FPS at 1k	1.1	☑
FPS at 3k	1.2	☑
FPS at 4k	1.3	☑
Frame Transmission	2	☑

Fig 238 After releasing mouse cursor, the "Frame Transmission" is at the bottom

1.23.7.3 Test Case List Column

The descriptions of each test case column is as follows:

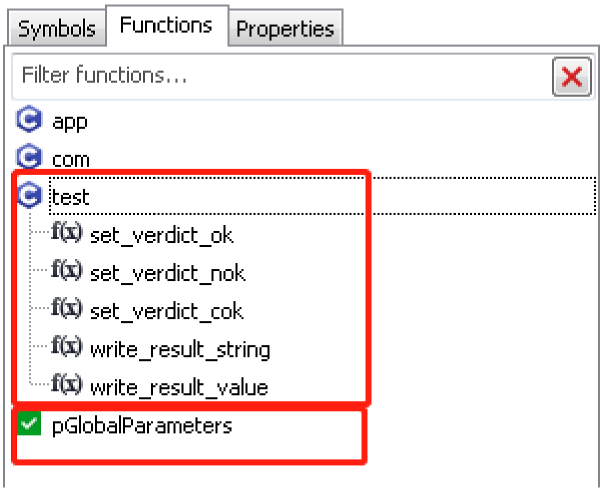
Table 5 Test Case List Columns

Column Name	Description
Test Case Name	You can edit the test group name or test case name here, which will become the name of its associated mini program.
Identifier	Unique identifier of test group or test case, which is named automatically by the ordering of the test cases. Note: this value is read only.
Select	Tick the checkbox to select the test case or group, which will be executed in the test run.
Type	Can be “Test Group” or “Test Case”. “Test Case” can be executed but can not contain other test cases or groups. “Test Group” is container only, which cannot be executed.
Execution Count	You can specify how many times this test case is executed, the default count is 1.

Description	You can write comments of any test case or test group here.

1.23.7.4 Test Case Code in Mini Program

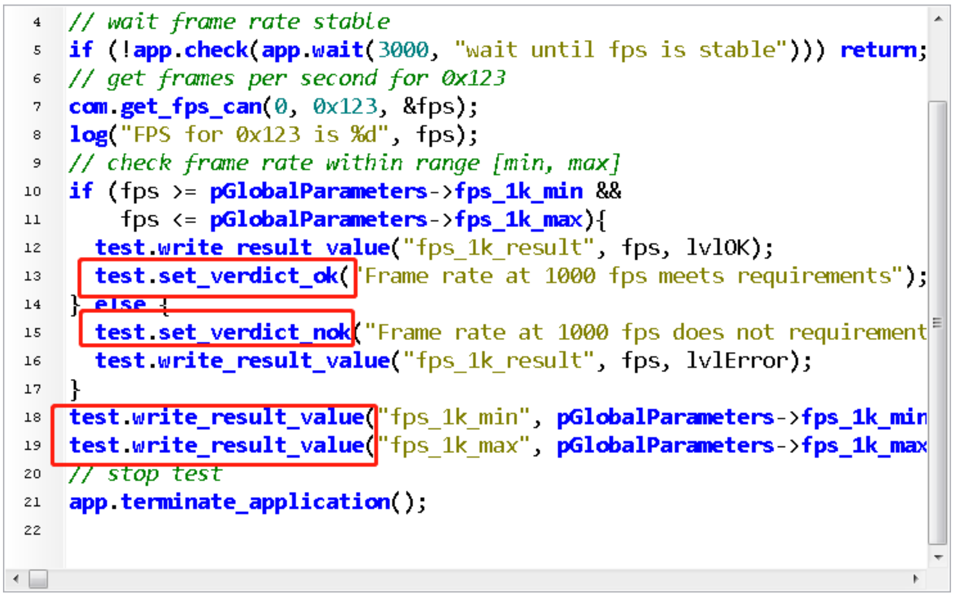
Test case is implemented in mini program, besides all available features of mini program engine, it can use additional “Test” features as described below:



- app
- com
- test
  - f(x) set_verdict_ok
  - f(x) set_verdict_nok
  - f(x) set_verdict_cok
  - f(x) write_result_string
  - f(x) write_result_value
- pGlobalParameters

Fig 239 Test case additional features

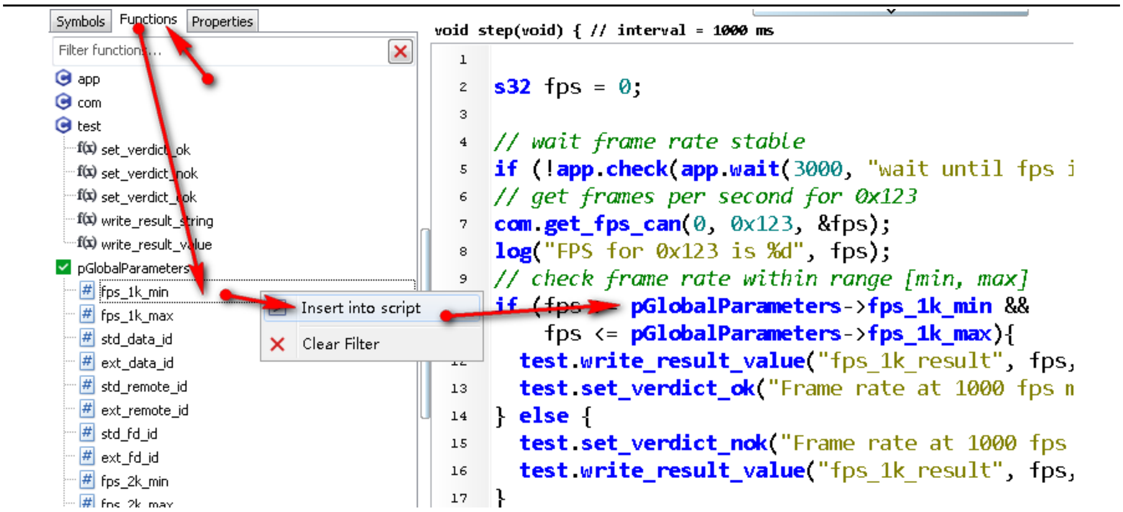
Test functions can be called within any test case to make verdicts or write test related outputs.



```
// wait frame rate stable
if (!app.check(app.wait(3000, "wait until fps is stable"))) return;
// get frames per second for 0x123
com.get_fps_can(0, 0x123, &fps);
log("FPS for 0x123 is %d", fps);
// check frame rate within range [min, max]
if (fps >= pGlobalParameters->fps_1k_min &&
    fps <= pGlobalParameters->fps_1k_max){
  test.write_result_value("fps_1k_result", fps, lvlOK);
  test.set_verdict_ok("Frame rate at 1000 fps meets requirements");
} else {
  test.set_verdict_nok("Frame rate at 1000 fps does not requirement
  test.write_result_value("fps_1k_result", fps, lvlError);
}
test.write_result_value("fps_1k_min", pGlobalParameters->fps_1k_min
test.write_result_value("fps_1k_max", pGlobalParameters->fps_1k_max
// stop test
app.terminate_application();
```

Fig 240 Test functions are available to test cases

Parameters can also be inserted easily into you test case:

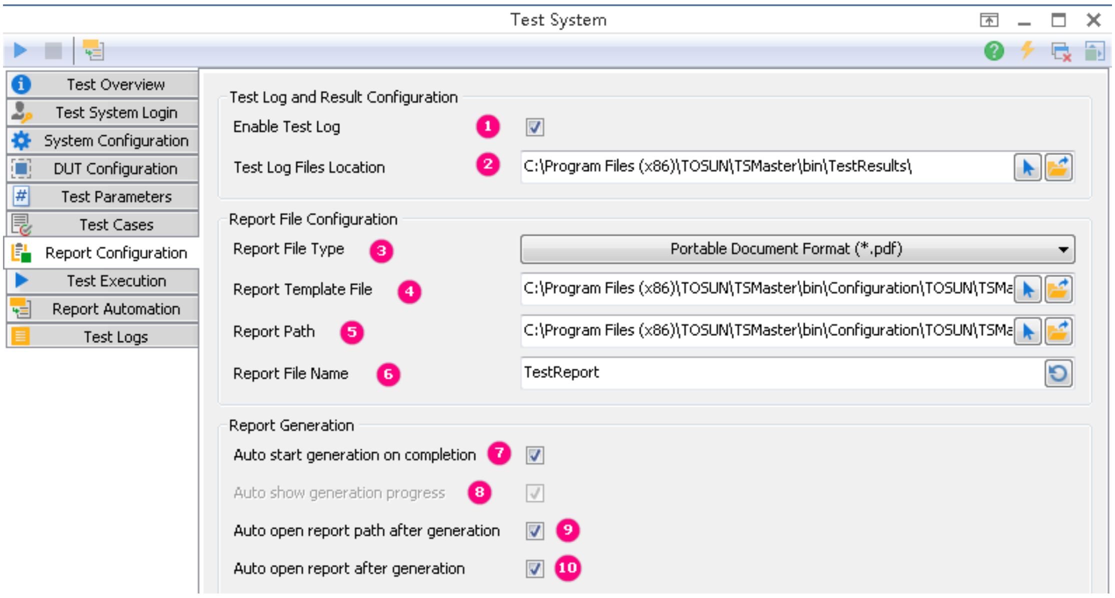


```
void step(void) { // interval = 1000 ms

s32 fps = 0;

// wait frame rate stable
if (!app.check(app.wait(3000, "wait until fps i
// get frames per second for 0x123
com.get_fps_can(0, 0x123, &fps);
log("FPS for 0x123 is %d", fps);
// check frame rate within range [min, max]
if (fps >= pGlobalParameters->fps_1k_min &&
    fps <= pGlobalParameters->fps_1k_max){
  test.write_result_value("fps_1k_result", fps,
  test.set_verdict_ok("Frame rate at 1000 fps n
} else {
  test.set_verdict_nok("Frame rate at 1000 fps
  test.write_result_value("fps_1k_result", fps,
}
```

Fig 241 Test parameters can be inserted easily

1.23.8 Report Configuration

You can configure how to generate your own test report in this section:



Test Log and Result Configuration

Enable Test Log ☑

Test Log Files Location C:\Program Files (x86)\TOSUN\TSMaster\bin\TestResults\

Report File Configuration

Report File Type Portable Document Format (*.pdf)

Report Template File C:\Program Files (x86)\TOSUN\TSMaster\bin\Configuration\TOSUN\TSMa

Report Path C:\Program Files (x86)\TOSUN\TSMaster\bin\Configuration\TOSUN\TSMa

Report File Name TestReport

Report Generation

Auto start generation on completion ☑

Auto show generation progress ☑

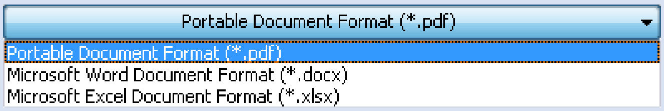
Auto open report path after generation ☑

Auto open report after generation ☑

Fig 242 Report Configuration

Table 6 Report Configuration Description

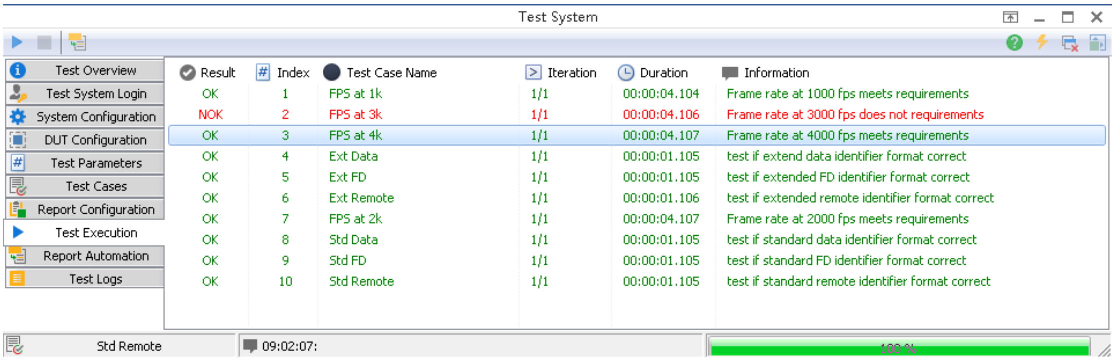
Item Name	Description
Enable Test Log	Test reports are generated based on test logs, you must first enable test log in order to generate reports.
Test Log Files Location	You can specify a location to save test logs.

	Use the left pointer button to specify a new location for the test reports, and use the right folder button to open the folder you specified.
Report File Type	Can be “pdf”, “word” and “excel”  Portable Document Format (*.pdf) Portable Document Format (*.pdf) Microsoft Word Document Format (*.docx) Microsoft Excel Document Format (*.xlsx)
Report Template File	You can specify a location for the report template file, which is used for the generation of each test report.
Report Path	You can specify the path storing the final test report. TSMaster report automation engine will automatically store the test report under this directory.
Report File Name	You can specify the file name of your final report here.
Auto start generation on completion	Tick this check box to allow automatic report generation after all test executions are completed.
Auto show generation progress	Tick this check box to allow automation Interfaces (Word or Excel) display their working progress on your desktop.
Auto open report path after generation	Tick this check box to automatically open the report directory after the test report is generated.
Auto open report after generation	Tick this check box to automatically open the report after its has been generated.

You have to configure this setting before you use the “Report Automation”.

1.23.9 Test Execution

The test execution page provides a real-time monitor for each test case being executed. The passed test cases will be marked green color and the failed test cases will be marked red color. During the execution of one test case, the real-time log information will be displayed and updated in “Information” column.



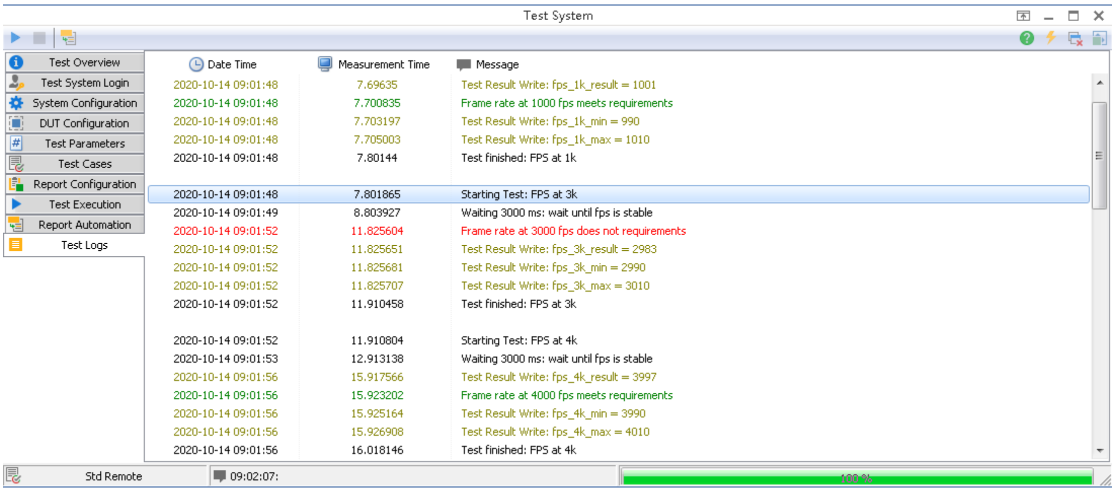
Result	Index	Test Case Name	Iteration	Duration	Information
OK	1	FPS at 1k	1/1	00:00:04.104	Frame rate at 1000 fps meets requirements
NOK	2	FPS at 3k	1/1	00:00:04.106	Frame rate at 3000 fps does not requirements
OK	3	FPS at 4k	1/1	00:00:04.107	Frame rate at 4000 fps meets requirements
OK	4	Ext Data	1/1	00:00:01.105	test if extend data identifier format correct
OK	5	Ext FD	1/1	00:00:01.105	test if extended FD identifier format correct
OK	6	Ext Remote	1/1	00:00:01.106	test if extended remote identifier format correct
OK	7	FPS at 2k	1/1	00:00:04.107	Frame rate at 2000 fps meets requirements
OK	8	Std Data	1/1	00:00:01.105	test if standard data identifier format correct
OK	9	Std FD	1/1	00:00:01.105	test if standard FD identifier format correct
OK	10	Std Remote	1/1	00:00:01.105	test if standard remote identifier format correct

Fig 243 Test Execution

1.23.10 Test Logs

Test logs displays the log information output from mini program using the "test" APIs and the following log APIs:

- test_log
- test_log_ok
- test_log_nok
- test_logCAN



```
Date Time             Measurement Time   Message
2020-10-14 09:01:48   7.69635            Test Result Write: fps_1k_result = 1001
2020-10-14 09:01:48   7.700835           Frame rate at 1000 fps meets requirements
2020-10-14 09:01:48   7.703197           Test Result Write: fps_1k_min = 990
2020-10-14 09:01:48   7.705003           Test Result Write: fps_1k_max = 1010
2020-10-14 09:01:48   7.80144            Test finished: FPS at 1k

2020-10-14 09:01:48   7.801865           Starting Test: FPS at 3k
2020-10-14 09:01:49   8.803927           Waiting 3000 ms: wait until fps is stable
2020-10-14 09:01:52   11.825604          Frame rate at 3000 fps does not requirements
2020-10-14 09:01:52   11.825651          Test Result Write: fps_3k_result = 2983
2020-10-14 09:01:52   11.825681          Test Result Write: fps_3k_min = 2990
2020-10-14 09:01:52   11.825707          Test Result Write: fps_3k_max = 3010
2020-10-14 09:01:52   11.910458          Test finished: FPS at 3k

2020-10-14 09:01:52   11.910804          Starting Test: FPS at 4k
2020-10-14 09:01:53   12.913138          Waiting 3000 ms: wait until fps is stable
2020-10-14 09:01:56   15.917566          Test Result Write: fps_4k_result = 3997
2020-10-14 09:01:56   15.923202          Frame rate at 4000 fps meets requirements
2020-10-14 09:01:56   15.925164          Test Result Write: fps_4k_min = 3990
2020-10-14 09:01:56   15.926908          Test Result Write: fps_4k_max = 4010
2020-10-14 09:01:56   16.018146          Test finished: FPS at 4k
```

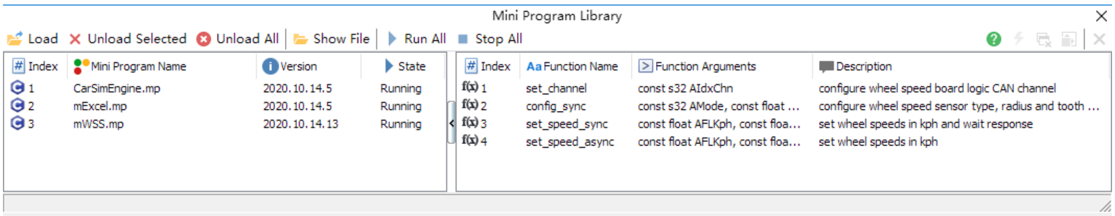
Fig 244 Test Logs

1.24 Mini Program Library

1.24.1 Mini Program Library Concept

Mini program library helps you to manage reuseable executable packages in your TSMaster mini program environment. A mini program will become a library when it is loaded by the “Mini Program Library”, it will stay in background providing the following features:

- All step functions, message callbacks or key events of this mini program can be executed in background for automation:

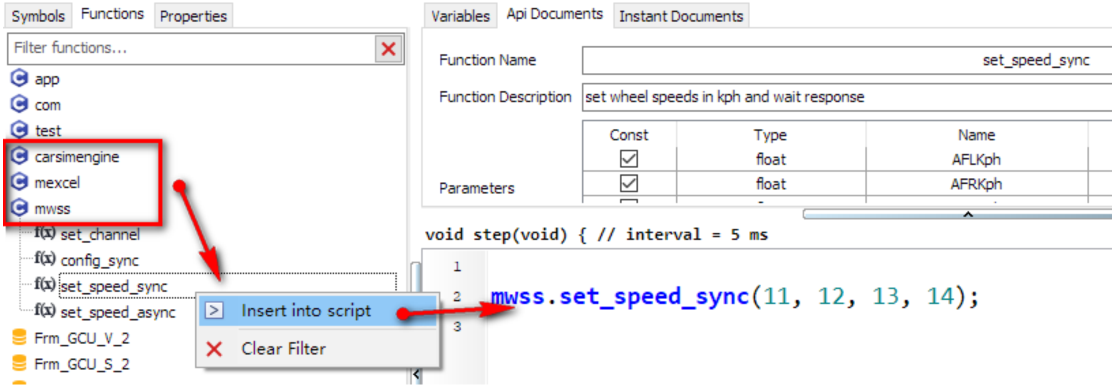


Index	Mini Program Name	Version	State
1	CarSimEngine.mp	2020. 10. 14. 5	Running
2	mExcel.mp	2020. 10. 14. 5	Running
3	mWSS.mp	2020. 10. 14. 13	Running

Index	Function Name	Function Arguments	Description
f(x) 1	set_channel	const s32 AIdxChn	configure wheel speed board logic CAN channel
f(x) 2	config_sync	const s32 AMode, const float ...	configure wheel speed sensor type, radius and tooth ...
f(x) 3	set_speed_sync	const float AFLKph, const floa...	set wheel speeds in kph and wait response
f(x) 4	set_speed_async	const float AFLKph, const floa...	set wheel speeds in kph

Fig 245 Mini program library running in background

- Custom functions of this mini program can be used by other mini programs as their function library providers:



Function Name: set_speed_sync

Function Description: set wheel speeds in kph and wait response

Parameters

Const	Type	Name
☑	float	AFLKph
☑	float	AFRKph

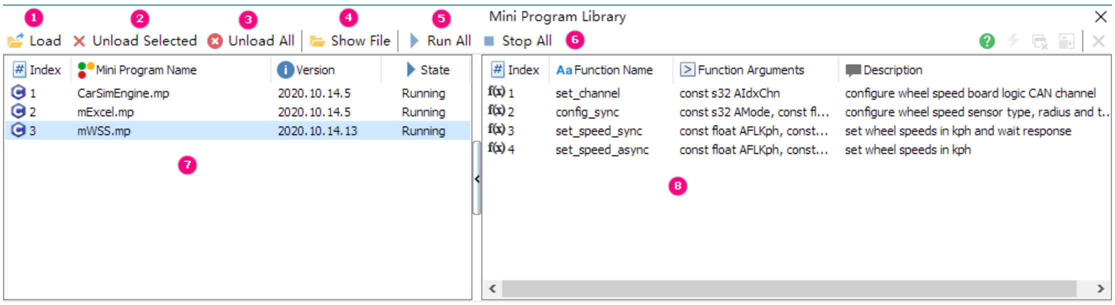
```
void step(void) { // interval = 5 ms

mwss.set_speed_sync(11, 12, 13, 14);

```

Fig 246 Mini program library as function providers for other mini programs

With the help of mini program library, modular design of test automation or simulation logics can be realized.

1.24.2 Mini Program Library User Interface

Mini program library user interface is described below:



Index	Mini Program Name	Version	State
1	CarSimEngine.mp	2020.10.14.5	Running
2	mExcel.mp	2020.10.14.5	Running
3	mWSS.mp	2020.10.14.13	Running

Index	Function Name	Function Arguments	Description
1	set_channel	const s32 AIdxChn	configure wheel speed board logic CAN channel
2	config_sync	const s32 AMode, const fl...	configure wheel speed sensor type, radius and t..
3	set_speed_sync	const float AFLKph, const...	set wheel speeds in kph and wait response
4	set_speed_async	const float AFLKph, const...	set wheel speeds in kph

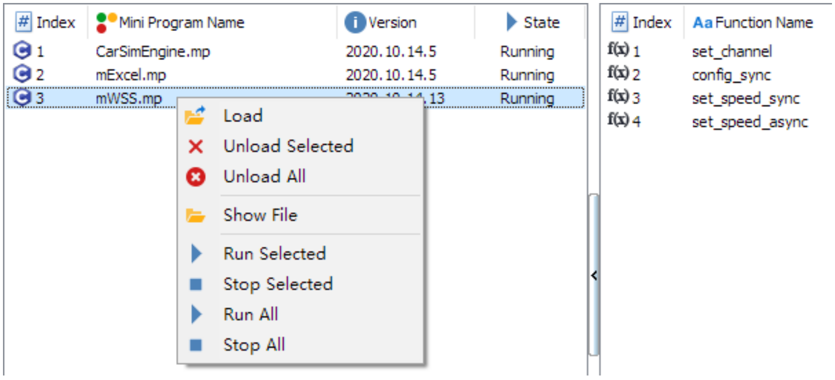
Fig 247 Mini program library user interface

Table 7 Mini program library user interface description

Index	Element	Description
1	Load	To load a mini program (*.mp) or (*.dll) in the library
2	Unload Selected	Unload the selected mini program library from the list
3	Unload All	Unload all the mini program libraries
4	Show File	Open the directory containing the selected mini program
5	Run All	Run all the mini program in background, after mini program is running, its step function, message callbacks and key events are working as they are executed in C code editor
6	Stop All	Stop the execution of all the mini programs
7	Library file area	This list shows all the loaded mini program with their names, version and running state displayed
8	Library function list	This list shows all the custom functions provided by the selected mini program. These functions can be used in any of your mini program in C code editor

1.24.3 Mini Program Library Popup Menu

When you right click on the library file area, you can see the following popup menu appears:



Index	Mini Program Name	Version	State
1	CarSimEngine.mp	2020.10.14.5	Running
2	mExcel.mp	2020.10.14.5	Running
3	mWSS.mp	2020.10.14.13	Running

Index	Function Name
1	set_channel
2	config_sync
3	set_speed_sync
4	set_speed_async

Fig 248 Mini program library popup menu

Besides the same items appear in toolbars, you can run or stop selected mini programs separately by using “Run Selected” and “Stop Selected” if you do not want to run or stop all the mini program libraries in the list.

1.25 Diagnostics

TODO: coming soon…

1.26 Calibration

1.26.1 Calibration Introduction

1.26.2 Calibration Data Types

Calibration data types are summarized in the following table:

Table 8 Calibration data types

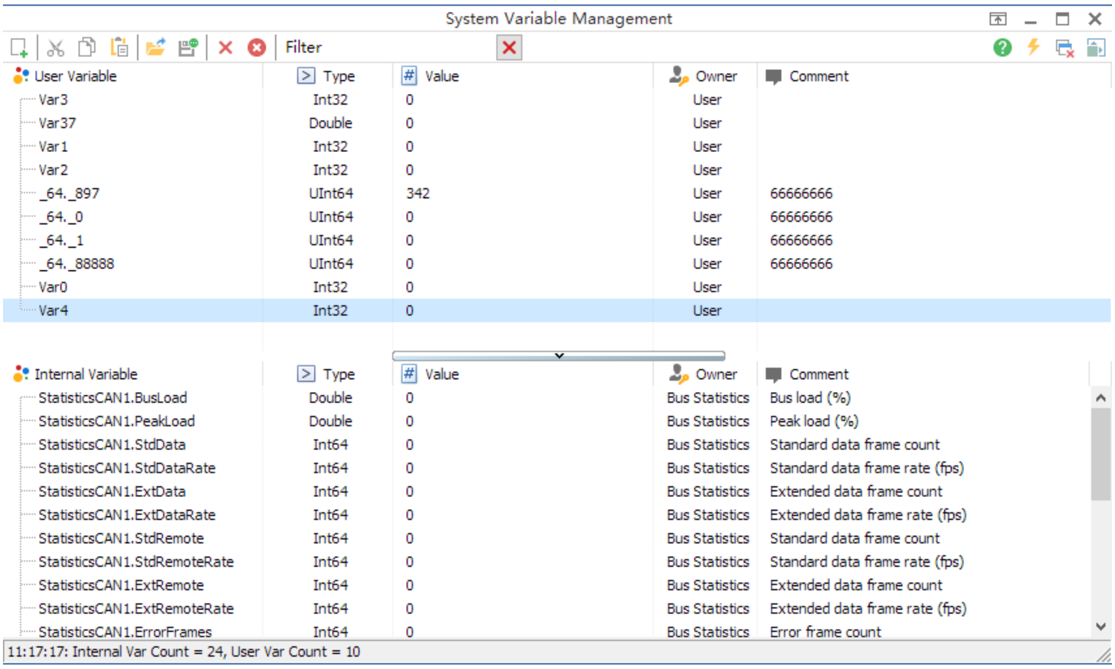
Icon	Description
	Normal measurement variable, read only
	Read/Write measurement variable
	Virtual measurement variable

▦	Array variable
—●	Characteristic variable
📈	Curve variable
🗺	Map variable
Aa	ASCII variable
∟	Axis points

1.27 System Variable Manager

1.27.1 System Variable Manager Introduction

All system variables (user defined or internal variables) are listed in “System Variable Manager”, you can use this manager to view, edit, or select specific system variables in measurement windows.



User Variable	Type	Value	Owner	Comment
Var3	Int32	0	User	
Var37	Double	0	User	
Var1	Int32	0	User	
Var2	Int32	0	User	
_64._897	UInt64	342	User	66666666
_64._0	UInt64	0	User	66666666
_64._1	UInt64	0	User	66666666
_64._88888	UInt64	0	User	66666666
Var0	Int32	0	User	
Var4	Int32	0	User	

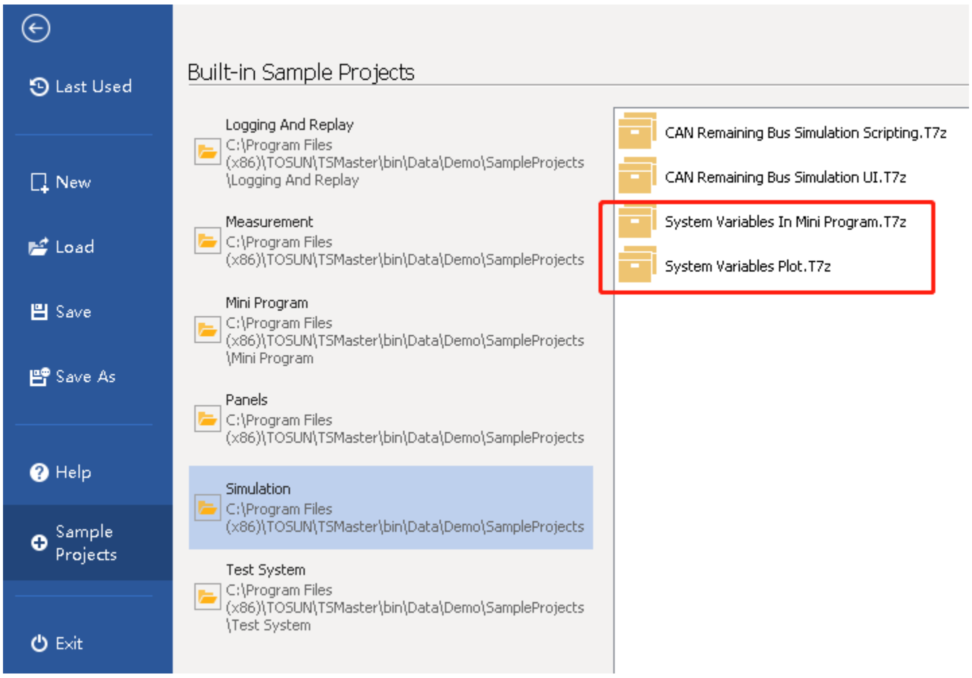
Internal Variable	Type	Value	Owner	Comment
StatisticsCAN1.BusLoad	Double	0	Bus Statistics	Bus load (%)
StatisticsCAN1.PeakLoad	Double	0	Bus Statistics	Peak load (%)
StatisticsCAN1.StdData	Int64	0	Bus Statistics	Standard data frame count
StatisticsCAN1.StdDataRate	Int64	0	Bus Statistics	Standard data frame rate (fps)
StatisticsCAN1.ExtData	Int64	0	Bus Statistics	Extended data frame count
StatisticsCAN1.ExtDataRate	Int64	0	Bus Statistics	Extended data frame rate (fps)
StatisticsCAN1.StdRemote	Int64	0	Bus Statistics	Standard data frame count
StatisticsCAN1.StdRemoteRate	Int64	0	Bus Statistics	Standard data frame rate (fps)
StatisticsCAN1.ExtRemote	Int64	0	Bus Statistics	Extended data frame count
StatisticsCAN1.ExtRemoteRate	Int64	0	Bus Statistics	Extended data frame rate (fps)
StatisticsCAN1.ErrorFrames	Int64	0	Bus Statistics	Error frame count

11:17:17: Internal Var Count = 24, User Var Count = 10

Fig 249 System Variable Manager

Please refer to TSMaster example “System Variables In Mini Program.T7z” and

“System Variables Plot.T7z”:



Built-in Sample Projects

Logging And Replay
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Logging And Replay

Measurement
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Mini Program
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Mini Program

Panels
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Simulation
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Test System
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Test System

CAN Remaining Bus Simulation Scripting.T7z

CAN Remaining Bus Simulation UI.T7z

System Variables In Mini Program.T7z

System Variables Plot.T7z

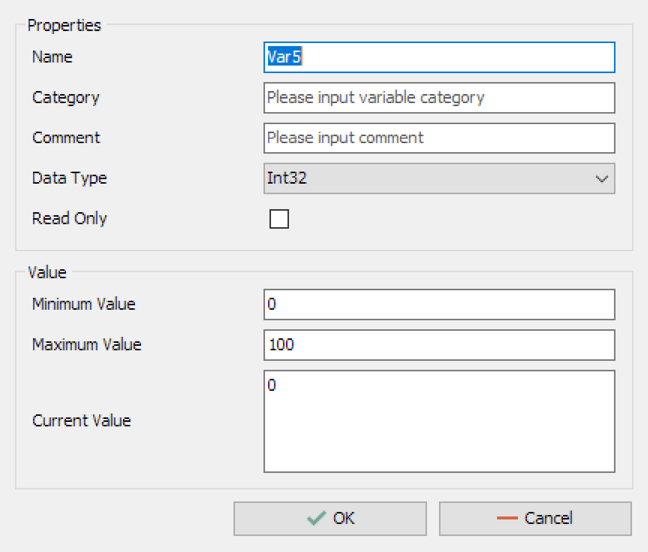
Fig 250 System Variables Management

1.27.2 Toolbar of System Variable Manager

The items in system variable manager toolbar are listed below:

Note: all these toolbar buttons operate only on user variables, and internal variables are not affected.

□ Create a new system variable in user list. This will create a auto-renamed system variable and popup an system variable editor for you to edit its properties.



Properties

Name: Var5

Category: Please input variable category

Comment: Please input comment

Data Type: Int32

Read Only □

Value

Minimum Value: 0

Maximum Value: 100

Current Value: 0

Fig 251 System variable editor

The items in the system variable editor are described below:

Table 9 System variable editor description

Item	Description
Name	The name of the system variable under its category as described below.
Category	The category of the system variable. Together with the name forms the complete name of the system variable. For example: *Name = name1* *Category = cat1* The complete name of this system variable is “cat1.name1”, and this complete name must be unique in all the system variable list.
Comment	You can write comments for the current system variable.
Data Type	All the supported data types are listed below, you can pick one of them in the combo box: ■ Int32 ■ UInt32 ■ Int64 ■ UInt64

	■ UInt8 Array ■ Int32 Array ■ Int64 Array ■ Double ■ Double Array ■ String
Read Only	Whether this variable is read only
Minimum Value	The minimum value of this variable if it is not array type
Maximum Value	The maximum value of this variable if it is not array type
Current Value	The current value of this variable in text You can modify the system variable value here by directly typing the value representation

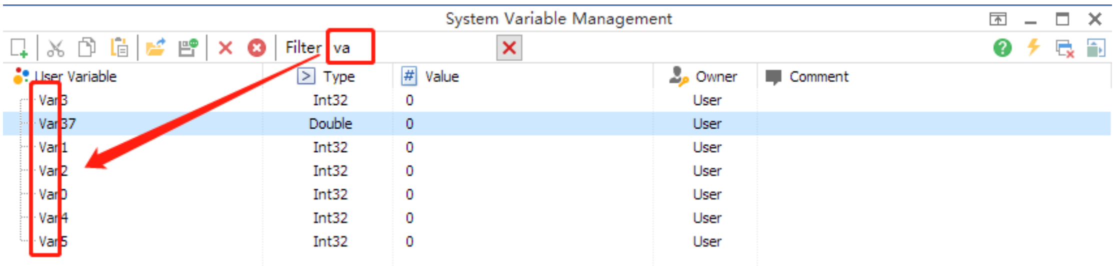
Cut, Copy and Paste buttons. You can select on or multiple system variables and use these buttons to cut, copy or paste variables freely. Note: if the complete name of the pasted variable is the same with existing one, it will be automatically renamed to keep name uniqueness.

Import and Export buttons. You can import system variable list from external files, or export them to external files, which can be loaded by another TSMaster application.

Delete and Delete All buttons. Use these buttons to delete selected system variables, or to delete all of them.

Filter of all the system variables by any field: variable name, type, value, owner and comment.

While typing, the user list and internal list will be filtered to display variables that only contain the typed string in any field.



System Variable Management

Filter va

User Variable	Type	Value	Owner	Comment
Var3	Int32	0	User	
Var37	Double	0	User	
Var1	Int32	0	User	
Var2	Int32	0	User	
Var0	Int32	0	User	
Var4	Int32	0	User	
Var5	Int32	0	User	

Fig 252 Filtering of System Variables

1.27.3 Popup Menu of System Variables

If you right click on the user list, you can see the following popup menu appears:

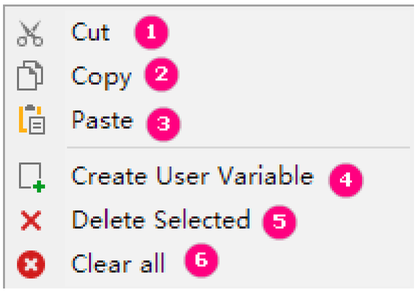


Fig 253 System Variables popup menu

1. Cut: Cut the selected user variables into clipboard
2. Copy: Copy the selected user variables into clipboard
3. Paste: Paste the selected user variables from clipboard in the user list
4. Create User Variable: Create a new user variable in the user list
5. Delete Selected: Delete the selected user variables from the user list
6. Clear All: Delete all the user variables

1.27.4 Working with System Variables

Please always use the complete name to identify any system variable. For example, if a system variable name is “Var1”, with its category named “Cat1”, please use “Cat1.Var1” to globally identify this system variable, since this complete name is unique in TSMaster.

1.28 Measurement Setup

Measurement Setup displays the data flow from data source to each measurement window. Apart from “Data Source”, each measurement window represents a node in the measurement setup. You can use drag and drop feature of this treeview to parameterize the measurement filter for data reduction.

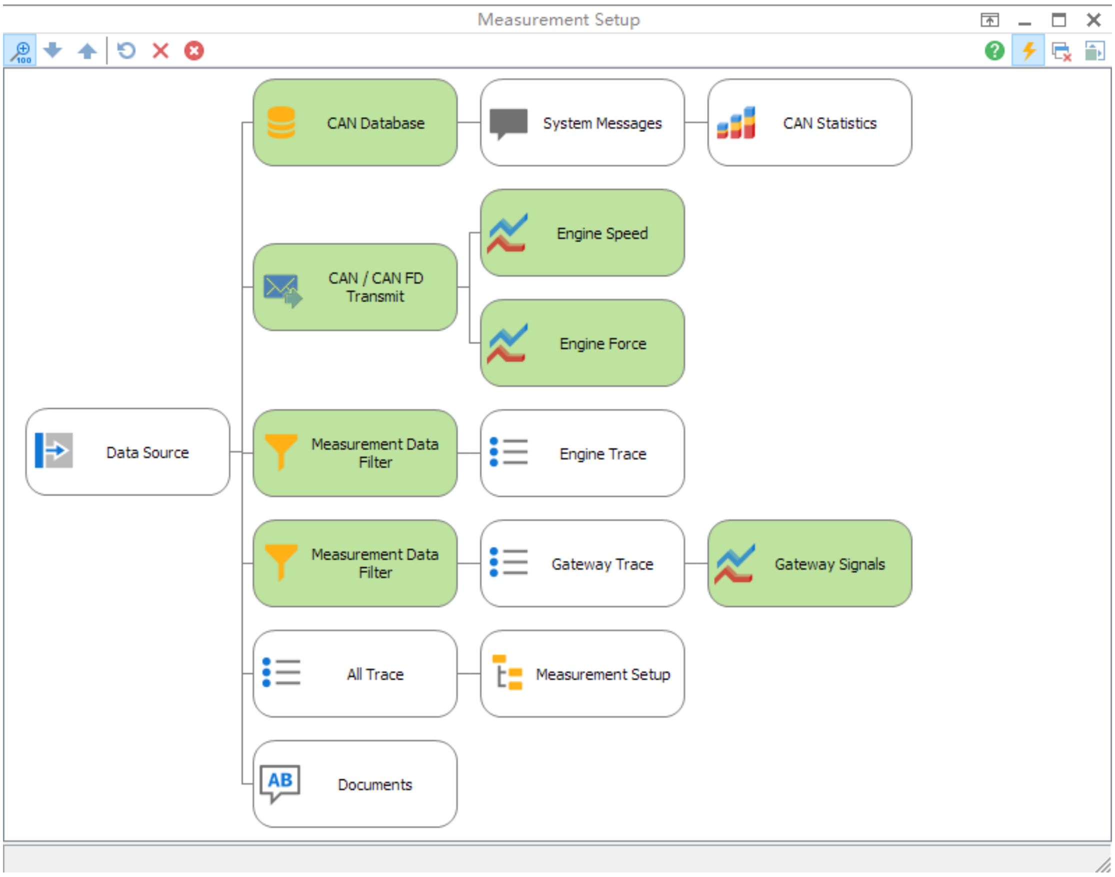
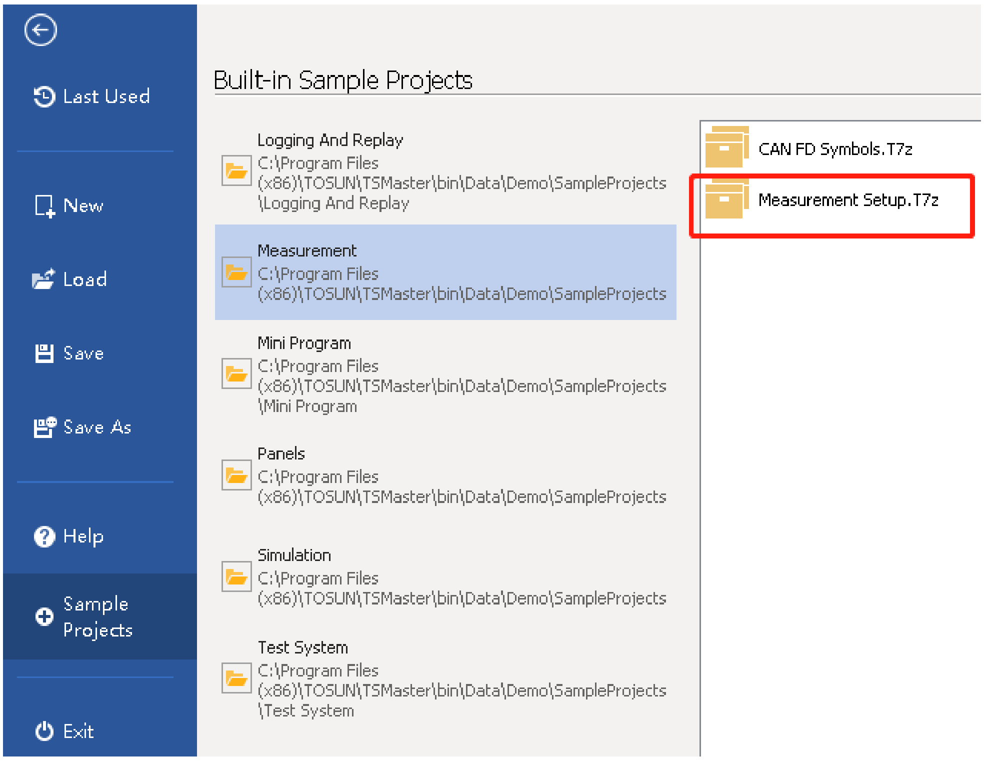


Fig 254 Measurement Setup

Please refer to TSMaster example “Measurement Setup.T7z” to see how to arrange multiple layouts and windows:



Built-in Sample Projects

Logging And Replay
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Logging And Replay

Measurement
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Mini Program
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Mini Program

Panels
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Simulation
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Test System
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Test System

CAN FD Symbols.T7z

Measurement Setup.T7z

Fig 255 Measurement Setup Example

1.28.1 Mesurement Setup Toolbar

Auto zoom of the measurement treeview chart, if checked, the treeview will be fitted into the current display area:

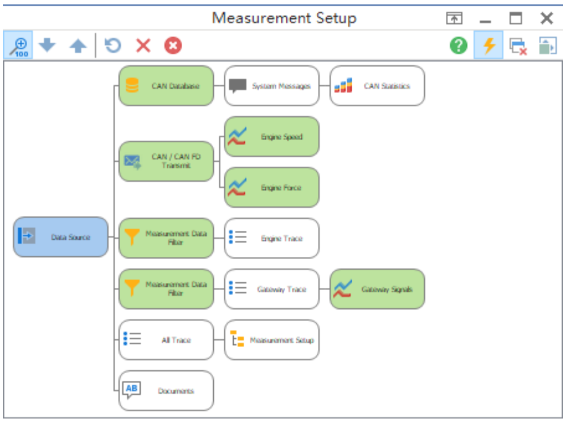


Fig 256 Zoom to fit of Measurement Setup

If this button is unchecked, the treeview items will be displayed with their original size, and you can drag the horizontal or vertical scroll bars to view the whole treeview:

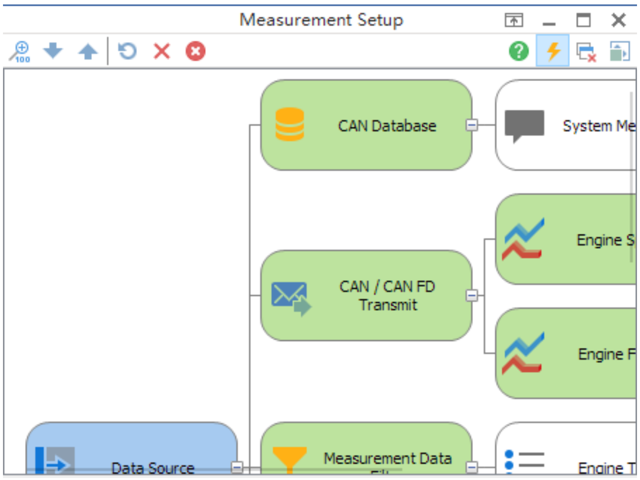


Fig 257 Measurement Setup without zoom support

⬇ ⬆ Expand all or Collapse all buttons. Use these buttons to expand all the nodes of the measurement setup treeview, or to collapse all of them.

↺ Reinitialize the struct button. Click this button to discard the current data reduction structure you just built and will result in the following plain display of treeview items:

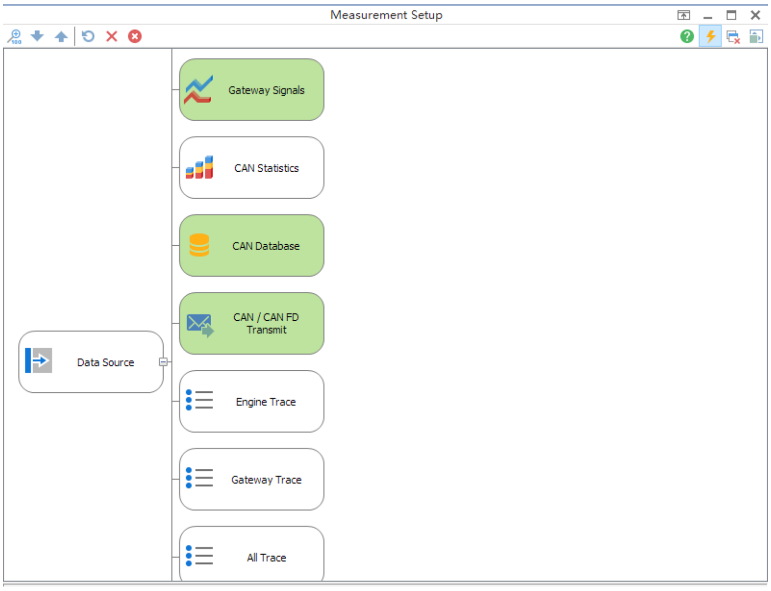


Fig 258 Measurement Setup Structure re-initialized

✕ ⊗ Delete the selected window or delete all the measurement windows from memory.

1.28.2 Measurement Setup Popup Menu

If you right click on each of the node in the measurement setup treeview, you can see the following popup menu appears:

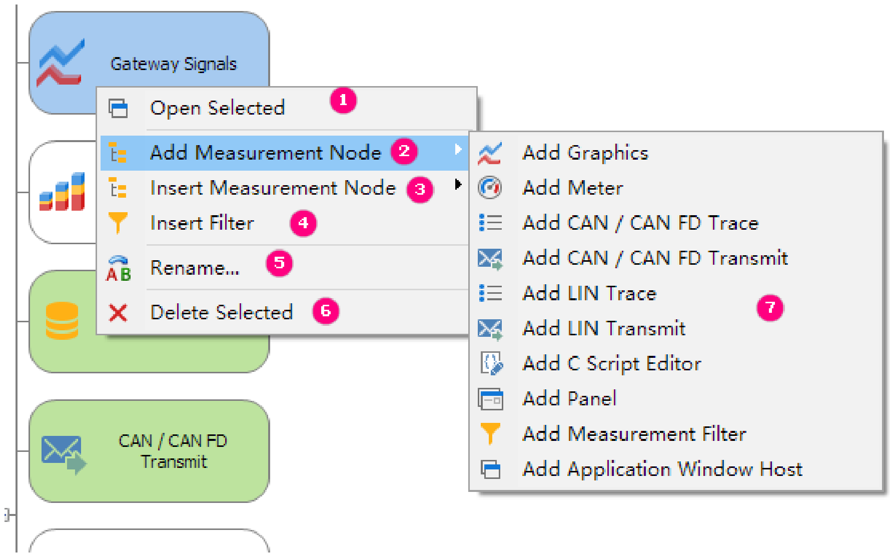


Fig 259 Measurement Setup Popup Menu

1. Open Selected: Show the selected window
2. Add Measurement Node: To add a measurement node from the sub-menu list as a child node after the selected node:

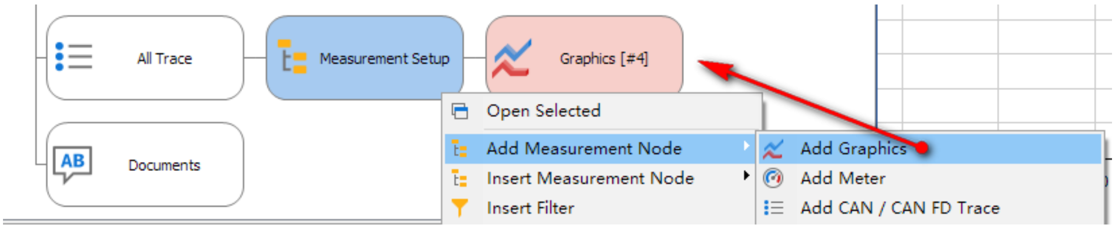


Fig 260 Add a measurement window as a child

3. Insert Measurement Node: To add a measurement node from the sub-menu list as a filter node in front of the selected node

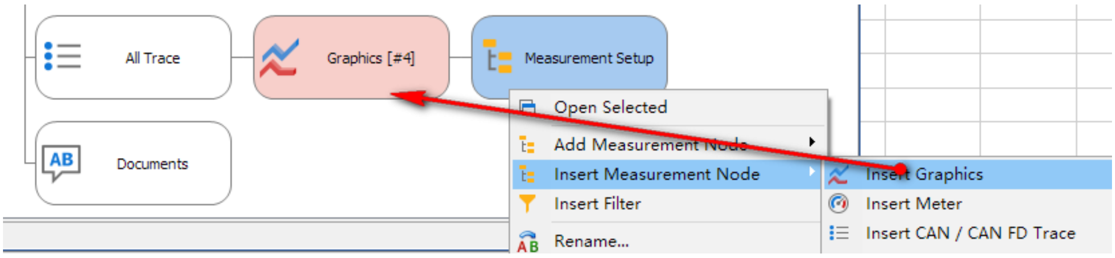
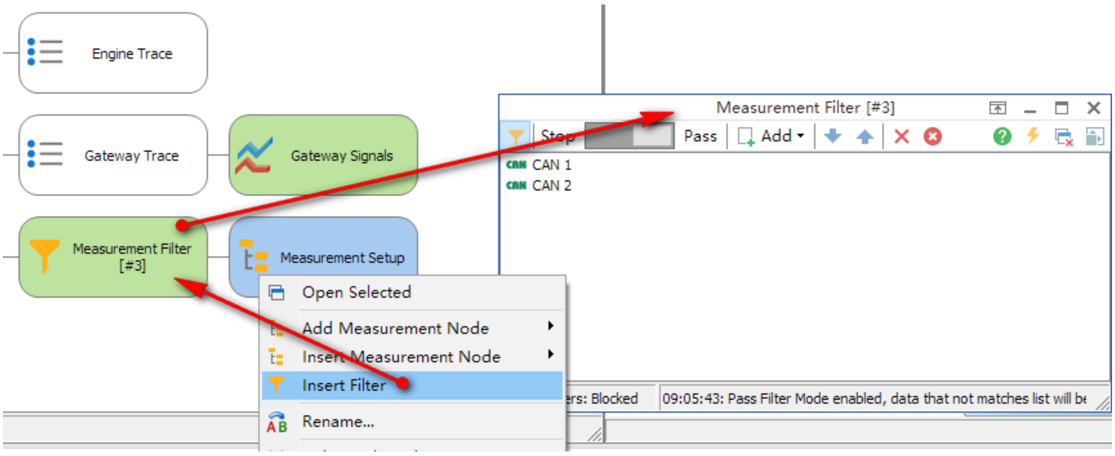


Fig 261 Insert a measurement window before the selected node

4. Insert Filter

To insert a filter window before the selected node, the filter can be configured to filter the nodes after itself.



09:05:43: Pass Filter Mode enabled, data that not matches list will be

Fig 262 Insert a fitler for the selected measurement node

5. Rename

You can rename any measurement window so as to identify it easily in the future.

6. Delete Selected

The selected node with its associated measurement window will be removed from memory.

7. Sub-Menu for Measurement Window

You can pick an item to add or insert it into the measurement setup.

1.28.3 Working with Measurement Setup

1.28.3.1 Measurement Setup Node State

There are 4 states of a measurement setup node:

1. Deleted State

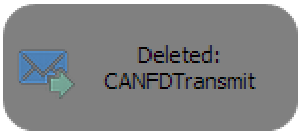


Fig 263 Measurement Window Deleted State

This means this window is removed from memory, the data flow is cut off and will not be transfered to its sub nodes. You can simply double click this delete node to create it and show it again.

2. Feed Through State

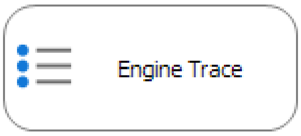


Fig 264 Measurement Window Feed Through State

This state means the associated measurement window does not have any configured filter for its sub nodes. The data flows into this node and will directly flows out from this node without any filter and goes to its sub nodes.

3. Filter Applied State

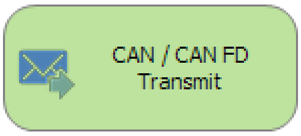
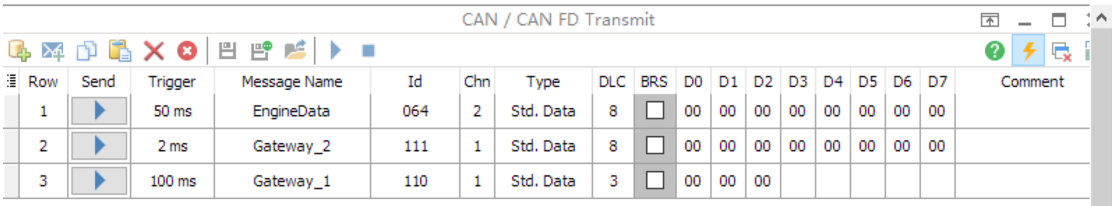


Fig 265 Measurement Filter Applied State

This state means the associated measurement window has internal filter for the current window and also for the sub windows after it. For example, the following transmit window has three transmit messages:



Row	Send	Trigger	Message Name	Id	Chn	Type	DLC	BRS	D0	D1	D2	D3	D4	D5	D6	D7	Comment
1	▶	50 ms	EngineData	064	2	Std. Data	8	□	00	00	00	00	00	00	00	00	
2	▶	2 ms	Gateway_2	111	1	Std. Data	8	□	00	00	00	00	00	00	00	00	
3	▶	100 ms	Gateway_1	110	1	Std. Data	3	□	00	00	00						

Fig 266 Transmit window with 3 messages in the list

The measurement windows after this transmit window are automatically filtered to allow only three identifiers 0x64, 0x111 and 0x110 to be flowed into them.

4. Filter Blocked State

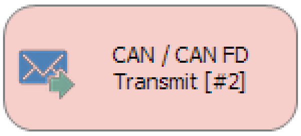


Fig 267 Measurement Window Filter Blocked State

This state means the current measurement window has built in filter, but the filter configuration does not allow any data pass it. In this case all the sub nodes after it will all be blocked and cannot receive any messages.

5. Selected State

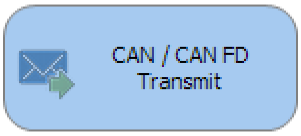


Fig 268 Measurement Window Selected State

This state means this measurement node is currently selected by user, you can remove it from memory, or to rename it, or to drag it to other measurement node as a child node.

1.28.3.2 Measurement Windows Filter Capabilities

The capabilities of each measurement window is listed below:

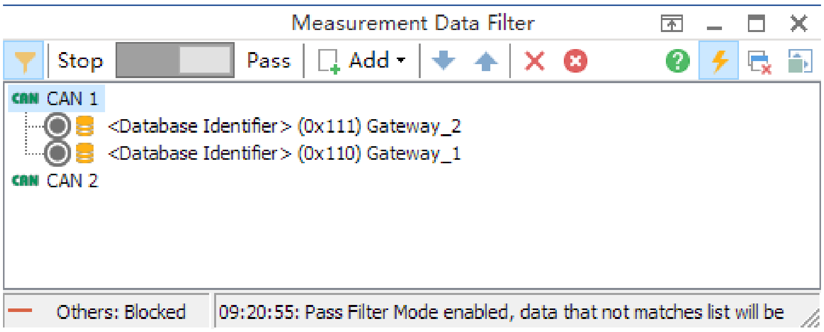
Table 10 Measurement Window Filter Capabilities

Measurement Window	Filter Capability
Measurement Setup	Feed Through
Message	Feed Through
CAN / CAN FD Trace	Built-In Filter in Trace
LIN Trace	Built-In Filter in Trace
CAN / CAN FD Transmit	The transmit messages act as filter
LIN Transmit	The messages in schedule table act as filter
Graphics	The added signal’s message act as filter
Gauges	The added signal’s message act as filter
Statistics	Feed Through
CAN Database	The messages in the loaded database (Channel specific) act as filter
LIN Database	The messages in the loaded database (Channel

	specific) as as filter
Bus Logger	Feed Through
Bus Replay	Feed Through
System Variables	Feed Through
Panel	The signals or messages in the panel act as filter
C Code Editor	The messages in the receive/transmit/pre-transmit callbacks act as filter
CAN RBS Simulation	The messages in the loaded database (Channel specific) act as filter
LIN RBS Simulation	The messages in the loaded database (Channel specific) act as filter
Test System	Feed Through
Diagnostics Manager	Feed Through
Calibration Manager	Feed Through
System Information	Feed Through
Application Host	Feed Through
Automotive File Converter	Feed Through

1.29 Measurement Filter

Measurement Filter Window is a universal filter for all kinds of bus signals.



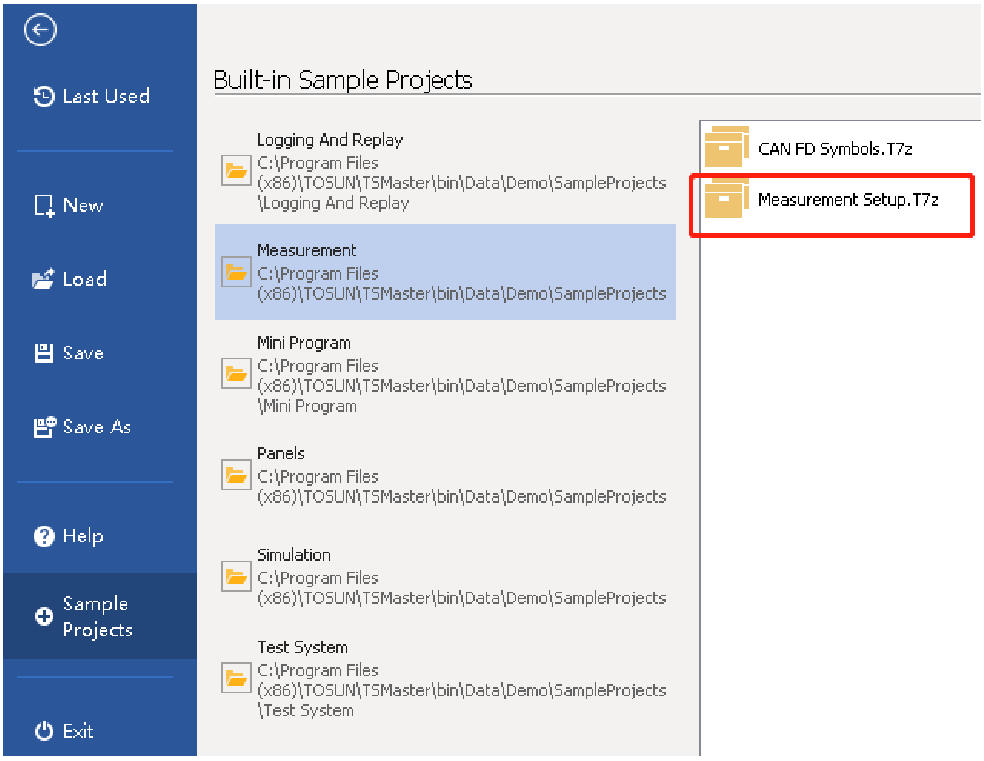
CAN 1
<Database Identifier> (0x111) Gateway_2
<Database Identifier> (0x110) Gateway_1
CAN 2

Others: Blocked

09:20:55: Pass Filter Mode enabled, data that not matches list will be

Fig 269 Measurement Filter Window

Please refer to TSMaster example “Measurement Setup.T7z” to see how to use measurement filter:



Built-in Sample Projects

Logging And Replay
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Logging And Replay

Measurement
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Mini Program
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Mini Program

Panels
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Simulation
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects

Test System
C:\Program Files (x86)\TOSUN\TSMaster\bin\Data\Demo\SampleProjects \Test System

CAN FD Symbols.T7z

Measurement Setup.T7z

Fig 270 Measurement Setup Example

1.29.1 Measurement Filter Toolbar

Measurement Filter global switch in ON state, which means the current filter is activated, which is performing filter functions for all the sub measurement windows:

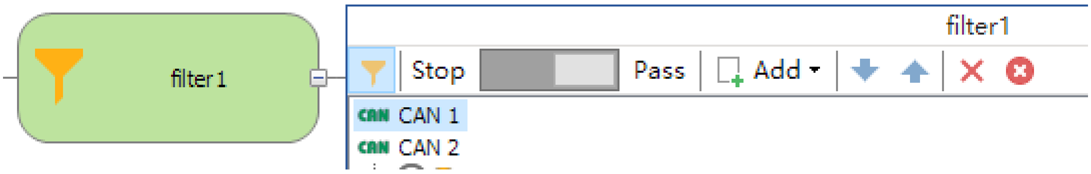


Fig 271 Measurement Filter with activated state

Measurement Filter global switch in OFF state, which means the current filter is deactivated, the data will be feed through this filter, all sub measurement windows will directly get the data.

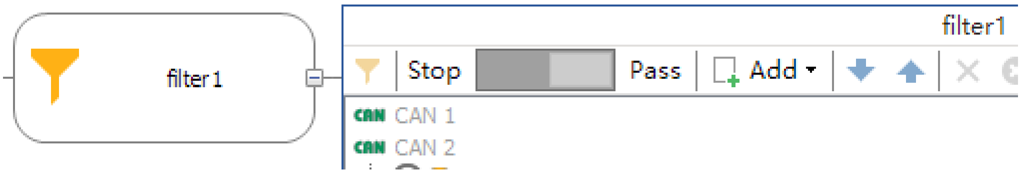
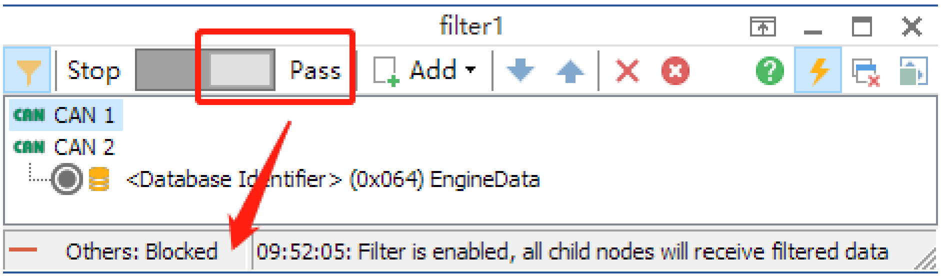


Fig 272 Measurement Filter with deactivated stae

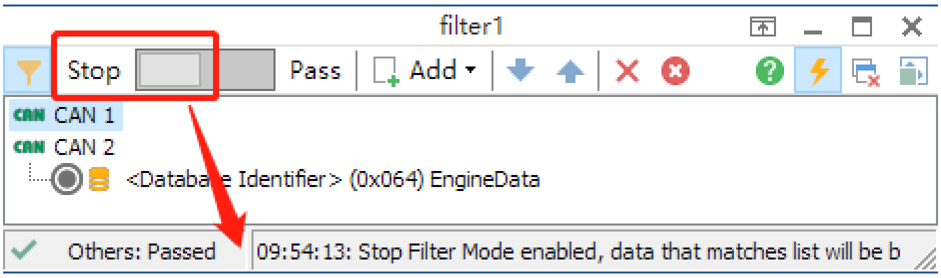
Pass Filter mode. This means data matches the items in the filter list will be passed to sub nodes, others will be blocked:



09:52:05: Filter is enabled, all child nodes will receive filtered data

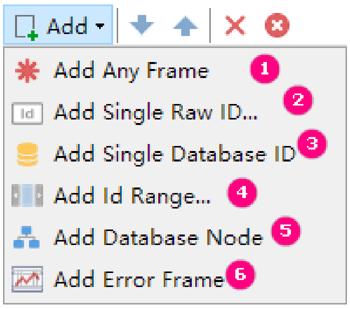
Fig 273 Measurement filter in pass filter mode

Stop Filter mode. This means data matches the items in the filter list will be blocked, others will be passed to sub nodes:



09:54:13: Stop Filter Mode enabled, data that matches list will be b

Fig 274 Measurement Filter in stop filter mode



Add items sub menu, which has the following 6 menu items:

- Add Any Frame

  This means any frame will match this filter, in “Filter Pass Mode” every frame will be passed by this filter, while in “Filter Stop Mode” every frame will be blocked by this filter.

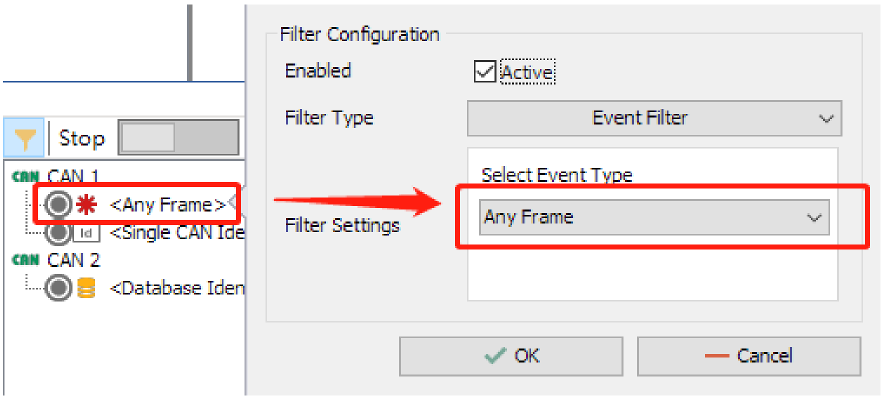


Fig 275 Any Frame filter

- Add Single Raw ID

You can modify this filter to allow a specific identifier mathes this filter.

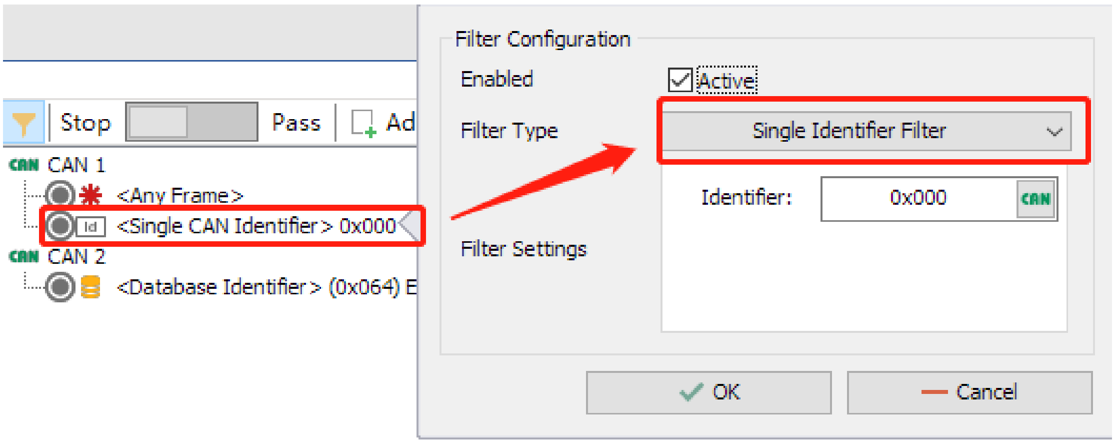
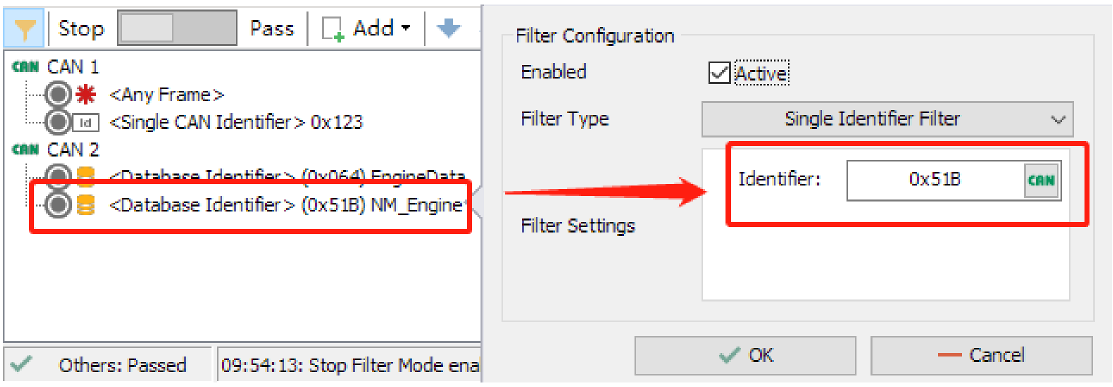


Fig 276 Measurement Single Raw ID Filter

- Add Single Database ID

You can pick a an identifier from database by clicking on the CAN button of the following popup window:



CAN 1
- <Any Frame>
- <Single CAN Identifier> 0x123

CAN 2
- <Database Identifier> (0x064) EngineData
- <Database Identifier> (0x51B) NM_Engine

Others: Passed
09:54:13: Stop Filter Mode ena

Filter Configuration

Enabled ☑ Active

Filter Type: Single Identifier Filter

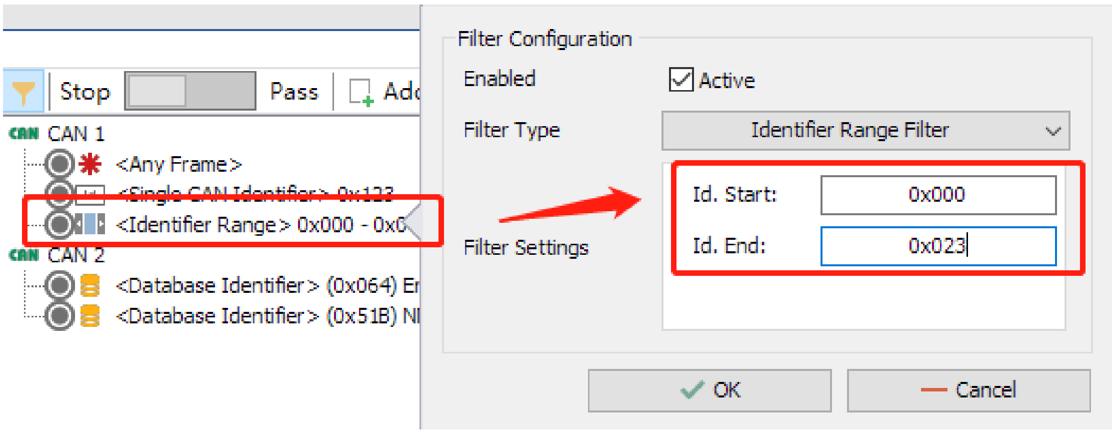
Filter Settings

Identifier: 0x51B

Fig 277 Measurement Database Identifier

- Add Id Range

  You can add “Identifier Range” to filter a range of specific identifiers by specifying the start and end identifiers. In the following filter configuration, the identifier range is 0x0 to 0x23, if any identifier is within this range, it will match this filter:



CAN 1
- <Any Frame>
- <Single CAN Identifier> 0x123
- <Identifier Range> 0x000 - 0x0

CAN 2
- <Database Identifier> (0x064) En
- <Database Identifier> (0x51B) N

Filter Configuration

Enabled ☑ Active

Filter Type: Identifier Range Filter

Filter Settings

Id. Start: 0x000

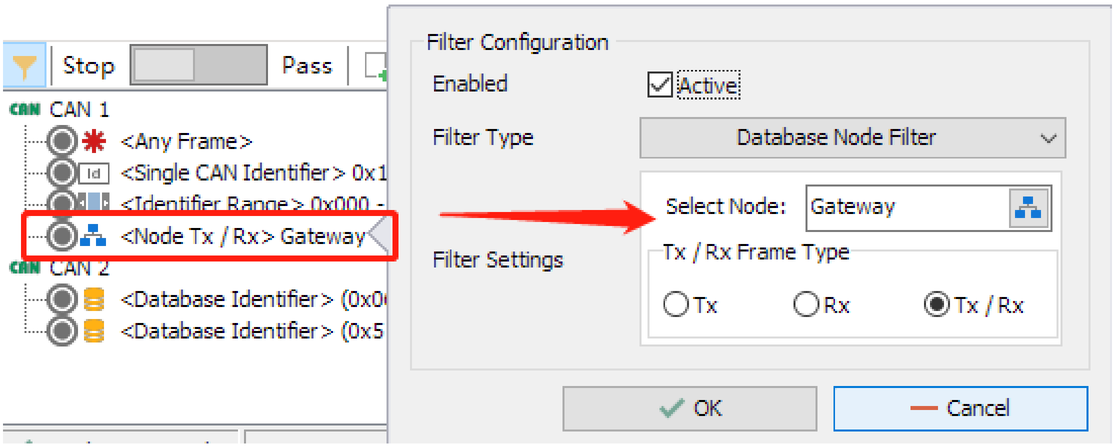
Id. End: 0x023

Fig 278 Measurement Filter of Identifier Range

- Add Database Node

  You can add “Node” filter to allow a group of transmitting or receiving message that are associated with the specific node to be matched.

  The direction of the messages in the node can also be modified as “Tx”, “Rx” or “Both Tx and Rx”:



CAN 1
- <Any Frame>
- <Single CAN Identifier> 0x1
- <Identifier Range> 0x000 -
- <Node Tx / Rx> Gateway

CAN 2
- <Database Identifier> (0x0
- <Database Identifier> (0x5

Filter Configuration

Enabled: ☑ Active

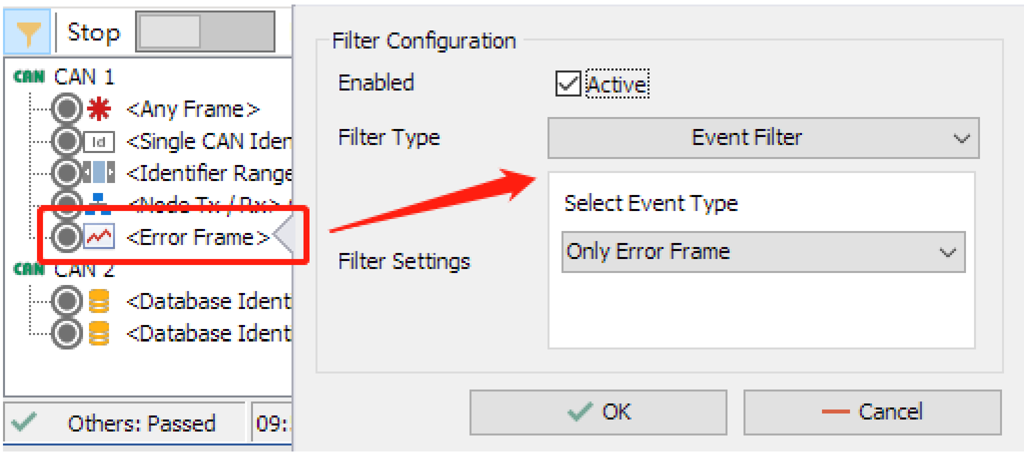
Filter Type: Database Node Filter

Filter Settings:
Select Node: Gateway
Tx / Rx Frame Type: ○ Tx ○ Rx ● Tx / Rx

Fig 279 Measurement filter of Node messages

- Add Error Frame

Error frames can also be matched by adding “Error Frame” filter. This is really useful in test situations.



CAN 1
- <Any Frame>
- <Single CAN Ider
- <Identifier Range
- <Node Tx / Rx>
- <Error Frame>

CAN 2
- <Database Ident
- <Database Ident

✓ Others: Passed 09:

Filter Configuration

Enabled: ☑ Active

Filter Type: Event Filter

Filter Settings:
Select Event Type: Only Error Frame

Fig 280 Error Frame Filter in Measurement Filter

⬇ ⬆ Expand All and Collapse All

You can expand all channels to view details or collapse all of them.

✕ ⊗ Delete selected or Delete All

1.29.2 Measurement Filter Popup Menu

If you right-click on the list of the filter window, you can see the following popup menu appears:

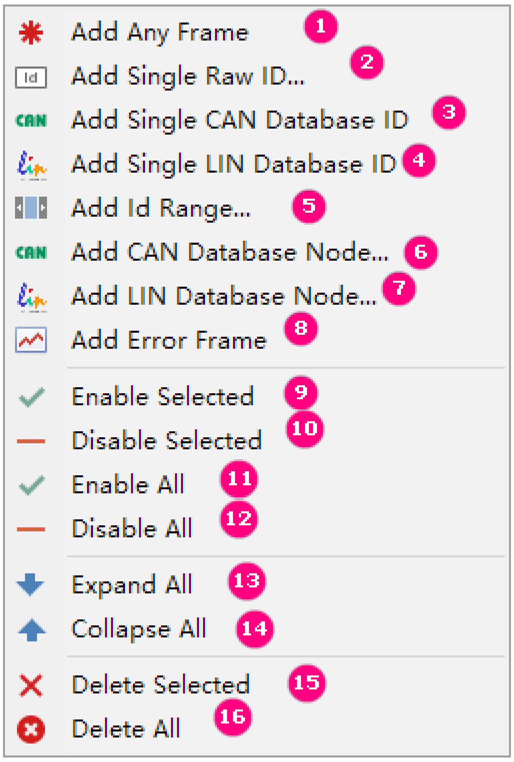


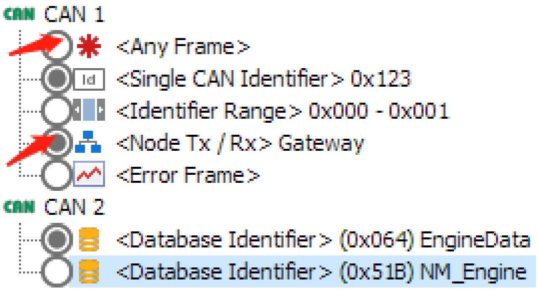
Fig 281 Measurement Filter Popup Menu

1. Add Any Frame: this filter will match any frame on Bus
2. Add Single Raw ID: this filter will match a single identifier
3. Add Single CAN Database ID: this filter will match a single identifier in CAN database
4. Add Single LIN Database ID: this filter will match a single identifier in LIN database
5. Add Id Range: this filter will match a range of identifiers specified by start and end identifiers
6. Add CAN Database Node: this filter will match a group of messages transmitted or received by the specified CAN node
7. Add LIN Database Node: this filter will match a group of messages transmitted or received by the specified LIN node
8. Add Error Frame: this filter will match error frames appear on Bus
9. Enable Selected: the selected filter items will be activated
10. Disable Selected: the selected filter items will be deactivated
11. Enable All: all filter items will be activated

12. Disable All: all filter items will be deactivated
13. Expand All: the treeview items will be expanded
14. Collapse All: the treeview items will be collapsed
15. Delete Selected: the selected filter item will be deleted
16. Delete All: all the filter items will be deleted

1.29.3 Filter List Operation

Items in the filter list can be dynamically switched to enabled or disabled state with a single mouse click even if the application is running. The filter behavior of the items will be affected immediately:



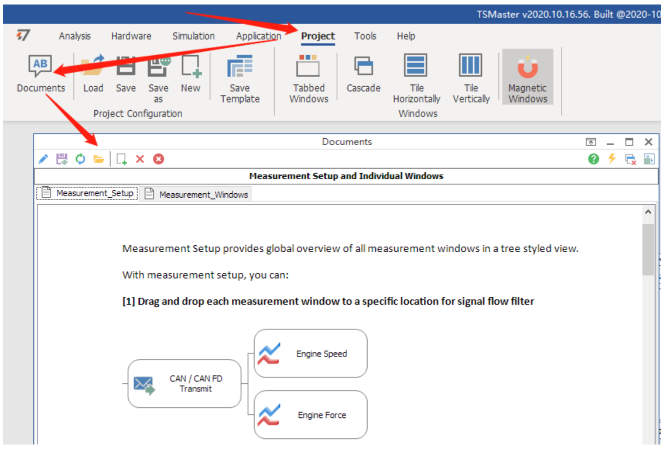
CAN 1
- ○ <Any Frame>
- ● <Single CAN Identifier> 0x123
- ○ <Identifier Range> 0x000 - 0x001
- ● <Node Tx / Rx> Gateway
- ○ <Error Frame>

CAN 2
- ● <Database Identifier> (0x064) EngineData
- ○ <Database Identifier> (0x51B) NM_Engine

Fig 282 Enable or Disable filter items in runtime

1.30 Document

Document window can be opened in Project page of main ribbon:



Measurement Setup and Individual Windows

Measurement Setup provides global overview of all measurement windows in a tree styled view.

With measurement setup, you can:

[1] Drag and drop each measurement window to a specific location for signal flow filter

Fig 283 Document Window

You can write comments, descriptions and tutorials in the document with mixed text and images. You can create multiple documents in this window. The file format of the document is “.rtf”.

1.30.1 Document Toolbar

✎ Edit the current document in external program. If you click this button, a default program for editing “.rtf” file in your computer will be opened.

💾 Save the current document.

🔄 Refresh the current document to the lastest state. If this document file is modified by external program, use this button to refresh it.

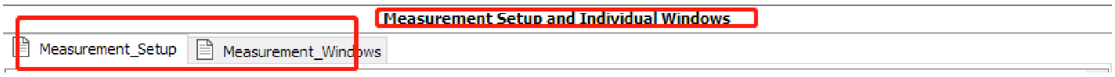
📂 Open the directory containing the current document.

🗋 Create a new document in the tabs.

✕ Delete the current document in this window. Note: this operation will not remove the rtf file from the disk.

⊗ Delete all the documents in this window. Note: this operation will not remove the rtf files from the disk.

1.30.2 Document Area



Measurement Setup and Individual Windows

Fig 284 Document Area

The top text box is used to make description of the current project document window. And the selection in this window will show different documents in tabs. You can add a tab by clicking 🗋 button and assign a name to the newly created document file.

1.30.3 Document Popup Menu

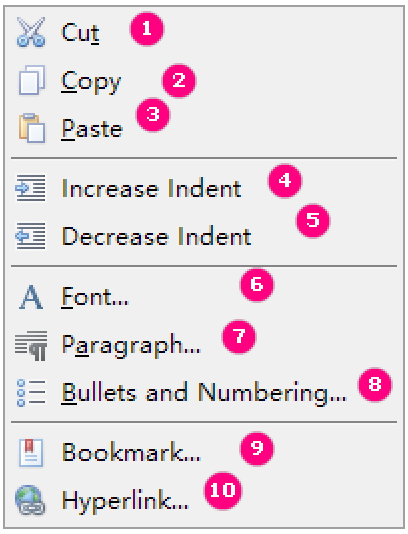


Fig 285 Document Popup Menu

1. Cut: Cut the selected text or images to clipboard
2. Copy: Copy the selected text or images to clipboard.
3. Paste: Paste clipboard contents to the text box area.
4. Increase Indent: Increase the ident count of the selected text lines.
5. Decrease Indent: Decrease the ident count of the selected text lines.
6. Font: You can assign font styles to the selected text block.
7. Paragraph: You can change the paragraph properties of the selected text blocks.
8. Bullets and Numbering: You can assign bullets or number prefixes to your selected text blocks.
9. Bookmark: You can add new bookmarks.
10. Hyperlink: You can assign hyperlinks to the text lines you selected.

1.31 LIN Remaining Bus Simulation

Similar to CAN Remaining Bus Simulation, please refer to “CAN Remaining Bus Simulation” chapter.

1.32 Automotive File Converter

Automotive File Converter is use to convert automotive database files from one format to another. This window can be opened in “Tool” page in the main ribbon:

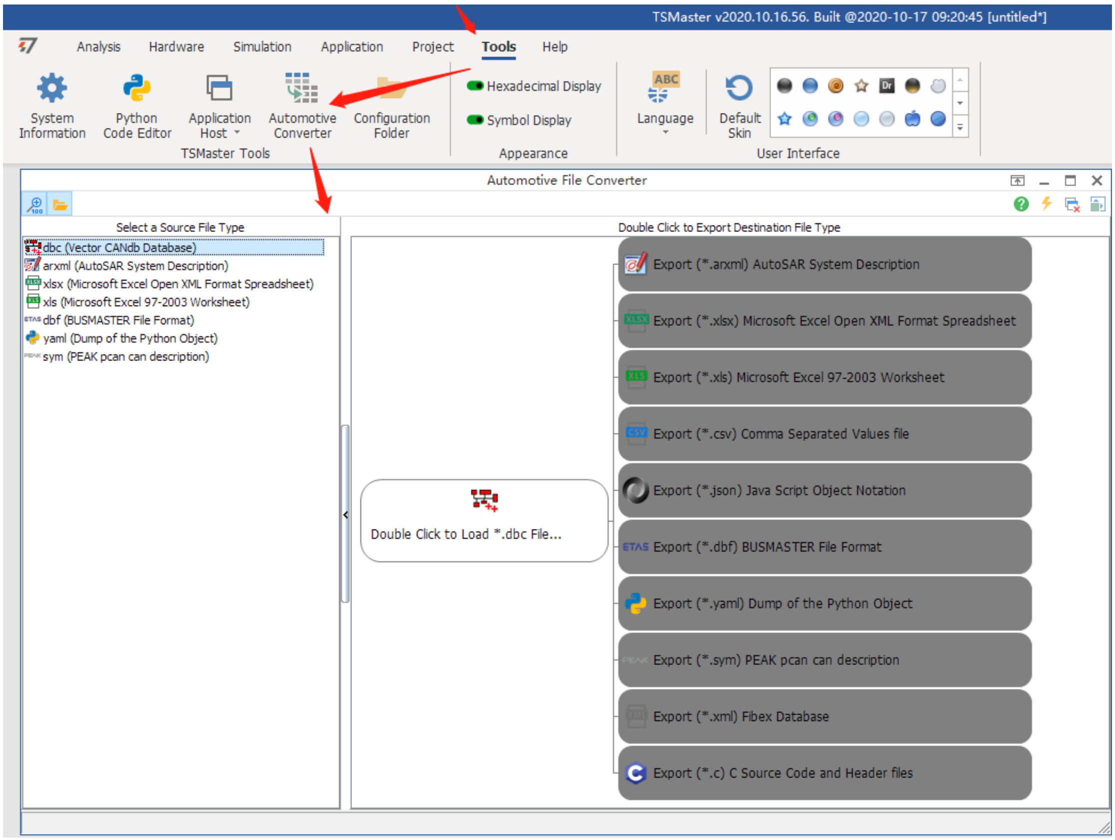

TSMaster v2020.10.16.56. Built @2020-10-17 09:20:45 [untitled*]
Analysis
Hardware
Simulation
Application
Project
Tools
Help
System Information
Python Code Editor
Application Host
Automotive Converter
Configuration Folder
TSMaster Tools
Hexadecimal Display
Symbol Display
Appearance
Language
Default Skin
User Interface
Automotive File Converter
Select a Source File Type
dbc (Vector CANdb Database)
arxml (AutoSAR System Description)
xlsx (Microsoft Excel Open XML Format Spreadsheet)
xls (Microsoft Excel 97-2003 Worksheet)
dbf (BUSMASTER File Format)
yaml (Dump of the Python Object)
sym (PEAK pcan can description)
Double Click to Export Destination File Type
Double Click to Load *.dbc File...
Export (*.arxml) AutoSAR System Description
Export (*.xlsx) Microsoft Excel Open XML Format Spreadsheet
Export (*.xls) Microsoft Excel 97-2003 Worksheet
Export (*.csv) Comma Separated Values file
Export (*.json) Java Script Object Notation
Export (*.dbf) BUSMASTER File Format
Export (*.yaml) Dump of the Python Object
Export (*.sym) PEAK pcan can description
Export (*.xml) Fibex Database
Export (*.c) C Source Code and Header files

Fig 286 Automotive File Converter

1.32.1 Automotive File Converter Toolbar

Auto zoom of the converter treeview chart, if checked, the treeview will be fitted into the current display area.

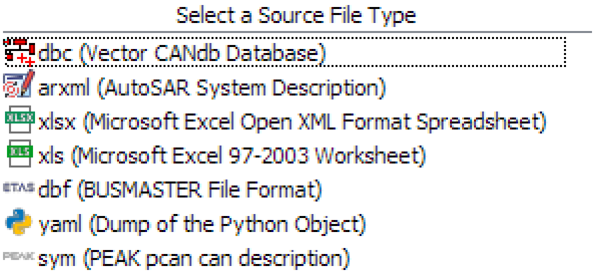
If this button is unchecked, the treeview items will be displayed with their original size, and you can drag the horizontal or vertical scroll bars to view the whole treeview.

Auto open the directory containing the destination file. If a new file is converted, a directory containing this file is opened.

Do not auto open the directory containing the destination file.

1.32.2 Supported input files

The following inputs files are currently selected (continuously growing):

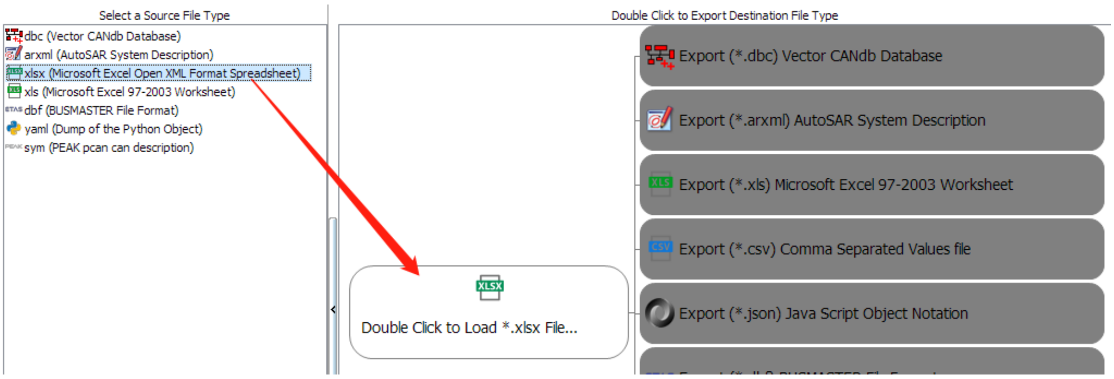


Select a Source File Type

- dbc (Vector CANdb Database)
- arxml (AutoSAR System Description)
- xlsx (Microsoft Excel Open XML Format Spreadsheet)
- xls (Microsoft Excel 97-2003 Worksheet)
- dbf (BUSMASTER File Format)
- yaml (Dump of the Python Object)
- sym (PEAK pcan can description)

Fig 287 Supported source file type

You can select one of them from the list, and you will see the treeview containing the supported output file types on the right will be synchronized to the file type you selected:



Select a Source File Type

- dbc (Vector CANdb Database)
- arxml (AutoSAR System Description)
- xlsx (Microsoft Excel Open XML Format Spreadsheet)
- xls (Microsoft Excel 97-2003 Worksheet)
- dbf (BUSMASTER File Format)
- yaml (Dump of the Python Object)
- sym (PEAK pcan can description)

Double Click to Export Destination File Type

- Export (*.dbc) Vector CANdb Database
- Export (*.arxml) AutoSAR System Description
- Export (*.xls) Microsoft Excel 97-2003 Worksheet
- Export (*.csv) Comma Separated Values file
- Export (*.json) Java Script Object Notation

Double Click to Load *.xlsx File...

Fig 288 Select a source file type first

1.32.3 Supported output files

Source file should be assigned before double clicking on the right nodes of exported file type.

The supported file types are listed below:

Table 11 Automotive File Converter Output Matrix

Output\Input	DBC	ARXML	Xlsx	Xls	DBF	YAML	SYM
DBC		●	●	●	●	●	●

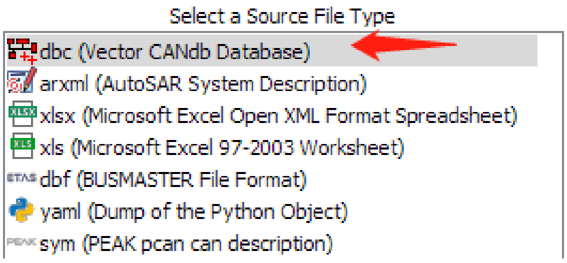
ARXML	●		●	●	●	●	●
Xlsx	●	●		●	●	●	●
Xls	●	●	●		●	●	●
CSV	●	●	●	●	●	●	●
Json	●	●	●	●	●	●	●
DBF	●	●	●	●		●	●
YAML	●	●	●	●	●		●
SYM	●	●	●	●	●	●	
FIBEX	●	●	●	●	●	●	●
C Source	●						

Note: Xlsx and xls file are format specific. If you want to import Xlsx or xls files, you should make sure the formats are correct. You can get the template by simply convert any dbc to Xlsx and start working on such file.

1.32.4 Steps to Convert Database Files

- Select a source file type

  for example, if we want to convert a dbc file to excel, you should first select “dbc” format in the left list:

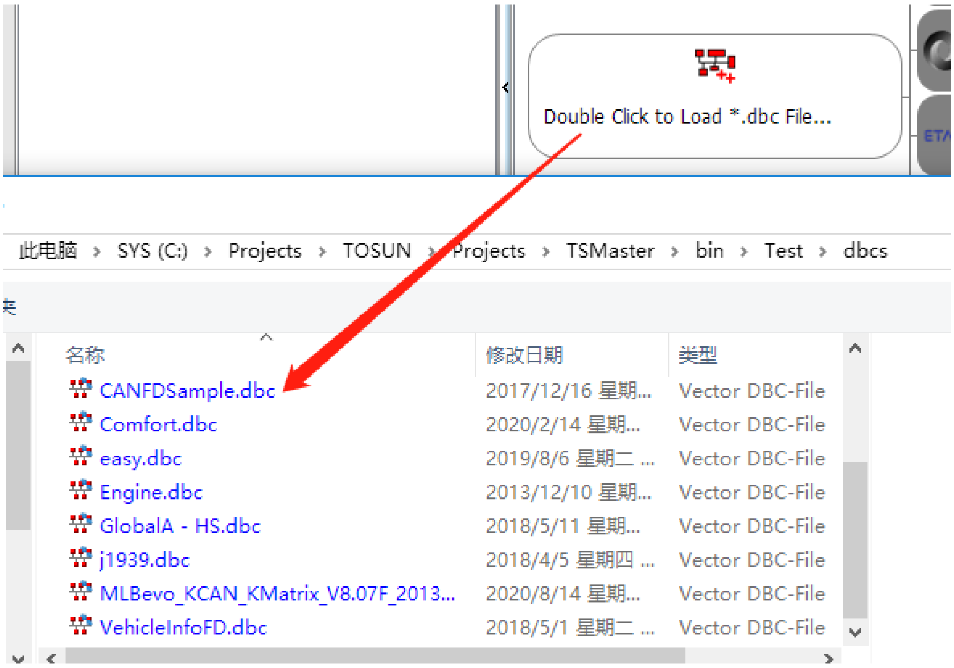


Select a Source File Type

dbc (Vector CANdb Database)
arxml (AutoSAR System Description)
xlsx (Microsoft Excel Open XML Format Spreadsheet)
xls (Microsoft Excel 97-2003 Worksheet)
dbf (BUSMASTER File Format)
yaml (Dump of the Python Object)
sym (PEAK pcan can description)

Fig 289 Select source file type

- Select a source file to input by double clicking on the “Source Node”



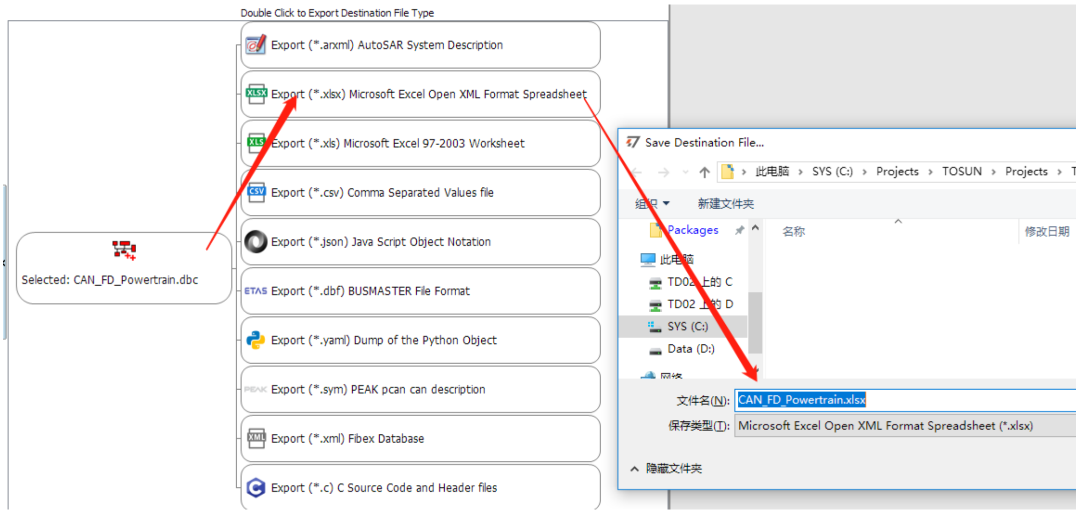
Double Click to Load *.dbc File...

此电脑 › SYS (C:) › Projects › TOSUN › Projects › TSMaster › bin › Test › dbcs

名称	修改日期	类型
CANFDSample.dbc	2017/12/16 星期...	Vector DBC-File
Comfort.dbc	2020/2/14 星期...	Vector DBC-File
easy.dbc	2019/8/6 星期二 ...	Vector DBC-File
Engine.dbc	2013/12/10 星期...	Vector DBC-File
GlobalA - HS.dbc	2018/5/11 星期...	Vector DBC-File
j1939.dbc	2018/4/5 星期四 ...	Vector DBC-File
MLBevo_KCAN_KMatrix_V8.07F_2013...	2020/8/14 星期...	Vector DBC-File
VehicleInfoFD.dbc	2018/5/1 星期二 ...	Vector DBC-File

Fig 290 Load an input file

- Double click the “xlsx” icon on the right tree, a “Save” dialog will popup for you to specify the destination file you want to save.



Selected: CAN_FD_Powertrain.dbc

Double Click to Export Destination File Type

- Export (*.arxml) AutoSAR System Description
- Export (*.xlsx) Microsoft Excel Open XML Format Spreadsheet
- Export (*.xls) Microsoft Excel 97-2003 Worksheet
- Export (*.csv) Comma Separated Values file
- Export (*.json) Java Script Object Notation
- Export (*.dbf) BUSMASTER File Format
- Export (*.yaml) Dump of the Python Object
- Export (*.sym) PEAK pcan can description
- Export (*.xml) Fibex Database
- Export (*.c) C Source Code and Header files

Save Destination File...

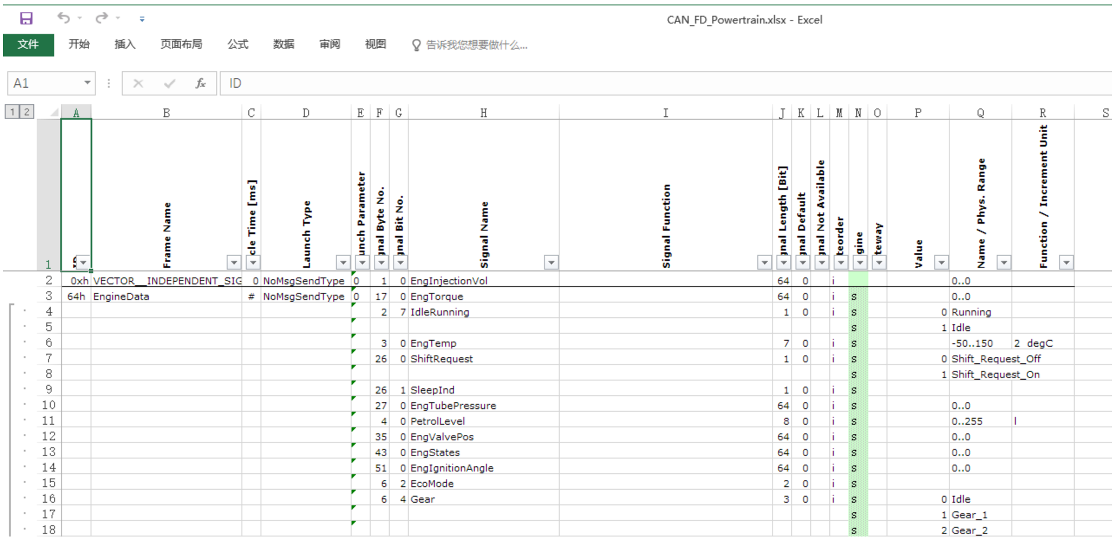
此电脑 › SYS (C:) › Projects › TOSUN › Projects ›

文件名(N): CAN_FD_Powertrain.xlsx

保存类型(T): Microsoft Excel Open XML Format Spreadsheet (*.xlsx)

Fig 291 Convert to xlsx file

- Finally, you will get the destination file



CAN_FD_Powertrain.xlsx - Excel

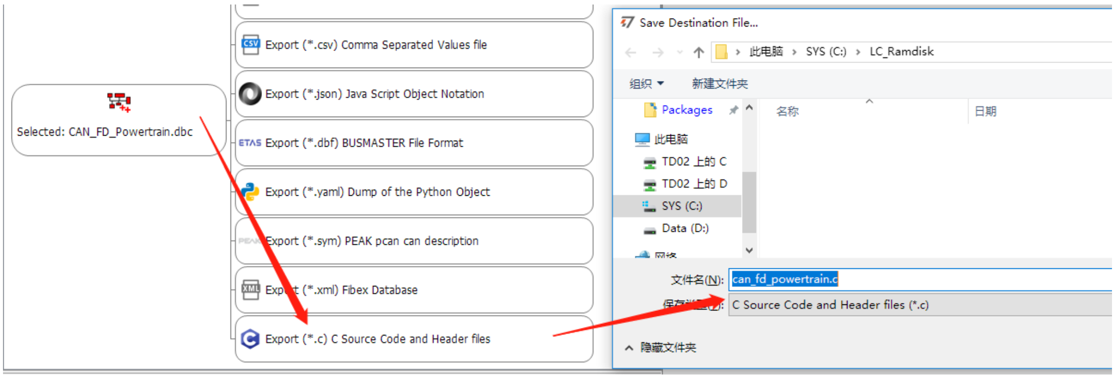
A1 ID

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	S	Frame Name	cle Time [ms]	Launch Type	unch Parameter	gnal Byte No.	gnal Bit No.	Signal Name	Signal Function	gnal Length [Bit]	gnal Default	gnal Not Available	teorder	gine	teway	Value	Name / Phys. Range	Function / Increment Unit
2	0xh	VECTOR__INDEPENDENT_SIG	0	NoMsgSendType	0	1	0	EngInjectionVol		64	0		i				0..0	
3	64h	EngineData	#	NoMsgSendType	0	17	0	EngTorque		64	0		i	s			0..0	
4						2	7	IdleRunning		1	0		i	s		0	Running	
5														s		1	Idle	
6						3	0	EngTemp		7	0		i	s			-50..150	2 degC
7						26	0	ShiftRequest		1	0		i	s		0	Shift_Request_Off	
8														s		1	Shift_Request_On	
9						26	1	SleepInd		1	0		i	s				
10						27	0	EngTubePressure		64	0		i	s			0..0	
11						4	0	PetrolLevel		8	0		i	s			0..255	l
12						35	0	EngValvePos		64	0		i	s			0..0	
13						43	0	EngStates		64	0		i	s			0..0	
14						51	0	EngIgnitionAngle		64	0		i	s			0..0	
15						6	2	EcoMode		2	0		i	s				
16						6	4	Gear		3	0		i	s		0	Idle	
17														s		1	Gear_1	
18														s		2	Gear_2	

Fig 292 The destination file is generated

1.32.5 Steps to Convert dbc file to C Code

- Select dbc source and assign a dbc file as the steps above
- Double click on the “C Source Code” node, then you are asked to save a C Source file with the same name of the dbc file


Export (*.csv) Comma Separated Values file
Export (*.json) Java Script Object Notation
Export (*.dbf) BUSMASTER File Format
Export (*.yaml) Dump of the Python Object
Export (*.sym) PEAK pcan can description
Export (*.xml) Fibex Database
Export (*.c) C Source Code and Header files
Save Destination File...
此电脑 › SYS (C:) › LC_Ramdisk
组织
新建文件夹
Packages
名称
日期
此电脑
TD02 上的 C
TD02 上的 D
SYS (C:)
Data (D:)
网络
隐藏文件夹

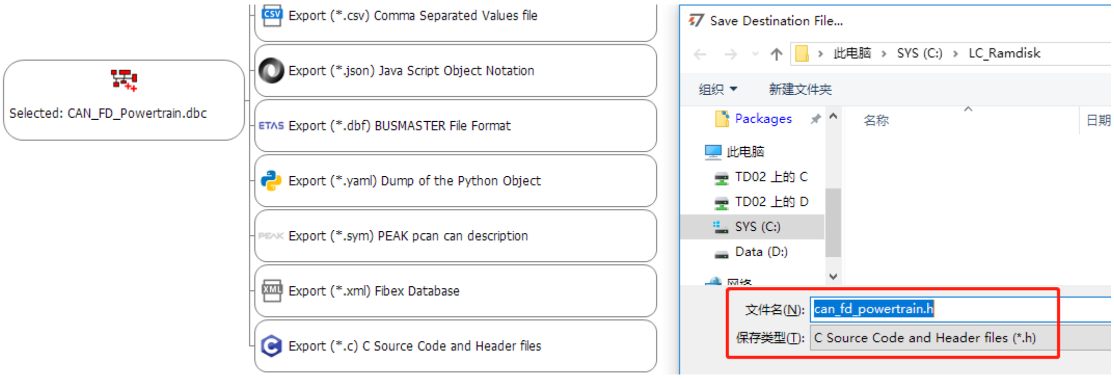
Selected: CAN_FD_Powertrain.dbc

文件名(N): can_fd_powertrain.c

保存类型(T): C Source Code and Header files (*.c)

Fig 293 Save C Source File

After C source file is saved, another save dialog is poped up for header file storage, this is because this conversion generates two files for C code source and header, you can save it to the same directory:

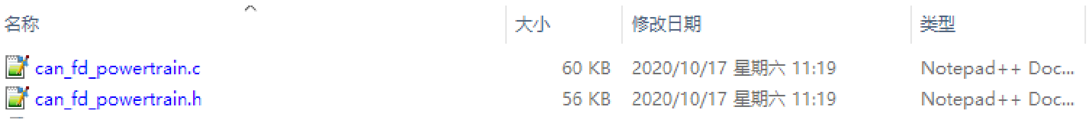

Selected: CAN_FD_Powertrain.dbc
Export (*.csv) Comma Separated Values file
Export (*.json) Java Script Object Notation
Export (*.dbf) BUSMASTER File Format
Export (*.yaml) Dump of the Python Object
Export (*.sym) PEAK pcan can description
Export (*.xml) Fibex Database
Export (*.c) C Source Code and Header files
Save Destination File...
此电脑 › SYS (C:) › LC_Ramdisk
组织 ▾
新建文件夹
Packages
此电脑
TD02 上的 C
TD02 上的 D
SYS (C:)
Data (D:)
名称
日期

文件名(N): can_fd_powertrain.h

保存类型(T): C Source Code and Header files (*.h)

Fig 294 Save C Header File

- You can find these files in the directory you specified



名称	大小	修改日期	类型
can_fd_powertrain.c	60 KB	2020/10/17 星期六 11:19	Notepad++ Doc...
can_fd_powertrain.h	56 KB	2020/10/17 星期六 11:19	Notepad++ Doc...

Fig 295 C Code generated by dbc

1.33 Symbol Mapping

1.34 Stimulation

1.35 Calibration Curve

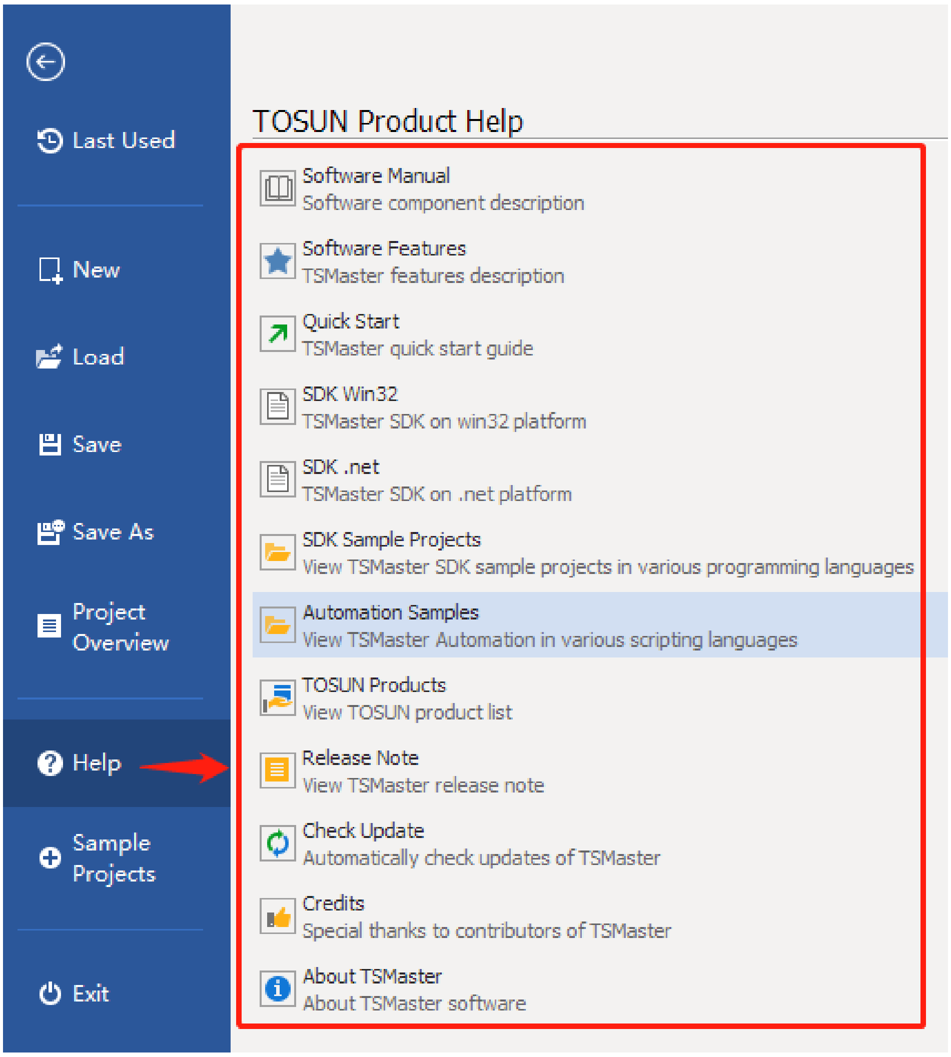
1.36 Video Replay

1.37 Excel Test Module

Chapter 2 TSMaster Help Files

2.1 Help Content

TSMaster help content can be accessed in the application button of TSMaster main interface:



TOSUN Product Help

Software Manual
Software component description

Software Features
TSMaster features description

Quick Start
TSMaster quick start guide

SDK Win32
TSMaster SDK on win32 platform

SDK .net
TSMaster SDK on .net platform

SDK Sample Projects
View TSMaster SDK sample projects in various programming languages

Automation Samples
View TSMaster Automation in various scripting languages

TOSUN Products
View TOSUN product list

Release Note
View TSMaster release note

Check Update
Automatically check updates of TSMaster

Credits
Special thanks to contributors of TSMaster

About TSMaster
About TSMaster software

Fig 296 TSMaster Help Contents