Never stop thinking

Driver SBC Evaluation Board

Getting Started

Rev 1.0 2013-08-02

Automotive Power

Driver SBC Evaluation Board
Revision History: Rev 1.0, 2013-08-02
Previous Version: none

Page	Subjects (major changes since last revision)

Table of Contents

1 Abstract

Note: The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device.

This Evaluation Board description is intended to provide an overview to the hardware and software operation of the Driver SBC Evaluation Board. The Evaluation Board can work with the following devices:

- TLE9264QX/-2QX
- TLE9266QX/-2QX
- TLE9268QX/-2QX

For simplification reasons, the document it will be referred to the Driver SBC Evaluation Board

2 Introduction

Driver SBC family is designed specifically for automotive applications such as Door, Seat Control, HVAC, Body Controller. The devices include a LIN and/or CAN physical interface.

The Driver SBC Evaluation Board is intended to provide a simple, easy-to-use tool for getting familiar with the device and for first application tests. The Evaluation Board contains a Driver SBC application board, which is equipped with a 96-pin connector to interface to the Power Easy kit (microcontroller board).

The Power Easy Kit is a testing and development platform to be used with Infineon devices. This kit uses a 16-bit microcontroller of the XC2000 processor family based on the high-performance C166S V2 core. The Power Easy Kit board is designed with a special 96-pin connector for board extension test capability, i.e. to interface with an application board such as the Driver SBC.

The Driver SBC SPI communication is emulated by the Power Easy Kit which is controlled by a PC-Software (also included in the demo-kit wih installation instructions).

Please note that the uC Power Easy Kit needs to be obtained separately.

Driver SBC Features:

- Very low quiescent current consumption in Stop- and Sleep Mode
- Periodic cyclic sense in Normal-, Stop- and Sleep Mode
- Periodic cyclic wake in Normal- and Stop Mode
- Low-Drop Voltage Regulator 5V, 250mA
- Low-Drop Voltage Regulator 5V, 100mA, robust against short to VS
- High-Speed CAN Transceiver ISO11898-2/5 with Partial Networking
- LIN Transceiver LIN2.1, J2602
- Two Low-Side Outputs for Relay Drive with active zener clamping
- Two High-Side Output 2Ω typ., four High-Side Outputs 7Ω typ., e.g. for LED lighting, cyclic sensing, etc.
- Four independent PWM generators and two On/Off Timers
- Three universal High-Voltage Wake Inputs for voltage level monitoring with cyclic sense functionality
- Alternate High-Voltage Measurement Function, e.g. for battery voltage sensing
- One universal Low-Voltage Wake Input for voltage level monitoring with cyclic sense functionality
- SYNC input for external cyclic sense control via micro controller
- Reset Output and Fail Output
- Over temperature and short circuit protection feature
- Wide input voltage and temperature range
- Green Product (RoHS compliant) & AEC Qualified

3 Hardware

The Driver SBC Evaluation Board is designed to be compatible with the Easy Kit Microcontroller Evaluation Board. The Easy Kit plugs into the Evaluation Board via a standard 96-pin connector and allows easy interface to the microcontroller via USB for SPI, CAN, LIN communication etc.

3.1 Box Contents

The following items are included in the Driver SBC Evaluation Board box:

- Application Evaluation Board (Connection to the Power Easy Kit via 96-pin connector)

Note: The uC Power Easy Kit needs to be obtained separately

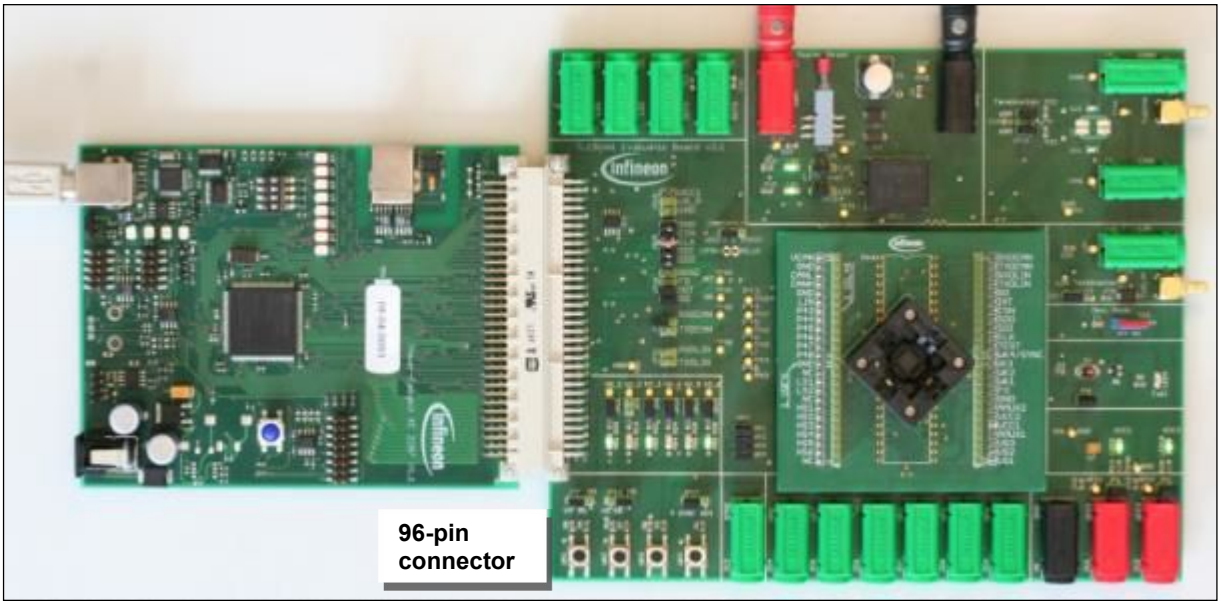


Figure 1 Power Easy Kit (left) connecting to the Driver SBC Evaluation Board (right)

3.2 Application Board overview

3.2.1 Circuit Description and Layout

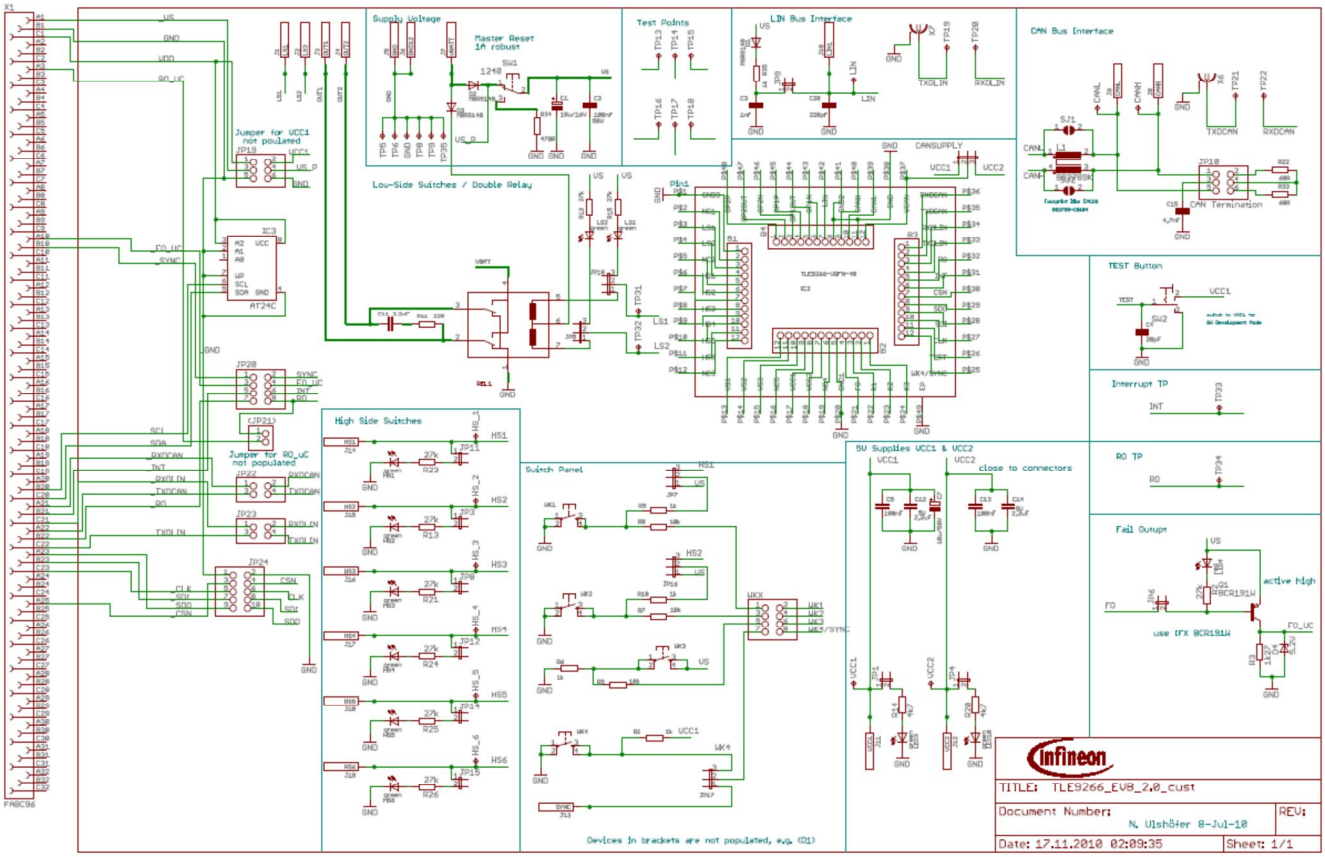


Figure 2 Driver SBC Evaluation Board Schematic

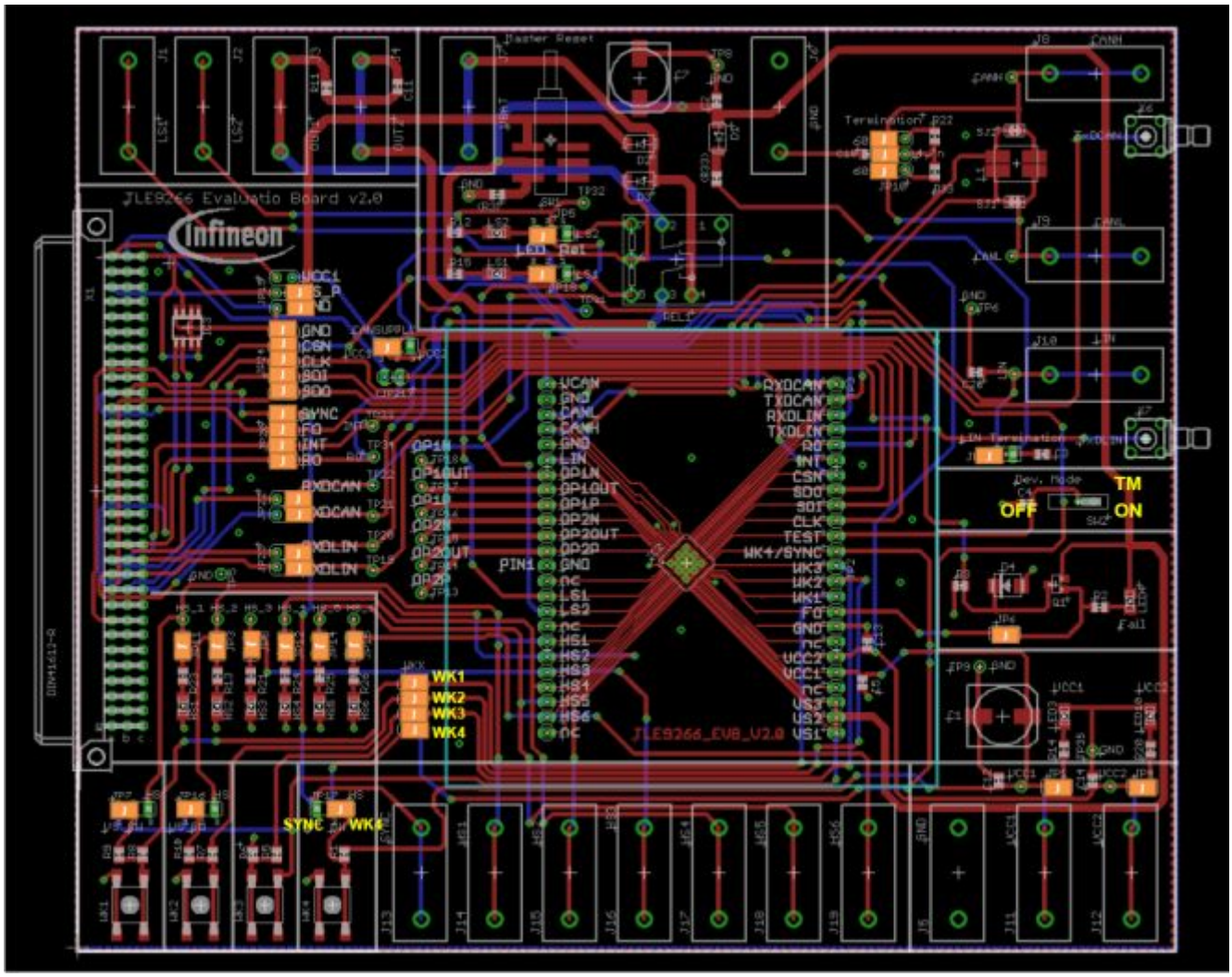


Figure 3 Driver SBC Evaluation Board Layout including default jumper settings.

The Evaluation board comprises of 2 layers, 35µm Cu. A small adapter board with a socket for a VQFN-48 package and a connector row on each side for easy measurement acces connects to the double connector row (please note to connect in the right pinning order to avoid short circuits).

The PG-VQFN-48 package has an exposed pad and for good thermal performance. It is also possible to solder the device directly on the PCB. Overall 9 thermal vias are placed directly below the exposed pad island. The footprint is an absolute minial with no additional copper area. The most obvious heat flow is via the exposed pad through the thermal vias.

3.3 Hardware Settings

3.3.1 Power Settings

Connect VBATT and GND via standard power supply, with a nominal voltage of 13.5V. The Driver SBC is only powered through this power supply.

3.3.2 Jumper Overview & Settings

For configuration purposes, there are several jumpers on the application board:

- JP1 :

To be added in a table overview

4 Software

4.1 Software Installation

The Power Easy Kit software delivered with the µC board must be installed first. Instruction details to the Power Easy Kit software installation can be found in the Power easy Kit getting started V1_3.pdf document.

The latest ‘version file’ (Version 1.12 at the time this document was created) is required to be installed first. This version is not compatible for the Driver SBC (another version will be released later). Therefore, additional stand-alone Power Easy Kit software needs to be installed by first uninstalling the existing Power Easy Kit version and then installing the new version. This version is currently only available via our FAE team.

There is a version file called “*version.txt*”, which ensures that the correct GUI for the TLE9264/66/68 is selected. The version file must be located in the same directory as the Power Easy Kit directory (\My Documents\LabVIEW Data\power_easy_kit_data\version.txt).

In addition, the programmed firmware for the Power Easy Kit XC2287 microcontroller needs to have a revision R15 or higher. If an existing uC-Power Easy Kit is used, it could be necessary to program the new .hex file to the microcontroller (My Documents\LabVIEW Data\power_easy_kit_data\DemoEvalKitVX2.1R15.hex). Please click the “**Version Check**” button in the main menu of the Power Easy Kit GUI to find out the programmed version for the uC. Please use the “**Update**” button the main menu of the Power Easy Kit GUI to program a new firmware on the microcontroller.

For older Power Easy Kit versions it could be necessary to modify the “*version.txt*” file for the latest GUI version.

4.2 Getting Started

The Power Easy Kit software is executed by starting the 'Power Easy Kit.exe' in the installation directory or via the Start Menu.

The following window will appear:

- '**Start Demo**': A new window will open up to operate the Driver SBC. The device is automatically indentified by the EEPROM located on the evaluation board and the respective GUI is started.
- **'Stop**': The Power Easy Kit software will be closed. This is the safest way to end the program and is recommended to avoid error messages or 'bluescreens'.
- '**Version check**': The actual firmware version of the microcontroller is displayed. Furthermore the EEPROM of the evaluation board is read out.
- '**Update**': The firmware of the microcontroller can be updated.

Notes:

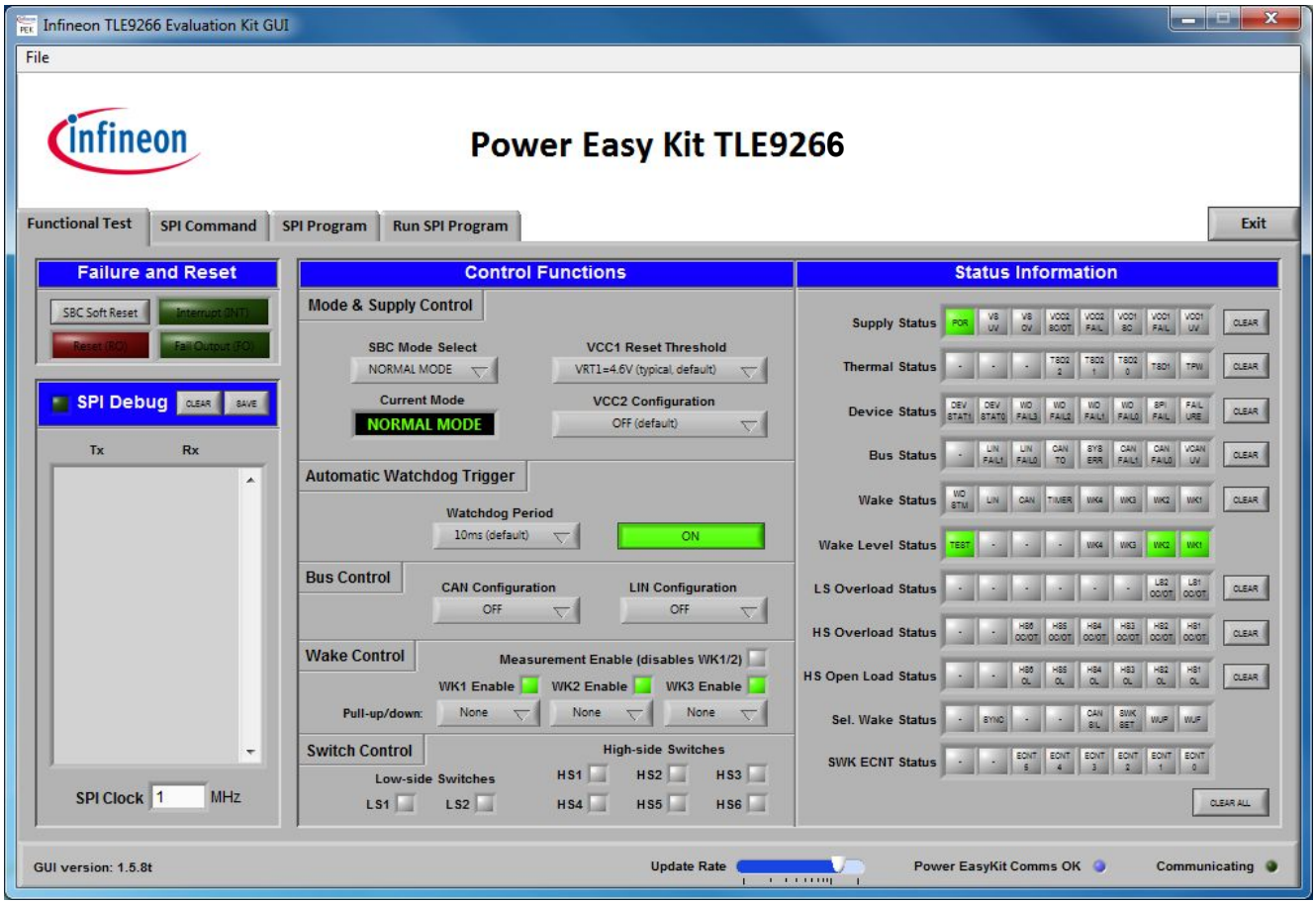
Windows will resize all application fonts if your Windows font size is set to anything other than normal. This will only affect compiled executables and not code running in the LabVIEW development environment.

Windows font size can be changed by navigating to Start Menu»Settings»Control Panel»Display»Appearance Tab»Font Size (smaller 100%).

The window size of the GUI is fixed by LabView, i.e. it cannot be resized. To achieve a bigger font size the screen resolution can be changed.

The "version.txt" file is in \MyDocuments\LabViewData\Power_easy_kit_data\version.txt

After a click on '**Start-Demo**' the following window will appear:



4.2.1 Infineon Driver SBC Evaluation Board GUI

The window above contains four tabs **'Functional Test'**, **'SPI Command'**, **'SPI Programm'** and **'Run SPI Program'** to control and observe the Driver SBC.

The bar at the bottom of the window displays the connection status to the Driver SBC:

- **'Communicating'**
  A light green flashing symbol indicates SPI data transmission between software and the Driver SBC.

- **'Power EasyKit Comms OK'**
  If the symbol remains blue, the communication is working fine. Otherwise if the symbol is flashing yellow, this indicates a communication problem between software and microcontroller. The safest way to re-establish the connection is to close the software, reset the evalution and microcontroller board and start the program again.

- **'Update Rate'**
  The sliding controller allows configuring the update rate of the status register in the "Status Information" field and the MS_CTRL register read out periodically. The period ranges from 64ms to 1.15s.

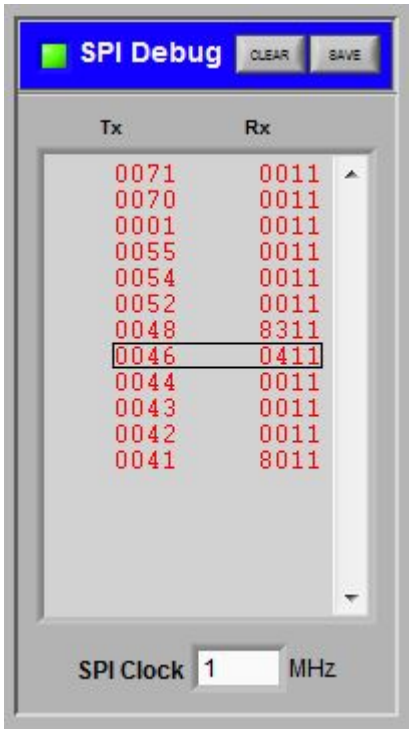
In the **'File'** menu at the top the user can open and save his self-provided commands and programs (XML data format). This functionalty will be described in detail later.

4.2.2 'Functional Test' tab

This tab informs the user about the chip status and allows controlling the most important Driver SBC settings.

In the upper left corner the section '**Failure and Reset**' is located.

The button '**SBC Soft Reset**' will send an SPI command to return all SPI registers back to default and set the chip to "INIT MODE".
The three symbols **'INT'**, **'RO'** and **'FO'** have a kind of "artificial glow" to visualize the according signals to the user.



On the left side a section for **SPI debugging** can be found.

The 16 bit SPI words sent and received by the microcontroller can be recorded by enabling the green checkbox on the left of **'SPI Debug'**.

In the listbox below the SPI data are displayed and the checkbox is flashing light green and yellow to indicate data recording.

The recorded data are separated into transmitted and received SPI words, each consisting out of a 4-bit hexadecimal number. At the top of the list the last SPI sequence sent/received is displayed.

At the bottom of the section the **SPI Clock** frequency can be modified.

Note: *In the GUI the SPI word is displayed with the MSB on the left. The microcontroller in contrast is sending the SPI word inversely, starting with the LSB!*

The framed sequence in the picture is taken as an example to illustrate the relevance of the individual **Tx** and **Rx** bits:

$$Tx: 0046_h = 0000\ 0000\ 0100\ 0110_b$$
$$Rx: 0411_h = 0000\ 0100\ 0001\ 0001_b$$

Transmitted SPI word

Data Bits to the Driver SBC								R/W	Address Bits						
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0

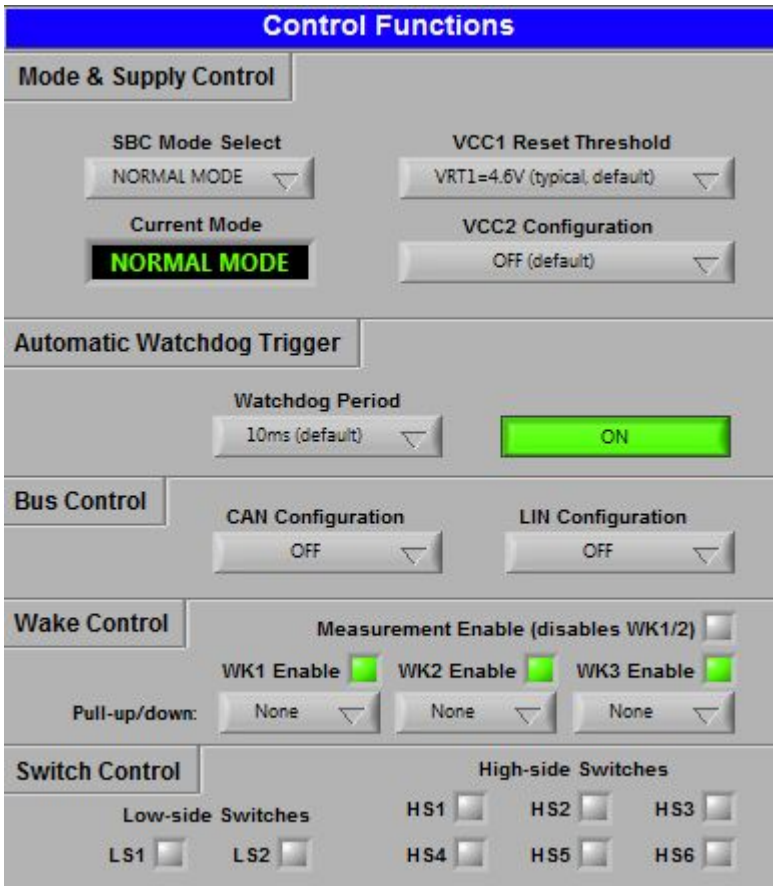
Bit 7 (Read/Write) is set to zero, i.e. the program is reading the register addressed by the bits 6...0; In this case the address “0100110” belongs to the WK_STAT register.

Received SPI word

Data Bits from the Driver SBC								Status Information							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1

The data from the WK_STAT register are received in the bits 15...8. In the example the WK3_WU bit is set. The bits 7...0 show if a bit is set in one of the according status register. [see data sheet 16.3]

The section **'Control Functions'** allows the user to change the main Driver SBC settings and is divided into several sub-sections:



'Mode and Supply Control':
The SBC Mode can be changed by selecting the respective entry in the **'SBC Mode Select'** dropdown menu, the actual mode is displayed in the textbox below.

'VCC1 Reset Threshold' allows the user to choose between four different values of VCC1 undervoltage detection

'VCC2 Configuration' is used to enable/disable VCC2 in the different modes.

'Automatic Watchdog Trigger':
It is possible to enable/disable the automatic watchdog triggering and select between four timer periods.

'Bus Control'
The two dropdown menus **'CAN Configuration'** and **'LIN Configuration'** are used to configure the CAN- and LIN Bus settings.

'Wake Control'
The pins WK1/2/3 can be configured as wake capable by activating the respective checkbox.
If a pin is set to be wake capable, a voltage level change form low to high or high to low will cause a wake event.
Each wake input can be connected to an internal pull-up/down resistor by selecting the respective entry from the dropdown menu. Automatic means, that if a high level is detected the pull-up is activated, otherwise the pull-down resistore for a low level.
Furthermore the alternate measurement function with WK1 and WK2 can be enabled.

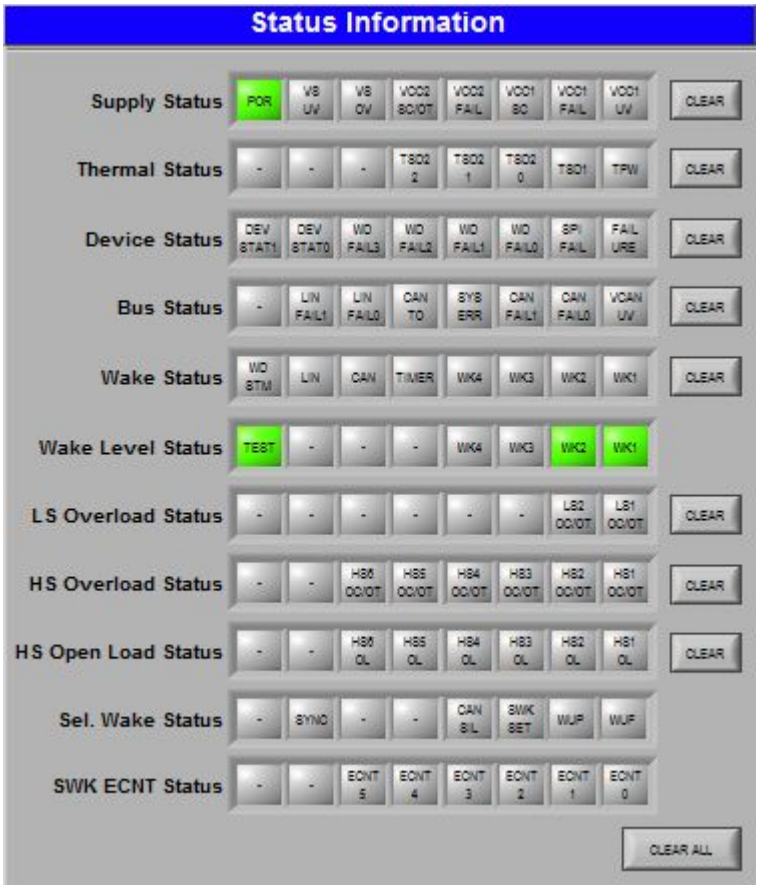
'Switch Control'
The **'Low-side Switches'** and **'High-side Switches'** can be enabled/disabled manually by klicking the corresponding HSx oder LSx checkbox.

Note: *Once the watchdog triggering has been enabled in the "Functional Test" tab, it continues regardless of which tab ('Functional Test', 'SPI Command', 'SPI Program' or 'Run SPI Program') is selected. The watchdog trigger period can be changed in the other tabs but the automatic trigger function will overwrite this setting with the next WD trigger.*

Note: *If the settings are modified in one of the other tabs ('SPI Command', 'SPI Programm' or 'Run SPI Program') and you return back to the 'Functional Test' tab, the controls are not updated!*
For example if the HS1 has been enabled in the SPI Command tab, the HS1 checkbox however will be grey. It would be a high effort to read out the current state of all registers.

The **'Status Information'** section displays the bit mapping of the Driver SBC's status register.

The software is only updating the status register automatically, when the 'Functional Test' tab is active.



A symbol is glowing light green, if the respective bit in the status register is set.

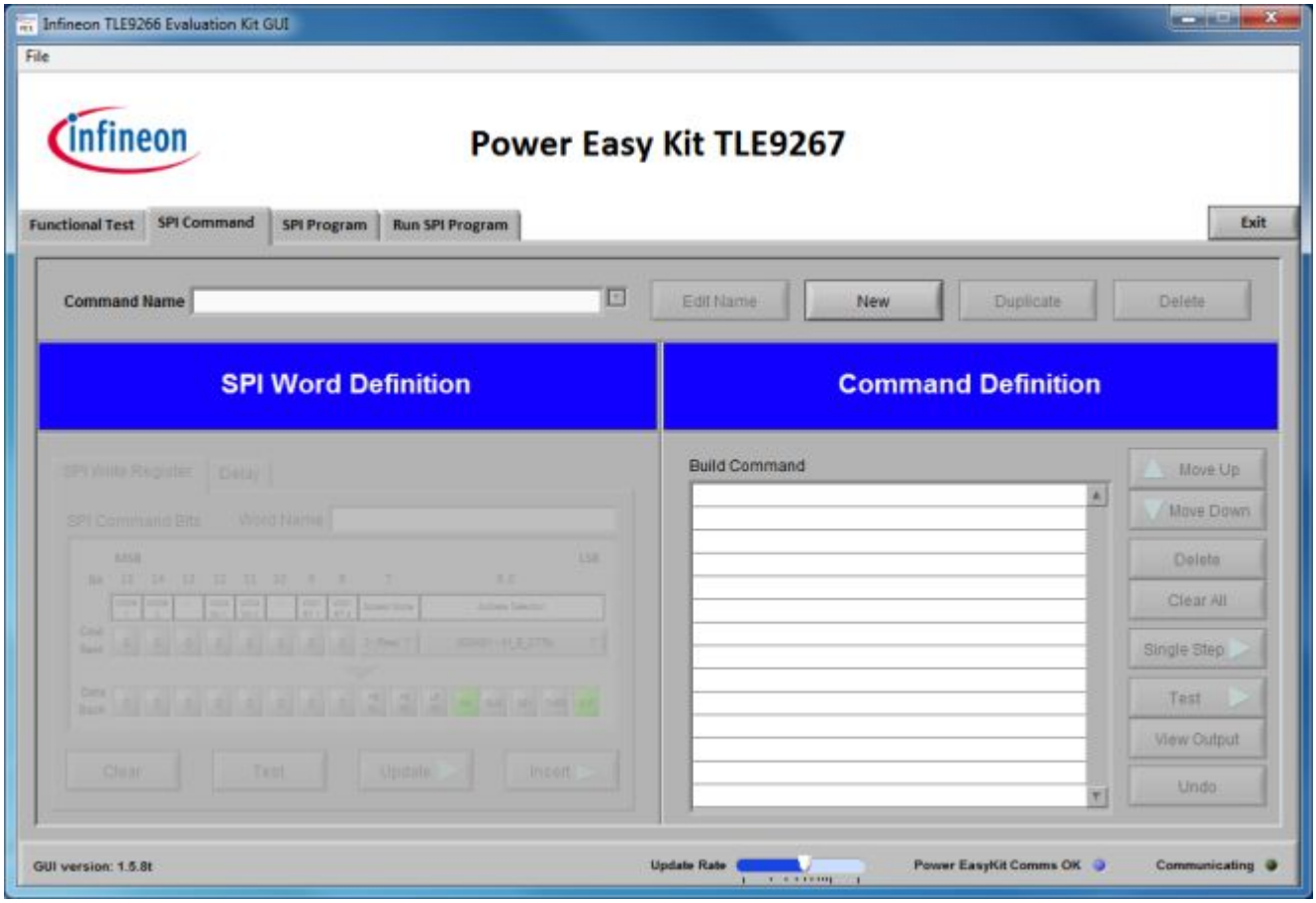
Additional information of a bit is given when the mouse pointer stays above the corresponding symbol (hover tip):

Each status register can be cleared through the button on the right.
All status registers are set to default by pressing the **'CLEAR ALL'** button in the lower right corner.

4.2.3 'SPI Command' tab

This tab allows the definition of SPI commands. A **command** consists of one or more SPI **words** which can be defined bit by bit and it can also contain a defined delay

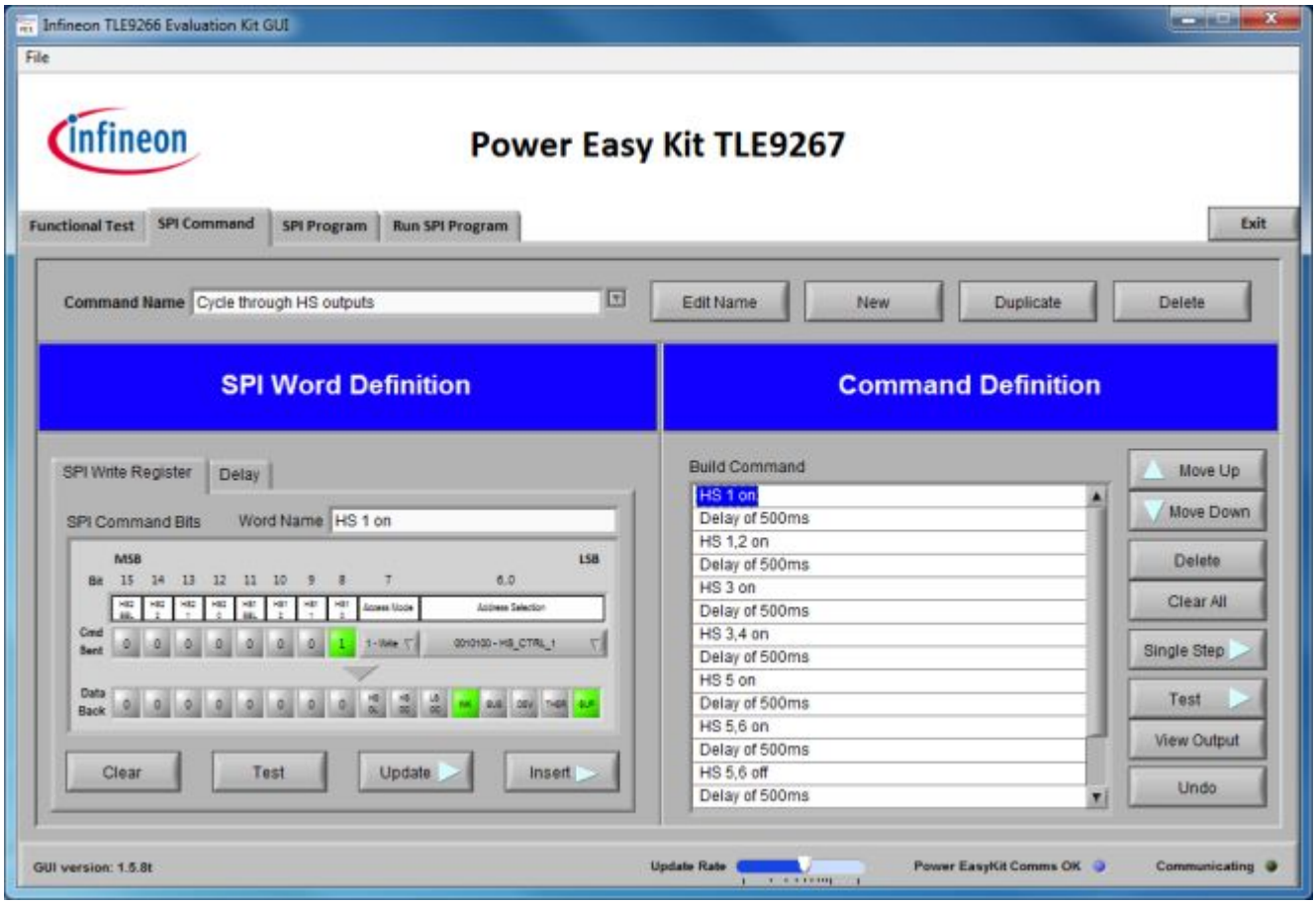
When switching to 'SPI Command' for the first time after the program starts the tab will look like the following:



At the beginning almost every control device is greyed out and the **'Build Command'** list is empty.

To edit/open a pre-saved command select the corresponding XML file via **'File'** -> **'Open'**:
'…TLE9266\Software\TLE9266 programs.xml'
To simply start with defining a new command press the **'New'** button above

After opening the xml file or defining a new command, the tab will look like the following and every control device is now accessible:



At the top of the 'SPI Command' tab is a bar to manage the SPI commands:

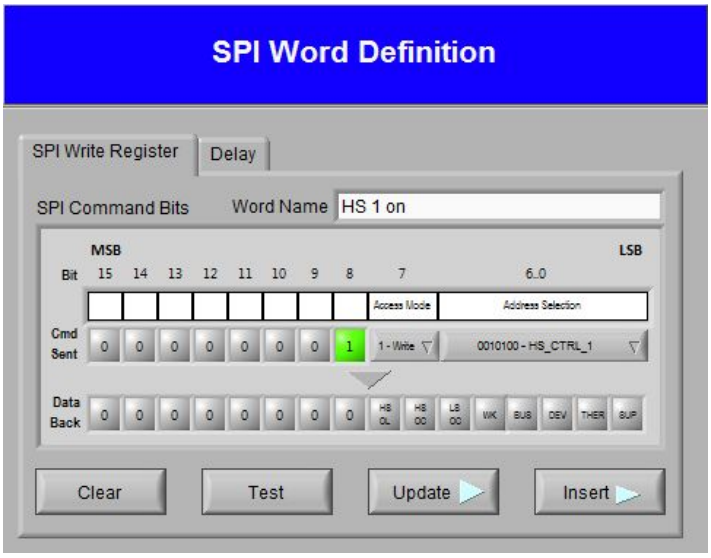
In the middle is a dropdown symbol which enlists the commands from the XML file. The actual command is displayed in the textbox on the left.

On the right are four buttons to edit the SPI commands in the xml file:

- **'Edit Name'**: A popup window will appear where the user is able to change the name of the actual command
- **'New'**: A blank SPI command will be created and a popup window will appear to enter the name.
- **'Duplicate'**: The actual command is copied and inserted into the list as '…(copy)'
- **'Delete'**: The actual command is removed from the list

Note: *New or changed commands are not automatically saved to the xml file! Always save your list to the XML file via 'File' -> 'Save'.*

The sub-section **'SPI Word Definition'** is divided into two sub-tabs, **'SPI Write Register'** and **'Delay'**



'SPI Write Register' is used to define a SPI word.

The name of the actual SPI word is displayed in the **'Word Name'** textbox and can be edited there.

Below, the 16 bits of the word sent to the Driver SBC can be arranged; their relevance is equal to 4.2.2 SPI Debug.

The address **bits 0...6** are configured by selecting an entry from the **'Address Selection'** dropdown list. By doing so the respective register is read from the Driver SBC and the result is returned in the **'Data Back'** row to display the actual bit mapping.

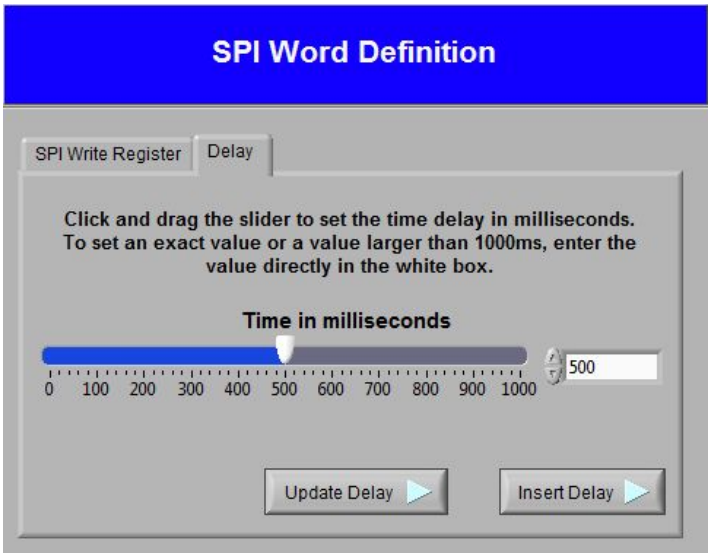
A hover tip on the address displays additional information about the register function.

The **bit 7 (Access Mode)** can be selected write/read for control register and read/clear for status register.

The remaining **bits 8…15** are the data bits and can be set to one/zero by enabling/disabling the respective checkbox. Their function is displayed in the white textbox above.

The four buttons at the bottom have the following functionality:

- **'Clear'**: All bits in 'Cmd Sent' and 'Data Back' and the 'Word Name' are cleared
- **'Test'**: The actual configuration is directly sent to the Driver SBC
- **'Insert'**: The actual configuration is inserted into the neighboring 'Build Command' list on the right.
- **'Update'**: The actual configuration overwrites the word selected in the 'Build Command' list

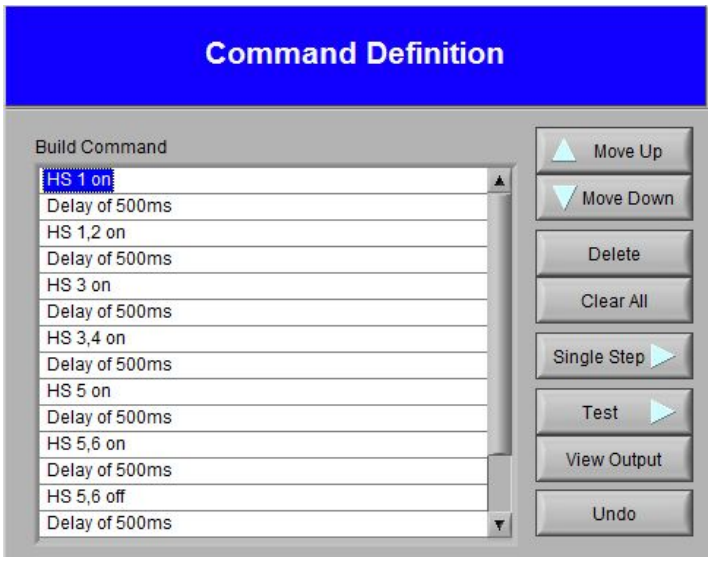


In the **'Delay'** tab a specific delay time can be defined.

The time is configured by adjusting the slider or directly writing the value into the white textbox.

- **'Insert Delay':**
  Adds the selected value to the 'Build Command' list on the right.
- **'Update Delay':** Modifies the delay value selected in the 'Build Command' list

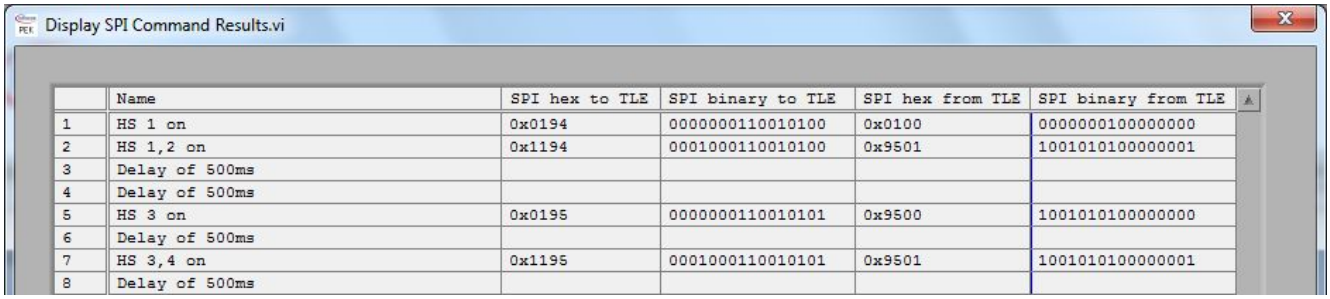
The sub-section **'Command Definition'** is used to arrange the individual words of the SPI command that is selected in the textbox **'Command Name'.** The list can contain up to 20 entries.



- **'Move Up/Down'**: Changes the order of the SPI words in the list
- **'Delete'**: Removes an entry from the list
- **'Clear All'**: Cleares the whole list
- **'Single Step'**: The SPI word marked blue is executed an the cursor jumps to the next entry. This allows sequential testing of the words in the list.
- **'Test'**: Executes the whole list in the given order.[1] At the end a window pops up showing a summary of the transmitted and received data, which can be stored in a text file. [Figure 1]
- **'View Output'**: Opens a window showing the transmitted data. [Figure 2]
- **'Undo'**: Revokes the last change made.

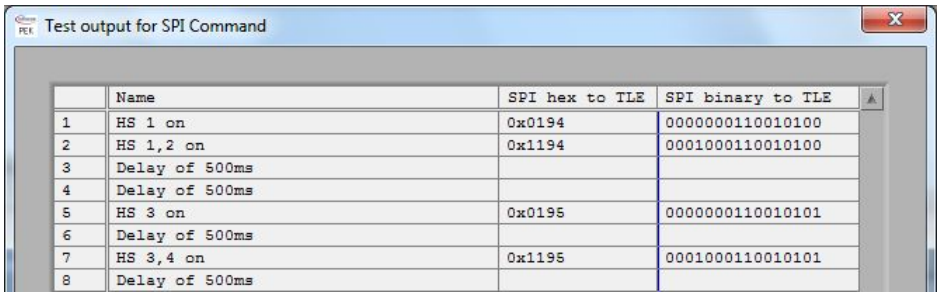
In this example the build command is a "running light" through the high side LED's on the evaluation board.

Note: *If there is an empty command or a command which only contains a delay, this will result in an error. In each command the use of SPI is necessary; otherwise the program is stuck when executing the SPI program.*



	Name	SPI hex to TLE	SPI binary to TLE	SPI hex from TLE	SPI binary from TLE
1	HS 1 on	0x0194	0000000110010100	0x0100	0000000100000000
2	HS 1,2 on	0x1194	0001000110010100	0x9501	1001010100000001
3	Delay of 500ms				
4	Delay of 500ms				
5	HS 3 on	0x0195	0000000110010101	0x9500	1001010100000000
6	Delay of 500ms				
7	HS 3,4 on	0x1195	0001000110010101	0x9501	1001010100000001
8	Delay of 500ms				

Figure 1



	Name	SPI hex to TLE	SPI binary to TLE
1	HS 1 on	0x0194	0000000110010100
2	HS 1,2 on	0x1194	0001000110010100
3	Delay of 500ms		
4	Delay of 500ms		
5	HS 3 on	0x0195	0000000110010101
6	Delay of 500ms		
7	HS 3,4 on	0x1195	0001000110010101
8	Delay of 500ms		

Figure 2

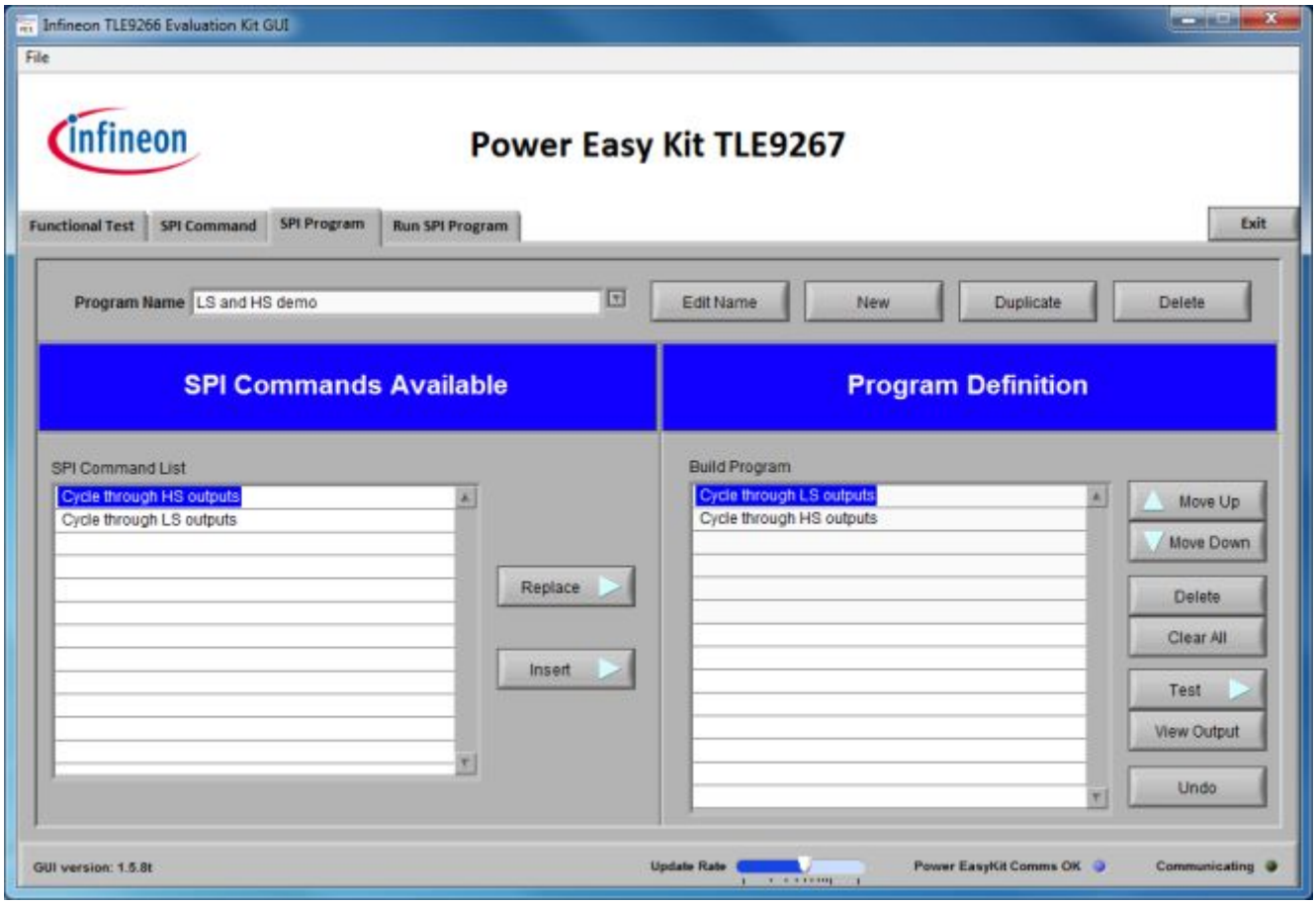
4.2.4 'SPI Program' tab

[1] In the actual software version the **Fail Output** may be triggered by mistake.An internal software error triggers chip select, without sending data. The Driver SBC interprets this as **SPI Stuck** and activates the Fail Output.
Just clear the **'Device Status'** register in the Driver SBC Functional Tab and continue working.

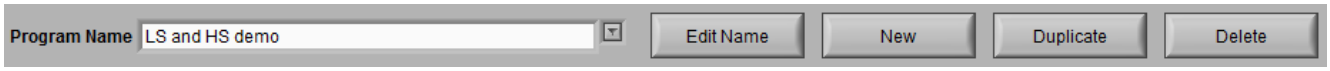
The **'SPI Program'** tab allows creating and modifying SPI programs. An SPI program is a list of SPI commands which are executed sequentially.

The structure of the **'SPI Program'** tab is very similar to the the **'SPI Command'** tab described in the chapter before.

Opening the tab for the first time after program start, most control devices are greyed out until a new program is created or a pre-saved program is loaded from the XML file. It is the same file the SPI commands are stored in.



At the top of the 'SPI Program' tab is a bar to manage the available SPI programs:

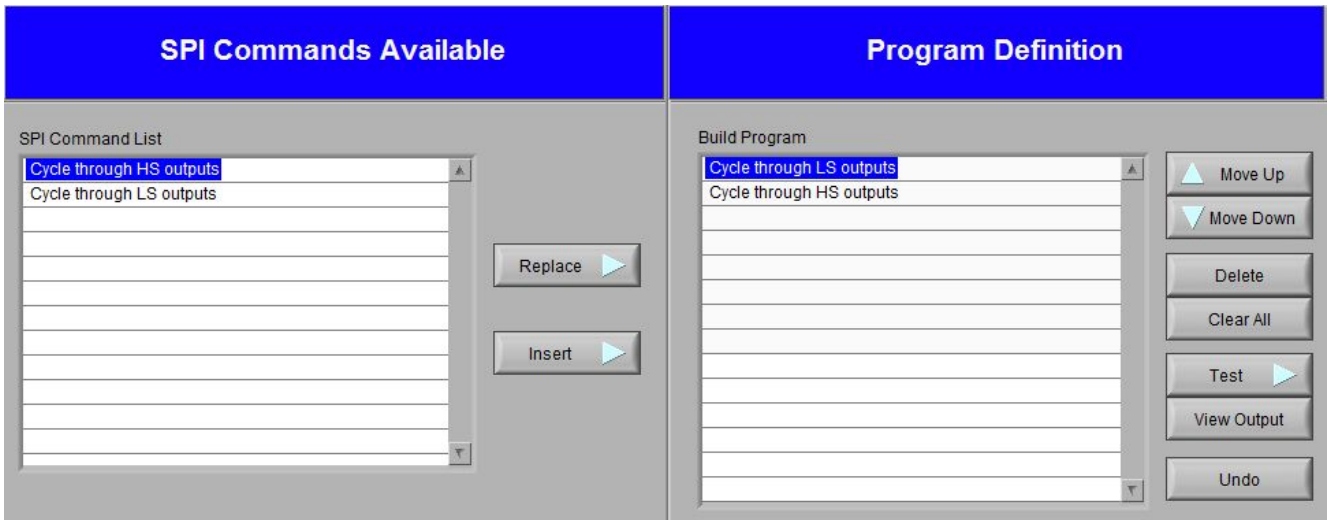


In the middle is a dropdown symbol  which enlists the programs from the XML file. The actual program is displayed in the textbox on the left.

On the right are four buttons to edit the SPI programs in the xml file:

- **'Edit Name'**: A popup window will appear where the user is able to change the name of the actual program
- **'New'**: A blank SPI program will be created and a popup window will appear to enter the name.
- **'Duplicate'**: The actual program is copied and inserted into the list as "….(copy)"
- **'Delete'**: The actual program is removed from the list

Note: *New or changed programs are not automatically saved to the xml file! Always save your list to the XML file via 'File' -> 'Save'.*



The sub-section **'SPI Commands Available'** displays the configured SPI commands from the list.

- **'Insert'**: The selected command is inserted into the neighboring 'Build Programm' list on the right.
- **'Update'**: The selected command overwrites the command selected in the 'Build Program' list

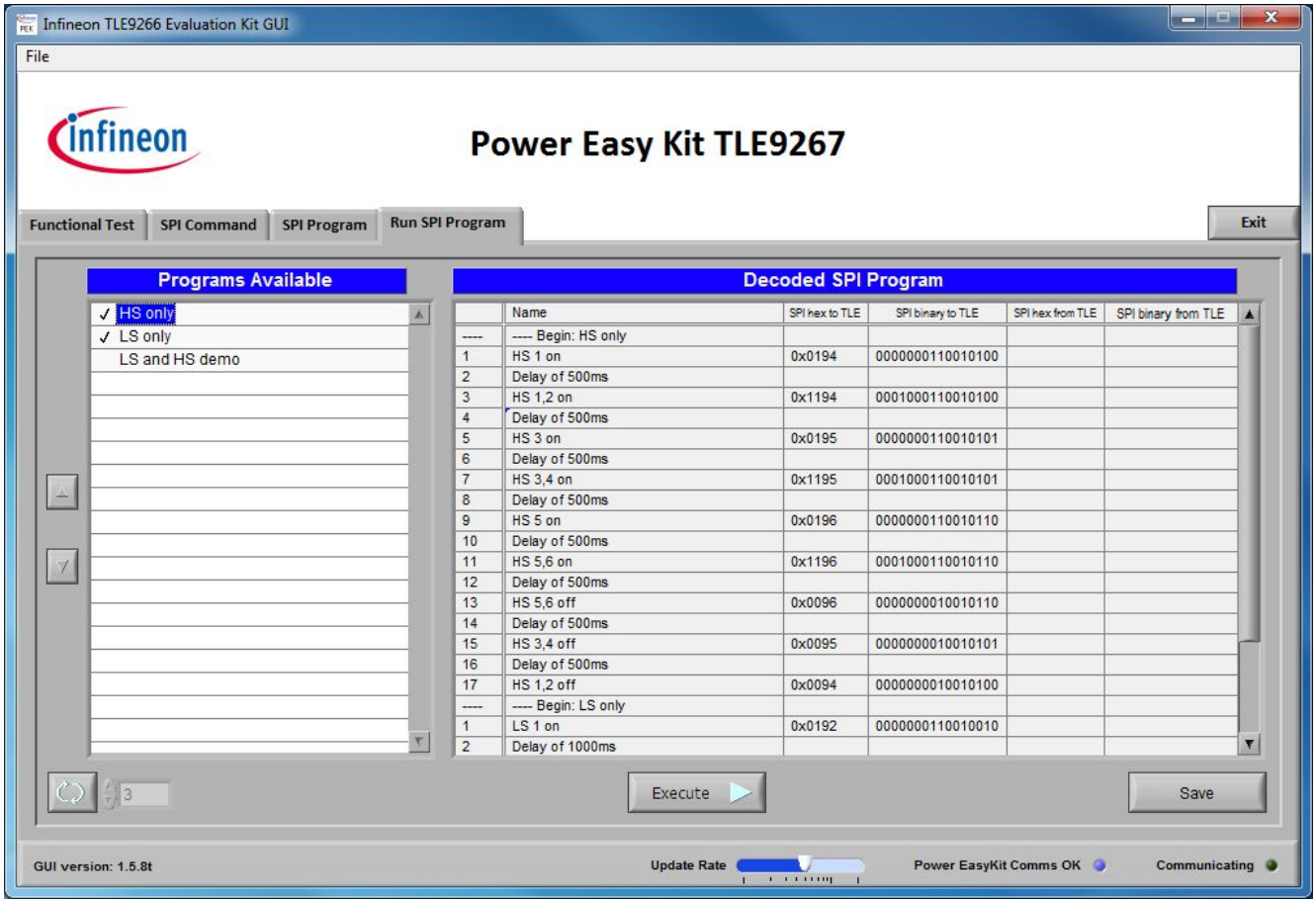
The sub-section **'Program Definition'** allows arranging the commands of the actual SPI program.

- **'Move Up/Down'**: Changes the order of the SPI commands in the list
- **'Delete'**: Removes an entry from the list
- **'Clear All'**: Cleares the whole list
- **'Test'**: Executes the whole list in the given order.[1] The active command is highlighted by a yellow background. At the ending a window pops up showing a summary of the transmitted and received data, which can be stored in a text file. [Figure 1 on page 19]
- **'View Output'**: Opens a window showing the transmitted data. [Figure 2 on page 19]
- **'Undo'**: Revokes the last change made.

[1] In the actual software version the **Fail Output** may be triggered by mistake.An internal software error triggers chip select, without sending data. The Driver SBC interprets this as **SPI Stuck** and activates the Fail Output.
Just clear the **'Device Status'** register in the Driver SBC Functional Tab and continue working.

‘Run SPI Program’ tab

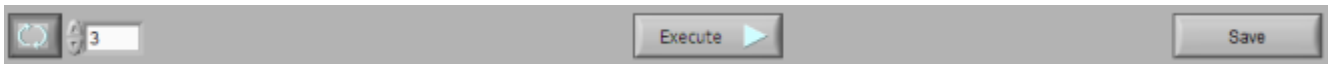
The ‘Run SPI Program’ tab allows multiple programs to be run sequentially or a single program to be run in loops. This window is suitable for regression testing under various application conditions:



The **‘Programs Available’** section displays the SPI programs stored in the xml file. If the respective entry is checked by a mouseclick, the program is added to the ‘Decoded SPI Program’ list.
The order of the programs can be modified by using the two arrows on the left.

The **‘Decoded SPI Program’** section itemizes the selected programs down to the lowest level and displays the pre-configured SPI words.

At the bottom are further control elements:



- The **loop** button on the left allows running the **'Decoded SPI Program'** several times.
- **'Execute'**: Starts to execute the **'Decoded SPI Program'**list.[1] A small window opens up showing the current number of iterations.

  Via the '**STOP'** button the excecution of the sequence can be interrupted.

  The active part of the program is highlighted by a yellow background in the Program Available section. [Figure 3]

  After the execution of the program was successful, a window pops up showing a summary of the transmitted and received data. Again these data can can be stored in a text file. [Figure 4]
- **'Save'**: The **'Decoded SPI Program'** can be stored to a text file for documentation only. It is not possible to use the text file like the xml file as a template.

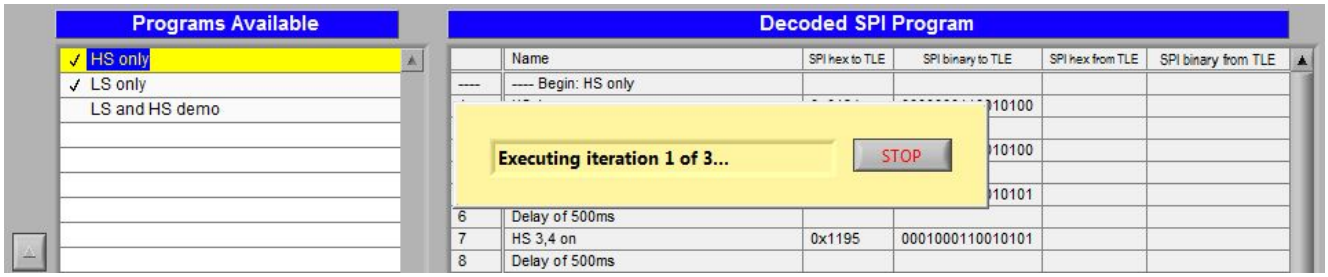
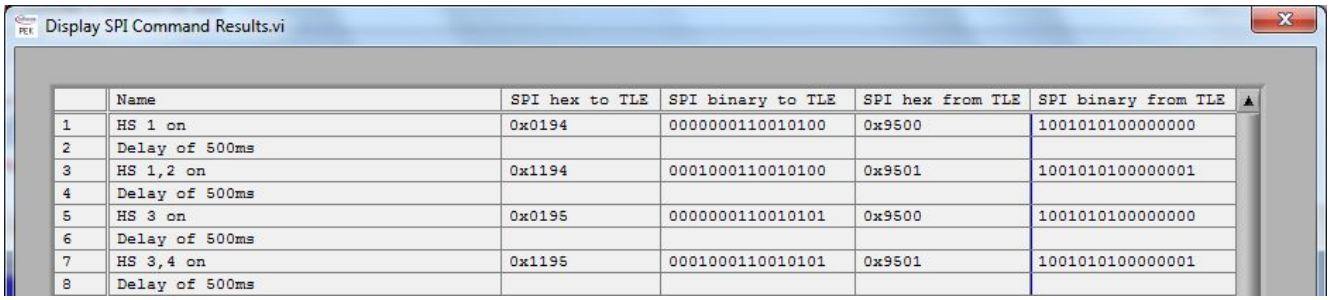


Figure 3



	Name	SPI hex to TLE	SPI binary to TLE	SPI hex from TLE	SPI binary from TLE
1	HS 1 on	0x0194	0000000110010100	0x9500	1001010100000000
2	Delay of 500ms				
3	HS 1,2 on	0x1194	0001000110010100	0x9501	1001010100000001
4	Delay of 500ms				
5	HS 3 on	0x0195	0000000110010101	0x9500	1001010100000000
6	Delay of 500ms				
7	HS 3,4 on	0x1195	0001000110010101	0x9501	1001010100000001
8	Delay of 500ms				

Figure 4

[1] In the actual software version the **Fail Output** may be triggered by mistake.An internal software error triggers chip select, without sending data. The Driver SBC interprets this as **SPI Stuck** and activates the Fail Output.
Just clear the **'Device Status'** register in the Driver SBC Functional Tab and continue working.

5 Additional Information

- For further information you may contact **http://www.infineon.com/SBC** or your regional FAE.

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