

# SPOC™+2 User Manual

## Multichannel SPI High-Side Power Controller

### About this document

#### Scope and purpose

This User Manual is intended to enable users to integrate the SPOC™+2 Software for the SPOC™+2-Demoboard.

#### Intended audience

This document is intended for anyone using the SPOC™+2 Software.

#### Document conventions

**Table 1** Conventions

| Convention  | Explanation                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Bold        | Emphasizes heading levels, column headings, table and figure captions, screen names, windows, dialog boxes, menus and sub-menus                     |
| Italics     | Denotes variable(s) and reference(s)                                                                                                                |
| Courier New | Denotes APIs, functions, interrupt handlers, events, data types, error handlers, file/folder names, directories, command line inputs, code snippets |

#### Conventions for reading the configuration class field

The following examples help the integrator to identify the configuration class of the parameter for a given delivery type.

## Abbreviations and definitions

**Table 2**      **Abbreviations**

| <b>Abbreviation</b>      | <b>Definition</b>                   |
|--------------------------|-------------------------------------|
| SPOC <sup>TM</sup> +2    | SPI Power Controller                |
| SPOC <sup>TM</sup> +2 MB | SPOC <sup>TM</sup> +2 Motherboard   |
| SPOC <sup>TM</sup> +2 DB | SPOC <sup>TM</sup> +2 Daughterboard |
| NC                       | Not Connected                       |
| LHI                      | Limp Home Input                     |
| IS                       | Sense current                       |

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## 1 General information

### 1.1 Required hardware

First of all some special hardware is needed:

- **SPOC™+2 MB**
  - SPOC™+2 Motherboard
  - See Figure 1



Figure 1 – SPOC™+2 MB

- **SPOC™+2 DB**
  - Product specific (BTSxxxxx-xxxx)
  - See Figure 2



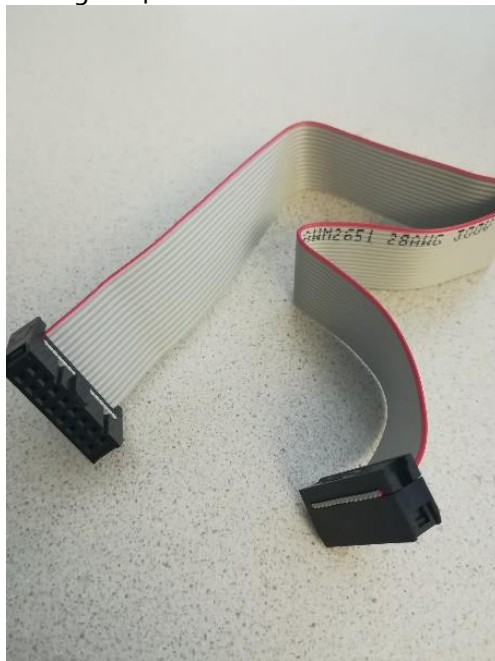
Figure 2 – SPOC™+2 DB

- **μIO-Stick**
  - Communication between your computer and the Demoboard
  - Isar Number: SP00121532
  - See Figure 3



**Figure 3 - μIO-Stick**

- **Connection cable**
  - Ribbon cable
    - 16 pin female connector
  - See figure 4



**Figure 4 - Connection cable**

- **USB-Stick**
  - For software installation
  - See Figure 5



Figure 5 - Software installation USB-Stick

## 1.2 Software Installation

### 1.2.1 SPOC™+2 Application

How to install software for the **SPOC™+2 Evaluation Board**:

- Plug in the Software-USB-Stick into a USB port of your computer
- Run **setup.exe** in the following location:
  - **USB-Drive:\SPOC+2\_Installer\Volume\setup.exe** (see Figure 6)

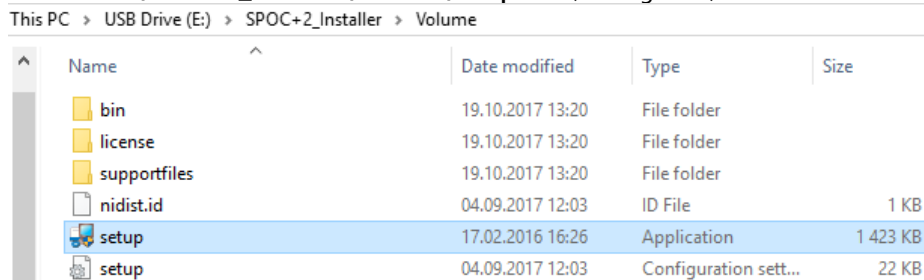


Figure 6 – SPOC™+2 - setup.exe

- Note: You must log in as administrator!
- Follow the steps of the Installation Wizard (see Figures below):
  - Select installation directory, then click "next"

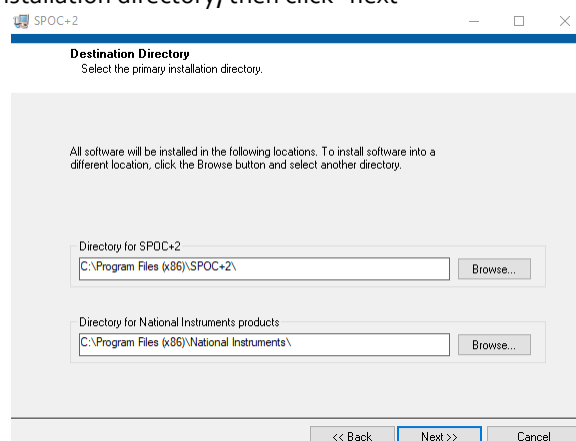


Figure 7 - SPOC™+2 Application - Select Directory

- Again click "next"

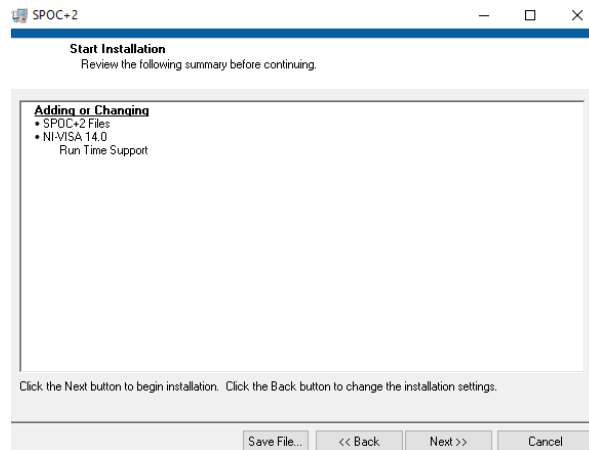


Figure 8 – SPOC™+2 - Application - Start Installation

- The installation will start, after that click „finish“

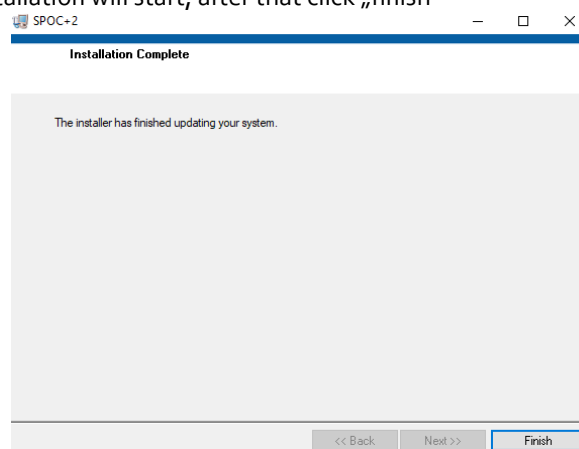


Figure 9 – SPOC™+2 - Application – Finish

### 1.2.2 $\mu$ IO-Stick Driver Install

After installing the SPOC™+2-Application keep the Software-USB plugged in and plug in the  $\mu$ IO-Stick. In order to use the virtual COM-port (necesairry for the application) go to <https://www.ehitex.de/usb-application-sticks/infineon/2529/uio-stick>, scroll to **Available Downloads** and select **Download uIO Updater (zip file)** see Figure 10. Extract the zip file and run *UpdatePEK* afterwards.

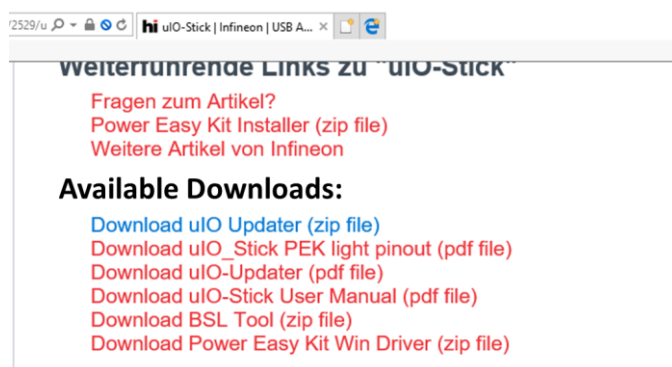
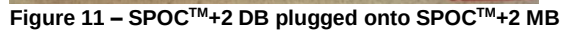


Figure 10 -  $\mu$ IO-Updater (for vCOM)

### 1.3 Setup Hardware

- Plug the SPOC™+2 DB onto the SPOC™+2 MB (see Figure 11)





- 
- Pin 1

**Figure 12 - Connecting  $\mu$ IO-Stick to SPOC™+2 MB**

- Version 1.0  
2017-11

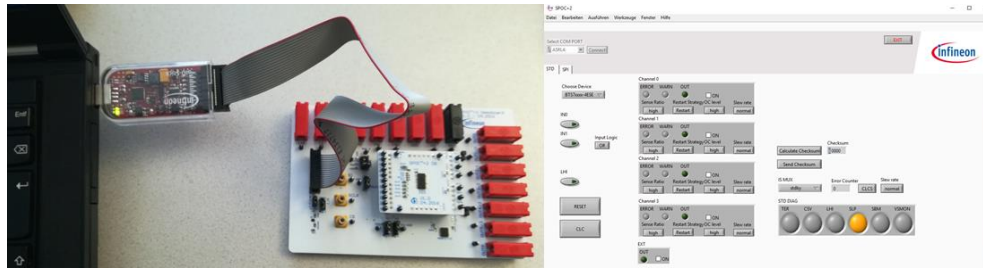


Figure 13 - Finished setup

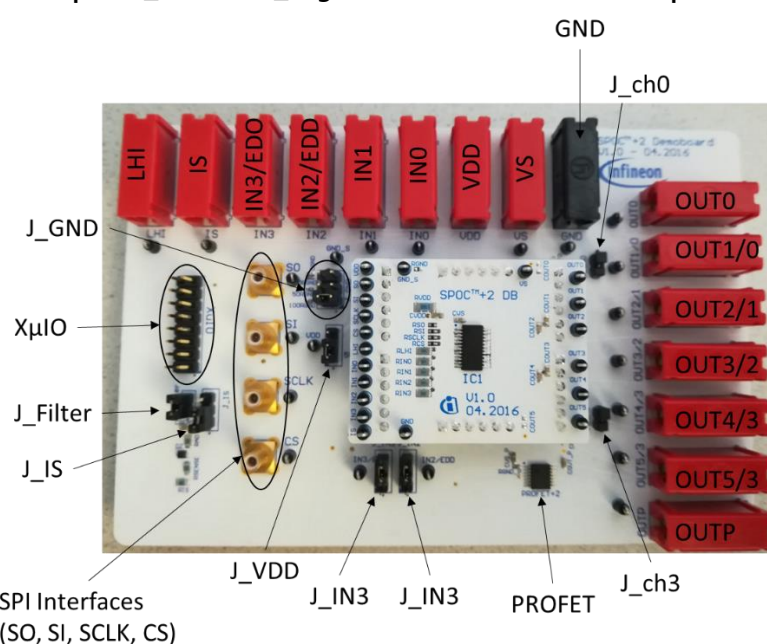
### 1.3.1 Setup details

| Table 3            |                                                                                                                                                                                                                            |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| XμIO               |                                                                                                                                                                                                                            |
| Pin #              |                                                                                                                                                                                                                            |
| ○ 1                | NC                                                                                                                                                                                                                         |
| ○ 2                | GND                                                                                                                                                                                                                        |
| ○ 3                | NC                                                                                                                                                                                                                         |
| ○ 4                | +5VμIO                                                                                                                                                                                                                     |
| ○ 5                | NC                                                                                                                                                                                                                         |
| ○ 6                | NC                                                                                                                                                                                                                         |
| ○ 7                | NC                                                                                                                                                                                                                         |
| ○ 8                | IN <sub>3</sub>                                                                                                                                                                                                            |
| ○ 9                | CS                                                                                                                                                                                                                         |
| ○ 10               | IN <sub>2</sub>                                                                                                                                                                                                            |
| ○ 11               | SCLK                                                                                                                                                                                                                       |
| ○ 12               | IN <sub>1</sub>                                                                                                                                                                                                            |
| ○ 13               | SO                                                                                                                                                                                                                         |
| ○ 14               | IN <sub>0</sub>                                                                                                                                                                                                            |
| ○ 15               | SI                                                                                                                                                                                                                         |
| ○ 16               | Sense                                                                                                                                                                                                                      |
| J_Filter           | Closed by default                                                                                                                                                                                                          |
| J_IS               | 1-2 closed by default<br>If 2-3 is closed: <ul style="list-style-type: none"> <li>J_Filter has to be opened!</li> <li>Sense directly switched to IS (Filter disconnected)</li> </ul>                                       |
| J_GND              | 1-2 closed: R_GND = 150 Ω (default)<br>3-4 closed: R_GND = 50 Ω<br>5-6 closed: R_GND = 0 Ω                                                                                                                                 |
| J_IN <sub>2</sub>  | 3-2 closed by default.<br>If 1-2 is closed: <ul style="list-style-type: none"> <li>Connect PROFET <sup>2</sup></li> </ul>                                                                                                  |
| J_IN <sub>3</sub>  | 3-2 closed by default.<br>If 1-2 is closed: <ul style="list-style-type: none"> <li>Connect PROFET <sup>2</sup></li> </ul>                                                                                                  |
| J_VDD              | 1-2 closed (default VDD via μIO-Stick): <ul style="list-style-type: none"> <li>Use +5VμIO (USB) as digital supply voltage</li> </ul> 2-3 closed: <ul style="list-style-type: none"> <li>VDD via external supply</li> </ul> |
| J_cho <sup>1</sup> | Closed if 4 Channel SPOC <sup>TM</sup> +2 is used:                                                                                                                                                                         |

|                                   |                                                                                                                                            |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
|                                   | <ul style="list-style-type: none"> <li>OUT<sub>0</sub> and OUT<sub>1/0</sub> in parallel.</li> </ul>                                       |
| J_ch3 <sup>1</sup>                | Closed if 4 Channel SPOC+2 is used: <ul style="list-style-type: none"> <li>OUT<sub>4/3</sub> and OUT<sub>5/3</sub> in parallel.</li> </ul> |
| SO                                | Slave Out (SPI Interface)                                                                                                                  |
| SI                                | Slave In (SPI Interface)                                                                                                                   |
| SCLK                              | Serial Clock (SPI Interface)                                                                                                               |
| CS                                | Chip Select (SPI Interface)                                                                                                                |
| IN <sub>0</sub>                   | activate the corresponding output channel                                                                                                  |
| IN <sub>1</sub>                   | activate the corresponding output channel                                                                                                  |
| IN <sub>2</sub> /EDD <sup>2</sup> | activate the corresponding output channel                                                                                                  |
| IN <sub>3</sub> /EDO <sup>2</sup> | activate the corresponding output channel                                                                                                  |
| OUT <sub>0</sub>                  | Output channel 0                                                                                                                           |
| OUT <sub>1/0</sub> <sup>1</sup>   | Output channel 1 if J_ch0 is open,<br>Output channel 0 if J_ch0 is closed                                                                  |
| OUT <sub>2/1</sub> <sup>1</sup>   | Output channel 2 if J_ch0 is open,<br>Output channel 1 if J_ch0 is closed                                                                  |
| OUT <sub>3/2</sub> <sup>1</sup>   | Output channel 3 if J_ch0 is open,<br>Output channel 2 if J_ch0 is closed                                                                  |
| OUT <sub>4/3</sub> <sup>1</sup>   | Output channel 4 if J_ch3 is open,<br>Output channel 3 if J_ch3 is closed                                                                  |
| OUT <sub>5/3</sub> <sup>1</sup>   | Output channel 5 if J_ch3 is open,<br>Output channel 3 if J_ch3 is closed                                                                  |
| OUTP                              | Output PROFET <sup>2</sup>                                                                                                                 |
| IS                                | Sense current                                                                                                                              |
| LIH                               | Limp Home Input                                                                                                                            |
| VDD                               | Digital supply voltage                                                                                                                     |
| GND                               | Ground                                                                                                                                     |
| VS                                | Supply voltage                                                                                                                             |

<sup>1</sup> If 4-Channel-SPOC™ are used J\_ch0 and J\_ch3 had to be closed, otherwise (6-Channel-SPOC) opened.

<sup>2</sup> If Jumpers J\_IN2 and J\_IN3 are set to 1-2: SPOC™ Outputs EDD and EDO can control the PROFET.



**Figure 14 - Device components**

## 2 Using the software

### 2.1 Starting the program

- Installed Application can be found in the windows start menu in the section "all programs" → "SPOC+2" → SPOC+2 (see Figure 15):

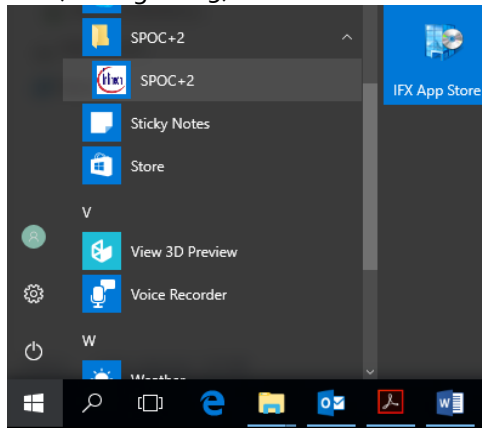


Figure 15 - SPOC+2 - Application - Finding it

or by using the search bar (see Figure 16):

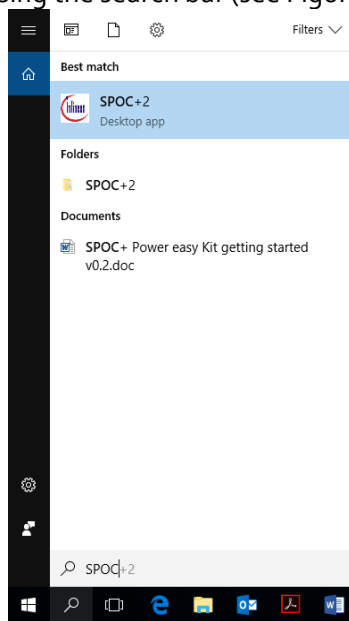


Figure 16 – SPOC<sup>TM</sup>+2 - Application - searching for it

- Run the program by clicking on the file (see Figures 15 and 16)

## 2.2 User Interface

### 2.2.1 STD-View

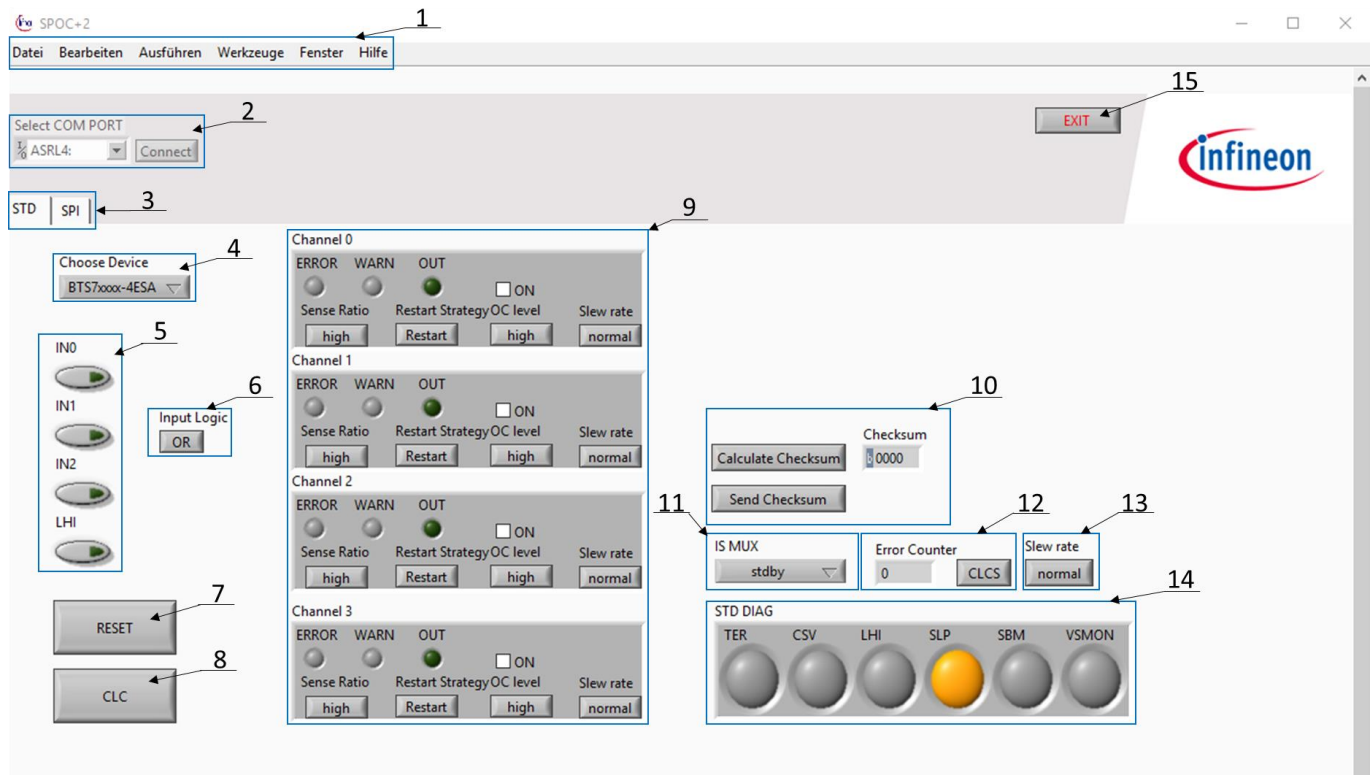


Figure 17 - User Interface - STD-View

Table 4 - STD-View

| 1  | Menu bar              | *                                                                                                                                                                                           |
|----|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2  | Port selection        | Software should detect the Comport automatically. <ul style="list-style-type: none"> <li>If not: select the needed Comport.</li> </ul>                                                      |
| 3  | Standard or SPI view  | Change between a button based control(Figure 17) and a low level SPI command control(Figure 18)                                                                                             |
| 4  | Device selection      | Select the used device type                                                                                                                                                                 |
| 5  | Direct inputs and LHI | <ul style="list-style-type: none"> <li>Switch IN0-IN2 on or off</li> <li>LHI can be set on or off</li> </ul>                                                                                |
| 6  | Input logics          | OR/AND operation between direct inputs (IN0-IN3) with the channel's on-status (channel 0 to 3)                                                                                              |
| 7  | Reset                 | Reset SPOC <sup>TM</sup> +2                                                                                                                                                                 |
| 8  | Clear                 | Clear all Error latches and error counter                                                                                                                                                   |
| 9  | Channels              | Indicates the Status of a channel (Error, Warn, OUT, Slew rate) and configures the channel (ON, Sense ratio, Restart Strategy, OC level) <ul style="list-style-type: none"> <li></li> </ul> |
| 10 | Checksum              | Shows the calculated checksum reflecting the configuration. This value will be transmitted when clicking on send checksum.                                                                  |
| 11 | IS MUX                | Configure the mux setting. For more information see datasheet of SPOC <sup>TM</sup> +2                                                                                                      |
| 12 | Error counter         | Error counter of the selected channel <ul style="list-style-type: none"> <li></li> </ul>                                                                                                    |
| 13 | Slew rate settings    | configures the slew rate of the selected channel                                                                                                                                            |
| 14 | Status display        | Visualizes the standard diagnosis (spi response)                                                                                                                                            |
| 15 | Exit button           | Closes connection and program                                                                                                                                                               |

## 2.2.2 SPI-View

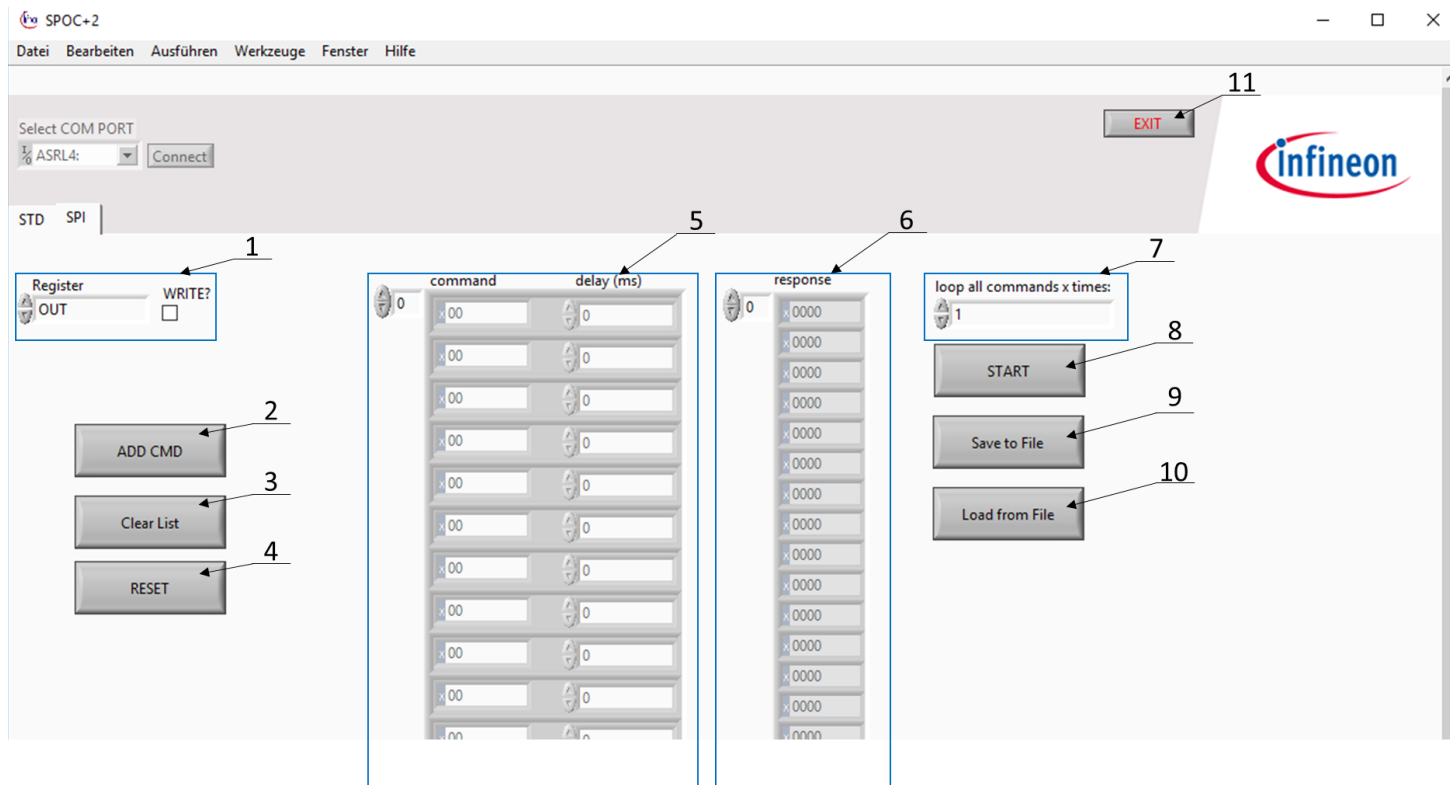


Figure 18 - User Interface - SPI-View

Table 5 - SPI-View

|    |                    |                                                                                                                                                   |
|----|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Register selection | Select the register address and in case WRITE is enabled the content for the next spi command. If WRITE is disabled a read command will be added. |
| 2  | Add command        | Adds the composed command to the command list (see 8)                                                                                             |
| 3  | Clear command list | Clears the content of the command list                                                                                                            |
| 4  | Reset              | Resets SPOC <sup>TM</sup> +2                                                                                                                      |
| 5  | Command list       | Displays all added commands in ascending order                                                                                                    |
| 6  | Response list      | Displays SPOC <sup>TM</sup> +2's response to the currently processed command (see datasheet of the used SPOC <sup>TM</sup> +2)                    |
| 7  | Loop configuration | Commands are embedded in a loop<br>Change the number of iterations (default is 1)                                                                 |
| 8  | Start button       | Starts the command sequence resp. the loop                                                                                                        |
| 9  | Save to file       | Saves the command sequence to a file                                                                                                              |
| 10 | Load from File     | Loads a saved command sequence from a file                                                                                                        |
| 11 | Exit button        | Closes connection and program                                                                                                                     |

\*...menu description not necessary at the moment → Tobias



2.3 Examples: Command sequences, SPI-View

Figure 19 below illustrates a possible test setup. The examples in 2.3.1 and 2.3.2 refer to this setup.

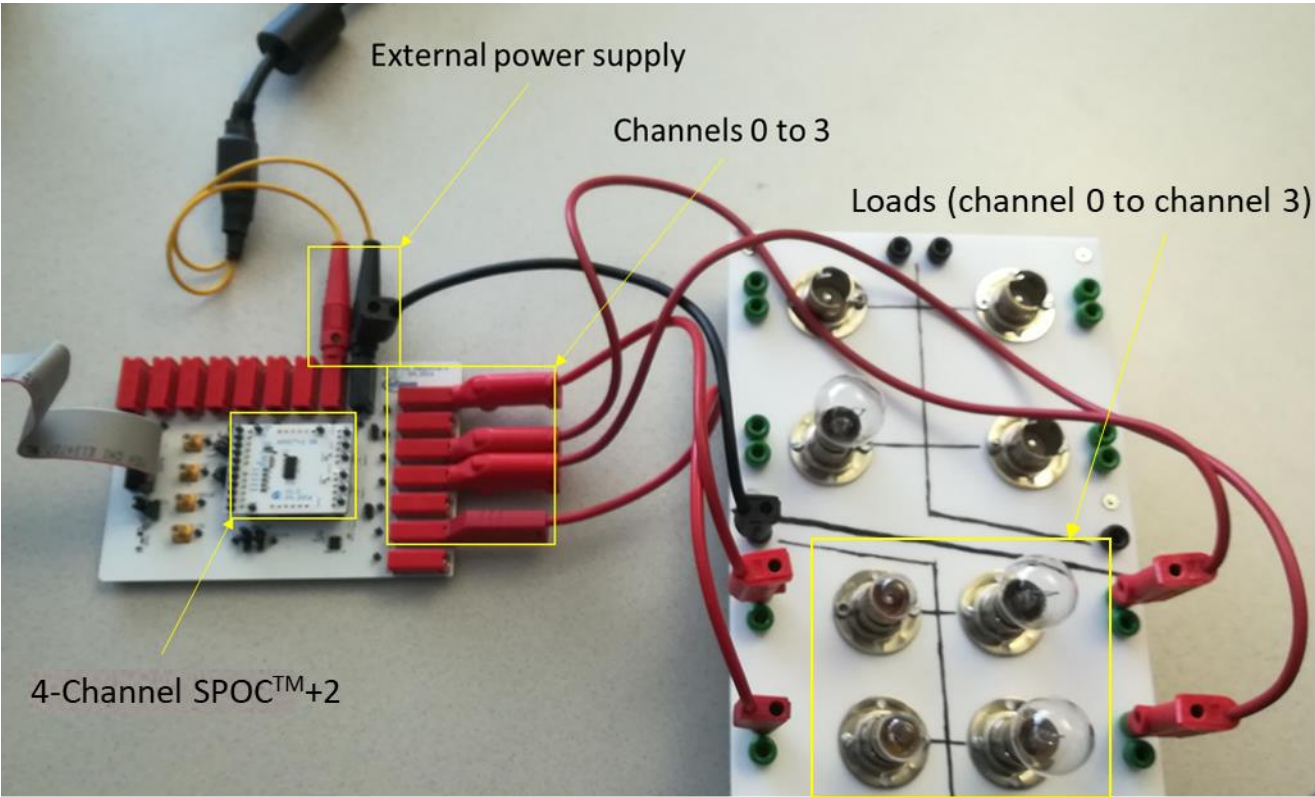


Figure 19 - Possible setup

2.3.1 Example 1: Switching on 4 lights step by step with 1 Second delay

- Switch to SPI view and select register OUT (See Figure 20)

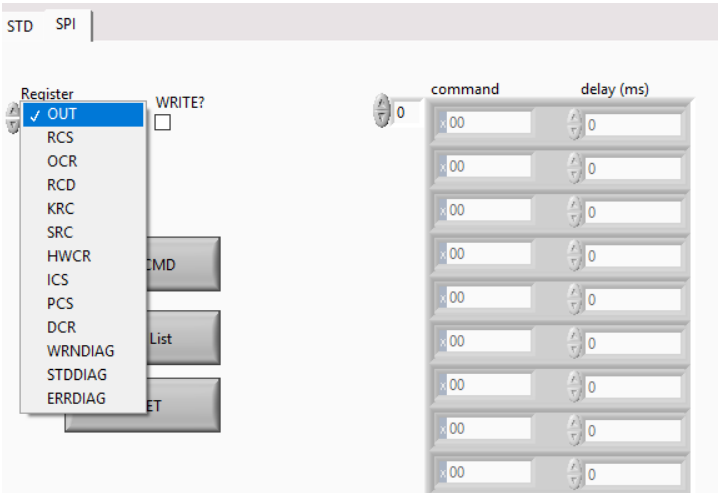
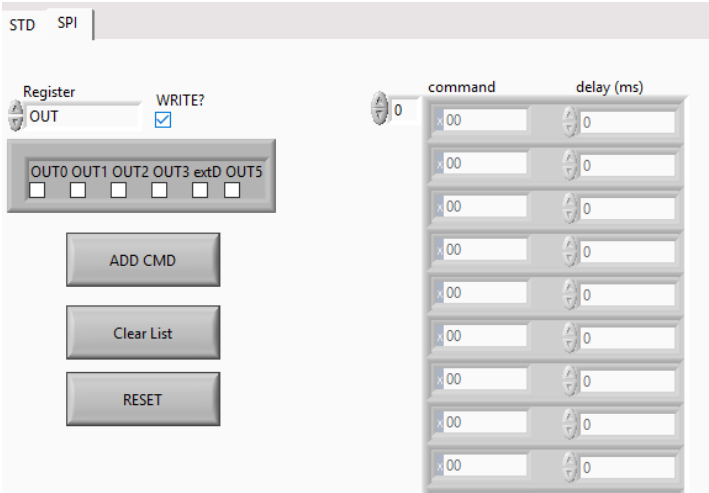


Figure 20 - Select register OUT

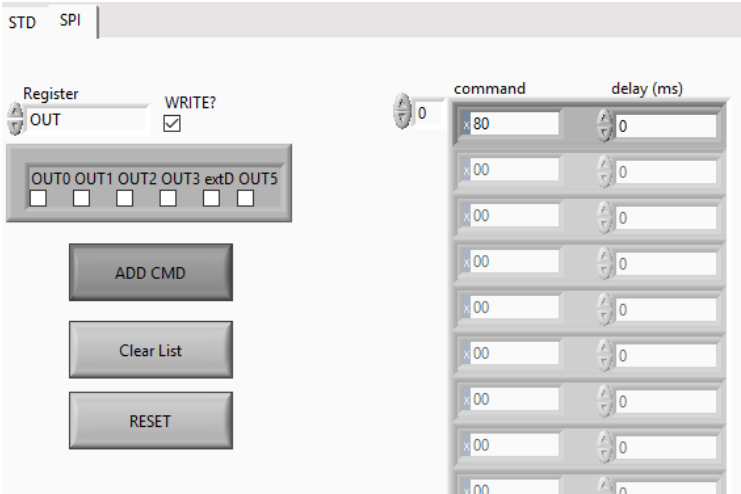
- Tick the WRITE?-Box and select no Output (See Figure 21)



The screenshot shows the 'STD' and 'SPI' tabs at the top. Below them, the 'Register' dropdown is set to 'OUT' and the 'WRITE?' checkbox is checked. A group of checkboxes for 'OUT0', 'OUT1', 'OUT2', 'OUT3', 'extD', and 'OUT5' are shown, all of which are currently unchecked. Below these are three buttons: 'ADD CMD', 'Clear List', and 'RESET'. To the right, a table with two columns, 'command' and 'delay (ms)', is visible. The 'command' column has a value of 'x00' and the 'delay (ms)' column has a value of '0'.

Figure 21 - Write to register OUT

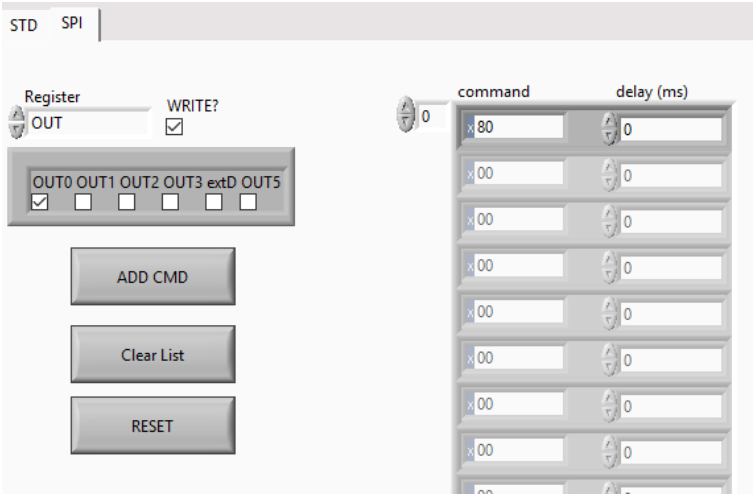
- Click ADD CMD and your command is added to the command list (See Figure 22)



The screenshot shows the same interface as Figure 21, but now the 'command' column in the table has a value of 'x80' and the 'delay (ms)' column has a value of '0'. The 'ADD CMD' button is highlighted, indicating it was just clicked.

Figure 22 - Add command to command list

- Select OUT0 in the WRITE-Box (See Figure 23)

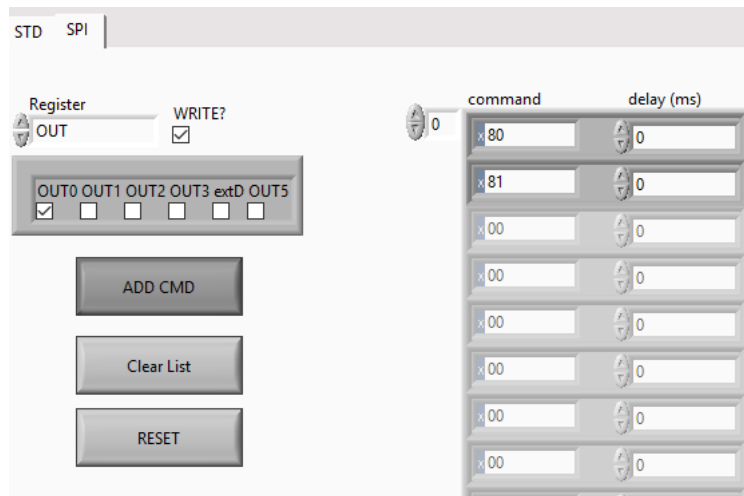


The screenshot shows the same interface as Figure 22, but now the 'Register' dropdown is set to 'OUT0' and the 'WRITE?' checkbox is checked. The 'OUT0' checkbox in the group of checkboxes is now checked, while the others remain unchecked. The 'command' column in the table still has a value of 'x80' and the 'delay (ms)' column has a value of '0'.

Figure 23 - Write OUT0



- Click ADD CMD (See Figure 24)



STD SPI

Register: OUT WRITE? ☒

OUT0 OUT1 OUT2 OUT3 extD OUT5

☒ ☐ ☐ ☐ ☐ ☐

ADD CMD

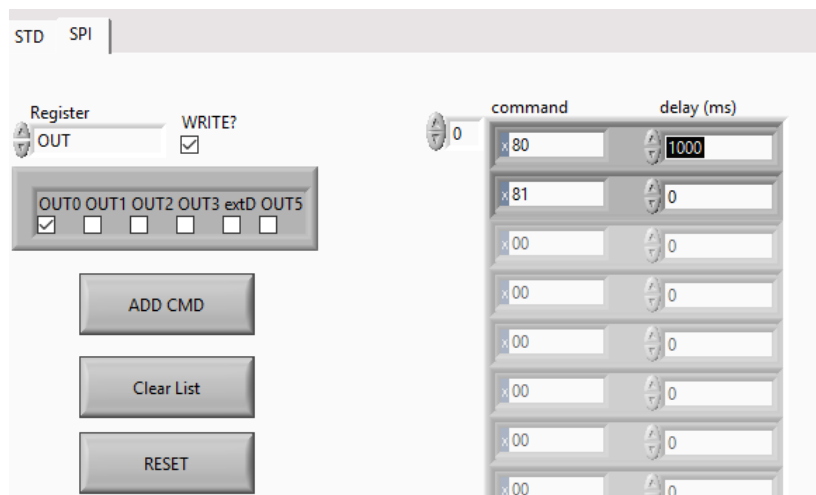
Clear List

RESET

| command | delay (ms) |
|---------|------------|
| x80     | 0          |
| x81     | 0          |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |

Figure 24 - Add to command list

- Change the delay of each command to 1000 (delay of 1 second, See Figure 25)



STD SPI

Register: OUT WRITE? ☒

OUT0 OUT1 OUT2 OUT3 extD OUT5

☒ ☐ ☐ ☐ ☐ ☐

ADD CMD

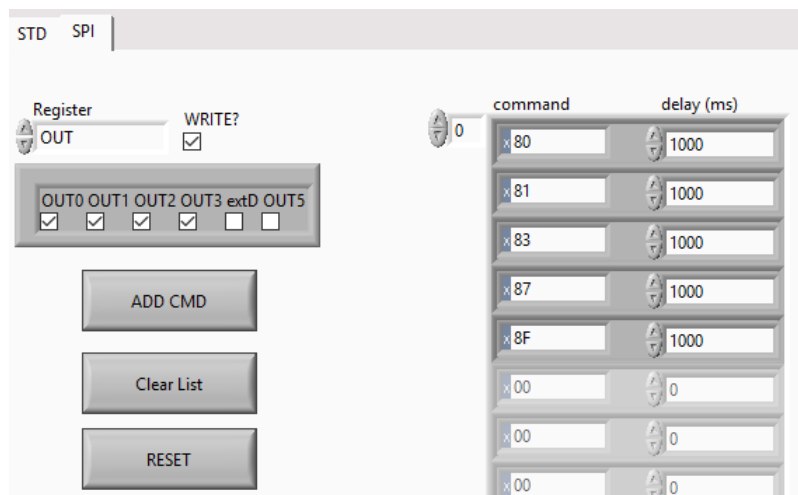
Clear List

RESET

| command | delay (ms) |
|---------|------------|
| x80     | 1000       |
| x81     | 0          |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |

Figure 25 - change delay of cammands

- Repeat the last three steps until you reach OUT<sub>3</sub> (See Figure 26)



STD SPI

Register: OUT WRITE? ☒

OUT0 OUT1 OUT2 OUT3 extD OUT5

☒ ☒ ☒ ☒ ☐ ☐

ADD CMD

Clear List

RESET

| command | delay (ms) |
|---------|------------|
| x80     | 1000       |
| x81     | 1000       |
| x83     | 1000       |
| x87     | 1000       |
| x8F     | 1000       |
| x00     | 0          |
| x00     | 0          |
| x00     | 0          |

Figure 26 - repeat until all OUTS (OUT0-OUT3) are selected

- Switch to STD view (See Figure 27) and select a channel (0 – 3) at IS MUX (See Figure 28)

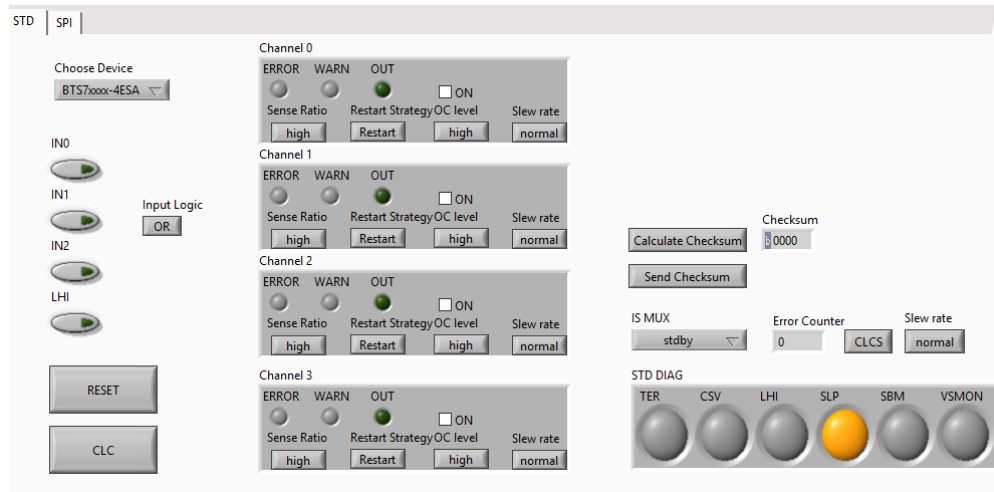


Figure 27 - switch to STD view

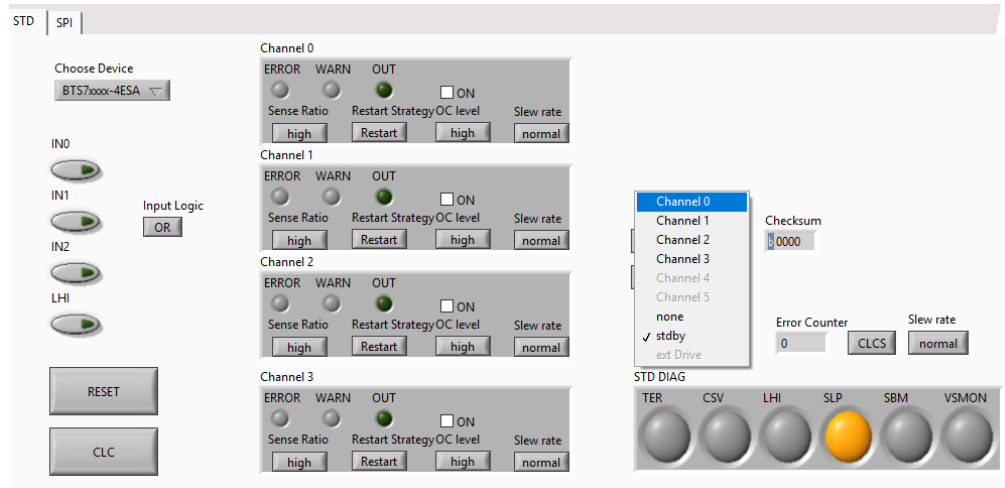


Figure 28 - Select channel at IS MUX

- Switch back to SPI view and click the START-button (See Figure 29)

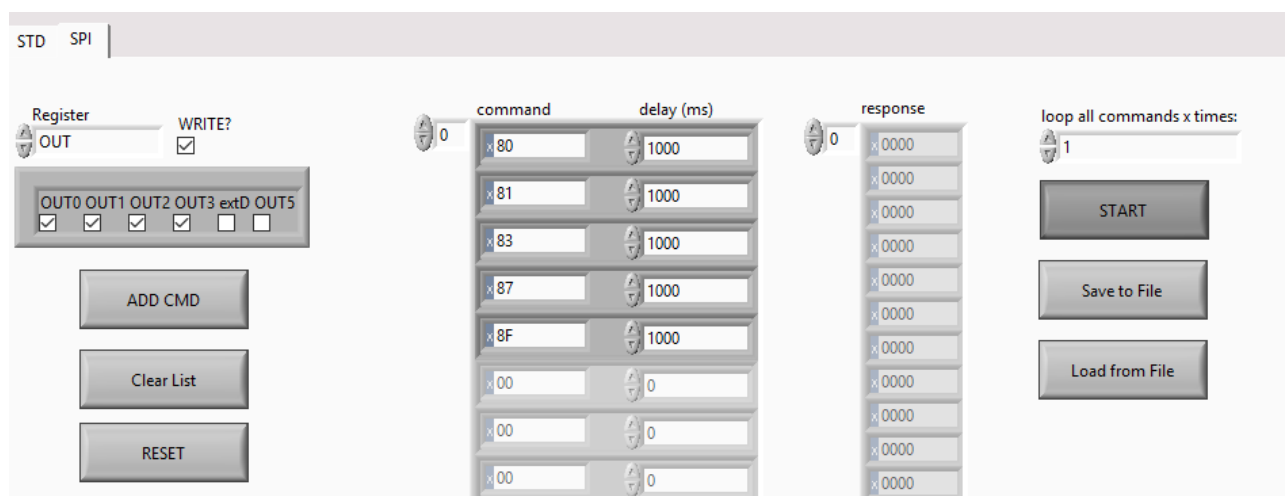


Figure 29 - Start command sequence

- The response of the SPOC™+2 is shown in the response list (See Figure 30)

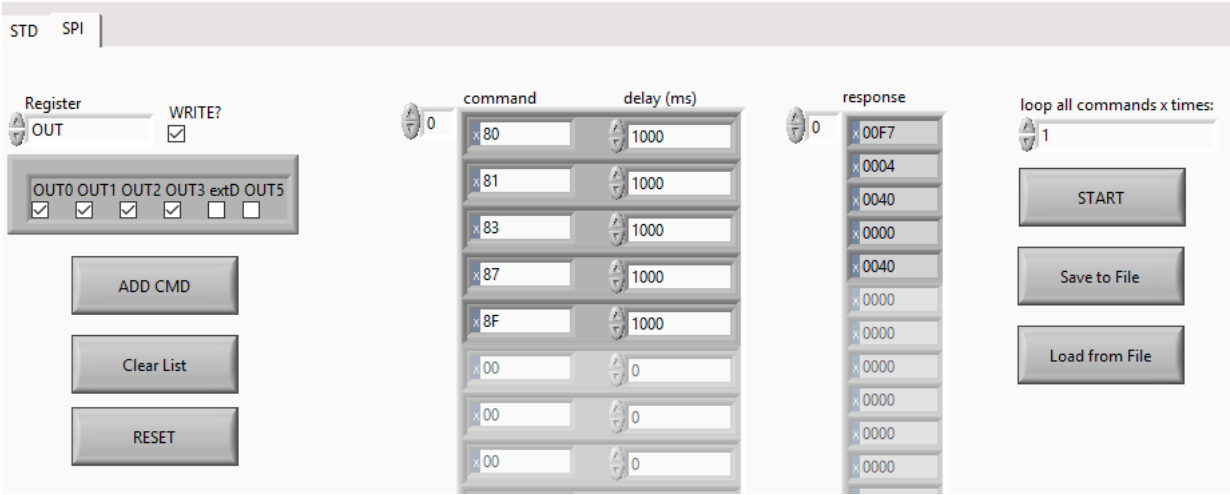


Figure 30 - response of SPOC™+2 to command sequence

### 2.3.2 Example 2: Let one light blink 10 times

|       | Description        | t [ms] |
|-------|--------------------|--------|
| T_ON  | Duration light on  | 500    |
| T_OFF | Duration light off | 500    |

- Switch to SPI view and select register OUT (See Figure 31)

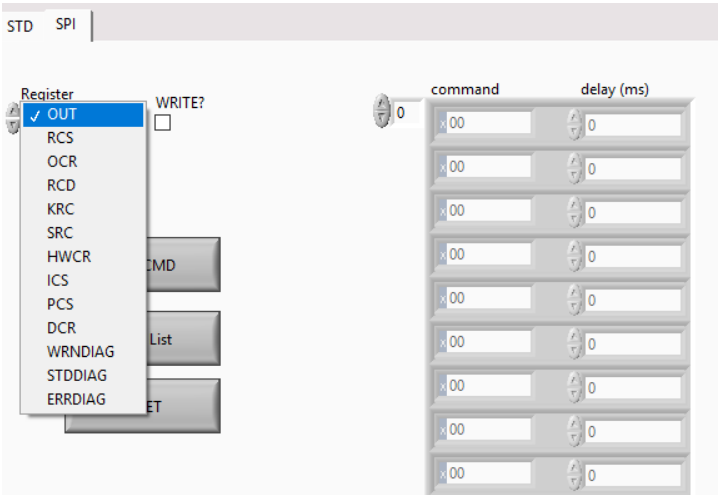
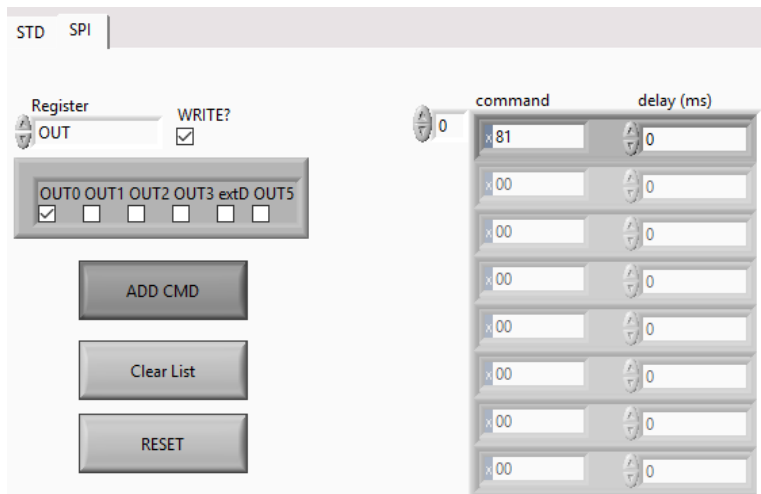


Figure 31 - Select Register OUT

- Tick the WRITE?-Box and select OUT0 and click ADD CMD (See Figure 32)

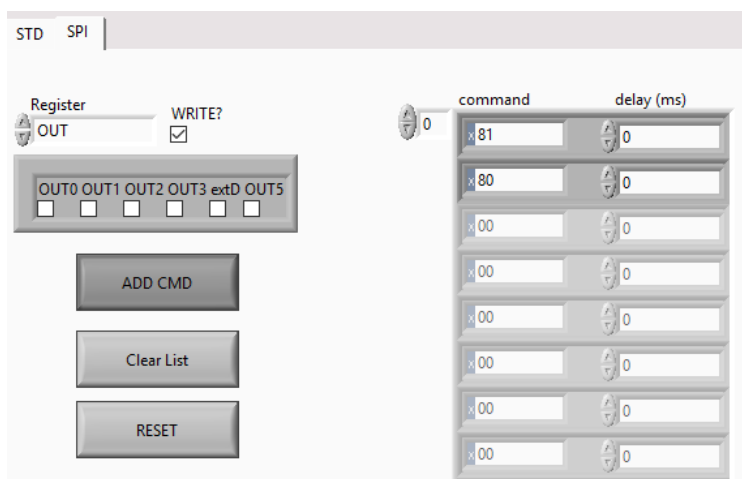


The screenshot shows the 'STD' and 'SPI' tabs. Under 'Register', 'OUT' is selected. The 'WRITE?' checkbox is checked. Below, a row of checkboxes for 'OUT0', 'OUT1', 'OUT2', 'OUT3', 'extD', and 'OUT5' is shown, with 'OUT0' checked. To the right, a table lists commands and delays:

| command | delay (ms) |
|---------|------------|
| 81      | 0          |
| 00      | 0          |
| 00      | 0          |
| 00      | 0          |
| 00      | 0          |
| 00      | 0          |
| 00      | 0          |
| 00      | 0          |

**Figure 32 - Select OUT0 and add command**

- Select no output in the WRITE-Box and click ADD CMD (See Figure 33)



The screenshot shows the 'STD' and 'SPI' tabs. Under 'Register', 'OUT' is selected. The 'WRITE?' checkbox is checked. Below, a row of checkboxes for 'OUT0', 'OUT1', 'OUT2', 'OUT3', 'extD', and 'OUT5' is shown, with none checked. To the right, a table lists commands and delays:

| command | delay (ms) |
|---------|------------|
| 81      | 0          |
| 80      | 0          |
| 00      | 0          |
| 00      | 0          |
| 00      | 0          |
| 00      | 0          |
| 00      | 0          |
| 00      | 0          |

**Figure 33 - Select no output and add command**

- Also typing in commands directly is possible (See SPOC<sup>TM</sup>+2 datasheet for command reference)
  - E.g.:
    - The command 80<sub>h</sub> means *Write no output to OUT*
    - The command 81<sub>h</sub> would mean *Write to OUT and set OUT0 high.*
    - See Figure 32 above
- Change the delay of command 81 to T\_ON, the delay of command 80 to T\_OFF (See Figure 34)

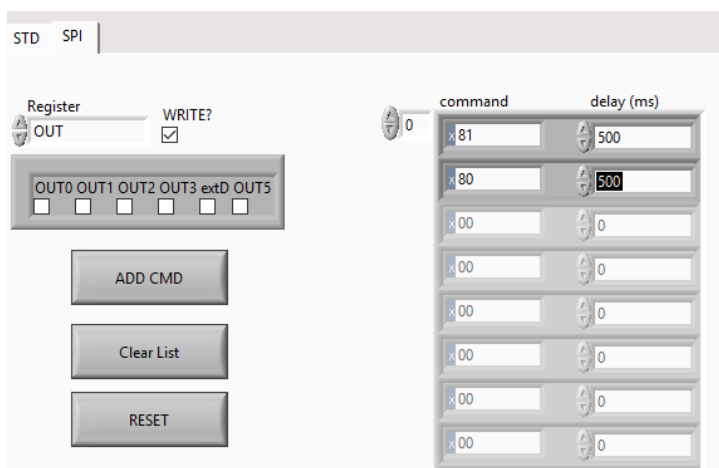


Figure 34 - change delay of commands

- Change loop all commands x times to 10 (See Figure 35)

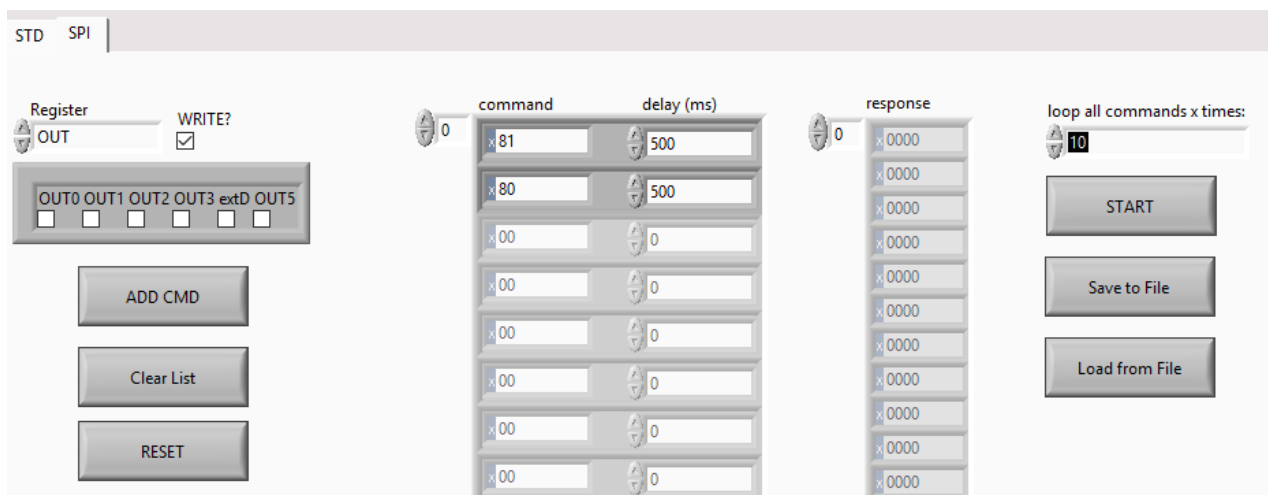


Figure 35 - change number of command sequences iterations

- Switch to STD view (See Figure 36) and select a channel (0 – 3) at IS MUX (See Figure 37)

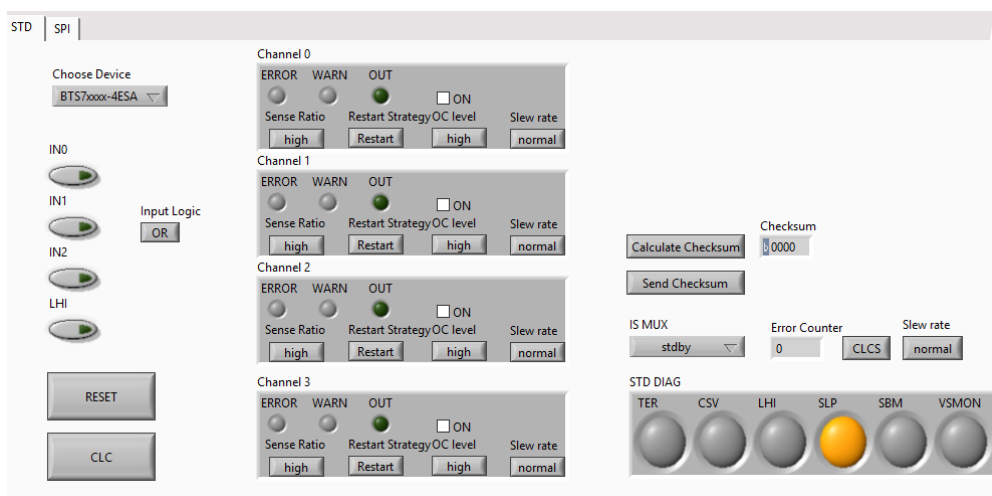


Figure 36 - Switch to STD view

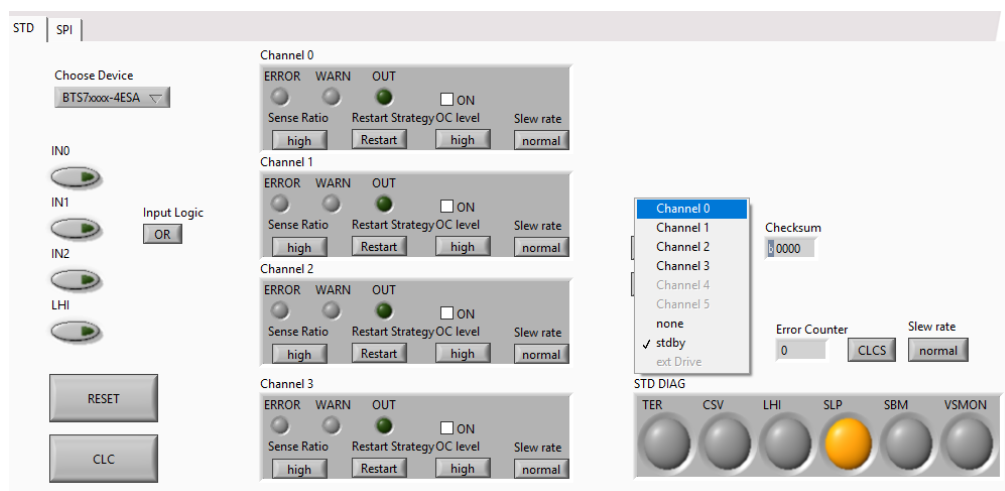


Figure 37 - Select a channel at IS MUX

- Switch back to SPI view and click the START-button (See Figure 38)

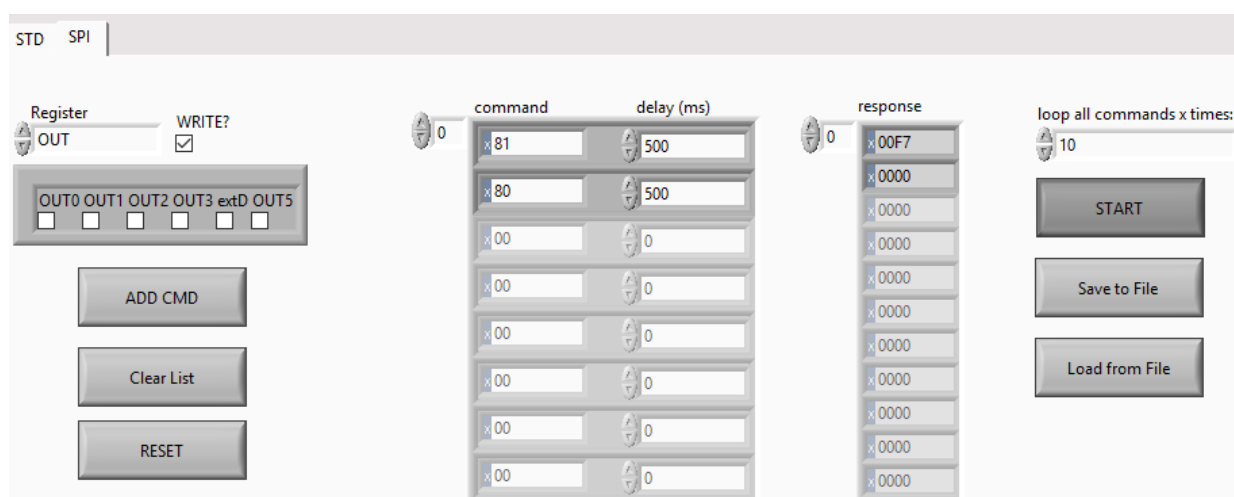


Figure 38 - Switch to SPI and start command sequence

- The response of the SPOC<sup>TM</sup>+2 is shown in the response list (See Figure 39)

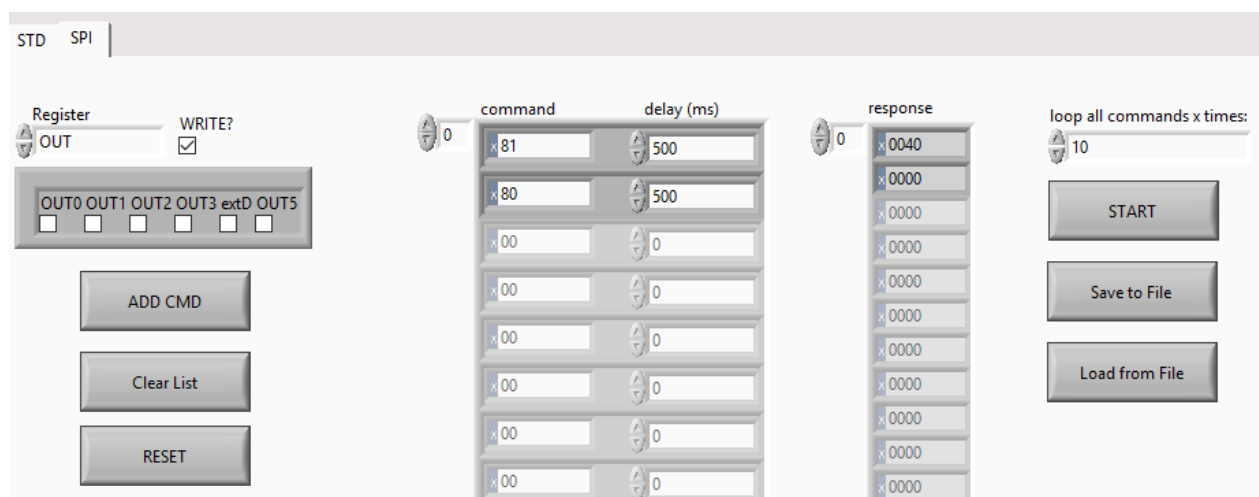


Figure 39 - Response of SPOC<sup>TM</sup>+2 in response list

## Revision history

### Major changes since the last revision

| Date | Version | Description |
|------|---------|-------------|
|      |         |             |
|      |         |             |
|      |         |             |

### Template revision history

*Note: The below table is for reference purpose only. Delete this table before circulation.*

### Changes since the last revision

| Date    | Version | Author      | Description              |
|---------|---------|-------------|--------------------------|
| 11-2017 | 1.0     | Rasser René | Initial released version |
|         |         |             |                          |



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Edition <yyyy-mm>  
Published by

Infineon Technologies AG  
81726 Munich, Germany

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