# SPC5 Connect
# Getting started and tutorials

APG MID Software and Tools

July 2014

# SPC5 Connect

The **SPC5 Connect** is a programmable USB interface designed to support most common automotive communication interfaces in a simple tool.

Target applications are ASIC control or communication control and monitoring.

The hardware features, accessible through the Script Engine, makes the SPC5 Connect a powerful, low cost and easy to use tool for rapid development of small scripts in lab applications.

# New and improved features

- USB connection to PC, two header connectors for accessing device signals, one cable with DB9 for CAN/UART connections, provision for JTAG output.

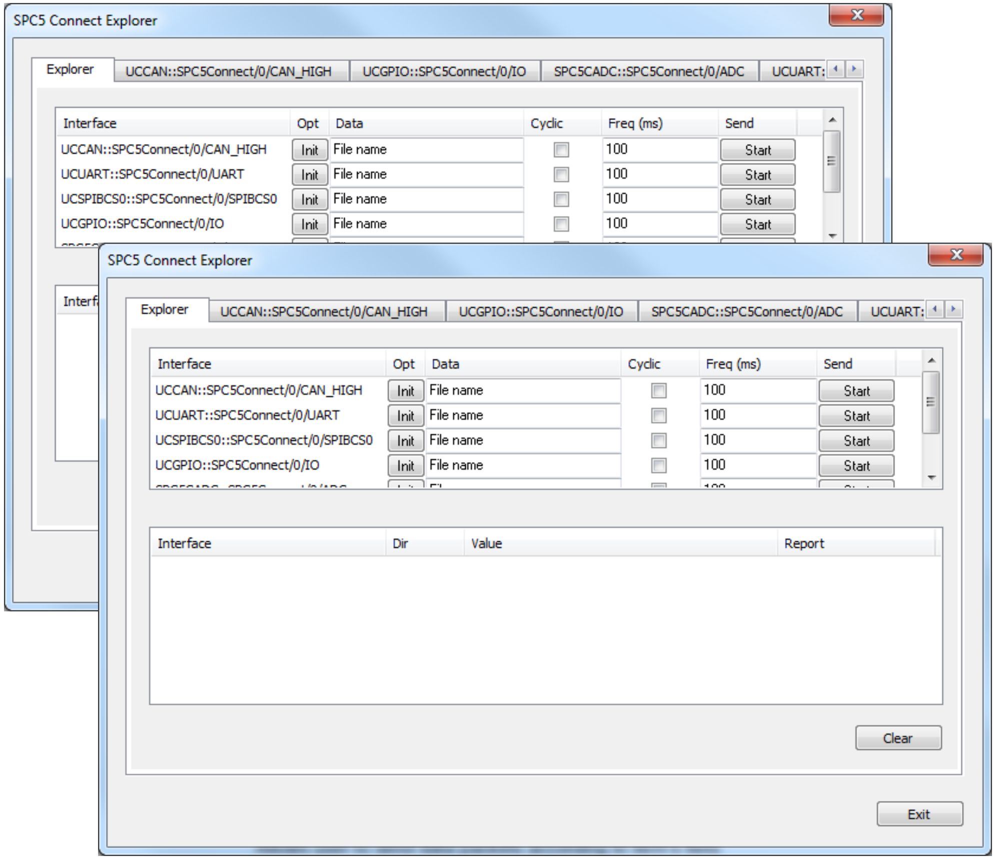
- Three eMIOS, four ADC, one SPI with two CS (shared with GPIO), one NMI and one CAN.
- Three eMIOS, one SPI with one CS (shared with GPIO), one CAN and one UART/LIN /Kline.
- Transceivers for CAN/UART/LIN/Kline.

- Three LED (one power-on LED controllable via software), one reset button, boot mode config.

- Preprogrammed script engine with communications manager USB to CAN/LIN/UART/KLINE/SPI.

Full automotive connectivity on your PC

# One PC interface



| Interface | Opt | Data | Cyclic | Freq (ms) | Send |
|---|---|---|---|---|---|
| UCCAN::SPC5Connect/0/CAN_HIGH | Init | File name | □ | 100 | Start |
| UCUART::SPC5Connect/0/UART | Init | File name | □ | 100 | Start |
| UCSPIBCS0::SPC5Connect/0/SPIBCS0 | Init | File name | □ | 100 | Start |
| UCGPIO::SPC5Connect/0/IO | Init | File name | □ | 100 | Start |

| Interface | Dir | Value | Report |
|---|---|---|---|

The **SPC5 Connect Explorer PC Interface** allows easy programming of the device together with basic control and monitoring features of target signals.

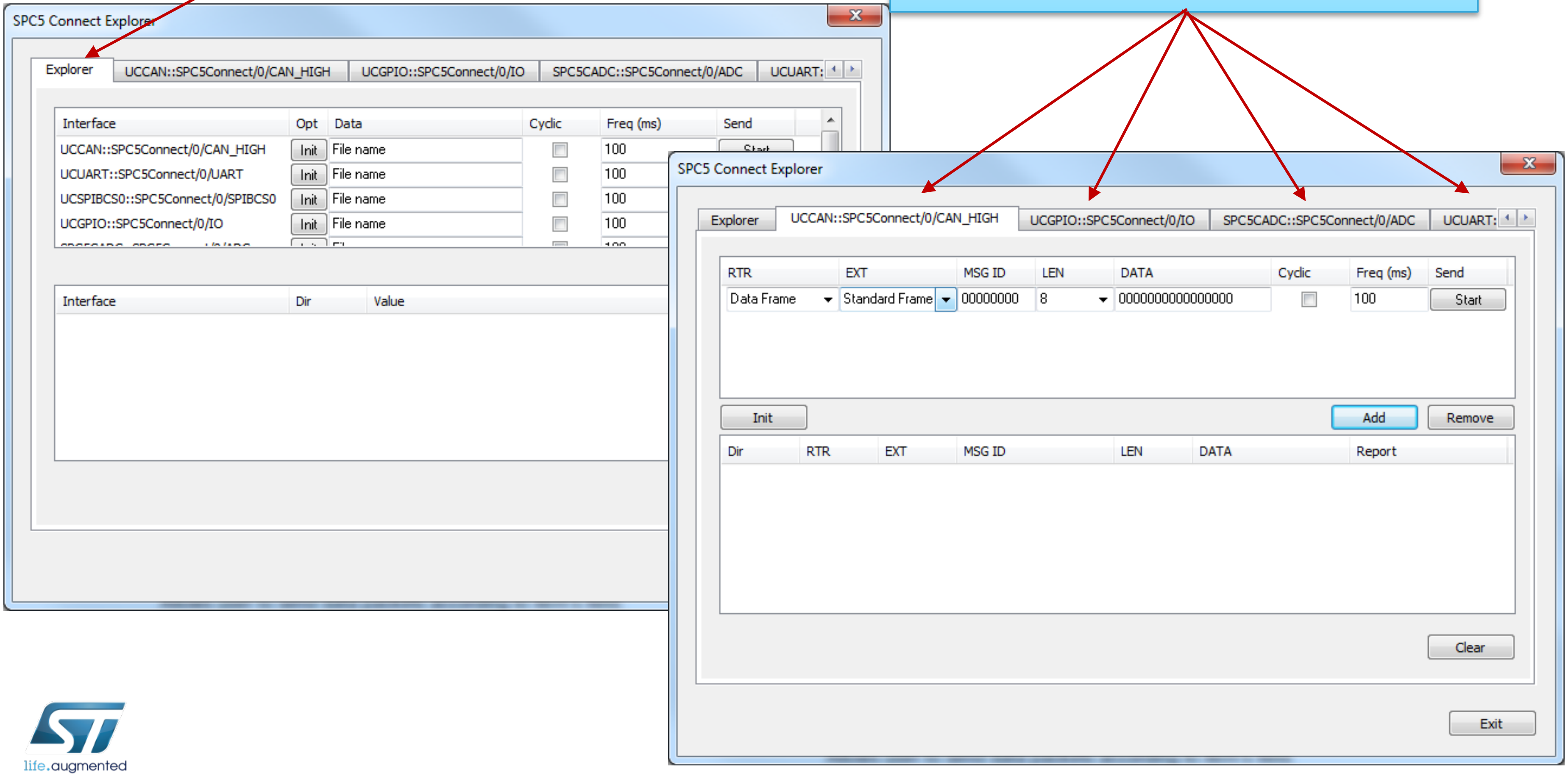
In order to run the interface:

- From the Start menu, program files, STMicroelectronics, SPC5 Connect
- Select SPC5 Connect Explorer.

# SPC5 Connect Explorer GUI

Explorer page: contains all available interfaces. It allows to execute a single command or to execute the SPC5 Explorer scripts.

Interface pages: there is one page for each interface available and it allows to execute commands. Each page for every interface contains all field available for each command.



SPC5 Connect Explorer

Explorer
UCCAN::SPC5Connect/0/CAN_HIGH
UCGPIO::SPC5Connect/0/IO
SPC5CADC::SPC5Connect/0/ADC
UCUART:

| Interface | Opt | Data | Cyclic | Freq (ms) | Send |
|---|---|---|---|---|---|
| UCCAN::SPC5Connect/0/CAN_HIGH | Init | File name | □ | 100 | Start |
| UCUART::SPC5Connect/0/UART | Init | File name | □ | 100 | |
| UCSPIBCS0::SPC5Connect/0/SPIBCS0 | Init | File name | □ | 100 | |
| UCGPIO::SPC5Connect/0/IO | Init | File name | □ | 100 | |

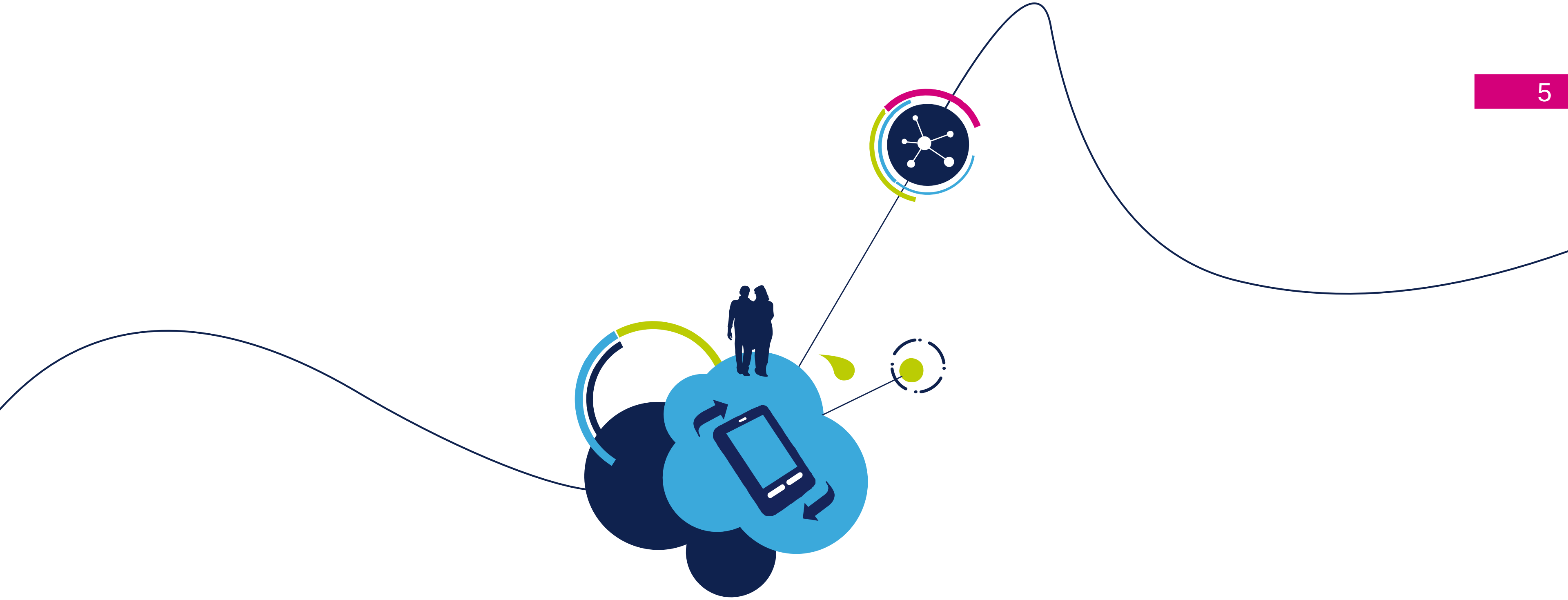
| Interface | Dir | Value |
|---|---|---|

SPC5 Connect Explorer

Explorer
UCCAN::SPC5Connect/0/CAN_HIGH
UCGPIO::SPC5Connect/0/IO
SPC5CADC::SPC5Connect/0/ADC
UCUART:

| RTR | EXT | MSG ID | LEN | DATA | Cyclic | Freq (ms) | Send |
|---|---|---|---|---|---|---|---|
| Data Frame | Standard Frame | 00000000 | 8 | 0000000000000000 | □ | 100 | Start |

| Dir | RTR | EXT | MSG ID | LEN | DATA | Report |
|---|---|---|---|---|---|---|



# Tutorials

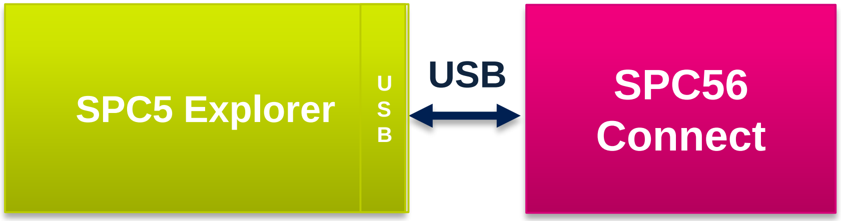
# Tutorials

- SPC5 Connect Explorer examples:
  - LED Blinking
  - CAN Communication
  - SPI Communication
  - Analog readings
  - UART Communication
  - SYS Interface

# Sample: GPIO LED 0 Blinking

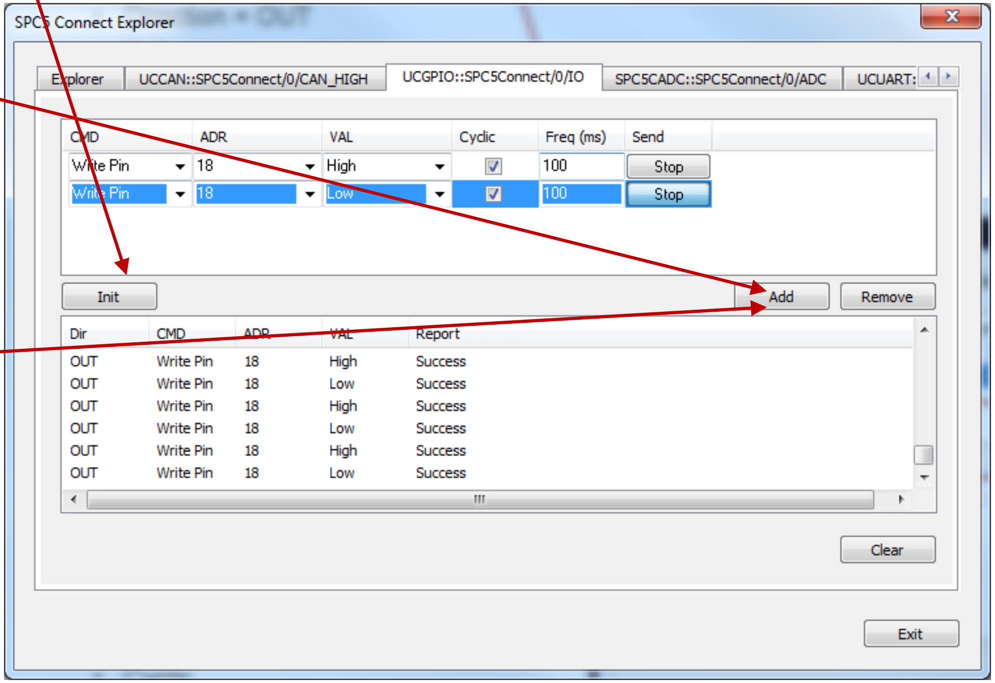
- This sample will explain how to set a GPIO using SPC5 Connect explorer. This example will use the GPIO 202 (Index 18) connected to LED 0 of SPC5 Connect. This allows to show the result of the test.

- Steps:
  - Connect the SPC5Connect to the PC.
  - Launch SPC5 Connect Explorer.
  - Verify if GPIO Interface is enabled pushing «Init» button.



# Sample: GPIO LED 0 Blinking

- Select GPIO tab and push «Init» button to configure the GPIO 202 (Index 18):
  - Direction = OUT
  - Default Value = High
  - Mode = PUSHPULL
  - Slew rate = MINIMUM
- Push «Add» button to add the first row:
  - CMD: Write Pin
  - ADR: 18 [GPIO 202 (LED 0)]
  - VAL: High
  - Cyclic
  - Freq: 100ms
- Push «Add» button to add the second row:
  - CMD: Write Pin
  - ADR: 18 [GPIO 202 (LED 0)]
  - VAL: Low
  - Cyclic
  - Freq: 100ms
- Push «Start» button.
- SPC5 Connect LED 0 will blink.



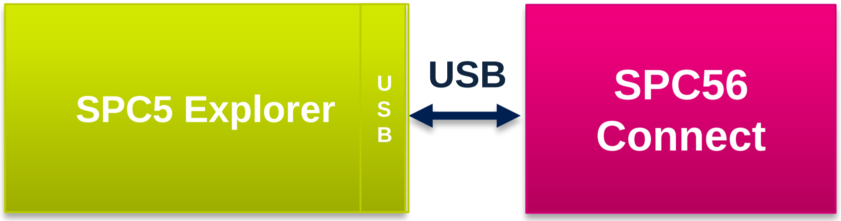
| CMD | ADR | VAL | Cyclic | Freq (ms) | Send |
|---|---|---|---|---|---|
| Write Pin | 18 | High | ☑ | 100 | Stop |
| Write Pin | 18 | Low | ☑ | 100 | Stop |

| Dir | CMD | ADR | VAL | Report |
|---|---|---|---|---|
| OUT | Write Pin | 18 | High | Success |
| OUT | Write Pin | 18 | Low | Success |
| OUT | Write Pin | 18 | High | Success |
| OUT | Write Pin | 18 | Low | Success |
| OUT | Write Pin | 18 | High | Success |
| OUT | Write Pin | 18 | Low | Success |

# Sample: GPIO LED 0 Blinking by script

- This sample will explain how to set a GPIO using SPC5 Connect explorer. This example will use the GPIO 202 connected to LED 0 of SPC5 Connect (Index 18). This allows to show the result of the test.

- Steps:
  - Connect the SPC5Connect to the PC.
  - Launch SPC5 Connect Explorer.
  - Verify if GPIO Interface is enabled pushing «Init» button.

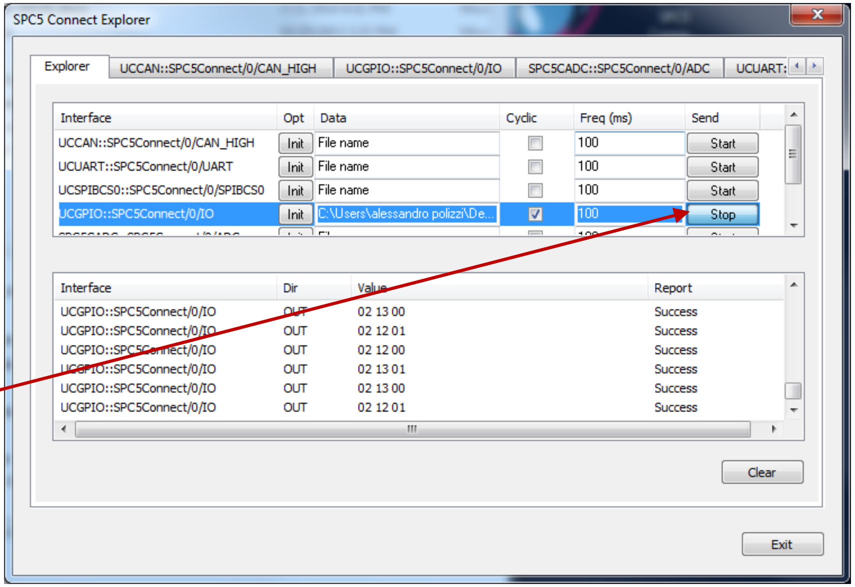


# Sample: GPIO LED 0 Blinking by script

- Create the script file to drive GPIO 202 and GPIO 193 pins. Each row contains a GPIO Frame to set a single GPIO:

```
//GPIO Script
//[CMD][ADR][VAL]
//[CMD: 0x02 Write - 0x00 Read]
//[ADR: GPIO Index: GPIO[202]:0x12 - GPIO[193]:0x13]
//[VAL: 0x00 Low - 0x01 High]

021201   /*GPIO 202 Index 0x12 LED 0 High*/
021200   /*GPIO 202 Index 0x12 LED 0 Low*/
021301   /*GPIO 193 Index 0x13 LED 1 High*/
021300   /*GPIO 193 Index 0x13 LED 1 Low*/
```

- Insert the script file name in the Data field og GPIO interface.
- Set Cyclic and freq
- Push «Start» button.
- Low window will show  all messages.
- LED 0 and LED 1 will blink.

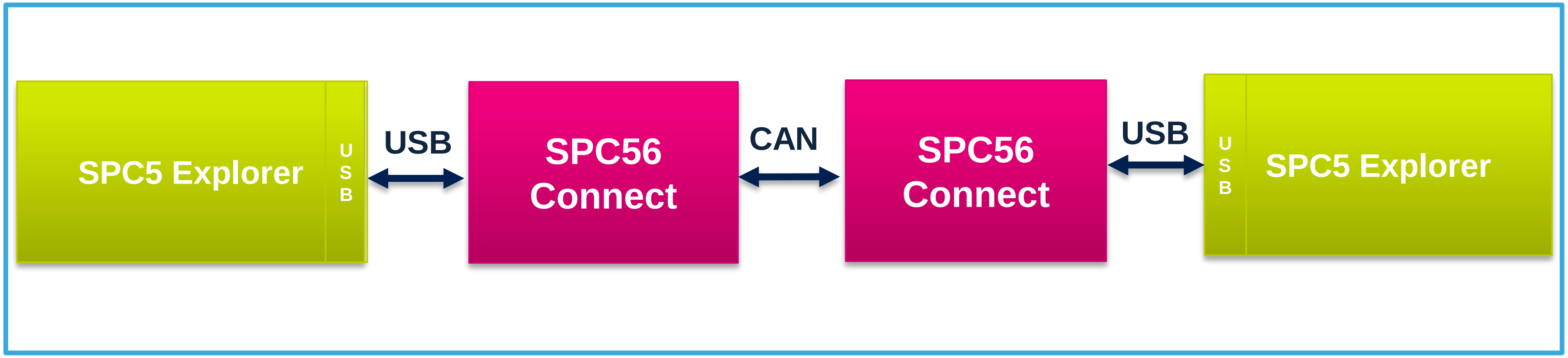


| Interface | Opt | Data | Cyclic | Freq (ms) | Send |
|---|---|---|---|---|---|
| UCCAN::SPC5Connect/0/CAN_HIGH | Init | File name | ☐ | 100 | Start |
| UCUART::SPC5Connect/0/UART | Init | File name | ☐ | 100 | Start |
| UCSPIBCS0::SPC5Connect/0/SPIBCS0 | Init | File name | ☐ | 100 | Start |
| UCGPIO::SPC5Connect/0/IO | Init | C:\Users\alessandro polizzi\De... | ☑ | 100 | Stop |

| Interface | Dir | Value | Report |
|---|---|---|---|
| UCGPIO::SPC5Connect/0/IO | OUT | 02 13 00 | Success |
| UCGPIO::SPC5Connect/0/IO | OUT | 02 12 01 | Success |
| UCGPIO::SPC5Connect/0/IO | OUT | 02 12 00 | Success |
| UCGPIO::SPC5Connect/0/IO | OUT | 02 13 01 | Success |
| UCGPIO::SPC5Connect/0/IO | OUT | 02 13 00 | Success |
| UCGPIO::SPC5Connect/0/IO | OUT | 02 12 01 | Success |

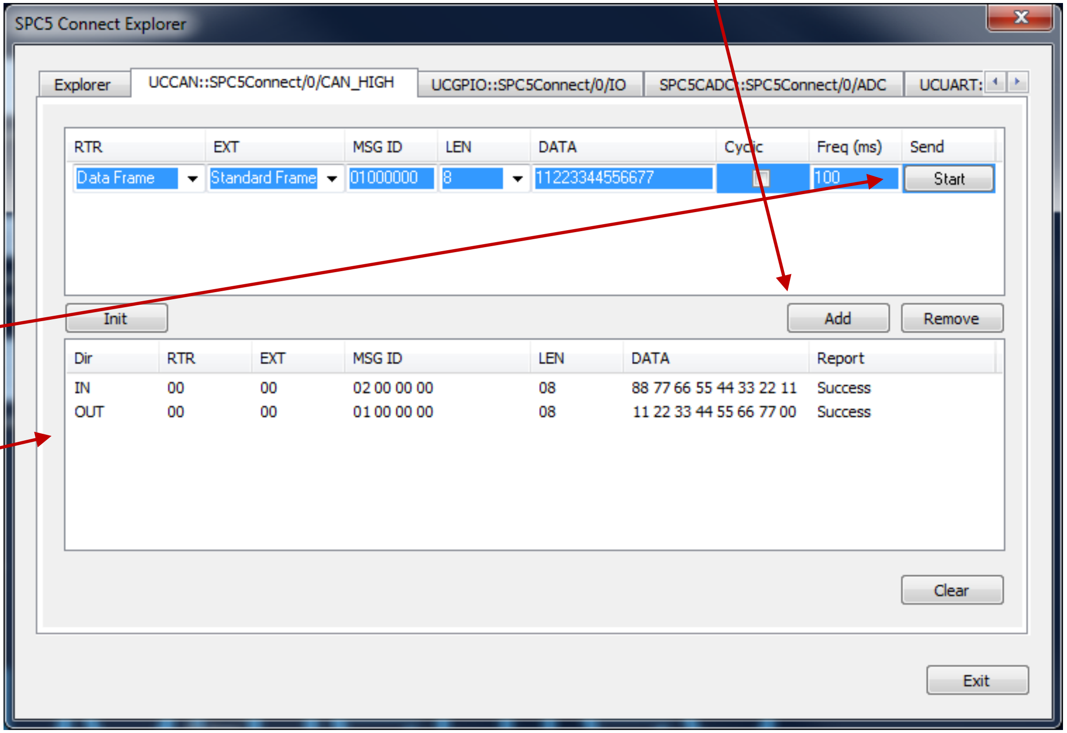
# Sample: CAN Communication

- This sample will explain how to send and receive CAN messages using two SPC5 Connect.
- Steps:
    - Connect the first SPC5Connect to the first PC and the second SPC5Connect to the second PC.
    - Connect each other the two CAN connectors.
    - Launch SPC5 Connect Explorer in both PCs.
    - Launch SPC5 Explorer on both PC.
    - Verify if the CAN interface is enabled.



# Sample: CAN Communication

- From SPC5 Explorer of first PC create one message pushing “Add” button with following data
  - RTR: Data Frame
  - EXT: Standard Frame
  - MSG ID: Message ID (hex): 01000000
  - LEN: Message Lenght: 8
  - DATA: Data message (hex): 1122334455667788
- Repeat the same operation on the second PC changing MSG ID (hex): 02000000 and DATA (hex): 8877665544332211.
- Push «Start» button to send the message on each PC.
- Log view will show the message sent and the message received by each SPC5 Connect Explorer.



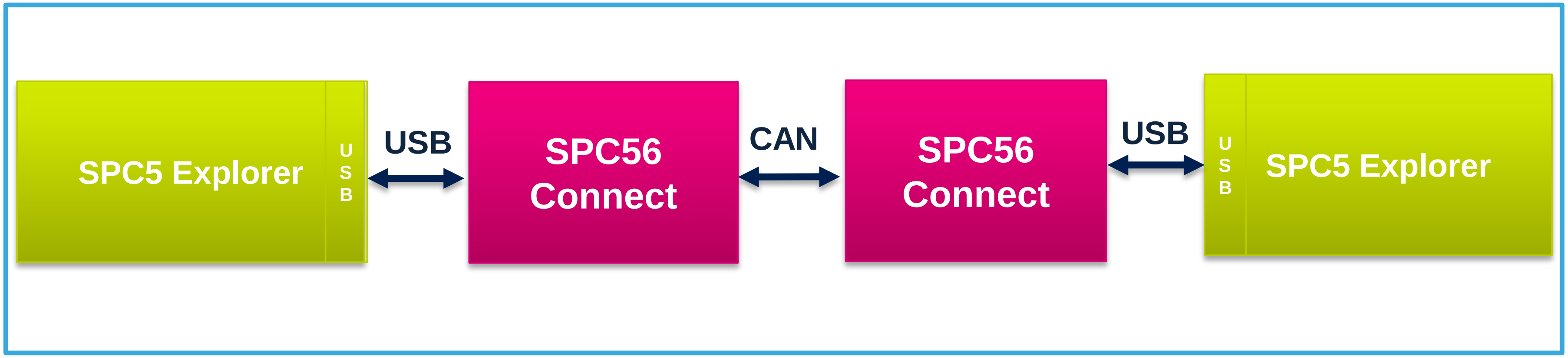
| RTR | EXT | MSG ID | LEN | DATA | Cyclic | Freq (ms) | Send |
|---|---|---|---|---|---|---|---|
| Data Frame | Standard Frame | 01000000 | 8 | 11223344556677 | ☐ | 100 | Start |

| Dir | RTR | EXT | MSG ID | LEN | DATA | Report |
|---|---|---|---|---|---|---|
| IN | 00 | 00 | 02 00 00 00 | 08 | 88 77 66 55 44 33 22 11 | Success |
| OUT | 00 | 00 | 01 00 00 00 | 08 | 11 22 33 44 55 66 77 00 | Success |

# Sample: CAN Communication using Script

- This sample will explain how to send and receive CAN messages by file script using two SPC5 Connect.

- Steps:
  - Connect the first SPC5Connect to the first PC and the second SPC5Connect to the second PC.
  - Connect each other the two CAN connectors.
  - Launch SPC5 Connect Explorer in both PCs.
  - Launch SPC5 Explorer on both PC.
  - Verify if the CAN interface is enabled pushing «Init» button.

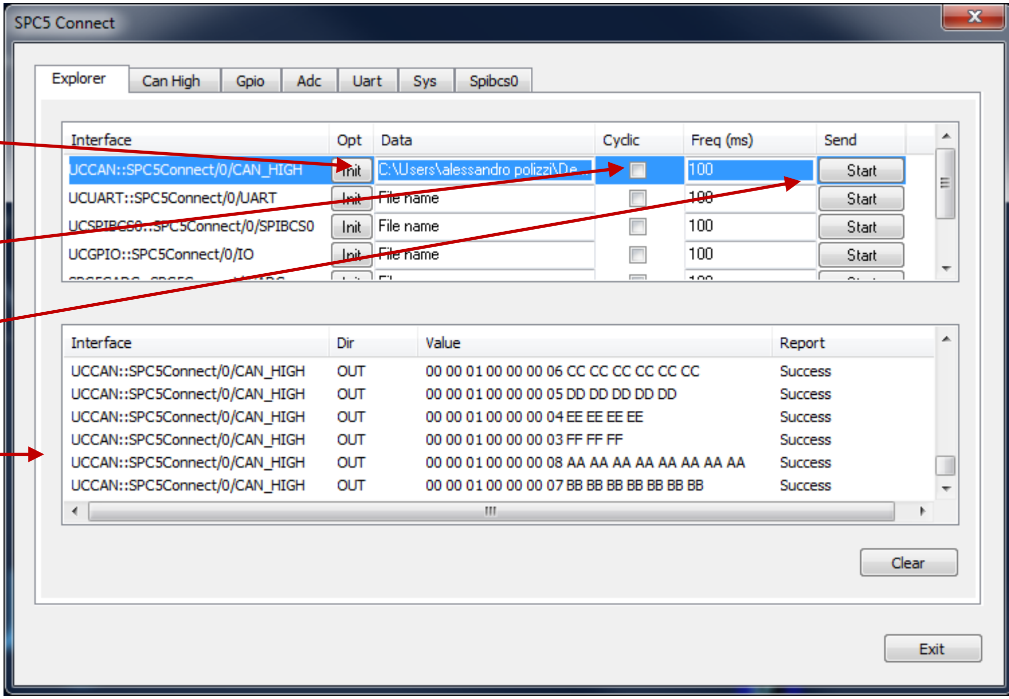


# Sample: CAN Communication using Script

- Create the script file to send CAN messages. Each row contains a CAN Frame to sent as follow:

```
//CAN FRAME in hexadecimal format
//[RTR:1byte][EXT:1byte][MSG ID:4bytes][LEN:1byte][DATA:1-8bytes]
00000100000008AAAAAAAAAAAAAAAA /*Frame 1*/
00000100000007BBBBBBBBBBBBBB   /*Frame 2*/
00000100000006CCCCCCCCCCCC     *Frame 3*/
00000100000005DDDDDDDDDD       /*Frame 4*/
00000100000004EEEEEEEE         /*Frame 5*/
00000100000003FFFFFF           /*Frame 6*/
```

- Insert the file name into Data field.
- Check Cyclc field and insert Freq (ms).
- Push «Start» button
- The log will show the messages sent.

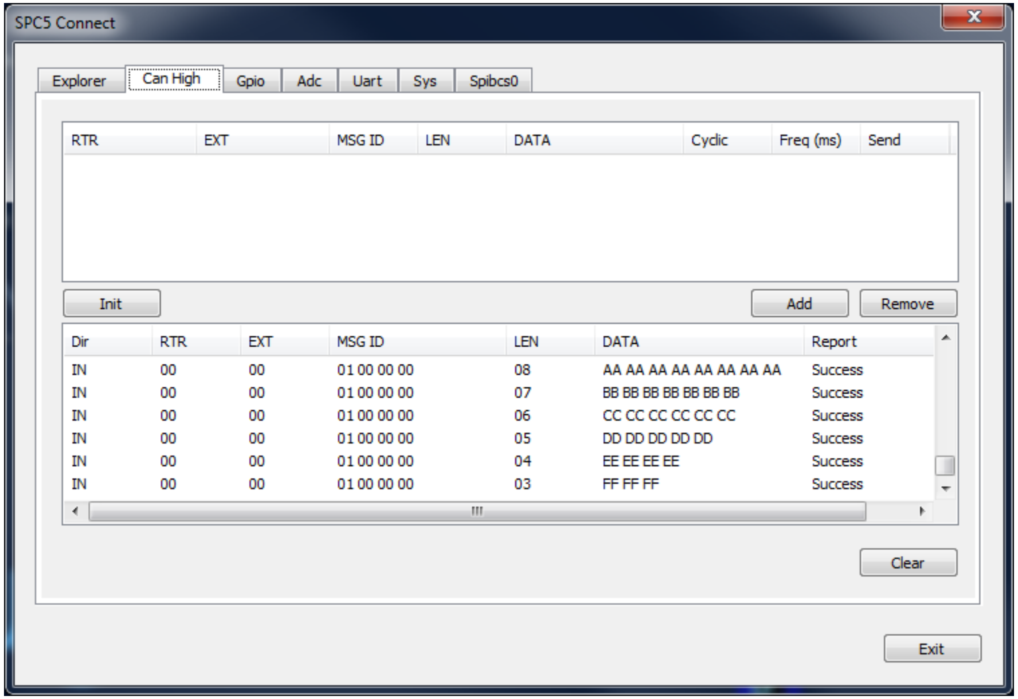


| Interface | Opt | Data | Cyclic | Freq (ms) | Send |
|---|---|---|---|---|---|
| UCCAN::SPC5Connect/0/CAN_HIGH | Init | C:\Users\alessandro polizzi\De... | □ | 100 | Start |
| UCUART::SPC5Connect/0/UART | Init | File name | □ | 100 | Start |
| UCSPIBCS0::SPC5Connect/0/SPIBCS0 | Init | File name | □ | 100 | Start |
| UCGPIO::SPC5Connect/0/IO | Init | File name | □ | 100 | Start |

| Interface | Dir | Value | Report |
|---|---|---|---|
| UCCAN::SPC5Connect/0/CAN_HIGH | OUT | 00 00 01 00 00 00 06 CC CC CC CC CC CC | Success |
| UCCAN::SPC5Connect/0/CAN_HIGH | OUT | 00 00 01 00 00 00 05 DD DD DD DD DD | Success |
| UCCAN::SPC5Connect/0/CAN_HIGH | OUT | 00 00 01 00 00 00 04 EE EE EE EE | Success |
| UCCAN::SPC5Connect/0/CAN_HIGH | OUT | 00 00 01 00 00 00 03 FF FF FF | Success |
| UCCAN::SPC5Connect/0/CAN_HIGH | OUT | 00 00 01 00 00 00 08 AA AA AA AA AA AA AA AA | Success |
| UCCAN::SPC5Connect/0/CAN_HIGH | OUT | 00 00 01 00 00 00 07 BB BB BB BB BB BB BB | Success |

# Sample: CAN Communication using Script

- Start SPC5 Connect explorer from sencond PC.
- Select Can High tab from the GUI.
- Check if CAN interface is enabled and set with the right value.
- The Log will show all CAN messages received.



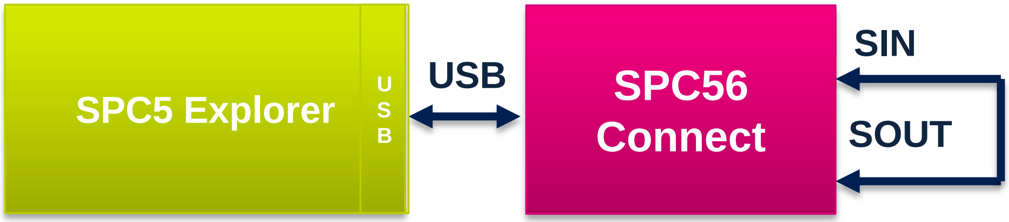
| RTR | EXT | MSG ID | LEN | DATA | Cyclic | Freq (ms) | Send |
|---|---|---|---|---|---|---|---|

| Dir | RTR | EXT | MSG ID | LEN | DATA | Report |
|---|---|---|---|---|---|---|
| IN | 00 | 00 | 01 00 00 00 | 08 | AA AA AA AA AA AA AA AA | Success |
| IN | 00 | 00 | 01 00 00 00 | 07 | BB BB BB BB BB BB BB | Success |
| IN | 00 | 00 | 01 00 00 00 | 06 | CC CC CC CC CC CC | Success |
| IN | 00 | 00 | 01 00 00 00 | 05 | DD DD DD DD DD | Success |
| IN | 00 | 00 | 01 00 00 00 | 04 | EE EE EE EE | Success |
| IN | 00 | 00 | 01 00 00 00 | 03 | FF FF FF | Success |

# Sample: SPI Communication in loopback

- This sample will explain how to send and receive an SPI messages using one SPC5 Connect with SIN and SOUT connected in loopback.

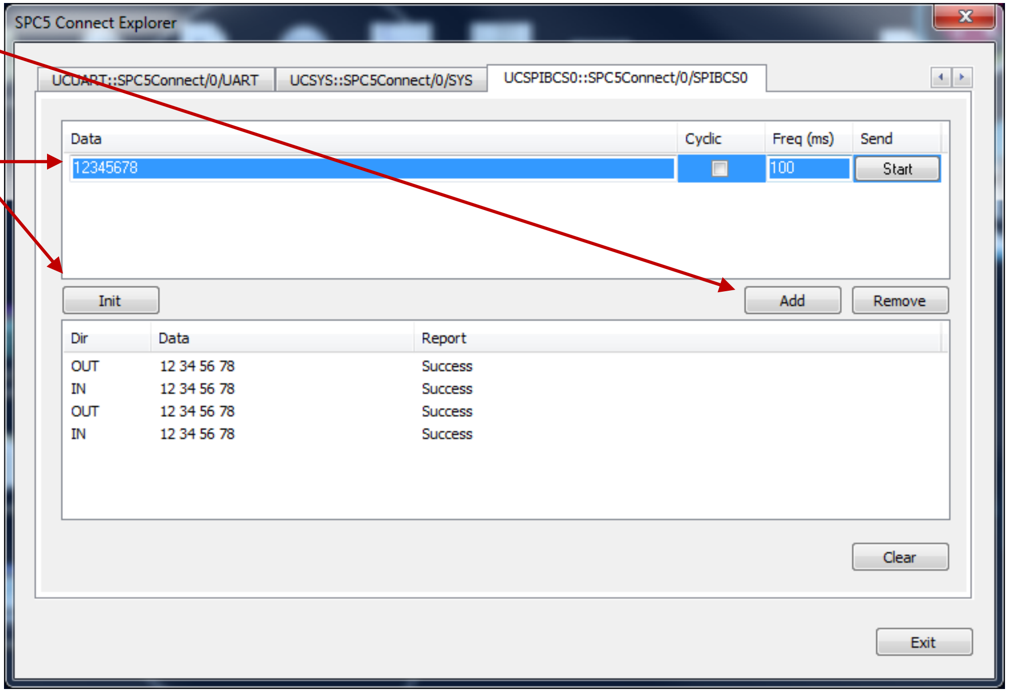
- Steps:
  - Connect the SPC5Connect to the PC.
  - Connect pin 5 of P3 to pin 7 of P3.
  - Launch SPC5 Connect Explorer.
  - Verify if SPI Interface is enabled pushing «Init» button.



# Sample: SPI Communication in loopback

- Push «Init» button to configure the SPI message:
  - Frequency (Hz) = 10000000
  - Word size (bit) = 16
  - Bus Role = MASTER
  - Active clock = HIGH
  - Data capturing clock edge = FIRST

- Push «Add» button to add a new row.
- Insert Data = 12345678
- Push «Start» button to send the message.
- Log view will show the message sent and the message received by SPC5 Connect Explorer. OUT message is the message sent and IN message is the message received.



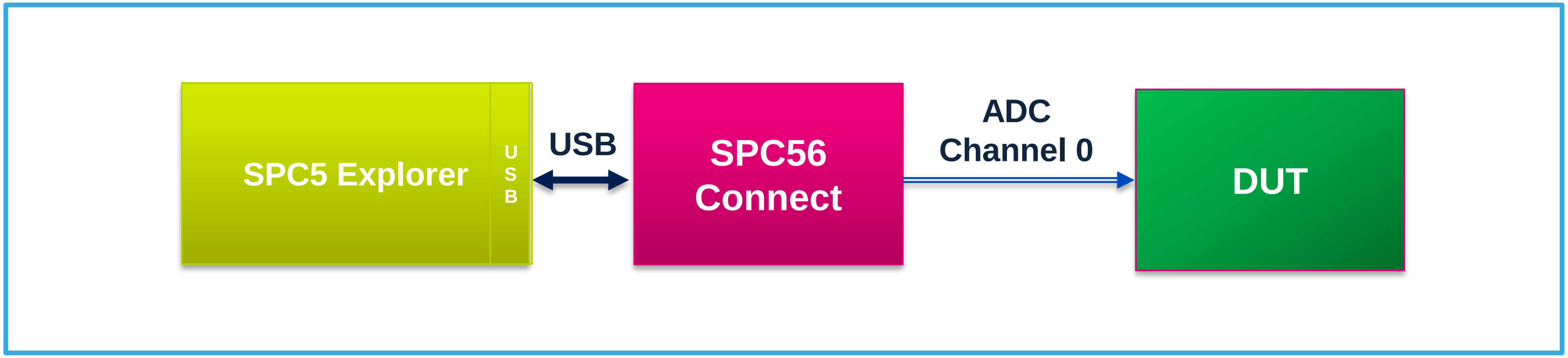
| Data | Cyclic | Freq (ms) | Send |
|---|---|---|---|
| 12345678 | □ | 100 | Start |

| Dir | Data | Report |
|---|---|---|
| OUT | 12 34 56 78 | Success |
| IN | 12 34 56 78 | Success |
| OUT | 12 34 56 78 | Success |
| IN | 12 34 56 78 | Success |

# Sample: ADC

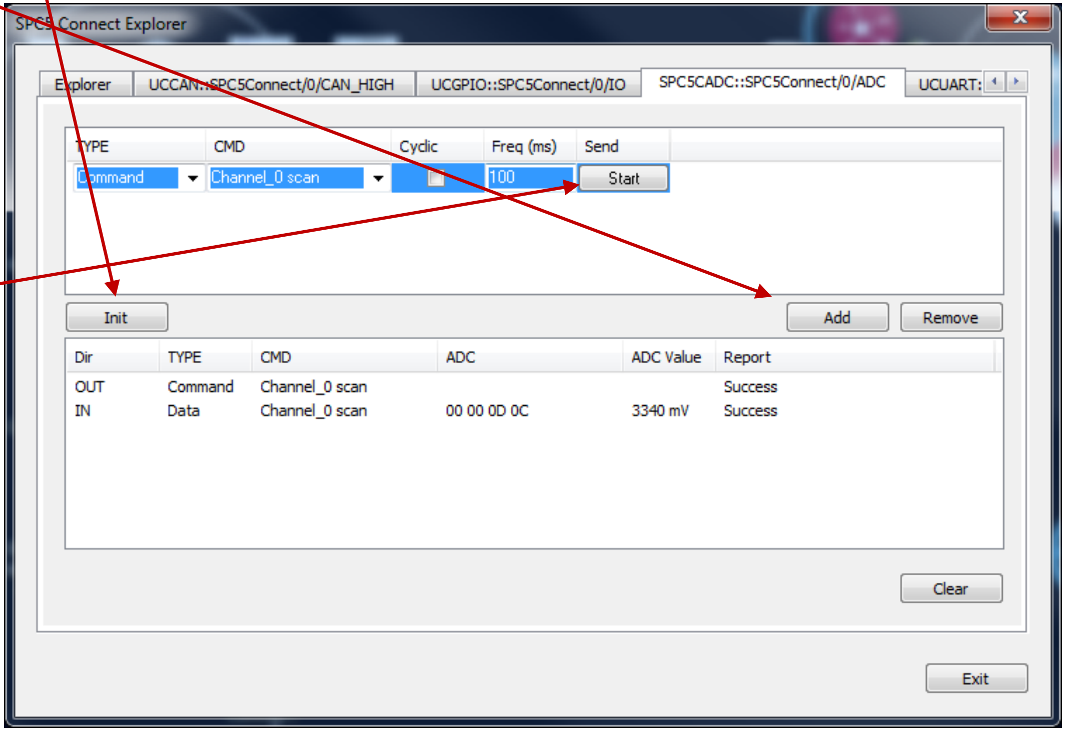
- This sample will explain how to read a voltage level of a pin connected to AN 0 of SPC5 Connect. In this example the ADC Channel 0 is connected to 3.3v external source.

- Steps:
  - Connect the SPC5Connect to the PC.
  - Connect AN0 [P3-Pin 10] of SPC5 Connect to DUT (Device Under Test)
  - Launch SPC5 Connect Explorer.
  - Verify if ADC Interface is enabled pushing «Init» button.



# Sample: ADC

- Select ADC tab and push «Init» button to configure Scan period:
  - Scan  = Manual
- Push «Add» button and set the parameters:
  - TYPE: Command
  - CMD: Channel_0 scan
  - Cyclic: unchecked
  - Freq: 100ms
- Push «Start» button to acquire the ADC value.
- SPC5 Connect  log window will show the value acquired. ADC column will show the message received and ADC Value column will show the value converted in mV.

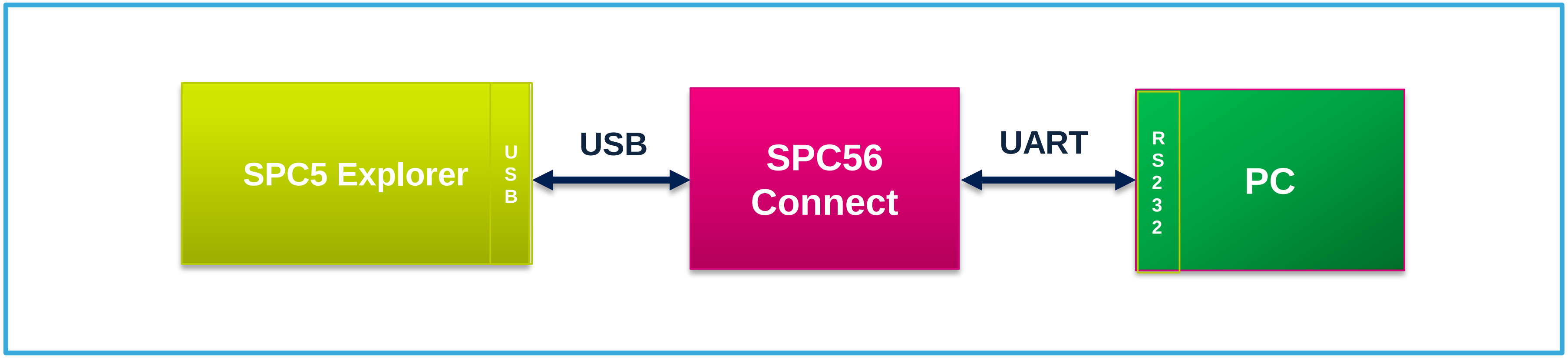


| TYPE | CMD | Cyclic | Freq (ms) | Send |
|---|---|---|---|---|
| Command | Channel_0 scan | □ | 100 | Start |

| Dir | TYPE | CMD | ADC | ADC Value | Report |
|---|---|---|---|---|---|
| OUT | Command | Channel_0 scan | | | Success |
| IN | Data | Channel_0 scan | 00 00 0D 0C | 3340 mV | Success |

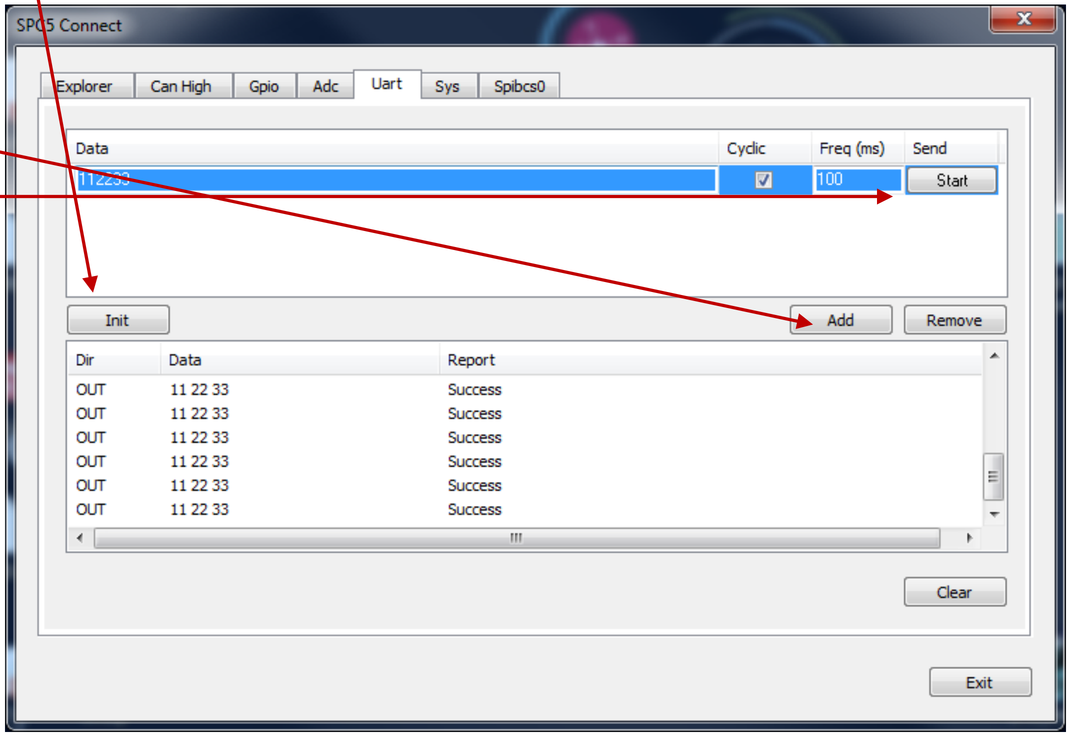
# Sample: UART Communication

- This sample will explain how use UART interface of SPC5 Connect.
- Steps:
  - Connect the SPC5Connect to the PC.
  - Connect the flat cable to P2 and the DB9 to the PC RS232 serial port.
  - Launch SPC5 Connect Explorer.
  - Verify if UART Interface is enabled.



# Sample: UART Communication

- Select UART tab and push «Init» button:
  - Bit per second = 115200
  - Data bits = 8
  - Parity = None
  - Stop bits = 1
- Push «Add» button and set the parameters:
  - Data: 112233
- Push «Start» button to send the message:
- SPC5 Connect  log window will show the value sent.
- Opening a serial terminal PC side and configuring the serial port connected in the same way, it will receive the data sent. Also, sending by serial terminal some data, they will be showed in the log window.



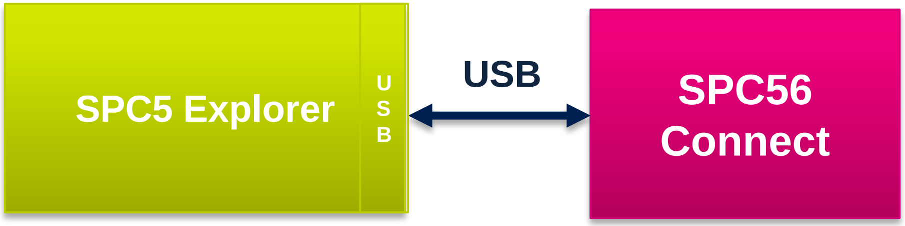
| Data | Cyclic | Freq (ms) | Send |
|---|---|---|---|
| 112233 | ☑ | 100 | Start |

| Dir | Data | Report |
|---|---|---|
| OUT | 11 22 33 | Success |
| OUT | 11 22 33 | Success |
| OUT | 11 22 33 | Success |
| OUT | 11 22 33 | Success |
| OUT | 11 22 33 | Success |
| OUT | 11 22 33 | Success |

# Sample: SYS Interface

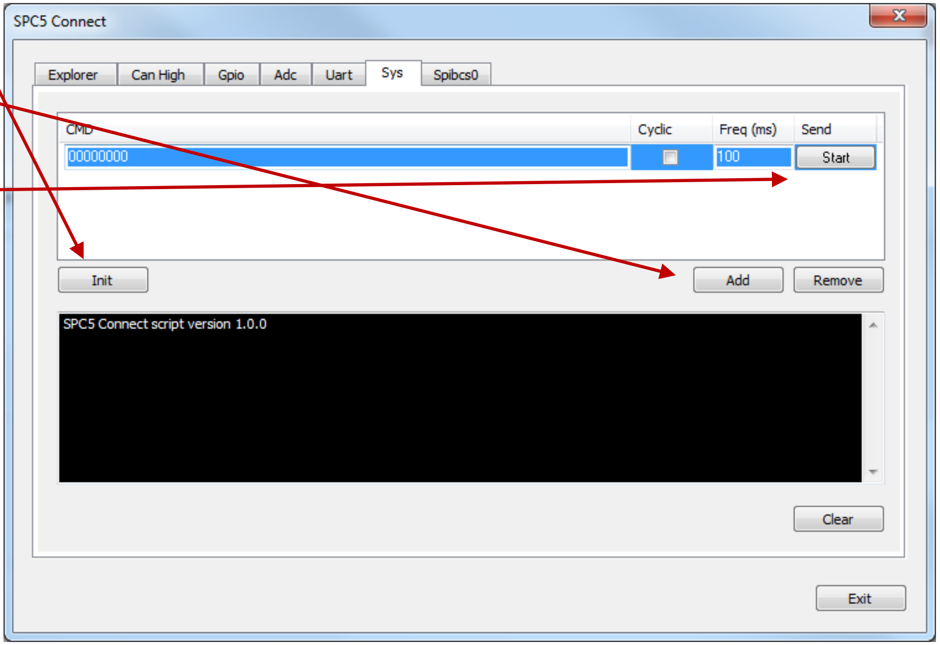
- This sample will explain how use SYS interface of SPC5 Connect to read the script version.

- Steps:
  - Connect the SPC5Connect to the PC.
  - Launch SPC5 Connect Explorer.
  - Verify if SYS interface is enabled pushing «Init» button.



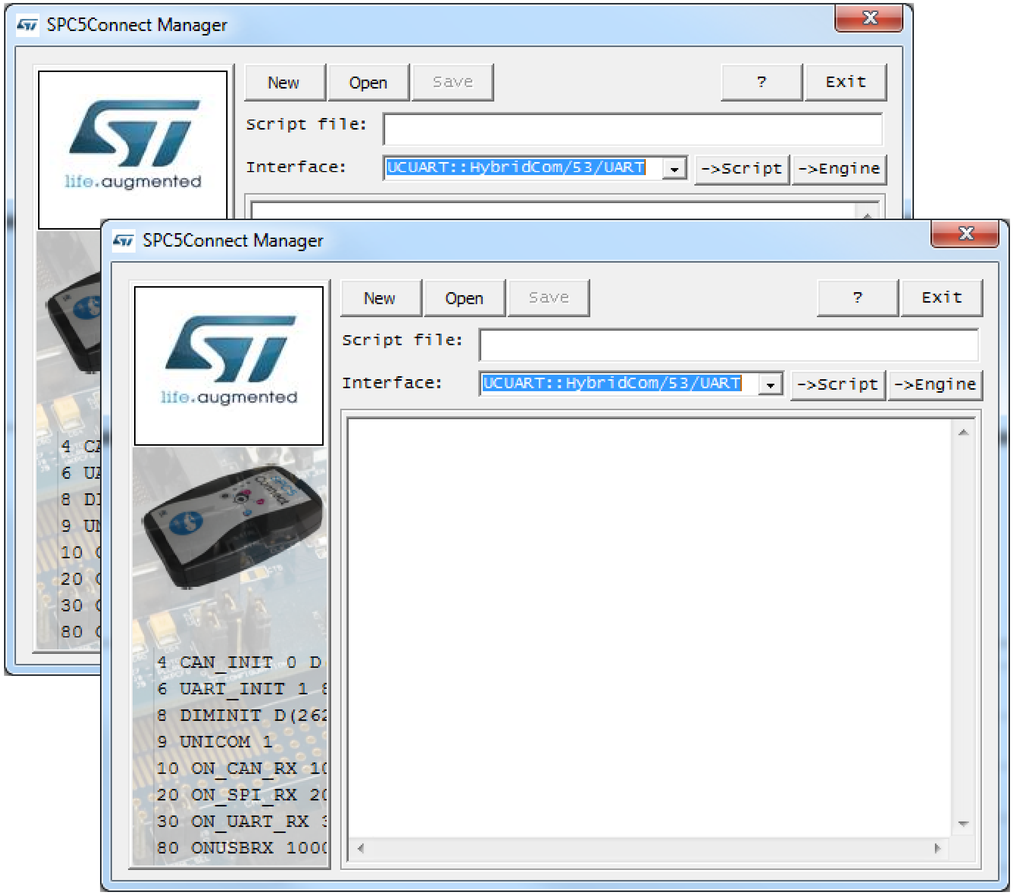
# Sample: SYS Interface

- Select SYS tab and push «Init» button:
  - Enabled this module = checked
- Push «Add» button and set the parameters:
  - Data: 00000000
- Push «Start» button to send the message.
- SPC5 Connect log window will show the script version.



```
SPC5 Connect script version 1.0.0
```

# SPC5 Connect Manager



SPC5Connect Manager

Script file:

Interface: UCUART::HybridCom/53/UART

```
4 CAN_INIT 0 D
6 UART_INIT 1 8
8 DIMINIT D(262
9 UNICOM 1
10 ON_CAN_RX 10
20 ON_SPI_RX 20
30 ON_UART_RX 3
80 ONUSBRX 1000
```

SPC5 Connect firmware is based on a script and an engine. SPC5 Connect explorer works only with the default firmware but the user can change the script to execute personalized tasks.

The **SPC5 Connect Manager** is a tool that allows easily to update the script. It allows also to update the engine of the SPC5 Connect.

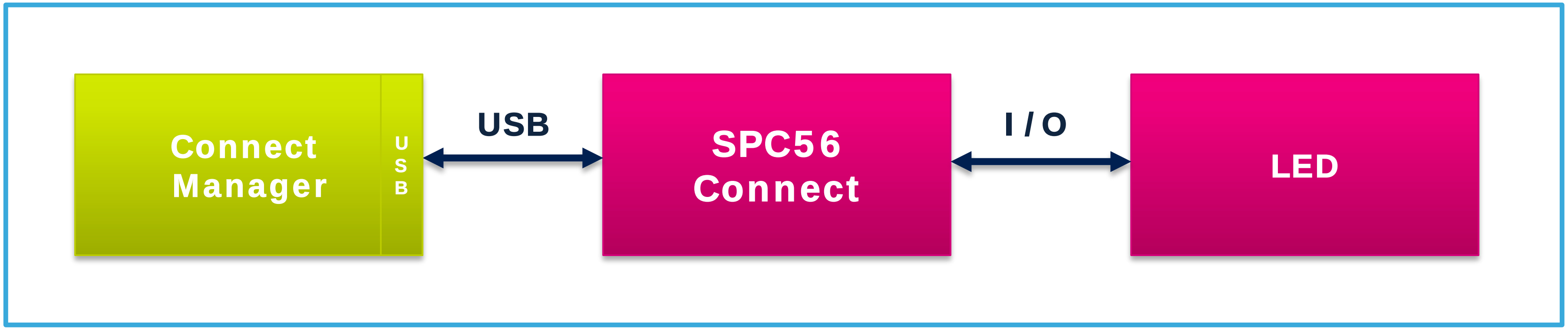
# Tutorials

- SPC5 Connect Manager examples:
  - LED Blinking
  - PWM Signal
  - SPI Communication
  - Analog readings

# Sample: LED blinking

- This sample will explain how to control LED blinking with SPC5 Connect.

- Steps:
  - Launch SPC5 Connect Manager and download the LED blinking sample script.
  - A, B and C LED on SPC5 Connect will blink.

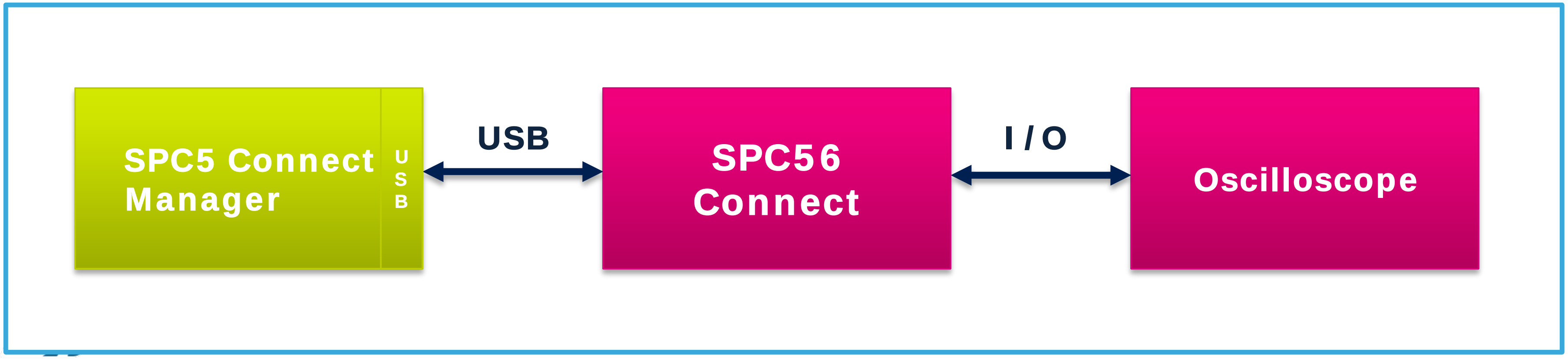


# Sample: LED blinking

```
REM Initializes I/O using EMIOS 0 as output
REM Configure GPIO 202 (LED 0, Index 18), 193 (LED 1, Index 19) and 115 (LED 2, Index 20) as output
REM  0, 1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
REM 88,87,183,188,189,107,108,109,110,213,179,181,187,103,102,104,105,106,202,193,115
10 DIM GPIOB(21) = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 3, 3, 3
20 GPIO_INIT GPIOB(21)

REM Toggle LED and wait
30 GPIO_SET 18
40 GPIO_SET 19
50 GPIO_SET 20
60 DELAY 100000

REM Toggle LED again and loop
70 GPIO_RESET 18
80 GPIO_RESET 19
90 GPIO_RESET 20
100 DELAY 100000

REM Loop
110 GOTO 30
```

# Sample: Generate a PWM signal

- This sample will explain how to generate a PWM signal with SPC5 Connect.
- Steps:
  - Connect the signal probe from your oscilloscope to pin 2 / eMIOS0 of the header connector (cable must be on PCB's Header A), ground is on pin 14 of the same header.
  - Launch SPC5 Connect Manager and download the PWM sample script.
  - Reset the Connect hardware.
  - Set your oscilloscope and watch the generated PWM signal.



# Sample: Generate a PWM signal

```
REM initialize PWM
10 PWM_INIT

REM set Ton and Toff of PWM signal
20 LET TON = 100
30 LET TOFF = 200

REM PWM_START [0: One Shot;1: Running] [EMIOS Channel] [Ton microsecond] [Toff Microsecond]
40 PWM_START 1 0 TON TOFF

REM Infinite Loop
50 GOTO 50
```

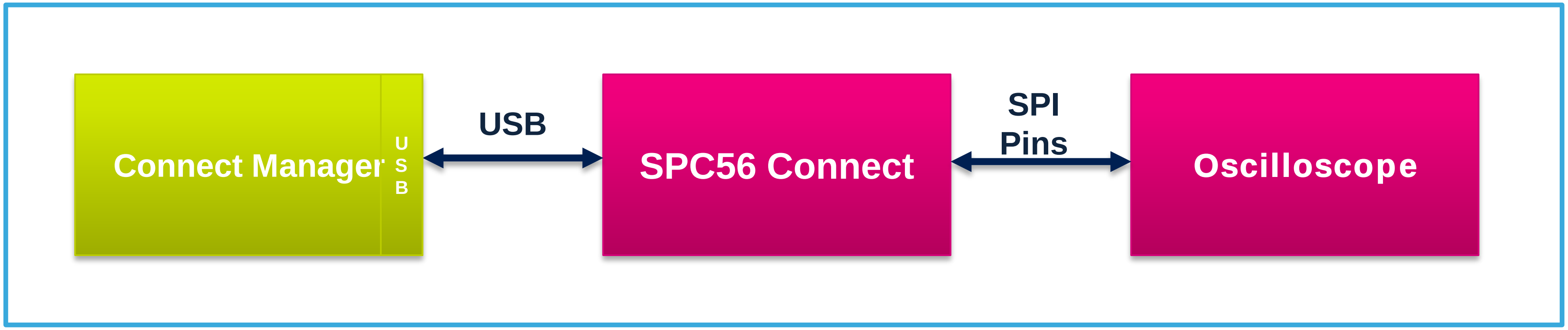
# Sample: Generate a PWM signal on SPC5-Connect LED

```
///Generate a PWM on SPC5 Connect LED (LED 1: EMIOS 23; LED 2: EMIOS 14)

REM initialize PWM
10 PWM_INIT

REM set Ton and Toff of PWM signals
20 LET TON1 = 100000
30 LET TOFF1 = 100000

40 LET TON2 = 200000
50 LET TOFF2 = 200000

REM PWM_START [0: One Shot;1: Running] [EMIOS Channel] [Ton microsecond] [Toff Microsecond]
60 PWM_START 1 23 TON1 TOFF1
70 PWM_START 1 14 TON2 TOFF2

REM Infinite Loop
100 GOTO 100
```

# Sample: Send an SPI message

- This sample will explain how to send an SPI message with SPC5 Connect using a specific script.

- Steps:
  - Launch SPC5 Connect Manager and download the SPI script.
  - Connect MOSI and MISO in loopback and Monitor the signals using an oscilloscope.



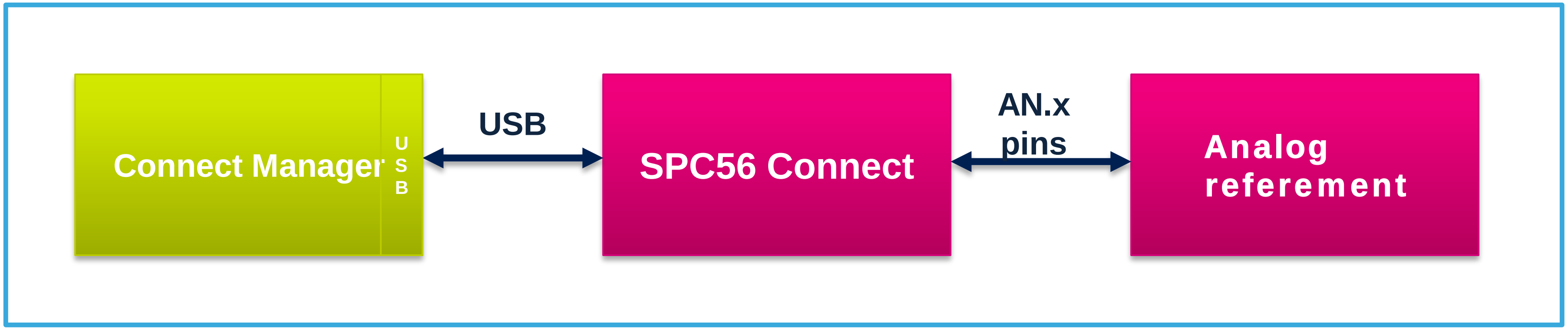
# Sample: Send an SPI message

```
REM SCRIPT to send an SPI message
20 DIM D(16) = 15, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 0\n"

REM SPI_INIT [SPI_B - 8bit frame size - 5MHz - CS Active Low 0 - CPHA - MSB First - CPOL Low - Master Mode]
30 SPI_INIT 0 8 5 1 0 0 0 1

REM Send SPI message
40 SPI_WRITE 0 0 0 D(1) SPIREPLY(1)=0

REM Loop
50 GOTO 20
```

# Sample: Analog reading

- This sample will explain how to read 4 analog channels with SPC5 Connect using a specific script.

- Steps:
  - Launch SPC5 Connect Manager and download the script described in the next page.
  - Connect AN.0 (P3-pin10), AN.1 (P3-pin11), AN.2 (P3-pin12) and AN.3 (P3-pin13) to external voltage referements.
  - Close SPC5 Connect Manager and start a serial terminal (baudrate: 115200bps).
  - The serial terminal will show the result of conversion.



# Sample: Analog reading

```
10 USB_WRITE "| ADC Read: "
20 ADC_INIT
30 ADC_READ 0 1 0 ADCVAL
35 USB_WRITE " - Ch 00: "
40 USB_WRITE ADCVAL
50 DELAY 200000
60 ADC_READ 0 1 1 ADCVAL
65 USB_WRITE "mV - Ch 01: "
70 USB_WRITE ADCVAL
80 DELAY 200000
90 ADC_READ 0 1 2 ADCVAL
95 USB_WRITE "mV - Ch 02: "
100 USB_WRITE ADCVAL
110 DELAY 200000
120 ADC_READ 0 1 3 ADCVAL
125 USB_WRITE "mV - Ch 03: "
130 USB_WRITE ADCVAL
135 USB_WRITE "mV | "
150 DELAY 200000
200 GOTO 30
```

# Other possible applications

- Signal injection
  - For functional tests.
- Sensor simulation
  - Through the script it is possible to simulate more complex signals including most common protocols used by automotive ASICs (Manchester, etc).
- ASIC Test:
  - Time based task
  - On event task
  - SPI output monitoring task
- EMC Test:
  - Device initialization task
  - SPI /output monitoring task
  - Loop peripheral checking task