

# 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<sup>TM</sup>+2 Software for the SPOC<sup>TM</sup>+2-Demoboard.

#### Intended audience

This document is intended for anyone using the SPOC<sup>™</sup>+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		
Abbreviation	Definition	
SPOC <sup>TM</sup> +2	SPI Power Controller	
SPOC <sup>™</sup> +2 MB	SPOC <sup>™</sup> +2 Motherboard	
SPOC <sup>™</sup> +2 DB	SPOC <sup>™</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<sup>™</sup>+2 MB
  - SPOC<sup>™</sup>+2 Motherboard
  - o See Figure 1



Figure 1 – SPOC<sup>™</sup>+2 MB

- **SPOC<sup>™</sup>+2 DB** 
  - Product specific (BTSxxxxx-xxxx)
  - See Figure 2



Figure 2 – SPOC<sup>™</sup>+2 DB



- μIO-Stick
  - $\circ$   $\,$  Communication between your computer and the Demoboard  $\,$
  - o Isar Number: SP001215532
  - See Figure 3



#### 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<sup>™</sup>+2 Application

How to install software for the **SPOC<sup>™</sup>+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)

This PC > USB Drive (E:) > SPOC+2\_Installer > Volume

^	Name	Date modified	Туре	Size
	📙 bin	19.10.2017 13:20	File folder	
	license	19.10.2017 13:20	File folder	
	supportfiles	19.10.2017 13:20	File folder	
	nidist.id	04.09.2017 12:03	ID File	1 KB
	😽 setup	17.02.2016 16:26	Application	1 423 KB
	a setup	04.09.2017 12:03	Configuration sett	22 KB
Figur	e 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"

Destination Directory Select the primary installation directory.
All software will be installed in the following locations. To install software into a different location, click the Browse button and select another directory.
Directory for SPOC+2 C:\Program Files (x86)\SPOC+2\ Browse
Directory for National Instruments products C:\Program Files (x86)\National Instruments\ Browse

Figure 7 - SPOC<sup>™</sup>+2 Application - Select Directory

Again click "next"



	₩ SPOC+2	-		×
	Start Installation Review the following summary before continuing.			
	Adding or Changing SPOCx2 Files • NI-VISA 14.0 Run Time Support			
	Click the Next button to begin installation. Click the Back button to change the install	ation settings		
	Save File ≪ Back I Figure 8 – SPOC <sup>™</sup> +2 - Application - Start	∖ext>> Install	Cancel ation	
The insta	allation will start, after that click "finish	n	_	
	Installation Complete	-		×
	The installer has finished updating your system.			
	<< Back N	ext>>	Finish	

Figure 9 – SPOC<sup>™</sup>+2 - Application – Finish

### 1.2.2 µIO-Stick Driver Install

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

vveitertunrenae Links zu "uio-Stick"



Figure 10 - µIO-Updater (for vCOM)

#### 1.3 Setup Hardware

• Plug the SPOC<sup>TM</sup>+2 DB onto the SPOC<sup>TM</sup>+2 MB (see Figure 11)





Figure 11 – SPOC<sup>™</sup>+2 DB plugged onto SPOC<sup>™</sup>+2 MB

- Connect the  $\mu$ IO-Stick to the SPOC<sup>TM</sup>+2 MB via the connector cable (see Figure 12)
  - **Be careful**: Position of Pin 1 is marked with a dot on the SPOC<sup>TM</sup>+2 MB!



Figure 12 - Connecting µIO-Stick to SPOC<sup>™</sup>+2 MB

• Connect the μIO-Stick to your computer and run the SPOC<sup>TM</sup>+2-Application. (see Figure 13)





Figure 13 - Finished setup

# 1.3.1 Setup details

Table 3	
ΧμΙΟ	
Pin #	
0 1	NC
0 2	GND
03	NC
o 4	+5VμΙΟ
0 5	NC
0 6	NC
0 7	NC
0 8	IN <sub>3</sub>
o 9	CS
0 10	IN2
0 11	SCLK
0 12	IN1
0 13	SO
0 14	INo
0 15	SI
o 16	Sense
J_Filter	Closed by default
J_IS	1-2 closed by default
	If 2-3 is closed:
	<ul> <li>J_Filter has to be opened!</li> </ul>
	<ul> <li>Sense directly switched to IS (Filter</li> </ul>
	disconnected)
J_GND	1-2 closed: R_GND = 150 $\Omega$ (default)
	3-4 closed: R_GND = 50 Ω
	5-6 closed: R_GND = 0 $\Omega$
J_IN2	3-2 closed by default.
	If 1-2 is closed:
	Connect PROFET <sup>2</sup>
J_IN3	3-2 closed by default.
	If 1-2 is closed:
	Connect PROFET <sup>2</sup>
J_VDD	1-2 closed (default VDD via µIO-Stick):
	<ul> <li>Use +5VµIO (USB) as digital supply</li> </ul>
	voltage
	2-3 closed:
	VDD via external supply
J_cho ¹	Closed if 4 Channel SPOC <sup>™</sup> +2 is used:



	<ul> <li>OUTo and OUT1/o in parallel.</li> </ul>	
J_chȝ ¹	Closed if 4 Channel SPOC+2 is used:	
	<ul> <li>OUT<sub>4</sub>/<sub>3</sub> and OUT<sub>5</sub>/<sub>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)	
INo	activate the corresponding output channel	
IN1	activate the corresponding output channel	
IN2/EDD <sup>2</sup>	activate the corresponding output channel	
IN <sub>3</sub> /EDO <sup>2</sup>	activate the corresponding output channel	
OUT₀	Output channel o	
OUT1/0 <sup>1</sup>	Output channel 1 if J_cho is open,	
	Output channel o if J_cho is closed	
OUT2/1 <sup>1</sup>	Output channel 2 if J_cho is open,	
	Output channel 1 if J_cho is closed	
OUT3/2 <sup>1</sup>	Output channel 3 if J_cho is open,	
	Output channel 2 if J_cho is closed	
OUT4/3 <sup>1</sup>	Output channel 4 if J_ch3 is open,	
	Output channel 3 if J_ch3 is closed	
OUT5/3 <sup>1</sup>	Output channel 5 if J_ch3 is open,	
	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<sup>™</sup> are used J\_cho and J\_ch<sub>3</sub> had to be closed, otherwise (6-Channel-SPOC) opened.

<sup>2</sup> If Jumpers J\_IN<sub>2</sub> and J\_IN<sub>3</sub> are set to 1-2: SPOC<sup>™</sup> 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):

≡	E D Ø	ilters 🗸
俞	Best match	
	SPOC+2 Desktop app	
	Folders	
	SPOC+2	
	Documents	
	SPOC+ Power easy Kit getting starter v0.2.doc	ed
ŝ		
r		
	P spod+2	
	A 🗆 🤤 🚍 🔽	

Figure 16 – SPOC<sup>™</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
------------------	----------------------

Tabl	e 4 - STD-View	
1	Menu bar	*
2	Port selection	Software should detect the Comport automatically.
		If not: select the needed Comport.
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	Switch INo-IN2 on or off
		LHI can be set on or off
6	Input logics	OR/AND operation between direct inputs (INo-IN3) with the channel's on-status
		(channel o to 3)
7	Reset	Reset SPOC <sup>™</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)
		•
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>™</sup> +2
12	Error counter	Error counter of the selected channel
		•
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



 $\times$ 

### 2.2.2 SPI-View





Figure 18 - User Interface - SPI-View

Table 5	Table 5 - SPI-View				
1	Register selection Select the register addres 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>™</sup> +2			
5	Command list	Displays all added commands in ascending order			
6	Response list	Displays SPOC <sup>™</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			
		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 necessairy at the moment  $\rightarrow$  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

STD SPI

### 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)

_				deles (mer)
Register	WRITE?	A.	command	uelay (ms)
J OUT		0 3	× 00	A D
RCS		-	line .	- Mo
OCR			× 00	<u>A</u> D
RCD			Part of the second seco	5/1°
KRC			× 00	A) 0
SRC			ļ	
HWCR			× 00	<u>^</u> 0
ICS	LMD			
PCS			× 00	× 0
DCR				
WRNDIAG	List		× 00	(x) 0
STODIAG			1	0
EPPDIAG			× 00	(×) (v)
EKKDIAG	ET		1	
			× 00	70
				A)-
			× 00	T 0

Figure 20 - Select register OUT



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

Register WRITE? Command delay (m:	;)
OUTO OUT1 OUT2 OUT3 extD OUT5	
ADD CMD	
Clear List	
RESET	

Figure 21 - Write to register OUT

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

STD SPI		
Register WRITE?	0 command	d delay (ms)
OUT0 OUT1 OUT2 OUT3 extD OUT5	×00	
ADD CMD	×00	
Clear List	× 00	
RESET	× 00	
	100	Alo

Figure 22 - Add command to command list

• Select OUTo in the WRITE-Box (See Figure 23)

STD SPI			
Register WRITE?	eon con	nmand	delay (ms)
OUT0 OUT1 OUT2 OUT3 extD OUT5		00	
ADD CMD		0	
Clear List		0	
RESET		0	
		10	

Figure 23 - Write OUT0



• Click ADD CMD (See Figure 24)

STD SPI			
Register WRITE?	0	command	delay (ms)
OUT0 OUT1 OUT2 OUT3 extD OUT5		×81 ×00	
ADD CMD		× 00	
Clear List		× 00	
RESET		× 00	€0 €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 WRITE?	<u>/</u> 0	command	delay (ms)	
OUTO OUT1 OUT2 OUT3 extD OUT5		x81		
		× 00	0	
ADD CMD		× 00	0	
		× 00	0	
Clear List		× 00	0	
RESET		× 00	() ()	
NESET		00		

Figure 25 - change delay of cammands

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

STD SPI			
Register WRITE?	0	command	delay (ms)
		×81	A) 1000
ADD CMD		×83 ×87	1000
Clear List		×8F	A 1000
RESET		× 00	
		× 00	(x) (x)

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)

STD	SPI		
		Channel 0	
	Choose Device	ERROR WARN OUT	
	BTS7xxxx-4ESA 🤝	○ ○ ○ □ ON	
		Sense Ratio Restart Strategy OC level Slew rate	
	INO	high Restart high normal	
		Channel 1	
		ERROR WARN OUT	
	IN1 Input Logic	○ ○ ○ □ ON	
		Sense Ratio Restart Strategy OC level Slew rate	Checksum
	IN2	high Restart high normal	Calculate Checksum
		Channel 2	
		ERROR WARN OUT	Send Checksum
	LHI	○ ○ ○ □ ON	IC MUV
		Sense Ratio Restart StrategyOC level Slew rate	IS MOX Error Counter Siew rate
		high Restart high normal	stuby V 0 CLCS normal
		Channel 3	STD DIAG
	RESET	ERROR WARN OUT	TER CSV LHI SLP SBM VSMON
		○ ○ ○ □ ON	000000
		Sense Ratio Restart Strategy OC level Slew rate	
	cic	high Restart high normal	

Figure 27 - switch to STD view

STD SPI			
Choose Device BTS7xxxx-4ESA マ IN0	Channel 0 ERROR WARN OUT Sense Ratio Restart Strategy OC level Slew rat high Restart high norma Channel 1 ERROR WARN OUT	e 1	
IN1 Input Logic IN2 IN2 LHI	ON Sense Ratio Restart Strategy OC level Slew rat high Restart high norma Channel 2 ERROR WARN OUT Sense Ratio Restart Strategy OC level Slew rat high Restart bigh	Channel 0 Channel 1 Channel 2 Channel 3 Channel 4 Channel 5 none y stdby	Checksum 00000 Error Counter Slew rate 0 CLCS normal
CLC	Channel 3 ERROR WARN OUT Sense Ratio Restart StrategyOC level Slew rat high Restart high norma	STD DIAG TER CSV	

#### Figure 28 - Select channel at IS MUX

STD SPI

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

Register WRITE?	command 0	d delay (ms)	response	loop all commands x times:
	×81	3 1000	× 0000 × 0000	START
ADD CMD	× 87		× 0000 × 0000 × 0000	Save to File
Clear List	x 00		× 0000 × 0000 × 0000	Load from File
RESET	× 00		× 0000 × 0000	





• The response of the SPOC<sup>™</sup>+2 is shown in the response list (See Figure 30)



Figure 30 - response of SPOC<sup>™</sup>+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)

STD SPI				
Register		2	command	delay (ms)
✓ OUT RCS		0	× 00	
OCR RCD			× 00	
KRC SRC			× 00	
HWCR ICS	IMD		× 00	0
PCS DCR			× 00	
WRNDIAG STDDIAG	List		× 00	
ERRDIAG	ET		×00	
			× 00	
			T.	100 C

Figure 31 - Select Register OUT



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

STD SPI			
Register WRITE?	<u>^</u> 0	command	delay (ms)
OUTO OUT1 OUT2 OUT3 extD OUT5		×00	
ADD CMD		×00	
Clear List		x00	
RESET		× 00	

Figure 32 - Select OUT0 and add command

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

STD SPI			
Register WRITE?	() 0	command	delay (ms)
OUT0 OUT1 OUT2 OUT3 extD OUT5		× 80	
ADD CMD		×00	
Clear List		× 00	
RESET		× 00	

Figure 33 - Select no output and add command

- Also typing in commands directly is possible (See SPOC<sup>™</sup>+2 datasheet for command reference)
   E.g.:
  - The command 80<sup>h</sup> means Write no output to OUT
  - The command 81<sub>h</sub> would mean *Write to OUT and set OUTo 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)



STD SPI			
Register WRITE?	<u>^</u> 0	command	delay (ms)
OUTO OUT1 OUT2 OUT3 extD OUT5		× 80	A) 500
ADD CMD		x 00	
Clear List		×00	
RESET		×00 ×00	

Figure 34 - change delay of commands

STD SPI

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

Register WRITE?	0	command	delay (ms)	response	loop all commands x times:
OUT0 OUT1 OUT2 OUT3 extD OUT5		× 80	3500	× 0000	START
ADD CMD		200		× 0000	Save to File
Clear List		×00		× 0000	Load from File
PECET		x 00		× 0000	
REJEI		× 00	$\frac{\lambda}{\nabla}$ 0	× 0000	

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)

STD SPI		
	Channel 0	
Choose Device	ERROR WARN OUT	
BTS7xxxx-4ESA 🤝	○ ○ ○ □ ON	
	Sense Ratio Restart StrategyOC level Slew rate	
IN0	high Restart high normal	
	Channel 1	
	ERROR WARN OUT	
Input Logic		
OR	Sense Ratio Restart Strategy OC level Slew rate	Checksum
IN2	high Restart high normal	Calculate Checksum
	Channel 2	Send Checksum
LHI		
	Sense Ratio Restart Stratemy/OC level Slow rate	IS MUX Error Counter Slew rate
	high Restart high normal	stdby  v 0 CLCS normal
	nign nestare nign normal	
RESET	Channel 3	STD DIAG
RESET	ERROR WARN OUT	TER CSV LHI SLP SBM VSMON
CLC	Sense Ratio Restart Strategy OC level Slew rate	
	high Kestart high normal	

Figure 36 - Switch to STD view



STD	SPI			
		Channel 0		
	Choose Device BTS7xxxx-4ESA 💎	ERROR WARN OUT		
	INO	Sense Ratio         Restart Strategy OC level         Slew rate           high         Restart         high         normal		
		Channel 1		
	IN1 Input Logic		Channel 0	1
	OR	Sense Ratio Restart Strategy OC level Slew rate	Channel 1	Checksum
	IN2	high Kestart high normal	Channel 2 Channel 3	0000
		FRROR WARN OUT	Channel 4	
	LHI	ON	Channel 5 none	Fires Counter Slew rate
		Sense Ratio         Restart Strategy OC level         Slew rate           high         Restart         high         normal	✓ <b>stdby</b> ext Drive	0 CLCS normal
		Channel 3	STD DIAG	
	RESET	ERROR WARN OUT	TER CSV	LHI SLP SBM VSMON
	CLC	Sense Ratio Restart StrategyOC level Slew rate	$\bigcirc \bigcirc$	$\bigcirc \bigcirc $
		nign restart nign normal		

Figure 37 - Select a channel at IS MUX

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

STD SPI					
Register WRITE?	0	command	delay (ms)	0 response	loop all commands x times:
		× 00		× 0000 × 0000	START
ADD CMD		x 00		× 0000 × 0000	Save to File
Clear List		×00	() 0 () 0	× 0000 × 0000	Load from File
RESET		×00		× 0000 × 0000	
INCOL 1		x 00	0	× 0000	

Figure 38 - Switch to SPI and start command sequence

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

STD SPI					
Register WRITE?	0	command	delay (ms)	response	loop all commands x times:
		× 80	<ul> <li>★ 500</li> <li>★ 0</li> </ul>	× 0000 × 0000	START
ADD CMD		× 00		× 0000	Save to File
Clear List		× 00		× 0000 × 0000	Load from File
RESET		× 00		× 0000 × 0000 × 0000	

Figure 39 - Response od SPOC<sup>™</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