UM1540
User manual

Opto-isolated universal USB to serial bridge

Introduction

This user manual explains the functioning of the STM32F103xx based universal USB to serial communication interface (UUSCI) with opto-isolated channels suitable for applications such as motor control boards directly supplied from the mains.

This user manual describes the functionalities present in the opto-isolated UUSCI demonstration board and demonstrates how to use them.

The STM32F103xx microcontroller is used as the main digital controller to interface with the slave devices. The system utilizes opto-isolators to isolate the STM32F103xx and slave devices to control, configure and monitor it. The UUSCI has a 16-pin interface with which it is possible to connect a device which can communicate using SPI and UART. Therefore, the UUSCI tool allows the user to connect a serial communication based device to the PC. It also allows, at the same time, some GPIOs available in that 16-pin interface to be controlled and set in input/output modes as shown in the pin diagram.

In this demonstration board, the STM32F103xx microcontroller is used as the interface between the PC and the end device. Due to intelligence available in the STM32F103xx device, SPI and UART are connected to the 16-pin interface.

Power to the board is provided from a USB mini B-type connector. In addition, external target VDD_T and GND_T supply is used to power up the opto-isolators output section.

Here, DLL files of the PC GUI are provided with this tool. So the user can use these DLL files to make their own customized PC GUI as per requirements.

Therefore, the UUSCI tool provides an option for end users to just focus on its application development as the complexity of the microcontroller is taken care of by the tool itself, so increasing its efficiency and time to market.

The UUSCI tool supports two PC GUIs:

- Universal dongle PC GUI: this PC GUI allows the interfacing of the SPI, and the UART interface, and the communication parameters to be controlled with the help of the GUI itself.
- DFU mode PC GUI: this PC GUI allows the firmware to be changed if required by the user to suit their applications. In the UUSCI demonstration board, all the other pins are available in the form of jumpers which can be programmed by changing the firmware in DFU mode.

Therefore, the UUSCI board is a complete tool to rapidly develop the prototyping development of the applications.

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1 Getting started

1.1 System requirements

In order to use the universal USB to serial communication interface (UUSCI) with a Windows® operating system, a recent version of Windows, such as Windows 2000 or Windows XP must be installed on the PC.

The version of the Windows OS installed on your PC may be determined by clicking on the “System” icon in the control panel.

1.2 Package contents

The UUSCI demonstration board includes the following items:

- Hardware content:
  - One demonstration board.
  - BOM
  - Schematic
- Software content:
  - PC GUI software to be used along with demonstration board
  - DFU software
  - DLL files of the SPI and UART interface
  - Source code (including DFU)
- Documentation:
  - User manual.

1.3 Software installation

Available software for the STEVAL-PCC009V4:

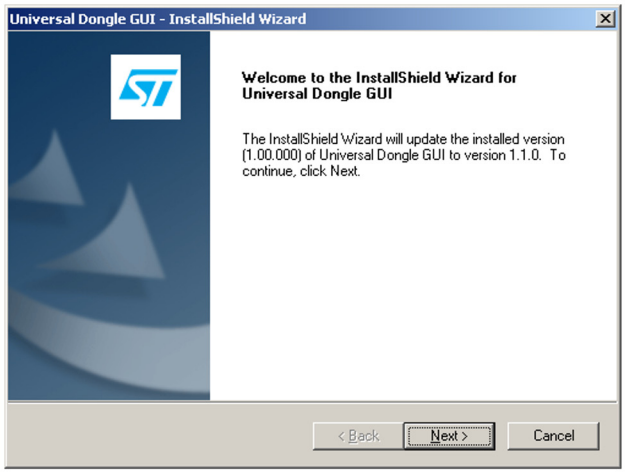
PC GUI software setup for Universal Dongle (version 1.1) is available from:

http://www.st.com/internet/com/SOFTWARE_RESOURCES/SW_COMPONENT/SW_FUNCTION/STEVAL-PCC009V1_sw_gui_v1_3.zip

To install the PC GUI software, follow the steps below:

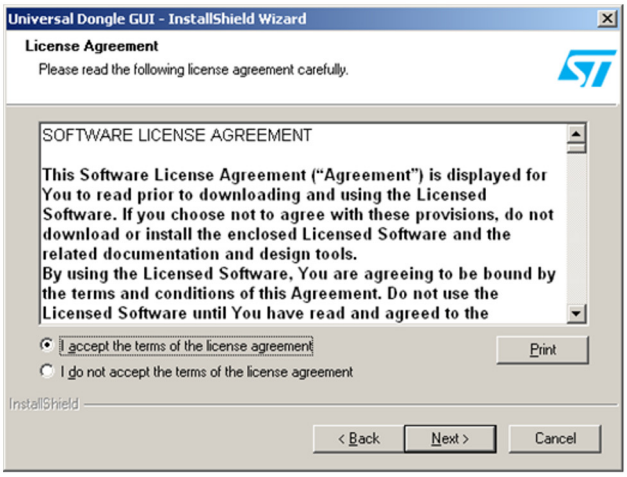
Step1: As soon as the user clicks the setup.exe icon, the following window appears.

Figure 1. Installation window



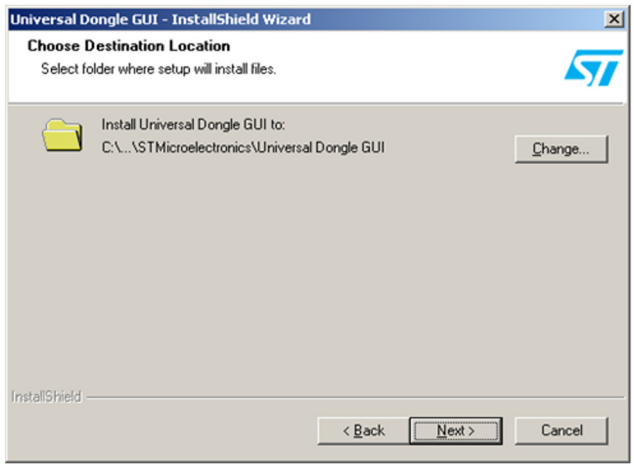
Step 2: Read the license file and click the “Yes” button to accept the license.

Figure 2. License window



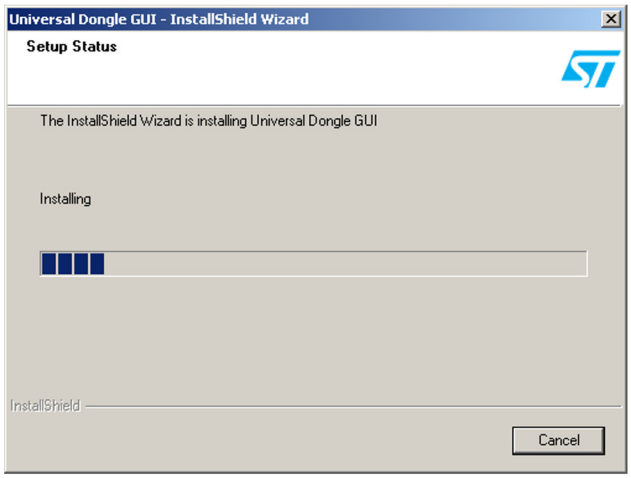
Step 3: Please select the folder in which to install the software. By default, it installs the software in the following path: C:\....\STMicroelectronics\Universal Dongle GUI.

Figure 3. Destination folder



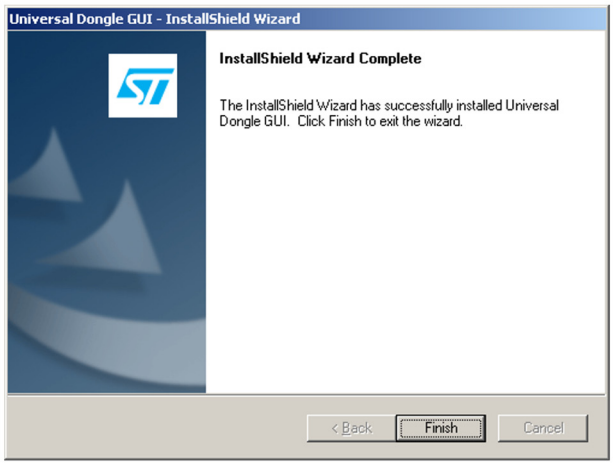
Step 4: After selecting the folder and clicking the “Next” button, it starts to install the software.

Figure 4. Installation ongoing



Step 5:

Figure 5. Installation complete

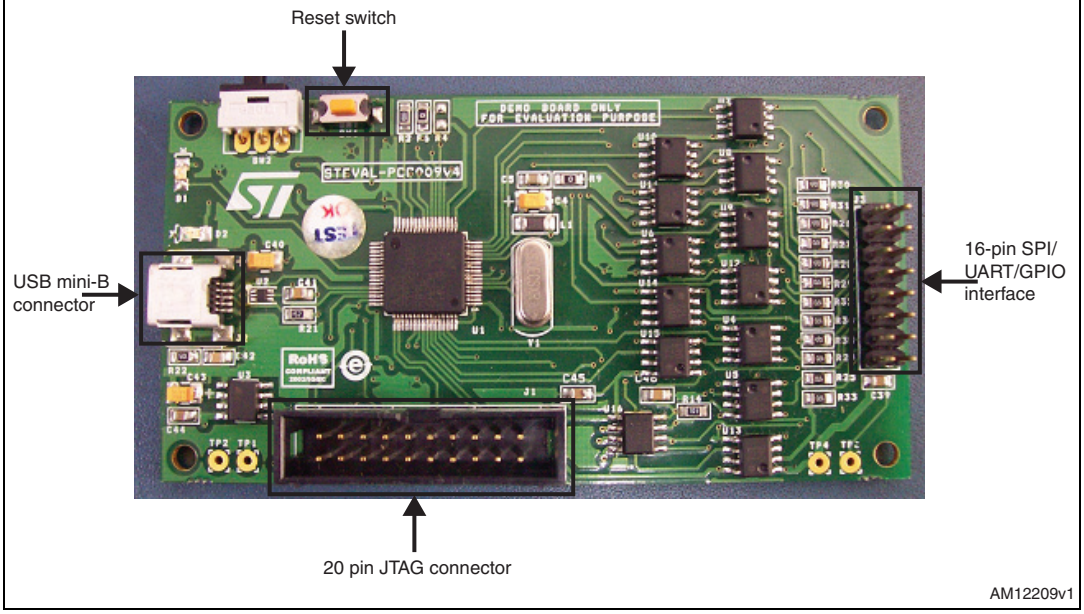


After clicking “Finish”, the software is installed in the directory selected or in the default directory. A shortcut for the software is also available in the START menu. This user manual is available in the same directory.

1.4 Hardware setup

The figure below shows a snapshot of the UUSCI demonstration board.

Figure 6. STEVAL-PCC009V4, universal USB to serial communication interface demonstration board



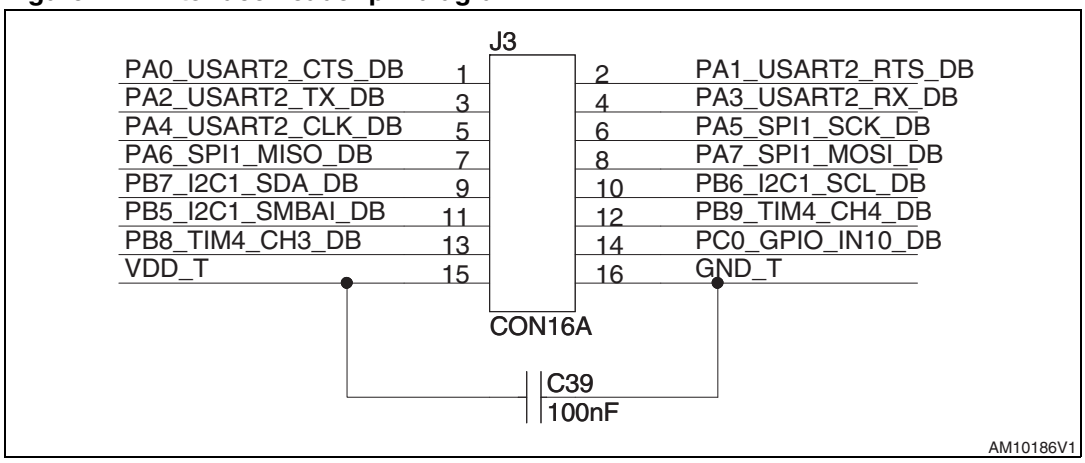
1.4.1 Power supply

The demonstration board is directly powered by the USB mini B-type connector (bus powered). In addition, the demonstration board should be powered externally with VDD_T and GND_T.

1.4.2 Jumper / connector settings

J3 is the 16-pin connector available as the default interface for UUSCI this demo board. There are 14 GPIOs, Gnd, and VDD lines available, as shown below:

Figure 7. Interface header pin diagram



Pin no.: 1, 4, 7, 10, 11 are input pins.

Pin no.: 2, 3, 5, 6, 8, 9, 12, and 13 are output pins.

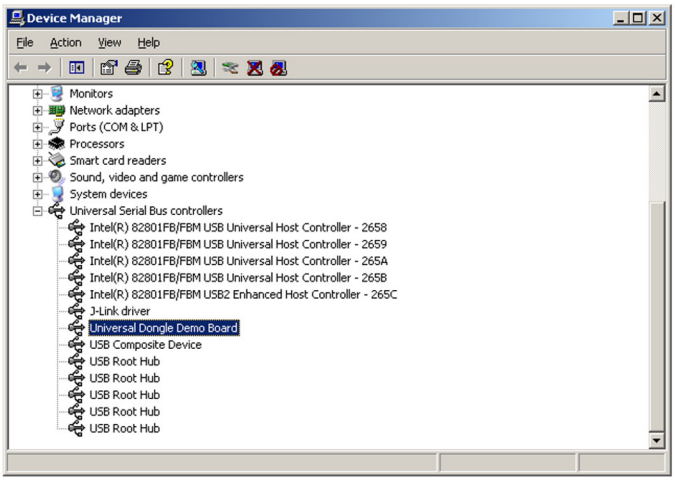
J1: This is the standard 20-pin JTAG connector available on the demonstration board. This can be used to test the board in debug mode using any JTAG based debugger for the STM32F103xx device.

2 Running the demonstration board

To run the demonstration board, connect it to the PC with the USB mini B-type cable.

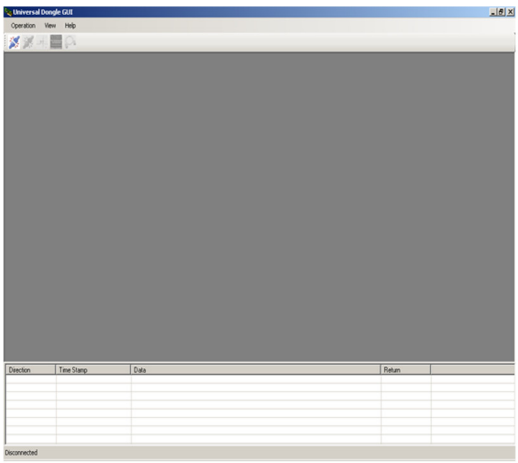
As a result, the demonstration board should be enumerated as universal serial bus controllers and it is shown as “Universal Dongle Demo Board”, as seen in *Figure 8* in the Device Manager window. If this message does not appear, please contact technical support.

Figure 8. Enumeration result



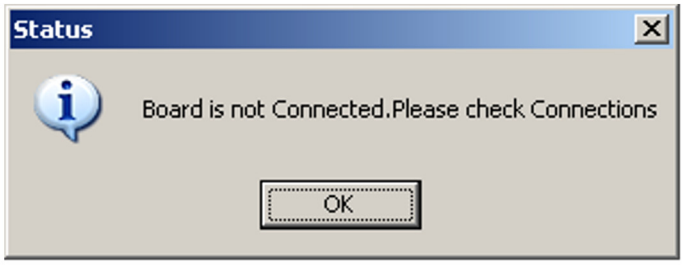
By starting the universal dongle GUI on the PC, a graphical interface (*Figure 9*) for controlling the demonstration board is seen. This PC software is used to issue various commands and to control data transfer.

Figure 9. Universal dongle GUI



You can check whether the board is connected or not by clicking the connection check button. If the board is not connected then the following message appears.

Figure 10. Board is not connected to PC



If the board is connected, the following message appears:

Figure 11. Board is connected to PC

Once this is done, the PC GUI is properly connected to the demonstration board and ready to be used.

2.1 Using SPI interface

To connect the SPI interface, first select “Synchronous” from the operation menu, as shown in *Figure 12*.

Figure 12. Selection of synchronous interface

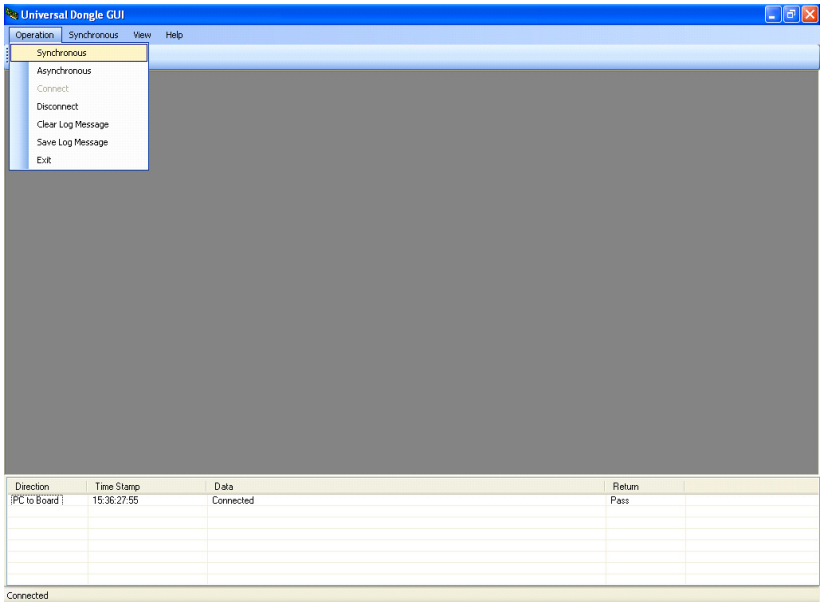


Figure 13. Selection of SPI interface

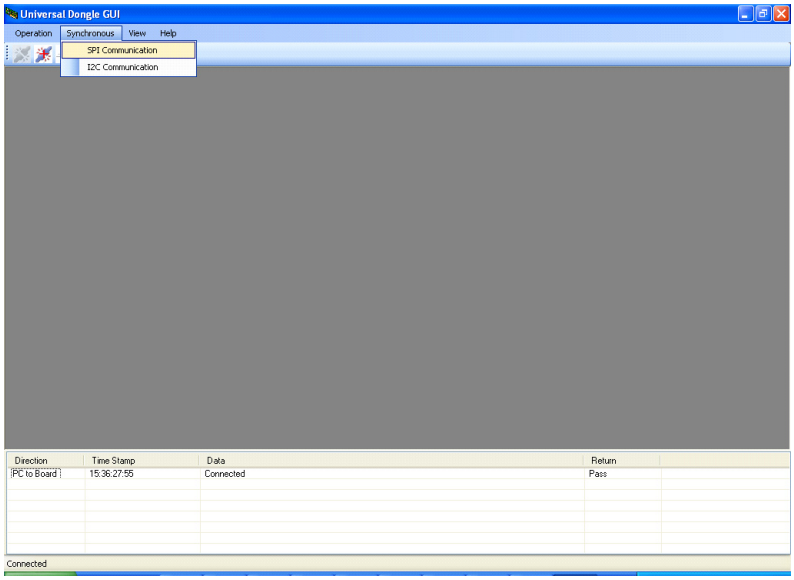
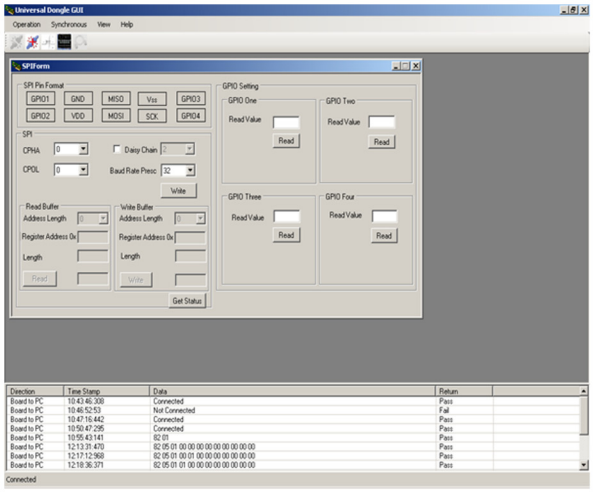


Figure 14. SPI interface window



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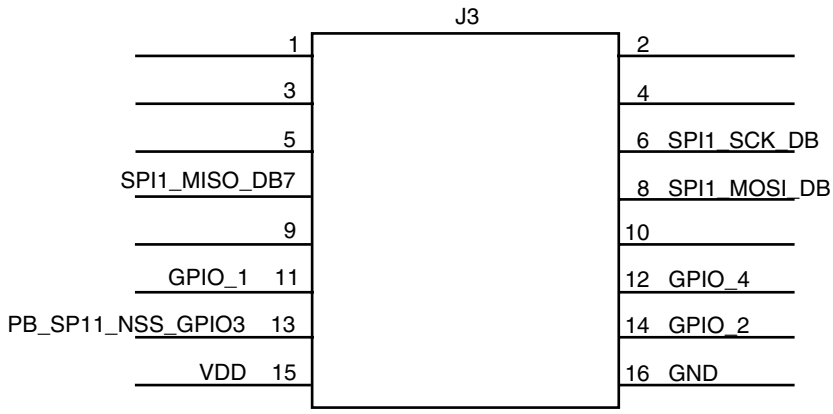
Now the PC GUI is ready to be used for testing SPI based slave devices. But before it can be used, make the connection for jumper J3, as shown in *Figure 14*.

Figure 15. J3 interpretation for SPI interface



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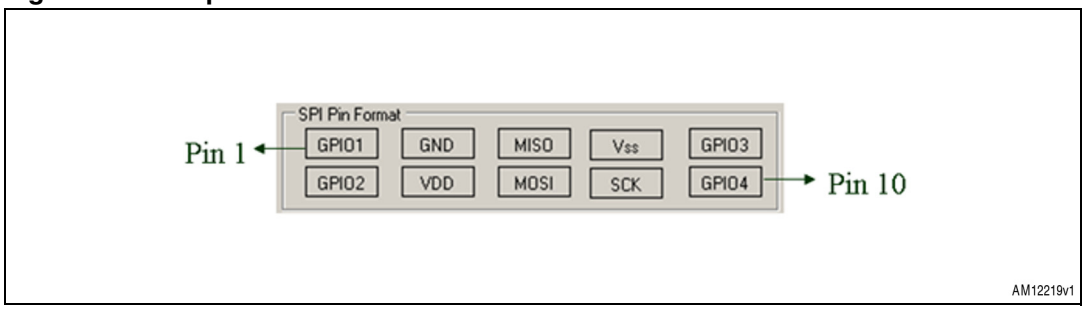
2.1.1 GPIO settings

Before making the connection to the J2, it is necessary to make the proper settings of the GPIOs which are to be used along with the SPI interface.

This can be done be clicking the SPI pin interface, as shown in *Figure 16*.

Figure 16. SPI pin interface in PC GUI

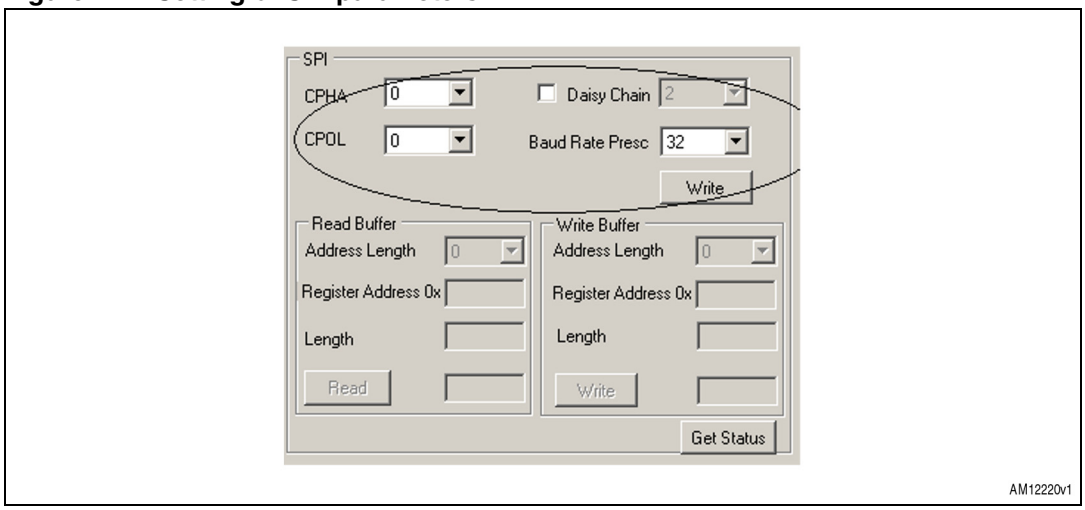


Please follow the instructions given in *Section 2.2.1* to perform the GPIO settings. Note here that, in this case, only GPIO3 and GPIO 4 have the PWM clock generation capability.

2.1.2 SPI header settings

Once the GPIO settings are completed, it is possible to connect the daughterboard to the UUSCI demonstration board and it can be assumed that correct settings of the daughterboard control and status lines have been performed. Now, before it is possible to use the SPI communication, it is necessary to first define some parameters, shown in *Figure 17*.

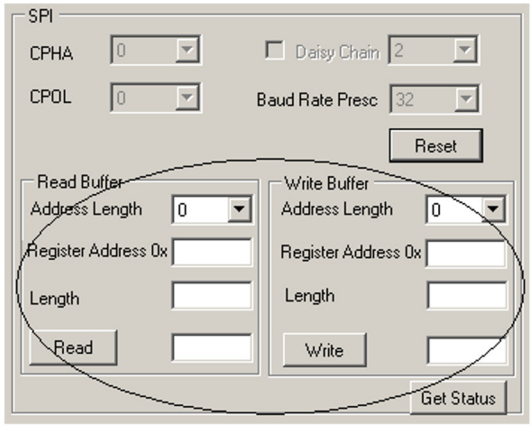
Figure 17. Setting of SPI parameters



These parameters include selection of CPHA, CPOL, and baud rate prescaler selection. (By default, the most significant bit is put first.) Once the selection is made, click the “Write” button. It sets the SPI interface and the system is now ready to read or write the data from the SPI interface based daughterboard connected to the UUSCI demonstration board. As soon as this is done, the control settings part is frozen and the Write button becomes the “Reset” button, whose purpose is to reset the SPI settings.

The read and write window looks like that shown in *Figure 18*.

Figure 18. SPI read/write window



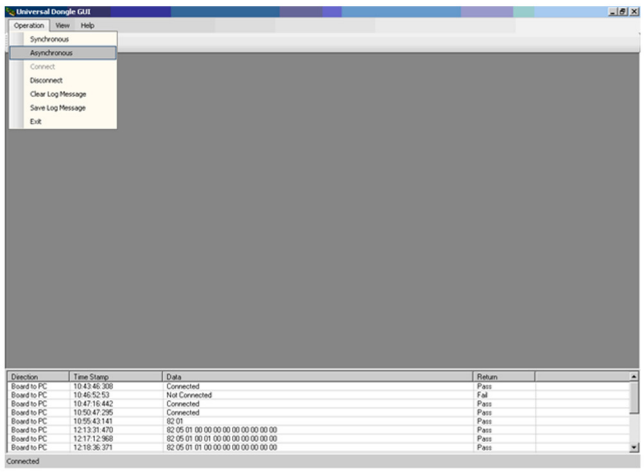
In this window, depending on the slave device, the register address length (from 0 to 4 bytes) can be selected; 0 byte length is used for random read and write operation. The values to read and write from the slave device can be filled accordingly. After every read or write operation, the GUI updates the status in the status section (for example: status: communication complete / bus free) so that the user can check the status of the SPI communication happening between the UUSCI demonstration board and the SPI slave daughterboard.

Therefore, this interface allows the user to connect any SPI interface based slave device.

2.2 Using UART (SCI) interface

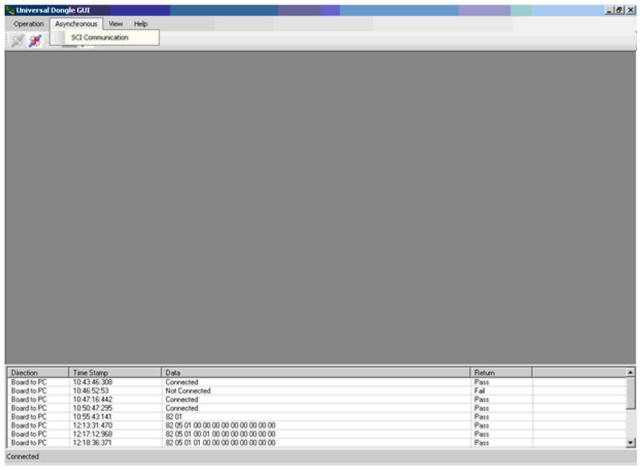
To connect the UART (SCI) interface, first it is necessary to select “Asynchronous” from the Operation menu, as shown in *Figure 19*.

Figure 19. Selection of asynchronous interface



Once the asynchronous interface is selected, an additional menu for asynchronous interfacing is open in the GUI which allows the selection of the SCI or UART interface, as shown in *Figure 20*.

Figure 20. Selection of SCI (UART) interface



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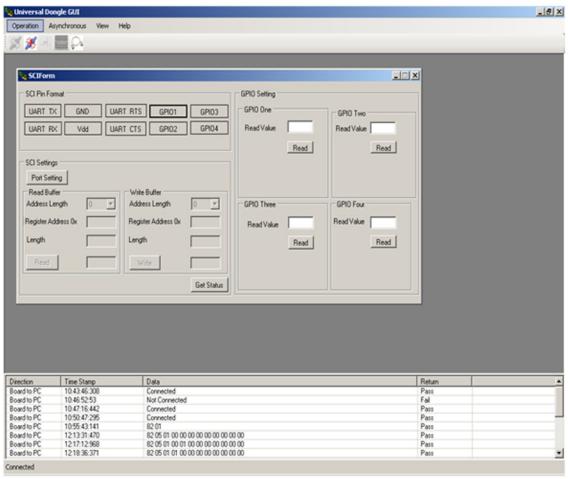
Now, if the user clicks the SCI interface option, a window for SCI interface control is opened, as shown in *Figure 21*.

Figure 21. SCI interface window



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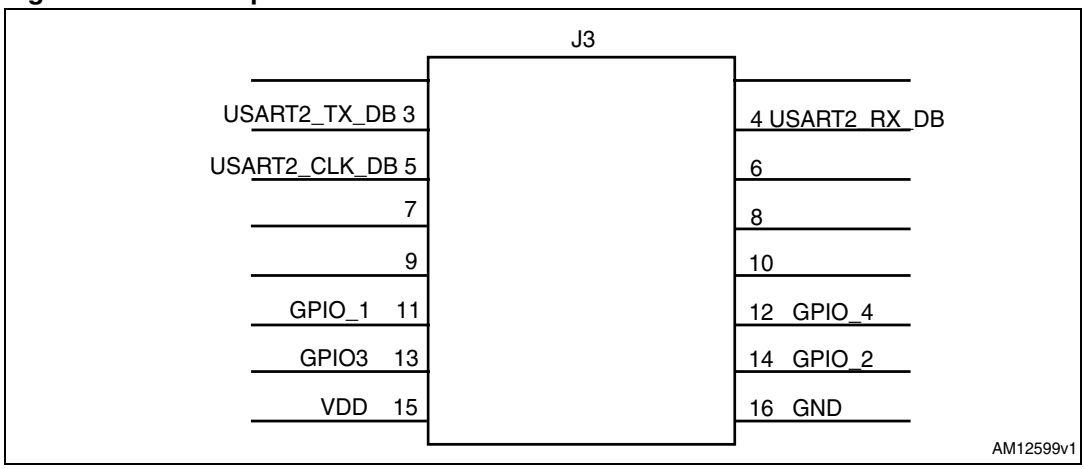
The PC GUI is now ready to be used for testing SCI based devices. To use any SCI based slave devices, the user needs to make the connection for jumper J2, as shown in *Figure 22*.

Figure 22. J3 interpretation for SCI interface

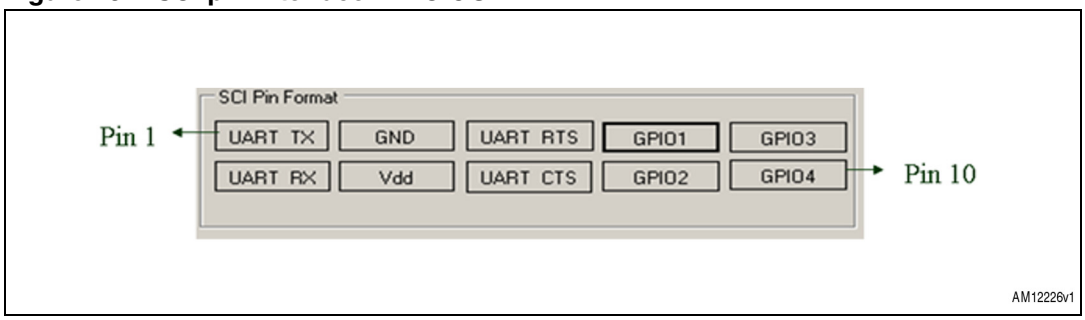


2.2.1 GPIO settings

Before making the connection to the J2, it is necessary to perform the proper settings of the GPIOs which are to be used along with the SCI interface.

This can be done be clicking the SCI pin interface, as shown in *Figure 23*.

Figure 23. SCI pin interface in PC GUI

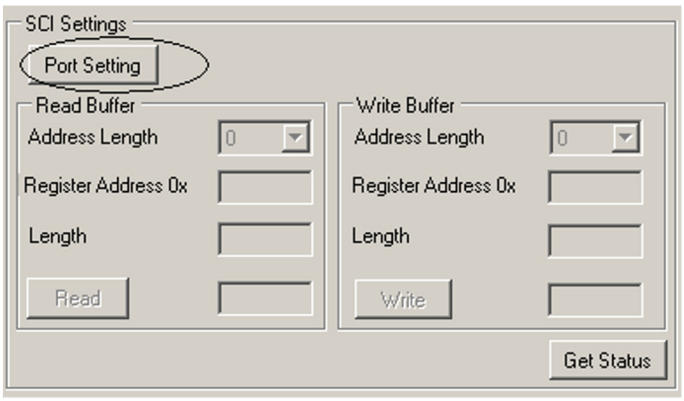


Please follow the instructions given in *Section 2.2.1* to perform the GPIO settings. Note that, in this case, only GPIO 3 and GPIO 4 have PWM clock generation capability.

2.2.2 SCI header settings

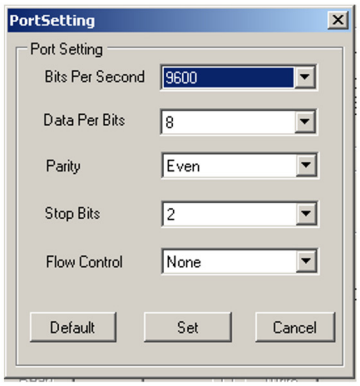
Once the GPIO settings have been completed, it is possible to connect the daughterboard to the UUSCI demonstration board and it can be assumed that the correct settings of daughterboard control and status lines have been performed. Now, to make the settings for the SCI interface, click on “Port Setting”, as shown in *Figure 24*.

Figure 24. Setting of SCI parameters



Another window opens up for port settings, which includes parameters such as bit rate, parity bits, stop bits and hardware flow control required, as shown in *Figure 25*.

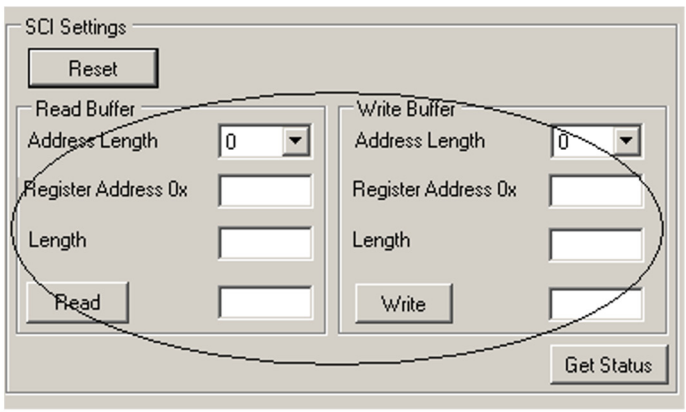
Figure 25. Port setting window



Once the selection is made, click the “Set” button. As soon as this is done and the user exits from the port settings window, the control settings part is frozen and the “Port Setting” button becomes the Reset button, whose purpose is to reset the SCI settings.

The read and write window looks like that shown below.

Figure 26. SCI read/write window



In this window, depending on the slave device, the register address length (from 0 to 4 bytes) can be selected; 0 byte length is used for random read and write operation. The values to read and write from the slave device can be filled accordingly. After every read or write operation, the GUI updates the status in the status section (for example: status: communication complete / bus free) so that the user can check the status of the SCI communication happening between the UUSCI demonstration board and the SCI slave daughterboard.

Therefore, this interface allows the user to connect any SCI interface based slave device.

3 Working in DFU mode

To work in DFU mode, push the switch SW2 so as to connect it to R17, then, press the Reset button on the board. LED D1 indicates power and D2 glows as an indicator for DFU mode.

DFU setup is available at the following link:

http://www.st.com/mcu/modules.php?name=mcu&file=familiesdocs&fam=110.

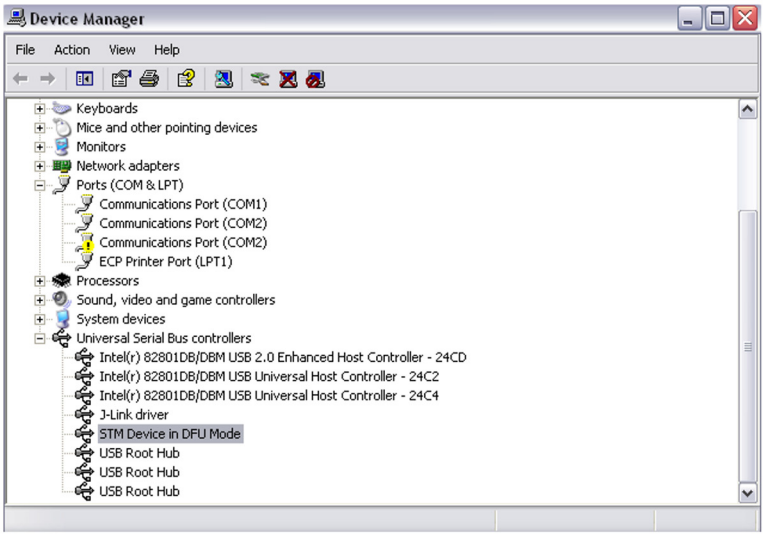
Scroll down to Software-PC\DFUSE on the web page to download the zip folder.

The folder includes the setup. After installing the setup, the board can be plugged in. When the PC asks for the driver, browse to the path of the driver. The driver is available at the installed software path in the PC at Program Files\STMicroclectronics\DFUSe\Driver.

The user manual for the DFU GUI is also available on the same link.

As a result, the demonstration board should be enumerated as device firmware upgrade and is shown as “Device Firmware Upgrade”, as shown in *Figure 27* in the device manager window. If this message does not appear, please contact technical support.

Figure 27. Enumeration in DFU mode



4 Schematics

Figure 28. Microcontroller section

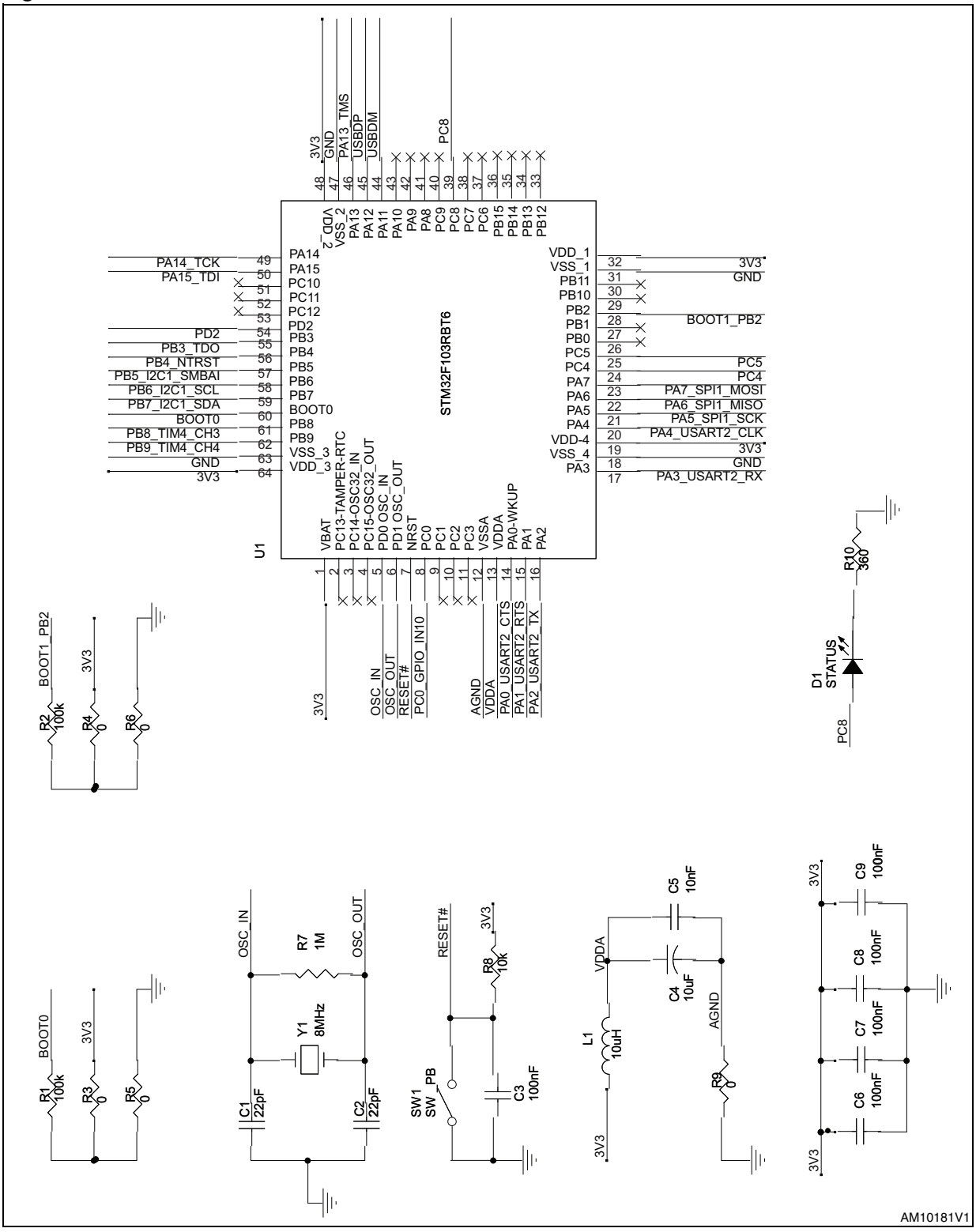


Figure 29. JTAG interface

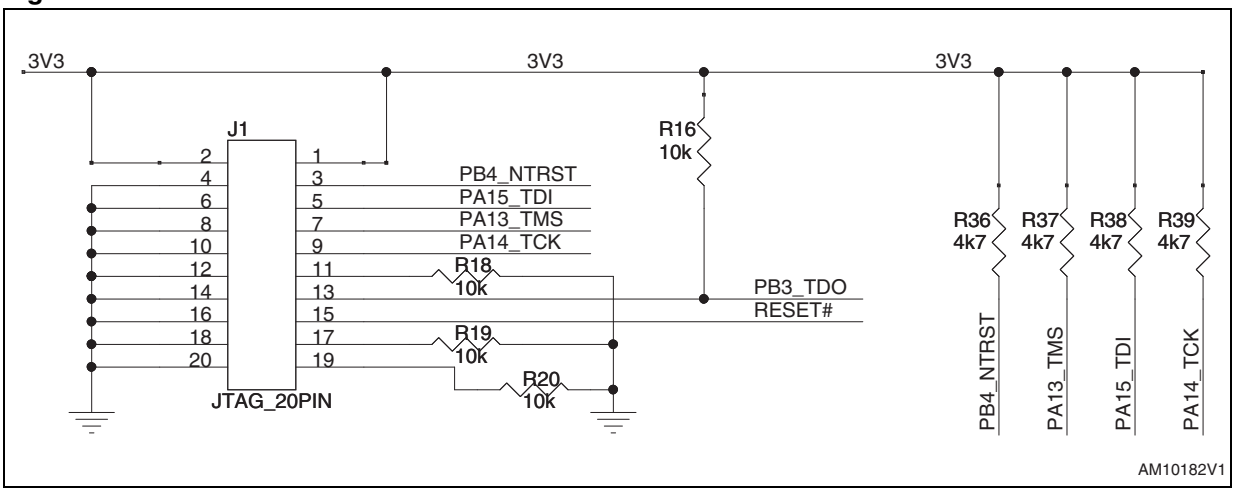


Figure 30. Mode selection switch

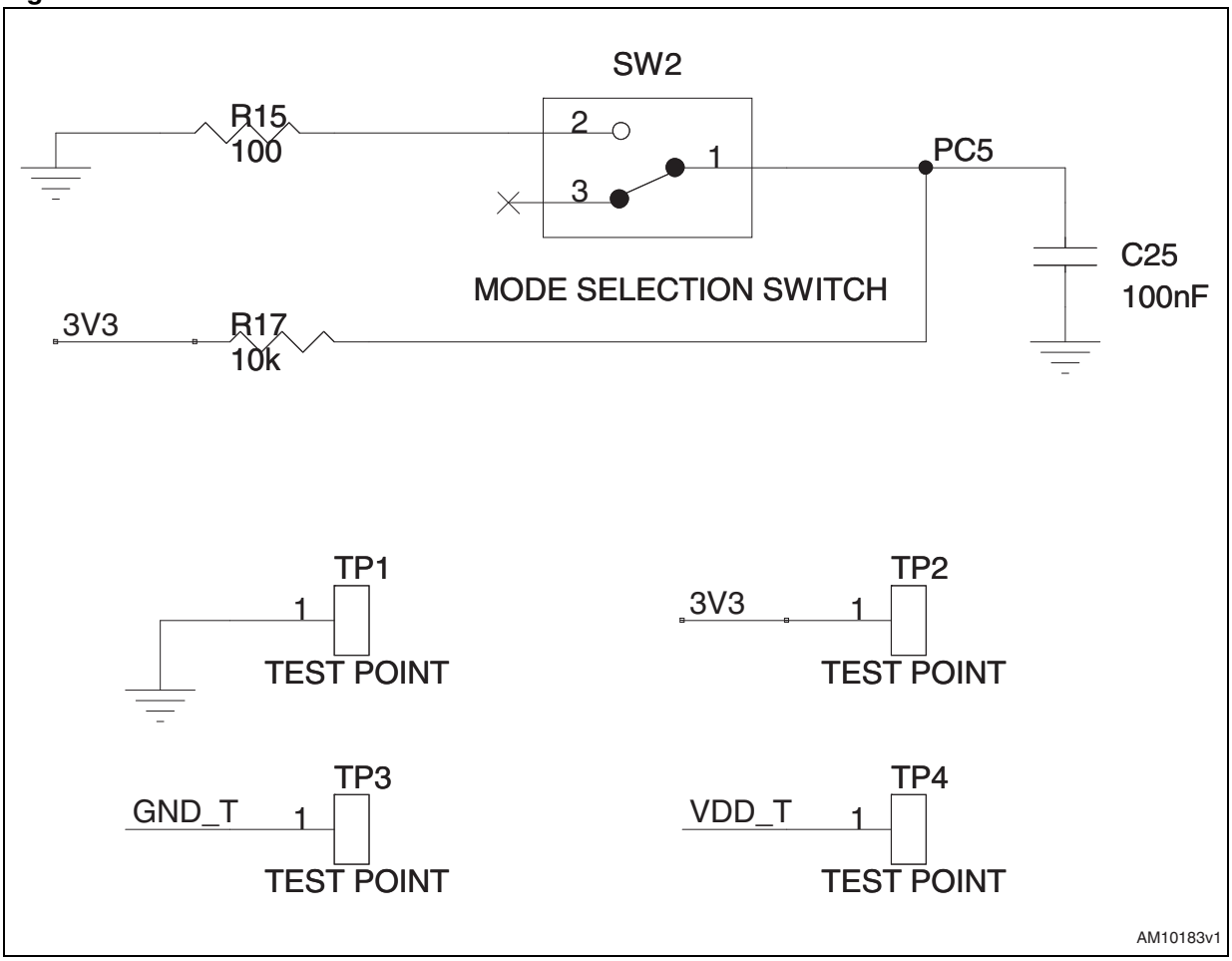


Figure 31. Power supply

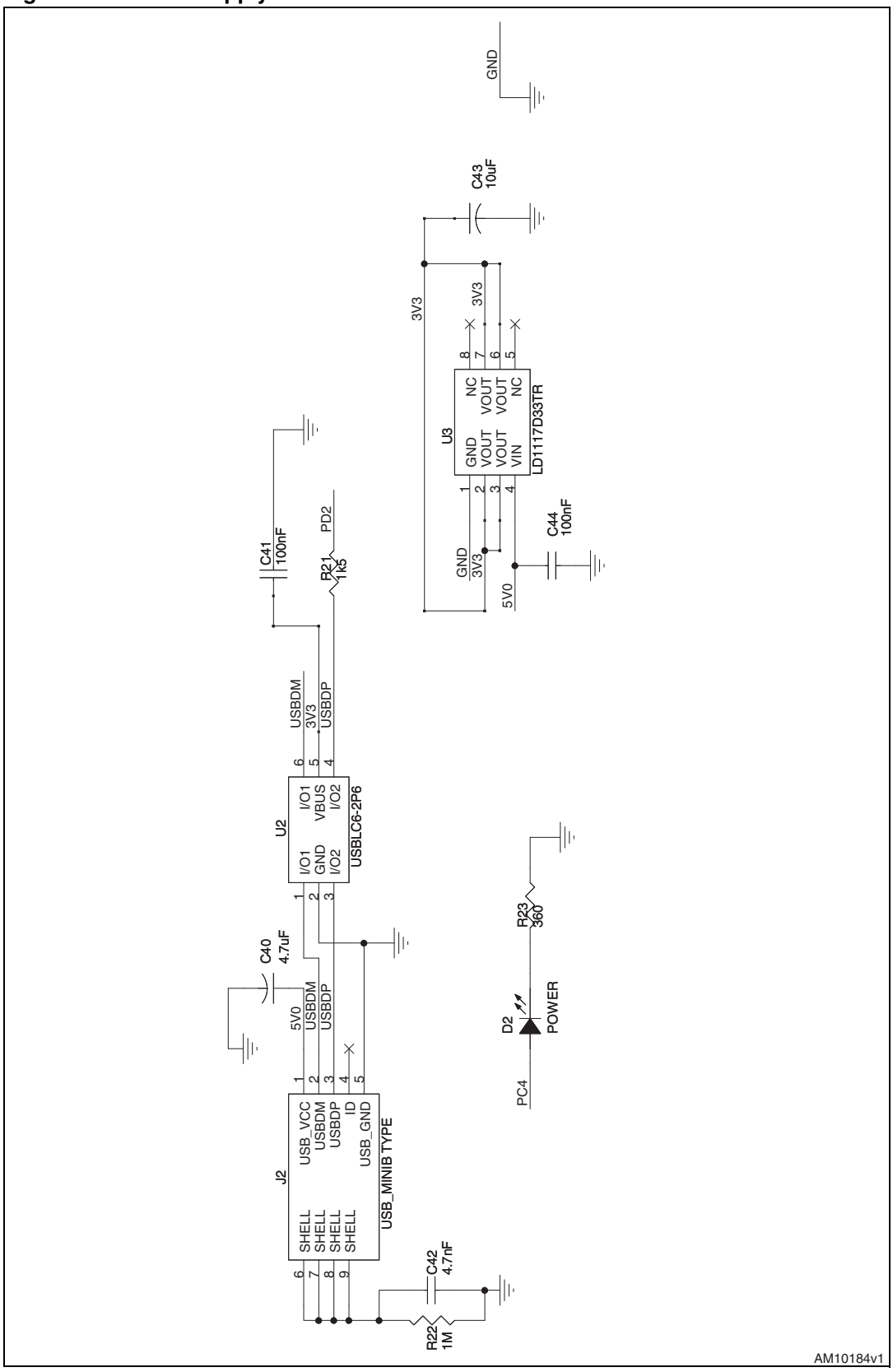


Figure 32. Opto-isolator section

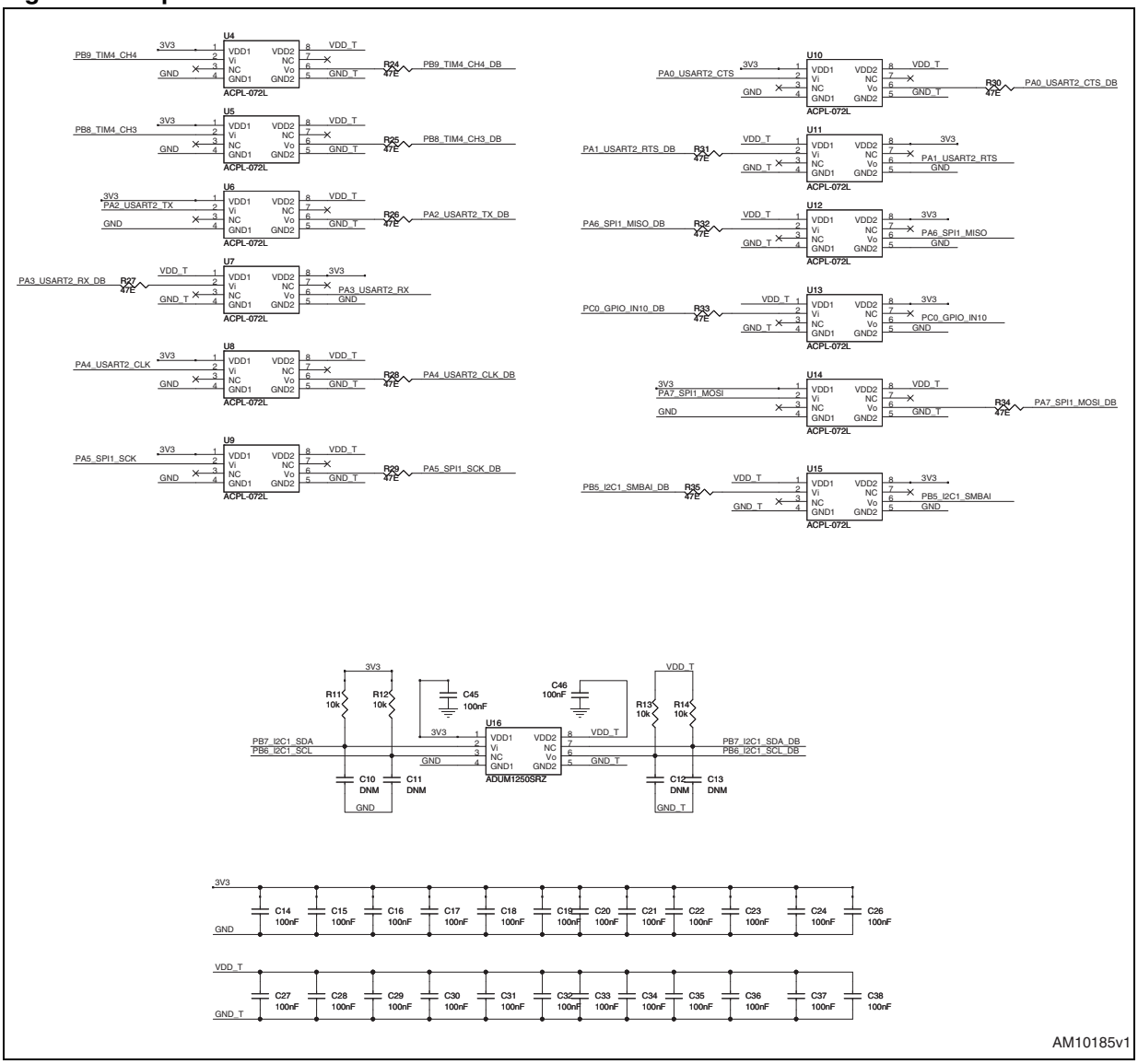
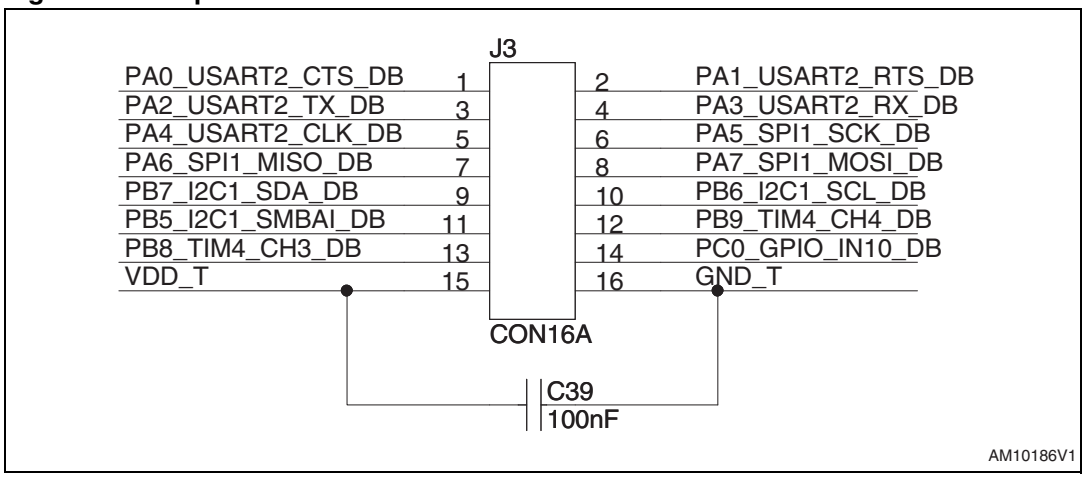


Figure 33. 16-pin communication interface



5 Bill of materials

Table 1. BOM

Category	Refer. design.	Component description	Package	Manuf.	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
ST devices	U1	STM32F103RBT6	LQFP64	ST	STM32F103RBT6		
	U1	USBLC6-2P6	SOT-666	ST	USBLC6-2P6		
	U3	LD1117D33TR	SO-8	ST	LD1117D33TR		
Non ST devices	U4,U5,U6,U7,U8,U9,U10,U11,U12,U13,U14,U15	ACPL-072L	SO-8	Avago Tech	ACPL-072L	Digi-Key	516-1732-5-ND
	U16	ADUM1250SRZ	SO-8	Analog devices	ADUM1250SRZ	Digi-Key	ADUM1250ARZ-ND
Crystal and oscillator	Y1	Crystal 8.000 MHZ SER 49US	11.35 x 4.5 mm crystal	Any		Digi-Key	535-9864-1-ND
Connectors and jumpers	J3	CON16A 90 degree	Header 2x5 pin, 2.54 mm x 2.54 mm pitch	Any		Digi-Key	S9177-ND
	J1	JTAG connector 90 degree	Header 2x10 pin, 2.54 mm x 2.54 mm pitch	Any		Digi-Key	S9180-ND
	J2	Mini USB B-type	USB mini B-type	Any		Samtec/ Digi-Key	H2959CT-ND
	SW1	Pushbutton switch					
	SW2	SPDT switch					
LEDs	D1, D2	LED clear 0805 SMD	3 mm SMD LED	Any		Digi-Key	160-1176-1-ND
Inductors	L1 (replaced with 0 Ω)	Inductor multi-layer 10 µH	SMD inductor	Any			

Table 1. BOM (continued)

Category	Refer. design.	Component description	Package	Manuf.	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
Capacitor	C1,C2	22 pF	SMD0805	Any		Digi-Key	709-1172-1-ND
	C3,C6,C7,C8,C9,C14,C15,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30,C31,C32,C33,C34,C35,C36,C37,C38,C39,C41,C44,C46	CAP 0.1 µF 50 V ceramic X7R 0805	SMD0805	Any		Digi-Key	PCC2452TR-ND
	C4,C43	10 µF	SMD0805	Any		Digi-Key	PCC2417CT-ND
	C40	10 nF	SMD0805	Any		Digi-Key	399-1159-1-ND
	C42	4.7 nF	SMD0805	Any		Digi-Key	399-1155-1-ND
	C10,C11,C12,C13	CAP 0.1 µF 50 V ceramic F 1206	SMD1206	Any		Digi-Key	PCC2234TR-ND
	C28	4.7 µF	SMD1206	Any		Digi-Key	PCC2297CT-ND
Resistors	R1,R2	RES 100 kΩ 1/8 W 5% 0805	SMD0805	Any		Digi-Key	RHM100KATR-ND

Table 1. BOM (continued)

Category	Refer. design.	Component description	Package	Manuf.	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
Resistors	R5,R6,R9	RES 0.0 Ω 1/8 W 0805 SMD	SMD0805	Any		Digi-Key	RMCF1/100RTR-ND
	(R3,R4)(DNM)	RES 0.0 Ω 1/8 W 0805 SMD	SMD0805	Any		Digi-Key	RMCF1/100RTR-ND
	R7,R22	RES 1 MΩ 1/8 W 5% 0805 SMD	SMD0805	Any		Digi-Key	RMCF1/101MJRTR-ND
	R8,R11,R12,R13,R14,R16,R17,R18,R19,R20	10 kΩ	SMD0805	Any		Digi-Key	P10KADTR-ND
	R21	RES 1.5 kΩ 1/8 W 5% 0805	SMD0805	Any		Digi-Key	P1.5KACT-ND
	R10,R23	360E	SMD0805	Any		Digi-Key	
	R15	100E	SMD0805				
	R24,R25,R26,R27,R28,R29,R30,R31,R32,R33,R34,R35	47E	SMD0805	Any			
	R36,R37,R38,R39	47 kΩ	SMD0805	Any			

Revision history

Table 2. Document revision history

Date	Revision	Changes
12-Nov-2012	1	Initial release.

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