UM0726
User manual

STEVAL-PCC009V1, universal USB to serial communication interface (UUSCI) based on the STM32x

Introduction

This user manual explains the functions of the STM32-based universal USB to serial communication interface (UUSCI).

The objective of this manual is to demonstrate the functions present in the UUSCI demonstration board and how they can be utilized.

The UUSCI is a tool which has a 10-pin interface. In this interface, there is a provision for connecting a device which can communicate using I^2C, SPI and UART. Therefore the UUSCI tool allows the user to connect a serial communication-based device to the PC. While at the same time it allows the user to control some GPIOs available in the 10-pin interface and set them in input/output modes as per application requirements.

In the UUSCI demonstration board, the STM32 microcontroller is used as the interface between the PC and the end device. Due to intelligence available in the STM32 device, I^2C, SPI and UART are multiplexed in the same 10-pin interface, leading to reduced board size and allowing more complex use.

Power to the board is provided from a USB mini B-type connector.

The DLL files of the PC graphical user interface (GUI) are provided with this tool and the user can use these files to construct their own customized PC GUI as per requirements.

Therefore, the UUSCI tool provides an option for the end user to focus solely on its application development, as the complexity of the microcontroller is taken care of by the tool itself, therefore 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, I^2C and UART interface and the controlling of the communication parameters with the help of the GUI itself.
- DFU mode PC GUI: this PC GUI allows the changing of the firmware if required by the user to suit its applications. All the other pins in the UUSCI demonstration board are available in the forms of jumpers, which can be programmed by changing the firmware in DFU mode.

Therefore, the UUSCI is a complete tool that rapidly allows the prototyping development of applications.

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1 Getting started

1.1 System requirements

In order to use the UUSCI demonstration board with a Windows® operating system, a recent version, 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:

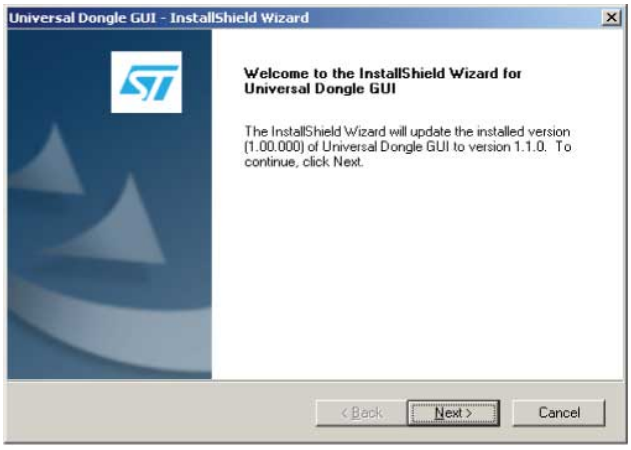
- Hardware content:
  - One demonstration board
  - Bill of materials
  - Schematic
- Software content:
  - PC GUI software to be used along with the demonstration board
  - DFU software
  - DLL files for the I^2C, SPI and UART interface
  - Source code (including DFU)
- Documentation:
  - User manual (to work in functional mode)
  - User manual (to work in DFU mode)
  - Help file on how to use the DLL file

1.3 Software installation

To install the PC GUI software, follow the steps mentioned below, please download the PC GUI software setup for the universal dongle (version 1.3) from the ST.com website. The zip folder includes the setup.

- Step1: as soon as the user clicks the setup.exe icon, the following window opens:

Figure 1. Installation window



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- Step 2: read the license file and click the “Yes” button if you accept the license.

Figure 2. License window

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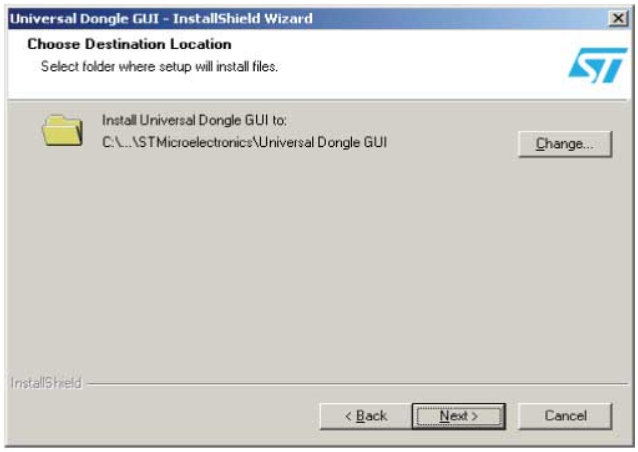
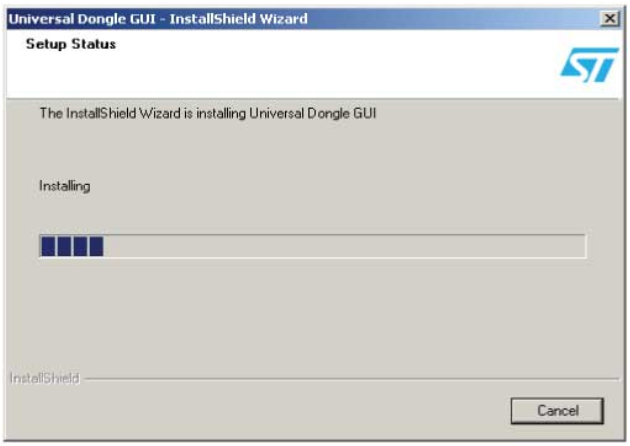
- Step 3: please select the folder in which to install the software. By default it installs the software in the following path: C:\....\STMicroelectronics\Universal Dongle GUI.

Figure 3. Destination folder



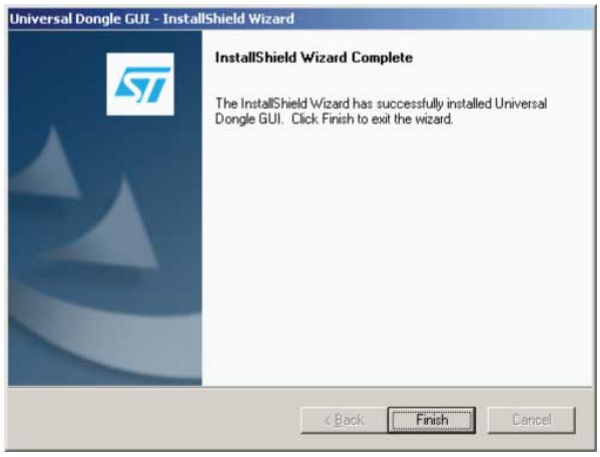
- Step 4: after selecting the folder and clicking the “Next” button, installation of the software starts.

Figure 4. Installation ongoing



- Step 5: when installation is complete, click “Finish”.

Figure 5. Installation



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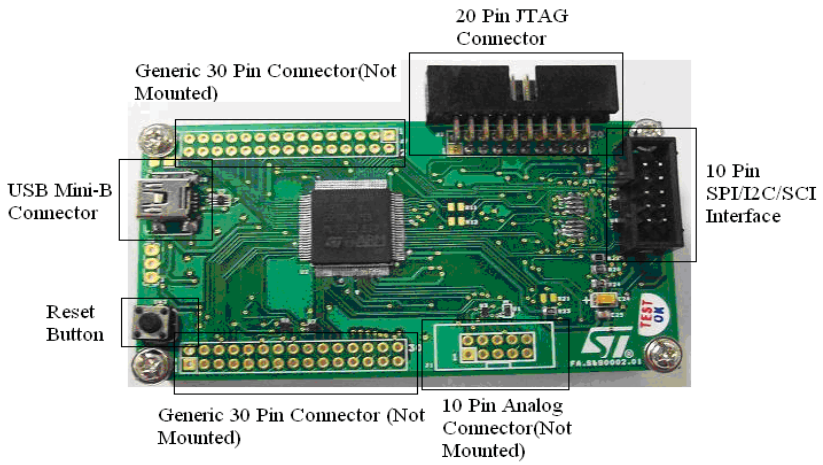
1.4 Hardware installation

Figure 6 shows a snapshot of the UUSCI demonstration board.

Figure 6. STEVAL-PCC009V1, UUSCI demonstration board



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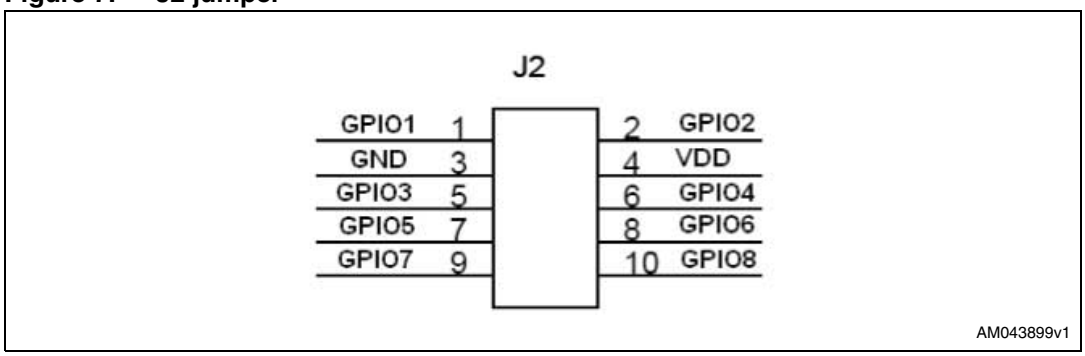
1.4.1 Power supply

The demonstration board is directly powered by the USB mini B-type connector (bus powered).

1.4.2 Jumper/connector settings

- J2: J2 is the 10-pin connector available as the default interface for the UUSCI demonstration board. There are 8 GPIOs, GND, and VDD lines available, as shown in *Figure 7*:

Figure 7. J2 jumper



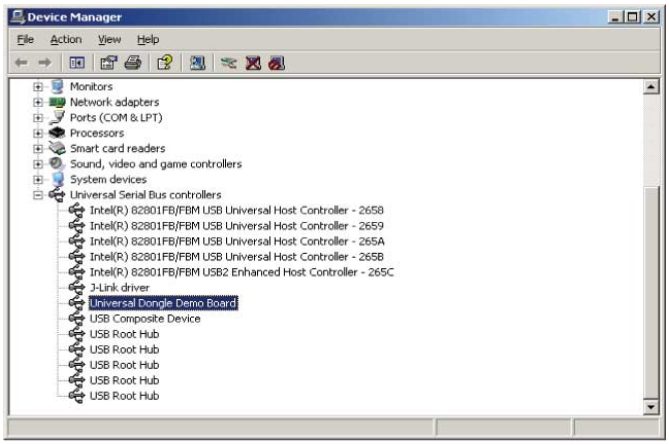
- J1, J4 and J7: only the footprint of this connector is available. The user can use these jumpers as per application. These are not part of the default settings, but they can be used by modifying the firmware using the DFU mode.
- J3: this is the standard 20-pin JTAG connector available in the demonstration board. This can be used to test the demonstration board in debug mode using any JTAG-based debugger for the STM32 device.

2 Running the demonstration board

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

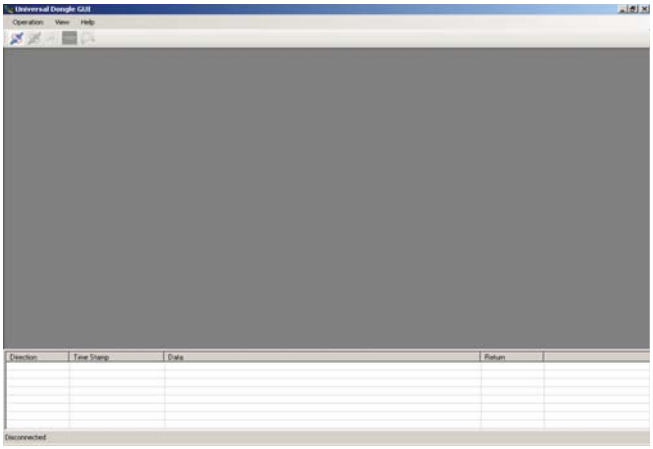
As a result, the demonstration board should be enumerated as universal serial bus controllers and appears as “universal dongle demonstration board” in the device manager window, as shown in *Figure 8*. If this message does not appear, please contact technical support.

Figure 8. Enumeration result



When 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 you see the following message:

Figure 10. Board is not connected to PC

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If the board is connected the following message appears:

Figure 11. Board is connected to PC

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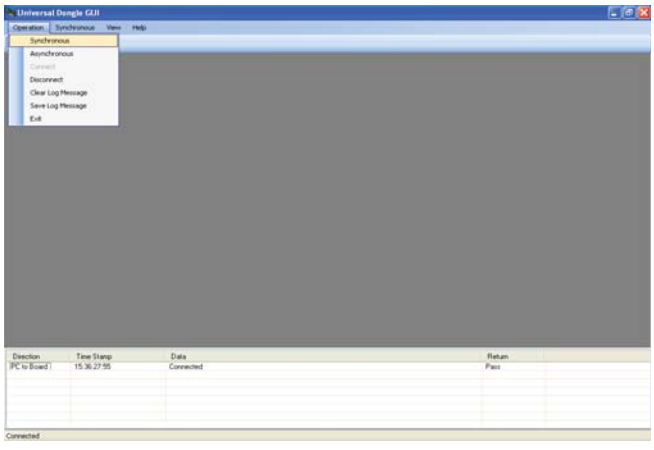
Once this is done, the PC GUI is properly connected to the demonstration board and ready to be used.

2.1 Using the I²C interface

To connect the I²C interface, “synchronous” must first be selected from the operation menu, as shown in *Figure 12*.

Figure 12. Selection of synchronous interface



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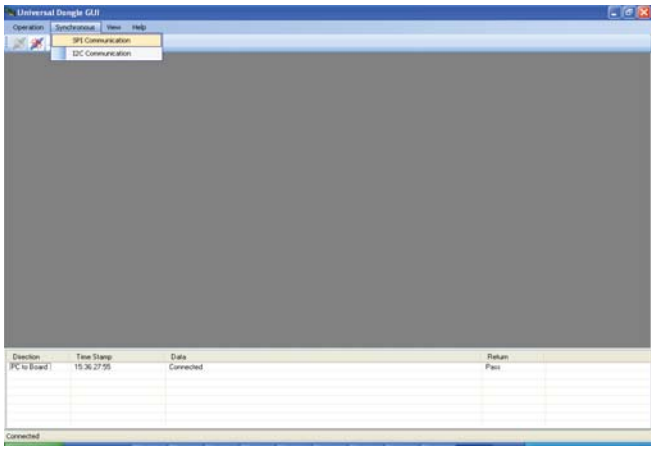
Once the synchronous interface is selected, an additional menu for the synchronous interface is open in the GUI which allows you to choose between the I²C and SPI interface, as shown in *Figure 12*.

Figure 13. Selection of I²C/SPI interface



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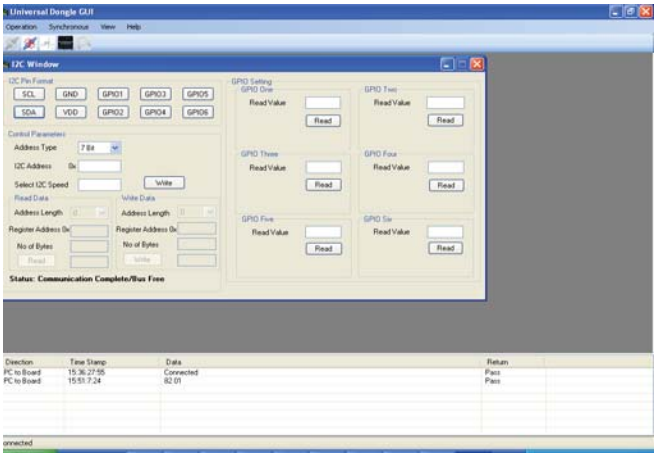
Now, click the I²C interface option and a window for I²C interface control opens, as shown in *Figure 14*.

Figure 14. I²C interface window



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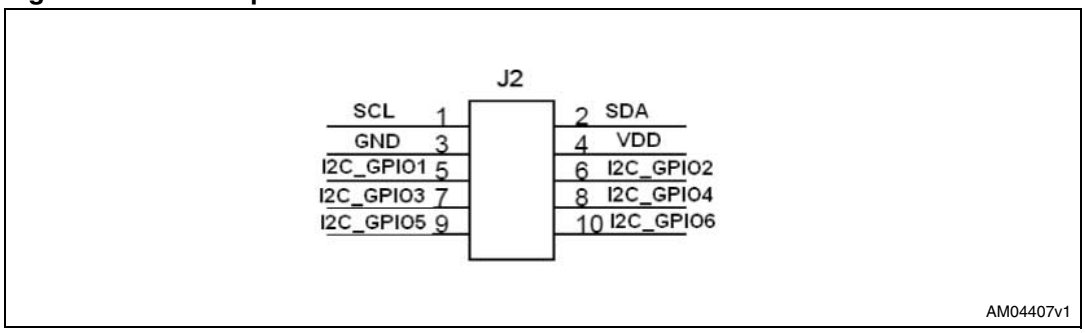
The PC GUI is now ready to be used for testing I²C-based slave devices. To use any I²C-based slave, the connection for the J2 jumper must be set, as shown in *Figure 15*.

Figure 15. J2 interpretation for the I²C interface

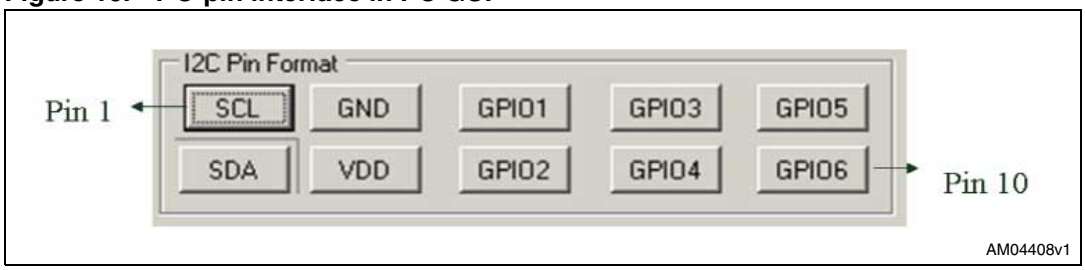


2.1.1 GPIO settings

Before making the connection to the J2, check the proper settings of the GPIOs which are to be used along with the I²C interface. These may be control lines chip select or status line, such as interrupt line. Therefore, you must accordingly set the GPIOs only in this way.

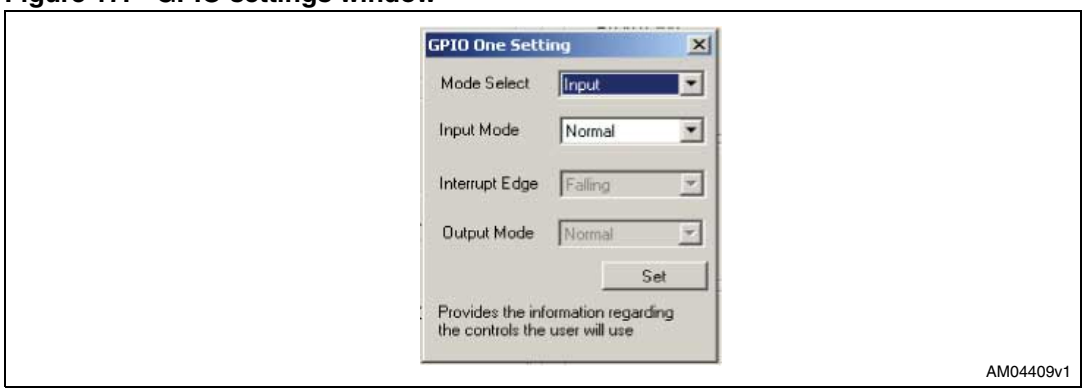
This can be done be clicking the I²C pin interface, as shown in *Figure 16*.

Figure 16. I²C-pin interface in PC GUI



You can only set the GPIOs mentioned. I²C lines and power lines are fixed. To check the settings of a GPIO, click on that GPIO. Once clicked, a setting window opens, as shown in *Figure 17*.

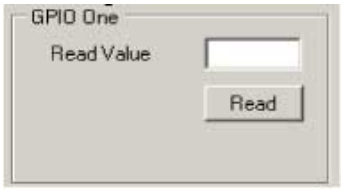
Figure 17. GPIO settings window



By selecting the option in the GPIO setting window, you can set the GPIO in different modes, such as simple input mode, input with interrupt, or push-pull output mode. Also in the I²C interface, there is an option in GPIO5 and GPIO6 to use these GPIOs as the PWM clock signal.

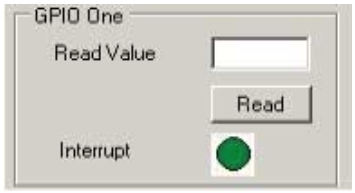
If you select the GPIO in normal input mode, the GPIO1 window opens, as in *Figure 17*. If you click the “Read” button, you see the GPIO 1 value as '0' or '1'.

Figure 18. GPIO mode in normal input



If the GPIO in normal input mode with interrupt is selected, the GPIO1 window opens, as in *Figure 19*. In addition to the input mode interface, there is an LED shown, which is green, if there is an interrupt condition and red, if there is an interrupt condition.

Figure 19. GPIO 1 setting in normal input with interrupt



If you select the GPIO in push-pull output mode, the GPIO1 window opens, as in *Figure 20*. Put '0' or '1' and click the “Write” button to set the GPIO low and high respectively.

Figure 20. GPIO 1 setting in push-pull output mode

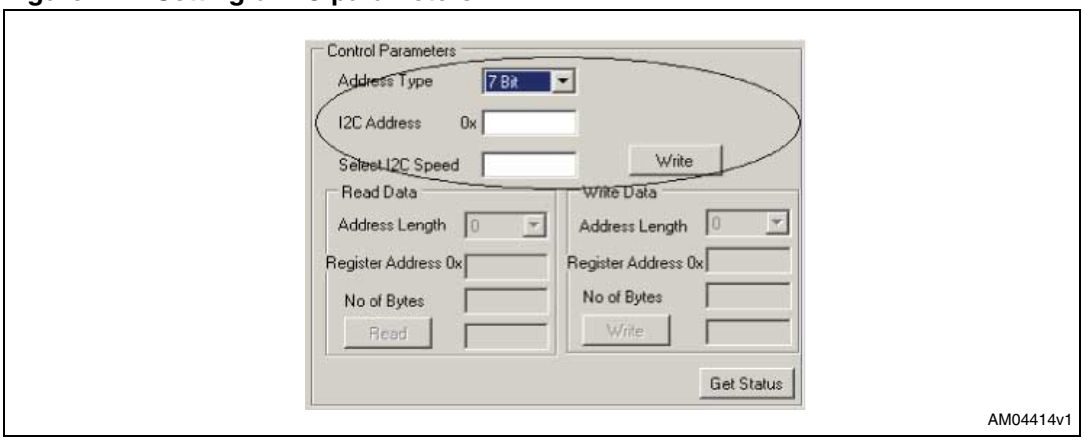
As previously mentioned, GPIO 5 and GPIO 6 can also be set in PWM mode. If you make the selection in the GPIO 5 setting window in PWM mode, it appears as in *Figure 21*. Here you can put the PWM frequency (maximum value tested is around 10 MHz) and also the duty cycle to generate different kinds of clocks.

Figure 21. GPIO 5 setting in PWM mode

2.1.2 I²C header settings

Once you have completed the GPIO settings, you can connect the daughter board to the UUSCI demonstration board, assuming that the correct settings of the daughter board control and status lines have been made. Before using the I²C communication, some parameters must firstly be defined, as shown in *Figure 22*.

Figure 22. Setting of I²C parameters

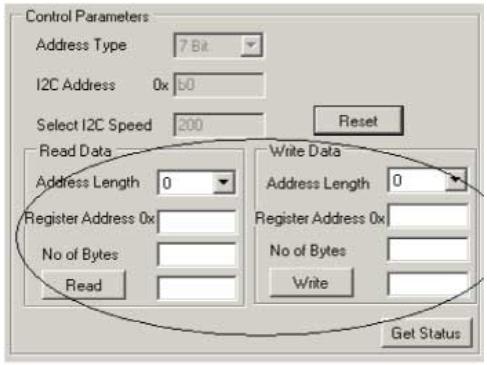


These parameters include the selection of the I²C address types (7 bit or 10 bit), the I²C slave device address, and the I²C speed.

Once the selection is made, click the “Write” button. This sets the I²C interface and now the system is ready to read or write the data from the I²C slave device connected to the UUSCI demonstration board. As soon as this is done, the control settings part freezes and the “Write” button becomes the “Reset” button, the purpose of which is to reset the I²C settings.

The “Read” and “Write” window opens, as shown in *Figure 23*.

Figure 23. I²C Read/Write window



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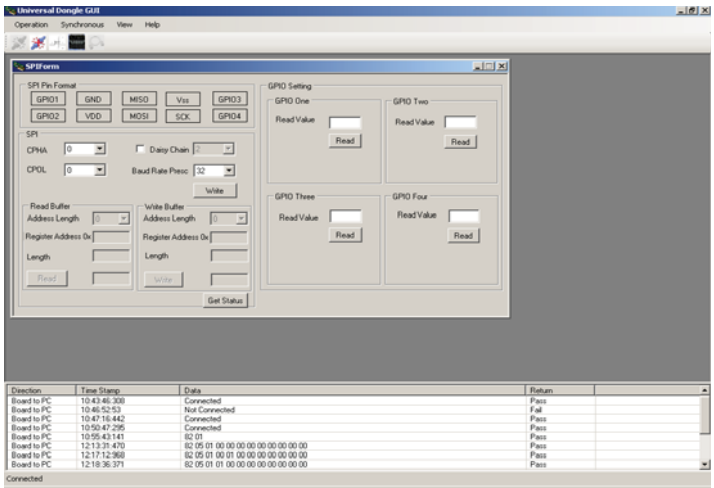
Depending on the slave device, you can select the register address length (from 0 to 4 bytes, 0 byte length is used for random read and write operation), and then fill the values accordingly to read and write from the slave device. After every read or write operation, the GUI updates the status in the status section (e.g. status: communication complete/bus free) so that you can check the status of I²C communication taking place between the UUSCI demonstration board and the I²C slave daughter board.

Therefore, this interface allows the connection and testing of any I²C interface-based slave device.

2.2 Using the SPI interface

To connect the SPI interface please follow the steps mentioned in *Section 2.2* and then instead of the I²C interface, select the SPI interface. The window that opens is shown in *Figure 24*.

Figure 24. SPI interface Window



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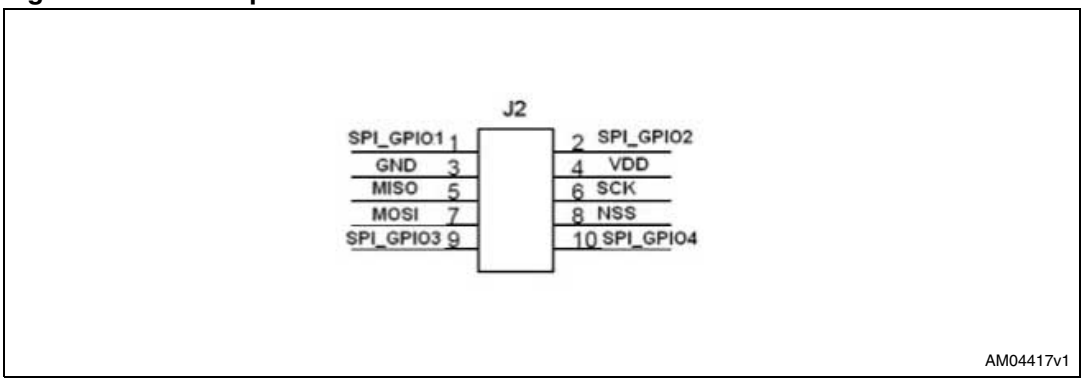
Now the PC GUI is ready to be used for testing SPI-based slave devices. But before you can use it, the connection for the J2 jumper must be set, as shown in *Figure 25*.

Figure 25. J2 interpretation for the SPI interface

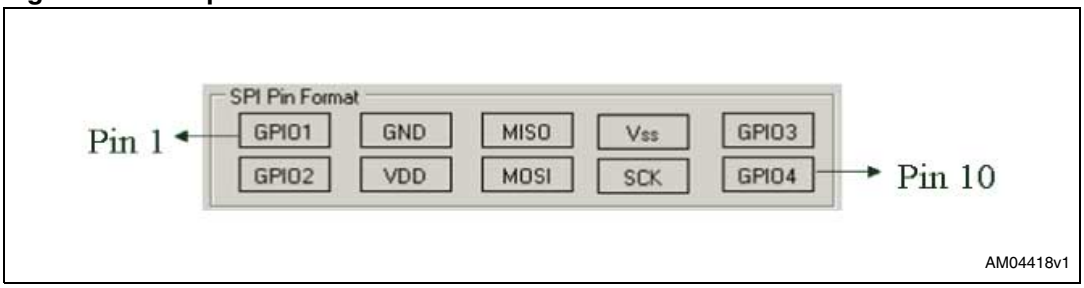


2.2.1 GPIO settings

Before making the connection to the J2 jumper, check the proper settings of the GPIOs which are to be used along with the SPI interface. These may be control lines chip select or status line, such as interrupt line. Therefore, you must accordingly set the GPIOs only in this way.

This can be done be clicking the SPI-pin interface as shown in *Figure 26*.

Figure 26. SPI-pin interface in the PC GUI

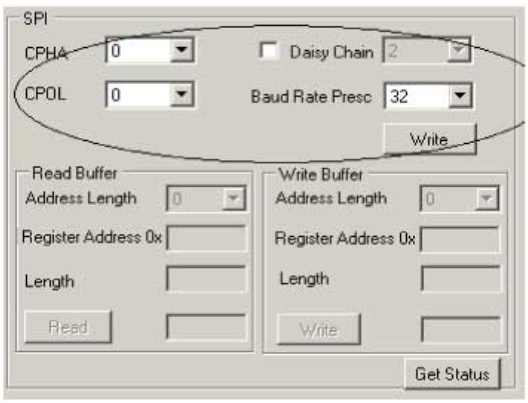


Please follow the instructions given in *Section 2.1.1* for checking the GPIO settings. Please note that in this case, only GPIO3 and GPIO 4 have PWM clock generation capability.

2.2.2 SPI header settings

Once you have completed the GPIO settings, the daughter board can be connected to the UUSCI demonstration board, assuming that the correct settings of the daughter board control and status lines have been made. Before it's possible to use SPI communication, some parameters must firstly be defined, as shown in *Figure 27*.

Figure 27. Setting of SPI parameters



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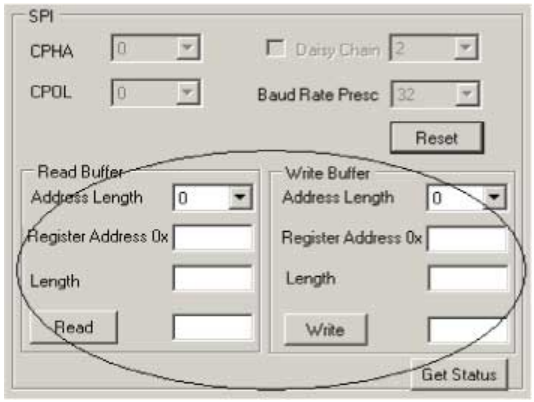
These parameters include the selection of CPHA, CPOL, and baud rate prescaler selection. (by default, the most significant bit is put first). Once the selection is made, click the "Write" button. This sets the SPI interface and now the system is ready to read or write the data from the SPI interface-based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

The "Read" and "Write" window opens, as shown in *Figure 28*.

Figure 28. SPI Read/Write window



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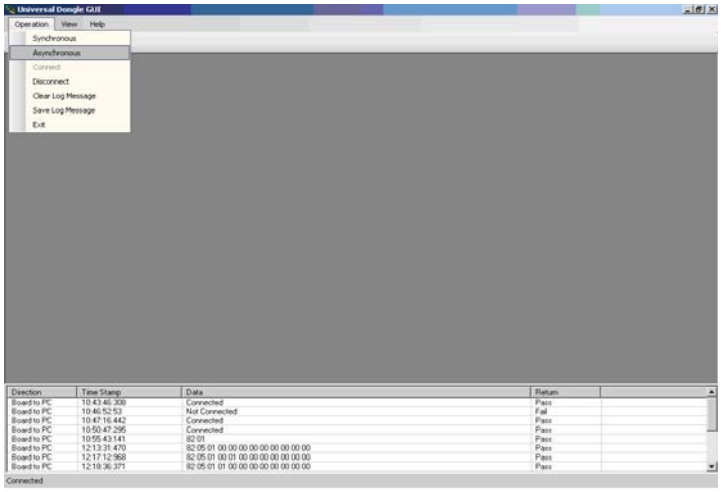
Depending on the slave device, you can select the register address length (from 0 to 4 bytes, 0 byte length is used for random read and write operation), and then fill the values accordingly to read and write from the slave device. After every read or write operation, the GUI updates the status in the status section (e.g. status: communication complete/bus free) so that you can check the status of SPI communication taking place between the UUSCI demonstration board and the SPI slave daughter board.

Therefore, this interface allows the connection of any SPI interface-based slave device.

2.3 Using the UART (SCI) interface

To connect the UART (SCI) interface, firstly select “Asynchronous” from the operation menu, as shown in *Figure 29*.

Figure 29. Selection of asynchronous interface



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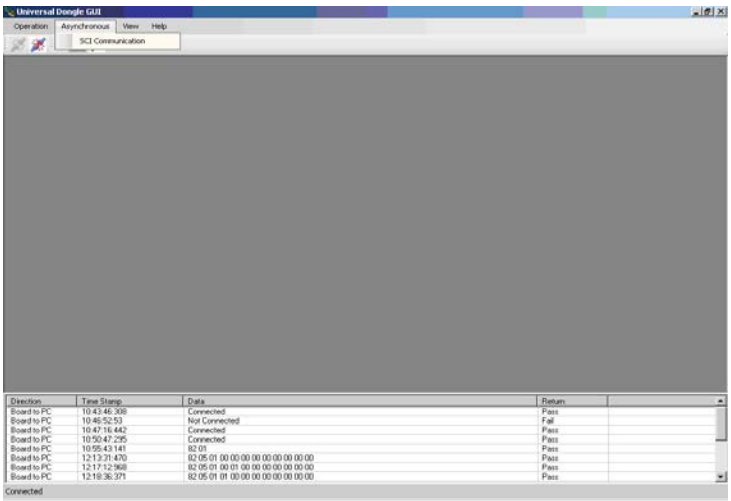
Once the asynchronous interface is selected, an additional menu for asynchronous interface opens in the GUI, which allows the selection of the SCI or UART interface, as shown in *Figure 30*.

Figure 30. Selection of the SCI (UART) interface



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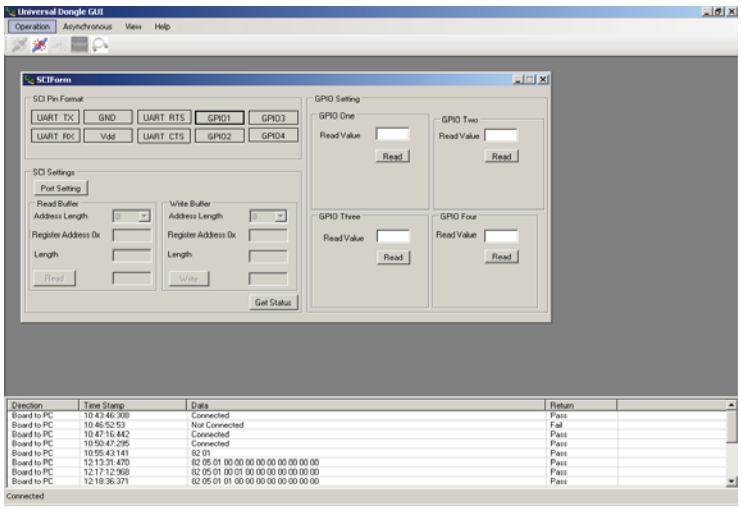
If you click the SCI interface option a window for SCI interface control opens, as shown in *Figure 31*.

Figure 31. SCI interface window



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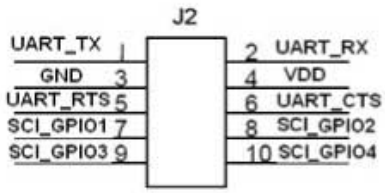
Now the PC GUI is ready to be used for testing SCI-based devices. To use any SCI-based slave device the connection for the J2 jumper must be set, as shown in *Figure 32*.

Figure 32. J2 interpretation for the SCI interface



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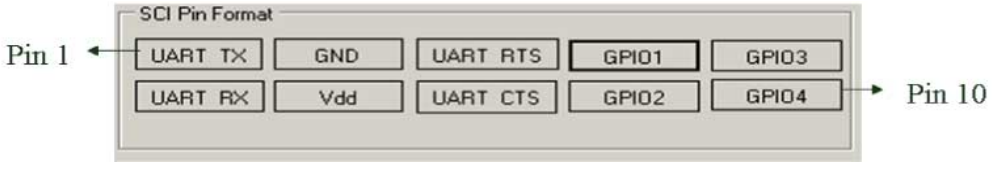
2.3.1 GPIO settings

Before making the connection to the J2, check the proper settings of the GPIOs which are to be used along with the SCI interface. These may be control lines chip select or status line, such as interrupt line. Therefore, you must accordingly set the GPIOs only in this way.

This can be done be clicking the SCI-pin interface, as shown in *Figure 33*.

Figure 33. SCI-pin interface in the PC GUI



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Please follow the instructions given in *Section 2.1.1* for checking the GPIO settings. Please note that in this case, only GPIO 3 and GPIO 4 have the PWM clock generation capability.

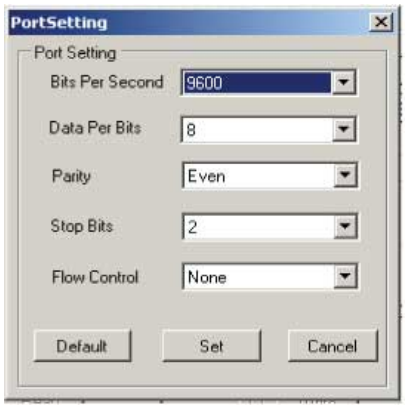
2.3.2 SCI header settings

Once you have completed the GPIO settings, you can connect the daughter board to the UUSCI demonstration board, assuming that the correct settings of the daughter board control and status lines have been made. To impose the settings for the SCI interface, click on the “Port Setting” button, as shown in *Figure 34*.

Figure 34. Setting of SCI parameters

There is another window open in port settings, which includes parameters like the bit rate, parity bits, stop bits and hardware flow control required, as shown in *Figure 35*.

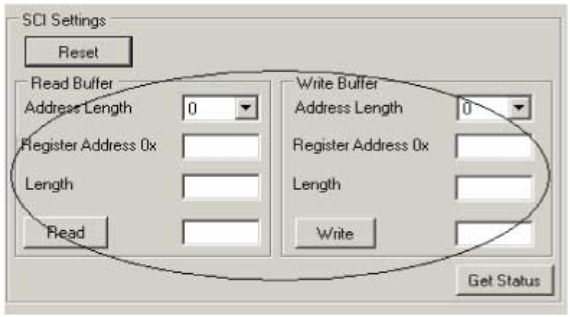
Figure 35. Port setting window



Once the selection is made, the “Set” button must be clicked. As soon as this is done and you exit from the port settings window, the control settings part freezes and the “Port Setting” button becomes the “Reset” button, the purpose of which is to reset the SCI settings.

The “Read” and “Write” window opens, as shown in *Figure 36*.

Figure 36. SCI Read/Write window



Depending on the slave device, you can select the register address length (from 0 to 4 bytes, 0 byte length is used for random read and write operation), and then fill the values to read and write from the slave device. After every read or write operation, the GUI updates the status in the status section (e.g. status: communication complete/bus free) so that you can check the status of SCI communication taking place between the UUSCI demonstration board and the SCI slave daughter board.

Therefore, this interface allows the connection of any SCI interface-based slave device.

3 Working in DFU mode

To work in DFU mode, please short pin 9 and 11 of J4 by connecting the 2-pin jumper mounted on J4. Then, press the reset button on the board.

DFU Setup is available for download at the ST.com website.

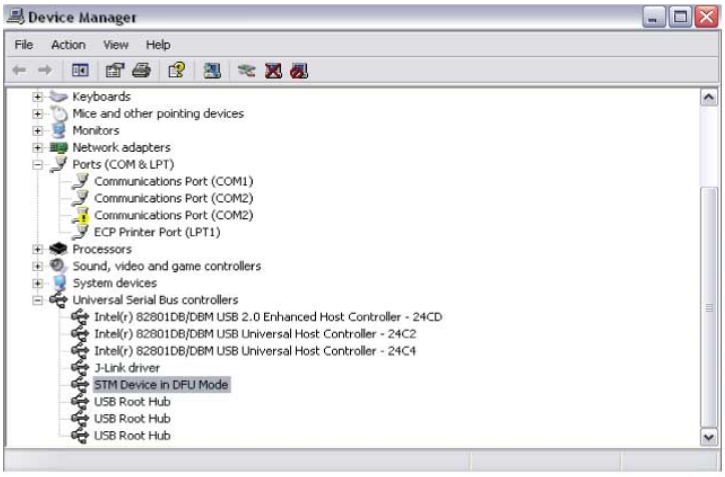
Scroll down to software-PC\DFUSE on the webpage and download the zip folder.

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

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

As a result, you should find the demonstration board enumerated as device firmware upgrade and it appears as “device firmware upgrade” in the device manager window, as shown in *Figure 37*. If this message does not appear, please contact technical support.

Figure 37. Enumeration in DFU mode



Appendix A Schematic and bill of materials

3.1 Schematic

Figure 38. UUSCI demonstration schematic (part 1)

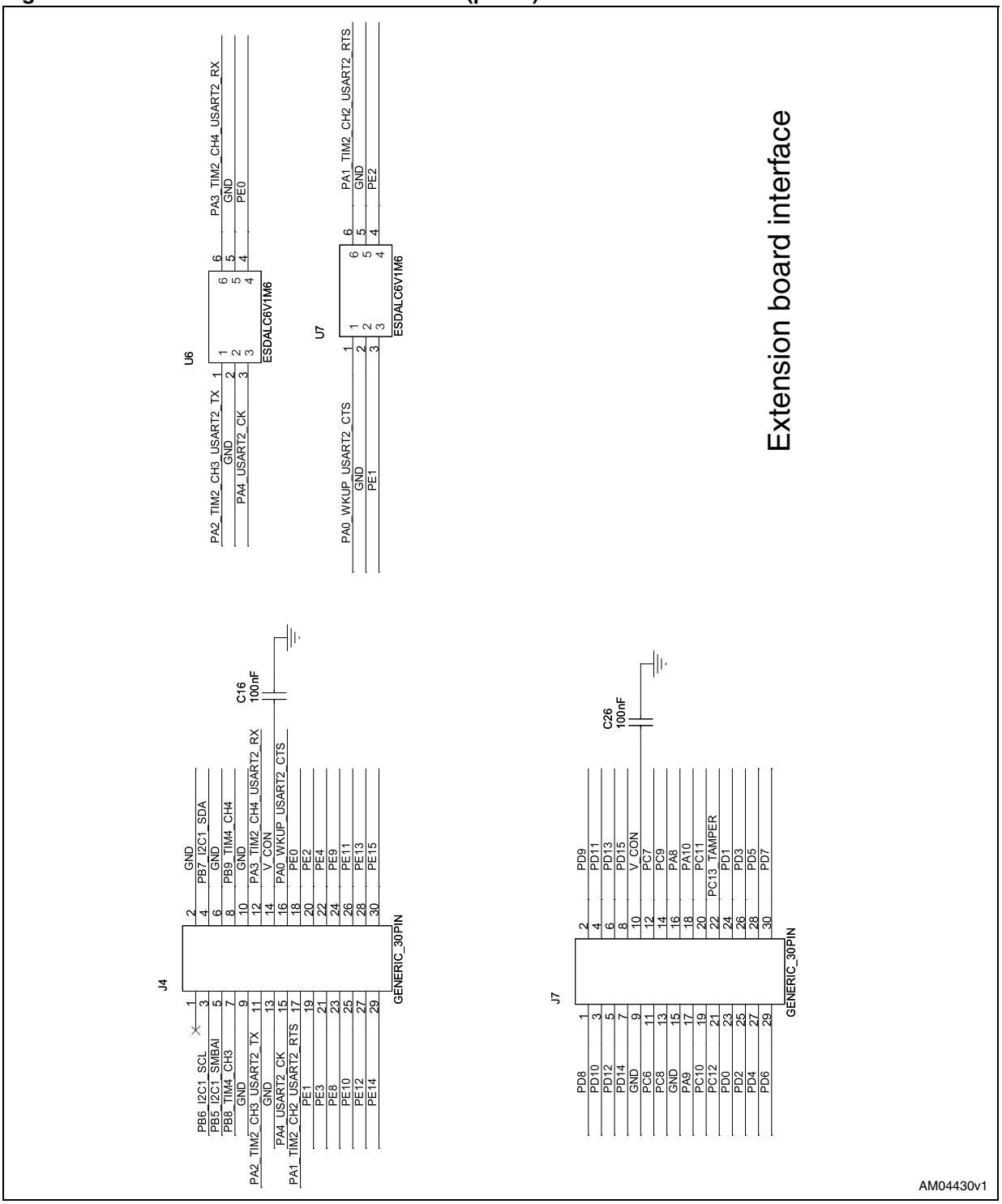


Figure 39. UUSCI demonstration schematic (part 2)

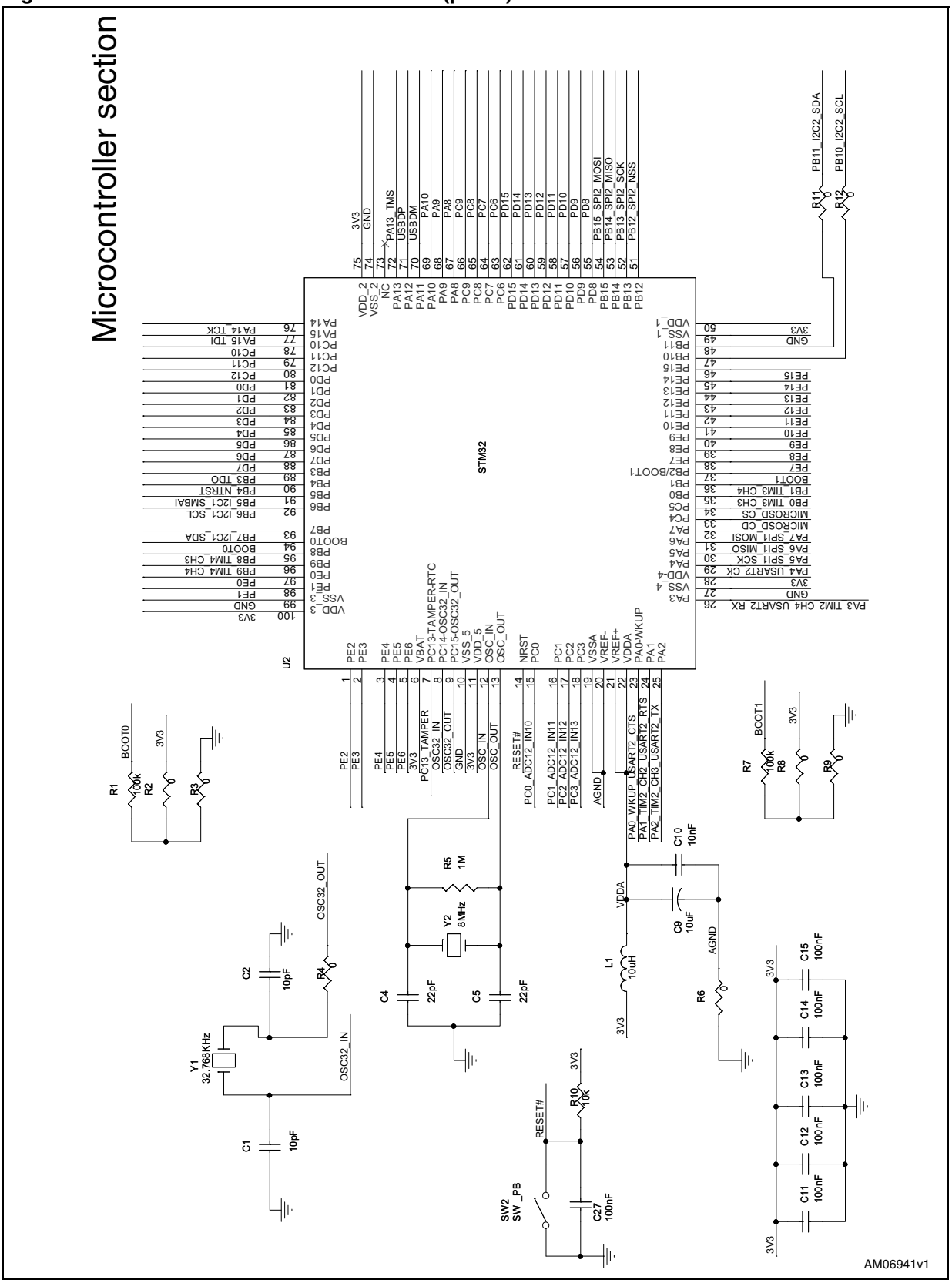


Figure 40. UUSCI demonstration schematic (part 3)

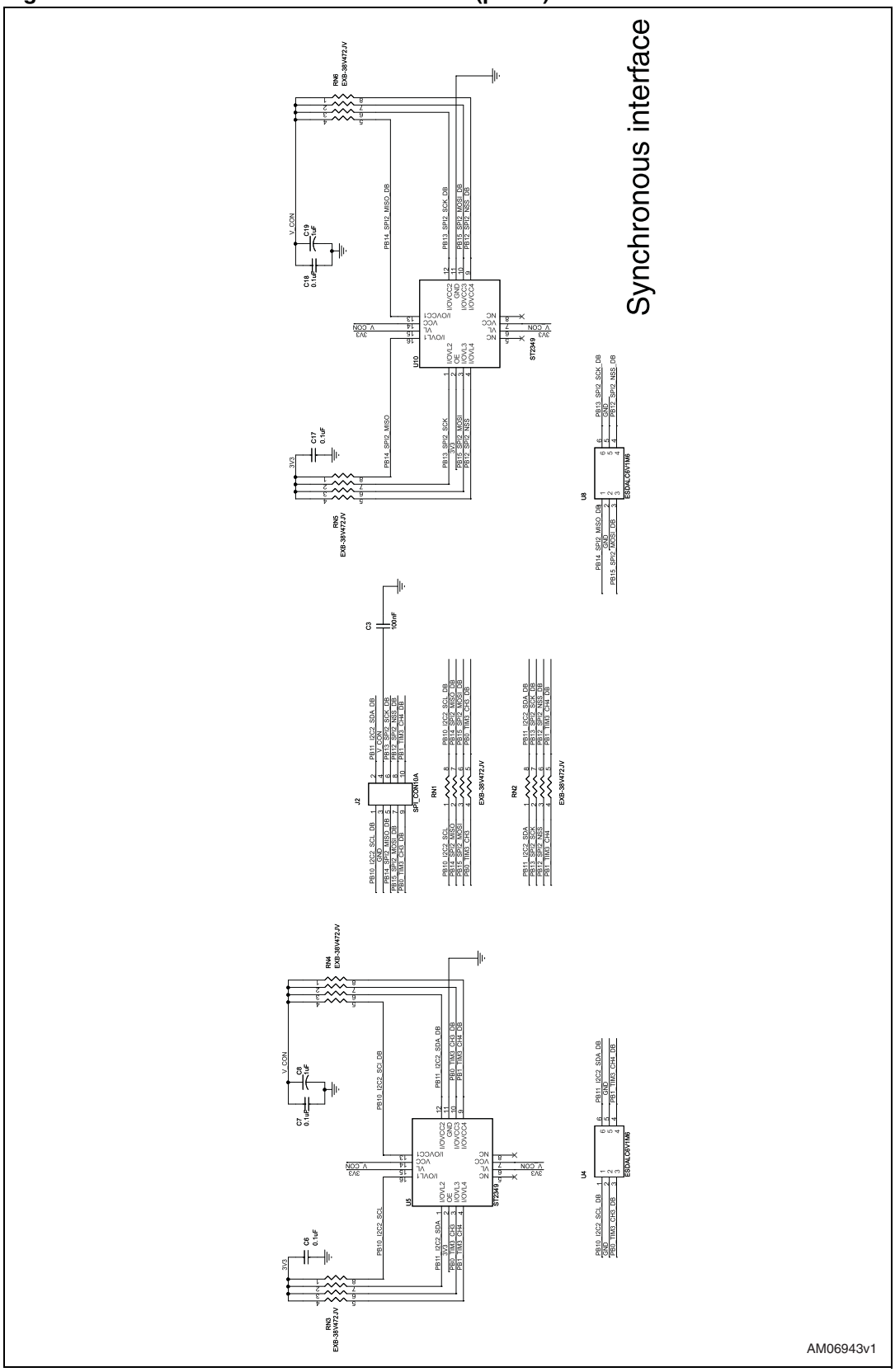


Figure 41. UUSCI demonstration schematic (part 4)

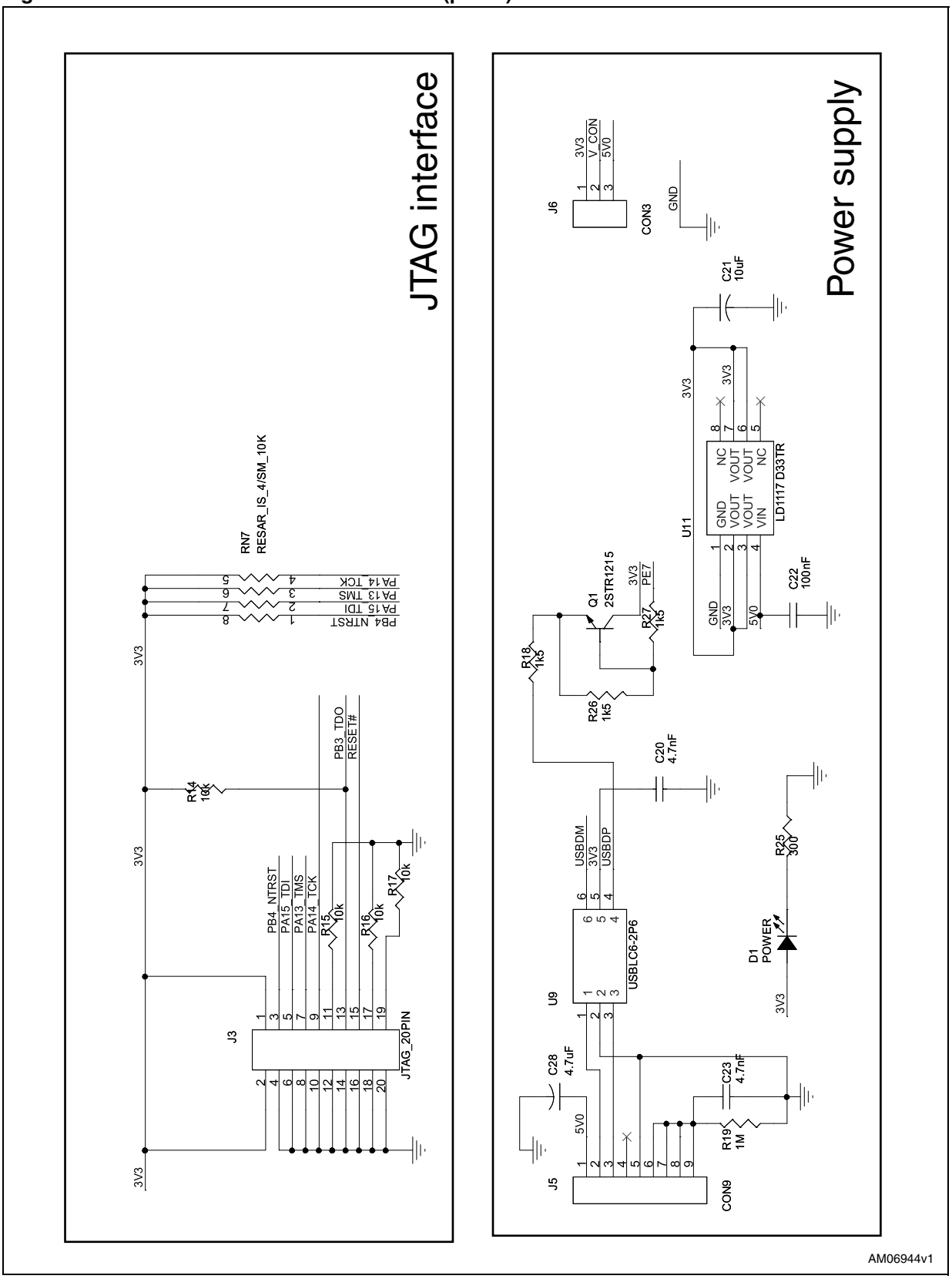
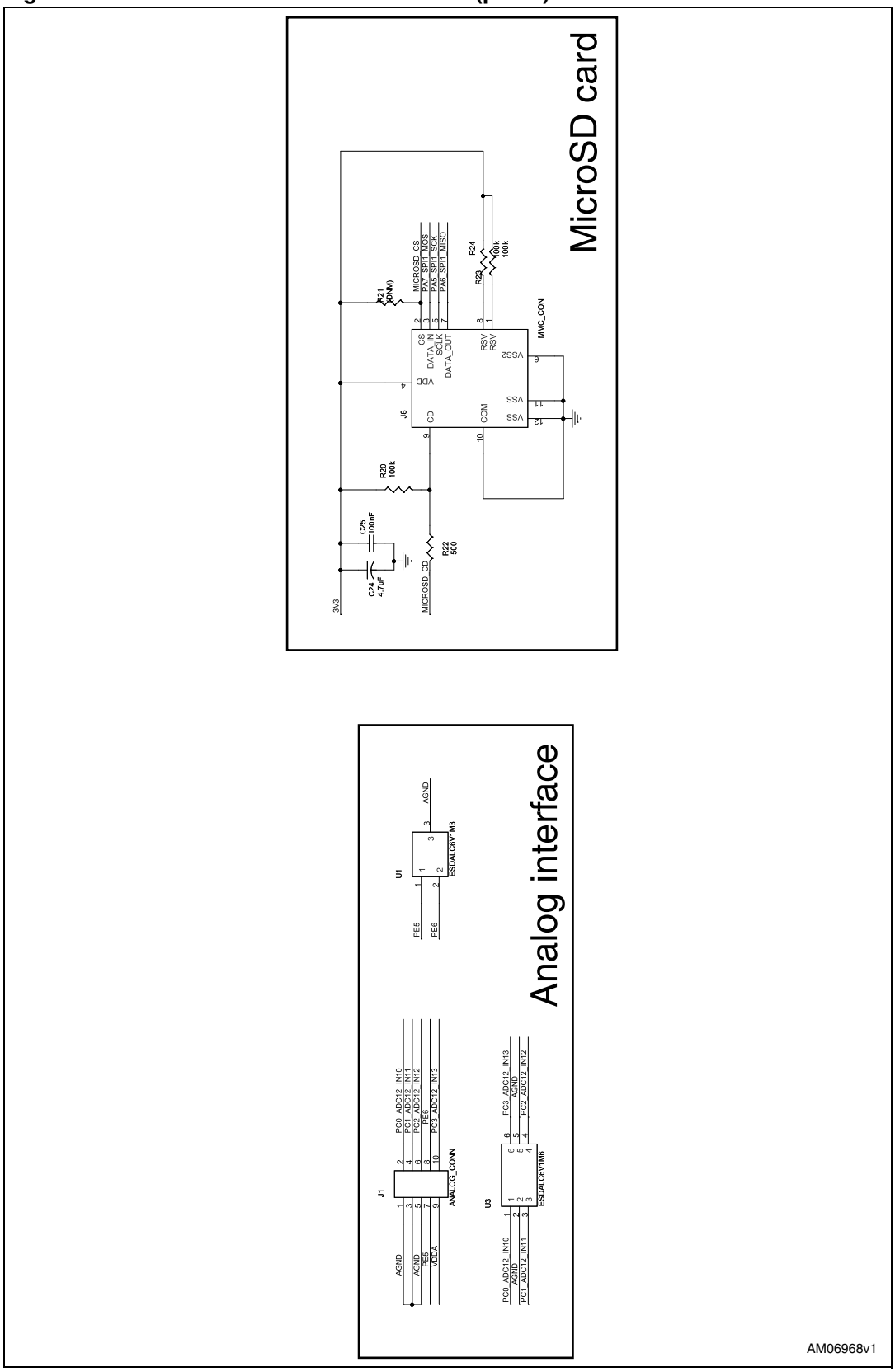


Figure 42. UUSCI demonstration schematic (part 5)



3.2 Bill of materials

Table 1. BOM

Category	Reference designator	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
ST devices	U1 (DNM)	ESDALC6V1M3	SOT883	STMicroelectronics	ESDALC6V1M3		
	U11	LD1117D33TR	SO-8	STMicroelectronics	LD1117D33TR		
	(U5,U10) (DNM)	ST2349QTR	QFN16	STMicroelectronics	ST2349QTR		
ST devices	U2	STM32F103VBT6	LQFP100	STMicroelectronics	STM32F103VBT6		
	U9	USBLC6-2P6	SOT-666	STMicroelectronics	USBLC6-2P6		
	U4,U8	ESDALC6V1M6	uQFN16	STMicroelectronics	ESDALC6V1M6		
	(U3,U6,U7) (DNM)	ESDALC6V1M6	uQFN16	STMicroelectronics	ESDALC6V1M6		
	Q1(DNM)	2STR1215	SOT-23	STMicroelectronics	2STR1215		
Non ST devices							
Crystal and oscillator	Y2	Crystal 8.000 MHZ SER 49US	11.35 x 4.5 mm crystal	Any		Digi-Key	535-9864-1-ND
	Y1	Crystal 32.768 kHZ 12.5PF CYL	Through hole	Any		Digi-Key	535-9032-ND
Connectors and jumpers	J2	CON10A 90°	Header 2x5 pin, 2.54 mm x 2.54 mm pitch	Any		Digi-Key	S9177-ND
	J1 (DNIM)	CON10A 90°	Header 2x5 pin, 2.54 mm x 2.54 mm pitch	Any		Digi-Key	S9177-ND
	J3	JTAG connector 90°	Header 2x10 pin, 2.54 mm x 2.54 mm pitch	Any		Digi-Key	S9180-ND
	J5	Mini USB B-Type	Mini USB B-Type	Any		Samtec/ Digi-Key	H2959CT-ND_

Table 1. BOM (continued)

Category	Reference designator	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
Connectors and jumpers	J6	Power selection jumper	Jumper 1x3 pin, 2.54 mm pitch	Any		Digi-Key	609-2223-ND
	(J4, J7) (DNM)	30-pin connector	Header 2x15 pin, 2.54 mm x 2.54 mm Pitch	Any		Any	
	J7a	DFU mode selection pin (to short pin 9 and pin 11 of J4)	Jumper 1x2 pin, 2.54 mm right angle pitch	Any		Digi-Key	609-2227-ND
	J8 (DNM)	uSD card connector	uSD card connector	Any		Any	
	SW2	Push button switch	(6 mm X 6 mm) push button, through hole	Any		Digi-Key	P8079SCT-ND
LEDs	D1	LED red clear 0805 SMD	3 mm SMD LED	Any		Digi-Key	160-1176-1-ND
Capacitors	C1,C2	10 pF	SMD0805	Any		Digi-Key	399-1108-2-ND
	C4,C5	22 pF	SMD0805	Any		Digi-Key	709-1172-1-ND
	C3,C11,C12,C13, C14,C15,C16,C22 ,C26,C27,C17	CAP .10 µF 50 V CERAMIC X7R 0805	SMD0805	Any		Digi-Key	PCC2452TR-ND
	(C6, C7, C17, C18, C25) (DNM)	CAP .10 µF 50 V CERAMIC X7R 0805	SMD0805	Any		Digi-Key	PCC2452TR-ND
	C9,C21	10 µF	SMD0805	Any		Digi-Key	PCC2417CT-ND
	C10	10 nF	SMD0805	Any		Digi-Key	399-1159-1-ND
	C20,C23	4.7 nF	SMD0805	Any		Digi-Key	399-1155-1-ND
Capacitors	(C8,C19) (DNM)	CAP 1.0 µF 50 V CERAMIC F 1206	SMD1206	Any		Digi-Key	PCC2234TR-ND
	C28	4.7 µF	SMD1206	Any		Digi-Key	PCC2297CT-ND
	C24(DNM)	4.7 µF	SMD1206	Any		Digi-Key	PCC2297CT-ND

Table 1. BOM (continued)

Category	Reference designator	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
Inductors	L1 (Replaced with 0 Ω)	Inductor multi-layer 10 µH	SMD Inductor	Any			
Resistors	R1,R7	RES 100 kΩ 1/8 W 5 % 0805	SMD0805	Any		Digi-Key	RHM100KATR-ND
	(R20,R23,R24) (DNM)	RES 100 kΩ 1/8W 5 % 0806	SMD0806	Any			
	R3,R4,R6,R9, R11, R12	RES 0.0 Ω 1/8 W 0805 SMD	SMD0805	Any		Digi-Key	RMCF1/100RTR-ND
	(R2,R8)(DNM)	RES 0.0 Ω 1/8 W 0805 SMD	SMD0805	Any		Digi-Key	RMCF1/100RTR-ND
	R5,R19	RES 1 MΩ 1/8 W 5 % 0805 SMD	SMD0805	Any		Digi-Key	RMCF1/101MJRTR-ND
	R10,R14,R15,R16 ,R17	10 kΩ	SMD0805	Any		Digi-Key	P10KADTR-ND
	R18, (R26, R27) (0 ohm mounted)	RES 1.5 kΩ 1/8 W 5 % 0805	SMD0805	Any		Digi-Key	P1.5KACT-ND
	R21 (DNM)	SMD	SMD0805	Any			
	R22 (DNM)	RES 500 Ω 1/8 W 5 % 0805 SMD	SMD0805	Any		Any	
	R25	RES 300 Ω 1/8 W 5 % 0805 SMD	SMD0805	Any		Digi-Key	311-300ARTR-ND

Table 1. BOM (continued)

Category	Reference designator	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
Resistors	RN1,RN2,	Res array zero Ω jumper	SMD0805	Any		Digi-Key	YC164J-4.7KCT-ND
	RN4,RN6	Res array 4.7 kΩ 8TRM 4RES SMD	SMD0805	Any		Digi-Key	YC164J-0.0TR-ND
	(RN5, RN3) (DNM)	Res array 4.7 kΩ 8TRM 4RES SMD	SMD0805	Any		Digi-Key	YC164J-4.7KCT-ND
	RN7	Res array 10 kΩ 5 % 4 res	SMD0805	Any		Digi-Key	Y9103CT-ND

Revision history

Table 2. Document revision history

Date	Revision	Changes
09-Jun-2010	1	Initial release

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