

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.

# Contents

1	Getti	ng start	ed	4
	1.1	System	requirements	4
	1.2	Packag	e contents	4
	1.3	Softwar	re installation	4
	1.4	Hardwa	are setup	7
		1.4.1	Power supply	. 8
		1.4.2	Jumper / connector settings	. 8
2	Runn	ning the	demonstration board	10
	2.1	Using S	SPI interface	11
		2.1.1	GPIO settings	13
		2.1.2	SPI header settings	14
	2.2	Using L	JART (SCI) interface	15
		2.2.1	GPIO settings	17
		2.2.2	SCI header settings	17
3	Work	ing in D	OFU mode	20
4	Sche	matics		21
5	Bill o	f materi	ials	26
Revisio	n histor	<i>у</i>		29



# List of figures

Figure 1.	Installation window	5
Figure 2.	License window	5
Figure 3.	Destination folder	3
Figure 4.	Installation ongoing	3
Figure 5.	Installation complete	7
Figure 6.	STEVAL-PCC009V4, universal USB to serial communication interface demonstration	
	board	3
Figure 7.	Interface header pin diagram	3
Figure 8.	Enumeration result	)
Figure 9.	Universal dongle GUI	)
Figure 10.	Board is not connected to PC11	I
Figure 11.	Board is connected to PC11	ĺ
Figure 12.	Selection of synchronous interface	2
Figure 13.	Selection of SPI interface	2
Figure 14.	SPI interface window	3
Figure 15.	J3 interpretation for SPI interface	3
Figure 16.	SPI pin interface in PC GUI	ł
Figure 17.	Setting of SPI parameters14	ł
Figure 18.	SPI read/write window	5
Figure 19.	Selection of asynchronous interface15	5
Figure 20.	Selection of SCI (UART) interface	3
Figure 21.	SCI interface window	3
Figure 22.	J3 interpretation for SCI interface	7
Figure 23.	SCI pin interface in PC GUI	7
Figure 24.	Setting of SCI parameters	3
Figure 25.	Port setting window	3
Figure 26.	SCI read/write window	)
Figure 27.	Enumeration in DFU mode	)
Figure 28.	Microcontroller section	ĺ
Figure 29.	JTAG interface	2
Figure 30.	Mode selection switch	2
Figure 31.	Power supply	3
Figure 32.	Opto-isolator section	ł
Figure 33.	16-pin communication interface	5



# 1 Getting started

## 1.1 System requirements

In order to use the universal USB to serial communication interface (UUSCI) with a Windows<sup>®</sup> 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\_FUN CTION/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

Un	iversal Dongle GUI - InstallS	hield Wizard Welcome to the InstallShield Wizard for Universal Dongle GUI The InstallShield Wizard will update the installed version (1.00.000) of Universal Dongle GUI to version 1.1.0. To continue, click Next.	X	
		< Back		

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

#### Figure 2. License window

License Agreement Please read the following license ag	reement carefully.	4	57	
SOFTWARE LICENSE AGR	EEMENT	1	<u> </u>	
This Software License Agr You to read prior to downl Software. If you choose no download or install the en related documentation an By using the Licensed Soft the terms and conditions o Licensed Software until Yo	eement ("Agreement") is d oading and using the Licer ot to agree with these provi closed Licensed Software d design tools. ware, You are agreeing to f this Agreement. Do not us ou have read and agreed to	lisplayed for nsed sions, do not and the be bound by se the o the	-	
<ul> <li>I accept the terms of the license</li> <li>I do not accept the terms of the</li> </ul>	agreement	Print		
InstallShield	-			
	< <u>B</u> ack <u>N</u> ex	t > Cance	el	
				AM

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.



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Choose Destination Location Select folder where setup will install files.
Install Universal Dongle GUI to: C:\\STMicroelectronics\Universal Dongle GUI <u>Change</u>

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

#### Figure 4. Installation ongoing

Universal Dongle GUI - InstallShield Wizard	×
Setup Status	7
The InstallShield Wizard is installing Universal Dongle GUI	
Installing	
InstaliShieldCancel	]
	AM12206v1



### Step 5:

Figure 5.	Installation complete

InstallShield Wizard Complete The InstallShield Wizard has successfully installed Universal Dongle GUI. Click Finish to exit the wizard.	
< <u>B</u> ack <b>Finish</b> Cancel	

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



57

## 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:

J3       2       PA1_USART2_RTS_DB         PA2_USART2_TX_DB       3       4       PA3_USART2_RX_DB         PA4_USART2_CLK_DB       5       6       PA5_SPI1_SCK_DB         PA6_SPI1_MISO_DB       7       8       PA7_SPI1_MOSI_DB         PB5_12C1_SDA_DB       9       10       PB6_12C1_SCL_DB         PB8_TIM4_CH3_DB       11       12       PB9_TIM4_CH4_DB         VDD_T       15       16       GND_T         CON16A         CON16A       C39	10186//1

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

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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*.



	rsal Dongle	GUI			
Operatio	n Synchron	nous View Help			
Sy	nchronous				
As	nchronous				
G	nnect				
Dis	connect				
Cle	ar Log Messag	7e			
Sa	re Log Messag	je 🛛			
Ex	t				
Direction	Ti	ine Stano	Data	Return	
Direction IPC to Bo	Tin ard 15:	ime Stamp 38:27:55	Data Connected	Roturn Poss	
Direction IPC to Bo	n Tit	ine Stamp - 36-27-55	Data Connected	Return Pass	
Direction IPC to Bo	n Tin ard 15	ime Stamp 36-27-55	Data Connected	Roturn Pass	
Direction IPC to Bo	n Tin and 1 15:	ine Stamp -36-27:55	Data Connected	Roturn Poss	
Direction (PC to Bo	n Tin ard († 15)	ine Stamp - 36-27-55	Data Connected	Return Pass	

Figure 12. Selection of synchronous interface

Figure 13. Selection of SPI interface

🛰 Universal D	Dongle GUI	
Operation S	ynchronous View Help	
- X 🐨 -	SPI Communication	
	I2C Communication	
Direction	Time Stamp	Data Beturn
PC to Board	15:36:27:55	Connected Pass



Viniversal Dongle GUI		X
Operation Synchronous Wew Help		
※第四■○		
SPIForm		
PR Fname         GR01         Ws         GR02           GR01         K00         M00         GR02         GR02           GR02         V00         M00         GR02         GR02           GR03         GR02         M00         GR02         GR02           GR03         GR02         M00         GR02         GR03           GR03         GR02         GR03         GR02         M00           GR03         GR02         GR03         GR03         GR03           GR03         GR03         GR03         GR03         GR03         GR03           GR04         GR03         GR03 </th <th>OD Selop GRD Dee RestVala RestVala RestVala RestVala RestVala RestVala RestVala RestVala</th> <th></th>	OD Selop GRD Dee RestVala RestVala RestVala RestVala RestVala RestVala RestVala RestVala	
Direction Time Stamp Data		Return
Board to PC 10.43.46.308 Connected Board to PC 10.43.45.253 Not Connected		Pass Fail
Board to PC 10.47.16.442 Connected		Pass
Board to PC 10:50.47:295 Connected Board to PC 10:55.43.141 82.01		Patt
Board to PC 1213 31:470 82 05 01 00 00 00	00 00 00 00 00	Pass
Board to PC 1217.12368 82.05.01.00.01.00.00 Board to PC 1218.36.371 82.05.01.01.00.00.00	00 00 00 00 00	Pass V

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



## 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*.





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
-----------------------	----------------

СРНА 0 💽	Daisy Chain 2	
CPOL 0 -	Baud Rate Presc 32 💌	
	Write	r -
Read Buffer	Write Buffer	
Address Length 0 💌	Address Length 0 💌	
Register Address 0x	Register Address 0x	
Length	Length	
Read	Write	
	Get Status	
		AM12220v1

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*.



I/v	vrite wi	indow	v			
	CPHA	0	V	🗖 Daisy Chain 🛛	<b>V</b>	
	CPOL	0	Ŧ	Baud Rate Presc 32	~	
				Re	eset	
	- Read B	uffer		Write Buffer		
	Address	Length	0	▼ Address Length		

Get Status

Register Address 0:

Length

Write

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

egister Address Ox

Length Read



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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*.

_	🍇 Universal Do	ongle GUI			X	
L	Operation A	synchronous View Help				
L	1000 000	SCI Communication				
L	- M 🔊 🕹					
L						
L						
L						
L						
L						
L						
L						
L						
L						
L						
L						
L						
L						
L						
L						
L						
	Direction	Time Stamp	Data	Beturn		
L	Board to PC	10.43.46.308	Connected	Patt		
L	Board to PC	10.46.52.53	Not Connected	Fal		
L	Board to PC	10.47.16.442	Connected	Patt		
L	Board to PC	10.55.43.141	82 01	Pass		
L	Board to PC	12:13:31:470	82 05 01 00 00 00 00 00 00 00 00 00 00	Pass		
L	Board to PC	1217:12968	82 05 01 00 01 00 00 00 00 00 00 00 00	Patt		
L	Looso IO PC	Tel 19.39.371	02 03 01 01 00 00 00 00 00 00 00	P 811		
L	connected					
L						
L						AM10000v1
l						AM12223v1
I	Board to PC Board to PC Board to PC Connected	1213:31:470 1217:12:968 1218:36:371	22 05 01 001 00 000 000 000 000 000 22 05 01 001 000 000 000 000 000 22 05 01 01 00 000 000 000 00 00 00	Pass Pass Pass	Y	

Figure 20. Selection of SCI (UART) interface

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

	Read		
artras a	Fean Pro Pau Pau Pau	ŕ	
	5 1000000000 000000000 0000000000	Patan           8         Patan           9         Patan	Patan         *           #         Patan         *

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*.

57

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*.



Fiaure 24.	Setting of SCI parameters

SCI Settings Port Setting Read Buffer Address Length Register Address 0x Length Read	Write Buffer Address Length Register Address 0x Length Write	0 V Get Status	
			AM12227v1

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

,	PortSettina	×	1
	Port Setting		
	Bits Per Second	9600 💌	
	Data Per Bits	8	
	Parity	Even	
	Stop Bits	2	
	Flow Control	None	
	Default	Set Cancel	
			AM12228v1

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.





SCI S Regi Leny F	Settings Reset ad Buffer dress Length 0 ister Address 0x ngth Read	Write Buffer Address Length Register Address 0x Length Write	Get Status		
				AM122	29v1

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.







# 4 Schematics









57

#### Figure 29. JTAG interface







57





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#### Figure 32. Opto-isolator section



J3

Figure 33. 16-pin communication interface



# 25/29

Doc ID 023152 Rev 1

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# Bill of materials

## Table 1. BOM

Category	Refer. design.	Component description	Package	Manuf.	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
	U1	STM32F103RBT6	LQFP64	ST	STM32F103RBT6		
ST devices	U1	USBLC6-2P6	SOT-666	ST	USBLC6-2P6		
	U3	LD1117D33TR	SO-8	ST	LD1117D33TR		
Non ST	U4,U5,U6,U7,U8,U9,U1 0,U11,U12,U13,U14,U1 5	ACPL-072L	SO-8	Avago Tech	ACPL-072L	Digi-Key	516-1732-5-ND
uevices	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
	J3	CON16A 90 degree	Header 2x5 pin, 2.54 mm x 2.54 mm pitch	Any		Digi-Key	S9177-ND
Connectors	J1	JTAG connector 90 degree	Header 2x10 pin, 2.54 mm x 2.54 mm pitch	Any		Digi-Key	S9180-ND
and jumpers	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 $\Omega$ )	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
	C1,C2	22 pF	SMD0805	Any		Digi-Key	709-1172-1-ND
Capacitor	C3,C6,C7,C8,C9,C14,C 15,C16,C17,C18,C19,C 20,C21,C22,C23,C24,C 25,C26,C27,C28,C29,C 30,C31,C32,C33,C34,C 35,C36,C37,C38,C39,C 41,C44,C46	CAP 0.1 µF 50 V ceramic X7R 0805	SMD0805	Any		Digi-Key	PCC2452TR-ND
Cupuonoi	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

Doc ID 023152 Rev 1

5

26/29

UM1540

**Bill of materials** 

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,R 16,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			

27/29

Doc ID 023152 Rev 1

5

UM1540

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# **Revision history**

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



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