

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, I²C, 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, I²C 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 I²C, 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



• Step 2: read the license file and click the "Yes" button if you accept the license.

Figure 2. License window

License Please	Agreement ead the following license agreement carefully.		47	
SOFT This Yout Softw down relat By us the tr Licer	WARE LICENSE AGREEMENT ioftware License Agreement ("Agre o read prior to downloading and us are. If you choose not to agree with load or install the enclosed License d documentation and design tools, ing the Licensed Software, You are rms and conditions of this Agreeme sed Software until You have read a	ement") is display in the Licensed in these provisions, ed Software and the agreeing to be bo ent. Do not use the and agreed to the	ed for do not e und by	
C I go C I go InstallShield	cept the terms of the license agreement not accept the terms of the license agreement	ack <u>N</u> ext >	<u>Print</u>	
-		3. K		AM0437



• 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

Universal Dongle GUI - InstallShield Wizard Choose Destination Location Select folder where setup will install files.	
Install Universal Dongle GUI to: C:\\STMicroelectronics\Universal Dongle GUI <u>C</u> hange	
InstallShield	
< Back Next > Cancel	AM043

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

Figure 4. Installation ongoing

Setup Status	
The InstallShield Wizard is installing Universal Dongle GUI	
Installing	
InstallShield	



• Step 5: when installation is complete, click "Finish".





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*:



- 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 JTAGbased debugger for the STM32 device.



Running the demonstration board 2

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.





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:



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Figure 10. Board is not connected to PC

Status	×
(i)	Board is not Connected.Please check Connections
	AM04402v1

If the board is connected the following message appears:

Figure 11. Board is connected to PC

State	IS	×	
(i	2	Board is Connected to PC	
		ОК	

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 I^2C 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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Sector Control Control Control Sector Ent	Maria Carlos de	-		
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Convected :				AM0440

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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*.





Now, click the I^2C interface option and a window for I^2C interface control opens, as shown in *Figure 14*.

Figure 14. I²C interface window

Image: State: Consistent	Operation Synchronicus View Help			
Chickdow Control of the second of the se	X X +			
Change Change <th>a IPC Window</th> <th></th> <th></th> <th>3</th>	a IPC Window			3
Constant Tan Samp Data Petan C-s Road 15 X 27-56 Connected Factor C Road 15 X 27-56 Connected Factor	ICC/IN/and ICC/IN	OPD Intro OPD Dev Read Value GHD Intro Read Value Read Value Read Value Read Value	DPD Twi RearVala (DPD Trai RearVala RearVala RearVala RearVala RearVala RearVala	
	Deecton Texe Stanp Data PC to Board 15 36 2755 Convected PC to Board 15 53 7 24 82 (0			Return Para Para

The PC GUI is now ready to be used for testing I^2 C-based slave devices. To use any I^2 C-based slave, the connection for the J2 jumper must be set, as shown in *Figure 15*.



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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 I^2C pin interface, as shown in *Figure 16*.

Figure 16. I²C-pin interface in PC GUI



You can only set the GPIOs mentioned. I^2C 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

GPIO One Settin	ng	×	
Mode Select	Input		
Input Mode	Normal	-	
Interrupt Edge	Falling	*	
Output Mode	Normal	~	
	Se	et	
Provides the info the controls the u	rmation regardir user will use	ng	
			AM044

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 I^2 C 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'.

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Figure 18. GPIO mode in normal input

GPID One Read Value Read	
	AM04410v1

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.



GPIO One Read Value	
Interrupt	Read
	AM04411v1

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

GPIO One Out Value	Write	
		AM04412v1

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.



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Figure 21. GPIO 5 setting in PWM mode

GPIO Five PWM Freq		
DutyCycle	0% 💌 Set	
		AM04413v1

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 I^2C address types (7 bit or 10 bit), the I^2C slave device address, and the I^2C speed.

Once the selection is made, click the "Write" button. This sets the I^2C interface and now the system is ready to read or write the data from the I^2C 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 I^2C settings.

The "Read" and "Write" window opens, as shown in Figure 23.



Control Parameters	
Address Type 7 Bit 💌	
I2C Address 0x b0	
Select I2C Speed 200 Reset	
Read Data Write Data	
Address Length 0 - Address Length 0	
Register Address 0x Register Address 0x	
No of Bytes	
Read Write	
Get Status	

Figure 23. I²C 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 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 I^2C communication taking place between the UUSCI demonstration board and the I^2C slave daughter board.

Therefore, this interface allows the connection and testing of any I^2C 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 I^2C interface, select the SPI interface. The window that opens is shown in Figure 24.

Operation Synchronous View Help	
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SPIform	
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Direction Time Stamp Data Return	
Direction Time Stamp Data Return Boards PC 10.43.45.00 Connected Pass Boards PC 10.45.25.3 Not Connected Pass	
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Figure 24. SPI interface Window

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*.







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.

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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*.



F	SPI		L	
		Daisy Chain 2		
		Write_	1	
	Read Buffer	Write Buffer	-	
	Register Address 0x	Register Address 0x		
	Length	Length		
	Read	/rite		
		Get Sta	tus	
			AM044	419v

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.

CPHA 0 C Daisy Chain 2	
CPOL 0 💌 Baud Rate Presc 32 💌	
Reset	
Read Buffer Write Buffer Address Length 0	
Register Address 0x Register Address 0x	
Length Length	
Read	
Get Status	
	AM0442

Figure 28. SPI 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 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

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*.



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Direction Board to PC Board to PC Board to PC Board to PC	Time Stamp. 10 43 45 308 10 45 52 53 10 47 16 446	Data Convected NG Convected Convected	Rasan Pata Fal Pat	-
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Direction Board to PC Board to PC Board to PC Board to PC Board to PC Board to PC	Tree Starsp. 10 42 46 508 10 45 52 53 10 55 42 265 10 55 42 141 12 12 31 470	Data Connected Connected Connected Connected Connected Str. 56-51 or 00.000 00.000 00.000 Str. 56-51 or 00.000 00.000 00.000	Prom Fols Fols Pols Pols Pols Pols	
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If you click the SCI interface option a window for SCI interface control opens, as shown in *Figure 31*.



🐛 Universal Do	ngle GUI						18 ×	1
Operation As	synchronous View Help							
12 🗯 A.								
SCIForm								
SCI Pin For	mat		GPI0 Setting					
UART TO	GND UART	RTS GPI01 GPI03	GPI0 One		- 680 Two			
LIART F		TS 6802 6804	BeadValue		BeadValue			
CONTENT IN				-	11000 1000 1			
				Read	Read			
SCI Setting	в							
Port Set	no							
Read But	er to the total land	Write Buffer	GPI0 Three		GPIO Form			
			dirio mue		Des databas			
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Length		ength		Read	Read			
Bead		Wite						
		Get Status						
				_				
Direction	Time Stamp	Data				Beturn	-	1
Board to PC Board to PC	10.43.46.300 10.46.52.53	Connected Not Connected				Fail		
Board to PC	10.47:16.442	Connected				Patt		
Board to PC	10.55:43:141	82 01				Patt		
Board to PC	1213:31:470 1217:12:968	62 05 01 00 00 00 00 00 00 00 00 00 00 00 00	00 00			Patt		
I DOWN TO PT	12.11.12.300		20.00			Deer		1
Board to PC Board to PC	1218.36371	82 05 01 01 00 00 00 00 00 00	00.00			Pass		

Figure 31. SCI interface window

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



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.





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*.

Fiaure 34.	Setting (of SCI	parameters
igaio o ii	ootting	0.00.	paramotoro

Read Buffer		Write Buffer	
Address Length	0 🔻	Address Length	0 💌
Register Address 0x		Register Address 0x	
Length		Length	
Read		Write	

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

its Per Second	9600		
ata Per Bits			
and the letter in the	8 💌		
Parity E	Even 💌		
top Bits	2		
low Control	None		
Default	Set Cancel		
	Parity itop Bits low Control Default	Parity Even Parity Even Stop Bits 2 Flow Control None Default Set	Parity Even Stop Bits 2 Flow Control None Default Set Cancel

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.





SCI Settings Reset			
Read Buffer Address Length 0	Write Buffer Address Length	-	
Register Address 0x	Length		
Read	Write		
		Get Status	
			AM04428v1

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.



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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.



📇 Device Manager	
File Action View Help	
Keyboards Mice and other pointing devices Ports (COM & LPT) Communications Port (COM1) Communications Port (COM2) Communications Communication	

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Appendix A Schematic and bill of materials

3.1 Schematic





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Figure 39. UUSCI demonstration schematic (part 2)



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Figure 40. UUSCI demonstration schematic (part 3)



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Figure 42. UUSCI demonstration schematic (part 5)



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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
	U1 (DNM)	ESDALC6V1M3	SOT883	STMicroelectronics	ESDALC6V1M3		
ST devices	U11	LD1117D33TR	SO-8	STMicroelectronics	LD1117D33TR		
	(U5,U10) (DNM)	ST2349QTR	QFN16	STMicroelectronics	ST2349QTR		
	U2	STM32F103VBT6	LQFP100	STMicroelectronics	STM32F103VBT6		
	U9	USBLC6-2P6	SOT-666	STMicroelectronics	USBLC6-2P6		
ST devices	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	Y2	Crystal 8.000 MHZ SER 49US	11.35 x 4.5 mm crystal	Any		Digi-Key	535-9864-1-ND
oscillator	Y1	Crystal 32.768 kHZ 12.5PF CYL	Through hole	Any		Digi-Key	535-9032-ND
	J2	CON10A 90°	Header 2x5 pin, 2.54 mm x 2.54 mm pitch	Any		Digi-Key	S9177-ND
Connectors	J1 (DNIM)	CON10A 90°	Header 2x5 pin, 2.54 mm x 2.54 mm pitch	Any		Digi-Key	S9177-ND
and jumpers	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_

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Table 1. B	OM (continued)	1			1	r.	
Category	Reference designator	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
	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	
Connectors and jumpers	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
	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
Capacitors	(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
	(C8,C19) (DNM)	CAP 1.0 µF 50 V CERAMIC F 1206	SMD1206	Any		Digi-Key	PCC2234TR-ND
Capacitors	C28	4.7 μF	SMD1206	Any		Digi-Key	PCC2297CT-ND
	C24(DNM)	4.7 μF	SMD1206	Any		Digi-Key	PCC2297CT-ND

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ible 1. B	OM (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 μΗ	SMD Inductor	Any			
	R1,R7	RES 100 kΩ 1/8 W 5 % 0805	SMD0805	Any		Digi-Key	RHM100KATR-NE
	(R20,R23,R24) (DNM)	RES 100 kΩ 1/8W 5 % 0806	SMD0806	Any			
R3,R4,R6,R9, R11, R12 (R2,R8)(DNM) Resistors R5,R19 R10,R14,R15,R16 ,R17	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
	RES 1 MΩ 1/8 W 5 % 0805 SMD	SMD0805	Any		Digi-Key	RMCF1/101MJRT -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-NE

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Table 1.	BOM (continued)						
Category	Reference designator	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
	RN1,RN2,	Res array zero Ω jumper	SMD0805	Any		Digi-Key	YC164J-4.7KCT- ND
Popiatoro	RN4,RN6	Res array 4.7 k Ω 8TRM 4RES SMD	SMD0805	Any		Digi-Key	YC164J-0.0TR-ND
nesisiors	(RN5, RN3) (DNM)	Res array 4.7 kΩ 8TRM 4RES SMD	SMD0805	Any		Digi-Key	YC164J-4.7KCT- ND
	RN7	$\begin{array}{c} \text{Res array 10 k}\Omega \ 5 \ \% \\ 4 \ \text{res} \end{array}$	SMD0805	Any		Digi-Key	Y9103CT-ND

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Revision history

Table 2.	Document	revision	history
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Date	Revision	Changes
09-Jun-2010	1	Initial release

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