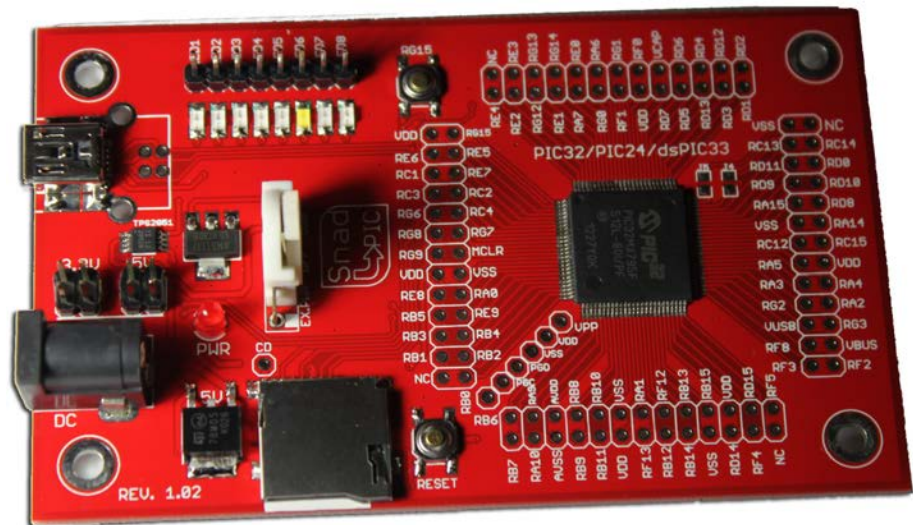




# PIC32, PIC24 and dsPIC Starter Kit User's Guide



## 1 - Overview

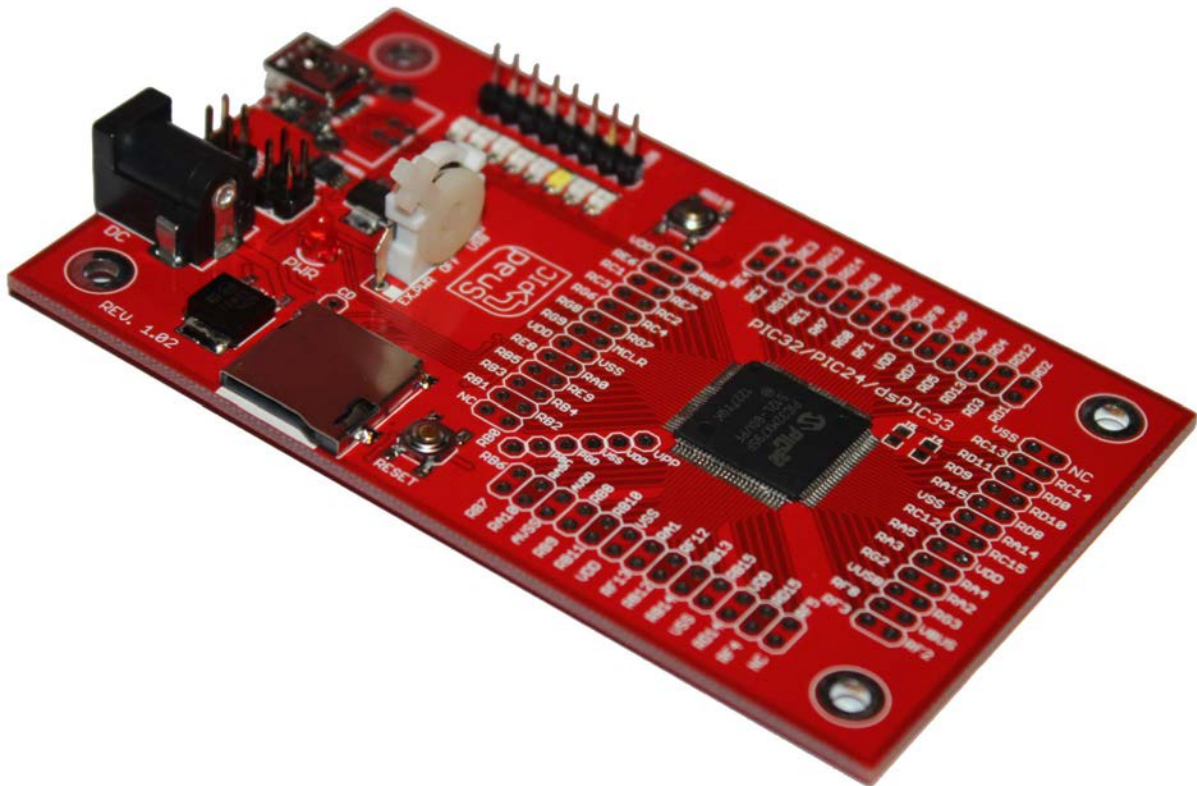
The SnadPIC is a microcontroller board based on the Microchip PIC32, PIC24 and dsPIC families. It is designed to be easy to use and suitable for use by anyone from beginners to advanced users for experimenting with electronics and embedded control systems. It contains everything needed to start developing embedded applications.

It is designed to provide a low cost small control solution. It is intended to introduce and demonstrate the capabilities and features of PIC32, PIC24 and dsPIC with on-chip **USB OTG**. The board also comes with all the basic components needed for the Microchip PIC32, PIC24 and dsPIC families, so you can use it straight out of the box. Except for a single connection to a computer, no additional hardware or configuration is necessary. A USB connection to a host computer supplies communications and power to the board. For independent host-side USB operation, the starter kit may be disconnected from the PC and powered through DC Power Jack for independent functionality.

The starter kit provides 83 I/O pins that support a number of peripheral functions, such as UART, SPI and I2C™ ports and pulse width modulated outputs. Use of these advanced peripherals requires an add on board to provide the additional hardware required.

Through the USB interface, it can also be programmed without the need of a programmer, as there is a built in Microchip boot loader.

The starter kit can be powered via USB, an external DC power adapter, or batteries.



## 2 - Features

- PIC32, PIC24 and dsPIC with on-chip USB OTG
- Microchip bootloader Firmware
- USB serial interface easily can be used as USB host and USB device
- On-board Micro USB Connector
- On-board Micro SD Card holder
- On-board External Power Connector
- On-board Power Supply Switch (ON OFF ON)
- On-board 5V regulator
- On-board 3.3V regulator
- On-board Shield Power Connector
- On-board RESET (MCLR) Switch
- On-board General purpose Switch
- On-board LED Power Supply indicator
- On-board 8 User LEDs, and 1x8 male/female pin header that provides connections to these LEDs
- Most of the processor pins available, and the breakout pins can be soldered with standard 0.1" male/female header to easily plug it into a mother board
- 4 holes to fix the board into a mother board
- On-board 12Mhz Crystal and two capacitors
- On-board 32.768Khz Crystal and two capacitors for RTCC/Timer1
- On-board 1x6 footprint for ICSP connection that provides Microchip Debug Tool Connector
- Board Size *Inches (mm)* : 3.94 (100.25) x 2.39 (60.95)

## 3 - Hardware Overview

The SnadPIC board provides the following hardware features:

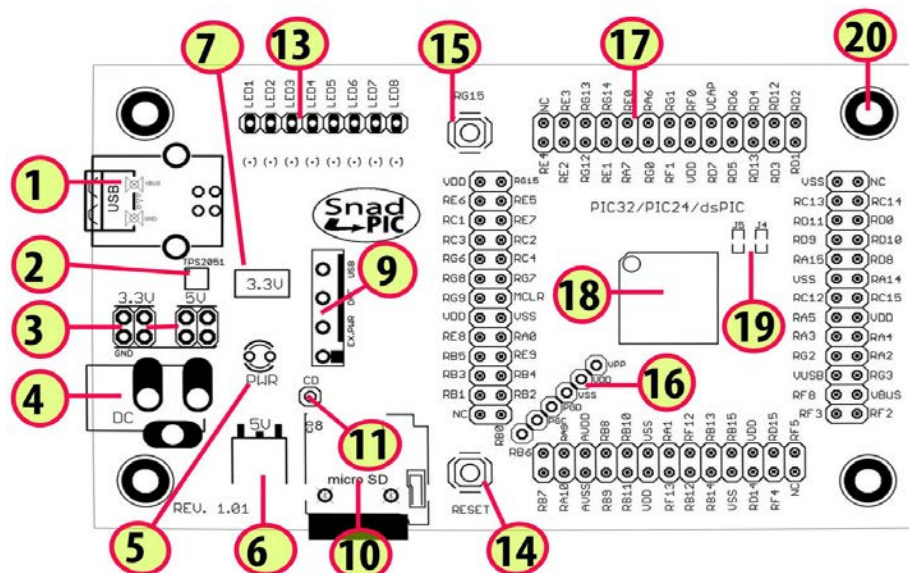


Figure 3- 1

## □ No. 1 USB Connector

This provides 2 functionalities :

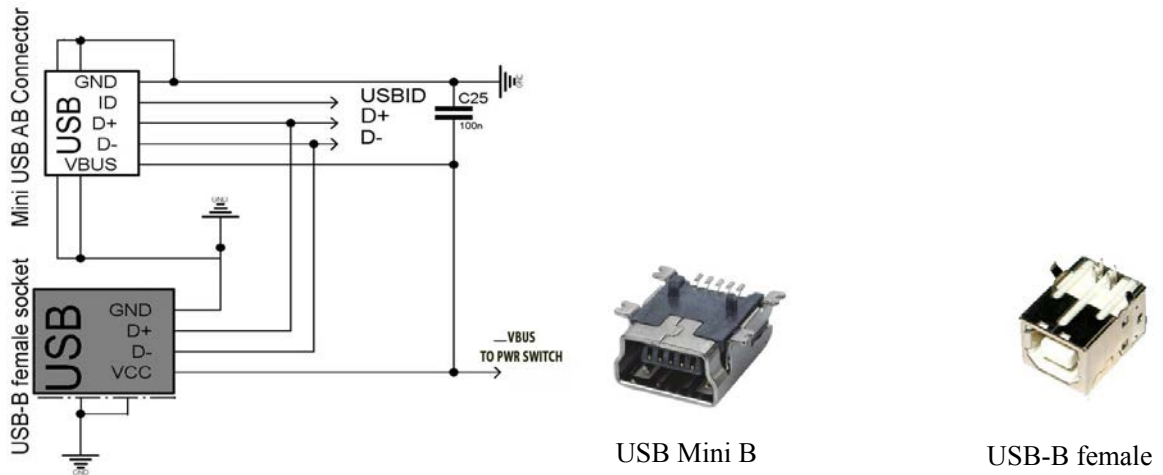
1- connects to a USB port on the PC to provide the communications port used by any application designed for this reason (ex. Bootloader) to talk to the board as a device. This can also be used to power the board when connected to the PC.

2- while operating as an embedded host, it connects to a USB device (ex. **USB Flash drive**) to provide the bidirectional communications and provides device power. This USB Connector is a mini USB AB Connector - 5 pins (default on-board),

also on-board footprint for **USB-B female Connector** - 4 pins.

Only one connector can be mounted each time.

Here is the schematic :

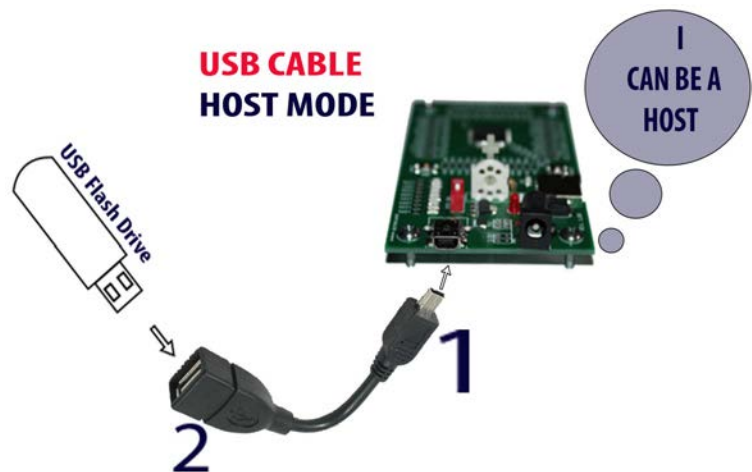


**Figure 3- 2**

In embedded host mode like reading data from USB Flash drive, another USB adapter (**Figure 3- 4**) is needed to connect the USB Flash drive.



**Figure 3- 3**



**Figure 3- 4**

## □ No. 2 USB Host mode Power Switch

This is TPS2051 (ACTIVE) Single, Current-Limited, USB Power Switch. It is used in host mode to provide power to devices like USB Flash drive.

Here is the schematic :

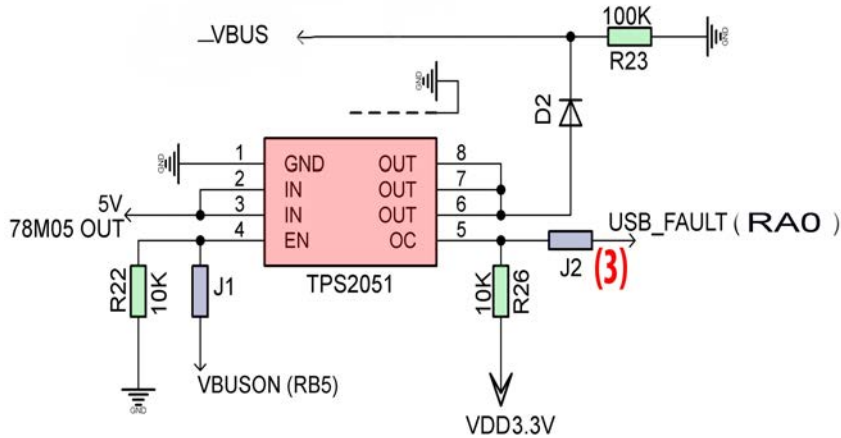


Figure 3- 5

Notes :

- Switching between Device and Host modes only under software control.  
No Hardware change will be made on the board.
- (3) J2 is a Jumper pad NOT installed by default. shorting solder jumper pad if used. It is for monitoring VBUS power(PGOOD).
- J1 is a Jumper installed by default, Shorting VBUSON (RB5) to EN (Enable) Pin of USB Power Switch IC. (TPS2051).
- D2 is FMKA140 Schottky Diode 40V 1A.
- D2 is FMKA140 Schottky Diode 40V 1A.
- R23 is used to pull-down VBUS pin in USB device/peripheral mode. NOT installed by default (its value is user decision), its importance is in application that uses USBID to detect VBUS when USB module is disabled.

## □ No. 3 Shield Power Connector



Figure 3- 6



This connector provides power to I/O expansion shields connected to the board :

- 2x2 pins : 2 pins 3.3V + 2 pins GND.
- 2x2 pins : 2 pins 5V + 2 pins GND.
- **3.3V** is limited by **AMS1117 (Max 1A)** and by USB ( **Max 100mA**).
- In case External Power Supply used **3.3V** pins = **Max 500mA**.
- In case USB Power Supply used **3.3V** pins = **Max 100mA**.
- **5V** is limited by **78M05 (Max 500mA)**.
- In case USB Power Supply used **5V** pins = **No Power**.

USB Power Supply and Ext. Power Supply can be used together only if VBUSON (RB5) is pulled down, to not enabling USB Power Switch IC TPS2051 which is active HIGH.

#### □ No. 4 External Power Connector

This is used to power the board from an external power supply. This is a 5.5mm x 2.1mm barrel connector. It is wired with the center terminal as the positive supply voltage. The power supply voltage must be in the range 7V to 12V.

#### □ No. 5 LED power indicator

A LED indicator (PWR) will lit on when there is a power.

#### □ No. 6 Power Supply – 5V regulator

On-Board 5V voltage regulator. This regulates the input voltage applied at the external power connector to 5V. This is used to power the 3.3V regulator and to provide 5V power to shields. This regulator can provide up to 500mA of current. **78M05** 5V 500mA Positive Voltage Regulator used.

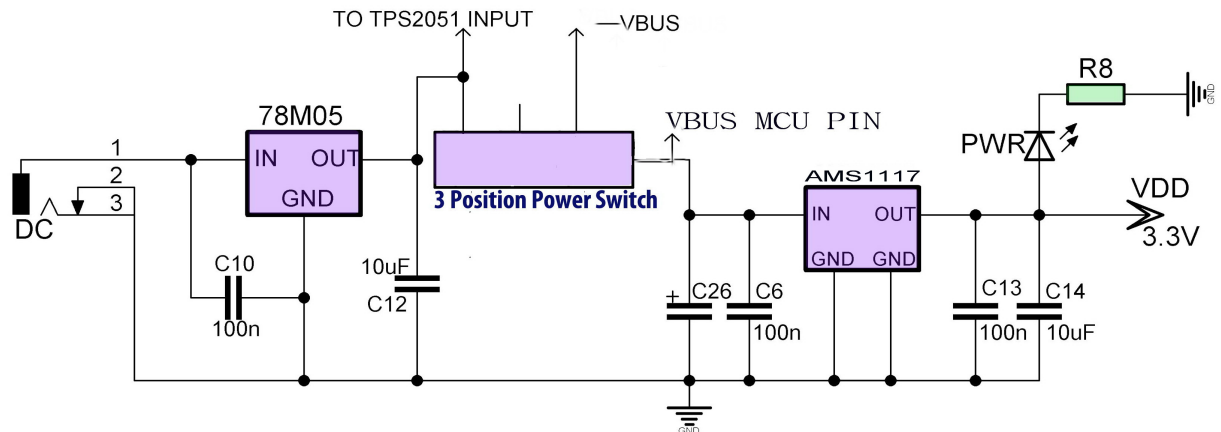


Figure 3- 7

#### □ No. 7 Power Supply – 3.3V regulator

Voltage regulator for the 3.3V power supply. This power supply can provide up to 1A of current. **AMS1117** 3.3V 1A Positive Voltage Regulator used.

□ No. 8 --

### □ No. 9 3-Position Power Switch

This is a 3-Position Power Supply Switch : *USB PWR - PWR OFF - EXT.PWR*

### □ No. 10 Micro SD Card Socket

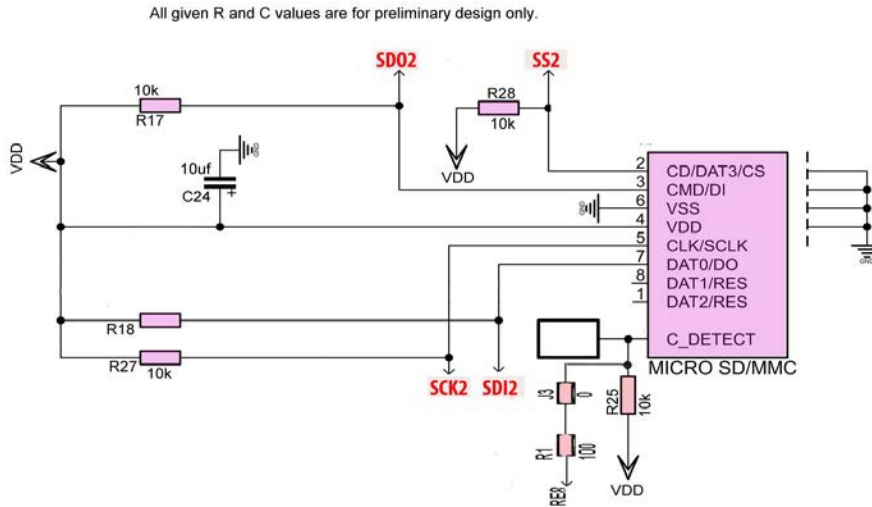


Figure 3- 8

*Notes :*

- SPI2 used for communicating with a SD Card: **SDI2**, **SDO2**, **SCK2** and **SS2**.
- **J3** (Jumper Pad) is installed by default, card detection connected to RE8.
- R1 (100 Ohm) is used for protection purpose.
- The square besides R25 is a 1x pin header on the board used for card detection (CD) , use Dupont Wire Connector to connect it to any MCU pin if RE8 not used.

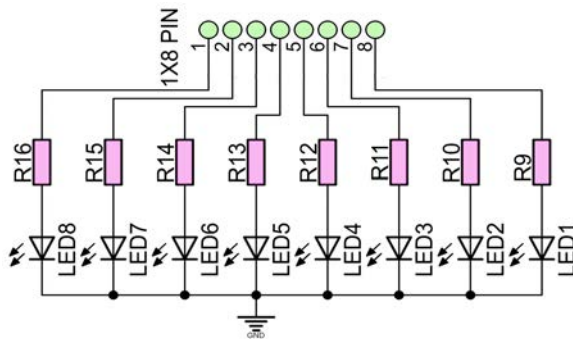
### □ No. 11 Card detection pin header

This provides SD Card detection option (user choice). Use Dupont Wire Connector to connect it to any MCU pin if used.

□ No. 12 --

□ No. 13 **User LED**

These are Test I/O LEDs that consists of 8 LEDs and its circuit is shown below:

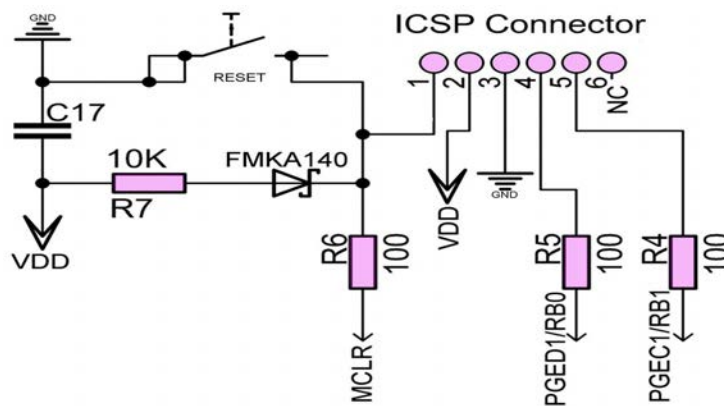


**Figure 3- 9**

- LED colour = May be any colour or many colours.
- R9, R10, R11, R12, R13, R14, R15, R16 are current limiting resistors for LEDs 1k.
- Use Dupont Wire Connectors to connect any LED to any MCU pin.

□ No. 14 **Reset Button**

This button can be used to reset the microcontroller.

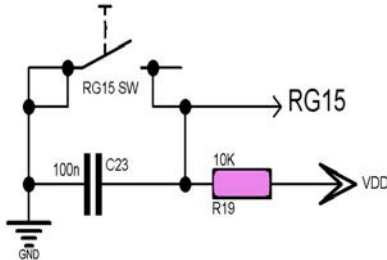


**Figure 3- 10** RESET button and ICSP circuit (Microchip Debug Tool Connector)



**□ No. 15 RG15 Switch**

This is used for general purpose, and used in case of entering bootloader mode.



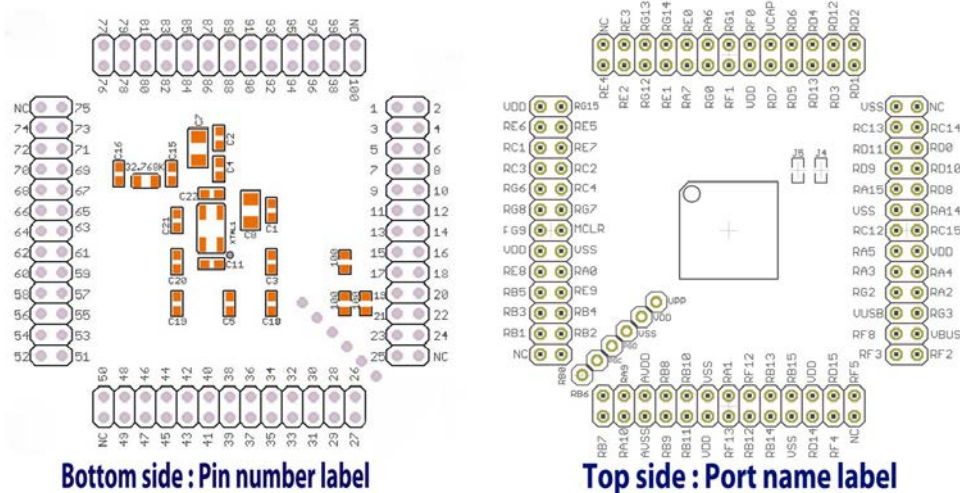
**Figure 3- 11** RG15 Switch

**□ No. 16 Microchip Debug Tool Connector**

This connector is used to connect Microchip programmer/debugger tools, such as PICkit™3. This allows the board to be used as a traditional microcontroller development board using the Microchip MPLAB®IDE. (Figure 3- 10)

**□ No. 17 I/O microcontroller's pins**

This are 4 Connectors 2x13 male/ female pin headers (0.1 inch standard )that provide I/O microcontroller's pins. User is free to connect the pins according to their application. All the breakout pins are label clearly with their port name in one Side, and all the breakout pins are label clearly with their pin number in the other Side.



**Figure 3-12**

*Notes :*

**MCU Oscillator :** RC12 and RC15 are connected with Crystal 12.00MHz

**RTC Oscillator :** RC13 and RC14 are connected with Crystal 32.768KHz

**USB :** D+, D-, and USBID are connected with Mini USB AB Connector

VBUSON is connected with TPS2051B USB Power Switch

**SPI :** SDI2, SDO2, SCK2 and SS2 are connected with Micro SD Card Socket

**RG15 :** RG15 is connected with a switch

*Other resources may be used by shortening jumpers, Refer to schematics.*

**No. 18 main processor**

This is the TQFP100 microcontroller that is the main processor for the board.

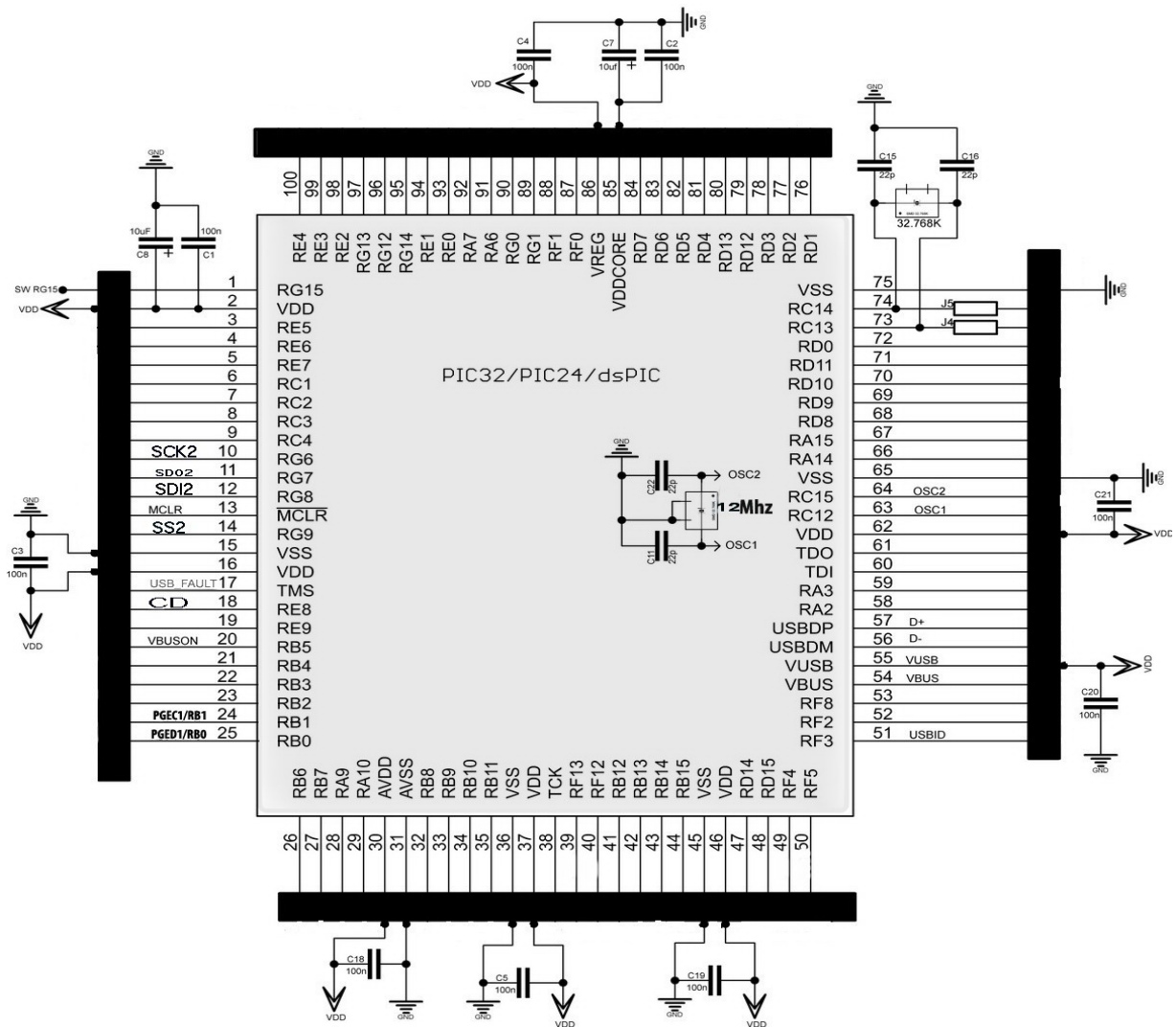


Figure 3- 13

### □ No. 19 *RTC Jumpers*

These are **J4** and **J5**, they are not installed.

### □ No. 20 **Holes**

These are 4 holes 3.6mm provided in each corner to fix the board on a mother board, exp. home made PCB, to expand the hardware, and test a user application-specific. This board was designed to fit perfectly on standard 100mil prototyping board. When you design you expansion board, just work in a grid of 0.05 inch (1.27mm), and you will realize that all dimensions are multiple of 0.05 inch (1.27mm).

Here are all dimensions :

#### Dimension : Inches(mm)

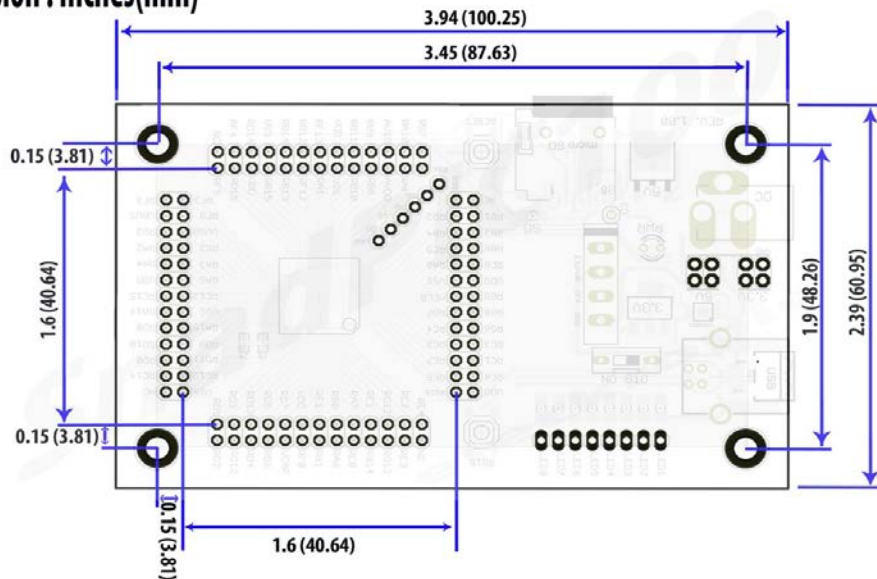


Figure 3- 14

## 4 - Bottom Board Components

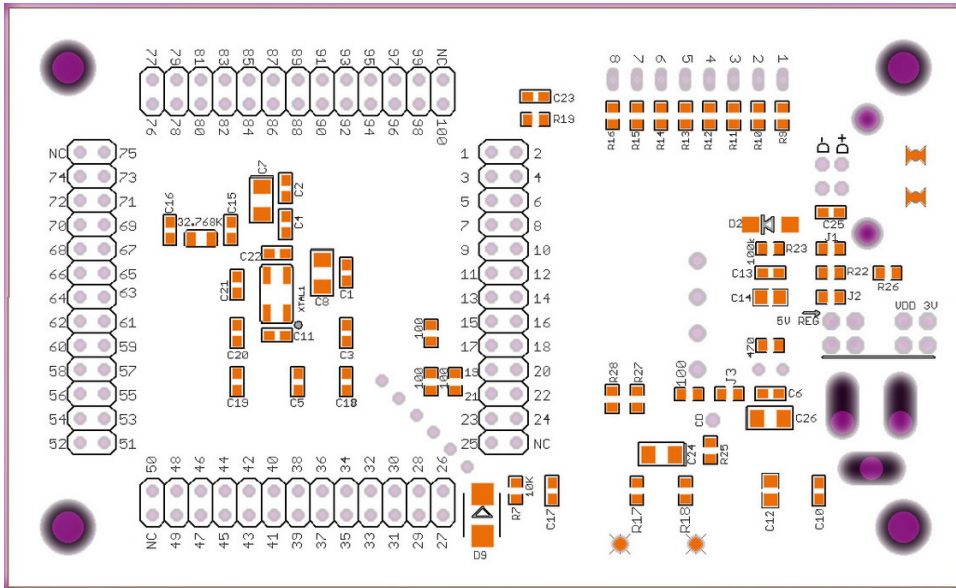


Figure 4- 1

Components	Values	Qty	Description
C1,C2,C3,C4,C5,C6,C10,C13,C17,C18,C19,C20,C21,C23, C25	100nF/50V	15	0603 capacitor.
C12, C14	10uF/10V	2	Capacitor: ceramic; 10uF; 10V; 0805
C7, C8,C24, C26	10uF	4	Tantalum Capacitor 10uf 10v 3216
C11, C22	22pF/50V	2	0603 capacitors
C15, C16	22pF/50V	2	0603 capacitors
R4, R5, R6	100 Ohm	3	0603 resistors
R7,R17,R18,R19,R22,R25,R26,R27,R28	10K	9	0603 resistors
-	-	0	-
R9,R10,R11,R12,R13,R14,R15,R16	1K	8	0603 resistors (LED current limiting)
R23	User		OTG
-	xx	-	-
J3		1	Card detection : RE8 used
J1, J2		2	OTG, (J2 NOT INSTALLED)
XTAL1	SMDXT324	1	12Mhz +-30ppm, 20pF
32.768k	32.768k-CFPX217	1	12.5pF
D2, D9	FMKA140	2	Schottky Diode 40V 1A

## 5 - Input/Output Connections

The PIC32 microcontroller can source or sink a maximum of 18mA on all digital I/O pins. However, to keep the output voltage within the specified voltage range (VOL 0.4V, VOH 2.4V) the pin current must be restricted to +/-12mA. The maximum current that can be sourced or sunk across all I/O pins simultaneously is +/-200mA. The maximum voltage that can be applied to any I/O pin is 5.5V.

For more detailed specifications, refer to device Data Sheet available from the Microchip web site.

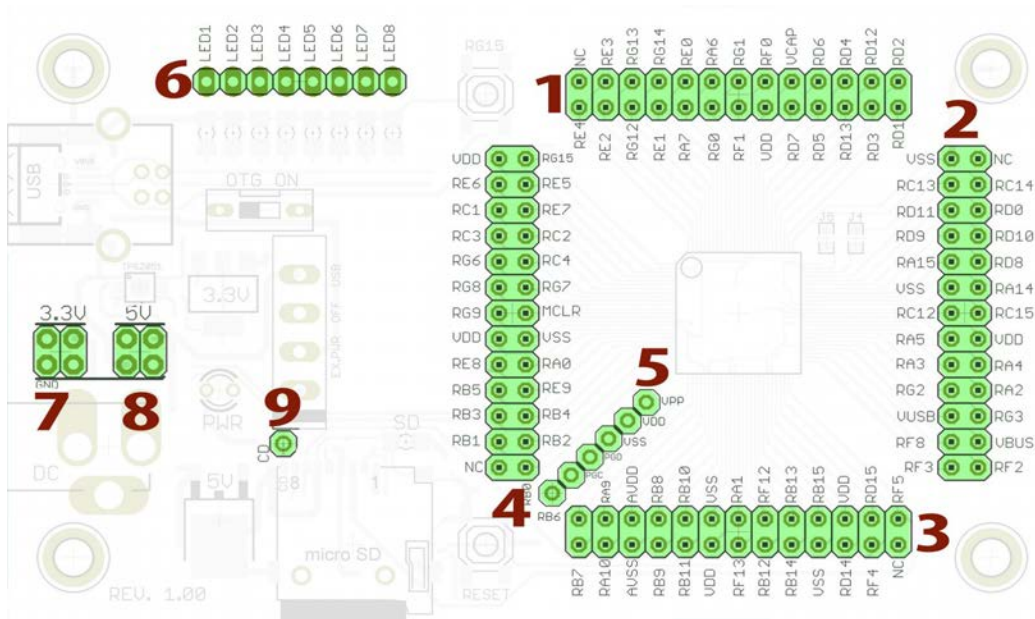


Figure 5- 1

The board provides all I/O pins from the microcontroller to pins on the input/output connectors, and provides Peripheral I/O Functions. These pins are labeled in the silk screen on the board to easily identify them :

- Connectors **1, 2, 3,** and **4** are 2x13 male/ female pin headers connectors that provide 100 I/O microcontroller's pins.
- Connector **5** is 1x6 male/ female pin header that provides Microchip Debug Tool Connector .
- Connector **6** is 1x8 male/ female pin header that provides connections to user LEDs .  
Driving a pin high turns its LED on, driving it low turns it off.
- Connector **7** is 2x2 male/ female pin header **Shield Power Connector** that provides two pins connected to the **VCC3V3** bus and two pins connected to **GND**.
- Connector **8** is 2x2 male/ female pin header **Shield Power Connector** that provides two pins connected to the **VCC5V0** bus and two pins connected to **GND**.
- Connector **9** is 1x1 male/ female pin header that provide **SD Card detection functionality**.



## 6 - General Specifications of Board

### USB

USB OTG controller allows using the board to implement a USB device, USB host or USB OTG host/device. The following pins are used by the USB interface:

- Pin 57 (D+), Pin 56 (D-), Pin 51 (USBID), Pin 54 (VBUS).
- Pin 20 (VBUSON), Pin 17 (RA0), see **Figure 3- 5**.

Pin 54 (VBUS) can be used by a self powered USB device to monitor the presence of bus voltage on the USB bus. This pin on the PIC32 microcontroller is an analog input pin used by the USB controller, and is not useable as a user I/O pin even when not using the USB controller.

### RTCC: Real Time Clock Calendar

The PIC32 microcontroller contains an RTCC circuit that can be used to maintain time and date information. The operation of the RTCC requires a 32.768Khz frequency source. A 32.768Khz crystal is connected to RC13 and RC14 pins to allow use of the RTCC.

### Shield Power Connector

The PIC32 microcontroller is rated to use a maximum of 98mA of current when operating at 80Mhz. This allows up to ~400mA from the VCC3V3 bus and from the VCC5V0 bus to power external devices. The power connector, (**Figure 3- 6** Shield Power Connector), is used to provide power to shields connected to the board.

### 5V Compatibility

The PIC32 microcontroller operates at 3.3V, and many Arduino shields are designed to operate at 5V. There are two issues to consider when dealing with 5V compatibility for 3.3V logic. The first is protection of 3.3V inputs from damage caused by 5V signals. The second is whether the 3.3V output is high enough to be recognized as a logic high value by a 5V input. The digital I/O pins on the PIC32 microcontroller are 5V tolerant.

The analog capable I/O pins are not 5V tolerant, so applying 5V logic levels to any not 5V tolerant pin may damage the microcontroller!

The minimum output high voltage of the PIC32 microcontroller is rated at 2.4V when sourcing 12mA of current. When driving a high impedance input (typical of CMOS logic) the output high voltage will be close to 3.3V. Some 5V devices will recognize this voltage as a logic high input, and some won't. Many 5V logic devices will work reliably with 3.3V inputs.



### *Microchip Development Tool Compatibility*

The board can be used as a more traditional microcontroller development board using Microchip Development Tools. Unloaded connector Microchip Debug Tool Connector is used to connect to a Microchip development tool, such as the PICkit™3. The holes are narrowed so that a standard, 100mil spaced, 6-pin header can be press fit to the board without the need to solder it in place. Any Microchip development tool that supports the microcontroller family, and can be connected via the same 6-pin interface as the PICkit3 can be used. Typically, a short six-wire cable can be used between the PICkit3 and the board.

The Microchip MPLAB®IDE or the MPLAB®X IDE can be used to program and debug code running on the board. These programs can be downloaded from the Microchip web site. *Using the Microchip development tools to program the board will cause the boot loader to be erased.* To use the board with the boot loader again, it is necessary to program it back onto the board.

## **6 - Quick Start**

With its pre-installed demo application, the Starter Kit is designed to be used straight out of the box. Except for a single connection to a computer, no additional hardware or configuration is necessary. Connect the Starter Kit with USB cable ( **Figure 3- 3**) to any available USB port on the PC or powered hub, open the power switch, the red power LED should light indicating the presence of power. Now, using Dupont wire(s) connect any port pin(s) of the MCU to any/many on board LED(s). The LED(s) should blink.

This demo application blinks all ports pins of the MCU, each time only one port pin goes high to blink a LED.

with Microchip's HID bootloader -which allow you to load the program without any other programmer- and which is already programmed into the microcontroller - you can now easily load your program.

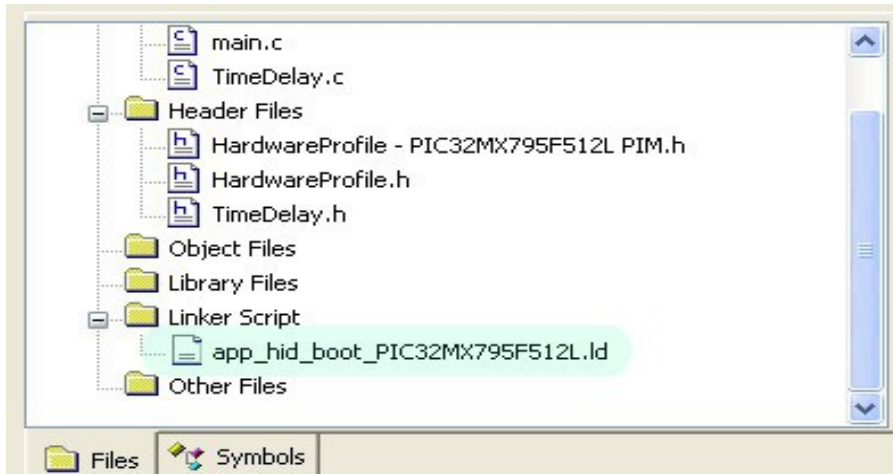
But before doing so, you need to download the PC program from [www.Microchip.com](http://www.Microchip.com)

Do search for “ *Microchip Application Libraries* “ ,download and install.

We used this version : “*MCHP\_App\_Lib\_v2010\_04\_28\_Installer.zip*”

In folder “*USB Device – Bootloaders*” you will find the PC program “*HIDBootLoader.exe*”. Execute it. You will see that the device was not detected, don't worry.. it is because you are not in bootloader mode. To be in bootloader mode, you should press both switches at the same time, and release RESET switches while keeping the other switch (RG15) pressed, and the PC program should detect it now, so release the last switch.. Now you can read, write, erase... the device using that PC program. You may need to export the demo application (blinking LED) for further use.

you can compile your code with MPLAB C32 C Compiler and program the chip using “*HIDBootLoader.exe*”, but to ensure your code works, you should always include Linker Script in the project as shown at the figure below **Figure 6 - 1**:

**FIGURE 6- 1**

Also you should use this Configuration:

```
#pragma config FPLLIDIV = DIV_3 // PLL Input Divider
```

DIV\_3 is used when there is 12Mhz crystal for primary Oscillator, and this is the case.

The bootloader which is programmed in the chip is the same found in Microchip Application Libraries, but changed the switch to enter bootloader mode which is connected to RG15 in our case.

### *Electrostatic warning*

The board is shipped in a protective anti-static package. The board must not be exposed to high electrostatic potentials. A grounding strap or similar protective device should be worn when handling the board. Avoid touching the component pins or any other metallic element.

This datasheet is being updated..

