MultiMedia Board™

for PIC32MX4

Manual

Development System

All MikroElektronika´s development systems represent irreplaceable tools for programming and developing microcontroller-based devices. Carefully chosen components and the use of machines of the last generation for mounting and testing thereof are the best guarantee of high reliability of our devices. Due to simple design, a large number of add-on modules and ready to use examples, all our users, regardless of their experience, have the possibility to develop their project in a fast and efficient way.

MikroElektronika
SOFTWARE AND HARDWARE SOLUTIONS FOR EMBEDDED WORLD ...making it simple

TO OUR VALUED CUSTOMERS

I want to express my thanks to you for being interested in our products and for having confidence in mikroElektronika.
The primary aim of our company is to design and produce high quality electronic products and to constantly improve the performance thereof in order to better suit your needs.

Nebojsa Matic
General Manager

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Introduction to MultiMedia Board

The *MultiMedia Board*® is a compact development system which provides a convenient platform for developing devices with multimedia content. The heart of the system is a 32-bit microcontroller PIC32MX4XXL which is programmed by using external programmers ICD2® and ICD3® from Microchip®. The *MultiMedia Board* features many peripheral modules such as ZigBee wireless communication module, RS-232 serial communication module, TFT 320x240 touch screen display, two USB connectors for communication with the microcontroller, temperature sensor, etc.

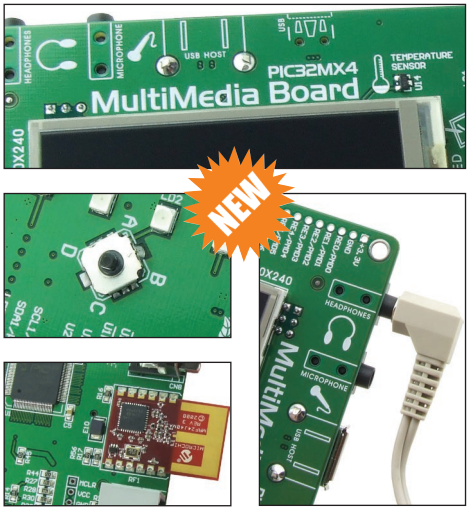
PIC32MX4 MultiMedia BOARD — Multimedia Board may be used as a stand-alone control device

TFT 320X240 Display — TFT 320X240 display provides a palette of 262.000 colors. It is used to display graphic contents

TOUCHSCREEN — Touch panel is integrated in TFT display. Together they form a touch screen module

ZIGBEE — ZigBee communication based on the IEEE 802.15.4 standard

JOYSTICK — Joystick is an integral part of this multimedia system



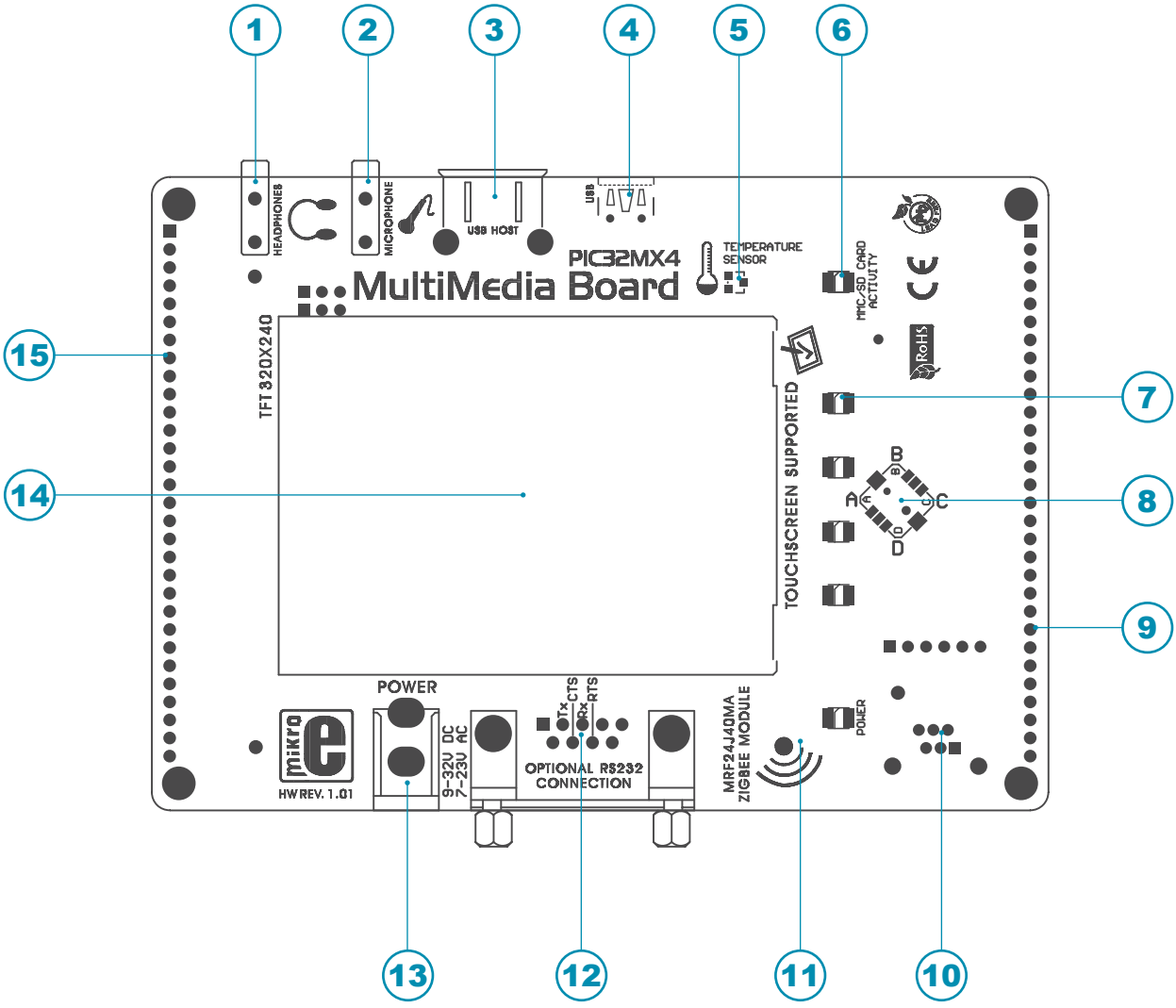
The MPLAB® program from Microchip is used for programming microcontrollers. An updated list of all supported microcontrollers may be found on the Microchip's website at www.microchip.com.

Package contains:

Development system:	MultiMedia Board
CD:	product CD with the appropriate software
Cables:	USB cable
Documentation:	MultiMedia Board manual; Connection Schematic of the system

System Specification:

Power supply:	over an AC/DC connector (7-23V AC or 9-32V DC) or a USB cable (5V DC)
Power consumption:	50mA in idle state (on-board modules are not active)
Size:	12,6 x 8,9cm (4,9 x 3,5inch)
Weight:	~200g (0.5lbs)



Key Features

1. Headphone connector
2. Microphone connector
3. USB A HOST connector
4. USB MINI-B connector
5. Temperature sensor
6. MMC/SD card activity indicator
7. Signal LEDs
8. Navigation joystick
9. Pads
10. ICD2 and ICD3 programmers connector
11. Optional ZigBee module
12. RS-232 communication connector
13. AC/DC connector
14. TFT 320x240 display
15. Pads

1.0. Power Supply

There is an AC/DC connector marked POWER provided on the *MultiMedia Board*. It enables the board to be interfaced to a power supply source. Plug the appropriate power supply cable connector (A) into the AC/DC connector POWER (B), Figure 1-1.

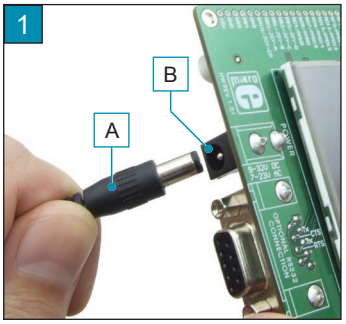


Figure 1-1: Plugging power supply cable in

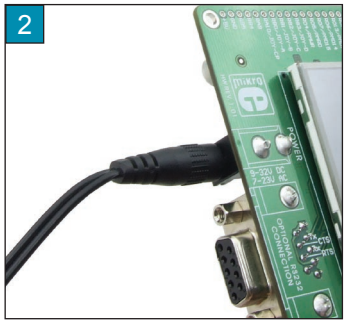


Figure 1-2: Power supply cable is plugged in

A PC power supply may be used over a USB connector as an alternative power supply source. In this case, it is necessary to have a USB cable provided with an A type USB connector on its one end and a MINI-B type USB connector on its other end. There is a female MINI-B type USB connector provided on the *MultiMedia Board*. If the *MultMedia Board* is powered via the USB connector, then it has to be linked to a PC by using the appropriate USB cable.

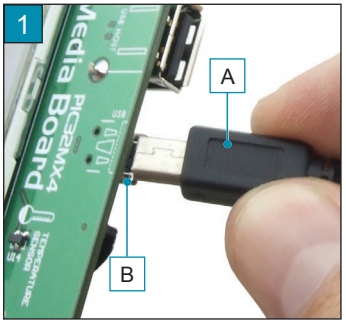


Figure 1-3: Plugging USB connector in

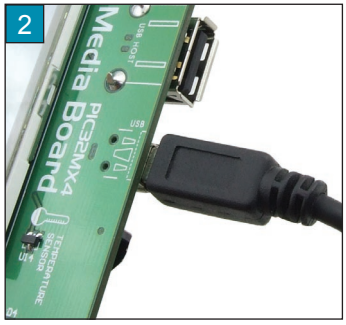


Figure 1-4: USB connector is plugged in

Figure 1-5: USB cable for connection with a PC

NOTE: USB cable with MINI-B type USB connector is not delivered with the system.

The *MultiMedia Board* may use one of two power supply sources:

1. External power supply source connected to an AC/DC connector provided on the board;
2. +5V PC power supply over the USB cable.

The MC34063A voltage regulator and Gretz rectifier enable external power supply to be either AC (in the range between 7V and 23V) or DC (in the range between 9V and 32V). Upon voltage stabilization, the MCP36063A circuit will provide +5 V on its output. As soon as the power supply voltage is supplied on the DC connector, the *MultiMedia Board* is ready for use. A USB cable with the appropriate connector is needed for powering the system over a MINI-B type USB connector. The function of the other voltage regulator MCP1825 is to lower the power supply voltage from 5V to 3.3V. Again, the system is ready for use as soon as the power is supplied to it. The *MultiMedia Board* may be connected to both power supply sources at the same time.

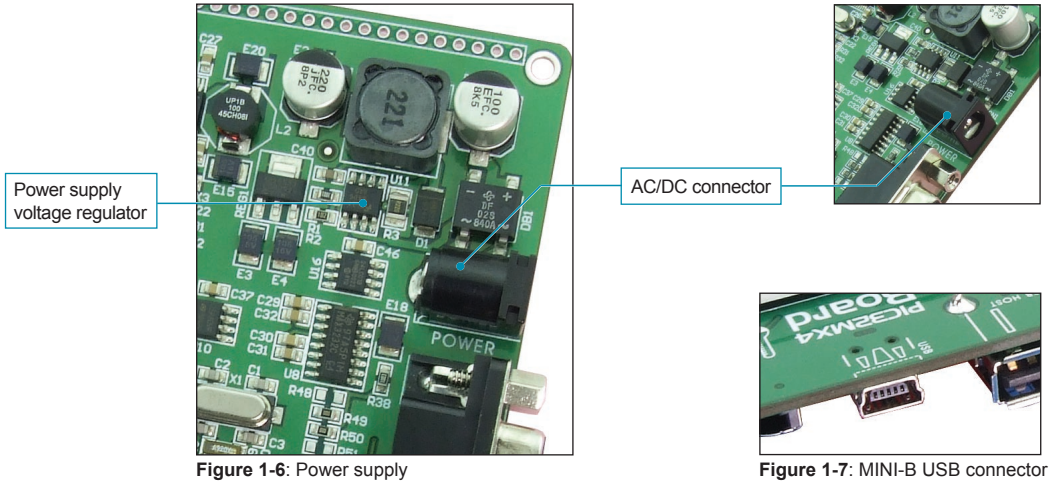


Figure 1-6: Power supply

Figure 1-7: MINI-B USB connector

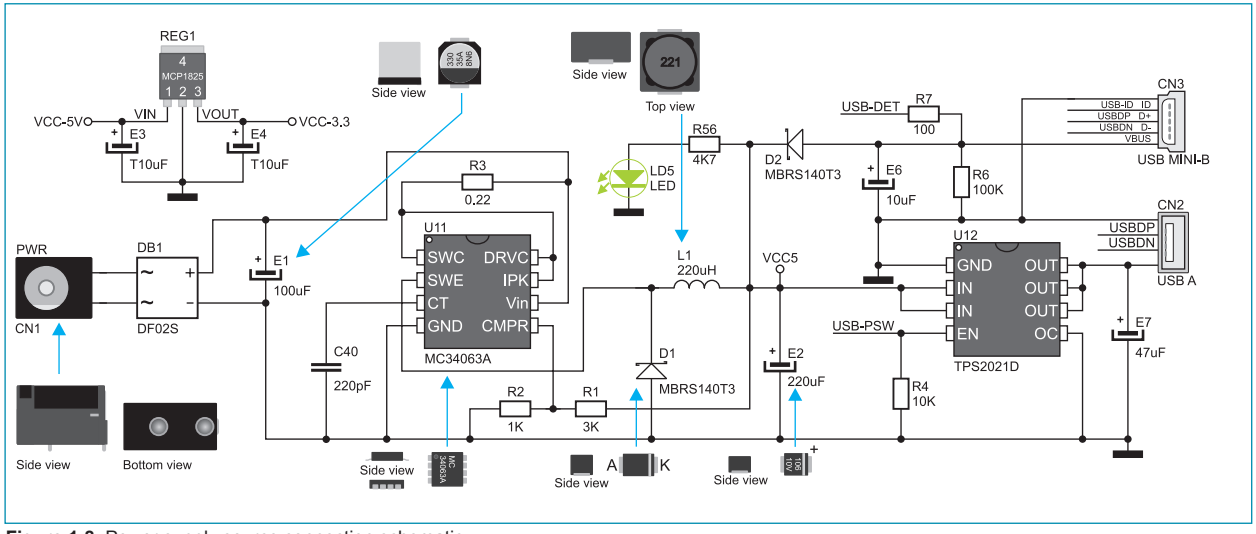


Figure 1-8: Power supply source connection schematic

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2.0. PIC32MX4 Microcontroller

The PIC32MX460F512L microcontroller, belonging to the 32-bit PIC microcontroller family from Microchip, is provided on the board. The microcontroller alone interfaces a large number of peripheral modules, which enables it to be used in numerous applications. Being effective in data processing, the PIC32MX460F512L microcontroller is the right choice for development of devices with multimedia content.

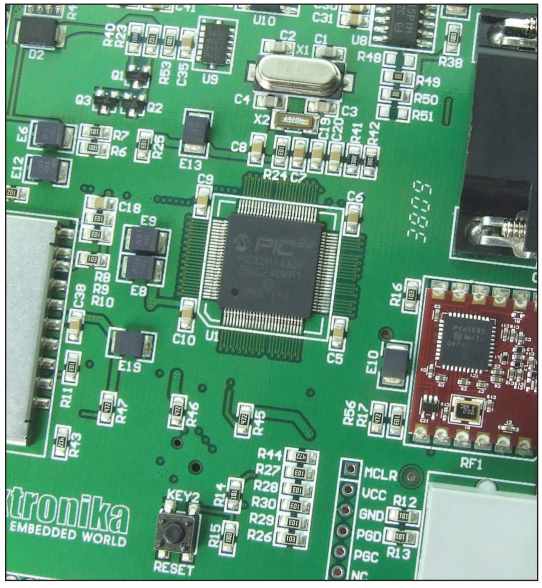

Figure 2-1: PIC32MX4 Microcontroller

The PIC32MX460F512L microcontroller uses two quartz crystal oscillators. The 8MHz oscillator is a primary clock frequency stabilizator, whereas the other, the 32.768 kHz oscillator, is used by a built-in real-time clock. The PIC32MX460F512L microcontroller features 512KB flash memory and 32KB RAM memory. It also provides other peripheral modules such as SPI and I^2C communication modules, DMA channels, I/O pins (85 in total), RTC, internal oscillator etc.

The function of the microcontroller is to control modules on the *MultiMedia Board*. The access to the appropriate microcontroller pins is enabled via pads arranged along two opposite sides of the board. Each pad is marked as the pin it is connected to. The advantage of these pads is that they also enable access to the microcontroller pins which are not used by the *MultiMedia Board's* modules. Due to it, the 32-bit microcontroller can be used to its full capacity.

3.0. RS-232 Communication Interface

The UART (*Universal Asynchronous Receiver/Transmitter*) is one of the most common ways of exchanging data between a PC and peripheral devices. RS-232 serial communication is performed through a 9-pin SUB-D connector and the microcontroller's UART module. The *MultiMedia Board* provides one single RS-232 port. The microcontroller pins used in such communication are marked as follows: RX - *receive data line* and TX - *transmit data line*. Baud rate goes up to 115 kbps.

In order to enable the UART module of the microcontroller to receive input signals with different voltage levels from a PC, it is necessary to provide a voltage level converter such as MAX3232CDR.

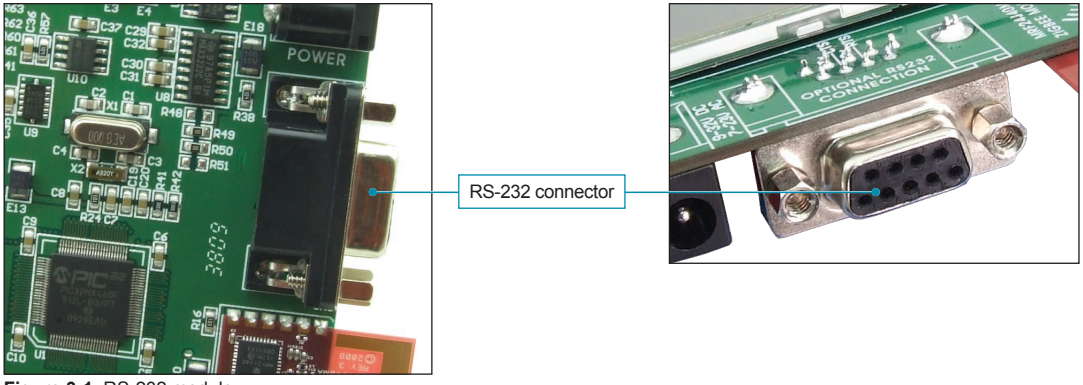

Figure 3-1: RS-232 module

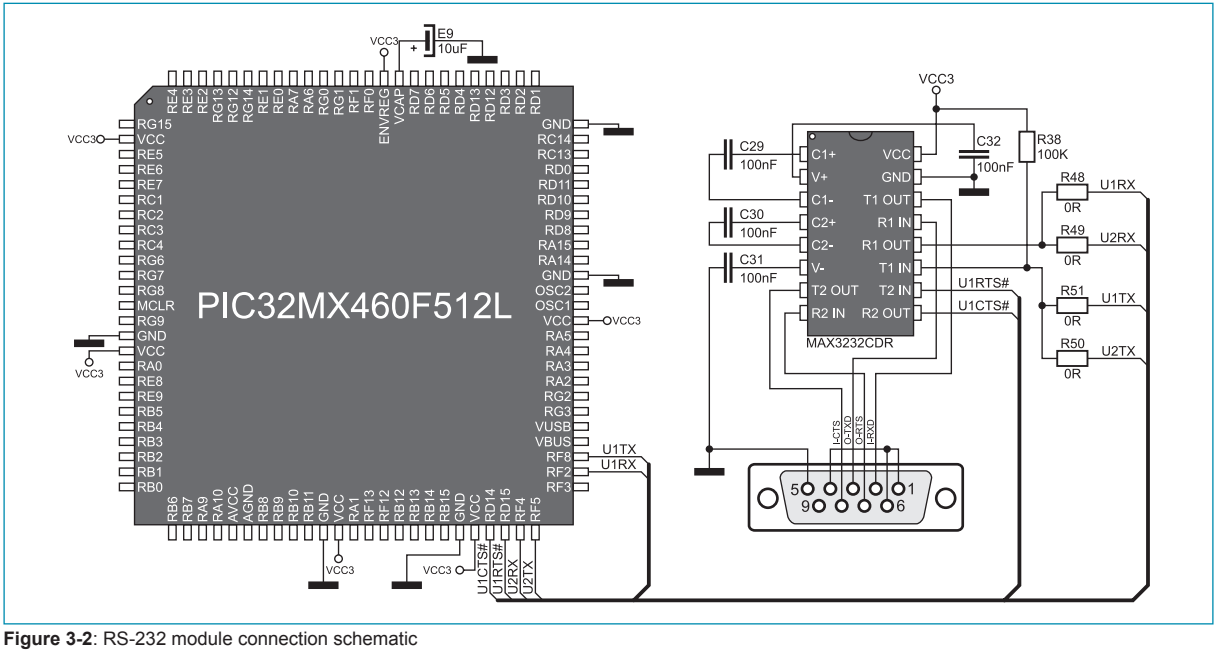

Figure 3-2: RS-232 module connection schematic

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4.0. Accelerometer

The ADXL345 circuit enables the *MultiMedia Board* to measure acceleration, space orientation, gravitation etc. One of its main functions here is to determine the orientation of the graphic contents shown on the TFT display. Communication between the ADXL345 circuit and the microcontroller is enabled via a Serial Peripheral Interface (SPI).

The ADXL345 circuit is an accelerometer with three axes capable of performing 13-bit resolution measurement. Due to its compact design and low-power consumption, this circuit is ideal for embedding in portable devices.

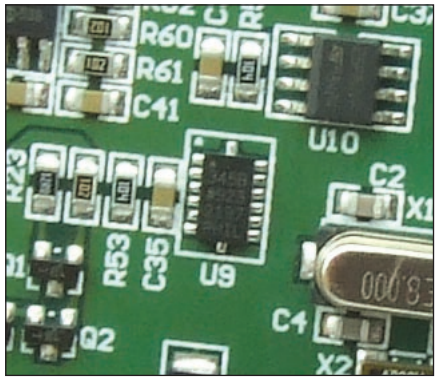

Figure 4-1: ADXL345 circuit

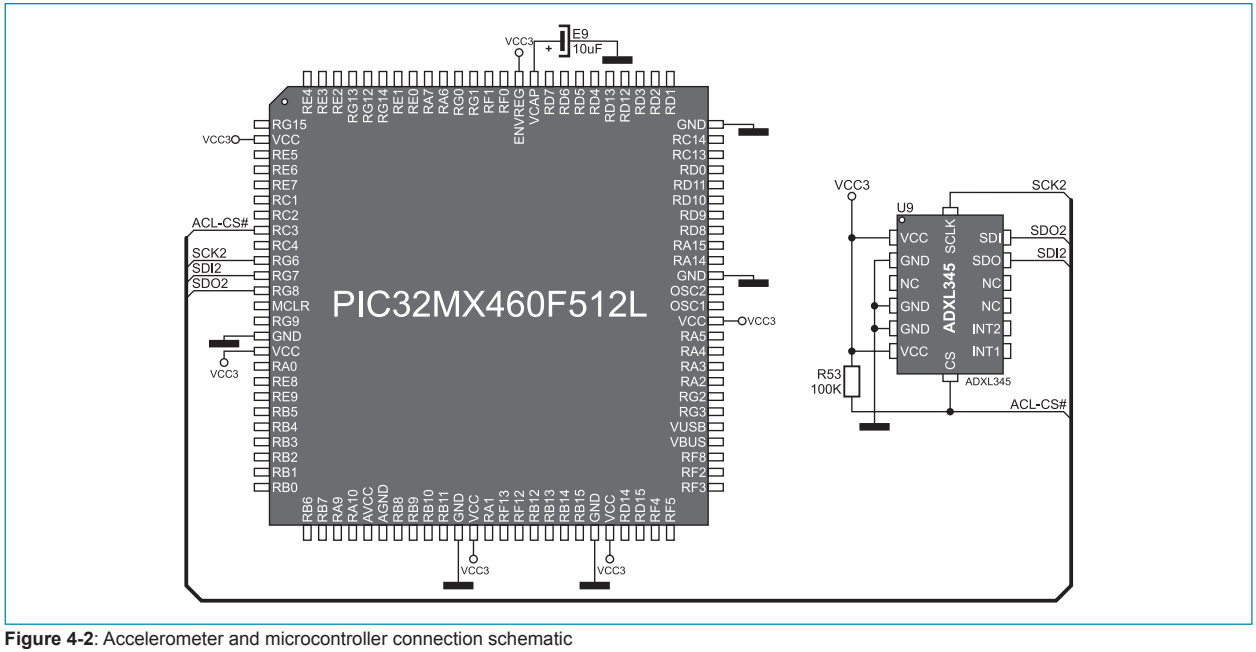

Figure 4-2: Accelerometer and microcontroller connection schematic

5.0. Temperature Sensor

Measuring temperature is one of the most commonly performed measurement operations. The *MultiMedia Board* is capable of measuring temperature within the range of -40°C to +125°C with +/-2°C accuracy by means of the MCP9700A temperature sensor provided on the board. The principle of its operation is based on temperature conversion into the analog voltage signal. The RB8 microcontroller pin is fed with an analog voltage signal whose value varies depending on the temperature value. This signal is then converted into a digital number by using the A/D module built into the microcontroller.

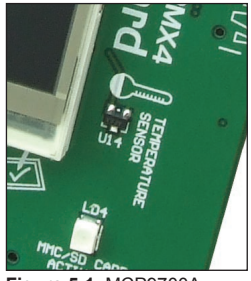

Figure 5-1: MCP9700A

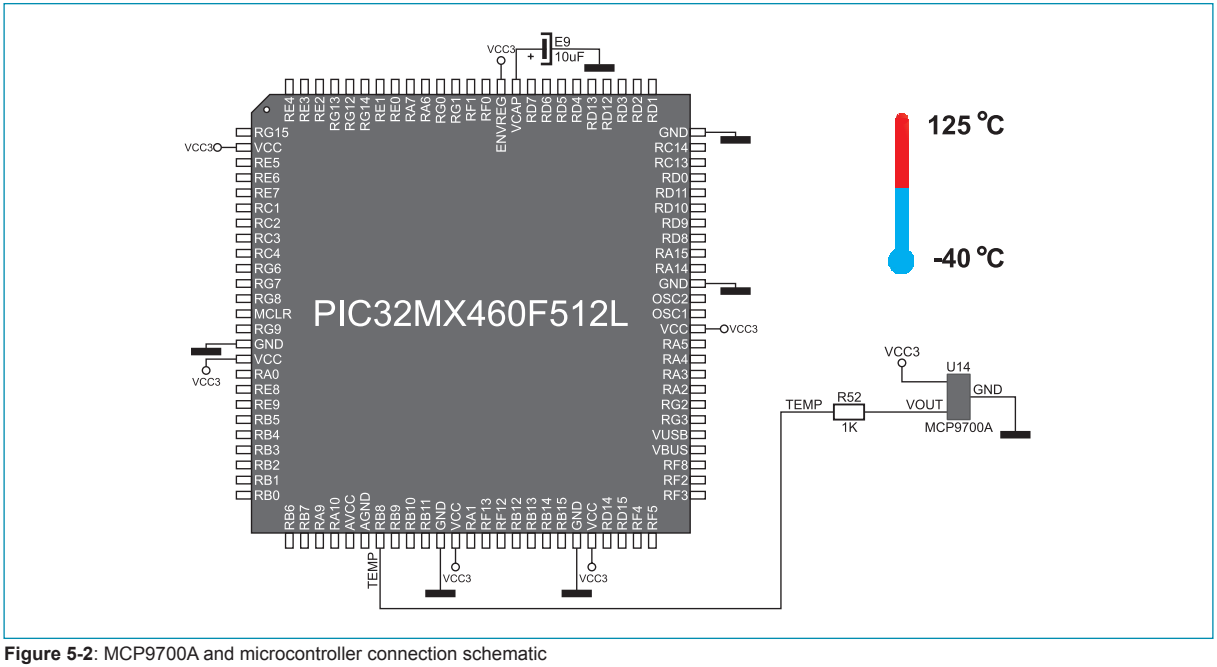

Figure 5-2: MCP9700A and microcontroller connection schematic

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6.0. ZigBee Module

The *MultiMedia Board* keeps side by side to the wireless communication development so that it provides an interface to the ZigBee module. The operation of the ZigBee module is based on the IEEE 802.15.4-2003 standard which relates to wireless data transfer on short distances with low-power consumption. The MRF24J40MA ZigBee module provided on the *MultiMedia Board* is optional. Some of its key features are as follows: up to 250kbps baud rate, 2.4GHz operating frequency, ~20mA power consumption, up to 400m coverage etc. The microcontroller communicates to this module via a Serial Peripheral Inerface (SPI).

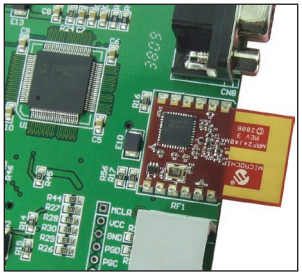

Figure 6-1: MRF24J40MA ZigBee module

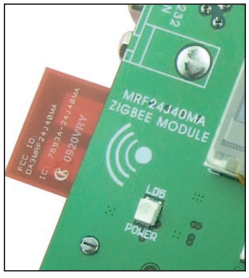

Figure 6-2: ZigBee module's antenna

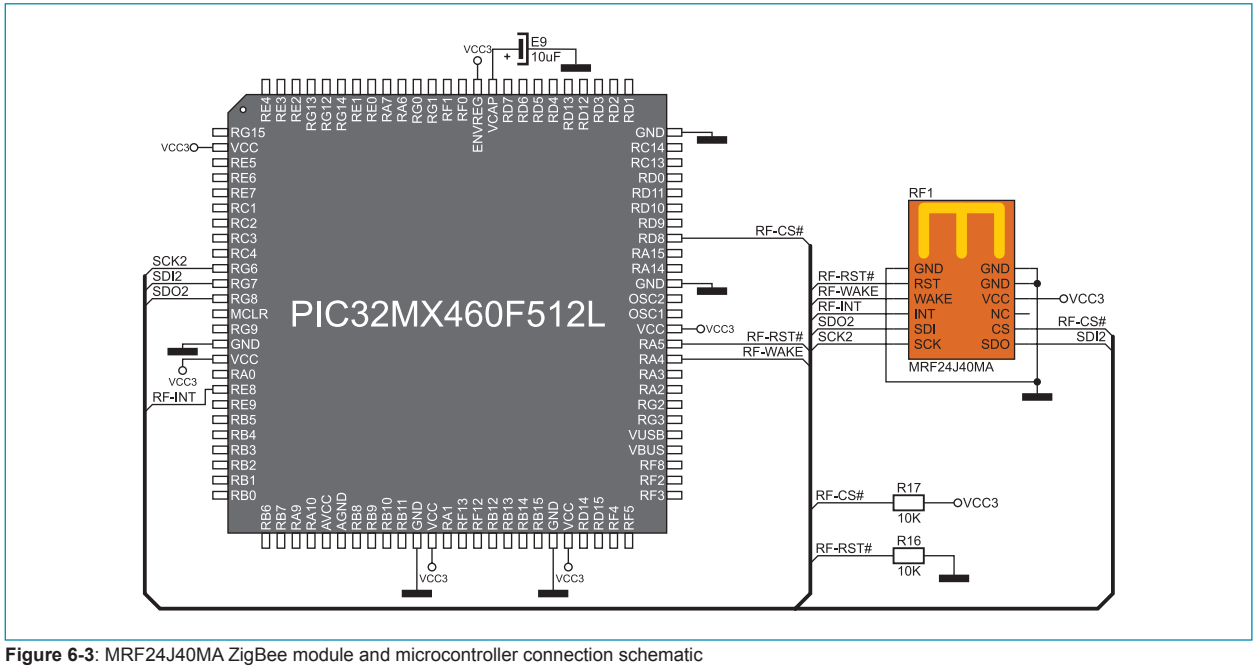

Figure 6-3: MRF24J40MA ZigBee module and microcontroller connection schematic

7.0. Joystick

A joystick is a movable stick that can be moved in several directions. Every movement can be registered by the software. The *MultiMedia Board* provides a joystick used as a push-button. Its function is determined in the program, written by the user, and loaded into the microcontroller.

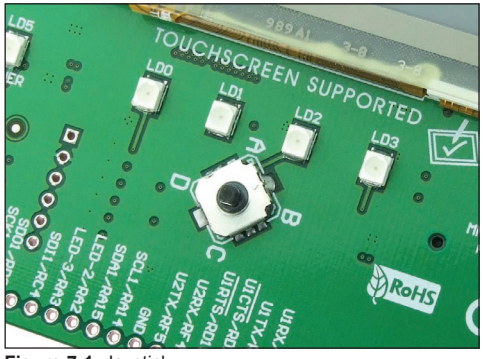

Figure 7-1: Joystick

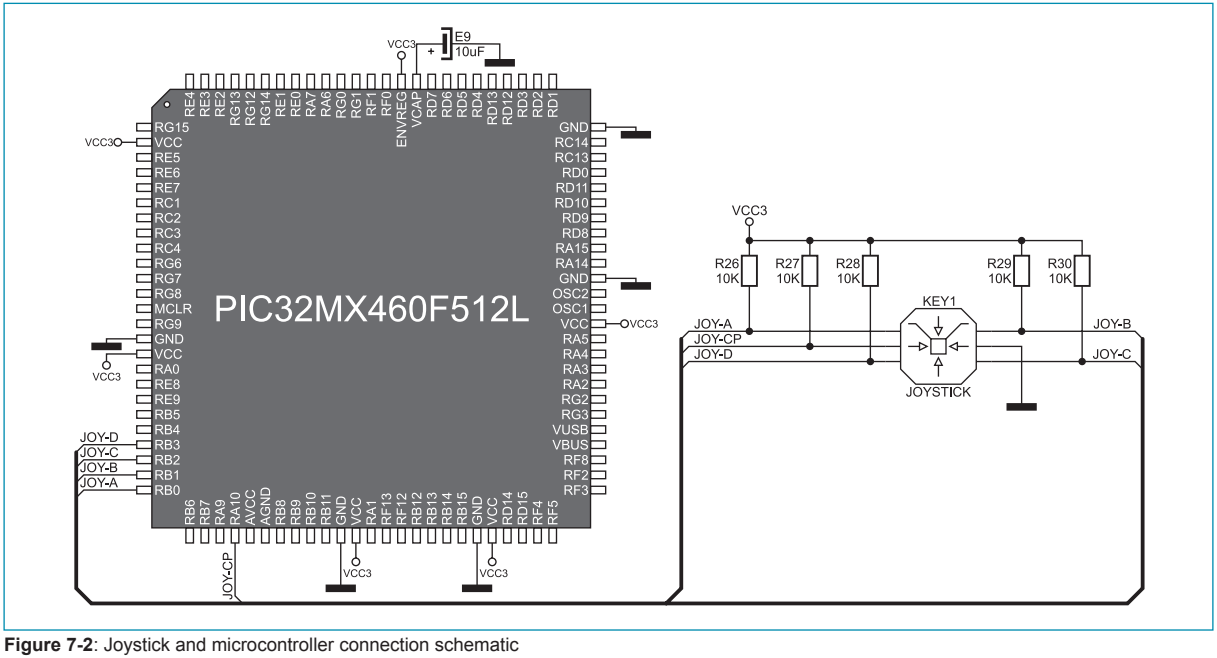

Figure 7-2: Joystick and microcontroller connection schematic

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8.0. Touch Screen

The *MultiMedia Board* features a 320x240 resolution TFT display covered with a touch panel sensitive to touch. The display is capable of showing 262.000 different colors. The TFT display and touch panel together form a functional unit called a touch screen. The touch screen can be used to show images, videos and other graphic content, menu navigation etc. It enables the user to make interactive applications, such as virtual keyboard, when writing a program for the microcontroller. Touch screen backlight can be adjusted by the software via the LCD-BLED line.

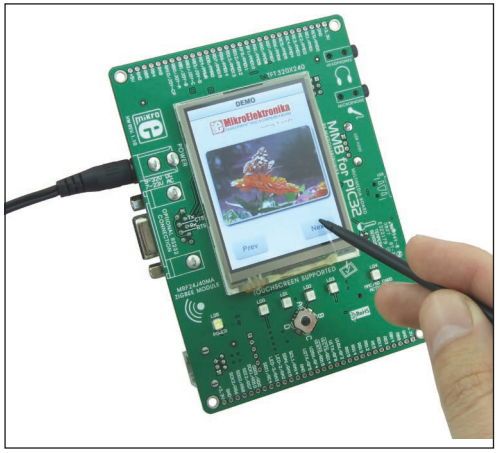

Figure 8-1: Touch screen

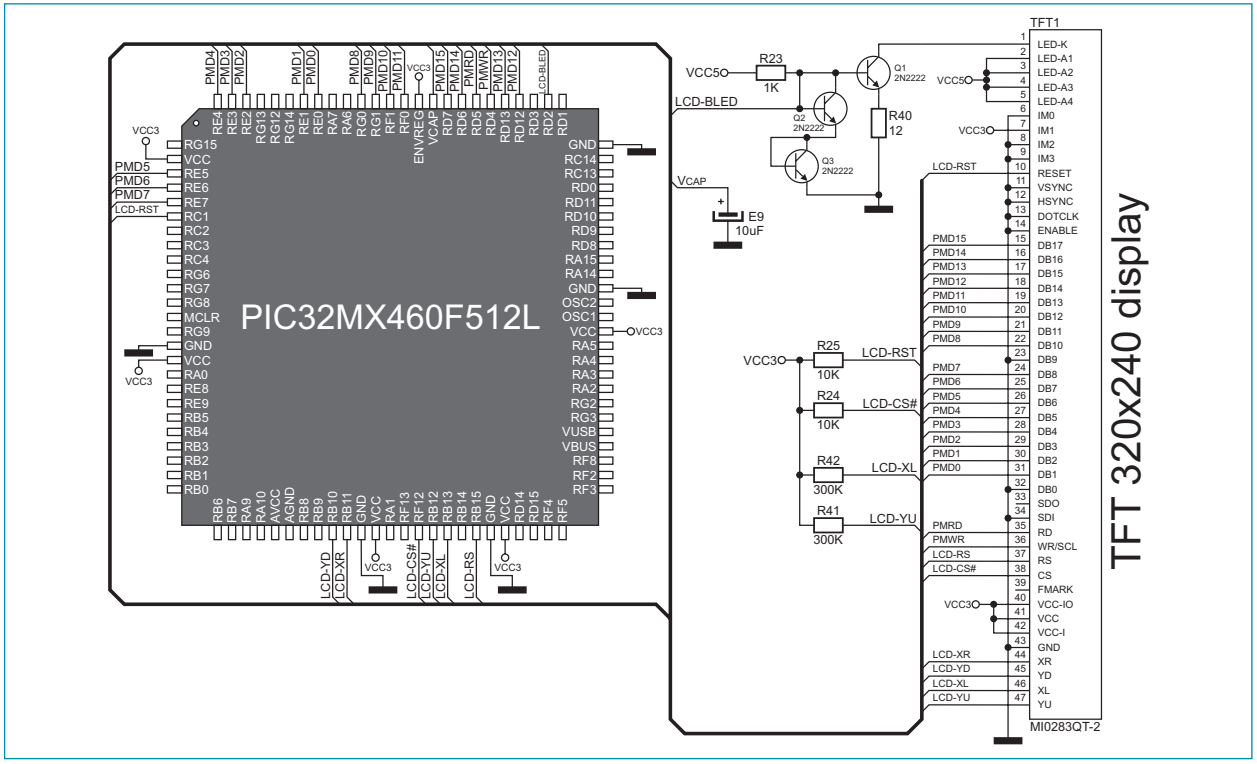

Figure 8-2: Touch screen and microcontroller connection schematic

9.0. Flash Memory

Since multimedia applications are getting increasingly demanding, it is necessary to provide additional memory space that the microcontroller can use to store programs. The M25P80 circuit enables the microcontroller to use additional 8Mbit flash memory. This memory module is connected to the microcontroller via a Serial Peripheral Interface (SPI).

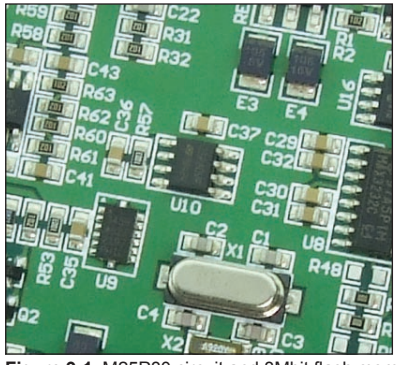

Figure 9-1: M25P80 circuit and 8Mbit flash memory

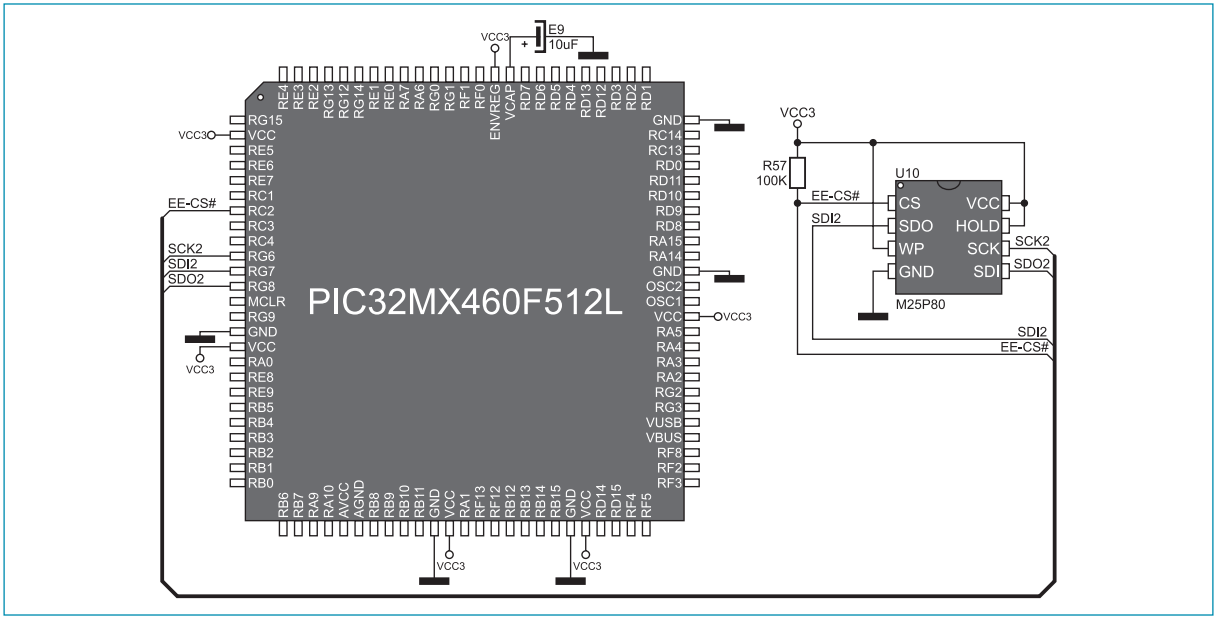

Figure 9-2: Flash memory and microcontroller connection schematic

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10.0. Serial EEPROM Module

EEPROM (Electrically Erasable Programmable Read-Only Memory) is a built-in memory module used to store data that must be saved when the power goes off. The 24AA01 circuit is capable of storing up to 1Kbit data and uses serial I^2C communication to exchange data with the microcontroller via its pins RA14 and RA15.

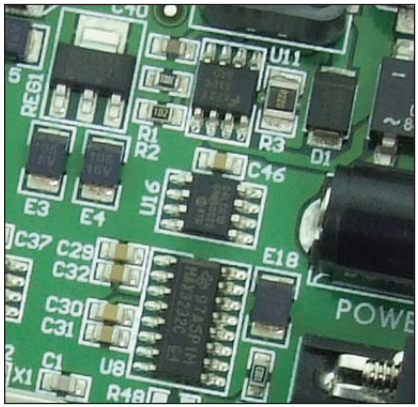

Figure 10-1: 24LC01 circuit and 1Kbit EEPROM memory

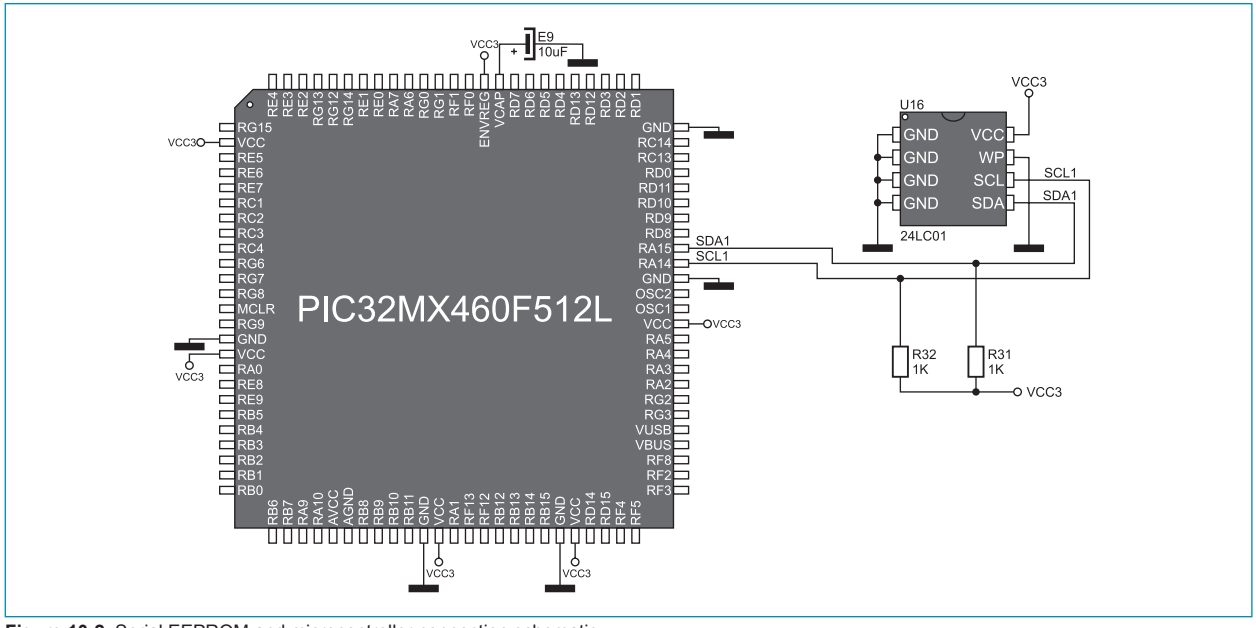

Figure 10-2: Serial EEPROM and microcontroller connection schematic

11.0. MMC/SD Connector

There is a built-in MMC/SD connector used to insert MMC/SD card provided on the *MultiMedia Board.* It enables the system to additionally expand memory space. SPI interface is used for communication between the microcontroller and MMC/SD card, whereas a LED marked MMC/SD CARD ACTIVITY (LD4) indicates data transfer between them.

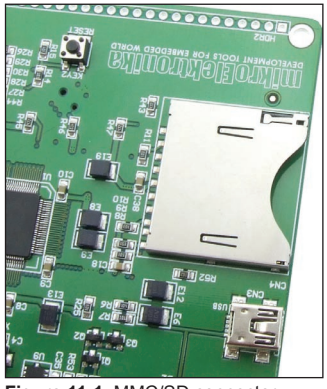

Figure 11-1: MMC/SD connector

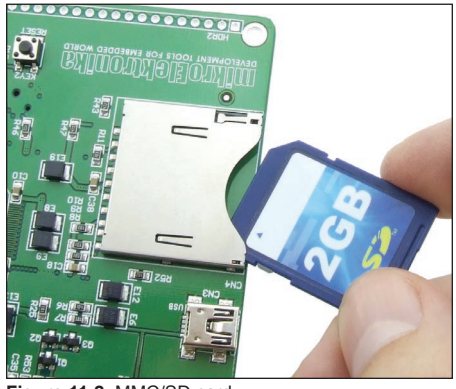

Figure 11-2: MMC/SD card

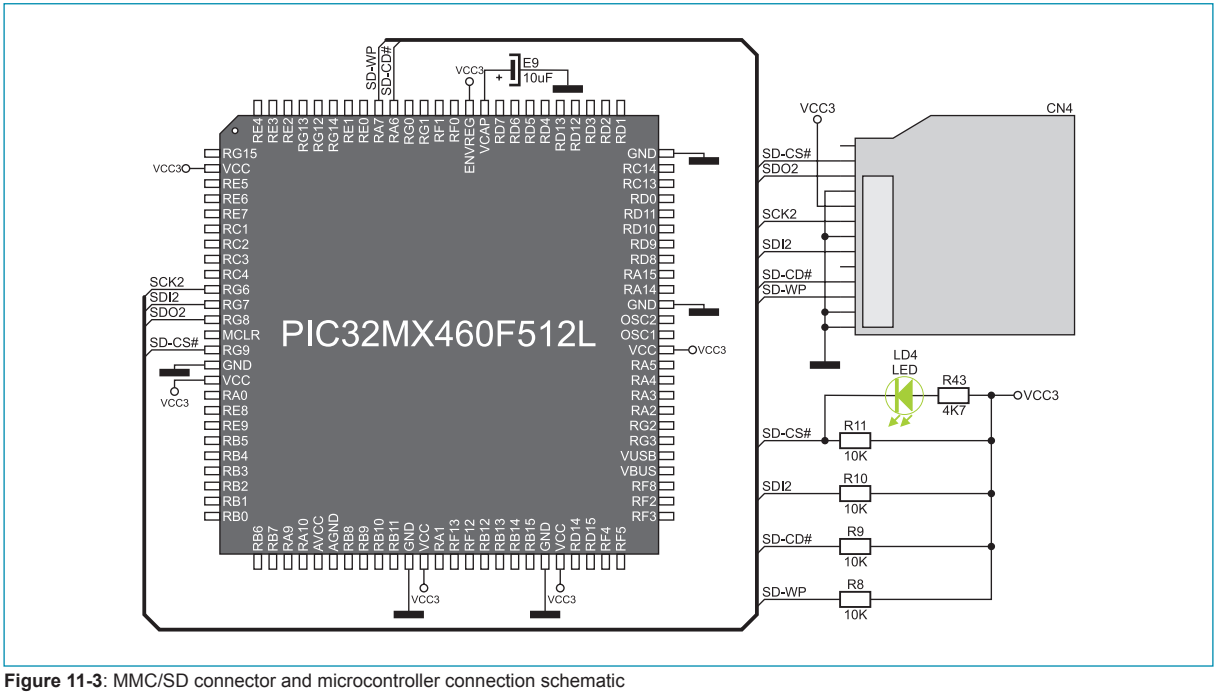

Figure 11-3: MMC/SD connector and microcontroller connection schematic

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12.0. LEDs

A LED (Light-Emitting Diode) is a highly efficient electronic light source. When connecting LEDs, it is necessary to use a current limiting resistor. A common LED voltage is approximately 2.5V, while the current varies from 1 to 20mA depending on the type of LED. The *MultiMedia Board* uses LEDs with current I=1mA.

There are four LEDs provided on the *MultiMedia Board* that can be assigned a signal function. They are connected to the following I/O microcontroller pins: LD0 - RA0, LD1 - RA1, LD2 - RA2 and LD3 - RA3. A LED marked POWER is used to indicate that the system is turned on, whereas a diode marked MMC/SD indicates memory card activity.

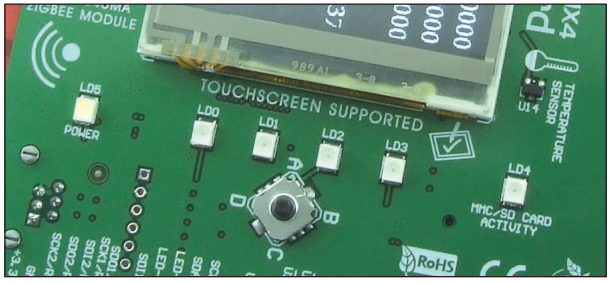

Figure 12-1: Signal LEDs

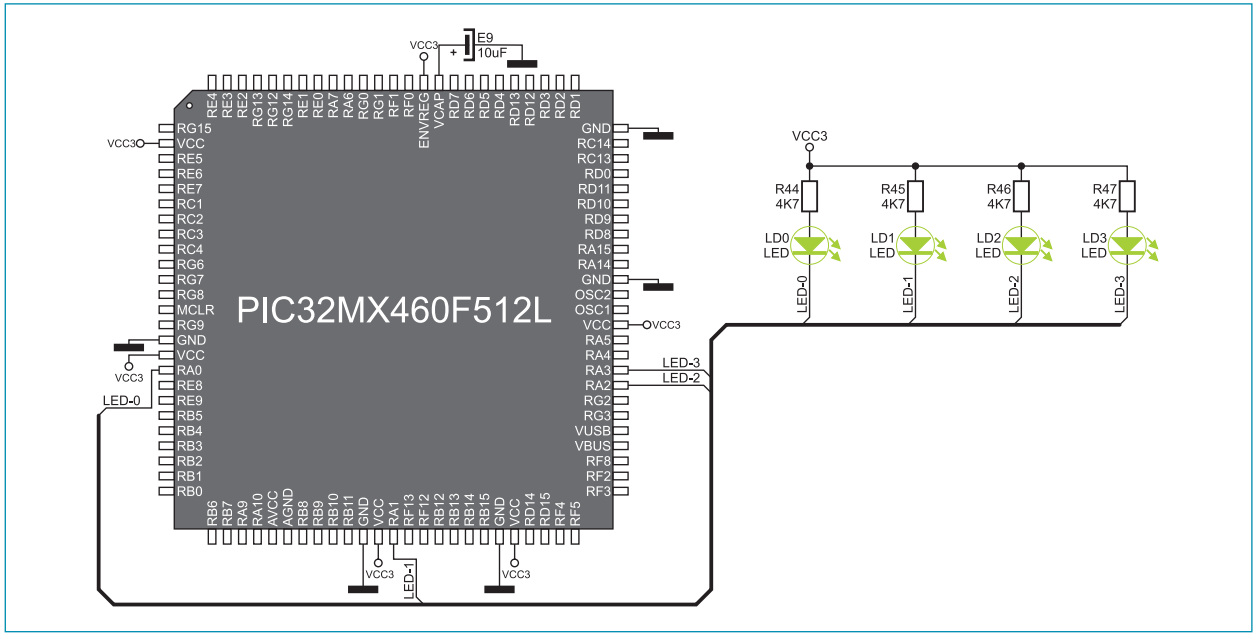

Figure 12-2: Signal LED and microcontroller connection schematic

13.0. Microphone Input

A microphone can be interfaced to the system via a 3.5mm connector CN7 and the WM8731SEDS circuit. This circuit is a stereo CODEC with an integrated headphones driver. Its function is to convert an analog signal from interfaced microphone to a digital value, then to transfer it to the microcontroller or as a sidetone to the headphones output. A sidetone volume control can be programmed by the software so that no additional potentiometer is needed. In case the microphone signal is transferred to headphones as a sidetone, it is necessary to place jumpers J1 and J2 in the upper position, as shown in Figure 13-2. When jumpers are placed in the upper position, the WM8731SEDS headphones output is connected to the 3.5mm headphones connector CN6. The WM8731SEDS output signal is transferred to the CN6 connector via LHPO and RHPO lines. Figure 14-4 (page 20) illustrates jumpers, LHPO and RHPO lines and CN6 connector connection.

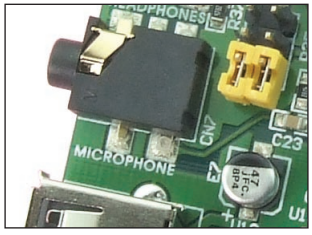

Figure 13-1: 3.5mm microphone connector CN7

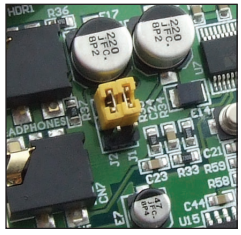

Figure 13-2: Jumpers J1 and J2 in the upper position

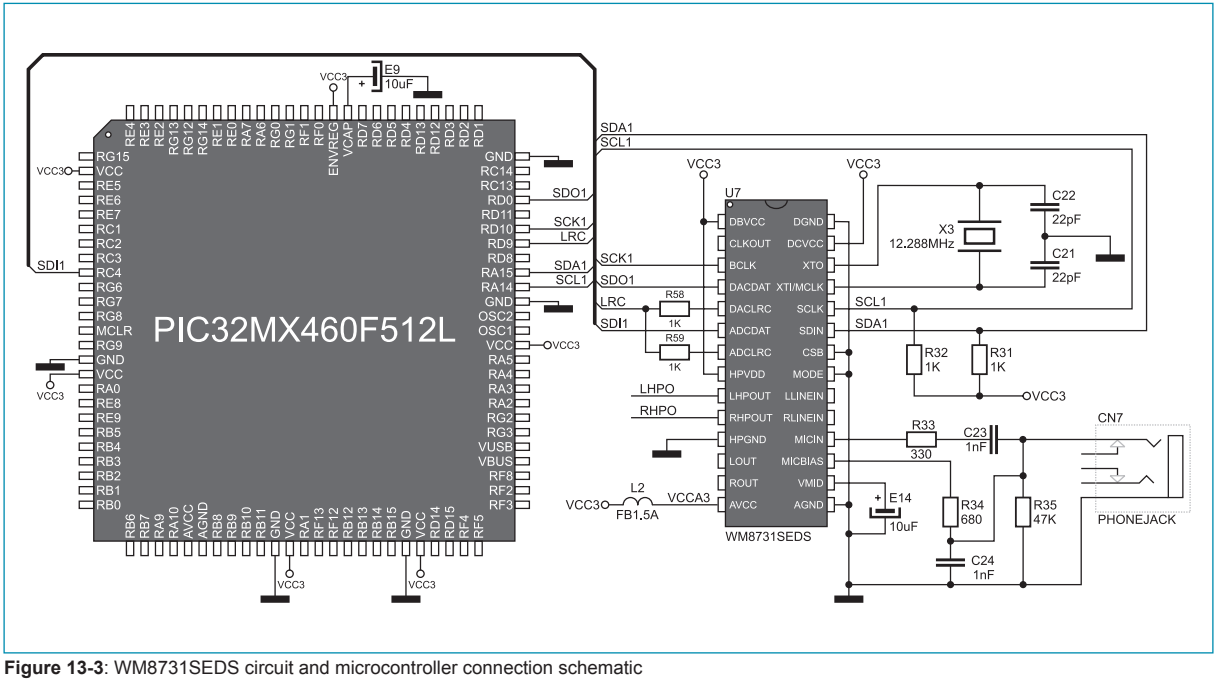

Figure 13-3: WM8731SEDS circuit and microcontroller connection schematic

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14.0. Audio Output

The *MultiMedia Board* is also able to generate an audio signal using WM8731SEDS or MCP6022 circuits. The WM8731SEDS is used to convert digital data from the microcontroller to audio signal to be transferred to headphones. Communication between this circuit and the microcontroller is performed via a Serial Peripheral Interface (SPI). The MCP6022 circuit is used to filter PWM signal generated by the microcontroller. The headphones may be connected to the system via a 3.5mm connector CN6. The function of jumpers J1 and J2 is to select signal to be transferred to the 3.5mm connector. When jumpers J1 and J2 are placed in the lower position, as in Figure 14-2, the CN6 connector is fed with a signal from the MCP6022 circuit. When jumpers J1 and J2 are placed in the upper position, as in Figure 14-3, the CN6 connector is fed with an audio signal from the WM8731SEDS circuit via LHPO and RHPO lines.

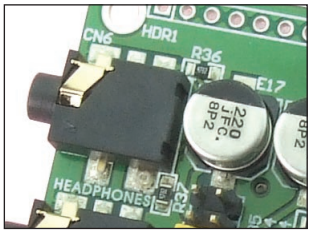

Figure 14-1: 3.5mm headphones connector CN6

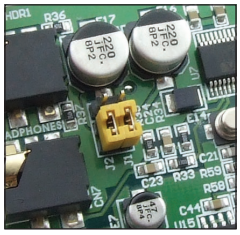

Figure 14-2: Jumpers J1 and J2 in the lower position

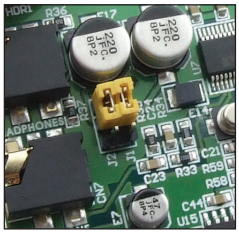

Figure 14-3: Jumpers J1 and J2 in the upper position

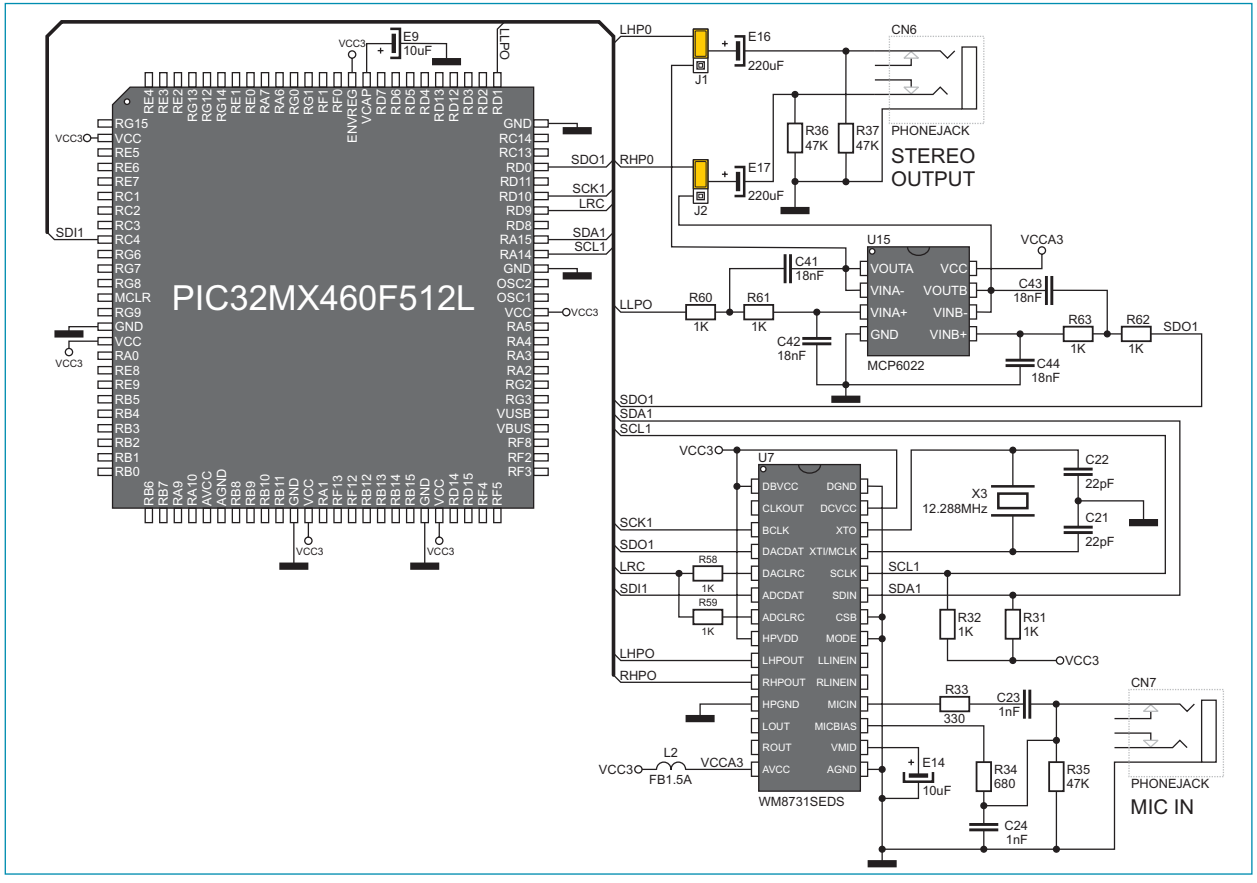

Figure 14-4: MCP6022 circuit and microcontroller connection schematic

15.0. USB Connectors

There are two USB connectors provided on the *MultiMedia Board*. One is a MINI-B type USB connector which is used for connection with a PC, whereas the other is an A type USB connector which serves as a USB HOST connector. The latter enables peripheral devices, such as printer, to be connected to the system. Communication between the microcontroller and USB devices is performed via the RG2, RG3 and RF3 microcontroller pins.

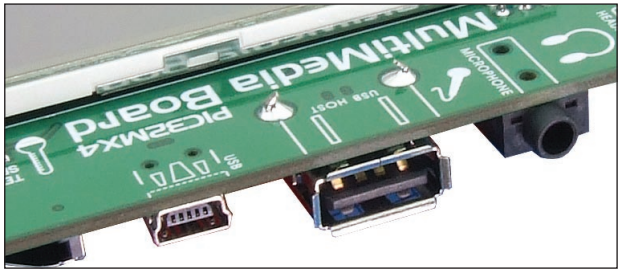

Figure 15-1: USB connectors

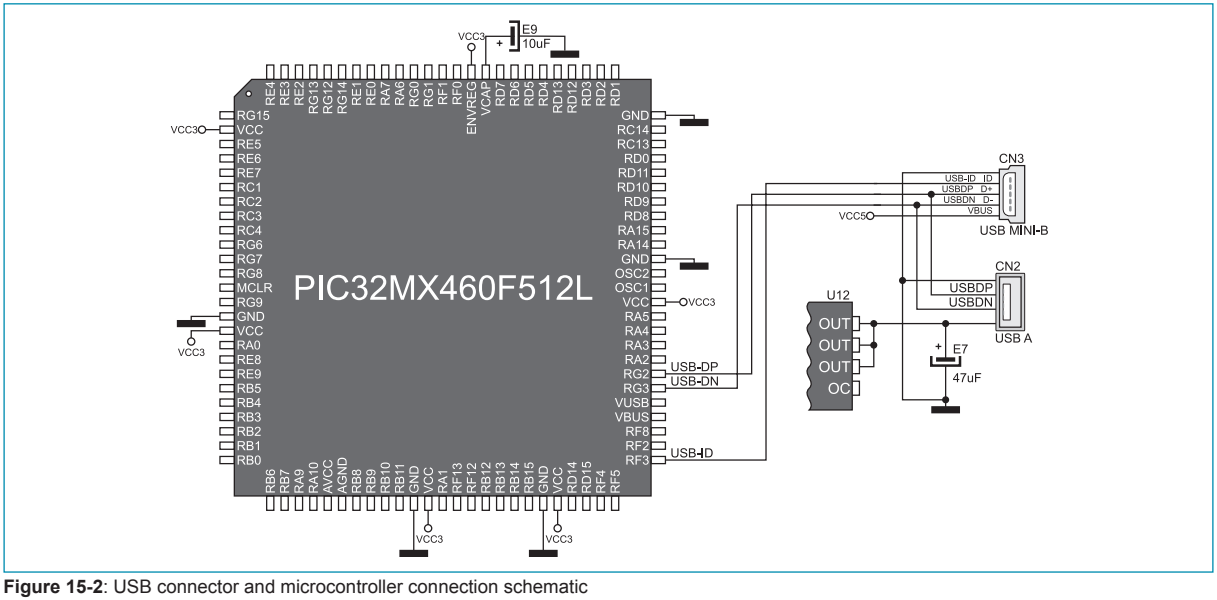

Figure 15-2: USB connector and microcontroller connection schematic

page

16.0. ICD Programmer

The microcontroller provided on the *MultiMedia Board* can be programmed using either ICD2 or ICD3 programmer from Microchip. When using these programmers, it is necessary to provide the *MultiMedia Board* with the power supply voltage first. If the system is powered via the ICD2 or ICD3 programmer, it is crucial to activate the appropriate option within the MPLAB program.

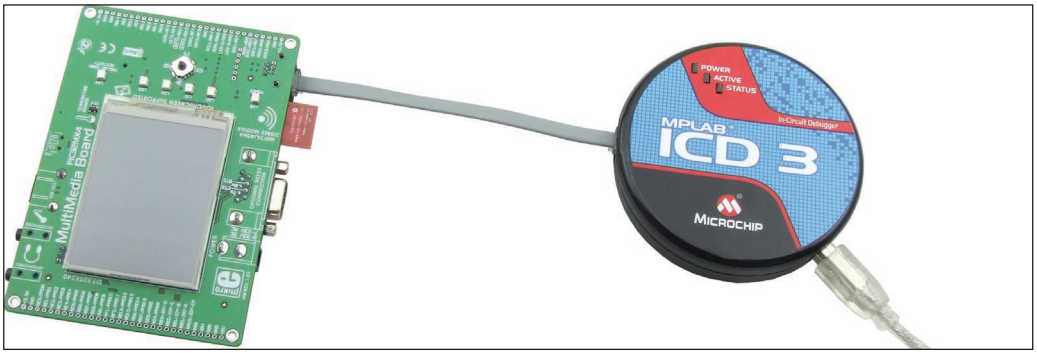

Figure 16-1: MultiMedia Board connected to ICD3 programmer

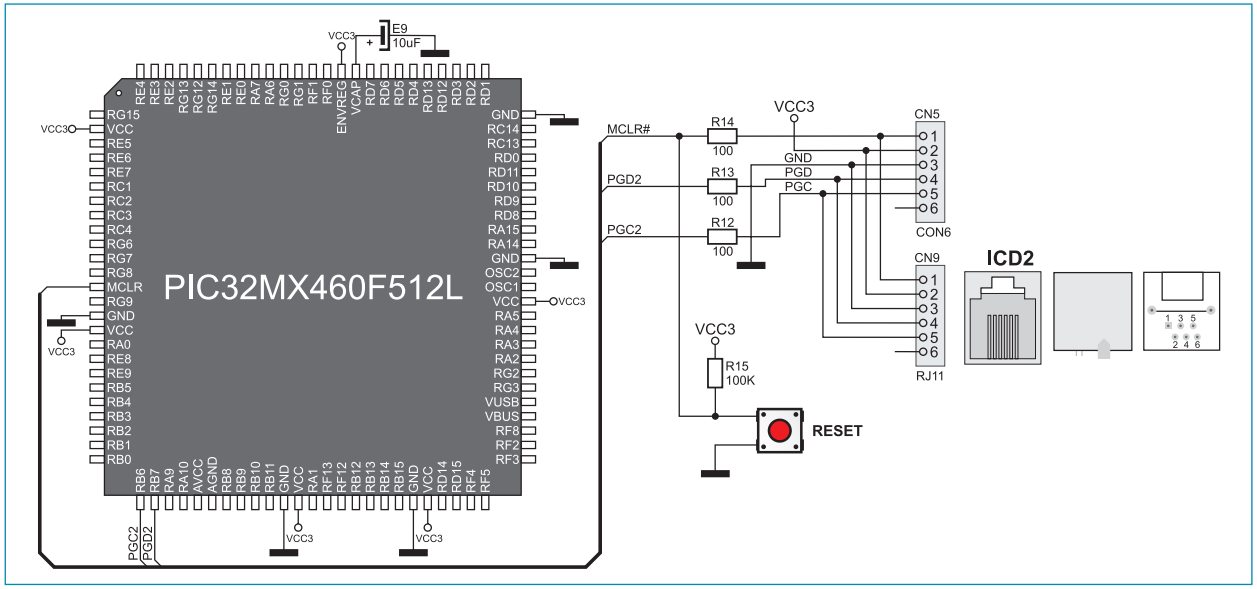

Figure 16-2: ICD connectors and microcontroller connection schematic

For loading a .hex file into the microcontroller, it is compulsory to provide the appropriate program. The MPLAB program from Microchip enables you to write a code and load it later into a desired microcontroller. The *Programmer* option within the MPLAB program's window allows you to select programmer to be used for programming the microcontroller.

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