# MultiMedia Board®

## for PIC32MX4

User 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

## TABLE OF CONTENTS

page

## Introduction to MultiMedia Board

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

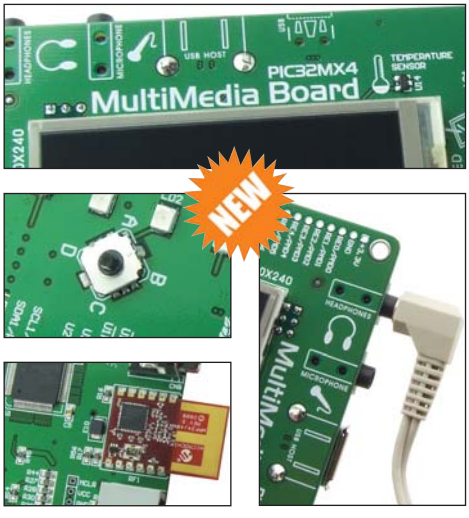

PIC32MX4 MultiMedia BOARD — Multimedia system may be used as a stand-alone control device

TFT 320X240 Display — TFT 320X240 display provides a palette of 262.000 colours. 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



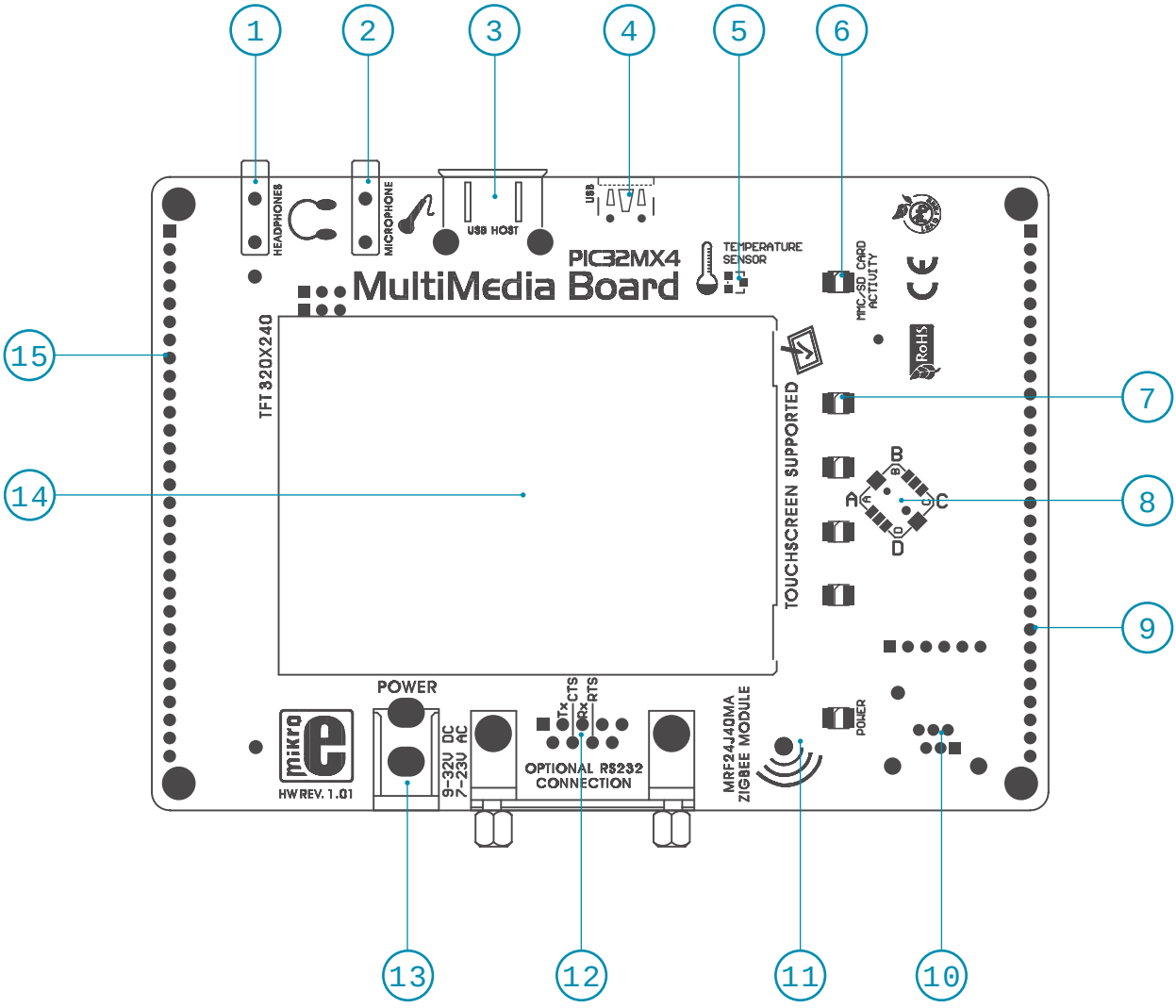

The MPLAB® program from Microchip is used for programming the microcontroller. An updated list of supported microcontrollers may be found on the Microchip website at www.microchip.com.

**Package contains:**

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

**System Specification:**

| | |
|---|---|
| Power supply: | over a DC connector (7-23V AC or 9-32V DC) or a USB cable (5V DC) |
| Power consumption: | 50mA in idle state (when on-board modules are off) |
| 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 LED diodes
8. Navigation joystick
9. Soldering 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. Soldering pads

page

## 1.0. Power Supply

There is a DC connector marked as POWER provided on the *MultiMedia Board* to interface it to a power supply source. Plug in an appropriate power supply DC connector (A) into the DC connector POWER (B), Figure 1-1.

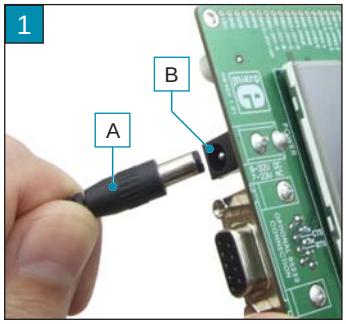



**Figure 1-1**: Plugging in DC connector

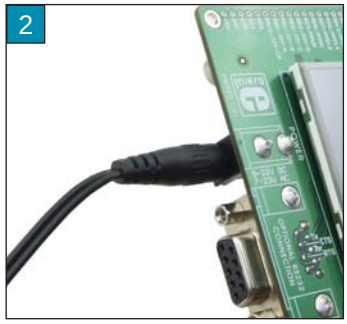



**Figure 1-2**: DC connector is plugged in

A PC power supply over a USB connector may be used 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 USB connector, then it has to be linked to a PC using appropriate USB cable.

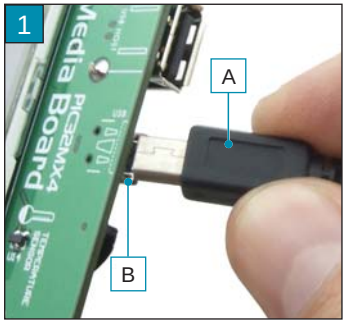



**Figure 1-3**: Plugging in USB connector

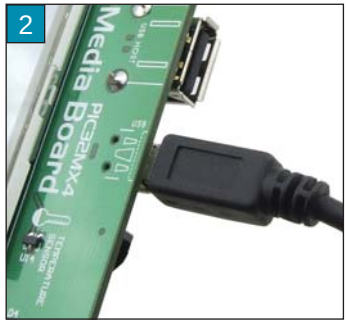



**Figure 1-4**: USB connector is plugged in


**Figure 1-5**: USB cable for connecting to 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 a 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 of 7V to 23V) or DC (in the range of 9V to 32V). Upon voltage stabilization 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 to use. A USB cable with the appropriate connector is needed in order for the system to be powered over a MINI-B type USB connector. The function of the REG1 voltage regulator is to lower the power supply voltage from 5V to 3.3V using the MCP1825 circuit. Again, the system is ready to 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.

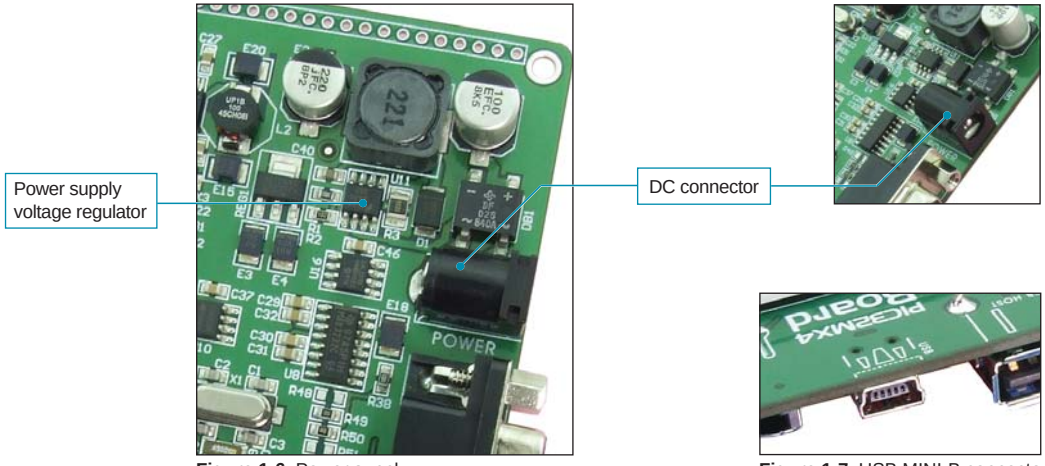



**Figure 1-6**: Power supply

**Figure 1-7**: USB MINI-B connector

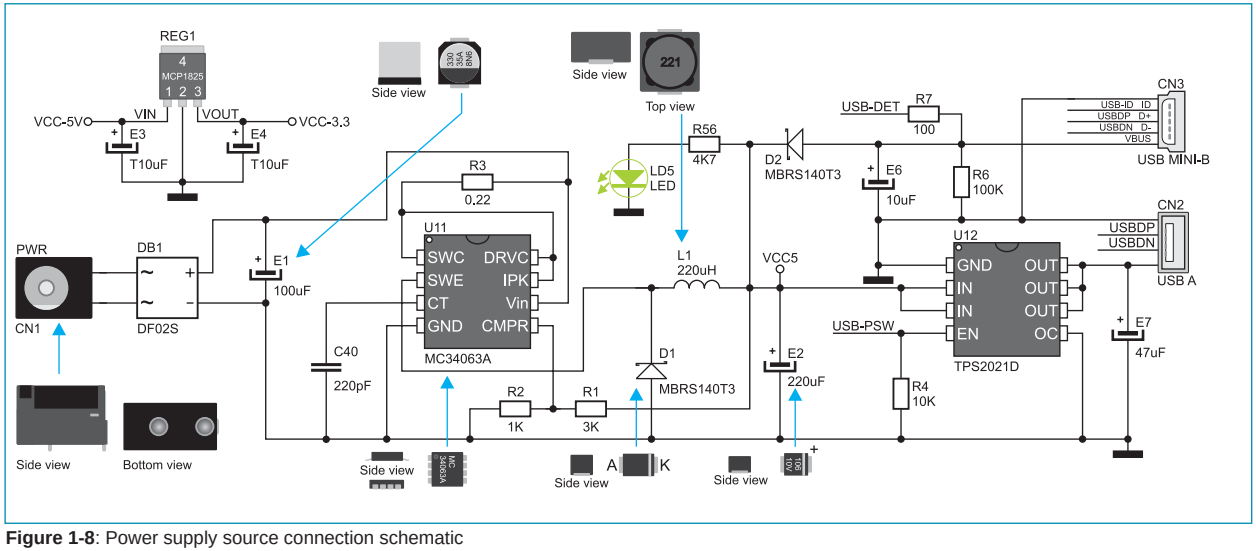



**Figure 1-8**: Power supply source connection schematic

page

## 2.0. PIC32MX4 Microcontroller

There is a PIC32MX460F512L microcontroller provided on the board which belongs to the 32-bit PIC microcontroller family from Microchip. The microcontroller alone interfaces a large number of integrated 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.

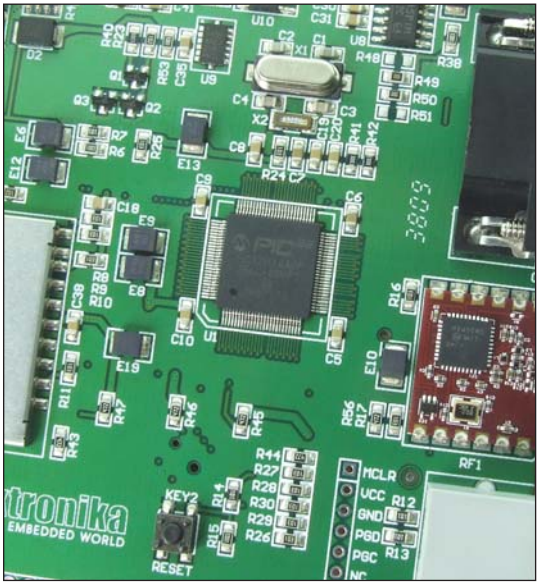



**Figure 2-1:** PIC32MX4 Microcontroller

This microcontroller provided on the *MultiMedia Board* uses two quartz crystall oscillators. The 8MHz oscillator is a primary clock frequency stabilizator, whereas the other, 32.768 kHz oscillator, is used by a built-in real-time clock. The PIC32MX460F512L microcontroller features 512KB flash memory and 32KB RAM memory. In addition, it provides other integrated modules such as SPI and $I^2C$ communication, 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 soldering 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. In this way, 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 the 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*. Boud 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.

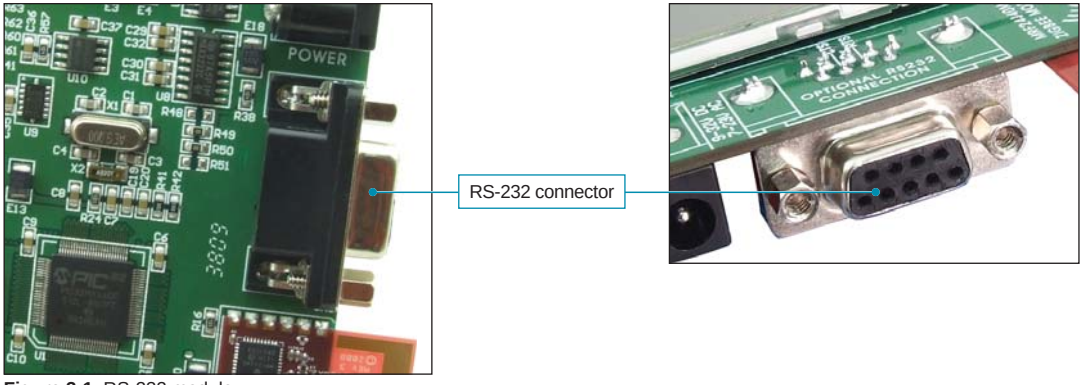



**Figure 3-1**: RS-232 module

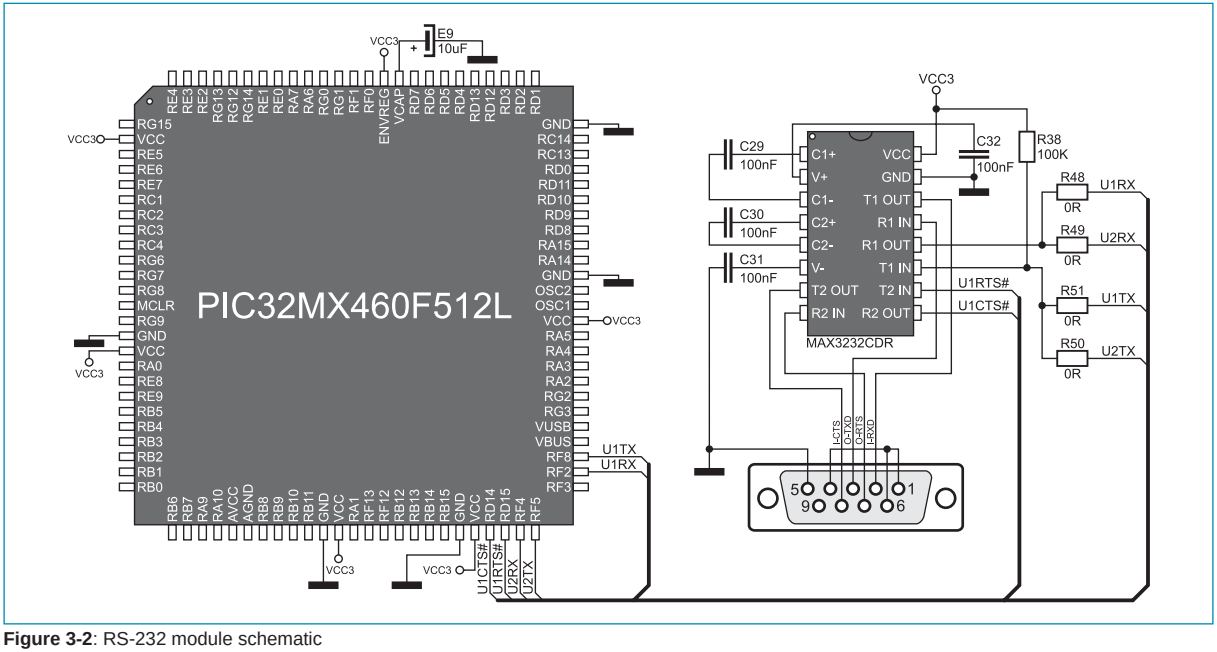



**Figure 3-2**: RS-232 module schematic

page

## 4.0. Accelerometer

The ADXL345 circuit enables the *MultiMedia Board* to measure acceleration, space orientation, gravitation etc. One of its main functions on the board 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 SPI serial interface.

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

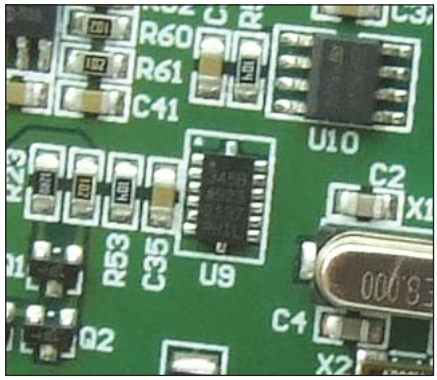



**Figure 4-1**: ADXL345 circuit

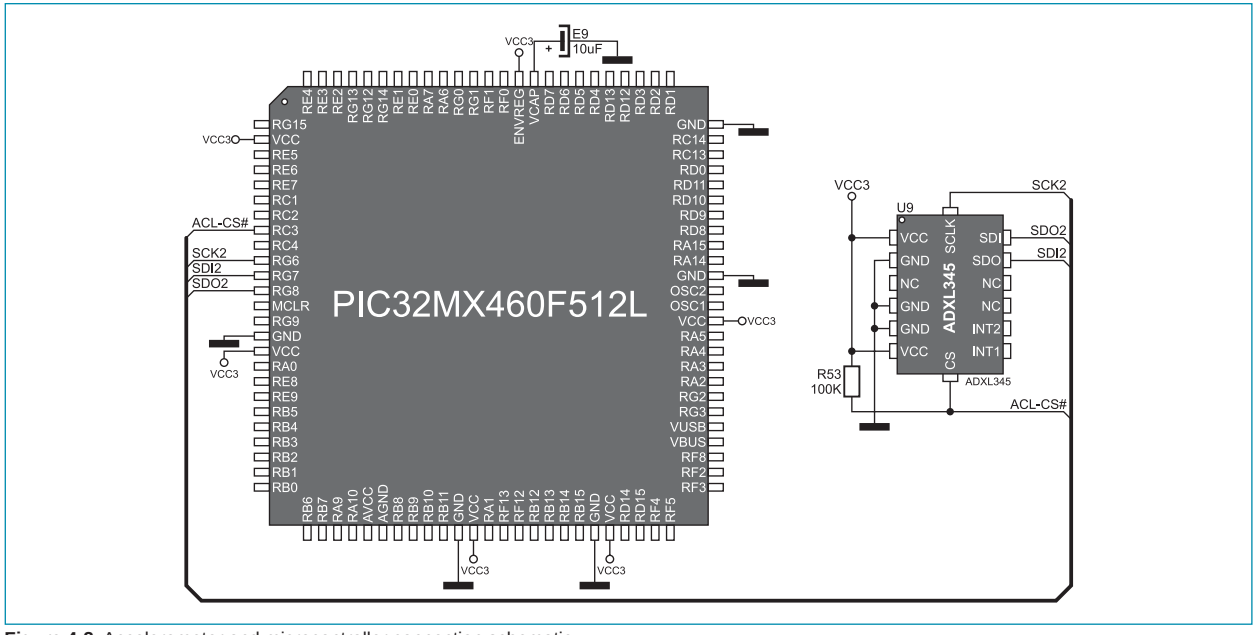



**Figure 4-2**: Accelerometer and microcontroller connection schematic

## 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 circuit 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 the value of which varies depending on the temperature value. Such signal is then converted to a digital number using the A/D module built into the microcontroller.


**Figure 5-1**: MCP9700A temperature sensor

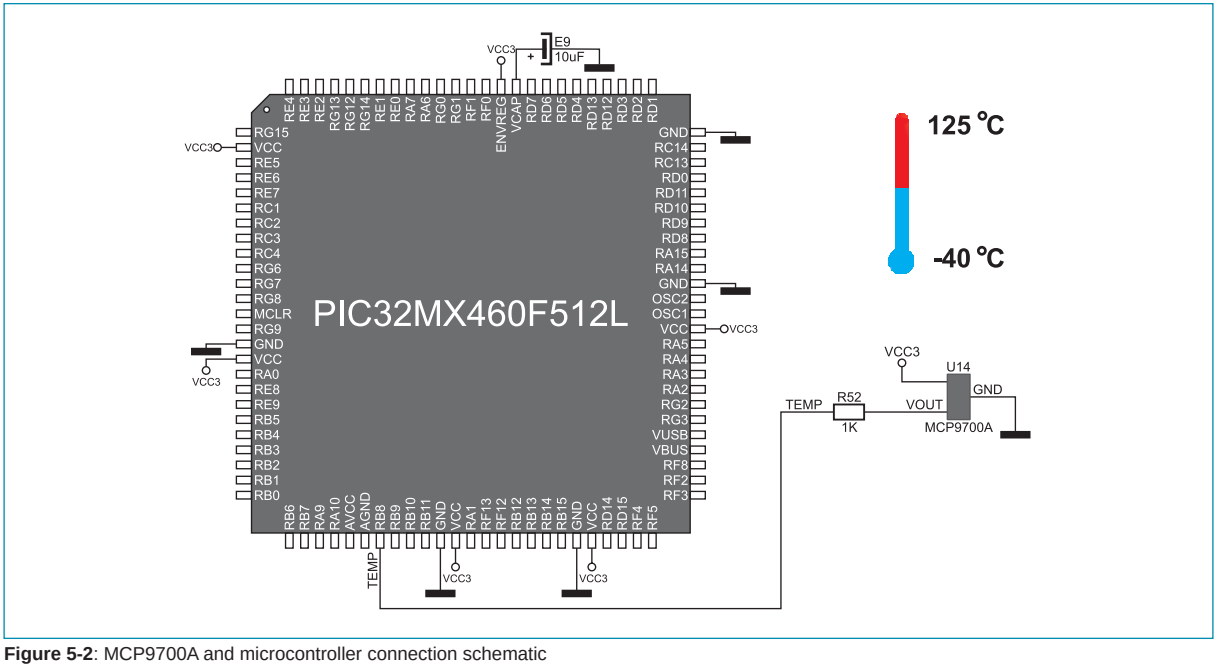



**Figure 5-2**: MCP9700A and microcontroller connection schematic

page

## 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 consumption. The ZigBee provided on the *MultiMedia Board* is an optional module marked as MRF24J40MA. Some of the key features are as follows: baud rate up to 250kbps, 2.4GHz operating frequency, ~20mA power consumption, up to 400m coverage etc. The microcontroller communicates to this module via SPI serial interface.

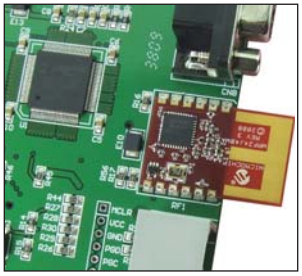


**Figure 6-1**: MRF24J40MA ZigBee module

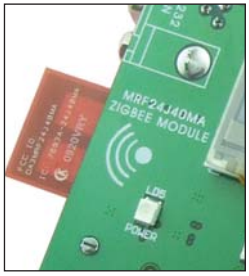



**Figure 6-2**: ZigBee module's antenna

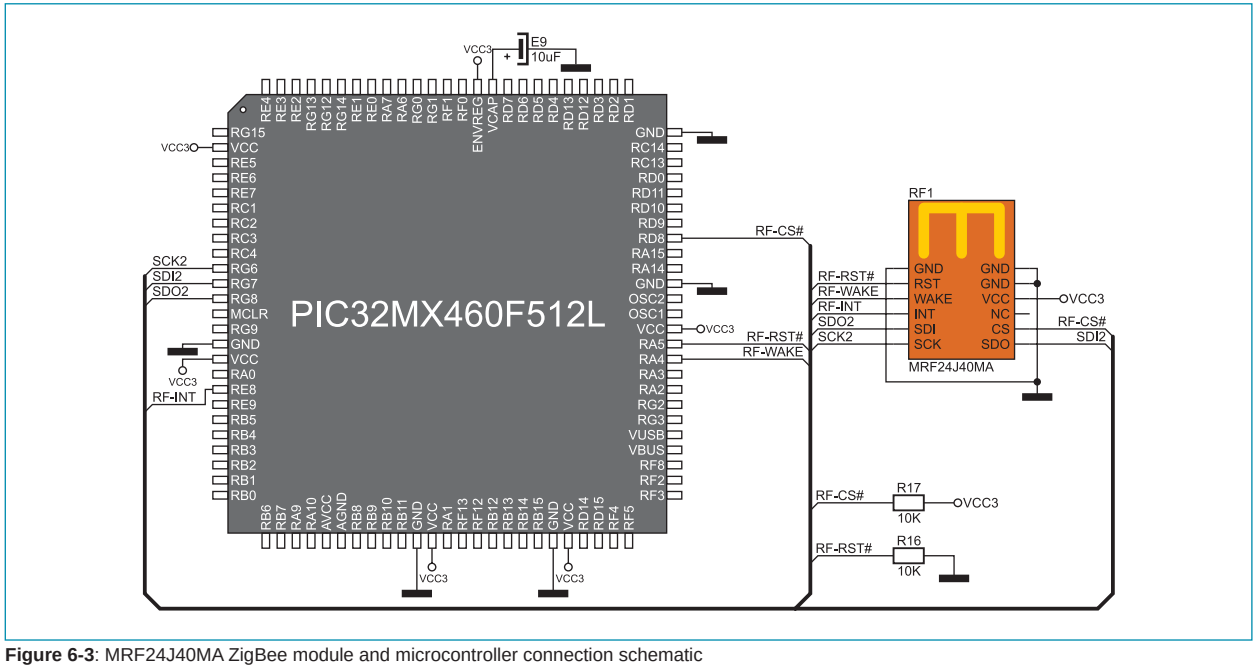



**Figure 6-3**: MRF24J40MA ZigBee module and microcontroller connection schematic

## 7.0. Joystick

A joystick is a movable stick that can be moved in four directions. Every movement can be registered by a software. The *MultiMedia Board* provides a joystick that can be moved in four directions and used as a push-button. The function thereof is determined in the program written by the user and loaded into the microcontroller. However, the joystick can be assigned various functions. In this case, it is typically used for navigation through the user menu.

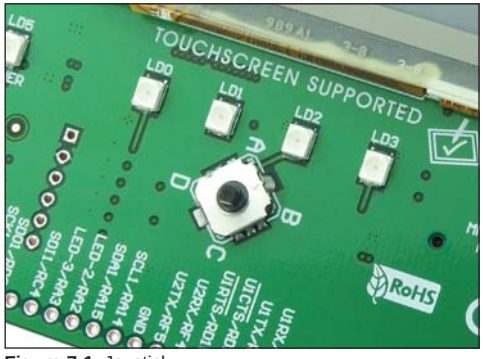



**Figure 7-1**: Joystick

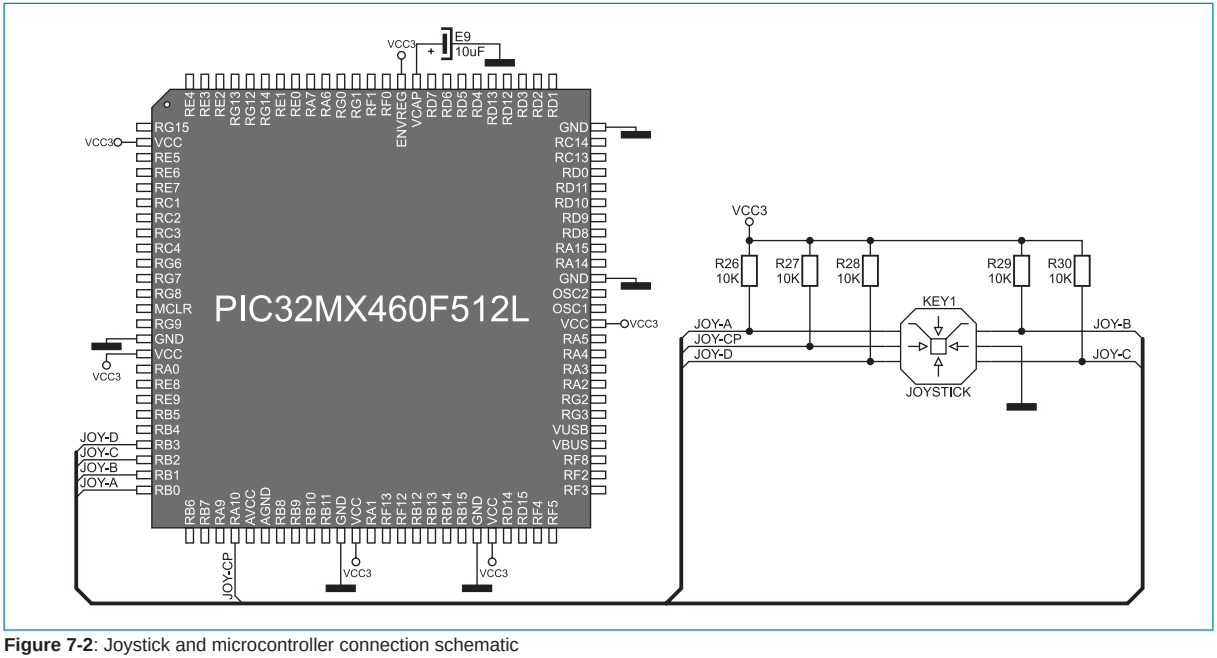



**Figure 7-2**: Joystick and microcontroller connection schematic

page

## 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 colours. 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 makes it possible for the user to make interactive applications such as virtual keyboard when writing a program for the microcontroller. Touchscreen backlight can be adjusted by a software via LCD-BLED line.

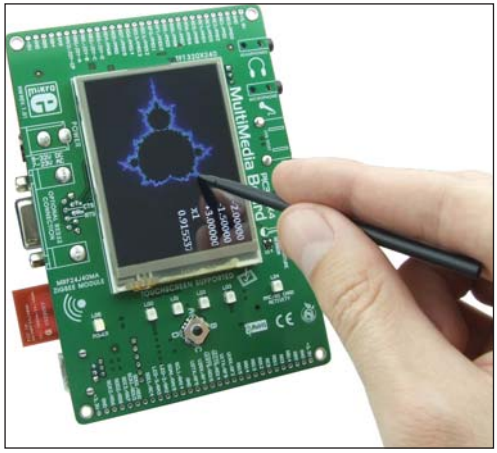


**Figure 8-1**: Touch screen

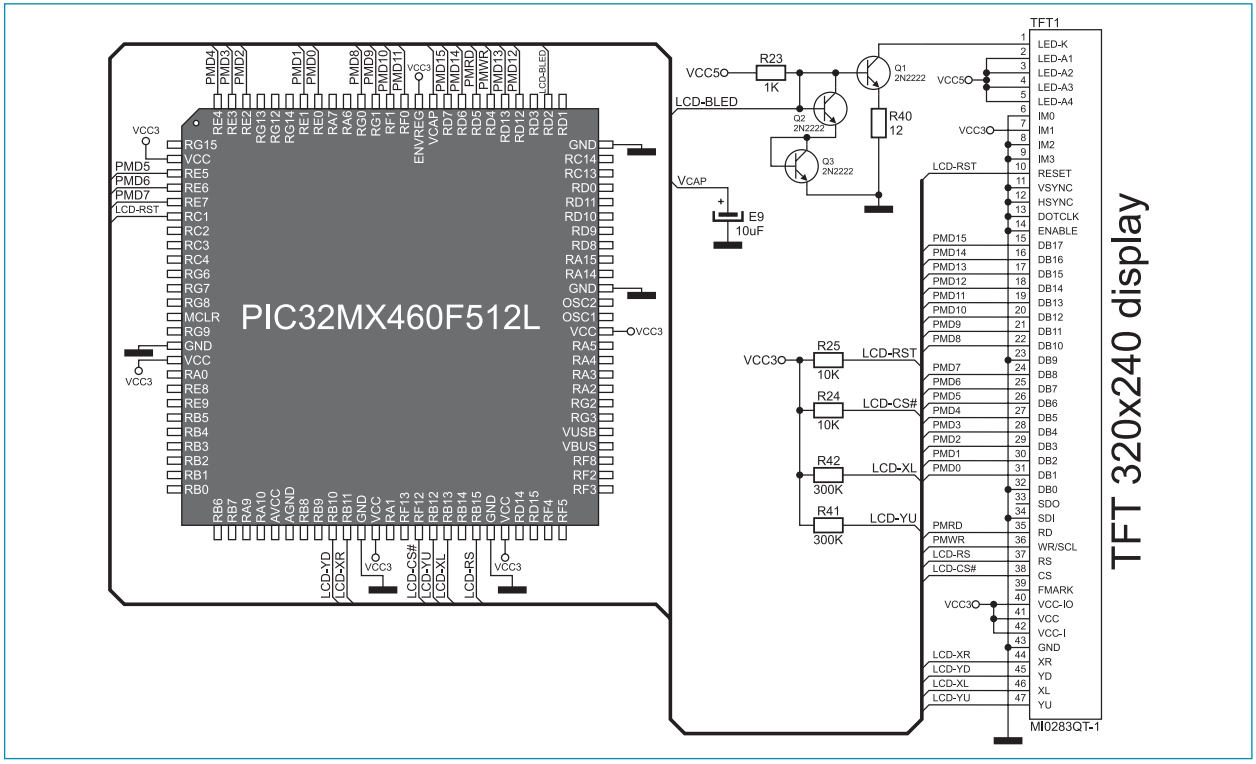



**Figure 8-2**: Touch screen and microcontroller connection schematic

## 9.0. Flash Memory

Since multimedia applications are getting increasingly demanding, it is necessary to provide additional memory space to be used for storing programs by the microcontroller. The M25P80 circuit enables the microcontroller to use additional 8Mbit flash memory. Such memory is connected to the microcontroller via SPI serial inteface.

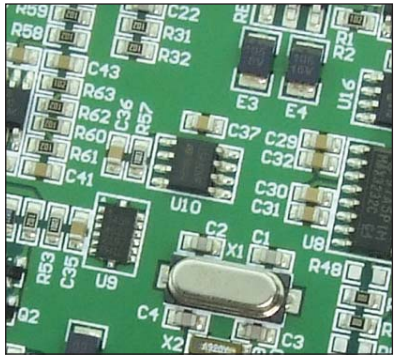


**Figure 9-1**: M25P80 circuit and 8Mbit flash memory

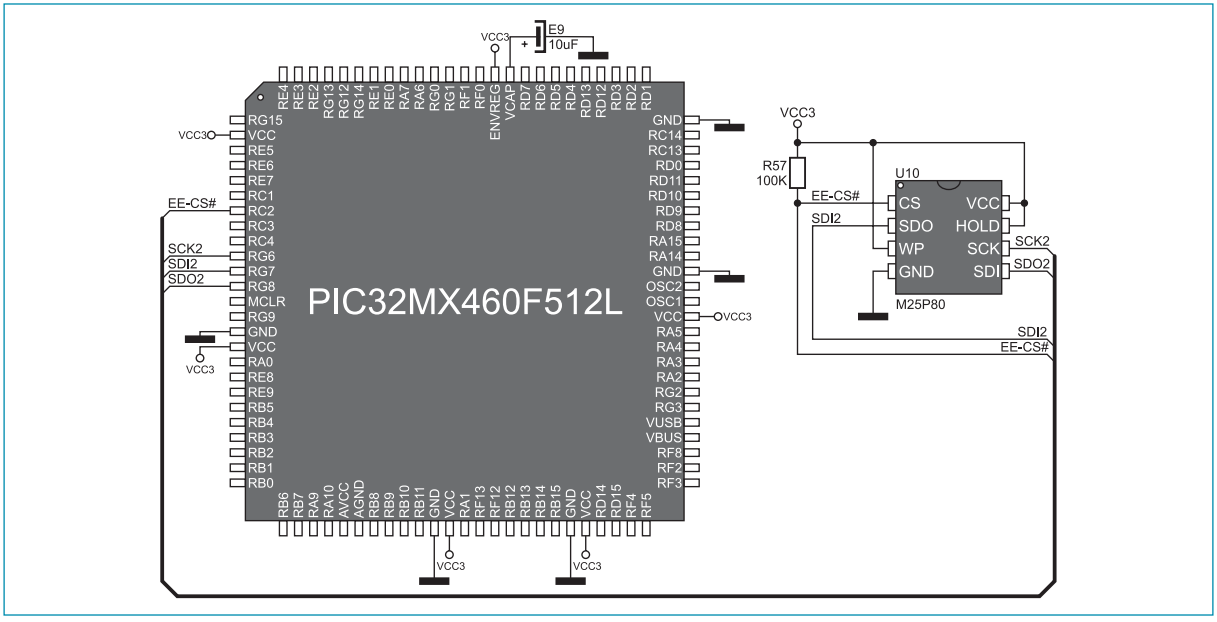



**Figure 9-2**: Flash memory and microcontroller connection schematic

page

## 10.0. Serial EEPROM

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

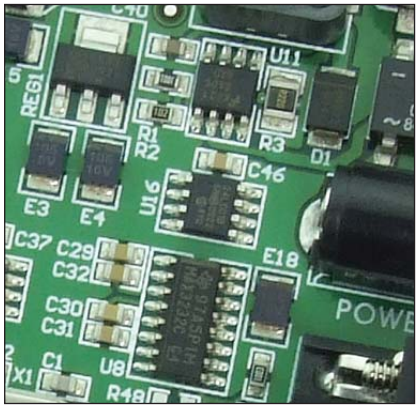



**Figure 10-1**: 24LC01 circuit and 1Kbit EEPROM memory

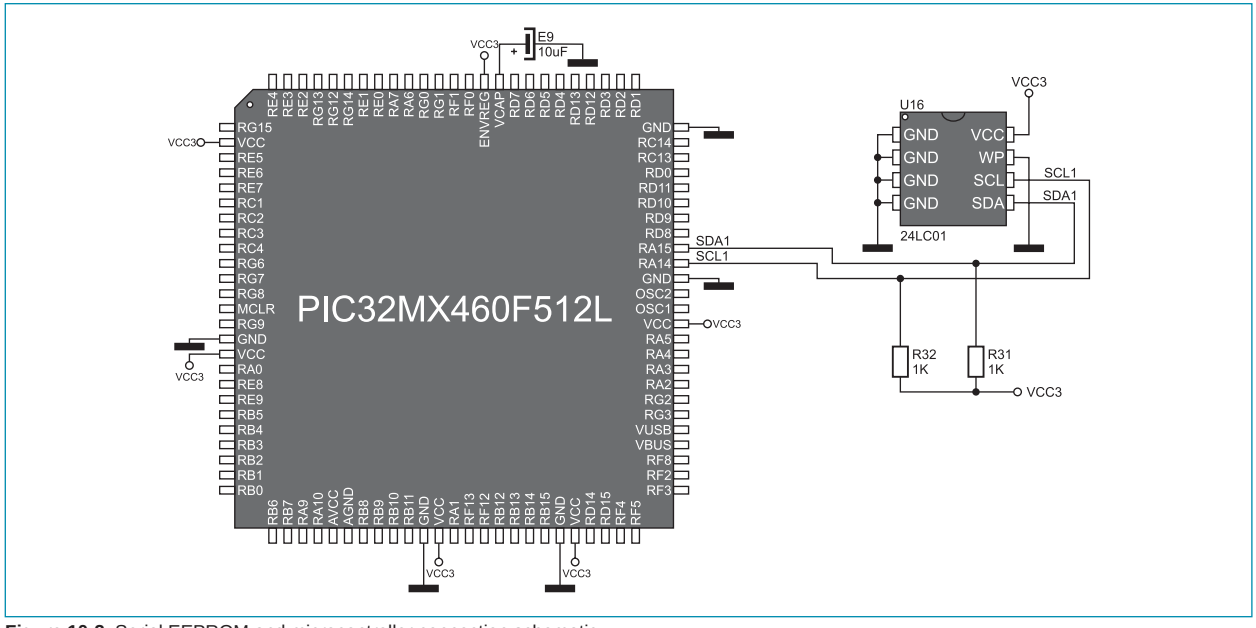



**Figure 10-2**: Serial EEPROM and microcontroller connection schematic

## 11.0. MMC/SD Connector

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

**Figure 11-1**: MMC/SD connector

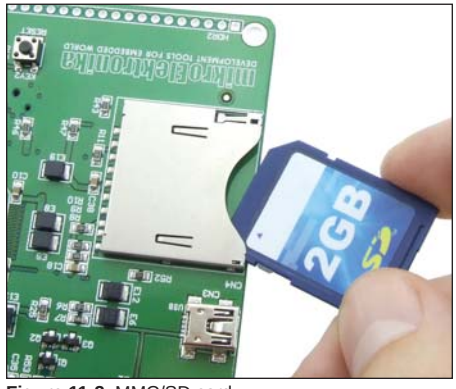



**Figure 11-2**: MMC/SD card

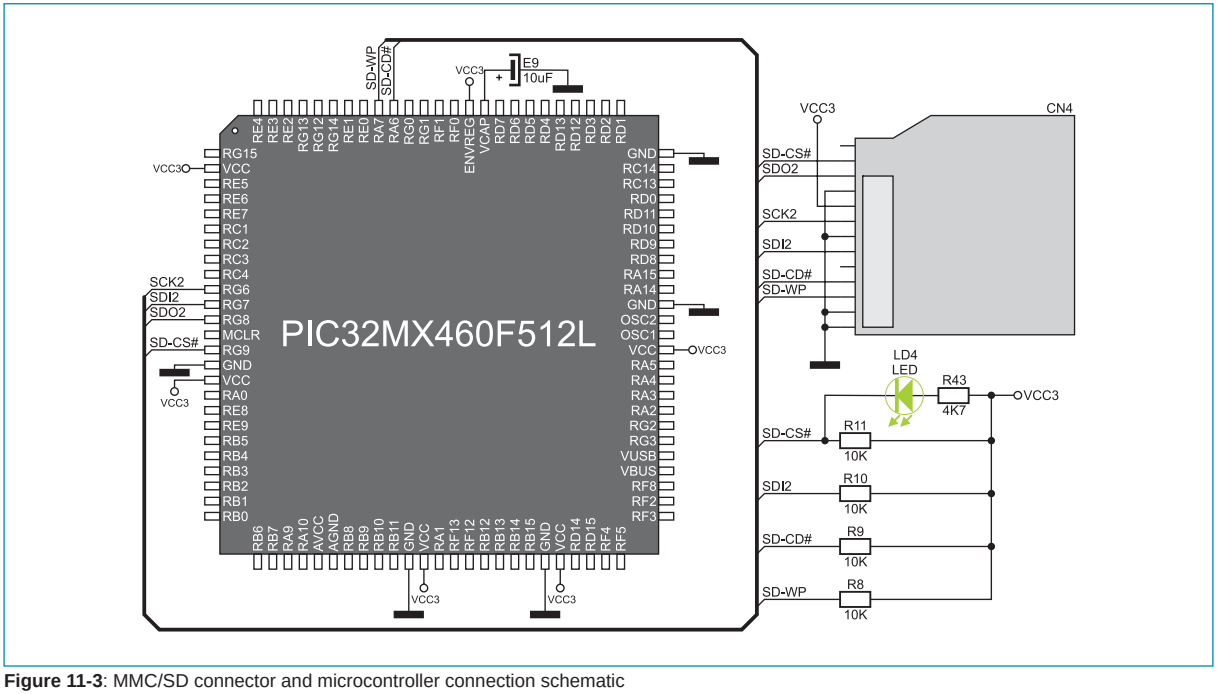



**Figure 11-3**: MMC/SD connector and microcontroller connection schematic

page

## 12.0. LED Diodes

LED diode (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 diode voltage is approximately 2.5V, while the current varies from 1 to 20mA depending on the type of LED diode. 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. LED diodes are connected to the following I/O microcontroller pins: LD0 - RA0, LD1 - RA1, LD2 - RA2 and LD3 - RA3. The LED diode marked as POWER is used to indicate that the system is turned on, whereas the diode marked as MMC/SD indicates memory card activity.

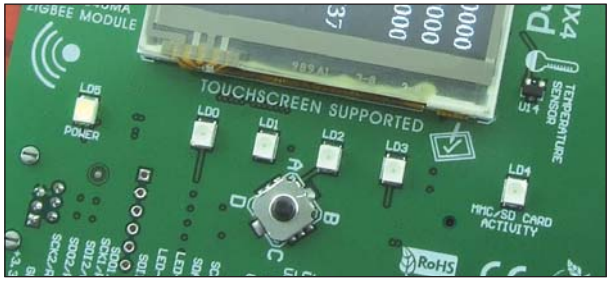



**Figure 12-1**: Signal LED diodes

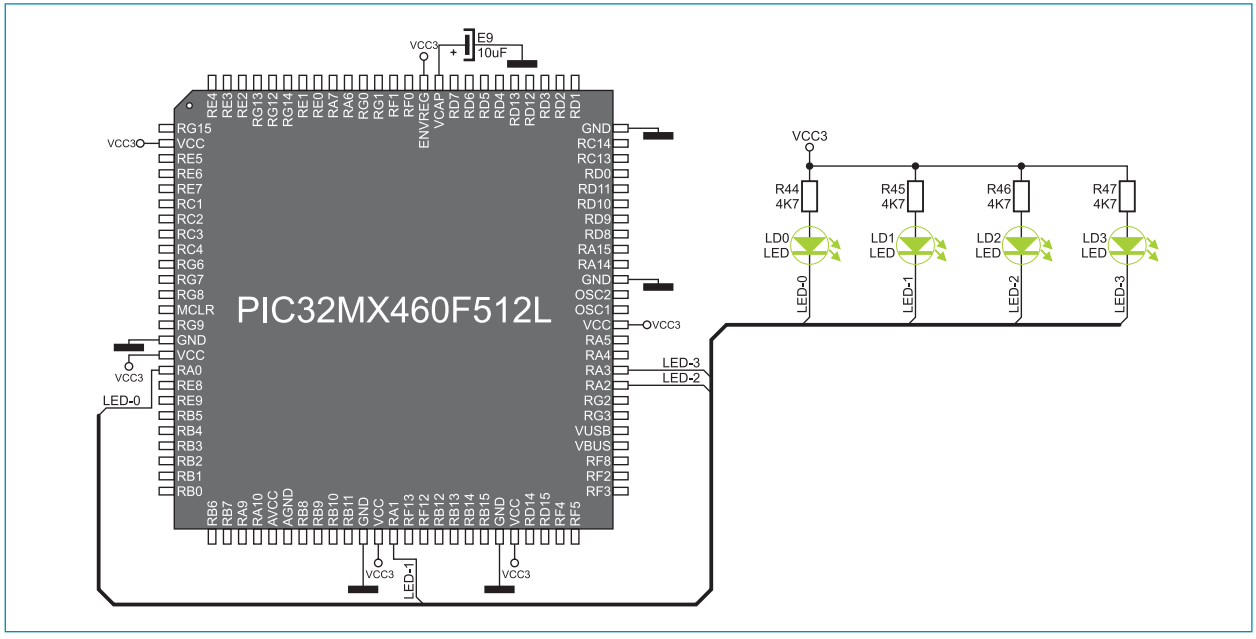



**Figure 12-2**: Signal LED diode and microcontroller connection schematic

## 13.0. Microphone Input

A microphone can be interfaced to the system via a 3.5mm connector CN7 and a WM8731SEDS circuit. This circuit is a stereo CODEC with an integrated headphones driver. Its function is to convert an analogue signal from interfaced microphone to a digital value, then to transfer it to a microcontroller or as a sidetone to headphones output. A sidetone volume control can be programmed by a software so an additional potenciometer is not necesarry. In case the microphone signal is transferred to headphones as a sidetone, it is necessary to set jumpers J1 and J2 to upper position as shown in Figure 13-2. When setting jumpers to upper position the WM8731SEDS headphones output is connected to the 3.5mm headphones connector CN6. The WM8731SEDS output signal is transferred to the connector CN6 via LHPO and RHPO lines. The picture 14-4 (page 20) illustrates jumpers, LHPO and RHPO lines and the connector CN6 connection.

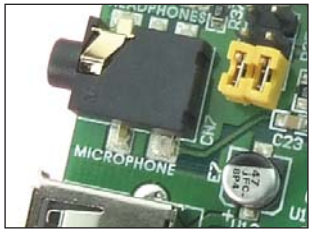



**Figure 13-1**: 3.5mm microphone connector CN7

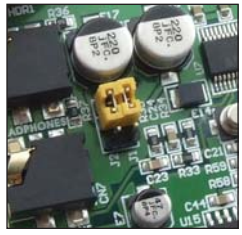



**Figure 13-2**: Jumpers J1 and J2 in upper position

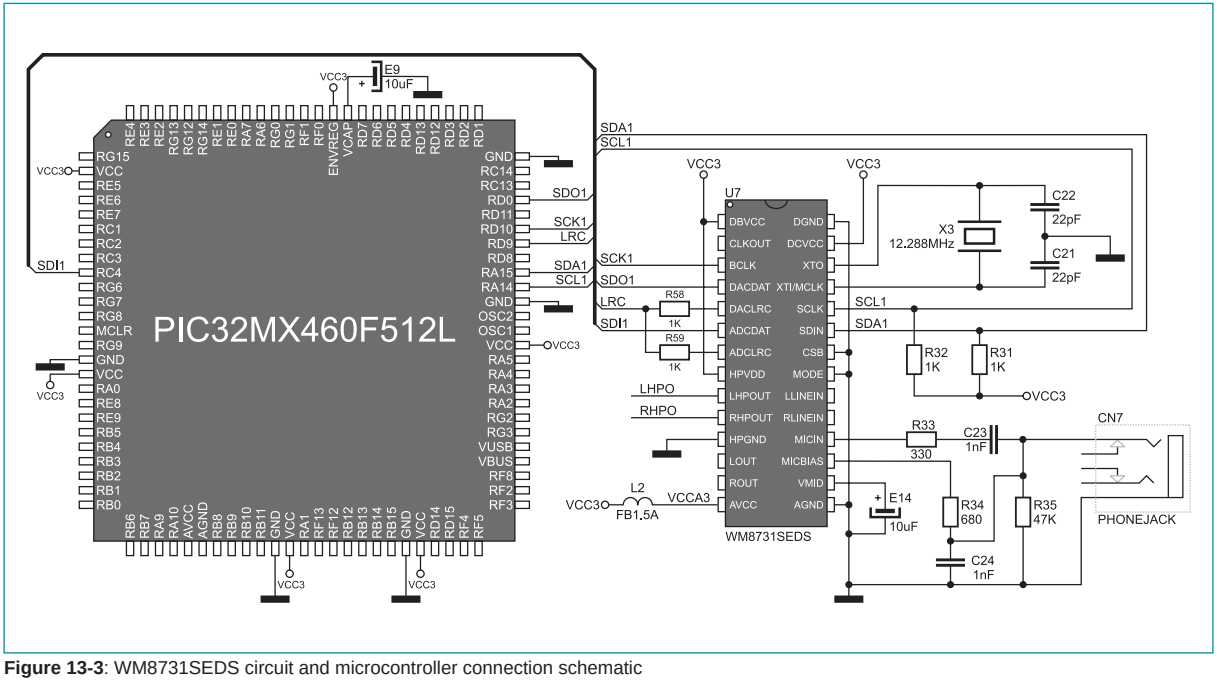



**Figure 13-3**: WM8731SEDS circuit and microcontroller connection schematic

page

## 14.0. Audio Output

The *MultiMedia Board* is able to generate an audio signal using WM8731SEDS or MCP6022 circuit. 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 SPI serial interface. The MCP6022 circuit is used for filtering PWM signal generated using the microcontroller. The headphones may be connected to the system using 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 set to lower position, as shown in Figure 14-2, the connector CN6 is fed with a signal from MCP6022 circuit. When jumpers J1 and J2 are set to the upper position, as shown in Figure 14-3, the connector CN6 is fed with an audio signal from WM8731SEDS circuit via LHPO and RHPO lines.

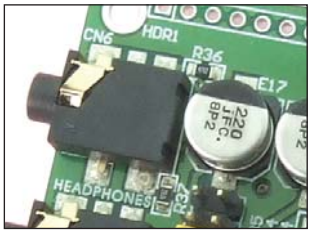



**Figure 14-1**: 3.5mm headphones connector CN6

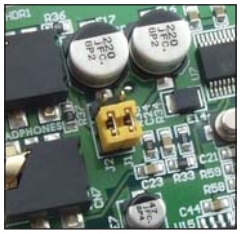


**Figure 14-2**: Jumpers J1 and J2 in lower position

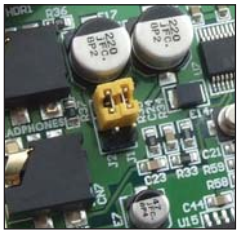


**Figure 14-3**: Jumpers J1 and J2 in upper position

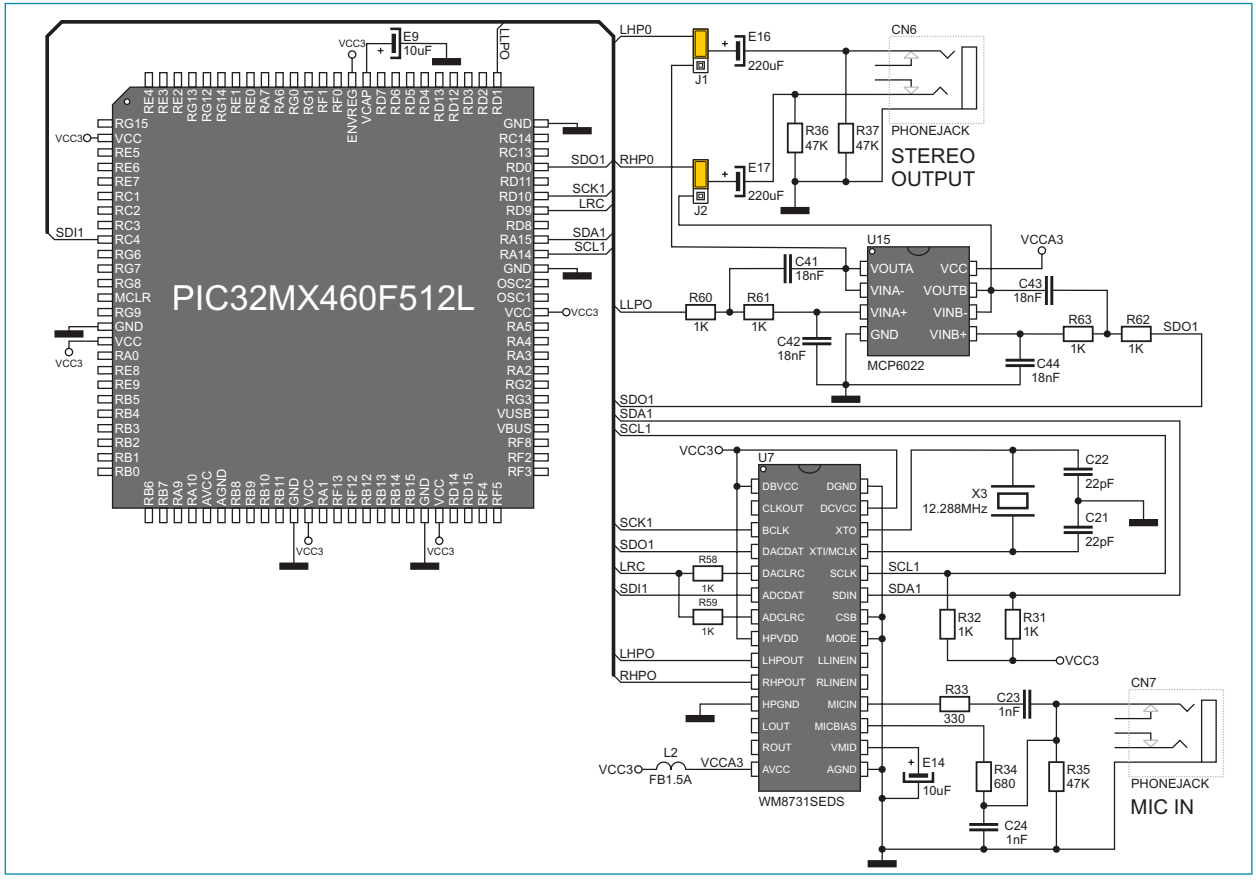



**Figure 14-4**: MCP6022 circuit and microcontroller connection schematic

## 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 connecting to a PC, whereas the other is an A type USB connector which serves as a USB HOST connector. The latter one enables peripheral devices, such as a printer, to be connected to the system. Communication between the microcontroller and USB device is performed via the RG2, RG3 and RF3 microcontroller pins.

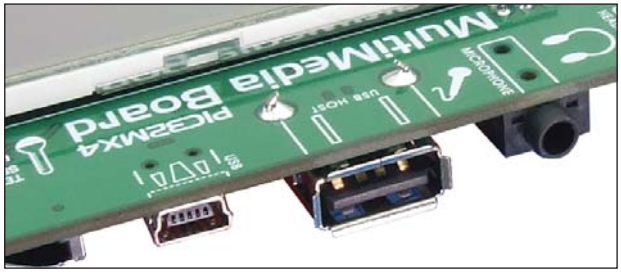



**Figure 15-1**: USB connectors

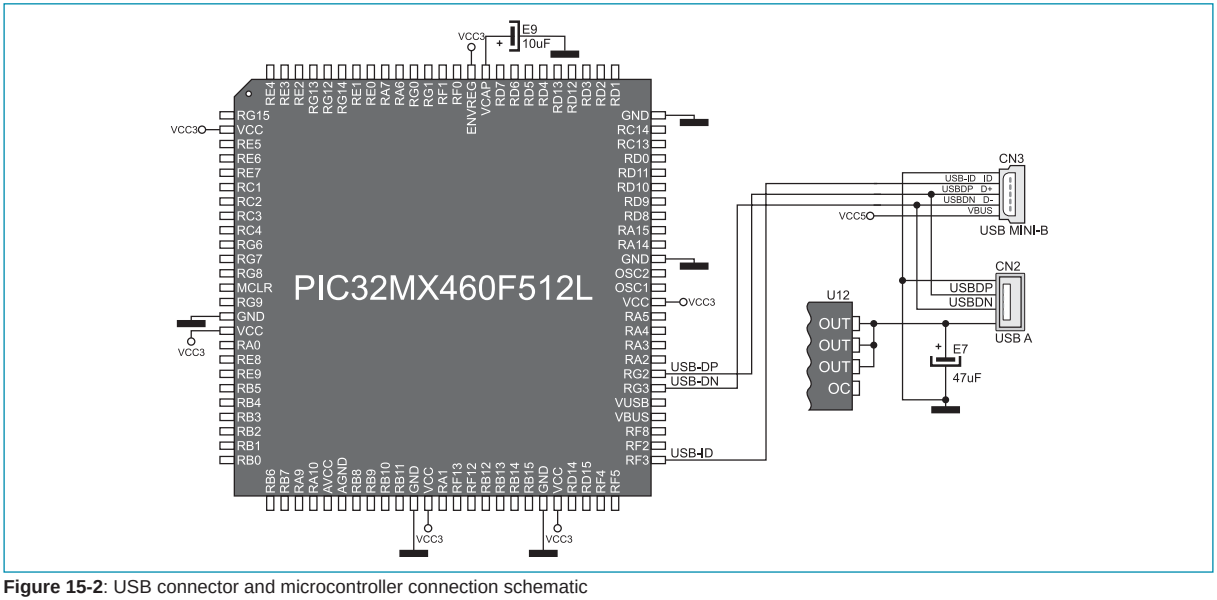



**Figure 15-2**: USB connector and microcontroller connection schematic

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 ICD2 or ICD3 programmer, it is crucial to enable the appropriate option within the MPLAB program.


**Figure 16-1**: MultiMedia Board connected to ICD3 programmer

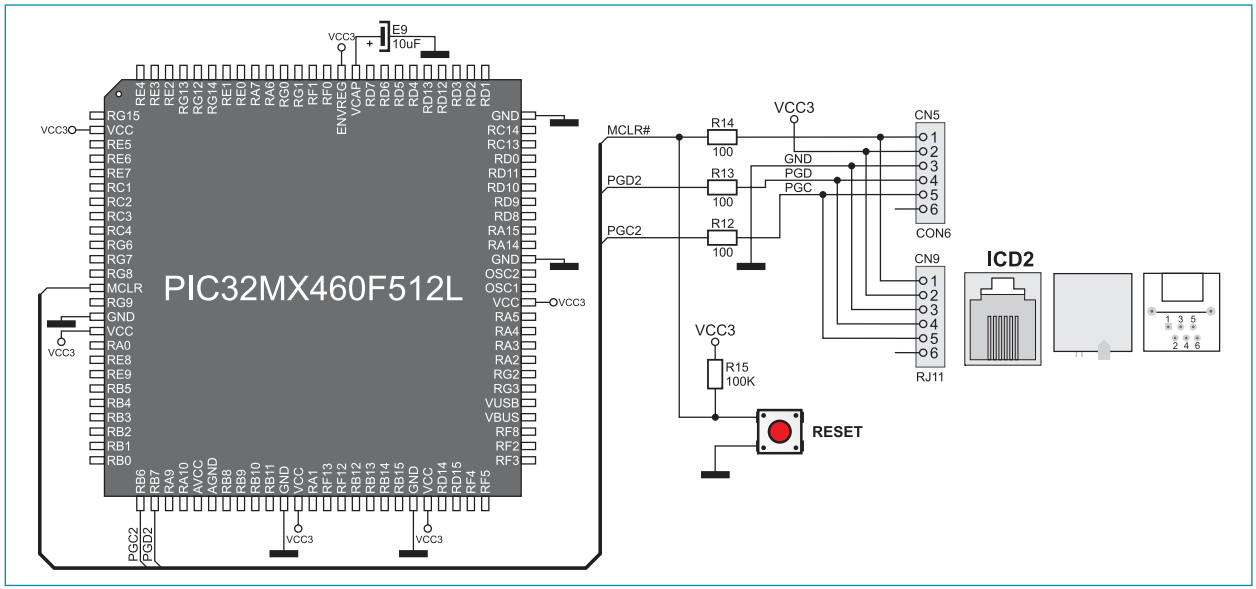



**Figure 16-2**: ICD connectors and microcontroller connection schematic

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

## DISCLAIMER

All the products owned by MikroElektronika are protected by copyright law and international copyright treaty. Therefore, this manual is to be treated as any other copyright material. No part of this manual, including product and software described herein, may be reproduced, stored in a retrieval system, translated or transmitted in any form or by any means, without the prior written permission of MikroElektronika. The manual PDF edition can be printed for private or local use, but not for distribution. Any modification of this manual is prohibited.

MikroElektronika provides this manual 'as is' without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties or conditions of merchantability or fitness for a particular purpose.

MikroElektronika shall assume no responsibility or liability for any errors, omissions and inaccuracies that may appear in this manual. In no event shall MikroElektronika, its directors, officers, employees or distributors be liable for any indirect, specific, incidental or consequential damages (including damages for loss of business profits and business information, business interruption or any other pecuniary loss) arising out of the use of this manual or product, even if MikroElektronika has been advised of the possibility of such damages. MikroElektronika reserves the right to change information contained in this manual at any time without prior notice, if necessary.

All the product and corporate names appearing in this manual may or may not be registered trademarks or copyrights of their respective companies, and are only used for identification or explanation and to the owners' benefit, with no intent to infringe.

## HIGH RISK ACTIVITIES

The products of MikroElektronika are not fault – tolerant nor designed, manufactured or intended for use or resale as on – line control equipment in hazardous environments requiring fail – safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines or weapons systems in which the failure of Software could lead directly to death, personal injury or severe physical or environmental damage ('High Risk Activities'). MikroElektronika and its suppliers specifically disclaim any expressed or implied warranty of fitness for High Risk Activities.

If you want to learn more about our products, please visit our website at www.mikroe.com

If you are experiencing some problems with any of our products or just need additional information, please place your ticket at www.mikroe.com/en/support

If you have any questions, comments or business proposals, do not hesitate to contact us at office@mikroe.com