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Nebojša Matic
General Manager

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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.

Multimedia system may be used as a stand-alone control device

TFT 320X240 display provides a palette of 262,000 colours. It is used to display graphic contents

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

ZigBee communication based on the IEEE 802.15.4 standard

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
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.

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 MultiMedia Board is powered via USB connector, then it has to be linked to a PC using appropriate USB cable.

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.
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.

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 I2C 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. 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.
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.

![ADXL345 circuit](Figure 4-1: ADXL345 circuit)

![Accelerometer and microcontroller connection schematic](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
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.
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
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.
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 interface.

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

Figure 9-2: Flash memory and microcontroller connection schematic
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 I²C 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
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.
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 potentiometer is not necessary. 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.
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](image1)

![Figure 15-2: USB connector and microcontroller connection schematic](image2)
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.

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.
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Nebojša Matic  
General Manager

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