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CONTENTS

Chapter 1: Introduction

1.What's easyPIC-40?

The **easyPIC-40** Development Board is a flexible and convenient development, demonstration and testing platform for Microchip's 8-bit PIC16F and PIC18F microcontrollers (MCUs) with 40 DIP packaging. It features lots of simple and basic modules to begin developing and learning a complete embedded application. All the modules on board are fully independent, which makes it easy and free to connect. The **easyPIC-40** is an old friend. It has been with us for three generations. Many of us made our first steps in embedded world with **easyPIC-40**. Today it has thousands of users: students, hobbyists, enthusiasts and professionals. It is used in many schools and other educational institutions across the globe. We have sold them over 3000pcs in the world in the passed 3 years. It provides an low-cost easy-to-use platform with common modules to bring you into the colorful embedded world. Of course, we are not perfect and we asking ourselves what we can do to make such a board even better, and at the same time, we are looking forward to receiving your valuable suggestions.
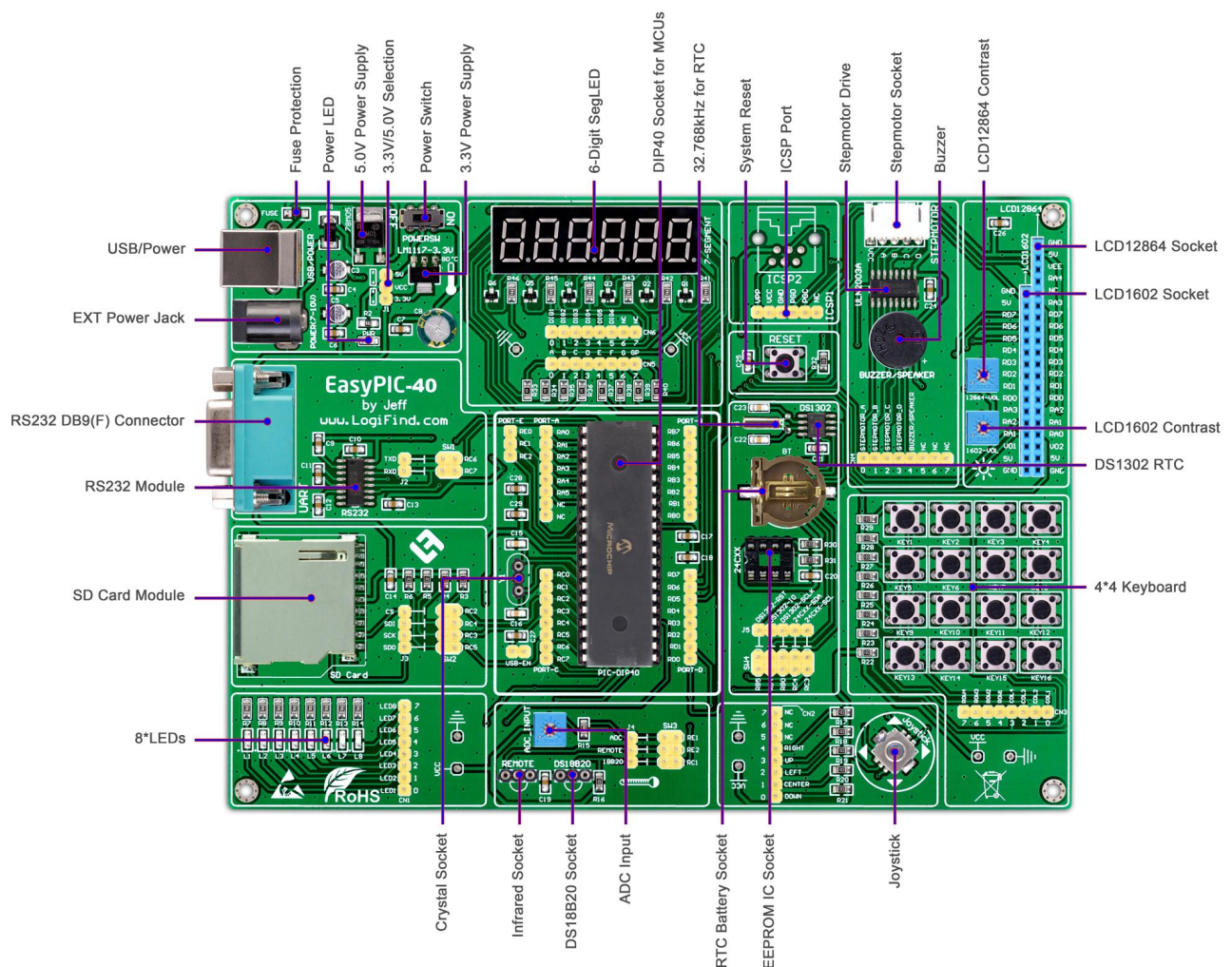
2.What's on Board?

Figure 1-1.What's on board

3.Power Supply

For connection with a power supply source the easyPIC-40 uses a Jack EX-PWR. The power supply voltage level can vary from +7-10V DC.

4.Programmer/Debugger Requirement

An external PIC programmer or Debugger is required to download code to the DIP-40 PICs on the board. It supports many Programmers or Debuggers like PICKIT2，PICKIT3 or ICD2 etc.

5.Devices Supported

The easyPIC-40 supports most 8bit DIP40 PICs,the following table shows the common devices.

PIC16Cxxx PIC16LCxxx Series
PIC16C64 PIC16LC64 PIC16C64A PIC16LC64A PIC16CR64 PIC16LCR64 PIC16C65 PIC16LC65 PIC16C65A PIC16LC65A PIC16C65B PIC16CR65 PIC16LCR65 PIC16C67 PIC16LC67 PIC16C74B PIC16C765 PIC16C774 PIC16LC774

PIC16Fxxx PIC16LFxxx Series
PIC16F724 PIC16F727 PIC16LF724 PIC16LF727 PIC16F74 PIC16LF74 PIC16F77 PIC16LF77 PIC16F747 PIC16LF747 PIC16F777 PIC16LF777 PIC16F871 PIC16LF871 PIC16F874A PIC16LF874A PIC16F877A PIC16LF877A PIC16F884 PIC16F887 PIC16F914 PIC16F917

PIC18Fxxx PIC18LFxxx Series
PIC18F4220 PIC18LF4220 PIC18F4221 PIC18LF4221 PIC18F4320 PIC18LF4320 PIC18F4321 PIC18LF4321 PIC18F4331 PIC18LF4331 PIC18F43K20 PIC18F4410 PIC18LF4410 PIC18F4420 PIC18LF4420 PIC18F4423 PIC18LF4423 PIC18F4431 PIC18F4450* PIC18LF4450* PIC18F4455* PIC18F4458* PIC18LF4458* PIC18F4480 PIC18LF4480 PIC18F44K20 PIC18F44J10 PIC18LF44J10 PIC18F4510 PIC18LF4510 PIC18F4515 PIC18F4520 PIC18LF4520 PIC18F4523 PIC18LF4523 PIC18F4525

Chapter 2: Hardware Details
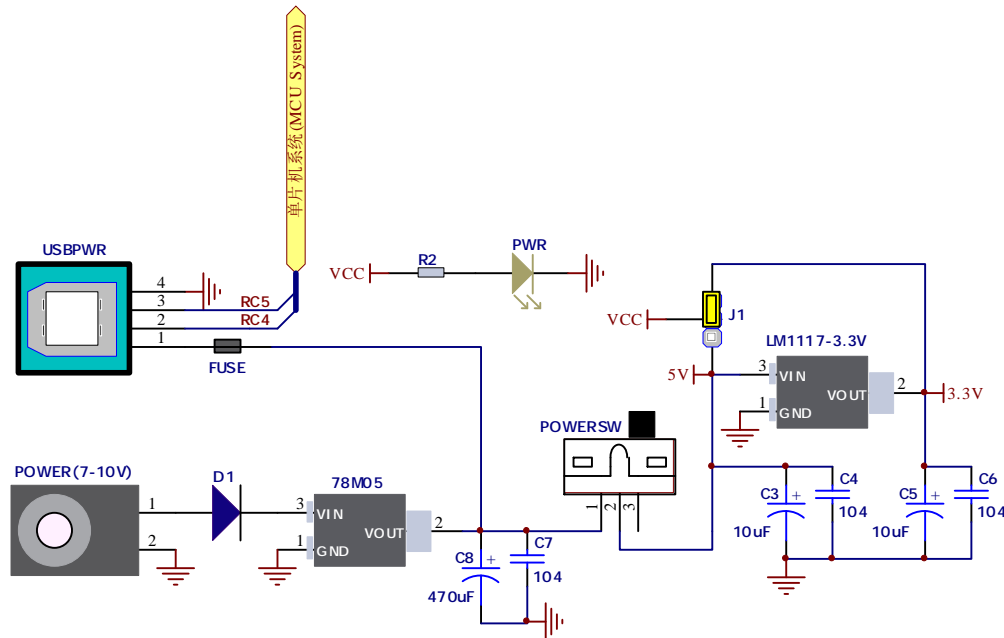
1.Power Supply and USB Connector

Figure 2-1: Dual power supply unit schematic

easyPIC-40 Board contains power supply that creates stable voltage **5V** and **3.3V** and current levels necessary for powering each part of the board. Power supply section contains two power regulators: **78M05**, which generates **5V**, and LM1117-3.3 which creates **3.3V** power supply. The board can be powered in two different ways: with USB power supply (**USB/POWER**), or using external adapters via adapter connector Jack (**POWER(7-10V)**). External adapter voltage levels must be in range of **7-10V** DC. Use **J1** to specify whether you are using **5V** or **3.3V** power supply for the system. Upon providing the power using either external adapter or USB power source you can turn on power supply by using **POWERSW** (**Figure 2-1**). Power LED (**PWR**) will indicate the presence of power supply.
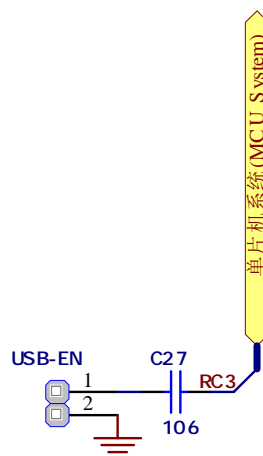

Figure 2-2: USB enable Jumper

The D- and D+ lines on USB power supply connector (**USB/POWER**) are connected to the Microcontroller socket, which are for creating a USB HID application if you are using a microcontroller

with USB module inside like PIC18F4550. The USB enable Jumper(**Figure 2-2**) is used to enable the USB communication.

2.DIP40 MCU Socket and Pinouts

The board contains a **DIP40** socket which supports over **50** microcontrollers from PIC16F, PIC16LF, PIC18F and PIC18LF families. The **easyPIC-40** development system comes with the **PIC16F877A** microcontroller in a **DIP40** package by default.
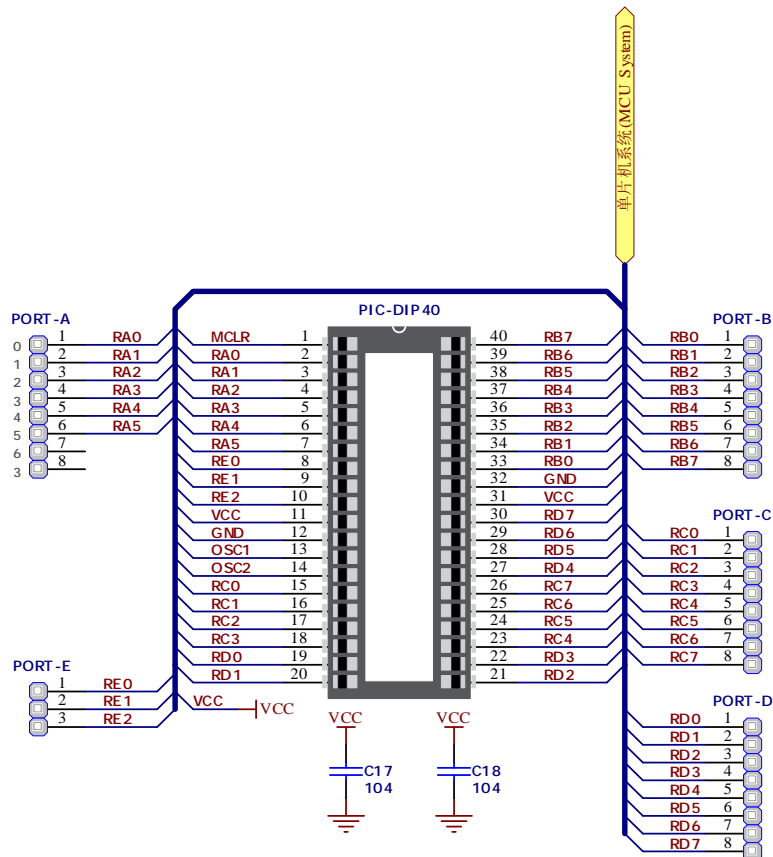

Figure 2-3: DIP40 MCU Socket and Pinouts

3.System Clock

The board contains a socket(**Y1**) which allow you to change the different crystal very easily.
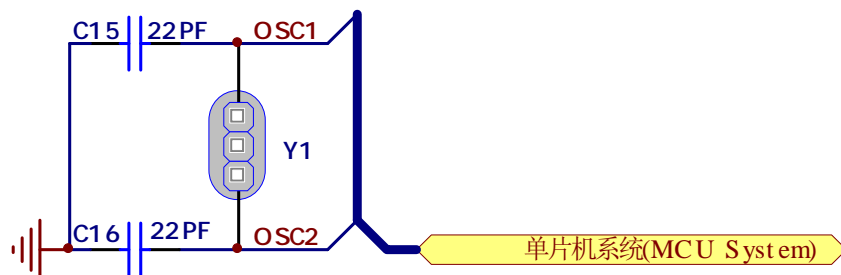

Figure 2-4: System Clock

4. 6-Digit SEGLED Display

One seven segment digit consist of 7+1 LEDs which are arranged in a specific formation which can be used to represent digits from 0 to 9 and even some letters. One additional LED is used for marking the decimal dot, in case you want to write a decimal point in the desired segment. The **easyPIC-40** contains six of these digits put together to form 6-digit 7-segment display. Driving such a display is done using **multiplexing techniques**. Data lines are shared between segments, and therefore the same segment LEDs in each digit are connected in parallel. Each digit has it's **unique digit select line**, which is used to enable the digit to which the data is currently being sent. By multiplexing data through all six segments fast enough, you create an illusion that all six segments are in operation simultaneously. This is possible because human eye has a slower reaction time than the mention changes. This way you can represent numbers in decimal or hexadecimal form. Eight data lines that are common for all the digits are connected to connector (**CN5**), and digit select lines are connected to connector (**CN6**).

The two connectors does not be connected to any IOs by default, and it makes your experiments more flexible. In order to enable Six Digit 7-seg Display Module, it is necessary to connected it to the appropriate IOs Port via connector (**CN5**) and (**CN6**) using dupont wires. See the comments in the source code provided in CD Rom for how to connect the hardware.
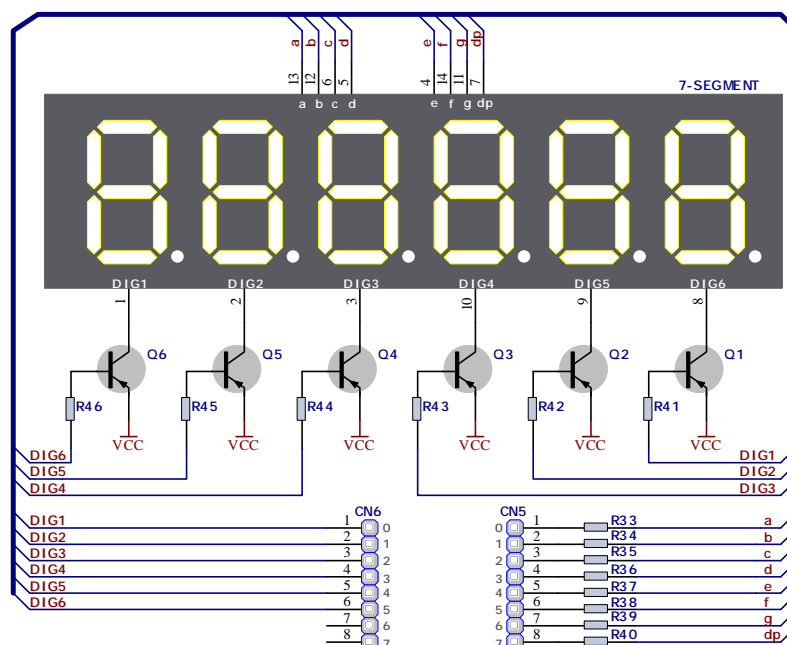

Figure 2-5: Six Digit 7-seg Display Module

5.Eight LEDs

LED (Light-Emitting Diode) is a highly efficient electronic light source. When connecting LEDs, it is necessary to place a current limiting resistor in series so that LEDs are provided with the current value specified by the manufacturer. The current varies from 0.2mA to 20mA, depending on the type of the LED and the manufacturer. The **easyPIC-40** board uses low-current LEDs with typical current consumption of 0.2mA or 0.3mA, depending of VCC voltage selection. Board contains 8 LEDs which can be used for visual indication of the logic state on PORT pins. An active LED indicates that a logic high (1) is present on the pin.

The **CN1** connector does not be connected to any IOs by default, and it makes your experiments more flexible. In order to enable LEDs, it is necessary to connected them to the appropriate IOs Port via connector (**CN1**) using dupont wires. See the comments in the source code provided in CD Rom for how to connect the hardware.
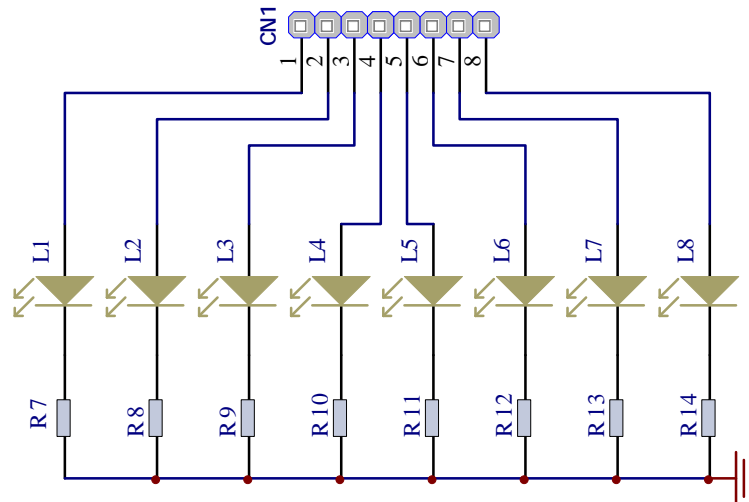

Figure 2-6: LEDs

6.4X4 Matrix Keypad

4X4 Matrix Keypad is used for loading numerics into the microcontroller. It consists of 16 buttons arranged in a form of an array containig four Rows and four columns.

The **CN3** connector does not be connected to any IOs by default, and it makes your experiments more flexible. In order to enable the **4X4 Matrix Keypad**, it is necessary to connected it to the appropriate IOs Port via connector (**CN3**) using dupont wires. See the comments in the source code provided in CD Rom for how to connect the hardware.
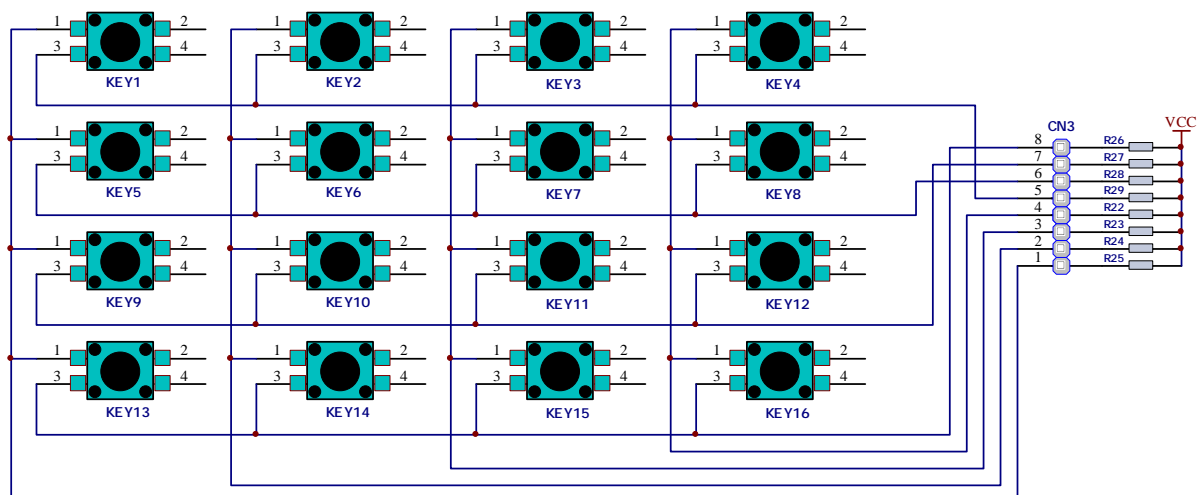

Figure 2-7: 4X4 Matrix Keypad

7.Joystick

Joystick is a smart navigation key concept based on contactless, magnetic movement detection. You can think it simply as 5 Tact Switchs installed on one device, and they are the Left, Right, Up, Down and

Center. The **easyPIC-40** contains a 5-Direction Jostick.

The **CN2** connector does not be connected to any IOs by default, and it makes your experiments more flexible.In order to enable the **Joystick**, it is necessary to connected it to the appropriate IOs Port via connector (**CN2**) using dupont wires. See the comments in the source code provided in CD Rom for how to connect the hardware.
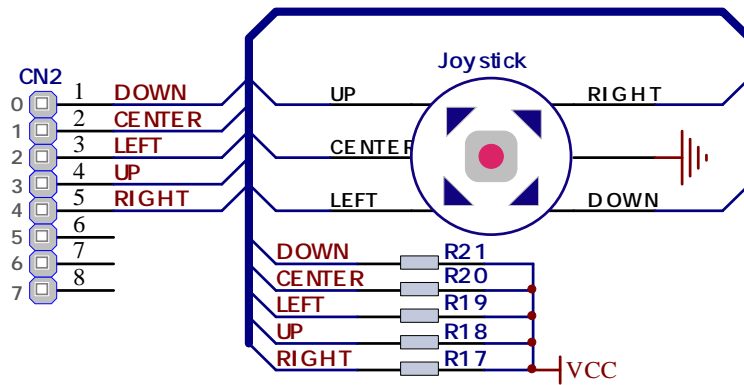
Figure 2-8: Joystick

8.ULN2003A for Step Motor and Buzzer

The ULN2003A is high-voltage high-current Darlington transistor arrays. Each consists of seven npn Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of a single Darlington pair is 500 mA. The Darlington pairs can be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers. We use the ULN2003A to drive a Buzzer and a Stepper Motor (**Figure 2-9**).
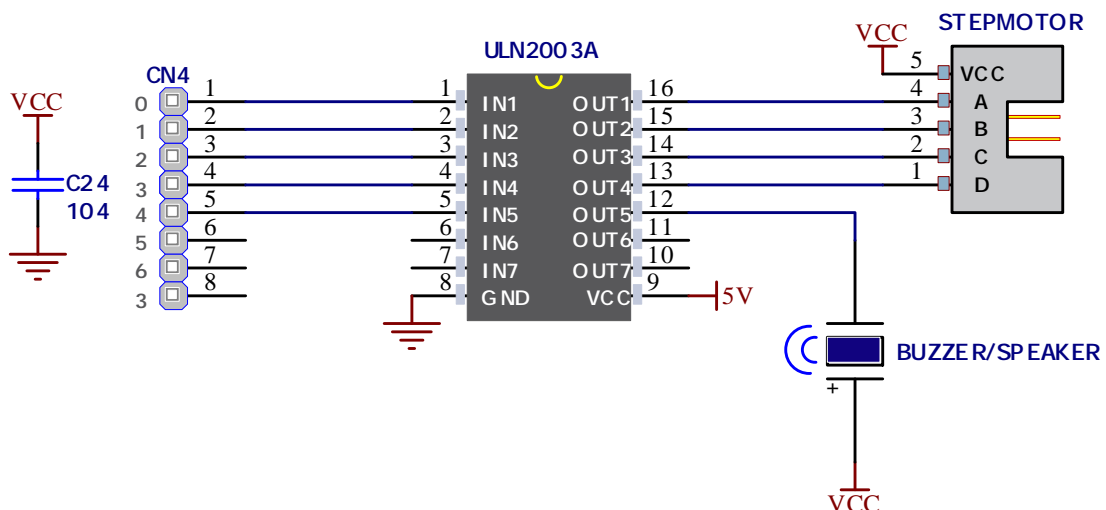
Figure 2-9: ULN2003A Drive Module for Step Motor and Buzzer

Figure 2-10: BYJ-48-5V Step Motor

The **CN4** connector does not be connected to any IOs by default, and it makes your experiments more flexible.In order to enable the **ULN2003A Drive Module** to drive the stepmotor, it is necessary to connected it to the appropriate IOs Port via connector (**CN4**) using dupont wires. See the comments in the source code provided in CD Rom for how to connect the hardware.

9.DS18B20,Remote and ADC Modules

1.DS18B20 - Digital Temperature Sensor

DS18B20 is a digital temperature sensor that uses 1-wire® interface for it's operation. It is capable of measuring temperatures within the range of -55 to 128°C, and provides ±0.5°C accuracy for temperatures within the range of -10 to 85°C. It requires 3V to 5.5V power supply for stable operation. It takes maximum of 750ms for the DS18B20 to calculate temperature with 9-bit resolution. 1-wire® serial communication enables data to be transferred over a single communication line, while the process itself is under the control of the master microcontroller. The advantage of such communication is that only one microcontroller pin is used. Multiple sensors can be connected on the same line. All slave devices by default have a unique ID code, which enables the master device to easily identify all devices sharing the same interface.The **easyPIC-40** provides a separate socket for the **DS18B20**. Communication line with the microcontroller is connected via jumper **SW3.3**.

In order to connect the **DS18B20** to the microcontroller you must enable the connection on jumper **SW3**.Prior to using **DS18B20** in your application, make sure to disconnect other unused peripherals, LEDs and additional pull-up or pull-down resistors from the interface lines in order not to interfere with signal/data integrity. See the comments in the source code provided in CD Rom for how to connect the hardware.

2.ADC input

Digital signals have two discrete states, which are decoded   as high and low, and interpreted as logic 1 and logic 0. Analog signals, on the other hand, are continuous, and can have any value within defined range. A/D converters are specialized circuits which can convert analog signals (voltages) into a digital representation, usually in form of an integer number. The value of this number is linearly dependent on the input voltage value. Most microcontrollers nowadays internally have A/D converters connected to one or more input pins. Some of the most important parameters of A/D converters are conversion time and resolution. Conversion time determines how fast can an analog voltage be represented in form of a digital number. This is an important parameter if you need fast data acquisition. The other parameter is resolution. Resolution represents the number of discrete steps that supported voltage range can be

divided into. It determines the sensitivity of the A/D converter. Resolution is represented in maximum number of bits that resulting number occupies. Most PIC® microcontrollers have 10-bit resolution, meaning that maximum value of conversion can be represented with 10 bits, which converted to integer is $2^{10}=1024$. This means that supported voltage range, for example from 0-5V, can be divided into 1024 discrete steps of about 4.88mV. **easyPIC-40** provides an interface in form of a potentiometer for simulating analog input voltages that can be routed to any of the 10 supported analog input pins.

In order to connect the **ADC INPUT** to the microcontroller you must enable the connection on jumper **SW3**.Prior to using **ADC** in your application, make sure to disconnect other unused peripherals, LEDs and additional pull-up or pull-down resistors from the interface lines in order not to interfere with signal/data integrity. See the comments in the source code provided in CD Rom for how to connect the hardware.

3.1838V Remote Control

1838V is miniaturized infrared receivers for remote control and other applications requiring improved ambient light rejection.The separate PIN diode and preamplifier IC are assembled on a single leadframe. The epoxy package contains a special IR filter.This module has excellent performance even in disturbed ambient light applications and provides protection against uncontrolled output pulses.

In order to connect the **1838V** to the microcontroller you must enable the connection on jumper **SW3**.Prior to using **1838V** in your application, make sure to disconnect other unused peripherals, LEDs and additional pull-up or pull-down resistors from the interface lines in order not to interfere with signal/data integrity. See the comments in the source code provided in CD Rom for how to connect the hardware.
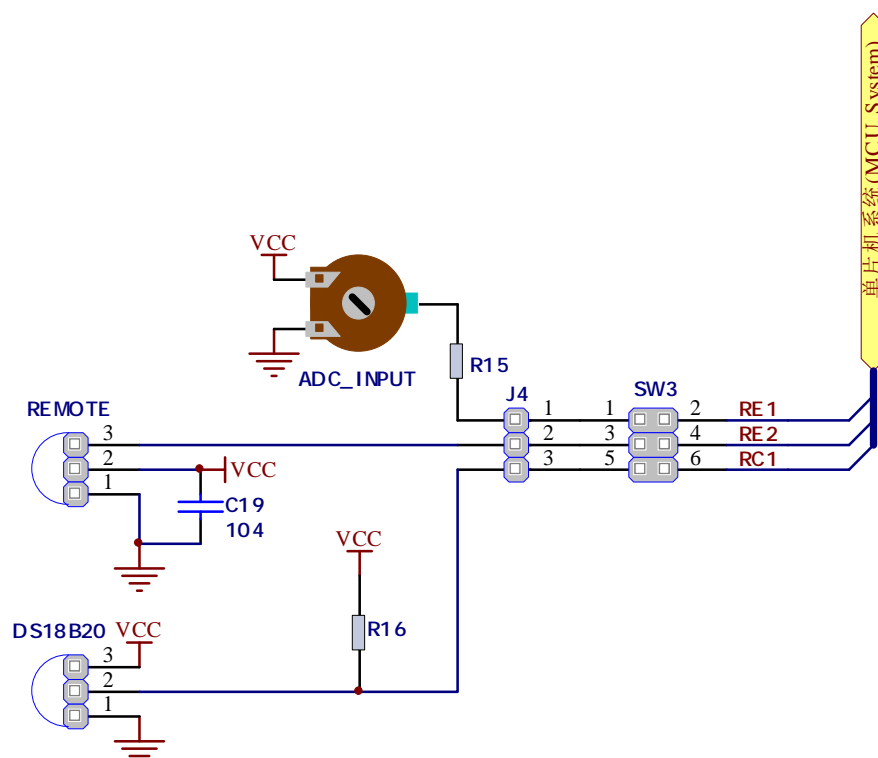

Figure 2-11: DS18B20,Remote and ADC Modules

10.Real Time Clock and EEPROM Module

1.EEPROM

EEPROM is short for Electrically Erasable Programmable Read Only Memory. It is usually a secondary storage memory in devices containing data that is retained even if the device looses power supply. Because of the ability to alter single bytes of data, **EEPROM** devices are used to store personal preference and configuration data in a wide spectrum of consumer, automotive, telecommunication, medical, industrial, and PC applications.

I2C is a multi-master serial single-ended bus that is used to attach low-speed peripherals to computer or embedded systems. I²C uses only two open-drain lines, Serial Data Line (SDA) and Serial Clock (SCL), pulled resistors. SCL line is driven by a master, while SDA is used as bidirectional line either by master or slave Up to 112 slave devices can be connected to the same bus. Each slave must have a unique address.

easyPIC-40 equips an socket for external **EEPROM** IC with different capacity,which is connected to **RC3(SCL) and RC4(SDA)) via** jumper **SW4**. Of course, you can also connect other IOs to **EEPROM** module,like **RB0**(SDA) and **RB1**(SCL) of PIC18F4550,via **J5** using dupont wires,and and this time you need to disconnect the jumper **SW4**. See the comments in the source code provided in CD Rom for how to connect the hardware.
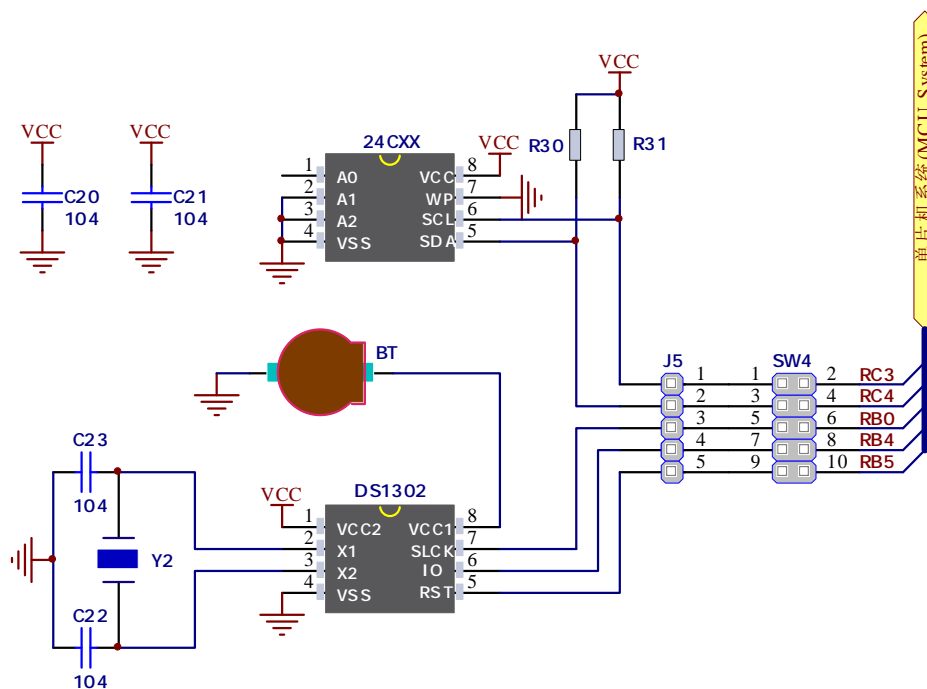

Figure 2-12: Real Time Clock and EEPROM Module

2.DS1302 Real Time Clock

The **DS1302** Trickle Charge Timekeeping Chip contains a real time clock/calendar and 31 bytes of static RAM. It communicates with a microprocessor via a simple serial interface. The real time clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The end of the month date is automatically adjusted for months with less than 31 days, including corrections for leap year. The clock operates in either the 24–hour or 12–hour format with an AM/PM indicator. Interfacing the **DS1302** with a microprocessor is simplified by using synchronous serial communication. Only three wires are required

to communicate with the clock/RAM: (1) RST (Reset), (2) I/O (Data line), and (3) SCLK (Serial clock). Data can be transferred to and from the clock/RAM 1 byte at a time or in a burst of up to 31 bytes. The **DS1302** is designed to operate on very low power and retain data and clock information on less than 1 microwatt. The **DS1302** is the successor to the **DS1202**. In addition to the basic timekeeping functions of the **DS1202**, the **DS1302** has the additional features of dual power pins for primary and back–up power supplies, programmable trickle charger for VCC1, and seven additional bytes of scratchpad memory.
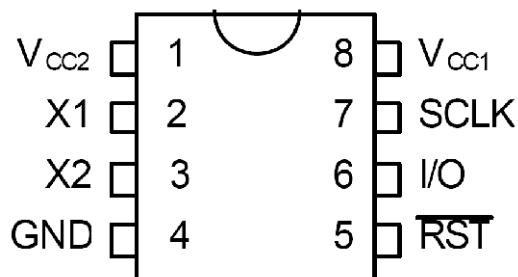
Figure 2-13: DS1302 pin assignment

Num	Name	Function
1	VCC2	Power Supply Pins
2	X1,	32.768 kHz Crystal Pins
3	X2	32.768 kHz Crystal Pins
4	GND	Ground
5	RST	Reset
6	I/O	Data Input/Output
7	SCLK	Serial Clock
8	VCC1	Power Supply Pins

In order to connect **DS1302 module** to the microcontroller you must enable the connection on jumper **SW4** .Prior to using DS1302 RTC in your application,make sure to disconnect other unused peripherals, and additional pull-up or pull-down resistors from the interface lines in order not to interfere with signal/data integrity.

11.SD/MMC Card Module

A MultiMedia Card (MMC) is a memory card manufactured in Flash technology. The standard size of these cards is 24×32×1.4 mm. MMC cards have been superseded by Secure Digital Cards (SD cards) lately, but they are still very popular and widely used because they can be utilized with most devices that support SD cards.

Both types of cards are used as memory data storage in portable devices such as cameras, digital audio players, cellular phones, etc. Most modern computers are supplied with an MMC/SD slot that can read both MMC and SD cards. The MMC/SD module enables data read/write between a microcontroller and MMC/SD cards. Data transfer is performed via a standard Serial Peripheral Interface (SPI). This module only 3.3V power supply.
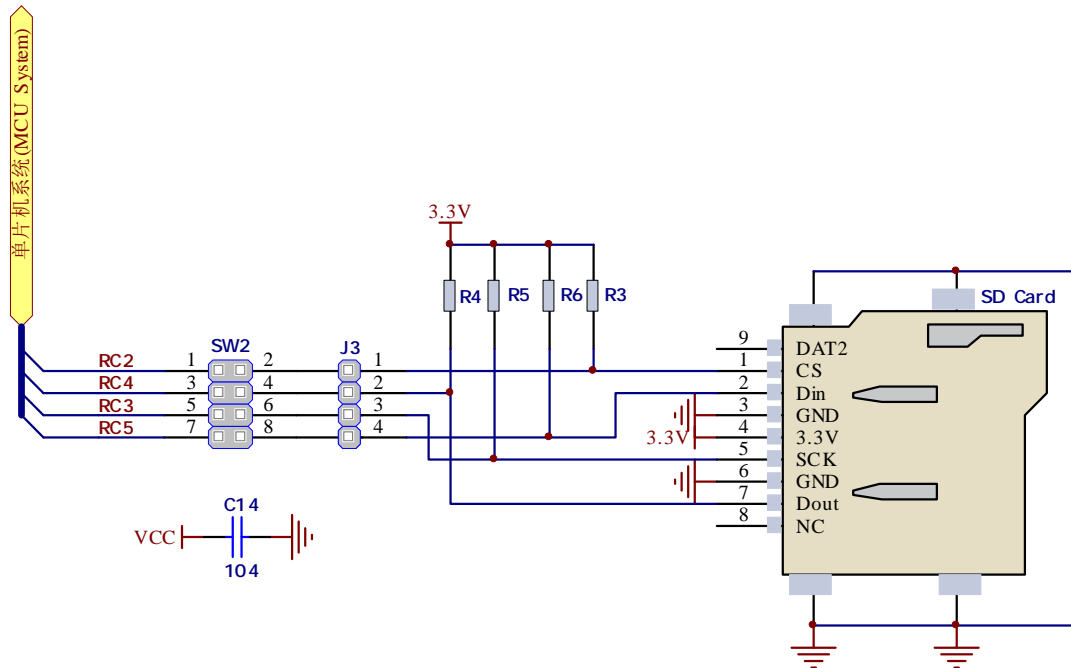
Figure 2-14: SD/MMC Card Module

In order to connect SD/MMC Card Module to the microcontroller you must enable the connection on jumper **SW2** . Prior to using The SD/MMC Card Module in your application, make sure to disconnect other unused peripherals, and additional pull-up or pull-down resistors from the interface lines in order not to interfere with signal/data integrity.
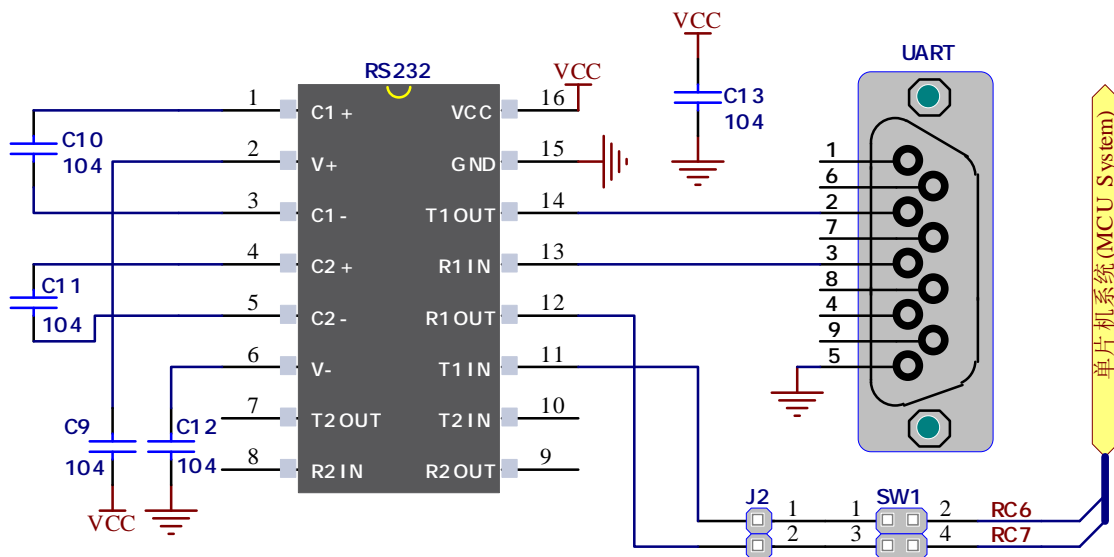
12.UART via RS-232

Figure 2-15: RS232 Module

The **UART** (universal asynchronous receiver/transmitter) is one of the most common ways of exchanging data between the MCU and peripheral components. It is a serial protocol with separate transmit and receive lines, and can be used for full-duplex communication. Both sides must be initialized with the same baud rate, otherwise the data will not be received correctly. **RS-232** serial communication is performed through a 9-pin SUB-D connector and the microcontroller **UART** module. In order to enable this communication, it is necessary to establish a connection between RX and TX lines on SUB-D

connector and the same pins on the target microcontroller. Since RS-232 communication voltage levels are different than microcontroller logic levels, it is necessary to use a RS-232 Transceiver circuit. **easyPIC-40** equips an **RS-232** module with a sp3232/max3232 IC, which is connected to **MCU** via jumper **SW1**.

13.LCD 2x16 characters (Socket)

Liquid Crystal Displays or LCDs are cheap and popular way of representing information to the end user of some electronic device. Character LCDs can be used to represent standard and custom characters in the predefined number of fields. The **easyPIC-40** provides the connector and the necessary interface for supporting 2x16 character LCDs. This type of display has two rows consisted of 16 character fields. Each field is a 7x5 pixel matrix. Board equips an universal socket allowing you to install 16x2 LCD very easily.

Connector pinout explained

1-GND

2-5V

3-Vo,LCD contrast level from potentiometer 1602-VOL

4-RS,Register Select Signal

5-E,Display Enable

6-R/W,Determines whether display is in Read or Write mode. It's always connected to GND, leaving the display in Write mode all the time.

7~14-Data Port,Display is supported in 8-bit data mode.
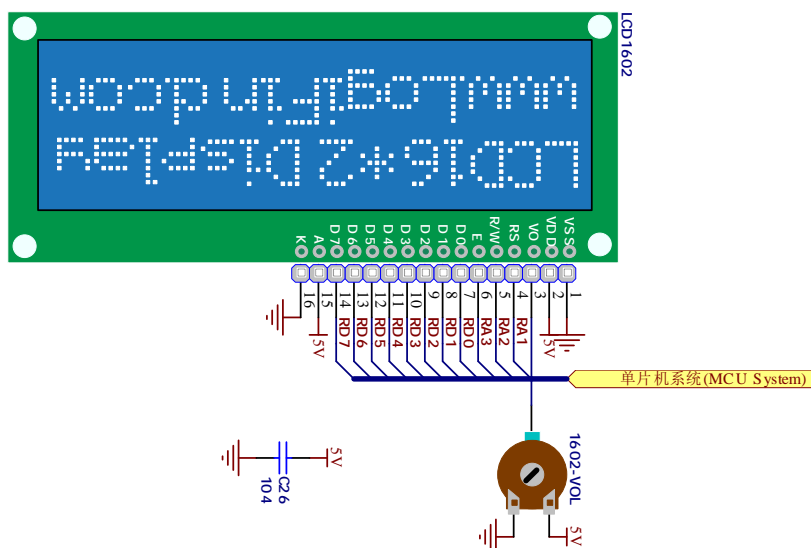
15-LED+,Connection with 5V

16-LED-,Connection with GND

Figure 2-16: LCD 2x16 characters Socket

IMPORTANT:

Make sure to Place the LCD1602 in the right direction.

Make sure to turn off the power supply before placing LCD onto the board. Otherwise your display can be permanently damaged.
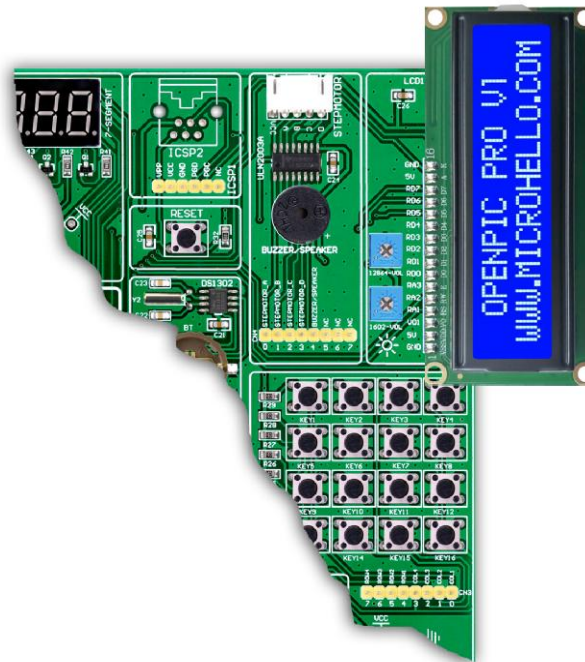
Figure 2-17: LCD1602 Installing Direction

14.GLCD 128x64(Socket)

Graphical Liquid Crystal Displays, or GLCDs are used to display monochromatic graphical content, such as text, images, humanmachine interfaces and other content. The easyPIC-40 provides the connector and necessary interface for supporting GLCD with resolution of 128x64 pixels and proper PINOUTs.It is compatible with the most popular LCD12864 in the market with KS108 or ST7920 display controller.The
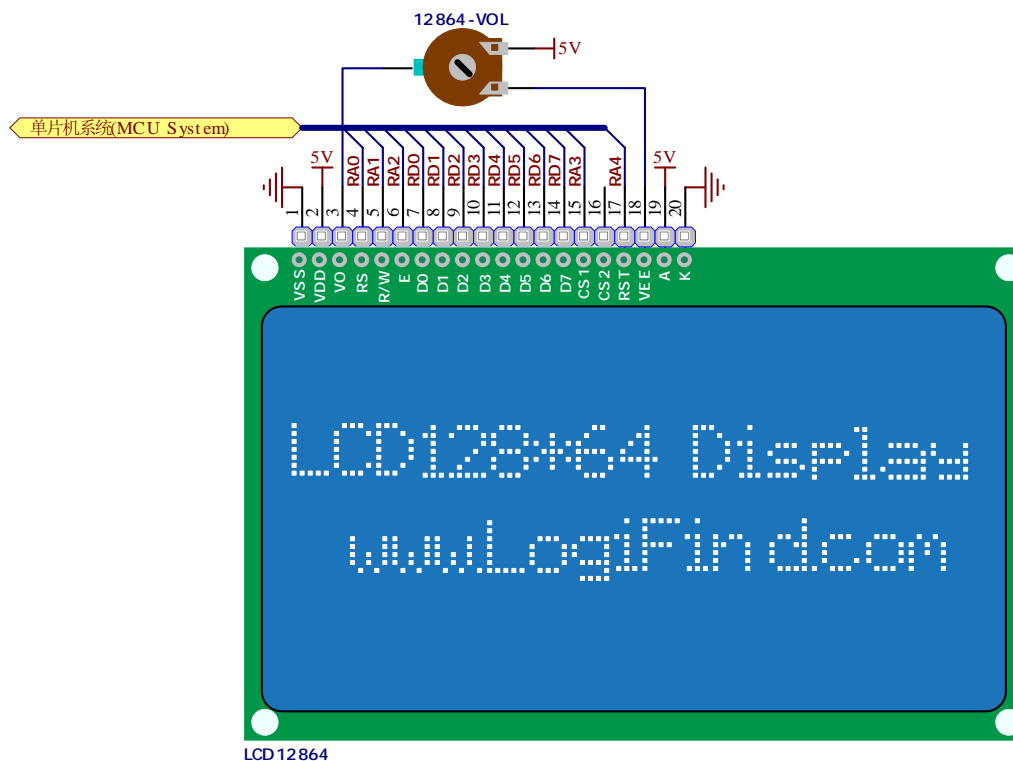

Figure 2-18: LCD12864 characters Socket

example we provide is only for LCD12864 with ST7920 display controller.The **easyPIC-40** equips an universal socket allowing you to install 128*64 Graphical LCD very easily.

Connector pinout explained:

1-GND

2-VCC

3-Vo,GLCD contrast level from potentiometer 12864-VOL

4-RS,Data (High), Instruction (Low) selection

5-R/W,Determines whether display is in Read or Write mode.

6-E,Display Enable line

7~14,D0–D7,Data lines

15-PSB,Parallel/Serial Mode Selection

16-NC

17-RST

18-VEE

19-LEDA - 5V

20-LEDK – GND
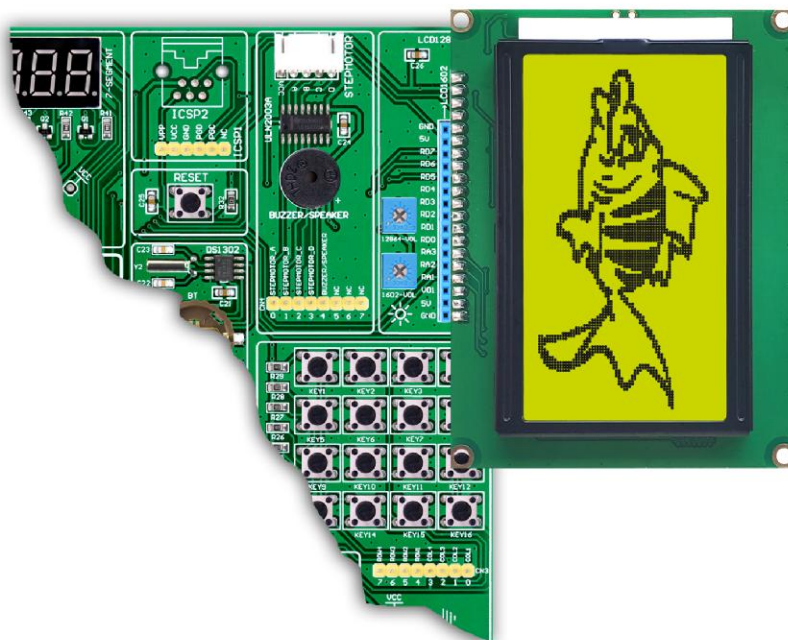
Figure 2-19: LCD12864 Installing Direction

IMPORTANT:

Make sure to Place the LCD12864 in the right direction.

Make sure to turn off the power supply before placing LCD onto the board. Otherwise your display can be permanently damaged.

15.ICSP Programming Port

In-Circuit Serial Programming (ICSP) is an enhanced ISP technique implemented in Microchip's PICmicro One-Time-Programmable (OTP) and FLASH RISC microcontrollers (MCU). Use of only two I/O pins to serially input and output data makes ICSP easy to use and less intrusive on the normal operation of the MCU.
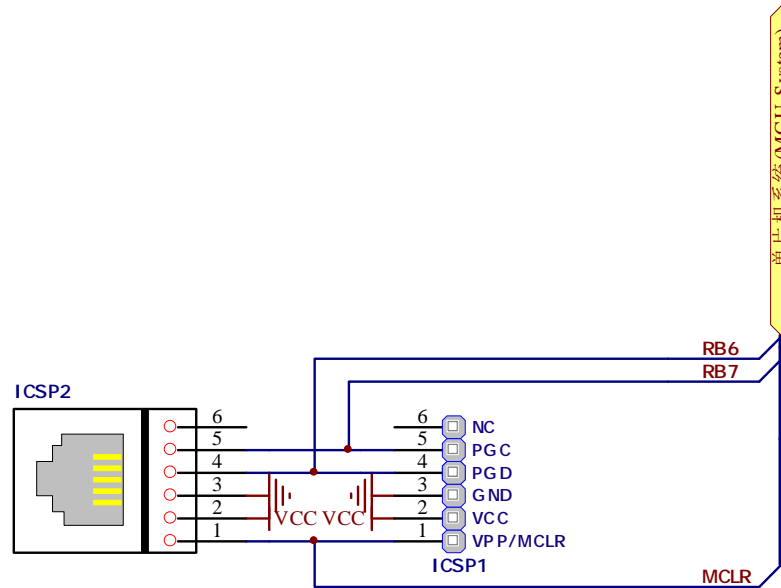
Figure 2-20: ICSP Connector

The **easyPIC-40** has two standard ICSP interfaces (ICSP1 and ICSP2) which allow you to connect PICKIT2, PICKIT3, ICD2 or other Third-party Programmer/debugger directly.

16.System Reset

The **easyPIC-40** reset circuit is made with 10K pull-up resistor, **RESET** button connected to GND and a 0.1uF capacitor for filtering.
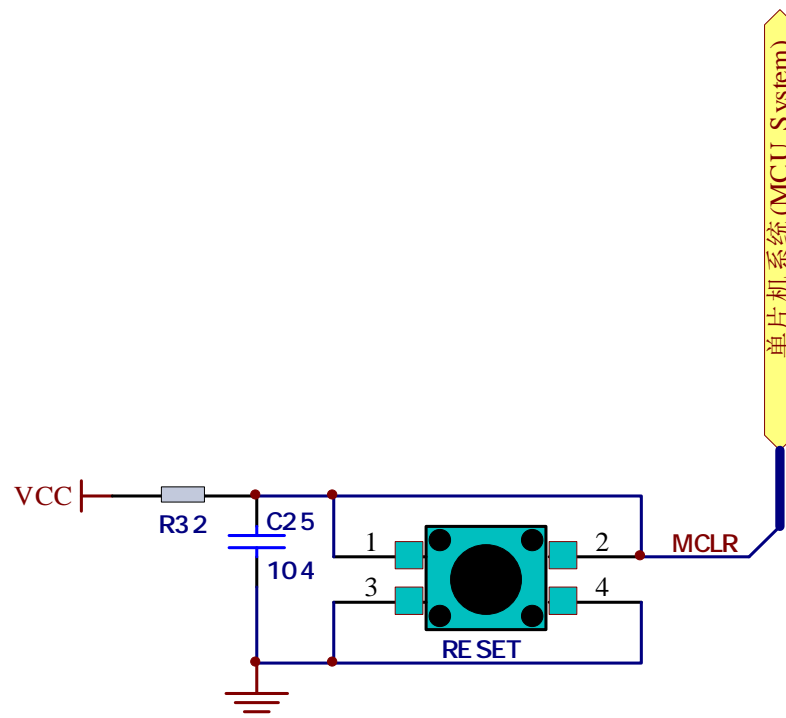

Figure 2-21: System Reset

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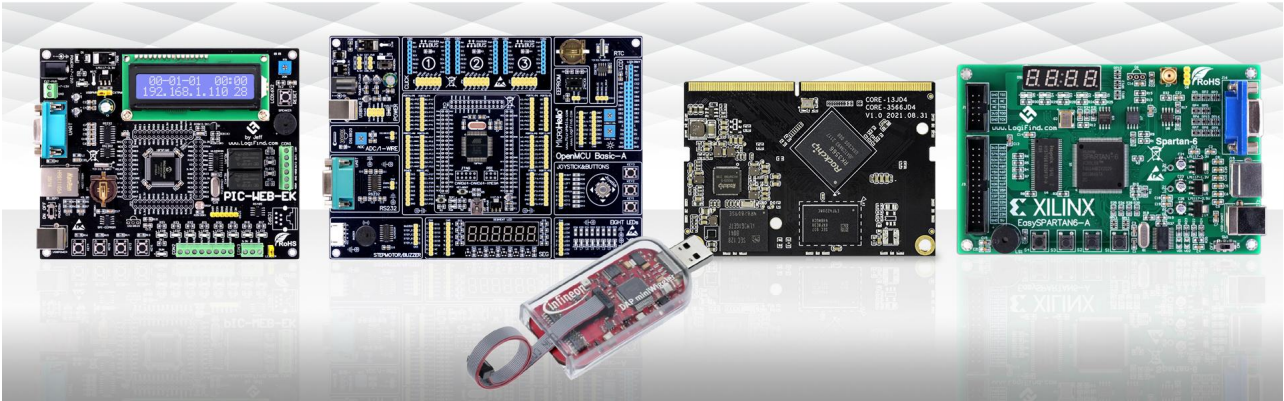
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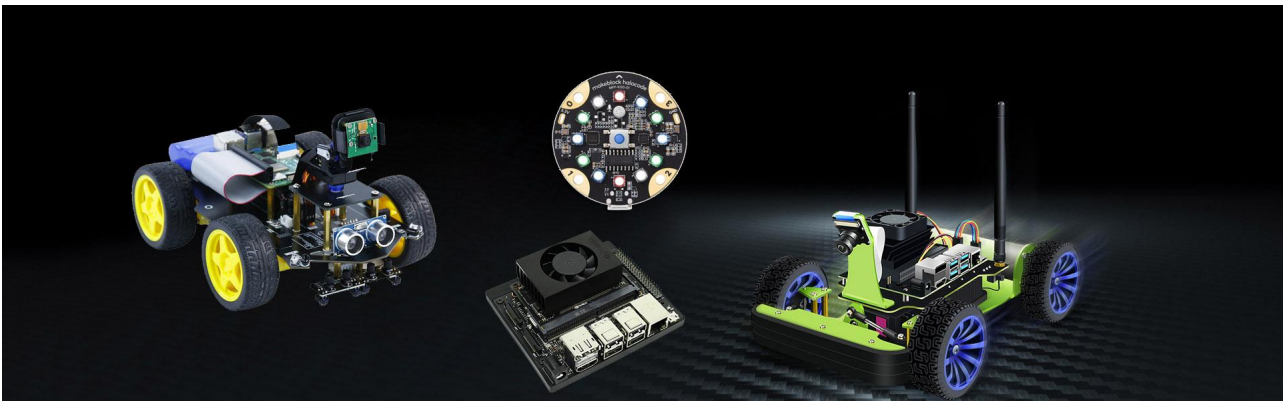
3. Attitude Solutions: Inclinometer，Dynamic Inclinometer，Tilt Switch，Dynamic Tilt Switch，

Digital Compass，Accelerometer，Digital Display Inclinometer，GYRO，AHRS，North Finder，Inertial Navigation System，Photovoltaic Tilt Sensor.

4. CAN Bus Series: CAN Analyzer, USBCAN-OBD, Ethernet/Modbus TCP/Modbus RTU/WIFI to CAN, CANopen to UART, CANopen slave/master Converter, Programmable Smart Gateway Series, CANopen IO Coupler, Modbus IO Coupler.

5. Displays: Character LCD display, Graphic LCD display, Color LCD display(TFT), Segment LCD display, Segment LED display, Black & White ePaper, Multi-Color ePaper, Full Color ePaper.

6. Sensors and Sensor Modules: Pressure/Force Sensor,Distance Measuring Sensor, Acceleration Sensor, Micro Flow/Air Flow Sensor, Dust Sensor, Temperature and Humidity Sensor, Transmissive Sensor, Hall-effect Rotary Position Sensor, Air Quality Sensor,Gas sensor(for CO2，CH4，O2，NH3，H2S，NO2，O3，SO2，CL2，HCL，HF，PH3，ETO，H2，HCHO，C2H5OH，C3H8，NO，CLO2，HCN or CH3SH，etc.)
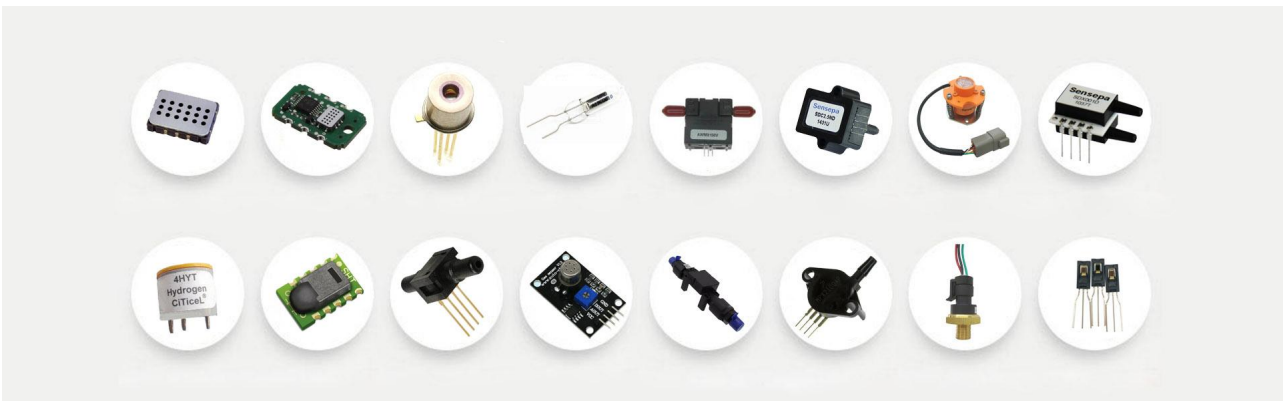
7. Wireless Modules: RF Module，LoRa Module，FSK Front-End RF Module，Sensor Acquisition

Gateway and Node，Data Transceiver Module，Walkie Talkie Module，Wireless Switch Module，Wireless Audio Module，GPS Module，SDR，LoRaWan Gateways and Nodes，ASK & Superheterodyne Module.
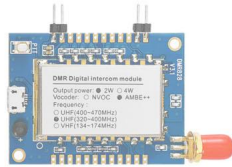

LoRa module

Wireless Data Transceiver Module

Wireless Switch Module

Digital Walkie Talkie Module

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