FARES PCB

For Electronic Solutions

Eta32mini

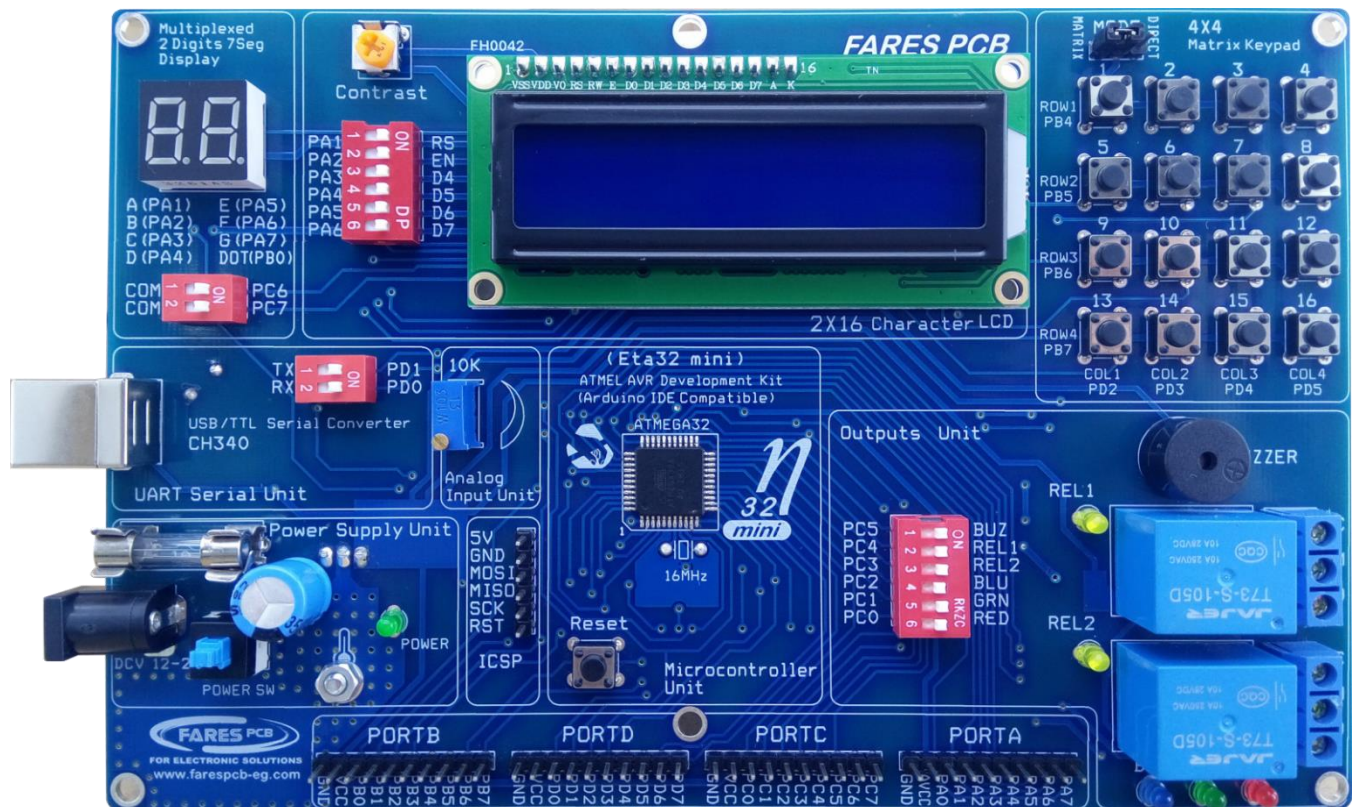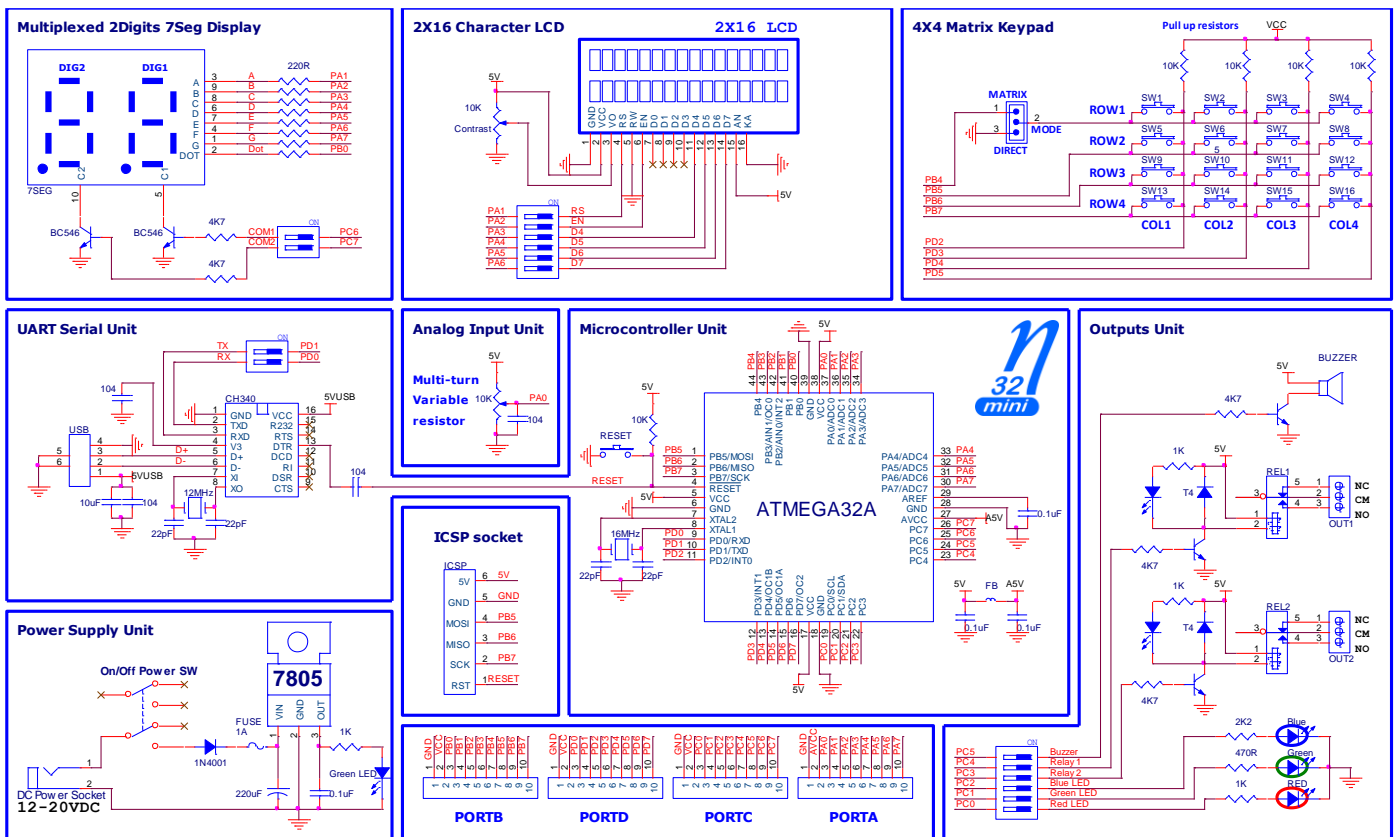# ATMEL AVR Development Kit

General Description

Eta32mini kit is an AVR development board designed particularly for students, beginners and recent graduated engineers to provide easy developing of AVR microcontroller projects.

Eta32mini supports ATMEGA32 microcontroller chip. *Eta32mini* kit provides the most common primary devices and circuits, such as LCD, KEYPAD, serial interface, and more. Thus, it saves most of the wasted time and efforts in hardware design and test, hence, a developer can focus his efforts on firmware development. All I/O pins are brought out via pin header for direct port accessing.

Eta32mini kit comes preprogrammed with UART bootloader, which eliminates the need for external programmer (programming using Eta32mini IDE from FARES PCB Co). However, kit can be programmed using Arduino IDE (another bootloader). Also standard 6 pin header socket is included (ICSP) for external programmers.

FARES PCB

Multiplexed 2 Digits 7Seg Display

Contrast

FH0042

16

VSS VDD V0 RS RW E D0 D1 D2 D3 D4 D5 D6 D7 A K

4X4 Matrix Keypad

MODE DIRECT

MATRIX

A (PA1)   E (PA5)
B (PA2)   F (PA6)
C (PA3)   G (PA7)
D (PA4)   DOT(PB0)

PA1 RS
PA2 EN
PA3 D4
PA4 D5
PA5 D6
PA6 D7

ON / DP

ROW1 PB4   1 2 3 4
ROW2 PB5   5 6 7 8
ROW3 PB6   9 10 11 12
ROW4 PB7   13 14 15 16

COM1   ON   PC6
COM2   PC7

2X16 Character LCD

COL1 PD2 COL2 PD3 COL3 PD4 COL4 PD5

TX   ON   PD1
RX   1 2 PD0

10K

(Eta32 mini)
ATMEL AVR Development Kit
(Arduino IDE Compatible)

ATMEGA32

Outputs Unit

BUZZER

USB/TTL Serial Converter
CH340

Analog Input Unit

16MHz

PC5 BUZ
PC4 REL1
PC3 REL2
PC2 BLU
PC1 GRN
PC0 RED

ON / RX2C

REL1

UART Serial Unit

Power Supply Unit

5V
GND
MOSI
MISO
SCK
RST

Reset

Microcontroller Unit

REL2

ICSP

POWER

DCV 12-20

POWER SW

FARES PCB
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PORTB   PORTD   PORTC   PORTA

Eta32mini kit

Multiplexed 2Digits 7Seg Display

DIG2   DIG1   220R

A PA1
B PA2
C PA3
D PA4
E PA5
F PA6
G PA7
DOT PB0

7SEG

BC546   BC546   4K7   COM1 ON PC6
                      COM2   PC7
                4K7

2X16 Character LCD

2X16 LCD

5V

10K

Contrast

PA1 RS
PA2 EN
PA3 D4
PA4 D5
PA5 D6
PA6 D7

5V

XXXX

4X4 Matrix Keypad

Pull up resistors   VCC

10K 10K 10K 10K

MATRIX

MODE

DIRECT

ROW1   SW1 SW2 SW3 SW4
ROW2   SW5 SW6 SW7 SW8
ROW3   SW9 SW10 SW11 SW12
ROW4   SW13 SW14 SW15 SW16

PB4
PB5
PB6
PB7

PD2
PD3
PD4
PD5

COL1 COL2 COL3 COL4

UART Serial Unit

TX ON PD1
RX 1 2 PD0

104

CH340
GND VCC
TXD R232
RXD RTS
V3   DTR
D+   DCD
D-   RI
XI   DSR
XO   CTS

USB

5VUSB

12MHz

10uF 104 22pF 22pF 104

Analog Input Unit

Multi-turn Variable resistor

5V

10K   PA0

104

Microcontroller Unit

5V

ATMEGA32A

RESET

10K

RESET

16MHz

22pF 22pF

PB5/MOSI
PB6/MISO
PB7/SCK
RESET
VCC
GND
XTAL2
XTAL1
PD0/RXD
PD1/TXD
PD2/INT0

PA4/ADC4
PA5/ADC5
PA6/ADC6
PA7/ADC7
AREF
GND
AVCC
PC7
PC6
PC5
PC4

5V FB A5V

0.1uF 0.1uF

ICSP socket

ICSP
5V   6   5V
GND   5   GND
MOSI 4   PB5
MISO 3   PB6
SCK   2   PB7
RST   1   RESET

Outputs Unit

BUZZER

5V

4K7

1K 5V

REL1

NC
CM
NO
OUT1

4K7

1K 5V

REL2

NC
CM
NO
OUT2

4K7

PC5 Buzzer
PC4 Relay 1
PC3 Relay 2
PC2 Blue LED
PC1 Green LED
PC0 Red LED

ON

2K2 Blue
470R Green
1K RED

Power Supply Unit

On/Off Power SW

7805
VIN GND OUT

FUSE 1A   1K

1N4001

DC Power Socket
12-20VDC

220uF   0.1uF   Green LED

PORTB / PORTD / PORTC / PORTA

PORTB   PORTD   PORTC   PORTA

Eta32mini kit (schematic)

Eta32mini key features

- Power supply unit.
- ATMEGA32 Microcontroller with reset switch and crystal oscillator.
- 4X4 matrix keypad.
- Output unit involves three output LEDs, two output relays and one output buzzer.
- Multiplexed two digits 7 segments display.
- 2X16 LCD display.
- Variable analog input using high precise multi-turn resistor.
- Virtual COM port via USB.
- Standard 6 pin header socket ICSP for external programmers.
- All microcontroller I/O pins are brought out via pin header.

Power Supply Unit

Power could be supplied from DC power supply adaptor via DC power socket (12V - 20V).

Power supply unit features:

- On/Off Power switch.
- Green LED power indicator.
- 7805 (5V power regulator 5% tolerance).
- 1A Fuse for over current protection.

Note: - Eta32mini kit is protected against reversed polarity of power.

Power supply unit
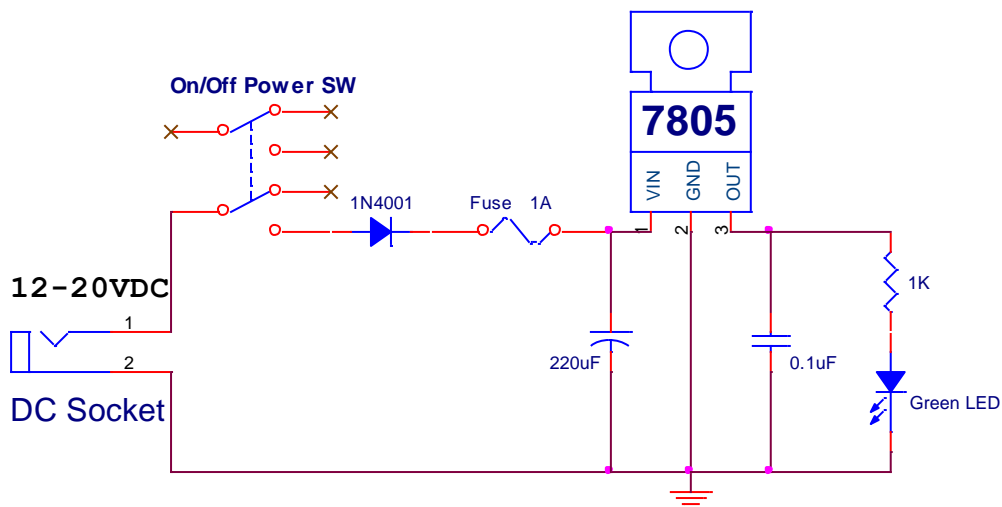
Power supply unit (schematic)

Microcontroller Unit

44 pin TQFP ATMEGA32A chip with 16 MHz crystal oscillator and Push button reset switch.

Microcontroller unit
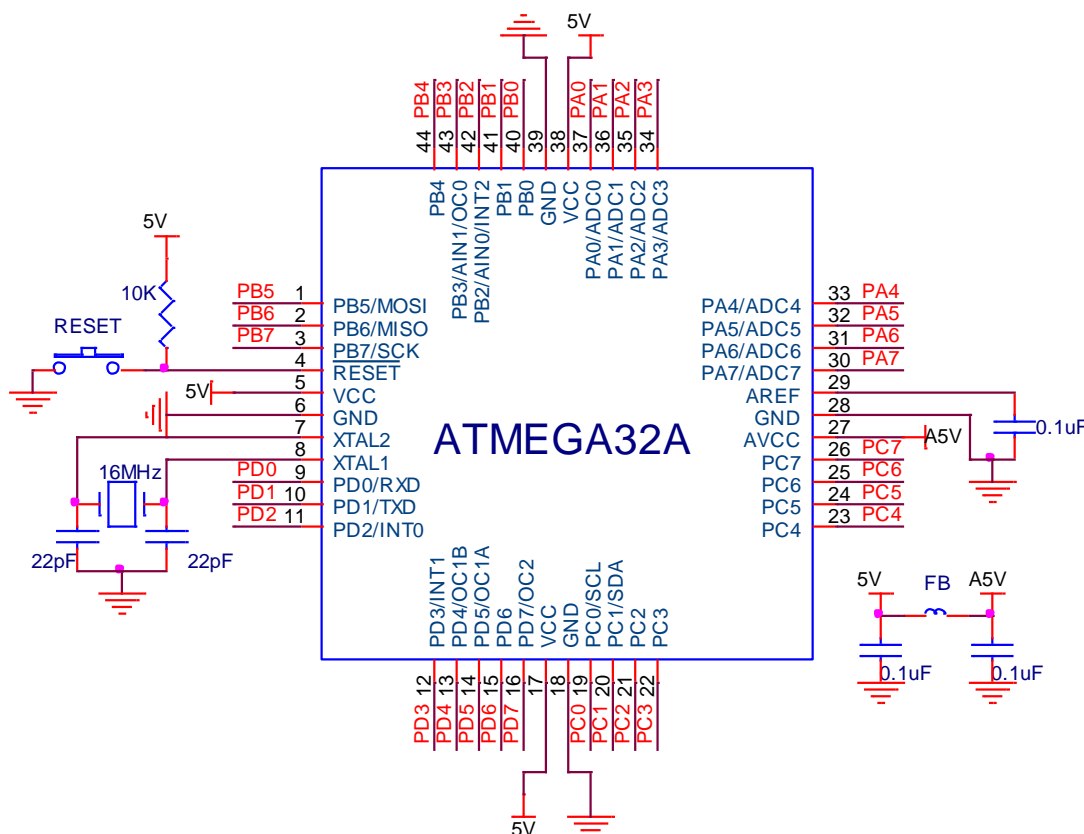
Microcontroller unit (schematic)

4X4 Matrix Keypad Unit

Eta32mini Kit includes 16 push button switches. Switches are configured as 4 rows intersected by 4 columns. Each intersection creates a switch position.
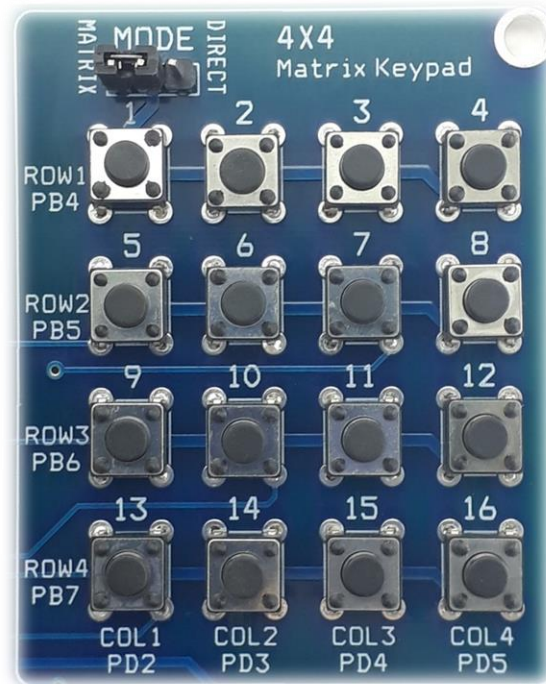
4X4 matrix keypad unit
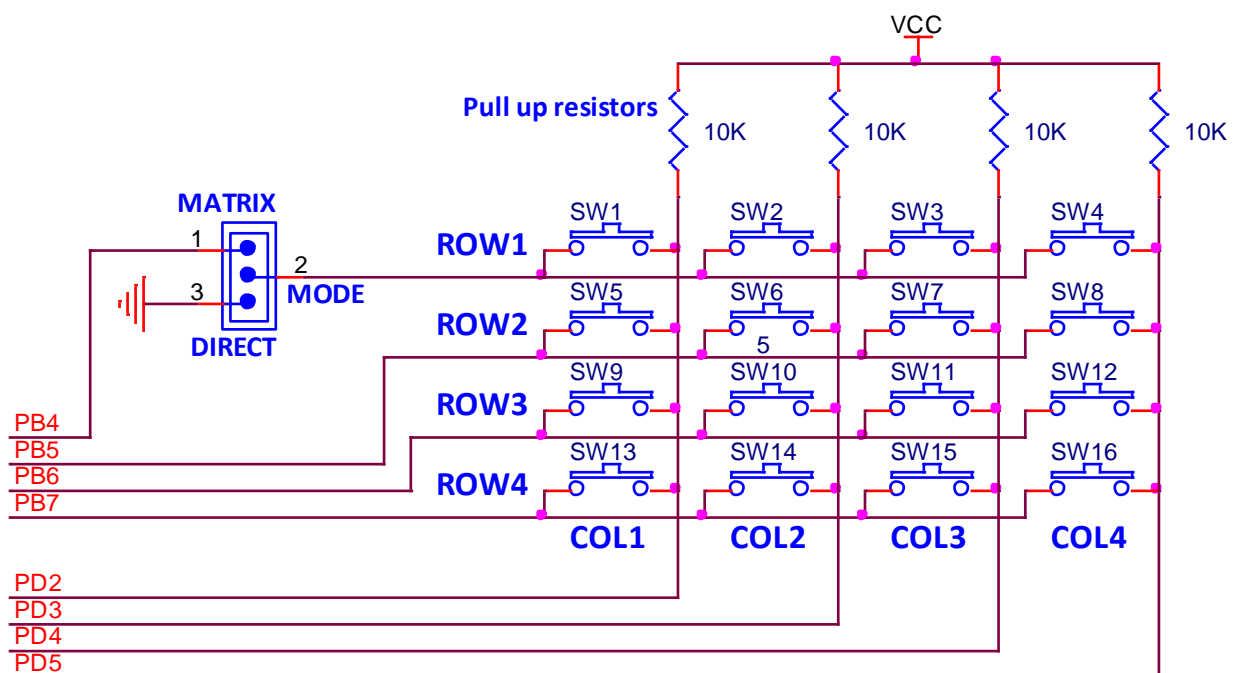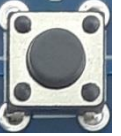
4X4 matrix keypad unit (schematic)

Rows and Columns are connected to microcontroller as following.

Row number	*Microcontroller pin*	Arduino pin
ROW 1	PB4	4
ROW 2	PB5	5
ROW 3	PB6	6
ROW 4	PB7	7

Column number	*Microcontroller pin*	Arduino pin
COL 1	PD2	10
COL 2	PD3	11
COL 3	PD4	12
COL 4	PD5	13

ROW		1	2	3	4
	ROW1 (PB4)				
	ROW2 (PB5)	5	6	7	8
	ROW3 (PB6)	9	10	11	12
	ROW4 (PB7)	13	14	15	16
		COL1 (PD2)	COL2 (PD3)	COL3 (PD4)	COL4 (PD5)
		COLUMN			

Keypad can be configured as 4X4 matrix keypad (16 switches used) or as 4 direct switches.

Matrix Mode

In matrix mode, all 16 switches are activated and configured as four row lines and four column lines. Microcontroller scans these lines to detect a button pressed state. Column lines are pulled up by 10KΩ resistors. (i.e. microcontroller port pin reads high if no switch is pressed).

Scan process starts by setting all rows and columns as inputs.

To scan switches in a row, microcontroller configures it as output and sets it to low, then checks columns one at a time. If a column line goes low, microcontroller detects a pressed switch, otherwise, no pressed switch and goes to scan next row and so on.

To set keypad in matrix mode, just set MODE jumper to Matrix position as shown below.
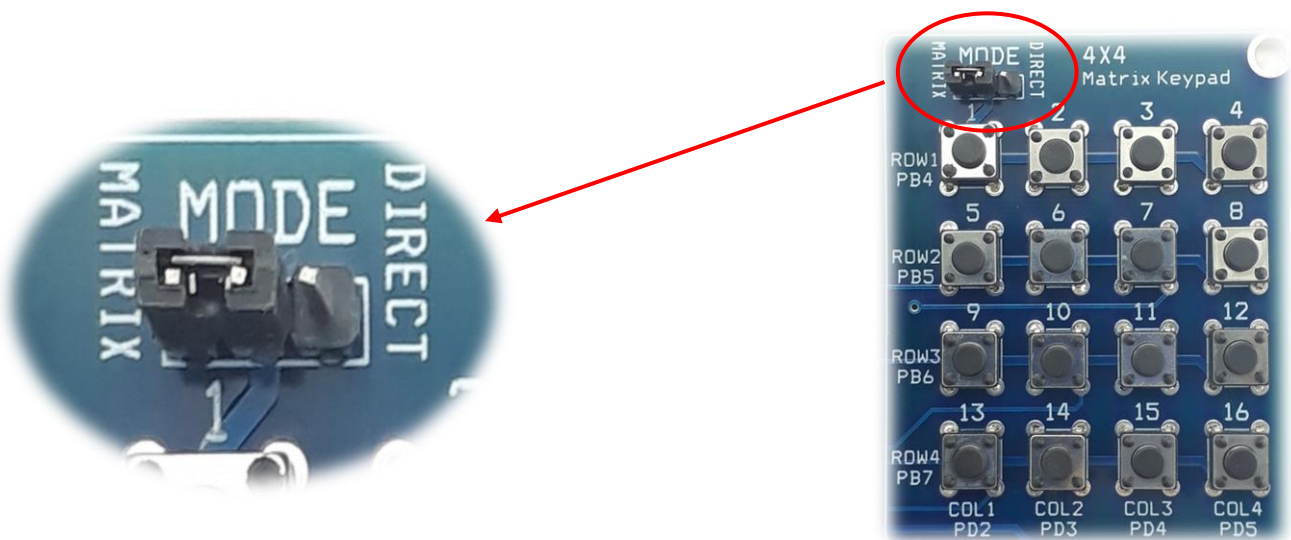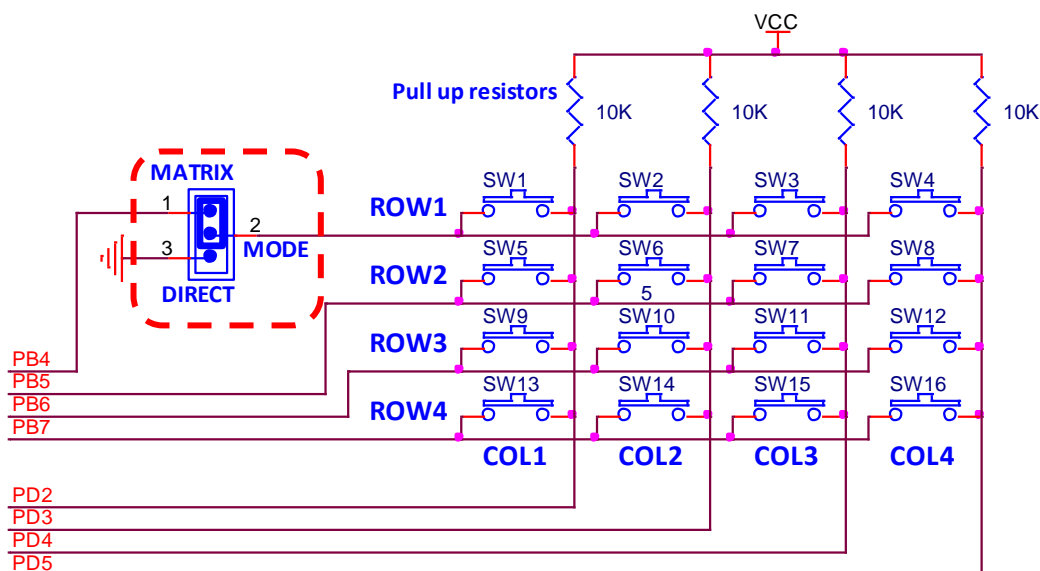
Direct Mode

In direct mode, just 4 switches are activated to save microcontroller pins in case of no need for more switches and reducing firmware complexity in scanning operation. Switches in first row only is enabled (i.e. SW1, SW2, SW3 and SW4) and can be read directly as inputs through column lines. Microcontroller checks the column lines. If a column line goes low, it means a switch is pressed.

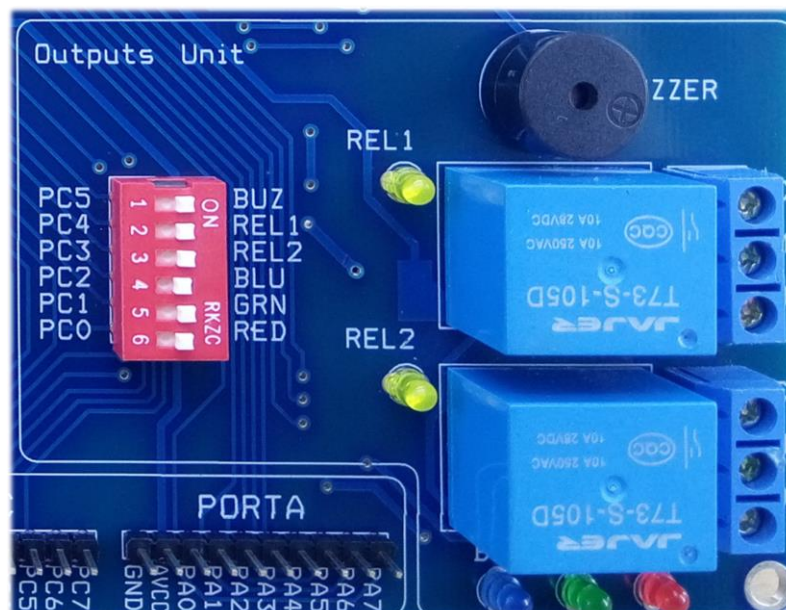To set keypad in direct mode, just set MODE jumper to direct position, as shown below:
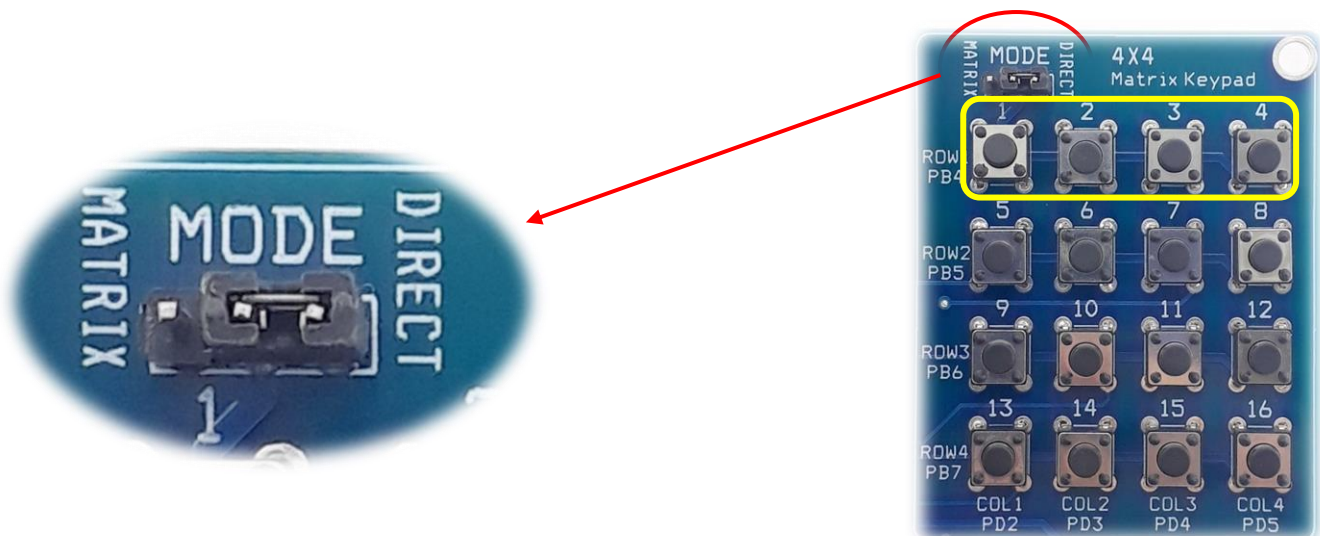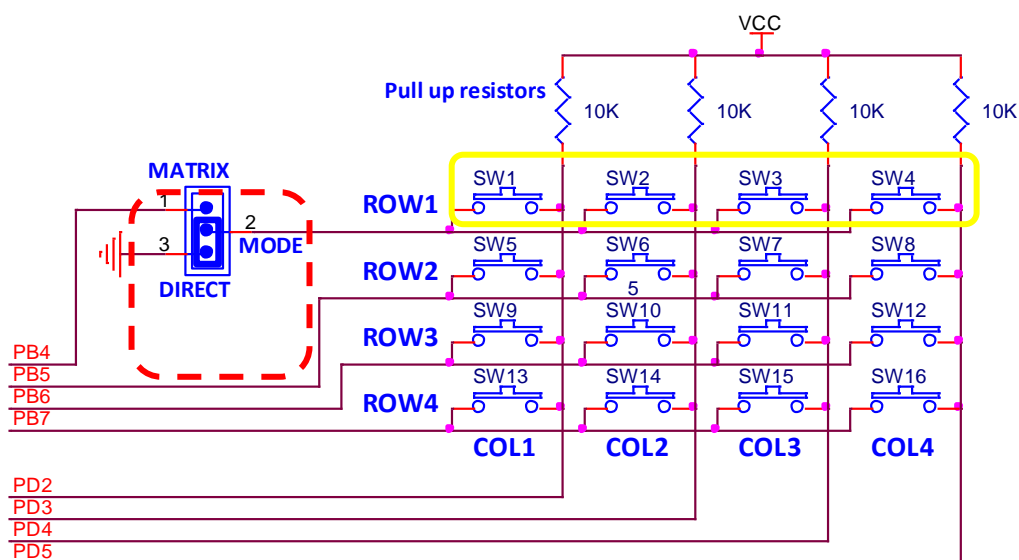
Output Unit

This unit contains six outputs distributed as three LEDs, two relays and one Buzzer.

Outputs are connected to microcontroller as following:

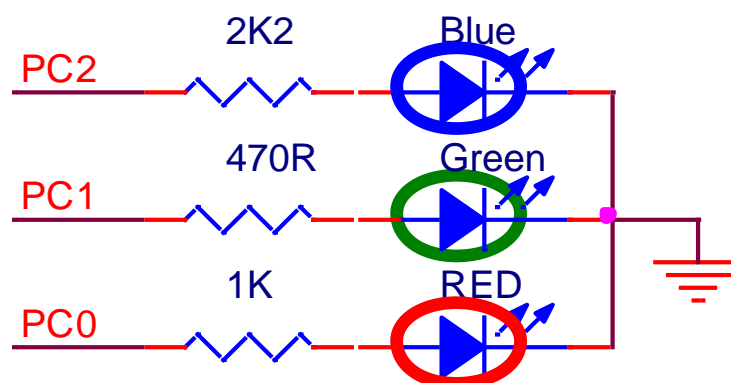| Output	Microcontroller pin	Arduino pin
Buzzer	PC5	21
Relay1	PC4	20
Relay2	PC3	19
Blue LED	PC2	18
Green LED	PC1	17
Red LED	PC0	16

Output unit
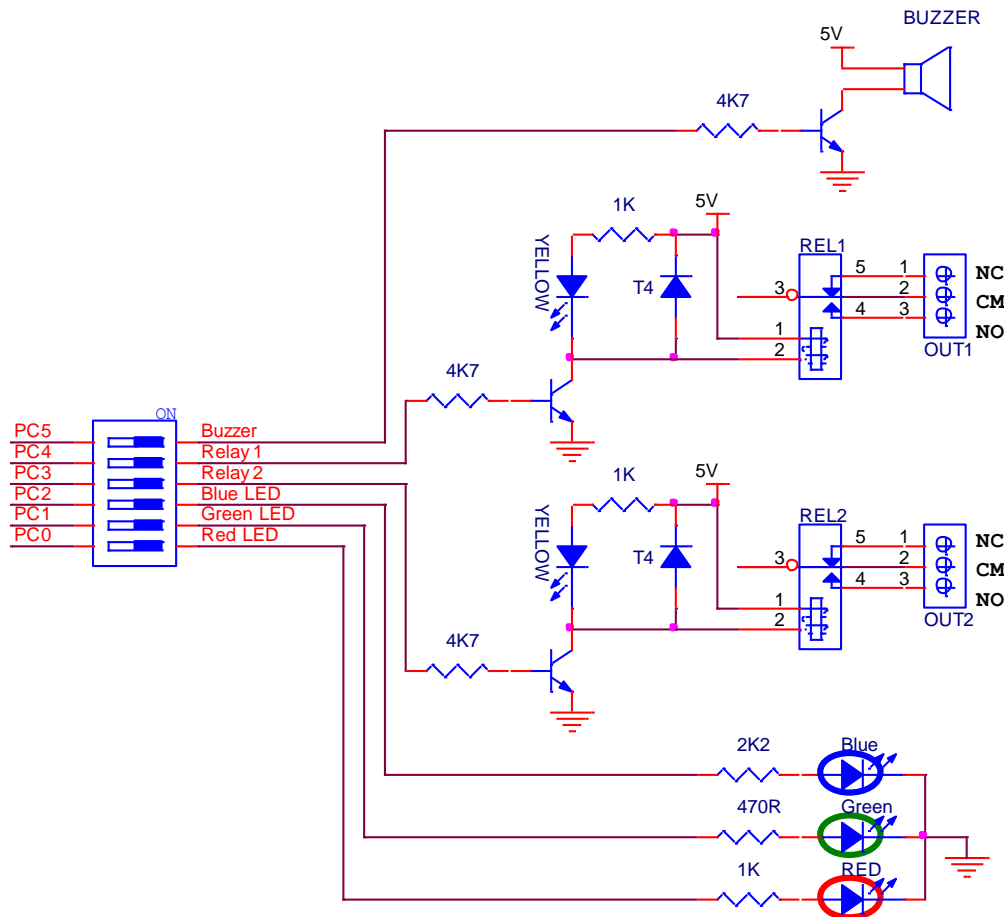
Output unit (Schematic)

Three output LEDs

Three LEDs with current limiting resistors are connected to port pins **(PC0, PC1 and PC2)**. Red, Green and Blue LED.

Blue LED is connected to **PC.2** in microcontroller.
**Green** LED is connected to **PC.1** in microcontroller.
Red LED is connected to **PC.0** in microcontroller.

Each LED can be enabled or disabled via DIP switch. LEDs are active high. i.e. output high turns on LED and output low turns off it.

Two output relays

Two output relays are added to *Eta32mini* kit to allow dry contact switches, which is suitable for AC or DC switching applications. Each relay has its own related LED for status indication and can be individually enabled via DIP switch. Relays are driven from NPN transistors. Freewheeling diodes are included to protect transistors from back EMF voltage that arises on relay coil during switching off.
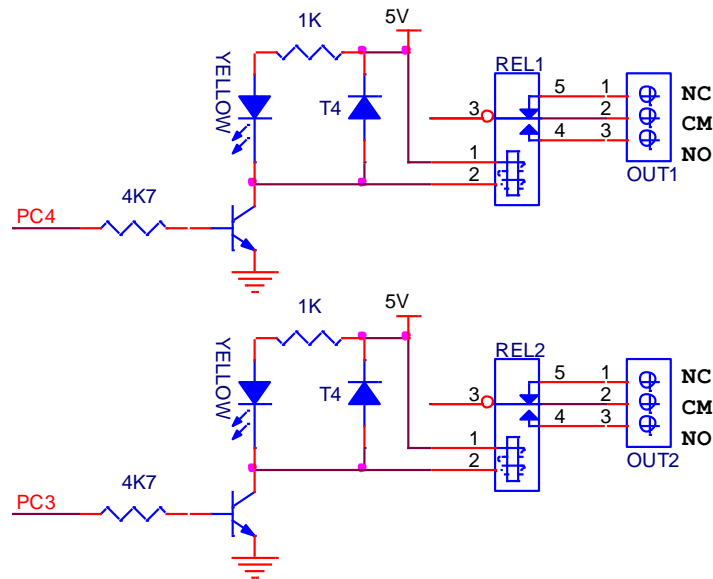
Relay1 is attached to port pin **PC4** and relay2 is attached to port pin **PC3**. Relays are 5V coil and rated to 5A contacts (resistive load).
Both of normally open and normally closed contacts are brought out via screw clamp terminals.

One output buzzer

One output buzzer (6VDC) is included in output unit to port pin **PC5**. Also, it may be enabled using DIP switch.
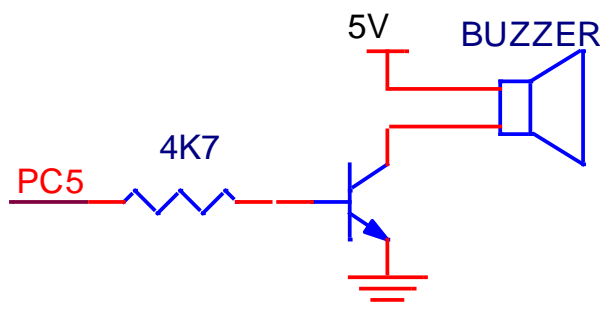
7Segment Display

7segment display is used to indicate numerical data. It can display digits from 0 to 9 and some characters such as A,B,C,H,E,F ,etc. 7segment display is very popular and has many applications.

Eta32mini includes multiplexed two digits 7segment display.

Multiplexed Two Digits 7seg Display Unit

Two multiplexed 7seg digits are added to *Eta32mini* kit. 7segments are referred to by letters "a", "b", "c", "d", "e", "f", "g", "dot". Both digits share the same segments. i.e. segment "a" is the same for DIG1 and DIG2. Each digit has its own common, so there are two commons for the two digits. 7segment display is common cathode, so a high on a segment turns it ON while low turns it OFF. Commons are driven from NPN transistors .So, a high from microcontroller turns transistor on, which enables the digit.

Segments commons are connected to microcontroller as shown in table：

Segment	microcontroller Pin	Arduino Pin
A	PA1	25
B	PA2	26
C	PA3	27
D	PA4	28
E	PA5	29
F	PA6	30
G	PA7	31
Dot	PB0	0

7Seg Commons are connected to microcontroller as shown in table：

Common	microcontroller Pin	Arduino Pin
Digit 1	PC6	22
Digit 2	PC7	23

Note:-
- Each 7seg digit can be enabled or disabled individually using DIP switch.
- 7seg module and 2X16LCD share the same port. So, disable LCD before using 7Segments display.

7Segment display
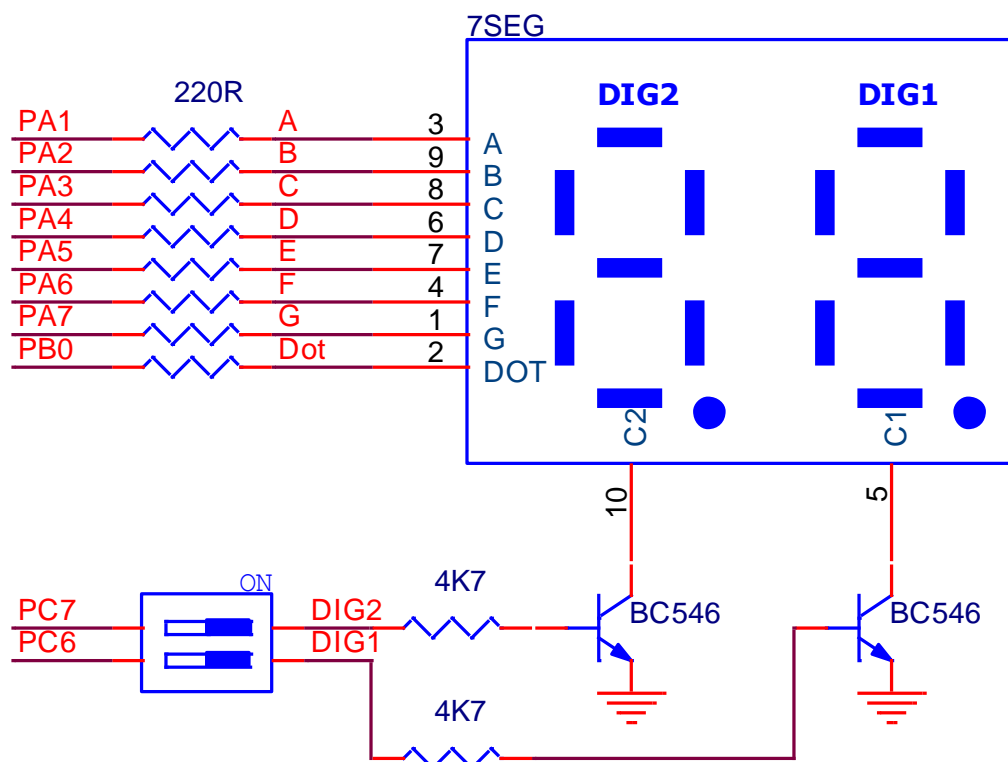
7Segment display (schematic)

2X16 LCD Display Unit

2X16 alphabetic LCD with contrast control configured in 4 bit mode is connected to **PORTA** via DIP switch as following:

LCD module pinout number, symbol and function:

LCD pin number	LCD pin symbol	LCD pin function
1	VSS	Ground
2	VCC	+5V
3	VO	Contrast adjustment
4	RS	Register Select(0:Command , 1:Data)
5	R/W	R/W(0:Write , 1:Read)
6	EN	Enable
7	D0	Data bit 0
8	D1	Data bit 1
9	D2	Data bit 2
10	D3	Data bit3
11	D4	Data bit4
12	D5	Data bit5
13	D6	Data bit6
14	D7	Data bit7
15	A	Back light anode(+)
16	K	Back light cathode(-)

LCD connection to microcontroller port pins:

LCD pin number	LCD pin symbol	Microcontroller pin	Arduino Pin
4	RS	PA1	25
6	EN	PA2	26
11	D4	PA3	27
12	D5	PA4	28
13	D6	PA5	29
14	D7	PA6	30

*Note***:**
- LCD R/W signal is tied to ground.
- 10KΩ variable resistor labeled "Contrast" is adjusted to control the LCD contrast.
- Disable 7Segment module before using LCD module.
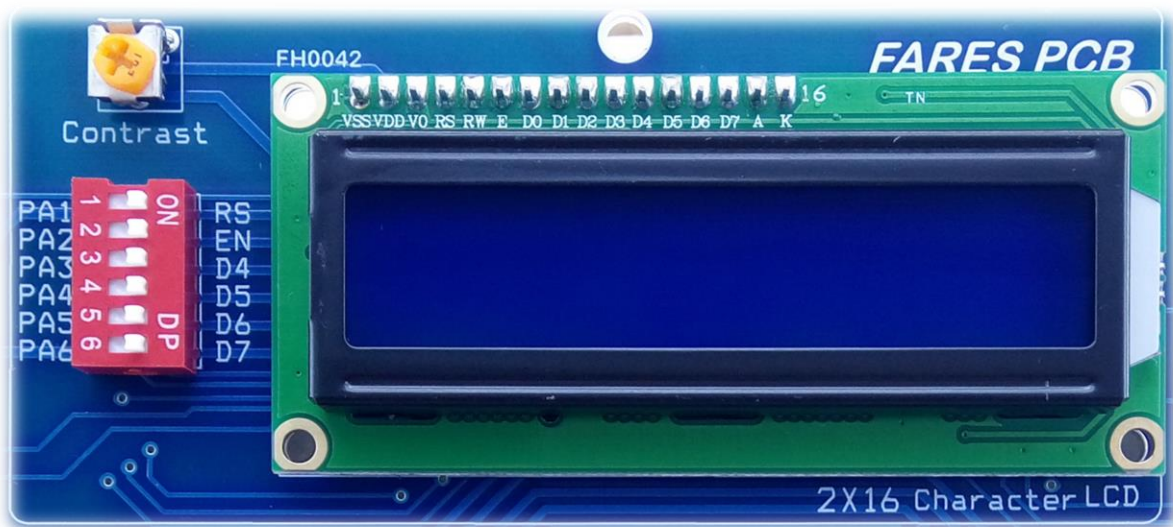
2X16 LCD display unit
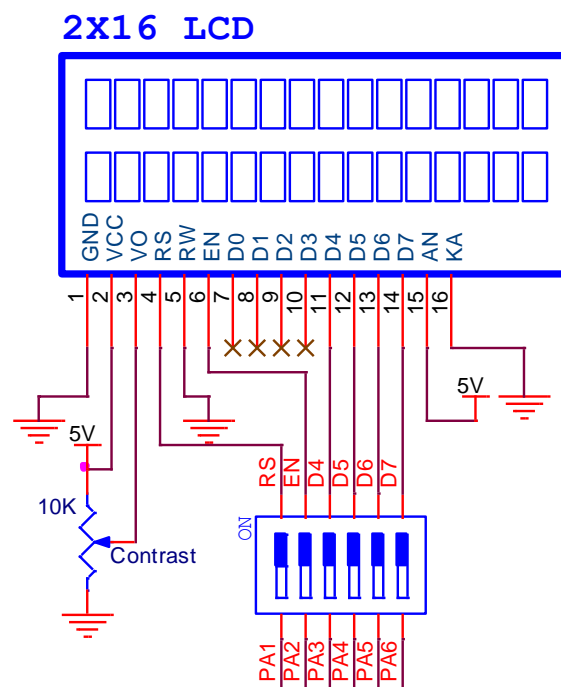
2X16 LCD display unit (Schematic)

Analog Input Unit

Eta32mini includes 10KΩ multi-turn variable resistor. The fixed terminals of variable resistor are connected to GND and +5VDC whereas the variable terminal is connected to Port pin **PA0** of the microcontroller. The resistor may be adjusted precisely to the required voltage (0.00V to 5.00V).

Analog input connected to microcontroller as shown in table:

Analog Input	microcontroller Pin	Arduino Pin
Variable resistor	PA0	24/A0

**Analog input unit**
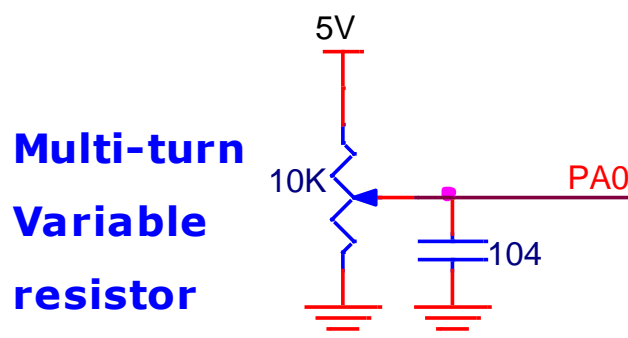
Analog input unit (schematic)

USB Virtual COM Unit

This unit includes USB/TTL logic converter using CH340 IC and provides USB type B socket for PC serial communication. Serial interface circuit can be enabled or disabled using DIP switch (see figure 25). USB/TTL Converter IC is connected to ATMEGA32 microcontroller port pins **PD0 (RX)** and **PD1 (TX)** via DIP switch.
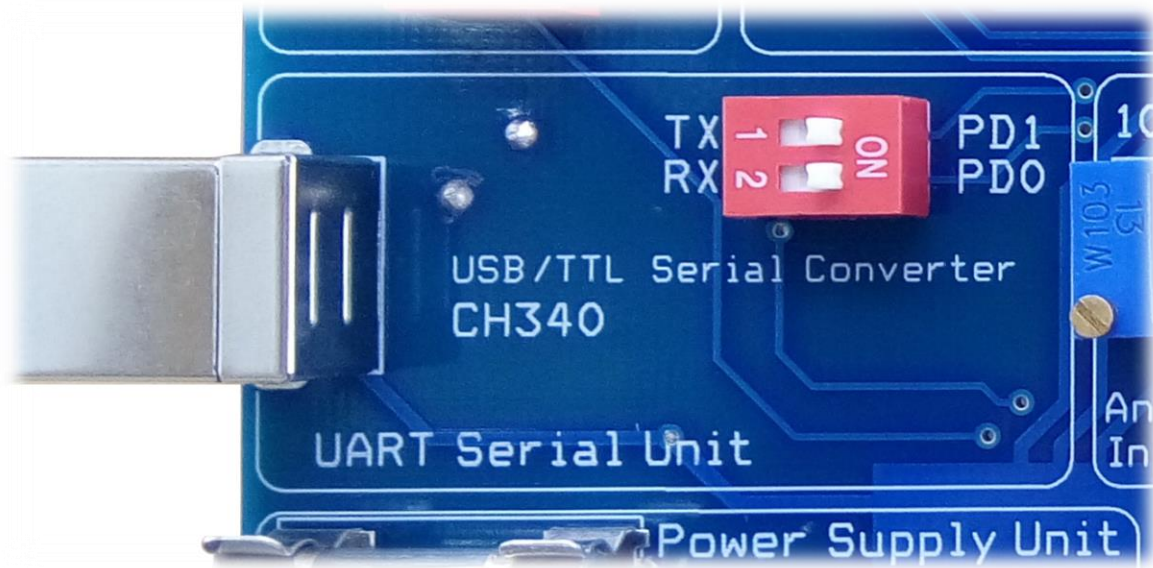

Serial unit
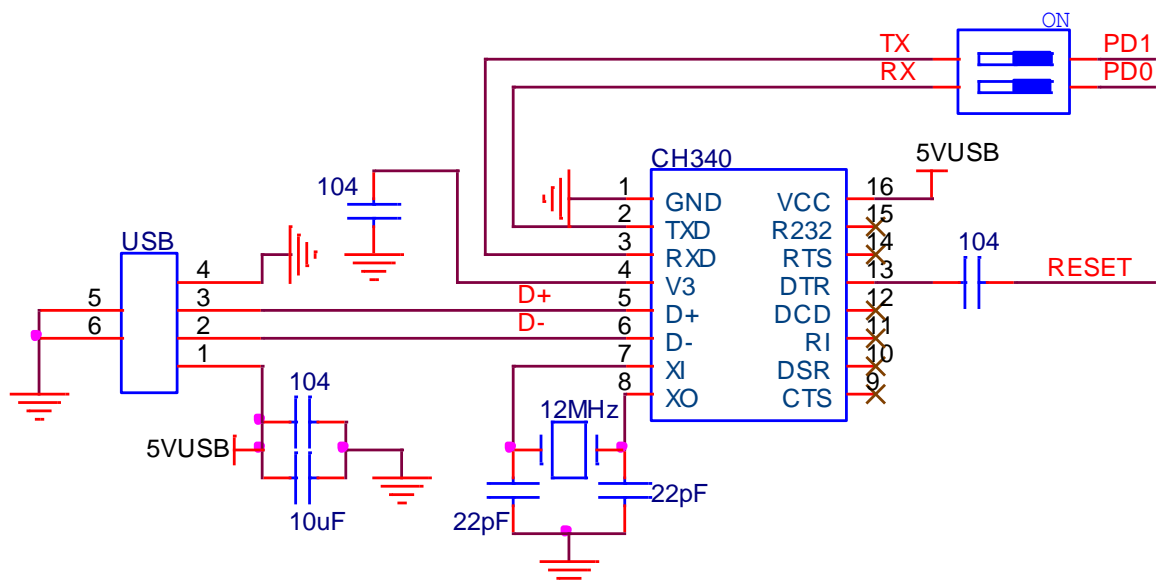
Serial unit (schematic)

Uploading Hex Code

There are three ways to burn hex code on *Eta32mini* kit.

1) *Eta32mini* software tool (Eta32mini bootloader from FARES PCB)
2) Arduino IDE.
3) External programmer.

Programming using *Eta32mini* tool

Eta32mini does not require any sort of external programmers to be programmed. *Eta32mini* kit comes with Eta32mini bootloader, which interfaces an *Eta32mini* software tool (from FARES PCB). *Eta32mini* software tool is used to download/upload hex code from/to ROM and EEPROM contents of ATMEGA32 microcontroller.
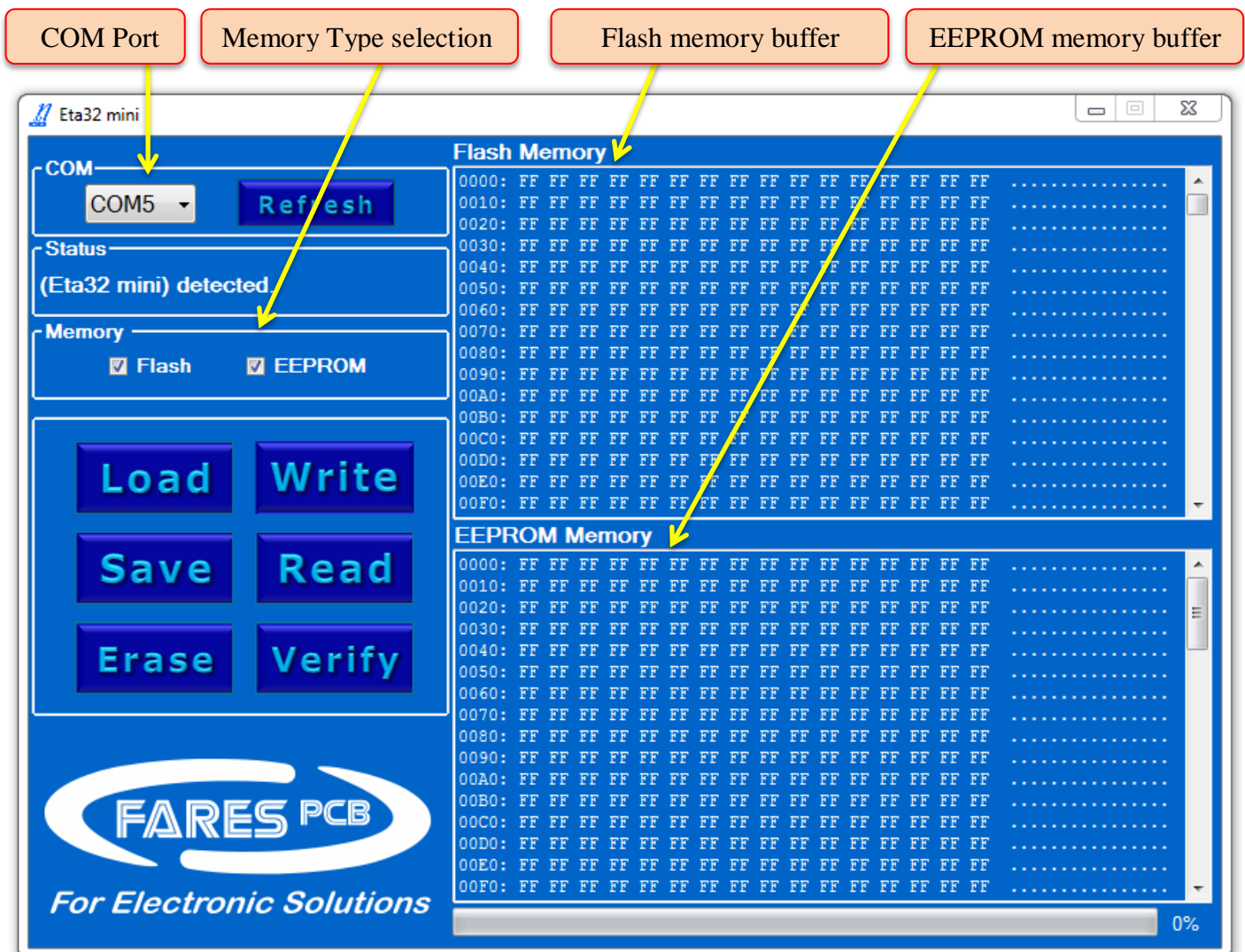
Eta32mini Software tool is developed specifically for *Eta32mini* kit. It detects the kit automatically just after opening it or by clicking re-connect button.

Select memory type (Flash, EEPROM or both) before any programming operation.

Use "Load" button to load hex file to buffer related to selected memory.

Use "Save" button to store data in the buffer related to selected memory into a hex file (Intel format).

Use "Write" button to burn loaded hex file to selected memory on microcontroller.

Use "Read" button to read hex code from selected memory of microcontroller.

Use "Erase" button to erase selected memory of microcontroller.

Use "Verify" button to compare hex code from selected memory of microcontroller to the related memory buffer.

Fuse settings

By default, fuse bytes are set to the proper values as shown in table

Fuse byte	Hex value
Low	9F
High	CA

Brown-out Detector (BOD): Enabled (2.7V).
Clock Source: External crystal oscillator.
Boot reset vector is selected. Bootloader occupies 2K bytes from flash memory

Note:

If fuse bytes are changed to any values other than those shown in the previous table, they must be reprogrammed to the proper values before using *Eta32mini* programming tool.

After programming is completed, a reset operation is performed to ensure microcontroller correct operation.

Warning:

Random fuse settings changing is risky. You should take special care while changing these settings. Incorrect fuse settings may cause incorrect microcontroller functioning.

Programming using Arduino IDE

If Arduino software tool is your preferred IDE, follow the next steps to add *Eta32mini* kit to Arduino boards,

Fuse byte	Hex value
Low	9F
High	CE

1 - Upload Arduino bootloader firmware (ArduinoBL.hex) included in CD using any external programmer such as USBasp programmer. (See programming using external programmer).
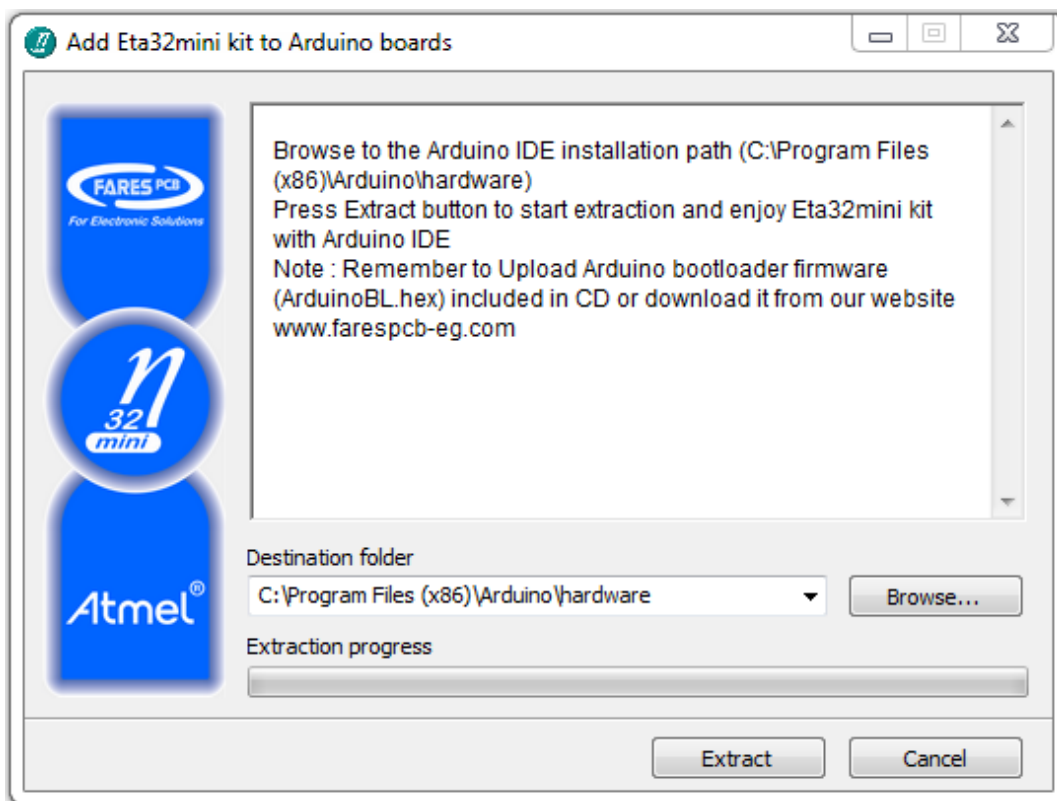Fuse Bytes must be set as shown in table below

2 - Download Arduino IDE from the following link
https://www.arduino.cc/en/Main/Software
3 - Close Arduino IDE.
4 - Run the self-extracted file (Eta32miniDuino.exe) included in CD, and browse to the Arduino IDE installation path (C:\Program Files (x86)\Arduino\hardware), and press Extract button to start extraction

5 – After extraction, *Eta32mini* board is added to Arduino Boards. You can select Eta32mini board as following:
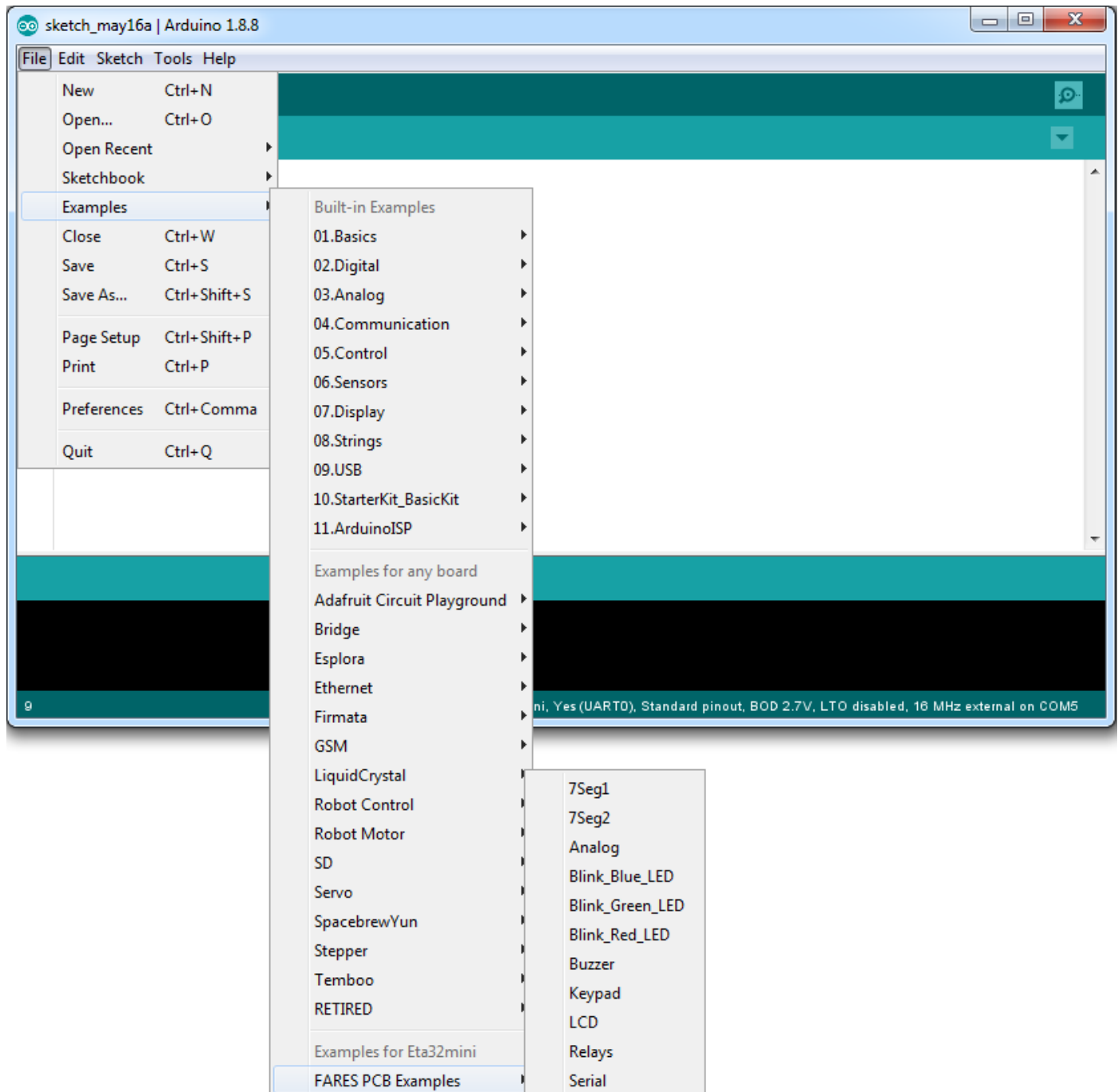
Tools >> Board: >> Eta32mini.
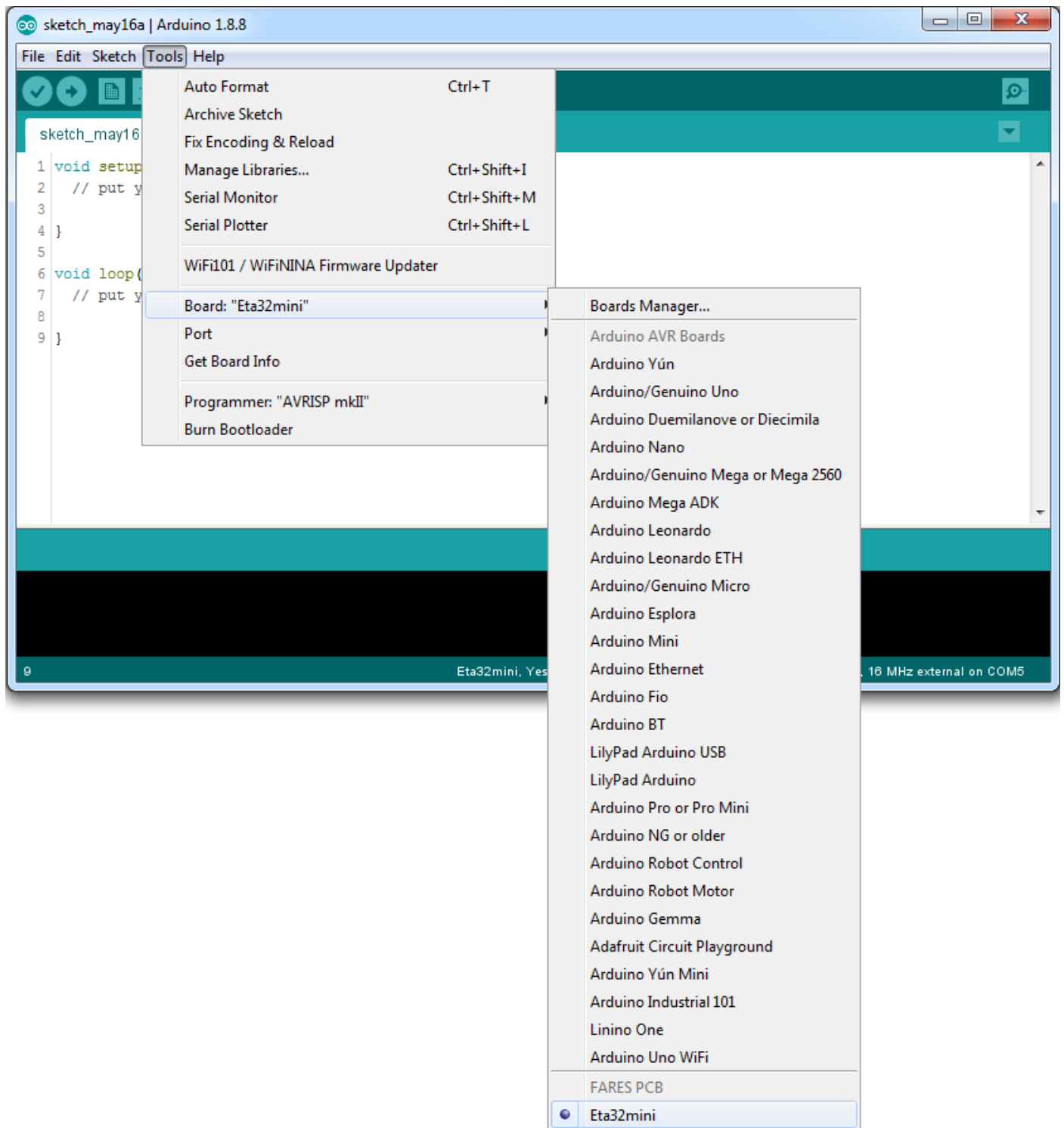
6 - Also, you will find many Arduino example codes to test all units in kit. You can go to:

File >> Examples >> Examples for Eta32mini.

Programming using external programmer

Although *Eta32mini* is designed mainly to be programmed using bootloader. However, it offers ICSP socket to enable programming using any external programmer that supports standard 6 pin ICSP socket, such as USBasp programmer. Use external programmer to download your own application code or even a bootloader firmware such as Arduino bootloader.

Standard 6 pin ICSP header socket
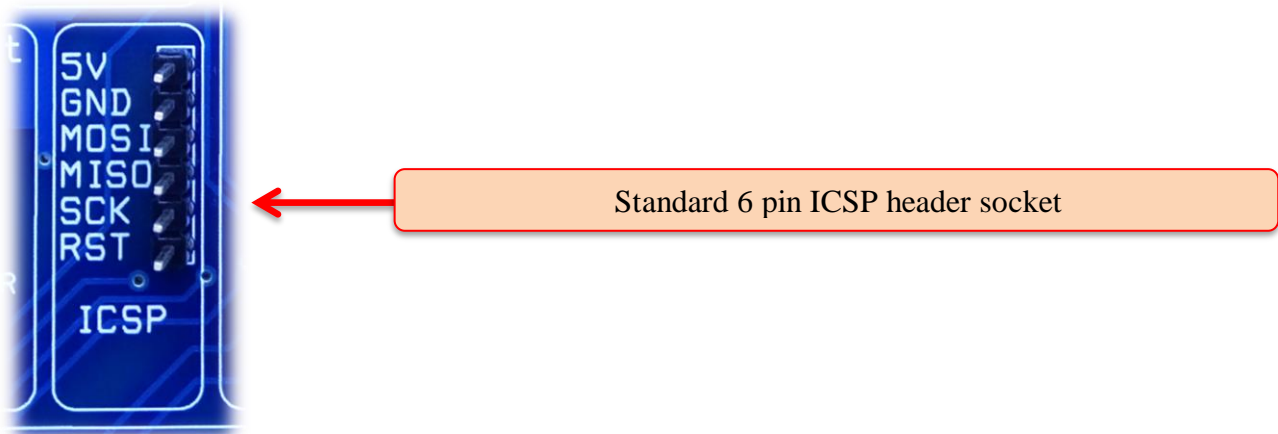
For more details about programming using USBasp programmer, please refer to USBasp CD from FARES PCB products from this link:
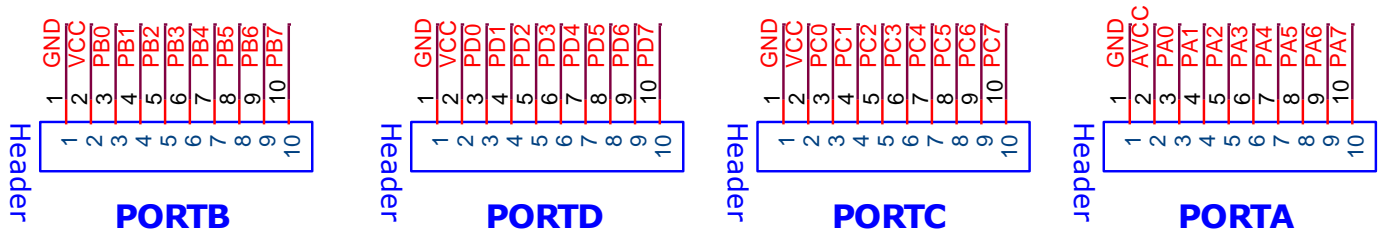
I/O PORT

In addition to the popular built-in circuits and devices included in *Eta32mini* kit, all microcontroller port pins are brought out for external using via header sockets.

External connectors are grouped into 4 units. Each represents one microcontroller port (8 I/O), in addition to GND and 5V.
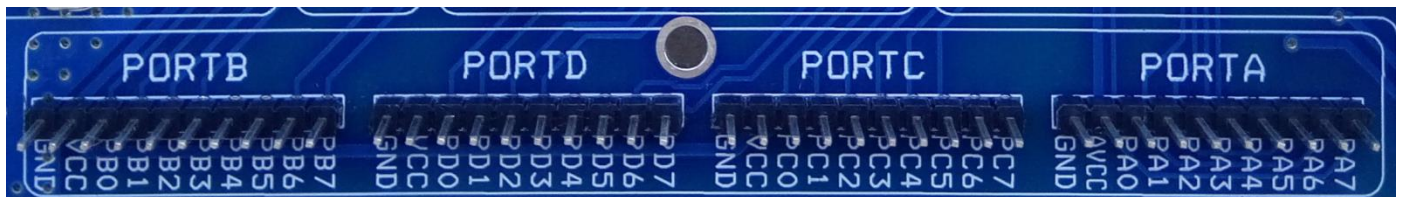
Microcontroller port pins

Microcontroller port pins (Schematic)

Note:

Please ensure to disconnect the built-in circuits attached to the port pins intended to use.

HOW TO START?

Step1

Install USB driver for ch340.

Step2

Install *Eta32mini* Software tool.

Step3

Connect USB cable to *Eta32mini* kit and open *Eta32mini* software tool. *Eta32mini* tool starts to search COM ports and detect kit automatically. If there's a problem in connection, please review USB cable connection to kit and click "Re-Connect" button to try again.

Step4

Now you are ready to upload your hex code and enjoy working with *Eta32mini* kit. Refer to Programming Using Eta32mini Tool for more details about using Eta32mini IDE.

If it is the first time to use *Eta32mini* kit, you should perform some test operations on kit before start working on it. The CD included with package contains the firmware code required for testing all modules in kit. So, it's recommended to upload this test code before going to your own application firmware to ensure correct functioning.

Upon burning "**Eta32mini_Test.hex**" code user could test

- Keypad in matrix mode.
- 2X16 LCD.
- Outputs unit (Relays, LEDs and Buzzer).
- 7segments.
- UART Serial operation.
- Analog Input.

- Enable DIP switches of all modules on kit.
- Set keypad to matrix mode (Set KB Mode to Matrix position).
- Plug in USB cable.
- Turn on power switch.
- Open *Eta32mini* programming tool.
- Click "LOAD" button to load the test code included in CD **(Eta32mini_Test.hex)**.
- Click Write button.
- After programming is completed the microcontroller is reset automatically.

After power on or reset operation the test sequence is

1 - Serial module transmits this message to serial port

"FARESPCB Co."

"ATMEL AVR Development kit."

"Eta32mini kit."

"Arduino IDE compatible."

User may receive this statement by HyperTerminal program or any other serial monitor software.

2 - LCD displays the following messages one by one.

3 – After that this screen is shown

4 – If a switch is pressed the microcontroller sends a message to serial port contains the pressed switch number and LCD displays the same message such as

When switch "1" is pressed

When switch "16" is pressed

Some switches perform a test operation for specified modules in kit. These tests are listed in table below

Switch	Function	
	Serial port / LCD (line2) message	Test operation
SW1	"SW 1 is pressed."	Toggle Relay1 status
SW2	"SW 2 is pressed."	Toggle Relay2 status
SW3	"SW 3 is pressed."	Toggle Blue LED
SW4	"SW 4 is pressed."	Toggle Green LED
SW5	"SW 5 is pressed."	Toggle Red LED
SW6	"SW 6 is pressed."	Digits counts from 00 to 99 and perform auto reset
SW7	"SW 7 is pressed."	LCD displays the analog volt measured on port pin (PA0)
SW8	"SW 8 is pressed."	LCD displays any received text from the serial port in the second line.
SW9	"SW 9 is pressed."	---
SW10	"SW10 is pressed."	---
SW11	"SW11 is pressed."	---
SW12	"SW12 is pressed."	---
SW13	"SW13 is pressed."	---
SW14	"SW14 is pressed."	---
SW15	"SW15 is pressed."	---
SW16	"SW16 is pressed."	---

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