Hardware Manual

for eYFi-Mega Development Board

Produced by: e-Yantra Team

https://e-yantra.org/products/eyfi-mega

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About this Document

This document is created for all developers wanting to work with the **eYFi-Mega** development board. It provides the detailed description and specification of the board.

Revision History

For revision history of this document, please refer to the Appendix A.

Disclaimer and Copyright Notice

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Board Overview

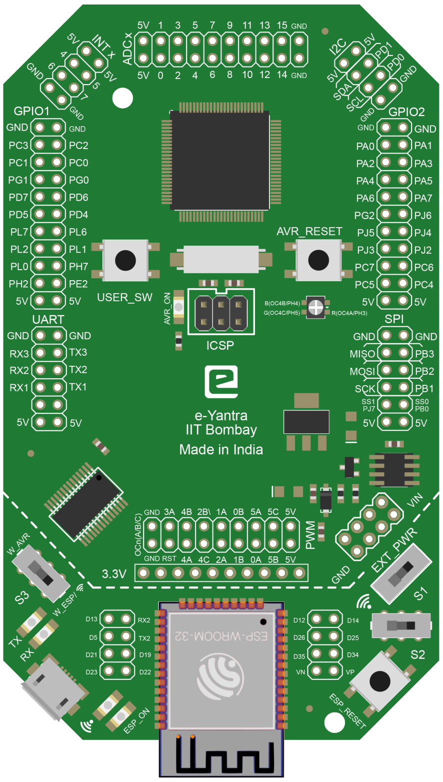

Figure 1: eYFi-Mega development board

The **eYFi-Mega** board provides an flexible and affordable way for users to try out new concepts and build prototype projects with the **8-bit ATmega2560** micro-controller in TQFP100 package and the **32-bit ESP32** micro-controller, choosing from the various combinations of performance, power consumption and features.

The eYFi-Mega board does not require any specialized hardware for programming as it comes with pre-installed bootloader file thus, the firmware on ATmega2560 and ESP32 can be easily updated either wired / wirelessly (Over-The-Air).

The eYFi-Mega board comes with the comprehensive support of Arduino Programming Language and Espressif IoT Development Framework (esp-idf) which is the official development framework for the ESP32 chip.

The eYFi-Mega board comes with the pre-defined group of pins having the same functionality, making it easier for the developer to access and work with it.

1.1 Kit Contents

The eYFi-Mega Kit contains the following items:

- eYFi-Mega Development Board
- Interface Board
- USB micro-B plug to USB-A plug cable

1.2 Quick Start

For more information on the eYFi-Mega board and to access the documentation and tutorials, visit https://e-yantra.org/products/eyfi-mega.

1.2.1 Getting Started

Follow the sequence below to configure the eYFi-Mega and launch the demo software:

- Connect the eYFi-Mega board to a PC with a USB micro-B plug to USB-A plug cable through USB connector to power the board. The red LEDs AVR_ON and ESP_ON should light up.
- The RGB LED should light up and blink Red, Green and Blue colors in a sequence at the intervals of a second.
- Press button USER_SW (User Switch).
- Observe the change in colors on the RGB LED, by pressing the button USER_SW. It will glow the colors Yellow, Cyan, Magenta, Red, Green, Blue in a sequence. After this, the RGB LED will reset to the blinking of Red, Green and Blue color in the interval of a second.

1.2.2 System Requirements

- Linux: Ubuntu LTS 16.04 and 18.04
- USB micro-B plug to USB-A plug cable

1.2.3 Development Toolchains

- eY-IDE (Visual Studio Code extension)
- AVR-GCC
- ESP-IDF

1.3 Features

Your eYFi-Mega development board includes the following features:

Dual Micro-controller Board	8-bit ATmega2560 & 32-bit ESP32
High Output Power	12.5 W (5V, 2.5A)
Wi-Fi	Protocol: 802.11 b/g/n (802.11n up to 150 Mbps), Frequency Range: 2.4 GHz 2.5 GHz
Bluetooth Low Energy	Protocol: Bluetooth v4.2 BR/EDR and BLE specification
On-board File Storage	700 KB SPI-Flash File System (expandable up to 3 MB)
Compatible with FreeRTOS	Both micro-controllers are capable of running FreeRTOS, ESP32 runs FreeRTOS out-of-the-box
Arduino Programming Language	Both micro-controllers can be programmed using Arduino Programming Language

1.4 Specifications

Table 1 summarizes the specifications of the eYFi-Mega board.

Table 1: Specifications of eYFi-Mega development board

Parameter	**Value**
Board Supply Voltage	4.75 V_{DC} to 5.25 V_{DC} from USB Micro-B cable (connected to a PC) 7.0 V_{DC} to 21.0 V_{DC} from External Power Supply
Dimensions	107.95 mm x 64.01 mm x 24 mm (L x W x H)
Break-out power output	3.3 V_{DC} (800 mA max) 5.0 V_{DC} (2.5 A max)
RoHS status	Compliant

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Hardware Description

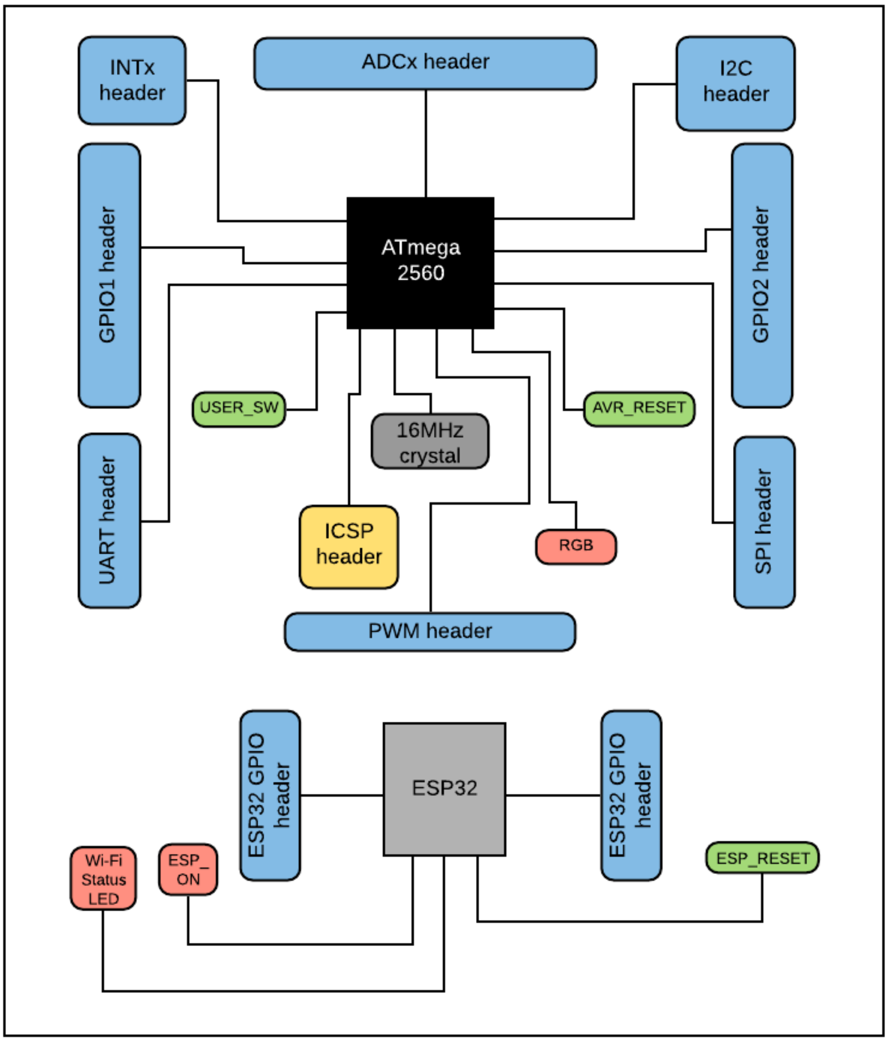


Figure 2: Block diagram of eYFi-Mega

The **eYFi-Mega** board includes ATmega2560 and ESP32 micro-controllers and a range of useful peripheral features (as the block diagram in Figure 2). This chapter describes how these peripherals operate and interface to the micro-controller.

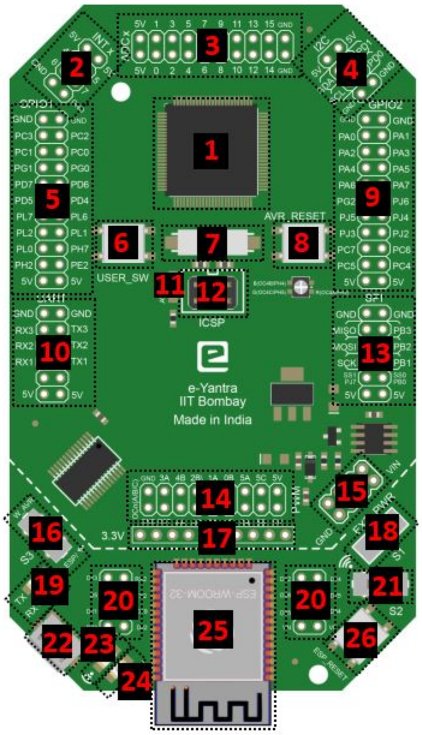


Figure 3: Functional diagram of eYFi-Mega

Table 2-1 summarizes the parts of the eYFi-Mega board with respect to the Figure 3.

Table 2: Functional Diagram of eYFi-Mega

#	Component Name	#	Component Name
1	ATmega2560 micro-controller	14	PWM header
2	INTx header	15	EXT_PWR header
3	ADCx header	16	S3 switch
4	I2C header	17	3.3 V header
5	GPIO1 header	18	S1 switch
6	USER_SW push button	19	TX LED and RX LED
7	16 MHz crystal	20	ESP32 GPIO header
8	AVR_RESET push button	21	S2 switch
9	GPIO2 header	22	Micro-USB connector
10	UART header	23	Wi-Fi Status LED
11	AVR_ON LED	24	ESP_ON LED
12	ICSP connector	25	ESP32 micro-controller
13	SPI header	26	ESP_RESET push button

2.1 Functional Description

2.1.1 ATmega2560 micro-controller

ATmega2560 micro-controller is one of the most rich feature AVR micro-controller from Atmel featuring 256K Flash, 8K RAM, 86 I/O lines, 16 ADCs, 4 UARTs, 6 Timers, 8 Interrupts and much more.
All AVR micro-controllers can be programmed using ICSP, external programmer or boot-loader. Advantage with the boot-loader is that you don't need any external hardware to load the .hex file on the micro-controller. If Boot-loader firmware is loaded on the micro-controller then it can be programmed directly via serial port of USB using PC.
We have already loaded the boot-loader firmware on ATmega2560 micro-controller. It is recommended that you always update the firmware on ATmega2560 either through wired via Micro-USB port or wirelessly i.e. Over-The-Air (OTA). For more information on how to update the firmware OTA, refer the Section **Button - Wireless Flash** in the **Software Manual of eYFi-Mega development board**.

2.1.2 ESP32 micro-controller

ESP32-WROOM-32 is a powerful, generic Wi-Fi+BT+BLE MCU module that targets a wide variety of applications, ranging from low-power sensor networks to the most demanding tasks, such as voice encoding, music streaming and MP3 decoding.
It has integrated SPI flash of **4 MB**. We have partitioned this memory of on-board ESP32 to accommodate **1 MB OTA (Over-The-Air)** application, **2 MB User** application and **700 KB File Storage**. This partition table can be modified by you as per your requirement. For example, if you want to increase or decrease the size of the 700 KB File Storage you can update the partition table. If you decide to modify the partition table for your project, you might not be able to use the OTA App because our OTA App is compatible with the partition table described below (Refer Table 3). In case you accidentally erase the partition you can download our Partition Table and our OTA App from our website. The current partition table is described below:

Table 3: Partition Table of on-board ESP32 micro-controller

Partition Name	Start Address	Size
reserved area (nvs, otadata, phy_init)	–	300 KB
factory (ota-app)	0x10000	1 MB
app1 (user-app)	0x110000	2 MB
storage (spiffs)	0x310000	700 KB

2.1.3 16 MHz crystal

The frequency of crystal connected to ATmega2560 is **16 MHz**.

2.1.4 LEDs

1. **AVR_ON**
   This **Red** colored LED indicates that the AVR chip ATmega2560 is powered ON.

2. **ESP_ON**
   This **Red** colored LED indicates that the ESP32 chip is powered ON.

3. **RGB LED**
   This is a tri-color user LED. It is a **Common Anode** type LED which is connected to ATmega2560 as follows:

   (a) **Red** terminal is connected to **OC4A / PH3**.

   (b) **Green** terminal is connected to **OC4C / PH5**.

   (c) **Blue** terminal is connected to **OC4B / PH4**.

4. **Wi-Fi Status LED**
   This **Blue** colored LED indicates whether any device is connected to the ESP32's **Wi-Fi** access point. Once a device is connected, this LED glows. It is connected to ESP32 **GPIO18** pin.
   When you are connected to your **eYFi-Mega** over a Wi-Fi link, it is important to know the different states in which your board is. These states are indicated by this LED. Below is the description of different LED patterns associated with different states of the board.

Table 4: Patterns of Wi-Fi status LED with various states of the board

State	Wi-Fi Status LED Pattern
Wi-Fi client is connected to ESP32	ON
Wi-Fi client disconnected from ESP32	OFF
File Upload Start	OFF
File Upload End	Blink Fast for 100 ms
Firmware Flash Start	Blink Fast
Firmware Flash End - AVR	Blink Slow for 5 sec
Firmware Flash End - ESP32	Blink Slow till S1 switch is toggled

5. **TX LED and RX LED**

   - **TX LED**: This green colored LED indicates whether ATmega2560 or ESP32 is transmitting any information to the PC via wired connection.
   - **RX LED**: This green colored LED indicates whether ATmega2560 or ESP32 is receiving any information to the PC via wired connection.

2.1.5 Switches

1. **AVR_RESET**
   This push button is used to reset the AVR chip ATmega2560 micro-controller.

2. **ESP_RESET**
   This push button is used to reset the ESP32 micro-controller.

3. **USER_SW**
   This push button is a User Switch. It is connected to **PE7 / INT7** pin of ATmega2560.

4. **S1**
   This switch is used to decide which application code ESP32 should be running. If S1 is switched to the left side (indicated with a **Wi-Fi symbol**), ESP32 will run the Over-The-Air (OTA) application. This application turns ON the ESP32 Wi-Fi Access Point, listens and waits for any client to get connected with itself. It is also used for flashing the firmware for ATmega2560 and ESP32 wirelessly. If S1 is switched to right side, ESP32 will run the User application (which is flashed on ESP32 either via wired connection or wirelessly).

5. **S2**
   This switch is used to make or break the connection between ATmega2560 and ESP32. If S2 is switched to left side (indicated with a **Wi-Fi symbol**), the **UART0** TX, RX lines of ATmega2560 gets connected to the **UART1** RX, TX lines of ESP32 respectively. Through this connection, one can send and receive any data between ATmega2560 and ESP32. If S2 is switched to right side, the connection between ATmega2560 and ESP32 breaks.
   Note: Make sure that while flashing the firmware for ATmega2560 wirelessly, the S2 switch is on the left side.

6. **S3**
   This switch is used to decide whether to flash firmware on ATmega2560 or ESP32 through wired connection. If S3 is switched to left side (indicated with **W_AVR**), one can flash firmware to ATmega2560 and if it is switched to right side (indicated with **W_ESP/Wi-Fi symbol**), one can flash firmware to ESP32 through wired connection. One can also use this switch for debugging purposes by printing data on the Wired Serial Monitor. For more information on Wired Serial Monitor, refer to the Section **Button - Wired Serial Monitor** in the **Software Manual of eYFi-Mega development board**.
   Note: Make sure that while flashing the firmware for ATmega2560 wirelessly, the S3 switch is on the right side.

Table 5 highlights the function of Switches **S1**, **S2** and **S3** in short.
Table 6 summarizes the use of the Switches **S1**, **S2** and **S3** and their positions for flashing the firmware on ATmega2560 and ESP32 via wired connection or wirelessly (OTA).

Table 5: Function of Switches S1, S2 and S3

Switch	Function
Switch #1 (S1)	ESP32 Partition Selection Switch (OTA-App / User-App selection) Using this switch you can toggle between OTA application and User application on ESP32
Switch #2 (S2)	Toggle ESP32 UART#1 connection with ATmega2560 UART#0 This switch can make or break connection between UART#1 of ESP32 and UART#0 of ATmega2560
Switch #3 (S3)	Wired ATmega2560 or Wired ESP32 Using this switch you can select which micro-controller you want to wire-program

Table 6: Switch positions for various programming modes

Programming Mode	**S1 Position** (towards)	**S2 Position** (towards)	**S3 Position** (towards)
ATmega2560 Wired	–	–	W_AVR
ATmega2560 Wireless	Wi-Fi symbol	Wi-Fi symbol	W_ESP / Wi-Fi symbol
ESP32 Wired	–	–	W_ESP / Wi-Fi symbol
ESP32 Wireless	Wi-Fi symbol	Wi-Fi symbol	W_ESP / Wi-Fi symbol

2.1.6 ICSP connector

This is a **six**-pin **ICSP (In-Circuit Serial Programming)** or **ISP (In-System Programming)** header of ATmega2560. For more details about ISP and boot-loader, refer to Section 2.1.1. The ICSP connector pins are shown in Figure 4.

Note: If you use ISP programmer with the eYFi-Mega board and try to load .hex file on to ATmega2560 then boot section code will get erased and the ATmega2560 will no longer be programmable via wired connection or wirelessly. In case you accidentally erase the boot section code you can always download the Boot-loader firmware from the website and flash it on ATmega2560 using ISP programmer through the ICSP header pins. To know about how to flash the boot-loader firmware on ATmega2560, refer to Appendix B.

2.1.7 GPIO1 header

This header is a group of pins of ATmega2560 that can be used as **General Purpose Input Output (GPIO)** to connect any input or output peripheral devices. Apart from using these pins as GPIO, they also have certain alternative functions, the details of the same is shown in Figure 4. This header also has two pins of VCC i.e. 5V and GND each.

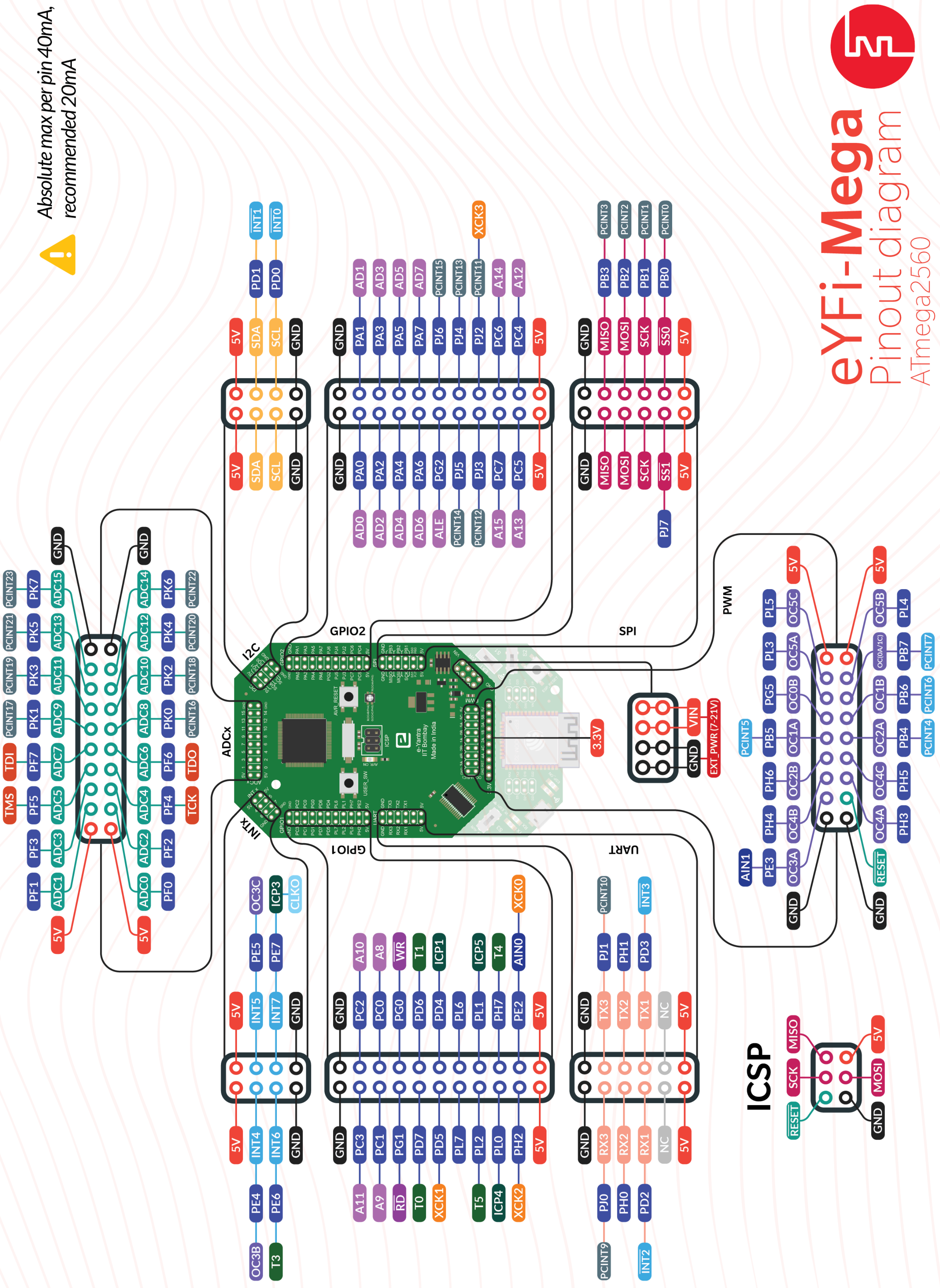

Absolute max per pin 40mA,
recommended 20mA
eYFi-Mega
Pinout diagram
ATmega2560
I2C
5V SDA SCL GND
PD1 PD0
INT1 INT0
GPIO2
GND PA1 PA3 PA5 PA7 PJ6 PJ4 PJ2 PC6 PC4 5V
AD1 AD3 AD5 AD7 PCINT15 PCINT13 PCINT11 A14 A12
XCK3
GND PA0 PA2 PA4 PA6 PG2 PJ5 PJ3 PC7 PC5 5V
AD0 AD2 AD4 AD6 ALE PCINT14 PCINT12 A15 A13
SPI
GND MISO MOSI SCK SS0 5V
PB3 PB2 PB1 PB0
PCINT3 PCINT2 PCINT1 PCINT0
GND MISO MOSI SCK SS1 5V
PJ7
ADCx
GND PK7 PK5 PK3 PK1 PF7 PF5 PF3 PF1 5V
ADC15 ADC13 ADC11 ADC9 ADC7 ADC5 ADC3 ADC1
PCINT23 PCINT21 PCINT19 PCINT17 TDI TMS
GND PK6 PK4 PK2 PK0 PF6 PF4 PF2 PF0 5V
ADC14 ADC12 ADC10 ADC8 ADC6 ADC4 ADC2 ADC0
PCINT22 PCINT20 PCINT18 PCINT16 TDO TCK
INTX
5V INT5 INT7 GND
PE5 PE7
OC3C ICP3 CLKO
5V INT4 INT6 GND
PE4 PE6
OC3B T3
GPIO1
GND PC2 PC0 PG0 PD6 PD4 PL6 PL1 PH7 PE2 5V
A10 A8 WR T1 ICP1 ICP5 T4 AIN0
XCK0
GND PC3 PC1 PG1 PD7 PD5 PL7 PL2 PL0 PH2 5V
A11 A9 RD T0 XCK1 T5 ICP4 XCK2
UART
GND TX3 TX2 TX1 NC 5V
PJ1 PH1 PD3
PCINT10 INT3
GND RX3 RX2 RX1 NC 5V
PJ0 PH0 PD2
PCINT9 INT2
3.3V
VIN
GND
EXT_PWR (7-21V)
PWM
5V PL5 PL3 PG5 PB5 PH6 PH4 PE3 GND
OC5C OC5A OC0B OC1A OC2B OC4B OC3A
PCINT5 AIN1
5V OC5B PL4 OC(0A/1C) PB7 OC1B PB6 OC2A PB4 OC4C PH5 OC4A PH3 RESET GND
PCINT7 PCINT6 PCINT4
ICSP
RESET SCK MISO
GND MOSI 5V
e-Yantra
IIT Bombay
Made in India

Figure 4: eYFi-Mega Pinout Diagram for ATmega2560

2.1.8 GPIO2 header

This is another header which is also a group of pins of ATmega2560 that can be used as **General Purpose Input Output (GPIO)** to connect any input or output peripheral devices. Apart from using these pins as GPIO, they also have certain alternative functions, the details of the same is shown in Figure 4. This header also has two pins of VCC i.e. 5V and GND each.

2.1.9 INTx header

This header is a group of pins of ATmega2560 that can be used as External Hardware Interrupt (INT) sources. There are **eight** External Interrupt sources from **INT7** to **INT0** in ATmega2560. The Interrupt sources **INT7:4** are present on this header. The other four Interrupt sources **INT3:0** are also available on the board but are not present on this header, since they have other alternate functions which are given more priority. These pins **INT3:0** can be found in Figure 4. The **x** in the header name **INTx** stands for Interrupt source number and ranges from **7** to **4** for this board. Apart from using these pins as External Interrupts, they also have certain alternative functions, the details of the same is shown in Figure 4. This header also has two pins of VCC i.e. 5V and GND each.

2.1.10 ADCx header

This header is a group of pins of ATmega2560 that can be used as analog inputs or channels for the **Analog to Digital Converter (ADC)** inside the micro-controller. There are **sixteen** ADC channels from **ADC15** to **ADC0** in ATmega2560. All ADC channels are present on this header. The **x** in the header name **ADCx** stands for ADC channel and ranges from **16** to **0**. Apart from using these pins as ADC channels, they also have certain alternative functions, the details of the same is shown in Figure 4. This header also has two pins of VCC i.e. 5V and GND each.

2.1.11 I2C header

This header is a group of pins of ATmega2560 that can be used as 2-wire Serial Interface Data and Clock for **Inter-Integrated Circuit (I2C or I^{2}C)** protocol in the micro-controller. The **SDA** or **PD1** are two names of the same pin of micro-controller. Similarly, **SCL** or **PD0** are two names of the same pin of micro-controller. Apart from using these pins as I^{2}C serial data and clock, they also have certain alternative functions, the details of the same is shown in Figure 4. This header also has two pins of VCC i.e. 5V and GND each.

2.1.12 UART header

This header is a group of pins of ATmega2560 that can be used as Transmit (TX) and Receive (RX) Data pins for **Universal Asynchronous Receiver and Transmitter (UART)** protocol in the micro-controller. There are **four** UART modules from **UART3** to **UART0** in ATmega2560. The TX and RX pins of **UART3:1** are present on this header. The TX and RX pins of **UART0** is not made available on the board. Apart from using these pins as TX and RX pins of UART module, they also have certain alternative functions, the details of the same is shown in Figure 4. This header also has two pins of VCC i.e. 5V and GND each.

2.1.13 SPI header

This header is a group of pins of ATmega2560 that can be used as Bus pins for **Serial Peripheral Interface (SPI)** protocol in the micro-controller. The **MISO** or **PB3** are two names of the same pin of micro-controller. Similarly, **MOSI** or **PB2** and **SCK** or **PB1** are two names of the same pin of micro-controller. The other name for the **Slave Select** pin $\overline{\mathbf{SS0}}$ is **PB2**. There is only one Slave Select pin available in ATmega2560, but for interfacing multiple devices via SPI protocol, one can configure any GPIO pin as Slave Select. We have provided one such GPIO pin **PJ7** and named it as $\overline{\mathbf{SS1}}$. Apart from using these pins as Bus pins of SPI, they also have certain alternative functions, the details of the same is shown in Figure 4. This header also has two pins of VCC i.e. 5V and GND each.

2.1.14 PWM header

This header is a group of pins of ATmega2560 that can be used as **Output Compare** or **Pulse Width Modulation (PWM)** pins for the Timers in the micro-controller. There are **two 8-bit** Timers, **Timer 0** and **2** and **four 16-bit** Timers, **Timer 1**, **3**, **4** and **5** in ATmega2560. **8-bit** Timers have **two** PWM Channels named as **OCnA** and **OCnB** where **n** stands for Timer number and will be of value **0** and **2**. **16-bit** Timers have **four** PWM Channels named as **OCnA**, **OCnB** and **OCnC** where **n** stands for Timer number and will be of value **1**, **3**, **4** and **5**. Total **14** PWM Channels available on this header, they are: **OC0A**, **OC0B**, **OC1A**, **OC1B**, **OC1C**, **OC2A**, **OC2B**, **OC3A**, **OC4A**, **OC4B**, **OC4C**, **OC5A**, **OC5B** and **OC5C**. The PWM channel **OC0A** and **OC1C** are two names of the same pin of micro-controller. The PWM channels **OC3B** and **OC3C** are not present on this header, since they have other alternate functions which are given more priority. These channels **OC0A** and **OC1C** can be found in Figure 4. The **x** in the header name **OCn(A/B/C)** stands for Timer number and ranges from **5** to **0**. Apart from using these pins as Output Compare or PWM channel, they also have certain alternative functions, the details of the same is shown in Figure 4. This header also has two pins of VCC i.e. 5V and GND each. Also, the $\overline{\mathbf{RESET}}$ pin of ATmega2560 is available on this header.

2.1.15 ESP32 GPIO header

This is divided into **two** headers, each of **2 x 4** pins header. These are the pins of ESP32 and are named with their default functionality of GPIO. Apart from using these pins as GPIO, they also have certain alternative functions, the details of the same is shown in

Figure 5. This header also has Transmit (TX) and Receive (RX) Data pins of **UART2** of ESP32.

2.1.16 Micro-USB connector

This is a Micro-USB port where a USB micro-B plug to USB-A plug cable can be connected to the PC. It can be used to flash the firmware on ATmega2560 or ESP32 via wired connection. Also, one can connect the board to PC via this connector for the debugging purposes by printing data on the Wired Serial Monitor.

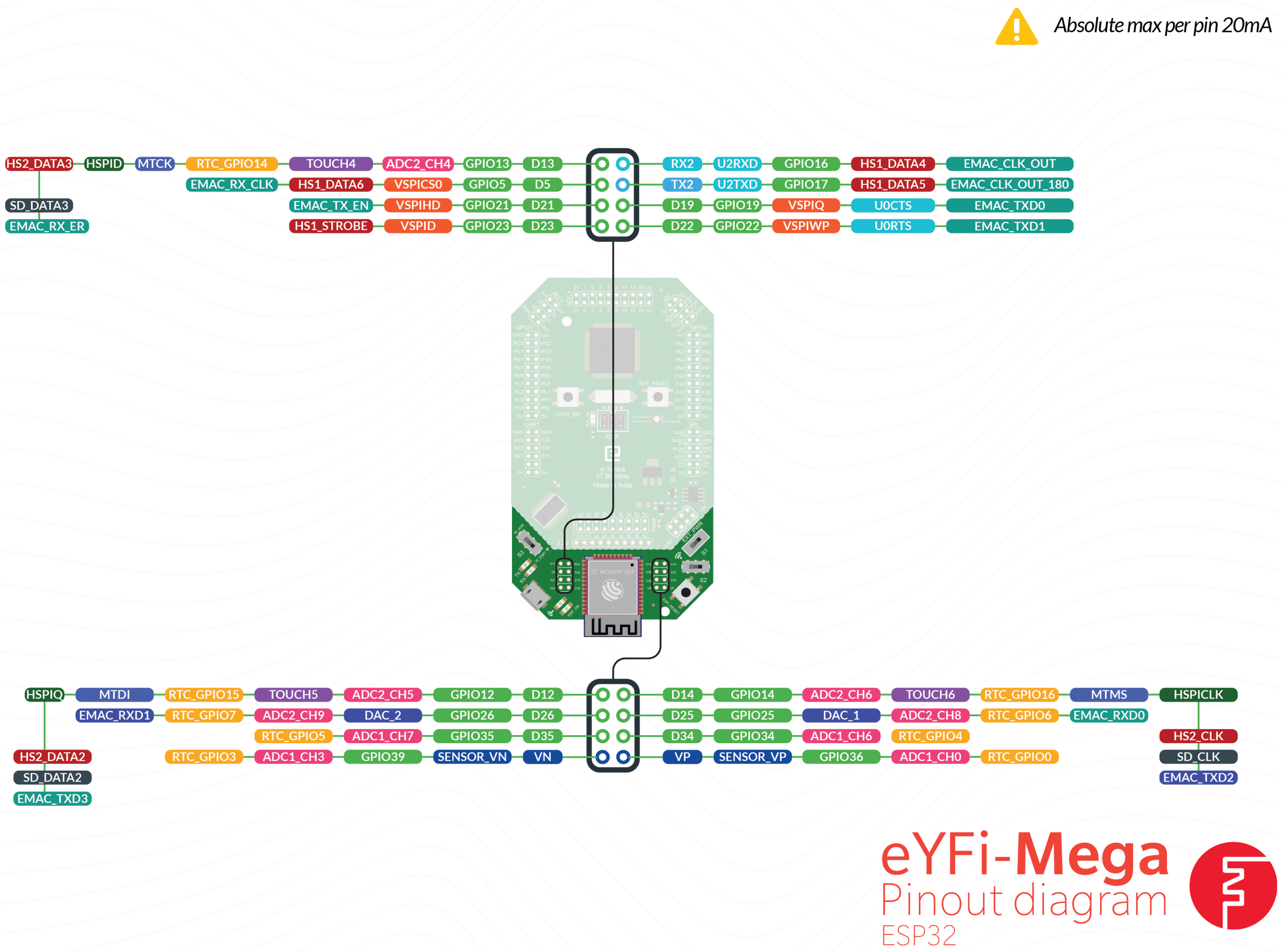

Absolute max per pin 20mA
HS2_DATA3 HSPID MTCK RTC_GPIO14 TOUCH4 ADC2_CH4 GPIO13 D13
SD_DATA3
EMAC_RX_ER
EMAC_RX_CLK HS1_DATA6 VSPICS0 GPIO5 D5
EMAC_TX_EN VSPIHD GPIO21 D21
HS1_STROBE VSPID GPIO23 D23
RX2 U2RXD GPIO16 HS1_DATA4 EMAC_CLK_OUT
TX2 U2TXD GPIO17 HS1_DATA5 EMAC_CLK_OUT_180
D19 GPIO19 VSPIQ U0CTS EMAC_TXD0
D22 GPIO22 VSPIWP U0RTS EMAC_TXD1
HSPIQ MTDI RTC_GPIO15 TOUCH5 ADC2_CH5 GPIO12 D12
HS2_DATA2
SD_DATA2
EMAC_TXD3
EMAC_RXD1 RTC_GPIO7 ADC2_CH9 DAC_2 GPIO26 D26
RTC_GPIO5 ADC1_CH7 GPIO35 D35
RTC_GPIO3 ADC1_CH3 GPIO39 SENSOR_VN VN
D14 GPIO14 ADC2_CH6 TOUCH6 RTC_GPIO16 MTMS HSPICLK
HS2_CLK
SD_CLK
EMAC_TXD2
D25 GPIO25 DAC_1 ADC2_CH8 RTC_GPIO6 EMAC_RXD0
D34 GPIO34 ADC1_CH6 RTC_GPIO4
VP SENSOR_VP GPIO36 ADC1_CH0 RTC_GPIO0
eYFi-Mega
Pinout diagram
ESP32

Figure 5: eYFi-Mega Pinout Diagram for ESP32

3

Power Management

3.1 5V DC Supply

There are multiple **5V$_{DC}$** supply available on the board, which one can use to power multiple devices easily and there will be no need to divide the supply further.

3.2 3.3V header

This header is a group of pins that provide **3.3V$_{DC}$** supply. Maximum of **800 mA** current can be drawn from these pins, but if high current is drawn from these pins, it will also affect the power delivered to ESP32 and will reduce its Wi-Fi signal strength.

3.3 EXT_PWR header

This header is a group of pins where the eYFi-Mega board can be powered by an External DC Supply. These pins are divide into **VIN** and **GND** each having **four** pins. The **positive** terminal of External DC Supply should be connected to any of the four **VIN** pins and the **negative** terminal should be connected to any of the four **GND** pins. The External DC Supply Voltage should strictly be within the range **7.0 V$_{DC}$ to 21.0 V$_{DC}$**.
When the board is powered from External DC Supply, typically **1A** and maximum **2.5A** current can be drawn from the **5V** pins. But if current more than **1.5A** is drawn from the 5V pins, one has to use cooling mechanism as the board will become hot on drawing larger currents.

4

References

In addition to this document, the following references will be helpful:

1. ATmega2560 datasheet, available at `https://ww1.microchip.com/downloads/en/devicedoc/atmel-2549-8-bit-avr-microcontroller-atmega640-1280-1281-2560-2561_datasheet.pdf`
2. ESP32-WROOM32 datasheet, available at `https://www.espressif.com/sites/default/files/documentation/esp32-wroom-32_datasheet_en.pdf`
3. Espressif IoT Development Framework (ESP-IDF) Programming Guide, available at `https://docs.espressif.com/projects/esp-idf/en/stable/index.html`
4. I2C Protocol explained
   (a) by Sparkfun: `https://learn.sparkfun.com/tutorials/i2c`
   (b) by Texas Instruments (TI) `http://www.ti.com/lit/an/slva704/slva704.pdf`
5. SPI Protocol explained
   (a) by Sparkfun: `https://learn.sparkfun.com/tutorials/serial-peripheral-interface-spi`
   (b) by electroSome `https://electrosome.com/spi/`

A

Revision History

Table 7: Revision History of the document

Date	**Version**	**Release notes**
December 14, 2019	v0.1	First release of the document

B

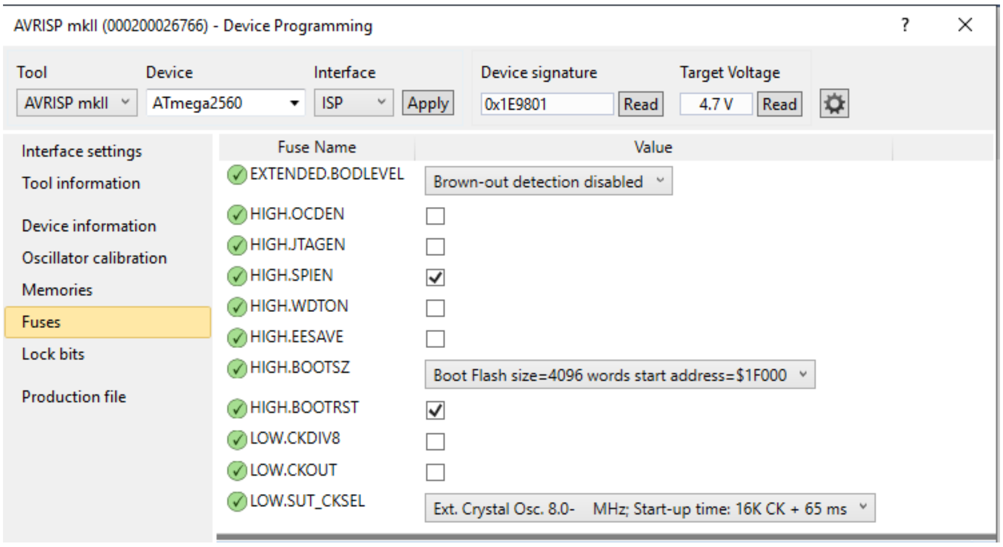
Flashing Boot-loader on ATmega2560

Note: Refer to this section only if you have accidentally overwritten the Boot-loader firmware of ATmega2560 on eYFi-Mega board.

Follow each of the steps given below carefully:

1. Components and Software required to get started:
    (a) eYFi-Mega board
    (b) USB micro-B plug to USB-A plug cable
    (c) USB A-Male to B-Male cable
    (d) Atmel AVRISP mkII (for more details, refer to link)
    (e) Atmel Studio 7 software (only on Windows platform)
    (f) Boot-loader firmware of ATmega2560 micro-controller on eYFi-Mega board (can be downloaded from **Downloads** section on **eYFi-Mega** page, link: `https://e-yantra.org/products/eyfi-mega`).
2. Connect the USB A-Male to B-Male cable to the PC and Atmel AVRISP mkII.
3. Connect the 6-pin AVR ISP FRC cable of Atmel AVRISP mkII to the ICSP header on eYFi-Mega board.
   Note: The notch on the FRC cable should match with the notch provided around the ICSP header.
4. Connect the USB micro-B plug to USB-A plug cable to the PC and Micro-USB connector on eYFi-Mega board.
5. Once the above connections are done, check the LED status on Atmel AVRISP mkII. If the LED color is **Green**, this means that everything is working fine and you can proceed with the next step. But, if the LED color is **Orange** or **Red**, this means that the connections between the Atmel AVRISP mkII and eYFi-Mega board is weak.

6. Open the Atmel Studio 7 software. Select the option **Device Programming** or use the shortcut **Ctrl + Shift + P**. A dialog box will open as shown in Figure 6.
7. Under **Tool** option, select **AVRISP mkII**.
8. Under **Device** option, select **ATmega2560**.
9. Under **Interface** option, select **ISP**.
10. Click on **Apply**.
11. Click on **Read** to read the Device Signature.
12. Check whether the **Device Signature** value is **0x1E9801** and the **Target Voltage** is around **5V**.
13. Go to **Fuses** and select the Fuse settings as shown in the Figure 6.



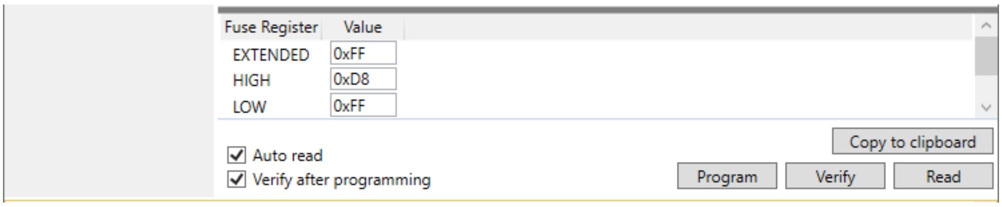
AVRISP mkII (000200026766) - Device Programming

Tool: AVRISP mkII
Device: ATmega2560
Interface: ISP
Device signature: 0x1E9801
Target Voltage: 4.7 V

Fuse Name	Value
EXTENDED.BODLEVEL	Brown-out detection disabled
HIGH.OCDEN	☐
HIGH.JTAGEN	☐
HIGH.SPIEN	☑
HIGH.WDTON	☐
HIGH.EESAVE	☐
HIGH.BOOTSZ	Boot Flash size=4096 words start address=$1F000
HIGH.BOOTRST	☑
LOW.CKDIV8	☐
LOW.CKOUT	☐
LOW.SUT_CKSEL	Ext. Crystal Osc. 8.0- MHz; Start-up time: 16K CK + 65 ms

Figure 6: Device Programming dialog box in Atmel Studio 7

14. Make sure that the option of **Auto read** and **Verify after programming** are selected as shown in Figure 6.



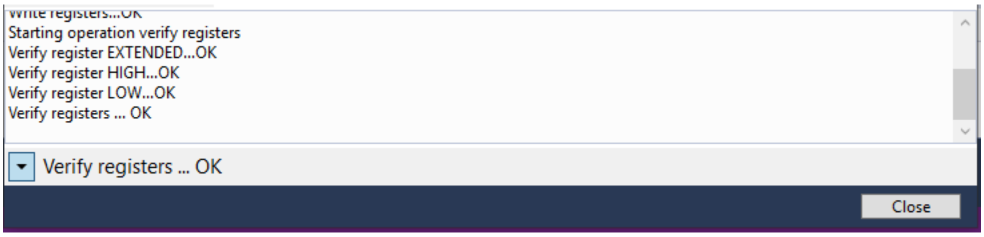
Fuse Register	Value
EXTENDED	0xFF
HIGH	0xD8
LOW	0xFF

☑ Auto read
☑ Verify after programming

Figure 7: Fuse settings to be done

15. Once you are done with the above settings, click on **Program**.

16. After the programming is complete, you will see the message as shown in the below Figure 6.



```
Write registers...OK
Starting operation verify registers
Verify register EXTENDED...OK
Verify register HIGH...OK
Verify register LOW...OK
Verify registers ... OK
```

Verify registers ... OK

Figure 8: All OK message after programming the Fuses

17. Go to **Memories**, select **Erase Now** to erase the ATmega2560 chip before flashing the Boot-loader firmware on to it.

18. Make sure the options **Erase device before programming** and **Verify flash device after programming** are selected.

19. Select the Boot-loader firmware downloaded under the **Flash (256 KB)** section and press **Program**.

20. Once the programming is complete, you will get the message: **Verifying Flash....OK**. The LED color on Atmel AVRISP mkII will turn to **Orange** and will blink continuously.

21. Congrats! Your eYFi-Mega board is updated with the Boot-loader firmware of ATmega2560.

C

Flashing Boot-loader on ESP32

Note: Refer to this section only if you have accidentally overwritten the Boot-loader firmware / Partition Table / OTA Application of ESP32 on eYFi-Mega board.

1. To upload the Boot-loader firmware of ESP32: refer the Section **Flashing eYFi-Mega ESP32 Bootloader** in the **Software Manual of eYFi-Mega development board**.
2. To upload the Partition Table of ESP32: refer the Section **Flashing eYFi-Mega ESP32 Partition Table** in the **Software Manual of eYFi-Mega development board**.
3. To upload the OTA Application of ESP32: refer the Section **Flashing eYFi-Mega ESP32 OTA Application** in the **Software Manual of eYFi-Mega development board**.