Peripheral Circuitry and Subsystems of Arduino Mega 2560

Arduino is an open-source hardware and software company. Arduino boards come with different microprocessors/ microcontrollers such as Atmel AVR, ARM Cortex, Intel Quark. Arduino Mega 2560 based on ATmega2560. It has 54 digital I/O pins 16 analog inputs, 4 UART, USB connection, a power jack, 256KB Flash memory, 8 KB SRAM, 4KB EEPROM, ICSP header, 16 MHz crystal and a reset button. In Arduino Meg 2560 we can observe the main peripheral circuits and subsystems. Those are,

1. Atmega2560 microcontroller
2. Clock
3. Power supply and regulating
4. USB interfacing
5. In-Circuit Serial Programming
6. Reset Mechanism

Atmega2560 microcontroller

ATmega 2560 is 8bit AVR RISC based microcontroller that comes in the TQFP package.

which has

- 256HB flash memory (ISP),
- 8KB SRAM,
- 4KB EEPROM
- 32 general-purpose working Registers,
- 86 GPIO lines
- real-time counter
- 6 flexible counters with compare modes(Two 8-bit and Four 16-bit)
- Four 8 Bit and 6/12 programmable resolution PWM
    - PWM pins on Arduino (2 - 13, 44 - 46)
- 4 Programmable Serial USARTs
    - USART pins on Arduino ([0, 1], [15, 14], [17 ,16], [19, 18])
- 16-channel 10-bit A/D converter
- byte oriented 2-wire serial interface
- Master/Slave SPI Serial Interface
    - SPI pins on Arduino (50(MISO), 51(MOSI), 52(SCK), 53(SS))
- JTAG interface for on-chip debugging
    - JTAGPIN9->TDI->ADC7
    - JTAGPIN3->TDO->ADC6
    - JTAGPIN5->TMS->ADC5
    - JTAGPIN1->TCK->ADC4
    - JTAGPIN10->ARDUINO GRND
    - JTAGPIN6->ARDUINO RESET
    - JTAGPIN4->ARDUINO 5V

ATmega2560 can achieve a throughput of 16 MIPS at 16 MHz. Atmega2560 has ultra-low power consumption in active mode 1 MHz, 1. 8V:500uA. Every digital pin comes to an internal pull-up resistor.

- 6 external interrupts (2, 3, 18- 21)

- I2C pins (20, 21)
- AREF pin for different reference voltage for analog inputs.
- RESET pin can reset the microcontroller.

Clock

The Atmega2560 microcontroller has an internal clock in it but Arduino mega comes with an external 16 MHz (SMD) oscillator. There are two 22 pF. capacitors connected parallel with the oscillator. The clock is used for reference frequency in microcontroller operations.

Power Supply

In Arduino Mega, we have two power options, one is through the USB connection and the other one is through Power jack. Logic voltage is 5V and the recommended Voltage input is 7-12 V. In the power pin area we can see Vin pin that also can use as a power input. Arduino Mega 2560 also can decide what source should use by the power switching circuit built-in.

Power Regulation

5V regulation- SPX1117M3-L-5-0/TR
3.3V regulation- LP2985-33DBVR
Power switcher - LMV358IDGKR as the comparator, irlml6402 MOSFET for switch

USB Interfacing

The USB interfacing is used to communicate with the computer through the USB connector. The Arduino Mega has an ATmega16U2 microcontroller that acts as a USB-to-Serial. On a normal Arduino, it same as an FTDI converter, but we can flash it with any firmware. This microcontroller also has a 16 MHz oscillator (THD) connected to it as an external clock.

In-Circuit Serial Programming

In-Circuit Serial Programming (ICSP) uses an ICSP programmer to program the microcontroller. The ICSP programmer communicates load the compiled program (Hex) into it. When we upload sketches through USB a small program known as the bootloader will help to upload the program. When the microcontroller resets, the bootloader looks for a new program to be uploaded. If there is not a new program to be upload, the previous program will begin to run. When we use ICSP we can program the IC also if we need, we can update, change, or remove bootloader.

Reset Mechanism

The reset mechanism plays a major part in Microcontroller. Atmega2560 microcontroller has a reset pin in PIN 3. It is an active low reset mechanism which is if the reset pin is grounded microcontroller will be reset. Arduino Mega 2560 board provides a reset button with another circuitry required to reset the microcontroller (10 $k\Omega$ resistor parallel with a diode, a 22 pF capacitor, and a pushbutton).

Reference

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5. https://www.microchip.com/wwwproducts/en/ATmega2560