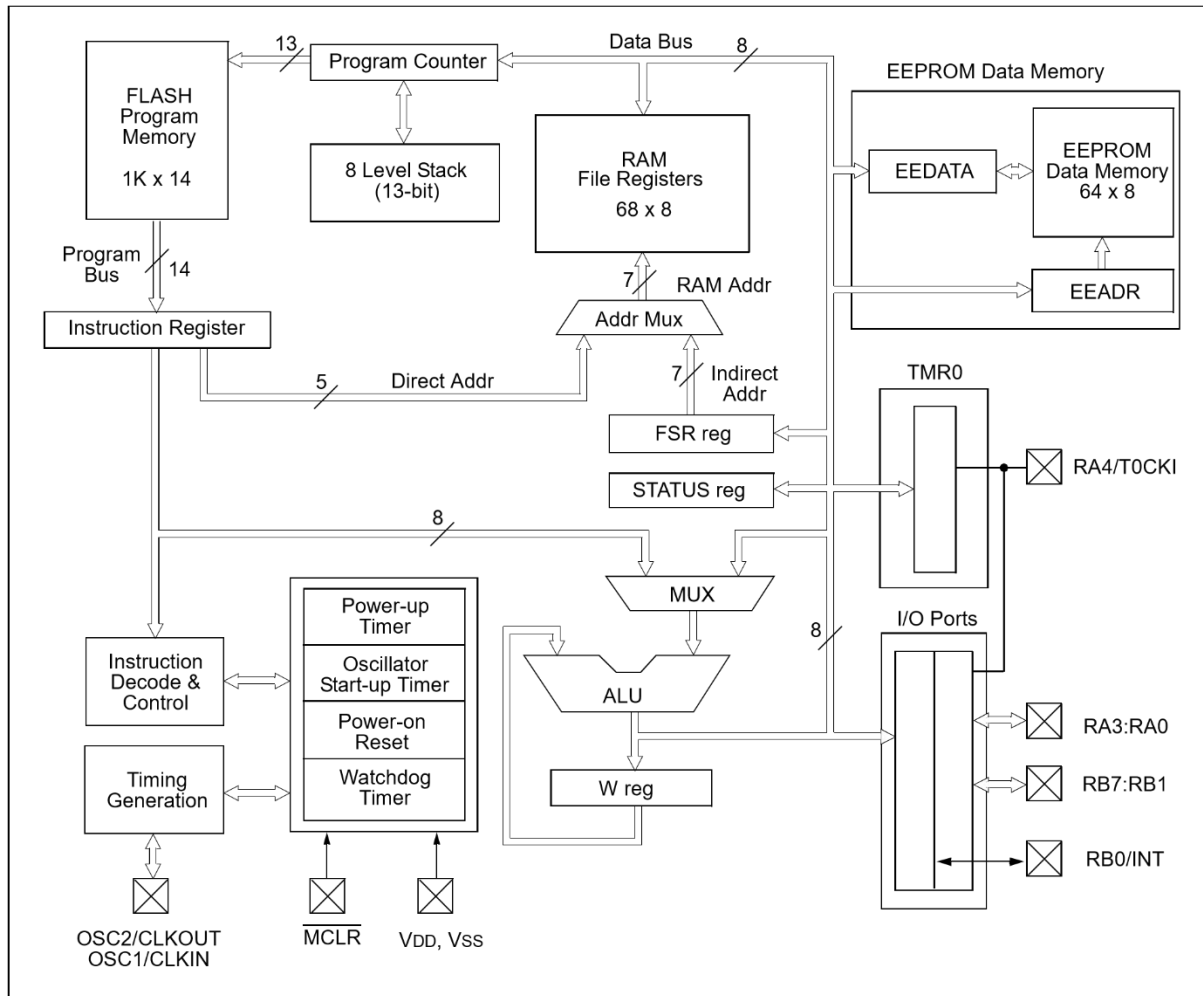# Internal Architecture of the PIC16F84A

Main Processor

Consists of three main blocks:

- Multiplexer (MUX)
- Watchdog Timer (WDT)
- Arithmetic Logic Unit (ALU)

Architecture

- RISC type (Reduced Instruction Set Computer)
- 14-bit operation code (Opcode)

Memory

- Two types of registers:
  - **SFR** (Special Function Registers)
  - **GPR** (General Purpose Registers)
- Two banks with twelve registers each, 14 bits per register

Interface

- **(MCLR)** – Master Clear (Reset) pin with inversion.
  Used to reset the program counter (PC - Program Counter).
- **PORTA** – 8-bit port, but only the lower 5 bits are used, resulting in 5 physical pins.
- **PORTB** – 8-bit port that uses all 8 bits, providing 8 physical pins.

Stack Memory

- 8 levels, each with 13 cells → 8 × 13

Oscillator

- Quartz Crystal Resonator (XT_OSC) – 32 KHz
- Capacitor C1: 100 nF
- Capacitor C2: 22 pF
- Capacitor C3: 22 pF

Power Supply

- Power source (VDD)
- Ground (VSS)

TMR0

TMR0 – Timer 0 is an 8-bit register whose purpose is to count from 0 to 255. This generates a precisely defined operating frequency for Timer 0 overflow. When the timer is initially reset and the operating frequency of the quartz resonator and the division coefficient of Timer 0 are determined, their values are used in the formula:

From 256, the value of TMR0, which is reset by the program, is subtracted. This result is then multiplied by **1 divided by the division coefficient (Kdel)**, which is set by the program, and further multiplied by **1 divided by the oscillator frequency (Fosc)**, which is set using a quartz resonator (XT _OSC) with a value of **32 KHz**. This determines the time period for which TMR0 overflows from 0 to 255.

Division Coefficients

OPTION_REG

RP0	0	1	0	1	0	1	0	1
RP1	0	0	1	1	0	0	1	1
RP2	0	0	0	0	1	1	1	1

| Division Ratio | 1:2 | 1:4 | 1:8 | 1:16 | 1:32 | 1:64 | 1:128 | 1:256 |

$TI = (256 - (TMR0)) * (1 / Kdiv) * (4 / Fosc)$
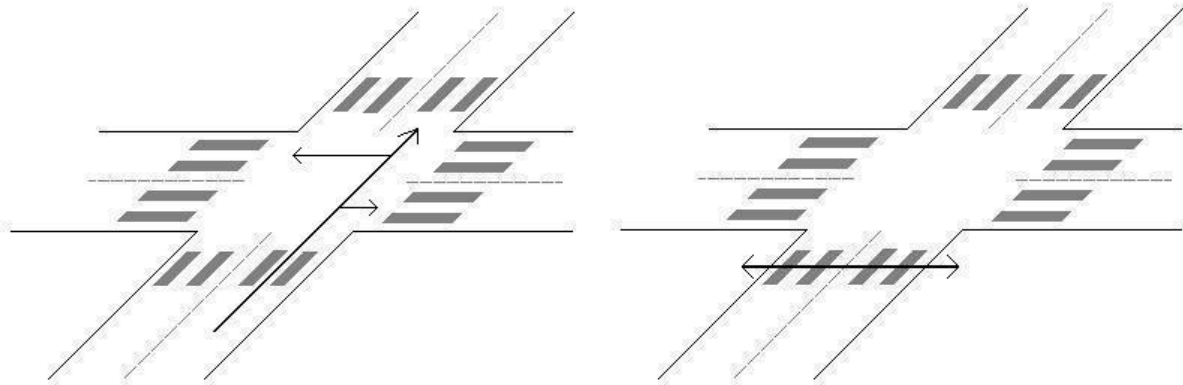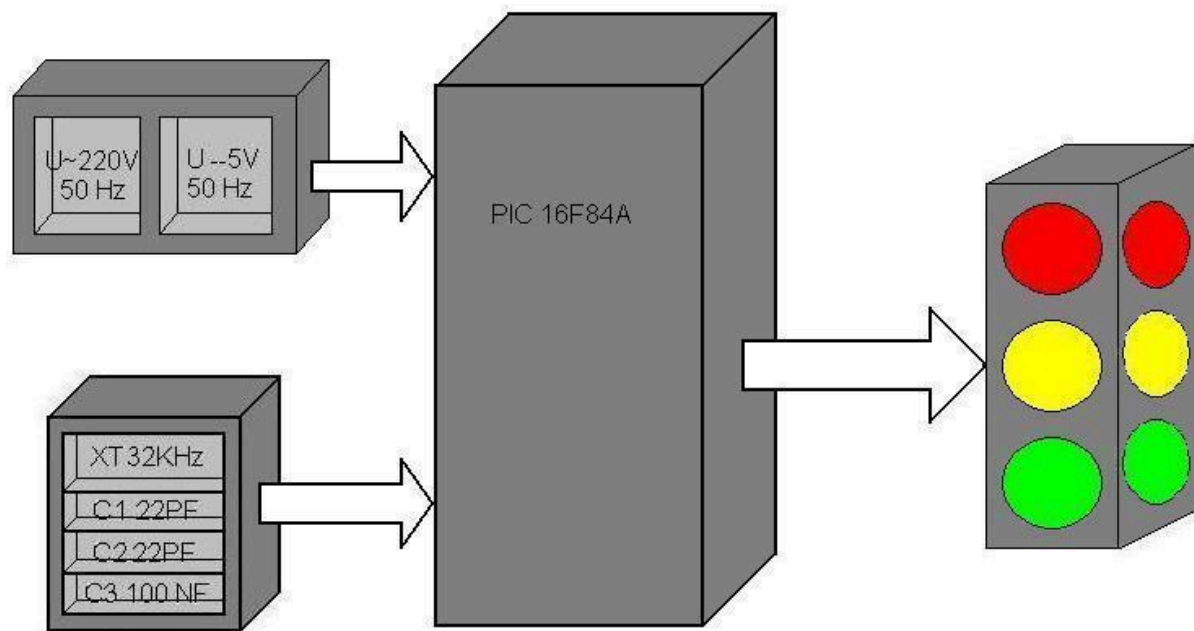
$(256 - 0) * (1 / 32) * (4 / 32{,}768)$

$256 * (1 / 32) * (4 / 32{,}768)$

$8 * (4 / 32{,}768) = 32 / 32{,}768 = 0.0009765625$ seconds

(or 976.56 microseconds)

This means the timer overflows: $1 / 0.0009765625 = 1024$ times per second (1024 Hz)

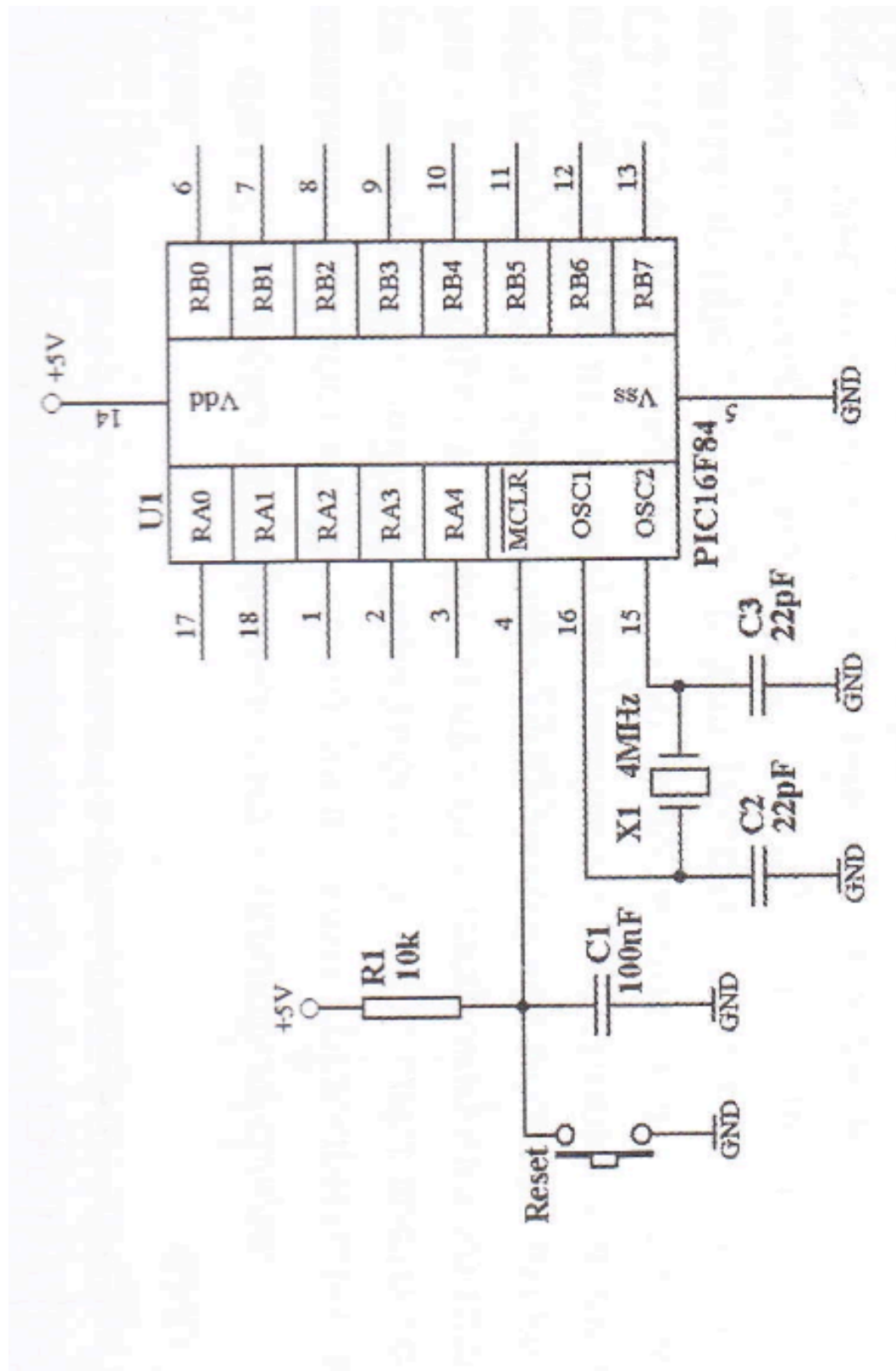# Block Diagram

Parts lists

Number	Component	Designation	Symbol	Quantity
1	Microcontroller	PIC16F84A	IC1	1
2	Traffic light system with two sectors	—	—	1
3	Quartz Resonator	XT_OSC	X1	1
4	Resistor R1	10KΩ ±10% 0.125W	R1	1
5	Resistors R2-R7	470Ω ±10% 0.125W	R2-R7	6
6	Capacitor C1	100nF	C1	1
7	Capacitors C2-C3	22pF	C2-C3	2
8	LED VD1 & VD4	Red	VD1 & VD4	2
9	LED VD2 & VD5	Yellow	VD2 & VD5	2
10	LED VD3 & VD6	Green	VD3 & VD6	2
11	Switch	S1	S1	1

Power and Frequency System Schematic

Basic Schematic for Connecting the LEDs

RB0

RB1

RB2

RB3

RB4

RB5

RB6

RB7