This Is a 4-bit microprocessor like intel 4004, It has 16 basic Instruction set which is necessary for basic arithmetic and logical operations.

**Specifications:**

4-Bit processor

2040(2Kb)-bit program memory

64 bits data memory

Operating frequency 100-1000 kHz

5 Bit flag register (Great, Less, Equal, Carry, Borrow)

Pin Numbers:

+---\/---+

RST 1| |14 VCC

D0 2| |13 D8

D1 3| |12 D7

D2 4| |11 D6

D3 5| |10 D7

CLK 6| |9 NC

GND 7| |8 Result

+--------+

Instruction sets

NOP - 0000

ADD - 0001

SUB - 0010

AND - 0011

OR - 0100

XOR - 0101

CMP - 0110

JMP - 0111

JZ - 1000

JNZ - 1001

HALT - 1010

RIN - 1011

LDA - 1100

STA - 1101

WOP - 1110

LDI - 1111

Instruction Set Description :

NOP – No Operation occurs in that program cycle.

ADD – Addition of 2 (4 bit) number with carry, the carry is updated in flag register, one value should be loaded in Ram and other from Accumulator.

SUB – Subtraction of 2 (4 bit) number with carry, the borrow is updated in flag register, one value should be loaded in Ram and other from Accumulator.

AND – Bitwise AND operation between 2 (4 bit) numbers, one value should be loaded in Ram and other from Accumulator.

OR – Bitwise OR operation between 2 (4 bit) numbers, one value should be loaded in Ram and other from Accumulator.

XOR – Bitwise XOR operation between 2 (4 bit) numbers, one value should be loaded in Ram and other from Accumulator.

CMP – Bitwise CMP operation between 2 (4 bit) numbers (Greater, Lesser, Equal flags are updated in flag register).

JMP – Jumps to specific program address out of 8-bit location, first 4 bits are retrieved from RAM location 4’b1111 and other value should be stored in Accumulator and 8 bit value is used for jumping to a program address

JZ – Jumps to specific program address if accumulator value is “0” but limited to first 16 location of Program memory(Will update this problem soon), address needs to be stored in reserved jump address in RAM location 4’b1111.

JNZ – Jumps to specific program address if accumulator value is not “0” but limited to first 16 location of Program memory(Will update this problem soon), address needs to be stored in reserved jump address in RAM location 4’b1111.

HALT – Halt the program execution and make the processor to an idle state.

RIN – Reads the input pins D4, D5, D6, D7 pins and stores in RAM as bit value(On – 1, OFF - 0) to specified address.

LDA – Load Accumulator, Loads the Accumulator with a value from RAM address location. STA – Stores Accumulator value to specific RAM address, specified along with Instruction.

WOP – Write the values from specified RAM location to 4 different outputs, 1 as ON and 0 as OFF.

LDI – Loads an immediate value to the accumulator , value specified along with the instructions.

Each operation updates the result register and output can be obtained periodically, Input clock is powered by internal clock, need to update with external clock. Operations involving flag register updates the value in control unit, RAM location 1111(16) is reserved for Program Jump operation.

Program memory has 256 locations, controlled by 8-bit values, the values are stored in LUT.