UNIT - 3

Counters and time delays - hexadecimal counter module ten counter pulse timing for flashing lights debugging counters and delays program stack subroutine conditional call and return instructions

Delay calculation

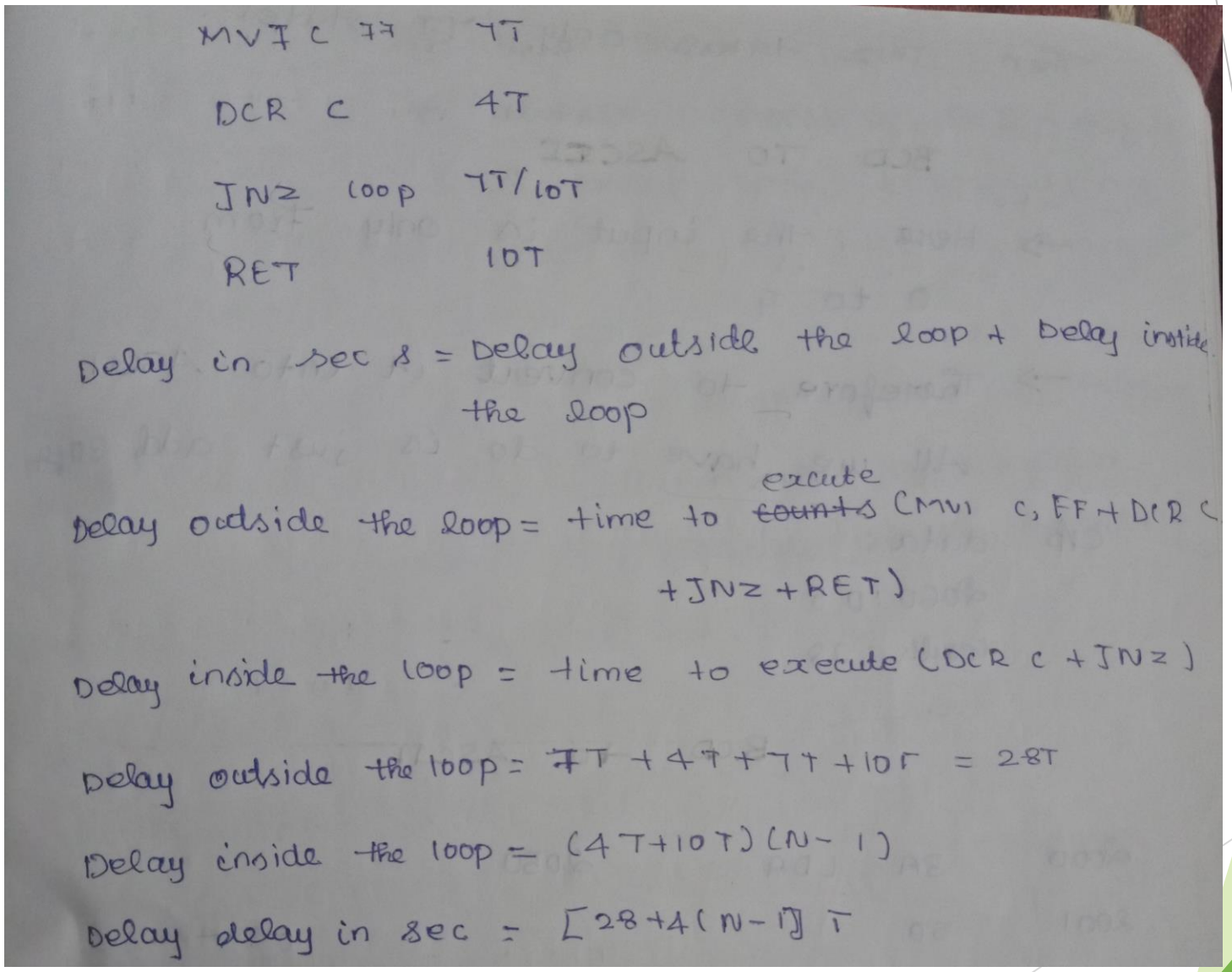
Time delay using a single register :

* A single register is loaded with a desired number.

* The contents of the register is Decremented one by one.

* The program moves in a loop till the content of the

Then, the program returns to the main program with a RET instruction.



MVI C ?? 7T

DCR C 4T

JNZ loop 7T/10T

RET 10T

Delay in sec s = Delay outside the loop + Delay inside the loop

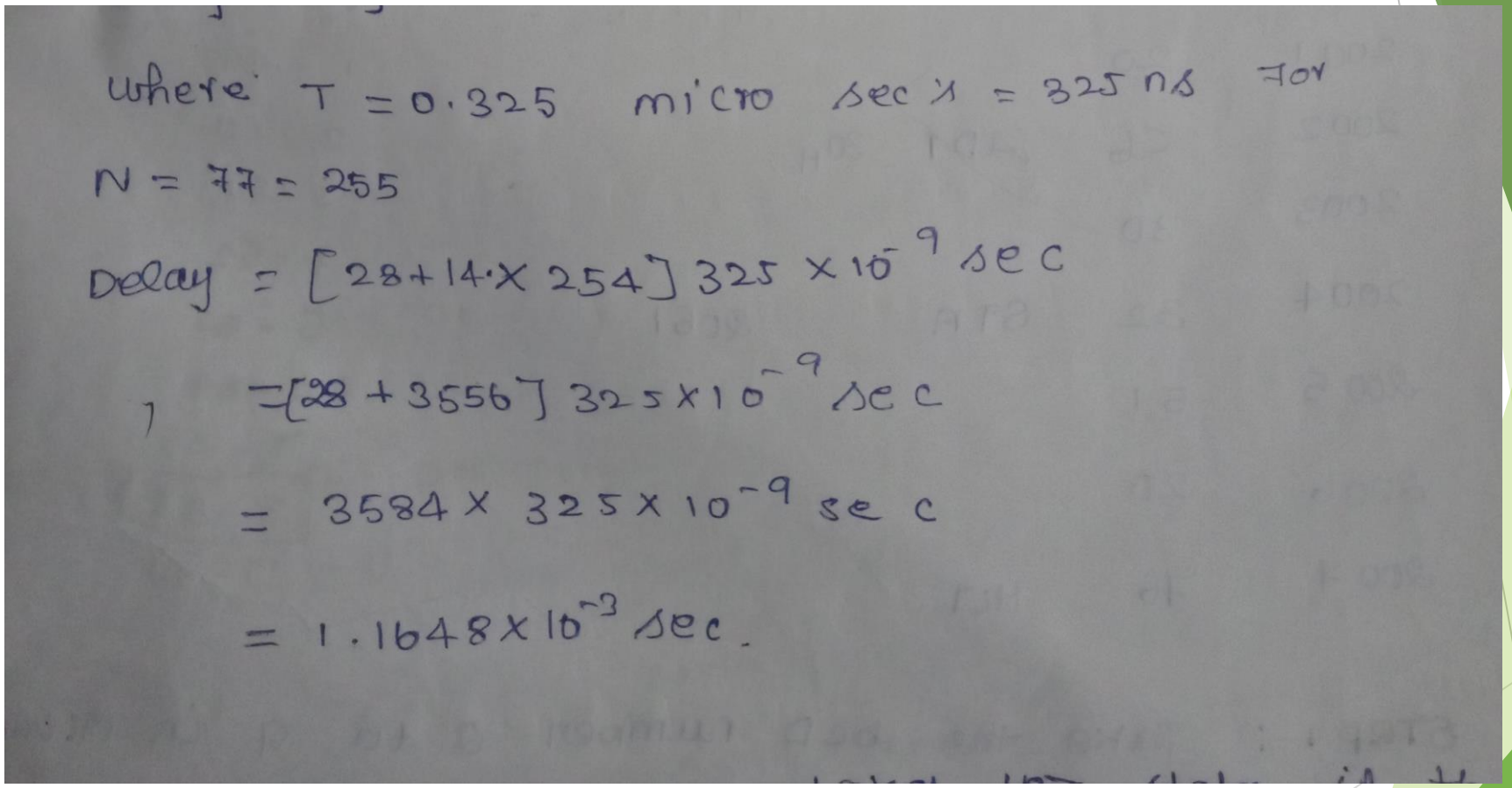
Delay outside the loop = time to ~~counts~~ execute (MVI C, FF + DCR C + JNZ + RET)

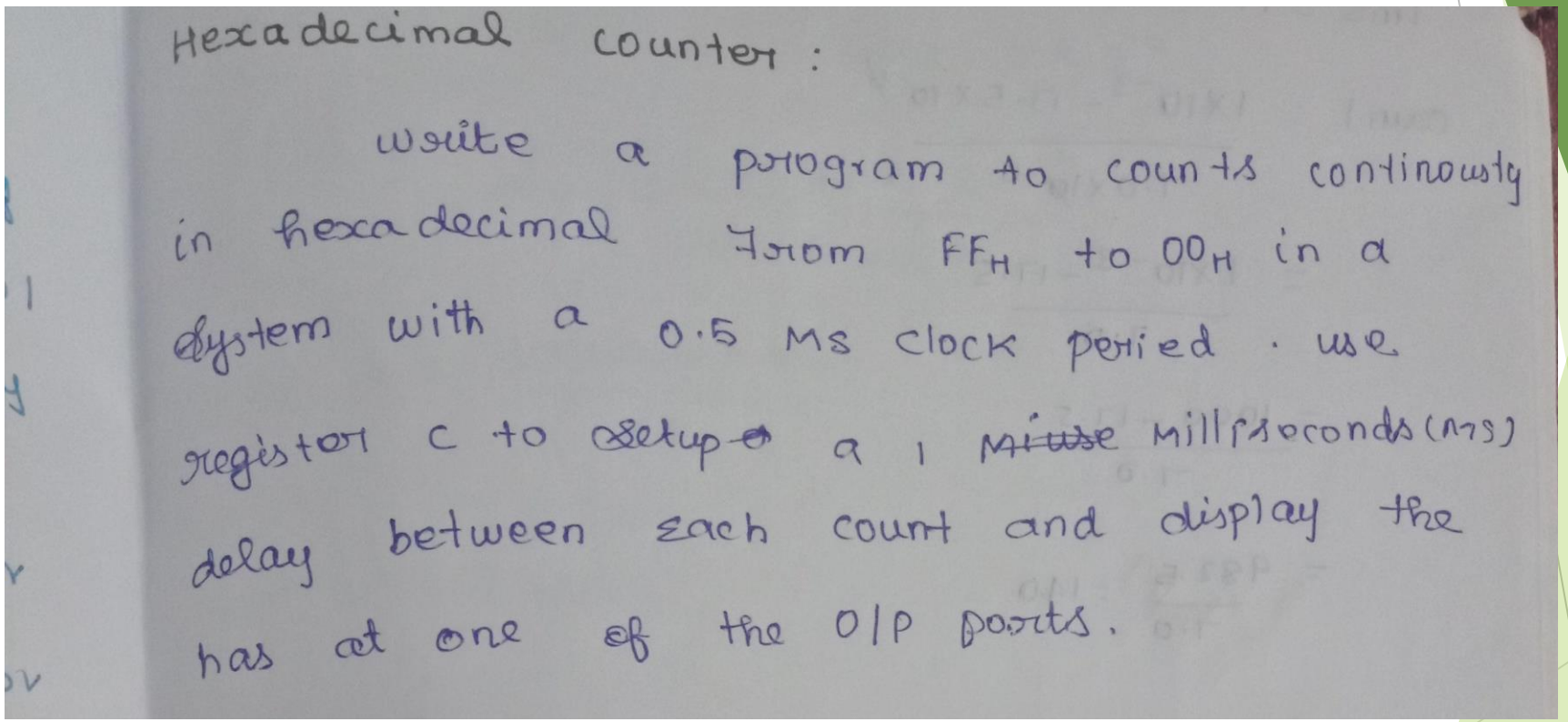
Delay inside the loop = time to execute (DCR C + JNZ)

Delay outside the loop = 7T + 4T + 7T + 10T = 28T

Delay inside the loop = (4T+10T)(N-1)

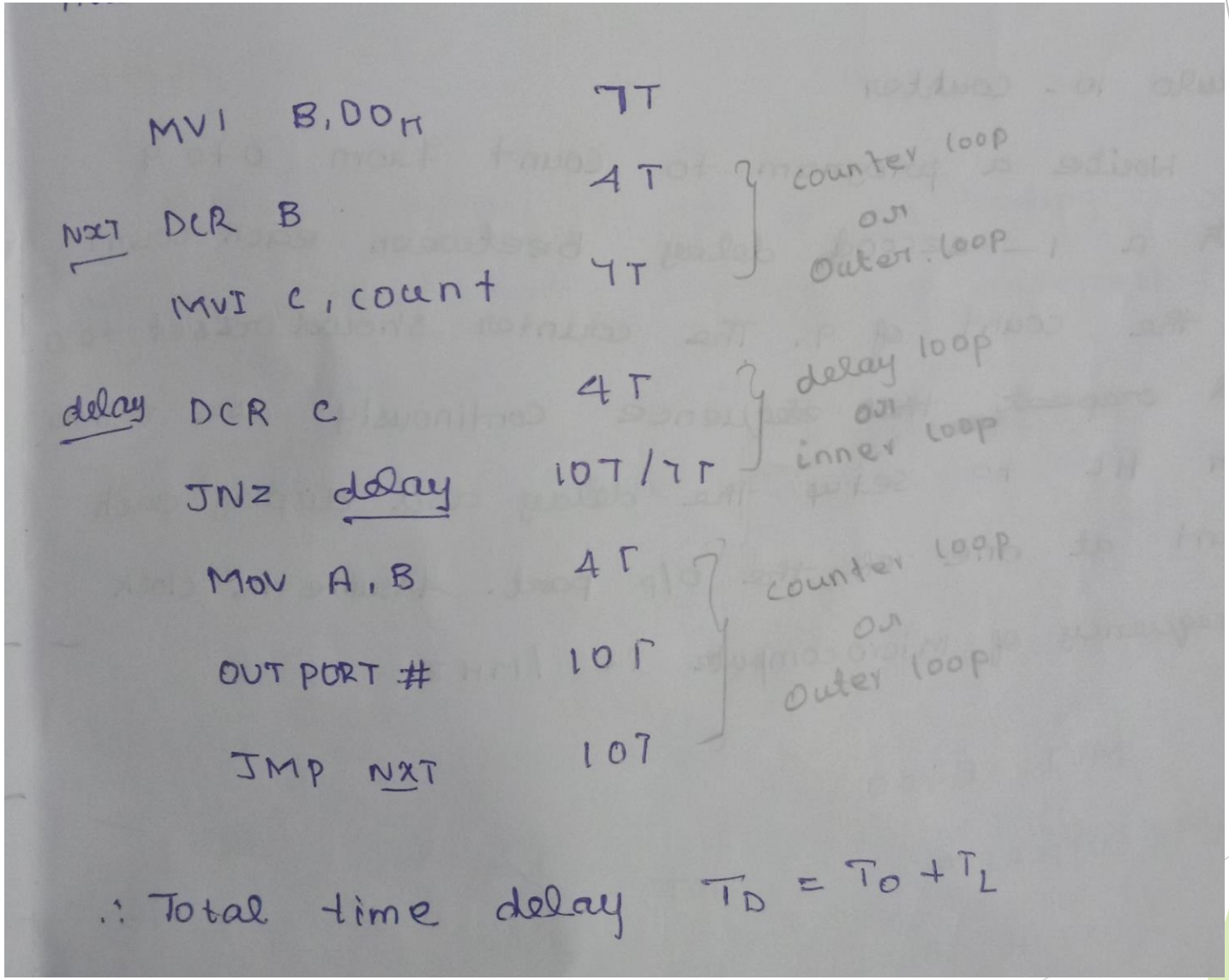
Delay delay in sec = [28+4(N-1)] T


where T = 0.325 micro sec λ = 325 nS for
N = 77 = 255
Delay = [28+14·X 254] 325 x 10^-9 sec
= [28 + 3556] 325 x 10^-9 sec
= 3584 x 325 x 10^-9 sec
= 1.1648 x 10^-3 sec.



Hexadecimal counter :

write a program to counts continously in hexadecimal from FF_H to 00_H in a system with a 0.5 Ms clock period . use register C to ~~setup~~ a ~~Misuse~~ Milliseconds (ms) delay between each count and display the has at one of the O/P ports.


MVI B, 00H 7T
NXT DCR B 4T
MVI C, count 7T
counter loop or Outer loop
delay DCR C 4T
JNZ delay 10T/7T
delay loop or inner loop
MOV A, B 4T
OUT PORT # 10T
JMP NXT 10T
counter loop or Outer loop
∴ Total time delay $T_D = T_O + T_L$

$T_0 = 35\ T\text{-}States \times T$

$= 35 \times (0.5 \times 10^{-6})$

$= 17.5\ MS \times 10^{-6}$

$T_L = 14\ TS \times (T_{clock}) \times count$

$= 14 \times 0.5 \times 10^{-6} \times count$

$= 7.0 \times 10^{-6} \times count$

$T_D = T_0 + T_L$

$$1ms = 17.5 \times 10^{-6} + 7.0 \times 10^{-6} \times count$$

$$count = \frac{1 \times 10^{-3} - 17.5 \times 10^{-6}}{7.0 \times 10^{-6}}$$

$$= \frac{1 \times 10^{-3} - 17.5}{7.0}$$

$$= \frac{1000 - 17.5}{7.0}$$

$$= \frac{982.5}{7.0} = 140$$

Modulo 10 - counter

Write a program to count from 0 to 9 with a 1 — second delay between each count At the count of 9. The counter should reset to 0 and repeat the sequence continously use register pair HL to setup the delay and display each count at one of the o/p port. Assume the clock frequency of Microcompute is 1MHz.

```
        MVI   B,00
display OUTPORT #        10T
        LXI   H, A2b2    10T
loop    DCX   H          6T
        MOV   A,L        4T
        ORA   H          4T
        JNZ   loop       10T/7T
        INR   B          4T
        MOV   A,B        4T
        CPI   0A         7T
        JNZ   display    10T
```

$$T_D = T_0 + T_2$$

$$1ms = 45 \times 10 \times 10^{-6} + 24 \times 1.0 \times 10^{-6}$$

$$= \frac{1 \times 10^6 - 45 \times 1.0 \times 10^{-6}}{24 \times 1.0 \times 10^{-6}}$$

$$= \frac{1000000 - 45}{24}$$

$$= 41664.7$$

$$= 41665$$

ii. Conditional Call and Return

Conditional call instructions such as **CZ** (call on zero) or **CC** (call on carry) will cause the program counter to be loaded with the 16-bit address given in the instruction only if the specified condition is true (Z = 1 or Cy = 1). Otherwise, the execution of instructions will continue in its normal sequence.

The various conditional call instructions are listed below.

CZ	call if zero flag is set.	Z = 1.
CNZ	call if zero flag is not set.	Z = 0.
CC	call if carry flag is set.	Cy = 1.
CNC	call if carry flag is not set.	Cy = 0.
CPE	call if parity flag is set.	P = 1. Even parity.
CPO	call if parity flag is not set.	P = 0. Odd parity.
CM	call if sign flag is set.	S = 1. MSB bit = 1.
CP	call if sign flag is not set.	S = 0. MSB bit = 0.

Return to the main program can also be conditional. Conditional return instructions such as **RZ** (return on zero) or **RC** (return on carry) will cause the program counter to be loaded with the 16-bit address from the stack only if the specified condition is true (Z = 1 or Cy = 1). Otherwise, the execution of instructions will continue in its normal sequence in the subroutine.

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The various conditional return instructions are listed below.

RZ	return if zero flag is set.	Z = 1.
RNZ	return if zero flag is not set.	Z = 0.
RC	return if carry flag is set.	Cy = 1.
RNC	return if carry flag is not set.	Cy = 0.
RPE	return if parity flag is set.	P = 1. Even parity.
RPO	return if parity flag is not set.	P = 0. Odd parity.
RM	return if sign flag is set.	S = 1. MSB bit = 1.
RP	return if sign flag is not set.	S = 0. MSB bit = 0.

THANK YOU