

Fetch:-

$$T_0: AR \leftarrow PC$$

$$T_1: IR \leftarrow M[AR], PC \leftarrow PC + 1$$

Decode:-

$$\begin{aligned} T_2: D_7, \dots, D_1, D_0 &\leftarrow IR[12-14], \\ J &\leftarrow IR[15], \\ AR &\leftarrow IR[0-11] \end{aligned}$$

Indirect:-

$$\overline{D}_7 J T_3: AR \leftarrow M[AR]$$

Memory-reference:-

$$\begin{aligned} \text{NAND} \quad D_0 T_4: DR &\leftarrow M[AR] \\ D_0 T_5: AC &\leftarrow \overline{DR \cdot AC}, SC \leftarrow 0 \end{aligned}$$

$$\begin{aligned} \text{ADD} \quad D_1 T_4: DR &\leftarrow M[AR] \\ D_1 T_5: AC &\leftarrow AC + DR, E \leftarrow \text{Cout}, SC \leftarrow 0 \end{aligned}$$

$$\begin{aligned} \text{OR} \quad D_2 T_4: DR &\leftarrow M[AR] \\ D_2 T_5: AC &\leftarrow DR \text{ or } AC, SC \leftarrow 0 \end{aligned}$$

$$\begin{aligned} \text{LDA} \quad D_3 T_4: DR &\leftarrow M[AR] \\ D_3 T_5: AC &\leftarrow DR, SC \leftarrow 0 \end{aligned}$$

$$\text{STA} \quad D_4 T_4: M[AR] \leftarrow AC, SC \leftarrow 0$$

$$\begin{aligned} \text{MUL_8} \quad D_5 T_4: DR &\leftarrow M[AR] \\ D_5 T_5: AC[15:0] &\leftarrow AC[7:0] + DR[7:0], SC \leftarrow 0 \end{aligned}$$

Register-reference:- $D_7\bar{J}T_3 = r$

$r : SC \leftarrow 0$

INC $rB_{11} : AC \leftarrow AC + 1$

CLA $rB_{10} : AC \leftarrow 0$

SPA $rB_9 : \text{if}(AC(15)=0) \text{ then}(PC \leftarrow PC + 1)$

CIR $rB_8 : AC \leftarrow \text{shr } AC, AC(15) \leftarrow E, E \leftarrow AC(0)$

HLT $Rb_7 : S \leftarrow 0$

IN\OUT-reference:- $D_7JT_3 = p$

OUT $pB_{11} : OUTR \leftarrow AC(0-7), FGO \leftarrow 1, SC \leftarrow 0$

INT-LCD $pB_{10} : rs \leftarrow 0, e \leftarrow 1, SC \leftarrow 0$

PRINT $D_7J T_3 B_9 : rs \leftarrow 1, e \leftarrow 1$
 $D_7J T_4 B_9 : OUTR \leftarrow 0, FGO \leftarrow 0, SC \leftarrow 0$