1. 微指令格式：

微指令字长为28位，即uIR27-uIR0

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27 | | 26 | | | 25 | | | 24 | | 23 | | | 22 | | | 21 | | 20 | | | 19 | | |
| ALU选择 | | | | | | | | M | | S3 | | | S2 | | | S1 | | S0 | | | CN | | |
| 18 | 17 | | | 16 | | 15 | | | 14 | | 13 | | 12 | 11 | | | 10 | | | 9 | | 8 | | | 7 |
|  | A选择器 | | | | | | | | B选择器 | | | | |  | | | 寄存器选择 | | | | | | | | | |
| 后继地址（12位） | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | 5 | | | | 4 | | | | | 3 | | | 2 | | | | 1 | | | | 0 | | | |
| RD | | | WR | | | | G | | | | | 后继地址形成 | | | | | | | | | | | | | | |

1. 微指令字段定义：
2. ALU选择：uIR27，uIR26，uIR25

将基本ALU(ALUA)、阵列乘法器(ALUB)、移位器(ALUC)、除法器(ALUD)的结果以及余数的输出之一传输至总线上。

|  |  |  |  |
| --- | --- | --- | --- |
| uIR27 | uIR26 | uIR25 |  |
| 0 | 0 | 0 | ALUA |
| 0 | 0 | 1 | ALUB |
| 0 | 1 | 0 | ALUC |
| 0 | 1 | 1 | ALUD(结果) |
| 1 | 1 | 1 | ALUD(余数) |

1. ALU控制：uIR24，uIR23，uIR22，uIR21，uIR20，uIR19

控制ALUA进行算术运算、逻辑运算、数据直传等，控制ALUC进行移位运算。

1. A选择器控制：uIR17，uIR16，uIR15

控制ALU的A端输入，选择范围为{R0, RAM, SP, R3, CX}.

|  |  |  |  |
| --- | --- | --- | --- |
| uIR17 | uIR16 | uIR15 |  |
| 0 | 0 | 0 |  |
| 0 | 0 | 1 | R0 |
| 0 | 1 | 0 | RAM |
| 0 | 1 | 1 | SP |
| 1 | 0 | 0 | R3 |
| 1 | 0 | 1 | CX |

1. B选择器控制：uIR14，uIR13，uIR12

控制ALU的B端输入，选择范围为{PC, R1, R2}.

|  |  |  |  |
| --- | --- | --- | --- |
| uIR14 | uIR13 | uIR12 |  |
| 0 | 0 | 0 |  |
| 0 | 0 | 1 | PC |
| 0 | 1 | 0 | R1 |
| 0 | 1 | 1 | R2 |

1. 寄存器选择：uIR10，uIR9，uIR8，uIR7

将运算结果存入指定的寄存器。

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| uIR10 | uIR9 | uIR8 | uIR7 |  |
| 0 | 0 | 0 | 0 |  |
| 0 | 0 | 0 | 1 | R0 |
| 0 | 0 | 1 | 0 | R1 |
| 0 | 0 | 1 | 1 | PC |
| 0 | 1 | 0 | 0 | IR |
| 0 | 1 | 0 | 1 | MAR |
| 0 | 1 | 1 | 0 | R2 |
| 0 | 1 | 1 | 1 | R3 |
| 1 | 0 | 0 | 0 | SP |
| 1 | 0 | 0 | 1 | CX |

1. 存储器的读写控制：uIR6，uIR5

|  |  |  |
| --- | --- | --- |
| uIR6 | uIR5 |  |
| 0 | 0 |  |
| 0 | 1 | WR |
| 1 | 1 | RD |

1. 停机控制：uIR4

uIR4为0时，G=0，机器运行；uIR4为1时，G=1，机器停机。

1. 后继微地址形成控制：uIR3，uIR2，uIR1，uIR0

一共设计了9种后继微地址形成方式，其中基本跳转为uPC+1，JP，QJP，分别实现微地址自增使微程序顺序执行，执行取指周期以及根据指令寄存器IR内容进行跳转以寻找指令对应的为程序入口地址。条件跳转基于前者实现，通过判断标志寄存器的值决定执行uPC+1或者JP.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| uIR3 | uIR2 | uIR1 | uIR0 |  |
| 0 | 0 | 0 | 0 |  |
| 0 | 0 | 0 | 1 | uPC+1 |
| 0 | 0 | 1 | 0 | JP |
| 0 | 0 | 1 | 1 | QJP |
| 0 | 1 | 0 | 0 | JZ |
| 0 | 1 | 0 | 1 | JL |
| 0 | 1 | 1 | 0 | JG |
| 0 | 1 | 1 | 1 | JC |
| 1 | 0 | 0 | 0 | JA |
| 1 | 0 | 0 | 1 | JNZ |