

## Single issue

Instruction	issue	EX	MEM	WB
LD F0,0(R1)	1	2	3	4
FMUL F4,F0,F6	2	5,6,7		8
FADD F4,F4,F2	3	9		10
ST F4,0(R1)	4	5	11	
ADDI R1,R1,8	5	6		7
BEQ R1,R2,loop	6	8		
LD F0,0(R1)	9	10	11	12
FMUL F4,F0,F6	10	13,14,15		16
FADD F4,F4,F2	11	17		18
ST F4,0(R1)	12	13	19	
ADDI R1,R1,8	13	14		15
BEQ R1,R2,loop	14	16		
LD F0,0(R1)	17	18	19	20
FMUL F4,F0,F6	18	21,22,23		24
FADD F4,F4,F2	19	25		26
ST F4,0(R1)	20	21	27	
ADDI R1,R1,8	21	22		23
BEQ R1,R2,loop	22	24		

## 2-issue

Instruction	issue	EX	MEM	WB
LD F0,0(R1)	1	2	3	4
FMUL F4,F0,F6	1	5,6,7		8
FADD F4,F4,F2	2	9		10
ST F4,0(R1)	2	3	11	
ADDI R1,R1,8	3	4		5
BEQ R1,R2,loop	3	6		
LD F0,0(R1)	7	8	9	10
FMUL F4,F0,F6	7	11,12,13		14
FADD F4,F4,F2	8	15		16
ST F4,0(R1)	8	9	17	
ADDI R1,R1,8	9	10	11	
BEQ R1,R2,loop	9	12		
LD F0,0(R1)	13	14	15	17
FMUL F4,F0,F6	13	18,19,20		21
FADD F4,F4,F2	14	22		23
ST F4,0(R1)	14	15	24	
ADDI R1,R1,8	15	16		17
BEQ R1,R2,loop	15	18		

# VLIW

No stalls in the iteration, stall in different functional units between iteration (bold is for next iteration)

MEM	MEM	FLOAT	FLOAT	INT	
LD	LD				
LD	LD				
LD		MUL	MUL		
		MUL	MUL		
		MUL			
		ADD	ADD		
ST	ST	ADD	ADD		
ST	ST	ADD	ADD		
ST					
<b>LD</b>	<b>LD</b>				
<b>LD</b>	<b>LD</b>				
<b>LD</b>		<b>MUL</b>	<b>MUL</b>		
		<b>MUL</b>	<b>MUL</b>		
		<b>MUL</b>	<b>MUL</b>		
		<b>ADD</b>	<b>ADD</b>		
<b>ST</b>	<b>ST</b>	<b>ADD</b>	<b>ADD</b>		
<b>ST</b>	<b>ST</b>	<b>ADD</b>	<b>ADD</b>		
<b>ST</b>	<b>ST</b>				

Unrolling of 5

No stalls for the entire units

Unroll of 6 no stalls in the iteration, but stalls between iterations. Bold is for the next iteration

MEM	MEM	FLOAT	FLOAT	INT
LD	LD			
LD	LD			
LD	LD	MUL	MUL	
<b>LD</b>	<b>LD</b>	MUL	MUL	
<b>LD</b>	<b>LD</b>	MUL		
<b>LD</b>	<b>LD</b>	ADD	ADD	
ST	ST	ADD	ADD	
ST	ST	ADD	ADD	
ST	ST	<b>MUL</b>	<b>MUL</b>	
		<b>MUL</b>	<b>MUL</b>	
		<b>MUL</b>	<b>MUL</b>	
		<b>ADD</b>	<b>ADD</b>	
<b>ST</b>	<b>ST</b>	<b>ADD</b>	<b>ADD</b>	
<b>ST</b>	<b>ST</b>	<b>ADD</b>	<b>ADD</b>	
<b>ST</b>	<b>ST</b>			

# Vector Processing

```
10 | 63
   | 6 | 63
     | 4 | 63
       | 10 | 63
```

```
LD
MUL
ADD
ST
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$$63+10+4+6+10 = 93$$