

Tomasulo Loop Example

Loop: LD	F0	0	R1
MULTD	F4	F0	F2
SD	F4	0	R1
SUBI	R1	R1	#8
BNEZ	R1	Loop	

- ☐ Assume Multiply takes 4 clocks
- ☐ Assume first load takes 8 clocks (cache miss?), second load takes 4 clocks (hit)
- ☐ To be clear, will show clocks for SUBI, BNEZ
- ☐ Reality, integer instructions ahead

Loop Example Cycle 0

Instruction status

Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	Issue	Execution	Write Result	Busy	Address
LD F0	0	R1	1			Load1	No	Qi
MULT F4	F0	F2	1			Load2	No	
SD F4	0	R1	1			Load3	No	
LD F0	0	R1	2			Store1	No	
MULT F4	F0	F2	2			Store2	No	
SD F4	0	R1	2			Store3	No	

Reservation Stations

Time	Name	Busy	Op	<i>S1</i> <i>Vj</i>	<i>S2</i> <i>Vk</i>	<i>RS for j</i> <i>Qj</i>	<i>RS for k</i> <i>Qk</i>	Code:
0	Add1	No						LD F0 0 R1
0	Add2	No						MULT F4 F0 F2
0	Add3	No						SD F4 0 R1
0	Mult1	No						SUBI R1 R1 #8
0	Mult2	No						BNEZ R1 Loop

Register result status

Clock	R1	<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
0	80	<i>Qi</i>							

Loop Example Cycle 1

Instruction status

Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	Issue	Execution	Write Result	Busy	Address
LD F0	0	R1	1	1		Load1	Yes	80
MULT F4	F0	F2	1			Load2	No	
SD F4	0	R1	1			Load3	No	Qi
LD F0	0	R1	2			Store1	No	
MULT F4	F0	F2	2			Store2	No	
SD F4	0	R1	2			Store3	No	

Reservation Stations

Time	Name	Busy	Op	<i>S1</i> <i>Vj</i>	<i>S2</i> <i>Vk</i>	<i>RS for j</i> <i>Qj</i>	<i>RS for k</i> <i>Qk</i>	Code:
0	Add1	No						LD F0 0 R1
0	Add2	No						MULT F4 F0 F2
0	Add3	No						SD F4 0 R1
0	Mult1	No						SUBI R1 R1 #8
0	Mult2	No						BNEZ R1 Loop

Register result status

Clock	R1	<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
1	80	Qi	Load1						

Loop Example Cycle 2

Instruction status

Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>Execution complete</i>	<i>Write Result</i>	Busy	Address
LD F0	0	R1	1	1		Load1	Yes	80
MULT F4	F0	F2	1	2		Load2	No	
SD F4	0	R1	1			Load3	No	Qi
LD F0	0	R1	2			Store1	No	
MULT F4	F0	F2	2			Store2	No	
SD F4	0	R1	2			Store3	No	

Reservation Stations

Time	Name	Busy	Op	<i>S1</i> <i>Vj</i>	<i>S2</i> <i>Vk</i>	<i>RS for j</i> <i>Qj</i>	<i>RS for k</i> <i>Qk</i>	Code:
0	Add1	No						LD F0 0 R1
0	Add2	No						MULT F4 F0 F2
0	Add3	No						SD F4 0 R1
0	Mult1	Yes	MULTD		R(F2)	Load1		SUBI R1 R1 #8
0	Mult2	No						BNEZ R1 Loop

Register result status

Clock	R1	F0	F2	F4	F6	F8	F10	F12...	F30
2	80	Qi	Load1	Mult1					

Loop Example Cycle 3

Instruction status				Execution			Write	
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>	Busy	Address
LD F0	0	R1	1	1		Load1	Yes	80
MULT F4	F0	F2	1	2		Load2	No	
SD F4	0	R1	1	3		Load3	No	Qi
LD F0	0	R1	2			Store1	Yes	80
MULT F4	F0	F2	2			Store2	No	
SD F4	0	R1	2			Store3	No	

Reservation Stations

Time	Name	Busy	Op	<i>S1</i> <i>Vj</i>	<i>S2</i> <i>Vk</i>	<i>RS for j</i> <i>Qj</i>	<i>RS for k</i> <i>Qk</i>	Code:
0	Add1	No						LD F0 0 R1
0	Add2	No						MULT F4 F0 F2
0	Add3	No						SD F4 0 R1
0	Mult1	Yes	MULTD		R(F2)	Load1		SUBI R1 R1 #8
0	Mult2	No						BNEZ R1 Loop

Register result status

Clock	R1	<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
3	80	Qi	Load1	Mult1					

- Note: MULT1 has no registers names in RS

Loop Example Cycle 4

Instruction status

Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>Execution complete</i>	<i>Write Result</i>	Busy	Address
LD F0	0	R1	1	1		Load1	Yes	80
MULT F4	F0	F2	1	2		Load2	No	
SD F4	0	R1	1	3		Load3	No	Qi
LD F0	0	R1	2			Store1	Yes	80
MULT F4	F0	F2	2			Store2	No	
SD F4	0	R1	2			Store3	No	

Reservation Stations

Time	Name	Busy	Op	<i>S1</i> <i>Vj</i>	<i>S2</i> <i>Vk</i>	<i>RS for j</i> <i>Qj</i>	<i>RS for k</i> <i>Qk</i>	Code:
0	Add1	No						LD F0 0 R1
0	Add2	No						MULT F4 F0 F2
0	Add3	No						SD F4 0 R1
0	Mult1	Yes	MULTD		R(F2)	Load1		SUBI R1 R1 #8
0	Mult2	No						BNEZR1 Loop

Register result status

Clock	R1	<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
4	72	Qi	Load1	Mult1					

Loop Example Cycle 5

Instruction status				Execution Write				
Instruction	<i>j</i>	<i>k</i>	iteration	Issue	complete	Result	Busy	Address
LD F0	0	R1	1	1		Load1	Yes	80
MULT F4	F0	F2	1	2		Load2	No	
SD F4	0	R1	1	3		Load3	No	Qi
LD F0	0	R1	2			Store1	Yes	80
MULT F4	F0	F2	2			Store2	No	
SD F4	0	R1	2			Store3	No	

Reservation Stations			S1	S2	RS for <i>j</i>	RS for <i>k</i>	Code:
Time	Name	Busy Op	<i>V_j</i>	<i>V_k</i>	<i>Q_j</i>	<i>Q_k</i>	
0	Add1	No					LD F0 0 R1
0	Add2	No					MULT F4 F0 F2
0	Add3	No					SD F4 0 R1
0	Mult1	Yes MULTD		R(F2)	Load1		SUBI R1 R1 #8
0	Mult2	No					BNEZ R1 Loop

Register result status											
Clock	R1	F0	F2	F4	F6	F8	F10	F12...	F30		
5	72 Qi	Load1		Mult1							

Loop Example Cycle 6

Instruction status					Execution	Write				
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address	
LD F0	0	R1	1	1			Load1	Yes	80	
MULT F4	F0	F2	1	2			Load2	Yes	72	
SD F4	0	R1	1	3			Load3	No		Qi
LD F0	0	R1	2	6			Store1	Yes	80	Mult1
MULT F4	F0	F2	2				Store2	No		
SD F4	0	R1	2				Store3	No		
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>			
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>	
	0	Add1	No						LD F0	0 R1
	0	Add2	No						MULT F4	F0 F2
	0	Add3	No						SD F4	0 R1
	0	Mult1	Yes	MULTD		R(F2)	Load1		SUBI R1	R1 #8
	0	Mult2	No						BNEZ R1	Loop
Register result status										
Clock	R1		F0	F2	F4	F6	F8	F10	F12...	F30
6	72	Qi	Load2		Mult1					

- Note: F0 never sees Load1 result

Loop Example Cycle 7

Instruction status					Execution	Write				
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address	
LD F0	0	R1	1	1			Load1	Yes	80	
MULT F4	F0	F2	1	2			Load2	Yes	72	
SD F4	0	R1	1	3			Load3	No		Qi
LD F0	0	R1	2	6			Store1	Yes	80	Mult1
MULT F4	F0	F2	2	7			Store2	No		
SD F4	0	R1	2				Store3	No		
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>			
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>	
	0	Add1	No						LD F0	0 R1
	0	Add2	No						MULT F4	F0 F2
	0	Add3	No						SD F4	0 R1
	0	Mult1	Yes	MULTD		R(F2)	Load1		SUBI R1	R1 #8
	0	Mult2	Yes	MULTD		R(F2)	Load2		BNEZ R1	Loop
Register result status										
Clock	R1		F0	F2	F4	F6	F8	F10	F12...	F30
7	72	Qi	Load2		Mult2					

- Note: MULT2 has no registers names in RS

Loop Example Cycle 8

Instruction status

Instruction	<i>j</i>	<i>k</i>	iteration	Issue	Execution complete	Write Result	Busy	Address	
LD F0	0	R1	1	1		Load1	Yes	80	
MULT F4	F0	F2	1	2		Load2	Yes	72	
SD F4	0	R1	1	3		Load3	No		Qi
LD F0	0	R1	2	6		Store1	Yes	80	Mult1
MULT F4	F0	F2	2	7		Store2	Yes	72	Mult2
SD F4	0	R1	2	8		Store3	No		

Reservation Stations

Time	Name	Busy	Op	S1 <i>V_j</i>	S2 <i>V_k</i>	RS for <i>j</i> <i>Q_j</i>	RS for <i>k</i> <i>Q_k</i>	Code:
0	Add1	No						LD F0 0 R1
0	Add2	No						MULT F4 F0 F2
0	Add3	No						SD F4 0 R1
0	Mult1	Yes	MULTD		R(F2)	Load1		SUBI R1 R1 #8
0	Mult2	Yes	MULTD		R(F2)	Load2		BNEZ R1 Loop

Register result status

Clock	R1		F0	F2	F4	F6	F8	F10	F12...	F30
8	72	Qi	Load2		Mult2					

Loop Example Cycle 9

Instruction status

Instruction	<i>j</i>	<i>k</i>	iteration	Issue	Execution complete	Write Result	Busy	Address	
LD F0	0	R1	1	1	9	Load1	Yes	80	
MULT F4	F0	F2	1	2		Load2	Yes	72	
SD F4	0	R1	1	3		Load3	No		Qi
LD F0	0	R1	2	6		Store1	Yes	80	Mult1
MULT F4	F0	F2	2	7		Store2	Yes	72	Mult2
SD F4	0	R1	2	8		Store3	No		

Reservation Stations

Time	Name	Busy	Op	S1 <i>V_j</i>	S2 <i>V_k</i>	RS for <i>j</i> <i>Q_j</i>	RS for <i>k</i> <i>Q_k</i>	Code:
0	Add1	No						LD F0 0 R1
0	Add2	No						MULT F4 F0 F2
0	Add3	No						SD F4 0 R1
0	Mult1	Yes	MULTD		R(F2)	Load1		SUBI R1 R1 #8
0	Mult2	Yes	MULTD		R(F2)	Load2		BNEZ R1 Loop

Register result status

Clock	R1		F0	F2	F4	F6	F8	F10	F12...	F30
9	64	Qi	Load2		Mult2					

- Load1 completing; what is waiting for it?

Loop Example Cycle 10

Instruction status

Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>Execution complete</i>	<i>Write Result</i>	Busy	Address
LD F0	0	R1	1	1	9	10	No	
MULT F4	F0	F2	1	2			Yes	72
SD F4	0	R1	1	3			No	Qi
LD F0	0	R1	2	6	10		Yes	80
MULT F4	F0	F2	2	7			Yes	72
SD F4	0	R1	2	8			No	

Reservation Stations

Time	Name	Busy	Op	<i>S1</i> <i>Vj</i>	<i>S2</i> <i>Vk</i>	<i>RS for j</i> <i>Qj</i>	<i>RS for k</i> <i>Qk</i>	Code:
0	Add1	No						LD F0 0 R1
0	Add2	No						MULT F4 F0 F2
0	Add3	No						SD F4 0 R1
4	Mult1	Yes	MULTD	M(80)	R(F2)			SUBI R1 R1 #8
0	Mult2	Yes	MULTD		R(F2)	Load2		BNEZ R1 Loop

Register result status

Clock	R1	F0	F2	F4	F6	F8	F10	F12...	F30
10	64	Qi	Load2	Mult2					

- Load2 completing; what is waiting for it?

Loop Example Cycle 11

Instruction status					Execution	Write				
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address	
LD F0	0	R1	1	1	9	10	Load1	No		
MULT F4	F0	F2	1	2			Load2	No		
SD F4	0	R1	1	3			Load3	Yes	64	Qi
LD F0	0	R1	2	6	10	11	Store1	Yes	80	Mult1
MULT F4	F0	F2	2	7			Store2	Yes	72	Mult2
SD F4	0	R1	2	8			Store3	No		
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>			
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>	
	0	Add1	No						LD F0	0 R1
	0	Add2	No						MULT F4	F0 F2
	0	Add3	No						SD F4	0 R1
	3	Mult1	Yes	MULTD	M(80)	R(F2)			SUBI R1	R1 #8
	4	Mult2	Yes	MULTD	M(72)	R(F2)			BNEZ R1	Loop
Register result status										
Clock	R1		<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
11	64	Qi	Load3		Mult2					

Loop Example Cycle 12

Instruction status					Execution	Write				
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address	
LD F0	0	R1	1	1	9	10	Load1	No		
MULT F4	F0	F2	1	2			Load2	No		
SD F4	0	R1	1	3			Load3	Yes	64	Qi
LD F0	0	R1	2	6	10	11	Store1	Yes	80	Mult1
MULT F4	F0	F2	2	7			Store2	Yes	72	Mult2
SD F4	0	R1	2	8			Store3	No		
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>			
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>	
	0	Add1	No						LD F0	0 R1
	0	Add2	No						MULT F4	F0 F2
	0	Add3	No						SD F4	0 R1
	2	Mult1	Yes	MULTD	M(80)	R(F2)			SUBI R1	R1 #8
	3	Mult2	Yes	MULTD	M(72)	R(F2)			BNEZ R1	Loop
Register result status										
Clock	R1		<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
12	64	Qi	Load3		Mult2					

Loop Example Cycle 13

Instruction status					Execution	Write				
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address	
LD F0	0	R1	1	1	9	10	Load1	No		
MULT F4	F0	F2	1	2			Load2	No		
SD F4	0	R1	1	3			Load3	Yes	64	Qi
LD F0	0	R1	2	6	10	11	Store1	Yes	80	Mult1
MULT F4	F0	F2	2	7			Store2	Yes	72	Mult2
SD F4	0	R1	2	8			Store3	No		
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>			
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>	
	0	Add1	No						LD	F0 0 R1
	0	Add2	No						MULT	F4 F0 F2
	0	Add3	No						SD	F4 0 R1
	1	Mult1	Yes	MULTD	M(80)	R(F2)			SUBI	R1 R1 #8
	2	Mult2	Yes	MULTD	M(72)	R(F2)			BNEZ	R1 Loop
Register result status										
Clock	R1		<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
13	64	Qi	Load3		Mult2					

Loop Example Cycle 14

Instruction status					Execution	Write				
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address	
LD F0	0	R1	1	1	9	10	Load1	No		
MULT F4	F0	F2	1	2	14		Load2	No		
SD F4	0	R1	1	3			Load3	Yes	64	Qi
LD F0	0	R1	2	6	10	11	Store1	Yes	80	Mult1
MULT F4	F0	F2	2	7			Store2	Yes	72	Mult2
SD F4	0	R1	2	8			Store3	No		
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>			
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>	
	0	Add1	No						LD F0	0 R1
	0	Add2	No						MULT F4	F0 F2
	0	Add3	No						SD F4	0 R1
	0	Mult1	Yes	MULTD	M(80)	R(F2)			SUBI R1	R1 #8
	1	Mult2	Yes	MULTD	M(72)	R(F2)			BNEZ R1	Loop
Register result status										
Clock	R1		<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
14	64	Qi	Load3		Mult2					

- Mult1 completing; what is waiting for it?

Loop Example Cycle 15

Instruction status					Execution	Write					
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address		
LD F0	0	R1	1	1	9	10	Load1	No			
MULT F4	F0	F2	1	2	14	15	Load2	No			
SD F4	0	R1	1	3			Load3	Yes	64	Qi	
LD F0	0	R1	2	6	10	11	Store1	Yes	80	M(80)*R(F	
MULT F4	F0	F2	2	7	15		Store2	Yes	72	Mult2	
SD F4	0	R1	2	8			Store3	No			
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>				
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>		
	0	Add1	No						LD	F0	0 R1
	0	Add2	No						MULT	F4	F0 F2
	0	Add3	No						SD	F4	0 R1
	0	Mult1	No						SUBI	R1	R1 #8
	0	Mult2	Yes	MULTD	M(72)	R(F2)			BNEZ	R1	Loop
Register result status											
Clock	R1			F0	F2	F4	F6	F8	F10	F12...	F30
15	64	Qi		Load3		Mult2					

- Mult2 completing; what is waiting for it?

Loop Example Cycle 16

Instruction status					Execution	Write				
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address	
LD F0	0	R1	1	1	9	10	Load1	No		
MULT F4	F0	F2	1	2	14	15	Load2	No		
SD F4	0	R1	1	3			Load3	Yes	64	Qi
LD F0	0	R1	2	6	10	11	Store1	Yes	80	$M(80)*R(F$
MULT F4	F0	F2	2	7	15	16	Store2	Yes	72	$M(72)*R(7$
SD F4	0	R1	2	8			Store3	No		
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>			
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>	
	0	Add1	No						LD F0	0 R1
	0	Add2	No						MULT F4	F0 F2
	0	Add3	No						SD F4	0 R1
	0	Mult1	Yes	MULTD		R(F2)	Load3		SUBI R1	R1 #8
	0	Mult2	No						BNEZ R1	Loop
Register result status										
Clock	R1		<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
16	64	Qi	Load3		Mult1					

Loop Example Cycle 17

Instruction status				Execution				Write Back			
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address		
LD F0	0	R1	1	1	9	10	Load1	No			
MULT F4	F0	F2	1	2	14	15	Load2	No			
SD F4	0	R1	1	3			Load3	Yes	64	Qi	
LD F0	0	R1	2	6	10	11	Store1	Yes	80	M(80)*R(F	
MULT F4	F0	F2	2	7	15	16	Store2	Yes	72	M(72)*R(7	
SD F4	0	R1	2	8			Store3	Yes	64	Mult1	
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>				
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>		
	0	Add1	No						LD F0	0	R1
	0	Add2	No						MULT F4	F0	F2
	0	Add3	No						SD F4	0	R1
	0	Mult1	Yes	MULTD		R(F2)	Load3		SUBI R1	R1	#8
	0	Mult2	No						BNEZ R1	Loop	
Register result status											
Clock	R1		<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>	
17	64	Qi	Load3		Mult1						

Loop Example Cycle 18

Instruction status					Execution	Write				
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address	
LD F0	0	R1	1	1	9	10	Load1	No		
MULT F4	F0	F2	1	2	14	15	Load2	No		
SD F4	0	R1	1	3	18		Load3	Yes	64	Qi
LD F0	0	R1	2	6	10	11	Store1	Yes	80	M(80)*R(F
MULT F4	F0	F2	2	7	15	16	Store2	Yes	72	M(72)*R(7
SD F4	0	R1	2	8			Store3	Yes	64	Mult1
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>			
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>	
	0	Add1	No						LD F0	0 R1
	0	Add2	No						MULT F4	F0 F2
	0	Add3	No						SD F4	0 R1
	0	Mult1	Yes	MULTD		R(F2)	Load3		SUBI R1	R1 #8
	0	Mult2	No						BNEZ R1	Loop
Register result status										
Clock	R1		<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
18	56	Qi	Load3		Mult1					

Loop Example Cycle 19

Instruction status					Execution	Write				
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address	
LD F0	0	R1	1	1	9	10	Load1	No		
MULT F4	F0	F2	1	2	14	15	Load2	No		
SD F4	0	R1	1	3	18	19	Load3	Yes	64	Qi
LD F0	0	R1	2	6	10	11	Store1	No		
MULT F4	F0	F2	2	7	15	16	Store2	Yes	72	M(72)*R(7)
SD F4	0	R1	2	8			Store3	Yes	64	Mult1
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>			
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>	
	0	Add1	No						LD F0	0 R1
	0	Add2	No						MULT F4	F0 F2
	0	Add3	No						SD F4	0 R1
	0	Mult1	Yes	MULTD		R(F2)	Load3		SUBI R1	R1 #8
	0	Mult2	No						BNEZ R1	Loop
Register result status										
Clock	R1			<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12... F30</i>
19	56	Qi		Load3		Mult1				

Loop Example Cycle 20

Instruction status					Execution	Write				
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address	
LD F0	0	R1	1	1	9	10	Load1	No		
MULT F4	F0	F2	1	2	14	15	Load2	No		
SD F4	0	R1	1	3	18	19	Load3	Yes	64	Qi
LD F0	0	R1	2	6	10	11	Store1	No		
MULT F4	F0	F2	2	7	15	16	Store2	Yes	72	M(72)*R(7)
SD F4	0	R1	2	8	20		Store3	Yes	64	Mult1
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>			
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>	
	0	Add1	No						LD F0	0 R1
	0	Add2	No						MULT F4	F0 F2
	0	Add3	No						SD F4	0 R1
	0	Mult1	Yes	MULTD		R(F2)	Load3		SUBI R1	R1 #8
	0	Mult2	No						BNEZ R1	Loop
Register result status										
Clock	R1		<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>
20	56	Qi	Load3		Mult1					

Loop Example Cycle 21

Instruction status				Execution				Write			
Instruction	<i>j</i>	<i>k</i>	<i>iteration</i>	<i>Issue</i>	<i>complete</i>	<i>Result</i>		Busy	Address		
LD F0	0	R1	1	1	9	10	Load1	No			
MULT F4	F0	F2	1	2	14	15	Load2	No			
SD F4	0	R1	1	3	18	19	Load3	Yes	64	Qi	
LD F0	0	R1	2	6	10	11	Store1	No			
MULT F4	F0	F2	2	7	15	16	Store2	No			
SD F4	0	R1	2	8	20	21	Store3	Yes	64	Mult1	
Reservation Stations				<i>S1</i>	<i>S2</i>	<i>RS for j</i>	<i>RS for k</i>				
	<i>Time</i>	<i>Name</i>	<i>Busy</i>	<i>Op</i>	<i>Vj</i>	<i>Vk</i>	<i>Qj</i>	<i>Qk</i>	<i>Code:</i>		
	0	Add1	No						LD F0	0	R1
	0	Add2	No						MULT F4	F0	F2
	0	Add3	No						SD F4	0	R1
	0	Mult1	Yes	MULTD		R(F2)	Load3		SUBI R1	R1	#8
	0	Mult2	No						BNEZ R1	Loop	
Register result status											
Clock	R1		<i>F0</i>	<i>F2</i>	<i>F4</i>	<i>F6</i>	<i>F8</i>	<i>F10</i>	<i>F12...</i>	<i>F30</i>	
21	56	Qi	Load3		Mult1						