

新增指令冲突测试

冲突位置	前序指令	后继指令	测试样例
ALU	mtc0	mfc0	mtc0 \$29 \$14
			mfc0 \$28 \$14
			mtc0 \$29 \$14
			nop
			mfc0 \$28 \$14
			mtc0 \$29 \$14
			nop
			nop
			mfc0 \$28 \$14
	R-type (addu)	mtc0	addu \$4 \$4 \$5
			mtc0 \$4 \$14
			addu \$4 \$4 \$5
			nop
			mtc0 \$4 \$14
			addu \$4 \$4 \$5
nop			
nop			
mtc0 \$4 \$14			
I-type (ori)	ori \$4 \$5 \$6		
	mtc0 \$4 \$14		
	ori \$4 \$5 \$6		
	nop		
	mtc0 \$4 \$14		
	ori \$4 \$5 \$6		
nop			
nop			
mtc0 \$4 \$14			
GRF	jal/jalr		jalr \$5 \$6
			mtc0 \$5 \$14
			jalr \$5 \$6
			nop
			mtc0 \$5 \$14
			jalr \$5 \$6
	nop		
	nop		
	mtc0 \$5 \$14		
load	lw \$4 0(\$5)		
	mtc0 \$4 \$14		
	lw \$4 0(\$5)		
	nop		
mtc0 \$4 \$14			
lw \$4 0(\$5)			

	mfc0		nop nop mtc0 \$4 \$14
			mfc0 \$4 \$14 mtc0 \$4 \$15
			mfc0 \$4 \$14 nop mtc0 \$4 \$15
			mfc0 \$4 \$14 nop nop mtc0 \$4 \$15
EPC	mtc0	eret	mtc0 \$29 \$14 eret
			mtc0 \$29 \$14 nop eret
			mtc0 \$29 \$14 nop nop eret
ALU	mfc0	R-type (addu)	mfc0 \$4 \$14 addu \$6 \$4 \$5
			mfc0 \$4 \$14 nop addu \$6 \$4 \$5
			mfc0 \$4 \$14 nop nop addu \$6 \$4 \$5
		i-type (ori)	mfc0 \$4 \$14 ori \$5 \$4 0x1234
			mfc0 \$4 \$14 nop ori \$5 \$4 0x1234
			mfc0 \$4 \$14 nop nop ori \$5 \$4 0x1234
		b-type (beq)	mfc0 \$4 \$14 beq \$4 \$5 label
			mfc0 \$4 \$14 nop beq \$4 \$5 label
D			

			mfc0 \$4 \$14 nop nop beq \$4 \$5 label
		j-type	mfc0 \$4 \$14 jalr \$5 \$4
			mfc0 \$4 \$14 nop jalr \$5 \$4
			mfc0 \$4 \$14 nop nop jalr \$5 \$4
DM		store	mfc0 \$4 \$14 sw \$4 0(\$5)
			mfc0 \$4 \$14 nop sw \$4 0(\$5)
			mfc0 \$4 \$14 nop nop sw \$4 0(\$5)
ALU			mfc0 \$4 \$12 sw \$5 0(\$4)
			mfc0 \$4 \$12 nop sw \$5 0(\$4)
			mfc0 \$4 \$12 nop nop sw \$5 0(\$4)
		load	mfc0 \$4 \$12 lw \$5 0(\$4)
			mfc0 \$4 \$12 nop lw \$5 0(\$4)
			mfc0 \$4 \$12 nop nop lw \$5 0(\$4)

中断异常测试

类别	编码	描述	测试样例
取数异常	4	使用 lw 、 lh 、 lhu 这三种取数指令时，地址没有按照要求对齐	ori \$5 \$0 0x0088 lw \$10 1(\$5)
		使用 load 类指令时范围超出 0x0000~0x2ffc 以及 0x7F00~0X7F0B 和 0x7F10~0X7F1B	ori \$5 \$0 0x7f0c lw \$12 0(\$5)
		使用 lh 、 lhu 、 lb 、 lbu 加载定时器中的值	ori \$5 \$0 0x7f10 lh \$12 0(\$5)
存数异常	5	使用 sw 、 sh 这两种取数指令时，地址没有按照要求对齐	ori \$6 \$0 0x0088 sw \$5 1(\$6)
		使用 store 类指令时范围超出 0x0000~0x2ffc 以及 0x7F00~0X7F0B 和 0x7F10~0X7F1B	ori \$6 \$0 0x2fff sw \$5 0(\$6)
		试图往定时器的 COUNT 寄存器写入值	ori \$6 \$0 0x7f08 sw \$5 0(\$6)
		使用 sh 或 sb 向定时器写入值	ori \$6 \$0 0x7f08 sh \$5 0(\$6)
溢出	12	add 溢出	lui \$4 0x7fff add \$4 \$4 \$4
		addi 溢出	ori \$7 \$0 0x7fffffff addi \$8 \$7 1
		sub 溢出	lui \$5 0x8000 ori \$6 0x7fffffff sub \$7 \$5 \$6
		store 类要用到加法的情况如有溢出，不报 0v 异常，而是报 AdES 异常。	ori \$7 \$0 0x7fffffff sw \$7 1(\$7)
		load 类要用到加法的情况如有溢出，不报 0v 异常，而是报 AdEL 异常。	ori \$7 \$0 0x7fffffff lw \$8 1(\$7)
取指异常	4	取指超范围 0x3000~0x4ffc	ori \$5 \$0 0x2000 jalr \$6 \$5
		PC 值没有以 4 对齐 (如果 jr 到一个不对齐的地址，那么 EPC 的值应该为该地址，而非 jr 指令的 PC 值。 需要硬件对齐到 00)	ori \$5 \$0 0x3015 jalr \$6 \$5
	10	不认识的非法指令	msub \$3 \$4
延迟槽异常	12(以溢出为例)	前序指令为 b 类型，CAUSE(BD) 就会置位, EPC 指向分支指令。	lui \$4 0x7fff beq \$4 \$4 label add \$5 \$4 \$4
		前序指令为 j	
		前序指令为 jal, jalr	lui \$9 0xffff

			#label jal label2 add \$6 \$4 \$4
		前序指令为 jr	
乘除部件相关指令异常		????	
模式 0 中断	0	程序开始时设置定时器的模式为模式 0 进入中断后, 停止计数, 软件修改定时器设置为 enable, 再允许计数	
模式 1 中断	0	程序开始时设置定时器的模式为模式 1	
定时器规范	无	在对定时器写入时不计数, 不转移状态	
屏蔽中断	忽视	在执行中断处理程序时, 无视其他中断	
屏蔽异常	忽视	在执行中断处理程序时, 无视其他异常	
中断优先	0	中断的优先级高于异常的优先级。即若有异常提交到 CP0 寄存器时, 有中断发生, 应先处理中断, 并重新执行受害指令及其后续指令。若没有中断发生, 则处理异常。	
eret+中断	0	异常处理程序刚退出时, 若此时紧接中断, 期望结果为EPC保存受害指令地址. 再次进入中断处理程序.	
CP0. SR. IE		CP0. SR 全局中断使能关闭则无法进入中断	
CP0. SR. IM		CP0. SR 开启中断屏蔽位则无法进入中断	
timer. IM		计时器开启中断屏蔽位则无法产生中断	

冲突测试

测试 1

测试点:all+mtc0

```

9@00003000: $ 4 <= 00003020
11@00003004: $ 5 <= 00000008
13@00003008: $ 6 <= 00003028
13@0000300c: $CP0_14 <= 00003028
21@00003018: $ 7 <= 00003030
23@00003020: $CP0_14 <= 00003030
27@00003028: $CP0_12 <= 00000000
33@00003030: $ 8 <= 00003038
37@0000303c: $CP0_14 <= 00003038
47@0000304c: $ 9 <= 0000304c
47@00003050: $CP0_14 <= 0000304c
57@00003060: $ 9 <= 00003048
59@00003068: $CP0_14 <= 00003048
69@00003078: $ 9 <= 00003044

```

73@00003084: \$CP0_14 <= 00003044
77@00003088: \$ 9 <= 00003040
79@0000308c: \$10 <= 00000088
79@00003090: *00000088 <= 00003040
83@00003094: \$11 <= 00003040
83@00003098: \$CP0_14 <= 00003040
87@0000309c: \$12 <= 00003050
87@000030a0: *0000008c <= 00003050
95@000030ac: \$13 <= 00003050
97@000030b4: \$CP0_14 <= 00003050
101@000030b8: \$15 <= 00003054
101@000030bc: *00000090 <= 00003054
109@000030c8: \$16 <= 00003054
113@000030d4: \$CP0_14 <= 00003054
117@000030d8: \$17 <= 000030e0
117@000030dc: \$CP0_14 <= 000030e0
119@00003028: \$CP0_12 <= 00003000
125@00003030: \$ 8 <= 00003038
129@0000303c: \$CP0_14 <= 00003038
139@0000304c: \$ 9 <= 0000304c
139@00003050: \$CP0_14 <= 0000304c
149@00003060: \$ 9 <= 00003048
151@00003068: \$CP0_14 <= 00003048
161@00003078: \$ 9 <= 00003044
165@00003084: \$CP0_14 <= 00003044
169@00003088: \$ 9 <= 00003040
171@0000308c: \$10 <= 00000088
171@00003090: *00000088 <= 00003040
175@00003094: \$11 <= 00003040
175@00003098: \$CP0_14 <= 00003040
179@0000309c: \$12 <= 00003050
179@000030a0: *0000008c <= 00003050
187@000030ac: \$13 <= 00003050
189@000030b4: \$CP0_14 <= 00003050
193@000030b8: \$15 <= 00003054
193@000030bc: *00000090 <= 00003054
201@000030c8: \$16 <= 00003054
205@000030d4: \$CP0_14 <= 00003054
209@000030d8: \$17 <= 000030e0
209@000030dc: \$CP0_14 <= 000030e0
211@00003028: \$CP0_12 <= 00003000
217@00003030: \$ 8 <= 00003038

...

测试 2

测试点: mfc0+mtc0, mtc0+mfc0

```
9@00003000: $ 4 <= 00000123
9@00003004: $CP0_14 <= 00000123
13@00003008: $ 5 <= 00000123
19@00003014: $ 6 <= 00001234
19@00003018: $CP0_14 <= 00001234
25@00003020: $ 7 <= 00001234
33@00003030: $ 8 <= 00002345
33@00003034: $CP0_14 <= 00002345
41@00003040: $ 9 <= 00002345
49@00003050: $10 <= 00002345
49@00003054: $CP0_12 <= 00002001
59@00003064: $11 <= 00002345
61@0000306c: $CP0_12 <= 00002001
71@0000307c: $12 <= 00002345
75@00003088: $CP0_12 <= 00002001
```

测试 3

测试点: mfc0+all

```
ori $4 $0 0x1234
mtc0 $4 $14
nop
nop
nop
nop
#addu
mfc0 $5 $14
addu $6 $5 $0
addu $7 $5 $0
addu $8 $5 $0
nop
nop
nop
nop
#ori
mfc0 $6 $14
ori $7 $6 0x2345
ori $8 $6 0x3456
ori $9 $6 0x4567
nop
nop
nop
```

```

nop
#beq
mfc0 $10 $14
beq $4 $10 label1
nop
nop
nop
nop
label1:
mfc0 $11 $14
nop
beq $4 $11 label2
nop
nop
nop
nop
label2:
mfc0 $12 $14
nop
nop
beq $12 $4 label3
nop
nop
nop
nop
label3:
#jalr
ori $13 $0 0x30c0
mtc0 $13 $14
mfc0 $14 $14
jalr $15 $14
nop
nop
nop
nop
ori $13 $0 0x30e8
mtc0 $13 $14
mfc0 $14 $14
nop
jalr $15 $14
nop
nop
nop
nop
```



```
ori $13 $0 0x3110
mtc0 $13 $14
mfc0 $14 $14
nop
nop
jalr $15 $14
nop
nop
#store rt
mfc0 $16 $14
sw $16 0($0)
nop
nop
nop
mfc0 $17 $14
nop
sw $17 4($0)
nop
nop
nop
mfc0 $18 $14
nop
nop
sw $18 8($0)
nop
nop
nop
nop
#store rs
ori $19 $0 0x0088
mtc0 $19 $14
mfc0 $20 $14
sw $19 0($20)
nop
addu $21 $20 $20
mtc0 $21 $14
mfc0 $22 $14
nop
sw $19 0($22)
nop
nop
nop
addu $23 $22 $20
mtc0 $23 $14
```

```

mfc0 $24 $14
nop
nop
sw $19 0($24)
#load
ori $19 $0 0x0088
mtc0 $19 $14
mfc0 $20 $14
lw $19 0($20)
nop
addu $21 $20 $20
mtc0 $21 $14
mfc0 $22 $14
nop
lw $19 0($22)
nop
nop
nop
addu $23 $22 $20
mtc0 $23 $14
mfc0 $24 $14
nop
nop
lw $19 0($24)

```

```

45@00003000: $ 4 <= 00001234
55@00003004: $CP0_14 <= 00001234
105@00003018: $ 5 <= 00001234
115@0000301c: $ 6 <= 00001234
125@00003020: $ 7 <= 00001234
135@00003024: $ 8 <= 00001234
185@00003038: $ 6 <= 00001234
195@0000303c: $ 7 <= 00003375
205@00003040: $ 8 <= 00003676
215@00003044: $ 9 <= 00005777
265@00003058: $10 <= 00001234
305@00003070: $11 <= 00001234
345@0000308c: $12 <= 00001234
395@000030ac: $13 <= 000030c0
405@000030b0: $CP0_14 <= 000030c0
415@000030b4: $14 <= 000030c0

```

435@000030b8: \$15 <= 000030c0
485@000030cc: \$13 <= 000030e8
495@000030d0: \$CP0_14 <= 000030e8
505@000030d4: \$14 <= 000030e8
525@000030dc: \$15 <= 000030e4
565@000030f0: \$13 <= 00003110
575@000030f4: \$CP0_14 <= 00003110
585@000030f8: \$14 <= 00003110
615@00003104: \$15 <= 0000310c
635@00003110: \$16 <= 00003110
635@00003114: *00000000 <= 00003110
685@00003124: \$17 <= 00003110
695@0000312c: *00000004 <= 00003110
745@0000313c: \$18 <= 00003110
765@00003148: *00000008 <= 00003110
825@0000315c: \$19 <= 00000088
835@00003160: \$CP0_14 <= 00000088
845@00003164: \$20 <= 00000088
845@00003168: *00000088 <= 00000088
875@00003170: \$21 <= 00000110
885@00003174: \$CP0_14 <= 00000110
895@00003178: \$22 <= 00000110
905@00003180: *00000110 <= 00000088
955@00003190: \$23 <= 00000198
965@00003194: \$CP0_14 <= 00000198
975@00003198: \$24 <= 00000198
995@000031a4: *00000198 <= 00000088
1015@000031a8: \$19 <= 00000088
1025@000031ac: \$CP0_14 <= 00000088
1035@000031b0: \$20 <= 00000088
1045@000031b4: \$19 <= 00000088
1065@000031bc: \$21 <= 00000110
1075@000031c0: \$CP0_14 <= 00000110
1085@000031c4: \$22 <= 00000110
1105@000031cc: \$19 <= 00000088
1145@000031dc: \$23 <= 00000198
1155@000031e0: \$CP0_14 <= 00000198
1165@000031e4: \$24 <= 00000198
1195@000031f0: \$19 <= 00000088

测试点: mtc0+eret

.text//代码段

lui \$7 0x7fff

add \$7 \$7 \$7

ori \$8 \$7 0

ori \$9 \$7 0

ori \$10 \$7 0

//异常处理

#1

.ktext 0x4180

mfc0 \$29, \$14

addi \$29, \$29, 8

nop

nop

nop

mtc0 \$29, \$14

eret

#2

.ktext 0x4180

mfc0 \$29, \$14

addi \$29, \$29, 8

nop

nop

nop

mtc0 \$29, \$14

nop

eret

#3

.ktext 0x4180

mfc0 \$29, \$14

addi \$29, \$29, 8

nop

nop

nop

mtc0 \$29, \$14

nop

nop

eret

结果都是：

```
45@00003000: $ 7 <= 7fff0000
95@00004180: $29 <= 00003004
105@00004184: $29 <= 0000300c
145@00004194: $CP0_14 <= 0000300c
175@0000300c: $ 9 <= 7fff0000
185@00003010: $10 <= 7fff0000
```

异常测试

测试 1

测试点：溢出，且中断处理程序保存现场

```
9@00003000: $ 4 <= 7fff0000
19@00004180: $26 <= 00000030
21@00004184: $27 <= 00003004
23@00004188: $28 <= 00001800
25@0000418c: $29 <= 00002ffc
31@0000430c: $29 <= 00002f84
31@00004310: *00002f84 <= 00000000
33@00004314: *00002f88 <= 00000000
35@00004318: *00002f8c <= 00000000
37@0000431c: *00002f90 <= 7fff0000
39@00004320: *00002f94 <= 00000000
41@00004324: *00002f98 <= 00000000
43@00004328: *00002f9c <= 00000000
45@0000432c: *00002fa0 <= 00000000
47@00004330: *00002fa4 <= 00000000
49@00004334: *00002fa8 <= 00000000
51@00004338: *00002fac <= 00000000
53@0000433c: *00002fb0 <= 00000000
55@00004340: *00002fb4 <= 00000000
57@00004344: *00002fb8 <= 00000000
59@00004348: *00002fbc <= 00000000
61@0000434c: *00002fc0 <= 00000000
63@00004350: *00002fc4 <= 00000000
65@00004354: *00002fc8 <= 00000000
67@00004358: *00002fcc <= 00000000
69@0000435c: *00002fd0 <= 00000000
71@00004360: *00002fd4 <= 00000000
73@00004364: *00002fd8 <= 00000000
75@00004368: *00002fdc <= 00000000
77@0000436c: *00002fe0 <= 00000000
79@00004370: *00002fe4 <= 00000000
81@00004374: *00002ff0 <= 00001800
```

83@00004378: *00002ff4 <= 00000000
85@0000437c: *00002ff8 <= 00000000
93@00004198: \$ 1 <= 80000000
95@0000419c: \$ 1 <= 80000000
97@000041a0: \$ 8 <= 00000000
105@000041b8: \$ 8 <= 00000030
107@000041bc: \$10 <= 00000030
115@000041fc: \$ 1 <= 12120000
117@00004200: \$16 <= 12121212
123@000042f4: \$27 <= 00003008
123@000042f8: \$CP0_14 <= 00003008
131@00004388: \$ 1 <= 00000000
133@0000438c: \$ 2 <= 00000000
135@00004390: \$ 3 <= 00000000
137@00004394: \$ 4 <= 7fff0000
139@00004398: \$ 5 <= 00000000
141@0000439c: \$ 6 <= 00000000
143@000043a0: \$ 7 <= 00000000
145@000043a4: \$ 8 <= 00000000
147@000043a8: \$ 9 <= 00000000
149@000043ac: \$10 <= 00000000
151@000043b0: \$11 <= 00000000
153@000043b4: \$12 <= 00000000
155@000043b8: \$13 <= 00000000
157@000043bc: \$14 <= 00000000
159@000043c0: \$15 <= 00000000
161@000043c4: \$16 <= 00000000
163@000043c8: \$17 <= 00000000
165@000043cc: \$18 <= 00000000
167@000043d0: \$19 <= 00000000
169@000043d4: \$20 <= 00000000
171@000043d8: \$21 <= 00000000
173@000043dc: \$22 <= 00000000
175@000043e0: \$23 <= 00000000
177@000043e4: \$24 <= 00000000
179@000043e8: \$25 <= 00000000
181@000043ec: \$28 <= 00001800
183@000043f0: \$31 <= 00000000
185@000043f4: \$30 <= 00000000
187@000043f8: \$29 <= 00002ffc
197@00003008: \$ 9 <= ffff0000
199@0000300c: \$10 <= ffff0000
201@00003010: \$11 <= ffff0000
203@00003014: \$12 <= ffff0000

205@00003018: \$13 <= ffff0000
207@0000301c: \$14 <= ffff0000
209@00003020: \$ 5 <= 80000000
211@00003024: \$ 1 <= 7fff0000
213@00003028: \$ 1 <= 7fffffff
215@0000302c: \$ 6 <= 7fffffff
225@00004180: \$26 <= 00000030
227@00004184: \$27 <= 00003030
229@00004188: \$28 <= 00001800
231@0000418c: \$29 <= 00002ffc
237@0000430c: \$29 <= 00002f84
237@00004310: *00002f84 <= ffff0000
239@00004314: *00002f88 <= 00000000
241@00004318: *00002f8c <= 00000000
243@0000431c: *00002f90 <= 7fff0000
245@00004320: *00002f94 <= 80000000
247@00004324: *00002f98 <= 7fffffff
249@00004328: *00002f9c <= 00000000
251@0000432c: *00002fa0 <= 00000000
253@00004330: *00002fa4 <= ffff0000
255@00004334: *00002fa8 <= ffff0000
257@00004338: *00002fac <= ffff0000
259@0000433c: *00002fb0 <= ffff0000
261@00004340: *00002fb4 <= ffff0000
263@00004344: *00002fb8 <= ffff0000
265@00004348: *00002fbc <= 00000000
267@0000434c: *00002fc0 <= 00000000
269@00004350: *00002fc4 <= 00000000
271@00004354: *00002fc8 <= 00000000
273@00004358: *00002fcc <= 00000000
275@0000435c: *00002fd0 <= 00000000
277@00004360: *00002fd4 <= 00000000
279@00004364: *00002fd8 <= 00000000
281@00004368: *00002fdc <= 00000000
283@0000436c: *00002fe0 <= 00000000
285@00004370: *00002fe4 <= 00000000
287@00004374: *00002ff0 <= 00001800
289@00004378: *00002ff4 <= 00000000
291@0000437c: *00002ff8 <= 00000000
299@00004198: \$ 1 <= 80000000
301@0000419c: \$ 1 <= 80000000
303@000041a0: \$ 8 <= 80000000
315@000041b4: \$27 <= 00003034
317@000041b8: \$ 8 <= 00000030

319@000041bc: \$10 <= 00000030
327@000041fc: \$ 1 <= 12120000
329@00004200: \$16 <= 12121212
335@000042f4: \$27 <= 00003038
335@000042f8: \$CP0_14 <= 00003038
343@00004388: \$ 1 <= ffff0000
345@0000438c: \$ 2 <= 00000000
347@00004390: \$ 3 <= 00000000
349@00004394: \$ 4 <= 7fff0000
351@00004398: \$ 5 <= 80000000
353@0000439c: \$ 6 <= 7fffffff
355@000043a0: \$ 7 <= 00000000
357@000043a4: \$ 8 <= 00000000
359@000043a8: \$ 9 <= ffff0000
361@000043ac: \$10 <= ffff0000
363@000043b0: \$11 <= ffff0000
365@000043b4: \$12 <= ffff0000
367@000043b8: \$13 <= ffff0000
369@000043bc: \$14 <= ffff0000
371@000043c0: \$15 <= 00000000
373@000043c4: \$16 <= 00000000
375@000043c8: \$17 <= 00000000
377@000043cc: \$18 <= 00000000
379@000043d0: \$19 <= 00000000
381@000043d4: \$20 <= 00000000
383@000043d8: \$21 <= 00000000
385@000043dc: \$22 <= 00000000
387@000043e0: \$23 <= 00000000
389@000043e4: \$24 <= 00000000
391@000043e8: \$25 <= 00000000
393@000043ec: \$28 <= 00001800
395@000043f0: \$31 <= 00000000
397@000043f4: \$30 <= 00000000
399@000043f8: \$29 <= 00002ffc
409@00003038: \$10 <= ffff0000
411@0000303c: \$11 <= ffff0000
413@00003040: \$12 <= ffff0000
415@00003044: \$13 <= ffff0000
417@00003048: \$14 <= ffff0000
419@0000304c: \$ 1 <= 7fff0000
421@00003050: \$ 1 <= 7fffffff
423@00003054: \$ 7 <= 7fffffff
425@00003058: \$ 8 <= 80000000
427@0000305c: \$ 9 <= ffff0000

429@00003060: \$10 <= ffff0000
431@00003064: \$11 <= ffff0000
433@00003068: \$12 <= ffff0000
435@0000306c: \$13 <= ffff0000
437@00003070: \$14 <= ffff0000

测试 2

测试点:load 类异常, 中断处理程序仅 pc+4, 不保存现场

325@00004180: \$26 <= 00003094
329@00004184: \$26 <= 00003098
331@0000418c: \$CP0_14 <= 00003098
353@00004180: \$26 <= 00003098
357@00004184: \$26 <= 0000309c
359@0000418c: \$CP0_14 <= 0000309c
381@00004180: \$26 <= 0000309c
385@00004184: \$26 <= 000030a0
387@0000418c: \$CP0_14 <= 000030a0
401@000030a0: \$ 5 <= 00007f00
403@000030a4: \$12 <= 00000000
405@000030a8: \$ 5 <= 00007f04
407@000030ac: \$12 <= 00000000
409@000030b0: \$ 5 <= 00007f08
411@000030b4: \$12 <= 00000000
413@000030b8: \$ 5 <= 00007f0c
423@00004180: \$26 <= 000030bc
427@00004184: \$26 <= 000030c0
429@0000418c: \$CP0_14 <= 000030c0
443@000030c0: \$ 5 <= 00007f10
453@00004180: \$26 <= 000030c4
457@00004184: \$26 <= 000030c8
459@0000418c: \$CP0_14 <= 000030c8
481@00004180: \$26 <= 000030c8
485@00004184: \$26 <= 000030cc
487@0000418c: \$CP0_14 <= 000030cc
509@00004180: \$26 <= 000030cc
513@00004184: \$26 <= 000030d0
515@0000418c: \$CP0_14 <= 000030d0
537@00004180: \$26 <= 000030d0
541@00004184: \$26 <= 000030d4
543@0000418c: \$CP0_14 <= 000030d4

测试 3

测试点:store 类异常, 中断处理程序仅 pc+4, 不保存现场

9@00003000: \$ 1 <= 12340000

11@00003004: \$ 1 <= 12345678
13@00003008: \$ 5 <= 12345678
15@0000300c: \$ 6 <= 00000088
15@00003010: *00000088 <= 12345678
27@00004180: \$26 <= 00003014
31@00004184: \$26 <= 00003018
33@0000418c: \$CP0_14 <= 00003018
55@00004180: \$26 <= 00003018
59@00004184: \$26 <= 0000301c
61@0000418c: \$CP0_14 <= 0000301c
83@00004180: \$26 <= 0000301c
87@00004184: \$26 <= 00003020
89@0000418c: \$CP0_14 <= 00003020
101@00003020: *0000008c <= 12345678
103@00003024: *00000088 <= 12345678
115@00004180: \$26 <= 00003028
119@00004184: \$26 <= 0000302c
121@0000418c: \$CP0_14 <= 0000302c
133@0000302c: *00000088 <= 56785678
145@00004180: \$26 <= 00003030
149@00004184: \$26 <= 00003034
151@0000418c: \$CP0_14 <= 00003034
163@00003034: *0000008c <= 12345678
165@00003038: *00000088 <= 56785678
167@0000303c: *00000088 <= 56787878
169@00003040: *00000088 <= 56787878
171@00003044: *00000088 <= 78787878
173@00003048: *0000008c <= 12345678
177@0000304c: \$ 6 <= 00002fff
187@00004180: \$26 <= 00003050
191@00004184: \$26 <= 00003054
193@0000418c: \$CP0_14 <= 00003054
215@00004180: \$26 <= 00003054
219@00004184: \$26 <= 00003058
221@0000418c: \$CP0_14 <= 00003058
243@00004180: \$26 <= 00003058
247@00004184: \$26 <= 0000305c
249@0000418c: \$CP0_14 <= 0000305c
263@0000305c: \$ 6 <= 00007f00
275@00004180: \$26 <= 00003064
279@00004184: \$26 <= 00003068
281@0000418c: \$CP0_14 <= 00003068
303@00004180: \$26 <= 00003068
307@00004184: \$26 <= 0000306c

```

309@0000418c: $CP0_14 <= 0000306c
323@0000306c: $ 6 <= 00007f04
327@00003074: $ 6 <= 00007f08
337@00004180: $26 <= 00003078
341@00004184: $26 <= 0000307c
343@0000418c: $CP0_14 <= 0000307c
357@0000307c: $ 6 <= 00007f0c
367@00004180: $26 <= 00003080
371@00004184: $26 <= 00003084
373@0000418c: $CP0_14 <= 00003084
387@00003084: $ 6 <= 00007f10
391@0000308c: $ 6 <= 00007f14
395@00003094: $ 6 <= 00007f18
405@00004180: $26 <= 00003098
409@00004184: $26 <= 0000309c
411@0000418c: $CP0_14 <= 0000309c
425@0000309c: $ 6 <= 00007f1c
435@00004180: $26 <= 000030a0
439@00004184: $26 <= 000030a4

```

测试 4

测试点:

store 类要用到加法的情况如有溢出, 不报 0v 异常, 而是报 AdES 异常。
load 类要用到加法的情况如有溢出, 不报 0v 异常, 而是报 AdEL 异常。

```

9@00003000: $ 1 <= 7fff0000
11@00003004: $ 1 <= 7fffffff
13@00003008: $ 7 <= 7fffffff
23@00004180: $26 <= 00000002
25@00004184: $26 <= 00000014
27@00004188: $26 <= 0000300c
31@0000418c: $26 <= 00003010
33@00004194: $CP0_14 <= 00003010
45@00003010: *00000000 <= 7fffffff
57@00004180: $26 <= 00000002
59@00004184: $26 <= 00000010
61@00004188: $26 <= 00003014
65@0000418c: $26 <= 00003018
67@00004194: $CP0_14 <= 00003018
81@00003018: $ 9 <= ffff0000

```

测试 5

测试点: jalr 超范围

```
9@00003000: $ 5 <= 00002000
13@00003004: $ 6 <= 0000300c
25@00004180: $26 <= 00000002
27@00004184: $26 <= 00000010
29@00004188: $26 <= 00002000
31@0000418c: $26 <= 0000300c
33@00004194: $CP0_14 <= 0000300c
```

测试 6

测试点: jalr/jr 未对齐

```
9@00003000: $ 5 <= 00003003
25@00004180: $26 <= 00000002
27@00004184: $26 <= 00000010
29@00004188: $26 <= 00003000
33@0000418c: $26 <= 00003008
35@00004194: $CP0_14 <= 00003008
51@0000300c: $ 5 <= 00003015
55@00003010: $ 6 <= 00003018
67@00004180: $26 <= 00000002
69@00004184: $26 <= 00000010
71@00004188: $26 <= 00003014
75@0000418c: $26 <= 0000301c
77@00004194: $CP0_14 <= 0000301c
```

测试 7

测试点: beq 超范围, 未对齐

测试 8

测试点: 非法指令

```
9@00003000: $ 4 <= 00001234
19@00004180: $26 <= 00000002
21@00004184: $26 <= 00000028#cause=0x28 为非法指令
23@00004188: $26 <= 00003004
27@0000418c: $26 <= 00003008
29@00004194: $CP0_14 <= 00003008
```

测试 9

测试点: 延迟槽溢出异常

9@00003000: \$ 4 <= 7fff0000
23@00004180: \$26 <= 00000002
25@00004184: \$26 <= 80000030
27@00004188: \$26 <= 00003004
31@0000418c: \$26 <= 0000300c
33@00004194: \$CP0_14 <= 0000300c
53@00003018: \$ 9 <= ffff0000
55@0000301c: \$31 <= 00003024
65@00004180: \$26 <= 00000002
67@00004184: \$26 <= 80000030
69@00004188: \$26 <= 0000301c
73@0000418c: \$26 <= 00003024
75@00004194: \$CP0_14 <= 00003024
95@00003030: \$10 <= ffff0000

测试 10

测试点:乘除部件相关指令异常

中断测试

测试 1

测试点:定时器模式 0 中断, 模式 1 中断. 在对定时器写入时不计数, 在执行中断处理程序时, 无视其他中断

9@00003000: \$ 4 <= 00004c01
9@00003004: \$CP0_12 <= 00004c01
13@00003008: \$ 4 <= 0000000c
15@0000300c: \$20 <= 00007f00
19@00003014: \$ 4 <= 00000009
23@0000301c: \$ 4 <= 0000000c
25@00003020: \$21 <= 00007f10
29@00003028: \$ 4 <= 0000000a
33@00003030: \$ 5 <= abcd0000
35@00003034: \$ 5 <= abcd0000
37@00003038: \$ 5 <= abcd0000
39@0000303c: \$ 5 <= abcd0000
41@00003040: \$ 5 <= abcd0000
43@00003044: \$ 4 <= 0000000c
45@00003048: \$20 <= 00007f00
49@00003050: \$ 4 <= 0000000c
51@00003054: \$21 <= 00007f10

61@00004180: \$26 <= 00004c03
63@00004184: \$26 <= 00000400
65@00004188: \$26 <= 00003058
69@0000418c: \$26 <= 0000305c
71@00004194: \$CP0_14 <= 0000305c
77@0000419c: \$ 4 <= 0000000e
79@000041a0: \$20 <= 00007f00
83@000041a8: \$ 4 <= 00000009
87@000041b0: \$ 4 <= 0000000e
89@000041b4: \$21 <= 00007f10
93@000041bc: \$ 4 <= 0000000a
105@0000305c: \$ 5 <= abcd0000
107@00003060: \$ 5 <= abcd0000
109@00003064: \$ 5 <= abcd0000
111@00003068: \$ 5 <= abcd0000
113@0000306c: \$ 5 <= abcd0000
115@00003070: \$ 5 <= abcd0000
117@00003074: \$ 5 <= abcd0000
127@00004180: \$26 <= 00004c03
129@00004184: \$26 <= 00000400
131@00004188: \$26 <= 00003078
135@0000418c: \$26 <= 0000307c
137@00004194: \$CP0_14 <= 0000307c
143@0000419c: \$ 4 <= 0000000e
145@000041a0: \$20 <= 00007f00
149@000041a8: \$ 4 <= 00000009
153@000041b0: \$ 4 <= 0000000e
155@000041b4: \$21 <= 00007f10
159@000041bc: \$ 4 <= 0000000a
171@0000307c: \$ 5 <= abcd0000
173@00003080: \$ 5 <= abcd0000
175@00003084: \$ 5 <= abcd0000
177@00003088: \$ 5 <= abcd0000
179@0000308c: \$ 5 <= abcd0000
181@00003090: \$ 5 <= abcd0000
183@00003094: \$ 5 <= abcd0000
193@00004180: \$26 <= 00004c03
195@00004184: \$26 <= 00000400
197@00004188: \$26 <= 00003098
201@0000418c: \$26 <= 0000309c
203@00004194: \$CP0_14 <= 0000309c
209@0000419c: \$ 4 <= 0000000e
211@000041a0: \$20 <= 00007f00
215@000041a8: \$ 4 <= 00000009

219@000041b0: \$ 4 <= 0000000e
221@000041b4: \$21 <= 00007f10
225@000041bc: \$ 4 <= 0000000a
237@0000309c: \$ 5 <= abcd0000
239@000030a0: \$ 5 <= abcd0000
241@000030a4: \$ 5 <= abcd0000
243@000030a8: \$ 5 <= abcd0000
245@000030ac: \$ 5 <= abcd0000
247@000030b0: \$ 5 <= abcd0000
249@000030b4: \$ 5 <= abcd0000
259@00004180: \$26 <= 00004c03
261@00004184: \$26 <= 00000400
263@00004188: \$26 <= 000030b8
267@0000418c: \$26 <= 000030bc
269@00004194: \$CP0_14 <= 000030bc
275@0000419c: \$ 4 <= 0000000e
277@000041a0: \$20 <= 00007f00
281@000041a8: \$ 4 <= 00000009
285@000041b0: \$ 4 <= 0000000e
287@000041b4: \$21 <= 00007f10
291@000041bc: \$ 4 <= 0000000a
303@000030bc: \$ 5 <= abcd0000
305@000030c0: \$ 5 <= abcd0000
307@000030c4: \$ 5 <= abcd0000
309@000030c8: \$ 5 <= abcd0000
311@000030cc: \$ 5 <= abcd0000
313@000030d0: \$ 5 <= abcd0000
315@000030d4: \$ 5 <= abcd0000
325@00004180: \$26 <= 00004c03
327@00004184: \$26 <= 00000400
329@00004188: \$26 <= 000030d8
333@0000418c: \$26 <= 000030dc
335@00004194: \$CP0_14 <= 000030dc
341@0000419c: \$ 4 <= 0000000e
343@000041a0: \$20 <= 00007f00
347@000041a8: \$ 4 <= 00000009
351@000041b0: \$ 4 <= 0000000e
353@000041b4: \$21 <= 00007f10
357@000041bc: \$ 4 <= 0000000a
369@000030dc: \$ 5 <= abcd0000
371@000030e0: \$ 5 <= abcd0000
373@000030e4: \$ 5 <= abcd0000
375@000030e8: \$ 5 <= abcd0000
377@000030ec: \$ 5 <= abcd0000

379@000030f0: \$ 5 <= abcd0000
381@000030f4: \$ 5 <= abcd0000
391@00004180: \$26 <= 00004c03
393@00004184: \$26 <= 00000400
395@00004188: \$26 <= 000030f8
399@0000418c: \$26 <= 000030fc
401@00004194: \$CP0_14 <= 000030fc
407@0000419c: \$ 4 <= 0000000e
409@000041a0: \$20 <= 00007f00
413@000041a8: \$ 4 <= 00000009
417@000041b0: \$ 4 <= 0000000e
419@000041b4: \$21 <= 00007f10
423@000041bc: \$ 4 <= 0000000a
435@000030fc: \$ 5 <= abcd0000
...

测试 2.0

测试点：在执行中断处理程序时，无视其他异常(无需支持嵌套异常)

45@00003000: \$ 4 <= 00004c01
45@00003004: \$CP0_12 <= 00004c01
65@00003008: \$ 4 <= 0000000c
75@0000300c: \$20 <= 00007f00
95@00003014: \$ 4 <= 00000009
115@0000301c: \$ 5 <= abcd0000
125@00003020: \$ 5 <= abcd0000
135@00003024: \$ 5 <= abcd0000
145@00003028: \$ 5 <= abcd0000
155@0000302c: \$ 5 <= abcd0000
165@00003030: \$ 5 <= abcd0000
175@00003034: \$ 5 <= abcd0000
185@00003038: \$ 5 <= abcd0000
195@0000303c: \$ 5 <= abcd0000
205@00003040: \$ 5 <= abcd0000
215@00003044: \$ 5 <= abcd0000
225@00003048: \$ 5 <= abcd0000
235@0000304c: \$ 5 <= abcd0000
245@00003050: \$ 5 <= abcd0000
295@00004180: \$26 <= 00004c03
305@00004184: \$26 <= 00000400
315@00004188: \$26 <= 00003054
335@0000418c: \$26 <= 00003058
345@00004194: \$CP0_14 <= 00003058
375@0000419c: \$ 4 <= 0000000e


```

385@000041a0: $20 <= 00007f00
405@000041a8: $ 4 <= 00000009
425@000041b0: $ 7 <= 7fff0000
435@000041b4: $ 7 <= fffe0000
455@000041bc: $ 7 <= 00000000
515@00003058: $ 5 <= abcd0000
525@0000305c: $ 5 <= abcd0000
535@00003060: $ 5 <= abcd0000
545@00003064: $ 5 <= abcd0000
555@00003068: $ 5 <= abcd0000
565@0000306c: $ 5 <= abcd0000
575@00003070: $ 5 <= abcd0000
625@00004180: $26 <= 00004c03
635@00004184: $26 <= 00000400
645@00004188: $26 <= 00003074
665@0000418c: $26 <= 00003078
675@00004194: $CP0_14 <= 00003078
705@0000419c: $ 4 <= 0000000e
715@000041a0: $20 <= 00007f00
735@000041a8: $ 4 <= 00000009
755@000041b0: $ 7 <= 7fff0000
765@000041b4: $ 7 <= fffe0000
785@000041bc: $ 7 <= 00000000
845@00003078: $ 5 <= abcd0000
855@0000307c: $ 5 <= abcd0000
865@00003080: $ 5 <= abcd0000
875@00003084: $ 5 <= abcd0000
885@00003088: $ 5 <= abcd0000
895@0000308c: $ 5 <= abcd0000
905@00003090: $ 5 <= abcd0000
955@00004180: $26 <= 00004c03
965@00004184: $26 <= 00000400
975@00004188: $26 <= 00003094
995@0000418c: $26 <= 00003098

```

测试 3

测试点: 中断优先

```

.text
ori $4 $0 0x4c01
mtc0 $4 $12

```



```

lui $5 0xabcd
lui $5 0xabcd
lui $5 0xabcd
lui $5 0xabcd
lui $5 0xabcd
lui $5 0xabcd
lui $5 0xabcd
lui $5 0xabcd
lui $5 0xabcd
lui $5 0xabcd
lui $5 0xabcd

```

```

.ktext 0x4180
_main_handler:
    mfc0    $k0, $12
    mfc0    $k0, $13
    mfc0    $k0, $14 #_main_handler
    addi    $k0 $k0 0
    nop
    mtc0    $k0, $14
    nop

    ori $4 $0 0xe
    ori $20 $0 0x7f00
    sw $4 4($20)
    ori $4 $0 9 #1001 im=1,mode=00,enable=1
    sw $4 0($20)

    j _restore
    nop

_restore:
    eret #_restore

```

```

45@00003000: $ 4 <= 00004c01
45@00003004: $CP0_12 <= 00004c01
65@00003008: $ 4 <= 0000000c
75@0000300c: $20 <= 00007f00
95@00003014: $ 4 <= 00000009
115@0000301c: $ 5 <= abcd0000
125@00003020: $ 5 <= abcd0000
135@00003024: $ 5 <= abcd0000

```

145@00003028: \$ 5 <= abcd0000
155@0000302c: \$ 5 <= abcd0000
165@00003030: \$ 5 <= abcd0000
175@00003034: \$ 5 <= abcd0000
185@00003038: \$ 5 <= abcd0000
195@0000303c: \$ 5 <= abcd0000
205@00003040: \$ 5 <= abcd0000
215@00003044: \$ 5 <= abcd0000
225@00003048: \$ 5 <= abcd0000
235@0000304c: \$ 5 <= abcd0000
245@00003050: \$ 5 <= abcd0000
255@00003054: \$ 6 <= 7fff0000
305@00004180: \$26 <= 00004c03
315@00004184: \$26 <= 00000000 #cause=0x00, 而非 0x30
325@00004188: \$26 <= 00003058
345@0000418c: \$26 <= 00003058
355@00004194: \$CP0_14 <= 00003058
385@0000419c: \$ 4 <= 0000000e
395@000041a0: \$20 <= 00007f00
415@000041a8: \$ 4 <= 00000009
515@00004180: \$26 <= 00004c03
525@00004184: \$26 <= 00000030 #cause=0x30
535@00004188: \$26 <= 00003058
555@0000418c: \$26 <= 00003058
565@00004194: \$CP0_14 <= 00003058
595@0000419c: \$ 4 <= 0000000e
605@000041a0: \$20 <= 00007f00
625@000041a8: \$ 4 <= 00000009
725@00004180: \$26 <= 00004c03
735@00004184: \$26 <= 00000030
745@00004188: \$26 <= 00003058
765@0000418c: \$26 <= 00003058
775@00004194: \$CP0_14 <= 00003058

45@00003000: \$ 4 <= 00004c01
45@00003004: \$CP0_12 <= 00004c01
65@00003008: \$ 4 <= 0000000c
75@0000300c: \$20 <= 00007f00
95@00003014: \$ 4 <= 00000009
115@0000301c: \$ 5 <= abcd0000
125@00003020: \$ 5 <= abcd0000
135@00003024: \$ 5 <= abcd0000
145@00003028: \$ 5 <= abcd0000
155@0000302c: \$ 5 <= abcd0000

165@00003030: \$ 5 <= abcd0000
175@00003034: \$ 5 <= abcd0000
185@00003038: \$ 5 <= abcd0000
195@0000303c: \$ 5 <= abcd0000
205@00003040: \$ 5 <= abcd0000
215@00003044: \$ 5 <= abcd0000
225@00003048: \$ 5 <= abcd0000
235@0000304c: \$ 5 <= abcd0000
245@00003050: \$ 6 <= 7fff0000
295@00004180: \$26 <= 00004c03
305@00004184: \$26 <= 00000430
315@00004188: \$26 <= 00003054
335@0000418c: \$26 <= 00003058
345@00004194: \$CP0_14 <= 00003058
375@0000419c: \$ 4 <= 0000000e
385@000041a0: \$20 <= 00007f00
405@000041a8: \$ 4 <= 00000009
465@00003058: \$ 5 <= abcd0000
475@0000305c: \$ 5 <= abcd0000
485@00003060: \$ 5 <= abcd0000
495@00003064: \$ 5 <= abcd0000
505@00003068: \$ 5 <= abcd0000
515@0000306c: \$ 5 <= abcd0000
525@00003070: \$ 5 <= abcd0000
535@00003074: \$ 5 <= abcd0000
545@00003078: \$ 5 <= abcd0000
555@0000307c: \$ 5 <= abcd0000
565@00003080: \$ 5 <= abcd0000
575@00003084: \$ 5 <= abcd0000
625@00004180: \$26 <= 00004c03
635@00004184: \$26 <= 00000400
645@00004188: \$26 <= 00003088
665@0000418c: \$26 <= 0000308c
675@00004194: \$CP0_14 <= 0000308c
705@0000419c: \$ 4 <= 0000000e
715@000041a0: \$20 <= 00007f00
735@000041a8: \$ 4 <= 00000009
795@0000308c: \$ 5 <= abcd0000
805@00003090: \$ 5 <= abcd0000
815@00003094: \$ 5 <= abcd0000
825@00003098: \$ 5 <= abcd0000
835@0000309c: \$ 5 <= abcd0000
845@000030a0: \$ 5 <= abcd0000
855@000030a4: \$ 5 <= abcd0000

```
865@000030a8: $ 5 <= abcd0000
875@000030ac: $ 5 <= abcd0000
885@000030b0: $ 5 <= abcd0000
895@000030b4: $ 5 <= abcd0000
905@000030b8: $ 5 <= abcd0000
955@00004180: $26 <= 00004c03
965@00004184: $26 <= 00000400
975@00004188: $26 <= 000030bc
995@0000418c: $26 <= 000030c0
```

测试 4

测试点:eret+中断

#第一次中断时 eret 在 M 级, 第二次中断时 eret 在 E 级

```
.text
ori $4 $0 0x4c01
mtc0 $4 $12
```

```
ori $4 $0 0xe
ori $20 $0 0x7f00
sw $4 4($20)
ori $4 $0 10
sw $4 0($20)
```

[illegible]

nop

ori \$4 \$0 0xe
ori \$20 \$0 0x7f00
sw \$4 4(\$20)

lui \$7 0x7fff
add \$7 \$7 \$7
eret #_restore

45@00003000: \$ 4 <= 00004c01
45@00003004: \$CP0_12 <= 00004c01
65@00003008: \$ 4 <= 0000000e
75@0000300c: \$20 <= 00007f00
95@00003014: \$ 4 <= 0000000a
115@0000301c: \$ 5 <= abcd0000
125@00003020: \$ 5 <= abcd0000
135@00003024: \$ 5 <= abcd0000
145@00003028: \$ 5 <= abcd0000
155@0000302c: \$ 5 <= abcd0000
165@00003030: \$ 5 <= abcd0000
175@00003034: \$ 5 <= abcd0000
185@00003038: \$ 5 <= abcd0000
195@0000303c: \$ 5 <= abcd0000
205@00003040: \$ 5 <= abcd0000
215@00003044: \$ 5 <= abcd0000
225@00003048: \$ 5 <= abcd0000
235@0000304c: \$ 5 <= abcd0000
245@00003050: \$ 5 <= abcd0000
255@00003054: \$ 6 <= 7fff0000
305@00004180: \$26 <= 00004c03
315@00004184: \$26 <= 00000030
325@00004188: \$26 <= 00003058
345@0000418c: \$26 <= 0000305c
355@00004194: \$CP0_14 <= 0000305c
385@0000419c: \$ 4 <= 0000000e
395@000041a0: \$20 <= 00007f00
415@000041a8: \$ 7 <= 7fff0000
425@000041ac: \$ 7 <= fffe0000
475@00004180: \$26 <= 00004c03
485@00004184: \$26 <= 00000000
495@00004188: \$26 <= 0000305c


```
ori $20 $0 0x7f00
sw $4 4($20)
ori $4 $0 10
nop
```

```
lui $7 0x7fff
add $7 $7 $7
eret #_restore
```

```
45@00003000: $ 4 <= 00004c01
45@00003004: $CP0_12 <= 00004c01
65@00003008: $ 4 <= 0000000e
75@0000300c: $20 <= 00007f00
95@00003014: $ 4 <= 0000000a
115@0000301c: $ 5 <= abcd0000
125@00003020: $ 5 <= abcd0000
135@00003024: $ 5 <= abcd0000
145@00003028: $ 5 <= abcd0000
155@0000302c: $ 5 <= abcd0000
165@00003030: $ 5 <= abcd0000
175@00003034: $ 5 <= abcd0000
185@00003038: $ 5 <= abcd0000
195@0000303c: $ 5 <= abcd0000
205@00003040: $ 5 <= abcd0000
215@00003044: $ 5 <= abcd0000
225@00003048: $ 5 <= abcd0000
235@0000304c: $ 5 <= abcd0000
245@00003050: $ 5 <= abcd0000
255@00003054: $ 6 <= 7fff0000
305@00004180: $26 <= 00004c03
315@00004184: $26 <= 00000030
325@00004188: $26 <= 00003058
345@0000418c: $26 <= 0000305c
355@00004194: $CP0_14 <= 0000305c
385@0000419c: $ 4 <= 0000000e
395@000041a0: $20 <= 00007f00
415@000041a8: $ 4 <= 0000000a
435@000041b0: $ 7 <= 7fff0000
445@000041b4: $ 7 <= fffe0000
475@0000305c: $ 5 <= abcd0000
485@00003060: $ 5 <= abcd0000
495@00003064: $ 5 <= abcd0000
505@00003068: $ 5 <= abcd0000
```

515@0000306c: \$ 5 <= abcd0000

525@00003070: \$ 5 <= abcd0000