

## ULNAv2-B Instruction Set, by Alphabetical Order

| Instruction | Instruction Class | Instruction Number | RTN (PC $\leftarrow$ PC + 1, unless otherwise specified)                                                          | Updates Cond Codes |
|-------------|-------------------|--------------------|-------------------------------------------------------------------------------------------------------------------|--------------------|
| add.        | A                 | 1                  | $R[W] \leftarrow R[A] + R[B]$                                                                                     | Y                  |
| addi.       | B                 | 9                  | $R[W] \leftarrow R[A] + \text{SignExtend}(\text{Imm5})$                                                           | Y                  |
| and.        | A                 | 2                  | $R[W] \leftarrow R[A] \text{ AND } R[B]$                                                                          | Y                  |
| andi.       | C                 | 18                 | $R[W] \leftarrow R[W] \text{ AND } \text{OneExtend}(\text{Imm8})$                                                 | Y                  |
| ash         | B                 | 8                  | $R[W] \leftarrow \text{ArithmeticShiftRight}(R[A], \text{SignExtend}(\text{Imm5}))$                               |                    |
| b           | D                 | 24                 | $\text{PC} \leftarrow \text{PC} + \text{SignExtend}(\text{Imm11})$                                                |                    |
| b.eq        | D                 | 26                 | $\text{PC} \leftarrow \text{PC} + \text{SignExtend}(\text{Imm11})$<br>if $Z == 1$                                 |                    |
| b.ge        | D                 | 27                 | $\text{PC} \leftarrow \text{PC} + \text{SignExtend}(\text{Imm11})$<br>if $N == V$                                 |                    |
| b.gt        | D                 | 25                 | $\text{PC} \leftarrow \text{PC} + \text{SignExtend}(\text{Imm11})$<br>if $Z == 0 \text{ AND } N == V$             |                    |
| b.le        | D                 | 30                 | $\text{PC} \leftarrow \text{PC} + \text{SignExtend}(\text{Imm11})$<br>if $\text{NOT}(Z == 0 \text{ AND } N == V)$ |                    |
| b.lt        | D                 | 28                 | $\text{PC} \leftarrow \text{PC} + \text{SignExtend}(\text{Imm11})$<br>if $\text{NOT}(N == V)$                     |                    |
| b.ne        | D                 | 29                 | $\text{PC} \leftarrow \text{PC} + \text{SignExtend}(\text{Imm11})$<br>if $Z == 0$                                 |                    |
| bl          | C                 | 23                 | $R[W] \leftarrow \text{PC} + 1;$<br>$\text{PC} \leftarrow \text{PC} + \text{SignExtend}(\text{Imm8})$             |                    |
| br          | A                 | 4                  | $\text{PC} \leftarrow R[A]$                                                                                       |                    |
| brl         | B                 | 13                 | $R[W] \leftarrow \text{PC} + 1;$<br>$\text{PC} \leftarrow R[A]$                                                   |                    |
| cmp.        | A                 | 5                  | Update Cond Codes by performing $R[A] - R[B]$                                                                     | Y                  |
| cmpi.       | C                 | 21                 | Update Cond Codes by performing $R[W] - \text{SignExtend}(\text{Imm8})$                                           | Y                  |
| halt        | D                 | 31                 | $\text{MemWord}[0\text{xFFFF}] \leftarrow \text{SignExtend}(\text{Imm11});$<br>$\text{PC} \leftarrow \text{PC}$   |                    |
| ldw         | A                 | 7                  | $R[W] \leftarrow \text{MemWord}[R[A] + R[B]]$                                                                     |                    |
| ldwi        | B                 | 15                 | $R[W] \leftarrow \text{MemWord}[R[A] + \text{SignExtend}(\text{Imm5})]$                                           |                    |
| lsh         | B                 | 10                 | $R[W] \leftarrow \text{LogicalShiftRight}(R[A], \text{SignExtend}(\text{Imm5}))$                                  |                    |
| movi        | C                 | 20                 | $R[W] \leftarrow \text{ZeroExtend}(\text{Imm8})$                                                                  |                    |
| movis       | C                 | 22                 | $R[W] \leftarrow R[W][7:0] \text{ OR } \text{LogicalShiftLeft}(\text{Imm8}, 8)$                                   |                    |
| negi.       | B                 | 12                 | $R[W] \leftarrow \text{NOT } R[A] + \text{SignExtend}(\text{Imm5})$                                               | Y                  |
| or.         | A                 | 0                  | $R[W] \leftarrow R[A] \text{ OR } R[B]$                                                                           | Y                  |
| ori.        | C                 | 16                 | $R[W] \leftarrow R[W] \text{ OR } \text{ZeroExtend}(\text{Imm8})$                                                 | Y                  |
| rot         | B                 | 14                 | $R[W] \leftarrow \text{RollRight}(R[A], \text{SignExtend}(\text{Imm5}))$                                          |                    |
| stw         | A                 | 3                  | $\text{MemWord}[R[A] + R[B]] \leftarrow R[W]$                                                                     |                    |
| stwi        | B                 | 11                 | $\text{MemWord}[R[A] + \text{SignExtend}(\text{Imm5})] \leftarrow R[W]$                                           |                    |
| undef - 06  | A                 | 6                  | don't care                                                                                                        |                    |
| undef - 17  | C                 | 17                 | don't care                                                                                                        |                    |
| undef - 19  | C                 | 19                 | don't care                                                                                                        |                    |

## ULNAv2-B Instruction Set, by Instruction Number Order

| Instruction Number | Instruction |
|--------------------|-------------|
| 0                  | or.         |
| 1                  | add.        |
| 2                  | and.        |
| 3                  | stw         |
| 4                  | br          |
| 5                  | cmp.        |
| 6                  | undef - 06  |
| 7                  | ldw         |
| 8                  | ash         |
| 9                  | addi.       |
| 10                 | lsh         |
| 11                 | stwi        |
| 12                 | negi.       |
| 13                 | brl         |
| 14                 | rot         |
| 15                 | ldwi        |
| 16                 | ori.        |
| 17                 | undef - 17  |
| 18                 | andi.       |
| 19                 | undef - 19  |
| 20                 | movi        |
| 21                 | cmpi.       |
| 22                 | movis       |
| 23                 | bl          |
| 24                 | b           |
| 25                 | b.gt        |
| 26                 | b.eq        |
| 27                 | b.ge        |
| 28                 | b.lt        |
| 29                 | b.ne        |
| 30                 | b.le        |
| 31                 | halt        |