

# Proposed Instruction Encodings for the RISC-V Base P Extension

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**Warning! This document is only a draft proposal and is not an official document of the RISC-V International Association. The Base P extension that is eventually ratified by RISC-V International is liable to differ from this proposal in many details.**

This document proposes encodings for the instructions of the RISC-V Base P extension, both for RV32 and for RV64. For more about this proposal, see my other documents:

- *System for RISC-V P Extension Instruction Names*
- *Proposed Instructions for the RISC-V Base P Extension*

This version (015) adds encodings for these RV32 double-wide instructions that were missing from version 014:

PMIN.DW PMINU.DW PMAX.DW PMAXU.DW

# 1 Instruction formats

A few non-SIMD instructions of the P extension (including SH1ADD, ABS, SEXT.B, SEXT.H, CLZ, CLS, MIN, MINU, MAX, MAXU, PACK, REV8, and REV16) are encoded alongside other ordinary RISC-V “scalar” instructions in the major opcodes known as OP (binary code 0110011), OP-IMM (0010011), and OP-IMM-32 (0011011).

All other Base P instructions are encoded either: (a) within major opcode OP-32 (binary code 0111011) with instruction bit 31 = 1; or (b) within OP-IMM-32 with bits 14:12 (func3) = binary 010, 100, or 110.

Apart from the subset of non-SIMD instructions already mentioned plus a few other special cases, the following instruction formats are used for all Base P instructions that have no register-pair operands, only single registers:

|    |         |        |     |       |    |               |
|----|---------|--------|-----|-------|----|---------------|
| 32 | 27      | 20     | 15  | 12    | 7  | 0             |
| 1  | x x x 0 | w-uimm | rs1 | 0 1 0 | rd | 0 0 1 1 0 1 1 |

  

|    |         |    |     |     |       |    |               |
|----|---------|----|-----|-----|-------|----|---------------|
| 32 | 27      | 25 | 20  | 15  | 12    | 7  | 0             |
| 1  | x x x 1 | w  | rs2 | rs1 | 0 1 0 | rd | 0 0 1 1 0 1 1 |

  

|    |         |        |     |       |    |               |
|----|---------|--------|-----|-------|----|---------------|
| 32 | 27      | 20     | 15  | 12    | 7  | 0             |
| 1  | x x x 0 | w-uimm | rs1 | 1 0 0 | rd | 0 0 1 1 0 1 1 |

  

|    |         |    |     |     |       |    |               |
|----|---------|----|-----|-----|-------|----|---------------|
| 32 | 27      | 25 | 20  | 15  | 12    | 7  | 0             |
| 1  | x x x 1 | w  | rs2 | rs1 | 1 0 0 | rd | 0 0 1 1 0 1 1 |

  

|    |         |    |     |     |       |    |               |
|----|---------|----|-----|-----|-------|----|---------------|
| 32 | 27      | 25 | 20  | 15  | 12    | 7  | 0             |
| 1  | x x x x | w  | rs2 | rs1 | x x 0 | rd | 0 1 1 1 0 1 1 |

  

|    |       |    |    |     |     |       |    |               |
|----|-------|----|----|-----|-----|-------|----|---------------|
| 32 | 28    | 27 | 25 | 20  | 15  | 12    | 7  | 0             |
| 1  | x x x | R  | w  | rs2 | rs1 | x x 1 | rd | 0 1 1 1 0 1 1 |

Note that the first four formats are in major opcode OP-IMM-32, and the last two are in OP-32. Of the OP-IMM-32 formats, those with func3 = binary 010 are mostly shifts left, while those with func3 = binary 100 are mostly shifts right.

The two-bit field w often selects the SIMD element width, whether bytes, halfwords, or words, although that is not its only function. The most common, though not universal, encoding for w has binary 00 = halfwords, 01 = words, 10 = bytes, and 11 = a doubleword. Field w-uimm encodes both an element width and an unsigned immediate operand whose size varies with the element width; for example, 3 bits for bytes, 4 bits for halfwords, 5 bits for words, and 6 bits for a doubleword.

For the last format, when bit R = 1, an instruction both reads and writes the destination operand. Usually this is done for an accumulate operation, although there are some other instances, such as SRX (Shift Right Extended) and MVM (Move Masked). Instructions encoded in the other formats listed above never read the destination.

With RV32, the P extension has additional instruction formats for the cases when operands are even-odd register pairs:

|    |         |        |     |       |                 |                 |
|----|---------|--------|-----|-------|-----------------|-----------------|
| 32 | 27      | 20     | 15  | 12    | 8               | 0               |
| 0  | x x x 0 | w-uimm | rs1 | 0 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |

  

|    |         |    |     |     |       |                 |                 |
|----|---------|----|-----|-----|-------|-----------------|-----------------|
| 32 | 27      | 25 | 20  | 15  | 12    | 8               | 0               |
| 0  | x x x 1 | w  | rs2 | rs1 | 0 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |

  

|    |       |    |    |     |     |       |                 |                 |
|----|-------|----|----|-----|-----|-------|-----------------|-----------------|
| 32 | 28    | 27 | 25 | 20  | 15  | 12    | 8               | 0               |
| 0  | x x x | R  | w  | rs2 | rs1 | 0 1 0 | rd <sub>p</sub> | 1 0 0 1 1 0 1 1 |

  

|    |         |        |                  |         |    |               |
|----|---------|--------|------------------|---------|----|---------------|
| 32 | 27      | 20     | 16               | 12      | 7  | 0             |
| 0  | x x x 0 | w-uimm | rs1 <sub>p</sub> | 1 1 0 0 | rd | 0 0 1 1 0 1 1 |

  

|    |         |    |     |                  |         |    |               |
|----|---------|----|-----|------------------|---------|----|---------------|
| 32 | 27      | 25 | 20  | 16               | 12      | 7  | 0             |
| 0  | x x x 1 | w  | rs2 | rs1 <sub>p</sub> | x 1 0 0 | rd | 0 0 1 1 0 1 1 |

  

|    |         |        |                  |         |                 |                 |
|----|---------|--------|------------------|---------|-----------------|-----------------|
| 32 | 27      | 20     | 16               | 12      | 8               | 0               |
| 0  | x x x 0 | w-uimm | rs1 <sub>p</sub> | x 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |

  

|    |         |    |     |                  |         |                 |                 |
|----|---------|----|-----|------------------|---------|-----------------|-----------------|
| 32 | 27      | 25 | 20  | 16               | 12      | 8               | 0               |
| 0  | x x x 1 | w  | rs2 | rs1 <sub>p</sub> | x 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |

  

|    |         |    |                  |    |                  |         |                 |                 |
|----|---------|----|------------------|----|------------------|---------|-----------------|-----------------|
| 32 | 27      | 25 | 21               | 20 | 16               | 12      | 8               | 0               |
| 1  | x x x x | w  | rs2 <sub>p</sub> | x  | rs1 <sub>p</sub> | x 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |

All of these are in major opcode OP-IMM-32. The formats here with func3 = binary 010 primarily encode widening shifts left and other widening instructions, and those with func3 = binary 100 encode narrowing shifts right and reductions. The last three formats, with func3 = binary 110, encode all the double-wide instructions, which have at least the first source and destination as register pairs, and often the second source operand as well.

The third format listed above, with an R bit, encodes widening adds, subtracts, and multiplies that may optionally read the destination for an accumulate operation (WADDA, WSUBA, WMACC, etc.).

*The following format is not used by Base P but is recommended for a Zp\* extension that adds double-wide multiply instructions:*

|    |       |    |    |                  |    |                  |         |                 |                 |
|----|-------|----|----|------------------|----|------------------|---------|-----------------|-----------------|
| 32 | 28    | 27 | 25 | 21               | 20 | 16               | 12      | 8               | 0               |
| 1  | x x x | R  | w  | rs2 <sub>p</sub> | x  | rs1 <sub>p</sub> | x 1 1 0 | rd <sub>p</sub> | 1 0 0 1 1 0 1 1 |

## 2 Encodings of instructions with no register-pair operands

In this section, all instruction tables show separately the allocations of instructions for RV32 and for RV64. Asterisks (\*) mark where there are differences between the RV32 and RV64 halves of a table.

Where an instruction name is within braces { }, there is no such instruction proposed for the Base P extension, but the indicated encoding is recommended should the instruction be provided by another extension.

|    |    |    |    |    |   |   |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
|----|----|----|----|----|---|---|---|---|---|-----|-----|-----|---|----|----|----|---|---|---|---|---|-----|-------------|--------------|
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 0  | 0 | 0 | 0 | 0 | 0 | rs1 | 0   | 0   | 1 | rd | 0  | 0  | 1 | 0 | 0 | 1 | 1 | CLZ |             |              |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 0  | 0 | 0 | 0 | 1 | 1 | rs1 | 0   | 0   | 1 | rd | 0  | 0  | 1 | 0 | 0 | 1 | 1 | CLS |             |              |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 0  | 0 | 0 | 0 | 1 | 0 | 0   | rs1 | 0   | 0 | 1  | rd | 0  | 0 | 1 | 0 | 0 | 1 | 1   | SEXT.B      |              |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 0  | 0 | 0 | 0 | 1 | 0 | 1   | rs1 | 0   | 0 | 1  | rd | 0  | 0 | 1 | 0 | 0 | 1 | 1   | SEXT.H      |              |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 0  | 0 | 0 | 0 | 1 | 1 | 1   | rs1 | 0   | 0 | 1  | rd | 0  | 0 | 1 | 0 | 0 | 1 | 1   | ABS         |              |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 1  | 0 | 0 | 1 | 1 | 0 | 0   | 0   | rs1 | 1 | 0  | 1  | rd | 0 | 0 | 1 | 0 | 0 | 1   | 1           | REV8 (RV32)  |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 1  | 0 | 0 | 1 | 1 | 1 | 1   | 1   | rs1 | 1 | 0  | 1  | rd | 0 | 0 | 1 | 0 | 0 | 1   | 1           | REV (RV32)   |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 1  | 0 | 1 | 1 | 0 | 0 | 0   | 0   | rs1 | 1 | 0  | 1  | rd | 0 | 0 | 1 | 0 | 0 | 1   | 1           | REV16 (RV64) |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 1  | 0 | 1 | 1 | 1 | 0 | 0   | 0   | rs1 | 1 | 0  | 1  | rd | 0 | 0 | 1 | 0 | 0 | 1   | 1           | REV8 (RV64)  |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 1  | 0 | 1 | 1 | 1 | 1 | 1   | 1   | rs1 | 1 | 0  | 1  | rd | 0 | 0 | 1 | 0 | 0 | 1   | 1           | REV (RV64)   |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0   | 0   | rs1 | 0 | 0  | 1  | rd | 0 | 0 | 1 | 1 | 0 | 1   | 1           | CLZW (RV64)  |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 0  | 0 | 0 | 0 | 0 | 1 | 1   | rs1 | 0   | 0 | 1  | rd | 0  | 0 | 1 | 1 | 0 | 1 | 1   | CLSW (RV64) |              |
| 32 | 27 | 20 | 15 | 12 | 7 | 0 |   |   |   |     |     |     |   |    |    |    |   |   |   |   |   |     |             |              |
| 0  | 1  | 1  | 0  | 0  | 0 | 0 | 0 | 1 | 1 | 1   | rs1 | 0   | 0 | 1  | rd | 0  | 0 | 1 | 1 | 0 | 1 | 1   | ABSW (RV64) |              |

|     |     |    |    |    |    |   |        |
|-----|-----|----|----|----|----|---|--------|
| 32  | 25  | 20 | 15 | 12 | 7  | 0 |        |
| 0   | 0   | 1  | 0  | 0  | 0  | 0 | SH1ADD |
| rs2 | rs1 | 0  | 1  | 0  | rd | 0 |        |
| 1   | 0   | 0  | 1  | 1  | 0  | 0 |        |
| 1   | 1   |    |    |    |    |   |        |
| 32  | 25  | 20 | 15 | 12 | 7  | 0 |        |
| 0   | 0   | 0  | 0  | 1  | 0  | 0 | PACK   |
| rs2 | rs1 | 1  | 0  | 0  | rd | 0 |        |
| 1   | 0   | 0  | 1  | 1  | 0  | 0 |        |
| 1   | 1   |    |    |    |    |   |        |
| 32  | 25  | 20 | 15 | 12 | 7  | 0 |        |
| 0   | 0   | 0  | 0  | 1  | 0  | 1 | MIN    |
| rs2 | rs1 | 1  | 0  | 0  | rd | 0 |        |
| 1   | 0   | 0  | 1  | 1  | 0  | 0 |        |
| 1   | 1   |    |    |    |    |   |        |
| 32  | 25  | 20 | 15 | 12 | 7  | 0 |        |
| 0   | 0   | 0  | 0  | 1  | 0  | 1 | MINU   |
| rs2 | rs1 | 1  | 0  | 1  | rd | 0 |        |
| 1   | 0   | 1  | 1  | 1  | 0  | 0 |        |
| 1   | 1   |    |    |    |    |   |        |
| 32  | 25  | 20 | 15 | 12 | 7  | 0 |        |
| 0   | 0   | 0  | 0  | 1  | 0  | 1 | MAX    |
| rs2 | rs1 | 1  | 1  | 0  | rd | 0 |        |
| 1   | 0   | 1  | 1  | 1  | 0  | 0 |        |
| 1   | 1   |    |    |    |    |   |        |
| 32  | 25  | 20 | 15 | 12 | 7  | 0 |        |
| 0   | 0   | 0  | 0  | 1  | 0  | 1 | MAXU   |
| rs2 | rs1 | 1  | 1  | 1  | rd | 0 |        |
| 1   | 0   | 1  | 1  | 1  | 0  | 0 |        |
| 1   | 1   |    |    |    |    |   |        |

|    |    |    |        |     |       |    |               |   |
|----|----|----|--------|-----|-------|----|---------------|---|
| 32 | 31 | 28 | 27     | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | 0  | w-uimm | rs1 | 0 1 0 | rd | 0 0 1 1 0 1 1 |   |

|      |   |                           |              |              |                |         |  |
|------|---|---------------------------|--------------|--------------|----------------|---------|--|
| RV32 | f | w-uimm                    |              |              |                |         |  |
|      |   | 0000xxx                   | 0001xxx      | 001xxxx      | 01xxxxx        | 1xxxxxx |  |
| 000  |   |                           | PSLLI.B      | PSLLI.H      | *              |         |  |
| 001  |   |                           | { PSSLLI.B } | { PSSLLI.H } | * { SSLLI }    |         |  |
| 010  |   |                           |              |              |                |         |  |
| 011  |   | <i>PLI instructions</i>   |              |              |                |         |  |
| 100  |   |                           |              |              |                |         |  |
| 101  |   |                           | { PSSLAI.B } | PSSLAI.H     | * SSLAI        |         |  |
| 110  |   | <i>unary instructions</i> |              |              |                |         |  |
| 111  |   | <i>PLUI instructions</i>  |              |              |                |         |  |
| RV64 | f | w-uimm                    |              |              |                |         |  |
|      |   | 0000xxx                   | 0001xxx      | 001xxxx      | 01xxxxx        | 1xxxxxx |  |
| 000  |   |                           | PSLLI.B      | PSLLI.H      | * PSLLI.W      |         |  |
| 001  |   |                           | { PSSLLI.B } | { PSSLLI.H } | * { PSSLLI.W } |         |  |
| 010  |   |                           |              |              |                |         |  |
| 011  |   | <i>PLI instructions</i>   |              |              |                |         |  |
| 100  |   |                           |              |              |                |         |  |
| 101  |   |                           | { PSSLAI.B } | PSSLAI.H     | * PSSLAI.W     |         |  |
| 110  |   | <i>unary instructions</i> |              |              |                |         |  |
| 111  |   | <i>PLUI instructions</i>  |              |              |                |         |  |

|           |     |            |       |    |               |       |
|-----------|-----|------------|-------|----|---------------|-------|
| 32        | 27  | 25         | 15    | 12 | 7             | 0     |
| 1 0 1 1 0 | 0 0 | imm[8:0 9] | 0 1 0 | rd | 0 0 1 1 0 1 1 | PLI.H |

|           |     |            |       |    |               |              |
|-----------|-----|------------|-------|----|---------------|--------------|
| 32        | 27  | 25         | 15    | 12 | 7             | 0            |
| 1 0 1 1 0 | 0 1 | imm[8:0 9] | 0 1 0 | rd | 0 0 1 1 0 1 1 | PLI.W (RV64) |

|           |       |          |         |    |               |       |
|-----------|-------|----------|---------|----|---------------|-------|
| 32        | 27    | 24       | 16      | 12 | 7             | 0     |
| 1 0 1 1 0 | 1 0 0 | imm[7:0] | 0 0 1 0 | rd | 0 0 1 1 0 1 1 | PLI.B |

|           |    |    |     |       |    |               |   |
|-----------|----|----|-----|-------|----|---------------|---|
| 32        | 27 | 25 | 20  | 15    | 12 | 7             | 0 |
| 1 1 1 0 0 | w  | uf | rs1 | 0 1 0 | rd | 0 0 1 1 0 1 1 |   |

| RV32  | w          |            |            |    |
|-------|------------|------------|------------|----|
| uf    | 00         | 01         | 10         | 11 |
| 00000 | { PCLZ.H } | *          | { PCLZ.B } |    |
| 00001 |            |            |            |    |
| 00010 |            |            |            |    |
| 00011 | { PCLS.H } | *          | { PCLS.B } |    |
| 00100 | PSEXT.H.B  | *          |            |    |
| 00101 |            | *          |            |    |
| 00110 |            |            |            |    |
| 00111 | PSABS.H    | * { SABS } | PSABS.B    |    |
| 01000 |            |            |            |    |
| 01001 |            |            |            |    |
| 01010 |            |            |            |    |
| 01011 |            |            |            |    |
| ...   |            |            |            |    |
| 11111 |            |            |            |    |

| RV64  | w          |               |            |    |
|-------|------------|---------------|------------|----|
| uf    | 00         | 01            | 10         | 11 |
| 00000 | { PCLZ.H } | * { PCLZ.W }  | { PCLZ.B } |    |
| 00001 |            |               |            |    |
| 00010 |            |               |            |    |
| 00011 | { PCLS.H } | * { PCLS.W }  | { PCLS.B } |    |
| 00100 | PSEXT.H.B  | * PSEXT.W.B   |            |    |
| 00101 |            | * PSEXT.W.H   |            |    |
| 00110 |            |               |            |    |
| 00111 | PSABS.H    | * { PSABS.W } | PSABS.B    |    |
| 01000 |            |               |            |    |
| 01001 |            |               |            |    |
| 01010 |            |               |            |    |
| 01011 |            |               |            |    |
| ...   |            |               |            |    |
| 11111 |            |               |            |    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |    |    |    |    |   |   |   |   |   |   |   |   |   |             |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|----|---|---|---|---|---|---|---|---|---|-------------|--|--|---|---|---|--|----|--|--|---|---|---|---|---|--|--|---|---|---|---|---|--|--|---|---|---|---|---|--|--|---|---|---|---|--------|
| 32                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 27 | 25 | 15 | 12 | 7 | 0 |   |   |   |   |   |   |   |             |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |        |
| <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td colspan="3">imm[6 15:7]</td><td>0</td><td>1</td><td>0</td><td></td></tr><tr><td colspan="3">rd</td><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td colspan="3">0</td><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td colspan="3">0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td colspan="3">1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr></table> |    |    |    |    |   |   | 1 | 1 | 1 | 1 | 0 | 0 | 0 | imm[6 15:7] |  |  | 0 | 1 | 0 |  | rd |  |  | 0 | 0 | 1 | 1 | 0 |  |  | 0 | 1 | 1 | 0 | 0 |  |  | 1 | 1 | 0 | 1 | 1 |  |  | 1 | 0 | 1 | 1 | PLUI.H |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1  | 1  | 1  | 0  | 0 | 0 |   |   |   |   |   |   |   |             |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |        |
| imm[6 15:7]                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |    | 0  | 1  | 0 |   |   |   |   |   |   |   |   |             |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |        |
| rd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |    |    | 0  | 0  | 1 | 1 |   |   |   |   |   |   |   |             |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |        |
| 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |    | 0  | 1  | 1 | 0 |   |   |   |   |   |   |   |             |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |        |
| 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |    | 1  | 1  | 0 | 1 |   |   |   |   |   |   |   |             |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |        |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |    | 1  | 0  | 1 | 1 |   |   |   |   |   |   |   |             |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |        |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |    |    |    |    |   |   |   |   |   |   |   |   |   |               |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|----|---|---|---|---|---|---|---|---|---|---------------|--|--|---|---|---|--|----|--|--|---|---|---|---|---|--|--|---|---|---|---|---|--|--|---|---|---|---|---|--|--|---|---|---|---|---------------|
| 32                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 27 | 25 | 15 | 12 | 7 | 0 |   |   |   |   |   |   |   |               |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |               |
| <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr><tr><td colspan="3">imm[22 31:23]</td><td>0</td><td>1</td><td>0</td><td></td></tr><tr><td colspan="3">rd</td><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td colspan="3">0</td><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td colspan="3">0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td colspan="3">1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr></table> |    |    |    |    |   |   | 1 | 1 | 1 | 1 | 0 | 0 | 1 | imm[22 31:23] |  |  | 0 | 1 | 0 |  | rd |  |  | 0 | 0 | 1 | 1 | 0 |  |  | 0 | 1 | 1 | 0 | 0 |  |  | 1 | 1 | 0 | 1 | 1 |  |  | 1 | 0 | 1 | 1 | PLUI.W (RV64) |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1  | 1  | 1  | 0  | 0 | 1 |   |   |   |   |   |   |   |               |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |               |
| imm[22 31:23]                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |    | 0  | 1  | 0 |   |   |   |   |   |   |   |   |               |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |               |
| rd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |    | 0  | 0  | 1 | 1 |   |   |   |   |   |   |   |               |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |               |
| 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |    |    | 0  | 1  | 1 | 0 |   |   |   |   |   |   |   |               |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |               |
| 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |    |    | 1  | 1  | 0 | 1 |   |   |   |   |   |   |   |               |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |               |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |    |    | 1  | 0  | 1 | 1 |   |   |   |   |   |   |   |               |  |  |   |   |   |  |    |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |   |  |  |   |   |   |   |               |

|    |    |    |    |     |     |       |    |               |   |
|----|----|----|----|-----|-----|-------|----|---------------|---|
| 32 | 31 | 28 | 27 | 25  | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | 1  | w  | rs2 | rs1 | 0 1 0 | rd | 0 0 1 1 0 1 1 |   |

|      |               |                 |               |            |
|------|---------------|-----------------|---------------|------------|
| RV32 | w             |                 |               |            |
| f    | 00            | 01              | 10            | 11         |
| 000  | PSLL.HS       | *               | PSLL.BS       |            |
| 001  | PADD.HS       | *               | PADD.BS       |            |
| 010  | { PSSHL.HS }  | * { SSSL }      | { PSSHL.BS }  | *          |
| 011  | { PSSHLR.HS } | * { SSSLR }     | { PSSHLR.BS } | *          |
| 100  |               |                 |               |            |
| 101  |               |                 |               |            |
| 110  | PSSHA.HS      | * SSHA          | { PSSHA.BS }  | *          |
| 111  | PSSHAR.HS     | * SSHAR         | { PSSHAR.BS } | *          |
| RV64 | w             |                 |               |            |
| f    | 00            | 01              | 10            | 11         |
| 000  | PSLL.HS       | * PSLL.WS       | PSLL.BS       |            |
| 001  | PADD.HS       | * PADD.WS       | PADD.BS       |            |
| 010  | { PSSHL.HS }  | * { PSSHL.WS }  | { PSSHL.BS }  | * { SHL }  |
| 011  | { PSSHLR.HS } | * { PSSHLR.WS } | { PSSHLR.BS } | * { SHLR } |
| 100  |               |                 |               |            |
| 101  |               |                 |               |            |
| 110  | PSSHA.HS      | * PSSHA.WS      | { PSSHA.BS }  | * SHA      |
| 111  | PSSHAR.HS     | * PSSHAR.WS     | { PSSHAR.BS } | * SHAR     |

|    |    |    |        |     |       |    |               |   |
|----|----|----|--------|-----|-------|----|---------------|---|
| 32 | 31 | 28 | 27     | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | 0  | w-uimm | rs1 | 1 0 0 | rd | 0 0 1 1 0 1 1 |   |

| RV32<br>f                | w-uimm  |                                         |                                     |                                           |                        |
|--------------------------|---------|-----------------------------------------|-------------------------------------|-------------------------------------------|------------------------|
|                          | 0000xxx | 0001xxx                                 | 001xxxx                             | 01xxxxx                                   | 1xxxxxx                |
| 000<br>001<br>010<br>011 |         | PSRLI.B<br>{ PSRLRI.B }<br>{ PUSATI.B } | PSRLI.H<br>{ PSRLRI.H }<br>PUSATI.H | *<br>* { SRLRI }<br>* USATI               | *<br>*                 |
| 100<br>101<br>110<br>111 |         | PSRAI.B<br>{ PSRARI.B }<br>{ PSATI.B }  | PSRAI.H<br>PSRARI.H<br>PSATI.H      | *<br>* SRARI<br>* SATI                    | *<br>*                 |
| RV64<br>f                | w-uimm  |                                         |                                     |                                           |                        |
|                          | 0000xxx | 0001xxx                                 | 001xxxx                             | 01xxxxx                                   | 1xxxxxx                |
| 000<br>001<br>010<br>011 |         | PSRLI.B<br>{ PSRLRI.B }<br>{ PUSATI.B } | PSRLI.H<br>{ PSRLRI.H }<br>PUSATI.H | * PSRLI.W<br>* { PSRLRI.W }<br>* PUSATI.W | * { SRLRI }<br>* USATI |
| 100<br>101<br>110<br>111 |         | PSRAI.B<br>{ PSRARI.B }<br>{ PSATI.B }  | PSRAI.H<br>PSRARI.H<br>PSATI.H      | * PSRAI.W<br>* PSRARI.W<br>* PSATI.W      | * SRARI<br>* SATI      |

|    |    |    |    |     |     |       |    |               |   |
|----|----|----|----|-----|-----|-------|----|---------------|---|
| 32 | 31 | 28 | 27 | 25  | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | 1  | w  | rs2 | rs1 | 1 0 0 | rd | 0 0 1 1 0 1 1 |   |

| RV32<br>f                | w                     |                           |                       |    |
|--------------------------|-----------------------|---------------------------|-----------------------|----|
|                          | 00                    | 01                        | 10                    | 11 |
| 000<br>001<br>010<br>011 | PSRL.HS<br>PREDSUM.HS | *<br>*                    | PSRL.BS<br>PREDSUM.BS |    |
| 100<br>101<br>110<br>111 | PSRA.HS               | *                         | PSRA.BS               |    |
| 000<br>001<br>010<br>011 | PSRL.HS<br>PREDSUM.HS | * PSRL.WS<br>* PREDSUM.WS | PSRL.BS<br>PREDSUM.BS |    |
| 100<br>101<br>110<br>111 | PSRA.HS               | * PSRA.WS                 | PSRA.BS               |    |

|    |    |    |     |     |       |    |               |   |
|----|----|----|-----|-----|-------|----|---------------|---|
| 32 | 31 | 27 | 25  | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | w  | rs2 | rs1 | 0 0 0 | rd | 0 1 1 1 0 1 1 |   |

| RV32<br>f | w        |               |          |    |
|-----------|----------|---------------|----------|----|
|           | 00       | 01            | 10       | 11 |
| 0000      | PADD.H   | *             | PADD.B   |    |
| 0001      |          |               |          |    |
| 0010      | PSADD.H  | * SADD        | PSADD.B  |    |
| 0011      | PAADD.H  | * AADD        | PAADD.B  |    |
| 0100      |          |               |          |    |
| 0101      |          |               |          |    |
| 0110      | PSADDU.H | * SADDU       | PSADDU.B |    |
| 0111      | PAADDU.H | * AADDU       | PAADDU.B |    |
| 1000      | PSUB.H   | *             | PSUB.B   |    |
| 1001      | PDIF.H   | * { DIF }     | PDIF.B   |    |
| 1010      | PSSUB.H  | * SSUB        | PSSUB.B  |    |
| 1011      | PASUB.H  | * ASUB        | PASUB.B  |    |
| 1100      |          |               |          |    |
| 1101      | PDIFU.H  | * { DIFU }    | PDIFU.B  |    |
| 1110      | PSSUBU.H | * SSUBU       | PSSUBU.B |    |
| 1111      | PASUBU.H | * ASUBU       | PASUBU.B |    |
| RV64<br>f | w        |               |          |    |
|           | 00       | 01            | 10       | 11 |
| 0000      | PADD.H   | * PADD.W      | PADD.B   |    |
| 0001      |          |               |          |    |
| 0010      | PSADD.H  | * PSADD.W     | PSADD.B  |    |
| 0011      | PAADD.H  | * PAADD.W     | PAADD.B  |    |
| 0100      |          |               |          |    |
| 0101      |          |               |          |    |
| 0110      | PSADDU.H | * PSADDU.W    | PSADDU.B |    |
| 0111      | PAADDU.H | * PAADDU.W    | PAADDU.B |    |
| 1000      | PSUB.H   | * PSUB.W      | PSUB.B   |    |
| 1001      | PDIF.H   | * { PDIF.W }  | PDIF.B   |    |
| 1010      | PSSUB.H  | * PSSUB.W     | PSSUB.B  |    |
| 1011      | PASUB.H  | * PASUB.W     | PASUB.B  |    |
| 1100      |          |               |          |    |
| 1101      | PDIFU.H  | * { PDIFU.W } | PDIFU.B  |    |
| 1110      | PSSUBU.H | * PSSUBU.W    | PSSUBU.B |    |
| 1111      | PASUBU.H | * PASUBU.W    | PASUBU.B |    |

|       |    |    |     |     |       |    |               |
|-------|----|----|-----|-----|-------|----|---------------|
| 32 31 | 27 | 25 | 20  | 15  | 12    | 7  | 0             |
| 1     | f  | w  | rs2 | rs1 | 0 0 1 | rd | 0 1 1 1 0 1 1 |

|                              |                                        |                                         |                                    |                                  |
|------------------------------|----------------------------------------|-----------------------------------------|------------------------------------|----------------------------------|
| RV32<br>f                    | w                                      |                                         |                                    |                                  |
|                              | 00                                     | 01                                      | 10                                 | 11                               |
| 0000<br>0001<br>0010<br>0011 | PMUL.H.B01<br>{ PMACC.H.B01 }          | * MUL.H01<br>* MACC.H01                 |                                    | SLX<br>*<br>*                    |
| 0100<br>0101<br>0110<br>0111 | MVM<br>PMULU.H.B01<br>{ PMACCU.H.B01 } | MVMN<br>* MULU.H01<br>* MACCU.H01       | MERGE<br>PDIFSUMU.B<br>PDIFSUMAU.B | SRX<br>*<br>*                    |
| 1000<br>1001<br>1010<br>1011 |                                        |                                         |                                    |                                  |
| 1100<br>1101<br>1110<br>1111 |                                        |                                         |                                    |                                  |
| RV64<br>f                    | w                                      |                                         |                                    |                                  |
|                              | 00                                     | 01                                      | 10                                 | 11                               |
| 0000<br>0001<br>0010<br>0011 | PMUL.H.B01<br>{ PMACC.H.B01 }          | * PMUL.W.H01<br>* PMACC.W.H01           |                                    | SLX<br>* MUL.W01<br>* MACC.W01   |
| 0100<br>0101<br>0110<br>0111 | MVM<br>PMULU.H.B01<br>{ PMACCU.H.B01 } | MVMN<br>* PMULU.W.H01<br>* PMACCU.W.H01 | MERGE<br>PDIFSUMU.B<br>PDIFSUMAU.B | SRX<br>* MULU.W01<br>* MACCU.W01 |
| 1000<br>1001<br>1010<br>1011 |                                        |                                         |                                    |                                  |
| 1100<br>1101<br>1110<br>1111 |                                        |                                         |                                    |                                  |

|    |    |    |    |     |     |       |    |               |   |
|----|----|----|----|-----|-----|-------|----|---------------|---|
| 32 | 31 | 28 | 27 | 25  | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | 0  | w  | rs2 | rs1 | 0 1 0 | rd | 0 1 1 1 0 1 1 |   |

| RV32<br>f | w             |               |                |             |
|-----------|---------------|---------------|----------------|-------------|
|           | 00            | 01            | 10             | 11          |
| 000       |               |               |                |             |
| 001       |               |               |                |             |
| 010       | PSH1ADD.H     | *             |                |             |
| 011       | PSSH1SADD.H   | * SSH1SADD    |                |             |
| 100       |               |               |                |             |
| 101       |               |               |                |             |
| 110       | * { UNZIP8P } | *             | * { UNZIP8HP } | *           |
| 111       | * { ZIP8P }   | *             | * { ZIP8HP }   | *           |
| RV64<br>f | w             |               |                |             |
|           | 00            | 01            | 10             | 11          |
| 000       |               |               |                |             |
| 001       |               |               |                |             |
| 010       | PSH1ADD.H     | * PSH1ADD.W   |                |             |
| 011       | PSSH1SADD.H   | * PSSH1SADD.W |                |             |
| 100       |               |               |                |             |
| 101       |               |               |                |             |
| 110       | * UNZIP8P     | * UNZIP16P    | * UNZIP8HP     | * UNZIP16HP |
| 111       | * ZIP8P       | * ZIP16P      | * ZIP8HP       | * ZIP16HP   |

|    |    |    |    |     |     |       |    |               |   |
|----|----|----|----|-----|-----|-------|----|---------------|---|
| 32 | 31 | 28 | 27 | 25  | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | 1  | w  | rs2 | rs1 | 0 1 0 | rd | 0 1 1 1 0 1 1 |   |

| RV32<br>f | w            |                |              |    |
|-----------|--------------|----------------|--------------|----|
|           | 00           | 01             | 10           | 11 |
| 000       | { PSLL.H }   | *              | { PSLL.B }   |    |
| 001       |              |                |              |    |
| 010       | { PSSHL.H }  | *              | { PSSHL.B }  |    |
| 011       | { PSSHLR.H } | *              | { PSSHLR.B } |    |
| 100       |              |                |              |    |
| 101       |              |                |              |    |
| 110       | { PSSHA.H }  | *              | { PSSHA.B }  |    |
| 111       | { PSSHAR.H } | *              | { PSSHAR.B } |    |
| RV64<br>f | w            |                |              |    |
|           | 00           | 01             | 10           | 11 |
| 000       | { PSLL.H }   | * { PSLL.W }   | { PSLL.B }   |    |
| 001       |              |                |              |    |
| 010       | { PSSHL.H }  | * { PSSHL.W }  | { PSSHL.B }  |    |
| 011       | { PSSHLR.H } | * { PSSHLR.W } | { PSSHLR.B } |    |
| 100       |              |                |              |    |
| 101       |              |                |              |    |
| 110       | { PSSHA.H }  | * { PSSHA.W }  | { PSSHA.B }  |    |
| 111       | { PSSHAR.H } | * { PSSHAR.W } | { PSSHAR.B } |    |

|    |    |    |     |     |       |    |               |   |
|----|----|----|-----|-----|-------|----|---------------|---|
| 32 | 31 | 27 | 25  | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | w  | rs2 | rs1 | 0 1 1 | rd | 0 1 1 1 0 1 1 |   |

| RV32<br>f | w                 |              |    |    |
|-----------|-------------------|--------------|----|----|
|           | 00                | 01           | 10 | 11 |
| 0000      | PMUL.H.B00        | * MUL.H00    |    | *  |
| 0001      | { PMACC.H.B00 }   | * MACC.H00   |    | *  |
| 0010      | PMUL.H.B11        | * MUL.H11    |    | *  |
| 0011      | { PMACC.H.B11 }   | * MACC.H11   |    | *  |
| 0100      | PMULU.H.B00       | * MULU.H00   |    | *  |
| 0101      | { PMACCU.H.B00 }  | * MACCU.H00  |    | *  |
| 0110      | PMULU.H.B11       | * MULU.H11   |    | *  |
| 0111      | { PMACCU.H.B11 }  | * MACCU.H11  |    | *  |
| 1000      |                   |              |    |    |
| 1001      |                   |              |    |    |
| 1010      |                   |              |    |    |
| 1011      |                   |              |    |    |
| 1100      | PMULSU.H.B00      | * MULSU.H00  |    | *  |
| 1101      | { PMACCSU.H.B00 } | * MACCSU.H00 |    | *  |
| 1110      | PMULSU.H.B11      | * MULSU.H11  |    | *  |
| 1111      | { PMACCSU.H.B11 } | * MACCSU.H11 |    | *  |

| RV64<br>f | w                 |                 |    |              |
|-----------|-------------------|-----------------|----|--------------|
|           | 00                | 01              | 10 | 11           |
| 0000      | PMUL.H.B00        | * PMUL.W.H00    |    | * MUL.W00    |
| 0001      | { PMACC.H.B00 }   | * PMACC.W.H00   |    | * MACC.W00   |
| 0010      | PMUL.H.B11        | * PMUL.W.H11    |    | * MUL.W11    |
| 0011      | { PMACC.H.B11 }   | * PMACC.W.H11   |    | * MACC.W11   |
| 0100      | PMULU.H.B00       | * PMULU.W.H00   |    | * MULU.W00   |
| 0101      | { PMACCU.H.B00 }  | * PMACCU.W.H00  |    | * MACCU.W00  |
| 0110      | PMULU.H.B11       | * PMULU.W.H11   |    | * MULU.W11   |
| 0111      | { PMACCU.H.B11 }  | * PMACCU.W.H11  |    | * MACCU.W11  |
| 1000      |                   |                 |    |              |
| 1001      |                   |                 |    |              |
| 1010      |                   |                 |    |              |
| 1011      |                   |                 |    |              |
| 1100      | PMULSU.H.B00      | * PMULSU.W.H00  |    | * MULSU.W00  |
| 1101      | { PMACCSU.H.B00 } | * PMACCSU.W.H00 |    | * MACCSU.W00 |
| 1110      | PMULSU.H.B11      | * PMULSU.W.H11  |    | * MULSU.W11  |
| 1111      | { PMACCSU.H.B11 } | * PMACCSU.W.H11 |    | * MACCSU.W11 |

|    |    |    |    |     |     |       |    |               |   |
|----|----|----|----|-----|-----|-------|----|---------------|---|
| 32 | 31 | 28 | 27 | 25  | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | 0  | w  | rs2 | rs1 | 1 0 0 | rd | 0 1 1 1 0 1 1 |   |

| RV32<br>f | w         |             |    |          |
|-----------|-----------|-------------|----|----------|
|           | 00        | 01          | 10 | 11       |
| 000       | PPACK.H   | *           |    |          |
| 001       | PPACKBT.H | * PACKBT    |    | *        |
| 010       | PPACKTB.H | * PACKTB    |    | *        |
| 011       | PPACKT.H  | * PACKT     |    | *        |
| 100       |           |             |    |          |
| 101       |           |             |    |          |
| 110       |           |             |    |          |
| 111       |           |             |    |          |
| RV64<br>f | w         |             |    |          |
|           | 00        | 01          | 10 | 11       |
| 000       | PPACK.H   | * PPACK.W   |    |          |
| 001       | PPACKBT.H | * PPACKBT.W |    | * PACKBT |
| 010       | PPACKTB.H | * PPACKTB.W |    | * PACKTB |
| 011       | PPACKT.H  | * PPACKT.W  |    | * PACKT  |
| 100       |           |             |    |          |
| 101       |           |             |    |          |
| 110       |           |             |    |          |
| 111       |           |             |    |          |

|    |    |    |    |     |     |       |    |               |   |
|----|----|----|----|-----|-----|-------|----|---------------|---|
| 32 | 31 | 28 | 27 | 25  | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | 1  | w  | rs2 | rs1 | 1 0 0 | rd | 0 1 1 1 0 1 1 |   |

| RV32<br>f | w          |              |            |    |
|-----------|------------|--------------|------------|----|
|           | 00         | 01           | 10         | 11 |
| 000       | { PSRL.H } | *            | { PSRL.B } |    |
| 001       |            |              |            |    |
| 010       |            |              |            |    |
| 011       |            |              |            |    |
| 100       | { PSRA.H } | *            | { PSRA.B } |    |
| 101       |            |              |            |    |
| 110       |            |              |            |    |
| 111       |            |              |            |    |
| RV64<br>f | w          |              |            |    |
|           | 00         | 01           | 10         | 11 |
| 000       | { PSRL.H } | * { PSRL.W } | { PSRL.B } |    |
| 001       |            |              |            |    |
| 010       |            |              |            |    |
| 011       |            |              |            |    |
| 100       | { PSRA.H } | * { PSRA.W } | { PSRA.B } |    |
| 101       |            |              |            |    |
| 110       |            |              |            |    |
| 111       |            |              |            |    |

|    |    |    |     |     |       |    |               |   |
|----|----|----|-----|-----|-------|----|---------------|---|
| 32 | 31 | 27 | 25  | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | w  | rs2 | rs1 | 1 0 1 | rd | 0 1 1 1 0 1 1 |   |

| RV32<br>f | w           |    |              |    |
|-----------|-------------|----|--------------|----|
|           | 00          | 01 | 10           | 11 |
| 0000      | PM2ADD.H    | *  | PM4ADD.B     | *  |
| 0001      | PM2ADDA.H   | *  | PM4ADDA.B    | *  |
| 0010      | PM2ADD.HX   | *  |              |    |
| 0011      | PM2ADDA.HX  | *  |              |    |
| 0100      | PM2ADDU.H   | *  | PM4ADDU.B    | *  |
| 0101      | PM2ADDAU.H  | *  | PM4ADDAU.B   | *  |
| 0110      | PMQ2ADD.H   | *  | PMQR2ADD.H   | *  |
| 0111      | PMQ2ADDA.H  | *  | PMQR2ADDA.H  | *  |
| 1000      | PM2SUB.H    | *  | PM2SADD.H    |    |
| 1001      | PM2SUBA.H   | *  |              |    |
| 1010      | PM2SUB.HX   | *  | PM2SADD.HX   |    |
| 1011      | PM2SUBA.HX  | *  |              |    |
| 1100      | PM2ADDSU.H  | *  | PM4ADDSU.B   | *  |
| 1101      | PM2ADDASU.H | *  | PM4ADDASU.B  | *  |
| 1110      |             |    |              |    |
| 1111      | * MQACC.H01 | *  | * MQRACC.H01 | *  |

| RV64<br>f | w              |               |                 |               |
|-----------|----------------|---------------|-----------------|---------------|
|           | 00             | 01            | 10              | 11            |
| 0000      | PM2ADD.H       | * PM2ADD.W    | PM4ADD.B        | * PM4ADD.H    |
| 0001      | PM2ADDA.H      | * PM2ADDA.W   | PM4ADDA.B       | * PM4ADDA.H   |
| 0010      | PM2ADD.HX      | * PM2ADD.WX   |                 |               |
| 0011      | PM2ADDA.HX     | * PM2ADDA.WX  |                 |               |
| 0100      | PM2ADDU.H      | * PM2ADDU.W   | PM4ADDU.B       | * PM4ADDU.H   |
| 0101      | PM2ADDAU.H     | * PM2ADDAU.W  | PM4ADDAU.B      | * PM4ADDAU.H  |
| 0110      | PMQ2ADD.H      | * PMQ2ADD.W   | PMQR2ADD.H      | * PMQR2ADD.W  |
| 0111      | PMQ2ADDA.H     | * PMQ2ADDA.W  | PMQR2ADDA.H     | * PMQR2ADDA.W |
| 1000      | PM2SUB.H       | * PM2SUB.W    | PM2SADD.H       |               |
| 1001      | PM2SUBA.H      | * PM2SUBA.W   |                 |               |
| 1010      | PM2SUB.HX      | * PM2SUB.WX   | PM2SADD.HX      |               |
| 1011      | PM2SUBA.HX     | * PM2SUBA.WX  |                 |               |
| 1100      | PM2ADDSU.H     | * PM2ADDSU.W  | PM4ADDSU.B      | * PM4ADDSU.H  |
| 1101      | PM2ADDASU.H    | * PM2ADDASU.W | PM4ADDASU.B     | * PM4ADDASU.H |
| 1110      |                |               |                 |               |
| 1111      | * PMQACC.W.H01 | * MQACC.W01   | * PMQRACC.W.H01 | * MQRACC.W01  |

|    |    |    |     |     |       |    |               |   |
|----|----|----|-----|-----|-------|----|---------------|---|
| 32 | 31 | 27 | 25  | 20  | 15    | 12 | 7             | 0 |
| 1  | f  | w  | rs2 | rs1 | 1 1 0 | rd | 0 1 1 1 0 1 1 |   |

| RV32<br>f | w        |            |          |           |
|-----------|----------|------------|----------|-----------|
|           | 00       | 01         | 10       | 11        |
| 0000      | PAS.HX   | *          | PSA.HX   | *         |
| 0001      |          |            |          |           |
| 0010      | PSAS.HX  | *          | PSSA.HX  | *         |
| 0011      | PAAS.HX  | *          | PASA.HX  | *         |
| 0100      |          |            |          |           |
| 0101      |          |            |          |           |
| 0110      |          |            |          |           |
| 0111      |          |            |          |           |
| 1000      | PMSEQ.H  | * MSEQ     | PMSEQ.B  |           |
| 1001      |          |            |          |           |
| 1010      | PMSLT.H  | * MSLT     | PMSLT.B  |           |
| 1011      | PMSLTU.H | * MSLTU    | PMSLTU.B |           |
| 1100      | PMIN.H   | *          | PMIN.B   |           |
| 1101      | PMINU.H  | *          | PMINU.B  |           |
| 1110      | PMAX.H   | *          | PMAX.B   |           |
| 1111      | PMAXU.H  | *          | PMAXU.B  |           |
| RV64<br>f | w        |            |          |           |
|           | 00       | 01         | 10       | 11        |
| 0000      | PAS.HX   | * PAS.WX   | PSA.HX   | * PSA.WX  |
| 0001      |          |            |          |           |
| 0010      | PSAS.HX  | * PSAS.WX  | PSSA.HX  | * PSSA.WX |
| 0011      | PAAS.HX  | * PAAS.WX  | PASA.HX  | * PASA.WX |
| 0100      |          |            |          |           |
| 0101      |          |            |          |           |
| 0110      |          |            |          |           |
| 0111      |          |            |          |           |
| 1000      | PMSEQ.H  | * PMSEQ.W  | PMSEQ.B  |           |
| 1001      |          |            |          |           |
| 1010      | PMSLT.H  | * PMSLT.W  | PMSLT.B  |           |
| 1011      | PMSLTU.H | * PMSLTU.W | PMSLTU.B |           |
| 1100      | PMIN.H   | * PMIN.W   | PMIN.B   |           |
| 1101      | PMINU.H  | * PMINU.W  | PMINU.B  |           |
| 1110      | PMAX.H   | * PMAX.W   | PMAX.B   |           |
| 1111      | PMAXU.H  | * PMAXU.W  | PMAXU.B  |           |

|       |   |       |     |     |   |    |   |    |   |   |   |   |   |   |   |
|-------|---|-------|-----|-----|---|----|---|----|---|---|---|---|---|---|---|
| 32 31 |   | 27 25 |     | 20  |   | 15 |   | 12 |   | 7 |   | 0 |   |   |   |
| 1     | f | w     | rs2 | rs1 | 1 | 1  | 1 | rd | 0 | 1 | 1 | 1 | 0 | 1 | 1 |

| RV32<br>f | w           |            |               |              |
|-----------|-------------|------------|---------------|--------------|
|           | 00          | 01         | 10            | 11           |
| 0000      | PMULH.H     | *          | PMULHR.H      | * MULHR      |
| 0001      | PMHACC.H    | * MHACC    | PMHRACC.H     | * MHRACC     |
| 0010      | PMULHU.H    | *          | PMULHRU.H     | * MULHRU     |
| 0011      | PMHACCU.H   | * MHACCU   | PMHRACCU.H    | * MHRACCU    |
| 0100      | PMULH.H.B0  | * MULH.H0  | PMULHSU.H.B0  | * MULHSU.H0  |
| 0101      | PMHACC.H.B0 | * MHACC.H0 | PMHACCSU.H.B0 | * MHACCSU.H0 |
| 0110      | PMULH.H.B1  | * MULH.H1  | PMULHSU.H.B1  | * MULHSU.H1  |
| 0111      | PMHACC.H.B1 | * MHACC.H1 | PMHACCSU.H.B1 | * MHACCSU.H1 |
| 1000      | PMULHSU.H   | *          | PMULHRSU.H    | * MULHRSU    |
| 1001      | PMHACCSU.H  | * MHACCSU  | PMHRACCSU.H   | * MHRACCSU   |
| 1010      | PMULQ.H     | * MULQ     | PMULQR.H      | * MULQR      |
| 1011      |             |            |               |              |
| 1100      |             |            |               |              |
| 1101      | * MQACC.H00 | *          | * MQRACC.H00  | *            |
| 1110      |             |            |               |              |
| 1111      | * MQACC.H11 | *          | * MQRACC.H11  | *            |

| RV64<br>f | w              |               |                 |                 |
|-----------|----------------|---------------|-----------------|-----------------|
|           | 00             | 01            | 10              | 11              |
| 0000      | PMULH.H        | * PMULH.W     | PMULHR.H        | * PMULHR.W      |
| 0001      | PMHACC.H       | * PMHACC.W    | PMHRACC.H       | * PMHRACC.W     |
| 0010      | PMULHU.H       | * PMULHU.W    | PMULHRU.H       | * PMULHRU.W     |
| 0011      | PMHACCU.H      | * PMHACCU.W   | PMHRACCU.H      | * PMHRACCU.W    |
| 0100      | PMULH.H.B0     | * PMULH.W.H0  | PMULHSU.H.B0    | * PMULHSU.W.H0  |
| 0101      | PMHACC.H.B0    | * PMHACC.W.H0 | PMHACCSU.H.B0   | * PMHACCSU.W.H0 |
| 0110      | PMULH.H.B1     | * PMULH.W.H1  | PMULHSU.H.B1    | * PMULHSU.W.H1  |
| 0111      | PMHACC.H.B1    | * PMHACC.W.H1 | PMHACCSU.H.B1   | * PMHACCSU.W.H1 |
| 1000      | PMULHSU.H      | * PMULHSU.W   | PMULHRSU.H      | * PMULHRSU.W    |
| 1001      | PMHACCSU.H     | * PMHACCSU.W  | PMHRACCSU.H     | * PMHRACCSU.W   |
| 1010      | PMULQ.H        | * PMULQ.W     | PMULQR.H        | * PMULQR.W      |
| 1011      |                |               |                 |                 |
| 1100      |                |               |                 |                 |
| 1101      | * PMQACC.W.H00 | * MQACC.W00   | * PMQRACC.W.H00 | * MQRACC.W00    |
| 1110      |                |               |                 |                 |
| 1111      | * PMQACC.W.H11 | * MQACC.W11   | * PMQRACC.W.H11 | * MQRACC.W11    |

### 3 Encodings of instructions with one or more register-pair operands (RV32 only)

As before, where an instruction name is within braces { }, there is no such instruction proposed for the Base P extension, but the indicated encoding is recommended should the instruction be provided by another extension.

|       |   |       |        |    |     |    |       |    |                 |   |                 |   |  |
|-------|---|-------|--------|----|-----|----|-------|----|-----------------|---|-----------------|---|--|
| 32 31 |   | 28 27 |        | 20 |     | 15 |       | 12 |                 | 8 |                 | 0 |  |
| 0     | f | 0     | w-uimm |    | rs1 |    | 0 1 0 |    | rd <sub>p</sub> |   | 0 0 0 1 1 0 1 1 |   |  |

| RV32<br>f | w-uimm                   |          |          |         |
|-----------|--------------------------|----------|----------|---------|
|           | 000xxxx                  | 001xxxx  | 01xxxxx  | 1xxxxxx |
| 000       |                          | PWSLLI.B | PWSLLI.H | WSLLI   |
| 001       |                          |          |          |         |
| 010       |                          |          |          |         |
| 011       | <i>PLI instructions</i>  |          |          |         |
| 100       |                          | PWSLAI.B | PWSLAI.H | WSLAI   |
| 101       |                          |          |          |         |
| 110       |                          |          |          |         |
| 111       | <i>PLUI instructions</i> |          |          |         |

|           |    |     |            |    |       |                 |                 |
|-----------|----|-----|------------|----|-------|-----------------|-----------------|
| 32        | 27 | 25  | 15         | 12 | 8     | 0               |                 |
| 0 0 1 1 0 |    | 0 0 | imm[8:0 9] |    | 0 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |
| PLI.DH    |    |     |            |    |       |                 |                 |

PLI.DH

|    |    |    |   |    |    |   |  |            |   |   |   |                 |   |   |   |   |   |   |   |   |          |
|----|----|----|---|----|----|---|--|------------|---|---|---|-----------------|---|---|---|---|---|---|---|---|----------|
| 32 | 27 | 25 |   | 15 | 12 | 8 |  | 0          |   |   |   |                 |   |   |   |   |   |   |   |   |          |
| 0  | 0  | 1  | 1 | 0  | 0  | 1 |  | imm[8:0 9] | 0 | 1 | 0 | rd <sub>p</sub> | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | {PLI.DW} |

{ PLI.DW }

|           |    |    |    |       |  |          |    |   |  |         |  |                 |  |                 |  |  |  |
|-----------|----|----|----|-------|--|----------|----|---|--|---------|--|-----------------|--|-----------------|--|--|--|
| 32        | 27 | 24 | 16 |       |  |          | 12 | 8 |  |         |  | 0               |  |                 |  |  |  |
| 0 0 1 1 0 |    |    |    | 1 0 0 |  | imm[7:0] |    |   |  | 0 0 1 0 |  | rd <sub>p</sub> |  | 0 0 0 1 1 0 1 1 |  |  |  |
| PLI.DB    |    |    |    |       |  |          |    |   |  |         |  |                 |  |                 |  |  |  |

PLI.DB

|    |    |    |   |    |    |   |             |   |   |   |                 |   |   |   |   |   |   |   |   |         |
|----|----|----|---|----|----|---|-------------|---|---|---|-----------------|---|---|---|---|---|---|---|---|---------|
| 32 | 27 | 25 |   | 15 | 12 | 8 |             | 0 |   |   |                 |   |   |   |   |   |   |   |   |         |
| 0  | 1  | 1  | 1 | 0  | 0  | 0 | imm[6 15:7] | 0 | 1 | 0 | rd <sub>p</sub> | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | PLUI.DH |

PLUI.DH

|    |    |    |   |    |    |   |               |   |   |   |                 |   |   |   |   |   |   |   |   |             |
|----|----|----|---|----|----|---|---------------|---|---|---|-----------------|---|---|---|---|---|---|---|---|-------------|
| 32 | 27 | 25 |   | 15 | 12 | 8 |               | 0 |   |   |                 |   |   |   |   |   |   |   |   |             |
| 0  | 1  | 1  | 1 | 0  | 0  | 1 | imm[22 31:23] | 0 | 1 | 0 | rd <sub>p</sub> | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | { PLUI.DW } |

{ PLUI.DW }

|    |    |    |    |     |     |       |                 |                 |   |
|----|----|----|----|-----|-----|-------|-----------------|-----------------|---|
| 32 | 31 | 28 | 27 | 25  | 20  | 15    | 12              | 8               | 0 |
| 0  | f  | 1  | w  | rs2 | rs1 | 0 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |   |

| RV32<br>f                | w                  |                     |    |      |
|--------------------------|--------------------|---------------------|----|------|
|                          | 00                 | 01                  | 10 | 11   |
| 000<br>001<br>010<br>011 | PWSLL.BS           | PWSLL.HS            |    | WSLL |
| 100<br>101<br>110<br>111 | PWSLA.BS<br>WZIP8P | PWSLA.HS<br>WZIP16P |    | WSLA |

|    |    |    |     |     |       |                 |                 |   |
|----|----|----|-----|-----|-------|-----------------|-----------------|---|
| 32 | 31 | 27 | 25  | 20  | 15    | 12              | 8               | 0 |
| 0  | f  | w  | rs2 | rs1 | 0 1 0 | rd <sub>p</sub> | 1 0 0 1 1 0 1 1 |   |

| RV32<br>f                    | w                                            |                                  |                                                  |                                                      |
|------------------------------|----------------------------------------------|----------------------------------|--------------------------------------------------|------------------------------------------------------|
|                              | 00                                           | 01                               | 10                                               | 11                                                   |
| 0000<br>0001<br>0010<br>0011 | PWADD.H<br>PWADDA.H<br>PWADDU.H<br>PWADDAU.H | WADD<br>WADDA<br>WADDU<br>WADDAU | PWADD.B<br>PWADDA.B<br>PWADDU.B<br>PWADDAU.B     | PM2WADD.H<br>PM2WADDA.H<br>PM2WADD.HX<br>PM2WADDA.HX |
| 0100<br>0101<br>0110<br>0111 | PWMUL.H<br>PWMAcc.H<br>PWMULU.H<br>PWMAccU.H | WMUL<br>WMAcc<br>WMULU<br>WMAccU | PWMUL.B<br>{PWMAcc.B}<br>PWMULU.B<br>{PWMAccU.B} | PM2WADDU.H<br>PM2WADDAU.H                            |
| 1000<br>1001<br>1010<br>1011 | PWSUB.H<br>PWSUBA.H<br>PWSUBU.H<br>PWSUBAU.H | WSUB<br>WSUBA<br>WSUBU<br>WSUBAU | PWSUB.B<br>PWSUBA.B<br>PWSUBU.B<br>PWSUBAU.B     | PM2WSUB.H<br>PM2WSUBA.H<br>PM2WSUB.HX<br>PM2WSUBA.HX |
| 1100<br>1101<br>1110<br>1111 | PWMULSU.H<br>PWMAccSU.H<br>PMQWACC.H         | WMULSU<br>WMAccSU<br>PMQWACC     | PWMULSU.B<br>{PWMAccSU.B}<br>PMQRWACC.H          | PM2WADDU.SU.H<br>PM2WADDASU.H<br>PMQRWACC            |

|    |    |    |    |     |                  |         |    |               |   |
|----|----|----|----|-----|------------------|---------|----|---------------|---|
| 32 | 31 | 28 | 27 | 25  | 20               | 16      | 12 | 7             | 0 |
| 0  | f  | 1  | w  | rs2 | rs1 <sub>p</sub> | 0 1 0 0 | rd | 0 0 1 1 0 1 1 |   |

| RV32<br>f | w            |    |              |    |
|-----------|--------------|----|--------------|----|
|           | 00           | 01 | 10           | 11 |
| 000       | PREDSUM.DHS  |    | PREDSUM.DBS  |    |
| 001       |              |    |              |    |
| 010       |              |    |              |    |
| 011       | PREDSUMU.DHS |    | PREDSUMU.DBS |    |
| 100       |              |    |              |    |
| 101       |              |    |              |    |
| 110       |              |    |              |    |
| 111       |              |    |              |    |

|    |    |    |        |                  |         |    |               |   |
|----|----|----|--------|------------------|---------|----|---------------|---|
| 32 | 31 | 28 | 27     | 20               | 16      | 12 | 7             | 0 |
| 0  | f  | 0  | w-uimm | rs1 <sub>p</sub> | 1 1 0 0 | rd | 0 0 1 1 0 1 1 |   |

| RV32<br>f | w-uimm  |               |               |            |
|-----------|---------|---------------|---------------|------------|
|           | 000xxxx | 001xxxx       | 01xxxxx       | 1xxxxxx    |
| 000       |         | PNSRLI.B      | PNSRLI.H      | NSRLI      |
| 001       |         | { PNSRLRI.B } | { PNSRLRI.H } | { NSRLRI } |
| 010       |         | PNCLIPIU.B    | PNCLIPIU.H    | NCLIPIU    |
| 011       |         | PNCLIPRIU.B   | PNCLIPRIU.H   | NCLIPRIU   |
| 100       |         | PNSRAI.B      | PNSRAI.H      | NSRAI      |
| 101       |         | PNSRARI.B     | PNSRARI.H     | NSRARI     |
| 110       |         | PNCLIP.I.B    | PNCLIP.I.H    | NCLIP.I    |
| 111       |         | PNCLIPRI.B    | PNCLIPRI.H    | NCLIPRI    |

|    |    |    |    |     |                  |         |    |               |   |
|----|----|----|----|-----|------------------|---------|----|---------------|---|
| 32 | 31 | 28 | 27 | 25  | 20               | 16      | 12 | 7             | 0 |
| 0  | f  | 1  | w  | rs2 | rs1 <sub>p</sub> | 1 1 0 0 | rd | 0 0 1 1 0 1 1 |   |

| RV32<br>f | w             |               |    |           |
|-----------|---------------|---------------|----|-----------|
|           | 00            | 01            | 10 | 11        |
| 000       | PNSRL.BS      | PNSRL.HS      |    | NSRL      |
| 001       | { PNSRLR.BS } | { PNSRLR.HS } |    | { NSRLR } |
| 010       | PNCLIPU.BS    | PNCLIPU.HS    |    | NCLIPU    |
| 011       | PNCLIPRU.BS   | PNCLIPRU.HS   |    | NCLIPRU   |
| 100       | PNSRA.BS      | PNSRA.HS      |    | NSRA      |
| 101       | PNSRAR.BS     | PNSRAR.HS     |    | NSRAR     |
| 110       | PNCLIP.BS     | PNCLIP.HS     |    | NCLIP     |
| 111       | PNCLIPR.BS    | PNCLIPR.HS    |    | NCLIPR    |

|       |   |       |        |    |                  |    |         |    |                 |   |                 |   |  |
|-------|---|-------|--------|----|------------------|----|---------|----|-----------------|---|-----------------|---|--|
| 32 31 |   | 28 27 |        | 20 |                  | 16 |         | 12 |                 | 8 |                 | 0 |  |
| 0     | f | 0     | w-uimm |    | rs1 <sub>p</sub> |    | 0 1 1 0 |    | rd <sub>p</sub> |   | 0 0 0 1 1 0 1 1 |   |  |

| RV32<br>f | w-uimm                    |               |               |               |         |
|-----------|---------------------------|---------------|---------------|---------------|---------|
|           | 0000xxx                   | 0001xxx       | 001xxxx       | 01xxxxx       | 1xxxxxx |
| 000       |                           | PSLLI.DB      | PSLLI.DH      | PSLLI.DW      |         |
| 001       |                           | { PSSLLI.DB } | { PSSLLI.DH } | { PSSLLI.DW } |         |
| 010       |                           |               |               |               |         |
| 011       |                           |               |               |               |         |
| 100       |                           |               |               |               |         |
| 101       |                           | { PSSLAI.DB } | PSSLAI.DH     | PSSLAI.DW     |         |
| 110       | <i>unary instructions</i> |               |               |               |         |
| 111       |                           |               |               |               |         |

|           |    |    |                  |         |                 |                 |   |
|-----------|----|----|------------------|---------|-----------------|-----------------|---|
| 32        | 27 | 25 | 20               | 16      | 12              | 8               | 0 |
| 0 1 1 0 0 | w  | uf | rs1 <sub>p</sub> | 0 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |   |

| RV32<br>uf | w           |              |             |    |
|------------|-------------|--------------|-------------|----|
|            | 00          | 01           | 10          | 11 |
| 00000      | { PCLZ.DH } | { PCLZ.DW }  | { PCLZ.DB } |    |
| 00001      |             |              |             |    |
| 00010      |             |              |             |    |
| 00011      | { PCLS.DH } | { PCLS.DW }  | { PCLS.DB } |    |
| 00100      | PSEXT.DH.B  | PSEXT.DW.B   |             |    |
| 00101      |             | PSEXT.DW.H   |             |    |
| 00110      |             |              |             |    |
| 00111      | PSABS.DH    | { PSABS.DW } | PSABS.DB    |    |
| 01000      |             |              |             |    |
| 01001      |             |              |             |    |
| 01010      |             |              |             |    |
| 01011      |             |              |             |    |
| ...        |             |              |             |    |
| 11111      |             |              |             |    |

|       |   |       |   |     |                  |   |    |   |    |                 |   |   |   |   |   |   |   |   |
|-------|---|-------|---|-----|------------------|---|----|---|----|-----------------|---|---|---|---|---|---|---|---|
| 32 31 |   | 28 27 |   | 25  | 20               |   | 16 |   | 12 |                 | 8 |   | 0 |   |   |   |   |   |
| 0     | f | 1     | w | rs2 | rs1 <sub>p</sub> | 0 | 1  | 1 | 0  | rd <sub>p</sub> | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |

| RV32<br>f | w              |                |                |    |
|-----------|----------------|----------------|----------------|----|
|           | 00             | 01             | 10             | 11 |
| 000       | PSLL.DHS       | PSLL.DWS       | PSLL.DBS       |    |
| 001       | PADD.DHS       | PADD.DWS       | PADD.DBS       |    |
| 010       | { PSSHL.DHS }  | { PSSHL.DWS }  | { PSSHL.DBS }  |    |
| 011       | { PSSHLR.DHS } | { PSSHLR.DWS } | { PSSHLR.DBS } |    |
| 100       |                |                |                |    |
| 101       |                |                |                |    |
| 110       | PSSHA.DHS      | PSSHA.DWS      | { PSSHA.DBS }  |    |
| 111       | PSSHAR.DHS     | PSSHAR.DWS     | { PSSHAR.DBS } |    |

|    |    |    |        |                  |         |                 |                 |   |
|----|----|----|--------|------------------|---------|-----------------|-----------------|---|
| 32 | 31 | 28 | 27     | 20               | 16      | 12              | 8               | 0 |
| 0  | f  | 0  | w-uimm | rs1 <sub>p</sub> | 1 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |   |

| RV32<br>f | w-uimm  |               |               |               |         |
|-----------|---------|---------------|---------------|---------------|---------|
|           | 0000xxx | 0001xxx       | 001xxxx       | 01xxxxx       | 1xxxxxx |
| 000       |         | PSRLI.DB      | PSRLI.DH      | PSRLI.DW      |         |
| 001       |         | { PSRLRI.DB } | { PSRLRI.DH } | { PSRLRI.DW } |         |
| 010       |         | { PUSATI.DB } | PUSATI.DH     | PUSATI.DW     |         |
| 011       |         |               |               |               |         |
| 100       |         | PSRAI.DB      | PSRAI.DH      | PSRAI.DW      |         |
| 101       |         | { PSRARI.DB } | PSRARI.DH     | PSRARI.DW     |         |
| 110       |         | { PSATI.DB }  | PSATI.DH      | PSATI.DW      |         |
| 111       |         |               |               |               |         |

|    |    |    |    |     |                  |         |                 |                 |   |
|----|----|----|----|-----|------------------|---------|-----------------|-----------------|---|
| 32 | 31 | 28 | 27 | 25  | 20               | 16      | 12              | 8               | 0 |
| 0  | f  | 1  | w  | rs2 | rs1 <sub>p</sub> | 1 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |   |

| RV32<br>f | w        |          |          |    |
|-----------|----------|----------|----------|----|
|           | 00       | 01       | 10       | 11 |
| 000       | PSRL.DHS | PSRL.DWS | PSRL.DBS |    |
| 001       |          |          |          |    |
| 010       |          |          |          |    |
| 011       |          |          |          |    |
| 100       | PSRA.DHS | PSRA.DWS | PSRA.DBS |    |
| 101       |          |          |          |    |
| 110       |          |          |          |    |
| 111       |          |          |          |    |

|    |    |    |                  |    |                  |         |                 |                 |   |
|----|----|----|------------------|----|------------------|---------|-----------------|-----------------|---|
| 32 | 31 | 27 | 25               | 21 | 20               | 16      | 12              | 8               | 0 |
| 1  | f  | w  | rs2 <sub>p</sub> | 0  | rs1 <sub>p</sub> | 0 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |   |

| RV32<br>f | w         |              |           |      |
|-----------|-----------|--------------|-----------|------|
|           | 00        | 01           | 10        | 11   |
| 0000      | PADD.DH   | PADD.DW      | PADD.DB   | ADDD |
| 0001      |           |              |           |      |
| 0010      | PSADD.DH  | PSADD.DW     | PSADD.DB  |      |
| 0011      | PAADD.DH  | PAADD.DW     | PAADD.DB  |      |
| 0100      |           |              |           |      |
| 0101      |           |              |           |      |
| 0110      | PSADDU.DH | PSADDU.DW    | PSADDU.DB |      |
| 0111      | PAADDU.DH | PAADDU.DW    | PAADDU.DB |      |
| 1000      | PSUB.DH   | PSUB.DW      | PSUB.DB   | SUBD |
| 1001      | PDIF.DH   | { PDIF.DW }  | PDIF.DB   |      |
| 1010      | PSSUB.DH  | PSSUB.DW     | PSSUB.DB  |      |
| 1011      | PASUB.DH  | PASUB.DW     | PASUB.DB  |      |
| 1100      |           |              |           |      |
| 1101      | PDIFU.DH  | { PDIFU.DW } | PDIFU.DB  |      |
| 1110      | PSSUBU.DH | PSSUBU.DW    | PSSUBU.DB |      |
| 1111      | PASUBU.DH | PASUBU.DW    | PASUBU.DB |      |

|    |    |    |    |                  |    |                  |         |                 |                 |   |
|----|----|----|----|------------------|----|------------------|---------|-----------------|-----------------|---|
| 32 | 31 | 28 | 27 | 25               | 21 | 20               | 16      | 12              | 8               | 0 |
| 1  | f  | 0  | w  | rs2 <sub>p</sub> | 1  | rs1 <sub>p</sub> | 0 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |   |

| RV32<br>f | w            |              |    |    |
|-----------|--------------|--------------|----|----|
|           | 00           | 01           | 10 | 11 |
| 000       |              |              |    |    |
| 001       |              |              |    |    |
| 010       | PSH1ADD.DH   | PSH1ADD.DW   |    |    |
| 011       | PSSH1SADD.DH | PSSH1SADD.DW |    |    |
| 100       |              |              |    |    |
| 101       |              |              |    |    |
| 110       |              |              |    |    |
| 111       |              |              |    |    |

|    |    |    |    |                  |    |                  |         |                 |                 |   |
|----|----|----|----|------------------|----|------------------|---------|-----------------|-----------------|---|
| 32 | 31 | 28 | 27 | 25               | 21 | 20               | 16      | 12              | 8               | 0 |
| 1  | f  | 1  | w  | rs2 <sub>p</sub> | 1  | rs1 <sub>p</sub> | 0 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |   |

| RV32<br>f | w             |               |               |    |
|-----------|---------------|---------------|---------------|----|
|           | 00            | 01            | 10            | 11 |
| 000       | { PSL.L.DH }  | { PSL.L.DW }  | { PSL.L.DB }  |    |
| 001       |               |               |               |    |
| 010       | { PSSHL.DH }  | { PSSHL.DW }  | { PSSHL.DB }  |    |
| 011       | { PSSHLR.DH } | { PSSHLR.DW } | { PSSHLR.DB } |    |
| 100       |               |               |               |    |
| 101       |               |               |               |    |
| 110       | { PSSHA.DH }  | { PSSHA.DW }  | { PSSHA.DB }  |    |
| 111       | { PSSHAR.DH } | { PSSHAR.DW } | { PSSHAR.DB } |    |

|    |    |    |    |                  |    |                  |         |                 |                 |   |
|----|----|----|----|------------------|----|------------------|---------|-----------------|-----------------|---|
| 32 | 31 | 28 | 27 | 25               | 21 | 20               | 16      | 12              | 8               | 0 |
| 1  | f  | 0  | w  | rs2 <sub>p</sub> | 0  | rs1 <sub>p</sub> | 1 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |   |

| RV32<br>f | w          |            |    |    |
|-----------|------------|------------|----|----|
|           | 00         | 01         | 10 | 11 |
| 000       | PPACK.DH   | PPACK.DW   |    |    |
| 001       | PPACKBT.DH | PPACKBT.DW |    |    |
| 010       | PPACKTB.DH | PPACKTB.DW |    |    |
| 011       | PPACKT.DH  | PPACKT.DW  |    |    |
| 100       |            |            |    |    |
| 101       |            |            |    |    |
| 110       |            |            |    |    |
| 111       |            |            |    |    |

|    |    |    |    |                  |    |                  |         |                 |                 |   |
|----|----|----|----|------------------|----|------------------|---------|-----------------|-----------------|---|
| 32 | 31 | 28 | 27 | 25               | 21 | 20               | 16      | 12              | 8               | 0 |
| 1  | f  | 1  | w  | rs2 <sub>p</sub> | 0  | rs1 <sub>p</sub> | 1 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |   |

| RV32<br>f | w           |             |             |    |
|-----------|-------------|-------------|-------------|----|
|           | 00          | 01          | 10          | 11 |
| 000       | { PSRL.DH } | { PSRL.DW } | { PSRL.DB } |    |
| 001       |             |             |             |    |
| 010       |             |             |             |    |
| 011       |             |             |             |    |
| 100       | { PSRA.DH } | { PSRA.DW } | { PSRA.DB } |    |
| 101       |             |             |             |    |
| 110       |             |             |             |    |
| 111       |             |             |             |    |

|    |    |    |                  |    |                  |         |                 |                 |   |
|----|----|----|------------------|----|------------------|---------|-----------------|-----------------|---|
| 32 | 31 | 27 | 25               | 21 | 20               | 16      | 12              | 8               | 0 |
| 1  | f  | w  | rs2 <sub>p</sub> | 1  | rs1 <sub>p</sub> | 1 1 1 0 | rd <sub>p</sub> | 0 0 0 1 1 0 1 1 |   |

| RV32<br>f | w         |           |           |    |
|-----------|-----------|-----------|-----------|----|
|           | 00        | 01        | 10        | 11 |
| 0000      | PAS.DHX   |           | PSA.DHX   |    |
| 0001      |           |           |           |    |
| 0010      | PSAS.DHX  |           | PSSA.DHX  |    |
| 0011      | PAAS.DHX  |           | PASA.DHX  |    |
| 0100      |           |           |           |    |
| 0101      |           |           |           |    |
| 0110      |           |           |           |    |
| 0111      |           |           |           |    |
| 1000      | PMSEQ.DH  | PMSEQ.DW  | PMSEQ.DB  |    |
| 1001      |           |           |           |    |
| 1010      | PMSLT.DH  | PMSLT.DW  | PMSLT.DB  |    |
| 1011      | PMSLTU.DH | PMSLTU.DW | PMSLTU.DB |    |
| 1100      | PMIN.DH   | PMIN.DW   | PMIN.DB   |    |
| 1101      | PMINU.DH  | PMINU.DW  | PMINU.DB  |    |
| 1110      | PMAX.DH   | PMAX.DW   | PMAX.DB   |    |
| 1111      | PMAXU.DH  | PMAXU.DW  | PMAXU.DB  |    |